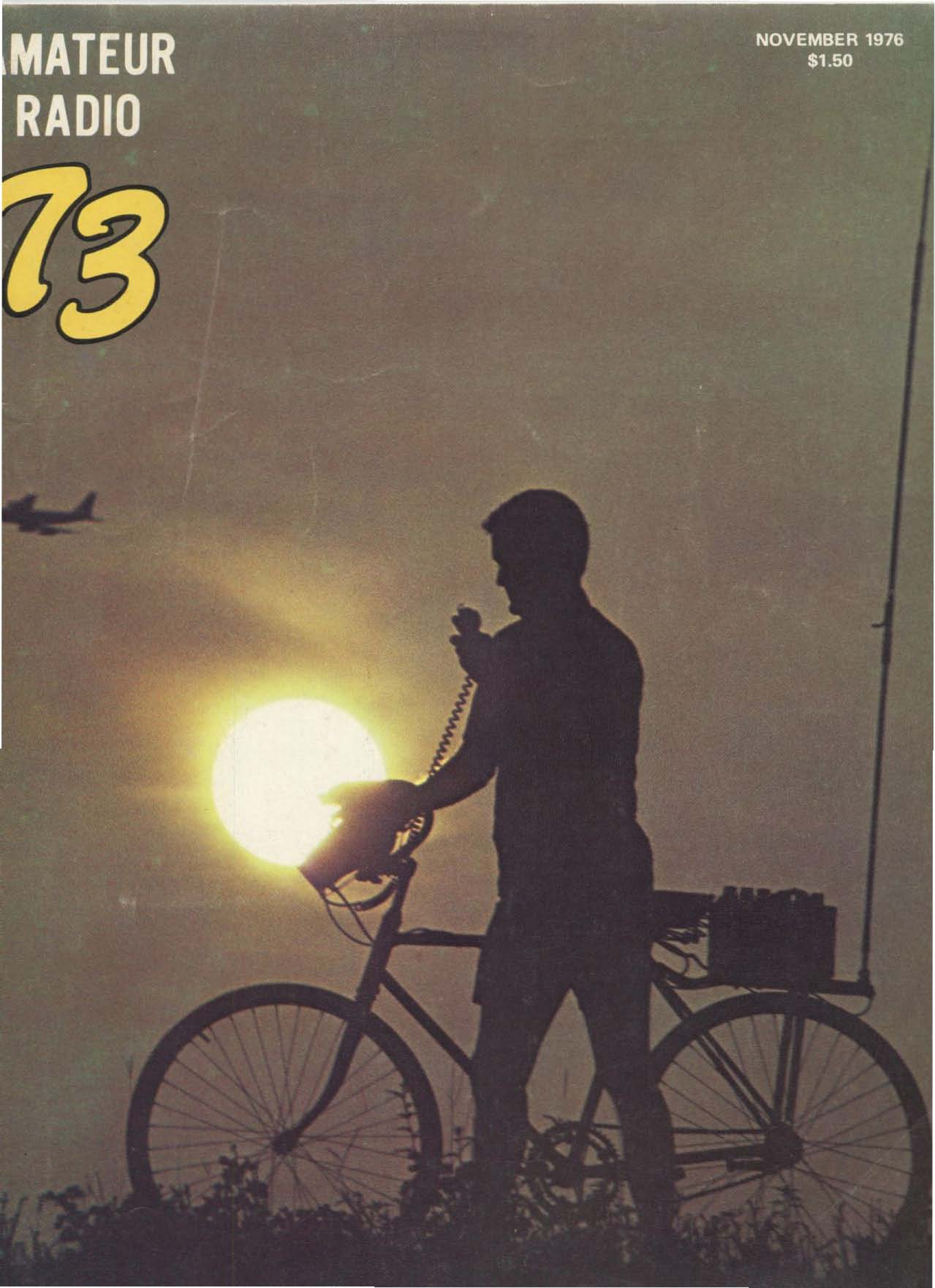
AMATEUR RADIO

73

NOVEMBER 1976
$1.50



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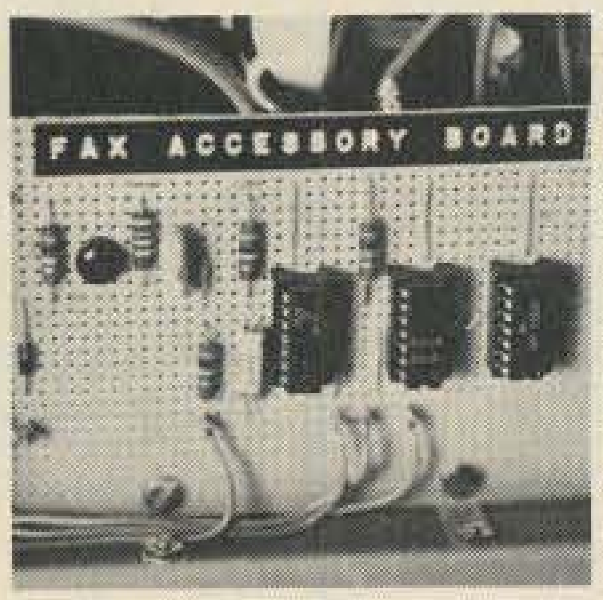

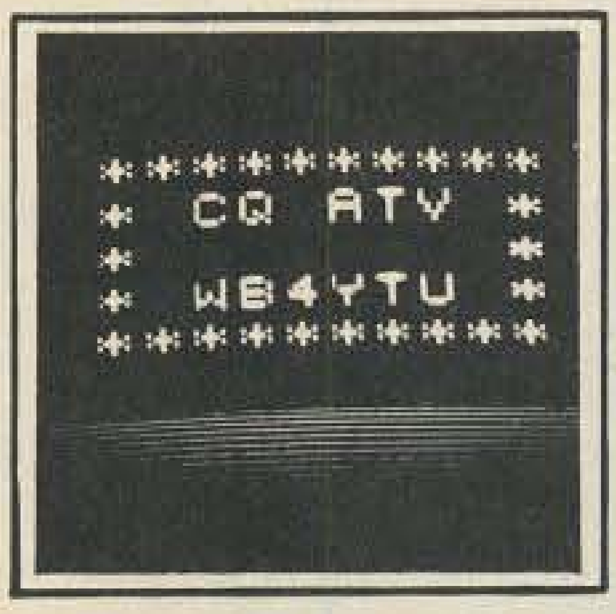

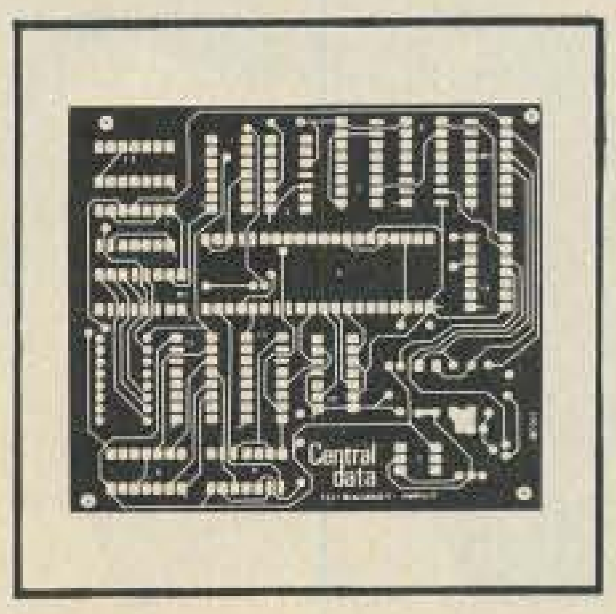

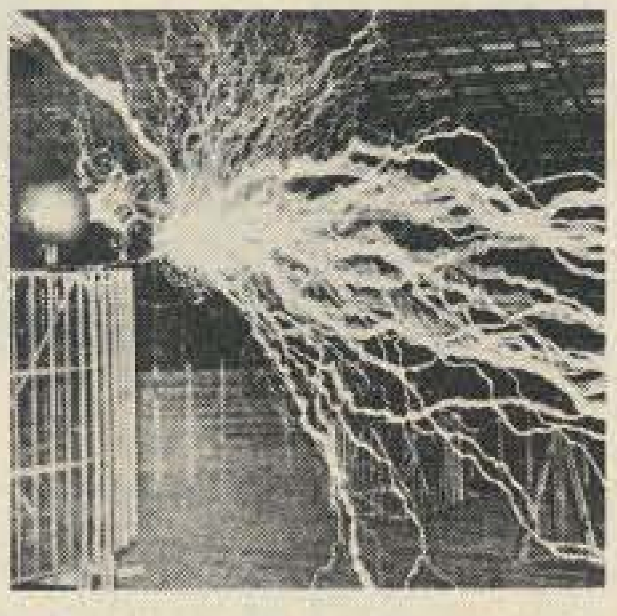

#193 NOV 1976

COVER: Photo by Albert Coya WB4SNC. Article begins on page 30.

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NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

WD CALLS STARTED

The FCC has started issuing WD4 calls, so don't be surprised or think they are just special events calls. What happened to WC calls? These have been reserved for RACES stations and are being bypassed for general ham licenses.

PARKING SOLUTION

The parking lot for the downtown Hartford shopping complex has a special section for CB radio parking . . . right under the watchful eye of the cashier at the exit. This looks like a good solution to the problem of getting CB and ham rigs ripped from your car. You might show this picture to your local parking lot manager and see if he won't provide a similar service.

ATLANTA 73 BOOTH VISITORS

Some well-known hams stopped by the *73* booth at Atlanta and got their pictures snapped.

FCC WRONG

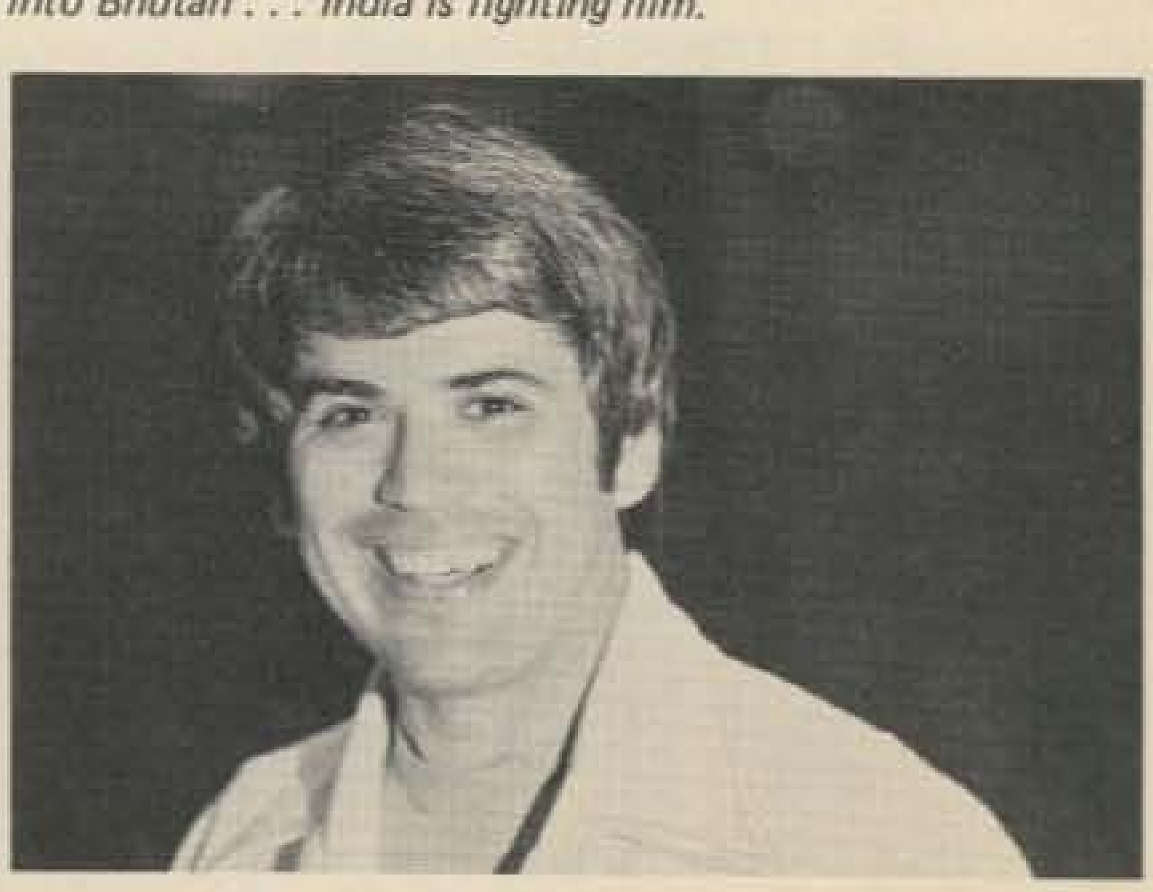
During a discussion on a San Francisco radio talk show a couple weeks ago, I faced the head of the FCC for the area telling me that CB was just awful there . . . bad language . . . a mess. He said that CB might be okay back East where I lived, but I would disown the whole thing if I heard how it was in California.

Continued on page 156

Mike Stahl K6MYC of KLM . . . antennas . . . amplifiers . . . transceivers . . . and much etc.

Gus Browning W4BPD, well-known DXer and publisher of the DX Bulletin. Gus is angling for permission to get back into Bhutan . . . India is fighting him.

Chaz Cone W4GKF of Navassa Island fame . . . and the head of the 1976 Atlanta Hamfest . . . the biggest and best yet.



Tom Gentry K5VOU of Icom in Dallas, and more recently involved with the hobby computer market.

either way is the right way

...they're both KENWOOD

the TR-7200A

Kenwood's superb 2-meter FM mobile transceiver. Designed to withstand the most severe punishment while providing consistently excellent performance.

Packed with features like the PRIORITY function . . . Put your favorite crystals in channel 7, and the 7200A automatically returns to that frequency when it senses activity there. 146-148 MHz coverage, 22 channels, 6 supplied. Completely solid state. Voltage required: 13.8 VDC. Antenna impedance: 50 ohms. Frequency adjusting trimmers on every crystal. RF output power: 10 watts (or 1 watt at low power). Adjustable frequency deviation (factory set at ±5 kHz). Automatic VSWR protection. Receiver sensitivity less than .5 uV for 27 dB. Selectivity: 12 kHz/ −6 dB and 24 kHz/−70 dB. Size: 7-1/16" W x 2-3/8" H x 9-7/16" D, 5-1/2 lbs.

Complete with dynamic mike, DC power cord, mobile mount, mike hanger, auxiliary connector and external speaker plug. Amateur net . . . $249.00.

The perfect companion to the TR-7200A is the PS-5 AC/DC power supply. Together they provide an efficient and handsome base station. The PS-5 is complete with a digital clock and automatic time control feature built in. Amateur net . . . $79.00.

the TR-2200A

Kenwood's high performance portable 2-meter FM transceiver . . . completely transistorized, rugged and compact.

12 channel capacity. Built in telescoping antenna can be easily replaced, or stored in carrying case. Connector for external antenna also. External 12 VDC or internal ni-cad batteries, complete with 120 VAC battery charger. 146-148 MHz frequency coverage. 12 channels, 6 supplied. Battery saving "light off" position. Hi-Lo power switch (2 watts −400 mW). Sensitivity: 0.5 uV or less/26 dB S+N/N. Built-in speaker. Size: 5-3/8"x 2-5/16"x 7-1/8", 3-3/4 lbs.

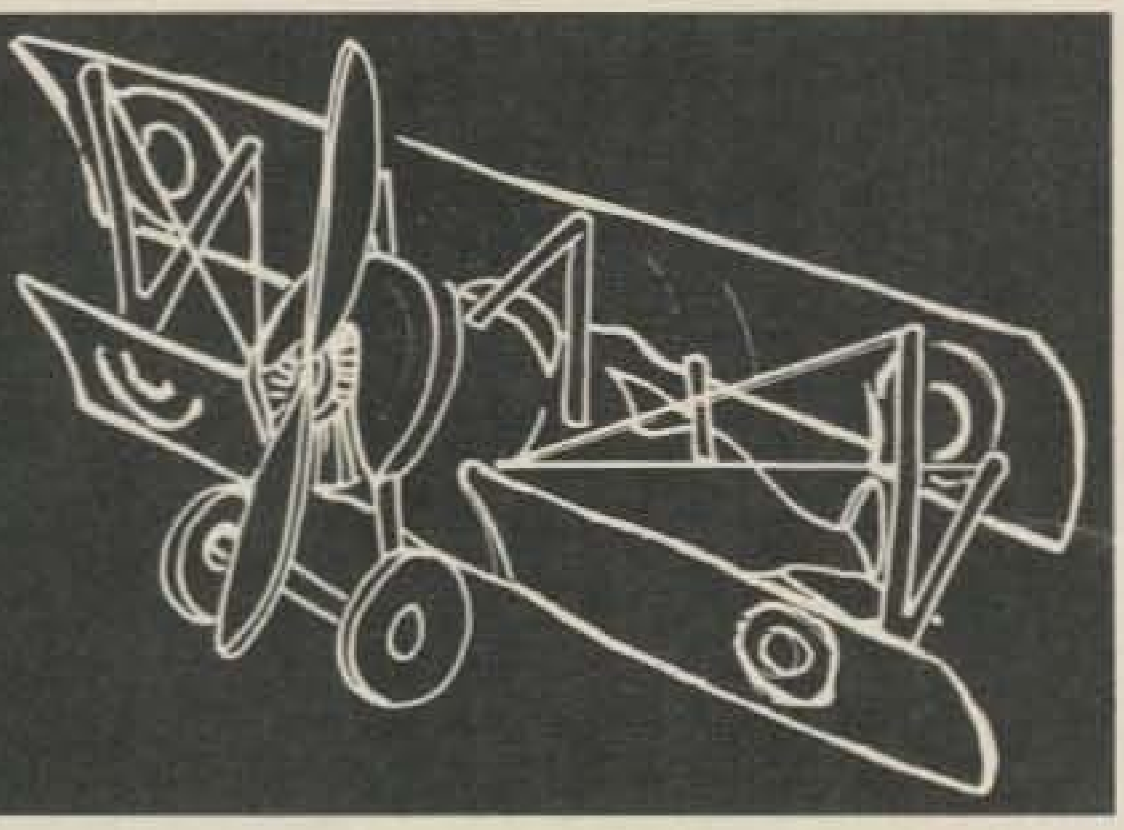
Complete with Dynamic mike, O-T-S carrying case, all cables, speaker/headphone plug and 10 Ni-Cad batteries. Amateur net . . . $229.00.

KENWOOD *. . . pacesetter in amateur radio*

TRIO-KENWOOD COMMUNICATIONS INC. 116 EAST ALONDRA/GARDENA, CA 90248

Autobiography of an Ancient Aviator

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



I returned to Genoa after a 16 day survey trip to Marseille and the northwest African coast. Genoa felt like home — but not for long. I had three days to make up my report and get ready for a trip to Egypt and the Levant. On January 12th, Jim Eaton flew down to Rome with me on Ala Littoria. Since we arrived late, we just had time to check in at the Ambassadore and have a quick dinner before an evening conference with our Commercial Attaché. This was interesting, as he appeared to know more about Export's plans than Export did. After he finally bought us a drink, we retired.

My schedule was to take the 05:30 Ala Littoria plane from Rome to Brindisi (about 300 miles), arriving there in plenty of time to catch the 10:30 Imperial Airways (British) flying boat to Alexandria via Athens. All very fine. Up at 03:00, shower and shave in haste, no coffee, bus to the 20 mile distant airport, no coffee, bumpy ride to 09:10 arrival at Brindisi, and still no coffee. Then, finally, breakfast at the International Hotel. Then I found that Imperial Airways would be a day late: "Be in some time tomorrow morning." What do you do with a day at your disposal in Brindisi?

That question was solved for me by what you might call a coincidence. Just as I was leaving the Imperial Airways office at the airport I heard well-raised voices in an adjoining room, some Italian and one American that I recognized as that of an old friend — Wesley Smith from Philadelphia. It seems that a fellow named Welch had shipped his plane over to Le Havre and had hired Wes to fly it and him from there to Saigon. They had arrived at Brindisi that morning and had planned on going on to Athens after refueling. The Italian officials had different ideas. Some technicality was preventing them from clearing Wes's flight. Their negotiations were apparently quite difficult due to the Americans not understanding Italian and vice versa. I butted in and helped get matters cleared up by getting the Imperial Airways Station Manager to act as interpreter. By that time, however, it was too late for Wes to start for Athens, so Wes, Welch and I had an enjoyable evening together "on the town." They got away early the next morning, but my 10:30 Imperial Airways flying boat didn't arrive until 13:00. Accommodations and service on Imperial were the best, and we had a good flight to Athens. Wes and Welch were already checked in at the El Brittan Hotel when I arrived, so we had dinner and a night club together. Next morning I had a stormy and very bumpy three hour crossing to Alexandria. Jim McCormack (Export's Near East representative) met me at the flying boat station and settled me in at the Windsor Hotel.

I have a couple of clippings from the Egyptian Gazette (Alexandria) following up the Smith-Welch Saigon flight story. Both dispatches were from Nicosia, Cyprus. The first, dated 1/16/37, reported that Smith and Welch had arrived there at 07:30 that morning after a flight of nearly 600 miles from Athens, and that "The recent rains having left the Airdrome in a very muddy state, the wheels of the machine became embedded in the ground when landing, but were later extricated and the plane was found to be undamaged." The second, dated 1/18/37, stated that Smith and Welch "left at 10:15 for Damascus. The airdrome officials witnessed the takeoff which they believed to be impossible owing to the muddy state of the ground, and they held fire extinguishers ready in case of emergency." I have talked with Wes about this trip several times since at Quiet Birdmen meetings in New York.

I found that Jim McCormack had a fairly tight schedule arranged for me. My first evening in Alexandria he took me out to Judge Brinton's home after dinner to obtain his advice on how to proceed with my mission in Egypt. The judge was an American and for years had presided over the "Mixed Court" in Alex. He was very friendly and advised us not to talk with any Egyptian officials at that time, but to put the matter before Mr. Childs, our Consul, and the Minister (don't remember his name) in Cairo for our guidance. So we made an appointment with them for Sunday afternoon, January 17th, and rode the railway up to Cairo. They told us that since the August 1936 Anglo-Egyptian Treaty which turned the government of Egypt back to the Egyptians, most of the new government's efforts had been directed at replacing British civil servants with Egyptians. They thought that the time was inopportune to try to talk with them about air rights. Their advice was to wait a few months until things had settled down a bit. With this, my business in Egypt was concluded for the time being. I still had Haifa and Beirut to check, but had to wait until January 23rd for the Exochorda (one of Export's Four Aces) to make the trip up the Levant coast and back. A brand new Chevrolet sedan belonging to John Gehan was unloaded from the Exochorda at Alex. It already had Italian number plates on it and a note from John Gehan told me that it was completely insured and to use it as much as I wanted to. I didn't have an international driver's license (don't even know whether they were available at that time), so I took out an Egyptian driver's license and drove all around Alexandria as well as to Rosetta, Damanhur and other native villages. Driving through a native village was a pretty slow process in those days. No amount of horn blowing, yelling or nudging would get a person, donkey or camel to move over to let you pass — particularly in a narrow street. Small boys would jump on your running board, some for the ride, but mostly to yell for alms.

Alexandria is pretty well surrounded by water with the Mediterranean on the north, Lake Mariut on the southwest and Lake Idku on the east. Both these lakes were too shallow for flying boat operations. It wouldn't take much wind to build up too much of a sea. Imperial Airways used the ship harbor which was well protected, so I decided to recommend that for our use.

Speaking of Lake Mariut reminds me of the novel way of catching wild ducks that was practiced in the lake. As I mentioned before, Lake Mariut was quite shallow in places. Several Egyptian young men equipped with weighted shoes, a hat with a lot of reeds or rushes sticking up from it, a wide belt with cord loops attached all around it (20-25) and five or six live decoys with strings attached to one leg, would wade out in the lake until the water was nearly up to their chins and have the decoys swim around near their hats. Cruising wild ducks would spot the decoys and join them. When one got close enough, the hunter would grab its feet and pull it under water and attach its feet to a loop on this belt where it would drown quickly with a minimum of commotion. When his belt was full he would bring them into the city (Alex) and sell them for anywhere from 10 to 20 Piasters each (50¢ to $1), according to the buyer's bargaining ability. They were mostly small black ducks and were delicious if not overcooked. Guess I better stop here and not get into any cooking directions.

Next month: Jerusalem to Beirut in 1937.

Tracking the Hamburglar

PURLOINED: TR22-C s/n 850278; Swan 350 s/n C847975. These were taken from my automobile at the Northwest Plaza shopping center in St. Ann, Missouri on June 24, 1976. Please contact W2ZKE, 1150 Staffler Road, Bridgewater NJ 08807.

STOLEN: Regency HR2-B s/n 49-05424. Contact Well Howell WA2RZP, 107 Ivy Lane, Bridgewater NJ 08807, 201-526-4128.

SHANGHAIED: EBC-144JR, 2 meter transceiver, s/n 7514359A and "tuna two" home brew antenna with magnetic mount. Taken from automobile in Basking Ridge, New Jersey on August 10, 1976. Unit is inscribed on bottom with: J.C. Maikisch WA2OFT, 089-32-6899, M01814076312424, (201) 538-1667. If found please contact John Maikisch WA2OFT, H-11 Farmhouse Lane, Morristown NJ 07960, 201-538-1667 or Bernards Township Police 201-766-1122.

KIDNAPPED: Genave GTX-200 #20-37 taken from my car on 12/10/75 in New Haven; Genave GTX-200 #32-44 taken from my car on 3/25/76 same place. Both had USAF/MARS and CAP repeater xtals in them. Contact William M. Welch WA1BER, 34 Sunset Road, West Haven CT 06516.

ABDUCTED: Drake ML-2 and mounting bracket s/n 11446. Stolen on evening of June 17 from James R. Johns WB2FHS, 24 Fairview Drive, Middletown NJ 07748, 201-842-8403.

LOOTED: IC230 s/n 2840. Contact David Mello W3FOR, 208 E. University Pkwy., Baltimore MD 21218, 301-366-2157.

HIJACKED: Regency HR2B, s/n 49-02817. Stolen from automobile. Microphone cable is hand-wired to set (instead of conventional cable-jack). Kristen N. Johnson WA1TJP, 86 Alton Road, Quincy, Mass. 02169.

BE MY GUEST

visiting views from around the globe

Belle

Hurricane Belle turned out to be much less of a storm than expected. But Civil Defense officials and radio amateurs from South Carolina to Maine were ready. By the time Belle, packing 80 mile an hour winds, hit Long Island and Southern Connecticut on the eve of August 9th, local CD directors and their ham helpers had as much as four days' notice.

In most areas, 2 meter repeaters furnished the first line of communications. Here in New Hampshire, for example, the Concord 34/94 (W1ALE) was taken over by the state Civil Defense, led by W1EDU, who set up a 2 meter control base at the Concord Armory. 34/94 then became the primary link for the entire state CD. That was more than twelve hours before Hurricane Belle, in a much toned down form, rolled into southern New Hampshire.

On the lower bands, weather and Red Cross nets were the order of the evening, with SSB taking the biggest load. CW nets were started up, but the volume of takers was insignificant compared to the SSB nets. Northeastern University Club Station W1KBN utilized an FCC designated emergency frequency at 3910 and dispatched net controls plus liaison stations at ten kHz intervals according to state. It was possible to tune any area, any state and get the latest track on Hurricane Belle. Meanwhile some states had started their own nets, extending the earlier established 2 meter FM nets.

ARRL Memorial Station W1AW jumped from net to net, gathering the latest information, and passing it along to the rest of the country by Official Bulletin. *73* staffers WB6BED/1 and WA1GUD/1 manned 75 meters for New Hampshire until nearly 0200 local time.

It was something to behold – 2 meters and the low bands linked by control stations, tying the entire eastern seaboard together with emergency communications, much of it on emergency power. Through the next day, August 10th, local groups continued their vigil, watching over swollen streams and rivers, and assisting in the few evacuations that were necessary.

Many local CD officials first heard the course of the storm from hams monitoring on the low bands, and relaying word by 2 meter FM. CBers too played their role, furnishing coordination between emergency officials and Red Cross groups. There were only a few reports of problems between CB and amateur groups, but they were promptly cleared up after some ham diplomacy and a demonstration of what 2 meters could do. It was easy for local police and fire officials to draw a comparison between their own FM Public Service communications and the amateur systems.

So, if Hurricane Belle is to go down in the amateur radio record books, it would have to be a measure of just how well prepared we are. Despite the lack of a life and death emergency in the long run, New England's experience with Belle proves amateurs are ready and able to furnish immediate and reliable communications. But it is a lesson as well in the value of advanced warning, and the need for continued planning at the local, regional and national levels.

Warren Elly WA1GUD/1
Deering NH

Dixie

Dave Blackmer, the retired Air Force man who lives in Nipomo, is an amateur radio buff. He has his own 1,000 Watt station, WA6UNK, and spends countless hours talking with and listening to people around the world. He was thus engrossed last Thursday afternoon, moving his dial to see what was going on.

Suddenly there came an SOS signal from a yacht off the coast of Baja California. The yacht, becalmed and with an ailing and idle engine, had aboard a man who appeared to be suffering from a heart attack. His wife was at the radio transmitter, sounding her emergency call.

Dave latched on. Next thing he did was to get a telephone patch to Marian Hospital's emergency ward, where Dr. Carl D. (Doug) Shaw was on duty. For about 15 minutes Doug and the stricken man's wife discussed the case and he advised her. Then came an emergency at Marian and Dough had to attend to that, so Blackmer now patched the woman into Arroyo Grande Hospital and Dr. Carl Shirk.

The woman (her name is Dixie but the amateur radio buffs don't use last names) read off to Carl the list of contents in the yacht's emergency kit.

"You've got everything you need right there," the doctor told Dixie. Then he told her how to administer a shot and otherwise care for her husband.

Meanwhile, an amateur radio operator in Panama City and one in Uruguay picked up on the conversations and posted themselves above and below the wave length in use, to keep others from butting in and interfering. Also, a ship in the neighborhood locked in on the conversation and made it to the disabled yacht to take the patient (he had strained himself lowering the anchor) to shore.

Dave, in the middle of all the excitement, doesn't know how it all ended. Just at this point the wind blew over a tree in Nipomo, cutting off his power. When service was restored, the emergency was apparently over and the airlanes were quiet.

Reprinted from the Santa Maria (Cal.) Times, June 14, 1976.

Aloha

Tony Tamosaitis K1VTE of 147 Neal St., Malden, Massachusetts, provided a unique way for ham radio operators in seven states to celebrate our country's 200th birthday.

On Sunday, July 4, originating at 5 pm local time (11 am Hawaii time), the 19/79 amateur radio repeater WR1ACO located at Beachview Ter., Malden, was linked simultaneously with WR6AGE in Honolulu, Hawaii and WR3PHL in Valley Forge, Pa. After establishing the link-up, network control stations asked for a roll call from the three repeaters. Amateur radio stations from Massachusetts, Maine, New Hampshire, New Jersey, Pennsylvania and the first and fiftieth states respectively, Delaware and Hawaii, checked in to begin communications.

Also included in the Hawaiian link were the smaller islands of Maui, Molokai and Oahu.

One of the first stations into the Hawaii system was WA1SQR marine mobile aboard the *Fifth Amendment* off Cape Ann exchanging greetings with KH6IPN in Honolulu. Throughout the evening, base stations, marine mobile, land mobile and hand-held walkie-talkies communicated and exchanged greetings from the East Coast to the West Coast.

The high point came early in the four-hour link-up when AA8ARV/KH6 transmitted the following message: "This is AA8ARV portable six, hand-held walkie-talkie in Waikiki. The Lieutenant Governor of the state of Hawaii, Nelson K. Doi, has asked me to extend to all stations participating in this historic link-up of the East Coast with the West Coast of the United States and the first and fiftieth states in the Union, and other historic places, his warmest congratulations. The Lt. Governor is well aware of the contributions of ham radio not only to the local communities, but also to our nation. And in keeping with the spirit of our Bicentennial, he extends warmest aloha to all stations and operators participating in today's historic link-up. This is AA8ARV portable six Waikiki ... back to KH6IPN Hawaii control."

The Hawaii link was terminated at 8:45 pm and communications through the Philadelphia link continued until

9:15 pm when this link was terminated.

The stations handling net control duties were as follows: Tony Tamosaitis K1VTE, assisted by Tom Cook K1OCD, handled the Hawaii input at the Beachview Ter. repeater site, and also the Philadelphia input fed in from a remote station operated by Alan Carp K1HLZ, assisted by Frank Carp WA1RIY, both of James St., Malden, Mass. Net control operators in Philadelphia were Jesse Wagner K3GKB, assisted by Bill K3JPB. In Hawaii Don Blaisdell KH6IPN was assisted by Steve Gross KH6HGG.

Reprinted from the Malden Evening News, *Malden, Mass., July 15, 1976, and the* Medford Daily Mercury, *Medford, Mass., July 15, 1976.*

Giving Nothing and Expecting Nothing

One of the local QRpers came by last week and we sat in the sun to watch the bees work hard to make a living. The well-aged QRPer was a bit restless, and we thought we knew the answer. "Been reading 'Silent Keys' in *QST* again?" we asked, and the QRPer nodded. After a bit he spoke. "This DXing has always been an unusual thing to me," he said. "A DXer makes an acquaintance that may be thousands of miles away, in another country, and with the odds that most will never meet face-to-face. Yet there exists a bond and that feeling of loss when they are no longer with us. Why is that?" In turn, we held our own silence, for the feeling has often come to us also. Finally the QRPer spoke again. "I have long felt that DXers offer what is closer to true friendship than any other activity. We meet another DXer on the air, we give nothing and expect nothing. Only friendship. That and nothing more." We both were silent for a long time after this, for most DXers do know the feeling and the friendships. The true Internationalists of Amateur Radio are the DXers, and their bonds of friendship are far flung. Come! Join with the DXers who want naught but friendship and a new country or two once in a while.

Reprinted from the West Coast DX Bulletin.

Oscar Orbits

Oscar 6 Orbital Information					Oscar 7 Orbital Information			
Orbit	Date (Nov)	Time (GMT)	Longitude of Eq. Crossing °W	Mode	Orbit	Date (Nov)	Time (GMT)	Longitude of Eq. Crossing °W
18500	1	0108:17	74.8	B	8974	1	0016:01	53.8
18512	2	0008:13	59.8	A	8987	2	0110:18	67.4
18525	3	0103:09	73.5	BX	8999	3	0009:38	52.2
18537	4	0003:05	58.5	A	9012	4	0103:55	65.8
18550	5	0058:01	72.3	B	9024	5	0003:15	50.6
18563	6	0152:56	86.0	A	9037	6	0057:32	64.2
18575	7	0052:52	71.0	B	9050	7	0151:49	77.7
18588	8	0147:48	84.7	A	9062	8	0051:10	62.6
18600	9	0047:44	69.7	B	9075	9	0145:27	76.2
18613	10	0142:40	83.5	AX	9087	10	0044:47	61.0
18625	11	0042:36	68.5	B	9100	11	0139:04	74.6
18638	12	0137:31	82.2	A	9112	12	0038:24	59.4
18650	13	0037:27	67.2	B	9125	13	0132:41	73.0
18663	14	0132:23	81.0	A	9137	14	0032:01	57.8
18675	15	0032:19	66.0	B	9150	15	0126:18	71.4
18688	16	0127:15	79.7	A	9162	16	0025:39	56.2
18700	17	0027:11	64.7	BX	0175	17	0119:56	69.8
18713	18	0122:06	78.5	A	9187	18	0019:16	54.6
18725	19	0022:02	63.5	B	9200	19	0113:33	68.2
18738	20	0116:58	77.2	A	9212	20	0012:53	53.0
18750	21	0016:54	62.2	B	9225	21	0107:10	66.6
18763	22	0111:50	76.0	A	9237	22	0006:30	51.4
18775	23	0011:46	61.0	B	9250	23	0100:47	65.0
18788	24	0106:41	74.7	AX	9262	24	0000:08	49.8
18800	25	0006:37	59.7	B	9275	25	0054:25	63.4
18813	26	0101:33	73.4	A	9288	26	0148:42	77.0
18825	27	0001:29	58.4	B	9300	27	0048:02	61.8
18838	28	0056:25	72.2	A	9313	28	0142:19	75.4
18851	29	0151:20	85.9	B	9325	29	0041:39	60.2
18863	30	0051:17	70.9	A	9338	30	0135:56	73.8

Looking West

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

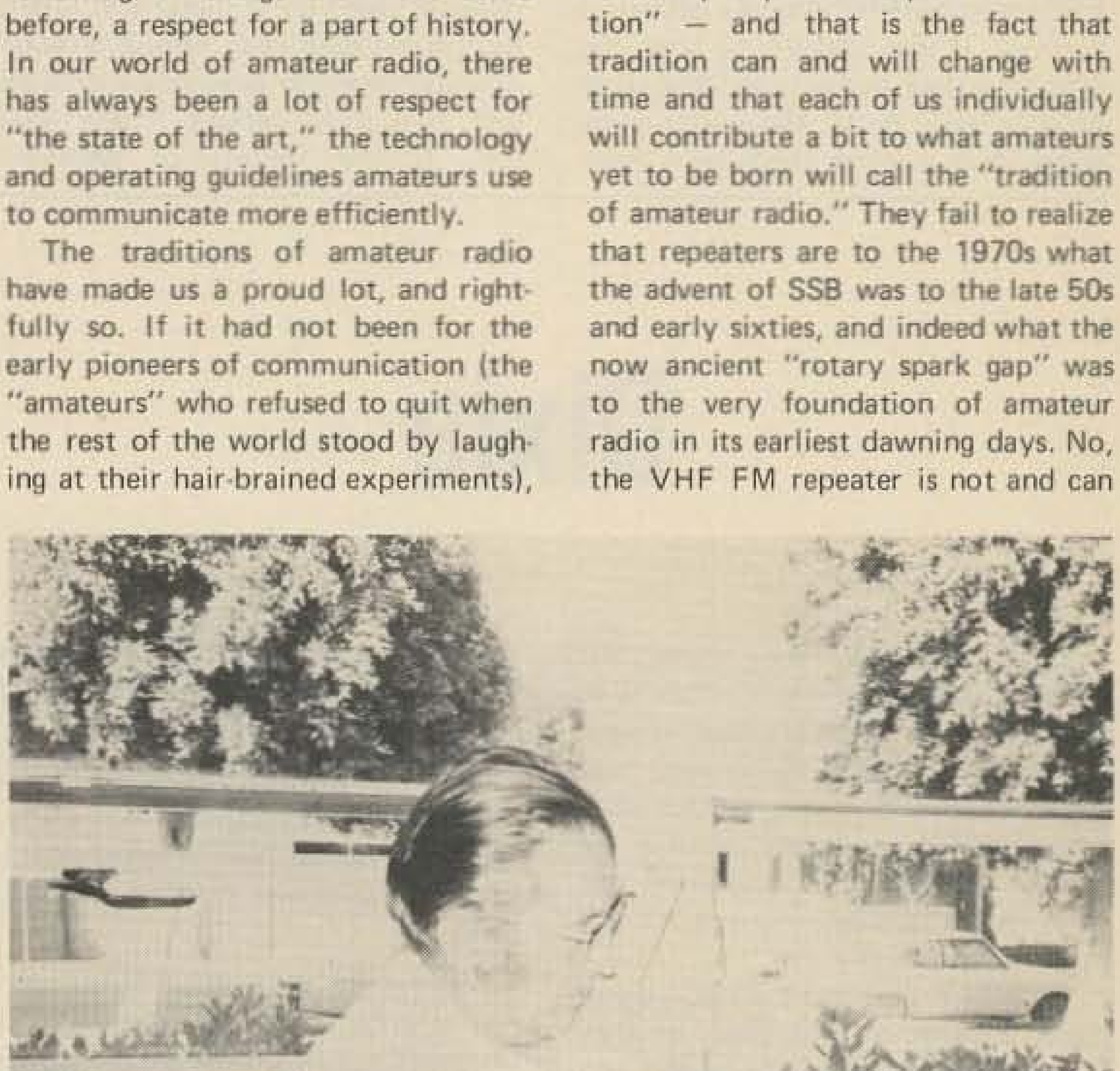
I have always found that a trip aboard an airliner is a great time to relax and let your mind wander, to go off in search of new directions and ideas. At present I am somewhere over middle America on United Flight 5, enroute from New York's JFK International Airport back to my wife Sharon and my home in Los Angeles. More on this unplanned trip later, but for the moment join me aboard this Boeing 747 and think about a subject that is very much a part of amateur radio: tradition.

When you have been around as long as amateur radio, you are bound to develop some traditions along the way. First, though, we should ask ourselves the meaning of the word, "tradition." Since you rarely find a copy of *Webster's New World Dictionary* on a 747, I will have to trust my memory and interpret the word to mean a respect, reverence and/or following of things that have come before, a respect for a part of history. In our world of amateur radio, there has always been a lot of respect for "the state of the art," the technology and operating guidelines amateurs use to communicate more efficiently.

The traditions of amateur radio have made us a proud lot, and rightfully so. If it had not been for the early pioneers of communication (the "amateurs" who refused to quit when the rest of the world stood by laughing at their hair-brained experiments), there is a good chance the hobby/service we all love (as well as all other forms of communication like the AM radio station we listen to daily) would have never come to pass. You and I know how much amateurs have accomplished over the years and how amateur radio has benefitted all mankind.

Now, enter the VHF repeater. I have often heard it said by many a long-time amateur that repeaters and the type of operation they foster are nothing but a breakdown of the traditional operating practices that are indeed an integral part of amateur radio. I have lost count of the number of times that fellow amateurs have come to me and said that we need more of the traditional things of VHF amateur operation, such as working DX on six and two, or more utilization of the VHF bands for CW practice, and less about these "newfangled" repeaters that are destroying amateur radio.

I have to feel sorry for these people, because they fail to realize one very important aspect of "tradition" — and that is the fact that tradition can and will change with time and that each of us individually will contribute a bit to what amateurs yet to be born will call the "tradition of amateur radio." They fail to realize that repeaters are to the 1970s what the advent of SSB was to the late 50s and early sixties, and indeed what the now ancient "rotary spark gap" was to the very foundation of amateur radio in its earliest dawning days. No, the VHF FM repeater is not and can



Caught at the June SCRA meeting is the man generally credited with being the "Father" of VHF repeaters: Art Gentry W6MEP, owner of WR6ABN (formerly K6MYK).

never be what many consider the traditional way in which amateurs should operate. The rather rigid channelization necessitated by repeater operation is to many a direct contradiction to the way that they have operated their amateur stations for many a year. It was to me, when I first got involved in this rather unique aspect of the hobby almost 12 years ago. However, rather than fighting it, I was willing to accept the challenge offered and never have regretted my decision. Even putting aside the technological knowledge I have garnered over the years, and not counting the many lifelong friends I have gathered along the way, operating a diverse number of repeaters and learning more about my fellow man has made the "trip" well worth it. For indeed, the VHF repeater has become the melting pot for people representing every aspect of both amateur radio and our society in general.

No, the VHF repeater is not "yesterday's" traditional portrait of amateur radio. It is a new aspect of our world, and along the way it is creating a lot of traditions of its own. Best of all, you and I are helping to create for the future some sound traditions, since we are a part of this "wild new breed" of amateur.

The .01-.61 problem is well on its way toward a solution, thanks to a lot of hard work by SCRA Chairman Bob Thornburg WB6JPI. As I have stated in the past, being involved as a control station for one of the two systems, namely PARC's WR6ABB, I did not feel that I should personally comment on this situation. Thanks to the SCRA, I have been spared being put in this position, since the following report to the SCRA membership by Chairman Thornburg more than details the problem, the points of responsibility in the situation and what steps the SCRA is taking to solve the problem.

SCRA
THE .01-.61 PROBLEM
STATUS REPORT
June 17, 1976
Bob Thornburg

1. By majority vote (Item 13 of the February 21 meeting), the SCRA chairman was directed to instruct WR6AFR to vacate the .01/.61 pair and resubmit for coordination on a different channel pair.

2. This motion was passed based upon the Technical Committee's report of the investigatory measurements. This report was first presented at the February meeting.

3. Examination of this report clearly showed that, indeed, interference could and did exist but:

a) It took 200 W ERP to make .85 uV in ABB from the best (worst) site,

b) It also showed that ABB has a 10-15 dB alligator ratio, i.e., 200 W ERP = .85 uV at ABB but ABB put 6.5 uV back at the same site.

4. Based upon reexamination of this data and

a) at that time a strong feeling that WR6AFR would not submit to moving, and

b) that a demand by the SCRA for them to vacate and resubmit would be ignored by AFR,

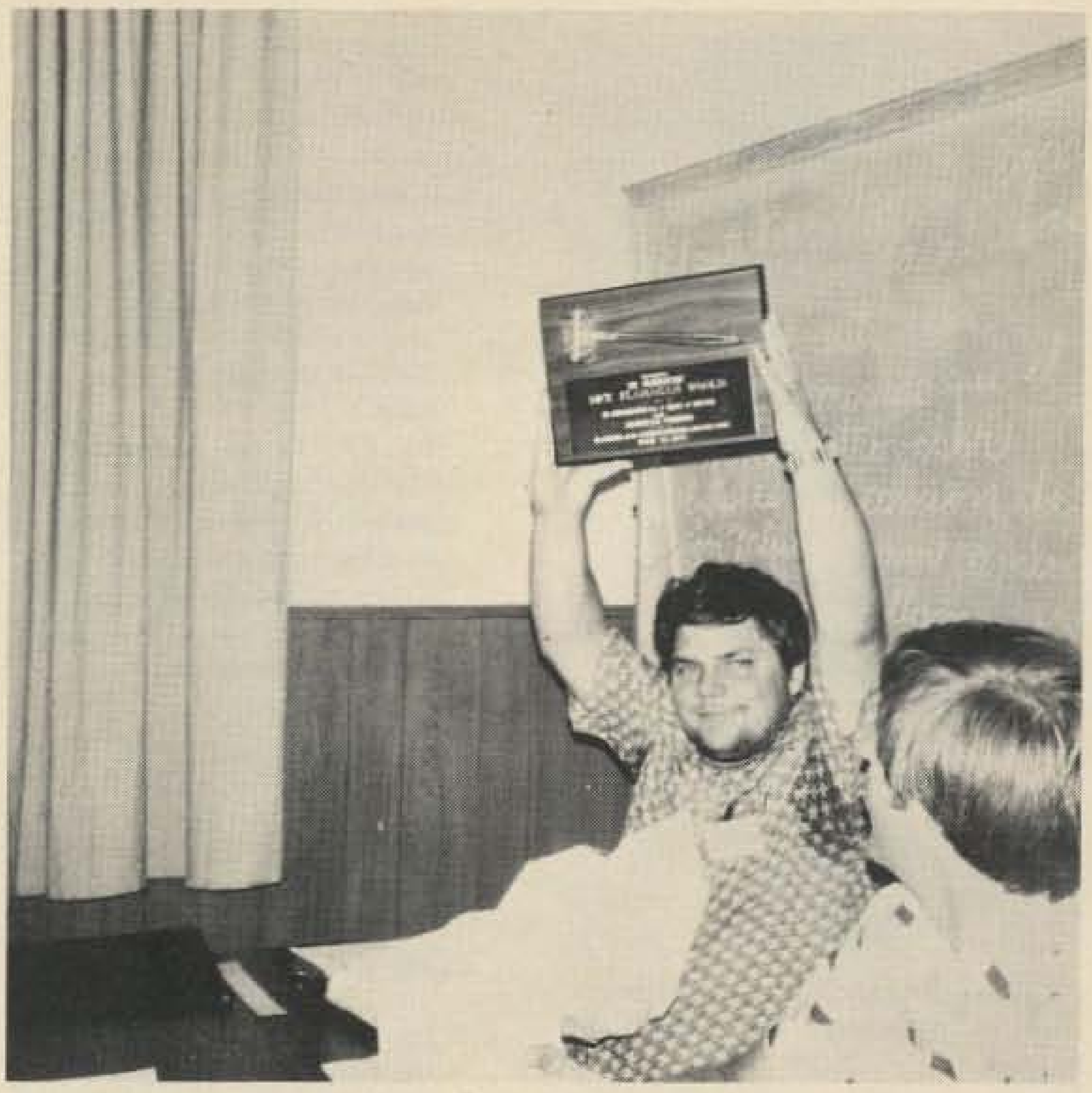
The measured data just wasn't felt to be of enough significance to convince and the interference problem would continue if this line was followed.

5. As an alternative, Bill Wood arranged a meeting with AFR to discuss the problem. On April 23, Bill Wood, Bob Thornburg, Kit and Marvel Clover, and Dick Miller met and the following came out:

a) SCRA has in the past pointedly ignored the high desert and the attitude of the high desert people is that the SCRA did not care nor would be interested in coordinating AFR. So AFR measured many frequencies and concluded .01/.61 was the best from their site. This was before ABB put up the Micor.

b) Now the ABB output is very strong in the high desert and required a beep/delay mode on AFR to separate the two repeaters in the high desert.

c) Kit felt he could control his users to reduce the interference into ABB.



Don Root, SCRA Secretary, displays plaque awarded to ex-SCRA "Chairperson" Dick Flanagan W6OLD for his many years of service to the SCRA.

d) Only if all else failed and the interference to ABB was (is) significant would he move frequencies.

e) In Bob Thornburg's opinion, Kit is an amateur in the true sense and interested and sensitive to the interference problem. He is employed as Range Frequency Coordinator at Edwards, technically competent, and has a fine home brew repeater with most all the bells and whistles. He is also defensive of his users, but aware of their involvement in the interference problem.

f) The following morning I attended a breakfast with about 100 of the users of AFR and, again, was impressed with their respect for Kit and the performance of AFR.

6. The SCRA Technical committee first heard of the interference to ABB in about February, 1975, and did nothing (due to other more pressing problems) until November, 1975, with

Meet the SCRA's 1976 "Mr. Chairperson" Bob Thornburg WB6JPI, as he conducts an SCRA meeting with Vice "Chairperson" Charlie Ellis K6PNM at his right.

Ed Tipler WA6KYZ, climbing antenna pole of WR6AMZ. Photo by Jim Rieger.

the Technical committee's report coming out in February, 1976. By this time, AFR was well established serving, and serving well, about 100 users in the high desert.

a) Interference does exist to ABB and don't forget it, but

b) Due to the delay in the SCRA action, and due to the SCRA's interpreted position on the high desert, I do not feel it is justified to label AFR as a renegade or pirate repeater.

7. A special meeting of the ABB repeater committee was held on May 14, 1976, for Bill Wood and myself. At this meeting, the following came out:

a) The interference to ABB from AFR users is severe and could be documented in detail if necessary.

b) PARC is possibly willing (based upon membership approval) to assist in funding a move by AFR — like sponsoring a mutual fund raising "event."

8. The information from the PARC repeater committee meeting was relayed to AFR by Bill Wood and the present position of AFR is:

a) AFR will move if it must.

b) AFR suggests maybe — possibly — please — ABB could put a NNE null in their antenna pattern. 6-10 dB is all that's needed.

c) Principal interfering base stations have been asked to reduce power toward ABB.

9. Clearly, WR6ABB has no liability or blame in causing, or continuing to cause, interference to their repeater. However, and as always, they are being "good guys" and constructively trying to resolve the problem.

10. I would like the SCRA to recognize the cooperation of both groups and provide the technical committee the following help in resolving this problem:

a) Recognize AFR as a cooperative entity by directing the Technical committee to renew AFR's testing status, valid for 90 days, with a recognized and working interference problem. Final coordination will only be issued upon resolution of the interference problem.

b) Remove the requirements of the SCRA motion.

While speaking about the high desert area of California, and repeater operation in that area, we are happy to introduce a new addition: WR6AMZ on Laurel Mountain, near the town of Ridgecrest, California. This system has been coordinated to and operates on a channel pair of 146.04 in, .64 out, and is co-channeled with the San Diego-based Mt. Otay system, WR6ACF. While on days that the famed Southern California inversion is "in," there does exist a bit of overlap between the coverage of the two systems; in my opinion this is a good choice, in that it permits the traveler coming from the high desert area en route to San Diego almost continuous coverage using that single channel pair. It is, I guess, also the price you have to pay when there are more repeaters than there are available channel pairs on two meters. I have a feeling that in densely populated areas such as this, with thousands of amateurs using VHF and the need for more repeaters ever on the increase, the day of the "super wide coverage, talk-to-the-world" repeater may be drawing to an end. As we grow, and as we need spectrum space for more and more repeaters, the time will come when we all may have to give up a bit and learn to share for the common good of all amateurs. But . . . we are getting off the subject at hand.

WR6AMZ is the brainchild of Ed Tipler WA6KYZ, through whose technological know-how WR6AMZ came to be. Ed is one of those super nice guys who seems to care about the amateurs around him. He decided that AMZ would be a good way to help the amateurs of his community as well as the many transients crossing the high desert equipped with two meter radios. He went forth to create his fully solid state home brew two meter system. Ed designed it so that if you could hear it, it would hear you and when you could not hear it any more, it would not hear you either . . . a "by-the-book" repeater, inversion notwithstanding. The word coming back to me from amateurs who have used it is that AMZ works like a champ and is a pleasure to operate. Come SAROC-Las Vegas time, we will have a chance to see for ourselves . . . if not sooner. AMZ may be smaller than a breadbox, but from what I have heard, it delivers. My thanks to Jim Rieger for the fine photos of the AMZ operation.

"Breadboard" system of WR6AMZ. Photo by Jim Rieger.

When a VHF-type amateur hears the term scatter, he usually thinks in terms of bouncing signals of the ionized tails of meteors as they burn their way through our atmosphere. Any true "traditional" VHFer will tell you that you can make some rather spectacular contacts that way, especially if you are adept at high speed CW. All this notwithstanding, when you mention "scatter" here in the southland, you are more than likely talking about a new group known as the "Southern Counties Amateur Teleprinters Society" or SCATS, with *SCATTER* being the title given to their monthly newsletter. SCATS is a new RTTY organization that sponsors an open VHF RTTY repeater, WR6ACA (146.10 in, .70 out), located atop Contractor's Point in the northeast San Fernando Valley and with coverage over a wide area of Southern California. As its newsletter, edited by Arny Gamson K6PXA, states: "The purpose of the club is firmly established on the five principals of the fundamental purpose of the amateur radio service as defined in the FCC rules and regulations. In essence: (A) Public Service; (B) Advancement of the radio state of the art; (C) Improvement of skills; (D) Expansion of operators and technicians; (E) Extension of local, national and international goodwill. The club was established for the purpose of achieving these objectives through the unique mode of telecommunications (radio teletype) and to achieve satisfaction and fun while accomplishing this."

While around for only about half a year now, SCATS is well on its way toward achieving its goals. Already they have instituted regular meetings on the second Saturday of each month, alternating between Los Angeles County and Orange County, have gotten WR6ACA totally revamped and fully operational, have set up a weekly SCATS net via ACA that meets every Wednesday at 20:00 hours local time, have gotten active in amateur radio public relations, have held their first annual picnic at the ACA site, and have done a myriad of other things too numerous to mention. They are an interested, progressive group of amateurs who have found another way of serving their community through their hobby, and thereby serve the goals of amateur radio itself.

They also put out one of the most professional-looking newsletters passing through these portals monthly. I wish that you could get a look at it yourself — it is just chock full of information about happenings within the organization, as well as information about the RTTY mode itself. Unfortunately, the cost of sending out individual sample copies to every amateur requesting such would be highly prohibitive, according to my discussion with Arny; however, the club is willing to send a sample to any radio club interested in RTTY, and/or set up a "bulletin exchange" with such organizations so that knowledge can be shared by all. If your organization is into RTTY, then an SASE to Arny Gamson, Editor, *SCATTER*, 8034 Gentry Avenue, North Hollywood CA 91605, will get the ball rolling.

As I said earlier in this column, I am en route home after almost two weeks in the "Big Apple." A few quick but interesting sidelights on what I picked up in the way of "repeater happenings" while back there . . . or perhaps I should call this "what a difference 10 weeks make," since it has only been that long since I was last there.

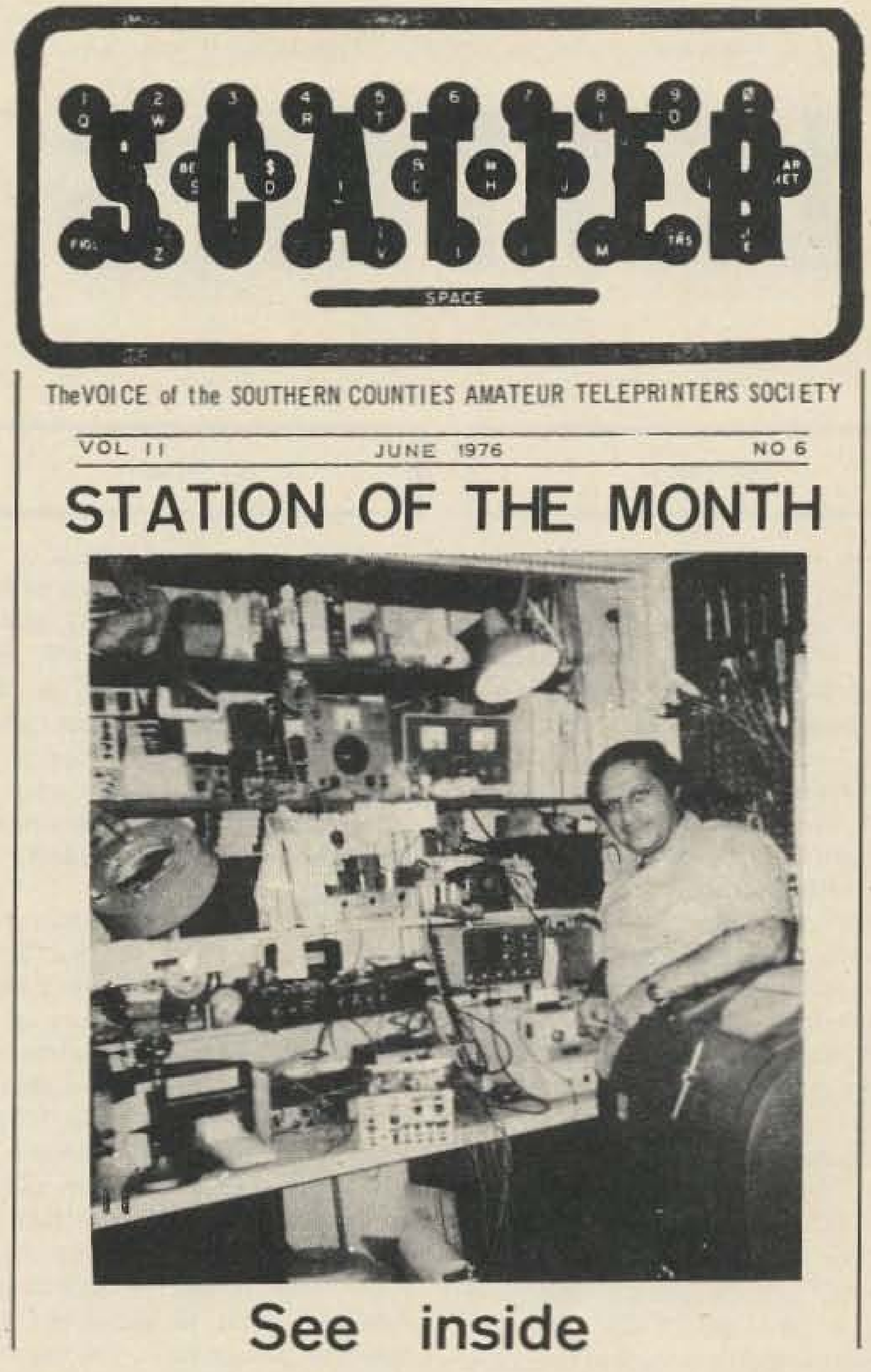
First, when I was here in late April, as usual I found WR2AAA on .13-.73. Well, that has all changed. While most of the faces . . . errr . . . voices are still the same, both the callsign and the equipment are new. According to a long-time friend Ted WA2RGB, one of those in charge of the system, the ID now says WR2ACX, the old GE Progline of the AAA days has been replaced by a shiny new VHF Engineering repeater, and a support group, the .13-.73 Repeater Association, is now in its formative stages. The machine works great, but if you plan to use it, you had better be smack on channel and have your deviation level set properly, as that receiver is razor sharp and will squelch out if your deviation level is too high. With this move, .13-.73 has gone full circle in NYC from the early days of WA2SUR, through WR2AAA, then the revamped WR2AAA on its 1 MHz channel pair of 147.73 in/146.73 out, and now to WR2ACX/2 back on .13-.73. As of this writing, ACX operates from about 6 am till 11:30 pm, but Teddy told me that as soon as a few technical improvements are made they plan to go 24 hours a day. In the meantime, much success to Teddy and crew on one heck of a good "Big City" repeater system.

Secondly, LIMARC, the Long Island Mobile Amateur Radio Club, has put on the air the New York area's first amateur television repeater. The purpose is two-fold, according to Ed Piller W2KPQ, who sort of fathered the project. First, to foster full utilization of spectrum space in order to protect the amateur service from the onslaught of other services that are after the frequencies we now use. Secondly, but equally important, is the intention of LIMARC to use this machine as a tool to interest and educate the public as to what the amateur service is all about, as well as a teaching aid in the training of new amateurs. Rather than go further at this time, I am planning an "LW Feature" on this system and its diverse uses, based on a telephone interview I did with Ed just prior to this trip. That will be coming up in a few months, so hold tight; I think you will find the concept of interest.

The Captain just announced that we will be landing at LAX in about an hour and a half, so that puts us someplace over New Mexico — probably just north of Albuquerque. With the shades pulled down so that everyone can enjoy the inflight movie, I do not want to disturb people by opening mine to look out; besides, having made this trip so many times I can just about guesstimate it. It's been a good trip home, "smooth air" all the way and, as anyone who has ever been on a 747 will tell you, rather a quiet trip as aircraft go. I only wish that the trip had been made for more pleasant reasons, but life does take its toll on us all and such was the case.

About 13 days ago my brother Bob called to tell me that our dad had entered the terminal phase of his illness and that it was time to come East. A week ago Sunday, I flew the other complement of this flight, United 8 to NYC, so that I could be with Dad for whatever the future would hold for him. The Almighty was good to him, in that he did not suffer long and passed on very peacefully at 2:30 last Monday. Bob and I were with him to the end.

I would like to take this opportunity to publicly thank the "users and management" of three New York City area repeaters, namely WR2ACX/2, WR2ACD and WR2ADM, for helping to lighten my burden a bit. It was no secret as to why I had made the trip East and anytime that I felt the need to talk, to let go a bit, there was always a fellow amateur who cared to be found just on the "other side" of my Tempo FMH. I spent many hours in QSO with some of the greatest people I have ever known, the users of the three aforementioned repeaters. While a lot of these people were old friends, many were new faces to me, many not even amateurs when I moved away from New York, many knowing me only as the voice of this column. They all had one thing in common: in the true spirit of amateur radio they cared about me and the situation I was facing. They went out of their way to try to help, to be friends to this "stranger in a strange land" sporting a 6 callsign and ending a QSO with a bunch of numbers.


SCATTER

The VOICE of the SOUTHERN COUNTIES AMATEUR TELEPRINTERS SOCIETY

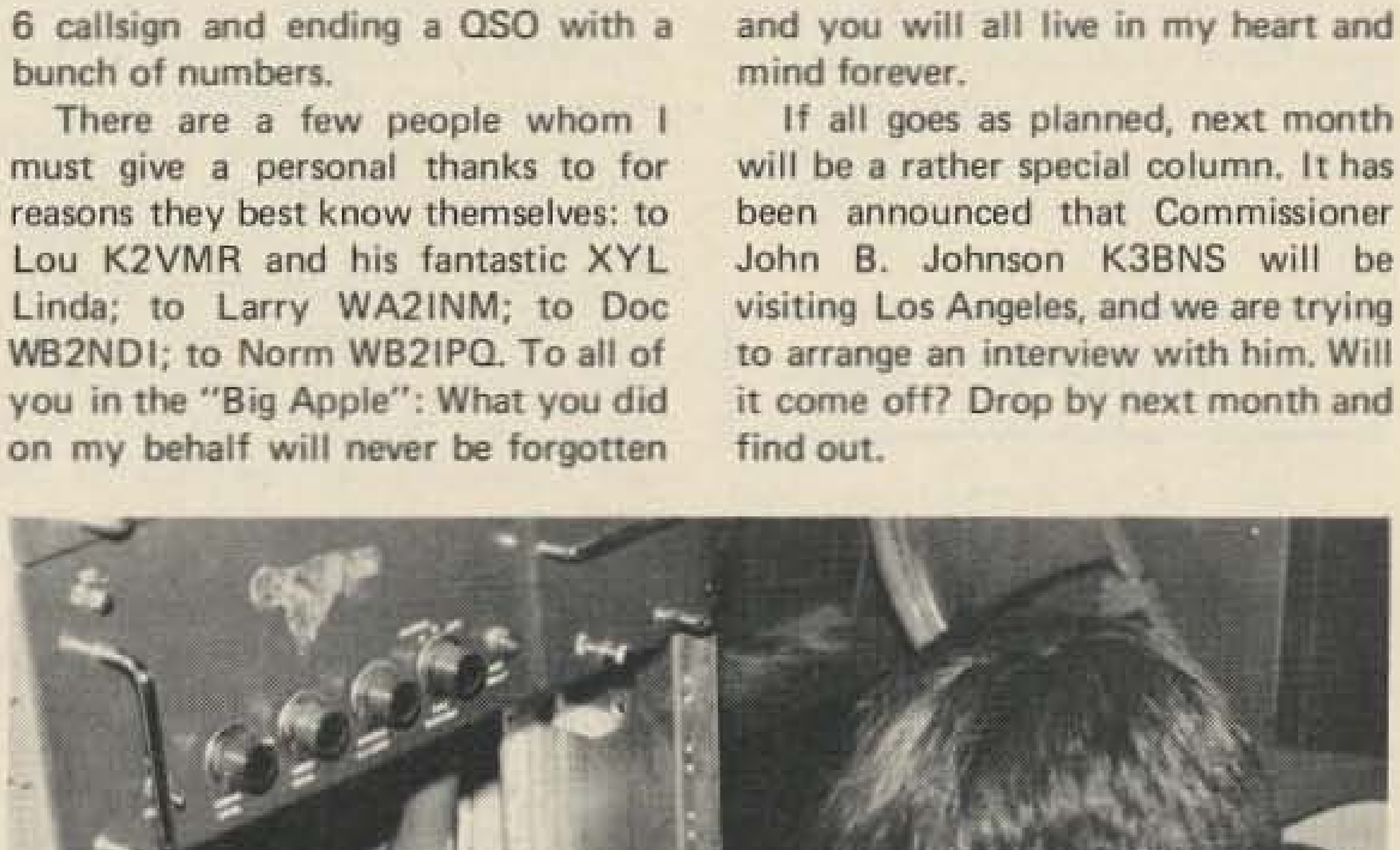
VOL 11 JUNE 1976 NO 6

STATION OF THE MONTH

See inside

There are a few people whom I must give a personal thanks to for reasons they best know themselves: to Lou K2VMR and his fantastic XYL Linda; to Larry WA2INM; to Doc WB2NDI; to Norm WB2IPQ. To all of you in the "Big Apple": What you did on my behalf will never be forgotten and you will all live in my heart and mind forever.

If all goes as planned, next month will be a rather special column. It has been announced that Commissioner John B. Johnson K3BNS will be visiting Los Angeles, and we are trying to arrange an interview with him. Will it come off? Drop by next month and find out.


Ed Tipler alongside repeater WR6AMZ. Photo by Jim Rieger.

LETTERS

BIRCHER

What is with these old-timers who hate CBers? When I was 9 years old I got my first CB radio; there were 22 people on channel 23, all of whom were 9 to 13 years old. Out of those 22 people, 18 went on to become hams; 3 now have E.E. degrees, three have first phones, and all of those 18 are in the electronics field. Without any question, CB radio was the thing that sparked them onto electronics and took them into the world of ham radio. If anyone has or knows of a young person who wants to be a ham but is not ready to take a code or theory test, send him on to CB radio. I know that it works to promote ham radio.

James W. Menefee, Jr. WA4KKY
New Albany IN

P.S. For myself, CB radio was the thing that got me going in the radio field. At the age of 23 I am the youngest station manager in the country! I also want to thank you for some of the finest editorials I have ever seen. Some of the local hams (Louisville) know that I support you, and think that I must be a John Bircher of ham radio. Keep up the good work.

KEEPING UP WITH HERB

I was quite shocked to read KL7AE's letter in the September *73*. I ordered Wilson HTs for 2m and 450 MHz on the first of June, and now 8 weeks and 3 phone calls later I still am awaiting my HTs from those Wilson "Good Guys." Who did Herb know to get such service?

Bill Fulcher W4AST/K4RTA
Hendersonville TN

BUG I

Please publish the following corrections to my "Touchtone Sequence Decoder" article published on page 52 of the June issue of your magazine: 1) missing pin number on top of the 74122 in Fig. 4 is pin 11; 2) wire from pin 12, IC1, Fig. 4 goes to pin 9 of IC1, not pin 8 as shown; and 3) in Fig. 2, the C3 symbol is reversed. The plus side must face pin 6 of the 741 if the circuit is to work properly.

C. W. Andreasen WA6JMM
Van Nuys CA

&#*$(%.!!!

I have just applied stamps to two letters. One requests a couple of tapes and some back issues of *73*, and the other a subscription to *73*. Even though I have never seen an issue before this day I am sure that I will be very satisfied. Your magazine has style. I particularly enjoyed your editorial pages. For some reason they remind me of John Campbell's editorials.

Now for some invective: @*#¢%*#¢ #&$(@*#¢ &#*$(%.!!! Why didn't someone tell me? Here I am patiently plugging away at the code on a record that I purchased in good faith, and now I find that the test will be administered at 13 wpm spaced to 5. I do not remember this fact being mentioned in any publication which I have read. In fact, I do not remember it being mentioned in either your books on General class, Advanced class, or Advanced Extra licensing. The point is, you say that it might be well for prospective hams to attempt General class immediately. I would have, had I known that little 13 wpm fact from the beginning. Now I get that sinking feeling that comes from going to Jail without passing Go. So maybe it was in your Novice book. I confess I only skimmed it, since by the time it got back to the library I had already read the General book. It would have been nice had there been some mention of the fact in the General book. It would also have been nice if there had been some mention of how one might have subscribed to *73*, along with the fact that the book is a reprint of articles from that magazine. Spilt milk.

May I say Amen to Mr. James Whitfield's comment on keyboards in your August issue. I own a Dvorak-style typewriter. Finest kind.

Finally, I hope that I will be seeing a lot of info in the coming issues on microprocessors. They are, from what I have seen, astounding.

Let me explain why they flabbergast me. One year ago, as a teacher, I attended a seminar on the new curricula for science. Along with some of the more ridiculous things which will, I fear, be foisted on our children in the future (imagine, if you will, the totally serious proposal of one curriculum that physics be taught by having the students write Japanese poetry!) was one system that would have students use an in-classroom computer. I knew nothing of computers at the time and that computer looked awfully impressive. It was as big as two suitcases. It cost better than $900.00. You needed at least two of the things to teach the class properly. It was an analog device which would, if you treated it properly, add voltages from two power supplies and display the results on an oversized voltmeter. For only $900.00. Now I find that there are digital devices available that are immensely better at a fraction of the cost . . .

Am looking forward to receiving my subscription. Keep up the good work.

Walter Norton
Nashville TN

OFF TARGET I

For the past few months I have noticed a fair number of letters on these pages from angry customers of Trigger Electronics. I would like to add my story to the long list of complaints, for the benefit of any others now facing this problem.

Last November I ordered several items for a fair amount of money and, hearing nothing after two months, I wrote them a polite letter asking about the delay. I got back a postcard saying that the goods would soon arrive. Still hearing nothing further after two more months, I called them and got the same response.

To make a very long story short, I wrote more letters and got a brush-off, after which I saw the letters in the June, '76, issue of *73* and followed some of their suggestions. I wrote to the FTC and got a polite brush-off. Then I went to the postal authorities with all the information. They immediately took it up and sent it on to the Postal Inspector, and there it has been bogged down for almost a month.

I would now like to request of anybody who has had trouble with Trigger that they, if possible, write me a letter telling me about it.

I suspect from the number of letters I have seen in *73* on this matter that there are many more who have complaints against Trigger. If enough people come forward, we could consider a class action suit against Trigger.

I hope this letter will appear in *73* and maybe help to clear up this situation.

To close this letter, I would just like to say that I enjoy this magazine and hope I do not again have need to take up space in this column for complaints.

Harold Chase WN1VVH
62 Pratt St.
Reading MA 01867

WHAT FUN!

I've never written a magazine before, as it takes a lot to make me write, but you have done it. Having been in CB for ten years, I know the joys of portable communication that walkie-talkies provide and the frustration caused by the lack of operation procedures by other CBers. I have been looked down on by other hams, and thought it unfair, but let it ride. None of them took the time to find out that I have an electronics background and that I knew about hams long before CB. Shortwave receivers and I have been friends for a very long time, with the ham bands capturing most of my attention and enjoyment. Then I discovered 100 mW walkie-talkies — boy, what fun! Biking, hiking, transmitter hunts and "rag chewing" with friends opened up a whole new world. Eventually I wanted more fun and more power, so I got a CB license in 1966. After a couple of years I gave up in disgust, sold all my gear, and let the license expire. In 1973, I renewed my CB license and purchased a 5 Watt walkie-talkie. Again, the fun and frustration. I told myself it was time to get my ham ticket, time to quit talking about that "someday," and do it. The code did not come easy for me, even though your "Novice" tape helped a lot. I planned on shipping right on to the General, but I couldn't seem to practice code regularly enough. I decided to take what I could get and got my Novice. After a 3½ month wait, my license came last week. Boy, what fun! I can't wait to get off work each night to get on the air. What a way to practice code! Those guys with the keys are more fun to practice with then the tapes.

Then I read your comments about deleting the Novice class! I for one will remember these Novice days with fondness. I don't consider myself a CBer gone ham — I don't like being that kind of statistic. First I am looked down on by hams for being on CB, and then I hear that to be a Novice is a waste to hamdom. Gee, I can't seem to win for losing.

Well, when I get to 14 wpm or so I am going to test for my Advanced . . . and settle for a General.

Thanks for a unique magazine that I enjoy so much.

William F. Stamps, Jr.
WN8ARZ/KWH7698
Sault Ste. Marie MI

BAD DEAL

I have a few things to get off my chest. First, I think that Docket 20777 is a bad, *bad*, deal. Docket 20777 won't hurt me, but it sure does bother me! If I ever get to 35 or 40 wpm I will feel ripped-off if I can't do it in the CW band. My first QSO, as a General, was on AM, and I didn't hear one garbage mouth. Also, AM might be almost dead, but why kill it?

I like your I/O section, even if I only fully understand the editorials. I think I am slowly but surely learning about microcomputers and, the more I understand, the more I enjoy the I/O section.

I for one enjoy CW, and in your September editorial, when you said that there wasn't a lot of CW activity, you were wrong. The general CW band on 40 meters is very crowded at night.

I really enjoy your editorials, and I have had many pleasant experiences with your advertisers. Keep up the good work.

Penn McClatchey WB4DPT
Atlanta GA

STIMULATED

I am really interested in the computer aspects in relation to ham radio. I was getting a little bored with ham radio in general, and the computer articles and ads in your great magazine have stimulated my interest. I subscribe to about eight different radio and electronic and scientific type magazines — *73* is #1.

I also would like to comment about two of your advertisers, as many have done before me. Namely, S. D. Sales and James Electronics. Their *service* and prices can't be beat. They will have all my business.

Jack Ehrlich WA6ASQ
Eureka CA

ANGOLA ANGUISH

I have just returned from a two week tour of duty in Luanda, Angola. The company I work for has a contract with the government of Angola to install some communications equipment. I was over there checking out several of the transmitters to be used in the system.

While I was there, I was told about the following incident. Near our warehouse on the outskirts of Luanda is the site of a very interesting ham station. This station had the most beautiful dish and helix antennas you would want to see. The chap who had spent his whole life building up this fine station was CR6CH, Sr. Carlos M. Bettencourt. Well, when the change in government came to pass recently the Cubans came in and stole all his equipment they could cart off. The dish and helix antenna are still there, but that is about all. Then about three weeks ago "bandits" broke into his house and murdered him. That is the "official" explanation. No one believes that story, though. As far as I was able to determine, there are no hams active in Angola legally at this time. The country designation has been changed from a CR6 to D2 . . . but no hams could I find. I don't blame them, considering "bandits" on the loose!

So much for Angola. Now that I have returned home from that long trip I plan to get at it again and do some more experimenting with my microcomputer and put it on the air with my station. Will write up my experiments and send them to you for possible publication . . . back to the workbench . . .

Louis I. Hutton K7YZZ
Bellevue WA

QUALITY

Enclosed is a check in the amount of $10.00 for a 1 year subscription to *73 Magazine*. While I have little active interest in the hobby of amateur radio, I find your new computer columns and articles to be of excellent quality and contain more good technical information than is available from any other source — not to mention the best selection of computer equipment advertisements of any magazine around.

Robert H. Lyons
Lansing MI

BUG II

Please note the following corrections to my article, "500 MHz Scaler" (October, 1976, page 62): 1) the CE output of the 11C90 is at pin 1, while that for MS is at pin 14; and 2) the unlabeled capacitor on the component layout should have a value of 10.

Peter Stark K2OAW
Mt. Kisco NY

KENSCO CARES

Thought I would write you and tell you about one of your advertisers, Kensco Comm. of Quincy, Mass.

I had bought 2 sets of xtals from them and used them on my mobile and home 2 meter rig. Then the guys who own one of the local repeaters, because of some 3rd order intermod, decided to change frequency. I figured I was out $20 for the 4 xtals, having none for the new frequency. So I write to Kensco and they came back with a very interesting policy: "If you bought xtals from them, you can exchange them with Kensco for any other ones you may want at no charge."

How about that for a policy? If Kensco would allow you to mention this policy in your magazine, it would be giving the ham who buys from them a break.

Jim Dates W2QLI
Corning NY

BUG III

Just returned from an extended vacation (cum job-hunting expedition) and, after sorting through about 10 pounds of mail, I came across a letter (read plea for help) from Bob Brown WA6ZKI in Long Beach, California. The poor guy read my article on the soldering iron holder in the July issue of *73* and decided it was just what he needed, so he built it exactly as shown and wired it in accordance with the published diagram. To make a long tale even longer, it didn't work right and he couldn't figure out why. I dug out the original copy and checked my pencil drawn diagram against the one on page 18, and, lo and behold, there is a small but oh-so-significant typo. The original shows a connection between the lead from SW3 and 4 to the lead from SW1 and the green pilot light to D1. There should have been a connection dot where those lines cross — and there ain't no such animal. No wonder the poor guy couldn't get it working right. I sent him a correction and hope that you can publish one also, before too many guys think that this is just another cloonge article.

Arny Cain WB4FDQ
Melbourne FL

CAPITOL QSOs

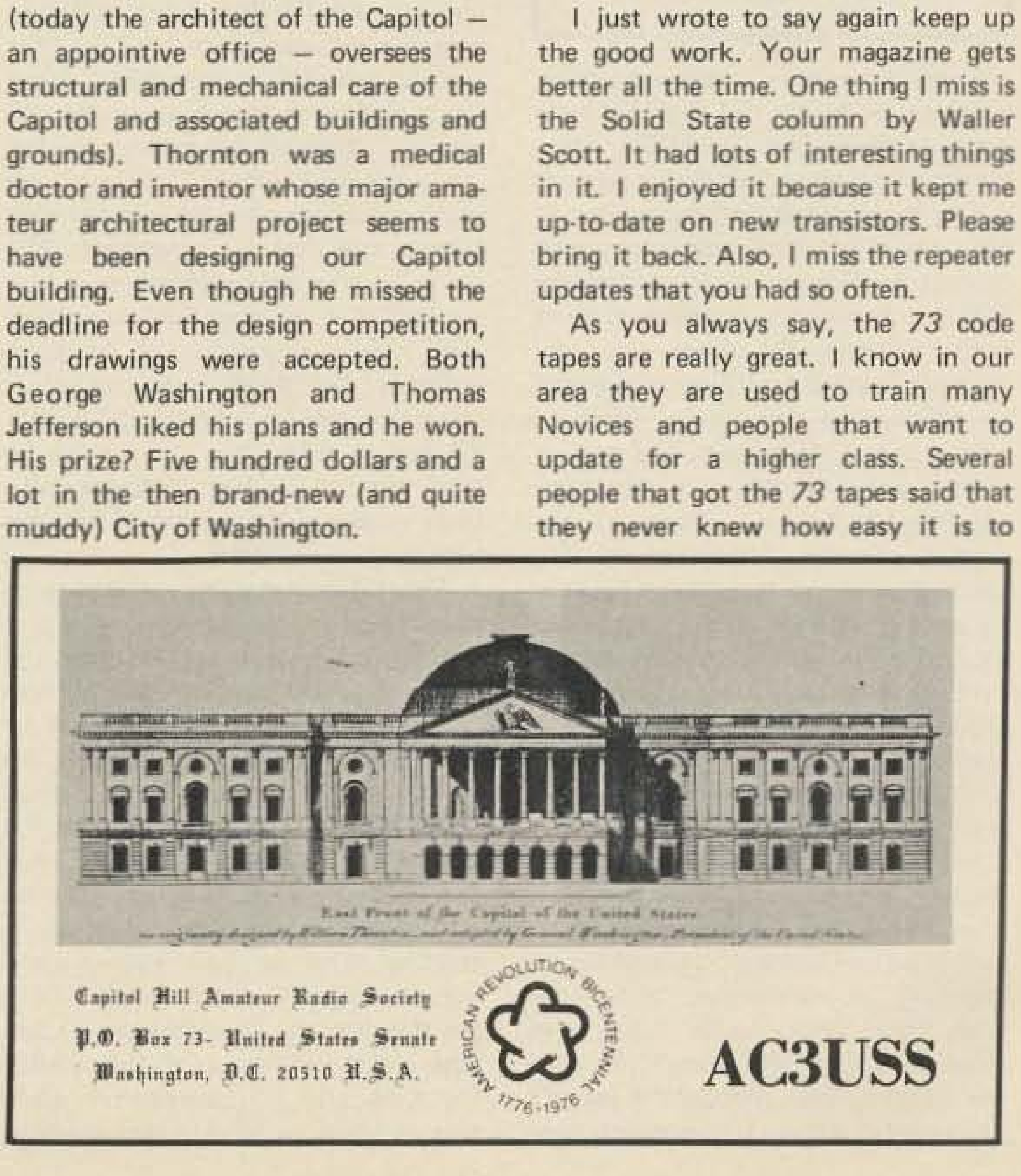
With interest I read your editorial on page 4 of the July, 1976, *73*, a portion of which concerned the use — or nonuse — of bicentennial callsigns. Certainly it is in the great American tradition of freedom that each individual amateur operator is allowed to independently decide whether or not to use the optional identification. Your readers may be interested to learn that we at the Capitol Hill Amateur Radio Society confirm AC3USS QSOs with a special three color QSL.

The card depicts the "East Front of the Capitol of the United States as originally designed by William Thornton — and adopted by General Washington — President of the United States." It looks quite different today, having been added to and modified several times. Visitors to the Capitol may view a history of the Capitol's physical evolution in the "crypt." The drawing reproduced on our QSL card is in this exhibit.

There is quite a history behind Dr. Thornton, the Capitol's architect (today the architect of the Capitol — an appointive office — oversees the structural and mechanical care of the Capitol and associated buildings and grounds). Thornton was a medical doctor and inventor whose major amateur architectural project seems to have been designing our Capitol building. Even though he missed the deadline for the design competition, his drawings were accepted. Both George Washington and Thomas Jefferson liked his plans and he won. His prize? Five hundred dollars and a lot in the then brand-new (and quite muddy) City of Washington.

AC3USS operates from the Senate Office Building on the Capitol grounds. Over one half of the Senators and many committees have their offices in the same building (and are thus susceptible to our RFI). The station is entirely financed from the private funds of members and began operation in 1969. It was, according to the Capitol Hill Historical Society, the first recorded amateur radio station operated from the legislative branch of government. Up to one kilowatt of power is used on 160-10 and 2 meters to contact hams around the nation and around the world from this historic landmark and institution.

David R. Siddall WA1FEO
Washington DC



RAMSEY RECOMMENDED

Kudos for Ramsey Electronics of Rochester NY, an advertiser in *73*. John Ramsey and his wife were exhibitors at the ARRL Atlantic Division Convention in Philadelphia on July 23-25. I purchased a fantastic little 6-LED clock which didn't work due to a couple of solder bridges I had added but didn't find. John straightened the problem out in a couple of minutes at no charge. Very friendly and personable with all who came to his booth. I'm sure the firm will do quite well and I recommend Ramsey Electronics without reservation.

Thomas R. Sundstrom WB2AYA
Willingboro NJ

1000%

I just wrote to say again keep up the good work. Your magazine gets better all the time. One thing I miss is the Solid State column by Waller Scott. It had lots of interesting things in it. I enjoyed it because it kept me up-to-date on new transistors. Please bring it back. Also, I miss the repeater updates that you had so often.

As you always say, the *73* code tapes are really great. I know in our area they are used to train many Novices and people that want to update for a higher class. Several people that got the *73* tapes said that they never knew how easy it is to learn the code. Learn it at 13 wpm once and be done with the hump and all the frustrations that go with it.

I believe that you are doing the ham radio fraternity a great service by selling these tapes at such a low price. I know that they have helped many new hams get started. They really are revolutionary in their methods and speed of learning for the student.

Keep fighting Ma Bell, too. She rips us all off! I don't know what she did to *Telephone Electronics Line*, but the magazine must have gone under because I get no more copies and have written them several times with no reply. I did get a notice from Pacific Bell sent to all subscribers not to use any information in the magazines. I don't know what gives Ma Bell or anybody else the right to censor the press so it can't print information on it, but if it can, then we are ruled by the big corporations.

We need more men like you, Wayne, to wake people up before it is too late and we are no longer free. I know we are not free now, but slowly but surely 1984 will really be with us with Big Brother at the controls and us just puppets.

Keep fighting the ARRL too, because they are against progress (or so it seems to me), and let's get some new blood in the ham ranks that will stand up to get more frequencies for our bands. We could sure use them, as many of them lie fallow. Used only by the government occasionally. We could put them to better use!

I am with you 1000%, Wayne. Keep *73*'s high standards up there.

Pete Hons W3PKH
Portage PA

WATCHING BELLE

Student amateur radio operators, members of Maple Hill High School's Amateur Radio Club, WB2YCR, stood hurricane watch at their home stations during Hurricane Belle's recent visit to our area. Alerted by telephone, each student monitored special emergency net frequencies on receivers at their home stations. On these nets, the students learned by listening to actual emergency net procedures, information bulletins on damage and evacuations, and "traffic" or message-handling techniques. Most of the student operators listened to the Red Cross Emergency East Coast Net run by station W1KBN in Boston. Others monitored state nets in New Jersey, Pennsylvania, Delaware, Connecticut, Massachusetts, New York, and New Hampshire.

Students also copied detailed information on the storm's progress from station WWV, run by the National Bureau of Standards. These bulletins gave the storm center's location in longitude and latitude, its wind speed, direction of movement, and other vital data. Using skills learned in Geography class and maps from local gas stations, they plotted the storm's progress from Cape Hatteras into New England. In this way, they were able to utilize their home stations, their radio skills, and their geographic knowledge in a useful and exciting way.

John Kienzle WA2UON
Castleton NY

OFF TARGET II

As a subscriber to your fine magazine, I've seen your comments on Trigger Electronics.

I recently received my Novice license and, with it, a batch of advertisements with mailing labels distributed (sold?) by the FCC. One such advertisement was from Trigger Electronics, a catalog. The catalog was full of such bargains, that, forewarned by letters in *73*, I took a second look. What I found was a catalog printed in 1973. It was mailed to me in June, 1976.

I wish to bring this to your attention and, hopefully, keep some new ham from making a bad mistake.

Thomas G. Vavra WN8ZRL
Fairborn OH

THE CAUSE OF IT ALL

Well, you're the cause of it all! Your I/O articles got me hooked on this computer business, and now I'm knee deep in it. I've been going to a microcomputer class given by the "Byte Shop" here in Santa Clara, and, besides learning a lot, I've found that most computer hobbyists aren't all that familiar with ham radio and *73 Magazine* in particular. There is a definite crossover point in the technology, and the two fields certainly complement each other. Take, for instance, the use of ham AFSK tones for digital data recording vs. the KC standard (with all due respect to your trip to Kansas City). The baud rate using our standard tones can be much faster than the KC standard. The point is, the technologies cross, and systems that we consider "run of the mill" can be a godsend to computerists. I've done my bit as far as informing the local group as to what *73* has to offer, but there must be some way to let the computer hobbyist audience know the advantages ham radio has to offer.

Your idea of making cassette tapes available with computer programs is outstanding. My entrance into the computer field was via MOS Technology's KIM-1 CPU board. One of the main reasons I purchased this board was the on-board cassette interface. KIM-1 does not use the KC standard, but it is an excellent interface system and may be recorded on normal cassettes. This could be a starting point for your software distribution system, and I'd really like to see this happen. A gentleman in San Jose is just finishing a 2K Tiny BASIC for KIM, and I'll contact him when he's finished to let him know about your distribution, royalties, etc. I'd like to see a good software distribution for KIM, since the 6502 is a really nice CPU.

Bob Grater K6SUB
Santa Clara CA

DOWN TO REAL GOOD

How about some articles for the ham that do not have anything about them except that they are expensive?

Super great magazine, except for those I/O articles — they cut it down to real good.

Well, 73, and thanks for the good magazine.

Curtis Junck WBØJYF/6
Fair Oaks CA

BUG IV

Concerning the article on the "TT Pad for the Wilson HT," July, 1976, I have found that the part number given for the Motorola belt clip is the number stamped into the plastic, but the parts catalog lists this part as #1-84206D81 and sells for $3.50. I ordered mine through the local Motorola shop and, sure enough, this was the number on the plastic bag the part came in. Hope this info helps those who want a good belt clip for their HT.

Harold C. Hageman WA5FCV
El Paso TX

REJECTION REJECTED

I rejected *73* earlier this year, as I subscribed to *QST* and *HR*. Last week I borrowed a copy of your June issue from K4FTY and realized I should have subscribed.

Michael E. Casciolo
K1DZH/WB4DOD
Huntsville AL

HATS OFF

Listening to WB4GLG in Kentucky working on the hurricane watch net was not only refreshing but truly exhilarating. Being a 4 year vet of CB and seeing how "good buddies" spend most of their time arguing about whose "channel" it is and whose mike is splattering who, it was good to hear him (and the countless others) really putting their all into helping those in need.

I myself have to say "hats off" to those involved in the net helping others. And to the few idiots on the band — may the short circuits of a thousand Hurricane "Belles" invade their shacks, along with the FCC with their axe.

I am working to get my Novice, then General, ticket in the near future (January, hopefully), the Good Lord and FCC willing. Looking forward to talking to all of the great people in the world of radio and handing them the respect they very much deserve,

John P. Keefe
Waterford NY

P.S. My first issue of *73* was the September, 1976, one. That is where I read of the net and found out about it. It will become #1 in my magazine library, as I won't miss any coming issues. Just got started with a 101-B — a few kft of wire. Who said all CBers were clowns?

BLESS TRUCKERS

I find it amusing to read letters that you have printed, written by hams, that castigate you for advertising CB radio and advocating recruiting future amateur operators from the ranks of CB operators. Personally, I agree with your stand on the subject. CB has grown up quite a bit since the fuel crunch and the advent of the 55 mph speed limit. CB radio has its place in the overall scheme of communications.

For instance, when I travel, I have a CB, a 2m amateur FM rig, and my "company" radio in the car. I work for a large governmental public safety communications agency, and thus have the 24-hour-per-day services of a public safety dispatcher available at the push of a mike button. And, since our agency uses multiple high level repeaters, I can contact the office over much of central California.

Most hams wouldn't scoff if I happened to report some sort of emergency over the company radio, yet these same hams would look at me funny if I reported this same emergency to the West Dismal Seepage REACT on channel 9. They also would probably think that familiarity with the 10-code on a public safety frequency is the mark of the professional, but if I should use that same radio code on CB I would be branded a nerd — or worse.

CB radio lets me talk to my lady legally, without her having to become technically oriented or take any test. When we visit her family on the north California coast, CB is virtually the only communications we have. There are few hams up there on 2 meters, but there are plenty of CBers.

On the highway, my little 11 meter rig has paid for itself over the past year by helping me avoid speeding tickets with their attendant fines, not to mention the insurance premium increases. When the speaker spats out, "Break for that Southbound, you got a Smokey on your back door," it's just natural to back down to "double nickels." Bless the truckers. They have set up a really efficient communications system.

The CBers I've met on the road are, for the most part, every bit as friendly as the hams I ran into fifteen years ago when the ink was still moist on my new license and I hesitated before entering a club meeting of electronic supermen. The Marin Amateur Radio Club of Novato treated me wonderfully and made me feel at home, even though I had a Technician license and couldn't operate on the "club" frequency of 3885 kHz. They encouraged me to write a VHF column for the club paper, and to set up the VHF stations for field day. I felt appreciated, and it was great. If ham clubs made newcomers feel at home, welcome, and "proud to have ya here, Podner (with a capital P)," I feel that the ranks of amateur radio would swell visibly. People are insecure in strange surroundings, and a neophyte ensnarled in a snobbish ham club meeting will probably leave, disillusioned, and take up photography, sky diving, or some such. If I had been treated discourteously during my early days as a ham, I never would have pursued the hobby. I feel that most folks feel the same way. No one enjoys being made to feel stupid or inadequate.

Another thing to remember: A CBer (or other person who has not been initiated into the world of electronics) can *never* ask a stupid technical question. Be patient. If they knew as much as you do, they'd have a ham ticket. But they're just starting out, just as you and I did many years ago. They don't have the amateur license or skills, or a commercial radiotelephone license. CBers appreciate patient, detailed, simple answers to their queries. Don't try to snow them with your great knowledge — *help* them with it. Be sure that they understand what you are telling and showing them. While you're at it, show them amateur radio, and how easy it really is to get started. Chances are, you'll have a new recruit for the amateur ranks. But if you ridicule him, and make him feel so low that a snake wouldn't have to step high to get over him, don't expect him to be enthusiastic about getting into amateur radio. No man goes readily where he feels outcast before he begins.

Thanks for taking the time to read this letter. You have my permission to line the bottom of the birdcage with it.

I am enclosing a check to cover the cost of the 14 wpm code cassette and the Advanced Class license study manual. After 15 years as a Technician licensee, I have decided to go for the biggee. And, as a lifetime 'scriber, let me add, Keep It Coming. Your publication is the best I've seen in the field.

Alan Christian WA6YOB
San Jose CA

BUG V

I have found an error in my article in *73*, April, 1976, p. 55, "One IC Tone Burster." Here's the change.

The emitter and base of the NPN xstr are switched; the amp is common *base*, not common *emitter*.

Lhary Meyer WB6ZMA
Fairfax CA

ATLAS ANSWERS

A little experience you might get a kick out of happened just recently. I got a great buy on an Atlas 210x from a dealer who picked it up from a CB dealer on a bad debt. Lo and behold, it had on the dial and on the freqs the 11 meter band all marked out as pretty as can be. And, of course, with 200 Watt input.

A letter to Atlas complaining about this setup brought a quick telephone call from the California firm with the information they did not put this rig out in that condition and they had encountered this before. They kindly sent me a new dial and a little tweaking brought it back on 10 meters. Incidentally, that is one helluva rig and every mobile HFer should have one.

Wm. R. Doctor WA9QJQ
Angola IN

OFF TARGET III

Concerning "Another Shooting Victim" and Trigger Electronics, River Forest, Illinois:

My advice to all the amateurs out there who are waiting and waiting is that a few complaints to the postal authorities will straighten out Mister Trigger pretty quick. The Post Office is very eager to go after people like that.

The August issue of *73* is the first one for me and it looks like a very interesting magazine. I'm sure I will enjoy it for many years to come.

Gerald Greenwood WB9SWA
Chicago IL

MISSED

Hermann Kortbus WA2LWK was killed today in a car accident. Many hams will miss his schedules, help and friendliness. Hermann had his 60 ft tower and 4 el quad ready to put up, but he never got to it.

Kurt Bittmann WB2YVY
Centereach NY

SHOCKED

September '76 *73 Magazine* arrived today. I am shocked to learn that FCC Docket 20777 is so restricting, especially since "de-regulation" is supposed to be the FCC's new motto.

It seems to be another case of a government bureau pushing the citizens around — like auto seat/strangle belts and inflatable cushions — motorbike helmets — father-son/mother-daughter banquets, and so on — including confiscatory taxes.

Your comment in "Never Say Die" regarding opening up the bands: Any mode anywhere sounds excellent and makes good horse sense. The bureaucrats and the ARRL will hate you and villify you for it, but I love you for it.

Paul L. Schmidt W9IDP
Bloomfield IN

U-HUM

It seems that every simple QRP rig is meant for 40 meters. I wish someone would design a simple transmitter (with a complete parts list) for the 15 or 10 meter Novice bands.

The only thing I have against 40 meters is all those u-hum foreign stations. It's almost impossible to find a section of the band that's clear.

Whoever had the idea of combining broadcasting and amateur stations is off his or her rocker!

I'm 14 years old, and am waiting for my Novice test to arrive.

John Halliwell
Hampton TN

P.S. This letter was inspired by your editorial in the July issue of *73*. I hope it meets your standards of complaining.

ANTI-73?

Having been a member of the ARRL for two years, I was never exposed to the "other side" of ham radio — that is, until a friend gave me a couple of back issues of *73*.

Now a subscriber, I find *73* an entertaining as well as useful magazine. However, I have a few suggestions which I think would make a good thing better. First (and most annoying), is the fact that you rarely (if ever) publish an anti-*73* letter in your "Letters" column (and don't tell me there aren't any!). Even *QST* has one or two anti-ARRL letters in their correspondence column — even though they obviously disagree. Sincere negative criticism is a useful tool — and should be voiced.

Another problem is one you rightly accused *QST* of — too technically-oriented copy. Lately, *73* has more closely resembled an RCA TTL manual than a ham magazine — how about some basic projects?

One thing which I was at first opposed to, but later very much pleased with, is the I/O section. Although some articles are out of my reach, *73* has effectively introduced me to microprocessors which I soon hope to become involved in.

Another advantage of *73* over *QST* is *73*'s lack of dull columns of call letters, contest results, "News and Views," etc. *QST* wastes half an issue each month on this. Ugghh!!

As far as *QST* goes, I find it a worthwhile magazine because it gives current news, has some basic and practical articles each month, has want ads, and is published by the ARRL, which, although it is not the best organization and is not totally agreeable with my views, is still worthy of my support.

So, all in all, I think I speak for at least a few hams when I say *73* and *QST* are both good and worthwhile magazines, and contribute to the safe growth and support of our hobby.

Brian Rackham WA7ZHJ
Scottsdale AZ

P.S. Notice how I didn't even bring up the fact that *73* has published CB ads (a commercial sellout?) and *QST* hasn't. And notice how I didn't mention how, as you stated, "informing CBers is our duty as hams." I didn't say, "no, it isn't — it is our duty to convert CBers to ham radio?" Don't worry, I won't say it.

Well, Brian, I've been reading QST *for over 40 years now . . . it's okay. Regarding anti-73 letters . . . yes, we got one last month . . . it wasn't very interesting. — Wayne.*

OFF TARGET IV

Just a quick note to tell you guys what a great magazine you put out.

Now that I've got your attention, I also want to complain about Trigger Electronics. 7 weeks ago I ordered two measly Novice band crystals for $6.30. According to my canceled check, they cashed it 3 days later and I haven't heard from them since. After phone calls and letter writing, I finally had to go to the Better Business Bureau. It would have been quicker to have my local supplier back order it from the factory. Fine way for a new Novice to start out — shining new equipment and no crystals. Oh, well.

Keith Payea WN1WWX
Fitzwilliam NH

STUCK UP

I am glad to see all of the ham magazines finally covering the CB scene. I cannot say that I am in total favor of CB, but I see the need for it and understand the reason for its popularity.

I have had a CB license since 1961, obtaining my amateur license in 1965 and FCC Commercial license in 1968. I will not in any way have a CB rig in my house, but on the other hand I go nowhere in my auto without one.

On a recent 5028 mile trip from the west coast back east and back through the northwest, I became more convinced that the majority of hams are stuck up. I met very helpful hams in all states, especially Denver, Salt Lake, Oklahoma City and Phoenix. However, in general they wouldn't even talk. In many cases, QSOs on a repeater would stop, and then several minutes later I would hear, "Well, guess that 'nut' is gone — now we can continue." The number of closed repeaters is amazing.

On the other hand, I never met an unfriendly CBer. Some rough language many times, but at least an answer.

Also, there is always someone mon-

Continued on page 18

CONTESTS

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

IARS/CHC, FHC, SWL-CHC, HTH QSO PARTY
Starts: 2300 GMT Friday, November 5
Ends: 0000 GMT Monday, November 8

An SASE to K6BX will bring more detailed information. Contest is open to all amateurs and SWLs worldwide. Same station may be worked on each band and mode; SSB and AM are different modes.

EXCHANGE:

QSO Nr., RS(T), name, CHC/FHC Nr., US state and county or similar division. Non-members send "HTH" instead of CHC/FHC nr.

SCORING:

For CHC – 1 point per QSO with other CHCers, 2 points if HTHer, and 1 additional point if YL, B/P, FHC, Novice, CHC-200, Merit or Club station, or if on VHF/UHF. Double above points if QSO is out of own country. For HTH – contacts with other HTHers count 1 point, with CHCers count 3 points. Rest same as above. For SWL – use same as above depending on whether CHC or not.

MULTIPLIERS:

Each different continent, country, ITU zone and US state (counted only once).

FINAL SCORE:

Multiplier times total points is final score. Multi-operator stations divide score by number of operators.

FREQUENCIES (for US and DX as allowed):

CW: 3575, 3710, 7070, 7125, 14075, 21075, 21090, 21140, 28090, 28125.

Phone: 3770, 3775, 3790, 3943, 3960, 7070, 7210, 7260, 7275, 14320, 14340, 21360, 21440, 28620, 50.1-50.5, 145-147.

AWARDS:

Hundreds of certificates and trophies in all categories and divisions are awarded. An SASE will bring further information. Send all requests and logs to: International Amateur Radio Society K6BX, PO Box 385, Bonita CA 92002. Logs should be mailed within 15 days after the close of the QSO Party.

RSGB 7 MHz DX CONTEST
Phone
Starts: 1800 GMT Saturday, November 6
Ends: 1800 GMT Sunday, November 7

EXCHANGE:

Report and serial number, starting with 001.

SCORING:

Non-British Isles stations score 5 points for each contact with the British Isles; those outside Europe score 50 points. All may claim a bonus of 20 points for each British Isles numerical prefix worked (G, GC, GD, GI, GM, GW – 2, 3, 4, 5, 6). Contacts with stations using GB prefixes will not count for bonus points.

AWARDS:

Non-European stations must make at least 10 QSOs to qualify for an award.

LOGS:

Logs and entries must be addressed to the HF Contests Committee, c/o J. Bazley G3HCT, Brooklands, Ullenhall, Solihull, West Midlands, England, to arrive no later than December 29th.

CALENDAR

Nov 5 - 8	IARS/CHC/FHC/HTH QSO Party
Nov 6 - 7	RSGB 7 MHz Contest – SSB
Nov 6 - 8	ARRL Sweepstakes – CW
Nov 9 - 10*	YL Anniversary Party – Phone
Nov 13 - 14	European DX Contest – RTTY
Nov 13 - 14	Delaware QSO Party
Nov 13 - 14	Missouri QSO Party
Nov 14	International OK DX Contest
Nov 20 - 22	ARRL Sweepstakes – Phone
Nov 20 - 21	All Austrian Contest
Nov 27	10 Meter Ground Wave Contest
Nov 27 - 28	CQ Worldwide DX Contest – CW
Dec 4 - 5	ARRL 160 Meter Contest
Dec 4 - 5	TAC Contest
Dec 11 - 12	ARRL 10 Meter Contest
Dec 31	Straight Key Night
Feb 19 - 20	YLRL YL-OM Contest – Phone
Mar 5 - 6	YLRL YL-OM Contest – CW
Apr 12 - 13	YLRL DX-YL to Stateside YL Contest – CW
Apr 26 - 27	YLRL DX-YL to Stateside YL Contest – Phone

* = described in last issue

ARRL SWEEPSTAKES
CW
Starts: 2100 GMT Saturday, November 6
Ends: 0300 GMT Sunday, November 8
Phone
Starts: 2100 GMT Saturday, November 20
Ends: 0300 GMT Sunday, November 22

Sweepstakes is sponsored by the ARRL and is open to all amateurs in the US, US possessions, and Canada. No more than 24 hours of operation are permitted during the 30 hour contest period. Time spent listening counts as operating time and OFF periods may not be less than 15 minutes. Times on and off as well as QSO times must be entered in the log. Each station may be worked only once, regardless of band.

CLASSES:

All entries will be classified as either single or multiple operator stations. Single operator stations will be further classified by input power: Class A = 200 Watts dc or less, Class B = above 200 Watts. All ARRL affiliated clubs may also participate in the club competition.

EXCHANGE:

Number, precedence, your call, CK and ARRL section. Send A for precedence if power is 200 Watts dc or less, otherwise send B. For CK, send the last 2 digits of the year you were first licensed.

SCORING:

Score 2 points for each completed QSO. Final score is sum of QSO points multiplied by the total number of ARRL sections plus VE8 (max. 75).

AWARDS:

Certificates will be awarded to the highest scoring Class A entry and the highest scoring Class B entry in each section, provided there are at least 3 single operator entries or the score is 10,000 points or more. Certificates will also be awarded for high scoring Novices and Technicians. Multi-operator entries are not eligible for certificate awards and will be listed separately in the results.

FORMS:

It is suggested that contest forms be obtained from ARRL, 225 Main St., Newington CT 06111. All entries with 200 or more QSOs must have a cross-check sheet to check for duplicate QSOs. Each log must show date, QSO time, times on/off, exchanges sent and received, band and mode.

Note: These rules were taken from last year's contest.

EUROPEAN DX CONTEST
RTTY
Starts: 0000 GMT Saturday, November 13
Ends: 2400 GMT Sunday, November 14

Rules for the contest are the same as for the Phone section, with one exception: In the RTTY section, contacts with one's own continent are permitted and count 1 point per QSO. Multipliers will be counted as before.

Complete rules appeared in the August issue on page 11. Briefly, the basic rules are as follows:

Use all bands 3.5 through 28 MHz, with only 36 hours of operation out of the 48 hour contest period for single operator stations. The 12 hour rest period may be taken in up to 3 periods. Classes include single operator (all band), and multi-operator with single transmitter.

EXCHANGE:

RST and progressive QSO number starting with 001.

SCORING:

Each QSO will count 1 point. A station may be worked once per band. Each QTC (given or received) counts 1 point – see August issue. The multiplier for non-European stations is the number of European countries worked on each band. Europeans will use the ARRL countries list. In addition, each call area in the following countries will be considered a multiplier: JA, PY, VE, VO, VK, W/K, ZL, ZS, UA9/UA0. The multiplier on 3.5 MHz may be multiplied by 4; the multiplier on 7 MHz may be multiplied by 3; the multiplier on 14/21/28 MHz may be multiplied by 2. The final score is the total QSO points plus QTC points, multiplied by the sum total multipliers from all bands.

AWARDS:

Certificates to highest scorer in each country, reasonable score provided. Continental leaders will be honored. Certificates will also be given to stations with at least half the score of the continental leader.

