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NOVEMBER 1974

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HOW TO WIN
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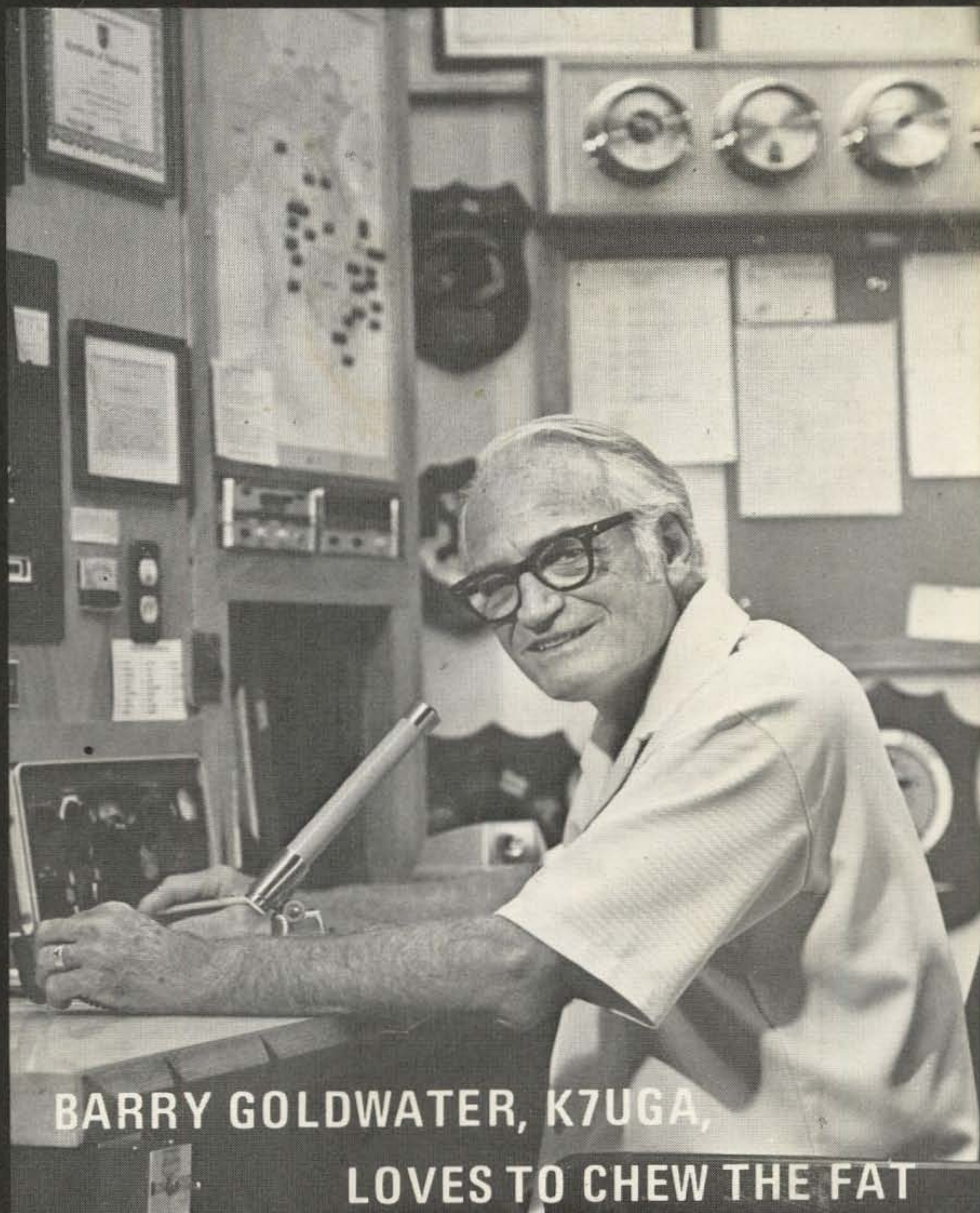
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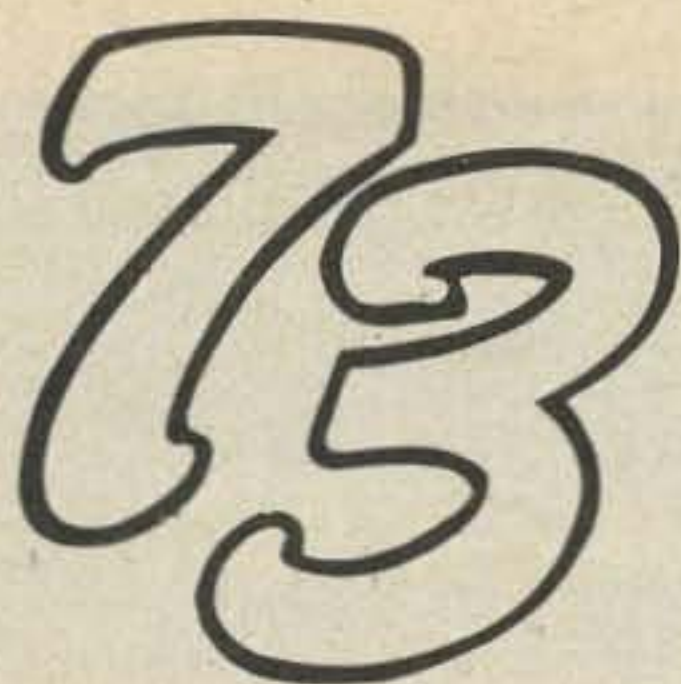
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AMATEUR RADIO

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COVER STORY: An inside look at the club whose members spent so many dedicated hours completing phone patches for airmen overseas. Senator Barry Goldwater, above, is one of its members.

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NEVER SAY DIE

...de W2NSD/I

EDITORIAL BY WAYNE GREEN

PAYING THE FREIGHT

Inflation is doing fine, as you know. In the ham rag business we notice the frequent increases in paper prices, printing prices, postage and salaries for staffers who go to the A&P expecting to say WeeeO, but instead say WOW!

Our subscription rates will inch up a tad, but this isn't enough. We can't raise our advertising rates too much without hurting all of those small companies who depend heavily on 73 to bring them customers.

After a lot of thought — and figuring that a page of ads in 73 will pay for almost three pages of articles and news — the obvious solution was to encourage non-ham advertisers to help pick up the tab. Since most hams wear pants, the Haband ad last month seemed like a good start — and we are very familiar with their amazingly good clothes. We think the Haband pants and shoes are one of the best bargains around, possibly with the exception of the 73 subscription rate.

The advertising department is working on a few more surprises like that, all of which means a thicker magazine for you and a lot more articles. Oddly enough, the cost of reaching prospective customers via 73 is incredibly low — much lower than most companies in other fields believe is possible. This may have something to do with our running the magazine from one of the United States' low rent districts.

ANTENNA GADGETEERS ARISE

Not since the olden days when Sam Harris (W8UKS and W1FZJ) was playing around with his 75m bi-square beams has much been done to develop gain on that band — at least as far as the work resulting in any articles of value to antenna experimenters.

The fact is that during these un-sun-spot days quite a few of us would be interested in some antenna info for the lower bands. Has anyone been working on this? Perhaps someone has tried out a twin-three antenna on 75m? Let's see some work on this and some articles.

I remember all too well how Sam used to work all over the world on 75m with 50 watts and his bi-square — and how my kilowatt and dipole was

quite a few dB down in South Africa and Europe. It seems like some new work *must* have been done in the last twenty-five years on antennas for 75m.

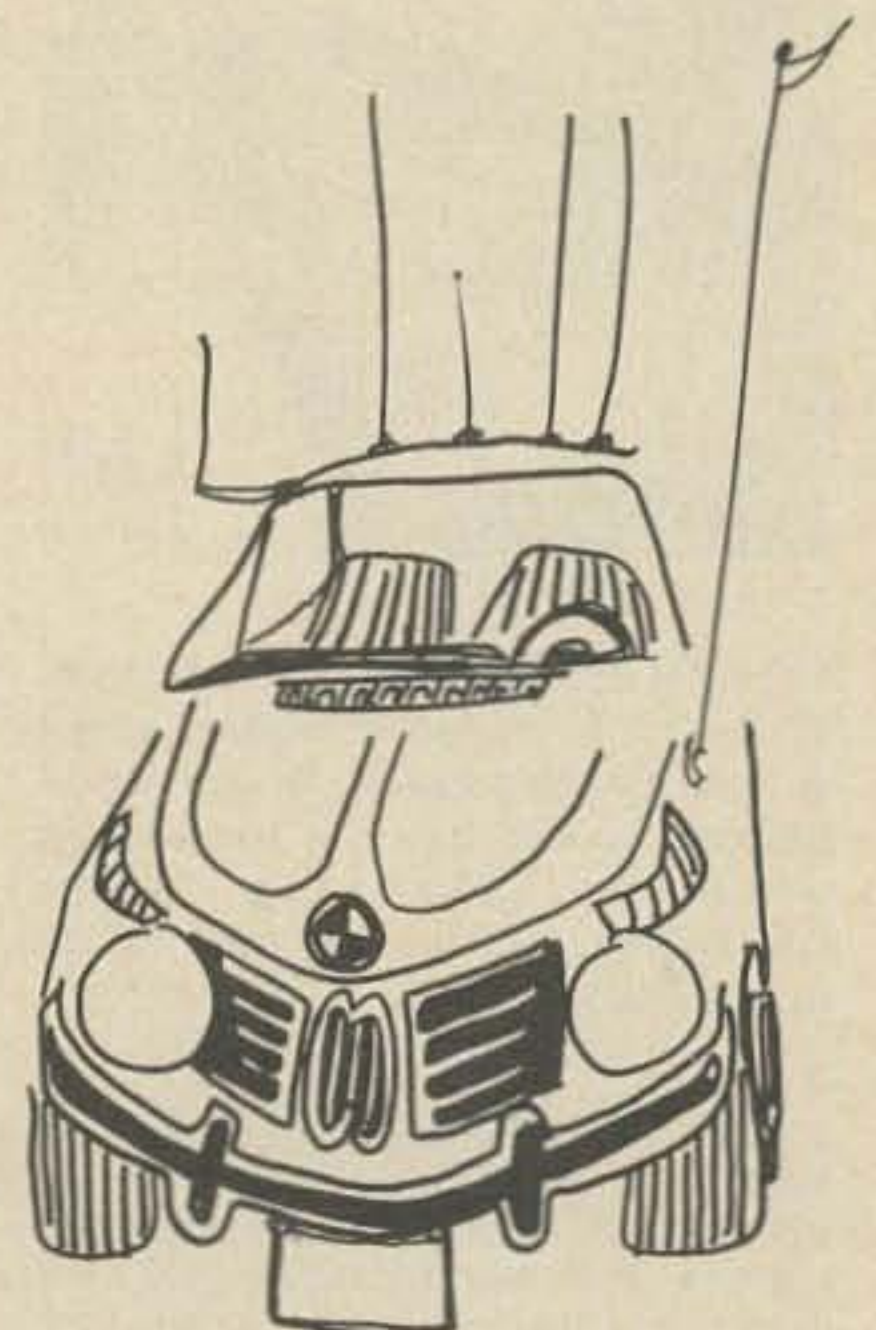
ARTICLES WANTED

A newspaper clipping sent in by reader Joecks from up in Vermont tells about a chap who has hooked up his phone so he can turn on his air conditioning by remote control. Hmm. Seems this chap uses a Touchtone pad and has thirty different things he can do by remote control. Why anyone would want to turn on his television set by remote control is probably not worth a lot of consideration — the reason is probably simple — just to be able to do it.

The ham applications are many (obviously) and I think a few of the 73 readers might like to whomp up something like this, if there are any builders out there with more time and ICs than they need to do a minimum while waiting out their lives.

Some of us would like to be able to call home and tone on the 2m rig and monitor the local channel — maybe even be able to call in and casually describe the process, with just that right sigh of slight boredom.

Tell you what — you build up the gadget and we'll print the article. And you think up the clever applications.





Bill Pasternak WA2HVK/6
14725 Titus St. #4
Panorama City CA 91402

In a recent T.V. Guide interview, F.C.C. Chairman Richard Wiley stated that he was opposed to unnecessary regulation of the broadcast media. Based on some of the newly proposed legislation regarding amateur radio, it is becoming obvious that Commissioner Wiley and the FCC are really listening to us and that his opposition to unnecessary regulation is being extended to us also. Therefore, if no one else has said it yet, a hearty thank you Chairman Wiley from those of us who make up the amateur radio community.

Some of the legislation I speak of, which by the time you read this may have been enacted, was released in docket form on July 25 as dockets number 20112 and 20113 respectively. 20112 deals with permitting automatic remote control of amateur repeaters while 20113 is designed to ease restrictions against cross-band operation of repeaters. The latter is based on a petition filed by the ARRL (RM 2337) while the former, 20112 can in good part be credited to hard work on the part of the Southern California Association and especially its Vice-Chairman Dick McKay K6VGP.

Late in 1973, Dick approached the F.C.C. for permission to experiment with a control system on the repeater's input channel. In January of this year, Dick was granted a six month "Special Temporary Authorization" to experiment with a semi-automatic remote control system on his two repeaters WR6AAD and WR6AAE. It took very little time to prove that the concept was both valid and viable. But AAD and AAE are sub-audible tone access repeaters with limited membership. Could this same system work on a heavily populated open system? A short time ago Fred Deeg K6AEH repeater trustee for the Palisades Amateur Radio Club, applied for and was granted an STA to experiment with a fully automatic remote control system on the input to the club repeater WR6ABB. It was felt that the PARC machine with over half the club's membership using it daily plus a large number of non club

members also communicating on it would make for an ideal test bed. Without being long winded about it, it worked perfectly! Based on this dual success, Dick prepared a petition asking that Part 97 be amended "To allow for the definition and operation of automatically remote controlled repeater stations"; doing so in the name of the Southern California Repeater Association. Shortly thereafter, 20112 was released and while it does not mention either Dick or the SCRA by name, it does thank those amateurs and organizations that experimented with semi-automatic and fully automatic remote control systems. Unless I miss my guess, we here in L.A. are those amateurs they are talking about. Dick, Fred and the rest of the SCRA have put in many long hours on this project, not just for those of us out here but for all of you. When 20112 is finally enacted it will be a giant step forward in providing again that round-the-clock operation that makes the amateur repeater one of the most valuable aspects of amateur radio.

Five days after 20112 was released your reporter flat on his back in Ceders-Sinai Medical Center - Mt. Sinai Hospital recovering from an attack of kidney stones; the seventh time in the same number of years. Now while no one likes to go to the hospital, least of all yours truly, there are times when these things cannot be avoided. However, Ceders-Sinai is unlike any other hospital I have ever been in and if ever the need arises again it is the place I will pick. They seem to believe if you treat a patient as a guest, carefully cater to a patient's needs promptly and most important keep the atmosphere cheerful, a person will recover a lot more quickly. From first hand experience I can tell you that it works, and works well. Most important to me, the food they served was not just good but better than many restaurants I have frequented. As to medical attention, it was the finest I have ever received and everyone on the staff went out of his or her way to make me as comfortable as possible. This then is my personal thank-you to those fine men and women who helped me recover so quickly, and to Denny WA6LVO for loaning me his KP202 HT to keep HVK/6 on-the-air while there.

A number of friends suggested that I get away for a few days to recuperate. My physician gave me a green light as long as I was back in time for some tests. Since Sharon's mom and dad were visiting from New York we decided to make Las Vegas our destination. Though I have been there a number of times in the past, I always flew there via Air-West and never had

a radio with me. This time we drove and were never out of range of a repeater, a comforting thought when you cross the Mojave Desert and it's about 110 degrees outside. Since I live in the San Fernando Valley it was faster for us to head north on the San Diego Freeway (I-405) to the Newhall area and head out the newly completed Antelope Valley Freeway (Cal. 14). Heading out of town we QSO'd the AM rush-hour crowd on the WR6ABE Mt. Wilson Repeater (147.435 - 146.40) though once in the hills along 14 it was spotty. About 20 miles west of Palmdale we lost ABE completely. As we came down out of the hills and approached the Palmdale area we were able to access the .16 - .76 Table Mountain Machine located near Barstow. As we soon learned, WR6AFB does cover a large section of the Southern California Desert area along I-15 and Cal. 58. We were able to use it from Palmdale, through Mojave, Barstow finally losing it while going through Mountain Pass at better than 4,000 feet, descending the eastern side. Scanning the eight available channels in my Sonar 3601, I came across a QSO on .28 - .88. Not having anything to add to the QSO, I just SWL'ed it into Las Vegas proper. Arriving at our hotel, we went QRT for the rest of the day. Since this was an overnight one day venture we were on the road the next morning. We found a machine on .34 - .94 and after a short QSO there went back to .28 - .88 and worked some stations there that filled us in on what machine covers what area of Las Vegas. .28 - .88 is the home of WR7ADZ, part of the famous Gronk Radio Network. Sitting atop Mt. Potosi, ADZ has almost phenomenal coverage extending from St. George, Utah to the northeast and San Bernadino, California to the southwest. A quick look at a roadmap will give you a better idea of ADZ's coverage than my description here. I also personally can verify coverage to the southwest at least as far as the Cajon Pass on the return trip. Now that's what I call coverage!

WR7AEH on .34 - .94 is the local coverage machine designed for in town coverage. I found it could be accessed as long as the "Strip" was in sight from I-15. There are also two other machines in the Las Vegas area I was told. The .07 - .67 repeater covers north Las Vegas and a machine on 147.18 - 147.84 covers the western area. Due to lack of proper crystals I was unable to use these latter machines. WR7AEH is operated by the Las Vegas Radio Amateur Club while the two other machines are privately owned. All machines are

open carrier squelch and judging from those I worked while there, the Las Vegas area repeaters are inhabited by a friendly bunch of amateurs.

Well, the shows were great, and I made it home with the shirt still on my back. In fact I even came out a couple bucks ahead! Most of all, it was the kind of fun I needed to help forget the previous three weeks. Good old New York may call itself *Fun City*, but Las Vegas is also deserving of that same title. At least in my book.

de WA2HVK/6

SSTV SCENE

Dave Ingram K4TWJ

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Birmingham AL 35210

Is Slow Scan TV Dying?

Some serious questions have been raised on Slow Scan TV lately which deserve our utmost consideration. Is SSTV interest dwindling? Why are we not hearing more activity on the air? Is it a result of recently poor band conditions that seemingly isolate various SSTVers around the world or are newcomers merely replacing older enthusiasts who become bored due to the lack of interesting material on the air? Is SSTV interest great enough to attract commercial manufacturers or will they, like some others, fall by the wayside? We know many SSTVers are involved with experimentation more than actual operation because each year's knowledge gain is twice the previous year. We can scan convert pictures on *both ends* of a QSO, ASCII Typewrite messages on a SSTV screen, exchange color pictures and even span continents with these pictures. However, a means of communication is only as good as its use. More imaginative operators would be enthusiastically received on the air. Let's all try to work up more interesting pictures (if one picture is worth a thousand words, let's prove it!) and recruit more SSTV operators. Operators with gear ready to move in time of emergency can prove SSTV's full capabilities. Bring your thoughts out on the air...send me your comments. Let's not allow SSTV to fall into the "way out group" category by doing like so many people today...reading this, then forgetting it. Do so and SSTV will surely fade out.

Newcomers

Newcomers can now get started in Slow Scan TV quite easily. Used monitors are periodically appearing for around \$200, the same price as many 2 meter rigs. Through Slow

Scan TV you can see various places around the world, swap circuits over the air or see those items of interest many hams have. Does 2 meters offer this kind of excitement or do you find it fun to hear the same people say the same things every day.

An excellent way to get started in Slow Scan TV is the W6MXV kit unit which is available from Mike Tallant for around 100 to 150 dollars, depending on your junkbox. This unit is tops. Mike's detailed instructions, neat P.C. boards, X-Ray plans, etc., make it easier to construct than Heath gear! I built much of mine by carrying the boards with me, adding parts in my spare time and then soldering the connections at night. Recently I forwarded one of these kits down to WA2ZDF/CP1. Mike is really doing them up neat now...nice packing, large plans, gosh, it even includes the sync tuning tube! I don't know how he manages to break even on the kits.

Want to know more about what countries are on SSTV? Look over the following list of contacts from one of the DX leaders, Jack VE3GMT. There are around 90 countries presently on SSTV which means DXCC isn't far off. It's looking like the first certificates will be going to VE3GMT, W8YEK and W4MS. Any other challengers? What's your DXCC/SSTV total?

DJ0CN	W. Germany
EA4DT	Spain
EA8CI	Canaries
EL2CB	Liberia
ET3DS	Ethiopia
F6AXT	France
FG7XT	Guadeloupe
FM7WW	Martinique
FO8DO	French Oc.
G3RHI	England
GC3YIZ	Guernsey
GI3NBB	N. Ireland
GW3DZJ	Wales
HA7LF	Hungary
HB9IT	Switzerland
HB0NL	Liechtenstein
HK3CF	Colombia
HR2HH	Honduras
I1BNT	Italy
IS1PEM	Sardinia
JA7FS	Japan
W4YK	U.S.A.
KC4DX	Navassa
KC4USX	Antartica
KH6HJF	Hawaii
KL7HAB	Alaska
KP4GN	P. Rico
KV4CM	Virgins
KX6DR	Marshalls
LA2BK	Norway
LU7AAG	Argentina
OD5HC	Lebanon
OE6GC	Austria
OK1NH	Czech
ON5SV	Belgium
OX3LP	Greenland

OY1M	Faroes
OZ4IP	Denmark
PA0LAM	Netherlands
PJ2CU	Antilles
PY1DCB	Brazil
PZ1DX	Surinam
SM0BUO	Sweden
VK5MF	Australia
VP2AR	Antigua
VP2ME	Monserrat
K4GXO/VP7	Bahamas
VP9GR	Bermuda
VQ9R	Seychelles
VU25KV	India
XE1JM	Mexico
YN3RBD	Nicaragua
YU2CDS	Yugoslavia
YU5AJ	Venezuela
ZF1TV	Cayman
ZC1AOY	N. Zealand
ZS6PP	S. Africa
ZS3B	S.W. Africa
4X4TW	Israel
6Y5GB	Jamaica
8RIW	Guyana
9K2AM	Kuwait
9Q5BG	Zaire
9X5PB	Rawanda
9Y4VU	Trinidad

Late additions into SSTV:

OA4F	JY8AA
HZ1SH	9V1RA
YU2CDS	W6AXE/KG6
DU1SS	AP2AD
OH2KT	VK9XX

Incidentally, you don't need an expensive rig to work SSTV: 90 percent of the DX stations show on 20 meters exclusively. A single bander SSB rig and, if you like, a single band homebrew linear amplifier are quite sufficient.

Scan Converter

Several Slow Scanners have asked how Slow-to-Fast Scan converted pictures look and if there are any simple shortcuts for accomplishing the same results. Not really! However a simple "visual coupler" could be constructed using an inexpensive closed circuit (Fast Scan) camera which has a "channel" rf output and your present SSTV monitor. Place the camera to view your Slow Scan monitor screen, then adjust contrast and brightness for optimum results. A hood or light-tight enclosure between camera lens and monitor screen would be advantageous in brightly illuminated rooms. Next, feed the camera's rf output to

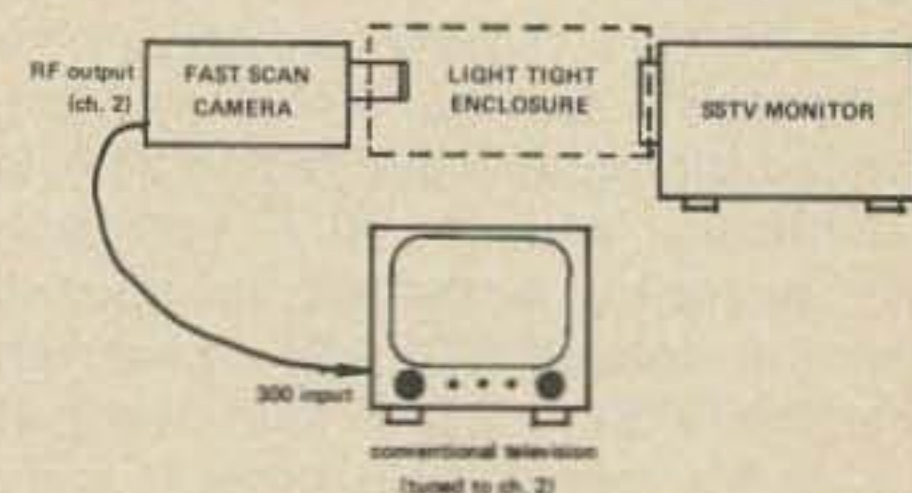
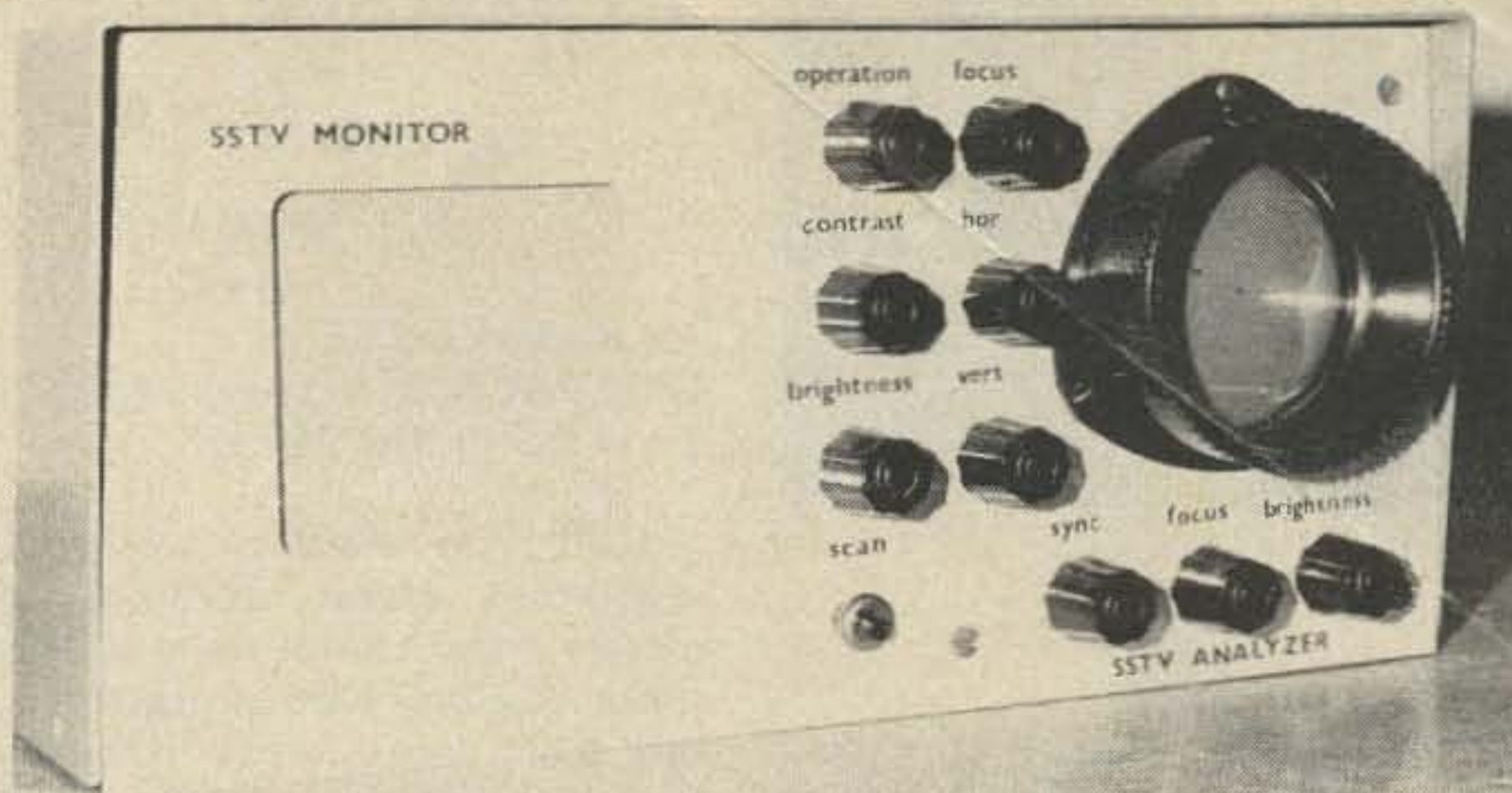


Fig. 1. Simple "Visual Coupler" SSTV converter.

Front panel and interior view of
OK2PAD's homebrew monitor.
Note the outstanding workmanship.



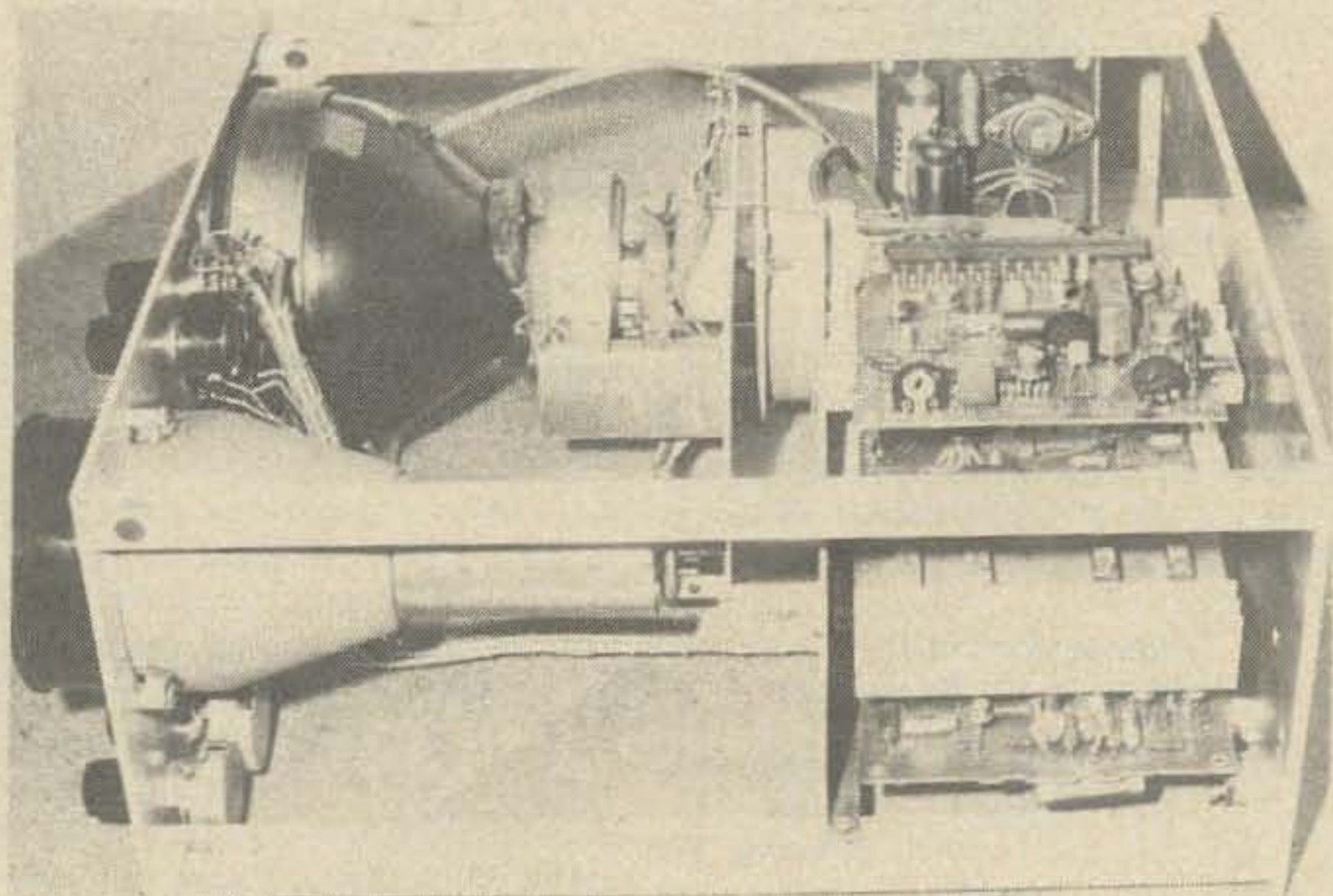
your regular TV and you can view large, bright pictures. Nice, eh?

Slow Scan TV activity in Czechoslovakia appears on the upswing, as reported by Franta, OK100. There are approximately 15 stations presently active on SSTV, with around 35 more interested and due to have gear going soon. The more active stations include OK1GW, OK3ZAS, OK2BNE and OK100. Their most popular frequency is 14.230 kHz. Although "Telsa" is their only manufacturer and IC availability is limited, transistors are rather plentiful. Shift Register memories are presently not available. Prices are high compared to our standards (would you work 7 or 8 hours to afford 3 or 4 simple ICs?) so amateurs must have a genuine interest before indulging in a SSTV venture. Their main SSTV cathode ray tubes are similar to our 5FP7 and use numbers like 13LM31, 25QP21 and 180QQ86. The first numbers appear to designate screen size in centimeters. Most of the fellows live some distance apart and work dilligently building their gear to reduce unnecessary components. OK3ZAS and OK2BNE, for example, are getting good results from the W7ABW camera while using regular vidicons.

This month's pictures are of OK2PAD's homebrew monitor and reveal outstanding workmanship. The unit uses a 13LM31 and much modified W6MXV circuit. Two emitter coupled transistors replace a CA3028 IC and sweep circuits are similar to W9LUO design. A W0LMD type video analyzer is included on the unit's right. The single tube visible behind the c.r.t. yoke is the high voltage rectifier.

A while back, Jack VE3GMT, suggested a monthly newsletter on SSTV. Interested parties could send info to him and he would get this out to all active SSTVers. He never received any letters! Come on now, aren't you proud of your accomplishments? How long does it take to scribble a short note? We are going to that same idea in this column, so drop me a card now on your new gear, DX worked, planned modifications or whatever. I'll get this right into the next month's column so we all will know more about "what's happening."

... K4TWJ



Exciting New Type of TV Tube

W.E. Parker W8DMR
2738 Floribunda Dr.
Columbus, Ohio 43209

I believe this is the first amateur television test pattern reproduced by the new solid state self-scanning image sensor. The sensor is a 100 by 100 element charged coupled device (CCD). Instead of the conventional vidicon camera tube employed in generating television pictures, a Fairchild CCD-201 was used. The 10,000 element self-scanning image sensor is mounted in a 24 lead dual-in-line package with an optical glass window. I believe the CCD's impact on TV cameras can be considered analogous to that of the transistor on vacuum tubes.

The image sensing elements are 1.2 mils by 0.8 mils located on 1.2 mil vertical centers and 1.6 horizontal centers. The light sensitive area is a 100 by 100 array of photo elements which provide an image aspect ratio of 4 by 3. In addition, the image sensing chip includes 100 columns of two-

phase shift registers interdigitated among; the photo elements, a 102 unit two-phase analog output shift register, an output preamplifier, and a compensation amplifier. Charge coupled devices are a new class of semiconductor structures. When arrays of 512 by 512 elements are commercially available, the resolution wedges on the test pattern will be distinct from the outer circle to the inner circle.

... W8DMR



AMSAT NEWS

Michael Frye WB8LBP
640 Deauville Dr.
Dayton OH 45429



AMSAT-OSCAR-B before final thermal-vacuum testing of the spacecraft. The ten-meter antenna (provided by Amatek-Hunter Spring), and 2304 MHz quadrifilar antenna (furnished by RCA Astro-Electronics Div.) are on the top of the spacecraft. With the spacecraft is Elizabeth, XYL of WA3LND.

Oscar 6 orbiting information for November.

Orbit	Date (Nov.)	Time (GMT)	Longitude of Eq. Crossing 'W'
4775	1	0008.7	49.8
4788	2	0103.6	63.5
4800	3	0003.5	48.5
4813	4	0058.5	62.2
4826	5	0153.4	76.0
4838	6	0053.3	61.0
4851	7	0148.3	74.7
4863	8	0048.2	59.7
4876	9	0143.1	73.4
4888	10	0043.1	58.4
4901	11	0138.0	72.1
4913	12	0037.9	57.1
4926	13	0132.9	70.9
4938	14	0032.8	55.8
4951	15	0127.7	69.6
4963	16	0027.7	54.6
4976	17	0122.6	68.3
4988	18	0022.5	53.3
5001	19	0117.4	67.0
5013	20	0017.4	52.0
5026	21	0112.3	65.7
5038	22	0012.2	50.7
5051	23	0107.2	64.4
5063	24	0007.1	49.4
5076	25	0102.0	63.2
5088	26	0002.0	48.1
5101	27	0056.9	61.9
5114	28	0151.8	75.6
5126	29	0051.8	60.6
5139	30	0146.7	74.3

ANSWER TO LAST MONTH'S CRYPTOGRAM

Secret message from kindly editor: Shape up or else! Tell the damned FCC what you think re proposed regs.



Joe Kasser G3ZCZ
1701 East West Highway, Apt. 205
Silver Spring MD 20910

Have you heard or worked those ubiquitous Italian stations on 20 meters lately? What do you think of those stations who proceed to spell out their name, which is ten letters long, phonetically, twice or three times, and then the name of their town, which has twenty letters and then say "seventy threes"?

Do you realize that they are holding the QSO in what is to them a foreign language? Could you do the same, say hold a QSO in Italian or Spanish.

Italy has a very competent amateur radio set up. The national club is called the Associazione Radiotecnica Italiana, and they put out a very fine monthly magazine called Radio Rivista. The magazine contains a number of original technical articles as well as the occasional translated one from Radio Communication or from QST. It is full of advertisements for Yaesu, Drake, Gladding, Standard, Ten-Tec, Clegg and locally built equipment. Rigs are available for both FM and SSB on two meters, a band that is planned for mode sharing, with calling frequencies, RTTY frequencies and FM channels. The Clegg FM-27B is also sold covering the range of 144-146MHz. The published address of the ARI is: Via Domenico Scarlatti 31, 20124 Milano, Italy. Tel 203192.

Although Italy does not yet have a reciprocal agreement with the USA, it does have one with the countries comprising the European Common Market. So if you get a permit from one of these countries you may be able to get an Italian permit using one of your other reciprocal permits. It's not so complicated as it sounds, for there is an ON8. /W on the air from the USA, and ON8 is the "call are" allocated to foreign residents or visitors under the reciprocal agreements with Belgium. It must be explained though that this ON8 is a native of Belgium but received his first ham license in France and was subsequently issued with an ON8 call. I've also heard a WN call signing Portable From South America on twenty meter phone, so strange things happen in the world of overseas operations.

For those intending to visit Italy on the most useful two meter frequencies are the calling channel on 145.5MHz

and the International calling Channel on 145.55MHz. There is also an SSB calling channel on 144.2MHz. There is a lot of activity on SSB and in the summer, DX contacts can be made over the Mediterranean Sea. If you are taking a qrp hf rig, you might consider adding a grp transverter module as described in vhf communications magazine. This unit would be advantageous in most European countries because a lot of mobile activity is on SSB using commercial equipment.

Does anybody read this column and if so what would you like it to cover? Reader response has been abismal lately and, if nobody reads this column then I might as well turn the space back to Wayne to fill with something of more interest to you readers.

... G3ZCZ/W3



Schley Cox WN9LHO
219 Kilgore Avenue
Muncie IN 47305

WHAT DO YOU SAY?

At 0011 GMT the other night I called a WN8 in answer to his CQ. I didn't get a chance to give him his 479C signal report because he answered my call with a too lengthy preamble and then sent "QRM 73 CUL" and then signed off the air. At 0015 I logged an end to my shortest contact on record outside the Novice Roundup.

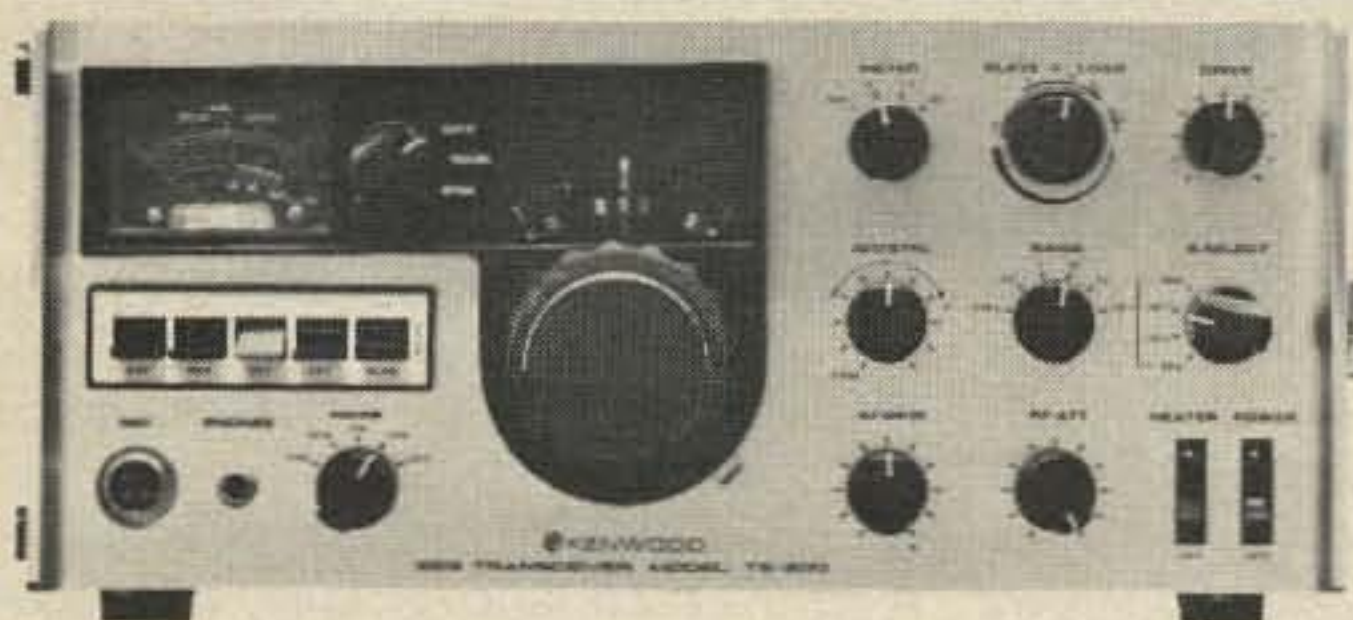
I know that sometimes we get on the air and the dinner call suddenly comes 30 minutes early or the envelope starts to melt on the final amplifier tube, but I have a suspicion that sometimes the super short contact is due to one or both operators having nothing to say.

Tradition has saved some new ops from mike fright by dictating that the RST, QTH and name be sent on the first transmission; the rig and antenna on the second; and finally, heart warming 73s and fervent CUL's on the third and last.

This is unfortunate unless there is a distinct need for brevity — e.g., contests, traffic or emergencies. There is a lot to talk about even at 5 wpm. I like to know something about who I am talking to on the air. How old is the other person, what does he (or she) do for a living, how many states has he

Suddenly...the answer is KENWOOD

Today when you ask "How can I modernize my SSB operation?", the answer certainly is KENWOOD. The deluxe TS-900 transceiver, the superb, go-anyplace TS-520 transceiver and the versatile R-599A receiver and T-599A transmitter offer today's amateur advanced design, reliable solid-state performance, contemporary styling. . . and the cost is modest. Now more than ever the answer is KENWOOD.



TS-900 Kenwood's superb state-of-the-art SSB transceiver

. . . the ultimate transceiver. The promise of the transistor has been fulfilled. Here is the transceiver you will want to own . . . whatever you have now, get ready to trade up. Its important features are far too numerous to list. Its specifications are superb. The TS-900 is unquestionably the best transceiver of its kind ever offered. The price . . . \$795.00
PS-900 (AC Supply) \$120.00, the DS-900 \$140.00



TS-520 Kenwood's go every place . . . do everything transceiver

The new TS-520 is the transceiver you have wanted, but could not buy until now. It is a non-compromise, do everything, go everywhere 5 band transceiver for SSB or CW that performs equally well at home, in an automobile, airplane, boat or trailer. The TS-520 features built-in AC power supply, built-in 12 volt DC power supply, built-in VOX with adjustable gain delay and anti-VOX. The price . . . \$629.00

The "Twins" by Kenwood



R-599A Receiver

The R-599A is the most complete receiver ever offered. It is solid state, superbly reliable, small and lightweight, covers the full amateur band . . . 10 thru 160 meters, CW, LSB, USB, AM, AM.N and FM.

The price . . . \$459.00

The T-599A is mostly solid state . . . only 3 tubes, has built-in power supply, full metering (ALC, Ip, RF output & high voltage), CW-LSB-USB-AM operation.

The price . . . \$479.00



T-599A Transmitter

See the Kenwood line at the following dealers: • ALABAMA / L & T Electronic Specialties, Birmingham • ALASKA / Service Electric Co., Inc., Ketchikan • ARIZONA / Ham Shack, Mesa • Orbit Electronics, Tucson • CALIFORNIA / Communications Headquarters, San Diego • Gary Radio, Inc., San Diego • Ham Radio Outlet, Burlingame • Henry Radio, Anaheim • Henry Radio, Los Angeles • Webster Radio, Fresno • COLORADO / Radio Communication Company, Arvada • FLORIDA / Amateur Electronic Supply, Orlando • Amateur Radio Center Inc., Miami • Amateur Wholesale Electronics, Miami • Grice Electronics Inc., Pensacola • Hollister Electronic Supply, Jacksonville • GEORGIA / Clayton Communications, College Park • IDAHO / United Electronics Wholesale, Twin Falls • ILLINOIS / Klaus Radio, Inc., Peoria • INDIANA / Graham Electronics, Indianapolis • Hoosier Electronics, Terre Haute • Radio Distributing Company, South Bend • IOWA / Hobby Industry, Council Bluffs • KANSAS / Associated Radio Communications, Overland Park • MAINE / Down East Ham Shack • MARYLAND / Electronic International Service Corp., Wheaton • Professional Electronics, Baltimore • MICHIGAN / Electronic Distributors, Muskegon • Radio supply & Engineering Company, Detroit • MINNESOTA / Electronic Center, Minneapolis • MISSOURI / Ham Radio Center, St. Louis • Henry Radio, Butler • MONTANA / Conley Radio Supply, Billings • NEW MEXICO / Gene Hansen Company, Corrales • NEW YORK / Adirondack Radio, Amsterdam • Harrison Radio Corp., Farmingdale, New York City, Spring Valley • Tom's Radio, Johnson City • NORTH CAROLINA / Freck Radio, Asheville • Vickers Electronics, Durham • OHIO / Amateur Electronic Supply, Cleveland • Communications World, Cleveland • Queen City Electronics, Cincinnati • Srepcu Electronics, Dayton • OKLAHOMA / Derrick Electronics, Broken Arrow • Radio, Inc., Tulsa • OREGON / Portland Radio Supply, Portland • PENNSYLVANIA / Electronic Exchange, North Wales • JRS Distributors, York • Kass Electronics, Drexel Hill • SOUTH CAROLINA / Accutek, Inc., Greenville • SOUTH DAKOTA / Burghardt Amateur Center, Watertown • TEXAS / Douglas Electronics, Corpus Christi • Electronics Center, Inc., Dallas • Ed Juge Electronics, Inc., Fort Worth • Madison Electronics, Houston • UTAH / Manwill Supply Company, Salt Lake City • WASHINGTON / Amateur Radio Supply Company, Seattle • WISCONSIN / Amateur Electronic Supply, Milwaukee •

Prices subject to change without notice.

worked, does he build or buy, has he ever visited Indiana (or wherever I might be)?

One of the important things I like to hear from other ops is how my signal sounds. I have heard a few novices get into lengthy discussions about signal reports and maybe how one person's signals are not quite chirpy but that there is a definite frequency change during key down.

Some amateurs seem to be afraid to tell the other operator if they have a little chirp or click. There are some people on the air who either never work weak stations or they just can't bring themselves to give an honest 249 signal report.

Most novice ops have to depend on signal reports from other hams for any idea how their transmitter or antenna is performing. Sending an inflated signal report in hopes of avoiding embarrassment or insuring receipt of a much needed QSL card is a disservice to any operator.

If you feel like talking awhile you may have to ask some questions of the other guy before you get the conversation going. But if you do get a rag chew going remember to keep the transmissions short to make sure you are being copied.

There is very little reason for hit and run contacts on the novice bands. The ARRL suggests we refrain from talking about religion, politics or sex on the air. That leaves a pretty good selection of things we can and should be discussing.

Schley Cox WN9LHO

Guest Editorial

JERSEY SHORE
AMATEUR RADIO SOCIETY

Ye olde editorial staff was sitting around with a bunch of hams at the recent ARRL convention. We had been up and down the three "large" rooms of exhibits, and had sat in on one forum and part of a second. About halfway through the second forum, we started getting internal signal reports that it was time to refresh and restoke. Finding a nearby oasis, we cuddled around a Tequila Daisy and then noted that we were surrounded by several other hams intent on the same purpose. After nodding a time or two to establish our mutual relationship in amateur radio, we gave a password which joined us all

into a small congenial group, "Hi there, can I buy you a drink?" Several Tequila Daisies later, we were all well introduced and seemed to represent not only the W2 area, but also several W3's, W4's and one W6.

Discussions began with reaction to the convention. It must be reported that aside from two of the fellows who were involved in part of the convention activity as participants, the overall reaction was one of disappointment. "Oh, it's great to eyeball so many of your old contacts" but it would appear that the facilities were not particularly geared to what one might expect of a convention which was billed as being national in concept. Great expectations regarding what the major manufacturers were going to unveil during this gathering were dashed as one traveled through the exhibition rooms. Oh there were a few presentations, but the absence of companies such as Drake and Heath were apparent. One could purchase touch tone pads and bargain LEDs (shades of our local flea market). The fellow cutting callsign badges had a waiting line, even the opportunity to guess how many pieces of junk (including used cigar butts) were contained in a bottle for a prize seemed to draw a crowd seeking fulfillment of their original expectations. A stranger to the hobby could easily wonder at the limited amount of emphasis placed on other than 2 meter FM.

Another point which met with accumulated nods of our assembled group was that several of the forums and seminars did an excellent job in presenting programs geared towards specific interests. One of the W3's noted, however, that in his opinion, some of the interest areas were so esoteric that the average ham who enjoys amateur radio as an outside hobby might find himself as lost as a high school youngster sitting in on a graduate class. This thought was picked up by the W6 who advised that he had sat in with the W3, and although he had professional background in the field, he found the choice of interesting groups was rather limited. The ad hoc group agreed that more choice on the part of the general membership to suggest seminars and forums might have engendered specific areas to be presented which would have more realistically represented the broad spectrum and level of ham interests. The W6 suggested that it was the responsibility of the member to rise to the level of the presentation or he really couldn't consider being a "real" amateur. (The fact that he had ceased to spring for any more rounds was not lost upon the group, and so they gave this arrogance the sneer that it deserved.)

About this time, our group was graced with the presence of a rather fetching YL who soon introduced herself as a fellow ham from W4 land. Sharing from our beaker of Daisies, she also shared a personal view with us. It seems that although she has been in amateur radio for quite a few years and holds a respectable advanced license, her status in the fraternity is generally relegated to a subservient level of something classified as "XYL or YL." "Good grief" she exclaimed, "I can handle a key, mike or soldering iron as well as most other hams (the Tech's and Conditional's in the group seemed somewhat nervous). Why do the various groups seem to consider us as people who make sandwiches while ham activity takes place? Why do they always seem to think that they must advise that YL activities are available? In point of fact, why do they set up YL groups and nets which definitely create a difference in the minds of many as to the ability of female amateurs? An amateur is an amateur. No wonder so few XYL's take an active interest in what seems to be a male-oriented activity.

"We feel as if we are trespassing into the 'MEN'S ROOM!'" (Noting the number of Daisies she had consumed in this short time, we can attest that she would fit right into many of the radio club meetings we know of.)

Well, it seemed time to return to the convention room and so we set on and said our 73's to the group. Our discussion had turned to what several of the members termed, "the attitude of apathy within the radio fraternity" and we felt that this was discussion for another day. We admit to thinking how sad their home clubs must seem if they were beset with this problem of membership apathy — and we bethought of how lucky we were in our own JSARS club. So we merely smiled and walked out — warmed by the thought of the upcoming annual club picnic.

The KaChunker WR2ABR

Book Review

WORKING 1600 METERS

W2IMB has a little book out on QRP use of the 160-190 kHz band. This is NOT a hamband, but one open (with some restrictions) to anyone who wants to experiment with it. The book discusses antennas, circuits, DX that has been worked, sked times, etc. Send \$1.75 for the book to Ken Cornell, Box 721, Westfield NJ 07091.

50 MHz BAND

Bill Turner WA0ABI
Five Chestnut Court
St. Peters MO 63376

WB4OSN says August brought a number of openings but nothing very spectacular. Joe worked the Northeast, plus a few 8's, 9's and 0's and heard the T12NA beacon a few times. The WB0ELN QSL finally arrived in Margate, Florida making 48 confirmed for Joe...congratulations are due! The final comment is a sad one, other KZ5's report that Don KZ500 has left the Canal Zone.

John WA2UON says he has been reading this column for some months and has recently gotten active on the band. John lives in Castleton-on-Hudson, New York and is interested in contacting a club in the Eastern New York area. Anyone with information is invited to contact John at 1216 Maple Hill Road...the ZIP is 12033.

Seven contacts in six new states isn't a bad evenings work. That is the record according to Nick WA4ZDP of Jacksonville, Florida (wife Diane is WA4ZDQ). Nick worked Vermont, Connecticut, Ohio and four other states during an opening July 25th. Stations were heard as high as 50.200 and as low as the bottom of the phone band. The equipment consists of an FT-101B, FTV650 transverter, five elements at 60 feet with a Spectronics DD-1 digital readout as frosting on the cake. Commenting on other local activity, Nick says "Big Al" WA4HLP worked VE, KP4 and 30 states in one month.

SMIRK has passed the 500 member mark and shows no sign of stopping there. It is very encouraging to note the amount of activity generated by a relatively new organization founded by a relatively small group. This group has promoted 50MHz operation to a greater extent than anything since the Sunspot peak of the late 50's. More power to them and others working along side to generate the interest and activity the band so sorely needs. I for one would very much like to see a close association between the major Six Meter organizations, SMIRK, S.P.E.S.M., and the SIX-SIX Club, Inc plus the numerous smaller groups in order to further increase activity, work for RFI legislation, persuade manufacturers to design and produce equipment, and represent the 50MHz fan in FCC matters.

As an example, would it not be worthwhile to petition the FCC to allow phone in the 50.0-50.1 band segment? I cannot recall having ever heard more than a half dozen stations

on CW in this 100kHz, even during the widest of openings. What little CW there is normally finds its way into the phone segment (or should I say Technician segment). Obviously the lower the frequency the more common the openings and the longer they last. Why should the vast majority be denied for the benefit of the few? Incentive you say? NONSENSE! If the desire were to upgrade the quality of the operator the proper way to go about it would be to dangle something he wants. My proposal is this.

1. Open 50.0-50.01 to all classes, CW ONLY. The space available would then be in keeping with the number involved.

2. Open 50.01-50.1 to PHONE, General and above. There would then be valid reason for the thousands of Technician Class licensees to improve their lot by upgrading.

I frankly have reservations in proposing the above. I have never felt that the good of amateur radio was served by setting off "lower" class operators to themselves. I know of no other activity which segregates the master from the apprentice. The archer, the bowler, the ball player all play on the same field and learn from the more experienced. If we must be divided, let us do it in some reasonable manner. ...WA0ABI

HAM HELP

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

If you need help, let 73 know — don't be bashful — the readers are solid gold and are anxious to help you. If you would like to help, let 73 know about that plus your area of expertise, if any, so we can list you for either general help or as a technical advisor.

The following need some help — can you spare some time? Clubs in particular take note.

Authur L. Aвило, 5848 Garden Avenue, Marysville CA 95401.

Alan Kline, 30 King Street, Lynn, Mass. (ph 617 595-0873).

Leonard E Booth, 3123 South 13th, Niles MI 49120. (ph 684-3578).

W. Kenneth Lidman, c/o Walter Lidman, 12 Irwin Place, Hazlet NY 07730. (ph 201 26405371).

W. J. Elperin WN0LDN, 936 Curran Avenue, Kirkwood MO 63122.



SAN DIEGO NOV 1-3

ARRL SW Division convention — Town and Country Hotel — talk in 34-94, 3900, 7250. \$5.50 registration, \$9.75 banquet. Write Box 82297, San Diego CA 92138 for info and pre-registration details.

MANILA NOV 8 & 9

South East Asian Net Convention. For info write DU1JO, P.O. Box 386 MCC, Makati, Philippines.

CANTON — NOV 22

Massillon ARC Annual Flea Market and Auction. Send card for map and details: Marc, Box 8711, Canton OH 44711.

DELAWARE QSO PARTY NOV 30

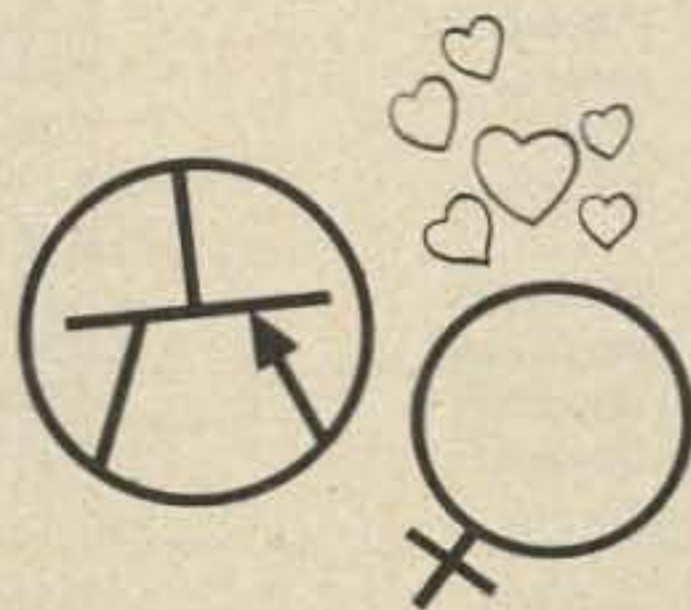
Starts 0001z Sat. Nov. 30 and runs for 24 hours. Good news for ops still needing Delaware on some band. Try 3560 7060 14060 28160 or 3975 7275 14325 21425 28650 or (Novices) 3710 7120 21120 28160. 5 pts per Delaware station, 3 for two counties worked or 5 for all three counties. Send logs to K3YHR.

FORT WAYNE, IND—JAN 19

The Fort Wayne Hamfest is January 19, 1975 at Shiloh Hall (½ mile west of Ind. 3 on Carroll Rd.). Flea market, food. Tickets are \$1.50 at the door. XYLs and children under 12 years free. Tables available at \$1.00 for 4 ft. Talk in on 28 — 88 and 16 — 76.

STOUGHTON, MASS. NOV 10

HUGE AUCTION. The Minuteman Repeater Assn., a club with more than 300 members, will hold an auction with tons of good equipment on Sunday, Nov. 10, starting at 1PM, at the Stoughton High School. Bring your own goodies to be auctioned if you wish (club takes 10% of selling price). Snack bar, refreshments. For info call Maurice Finer K1GGP, Milton MA 617-698-7198.





Revision of Recently Published Repeater Atlas

NEW MEXICO

WR5ABH	Albuquerque	6.91-6.31
WA5VKY	Albuquerque	6.13-7.06
WR5ABV	Capitan	6.34-6.94
WR5ABU	Los Alamos	6.28-6.88
WR5ACE	San Antonio	6.16-6.76
WR5ACM	Mt. Taylor	6.34-6.94

NEW YORK

WR2ADM	Bellmore	6.25-6.85
WR2ABU	Boston	6.31-6.91
WR2ADR	Buffalo	6.13-6.73
WR2ACM	Dunkirk	6.25-6.85
WR2ABL	Elmira	6.10-6.70
WR2	Hunter	6.28-6.88

WR2ABD	Ithaca	6.37-6.97
WR2ABW	Larchmont	CLOSED
WR2ADZ	Long Island	7.973-7.375
WR2ABA	Long Island	52.64-52.525

WA2KSB	Long Island	7.81-7.21
WR2ACW	Long Island	6.10-6.70
W20QI	Long Island	6.145-6.743

WR2ACG	Long Island	6.22-6.82
WR2	Long Island	6.58-6.82
WR2ACG	Long Island	7.085-7.685
WR2	Long Island	7.73-7.13
WR2ACH	New York City	6.28-6.88
WR2ACO	New York City	7.69-7.09
W2JUP	New York City	7.87-7.27

WR2ABK	New York City	7.915-7.315
WR2	New York City	444.55-449.55
WR2	New York City	223.26-224.86
K2QGT	New York City	444.70-449.70
WR2AAA	Manhattan	449.30-444.20

WR2ACD	Manhattan	442.05-447.05
WR2	Manhattan	7.73-6.73
WR2	Manhattan	6.40-7.00
WR2	Manhattan	449.30-444.30

WR2	Norwich	6.07-6.67
WR2ACT	Olean	6.25-6.85
WR2ADF	Oswego	6.34-6.94

WR2ADC	Pearl River	6.25-6.85
WA2UWQ	Rochester	7.72-7.12
WR2ADW	Rome	6.28-6.88
WR2ADN	Saratoga	6.34-6.94
WR2ABV	Schenectady	6.40-7.00
WR2ABV	Schenectady	445.50-147.00

WA2RJX	Syracuse	6.46-7.06
WR2ACL	Troy	6.04-6.64
WR2ADW	Utica-Rome	6.34-6.94
WR2ACR	Watertown	444.2-449.2
WR2	Watertown	6.34-6.94

WR2ACN	Woodmere	6.10-6.70
WR2ABW	Yonkers	6.16-6.76
WR2ACN	Woodmere	6.04-6.64
WR2ABW	Yonkers	6.31-6.91

NORTH CAROLINA

WR4AEV	Asheville	6.16-6.76
WR4AEV	Asheville	222.34-223.94

WR4AGF	Asheville	6.22-6.82
WR4	Asheville	6.31-6.91
WR4	Burlington	6.07-6.67
WR4AGC	Durham	6.22-6.82
WB4QFT	Durham	449.10-444.10
WR4ADT	High Point	6.40-7.00
WR4ADT	High Point	447.90-442.90

WR4AFV	High Point	6.19-6.79
WR4	Laurinburg	6.07-6.67
WR4ABX	Lexington	6.31-6.91
WR4ABX	Lexington	222.30-223.90
WR4ABX	Lexington	443.31-448.91

WR4	Manteo	6.34-6.94
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NORTH DAKOTA

WR8ACJ	Bismark	6.34-6.94
WR8ADQ	Fargo	6.16-6.76

OHIO

WB8CXO	Akron	7.69-7.09
WR8ACI	Athens	6.34-6.94
UC	Canton	6.19-6.79
WR8	Central Ohio	6.46-6.06
WR8ACB	Cincinnati	6.115-6.70
WR8ACC	Cincinnati	7.99-7.39
WR8	Cincinnati	448.90-443.90
WR8ACP	Cleveland	53.15-52.79
WR8ABL	Cleveland	53.25-52.60
WB8APD	Cleveland	52.92-52.68
WA8CEW	Cleveland	52.96-52.72
WB8CRV	Cleveland	6.28-6.88
WB8CRP	Cleveland	6.22-6.82
WR8ABC	Cleveland	6.16-6.76

WA8BBN	Cleveland	6.355-6.76
W8WV	Cleveland	449.95-447.95
W8TQA	Columbus	6.25-6.85
WR8ABV	Columbus	6.115-6.715
WR8ABR	Columbus	52.76-52.525
WR8ACA	Columbus	6.16-6.76
WR8ABR	Columbus	6.31-6.91
WR8ACV	Dayton	7.81-7.21
WA8PIA	Dayton	6.37-6.97
UC	Freemont	6.04-6.64
WR8ABW	Galion	443.75-448.75
WR8ACU	Hudson	6.31-6.91
WR8ACM	Marietta	6.25-6.85
UC	McConnelsville	6.115-6.715
WR8	Millersburg	52.76-52.525
WR8ABS	Monroe	6.16-6.76
WR8ABX	Newark	6.31-6.91
WR8ABJ	Newcomerstown	7.81-7.21

K8JHG	Ottawa	6.13-6.73
K8JHG	Ottawa	6.325-6.73
WR8ADC	Toledo	6.28-6.88
WR8ACT	Toledo	52.76-52.525
WR8ABU	Vandalia	6.01-6.61
WR8ACZ	Vandalia	6.25-6.85
K8NPY	Willowick	6.34-6.94

WR8ABU	Vandalia	6.19-6.79
WR8ACZ	Vandalia	6.25-6.85
K8NPY	Willowick	442.85-447.85
K8NPY	Willowick	53.70-53.46

OKLAHOMA

WR5ADO	Bartlesville	6.16-6.76
WR5	Elk City	6.16-6.76
WR5	Lawton	6.34-6.94
WR5	Norman	6.28-6.88
WR5ADE	Oklahoma City	6.28-6.88
WR5ADO	Ponca City	6.34-6.94
WR5	Still Water	6.37-6.97
WR5	Still Water	6.13-6.73

OREGON

W7DBS	Eugene	T1.8
K7TBL	Eugene	6.10-6.70
W70FY	Grants Pass	6.16-6.76
WR7ADC	Klamath Valley	6.34-6.94
WR7ABK	Medford	6.01-6.61
WR7ADD	Philomath	6.34-6.94
WA7CHL	Portland	6.22-6.82
WR7ABE	Portland	6.10-6.70
WR7ADI	Portland	444.45-445.45
WR7ADI	Portland	444.17-449.17
WR7ADI	Portland	6.34-6.94
WR7ADI	Portland	6.40-7.00

PENNSYLVANIA

WR3ACM	Altoona	6.22-6.82
WR3AAA	Freedom	6.25-6.85
WR3AAB	Lehigh Valley	6.10-6.70
WR3ABR	Mt. Holly Springs	6.28-6.88
WR3ADB	Muncit	6.22-6.82
WR3ACE	New Holland	6.01-6.61
WR3ACE	New Holland	223.34-224.94
WR3ACE	New Holland	444.15-444.15
WA3BKO	Philadelphia	6.16-6.76
WR3ABE	Philadelphia	52.76-52.64
WR3ABE	Philadelphia	448.80-443.80
WR3ABK	Philadelphia	6.37-6.97
WR3ACK	Reading	52.575-52.680
WR3ACU	Philadelphia	52.82-52.38
WR3	Philadelphia	7.63-7.03
WR3ABZ	Philadelphia	7.66-7.06
WR3ABX	Philadelphia	223.34-224.94
WR3ACI	Pine Grove	6.04-6.64

TEXAS

WB5AEI	Alice	444.10-449.10
W5CBT	Amarillo	6.34-6.94
W5CBT	Amarillo	444.50-449.50
WR5ACO	Arlington	6.07-6.67
WR5	Arlington	7.75-7.15
WR5	Arlington	449.20-444.20
WA5YUO	Austin	449.10-444.10
WR5ACS	Beaumont	6.16-6.76
K5FPJ	Beeville	6.34-6.94
WR5ACI	Big Spring	6.22-6.82
WR5AEA	College Stn.	6.22-6.82
WR5ACD	Corpus Christi	6.34-6.94
WR5ACT	Corpus Christi	6.22-6.82
WA5YVK	Corpus Christi	6.28-6.88
WR5ABE	Dallas	6.13-6.73
WR5ABY	Dallas	6.28-6.88
WA5VKV	Dallas	449.00-444.00
K5IQP	Denton	6.28-6.88
WA5YTL	Denton	6.31-6.91
K5ZCO	Dallas	6.25-6.85
WA5YTM	Ft. Worth	6.34-6.94
WA5YTM	Ft. Worth	6.16-6.76
WA5YTM	Ft. Worth	449.10-444.10

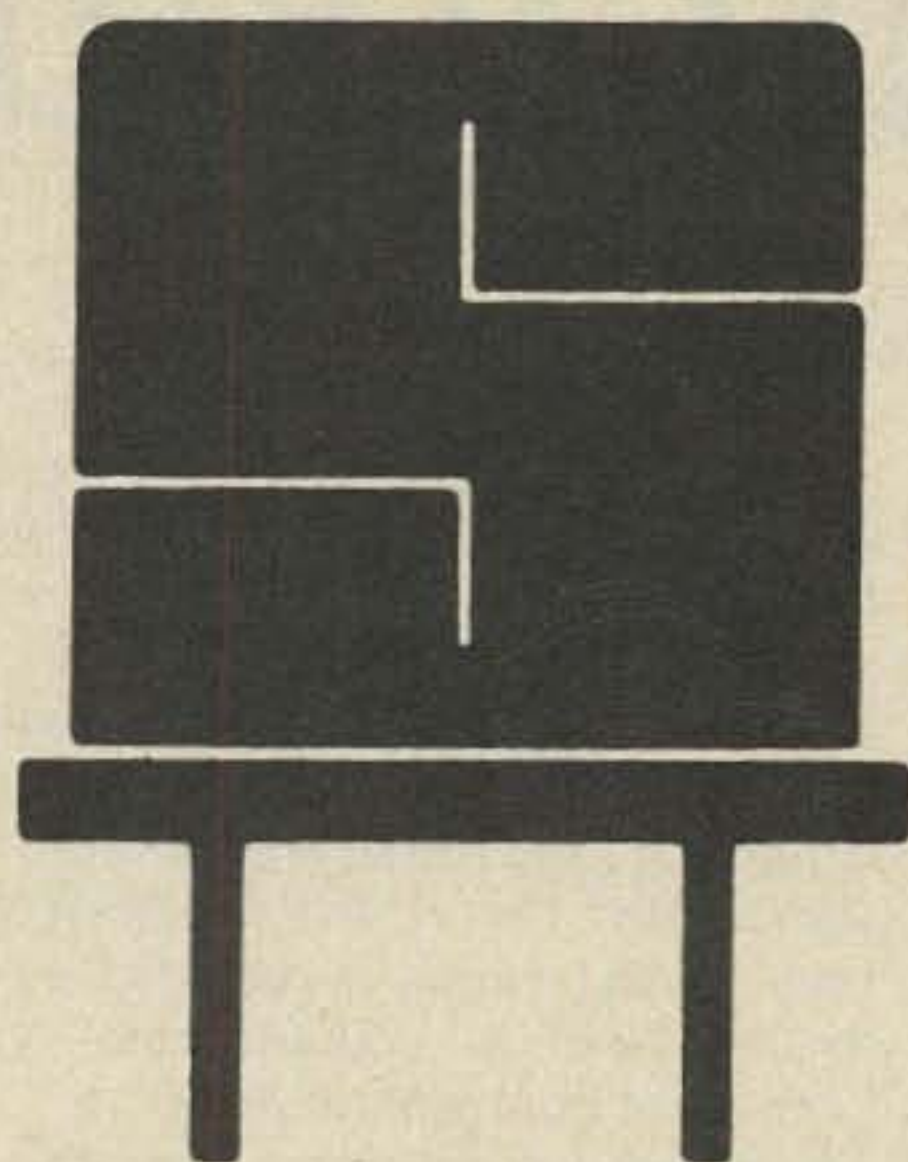
WA5YUM	Ft. Worth	53.16-52.56
WA5YVC	Ft. Worth	448.90-443.90
WR5ACW	Georgetown	6.16-6.76
WR5ABJ	Houston	6.07-6.67
W5KAB	Houston	6.10-6.70
K5IHK	Houston	6.13-6.73
WA5YUB	Houston	6.16-6.76
WA5YUJ	Houston	6.19-6.79
W5PMQ	Houston	6.25-6.85
WA5LJO	Houston	6.31-6.91
WR5ABX	Houston	6.34-6.94
WR5ABS	Killeen	6.34-6.94
WR5ACZ	Lubbock	6.34-6.94
WR5	McAllen	6.61-6.76
W5TJD	Mineral Wells	6.04-6.64
K5FPI	Mt. Pleasant	6.34-6.94
W5LUP	Odessa	6.34-6.94
WR5ACA	Plainview	6.22-6.82
WR5ACA	Plainview	6.22-6.94

WA5RUQ	San Angelo	449.20-444.20
WR5ADH	San Antonio	52.880-52.525
WR5ADH	San Antonio	6.22-6.82
WR5ADH	San Antonio	6.34-6.94

WR5ACL	San Antonio	6.01-6.61
WR5ACL	San Antonio	6.28-6.88
WR5ABR	San Antonio	6.16-6.76
WR5ADJ	San Antonio	449.10-444.10
WR5ACK	San Benito	6.34-6.94
WA5ZUP	Temple	6.13-6.73
WR5ACP	Temple	6.22-6.82
WR5ABF	Texarkana	6.22-6.82
WA5YTN	Victoria	6.34-6.94
WR5ABK	Waco	6.28-6.88
WR5ABO	Wichita Falls	6.34-6.94

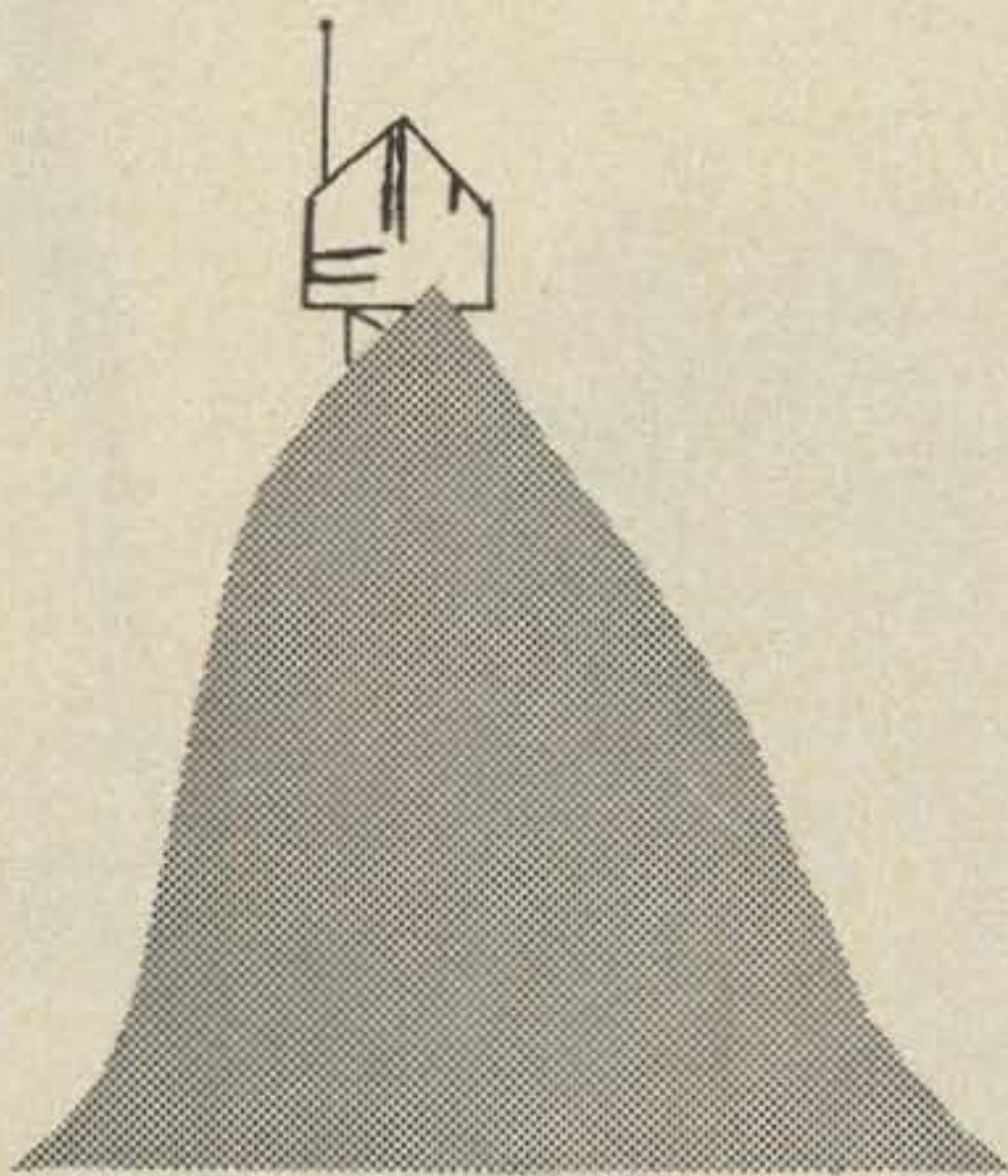
MORE NEXT MONTH

Send any and all corrections, updates or new listings to 73 Magazine, Peterborough NH 03458.



REPEATER OWNERS

Don't Take Chances. SENTRY offers custom made crystals made exactly to your specifications. When it comes to crystals for your repeater, BUY THE BEST - SENTRY.



REPEATER USERS

If you want reliable access to the repeaters in your area, you want and need SENTRY CRYSTALS. SENTRY CRYSTALS are custom made for your rig. We don't stock a large quantity of crystals for a certain frequency and hope you can tweak them to frequency in your rig. We do offer FAST service on crystals made especially for you and your rig. If you want reliable, on-frequency operation, INSIST ON SENTRY.



SENTRY MANUFACTURING COMPANY
Crystal Park, Chickasha, Oklahoma 73018

PHONE: (405) 224-6780

TWX-910-830-6425

Amateur Radio

MCMLXXIV

Monthly Ham

THE NEXT VOICE YOU HEAR WILL BE...A HOOLIGAN

MOSCOW —Strange things can be heard crackling over the Soviet air waves these days — not from the hated foreign broadcast but from such stations as Radio Demon, The Diamond, Dragon, Ninotchka, Black Soul, Sea Devil and Tempest.

They are all illegally operated inside the Soviet Union — mostly by young radio enthusiasts — and the government is taking ever more serious measures to stamp them out. However, with all of the modern electronic means of tracking down the private shortwave and ultrashortwave broadcasts, the authorities have found that as soon as one is silenced another pops up.

But the fact that the term applied to these illegal operators is "radio hooligans" indicates an even more serious official displeasure over the political jokes criticizing the regime, the distribution of information offending the government and the Communist Party, and the playing of rock music, which is regarded by the authorities as "degenerate" and "decadent bourgeois culture."

The above was reprinted from the Los Angeles Times and brought to our attention by Dave WB6ZGF.

STUDY OF LDE PHENOMENON

A startling new interpretation of the rarely observed phenomenon of "Long Delayed Echoes" is being researched by a small group of engineers

at EMI's SE Computer Peripherals plant in Feltham, Middlesex, England.

The effect was first investigated by radio pioneers in the 1920s.

Led by Tony Lawton, SE's technical manager, the group is setting up an experiment to test an hypothesis by Scottish researcher, Duncan Lunan.

Lawton and his team are conducting the investigation in their own time, but with EMI's full backing. Even if they disprove Lunan's theory, they hope to shed light on a phenomenon that has puzzled scientists for decades.

The first reports of LDEs was published in a letter to *Nature* on November 3, 1928 by the ionospheric expert, the late Prof. Carl Stormer of Oslo. He and engineer Jorgen Hals observed LDEs on transmissions made by Dr. van der Pol using the Phillips experimental transmitter PCJJ at Eindhoven in Holland. The frequency used was 9.55 MHz with 15 kW into a long wire aerial.

Morse letter "S" was repeated at intervals of 30 seconds, and received almost instantaneously by Stormer and Hals. Also noticed was the fairly common one-seventh second echo effect as the signals circled the globe, but other distinct echoes were heard with intervals varying between 3 and 15 seconds.

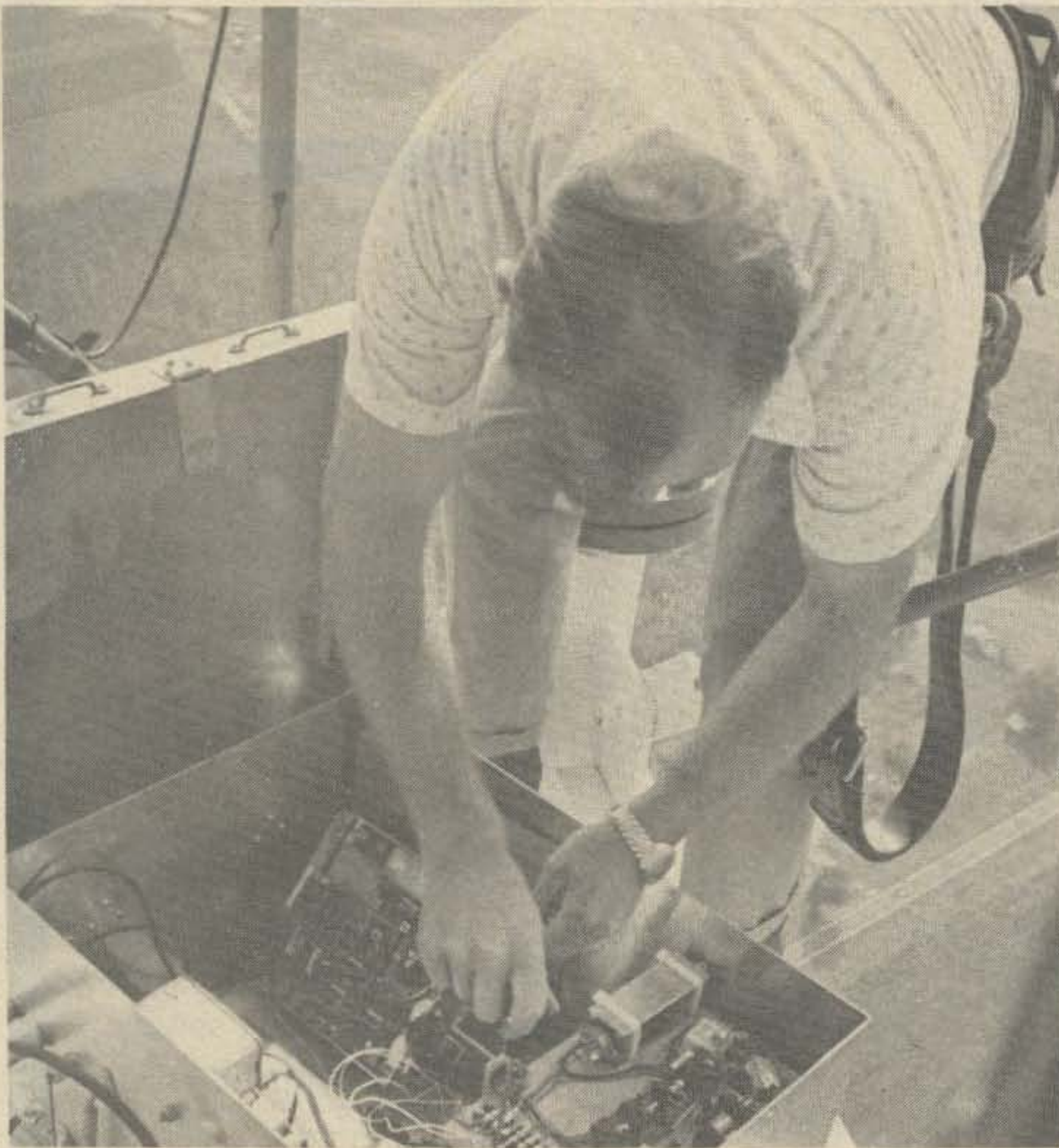
Two French workers, J.B. Galle and G. Talon observed LDEs in May 1929 using a 500 watt transmitter on a wavelength of 25 meters. A description of the very long sequence of echoes with delays between 1 and 30 seconds was published by Galle and "L'Onde Electrique" Vol. 9, 1930.

The key lies in the plotting of a simple graph for each echo sequence. The sequence of transmitted signals is plotted along the horizontal axis, while the delay of the echo (in seconds) is plotted on the vertical axis.

Stormer's sequence plotted in this way gives a pattern which Lunan points out bears a striking resemblance to the constellation Bootis.

The graphs for other sequences yield plots of many other recognizable stars and constellations.

Overall, the information, if such it is, decoded by Lunan is consistent with the hypothesis that LDEs are being returned by a space probe that arrived in the solar system from the star Bootis some 13,000 years ago to



Curt Powell, WB4WAA, makes an adjustment to the WR4ABP repeater located at 1300' on the WITN-TV tower at Grifton, N. C. The 146.16/76 FM repeater was first licensed in May 1972 as W4NBR and was constructed by F N C Repeater, Inc., an amateur club of 60 members residing

throughout eastern North Carolina. The unit is radio controlled via 450 MHz from five control points. An elevator in the WITN-TV tower provides easy access for infrequent maintenance of the solid state repeater which now uses transmitter and receiver boards from a Standard 803 transceiver.

News Pages

News of the World

73 MAGAZINE

search for intelligent life, as manifested by radio transmissions.

Tony Lawton and his colleagues plan to put this to the test by beaming transmissions, probably using a high powered 144 MHz transmitter and a high gain aerial.

PEOPLE'S REPUBLIC OF CHINA

The People's Republic of China has acceded to the International Telecommunication Convention, 1965, but has made three statements including one to the effect that China makes reservations on the articles concerning the assignment and utilization of radio frequencies in the Radio Regulations. In other words there is still no regulatory backing for repeated requests for the removal of unwanted broadcast stations in the amateur exclusive band, 7 to 7.1 MHz.

The form of call signs to be issued by the Chinese administration to amateur stations is:

The letter B followed by a letter designating the geographical area followed by a single digit, and then followed by the letter A or A with one of two letters.

The letters designating the geographical areas are listed below:

- F — Shensi, Honan
- G — Nanking
- H — Shanghai
- I — Kiangsu, Chekiang, Anhwei
- J — Hankow
- K — Hupeh, Hunan, Kiangsi
- L — Chungking, Szechwan, Sikang, Tibet
- M — Yunnan, Kweichow
- N — Kwangtung
- O — Canton, Kwangsi, Fukien
- P — Peiping, Tientsin
- Q — Hopeh, Shantung, Shansi
- R — Jeohl, Chahar, Sulyuan
- S — Kansu, Ningsia, Chinghai
- T — The nine northeastern Provinces
- U — Sinkiang
- V — Taiwan

FCC TASK FORCE HUNTS FOR HOME RADIO ABUSERS

No one knows when they'll hit town — it could be tomorrow. They move in under a cloak of secrecy and set themselves up in a lonely motel room or vacant office. They bring

their equipment with them, the most sophisticated in electronics gear. Their cars are specially rigged with tracking devices. They have a van crammed with recorders, meters and detectors. The job takes about a week. They get what they need and move on to another town, another state.

These are not a band of super criminals setting up some slick caper. They come to town to track down the source of a common complaint from families throughout the nation — TV interference from home radio hobbyists. The FCC has recently reorganized and expanded a special task force division, setting up specialized 10-man enforcement teams assigned to "clean up" mounting abuses among operators of the popular "Citizens Band" radio rigs.

Reprinted from the Sunday Star-Ledger, Newark NJ.

WB1ETH

A Special Events Station, WB1ETH, was operated for the Bethlehem, NH Bicentennial the weekend of August 9, 10 and 11. Operators were Mike Blandin WA1RKH, Chris Hanson WA1SHO and Bob Daniels WA1ODG. The station transmitted approximately 35 radiograms, many being from passers-by to friends or relatives. We made approximately 90 contacts on 15, 20, 40 and 80 meters using a Ranger and an HW-101. Antennas were a 120' dipole and a 22' vertical. Those who contacted WB1ETH are requested to send a QSL and SASE to WA1RKH.

Mike Blandin WA1RKH
Box 25
Bethlehem NH 03574

RECIPROCAL LICENSING IN ISRAEL

Every radio amateur who presents a valid license from his own country can receive an Israeli license. At the time of government examinations, he will be questioned in those specific areas where it is felt that the technical level in his own country is lower than in Israel. Decisions regarding the technical levels will be based upon a comparison of the syllabus from the amateur's own country to the syllabus in Israel. An amateur who does not pass the examination, or decides not to sit

for it, will automatically be issued an Israeli license that is one grade lower than his original license. Examinations are currently held in Israel twice a year during the school vacations of the holidays Passover and Rosh Hashana (the Jewish New Year).

In the case of the U.S., Canada, U.K. Austria and Costa Rica, special reciprocal licensing agreements exist. Amateurs from these countries may receive licenses during any period of their stay in Israel, and they are not required to sit for any examinations.

Amateurs who do not bring equipment can receive permission to operate every amateur station in Israel as second operators.

Further information, application forms for reciprocal licenses may be obtained from:

Ministry of Communications,
Engineering Services
Postbox 29107
Tel-Aviv, Israel

(from R. Kline 4X4NJ)

COUNCIL AVOIDS ROW WITH HAMS

Bell, California's City Council warded off a confrontation with irate ham and citizen band radio operators worrying that restrictive rules might be passed by the council (they were not considered).

The meeting started off with an overflow crowd of some 125 persons jamming the council chambers, most of them amateur radio operators alarmed over reports that city officials might consider requiring special permits as a way of controlling transmitters interfering with television and radio reception and even telephone communications.

But a threatened protest never developed because city officials heard a report from City Administrator John Pitts that he had contacted owners of offending transmitters and they had cooperated fully by adjusting their sets or dismantling overpowered transmission equipment.

The council heeded the administrator's recommendation to drop the matter, and was immediately treated to the rare sight of a packed house cheering their actions.

Courtesy of Leonard R. Fox WA6SXX

ou goons don't ever proofr
easy man scripts from bab
bunch of rocks preening on
you ignored my comments in
I insist that you print ev

FM REBUTTAL

Re Al Chapman's (W6MEO) letter in the September issue of 73. The two meter FM "growing pains" here in the Southland are no different than most other large urban areas throughout the country. I can attest to this since I have had the opportunity to see the situation on both sides of the continent and a number of places in between; In most cases, one repeater, the one that combines the virtues of best area coverage with a minimal number of operating restrictions will become the congregating spot for the majority of operators. It will become the training ground for 9 out of every 10 newcomers to two meter FM. It was that way back in N.Y.C. on the old WA2SUR and is the same out here on a number of machines. No ham, whether he or she has been around amateur radio for more years than they wish to remember or is the newest of newcomers can be an "A-1 Op" the moment they enter the world of VHF-FM. Operating technique on a VHF repeater takes time and effort to learn in the same way one learns to be a champion DXer.

I must, however, take exception to Al's suggestion concerning types and duration of license. One cannot legislate a good operator into existence. A ham either wants the respect of his peers or he doesn't. It is not the class of license that one holds that makes him or her a good operator, but a sense of self respect. To carry this further, if a person has no respect for himself, then he will show little respect for others. The ham who will "step on you" on a two meter repeater is the same type of ham that will "step on you" while you are trying to get that "rare one" on 20 SSB. It's not the class of license that is at fault, but rather the personality traits of the operator.

Sure, many of our machines get plagued by "Kerrchunker's," Jammers and poor operators. But a combination of peer pressure and the marvelous ability that we in amateur radio have to police ourselves usually works and those that are habitual offenders eventually change their ways or just "go away." If there is one shame to be found in this whole affair it is that in the process we sometimes also loose potentially fine members of the VHF-FM community due to the poor first impressions they may get. However, before you prejudge two meter FM and its associated repeaterized operation I suggest you think

carefully about one of those "DX Pile-ups." In both cases you will find the "screwball" who has to spoil it for the rest of us. Remember, though, that we are hams because we love amateur radio and that there is a place in it for all of us regardless of what class we may hold. No band or mode is a utopia and each suffers in its own way. It is the obligation of all of us to build amateur radio from within if we are to survive.

Bill Pasternak WA2HVK/6
Associate Editor-Looking West

THANKS, STEVE WA1DFL

While reading the September 74 issue of 73, I noticed a letter from a ham whose call was very familiar. I refer to Steve Rich WA1DFL from Revere, Massachusetts.

I was a patient at Chelsea Naval Hospital in 1966 like a lot of other Viet Nam veterans. My dad brought my PC62B to the hospital for me to use to help pass the time. This is where I met Steve.

Steve became very friendly with us at the hospital. He began running phone patches and messages for the guys making them very happy. I'm sure I speak for all the guys when I say thanks Steve for making our stay enjoyable!

Ron Pariseau K1VSC

RECEIVER PROJECT WANTED

Your questionnaire in the back of the just received 73 prompts me to write. Yes, there is definitely something I'd like to see in the way of a construction article.

Remember the old 6L6-807 ARRL rig? Everybody built one...at least it seemed that way back in 1946 when I first got my ticket...now nobody builds unless it's a Heathkit.

What I'd like to see in the way of a construction article would be a receiver...from 80 through 10 meters...using standard and readily available parts, straightforward circuitry and transistors where possible. I'd like to see this in the light of a re-birth of the home-built station where you can build something that is at least capable of keeping up with what is offered built up commercially, then possibly later, a matching transmitter. AM, CW and SSB, of course.

I am not capable of designing such a rig and I've written to QST every so often over the last quarter century and got nothing. Most responses are "design it yourself and submit it and

we'll print it". Hmmmm...nobody likes a smartass and so it goes, the good basic ham receiver you can build yourself is yet to be offered. Sure there is the specialized CW or SSB receiver either for a single band or one some engineer whipped up with exotic components or a squirrily circuit nobody could get to work. There must be someone in your vast circle of acquaintances in the ham world that can give us "The 73 Basic Receiver - you can build it yourself."

Oh, yes, how did you get the apple to move so fast and the bullet to stand still for the apple to pass through the bullet...at least that's the caption on the apple/bullet photo - OK so everybody makes a mistake.

Best to you and keep up the fine magazine.

...W4KFK

A GREAT AMPLIFIER

Wayne, I want to tell you about a great company that I read about in 73. I ordered a 2-meter 15 watt amplifier from VHF Engineering. It is well engineered and easy to build. I tested it and found it very stable and easy to tune up and broad band.

I drive the amp with a TR-22 measuring the power output with a Bird wattmeter from the front seat of my car - 20 watts out. Then I started my car engine - 26 watts out with a 5/8λ whip on the rear deck and 52 watts ERP.

Now that's a product that gives you your moneys worth.

Keep up the best magazine there is!

Robert A. Daffer, Jr. WBØFUR
3016 Bristol Court
Blue Springs MO 64015

COMTEC?

The communications technologies described by G. J. Hanneman (September, 1974) are exciting. The sad part is that we hams remain largely unaware of what lies around the next bend in the wire. Communications is what ham radio is all about. Yet we tend to think entirely in terms of ham radio (the far past) plus a little new stuff when the related ICs become available from the surplus dealers (the near past).

Hanneman has offered to write a couple of articles on the state of the art. By all means, let him bring us up to date. But don't stop there - 73 should keep us up to date with regular articles or even a column on communications technologies.

William W. Creitz K3TJC
Columbia MD

NOSTALGIA

And to think when I first subscribed you were selling lifetime subs for \$25. Keep your head above water, we need you.

WA2MGA

WARNING

Fig. 4 of the 3000 volt power supply article in the July issue has a note that says to connect the neutral of the 220 volt (3 wire) line to the transformer if operating two 110 volt primaries in series.

This is very bad business, because if one of the line fuses blows you won't know it. A very slight drop in high voltage output results that is easily passed off as line voltage fluctuation, or is overlooked entirely. The primary with the fuse that didn't blow takes the entire load, and will overheat and burn out if operation is protracted or if the transformer is not greatly over-size.

The reason for this is that the transformer primary connected to the fuse that blew begins to act as a 110 volt secondary winding, excited from the other 110 volt primary that is still energized by the good fuse. If the upper fuse on the diagram blows, the fan will still operate and the bulb lights. If the bottom fuse blows, the relay still works.

One fuse blowing (normally only one will blow in case of momentary overload, or just old age sometimes) is an extreme case. In the meantime, differences in voltage between the two 110 volt sides, and they are never exactly the same, will cause differences in load sharing between the two primaries.

It is best not to make this connection. It is best to treat the two 110 volt windings in series the same as if they were one continuous 220 volt winding. Indeed, that's what they are, as far as the transformer operation is concerned. It's like having a 220 volt winding with a 110 volt tap, when the two primary ends (one start end, one finish end) are connected together, with the tap unused.

When the transformer is used on 110 volts, the two primaries are connected in parallel, and both share the load equally if the connections are made properly. They are treated like a single heavy winding and never individually fused. Similarly in series, the only way to ensure equal load sharing is to leave the "center-tap" unconnected to neutral, so that in effect one continuous 220 volt winding is active.

Ted Chernin KH6GI

TEETH GIVE FEEDBACK

It was one of those cases, my 90 day guarantee was in its last couple of weeks. One morning I was talking on my handheld 2m unit when, "Hey you have a sick radio there old man, you have feedback on your signal!" Well, the next day I went back to

where I bought the unit to get it repaired. A day later it was back and there was that feedback again! I took it over to a friend's house and we talked over it with no feedback. I took a transmission — bang — there was the feedback. He placed his car keys near the mike and there was the feedback. Next we tried it with my partial dental plate out and no feedback. I put a 150pF silver mica from each side of the mike to ground and this cleared up the problem. Now I can wear my teeth and talk at the same time.

J.W. Greelak
Ontario CA 91762

MONO-REPRODUCER IMPROVEMENTS

Having built the Mono-Reproducer (K9VXZ Sept 74, 73 Magazine) I would like to pass along some improvements I made while experimenting with the unit.

I changed C1 to .01 from .05 to improve the high frequency response. The entire assembly was built in a Pamona box with BNC plug and jack already mounted (available from Gateway Electronics, St. Louis) for ease in connecting and disconnecting the unit, a feature valuable in demonstrations. All parts were mounted on a PC board to conserve space and improve the appearance of the unit. For line (1) in the original figure I used a piece of RG-17U coaxial cable, which I had in the junkbox, to improve the RF characteristics and to eliminate stray capacitance. This should, of course, be as short as practicable.

I am now working on a Stereo Reproducer, utilizing the same design, while trying to retain the valuable foolproof features incorporated.

Michael R. Hanna K8UUO

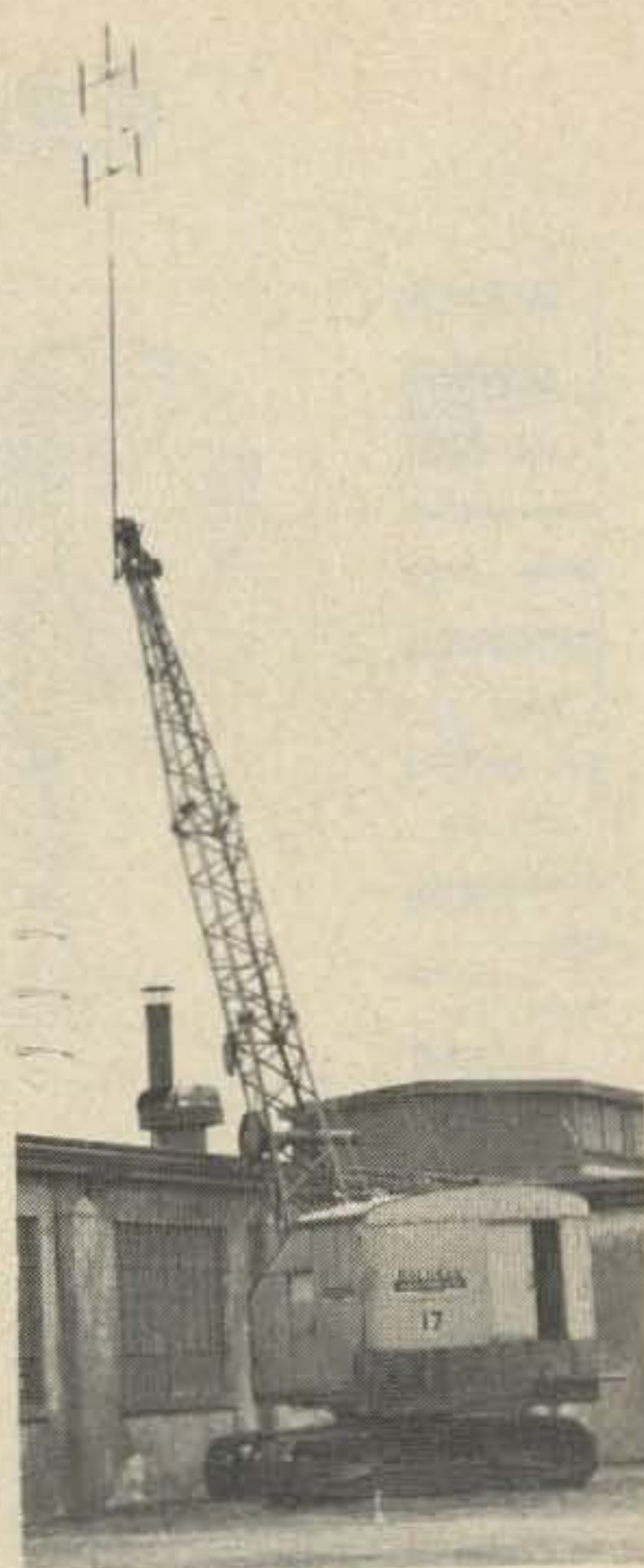
GREEN SUPPORTER

I've just heard the news and I'm horrified. Guess this is "old hat" to you and much could have happened since the original verdict was promulgated... I hope it has and I'm sure the "gang" is rallying round to give you support. Just what form this might take is difficult for me to imagine from this part of the world but I want you to know that I'm a Wayne Green supporter and if there is a call for some monetary aid, then I'll be a supporter again.

I realize too that you gave NZART some real help last year because of my request — just another aspect of your efforts in support of amateur radio in general. So — old friend — keep on keeping on. In spite of all, ever so many folks are very appreciative of your efforts over the years and I'm sure will expect you and "73" to continue to flourish in the future.

Good cheer to you and kindest to the family.

Jock White ZL2GX



ANTENNA

Enclosed is a photograph of, I think, a rather unique VHF antenna installation that I happened to come across recently. Possibly you will be able to use this photo in some future issue of 73 Magazine. Hope you can use it.

Pete Walton VE3FEZ

BACK ISSUES

I received the 36 issues of 73 which I ordered from the Book 'n Stuff portion of your magazine. I would like to say that it was one of the most enlightening deals I ever got. Just skimming through them brought back memories of circuits that were tried and, due to my ignorance, failed.

Most of them were from my "pre-FM" days and, having been almost exclusively FM for the last few years, I really got an education in the old tube circuits. Currently, there are plans afoot to put squelch in a converted AM rig (December '60 page 26) as the highly modified circuit I "stole" from a military receiver ain't so hot.

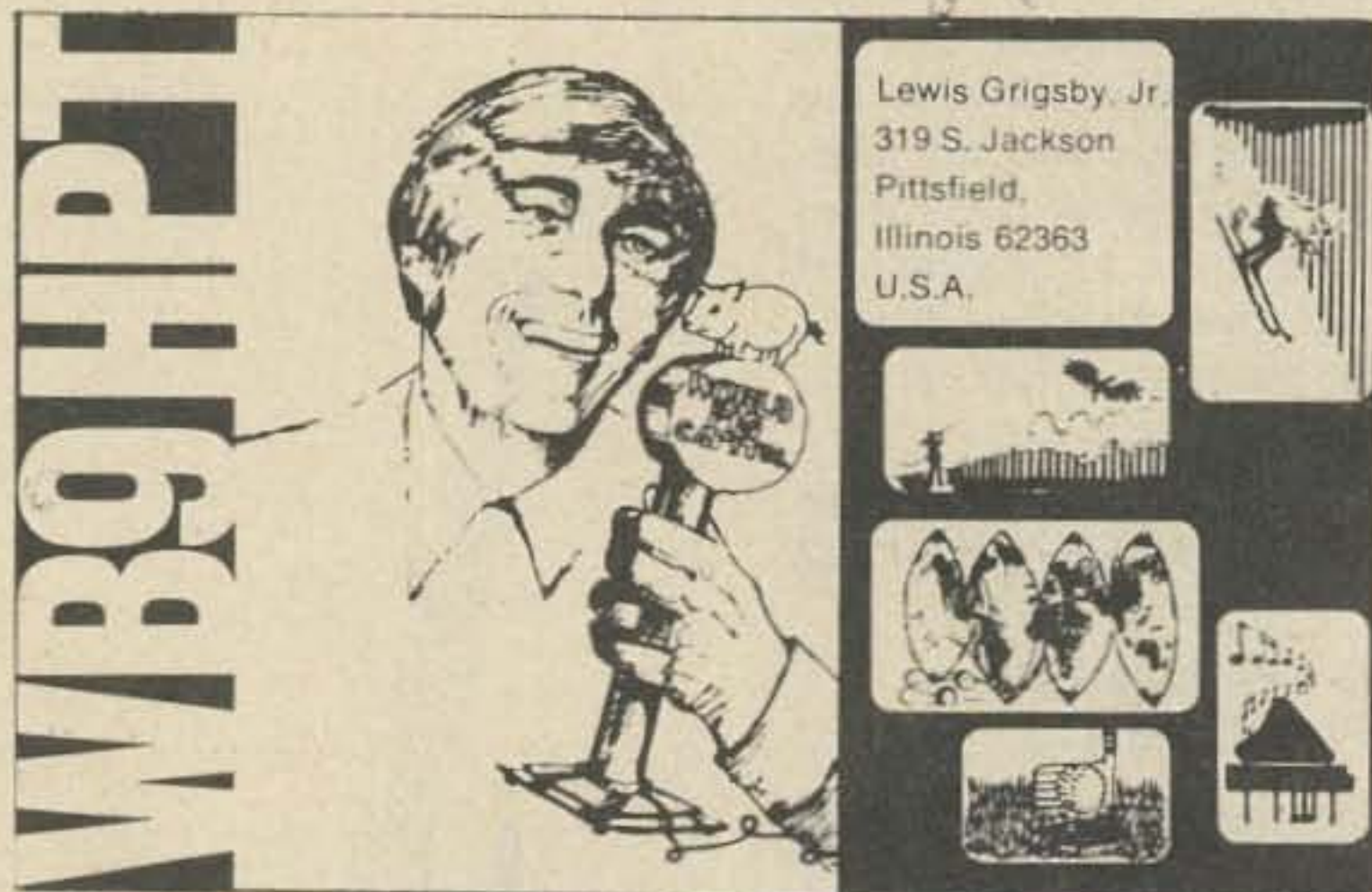
Again, many thanks for offering this fine selection. At 33¢ a copy, I kind of felt guilty about ripping you off. The other books I ordered were also quite interesting, especially the *VHF Projects for Amateur and Experimenter*."

TNX es BCNU on VHF/UHF FM es CW.

Carl Hattan KØBZV/KL7

More LETTERS on page 144.

QSL CONTEST



We have two winners this month. WB9HPT has not only designed a card which really stands out on a wall but by including illustrations of his other interests, he lets his contacts know more about himself. We have included the note which our co-winner, WA9FTH, sent along with his card. He receives a free one year sub as well as WB9HPT, proving that it pays to blow your own horn. If you think your QSL is something special, send it to 73, QSL Contest, Peterborough, NH 03458. You could win a one year subscription.

WINNING CARD

Enclosed you will find the winning entry for your QSL design contest. I am sure you will notice that this card design is striking and beautiful. I am almost ashamed to turn this beautiful card into your contest as it is so obviously superior to any other card in the world.

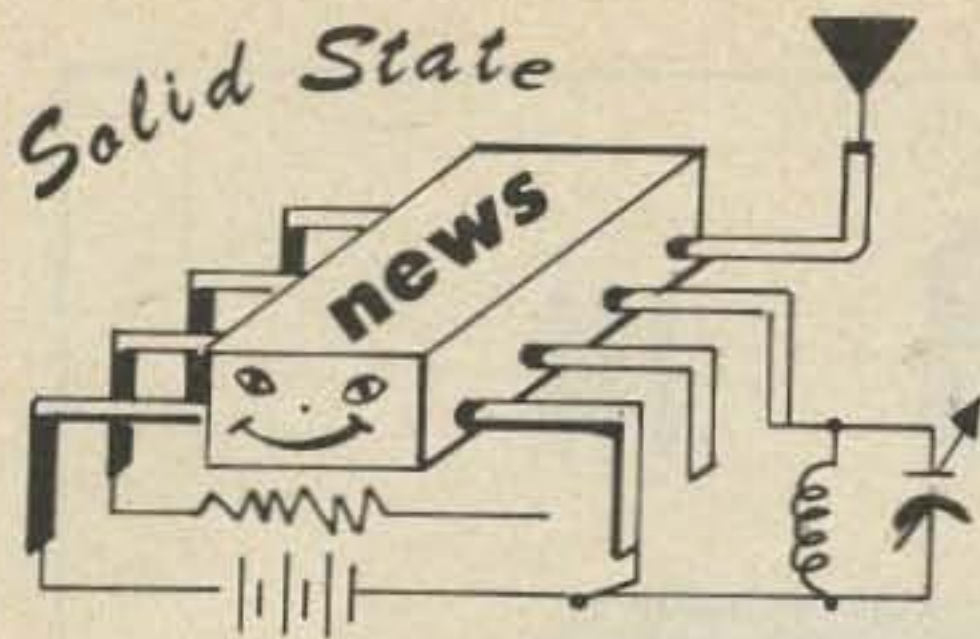
... WA9FTH



Mfr., Model, Ser. No.	Owner	Issue
Clegg 27B No. 72013-1068	W3BXL	7/73
STD. 826 MA No. 208078	WB2DEW	7/73
Drake ML-2 No. 10582	W3MSN	8/73
Sonar FR-2528 No. 21-4250	Doherty	12/73
STD SRC-851-SH No. 9725		
STD SRC-707C No. 2833		
TPL PA-6-IDE No. 1092		
RP MEA-22 No. 212		
Two Larsen Antennas		
Swan 270 No. M-252616	W4NTB	12/73
STD SRC-146A No. 208070	W7DKB	12/73
Marker Luxury No. 2296	W7BVP/6	2/74
Regency HR-2A 2m FM No. 04-05632	WB8NSU	3/74
Collins Model KWM-2 No. 13551	W9JS	3/74
Regency HR-2A No. 04-0787	WA3TVI	4/74
Kenwood TS-520 No. 840092	W7JFR	5/74
CW-520/511S filter		
Inoue EC-20 No. 1161	W1PVF	7/74
1-RF Communications		
RF-403-2 VHF-FM XCUR No. 1277	K3YHR	7/74
Sonar 3601 No. 1416	K1UXD	7/74
SBE Model SB-144 No. 46316 \$25 reward		
\$25 for information for arrest and conviction of thief.	K4KVF/5	7/74



Mfr., Model, Ser. No.	Owner	Issue
Clegg 27B No. 27103-2891	WA1ECF	7/74
Clegg 27B No. 27104-3498	W9VHD	11/74
Drake TR3 No. 12746A	W9VHD	11/74
Collins 30L1 No. 29625	W9VHD	11/74
Drake TR22 No. 620272	K3NCL	11/74
VHF Eng. 1501 amp	K3NCL	11/74
Std. 826M No. 203085	WA9VNW	11/74
Motorola Motran VHF Trans Serial No. DG153W	Contact 73	11/74
SBE SB-144 2m FM Trans Serial No. 720087	WA3IID	11/74
Varitronics HT-2, 146.97MHz Serial No. 640256	K3ZPH	11/74
Unimetrics Ultracom-25 Serial No. 090561	VE7AZG	11/74



Waller Scott K8DIZ
7318 Hollywood Drive
West Chester OH 45069

Thanks to the response of several of you readers, I have been selected to provide you with a monthly update on the world of solid state electronics. While I may have my ideas as to what types of circuits and devices you are interested in hearing about, I would greatly appreciate a short note, or even a QSL card, listing your solid state and experimenting interests. With your help we can make the best use of this space each month.

A growing number of hams are becoming interested in tone control circuits: repeater access control, Touch Tone signaling for auto-patch systems, tone keyed squelch, and remote control of whatever needs to be controlled.

Microsystems International has developed a series of telecommunication products using monolithic linear and digital ICs together with Tantalum thin and thick film technologies. Of particular interest is the MH8900 series of tone generators. This unit requires double pole Touch-Tone type switches in its keying circuit. It generates the standard tone dialing frequencies of 697, 770, 852, 941 Hz (low group) and 1209, 1336, 1477, 1633 Hz (high group). Supply voltage can be between 4.5 and 35 VDC. Current requirements are from 7 to 12mA depending on supply voltage. Typical rise time to a specified output frequency even when V_{cc} is switched — 5ms max. The tone generator is constructed in hybrid form using silicon ICs and the Tantalum thin-film process developed by Micro-systems. The circuit comprises unique, dual, high gain amplifiers with a bias and clipping network, coupled to modified parallel T filters. All capacitors and all but four resistors are fabricated using Tantalum thin-film resulting in a high degree of frequency stability and close tolerance. The resistors in each IC are precisely adjusted, with the circuit operating, by burning away resistance material with a laser! Worst case frequency drift of this IC is less than 1.5% when considering the effects of the temperature coefficients of the passive components, amplifier pulling, long term drift for the full lifetime (greater than 15 years), and varying supply voltages.

The MH8913J is being offered for sale by KA Electronics Sales (1220 Majesty Drive, Dallas TX 75247), including data and application sheets for \$18.00 (see Sept. 73, pg. 153). Further info on this series of ICs can be obtained from Microsystems International Ltd., Marketing Mgr. — Telecom Products, Box 3529 Sta. C, Ottawa, Canada K1Y 4J1.

Other manufacturers are interested in the telecommunication market. Motorola will soon have available a CMOS version of a Touch Tone generator. The low power requirement should make this a winner. A CMOS Touch Tone receiver should be available in the not too distant future. More on these as info becomes available.

In those areas where Touch Tone service is not yet available on the land line circuits, some additional circuitry is necessary to interface your tone signals with the phone line for remote control or auto patch use. General Instruments has introduced a telephone dialer circuit which could perform the dialing into a pulsed dialing phone system. The AY-5-9100 is primarily intended for providing a way to use a push-button phone with a dial pulse only system. In a radio system a Touch Tone receiver could take the place of the push-button dial or keyboard. The transmission path would be something like this: FM transmitter modulated with tones — FM receiver demodulates tones — tones fed to a Touch Tone decoder — decoder drives AY-5-9100—AY-5-9100 drives transistor and dialing relay. The Touch Tone decoder could be constructed of seven 567 PLL tone decoders and some logic gates.

The AY-5-9100 contains four storage registers to store the dialed number in BCD format either in total or partially depending upon the difference between the dial in and dial out speeds. Pulse repetition rate, interdigital pause, and mark-space ratio are all programmable. Outputs are provided for line pulsing and muting. An input inhibit is provided to allow storage of one number of up to 20

digits. This allows the original dialed number to be redialed just by providing one command signal rather than repeating the dialing procedure. The IC operates from -15VDC and only requires 2 milliwatts of power. This is a PMOS IC available in an 18 pin DIP. It is available in single quantities for \$20.00 from General Instruments Corporation, Microelectronics Div., 600 W. John Street, Hicksville, New York 11802. This is quite a sophisticated IC!

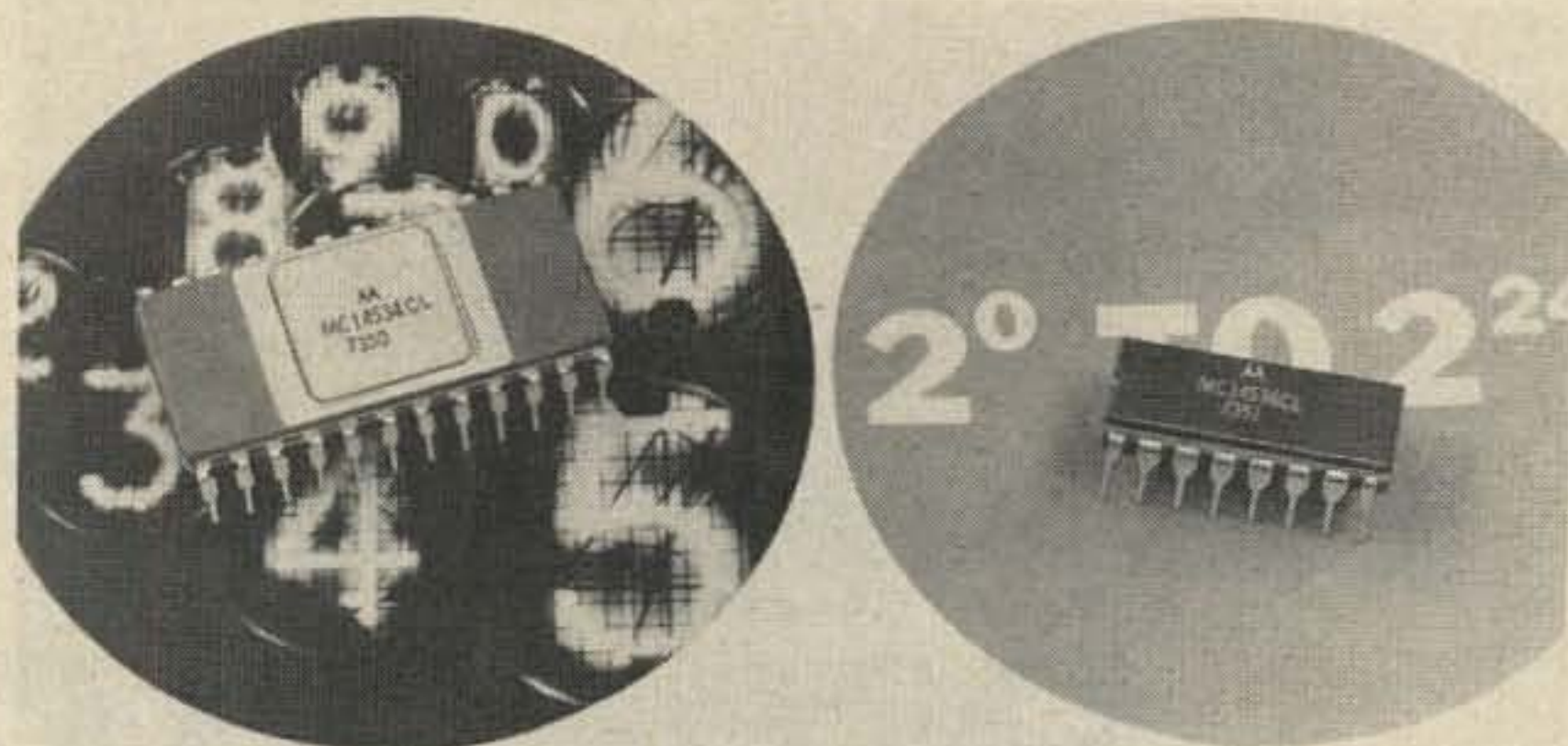
TIMERS AND COUNTERS

A flexible 24-stage ripple binary counter, and a real time 5-decade counter have been introduced by Motorola. Capable of counting from 1 to 2^{24} , the MC14536CP PROGRAMMABLE TIMER consists of 24 counters with the last 16 stages selectable by a four-bit select code. Real time event counting can be accomplished with the MC 14534CL FIVE DECADE COUNTER in continually update multiplexed displays.

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The MC 14534CL is a CMOS circuit composed of five decade ripple counters that have their respective outputs time multiplexed using an internal scanner. Outputs of each counter are selected by the scanner and appear on four BCD pins. The selected decade is indicated by a logic

Continued on page 139



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DIPOLE ANTENNA TUNING

Much of what has been written about antennas, includes something about tuning. Relative to the dipole antenna, the procedure is to add or subtract from the lengths of the legs. This is what I am writing about, except that presently I can stand on the ground and change the lengths of the legs of the dipole by merely pulling or pushing the transmission line. The drawings are almost completely explanatory. They describe the additions I made to my 40m Inverted "V" Antenna.

If you study the drawings a moment, you will see portions of the two legs of the antenna pulled into an aluminum pipe, which acts as a shield against pickup and radiation of radio frequency energy. The pipe is grounded of course, and each leg of the antenna is insulated for at least 3 meters beginning at the center of the dipole. I made my antenna from an old length of coax cable. The braid is stripped from the center conductor and insulation in one piece, and is

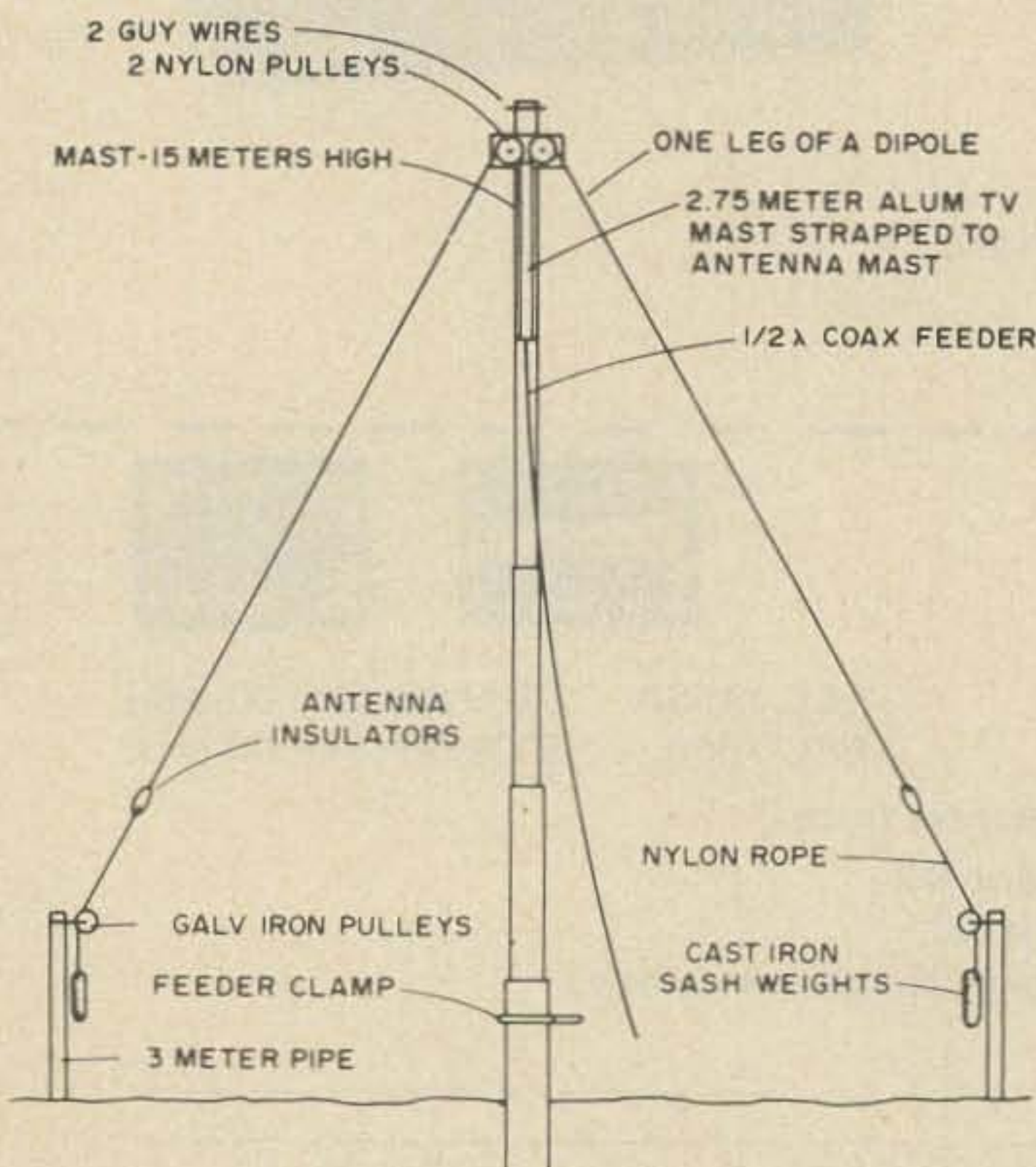


Fig. 1. Overall view of system.

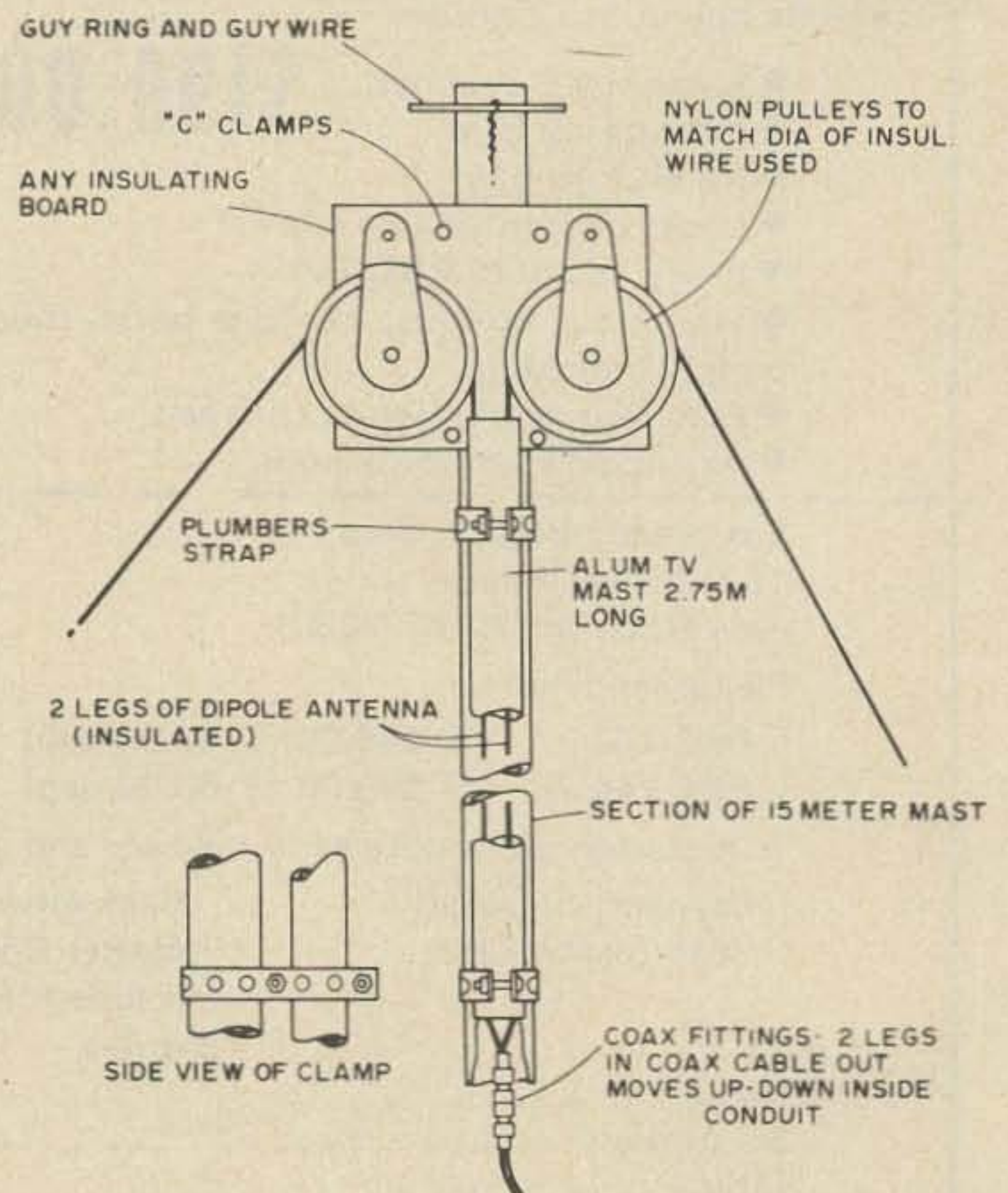


Fig. 2. Details of pulley mechanism at Apex.

taped to prevent contact with the pipe shield or any other metal part. The center conductor with its nylon cover is ready to be used.

The two wires, at one time antenna and at another time transmission line in a pipe, raised a question in my mind. What would happen to the impedance and SWR? Could a low SWR be obtained? There was always a chance that a combination of lengths, change in position, etc., might compensate for the variable and unknown impedance, so I made alterations to my antenna and gave it a trial run. SWR's between 1:1 and 1:2 were easy, and quickly secured.

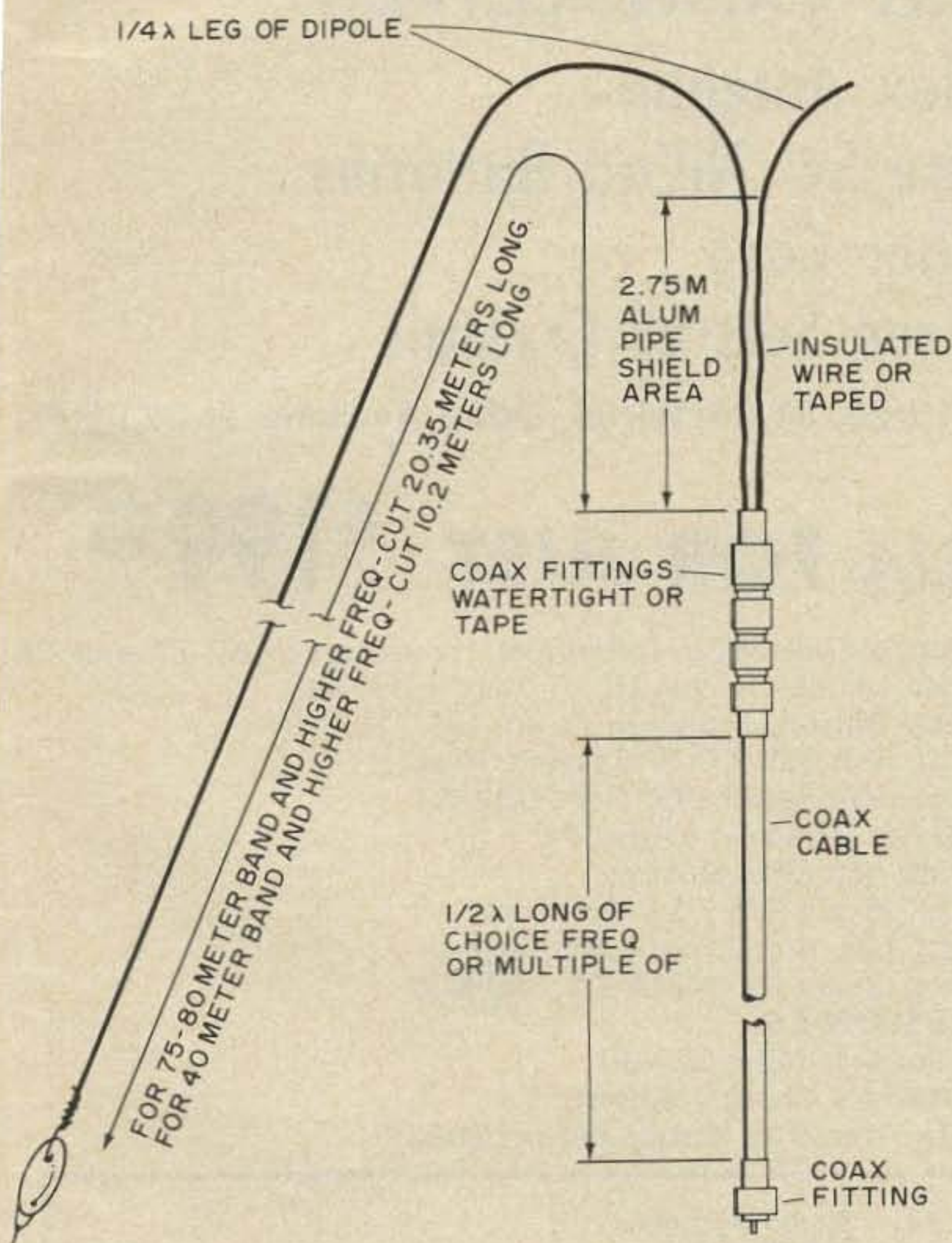


Fig. 3. A look at the actual antenna minus the supports.

Above the 80 and/or the 40 meter band the antennas act as harmonic antennas, for all higher frequencies, at least to the limit of the pipe shield length. Very little change in length of the legs is necessary to tune to the exact wavelength desired. It is recommended that the transmission line be calibrated for the most used frequencies so one can shift from one to the other without any trouble.

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223.26	224.74	146.19	146.72	52.82	52.68
223.30	224.86	146.22	146.76	52.88	52.72
223.34	224.90	146.25	146.79	52.92	52.79
223.50	224.94	146.28	146.82	52.96	52.80
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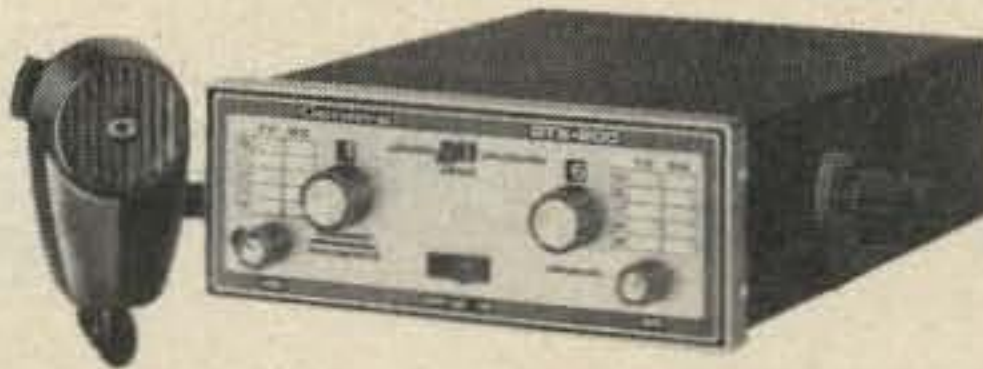
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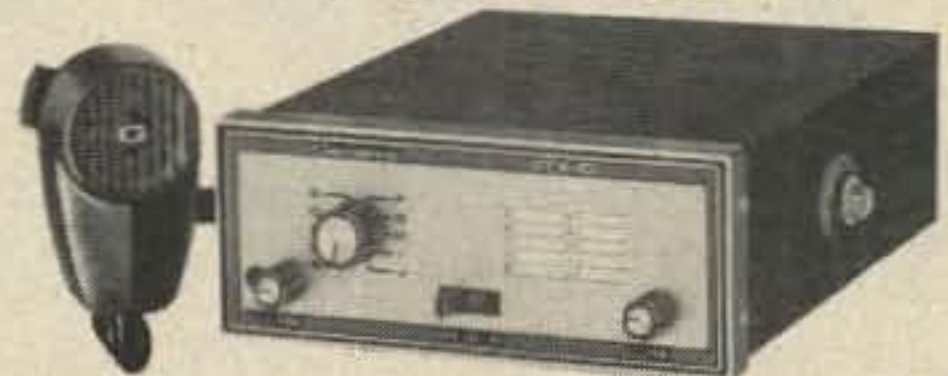
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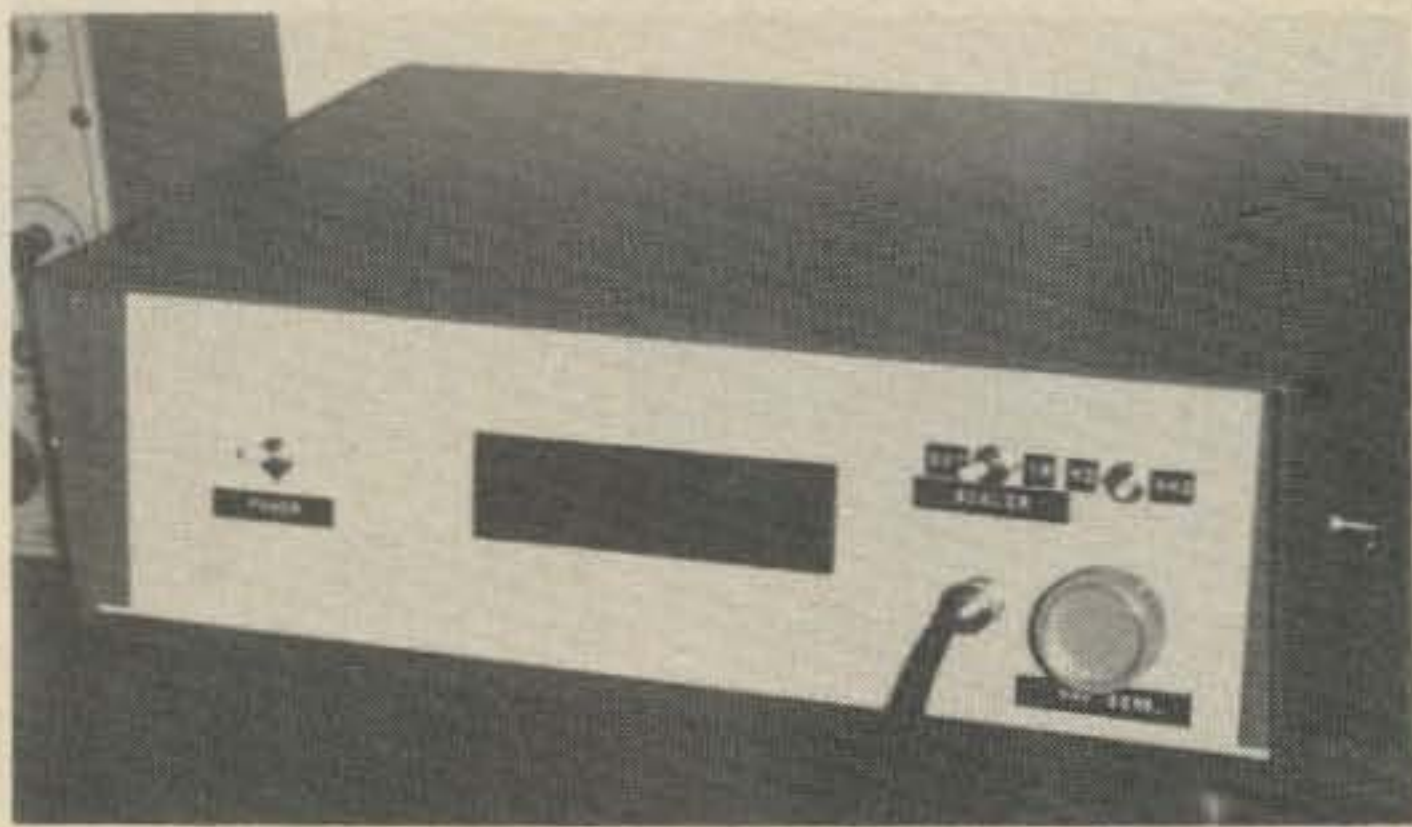
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Latest Counter Update

When I first wrote the article "A Modern VHF Frequency Counter" back in early 1972, I didn't expect anywhere near the enthusiastic response it received. Within a short time I got letters from almost every state as well as a number of foreign countries asking for printed circuit board layouts and further information. In addition to the two printed circuit suppliers listed in the original article, several groups of amateurs in various states have gone into business selling boards at hamfests and club meetings. In short, there are hundreds, and perhaps even thousands, of these counters already in existence.

So now, perhaps it is time to look back at the original design and talk about some modifications and improvements, as well as a few hints and solutions to common problems. But, there is an old Bulgarian proverb (or maybe it's Transylvanian or something) which says — "If it works OK, don't louse it up." In other words, the original design is still sound, and if you are satisfied with its performance, don't change it. With that warning, here goes.

Where to get Information

The original article appeared in three parts: Part I, May 1972 issue of 73 Magazine, carried the basic description and parts list. Part II, July 1972 issue, carried the logic diagrams. Part III, September 1972 issue, had the printed circuit board layouts

and parts location drawings. The entire article has since appeared in a Tab book; *RF and Digital Test Equipment You Can Build*.

In addition, 73 Magazine in November 1972 had some corrections, and an article by W9CGI in 73 Magazine for June 1973 had a variety of suggestions on possible modifications. The June 1972 issue of 73 Magazine had an article on a separate VHF frequency scaler using the same Fairchild IC as the entire counter, but using a slightly different circuit. And the March 1974 issue had an article by W4CUG on increasing the speed of the counter.

At the present time, printed circuit board layouts are available from me if an SASE is enclosed. Etched boards seem to be available from many sources, including the following: Westrock Repeater Association, P.O.Box 403, Bedford, N.Y., 10506; and D. L. McClaren W8URX, 19721 Maplewood Avenue, Cleveland, OH 44135. The former is our local repeater association which will put to good use any slight profits it might make on the boards.

Low-Frequency Input Sensitivity

My original prototype had an input sensitivity of roughly 200mV or so on the low-frequency input, but many readers reported being unable to get anywhere close to this figure. We have since built several counters, and all except one had a sensitivity of less than 400-500mV; but that one bad

one needed almost 2V to operate properly.

The original design used a 40673 MOSFET in a direct-coupled circuit which had only one isolation capacitor — at the very input, to avoid upsetting the MOSFET bias with any stray dc input voltage. It turned out to be a compromise in an effort to get a simple circuit, with high input impedance, which would work at very low audio frequencies. But direct-coupling from the MOSFET directly into IC1, the Schmidt trigger, forced the MOSFET to operate at very low drain voltage, which is not a very good idea. With the addition of four components, as shown in Fig. 1, it is possible to capacitor-couple the MOSFET to IC1; this allows the MOSFET to operate in a more linear portion of its range and provide more gain. Using a 0.1 μf disk capacitor for coupling, our unit performed down to about 100 Hz with an input sensitivity of roughly 50 or 100mV. The two 1N914 diodes are included to protect the input of IC1 from excessive voltage deviations; theoretically they should be included, although we have operated our unit without them with no damage to the IC. The 2200 Ω resistor should be selected, if needed, to make the input voltage into IC1 approximately 1.2V dc with no ac input.

The printed circuit design has no room for these added parts, so you will have to modify it slightly by cutting the copper conductor going from the drain of the MOSFET to pin 4 of IC1. Connect the capacitor across the break in this conductor, and connect the 2200 Ω resistor between pin 4 and pin 7 (ground). Measure the dc voltage at the input to IC1, and if it is much different from 1.2V or so, substitute a slightly different resistor value — lower to drop the voltage, higher to increase it. All of these components, as well as the diodes, if

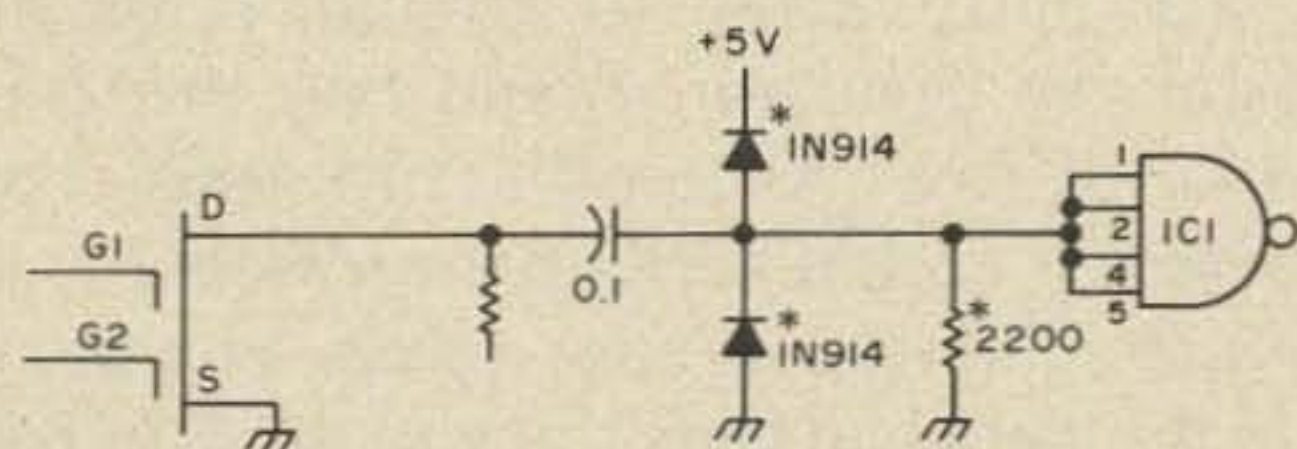


Fig. 1. Adding the starred components to the low-frequency input circuit (Fig. 3 in the original article) yields somewhat improved input sensitivity.



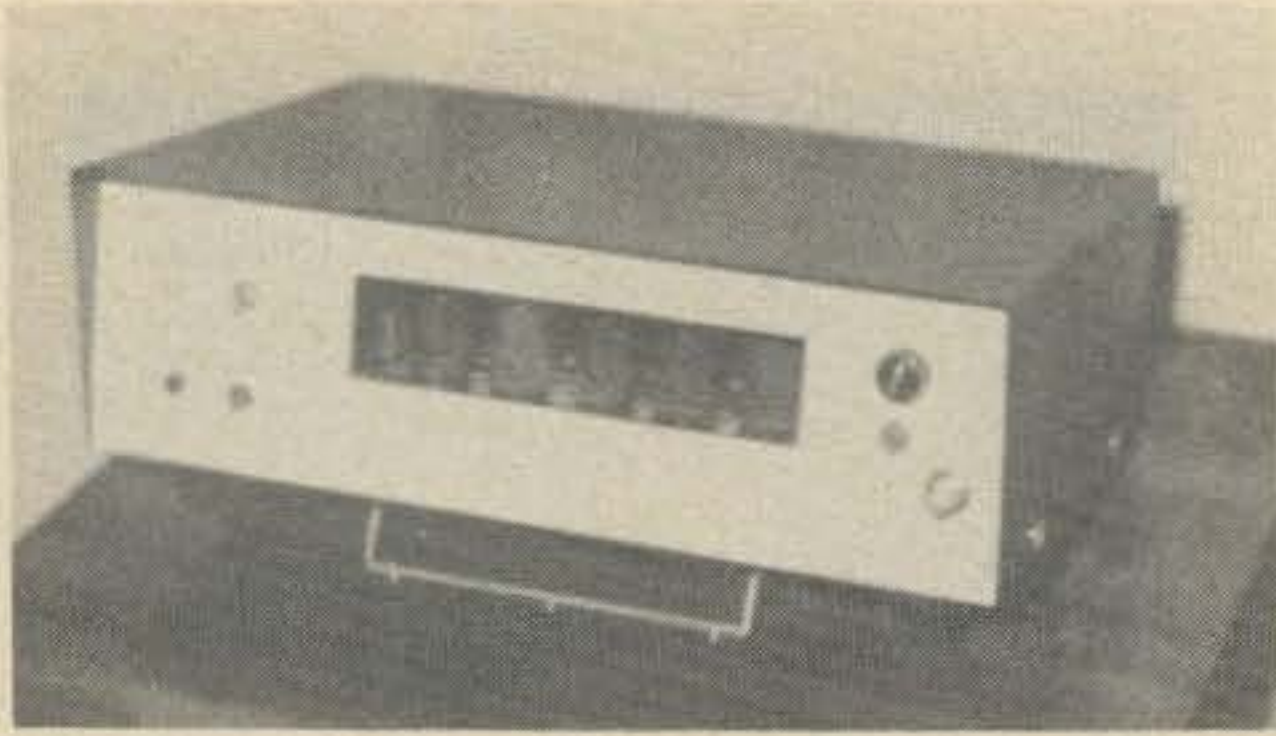
WB2CHW's version of the counter.

you use them, should be mounted on the bottom side of the board.

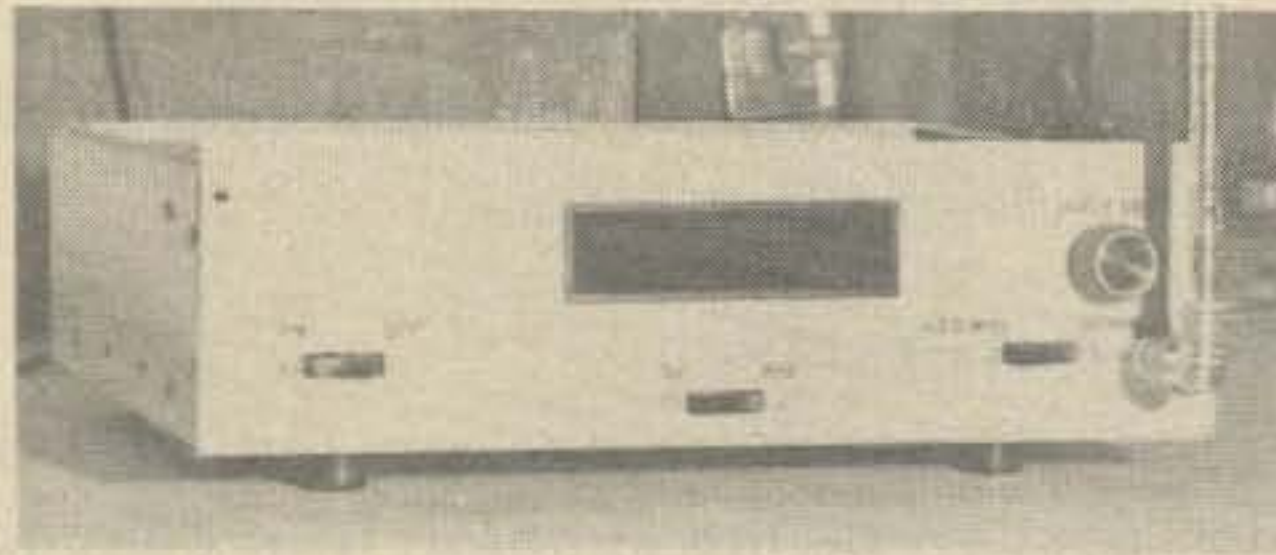
VHF Scaler Operation

Some readers have had trouble with the scaler portion of the counter. The Fairchild 95H90 scaler IC costs \$16, and so swapping ICs is not a popular troubleshooting method here! There have been a number of reasons for problems, the main one being that a sizable percentage of 95H90's have been defective right off the production line. Apparently Fairchild had some production problems at the beginning; but rumors have it now that the presently available ICs are better, and so we should see fewer and fewer troubles as time goes on.

The first thing you need is a way of testing the 95H90. This is not easy, since you have to test it under operating conditions and that means building another scaler. If you know someone else who has built the counter, perhaps you can interchange ICs. Another alternative is to build the VHF scaler written up in the June 1972 issue of 73 Magazine. To make sure you don't have other problems with the layout, be certain to use the same printed circuit pattern given in the article; you can make your own or obtain the small board from one of the board suppliers listed earlier. If your IC doesn't work in the simpler scaler circuit, then it's almost a certain bet that the IC itself is bad. (Two comments about the June 1972 scaler. First, make sure to use a good stiff 6V battery — a lantern battery is best. Don't try to use some AA cells, as the IC takes a lot of current. Second — and this is a long story that I won't repeat — the resistor labelled .18K in the article is supposed to be 180 Ω .)



WA9FCM's version.



And one built by K5PQK.



And by Don Hoos.

An interesting sidelight is that many readers wrote me to say that the 2N5771 specified in the scaler doesn't exist. Though it is listed in the Allied catalog and should be available from any Fairchild distributor, somehow it seems hard to get. Fortunately there is nothing magic about it, and many silicon PNP switching transistors will work just as well as long as they go up to high enough frequencies — for example a HEP52 or HEP715.

We have also found that the 95H90 IC in the scaler is very temperature and voltage sensitive. In normal operation it runs quite warm, almost hot. You can put your finger on it, but sometimes it is not very pleasant to keep it there for long. Hence, if you adjust the bias pot in the scaler while the unit is cold, it will not work well after everything warms up. The best solution is to cement a small aluminum heatsink to both scaler ICs and let everything heat up before adjusting the bias pot for best sensitivity. Mounting the bias pot on the outside of the case, or at least making sure you have a small access hole in the case that you can stick a screwdriver through to adjust it is also very

helpful. But if you mount the pot off the board, make sure to use very short leads, and bypass the pot at the board end with a 0.01 μ f disk capacitor.

The scaler ICs are designed for use with *negative* power supply voltages, with pins 4 and 5 grounded, and pin 12 connected to $-5.2V \pm 5\%$. In practice, most users reverse the connections and then use a +5.2V supply, since this makes it compatible with TTL ICs which need 5V. Since the allowable voltage range is then 5% above or below 5.2V, the IC is *supposed* to work at 5V. But that is not always true — we have run across a number of ICs that needed at least 5.1V, and sometimes even 5.2 or 5.3V. Some people have found that a slightly lower voltage, on the order of 4.9 or so, works better, but that is rare. In any case, if you find your IC is good but it won't work at 5V, try a few tenths more or less. (Note that the scaler in the June 1972 issue of 73 Magazine used 5.3V.) But be careful — the ECL ICs will easily stand up to 5.5V (the catalog says 6, but don't try it) but the TTL ICs are doomed above 5.25 or so (not always, but you've got thirty some ICs on that board so be careful). Adjusting voltage is not very easy with the LM309K regulator, but the alternate power supply in Fig. 18, of the original article is easily adjusted up and down, and will allow you to find the best operating point for the 95H90. If you have to go above 5.1V, it might be a better idea to build a separate supply just for the scaler ICs, and keep the rest of the ICs at 5V.

Power Supplies

If you used the LM309K regulated supply, you have already discovered that one of the diodes in the circuit was shorted. But whichever power supply you used, a "crowbar" circuit is a good idea. It is simply a 1A fuse in the 5V power line, followed by a 5.6V hefty Zener to ground. If for any reason the regulator should fail, the Zener blows the fuse. As to other problems — one reader got an LM309K that *oscillated* — the counter did very strange things as a result. The problem had something to do with parts placement; we finally got it to stop by removing the 0.1 μ f disk capacitor at the output of the power supply. Still haven't figured out why.

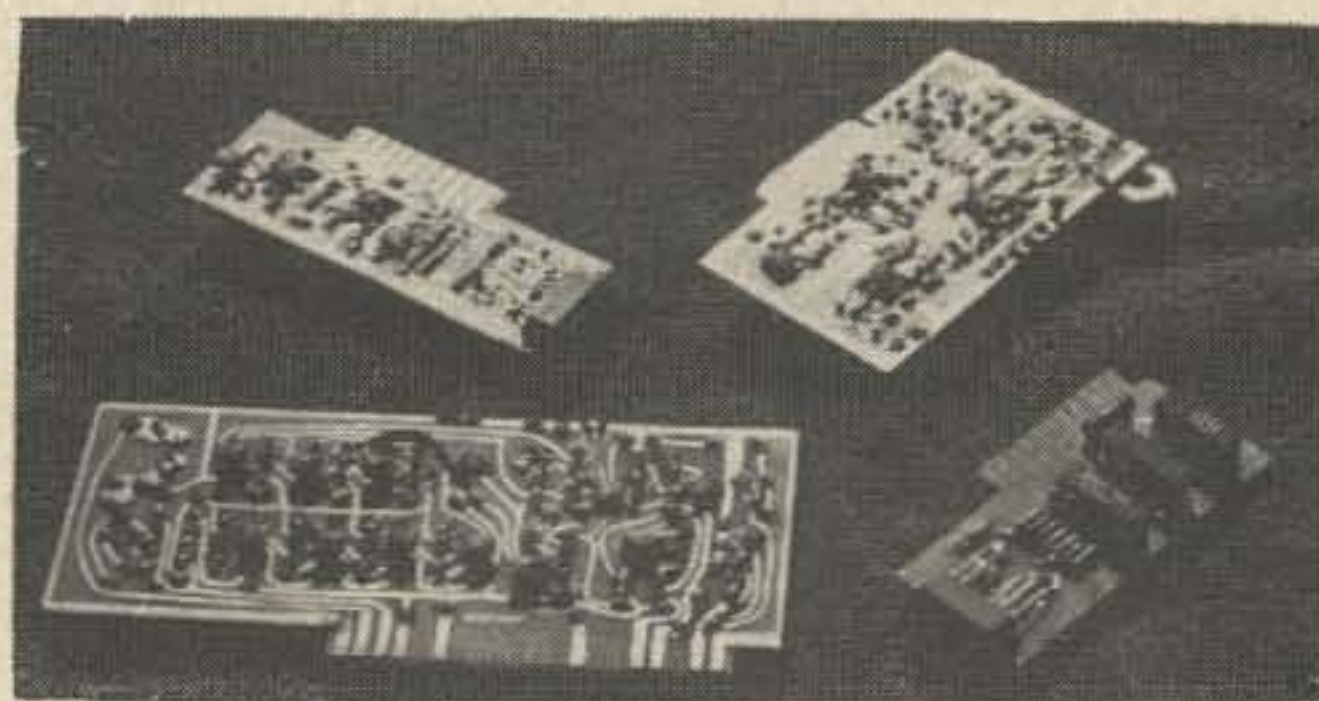
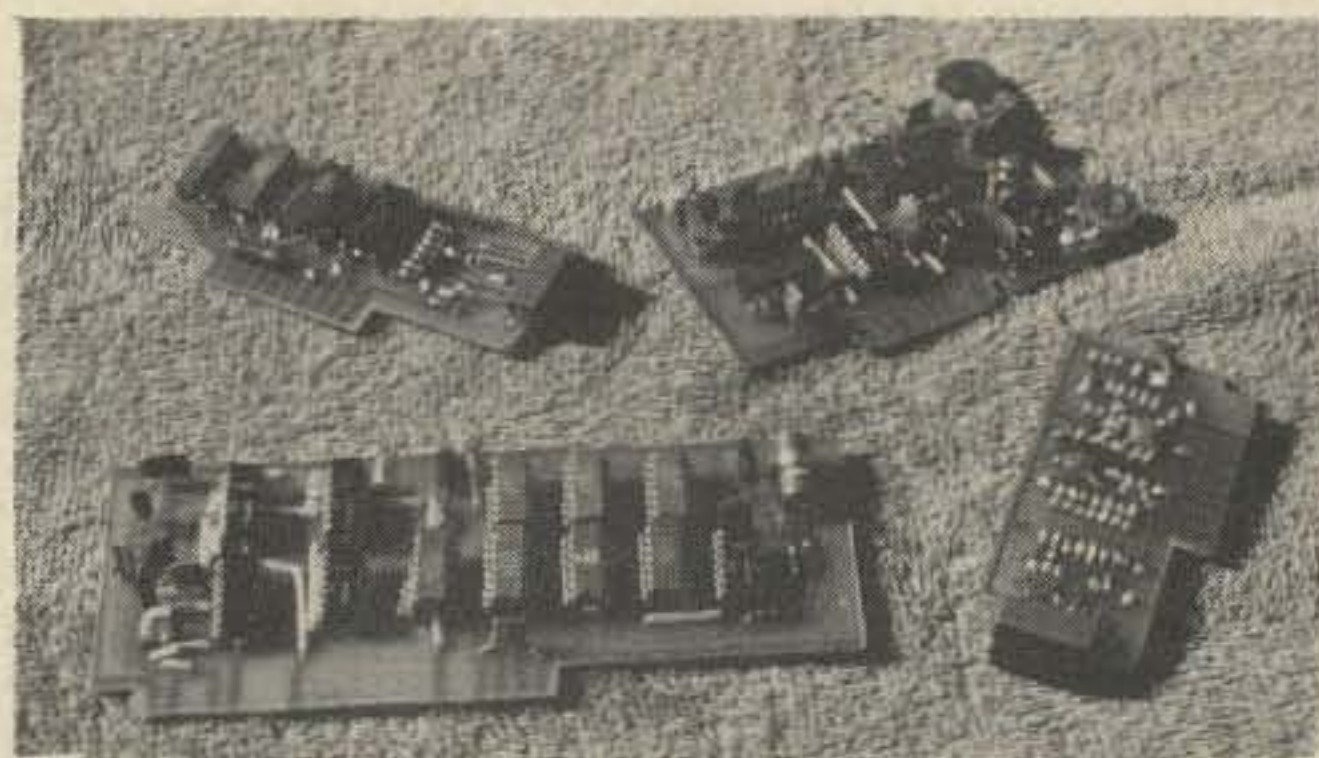
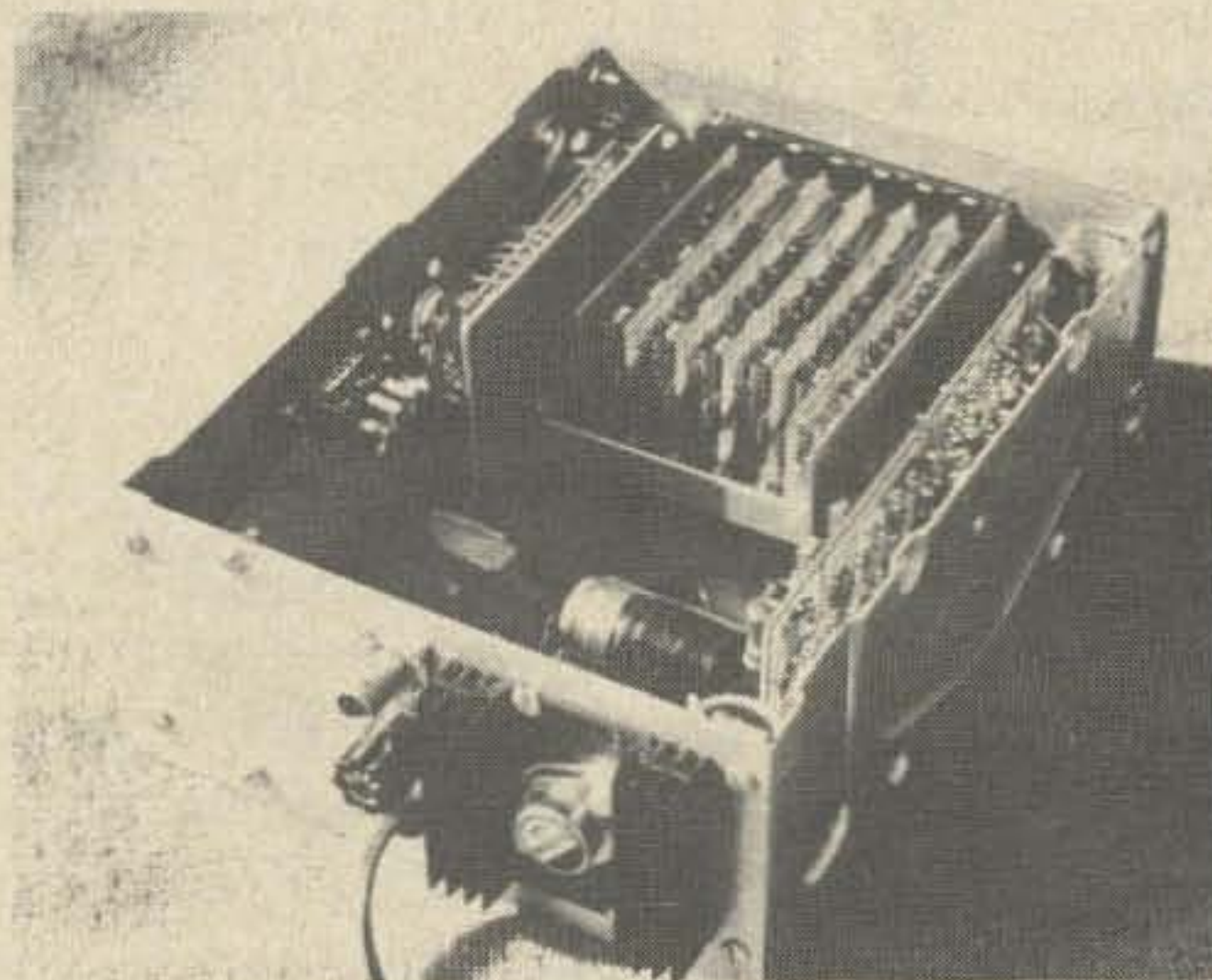
Occasionally, the LM309K does not regulate - its output voltage drops below 5V. Assuming that you don't have a short which draws excessive current, the reason is probably that the output voltage from the rectifier is too low. A 6.3V filament transformer in the power supply provides an input into the regulator of about 9V, which is just above the minimum that the LM309K needs. Occasionally we get just the right combination of low transformer voltage along with a slightly weak regulator, and then it just stops regulating. The solution is to try a different LM309K or a larger 6.3V transformer. The best solution would be to use an 8V transformer, but these are hard to get. Don't do what one reader did, though, running into this problem, he simply switched to a 12.6V transformer, which gave him almost 18V into the regulator. Even though the LM309K was mounted on a gargantuan heat sink, I burned my finger on it when I accidentally touched it. It worked, though.

The final problem is with the adjustable power supply in Fig. 18, of the original article. About three or four readers found that it did absolutely nothing when the scaler ICs were plugged in. As long as the 95H90 was unplugged, everything worked fine. But plug in this IC, and the 5V line went to 0V. Absolutely dead. Shorted IC??? No!

WB2AAQ finally found the solution with his power supply, and his solution has worked for others as well. The problem is caused by the fairly high current drain of the 95H90, combined with a high input offset in the 741 op amp used in the regulator. With the heavy load on the 5V line, the output voltage from the supply starts rising rather slowly. As soon as the voltage reaches a few tenths of a volt, the 741 looks at it and decides that the output voltage is too big - and promptly turns everything off again. WB2AAQ's solution was a very simple one, connect a 1 megohm resistor from ground to one of the 741 IC pins - pick whichever one makes the thing work.

Reference Oscillator Stability

Most counters built seem to have a very stable timing reference oscillator. For in-



Four views of WB2UKP's version.

stance, W4ZUS found it held within 5 cycles at 10 MHz for several hours (and suggested a tubular trimmer for adjustment, as the lead screw gives a vernier effect for adjustment); K7DTS/1 found it held within 20 cycles. Others decided that an oven would give

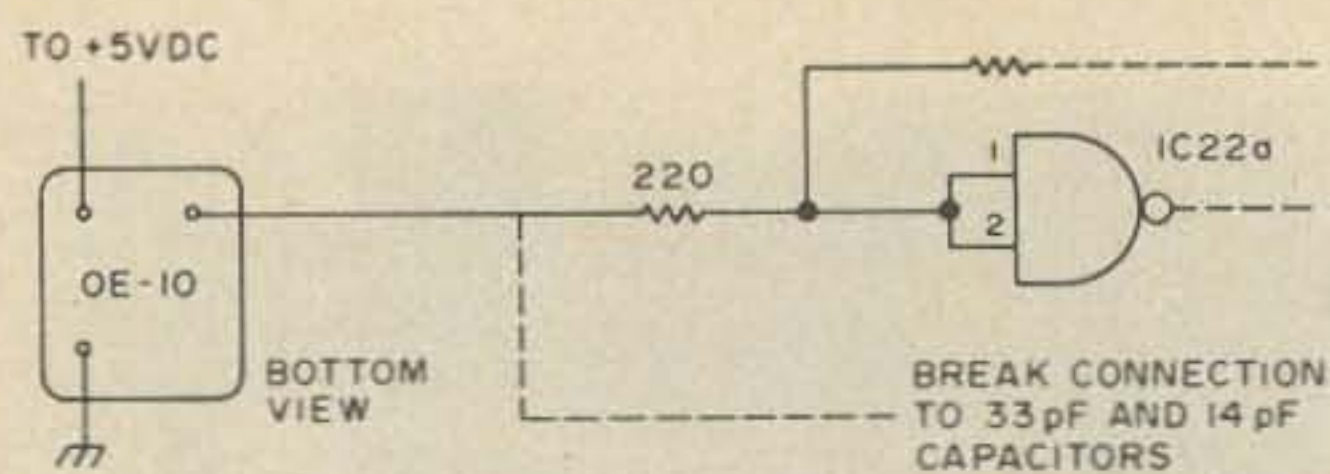


Fig. 2. Connecting the International Crystal OE-10 Oscillator to the crystal oscillator (see Fig. 7. of the original article).

better accuracy (WAØABI suggested that Gateway Electronics in St. Louis had a number of Collins 10 MHz crystals in 28V ovens for \$2.50). But there were a few readers who found that the crystal reference oscillator drifted very badly during warmup, though it seemed to settle down after 15 minutes or so.

The problem here seemed to be a crystal which had marginal activity, so that even small changes in operating parameters would result in a great change in frequency. A possible solution would be to get a good quality crystal, such as the HA series crystal from International. But for just a few dollars more there is an excellent solution to the whole problem which works so well that I'm sorry I didn't think of it earlier.

For \$19 you can order from International Crystal an OE-10 oscillator assembly, which is a complete oscillator, with crystal. If you specify 5V operation, they will even put it on frequency for you and give you a listing of drift against temperature. The unit I got was certified at 10.000026 MHz at -10°C (14°F), 10.000004 MHz at $+25^{\circ}\text{C}$ (77°F), 9.999958 MHz at $+60^{\circ}\text{C}$ (140°F), which is roughly .5 Hz drift per degree Fahrenheit. The rated temperature stability over the range from -10 to $+60^{\circ}\text{C}$ with respect to "room temperature" of 25°C is given as 0.0005%, while the tolerance *as shipped* is within 0.0001% at 25°C . All of this in a metal can roughly an inch square! No need to resort to ovens; in fact I didn't even bother to readjust it after receipt, since it seemed as close as I could use. And connecting it to the counter is done with three wires, as shown in Fig. 2. It is only necessary to lift one end of a 220Ω resistor off the board, and connect to it. Although the 33pf and 14pf capacitors and the crystal could be removed from the board as they will no longer be needed, I decided to leave them

just in case I wanted to switch oscillators in the future.

Control Circuit Operation

Two types of erratic operation of the control circuits have been observed by readers. In one case, observed by two or three persons, the reset circuit sometimes operates sluggishly or not at all; this is remedied by increasing the value of the 100pf capacitor connected to pin 3 of IC32a (See Fig. 10, of the original article) to a larger value such as 200 or 500pf.

Another interesting malfunction was found and solved by W2CLL; I have since run across about three or four other counters with the same problem. In Bob's unit, when in the Hz position, the counter would provide the correct reading for one second, followed by a second of 00000, rather than showing the correct reading for a full two seconds before the next update. This was caused by an extra strobe pulse sneaking in at a time it shouldn't.

As shown in Fig. 11, of the original article, the S and RC (or CR signal, as it is called on Fig. 10), should be exact opposites of each other. But this isn't so, since the RC signal has to travel through a few more flip flops than the S signal in the Hz position. As a result, the S signal gets to IC32d sooner than it should, and forces IC33b to quickly set and reset at a time when it should stay reset; this generates an extra strobe pulse at the wrong time. I must apologize for this little mistake in the original design, but fortunately it only happens with just the right combination of ICs; hence only a handful of units actually have had the problem. The solution is very simple — slow down the S signal by putting a 470pf capacitor from IC31d pin 11 to ground. Actually, anything that slows down the S signal a little will work, including a small capacitor from any one of the pins of IC33b to ground.

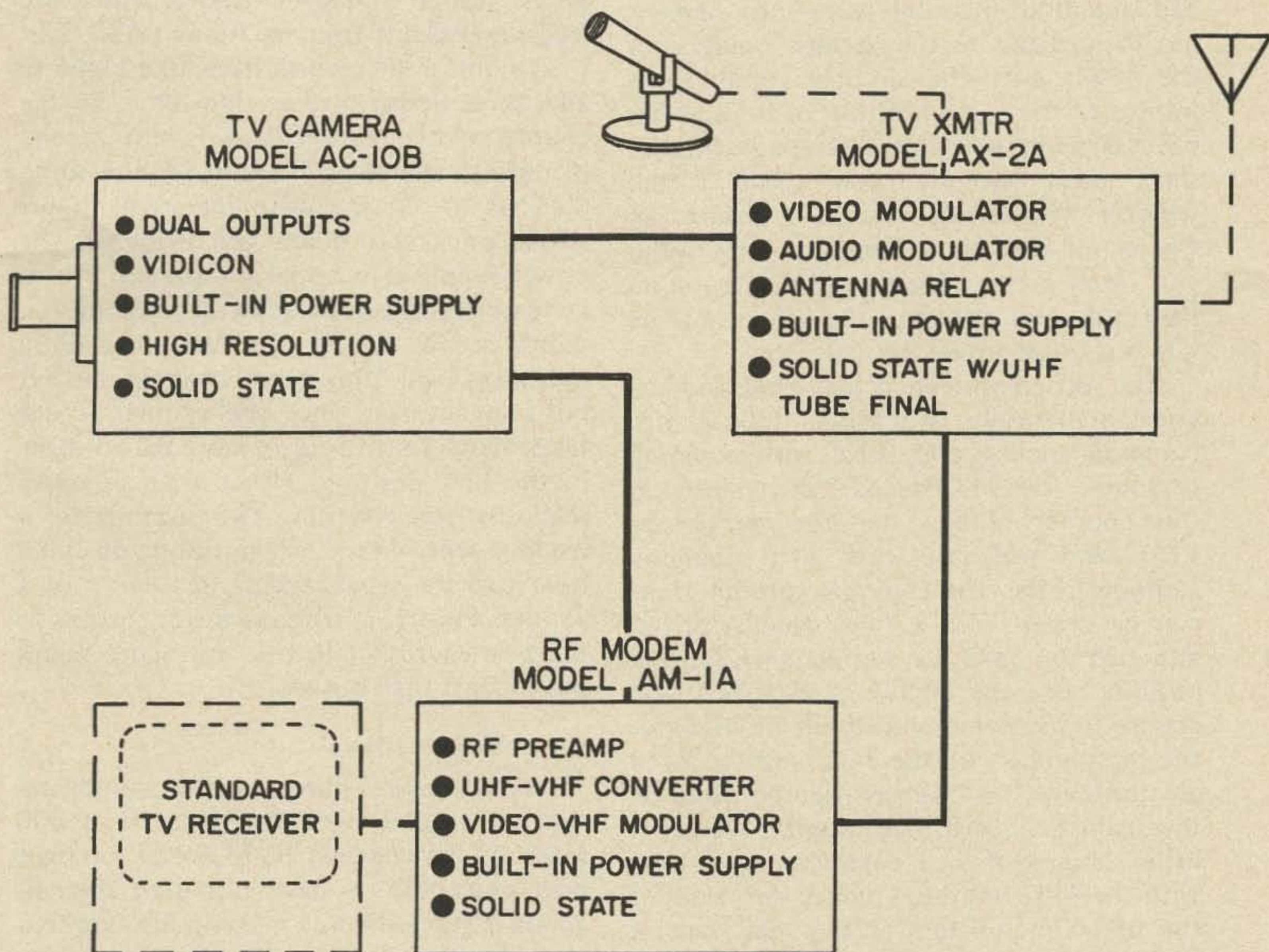
Readout Selection

When I wrote the original article, I correctly predicted that the price of LED 7-segment displays would drop by the time the article appeared in print. It is now possible to get LEDs for as little as \$3 a

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piece, which is less than the comparable incandescent readouts. Hence a number of the counters have been built with LED readout. But this has led to two problems.

First, the Numitrons generally sold for \$4 or so are priced very close to their list price, hence you are probably getting a new unit that has passed all the inspection steps. On the other hand, the \$4 or so LED is probably a reject or at least has a questionable origin. That means you may get a dud. Watching out for words in small print like "no chance to test them" etc., is a help, but even that doesn't work. I paid \$7.95 each for my Litronix LEDs in the original counter; so far three of the five have gone bad, and all in the same way — the element has shorted out to the decimal point, with the result that the decimal point lights instead of the e. And on top of it all, it has been difficult to get replacements cheaply, since until recently you couldn't tell whether you would get the Litronix, an Opcoa, or perhaps a Monsanto unit when you ordered the \$4 special. Since the numbers look a bit different, the only way to be safe was to get a new set of all five.

The second problem is that LED readouts come in basically two types — those with common anodes, and those with common cathodes. The 7447 decoder/drivers used in this counter require the *common anode* LED, and will not work with common cathode LEDs. The common cathode units can be driven with a 7448 decoder/driver, although the 7448 was not designed for that purpose. Use the circuit of Fig. 3 if you choose to use common-cathode LEDs. Since the pin numbers on the 7447 and the 7448 are the same, no changes need be made on the main pc board. The display will be a little dimmer than a common-anode LED with the 7447 but don't reduce the values of the 680-ohm resistors as this may damage the 7448 driver. (Another LED readout, containing an array of dots, isn't seven segment and therefore would require large changes in the counter board — don't use it unless you are willing to change the layout.) Since most of the LED advertisements compare the LEDs sold with the Monsanto MAN series, Table 1 gives some information on these units.

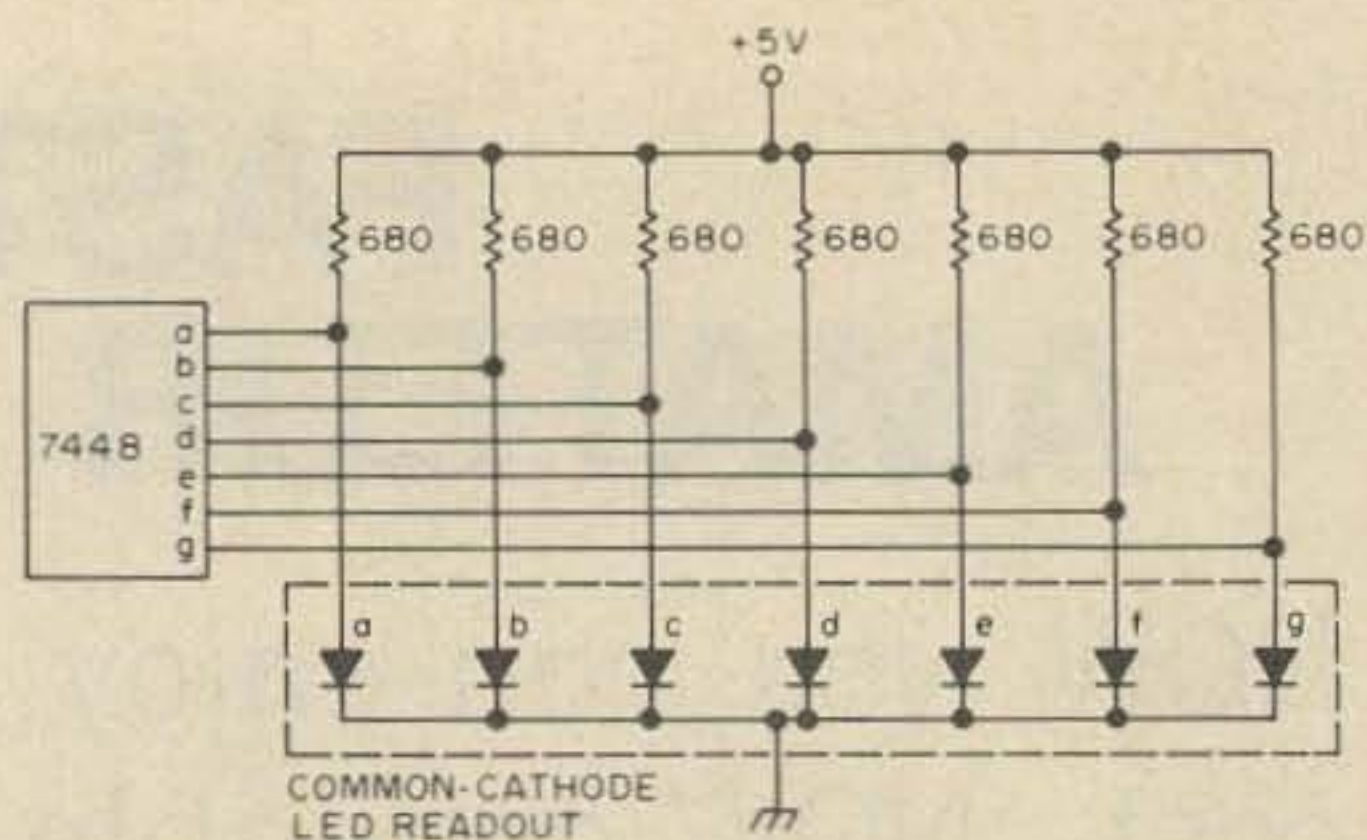


Fig. 3. Connection of a common-cathode LED readout to a 7448 decoder-driver.

Several readers have asked how to interface Nixie tubes with the counter; although this is not recommended, a layout for Nixie tubes (using unknown Nixies with wire leads) is available from me for an SASE.

A number of readers have asked how to add three more readout indicators to the counter. This modification is not recommended to anyone who has to ask how to do it. First of all, the drive requirements for strobe and reset pulses are marginal, the power supply is marginal and the extra three indicators don't really tell you anything you didn't know before. In fact, the extra indicators will only read when in the Hz position anyway, since the counter is not fast enough to read out in more than 5 digits in the kHz position. Hence you are automatically stuck waiting two seconds for a reading, when in the kHz position you could have had the same reading in a tenth of a second. Finally, it requires major changes to the printed circuit board, and hence seems more effort than it is worth.

Other Modifications

Several readers have asked for a modification to extend the range to at least 450 MHz. As the cheapest IC to do the job right now costs \$55, I have not even thought about it twice. Plessey makes a flip flop that goes above 1000 MHz, but costs over \$100; all of you readers out there are invited to try your luck with these — not me. It should be possible to build a flip flop that goes to 450 MHz out of discrete components (tunnel diodes, perhaps), but that appears to be a difficult job.

Several readers have suggested that the first decade divider in the counting circuits

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(IC5 and IC6) be replaced by a faster IC, such as perhaps a Schottky 74S73. This seems like a fairly good idea, except that I haven't done it yet. This method should extend the low-range to perhaps 80 MHz; a simple ECL flip flop would then double the range to 160 MHz without the need for a \$16 scaler IC, enough to cover the 2m band. But the scheme has two disadvantages — it doesn't cover 220 MHz, which the 95H90 does, and it also requires the redesign of the MOSFET/Schmidt trigger input circuit, since the 7413 is not available in a Schottky version. Further, to get a direct frequency readout, it requires some additional switching in the time chain dividers to give an extra division by 2, which lengthens the readout time in the HZ position to 4 seconds. This idea is presented to those readers who wish to make the modification, but as before, it is not recommended by me for the simple reason that it seems more effort than it is worth.

A simpler modification is to replace IC4 and IC5 with their Schottky equivalents, and then try several ICs as IC3 and IC6, picking the fastest. This can greatly improve the frequency range via the low frequency input. See the article by W4CUG in the March 1974 issue of 73 Magazine.

Finally, in his article in the June 1973 issue of 73 Magazine, W9CGI suggests several changes to improve the counter. The one given as Fig. 1, in his article is not recommended, as it violates TTL design rules. But the one in his Fig. 3, has merit, if we connect the left end of the 10K resistor to IC33a pin 15, rather than IC29 pin 11. When the counter is in the Hz position the added indicator will blink on for one second, and off for one second. It then indicates that the counter is counting when the light is on. This is a very worthwhile addition, since it enables you to make slight circuit adjustments when the light is off, and then use the next count interval to give you the next reading. I have used this technique (without the light, though) for adjusting 2m FM transmitters on frequency. The fine adjustment is done in the Hz mode, at which time you have one second for making slight adjustments, followed by one second of frequency indication. This trick enables you

to make one adjustment every two seconds, with no false readings in between.

To close these comments, let me again repeat the comment made at the beginning, "If it works OK, don't louse it up." If you already have a counter which works, and works to your satisfaction, then leave well enough alone. The original design was basically sound, and there is no reason to fiddle with a counter which works well. Instead, pride yourself on having a good reliable piece of equipment, which you have built yourself.

TABLE I Characteristics of MAN LED Readouts

- MAN-1 — Red, 69mm (0.27") high numbers, common anode, DIP case, uses 7447 driver.
- MAN-1A — Similar to MAN-1, but darker — has red epoxy case.
- MAN-1B — Similar to MAN-1, but different decimal point connection.
- MAN-1BA — Similar to MAN-1B but red epoxy case.
- MAN-1001 — Similar to MAN-1 but only displays +, -, or 1.
- MAN1001A — Similar to MAN1001 but red epoxy case.
- MAN1002 — Similar to MAN-1 but intended for hexadecimal display; can be used in counter same as MAN-1 but don't try to use decimal point.
- MAN1002A — Similar to MAN1002 but red epoxy case.
- MAN-2 — Alphanumeric display consisting of dots. Don't use.
- MAN-2A — Similar to MAN-2 but has red epoxy case.
- MAN-3 — Red, common cathode, 29mm (0.115") high numbers, flat case with different pin connections from MAN-1, uses 7448.
- MAN-3A — Similar to MAN-3 but has red epoxy case.
- MAN-3M — Similar to MAN-3A but has different pin arrangement.
- MAN-4 — Red, common cathode, needs 7448, 48mm (0.19") high letters, DIP case but different pin connections.
- MAN-5 — Green, otherwise similar to MAN-1.
- MAN-6A — Red and 1.42cm (0.6") high numbers, a wide DIP-style case, but otherwise similar to MAN-1A.
- MAN-66A — Similar to MAN-6A.
- MAN-8 — Yellow, otherwise similar to MAN-1.
- MAN-10 — Similar to MAN-1, requires slightly less current.
- MAN4001 — Similar to MAN-4 but only displays +, -, or 1.