LOGS:

Use a separate log sheet for each band. Logs for the RTTY section should be mailed no later than December 1st. North American stations may send their contest logs to: H. E. Weiss WA3KWD, 762 Church St., Millersburg PA 17061, USA. All others should send their logs to: WAEDC – Committee, D-895 Kaufbeuren, Postbox 262, Germany.

DELAWARE QSO PARTY
Contest periods:
0001 to 0600 GMT & 1600 to 2200 GMT November 13
0001 to 0600 GMT & 1600 to 2200 GMT November 14

This year's Delaware QSO party is sponsored by the Delaware Amateur Radio Club, W3SL. Stations may be worked once per band, per mode for QSO points.

EXCHANGE:

Delaware stations will send QSO number, RS(T), and county. All others send RS(T), ARRL section, or country.

FREQUENCIES:

CW: 3560, 7060, 14060, 21060, 28160.

Phone: 3975, 7275, 14325, 21425, 28650.

Novice: 3710, 7120, 21120, 28160.

SCORING:

Delaware stations score 1 point per QSO multiplied by the total number of sections and countries worked. Outside Delaware score 5 points per DEL QSO times 1 for one county worked, 3 for two counties worked, or 5 for all three DEL counties worked (DEL counties = Kent, New Castle, and Sussex).

ENTRIES AND AWARDS:

Appropriate awards will be given along with a certificate for working all three DEL counties. Mailing deadline is Dec. 31, 1976. Send logs to John Low K3YHR, 11 Scottfield Dr., Newark DE 19713. Include an SASE for results or the W-DEL award.

MISSOURI QSO PARTY
Starts: 1800 GMT Saturday, November 13
Ends: 2300 GMT Sunday, November 14

The 13th annual QSO party is sponsored by the St. Louis Amateur Radio Club in an effort to activate some of the hard to get Missouri counties. The same station may be worked once per band and mode. Missouri mobiles will count separate from each different county.

EXCHANGE:

QSO Number, RS(T), and QTH; county for MO stations; state, province, or country for others. MO mobiles start with #1 from each county activated.

FREQUENCIES:

3540, 3910, 7040, 7240, 14040, 14280, 21110, 21360, 28110, 28600, 50-50.5.

SCORING:

Score 1 point per QSO; MO stations multiply contact points times number of states, provinces, and countries; others multiply by number of MO counties (115 max). MO mobiles total separate score from each county activated.

AWARDS:

Certificates to top scores in each state, province, country, top 10 MO entries and top 3 MO mobiles.

ENTRIES:

Mailing deadline for logs is December 15th. Address all entries to: St. Louis ARC – KØLIR, 842 Tuxedo Blvd., Webster Groves MO 63119. Include an SASE for results.

INTERNATIONAL OK DX CONTEST
Starts: 0000 GMT Sunday, November 14
Ends: 2400 GMT Sunday, November 14

The participating stations work stations of other countries according to the official DXCC Countries List. Contacts between stations of the same country count only as a multiplier, but Ø points. All bands from 160 to 10 meters, CW and phone may be used. (OK stations are only licensed to operate CW on 160 meters.) Crossband as well as cross-mode contacts are not valid.

EXCHANGE:

Exchanges consist of a 4 or 5 digit number indicating the RS(T) and ITU zone.

SCORING:

A station may be worked once only on each band. A complete exchange of codes counts one point, but three points for a complete contact with a Czechoslovak station (except as noted above for stations in the same country). The multiplier is the sum of the ITU zones from all bands. Final score is then the sum total of contact points times the multiplier.

CATEGORIES:

A – single operator, all bands; B – single operator, one band; C – multi-operator, all bands. Any station operated by a single person obtaining assistance, such as in keeping the log, monitoring other bands, tuning the transmitter, etc., is considered as a multi-operator station. Club stations may work in category C only.

AWARDS:

A performance list of participants will be worked out by the contest committee for each country. A certificate will be awarded to the top scoring operators in each country and each category. The "100 OK" award may be issued to stations for contacts with 100 Czechoslovak stations, and the "S6S" award (and/or endorsements for individual bands) may be issued to a station for the contacts with all continents. Both awards will be issued upon a written application in the log. No QSL cards are required for either award.

LOGS:

A separate log must be kept for each band, and must contain date and time in GMT, station worked, exchange sent and received, points (Ø, 1 or 3), and ITU zone (with the first QSO for that zone only). The log must contain in its heading the category of the station (A, B or C), name and callsign, address and band or bands. Also, indicate the sum of contacts, QSO points, multipliers and the total score of the participating station. Each log must be accompanied by the following declaration:

I hereby state that my station was operated in accordance with the rules of the contest as well as all regulations established for amateur radio in my country, and that my report is correct and true to the best of my belief.

Logs must be sent to The Central Radio Club, Post Box 69, Prague 1, Czechoslovakia – postmarked no later than December 31, 1976. A list and map of ITU zones is available for 2 IRCs from the same address.

ALL AUSTRIAN CONTEST
Starts: 1900 GMT November 20
Ends: 0600 GMT November 21

The contest is open to all amateurs; power input must be in accordance with licensing regulations. All contacts must be on 160 meters, on CW only. Foreign stations use the call "CQ OE," Austrian stations will use the call "CQ TEST." The authorized suballocations for Austria are: 1.823-1.838, 1.854-1.873, 1.873-1.900 MHz.

EXCHANGE:

RST and QSO number starting with 001. Each exchange must be confirmed by repeating the exchange code.

SCORING:

Every completely logged QSO (date, time in GMT, frequency in MHz, call of station, exchanges given and received) counts one point. Multipliers are 2 points for every Austrian "Bundesland" (OE 1 – 9), and one point for every prefix. Multiply QSO points times multipliers for final score. Every station can be contacted only once. If a station is contacted twice, the second QSO must be clearly marked as a duplicate and does not count.

ENTRIES:

Logs must be postmarked no later than December 15th and sent to: Landesverband Salzburg des OVSV, "AOEC 1976," c/o Ing. Wolfgang Latzenhofer OE2LOL, Pfeifferhofstrabe 7, A-5020 Salzburg, Austria.

10 METER GROUND WAVE CONTEST
9 pm to 1 am local time, November 27

This is the 24th annual contest sponsored by the Breeze Shooters of PA. All modes are permissible with points determined on a distance and input power basis. Separate awards for leaders in four circular zones centered on downtown Pittsburgh PA. Mobiles and Novice/Technician also compete for separate awards. Logs must be postmarked no later than December 6th. Log sheets and complete rules are available from Richard Evanuik WA3LUM, 311 Evergreen Ave., Pittsburgh PA 15209.

CQ WW DX CONTEST – CW
Starts: 0000 GMT Saturday, November 27
Ends: 2400 GMT Sunday, November 28

The contest is open to all amateurs and all bands. 160 to 10 meters may be used. Stations are permitted to contact their own country and zone for multiplier credit. The *CQ* Zone map, DXCC and WAE country lists, and WAC boundaries are standards.

CLASSES:

Single Operator – single or all band; Multi-Operator – single or multi-transmitter (all band only). Also, club competition.

EXCHANGE:

RST and Zone.

SCORING:

Contacts between stations on different continents count 3 points. Contacts between stations on the same continent but different countries count 1 point. For North America stations only, contacts between stations within NA count 2 points. Contacts between stations in the same country are permitted for multipliers but do not count for QSO points. The multiplier is the total number of different zones and countries worked on each band. Final score is the sum of QSO points times the total multiplier.

AWARDS:

First place certificates will be awarded in each class in every participating country and in each call area of the US, Canada, Australia, and Asiatic USSR. Final results will be published in *CQ*. To be eligible for an award a single operator station must show a minimum of 12 hours of operation. Multi-operator stations must operate a minimum of 24 hours. A single band log is eligible for a single band award only. Second and third places will be awarded if warranted. There is also a long list of trophies that will be awarded.

LOGS:

All times in GMT. Indicate zone and country multipliers only the first time worked on each band. Check for duplicate QSOs and correct QSO points and multipliers. Use a separate log sheet for each band. For official logs, summary sheet, and zone maps, send a large SASE to: *CQ* WW Contest Committee, 14 Vanderventer Ave., Port Washington, L.I., NY 11050.

Logs should be postmarked no later than one month after the contest and should be sent to the address above. Indicate phone or CW on the envelope.

Note: These rules were taken from last year's contest.

RESULTS

RESULTS OF 1975 TOPS CW CONTEST

The top 10 scorers of a field of 173 are shown below. It is interesting to note that W1SWX was the only US station listed anywhere in the results – he finished 6th.

G3FXB	111,500	W1SWX	63,712
LZ1SS	107,863	YU3TJA	62,315
HA9RU	79,461	DL1BU	61,152
XN1KE	72,874	OH1LA	53,912
OK2BPO	71,295	DM3YBF	50,687

LETTERS

from page 15

itoring the CB channels, where, even though I could raise a repeater at all times on the trip, 9 out of 10 times no one was around. Of course, the number of CBers vs hams accounts for this.

I feel the problem with the ham ranks is the typical ham who looks down on the CBer. Here at Norton AFB, San Bernardino, California, we have combined the amateur radio club, CB radio club and MARS support group. Since the CB club's start in March, 1976, approximately 30 CBers have gotten their ham tickets. Most CBers want ham tickets to get off the crowded CB bands. They need the help of a few amateurs to do so.

I hope more amateurs will help, because if they don't, the ham bands will become CB bands when the Communicator licenses are granted, if these CBers are not properly trained. As an added note, in this area 1 of 4 CBers also holds an FCC Commercial license, where it's lucky to find 1 in 25 hams with a Commercial ticket. I realize this is a special group of hams and CBers on a military installation, but would be willing to bet that, overall, it's pretty close to the same percentage. Thus, the CBers *are* interested in electronics — maybe much more than many amateurs I know.

I think more ham clubs should sponsor CB clubs, and then many of our problems would be solved — especially in attitudes on both sides.

Lee Wm. Cook
AFB8WNK/WA8WNK/6
Norton AFB CA

COMMON SENSE

Congratulations on a fine publication: *73* is the first special interest magazine I have encountered that covers a broad range of topics without losing the beginner or the expert, and your ad layout is superb as it does not dominate the content. One criticism, however — with the pages and pages of copy that obviously go into the editorials, when does the editor have time to *edit?*

One thing that really caught my eye was "Hamburglar." The key here is common sense. To reiterate:

1. Do *not* talk about your equipment on the air. We all like to boast about our prized belongings, but remember that monitoring the airwaves is fair game and you have no idea who is listening — *especially* on 2 meters.
2. *Anticipate* being ripped off. Wire your shacks and cars for "sound." It won't guarantee safekeeping, but the chance of catching or at least scaring off the culprit will increase tenfold. It's merely low cost insurance.
3. If you're operating 2 meters mobile (and it's most likely you are), take a look at your installation from about 20 feet away. Glance through the window at your rig. You'll really be startled at the resemblance it all has to a CB setup, especially if you have a 5/8 wave or collinear whip. So if you think you've been ripped off by the all-too-common CB thief, you can really kiss your rig goodbye, as somebody will eventually hook it up to a CB antenna and blow the final sky-high.
4. A word to the wise is sufficient. If you think there is dirty work afoot (you people in central Colorado should pay attention), get the word around — *quick* — and use the telephone. Stay off the air and hide your gear, and with more emphasis, *stay off the repeaters.* During such times it is important to stay low. It's kinda like a scant bathing suit — the more people who know means a better chance of getting burned . . .

I heard somewhere among the pages of the 8/76 issue some grousing (albeit minor) about the intermod on 2 meters. What are you guys complaining about? I am one of those black sheep of the communications world, a scanning monitor listener, and you have never heard intermod like you get on 99-44/100% of the commercially available scanners. Front ends on most of this equipment are as broad as barns and the i-f filtration is no better. Try this — take one ham broadcasting at about 144 MHz and one police department dispatching at just under 155 MHz. If the difference happens to be 10.7, scanner users may as well turn off the power, because the first i-f is swamped and the bad filtration in the 2nd i-f helps matters little. (I'm not pointing any fingers — the same thing happens with police and commercial mobile telephone at 165 MHz.) At any rate, it's bad, especially here in the Los Angeles area where there is an unusually high concentration of rf in the 144-174 MHz range.

In closing, I'll admit that I am not a ham, but that I would like to become one. Only one thing is stopping me — the CW requirements (I can already see thousands of you ready to jump on my case). I cannot see why I have to relive the history of radio communications via International Code and flea power when my primary interests are FM radiotelephone and data communications on 2 meters and above (with a special weakness for omnidirectional work on ¼ meter). Someday, I hope, the regulations will be relaxed and amateur radio will be allowed to catch up with the rest of the communications world.

Michael C. Musick
3102 W. Monroe Ave
Anaheim CA 92801

HAMM ACT?

How about adding additional counts to the indictments in "Hamburglar," e.g., Purloined, Heisted. If transported across state lines, is it a violation of the Hamm Act?

Nubar Tashjian K6KVX
Oakland CA

BUG VI

I enjoyed your "fast shuffle" editorial in the September *73*, and "them's my sentiments," exactly! Like we are being administered by a bunch of kids. Perhaps with a new consumer-oriented administration we will fare better!

There was an error in my letter that was published in that issue commenting on your I/O editorial, in that my draft did not correctly get translated into the final copy. We have the *potential* to accept ASCII at the ATV repeater, but pending an OK on our petition or similar RMs, individual amateurs may not transmit ASCII except through OSCAR. The same action, however, could be triggered by any other means, such as CW combinations, RTTY, etc., though clumsier.

In this connection, you might check on touchtone pads, and Part 97.117. If I read it right, you could also get a pink ticket for using that unauthorized code. And thousands per day, too!

Charles E. Spitz W4API
Arlington VA

WORTH ITS PAPER

Help! Your mag is great, but the advertisers don't want to know about export orders. I have an import permit for R5000.00 (about seven thousand dollars) but no one answers my letters. You should try getting on moonbounce with the parts available here. I want to import just about anything in ham gear for the guys here, so perhaps you have a few good people to recommend.

We have a new repeater here in Johannesburg, and 2 is going crazy with A2C, 7P8 and 3D6 all getting in on the act. The frequency is 145.05/65 for anyone coming this way.

Next problem — I've just received your April issue a week earlier than usual.

Keep up the good work. At 3 dollars a copy there's only one mag that's worth its paper as far as I'm concerned.

C. R. Newport ZR6CW
Northcliff, South Africa

FIVE YEARS AHEAD

I would first like to say I truly think that *73* is five years into the future as to where ham radio will be.

When you first started putting out *73* with the new I/O computer sections, I thought it was a big waste of space and at one point I was thinking about not even renewing my subscription (as you could tell by the big lag of time after my last subscription terminated until I sent in my 3 year subscription). I now have a minute understanding of ICs, and I am developing an interest in computers for which your I/O section proves to mature my interest. If I remember right, my interest in ham radio started with me reading publications about ham radio. Could it be possible that after reading your I/O section for a few more months I might wish to purchase a computer?

Steve Branom WBØOIS
Des Peres MO

WRITTEN CRAZINESS

The written craziness appearing in the first three issues of *73* delivered to my door has prompted me to send in my $8.00 so that maybe I can understand the present by reviewing the past. After reading only official ARRL books, my closed mind was opend to a breath of fresh air upon my initial exposure to a copy of *73*. Aren't the low bands all there is to ham radio? After reading all the ARRL books I thought I was second best with my little Technician license, but after reading your articles I realize I'm right on top of the heap. After all, I was only looking for some dependable local communication when I sought the Tech ticket, not a way to talk to some people I've never even met in some country I have never even heard of.

I started this course after being in the middle of CB here in Memphis for the past ten years. Neighbors used to speak under their breaths as my brother and I drove by, calling us, "Those funny people with those strange radios in their cars and those funny antennas." Then, at the precise moment of my life when I was ready to sell out of CB, a friendly ham introduced me to a handie-talkie. I was hooked. No more would I have to call for my friends in vain on the CB when their units wore off. With an HT all I needed to do was punch up the patch and ring their phone. Total communications right in the palm of my hand.

Well, I'm into it now and with about two hundred avid listeners on the two meter autopatch repeater I'm a little bit shy about calling my CB friends who think it's cute to say 10-4 on two meters. And the guys on the machine have had their clique set up for at least a hundred years and don't have a thing in common with a converted CBer, so even with a handful of total communications I'm still stuck.

I work with CB everyday in my job at the local shack, so I know what it is, and I know what two meters is here in Memphis. Both are a real strikeout. You've been pushing both, but from my position neither one is worth the pushing. The real friendly folks who enjoy the art of conversation and enjoy listening to other people talk are the people in Memphis on six meters.

With a new six meter repeater and an ever-expanding club as a result of the six meter repeater — not to mention the two meter repeater of theirs now going through testing — this is the real home of amateur radio in our community. As usual, about half the ham population in our town is ignoring it.

So maybe that's why I still read your magazine — kindred spirits? Your brick wall at the ARRL is just about as big as the brick wall our group runs into every time we try to do something with another ham group here in town. If it's not pickiness, it's personalities they're objecting to. Cooperation is the key to success (to coin a phrase), and if there weren't a few good hams in the two meter group, I doubt if anything would get done by a combination effort. God bless 'em. 73s to *73*. Ship my 20 back issues quick and I'll keep reading your mag, no matter how many computer articles you put in.

John Wood WA4BPI
Memphis TN

P.S. By the way, check out the *QST* covers for July and June, 1976. Each story the cover promotes is in the other issue. The June "Amateur Radio at the Olympics" story is found in the July issue on page 50. The July story, "The ARRL Nat'l Convention, Denver," is found in the June, 1976, issue on page 53. Obviously you've noticed it, but since you didn't mention it in your September, 1976, issue, I thought I'd pass it along. Hope it gives you a laugh — it did us.

Okay on the QST covers . . . I hadn't noticed. Re 2m vs. CB vs. other ham bands . . . I suspect that we will get out of our hobby about what we put into it. Since most of my operating these days is while I'm driving, and since the driving process takes much of my attention, I'm afraid that contacts with me on 2m or CB are probably pretty dull. Any other readers with ideas on this? — Wayne.

GOODIES

On reading the I/O Editorial in the August *73*, I felt it necessary to let you know how much the I/O features are appreciated by some of us in the UK.

Here, as in most of Europe, the low end of the computer market has been neglected, and our present awareness of trends in the US of what must eventually turn out to be an enormous worldwide market is largely due to the features and advertisements that have appeared in *73* since November 1975.

My experience with a modest 6800 kit convinces me that you are perfectly correct in foreseeing a growing use of microprocessors in amateur equipment, and I only wish that we found it easy to import some of the "goodies" that are advertised so tantalizingly in your magazine.

You mention that a new magazine covering the computer hobby field may be introduced, and I hope that when this happens, the *73* agent in the UK will be able to handle subscriptions to it.

Finally, as a radio ham with a professional connection with large computer systems, I would like to say a sincere thank you to *73* for what has appeared so far, and for what I hope will continue to appear in the future.

W. D. Old G3CZZ
Camborne, Cornwall
England

HELL-BENT?

Would you please explain to me why you and other magazines seem so hell-bent on recruiting new members to ham radio? I am sincere when I say I really do not see any advantage to me by increasing the clutter on the air. Of course, I can see why *you* would want an increase — for more business, of course — and I don't blame you.

That goes for manufacturers of equipment — also more business. But why should I encourage people to be new hams? Have you ever tried to get on 20 meters around 6 o'clock in the evening? Have you ever heard the incredible pileups when DX starts to come in? The QRM is impossible.

I am not trying to be sarcastic with this letter. I really would like to know why it is to my advantage to encourage new hams. You may use this letter if you want to — possibly others may feel like I do.

Harry Torossian WB8SWD
Dearborn Hgts MI

Well, Harry, though parts of 20m may be overoccupied, even at peak hours of activity there are large parts of our ham bands which are almost unused. The "use it or lose it" theory is a valid one, and the fact is that we have far too few amateurs to use the channels allocated to us. When you have trouble getting through on 20m, you might tune up to 15m and be amazed at the wide open (unused) spaces. If that doesn't impress you, then tune the 1.7 MHz of 10m and listen to nothing. Up on 6m there is maybe 500 kHz of activity and 3.5 MHz has very, very little. In most areas of the country 144-146 is dry. And with the exception of a handful of pioneers and a few pioneering repeaters, 220-225 MHz (the band manufacturers want for CB) is empty. 420-440 is dry in many areas . . . and above 1215 MHz what have we? It does me no good to print a lot of articles exhorting hams to use these bands, for if they do then we will have less use of the other bands. We are spread so thin as it is that about 50% of the 2m repeaters are hurting badly for activity. If you want to really feel lonely try going on 6m or 220 MHz repeaters . . . with a very few exceptions. Yes, we are in great need of amateurs if we are going to have reasons to hold our bands . . . or to get more bands. If we continue to force all newcomers to come into amateur radio via the lowband $800 transceiver route (Novice license), we will end up with more and more jamming of the few low band frequencies and a continuation of the wide open VHF and UHF ham bands. Yet, with the discontinuance of the mail order Tech license, this is exactly what the FCC has brought about. — Wayne.

LESS AND LESS

First, thank you very much for the copy of the July issue. I have a subscription, so I got to see my article on computer Morse when it first came out. When that other copy came, I had further proof you and your staff have it where it counts — concern for people. You encouraged (almost cajoled) me into writing the article with your editorial calls for attempts. Then, to my astonishment, you publish it, my first ever attempt at publishing anything. Now, you make sure I have an extra copy to remind me to write more and better. Thank you all, very, very much.

The rest of this you may use in your Letters department if it would be of any value to your readers.

After reading three or four editorials of yours saying CB is not all that bad (or is it not all CB is bad) and talking with some local search and rescue people to make sure, I mailed in a CB application on 31 May. I settled down to wait the four months. Then I got the info on temporary licenses, filled out a form, bought two walkie-talkies for use on my impending vacation. I considered "bending the rules" after my 60 days were up. Then I realized that the main complaint against CB is people "bending rules" to one degree or another. I resolved that I would not attempt to face that moral issue until I actually was tempted to operate illegally. On 12 July my license arrived to the relief of my overtime conscience. 43 days' delay, and since my license was approved on 23 June, I suspect that a large part of that was in the postal system. It seems that the FCC is responding to the flood of CB applications. I wonder what else they will be doing for that large block of people.

By the way, out here I have never heard more than five channels busy at any one time. Occasionally, I hear callsigns used. I haven't heard a foul mouth or a conversation I wanted to join yet. My wife and I have found our walkie-talkies extremely useful, and we will continue working with search, rescue and service groups.

The article by Fields in the September issue ("How to Catch a CBer," pp. 74-77) was first rate. I learned a lot about CB from that article. I think we have to incorporate anything from CB that will serve a useful purpose. If we don't start selling ham radio on its merits, CB will remain in the spotlight. That means *they* will get the publicity and praise that leads to support in Congress and at the FCC. That means more goodies for *them* — which leaves less and less for us.

James Whitfield
Edwards AFB CA

SNEAKING ONE OVER

Finally, through Docket 20282, the FCC does something positive for ham radio. I am referring to the provision in the docket which allows for Novices to use 250 Watts of power. It also restricts other classes of licensees from using more power than that in the Novice portions of the bands.

I agree with you that now Novices can purchase the latest state-of-the-art transceivers. This will definitely aid Novices in the crowded bands.

After reading of these changes in the ham magazines, I went out and bought a new Yaesu FT-101E with accessories. I spent about $1000 on this rig. I am expecting my Novice ticket soon, if the FCC ever finishes grading it and issues my ticket.

What I wanted to inform your readers of is that "Mother" ARRL in the June 12, 1976, meeting of the Executive Committee unanimously *voted* to petition the FCC to reconsider that portion of Docket 20282 dealing with the 250 Watt power proposal for the Novice bands. I for one am very disappointed with this development. Not only have I invested a considerable amount of money in gear which today is legal, but tomorrow may not be, but also the ARRL, which is supposed to be looking out for ham radio, is trying to sneak one over on all prospective as well as currently active Novices. What I really

Continued on page 38

New Products

NEW 5½, 6½ DIGIT DIGITAL VOLTMETER CHECKS AND CALIBRATES ITSELF

Using two microprocessors, one for measurement control and the other for computation and remote programming, this new fully-guarded, integrating Hewlett-Packard Model 3455A Digital Voltmeter is a high-performance unit designed for bench or systems use. It measures dc from 1 uV to 1,000 volts, true rms from 10 microvolts to 1,000 volts, or, with an optional average ac converter, from 10 microvolts to 1,000 volts average. Resistance measurements cover from 1 milliohm to 15 megohms in six ranges, either two or four wire. A high-resolution mode uses 6½ digits, but for faster reading 5½ digits are used.

Use of a plug-in precision reference enables the instrument to check itself against the reference. Under control of the microprocessor, it makes its own corrections. The reference unit can be easily removed from the 3455A and calibrated periodically. A self-test feature verifies operation of the dc circuits. If a problem is found, it is easily analyzed using the front panel display.

Mathematical functions built into the 3455A let the user offset, take ratios, or scale readings so that readouts are in physical units. A "% ERROR" mode converts readings into percent change compared to a predetermined reference.

Dc measurements are made at 24 readings per second (22 readings per second for 50 Hz) with 1 microvolt sensitivity. Greater than 60 dB normal mode noise rejection is obtained on all dc ranges. Dc accuracy is ±0.0023% at full scale.

True rms measurements are made to 13 readings per second at frequencies above 300 Hz. True rms is measured with best accuracy of 0.1% over a 30 Hz to 1 MHz bandwidth. Signals with a crest factor as high as 7:1 full scale can be measured.

Average ac measurements (optional) are also made up to 13 readings per second at frequencies above 300 Hz. Average ac is measured with best accuracy of 0.1% over a 30 Hz to 250 kHz bandwidth from 1 to 1,000 volts in four ranges with 50% overranging. The Model 3455A can be ordered with Option 001, which provides average ac instead of true rms, at a reduced price.

Resistance is measured in six ranges from 100 Ohms to 10 megohms full scale with best accuracy of 0.0025% at full scale. Maximum current through the unknown is less than 1 milliampere. Internal circuits are protected against overvoltage.

Standard on the 3455A is an HP-IB (Hewlett-Packard's implementation of IEEE-488) I/O for systems operation. The front panel indicators on the 3455A display range, function and HP-IB status during remote operation.

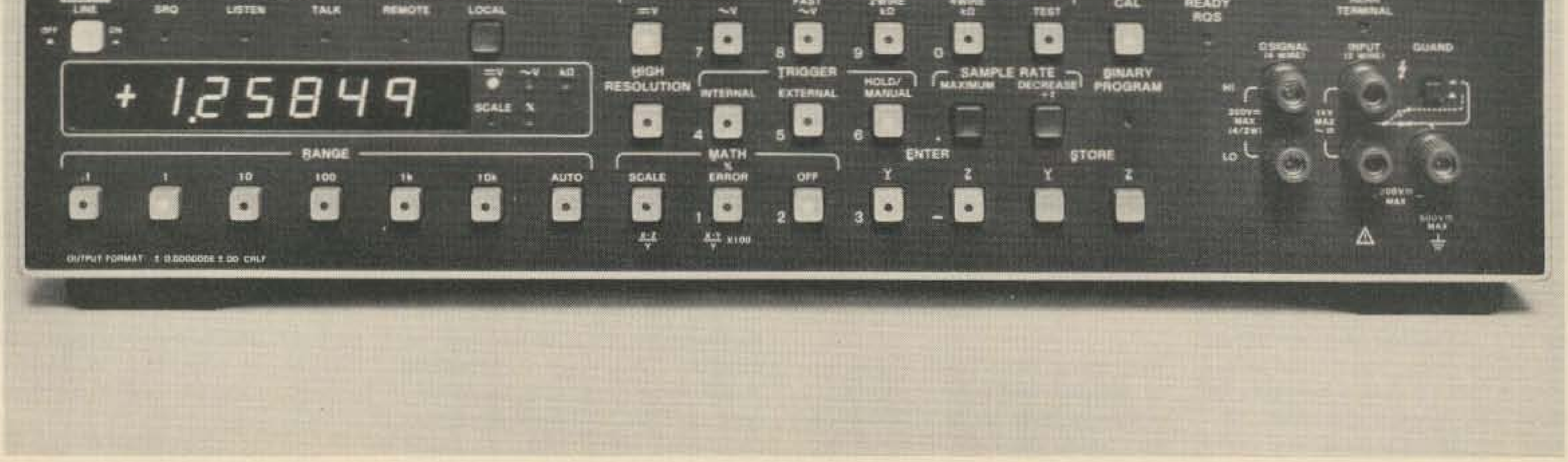
The U.S. price of the Hewlett-Packard Model 3455A Digital Voltmeter, including true rms measurement capability, is $3200. Model 3455A with Option 001 replaces true rms measurement with average ac measurement and sells for $3000. *Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto CA 94304.*

THE TF40 POCKET CRICKET

Sencore, Inc., manufacturer of electronic test and measuring equipment, has announced the release of an all new portable transistor/FET Tester: The Patented TF40 Pocket Cricket.

Bob Bowden, Sencore's Marketing Director, explained, "According to EIA figures, more transistors and FETs have been used in the last five years than any other active component, which means the service and maintenance of these components will be an ongoing process for many years to come, in both the consumer service market (including radio, TV, stereo, sound and communications) and the rapidly expanding industrial MRO (Maintenance Repair Operations) and medical test equipment markets."

The tremendous need for a fast, reliable GO/NO-GO test of transistors and FETs was clearly demonstrated by the overnight success of Sencore's patented TF26 Cricket transistor/FET tester, introduced three years ago. Since that time, the Cricket has become the most popular transistor/FET tester ever produced, with over 30,000 Cricket circuits in the field today. The Cricket has established itself as a standard in the industry for



speed and reliability.

However, there was a growing need for portable testing capabilities for numerous applications where on-site transistor/FET testing is required, such as field service work of medical products (where ac power may not be provided), consumer products service, business machines service (copiers, typewriters, and word processing units), general maintenance of industrial equipment, mobile communications stations, avionics, and numerous other applications. No reliable answer for this need for portable transistor/FET testing was available until now, with the patented TF40 Pocket Cricket.

By implementing a low current drain state-of-the-art design, the TF40 Pocket Cricket now incorporates the 99.9% reliable Cricket in a small, compact, rugged design for the first reliable, completely portable transistor/FET tester to meet this tremendous need for field maintenance and service of solid state equipment.

Mr. Bowden said, "The Cricket circuit tests all transistors and FETs in seconds using a Sencore-patented universal phase inversion test based on the fact that all transistors/FETs amplify and invert a signal if the device is properly working. Total GOOD/BAD testing takes only seconds and requires no setup information. The test leads are connected to the transistor in any order and the test switch is rotated. If the transistor is good, the Pocket Cricket will chirp and the meter will read upscale." (The test tone was added because the test can be made so quickly the meter may not have time to read upscale.)

Once a transistor is known to be good, the polarity can be determined and a transistor can be distinguished from an FET. This is extremely helpful in establishing a replacement part of a schematic is not available. And, the Cricket test circuit is 100 percent safe to the tester, circuit, and user.

Many times a transistor will show good gain, but not operate in circuit due to inter-element leakage. To be as reliable as possible, the Pocket Cricket is designed to measure all individual inter-element leakages on the meter for a 99.9% reliable check of all transistors and FETs. The Pocket Cricket's metered leakage test is exclusive in pocket portable transistor testers, offering the most reliable test available for field use.

For the first time in a portable transistor tester, all three transistor leads can be identified, in seconds. The exclusive lead ID control is adjusted until only one of two positions on the test switch indicates a good transistor. The lead configuration then can be read directly off the coded test switch. This feature can save time in determining proper basing configurations, without the use of reference material.

Included with every TF40 Pocket Cricket is a specially-prepared training tape explaining the overall operation and application of the TF40. Mr. Bowden explained, "The Pocket Cricket is an extremely versatile, reliable instrument that will undoubtedly be used by thousands of people in plants, field job sites, large service shops, and schools. The training tape is designed to give any new operator the basic instructions he needs to put the TF40 to work for him as soon as possible. With such a tremendous need for on-site servicing, the patented Pocket Cricket should receive tremendous response from all areas of the electronic maintenance and service markets, especially considering the low $98 price, plus the fact that the Pocket Cricket carries Sencore's 100 Percent Made Right Lifetime Guarantee, insuring a lifetime of performance free from factory workmanship error." *Sencore, Inc., 3200 Sencore Drive, Sioux Falls SD 57107.*

UC 1800 MICROCOMPUTER

The UC 1800 is a completely self-contained microcomputer designed to allow maximum ease of use.

It has significant value as a training device in the construction and use of computers in general, and as a device for evaluating the application of a microprocessor in new products.

The UC 1800 is completely assembled and tested. As such, it has important design cost saving advantages to industrial users contemplating the use of microprocessors in their products.

The comprehensive instruction manual, simple straightforward software instructions, self-contained keyboard, and four digit hexadecimal display provide a package which promotes rapid training and system development.

All users will benefit from the growth potential incorporated in the UC 1800. External bus access allows future connection to a host of peripheral devices and add-on memory which can provide full mini-level computer power.

The user of the OEM version will find such features as full military temperature range, low power CMOS, single 3 to 15 volt supply and TTL compatibility are decided advantages in a wide range of product applications.

The outstanding features are: low cost, built-in keyboard programming, digital (hexadecimal) display for address, memory contents, and I/O port, front panel control of interrupt, DMA, I/O flag, 256 byte RAM expandable to 65.5K bytes RAM or ROM externally, low power consumption, special circuit for saving memory content when unit is turned off, single power supply, parallel and serial I/O data line capability, availability as single PC board microcomputer with or without on-board power supply for OEM applications.

Applications include use as a computer training device for schools and industry, microprocessor application demonstrator/evaluator, software development trainer, household or hobby computer, or small business or industrial computer. The UC 1800 may also be used for process control, laboratory automation, traffic control, and data communications. *Infinite Incorporated, PO Box 906, 151 Center Street, Cape Canaveral FL 32920.*

NATIONAL SEMICONDUCTOR CORPORATION CONSUMER PRODUCTS DIVISION ANNOUNCES TV "ADVERSARY" GAME

National Semiconductor, Consumer Products Division, has announced it has received FCC approval for its TV game, "Adversary," which was previewed at the Consumer Electronics Show in Chicago June 13-16, 1976.

The video game, "Adversary," features a choice of 3 playing fields: Tennis – played by one or two players on green court; Ice Hockey – played by one or two players on blue ice; Handball – played by one or two players on brown court.

All games are in full color, have realistic sound effects when the ball or puck strikes a surface, and offer a choice of 3 individually-selectable paddle sizes. Serves are controlled by players, not by random. Scoring is automatically displayed in large easy-to-read numbers after each point is scored, and is off during play. Controls are individual, which enables players to sit in a favorite chair to compete.

"Adversary" offers 7 modes of operation: 3 modes of 2 players, 3 modes of player against himself, and 1 mode with player against machine.

A special feature allows "time out" during play without changing the score. Play can be resumed at the point where "time out" was called.

"Adversary" employs National Semiconductor's recently announced MM57100 video game logic circuit and LM1889 video modulator. *National Semiconductor, Sunnyvale CA 94086.*

ALL NEW SOLID STATE DC101A AUTOMOTIVE DIGITAL CLOCK

The DC101A digital clock sets the trend in digital automotive electronics which will be offered in the upcoming years. Its small size (1¼" x 2¼" x 5/8") and coordinated leather texture and chrome exterior make it an attractive addition to any car. Solid state electronics and a quartz crystal

KENWOOD'S TS-520

... worth waiting for!

Why wait any longer for a rig that offers top performance, dependability and versatility ... the TS-520 has proven itself in the shacks of thousands of discriminating amateurs, in field day sites, in DX and contest stations, and in countless mobile installations.

Superb craftsmanship is evident throughout ... in its engineering concepts as well as its construction and styling ... craftsmanship that is a Kenwood hallmark.

Maybe the Kenwood TS-520 is the one you have been waiting for.

Kenwood offers accessories guaranteed to add to the pleasure of owning the TS-520. The TV-502 transverter puts you on 2-meters the easy way. (It's completely compatibile with the TS-520.) Simply plug it in and you're on the air. Two more units designed to match the TS-520 are the VFO-520 external VFO and the model SP-520 external speaker. All with Kenwood quality built in.

TS-520 Specifications

MODES: USB, LSB, CW
POWER: 200 watts PEP input on SSB, 160 watts DC input on CW
ANTENNA IMPEDANCE: 50-75 Ohms, unbalanced
CARRIER SUPPRESSION: Better than -45 dB
UNWANTED SIDEBAND SUPPRESSION: Better than -40 dB
HARMONIC RADIATION: Better than -40 dB
AF RESPONSE: 400 to 2600 Hz (-6 dB)
AUDIO INPUT SENSITIVITY: 0.25μV for 10 dB (S+N)/N
SELECTIVITY: SSB 2.4 kHz (-6 dB), 4.4 kHz (-60 dB), CW 0.5 kHz (-6 dB), 1.5 kHz (-60 dB) (with accessory filter)
FREQUENCY STABILITY: 100 Hz per 30 minutes after warmup
IMAGE RATIO: Better than 50 dB
IF REJECTION: Better than 50 dB
TUBE & SEMICONDUCTOR COMPLEMENT: 3 tubes (2 x 6146B, 12BY7A), 1 IC, 18 FET, 44 transistors, 84 diodes
DIMENSIONS: 13.1" W x 5.9" H x 13.2" D
WEIGHT: 35.2 lbs.
SUGGESTED PRICE: $629.00

VFO-520

Provides high stability with precision gearing. Function switch provides any combination with the TS-520. Both are equipped with VFO indicators showing at a glance which VFO is being used. Connects with a single cable and obtains its power from the TS-520. Suggested price: $115.00.

SP-520

Although the TS-520 has a built-in speaker, the addition of the SP-520 provides improved tonal quality. A perfect match in both design and performance. Suggested price: $22.95.

TV-502

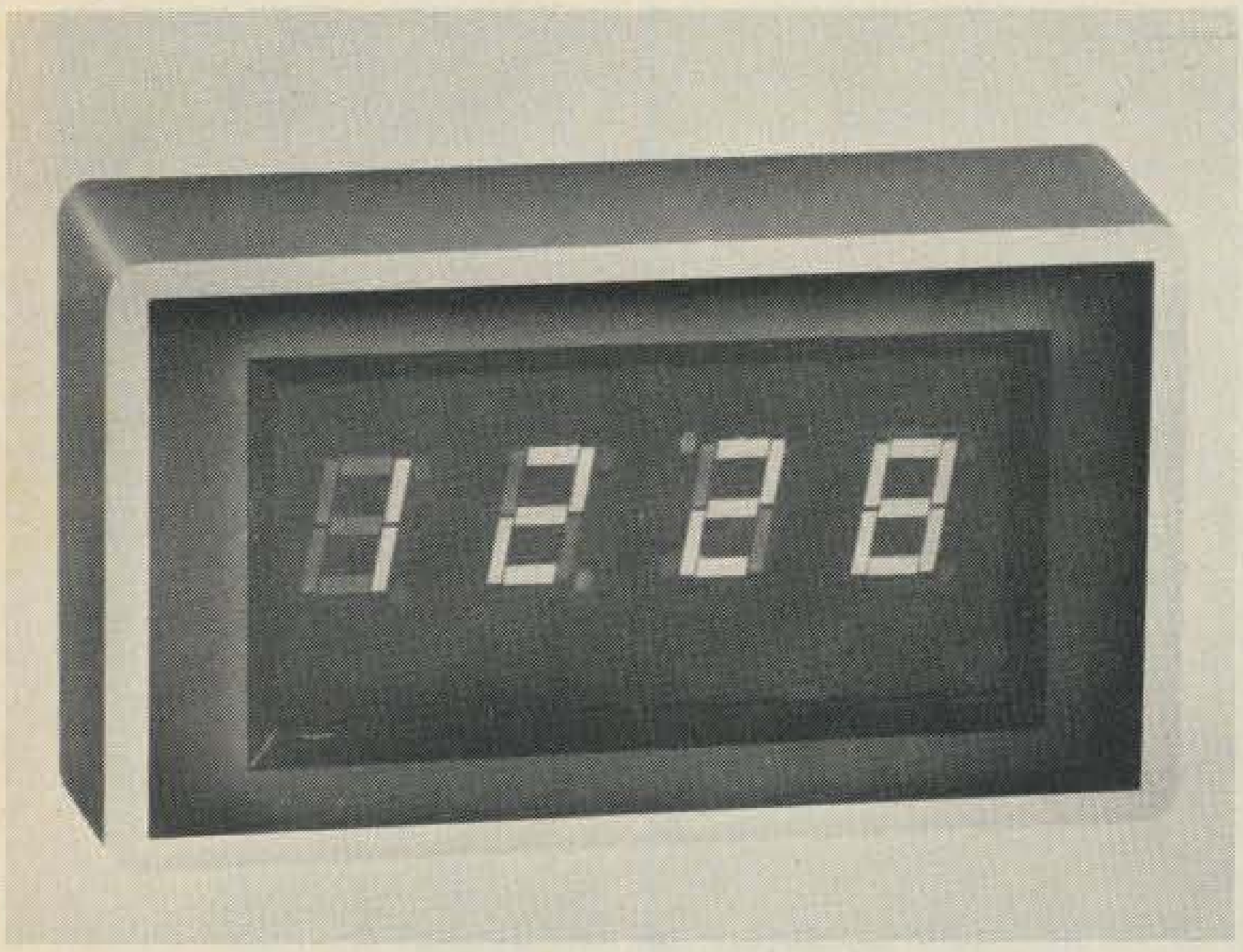
TRANSMITTING/RECEIVING FREQUENCY: 144-145.7 MHz, 145.0-146.0 MHz (option).
INPUT/OUTPUT IF FREQUENCY: 28.0-29.7 MHz
TYPE OF EMISSION: SSB (A3J), CW (A1)
RATED OUTPUT: 8W (AC operation)
ANTENNA INPUT/OUTPUT IMPEDANCE: 50Ω
UNWANTED RADIATION: Less than -60 dB
RECEIVING SENSITIVITY: More than 1μV at S/N 10 dB
IMAGE RATIO: More than 60 dB
IF REJECTION: More than 60 dB
FREQUENCY STABILITY: Less than ±2.5 kHz during 1-60 min after power switch is ON and within 150 Hz (per 30 min) thereafter.
POWER CONSUMPTION: AC 220/120V, Transmission 50W max., Reception 12W max. DC 13.8V, Transmission 2A max., Reception 0.4A max.
POWER REQUIREMENT: AC 220/120V, DC 12-16V (standard voltage 13.8V)
SEMI-CONDUCTOR: FET 5, Transistor 15, Diode 10.
DIMENSIONS: 6⅝" W x 6" H x 13¼" D
WEIGHT: 11.5 lbs.
SUGGESTED PRICE: $249.00

CW-520
500 Hz CW Crystal Filter: $45.00.

Prices subject to change without notice

KENWOOD
... pacesetter in amateur radio

TRIO-KENWOOD COMMUNICATIONS INC. 116 EAST ALONDRA/GARDENA, CA 90248



produces a clock that is the most modern timekeeping device for automobiles. It can be easily mounted in minutes in its compact ABS plastic case. Installation is accomplished by drilling a nine thirty seconds of an inch hole in the dash, passing the power wires through it, and connecting them to the power with quick-connect fuse clips. Bright light emitting diodes allow for easy reading in all conditions. Since the clock is all solid state, it is inherently long-life. A one year guarantee is offered on the clock. Price: $49.95. *Lectronix, PO Box 42, Madison Heights MI 48071.*

NEW CUSHCRAFT FACILITY

Construction is underway on the first phase of CushCraft Corporation's new 50,000 square foot antenna research and production facility.

All manufacturing operations, executive offices and research will be moved to the new facility by November 15th. It is located at the Grenier Industrial Park in Manchester, N.H.

Bob Cushman, treasurer of the company, reports this all new plant is designed specially for antenna manufacturing. It will allow increased production of current amateur, citizens band and professional antennas — plus the introduction of several new antenna types.

Planning for the new production lines and equipment has been in process for several years. When fully operational, the plant will be a model for the industry, allowing CushCraft to maintain its traditionally high value standards.

FS 20 FIELD STRENGTH METER

The FS 20 Field Strength Meter is a wide bandwidth, extremely high sensitivity, digital readout rf power monitor. This instrument is highly suited for monitoring the output power performance of communication transmitters over an extremely wide frequency range without connection to the transmitter.

All two-way radio users want the confidence of knowing their transmissions are getting out. The field strength meter approach to accomplishing this is especially valid since the *radiated* power from the antenna determines the reading obtained on the FSM.

Consequently, anything that causes a loss of rf power will be detected, be it a damaged antenna, loss of input power, or circuit defect. This is not necessarily true of in-system monitors. Some unique features include: six digit LED digital readout; battery or external power; instant Velcro attachment to metal, plastic, or wood; small attractive case design with non-glare epoxy finish; thin flexible antenna.

Weighing six ounces, the FS 20 FSM has a frequency range of from 2 MHz to 1100 MHz. Its dimensions are 5½" x 3" x 1¼". Applications include monitoring transmitter power, transmitter tuning, preflight radio checking, locating rf leakage points, adjusting antennas and transmission lines, locating radiating ELTs, locating radio bugs, and independent testing of EPIRB units. The FS 20 also satisfied FCC requirement 83.528 for marine VHF. Option 001, a high intensity readout, adds about three times the normal brightness and sells for an additional $5.00.

Each FSM is guaranteed for a period of one year. A modest fixed price repair service is available after the warranty expires. Introductory price: $49.95. *Infinite Incorporated, PO Box 906, 151 Center Street, Cape Canaveral FL 32920.*

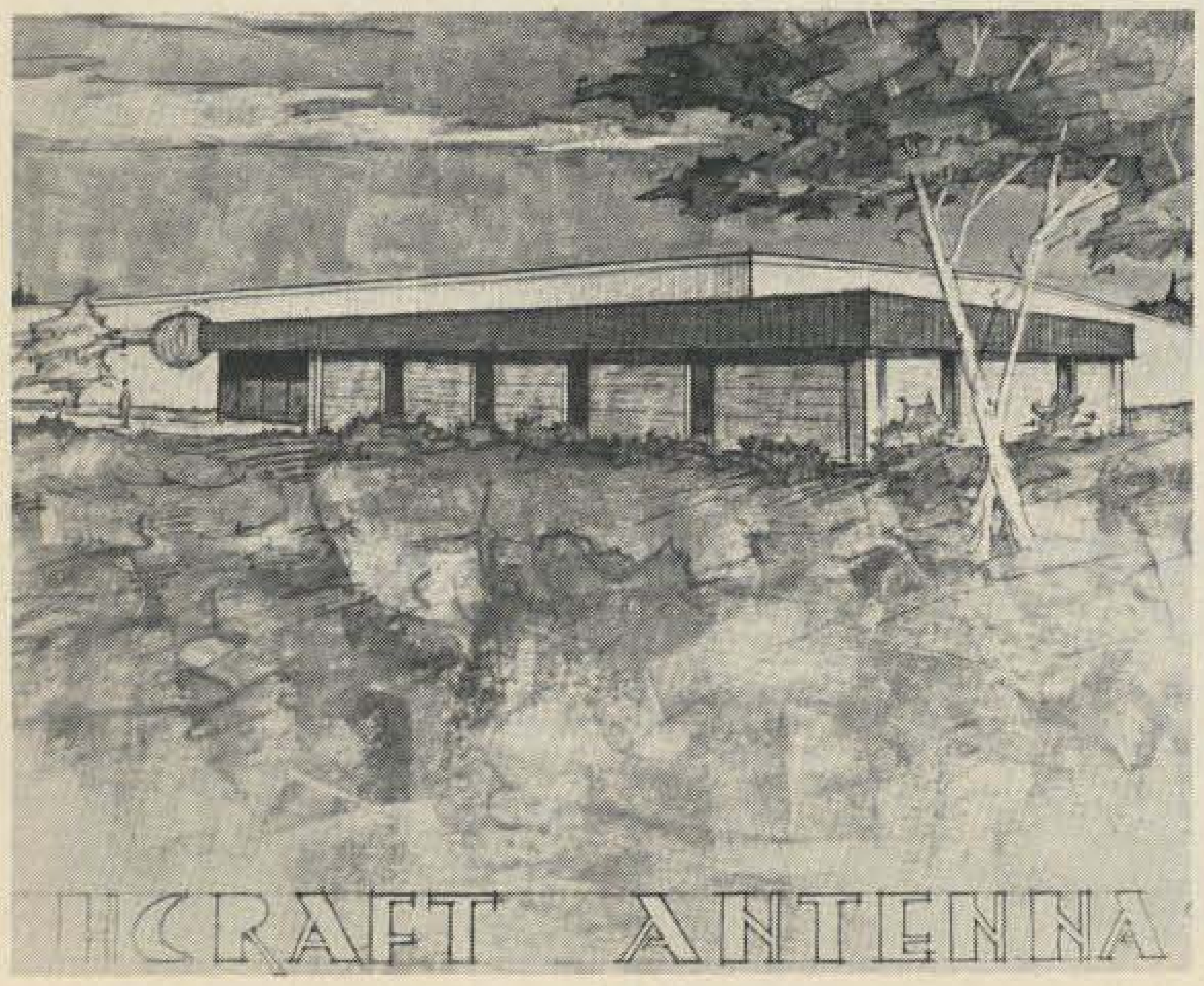
NEW LOW POWER, LARGE MONOLITHIC LED DISPLAYS

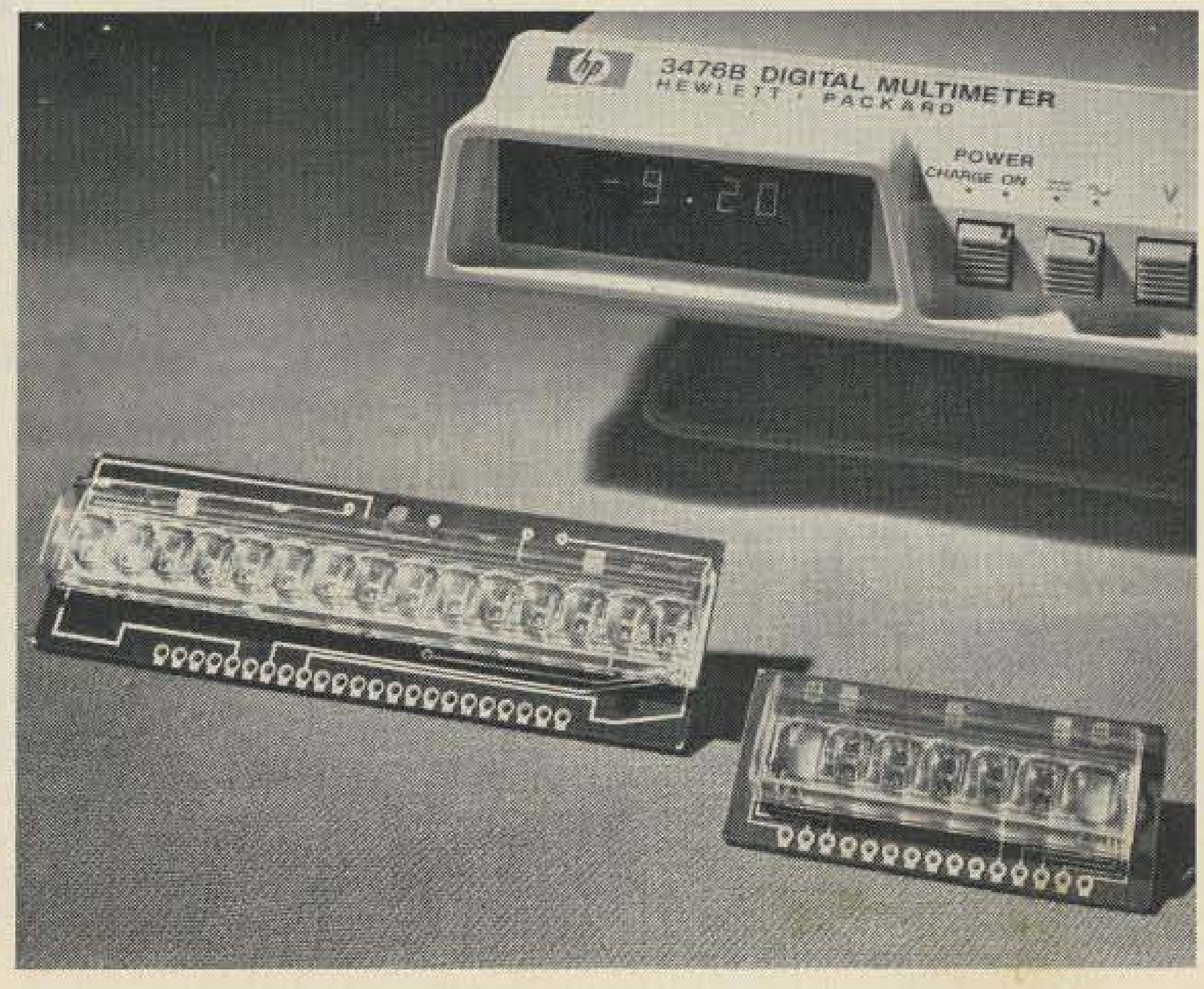
This new series of 4.45 millimeter (0.175 inch) high, seven segment numeric displays require only two milliamperes per segment — about 1/3 the power required by presently available displays. Designed for instrument applications, these HP 5082-7265, -7275, -7285 and -7295 LED indicators are available in five and 15 digit packages.

Close digit spacing of four digits per inch, combined with low power requirements, now give the designer of portable digital instruments, desktop calculators and other digital devices a large, easy-to-read display. They can be driven directly from MOS circuits.

Models 5082-7265 and -7275, five and 15 digit clusters respectively, have a center decimal point. Models 5082-7285 and -7295, also five and 15 digit clusters, have a right decimal point. Devices may be mounted with edge connectors or soldered wires.

Necessarily more costly than smaller displays, the five-digit 5082-7265 is $11.25 in quantities 200-999; the 15-digit 5082-7275 is similarly $31.95 (U.S. prices). *Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto CA 94304.*



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The new Robot Model 400 Scan Converter eliminates the problems, the mystery, and the high price from SSTV, and makes operating SSTV fun and inexpensive for everyone.

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Operation is easy to understand, simple to work. If you can operate a camera and adjust a TV set, you can operate the new Robot Model 400 SSTV Scan Converter.

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Please send me complete information on your new Solid State SSTV Scan Converter.

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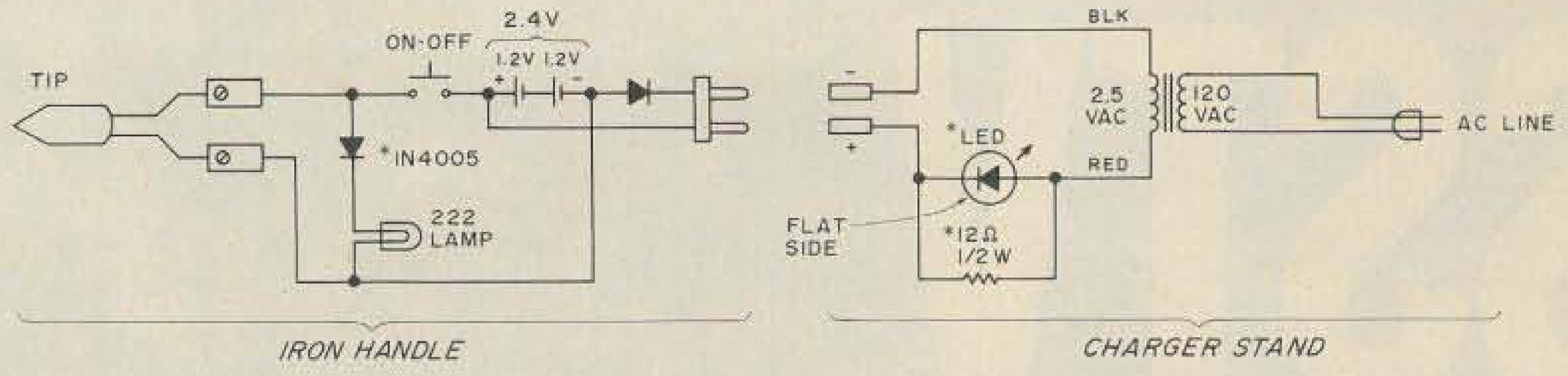


*Fig. 1. Wahl Model 7500 iron and stand. 90 mA total: 30 mA through LED, 60 mA through 12Ω ½ W resistor. * indicates parts added; all others are part of original circuitry.*

Cordless Iron Tips

-- when you're up against the Wahl

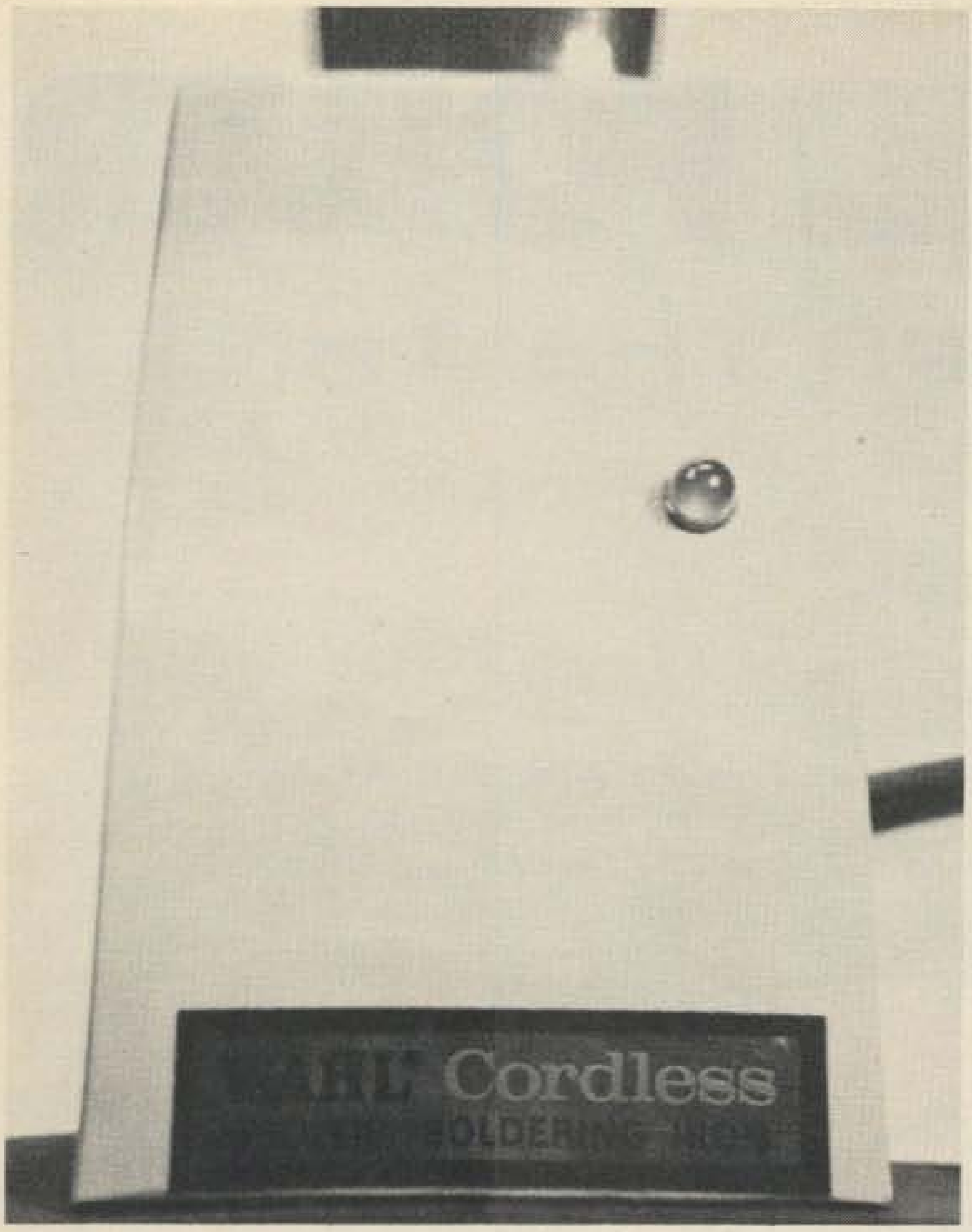
David F. Miller K9POX
7462 Lawler Avenue
Niles IL 60648

No, not the kind of tips that heat up, the kind of tips that keep the latter heated up! In a recent advertisement, the Wahl soldering iron people set forth the claim that many users have said that their $20 cordless soldering iron is worth its weight in gold. Ever since my wife bought me one two Christmases ago, I'll have to agree that for numerous tasks around the ham shack it is almost indispensable, especially once you get used to having one of the darn things. For example, for antenna jobs 150' from the nearest ac outlet, small "quickie" soldering jobs when you don't have time for the "landlocked" iron to get perking, and for mobile or vacation jobs to fix that intermittent *when* it happens. The extra fine tip that's available for these irons is great for making accurate joints on those little bitty circuit board pads that seem to be in the vogue now (you know, the ones that turn to goo with an American Beauty). The model that I have (Wahl 7500) comes with a charger stand, and all you have to do is drop it in the stand to revitalize those two little 1200 mAh nicads inside.

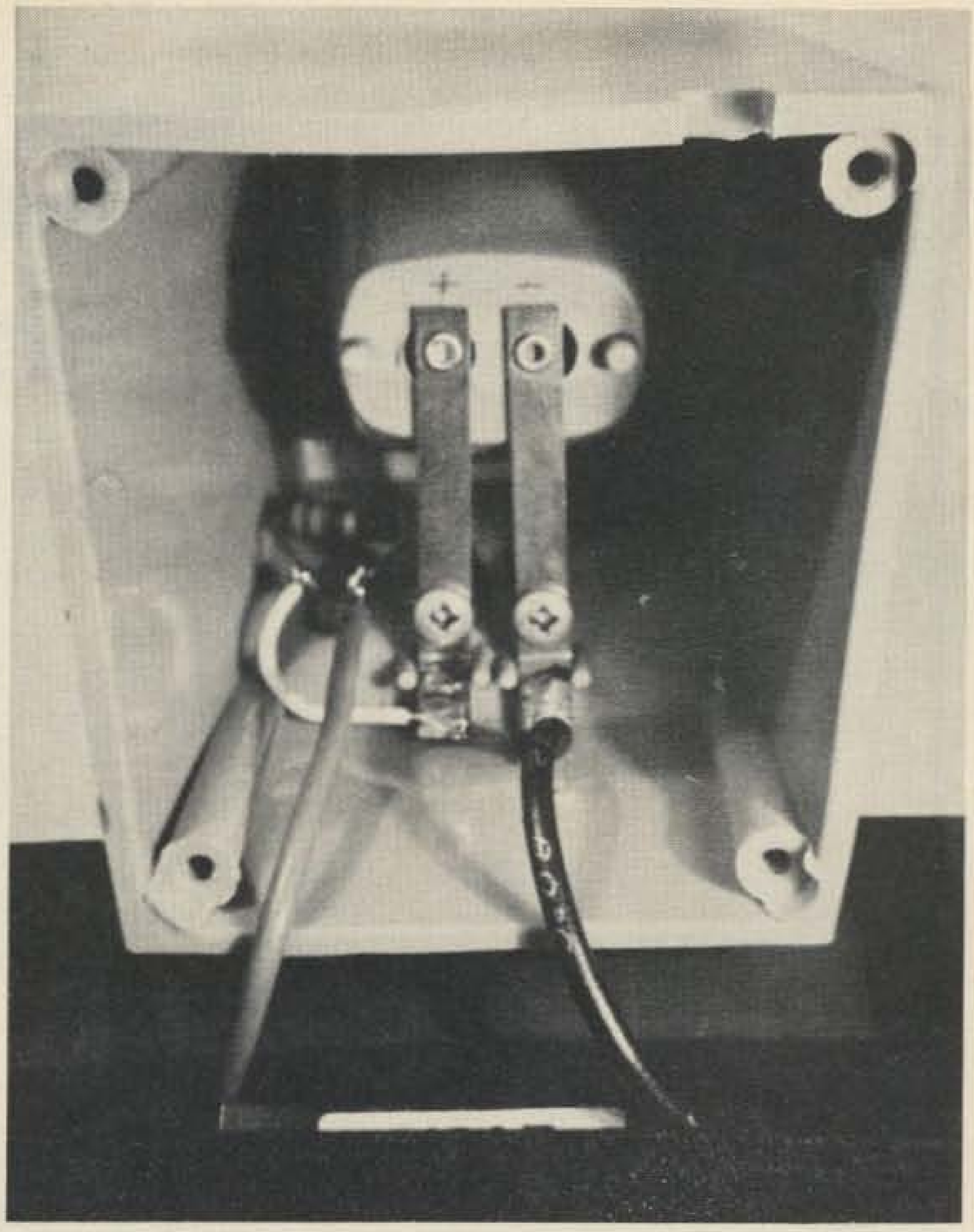
I often wondered whether or not the two contacts on the iron were making good connection with the matching contacts in the stand (I worry about things like that). After all, the iron element draws about 5 or 6 Amps when the cells are fully charged, which represents about 10 to 15 minutes of actual soldering, so it's important to keep it up to maximum in order to have it when you need it. I usually ended up jiggling the iron around in its stand just to make sure. The charging stand as it comes from the factory consists merely of a 120 V ac to 2.5 V ac transformer and the two mating contacts (Fig. 1). My unit has the *non*-rapid charge cells, so the maximum safe charging rate is 1/10 of 1200 mA, or 120 mA. Notice the clever placement of the diode in the iron itself so that reverse charging from the stand is impossible. (Also, if the charging terminals on the iron accidentally short to something metal, the nicads won't discharge because the diode won't conduct that way.) Back to the point: I took it upon myself to install an LED (light emitting diode), polarized as shown, in series with the red charger lead inside the charger itself. I chose to limit the charging current to 90 mA (nice and safe) with 30 mA through the LED (bright enough and also safe) – hence the 12 Ohm, 1/2 Watt resistor paralleling the LED. Now when I drop my iron into its stand I'm sure that it's taking a charge by the fact that the LED is releasing photons.

The actual modification is quite easily accomplished in one evening. I used a diffused red LED that required a 3/16" mounting hole deftly drilled in the front of the stand. After checking the fit and deburring the hole, apply a couple of drops of epoxy from the inside to hold the LED nicely. Clip the LED leads to a convenient length and make small loops in them to act as tie points for the resistor and charger leads. Incidentally, I've noticed rather wide variance in light output, current drain and chip centering in surplus LEDs, so check the device before committing yourself with epoxy. You may find that you will have to choose from several devices to get the desired results. All that's required to custom tailor this idea to your hardware is a meter that will read at least 100 mA, a few test leads with alligator clips on them, and some resistors (or a pot) around the value shown. If you don't worry as much as I do, you can just copy the circuit as shown and you'll be in the ball park.

As mentioned earlier, you may wish to use your cordless iron in the car or when on vacation, which, of course, necessitates bringing along the charger stand, right? Wrong! Consider whipping up a charger cord that will allow you to charge your iron directly from your automobile, boat, plane, etc., 12 volt system. The tactic that I use involves borrowing the cord from something that must go with you on every vacation (unless you're going camping in the north woods) – your electric shaver. Perchance the ac coiled cords for both my Schick "Flexamatic" and my



Front view of modified charger stand.



Interior view of modified charger stand. LED and its resistor are shown at the left of center.

Norelco "Tripleheader" shavers will mate with the Wahl 7500 iron with minimum modification. I found that I had to shave (no pun intended) about 1/32" off of the female cord receptacle end (completely around) with a sharp knife and then file it smooth to obtain a perfect fit in the iron. Don't get carried away – 1/32 isn't very much; yes, the cord still works in the shaver. I then wired the circuit shown in Fig. 2 into a standard female ac cord receptacle called a "STA-TITE," obtained from the local hardware emporium. Note the inclusion of the ever-present LED to show you when the iron is plugged into the shaver cord properly and/or when the shaver cord is plugged into the dc adapter cord properly. If the LED doesn't light, reverse either end of the shaver cord (no harm done because of that diode in the iron's case). The opposite end of the dc adapter cord is terminated in a standard cigar lighter plug; note that this end is polarity conscious. The present standard seems to be negative ground (lighter plug shell), so wiring as shown will be correct. By the way, this dc cord is intended as a charger cord only; attempting to solder a connection with it plugged into the vehicle's cigar lighter socket will only replace about 90 mA of the 5 or 6 Amps needed to run the iron – and that won't buy you much! The figures on this circuit are identical to the ac charger: 60 mA through the 150 Ohm, 1 Watt resistor and 30 mA through the LED/220 Ohm, 1/2 Watt resistor combination. These figures are based upon 13 V dc input, which is an average lead-acid storage battery value. You can purchase Wahl's plastic carrying tube for the iron, or you can do just as well using a decent 1-3/8" to 1-1/2" mailing or paper towel tube fitted with end caps (make it long enough to house the dc charging adapter, too).

Just as a bit of additional info, I mentioned that the Wahl 7500 cordless draws 5 to 6 Amps from the internal

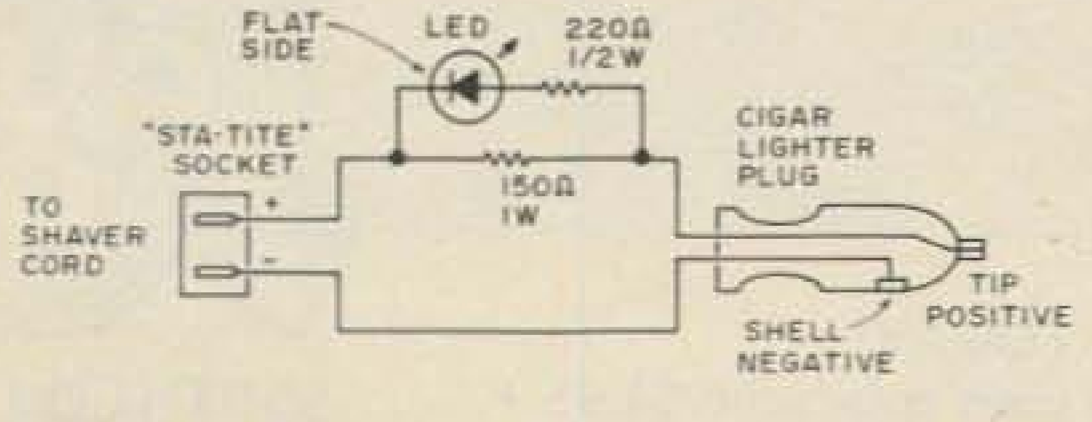
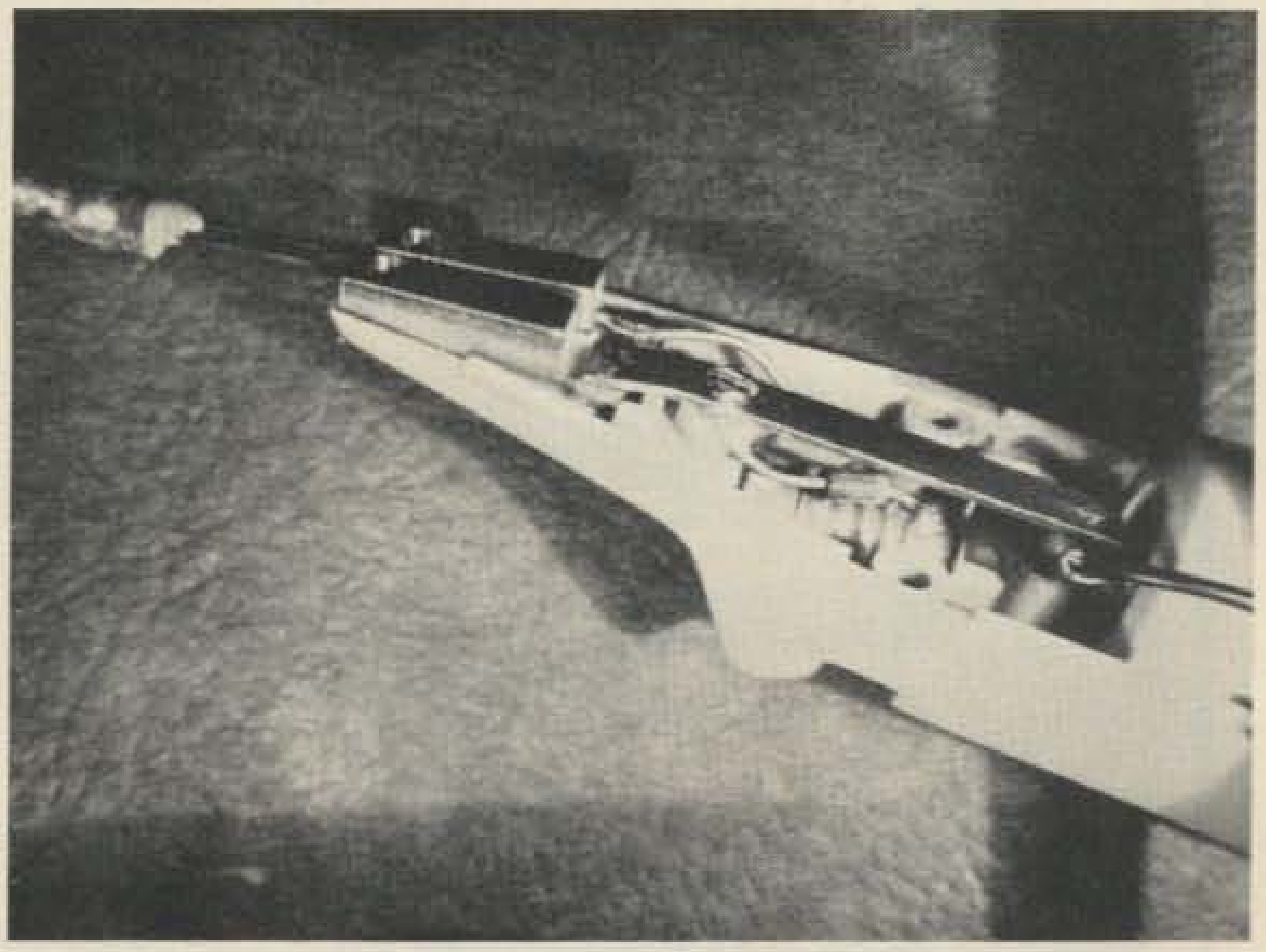


Fig. 2. Dc charging adapter cable for Wahl Model 7500. 90 mA total: 30 mA through LED and 220Ω ½ W resistor, 60 mA through 150Ω 1 W resistor.



Interior view of iron, showing diode used to slightly drop lamp voltage.

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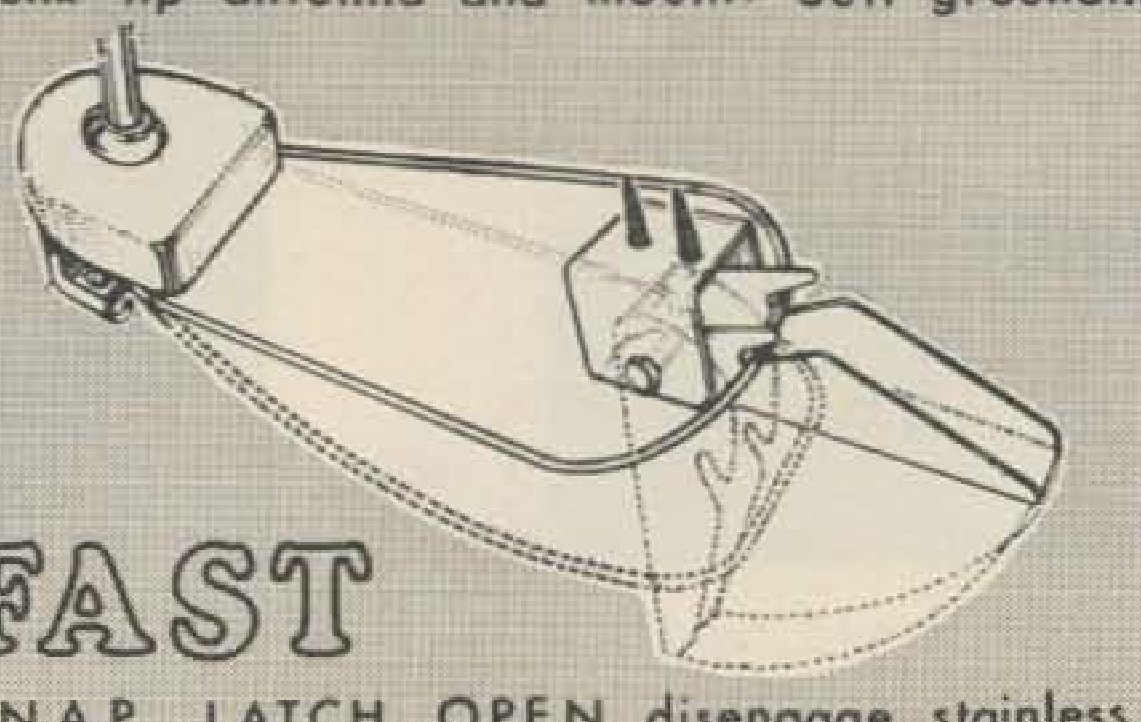

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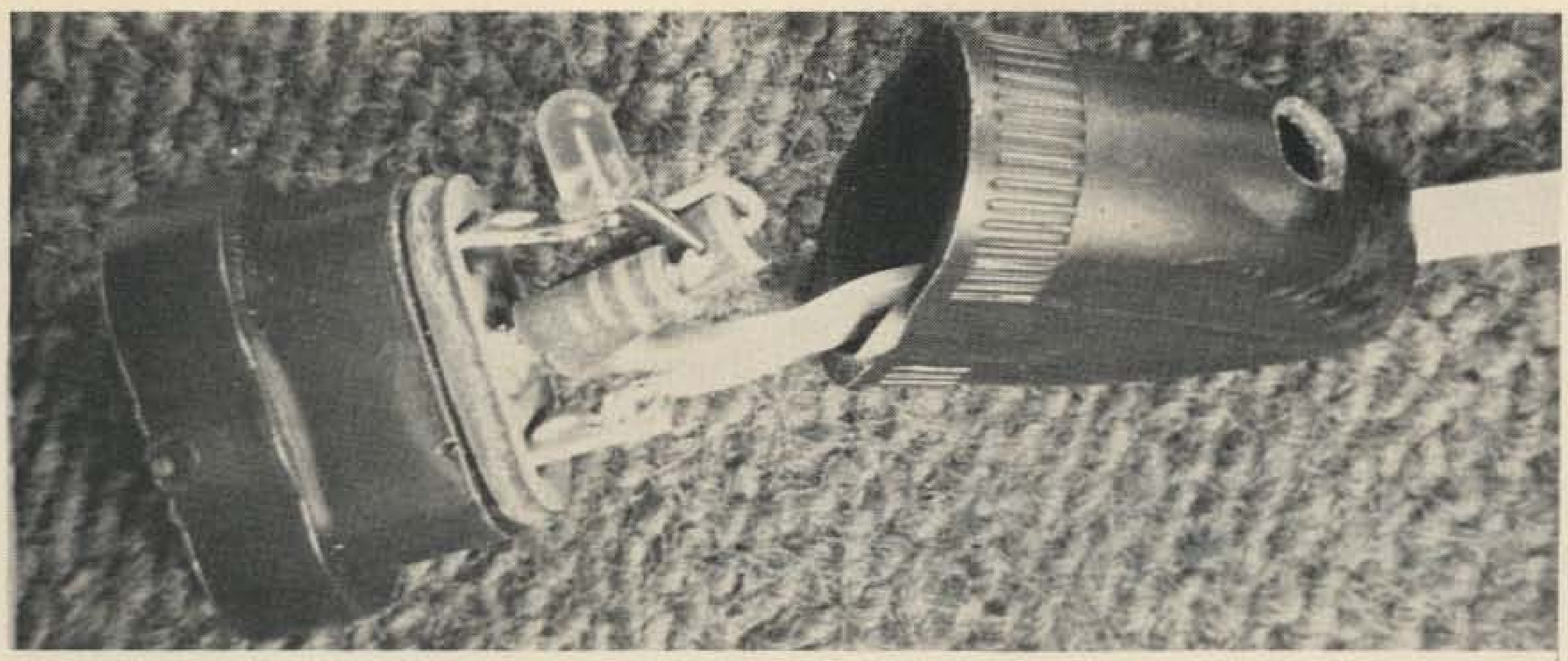


Interior view of dc adapter. Note the use of center screw threaded ferrule as tie point for resistors and positive dc lead.

batteries; this is true once the element is hot. The initial current through a cold or cool tip is about 9 Amps, tapering to the above after about 5 seconds. This suggests that the working time between charges is less when the iron is continually turned on and off. I checked my iron against the clock after a full charge and was able to get over 12-1/2 minutes of useful heat in a continuous ON condition. Presumably, off/on operation would yield something less than this. There are all kinds of ins and outs with something as simple as this seems to be, aren't there?

Before you relax for the evening, here's one additional easily accomplished modification, this time inside the iron itself. There's a very handy little light built into the business end of the Wahl 7500, with the nasty habit of burning out too fast. The type 222 bulb is rated at 2.25 V and 250 mA, but the fully-charged nicads put out 2.4 V (under load) and shorten the bulb life quite a bit. I installed a silicon diode (1N4005) in series with the bulb and am getting much better bulb life, plenty of light and more battery capacity for heat instead of wasted light (remember the energy crunch!). With this addition, the bulb has 1.5 V across its filament and draws 200 mA due to the drop across the diode (junction potential). The important thing here is the well-documented fact (in past issues of *73* and other publications) that as you lower the voltage across a lamp from its design voltage, the lamp life increases dramatically (the reverse is also true). Now that you're convinced, just remove the screw holding the bar that makes pressure contact with the shell of the lamp socket and install the diode in its stead, wrapping the anode end around the screw and soldering the cathode (banded end) to the lamp *socket* shell (use minimum heat and remove the lamp first). While you're inside the iron case, put a *small* dab of GC26-01 silicone lube on the switch contact; it's a good all-around contact keeper-cleaner. Note that these modifications directly apply to the model mentioned with *non*-rapid charge cells. However, they could be applied to other models and manufacturers, and, as such, will hopefully act as food for thought.

Now you can relax for the evening and read the rest of *73*, or you could try out your newly modified cordless iron on some of the other interesting projects in this issue, or you could just admire the LED in the stand while the iron is charging. ■

Albert H. Coya WB4SNC
1710 S.W. 83rd Ct.
Miami FL 33155

Bicycle Mobile

- - cover feature

After losing ten pounds and logging dozens of QSOs, I arrived at the conclusion that DXing bicyclemobile is not only fun, but also healthy!

The idea to add a rig to my bike came to me one night, when, after a few hours of sitting in my shack, I took a shower and stepped on the bathroom scale: I was ten pounds over my normal weight!

We have to do something about this situation. I love hamming, but the idea of turning myself into a blob of lard was not very appealing. The doctor agreed with me: I must cut down my hours in the shack and put in some time doing exercises. I started jogging and doing sit-ups. It was exhausting and boring. So I turned to the bike. Not so exhausting, but still boring.

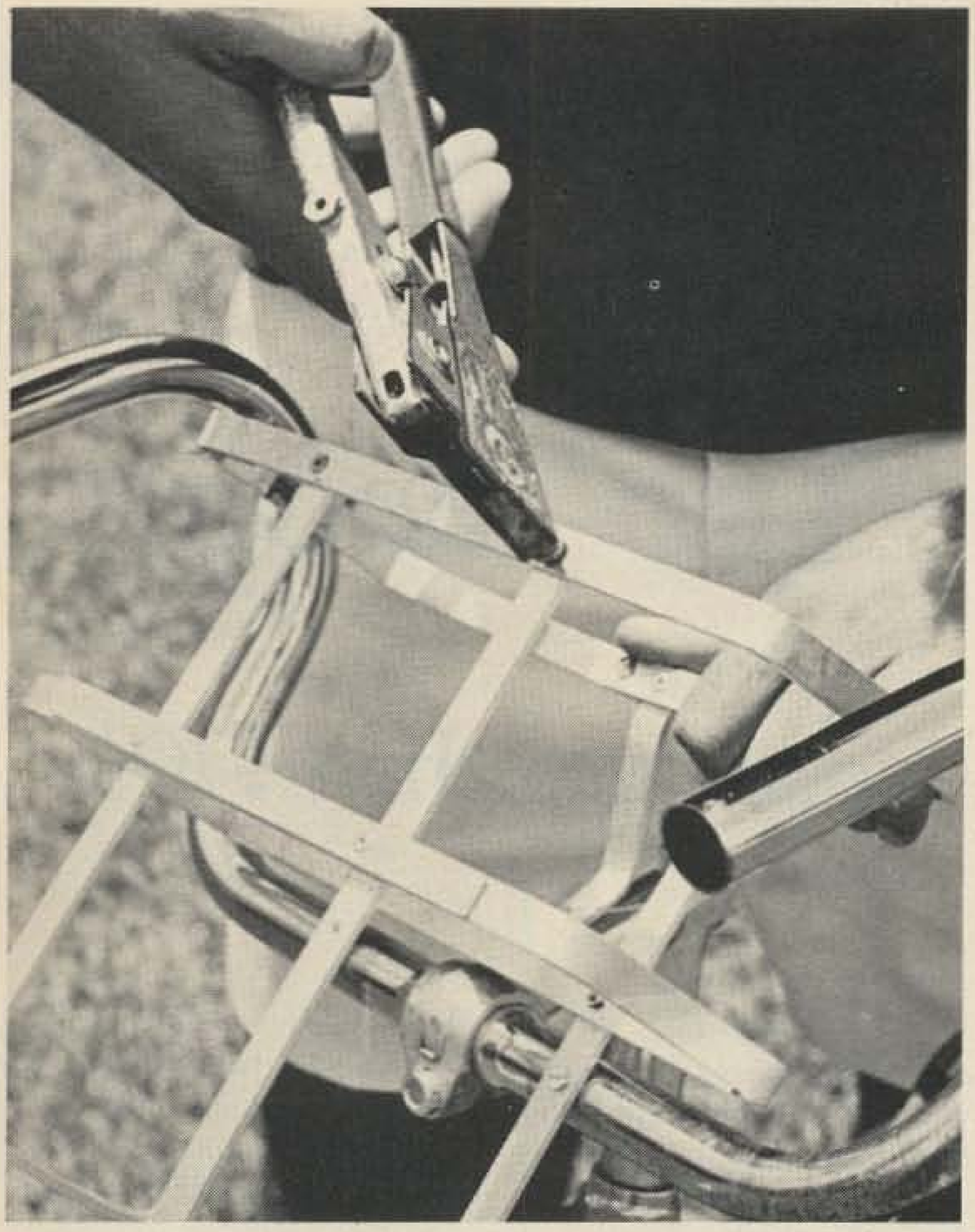
I tried reading while pedaling, but (after a near miss), decided that this was unsafe.

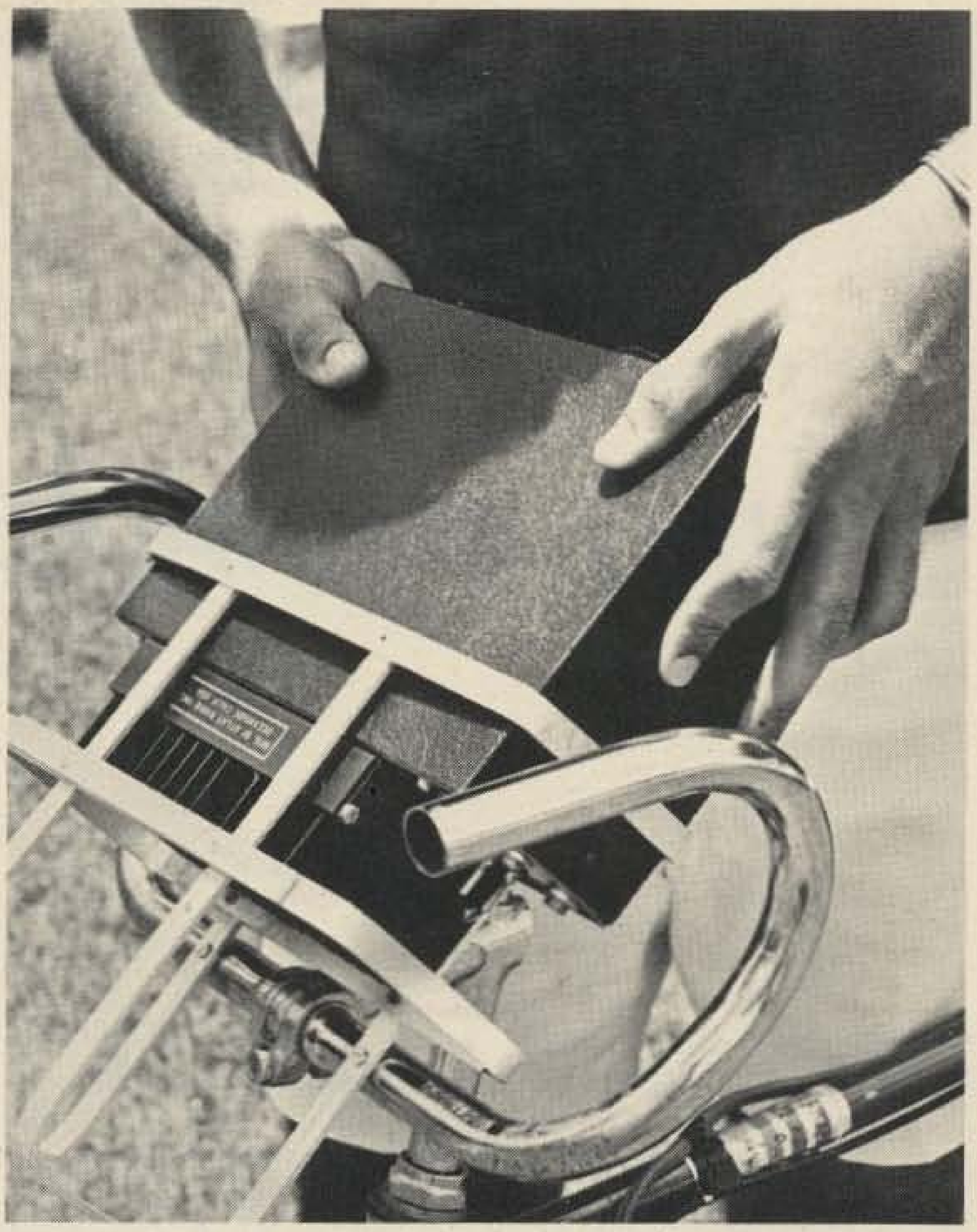
The next day, I brought along my two meter rig. That was quite an improvement. I had a chat with the local boys through the nearest repeater. To improve my signal, I installed an eight wave antenna on the back of the bike; the chitchat expanded to other repeaters.

Then the rechargeable battery gave up, and I installed an outboard heavy-duty battery.

I am never satisfied with what I have, and always seem to want something else. Maybe I was missing my DX friends, because the idea of adding an HF rig to the bike came to my mind. That invisible bulb lit in my head, and I started to look around for the right thing. The transceiver I had in mind had to be light, capable of putting out a decent signal, and, of course, battery-operated.

Even if you find the ideal rig, a friend of mine told me, it's going to be very difficult to use a vertical antenna. The bike is not enough for a ground plane . . .





My enthusiasm was dampened a little, but I decided to try my idea anyhow. I began thinking about building a solid state monobander transceiver. After looking over magazines and books I decided to go by one easy rule: "If you can buy it, don't build it." I got myself one of those little Atlas rigs. The name sounded like it was taken from a moving company, and the appearance was that of a shrunken Swan. The truth is that this tiny transceiver has a tiger in its guts! The only thing you need to operate this rig is a well matched antenna, and a battery with a good Amp hour rating, to feed those hungry finals transistors.

After taking a good look at my old bike, I decided to get rid of the hand brake and install a pedal brake, so that my hands would be free to operate the transceiver.

The Atlas is ideal because there is no tuning or loading. The whole operation is automatic. It's a rig for "appliance operators." If the antenna is matched, as I said before, the only thing you have to do is select the frequency, press the mike's button, and call "CQ."

I installed a rack over the back wheel to hold the battery and the antenna, a Hustler vertical. It is neat, light and well manufactured.

To hold the transceiver between the handlebars, I built a basket out of aluminum strips riveted and fitted to the handlebars with bolts and nuts. The rig sits very comfortably at a 45° angle, for better view and access to the controls. But if you want to spend a few more bucks and save work, Atlas sells a nice mobile rack.

With all the parts in place, my old bike looks like a very interesting contraption. "What will the neighbors say?" my XYL asked me. Well, nobody blinked an eye when we erected the tower and the cubical quad, and this time there is no more reason for anyone to be alarmed.

So I climb on my bike and pedal QSOs. ■

Daniel Metzger K8JWR
7741 Fir Drive
Toledo OH 43612

Build a Simple "Lab" Scope

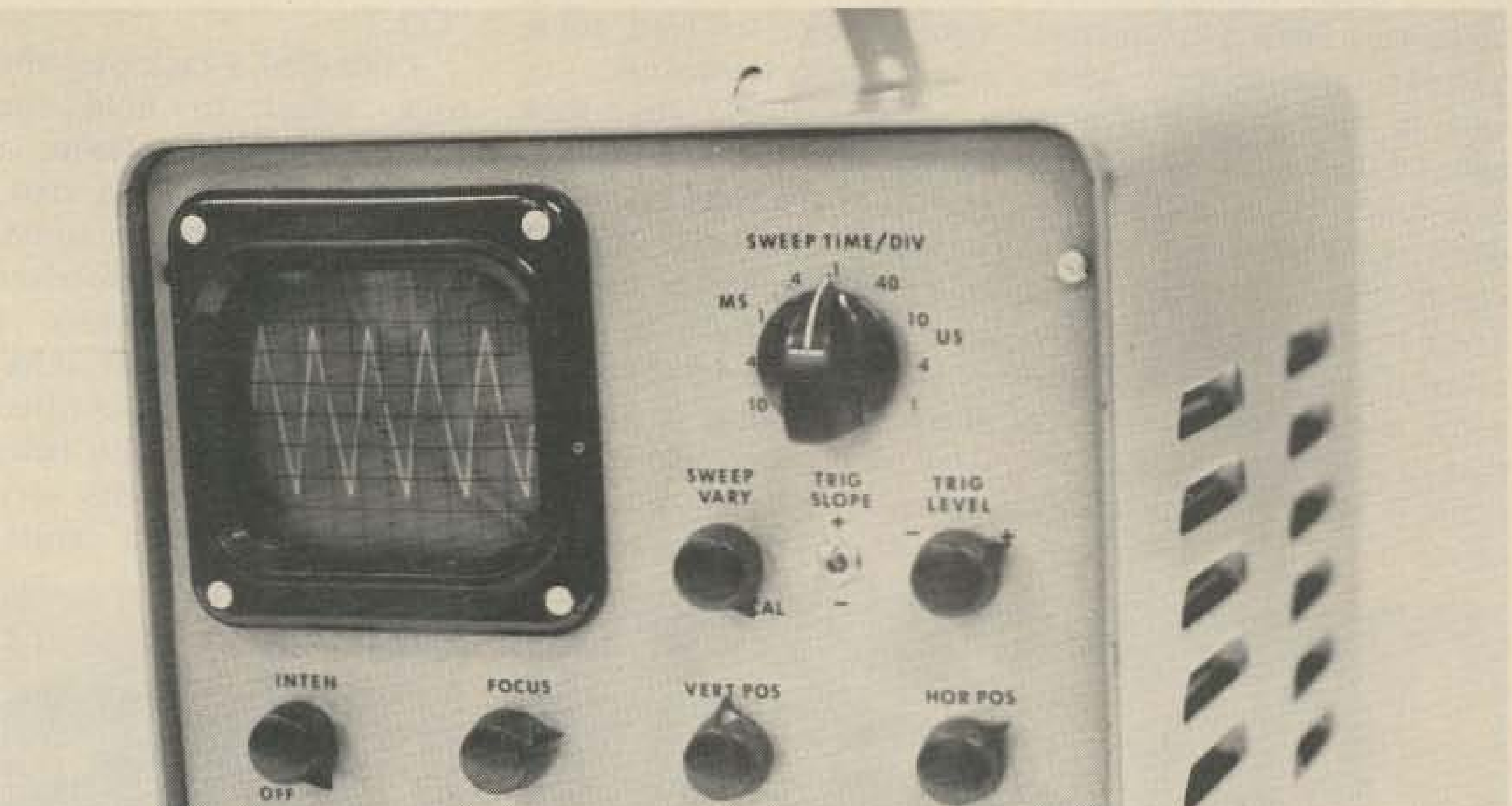
-- costs less than $70!

Watch any industrial electronics technician in action and you'll notice that he relies almost exclusively on his oscilloscope for troubleshooting. It can measure ac and dc voltages as easily and accurately as a VOM, while also measuring frequency, phase and waveshape. It can spot distortion or interfering signals, and can detect missing pulses and slow risetimes in digital circuits. No other instrument approaches it for versatility.

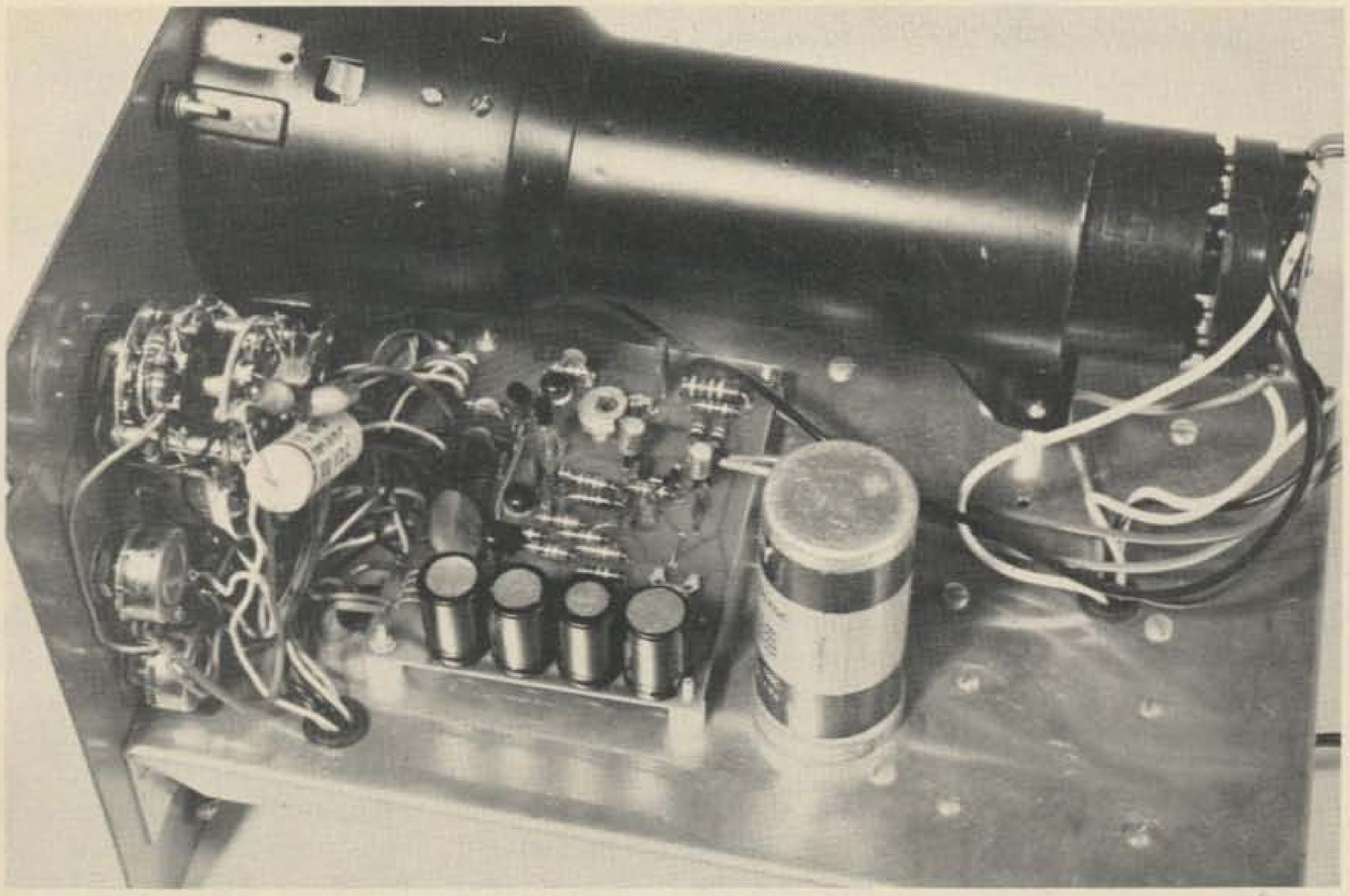
Unfortunately, the cost of lab-type oscilloscopes ($250 and up) has limited the experience of most servicemen and hobbyists to service-type scopes, which are not true measuring instruments, but merely waveform indicators. Most annoying of all, they require constant fiddling with a "sweep" or "sync" control to keep a steady waveform on the screen.

Now it is possible to build an oscilloscope with nearly all of the advantages of a lab-type scope for less than $70. The completed unit contains only 11 transistors all mounted on a single printed circuit board. It is only 8" high by 12" deep, and weighs less than 10 lbs. This simplicity has been obtained by keeping the frequency response and sensitivity of the scope relatively low (although both are quite adequate for normal use), and by the use of a novel unijunction sweep circuit. This last feature deserves a special explanation.

In a conventional recurrent sweep scope, the signal which moves the beam across the screen can vary in frequency by perhaps 10% to accommodate changes in signal frequency — see Fig. 1(a). The ratio of signal frequency to sweep frequency must always be a whole number, or the trace will be an unstable jumble of lines. If the signal frequency should change by more than 10%, it becomes necessary to readjust the sweep frequency to maintain a stable display. This need for constant adjustment



Oscilloscope front view.



Inside top view of scope, showing sweep time switch S6 (upper left), main circuit board, and filter can C18.

makes it impossible to keep the horizontal sweep calibrated, so measurements of time and frequency cannot be made. The unijunction sweep can vary its frequency by a factor of about 2.5 in response to the input signal, so whole number ratios are always obtainable, and the display is stable for any signal frequency down to one half the sweep frequency, with never any need for adjustment. The result is a sweep which behaves very much like the laboratory scope's triggered sweep — Fig. 1(c) — with about one fifth the complexity. The difference is apparent only if you try to display a small portion of a cycle or a single shot phenomenon, such as a relay closing.

Our scope also includes a calibrated vertical amplifier and timebase, and triggering controls like the lab scope's, making it a versatile and accurate measuring instrument.

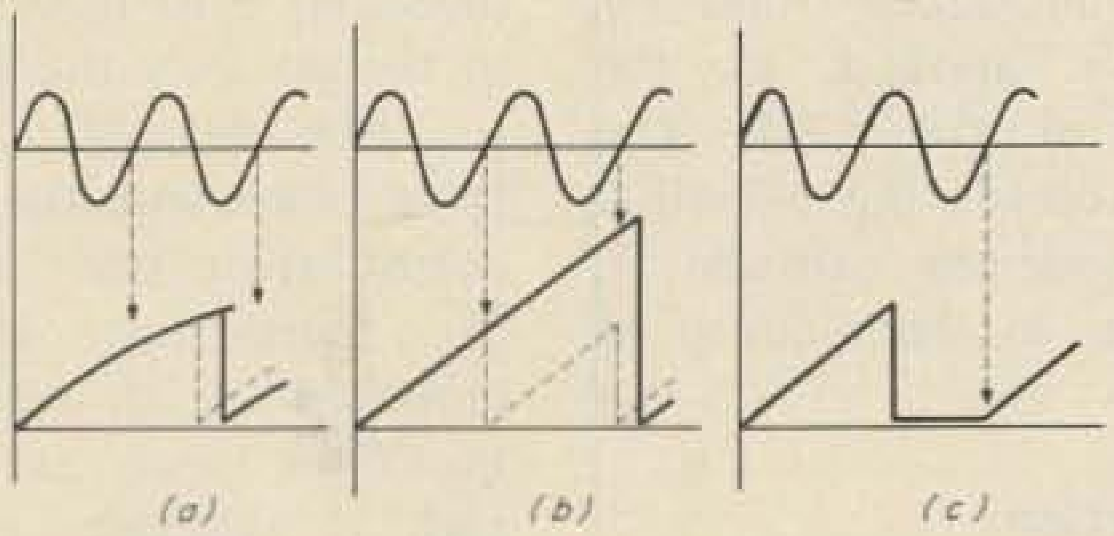


Fig. 1(a). The recurrent sweep generator can be restarted only about 10% sooner than full run-up time. The first triggering opportunity (downward arrow) may come too soon while the second comes too late, so each succeeding ramp shows the sine wave signal at a different horizontal position on the screen. Also, the ramp is usually curved, rather than linear, resulting in a distorted display.

Fig. 1(b). The unijunction sweep can be restarted after only 40% of a full run-up. Either the first or the second restart command could be obeyed, and either would result in a stable display. The ramp is perfectly linear.

Fig. 1(c). The lab scope uses triggered sweep — the ramp does not restart of itself, but waits for a triggering command derived from the displayed signal. The circuitry to achieve this is usually quite complex.

The circuit, which was designed to be absolutely as simple as possible, is shown in Fig. 2. It consists of dc coupled vertical and horizontal amplifiers, a sweep generator and four power supplies.

Vertical Amplifier

This is the "voltmeter" portion of the oscilloscope. It consists of an FET-bipolar Darlington pair, Q1-Q2, which provide a high input impedance and a low enough output impedance to drive the high gain, high voltage common base amplifier, Q3. Overall gain is about 150, variable by R4. C3 shunts extra signal to the Q3 input at high frequencies, thus extending the amplifier's frequency response to 600 kHz. D1 protects the gate of Q1 from accidental input overvoltages. The various values of RA and RB provide for division of the input voltage by factors from 1 to 400, giving voltage ranges of 0.1 V to 40 V per quarter inch division. CA and CB are required to compensate for stray capacitance in the resistors and switch wiring at high frequencies. CA is adjusted so that $X_{CA}/X_{CB} = R_A/R_B$ (i.e., the voltage division ratio of the capacitors equals that of the resistors). At frequencies above about 10 kHz, it is actually the capacitors and not the resistors which set the voltage division ratio.

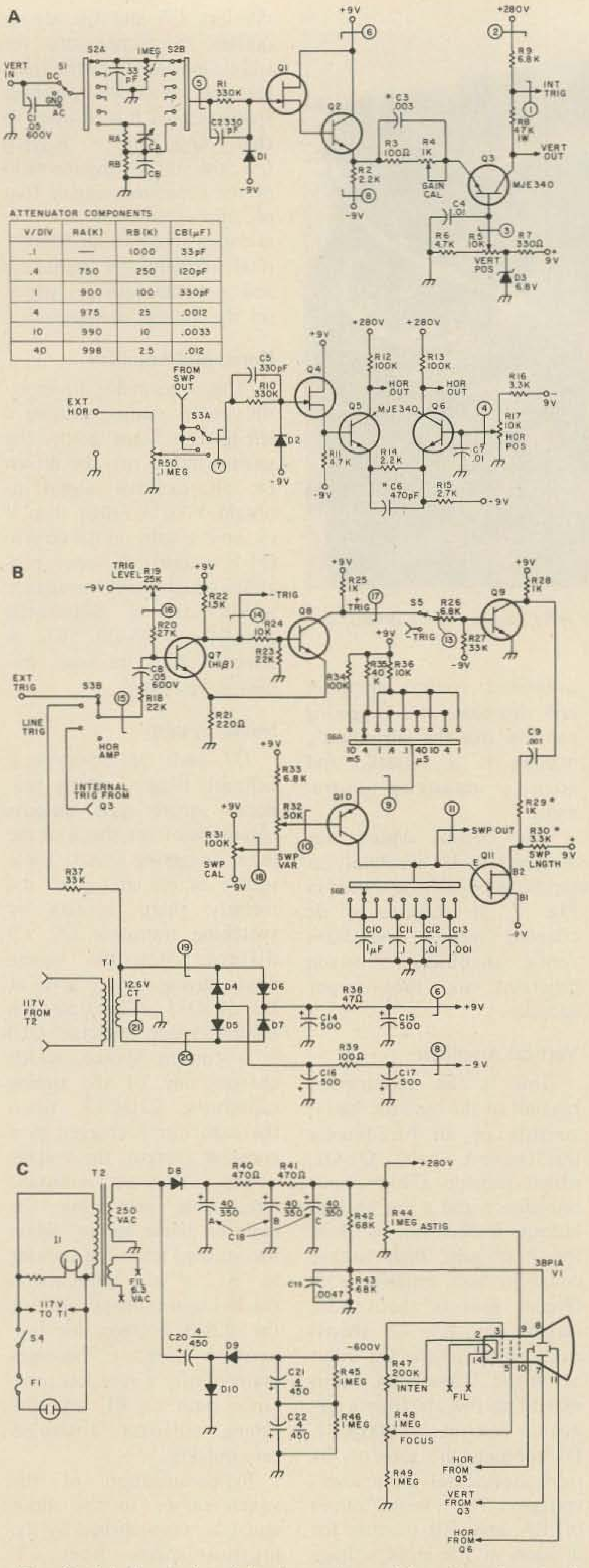
Horizontal Amplifier

This is normally driven by the sweep ramps, causing a left-to-right trace across the screen, but it may be driven by an external signal to obtain *Y vs. X* rather than *Y vs. time* graphs on the screen. Q4 is a source follower, providing a high input impedance while driving differential amplifier Q5-Q6. C6 is selected for optimum frequency response.

Sweep System

Q7 and Q8 comprise a Schmitt trigger, which produces square wave outputs regardless of the shape of the input triggering signal. These square waves are given extremely sharp corners by switching transistor Q9. C9 differentiates the square waves, giving a sharp spike at B2 of Q11 each time the Schmitt trigger switches. Q10 is a current source, which charges one of the timing capacitors, C10-C13. When the capacitor is charged by a constant current, the voltage across it rises at a constant rate, thus generating the required linear ramps. When the voltage from the emitter to B1 of the unijunction reaches approximately 75% of the B2-B1 voltage, the unijunction fires, E becomes momentarily a very low resistance path to B1, and the timing capacitor discharges very quickly.

Synchronization of the sweep ramps to the input signal is accomplished by the negative spikes from C9, which lower the B2-B1 voltage to slightly less than half its normal value for very



ATTENUATOR COMPONENTS

V/DIV	RA(K)	RB(K)	CB(µF)
.1	—	1000	33pF
.4	750	250	120pF
1	900	100	330pF
4	975	25	.0012
10	990	10	.0033
40	998	2.5	.012

Fig. 2. (a) Vertical and horizontal amplifiers for the simple oscilloscope. (b) Sweep system and low voltage power supplies. (c) High voltage power supplies and CRT circuit.

Vertical

Bandwidth – Dc to 600 kHz (-3 dB point)
Sensitivity – 0.1 V to 40 V per quarter inch division, calibrated in a 1-4-10 sequence
Input impedance – 1 megohm shunted by approximately 33 pF

Horizontal

Sweep – 1 usec to 10 ms per division, calibrated in a 1-4-10 sequence, variable to 500 ms per division
Trigger – 0.5 division p-p internal; 1 V p-p external; ac coupled
External Amp – Sensitivity continuously variable to 0.5 V per divison; bandwidth dc to 100 kHz

Table 1. Specifications.

short intervals. This gives the unijunction an opportunity to fire on command from the Schmitt trigger, provided that it has completed about 40% of a full run-up. R30 sets the full run-up ramp voltage, which should be about 2.5 times the voltage required for a full sweep of the screen. R29 sets the minimum ramp voltage, which should be just sufficient to drive the beam across the screen.

Power Supplies

Two full wave rectifiers followed by pi-section filters provide +9 V and -9 V to power the sweep system and low level amplifiers of the scope. The +280 V supply powers the output stages of the vertical and horizontal amplifiers, providing sufficient voltage to deflect the beam fully across the screen. A half wave voltage doubling supply produces -600 V which is applied to the cathode of the CRT. The overall accelerating potential from anode to cathode is, therefore, in the vicinity of +800 V.

Construction

Few of the components in the scope are critical and many substitutions are possible. The transistors may be nearly any silicon small signal types, with the exception that Q3, Q5, and Q6 must be rated at 300 V or more Vcer. The timing resistors and capacitors and the input voltage dividing resistors should be selected quite carefully, as these determine the ultimate accuracy of the instrument. It is not necessary that these components be the exact values specified, but only that they be in the same ratios. For example, if C10 is 6% high, C11-C13 should also be 6% high.

Many types of CRTs similar to the 3BP1 may be employed if the differences in base pin connections are noted. 3RP1s, 3EP1s, 3ACP11s and 3FP7s have been used with equal success, and there is nothing to prevent the use of 2-inch or 5-inch types. A number of flat-faced CRTs such as the 3RP1A and 3WP1 are available at somewhat higher cost for those who want to add the final professional touch to the scope.

The magnetic fields from the two power transformers will cause severe ripple on the CRT trace if special precautions are not taken. The transformers should be mounted with their windings in the plane of the CRT face so their magnetic lines of force travel with the electron beam rather than across it. The transformers should be mounted as far away from the CRT neck as possible, and, if available, sheets of mu-metal shielding should be placed under the transformers and around the CRT neck. The cleanest trace will be obtained if a full CRT shield can be obtained from one of the surplus houses.

All wiring involving vertical and sweep signals should be as short and direct as possible. In particular, the vertical input and vertical output wires should be kept away from each other and from other circuit wires. Note that the vertical input atten-

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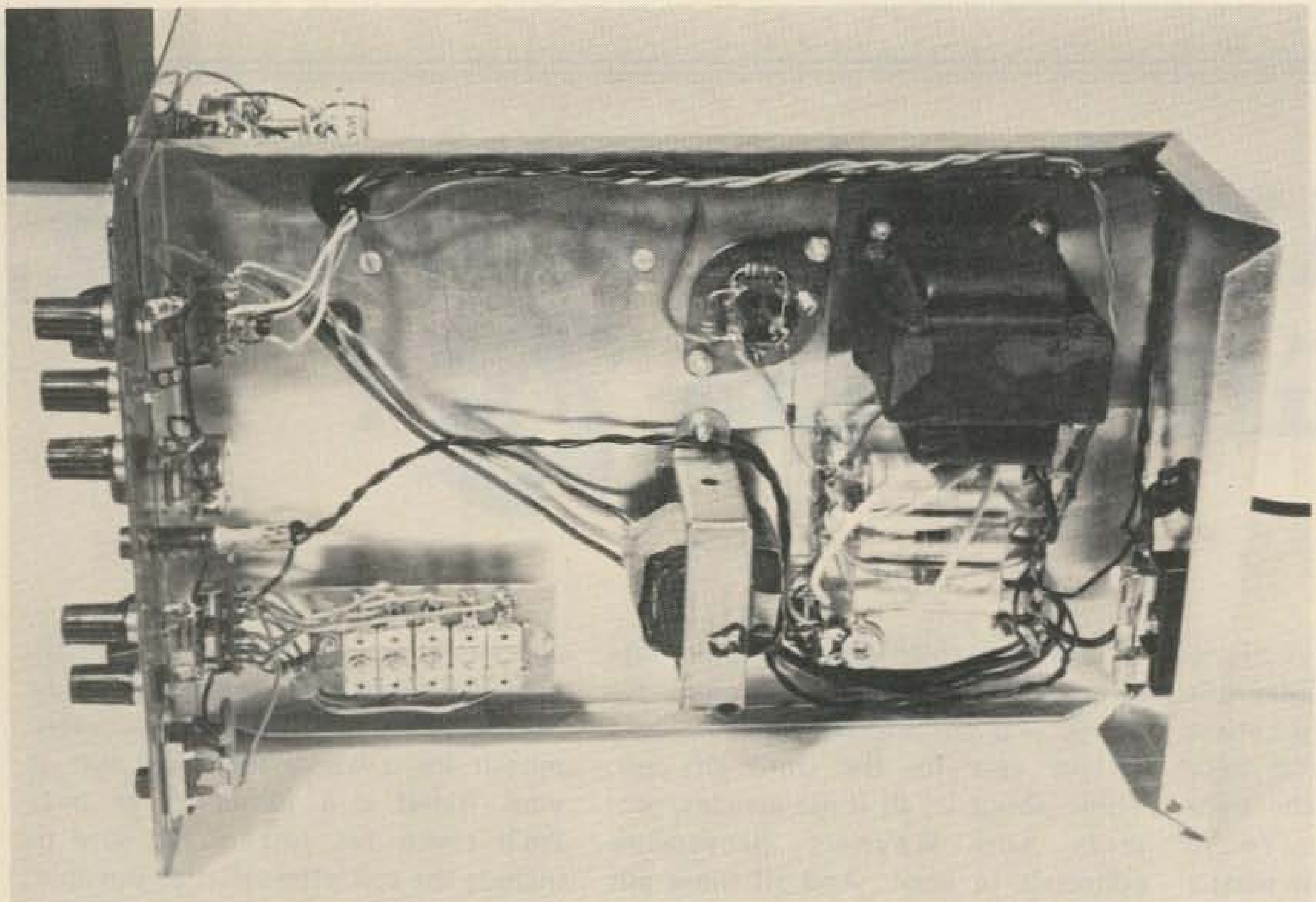


Inside under-chassis view showing function switch S3 (upper left), input attenuator with trimmer capacitors CB mounted (lower left), LV transformer T1 (bottom center), HV filters C20-C22 (lower right) with astigmatism trimmer R44 immediately below, and HV transformer T2 (upper right).

uator board is mounted directly behind the vertical sensitivity switch so that the wiring can be kept short.

Testing

It is suggested that the low voltage power supplies be wired to the circuit board first, with the high voltage transformer secondary left disconnected. The sweep circuit can then be tested without danger of shock or damage to the transistors from the high voltage supplies. Ironically, the best instrument for testing and troubleshooting the oscilloscope is another oscilloscope, but if none is available a VOM can be made to do. The output of the Schmitt trigger should switch from +2 to +9 V as the trigger level control is rotated. On the 10 ms/div range it should be possible to see the VOM follow the rise and fall of the sweep ramps if the sweep variable control is used to slow them down to a few sweeps per second. The outputs of the vertical and horizontal voltage followers (tops of R2 and R11 respectively) should rise and fall by about 1.2 V when a 1.5 V flashlight cell is connected in (first) positive, then negative polarity to the amplifier inputs.

Next, the +280 V supply should be connected and the vertical output should be checked for a swing from +75 to +250 V as the vertical position control is rotated. The two horizontal outputs should swing from +100 to +200 V, one going up as the other goes down, when the horizontal position control is rotated. If the two horizontal output voltages do not become equal at about +150 V, it may be necessary to alter the value of R15 to achieve proper balance. Finally, the -600 V supply can be connected and an attempt can be made to get a trace on the CRT.

Calibration

After the trace is focused and aligned, R30 can be selected to provide a maximum trace length of about 2.5 times the CRT width. Then R29 is selected to make the minimum length equal to the CRT width. These values depend on the characteristics of Q11. The trace length is changed from maximum to minimum simply by changing the frequency of the observed signal, or by adjusting the sweep variable control.

The vertical gain is set by adjusting R4 for a 3.9 division shift in the trace when a fresh flashlight battery (1.55 V) is connected with the scope on the 0.4 V/div scale. Next, a 1 kHz square wave is displayed and the five CA trimmers are adjusted for the cleanest display with no rounding or overshoot of the square wave corners. A square wave of about 50 kHz is then displayed and C3 is selected to make the corners of the wave as square and as sharp as possible without overshoot. Then a 10 kHz square wave is applied at the external horizontal input and C6 is selected so that the display consists of two sharply defined points at the left and right of the screen (the points will be elongated horizontally if the value of C6 is wrong). Finally, a 60 Hz ac signal is displayed (the one from the scope's own 12.6 V transformer will do nicely), and the sweep calibrate control is set so that one full cycle

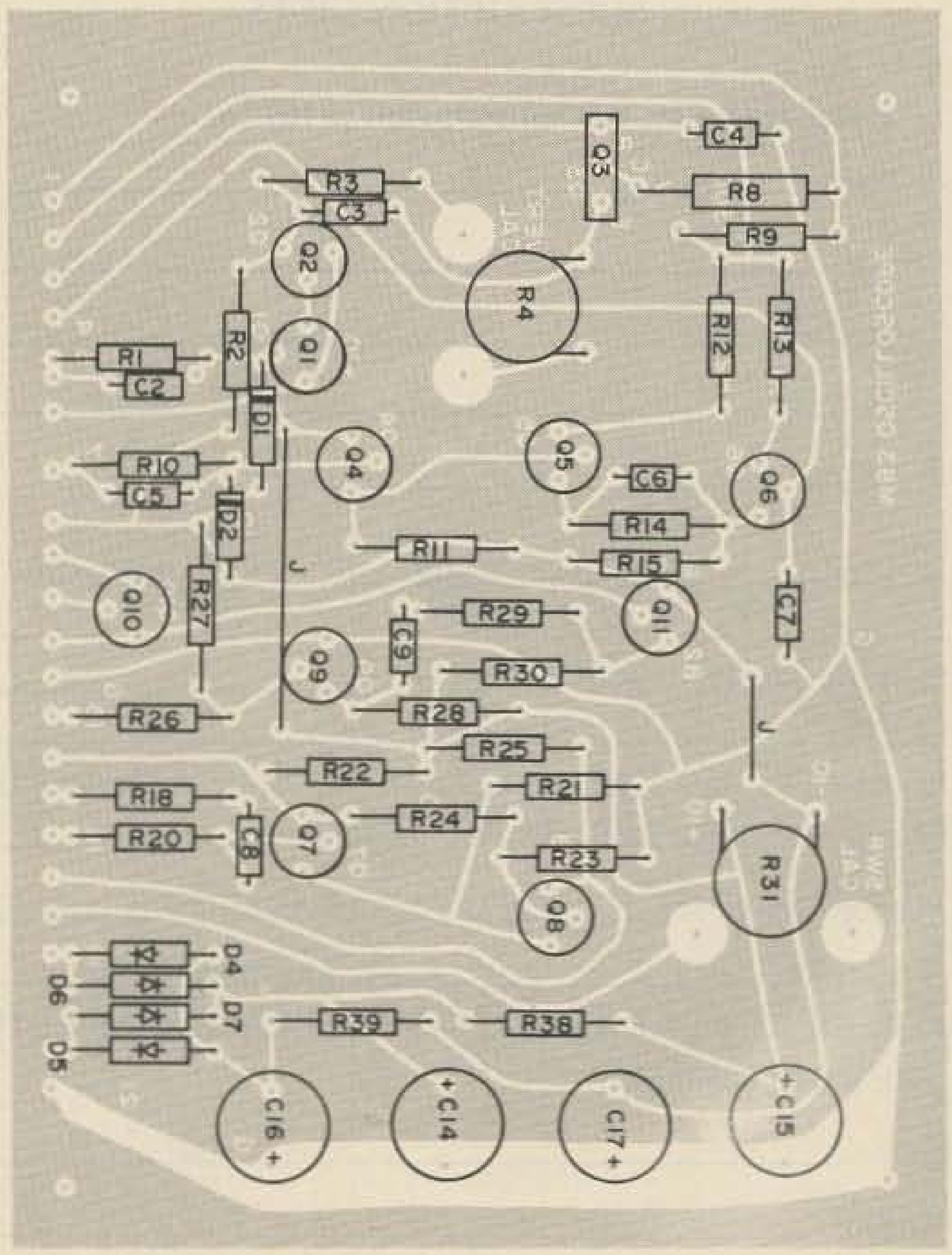
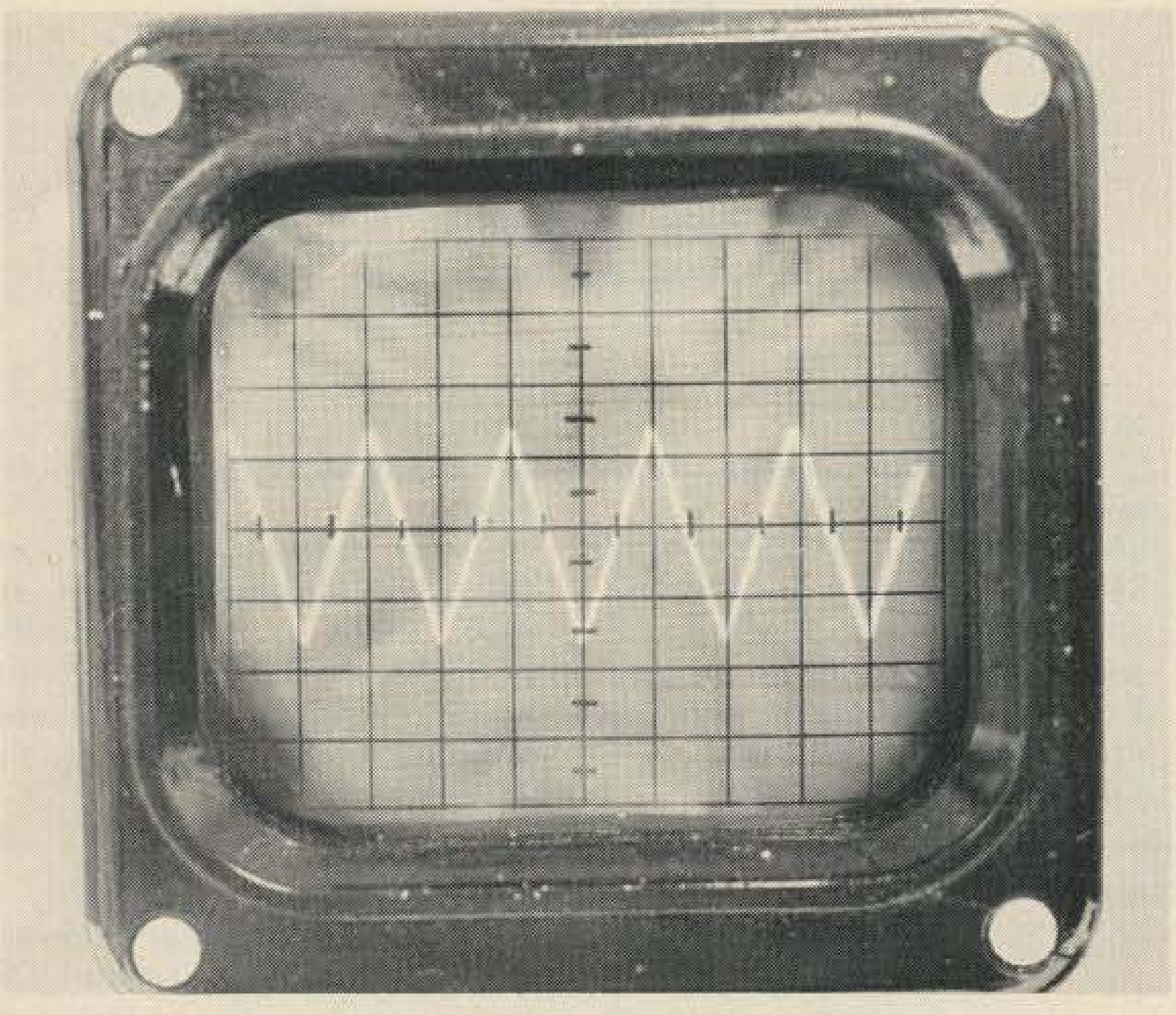


Fig. 3. Component placement on the main circuit board, top view. Note the two jumper wires, J.



Linearity of trace is demonstrated by this photo of a 5 kHz triangle wave on the 0.1 ms/div range.

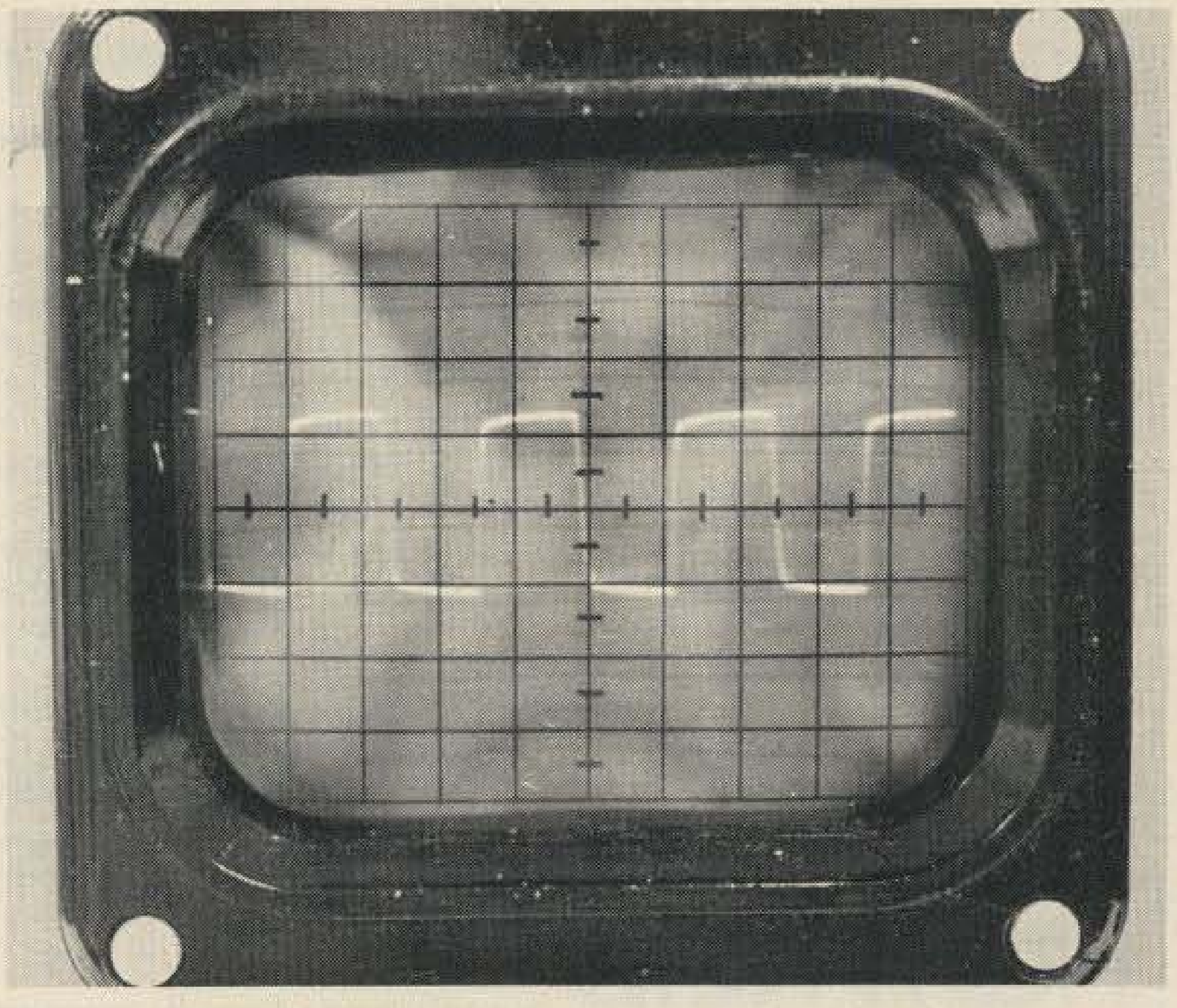


Photo of a 100 kHz square wave taken on the 4 usec/div range shows clean high frequency response and good calibration accuracy.

(16.7 ms) occupies 4.2 divisions on the 4 ms/div range. ■

Parts List

C1, C8 – 0.05 uF, 600 V disc capacitor
C2, C5 – 330 pF disc capacitor
C3 – Select for best vertical frequency response
C4, C7 – 0.01 uF disc capacitor
C6 – Select for best horizontal frequency response
C9 – 0.001 uF disc capacitor
C10 – 1 uF, 50 V mylar capacitor
C11 – 0.1 uF, 50 V mylar capacitor
C12 – 0.01 uF mylar capacitor
C13 – 0.001 uF mylar capacitor
C14-C17 – 500 uF, 25 V vertical mount electrolytic capacitor
C18 – 40 + 40 + 40 uF, 450 V three section can electrolytic
C19 – 0.0047 uF, 500 V disc capacitor
C20-C22 – 4 uF, 450 V electrolytic capacitor
CA (0.4-40 V scales) – 100 pF miniature compression trimmer capacitor, total of 5 required
CB – 0.1 V scale: 33 pF disc; 0.4 V scale: 120 pF disc; 1 V scale: 330 pF disc; 4 V scale: 0.0012 uF disc; 10 V scale: 0.0033 uF disc; 40 V scale: 0.012 uF disc
D1-D2 – silicon signal diode, 1N914 or similar
D3 – 6.8 V, ½ Watt zener diode (HEP Z0215 or equivalent)
D4-D7 – 100 PIV rectifier (HEP R0051 or similar)
D8-D10 – 1000 PIV rectifier (HEP R0056 or similar)
F1 – ½ A slow blow fuse
I1 – 117 V pilot lamp assembly (NE-2 bulb with 68k resistor)
Q1, Q4 – 2N3819 N-channel junction FET
Q2, Q7, Q8, Q9 – 2N3569 Si NPN transistor (or similar)
Q3, Q5, Q6 – MJE 340, 2N3440, or similar 300 V 1 W NPN transistor
Q10 – 2N3638 Si PNP transistor (or similar)
Q11 – 2N4891, HEP 310, or similar unijunction transistor
R1, R10 – 330,000 Ohm, ½ Watt resistor
R2, R14 – 2200 Ohm, ½ Watt resistor
R3, R39 – 100 Ohm, ½ Watt resistor
R4 – 1000 Ohm, ¼ Watt trimmer potentiometer
R5, R17 – 10,000 Ohm, linear taper potentiometer
R6, R11 – 4700 Ohm, ½ Watt resistor
R7 – 330 Ohm, ½ Watt resistor
R8 – 47,000 Ohm, 2 Watt resistor
R9, R26, R33 – 6800 Ohm, ½ Watt resistor
R12, R13 – 100,000 Ohm, ½ Watt resistor
R15 – 2700 Ohm, ½ Watt resistor
R16 – 3300 Ohm, ½ Watt resistor
R18, R23 – 22,000 Ohm, ½ Watt resistor
R19 – 25,000 Ohm, linear taper potentiometer
R20 – 27,000 Ohm, ½ Watt resistor
R21 – 220 Ohm, ½ Watt resistor
R22 – 1500 Ohm, ½ Watt resistor
R24 – 10,000 Ohm, ½ Watt resistor

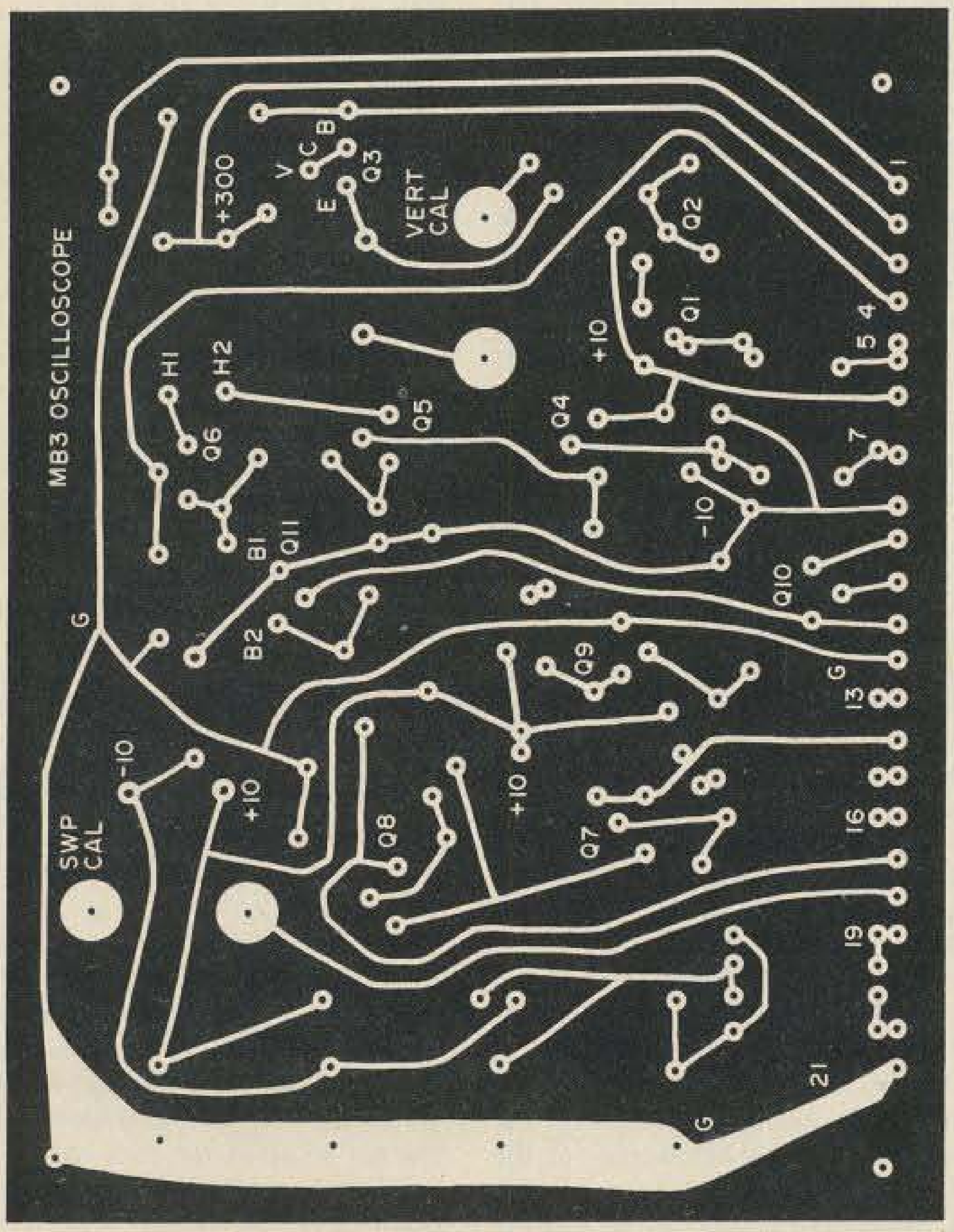


Fig. 4. Printed circuit artwork for the main board, bottom view.

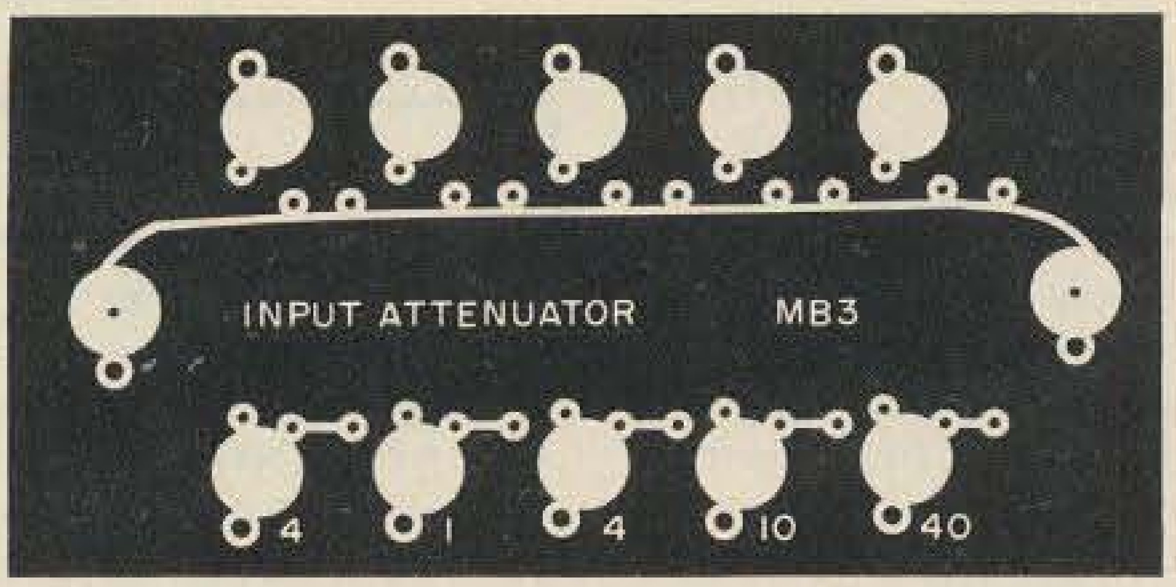


Fig. 5. Printed circuit artwork for the vertical input attenuator board. Voltage dividing resistors RA and RB are mounted on the copper side of the board with trimmer capacitors CA bridging across them between the large pads. Fixed capacitors CB are mounted on the opposite side of the board.

R25, R28 — 1000 Ohm, ½ Watt resistor
R27 — 33,000 Ohm, ½ Watt resistor
R29 — 100 to 2200 Ohm, selected for sweep length
R30 — 1000 to 5600 Ohm, selected for sweep length
R31 — 100,000 Ohm, ¼ Watt trimmer potentiometer
R32 — 50,000 Ohm, linear taper potentiometer
R34 — 100,000 Ohm, ±3% resistor
R35 — 40,000 Ohm, ±3% resistor
R36 — 10,000 Ohm, ±3% resistor
R37 — 33,000 Ohm, ½ Watt resistor
R38 — 47 Ohm, ½ Watt resistor
R40, R41 — 470 Ohm, ½ Watt resistor
R42, R43 — 68,000 Ohm, ½ Watt resistor
R44 — 1 mehohm, ¼ Watt trimmer potentiometer
R45, R46, R49 — 1 megohm, ½ Watt resistor
R47 — 200,000 Ohm, linear taper potentiometer with SPST switch
R48 — 1 megohm, linear taper potentiometer
R50 — 100,000 Ohm, linear taper potentiometer
Ra and Rb attenuator components, all ½ Watt carbon composition or film type resistors, ±3% tolerance — See Table 2
S1 — SPDT slide switch with center off position
S2 — 6-position, 2-pole rotary selector switch
S3 — 4-position, 2-pole rotary selector switch
S4 — SPDT switch (part of R47)
S5 — SPDT toggle switch
S6 — 11-position, 2-pole rotary selector switch (9 positions used)
T1 — 12.6 V center-tapped, 500 mA filament transformer
T2 — 250 V, 20 mA, 6.3 V, 2 A transformer
V1 — 3BP1A, 3 inch cathode ray tube
Chassis, cabinet, binding posts (5), CRT socket, line cord and plug, knobs (3 large, 7 small), CRT bezel and graticule, fuse holder, terminal strips, miscellaneous screws, grommets, and spacers

	RA	RB
0.1 V scale	none used	1 megohm
0.4 V scale	750,000 Ohm	250,000 Ohm
1 V scale	900,000 Ohm	100,000 Ohm
4 V scale	975,000 Ohm	25,000 Ohm
10 V scale	990,000 Ohm	10,000 Ohm
40 V scale	998,000 Ohm	2500 Ohm

Table 2.

Ham Help

I have a request for Ham Help. I need a service manual, or at least a schematic and specifications, for a Beckman Instruments electronic counter, Model 6020.

Blase J. Furfaro W7ISJ
10332 Camino De La Placita
Tucson AZ 85710

I'm looking for somebody who would help me in obtaining an amateur ticket. I am open for advice and help. I was hoping that someone could offer some type of course of study for me and when problems would arise I could contact him for help.

Peter Osroff
2442 East 26th Street
Brooklyn NY 11235
(212)-646-7757

I would appreciate any help in locating a schematic for a Singer portable TV, model number TV6U.

Would also appreciate schematics for BC-779 receiver and ART-13 transmitter.

Your magazine improves with each issue.

Harold D. Donaldson
8850 Phoenix Ave.
Fair Oaks CA 95628

I would appreciate some help in designing a communications device similar to the wireless broadcasters that seemed to be popular 10 or more years ago.

I am working with a group of hobbyists in putting on a large convention shortly. One of the major problems in managing a large convention is the communications area. We need to be able to contact key people immediately in emergencies. And, since this is a hobby group, the device should be cheap.

A base transmitter broadcasting an AM or FM signal through the hotel's 110 V power lines would serve adequately, since all that is needed to receive it would be a cheap pocket radio. A CB set might work, but the interference from competing stations is excessive. A simple wireless broadcaster using the 110 V line as a large antenna would seem easiest and cheapest.

However, circuits for such devices seem to have disappeared (or are no longer popular). Any help in design, suggesting references, etc., would be much appreciated.

David Lundy
18 Karen Drive
Cherry Hill NJ 08003

LETTERS

from page 19

don't like is the way they are going about it.

The only mention they make of this petition is in the Executive Committee Minutes, which few hams will actually read. This appears in a short paragraph on page 62 of the August *QST*, for those who might be interested.

I can only say that I am going to take some action on this. I will be writing to the FCC with my own comments on Docket 20282. I hope other hams and Novices-to-be will do the same. Wayne, since you agree with me according to your editorial, I hope you will also act. Let's nip this in the bud now.

Already I am getting involved in the politics of ham radio. I was licensed first as WN3FNT back in 1966. I was again licensed as WA3JDT/WB8FAR in 1967. I gave up ham radio to complete a degree in electrical engineering. I now want to return, and I see that the ARRL is again dividing ham radio into a class system. I don't like it. They are positive on Docket 20282 — yet are secretly trying to have it amended. This infuriates me very much.

Thanks for listening to me, and I hope some positive action can be taken.

Bob Hajdak
Youngstown OH

BOON

One of the big kicks that I get out of reading *73 Magazine* is your editorials. I do not agree with you all of the time and do agree with you some of the time, but I enjoy any controversy or debate on ham radio or the problems with frequency allotments and so forth.

The main reason for this letter is this: *I like CB radio* and I think that it is a great thing on the whole and am not going to let it get run down by some know-it-all amateur radio operators. I have had a CB license since 1961 and have been a licensed ham operator since 1962. I have sold and serviced CB sets since that time and had a 2nd phone commercial since that time, so I do have enough knowledge about it to be heard.

CB radio has emerged, in the last five years, to be a very strong system for emergencies on a local basis, and, recently, as a terrific extension of the eyes and ears of our law enforcement people. I can say that it is a boon to these people. After all, the quickest way to apprehend a criminal or thief is with the *cooperation* of the general public, and, with the advent of some very good organizations, such as REACT and some other fine groups, it has come to pass that we have an excellent and *speedy* means to inform, locate, advise and operate in a saner manner than ever before. I am glad to note that you have decided to tap the biggest reservoir of potential hams that exists today. An ardent CBer can be converted to an ardent ham, but not by slamming, ridiculing or looking down one's nose at him.

Now, as to the holier-than-thou attitude that *some* hams have, it is a slam to the whole fraternity to have him expound on the lousy CB activities. If *he* didn't pass his code test and/or exam, he would be the most skip and yakker worker in the CB group. There are a majority of fine CB personalities who would make a lot better hams than some whom I have heard on the ham bands. I have heard some stuff that makes me feel ashamed that I belong to this group, and no doubt the same goes for the majority of CBers.

So, in closing this tirade, let me say quit knocking CB and quit this I'm-better-than-you attitude, before we alienate the biggest group of potential hams available.

One more thing: I don't care a whit about microprocessors and fancy ICs and some of the stuff that you have in your magazine, but I tolerate it because it probably means something to the next guy, so I am willing to tolerate it and consider *73* and *QST* two of my favorite mags. I would not drop *QST* for the world either. So I am willing to fight for both of you . . .

Jack Golden WA2YPW
Portville NY

DOGGONE HOUNDED

Dag blasted you're right. I can't do it without your doggone tapes. My first thoughts were to try to copy W1AW, but QRM is bad, bad, bad. I tried other methods, but after reading comments from other frustrated hams I am going to try Uncle Wayne's 14 wpm tape. My XYL is hounding me to get on the General phone bands so she can get some of the nice recipes she has heard, not to mention the little QSOs with the other YLs on the

Continued on page 57

INTRODUCING

The TEMPO 2020

*Phase lock-loop (PLL) oscillator circuit minimizes unwanted spurious responses.
*Hybrid Digital Frequency Presentation.
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Get on Six with Surplus

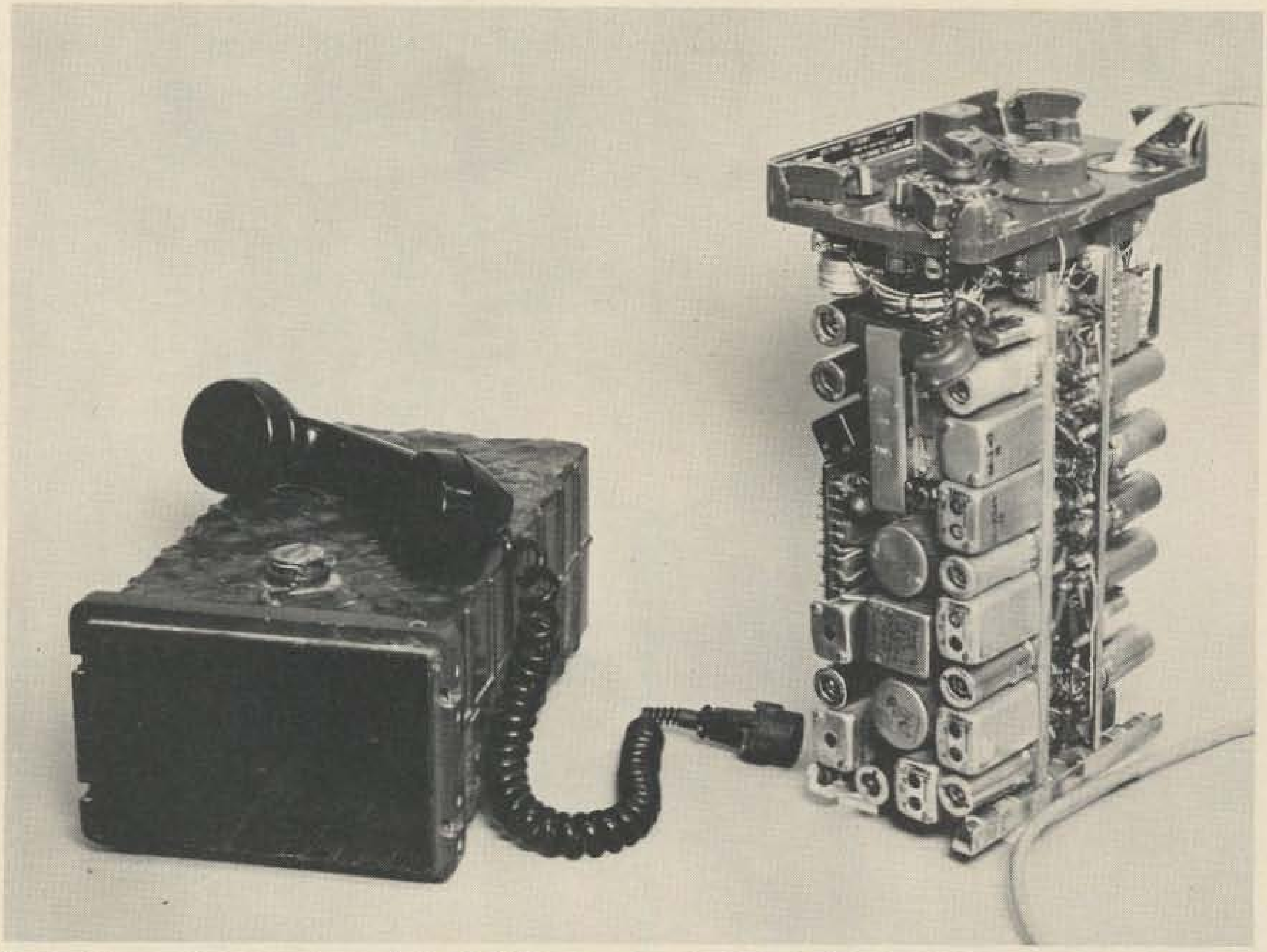
--the el cheapo RT-70 is a natural

The finished RT-70 modification ready for installation. Its small size and minimal power consumption make it ideal for mobile use, but for serious work you will need an "afterburner."

In recent months a large number of RT-70 transceivers have appeared on the surplus market at prices from $15 to $25. These transceivers are designed for the frequency band from 47 to 58.4 MHz and therefore completely straddle the 6 meter ham band. To find a surplus transceiver that doesn't require extensive changes to operate on a ham band, and is simultaneously cheap, is a real achievement that many hams would take advantage of if they knew for sure what the conversion entailed.

The RT-70 is an FM transceiver covering the entire 6 meter band in continuous tuning, and transmitting at 500 mW output. The receiver section is a very good unit as is and will operate alongside the best of them without modification. The transmitter section is equally good, but several peripheral modifications will make it more convenient to use.

The first thing that is noticed when an RT-70 is first fired up with its original microphone is that the audio quality is unbelievably lousy in that it won't modulate at all. Apparently years ago the carbon buttons were good but they have now deteriorated, because even the "new" buttons that I bought for 3 for $2.00, still packed in a hermetically sealed package, failed to remedy the situation. Fortunately this problem is easily solved. A standard telephone handset can be used as the microphone by placing a resistor across the button to decrease the sensitivity. Without the resistor you can stand across the room from the handset and have enough audio to modulate the transmitter. The resistor value has to be individually selected according to the handset used. Mine required a 27 Ohm resistor. If you can get a handset with push-button in the palm you have a fine TR switch built-in.



Left side and bottom view of the RT-70, showing the "Tank, Field, Veh" switch, S101, on the left side, in the "Veh" position. Look closely, just below the crystal Y-102, to see the regulator chip installation as described in the text.

Since some of the RT-70s being sold come without schematics, I will include partial schematics to illustrate the hook-ups. Fig. 1 shows the audio plug and connections to the handset. Place the resistor inside the handset on the terminals of the carbon button itself. Later in this article, I will show how to add a switch to turn off the earphone in the handset for speaker operation. Note that in most handsets the ground lead from microphone, earphone and TR switch are common and a single wire. This wire can connect to either pin H, pin E or pin B as all are grounded inside the set.

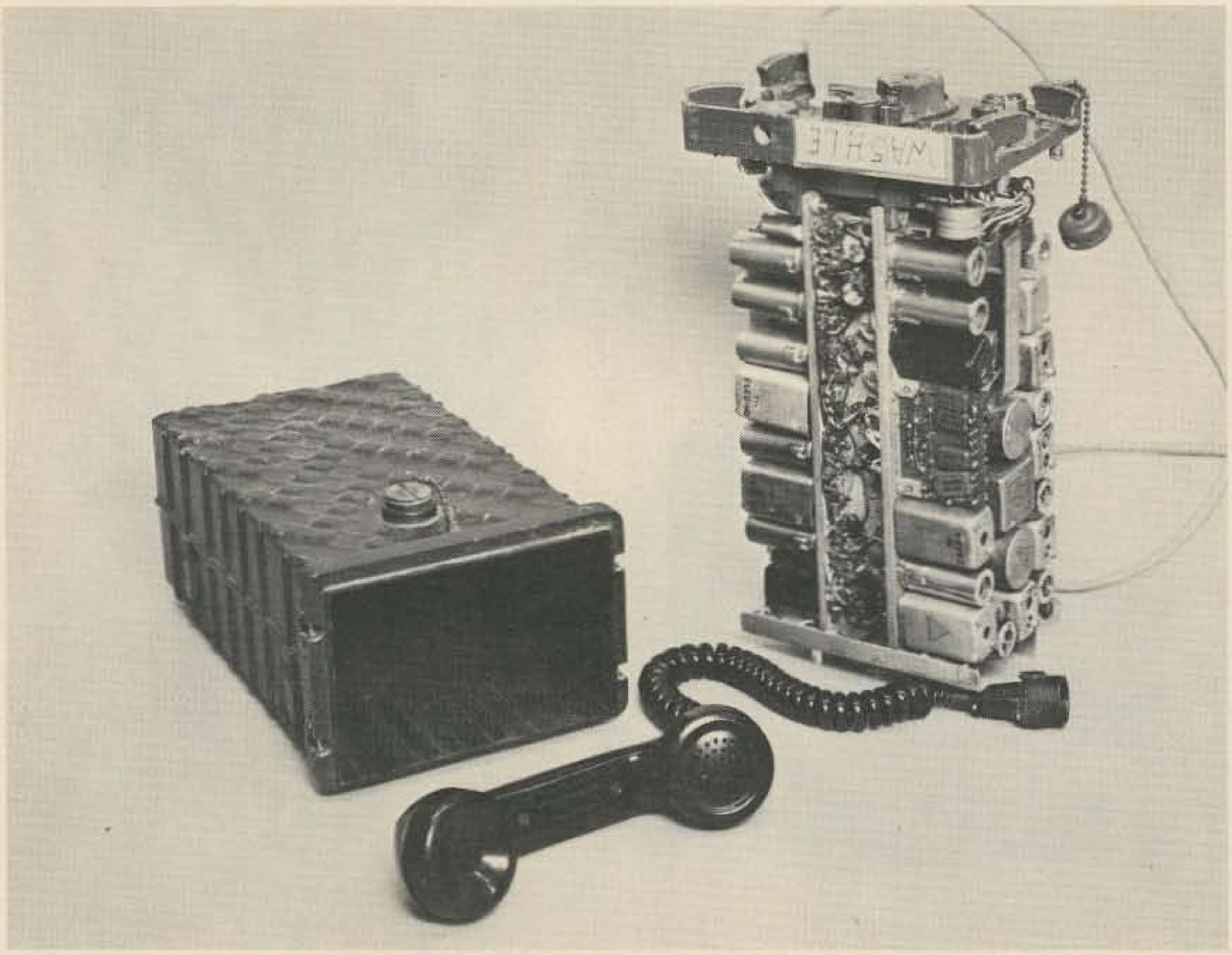
Finding audio plugs for the TR-70 is not as hard as finding power plugs; therefore, I have elected to modify the power input to use a piece of five conductor cable that can have any type of connector you like mounted on the outboard end. The modification is easy and works fine. Take a 5/16" drill and drill out the center of the present connector. Push the end of your 5 conductor cable through this hole, tie a knot in it and connect the five wires as follows (see Fig.2):

Fig. 1. Audio plug connections.

Connect the red one (if you have a red one) to pin J for the 90 V dc input. Next, connect the black one (again, note in parentheses above) to pin D for the ground. The remaining three wires are connected to pins B, F and A. But, prior to soldering to pin B, remove the wire already on that pin and place it on pin F along with the fourth wire in the cable. Now with the addition of a Fairchild 7806 regulator chip which will be described later, you can use the set with any voltage from 6 to 15 V dc. The Fairchild 7806 regulator chip is a 1 Amp 6 V regulator, all in one three head package with a mounting tab. The mounting tab is in most cases identical electrically to the center lead. Check your unit *first*, and if this is the case, the center lead can be cut off. Next, looking at the bottom of the chassis, you will see J1 mounted on the right side with two screws. Remove the nut on the screw toward the front of the chassis. Take a knife and scrape the protective coating from the chassis in a circle about 1/2" diameter around the screw. Now place the tab of the regulator over this screw so that the center lead of the regulator is pointing directly at the chassis mounting nut that holds the front panel on. This center lead may touch the nut, but no harm is done as this lead is grounded. The other two leads must be bent away from the chassis to avoid contact. Now replace the nut and tighten the regulator in place. This mounting will act as both ground and heatsink for the chip.

Now, using the diagram in Fig. 3, connect the input lead of the regulator to pin B on the power connector and the output lead to pin F of the power connector.

Now in operation, if you have a 6 V filament supply it can be connected to pin F (or



Left side and top view of the RT-70, showing the antenna connector on the end panel, and most of the tuning adjustments for the transmitter.

the cable conductor connected to pin F), while a filament supply of 8 to 15 V should be connected to pin B. Do not try to run a 6 V input through pin B and thus the regulator, as there is a 2 V drop in the chip which will result in a 4 V filament voltage, and the set will not operate on 4 volts. Also, do not connect both a 12 V and a 6 V supply simultaneously: You may blow the chip. And a final caution: Do not use ac filament voltages. The chip doesn't like ac, and neither do the filaments. Ac just will not work, so don't try it.

This regulator is an important addition, as the filament voltage is very critical for proper operation. A 5.5 V filament will cause a reduction of transmit power of 50%!

There is a switch, S101, on the left side of the receiver chassis. This switch is primarily used to compensate power supplies to hold the current drain constant during both transmit and receive modes. If correct drain is a problem, put it in the "field" position and then use a very well regulated 90 V supply capable of regulating from 30 mA to 80 mA. If on the other hand you have a good supply of 90 mA at anything from 90 V to 120 V dc, you can put the switch in the "Veh" position and use a dropping resistor to drop the voltage to 90 V. I used a surplus Sorensen power supply with an output of +107 V and a dropping resistor of 200 Ohms. The dropping resistor is calculated using the formulas in Table 1, and then adjusted to get what you want using a voltmeter.

I finally used a 200 Ohm 3 Watt resistor. Since the switch S101 is in "Veh" position the current remains nearly constant and the drop on the resistor remains constant.

The final three modifications I will describe are primarily convenience mods and not absolutely needed. The set will now run having made the modifications already described. Remember, FM on 6 meters is allowed only on the upper portion of the band. You can set the "preset" stops to mark the band edges, or use one of them for the local frequency.

If you use the set mobile, you will need a dial light. The one in the set is a 331 and is useless. Remove the bulb and replace it with a 328; then, in order to get the correct voltage on the tube, "short" out R-206. R-206 is mounted on the back wafer of the "Cal, Ant" switch, S-202, on the front panel. The resistor can be identified by its code, as it is an 82 Ohm resistor. Merely solder a piece of wire across it and your dial light is ready.

This modification is a matter of preference, but if you are to make the next modification, this one precedes it. The present antenna connection is on the front panel. I like mine on the back, so I moved it back. Remove the BNC connector and mount it on the chassis on the right side just above V1-1, in the aluminum web that supports the chassis mounting screws (see Fig. 4). Then drill a 3/8" hole in the cover so that when the set is in the cover the BNC antenna connector protrudes through the back. Now, using a miniature 50 Ohm coax such as RG-188A/U, connect the new antenna connector to the feedthrough originally connected to the front panel

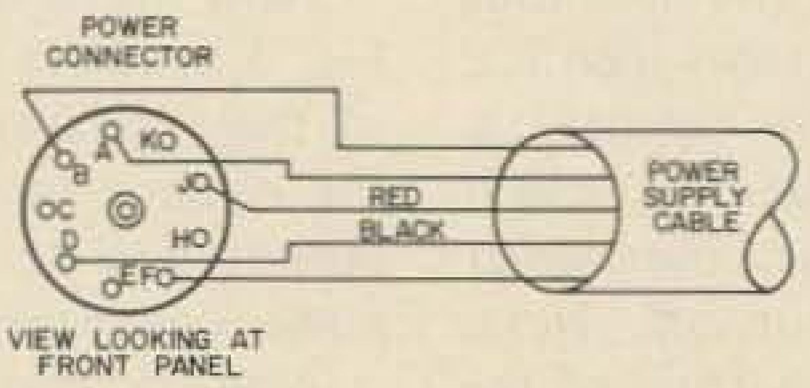


Fig. 2. Power cable connections.

R = E/I, where I is the current required to operate the unit (approximately .079 Amps) and E is the voltage of the power supply less 90 V.

Example: 107 − 90 = 17 volts = E

R = 17/.079 = 215 Ohms

P = E x I

Example: P = 17 x .079 = 1.3 Watts

Table 1.

connection. The shield should be grounded at both ends and placed in the channel runway along the housing of C-10.

Now, using the hole the original antenna connector came out of, put a single pole, single throw toggle switch in the front panel. Remove the red wire from pin A on the audio connector and connect it to one of the switch contacts; connect the other contact to pin A. Now you can disable the earphone in the handset to allow more volume in the speaker for monitoring when you are across the room, or for use when others in the car or shack want to hear both sides of the conversation, without blowing your ears off with the handset!

There are two further modifications that are possible on the RT-70. However, these are specialty items, and I won't go into great detail on them.

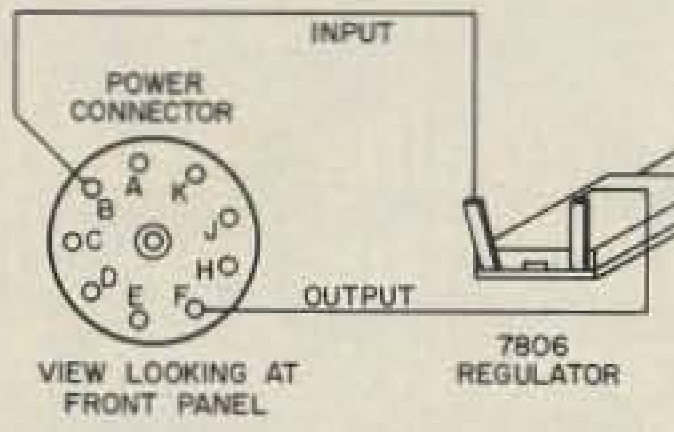


Fig. 3. Addition of regulator.

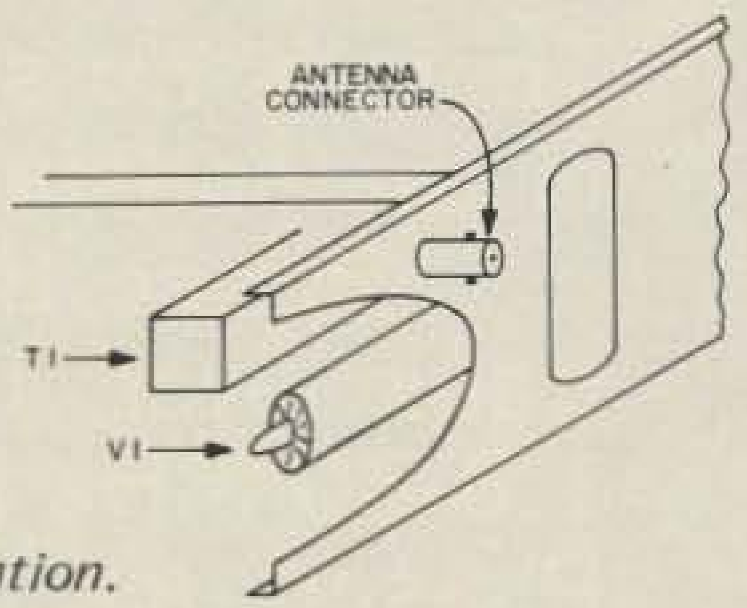


Fig. 4. New antenna connector location.

First, since this is an FM transmitter, a "cheap and dirty" amplifier can be placed on the output using a TR switch and rf power transistor to achieve 5 Watts or so in one stage.

Secondly, the RT-70 is ideally designed to use on a repeater. Since the transmit frequency is the sum of the variable local oscillator in the receiver and a 15 MHz transmitter oscillator, a change in the frequency of the 15 MHz oscillator allows the transmitter to be separately tuned. To operate on a repeater, it is only necessary to change the crystal in the 15 MHz oscillator/*doubler* (the crystal is 7.5 MHz— bear this in mind when calculating the transmit/receiver offset). Thus you will have a transmitter that tracks the receiver, offset from the receiver by a previously determined frequency difference.

Final notes: All these modifications work equally as well on the RT-70 as on the RT-70A, but, in selecting the unit, try to get an RT-70A. They usually are newer and in better condition. Second, don't pay extra for the 1 MHz crystal in the calibrator unless it is real cheap. Some places con you for $5.00 and you don't really need it at any price! It is nice for tuning up, but not at $5.00. And finally, try to get a manual. They are worth the price if available. The manual describes a complete tuning and maintenance procedure, as well as the equipment. It is one of the best equipment manuals I have ever seen.

If you can think of any other mods that would be helpful I would like to hear from you, and I will keep a file on any "new" mods that I will trade for your suggestions if you send an SASE. ■

The Beam Saver

-- rotor memory system

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Sepulveda CA 91343

This article is directed mainly at the ham who has had antenna rotator damage due to high velocity wind gusts. There is also information for anyone planning to purchase an antenna, tower, or rotor. In the main, I will present a modification for the Cornell Dubilier TR-44 antenna rotor that will automatically return the antenna to a pre-determined antenna azimuth or arc segment. This system is not limited to the TR-44, however.

I live in the San Fernando Valley of Southern California. During the months from February through April there are portions of this valley that have winds known as the Santa Anas. These can last for several days, carrying with them gusts from 20 to 85 knots. After each of these storms, one can drive down side streets and encounter a large number of twisted towers and beam antennas.

Many of the hams suffering damage could not believe this could happen to their structures, since they appeared robust enough to stand twice that wind velocity. Many hams purchase rotors, towers and antennas with hearsay information as to their structural wind strength, while other hams use the overkill theory. A tower designed for an antenna wind resistance of 2.5 to 5.0 square feet at 100 mph can have the tower twisted like a corkscrew with gusts of less than 50 to 70 mph.

After reading some of the latest specs from C.D. on the TR-44 and Ham M-2 rotors, I was surprised to see that they are rated for only 2.5 square feet and 7.5 square feet respectively. In this light it appears that a large percentage of hams are overloading these units with stacked beams that can easily be rated for wind ratings of 15 to 20 square feet or more. My tower is an aluminum 40' self-supporting structure capable of sustaining a 100 mph wind while decked with a 5 square feet array less than 1.5' above the top of the tower. The rotator is a TR-44. The antenna is a 4 element widely spaced 15 meter beam with a 3" diameter boom. After the first 35 mph wind, I guyed the tower. A subsequent wind broke one of the guy lines. I am sure that if the motor had had a strong brake the tower would have torqued sufficiently to have snapped. I had believed the many hams who had advised me that the TR-44 gear ratio would prevent the antenna from turning during exceedingly high velocity winds. Besides, the rotor would not turn beyond the end stops. Well, my coax was wrapped 5 times around the chrome molly mast post. Theoretically, the rotor cannot go beyond 360° because protrusions built into the casting come into contact with a hard drawn steel lever made of angled steel in the shape of a U channel. This strikes end stops, which are also built into the stationary part of the casting. I do not know how many pounds or tons of torque was created by the wind, but this piece of steel looked like it was on the losing end of a battle with a punch press.

With this background, we have arrived at the meat of the subject. How do we prevent this from reoccurring without having to replace everything with beefed up specs? A braking system had been contemplated at some length, but the prospect of having the tower torqued in half was quite evident. WA6MVP suggested the design of an electronic servo system with rubbery limits. The system in Fig. 1 is the result.

A breadboard model was devised to determine the circuit feasibility. A 500 Ω wirewound potentiometer and bench supplies were used to depicket the TR-44 rotor and control box. After being assured that the design was sound, most of the components were mounted on a 2¼" x 4½" universal PC board. Essentially, what is required are two 12 or 24 volt dc three pole double throw surplus relays, two inexpensive 741 op amps, or a single dual pack 747 IC, two 1N4004 diodes, two 10k Trimm potentiometers, three transistors (two used as relay driver switches and one as a B+ pass transistor), and one double pole double throw toggle switch.

Let's first look at the Cornell Dubilier control unit schematic as redrawn for better understanding. The uncircled numbers are those that appear on the C.D. schematic. Those circled are those that appeared on the particular relays used in my unit (I found some new surplus, very small 4PDT 24 volt units at 75¢ each). The lever switch on the control unit essentially does two things: It applies line power to the power transformer primary only when moved to the left or right position, and it also applies 26 volts ac to one or the other split phased windings of the rotor motor. (One winding causes the motor to rotate counterclockwise, and other winding changes the direction to clockwise.) Incidentally, if you have had your rotor for some years and it only rotates with much persuasion, you most likely have a defective motor phasing capacitor. This capacitor is a nonpolar electrolytic. The electrolyte dries out after a time and the capacity is insufficient to change the phase of the current sufficiently. A good substitute is to purchase computer-grade capacitors of twice the capacity and connect them back to back. Remember that the 50 volt rating on the original capacitor has an ac rather than dc rating. As the ac voltage is a peak-to-peak, the formula becomes RMS x 2 x 1.44. However, if the capacitors are placed back to back, each of these would have a rating of 1.414 times the RMS value.

One of the first things that came to my attention on the C.D. unit was the amount of heat generated in the 300 Ω zener current limiting resistor. When the control unit is *on* for a prolonged period, both the 300 Ω resistor and zener will blister the fingers if touched. This current measures approximately 90 mA. The regulated 14 volts only supplies 1 mA to the direction indicating meter, and about 30 mA to the 500 Ω pot located in the rotor housing, with the balance apparently used in biasing the zener. It isn't any wonder that the zener and its associated resistor get hot.

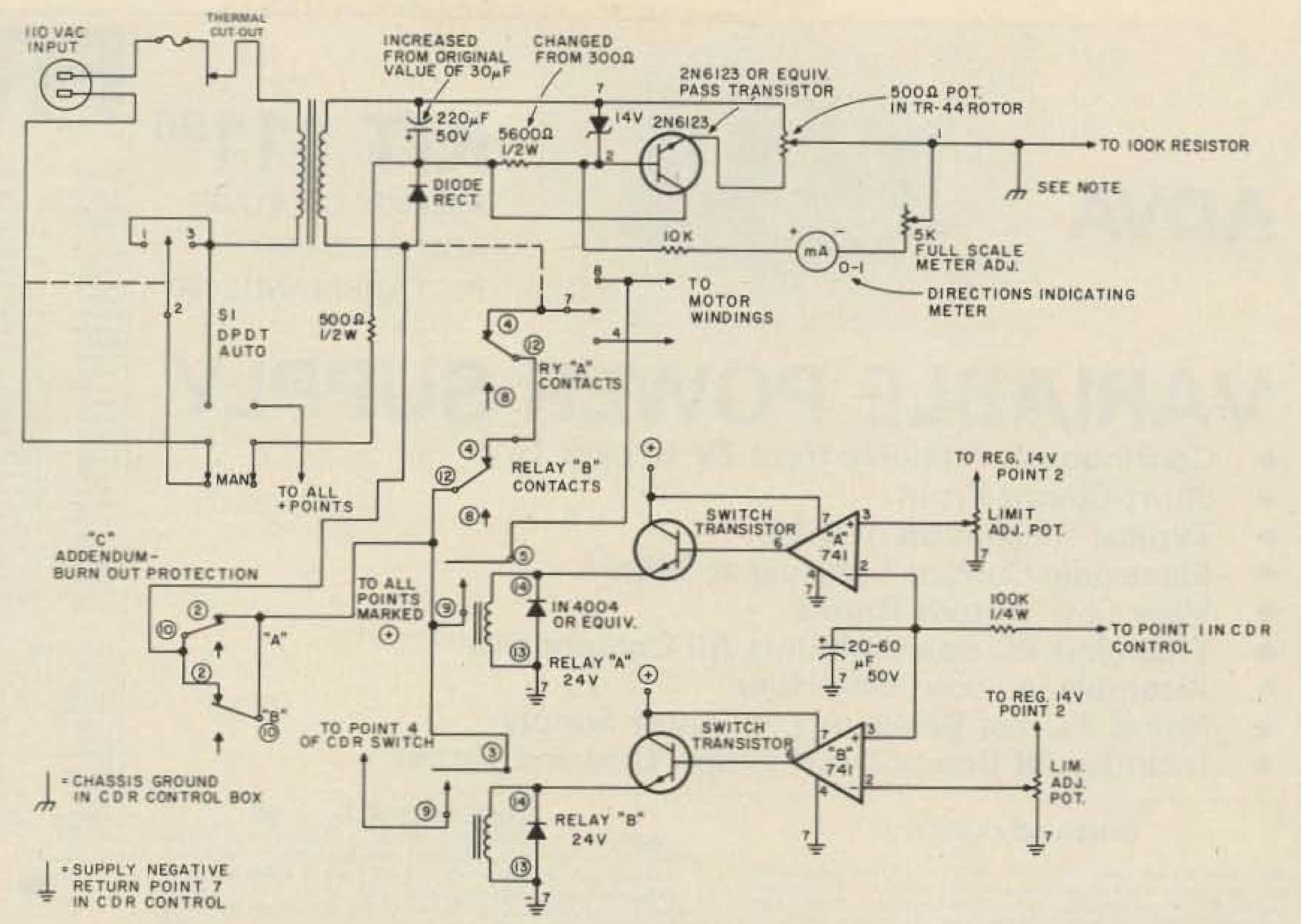

Fig. 1. S1 is shown in the manual position. Dashed lines represent wiring changes in the original circuitry. Relays A and B are shown in the de-energized position. Numbers not circled identify portions of the C. D. R. schematic. Numbers circled identify the terminal numbers on the particular relays used by author.

To operate the modified unit during a wind period, power must be applied to the transformer primary on a continuous basis. The zener and resistor are not rated to stand this kind of duty cycle. Therefore, a modification was incorporated to relieve this condition. A flat pack pass transistor, type 2N6123, was used. This transistor capability is like using a steamroller to crush a cinder. However, it is inexpensive, small and a heat sink is not required. This transistor has a minimum beta of 20 – thus the zener now only has to supply 1/20 of the current previously required. The 300 Ω resistor is now replaced with one of approximately 5.6k, and the zener still directly supplies the 1 mA maximum current to the azimuth indicating meter and biases the base of the pass transistor.

Notice that the 14 volt supply is a voltage source for the azimuth potentiometer. This pot acts as a variable voltage divider of zero to 14 volts; the 1 mA meter (1000 Ohms per volt) has a fixed 10 kΩ and variable 5 kΩ for full scale adjust. The 1 mA meter is set up to precisely indicate the source voltage.

Now let's look at the servo circuit. Note the two symbols for ground. This is not meant to confuse, but to identify two separate negative returns. The voltage negative return circuit of the control unit C.D. number "7" does not go to chassis ground, so do not make it a chassis ground when you make up your module. Note also that the only thing that goes to chassis ground in the control unit is the rotor of the azimuth pot. When this pot is in the most CCW position, its variable tap is at the "7" point or supply negative. In the opposite or clockwise position, point "2" is +14 volts. This variable ground potential point "1" is used as an offset voltage on pin 2 on op amp "A" and pin 3 on op amp "B." Note that this voltage is fed through a 100k resistor and junctions with a 20 uF capacitor. The capacitor takes time to build up and also takes time to drop its voltage. This makes for a hysteresis and allows the rotor to continue through and coast beyond the electrical limit. The outputs of the op amps are amplified by the emitter follower relay drivers A and B, which actuate either relay "A" or "B." Note that if 24 volt relays are used it may require about 18 volts for actuation. The relay energizes the proper motor winding and turns the antenna back to the initial point. You might ask why the motor doesn't just correct a few degrees and the relay drop out. The hysteresis introduced by the 20 uF and 100k resistor add a time delay, slowing down the buildup and drop-off of the op amp offset bias voltage. When you first try the unit, it is conceivable that the rotor will turn in the opposite direction from that desired. In this case, just reverse the relay contact wires going to switch points 4 and 8. Circled relay contacts 4, 12 and 8 on both relays are connected in such a way as to prevent inadvertent manual control when SW-1 is in the automatic position. The manual position causes both relays to take a de-energized position and the control unit is now ready for conventional manual control.

For the initial adjustments, you must determine in which direction you want the antenna pointing. When in automatic, manually position the antenna to this position. Now determine the leeway on each side of this position. Set the antenna to the CCW limit point and adjust the appropriate limit potentiometer until its associated relay energizes. It might be well at this point to jumper the 100k resistor, as this shorts out the delay. The correct setting can thus be found more readily. Now manually move the antenna to the opposite limit point and adjust the second limit potentiometer for actuation of the second relay. With the servo main switch in the automatic position, the antenna should correct to the predetermined direction. Both relays are now de-energized. Switch contacts 4 and 12 of both relays should be in the position as shown in the schematic. Although the switch mode has been set for automatic, the manual control lever on the control head will respond, opening the 4 and 12 contacts on that relay. Manual control is lost until the servo is again balanced.

Protection circuit "C" was added to prevent damage to the rotor motor should a component fail. Connect contacts 2 and 10 as shown. This circuit prevents having motor driving voltage on both the motor phased windings, should a circuit failure close both relays simultaneously.

The entire servo section is built on a canned PC board or any board type you desire. The board size is approximately 2¼" x 4½". The board is then mounted in an aluminum box approximately 5" x 2½" x 2", depending on the relay size. You might want to set the control unit on top of the servo system, in which case you should use a box with length and width compatible with the control unit base. The 741s have 8 pins, so both can be plugged into one IC socket (unless the dual pack is used). The manual autoswitch is the only control on the box. Wires emanate from the back through a grommeted hole. If 12 V relays are used, the 500 Ω ½ W current limiting resistor can be increased in size, or two resistors in a voltage divider circuit can be employed.

Unfortunately, the transformer in the control head, although large and visibly husky, was not designed for continuous duty. Mine was so hot after about 5 hours that it was painful to touch. The overload circuit breaker, a temperature-activated device built right into the transformer, did not cut out. The secondary winding is of very heavy wire, but the primary saturates the core while only loading about 80 or 90 mA. The replacement transformer I used is a 24 volt 2 Amp unit normally used to operate a latching relay in a garage door operator. This transformer is less than three fourths the size of the one in the control unit — yet is only slightly warm after a 24 hour duty cycle. Fortunately, there are any number of units available from electronic surplus houses throughout the country.

The prolonged detail of this article is intended for the less technical ham. The more technical ham may just need the schematic diagram.

My thanks to Doren Rozenthal WA6MVP for his suggestions and assistance. ■

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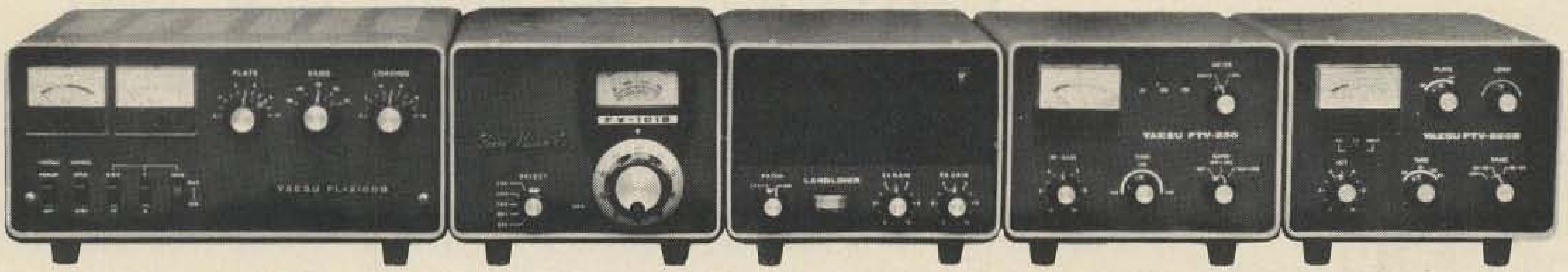

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Updated Universal Frequency Generator

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J. Schultz K3EZ
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The original article on the "Poor Man's Universal Frequency Generator" appeared in *73* for July, 1974. It has generated a great deal of reader response and it was considered worthwhile to review the instrument again and see if it could't be made even more reliable and versatile.

Basically, the generator is a collection of IC oscillators and dividers that can generate square waves from the HF range all the way down to the sub-audible AF range and can generate markers all the way into the VHF range. There is nothing sophisticated about the generator, and some of its function can be performed today by more advanced ICs with even greater versatility. But, the generator is hard to beat as a simple straightforward device that can be built at a very low cost (none of the ICs costs more than $1.00, except for one optional $3.00 type). It makes an excellent little project for those who still haven't started to experiment with digital ICs.

The uses for the generator, as suggested in the original article, are about as versatile as those of a grid-dip oscillator. Also, like such an oscillator which is not a very advanced type of instrument today, one nonetheless always keeps on discovering new and handy uses for the instrument. The broad uses still include: frequency marker generation, generation of crystal-stability RF or AF square wave signals, crystal activity checker, range extension for present AF or RF generators and a divider chain to allow HF oscillator stability and calibration to be checked by a low frequency receiver for those who lack a counter.

The block diagram of the updated generator is shown in Fig. 1. It consists of a selectable oscillator section, a fixed string of divide by 10 stages, and two divider stages which can be switched in at various points along the divide by 10 stages. The first oscillator is a 1 MHz crystal-controlled stage. Improved circuitry has been used which ensures more stable oscillation with any good 1 MHz frequency standard crystal. An LED indicates that the stage is oscillating. The second oscillator stage can be used with any external crystal extending up to the low VHF range. An LED again indicates that the oscillator is working. The stage can be used as a simple crystal activity checker with the LED, or crystal frequencies can be used which will give some desired output when the oscillator is fed into the divider chain. The third stage, as in the original generator, is not really an oscillator stage in itself, but an oscillator input stage. It will accept any external sine or square wave input, condition it, and then apply it to the divider chain. The fourth oscillator stage, which is new, really increases the versatility of the generator. It is a square wave generator whose frequency can be controlled by an external capacitor only. By proper selection of this capacitor, frequencies from several Hz to several MHz can be generated. Thus, in combination with the divider chain, any desired frequency or marker can be generated. The fifth oscillator stage, which is optional, is similar to the fourth oscillator except that it is intended mainly for the entire HF range up to about 25 MHz. Its frequency of oscillation is also controlled by an external capacitor, but its main feature is that it is a

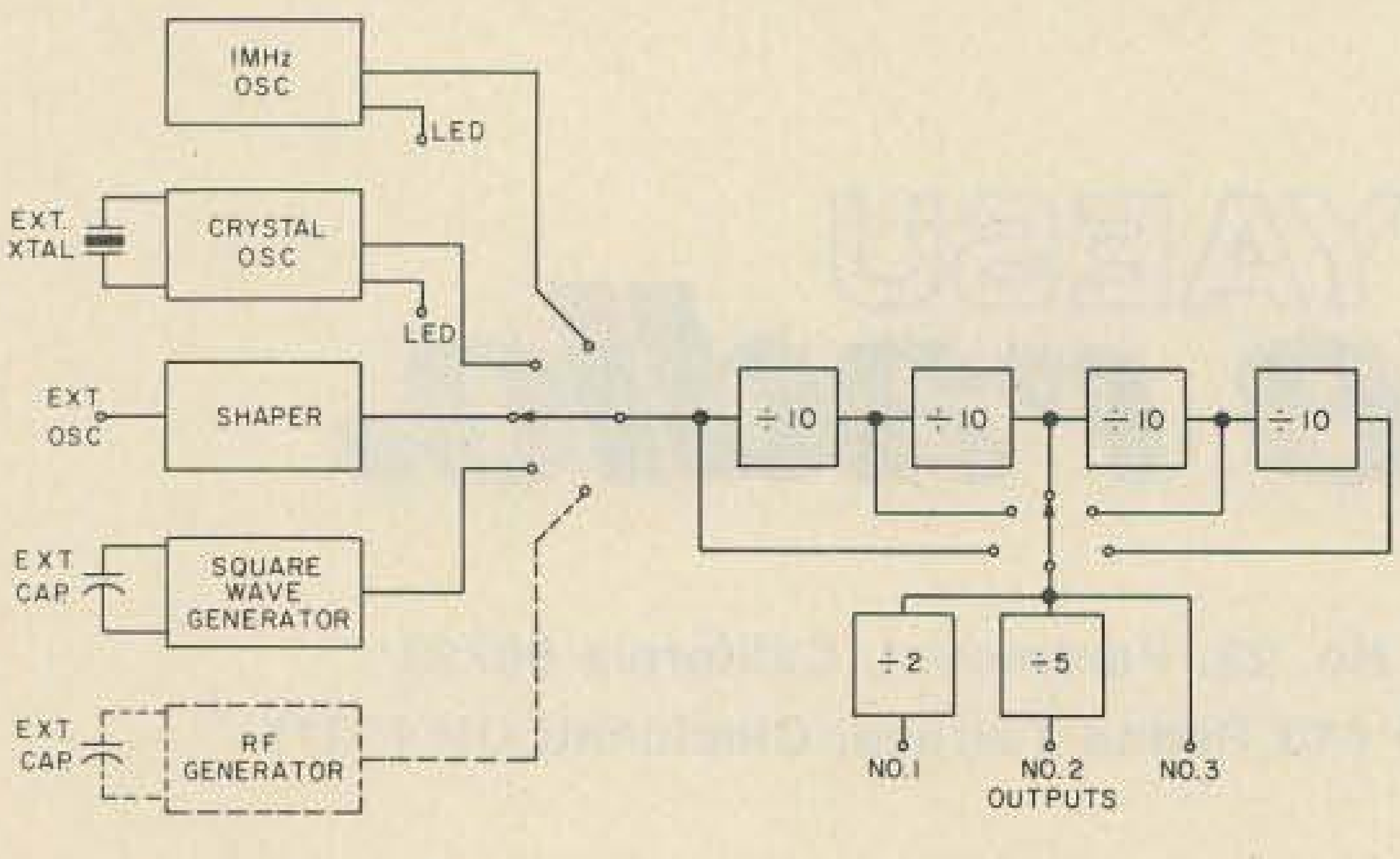


Fig. 1. Overall block diagram of the generator.

voltage controlled oscillator. By varying the voltage with a potentiometer to one section of this stage, a variable or sweep frequency output can be obtained.

The divider chain is a simple series of four divide by 10 stages. The outputs from a 1 MHz input will be at 100 kHz, 10 kHz, 1 kHz and 100 Hz. The stages are similar to those found in the timebase of any frequency counter or many crystal calibrators. The two divide by 2 and divide by 5 stages can be switched in along the divide by ten string. Using the 1 MHz oscillator input example again, the outputs of the divide by 2 stage will be 500 kHz, 50 kHz, 5 kHz, 500 Hz and 50 Hz. The outputs of the divide by 5 stage will be 200 kHz, 20 kHz, 2 kHz, 200 Hz and 20 Hz. This example may appear very obvious, but when dealing with inputs other than a simple 1 MHz one, it is important to list *all* the various output frequency possibilities to avoid confusion. Of course, looking the other way, that is, towards VHF marker frequencies, the above frequencies represent the intervals at which marker frequencies would appear since the output of the digital stages is a square wave with a very rich harmonic content.

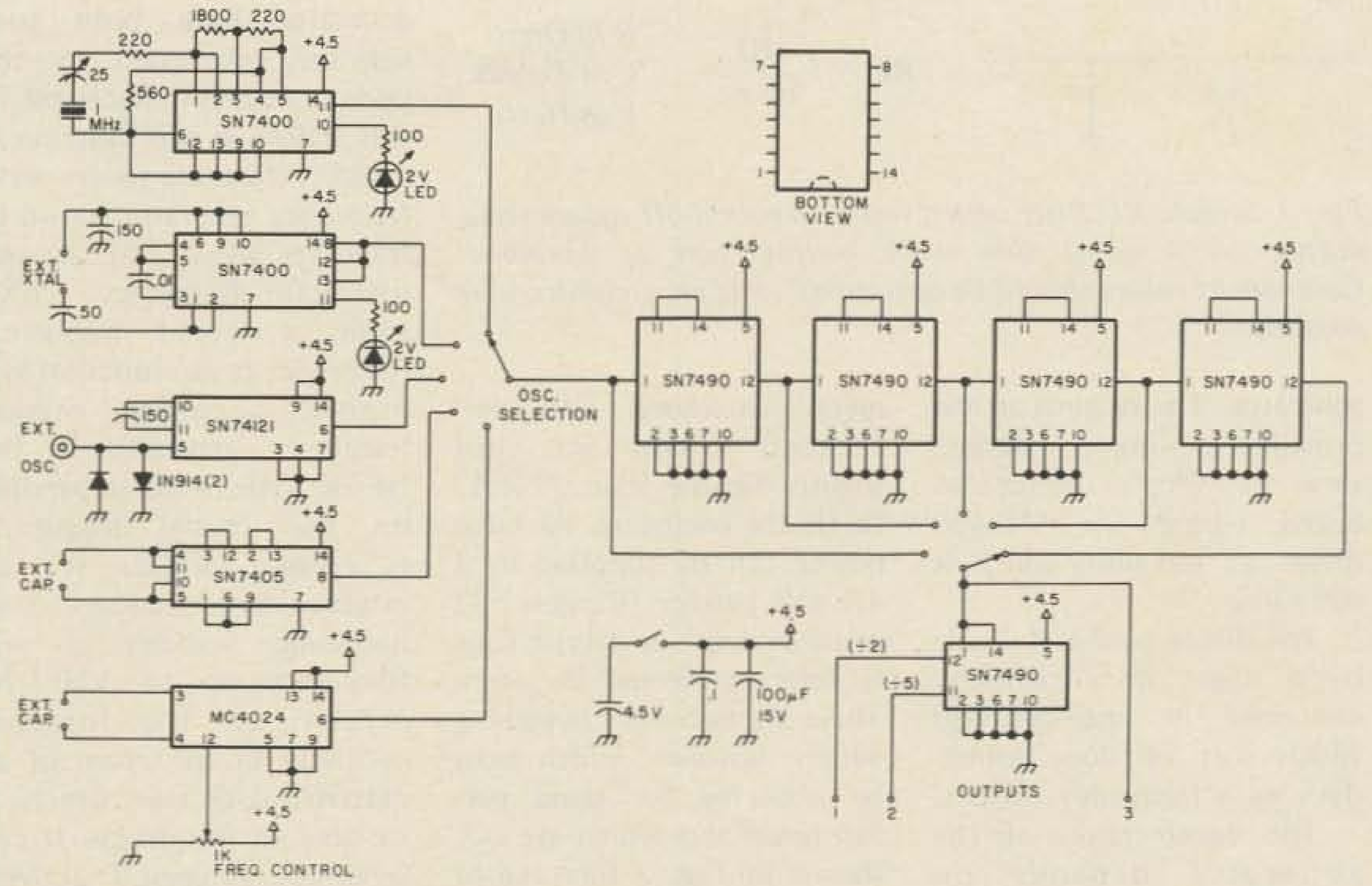


Fig. 2. Wiring diagram. Note that the divide by 5 and divide by 2 functions use only one SN7490. See text for some details on bypassing by each IC.

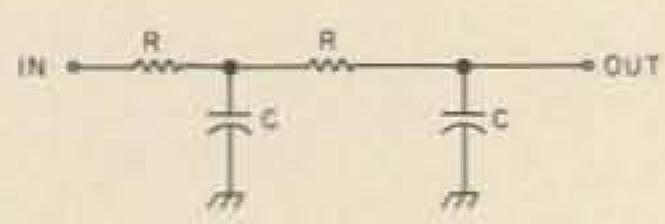
The actual circuit of the generator is shown in Fig. 2. Use is made, except for the optional fifth oscillator stage, of only simple SN7400 family ICs. The SN7400 1 MHz oscillator stage makes use of 2 of the gates for the oscillator itself, one for an output buffer, and one to drive the LED oscillator activity indicator. The oscillator can be beat against WWV for accurate calibration using the 25 pF trimmer. Do this by connecting the output of the oscillator, through a small coupling capacitor if necessary, to the antenna input of a receiver tuned to WWV on 5, 10, 15 MHz. During the 10 second tone pause on WWV, adjust the trimmer for zero beat. The second crystal oscillator will operate over a very wide range. The only component that may have to be changed with frequency to ensure stable oscillation is the 150 pF capacitor from one side of the crystal socket to ground. The 150 pF nominal value will operate satisfactorily with most HF crystals. The oscillator range can be extended higher or lower by making this capacitor have a value (in pF) equal approximately to 500 divided by the crystal frequency in MHz. Overtone as well as fundamental mode crystals will work.

The third oscillator, a SN7405, is a hex inverter which uses a single external feedback capacitor to produce a square wave output ranging from a few Hz to several MHz. The capacitor values needed will range from 300 uF to 30 pF. The output waveform is not exactly a square wave in the truest sense since the on and off times for each cycle are not exactly equal. Normally, this will not make any difference, but the situation can be corrected by connecting a 22k resistor from pin 4 to the supply voltage.

The fourth oscillator input stage has been found to function well and is left as originally shown. About a 1.5 to 2 volt input is required from any external sine or square wave generator to activate the multivibrator. The operation of the stage will be very obvious and even the output from a low voltage filament transformer through a current limiting resistor can be used to check that it is operative.

The fifth oscillator stage, a Motorola 4024, is a very interesting voltage controlled oscillator. Its circuit simplicity belies its very versatile usage. The operating frequency *range* of this oscillator (multivibrator) is controlled by the value of a single external capacitor connected between pins 3 and 4. The tuning or output *frequency* of the oscillator *within the range* established by the fixed external capacitor is determined by a variable 1 to 5 volt dc voltage applied to pin 12. For example, with a 430 pF capacitor between pins 3 and 4, the output frequency range as the voltage on pin 12 is varied between 1 and 5 volts is approximately 200 kHz to 1100 kHz. For a 100 pF capacitor, the range is 5 MHz to 25 MHz. The IC will actually operate up to 30 MHz with a bit of care as to lead dress, etc. The leads to the external frequency range determining capacitor should be kept as short as possible. Also, the ground leads and bypassing to the supply voltage pin should be short or the full frequency range of the oscillator may not be realized. Unlike the SN7400 series ICs which are widely available, one may have to look twice for a source of the MC4024. One source (at $3.00) is Circuit Specialists, P.O. Box 3047, Scottsdale AZ 85257.

The divide by 10 chain uses SN7490s in their conventional arrangement. Once the layout of a single stage has been determined, the rest need simply be duplicated. They can easily be wired on perforated board stock as can the other ICs in the



$$RC = \frac{10}{F 2\pi}$$ *R in Ohms*, *C in Farads*, *F in Hertz*

Fig. 3. Simple RC filter which will help round off square wave output so a quasi sine wave output can be obtained. Component values should be optimized using an oscilloscope if possible.

generator. The original article provided a simple enlarged view of simple perforated board wiring for SN7490 divide by ten units which is still valid.

The divide by 2 and divide by 5 stages are all actually contained in one SN7490 which sort of does double duty as a frequency divider.

The construction of the generator depends on individual taste. It can be constructed as an ac powered unit or as a portable unit. As an ac powered unit, a simple power supply using an LM309K regulator is recommended. My portable unit was constructed in an approximately 3" x 4" x 1¾" metal enclosure. The perforated board was just slightly smaller than 3" x 4" to fit the enclosure. Portable power can be supplied by a 4½ volt battery (Burgess 532 or equivalent) or 3 type C or D cells connected in series. There are two main bypassing details, however, which must be observed for good performance and which are *not* shown in Fig. 2 for sake of simplicity. *Each* IC must have a .1 uF disc capacitor going from its supply voltage terminal to ground. Also, a 100 to 500 uF/10 V electrolytic must be connected across the battery terminals for a portable unit.

The many uses of the generator have been considerably expanded by the update features described in this article. It can function as a highly accurate square wave frequency generator (down to fractions of a Hz) at any dividable frequency down from a crystal frequency reference. It can function as a highly accurate marker frequency generator in the HF or VHF range, depending on the crystal frequency reference used. It can produce basic frequencies or harmonic markers at any frequency up to VHF by means of its internal oscillator or by means of an external oscillator which is variable in frequency. It can serve as a crystal activity checker for almost all fundamental and overtone type crystals. The combination of having a crystal reference frequency oscillator available in combination with a variable AF or RF oscillator allows comparison to be made so one does not fall too far out of range within any variable frequency range.

A final word might be said about the output waveform of the generator. The output is a square waveform and hence quite rich in harmonic output. It cannot function as a pure, fundamental frequency sine wave generator and was never intended to do so. Reasonably good sine waves can be produced, however, at any output frequency by suitable RC filtering. The situation is very similar to that of filtering a sharply "clipped" audio signal before it is applied to a modulator stage in a transmitter. Fig. 3 provides the details of a 2 stage RC low pass filter which can be built for any AF to HF frequency to provide a reasonable sine wave output. Of course, LC filters will be better to get a pure sine wave, especially multi-section filters. The formulas for such LC low pass filters can be found in many reference texts on electronics. ■

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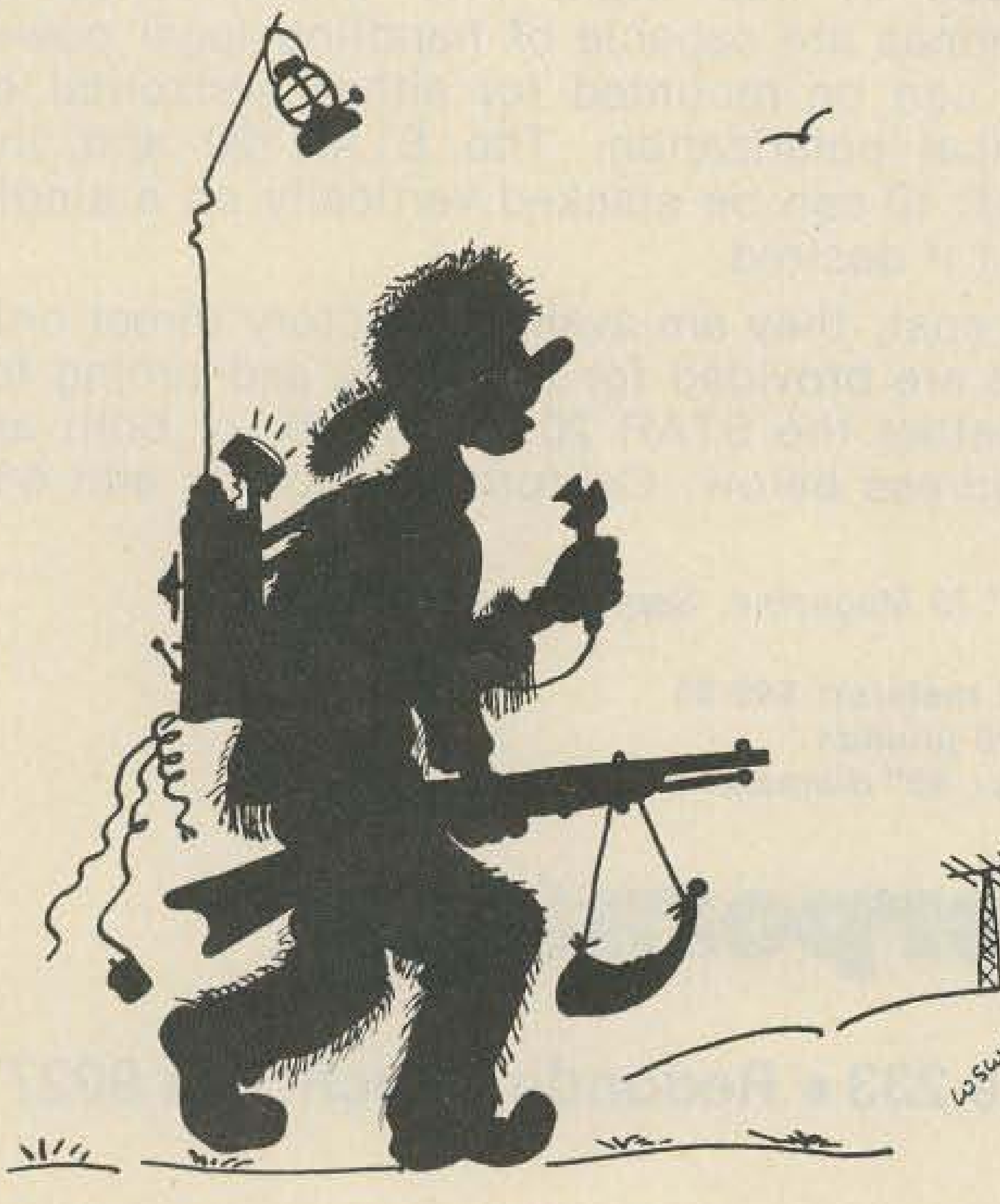
Who, me? A Pioneer?

- - some fantastic frontiers are wide open

There hasn't been a better time in the last fifty years than right now for the lone experimenter to do big things. There are still new frontiers that need exploring and some of these need just what the ham has to offer. If you have an unlimited curiosity about things electronic, and if new ideas are a great adventure to you. now is your time – that is, if you would like to do some research on your own.

Several areas that we would like to suggest are in the little known region where functions of the mind, body, electronics, and even communications just seem to overlap and blend. It's a sort of gray area where life itself may some day be explained by the laws of electronics.



There are still new frontiers for the ham.

True, it's not exactly communications, so why bring it up in a ham magazine? Mostly because it's an exciting new world of electronics for the ham to experiment with and because people in ham radio have such a versatile reserve of skills which can help. It's work that can use talents ranging from those of simple measurements to advanced computer processing of complex data.

It is a world where the mystics rush in and which most scientists prefer to avoid. Both groups are making noises, but few are coming up with any usable answers. With luck, the rewards to the experimenter could be great, and the right answers could change our whole way of life.

In the recent mad dash of space age research we learned how to ask more questions than we are able to answer. New developments in instrumentation and methods of observation have shown us that a lot of things are happening that we just can't explain. With the recent decline in research money for the big labs, and most of all, with ultraconservatism increasing in established science, many of these questions may remain unanswered for a long time unless they are tackled by adventurous individuals. When these new horizons are finally explored, the groundwork will probably have been done in someone's back room, garage, or on the kitchen table. But whoever does it will need an open mind, a lot of courage, and a thick skin to survive. A basketful of junk will also help.

Many of the unanswered questions are very embarrassing to the established lab worker because they cannot be answered on the basis of

Headache? Sore joints? Maybe it's positive ions!

facts that we now know. Many of the questions have been swept under the rug just to avoid the unorthodox answers that seem certain to follow.

To compound the embarrassment, some of the observed phenomena are even related to folklore subjects. New measurement techniques verify that some old and odd effects really do exist, but it is not easy to explain why or how. To make things even more confusing, some of the more spectacular subjects have been seized by the occult and psychic groups and converted into mystical exhibits. Even some of the so-called researchers seem to be hung-up in a fantasy world.

One question needing attention happens to be related to communications. What is really happening when people think they are communicating with plants and flowers? It sounds crazy' but there's more to it than you may think. We have all seen the wild publicity-seeking stories of how plants think and can sense man's feelings, both good and bad. Even electronic devices are being used to show how plants express their likes, dislikes, and fears. We must admit that when a meter moves to full scale, something must be causing it. Perhaps it's time we found out what is happening.

And here is where you will need some of the courage we mentioned. The people who are riding the crest of publicity will be quite upset when you prove that their great new mystic display is based on natural phenomena which you can demonstrate. Many of the people in the field of science are also quite narrow-minded. They will avoid you because you have been flirting with the mystics. I have been down this road before, with Kirlian photography.

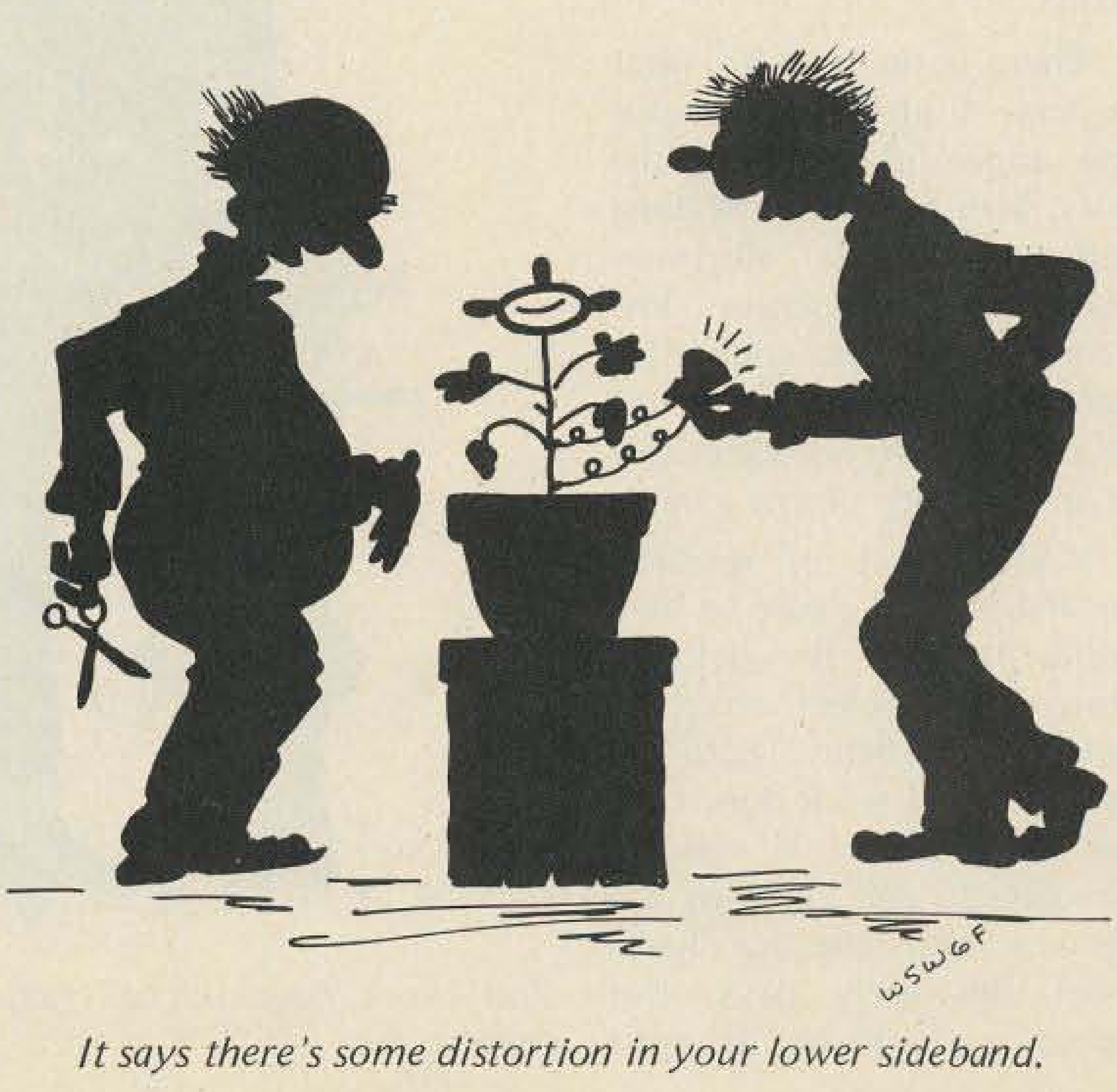
But somewhere a researcher is going to come up with some exciting new finds. Work in my own little lab leads me to believe that a few hams could put this whole plant dilemma in perspective. We will find that the phenomenon is based on sound principles, just like the night flying moth that uses microwave CW to communicate with its mate.

All things seem to indicate that the plant, when it reacts, is only acting as a detector and is sensing the changes in radiation from the human body. These changes are caused by the thoughts and emotions of the researcher or someone near. We already know that some of the signals are in the infrared spectrum, but who knows yet what other forms of transmissions are present? This could be important.

The plant, because its whole life process depends on forms of radiation, is simply acting as a transducer. Like the thermocouple, thermistor, or diode, it is merely converting a form of radiation into electrical impulses which can be read on ordinary instruments. The plant is not processing data and coming up with an opinion.

However, there is another exciting possibility if you care to speculate and crawl a little farther out on a limb. The electronics and chemistry of the plant may also be acting as a detector for forms of radiation which we do not know about yet. At this time, our thinking and theories are all built around electromagnetic radiation. Perhaps there are other forms of which we are not yet aware but which the right transducer could detect. There might be other natural transducers even better.

The well-known Dr. Rhine of Duke University fame proved in lab work that ESP involves a form of transmission that is neither time nor distance dependent. Perhaps it is time for some of us who specialize in detectors to try for some new answers. At this time there are at least six well-funded groups in the world trying to contact advanced civilizations in outer space. If people in outer space are as advanced as we would like to think they are, they may have long ago abandoned the use of slow, noisy, radio waves. Maybe we do need some new detectors. Perhaps your first far out space QSO will be using the old pine tree as a combined detector and antenna. Talk about the need for courage! You'd better be pretty well fortified when you tell your neighbor that you just received a message from Jupiter on the geranium. You may be lucky, though; he might just think you said



It says there's some distortion in your lower sideband.

germanium and are only half crazy.

But back to the serious business at hand; there is a lot of research needed in this area. We have found that certain plant leaves, even when removed from the plant, will give full scale readings on our instruments when a human hand is brought within four feet of the leaf. Just turning on a soldering gun across the room from the leaf will also produce full scale readings before the gun is hot enough to melt solder. A light beam on the leaf will do the same. But high background readings, even in a dark room, indicate that the leaf is also reacting to other signals. What are they? How about putting a leaf in a parabolic reflector? Where do we go from here? It's as wide open as ten meters in a high sunspot cycle.

Yes, this is unexplored territory, but there has been an occasional wanderer passing through. So don't be surprised if you find a few footprints as you travel along. Fifty years ago John L. Reinartz, one of the early all-time greats in ham radio (1XAM, later K6BJ), was interested in the electric currents generated by living plants.

There is no limit to what we may find now, with our new capabilities. All of the work with plants can be done with home-built electrometers and sensitive low frequency and dc voltmeters built from bargain ICs. It can be done on the kitchen table or in a corner of the garage.

Another bit of research needed is even closer to ham radio. It is in the field of atmospheric electricity, or potential gradient. There has been a lot of work done here but much more is needed. Needless to say, lightning has been a headache for hams from the early days. But lightning is probably the most publicized and least important part of the potential gradient story.

There is a voltage difference between the surface of the earth and the ionosphere of about 350,000 volts, with a continuous current of about 50,000 Amps at all times. This is distributed over the entire surface of the earth and at any given point the current is very small. However, the natural potential difference is vital to the balance of nature for the function of the human body and things that live above ground. One of the problems beginning to face us now is that with all of our electrical apparatus, power lines and such, we are destroying the original dc field. We are overriding it with pulsating ac fields which can have an adverse effect on both mind and body.

For a long time this idea was ridiculed by the scientific community. But just recently it was announced from Europe and verified by researchers in this country that people working in the vicinity of high tension power lines are developing health problems. This can also happen in the fields of other devices such as high power transmitters. Of course some of this work must be done by medics, but there is much that can be learned by the small worker.

The high level surges from power lines or other electrical equipment are suspected by some of being capable of even resetting biological time cycles. Dr. Ross Adey (WB6DEX) of the University of California School of Medicine has done some excellent work in this field.

It is known that altering the potential gradient within buildings can affect sleeping habits. In our own experiments we have found that restoring the voltage gradient in the home (artificially) can increase the ability to get a good night's sleep. It also increased the feeling of well being and the ability to think better during waking hours.

You don't have to be crazy – but you'll never convince anyone else.

In office experiments, returning the gradient to the normal values decreased work errors by 50% or more. This in turn brings up other questions. What does the HV supply in the TV do to the voltage gradient in the room? Is it good or bad? Perhaps its overall effects are worse than the x-rays we worry about? All of these things can be researched with instruments and power supplies that many hams can construct at little or no expense.

Still another of the interesting areas, which is somewhat related to potential gradient, is air ionization. An ion is just a particle that carries a charge. Of course they can be either positive or negative. The ions that we are interested in right now are air ions, or charged air particles. When the negative charges in the air that we breathe exceed the number of positive charges, we feel better, many respiratory ailments disappear, wounds heal faster, and all sorts of wonderful things happen. It's just one of those great days. Positive ions can cause the reverse, such as that old dopey, draggy feeling. Rheumatism, asthma, circulation, blood pressure, and all sorts of problems get worse. The medical effects of ions on life have been well researched by reliable labs in this country and in Europe. But that is just about where it has stopped. Perhaps one reason is that plenty of usable negative ions are hard to come by. And here is where the ham could really get involved – in the hardware. No one has seemed to come up with an easy way to generate negative ions without some unwanted side effects such as radiation, ozone, excess heat and the like.

As usual, the federal government has only made matters more confused. A few fast-buck artists got into the field early and peddled some phony equipment. Now everyone must suffer because the Food and Drug Administration has made rules that severely limit work in this area. Like many other things that the FDA has done, much of it is without rhyme or reason. It is another case of bureaucratic sheepdogs chasing phantoms and barking "wolf." However, if you don't hang out your shingle you are on safe ground.