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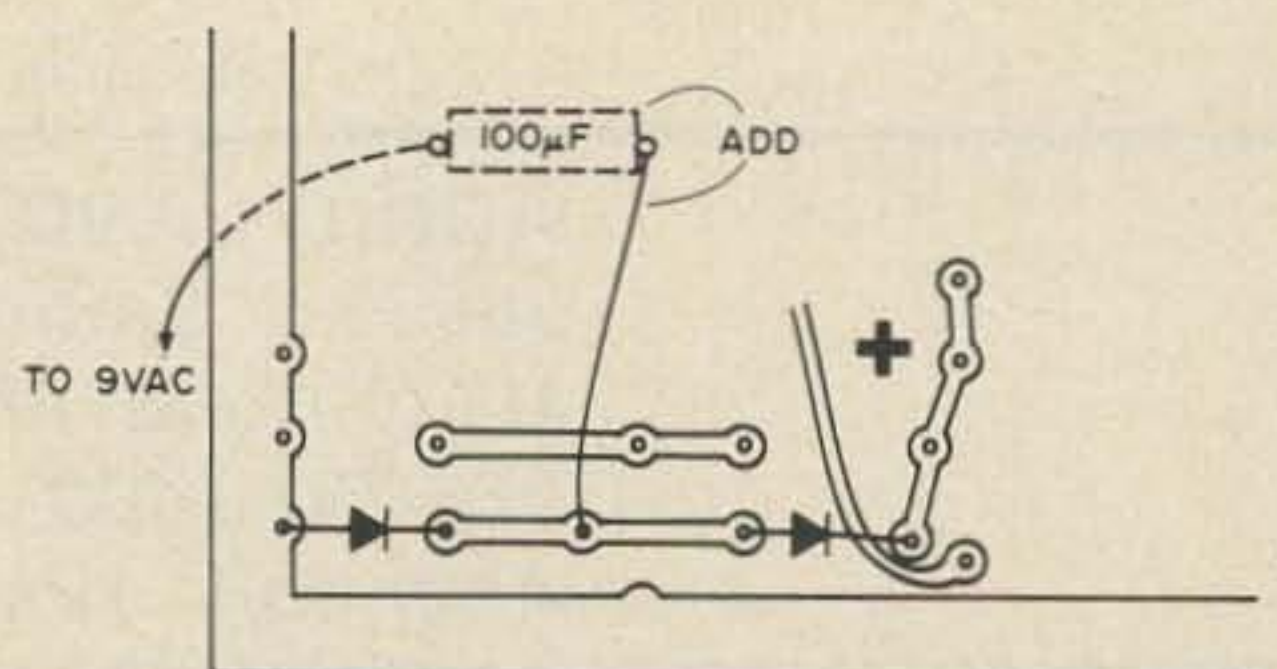
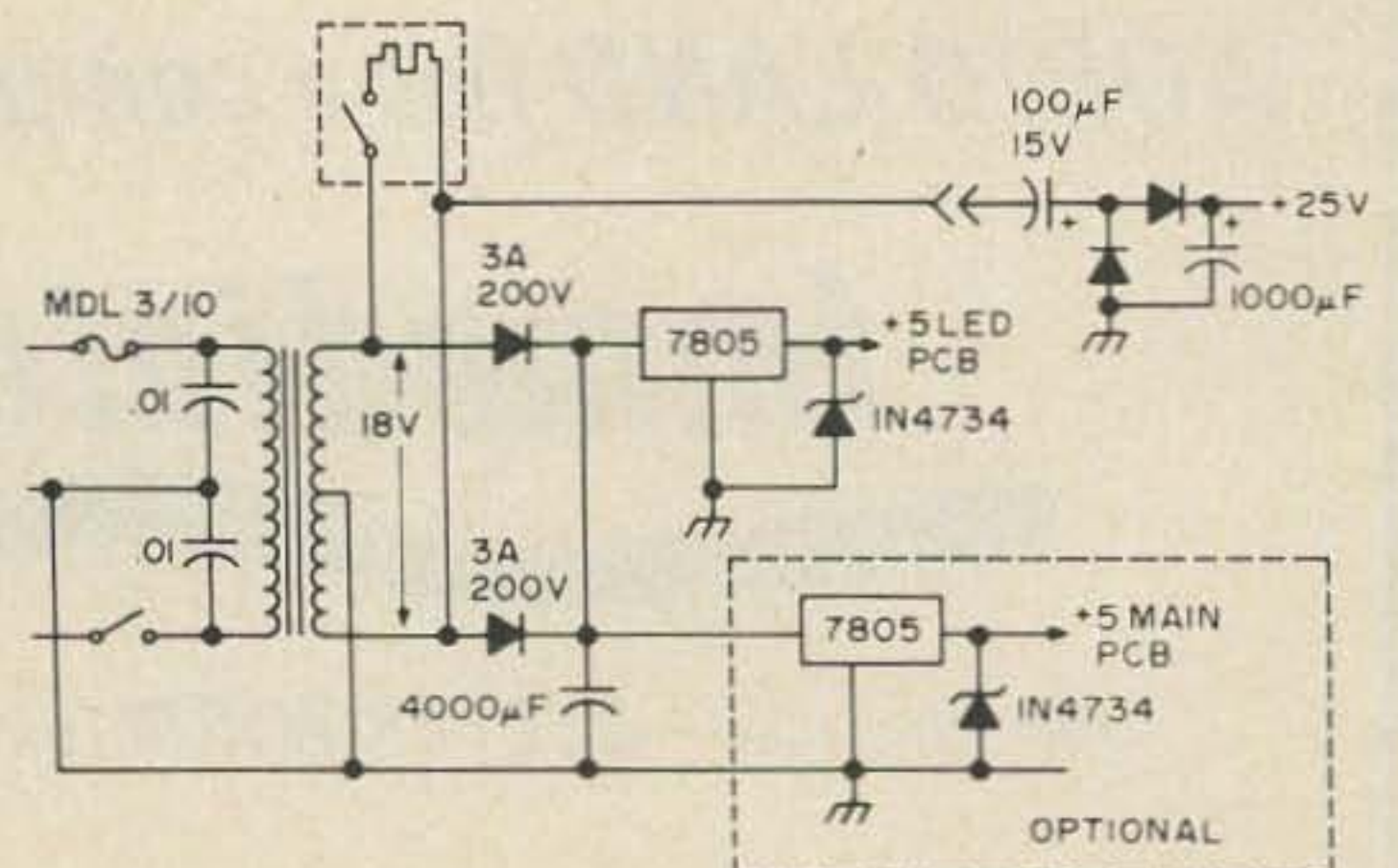
K2OAW counter builders do, for one.

The K2OAW counter published in 73 during the summer of 1972 has created a great deal of interest in counter construction. I know personally of a half dozen already completed and perhaps another dozen in various stages of construction. Every time the subject comes up there seems to be considerable interest in the modified power supply I use on my counter. The changes are nothing unusual but they do make for a simpler, more compact unit.

At the outset it should be known that my counter includes a surplus Collins crystal-oven for the time base which required a source of heater voltage in addition to the normal requirements of the counter proper. The counter requires 5V regulated at slightly over 1A and 20–30V at a few mA for the input amplifier. The oven in use requires 28V at 1A according to the nameplate. I used an 18VCT transformer at 2A to supply all of the above. The entire winding is used to heat the oven, while this is less than the stated voltage the oven starts cycling in approximately four minutes... which is satisfactory. The winding is full-wave center-tap rectified and applied to Fairchild (or equivalent) 7805 IC regulators to provide the 5V for the LEDs and logic. It would be safer to provide separate regulators for the two functions but my counter has worked nicely for over a year with a single 7805. LM309K regulators would work as well if they are more readily available. I personally prefer the 7805 due to the relative ease of mount-

ing the TO-220 case as compared to the TO-3 of the '309K. The 20V for the 40673 input amplifier is provided by a voltage doubler working off half of the winding. The series capacitor is added to the main counter PC board immediately in front of the existing 1000 μ F electrolytic. Jumper wire under the board connects the capacitor to pads originally intended for the bridge rectifier. Only two diodes are now required. The 5.6V Zener was added to the output to act as a crowbar to insure the primary fuse will blow if a regulator were to fail.

...WA0ABI



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How To Win A Big Contest



To win an Indy 500 or Grand Prix one would need more than average luck. You must have a good car that is super tuned and be in good shape yourself. To make it in the Top Ten of WW contest one must have a rabbit's foot (or whatever), a rig that's working smoothly and be able to do the 48 hour stint 'in a breeze.'

Many hams who make it to the immortal plane of the fortunate few, don't have a \$10,000 set up or a 10kW linear in the ceiling. Nor do they have 10-elements stacked up 30.5m (100'). Their rig and antennas are mainly standard commercial products often running at less than the full gallon. How then do they tote up such fantastic scores? Well, if it's not a 'freak' QTH, then it must be the operator who has that something extra.

Contest caperers come in two types. There's the casual 'goer' who's only in it for a few new countries or prefixes; knows he can't figure in a place but just wants to help swing the scene along a little. The other is a 'fair dinkum' trier whose mind is fixed on a tangible reward such as wallpaper, a medal or plaque etc.

Those who finally make it to the Top Ten are:

1. Under fifty years of age. There are exceptions but OT's by reason of advancing years are handicapped out of a two day 'sweat.'
2. Are fast, efficient and have a smooth operating technique.
3. Able to go non-stop all the way without

brain 'fag.' This is where the 'extra' comes into play and the men begin to show out from the boys. Human stayers are like racehorses, born rather than trained. But many who do have this stamina and ruin it by their approach and 'modus operandi.'

It's easy enough to stay awake for a weekend but to remain alert all this time while riveted to the rig and having your head pounded by QRM is a different matter altogether. Concentration is intense and the amount of mental energy expended is staggering. No wonder fatigue finishes off so many.

To excel, one must be fit. To assume that because amateur radio contesting is a sit-down struggle good physical shape doesn't count is a bad mistake. Those with good muscle tone 'stay' long and well. Like the rig he owns, each person knows best how to tune himself up. But six weeks jogging before a big 'scrap' should bring him to the rig on the gong, fit enough to eat it rather than work it. These ops are already half way there.

No boxer goes the distance without those vital between round rests — and they're just as important in a 48 hour contest. Those who cannot pace themselves fail. A short break away from the rig once every hour is a must. Resist the temptation to stay even if the whole band is calling. Get up and walk around for three or four minutes until your circulation is restored to full bore. Then return to the fray with concentration renewed and muscles relaxed.

If sleepiness is your problem, maybe it's best not to make the operating chair too comfortable. However, remember, physical discomfort saps concentration. So the idea is to sit 'loose.' A foot rest, a fairly low desk on which the arms hang slack at ease, a chair with an adjustable back support and all controls within effortless reach. All of this will add 5% to the total score.

All right, so you and the rig are GO. But don't forget that Lady Luck still holds the trump card. Without her favors you're an also ran. There are two sorts of luck and you'll need all that's going of both. It is vital to get away to a good start; fast flowing QSOs and not too much QRM. One must be up with the field at the half way mark to have any chance. Unlike many competitions, it is almost impossible to come from behind at the end and win. Also in any WW 'scrap' ionospheric conditions vary considerably between hemispheres and continents. It may happen that from your QTH all circuits on all bands to Europe out. Such a loss in DX and activity may be too much to lose.

Relaxation should be the aim for a day or so before a big contest. But many hams, excited at the prospects and urge to do better, go crazy and attempt impossible tasks. Some have the compulsion to change their sky-hooks and find right on starting time that the SWR is like their blood pressure — sky high. Others drive long distances to an S9 Eldorado and by the time the antennas are up, the gear assembled and the snags out, they're ready for bed not a contest. Some decide on last minute rig modifications. Anything from building a new final to attempts to sharpen i-f selectivity. The bell goes and half the equipment is still in pieces on the table. When minor adjustments can have disastrous consequences. I once went out to tighten a slightly slack leg of my 80/40m inverted Vee. It broke off right at the apex. When I attempted to lower the aerial I found that the pulley wheel at the top of the mast was rusted. Profanity in several tongues proved useless, so that was that. Moral: HAVE EVERYTHING TESTED AND READY DAYS BEFORE ANY BIG EVENT. EVEN IF SOME SMALL THING PROVES TO BE

AMISS ON COUNTDOWN, LEAVE IT IF YOU CAN.

A weekend international contest is a hard road and it takes an old dog who knows all the tricks (ethical ones), to win. Psychological pressure plays a part. You must appear to be 'movin' it along' at all costs. If the mode is A1 send as fast as conditions allow. Sound slightly aggressive. Don't struggle with QRM, change frequencies. Never be turned off by a high scoring competitor. He may be a phoney, the results sometimes show this to be the case.

If the rules of a contest make it permissible to commence with any three number digit between 001 and 100, it is often wise to let a few minutes of the 'scrap' get under way and then kick off with a fairly high number around 070. The idea is to keep the true score to yourself and confuse others. Study the form of previous contests and be 'teed' up on who the opposition might be and the likely scores. Check the lono charts for MUF times and best, use of all the bands. If you are a brass pounder vary the BFO tone regularly to ease brain 'fag.'

Keep a spare transceiver on hand, even if only a QRP job. Unless you are dead sure the race is lost never drop out. At all costs finish well; it might just nudge you into a place.

There are those cool contesting 'cats' who claim to use a keeper of the log. This extra hand and two ears is worth, they say, an added 10% in QSOs. Adjudicators might consider this a form of cheating but it's a breach impossible to police. This Man Friday help may work o.k. on phone where the digits given are an oral exercise but in my experience on CW it is NO GO combination. The pace is so hot and the QRM so thick, mistakes continually occur.

Hams, like all others, are drawn to an activity that throws up a challenge. And contesting is truly a stiff test of skill and stamina. There are many WW 'meets' each year and the fields in all continue to grow. There are the old familiar calls and the new. It's great to make it in the Top Ten but better still is the satisfaction that comes by taking on all comers.

...VK4SS

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Digital Wind Direction Indicator

Impress your friends — aggravate the XYL.

With the appearance of inexpensive and reliable magnetic reed switches on the surplus market, a digital wind direction indicator becomes quite easy to construct.

Magnetic reed switches are activated in the proximity of a magnetic field of sufficient intensity. Inexpensive ceramic magnets are readily available as magnetic memo holders, etc. These ceramic magnets, when placed near the reed switch, will cause it to "make" or close its contacts. The reed switches used in this wind direction indicator were purchased from Radio Shack in a pack of 10 for a little over \$1.00.

By mounting magnetic reed switches in a circle and rotating a magnet about the inside of the circle, the switches will close as the magnet passes near them.

The rotating magnet system lends itself perfectly for construction of a wind direction indicator. If an "arrow" capable of

following wind direction is used to drive the rotating ceramic magnet, appropriate switches would be closed thereby supplying wind direction data.

Our rooftop indicating device was constructed from a burned out muffin fan (rotron fan). The inside fan blades were ground off leaving only the rotating center piece. The ceramic magnet was bolted to the outer edge of this center section. With the use of a muffin fan your "bearing" surfaces are already made up and this saves considerable design work. The wind "arrow" was constructed from 1/4 inch copper tubing and tin can metal stock (see Fig. 1). This is attached to the center rotor with a metal plate and bolts. No doubt, other magnet rotating wind arrow devices can be created, however, the muffin fan assembly lends itself perfectly. After the arrow section is completed, a plastic protective spray should be applied to prevent weather corrosion, etc.

The magnetic reed switches are positioned at equal 45° intervals in a piece of 1/4 inch plastic attached to the outer shell of the

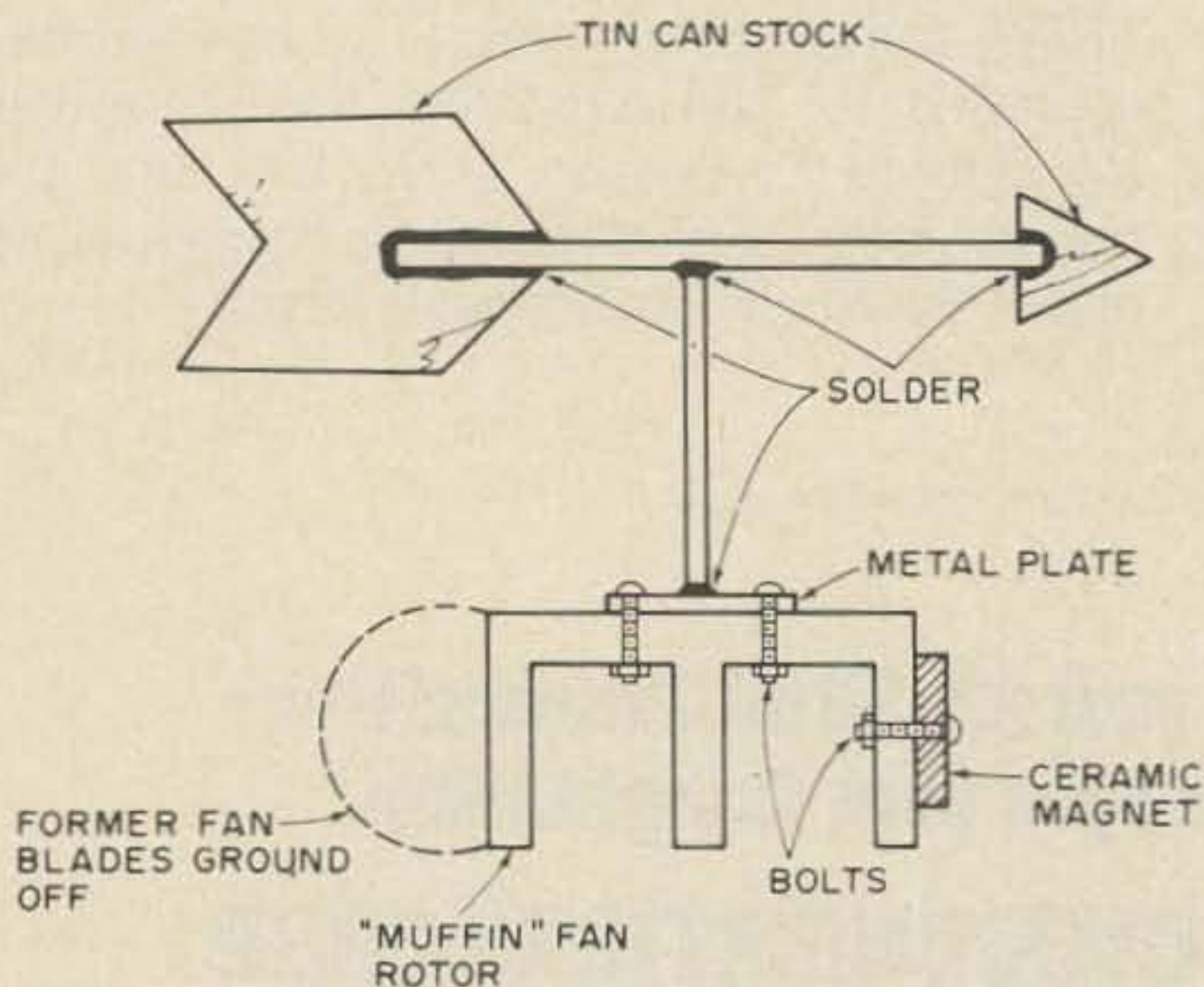


Fig. 1. Wind direction rotor assembly.

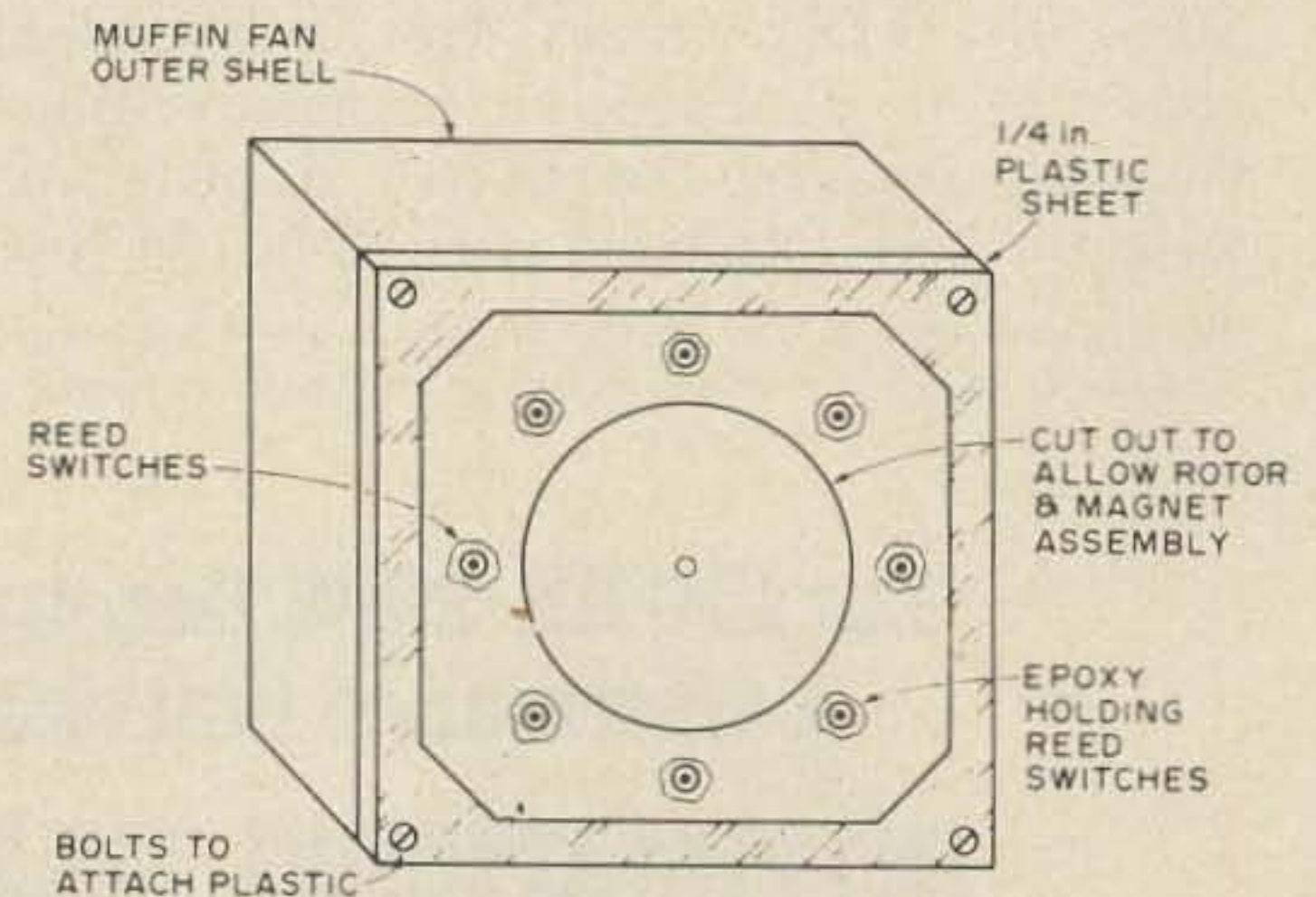


Fig. 2. Mounting of reed switches.

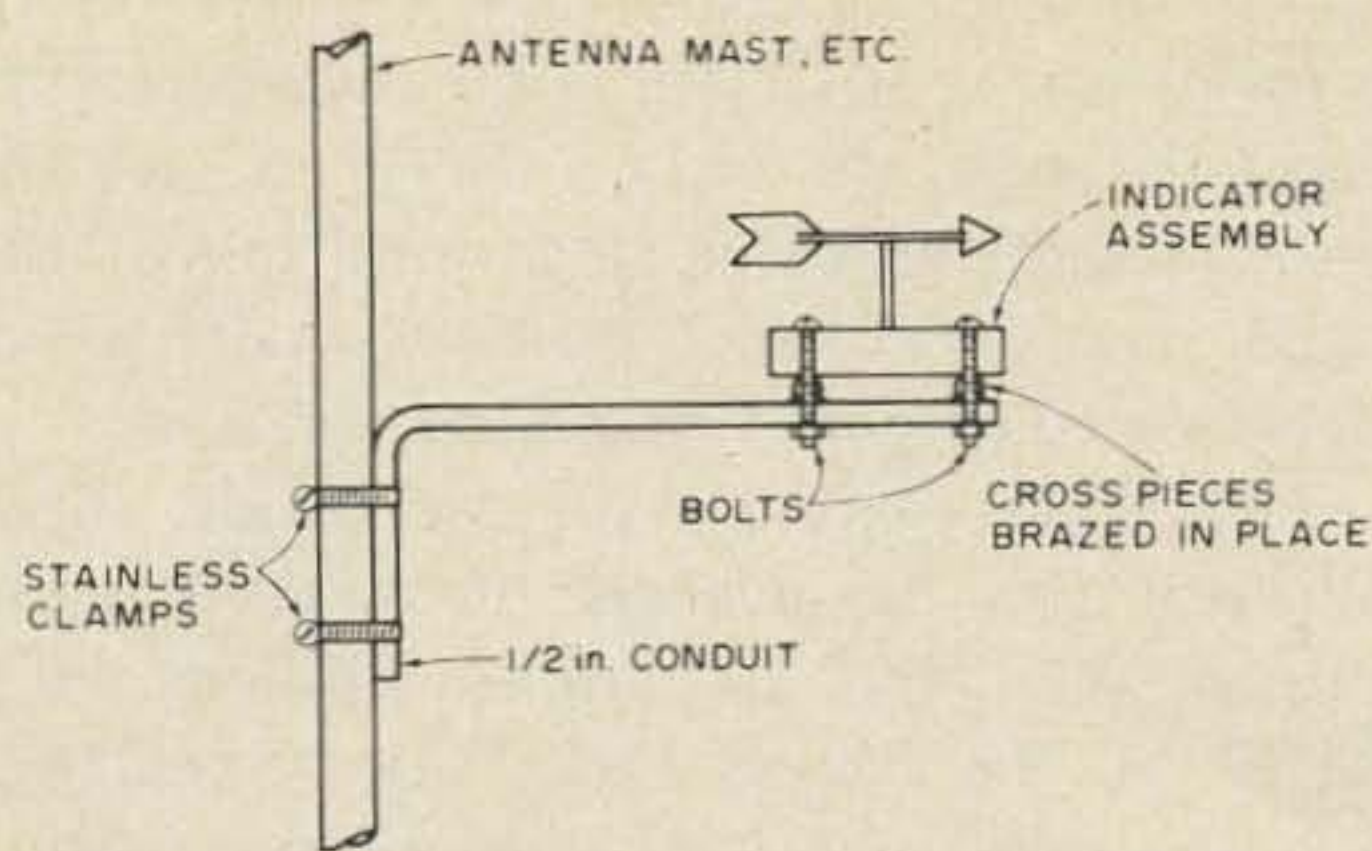


Fig. 3. Indicator to mast attachment.

muffin fan. The plastic was drilled so as to admit the reed switches and they were held in place by epoxy cement. It is necessary to plan the position of the switches before mounting them permanently so as to insure that they will be activated by proximity of the rotating magnet. (See Fig. 2.)

In order to attach the muffin fan assembly to an existing rooftop mast a bracket must also be devised. One-half inch steel conduit was bent so that stainless steel clamps could hold it to a main mast and it would extend out at a 90° angle. Two cross pieces of 1/2 inch conduit were then brazed to the main 1/2 inch stock so that bolts inserted through the muffin fan frame could hold the entire assembly in place. (See Fig. 3.)

Transmitting the reed switch information from the rooftop indicator to an inside

readout device would normally require quite a cable (9 wires). With binary or digital techniques, common four wire television rotor cable will convey all the necessary data.

In binary notation, eight different wind directions are represented as 0-7. Therefore, 0 = NW, 1 = N, 2 = NE, 3 = E, 4 = SE, 5 = S, 6 = SW and 7 = W. Considering that 0 requires no reed switch, only seven switches are required in the rooftop indicator with one blank position (0 or NW). If you will observe Fig. 7, it illustrates how ground and +5 VDC coming down the A, B and C rotor wires represent actual numbers or indicators

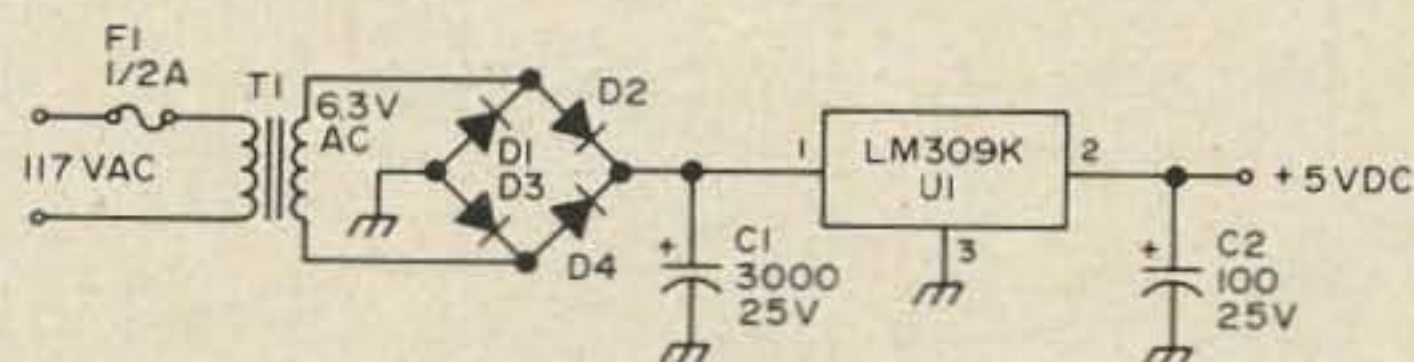


Fig. 4. 5V power supply. $D_1 - D_4$ - IN4002 Silicon Diodes. T_1 - 117AC to 6.3 AC at 1 amp. filament transformer. C_1 - 3000 μF , 25V elec. capacitor. C_2 - 100 μF , 25V elec. capacitor. U_1 - LM309K voltage regulator (5VDC).

when translated by the digital decoders (Fig. 5). The fourth (spare) rotor wire is at ground potential.

The SN7442 decoder (Fig. 5) translates the binary data back to decimal indications. The SN 7404 inverters "turn on" the driver

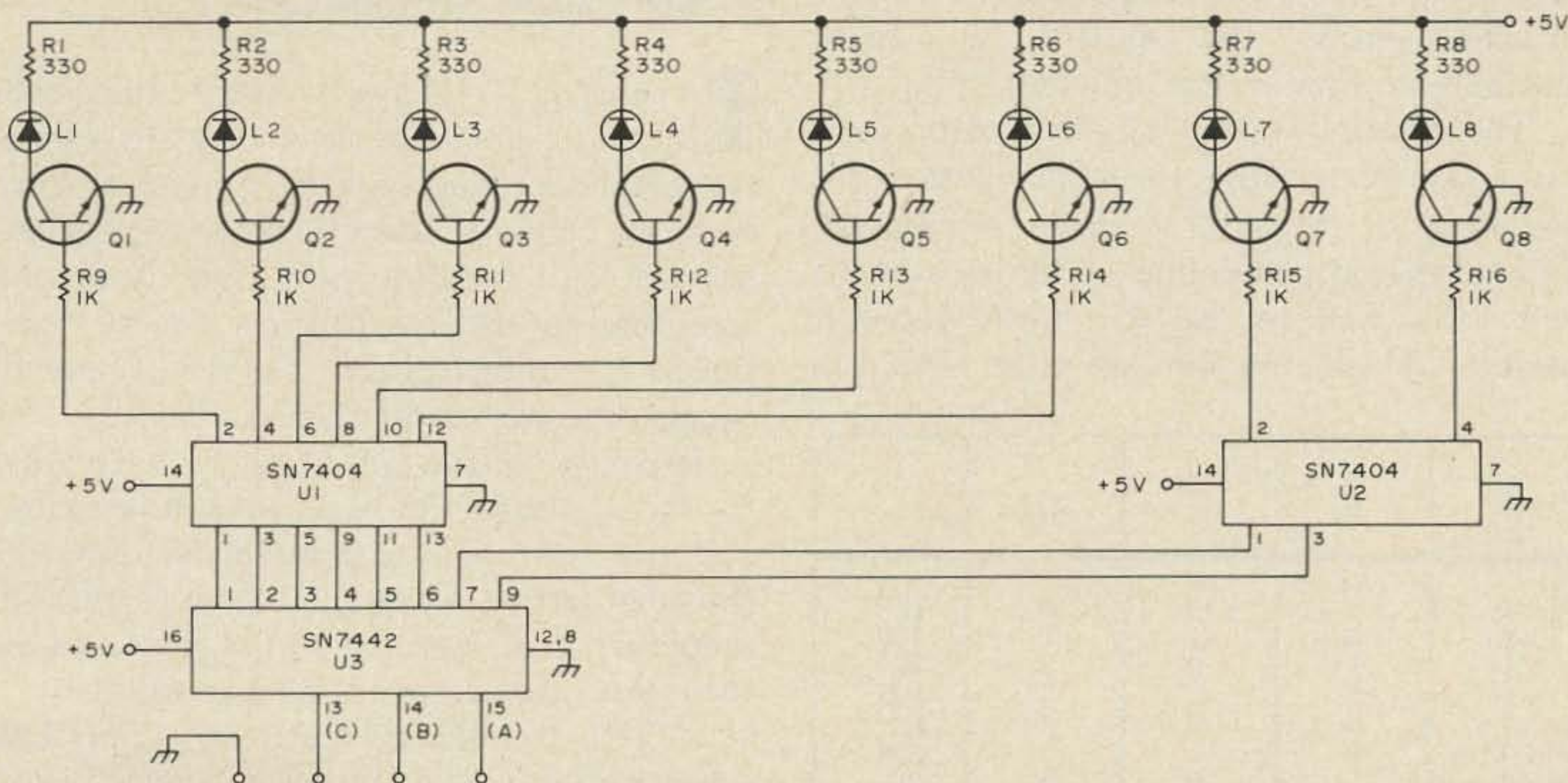


Fig. 5. Decoder and readout. U_1-U_2 - SN7404 Integrated Circuit. U_3 - SN7442 integrated circuit. Q_1-Q_8 - 2N3641 NPN transistors. R_1-R_8 - 330 ohm, 1/4 watt resistors. R_9-R_{16} - 1000 ohm, 1/4 watt resistors. $L_1 - L_8$ - Red LED indicators (most surplus houses).

transistors which in proper sequence illuminate the LED direction indicators.

To convert the 7 reed switches (and absence of a reed switch or blank position) to binary data, a diode matrix becomes necessary. (See Fig. 6.) Almost any silicon diode, such as the 1N914 or 1N4148, can be pressed into service in this matrix as the voltages and current required are quite low.

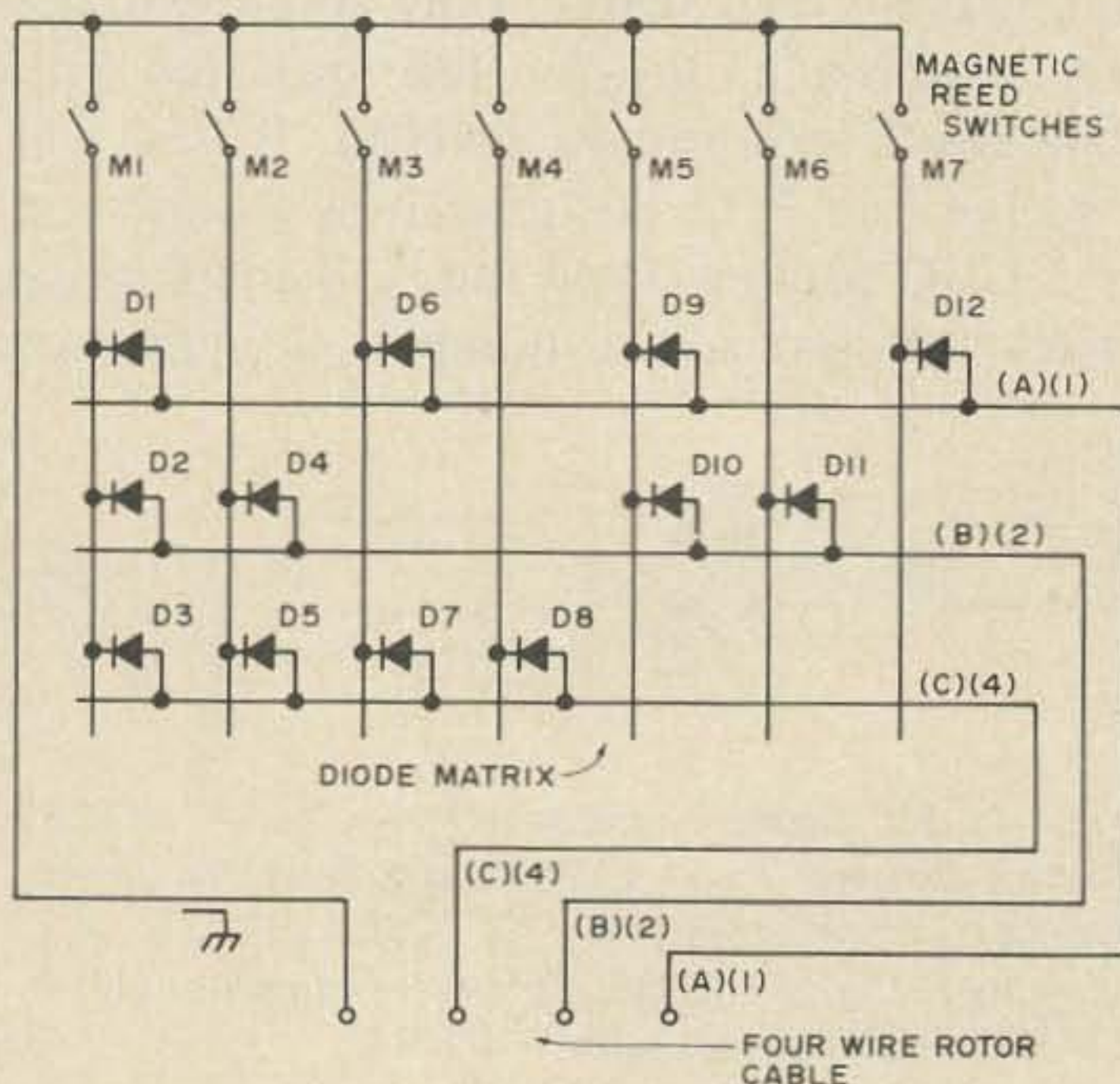


Fig. 6. Diode matrix. D_1 - D_{12} = 1N914 or 1N4148 silicon diodes. M_1 - M_7 = magnetic reed switches. (Radio Shack - 10 for \$1.19.)

Our particular diode matrix has constructed on a small printed circuit board and installed inside the muffin fan outer assembly on the rooftop indicator unit.

The bottom section of the rooftop indicator can be sealed against the elements by installing a "bottom" piece of plastic. Silicon sealing compound or epoxy cement will work well to seal the joints between plastic and the muffin fan base. The top

C 4	B 2	A 1	ACTUAL NUMBERS	INDICATORS
0	0	0	0	N
0	0	1	1	NE
0	1	0	2	E
0	1	1	3	SE
1	0	0	4	S
1	0	1	5	SW
1	1	0	6	W
1	1	1	7	NW

Fig. 7. BCD logic table. 0=ground, 1=+5 VDC.

section of a plastic gallon jug will work well to make a top protective cover, however, the reed switches are sealed in glass which protects them from weather conditions. The diode matrix was sealed inside a small plastic parts box to protect it from the weather.

The LED readouts on the inside wind indicator can be arranged in a circle with appropriate wind directions applied with decals of the "press type." Our indicator box was constructed of clear plastic with a white plastic front which contained the circle of indicator LEDs.

This entire unit is quite simple to construct and is reasonably inexpensive, considering the cost of surplus market integrated circuits. Creativity is essential as well as a well stocked junk box or local surplus electronics store.

The digital wind direction indicator is another device which will aid in cluttering up your ham shack, assist you in spending money, aggravate your XYL due to construction time and impress your friends when viewing this spectacular creation.

...W2A00

Emergency Ferrite Beads

In cases of TVI, a ferrite bead slipped over the base, collector, grid or plate lead of the offending stage can be a lifesaver. The compact choke is also utilized in top-quality laboratory oscilloscopes and spectrum analyzers to stop oscillations which sometimes go unrecognized as the cause of excessive power dissipation in a device.

Recently in the lab, a sudden need arose for ferrite beads and none were in stock. An effective solution was reached by using the threaded ferrite tuning slugs from small VHF inductors. One useful type has the hex hole throughout to accept the alignment tool.

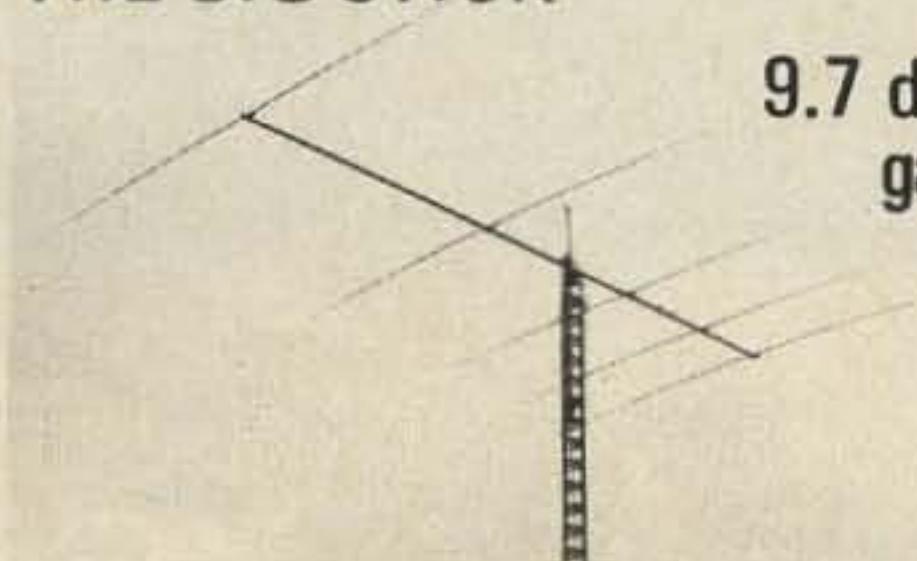
If VHF frequencies are to be suppressed, select a slug from a surplus coil which has 3 to 5 turns, to insure that the ferrite material is appropriate for that frequency range.

...W4ATE

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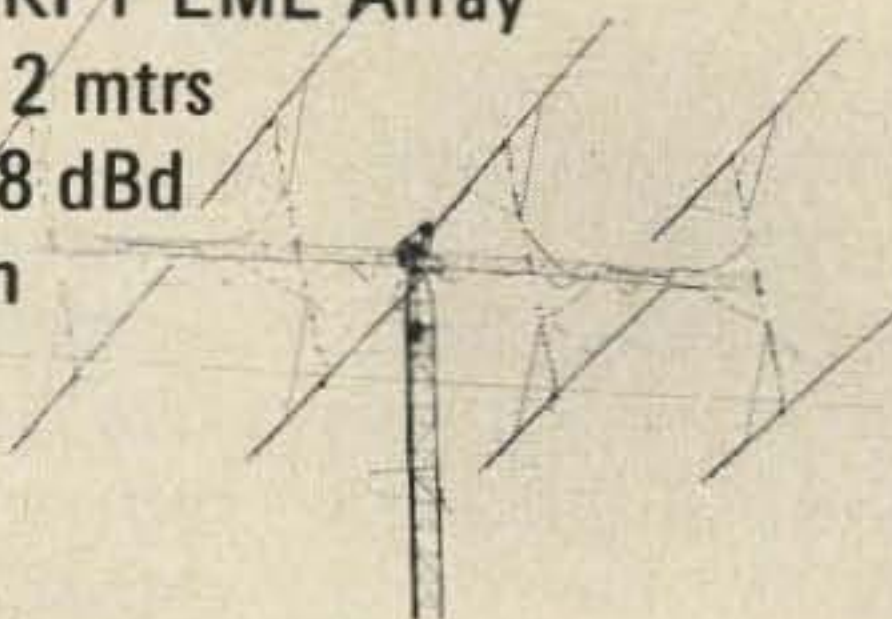


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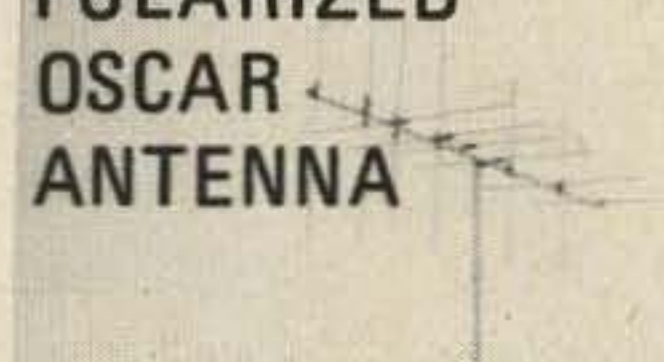


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Build a 2m Frequency Synthesizer



Complete construction details.

Part II

Part I (published last month) of this series gave a general description of the FS-220 frequency synthesized HT-220. It included a block diagram and just a hint of what the rig contains. In Part II I will give you a detailed description of the circuitry and how it all works together.

Reference Oscillator

The reference oscillator for the FS-220 is an AT-cut series resonant 10 MHz crystal in virtually the identical circuit used by K2OAW in his frequency counter and frequency synthesizer ("Frequency Synthesizer for 2m FM, Part II," 73, October, 1972). Reference his article for this and other circuits to come.

10 MHz Divider Chain

The 100 kHz square wave for the clock generator and the 1.111 kHz reference for the phase detector are derived from the 10 MHz crystal oscillator through a four stage divider shown in Fig. 2.

Phase Detector

The phase detector presently in use in my rig is the one described by K2OAW (October, 1972, 73). A 0.47 μ f capacitor

was used for creating the triangular wave with the 1.111 kHz reference. I didn't have an MFE3002 MOSFET, so I substituted a 2N4351. Although the base connections are different it works well and is a few pennies cheaper. Everything else is the same as given by K2OAW. I also tried other phase detectors, including the MC4044P (Motorola). I was able to reduce the reference signal feed-thru to an acceptable level using one stage of active low-pass filtering. This discreet component detector is, however, more desirable since it uses fewer components in the long run.

Unlock Detector

I used the unlock detector from K2OAW's synthesizer also, since the one which was originally designed for the IC detector is not fully compatible with the sample-and-hold type of phase detector. I did not use the LED lock indicator as suggested by K2OAW. Instead, I connected the blanking lead from the 5-digit Minitron readout in the FS-220 to the output of the unlock detector. I also used this point to prevent the HT-220 relay from energizing. With these connections, the transmitter will

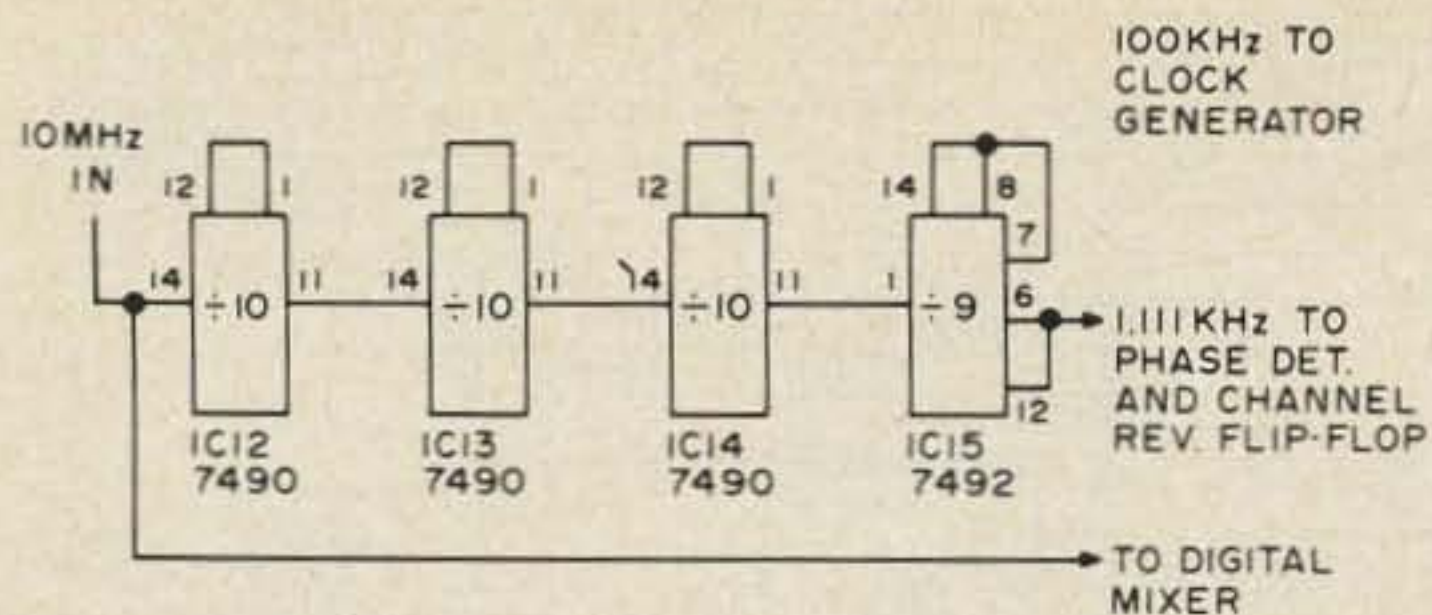


Fig. 2. Reference divider chain. Pins 2, 3, 6, 7, and 10 of IC12-IC14 are grounded. Pin 10 of IC15 is grounded. All IC's have pin 5 connected to 5 Volts.

not key and the digital display is blanked should an unlock condition be detected.

Voltage-Controlled Oscillator

The VCO consists of a Motorola MC1648P, using the essential ideas from K2OAW's article. Some changes were desirable. The varactor diode used at D1 was from a five-pack found at Radio Shack. A variable capacitor is used at C1. When the control line on the base of Q1 goes high (+3 to +5V) C1 is connected across the tank circuit, causing the VCO to tune the 14.000 – 14.443 MHz range. With the control line low, the VCO tunes 16.000 – 16.663 MHz. C1 was adjusted to provide about the same control voltage from the phase detector when working simplex on 146.52 MHz. The tuning range is actually a bit wider than required to insure that the VCO remains in lock at all times.

The dc control voltage must be extremely free from noise to prevent frequency modulation of the VCO. With all of the TTL logic in this rig, a great deal of care was necessary to keep the noise down. I found that a good part of the background noise on the VCO was entering through the switching transistor via the control line. Filtering this line greatly reduced background hiss and assorted weird grumblings.

The output of the VCO drives both the digital mixer and a switched buffer amplifier between the VCO and the frequency multipliers.

Programmable Divider

The techniques employed in this divider have been well published in the amateur magazines within the last year or so. The number N by which the counters are to divide is presented in BCD format to the individual 74192 programmable up-down counters. There is no fancy footwork required to shift to the receiver i-f frequency since in my HT-220 the i-f was an even megahertz. Circuitry must be provided to take care of the propagation delay in the ICs, however. K2OAW gave a good account of the techniques used for ÷N counters.

During receive conditions, the T/R logic sets pin 1 of IC 19 to +5V and grounds pin 10. This presets IC 19 to divide by three.

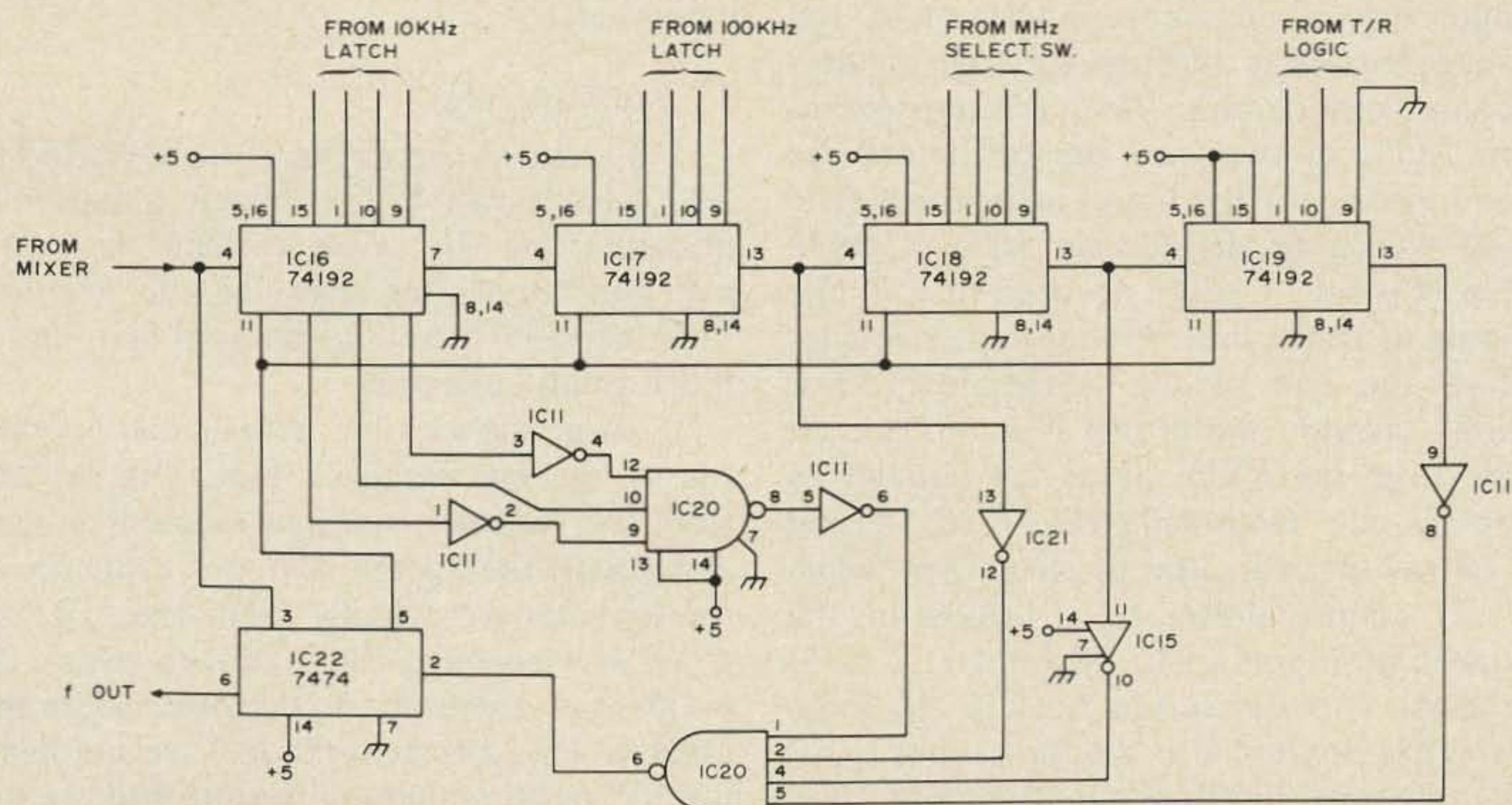


Fig. 3. Programmable Divider Chain (÷N). IC15, IC20, IC21, and IC22 initiate reloading 2 counts from 0000 to overcome propagation delay.

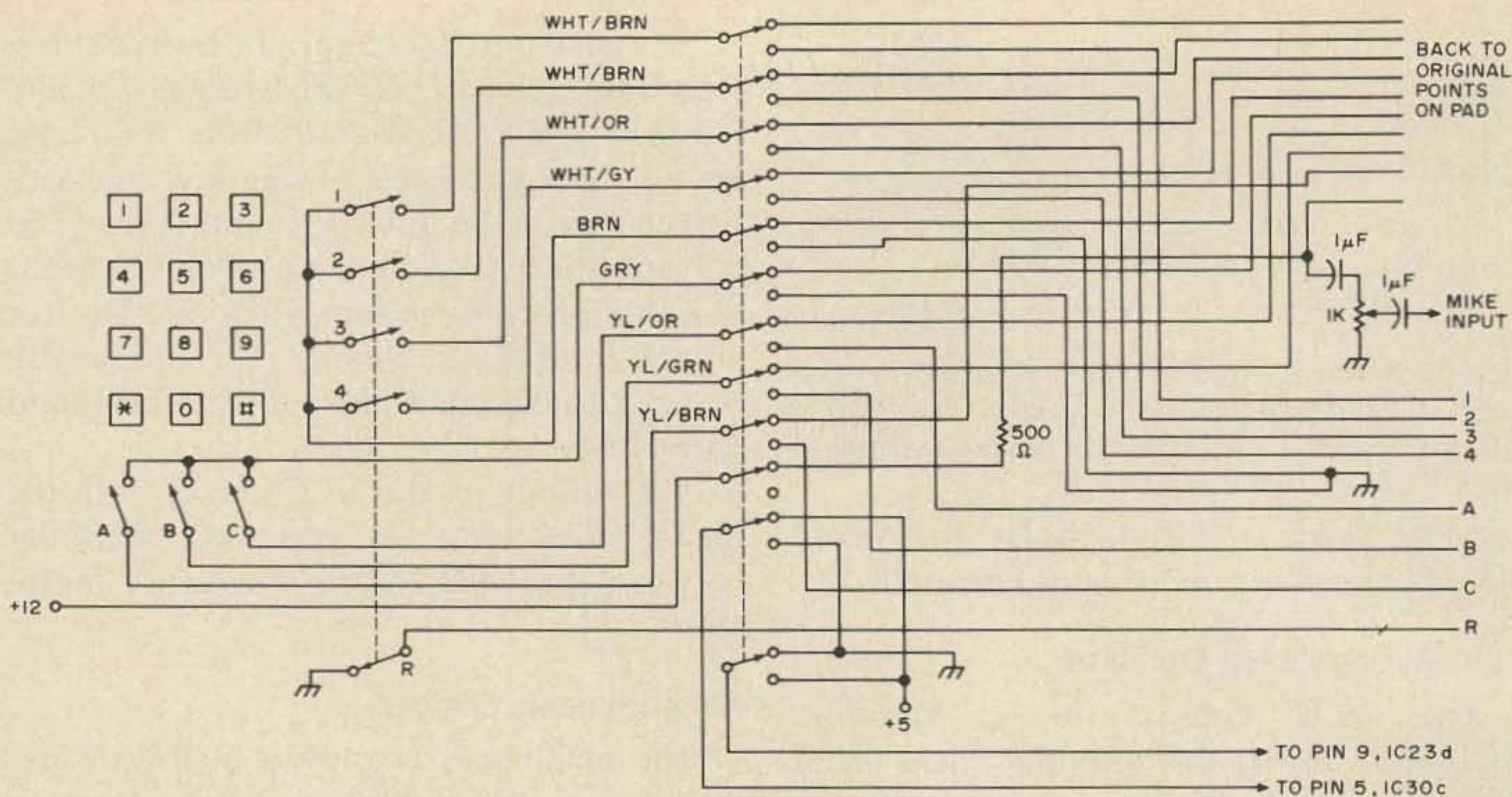


Fig. 4. Wiring of the Program-Operate switch which connects TT-pad switches to either the BCD encoder or the pad.

The MHz switch sets IC 18 to the proper divide number. In the 146 MHz portion of 2m, pins 15, 1, and 10 are grounded and pin 9 is at +5V, giving a preset count of 8. The remaining parts of the number N are set into IC 16 and IC 17 by either the memory or the scanner. In transmit, pin 1 of IC 19 goes low and pin 10 goes high presetting IC 19 to 5. The CHANNEL A MHz switch then sets IC 18 to the desired megahertz.

If the VCO input to the divider chain was low enough in frequency no other circuitry would be required. Above 4 MHz or so, the propagation delay through the four dividers becomes considerable. When this happens an extra cycle or two may slip by before the chain reloads for the next count down. The result would be division by 3601 or 3602 when N is set to 3600. To prevent this, the loading of the number N is begun two cycles before the end of the count down. For 146.22 transmit the proper N is 5622. Each cycle from the VCO causes the number to drop by one. Eventually IC 17, IC 18, and IC 19 will reach a count of zero. Then, when IC 16 counts down to 2 (0002 in the divider), all inputs to IC 20 (pins 1, 2, 4, 5) are high. This causes pin 6 of IC 20 to go low. That point is also the data input to IC 22, a D-type flip-flop. On the next VCO cycle, pin 5 of IC 22 goes low, grounding the LOAD inputs of all 74192 dividers (pin 11).

This forces the original count (5622) in to the divider chain. At the same time that pin 5 of IC 22 goes low pin 6 of the flip-flop goes high. On the next VCO cycle IC 22 sets (pin 5 high, pin 6 low). The output of the divider (IC 22, pin 6) therefore goes high for one half cycle of the VCO frequency once every 5622 counts (or N counts). This output is difficult to see unless you have an oscilloscope with at least a 10 MHz response since its width is typically 125 nanoseconds or so and it occurs only once in about a millisecond.

TT Pad Switching

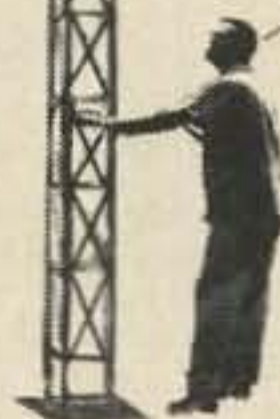
Fig. 4 shows the wiring of the OPERATE-PROGRAM switch. It is largely a matter of disconnecting the seven switches from the pad and connecting them to the encoder. Tone decoder ICs could be used here but at much greater expense.

I have shown the actual color-coding found on my standard pad. One of the auxiliary switches, normally closed, is used along with the button switches. Only six of the switches are actually used. The *, 0, and # are not encoded. Since a zero equals 0V on all lines, there was no need to encode this button. The special symbols have no meaning in the programming routine and are not used. They all will store in memory as 0. I have labelled the switches on the pad for

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ease in identification. The column switches are labelled A, B and C. The row switches are labelled 1, 2, 3 and 4. For example, pushing a 1 causes switches A and 1 to close (and opens the auxiliary switch). The auxiliary switch is labelled R because it is used to reset the bounceless pushbutton flip-flops.

The switch used to connect the pad to the BCD encoder was a multiple-wafer 12 PDT rotary switch. Contacts are provided for applying +12V to the pad for normal operation. The transmitter is also disabled by the switch during programming operations. Audio from the pad is applied in parallel with the mike through the attenuator network shown.

BCD Encoder

The awesome looking layout in Fig. 5 is the BCD encoder. I have shown the TT pad wired directly to the encoder for simplicity and clarity. IC 1 - IC 3 are used as bounceless pushbuttons to eliminate false data caused by the mechanical bouncing of the pad switches. IC 4 through IC 10 detect which two switches on the pad are closed and set the proper BCD output lines low.

The output lines are inverted. That is, when a 2 is pushed the BCD equivalent is 0010. The output of the encoder is not 0010, but 1101. This is indicated by the bars over the symbols. Another inversion takes place in the system before the number gets stored.

Note that there are also outputs from the A, B and C switch encoders. These lines are also inverted. For every button pushed, one of these three lines must go low. This flag is used to tell the clock generator that a TT pad button has been pushed; the BCD outputs tell the memory which button it was.

Clock Generator

The clock generator, shown in Fig. 6, is one of the more interesting circuits. It provides any preset number of pulses as desired.

The clock generator is started when one of the TT pad buttons is pushed while in the PROGRAM mode. The A, B and C inverted outputs from the BCD encoder go to IC 25a. When any one of them drops low, pin 6 of IC 25a goes high and remains high so long as the button is depressed. On the high to low

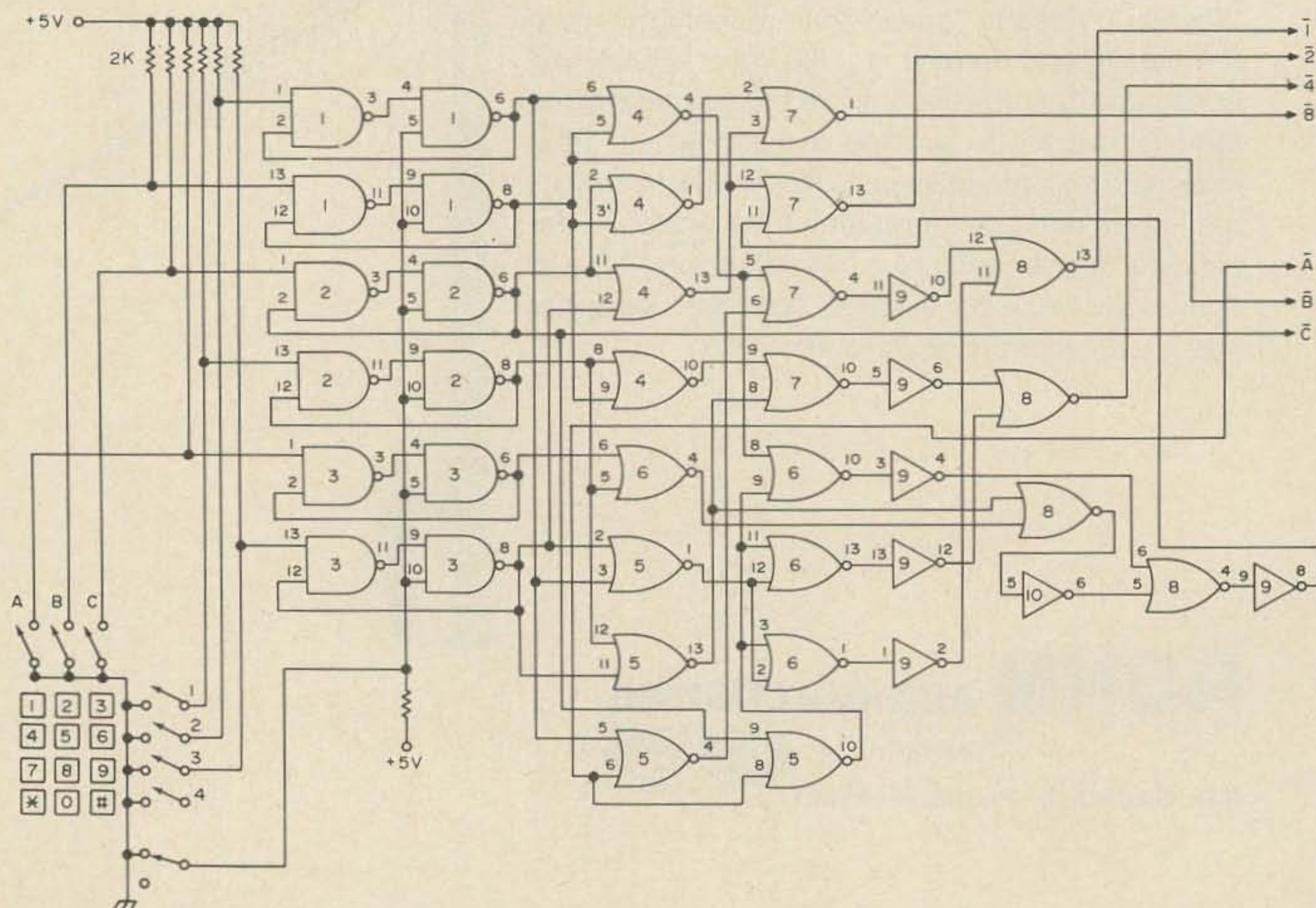


Fig. 5. BCD Encoder. IC numbers are shown on each logic element. The bars over the numbers and letters indicate inverted logic states. The Operate-Program switch is not shown here.



Rear view showing the connectors for power, antenna and microphone. The two LM309 regulators were mounted after scraping away enough paint to get good thermal contact with the chassis.

transition, a one-shot multivibrator IC 33 triggers for 25 milliseconds, storing the number in a quad latch, IC 34. At the same time, one-shot multivibrator IC 35 triggers for 150-200 milliseconds. Its output goes high for that length of time. At the end of the 150 ms pin 6 of IC 35 goes low. One of the places this signal goes is to another data selector made up of IC 30c, IC 29b, c and d. In the PROGRAM mode, this selector connects the output of IC 35 to the MODE inputs of the 7495 shift registers in the memory. When IC 35 goes high, then low, it selects right shift (parallel input) in the 7495

ICs. In the operate mode, the selector connects the MODE line to the output of IC 32a which determines left or right shifts as explained later. The output of IC 35 also goes to a second data selector consisting of IC 14b, c and d. In the PROGRAM mode this selector causes the P/S converter to load the BCD number from IC 34 as IC 35 makes its high to low transition. Later in the sequence the selector connects the P/S converter to the clock generator (which shifts the BCD number into the first memory slot. In the operate mode this data selector connects the P/S converter mode control directly to the clock generator.

So far all of the control lines have been explained, but nothing has been said about the clock generator itself. The output of IC 35 is also connected to inverter IC 26a. Its output is differentiated by an RC network, producing first a negative pulse and then a positive pulse. On the input of the positive pulse pin 4 of IC 23b goes low for the duration of the pulse. The negative transition of IC 23b causes the clock control flip-flop IC 24a to preset (Q output pin 15 goes high and remains high). This initiates (at long last) the clock generator sequence. Flip-flop IC 24b along with IC 31a make up a "ones-detector." This part of the circuit was found in "Designing with TTL Inte-

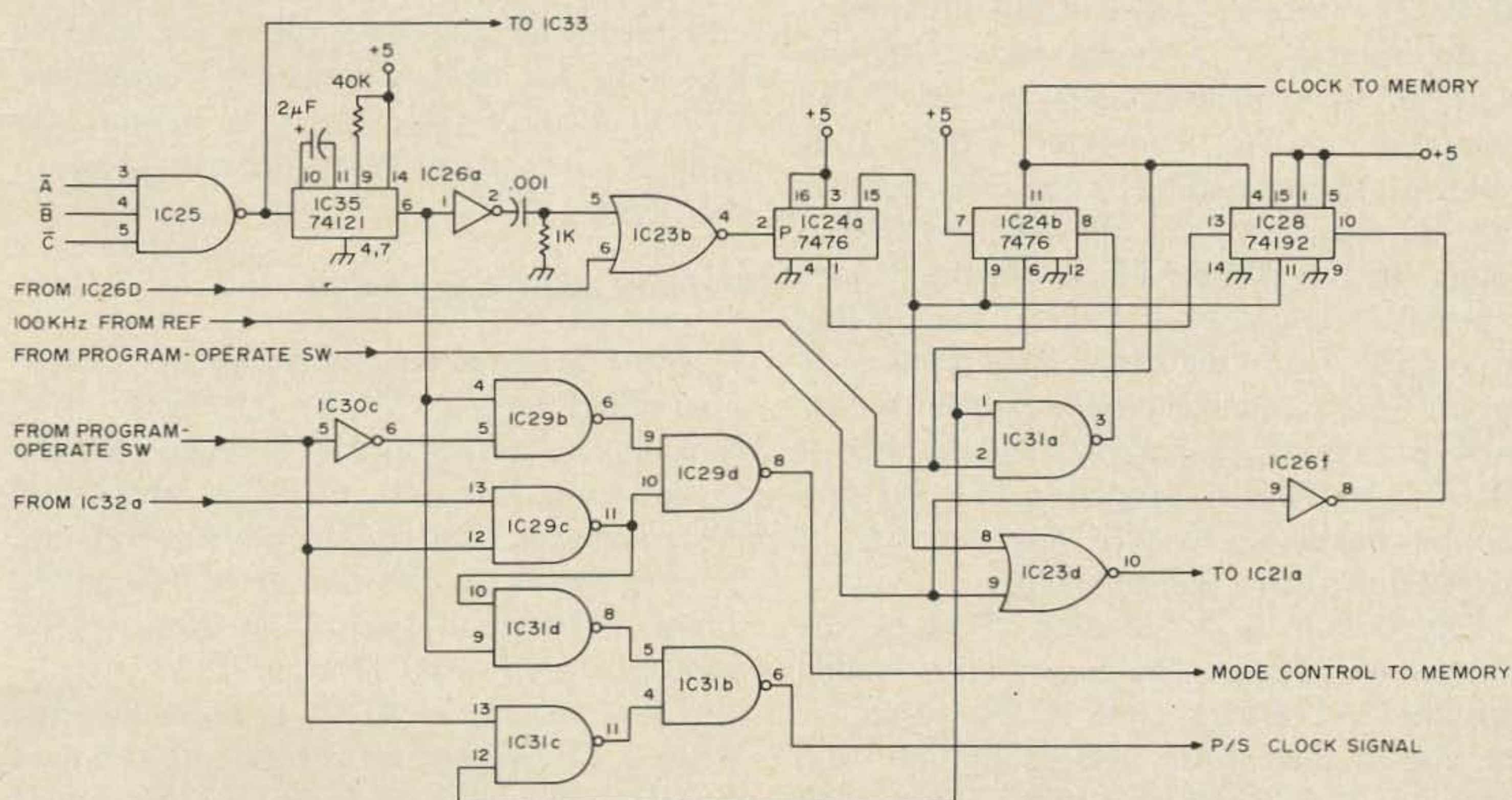


Fig. 6. Clock Generator. This circuit produces pulses for shifting the memory and inhibiting the transmitter during programming.

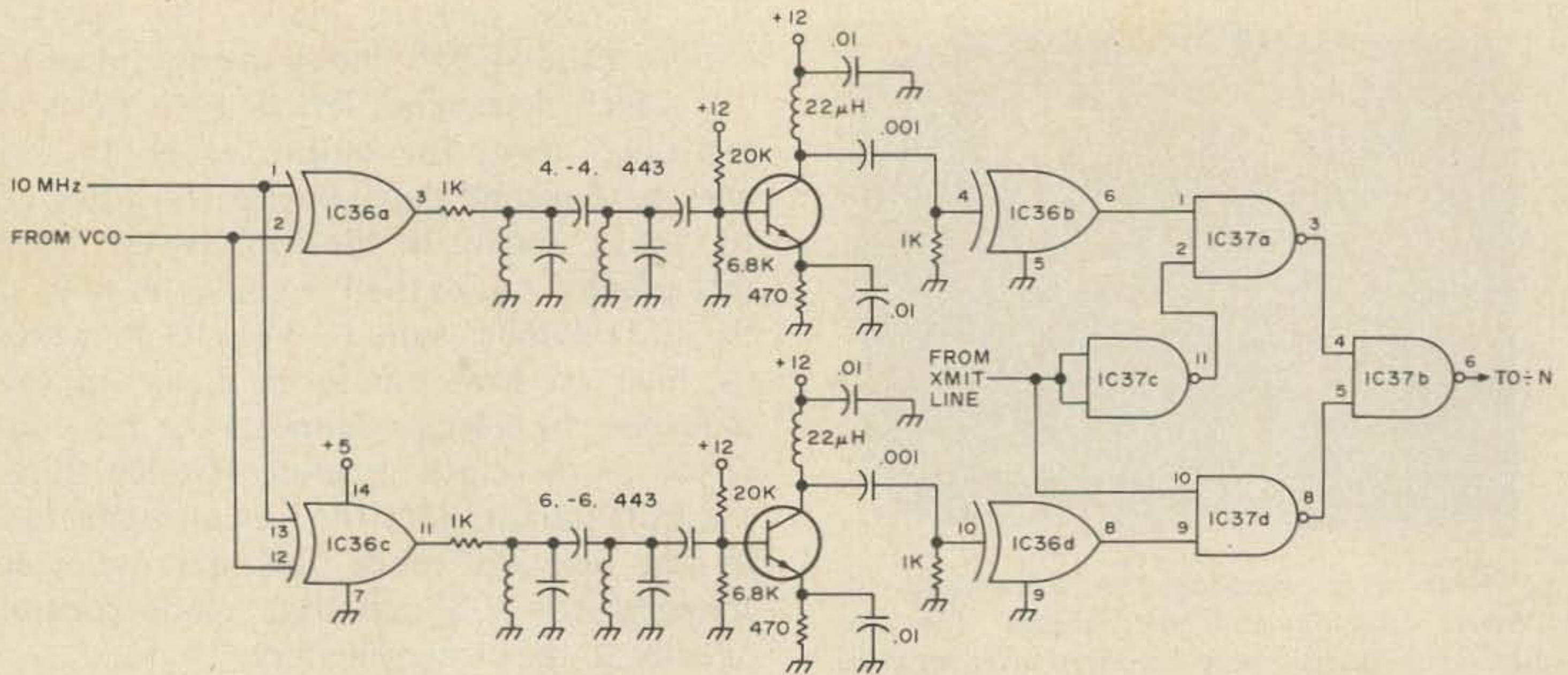


Fig. 7. Digital Mixer. A separate mixer and filter is provided for transmit and receive. IC37 is a switch to select the proper mixer output.

grated Circuits," one of Texas Instruments Electronics Series. A 100 kHz square wave feeds the clock input of IC 24b. This signal will appear at pin 11 of IC 24b so long as the J input, pin 9, is high. This arrangement allows integral numbers of cycles to pass through the "ones-detector." The output of IC 24b, pin 11, goes to the memory as the shift clock signal. It also feeds a programmable divider, IC 28. In the PROGRAM mode, this divider is preset to count from 3 down to 0. When it hits 0, the borrow output (pin 13) goes low, clearing the control flip flop IC 24a. That in turn shuts off IC 24. Since IC 24b will not shut down in the middle of a cycle, four complete cycles of the 100 kHz signal go out to the memory and P/S converter. Those four cycles cause the loading of one BCD number into the memory and the shifting of the others. In the OPERATE mode, the divider is preset to count from 7 down to 0, giving an output from the clock generator of 8 pulses. This particular circuit can be used by itself as a N-pulse generator. The number of 74192 (or 74193) programmable dividers can be increased to give any number of output pulses on a one-time basis.

The circuit is self-loading. That is, the number of pulses to be generated is loaded into the 74192 each time IC 24a resets (at the end of each shift). The gating line from pin 15 of IC 24a also goes to a NOR gate, IC 23d. Pin 10 of IC 23d goes low whenever the clock generator is causing a memory shift.

This low signal is used in inhibit the transmitter.

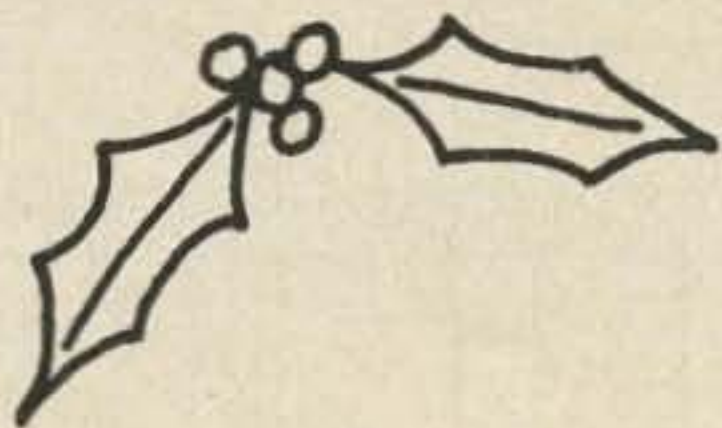
Digital Mixer

The VCO output frequency is just a little too high for reliable counting in my programmable divider, so I used a heterodyning method to lower the input frequency to the 74192 chain. As shown in Fig. 7, the mixer itself consists of a 7486 exclusive OR gate, IC 36. The output of the exclusive OR with two signals on the input includes the sum and difference frequencies, plus many harmonics. To prevent confusion of the $\div N$, separate mixers were used for transmitting and receiving. Bandpass filters are used to pass only the desired range of frequencies, IC 37a, b and c select the filter output. Q2 and Q3 are used to overcome the losses in the filters.

Memory and P/S Converter

The P/S converter and the memory were assembled using 7495 left/right shift registers. As shown in Fig. 8, seven of these ICs are used. The first, IC 38, is used as the P/S converter. The BCD number from the TT pad enters the P/S converter through IC 34, a 7475 quad latch. The data is temporarily stored in IC 34 when IC 33 triggers. Pin 6 of IC 33, a 74121, is normally low. When a TT pad button is pushed pin 6 goes high for 25 milliseconds or so. This causes the data to enter IC 34. When pin 6 goes low again the latch holds the data that was

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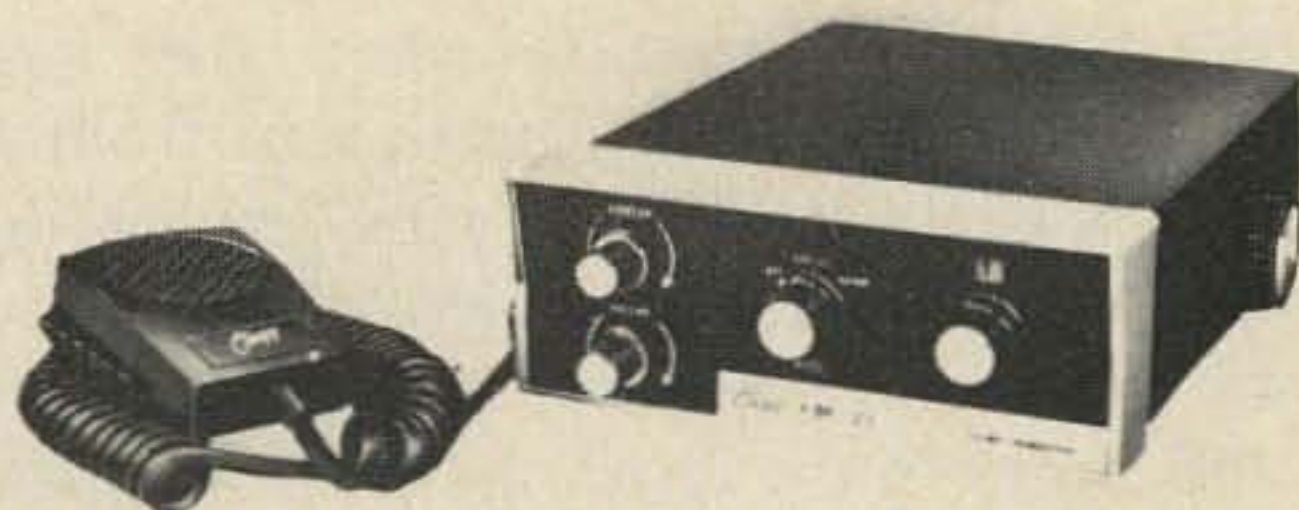
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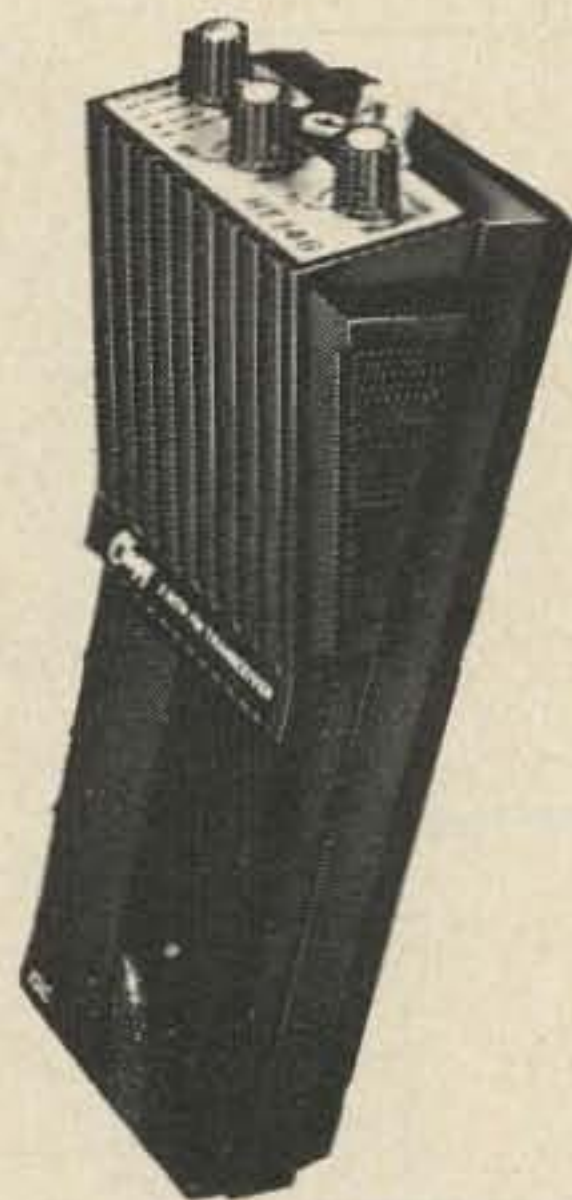
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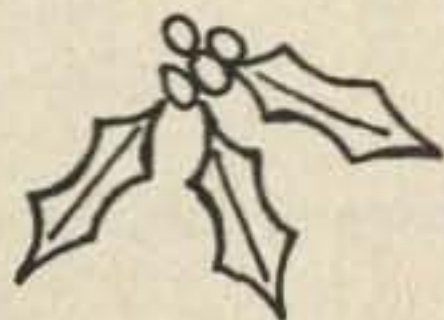
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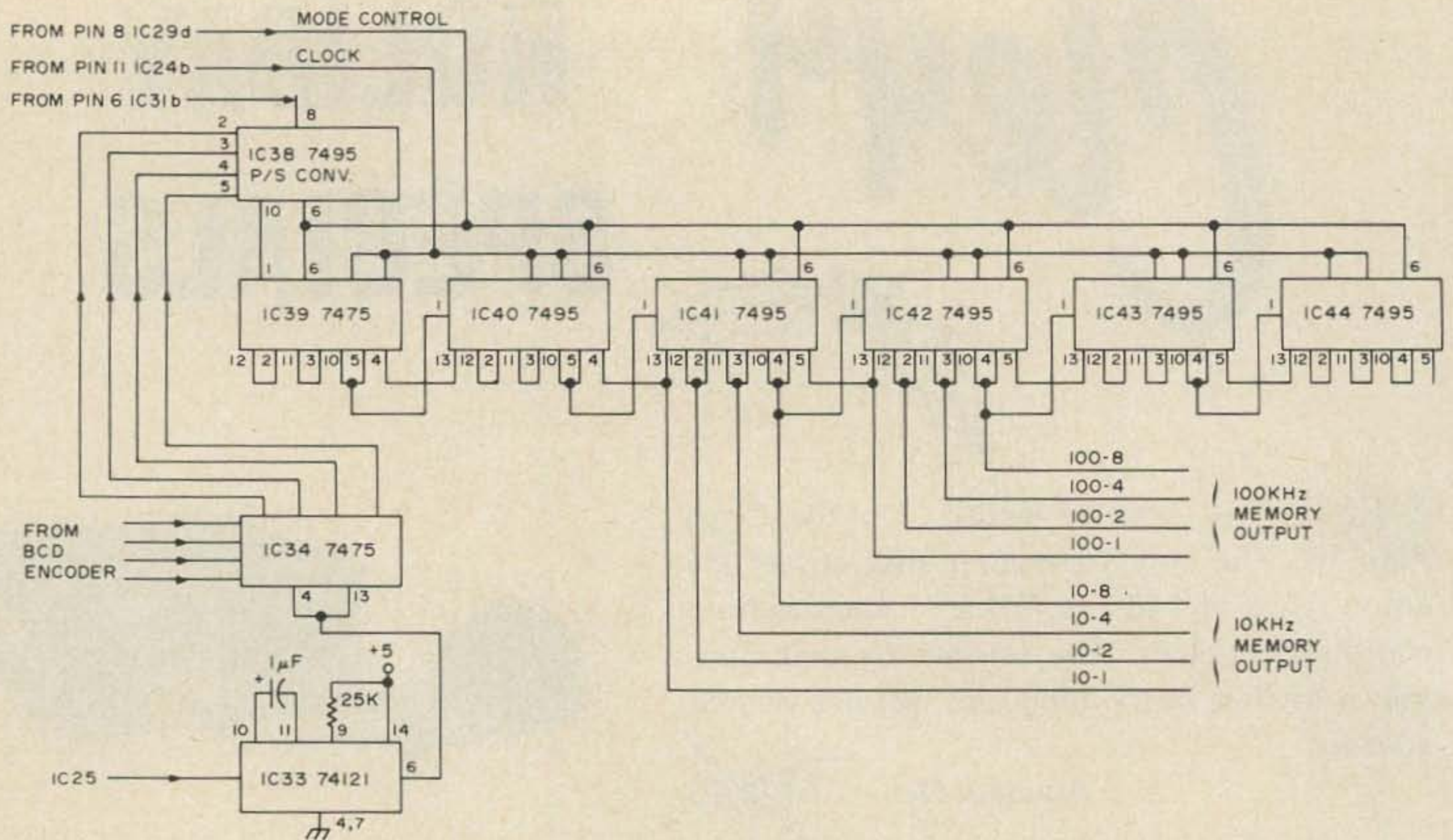


Fig. 8. P/S Converter and memory.

present at its inputs when the negative transition occurred. The output from IC 34 is taken from the \bar{Q} pins, providing the inversion necessary to give true BCD coding of the decimal number into the memory. At this point in the chain the BCD numbers will have the coding found in Table 1 (Oct. 1974).