There are many other unexplored areas, like the Lakhovsky effect, for those who like the unknown. Lakhovsky was a Russian refugee scientist who demonstrated years ago that bursts of low level broadband rf power in the microwave region would cause malignant growths, on both man and plants, to dry up and disappear. No harm was suffered by the patients. He proved his point in large hospitals in both Europe and this country. But like so many such discoveries, it was a good demonstration and that is where it stopped. Lakhovsky was not an M.D.; he was an engineer. This ruled out any use of his discovery. To close the incident, such effects as he demonstrated were theoretically impossible and therefore did not exist.

These are only a few of the fields that are electronic-related and are ripe for research. They also offer the chance to be tarred and feathered by our progressive and advanced society. However, considering that ham radio is a hobby that cuts across all professions and businesses, there is probably no group with more contacts to call on for help or additional information. As usual, some of your best help might come from your local politician. If worse comes to worst, you might end up with a job bugging . . . plants. ■

LETTERS

from page 38

bands.

The good people at the Baltimore FCC are tired of seeing me come in, pay my four bucks, and then blow the code test time and time again. My copy is good at home, but as your ad says, the steely-eyed monsters at the candy factory scare hell out of me. No kidding! I'm a big boy now and I feel that your tape is the answer. I'm not afraid of the truth.

I know that you most likely get tired of reading idiotic letters like this one, but your editorials and magazine in general has been the uplift that I needed to rekindle my interest in ham radio. I thought that everything had to be technical and impersonal with no fun, as depicted in other magazines. I admire your straightforward approach to state what you think is right or wrong – whatever the subject. Keep it up – that's what our society needs more of.

John J. Dippel, Jr. WA3YPS
Baltimore MD

READ THE RULES

I have your latest magazine at hand with the cover copy, "Hey, CBers!"

I have been a Novice for about seven months now and have had quite a bit of "on the air experience." My question is, "Why should any CBer want to change to ham?" Every time I make a good contact with someone, there is always another station that comes right on without listening, and starts calling. I in return simply QRT because it isn't worth it to continually buck this sort of thing. At least the CBer asks for a break and goes to another channel for the QSO. He also thanks you for the break. The CBer that I am in contact with is courteous and interested only in good clean contacts and signals. He is interested in good relations, and is an addition to his community and the many other CBers.

As far as rules are concerned, I can find as many offenders on the "ham band" as I can find on the CB channels. I have heard deliberate jamming, obscene language, lack of courtesy, operators using their equipment wrongly, and even solicitation.

So my question remains. I believe also that, before bragging too much that, "I am a ham, not a CBer," some of them had better read the rules again.

Louis Johnson WN1WHE
Shelburne Falls MA

SUCCESS

The Mount Airy VHF Radio Club (The Pack Rats) is pleased to announce that the Colombian moonbounce expedition was an unqualified success. We accomplished the following: 1) first 432 EME contact from South America; 2) first OSCAR 7 Mode "B" contacts from Colombia; 3) a total of 16 stations were worked on 432 EME, representing eight different countries; 4) there were approximately 75 OSCAR 7 Mode "B" contacts.

The station (HK1TL) was operated by the following individuals: Anthony Souza W3HMU, S. William Olson W3HQT, Walter Bohlman K3BPP, Elliott Weisman K3JJZ, Daniel Mitten WA3NFV, Socrates Martinez WB3AFY/HK1CWB, Bohlmar Aguilar WB3AOP/HK1AMW.

The trip was financed by the individuals listed, with assistance of the following: unidentified Pack Rat member, Mount Airy VHF Club treasury, Collins Radio, Northern California DX Association.

We deeply appreciate the South American coordination of HK1BYM, Dr. Atenogenes Blanco, and the complete support of the Area-2 Radio Club of Barranquilla, Colombia.

We would also like to acknowledge the stateside liaison work of W3KKN, Ernie Kenas, and W3TNP, Bertha Kenas. This liaison work was instrumental in developing new EME schedules. QSL via HK1TL, Box 169, Ottsville PA 18942.

Elliott T. Weisman K3JJZ
Philadelphia PA

STREAMING

Congratulations on the new format of *73*. It is a real nice magazine you are putting together. The pictures and diagrams look a lot better this way.

Our repeater, WR4AQR, is full of gadgets copied from *73*: I built the autopatch around an article printed in *73* a couple of years ago. I changed a few things around, like three digits to activate and three to deactivate, canceling activation if the digits are not pressed in less than four seconds, avoiding false triggering, time out limiting calls, activation of tape re-

Continued on page 288

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The Shirt Pocket Touchtone

-- autopatch from your HT or car

This article describes a simple and inexpensive touchtone encoder which can be built within an hour or two and used with any FM rig for autopatch operations.

Front view of touchtone encoder. Unit fits comfortably in shirt pocket.

Since the encoder is quite small, it is ideal for both mobile and portable work. When not in use, it can be concealed in an auto's glove box or carried in a shirt pocket. Connection to the FM rig may be acoustical or electrical as desired, thus permitting the pad to be swapped between several setups.

This little gem consists of a small "SME" touchtone generator manufactured by Data Signal, Inc., of Albany, Georgia, and any common, small transistor radio. The touchtone pad is mounted on the transistor radio, using its audio section for amplification. Output tones can then be fed into the mike of your FM rig. Data's inexpensive "SME" is sold in two parts: the printed circuit board tone generators and the keyboard proper. As several interchangeable keyboards are available, you can choose one which suits the particular transistor radio used.

Getting Started

First, select a touchtone

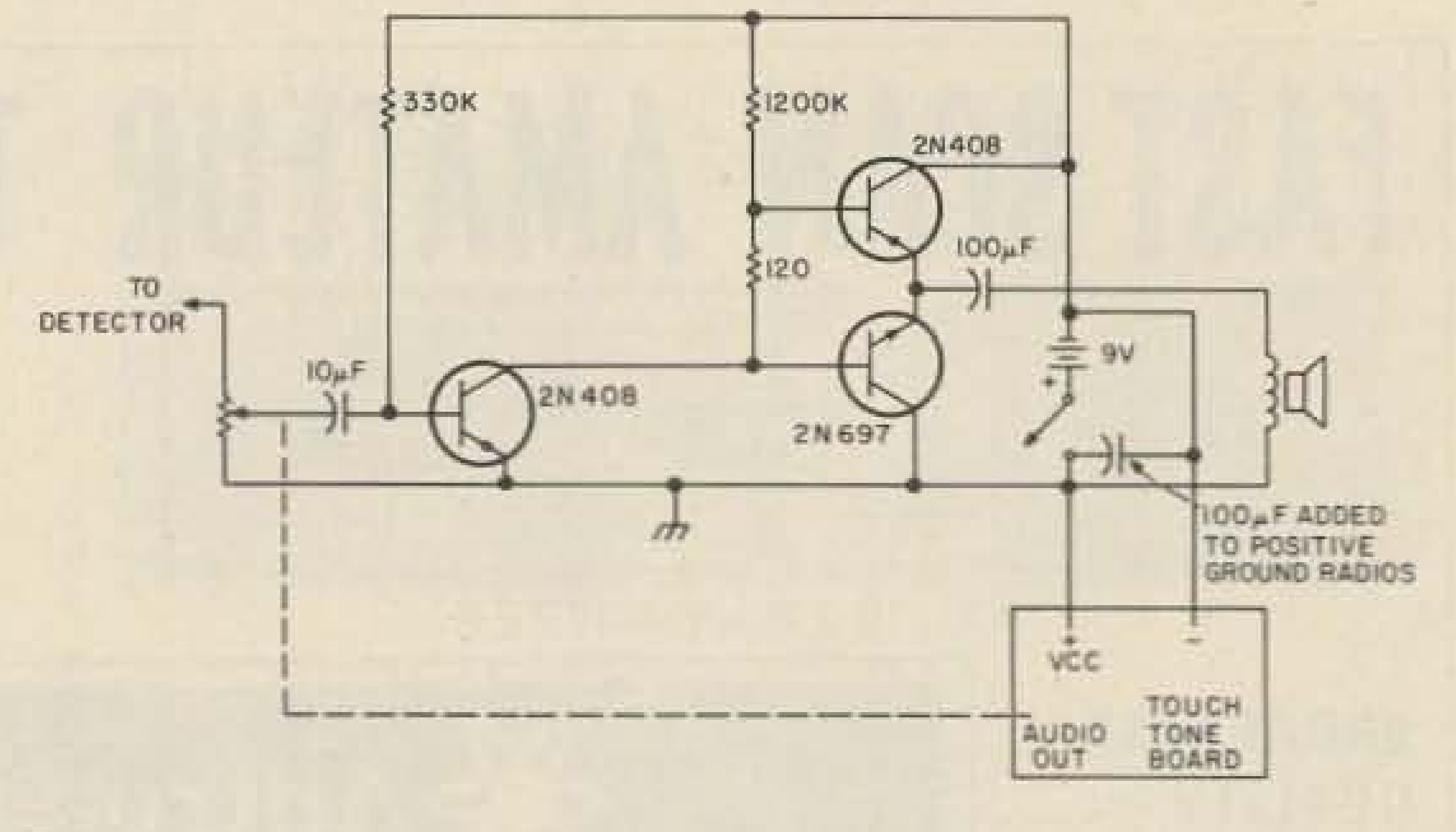

Fig. 1. Complementary-symmetry output of inexpensive transistor radio. Note use of 100 uF capacitor to facilitate mixing positive and negative ground circuits.

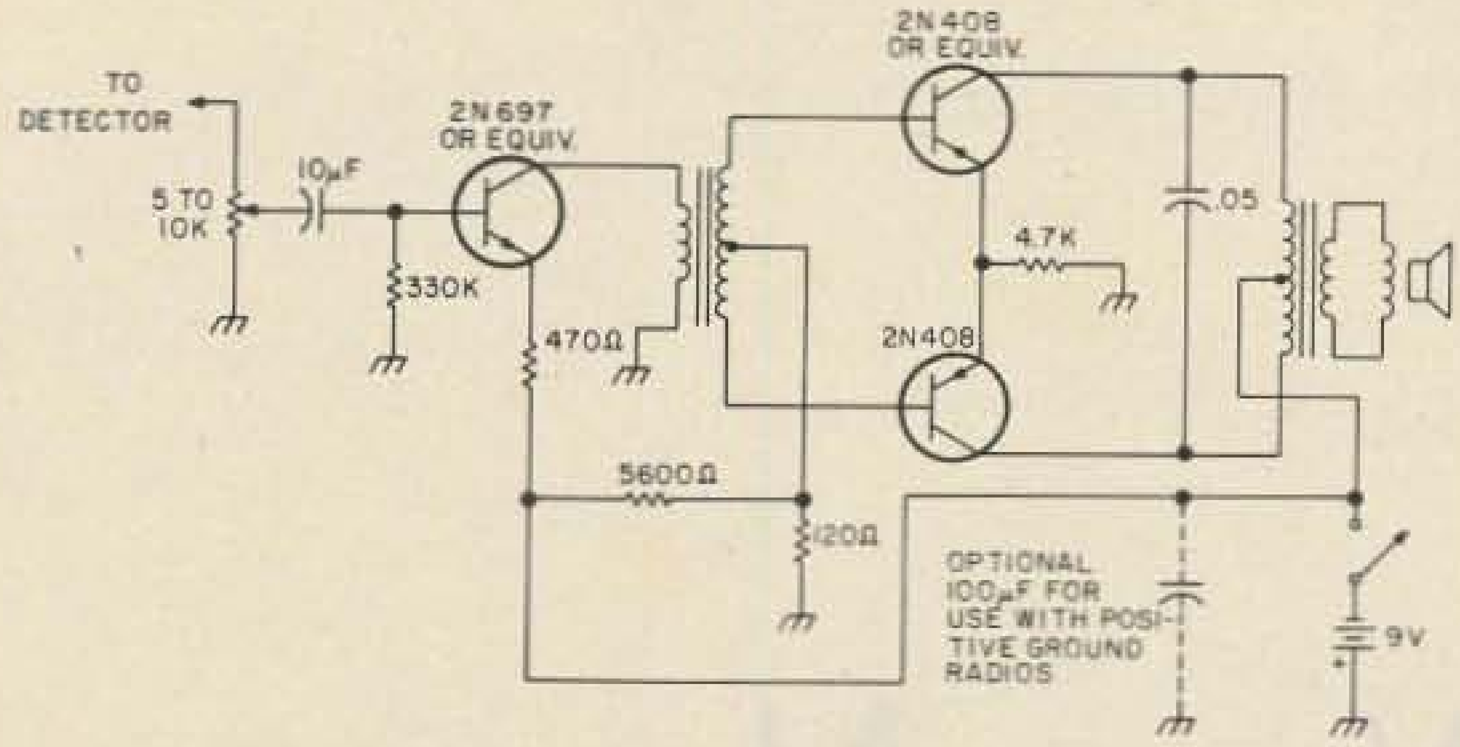

Fig. 2. Sample schematic of a push-pull output used in a transistor radio.

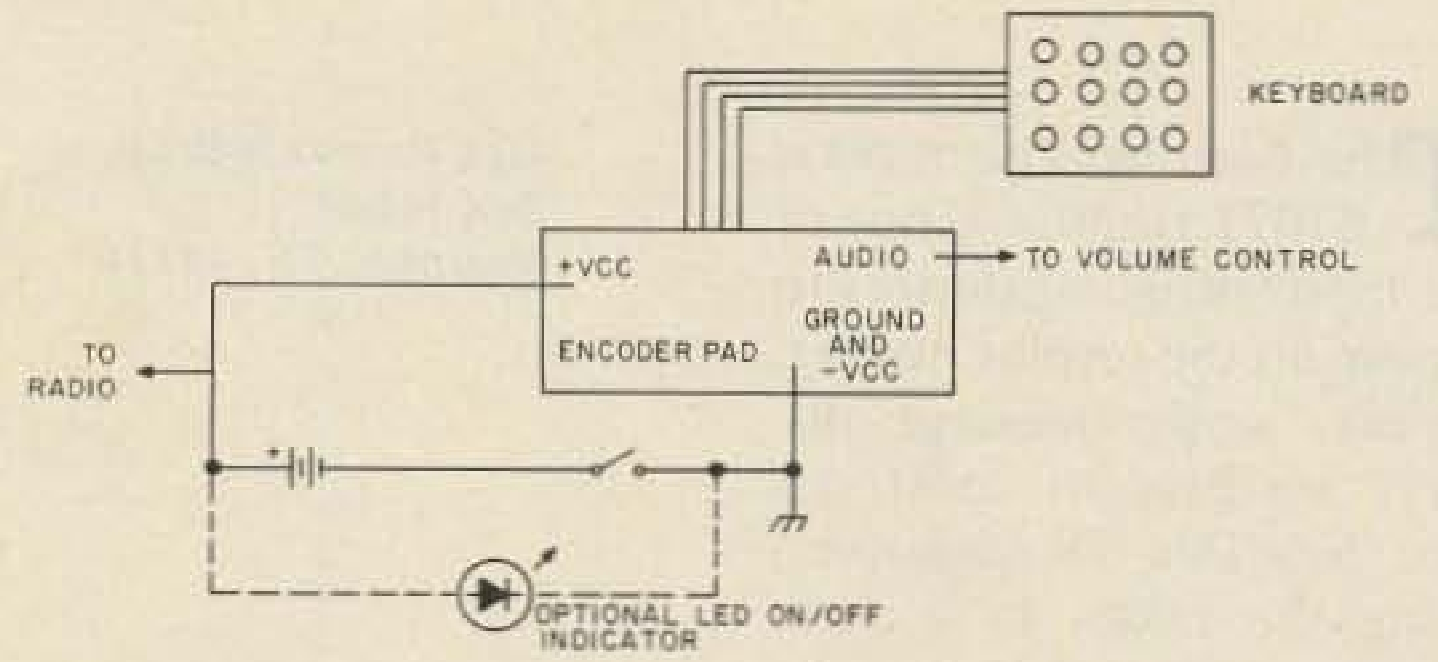

Fig. 3. Negative ground radio.

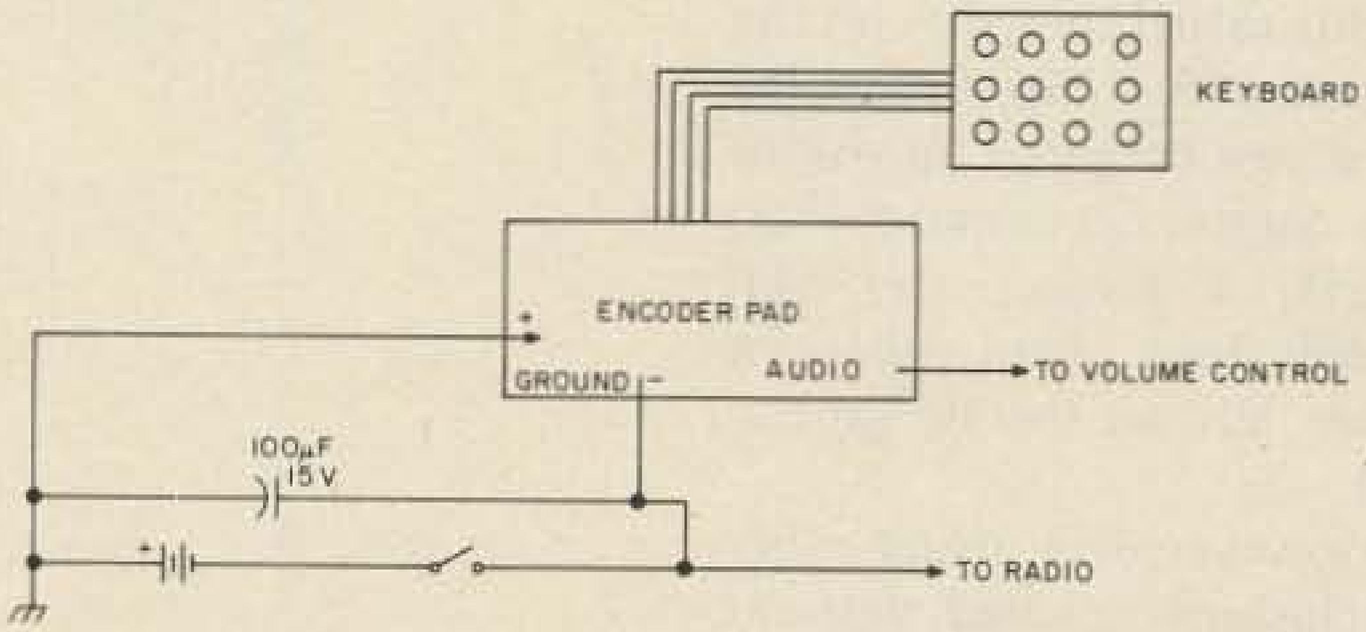

Fig. 4. Positive ground radio.

encoder and a small transistor radio which will look professional when mated together. Pick a radio with a straightforward audio circuit and negative ground (if possible). Make sure it has a long, flat loopstick antenna approximately the size of your encoder's printed circuit board. Most inexpensive radios use complementary-symmetry outputs similar to that shown in Fig. 1, while slightly more expensive radios use push-pull outputs similar to Fig. 2. Next, check out the radio's audio section when tones drive the isolated amplifier stage. This is best accomplished by connecting the encoder output to the wiper and one end of the volume control (you can also connect tones between the diode detector output side and ground, if the volume control method presents a problem). Clip lead jumpers are handy for this preliminary test.

Construction

If everything works properly, you are ready for the brutal part. Remove the radio's printed circuit board, and then detach the loopstick antenna and main tuning capacitor. Remove the tuning dial (if it wasn't removed along with the tuning capacitor) and any ornamentation covering the selected keyboard mounting area. Put the touchtone keyboard in place and mark the area which must be cut to allow proper fit (the keyboard's furnished paper template is ideal for this purpose). Now, carefully drill the necessary area to clear your keyboard's connectors. (This area can also be melted with a small, low wattage soldering iron.) I suggest that you make small oval connector openings, leaving the maximum amount of surface for pad support. After you become accustomed to working with plastic, you can move and reweld any printed circuit board supports removed during the previous drilling process. Next, drill four small holes for the pad corner studs and place a fine layer of cotton on the keyboard mounting surface. Now mount the pad, check to see that it isn't being bent or warped, and then lightly glue it in place.

After the glue dries, solder all connecting wires to the keyboard and tone generator board. Solder encoder ground and audio output wires to the radio volume control, and then reinstall the radio board while keeping everything intact and neat. The tone generator board can now be fitted into the loopstick antenna space. The final step involves connecting positive voltage to the encoder board. If you picked a negative ground radio, this is quite simple: just run leads to the *switched* nine volts, as illustrated in Fig. 3. If doubtful, use a VOM to find convenient take-off points and to make sure that low current isn't drawn while the unit is off (the SME doesn't draw current until a button is depressed). If you picked a positive ground radio, the encoder circuit will require grounding for ac (tones) but not for dc (nine volts). An arrangement which accomplishes this is shown in Fig. 4. The 100 uF capacitor passes tones while preventing dc from shorting the battery. Be sure the encoder and radio PC boards are not grounded together, and all will work fine.

The output level is adjustable with the radio's volume control. If your autopatch repeater is critical of tone amplitudes, just mark the exact tone level spot on the volume control knob.

Should you desire to electrically connect the encoder to a mobile rig and acoustically couple it to a handie-talkie, then make a small cable to use between the radio's earphone jack and your mobile FM rig. When using this method, best performance is realized by connecting the encoder output between ground and wiper of the FM rig's internal deviation potentiometer. This method eliminates any clipping or reshaping of tones that occur in the rig's audio section. (This modification is easily performed on gear like the TR-22. Reconnect speaker leads to bypass the front panel earphone jack, and then connect a wire from the deviation pot to the earphone jack "tip." Tape any exposed wires.)

Other Applications

Earlier, I suggested that you lightly glue the touchtone pad to the transistor radio. Should you later decide to mount this touchtone encoder onto a specific FM rig, cut the pad corner mounting studs and *carefully* work the pad loose (use fingernail polish remover if necessary). Cut connecting *wires* and remove both parts of encoder. Avoid resoldering to the pad – it's quite delicate. Now mount the complete works in your new rig.

Conclusion

During recent years, I have used several other touchtone encoders and they all had similar problems: They were inflexible and bulky. This little encoder is so small and handy that I can carry it anywhere, anytime. I think you, too, will enjoy owning and using such an interesting ham conversation piece. ■

Put Your Name in Lights

- - giant nixie message display

Jack Grimes W4LLR
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Memphis TN 38116

The Burroughs giant nixie B7971 readout is one of the most intriguing devices to appear on the surplus market. Simple, single message displays are easy to construct. (See Nov/Dec *73 Magazine*.) Using the nixies in a clock requires only a few more parts than the usual LED readout chronometers and is well worth the effort.

But casual thoughts on the subject of building a changing word sign conjured up visions of a complex, computer logic matrix, a project this old, middle-aged ham thought better left to the IC generation.

However, like many other conclusions reached without proper cogitation, this one had no basis in fact.

Unfortunately, keeping beans (and occasionally meat) on the table, gas in the Ford, and two jumps ahead of the utility company and Ma Bell's collection departments requires a bread and butter job. Mine happens to be in the sales field. A part of my duties includes setting up and manning a booth at various conventions. For the past year, each time I set up the booth and hung the same wrinkled banner used for the past ten years, I would think how attractive a nixie display sign would look. Then, further dreaming, I would picture in my mind a changing letter display with the product name alternating with a hard hitting sales message. The changing letters would *have* to attract attention.

So, finally, I began doodling, figuring out the words and combinations I would need, and how and when and which segments would need to light.

One key fact was immediately apparent: The lighted segments needed to form the two messages would be contained in three strings:

1. "A" Segments common to both sets of words and numerals.

2. "B" Other segments connected together, which, when added to the common segment string, would form the first message.

3. "C" The third string, when combined with the common segments only, would form the second message.

With this obvious and simple discovery, the complex job had now become commonplace. All that was necessary was to wire the segments that were common to both messages so that they would stay lighted at all times. Then, by switching on either of the other strings a message would be formed. A simple, single pole, double throw toggle action would complete the display.

There were several ways this could be accomplished: mechanically, with a geared motor and cam; with tubes and a polar relay; or with switching transistors.

Resisting the temptation to revert to tubes, I turned to solid state. As usual, a persual of my available magazines turned up no information. So I started from scratch.

The 555 IC looked like the ideal timing device. Tying it to a flip flop (7476 or 7473) would give two positive voltages of opposite timing and selected duration. This voltage, I reasoned, could be used to turn on transistors in the negative leads of the nixie segment strings.

Actual construction of a

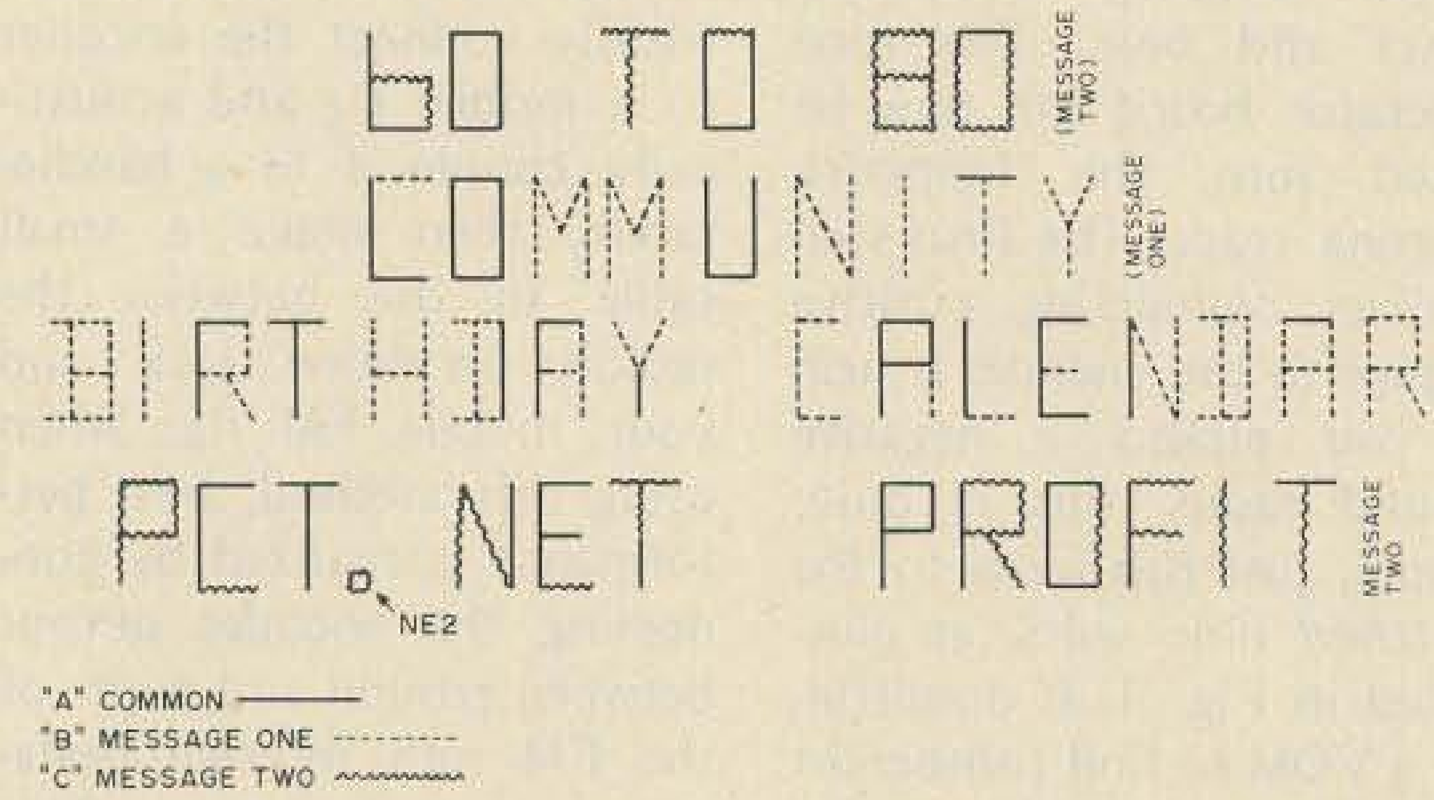

Fig. 1. Two center lines – first message. Top and bottom lines – second message. Only nixies in first message used to form second message. Two center lines change to form message shown here in top and bottom lines.

changing letter display of your choice is relatively easy. First, you must decide what you wish to say in each of the two messages. Then count the letters in the longest message. You will need this many B7971 nixie tubes and sockets.

(Let me say here that the article on simple displays in the Nov/Dec issue of *73* produced more reader correspondence than any article I've ever written for any magazine. Most wanted to know where to get the nixie tubes, which had been advertised in the May issue of *73*. At this writing, less than a week ago, I received tubes from Meshna, Lynn, Mass. A friend purchased six from Fair Radio Sales. All I can say is, watch the ads, and write to the surplus dealers.)

I found the easiest way to lay out the sign was to print the longest message in the center of a page, and the second message above (if a single line) or above and below (if a double line). See Fig. 1.

The next step was to code the letter segments. First I used a red Flair pen and drew (over the light pencil markings) all segments which would be common to both messages. Then the segments necessary to complete the first message in another color. And finally, the additional segments to complete the second message in the third color.

Once this task was completed, the sockets for the nixies could be arranged and mounted on the appropriate size sheet of plywood. If the sign contains two rows, the upper row of nixies should be mounted upside down. In this manner the sockets and wiring may be concealed by the cabinet frame. If you have bought the nixies with driver boards, use the aluminum brackets and sockets as removed from the boards.

The anode (pin 13) of each nixie is fed high voltage through an 800 to 1,000 Ohm resistor. (This resistor must be of a higher value if a higher voltage source is used.) All common segments are connected together and directly returned to the negative (-) terminal of the 150 V dc supply. The two other segment strings are tied together in a similar manner, but each of these strings terminates at a switching transistor. I used wire, the same colors as the sketch, which made it easy to correct mistakes. I also found it best to wire "live," with the voltage applied to the anodes, and with a test probe connected to ground. In this manner, a touch of the probe showed which segment was being wired.

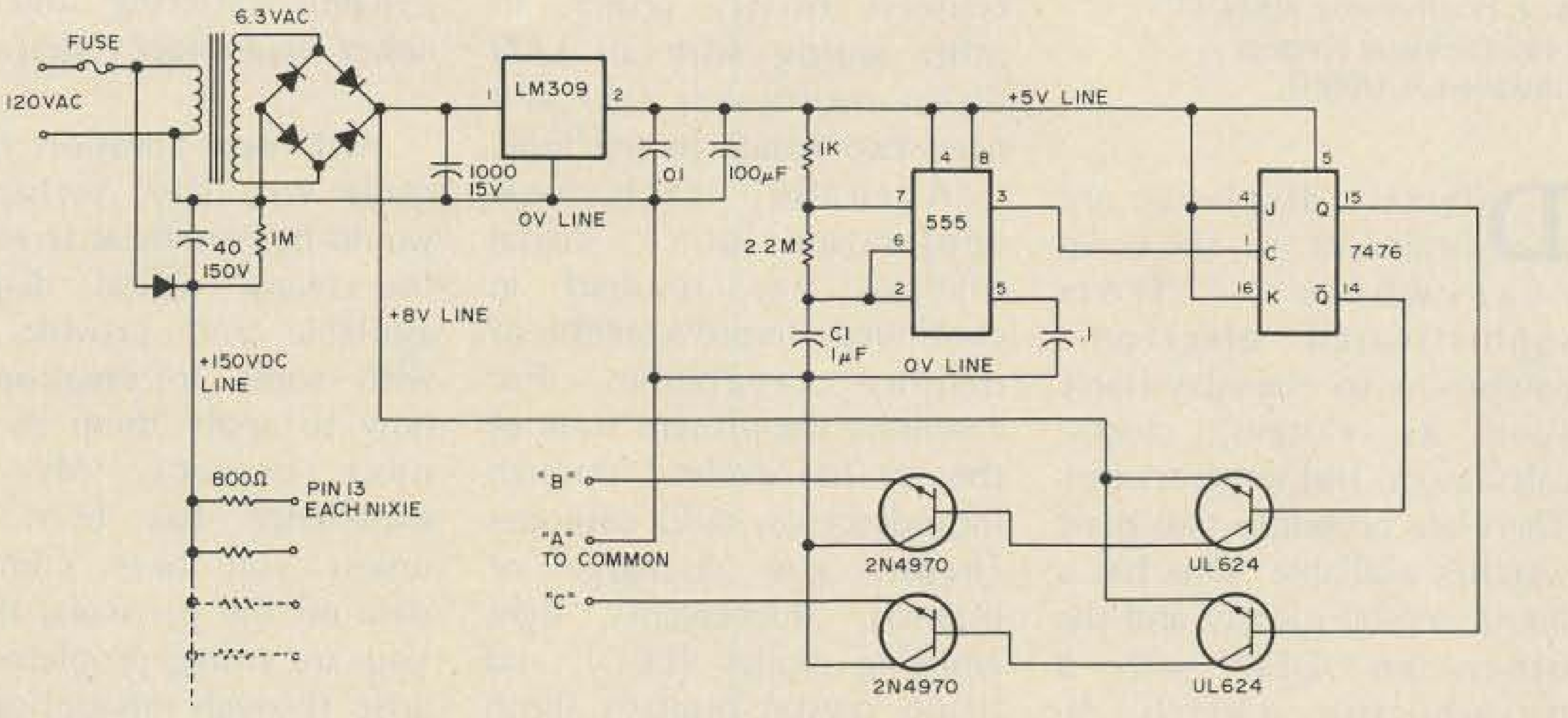

Fig. 2.

The power supply must provide two voltages, 5 V regulated, and 150 V dc. I used a half wave line voltage rectifier for the 150 volts. The low voltage supply is obtained from the rectified output of a small filament transformer and may be from 6.3 V to 12.6 V. I used a very small clock transformer giving 9 V ac. An LM309K provides the regulated 5 V.

The 555 circuit is standard. You may wish to change the 1 uF capacitor (C1) for a different display interval.

Only one half of the 7476 is used.

The only problem encountered was getting the right switching transistors for a clean on-off break so that no residual flicker remained on the turned off segments.

First, I tried driving the switching transistors directly with the 7476, but spikes coming from the high voltage nixie supply were too much for the 5 V IC.

All four driver transistors are NPN, and all are small, low wattage. The actual switching transistors used are 2N4970s (300 V, NPN). The isolation transistors are old UL624s, also NPNs removed from the surplus nixie boards.

A scope is not needed, as all measurements needed may be made with a VOM. Of course, when the power supply is complete, be sure the LM309 is doing its job before applying power to the 7476. If the 555 stage is working properly, you will read, at pin 3, approximately +4 volts, turned on, then off. If you use the 7476, the same voltage will be read at pins 14 and 15 (pins 5 and 6 with the 7473).

A printed circuit board would, of course, be the ideal way to wire the power supply and timer circuits. However, since this was a one of a kind project, I hand wired, soldering directly to the IC pins. A couple of hints for this type of construction: Use one strand from a small stranded wire to make the connections to the IC pins. Drill small holes through the board, looping the wire, up and back down to keep it secure and to provide tie points into heavier wire.

After the project is complete, mix clear five minute epoxy and apply to the fine wiring beneath the board. This makes the wiring practically immune to breakage, and is especially important if you intend to haul the sign around.

The cabinet may be constructed of any suitable material. I used plywood and 1 x 2 inch moulding for the framing, glued together.

One added thought: My particular sign contains an abbreviation, PCT. The period is formed with an NE2 and a 100k resistor wired in series between pin 13 of a nixie and segment string "C". Any small additional punctuation may be made in this manner.

Those of you who are in business will find many uses for a changing letter display. Others may end up with a novelty such as BAR OPEN / DOWN THE HATCH, or an alternating house number and street name, which would be a real conversation item.

So get out your scratch pad and start doodling. Who knows what you might come up with! ■

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Liquid Crystal Display Guide

--for low, low, low power consumption

Digital displays are beginning to show up everywhere – from sophisticated electronic equipment to everyday items such as ranges, clocks, calculators, and wristwatches. There are presently two basic watches available: One has a liquid crystal display and the other an LED with a push-button switch to conserve battery power. In other words, with an LED digital wristwatch you still need two hands to tell time.

Actually, each new application of a digital display has resulted in continued improvements of display capabilities. For example, the present state of the art has evolved through incandescents, cold cathodes (neon, gas discharge or plasma), fluorescents, light emitting diodes (LED), and liquid crystal displays (both dynamic-scattering and the newer field effect types).

With new advances being made very day, perhaps it would be beneficial to review the many digital displays available and provide you with some information on how to apply them in your next project. My own experience has been that unless you have complete data on the particular device you are using, problems can arise through misapplication. Perhaps this article will serve to acquaint you with the characteristics of each device and serve as a handy reference. Emphasis will be on liquid crystal displays since I feel these devices will dominate the display field in the future.

Display Types

It would not be appropriate if we did not begin our tour with the NIXIE (a trademark of Burroughs). This device is one

Display Model	Height (inches)	Drive Voltage	Power Consumption	Remarks	Manufacturer	Available From
3601	0.6	15-20 V ac	2.25 mW	3½ digit instrument display	Hamlin, Inc.	KA Electronic Sales
3501	0.47	@	1.5 mW	8 digit calculator display	Lake & Grove St.	1220 Majesty Dr.
3401	1.12	15-120 Hz	3.75 mW (all segments energized)	3½ digit clock display	Lake Mills, Wis. 53551	Dallas, Texas 75247
7543 (R/T)	0.5	Transmissive: 4-6 V ac @ 30-1000 Hz	0.5 uA per digit with all segments on	3½ digit instrument	Liquid XTAL Display Inc.	Various Distributors
7544 (R/T)	0.5			4 digit 24 hr. clock	24500 Highpoint	
7560 (R/T)	0.5	Reflective: 9-15 V ac @ 30-1000 Hz		6 digit counter display	Rd., Cleveland Ohio 44122	
701		3 or 6 V ac	1.0 uW	12 hr. watch display	Beckman Inst.,	Various
702		@	total	24 hr. watch display — All	Inc., Helipot Div.	Distributors
703		25-100 Hz	average power	12 hr. watch display — Field	Fullerton, Ca.	
705			for all digits	3½ digit watch with date — Effect		
SSSI P/N: 84-06051	0.4	7 V ac @ 30 to 100 Hz	0.5 uW per segment	Field effect type 3½ digit instrument	ILIXCO	Solid State Sales, Inc., P.O. Box 617 Columbia, Md. 65201

Fig. 1. Typical liquid crystal displays available with general characteristics for each type. The low voltage types (7 V ac or less) are field effect types, while the 15 V ac models are usually dynamic-scattering types.

of the oldest electronic displays available and it has a different element for each numeral 0 to 9. An obvious disadvantage of this display is that each of the numerals is on a different plane, besides requiring a very high operating voltage. Despite the initial drawbacks, these displays have served us well and we continue to see them used in various pieces of gear.

The next phase in the development of displays evolved into the seven segment variety with which we are all so familiar. There are several different types, one of which uses incandescent lamps to light each segment. New methods have greatly increased the reliability of incandescent displays and we are seeing lifetimes of 100,000 hours as evidenced by the Chicago Miniature Lamp CM5. The main advantages to incandescents are brightness and the availability of full color with proper filters.

Gas discharge displays are seven segment devices which operate with a high anode voltage in the neighborhood of 100-180 volts, but feature low power consumption. An example of this display is the familiar Burroughs Panaplex. A high potential between the anode and the cathode characters causes the segment to glow, much the same as a neon tube. A resistor is usually connected in series with the display to limit the current to a safe value.

Fluorescent displays, on the other hand, incorporate a small filament in the display which effectively lowers the ionization potential. They feature lower voltage (20-30 volts), and low power consumption, and emit a blue-green color. The main disadvantage is the requirement of power for the filament, usually 1 or 2 volts @ 40-50 mA. However, the lower anode voltage makes the fluorescent display easier to multiplex, which is the reason you may see them in desk-top calculators.

Parameter	Dynamic - Scattering	Field Effect
Capacitance Above Threshold	5-35 pF (per segment)	5-35 pF (per segment)
Capacitance Below Threshold	2-15 pF	2-15 pF
Resistance Above Threshold	1-10+ megohms	400+ megohms
Resistance Below Threshold	500k-5 megohms	200+ megohms
Drive Voltage	12-20 V ac	2-8 V ac
Typical total Power Consumption (3½ digit watch)	50 uW	1.0 uW

Fig. 2. Typical characteristics for liquid crystal displays. Note the total power consumption at the bottom of the chart. By comparison, a 3½ digit LED watch display consumes 60 mW or 60,000 times as much power as the field effect LCD. The ac drive voltage may range from 25 Hz to 1 kHz although 32 Hz is typical for battery operated equipment and 60 Hz for line operated equipment.

Now enters the light emitting diode (LED) on the scene and it becomes a whole new ball game. The LED is solid state and is usually made from gallium arsenide phosphide or gallium arsenide. Each of the seven segments usually consists of one or more LEDs whose brightness is dependent on the current applied (up to a point).

LEDs are susceptible to failure from overcurrent conditions and/or too high an inverse voltage. They are available in either 7 segment or dot matrices which can display alphanumerics. Usually red in color, yellow or green displays can be obtained at a slight premium. Until recently, they were available with character height from 0.1 to 0.8". However, one manufacturer has just announced a 1.0" LED which uses two diodes per segment, requiring a larger power consumption. The display from IEE, Inc., requires 3.3 volts @ 20 mA per segment and is 0.5" wide, giving it a slimmer appearance when compared to other LEDs. LITRONIX has also followed suit with the announcement of a new 1.0" LED display.

LED 7 segment displays are either common cathode (decoder/driver provides source current to the display), or common anode (decoder/driver sinks current from the display). Up until now, LEDs have dominated the display field, but as we will be seeing, a new generation of devices is about to emerge.

Liquid Crystal Displays

We are all aware that the liquid crystal display (although the effect was discovered many years ago) has taken a back seat to other, more popular, displays. This is not too surprising, since early LCDs had life expectancies of less than 5000 hours and would fail completely if operated below -20° C. The problems experienced when it was first introduced have hampered the LCD in gaining popularity. In spite of this, the LCD has some important advantages that are worth considering.

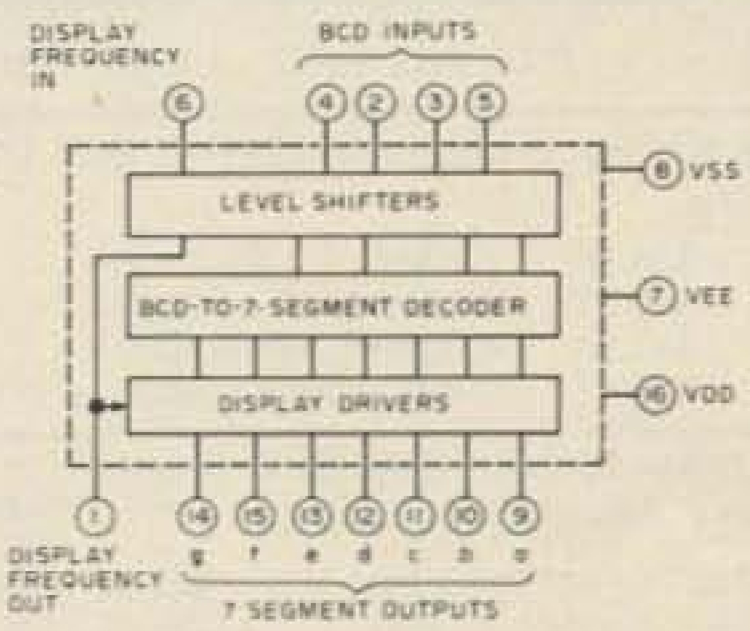


Fig. 3. Functional block diagram for the CD4055A BCD-to-7 segment decoder/driver with "display frequency" output.

Of all available displays, LCDs are the only ones that do not generate light. Rather, they scatter any light striking the display's surface. The two basic types are reflective (requiring illumination in front) and transmissive (which requires light from the rear). Since these devices do not generate light, they have the lowest power consumption requirements of any display developed to date. For example, the RCA TA8046R 3½ digit watch display with all segments energized requires a total current of 1.0 uA @ 15 volts! The average device dissipation (with 70% of segments energized during a 12 hour period) is only 10.5 uW.

While another advantage is readability in highly ambient light conditions, the LCD has a disadvantage of low readability in dimly lit areas. This, however, is being overcome with back lighting which is turned on for a reading in the dark. This does not offset the LCD's low power consumption, since studies have shown that watches are read very seldom in the dark.

Also, power consumption is dropping to even lower levels. With the development of field effect LCDs, it's possible to have a 200 mil high, 3½ digit LCD display that draws a total of 200 nW. Life expectancy is also increasing, with some units up to 100,000 hours.

Applications

The predominant application of the liquid crystal display to date has

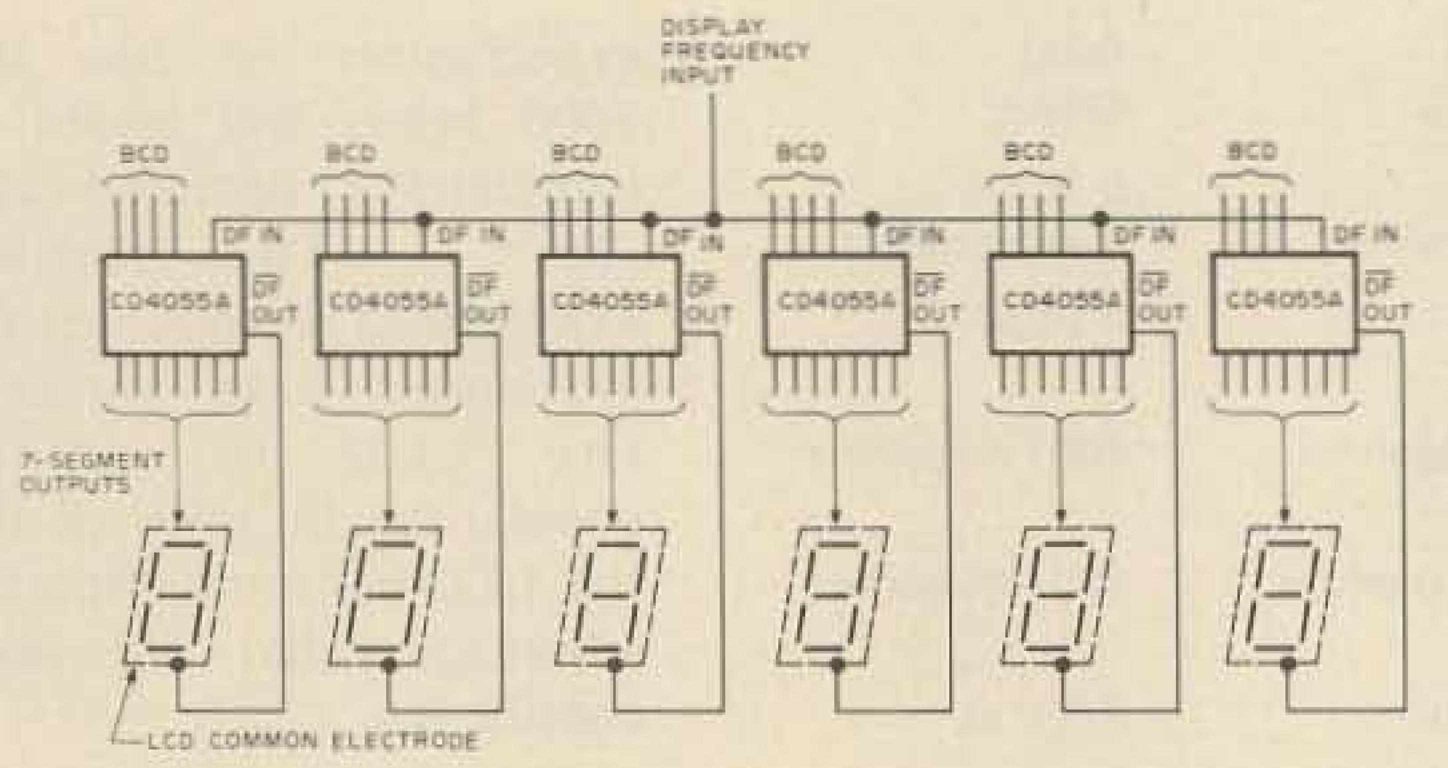


Fig. 4. Typical driver circuitry for liquid crystal clock display.

been in wristwatches, mainly due to their low power requirements. These displays are usually about 0.17" in height and a typical 3½ digit watch display can operate for a full year from a single dry cell watch-type battery.

You may be asking yourself, if the LCDs are so great, why haven't they appeared more in projects and articles? Perhaps the past reasons have been unfamiliarity of how to apply LCDs, price, or unavailability from the usual distributors. Notice I said "past reasons," because things are beginning to change fast and the LCDs are looking better every day (see Fig. 1).

Besides low power considerations, LCDs are ideal for use with CMOS circuits. It is now possible to construct compact portable equipment that can operate over extended periods of time from lightweight batteries. Also, for line-powered systems, the mating of LCDs and CMOS simplifies the driver circuitry, and eliminates current-limiting resistors.

Before you can properly apply LCDs, it will be necessary for you to put some of the LED techniques aside and consider a few new ones. To begin with, think of an LCD segment as a voltage dependent resistor in parallel with a capacitor instead of a diode as with the LED. The resistance of the segment is high above its threshold voltage and low below the threshold voltage. By now you may be realizing a primary difference between LCDs and LEDs: An LCD requires an *ac* voltage to operate and will actually be damaged by the application of dc. Consequently, driver circuitry is different, but in many cases less complicated than the LED driver. The basic parameters for both dynamic-scattering and field effect units are summarized in Fig. 2.

In addition, LCDs are temperature sensitive. Where an LCD is brought below or above its rated operating temperature range, it loses its liquid crystal characteristics. However, the condition is not permanent and the effects of temperature are reversible. When the LCD is brought back within its operating range, it will function again.

CMOS – LCD Decoder/Drivers

For a decoder/driver the Motorola MC14511 and MC14543 or RCA CD4055 and CD4056 can be used to drive the display (see Fig. 3). Also, there are many large scale integrated circuits available that provide parallel drive and eliminate external circuitry.

The RCA CD4055 and CD4056 are single digit BCD-to-7 segments that provide level shifting of the output. For example, output voltage swings of 0 to -3 volts or 0 to -15 volts are possible to drive either dynamic-scattering or field-effect displays. Fig. 4 shows a typical circuit for a clock display.

The CD4055A is a very versatile decoder/driver which can also be used for either common anode or cathode LEDs as well as LCDs. For example, if the DF input is maintained in a "low" state, the output segments will be "high" when selected by the BCD inputs. If the DF input is maintained in a "high" state, the output segments will "low." To drive an LCD, a square wave at 30 to 200 Hz is fed to the DF input. The selected segments will have a square wave output which is 180° out of phase with the DF input. When the DFout is level shifted (DFout) and applied to the LCD common line, the selected segments will be activated and displayed.

Where to Obtain LCDs

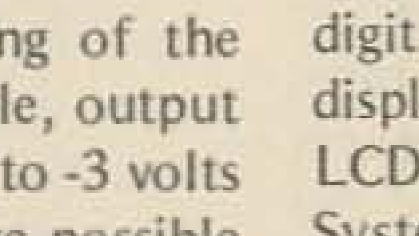
At present, I know of only three electronic suppliers catering to the ham market who advertise LCDs. Poly Paks has a small RCA wristwatch (3½ digit) display available, and KA Electronic Sales (Dallas) handles the Hamlin line of LCDs including a 3½ digit instrument (0.6" height), clock display (1.12" height) and an 8 digit (0.47" height) calculator display. Also of interest is the LCD sold by Solid State Systems, Inc., which is a field effect type from ILIXCO. This LCD is a 3½ digit (0.4" height) instrument type display and sells for $7.75 including the connector.

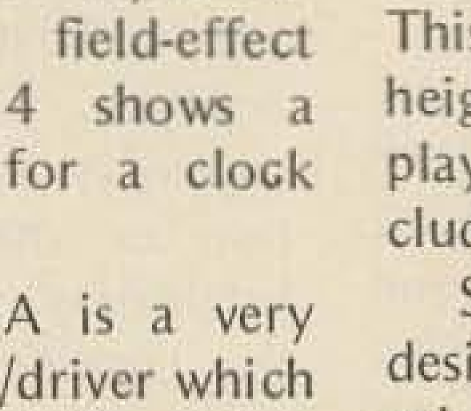
So let's get busy and start designing some equipment using liquid crystal displays. I think you will be pleasantly surprised with the results. ■

References

Electronic Design, Issue 19, September 13, 1975, p. 58.

COS/MOS Digital Integrated Circuits Data Book, RCA Solid State, Box 3200, Somerville, N.J. 08876.





Self-Powered Mike Preamp

- - when you need to SPEAK UP

Gene Hinkle WA5KPG
I/O Engineering
9503 Gambel's Quail
Austin TX 78758

While operating different SSB transceivers, I've noticed the difference in transmit audio gain between the different rigs on the market. The obvious solution for making up the gain necessary was the addition of a microphone preamp to each rig. After researching the literature for mike preamps, I soon discovered that most preamp circuits were too complicated or required power from the rig itself. A solution seemed to be battery operation of the preamp so it could be operated independently and be used with all rigs without any modifications necessary. My favorite hand mike is a Turner model 350C, which uses a ceramic element. A mike preamp was designed to boost the low level from the ceramic element to a more respectable level. The preamp was small enough to permit installation into the mike case itself, including the battery.

The three design objectives were small size, low power consumption, and operation over a wide battery voltage. Fig. 1 shows the design used to permit the use of an extremely small circuit board size. All components, if mounted on end, will fit on a tiny 1.5cm x 1.5cm vectorboard. This small board will fit inside of the Turner case as well as the case of any hand mike. The preamp is a common source amplifier with a gain of +20 dB. The frequency response is flat from 200 Hz to over 100 kHz. Because of the single FET stage and small voltages amplified, the power consumption during use is less than 200 uA. When not in use the power consumption is zero, permitting long battery life. Since the small circuit board easily fits into the Turner case, the only problem left was the placement of a battery. I found an Eveready 15 volt battery ideally suited for powering the preamp. The preamp circuit was designed to work down to a battery voltage of 7 volts, so the battery could be used as long as possible. Since the current is drawn from the battery only during transmissions, the battery should last nearly as long as its shelf life. The preamp has been left in the on mode for over a month before preamp failure due to low battery voltage.

The Eveready battery chosen is designated by the number 411, and costs less than $1.75 in single quantities. Its dimensions of 3.2cm x 2.5cm x 1.6cm allow it to just fit inside of the Turner case, as shown in Fig. 2. The battery rests on top of the mike cord where it enters the case, causing a clearance problem. This problem was resolved by carefully melting down the plastic cable strain relief channel with a soldering iron. The mike cord can then be pushed slightly deeper into the case, providing more room for the battery.

The push-to-talk switch was wired to disrupt the preamp output when not in use. A small power diode capable of handling the push-to-talk relay circuits was added to disable the preamp when not being operated. A small signal diode was inserted in series with the battery to prevent the reverse biasing of it during receive.

Since this mike preamp is self-powered, it can be used with any rig lacking in transmit audio gain. Since 20 dB of gain is used, overdriving the transmitter might be possible. The transmitter's mike gain will probably have to be adjusted to a low value to prevent excessive drive. The self-contained battery should last over a year, even with daily use of the mike. Although modifications were done on a hand-held Turner mike, the same circuit will work with other ceramic or crystal hand-held mikes, as well as with desk mikes. The only consideration would be the battery size. ■

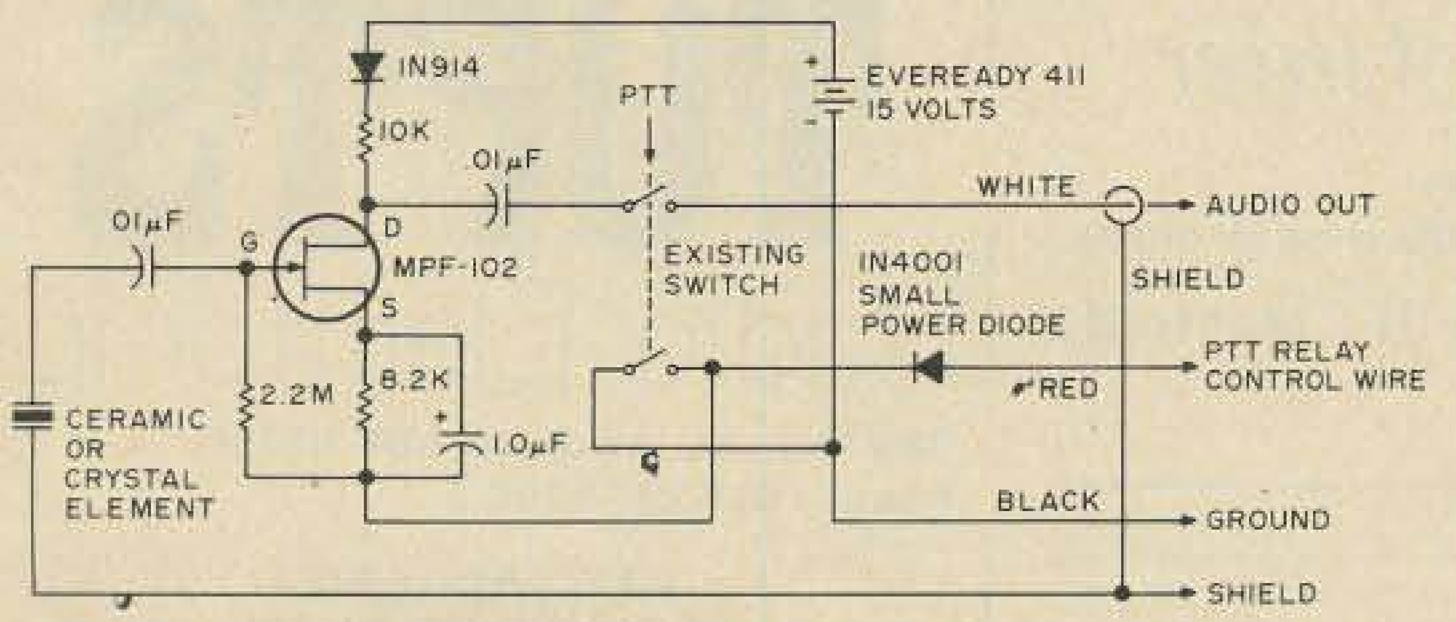


Fig. 1. Diagram of the preamp, which fits into the mike case. The unit requires less than 200 uA during use, and no current when not in use, permitting extended battery life. A small vectorboard is used to mount all components.

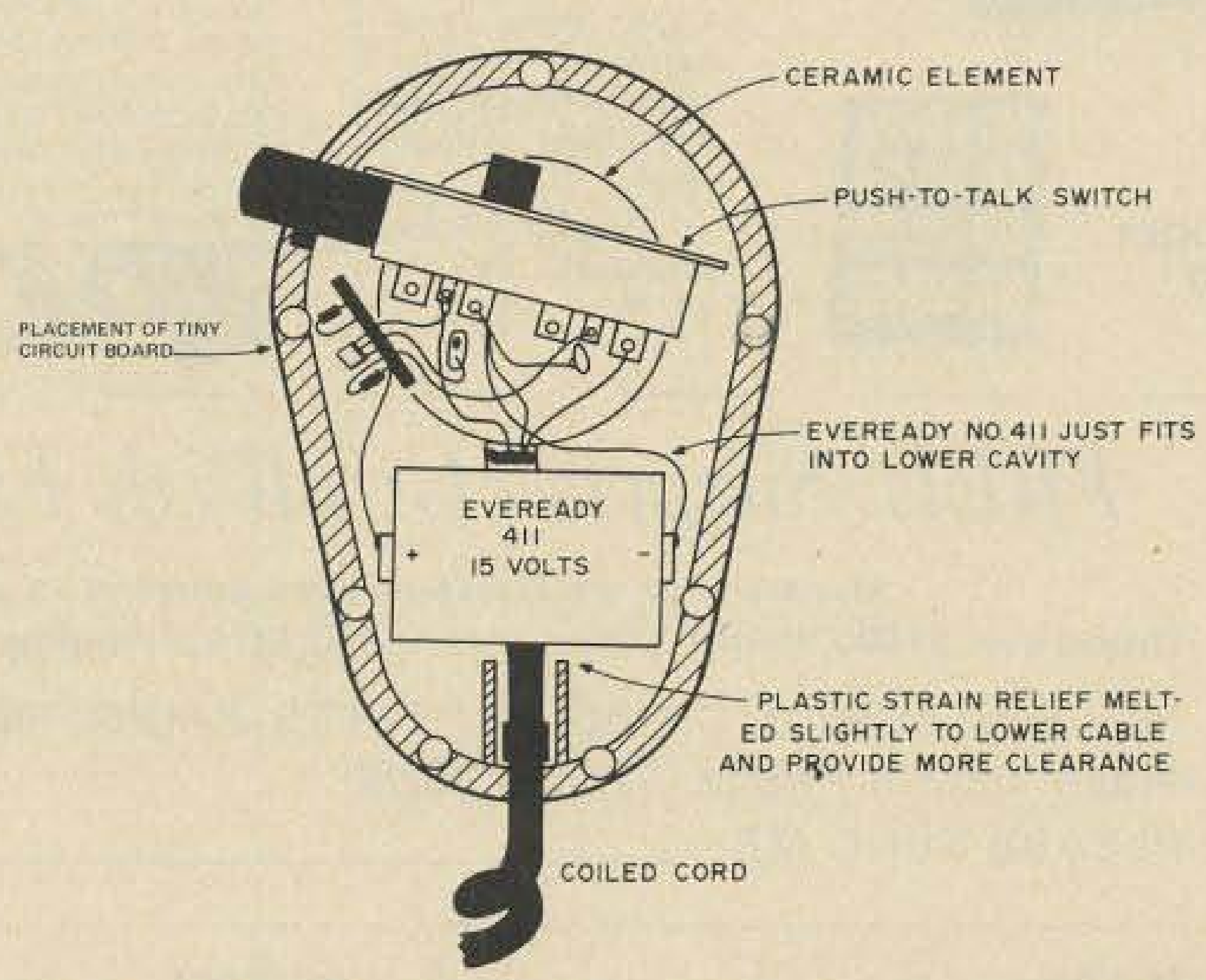


Fig. 2. Pictorial of the inside of the Turner case, which is similar to other types. The preamp circuit board and battery easily fit into the cavity. Battery terminals are soldered too, since a socket would not fit.

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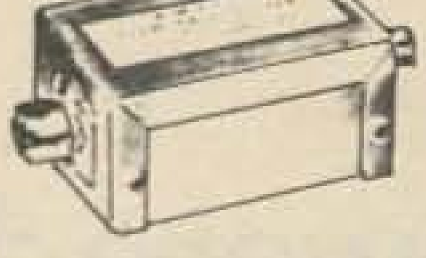

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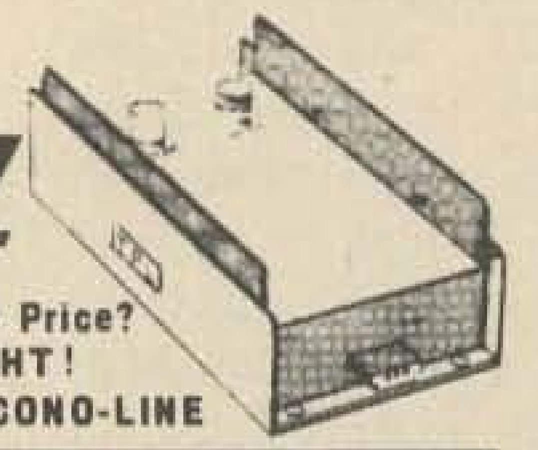

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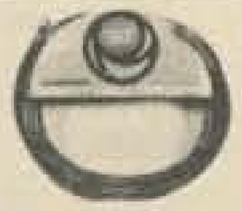

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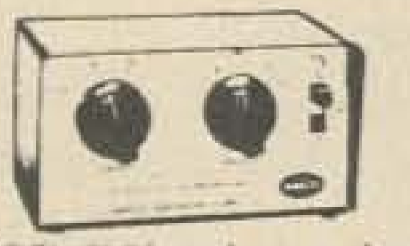

- 6 THRU 160 METERS
- TWO MODELS AVAILABLE
- RECOMMENDED FOR RECEIVER USE ONLY
- INCLUDES POWER SUPPLY

MODEL PLF employs a dual gate FET providing noise figures of 1.5 to 3.4 db., depending upon the band. The weak signal performance of most receivers as well as image and spurious rejection are greatly improved. Overall gain is in excess of 20 db. Panel contains switching that transfers the antenna directly to the receiver or to the Preamp.

Model PLF 117V AC, 60 Hz. Wired & Tested $44.00

MODEL PCLP is identical in all respects to the PLF except that two nuvistors are used instead of the FET.

Model PCLP 117V AC, 60 Hz. Wired & tested $39.00

UHF RF CONNECTORS

Low loss R-F connectors for Amateurs, Citizens Band and laboratory use. Silver plated for high RF conductivity.

A	PL-259	Coaxial Plug	$ .80
B	SO-239	Coaxial Receptacle	.68
C	M-359	Coaxial Right Angle Adapter	2.29
D	PL-258	Coaxial Junction	1.31
E	UG-175/U	Adapter for RG-58/U	.25
	DM	Double Male Plug	1.60

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Mail your order to Distributor: TUFTS RADIO, 386 Main St., Medford, Mass. 02155. Phone (617) 395-8280

PLEASE SEND ME: ____________________

Name ____________ Address ____________
City ____________ State ________ Zip ________

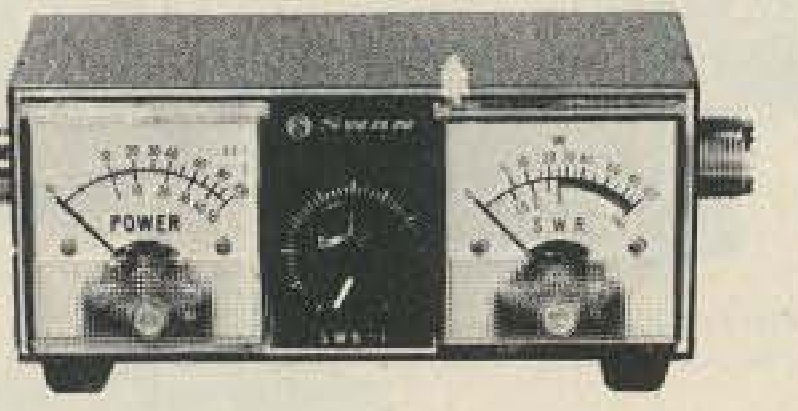
(Prices F.O.B. Medford, Mass. All units can be shipped U.P.S. Mass. residents add 5% sales tax.)
ALL SALES FINAL

TUFTS
Radio Electronics

386 Main St., Medford MA 02155
Phone: 617-395-8280

NEW ENGLAND'S FRIENDLIEST HAM STORE
Open 9 AM to 9 PM
Mon. – Sat.

why waste watts?



SWR-1 guards against power loss for $21.95

If you're not pumping out all the power you're paying for, our little SWR-1 combination power meter and SWR bridge will tell you so. You read forward and reflected power simultaneously, up to 1000 watts RF and 1:1 to infinity VSWR at 3.5 to 150 MHz.

Got it all tuned up? Keep it that way with SWR-1. You can leave it right in your antenna circuit.

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation

DELUXE 742 TRI-BAND MOBILE ANTENNA

- Automatically adjusts to proper resonance for 20, 40 and 75 meters.
- Power rated at 500 Watts P.E.P.
- Includes base section, automaticoil and whip top section. 742 Antenna $79.95

EXCLUSIVE DELUXE 5-BAND MOBILE 45 ANTENNA

- All band manual switching antenna for 10, 15, 20, 40 and 75 meters.
- Power rated at 1000 Watts P.E.P.
- Includes base section with mobilecoil and six foot whip top section. 45 Antenna $114.95

SWAN METERS HELP YOU GET IT ALL TOGETHER

These wattmeters tell you what's going on.

With one of these in-line wattmeters you'll know if you're getting it all together all the time. Need high accuracy? High power handling? Peak power readings? For whatever purpose we've got the wattmeter for you. Use your Swan credit card. Applications at your dealer or write to us.

WM2000 In-Line Wattmeter With Muscle. Scales to 2000 watts. New flat-response directional coupler for maximum accuracy. $49.95

WM3000 Peak-reading Wattmeter. Reads RMS power, then with the flick of a switch, true peak power of your single-sideband signal. That's what counts on SSB. $66.95

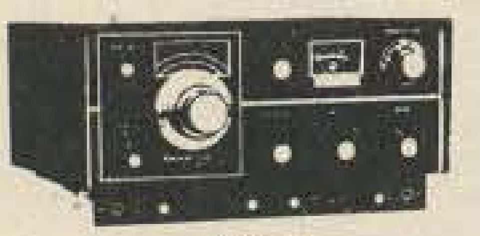
WM1500 High-Accuracy In-Line Wattmeter. 10% full scale accuracy on 5, 50, 500 and 1500 watt scales, 2 to 30 MHz. Forward and reflected power. Use it for trouble-shooting, too. $64.95

SWAN® ELECTRONICS
A subsidiary of Cubic Corporation

Hams the world over value amateur radio products from Swan Electronics. Among the most respected of these are the unique single-sideband rigs with that "special something" extra — like those illustrated here.

700 CX

SWAN 700CX Champion Transceiver. 700 watts P.E.P. input on the five most popular amateur bands. No other manufacturer gives you this much power and convenience for your money. $649.95



SS-200A

SWAN SS-200A Transceiver. Fully solid-state, unique broadband tuning on all five bands, and infinite VSWR protection. Maintains up to 300 watts P.E.P. input on any frequency selected. $799.95

SWAN LINEAR AMPLIFIERS A Mark II 2000 watt P.E.P. full legal input power unit or the 1200X matching Cygnet 1200 watt P.E.P. input powerhouse with built-in power supply. The choice is yours. $849.95

MARK II

CYGNET 1200X PORTABLE LINEAR AMPLIFIER

To quadruple the output of the 300B Cygnet de novo, simply add this matching unit for more than a kilowatt of power. Complete with self-contained power supply and provision for external ALC, this Cygnet offers exceptionally high efficiency and linearity. $349.95

1200 X

Additional Swan products include: fixed and mobile antennas, VFO's telephone patch, VOX, wattmeter, microphones and mounting kits. As another extra service, only Swan Electronics offers factory-backed financing to the amateur radio community. Visit an authorized Swan Electronics dealer for complete details or, if you prefer, write:

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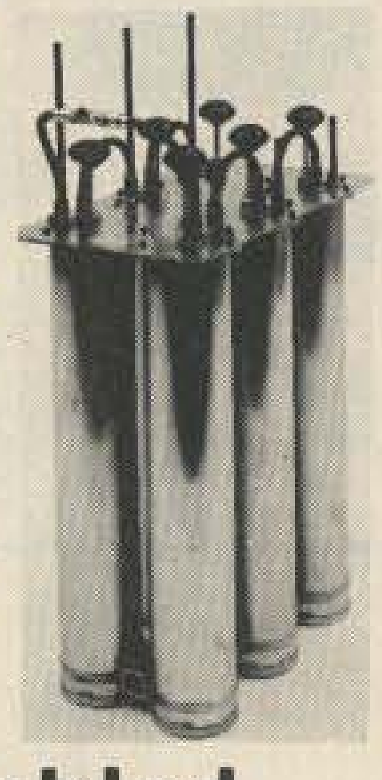
NORTH SHORE

RF TECHNOLOGY

DUPLEXER & CAVITY KITS... NOW available for you fully assembled and tuned!



- UPGRADE YOUR REPEATER WITH A RF TECHNOLOGY DUPLEXER.
- ALL DUPLEXERS AND CAVITIES ARE TEMPERATURE COMPENSATED WITH INVAR® AND MEET ALL COMMERCIAL STANDARDS
- ONLY TOP QUALITY MATERIALS GO INTO OUR PRODUCTS.
- BOTH KITS & ASSEMBLED DUPLEXERS AND CAVITIES ARE AVAILABLE TO YOU AT A SAVINGS TO YOU.

Mod. 62-3...6 cav., 2 mtr., insertion loss 0.6 db with isolation 100 db typical; pwr. 350 w. Kit $349 ea.-Assembled $439.

Mod. 4220-3...4 cav. 220 MHz insertion loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kit $249 ea. - Assembled $329.

Mod. 4440-3...4 cav. 440 MHz, insertion loss 0.6 db with 80 db isolation typical; pwr. 350 w. Kits $249 ea. - Assembled $329.

Mod. 30 Cavity Kits: 2 mtr. $65 ea., 220 MHz $65 ea., 440 MHz $65 ea.,; 6 mtr. $115 ea. Add $15 for Assembled Kit.

Also available: 6 mtr., 4 cav. Kit $399-Assembled $499, 2 mtr. 4 cav. Kit $249-Assembled $329, 440 MHz TV Repeater Duplexer

Only hand tools are necessary to assemble Kits!

Send your order to: Distributor: **TUFTS RADIO**, 386 Main St., Medford, Mass. 02155. Phone (617) 395-8280.

(Prices F.O.B. Medford, Mass. All units can be shipped U.P.S.-C.O.D. orders require $50 deposit —Mass. residents add 5% sales tax.)

- *Remote*
- *Motor Controlled*

RCS-4

COAX ANTENNA SWITCH

- Control unit works on 110/220 VAC, 50/60 Hz, and supplies necessary DC to motor.
- Excellent for single coax feed to multiband quads or arrays of monobanders. The five positions allow a single coax feed to three beams and two dipoles, or other similar combinations.
- Control cable (not supplied) same as for HAM-M rotator.
- Selects antennas remotely, grounds all unused antennas. GND position grounds all antennas when leaving station. "Rain-Hat" construction shields motor and switches.
- Motor: 24 VAC, 2 amp. Lubrication good to −40°F.
- Switch RF Capability: Maximum legal limit. Price: $120.00

MATCHING NETWORKS

MN-4
200 watts
Price: $110.00

MN-2000
2000 watts PEP
Price: $220.00

General: • **Integral Wattmeter** reads forward power in watts and VSWR directly; can be calibrated to read reflected power • **Matches 50 ohm transmitter output** to coax antenna feedline with VSWR of at least 5:1 • Covers ham bands 80 thru 10 meters • **Switches in or out** with front panel switch • **Size:** 5½"H, 10¾"W, 8"D (14.0 x 27.3 x 20.3 cm), MN-2000, 14⅜"D (36.5 cm).
• **Continuous Duty Output:** MN-4, 200 watts; MN-2000, 1000 watts (2000 watts PEP) • **MN-2000 only:** Up to 3 antenna connectors selected by front panel switch.

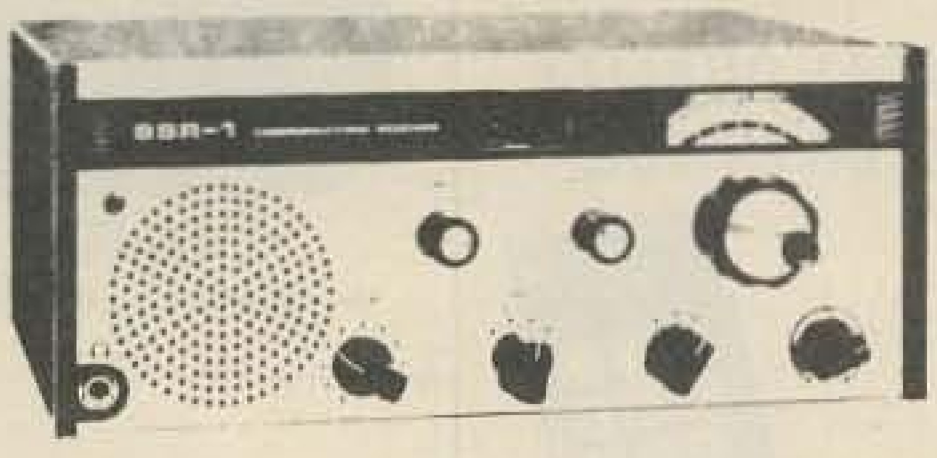
RF WATTMETERS

W-4 **1.8-54 MHz** Price: $ 72.00
WV-4 **20-200 MHz** Price: $ 84.00

Reads forward and reflected power directly in watts (VSWR from nomogram). Two scales in each direction. **Size:** 5½"H, 3¾"W, 4"D (14.0 x 9.5 x 10.2 cm).

Model	Full Scale	Calibration Accuracy
W-4	200 watts	(5% of reading + 2 watts)
	2000 watts	±(5% of reading + 20 watts)
WV-4	100 watts	±(5% of reading + 1 watt)
	1000 watts	±(5% of reading + 10 watts)

DRAKE



SSR-1 COMMUNICATIONS RECEIVER

- **Synthesized • General Coverage**
- **Low Cost • All Solid State • Built-in AC Power Supply • Selectable Sidebands**
- **Excellent Performance**

PRELIMINARY SPECIFICATIONS: • **Coverage:** 500 kHz to 30 MHz • **Frequency** can be read accurately to better than 5 kHz • **Sensitivity** typically .5 microvolts for 10 dB S+N/N SSB and better than 2 microvolts for 10 dB S+N/N AM • **Selectable sidebands** • **Built-in power supply:** 117/234 VAC ± 20% • **If the AC power source fails** the unit switches automatically to an internal battery pack which uses eight D-cells (not supplied) • **For reduced current drain** on DC operation the dials do not light up unless a red pushbutton on the front panel is depressed.
The performance, versatility, size and low cost of the SSR-1 make it ideal for use as a stand-by amateur or novice-amateur receiver, short wave receiver, CB monitor receiver, or general purpose laboratory receiver.

Price: $350.00

GENERAL: • **All amateur bands** 10 thru 80 meters in seven 600 kHz ranges • **Solid State VFO** with 1 kHz dial divisions • **Modes** SSB Upper and Lower, CW and AM • **Built-in Sidetone** and automatic T/R switching on CW • **30 tubes and semi-conductors** • **Dimensions:** 5½"H, 10¾"W, 14⅜" D (14.0 x 27.3 x 36.5 cm), **Wt.:** 16 lbs. (7.3 kg).

TRANSMIT: • **VOX or PTT** on SSB or AM • **Input Power:** SSB, 300 watts P.E.P.; AM, 260 watts P.E.P. controlled carrier compatible with SSB linears; CW, 260 watts • **Adjustable pi-network.**

RECEIVE: • **Sensitivity** better than ½ μV for 10 dB S/N • **I.F. Selectivity** 2.1 kHz @ 6 dB, 3.6 kHz @ 60 dB. • **AGC** full on receive modes, variable with RF gain control, fast attack and slow release with noise pulse suppression • **Diode Detector** for AM reception. Price: $599.00

34-PNB Plug-in Noise Blanker 100.00
FF-1 Crystal Control Unit 46.95
MMK-3 Mobile Mount 7.00
RV-4C Remote VFO 120.00

TR-4C SIDEBAND TRANSCEIVER

POWER SUPPLIES
AC-4 Power Supply $120.00
DC-4 Power Supply 135.00

Drake C Line

R-4C RECEIVER

R-4C Receiver 599.00

• **Linear permeability tuned VFO** • **Covers ham bands** 80, 40, 20, 15 meters completely and 28.5 to 29.0 MHz of 10 meters with crystals furnished • **Any fifteen 500 kHz ranges between 1.5 and 30 MHz** can be covered with accessory crystals for 160 meters, MARS etc. (5.0-6.0 MHz not recommended) • **Electronic Passband tuning** • **Accessory Noise blanker** • **Notch filter and 25 kHz crystal calibrator** • **Product detector** for SSB/CW, **diode detector** for AM • **Crystal Lattice Filter** • **Solid State Permeability Tuned VFO** • **Three AGC Release Times** • **Excellent Overload and Cross Modulation characteristics** • **Dimensions.** 5½"H, 10¾"W, 12¼"D. **Wt.**, 16 lbs.

ACCESSORIES
FOR R-4C RECEIVER
IF Filters: FL-250, FL-500, FL-1500, FL-4000, FL-6000 . . . . $52.00
4-NB Noise Blanker 70.00

T-4XC TRANSMITTER

T-4XC Transmitter 599.00

• **Covers ham bands** 80, 40, 20, 15 meters completely and 28.5 to 29.0 MHz of 10 meters with crystals furnished • **Upper and Lower Sideband** • **Automatic Transmit Receive Switching on CW** • **Controlled Carrier Modulation for AM** • **VOX or PTT** on SSB and AM • **Separate VOX Delay Controls** for SSB/AM and CW. • **Adjustable PI-Network Output** • **Two 8-pole Crysta -Lattice Filters** • **Transmitting AGC** • **Shaped Grid Block Keying** • **200 Watts PEP input on SSB** • **Meter indicates plate current and relative output** • **Solid State HF Crystal Oscillator** • **Dimensions:** 5½"H, 10¾"W, 12¼"D. **Wt.:** 14 lbs.

LINEAR AMPLIFIER L-4B

L-4B Linear Amplifier 895.00

• **2000 Watts PEP-SSB** • **Class B Grounded-Grid** — two 3-500Z Tubes • **Broad Band Tuned-Input** • **RF Negative Feedback** • **Transmitting AGC** • **Directional Wattmeter** • **Two Tautband Suspension Meters** • L-4B 13-15/16"W, 7-7/8"H, 14-5/16"D. Wt.: 32 lbs. • **Power Supply** 6-3/4"W, 7-7/8"H, 11"D. Wt.: 43 lbs.

POWER SUPPLIES
AC-4 Power Supply $120.00
DC-4 Power Supply 135.00

DRAKE

TVI MAY BE ELIMINATED WITH THESE DRAKE FILTERS

TV-5200-LP (formerly TV-1000-LP) rated 1000 watts input, 200 watts on 6 meters. SO-239 connectors built-in. $19.95.

TV-42-LP is a four section filter designed with 43.2 MHz cut-off and extremely high attenuation in all TV channels for citizens band and other transmitters 30 MHz and lower. Rated 100 watts input. SO-239 connecttors built-in. $10.95

TV-3300-LP 1000 watts max. below 30 MHz. Attenuation better than 80 dB above 41 MHz. $19.95

TV-300-HP High Pass Filter provides more than 40 dB attenuation at 52 MHz and lower. Protects the TV set from amateur transmitters 6 thru 160 meters. $9.95

TUFTS

Radio Electronics

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NEW ENGLAND'S FRIENDLIEST HAM STORE
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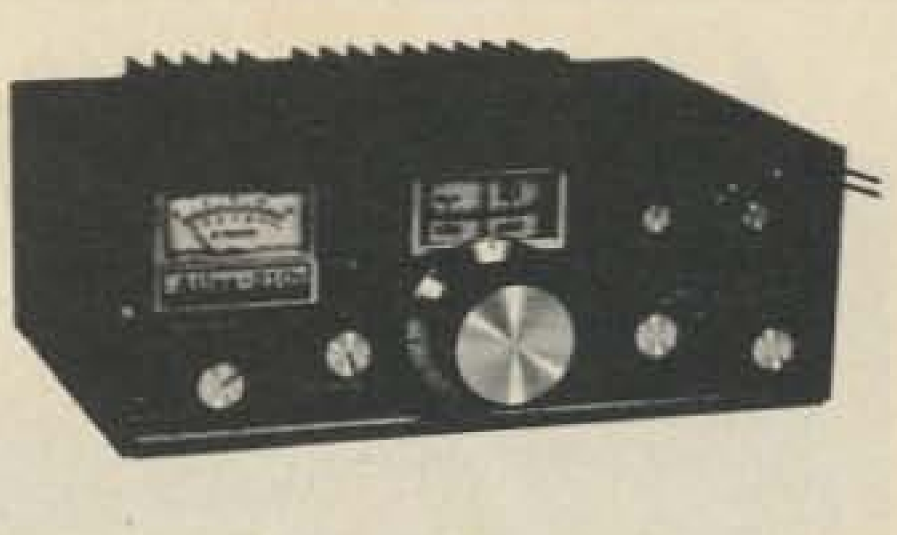
YAESU

FT 301	160M-10M Transceiver – 200 WPEP	$769.00
FT 301	Digital 160M-10M Transceiver – 200 WPEP	935.00
FP 301	AC Power Supply	125.00
FP 301	CID AC P.S. w/Clock and CW ID	199.00
FRG-7	General Cov. Synthesized Receiver	299.00
QTR-24	Yaesu World Clock	30.00
FT-101E		
160-10M	XCVR W/Processor	749
FT-101EE		
160-10M	XCVR W/O Processor	659
FT-101EX		
160-10M	XCVR W/O Processor AC Only, Less Mike	599
FL-2100B	Linear Amplifier	359
FTV-650B	6M Transverter	199
FTV-250	2M Transverter	229
FV-101B	External VFO	99
SP-101B	Speaker	19
SP-101PB	Speaker/Patch	59
YO-100	Monitor Scope	199
YD-844	Dynamic Base Mike	29
FA-9	Cooling Fan	19
MMB-1	Mobile Mount	19
RFP-102	RF Speech Processor	89
XF-30C	600 Hz CW Filter	45
XF-32A	8 Pole SSB Filter for FT-101	49
FR-101S		
SOLID STATE, 160-2M/SW RCVR		499
FR-101 Digital		
SOLID STATE, 160-2M/SW RCVR		659
Accessories:		
FC-6	6M Converter	30
FC-2	2M Converter	40
FM-1	FM Detector	20
–	Aux/SW Crystals	5
XF-30B	AM-Wide Filter	45
XF-30C	600 Hz CW Filter	45
XF-30D	FM Filter	49
SP-101B	Speaker	19
FL-101		
SOLID STATE 160-10M TRANSMITTER		554
Accessories:		
RFP-101	RF Speech Processor	89
MONITOR/TEST EQUIPMENT		
YC-355	30 MHz Counter	229
YC-355D	200 MHz Counter	289
YO-100	Monitor Scope	199
YP-150	Dummy Load/ Watt Meter	74
YC-601	Digital Readout (101/401 series)	179
VHF FM & SSB TRANSCEIVERS		
FT-224	24CH, 2M FM	249
FT-2 Auto 8CH/2M FM Scanner		379
200R	Sigmasizer 200CH, 2M FM Synthesizer	449
FT-620B	6M AM/CW/SSB	449
FT-221	2M AM/FM/CW/SSB	679
Accessories:		
MMB-2	Mobile Bracket (FT2A)	19
MMB-3	Mobile Bracket (200R)	19
MMB-4	Mobile Mount (FT-620B, FT-221)	19

FT-101E TRANSCEIVER



THE ATLAS 210x/215x

- Solid state SSB/CW transceivers
- 200 watts P.E.P. input
- No transmitter tuning
- The ultimate in sensitivity, selectivity, and overload immunity.
- Plus extended frequency coverage for MARS operation when used with 10x crystal oscillator.

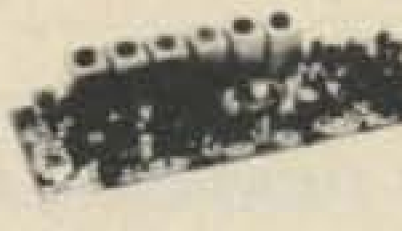
210x or 215x	**$649.**
210x or 215x with noise blanker	$689.
AC Console 110/220V	**$139.**
Portable AC Supply 110/220V	**$ 95.**
Plug-in Mobile kit	**$ 44.**
10x Osc. less crystals	**$ 55.**

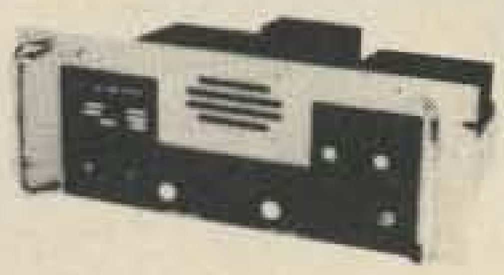
ATLAS RADIO INC.

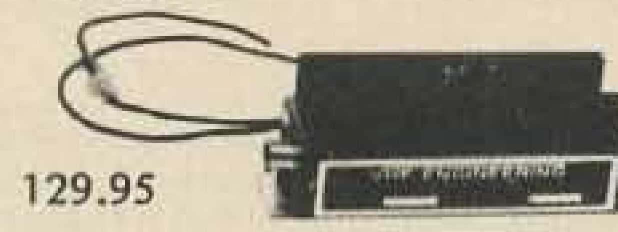
Vhf engineering

THE WORLD'S MOST COMPLETE LINE OF VHF-FM KITS & EQUIPMENT

TX144B Kit	transmitter exciter – 1 watt – 2 meters	$ 29.95
TX144B W/T.	same as above – factory wired and tested	49.95
TX220B Kit	transmitter exciter – 1 watt – 220 MHz	29.95
TX220B W/T.	same as above – factory wired and tested	49.95
TX432B Kit	transmitter exciter 432 MHz	39.95
TX432B W/T.	same as above – factory wired and tested	59.95
RX50C Kit	30-60 MHz rcvr w/2 pole 10.7 MHz crystal filter	59.95
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX144C W/T.	same as above – factory wired and tested	114.95
RX220C	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	69.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	79.95
RXCF.	accessory filter for above receiver kits gives 70DB adjacent channel rejection	8.50
HT144B Kit	2 meter – 2w – 4 channel – hand held xcvr with crystals for 146.52 simplex	129.95
PA2501H Kit	2 meter power amp – kit 1w in – 25w out with solid state switching, case, connectors	59.95
PA2501H W/T.	same as above – factory wired and tested	74.95
PA4010H Kit	2 meter power amp – 10w in – 40w out – relay switching	59.95
PA4010H W/T.	same as above – factory wired and tested	74.95
PA144/15 Kit	2 meter power amp – 1w in – 15w out – less case, connectors and switching	39.95
PA144/25 Kit	similar to PA144/15 kit except 25w out	49.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	39.95





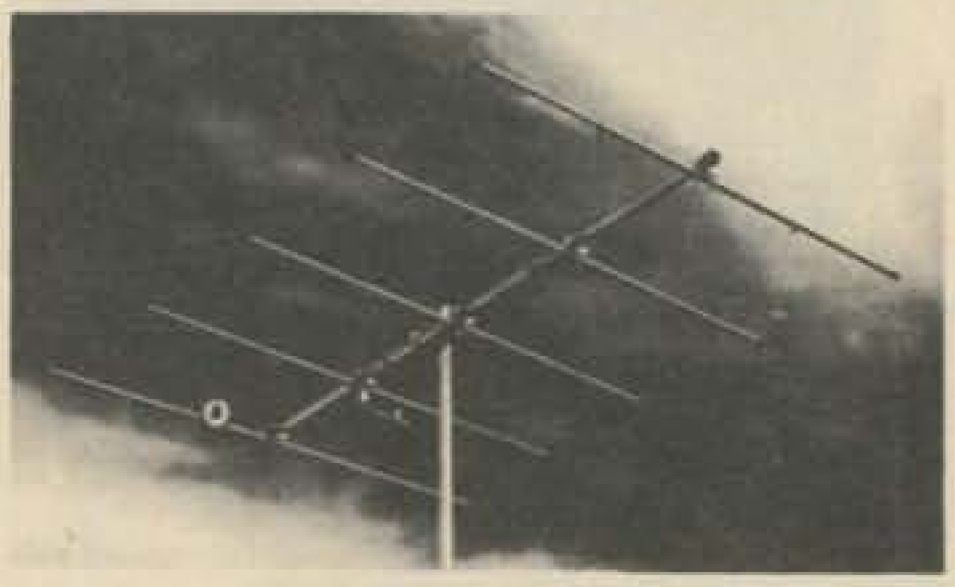


PA432/10 Kit	power amp – similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10	10w in – 140w out – 2 meter amp – factory wired and tested	179.95
PA140/30	30w in – 140w out – 2 meter amp – factory wired and tested	159.95
RPT144 Kit	repeater – 2 meter – 15w – complete (less crystals)	465.95
RPT220 Kit	repeater – 220 MHz – 15w – complete (less crystals)	465.95
RPT432 Kit	repeater – 10 watt – 432 MHz (less crystals)	515.95
RPT144	repeater – 15 watt – 2 meter – factory wired and tested	695.95
RPT220	repeater – 15 watt – 220 MHz – factory wired and tested	695.95
RPT432	repeater – 10 watt – 432 MHz – factory wired and tested	749.95
PS3 Kit	12 volt – power supply regulator card	8.95
PS15C Kit	NEW – 15 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T	same as above – factory wired and tested	94.95
PS25C Kit	NEW – 25 amp – 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	129.95
PS25C W/T	same as above – factory wired and tested	149.95

OTHER PRODUCTS BY VHF ENGINEERING

CD1 Kit	10 channel receive xtal deck w/diode switching	6.95
CD2 Kit	10 channel xmit deck w/switch and trimmers	14.95
COR2 Kit	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX	19.95
Crystals	we stock most repeater & simplex pairs from 146.0-147.0 (each)	5.00
Synn II Kit	synthesizer kit for 2M FM	169.95
CWID Kit	automatic identifier for repeaters, RTTY, etc.	39.95
CWID wired	same as above – wired	49.95

6 METER BEAMS



3 - 5 - 6 - 10 ELEMENTS

Proven performance from rugged, full size, 6 meter beams. Element spacings and lengths have been carefully engineered to give best pattern, high forward gain, good front to back ratio and broad frequency response.

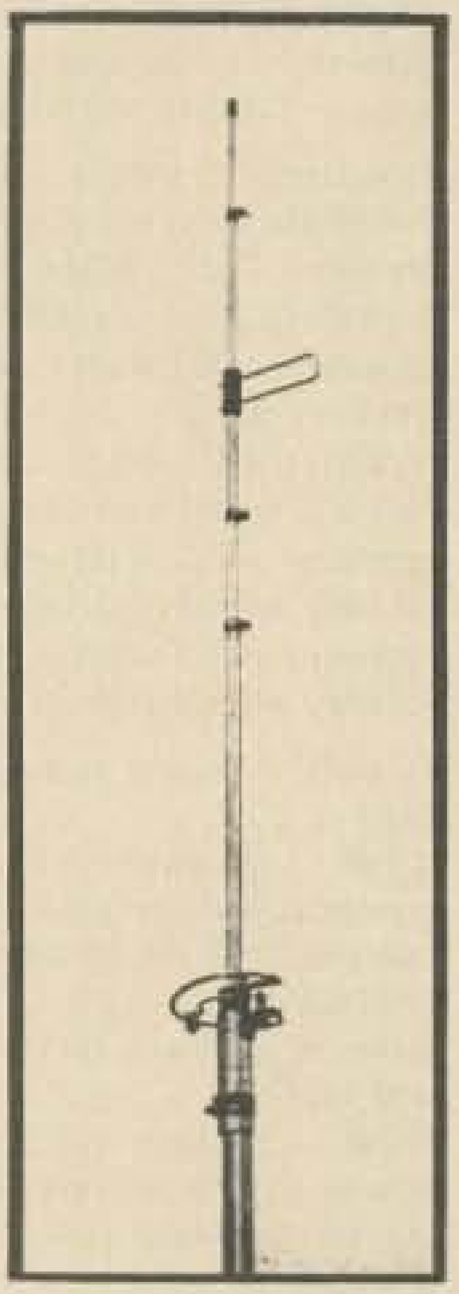
Booms are .058 wall and elements are 3/4" - 5/8" .049 wall seamless chrome finish aluminum tubing. The 3 and 5 element beams have 1 3/8" - 1 1/4" booms. The 6 and 10 element beams have 1 5/8" - 1 1/2" booms. All brackets are heavy gauge formed aluminum. Bright finish cad plated ubolts are adjustable for up to 1 5/8" mast on 3 and 5 element and 2" on 6 and 10 element beams. All models may be mounted for horizontal or vertical polarization.

New features include adjustable length elements, kilowatt Reddi Match and built-in coax fitting for direct 52 ohm feed. These beams are factory marked and supplied with instructions for quick assembly.

Description	3 element	5 element	6 element	10 element
Model No.	A50-3	A50-5	A50-6	A50-10
Boom Lngth	6'	12'	20'	24'
Longest El.	117"	117"	117"	117"
Turn Radius	6'	7' 6"	11'	13'
Fwd. Gain	7.5 dB	9.5 dB	11.5 dB	13 dB
F/B Ratio	20 dB	24 dB	26 dB	28 dB
Weight	7 lbs.	11 lbs.	18 lbs.	25 lbs.

new

RINGO RANGER for FM



4.5 dB* — 6 dB**

Omnidirectional

GAIN

BASE STATION

ANTENNAS

FOR MAXIMUM PERFORMANCE AND VALUE

Cush Craft has created another first by making the world's most popular 2 meter antenna twice as good. The new Ringo Ranger is developed from the basic AR-2 with three half waves in phase and a one eighth wave matching stub. Ringo Ranger gives an extremely low angle of radiation for better signal coverage. It is tunable over a broad frequency range and perfectly matched to 52 ohm coax.

ARX-2, 137-160 MHz, 4 lbs., 112"
ARX-220, 220-225 MHz, 3 lbs., 75"
ARX-450, 435-450 MHz, 3 lbs., 39"

* Reference ½ wave dipole.
** Reference ¼ wave whip used as gain standard by many manufacturers.

Work full quieting into more repeaters and extend the radius of your direct contacts with the new Ringo Ranger.

You can up date your present AR-2 Ringo with the simple addition of this extende. kit. The kit includes the phasing network and necessary element extensions. The only modifications required are easy to make saw slits in the top section of your antenna.

ARX-2K CONVERSION KIT

2 METER ANTENNAS FM

A-FM RINGO 3.75 dB Gain (reference ¼ wave whip). Half wave length antennas with direct dc ground, 52 ohm feed takes PL-259, low angle of radiation with 1-1 SWR. Factory preassembled and ready to install, 6 meter partly preassembled, all but 450 MHz take 1¼" mast. There are more Ringos in use than all other FM antennas combined.

Model Number	AR-2	AR-25	AR-6	AR-220	AR-450
Frequency MHz	135-175	135-175	50-54	220-225	440-460
Power—Hdlg. Watts	100	500	100	100	250
Wind area sq. ft.	.21'	.21'	.37'	.20'	.10'

B-4 POLE Up to 9 dB Gain over a ½ wave dipole. Overall antenna length 147 MHz — 23' 220 MHz — 15', 435 MHz — 8', pattern 360° — 6 dB gain, 180° — 9 dB gain, 52 ohm feed takes PL 259 connector. Package includes 4 complete dipole assemblies on mounting booms, harness and all hardware. Vertical support mast not supplied.

AFM-4D 144 - 150 MHz, 1000 watts, wind area 2.58 sq. ft.
AFM-24D 220 - 225 MHz, 1000 watts, wind area 1.85 sq. ft.
AFM-44D 435 - 450 MHz, 1000 watts, wind area 1.13 sq. ft.

D-POWER PACK The big signal (22 element array) for 2 meter FM, uses two A147-11 yagis with a horizontal mounting boom, coaxial harness and all hardware. Forward gain 16 dB, F/B ratio 24 dB, ½ power beamwidth 42°, dimensions 144" x 80" x 40", turn radius 60", weight 15 lbs., 52 ohm feed takes PL-259 fitting.

A147-22 146 - 148 MHz, 1000 Watts, wind area 2.42 sq. ft.

D-YAGI STACKING KITS VPK includes horizontal mounting boom, harness, hardware and instructions for two vertically polarized yagis gives 3 dB gain over the single antenna.

A14-VPK.	complete 4 element stacking kit
A14-SK.	4 element coax harness only
A147-VPK.	complete 11 element stacking kit
A147-SK.	11 element coax harness only
A449-SK.	6 + 11 element coax harness only

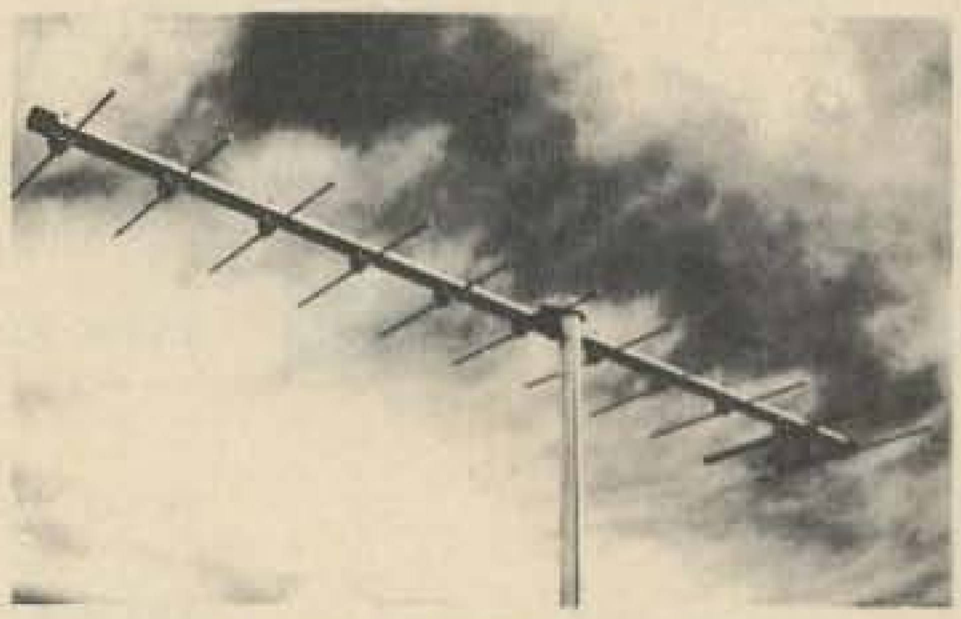
E-4-6-11 ELEMENT YAGIS The standard of comparison in VHF-UHF communications, now cut for FM and vertical polarization. The four and six element models can be tower side mounted. All are rated at 1000 watts with direct 52 ohm feed and PL-259 connectors.

Model Number	A147-11	A-147-4	A449-11	A449-6	A220-11
Boom/Longest ele.	144"/40"	44"/40"	60"/13"	35"/26"	102"/26"
Wght./Turn radius	6 lbs., 72"	3 lbs., 44"	4 lbs., 60"	3 lbs., 18"	5 lbs., 51"
Gain/F/B ratio dB	13.2/28	9/20	13.2/28	11/25	13.2/28
½ Power beam	48°	66°	48°	60°	48°
Wind area sq. ft.	1.21	.43	.39	.30	.50
Frequency MHz	146-148	146-148	440-450	440-450	220-225

F-FM TWIST 12.4 dB Gain: Ten elements horizontal polarization for low end coverage and ten elements vertical polarization for FM coverage. Forward gain 12.4 dB, F/B ratio 22 dB, boom length 130", weight 10 lbs., longest element 40", 52 ohm Reddi Match driven elements take PL-259 connectors, uses two separate Feed lines.

A147-20T 145 - 147 MHz, 1000 watts, wind area 1.42 sq. ft.

HIGH PERFORMANCE VHF YAGIS



3/4, 1-1/4, 2 METER BEAMS

The standard of comparison in amateur VHF/UHF communications. Cush Craft yagis combine all out performance and reliability with optimum size for ease of assembly and mounting at your site.

Lightweight yet rugged, the antennas have 3/16" O. D. solid aluminum elements with 5/16" center sections mounted on heavy duty formed brackets. Booms are 1" and 7/8" O.D. aluminum tubing. Mast mounts of 1/8" formed aluminum have adjustable u-bolts for up to 1-1/2" O.D. masts. They can be mounted for horizontal or vertical polarization. Complete instructions include data on 2 meter FM repeater operation.

New features include a kilowatt Reddi Match for direct 52 ohm coaxial feed with a standard PL-259 fitting. All elements are spaced at .2 wavelength and tapered for improved bandwidth.

Model No.	A144-7	A144-11	A220-11	A430-11
Description	2m	2m	1¼m	¾m
Elements	7	11	11	11
Boom Lngth.	98"	144"	102"	57"
Weight	4	6	4	3
Fwd. Gain	11 dB	13 dB	13 dB	13 dB
F/B Ratio	26 dB	28 dB	28 dB	28 dB
Fwd. Lobe @ ½ pwr. pt.	46	42	42	42
SWR @ Freq.	1 to 1	1 to 1	1 to 1	1 to 1

VHF/UHF BEAMS

A50-3	$ 27.50	A144-7	19.95
A50-5	39.50	A144-11	24.95
A50-6	59.50	A430-11	19.95
A50-10	89.50		

AMATEUR FM ANTENNAS

A147-4	$ 15.95	AFM-44D	47.50
A147-11	24.95	AR-2	18.50
A147-20T	47.50	AR-6	24.50
A147-22	69.50	AR-25	21.50
A220-7	18.95	AR-220	18.50
A220-11	22.95	AR-450	18.50
A449-6	15.95	ARX-2	28.50
A449-11	21.95	ARX-2K	11.95
AFM-4D	53.50	ARX-220	28.50
AFM-24D	49.50	ARX-450	28.50

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ARGONAUT, MODEL 509 AMPLIFIER, MODEL 405

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Model 206

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TRITON IV A new push-pull final amplifier with the latest gold metalized, zener protected transistors, operating at 200 input watts on all hf bands 3.5 through 29.7 MHz. Plus a new crystal heterodyne VFO for improved short and long term frequency stability and uniform 1 kHz readout resolution, even on ten meters. Unsurpassed selectivity is yours with the new eight pole i.f. crystal filter, and improved spurious rejection results from the new IC double balanced mixer.

Many small circuit improvements throughout, taken collectively, add more performance and quality pluses – such things as individual temperature compensated integrated circuit voltage regulators for final bias control and VFO supply. And toroid inductances in the ten and fifteen meter low pass filters, LED indicators for offset tuning and ALC threshold, accessory socket for added flexibility, and sequentially keyed mute, AGC and transmitter circuits for even better shaped and clickless CW.

TRITON IV $699.00
12 ac supply, with a built-in speaker and VOX – 262G $129.00

ARGONAUT, MODEL 509

Covers all Amateur bands 10-80 meters. 9 MHz crystal filter, 2.5 kHz bandwidth, 1.7 shape factor @ 6/50 dB points. Power required 12-15 VDC @ 150 mA receive, 800 mA transmit at rated output. Construction aluminum chassis, top and front panel, molded plastic end panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 13" x 7". Weight 6 lbs.

LINEAR AMPLIFIER, MODEL 405

Covers all Amateur bands 10-80 meters. 50 watts output power, continuous sine wave. RF wattmeter. SWR meter. Power required 12-15 VDC @ 8 A, max. Construction: aluminum chassis, top and front panel, molded plastic side panels. Cream front panel, walnut vinyl top and end trim. Size: HWD 4½" x 7" x 8". Weight 2½ lbs.

Argonaut, Model 509 .... $329.00
Linear Amplifier, Model 405 .... 159.00
Power Supply, Model 251
(Will power both units) 79.00
Power Supply, Model 210
(Will power Argonaut only) 27.50

MODEL 206 CRYSTAL CALIBRATOR SPECIFICATIONS

Power Required: 9 to 12 VDC @ 8 mA.
Fundamental Frequency 100 kHz
Circuit Description: Pierce crystal oscillator, followed by Schmitt trigger. Output gated from unijunction oscillator.
Calibration: Adjustable to WWV with internal variable capacitor.
Size: HWD 2-1/8" x 4-3/8" x 4-1/8"
Weight: ½ lb.

Model 206 Crystal Calibrator $26.95

KR20-A ELECTRONIC KEYER

A fine instrument for all-around high performance electronic keying. Paddle actuation force is factory adjusted for rythmic smooth keying. Contact adjustments on front. Weighting factor factory set for optimum smoothness and articulation. Over-ride "straight key" conveniently located for emphasis, QRS sending or tune-up. Reed relay output. Side-tone generator with adjustable level. Self-completing characters. Plug-in circuit board. For 117 VAC, 50-60 Hz or 6-14 VDC. Finished in cream and walnut vinyl. **PRICE $67.50**

KR5-A ELECTRONIC KEYER

Similar to KR20-A but without side-tone oscillator or AC power supply. Ideal for portable, mobile or fixed station. A great value that will give years of troublefree service. Housed in an attractive case with cream front, walnut vinyl top. For 6-14 VDC operation. **PRICE $38.50**

KR1-A DELUXE DUAL PADDLE

Paddle assembly is that used in the KR50, housed in an attractive formed aluminum case. **PRICE $25.00**

KR2-A SINGLE LEVER PADDLE

For keying conventional "TO" or discrete character keyers, as used in the KR20-A. **PRICE $15.00**

KR50 ELECTRONIC KEYER

A completely automatic electronic keyer fully adjustable to your operating style and preference, speed, touch and weighting, the ratio of the length of dits and dahs to the space between them. Self-controlled keyer to transmit your thoughts clearly, articulately and almost effortlessly. The iambic (squeeze) feature allows the insertion of dits and dahs with perfect timing.

An automatic weighting system provides increased character to space ratio at slower speeds, decreasing as the speed is increased, keeping the balance between smoothness at low speeds and easy to copy higher speed. High intelligibility and rythmic transmission is maintained at all speeds, automatically.

Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing.

PRICE $110.00

SPECIFICATIONS

Speed Range: 6-50 w.p.m.
Weighting Ratio Range: 50% to 150% of classical dit length.
Memories: Dit and dah. Individual defeat switches.
Paddle Actuation Force: 5-50 gms
Power Source: 117VAC, 50-60 Hz, 6-14 VDC
Finish: Cream front, walnut vinyl top and side panel trim.
Output: Reed relay. Contact rating 15 VA, 400 V. max.
Paddles: Torque drive with ball bearing pivot.
Side-tone: 500 Hz tone.
Adjustable output to 1 volt.
Size HWD: 2½" x 5½" x 8¾"
Weight: 1¾ lbs.

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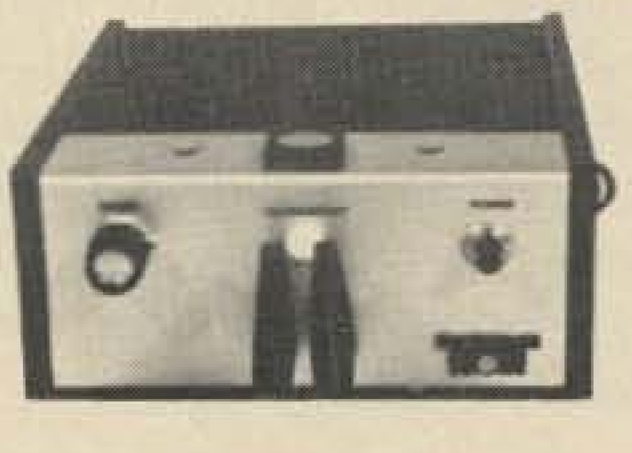

KR50A

Nye Viking

310-003

322-001

SSK-1

Model 310-001: Standard Key, nickel plated hardware, no switch – $6.65.

Model 310-003: Standard Key, nickel plated hardware, with switch – $8.25.

Model 320-001: Standard Heavy Duty Key with nickel plated hardware, no switch – $8.20.

Model 320-003: Same as -001 except with switch – $9.35.

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Code Practice Set with Key- $18.50.

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144-148	2M10-70L	10	70	8	7.1X10.2X16.5	139.95
144-148	2M10-140L	10	140	19	7.1X10.2X26.7	219.95
220-225	1.3M10-60L	10	60	7	7.1X10.2X16.5	159.95
420-450	70CM2-10L	2	10	2	7.1X10.2X16.5	109.95
420-450	70CM10-40L	10	35	6	7.1X10.2X16.5	139.95

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The 5 wpm code tape has verbal help along the way to get the beginner acquainted with the letters of the alphabet, the numbers and punctuation marks. . . and all this after only one hour's listening time. That's right! After only one hour's listening time even the newest beginner will know all the alphabet, numbers and punctuation to pass the test.Characters are sent at 13 wpm and spaced at 5 wpm to get your ear trained to the sound of the characters once without the exaggerated slowness of some systems. The other systems require you to train and re-train for each of the different speeds. With our tapes you will already know the sound of the faster character and as you progess through the code speeds only the spacing is shortened.

After you have learned the alphabet, numbers and punctuation, advance right away to the 6 wpm tape which in fact again is the 13 wpm character spaced at the 6 wpm speed needed to pass the Novice Class license with ease. Study habits vary but about 4 hours devoted to copying this tape should have you ready to pass your code test. You'll be so well prepared that you won't have to worry about that nervousness that sometimes accompanies you when you are taking a test . . . you'll actually think they are sending the code too slowly while you are being tested.

The 73 Novice Class Study Guide and Novice Theory tapes work hand in hand to explain in detail what is expected of the Novice ticket holder . . . The Novice Theory 4 tape set has three tapes of theory which explain the material so thoroughly even a person with no previous electronic background can easily comprehend it; the fourth tape has questions and answers to prepare for the F.C.C. Novice license test. The beauty of the tape-study guide combination is that you can repeat those areas of the theory that you may not understand over and over, reinforcing the concepts until comprehension (not just memorization) takes place. HINT: While you are learning the code and theory from the tapes, especially if you haven't been in the habit of studying for a while and your concentration leaves something to be desired, you might find it advantageous to listen to the tapes only a few minutes at a time and quit before your mind has started to wander and you start to get discouraged . . . increase your dosages each time you study --- in this way you can build up an understanding as well as sneak into good study habits.

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- - merchant marine radio officers: part I

A radio officer is a licensed United States Merchant Marine officer. He is a civilian who holds a dual license: a (minimum) second class radiotelegraph Federal Communications Commission (FCC) license and a United States Coast Guard issued Merchant Marine officer's license.

The primary responsibility of the radio officer is to satisfy the requirements of the International Act (Geneva) For Safety At Sea, which requires certain class vessels to have licensed radio stations and to keep watch on the international calling and distress frequency of 500 kilohertz. Thus in any distress situation assistance may be readily supplied or requested. Secondarily, the radio officer, under the authority exercised by the master of the vessel, handles communications between the ship and the ship's owners. Communications in the form of marine cables received and sent via commercial maritime stations comprise the bulk of traffic. However, modern day merchant ships often carry sophisticated voice communications equipment — single sideband, VHF, medium wave radiotelephones, even state of the art satellite facilities. Some vessels have radioteletype terminals. Weather and hydrographical information is often acquired via fascimile circuits. All this varied "communication" is essential in today's merchant fleet and requires competent, knowledgeable people to fill the role of radio officers.

The purpose of this primer is to provide accurate, practical data to those wishing to investigate a career as a Merchant Marine radio officer. While one must leave home for varying periods of time, the type of work involved is interesting; the travel, often to exotic ports; the financial remuneration, excellent. There is a limited amount of published information available. However, the novice would be hard pressed to gather a goodly amount of pertinent data without much laborious research and its attendant difficulties. I am, and have been for ten years, a licensed radio officer sailing with a major oil company tanker fleet. I have had experience on various classes of cargo and oil tanker vessels. My travels have routed me to the main ports of the world. With this background, I am able to give precise information concerning present day conditions in merchant fleet communications, discuss types of equipment and their maintenance, relate first hand details on major maritime traffic stations worldwide, and offer positive guidance on license attainment and avenues of employment. While not everyone who wishes to can become a radio officer, those with a sincere interest, drive sufficient to acquire the necessary knowledge and certification, and persistence in seeking employment, can become involved in this secure, rewarding and worthwhile career.

Licensing

Anyone aspiring to the career of Merchant Marine radio officer must have the initiative necessary to obtain the minimum license requirements. These are twofold: First, an FCC second class radiotelegraph certificate must be acquired. Secondly, upon issuance of the FCC license, seaman documents may be applied for with the radio officer endorsement. A U.S. Coast Guard Merchant Marine officer license will also be issued running concurrently (five years) with the radiotelegraph certificate. The following will detail possible methods of obtaining this certification.

Many people interested in a seagoing career as "sparks" already have a general background and interest in electronics. More particularly, some are even licensed radio operators in other types of

Photos courtesy of Gene D. Legler, Editor, *Exxon Fleet News*, Exxon Company, U.S.A., Houston TX.

Radio officer Raymond B. Hurley, aboard the 40,000 deadweight ton Exxon Lexington, *an Exxon tanker which carries petroleum products from Exxon Gulf Coast refineries to East Coast terminals.*

FCC service. Radiotelephone permits and amateur radio and citizens band tickets are the more commonly held Federal Communications Commission licenses. If a person has an amateur radio license, then he is familiar with the type of testing procedure employed by the FCC engineers. Like the amateur examination, a commercial second class radiotelegraph license examination is divided into two parts: the Morse code portion (20 words per minute) and the written technical examination (sections of the examinations are referred to as "elements").

Exact regulations governing test requirements are found in FCC rules and regulations. These are grouped into ten volumes. Each volume is divided into sections. Any volume or group of volumes can be obtained from the U.S. Government Printing Office.

Specifically pertaining to commercial radio operators would be Volume 1, Part 13. Volume IV, parts 81 and 83, give complete FCC regulations concerning maritime services. Part 81 deals with land based maritime services (coastal station operation). Part 83 contains regulatory matter directly concerning shipboard stations in the maritime service. Every United States registered vessel with a licensed station onboard is required to have on file copies of sections 81 and 83. If one fully masters the rules contained in these two articles, the "regulations" element of the written examination will be easily passed.

Thus, to qualify for a second class FCC radiotelegraph license (minimum requirement for shipboard operators), one must first successfully pass the Morse code test and then achieve a passing grade on the written examination. Let's delve into each of these two items.

To copy and transmit Morse code properly is an acquired skill and art. There is no "easy" way other than to diligently apply oneself to the mastery of the code. While "shortcuts" and mechanical aids are available to help one learn the sounds and proper rhythm of Morse, it is through the basic learning processes of concentration, repetition, and involvement that any person becomes proficient in handling code. A popular method by which thousands have learned the Morse alphabet is to memorize a few letters at a time until the entire twenty-six letters can be repeated and written without hesitation. Some find grouping letters with similar Morse sounds helpful; others find that opposite characters such as "A" and "N" prove helpful to their memories. Once a person has a good "sound" memory of the individual letters and numbers, and can recall them instantly, then work can begin seriously on acquiring speed. At this stage "cassettes" or tapes with code practice are an invaluable tool. If one is fortunate enough to possess a shortwave radio receiver, actual Morse signals can be used for practice. To recognize a letter every now and then in a plain language sequence will rapidly lead to faster, solid copy. Schedules of traffic lists and weather bulletins of leading commercial stations are found in Section Ten. Traffic lists are excellent practice, as the calls are repeated twice and are random letter and letter-number combinations. Station WSL, Amagansett Radio, New York, offers excellent weather schedules. This station is one of the fastest on the east coast. The schedules are sent on tape which approaches perfect CW sending. Once a person can copy, for example, the 2300 GMT weather schedule of this station, then the code examination for the FCC license is well within reach.

In learning any new skill, certain levels of achievement are reached and sustained. With Morse code these levels or plateaus can be bridged through increased effort and practice. The range of seven to ten words per minute for most is easily reached. Ten to fifteen wpm (words per minute is based on five characters to a word) requires sustained effort. The goal of twenty words per minute and beyond is achieved after persistent application to practice sessions. The FCC code test runs five minutes. An applicant must copy any one of the five minutes perfectly. Ordinarily this is not extraordinarily difficult. However, the "nervousness" factor is present as one takes the test under the watchful eye of the presiding FCC engineer.

A word here concerning actual code speeds used in shipboard/marine station traffic work. Once a person begins working commercial stations and puts in eight hours daily on a radio circuit (monitoring 500 kHz, weather reports, traffic lists, etc.), speed and accuracy steadily improve. With time, Morse ability becomes somewhat of a reflex action. I am often amused (perhaps forgetting my own real uneasiness once) at shipboard visitors inquiring about becoming radio officers. Most often their main concern is the ability to send and receive quickly. This skill gradually develops and becomes almost an automatic response. This allows one to then concentrate on other, more technical, aspects of shipboard communication, maintenance of the electronic gear being a major item.

As closing comments on the Morse code, it is generally accepted between commercial land marine stations and shipboard stations that "twenty is plenty." In other words, 20 wpm is quite sufficient to handle normal ship communications. However, many coastal stations are extremely busy with lots of traffic (messages) to send and receive. If the ship's operator is agreeable and capable, operating speeds will often go to 25 wpm and beyond. The point is, as long as solid copy is being achieved on both ends of a circuit, speed is adjusted accordingly. It is better to slow down and copy correctly the first time, rather than consume additional time getting "fills" (missed portions of messages – most stations use full "break-in," one operator can signal another of a missed word by the tap of the Morse key). Some ships will handle more traffic than others. Ships on coastal runs (east/west coast and Gulf of Mexico) will generally have occasion to send and receive more messages because of the frequency of ports. There are certain routine series of messages which concern the normal operation of the vessel: arrival times, crew changes, stores, cargo information, and other pertinent data.

With the code test successfully passed, the next hurdle is the written part of the examination. As a practical guide it can be stated that the written test covers three categories of knowledge: Federal Communications Commission rules and regulations concerning the maritime service, basic electronics theory, and basic communication equipment theory (receivers, transmitters, power supplies and related equipment).

There are several question and answer manuals available which cover all of the above categories. Often the answers to simulated test questions in these manuals will go into profuse detail for informational purposes. One recommended Q and A manual is Kaufman's particular edition. This is a comprehensive guide which covers all phases (elements) of various commercial license test requirements. There are other excellent study guides available found at most electronic supply outlets or specialized bookstores. Another text which has a wealth of background information is the *Rider Basic Electronics* series. This can be bought as a single large edition or five individual softbound volumes. It is well illustrated and technically but simply written. Sections on power supplies, transmitters, receivers, test devices, and even transistors are intended to give the reader a broad knowledge of basic electronic circuits and their behavior. Of course, any background a person has in electronics is obviously helpful. The *Radio Amateur's Handbook* is a practical and comprehensive reference work which covers a large segment of the radio frequency spectrum usage. It describes practical operating circuits for radio receiving and transmitting, plus additional chapters on specialized communications systems such as teletype, narrow band FM, satellite communicating techniques and others. Using these and similar aids, as well as a careful study of the FCC Rules, Volume IV, should adequately prepare one to succeed in the written examination. As added insurance to acquiring the license, commercial correspondence courses as well as residency classes are offered by various schools and institutes. Some of these carry a type of guarantee which allows a person to continue studies until successful acquisition of the desired license.

At this point one might well ask, "How much time will it take to prepare well enough to pass the test without waiting to repeat it?" This question is difficult to answer. Each person has different capabilities, memory, and grasp of abstract ideas. Some can memorize quickly and give back information without true understanding. Others can digest material and give back its essence showing complete grasp of the subject. Both approaches will successfully pass the examination; as long as one can correctly answer the multiple choice items (except for a diagram schematic or two), a passing grade will be achieved.

Some people devoting full time to studying for the examination – dividing the time between code practice and study of theory – could possibly be ready to "sit" for the examination in as little as eight weeks. Others, perhaps more methodical or thorough, may require two or three times that amount of time. In my case, bringing a general background in electronics plus three years experience as an active ham used to CW procedures, the test was successfully passed after a solid month of long days of preparation (often 12-14 hours a day). It is always better to be overprepared to help overcome any nervousness factor. Each person will have to evaluate his or her own abilities in judging how much study is needed to feel comfortable going into the examination. Some attempt it after short preparation, fail it, then restudy and pass it thirty days later. They reason that the first sitting gave them a better idea of what to emphasize in their preparation. This procedure isn't recommended, but it is definitely one which has been used.

It is well to mention here that one's motivation is important in license examination preparation. Once a person has examined a potential career opportunity and set goals to attain membership in those ranks, then the necessary driving force will be there to get one over the difficult steps in attaining the goal. As outlined previously, a radio officer in today's modern Merchant Marine has considerable responsibility. The possibility of disaster, though not a morbid preoccupation, is an ever present reality – an event which places the lives of the crew on the radio officer's electronic expertise. Rigging emergency antennas, quickly repairing faulty or damaged radio gear – all these are paramount to getting out a distress call asking for assistance. Not secondary is the excellent financial remuneration the seagoing radio operator enjoys. A person employed full time for a private company fleet can realistically expect his earnings to be between twenty-two and twenty-five thousand dollars a year on American flag vessels. Union contract ships have equitable salary scales. Employment on some of the larger foreign flag vessels will pay salaries in the neighborhood of ten to twelve thousand dollars per year. In addition to the high wages paid, radio officers, like all Merchant Marine officers, enjoy outstanding benefit packages. These items will be mentioned in another section. Thus, should license preparation require even several years of part-time study to achieve success, the rewards are certainly handsome for those who persevere.

Once the second class radiotelegraph license is in hand, the radio officer aspirant can proceed to obtaining complementary United States Coast Guard documents. The first step toward accomplishing this after the license is acquired is to obtain a letter of commitment. This is a statement of intent, on company/union letterhead, that the bearer will be employed in the capacity for which license application is being made. This letter of commitment is a Coast Guard requirement. It is one method of managing the employment situation and controlling excess licenses being issued. Many companies and agencies involved in ship management may issue such letters of commitment. Also there are two national unions from which the commitment statement may be requested. With union and private union contracts expiring yearly, and new increased vacation benefits being negotiated, it is advantageous for unions to have certified men on file to fill the vacancies that evolve. Often one does not necessarily find final employment with the company or union which issued the original letter of commitment; however, once the letter of commitment is issued there is an obligation of it being eventually honored. One must seek out some marine personnel or union personnel manager who has potential job openings and is willing to take the time to issue the brief commitment statement.

The letter of commitment and the bona fide second class radiotelegraph license are the two major components necessary for acquiring the United States Coast Guard documents. Three other items will complete the file for issuance of the desired seaman's papers: proof of citizenship (birth certificate) and two passport size photographs. One may apply at any of the many United States Coast Guard offices. These are located in all major port cities. A physical examination is required and will be given at government expense. Abnormalities in health will constitute an impediment to obtaining documents. While shipboard life is not particularly rigorous, normal health is required due to often lengthy absences from usual medical assistance. Glasses (corrective lenses) constitute an impediment which is normally waivered. This process of actual application for Coast Guard documents may require one to two days depending on number of applicants to be processed. However, once completed, the actual certifying papers ("Z" card and Merchant Marine officer license) will usually be received in six to eight weeks.

While the licenses crown much effort and give a definite satisfaction of achievement, two major steps remain for becoming a full-fledged radio officer: initial employment and obtaining the six months sea service endorsement.

Employment Procedures

Federal Communications Commission regulations make it mandatory for a licensed radio officer to acquire six full months (180 days) of sea service on a United States flag (U.S. registered) vessel equipped with a licensed radio station before he or she is able to sail as a single operator. Since the majority of U.S. merchant ships carry only one operator, compliance with the six months endorsement requirement becomes essential for a future radio officer career. While a major deterrent to many licensed applicants in utilizing their hard earned documents, the FCC six months endorsement ruling evidences bureaucratic wisdom. A newly licensed radio officer simply must get six months' actual on-the-job-training experience before he is deemed truly qualified to assume the full duties of a radio officer on a single operator ship. Often the road to the six months endorsement is strewn with faded dreams, foundered hopes, and bitter disappointments. This section will endeavor to guide a newly licensed radio officer along this road so that the ultimate goal of full single operator status and security may be reached.

From the above discussion it is obvious that initial radio officer employment is closely linked with the necessity of achieving the six months sea service endorsement. A quandary is encountered: One cannot "sign on" as a single operator radio officer because the experience is lacking; the experience cannot be acquired because one is not allowed to sail single operator without the six months' sea service. What courses of action can alternatively be pursued?

A brief discussion is relative here concerning classes of vessels. Without going into confusing tonnage figures, let it suffice to say that international regulations require certain categories of ships

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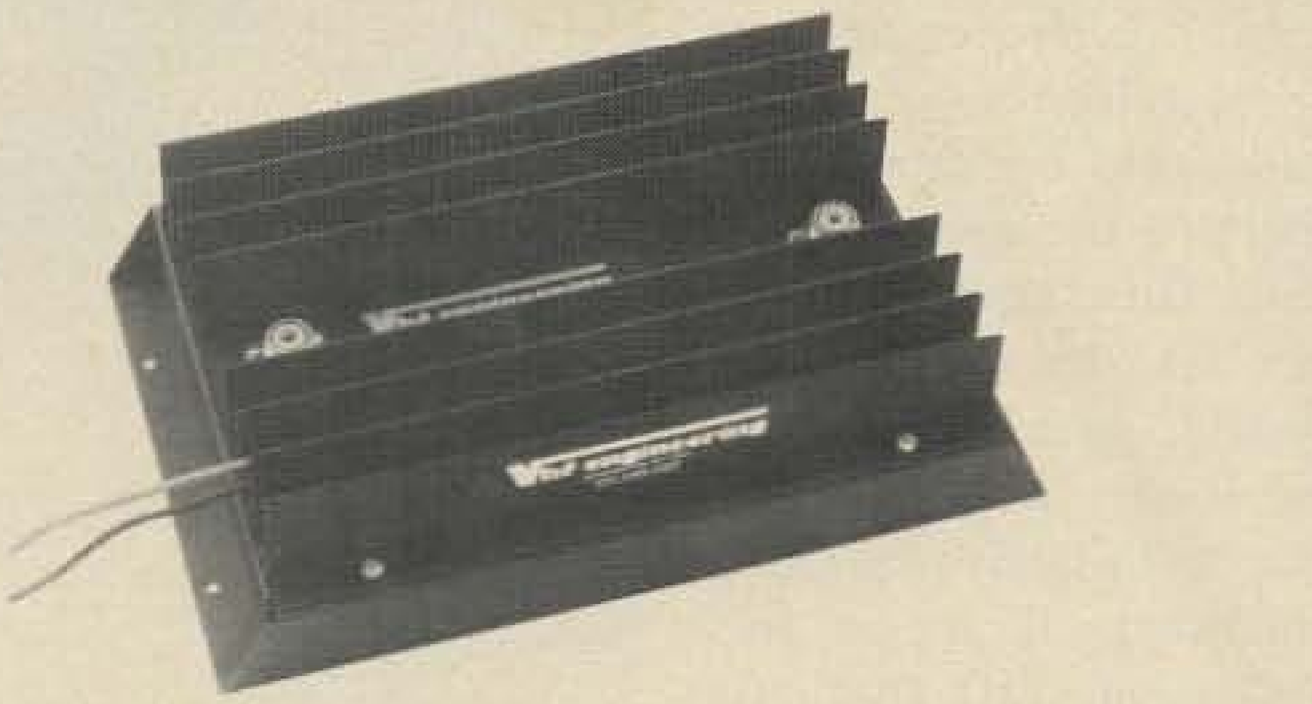

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(generally merchant freighters, tankers, bulk carriers, passenger liners) be fitted with compulsory radio stations. Such equipment must be licensed, and a licensed radio operator must be a part of the vessel's complement. Other smaller types of sea craft (deep sea towing/tug boats, research vessels, fishing craft, large yachts) may be voluntarily equipped and manned. It is on this latter class of craft that new radio officer license holders can find employment leading to the six months sea endorsement.

In past years when the United States had many passenger ships registered, these were the normal avenues of employment leading to the six months endorsement. These vessels often carried three or more radio officers. A new license holder could apprentice on one of these ships as junior operator and acquire a wealth of experience in operating procedures, traffic handling and other job facets. Today there are no United States passenger liners. Some of the larger freighters carry the legal maximum of twelve passengers, which still allows the company to employ a single operator. The many cruise ships plying the oceans today are all registered in foreign countries. A person with United States documents may certainly apply for employment on these foreign flag vessels and often with success. However, the time accrued on such non-United States-registered ships does not count toward achieving the six months sea service endorsement. But the experience one can gain from such ships can be very valuable.

Other than seeking out the voluntarily equipped sea craft to acquire the needed 180 days' sea service, another alternative is available. A person may sail as a lesser

unlicensed rating on a U.S. vessel – ordinary seaman, messman, utilityman, oiler – and with the company's and master's permission he or she may put in off watch hours in the radio shack in order to accrue the required experience. This scheme will probably take longer to acquire the endorsement; however, at the same time, pay is being received for one rating, few expenses are incurred aboard ship, and the opportunity of achieving the six months endorsement is available. Some companies or unions have programs whereby they will assign a newly licensed radio officer as second operator on a single operator vessel at reduced wages in order to allow the legal acquisition of the sea service sanction. This is usually done when openings are imminent. Fortunate is the person who applies to a company at such a propitious moment.

Summarizing, a person properly licensed for radio officer employment should vigorously pursue every avenue of opportunity. Persistent checking for union openings (both national and private company unions), applying to government agencies which employ civilian licensed personnel (MSC, Military Sealift Command, U.S. Coast and Geodetic Survey Agency), arranging interviews with owners of deep sea towing boats (often a combination of "deck hand"/radio operator position will be offered) and large yachts (information can be gleaned from brokerage houses for such craft): All these paths vigorously pursued will eventually yield positive employment commitments which will lead to the necessary and coveted six months sea service endorsement.

It was my experience after applying at the above listed sources that a three to four month wait – a discouraging period with no word from the myriad applications filed – was unavoidable. When that time passed (time used to gain experience as a single operator on a foreign flag vessel), the offers began trickling through the mail. Eventually choices could be made.

While a formidable obstacle, the six months endorsement, once achieved, offers a reasonable degree of future job security. The numerical job possibilities increase a hundredfold. By this time many contacts will have been made (keep a notebook). Offers of "come see us when you have the endorsement" should have been filed for future reference. One will also be able to make a more mature judgment concerning whether to make a career in one of the national radio officer maritime unions or opt for private company fleets. Each choice has advantages and disadvantages. It is a question of committing oneself one way or the other. A young man or woman (25-35) fully qualified as a single operator radio officer has much to offer the shipping industry. Reciprocally, shipping companies are interested in stable, career-oriented personnel.

Salaries vary among various radio officer employers. As mentioned before, a person who sails full time as a single operator on an American flag vessel can anticipate earnings beyond the twenty thousand dollar level. Benefit packages also vary, but in general are excellent and comprehensive. Hospitalization, annuity plans, pension plans, life insurance, equity funds, and stock options are some of the types of total packages offered. Vacation time (paid leave is the colloquial expression) averages ten to eighteen days for each thirty days of shipboard employment. Efficiency dictates companies to allow this time to accrue. For example, several tanker companies will work their officers eighty to ninety days, then grant forty to fifty day paid leaves. Items such as base salaries, overtime rates, vacation periods, and other working conditions are negotiated frequently and upgraded to keep pace with industrial trends.

Thus, to a person contemplating a seagoing career, the rating of radio officer offers a unique opportunity: above average wages, worldwide travel, participation in outstanding benefit plans, retirement at a relatively early age with potentially large savings and an adequate pension. It is these incentives which should urge one to pass the discouraging phases of becoming completely qualified as a radio officer.

Reporting Aboard Ship

This section is a "tour" for the uninitiated of modern shipboard organization and routine. Particularly, it will outline a normal procedure for a radio officer to follow when reporting aboard a vessel. Most people seeking shipboard employment will probably have visited various types of oceangoing ships. (This is an excellent idea. Ask for the radio officer – most will be helpful in giving a ship's tour and a detailed explanation of the electronic equipment on board.) Thus a general familiarity with the physical layout of ships will be acquired.

A merchant vessel like any business organization is structured along certain lines. The following is a brief explanation of shipboard organization. The personnel on a vessel are divided into two broad categories: licensed officers and unlicensed crew members. Operationally, these people are then working in one of three departments. Deck department is responsible for the safety and navigation of the vessel, the maintenance of deck spaces, and the supervision of cargo operations. Engine department is responsible for the operation/maintenance of the power plant (steam or diesel), systems upkeep, maintenance of cargo handling equipment (winches, pumps, etc.), and overall responsibility for the mechanical aspects of vessel operation. Steward's department does the housekeeping of the vessel: preparation and serving of meals, cleaning of quarters, care of linen and other housekeeping chores. The departments and their specific members are listed below. Actual number of crew varies from ship to ship. Officers are considered supervisors. Other crew members have Coast Guard papers with specific job or rating endorsements.

Deck (Captain overall in charge)
Chief Mate
Second Mate
Third Mates
Radio Officer
Ablebodied Seamen
Ordinary Seamen
Bosun

Engine
Chief Engineer
1st Engineer
2nd Engineer
3rd Engineers
Oilers
Wipers
Pumpmen

Steward
Steward
Chief Cook
2nd Cook
Messmen
Utilitymen
Gallyman

Ship's routine is conducted in periods of time called "watches." Normally a crew member or officer will stand four hours on watch and be off watch for eight hours – thus midnight to four am, four am to eight am, eight am to noon and then repeat the sequence. This system works well and contributes to the safe conduct of the vessel. Some ships will "break" sea watches in port allowing doubling up for more time off in port. Others will maintain the four on, eight off routine without change.

The radio officer by law must stand one-third of sea time at watch. It is a safety watch consisting of monitoring 500 kilohertz, the international calling and distress frequency. All ship's communications are conducted during watch hours whenever possible. While leeway is encountered as to actual hours of radio watch, custom dictates the usual hours of 9 am to noon, three pm to five pm, six pm to nine pm. These hours allow for the copying of appropriate traffic lists, weather schedules and other communications matters. While at sea, when the radio officer is not on watch, an automatic device called an auto-alarm stands guard on the distress frequency sounding an audible alert should a distress situation develop.

A new officer reporting aboard a vessel will usually proceed directly to the radio room ("shack") to meet the person to be relieved. If the captain is available, introductions will be made. Should the ship be on a coastal run, the radio officer will be signed on by the master of the vessel and officially become part of the ship's muster. Signing on for foreign voyages is done before a shipping commissioner who comes to the ship for this purpose. License data is always incorporated into the ship's articles.

New radio officers will find that the person they are relieving will be happy to spend time showing them the "ropes." Inspection, discussion of, and actual demonstration of the various electronic equipment will be part of the orientation. If the vessel is on a regularly scheduled itinerary, schedules, company procedures, and particular communications problems will all come under discussion. Reports, forms, log keeping, and maintenance procedures also constitute the relieving radio officer's briefing. As a new radio officer, don't hesitate to ask any and all questions. Once the radio officer you are relieving departs, the responsibility rests upon your competency. As a documented, qualified Merchant Marine radio officer, you will be expected to handle communication duties in a professional competent manner.

While bewildering the first time, one will find that experience allows this relieving procedure to become an informal, quick routine. The radio officer going off the vessel will usually leave a few typed paragraphs with key information. Usually, expected spare parts requisition forms, upcoming maintenance, or ordered shore-side repairs will comprise the file to be turned over to the relief. As physical layouts differ, a spare parts diagram location is usually found among the pertinent papers.

After official installation in the new capacity, the fledgling radio officer will usually have several days (except on tankers) while the vessel works cargo before sailing. This time can profitably be spent thoroughly informing oneself concerning the physical aspects of the electronic equipment. Radio office files will yield individual instruction manuals for each piece of gear. A careful reading of the manual with the radio equipment in front of you will help complete familiarization with the station.

While not going into specific details about various types of radio room equipment, for informational purposes most American flag vessels will be fitted with either ITT Mackay Marine or RCA Radiomarine installations. Sometimes there is a combination of both types of gear on one ship. Individual units such as transmitters, receivers, auto-alarms, auto-alarm keyers, battery chargers and so forth will often be consoled for convenience. This method provides a neat, efficient operating position. Many different manufacturers provide radiotelephone equipment. Collins Radio, RF Communications, CAI, Motorola, ITT, and RCA are but a few of many suppliers of single sideband, FM, and AM radiotelephone devices.

Radio rooms on foreign flag vessels are well equipped with systems provided by their respective countries. Two examples would be Marconi marine equipment found on many United Kingdom vessels and Electronik or Dansberg installations found on ships flying flags of the Scandanavian countries. Numerous other quality radio equipment manufacturers produce gear for vessels not flying the United States ensign.

Besides maintaining a listening watch on the distress frequency, the radio officer will generally copy weather bulletins twice a day. Each bulletin forecasts twelve hour weather system movement. If the vessel is equipped with facsimile receivers, one map is usually made daily unless some disturbed weather is being closely monitored. Other duties of the radio officer are to listen to applicable commercial station traffic lists for messages, perform required FCC tests, keep a current log, and generally keep the station in good operating order. ■

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Well, having voraciously consumed my recently arrived *73 Magazine* for March 1976, I concluded as always that therein contained is a wealth of information. Lest you think I conceitedly refer to my own two articles – I don't – I am referring to the great information contained in the article "Inherit the Wind" by W2AOO on page 72.

For several years I have been looking for a "weather station" device for this QTH, since I am out on a farm and rather unprotected from the wind – as a photo of our EME array in an earlier *73 Magazine* will testify!

The intent of this article is to add to Warren's fine article a couple of ideas that came up while rapidly brewing up his device for use here. Some of the ideas are purely mechanical ways of doing his ideas using the available parts that were either around in my "junque" box, or easily obtained due to past experience building one project or another.

Warren's idea using the L'eggs pantyhose containers is *great!* I have saved the darn things for years now, merely because there *had* to be a good ham use for such an item. It's like the plastic facial tissue containers that came out awhile back – they became good oval speaker holders in my test bench! Jello molds with a perforated cover make great smoke traps for smoke alarms, etc. Leave it to a ham to find a better use for the XYL's something or other. Along the same lines, a great material exists for outdoor enclosing of devices (loading coils, relays, etc.), and gets put into service here to house the wind pickup "container" mounted up my tower. That material is the PCV irrigation tubing available at supply houses, hardware stores, and most lumber yards. I used it to waterproof the buried cables going out to the EME tower house, and had a few short pieces left over. The tubing or pipe is approximately 4.250" in outside diameter, has .125" walls, and is quite rigid. It cuts readily with a fine hacksaw blade to the length you want. Nearly all the same sources carry accessory items for the pipe, such as the "Y", "T", and reducers, but not all carry the end cap. They do exist, and looking for two of them is well worth the effort, as it makes a very weather-tight enclosure when you slip these end caps over the pipe you have cut to length.

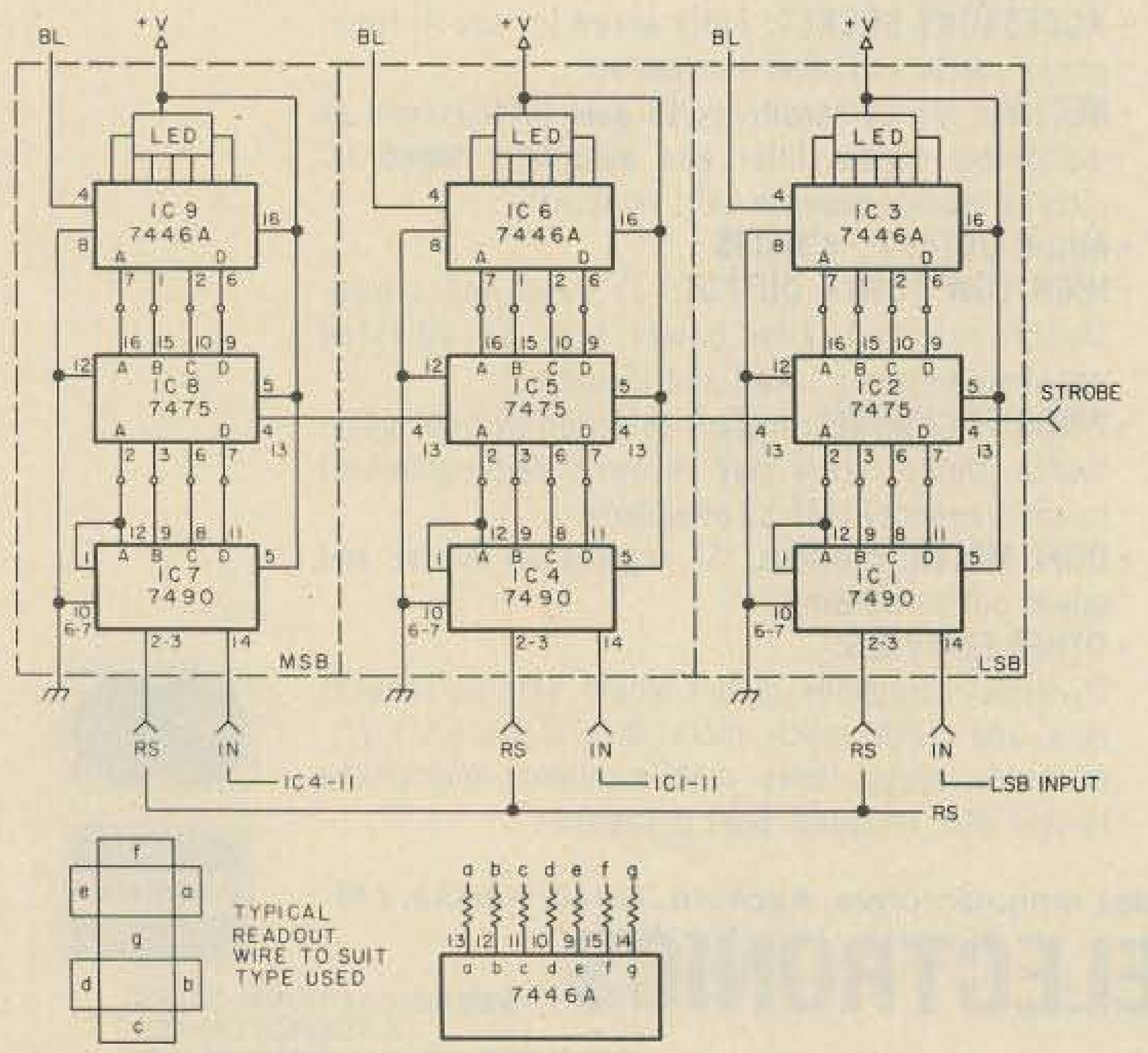

Fig. 1. Counter and readout. 7490 pins 8, 9, 11, 12 and 7475 pins 9, 10, 15, 16 should be brought to module plug; therefore a module socket of 14 lines is a minimum requirement.

While at the store, look over an item called "chipboard," "particle-board," or "underlayment," depending on where you live. It comes in 1/2" or 5/8" thickness and in 4' x 8' sheets, though often smaller 4' x 4' or 2' x 4' pieces are sold for the weekend carpenter. This material cuts easily with a saber saw or even a hand jigsaw, and can be cut in circles to go into the PCV pipe to mount the top and bottom bearings. It can even be cut out and drilled for a platform for the LED and phototransistor pickup.

If you have read the

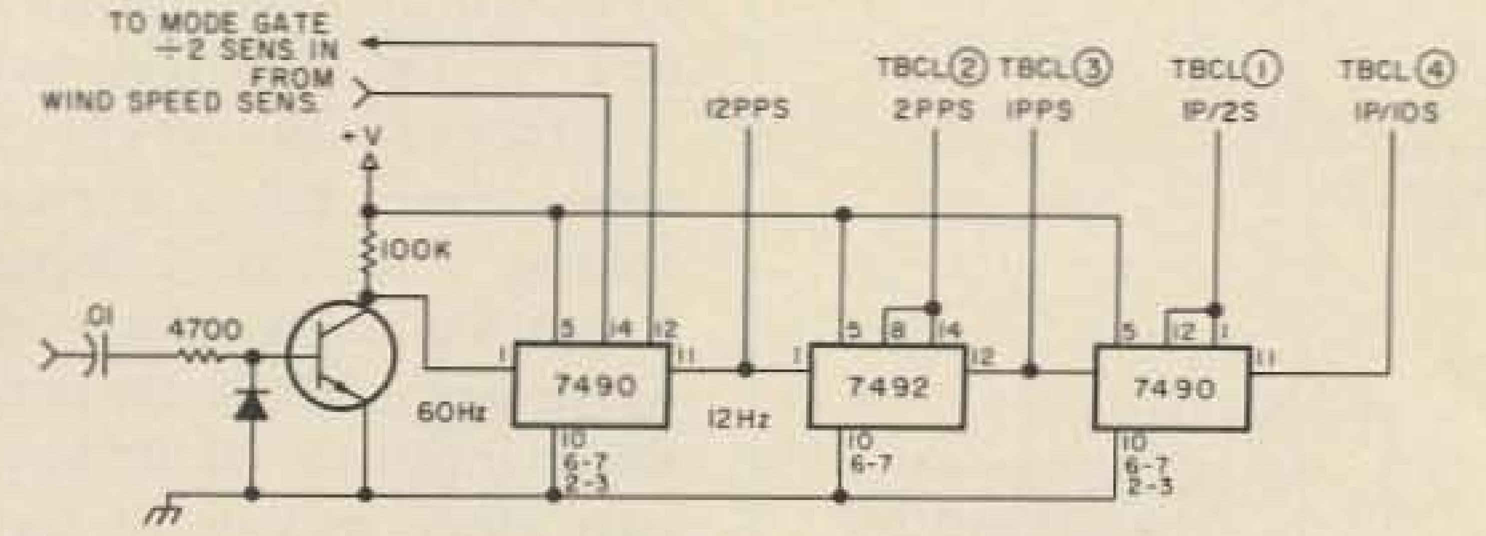

Fig. 2. "Cheapy" timebase.

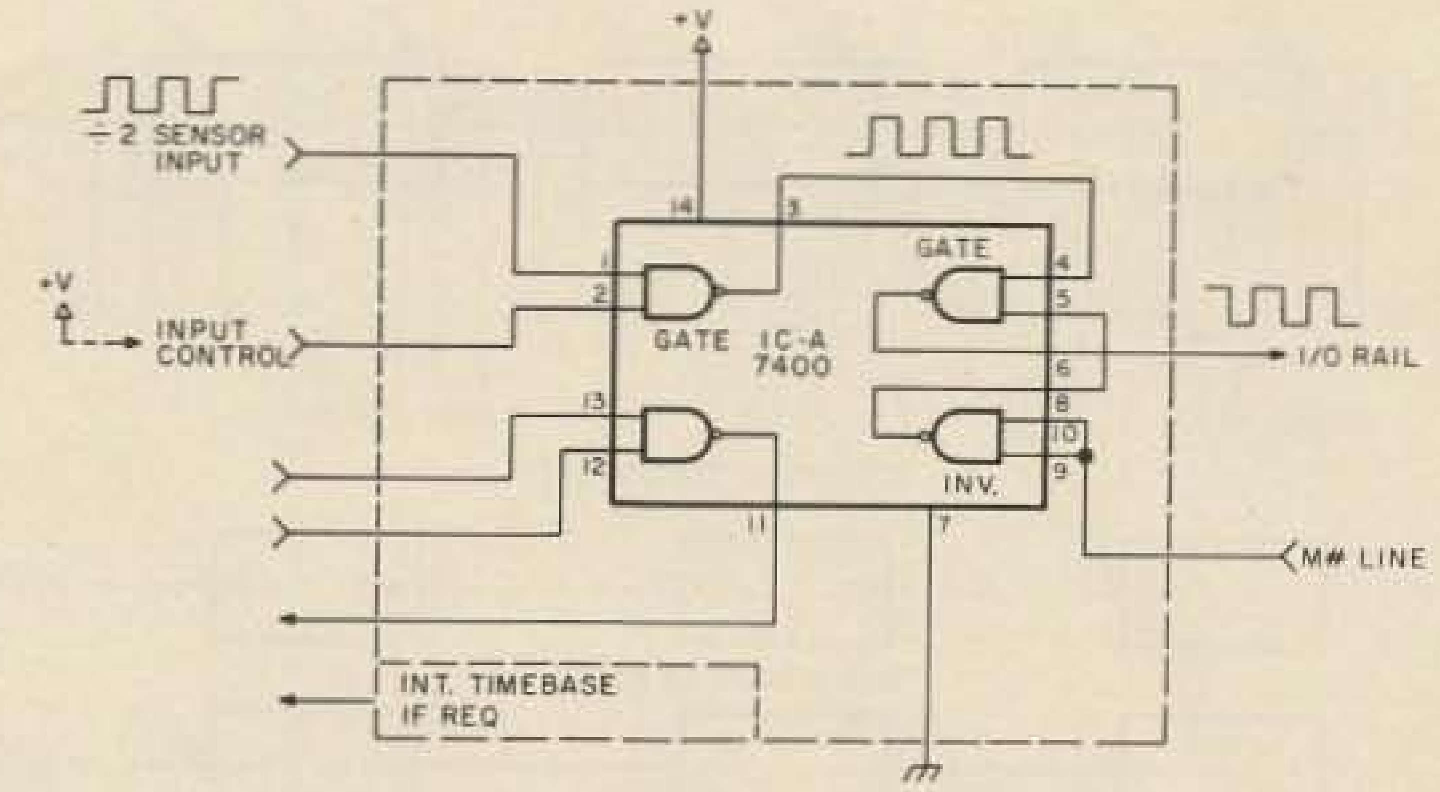

Fig. 3. Mode gate.

W2AOO article, you will readily see you are not going to get the 7" disc into my 4" I.D. pipe! Not to fear. There are easy ways around this.

I had held off building such a wind device for a long time since I was unaware how I would calibrate it. Also, I did not want to tie up a counter all the time, but for those of you without a counter, I fully agree with Warren – now is the time to build one! The K2OAW counter I built from three 1973 *73 Magazine* articles is a great starting point, and there are many updates. I am working on an article now on a 100 MHz basic and 650 MHz with scaler version. It uses the basic board from the K2OAW counter, since I already have built that one. With the TTL prices what they are, you are no longer talking about a 300-500 dollar instrument (i.e., to go from our 100 MHz to the 650 MHz is now about $19.95 – right out of a *73* ad – more on that another time).

The "counter" I am going to describe here is a special purpose unit, and as such can be built for even less than a home brew station test bench counter for your shack. It keeps the price to a minimum by doing such things as using the 60 Hz line frequency as a reference, but can be easily changed to a crystal timebase if you so demand. It has a "record" feature that you can build in, leave out, or add on later. It has a multi-mode deck for using it with more than one use that again can be left off, or added later. The very basic unit is therefore shown first for the wind speed indication only. The three digit capability is required for some of the later uses. Fig. 1 shows the basic display board and is built as a mother board with plug-in modules so things may be easily modified or added onto.

The basic counter and readout portion has been covered many times and should not need a detailed explanation. A stream of pulses comes from the pickup unit (wind speed in this case) through a control gate to the first counter. Each counter is a decade; thus the readouts read in ones, tens, and hundreds for the least significant to most significant bits or numbers from right to left.

LED readouts are so inexpensive now it doesn't pay to use anything else – see *73 Magazine* advertisements. The same source goes for the TTL IC logic required. If you don't mind the logic blinking during the count or are willing to add on the 7475 latches of my circuit, a good PC board can be readily had by building up the WA7SCB "counter" in a *73 Magazine* article from January or February this year. Since no high speeds are used, much lower power consuming MOS logic can be used for some of the circuits. I know of MOS equivalents for at least the 7400 and 7490 and they are the 74C00 and 74C90. They are pin for pin – just remove a 7400, plug in a 74C00, etc.

Fig. 2 covers the cheap 60 Hz timebase used in our inexpensive counter. A small portion of the 60 Hz is capacitively coupled out of the power supply to a discrete squaring circuit or can be fed to a 7413 Schmitt trigger IC. Hereafter, the output from this module is called the TBCL, or timebase clock.

The squared 60 Hz output from the 7413 or discrete squarer is fed to the ÷ 5 input of a 7490. Its output at 12 Hz is fed to a 7492 wired as a ÷ 6, then ÷ 2, for a 1 pps square wave output. The ÷ 2 function of the 7490 will be covered later. Of course for better accuracy, any one of a number of timebases leading to the same output (counter crystal controlled timebases, etc.) can be used into the same inputs that call for TBCL pulses.

Next, if more than one input is to be counted as I have plans to do (wind direction, etc.), some form of mode input gating must be used. Fig. 3 shows a simple gate arrangement using only one IC. Provisions for placing a secondary timebase on this module for future use are also shown. More on that later.

The incoming pulses from the generator-sensing device enter the mode gate at ICA-1, one side of a 2-input NAND gate. The other input, ICA-2, is used differently with different modes. The dotted lines show the hookup for the wind speed only version. ICA-3 is the output of this NAND gate and it goes to the input of a second NAND gate, ICA-4. This NAND gate allows the pulses to pass on to a common I/O line or "rail" for all modules only when the other input, ICA-5, is high. This occurs when ICA-8 is high, which is when ICA-9 and ICA-10 are low. They are tied together and

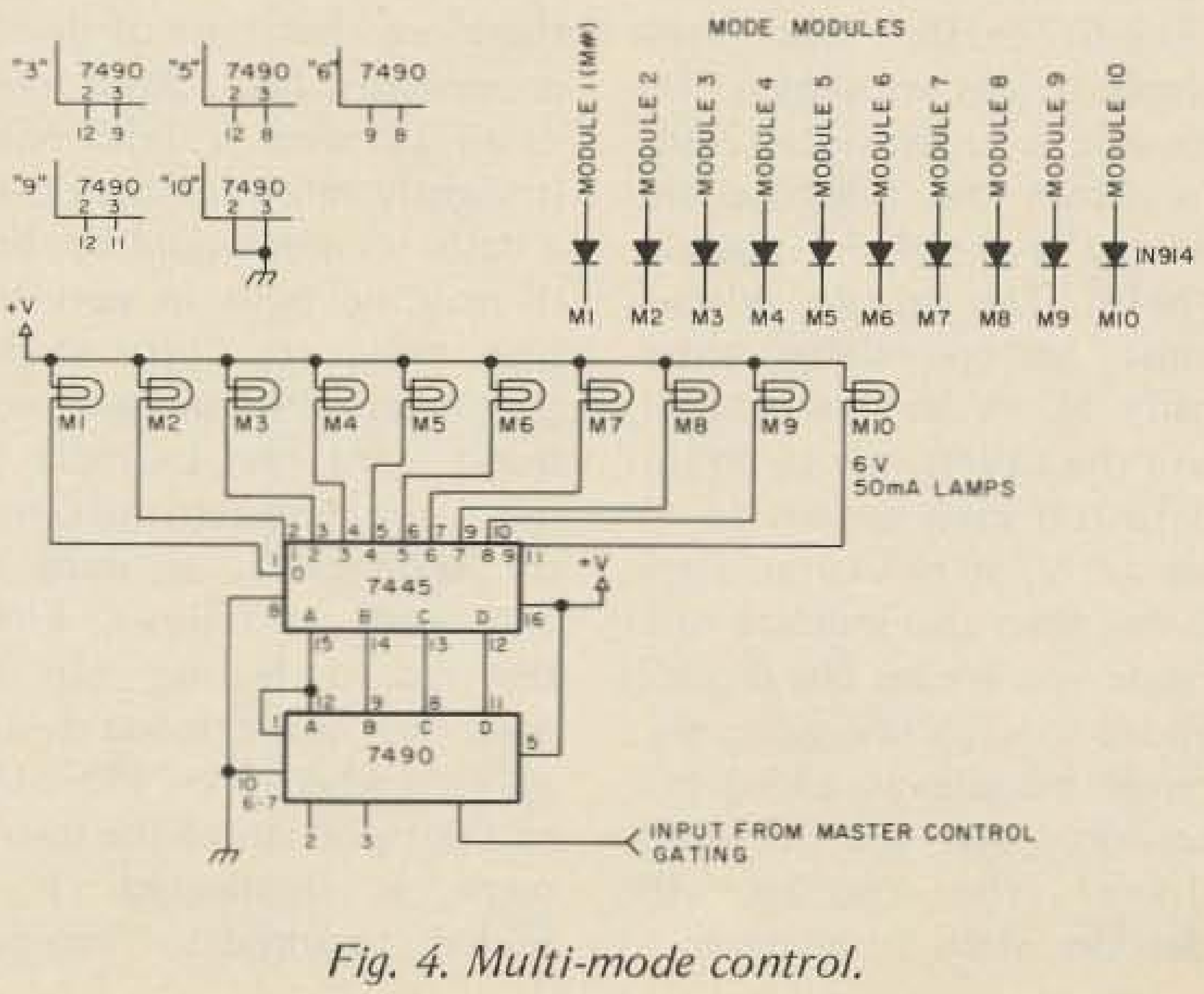

Fig. 4. Multi-mode control.

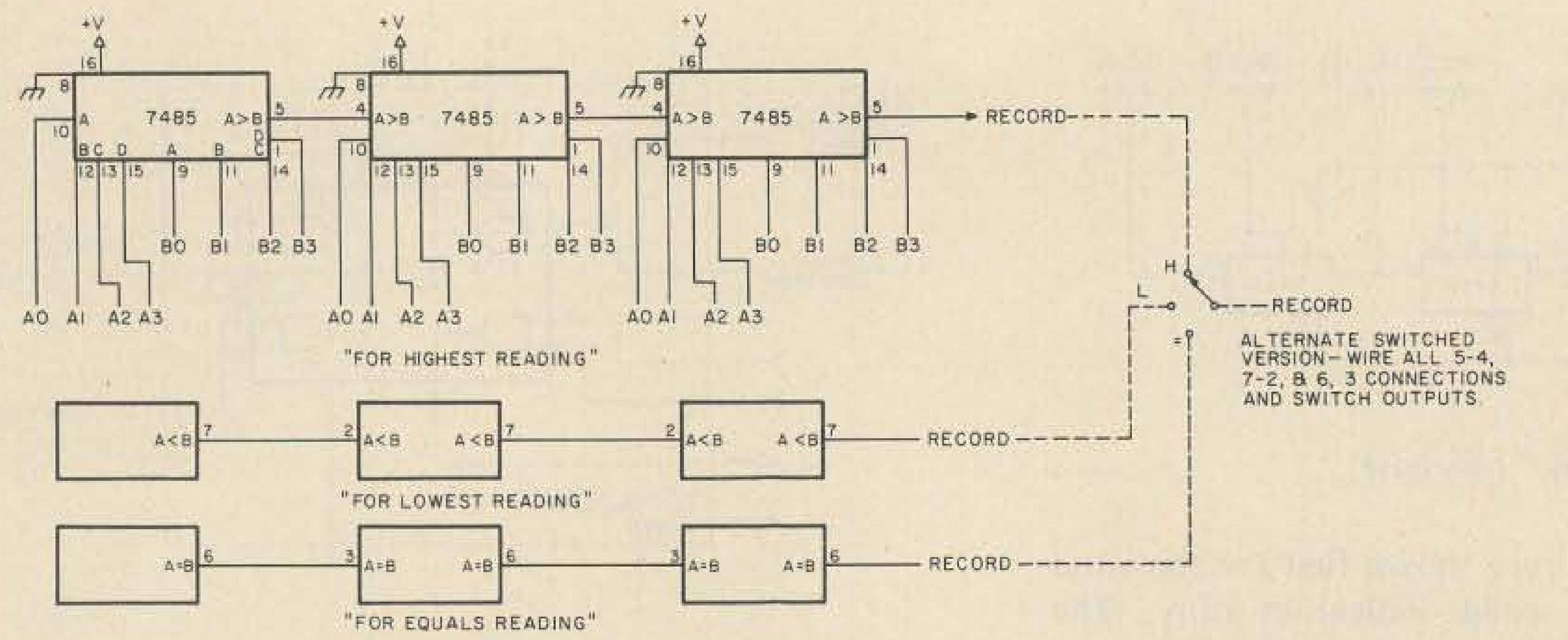

Fig. 5. Recording module. Pin connections: (A) A0 to IC7-12, A1 to IC7-9, A2 to IC7-8, A3 to IC7-11, B0 to IC8-16, B1 to IC8-15, B2 to IC8-10, B3 to IC8-9. (B) A0 to IC4-12, A1 to IC4-9, A2 to IC4-8, A3 to IC4-11, B0 to IC5-16, B1 to IC5-15, B2 to IC5-10, B3 to IC5-9. (C) A0 to IC1-12, A1 to IC1-9, A2 to IC1-8, A3 to IC1-11, B0 to IC2-16, B1 to IC2-15, B2 to IC2-10, B3 to IC2-9.

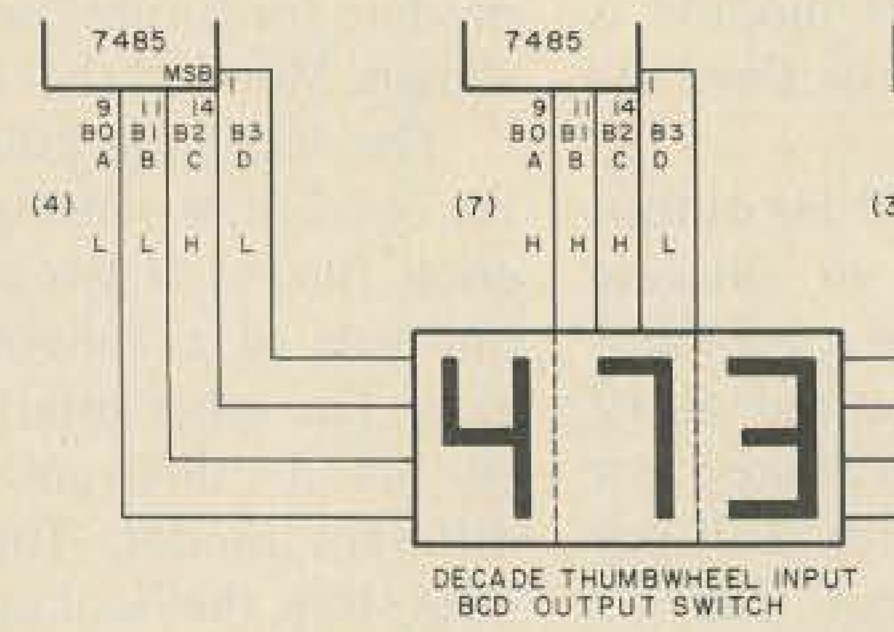

Fig. 5a. Wiring changes for fixed preset figure for B data.

this NAND gate is wired as a simple inverter. Again, the dotted lines show the wind speed only version. The M# line entering at ICA-9 and 10 is covered in the next module.

More than one mode may be monitored by adding the Fig. 4 multi-mode module. Modes may be added on easiest by certain numbers (3-5-6-7-9-10), and these combinations are shown. The module is an encoder (7490) run from the timebase and driving a 1 of 10 decoder (7445). The decoder outputs must be committed externally to +V in this decoder, and the easiest way to do this is to run each output to +V via a 6 V, 50 mA lamp. These lamps then also indicate what mode you are in. The diode is added to each line going to a mode module as added protection. As the timebase drives the encoder, the decoder steps from mode to mode, enabling the input modules as it goes.

An added feature I wanted around my QTH was an easy way to "record" the high or low readings for the day, and while reading through the first writing of this article and the W2AOO article, I realized how similar this requirement is to that of our EME automatic beam steering; therefore that type of device is presented here. Since most or all will want it, I did make it slightly more complex than a basic version would be, but it may be built in part for high only, etc., very easily. Just delete the functions you don't want. An example of use is the best demonstration of usefulness I can think of and reads as follows. First, the record feature can be used in a single mode device only, or where the 7475-7446 readout portion of the instrument is duplicated. It is seldom required to "record" more than one mode reading, so the version shown is for a single mode instrument. You may choose to record the highest readout (A > B), as in the highest wind speed, or only winds above a preset (by you) readout, in which case the readout is stored and the fact it was exceeded used to activate an external device (i.e., a crankup motorized tower lowered in high winds or an alert tone device triggered during tornado season to awaken the family). Or, you might choose to record and/or use the lowest reading (A < B). We are working on other sensors such as temperature, humidity, etc., and you may want to record the lowest temperature of the day (got your antifreeze in yet?) or temperatures below a preset reading – such as 32 degrees F (got the heater strip on the water pipe and the cat in for the night?). Or by adding a later clock module of sorts, you can turn on the house lights at dusk, etc. (A=B). It really can be made very versatile by building up and adding on our modules of future articles. Maybe you can think of something you want to monitor? Drop me a line and we'll see if we can write it up.

For you computer guys, we are already working on a little module to take the readout's information to the outside world as parallel or serial data and on to a teletype (hard copy of weather during a CD storm alert?), or to your computer to do goodness knows what. Using the computer at work is as close as I have gotten to that part of our changing hobby so far, but it does get my interest.

I'm sorry there are no board layouts at this time. We are very busy working on sensors, including wind speed, wind direction (leave extra room in the outdoor PCV pipe unit!), temperature (indoor/outdoor), humidity, barometric pressure, and such

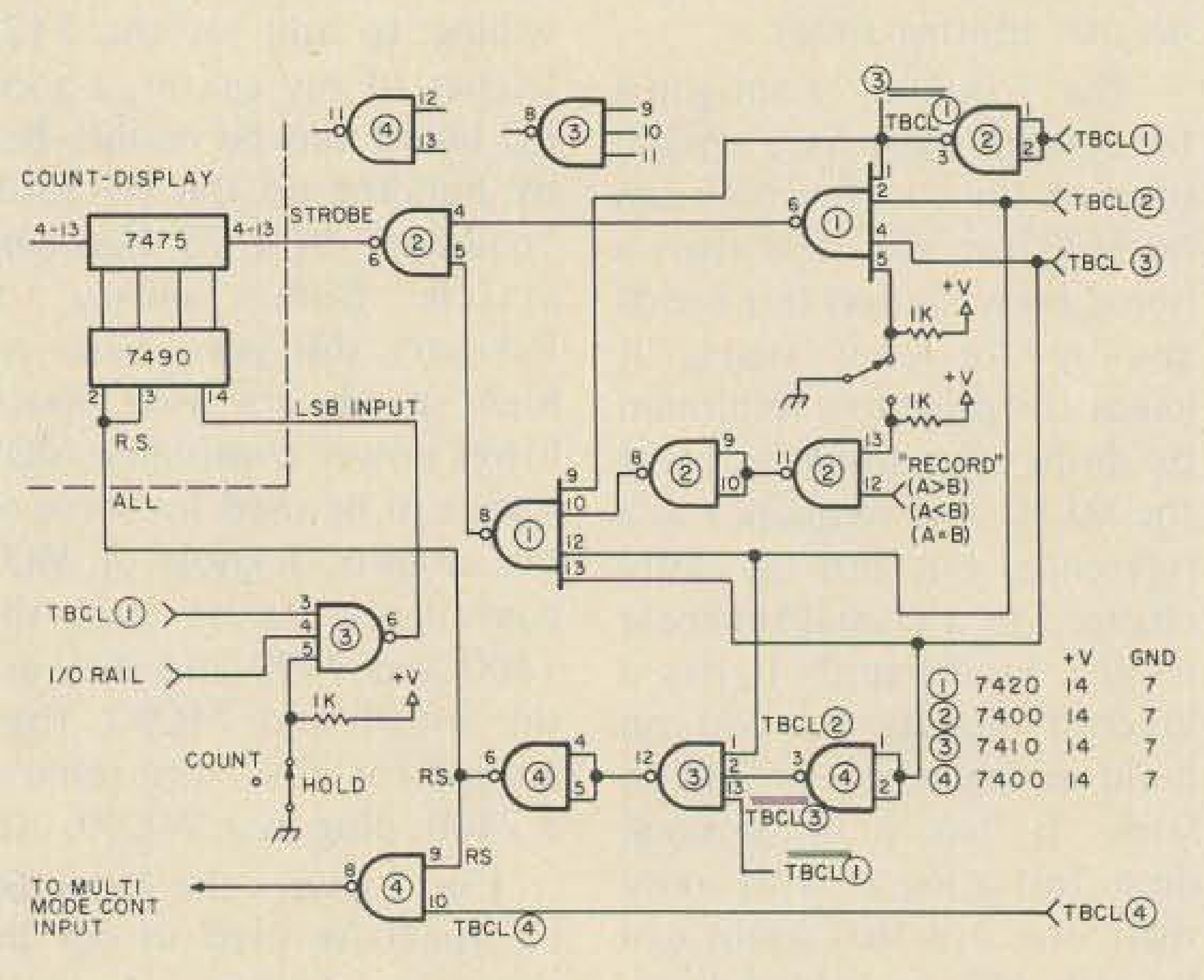

Fig. 6. Control gating module.

others as smoke, fire, and burglar alarms. The burglar sensor is such that shorting around it or shorting it to ground instantly sets it off! The sensors for the most part will be single IC devices. They generate a square wave that is modified by the item being sensed.

As for getting the wind speed running, cut your pipe and chipboard and arrange all the items just as in the original article. Your disc, however, should be cut to 3.75" to 3.80" in diameter to clear the inside of the PCV pipe. This means you have a radius of 1.90". Use a compass and scribe a circle of this radius on the 1/16" thick metal material as in the original. Scribe a line through the center and crossing both sides (straight line through the middle and crossing the scribed circle). Measure from the center along the line one way to a point 1.40" (1.400563499" for extremists) from the center. Center punch this point and the center. Drill the hole at the center 1/4" in diameter, and at the 1.40" point 1/8" in diameter. Now you can mount and assemble as the original, aligning the LED above and the phototransistor below the 1/8" hole. As the disc rotates, the hole produces a pulse every revolution. On a 1.40" radius, or 2.80" diameter, the circumference covered per revolution (or pulse) is 8.796". Every two revolutions (two pulses) the hole on the 2.80" diameter circle covers 17.59"; thus there are 2 pulses produced per second for a 1 mph wind. The sensor signal is routed through the mode gate, through the leftover ÷ 2 function of the 7490 in the timebase, and on to the control gate, as a 1 pulse per 1 mph, just as the original.

The control gating may vary or change as new sensors are developed, so it, too, was built as a module.

It should be easy to follow the gating in the control section. Just use the rule that the inputs to a NAND gate must all be high for the input to be low, and conversely, if any input is allowed to go low, a desired output high can be gotten.

I hope by breaking this up into module construction, each of you might find your own uses, be able to build your own versions, or be able to learn a little about TTL logic and use the circuitry toward your own designs. More input sensors and modules will follow as we perfect them, and I hope we then have more time so that board layouts may be provided for those who prefer PC board construction. I know how you feel, because I certainly prefer it. It makes it very hard to make any mistakes in wiring — hi.

At the cost of today's Pony Express, a SASE is sure appreciated for letters requiring a reply. I have gotten them on letters making only comments or suggestions for future articles, and while the loose stamps were appreciated (I do mail letters and I happen to collect stamps as another hobby — hi), they aren't required for that type of mail. Thanks anyway! On those types of letters, if they can be fit on a post card, by all means save yourself some money, and the comments and suggestions *are* really appreciated. On future board availability, etc., I will try to keep all advised via the *73* letters column if that is o.k. by you and Wayne (*sure . . . Wayne*). We have drawn up several "general" TTL type circuit boards that may be of interest to all, and I'll try to put them all together for a shorty article of nothing but that if there is an interest. They are very handy to "breadboard" up more complex circuits. You end up with multi boards, but maybe that isn't so bad. I hope this article helps make amateur weather observers of you. You would be surprised the effects it has on our radio hobby, and how appreciated the data is to your local CD net and weather bureau during the rough storms, tornadoes, etc. We sure have been warmly received by the local weather bureau during such times. Until the next modules, 73. ■

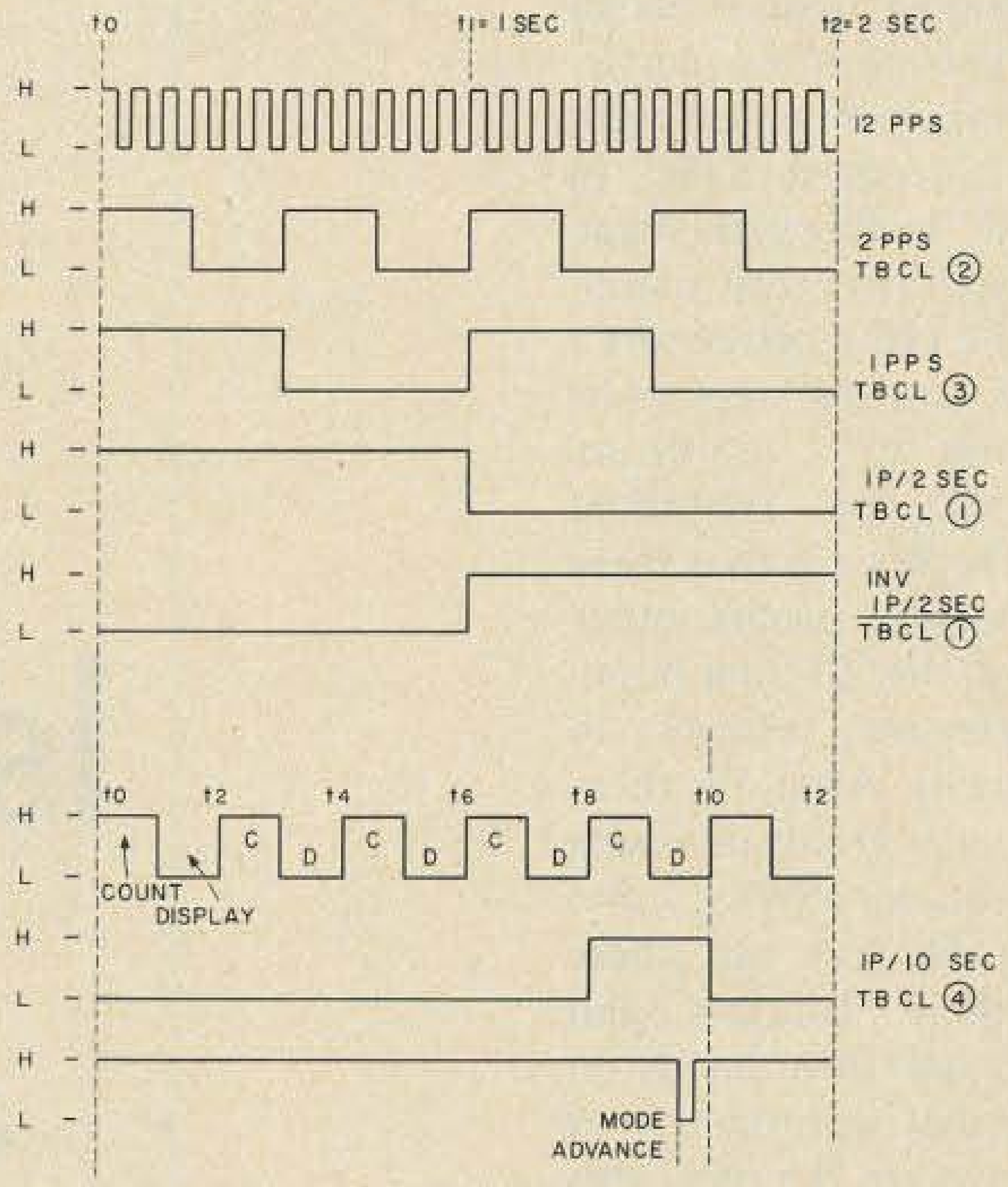

Fig. 7. Timing chart.

The S38 Is Not Dead!

-- a tale of resurrection

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I recently attended several San Francisco Bay Area ham auctions, with attached flea markets. For no particular reason, I ended up with an old Hallicrafters S38C, in the most bedraggled shape imaginable. The very condition of the old receiver was a challenge, and the steps in its resurrection to a useful receiver will be recounted herein. The hope is that these easy steps will inspire other owners of this all-time popular short-wave receiver to restore them. After all, there is still a large group of young experimenters, SWLs, and would-be Novices out there saving their quarters and dimes to get their hands on anything that will function as an HF receiver. To meet this group, simply attend the next ham auction or swapfest; it will restore your faith in the younger generation.

My receiver, as acquired, had no knobs, a torn speaker cone, a rusty cabinet, a missing receive-standby switch, no dial pointers, and (of course) was inoperative. Should yours be in similar shape, your first move should be to get a copy of the circuit (Sams' set 190, folder 4), preferably from a friend who does service work. Secondly, the speaker should be replaced; horizontal mounting of speakers in the tube-type sets eventually ruins them, so you might as well do it right away. Next pull the chassis, check tubes, and replace as needed. Be sure to replace the #47 pilot lamp if it's open, because otherwise you'll be buying a new 35Z5 rectifier tube shortly. A type #755 pilot lamp, with extended-life, might be considered here. The entire complement of eight or nine tubular (drippy, paper-wax type) capacitors should be replaced with the newer mylar and ceramic disc varieties. This step avoids the step-by-step isolation of a faulty capacitor, and should save time in the long run. I replaced the three-section electrolytic capacitor on general principles.

In the cosmetic area, I made new dial pointers by soldering short pieces of 1/16" brazing rod to grid-cap clips (1/4") and painted them white. The cabinet was wire-wheel cleaned of rust, masked, and painted with a spray-can coat of grey enamel. A new bottom plate was also made of sheet aluminum, and rubber feet attached. A set of four knobs (not original Hallicrafters, but adequate) was installed, and a new slide switch was put in the "receive-standby" position.

With these efforts, my receiver gave some indications of life, at least on the BC band. A simple i-f and rf alignment, following the procedure in Sams' with a signal generator, greatly improved sensitivity. At this point, the S38C was judged to be "as-good-as-new"; that

Hallicrafters S38C after resurrection, with FET preamp atop.

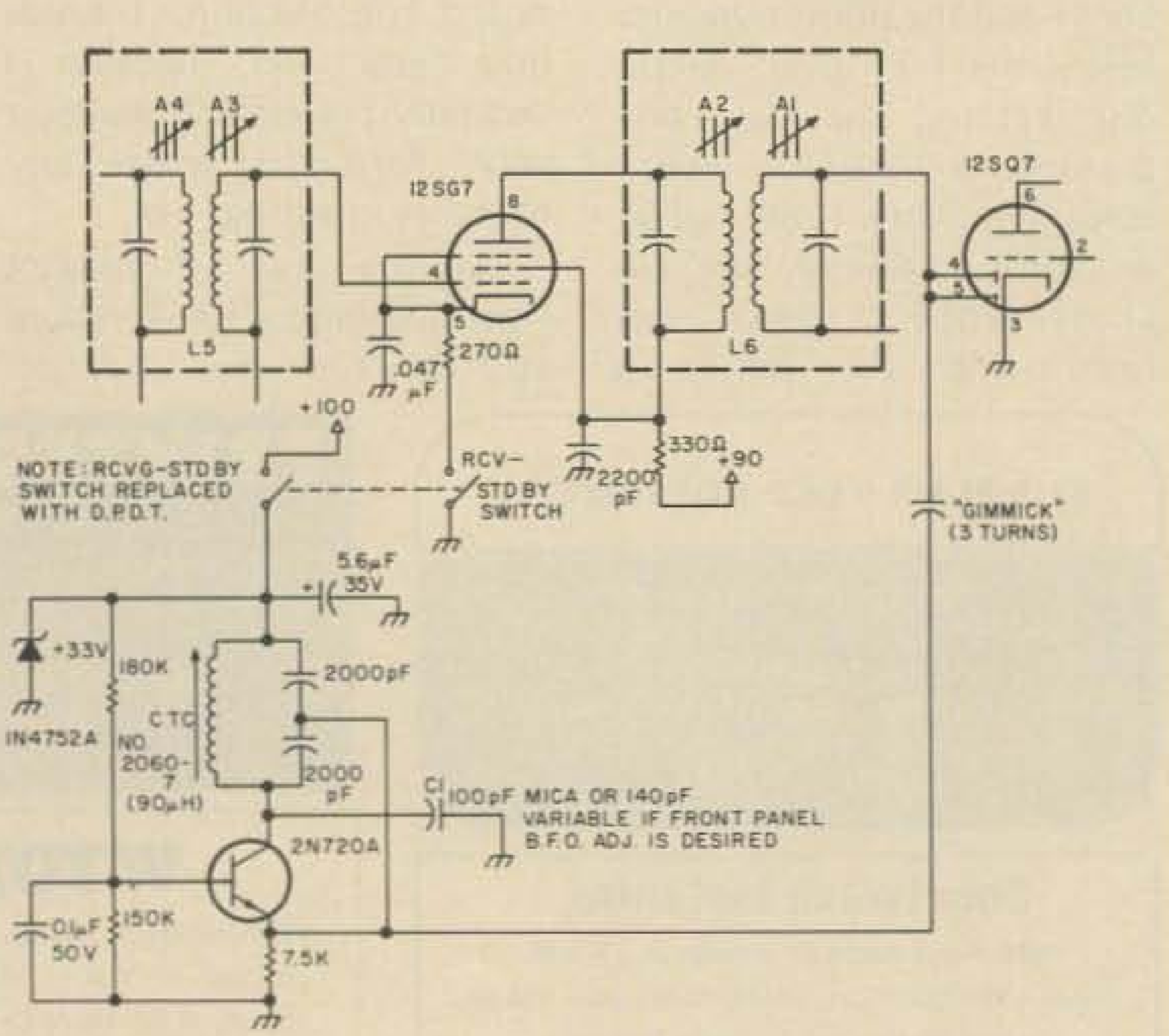
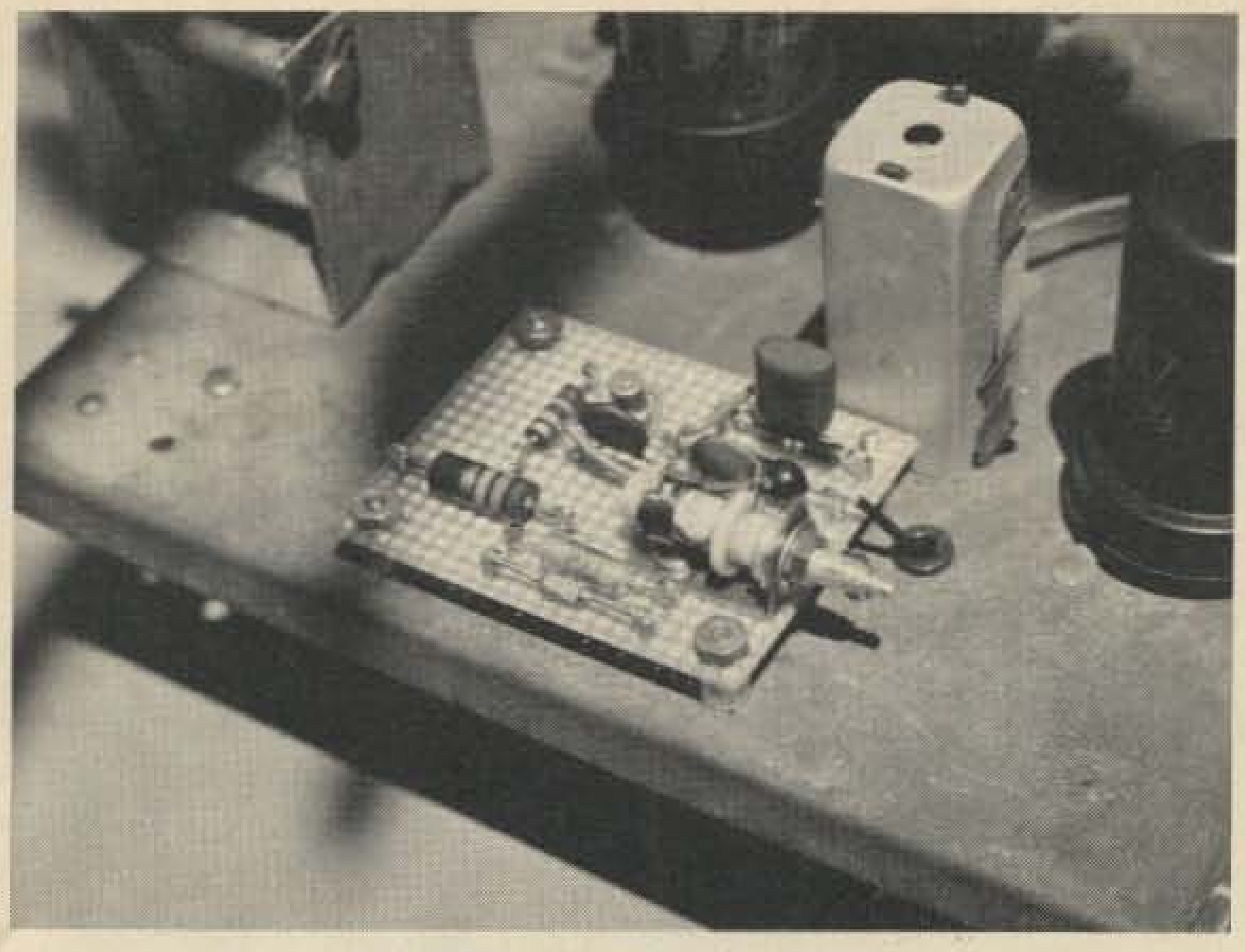
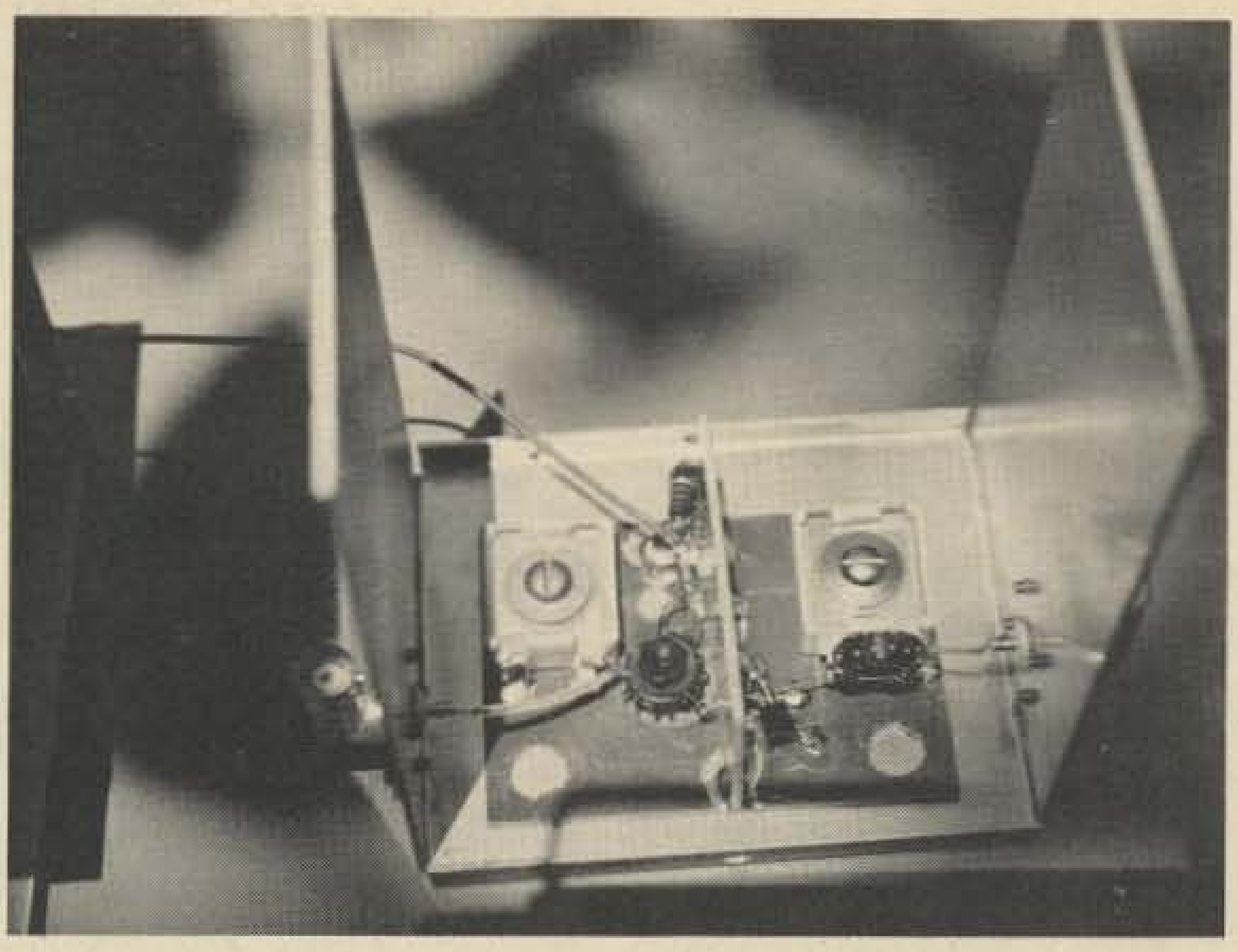


Fig. 1. New BFO in S38C. C1 = 100 pF mica or 140 pF variable if front panel BFO adjustment is desired.



Transistor BFO mounted on S38C chassis.



Rf portion (except power supply) of 14-30 MHz preamp, mounted on section of copper PC laminate.

is, a *fair* receiver considering its design limitations.

Changes and Additions

The BFO function in the original S38C is fulfilled by causing the i-f amplifier to go into regeneration. This rather critical circuitry was eliminated, and a more conventional BFO added. Since the S38C is an ac-dc type of radio, it was easier to make the new BFO a transistor type and avoid heater voltage problems. The new BFO and its placement in the S38C circuitry are shown in Fig. 1. A few milliamps from the B+ are used with a zener to provide the +33 volts to operate the BFO. If a front panel BFO control is desired, C1 can be made a variable (140 pF) rather than a fixed capacitor.

The shortcomings of the S38C are several: lack of image rejection, inadequate selectivity, and inadequate sensitivity (for starters). The sensitivity can be increased and image rejection improved by the addition of a preselector. There are many adequate designs for such preselectors, but most of these date back to the same era as the S38C and similar receivers.[1,2,3] The photo shows a simple preselector using an FET. This is an add-on unit, not designed to be included in or powered by the S38C.

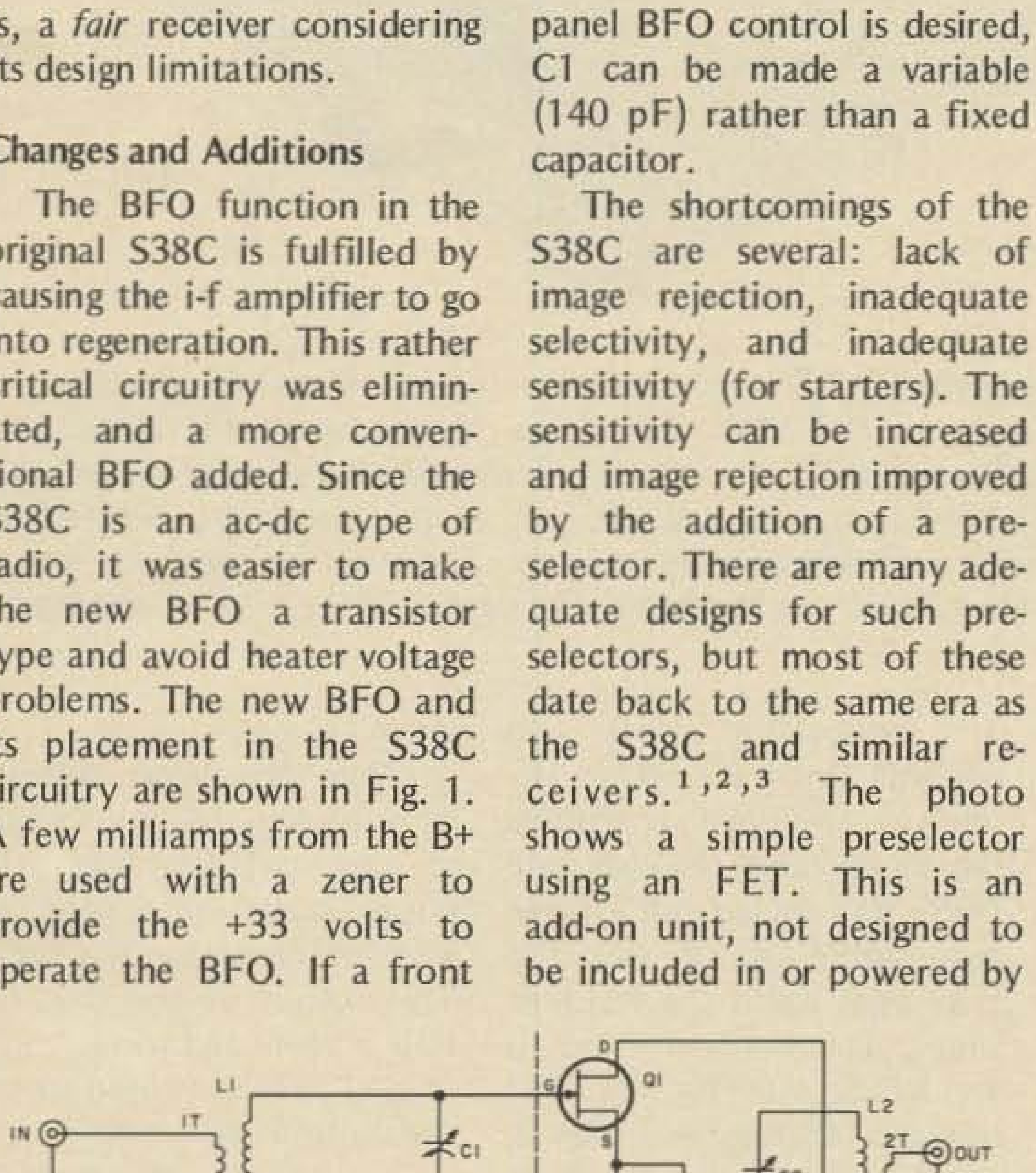


Fig. 2. Self-powered 14-30 MHz preselector for S38C. C1 = C2 = 50-500 pF (Miller 160B); L1 = 10T #22, T50-10 Micrometals core (0.37 uh) with 1 turn link; L2 = 10T #22 with c.t. and 2 turn link on T50-10 Micrometals core; Q1 = MPF102, HEP-802, HEP-F0015 (all Motorola); D1, D2 = 1N4002, HEP-R0051 (Motorola). Ferrite beads and Micrometals cores available from Amidon, 12033 Otsego St., N. Hollywood CA.

The preselector improves the overall receiver noise figure, and thus its sensitivity in the 14 to 30 MHz portion of the HF band. There is less to be gained by extending its range by adding the complication of coil switching for lower frequencies, since these frequencies are usually sky-noise limited. The preselector will help not only sensitivity but can also help reduce cross-modulation from strong out-of-band shortwave broadcast stations. The value in reducing images is noticeable too since the image is always 2 x 455 kHz away from the desired frequency. That is, at 14 MHz the ratio of desired frequency to image offset is 15/1. The coils used in the preselector have unloaded Q values of 100 or greater, and so would be expected to be of some help in image reduction. The Qs of the tiny powdered iron core coils used are nearly as high as one would obtain with air core type coils, and have a totally self-contained magnetic field. This latter fact makes it possible to use them in a compact preselector design with a minimum of shielding, yet one still having good selectivity and stability. The sensitivity improvement on 14, 21, and 28 MHz was measured to be between 10 and 20 dB; this is a significant improvement over the original. The basic preselector's circuit is shown in Fig. 2. The power supply section is not shown, as its layout is non-critical. The supply and preamp board were later combined in an LMB-140 box chassis, to package the unit for convenient operation. Note that two compression mica variable capacitors were used to tune the preamp; this was due to the scarcity of air-spaced tuning capacitors nowadays. Since *these* capacitors are screwdriver-adjust types, some may wish to substitute air spaced types – or modify the compression screws for shafts. If one band, say 15 meters, is used primarily, only slight retuning is necessary across the band, and a screwdriver adjust system is okay. The two 0.1 uF bypass capacitors in the preamp should be low inductance ceramic types (Erie Redcap are specified) to insure low rf impedances to ground at these points. Aerovox, Vitramon, and others make similar types of capacitors, however. ■

References

[1] "High Gain 5-Band Preselector," *Radio Handbook*, 7th Ed., Editors and Engineers, 1940.

[2] "A Bandswitching Preselector for 14 to 30 MC," *The Radio Amateur's Handbook*, 29th Ed., ARRL, 1952.

[3] "The R-9'er," *General Electric Ham News*, Vol. 1, No. 4, Nov.-Dec. 1946.

ID with a PROM

-- and program it yourself

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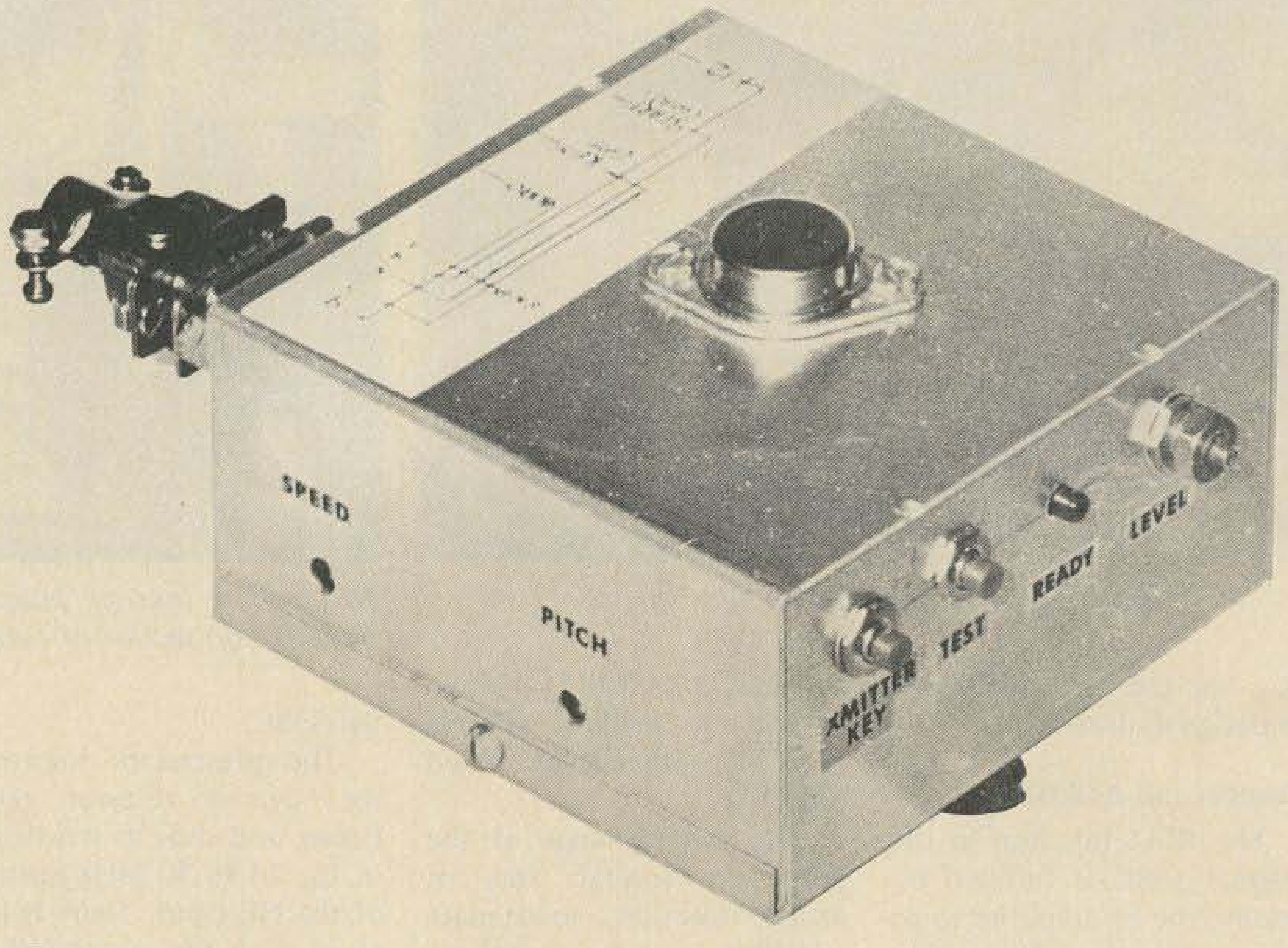
Here is another CW identifier using a Programmable Read Only Memory. Several circuits using PROMs have been floating around, but most of them were lacking one or more of the features I wanted. For my applications, I wanted a timed hold-off which would keep the IDer from being re-keyed within a specified time period. I also wanted the IDer to re-identify at the end of the time-out period.

This version of the identifier is about third generation, and conquers, I hope, some earlier limitations.



External view of the prototype identifier. The transistor on top is a five volt regulator. The XMITTER KEY button will key the PTT line. The TEST button sends the ID without triggering the timers. The READY is an LED (not shown on the schematic) which is on when the IDer is ready to be keyed. LEVEL sets the output level to the transmitter. PITCH and SPEED are self-explanatory and are screwdriver adjustments. The plug on the back was an afterthought in this case, for interface with our repeaters. The case is a 4" x 4" x 2" minibox.

Circuit

The basic CW generation technique is not new, and consists of U1, 2, 3 and 4 in Fig. 1. U1 and U2 are ripple counters whose input is a 555 clock. The first three stages of the counter drive a multiplexer/data selector, U4. Using the counter input, U4 repeatedly scans the memory (U3) outputs B0 and B7 for highs, which in turn appear on the output of U4. The last five stages of the counter provide the address inputs for U3. This input advances one count for each scan of the output bits. The result of this scheme is that the memory output is scanned sequentially (B0 to B7) for each word in order of address.

I used an NE555 for the clock and a pair of gates cross-connected as a flip flop to start and stop the clock. A pulse from the start circuitry sets the flip flop and starts the clock. When the end of the count is reached by U2, it triggers monostable U6A, which resets the counters and the start/stop flip flop. The inputs to U6A can be programmed to stop the counter after either 128 or 256 bits.

The start circuitry consists of monostable U6B and hold-off timer U7. When the input is grounded, it triggers the monostable through gate U9B. The pulse out of the monostable sets the start flip flop and starts the hold-off timer. The hold-off timer is an NE555 set for about 3 minutes. During this period, the monostable is kept from being triggered by further input keying.

When the timer releases, its output is capacity-coupled to the start flip flop. This pulse starts the identifier without restarting the timer. The output of the start flip flop is also used to turn on ½ of U11, which is used to key the transmitter.

A problem I encountered with this circuit was having

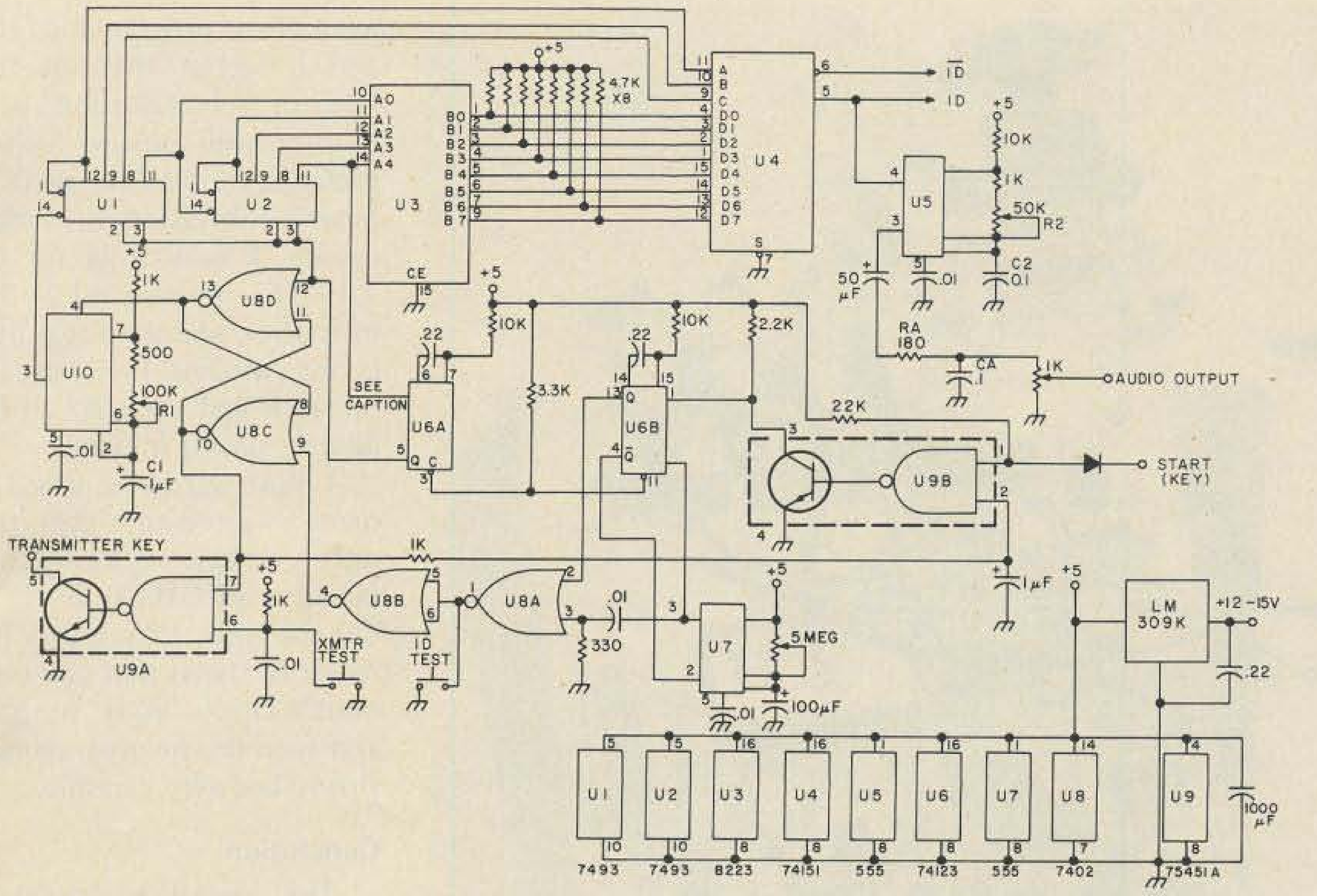


Fig. 1. Circuit of the identifier. For a 128 bit ID, connect U2, pin 11 to U6A, pin 10, and U6A, pin 9 to ground. For a 256 bit ID, connect U2, pin 11 to U6A, pin 9, and U6A, pin 10 to +5. R1C1 set the clock frequency and therefore the speed of the identifier. R2C2 set the tone of the audio output. Note IC numbers at bottom of figure.

the identifier re-keying itself and then identifying either continuously or once every three minutes. I wound up isolating the COR/PTT circuits with a diode, and using the second half of U11 as an input gate. This seems to work alright and not re-trigger.

Like all TTL circuits, this one is somewhat rf sensitive. As a result of this problem, I have built the last two of these identifiers in aluminum boxes and brought the connections out through feed-throughs. This appears to solve the rf susceptibility problem.

I am using the logic output of U4 to key an NE555 audio oscillator, which is in turn sent to the microphone input of the transmitter through RA and CA, which roll off the audio above 3 kHz. The logic out of U4 could be used to CW key a transmitter through a relay or transistor if desired.

Operation

A typical interconnect is shown in Fig. 2. Diode D1 alows the output keying to ground the transmitter PTT line without grounding the identifier input.

I have one of these installed on a Motorola repeater with solid state control logic. On that repeater, I use the "Repeater PTT" line to key the identifier and I use the identifier output to key the "Local PTT" line. In this application the diode is not required, since the

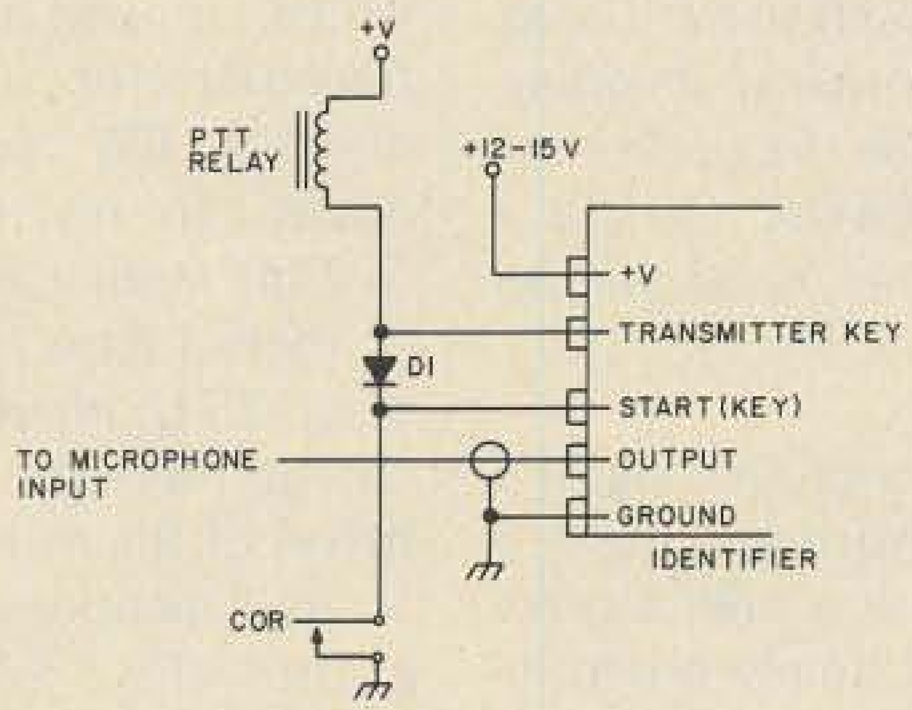


Fig. 2. Typical repeater interconnect with the identifier. The COR is in the receiver or terminal and the PTT relay is usually part of the transmitter power supply. Diode D1 must carry the current of the PTT relay.

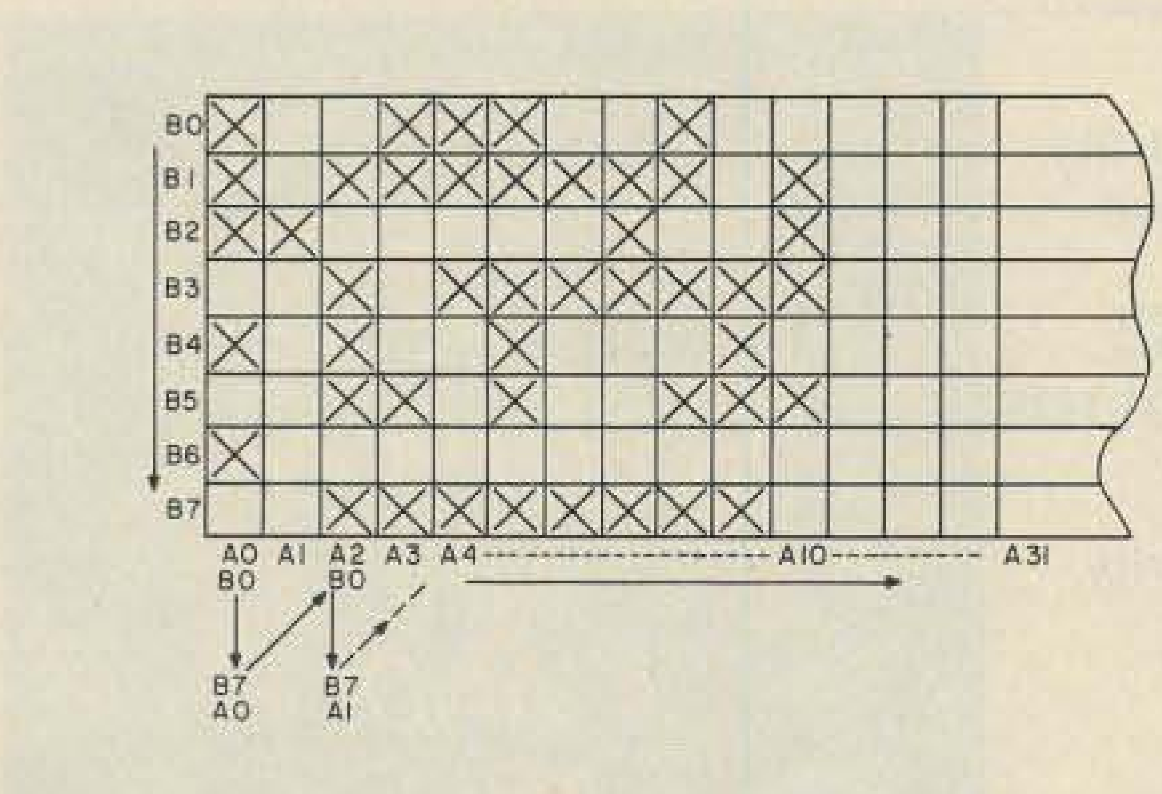


Fig. 3. This shows how the memory is programmed for "DE WR7ABC." An "X" indicates a programmed "1" and an open block indicates a "0". The memory is read from B0 to B7 and from A0 to A31, as shown by the arrows.