The data enters the P/S converter at the

parallel inputs. The 7495 can be used for several functions. When pin 6 is high (Mode control), parallel-in, parallel-out operations may be performed. The data present at pins 2, 3, 4 and 5 are transferred to the outputs (pins 13, 12, 11 and 10) on each pulse of the CLOCK 2 input (pin 8). Shift left can be implemented in this mode by connecting

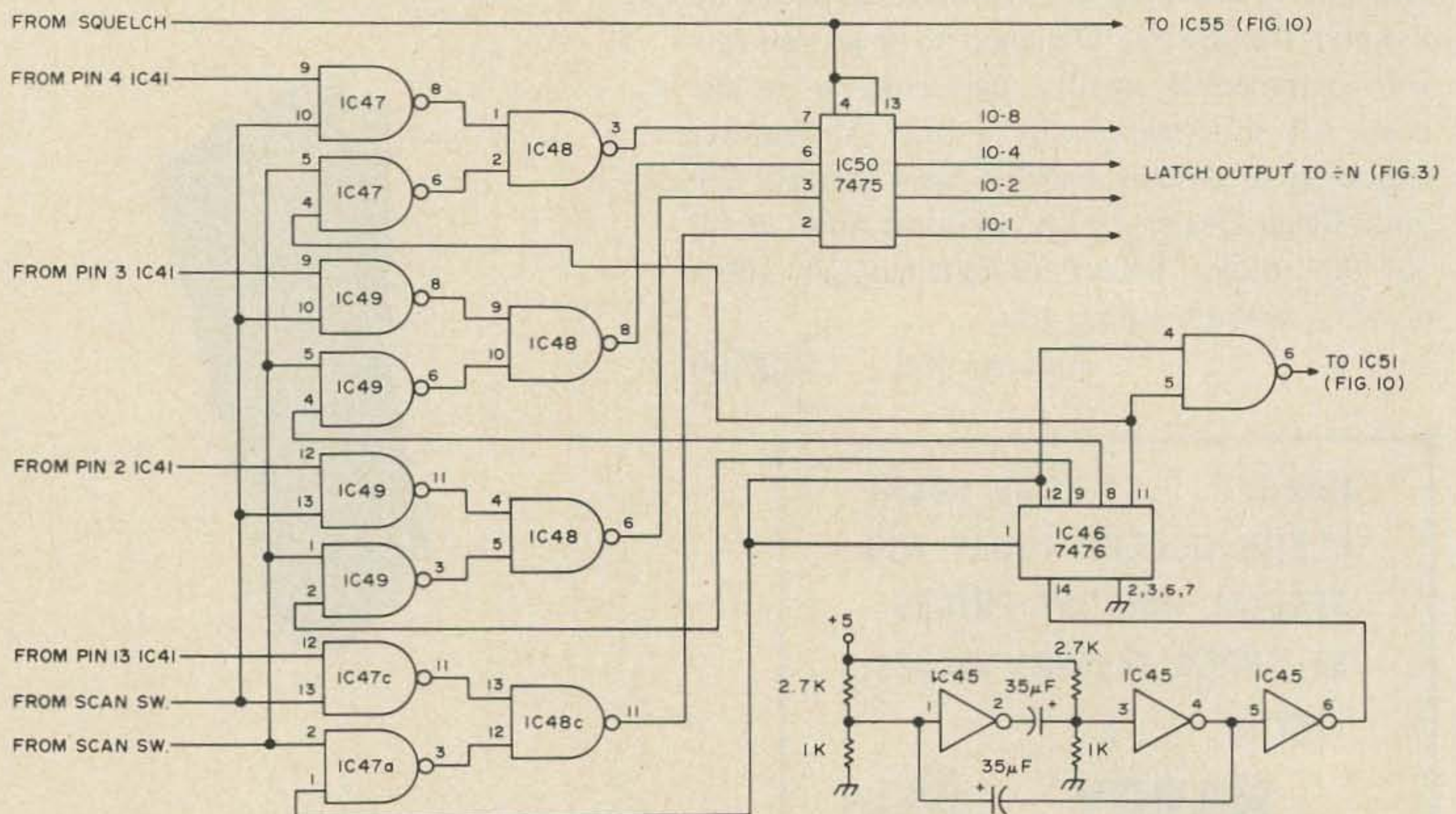
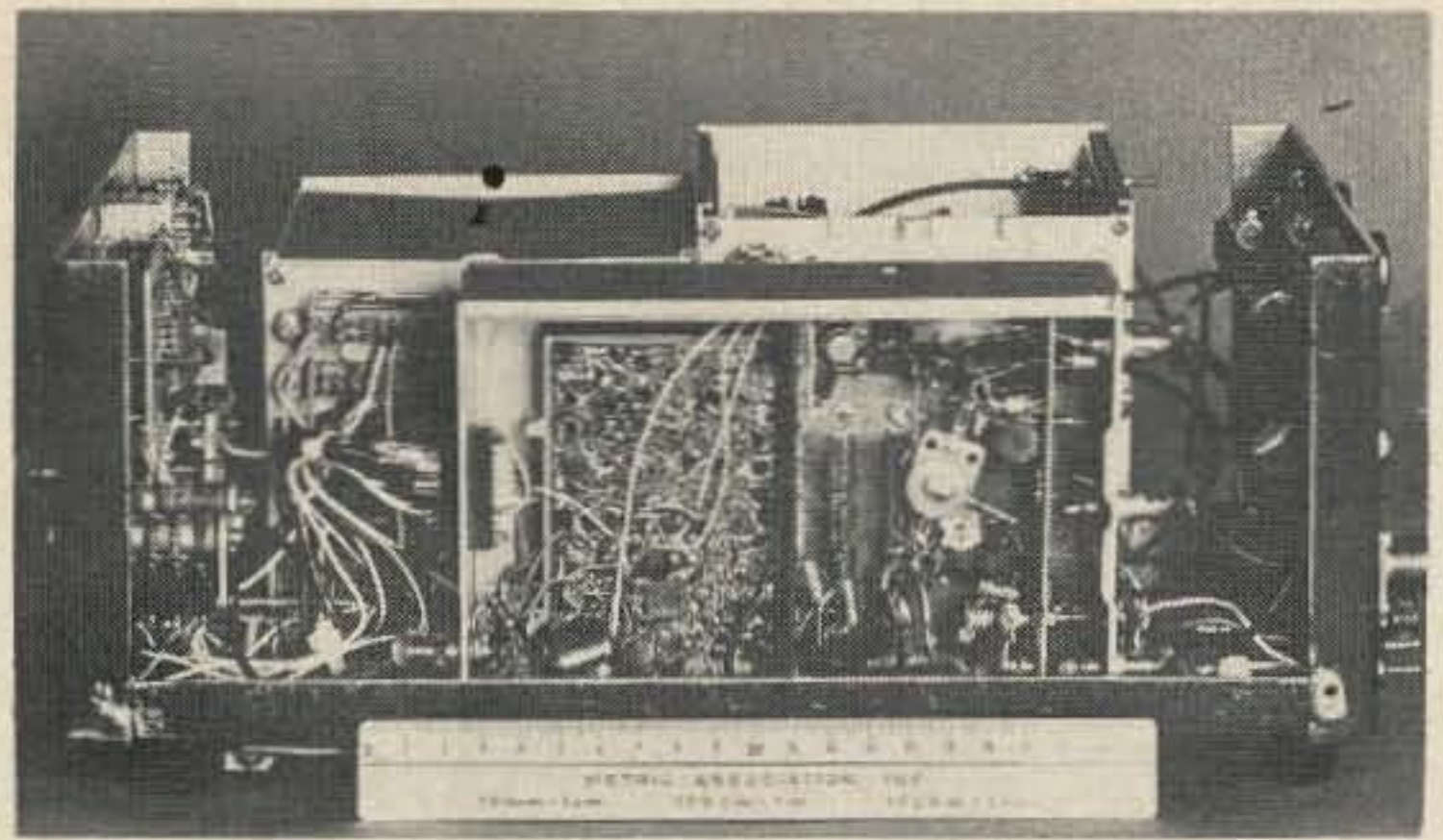


Fig. 9. 10 kHz Latch. IC47, IC48, and IC49 for a data selector to connect either the memory or the scanner to the ÷N.

each output to the parallel-input of the preceding flip flop (pin 10 to pin 4, pin 11 to pin 3, etc.). Serial data would be entered at pin 5. Shift-right operations are performed with the mode control pin 6 low. With each CLOCK 1 pulse data is transferred from one flip flop to the next flip flop down the line. Serial data is entered at pin 1 in this mode. IC 38 is used for parallel-in, shift-right operations only (parallel in to serial out). It accepts the data from the quad latch in parallel format, then shifts right on each of the four pulses from the clock generator. This moves one BCD number serially into IC 39, the first memory slot. IC 39 through IC 44 are wired for both left and right shifting operations. In the PROGRAM mode pin 6 of these six ICs is held low during the four clock generator pulses. The serial data from the P/S converter is loaded into each slot. In the OPERATE mode the mode control pin 6 changes depending upon the position of the CHAN REV switch. Normally, it is low for shifting right into the transmit frequency, and high for shifting left into the receive frequency. An exception to this is in SIMPLEX mode. Once set for either A or B channel simplex operation, the mode control signal is inhibited (does not change).

The output from memory is taken from



This side view clearly shows the HT-220 circuit board with the buffer/multipliers to the right. All circuit boards and other critical circuitry were mounted in shielded boxes.

the parallel outputs of IC 41 and IC 42. It should be obvious that with this shift register form of storage extra slots are necessary to save the data not currently being read out. That is the reason for 24 bits of storage with only 16 bits of data.

Scanner

The scanning circuitry is identified by two labels — the 10 kHz latch and the 100 kHz latch. The two parts are very much the same. The 10 kHz latch is shown in Fig. 9. Three sections of a hex inverter, IC 45, are used as an oscillator with constants fixed for a frequency of roughly 10 Hz. This oscillator

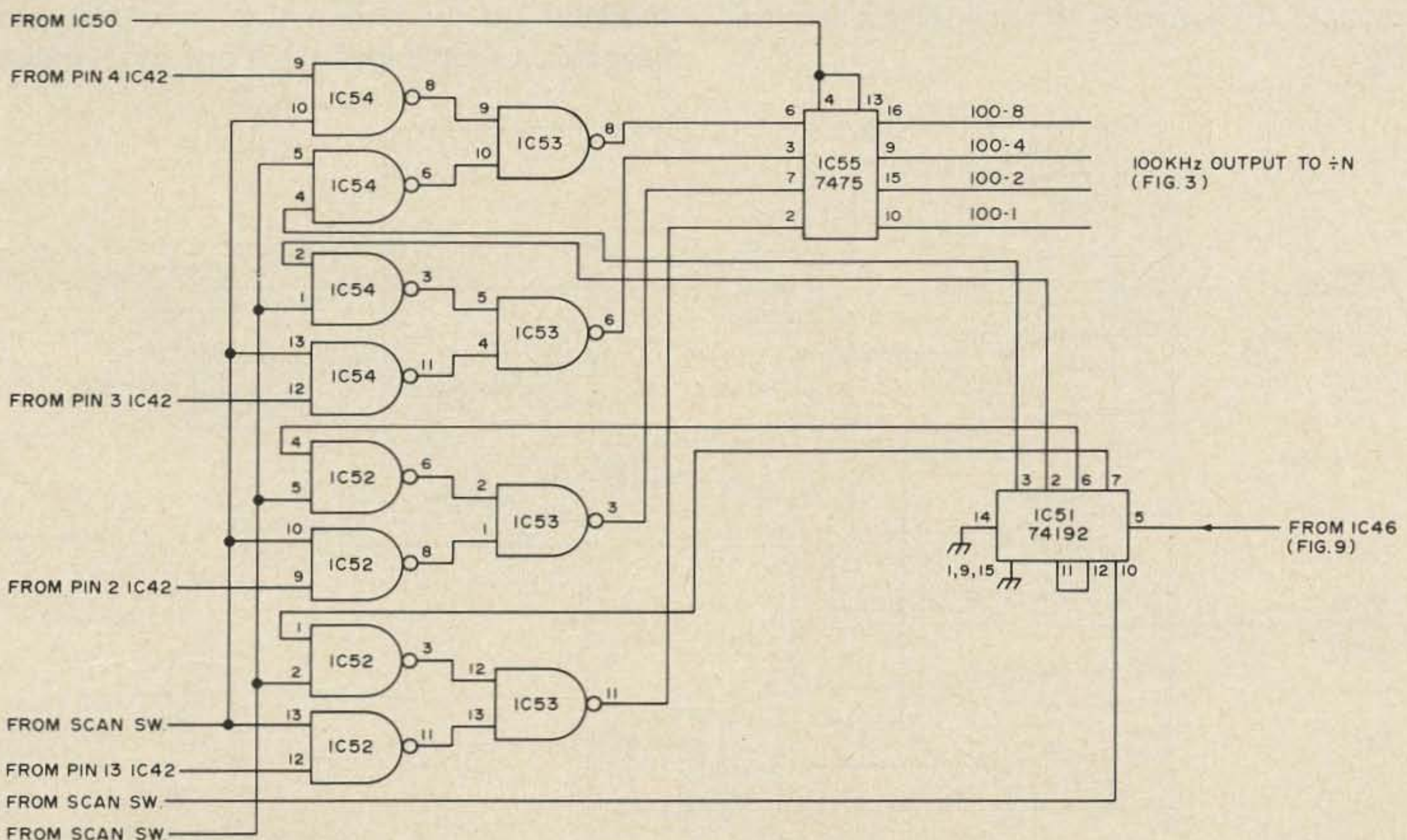


Fig. 10. 100 kHz Latch. Circuitry is the same as the 10 kHz latch with the exception of IC51.

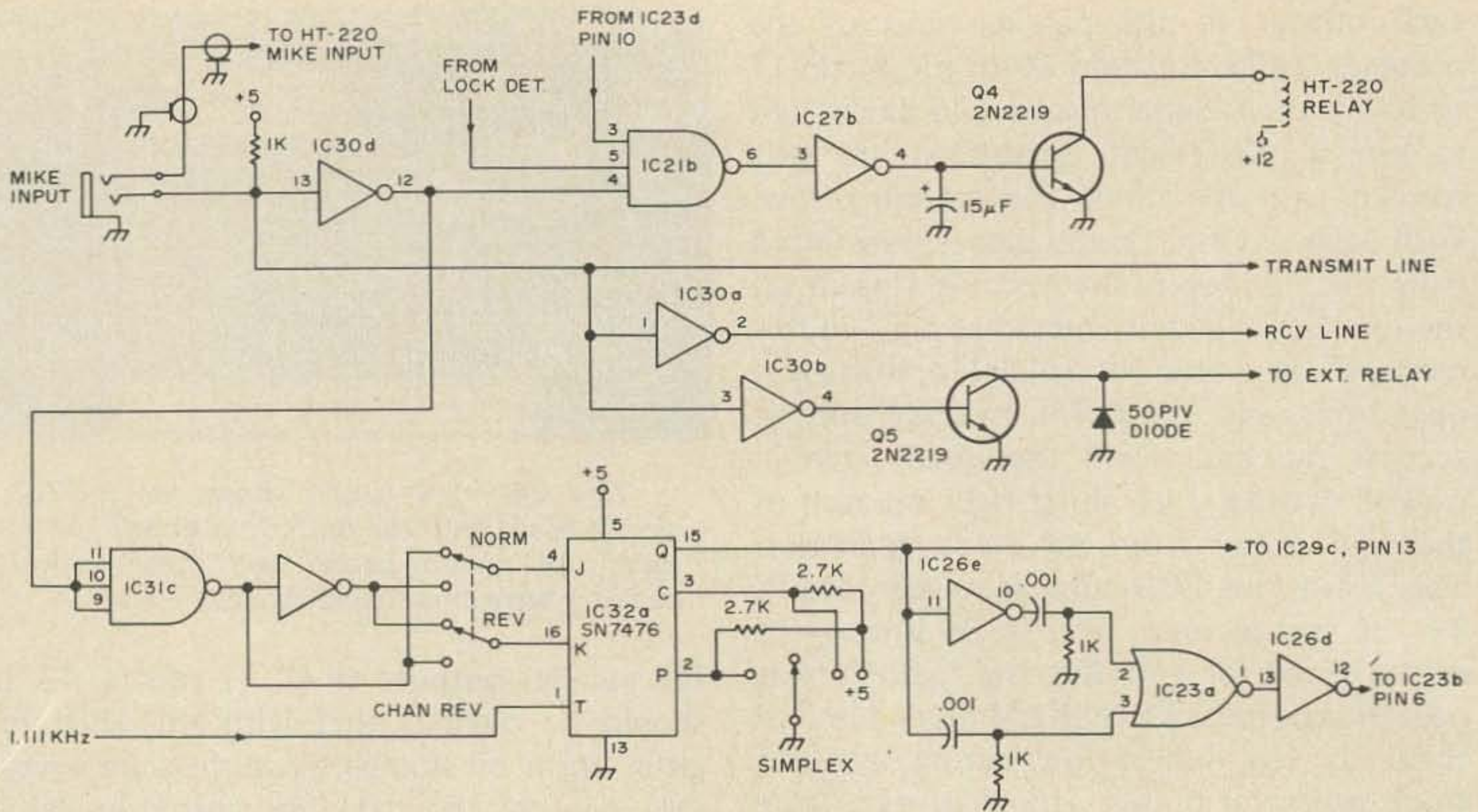


Fig. 11. T/R Logic. Transmitter keying, channel reversing, simplex, and memory control are controlled with this circuitry.

drives IC 46, a 7490. IC 46 and its companion IC 51 (74192) constitute a $\div 100$ or $\div 50$ chain. IC 46 is wired for BCD counting. Its outputs follow exactly the sequence found in Table I and are used in place of the memory outputs for scanning in 10 kHz steps. IC 47, IC 48, and IC 49 form another data selector. The operation of only one section will be described since the concept remains the same for all such selectors in this rig.

The 10-1 line (BCD 1 portion of the 10 kHz section) is switched by IC 47a, IC 47c, and IC 48c. When the SCAN switch is set to OFF pin 13 of IC 47c is high and pin 2 of IC 47a is low. Since IC 47 is a quad NAND gate pin 3 will remain high regardless of the state of pin 1 (because pin 3 is low). Pin 11 of IC 47c will be low when pin 12 is high and vice versa. The total action just described can be summed up by saying that a NAND gate becomes a simple inverter if one of its inputs

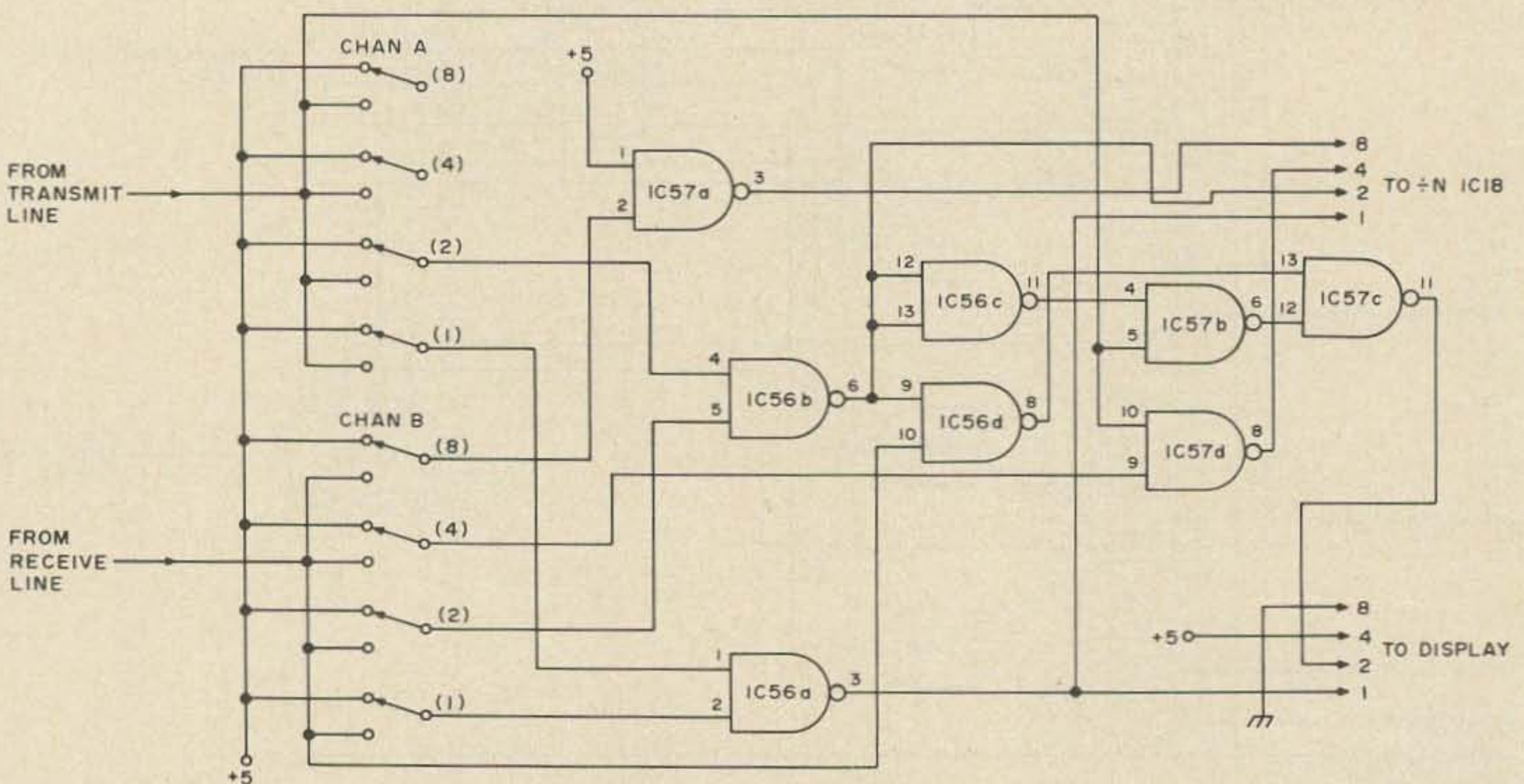


Fig. 12. 1 MHz Switching. This circuit provides the front-panel selection of the 1 MHz range setting for proper display during receive.

B. Rogers
1034 N. Fern
Escondido CA



1



2



3



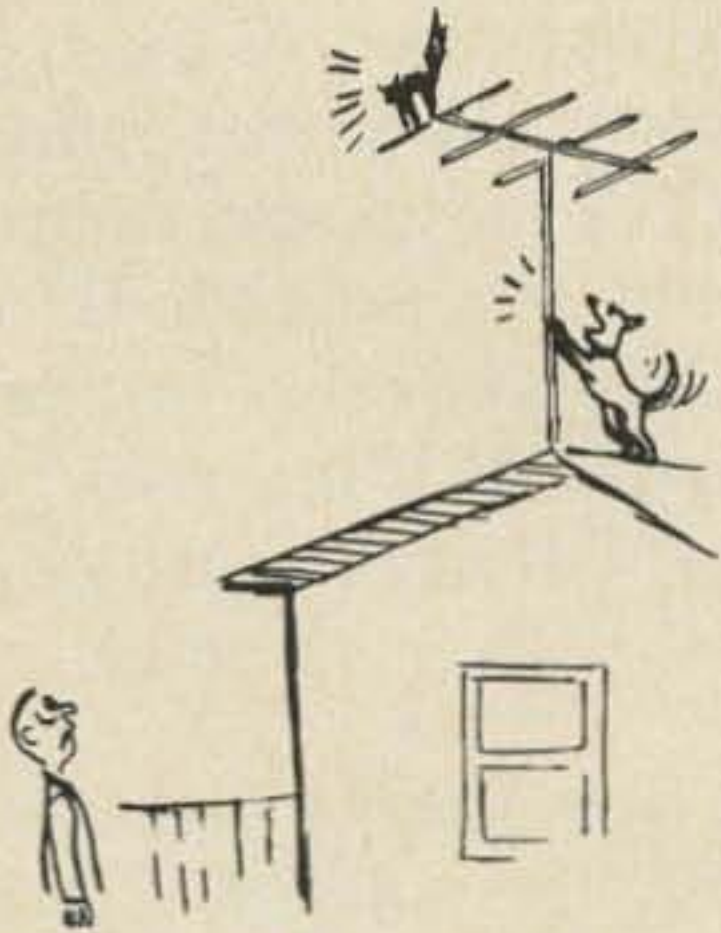
4



5



6



7



8



9



10



11



12

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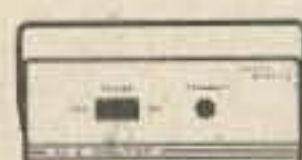
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is held high, and becomes inactive if either of its inputs is held low. IC 48c acts as an inverter all the time. Pin 12 of IC 48c remains high with the scan off, causing the output of the selector to follow the input at pin 12 of IC 47c. No inversion occurs through the selector. When the scan is turned on the output of the selector at pin 11 of IC 48c follows the input of IC 47a. That input is the 10-1 line from the 7490 BCD counter.

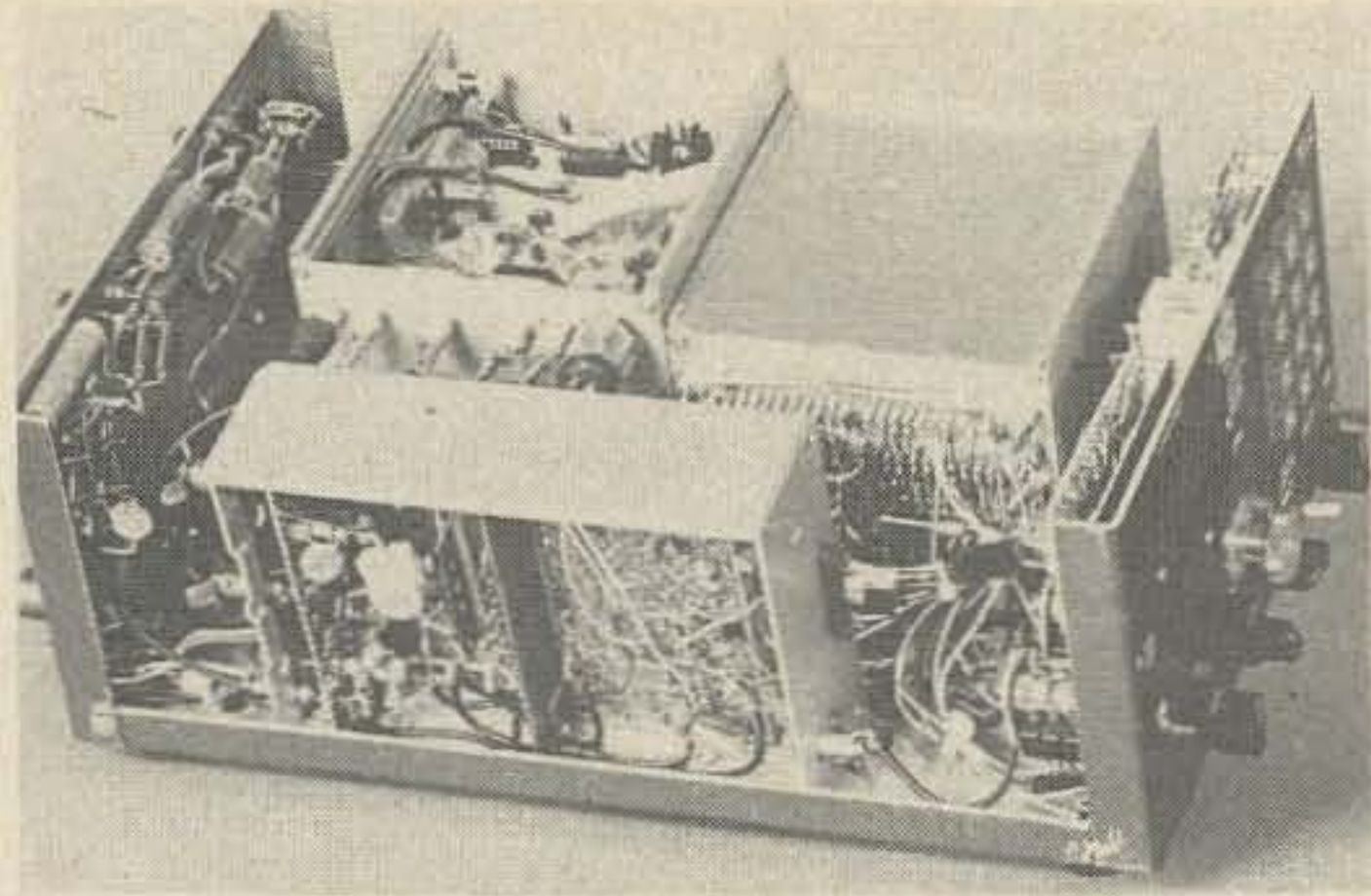
This data selector can be very handy in other applications since its switching time is limited only by the propagation delay within the ICs (in nanoseconds). The particular one used here is an 8 PDT switch. Using NAND gates to synthesize the selector was less expensive than buying a single IC data selector.

The output from the data selector goes to the quad latch, IC 50. Its clock inputs (pins 4 and 13) are normally held high and the outputs follow the inputs. The clock inputs drop low, freezing the data in the latch, whenever the squelch opens or the transceiver is in the PROGRAM mode.

Fig. 10 shows the 100 kHz latch. The data selector and latch are the same as just described. The counter in this case is a programmable up down counter, IC 51. It is wired to count up from the preset input. The setting of the SCAN switch determines where it begins to count. It is preset to 0 for an entire megahertz scan and to 5 for just the top half of a megahertz. It increases by one with every tenth count of the oscillator.

T/R Logic

The transmit receive switching is reasonably simple. The PTT line in Fig. 11, is isolated from the T/R logic by an inverter IC 30d. The inverter will cause the HT-220 relay to close on transmit through IC 31b and IC 27b if the Unlock Detector output and the Transmit Inhibit lines are both high. If PLL lock is not achieved pin 5 of IC 31 goes low, preventing transmitter keying. The same is true when the clock generator is running (pin 3 of IC 31 drops low). The "XMIT LINE" signal is inverted in IC 30a and becomes the "RCV LINE." These two lines provide logical "0" signals during transmit and receive respectively. Keying an



The HT-220 board and the buffer/multipliers are mounted in the box in the foreground. The two other boxes house all other circuit boards. The open box at the upper right holds the reference oscillator, phase detector, VCO and digital mixer.

external relay is possible using IC 30b and Q5.

Memory shifting during transmit and receive and during channel reversing is accomplished primarily with a J-K flip flop, IC 32a. IC 31c is in the line to the J-K flip flop for no other reason except to put it to use. Power requirements are reduced just a bit by connecting unused inputs to used inputs or to +5V on TTL chips. The J-K flip flop is clocked by the 1.111 kHz output of the $\div 9000$ chain. In the NORM position of the CHAN REV switch the J input is high and the K input is low. This forces the Q output high on the next clock pulse. With Q high (pin 15) the memory is set for a shift-left. When the PTT button is pushed the J input goes low and the K input goes high. On the next clock pulse this J-K data input causes the Q output to drop low and stay there regardless of the clock input. The mode control to the memory is therefore low, commanding a shift-right operation. The negative transition of the Q output is differentiated and inverted in IC 26e, IC 23a and IC 26d. The output of IC 26d is a short pulse (positive going). Since it is connected to IC 23b (Fig. 6), this pulse causes the clock generator to start feeding pulses to the memory. When the PTT button is released, J goes high (K goes low), programming a shift-left in the memory. Because of the wiring of the differentiator and inverter any change in the mode line causes the clock generator to start. Therefore, the memory

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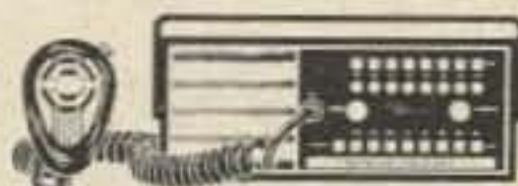
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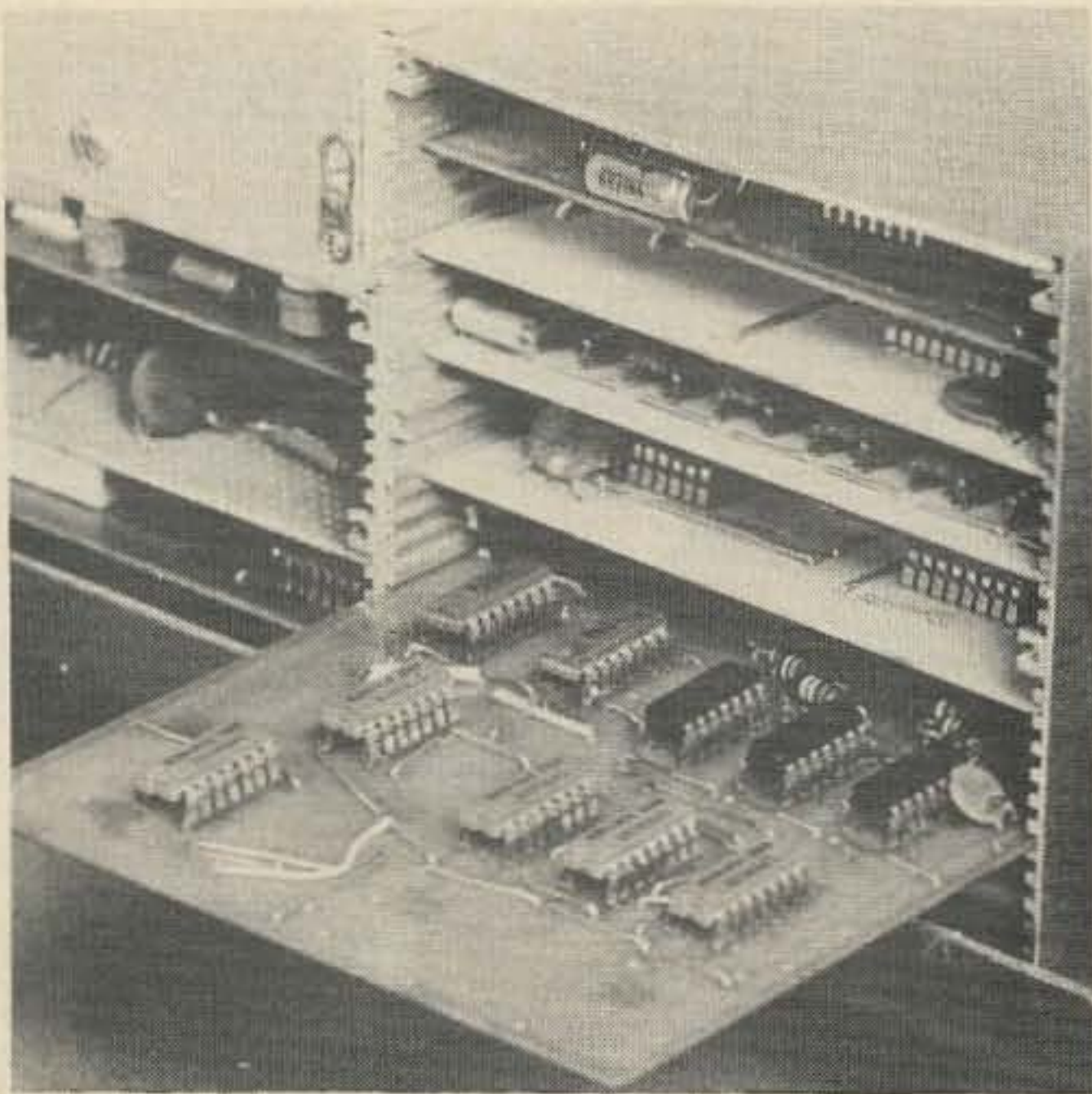
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Power Amplifier



The individual circuit boards plug into sockets in the shielded enclosures. Troubleshooting and circuit testing is simplified using a board extender. The board shown extended is the BCD Encoder board.

shifts left when the PTT switch is opened.

Channel reversing is simply a matter of convincing IC 32a that the PTT switch has been pushed when it hasn't. This is done by reversing the data into the J-K inputs. The contact bounce in the reversing switch causes many, many shifts to occur, but since each shift requires only 80 microseconds this is not noticeable. I have never observed a lost bit or incorrect shift due to this bouncing.

Simplex operation is obtained by holding

IC 32a in either the set or preset condition. If the SIMPLEX switch is moved so that the Clear input (pin 3) is grounded, the Q output drops low and remains so until the Clear input is high once again. That is, it remains low regardless of the clock and J-K inputs. The Q output is set permanently to a 1 if the Preset input is grounded. In this way, the memory cannot shift when the PTT switch is closed and opened and simplex operation is achieved.

1 MHz Switching

The 1 MHz portion of the $\div N$ programming is selected by two panel mounted switches. Although ordinary rotary switches and a diode matrix may be used for this (thumb wheel, too), I was fortunate to find in surplus some rotary switches with BCD output. Each switch had four micro-switches ganged together and operated from a camming surface to give BCD encoding of the rotary motion. These are shown in the wiring diagram in Fig. 12. The CHANNEL A MHZ switch is selected during transmit and the CHANNEL B MHZ switch is used during receiving. This circuitry also subtracts 2 from the CHANNEL B MHZ switch setting. This is necessary since an 8 must be set on the switch to receive 146 MHz signals and it is desirable to display a 6, not the 8.

A computer-type circuit could have been used to subtract 2 from the receive setting. Full adders such as the 7483 could be used and were tried. I saved some circuitry and

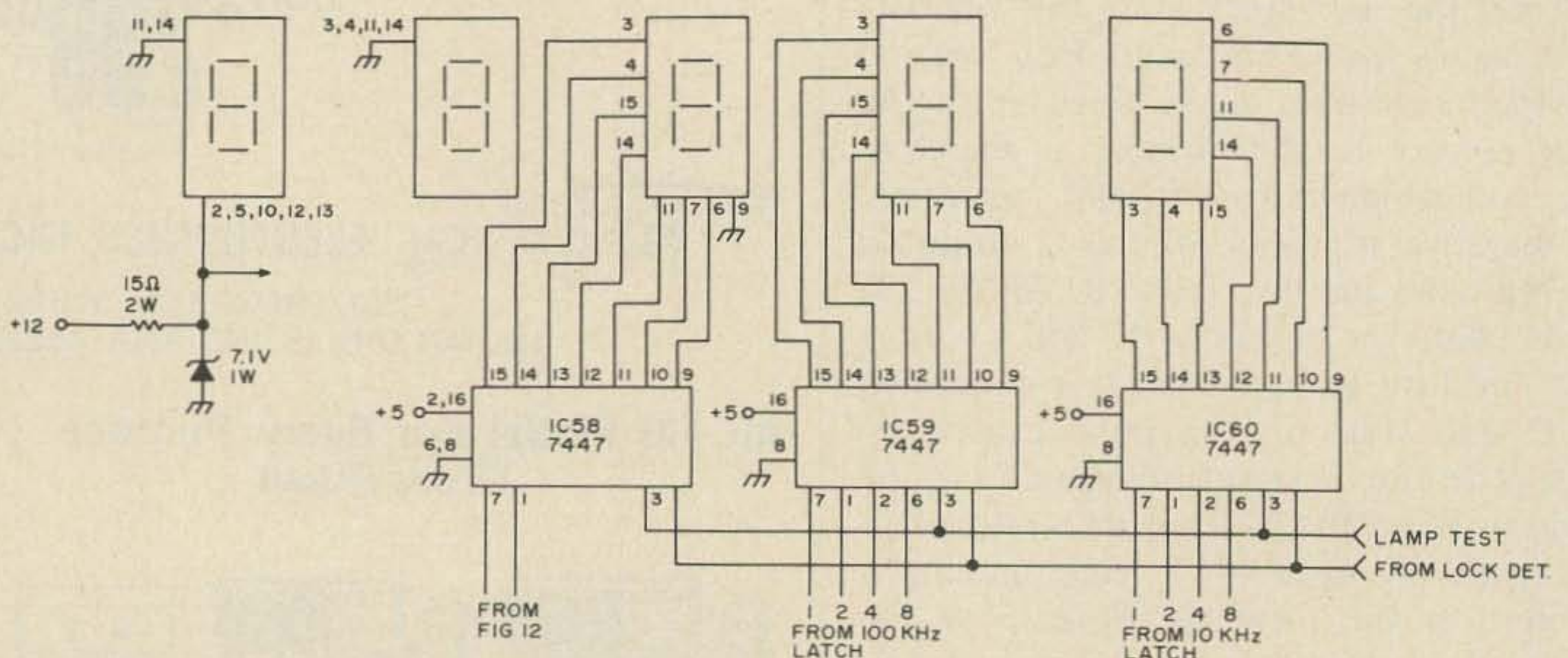


Fig. 13. Digital Display. All Minitrons have pins 2, 5, 10, 12, and 13 connected to 7 Vdc. Pin 9 is grounded on the center Minitron to provide a decimal point.

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H00	.30	S05	.50	S15	.50	32	.25	H50	.30	S65	.50	H76	.60	L93	1.25	125	.70	158	2.00	S175	3.00	L193	2.00
L00	.30	06	.40	16	.40	37	.35	51	.20	70	.30	H78	.80	94	1.00	126	.70	160	1.50	176	1.00	194	1.50
S00	.50	L06	.50	17	.40	38	.35	L51	.30	71	.35	L78	.80	95	1.00	132	3.00	161	1.50	177	1.00	195	1.00
01	.20	07	.40	20	.20	39	.50	H51	.30	H71	.50	83	1.00	L95	1.25	S140	1.50	L161	2.00	178	3.00	L195	1.50
H01	.30	08	.20	H20	.30	40	.20	H52	.40	L71	.50	85	1.50	96	1.00	141	1.50	162	1.50	179	3.00	196	2.00
02	.20	H08	.30	L20	.30	H40	.30	53	.20	72	.35	L85	2.50	L98	2.00	145	1.25	163	1.50	180	1.00	197	2.00
L02	.30	09	.20	S20	.50	S40	.50	H53	.30	H72	.50	86	.35	100	1.50	150	1.25	164	2.00	181	3.00	198	2.00
03	.20	10	.20	H21	.40	41A	1.00	54	.20	L72	.50	L86	.50	107	.40	151	1.00	L164	2.50	182	1.00	199	2.00
L03	.30	H10	.30	H22	.40	42	.90	H54	.30	73	.40	S86	.80	109	.90	152	3.00	165	2.00	184	2.00	200	7.00
S03	.50	L10	.30	S22	.50	L42	1.50	L54	.30	H73	.55	88	5.00	S112	1.50	153	1.00	L165	2.50	185	2.00	S200	9.99
04	.20	S10	.50	23	.40	43	1.50	L55	.40	L73	.55	89	3.00	S113	2.00	S153	1.50	166	1.50	189	3.00	251	1.75
H04	.30	11	.20	25	.40	44	1.50	H55	.40	74	.45	90	1.00	S114	2.75	154	1.50	170	3.00	190	2.50	284	4.25
L04	.30	H11	.30	26	.40	45	.90	60	.30	H74	.60	L90	1.25	121	.50	155	1.00	173	2.00	191	3.00	8288	2.50
S04	.50	S11	.50	27	.40	46	1.50	H60	.50	L74	.60	91	1.00	9601	.40	156	1.00	L173	2.50	192	1.50	8880	1.50
05	.20	12	.50	30	.20	47	1.50	H61	.50	S74	.80	L91	1.25	122	.75	157	1.00	174	2.00				
Brand New CMOS		74C42	2.75	74C89	12.75	74C162	3.00	74C195	3.00	Cd4002	.50	CD4013	1.10	CD4021	3.75	CD4035	2.75						
74C00	.50	74C73	1.50	74C95	3.50	74C163	3.00	74C901	1.25	Cd4006	3.75	CD4014	3.75	CD4022	4.00	CD4037	2.75						
74C02	.50	74C74	1.10	74C107	1.60	74C164	4.00	74C902	1.25	CD4007	.75	CD4015	3.75	CD4023	.50	CD4040	4.75						
74C04	.75	74C76	1.60	74C151	3.00	74C165	4.00	74C903	1.25	CD4008	3.75	CD4016	1.10	CD4024	2.75	CD4042	2.75						
74C10	.50	74C83A	3.25	74C154	5.00	74C173	3.75	74C904	1.25	CD4009	.80	CD4017	3.00	CD4025	.50	CD4044	2.75						
74C20	.50	74C85	3.25	74C157	2.50	74C174	3.75	80C95	1.50	Cd4010	.80	CD4018	4.75	CD4027	1.60	CD4049	1.10						
74C30	.50	74C86	1.25	74C160	3.00	74C192	5.00	80C97	1.50	CD4011	.50	CD4019	1.20	CD4029	5.75	CD4050	1.10						
				74C161	3.00	74C193	5.00	CD4001	.50	CD4012	.50	CD4020	5.25	CD4030	1.10	CD4116	1.30						

DTL SPECIALS

930	Dual 4 Gate/Exp	.18
932	Dual 4 Buffer	.18
933	Dual 4 Extender	.18
935	Hex Inverter/Exp	.18
936	Hex Inverter	.18
937	Hex Inverter Gate	.18
944	Dual Buffer	.18
945	RS Clocked FF	.25
946	Quad 2 Gate	.18
948	RS Clocked FF	.25
949	Quad 2 Gate	.18
957	Quad Buffer	.20
958	Quad Power Gate	.20
961	Dual 4 Gate/Exp	.18
962	Triple 3 Gate	.18
963	Triple 3 Gate	.18
9093	Dual JK FF	.34
9094	Dual JK FF	.34
9097	Dual JK FF	.34
9099	Dual JK FF	.34

Memories

MM 5260	1024 bit RAM (2nd generation 1103)	5.00
p1101	256 bit RAM	2.00
p1103a	1024 bit RAM	7.00
7489	64 bit RAM	2.75
8223	256 bit bipolar Field PROM	6.00
8225	64 bit RAM	3.75
74200	Tri-State 256 bit RAM	9.25
DM8599	Tri-State 64 bit RAM	3.75
p2102	1024 bit static RAM	15.00
2602	1024 bit Static RAM	16.00

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expense, however, by noting that this is a very special case. I had to subtract 2 only from the numbers 6, 7, 8 and 9. Table II lists the settings of the CHANNEL B switch for each step in the 2m band. Also listed are the BCD numbers that I wanted to display. Note that in the 1-columns of both numbers each bit is the same. I made no changes to the 1000-1 line (1000 kHz 1 line). Note also that the 2-columns are just the inverse of each other. For this line I simply inverted the output from the CHANNEL B switch during receive. The 4-column of the desired display is always a "1" and the 8-column is always a "0." This was easy to implement by permanently wiring the display input for a "1" on the 1000-4 line and a "0" on the 1000-8 line. IC 56 and IC 57, both 7400 NAND gates, create this very special "subtract 2" circuit. This one will not work for numbers other than 6, 7, 8 and 9.

Digital Display

The five digit display uses five Minitron seven-segment read-outs with three 7447 seven-segment decoder-drivers. Fig. 13 is the schematic of the display. The power for the Minitrons was taken from the 12-15 VDC source through a zener regulator circuit. With only 5V on the Minitrons, the display could not be read in sunlight. 7V makes the display easily readable and does not exceed the maximum of 9V. The lifetime of the filaments must be derated but I have no information regarding this. The 14 of 14X.XX is permanently wired into the display, reducing the number of 7447's required. The three 7447 ICs that are used are blanked when an out-of-lock condition occurs.

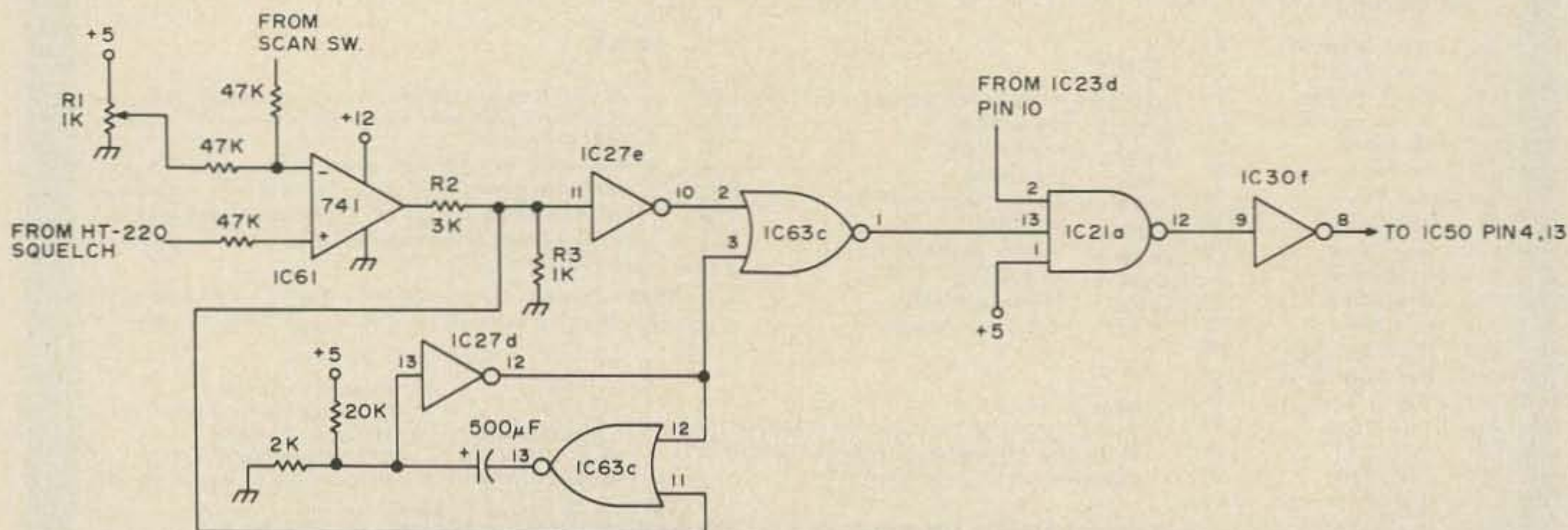
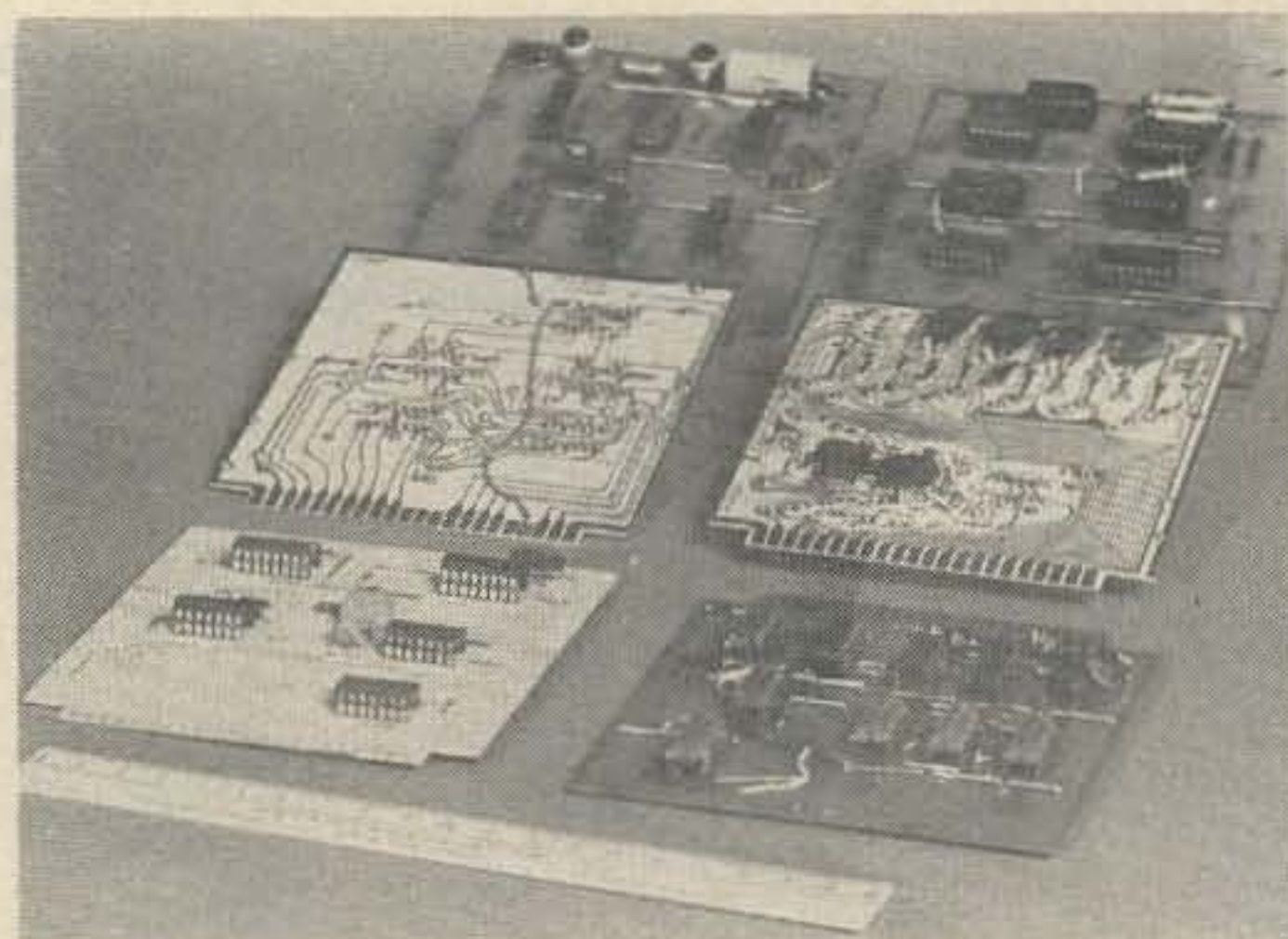


Fig. 14. Squelch Hold. R1 sets the threshold sensitivity.



Most of the circuitry was done on printed circuit boards. Six of the boards are shown here. Starting at the top, left to right, the boards are the T/R board, 10 kHz latch, 100 kHz latch, Memory, Clock Generator and BCD Encoder.

Frequency	CHANNEL B MHZ				Displayed BCD Number			
	8	4	2	1	8	4	2	1
144.00	0	1	1	0	0	1	0	0
145.00	0	1	1	1	0	1	0	1
146.00	1	0	0	0	0	1	1	0
147.00	1	0	0	1	0	1	1	1

Table II

Squelch Circuitry

The squelch hold circuitry is very simple. A 741 op amp is used as a voltage comparator. Its output swings rapidly between 0 and +12V as the squelch voltage from the 220 crosses a preset threshold. This point is adjusted by the setting of the 1K pot, R1. Normally, the signal from the 220 is near 0V. Under that condition, the output of IC 61 will be high (+12) because the inverting input is greater than the non-inverting input. R2 and R3 form a voltage divider to keep

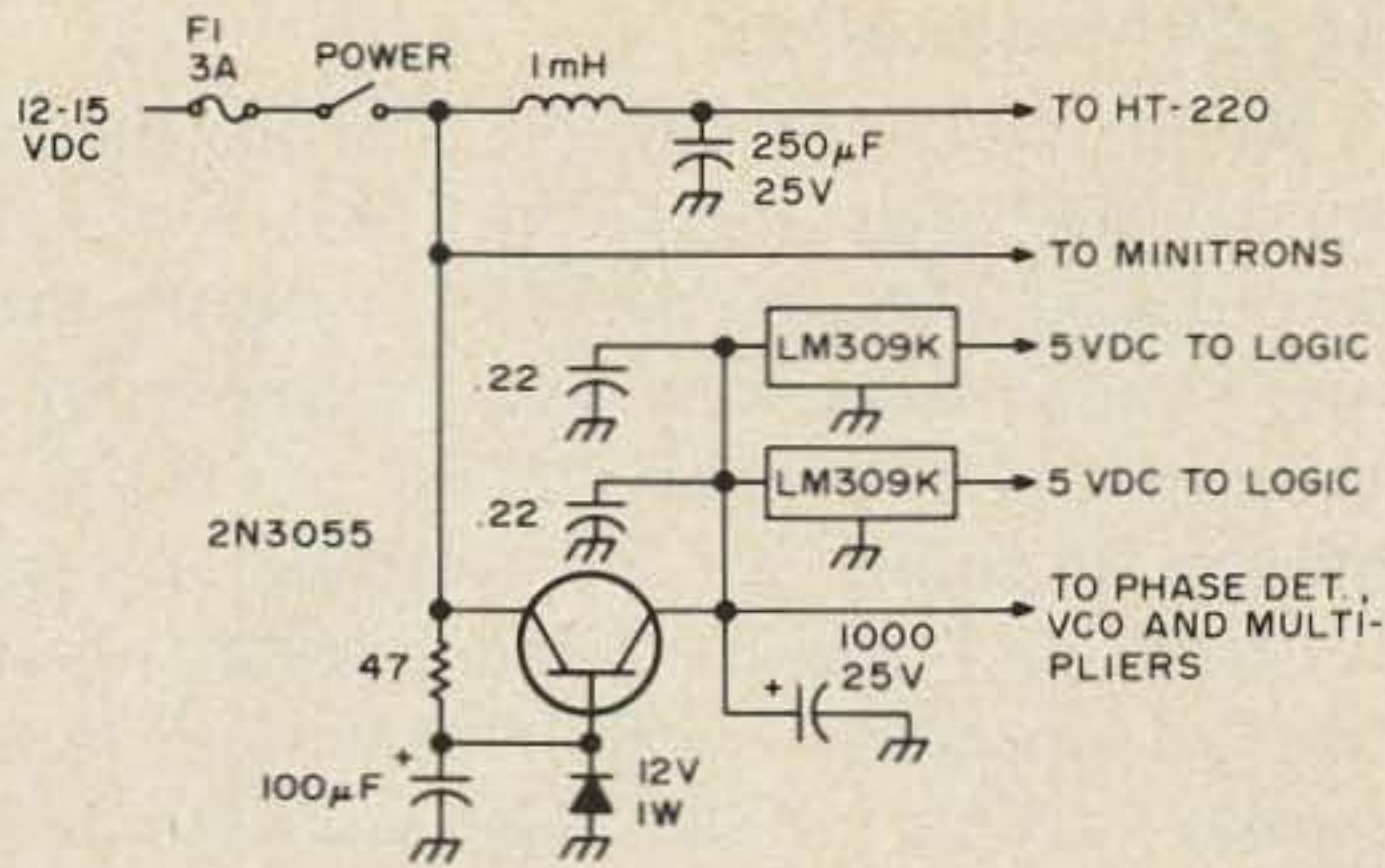


Fig 15. Power Supply.

the input to the TTL chips less than 7V. With the multiple inversions in IC 27e – IC 30f, the output of this squelch hold circuit is high (+3) when the HT-220 receiver is squelched. Since this output is the clock for IC 50 and IC 55, the latches do not hold the frequency. When a carrier is encountered the latches freeze the data. IC 27d, IC 63c and IC 63a form a one-shot multivibrator which is triggered by the disappearance of the carrier. It holds the latches in the "frozen" state for about three seconds after a carrier drops out. This allows you to listen to both sides of a conversation even though one side may be slow picking up the mike. This 3 second delay must be eliminated when not scanning, otherwise the time required to go from receive to transmit would be 3 seconds. This inhibiting mode is accomplished by setting the threshold in the 741 op amp much higher when not scanning. The squelch signal from the 220 can never reach it. A second input to the inverting input is activated when not scanning (raised to +5V).

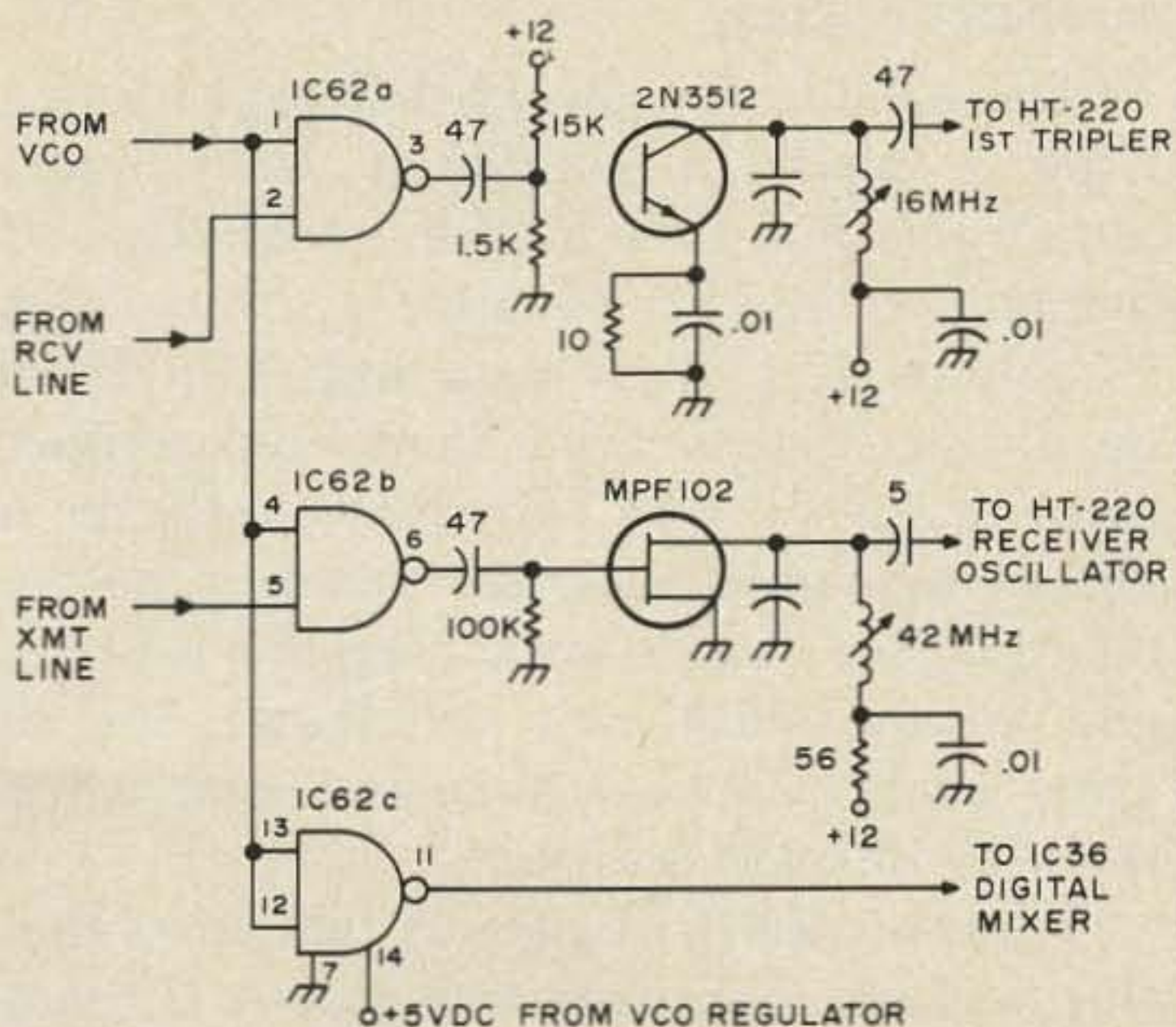


Fig 16. Buffer/Multiplier.

Power Supply

The transceiver was designed to operate from 12-15 VDC. The HT-220 board works better near the high end of this range, although I have experimented with it and can go as low as 11V with mine. The +5V for the IC packages is supplied by two LM-309K regulators mounted on the rear of the cabinet. The TTL load is evenly split between the two. A separate LM309H was used for the VCO and was mounted on the board with the oscillator. To keep ignition noise out of the rig and to provide more stable operation, the +12 regulator from K2OAW's article was also used. Fig. 15 shows the power system.

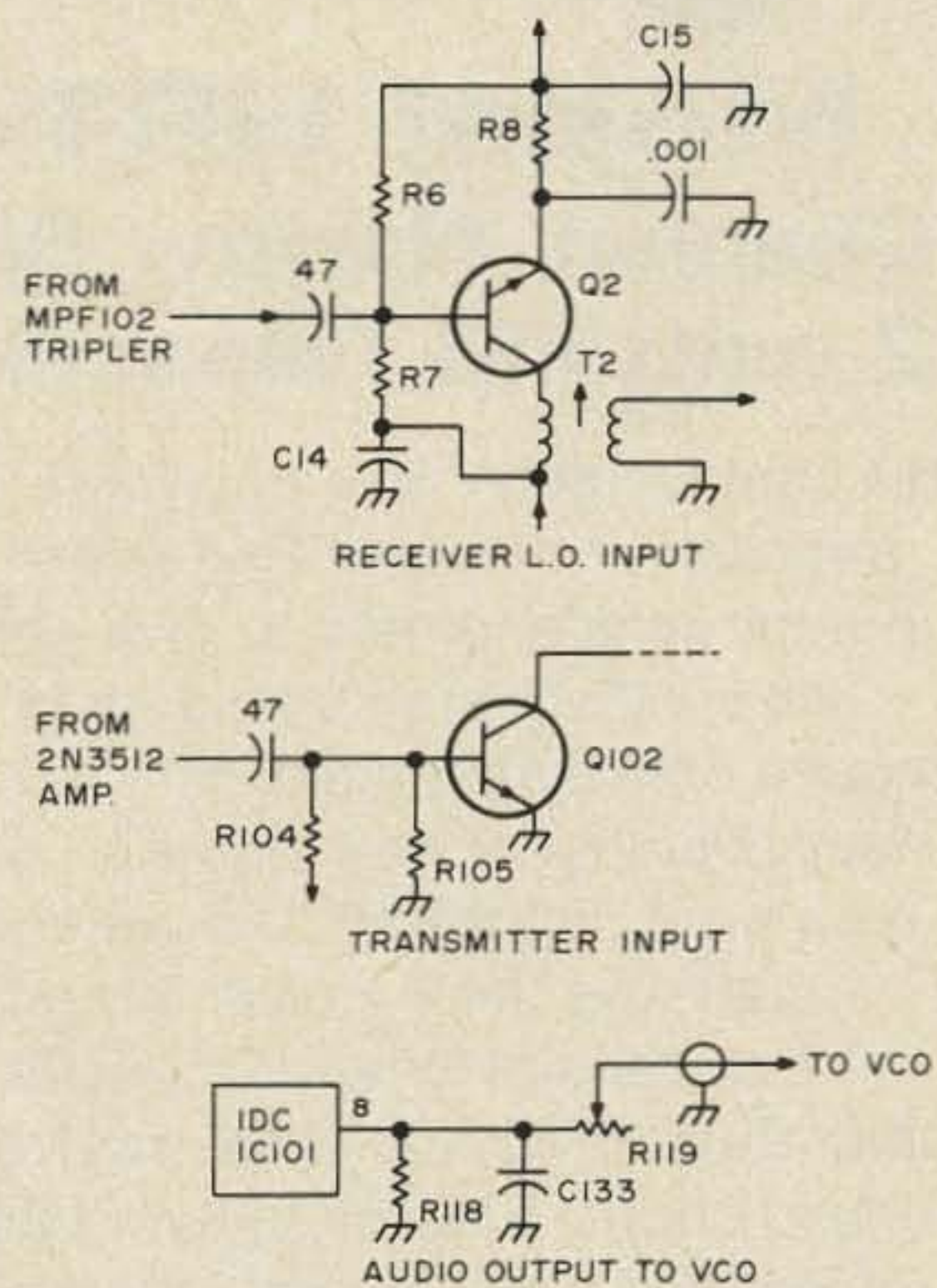


Fig. 17. HT-220 Connections. These connections are just one method for mating the synthesizer to the HT-220.

Buffer/Multiplier

The output of the VCO is buffered first by IC 62, a quad-NAND gate. One section is used to drive the digital mixer. Two more sections are used as switched amplifiers to drive the transmit buffer and the receive tripler. A 2N3512 was used as a buffer to drive the first tripler stage of the HT-220 transmitter. The 14 MHz output is tripled in an MPF102 stage before going into the receiver oscillator stage of the 220. These stages are right out of the Handbook and are shown in Fig. 16.

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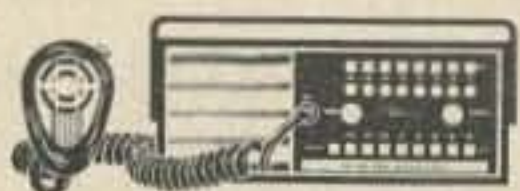
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AR-2
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Power Amplifier

HT-220 Modifications

My method of feeding the 220 board may not be the best or only way but it works well. If you are contemplating a rig like this one, I recommend that you acquire both a transmit and receive crystal for the HT-220 and get it tuned up and working to your satisfaction. I modified the original board for 2m operation with information from another article ("The 220 Amateur FM Rig," rpt. . . ,September, 1971). In addition to the padding and audio modifications, I made some of my own changes. The transmit oscillator circuit was removed entirely and the input was connected directly to the base of the first tripler. The receiver oscillator was changed by disconnecting the "rubbering" circuit and bypassing the emitter of the transistor with a .001 μ f disc capacitor. The 42 MHz input was connected to the base of the original oscillator. The coupling capacitor from the audio IC was connected to a shielded line and run to the VCO board. The squelch signal was taken from the base of Q12, the first audio amplifier. I was optimistic and mounted an S-meter on the FS-220, but up to this time I have not succeeded in coming up with a suitable means of driving it from the 220. A discriminator meter was easily wired in, however. Fig. 17, shows the connections made to the HT-220. A schematic is not given since so many different versions of this little rig exist.

Mechanical Work

The cabinet for the FS-220 was formed from a piece of aluminum 3mm thick. Starting with a piece 59.2cm by 24.3cm and bending as in Fig. 18, gave a cabinet size 21.6cm wide, 12.7cm high, and about 33cm deep. The top cover was bent from another piece of 1.6cm stock. The holes in the main chassis were punched before bending. Before painting, the chassis was etched in a lye bath and coated with zinc chromate. Several spray coats of blue enamel and some white lettering finished the job.

I said in the first part of this series that this was not a construction article. I meant that I did not think anyone would copy it

bolt for bolt. With all parts purchased new, rather than relying on surplus and several years worth of junkbox material, the cost of this transceiver would be high. It is certainly not necessary to have all plug-in boards enclosed in Vector EFP modules as I have done. Furthermore, my method of construction makes for much wasted space, but that is the way I wanted it on a prototype such as this.

Results

This rig has been operational for several months. It is a real joy to have around. I have discovered repeaters in the south-west Ohio area that I never knew existed. On trips the FS-220 has provided many hours of enjoyment without worry about being "crystalled up" as I have so often heard mentioned. I don't carry my repeater direc-

IC #	Type	IC #	Type
1	7400	34	7475
2	7400	35	74121
3	7400	36	7486
4	7402	37	7400
5	7402	38	7495
6	7402	39	7495
7	7402	40	7495
8	7402	41	7495
9	7404	42	7495
10	7404	43	7495
11	7404	44	7495
12	7490	45	7404
13	7490	46	7476
14	7490	47	7400
15	7490	48	7400
16	74192	49	7400
17	74192	50	7475
18	74192	51	74192
19	74192	52	7400
20	7420	53	7400
21	7410	54	7400
22	7474	55	7475
23	7402	56	7400
24	7476	57	7400
25	7410	58	7447
26	7404	59	7447
27	7404	60	7447
28	74192	61	741
			op amp
29	7400	62	7400
30	7404	63	7402
31	7400	64	LM309K
32	7476	65	LM309K
33	74121		

Table III
Integrated Circuit Types

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HR-2MS 8 Channel Transcan 2 Meter FM Transceiver

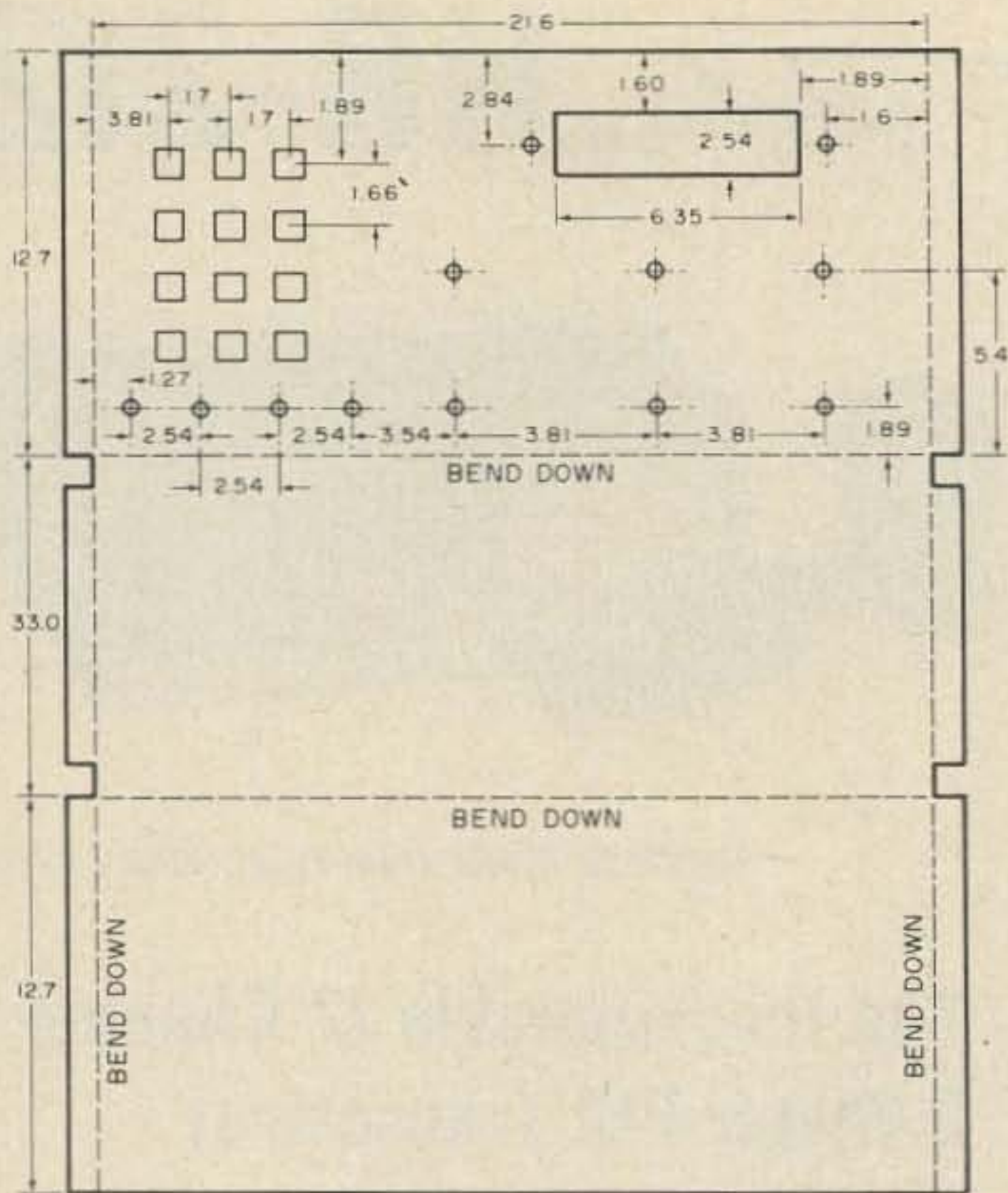


Fig. 18. The more important mechanical features are shown here to illustrate the technique used to construct the chassis (not to scale).

tory with me anymore. The scanner quickly tells me where the activity is.

All is not rosey, however. There are some draw backs to this rig (and similar synthesizers). If a repeater is encountered that is off frequency, you may be the only one who can't use it. So often the users "rubber" their crystals to match the repeater and then it doesn't matter what the frequency is, right? Good grief!

I have already considered modifications to this ultimate rig to improve it or make it more versatile. The VCO has some residual noise on it. The 1.111 kHz reference is still in there, but from reports it is apparently below the level of the alternator whine on many mobiles. I don't have my reference crystal in an oven and the warm-up time is too long on cold winter mornings (10 minutes). The next step is a read-only-memory (ROM), possibly reprogrammable, for all the standard FM frequencies. Scanning would then be faster and more efficient.

My thanks to the Dayton area FMers for tolerating the testing phase on this rig. Thanks also to WA8LSR for the photographic work on this article. Then there are

the wife and kids, who put up with yet another construction project and occasionally left bits of food and drink at the top of the cellar stairs.

... W8KBC

RF HOT DOG

Using a neon to indicate the presence of rf is well known, and some amateurs are known to keep a neon near a tank, tuner, or end-fed antenna, watching it glow as they tune up. Unfortunately, a neon bulb by itself does not work well with weak rf.

The glowing nose of the "Hot Dog" is enormously sensitised by applying enough ac to get it started. In Fig. 1, each resistor is 3.3 MΩ. Electrically, both could be in one lead, or they could be at the neon end of the flexible cord. Having them at the plug end and taping them up inside gives a neater and safer piece of equipment for obvious reasons.

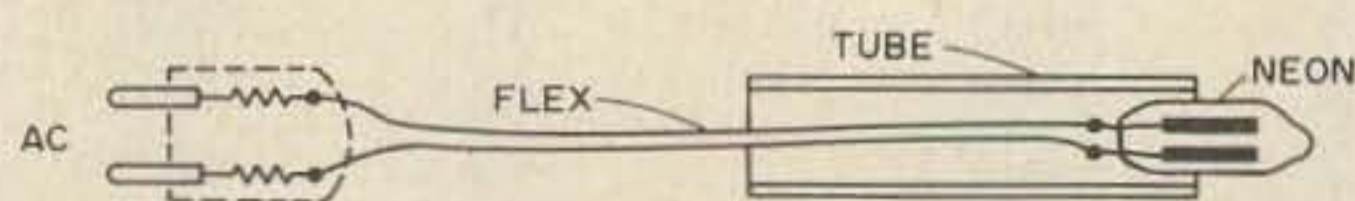


Fig. 1. This is all you need for a sensitive rf indicator.

The neon was a small one from a worn out soldering iron. Any neon will work, though the type with two small, nearly parallel inside electrodes (NE-2) seems best. The piece of insulated tube is only to cover joints and form a handle. Operation ought to be tried before finally sealing up the resistors. The idea is to use very high values, so that the neon barely glows with no rf nearby. The resistors need not be of the same value, and would be expected to be from 2 to 5 MΩ each.

The Hot Dog sniffs out rf like an ordinary neon, but responds to weak rf, either by a change in glow, or movement of the glow. It allows tuneup of weak or low-impedance rf circuits as well as showing rf hot spots and rf leaks in shielding.

...G3OGR

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"BK TNX VERN UR 599 DALLAS DALLAS - BILL IS 579 - NAME HR TOM TOM. UR OK VERN... THIS SEGMENT WS CHANGED BK TO GENERAL LAST THURSDAY BK"

"BK - WELL TOM, LAST HRD HR WAS THIS WAS NOVICE BAND - OVER TO VT, W1IK DE WA9VLK K"

"WA9VLK DE W1IK - U OMS SHOULD READ MORE - ADVANCED AND UP GOT THIS SEGMENT YESTERDAY - GENERALS ARE 150 KC DOWN. ADVANCED AND EXTRA GOT UPPER 200..."

"BK DE W3BYK"

"W3BYK DE W1IK HW?"

"W1IK DE W3BYK - LISTENING ES HRD U ALL DISCUSSING BAND CHANGES - NEW RULES THIS MORNING GAVE TECHS THIS SEGMENT - EXTRAS ARE UP 150, NOVICES GO 200 DOWN AND GENERALS ARE 250 DOWN HW? - W1IK DE W3BYK K"

"W3BYK DE W1IK - SRI OM FONE QRM - PSE TRY AGN BK"

"Break from WA2EWF"

"WA2EWF DE W3BYK - BETTER QSY OFF TECH CW SEGMENT BK"

"O.K.... (slurp, cough, hack) W3BYK from WA2EWF... helllllllllooooooooooooo, o.k.... there we go... name here's baker ocean baker runnin' kay-dubya in Brooklyn. Just ah - heard you guys down on see-dubya, man, this segment is now extra phone since yesterday so you boys better get off the "For Extras Only" net frequency and get a current copy of QSD magazine. So back to Kankakee and Stern... WA9VLK down on cw from WA2EWF."

"WA2EWF DE WA9VLK - SURE DO WISH I KNEW WHO HAS THE SEGMENT NOW - WL 73 ES TNX - WA9VLK SK"

"WA9VLK DE W1IK 73 ALL CU AGN - W1IK SK"

"BK 73 OMS W3BYK CL"

"Well... good luck all the way around, 73 - QR-Zed the FEO net from WA2EWF."

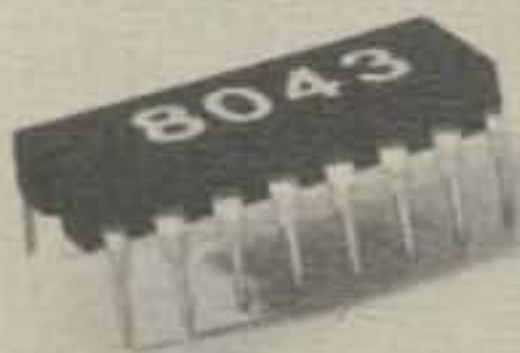
"WA2EWF DE WA6ZDO 73 ES HPE TO GET IT STRAIGHT GE DE WA6ZDO SK"

"KGX 2237 mobile to base..."

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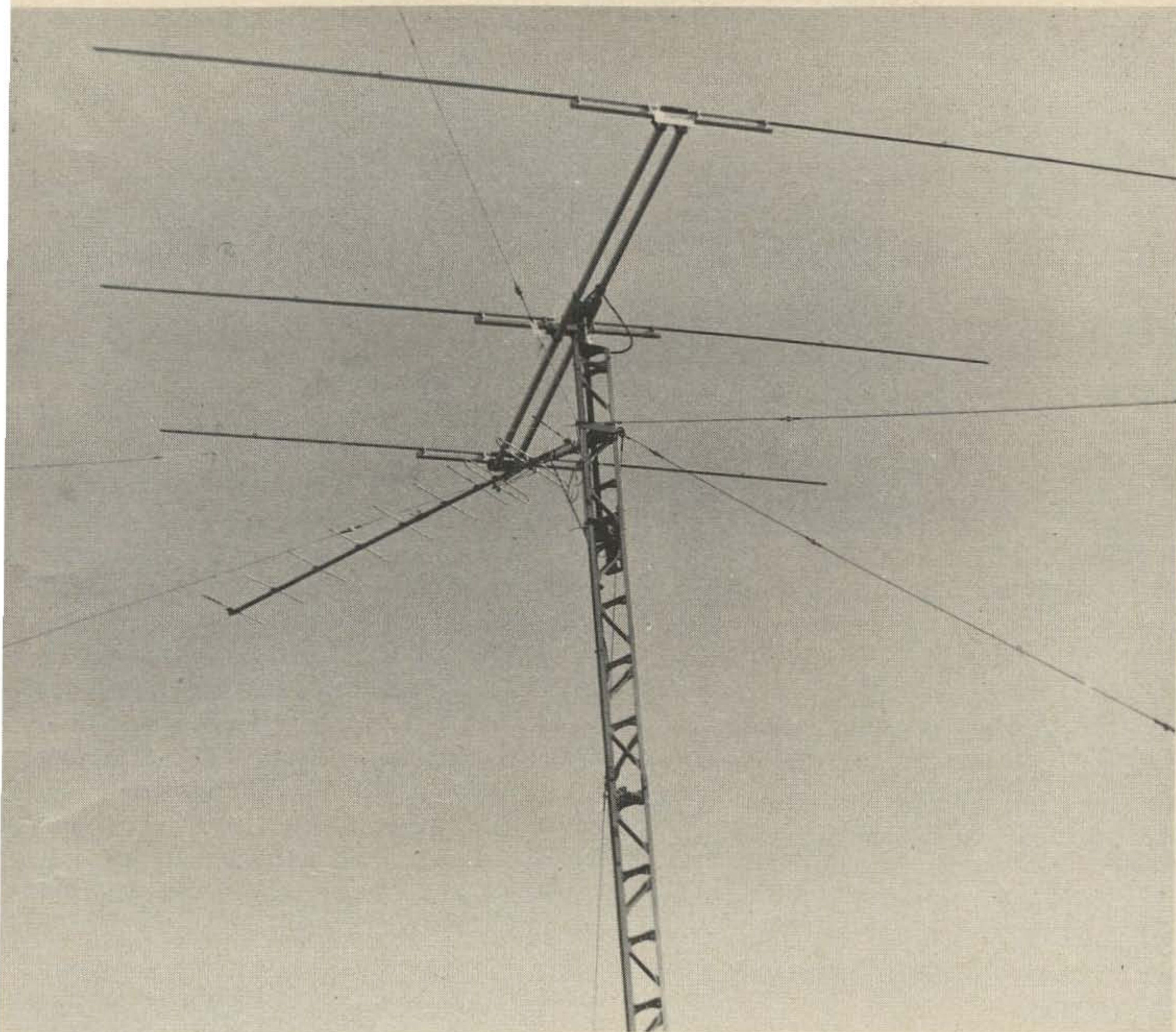
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A Wind-Proof 20m Beam

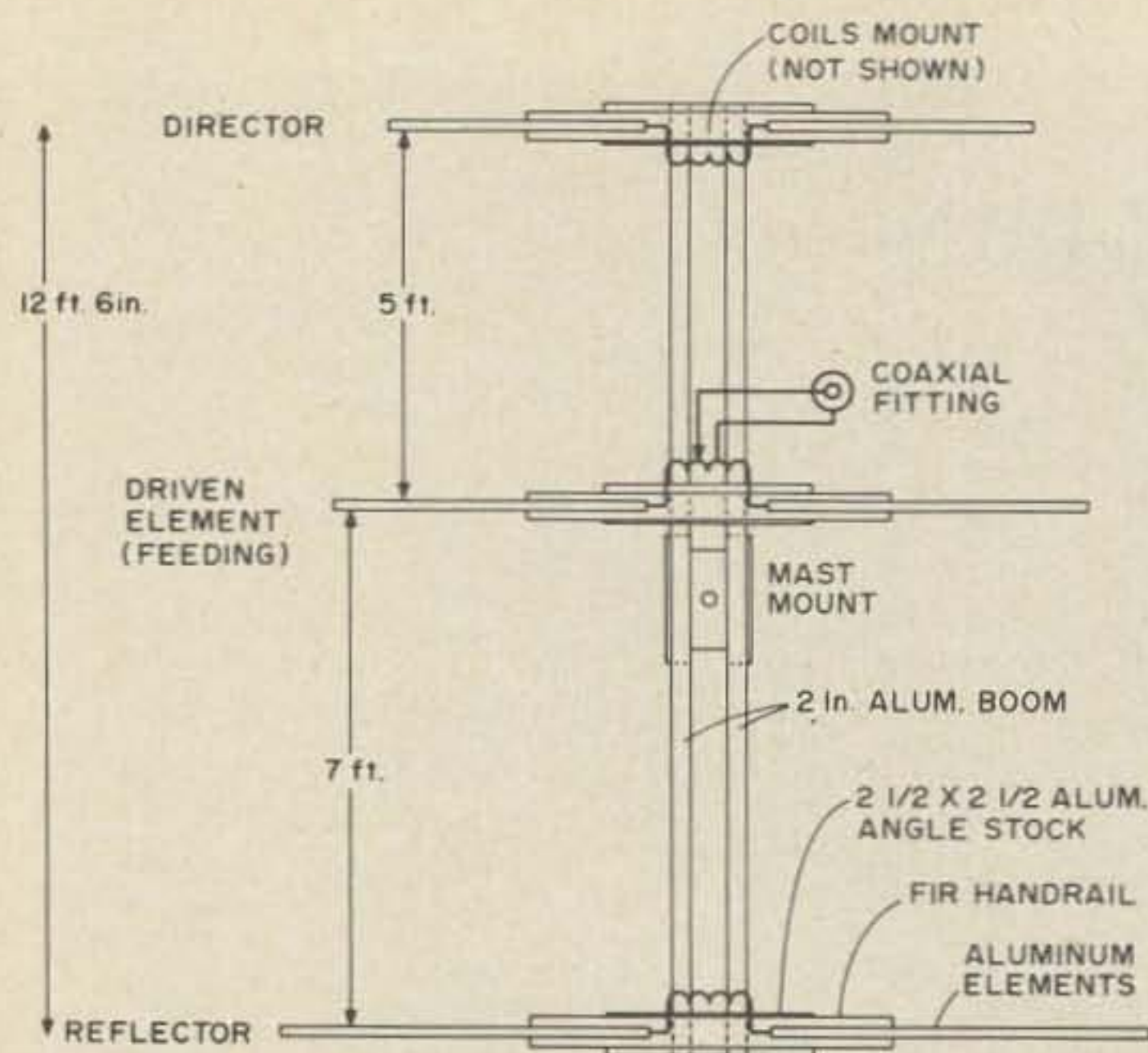


Fig. 1. Beam construction.

At my QTH due to regular windspeeds in excess of 110 mph, it was impossible to maintain a regular size 20m beam on the tower without it becoming damaged or broken.

So, if I wanted to operate on 20m with a rotating beam, I had to design a "wind-proof" version capable of withstanding such high windspeeds.

The local weather office windspeed gauges only read to a maximum of 110 mph and according to weather station records over the past dozen years or so, the maximum of 110 mph has been regularly recorded at least 3 or 4 times each year. Based on discussions I have had regarding wind problems experienced in other areas of the world (such as Hawaii), I am not the first ham to face severe wind problems in relation to the erection of a beam for 20m.

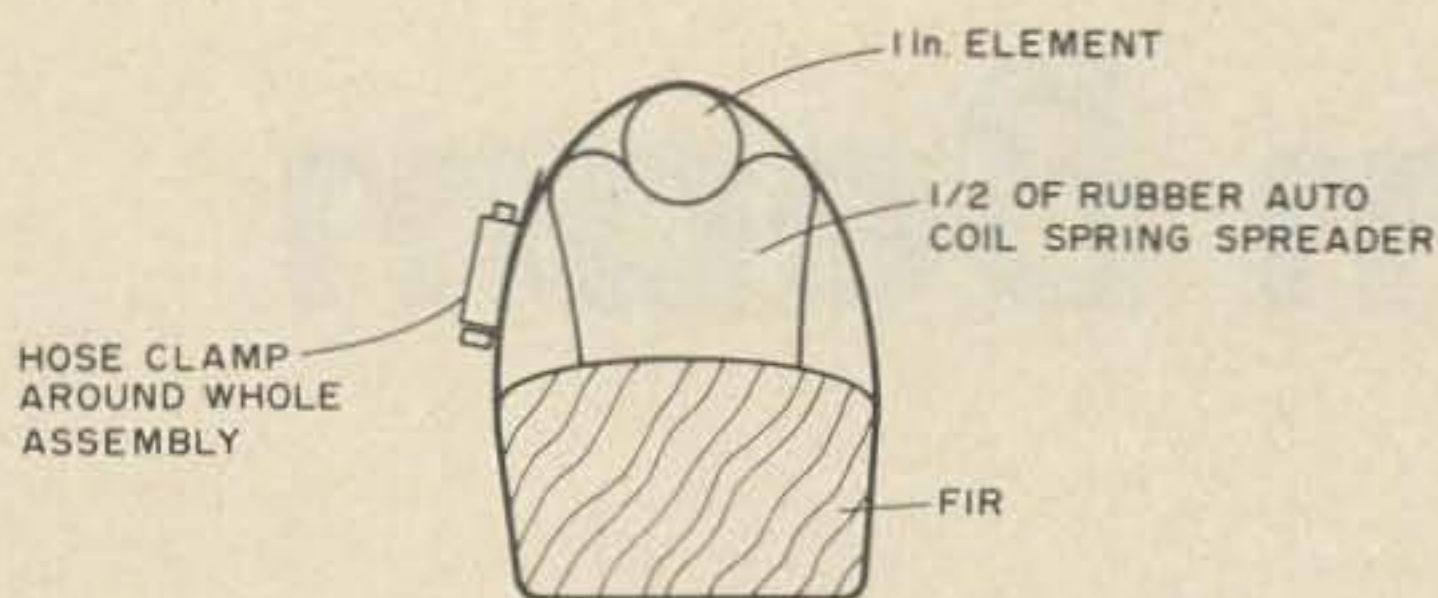
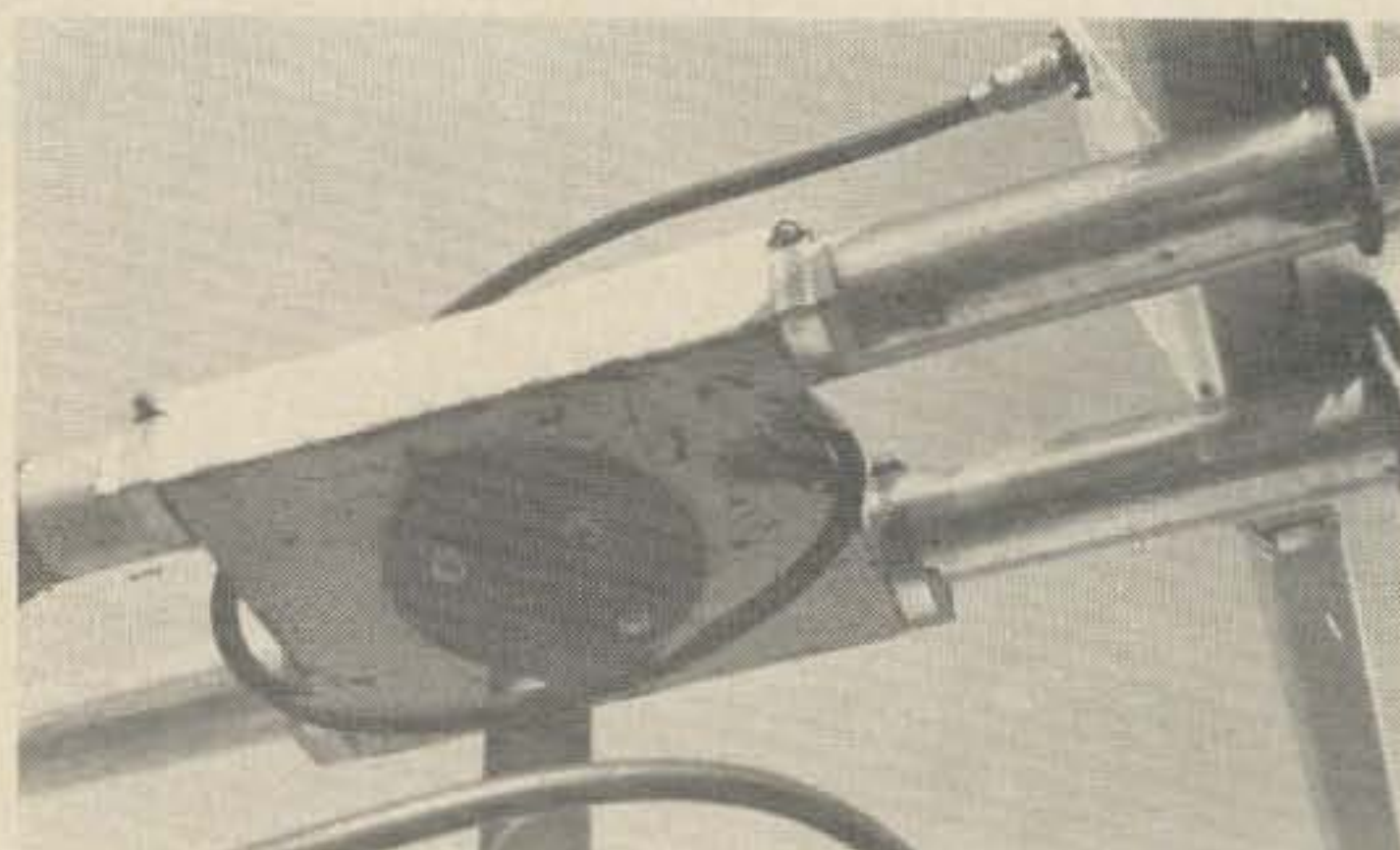


Fig. 2. End view of element mounting to 4' fir pieces.