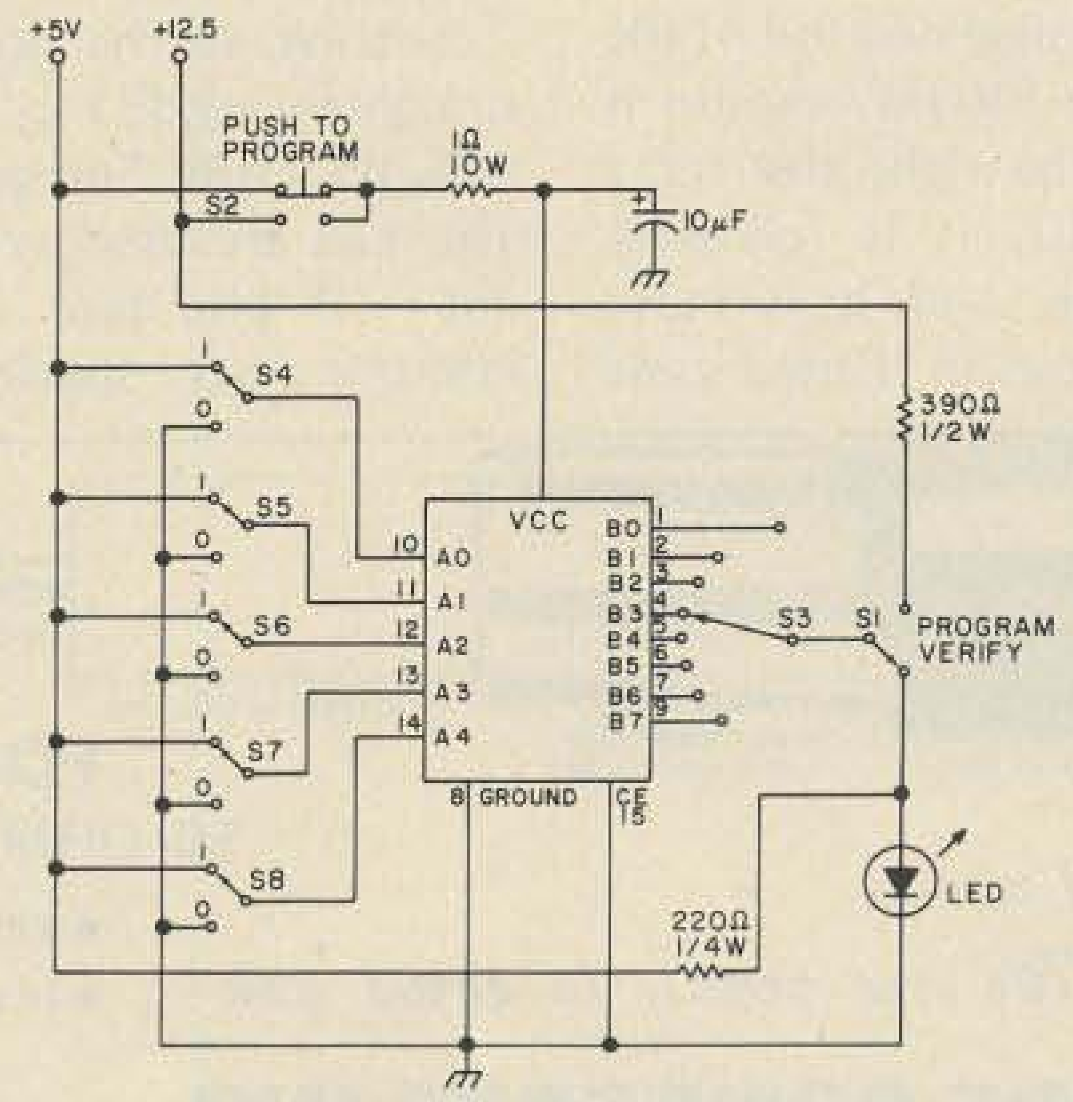
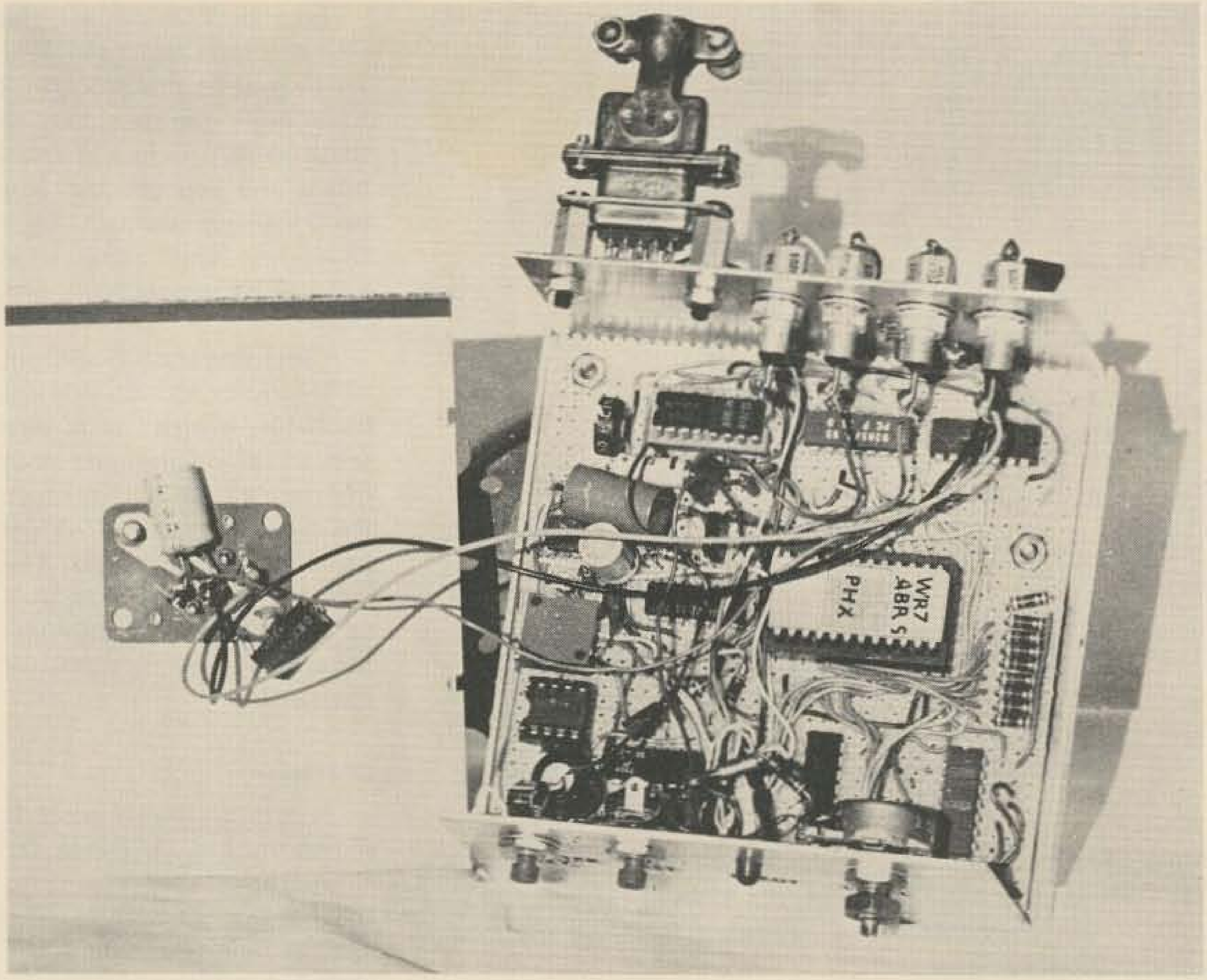


Fig. 4. A simple connection for programming an 8223 memory. The word address is selected by S4-S8. Each bit where a "1" is required is selected sequentially by S3. S2 is a push-button depressed momentarily after S1 is set to "Program."



Inside of the identifier. The construction is on perforated board with stick-on solder pads on the underside. This is a prototype unit and the large IC in the center is the PROM used instead of the 8223 shown on the schematic. On the rear of the chassis are filters to provide rf shielding of the leads. The plug on the left was an afterthought added to provide flexibility of connection. (In case you are wondering about the WR7ABR S PHX on the PROM . . . it is a 512 bit memory and has both ABR and ABS messages in it.) The wires and socket inside the top of the case are for the five volt regulator (LM309K).

"Repeater" and "Local" PTT lines are isolated.

Programming

I have suggested use of the 8223 type PROM because it is about the right size for a repeater ID, it is relatively inexpensive, and it is fairly easy to program. I used some larger (512 bit) memories for the units I built since they were available, but over half the memory is unused.

Setting up the program is straightforward. Fig. 3 shows "DE WR7ABC" programmed. The bits are used as follows: dot – 1 bit; dash – 3 bits, intercharacter spacing – 1 space; interletter spacing – 3 spaces; and word spacing – 6 spaces (a bit is a one, a space is a zero). A simple programming jig is shown in Fig. 4. This arrangement, although simple, is tedious because each binary address must be set in manually bit by bit (5 toggle switches). I have built a couple of programming rigs, and I suggest that the first step in sophistication be a thumbwheel address switch, preferably octal (as BCD to binary conversion is complicated). I have a jig for the 74186 type 512 bit memories, and used two BCD coded switches. I only use 0-7 on each and then do all my address setting in octal.

I must warn you, based on many wasted devices, that once you have set a particular bit in a PROM to a "1" it cannot be changed. The moral of this is that you must double-check your program and then do the programming slowly and very carefully.

Conclusion

This circuit has a lot of room for modification or change. For instance, the hold-off timer or re-trigger capability could be left out, or the time changed. The output of U4 is a TTL signal which, if used to turn on a transistor or relay, could directly CW key a transmitter. In my IDers I used 512 bit memories, and in one of them I have the capability of a TTL input which can change messages by switching halves of the memory.

As I mentioned, I can program the 54/74186 or MCM5003 type devices and will be glad to help people with information on programming. Please, however, if you request information, send an SASE. ■

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The Amazing Inverted L

-- antenna for 20, 40 and 80m

Are you looking for an antenna that will outperform the usual horizontal dipole or trap vertical? How about an antenna that "works" just as well day or night on 80, 75 and 40, whether it's long or short skip conditions prevailing at the moment? Does the thought of a tendency to minimize signal fading (QSB) strike your fancy?

As illustrated, this antenna system requires a transmatch. Well, there go about half of the readers scrambling off to the next article. Those remaining might want to try something that is out of the ordinary, and certainly better than some of the simple coax-fed types.

If you examine Fig. 1 closely, you will see why this is called a *system* antenna. It consists of *all* of the ground reflecting screen wires *and* radials, as well as the simple antenna radiating element. All of this is what gives it the above average characteristics in overall signal strength.

Some Theory

Ideas for this system were heavily borrowed from articles in *73*, *QST* and *CQ* magazines (see references). The inverted-L is somewhat noted for a bit of diversity action. I enhanced this by extended (at least for 40 and 20) radials for the vertically polarized field, and a ground "screen," parallel to the flattop, for the horizontal field. This seemed to stabilize the overall response regardless of seasonal weather changes upon the earth in the immediate vicinity.

There seem to be several factors concerning signal fading. Some of these are changes in the skywave angle for transmitting and reception, as well as polarization shifts. This antenna has vertical and horizontal polarization, as well as high, medium and low radiation angles. At first one might think that "spraying" the rf in many directions of angles and polarizations will reduce the field strength in any one plane. However, *on-the-air results* dispel this notion. Instead, the opposite seems to be true over skip paths, with a *higher* average of signal strength as compared to ordinary dipoles and verticals, trapped or untrapped.

For 20 meters, the end-fed flattop will have several lobes at the medium radiation angles. The vertical section has a very low angle omnidirectional pattern. On 80 (75) and 40 meters, the flattop contributes to the high angles necessary for daytime use. The ground screen underneath it seems to give it short skip gain on 80 (75) and 40. A "barefoot" transceiver at 130 Watts average input on SSB usually sounds stronger than "normal," for example. The vertical section, along with the radials, takes care of the low angles for DX at night.

Details

When it comes time to put in the grounding system, don't conjure up frightening ideas of deep long trenches tearing up your dandelions. In fact, a deeply entrenched ground system will not work as well for this antenna as one that is above, on, or just below the earth's surface! My first ground system was simply lying on the snow-covered yard (and part of the neighbors' backyards). The antenna worked fine. When soggy spring season rolled around, I then took a large hunting knife and slit the spongy earth alongside the grounding wires and pushed them in about one inch. Now some of the radials were running just underneath my neighbors' well-manicured lawns!

One important item should be noted: *All of the grounding wires must be fully insulated, including the soldered joints.* Use a plastic type of insulated wire such as bell wire or hookup wire. The wire size is not too important. I used #20 solid insu-

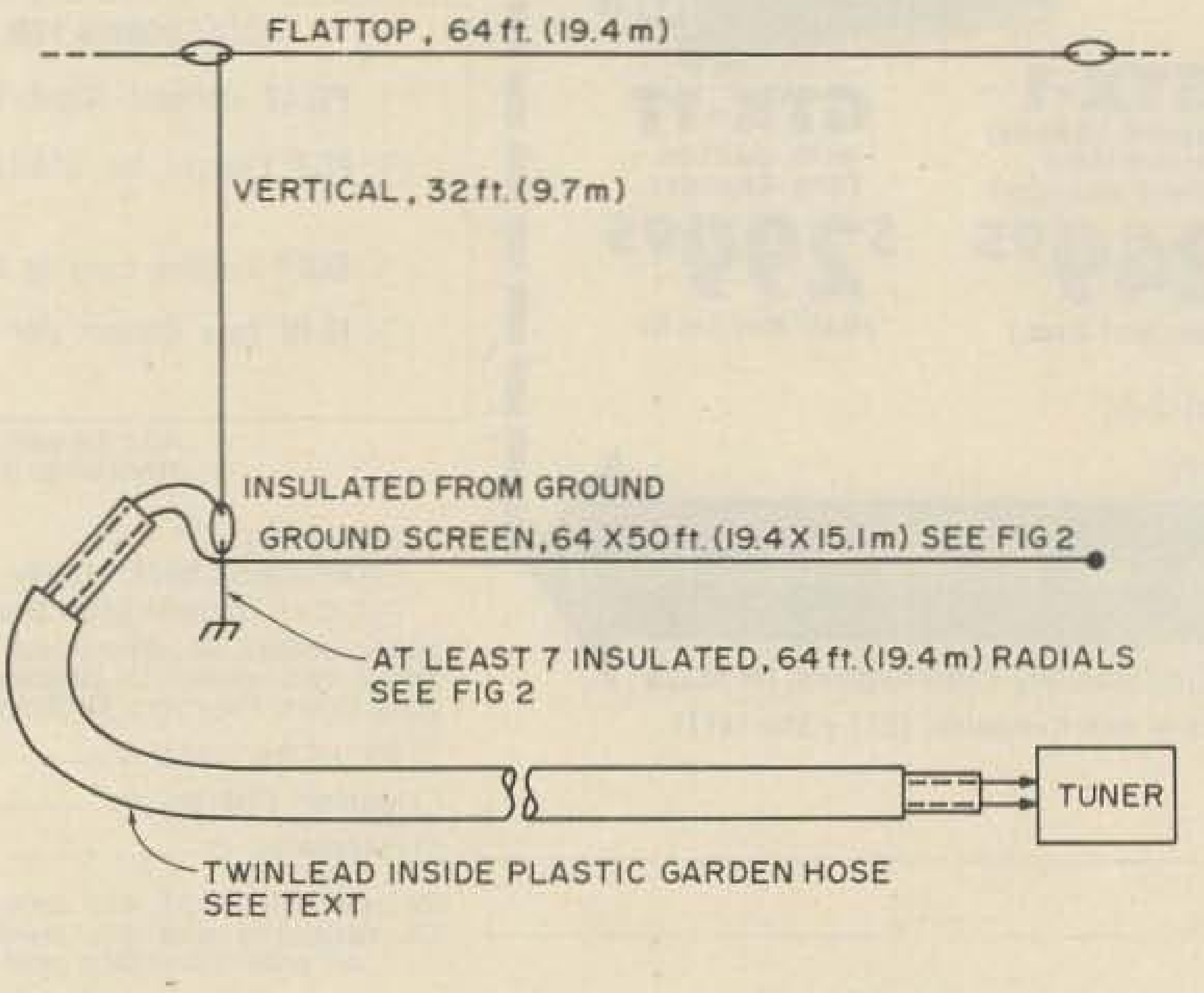

Fig. 1. Inverted-L system antenna for 80, 40 and 20, side view.

lated hookup wire from Radio Shack. Electrical tape can be used to insulate the soldered joints and ends of the wires.

Don't skimp on the radials. Laying them at night under a full moon into a reluctant neighbor's turf can be exciting. If your own property cannot accommodate fully stretched-out radials, and that German shepherd next door is uncooperative, then at least lay them zigzag on your own lot as best you can. Don't shorten or reduce the number of radials.

The radiating element is #12 hard drawn copper enameled "antenna" wire. I suppose #14 will work just as well. I happen to like #12 for increased strength and possibly lower losses. The flattop section was suspended between two maple trees. The "free" end was stabilized with a rope and pulley affair hooked to the tree, using an old rock-filled paint can as a weight. My flattop was oriented east and west.

Transmission Line

Here is the part that looks questionable, but it seems to work. The whole thing is fed with 300 Ohm "balanced" line. I used the oval foam core type of UHF TV line. This handled my rig's 100 Watts output. For high power, I recommend the 300 Ohm transmitting twinlead. My feed line was run through a cheap discount store ¾ inch plastic hose, buried about 3 inches. I split the ground with a garden spade, and wiggled it back and forth a couple of times to spread the earth after each "stab." Yes, it's a bit tedious. When the feed line equipped hose was buried, I then stomped on the trench over the entire length, and after a couple of rain showers, it became invisible.

Be sure that *both* ends of the hose are well sealed. I used tape, and then smeared G. E. Silicone Seal over this. It has been my experience to find that "breather" holes are prone to suck in water. So seal both ends of the hose well, and don't worry about so-called "condensation." If you are using the air-core type of twinlead, then seal up both of these ends also.

Perhaps the 300 Ohm *openwire* (half inch) TV "ladderline" may also fit inside a large diameter hose. Its own insulators may help to keep it "centered" within. I have not tried this, but it's an idea that should have good power handling capabilities. The hose is used only for the underground portion of the transmission line, to help keep it dry and physically separated from ground.

I used both a balanced and an unbalanced type of tuner. Either one gave the same field strength readings at about one city block distance. Both of mine were able to load the system easily. Should you encounter a loading problem on one of the bands, try cutting or lengthening the feeder a couple of feet or so. Chances are you will still load up all right on the other bands.

If you are going to use an *unbalanced* type of tuner, make sure that the "hot" lead goes to the "antenna" side of the line, and the grounded part of the tuner goes to the "ground" side of the line. That may have been stating the obvious, but it is easy to get these feeder leads reversed to an unbalanced coupler. Yours truly did it, and the effect is sneaky. Reception seems fine at first; however, your transmitted signal is very weak!

Conclusion

This antenna system does not completely eliminate QSB, but if you compare it by switching it between an ordinary dipole and vertical (including the trap varieties), you will hear the differences.

One more thing. A "different" type of antenna makes a good conversation topic — especially if your signal is above normal for that particular time of day! ■

References

A Super-Gain Antenna for 40 Meters, Dusina W4NVK, *73,* Oct. 1969, pp. 8-11.

Technical Correspondence, *Antenna Type vs. Distance,* Hardacker W6IT, *QST,* Oct. 1968, p. 43.

Vertical Antennas, Part XI, Lee W3JM, *CQ,* April 1969, pp. 38-43.

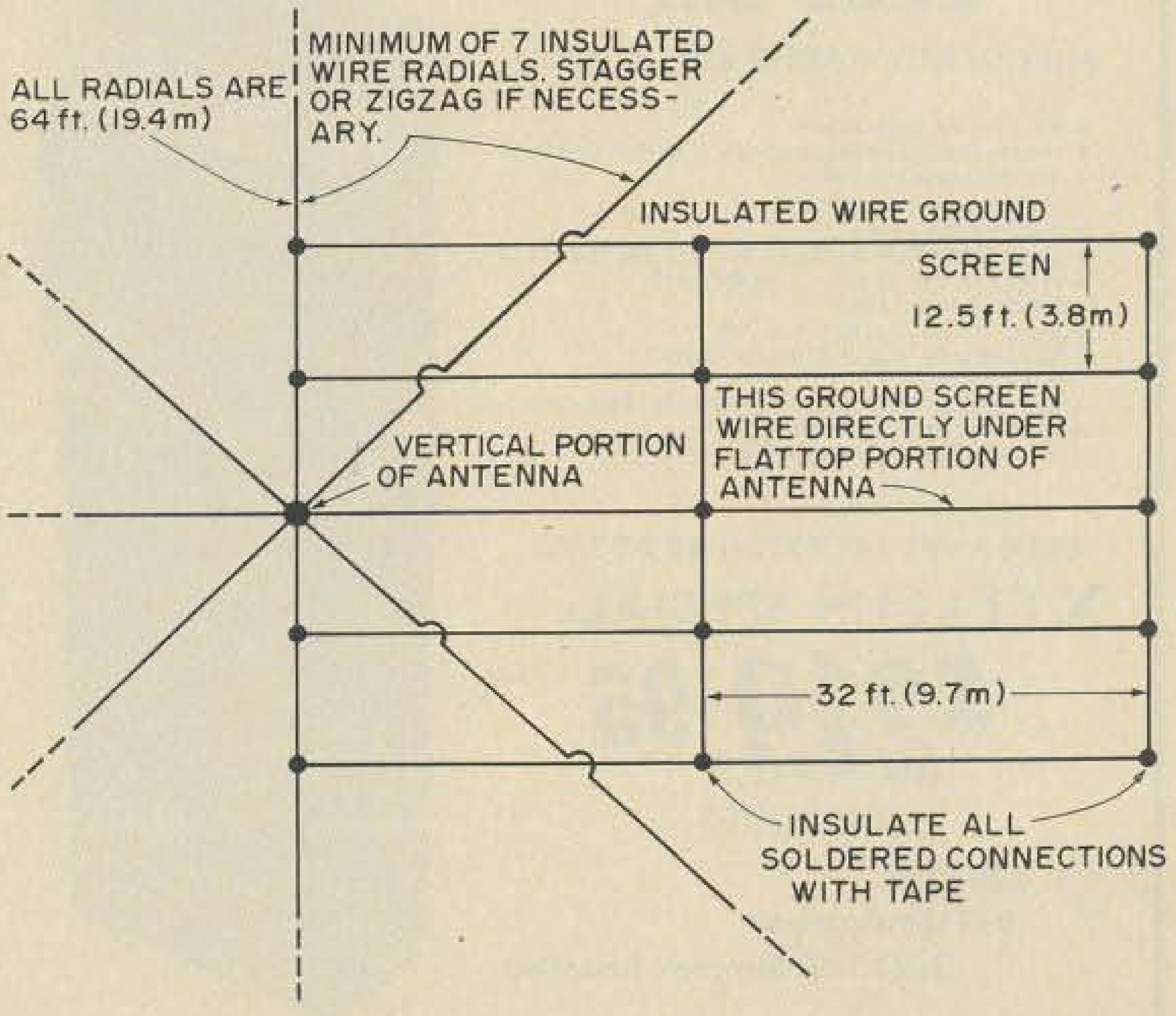

Fig. 2. Inverted-L ground system, top view.

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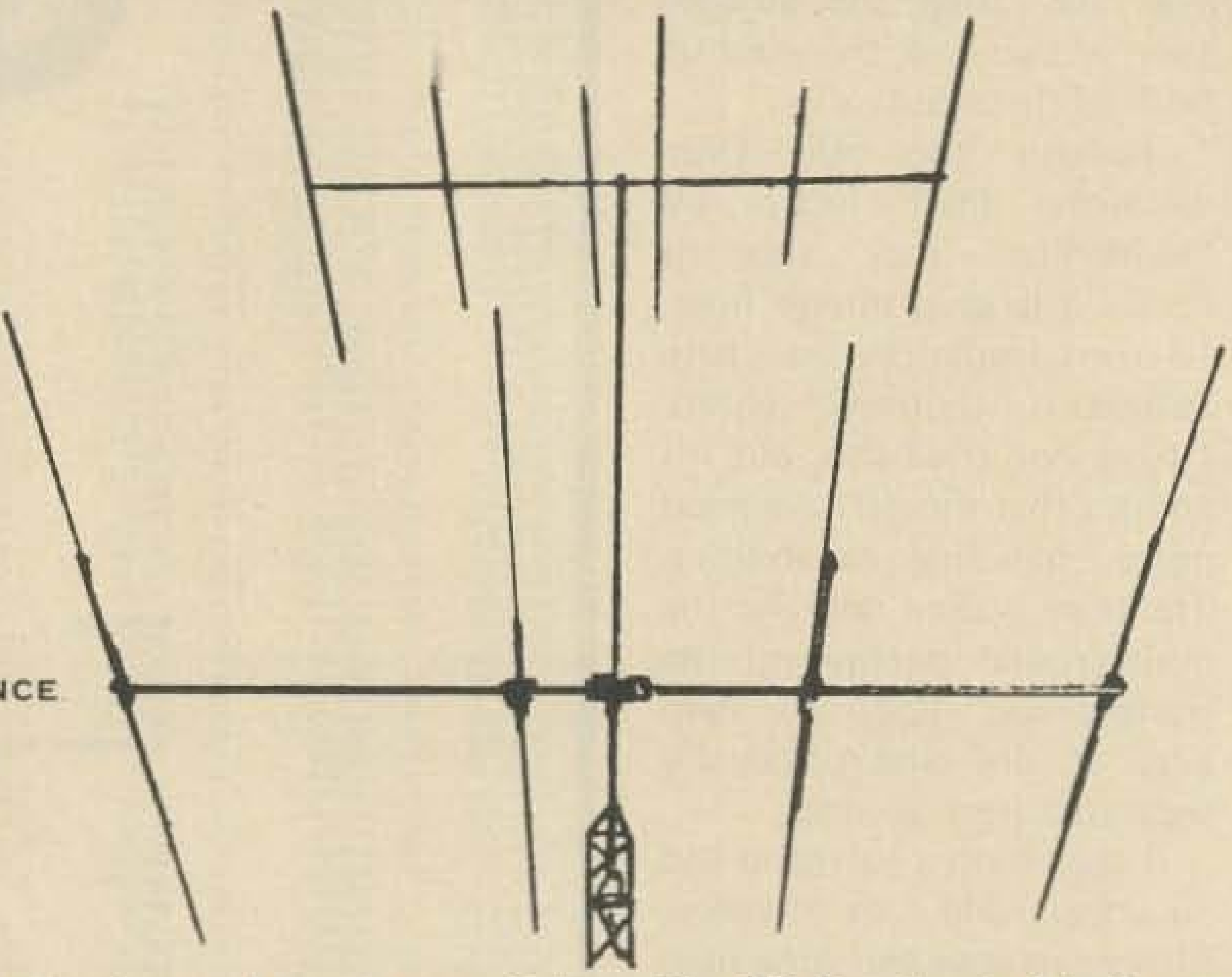

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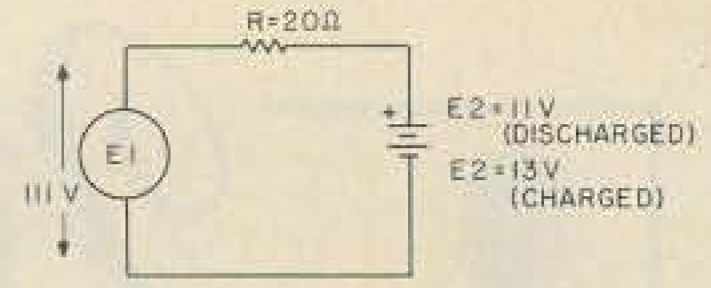

Fig. 3(a). With E_2 discharged, $I = (111-11)/20 = 5$ A; with E_2 charged, $I = (111-13)/20 = 4.9$ A.

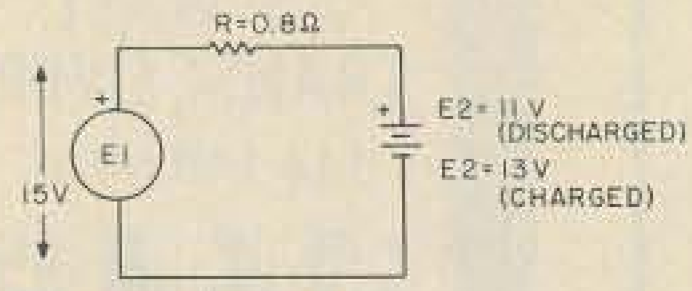

Fig. 3(b). With E_2 discharged, $I = (15-11)/0.8 = 5$ A; with E_2 charged, $I = (15-13)/0.8 = 2.5$ A.

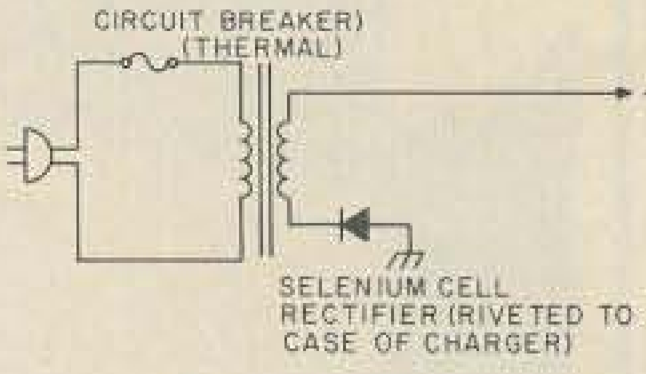

Fig. 4. Typical inexpensive commercial battery charger.

A battery charger is one of the most common dc power supplies in use by the general public today. Chargers are available from Wards or Sears catalogs for charging auto batteries at charge rates from several Amps to over 100 Amps. Also in common usage are the small battery chargers designed to recharge a variety of cordless appliances, from toothbrushes to electric carving knives. These smaller chargers are usually designed to charge tiny nickel-cadmium (nicad) batteries that are more or less permanently built into the appliances. More recently, the nicad battery has been supplemented by another "sealed" type of rechargeable battery: the "gelled-electrolyte" lead-acid battery. "Gell-Cell" is Globe-Union's trademark for such a battery. The gelled-electrolyte lead-acid batteries are generally of larger physical size and weight than nicads, and are used in portable transceivers, standby lighting systems, intrusion alarm systems, and similar applications.

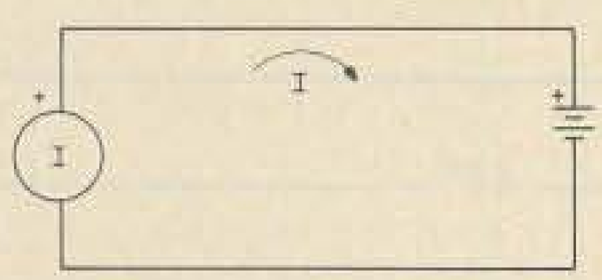

Fig. 1. Basic charger using constant-current generator.

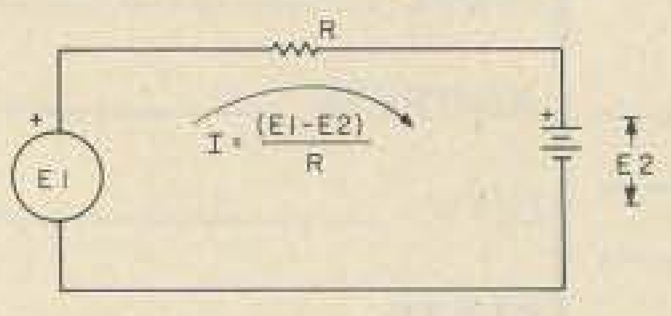

Fig. 2. Approximation of constant-current charging using constant-voltage generator and series resistor (R).

There are differences among chargers for use with conventional lead-acid batteries (such as used in autos), and still other differences among the small chargers designed for the "maintenance-free" batteries. We will look at a variety of chargers, to see what they basically do, and to see how they differ.

The main function of *any* battery charger is to cause *current* to flow back into a battery in the opposite direction from which current flowed during discharge. Batteries, when used properly, are relatively constant-voltage devices, so the most meaningful measurements in battery charging are made in *Amperes.* The current for charging can come from a number of sources; the commonest source, today, is a low voltage secondary transformer and solid state rectifier. In years past, motor generators, and low voltage transformers with older types of rectifiers, were extensively used as chargers. The principle was always the same: Force *current* back into the battery to charge it.

The basic battery charger, shown in Fig. 1, uses a current source. Since current sources are not as common as voltage sources, an approximation to a current source can be made as shown in Fig. 2. By making E_1 *large* compared to E_2 (the battery voltage), essentially constant current will flow during the battery charging cycle, even though E_2 rises slightly as the battery nears full charge. To see quantitatively how this works, let's take the two examples shown in Figs. 3(a) and 3(b). In both cases, we'll assume that the uncharged

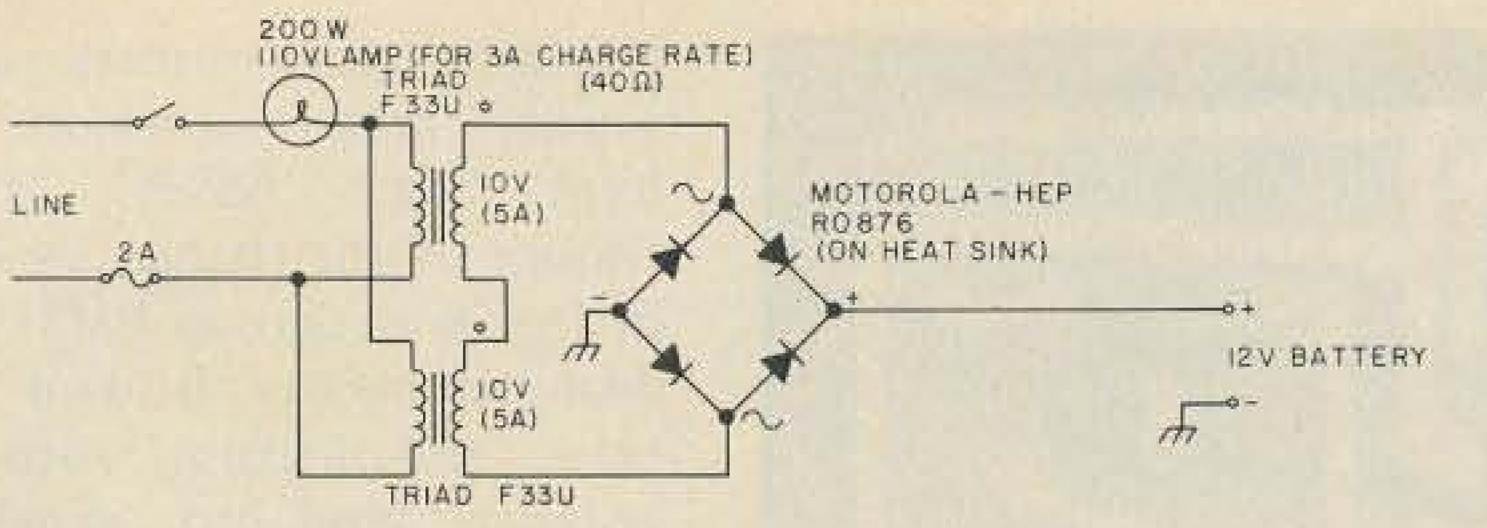

Fig. 5. Simple battery charger with current-limit resistor in transformer primary.

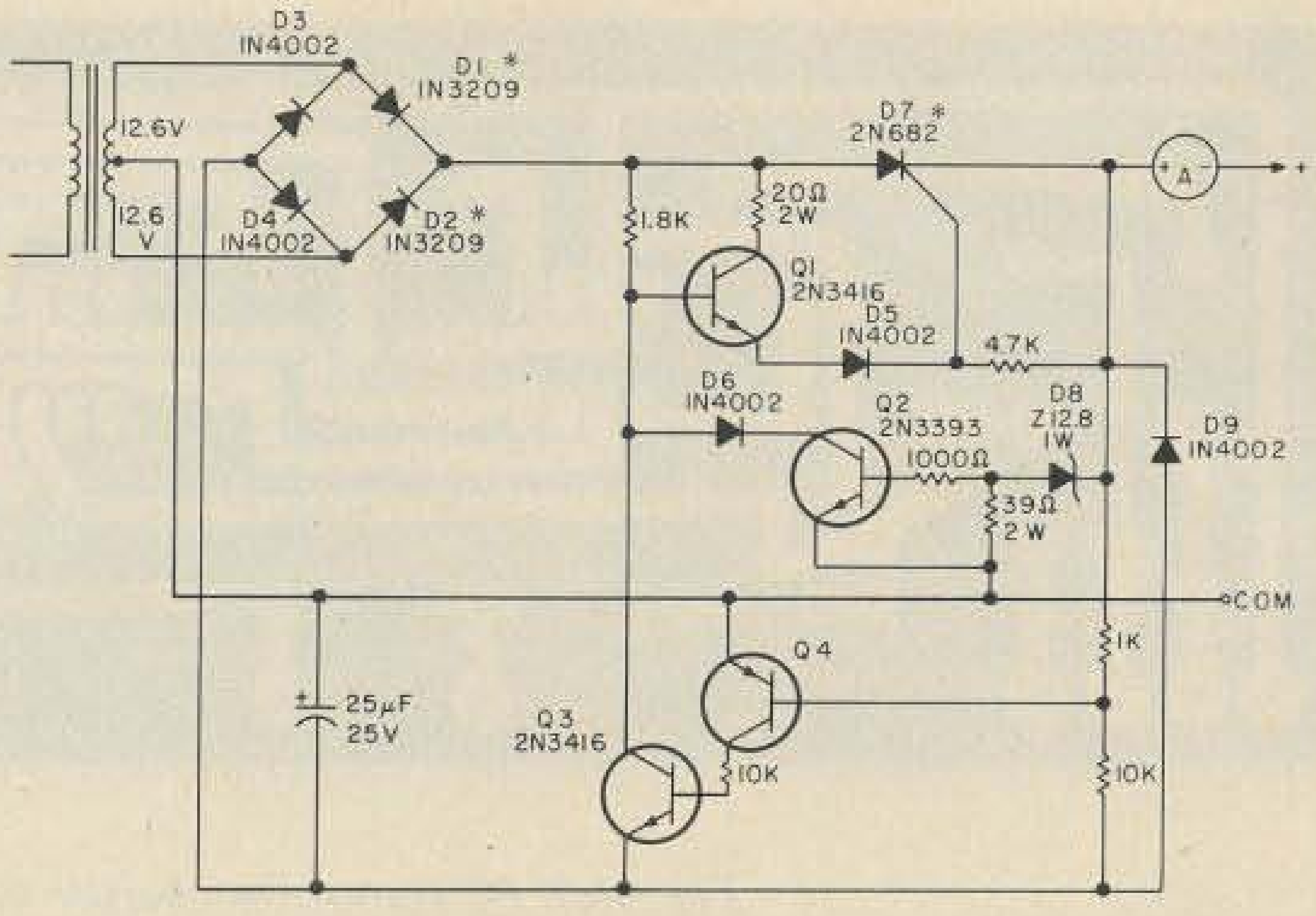

*Fig. 6. Heath GP-21. *All on one heat sink.*

(lead-acid) battery starts with an E_2 of 11 volts, and that E_2 at full charge rises to 13 volts. In Fig. 3(a), the current at the start of charge is 5 Amps and at the end of the charge cycle is 4.9 Amps. That is, the charge rate has only changed 2% during the charging cycle.

In the example in Fig. 3(b), however, current undergoes considerable change during the charge cycle. As in the first example, the charge starts out at 5 Amps, but drops to 2.5 Amps at the end of the cycle. This latter case is typical of most inexpensive battery chargers on the market; the number of Ampere hours put into the battery is difficult to calculate, however. This latter case is a simple form of "tapered charging" and is actually a reasonable approach, especially if you're the type who forgets to turn off the charger. The smaller end-charge current will not electrolyze away as much water from the battery as fast as with constant-current charging (if the charger is left on too long).

Modern commercial battery chargers, available from auto supply stores and mail order catalogs, are generally of the form shown in Fig. 4. Selenium disc rectifiers are still used because they have a rather large forward voltage drop, and so can make it unnecessary to use a dropping resistor. Another trick used in commercial battery chargers is to wind the transformer so as to have a relatively large equivalent secondary leakage inductance, and thus eliminate the need for a current-limiting resistor.

In older types of chargers, copper-oxide-disc and tungar-bulb rectifiers were used; these rectifiers also had considerable forward drop. Older chargers can occasionally be retrieved from the "back of the garage" and returned to use by replacing non-functioning rectifiers with modern silicon rectifiers. However, when doing this replacement, be sure to add some current-limiting resistance to make up for the higher efficiency of the new diodes. The value of resistance can readily be determined by charging a discharged battery, starting with a reasonable guess as to resistance value, and watching the ammeter. One can even add the current-limiting resistance in the primary of the charger transformer, if that's easier.

Primary current-limit resistors are, of course, higher in resistance than those in the secondary circuit. A home-made charger using a 200 Watt light bulb as such a primary resistor is shown in Fig. 5.

In recent years, there has been progress in making electronically-controlled chargers that charge conventional lead-acid batteries completely automatically. Such chargers are now commercially available, and you may connect

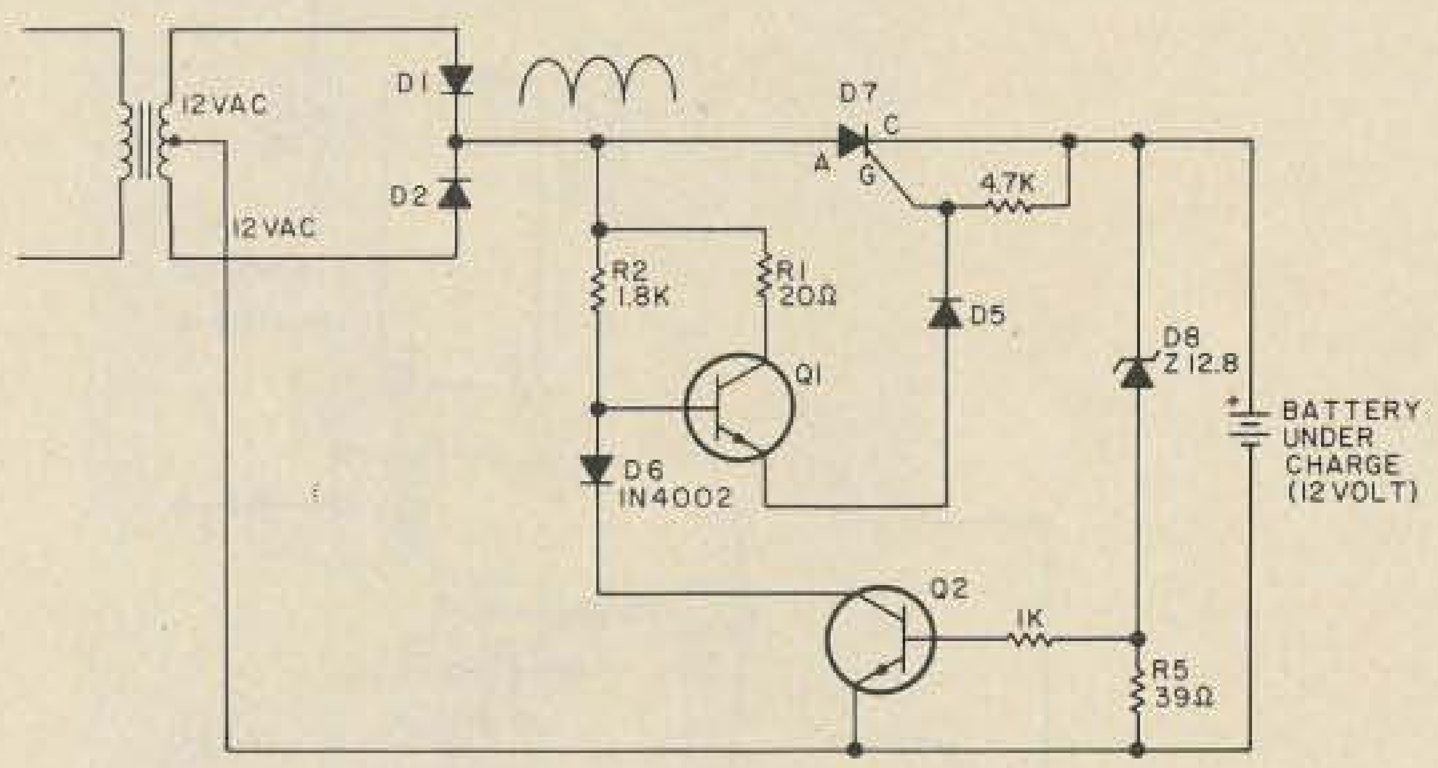

Fig. 7. Simplified circuit of GP-21.

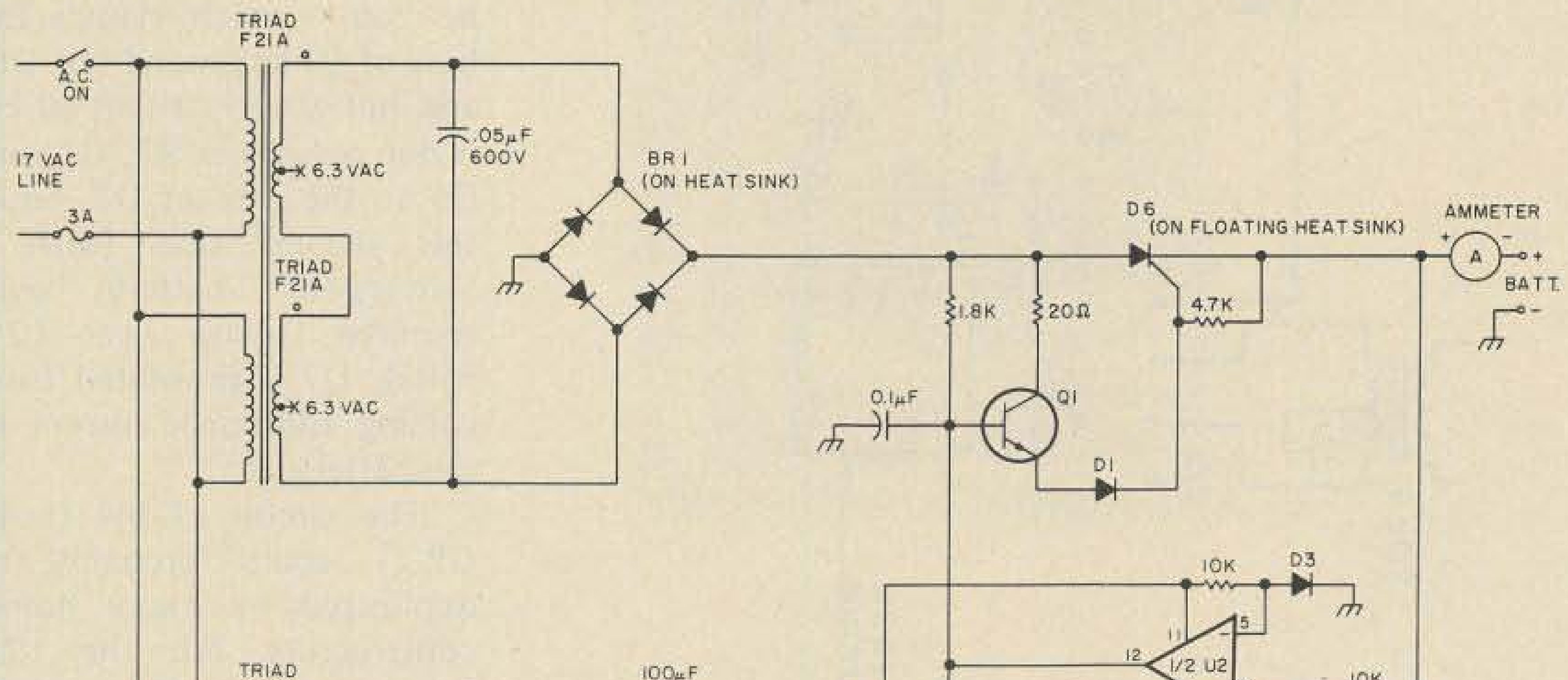

Fig. 8. Battery charger using IC control with adjustable finish voltage. D1-D5: 1N4002 or Motorola HEP-R0051. D6: 2N682 or Motorola HEP-R1471. BR1: 12 Amp integrated bridge, Motorola MDA980-2 or HEP-R0876. BR2: 1 Amp integrated bridge, Varo VE27. Q1: 2N3641 or Motorola HEP-S0015. U1: Raytheon RC4195NB. U2: National LM319D.

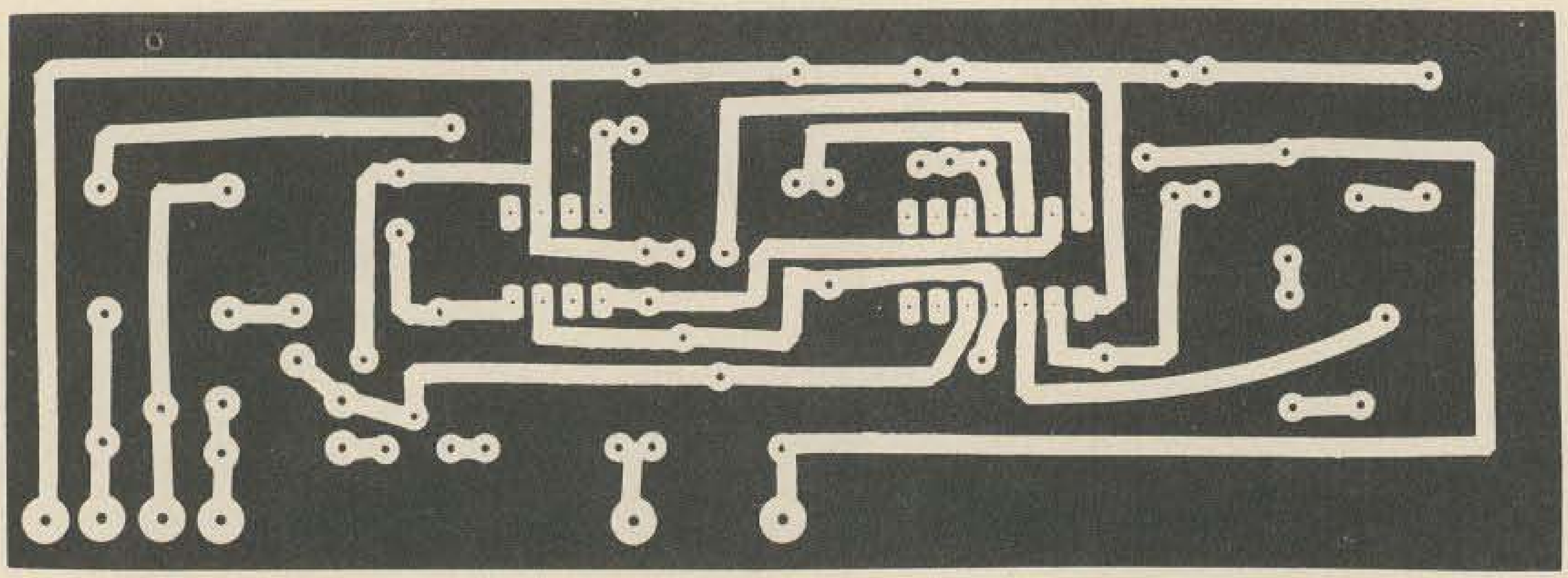

Fig. 9(a). PC layout for charger in Fig. 8.

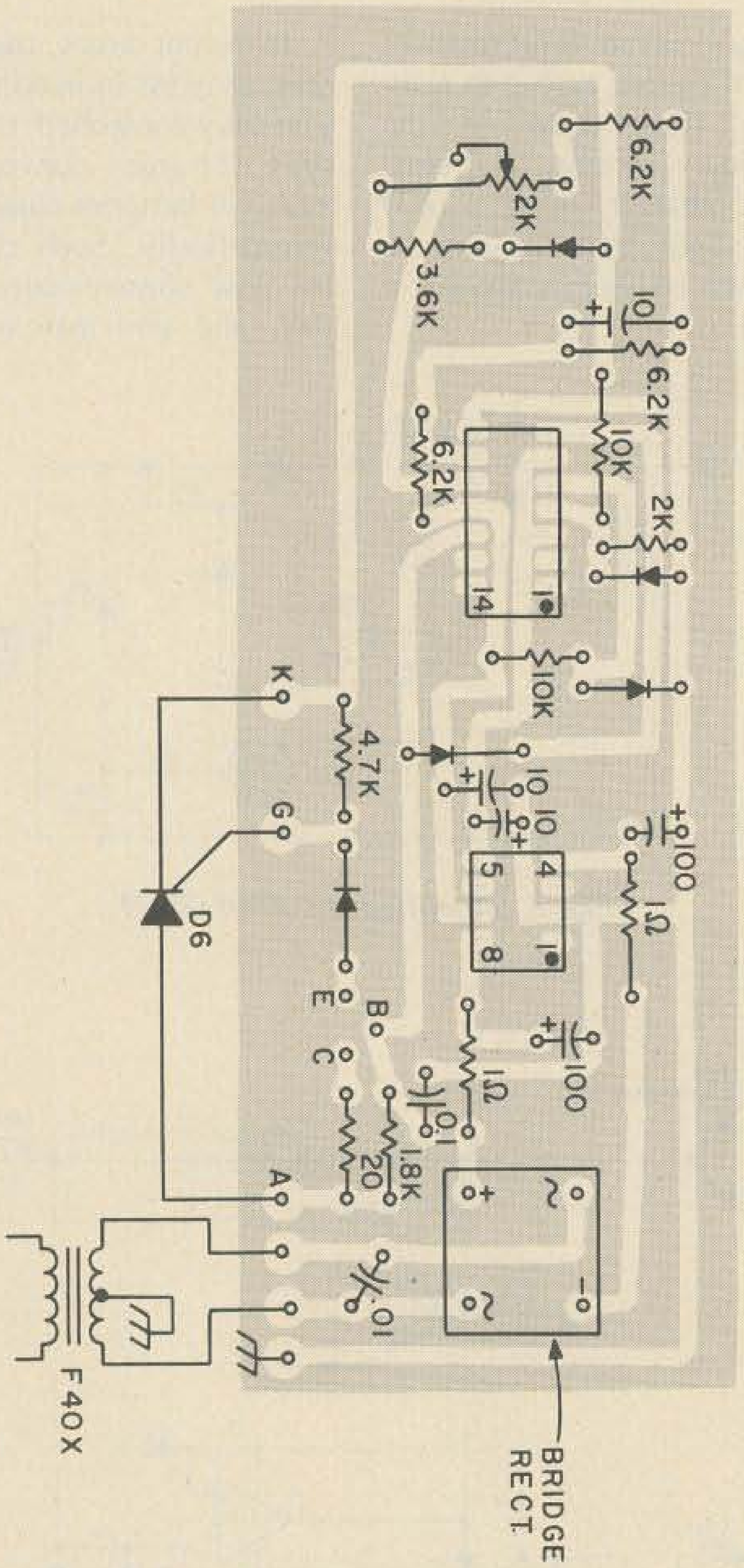

Fig. 9(b). PC parts placement.

your battery to the charger and essentially forget it. Such an automatic charger is the Heathkit GP-21. The GP-21 is not only self-controlling, but is protected against shorting the battery leads together and reversing the battery leads. Either of these two operator errors produces no sparks or opening of breakers, but simply non-operation. The Heathkit GP-21 is shown in Fig. 6. Note that Q3 and Q4 are involved in the lead-shorting and reversal protection; the basic charger can be simplified (for circuit understanding) to that of Fig. 7. Whether the GP-21 charges the battery depends on whether the 12.8 volt zener (D8) conducts; that is, whether the battery terminal voltage is over 12.8 volts. If the battery voltage is below 12.8 volts, the battery needs charge, D8 does *not* conduct, Q2 is "off," and Q1 is allowed to pass full wave rectified 60 Hz via R1 and D5 to the gate of D7. Thus D7 turns on (at 120 Hz rate) to pass current to the battery. If, on the other hand, the battery voltage is above 12.8 volts, D8 conducts, causing Q2 to be "on," which clamps the base of Q1 to ground (via D6) and full wave rectified 60 Hz is *not* passed via R1, Q1, and D5 to the gate of D7. So in this second case (with a "charged" battery, with terminal voltage over 12.8 volts), D7 is prevented from passing additional current to the battery.

The circuit of the Heath GP-21 could probably be duplicated by many home-constructors, but the 12.8 volt zener is a nonstandard value. The cost of parts would almost certainly exceed the Heathkit cost, however. I built an automatic charger that has performance similar to that of the Heath GP-21. This charger was built to use two 6.3 V, 10 Amp, filament transformers as the main current source; such filament transformers are usually pretty common in ham "junk boxes." The feature of the charger shown in Fig. 8 is that an LM319D dual comparator is used to sense "end-of-charge" battery voltage and to provide "reversed charger leads" and "shorted charger leads" protection sensing. In this circuit, the "end-of-charge" voltage is *adjustable* by means of a small 2k trimpot. The LM319D uses a ±15 volt supply which is provided by a Triad F40X, bridge rectifier, and Raytheon RC4195 dual regulator IC. A fraction of the +15 volts regulated voltage (as voltage-divided by the two 6.2k resistors in series) is used as the voltage reference against which the lower comparator compares a fixed fraction of the battery voltage. The function of the upper comparator is to sense a "reversed leads" or "shorted leads" condition. In order to facilitate construction of this charger, the control circuitry has been laid out on a PC board, shown in Fig. 9. The larger components, and those on the heat sink, are mounted off the PC board.

The nicad battery was one of the first "maintenance-free" rechargeable batteries introduced in the U.S. It is quite different from the lead-acid battery, in that the electrolyte is a strong base (potassium hydroxide or sodium hydroxide) instead of an acid. The plates are made of nickel hydroxide (positive) and cadmium (negative). Although nicads can be made with conventional filler caps, so that they may be maintained like auto batteries, most of the small ones are of the "sealed" type. These "sealed" nicad batteries are the ones most used in hand-held transceivers and small appliances. The electrolyte in such batteries is held in a separator between the positive and negative plates, which is also gas-permeable. The gas-permeable separator

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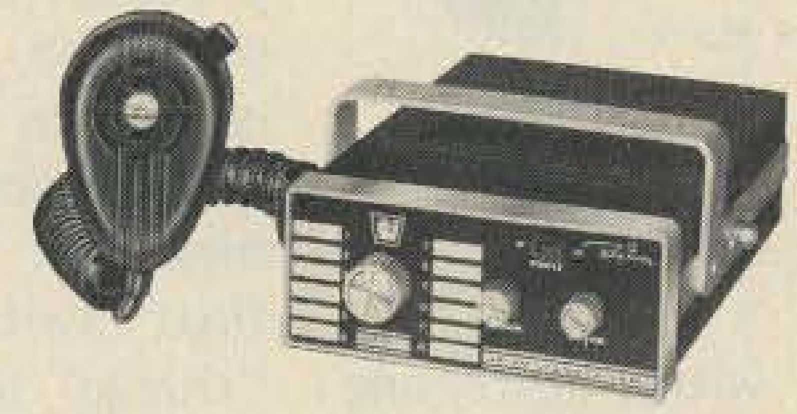

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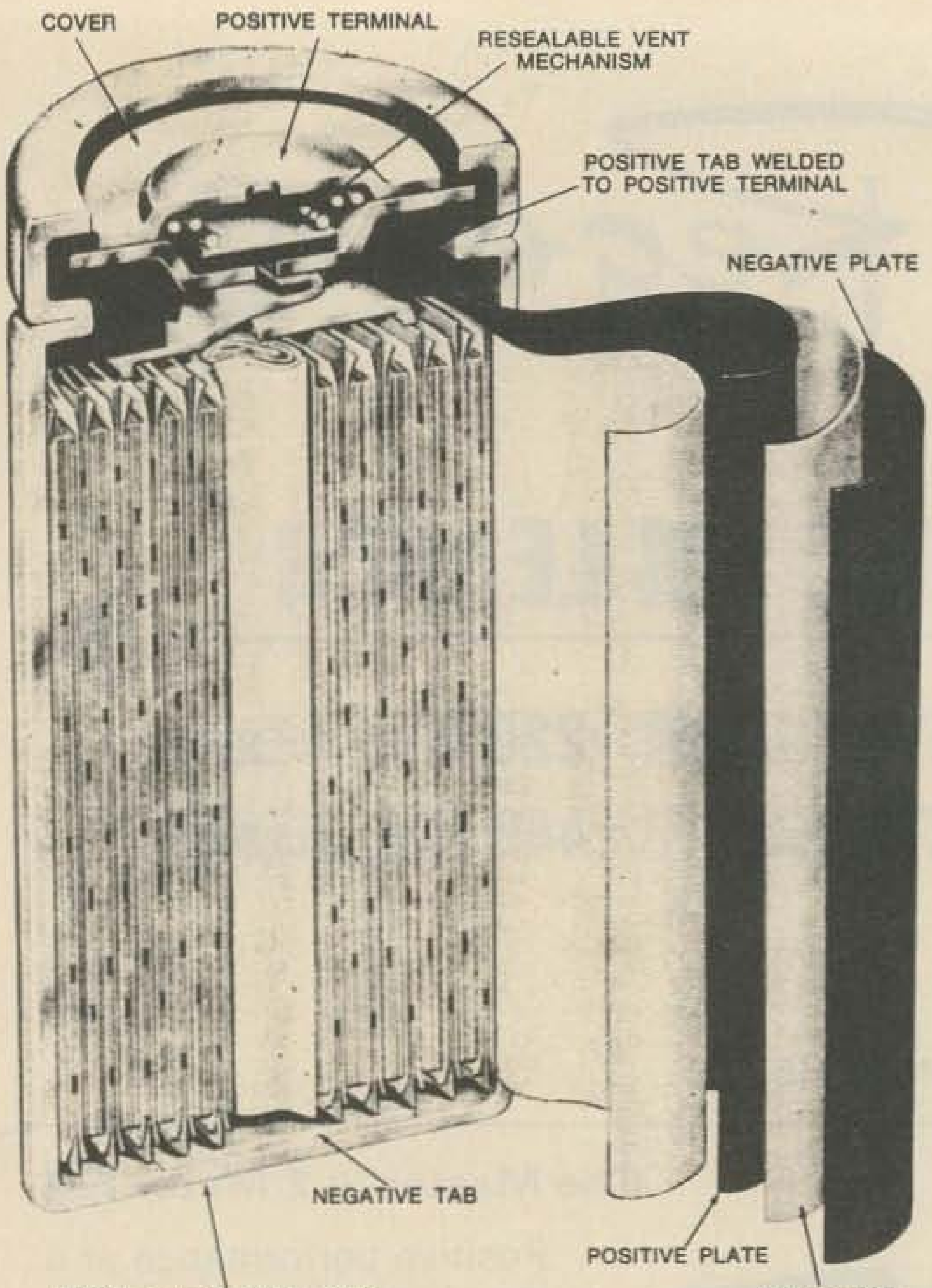

Fig. 10(a). General Electric nicad cell structure.

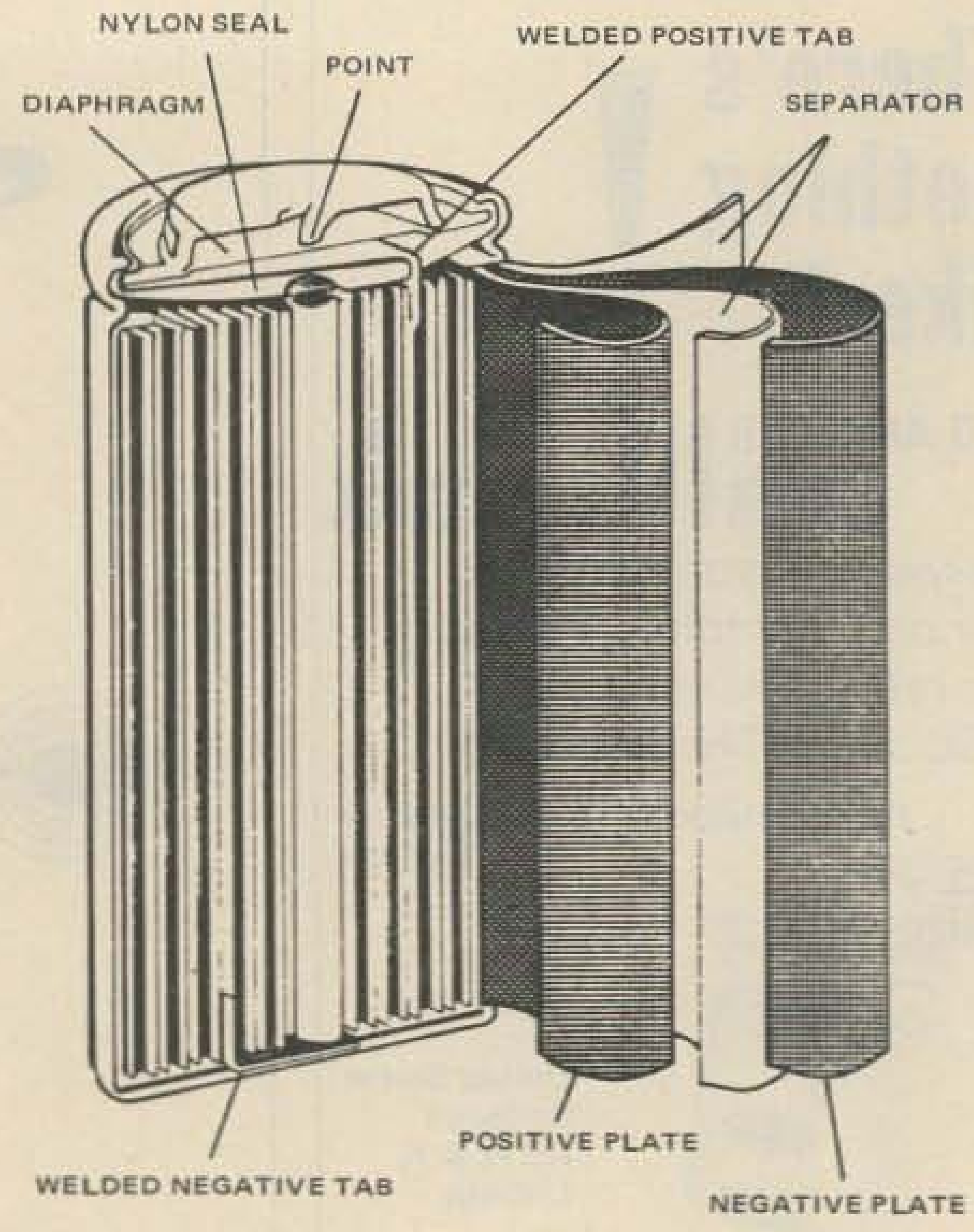

Fig. 10(b). Sonotone nicad cell structure.

absorbs oxygen which the battery liberates when it is over-charged. Almost all "sealed" nicad cells have a safety release value, however, so that in extreme overcharge conditions they won't explode. Some of these valves are of the resealing type and some are not. Fig. 10 shows the overpressure vents of the Sonotone and G.E. units. The point here is that even "sealed" nicads may vent gasses, if severely mistreated.

The "sealed" nicad is generally charged with a constant-current type of charger, with the addition of a voltage limit across the battery. This sort of charger can be relatively simple, as several construction articles in the amateur literature have shown.[2,3] In Fig. 11, three approaches to the constant-current, limited-finish-voltage charging method are shown. The first method relies on the nonlinearity of light bulbs to approximate constant current (the resistance of a light bulb decreases with decreasing voltage across it). The light bulb charger, Fig. 11(a), is similar to one shown in reference 2. Fig. 11(b) shows the FET approach of reference 3; the FET has an inherent constant-current characteristic which is utilized in this charger. The large number of FETs is required because it is desired to utilize the inexpensive plastic types. Since the nominal I_{dss} of the HEP-802 or F 0015 FETs is nominally 2 to 20 mA, some "picking and choosing" must be done. Units with I_{dss} of 8 to 15 mA will be considered usable in this circuit. The sum of I_{dss} for units Q1 and Q2 will be 15 mA, and the sum of I_{dss} for units Q3 through Q6 will be 35 mA. A switch is used to connect Q3 through Q6 for a total current of 50 mA during "charge"; when this switch is opened, the current drops to 15 mA for "float" or "trickle" charge. The zener diode D1 limits the "finish" voltage, as in Fig. 11(a).

The charger in Fig. 11(d) produces constant current by means of a simple transistor circuit, in which the current is adjustable by the user by means of R_1. The "charge-float" switch is closed during "charge" to raise the value of constant current. As in the chargers of Figs. 11(a) and 11(b), a zener diode is used to limit the "finish" voltage.

All of the chargers in Fig. 11 were intended to be used with a ten-cell pack of nominal 12.5 volts, as used in many transceivers. The individual cells in such a pack are of the AA size (penlite) and have about 400 mAh (milliamp-hour) capacity. The Sonotone S-101 or General Electric XGCF450ST are representative units of this type cell. As a general rule one charges at a rate that is 1/10 the mAh rating of the cell or battery. That is, for a 400 mAh battery, we should charge at a rate of about 40 mA. Such a charge rate would appear to fully charge a 400 mAh battery in 10 hours, but usually nicad batteries are overcharged at least 25%, as recommended by the manufacturer. No damage is supposed to occur if longer overcharging occurs, but most battery manufacturers recommend a much lower "float" or "trickle" rate after the battery has been overcharged about 150%. It is possible to use higher charge rates with nicads, especially if special types are used, and accurate timing is made certain. For example, in an AA cell, General Electric offers the XKCF450ST, which will take a 150 mA overcharge rate (more than 3 times normal). In any case, the recommended rates of the manufacturer should be consulted before any rapid charge mode is tried.

Although it has only indirect connection with nicad battery charging, the discharge cycle is also quite important, too. In series groups of nicad cells, the individual cells do not always hold equal charge, and the one which discharges first may be run down into "cell reversal." This is considered bad form, and can destroy the reversed cell. One way to help avoid cell reversal is to make sure that the system powered by the nicad battery stops its drain when the battery voltage drops to 1 volt per cell. That is, for our 12.5 volt pack, operation would be stopped at 10 volts, and a charging cycle started. A more detailed article on nicad batteries is presented in reference 4, for those interested in all the tricks.

The lead-acid, gelled-electrolyte battery has been introduced more recently, and is designed to be a lower cost "maintenance-free" unit. The gelled-electrolyte battery is similar to a standard lead-acid battery in per-cell-voltage and in the chemical reactions inside it. The electrolyte is held in a gell, however, so the battery may be used in any position, and there are no filler caps. The gelled electrolyte batteries have no "cell reversal" problem nor the "memory effect" characteristic of nicad batteries. They do vent during normal overcharge, and usually have resealing vent valves for this reason. This venting causes a loss of the water in the gelled electrolyte, which cannot be replaced, so the cells do have a limited life, depending on how much overcharge is used. The recommended method of charging one such gelled-electrolyte battery, the Elpower "Solid Gell" battery, will serve as an example of how at least one manufacturer feels it should be done. The Elpower EP1230A is a 12 volt, 3 Amp-hour unit and is charged at a maximum current of 0.45 Amps until a battery voltage of 14 volts is reached. The voltage is then held constant at 14 volts until the charge current drops to 0.040 Amps. At this point the charger is disconnected or switched to "float." The "float" mode keeps 2.2 volts per cell across the battery, or 13.2 volts for the EP1230A.

The charger in Fig. 12 is designed to charge a 12 volt, 3 Ah gelled-electrolyte battery, such as the Elpower EP1230A. It is essentially a constant-voltage regulator with current-limiting as designed around a National LM305H, with the usual PNP-NPN pair to increase current capability. The constant output voltage is adjusted by means of the 5k trimpot and the current limit is controlled by the value of the 0.68 Ω resistor. This 0.68 Ω resistor is actually a 1 Ω and a 2.2 Ω half-Watt resistor in parallel. All the circuitry above the dotted line is added to the standard regulator to accomplish the special gelled-electrolyte charging requirement. This added circuitry consists of 1N4454, LED, LM311H voltage comparator, 2N4302, FCD810 opto-coupler, six resistors, and two pots.

The way that the charger circuit works is as follows. When you connect a discharged battery across the output, the battery will tend to draw unlimited current, since the supply has constant voltage output, and the battery voltage is (presumably) lower. The current-limiting function of the LM305H immediately comes into effect, however, and only 0.45 Amps is passed, so the output voltage drops to that of the battery. As the battery charges (at the constant-current rate of 0.45 Amps), its terminal voltage rises slowly to 14 volts, but cannot rise above this voltage because of the *voltage* regulating action of LM305H circuit. So when the battery voltage gets up to 14 volts, the charging current starts to diminish. During the initial constant-current and constant-voltage phases of charge, the voltage at point "A" is higher than that at point "B," both with reference to point "C." The voltage "BC" is constant because of the regulator formed by the 2N4302 and 1N4454. As charging current through the 0.68 Ω resistor drops, the voltage "AC" drops until it is no longer more positive than voltage "BC." At this point the LM311H output changes from "high" to "low," which turns on the LED *and* the LED inside the optocoupler, FCD810. This in turn causes the optotransistor in the FCD810 to saturate, and connects the 10k and 250k pot across the LM305H sensor-divider. The constant-voltage output of the LM305H regulator is thereby dropped from +14 to +13.2 volts.

Since there are several adjustments on the charger, the setup is somewhat complicated. First, pull the FCD810 out of its socket, and with a voltmeter across the charger output (no battery, yet), adjust the 5k trimpot for +14 volts output. Then add a 350 Ω, 25 W rheostat across the terminals and decrease resistance until regulation is lost (as indicated by a drop in output voltage as read on the voltmeter). This point should correspond to 0.45 Amps on the ammeter; if it does not, the size of the 0.68 Ω current-sense resistor should be adjusted. The FCD810 should now be restored to its socket and the 350 Ω rheostat increased in resistance until the red LED lights. This should correspond to about 40 mA on the ammeter; if not, the 500 Ω trimpot should be adjusted until the proper trip point is achieved. Since the LM311H has deliberately had hysteresis added to its circuit (the 3.3 meg resistor), it will be necessary to adjust the 350 Ω load down in resistance considerably until the circuit untrips, as indicated by the LED going out. The 350 Ω rheostat is then decreased in resistance to find the new trip point, and so on.

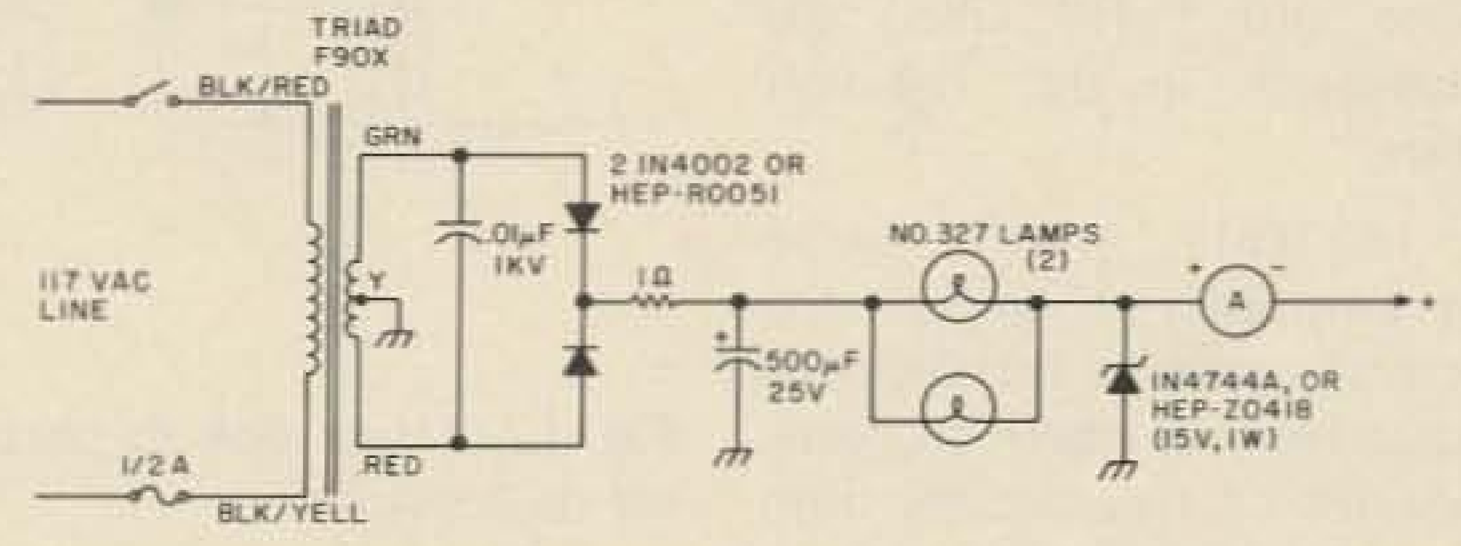

Fig. 11(a).

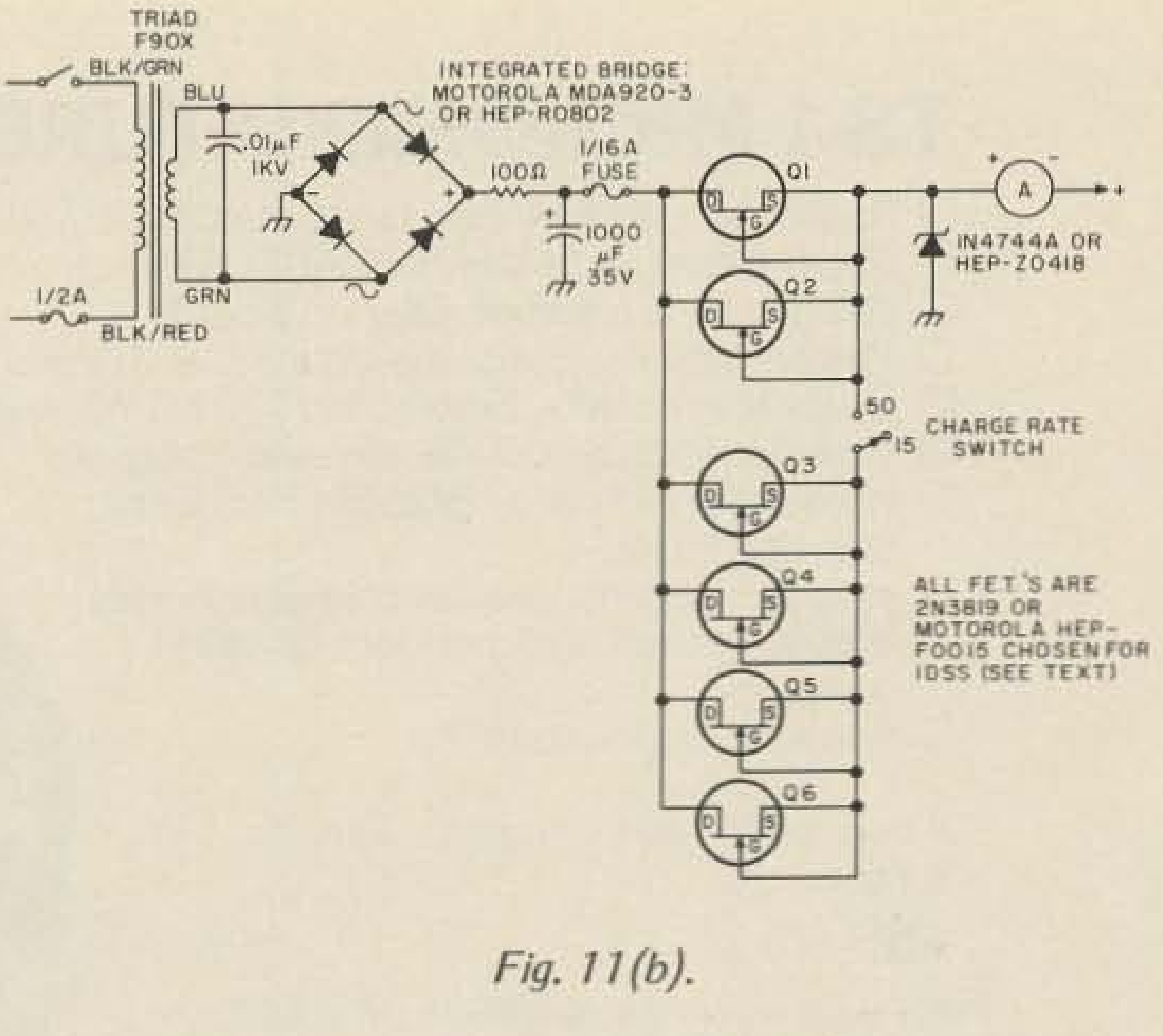

Fig. 11(b).

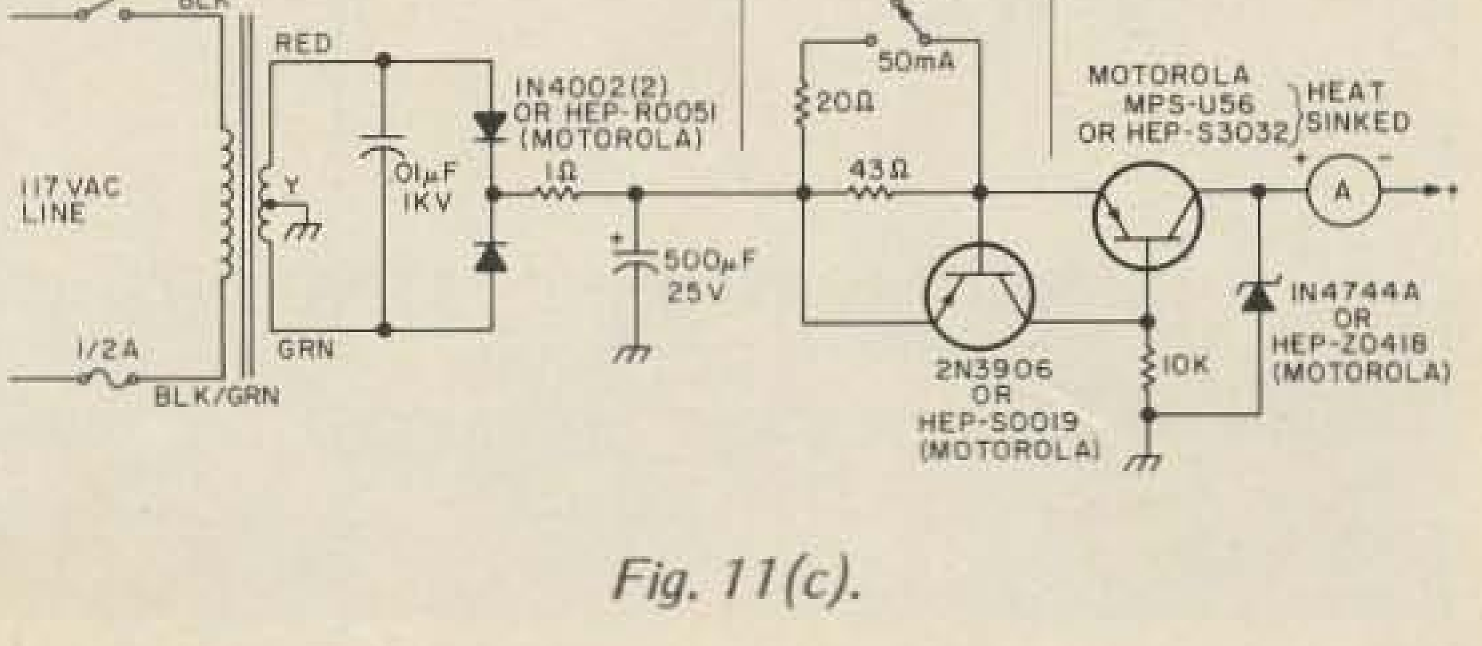

Fig. 11(c).

After a satisfactory trip point of about 40 mA is found, the float voltage may be set to approximately 13.2 volts. This is done with the 250k trimpot.

Finally, there is one awkward condition that may occur when charging a partially discharged battery. If the discharged battery does not draw enough current from the charger to "untrip" the LM311H, the output voltage will stay at +13.2 volts. This will not do much charging of the battery. A push-button switch and 50 Ω, 5 Watt load are provided to "untrip" the circuit and move the charger to +14 volt output state. The red LED indicator is "on" when the charger is in the +13.2 volt state and "off" when the charger is in the +14 volt state.

In this article we've attempted to cover the several common rechargeable batteries and their chargers. Specific charger circuits, both conventional and automatic, have been shown. Hopefully, enough details of circuit operation have been given to enable the astute experimenter to redesign the circuits for the particular battery he needs to charge. The references appropriate to each charger should be consulted, of course, to glean additional details when modifying these circuits. In addition, it cannot be emphasized too greatly that the manufacturer's recommendations on a particular battery should be followed regarding both charge and discharge cycles! ■

References

[1] Tektronix, "Nickel-Cadmium Review," *Tektronix TEKscope,* August 1969, pp. 8-11, Vol. 1, No. 4.

[2] Shriner, R., "Charging Nickel-Cadmium Walkie-Talkie Batteries," *QST*, August 1973, p. 44.

[3] Shubert, G., "FET-Controlled Charger for Small Nicad Batteries," *Ham Radio,* August 1975, p. 46.

[4] Stark, P., "How to Make Nicads Behave," *73*, December 1974, p. 24.

[5] Globe, "Gell-Cell Charging Manual," 41-2128, Globe Battery Division, Globe-Union, Inc., 5757 North Green Bay Avenue, Milwaukee WI 53201.

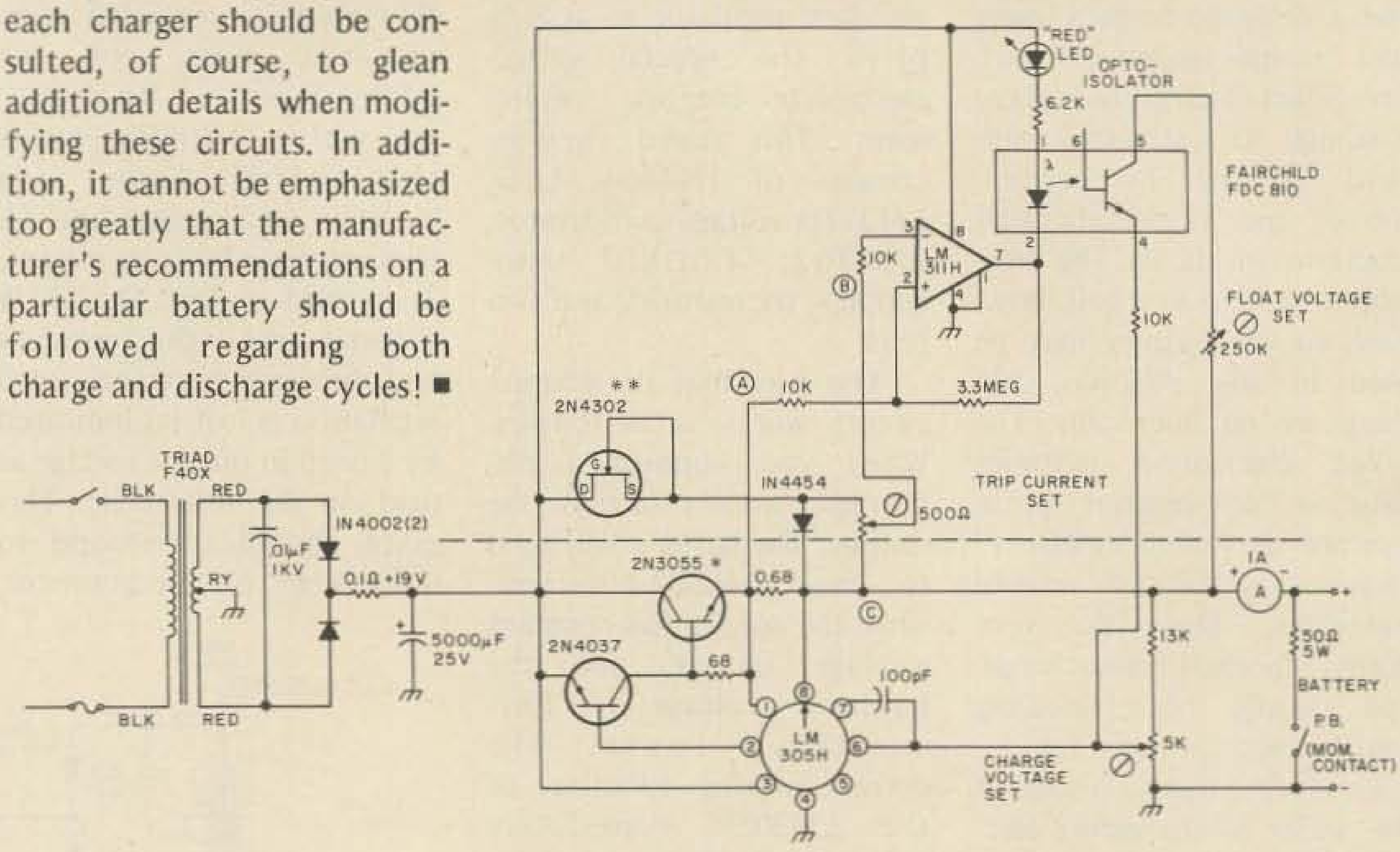

*Fig. 12. *Heat sink to chassis with mica washer and silicone grease. **Choose 2N4302 for I_{dss} = 1 or 2 mA.*

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How Do You Use ICs?

-- part III

The ICs (Integrated Circuits) used in frequency dividing circuits are one group of ICs that can restore your faith in the IC dream. While many of them were not primarily designed for just that purpose, they find wide application in many IC projects.

They are probably the easiest circuits to hook up and use, and in the applications to be shown, require no external parts. While there are several which are commonly known and used, there is one in particular that stands out as perhaps the most frequently used: the 7490 Decade Counter.

The 7490 is used two ways in a frequency counter. One section of the counter uses it as part of the actual counting circuit, where it connects with the driver that runs the numerical readout. Using a slightly different hookup of the same device, it is used in the timing chain to divide the basic "clock" or oscillator frequency to the desired time.

This is the hookup to be discussed here. It is so commonly used for all clock, timing or frequency dividing circuits that once it is learned, whole sections of equipment will fall into place.

Depending on how it is hooked up, the 7490 will divide the input frequency to it by two, five or ten. It will do this with any frequency up to the device's frequency limit, about 20 MHz for the 7490, and higher for the high speed versions of the 7490.

It is remarkably uncritical to use. The only basic requirement for it, and the other divider ICs, is to feed it a square wave. If you feed it with a 7400 oscillator or something similar, this will be taken care of automatically.

If you are using a sine wave source, you will have to run it through a clipping circuit. The IC oscillator feed is the more common by far. The signal is usually fed from one section of the 7400 used as a buffer stage between the oscillator and the divider, but this is not always done.

Once the basic patterns of hooking up the 7490 as a frequency divider are learned, you will have them, and it is just a question of applying them to your use.

Fig. 1 shows the divide by ten circuit. Simple, isn't it? All you do is ground pins 2, 3, 6, 7 and 10, connect pin 11 to pin 14, feed the input signal to pin 1, and take the output from pin 12.

As Fig. 2[1] shows, adding stages is just a matter of repeating the same thing, with the output of one stage going to the input of the next.

While not always used, it is not uncommon that there will be a bypass capacitor connected between the Vcc pin and ground with this and the other divider ICs. One is used for each IC in the chain. The value is usually 0.01 to 0.1 uF.

To get divide by two and divide by five, it helps to understand how divide by ten is arrived at. The 7490 actually starts off by dividing by five and two, the two being combined to get divide by ten.

Pin one is the divide by five input. The output is at pin eleven. The divide by two input is at pin fourteen and the output at pin twelve. For divide by ten, the divide by five output is connected to the divide by two input.

Without this connection between pins eleven and fourteen, the two sections are available for separate use. An

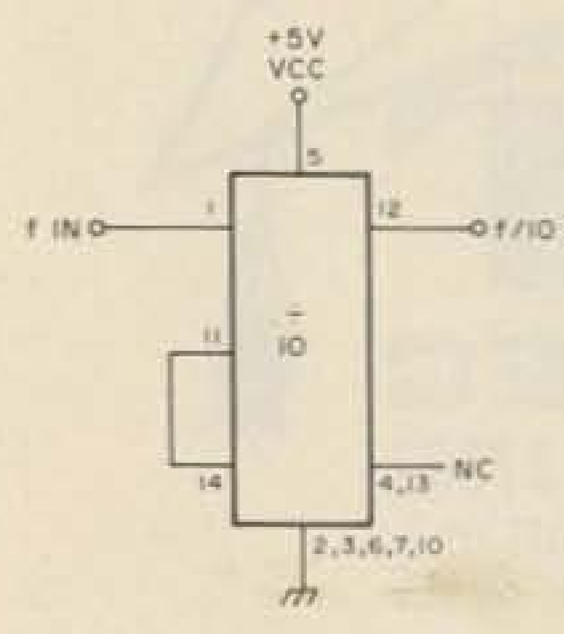


Fig. 1. 7490.

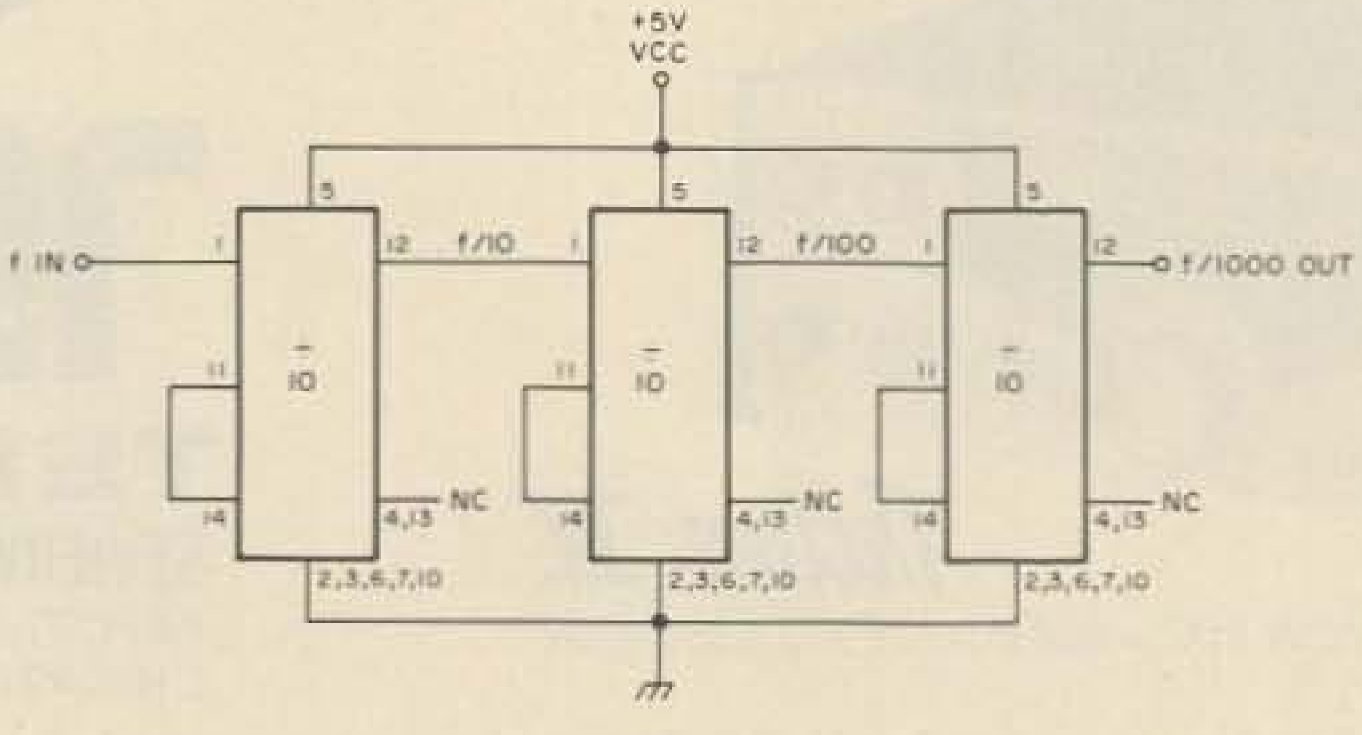


Fig. 2. 7490.

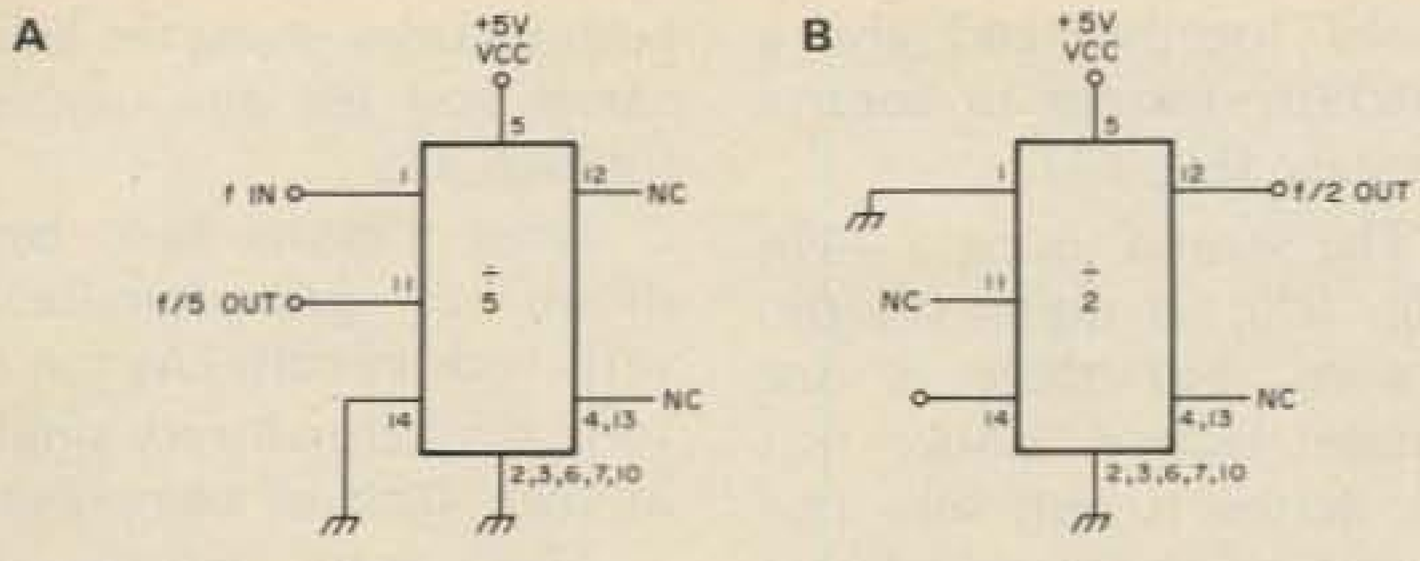


Fig. 3. 7490.

input to pin one will yield divide by five output at pin eleven. An input at pin fourteen will yield divide by two output at pin twelve.

If both outputs are desired, both inputs can be connected to the frequency source and the two outputs will be available at their respective output pins.

Examples of these hookups are shown in Fig. 3, A and B, and Fig. 4. That is all there is to it. Then it is just a question of deciding what frequency divisions you want, block diagramming it and assembling the needed ICs.

Switching is not critical, and it is easy to get a wide variety of combinations that will serve many purposes. Some forms of these hookups are the backbone of the various counter and clock timing circuits. Learn them and a whole section of the more complex equipment is yours.

Besides frequency counter use, this same type of circuit is used for a frequency calibrator (secondary frequency standard) for receivers and transmitters.

The output from an IC buffer stage is usually connected to the receiver. A switching arrangement provides a choice of available output frequencies, such as 1 MHz, 100 kHz, 10 kHz, 5 kHz, 2 kHz and 1 kHz.

For counter use, it is the final output signal gating the counter part of the circuit which determines what the frequency range is that is actually counted: MHz, kHz, Hz or whatever degree is desired.

Considering that the 7490s can be bought for as low as about 50¢ each, the temptation is to build a counter to read your frequency to maybe a few thousandths of a cycle – maybe even better if you get a good deal on the readouts.

Unfortunately, it just doesn't work that way. There is a law of diminishing returns that gets in the way. In this case, it is a matter of time.

Starting with a 1 MHz crystal, you have a signal of 0.000001 second per cycle. Six 7490s will give you a one cycle per second pulse.

If, for example, you wanted to read an audio signal to better than one cycle per second, you would have to have a slower timing pulse. This is easy to do by adding another divide by ten stage, but this is where the trouble starts.

One more stage makes a pulse that is ten seconds in length. Two stages would be needed to read an audio signal to within hundredths of a cycle per second.

This means one cycle per hundred seconds pulse. That works out to one minute and 40 seconds. Add two more decimal places and you will wait 1000 seconds which is over sixteen minutes.

Even if your counter had timing pulses of that duration, over a period of that long, a high frequency oscillator is going to have some drift. It will be in cycles or tens of cycles per second.

Even if your counter could read the actual frequencies, past a certain percentage of the frequency the readout would be a blur because the actual frequency would be instantaneously changing.

In practice, quite a bit before you reach this problem, you will run into the actual accuracy of the crystal used in the timing chain.

There is a limit to the overall accuracy to which you will be able to set and maintain the calibration of your oscillator, which is the overall determining factor in how accurate your counter will be.[2]

If the tolerance of your crystal is such that the best accuracy you can expect at two meters is within a few hundred cycles, it will add nothing to be able to read within cycles per second.

With the simpler circuits, you may have an actual accuracy to within a kHz or so at those frequencies, so the additional digits of readout may show you down to cycles per second and your answer may be off by kHz.

While you can read your transmitter frequency to within a very close tolerance (up to 30 MHz or so), there comes a point where a usable reading ceases to exist. For normal use, most inexpensive counters will put you within 100 cycles and may even get within ten.

Beyond that it begins to become impractical to get a figure that is usable with simple equipment. Of course, with audio frequencies you may be able to go down to parts of a cycle, but still there comes a point beyond which there is no usable advantage.

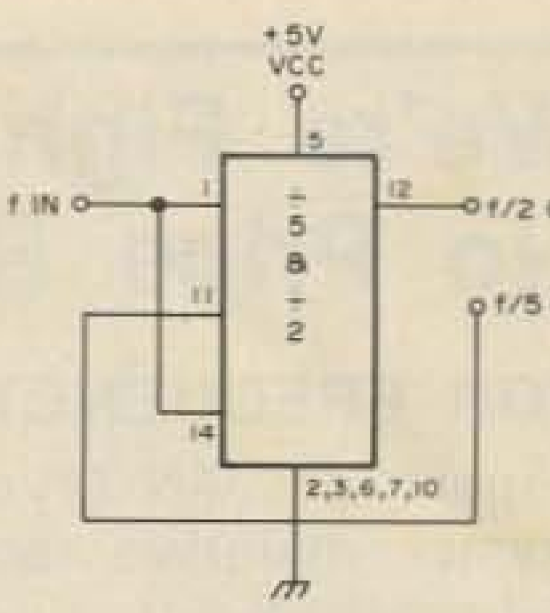


Fig. 4. 7490.

While the 7490 is the most commonly used divider IC, there are others common enough to warrant knowing about.

The 7493 Four Bit Binary Counter will give divisions by two, four, eight and sixteen when it is connected as a frequency divider.

The technical data lists two ways of hooking it up. The first, shown in Fig. 5A, is as a four bit binary counter with "A" output (pin 12) connected to "B" input (pin 1). This is shown as giving divisions of 2, 4, 8 and 16 at outputs A (pin 12), B (pin 9), C (pin 8), and D (pin 11) respectively.

The second hookup does not use the A section, but feeds the input directly to the B input as shown in Fig. 5B, getting divisions of 2, 4 and 8 at B, C and D respectively.

While the above information comes from the technical data on the device, Fig. 6[3] shows an actual circuit taken from a piece of equipment.

Here the device has been adapted to provide divide by six operation, which shows you how much respect some people have for what the device is supposed to be able to do.

The next device of interest is the 7492 Divide by Twelve Counter. This also has two

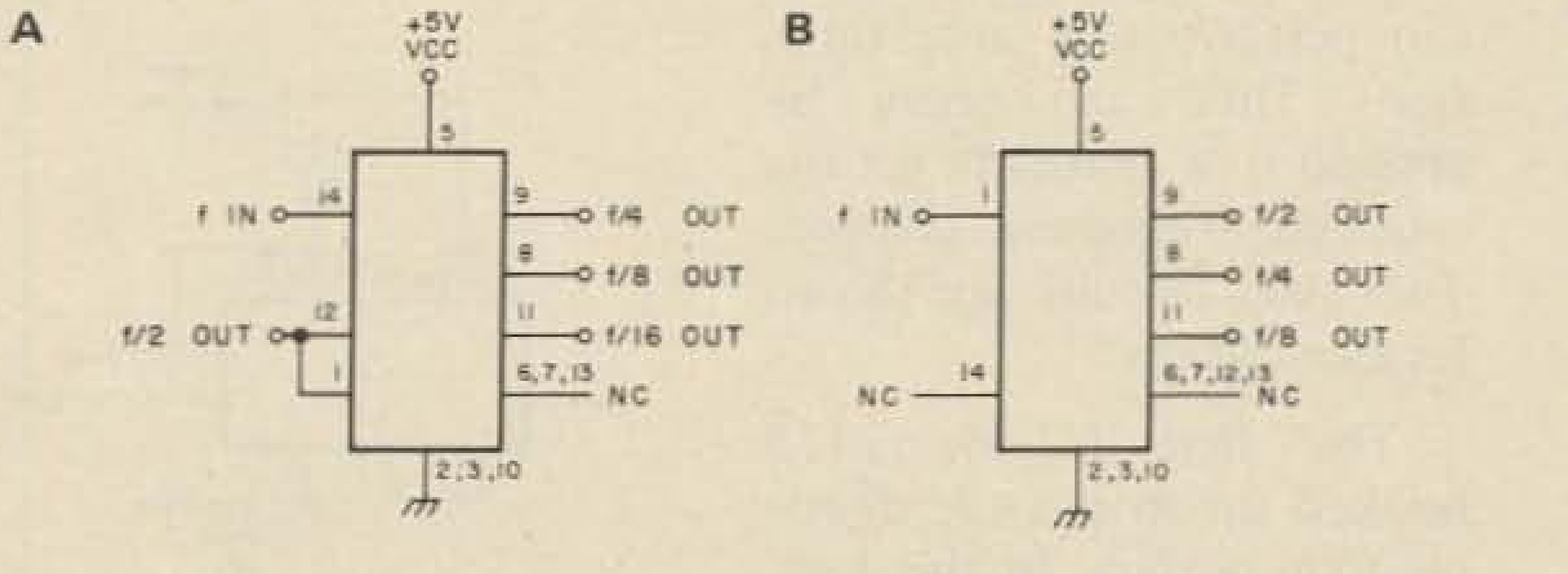


Fig. 5. 7493.

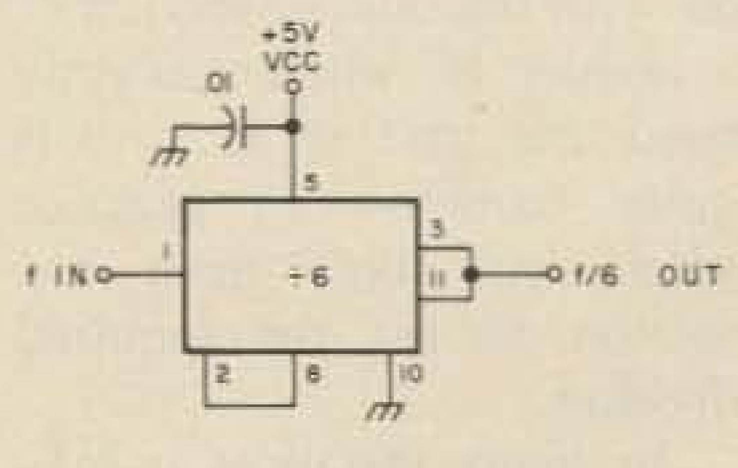


Fig. 6. 7493.

ways of hooking it up for different frequency divisions.

Connected as a divide by twelve counter (Fig. 7A), output A is connected to the BC input, giving divisions by 2, 6 and 12 at A, C and D respectively.

If A output is not connected and the signal is fed directly to the BC input, you get division by three and six at C and D outputs respectively, as shown in Fig. 7B.

These appear to be as easy to hook up and use as the 7490. You just decide which of these divisions you require and work out the device configuration to do it. They hook up like building blocks.

There does not appear to be a consensus about what to do with the unused section of a divider IC when you only need one part of it. This is quite common in practice where you only need one section to get the required division.

In many instances it may be safe to just leave the entire unused section floating, but this might be able to cause a false pulse or other unstable operation.

You can probably tie the unused input to the input of the section you are using and ignore the output from the unwanted section, but the safest method might be to tie the unused input to the Vcc source through a 1000 Ohm resistor.

Some of the circuits show the unused section's input connected to ground, but this may not be safe for all of the devices.

While not usually referred to as frequency dividers, there are flip flop ICs which can perform the same function. They can easily be applied to a circuit to get the required frequency division. Two such circuits are shown for illustration.

The first is the 7473 hooked up to provide divide by four output. In this case, pins two and six are connected together and give a switching feature to control the stage (Fig. 8[4]).

The second, using a 7476 (Fig. 9[5]), is quite straightforward, but there is one unusual feature. Notice that the device is split into two separate rectangles and that inside each are letter designations as well as the pin numbers outside.

For simplicity, most amateur schematics only make use of the pin numbers or sometimes use the computer schematic symbol for easy identification of the device.

Since these are computer circuits, they have a computer terminology not only for the device function, but also for the names of the various connections within.

The letters refer to those names. As they are not really needed for our purposes, they will not be explained. It is unlikely that you will find a schematic where the letters will be given without the pin numbers.

It is still easy to see that the diagram refers to just one device even though it is drawn in two parts.

In the unlikely event that you do find a schematic that just gives the letter names, you will have to refer to the technical data for that particular device.

Somewhere in there should be the full drawing of both sections giving the letter names and the pin numbers for each pin.

These circuits have been shown to gain familiarity with such circuits. As can be seen, they are all very similar in their lack of complexity.

These can actually be thought of as practical building blocks. These, or similar circuits, can usually be lifted bodily from one piece of equipment and used for the same purpose in another.

By keeping a card file of such circuits, you will build a reservoir of them that can be tapped when needed for your own equipment. Just determine what frequency divisions are necessary and pick the circuits needed from your file.

As you run across other devices used for this purpose, you should have no trouble in recognizing the complete circuit and isolating it schematically for your file. ■

References

1 "A Satellite FAX System You Can Build," Taggart, Ralph E., *73*, September 1975, page 39.

2 "How Accurate Is Your Counter – Really?" Bloom, Robert E., *73*, April 1976, page 110.

3,4 "Build This Exciting New TVT," Hutton, Louis E., *73*, March 1976, page 76.

5 "Inexpensive HF-VHF Frequency Standard," Hinkle, F. E., Adams, W. T., *73*, April 1976, page 62.

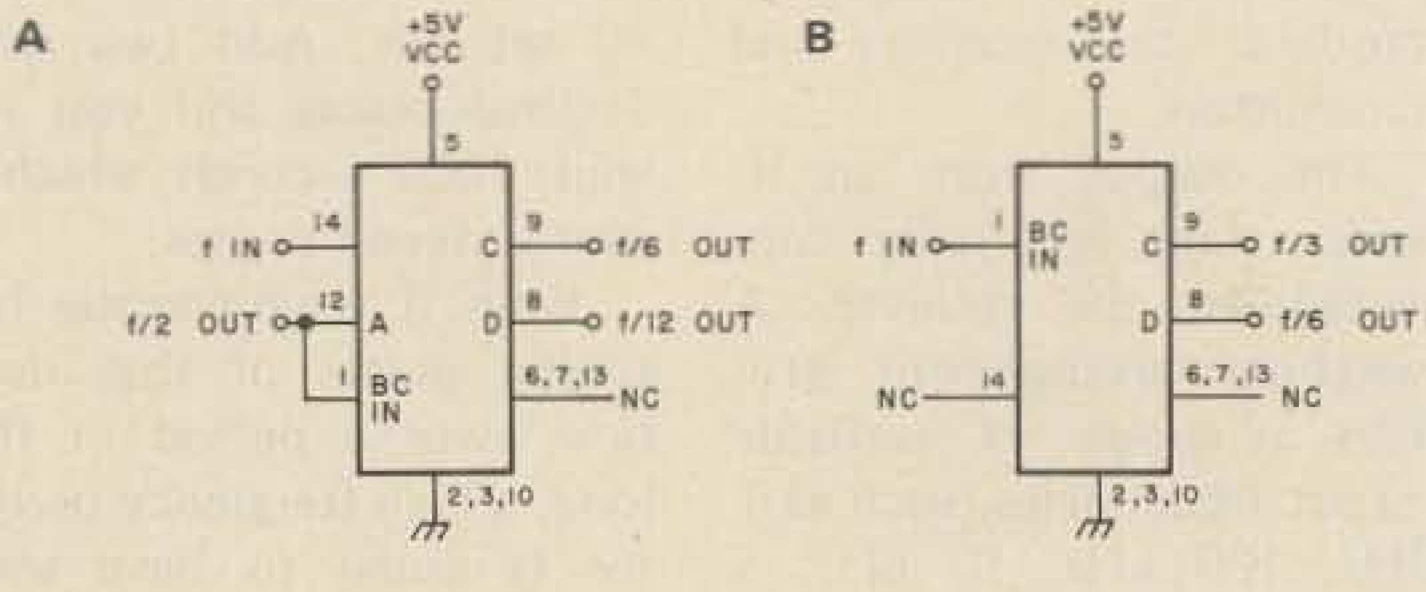


Fig. 7. 7492.

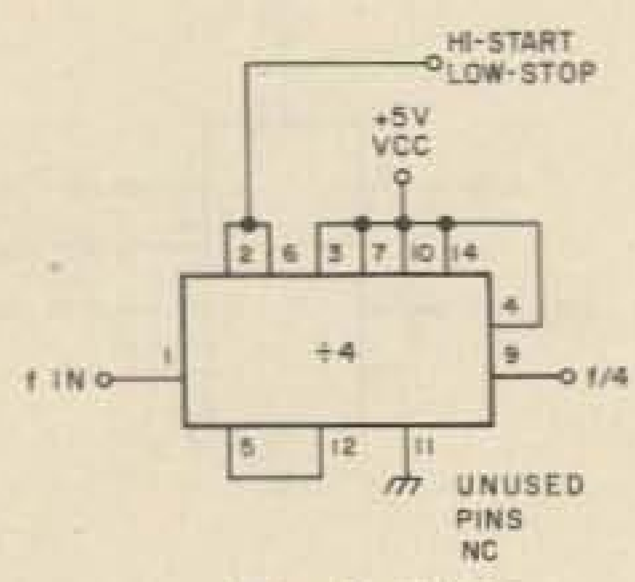


Fig. 8. 7473.

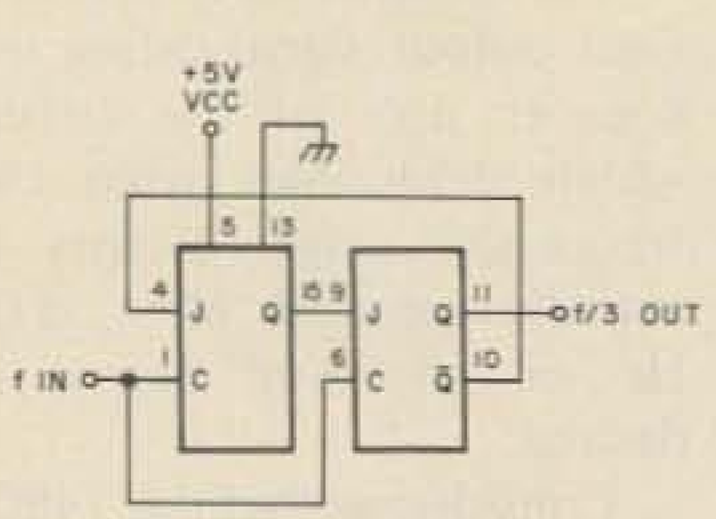


Fig. 9. 7476. Unused pins NC. 16 pin package.

Wayne Green W2NSD/1

Thirty Years of Ham RTTY

-- from the Model 12 to the microprocessor

Amateur radio teletype got its start in 1946 soon after the two meter amateur band was opened.

I remember getting word that 2½ meters was open along in September 1945. I was teaching radio and radar at the submarine base in New London at the time, and it took but minutes for me to dash up to the lab and put a rig on the air and start making ham contacts. The next weekend I drove home to Brooklyn and picked up my homemade battery transceiver . . . built pre-war out of *Radio* magazine. How many of you have seen copies of *Radio*? It was the *class* magazine of the 30's and made us all wonder what was wrong with *QST*.

The old Model 12 "warhorse" Teletype machine . . . the printer that got amateur radio teletype started back in 1946.

Ten meters was opened, as I recall, along about late November 1945, and the 2½ meters was changed to 2 meters in December 1945. Within weeks W2BFD was going hot and heavy with his audio frequency shift radio teletype up on 147.96 MHz and slowly gathering a group of interested pioneers.

The equipment in those days was a Model 12 Teletype machine with good strong electromagnets for each of the five pulses of the Baudot code and one whopping magnet to make the selected key print. Signals were sent serially and converted to parallel with a mechanical distributor on the keyboard. The whole works made a terrible racket and a lot of radio hash.

My own interest in RTTY was sparked in 1948 when I heard a peculiar tweedling of tones on the high end of two meters. It turned out to be John Williams and a dozen or so other RTTY amateurs hunting and pecking away at each other.

Within a few weeks, I had my own printer and had put together a tone generator and demodulator, complete with autocall circuits, and was joining in the fun. I also tried it out on 11 meters and made quite a few good contacts with W6s, including W6NRM, one of the more important RTTY pioneers. On 80m I had to use make-break keying since FSK was not yet permitted, but even so quite a few contacts were made, even out to California.

The two meter distances between stations were such that beams were required to make most of the contacts . . . and that meant that many operators were unable to copy what was going on. John solved this by setting up a repeater on top of the Municipal Building in downtown Manhattan. I won't soon forget the project as I was the one who climbed out on that copper roof one midnight in the middle of a snowstorm to set up the antennas. In case you wonder how I managed to hang on to the steep roof (you can see it as you drive across the Brooklyn Bridge or the Manhattan Bridge), there are little pegs sticking up, and these provided hand and foot holds. If it hadn't been the middle of the night I'd never have made it . . . one look down and I'd have had it.

The repeater made it possible for all of the RTTY gang to talk with each other. Most of us were using automatic circuits which made it so messages could be left for us when we were not present. Often I would leave my machine on short start, which would permit it to copy everything on the channel, and I would come home after a day or two away to find maybe fifty feet of rag chewing and gossip piled up on the floor.

Some stations were set up for automatic roger. This was a neat little circuit which would turn on the other fellow's rig and send back a couple of bleeps to let you know that your message had been copied. It wasn't exactly legal, but it was a good pioneering effort. It is a pity that the FCC has historically made it so difficult for amateurs to experiment and pioneer things. One wonders what might have been developed if amateurs had been permitted to have their head. Considering the resistance of the FCC to pioneering and their molasses-like acceptance of change, it's a wonder we've done as well as we have!

Speaking of resistance to change, we started to work toward getting the FCC to permit FSK on the low bands in 1950 ... it took several years before FSK was finally permitted. In all fairness to the FCC, the time it took was not so much a result of their slowness as the bitter fight put up against RTTY by the ARRL. The League countered every effort of RTTYers with legal efforts to stop them. Fortunately for the RTTY group, the ARRL was in very poor favor with the FCC. Despite their massive efforts, the ARRL racked up quite a few years when every single petition they put in was refused by the FCC and every one the ARRL fought was accepted.

Here's Wayne in 1952. Watching are Faye Emerson, Bill Halligan, Skitch Henderson, Conrad Nagle and Herb Sheldon.

This was the period when the Novice license was set up (with extreme resistance by the ARRL), and the Tech license. The chairman of the FCC was a ham and he was well aware of the attitude of ARRL HQ toward the hobby ... and he was determined to help amateur radio progress despite Budlong and Segal.

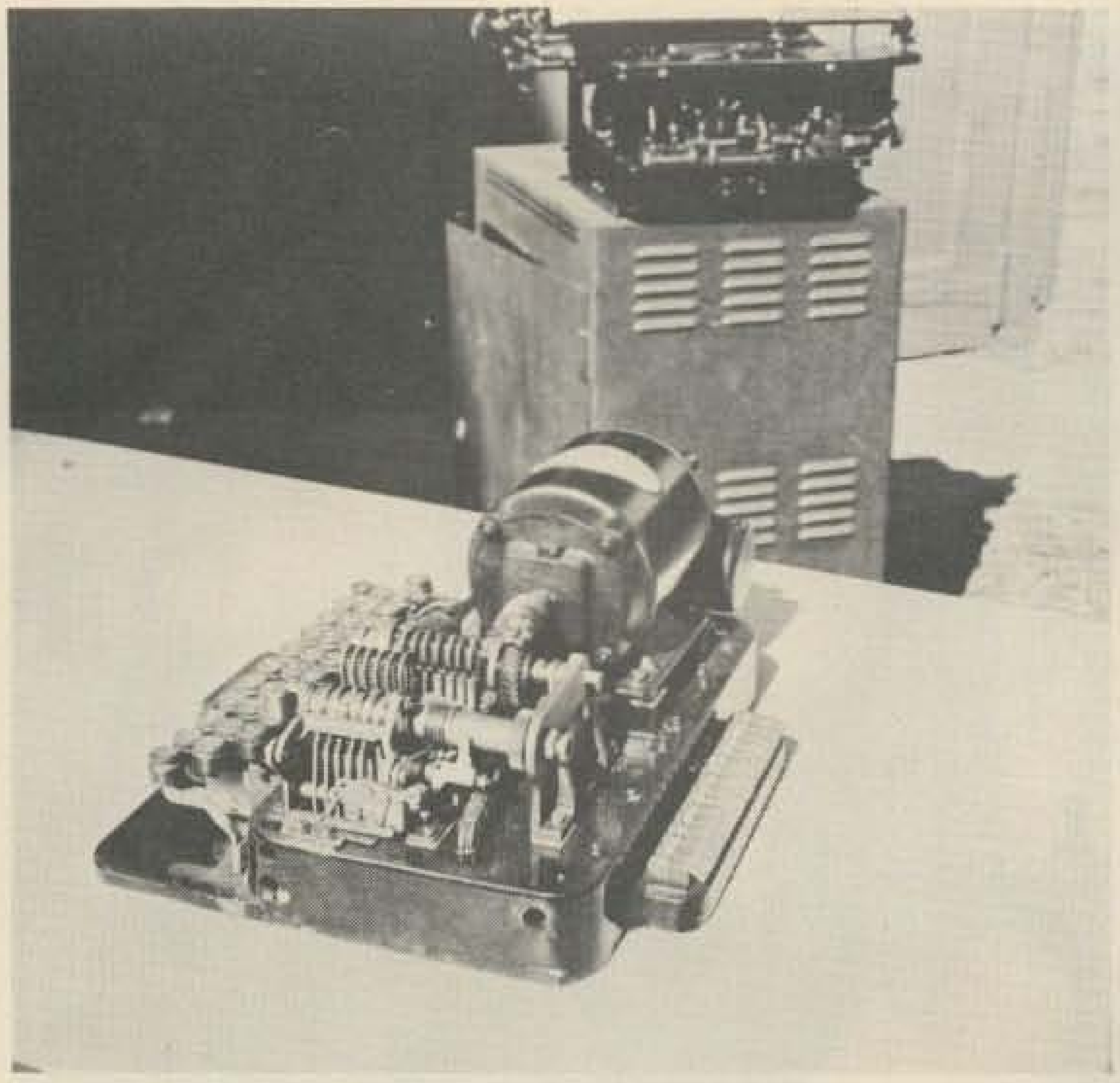
The ARRL didn't get a friendly reception in Washington until well after the uprising against Budlong and Segal led by Mort Kahn W2KR, when Budlong found himself suddenly "retired" and Segal replaced by Booth. Insiders, well aware of the utter contempt ARRL HQ had for their sheep-like members, found things somewhat improved under Huntoon (Kahn's protégé). Hopefully someone will someday write a true history of amateur radio and put ARRL in its real perspective.

In the late 50's when the Model 15 printers started becoming available at reasonable prices, the Model 12s were retired. The Model 14 strip printers never got to be very popular ... hams wanted pages of paper, not strips.

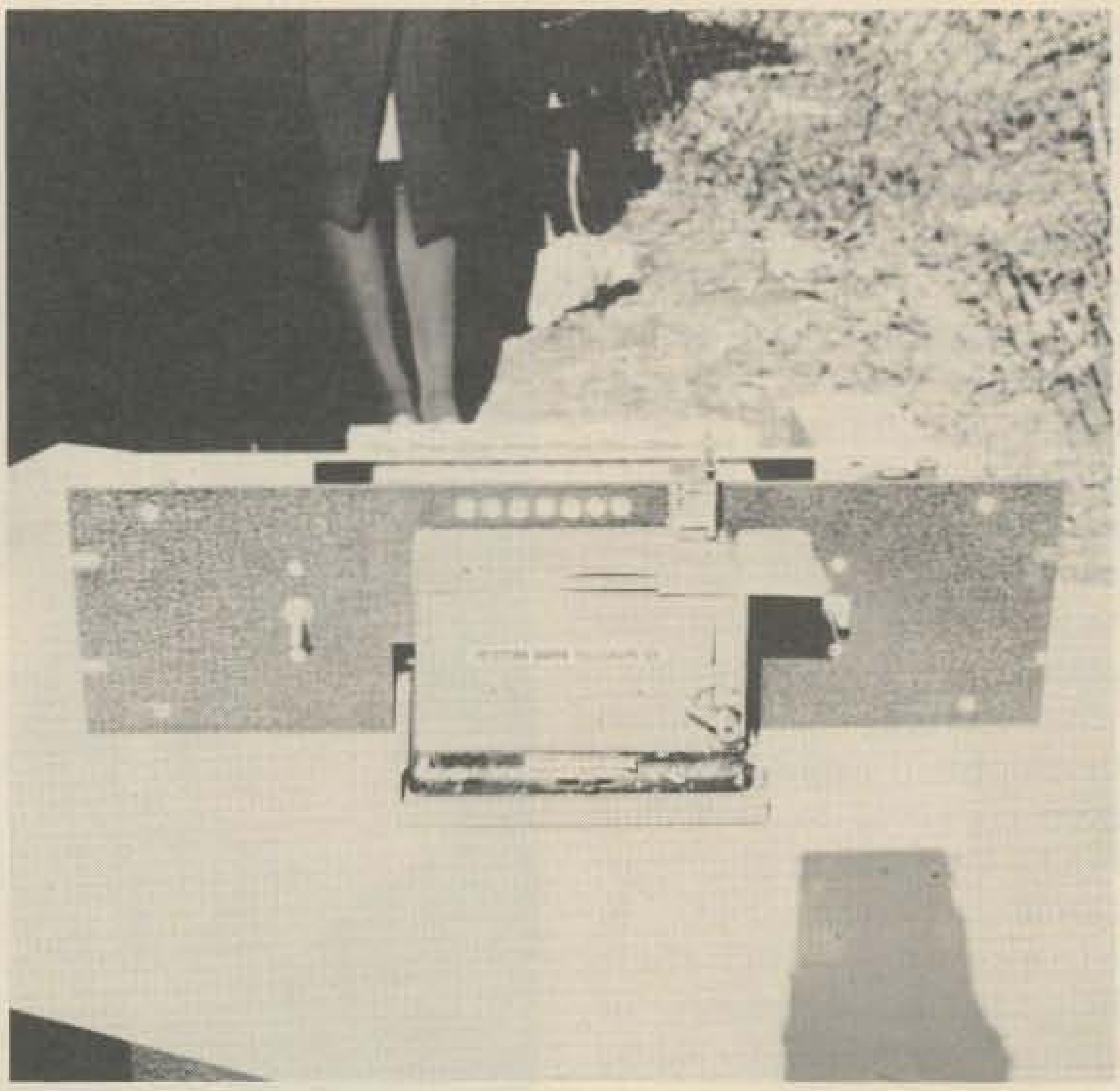
When the FCC finally released rules permitting FSK on the low bands, they were already out of date and extremely inhibiting to experimenters. A goodly percentage of the RTTY crowd was experimentally minded, more interested in technical developments than in rag chewing. The rules stipulated 850 Hz frequency shift at a time when amateurs were getting ready to change from this age-old standard to much narrower shifts. New filter techniques and detectors made narrow shifts practical. Years later the FCC finally okayed narrower shifts.

The requirement for Morse Code identification of the RTTY station, which the FCC eventually admitted was not needed, irritated RTTY purists. Some retaliated with RTTY simulated Morse callsigns, others with very high speed CW, and some by ignoring the whole thing as much as possible.

It was RTTY that got me into publishing in the first place. I found myself working in a spot with a mimeo machine in 1951 ... they were rather rare at that time ... and within days the first issue of the "Amateur Radio Teletype Bulletin" was in the mail to those amateurs I



The Model 12 keyboard plugged into the big heavy table. It is dominated by the motor which drives the transmitting and receiving distributors. It was very noisy.



Punched tape drive. This is unusual in that it was built in about 1952 and had an electronic distributor instead of the usual motor driven mechanical job.

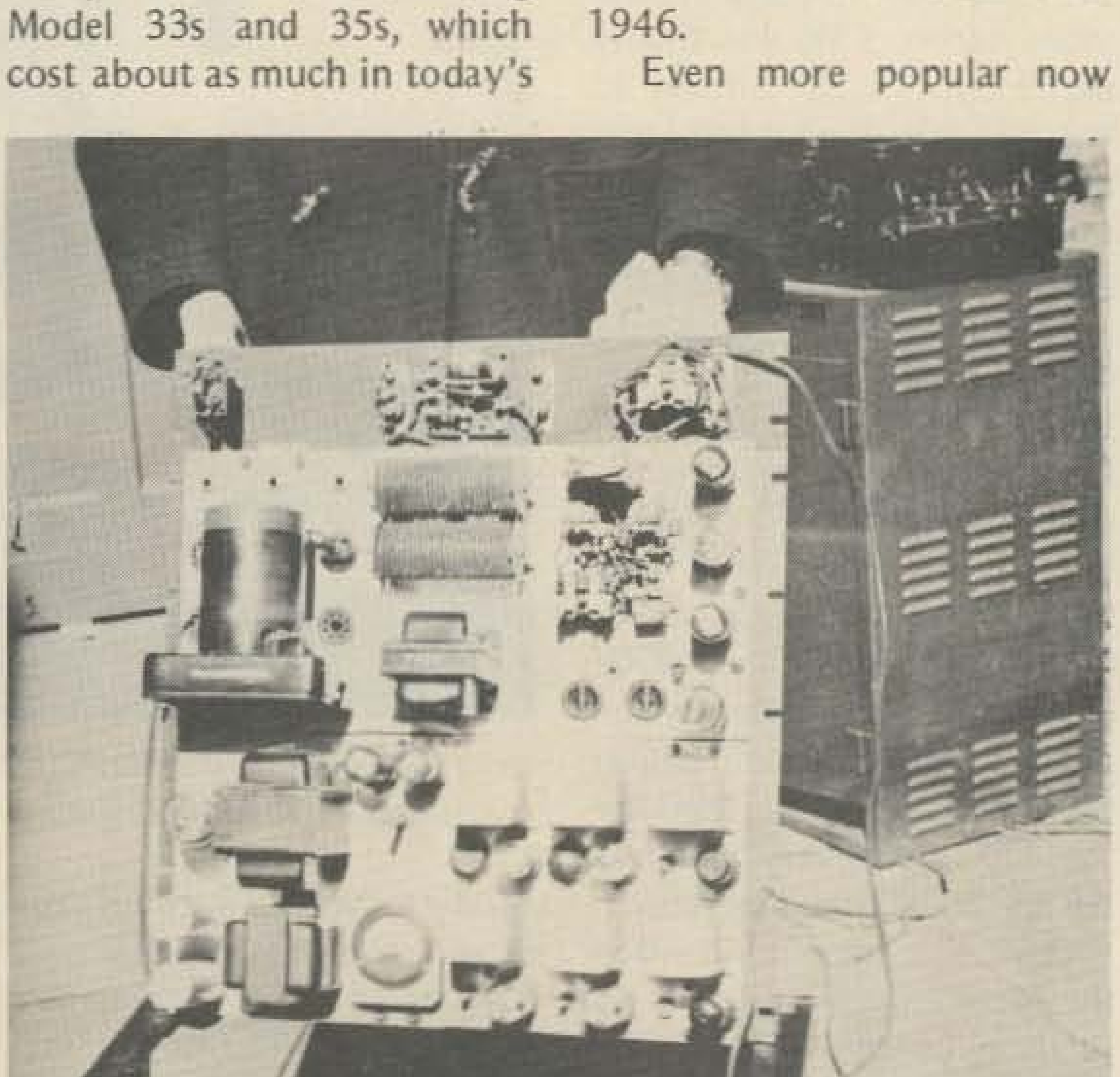
knew to be interested in the subject. I put this out monthly until I took over as editor of *CQ* magazine in January 1955.

As interest in the "Bulletin" grew, I shifted to offset printing, cramming as much as possible in the pages. By 1952 my column on RTTY started in *CQ*, and it was this that eventually led to my becoming editor. My enthusiasm for RTTY and other technical innovations has been apparent in the pages of the magazines I have edited down through the years.

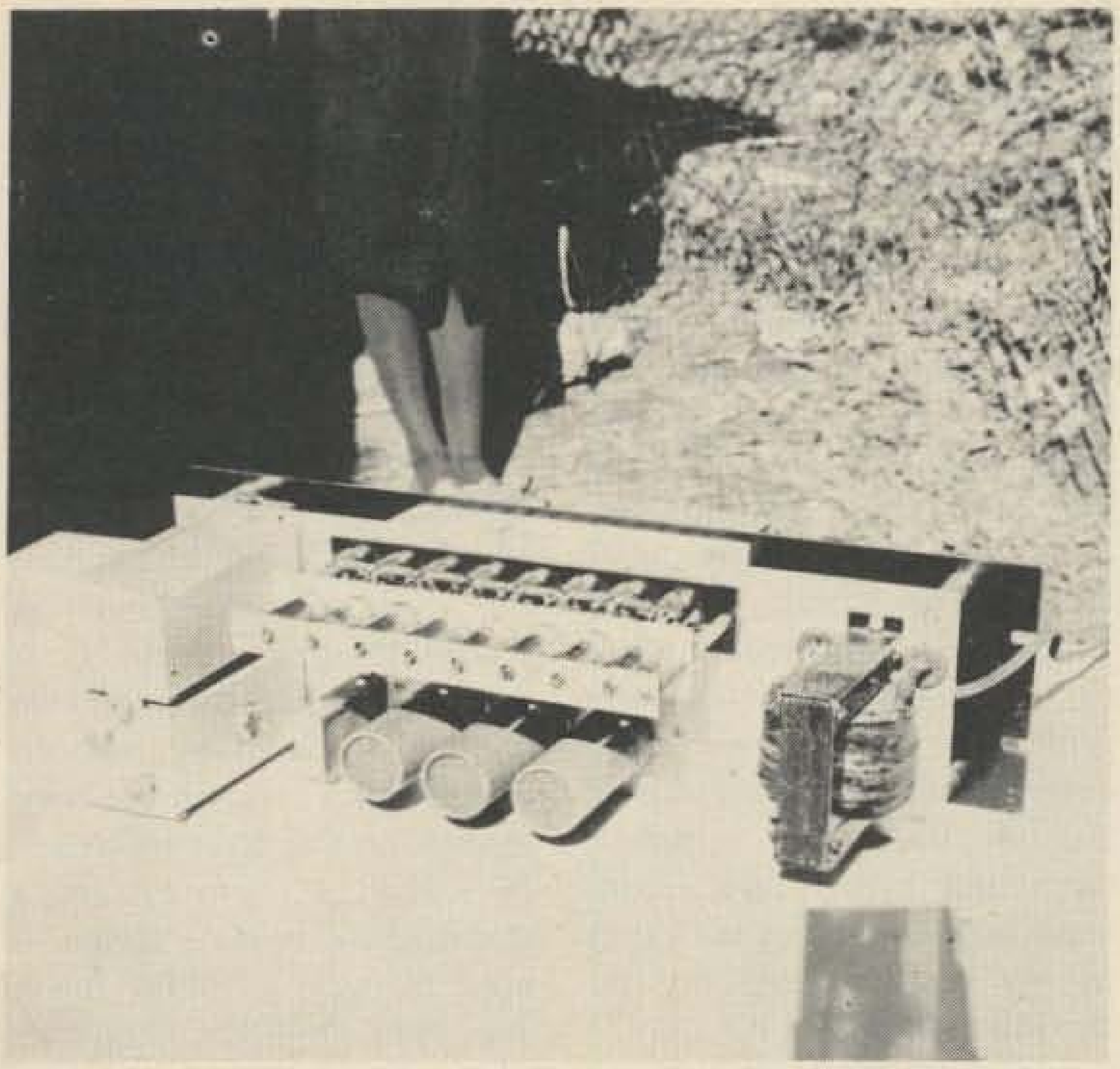
So here we are thirty years later ... the Model 12s are long gone, Model 15s are considered too old for most use, Model 28s are popular and many amateurs are using Model 33s and 35s, which cost about as much in today's dollarettes as the Model 12 in 1946.

Even more popular now

The Model 12 was eventually replaced by the Model 15 (19) printer. Here is a photo of an operator using a Model 15 in the 73 ham shack in 1963 ... note key for Morse ID. We've always had nice operators.



This is the converter and control panel for the Model 12. Note the filters at the lower right ... three for the mark and three for the space tones of 2125 and 2975 Hz. Upper left is the polar relay for driving the printer magnets ... selenium power supply for the magnets ... autocall circuits on the upper right. This was designed and built by the grandfather of all RTTYers, John Williams W2BFD.



Back view of the electronic distributor showing plug-in tube module, power supply and AFSK tuned circuits.

are the video printing systems such as the HAL. A few amateurs are into generating RTTY or Morse via microcomputers and this seems to be the way things will be going in the foreseeable future. It costs less than a Teletype machine and is infinitely more flexible.

By the end of 1977 we should have several systems available for the lazy to buy which permit you to type out your messages, edit them as you please, with often used paragraphs or even pages available in memory for instant recall . . . and the ability to make contact via FSK of any shift, make-break . . . and using any popular code such as Baudot, ASCII, or Morse (at any speed . . . probably up to or over 100 wpm).

W2TLY, W2DXD and John Williams W2BFD.

It's quite possible that the RTTYers will be pioneering computer interfacing via radio, permitting exchanges of information, playing games, and a lot of things we haven't even considered as yet.

Oddly enough, RTTY, with its capacity for handling large amounts of traffic, has never been used much for this in amateur radio. Perhaps the same dichotomy which made ARRL HQ feel that they had to fight RTTY with every weapon at their disposal has been responsible. Traffic has, since the early days of amateur radio, been almost entirely an ARRL dominated function . . . and the ARRL has never really come to terms with RTTY.

As far as I know, I am the only RTTY operator to ever make BPL using RTTY . . . back in 1952 I set up my station on 42nd Street in New York and accepted messages for servicemen overseas at Christmastime. They were routed by two meter RTTY to DX operators and many thousands were sent to servicemen. This was all arranged by the local RTTY amateurs and the station was manned by volunteers for several weeks.

In all fairness to the League, it should be pointed out that RTTY never got to be simple enough for the uneducated amateur. It did require a pioneering spirit that few of the traffic handling amateurs possessed. And the routine involved in traffic wasn't interesting to experimenters.

This may change as more and more RTTY equipment is made available which is relatively foolproof. One can foresee the ham station of a year or two from now with auto ID, auto search receiver, auto logging . . . things like that . . . and all spelled out by the built-in program so it tells the operator just what to do on the CRT.

There are more than a few amateurs who are so wrapped up in the past that they do not consider RTTY or computers as legitimate parts of amateur radio. Pity . . . for not only are they preventing themselves from having a lot of fun, they are pressuring other amateurs and the magazines to preserve things as they used to be instead of looking to the future.

Needless to say (hopefully), I am most interested in what you pioneers are doing with RTTY and microprocessors in the ham field. There is no question in my mind that this is one of the most important developments in the history of the hobby. Don't forget to keep notes of your work . . . and write articles so the rest of us can benefit by your work . . . and enjoy. ■

Group of pioneer RTTYers at meeting on Long Island about 1951.

Big Noise Burglar Alarm

- - lights flashing, horns blaring

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Ellicott City MD 21043

With the increase in crime rates, smart amateurs are giving serious thought to some sort of security system in their automobiles to protect their investment in communications equipment. While there have been dozens of articles published recently on alarm systems, with all sorts of fancy control circuitry, the majority of these alarms merely activate the regular car horn or a simple siren. Presented here are several other suggestions for drawing attention to your vehicle when there is an attack on the car.

A burglar alarm should fulfill two objectives. The first, hopefully, is to act as a deterrent and keep an intruder away from your property in the first place. If he wants what you have bad enough to attempt intrusion, the system should attract enough attention to make him extremely uncomfortable while he is in the progress of burgling. It is also advantageous if you get some sort of notification if you are removed from the vehicle.

The two things burglars hate are noise and light. Most alarm systems make some sort of noise, but not many people have given any thought to turning on some lights on the car when a break is detected. Many times I have heard an alarm system sounding on a vehicle in a crowded parking lot at night, but until you are standing right in front of it you cannot determine just which car is sounding off. It is a simple matter in most vehicles to activate the 4-way flashers with an alarm system and make the alarm that much more effective. As mentioned previously, the noisemaker device incorporated into the system is usually the car horn or one of the Mickey Mouse mechanical sirens. Either of these leave a lot to be desired in anything but the most elementary system. The car horn is not intended for continuous operation, and will soon overheat and burn out. A mechanical siren is not really loud or attention-getting, and can be easily disabled by the burglar by jamming the impeller with a screwdriver or ballpoint pen. In addition, these sirens are quite directional. They must be positioned near the front of the car and point out through the grille. The sound from these sirens is not the characteristic rise-fall sound of a police siren, but rather just a constant high frequency wail that in my opinion does not do the job required of it.

An excellent solution to the problems associated with the car horn is shown in Fig. 1. This circuit, engineered by K3UPU, overcomes most of the disadvantages of using the car horn that were discussed earlier. As the horns are switched on and off, the duty cycle is such that the horns will have time to cool off and can run in the alarm condition virtually forever with no adverse effects. By switching the two horns alternately, a very distinctive and effective sound is produced which is sure to draw attention to the vehicle. Most vehicles have two car horns which are driven in parallel. One side of each horn is always grounded, while 12 V dc is applied to the high side of the two horns by the horn relay when you push the horn button on the steering wheel. In K3UPU's alarm system, a standard heavy-duty flasher is used to cycle an SPDT relay. The N.O. and N.C. contacts of the relay are hooked to the high side of either horn. When 12 V dc is applied to the circuit from the alarm system control circuitry, the two horns on different frequencies are sounded alternately, producing a very penetrating foghorn-type sound. My vehicle, a 1971 Ford Torino, has only one horn installed. If this is the case with your car, a second horn can be obtained from a junkyard for a dollar and mounted in a convenient spot behind the grille.

A very excellent relay for the application is available from Tri-Tek for $1.50. These relays appeared in a recent advertisement in *73*. This circuit is good for a simple alarm when the car owner wishes to keep things uncomplicated and use equipment already available in the car.

Probably the best practical device for a mobile alarm system is an electronic siren. These can be obtained quite inexpensively, offer you much greater control, and are useful for a variety of other applications by the amateur. My favorite is the prepackaged siren/PA system designed for emergency vehicles. These are available from Federal, Motorola, or even Heathkit. I use the Heath unit in my car and am very pleased with it. The

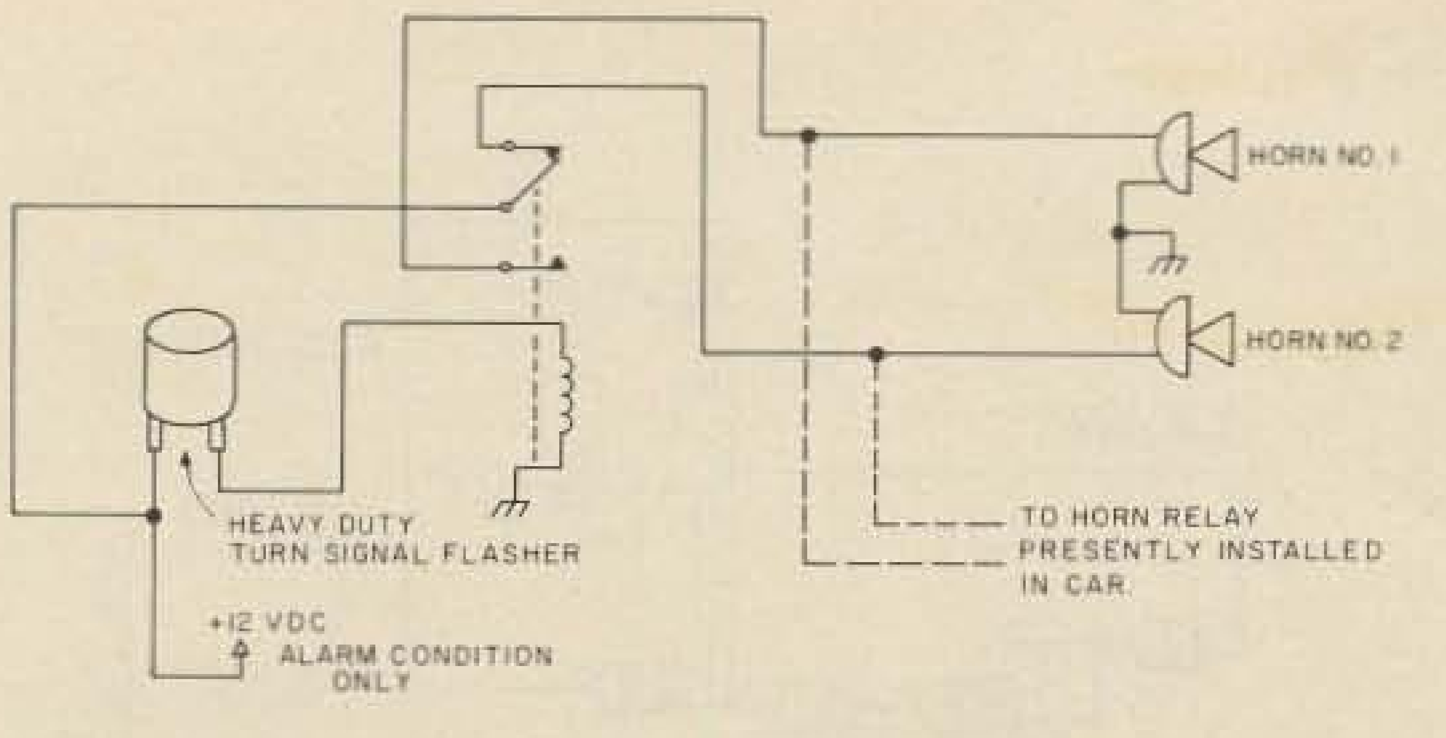

Fig. 1. K3UPU's foghorn alarm circuit.

Heath siren/PA offers both automatic and manual wail, yelp, and PA, as well as an input to the audio amplifier for a 2-way radio input. The wail takes 6 seconds to complete an up/down cycle, while the yelp takes 1/3 second for 1 cycle. To convert the Heath for use in a burglar alarm, it is necessary to have 12 V dc available when the alarm is tripped – as well as a dry contact closure. The unit draws about 7 Amps at 12 V dc for 55 Watts of audio out. This must be taken into account when selecting a relay for the system. The contact closure is necessary to select the mode of operation once an alarm has been detected and 12 V dc has been applied. I tapped in at the wafer switch on the front panel. The relay for this only needs to handle a few milliamps. 55 Watts audio output is about what a fire engine or police vehicle runs, so you can imagine the ruckus it will cause when a burglar sets it off.

Electronic sirens designed primarily for alarm use are popular in the security field and are available from most security equipment suppliers. There should be several listed in the Yellow Pages. These have the advantage of costing less than professional sirens, and are more readily adaptable to an alarm system. The audio output of these is usually only a few Watts, but is enough to do a very creditable job. These cost about the same as a cheap mechanical siren and are much better. The sirens are available either with a driver and speaker together, or separate, for special design applications.

Along the line of drawing attention to the car when an attack has been made, why not consider ways of turning on lights with the system? The leads to the 4-way flasher switch are accessible in the wiring harness that runs the length of the steering column. A contact closure will activate these. Another place to get at lighting wires is at the brake pedal switch. By putting a flasher in parallel with this switch, the brake lights will flash. Or by using K3UPU's circuit in Fig. 1, you can flash the headlights on and off, either alternately, simultaneously, or high and low beam. This will create a desirable effect. If you are serious about protecting your car, you can mount single faced trailer lights inside the back window on the rear deck. These can be wired in parallel with the bright filament of the 1157 taillight for normal brake lights and turn signals, or they can be used with the circuit in Fig. 1 and be flashed alternately. These lights also make for safer driving, as the car will be much more visible on the road. Another idea is to mount a rotating beacon inside the back window. Do not use any color other than orange without checking local regulations.

All this is great to scare the intruder away, but what if you are shopping or visiting and are some distance from the car? The alarm could sound for hours before you wandered back to hear it. Most likely it will not go too long, as I have seen police officers or residents rip out every wire in sight trying to disable the alarm. Remote notification systems are becoming more and more popular in commercial security. This should be right along the amateur's line. There are several companies that market transmitter/pager combinations designed for alarm use, but the same thing can be accomplished by an enterprising amateur for less money. A VHF Engineering transmitter board and a recycled commercial pager would make a good combination. If you use a receiver that does not have tone coded squelch, make sure to modulate the carrier somehow. I have had a receiver pick up an alarm signal which I didn't notice for some time, because the signal was full quieting. Keep the antenna inside the vehicle where it will be protected. You should still get enough range for most purposes. My system uses a TR-22C which has been modified to extend to my commercial frequency while remaining usable on 2 meters. It is modulated by an acoustically-coupled SC-628P Sonalert. This pulsating Sonalert is loud enough to fully modulate the transmitter when the microphone is on its clip on the dash and the Sonalert is under the dash. I have had some embarrassing moments when I was working an amateur channel before I left the car and the TR-22C was still on the amateur channel when the system tripped. In fact, I haven't been on the particular repeater since. I monitor the system on a commercial handie-talkie that I usually have with me. You can do all sorts of fancy things using your imagination. For a while I think I had the only mobile in existence that was connected to a central alarm monitoring station. I had a system that would bring up a repeater autopatch and dial my home, telling whoever answered that the car was being broken into. A COR monitored the repeater and stored the alarm message until the repeater had been off the air for 60 seconds. The tape mechanism for the voice signal was not reliable and the whole system was not really practical, but it was fun to play with for a while. It's important to keep the alarm down to a size that you can handle. If it gets too involved it won't be reliable – something to stay away from. Give some thought also to protecting the various components of the system from defeat. If the burglar wants what you have bad enough, as he will if you have a fancy mobile setup, he will be able to defeat *any* alarm you might have. Try to think like the burglar might. Is there a key switch he could monkey with? Can he get to the wiring from underneath the car? Slip some flexible conduit over the battery cables. Or, I went a step better. I am running a supervised alarm system in my mobile where if any part of the wiring is cut it will trip the system.

My regular car battery does NOT power the system. Even if the burglar does cut my battery wires, the system is still armed. Power for the alarm is provided by gel cells inside the car. These are recharged by the car's electrical system while I'm driving.

While the thought is in my mind, don't overlook a good loud bell for mobile applications. Bells sounding from a car are really attention-getting. Ademco makes good ones that are cheap but rugged. Again, check the Yellow Pages for alarm equipment distributors.

In closing, I'll say this: Don't put too much confidence in your alarm. Nothing will stop a determined burglar, especially if he has the time to figure it out. Be careful where you park the car and arrange for it to be checked up on occasionally if you are going to be away from it for a period of time. And again, the best security of all is having nothing worth stealing. ■

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Dandy Digital Dial Decoder

-- to control whatever you want

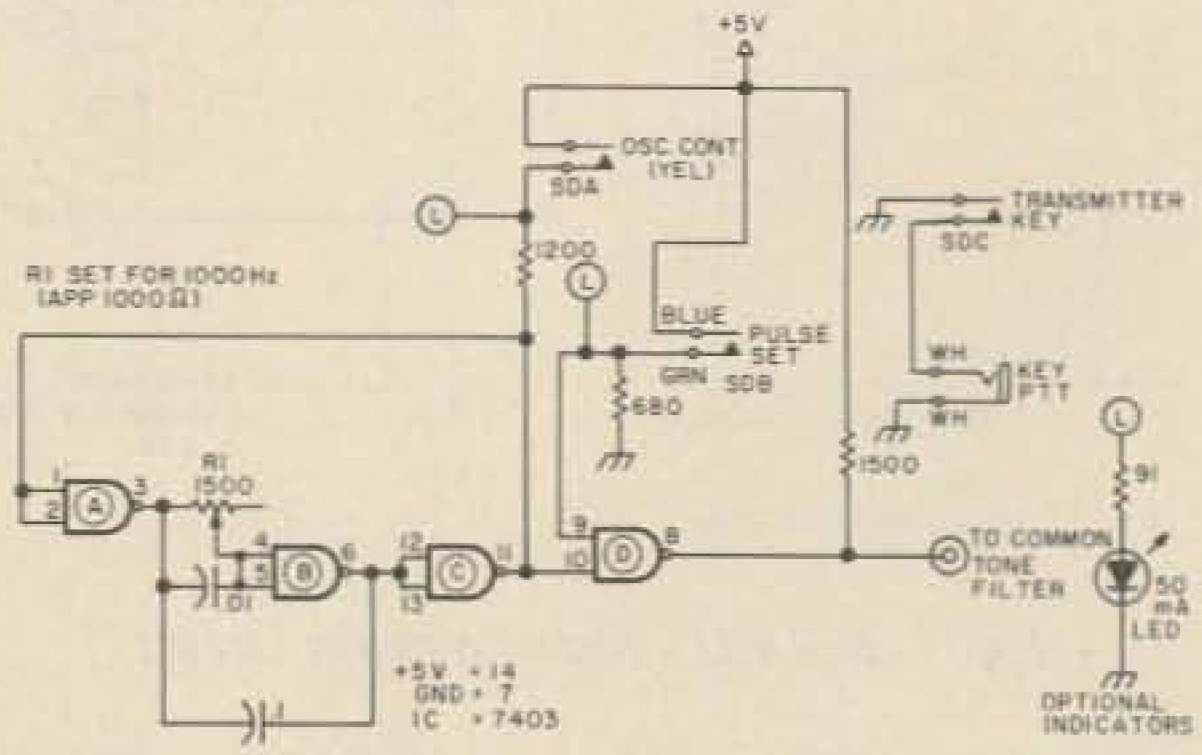

Fig. 1. Dial to tone encoder. Credit: Stamatios V. Kartalopoulos, University of Toledo, E. E. Department.

If you have a need for remote controlling anything and for whatever reason (cost, complexity, etc.) have found that touchtone signalling is not for you, then indeed this article may be the answer to your prayers. This article describes a two digit rotary dial decoder. Instead of a bundle for a touchtone dial, all you need on the sending end for this system is an easy-to-find rotary dial from the older series telephones and a single tone oscillator.

General Description of System

Following the system from the beginning with the originating station sending a tone, this tone is then broken up into pulses by the rotary dial. Whenever the dial leaves its rest position, there is one set of contacts that closes and remains closed until the dial again comes to rest. This set of contacts is wired in parallel with the user's PTT line, so the transmitter is automatically keyed while dialing. A second set of contacts that closes before the PTT set and opens after them allows the tone oscillator to run up to frequency before going out on the air. This set of contacts applies +5 V to the oscillator to turn it on.

A third set of contacts, called the pulser set, is closed during the clockwise rotation

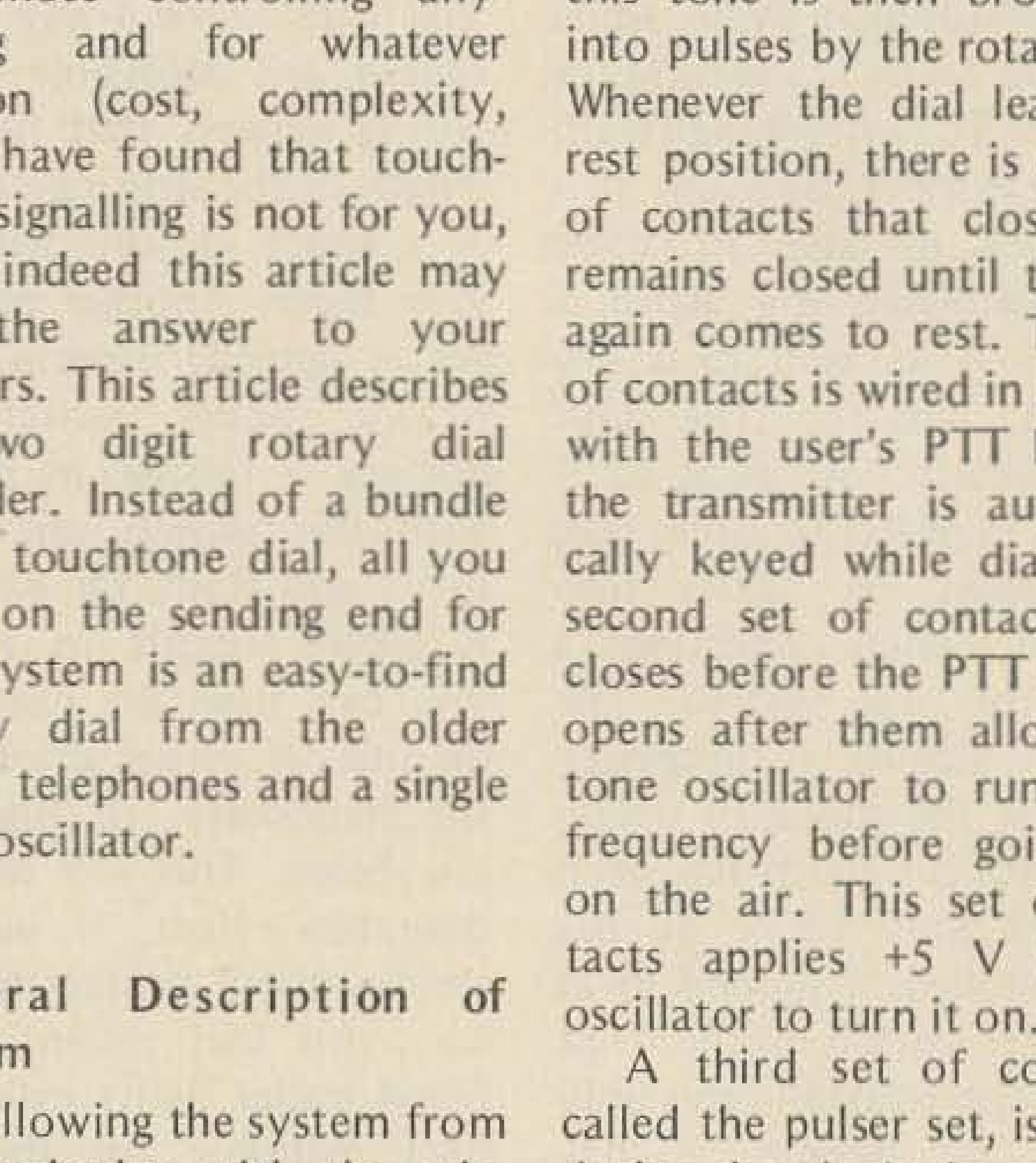

Fig. 2. C1: .1 uF. C2: 1.0 uF/6 V. C3: 2.2 uF/6 V. C4: 250 uF/6 V. R1: 6.8k to 15k. R2: 4700. R3: 2000. R2 reduces B.W. to 8% @ 100 mV in, 5% @ 50 mV in. Alternate (no R2, C4): Make C3 3.3 uF for 1000 Hz. C2 is loop low pass filter. For 1000 Hz, R1 is set at ≈ 10k. Input R = 20k. Smallest reliable V_i = 20 mV.

$$F_o = \frac{1.1}{R1C1} \qquad V_i \leq 200\ mV$$

$$B.W. = 1070 \sqrt{\frac{V_i}{f_o\,C2}} = \%\ DFf_o$$

of the dial, and then opens momentarily (like a ratchet action) at each digit position from the number you dial back to rest. There are eight openings for the digit "8," etc. This set of contacts is wired to keep the audio oscillator output from reaching the transmitter microphone audio input by any number of means (see Fig. 1).

The results are the operator sending a tone sequence of: 1. a steady tone for the duration of the clockwise rotation of the dial; 2. a number of "windows" of no tone as the dial returns to rest – equal in number to the number dialed; and then 3. a return to the transmitter unkeyed condition when the dial reaches the rest position. The decoding circuits are arranged in this "negative" logic sequence because this means a valid tone must first be received, thus leaving out incorrect tones and signals too weak to accurately trigger the system to a proper count. Only if the user is strong enough and has the proper tone will anything at all happen at the system! Also, only the addition of a second tone oscillator at the user end will double the number of system available codes. A duplicate decoder on the second tone channel at the remote site is required, but all boards are interchangeable with the first set except the tone signal decoder. This allows keeping at least one system up by using boards from the second set. If the system sees the first valid tone, it should in turn see each of the following tones and the windows between, and thus a proper count occurs.

The first decoding (for tone frequency) is done to separate the tone used for dialing and other tones used for control in our system. Therefore, the decoder appears separate from the control board as part of our

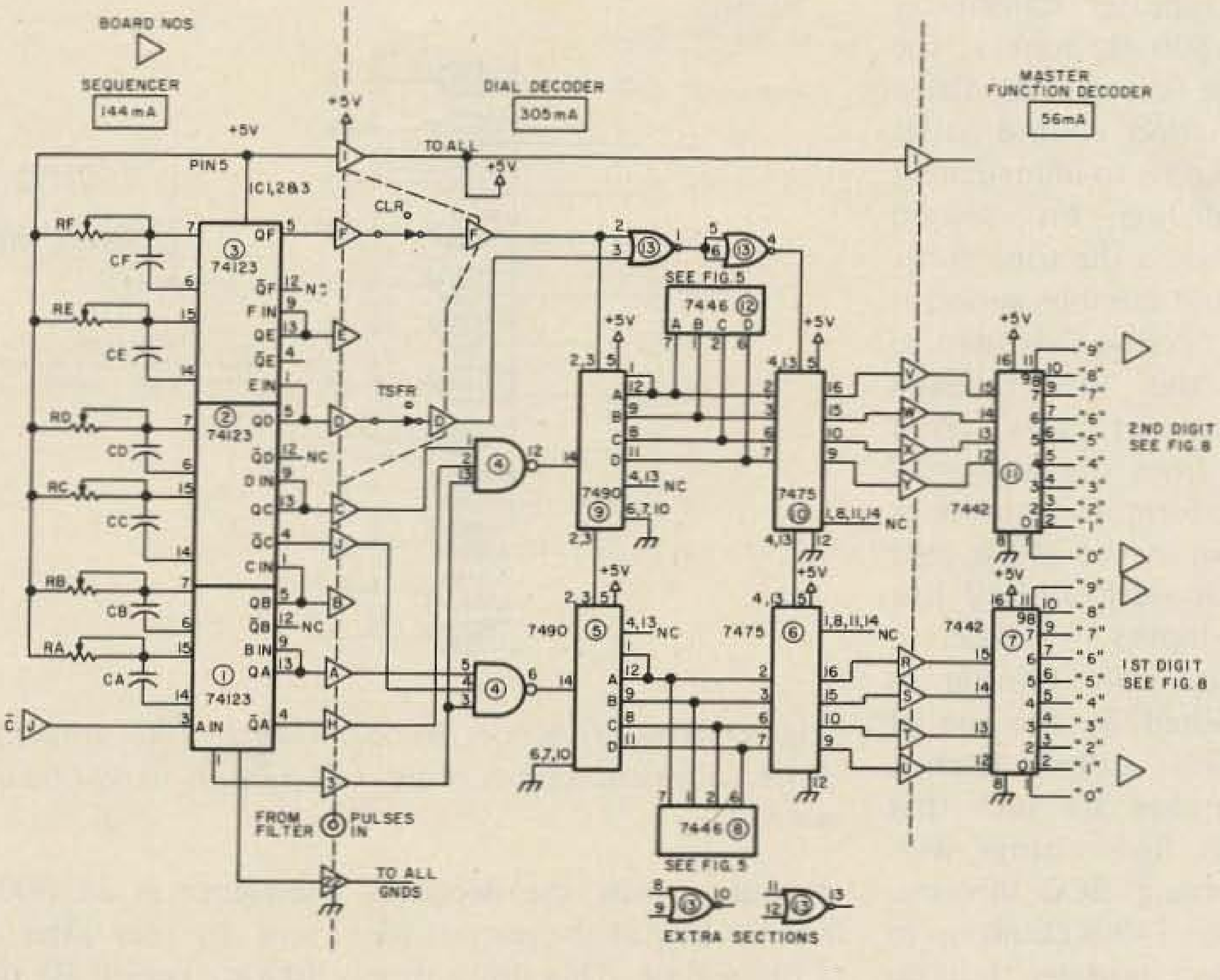

Fig. 3.

tone decoder board (see Fig. 2). The tone decoding is done by a rather conventional tone decoder PLL IC, a 567 type.

In our system, whenever a 1000 Hz tone is present, the decoding circuits of the 567 PLL produce a low on pin 8 of the 567 IC. This low is then carried into the control board on pin 3 (see Fig. 3).

The tone decoder changes the present or absent 1000 Hz tones into a TTL compatible level shift, from highs to lows. These pulses can then be operated on in a normal TTL manner.

The first negative going input pulse (tone received, dial moving clockwise) starts the sequencer running. The sequencer is a series of one-shot devices hooked "tail-to-head," such that the first input starts the first timing period, call it period A, and the action of its Q output going low at the end of period A then triggers the start of period B in the next one-shot, and so on through the end of period F. This makes the sequencer self-completing; thus if a user starts a dial command and only dials one number, the decoders decode the sequence

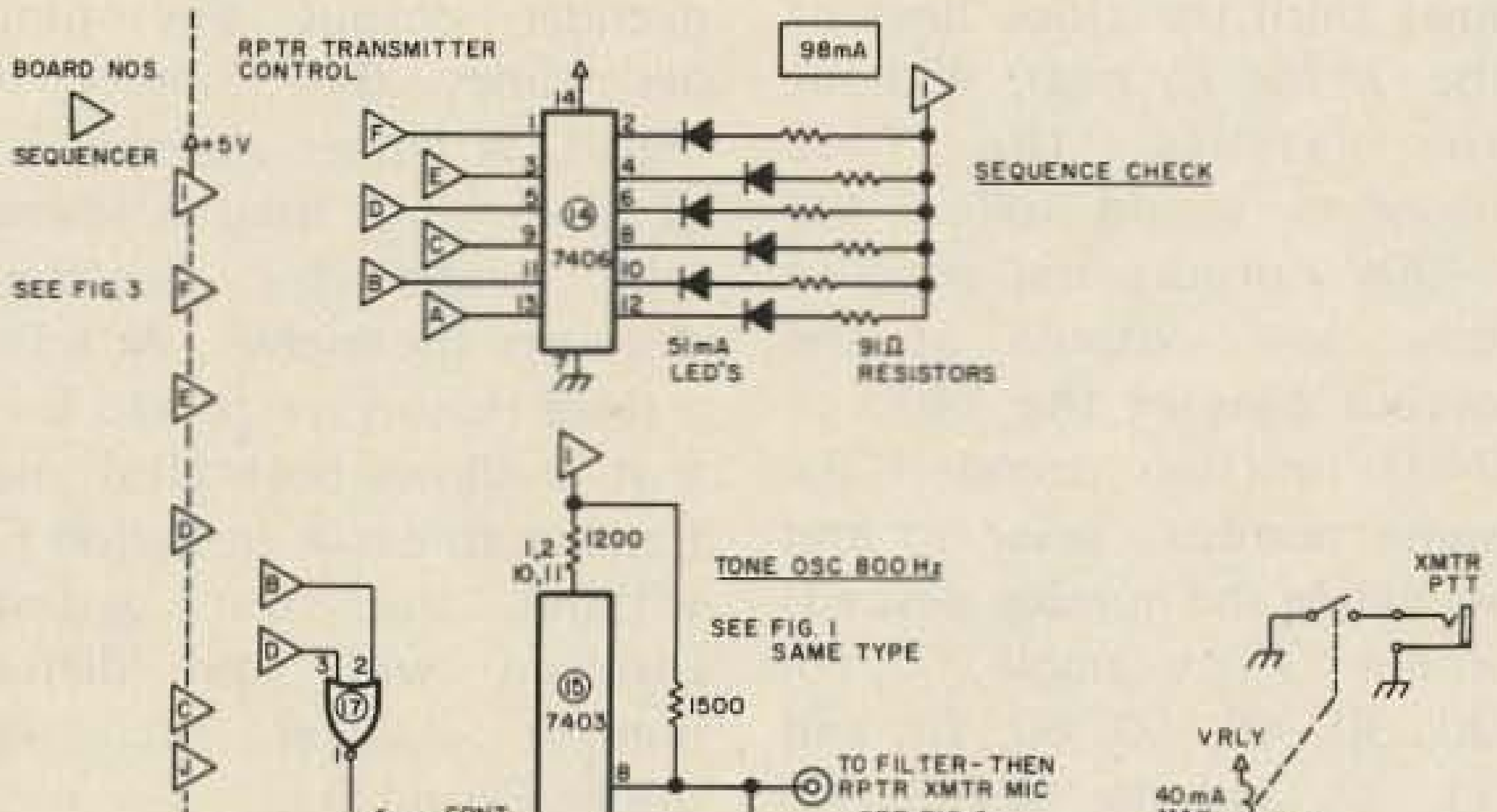

Fig. 3(a).

as a 10 - 20 - 30, etc., command zero understood. We use this to advantage as all-off, reset, stop, etc., for a row of commands. In the case of 10, this cancels or resets all commands 11 to 19. The sequencer goes all the way through its steps after the first valid command, regardless of the second digit dialed or not, and returns to 0 - 0.

This way it is impossible to "lock up" the system by dialing one number, dialing clockwise and holding the dial at the stop, etc.

The sequencer is the master timer, and as such, controls the decoding process from the first clockwise rotation of the dial through both numbers received (see Fig. 7).

Time period B is used to

key the repeater transmitter with an 800 Hz tone at the end of the first number dialed period, period A, and to let the user know to immediately begin dialing his second number when the tone quits. The second number period is period C. Period D is used to transfer the two received numbers, at this point changed from the sequential or serial form to parallel or BCD form by the 7490s, over to the decoder 1-of-10 line device's inputs – 7442s in this case. This transfer is accomplished by the use of the 7475s called latches. These latches are such that the input lines change with the incoming BCD information as the 7490s count up to the correct number, but do not "transfer" that BCD information to the output lines until the clock lines of the 7475s go high. Without the latches, the 7442 decoders would follow the 7490s' outputs and produce false low outputs at the output pins of the 7400 or 7403 function decoders for some numbers prior to and including the number desired: in our "73" example, 00, 10, 20, 30, 40, 50, 60, 70, and 71, 72, and the desired 73. This you do not want. With the latches you have exclusive outputs, at 00 and 73, the number desired.

Period E has several not too apparent reasons for its existence. One, it serves as a settling time to allow the translated (serial to BCD) and transferred number to be decoded by the function

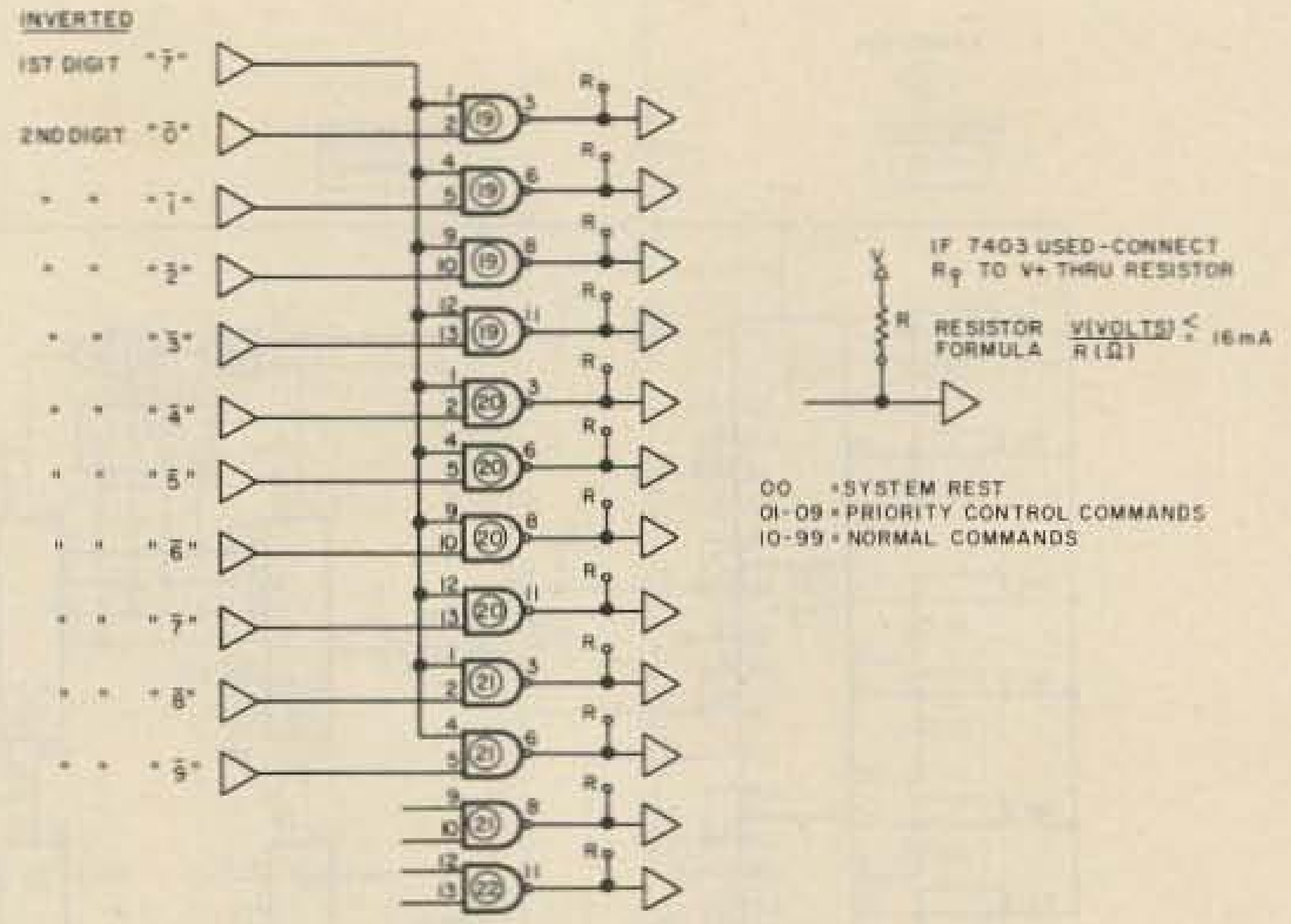

Fig. 4. (Row) function decoder boards. (70s shown.) 7403s – Note: If destination is more TTL, 7400s would be used (with no Rs).

decoders; thus the decoders remain low at the output for a finite time. This finite time is used in analog functions to allow a given amount of decoder output low time per times the number is dialed. A better explanation of how this is used is found later under the function decoders themselves. At least a third reason for period E is that it allows both clear and transfer to occur in Period F, without the clear getting involved with the dialed number transfer occurring during Period D.

Period F is a reset to 00 period by causing a high on both the clear and transfer lines at the same time, thus transferring the 00 cleared information to the function decoders. A 400 Hz tone is sent during this period back to the user, indicating the system is ready for more of the user's information. The sequence is an 800 Hz tone sent to user after period A (during period B), an 800 Hz tone sent again after period C (during period D), a brief pause of period E, and a 400 Hz tone sent indicating period F – see Fig. 3(a).

With the actual decoder functions covered, a final board is left in the control group, and it is what tells the user what is happening at the repeater. The transmitter board includes an LED driver package 7406 to indicate at the repeater what state the sequencer is in.

This board also contains the two tone oscillators for 800 and 400 Hz used into the repeater transmitter to tell the user the state of the sequencer. See Fig. 7 for the exact timing sequence we have found workable.

The decoding necessary for transmitter keying is also on the transmitter board, and the same IC uses LED indicators to show whether the transmitter is keyed and whether it has 800 Hz or 400 Hz on it. The proper sequence for these LEDs is: I1 (3 sec.), I2 (200 ms.), I3 (3 sec.), I2 (200 ms.), and I4 (800 ms.).

Fig. 4 shows a typical function decoder board. One reason for building them this way is the many wires required in and out of a board versus the available connectors. Taken a row at a time like this, one line is needed for the 10s line in, ten lines for the units inputs, ten lines for the discrete ten function outputs, and one each for the +5 V and ground, or 23 lines. This is one over the 22 pin single side connectors, which isn't bad, or you can use the 44 pin connectors throughout as we did. Either way, all function decoder boards are identical and interchangeable, and you need build only eleven of them to have a full deck plus a spare to fit any one of the ten in use. The spare board is a good idea for a heavily used system. Something about fixing the system in a hurry, and then figure out what gotcha later – hi!

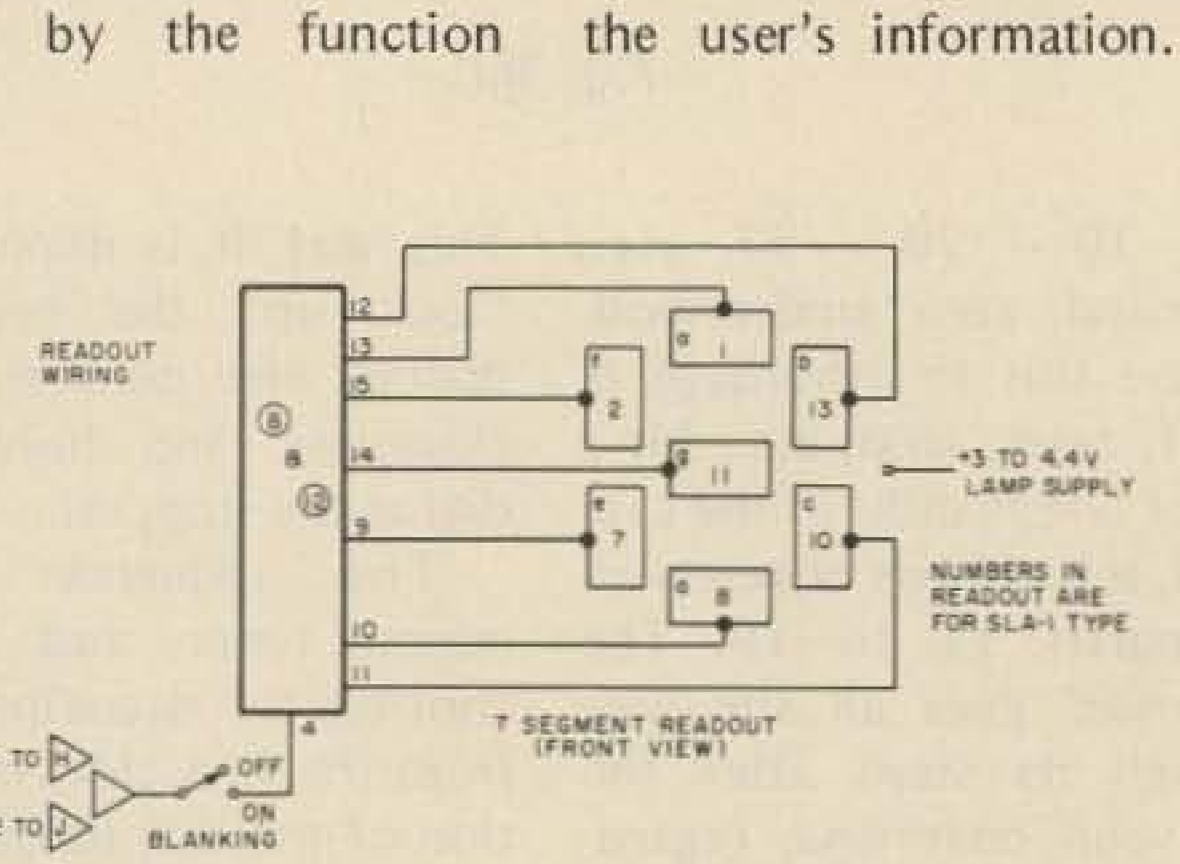

Fig. 5.

Fig. 5 gives the pinout on the readout decoders (BCD to 7 segment) and one possible readout arrangement. Without the readouts, troubleshooting becomes a nearly impossible task. You may want to leave the BCD from each digit as stakes or connectors, and build the decoder drivers and readouts in a separate little box as I did, thus allowing the readouts to troubleshoot other BCD type projects (i.e., DVM, counter, etc.).

Technical Breakdown

To describe a project of this complexity would require many pages on a pin-by-pin basis, so please allow me to run through the first digit, then point out only the differences for the second digit.

Sequencer – Heart and Brain of System

The 567 PLL decoder puts out a low for a 1000 Hz tone received, so as the dial goes clockwise, pins 3 of the sequencer and dial decoder boards go low. This low triggers the first one-shot on the sequencer board. Each IC section in the sequencer starts off with a high at all $\overline{Q}$

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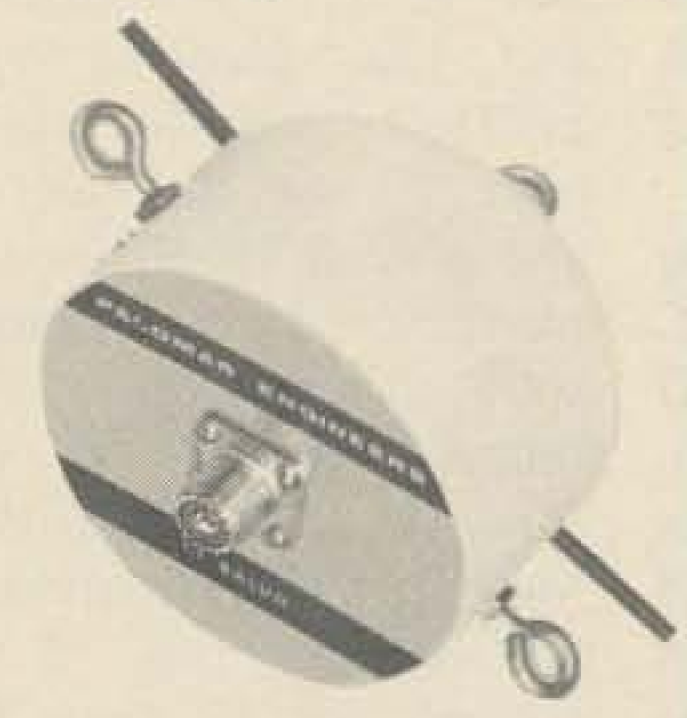

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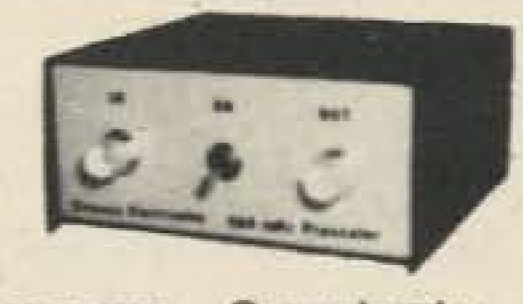

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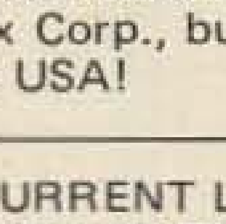

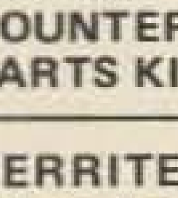

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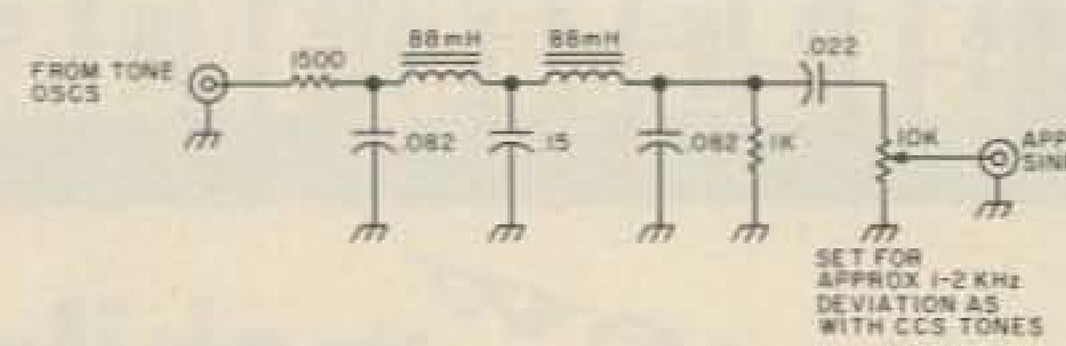

Fig. 6.

outputs and a low at the Q outputs. During each of the sequences, this reverses, such that Qa goes high and $\bar{Q}$a goes low for period A, *then* Qb goes high and $\bar{Q}$b goes low for period B, and so on. The only line then left unexplained is the IC1-3 going to $\bar{Q}$c. Pin 3 is the clear line for IC1 section A, and wiring it to $\bar{Q}$c, which is high during period A, allows the first low from the 567 to trigger section A, starting period A. When period C comes along, $\bar{Q}$c goes low and disables the retrigger feature of section A. This keeps the user's second digit from again triggering section A and starting a new sequence. Pots Ra through Rf set the exact one-shot times for sections A through F, and Ca through Cf are the Cs of the RC timing network. The Rs are all 10k thumbwheel PC mounted pots, and the Cs are chosen for the one-shot time desired. (Good starting values are: 500 to 1000 uF for Ca and Cc, 25 to 50 uF for Cb, Cd, and Ce, and 100 to 150 uF for Cf. The pots can then trim the time to the desired length.)

Dial Decoder

As the low from the 567 PLL sets the first one-shot period A, the same low is applied to IC4, pins 3 and 13. Any input line low forces these NAND gates to have a high output. Since $\bar{Q}$c is high at this time, IC4-4 is high. Qa is high so IC4-5 is high; thus only IC4-3 must return high to cause a low at the output IC4-6. This is exactly what happens during the pulse windows (no tone) of the dial returning to rest.

At this same time IC4-1 is low due to Qc being low. IC4-2 is also low due to $\bar{Q}$a being low. As such, IC4-12 output remains high regardless of the pulses on IC4-13, and the pulses only enter IC5-14 (Qc high, $\bar{Q}$a high, Qa low, $\bar{Q}$c low reverses this for the second digit during period C and one difference of the two digits is now pointed out).

The clear line of IC5, pins 2-3, is low during periods A through E, and therefore IC5 and IC9 are free to count during any of these periods (periods A and C being the ones that matter). If the readout blanking switch is turned to off, you will see each of these counts as changing BCD information (and thus readout numbers) during the dial returns.

After the period A loading of IC5 and the period C loading of IC9, period D occurs. A high on Qd, IC2-5, goes to IC13-3, a NOR gate. When either IC13-2 or IC13-3 goes high, IC13-1 goes low. A second section of IC13 is wired as an inverter to cause a high at IC13-4. This high goes to IC10 pins 4 and 13, and IC6, pins 4 and 13, the clock or transfer lines of the 7475s. Up until this clock high, the BCD output from the 7475s has been 00 or rest. Upon the clock high, the BCD outputs change directly to the loaded BCD information of their respective 7490s. In our example, the change is from 10s $\bar{Q}$a$\bar{Q}$b$\bar{Q}$c$\bar{Q}$d (0), units $\bar{Q}$a$\bar{Q}$b$\bar{Q}$c$\bar{Q}$d (0), to 10s QaQbQc$\bar{Q}$d (7), units QaQb-$\bar{Q}$c$\bar{Q}$d (3), or direct from 00 to 73.

This BCD is sent straight on to the 7442's 1-of-10 line decoders. The 10s "7" line, IC7-9, and units "3" line, IC11-4, go low.

All ten lines of the first digit (10s) and second digit (units), from IC7 and IC11 respectively, are taken to another board in our system, though that board's contents (see Fig. 8) could be built on the decoder board with IC7 and IC11. We wanted high and low decoded outputs available, and this made 20 high, 20 low, 8 input, +5 V, and ground, or 50 lines – too many for the connectors we were using. With a second board you have 10 inputs (one low), 10 outputs (one high), per IC (10s and units), for 40 lines, plus +5 V and ground, for 42 lines. Fig. 8 should be self-explanatory in that anywhere you have an input line coming in low, it leaves high, and vice versa. For our 73 example, the first digit "7" input is low entering and high leaving, and second digit "3" input is low entering and high leaving; thus only the "7" and "3" leave the inverter board as highs.

Following these two output highs to the (Row) function decoder board for 70s row, they enter the inverted first digit "7" and second digit "3" lines, and go to one pin of all the NAND gates, and to IC19-13 respectively. Regardless of whether the 7400 or 7403 ICs are used, two highs at the input

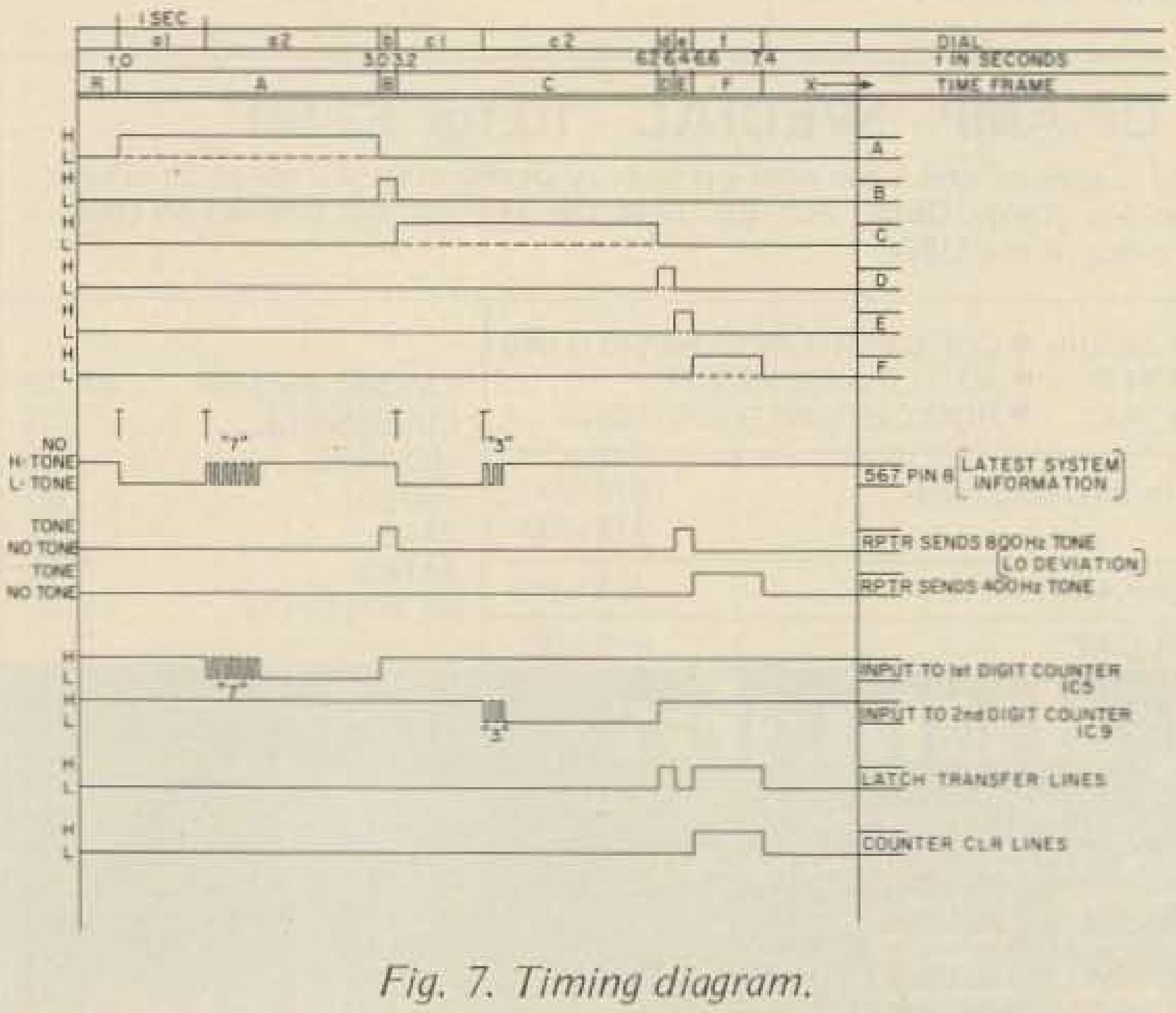

Fig. 7. Timing diagram.

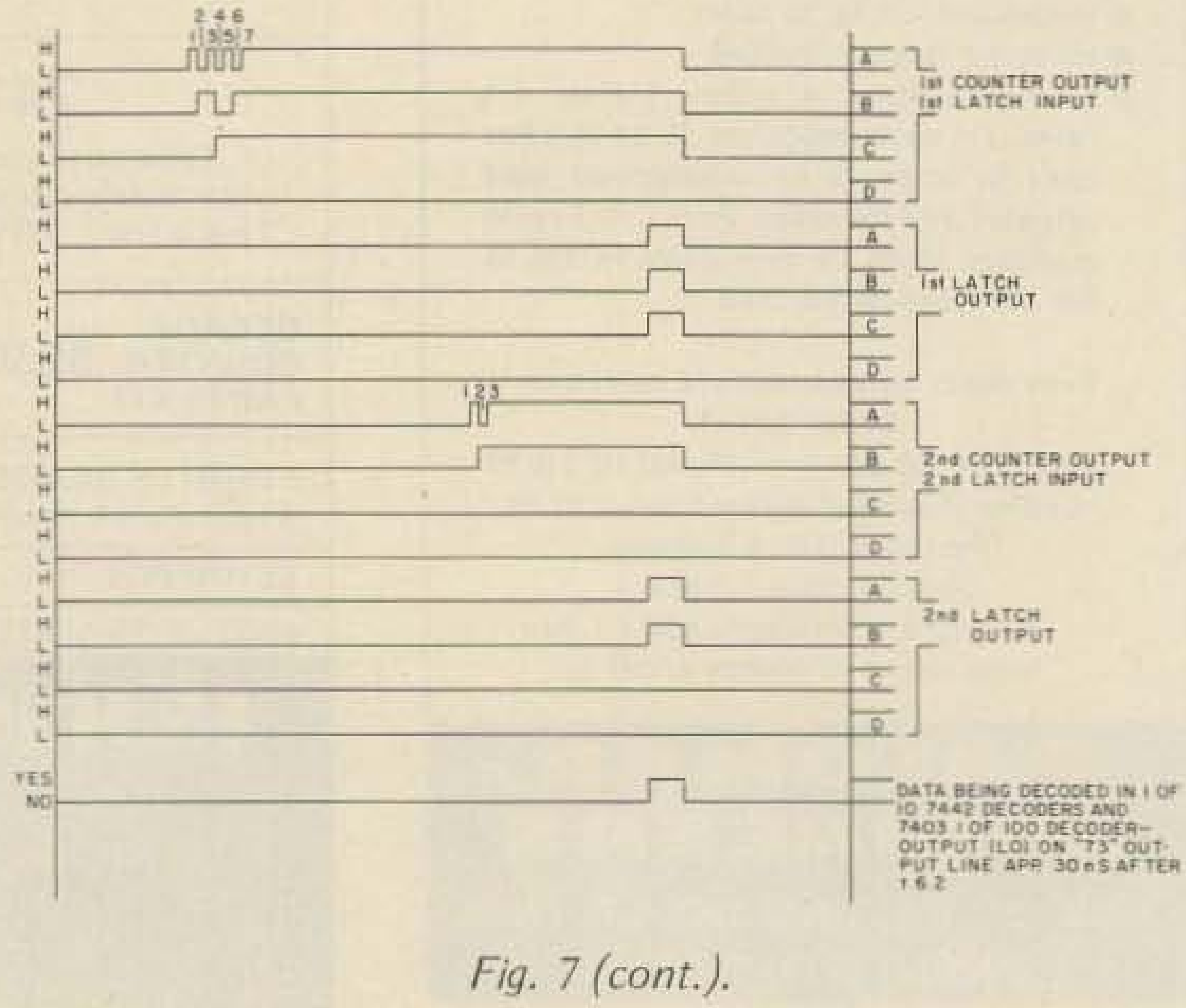

Fig. 7 (cont.).

of these gates cause a low at the output, and a low will appear at IC19-11 for a duration of slightly less than period E. You now have your 1-of-100 functions decoded.

Whether these final lows are going to drive further TTL level logic (use 7400), or drive devices such as triacs, relays, etc. (use 7403), will determine which NAND gate devices to use in the final row decoders. The 7403 has an uncommitted output device capable of sinking about 16 mA. A safer bet is to use at least a transistor buffer capable of the voltage and current you need for the relay, etc., and use the 16 mA capability lightly to just drive the transistor base. We do a little of each, so only one row decoder is shown, and it is shown less its final devices.

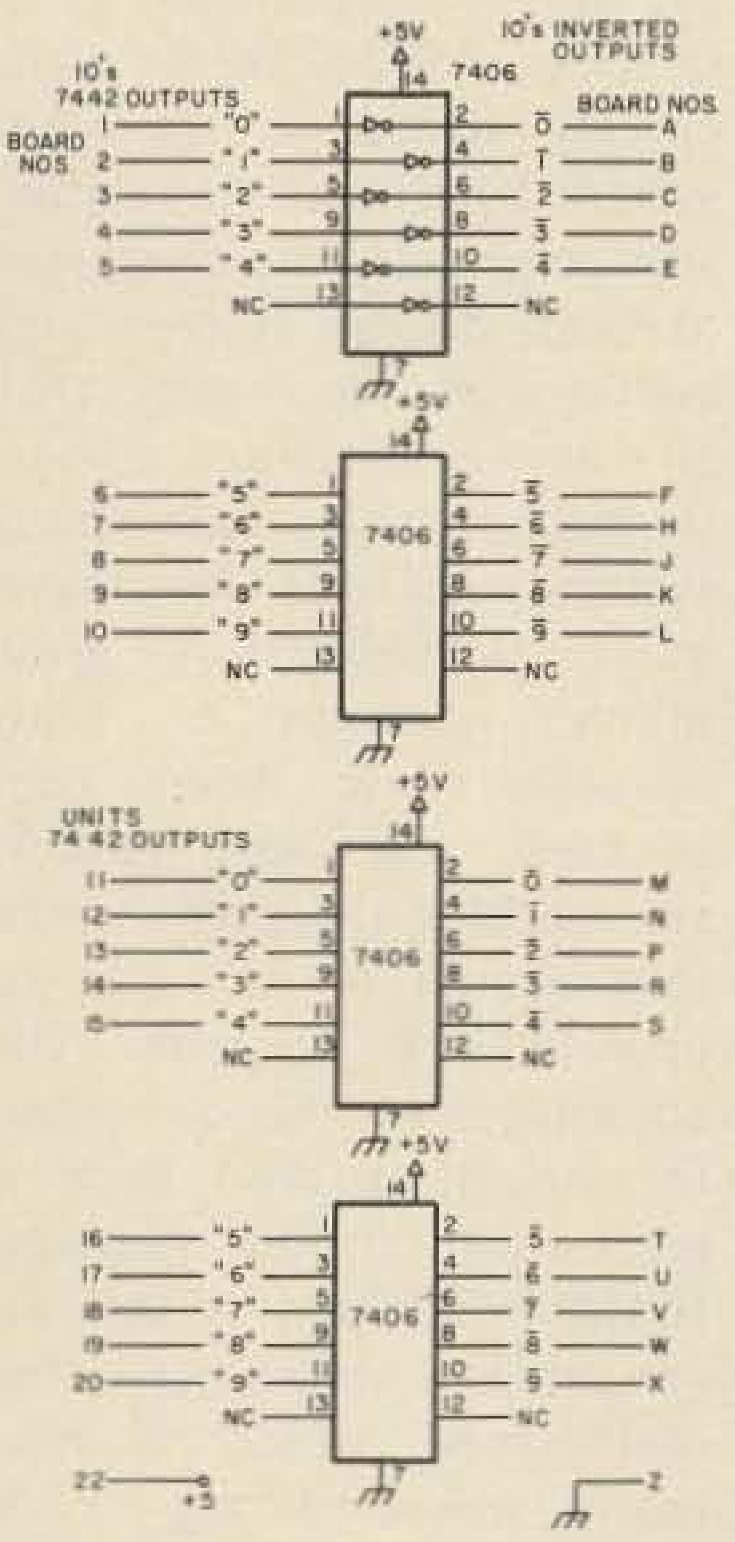

Fig. 8.

The range of devices is as varied as the things we are controlling, so none can be shown here or they would take more room than this entire article. For example's sake in the TTL device department: A 74193 and 7445 combination make up a 10 step volume control that is bi-directional. The same type pair make up a 10 step squelch control. This is our number 21-22, and 23-24 numbers for volume down-volume up, and squelch looser-squelch tighter respectively. Using a 60 series number enables a second tone decoder at a second frequency, and then 5 digit numbers can be received which represent antenna coordinates for the EME array. Example: 10165 dialed with the second tone decoder turned on by the 60 series number sent at 1000 Hz will decode as azimuth 101 degrees, elevation 65 degrees. That decoder works just like this one only there are 12 timing periods, 5-7490s, 5-7475s, and the rest from there out deleted. The BCD from the 7475s goes directly to 7485 comparator ICs that compare each number to where the beam is really at (using a coded disc on the elevation and azimuth drives), and then corrects the present location to the new dialed location in a most significant to least significant order at a different speed for each. High speed (1 rpm) for 100s, medium speed (.5 rpm) for 10s, and low speed (.1 rpm) for units, in the case of azimuth. This allows slowing down of a large mass (antennas) as it nears the desired heading.

The amount of hardware, kept mostly at the repeater site location to simplify the job for the user, has grown over five years now, and simply can't be described in a single article. Broken into several articles, I'm sure each part will find other uses – such is the way with hams. One side use at my QTH has already been found by using the teletype drive and comparator setup used for the antenna on EME coming out to a plug, so it may be plugged to more than one array. I am presently adapting it to an attic mounted 4 element yagi on 2m and crossed 6 elements on 3/4m to use mode B Oscar 7, or the 2m alone and a fixed array on 10m for A mode and Oscar 6.

Summary

That about describes how it works, and the usual SASE will get you a reply if any problems arise. I have even worked out a few ideas along other uses, such as a remote control device for devices at home while I'm away (don't care to try touchtone for *that* over the phone lines in a touchtone area!!). After I got this decoder working, I even worked out a touchtone-looking panel that sends out the dial pulses, for those of you who would rather punch than dial switch. Seriously, it makes a good push-button to serial device for other things, such as getting out just one to nine pulses whose duration (overall) you can easily vary. That's another whole article though.

There have been enough articles now to skip most of the cautions like *use a well regulated +5 V, not 4 or 6 V.* Our decoder worked the first time with the exception of the added $\overline{Q}c$ line back to the A section input clear line – an oversight on my part from working with too many non-retriggerable one-shots.

Please advise me of your uses, and may I add at this time, if you have a project that you think could be TTL digital (controlled, run, driven, etc.), please drop me a line. This is *not* a promise to design it for you, but if it corresponds to our needs, or is simple, or we have already done it but not written it up, or it is just plain intriguing and I have the time, I'll give it a whirl. Bear in mind, since the hardware answer to your idea or question will be my design, I would retain the right to write it up – build it – use it – etc. O.K.? Let's hear from you, and 73. ■

Ralph E. Taggart WB8DQT
602 S. Jefferson
Mason MI 48854

Weather Satellite Display Control

--integrating CRT and FAX displays

In a series of previous articles in *73*, I have described two basic systems for the display of weather satellite pictures. The first of these was a multimode weather satellite monitor unit using cathode ray tube (CRT) display (August, 1975) and the second was a photographic facsimile system for readout of NOAA satellite pictures (September and October, 1975). In the concluding article on the FAX system I outlined the relative advantages and disadvantages of both display systems and ended with the remark that an active satellite station should actually have both systems available for maximum flexibility. A great many versions of both systems have been constructed, and some stations are reaching the point where they would in fact like to operate both systems. The advantages of this are many for operators who copy a great many satellite pictures. If the interfacing of the two systems is done properly, the oscilloscope which is normally required for FAX picture phasing can be eliminated. The FAX component of the system can produce quality pictures in a relatively large format — and at a low cost. The CRT monitor can be used to make negatives of particularly interesting pictures for later duplication at any size desired. The monitor can also be used for APT WEFAX copy that is not compatible with the FAX recorder. This article will

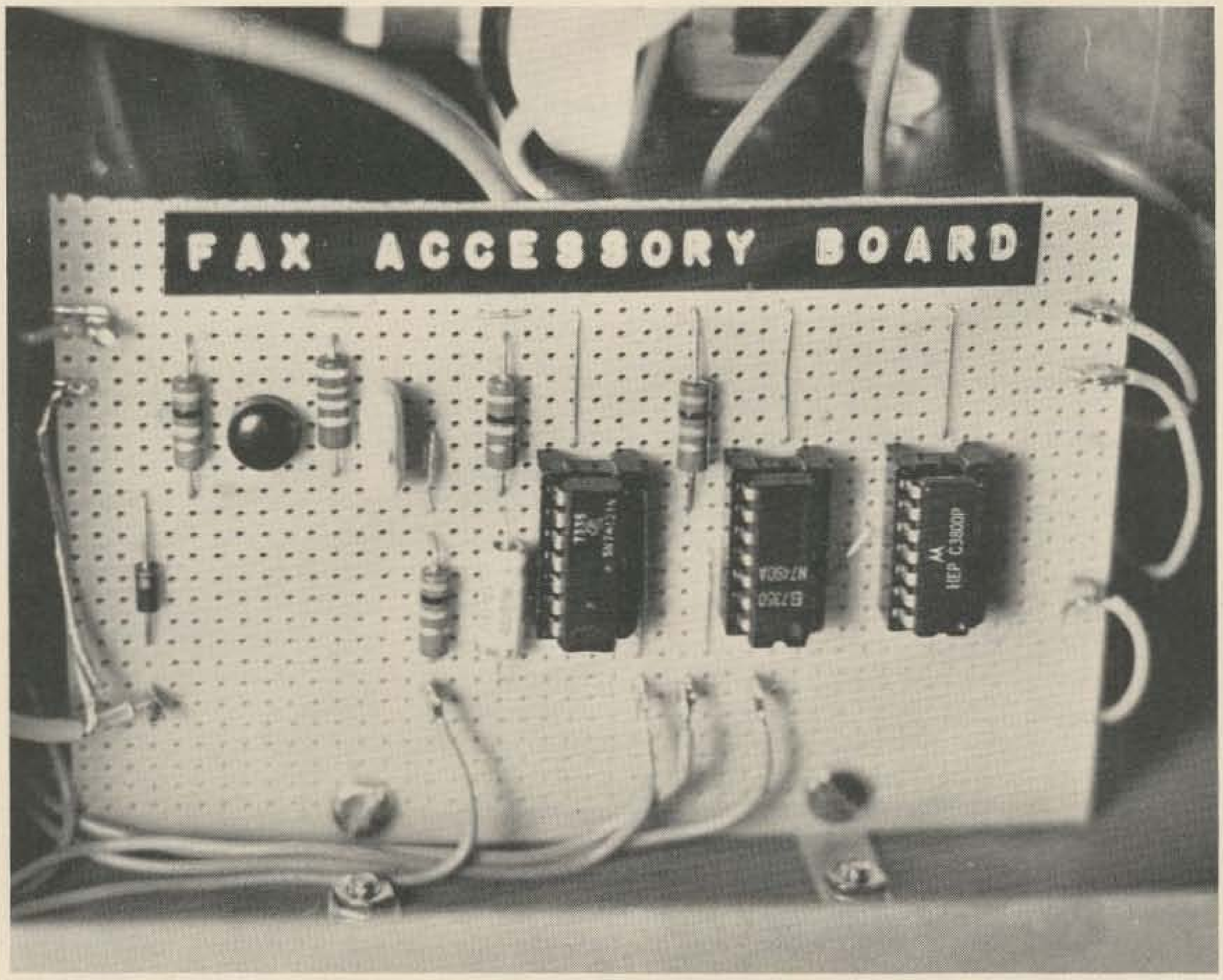

Fig. 1. Accessory FAX module installed in one of the author's multimode weather satellite monitors. A small piece of perforated board with 0.1 inch hole spacing accommodates the ICs and discrete components. Wiring the module itself takes about an hour and can be added to the monitor during or after construction.

describe a simple module that can be added to the satellite monitor to provide control of the FAX system. Pictures can be phased and adjusted on the monitor and the picture as seen on the monitor will be precisely what is printed out on the FAX recorder. The monitor can thus replace the solid state module in the FAX system, with the additional bonus that FAX printing will no longer be a "blind" operation. Simultaneous with the FAX printing, a photograph of the CRT display can be taken to provide a photographic negative for file use and later duplication in various size formats. I will also describe modifications to the FAX system that will enable you to print pictures at the 96 rpm drum rate with line blanking, thus resulting in large size pictures (averaging 5 x 7 inches for a 10 minute pass) with rolling pin sized drums. For stations who have not yet begun to construct display facilities, these modifications can be incorporated at the very beginning. If you start with the CRT system — a logical first step — FAX capability can be added at somewhat less cost than if it was a completely independent system.

If we are to tie together the operation of the CRT and FAX systems, several functions must be accomplished:

(1) The monitor must supply a phase locked 48 Hz ac signal for operation of the drum amplifier in the FAX system;

(2) Provisions must be made to trigger the monitor display from the rotation of the FAX drum;

(3) The video circuits of the monitor must drive the lamp driver circuit of the FAX system and, ideally, system levels should be such that the contrast as set on the monitor will correspond to the contrast range as printed in the FAX system;

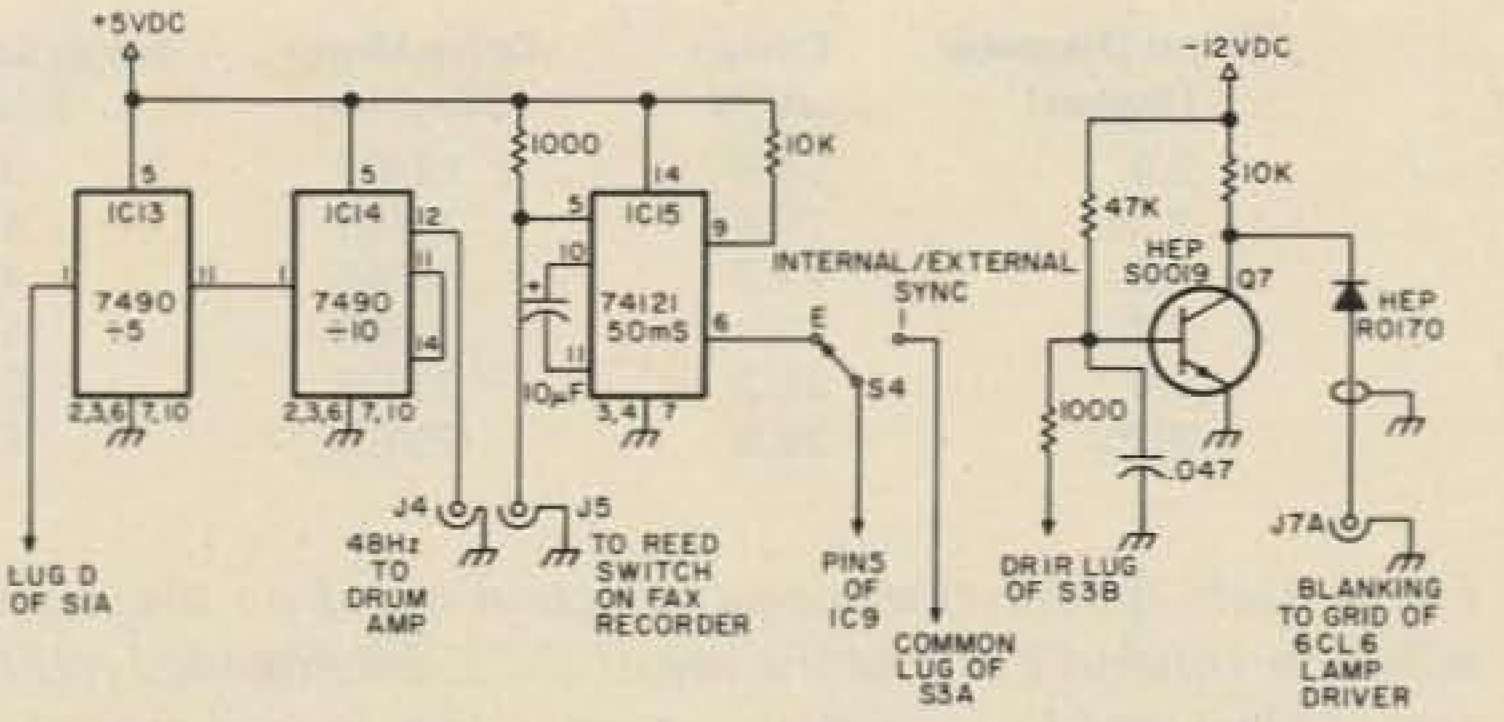

Fig. 2. Schematic of the accessory FAX module. Since the module is an addition to the basic monitor circuit, component numbers are consistent with the monitor circuit described in 73 *(August, 1975). All resistors are ¼ Watt, 10% composition. Decimal value capacitors are 50-100 V mylar tubulars, while capacitors with polarity indicated are 16 V miniature electrolytics. J4-J7A are new RCA phono jacks added to the rear apron of the monitor. S4 is SPDT toggle switch added to the front panel. Power for the module is obtained from the monitor circuit.*

4) The line blanking required to select either visible light or IR data in the monitor must control line blanking in the 96 rpm FAX system so the data channel displayed on the monitor corresponds to the FAX printout.

All of this sounds complicated, but in reality it can be accomplished by a small module consisting of three ICs and a single transistor. If this module, shown in Fig. 1, is added to the monitor, the monitor performs all of the functions of the original solid state module of the FAX system in addition to carrying out phasing and setting of proper video levels.

The schematic of the module is contained in Fig. 2 and, since it is essentially an "add on" to the monitor circuit, component designations follow those for the original monitor circuit. A sample of the phase locked 2400 Hz reference tone is routed to IC13 and IC14, providing a total frequency division of 50, which results in the desired 48 Hz output from IC14. This signal is routed to a new jack (J4) on the rear apron of the monitor, which is connected to the input of the FAX drum amplifier circuit.