After numerous disasters with quads and full size beams I developed a windproof minibeam which has been unharmed now for a year and a half. Based somewhat on an ARRL minibeam (*The ARRL Antenna Book*, ARRL, Newington CT, 1964, pp. 275-276), the present windproof version takes advantage of several additional features not utilized in the model which inspired it.

Physical Construction

A "double barrel shotgun" style boom was made from two 45.72m (12½ foot) lengths of 5.08cm (2") aluminum irrigation tubing, see Fig. 1. Three pieces of 5.24cm (2½") x 5.24cm (2½") aluminum right angle stock, 30.48cm (12" long), were attached to the two booms with U-bolts, with the outside of the booms spaced 17.78cm (7") apart. Each of the three elements, which has a coil in the centre, is mounted on 5.08cm (2") fir stairway hand rail measuring 10.16cm (4') in length. The aluminum elements are made from 2.54cm (1") and 2.22cm (7/8") O.D. aluminum tubing, left over after my Gotham beam fell down from the tower one windy night.



Special mounting channel fastened to the double boom with hose clamps.

The elements, although of different lengths when tuned, are each made exactly the same initially, except for the coils. Two 1.83m (6') lengths of 2.54cm (1") O.D. tubing are mounted on the fir hand rail with a 12.7cm (5") space between their inner ends. The outer ends of the 2.54cm (1") tubing are split about 3.18cm (1¼") and the 2.22cm (7/8") O.D. tubing can later be inserted and held at the desired length with hose clamps.

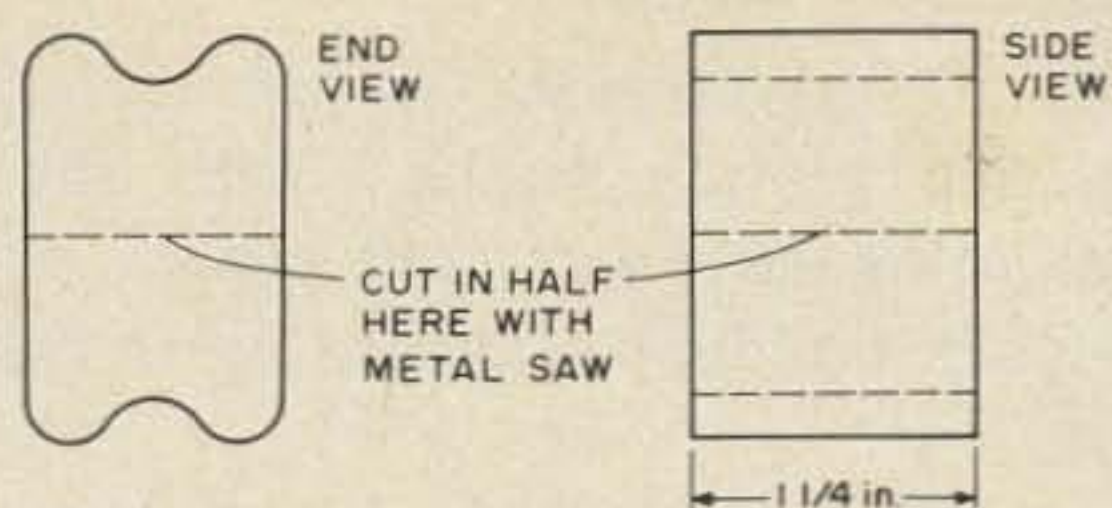
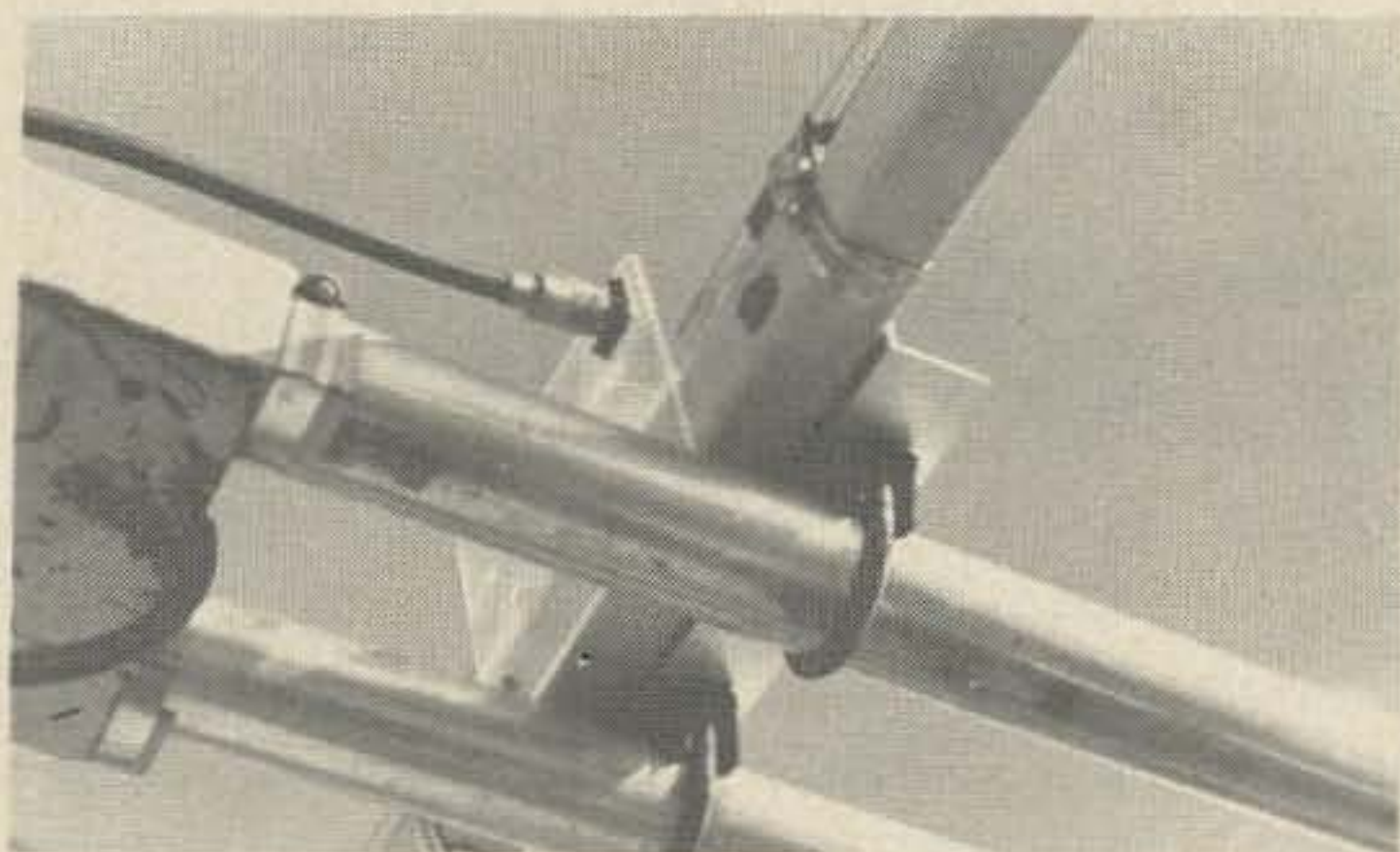


Fig. 3. Hard rubber coil spring spreaders.

The two 2.54cm (1") tubing lengths, 1.83m (6') each, are mounted to the fir with rubber stand-offs, made from hard black rubber auto coil spring spreaders cut in half so as to leave one side flat and the other with a round groove into which the elements fit, see Fig. 2. The original rubber spreaders cost 40¢ each at the local hardware store, and 6 are needed, see Fig. 3. The fir sections are mounted to the right-angle aluminum pieces in two ways. The driven element section is mounted differently than the other two elements. The right-angle piece is bolted to the two booms with 5.08cm x .95cm (2" x 3/8") U-bolts; then the fir section is bolted to the opposite surface of the angle with two chromed .95cm (3/8") bolts.



Driven element as viewed from below.

The aluminum angle stock is U-bolted to the ends of the two booms so that the opposite angle surface forms covers over the ends of the boom tubings. The fir sections are bolted onto the same surfaces as the U-bolts (for the two end elements only).

The mast used was a 5.08cm (2") diameter 1.83m (6') length of water pipe threaded and screwed into a flange plate. The threaded joint was then welded. Then the round flange plate was bolted to a piece of (homebrew) channel made by welding

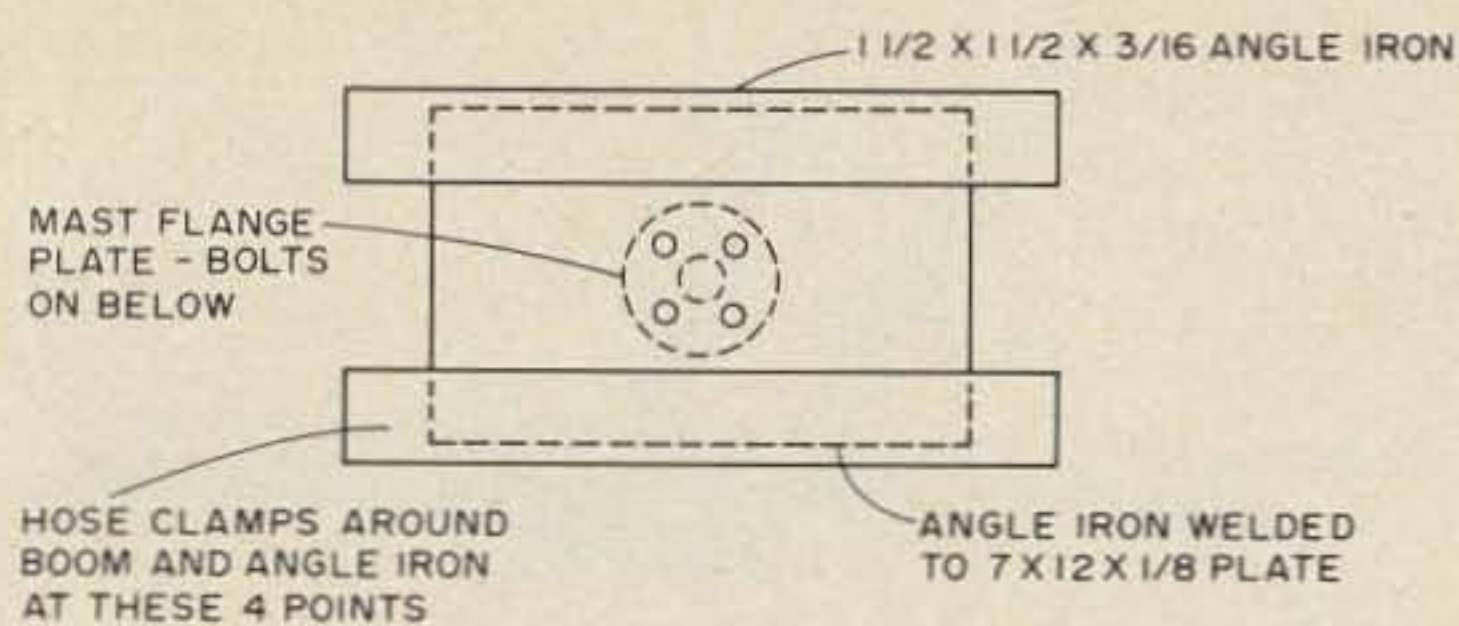


Fig. 4. Mast to boom mount. Beam is removed from the mast by removing the four 1-1/2 x 5/16 bolts used to secure flange plate to home-brewed fixture illustrated here.

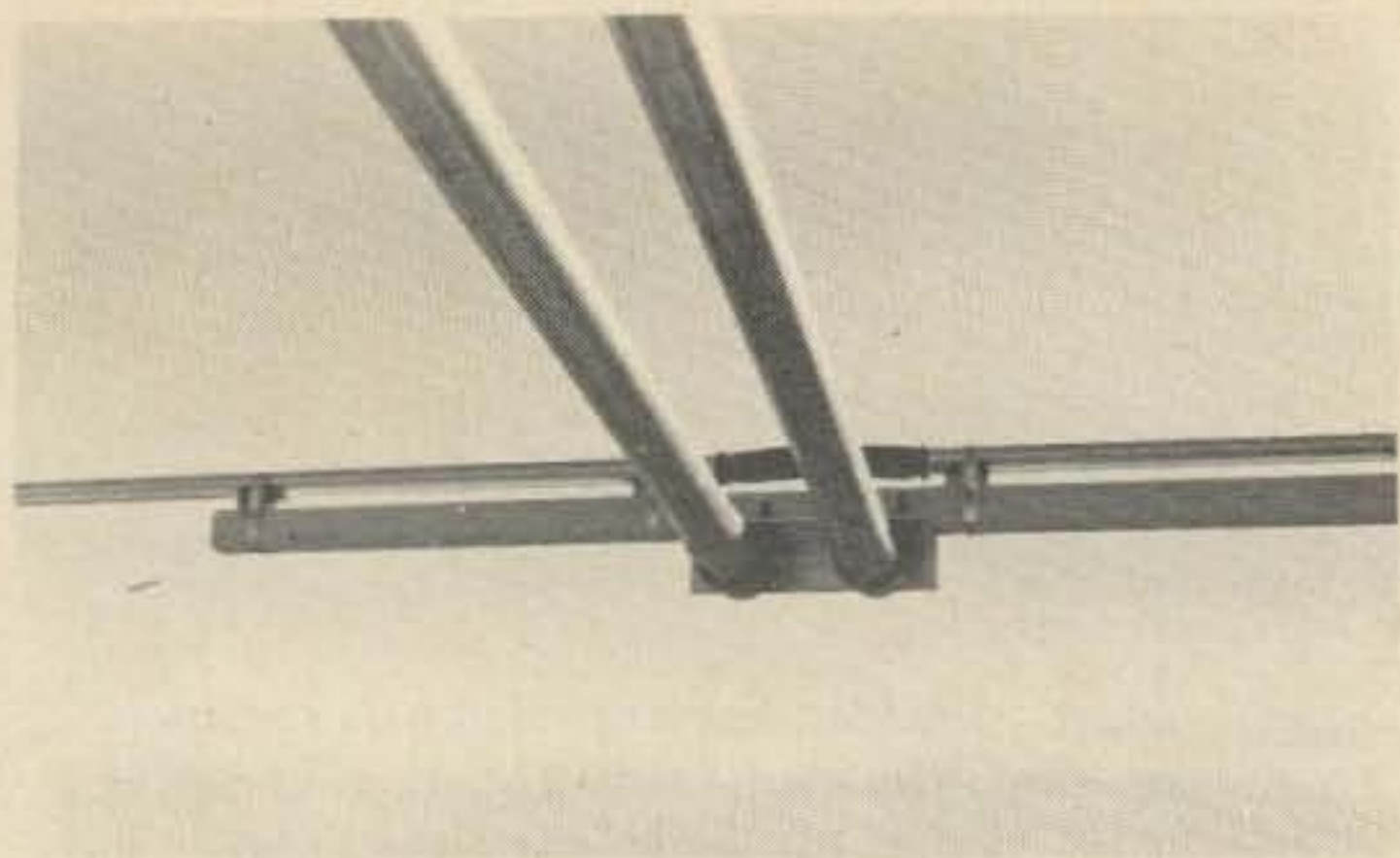
two 35.56cm (14") lengths of 3.81cm x 3.81cm x .48cm (1 1/2" x 1 1/2" x 3/16") angle iron to a 17.78cm x 30.48cm (7" x 12") piece of .32cm (1/8") sheet iron.

The angle iron protrudes 2.54cm (1") beyond the ends of the sheet iron and can be hose-clamped to the double boom with four large hose clamps, see Fig. 4.

The beam is easily removed from mast and tower by removing the four 3.81cm x .79cm (1 1/2" x 5/16") bolts on the flange plate. The complete beam is easily raised and lowered from the 12.19m (40') tower by means of a rope, with one man at the top of the tower and one below. The beam weighs only about 20 pounds complete, less mast and flange plate. It is rotated with a husky homebrew 1/4 RPM homebrew rotor, enabling utilization in high winds. Probably the HAM-M or ROTO BRAKE models would be ideal for use in high winds also. In low wind areas a heavy TV type rotor would be adequate.

Electronics

Loading coils are used at the mid-points in each of the three sets of elements. The idea in this beam is to use an inductance to effectively "shorten" the total element lengths. Although each element could be extended out and clamped with only 15.24cm or 20.32cm (6 or 8 inches) of overlap to give element lengths of 7m (23 feet) or so, only the reflector comes near that length. Element lengths used on my version are given below. Actually, the element lengths utilized are not critical, so long as the appropriate element length/coil resonance combination is utilized. Ordinary 2.54cm (1") diameter B&W coil stock was



Director element, showing rubber mounting of each half element, with clamps and bicycle inner tube over the loading coil.

used with a 30.48cm (12") length of bicycle inner tube later cut and placed over the coils (on Director and Reflector only) and tied tightly around 2.54cm (1") aluminum ends, for weather protection of the coils. The D.E. coil is made of much larger and heavier 5.08cm (2") B&W coil stock, which when soldered is self supporting and left open to weather.

The Reflector and Director loading coils were both made from 2.54cm (1") B&W coil stock, close spaced #20 wire, so as to resonate the Reflector 500 kHz below center frequency desired and the Director 500 kHz above center frequency desired.

The reflector coil consists of 13 turns of 2.54cm (1") diameter B&W coil stock 2.22cm (7/8" long) with each half of the element 3.25m (10'8"). A space of 12.7cm (5") is left between the two halves of the element, for a total reflector element plus coil "wingspread" of 6.63m (21'9").

The director coil consists of 16 turns of 2.54cm (1") diameter B&W coil stock 2.54cm (1" long), with each half of the element measuring 2.27m (7'5 1/2"). A space of 12.7cm (5") is left between the two halves of the element, for a total director element plus coil "wingspread" of 4.67m (15'4").

The driven-element coil consists of 8 1/2 turns #14 on 5.08cm (2") diameter 1.9cm (3/4" long) of B&W stock with each half of the element measuring 2.86m (112 1/2"). A space of 12.7cm (5") is left between the two halves of the element, for a total driven-element plus coil "wingspread" of 5.84m (19'2").

Feeding and Tuning:

The driven element is fed through an "inductive gamma match" with the coax shield going to exact coil centre and the inner coax conductor tapped 1 1/2 turns from center.

The RG 8/U feedline to the transceiver should be a multiple of a 1/2 wavelength of coax. For example, at 14.1 MHz it would be 14.02m (46'), one wavelength, 21.03m (69'), 1 1/2 wavelengths, or 28.04m (92'), 2 wavelengths, long. The coax is experimentally connected to various tap configurations, once the basic D.E. coil is installed, to obtain best SWR.

Each of the elements is again grid dipped by loosely coupling the dipper to each center coil, once the beam is assembled. The beam should be as high above ground for this adjustment as possible. I did these adjustments on my house rooftop, with the beam sitting on top of the 91.44cm (3') chimney (on a rare windless day).

Basic Materials Needed:

- 2 lengths of 5.08cm (2") O.D. aluminum irrigation tubing 3.81m (12'6") long
- 6 lengths 2.54cm (1") O.D. aluminum tubing 1.83m (6') long
- 6 lengths 2.22cm (7/8") O.D. aluminum tubing 1.83m (6') long
- 6 hose clamps for 2.54cm (1") diameter (element adjusting)
- 4 hose clamps for 6.35cm (2 1/2") diameter (mast to beam holding)
- 12 hose clamps for .762cm (3") diameter 2.54cm (1") element pieces to fir hand rail
- 6 corks suitable to plug ends of 2.22cm (7/8") aluminum tubing (apply varnish afterward to seal)
- Flange plate plus pipe for insertion onto rotor
- 3 pieces 6.35cm x 6.35cm x .48cm (2 1/2" x 2 1/2" x 3/16") aluminum right-angle stock, each 30.48cm (12") long
- 2 lengths of 3.81cm x 3.81cm x .48cm (1 1/2" x 1 1/2" x 3/16") angle iron 35.56cm (14" long each)
- 1 piece 17.78cm x 30.48cm x .32cm (7" x 12" x 1/8") iron plate
- coil stock as described in text.

... VE7DKR

TONES and How To Touch Them

As repeaters become more and more sophisticated, the main method of control seems to have standardized around the Touchtone pad. These devices are available from commercial outlets and the friendly 'Phone man. Cost varies and depends upon the source: they can be free or up to \$25 for the sixteen button computer console model.

Following are several circuits for using the pads:

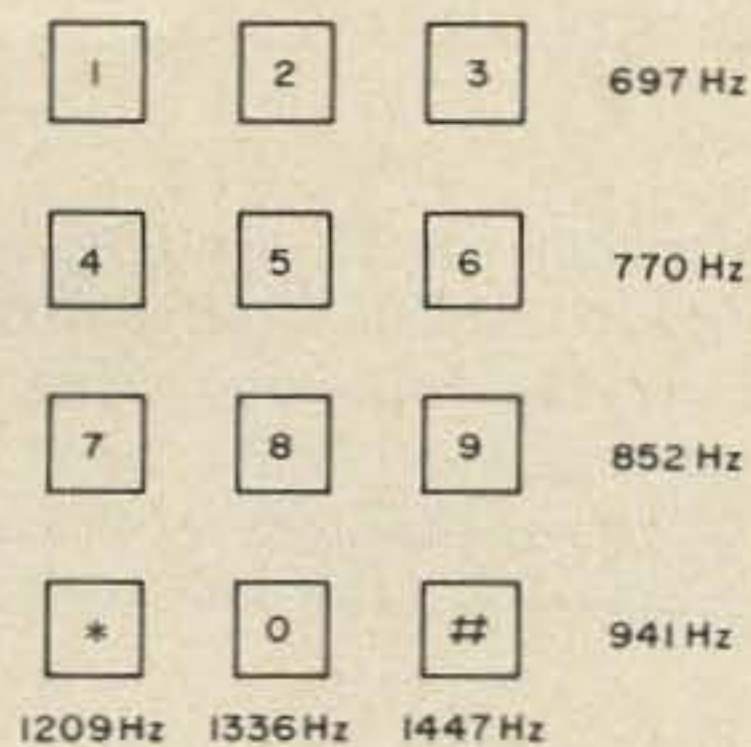


Fig. 1. Button locations and the corresponding audio frequencies produced.

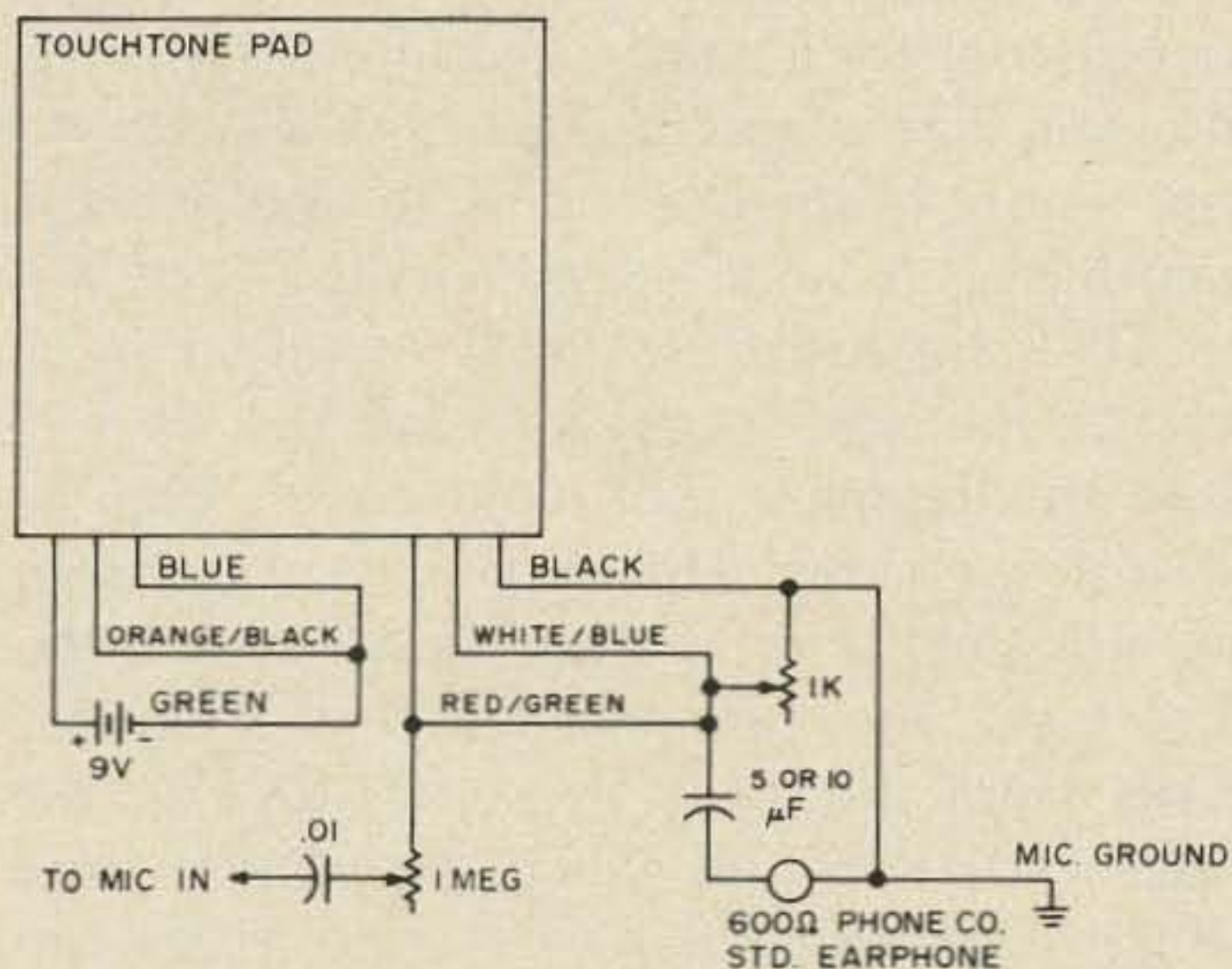


Fig. 2. Mike's WA4HQW circuit. Adjust 1k pot for clean non-distorted tones. Then adjust 1 meg pot for correct amount of audio to transceiver. HINT: Mike's pad worked with a 330 ohm fixed resistor for the 1k pot.

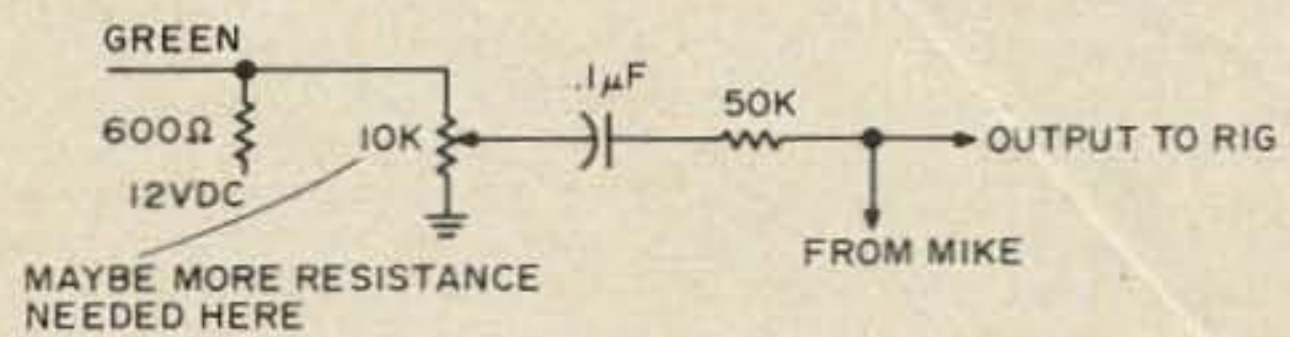


Fig. 3. Blue and orange-black = ground; black and red-green = together; green = output.

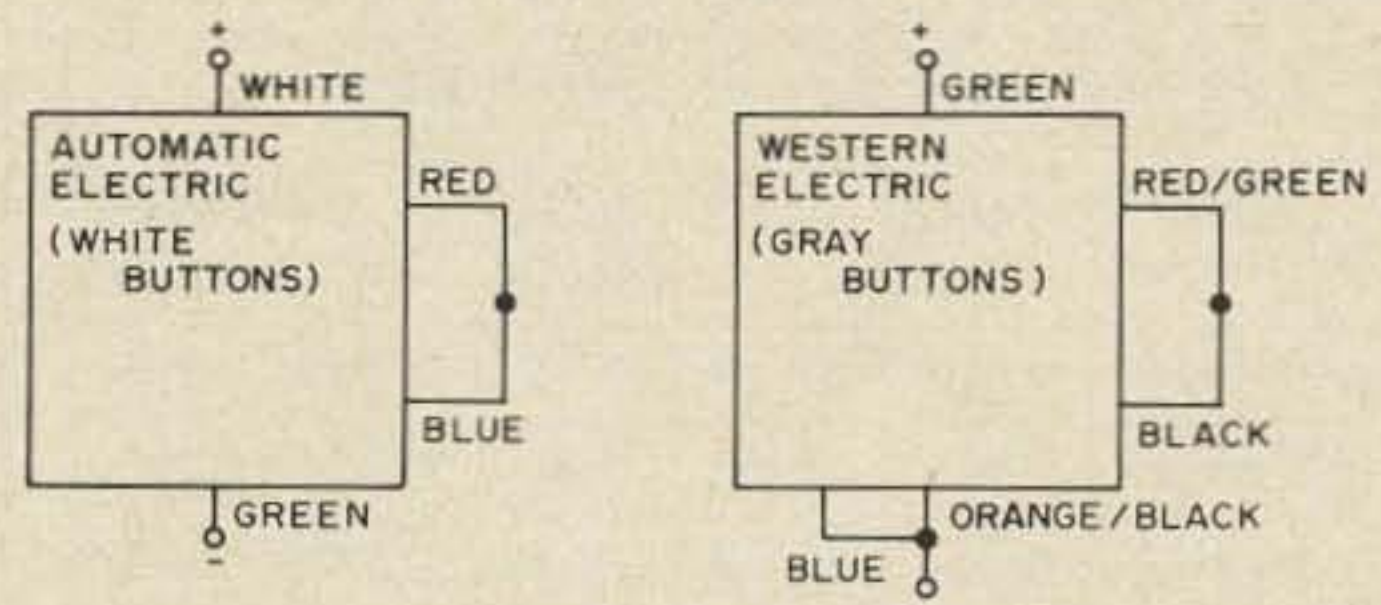


Fig. 4. There are two different wiring configurations for the pads. Pads made by Automatic Electric have one color code and pads by Western Electric, ITT, Northern Electric and Stromberg Carlson have a second code. (The Repeater Journal, Using the TouchTone Pad by WA4WTX.)

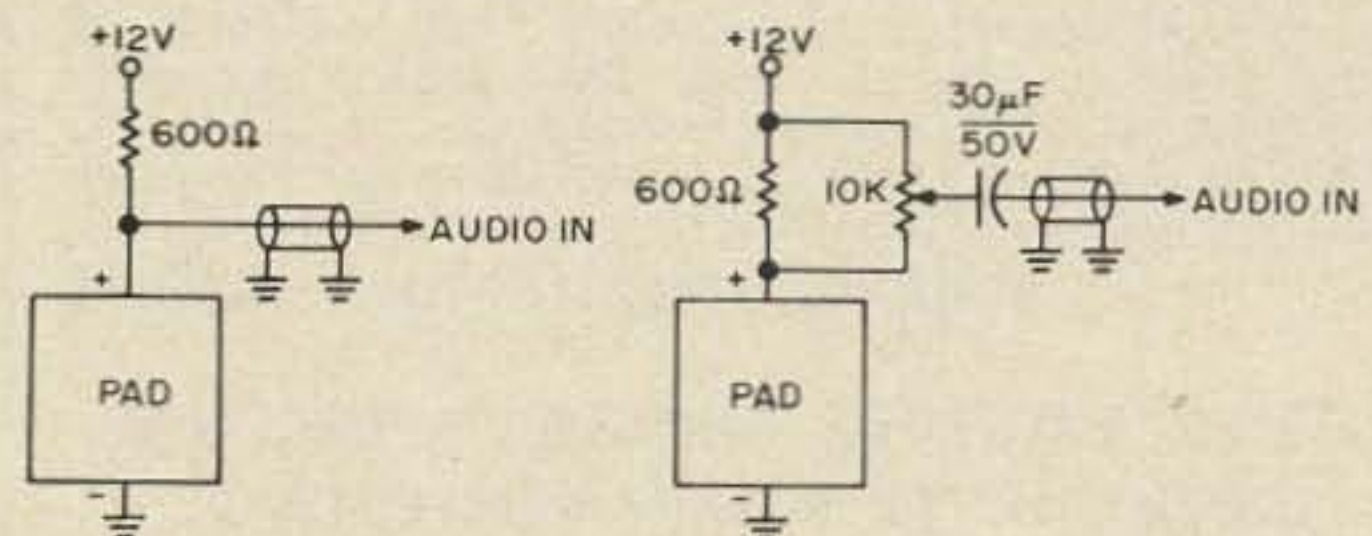


Fig. 5. There are two ways to connect the pads to the transmitter audio input.

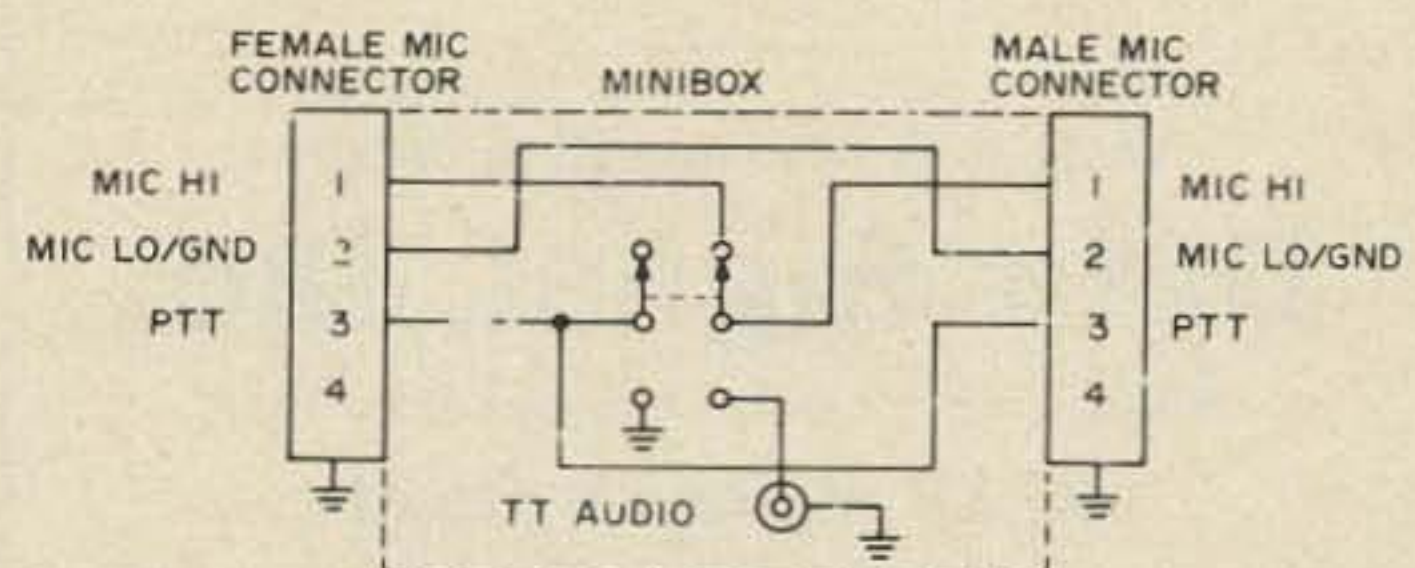


Fig. 6. In most cases the pad introduces noise into the transmitter if left connected. This noise is usually in the form of vibrator hash or transistor.

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2 meter	Double	40 dB	2.5 dB	\$30.50	\$36.50
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whine. A DPDT switch can be used to switch the pad into the audio circuit and key the transmitter. With the appropriate connectors and a minibox, the pad connects into the mike circuit with no modifications to the radio.

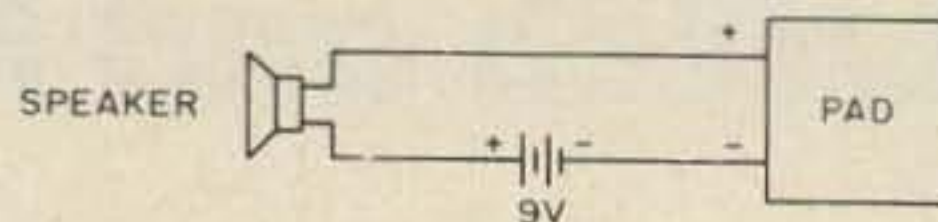


Fig. 7. For use with a walkie talkie, a small speaker can be used for the load resistor and a 9V battery can be used. Since no current is drawn until a button is pressed, a switch is not needed. Battery life is good as the pad draws less than 15mA. Voltages from 4 to 48 can be used on the pad and the frequency will not change. However, 12V is recommended.

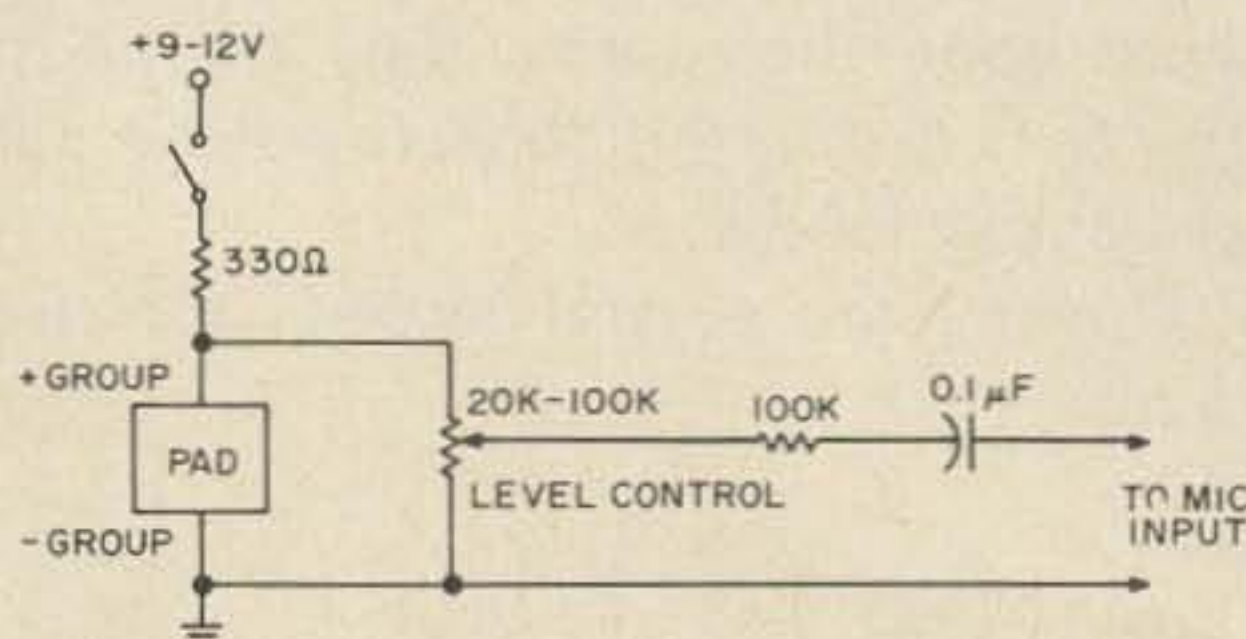


Fig. 8. Information on phone pad hookup for cabon mike input rigs has been published in the April issue of 73. The following circuit works very nicely for high impedance mike input rigs such as most of the all transistorized Japanese ones. (By Alan Tasker WA1NYZ from the WAIKHB Newsletter.

... K1NUN

TOOL AND TIME SAVER

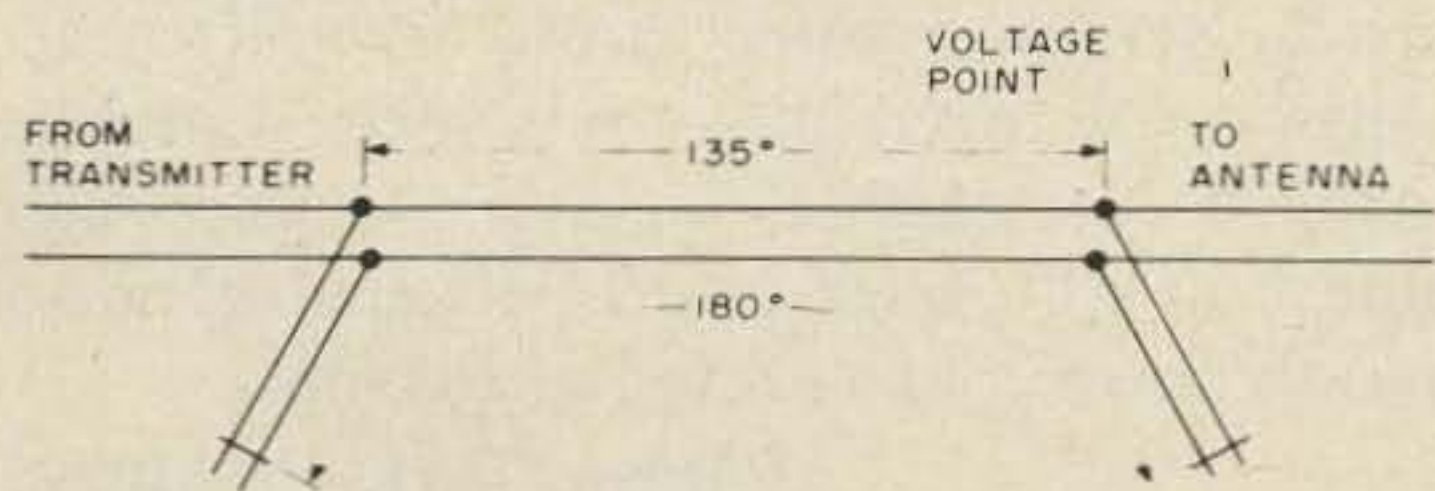
How many times have you needed a special tool for a piece of equipment only to discover that it had long since vanished into the limbo normally found in the average hamshack? A small magnet with a fuse clip or TO-5 heatsink attached, mounted in as out of the way location inside the rig will hold an alignment tool plus several Allen or Bristol wrenches. The magnet may be from an old speaker or if you really want to go first class you can buy one for 10 or 20 cents from the local 5 and 10 store, or the local outlet of an electronic chain store which will remain nameless. Epoxy the clip in place, install the tools the next time you run across them and never again spend half a day looking for the @+!\$%&! things.

... Bill Turner WA0ABI

The Double-Stub Matching System

Looking through the standard reference materials on antennas, the amateur notices a number of interesting antenna configurations that would be fun to try, assuming enough space is available. Commercially built beams and homebrew dipoles are fairly easy antennas to use since the impedance match presents no problem. Most of these can be directly connected to the transmitter output (using coax, of course, unless you can get the rig up there), and you're on the air. The more complex arrays, giving considerable gain and directivity, often do not have a direct 50Ω match, requiring some sort of impedance matching device to make everything perk along at peak efficiency.

There is considerable literature on common matching devices. The coax balun, for instance, gives a 4:1 step up. Toroids can be wired for all sorts of combinations using the transformer-turn-ratio theory. $\frac{1}{4}\lambda$ transmission line segments act like impedance transformers. Pi, L and T networks can be constructed from coils and capacitors. These projects can be done easily.



The transmission line stub method is also used with great success for matching impedances. Great quantities of information are available on how and where the stub method works. There is another method, the double-stub method, that isn't used too often but is surprisingly efficient and simple. At lower frequencies the single matching stub gets quite long; it isn't such a good idea to have these drag on the ground, especially if you're using open-wire line. The double-stub method reduces the length required. These are actually more convenient to adjust once the initial setup is made. A single stub has to be slid back and forth on the transmission line while the shorting bar has to be slid up and down until the proper match is found. The double stub sets by formula and measurement, and then the final adjustments are fairly easy.

In effect, the double-stub system is a transformer, a $\frac{1}{2}\lambda$ long, extending from closed stub to closed stub. One line begins at one stub, the other ends at the other, with the line in between a "common" winding. The "match" picks the proper impedance off the line at the appropriate point. Obviously, since there is a $\frac{1}{2}\lambda$ between the stubs, they cannot be adjusted independently — the adjustment of one affects the other and both have to be moved simultaneously the same distance and direction to

maintain the $\frac{1}{2}\lambda$ separation.

Assume you have built an exotic system, such as a Lazy H or 8JK as described in popular literature. These, along with others, have a tremendously high impedance at the feed point and you want to match to 300Ω open line, converting to 75Ω coax thru a balun. We're using open wire line since it is so much easier for the following steps than using coax would be. We can, of course, apply the same principles to coax and get the same results, but you'll see why open wire will be the choice.

It is fairly easy to get open wire line. A 152.4m (500') roll is not particularly expensive, but be sure to use transmitting type. 300Ω is the most convenient and easiest to get; 600Ω is still made but is fairly expensive. Of course, you can make some spacers or get some of the commercial spacers and make your own line of whatever impedance you may want. Sufficient data exists in standard reference books to come up with about anything you would want.

First, feed the antenna with the open-wire line and go back a convenient distance. You may want to use a precise length, coming to an exact $\frac{1}{2}\lambda$ point, for minimum SWR (tuned line), but if you do the next steps properly, you should get the SWR to 1.1:1 or better.

Next, find a voltage point on the line. Since the line and the antenna are not matched, you will have considerable SWR. Couple a neon bulb to a few turns of wire and move it back and forth on the line while applying a little power (watch those finals!) and when the bulb glows, you're at a voltage point. To make sure, you can go back toward the transmitter and the voltage peak should repeat every electrical $\frac{1}{2}\lambda$. Remember in verifying to consider the velocity factor of the line. A voltage maximum corresponds to a current minimum, and reactance will be zero at this point. This is where we attach the first stub.

Remember, the distance between the shorting stubs is to be a $\frac{1}{2}\lambda$. We could attach the second stub almost anywhere down the line toward the transmitter short of 180° (if the stubs were at exact $\frac{1}{2}\lambda$ points, we would lose our transformer action). However, the experts find that for maximum efficiency,

we want to go back precisely 135° . Calculate this at the design frequency remembering to multiply in the velocity factor. There are several fairly complicated formulas involving square roots and cosines, but we are not trying to get involved in higher math in this article. Take our word that 135° is the right place! Attach your second stub at this 135° point, and then short the line on the stubs 180° apart. You have a tolerance of $\pm 0.5\lambda$. Slide both stubs together the same direction in relation to the transmitter to maintain the 180° spacing until you have the proper match. That's it! The stub toward the antenna tunes out the reactance while the stub toward the transmitter is for the proper impedance match.

There are some more formulas that give the active lengths of thy stubs. There are variables, of course; for a start try between 20° and 25° down from the transmission line on the stub for the shorting bar (remember it's important to maintain the 180° between the stubs) and start tweaking from there.

...WA6CPP

HEAT SINKS FROM SCRAP

Nearly everyone who works in an office or industrial plant has seen the semipermanent walls and partitions which have become so popular due to the ease with which they may be installed, added to and moved. One of the most popular types consists of panels of laminated plaster-board and various types of aluminum extrusions. These extrusions are provided to attach the panels to the floor, to each other, to seal the top and bottom, make corners, etc., etc.

Several of these extrusions are excellent for making no cost heat sinks for power transistors, diodes, SCR's, and triacs. The spacing of the fins allows the installation of even the largest semiconductors. The next time you see such an installation being made, scrounge some scraps of each type. Any length over about one inch is usable. After a few minutes picking over the scrap pile you will never again be called upon to plunk down cold cash for a heat sink.

...William Turner WAØABI

How You Can Teach Novices

It's easy with the new teaching aids.

Amateur radio is one of the few technical hobbies that is regulated by the government. Because every radio amateur must show a minimum ability in morse code and theory, it is also one of the few hobbies where the beginner will face an almost impossible task unless help is offered by experienced amateurs.

Having taught code and theory courses for several years, I have found them to be helpful and a rewarding experience for both the beginner and teacher. Many hams have the time and knowledge, but lack the final push to start the course. Hopefully the suggestions in this article will provide that push.

The first step is to find a sponsor. This can be the local radio club, a Red Cross Chapter, or RACES. But the sponsor should be the type that would not be willing to take the credit and give the work to the teacher. Generally mentioning that the students will become a source of members for the sponsoring organization will produce results.

The second step is for the teacher to decide how many days he can devote to teaching the course. I found that teaching two days each week is the best way to go. I

try as close as possible to cover the same material each night. This allows students to switch from one night to the other night should they be unable to drop by on their regular night. Some weeks the course has an imbalance, but generally each night will average out to an equal number of students. I could tell that the students were getting more out of each session as the weeks progressed, because they were not falling behind due to missing as much as they would have done if I taught on only one night.

Once the nights have been established, then it is important to select the classroom. I have taught in county relief offices, civil defense rooms, rural electric co-operatives and board meeting rooms. The ideal classroom should have a large blackboard, a movie screen, electrical outlets, desks or tables and chairs and good lighting. It should be in a low crime area, there should be parking nearby and someone should be there to let the class in and to lock up. I generally reserve the room from 7:00 to 10:00 in the evening. I try to start out *promptly* at 7:30 with 30 minutes of code practice, and if I am teaching novices, to end with another 30

minutes of code practice. The *official* departure time is 9:30, however, there is almost always an interesting discussion going on that seems to last until 10:00. Reserving the room for 30 minutes before the class starts allows time for ragchewing and sometimes I have held a help session for those who are having a difficult time with the morse code.

I mentioned the time, because some locations that would make ideal classrooms close at 9:00 and this can complicate their schedule and yours.

Some public and private schools will open their doors to non-profit groups. Some libraries have free meeting rooms. Some YMCA, YMHA or YWCA organizations will welcome your class as an addition to their programs. Also some churches have a policy of allowing community groups to use their facilities. The important thing to stress is that the students are generally adults and that you will use their rooms without damage. Check also on a smoking policy. If smoking is allowed, then be sure that ashtrays are available and that they are used. It will win your group with the janitor if you "police" the area after the class is over to avoid leaving soda bottles or cigarette butts on the floor.

Once the room has been reserved, the time picked and the teacher is ready, the next step is the selection of textbooks. I started out teaching with the ARRL publication group "Gateway to Amateur Radio." When the FCC upgraded their test requirements it became difficult to memorize the questions and answers. I then switched to the Ameco "Radio Amateur Theory Course" with improved results. The student could use the same book for both Novice and General license tests. However, the FCC has once again upgraded their tests when they introduced incentive licensing. At present the prospective amateur cannot hope to memorize any textbook and hope to pass. Now the prospective amateur must know and understand the basics of radio theory. Searching for an improved text, I came upon the publications by 73 Magazine. 73 recommends the use of their 5 and 6 wpm code tapes as well as their Novice Theory Cassette Course and their Novice Theory book.

They develop the theory with a minimum of mathematics. And they deal with the study questions furnished by the FCC by amplifying them into easy to deal with questions and then they show how to solve the problems. The illustrations are easy to read and understand. If I had to find fault, then I would point out that a student wishing to go from novice to general needs to purchase two books. However, both texts are excellent study guides and would be welcome in any amateur's reference library.

I have found that while it can be done, it is difficult to run a code and theory course for both Novices and Generals in the same room at the same time. The Novices are left behind by the General theory and code, while the General class students become bored with relearning the basics of theory and code. The General class code and theory course has to be played by ear. The teacher will have to tailor the class to the needs of the class. I have yet to find two classes that act or react in the same manner. I would recommend that the "General Class Study Guide" by 73 Magazine be strongly considered as the text for the class. If the teacher feels ambitious, he may want to also consider the addition of the "Advanced Class Study Guide." (As well as 73's 13 and 20 wpm code cassette.)

The best combination of texts for the Novice class course, I have found to be the "Novice Class Study Guide," and "CW" both published by 73 Magazine. To keep the class current on the FCC rules and regulations, I would suggest 73's reprint of the amateur section of the rules and regulations. The class sometimes tends to become sidetracked with questions on antennas and on operating procedures. Including a copy of ARRL's "Understanding Amateur Radio" will take care of most of the questions that the class might come up with during your theory sessions.

One final word before we begin our search for students to fill the class. The teacher has enough problems without being forced to donate a code practice oscillator as well as his time. If he has one and is willing to bring it to class then I say fine. But I have been in the position of having to purchase an

oscillator with cash from my own pocket and that should be the responsibility of the sponsoring group.

The search for students begins with a press release. The press release should be given to the press, but in addition, copies should be given to the club bulletin editor, other local amateur clubs, CB organizations, Boy Scout Troops, Girl Scout Troops, Red Cross Chapters and anyone else that you might think of that would be interested in having an amateur radio license. Word of mouth is a powerful means of communication. Nuns comprised 20% of one of my classes one time. Now I automatically let them know before each course. Wives or husbands of hams are good student material, also. I try for families by requiring that there be at least one set of books per family. And I have had many husband/wife combinations.

The First Night

The first night should begin with a welcome speech and introduction by the teacher. Before they start with their questions, pass out their books to them, collect the money and announce that you will be glad to answer any and all questions after the code session is over. Begin with the letters E,I,S,H,A,W,J. (The reason for this order will be explained later.) These are among the easiest letters in the code. Take it easy and at the end of the code session compliment them on how well they are doing. Your praise and their newly learned code ability will encourage them. Many of their questions will be in two categories: how much does it cost and how far can they get with just dots and dashes?

You should answer their questions to the best of your ability, and the ones that you would rather not answer (antennas, SSB, etc.) at that time you can delay by telling them that you will be glad to answer their questions, but you feel that they would better understand your answer in a few weeks.

After a 15 minute question session teach them Ohm's Law and the Power formula. Stress and explain that the reason that they must learn to use these equations is that they are not only required knowledge by the

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FCC, but they are used almost every time a Novice operates. Keep the units basic. Leave the introduction of Mega-, kilo-, milla- and micro- for the next lesson.

When they leave, they should understand how to use the equations and what the units mean. Assign them the first two chapters in their Novice class study guides to be read for next week. Finish the first class session with a short and simple code test to see if they have learned their letters. Most students will know them and that leaves them with a good feeling and will tend to encourage them to return the next week.

The Second Night

Congratulate them on showing up and begin the code session with a review. This has two purposes. Those who missed the first session will have a chance to catch up. And it begins the session out on a positive note for those who were there the week before. After a brief review, introduce the letters F,V,L,P,R,U. Stress them as well as the letters learned the week before.

Review Ohm's law and the Power formula with them. Then introduce the concept of Mega-, Kilo-, milli- and micro-. Work some problems out with them using the new concepts. At this point, I try to have an active amateur with a General class or higher license in to speak to them and answer their questions. The questions should be allowed to continue until it is time for the code session. They should be assigned chapter 3 for next week. Finish with a good code session.

The Third Night

Review the previously learned letters and then introduce T,M,O,N,D,B,G. The theory session should begin with the concept of frequency and wavelength. Let them know where their bands will be. For a guest speaker, invite the local DXer to come and tell them the DX possibilities that they will have on their bands using 75W CW. Have him bring some of his cards and awards. This will give them a taste for wanting to really get their license and operate. Again finish with a review of the 20 letters that they have learned.

The Fourth Night

Some of your students will be falling behind in their code. Surprise the class and do not introduce the remainder of the letters. Instead, make this class session a review period. Review the letters that you have already taught them and review the theory they have learned. Introduce the formula for the resonant frequency of dipoles. Do not have a guest lecturer for the fourth session. Make certain that you are not leaving anyone behind in a state of confusion. Finish with another code review. Skip chapter four and assign chapter five.

The Fifth Night

Finish giving them the rest of the letters. I feel that the best practice is simple and straight text. Save the code groups for later. The important thing now is to stress accuracy and let their speed build. The guest lecturer should be an experienced Novice or former Novice. By now they will know enough to ask specific questions. The final code session should be straight text again.

The Remaining Sessions

Let the advanced students send to the class to build their sending ability and give the rest of the class experience in hearing fists other than the teachers. The theory sessions should revolve around the FCC regulations, and the guest lecturers should come from the local available talent.

Sometime toward the end of the allotted time, have each student fill out a 610 form. (But don't date them!!)

Give a mock written exam. Try to make it as close to the FCC multiple choice test as is possible. Go over the test with the class and make sure they understand any mistakes that they may have made. Stress always your satisfaction on how they are progressing.

The Final Session

Give them their code test. Those who pass should date their 610 forms. You as the examiner should send in their forms to the FCC. Then you can both fret until the test returns and they have passed.

Hints

The information given here is from my own experience. I have not seen two classes act or react in the same way. I have chosen the order of teaching the code given in the text, because it has cut the time to learn the code by 50% over any other system. (If you have never used this system before, it is based on learning those letters that begin with dot and then those that begin with dash. Try it. It works.)

I do not teach the numbers. They are not required by the FCC for novices and I feel that the process is confusing enough without adding any more confusion. However, numbers and punctuation is not difficult to learn and they can easily pick it up in one session after they have passed their Novice code test.

Teaching a code and theory course will bring you the first of your grey hairs. But it will also bring you many little novice friends and a warm glow inside from having shared our hobby with others. I tried it once and got hooked. I hope that you will too.

... WB2PTD

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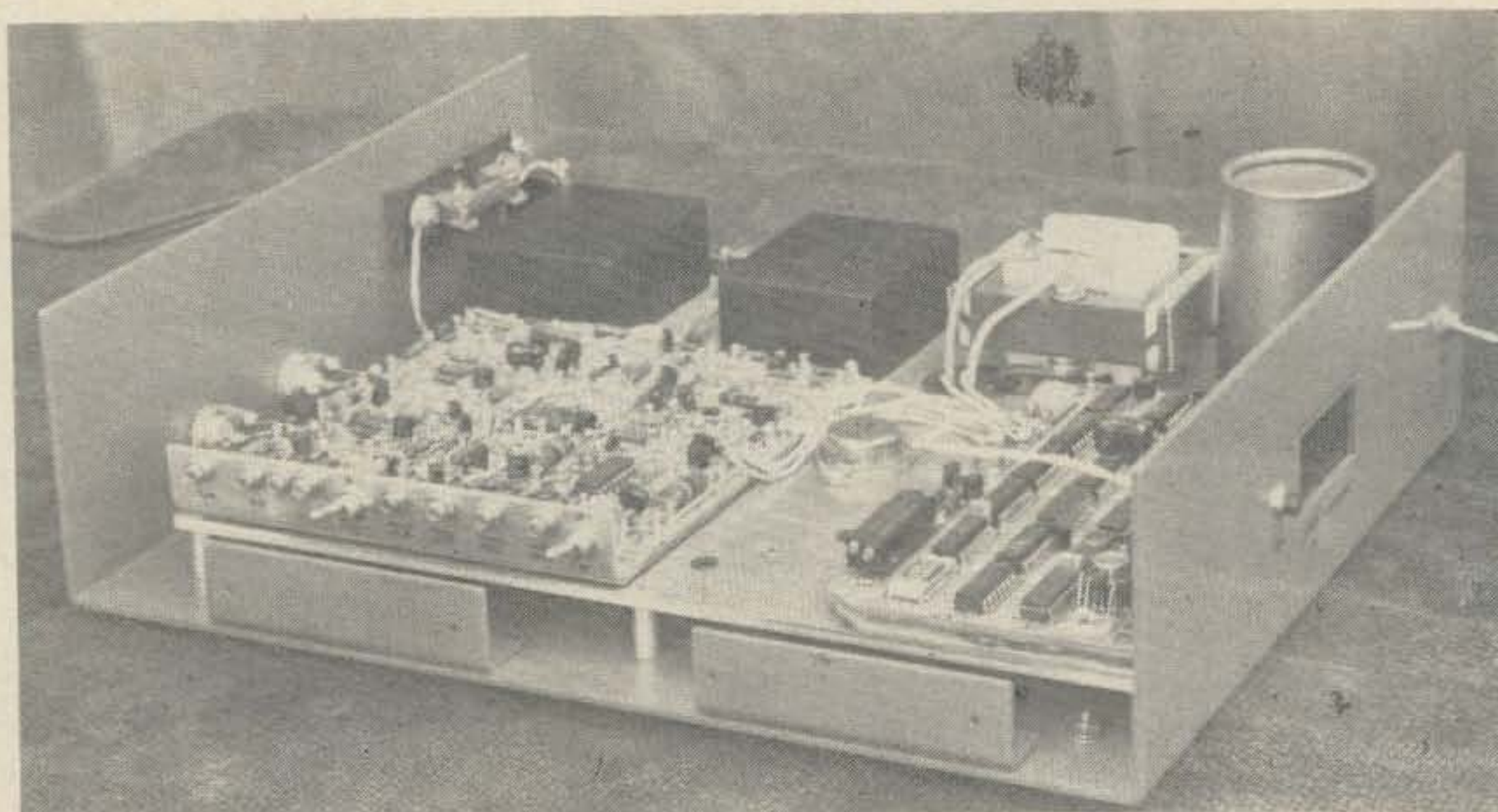
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A Digital SWR



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Computer!

Part 1

Although the average ham has to know very little about just how computers actually work he certainly can (and does) take advantage of their capability. Not only might a computer have helped to design some of the equipment in his shack, but he may be using a few special purpose digital computers himself to display the receiver frequency or to send pre-programmed CW messages.

This article describes a special purpose hybrid computer which automatically computes the SWR in a 50Ω coax feedline and numerically displays the answer. An operator using this device does not have to bother flipping switches to get forward and reverse readings while frantically trying to simultaneously tune his transmitter and/or transmatch, as he would on a typical SWR meter. This computer is called a hybrid because it is two computers in one — an analog computer and, if you will, a digital computer. The analog section does the actual SWR computation, and it is described in this article. If a meter type readout is desired this is all that need be built to have a computing SWR meter. Next month, the digital section consisting of an A/D converter and a display will be described.

The objective of the circuit design was to obtain the best accuracy available practically. Thus, some rather exotic op amps and metal film resistors were used in the final design. Some critical resistor values were precision matched during the alignment as described later, and this may be desirable to others constructing the complete instrument with the digital readout. Of course, if a panel meter readout is desired such accuracy isn't required and one could get away with using cheaper 741 type op amps. When you stop and think about it, who wants or needs to know his SWR so accurately? Actually, I don't think anyone does, but the circuitry is interesting and that will be reason enough for many to build the instrument.

Circuit Description

Analog Section

Fig. 1, is a schematic of the analog section. The computer receives two voltage outputs from the RF pickup, V_F and V_R , and then mathematically computes the SWR using the formula:

$$SWR = \frac{V_F + V_R}{V_F - V_R}$$

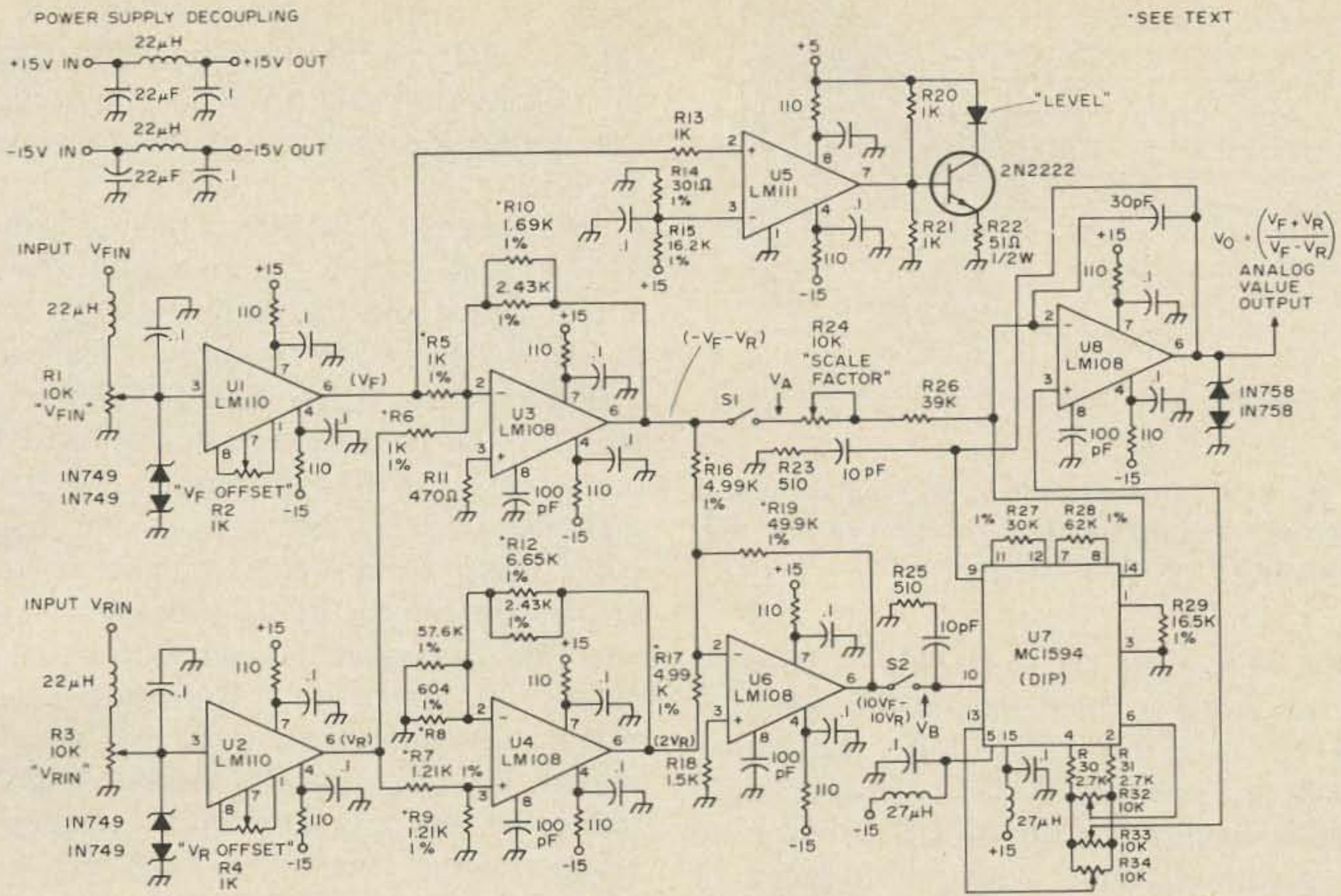


Fig. 1. Schematic diagram of the analog computer portion of the SWR meter.

The heart of this section is a monolithic analog multiplier chip, the MC1594, used in an analog divider configuration. If the op amps and alignment techniques suggested are used, the accuracy of this portion of the computer will be limited by the accuracy of the divider chip which is less than 1% over a much wider temperature range than the computer will ever see.

U1 and U2 serve as input buffers for V_F and V_R , respectively. U3 is a unity gain summer-inverter and produces at its output the sum $(-V_F - V_R)$. Resistors R5, R6 and R10 should be chosen from 1% metal film types to obtain the following ratios as accurately as possible:

$$\frac{R_{10}}{R_5} = 1 \quad \frac{R_{10}}{R_6} = 1$$

The values chosen for these resistors should lie between 1K and 10K for best results. Because I had several different metal films but not too many of any one value, I chose $R_5 = R_6 = 1K$ and initially chose R10 a little larger than necessary and then trimmed it later by paralleling another value across it as described in the alignment section.

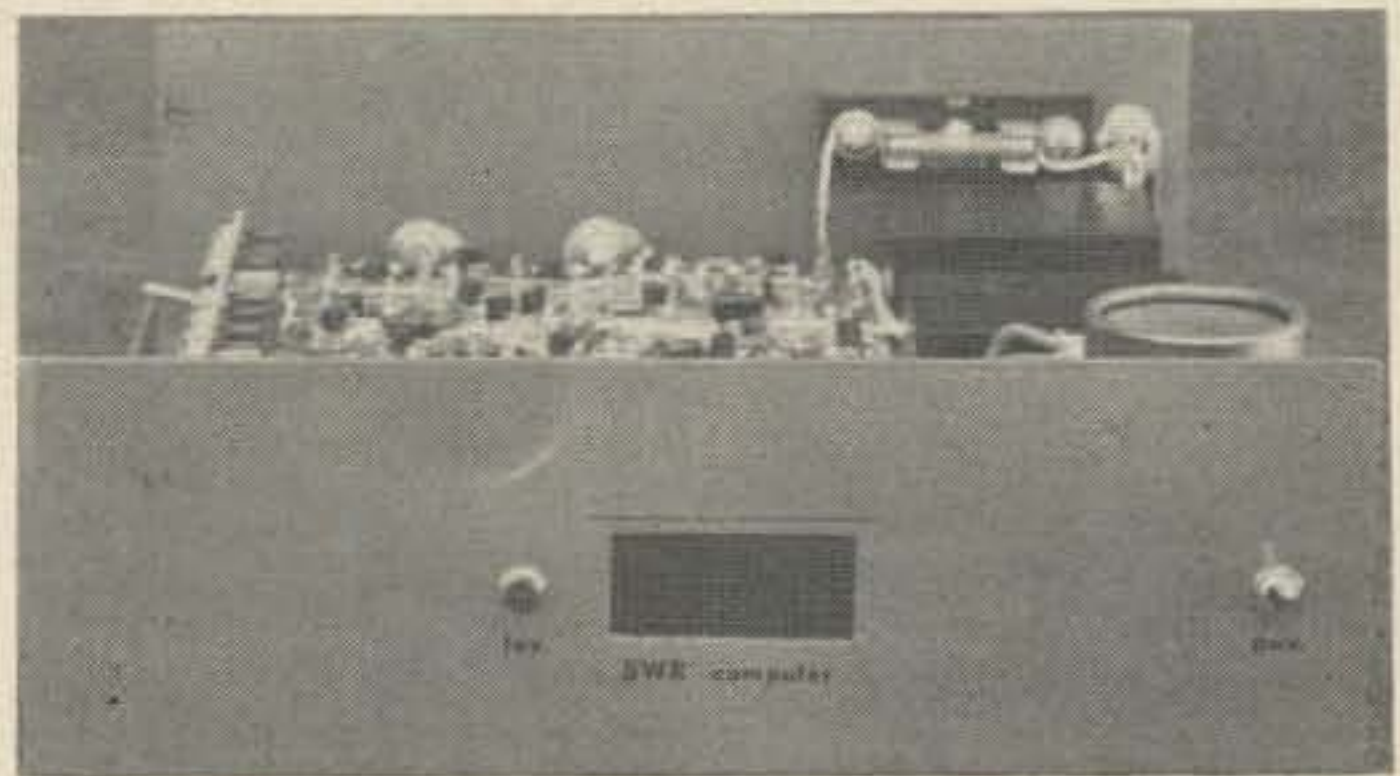
U4 is a simple precision X2 amp and values for R7, R8, R9 and R12 should be

chosen as follows:

$$\frac{R_7}{R_9} = 1 \quad \frac{R_{12}}{R_8} = 3$$

Again, I chose values for R7 and R9 but then trimmed R12 and R8 during alignment. U6 is a gain-of-10 summer-inverter and its feedback resistors are chosen as follows:

$$\frac{R_{19}}{R_{16}} = 10 \quad \frac{R_{19}}{R_{17}} = 10$$



A rectangular window is cut in the front panel for the display. A piece of transparent red plexiglass is epoxied in from behind for proper filtering for the LED display. The level indicator lamp is to the left of the window. The completed instrument was housed in a 9" x 3" x 11" homebuilt housing (with cover). BNC connectors for inputs from the rf pickup are on the rear wall. Alignment pots are on the L-bracket at the left.

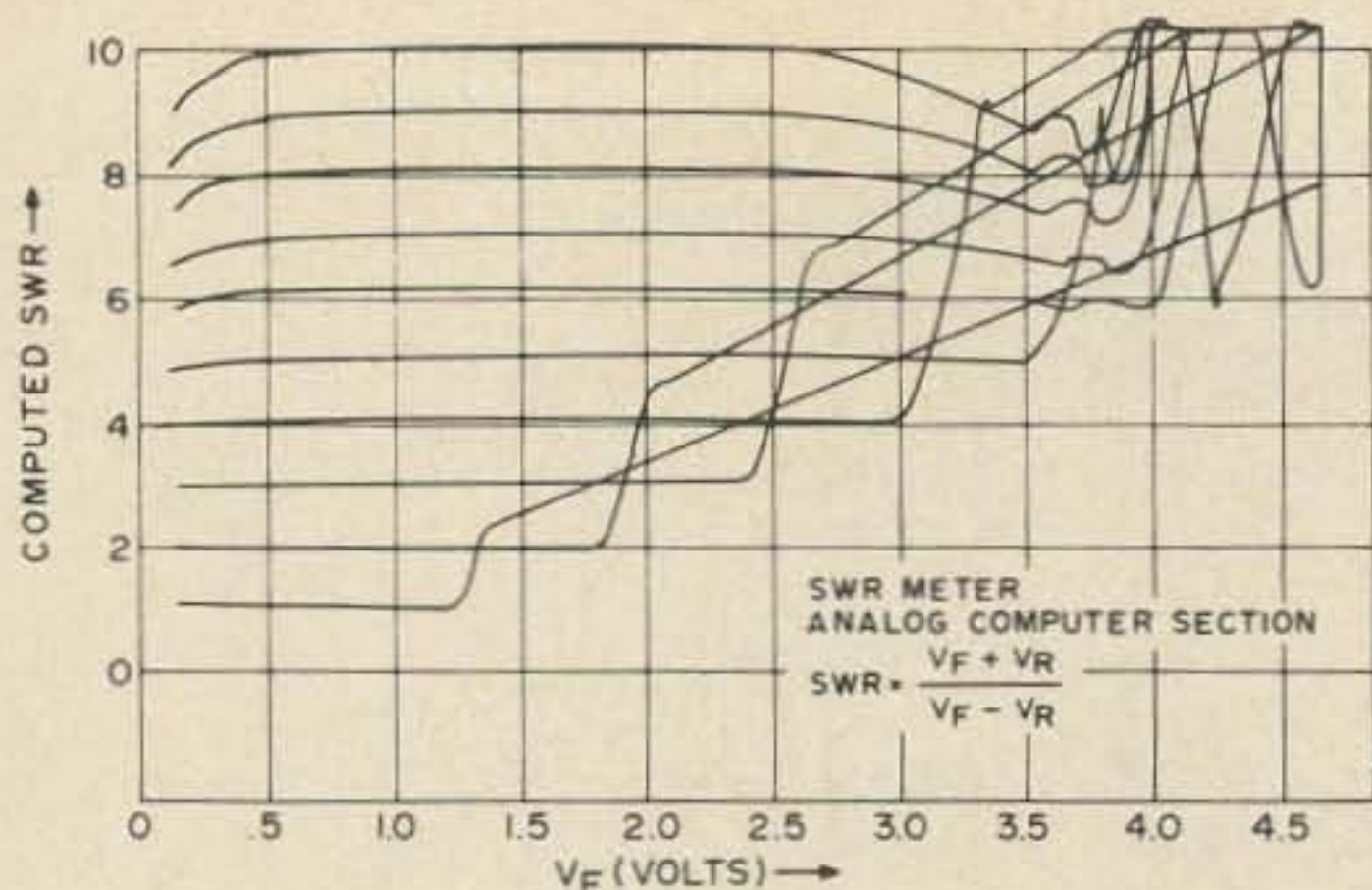


Fig. 2. X-Y recorder plot showing dynamic range of analog section exclusive of RF pickup as a function of V_F .

The output of U6 is $(10 V_F - 10 V_R)$, and this is fed to the divider as the denominator. The output of U3 is $(-V_F - V_R)$ and is used as the numerator. U7 is placed in the negative feedback path of U8 to form an analog voltage divider with a scale factor of -10. Therefore the output is $(V_F + V_R)/(V_F - V_R)$.

For best linearity in the divider, R28 should be twice the value of R27. Decoupling networks are used on each IC as well as on the input ports of U1, U2 and U7 to keep the rf out of the computer circuitry. U5 is a comparator which monitors the input level and lights a panel lamp to tell the operator that he is operating within the dynamic range capability of the device. This is necessary since all analog division schemes have good accuracy only over limited dynamic ranges. Fig. 2., illustrates the dynamic range of the analog section.

Regulated $\pm 15\text{VDC}$ supplies at 40mA are needed to complete the construction. Modular supplies were used in the prototype, but

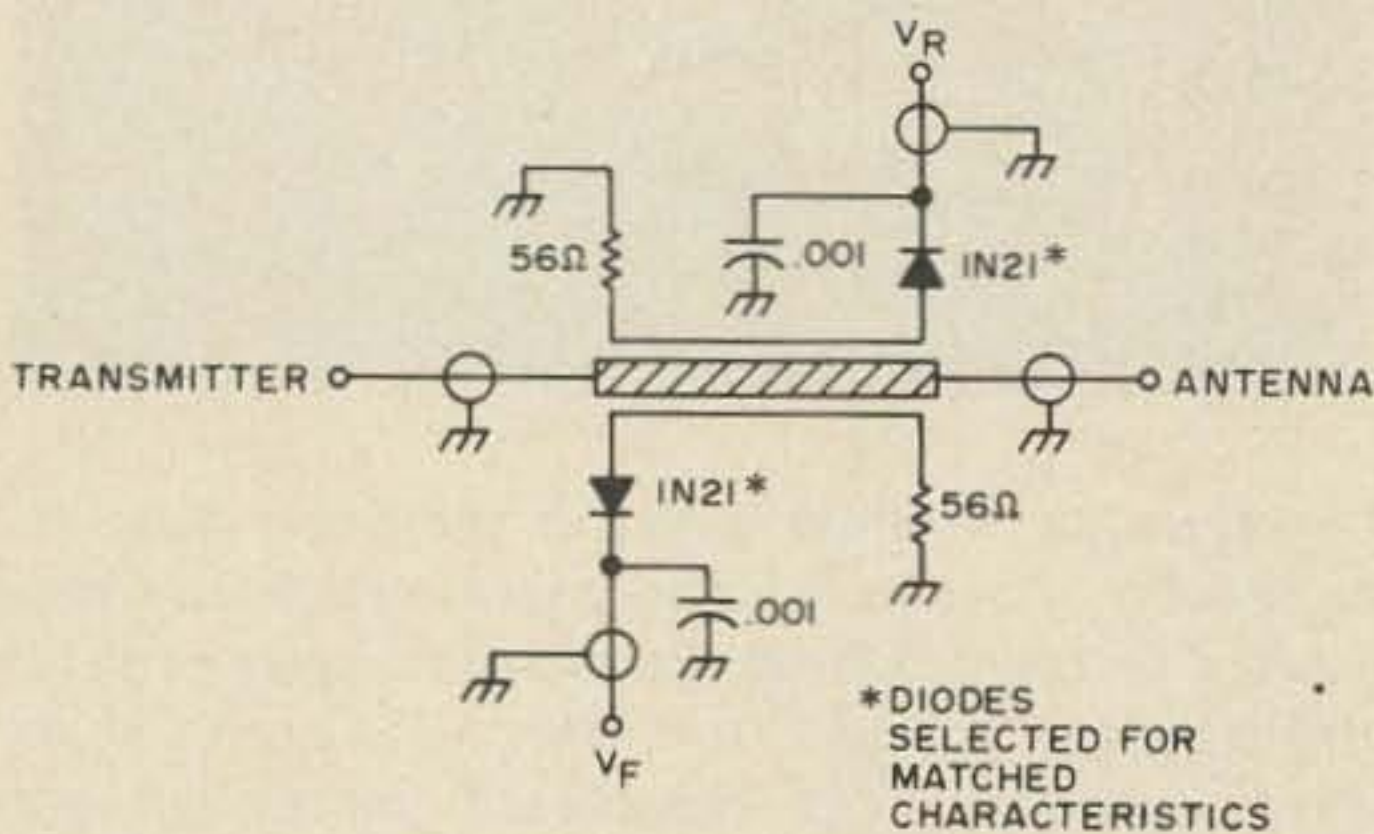


Fig. 3. Schematic of rf pickup. Diodes should be matched for best accuracy.

there are many designs available to the experimenter. A 5V supply is also used in the comparator, and it will also be needed in the digital portion to be described next month.

The schematic for the rf pickup is shown in Fig. 3. It is built on an etched fiberglass circuit board and the pattern used is shown in Fig. 4. The entire assembly is enclosed in a Bud minibox fitted with SO-239 connectors for the feedline connections and BNC connectors for the dc outputs. A pair of matched IN21 diodes was selected using a curve tracer from a bag I purchased from a surplus distributor but the builder may use what he has available and match them as closely as he desires. Unfortunately, the overall instrument accuracy will be determined by this match. Others might be interested in coming up with a temperature compensating scheme to keep the match valid over a wide temperature range. Temperature compensation techniques have never interested me and the rf pickup circuitry that I used shows it.

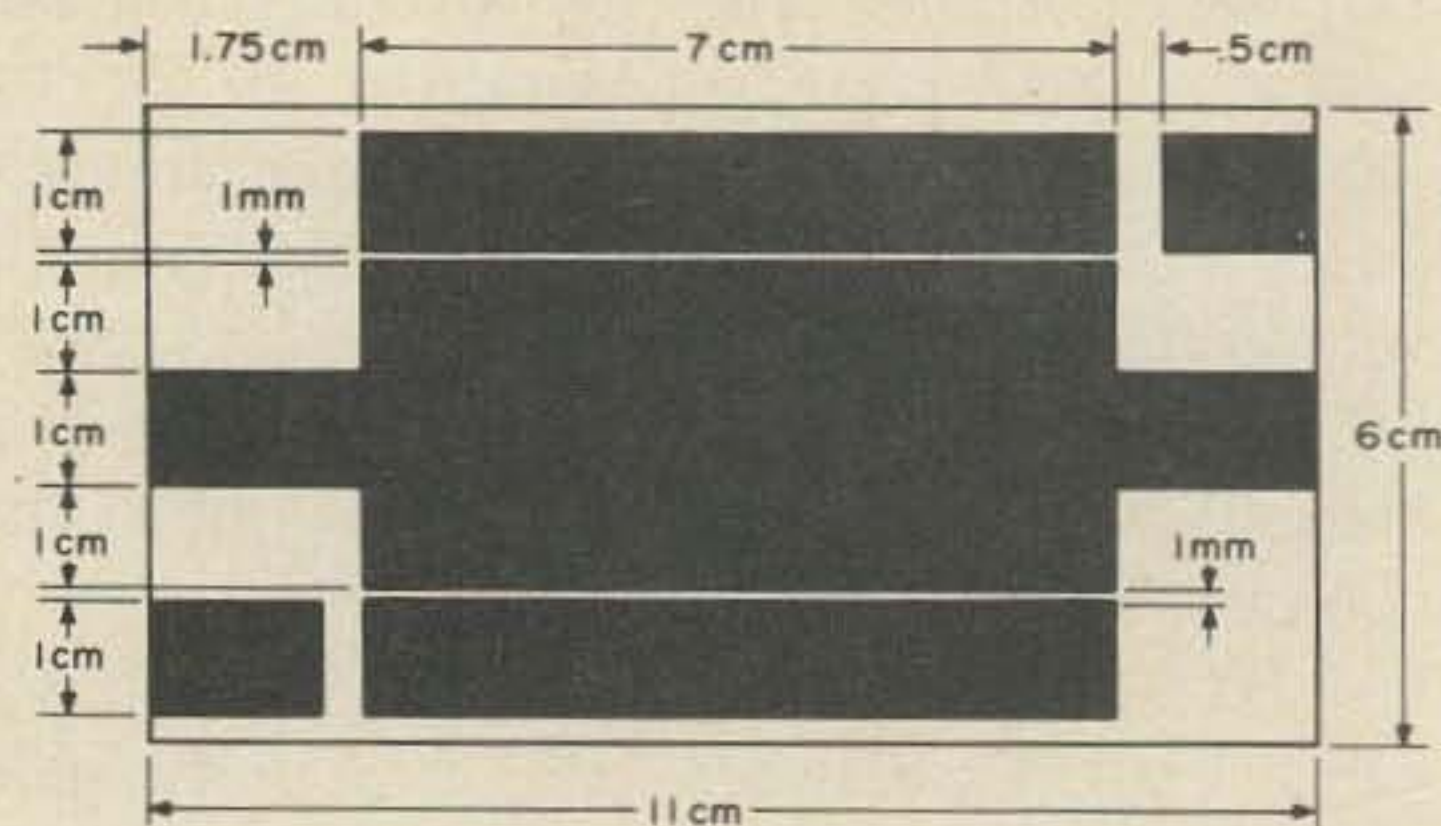


Fig. 4. Foil pattern for rf pickup. Black shaded areas are the foil lanes.

Alignment

Several alternatives are available for alignment depending on the accuracy and the type of readout desired. The following steps provide the most accurate alignment, but a DVM is required. The accuracy of the instrument can be no better than that of the DVM used. If a panel meter readout is desired a VTVM may be used for alignment and precise selection of the op amp feedback resistors is not necessary, although 1% values should be used to obtain the required ratios. The alignment procedure is as follows:



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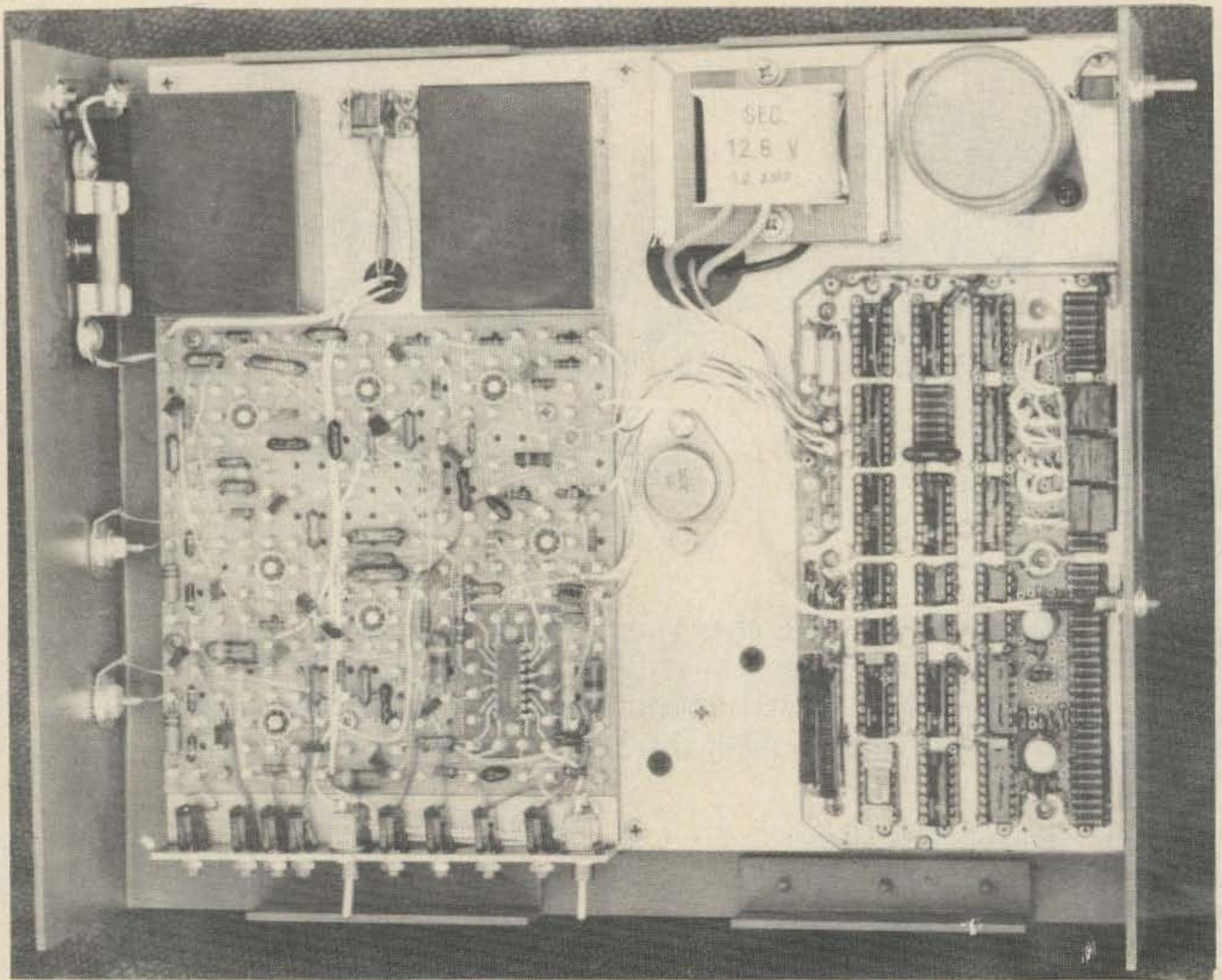
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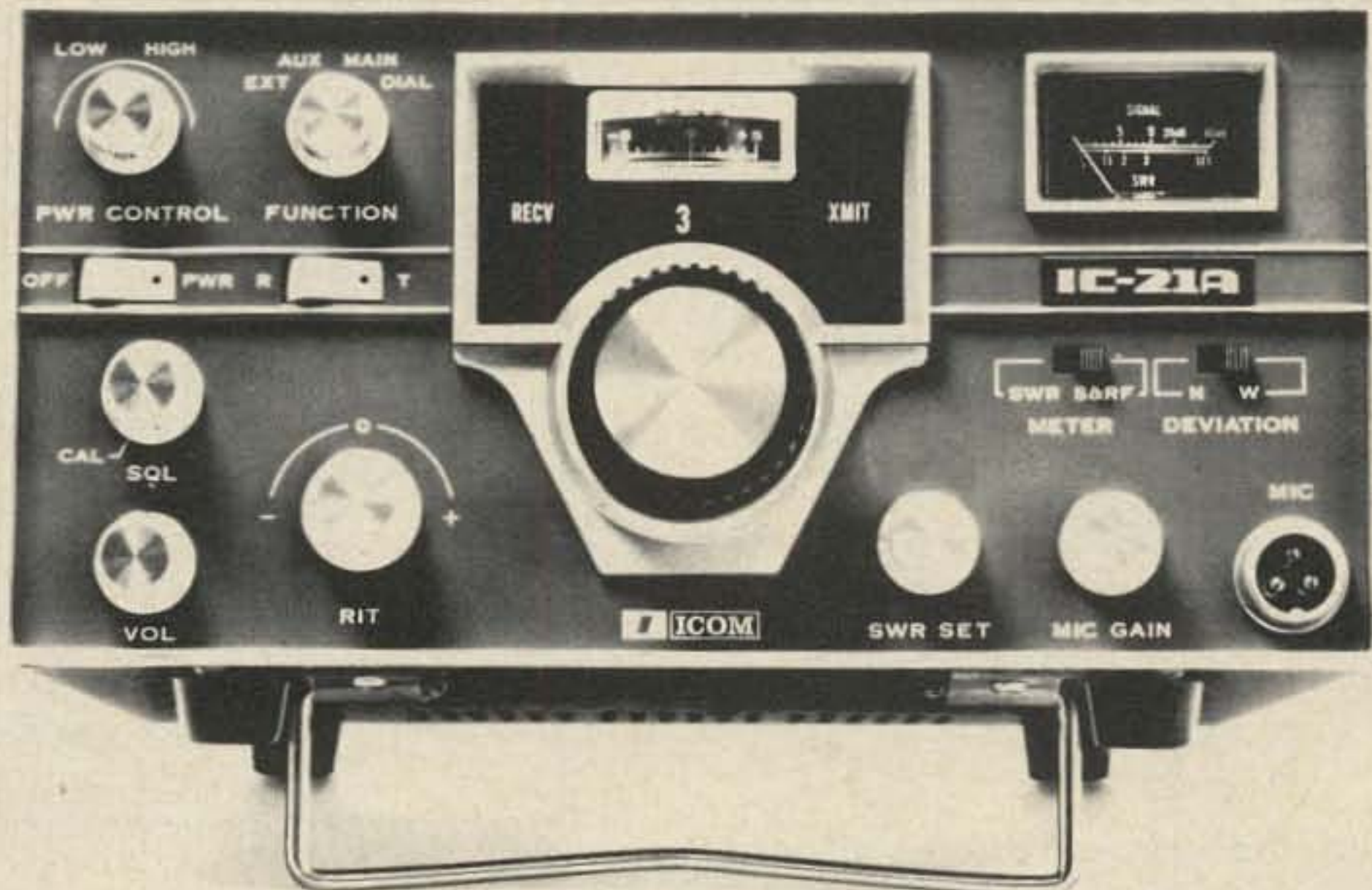


The digital board holds the display and is mounted at the front of the instrument. The analog components are mounted on the Vector board at the rear. The two black modules are the +/-15V supplies. The transformer is for the 5V supply.

- 1) Set controls R1 and R3 to their mid-range positions. Short the V_F and V_R inputs to ground and adjust R2 and R4 to give OVDC at the outputs of V1 and V2, respectively.
 - 2) Apply approximately 3VDC to the V_R input and then adjust R3 for exactly .5VDC out of U2. Then measure the output of U4. Trim R8 and/or R12 until the output measures exactly 1VDC.
 - 3) Measure the output of U3. Trim R10 until this voltage is exactly -.5VDC. Do not change the value of R10 in the following steps.
 - 4) Apply approximately 3VDC to the V_F input and then adjust R1 for exactly .5VDC out of U1. Again measure the output of U3 and trim R5 until the output measures exactly -1VDC.
 - 5) Remove the V_F input and trim R17 and/or R19 to obtain exactly -10 VDC at the output of U6. Do not change R19 in the following step.
 - 6) Replace the V_F input and trim R16 until the output of U6 measures OVDC.
- Open switches S1 and S2. The divider circuit will be aligned separately with externally applied voltages.
- 7) Set $V_A = 0$ (ground it) and adjust R33 until the output voltage (V_O) remains at some (not necessarily zero) constant value as V_B is varied between +1V and +10V.
 - 8) Maintain $V_A = 0$ volts, set $V_X = +10V$ and adjust R32 until $V_O = 0V$.
 - 9) With $V_A = V_B$ and adjust R34 until the output voltage remains at some (not necessarily -10V) constant value as $V_A = V_B$ is varied between +1V and +10V.
 - 10) Maintain $V_A = V_B$ and adjust R24 until the average value of V_O is -10V as $V_A = V_B$ is varied between +1V and +10V.
 - 11) Repeat steps 7 through 10 as necessary

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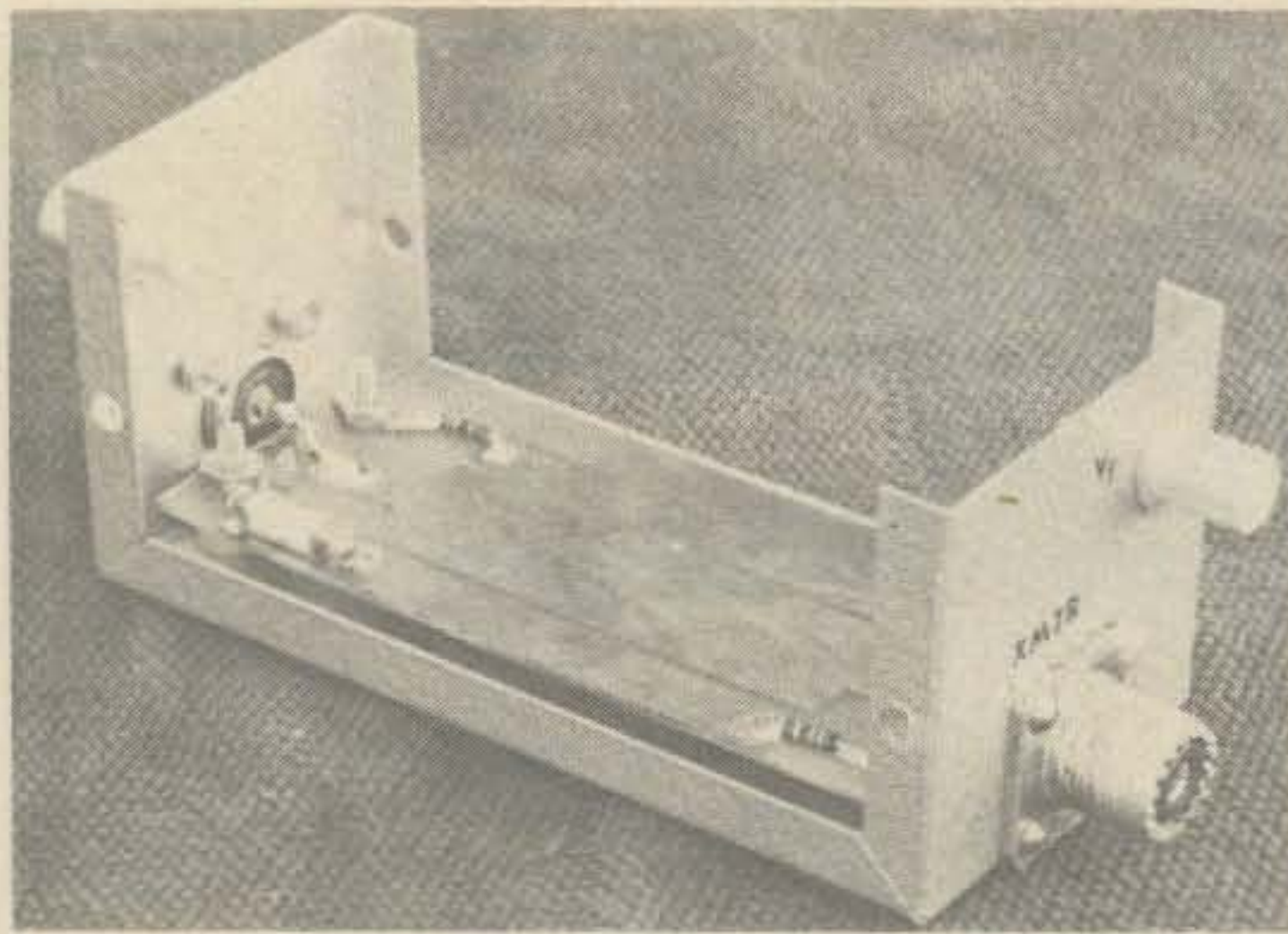


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The rf pickup is housed in a 2-1/4" x 2-1/4" x 5" Bud Minibox. Cartridge diodes were soldered directly to the pc board.

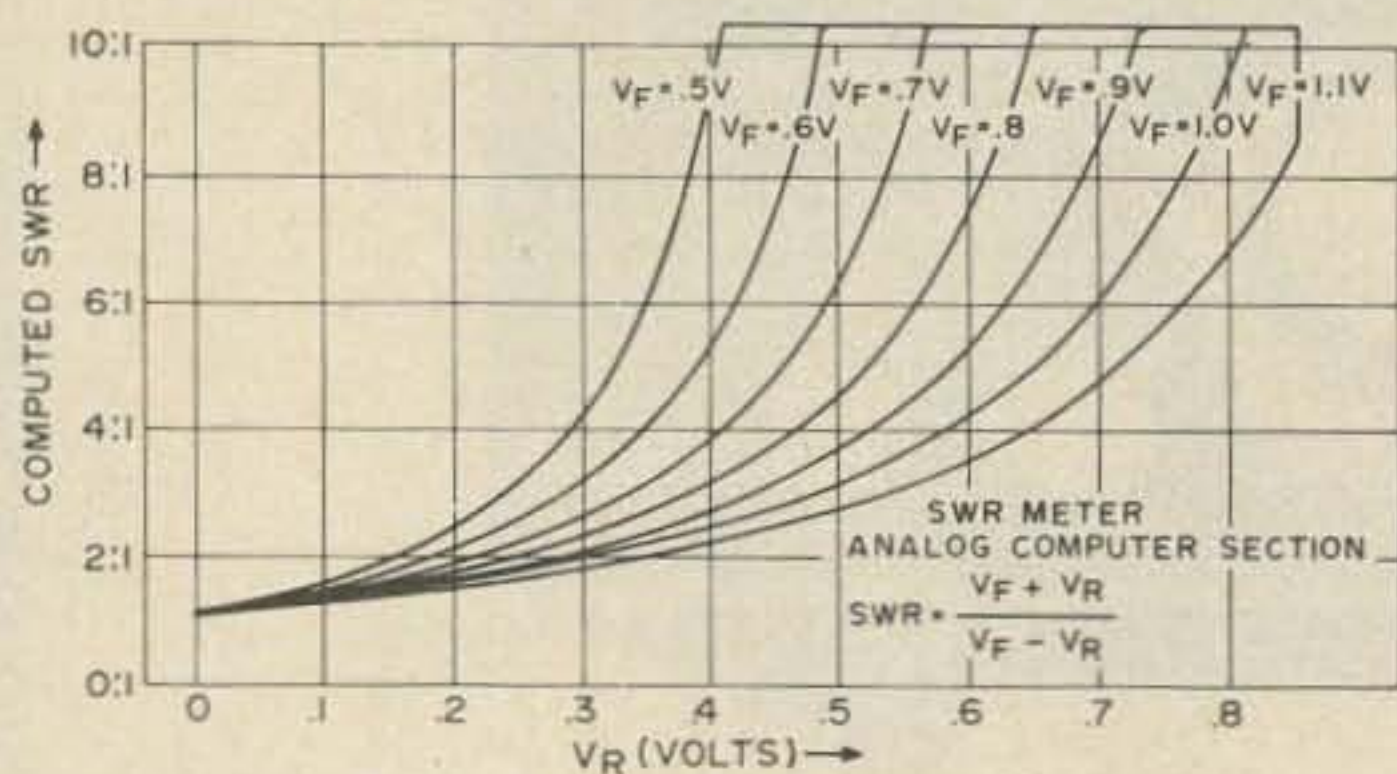


Fig. 5. X-Y recorder plot showing accuracy of analog section exclusive of rf pickup.

to achieve optimum performance.

Close switches S1 and S2 and the analog computer is ready for use. Fig. 5, shows recorder plots of the performance. If a digital readout isn't desired all that remains is to connect a 0-10VDC meter at V_O and the rf pickup, and SWR's from 1:1 to 10:1 can be read directly. The outputs are clamped to keep the meter from going off scale at higher SWR's.

R1 and R3 will have to be adjusted one time for the particular transmitter power used. I set R1 so that with about 50 watts dc transmitter input, there was about .3VDC measured at the output of U1. With my SB-401 at full CW power and my particular rf pickup, the maximum value of V_{F1N} is about 3VDC. The level indicator will light with V_F greater than approximately .25VDC so that the input is within the dynamic range of the instrument (as seen from Fig. 2).

The optional second half of the computer will be described next month. Even if you don't want to use it as a display for this instrument, it will make a great DVM for other uses around the shack. ... W6OTG

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The design of a complete rig may be taken up later, as it is a complicated affair with many choices such as a pocket set, helmet set, camera-case job, etc. Batteries are involved in such packaging, but this is not too bad a problem with the power requirements of microtransistors. Also to be considered are case size and disposition of tuning and switching knobs, speaker or phones, mic, antenna and cost.

I'm intrigued by cigarette pack-size rigs, Dick Tracy jobs, etc., but my common sense will probably call for a small camera-case type. You've got it on a strap over your shoulder, the battery is inside, you can tune the "dial," the antenna can stick out over your left shoulder, etc. So, later on for all that, and we take up here the basic circuit using small components, describing the rf, mixer, and oscillator — always the main key to a receiver — and a tunable module 1 1/4 in. square by 1/2 in. thick.

As an example of what can be done today at a reasonable cost with microtransistors, Fig. 1 shows a schematic and Fig. 2 the layout of an oscillator module. This particular unit is a tunable local oscillator, at present padded from 51 to 55 MHz, for use with a 1.65 MHz i-f. Pushing the power up a little, it will put out 15 to 20 mW of

rf as a test transmitter. This bandspread will probably be adjusted later to cover 51.5 to 53.5 as an L.O. for 50 to 52 MHz signals.

Looking at this unit you see at once the outsize components which are the tuning capacitor and, to a lesser extent, the inductance. I have a possibility of a micro-coil for around a dollar, of which more later. The Johnson type "U" 14 plate variable capacitor does for the moment. It came with a 3/32 in. shaft, which was adapted to a 1/4 in. shaft. Anyone knowing of a smaller suitable unit please let me know. A 1/4 in. brass shaft was drilled out for the 3/32 in. shaft and the end slotted with a jeweller's saw, and soldered. Depending on how many additional modules you use, and the exact final packaging shape, you can use a bigger or smaller knob and dial pointer.

At any rate, this oscillator module is right now only 1/2 in. high by 1 1/4 in. square, and can serve as a starting point for a tunable pocket-size 6 meter rig. You will

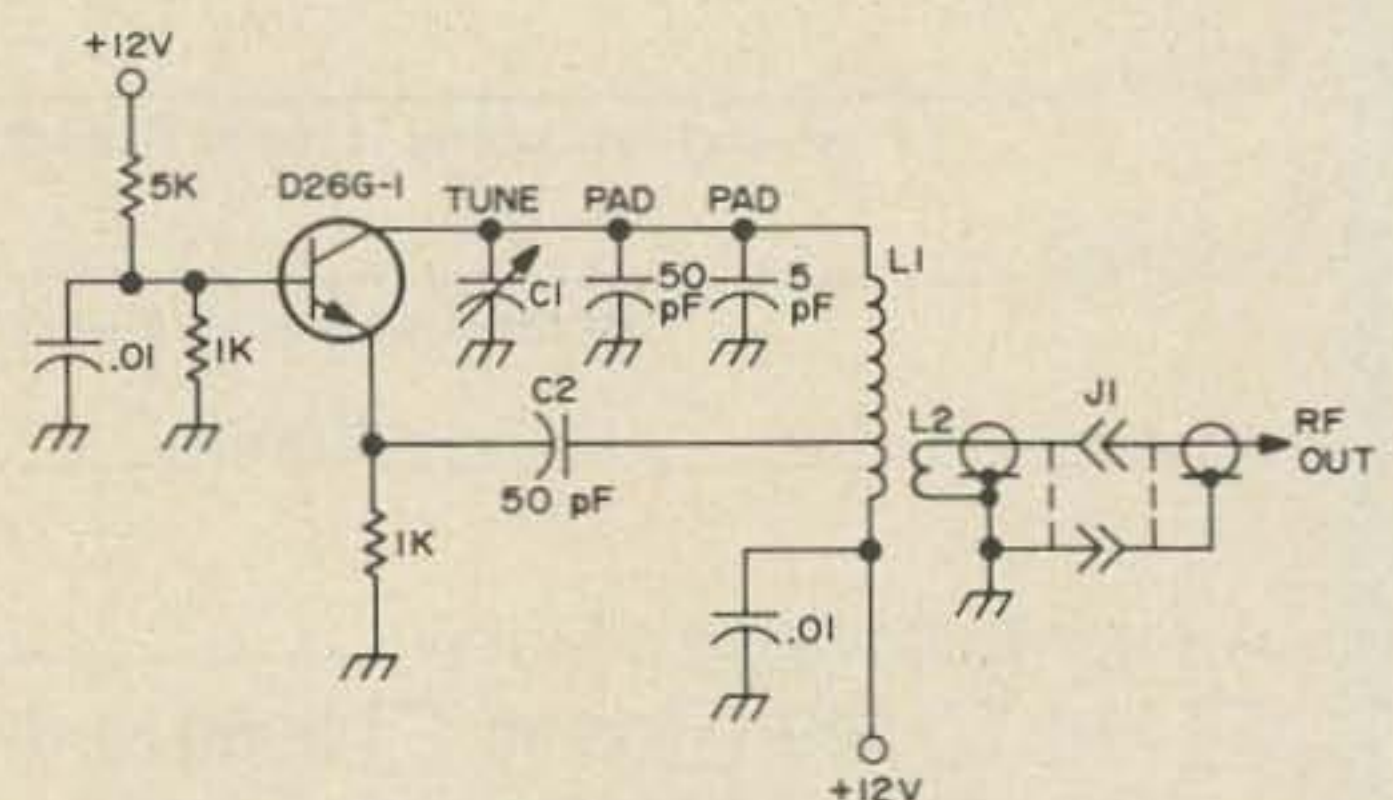


Fig. 1. Small oscillator module schematic. L1=9 turns No. 26 tapped at 1 turn from the low end and wound on a 1/8 in. impregnated form. L2=1 turn or 2 turns for more output. C1=14 plate Johnson type "U."

probably be safe in planning for each stage to be no larger than this little plank, as it has a functioning microtransistor, an inductance, a tuning capacitor, dc bias resistors, bypass capacitors, and padding capacitors. The device at present is the GE microtransistor D26G-1, with the usual Allen-Bradley 1/10th watt 5K and 1K resistors in the base circuit, bypassed with a .01 "Slim-cap" by Mucon, made by the Republic Electronics Corp., Paterson, N.J. They are really small, being only 60 mils O.D., but they do work!

The emitter has a 500Ω 1/10th watt, which may go to 1000Ω later because this unit is drawing about 7 mA at present, which is more than needed. During tuneup it was found that this is related to the position of the emitter feedback tap, which should be carefully adjusted so that it will not be too far up on L1 of Fig. 1. If this tap is placed up several turns on L1, there will be too much feedback and the current will be higher than needed. The final circuit shows one turn only. Check this point if you're in doubt.

A 50 pF capacitor from the emitter to the tap on L1 establishes the proper positive feedback, which is in phase with the collector. This makes the base out of phase with the collector, a necessary condition for oscillation.

L1 has 7 turns of No. 26 ssc, close-wound on a 1/8 in. form, with a tap at 1 turn. This produces a bandspread of about 4 MHz when using the parallel pad of C2, which is 55 pF in this unit. Naturally a different tuning capacitor for tuning may necessitate a change in L1 and C2 also. For more bandspread (less tuning range) go down on L1's inductance and up on C2's capacity. Do not use over 75 pF however, for a 6 meter L.O., as power will begin to drop, unless you use a bigger device and really need more padding.

Another component which is still "huge" is the rf output jack. The one shown is the smallest phono jack I know of, made by Teletronics, Yonkers, N.Y. Of course if you build the modules all together you can use the short open end of the small coax cable such as 50Ω

RG-174/U to hold the open end of the pickup loop L2.

The device itself is mounted on three .021 pins, as described in the first part of this series, which also serve to hold most of the other components too as you can see in the layout, Fig. 2.

L1 started out with about 10 turns, and some padding, and ended up with C2 being a 50 pF and a 5 pF in parallel. These little 60 mil cylindrical capacitors are not given away I might add; they run to around \$1 per capacitor, so please remember that I already have mentioned a rising cost with decreasing size.

I hope this completed and working module will give you some ideas of how to plan for a pocket rig. It's doing just that for me right now.

The Local Oscillator

A natural thing to do when building a local oscillator to tune from 50 to 52 MHz signals, is to put in what looks like a high Q coil, and then bring it to the desired frequency with a small tuning capacitor. In the case of 50 MHz L.O. this capacity may be very small in order to spread the 2, or 4 MHz desired over some 90 degrees of the dial. The results of the above procedure can be undesirable, as follows: (a) High harmonic content with consequent increased risk of harmonic detection. (b)

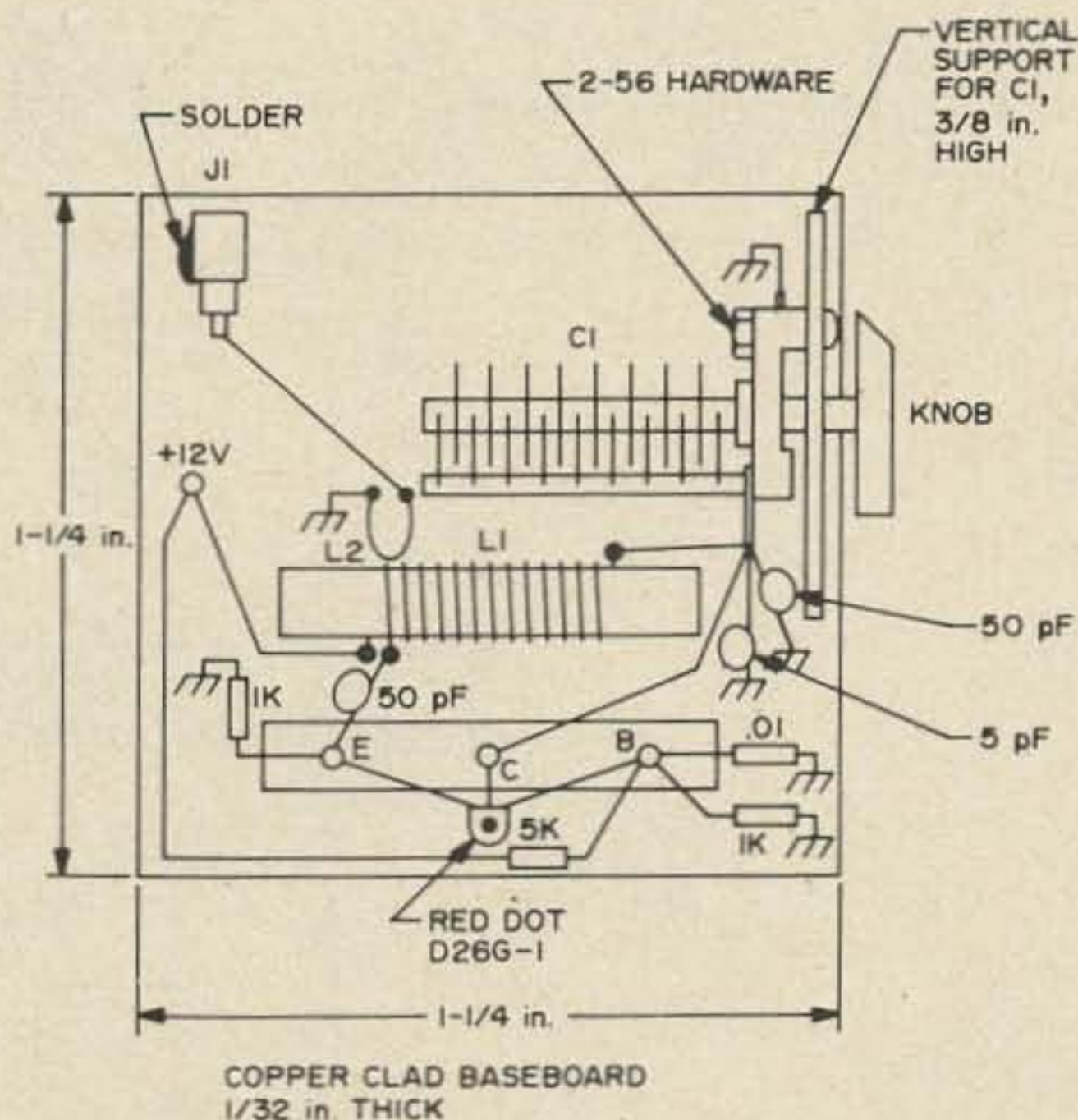


Fig. 2. Layout of the oscillator module. Note that L2 is over the cold end of L1.

Instability, where minute changes in circuit or device capacity can result in large and unwanted frequency changes. (c) Difficult padding and trimming due to the need for very small adjustments.

If, on the contrary, you start in with the idea of using maximum C, you will be much better off, so let's see how much can be used. A trial was made with an air-wound high Q coil, 7 turns of 5/8 in. O.D., 10 turns per inch. It worked fine, but hit 50 MHz with a small C, not allowing enough bandspread. A second coil had 6 turns of bare tinned No. 20, 7/16th in. long, tapped at one turn. Much better, very stable, uses about 75 pF of padding, but which, with the 20 pF variable chosen for tuning, covers only 1.5 MHz, which is not enough tuning range. The range is easily extended though by using a slightly larger coil. Checking on the maximum capacity that could be used and still have a good oscillator, one turn and then 2 turns were chopped off L1, at which time the rf power started to drop off, which indicates that between 75 and 100 pF is about it for this device and the dc power allocated to it for 6 meters. You could design a higher C oscillator if you had to, but in this case

we're only looking for a good, general purpose L.O., not an extreme maximum C job.

Going to a 6 turn coil for L1, slightly closer wound, we find about 60 pF for 50 MHz, total capacity, and 2.5 tuning range with a 20 pF tuning capacity for C1. It is now a very good stable oscillator, with smooth power control and current adjustment with R1, so this looks like what we're after.

The choice of a 20 pF tuning capacitor was not just an arbitrary one. It is also the range of the Miller three-gang variable capacitor which may be used later.

Various values were tried for C10, of Fig. 3, the emitter feedback capacitor, and from 1000 pF down to near 40 the power increased and then dropped out below 25. A 50 pF was found to be best, and was installed at that point.

The final circuit is shown in Fig. 3, and the breadboard test layout in Fig. 4.

The Front End

At first, nothing seemed right with the exception of the oscillator and even that was undercoupled. This is far from an unusual thing though, with new rigs. You

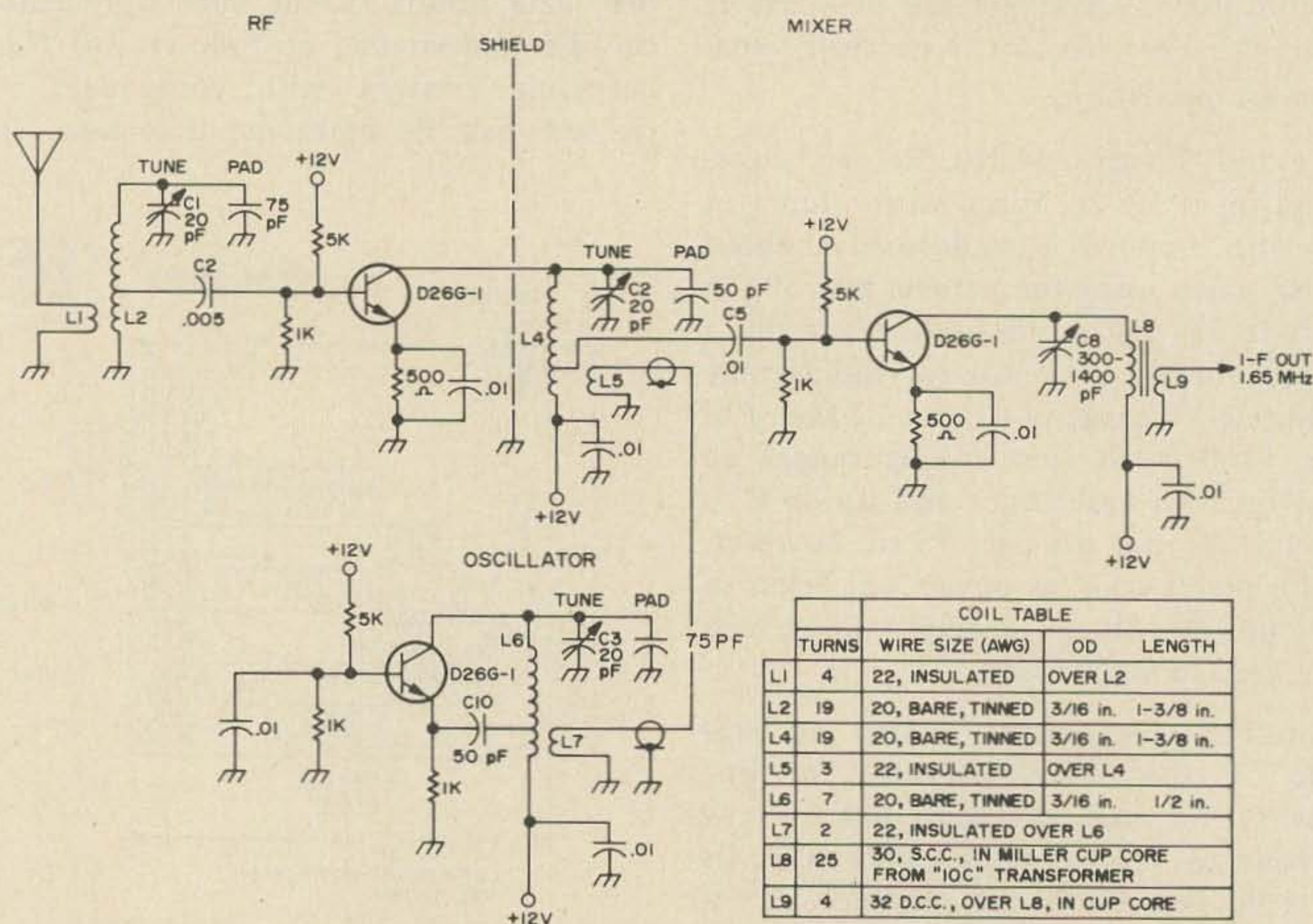


Fig. 3. Complete schematic for six meter front end using microtransistors (GE D26G-1).

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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.

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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take some new devices (new to you anyway) and hook them up to coils and other components in a circuit that worked well (on another band) and what happens? Zilch is what happens!

At this time go get a new cup of coffee and install a good signal in the band, not too weak, but not overloading either, and prepare for some hours or days of hard work. See also information in the rf stage section for details of a useful signal generator setup for this sort of work.

Points needing improvement were as follows, referring to Fig. 3. The oscillator was close to the frequencies needed, but proved to be undercoupled to the mixer base circuit. The mixer was undercoupled to the rf collector coil L4 with C5 being too small, and its emitter resistor was too large and L4 was too small, needing almost 100 pF to hit 50 MHz.

Also, the rf stage was far from its best, with L2 being too small, likewise C2, and the base was undercoupled to the input coil L2. The antenna was also too loosely coupled, and even the rf collector tap was too far down on L4. You might think it's a wonder that I heard anything at all with it, and you'd be exactly right. I didn't!

With the signal generator hooked up, some of the more glaring deficiencies were corrected and things began to perk up. Finally, with action showing in the mixer tuning, the usual gang on Six down in Massachusetts started booming in after breakfast, and the little microminiature specks began to shape up. Most of the low sensitivity seemed due to the low value of inductance I had put in and the small base coupling capacitors.

Don't forget, I was only running a single i-f stage with the front end, and this counts for a lot because every time I put the 1.65 MHz output into the lab receiver things sounded very powerful. This is a common fault when building converters. One tends to neglect absolute sensitivity (overall power gain) when using a high-power i-f. The single stage i-f on 1.65 MHz really makes you peak things up in the converter, with the result that you have a lively, matched, selective unit.

One of the items neglected when I first

set up the converter was the fact that on ten meters I had been using a ten turn coil, but it had a powdered iron core inside and out which greatly increased the inductance. So, on Six, I pruned L2 and L4 carefully, for gain and selectivity, still keeping the highest possible C for padding in order to get the needed bandspread, and suppression of harmonic detection and birdies.

The Mixer Circuit

Referring again to Fig. 3, the collector output coil tuned to 1.65 MHz by C8 is a more or less standard coil and worked right away. Miller 9054 coils will do all right also at this point.

The emitter was securely bypassed to ground to prevent the mixer from taking off as an oscillator (it didn't), which can happen with a tuned collector, a partially open (not tied to ground) emitter, and base tightly coupled to ground at 1.65 MHz through a small link or tap at 50 MHz.

Table 1. Mixer base tap on L4 using a 9-turn coil, 5/8 in. diameter, for L4.

Tap Turns From Low End	Relative Volts
2	10
3	19
4	17
5	17
6	14

Table 2. Capacity to rf base (C2 of Fig. 3).

pF	Relative Volts
100	10
1,000	18½
5,000	19

Table 3. RF base tap using 19 turn coil as L2 in Fig. 3.

Number of Turns From Ground	Relative Volts
3	22
4	26
6	25
9	20

Table 4. Number of turns in antenna link coil L1 of Fig. 3.

Number of Turns L1	Relative Volts
2	20 (some oscillation in RP stage)
3	23
4	24½ (very stable)

was very stable and tuned well as shown in Table 4. This is always nice because it takes up little space, is easily adjusted, and doesn't cost anything. You also avoid more trimmers, which are quite large compared to the transistors being used. You have to be sure it's working though. You don't always get the best match with such a link.

A final trim-up of the oscillator input link L5 placed its three turns of L4 from ground for the best sensitivity.

The lab receiver was then connected for a check, tuned to 1.65 MHz as an i-f and plugged into the mixer output. Absolutely everything on the band could be heard and separated in fine style.

Results

After all the pruning and peaking up shown in Tables 1 through 4, plus other little things, I now have one of the best and most economical receivers for Six I've ever used. Still running the single i-f stage on 1.65 MHz I can hear anything that moves on the band. There are some very small coils suitable for 1.65 i-f and filter work, but more on that later. The rf input tuning is particularly nice peaking right on frequency with good symmetry in the resonant tuning curve. I still find something definitely advantageous and different about those little GE gems as compared to the larger transistors used in the past.

At any rate, you have here a good sensitive, selective, six meter front end, with pocket size possibility.

Have another laugh on me . . . just a small one, but it might hit you too some day. Tuning up a single transistor af oscillator to modulate a test signal, I ran into trouble and changed the Motorola transistor that was in it, one of those little black plastic ones. The second one didn't work either (I hasten to say that both those units were perfectly good) so I checked the collector volts which were 12 on the meter, the base volts which were 2 to 3, also ok, but no emitter volts or current! Nothing I could do brought any current through the emitter or showed any bias volts. Finally, I just happened to look at those little silver colored tiny letters on the plastic case and found I was using a HEP56 instead of a 55. The 55's are my choice for a "Universal"

device, and I've put nearly 4 dozen of them into circuits in the last several months and they all worked well. Figures 5A and B show what was happening. I had been applying dc bias to the emitter instead of the base. So keep your eyes open and maybe it won't happen to you.

This six meter front end using micro-miniature transistors in a breadboard circuit with all small components and their best values determined, and working like a charm, is now ready for packaging, but small!

It is intended that two stages of 1.65 MHz i-f, with avc, will be tuned up using these little devices also, and packaged to match in size. As you can see by the module example, one stage including the variable capacity has been packaged 1/2 in. thick by 1 1/4 in. square, not counting the tuning knob. This indicates a possible pocket rig some 1 1/2 in. high, 1 1/2 in. wide, and 4 in. long. Battery, mic, speaker, and antenna yet to come. This is using 4 stages in the transmitter and about 8 in the receiver. Maybe it will take an overcoat pocket just now, but at least you can see where we're heading.

... K1CLL

AN EMERGENCY TRANSFORMER

How many times have you discovered a dead transformer just as sked time neared? And then found it was the primary of the transformer that had opened.

This happened to me a few weeks ago, and not having another suitable power transformer handy, I solved the problem by bringing into use an old junkbox job with a hefty low voltage secondary. This was hitched to the heater winding of the main transformer — and so fed the tubes direct as well as supplying B-plus. The actual output of the junkbox transformer under load was a trifle too high, so a wirewound resistor was put in series with the primary, and adjusted until the heater voltage was just over 6.3 volts. Although this was only a temporary lashup to get me on the air, it's been going fine for several weeks now, with no sign of smoke. It would appear to work with any main transformer which has a definite open circuited primary — but not, of course, one with shorted turns.

... G3KPO

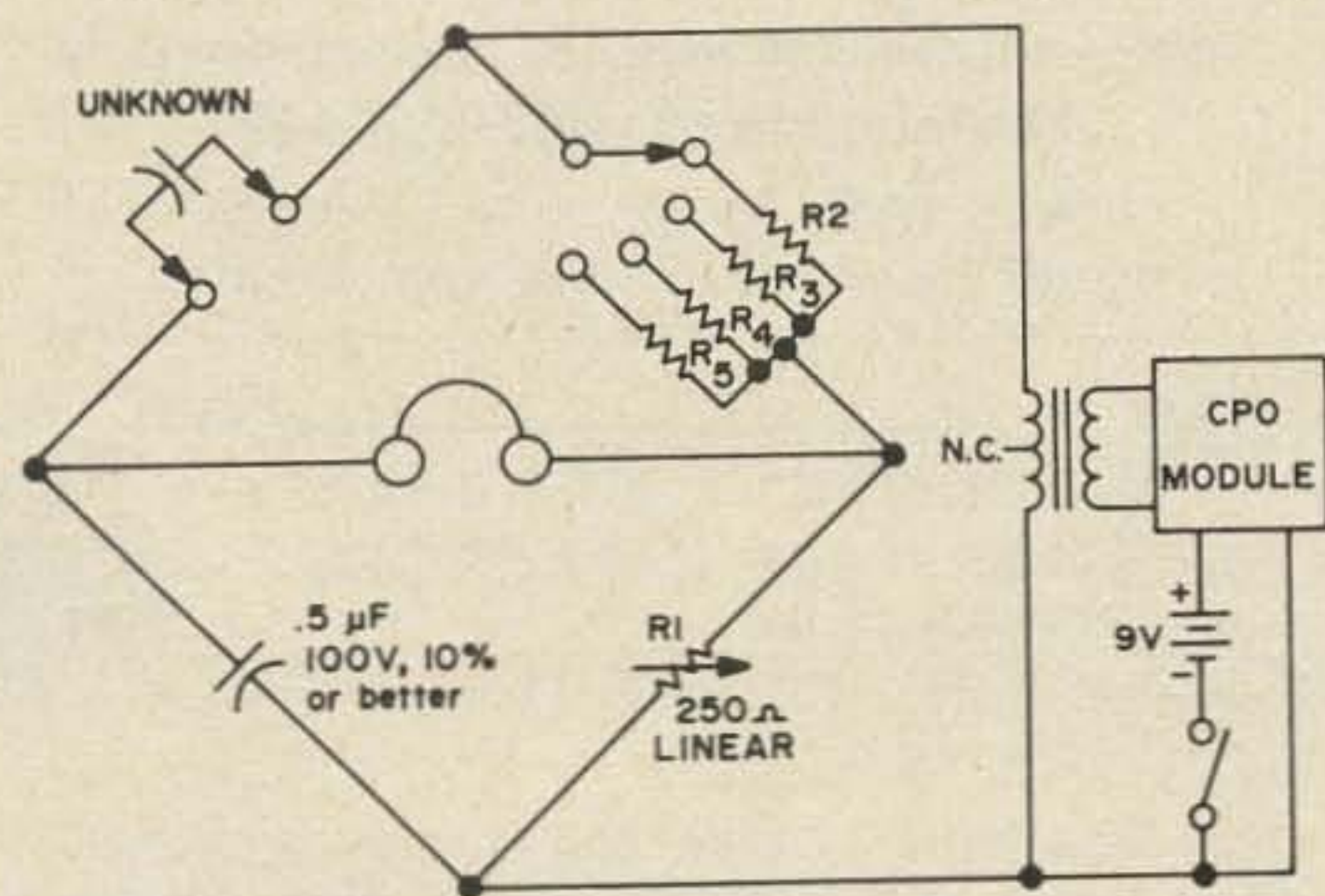
BUILD A BASIC BRIDGE

William P. Turner WAØABI
5 Chestnut Court
Saint Peters MO 63376

Occasionally the Novice or casual amateur requires the use of a capacitor checker while in the process of building or repairing his equipment. The frequency of this need is often such that the purchase of a kit or commercial checker could not be justified. Over the years many homebrew models have been presented in the various electronic magazines, but these are apt to be too expensive or too complicated to fill the need.

Presented here is a cheap, easy to construct checker which will measure capacitors from .0001 to 1.0 μF in four ranges with about as much accuracy as the builder might desire. While not covering a wide range of capacitance, it will check 90% or more of the capacitors found around the shack. The normal "entertainment" grade resistors, capacitor and potentiometer will do nicely... on the other hand, accuracy may be greatly increased if precision components are used and precision calibration undertaken.

The basic circuit is a bridge, one leg



RESISTOR	SCALE
R2 - 100K	X 100 pF
R3 - 10K	X 1000 pF
R4 - 1K	X .01 μF
R5 - 100 Ω	X .1 μF

ALL RESISTORS - 1/2W, 5% or better

Fig. 1. Transformer shown is 500ct:8 Ω

being a switch selected range resistor, the second a 250 Ω variable element, the third leg a .5 μF "standard" capacitor, and the fourth, the unknown. When the ratio of the unknown to the standard equals the ratio of R1 to R2, R3, R4, or R5, the bridge is in balance and no audio output appears across the null detector terminals.

The bridge is supplied with audio voltage by a packaged "code practice oscillator" module (in this case a Cordover CPO-4) of the 98¢ variety fed through a 79¢ transistor output transformer running backwards for impedance matching purposes. A similar homebrew oscillator could be used if desired. The null detector may be as simple or complicated as you have available. A pair of earphones, an amplifier,

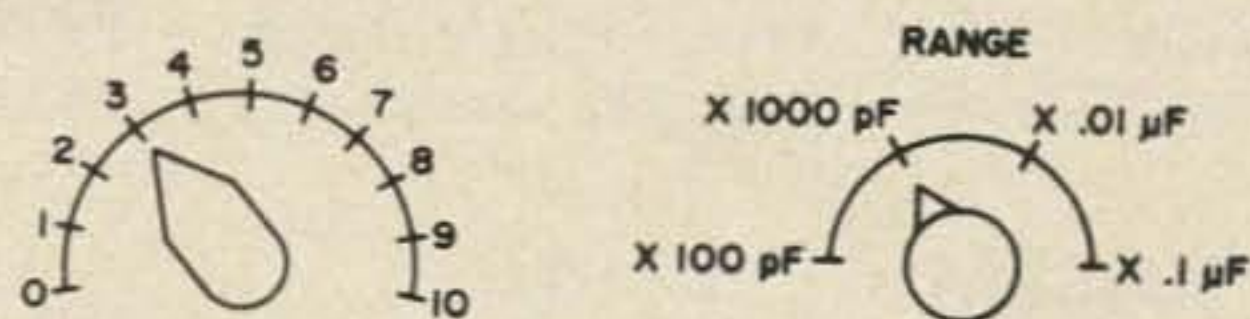


Fig. 2. Suggested method of calibration.

an ac VTVM, or a scope are usable. Phones are quite satisfactory and have the advantage of being readily available in the average shack.

Calibration consists of nulling the bridge with a known value capacitor across the unknown terminals and marking the scale at that point. Continue until the 1 through 10 positions have been located, changing or paralleling capacitors as necessary. It is not necessary to calibrate each range separately. The range resistors will insure that the scales are not too far from being exact multiples of the basic range. It will be noted that with the specified potentiometer the scale will cover only about 180° of shaft rotation. If desired, a 150 Ω pot could be used and the scale expanded to cover a full 270°.

The unit as originally constructed used a rotary switch to control the oscillator battery. If you are the forgetful type, a normally open pushbutton may be substituted in the interest of conserving the battery.

...WAØABI

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NA3026	Dual Diff. Array	12-TO5	0.99
NA3086	5-Trans. Array	14-DIP	0.45
NA3036	Dual Darlington	10-TO5	0.75
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NA8038	VCO/Sine/Sq./Tri.	14-DIP	4.50
NA1596	Bal. Mixer/Mod.	10-TO5	1.20

NA376	Voltage reg., pos. low stdby.	8-DIP	1.25
NA723	Voltage reg., pos/neg.	10-TO5	0.99
NA741	Op. amp.	8-DIP	0.45
NA1303	Stereo preamp	14-DIP	0.99
NA1304	Stereo multiplex decoder	14-DIP	1.20
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Part 3

The concluding part of this series covers the remaining functions such as the sidetone, transmitter keyer, power supply, and others necessary to complete the keyer.

Sidetone

Fig. 14, is the schematic of the sidetone oscillator and buffer to drive the speaker. The spare gates from Fig. 5, and from Fig. 8, are used in the sidetone circuit. The oscillator is adjusted for approximately 1 kHz. Each time OUTPUT goes high the oscillator is turned on. I originally used CMOS buffers instead of Q1 and Q2 and the circuit had adequate volume but no reserve. Now there is plenty of drive for the speaker and although I haven't tried it, the volume control could be connected to the unregulated 16V for even more output. Any NPN transistor from your junk box should work for Q1 and Q2.

Transmitter Keyer

I currently have a Heath SB-101 transceiver which uses grid block keying, keying about -60V at 1 to 2 mA to ground. I

decided to use an optical coupler to interface with the transmitter. (An optical coupler has a LED and a photo transistor in it. When current flows through the LED, it emits light. The light striking the base region of the photo transistor causes the transistor to turn on.) Since the voltage rating of the optical coupler transistor is only 30V, I use it to drive a high voltage PNP transistor for keying the transmitter. The circuit provides about 1 mA of base drive to the keying transistor, Q3. I used a D cell flashlight battery to provide the negative voltage for turning on Q3. A negative voltage could be generated from the ac power supply, but I decided that I may want to operate the keyer from an external battery some day for portable operation and then it would have required two external batteries. Only 1 mA is drawn from the flashlight battery during key down conditions and the battery should last for shelf life.

A small amount of rf interference was noted the first time the keyer was connected to the transmitter. C1401 cured all of the problems but I added a few extra for

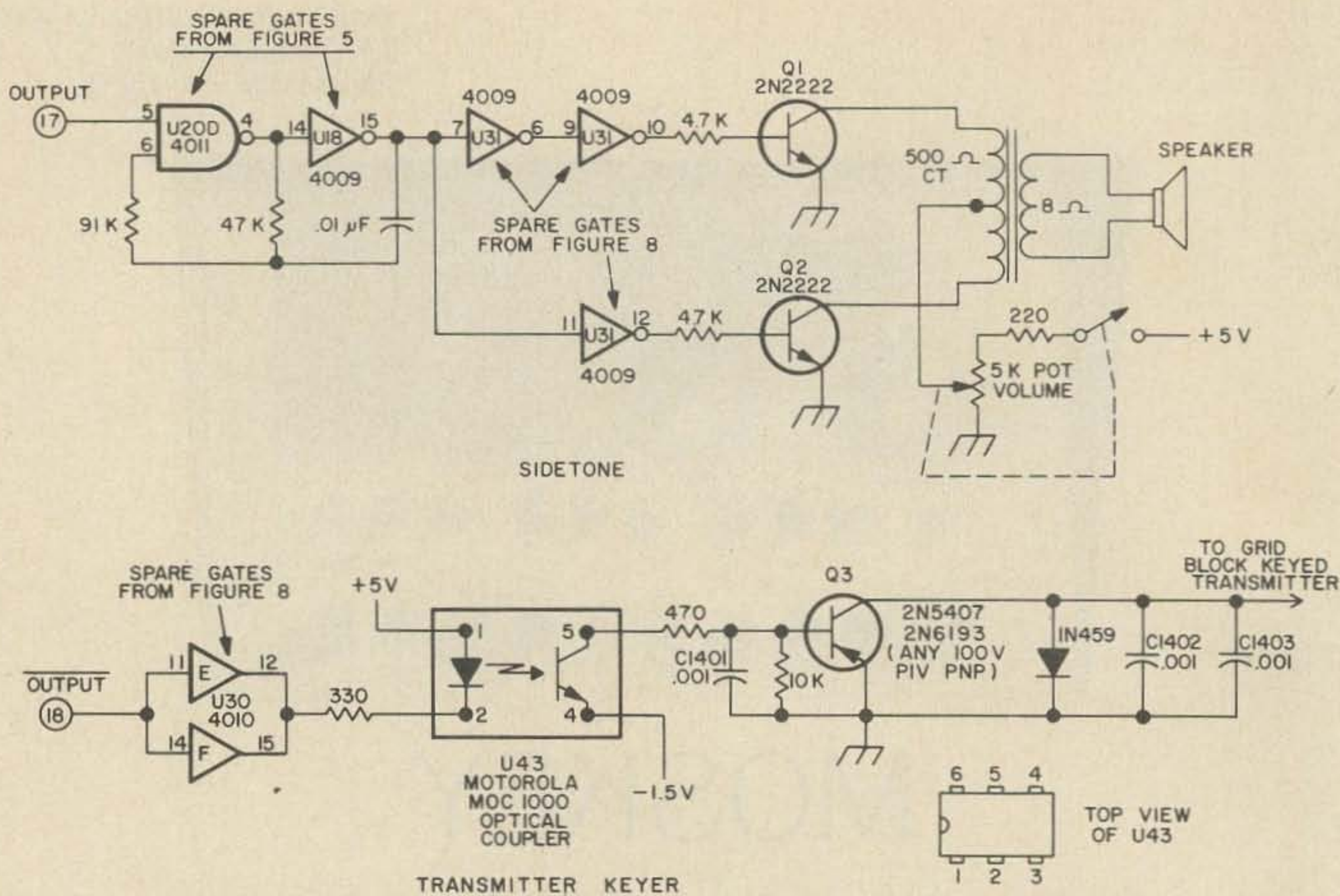


Fig. 14. Sidetone and transmitter keyer.

insurance. Install C1402 near Q3 and install C1403 at the panel jack that goes to the transmitter. I have found when digital circuits are operated near high power transmitter a handful of bypass capacitors installed on input/output lines is always worth the time and effort.

Other methods of keying the transmitter could be incorporated such as a reed relay, NPN transistor or whatever you desire. Gates U30 E and F, connected as a pair, are capable of sinking about 8 to 10 mA to ground, or sourcing 1.5 to 2 mA of current. If you decide to drive a relay use a buffer transistor.

Display

A four digit display (see Fig. 15) is used in the keyer and the numbers are displayed in octal or base 8 format. The first 3 address lines go to the units display. Address lines 4, 5 and 6 go to the tens display. Address lines 7, 8, and 9 go to the hundreds display and address line 10 goes to the thousands display. As the address counter counts up from zero, the address lines will advance in a binary mode. The units display will count

from 0 to 7. The next count is 8, with address line 4 high and 1 through 3 low. Line 4 makes the tens display read 1 and lines 1, 2, and 3 make the units display read 0. So we see 10 not 8 on the display. If you haven't worked with octal numbers before it may seem confusing at first, but it is a very convenient way of handling binary numbers. There are 1024 locations in memory or 0 to

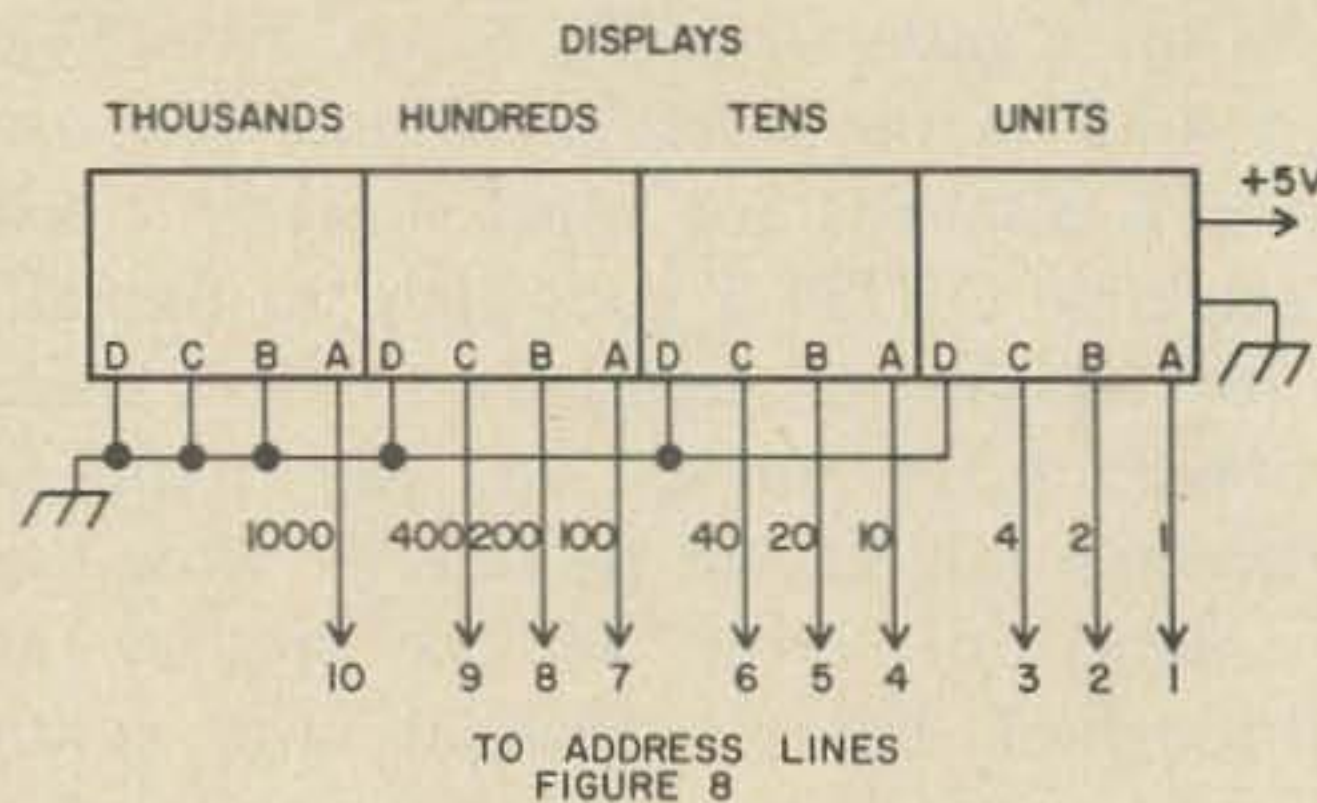
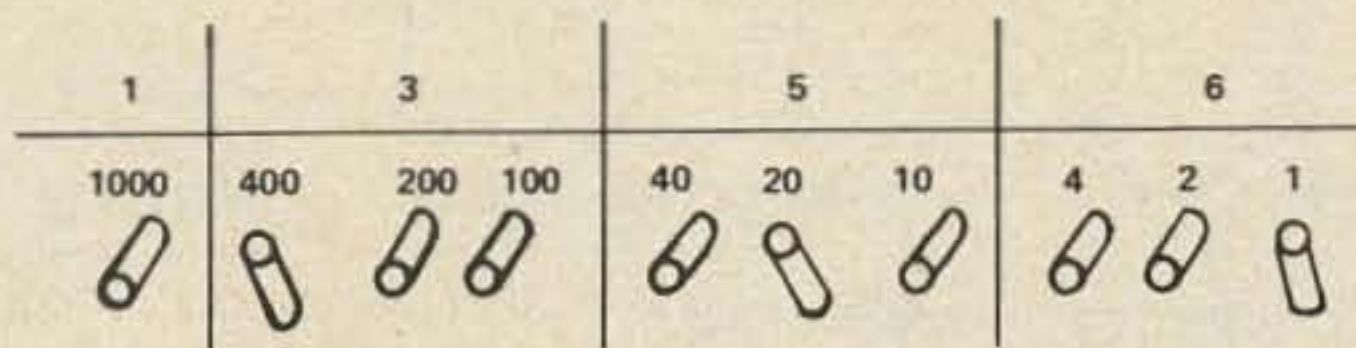


Fig. 15. Display wiring.

1023 decimal. The display will read from 0 to 1777. Don't even try to convert back to decimal when jotting down a starting address from the display. If the display reads 1356, write down 1356. If you group the address selection switches in groups of 3 with a little

separation between groups, each group of three is an octal digit. To obtain 1356 set the switches to:



The buffers on the address lines can drive about 3 TTL loads. Even with both PROMS installed that leaves enough drive for the displays. Any display, seven segment incandescent, LED (light emitting diode), or nixie type can be used with its appropriate decoder/driver provided the decoder/driver has TTL compatible inputs. There are many of these currently available on the market. Ten individual light bulbs could also be used provided some sort of transistor driver is incorporated. I use seven segment incandescent displays in my keyer.

Address Selection Switches

Fig. 16, shows two options for wiring the address selection switches. Fig. 16a, is the simplest way and just requires 10 switches. Space them in 3 groups of 3 and a single one as mentioned before. Having seven sequences programmed in PROM I decided it would be nice to have a single rotary switch to select any one of the seven starting locations. Fig. 16b, shows how this was done. You must first decide on what you are going to program in PROM to determine the needed starting locations. Then you can set up the diode matrix for those locations.

CMOS-TTL Compatability

CMOS logic can be operated over a voltage range of 3 to 15V, unlike TTL which is $5V \pm 5\%$ for commercial temperature range. The memories I have selected operate at 5V and since the PROM is a TTL device, the entire keyer is operated at 5V. TTL devices can be used in CMOS circuits provided a pull-up resistor is used on the output of any TTL device driving a CMOS device. This insures that logic 1 output levels are approximately 5V instead of only 3.3V, typically, which is adequate for a TTL logic 1 level. CMOS gate outputs switch logic levels when the input passes through a voltage level equal to approximately 45% to

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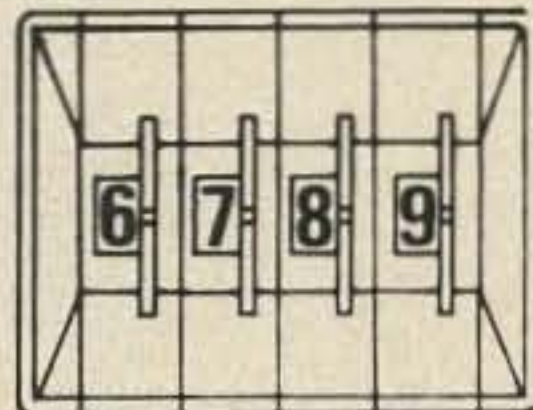
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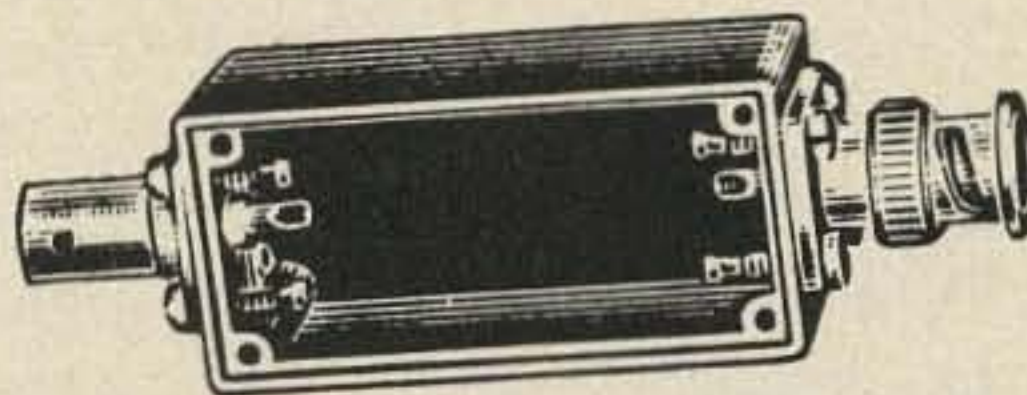
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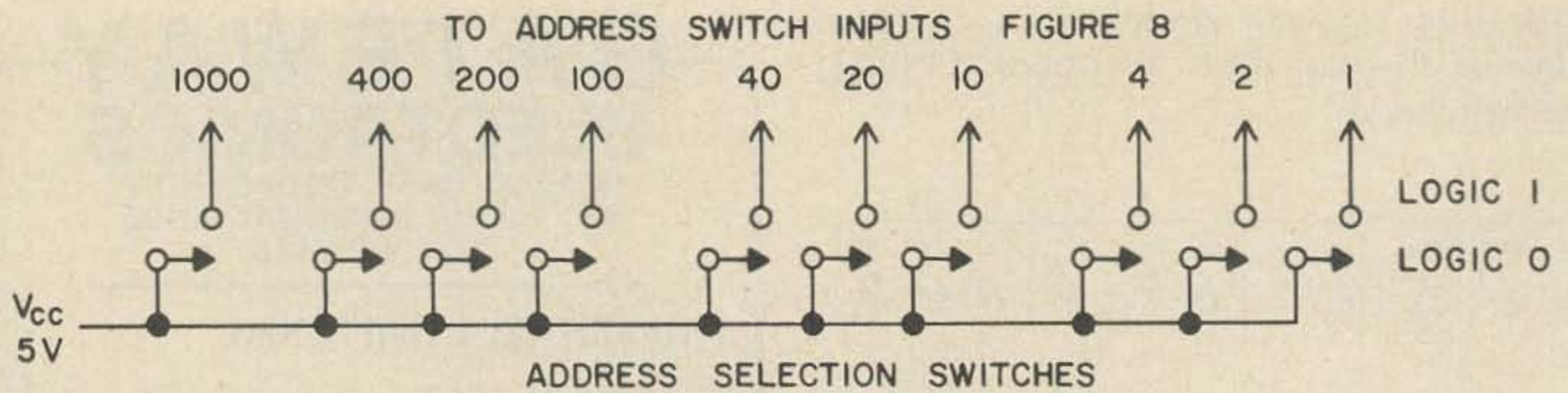


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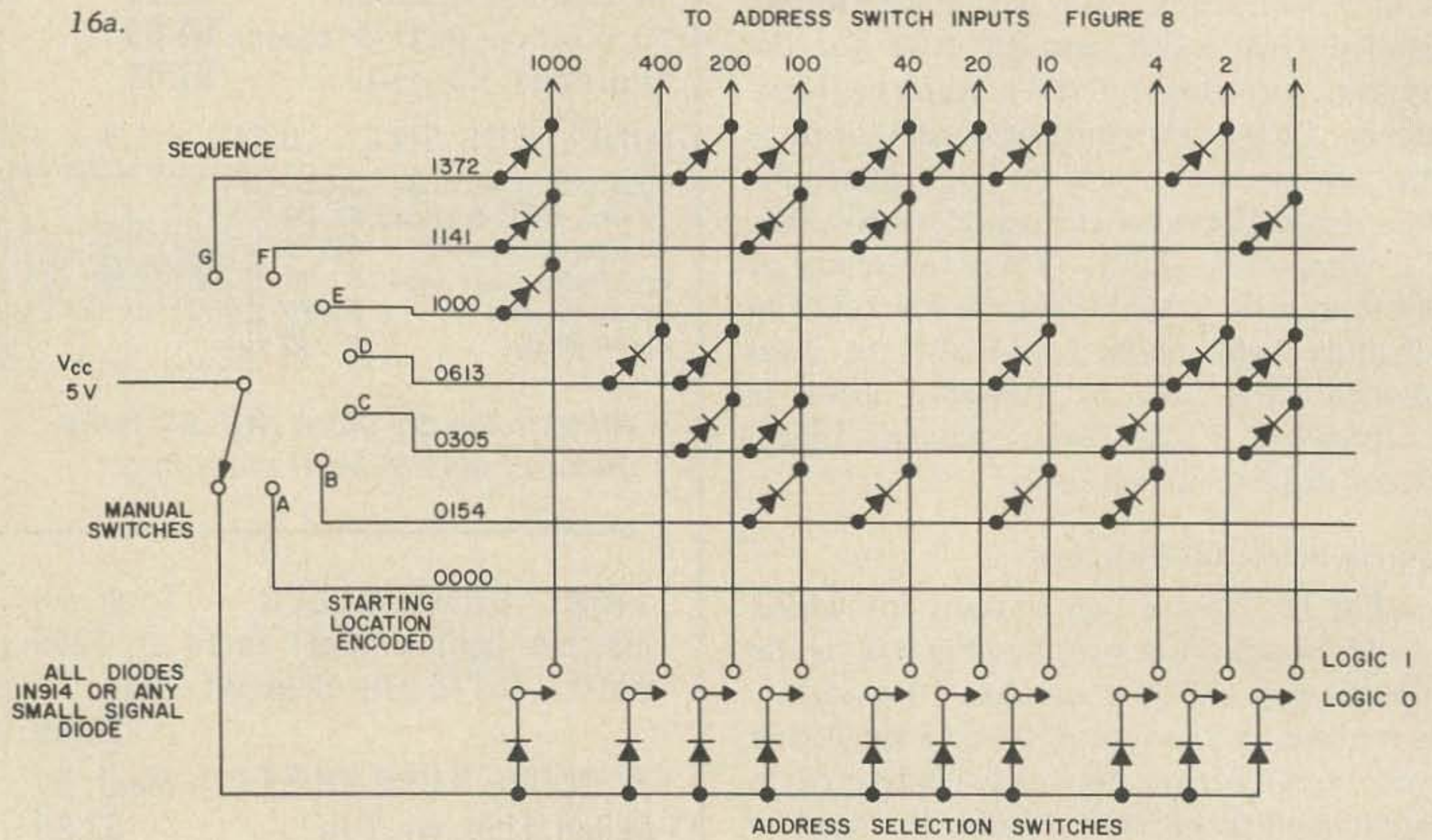
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16a.



16b.

Fig. 16 a and b. Two methods for wiring address selection switches.

55% of the supply voltage for the CMOS gate, that is a low input should be less than 45% of the supply voltage, and a high input should be greater than 55% of the supply voltage. For safe designs a low input should be less than 30% of the supply voltage or less than 1.5V at a supply of 5V. A high input should be greater than 70% of the supply voltage or greater than 3.5V at a supply of 5V. The pull-up resistors on the output of the memories and the PROMS insure a good logic 1 input to the CMOS multiplexer.

Power Supply

The CMOS logic in the keyer draws about 2 mA. The various pull-up/pull-down resistors draw several mA depending on the position its associated switch is in. The two RAMS draw 30 mA each, and each PROM draws 80 to 100 mA. The sidetone draws

about 20 mA at maximum volume. I used seven segment incandescent displays which draw a total of 700 mA. The total current requirements for the keyer is about 1A, but this is largely dependent on the displays used. A switch could be installed in the display power lines to conserve power when operating from battery. The power supply Fig. 17, uses a 24V filament transformer and a three terminal monolithic 5V regulator. This type of supply has appeared many times in current publications.

Construction

The keyer can be fabricated any way the builder desires. I built mine into a 15.24 x 17.7 x 25.4 cm box. Keep leads as short as possible and use a single point ground and a single point 5V connection from the supply. Run a separate ground and 5V line to each

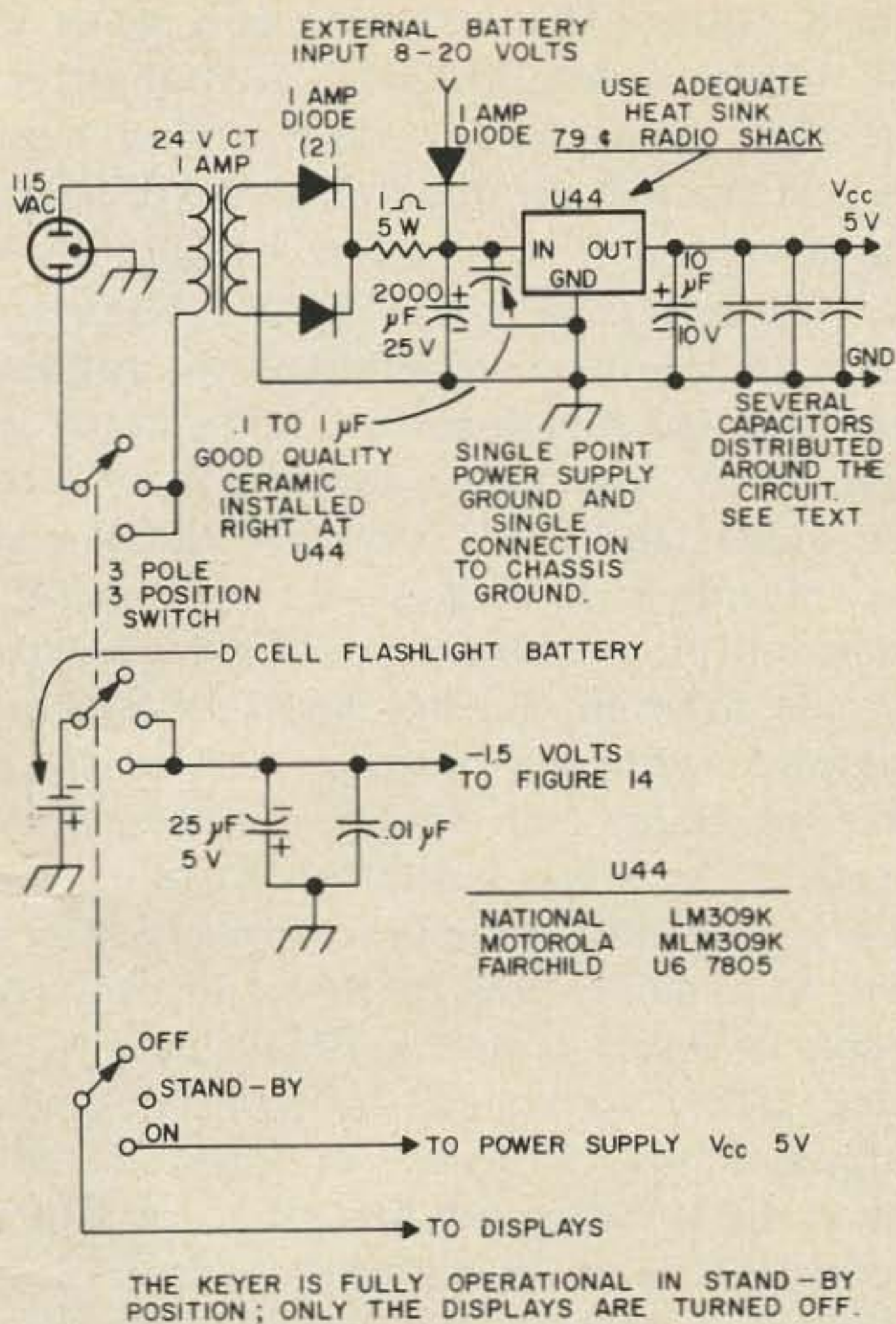


Fig. 17. Power supply

card or group of ICs, and run a separate ground and 5V line to whatever displays you choose. Use some .001 μF capacitors as bypasses from 5V to ground on each card or group of ICs. A couple of 10 to 50 μF capacitors sprinkled around will always make digital circuits quieter and never hurt.

If you counted the ICs on the two cards in the photographs you came up with 40. However, the schematic shows 42. CD4035, 4 bit shift registers can be used as quad D flip-flops, and 2 of these could replace 4 CD4013 dual D flip-flops. But since the Q and Q BAR outputs are not both available, other substitutions and rearrangements must be made. Because of the difficulty in splitting a complex device, such as the 4035, over several schematics, and the confusion it might create, I decided it was best in the long run to add two chips to simplify things. Also, the sidetone was modified after the pictures were taken, so you won't find Q1 or Q2, either.

PROM Coding

Figure 18 shows the coding in my PROM to call CQ. The sequence programmed is CQ CQ CQ DE WIGCA WIGCA WIGCA (re-

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Assort. NPN GP TYPES, 2N3565, 2N3641, etc. (15)	\$2.00

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2N3638 TYPE Gen. Purpose Amp & Sw	4/\$1.00
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2N5486 TYPE RF Amp to 450 MHz (plastic 2N4416)	3/\$1.00
2N5163 TYPE Gen. Purpose Amp & Sw (TO-106)	3/\$1.00
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	A	B	A	B			
	OUTPUT BITS						
	1	2	3	4			
1	1	0	0	1	—	●	C
2	1	1	1	0	LS	—	
3	1	0	0	1	—	●	
4	1	0	0	0	—	WS	Q
5	1	0	0	1	—	●	
6	1	0	0	1	—	●	C
7	1	1	1	0	LS	—	
8	1	0	0	1	—	●	
9	1	0	0	0	—	WS	Q
10	1	0	0	1	—	—	
11	1	0	0	1	—	●	C
12	1	1	1	0	LS	—	
13	1	0	0	1	—	●	
14	1	0	0	0	—	WS	Q
15	1	0	0	1	—	●	
16	0	1	1	1	●	LS	D
17	0	1	0	0	●	WS	E
18	0	1	1	0	●	—	
19	1	0	1	1	—	LS	W
20	0	1	1	0	●	—	
21	1	0	1	0	—	—	
22	1	0	1	1	—	LS	I
23	1	0	1	0	—	—	
24	0	1	1	1	●	LS	G
25	1	0	0	1	—	●	
26	1	0	0	1	—	●	C
27	1	1	0	1	LS	●	
28	1	0	0	0	—	WS	A
29	0	1	1	0	●	—	
30	1	0	1	1	—	LS	W
31	0	1	1	0	●	—	
32	1	0	1	0	—	—	
33	1	0	1	1	—	LS	I
34	1	0	1	0	—	—	
35	0	1	1	1	●	LS	G
36	1	0	0	1	—	●	
37	1	0	0	1	—	●	C
38	1	1	0	1	LS	●	
39	1	0	0	0	—	WS	A
40	0	1	1	0	●	—	
41	1	0	1	1	—	LS	W
42	0	1	1	0	●	—	
43	1	0	1	0	—	—	
44	1	0	1	1	—	LS	I
45	1	0	1	0	—	—	
46	0	1	1	1	●	LS	G
47	1	0	0	1	—	●	
48	1	0	0	1	—	●	C
49	1	1	0	1	LS	●	
50	1	0	0	0	—	WS	A
51	0	0	1	0	WS	—	Repeat
52	0	1	1	0	●	—	K
53	0	0	1	1	WS	LS	Stop

OP-CODE BIT

A	B	CHARACTER
0	0	Word Space — WS
1	0	Dash
0	1	Dot
1	1	Letter Space — LS

WS/WS = Repeat

WS/LS = Stop

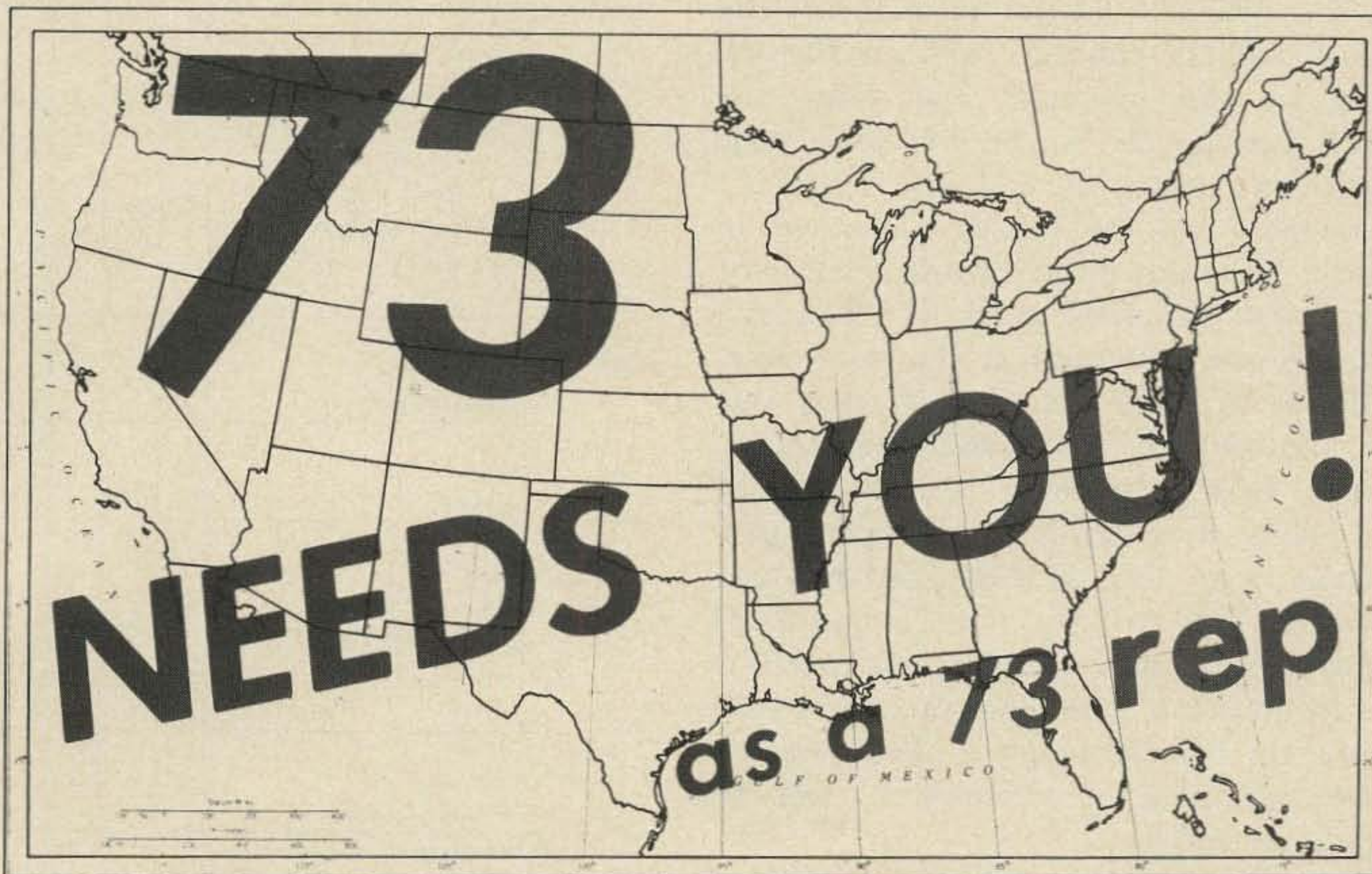
peat)K (stop). This will serve as a guide if you decide to install PROMS in your keyer. The logic levels are the same as they have been all through the discussion of MOSKEY; a high = logic 1 = 5V, a low = logic zero = 0V. Unfortunately some PROM manufacturers use this logic definition on the address lines and inverted logic on the outputs; a logic 1 = 0V, and a logic zero = 5V. Be sure you understand it for whatever PROM you use. Murphy's Law says you have a 50% chance of programming the PROM with the outputs inverted. I have seen PROMs programmed with the outputs inverted even after checking and double checking spec sheets. If by some fulfillment of Murphy's Law your PROM outputs are inverted, don't fret. You don't have to throw it away. A couple of inverters on the PROM outputs if using 256 x 4's or on the first level mux outputs if using 32 x 8's can correct it. But if you did it wrong the first time and add a second PROM, do it wrong the second time. Otherwise you'll have inverters on the first PROM and not on the second, etc., and it could get to be a confusing mess.

Operation

When the wiring is all completed and double checked, turn on the power. Usually one dot and one dash will be outputted when the keyer is turned on. Capacitors C301, C302, C303 and C304 cause the dot and dash latches to get set when power is turned on. To operate the keyer as a normal IAMBIC keyer, just plug in your squeeze paddle (or regular paddle) and send. Don't become discouraged if you're trying squeeze keying for the first time and find it difficult. I practiced for about three hours before I felt confident enough to put it on the air, but then the results are fantastic. The ease of squeeze keying combined with letter and word spacing will give you a fist to be proud of.

To program the keyer select a starting address and press the PRESET button. The displays will read the address selected. Turn on the PROGRAM switch and send your favorite sequence on the key. When you have completed sending press the STOP STORE button to store away a stop in-

Fig.18. Example of PROM coding to send CQ.



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struction. Turn off the PROGRAM switch. Press the PRESET button again to set the memory address counter back to the beginning of the sequence and press the START switch. The keyer will send your sequence and stop at the end of it.

Sequences can be loaded anywhere in memory. Write down the starting location of each so you can keep track of them and select the one you want at the right time. It's better to store them sequentially one after another so you don't accidentally program over something already stored away. Also if a sequence is being programmed near the end of memory and eventually gets to the last location of memory, the address counter will overflow back to location zero and the keyer will continue on. If something was already stored at the beginning of memory it will be written over and lost.

To use the repeat feature first decide what you want to send and which part you want to repeat. For example, to have the keyer send CQ DE WIGCA CQ DE WIGCA K (stop) program it as follows: Select a starting location, say 1000. Press the PRESET switch and turn on the PROGRAM switch. Send CQ DE WIGCA. (Display reads 1046, right?) Press the REPEAT STORE switch and then send the letter K. Press the STOP STORE switch, and turn off the PROGRAM switch. (Display reads 1054). Press the PRESET switch to set the memory address counter back to location 1000. The address switches must be left at 1000 when sending the sequence for it to come out properly. Press the START switch and the keyer will send CQ DE WIGCA CQ DE WIGCA K (stop).

One other feature the keyer has, although I haven't found a very practical use for it yet, is to cascade two sequences. You can have the keyer send a message and by use of the repeat instruction have the keyer jump to another message. Start at location 0000 and program HI. The display reads 10. Press the repeat store switch. Now select another address, for example, 50. Press the preset button and program in GANG. The display reads 66. Press the stop store switch and take the keyer out of programming mode. Select 0000 on the address switches and

Signal number	Signal name	Used on figure number				
		3	5	8	13	14
1	CLOCK	x	x			
2	CLOCK2 BAR	x	x			
3	EOI•CLOCK2	x		x		
4	EOI•CLOCK BAR	x		x	x	
5	KEY DASH IN PROGRESS	x			x	
6	KEY DOT IN PROGRESS	x			x	
7	KEY DOT + KEY DASH IN PROGRESS BAR	x		x		
8	MEMORY WS NEXT OP CODE	x		x	x	
9	MEMORY LS NEXT	x	x	x		
10	MEMORY DASH NEXT	x		x		
11	KEY WS NEXT BAR	x		x		
12	MEMORY WS NEXT NEXT BAR	x		x		
13	RUN	x	x		x	
14	KEY NEXT	x		x		
15	WSFF + LSFF	x		x		
16	EOI DELAYED BAR	x		x		
17	OUTPUT	x				x
18	OUTPUT BAR	x				x
19	WSFF	x	x		x	
20	KEYMODE FF	x		x		
21	CLOCK2		x	x		
22	CLOCK BAR		x		x	
23	STOP NEXT BAR		x	x		
24	STOP + REPEAT STORE BAR			x	x	
25	REPEAT SKIP BAR			x	x	
26	RAM A INPUT			x	x	
27	RAM B INPUT			x	x	
28	PRESET			x	x	

Fig.19. Final assembly figure interconnection check list.

press the preset button. Now select 50 on the address switcher but do not press the preset button. Press the start switch and the keyer sends HI. Then it comes to the repeat instruction and presets the counter to the address selected by the switches, which normally should be the starting location for the message being sent, but in this case it isn't. Instead of repeating HI, the keyer goes to memory location 50 and continues on to send GANG, and then stops. You can only do it once though, because the REPEAT FF gets set and any further repeat instructions are ignored.

Conclusion

The keyer has added a new dimension to CW operation and using it on the air has certainly been a pleasure. I find myself programming little short phrases into it to have at instant recall whenever I want to send them. All comments received on the air have been favorable as to the keyer's timing of characters and spacing of characters. I think it competes with W1AW's code practice machine!

... W3HPX

August 73 Scan Converter Update

The following changes are to be made in the camera scan converter article which appeared in August, 1974 issue of 73 Magazine.

Significant Text Errors:

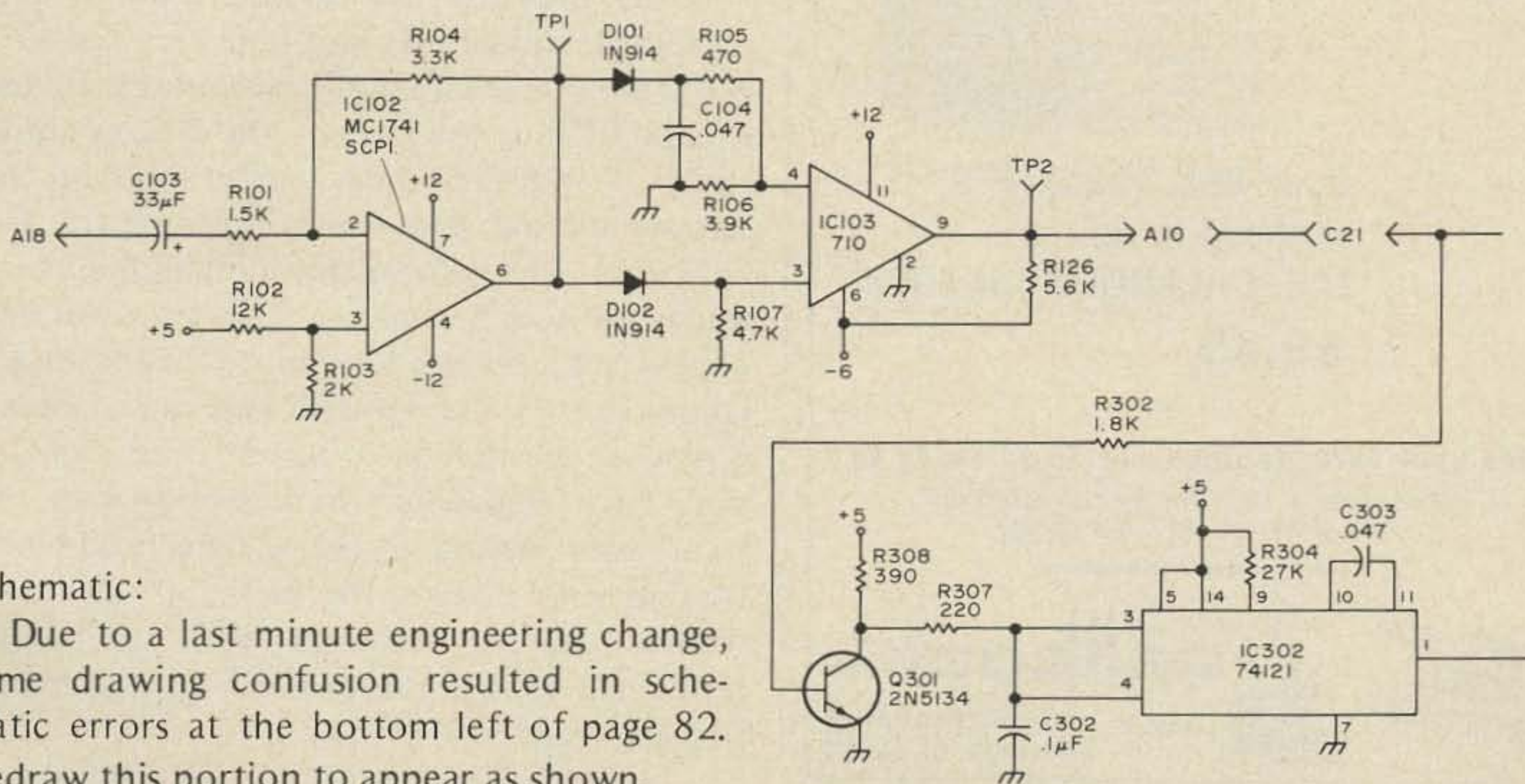
Page 77 Right column Line 8: \approx MHz should be \approx 5MHz Page 80 Line 29: TP14 should be TP13.

Parts List:

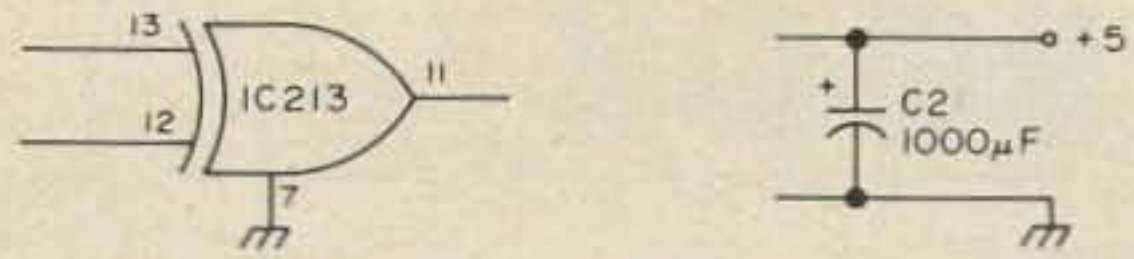
C105, C301* should be .001 Silver Mica
C107 should include 4.7mfd, 10v tantalum
C109* should be .0033 Mylar (.003 ok, though.)
C210, C202, C203 should read C201, C202, C203
C204, C205 should be 560 pf silver mica
C206*, C207* should be 47 pf silver mica
C209* should be a 800 pf silver mica
C302 is a .1 mfd Mylar
R1 is 200K
R2, R4 are 100K chassis mounted pots
R3 is 470K
R101 is 1.5K
R111▲, R113, R126 should be R111▲, R113, R306
R302, R306 should be only R302
Add: R308. . .390Ω

Schematic:

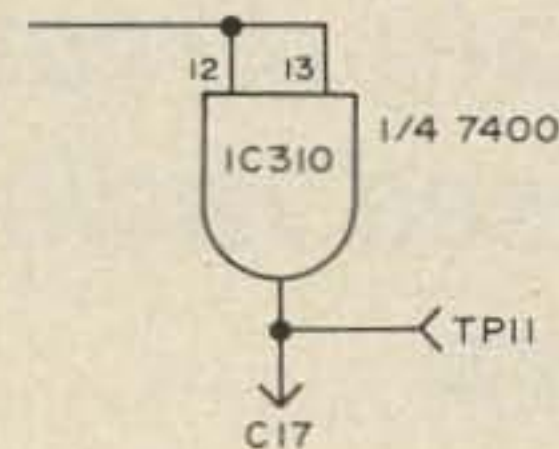
Due to a last minute engineering change, some drawing confusion resulted in schematic errors at the bottom left of page 82. Redraw this portion to appear as shown.



In addition:



Move TP11 from the present location to:



Scope Patterns:

The first dual trace pattern on page 78, showing TP21 and TP22 should read "-trigger".

Misc.

In the "volts" box of the bypass table on page 83, insert "-6" in the blank box between +12 and -12.

The following list of IC functions was edited out of the schematic. This list may be of use to your understanding of component functions.

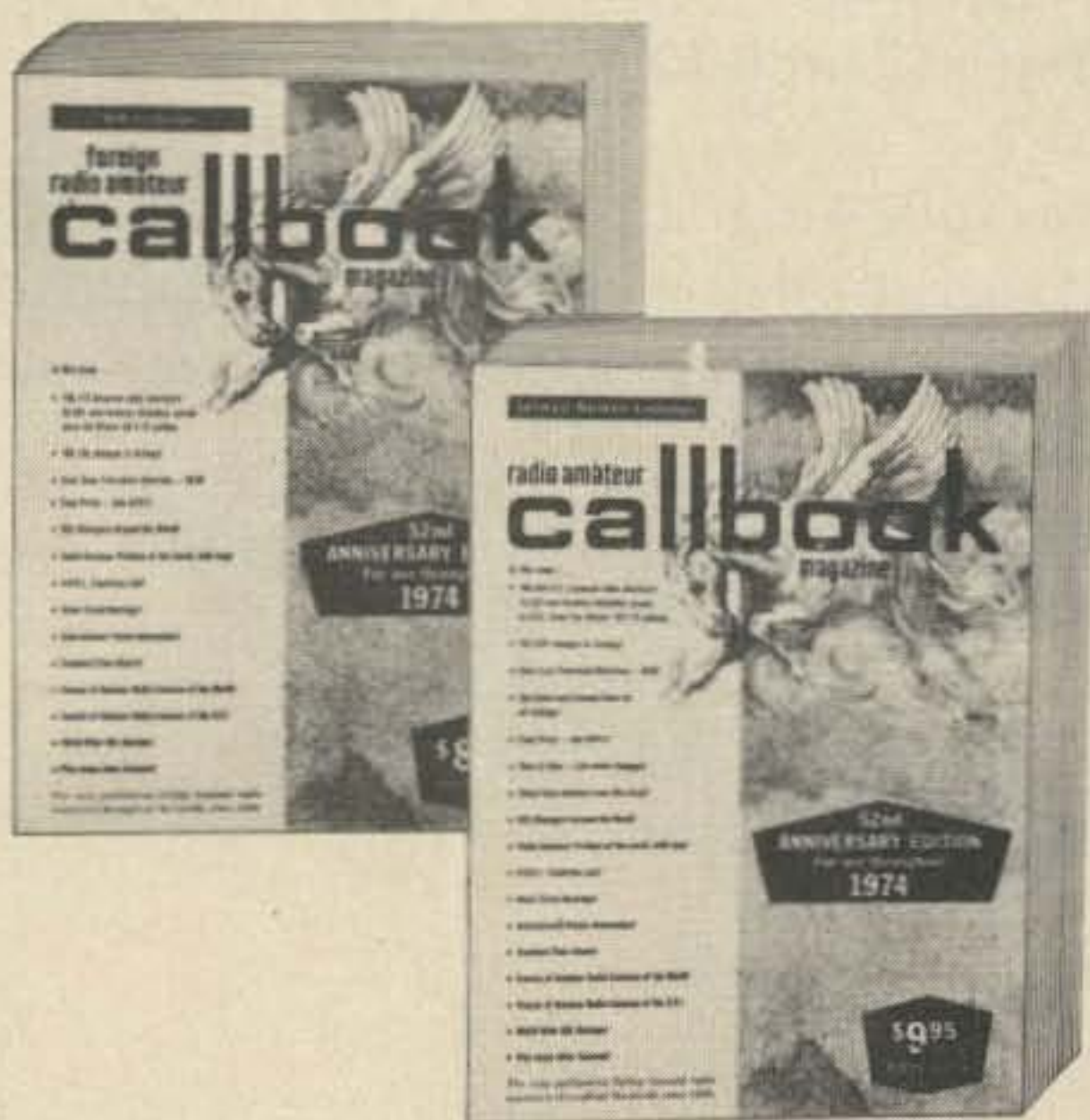
- IC101 - White and Black Compression
- IC102, IC103 - Sync stripper
- IC104 - D/A Converter
- IC105 - LPAF and D/A Amplifier
- IC106 - VCO

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IC202 to IC209 – A/D Converter
IC212 – Memory
IC213 – Gray to Binary Converter
IC214 – Reverser
IC215 – Video/Gray Scale Multiplexer
IC216 – 2 Phase Clock Driver
IC301, IC302 – Sync Separator
IC304 to IC306 – Vertical Counter
IC307, IC308 – Line Sample Selector
IC309 – 8-8.5 Seconds Gate
IC311 – Horz Sync Singleshot
IC312 – Vert Sync Singleshot

Several foreign hams have noted a picture foldover problem when operating from 50Hz lines. A "fix" is being investigated and will be reported later.

Jacking the Galaxy Transceivers

The earlier Galaxy III and V transceivers have no provision for using a pair of high-impedance headphones. These transceivers just happen to have a hole in the back panel for use with a remote vfo – you are supposed to run a length of coax through this hole to the phono jack that is mounted on the side of the vfo enclosure. Not many hams use a remote vfo with their transceiver, but more would like to use a set of high-impedance headphones instead of the speaker.

It just happens that a standard phone jack receptacle will fit into this hole very handily. A plate-to-voice coil audio output transformer will fit into the case of the Galaxy quite easily. I mounted mine under one of the screws holding down the cover of the vfo enclosure. The transformer's high impedance leads are connected to the newly-added phone jack and the low impedance leads are connected to the speaker jack that Galaxy provided on the back panel. You can use your high impedance headphones with the transceiver instead of the speaker, and when trading time comes, the jack and the transformer can be removed with no marks remaining to tell the dealer you had modified the transceiver.

...WB6PKA

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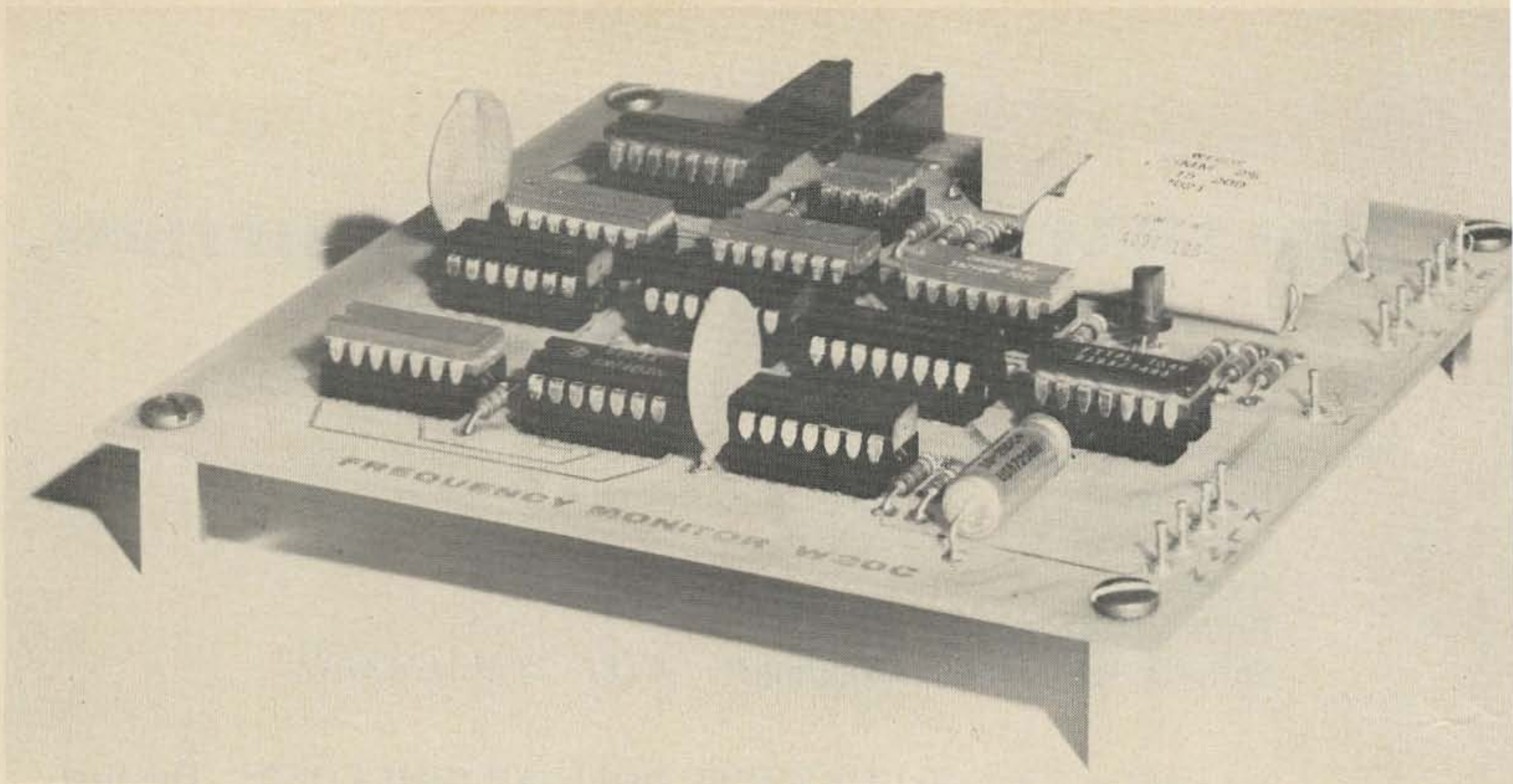
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NAME _____

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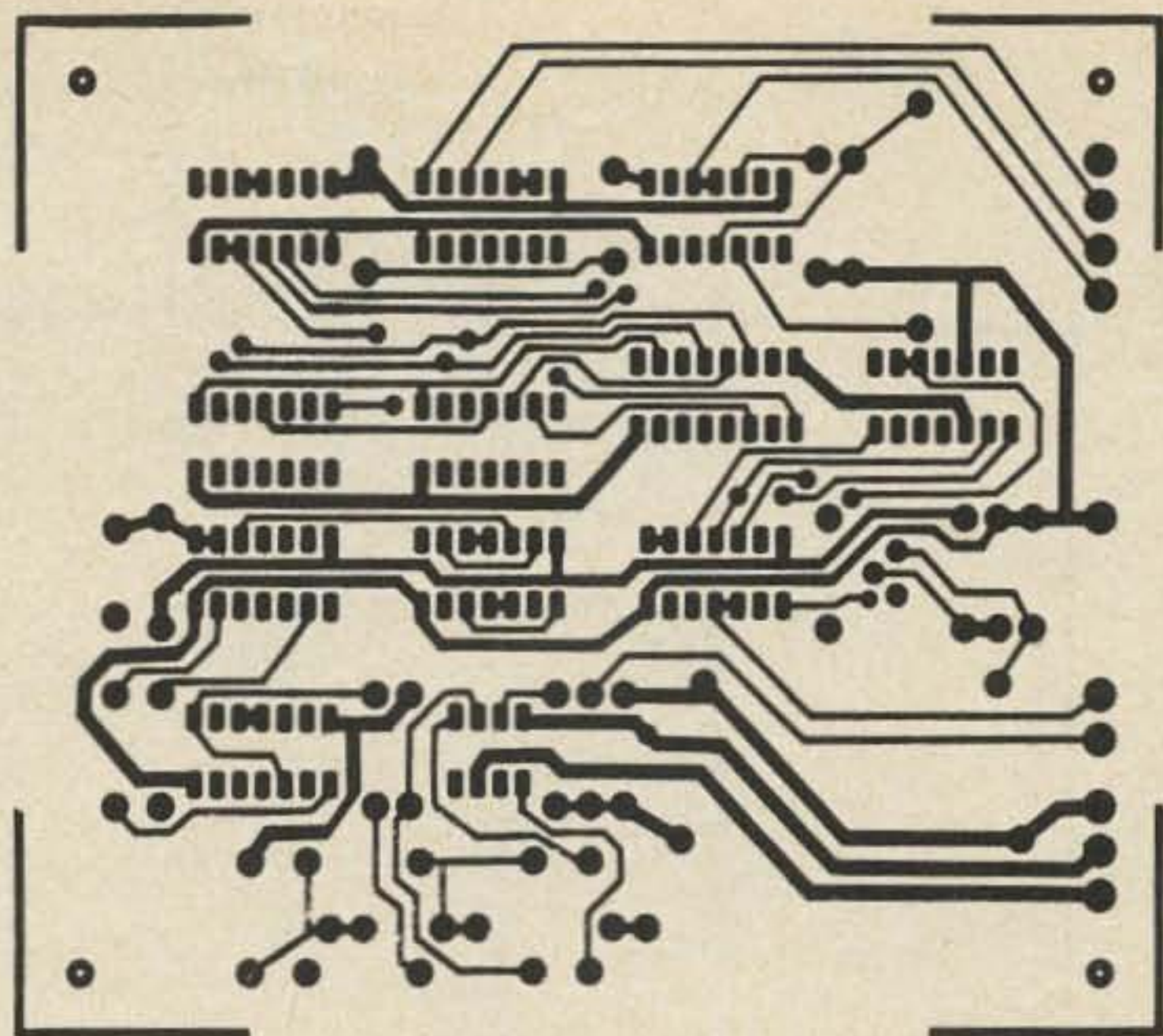
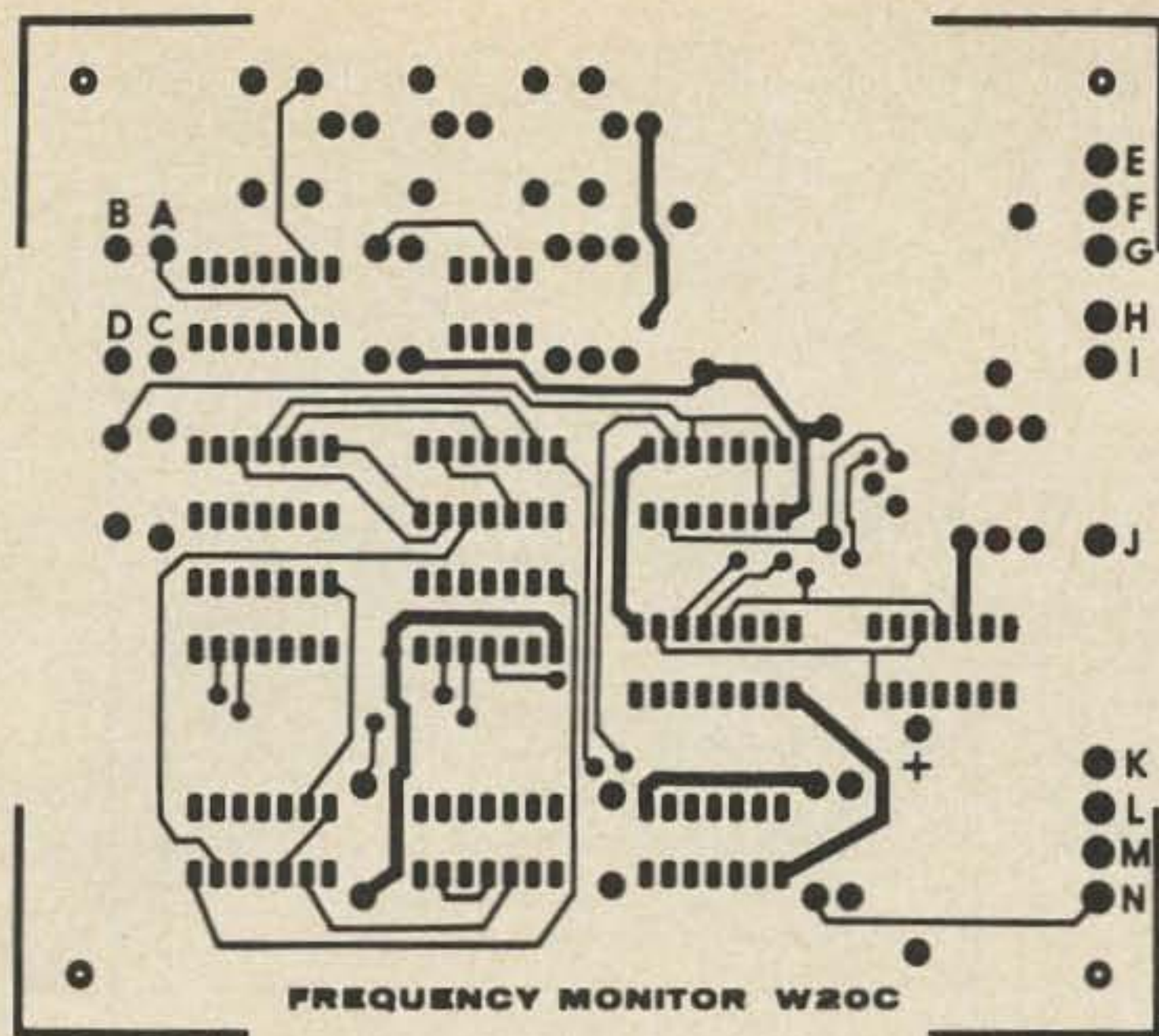
CITY STATE ZIP





Beep-Beep-Beep-Beep, You're High

Digital unit to automatically tell repeater users whether they are high or low in frequency. What self-respecting repeater group can pass up this bit of frosting?



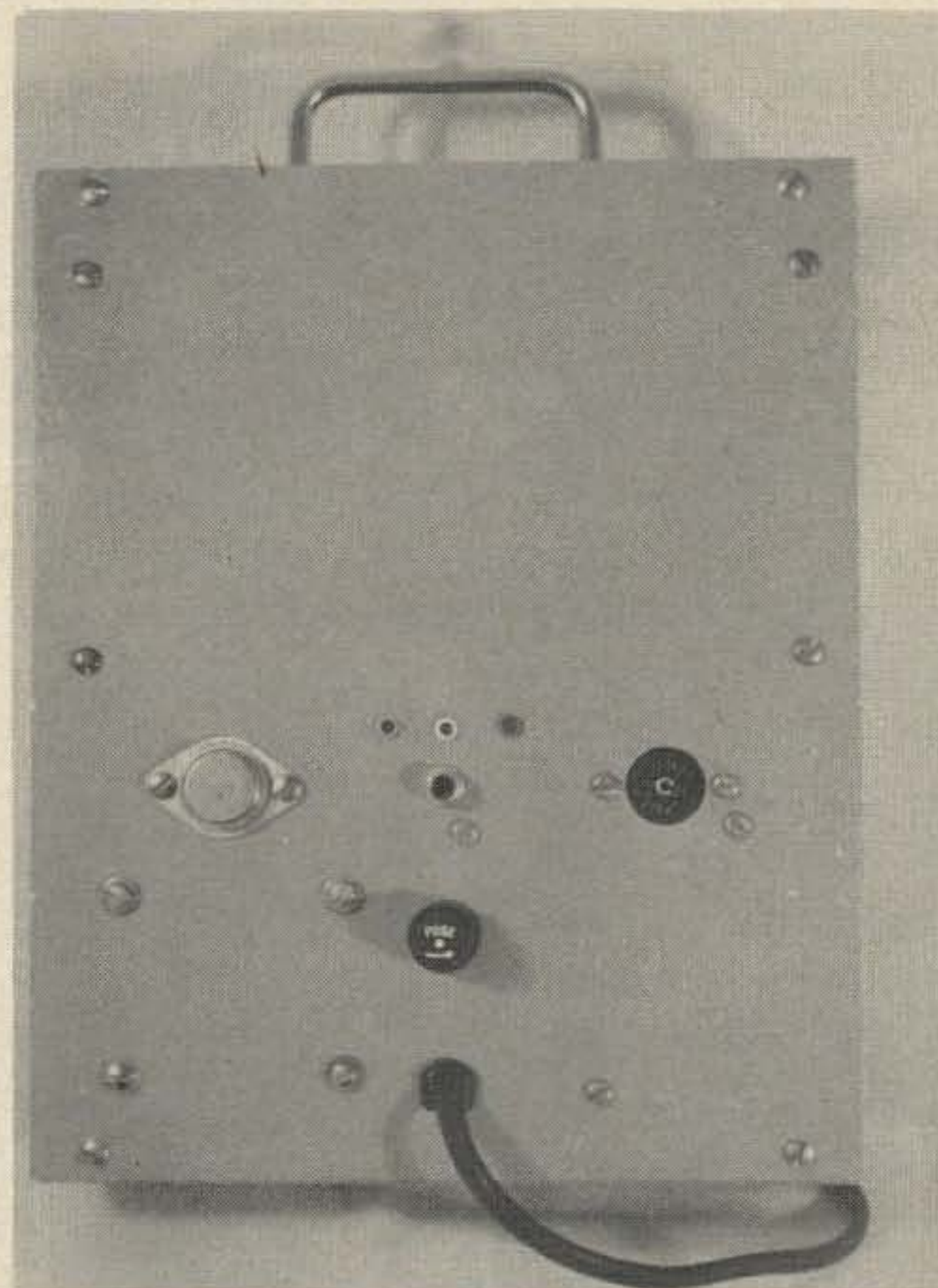
Front and back layout of the board — one half size here.

Bill Fisher W20C
2 Barnard Road
Armonk NY 10504

One of the most common adjustments that operators on FM repeaters find necessary to make, at one time or another, is the crystal trimming adjustment required to set their transmitters "on frequency." Most hams prefer to use a frequency counter to accomplish this, but although these instruments are increasing in number in ham shacks every day, they are still not readily available to the majority of operators. The alternative method of frequency adjustment usually employed is to be "talked on" frequency by someone at the receiver site watching a discriminator meter. This assistance, unfortunately, is not necessarily available very often or at a convenient time. The frequency monitor to be described here was designed to enable an operator to set his transmitter on frequency without the need for either a frequency counter or outside assistance. Furthermore, once this adjustment is made, the frequency monitor will continue to provide a constant check on it and automatically indicate if, and when, further adjustment is required.

The frequency monitor is installed at the repeater, connected to the input frequency

receiver, where it continuously monitors the output of the discriminator. When it detects a received carrier which is removed from the center frequency by a given amount, it signals this to the digital circuitry and also indicates whether the carrier is above or below the center frequency. This information is temporarily stored by the monitor until the carrier is removed from the receiver input. At that time the information is then transmitted by the repeater input. At that time the information is then transmitted by



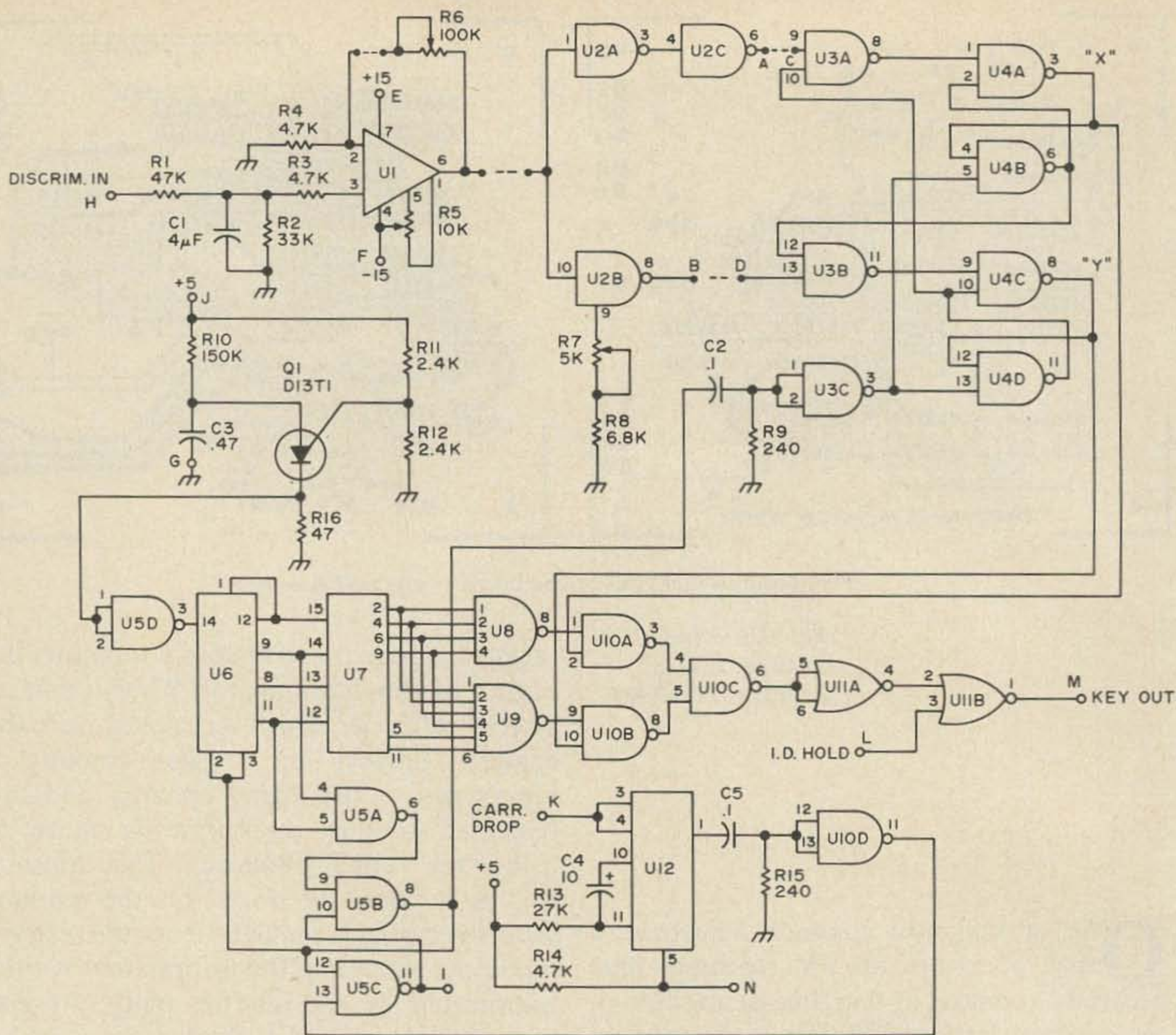


Fig. 1. Schematic of the high-low frequency monitor.

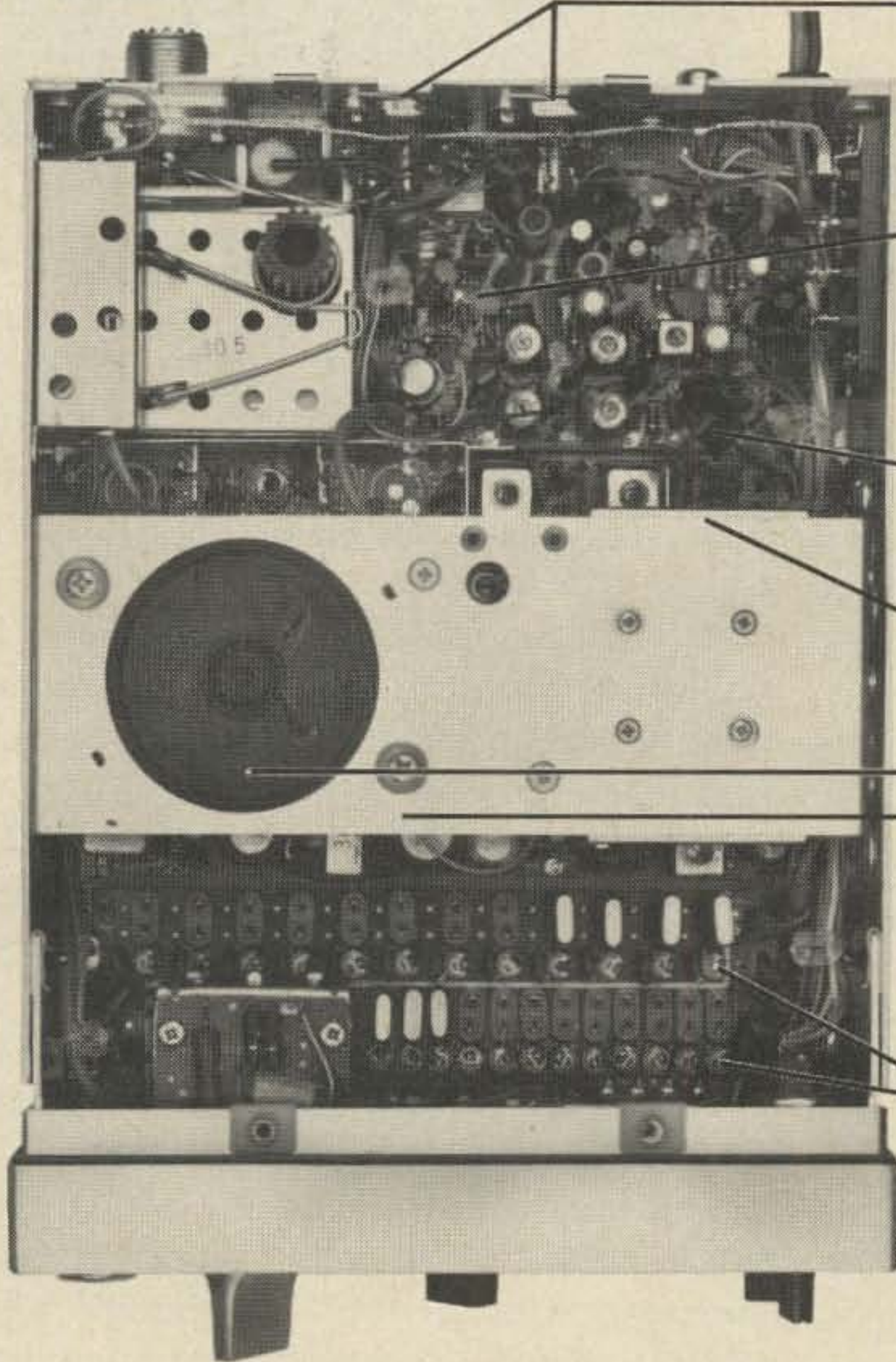
the repeater in Morse code in the form of a letter "H" or a letter "L" if the signal was high or low with reference to the center frequency. If, however, the received carrier at the repeater is within a frequency "window" (± 750 Hz from center), no Morse letter will be sent. The operator, therefore, merely has to adjust the crystal trimmer until he no longer hears an "H" or an "L" when he releases his push-to-talk button, indicating that he is within the "window." This frequency window is adjustable to whatever limits are desired, but the ± 750 Hz spread used at WR2AC1, White Plains, N.Y., has been found to be a practical figure.

The frequency monitor is designed to have its output key the same audio oscillator used for the repeater I.D. It also requires two logic signals normally present in I.D./control circuitry. They are: (1) a so-called

"carrier drop" signal which falls from a high (>2.4 v.) to a low (<0.8 v.) whenever a carrier is removed from the receiver input, and (2) a so-called "I.D. hold" signal which remains high during the I.D. Referring to Fig. 1, operation of the circuit is as follows: The output of the receiver discriminator is connected through R1 and R3 to the non-inverting input of U1, a 5556 op amp. (Note: The point of connection at the receiver is the same one ordinarily used for a zero-center microammeter.) The discriminator output is amplified by U1 and appears at pin 6. This bi-polar (i.e. positive and negative) signal at pin 6 is then presented to U2, pins 1 and 10. U2 is a 1489 which has four identical sections and is specifically designed to accept bi-polar signals and convert them to zero and +5 volt logic levels. Each section can be individually adjusted to

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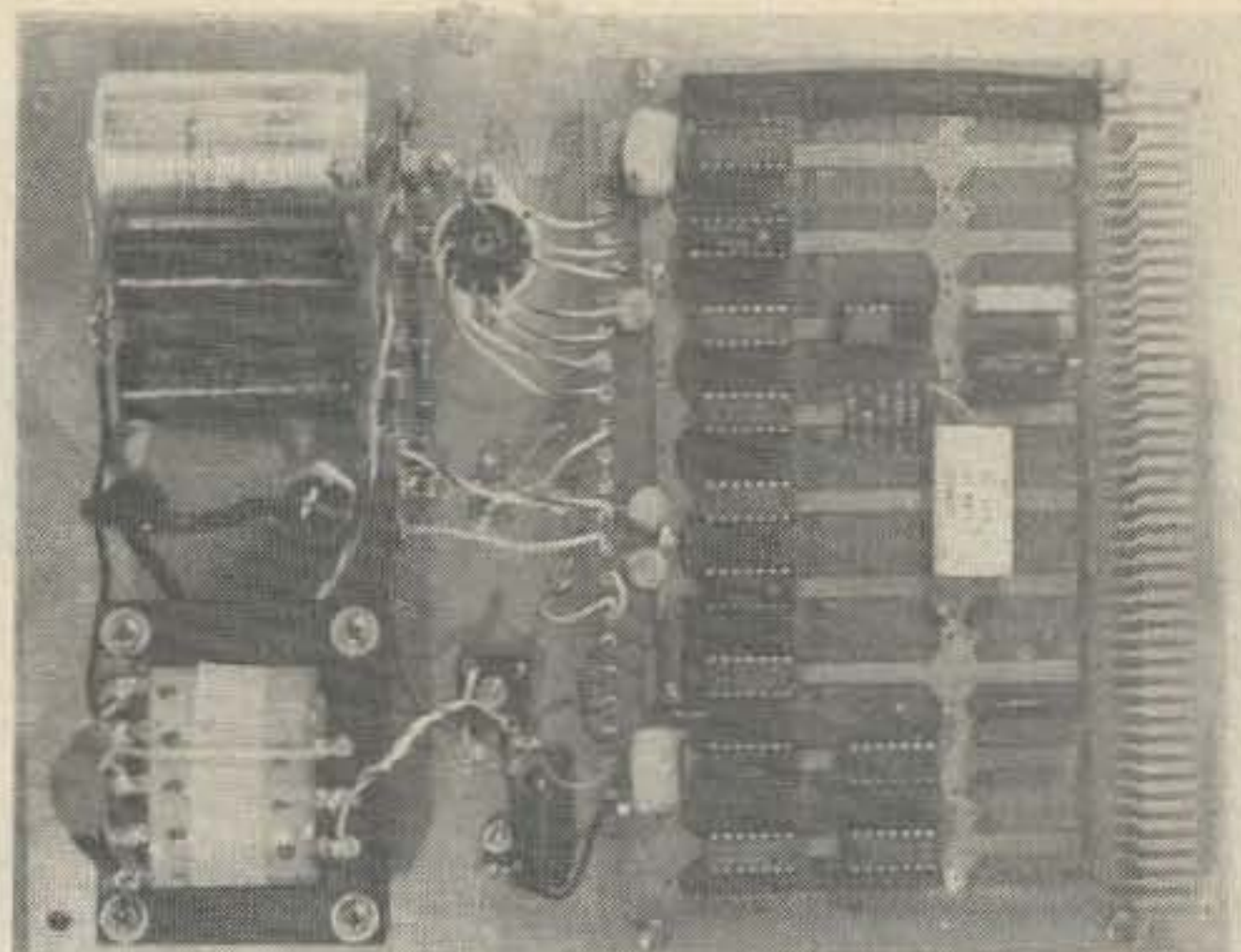
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a specific positive or negative threshold level and in this case one section (U2A) is set for a positive threshold of approximately 1.2V and another section (U2B) is adjusted for a negative threshold of equal value. A third section (U2C) is merely used as an inverter. (The fourth section is not used). Let's assume that a carrier is received which is just outside the high frequency limit of the window (i.e. 750 Hz high) and that this produces a positive voltage swing. The gain of U1 would then be adjusted (by means of R6) so that, under these conditions, pin 6 would just reach the threshold level of U2A (approximately +1.2 volts). When U2A sees this level, its output (pin 3) drops abruptly from a high (approximately +4V) to a low (approximately zero V). This low is then inverted by U2C and again by U3A causing RS flip flop U4A/U4B to "set" pin 3 (point X) high. Similarly, if a carrier is received which is just outside the low frequency limit of the window (750 Hz low), pin 6 of U1 would just reach the threshold of U2B (approximately -1.2 volts) and pin 8 of U2B would rise abruptly from a low to a high. This high would then be inverted by U3B and cause RS flip flop U4C/U4D to "set" pin 8 (point Y) high. In summary, therefore, point X will go high if a signal on the high side of the frequency window is received and point Y will go high if a signal on the low frequency side of the window is received. As soon as one of these points goes high, it will remain high (until cleared) and simultaneously the other point is inhibited from

IC #	IC Type	+5V PIN	GAD PIN
U1	5556	#	#
U2	1489	14	7
U3	7400	14	7
U4	7400	14	7
U5	7400	14	7
U6	7493	5	10
U7	7442	16	8
U8	7430	14	7
U9	7430	14	7
U10	7400	14	7
U11	7402	14	7
U12	74121	14	7

* PIN 7 = +15V
 PIN 4 = -15V

Table 1.



Prototype monitor and power supply.

going high by means of the transposed connections to pins 10 and 12 of U3A and U3B, respectively. This inhibit action insures that only one indication is processed at a time. The method of clearing the flip flops will be covered later.

U5 through U12 comprise the readout section of the monitor. Q1, a programmable unijunction, provides the clock signal. The frequency of oscillation of Q1 can be adjusted by selecting the value of R10. The 150K, shown for R10 in Fig. 1, corresponds to a code speed of approximately 20 wpm. Incidentally, if it is convenient to use a freerunning clock signal from existing I.D. circuitry, Q1 and its associated components may be omitted and the external clock signal connected to pins 1 and 2 of U5D. Assuming, for the moment, that pins 2 and 3 of U6 are low, U6, a four bit binary counter (7493), will be clocked by the oscillator (via U5D) and U6's binary output (pins 12, 9, 8 and 11) will address the inputs of U7, a one of ten decoder (7442). The outputs of U7 are connected to U8 and U9 in such a manner as to program (in Morse code) an H from U8 and an L from U9. The two outputs of U8 and U9 are gated through U10A and U10B, respectively. Point X, as previously discussed, when high, indicates a signal on the high side of the window. Point X connected to pin 2 of U10A, therefore, will permit the H to pass when it is high and Point Y, connected to pin 10 of U10B, will permit the L to pass when it is high. Whichever signal is permitted to pass is then routed through U10C, U11A and U11B. The purpose of U11B is to permit inhibiting any

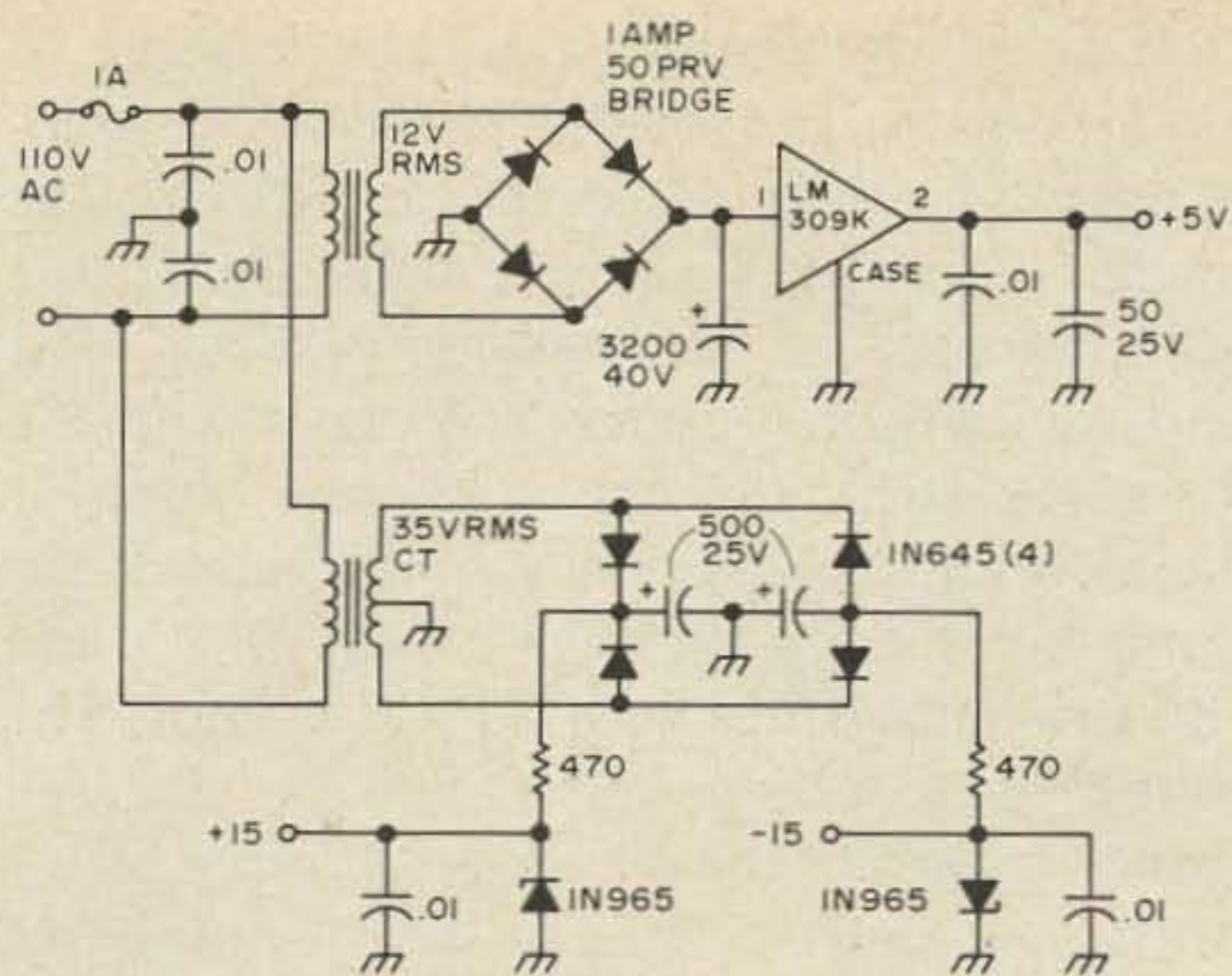


Fig. 2. Power supply, if needed.

Morse code output from the monitor while the repeater I.D. is being sent. To implement this inhibit action it is necessary to apply the "I.D. hold" signal (from existing I.D. circuitry) to pin 3 of U11B.

In the resting, or idle, state of the monitor, pins 2 and 3 of U6 are high and thus inhibit U6 from being clocked. Whenever a carrier is removed from the receiver input, however, the "carrier drop" signal causes pins 3 and 4 of U12 to go from a high to a low. This, in turn, causes U12, a one-shot multivibrator (74121), to produce a *negative-going* pulse at pin 1. The duration of this pulse is determined by R13 and C4, and for the values shown, is approximately 200 ms. Thus, 200 ms after the carrier drops, pin 1 of U12 *returns* to its high state and momentarily causes pins 12 and 13 of U10D to go high (via C5). Pin 11 of U10D, therefore, momentarily drops to a low causing RS flip flop U5B/U5C to set pin 11 of U5C (point I) high and pin 8 of U5B low. This results in pins 2 and 3 of U6 going low, allowing U6 to be clocked and thus initiates transmission of a frequency indication. Note that U6 will be so clocked each and every time a carrier is removed from the receiver input but a letter will be transmitted only if point X or point Y has been set high due to the carrier having been outside the frequency window. If neither X or Y is high, even though U6 goes through its counting sequence, the lows appearing at pins 2 and 10 of U10A and U10B will prevent any output from them. Similarly, when a carrier drop initiates an I.D., U6 will also be

clocked, but even if X or Y is high at that time, pin 3 of U11B will be held high during the I.D. sequence and so inhibit any output from the monitor. Once clocking of U6 is initiated, it will continue counting until the count of 10 when pins 9 and 11 are both high. When this occurs, pins 4 and 5 of U5A also go high causing pin 6 of U5A to go low, resetting RS flip flop U5B/U5C. This resetting once again places a high on pins 2 and 3 of U6 resetting it and also inhibiting further clocking. U6 remains in this state until the next carrier drop which starts the whole sequence over again. The reason for the one-shot multivibrator is merely to provide a suitable time interval between the dropping of the carrier and the transmission of the frequency indicating letter.

Simultaneously with pins 2 and 3 of U6 going high at the end of the counting sequence, pins 1 and 2 of U3C momentarily go high (via C2). This causes pin 3 of U3C to momentarily go low and thus reset both RS flip flops U4A/B and U4C/D. This resetting ensures that both points X and Y are reset to low to prepare them for the next frequency indication.

Point I in Fig. 1 is provided for those repeaters which do not employ any transmitter drop-out delay and can be used with existing control circuitry to ensure that the transmitter is held on for the duration of the readout sequence (approximately 1 second).

The prototype unit was constructed on an experimental type PC board which accepts the mounting of a multitude of ICs, all of which must be interconnected by hand-wiring. The board and its power supply was then mounted on a 7 x 10 panel and this panel then mounted in a 7 x 10 chassis so as to completely enclose the unit and provide effective shielding. With the PC board now available, a smaller enclosure may be used but shielding should still be provided for the monitor, as it should be for any solid state unit to be operated in the vicinity of a vhf transmitter. A 9 pin socket was used for the interconnecting (shielded) cable used to interface the monitor with the I.D./control circuitry. The lead from the receiver discriminator was brought in separately via an ordinary RCA type phono plug. This lead was also shielded and because of the location

of the receiver at the WR2ACI repeater site, was about 25 feet long.

Initial adjustment of the frequency monitor should begin by setting the threshold levels of U2A and U2B. Temporarily remove the jumper connecting pin 6 of U1 to pins 1 and 10 of U2. Next, apply a variable voltage source of approximately 0 to 2V dc to pins 1 and 10 of U2. (Any handy potentiometer connected across a flashlight battery will suffice to provide this variable voltage.) With just the 5 V supply connected to the frequency monitor, slowly vary the voltage to pins 1 and 10 of U2 while monitoring pin 3. As you bring the voltage up from zero, pin 3 will abruptly drop to zero from about 4V when the voltage on pin 1 reaches approximately +1.2V. Make note of the exact voltage on *pin 1* when this drop at pin 3 occurs. We will call this the positive threshold of U2A. Reverse the voltage (battery) polarity on pin 1 and 10 of U2 and monitor pin 8 of U2B. As you increase the voltage on pins 1 and 10 of U2 (in a negative direction), the voltage on pin 8 will abruptly rise from zero to about 4 volts. The threshold adjustment for U2B consists of setting R7 so that this abrupt change from low to high occurs at the same voltage on pin 10 (but negative in polarity) as previously noted for the positive threshold of U2A. Once set, this adjustment need not be touched again.

Disconnect the variable voltage source from pins 1 and 10 of U2 and reconnect the jumper between pin 6 of U1 and pins 1 and 10 of U2. Set R6 to about mid-range and verify that there is a jumper between pin 2 of U1 and the end of R6 as shown in Fig. 1. Connect the $\pm 15V$ supply to the frequency monitor, ground point H and monitor pin 6 of U1 with a voltmeter. Adjust R5 for zero (off-set) voltage indication of the voltmeter. This adjustment, like the previous one, is made once and then left alone. Remove the ground from point H, connect the 5V and the $\pm 15V$ supplies to the monitor and attach the variable voltage source to point H. For this step the voltage applied to point H should be variable in the range of 0 to $\pm 0.2V$. While varying the voltage to point H, monitor the voltage at pin 6 of U1. Pin 6 should follow the polarity of the input

voltage as you change it and also indicate an approximate gain of 10 (with R6 at mid-range). The final adjustment of R6 must be made with the monitor connected to the discriminator of the repeater receiver. The amount of gain required will depend on the characteristics of the particular receiver being used. If additional gain is required, the jumper provided between pin 2 of U1 and R6 can be replaced with a 100k resistor. The actual gain setting of R6 will be the one which produces the \pm voltages at pin 6 of U1 which are exactly equal to the previously set threshold levels of U2 *when* calibrated frequency signals, set to the desired high and low frequency limits, are fed, in turn, to the receiver input.

The connections between U2 and U3 shown in Fig. 1 (i.e. A to C and B to D) are to be used if a positive output from the receiver discriminator indicates a signal on the high frequency side of center frequency. If, however, the discriminator produces a negative output for a high frequency signal, these connections will have to be transposed so that A connects to D and B connects to C. (The PC board available provides convenient pads to facilitate these changes).

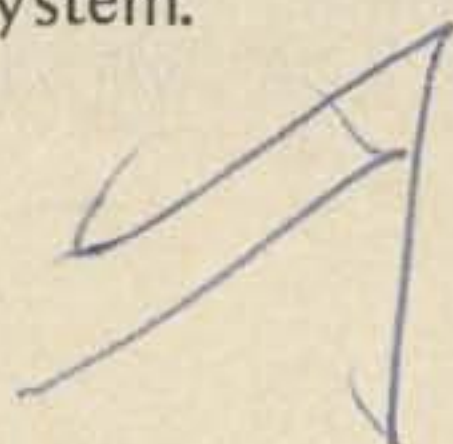
The time constant formed by R1, C1 at the input to the op amp is employed to allow time for transmitter oscillators (particularly frequency synthesizers) to "settle" before being processed by the monitor. Note: C1 must be a paper capacitor (not electrolytic).

Fig. 2 shows a suitable power supply for the monitor. If convenient, the unit may be powered from an existing power supply at the repeater. The monitor requires approximately 150 mils for the 5 volt digital circuits and 2 to 3 mils for the $\pm 15V$ supplied to the op amp.

Point N is provided to permit inhibiting operation of the frequency monitor, when desired, by remote control via control circuitry. To inhibit the monitor, Point N should be grounded.

This frequency monitor has been in continuous service at WR2ACI since January, 1974 and I am sure that other repeaters will find it to be, as we have, a useful addition to their system.

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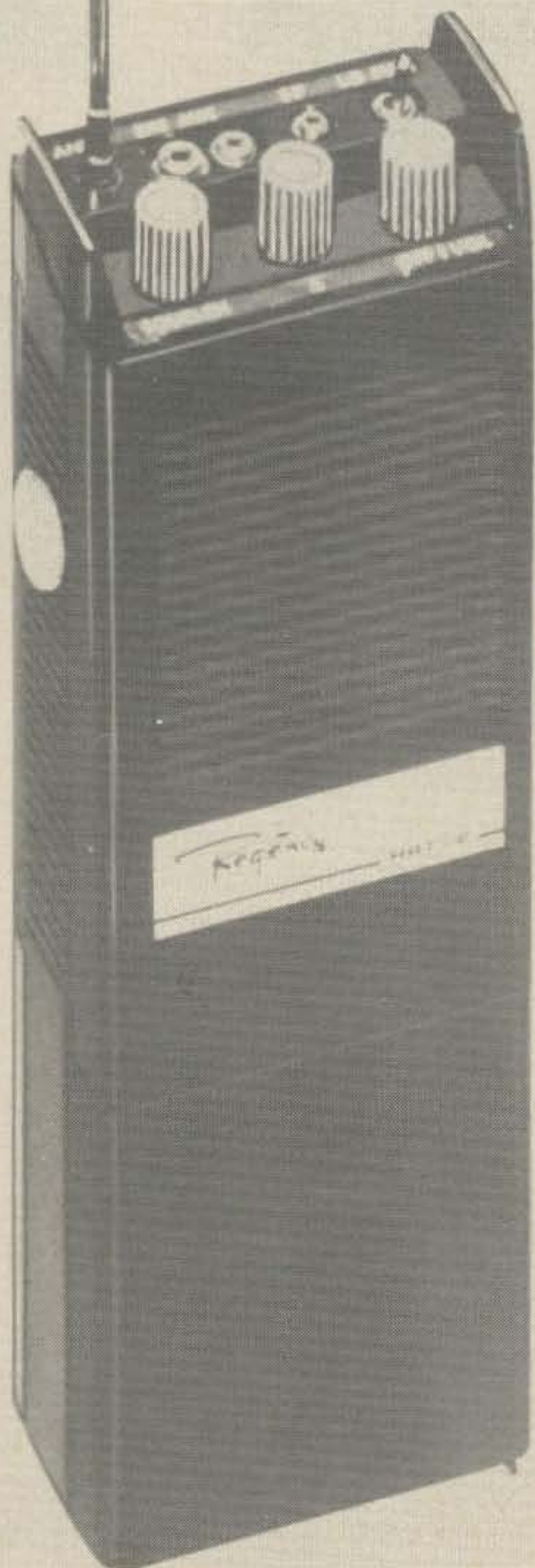
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What's Really Inside The Regency HT?



If you have been in the market for a hand-held transceiver for the 2-meter FM frequencies, you are by now aware that there are several such units on the market and that there is much diversity in both features and price. One unit, which is at the lower end of the price scale while still retaining a respectable position on the features chart, is the Regency Model HRT-2.

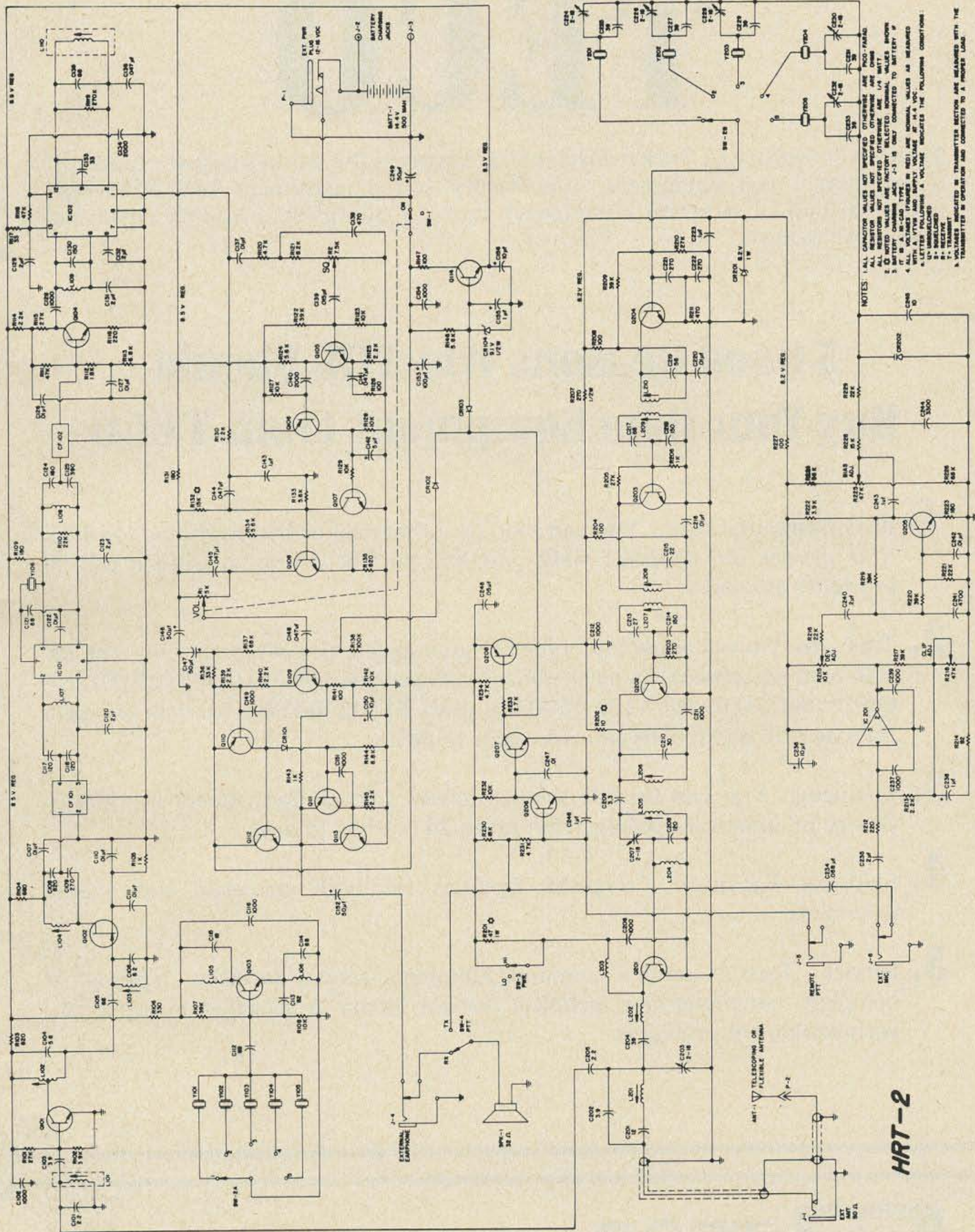
This transceiver is a five channel, all solid-state (3 IC's, 22 transistors, 6 diodes), compact package featuring a Hi-Low rf

output of 1W/2.2W and a receiver sensitivity of 0.7 μ V for 20dB quieting. Individual netting capacitors are provided for each of the 5 transmitting and 5 receiving crystals. All crystals are the plug-in type. Frequency modulation is generated via the standard biased varactor diode arrangement. An internal pot permits deviation adjustment from 0 to 7 kHz and is factory set at approximately 5 kHz. The receiver section is a double-conversion, super-hetrodyne design and uses two ceramic filters to assist in cross-channel interference rejection. Both transmitter and receiver are designed to operate uniformly across the entire 144-148 MHz band. Plug jacks are provided for using an external microphone with a remote PTT switch. (This is required when the rig is worn with a belt clip — a convenient mode of operation.) An external earphone jack is likewise provided.

The HRT 2 does not come battery equipped from the factory, leaving the operator with the choice of purchasing either the mercury type or the more expensive, rechargeable, nickel-cadmium battery pack. The ni-cad need not be removed from the transceiver for recharging, as there are two recessed contacts located on the bottom of the unit for this purpose. NOTE: these contacts are automatically *not* connected when a mercury battery is installed...they tend to make loud noises when an attempt is made at recharging. The battery charger, a rubber ducky antenna, external microphone, earphone, etc., are available from Regency.

One other feature of the handie-talkie, not yet mentioned, is that its case is made of Acrylonitrile-Butadiene-Styrene. Say that three times real fast! In other words, high impact plastic, for when the time comes that you will drop the unit from your beer can type grip.

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Behold, the complete schematic.

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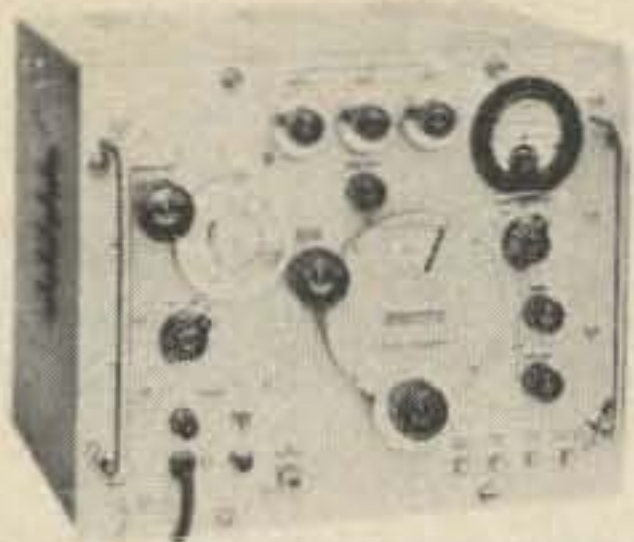
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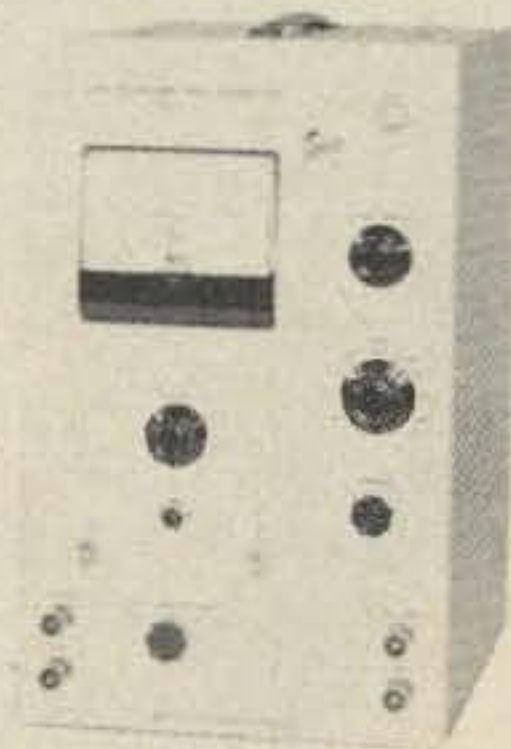
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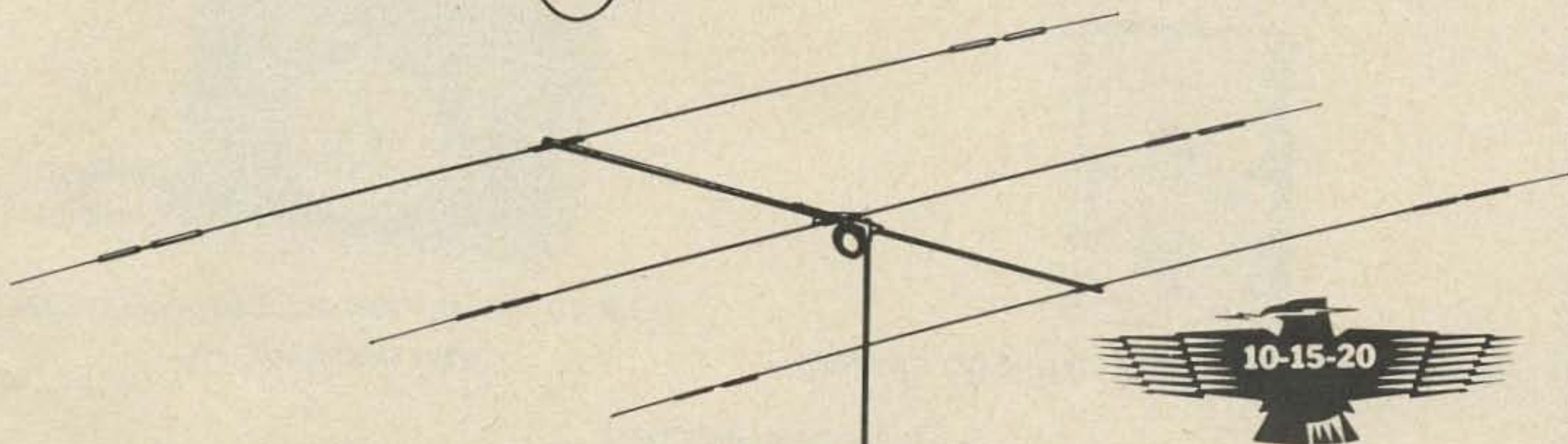
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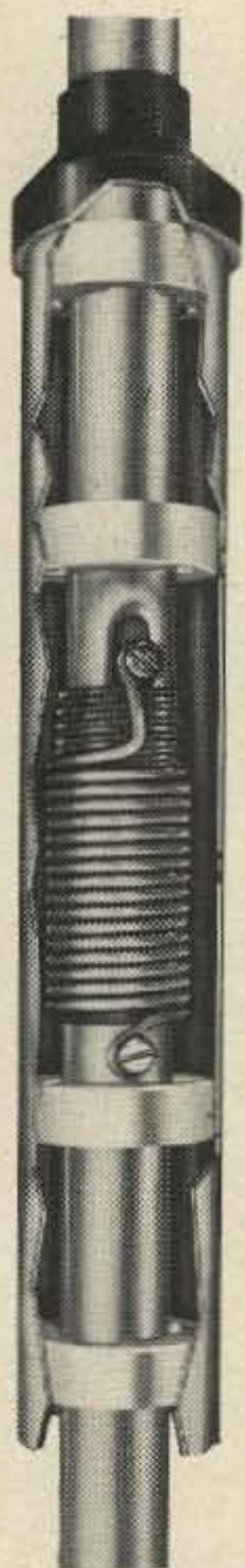
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Would You Believe 187,000 Phone Patches?

*Martin W. Krey K7NZA
7037 East Chaparral Road
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Some fine volunteer phone patch operations are going to bite the dust. The persistent winding down of American military involvement in Southeast Asia and the continuing homeward parade of servicemen are good indicators of the declining need for family communications between the U.S.A. and the Thailand area. It's a safe bet that with the need for their services gone, the groups providing the phone patch hookups stateside will disband, or change their equipment and operation so much as to be unrecognizable as the organization of Viet Nam conflict vintage.

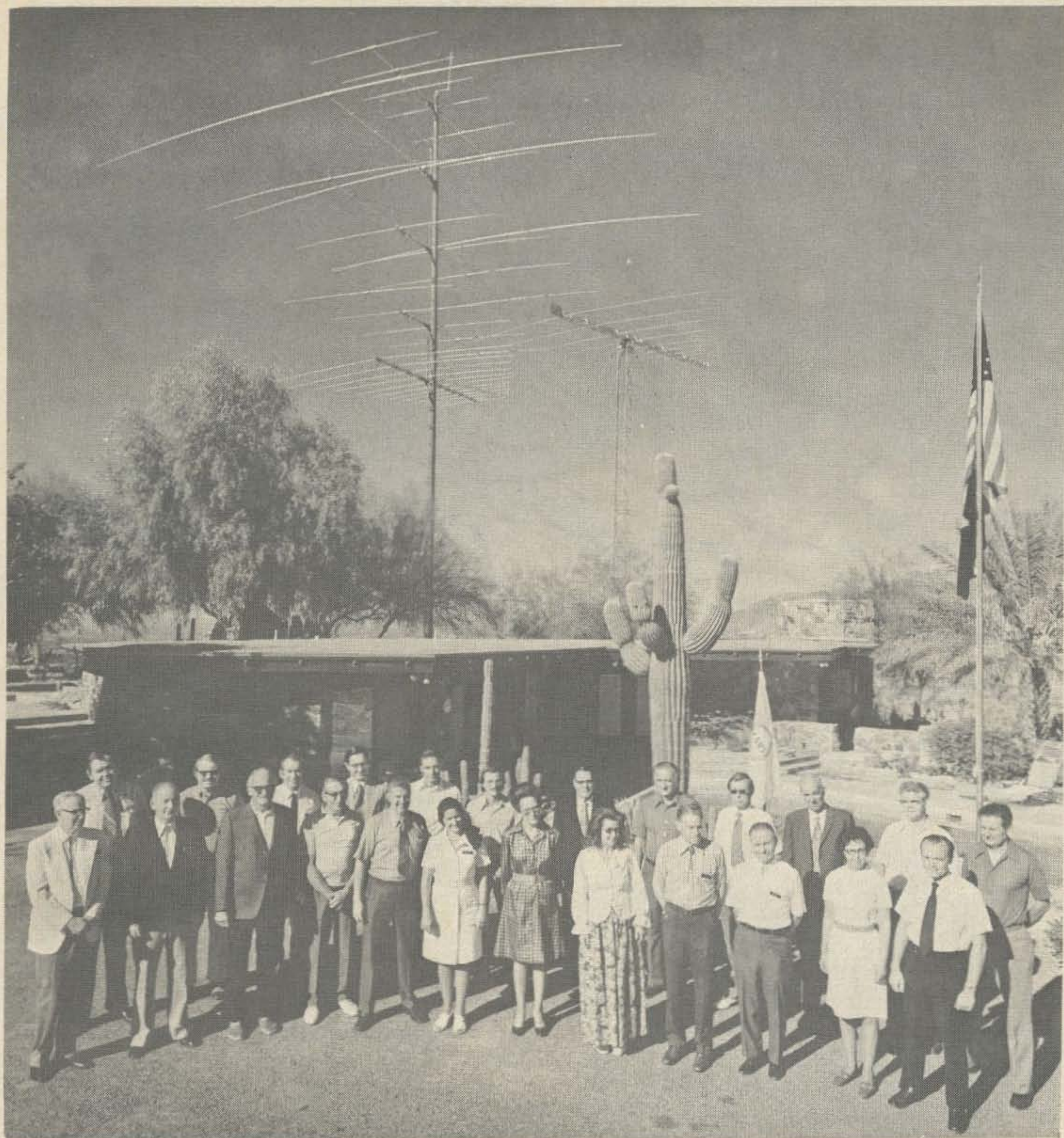
Before the big change is made, one ham decided to record as much as possible of the nature and spirit of one of the most successful patch outfits in the land, Bash-Hal-Ne-Ae. That's Navajo for "Metal that talks, sees and listens," and it's part of Ben-Nun-I-Kin; Navajo for "House on the Hill." Bash-Hal-Ne-Ae is a club station with 34 members, and it's owned by a guy described by an old friend as being "as common and down to earth as a dirt farmer." His main QTH is in Scottsdale, Arizona, and he's Barry Goldwater K7UGA.

Bash-Hal-Ne-Ae is known on the air as AFA7UGA, and according to Doris Counts, club secretary, the club began Air Force MARS service in August of 1967. Since that time, she says, the members have completed well over 187,000 phone patches for Airmen in the Viet Nam-Thailand-Philippines area. The club was organized solely to perform this service.

To visit Bash-Hal-Ne-Ae, you've got to get permission from the new head honcho, Tom Moore W7FCQ. (Bill Eccles K7MJC, well known manager for seven years recently retired due to illness.) The shack is just a few steps outside Senator Goldwater's back door, and while he is described as a very friendly guy, he doesn't want so many people up there that his grandchildren get trampled on their way to the swimming pool. Once you get inside Barry's shack, you will agree that it is one of the most far-out ham hangouts in existence.

First off, if Tom Moore or one of the other hams is inside chasing AIA8NA at Makhon Phanom, or one of the other seven Air Force MARS stations in Thailand all over the allotted frequencies, you won't make it inside the locked door. Nobody will hear you pounding. That means you're going to have to sit outside that beautiful stone shack in a stretchy relaxing chair and look out over a sparkling swimming pool, let your eyes take in the gorgeous homes and sprawling churches all around below you, and lay your eyeballs on serene desert mountain peaks such as Pinnacle Peak, Squaw Peak, and the famous Superstitions and other mountains that ring the Valley of the Sun. You can drink in great lungfuls of pure desert air and look up into a sky that is sparkling, bright and clear.

But you won't sit for long. Eagle-eyed Clarence Gartman will bear down upon you like he just caught you stealing the knob off the front door. You've blinked an electric



How can you ever get the whole membership of a club together? Here are 24 of the 38 Bash-Hal-Ne-Ae members. That's Barry Goldwater third from left in front and long-time station manager Bill Eccles first from the left. Husband and wife team of MARS members is Barbara Chamberlin WA7UHP, front center, and Bob WA7EIG. Group has completed over 187,000 phone patches for Airmen in Southeast Asia.

eye on the way in, and the grim caretaker has been sorting out your characteristics from inside the main house beyond the pool. He sees a strange car — no stars on the license plate — a droopy-shouldered guy with eyes glazed from hamming all night. You're gonna get bounced, unless you can prove that someone inside wants you in.

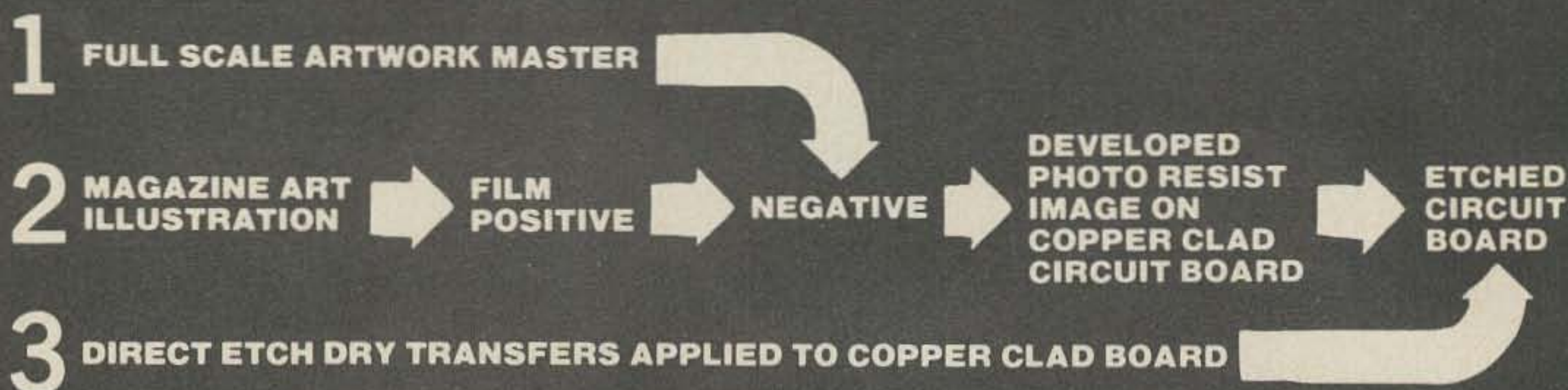
Then out pops a key, and Clarence lets his face wrinkle into a grin, and his eyes twinkle. You're inside.

The first thing you see is the friendly face of Tom Moore, Dave Pollard WA7OVH, or one of the other club members behind the mike turning knobs or gently reminding an emotional wife in Brooklyn or Miami that

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Tom Moore W7FCQ, station manager at Goldwater's Bash-Hal-Ne-Ae MARS station, wonders why they can't hear him in Thailand. Take heart, novices, for after checking the scope, this fine ham found he hadn't flipped the switch on the T-12 amplifier.

she's got to say "over" so that the radio hams can flip the switches to let her husband in Thailand or the Philippines talk.

Your eye quickly takes in the Robot slow scan television equipment and the double bank of Collins S-Line ham gear that is set in a gleaming wooden walk-in cabinet built by Elmer Olsen K7GPZ before he became a

silent key two years ago. You note the S-1 and T-12 amplifiers, the Tektronix RM-15 scope, and the digital Heathkit frequency indicator. You see the airplane pedal foot controls for transmitters and receivers and the row of weather instruments indicating air temperature, pressure, wind direction, etc.

A picture of Kenny Hinderleiter K7HQF stands on a shelf above the weather instruments. He's the ham, blind since age fifteen months, who has run over a hundred thousand phone patches for servicemen, and whom the Air Force flew to Okinawa and feted in 1971.

Your eye becomes aware of a vast array of art treasures and trophies that cover the walls of the shack. Forty colorful Kachina dolls pop out from the stones of the fireplace, forty sacred and valuable manifestations of the Hopi gods, given to Barry by Indian friends. The dolls are the remnant of a 400-doll collection that Barry gave to the Heard Museum. Over the fireplace is a color enlargement of an Indian photograph, a study of a pensive Indian woman's face.

A long, built-in, cushioned bench fits under a row of picture windows on the north wall, looking out upon the length of Mummy Mountain. Above it is a collection of Air Force shoulder insignias.

Awards and plaques cover the walls even behind the ham gear cabinet. The north wall beside the picture windows is perhaps the most striking, for it bears a pencil sketch of a youthful Goldwater, surrounded by hundreds of signatures. It bears a dateline of 1960, Waldorf Astoria and the letters CSSC. Around the picture are autographed pictures of Presidents Kennedy, Johnson, Nixon, Eisenhower and Hoover. Jimmy Doolittle and Eddie Rickenbacker are there, as well as generals Spatz, MacArthur, Twining, LeMay, Mark Clark and many others. Even the Duke of Windsor has his picture there.

Right under this display is a low refrigerator for cold refreshments and a setup for making hot drinks. Visiting hams are invited to partake.

A ten-foot bookcase reaches nearly to the ceiling left of the door, and a quick glance tells you that the OM who owns them has a mind that likes to poke into many corners of knowledge. Among the hundreds of books are Buckley's *Eye of the Hurricane*, White's *Christ and Satan*, Lasky's *J.F.K.*, and Copley and Pourade's *Anza Conquers the Desert*.

To the right of the door another wall is covered by plaques and awards, all given to Goldwater. There is a YMCA Distinguished Service Award, and Inspiring Leadership Certificate from the Republican Conference, 88th Congress, two honorary doctor of laws degrees, and two Goldwater golden dollars, with his face on one side and the Liberty Bell on the other. The whole wall is covered.

But this is primarily a MARS station, so in the most obvious places, right over the ham gear, Senator Goldwater has placed the awards and certificates earned by the men and women who belong to the club and are responsible for its remarkable DX phone patch record. There's a certificate from Air Force Communications dated October 12, 1968, showing appreciation to AFA7UGA hams for running 10,000 phone patches for soldiers in Southeast Asia. Another dated July 15, 1970, is a Certificate of Achievement from the Department of Defense,

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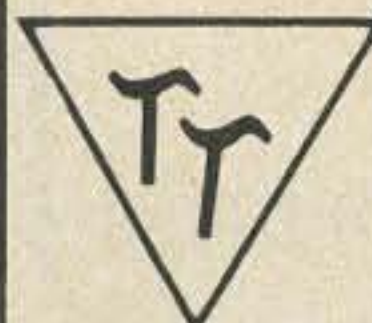
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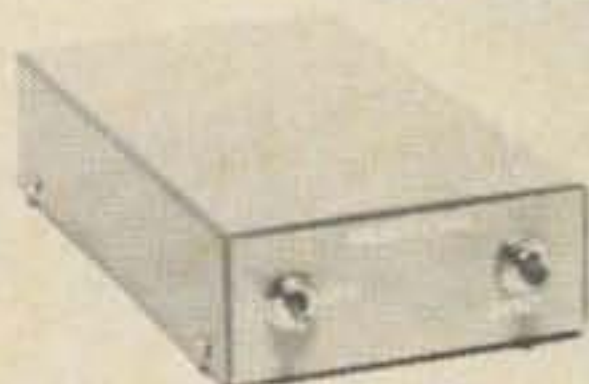
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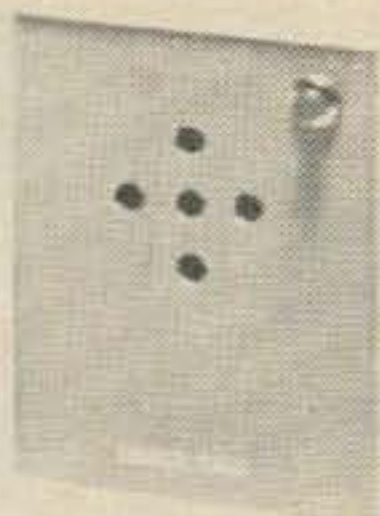
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Military Assistance Command, signed by General Creighton Abrams. Still another, from the Department of the Air Force, is for completing 100,000 phone patches between December 1965 and December 1971, signed by General John D. Ryan, Chief of Staff.

On the end of the rig cabinet, facing the door, are individual engraved name plates for the four club members who have become silent keys since the beginning of the phone patch service.

Between the rig and the long bench stands a glass-topped trophy table containing an array of pins, medalions, gavels, keys to cities, and other trophies given to K7UGA by people all over the nation. But placed prominently on top of the glass is a large, thick book of letters from soldiers, YL's, XYL's, and parents who wanted to say thanks for phone patches.

A wife in Tucson wrote in 1970, "No greater Christmas gift could I and my two children have than a call from my husband." A Houston father wrote in 1971, "My wife — in between tears — was thrilled to hear the voice of our son." An undated letter from a sergeant in the combat zone said simply, "A call to loved ones is the next best thing to being with them."

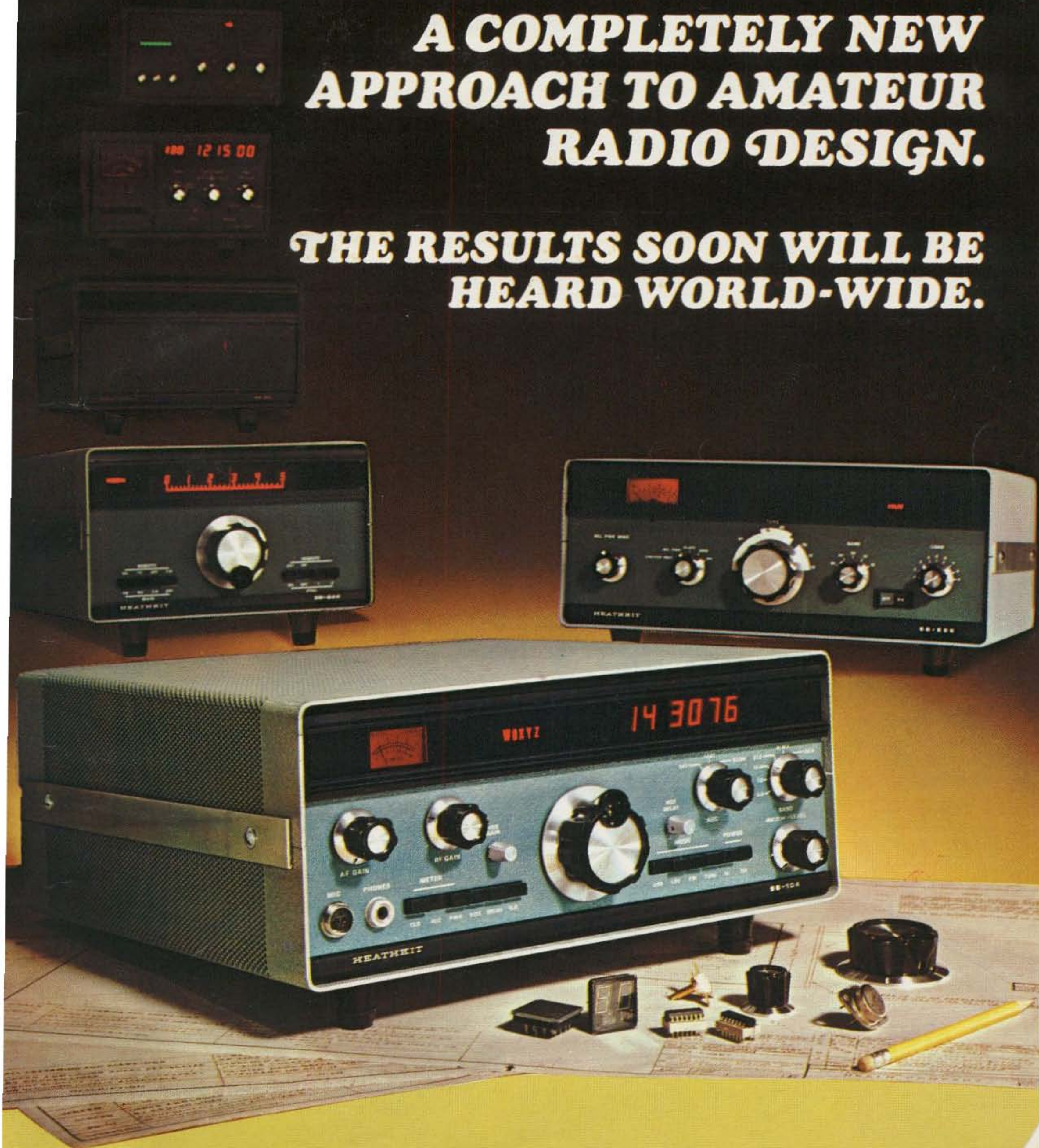
A letter from a Phoenix hospital thanks the hams for speedy contact with a doctor in Viet Nam when the postal service couldn't get the job done in two months. The writer voices surprise that the station could put the hospital person-to-person with their man so quickly "over a distance of 13,000 miles."

The most striking thing about the phone patch service is the apparent ease at which the whole thing is carried off. Tom Moore or another op points the Collins 237B log periodic beam toward Thailand, tunes the 32S-3 to a MARS frequency, zero beats the 75S-3C, and calls one of the stations he's recently had good, solid hook-ups with. If conditions are good, he gets a booming answer, signal reports are exchanged, the stateside ham gets a Ma Bell long distance operator on the line, and the waiting Airmen at some base in or near Thailand get to talk home.

The character of the conversations has changed since the life-or-death element has been lifted from Southeast Asian duty.

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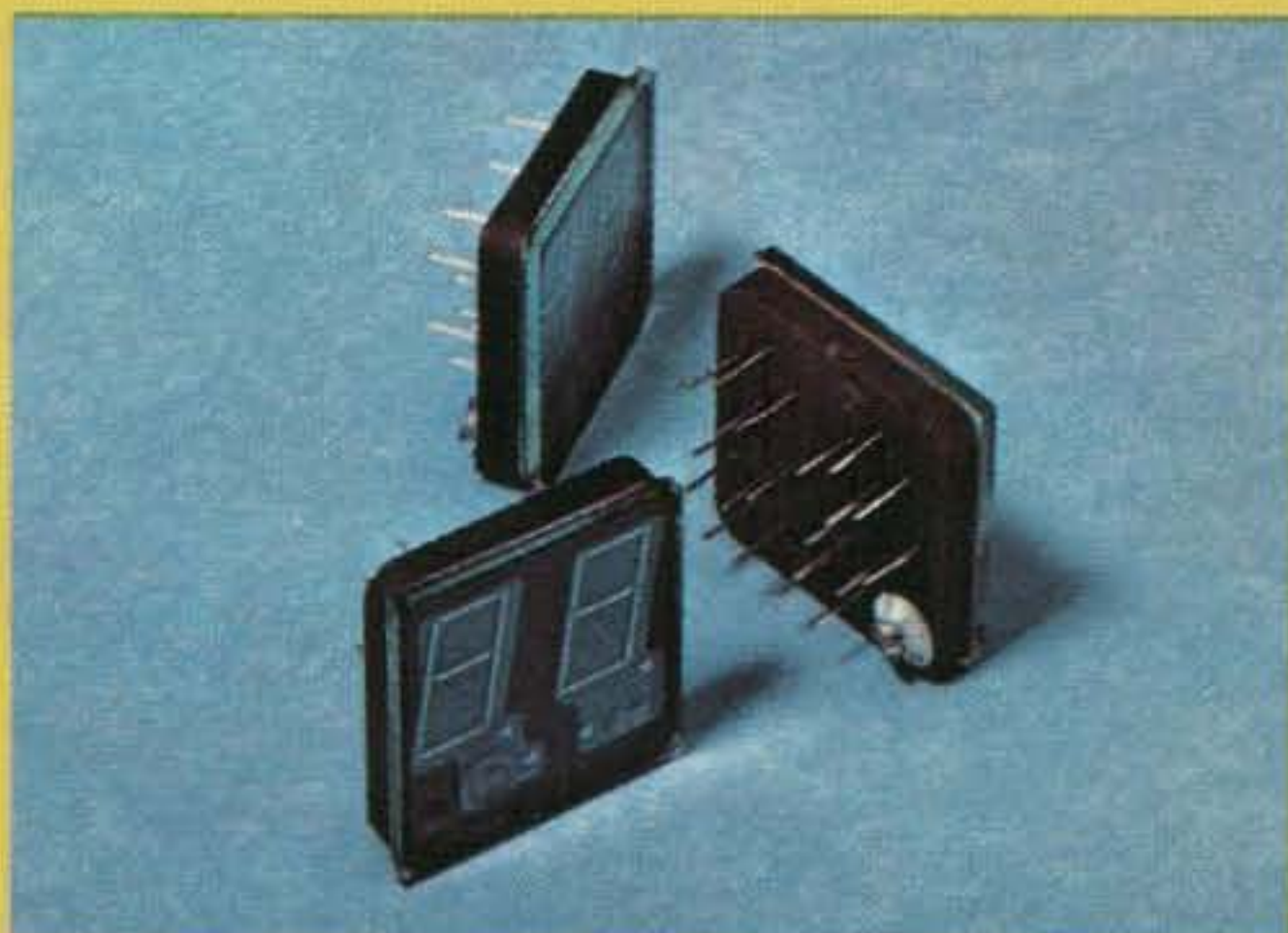
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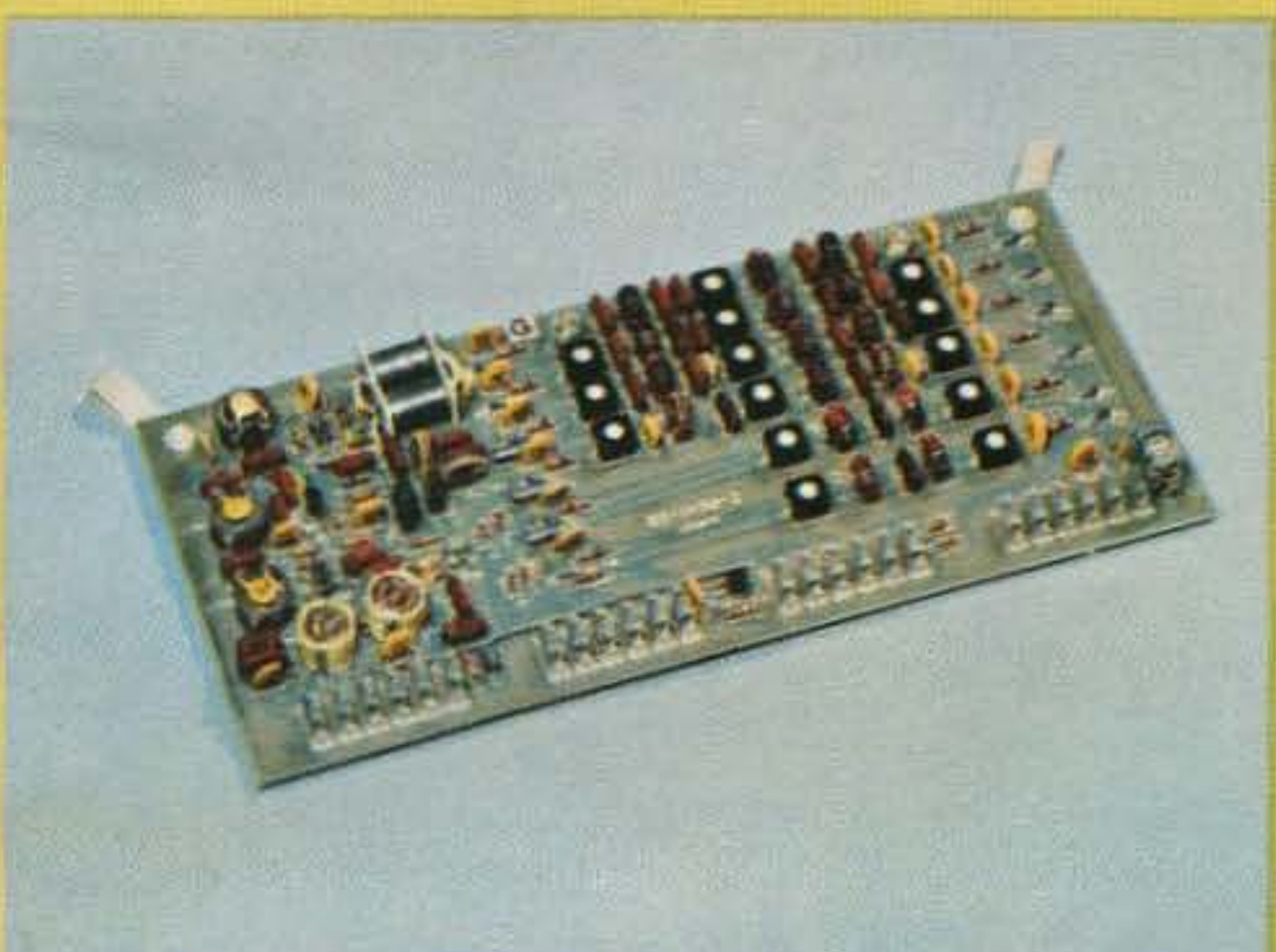
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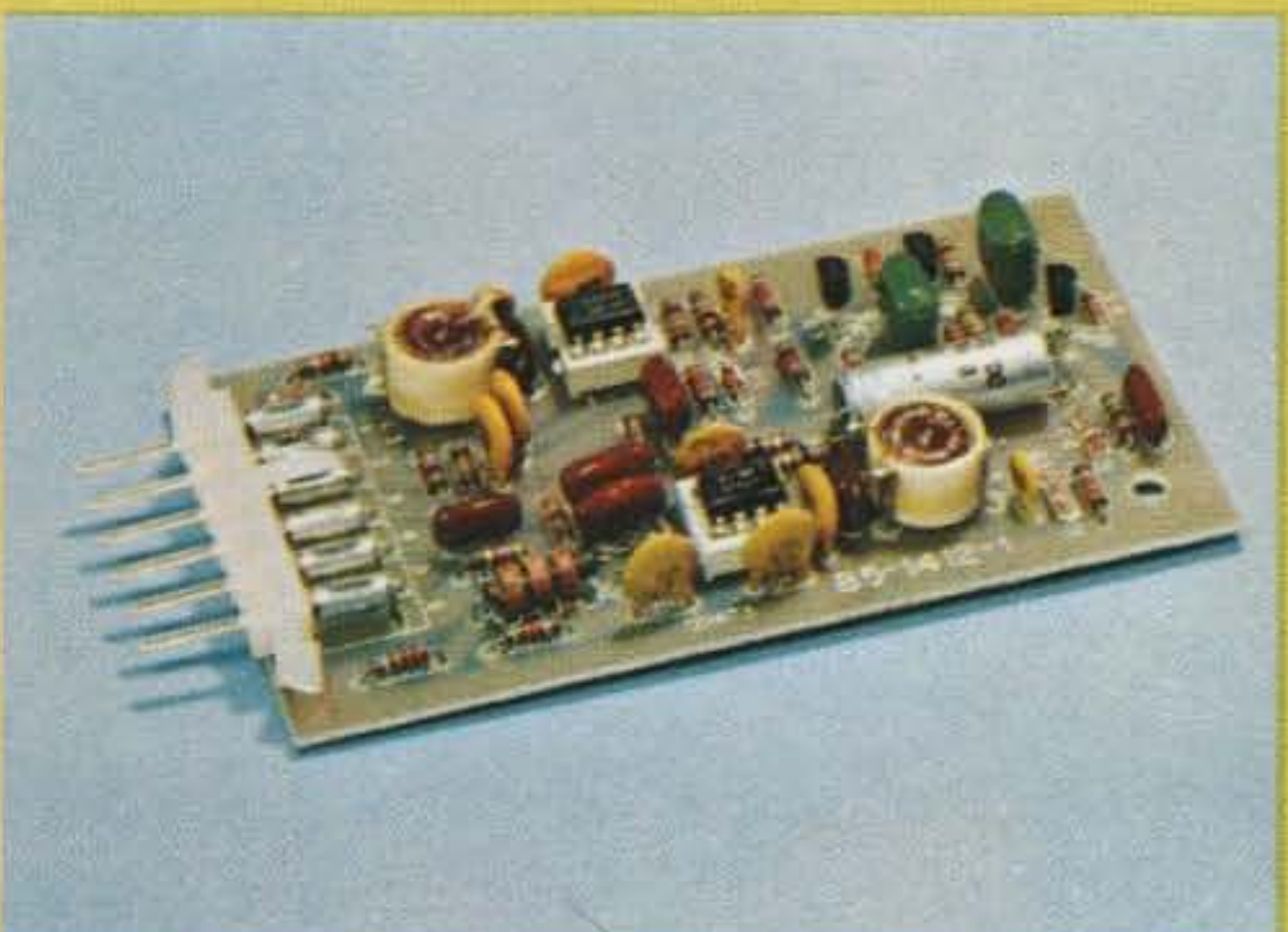
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SS-103

NEW SYSTEM-ENGINEERED



SB-604 Station Speaker

Designed and styled to match the new SB-104 Transceiver, the cabinet is large enough to house the HP-1144 AC Power Supply. The 5" x 7", 3.2 ohm speaker is response-tailored for SSB. Connector cable & plug are included.

Kit SB-604, Speaker & cabinet, 8 lbs., mailable **29.95**

HP-1144 Fixed-Station AC Power Supply



This new 120 V/240 VAC operated supply provides the 13.8 VDC required by the new SB-104 Transceiver. The full-wave bridge circuit has triple Darlington regulation with an integrated circuit which samples, compares, and automatically adjusts transistor bias to maintain a fixed output level. Output is remotely sampled at the load end of the power cable, thereby compensating for voltage drop across fuse and cable, to provide almost no change in voltage from no load to full load conditions. A cable and socket provide output power and a series connection to the SB-104 remote on-off switch. The generous heat sink fits on the back of the supply, and the entire unit may be mounted within the SB-604 speaker cabinet.

Kit HP-1144, fixed-station supply, 28 lbs., mailable **89.95**

SB-634 Station Console

Five station accessories in one!

24-hour digital clock: six half-inch gas discharge digits indicate hours, minutes and seconds. The clock runs continuously, as long as the console is plugged in.

Ten-minute ID timer: Three gas discharge digits indicate minutes and seconds up to 9:59. At ten minutes the timer recycles and provides either a visual alarm or both visual and audible alarms. Pushbutton zero reset.

RF wattmeter: The big meter delivers measuring capability of either 200 watts or 2000 watts full scale. 160 through 10 meters.

SWR bridge: Push a button to measure SWR. Separate front panel SWR sensitivity control.

Phone patch: The hybrid patch can be used either manually or with VOX control without switching connections. VU capability on the meter and separate front panel controls to adjust transmitter and receiver gain independently. Line isolation can be adjusted with a rear panel control.

Kit SB-634, 14 lbs. **179.95**

SB-644 Remote VFO

Designed exclusively for the new SB-104. The new SB-644 provides serious DXers with really useful split transmit/receive capability. With the "104/644" combination, you aren't frequency limited in any way—the transceiver can be at one end of the band, the remote VFO at the other end.

Multi-mode capability. The "644" allows transceive operation on either itself or the "104"... transmit on the "104" and receive on the "644"... receive on the "104" and transmit on the "644". And you can use either of the two crystal positions in the "644" for fixed-frequency control.

Easy pushbutton operation. Front panel pushbuttons on the "644" control all transceive, transmit and receive modes on both the "104" and the remote VFO. No switching on the "104" is necessary. Status lamps behind the window indicate frequency-control mode.

Digital readout in the SB-104. Although the SB-644 includes a linear dial on its front panel to get you into the right frequency area, actual frequency readout takes place in the "104". The display automatically changes to the correct frequency as you go from transmit to receive.

Kit-built VFO. The "644" uses the same kit VFO as the new SB-104. And thanks to the true digital frequency readout in the "104", concern about dial VFO linearity problems is a thing of the past. If you work serious DX with your new SB-104, you'll want the new "644".

Kit SB-644, 10 lbs. **119.95**

SPECIFICATIONS

SB-104 SPECIFICATIONS — TRANSCEIVER SECTION — GENERAL OPERATION: Frequency Coverage: 3.5 MHz through 29.7 MHz amateur bands, 15 MHz WWV receive only. Frequency Stability: Less than 100 Hz/hr drift after 30-min. warmup; less than 100 Hz drift for $\pm 10\%$ change in primary voltage. Modes of Operation: Selectable upper or lower sideband (suppressed carrier) and CW. Readout Accuracy: Within ± 200 Hz ± 1 count. Audio Frequency Response: 350 to 2450 Hz ± 75 Hz (6 dB bandwidth). Dial Backlash: 50 Hz max. Phone Patch Impedance: 4 ohm output to speaker; high impedance output to transmitter. Power Requirements: 13.8 VDC nominal (max. 16 VDC) at: Receive: 2 amp. Transmit: low power: 3 amps.; high power: 20 amps. TRANSMITTER: RF Power Output: High Power (50 ohm non-reactive load). SSB: 100 watts PEP ± 1 dB; CW: 100 watts ± 1 dB. Low Power SSB: 1 watt PEP (minimum); CW: 1 watt (minimum). Output Impedance: 50 ohms, less than 2:1 SWR. Carrier Suppression and Unwanted Sideband Suppression: 55 dB down from 100 watt single-tone output at 1000 Hz reference. Harmonic Radiation: 45 dB below 100 watt output. Spurious Radiation: -50 dB within ± 3 MHz of carrier; -60 dB farther than ± 3 MHz from carrier, except -40 dB at 3.39 MHz on 80 meter band. Third Order Distortion: 30 dB down from two-tone output, reference at 100 watts PEP. Transmit/Receive Operation: SSB: PTT or VOX; CW: Keyed-tone VOX or manual. CW Side-Tone: Internally switched to speaker or headphones in CW mode. Approximately 700 Hz tone. Microphone Input: High impedance with a rating of -45 to -55 dB; approx. 25K ohms to match Heath desk-type microphone. RECEIVER — Sensitivity: Less than 1.0 microvolt for 10 dB signal-plus-noise-to-noise ratio for SSB operation. Selectivity: 2.1 kHz minimum at 6 dB down, 5 kHz maximum at 60 dB down. (2:1 nominal shape factor). CW Selectivity: (with accessory CW filter) 400 Hz at 6 dB down; 2 kHz max. at 60 dB down. Overall Gain: Less than 1 microvolt for 0.5 watt audio output. Audio Output: 2.5 watts into 4 ohms, 1.25 watts into 8 ohms, at less than 10% THD. Low impedance headphones (4-8 ohm). AGC: Less than 1 millisecond attack time; switch selectable 100 μ sec. and 1 msec. release, and OFF. Intermodulation Distortion: -65 dB min. Image Rejection: -60 dB min. IF Rejection: -60 dB min. Internally Generated Spurious: Below 2 microvolt equivalent antenna input, except at 3.65, 3.74, and 21.2 MHz. MECHANICAL — Front Panel Controls/Switches: AGC — Off, Slow, Fast; AF Gain; Microphone Jack; Headphone Jack; Main Tuning; Mic/CW Level; Vox Gain; Vox Delay; Band Switch. Pushbuttons: ALC (Meter); 13.8V (Meter); Relative Power (Meter); 100 Hz (Disable); Noise Blanker (On/Off); LSB (Mode); USB (Mode); CW (Mode); Tune; Hi/Lo (Power Select); VOX (On/Off); PWR (On/Off). Rear Panel Controls/Socket: Anti-Trip; Sidetone Level; Linear Amplifier ALC Input; Phone Patch Input; Phone Patch Output; Key (CW) Input; Speaker (4 ohm) Output; Spare (2); Receiver Audio Input; VFO Input; VFO Output; IF Output; Driver Output; Ground Post; Power Plug; Accessory Socket (includes relay output); Antenna Input; Receiver Antenna Input; Common/Separate Antenna Switch. Dimensions: $5\frac{3}{4}$ " H x $14\frac{1}{2}$ " W x $13\frac{7}{8}$ " D. (Less knobs, feet and connectors). Weight: 20 lbs.

The SB-104 output board and final transistors are warranted for one full year.

HP-1144 SPECIFICATIONS — Output Voltage: 13.8 VDC regulated (Adjustable from approximately 11 to 16 VDC). Maximum Output Current: 20 amperes, Intermittent. 8 amps continuous. Transistor Integrated Circuit and Diode Complement: 2N3643 transistor; 2N3055 transistor; 40411 pass transistor (2); MFC6030 regulator IC; 1N4002 silicon diode; MDA990-2 bridge rectifier. Power Requirements: 110 to 130 VAC @ 6A or 220 to 260 VAC @ 3A, 50/60 Hz maximum. Dimensions: $5\frac{1}{2}$ " H x $9\frac{1}{4}$ " W x $10\frac{1}{4}$ " D. Regulation: Less than 2% output voltage variation from no load to 20 amperes. Ripple: Less than 1% at 20 amperes. Fuses: 7-amp, 3AG, slow-blow primary. 20-amp, 3AG, output. Net Weight: 23 lbs.

SB-604 SPECIFICATIONS — Speaker Size: 5" x 7" oval. Voice Coil Impedance: 3.2 ohms. Frequency Response: 300 to 3000 Hz. Magnet Weight: 3.16 oz. Cabinet: Aluminum with gray wrinkle finish. Dimensions: $7\frac{1}{8}$ " H x $10\frac{1}{8}$ " W x 14" D.

SB-644 SPECIFICATIONS — Frequency Coverage: 5.0 — 5.5 MHz allowing 80, 40, 20, 15, 10 meter operation in the SB-104. Frequency Stability: Less than 100 Hz drift per hour

after thirty minute warmup. Modes of Operation: Remote VFO; Main VFO; Receive Remote/Transmit Main; Receive Main/Transmit Remote; Crystal frequencies (2) (crystals not supplied). Dial Backlash: 100 cycles max. Power Requirements: 11V and 13.6V at 500 mA from the SB-104. RF Output: 0.34 to 0.4V RMS over 5 to 5.5 MHz into a 50 ohm load.

SB-634 SPECIFICATIONS — CLOCK — Display: Six full digits. Time Base: 24 hours. Accuracy: Determined by accuracy of power line frequency. TIMER — Display: Three full digits. Time Interval: 10 minutes with automatic reset. Manual reset at any portion of 10-minute period. Accuracy: Determined by accuracy of power line frequency. Signal: Visual only or both visual and aural; switch selected. RF POWER/SWR METER — Frequency Range: 1.8 to 30 MHz. Wattmeter Accuracy: $\pm 10\%$ of full-scale reading. Power Handling Capability: 2000 watts (maximum). SWR Sensitivity: Less than 10 watts. Impedance: 50 ohm nominal. SWR Bridge: Continuous to 2000 watts P.P. Connectors: UHF type SO-239. PHONE PATCH — Circuit: Telephone hybrid circuit. Allows voice control or manual operation. TELEPHONE LINES — Input Impedance: Approximately 600 ohm. Null Depth: At least 30 dB isolation between transmit and receive circuits. Receiver Impedance: Effective match from 3 to 16 ohm. Transmitter Impedance: 600 ohm or higher impedance output. GENERAL — Meter: 100 μ A movement. VU readings for phone patch monitoring. Null depth indication. RF power output, relative power, and SWR readings. FRONT PANEL CONTROLS — Timer: Off, Visual, Aural Visual. Reset: Push-button switch. Patch Gain: Transmitter, Receiver. SWR: Sensitivity. Mode: SWR, Forward and Reflected. 2000 W and 200 W. Phone Patch. Rear Panel Controls — Clock: Time hold, minutes set, seconds set. Null Adjust control; Null-Monitor switch; C adjust control; R adjust control. Power Requirements: 120/240 VAC, 50/60 Hz, 15 watts.

SB-614 SPECIFICATIONS — RF SAMPLING SECTION: Frequency Coverage: 80 through 6 meters (3.5 — 54 MHz). RF Power Limits: Exciter input (50 — 75 ohm) 10 to 300 watts; Antenna input (50 — 75 ohm) 10 to 1000 watts (up to 1500W PEP). Insertion Loss: Negligible. VERTICAL AMPLIFIER: Input Impedance: 1 Megohm shunted by 75 pf. Sensitivity: 60 mV rms/ $\frac{1}{4}$ " vertical deflection. Attenuator: 2 position; x1, 2 volts rms max. input; x10, 20 volts rms max. input. Frequency Response: 10 Hz to 50 kHz ± 3 dB. HORIZONTAL AMPLIFIER: Input Impedance: 1 Megohm shunted by 50 pf. Sensitivity: 50 mV rms/ $\frac{1}{4}$ " horizontal deflection. Frequency Response: 10 Hz to 3 MHz ± 3 dB. SWEEP GENERATION: Type: Recurrent, automatic sync. Frequency Range: 10 Hz to 10 kHz in three ranges. GENERAL: CRT: 3RP1/A flat face, green, medium persistence phosphor. Graticule: .250 inch squares 6 x 8 (1.5 x 2.0 inches total viewing area). Power Supplies: All solid-state rectifiers. All amplifier supplies regulated. Power Requirements: 110-130 or 220-260 VAC, 50/60 Hz, 35 watts. Front Panel Controls: Intensity — Off-on; Mode — SSB, TRAP, CROSS; Focus; Vertical Gain; Vertical Position; Horizontal Gain; Horizontal Position; Sweep — variable; Range — 100 Hz, 1 kHz, 10 kHz. Rear Panel Controls: Astigmatism; Vertical attenuator — X1, X10. Rear Panel Connectors: Antenna: SO-239; Exciter: Phono; Vertical Input: Phono; Horizontal Input: Phono. DIMENSIONS: $7\frac{1}{4}$ " H x $10\frac{1}{4}$ " W x $15\frac{1}{4}$ " D. Net Weight: 12 lbs.

SB-230 SPECIFICATIONS: Band Coverage: 80, 40, 20, 15 and 10 meter amateur bands. Maximum Power Input: 1200 W PEP SSB; 1000 W CW; 400 watts RTTY/SSTV. Duty Cycle: SSB: continuous voice modulation; CW: continuous (max. key-down time 30 seconds); RTTY/SSTV: 50% (max. transmit time 10 minutes at 400 watts). Driving Power Required: less than 100 W. Third Order Distortion: -30 dB or better. Output Impedance: 50 ohms at 2:1 SWR max. Input Impedance: 52 ohms at 1.5:1 SWR max. Meter Switch: Exciter only; Relative Power; Plate Current; Grid Current; High Voltage. Front Panel: Load; Tune; Band; Relative Power sensitivity; Power switch; Meter switch. Rear Panel: ALC output; Exciter relay; RF input; RF output; Ground lug; Fuse; Line cord. Tube: Type 8873. Zero signal plate current: 25 mA. Power Requirements: 120 VAC, 50/60 Hz, 14 A max. 240 VAC, 50/60 Hz, 7 A max. Dimensions: $14\frac{3}{4}$ " W x 16" D x 7" H. Net Weight: 33 $\frac{1}{2}$ lbs.

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There are still tears and emotion, but much of the anxiety and assurances of safety have been replaced by information on duty changes, instructions to wives, requests for information on the kids, wifely requests for blue star sapphire rings, etc.

Right now AFA7UGA is experiencing propagation problems because of the bottoming section of the eleven-year sunspot cycle, and Tom Moore has only two shifts of operators working. One starts at 4:30 a.m. and runs to 7:30 a.m.; then the other takes over and goes until the bottom falls out. Twenty-five to fifty completed patches a day is typical.

Typical, too, is the broken contact anywhere from 9:00 a.m. to noon, when the D-layers open up. "Four and a half KW's," says Tom then, "and all of it right out through the old chicken wire."

That's when he pulls the big switch and tells the sweet-voiced land-line operator, "We've been shot right out of the saddle. Better knock a couple of minutes of waiting time off that last call, and we'll buzz you tomorrow."

Then he secures the gear and the shack, ushers the nosey visitor out, and goes home to grab a bite before dashing off to work. Before he drives off, he hangs out of his car window and says, "You just can't imagine the dedication of our club members. Why, Bob Kraig W7OYC hasn't missed a Sunday in eight years. He works every Sunday from 4:30 a.m. until noon. That's the kind of participation that has made our station successful."

By the time the sunspot cycle has made MARS DX as good as an eyeball QSO again, there may be virtually no need for its Southeast Asian phone-patch services. But in case some other need arises, it's a good bet that Barry Goldwater and other shack owners will keep big books of thank you letters handy to remind them that they should keep the old bucket of bolts in good working order.

And the hams? You know they'll be ready.

...K7NZA



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73

Magazine — Peterborough NH — 03458

GRR
GRRREEN

SPELL MY NAME RIGHT

There is an old adage that any publicity is good publicity — say anything you want to about me, but spell my name right. In this vein I would like to express restrained appreciation for the PR job being done in my behalf by ARRL officials. It is nice to be recognized.

I am sure that some of the people who have devoted a good deal of the last ten years hating my guts for opposing the "incentive licensing" restructuring of amateur radio will be as astounded as I to hear that it was I who was responsible for this debacle which the FCC is now getting ready to try and rectify. My opposition to that ARRL petition for rule making (1963) was on the philosophical grounds that it is psychologically better to get desired results with a carrot than with a stick — the result in this case being to encourage amateurs to go for higher classes of license. Taking away bands to force amateurs to increase their grade of license would, I felt, create resentment and frustration.

The League worked hard and long to get their proposals accepted and they succeeded. Yet today I have a tape of my good buddy Lew McCoy telling a club that I was responsible for incentive licensing. While on the one hand I suppose that I should be flattered that the single most important change in the amateur rules, in recent years, was due to me, it is difficult to pretend anything but resentment over the whole concept of using punishment instead of rewards to achieve ends... which is what incentive licensing comes down to.

Surely I must be either lying or exaggerating — right? In case you might find a copy of this tape of interest — Lew talks about the current FCC plan to restructure amateur radio — tells how badly the recent FCC hearing went — and has some interesting things to say about Prose Walker — this is all available on a 90 minute tape for \$5 from 73, Peterborough NH 03458. Ask for the Real McCoy.

RADAR ZAPPER?

A chap stopped by the 73 offices the other day — reads 73 — goes by

the name of Bad Back on channel 10 he said. He was awfully concerned about the new two-way radar which allows police in unmarked cars to get copy on Bad Back's speed even when they're going in opposite direction. There must be something that can be done about an invasion of privacy like that!

Another channel 10 denizen who goes by the name of Radio Doctor (he fixes FM sets) stopped by and explained that what Bad Back needs is a simple 10.5GHz oscillator modulated at 3400Hz. This would add 100 mph to the radar reading, which would either result in one whale of a speeding ticket or a very confused cop.

While we certainly don't want to help people break the law, even by speeding, the idea that it would be nice to have a little old 10.5GHz oscillator circuit around for testing out those radar units stuck in mind. I'm sure that there are a whole lot of readers who at one time or another would like to be able to help a state trooper test out one of those damned radar units. So, how about it... any Edison types out there who can coax enough 10.5GHz rf out of something we can all afford to cut the mustard? You know, a thing like that might sell like crazy at truck stops if some entrepreneur got busy making them.

MAKING YOUR HOBBY PAY

I've been looking back over the last year or so of 73 and, while we've had some exciting articles, I just don't feel that overall we've had as much really good stuff as we used to. We need a lot more articles and we are going to pack the magazine with them.

If you've built something that your friends are enthusiastic about, whether it be a receiver, QRP rig, FM rig, repeater, sideband rig, amplifier, keyer, test equipment, an antenna, logic or digital circuits, preamplifier; if it's your own design then you should write it up (double space typed), sketch the circuit, and have a couple of pictures taken (or send in the unit so I can take the pictures).

There are several benefits. First of all it is nice to be a published author. Your friends will be impressed at the club — and when you get on the air you'll be surprised at how many fellows know you. It doesn't hurt with your own family and non-ham friends either. The cash we pay for articles may not put you into a higher income bracket, but it will help buy a new rig or some parts. We do pay well compared to some of the other ham magazines... very well. Several of our writers have made thousands of dollars.

It doesn't hurt when you're apply-

ing for a job to have a list of your published articles on your resume.

While I am more interested in construction projects, large and small, than anything else, we still need a lot of articles on every aspect of our hobby: DXing, traffic handling, MARS, Races, certificate hunting, contests, moonbouncing, satellite work, CW, VHF DXing, VHF sideband, antennas of all sorts, 160m, Novice problems and solutions, service net info, intelligent discussion of FCC dockets and proposals, and even humor.

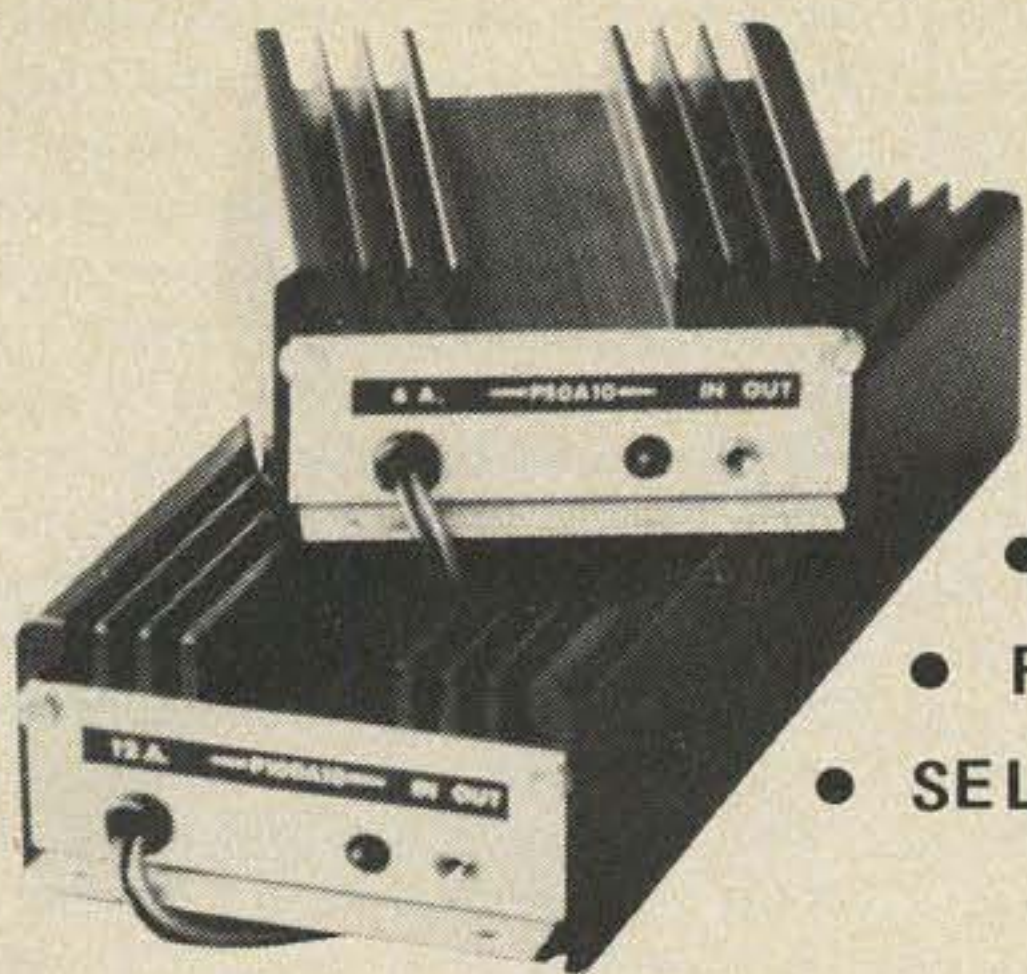
One warning — it might be prudent not to say too much around home about how much we pay for articles. One author let his wife know how much he was getting and from then on she made him write ten pages every night before she would let him go to bed with her. He was one of our most prolific writers.

... WAYNE



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Readers have been asking for articles and commenting on 73 — here are some of these recent comments: Let's see some RTTY info. How about a surplus column? You devote far too much space to 2m stuff! — WA6SOJ. *(That's a good idea about the surplus column, anyone interested in working on that? Send in an outline of what you would cover and a sample column. . .wayne)* Like the article on the 10 minute timer — WA1PAL. Need more product reviews. Encourage owners of new equipment to comment. Restrict the articles to top flight equipment only. Who cares if poor items are poor? — W9BNQ. *(Excellent! Readers should remember that 73 pays for articles, so if you get something new and have an interesting report on it, pass it along. . .wayne)* It was nice to see the 390/392 surplus article, but these are out of my price range so I would like to see articles on cheaper surplus — especially 160m and FM gear — WA6SLN. *(Right, how about it readers? . . .wayne)* Newspages are great and the IRS notes interesting to say the least. Would like to see more specialized columns such as RTTY, fast scan TV, and VHF work. The brevity of the DX and contest columns are appreciated, but also contain info enough for those who are interested in these fields. Keep up the good work — W5SSN. Keep up the IRS info — WB6AYJ. How about an article on a homebrew 2m FM repeater? Solid state or using the VHF Engineering modules? — WA3WID. *(In the works, watch for it. . .wayne)* Possibly more antenna articles, including 2m FM — WA7WOC. Enjoyed all your articles, particularly K1CLL! Maybe you could keep both solid state columns? — WB2PAP. Circuits is great and liked Scott's solid state column. Less repeaters and don't forget the CW guys, particularly QRP. More on ICs and simple transistor circuits — K6AE. *(Bill has said it, so let's see more QRP, more CW articles, more ICs, and build up those simple gadgets for us. . .wayne)* I'm tired of reading about your troubles with the IRS — WA7SFL. The magazine needs more theory articles such as in a continuing series — WN7VUC. *(Any volunteers to write same? . . .wayne)* Don't forget the Novice projects, we need them! — WN2TQM. *(Let's have a whole lot of info for Novices — simple projects to build — rigs — QRP — operating ideas, the lot. . .wayne)* Would like to see more of K1CLL; more VHF and UHF construction articles — K5HTE. *(We have a lot more in the works Doyle, and plead with readers who are playing with this*

stuff to write as CLL is retiring! . . .wayne) I like the editorials and newspapers the best. It's impossible to print too much on 2 meter FM. Like articles on antenna design and construction — WB0FZL General discussion of propagation conditions and the sunspot cycle and when it will get better — WN3VZN. *(Alas, better is still a long way off. It's best to cope with it as it is and enjoy — there's lots of good stuff to work. . .wayne)* Please put in more UHF construction articles — WN0MBY. Boy, do you troops fill a gap in the ham hobby! Just keep up the good work — more easy to build construction projects — how about the care and feeding of LEDs? Any tube projects in mind? Just curious — K7ATU. *(Yep, we have some coming along for us old timers and Novices too. . .wayne)* The Circuits column is great. How about an antenna column? . . .that's all that is keeping me subscribing to CQ — WB0ICG. *(Lordy! I never realized how badly 73 needed an antenna column before. Any volunteers with an outline and sample column? . . .wayne)* You got a good ham radio magazine, thanks — WN8RDN. *(Thanks Mike. . .wayne)* VHF 2m FM construction, starting simple and working up to the complex — W7DOU. Both solid state columns were good — WB0NAG. I liked Scott's solid state column best — WA2ADZ. We need more news about what the DOC/FCC is doing about clamping down on CB and what we hams can do about these bootleggers — VE2BAQ. *(The Canadian proposal to legalize hobby and skip CB operation could be the answer — and it could mark the end of amateur radio too. . .wayne)* I think 73 is well balanced so keep up the good and interesting work — WA8SHT.

RECIPROCAL LICENSES IN THE UNITED KINGDOM

Overseas members are reminded that there are several different types of license available to them allowing them to operate amateur radio stations in the U.K. provided a reciprocal licensing agreement exists between their country and the U.K.

The simplest form is an authorization for a visiting amateur to operate the station of a licensed U.K. amateur. In this case no call sign is issued. For example, should F8TH operate from G3BID under this arrangement he would use G3BID's call and sign the log as operator just as another G operating from G3BID would have to do. Such permission is granted for seven days maximum.

The other category is when a G5-plus-three call is granted and it is

here where some confusion seems to have arisen. There are two types of such license. Amateur (Sound) license C and Amateur (Sound Mobile) License C are valid for one year and are only issued to persons coming here for more than three months (NB this may be six months now). It is intended for those coming to work or live and such applicants must produce an Alien's Registration Certificate before a C License will be granted.

The second of this type of license is probably the more frequently issued and is the D License which is now valid for six months. This is the one to apply for when you are coming here on a vacation and, like the C version, is available for fixed or mobile operation.

An important point to remember is that you may apply just for the mobile license if you are not going to operate a fixed station. By contrast U.K. amateurs cannot be granted a mobile license unless they also hold a fixed station license.

Full information on reciprocal licensing can be obtained from the Society's Information Service. The address is: BCM/ARMS, London WC1V 6XX

Please do NOT send queries on reciprocal licensing to any other address as it will only delay matters. When you get the information, please read it carefully and make sure you apply for the proper type of license.

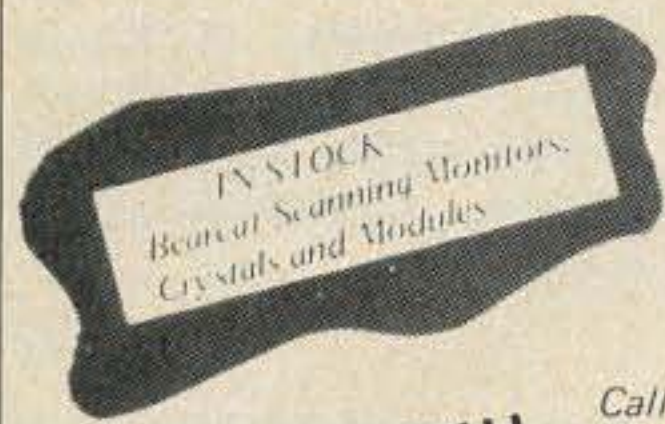
Mobile News

THE LONG WAVE CLUB OF AMERICA

Michael Kane's (WA1PJJ) letter about ULF listening prompted me to write. There is indeed a club devoted to dxing the frequencies below 550kHz known as The Long Wave Club of America which started this January. (Present membership is about 75.)

We publish an 8-page mimeo bulletin called the *Lowdown* which lists member's loggings and carries technical articles from time to time. Sample copies are available for SASE. Of particular interest is the license free band (160-190kHz) which we are trying to organize — I am looking for an editor to write a column on activities in this area. Dues are free and to join just send a letter that you wish to receive the *Lowdown*. I am, however, asking all joiners to send me a year's supply of self-addressed *legal size* envelopes to cut down on publishing time. Also a log of 2500 beacons in the western hemisphere is available in limited quantities (like about 80) from the club for \$2.00 postpaid. Write: John Clements, President, Long Wave Club of America, 11425 Albers Street #5, North Hollywood CA 91601.

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(73 Magazine test report)

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Solid State from page 17.

high on the appropriate digit select pin. Both BCD and digit select outputs have three state controls providing an "open circuit" when these controls are high and allowing time multiplexing. Several MC 14534CL's can be cascaded to provide higher count sequences. This counter can be used in many real time counting applications such as event, frequency and control counters. When used with faster logic families, it could become a significant part of a VHF frequency counter.

Both of these CMOS ICs are intended for 5 to 15 VDC operation. Power consumption is from 2 to 37 milliwatts. Both are available from your Motorola distributor at \$25.26 for the MC 14534CL and \$8.34 for the MC 14536CP in single quantities.

An observant reader, Max Hauser of W6-land, reminded me that in my July column (written in Jan.), I overlooked two quad op-amps that are now available. These are the National LM324 and Raytheon RC4136 which are claimed to meet or exceed all specifications for the single 741 op-amp. You can obtain these ICs from several 73 advertisers for approximately \$2.00.

Finally, why don't you send that QSL listing your ideas right now while you're thinking of it. 73 for now!

MORE IRS MAIL

I've been reading with initial shock and increasing horror about the tyrannical tactics of the IRS, both in 73 Magazine and in the newspapers (I remember seeing that story break last summer concerning the several IRS agents all coming up with different ways of figuring identical tax returns — it seemed funny then, but it isn't funny anymore). I was intrigued by your reporting the element of the "tax revolt" that crosses out the perjury statements on its several returns, and decided to try it. Much to my surprise, it works!! I mailed my form 1040A (short form) on 25 January and received my refund March 4. I also crossed out the perjury statement on my sister's return, which I prepared; her refund came in the mail with mine. Our refunds totaled over \$500.00. So, chalk one (or two) up to the "tax revolt." I hope we can, through modification (read "sweeping revision") of the federal tax laws, eliminate its necessity for existence, but until then, it is necessary for it to exist.

To change the subject (but not a lot), thank you for being controversial in 73. I am a life member of ARRL and a lifetime subscriber to 73, and I

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DUAL MODE Hal DKB-2010 keyboard with 128 key buffer. Factory assembled, brand new — won at Dayton 1974. \$510. Richard Mawhorter, 10584 Latina Ct., Cincinnati OH 45218.

INSTRUCTION MANUALS Thousands available for test equipment, military electronics. Send \$1.00 (refundable first order) for listing. Service of Tucker Electronics, Box 1050, Garland TX 75040.

AN/FRR-23 (AN/SRR-13) general coverage modular receiver with book, excellent condition. \$100. WA1TEJ, 100 Granite Street, Londonderry NH 03053.

suming. Use a tool for inserting and removing ICs. Stranded wire with fused tining is convenient to strip and handle but cannot be flexed much without breaking.

If the instrument consists of several functions, construct and test each

find both QST and 73 necessary to have. I think they complement each other quite well — the conservatism of QST and the liberal (if not sometimes radical) stands taken by 73. Your editorial policy re technical articles has been vindicated many times over, and I prefer your policy of finishing one article before starting another (thus eliminating the "see page x" nonsense found in almost any other given magazine of over 8 pages).

You got me interested in Mensa through editorial mention of it some 3 or 4 years ago. I've since joined and enjoy being an M quite a bit (when ever my ego is feeling bruised I get out my membership card and look at it for a while). Haven't seen anything about it lately in 73, though.

Enjoyed the article about calculators in December issue. Got a Texas Instruments SR-11 and that is one real nice piece of stuff for only a hundred and ten dollars — it's kinda like a "poor man's HP-35!"

Please don't publish my real name if you decide to print this letter in the magazine. I've got enough problems trying to graduate from college and work fulltime without having the IRS on my ass, as I'm sure they would be if my name and call were published.

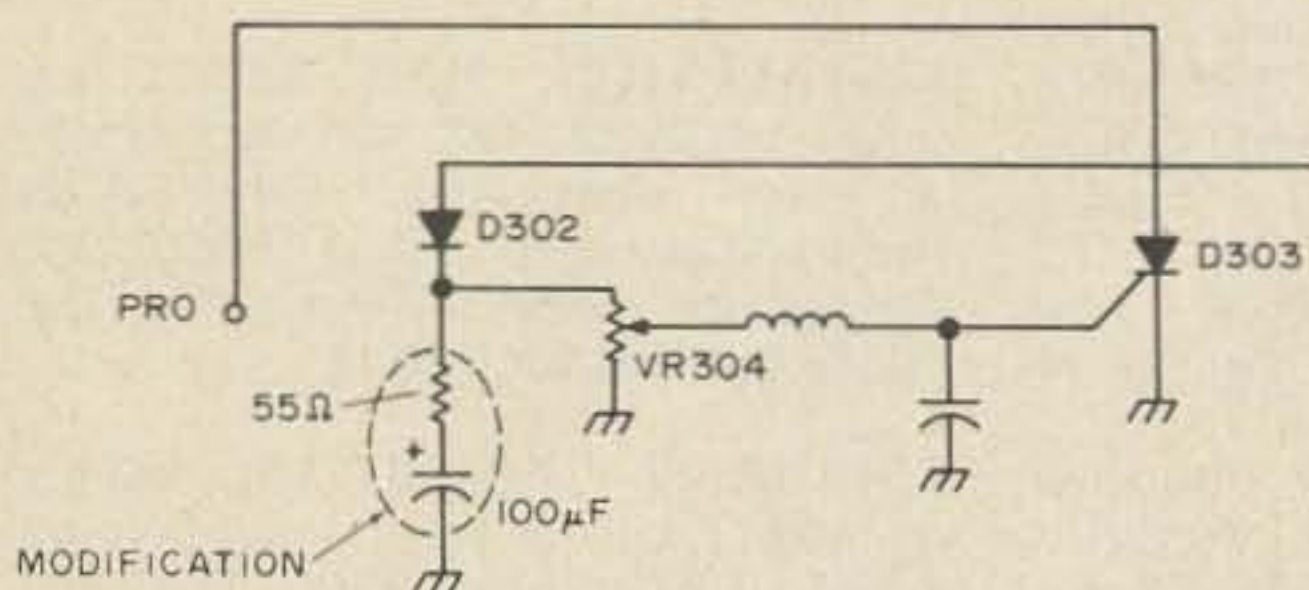
Keep on keepin' on, Wayne!

Name Withheld

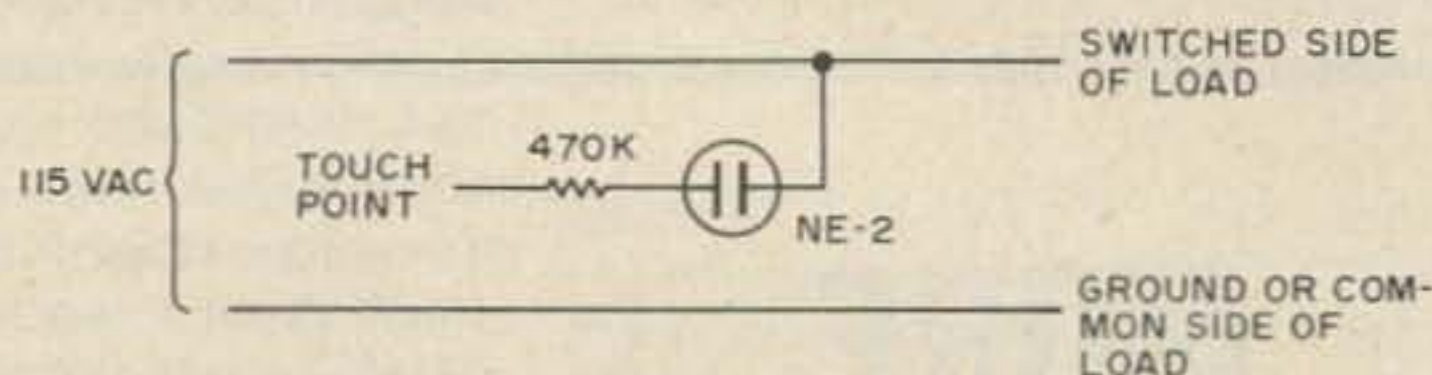
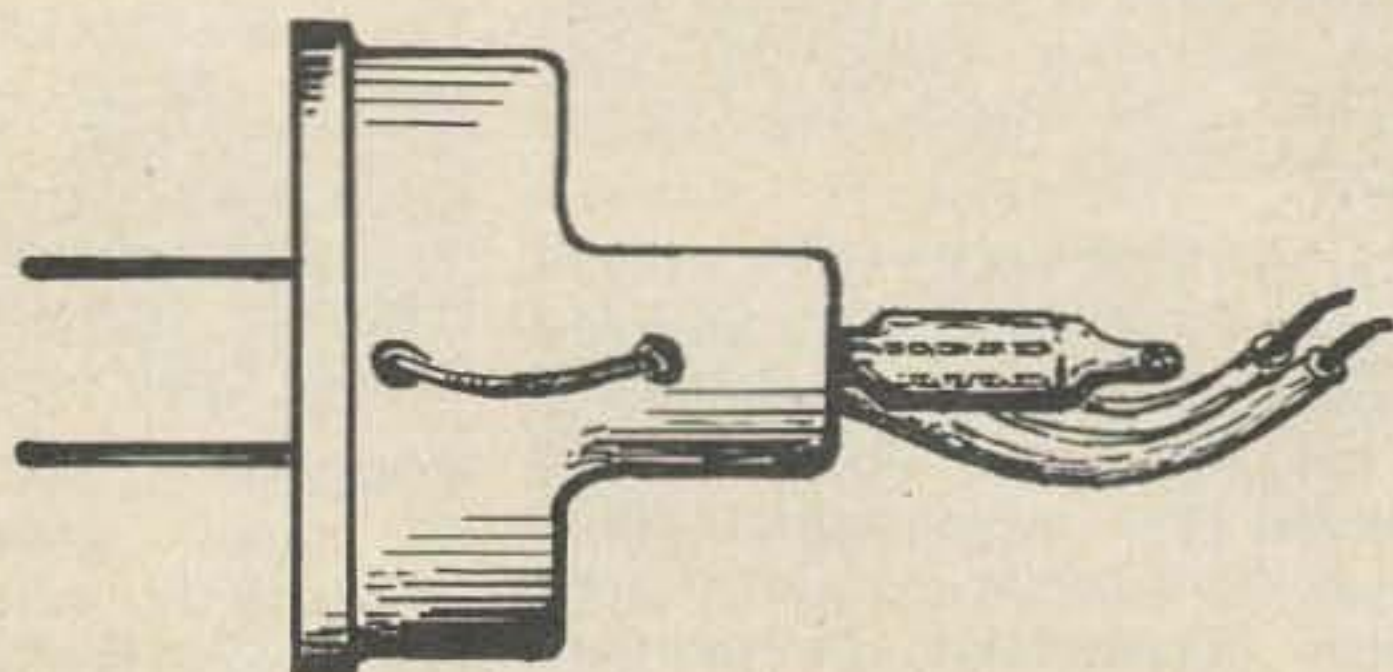
CIRCUITS, CIRCUITS, CIRCUITS...

The following circuits have appeared in the reference books, magazines, application notes, etc. While we try to reproduce all of the information that should be needed by an experienced constructor, readers may want to avail themselves of the original sources for peace of mind.

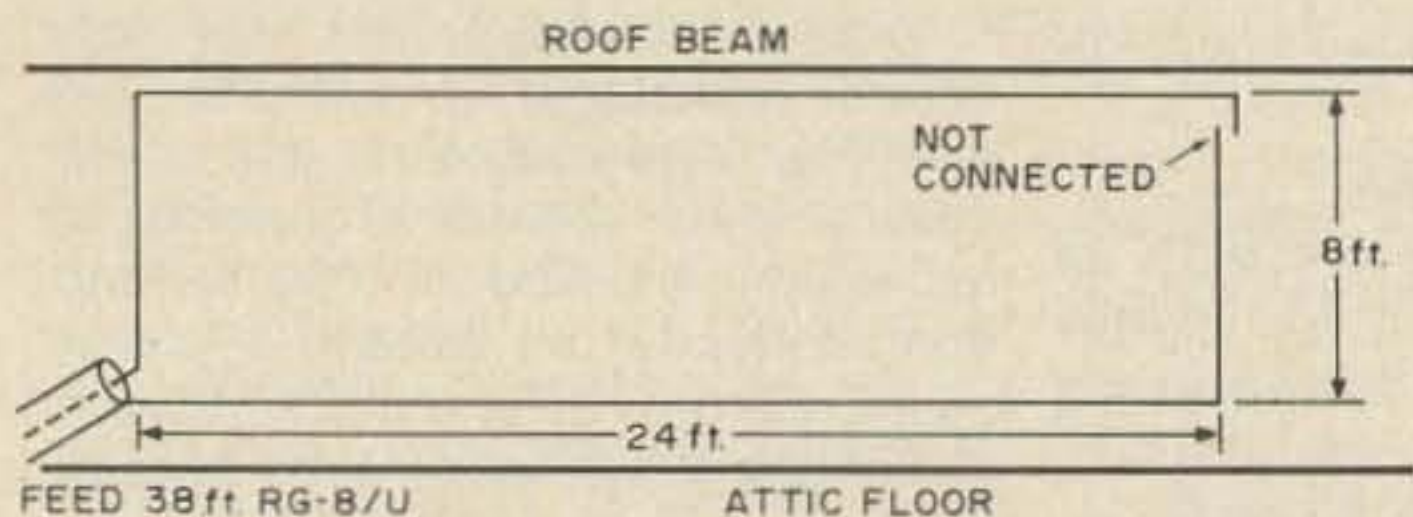
Readers are requested to pass along any interesting circuits that they discover in sources other than U.S. ham magazines. Circuits should be oriented toward amateur radio and experimentation rather than industrial or computer technology. Submit circuit with all parts values on it, a very brief explanation of the circuit and any additional parts information required, give the source and a note of permission to reprint from the copyright holder, if any, and the reward for a published circuit will be a choice of a 73 book. Send your circuits to 73 Circuits Page, 73 Magazine, Peterborough NH 03458.



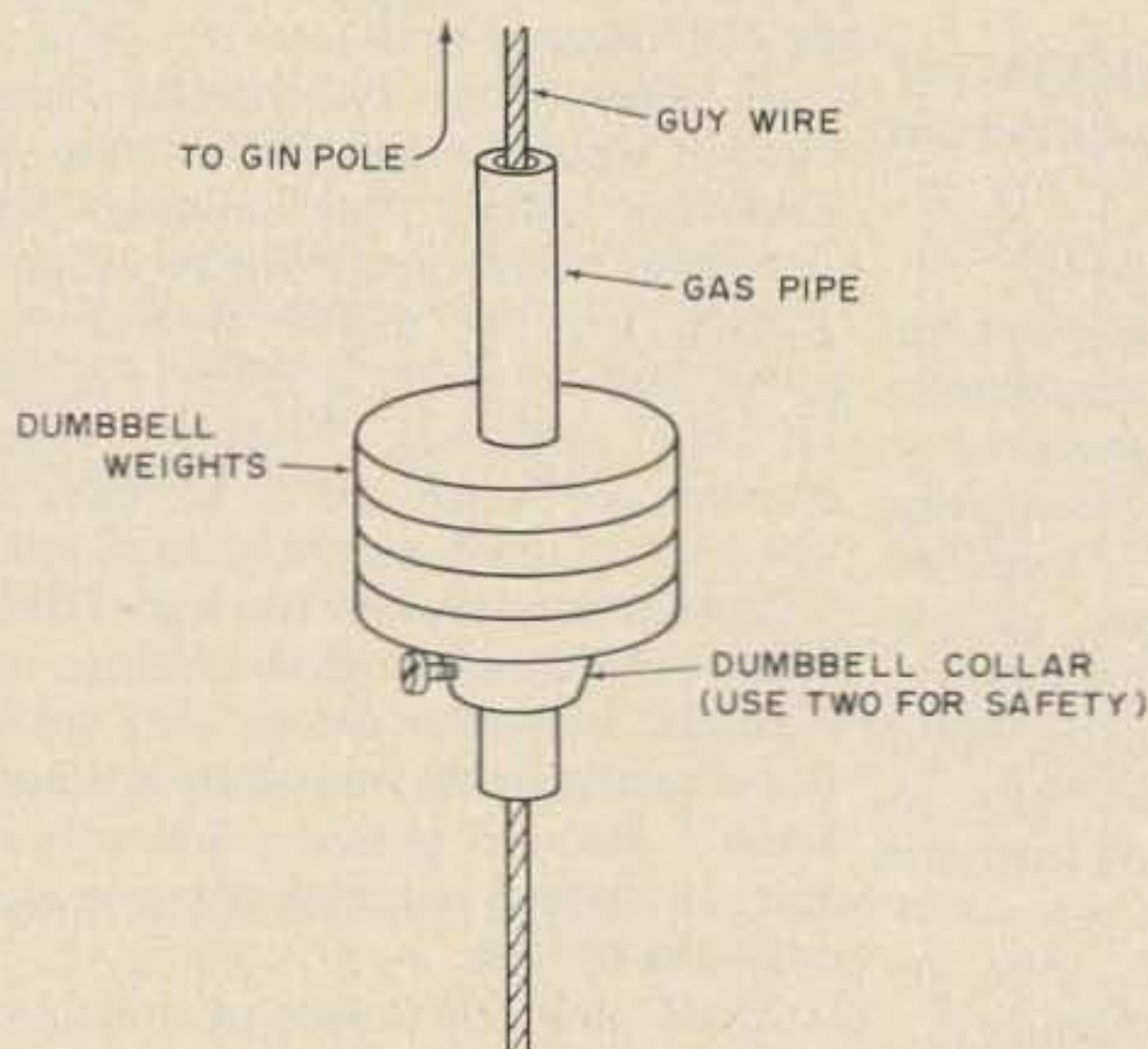
SB-144 mod to key an amplifier – added 55 ohm resistor and capacitor delay the SWR protection circuit for a fraction of a second permitting relay in amplifier to switch over. Thanks WB9IMM.



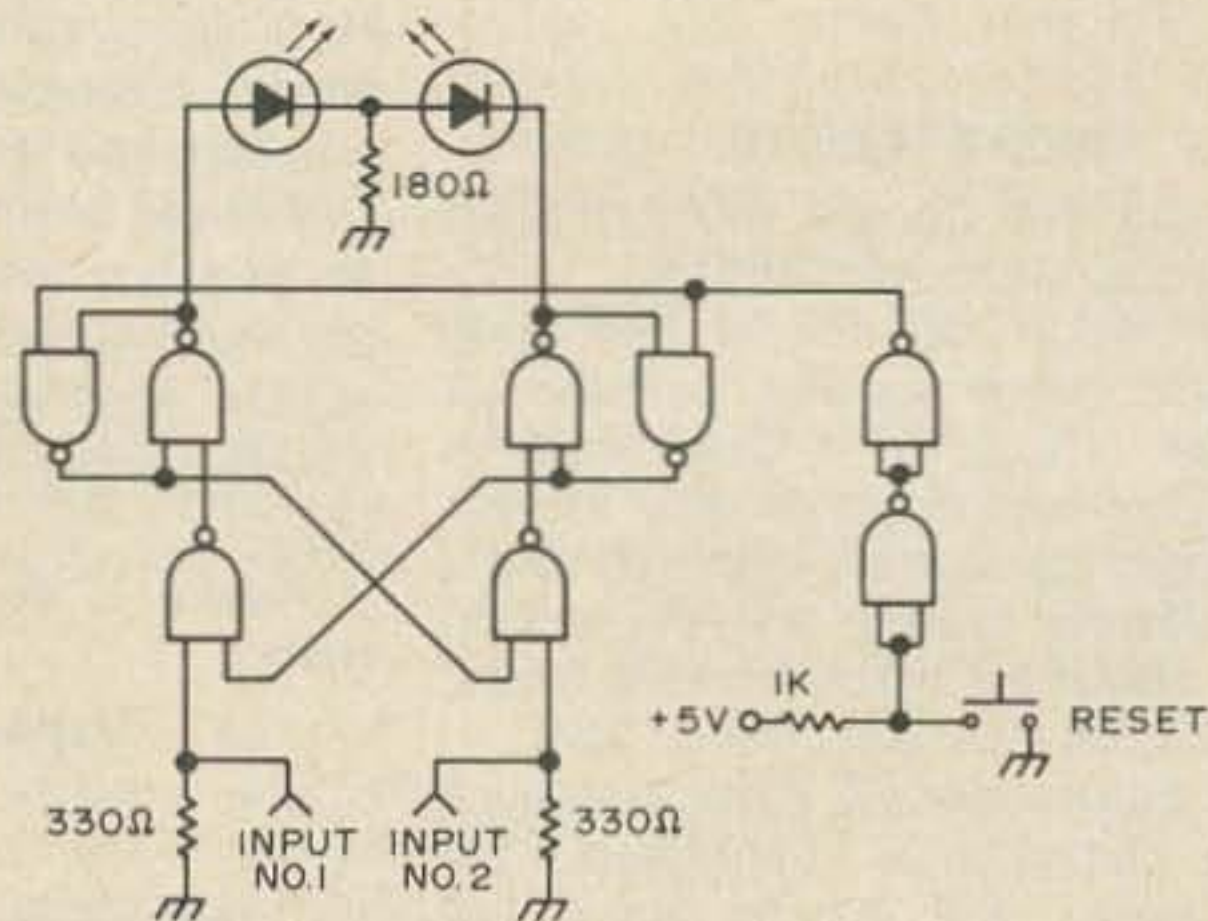
Hot line side finder – uses body capacity to light neon bulb – glows only when bulb connected to hot side of line – resistor value not critical. Thanks B. Sutphin of St. Petersburg FL. Could save your life.



W8KOI attic antenna for 40 and 15m. Uses RG8/U and no balun. Use #18 wire and staple gun for installation. No bad antenna where an outdoor antenna is a problem.



WA0KKC aid for pulling tower sections up a gin pole uses hollow gas pipe and dumb bell weights for counterbalance. Clever!



Which input is first? This circuit will tell. Makes a good game – with two people trying to push a button first, etc. Two 7400's may be used. Thanks WA7SBH, who gets a free book of his choice for submitting this circuit.

CORRECTION

73, June 74, p. 77

FSK Demodulator from July 19, 73 Electronics: You left out the Bridged Tee feedback loops on both 741's. I sent you the clipping from my copy, but I am sure they were on the original. Hi-Z in, so audio feed is no problem except for too much input and distortion.

Fritz K4ETZ

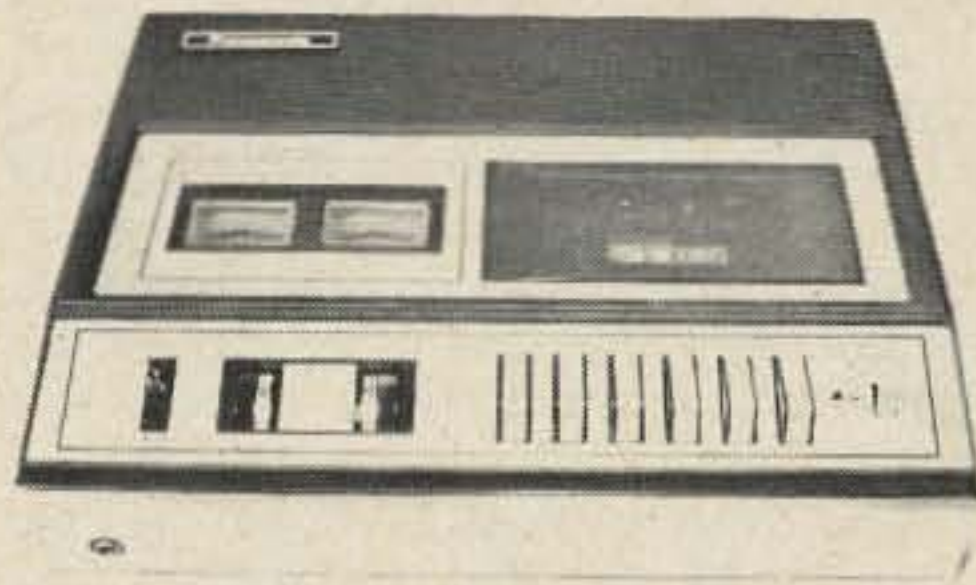
CASSETTE RECORDERS

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Features: Automatic shut-off - line in/line out - mike attenuator - spill-proof tape transport - separate monitor/playback vol and tone controls - tape counter - stereo headphone jack - pause control with lock - two VU meters - nicad recharger - peak limiter - Dolby noise reduction circuit - CrO₂/normal tape bias selector - 117 vac/ 12v dc operation - will work from car battery or optional nicad pack - built in monoural amplifier and speaker for monitoring - ferrite heads - slide record controls - just about the last word in tape decks, and portable too! Most cassette deck experts agree that this is the finest unit available today - and it is portable to boot.

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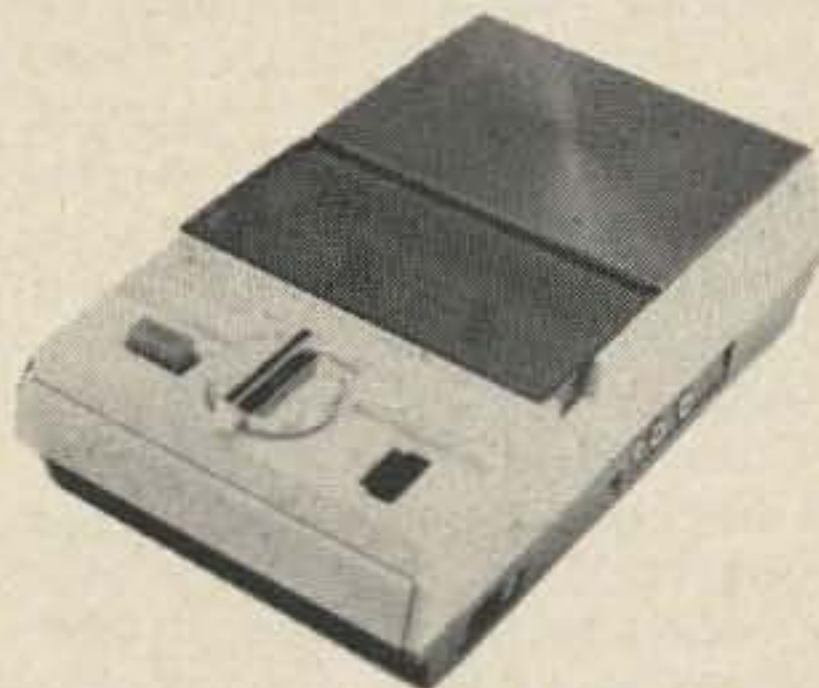
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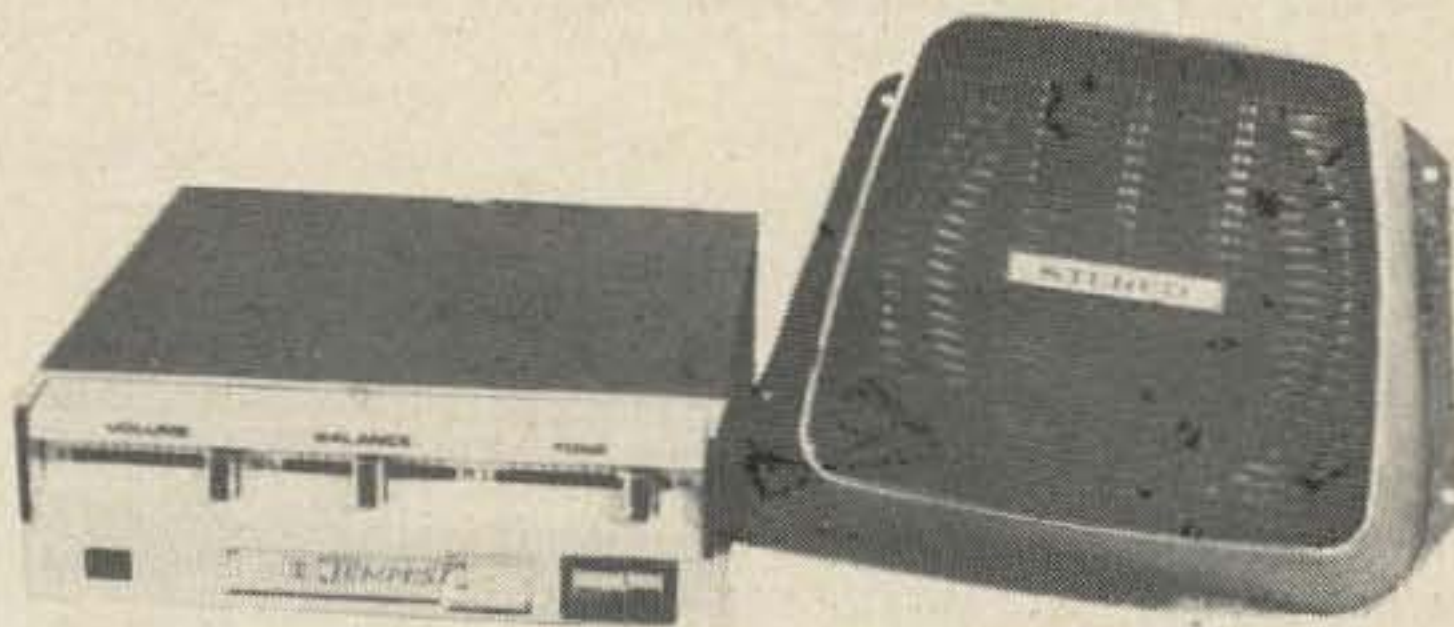
Features: stereo deck - pause control - CrO₂ bias or normal - automatic stop at end of tape - two VU meters - counter - headphone jack - mike input - line in and out. Great medium price cassette deck - quite adequate for top notch SSTV work - put your records on tape.

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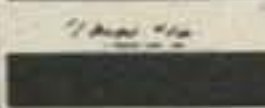
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FCC BRAVOS

Just like to send a note about an experience dealing with the FCC. I was employed this summer as one of two counselors in a summer camp instructing in ham radio. As part of the instruction, those interested in obtaining their licenses were drilled on code and theory and then administered their Novice tests while at camp. We had one camper pass his code test about halfway through the season and within two weeks had received his written. Somehow during the period he had completely lost interest and declined to take the written. Meanwhile another young camper had passed his code test and since time was running out, we feared the written portion of the test would not arrive in time. Being only 20 or so miles from Gettysburg, I made the trip there one afternoon. After passing the building 4 times, unknowingly, I got directions and entered the small recessed office. Upon entering I was ushered to the main office area from the lobby and proceeded to explain my problem to the woman at the nearest desk. She escorted me to another clerk to whom she explained the problem, and they both put aside what they were working on and began to pull out other files. In a matter of minutes the necessary paperwork had been completed and a Novice test package completed, addressed and sealed. When they handed me the test, it was with a smile and a wish of good luck for the applicant.

I was amazed that with all the work they have, they could make time to handle a problem like mine and be very friendly about it. Take my word for it when I say they have some wonderful people down there.

Chuck Davidson WA3LXB

PHONE PHREAKS VS MA BELL PART II

If you're like me, the original article on the "Phone Phreaks VS Ma Bell" left me on edge like an Alfred Hitchcock movie. Being an inquisitive individual, I began my search at the local library for the October 1971 issue of Esquire magazine. Mr. Rosenbaum's article was also a Hitchcock special, as he rather conveniently neglected to mention what the "super-secret" tone frequencies were. Needless to say, this was the driving force I needed to really launch an all-out search for those tones, AND HOW Ma Bell uses them. . .NOT to defraud the phone company, just to be able to say, "I know!"

After several months of searching the archives of various collections of electronics publications I found what I was looking for AND MORE!

All right, Mr. Rosenbaum's article was correct in that the whole show starts with 2600 Hz. Now, ever wonder why the common Touchtone

2-out-of-6 code	Assigned freq (Hz)	# Desired in dialing	Components of desired #
0	700	1 (0 plus 1)	700 + 900
1	900	2 (0 plus 2)	700 + 1100
2	1100	3 (1 plus 2)	900 + 1100
4	1300	4 (0 plus 4)	700 + 1300
7	1500	5 (1 plus 4)	900 + 1300
*	1700	6 (2 plus 4)	1100 + 1300
		7 (0 plus 7)	700 + 1500
		8 (1 plus 7)	900 + 1500
		9 (2 plus 7)	1100 + 1500
		0 (4 plus 7)	1300 + 1500
		Key Pulse (4 plus *)	1300 + 1700
		Start (7 plus *)	1500 + 1700

(TM) pad came equipped with such an array of wierd tones? I'm referring to those oddball frequencies of 697 Hz, 770 Hz, 1209 Hz, etc. Who was the nut who decided on these particular tones and why? The answer is simple. Touchtone (TM) frequencies were selected so they can in no way interfere with the trunk signaling tones. It soon becomes obvious that the trunk signaling tones were picked first, otherwise we would probably have nice even frequencies in our TT pads.

Yes, I hear the shouting, "what are the tones. . .what are the tones?" The trunk signaling tones ARE: 700, 900, 1100, 1300, 1500 and 1700 Hz. Ma Bell assigns these tones numbers, and pairs them together in a two-out-of-six code. The PAIRS are then and only then valid signaling information (see chart).

As shown in the chart, the tones are paired together so that the two-out-of-6 sequence adds up to the number desired in actual dialing. The Key pulse and Start digits are equipment information bits that tell the trunk decoding equipment that a series of tones are coming up or have ended. International country codes ALSO use these same tones, for uniformity.

How The Phone Phreaks Do It

They begin by dialing (on a regular phone) an 800 area code (INWATS) number KNOWN to be registered in a state besides their own. When the distant end begins ringing, then immediately beep out a short burst of 2600 Hz (disconnect tone). The distant end then stops ringing. Next they send out the "key pulse" pair followed by the area code and the number (using tones in above chart). This is followed immediately by the "start" pair. When the distant end rings this time, it is the number they desire, toll free!

They Get Caught

Ma Bell is always dreaming up super-sophisticated ways of foiling phone phreaks. A couple methods involve the use of 2600 Hz filters on the subscriber side of the line. One method filters out all 2600 Hz coming from the customer end, so the would-be phone phreak never gets off the ground. Another method brings up a central office alarm and seizes the incoming line. Even if the phreak hangs up, his line will remain seized until the phone company can trace

him down and ask him what he is using 2600 Hz for!

A loud and clear word of caution: Do not attempt to build, buy, beg, borrow or steal a tone generating device capable of reproducing the tones given in the chart, with the idea in mind of using it to place calls. Such use CONSTITUTES FRAUD AGAINST THE TELEPHONE COMPANY. This article is for educational information only.

...WB9FOP

References

- ESQUIRE, October 1971, P. 116 "Secrets of the Little Blue Box" by Don Rosenbaum.
- 73, January 1972, p. 31, "Phone Phreaks VS Ma Bell" by Martin Bradeley Weinstein.

A LITTLE DISSENT

Wayne Green may have a point. If the big magazines, newspapers, etc., are terrified of the IRS its up to the unterrified little guys to speak up. And it may be that a little dissent won't hurt amateur radio.

Anyway, here is a three year renewal to 73 to go along with my subscriptions to QST, Ham Radio and CQ. I think they all have something worthwhile.

M.C. Bowers, Jr. K4VQ

OUR REPEATER IS LICENSED

Enclosed is a check to help defray the cost of your HOTLINE paper which our club would like to subscribe to.

I would also like to take this opportunity to thank you for the information which your magazine covered about 18 months ago about how to license a repeater. I followed this guideline fairly close and was privileged to have the first repeater in the state to be licensed under a WR call. I received the call in about 3 months. A second application filed almost exactly like the first took 53 weeks. This one had to take an all out effort by the FCC to take so long, A couple of letters and a phone call finally woke them up.

Most of the members here take 73. All of us appreciate the efforts that you have made for us and other amateurs.

William C. Cousin



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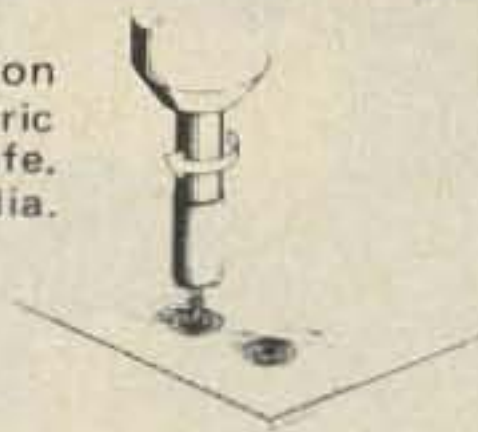
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This book presents the basics of two meter FM operation and repeaters in short form with the end in mind of getting you on FM quickly and easily.

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the Stuff

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Dress up the shack with this award for 2-way Slow Scan Television communications with 10 countries. Endorsement provisions for separate bands.

U.S. MAPS \$1

These wall sized maps show the states and call area. They are specially designed for coloring to show your progress toward the Worked All States award of ARRL or the Worked Almost All States award put out by 73 (for proof of contact with 49 states). Since you will probably be wanting to work for the award on several bands you will want several maps. They come in groups of four.

WORLD DX MAP \$2

This is the same wall-sized DX map that is included with the DX Handbook except it comes to you rolled up instead of folded. This is so you can put it on the wall or have it framed. The map is designed with all country prefixes indicated and space for you to color in the countries as

you work them. Visitors can see immediately how much of the world you have contacted! The zones are on the map as well as prefixes. Maybe you need several maps.

CUSTOMIZED DX BEARING CHART \$4

An amateur who works for a big computer company has a program which permits him to plug in your location and have it print out the bearings of all the countries of the world from your shack. Once you have this list you will use it for every DX contact. The chart gives the bearing and distance to all major cities and countries. Be patient when you order for these have to be run through in groups so that we can offer them to you at such a low cost.

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73 Magazine, Peterborough NH 03458

Why Is Tom Durston Smiling?



Tom Durston is an engineer at MITS, Inc. He's walking around these days with a big grin on his face. And he has plenty of reason.

Tom has designed a computer terminal called the Comter 256. It's the same terminal that is featured on the cover of this month's *Radio Electronics*. And it's the first computer terminal to be marketed in kit form. Anywhere.



When Tom says, the Comter 256 is a "low cost, high performance computer terminal", he isn't using rhetoric. Just look at the specs:

The MITS Comter 256 also has a tape play/record feature, giving it virtually unlimited memory capability. Almost any type of tape recorder may be used.

The ASCII coded keyboard and 110/300 band transmit/receive rate makes the terminal compatible with almost all systems today.

A hardwire in/out connection on the back of the unit allows direct wiring to a computer. The same connector will be used for add on features such as an RS232 connection and modification from full duplex to half duplex transmission.

The Comter 256, has an alphanumeric, thirty-two character Self-scan™ display. The terminal will store 256 characters with expandability to 1,024 characters.

The built-in acoustic coupler makes computer hookup much simpler, saves extra cost, and eliminates external connections.

The auto-transmit feature allows the operator to transmit data or program material to the computer line by line instead of typing it directly into the computer, saving computer time and your money.

And when Tom says, "The Comter 256 was created to give everyone access to the sophisticated world of computers" . . . Well, just look at the PRICES:

Comter 256, kit form, complete with easy-to-follow manual	\$495.00	Memory Expansion — per page (256 characters)	\$ 79.50
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"Creative Electronics"

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73-11-74

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7404	.22	7453	.27	74153	1.29
7405	.22	7454	.39	74154	1.59
7406	.39	7460	.19	74155	1.19
7407	.39	7464	.39	74156	1.29
7408	.25	7465	.39	74157	1.29
7409	.25	7472	.36	74161	1.39
7410	.19	7473	.43	74163	1.59
7411	.29	7474	.43	74164	1.89
7413	.79	7475	.75	74165	1.89
7415	.39	7476	.47	74166	1.65
7416	.39	7483	1.11	74173	1.65
7417	.39	7485	1.39	74176	1.09
7420	.19	7486	.44	74177	.99
7422	.29	7489	2.75	74180	1.09
7423	.35	7490	.76	74181	3.65
7425	.39	7491	1.29	74182	.89
7426	.29	7492	.79	74184	2.69
7427	.35	7493	.79	74185	2.19
7430	.22	7494	.89	74190	1.59
7432	.29	7495	.89	74191	1.59
7437	.45	7496	.89	74192	1.49
7438	.39	74100	1.65	74193	1.39
7440	.19	74105	.49	74194	1.39
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74L06	.33	74L73	.69	74L98	2.79
74L10	.33	74L74	.69	74L164	2.79
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74H08	.33	74H40	.33	74H62	.39
74H10	.33	74H50	.33	74H72	.49
74H11	.33	74H52	.33	74H74	.59
74H20	.33	74H53	.39	74H76	.59

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8095	1.39	8230	2.59	8822	2.59
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8123	1.59	8551	1.65	8831	2.59
8130	2.19	8552	2.49	8836	.49
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general specifications

Frequency Drift(1): < 1.5%
 Group Amplitude Stability: ±25%
 Total Distortion (Harmonic + Intermodulation): < 5% (relative to level of fundamental frequencies)

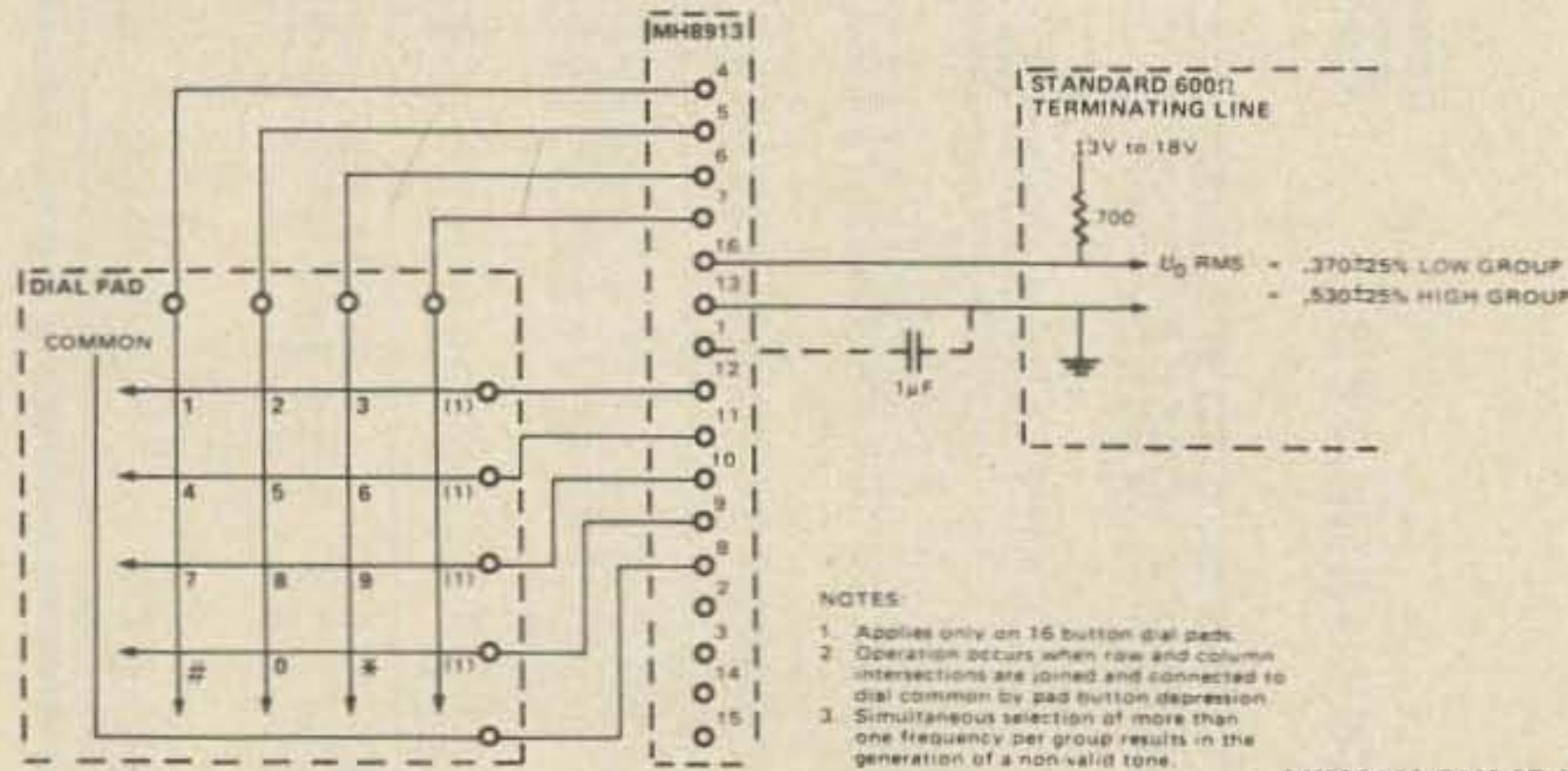
Typical Rise Time to Specified Output and Frequency:

- 1) Frequency selected, power supply switched < 5ms
- 2) Power applied, frequency selector switched < 2ms
- 3) Power applied, frequency within same group changed < 2μs

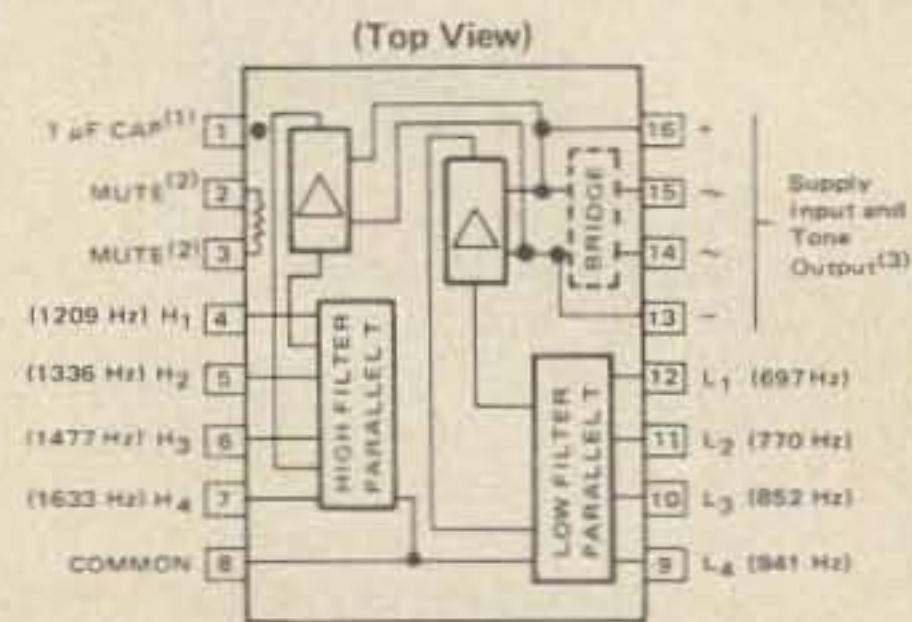
features

- Dual Frequency Capability
- Standard Telephone Tone-Dial Frequencies:
 Low Group - 697, 770, 852, 941 Hz; High Group - 1209, 1336, 1477, 1633 Hz
- Specification Ratings Exceed CCITT Recommendations

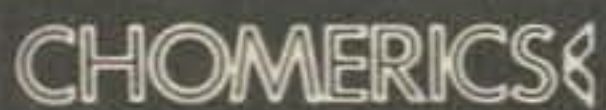
typical circuit connection diagram



block diagram and pin configuration



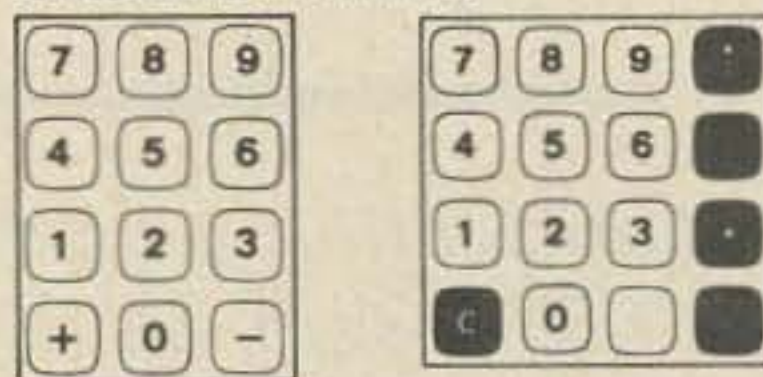
MH8913J CAN BE USED WITH CHOMERICS #ER21624 TOUCH TONE KEYBOARD



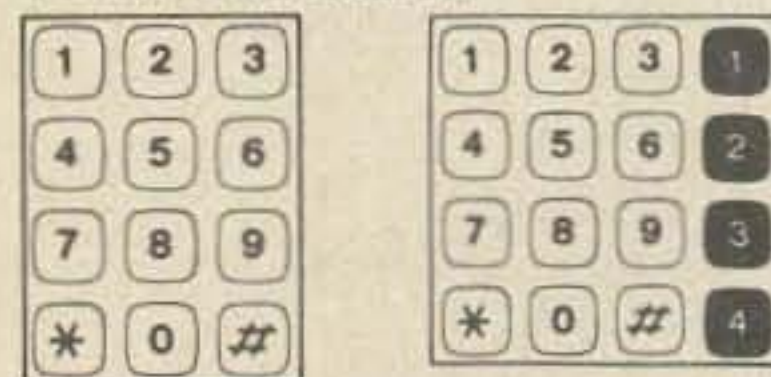
QUICKEY® TACTILE KEYBOARDS

FORMATS
 Standard legends are black and white set in Standard Medium type.

CALCULATOR FORMATS

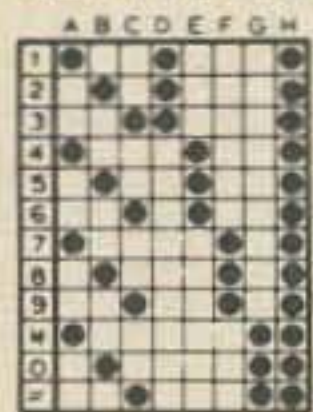


TOUCH TONE FORMATS



CODING

Touch Tone 12 Key



BCD 12 Key



Single Pole 12 Key



Touch Tone 16 Key



Single Pole 16 Key



1/2" centers		3/4" centers		Format	Coding	# of Keys
Model #	Price	Model #	Price			
ER 21622	7.15	ER 21605	7.70	Touch tone	Single pole	12
ER 21623	8.70	ER 21606	9.25	Touch tone	Touch tone	12
ER 21624	9.25	-	-	Touch tone	Direct to MH8913	12
-	-	ER 21607	7.70	Calculator	Single pole	12
-	-	ER 21608	11.00	Calculator	BCD	12
ER 21625	8.70	ER 21609	9.25	Calculator	Single pole	16
-	-	ER 21610	9.25	Touch tone	Single pole	16
-	-	ER 21611	11.15	Touch tone	Touch tone	16

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ELECTRONICS FOR THE HAM and EXPERIMENTER

SOLID STATE SURPLUS

... four months later

Dear Customer,

Four months ago we ran our first ad in these pages. You may even remember the "just what the world needs...another surplus place?" banner which said, in effect, we aim to do things a little differently.

Those of you who have ordered from us know what we're about...hobbyist parts at truly competitive prices, fast turnaround, no backordering...and judging from your reaction, this is what you want.

For those reading about us for the first time, a few comments. One, we do not publish a catalog, for two reasons. First, our "catalog" is this page - it lists every product we sell. (A couple of months ago, we had an ad saying "Solid State Surplus proudly announces its first catalog." The point of the ad was that the ad itself is our catalog, although we didn't manage to make that point too clearly... I guess that's what happens when you let electronics freaks do the advertising.) There's another reason why we don't have a catalog: We'd have to charge more for our parts. When you send in your 65¢ for a regulator, you want to pay for the regulator, not the price of mailing catalogs out to other people. We are trying to avoid anything that would force higher prices...hence, no catalog. What's for sale is listed in the ad.

Another comment: we enjoy dealing with you, our friends and customers. We appreciate the notes, the comments and the criticisms, too. If you have something you feel like saying to us, go right ahead; we've all got big ears and we listen hard. The increased interest in the 4016, for example, is what put it in our repertoire of ICs...and who knows what we'll come up with in the months ahead?

But to return to the present, here's what we sell now. You know the rest; spiffy data sheets, orders filled (usually airmail) within 48 hours of receipt, no backordering, and individual testing of each part...just what the world needs, another surplus place.

SOLID STATE SURPLUS

LM 309K 5V 1A regulator \$1.20
LM 311M high performance comparator \$1.00
LM 339 dip quad comparator \$1.50
LM 555 timer \$.85
LM 723D adjustable precision voltage regulator \$.65
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LM 747 dip dual 741 \$.70
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All for \$400.00

MOTOROLA H23AAC: 1½ watts output on two meters. This is the familiar "Lunchbox" which uses transistors in the receiver and instant heat tubes in the transmitter, with a dry battery supply. \$30.00 each

MOTOROLA HT200 (H23DEN) features solid state receiver and transmitter. These units require some repairs and are not operable at this time. Only 4 left at \$75.00 each

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BASE STATIONS:

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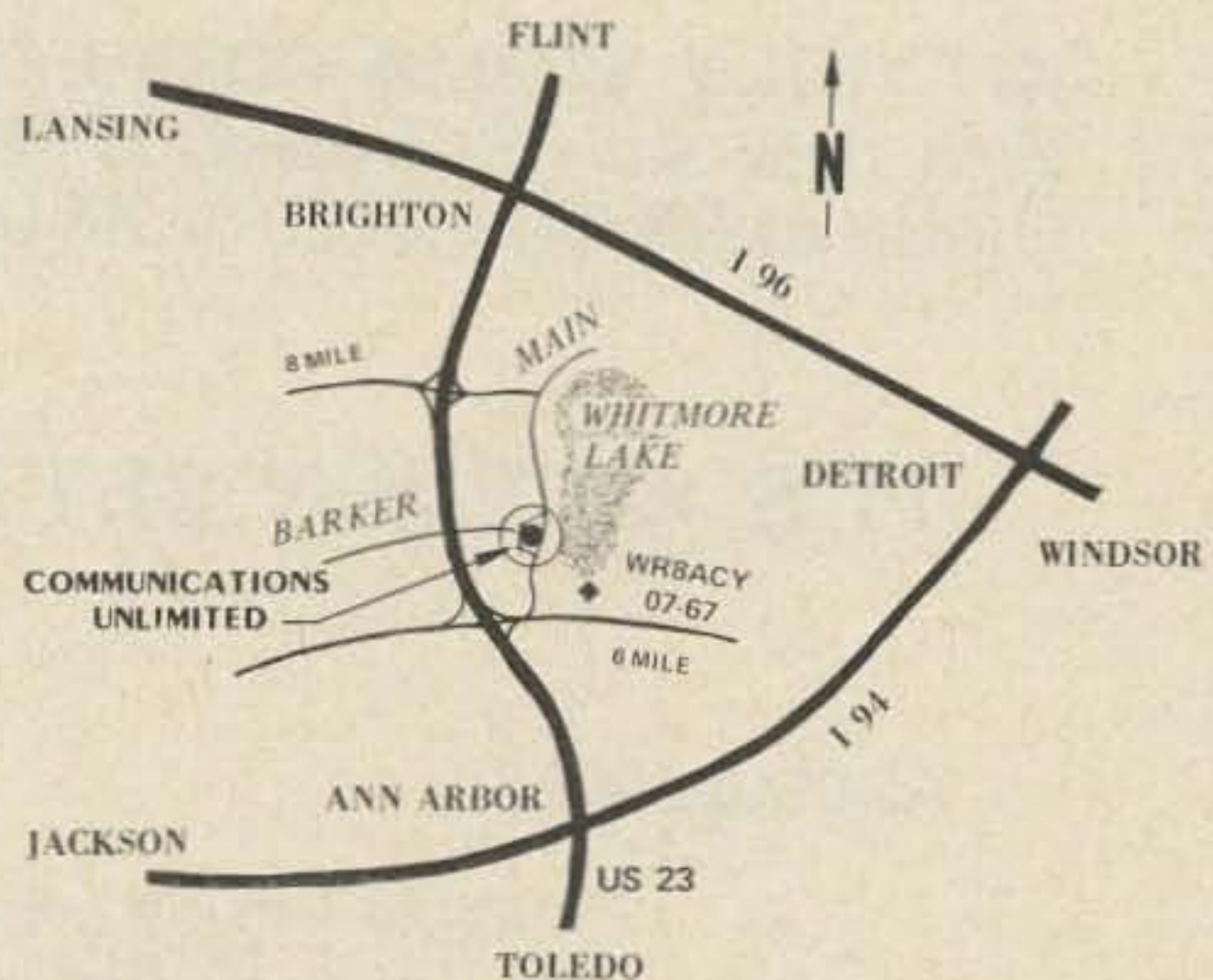


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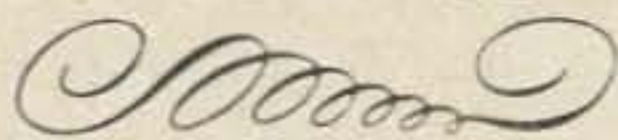
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NEW!

HT-144B

TWO METER F.M. PORTABLE

See p. 16 for New Product Review



**CRYSTAL SOCKETS INCLUDED!
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signal diodes in one package. 20
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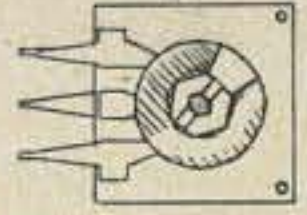
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7402	.35	74L55	.35
7404	.28	7460	.20
74H04	.35	74L71	.30
7405	.28	7472	.40
7406	.70	74L72	.50
7408	.35	7473	.60
74H08	.35	74L73	.75
7410	.25	7474	.65
7413	1.25	74H74	.80
7417	.40	7475	1.40
7420	.25	7476	.60
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74H20	.35	7480	.65
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25K Trimmer

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TTL DIP Hex Inverter; pin interchangeable with SN
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DATA 10 FOR..... 2.50
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Right-hand decimal point.
Flat-pack type case. Long
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for pocket calculators!



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Right-hand decimal point. Snaps in 14-
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This kit provides a highly sophisticated display
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NOTE: boards can be supplied in a single panel of
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COMPLETE KIT ONLY \$11.95
FULLY-ASSEMBLED
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710	Voltage comparator DIP.....	.75
711	Dual comparator DIP.....	.40
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741	Op amp TO-5/MINI DIP.....	.55
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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
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7437	.50	74154	1.70
7438	.50	74157	1.40
7440	.20	74161	1.50
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7451	.20	74175	2.20
7453	.20	74176	1.60
7454	.20	74177	1.35
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All FETs come with data sheets.

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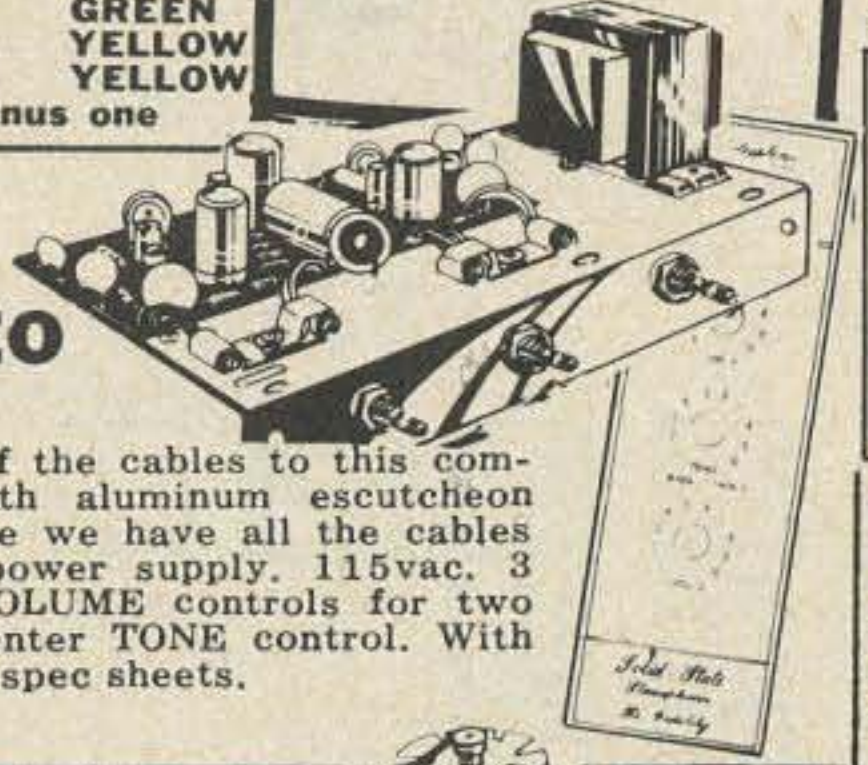
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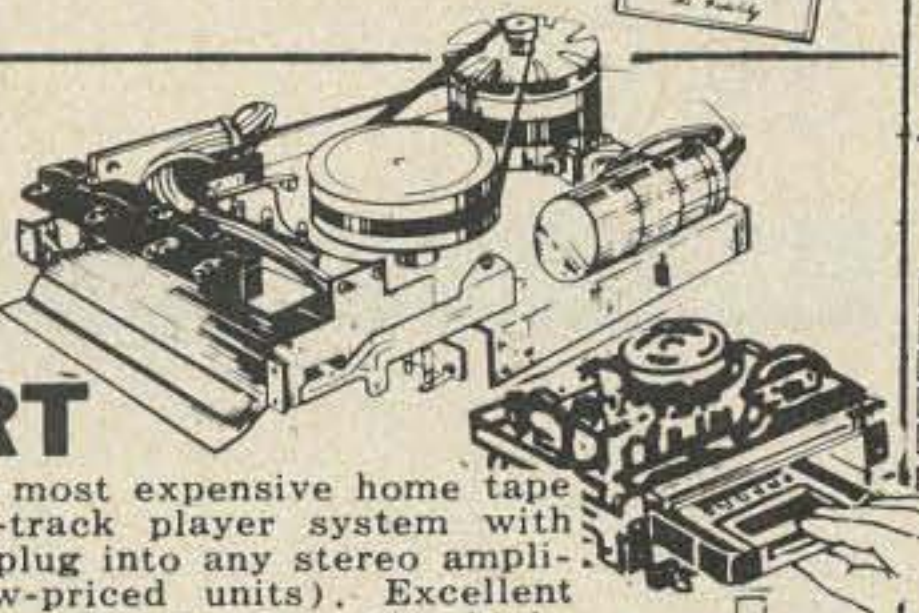
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ARGENTINA	14	7	7	7	7	7	7A	21	21	21	21	21
AUSTRALIA	14A	14	7B	7B	7B	7B	7	7	14	14	14	21
CANAL ZONE	14	7	7	7	7	7	7A	21	21	21	21	21
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AUSTRALIA	14A	14A	14	7B	7B	7B	7	7	14	14	14	21
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JAPAN	14A	14	7B	7B	7	7	7	3	7	7	7B	14
MEXICO	14	7A	7	7	7	7	7	7A	21	14A	14A	14
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PUERTO RICO	14	7	7	7	7	7	7	14	21	21	21	14
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A = Next higher frequency may be useful also.
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- Squelch Fast attack; noise operated
- Audio Output 2 wts (max)
- RF Output 5 wts (nom) @ 13.5 VDC
- Modulation Low distortion Phase Modulator, w/ up to 12dB of Speech Clipping
- Deviation Adjustable; factory set to \pm 5 kHz
- Final Stage Fully VSWR protected. No shutdown required
- Microphone Hi Z Ceramic, (Turner)
- Frequency Range 146 to 148 MHz
- 6 Channels w/trimmer caps on all xtals
- Reverse Polarity protected
- Built-in speaker
- Electronic T/R switching -
No relay problems

SPECTRUM COMMUNICATIONS

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There's nothing amateur about our radios.

Deluxe "101 Series"... The ultimate base station combination.



FR-101 Digital SOLID-STATE RECEIVER

- Total coverage capability: 160 thru 2 meters + 12 major S.W. bands.*
- Direct frequency readout to 100Hz.
- Provision for all-mode reception: SSB, CW, AM, RTTY & FM.**
- Reliable, plug-in, modular circuitry.
- Compatible transceive operation with 101 series.

* Six and two-meter converters and crystals optional. ** Filters and FM detector optional.



FL-101 SOLID-STATE TRANSMITTER

- 240 Watts PEP.
- 160 thru 10 meter coverage + 2 optional auxiliary bands.
- All-mode operation: SSB, CW, AM & FSK.
- Reliable, plug-in, modular circuitry.
- Provision for RF speech processor.

Specifications subject to change without notice.



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