Triggering the monitor display from the rotation of the FAX drum is accomplished by the small magnetic reed switch on the FAX recorder which closes once in every revolution of the FAX drum. This switch is connected to another new rear apron jack (J5) on the monitor. A lead from this jack to the input of IC15 in the module — a single shot multivibrator — results in a relatively long output pulse (50 ms) whenever the reed switch on the recorder closes. The long output pulse eliminates the effect of contact "bounce" in the reed switch, which might otherwise result in erratic triggering and blanking control. This pulse is routed to one lug of S4, a new switch on the monitor front panel which selects either internal triggering of the monitor display (normal) or external triggering from the FAX drum. In the external position, S4 routes the FAX trigger pulse to the horizontal trigger monostable in the satellite monitor, thus triggering the line display once every drum revolution.

Supplying processed video from the monitor to the FAX lamp driver is accomplished by connecting a shielded lead from the secondary of T1 to another rear apron jack (J6). (See Fig. 3.) Since the video level required to drive the lamp driver circuit is slightly less than that required for the monitor display, a 10k gain pot at the input of the lamp driver in place of the fixed 470k grid resistor permits the gain of the FAX unit to be adjusted so that proper FAX printing coincides with optimum display on the monitor.

FAX blanking with the 96 rpm format is accomplished by Q7 (Fig. 2) driven by the line blanking pulse from the monitor circuit. This transistor shuts off the lamp in the FAX recorder whenever a line is blanked in the monitor display; thus whatever channel (visible or IR) is

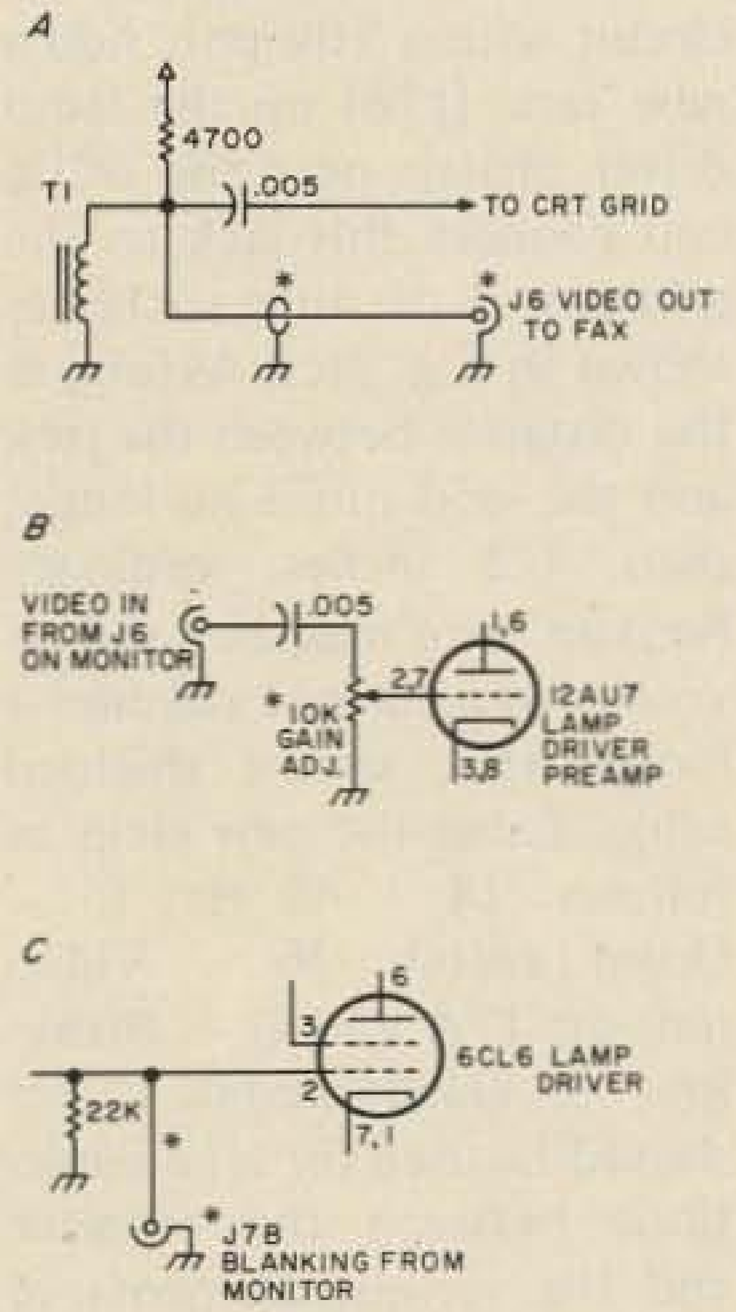

Fig. 3. (a) Video connection from the secondary of T1 in the monitor to the new video output jack on the rear apron. (b) Replacement of the fixed 470k resistor at the input of the FAX lamp driver to permit adjustment of video drive. (c) Addition of a blanking input signal (J7B) at the grid of the 6CL6 lamp driver of the FAX circuit. Asterisks (*) mark the new components.

viewed on the monitor will be printed by the FAX recorder. The signal from Q7 is routed to another new jack (J7A) on the rear apron of the monitor. J7A is connected to a new jack (J7B) on the lamp driver chassis that provides a connection to the grid of the 6CL6 lamp driver.

Construction

The new module for the monitor can be constructed on a small piece of perforated board and mounted wherever convenient for the proper interconnections to the monitor circuit elements.

The connection between IC14 and J4 and IC15 and J5 can be ordinary hookup wire, as can the wiring associated with S4. The connection between the secondary of T1 and J6 and the blanking connection from Q7 to J7A should be made with shielded audio cable, as these are high impedance connections and hum introduced here would appear on the monitor display or FAX printout.

Replace the fixed 470k resistor at the input to the 12AU7 in the lamp driver circuit with a 10k pot. Add a new jack (J7B) on the lamp driver chassis near the 6CL6 and connect this jack to the grid pin of the tube socket as shown in Fig. 3(c). As long as the distance between the jack and the grid pin is no longer than 1-2 inches, ordinary hookup wire may be used. If your chassis layout requires a longer run, use a shielded cable. Label the new jacks as follows: J4 – 48 Hz; J5 – Drum switch; J6 – Video output; J7A and B – Blanking. Shielded audio cables should be used for all connections between the monitor and the various elements of the FAX system.

The major element in the construction of the integrated system is the conversion of the FAX recorder to a 96 rpm format. There are two ways to accomplish this if the recorder has already been constructed for the 48 rpm format. The cheapest alternative, provided you have access to gears, is to install a 1:2 gear system between the traverse motor and the threaded rod and between the drum motor and drum shaft. This will up the drum speed from 48 to 96 rpm and will achieve the required doubling of the traverse rate which is required to preserve the proper aspect ratio at the new drum speed. If you are the mechanical type this is probably the easiest solution, but, if you are like me and abhor mechanical devices, the simplest alternative is to purchase a set of new motors. A Hurst series CA motor rated at 120 rpm at 60 Hz will provide the proper 96 rpm speed when run at 48 Hz. This motor will mount with no fuss on the mounting plate for the original 60 rpm drum motor. As in the original 48 rpm version, the selection of the proper traverse motor is dependent upon the diameter of the drum, if we are to achieve something close to the proper aspect ratio. The original article on the FAX system provided tables for selection of a traverse drive motor based on 48 rpm operation of the drum. Fig. 4 provides the same data for 96 rpm operation. The new motors are drop-in replacements for the types originally specified for 48 rpm service, and no modification of the traverse motor mounting system should be required. You can save some money and frustration caused by back orders if the motors are ordered directly from the Hurst factory. They welcome small orders and will ship immediately from stock even on phone orders. Contact the Hurst Manufacturing Corp., Princeton IN 47670, or call 812-385-2564. They are nice people and it is kind of amazing to run into an outfit that acts as if it wants your business!

Drum Diameter (Inches)	Design RPM	Drive Motor Selection	Earth Scan Width (Inches)	Picture Length (10 minutes)
2.0	13.8	12/60	3.8	6
2.25	15.4	20/48	4.2	8
2.5	17.2	20/48	4.8	8
2.75	19.0	20/60	5.2	10
3.0	21.2	20/60	5.6	10
3.25	22.0	20/60	6.0	10

Fig. 4. Data for traverse motor selection based on the diameter of the FAX drum. The motor selection column assumes the use of the ¼-20 threaded rod for the traverse drive, as specified in the original article. The design rpm is the desired traverse motor speed for optimum aspect rotation at the specified drum diameter. The motor selection column represents the closest approximation of this speed that can be obtained from stock motors (Hurst DA series, either 12 or 20 rpm at 60 Hz) operated off the 60 Hz line or the 48 Hz drum amplifier supply. The earth scan width represents the width of the actual earth scan in either the visible light or IR channel, and the picture length is specified on the basis of 10 minutes of a pass using the traverse motor specified in the motor selection column. Note that for drums between 2 and 2.25 inches the image will fit – when properly phased – on a piece of 5x7 inch photographic paper. Larger drums will require 8x10 inch paper if all of the earth scan or at least 10 minutes of the pass are to be displayed.

Setup and Operation

Obviously if you already have the FAX system going as originally described, your major task will be to build the monitor and get it going. The August, 1975, article in *73* will be your guide here – simply add the module to the circuit during construction. Follow the article for checkout procedures, being careful to keep the new S4 (internal/external triggering) in the internal position for all monitor setup adjustments. Modifying the recorder to 96 rpm is the next task, followed by interconnection of the monitor and FAX systems. Note that the monitor is now performing the functions of the solid state module, as well as providing a display for phasing and video gain adjustments – something that the solid state module did not accomplish. You might as well keep the original solid state module circuit elements on hand, for they are useful in the 96 rpm mode if you farm out either the FAX or monitor and have to run the FAX unit independently.

If you have the monitor on hand and are adding the FAX capability, follow the general description in the original article (except for the substitution of the 120 rpm CA series motor for the drum) and choose your traverse motor from the table in Fig. 4 of this article. You can omit the solid state module unless you wish to have it on hand for possible independent operation of the FAX unit. Proceed with the applicable instructions for checking the mechanical aspects of the FAX recorder and initial setup of the lamp driver and drum amplifier circuits. The following instructions for final setup will be slightly redundant for those stations that already have the FAX system in operation, but are provided for those who are adding FAX

capability for the first time:

(1) Turn on the monitor and set it up for normal NOAA display (the DRIR position).

(2) Apply power to the drum amplifier and lamp driver chassis, making sure that the lamp switch is off.

(3) As the circuit warms up, adjust the input level to the drum amplifier for 120 V ac across the motor windings (the drum should be clipping along if the drum motor switch is in the run position).

(4) Place a voltmeter across the drum reed switch and verify that it is closing once every revolution. If not, adjust its position in relation to the magnet on the drum until it does.

(5) With the FAX drum running, switch S4 to external, and the monitor should now be triggering from the drum.

(6) Play a satellite tape into the monitor and adjust the video gain for best contrast. Phase the picture as usual to verify that phasing operates normally when the display is triggered from the drum.

(7) With the picture being displayed in the normal manner, observe that the picture stays locked horizontally when triggered by the drum. Any tendency of the display to "wander" indicates that the drum is not holding sync. Provided that the mechanical checkout of the drum assembly indicated that the drum was not binding, carefully adjust both the drum amplifier level pot and the bias to the drum amplifier (6DQ5) to eliminate sync instability. The proper drum motor voltage will usually fall somewhere between 90 and 120 V ac. Adjusting the amplifier bias alters the 48 Hz waveform and by working both controls you optimize both waveform and voltage so that the drum will hold sync reliably. Once set, these controls will require no further adjustment.

(8) With the monitor picture showing normal contrast, turn on the lamp switch on the FAX recorder. The meter in the lamp driver circuit should bounce around in response to the video signal, and the lamp brightness should change in response as well.

(9) If you already have experience with the proper levels required for FAX printing, set the new input gain pot on the lamp driver chassis to approximate this proper swing. If in doubt as to the precise level, set it for a bit more current than normal, since you will be printing at a faster drum speed. If you have no previous experience to go by, set the input level pot so that the meter is peaking midway between zero and your black level setting.

(10) Turn off the recorder and look at the current indicator in the lamp driver circuit. It should be flipping back and forth from zero to black level, indicating the proper operation of the line blanking circuit.

If all has gone well to this point, you are ready to print a picture. If you have not already done so, mark a line on the drum to correspond to the position of the light gun when the drum magnet is opposite the reed switch. This line will serve to locate the edge of the paper when it is attached to the drum assembly.

The original article on the FAX system outlined the general requirements for photographic paper, safelights, etc. Extensive experience printing with the 96 rpm FAX system has shown that resin-coated bromide papers (such as Kodak Kodabrome RCM) are ideal. This paper can be handled under dim red safelight illumination and two safelights – one at the operating position for loading paper and watching meters and the other at the processing station – are ideal.

Under safelight illumination, mount a piece of photographic paper on the drum using doublestick tape. Position one edge of the paper parallel to the line you have marked on the drum. Fire up the monitor and FAX system and set S4 to external. Play the satellite tape through the monitor and phase the

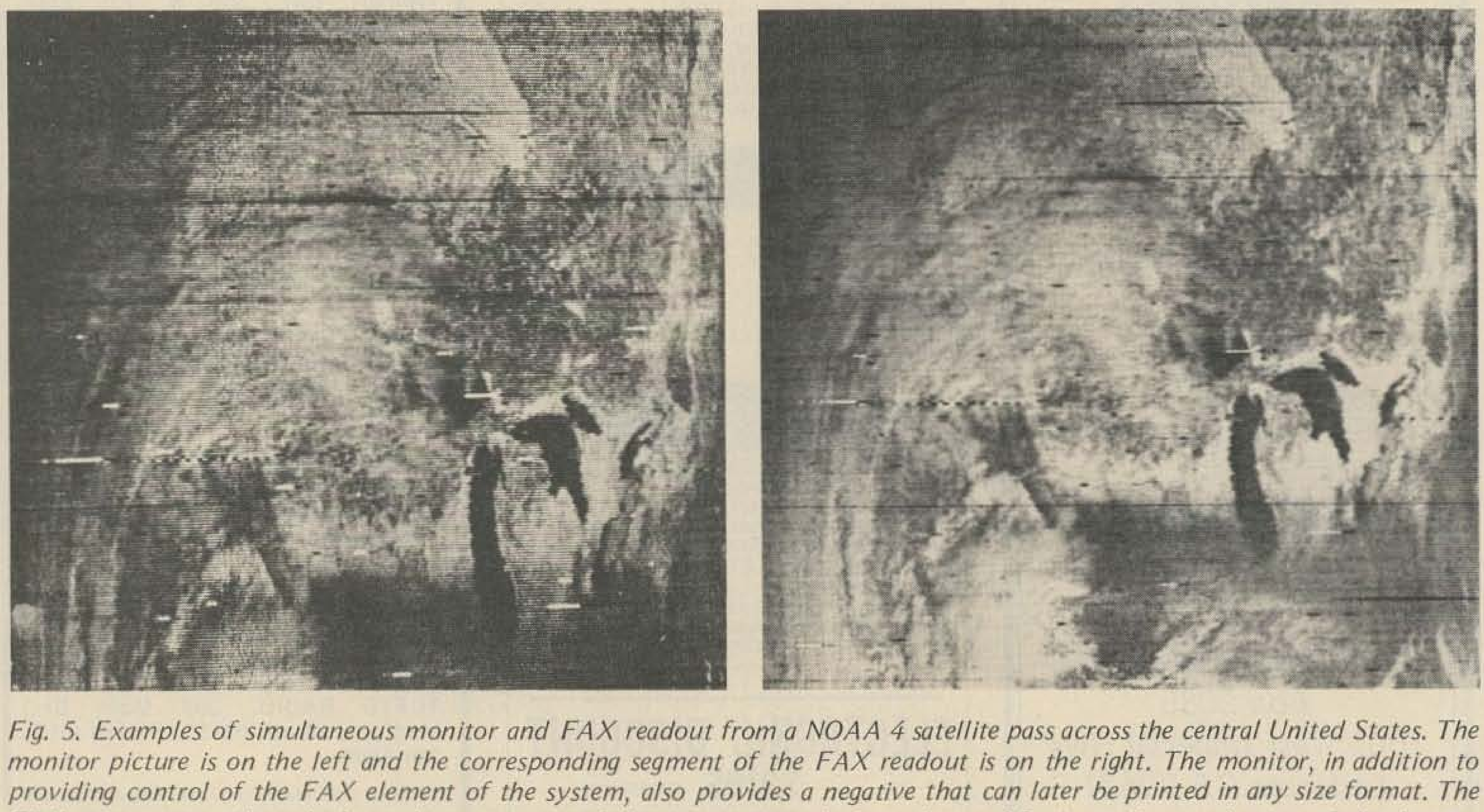

Fig. 5. Examples of simultaneous monitor and FAX readout from a NOAA 4 satellite pass across the central United States. The monitor picture is on the left and the corresponding segment of the FAX readout is on the right. The monitor, in addition to providing control of the FAX element of the system, also provides a negative that can later be printed in any size format. The FAX printout provides a high resolution picture of the entire pass, which can be used for immediate evaluation of cloud cover. The monitor also provides for picture readout in other modes that are not compatible with the NOAA FAX recorder.

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pictures from the ATS satellites, a mode that is not compatible with the NOAA FAX recorder.

Although having both CRT and FAX readout may sound like an extravagance, the monetary investment in the two readout devices is actually considerably less than having a monitor and camera for SSTV operation, for example. Like everything else, if you are hung up on a particular mode of operation you eventually reach the point where it is simply not enough to just operate that mode — you want flexibility and convenience as well. If you intend to occasionally read out a satellite picture, then the monitor with its multimode capability is the route to go. If you simply want to watch NOAA satellite readout and have a scope available for phasing, then the simple FAX system will do. As noted in the original article, a 48 rpm system can even be operated without phasing! The best FAX option of all is the 96 rpm format and, even if you do not intend to use a monitor, this article provides the needed design data for this mode of operation. If you find yourself dedicated to weather satellite activities of all sorts, you had better file this article with the data on the monitor and FAX system — you are likely to find that you ultimately will want to go the whole route! ■

Fig. 6. The author's satellite station, where the monitor (upper right) and FAX display systems are integrated into a single display system. The actual FAX recorder is on the upper shelf to the right of the monitor. The lamp driver and drum amplifier circuits are on the chassis on the lower shelf next to the SB102. To the right of this chassis is a chart recorder (Heathkit), which records satellite signal levels during unattended station operation.

picture. Close the lamp switch in the FAX circuit and start the traverse motor. As the picture is printing on the FAX recorder, you can watch it or even photograph it from the monitor display. When the vertical scanning reaches the bottom of the monitor screen there should still be unexposed paper on the FAX drum, so simply recycle the vertical sweep and continue to watch the display until your recording is finished or until you run out of paper on the drum. Notice that any abnormality in the operation of the drum will be immediately apparent on the monitor display, which saves you the wait until the end of the recording (plus processing time) to discover that the system has glitched.

When the pass is finished, process the paper, and you should see the facsimile version of the picture you saw on the monitor. If the FAX print is too dark after normal processing, increase the gain at the input of the lamp driver. If it is too light, decrease the gain slightly. Eventually you will arrive at a setting of the gain pot where the picture on the print matches the monitor display — at which point you should resist any further urge to tinker with it!

Fig. 5 shows a comparison of simultaneous monitor and FAX display from a NOAA 4 satellite pass. Fig. 6 shows my own equipment set up for operation. Normally I use the FAX print for immediate evaluation of cloud cover, and take photos of the monitor readout to provide negatives for the file. These file negatives can be used to reproduce pictures in any size format. The monitor is also used to display APT WEFAX

by Wayne Green W2NSD/1

I/O EDITORIAL

THE EDITORIAL DILEMMA

A letter from Donald Peasley of Wrightwood, California is typical of perhaps a dozen letters so far received. I realize that this is a matter of importance to possibly as much as half of the *73* readers, so it is not something to be swept lightly under the table.

I held a Novice and Technician ticket in 1968 but wasn't active because of other interests taking more of my time. Last year I again became interested in amateur radio and decided the best way to become informed and renew my interest and knowledge was to subscribe to a radio magazine. I chose 73 because a ham friend recommended it over other magazines. Well, I did subscribe, but in the short year that I have received it, the magazine seems no longer interested in new radio hams, *because of the type of articles. Also, the whole magazine is rapidly becoming a computer book. The number of articles on computers, etc., is overshadowing the articles touching on ham radio (Aug 76 issue: 12 computer articles, 8 radio-oriented articles). The way I see it is that the computer magazine "Byte" wasn't successful, but you still feel you have to push it on other people, so you add one more computer article each issue. Soon 73 will no longer be able to be called an amateur radio magazine, but a computer magazine. WHY? Just like a smoker forces his habit on nonsmokers by blowing his fumes around, why must an editor of a magazine use his* power *to influence a magazine since he is hung up on this particular phase of electronics? Can't you be convinced after one computer magazine didn't make it that* all *aren't that hooked on computers? Please give 73 back to amateur (ham) radio subscribers and let the computer experts get their information from other sources.*

I would be most surprised and pleased if the next issue of 73 I received *did* not *have a computer* section. *I would rather see a section for potential ham operators and those hams not 25 years in the hobby — something a newcomer or potential ham would understand and help them to become more entranced with ham radio. Let's not scare everyone away with all your computer articles, but give the magazine back to amateur radio as it was originally intended.*

Donald Peasley
Wrightwood CA

There are several points that deserve answers. Firstly, I agree with Don that there have not been enough articles of value to the newcomer in *73*. I've written some editorials asking for such articles to be written, and a few have shown up, but all too few. I'd like to see four or five good articles for Novices in each issue . . . articles on how to get higher grade licenses, how to pick a rig to use with the new rules, how to work DX, what kind of antennas to put up, what activities are available for the newcomer in the way of traffic nets, certificates, etc. I can get CBers to take a look at *73*, but if there is nothing in the magazine which will inspire them or help them get a ham ticket, both *73* and amateur radio are the losers.

Okay, now about computers. Yes, there have been a number of articles in *73* on the subject . . . most of them very much ham-oriented, but a few were just general theory to help amateurs understand the fundamentals of this new field. Since microprocessors are going to be built into more and more ham gear, I would be doing the readers a terrible disservice if I were not to publish enough articles to allow them to keep up with this fantastic development. I recognize that there is a strong temptation to bury one's head in the sand and hope that large scale integration will go away. Microprocessors are here and they are going to grow on us, no matter how wistfully we look back on the good old tube days.

It is interesting to note that despite the incredible growth of the computer hobby field, almost all of the serious microcomputer applications have been in amateur radio. Ask any ham who has attended a convention or big hamfest this last year which of the exhibit booths were the most crowded . . . and you'll learn it was the computer exhibits.

As far as *Byte* magazine goes, to the best of my knowledge it is doing okay. I note that other hobby computing magazines seem to be prospering . . . *Interface, Microtreck* is due to come out soon, *Megabyte* is rumored to be starting soon, *Kilobyte* (tentative name) is scheduled for debut this fall. To say that I have no connection with *Byte* is an understatement . . . note the article in the latest *Byte* extolling *CQ*'s virtues and trying to pretend that *73* doesn't exist. No, *Byte* was most successful . . . my estimate is that it was worth about $500,000 or so not long after I started publishing it.

There will be less computer material in *73*, but probably not for the reasons you might think. Firstly, it is darned difficult to get good fundamental articles for the magazine . . . there are too few people who know the subject well enough to write. Then, with our starting another computer hobby magazine this fall, there just won't be that much left for *73*. We'll continue to run as much ham-oriented uP material as we can, but unless there is a big change, there won't be as much as I think we should have.

Hams getting interested in uP would do well to look at the computer hobby magazines since uP and hamming are firmly entwined. The nice thing is that once you have a microcomputer, you cannot only use it to do all sorts of things with your ham station, but it will also play games, run a small business, or do almost anything else you can imagine. *Kilobyte* promises to have a lot of ham/computer articles.

One more thing, Don . . . the great bulk of the mail coming in has been very enthusiastic about the I/O section of *73*, so I don't know how much of a body of the readership you represent. Articles like that one by Don Alexander in August are a lesson to all old-timers who are afraid of ICs.

I can sympathize with anyone who finds microprocessors a bit frightening. Not only is this new subject a complex one, but the information is very difficult to get in any easy to understand form . . . which is why I've been trying to get articles . . . and why I started *Byte* last year. Heck, I still can't understand many of the uP ads. How these firms are able to sell anything at all is a mystery to me. I've read and talked enough about computers now so I understand the fundamentals . . . RAMs, ROMs, CPUs and such . . . I've even put a computer system together and got it working . . . still I'm lost when it comes to trying to figure out what some manufacturers are actually selling, what it will do and what else I need with it or will work with it.

To sum up . . . we do need articles for ham beginners . . . and we need material for computer/ham beginners. How about it?

10,000 MILES

A year ago I made a trip to visit the manufacturers of hobby computers and reported in *73* on my findings. At that time there were three . . . MITS, Sphere and Southwest Technical Products.

The field has grown a bit during the last year and it seemed like a good idea to update my visit exactly one year later . . . this time with a visit to MITS, Sphere, Southwest Tech . . . plus Jolt, Imsai, Apple, M&R, Godbout, Morrow, Wave Mate, and Intelligent Systems. It was a most interesting trip.

The manufacturers of hobby computers come in all sizes, from great big plants down to a corner of a garage. My reception ranged from the most formal of interviews and a refusal to let me take pictures at Imsai to a flight up to Santa Rosa for dinner by Godbout and an all-day rag chew with Ed Roberts of MITS, complete with some looks at his most tightly guarded developments.

The increasing number of ham applications for computers had gotten to Ed Roberts, and he was hard at work to get his ham ticket . . . look for him soon on 20m doing some DXing and undoubtedly in there with RTTY, computer assisted. Not a few of the computer hobbyists are getting into hamming these days.

One of the newest of computer firms is Apple. This is run by two youngsters (maybe 20?) out of one end of a garage in Los Altos. Despite the humble facilities, the system they've created is worthy of serious consideration and I'll be covering it in some depth in *Kilobyte Magazine*. Their main efforts, at the time of my visit, were on the development of programs for the system. This was about the same for almost all of the firms I visited.

CB activity in the Western reaches is much less than I expected. And though I had two meters with me too . . . and made a lot of fine contacts . . . I found CB invaluable for finding my way around strange places and avoiding traffic problems.

Jolt has a very interesting computer setup . . . a most interesting design . . . and I suspect that it is only a lack of general knowledge about it that has kept their sales down. I really can't put them down for that, since I honestly can't point at any manufacturer in the whole industry who has literature which is aimed at what I see as the main market for this equipment . . . the beginner. I wouldn't be surprised if the first firm to come out with really easy to understand literature might not find themselves in a runaway situation, trying to keep up with the flood of orders. There are an awful lot of people out there who think they want a computer, but who are unable to figure out what system they need . . . or how much it will cost. And a lot of people get mulish when faced with signing a blank check.

You'll be seeing a lot more about the Astral 2000 system . . . M&R . . .

Continued on page 187

THERE IS NO QUESTION

Our computer is a bore—

There is simply no point in trying to hide it, everyone is going to find out sooner or later anyway. The Southwest Technical Products 6800 computer is a big bore. Discussions with customers and dealers have confirmed our worse suspicions.

At first people thought that perhaps owners of our system were just a bit shy because they were outnumbered at local computer club meetings. But then as the number of owners rose it became clear that this was not the problem. And it wasn't that they were unsociable or anything like that; they were simply just bored because they had nothing to talk about.

Here they were, just sitting there while all the other members with other brands of computers exchanged data on circuit board errors, secret schemes of adding extra bypass capacitors to make the thing reliable, tricks to keep the clock phases from overlapping, corrections to manual errors and other fun subjects. Can you imagine the frustration this caused? All our customers could do was to sit and be bored. They had nothing to talk about.

Our 6800 has an internal monitor ROM that automatically puts the bootstrap loader in memory and refers control to the terminal, when you power up. This feature deprives you of the chance to tell sad stories of how many times you had to go back and flip the console switches before you got the loader program in right. Since you can do machine language programs directly from your video terminal or teletype in hexidecimal form, you will not have a chance to exchange horror stories with your friends about how you forgot the last zero when you entered 10100110 from the console on your 374th Byte and messed up the program that had just taken you two hours to put into memory. It just isn't fair.

Since we use full buffering on all data, address and control lines on all boards in our system and since we use low power 2102 static memories in our system, there are no noise sensitivity problems that can lead to hours of fun trying to figure out why a program "bombed". Dynamic memories that some others use can drop bits, fail to refresh random cells, cause programs to do crazy things by going into a refresh cycle at the wrong moment and all kinds of interesting things. Our poor customers will never have a chance to have these interesting experiences.

Even our documentation and software is no help. Not only do we have the most complete and thorough set of instructions available for any system, we are supplying software either free, or at crazy low prices. Our big documentation notebook for instance is just full of information on the system. There are complete sections on software with sample programs and information on programming. We have no assembly instructions in that big yellow notebook. They are packed with the kits themselves. The notebook is completely devoted to instruction on using your computer system. You are therefore not going to be spending day after jolly day trying to find out how to put a program into your machine; researching all available outside literature in an attempt to discover just how you write software for the beast. Sorry about that folks, we didn't mean to spoil all your fun.

So please, have a heart, when you see those poor lonely souls that have purchased our systems say "hello". All they have to keep them interested in computers is writing and running programs. Our editor, assembler, 4K and 8K BASIC programs work so well that even this is quick and easy. So be kind to those poor bored SwTPC-6800 owners, it's not their fault that they have nothing to talk about.

SwTPC 6800

Computer System

with serial interface and 2,048 words of memory. $395.00

☐ **I don't like puzzles anyway and have no free time to be bored so send information on your 6800 computer system and peripherals.**

☐ **Thanks for warning me. Send names of manufacturers of "interesting" computers.**

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ADDRESS ______________________________

CITY ______________ STATE ________ ZIP ________

Southwest Technical Products Corp., Box 32040, San Antonio, Texas 78284

I/O REPORT

by John Craig

I/O HELP

Received an interesting letter from Kenyon Karl in which he suggested we start an I/O Help column in the I/O section to complement the Ham Help column. He would like to get the ball rolling with this entry: "I can help with the writing and debugging of BASIC programs for your microprocessor system. I write COBOL programs (another high-level language . . . but for larger machines) for a living." – Kenyon F. Karl, 36 Prospect Street, Waterville ME 04901.

THE HOMEBREW COMPUTER CLUB

I recently made a run up to the San Francisco area to check on the Homebrew Computer Club. Not only are they a dedicated bunch (they meet twice a month) but they also have some of the sharpest talent in the country (which stands to reason since they're right in the heart of the "Silicon Valley"). The meetings are held at the Stanford Linear Accelerator Center. Stanford has a "no selling" policy, so there were about half a dozen systems set up for demonstration only (which precludes the flea market seen at most other club meetings). The iron hand of Lee Felsenstein (designer of the Pennywhistle Modem and other goodies) conducts the meetings . . . and with over 300 people in a room it helps to have someone keep things under control! One of the most interesting aspects of the meeting came when adjournment was announced. About two hundred fanatics rushed the podium to get first grabs at the stacks of pamphlets, data sheets, product descriptions, and flyers which were placed on the stage. (For an anxious moment I thought Felsenstein was about to meet his Maker!)

Marty Spergel of M & R Enterprises gave me a tour of his new baby, the Astral 2000. The Astral is a 6800-based system which has some really fantastic hardware features and powerful software to make it more than "just another computer coming on the scene." We should be getting one of these units for evaluation in the near future, so keep your eyes open for the write-up . . . it should be a corker!

Another system which has a high interest level among hobbyists is the PACER, built around National Semiconductor's PACE. Project Support Engineering of Sunnyvale, California, had their PACER doing its thing at the Homebrew meeting. I expressed an interest in doing an evaluation of the unit and they responded by sending me one within two weeks. It's sitting across the room waiting for me. We'll have a New Products write-up on it soon and give you some thoughts on the processing power of a 16-bit machine (versus the 8 bits we're used to).

RAP SESSIONS

While up in San Francisco I also had the opportunity to sit down and do some elbow-bending and jawboning with Jim Warren (of *Dr. Dobb's Journal*) and Bob Reiling (Homebrew newsletter editor). I also had a visit for an entire afternoon from Sheila Clark and Art Childs (editor and ex-editor of *Interface*, respectively). One of the common denominators of these conversations was the common agreement that the direction of home computer systems will be towards entertainment and education applications, with very little emphasis on exotic control applications (turning on the sprinklers, monitoring the environment, security systems, etc.) that we've heard so much about. The amount of hardware (and hardware expertise) to implement a 24-hour monitoring system would be considerable. Then, of course, the amount of electricity such an application would require would be something to consider. If these control applications are going to be handled by a computer they will have to be accomplished using a dedicated microprocessor-based controller.

FURTHER REFLECTIONS ON SMALL BUSINESS SYSTEMS

In last month's I/O Report, I mentioned the possibility of putting together a "dumb" key-to-tape data entry terminal which could be used for storing data and transactions on a cassette. The cassette would then be picked up (each evening) for processing at a central computer (the one in your home). Another important capability a small business would require would be the ability to retrieve data during the day (e.g., if a customer calls up and asks what his balance is, the secretary should be able to walk over to the terminal and get the information . . . rather than having to look it up in the files). Therefore, it's beginning to look more and more as though a "smart" terminal (one which contains a microprocessor) will be the answer for an application such as the one I've described.

I'm presently putting together a talk for a seminar at the Personal Computing '76 convention in Atlantic City. The seminar will be entitled, "The Outlook For Low Cost Small Business Systems," and it looks as though I'll have to emphasize what the future holds for small business systems, rather than what the present has to offer. It seems that there are several people working on the development of these systems around the country, but everyone is in the same boat . . . he has the hardware but the software is still a gleam in his eyes. There's an awful lot of it to be developed. The whole thing needs to be developed around a "people-oriented" executive program which will accept commands from the operator and run the other programs which make up the system. These other programs would include inventory control, accounts receivable, payroll, customer mailing lists, and text editing for generation of letters, just to name a few.

It occurs to me that the possibility exists for development of this software by several groups or individuals scattered across the country. If modular programming techniques were employed, and the developers were to agree upon the structure and commands of that executive program, it would seem that the individual programs could be integrated into a whole system. The only reason I even bring up such an idea is to help reduce the cost of software development – and thereby sell systems that cost less. (If I were a programmer and had just finished a year and a half developing all of those programs mentioned above, I certainly wouldn't want that software sold for anything less than a large chunk of money.) I'm fully aware of the fact that such an undertaking would require a certain amount of coordination and leadership from the person (or persons) "in charge" of the effort. If that person (whoever he is) wrote an article detailing the plan, he could probably get enough of a response from interested programmers to turn the thing into a reality.

CORRECTIONS AND ADDITIONS

Dick Whipple and John Arnold have discovered a couple of minor corrections to be brought to your attention regarding their "Baudot Monitor/Editor System" in the August issue: 1) In the fifth paragraph from the end, the output routine address should have been 001215 instead of 001205 (the address of the output routine shown in Table 4 is correct). 2) Location 000104 should be changed from 215 to 320 octal (as it was, a "?" would be printed in the wrong case when an unknown command was entered).

Dick reports that he is getting a steady stream of orders and inquiries concerning the BM/E article. Several people have called long distance to talk with him about it, and it appears interest among hams is beginning to pick up. His next article, on the amateur version of Tiny BASIC Extended, will be coming up in the near future.

We've received several comments on the fact that the listings for the PROM were not included in the article on "A Morse to RTTY Converter" by WB6SQU in the June issue. We have a policy here at *73* to make every attempt to insure that construction articles are complete. Therefore, you'll find a copy of those listings in this column. Stanley Levy WB6SQU was kind enough to make them available, but he also pointed out that a number of people have purchased the listings (as per the article) for $3.50. If you're a member of this group, *73* will be happy to give you a *$4.00* credit toward the purchase of any *73* publications, cassettes, or subscriptions (just send us a receipt or copy of your cancelled check). Incidentally, the new address of Levy Associates is PO Box 514, Monrovia CA 91016.

ON–LINE

Many moons ago when I was involved with the *Micro-Eight Newsletter*, I did a short write-up on a newsletter just coming on the scene called *On-Line*. With the passage of time, it turned out to be one of those things which fall by the wayside, and I never got a subscription. The other day I received a complimentary issue and now see what I've been missing. It's neat!

Each issue of *On-Line* contains 6 to 12 pages of classified advertisements devoted entirely to the computer hobbyist. It looks like a pretty good way to pick up or sell used gear. And a dollar for four issues is quite reasonable. Contact D. H. Beetle, Publisher, 24695 Santa Cruz Hwy., Los Gatos CA 95030, if you're interested.

MORSE CODE-TO-BAUDOT PROM LISTINGS

Following are listings for the PROM mentioned in "A Morse to RTTY Converter" (June, *73*). Stan Levy WB6SQU pointed out that the listed addresses are "system addresses" (i.e., used during development) and correspond to locations 000 through 1FF in the PROM. The addresses within the program do not need to be changed, since the PROM is addressed by only the nine least significant

Continued on page 177

Ham Time-Sharing is Here for You!

-- via a repeater

Bruce J. Brown WB4YTU/WA9GVK
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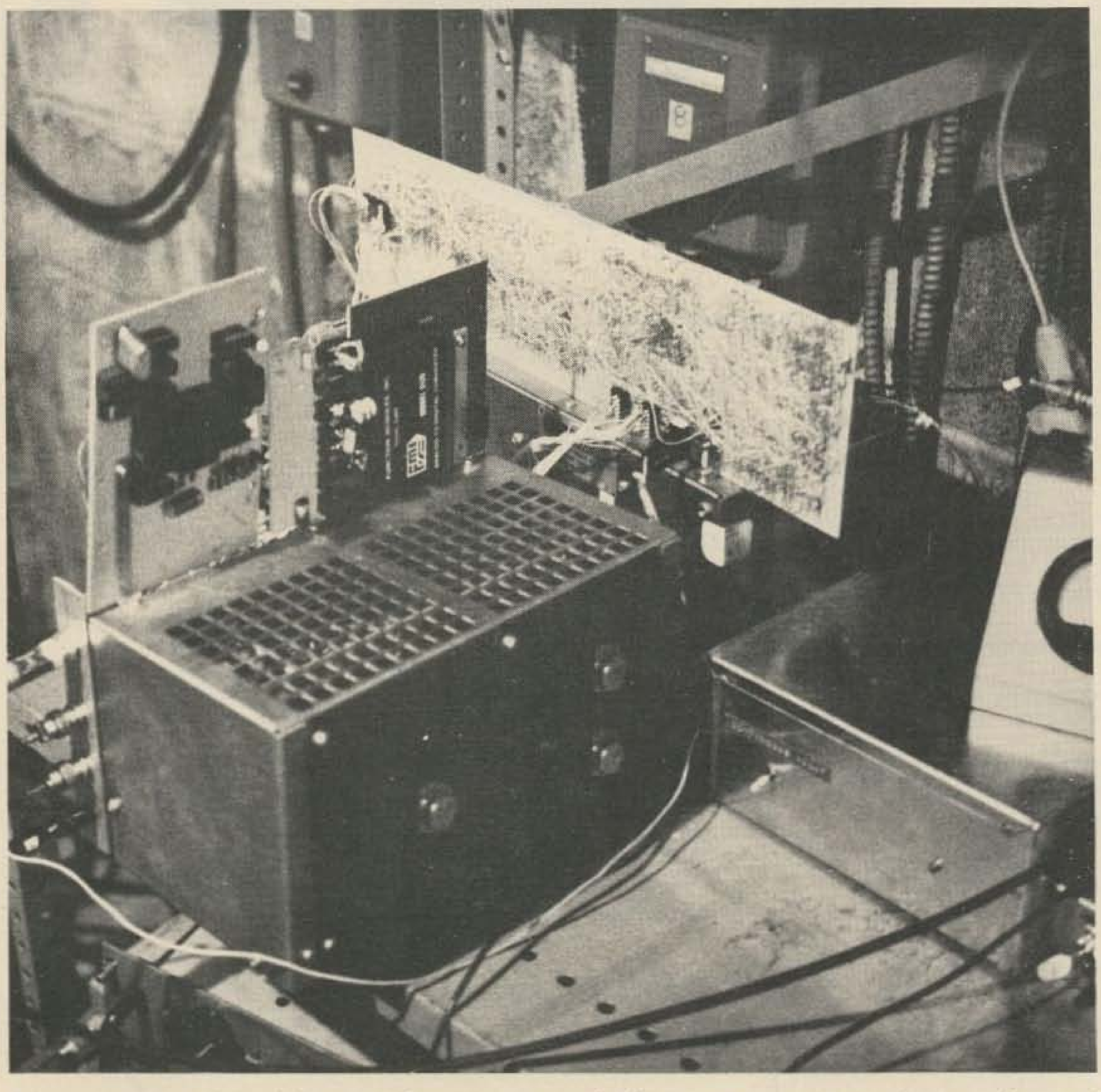

Microprocessor, demodulator, A-D converter, and character generator — the ingredients of RTACS at the WR4AAG ATV repeater.

Numerous magazine articles and symposium speakers have extolled the possible virtues of microprocessors in amateur radio applications. This plethora of prognostication, while generating considerable interest, has created a great deal of skepticism as well. After all, amateurs, being pragmatic by

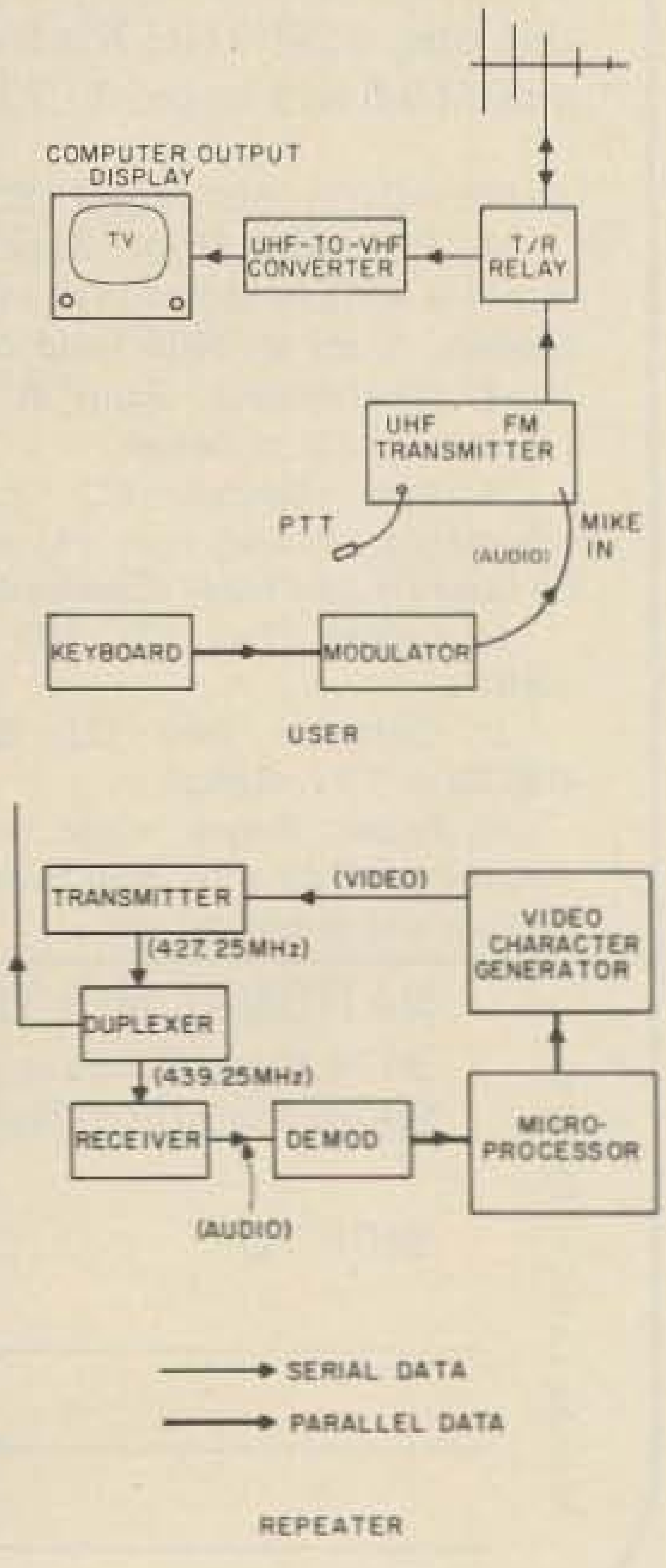

Fig. 1. Remote Terminal Access Computer System.

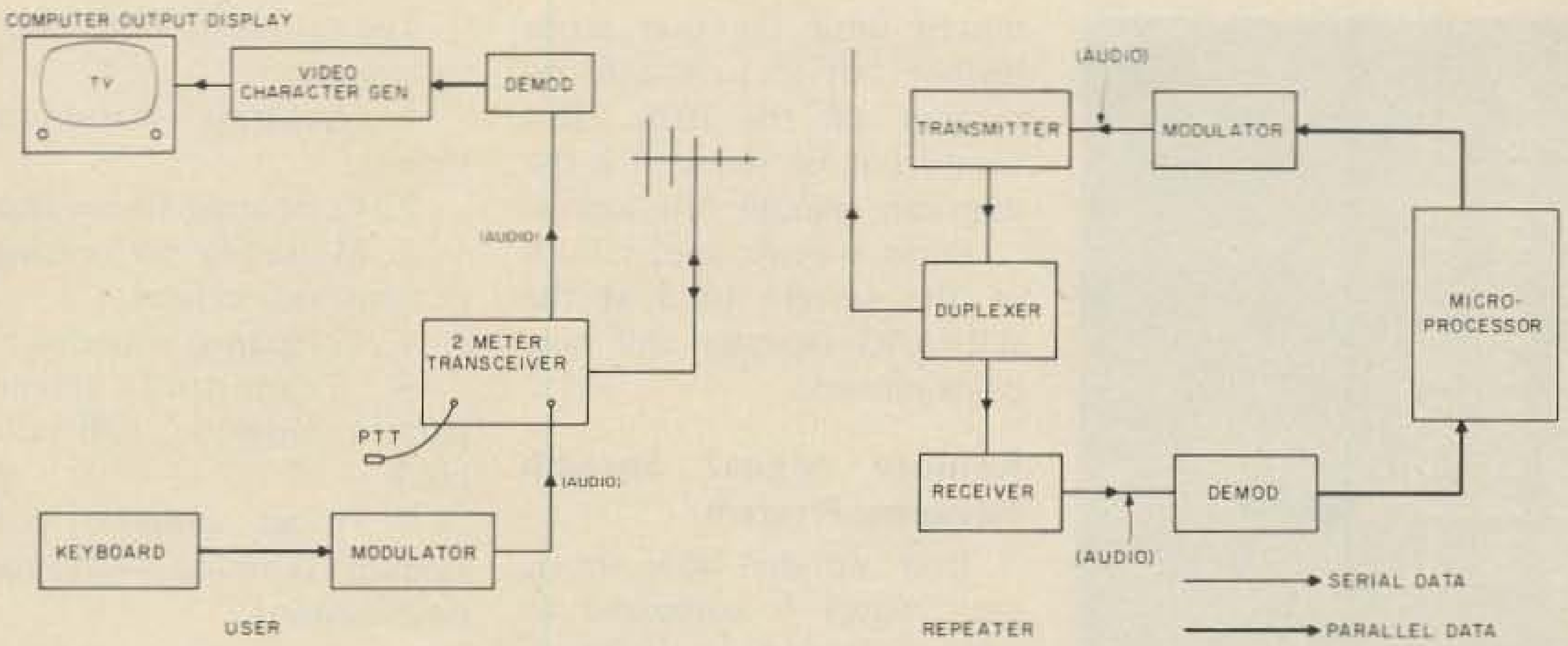

Fig. 2. Possible remote terminal system for voice-only repeaters.

nature, are more concerned with the realities of the present than the possibilities of the future. Few hams relish the thought of spending $1000 on a computer system which might ultimately serve, at best, as a light-blinking toy rather than as the useful station addition originally intended.

The purpose of this article is to affirm the present value of microprocessors in amateur radio, while demonstrating that their benefits can be reaped without undue individual expense. This will be shown by describing a unique computer-based system which has been operating successfully for well over a year in the Washington, D.C., area.

In early 1974, members of the Metrovision Amateur Television Club, sponsors of the first fast scan TV repeater (WR4AAG), recognized the potential power of recently introduced microprocessor chips and set out to design a far-reaching computer system to enhance amateur station performance both technically and operationally. The concept was to give numerous local hams computer capability at their own shacks through the use of a single, shared, centrally-located processor. Thus each station would be spared the expense of building or buying a separate computer. Furthermore, it was envisaged that the remote nature of the system could provide capabilities that even the most complex home-based computer could not render.

What is this super-system? It's called a Remote Terminal Access Computer System (RTACS), and is used as an integral part of a repeater.

Writing and executing computer programs from the comfort of your shack is just one basic capability. The system will also measure your signal strength into the repeater, power output from the repeater, automatically call CQ for you, store and forward messages to other amateurs, and serve as an information retrieval library. Let's take a look at the system configuration.

RTACS – General Background

The system is similar to commercial time-share computer networks using terminals at a location remote from the processor. You may already have some experience with remote terminals at work or school. Fig. 1 shows the amateur radio implementation of this approach, using a TV repeater.

At the home QTH, the user requires only a keyboard and modulator to convert the parallel keyboard data into a serial, tone-modulated signal which is applied to the microphone input of an existing transmitter.

The signal is sent up to the repeater, where it is received, converted back to parallel data and fed into a microcomputer. At the WR4AAG repeater, a home brew 8008-based processor is employed with 2K RAM and 2K PROM. The output of the computer is fed into a character generator, which formats the data into a standard 525 line video signal that is transmitted back to the user and displayed on a home TV set through a UHF-to-VHF converter modified for ATV (amateur television) reception.

It is thus possible for a ham to have computer capability in the home without the hassle of constructing or buying a processor and video display device – an investment easily amounting to several months of effort at a $1000 price tag. With RTACS it is possible to write programs, list data out of memory, and execute programs. It is invaluable as a learning aid for machine/assembly language programming, as well as for performing a myriad of beneficial tasks in direct support of amateur radio operations.

So as not to give the impression that RTACS is the greatest thing since the invention of the carbon resistor, it is fair to point out some inherent drawbacks. First, only one user at a time is possible. Common on-the-air courtesy dictates who uses it and for how long. Secondly, there is no security to your data. Everyone can see your inputs and outputs (if that's any concern to you). Finally, the system, as presently configured, precludes its use for direct control or switching applications around the home, as would be possible with a locally based device. Nevertheless, the simplicity and cost benefits outweigh the disadvantages in most instances.

When operating a computer remotely, some provision must be incorporated to allow the terminal user to restart the processor in the

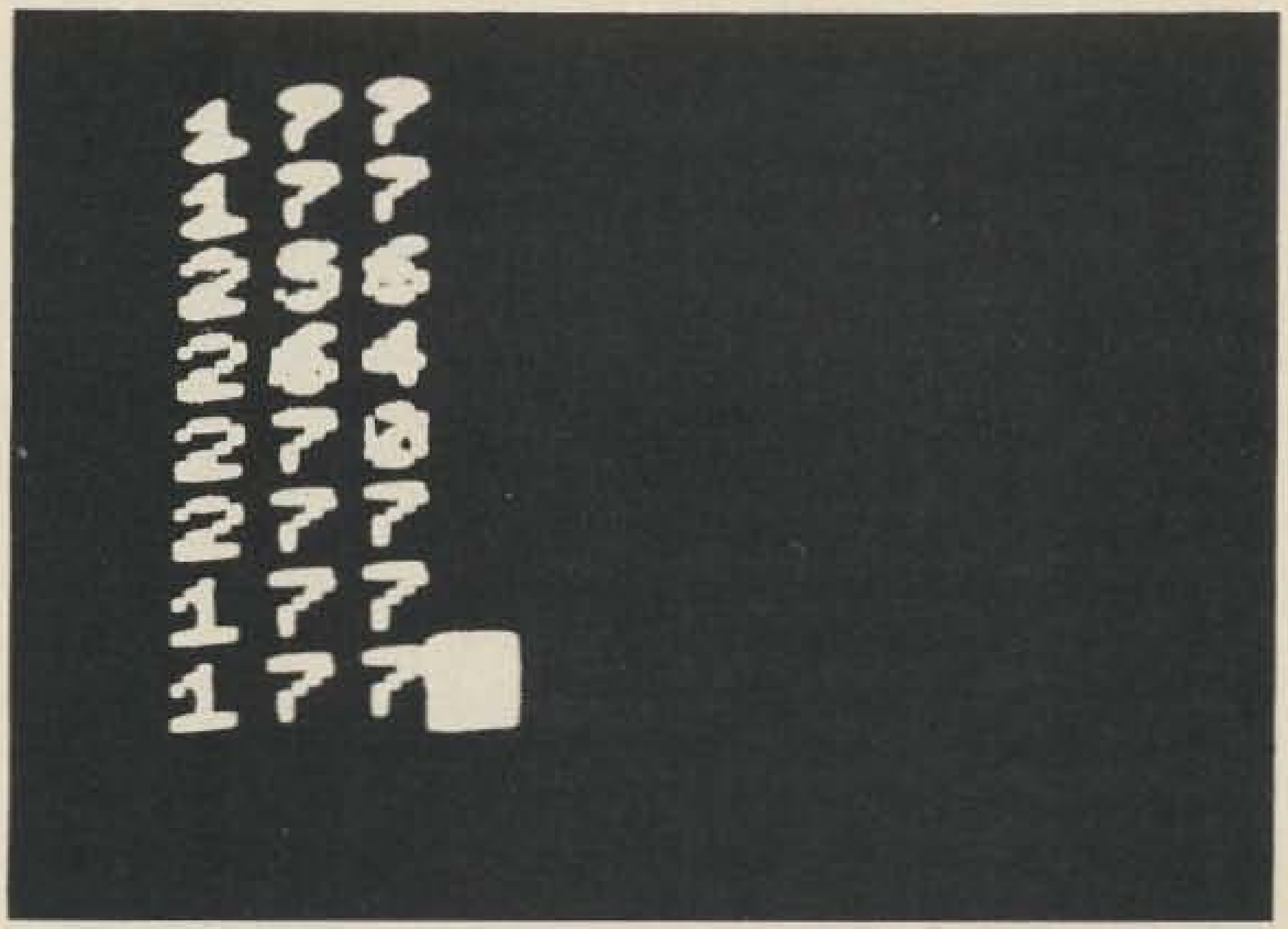

Fig. 3. Signal strength samples at 2 second intervals. No signal reads 177. Display shows transmitter turn-on, gradual increase in signal, followed by turn-off.

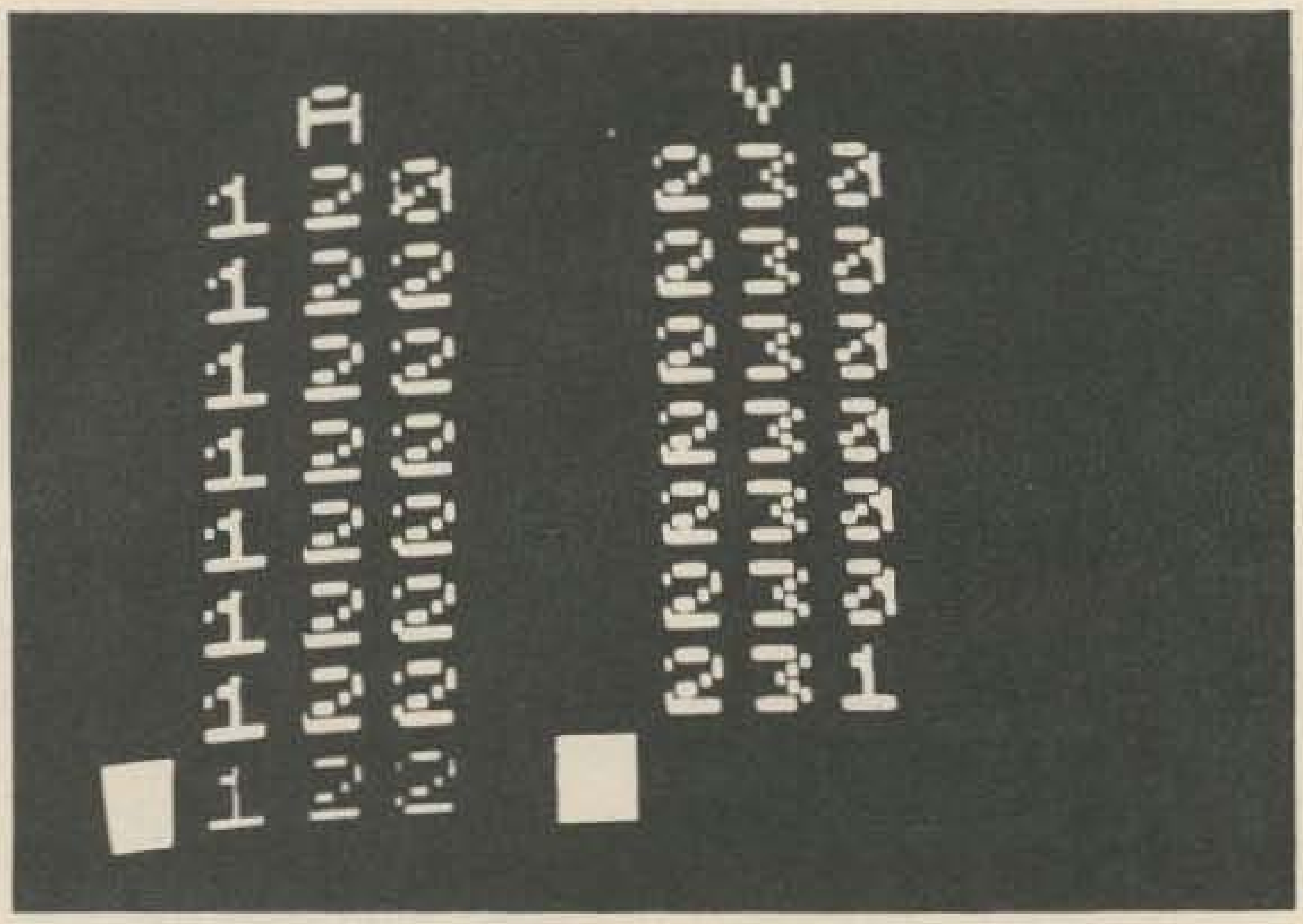

Fig. 4. Audio and video transmitter power levels in left and right columns, respectively. Samples at 2 second intervals. A separate calibration table is used to convert these numbers directly into Watts; e.g., 122 corresponds to 10 Watts, and 230 equals 80 Watts.

event of a software problem such as a loop or a halt. At the WR4AAG repeater, a hardware circuit monitors the output of the demodulator to sense a specific control character. Upon its detection, the circuit sends a 005 interrupt command to the 8008 processor, to override any other instruction that may be executing.

While the video output capability of the ATV repeater does conveniently lend itself to the RTACS, a standard voice-only repeater can be used. Fig. 2 shows one possible method for doing this. At the user station, a keyboard and modulator are also used. At the repeater, the character generator is replaced by a modulator to convert the parallel output data from the computer into serialized tones. On the receive side, the user would have a demodulator to convert the tones to parallel data for driving a local character generator. Thus, from the home QTH side, an additional $150 investment for a demodulator and character generator is required, as compared to the ATV repeater configuration. Another difference would be in the computer's control program which must prevent computer output from being transmitted until the user drops his/her carrier to enable reception of the data. This would not be required if the user can operate full duplex.

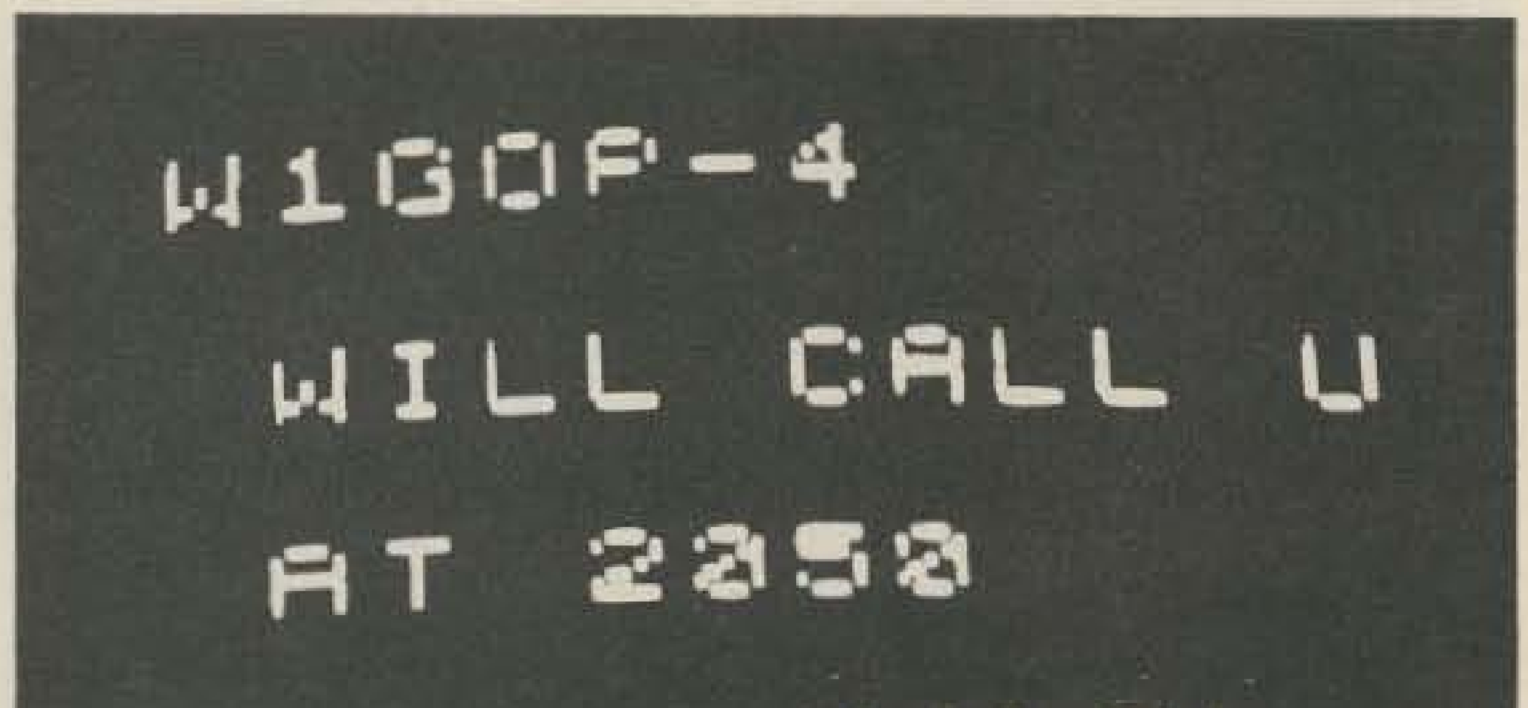

Fig. 5. Messages may be stored in the computer and later recalled by the intended recipient.

Some specific applications of the system used at the WR4AAG repeater will now be examined.

Remote Signal Strength Measuring Program

Ever wonder how strong your signal is compared to others? Would you like to measure antenna performance even though you don't own a field strength meter? Want to know if your transmitter is tuned up for greatest output power but don't have a wattmeter? Are you interested in knowing how day-to-day propagation changes affect your signal?

Amazingly, without any test equipment, you can determine all of the above with the RTACS. To call up this special program, you turn on your modulator and type the letters S-I-G-N-A-L on the keyboard.

While monitoring the output of the repeater, a 3 digit number will be seen on the left side of the TV screen. This number is directly proportional to your signal strength as sensed by the repeater's receiver. If you increase transmitter power, the number will increase in value; if you change to a lower gain antenna, the number will drop. Thus you get an objective figure of merit for your signal strength. No more inaccurate RS reports!

How does it work? An analog-to-digital converter is connected to the repeater TV receiver's AGC line. The A-D converter's digital output is fed into the microprocessor which, in turn, is connected to a video character generator tied to the repeater transmitter. Thus, a number is generated and displayed in a TV format which is directly proportional to received signal level. (A sample of this printout is shown in Fig. 3.)

Typical applications of the system are:

1. Accurate transmitter tune-up
2. Comparing transmitters
3. Measuring performance of transmission lines
4. Comparing antennas
5. Examining antenna pattern (sidelobe, F/B ratio, etc.)
6. Proper antenna positioning (azimuth, elevation, polarization)

Power Meter

Many times the question arises, "Is my receiver bad or is the power output of the repeater low?" Thanks to the microprocessor, the answer can quickly be found. By calling up the POWER program on the keyboard, the power output levels of the repeater's video and audio transmitters are given. The numbers that appear on the screen, while not in Watts, do directly correspond to a specific power level that can be determined by referring to a calibration table. (See Fig. 4.)

How does the system work? The detected rf output from the aural and video transmitters, derived from directional couplers with diode detectors, is fed into an A-to-D converter and on into an input port of the microprocessor. The microcomputer then formats the data into columns which are appropriately labeled.

Message Store and Forward

In this mode the user is able to remotely control the character generator at the repeater to place any desired message on the TV screen. The message may be in the form of a club bulletin or possibly be directed to a single individual. It is especially useful for leaving a message for a fellow amateur who is not home but can later turn on the TV and retrieve messages addressed to him. Several variations of this capability are provided to the

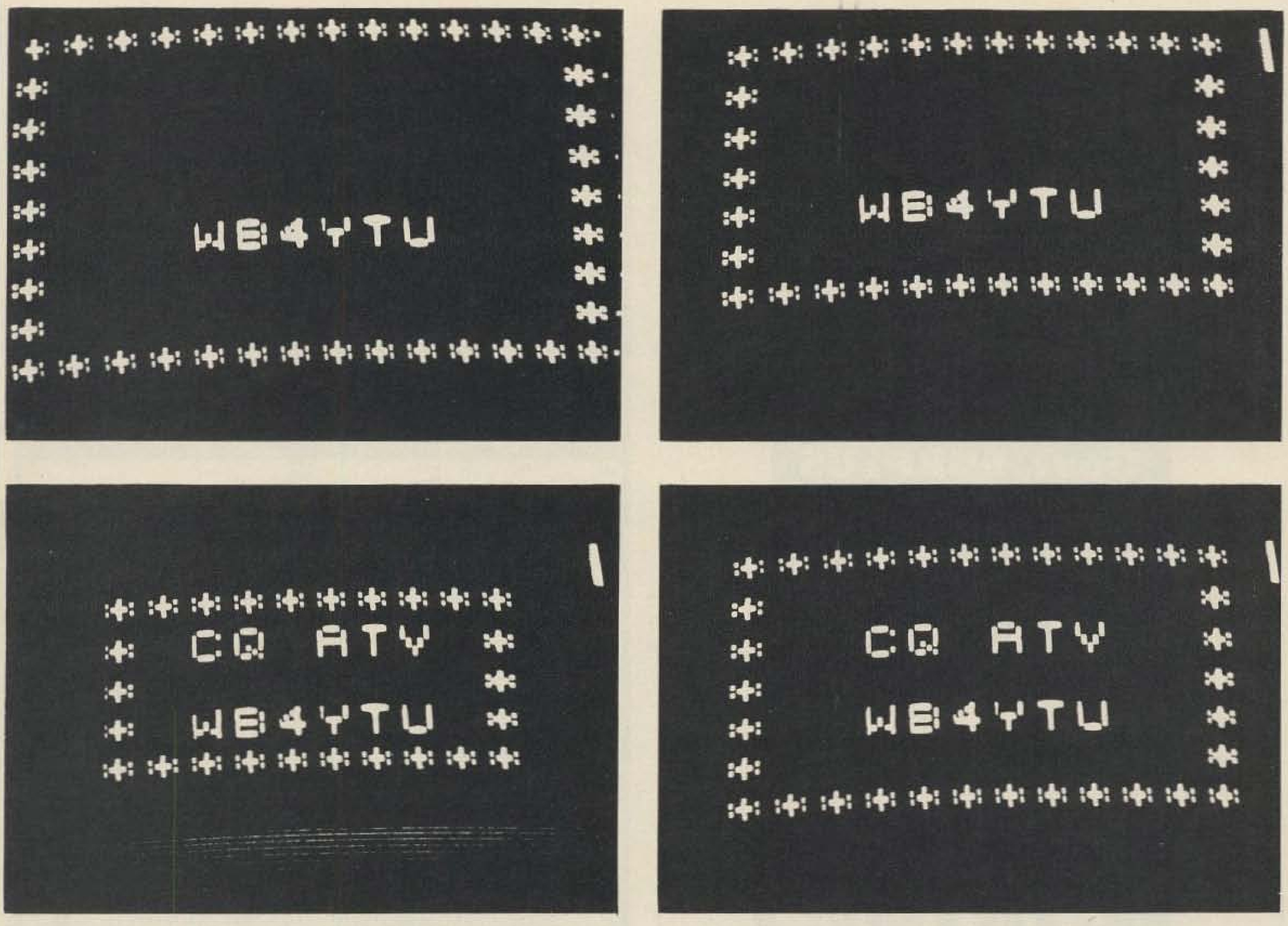

Fig. 6. Computer generates four "pages" of data in the character generator's buffer memory and then turns each page every 0.2 seconds for animation. In the display shown, "CQ ATV" will flash and the outside border will appear to expand and contract.

user. Fig. 5 illustrates a sample printout. Messages can be transistory (stored only in the buffer of the character generator) or can be made more permanent by storage in the computer's random access memory (RAM).

Automatic CQer

By typing the CQer command followed by your call letters, the microprocessor will generate an animated video CQ display. It does this by loading 4 pages of the character generator buffer memory and then turning the pages at high speed to create animation. The photos in Fig. 6 illustrate how this technique serves as a real "attention getter."

Data Retrieval

Several applications are possible involving the storage and selected recall of data. Call letters, addresses and dates can be entered into the computer's memory to serve as a paperless logbook. Once the information has been entered, a keyword can then be typed to retrieve desired information. For example, on the WR4AAG system, by typing call letters on the keyboard, the computer will tell you the person's handle, address and telephone number within 1 second – considerably faster than trying to look it up in a logbook or directory. Other uses include displaying pre-stored propagation or Oscar orbital information. The main limitation of all of these applications is in the size of the memory. An audio cassette tape recorder is an excellent low cost means to achieve the bulk storage of data for this purpose.

In Closing

You can now see how the microprocessor is presently employed in a practical role to assist amateur operations, and that these applications far transcend those possible using only random logic. Needless to say, *73* readers will be able to think of even more spectacular uses for the microprocessor in ham radio. ■

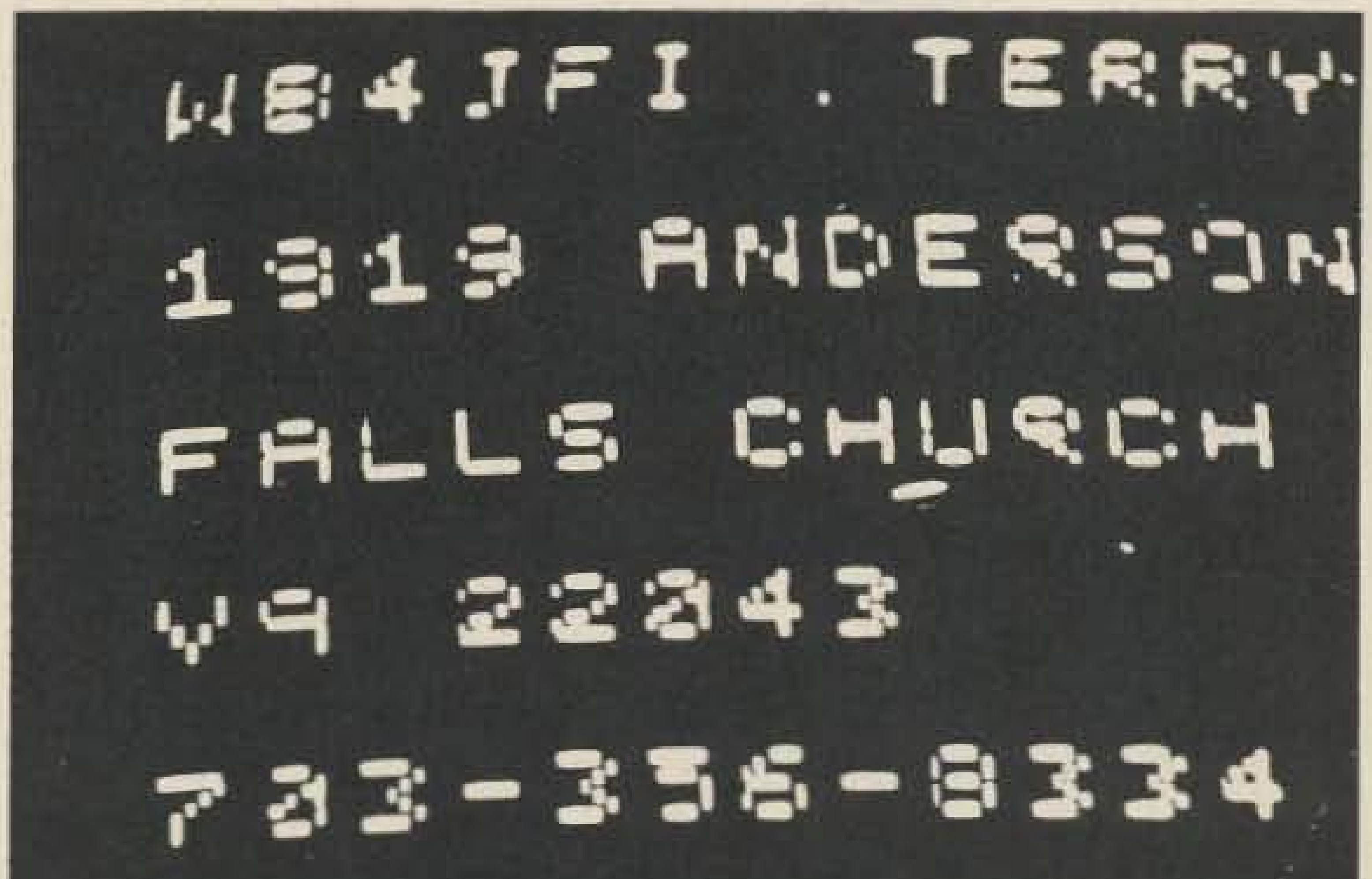

Fig. 7. After typing call letters on the keyboard, the computer will retrieve a corresponding name, address and phone number.

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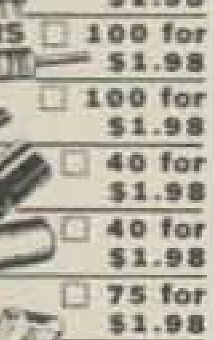

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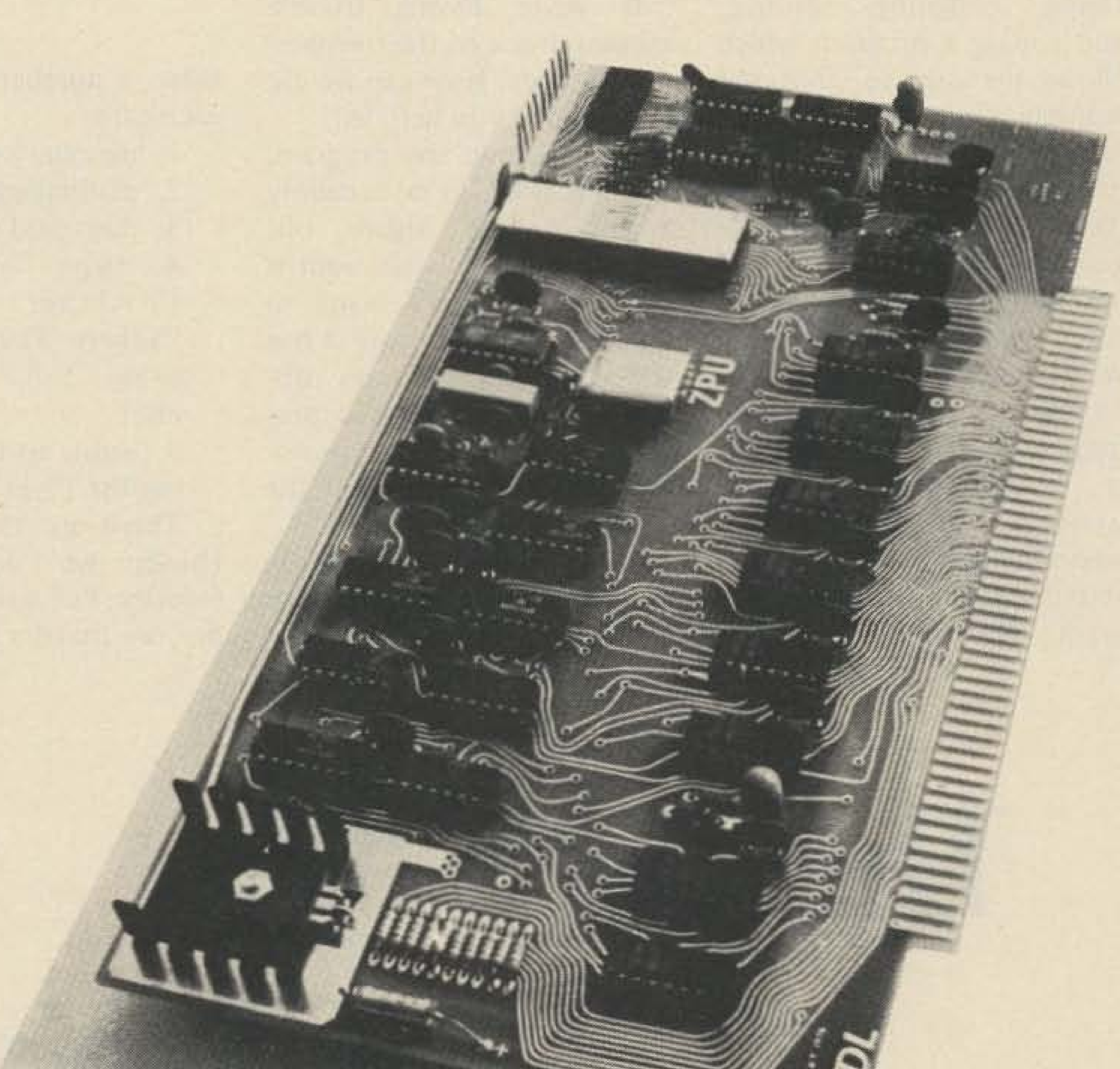

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The Soft Art of Programming

-- part II

Rich Didday
1218 Broadway
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What next? You've probably spent a fair amount of time playing around with your home computer system by now. You've gotten familiar with the features and basic elements of your programming language. You've copied some game programs and written some small, fun programs of your own. Maybe it's time to take the big plunge and try something "real," something you couldn't do just as well on a pocket calculator or by counting on your fingers.

In this article (and in the concluding part next month) I'm going to take you through the thought processes involved in defining, designing, refining, and coding a program which allows the user to store and manipulate a large file of information – a "data bank" of sorts. The goal is much more than just laying a program listing in front of you and saying, "Here it is, here's how to use it, copy it if you want." I hope to give you a feeling for *doing* programming and the confidence to try it yourself. That means we're not just going to zip smoothly along from problem statement to finished program. No, we're going to make a plan, start following it, stumble upon unforeseen problems, revise our plan, start in again, etc., etc. Programming can be frustrating at times, but it is also really exciting. It's like any other creative activity – there's no magic way to leap to a finished product without going through a struggle. Incidentally, although our path may be a little rocky, there *are* a number of ideas and techniques we'll come across which are valuable in many cases even if some of them ultimately fail in this specific problem.

Here's the problem we'll work on: Our local computer club has been growing so fast that we're having trouble keeping track of the membership records. How can we use our computer to help us?

In designing any program, the first thing to do is calmly and carefully figure out exactly what it is we want it to do. We don't want to spend days slaving over a hot teletypewriter only to discover that our finished program is inadequate, inconvenient, or irritating for the user to interact with.

Up to now, our club has used a 3x5 index card for each member, and we've listed a number of things on each card:

1. member's name
2. mailing address
3. dues paid until ____
4. type of system ("Altair 8800," "Sphere 320," "homebrew F-8," "none," etc.)
5. wants to be on mailing list ("yes" or "no")

There are three different things we do with the records. For each new member, we make a new card and insert it. We update the information on specific cards (when a member gets a new system, pays dues, . . .). We go through the whole stack of cards and pull out certain ones to do mailings (for example, every few months we go through and pull all the cards of people who need to be reminded to cough up more dues). See Table 1.

As we think about creating our program, we'll keep the different uses in mind to be sure they can all be done

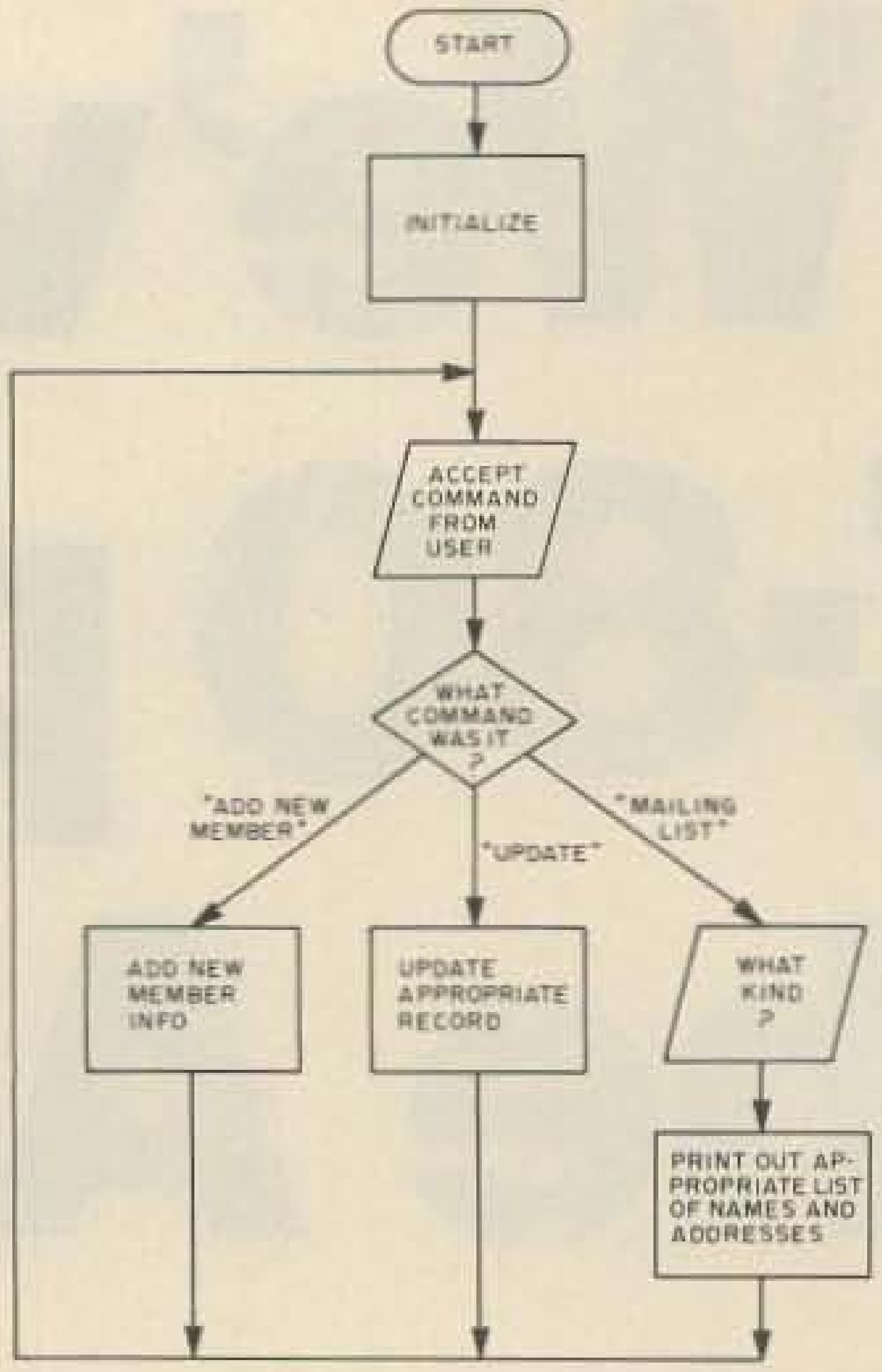

Fig. 1.

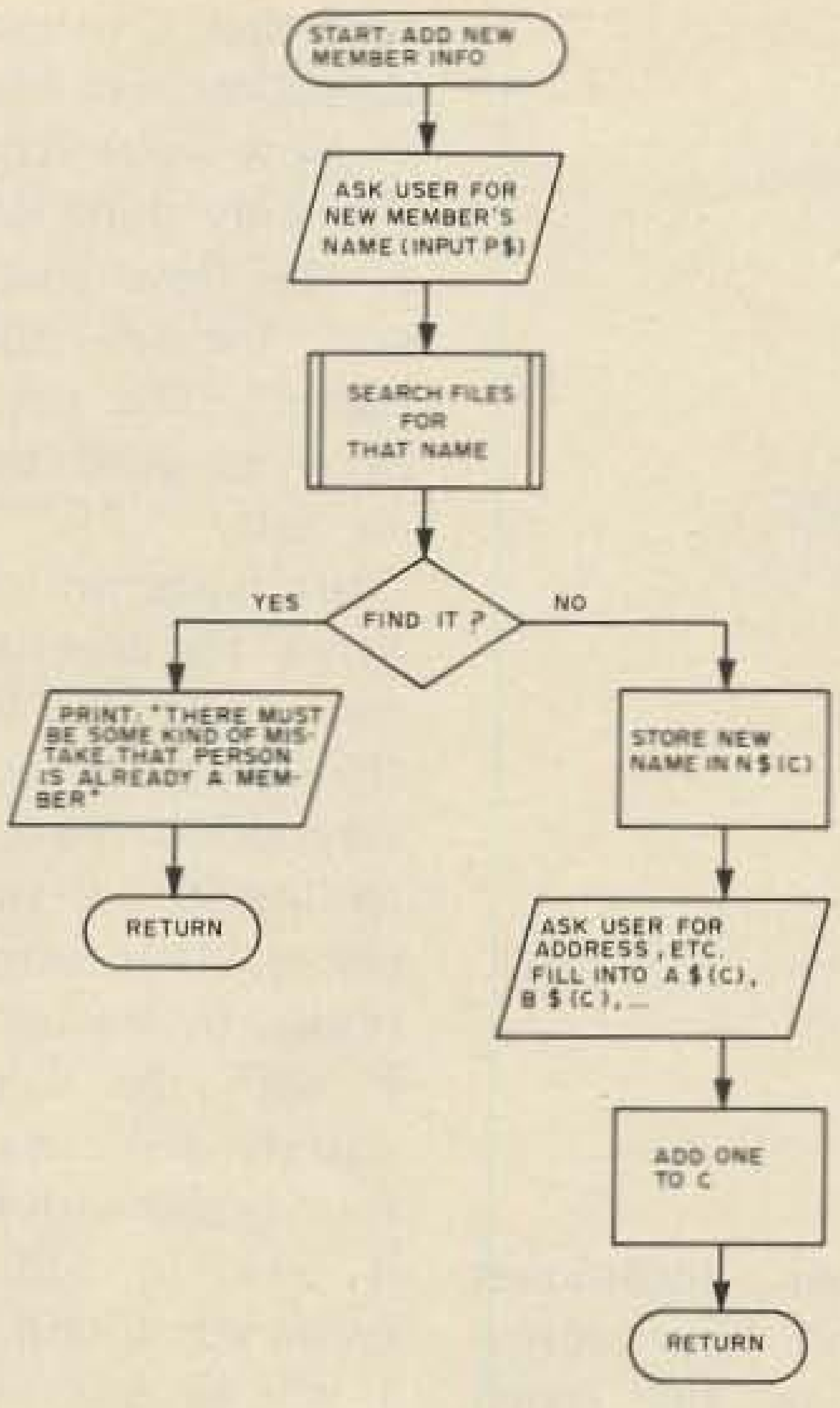

Fig. 2

conveniently. Since the way we store each member's data will affect how we access it, the first thing to do is to decide what memory organization to use. That is, we should design a *data structure*, one that is general and flexible enough for our purposes.

The simplest data structure that's made up of more than one memory word is the *array*. Arrays have been used as data structures from the very beginning of computing, and form the basis for the more elaborate organizations (stacks, lists, strings, etc.) that have evolved through the years.

An array-type organization is perfectly suited to our application because we have a large number of identically shaped items (the membership records) to store. Exactly how we use arrays to store the individual records depends to some extent on the details of the language being used.

I'll assume we have the features of Altair 8K Basic, and suggest what to do if you don't.

What we can do is declare an array for each different type of information we need to store, and associate (in our minds and in our program) the values which appear at the same location in the different arrays.

```
60  DIM N$(100),A$(100),B$(100),D$(100),S$(100),L$(100)
70  REM: N$(I) IS THE MEMBER'S NAME
80  REM: A$(I) IS THE MEMBER'S STREET ADDRESS
90  REM: B$(I) GIVES THE CITY, STATE, ZIP
100 REM: D$(I) IS THE DUES EXPIRATION DATE
110 REM: S$(I) DESCRIBES THE MEMBER'S SYSTEM
120 REM: L$(I) IS "YES" IF THE MEMBER WANTS
130 REM:         ON THE MAILING LIST
```

The value for "I" will correspond to the position in the array of that particular data. To store the required information about member number 12, we could use assignment statements (LET statements) like these:

```
LET N$(12)="RAYMOND LANGSFORD"
LET A$(12)="320 FERNLY DR. #256A"
LET B$(12)="LA CERVEZA  CA 92010"
LET D$(12)="JUNE,1978"
LET S$(12)="HOME BREW 8008"
LET L$(12)="NO"
```

In our final program, though, we'll use INPUT statements to request the information from the user instead of using assignment statements. After a number of records have been stored, the arrays will look something like Table 3.

Now that we've chosen a way to store our data, it's fairly obvious what the routines which maintain and access the file will have to do. We'll keep track of how many members we have so far (0 to begin with, 6 in Table 3); then if we want to add a new member's record, we fill the information into the next available array location and add one to the number of members. To update a member's record, we start at array location 0, and see if N$(0) is the member we're looking for. If not, we look at N$(1); if that's not it, we look at N$(2), etc. Eventually we'll come to the right place and make the desired change. To generate a mailing list, we go through the arrays one member at a time, printing out the names and addresses of those who meet the criterion (either having a "YES" in their L$ field, or owing dues soon, or having a certain kind of system).

Looking over things so far, we might feel pretty good. All our desired functions seem possible, even fairly easy, to program. We might even pride ourselves on the fact that if a member discovers that we have an error in his or her data, we have an easy way to correct it – by using the update feature. (For some insane mysterious reason, some commercial data gathering organizations don't seem to cope with this problem very well.)

But before we plunge ahead and code these schemes, we should think them through again, especially worrying about what sorts of errors *can* creep into our system. For instance: (1) What if there's a mixup and the same new member gets entered in twice? (2) What if we go to do an update and misspell the name accidentally? (3) What if we were using assembly language and limited names to having no more than 24 characters as suggested in Table 4, and the user enters a name that's too long? (4) Can you think of any more problems that we could have? (Unfortunately, there's a couple of biggies lurking in here. See if you can spot them.)

Problems (1), (2), and (3) all involve input data that doesn't fit the assumptions we've made. It's crucial to design programs so they don't blindly plunge ahead using invalid data. People make loads of typing mistakes as well as have mental lapses. It's a corollary of Murphy's Law that if your program *can* blow up on invalid data, sooner or later it will.

The solution to error (1) is to have our program search the data file to see if there is already an entry for the "new" member instead of just blindly adding a new record in. That won't involve much extra programming effort because we already have to be able to search for a particular name to do the update operation.

The solution to problem number (2) is to be sure that our search routine doesn't look farther into the arrays than the number of members, and if it comes to the end without finding the desired name, to inform the user of

---

The problem of storing records and manipulating files is a very widespread one. Even though we're dealing with a specific example here, the techniques we'll develop can be directly used in many other situations.

To name a few:

In a RTTY contest, you may want to keep track of the stations you've already worked.

Your club may want to keep a file of radio-electronics supply houses, storing name, address, type of material offered, people's experiences dealing with them, etc.

You could create a bibliography of reference books and magazines.

A store may want to keep a file of customers, storing name, address, previous purchases, needs, etc.

Etc.

Table 1.

that fact.

Finding a solution to problem (3) is more bothersome. One solution would be to redesign the data structure so it allows more characters per name. But that would require more memory, most of which would be used to store blanks at the end of normal sized names. Another solution would be to redesign the program so that it implements a string-like (variable length) data structure. But that would be a lot of work. A compromise is to have the program count the number of characters in each name that's entered, and if the count exceeds 24, to ask the user to supply an abbreviation. The last solution isn't perfect (what if two people abbreviate the name differently?), but it seems less offensive than having the program arbitrarily chop off part of someone's name.

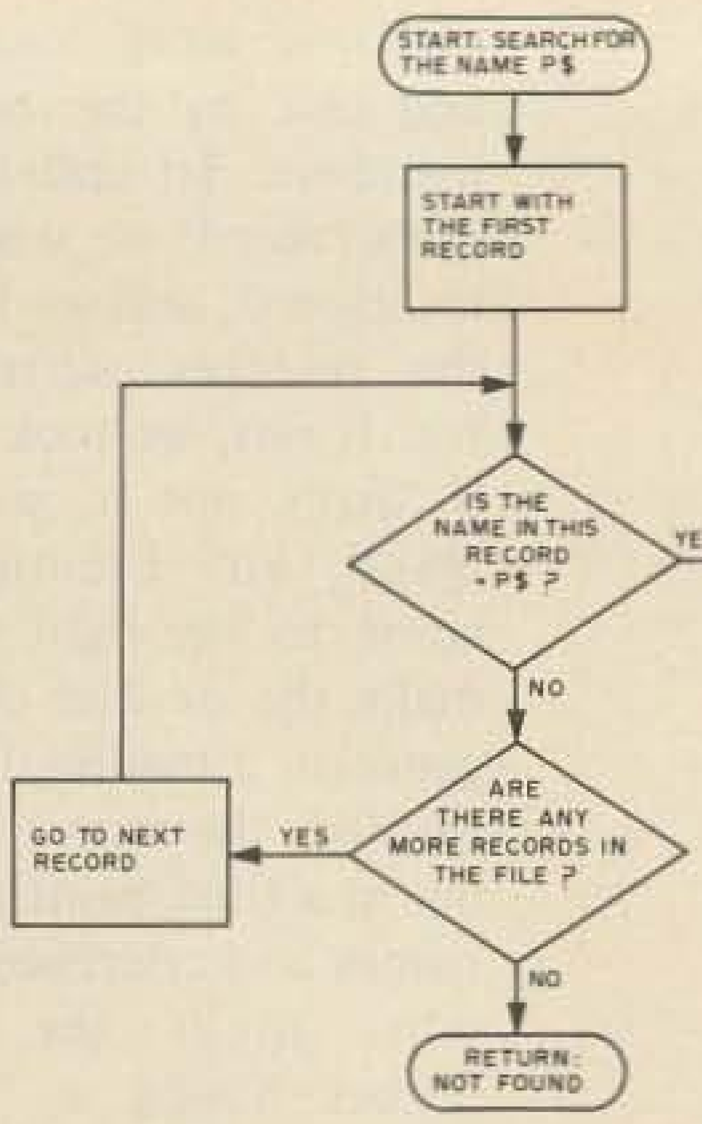

Fig 3.

Now that we've thought over the basic techniques we'll use, and have anticipated some of the rough spots, we can start designing the program in earnest. The main thing it has to do is repeatedly accept commands from the user and carry them out. See Fig. 1.

Now we can refine our plan by breaking down each of the boxes into finer and finer detail, ultimately converting each to some sequence of Basic statements.

Let's start with the one that says

To carry it out, we need to get the new member's name, look through our file to make sure it's not already there, and if it's not, fill the new member's information into the arrays. Let's use a variable C (for "member count") to store the number of members. Since arrays in Basic start with position 0, location C in the arrays will be the location of the next empty spot. That means we can fill the new information into N$(C), A$(C), ... ,L$(C). Finally, we add one to C since now there's one more member in the file. If that doesn't seem clear, draw the arrays out and go through a few cases by hand to make sure that C is updated at the right time. See Fig. 2.

Now we're starting to roll. The only thing left to specify is the flow chart box that says "search file for that name." The new name has been assigned to the string variable, "P$." The flow chart is shown in Fig. 3, and here's the translation of the flow chart into Basic. Notice that we've written it as a subroutine since we're going to use it in two different places. It communicates its results by leaving the variable F with the value 0 if the sought-for name wasn't found, and with the value 1 if it was. In addition, if the name *was* found, the variable I will be left with the subscript value of the desired record.

```
1000 REM: SEARCH SUBROUTINE
1010 REM: LOOK FOR THE NAME "P$" IN THE
1020 REM: ARRAY OF MEMBER NAMES ("N$")
1030 REM: "C" IS THE NUMBER OF ENTRIES
1040 REM: "I" IS THE SUBSCRIPT OF THE CURRENT RECORD
1050 REM: RETURNS: F=0 MEANS "NOT FOUND"
1060 REM:               F=1 MEANS "FOUND"
1070 LET I=0
1080 IF P$ = N$(I) THEN 1140
1090    LET I = I+1
1100    IF I<C THEN 1080
1110 REM: DIDN'T FIND IT
1120 LET F=0
1130 RETURN
1140 REM: FOUND IT. IT'S IN LOCATION "I".
1150 LET F = 1
1160 RETURN
```

Things still seem to be going all right, so let's forge ahead and convert our "add new member info" flow chart into Basic.

```
2000 REM: SUBROUTINE TO PROCESS "NEW MEMBER" COMMAND
2010 PRINT "WHAT'S THE NEW MEMBER'S NAME";
2020 INPUT P$
2030 REM: USE SEARCH SUBROUTINE TO PROTECT
2040 REM: AGAINST DUPLICATE ENTRIES
2050 GOSUB 1000
2060 REM: IF F = 1 , P$ WAS FOUND.
2070 IF F<>0 THEN 2230
2080    LET N$(C)=P$
2090    PRINT "STREET, APT #";
2100    INPUT A$(C)
2110    PRINT "CITY,STATE,ZIP";
2120    INPUT B$(C)
2130    PRINT "MONTH,YEAR DUES ARE PAID UP TO";
2140    INPUT M$,Y$
2150    LET D$(C)= M$ + "," + Y$
2160    PRINT "WHAT KIND OF SYSTEM";
2170    INPUT S$(C)
2180    PRINT "DOES ";N$(C);" WANT ON MAILING LIST (YES,NO)";
2190    INPUT L$(C)
2200    REM: INCREMENT "C"--WE HAVE A NEW MEMBER!
2210    LET C=C+1
2220    RETURN
2230 REM: ERROR OF SOME SORT.
2240 PRINT "SORRY, BUT ";P$;" IS ALREADY A MEMBER."
2250 PRINT "MAYBE YOU SELECTED THE WRONG COMMAND."
2260 RETURN
```

Again, everything went pretty smoothly, but let's look over the code closely to be sure there are no typos or other obvious errors. Everything looks pretty good . . . but wait! What's that? Statement 2210 looks a little funny all alone there. It's not very common to increment a counter without checking to make sure it's still within the proper range. What were we thinking? Hmmm. "C" is the number of club members. Of course our *club* wants as

---

Array

An *array* is a collection of memory cells, individual members of which may be referenced by specifying the array name plus a subscript value (index).

In Basic, Fortran, Algol, etc.	*In Assembly Language*
Usually you need some sort of "DIMension" statement telling how long the array is: DIM M(50)	When writing the program you reserve a contiguous chunk of memory of the appropriate size.
Each array has a name: M	Each array has a *starting* (or *base*) *address* which is the memory location of the first byte in the chunk you set aside.
Individual locations are identified by listing a subscript expression after the array name: M(24)	Individual locations are accessed by adding an *offset* (or *index*) to the starting address. Often the machine architecture includes an *index register* for this purpose.
The subscript expression may be computed from other values: M(N*2+J)	The index can be varied depending on other values.

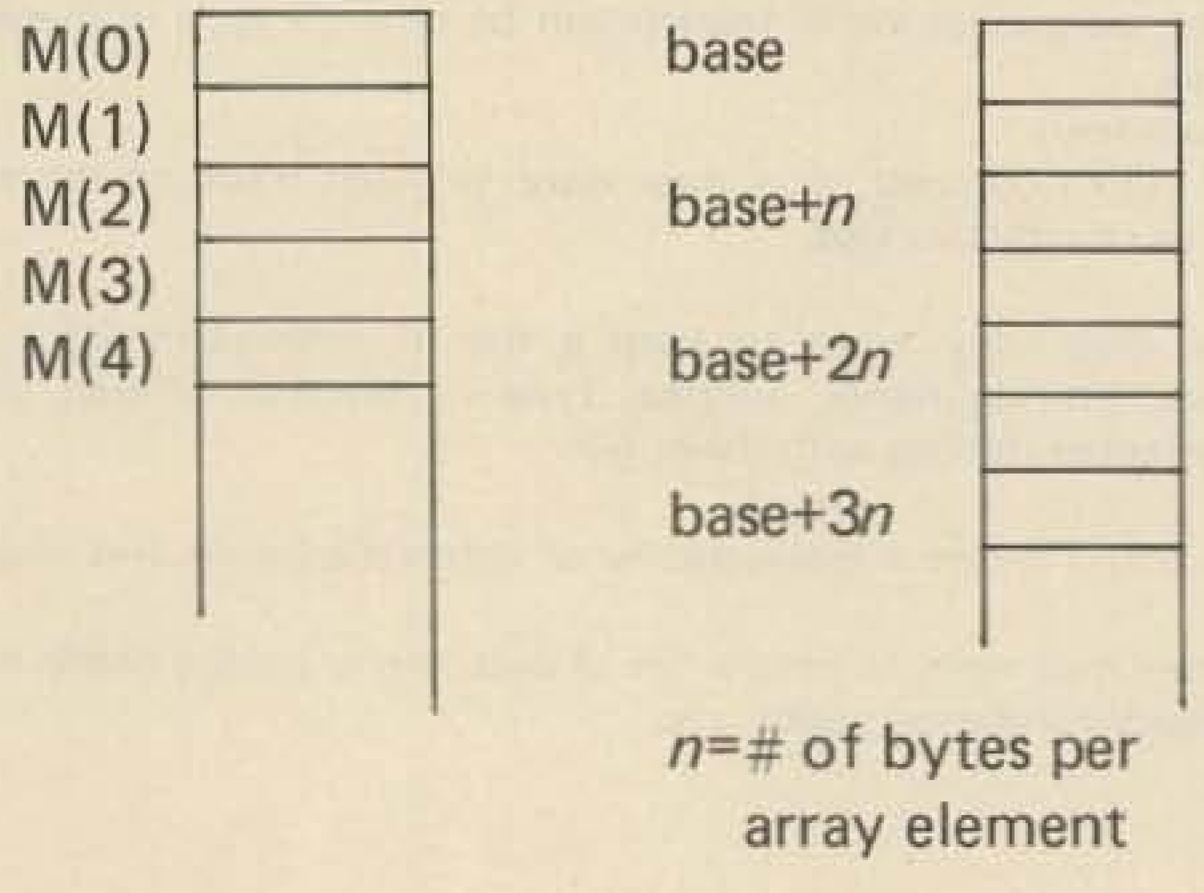

Table 2.

	N$	A$	B$	D$	S$	L$	
0	JOSE ALCALA	1347 BARSTOW RD.	WATSONVILLE CA 95050	JULY, 1977	SWTC 6800	YES	0
1	SANDY SWEICKERT	P.O. BOX 3279	CAPITOLA CA 95030	DEC, 1977	NONE	YES	1
2	ANTHONY TEMPLE	½ FOX DR.	SANTA CRUZ CA 95061	AUG, 1978	ALTAIR 680	NO	2
3	SUSAN BURGESS	97 LIGHTHOUSE DR., #3	SAN GAUCHOS CA 95070	SEPT, 1977	IMSAI 8080	YES	3
4	BILL MCKEEMAN	3224 STEVENS CR. BLVD.	EL CERRITO CA 94720	JANUARY, 1979	BURROUGHS B5500	NO	4
5	SAM WALSH	1202 BROADWAY	LOS PERROS CA	DEC, 1978	HOME-BREW 8008	YES	5

Table 3.

many members as we can get, but how many can our *program* handle? The way we declared our arrays, we left room for 101 members, but was *that* right? What if we get *thousands* of members? We can't just keep increasing the array sizes in our DIM statement – surely not that many records will fit in memory at once. But if they won't, our program won't work! Oh no!

Let's try to suppress that old sinking feeling and figure out what's going on here. Suppose the average name has 20 characters in it and the average address 50. The dues expiration date takes up about 9 bytes, the system description about 25, and the mailing list info takes 3. That's about 107 bytes per record. We're running 8K Basic and our computer has 16K bytes in all. That means we'll be able to fit about 8K/107 ≅ 80 records before completely running out of space. That won't do. Maybe we've been extravagant in the way we've organized our data.

There *are* a few things we could do to free up a little more memory (see Table 5). We can't cut out any of the data stored about the members without making our program pretty much useless. We could throw out the REMark statements, but that won't make much difference (we might squeeze in 2 or 3 more records that way).

We *can* convert some of the string values to numbers. For example, the mailing list entry could just as well be 1 or 0 instead of "YES" or "NO", and we could list the dues payment date in the form 1978.06 instead of "JUNE,1978." In fact, we can do both of those and cram both values into one array by leaving the date positive if the member wants to be on the mailing list and making it negative otherwise. That way,

```
-1978.02 is equivalent to D$(I)="FEB,1978"
                          L$(I)="NO"
          and
+1979.03 is equivalent to D$(I)="MARCH,1979"
                          L$(I)="YES"
```

If we do that, though, we want to be sure that no one who uses the program has to know about it (there'd be too many chances for error, plus who would want to explain it?). This would require subroutines to pack and unpack the information. Unfortunately, even that won't help very much (our club is very optimistic about our eventual size). The only option is number 6. We'll have to keep most of the data on an external storage device and bring it in in manageable sized chunks to process it. Maybe if we'd been a little more awake at the beginning (the Programmer's Lament), we could have seen that that was what we wanted to do all along – surely we weren't going to keep all the records in memory all the time! The Startrek freaks would have had our heads!

There are a number of different types of external storage we could use (including paper or mag tape, disc, etc.) and a number of different ways of interfacing to each. We can't go into them all here; instead I'll try to outline what to do assuming that we're using a cassette recorder. On most versions of Basic, you'll have to write machine language routines to handle the required I/O. You can either write machine language equivalents to the INPUT and PRINT statements, or you may want to write a routine that makes your cassette recorder look like the terminal to Basic. In that case, you would call the machine language routine, then INPUT from or PRINT to the tape, then call the routine again to restore the terminal as the I/O device. On the other hand, you may be able to connect your cassette recorder in parallel with your terminal (similar to the way Teletype paper tape equipment is related to the keyboard).

At any rate, let's assume that you have some way of getting records in and out of memory.

Interestingly, this doesn't force very many changes in our program. We just need another test here and there: a test which determines if we've finished searching through the records currently in memory. If we have, but still haven't found the record we want, we call a subroutine which reads a new memory-full of records from tape and forge ahead.

Now we have a scheme that's sure to work and we can push on, refining it and coding it . . . or do we? If our previous disaster should have taught us anything, it's not to get carried away with what seems to be a good idea without having a long hard look at it. We should review our plan, taking care to check not only whether we think we can

What if your version of Basic doesn't allow arrays of strings?

– If it allows string variables, but not arrays of strings, you can use a two-dimensional array to store names by ripping the string apart, converting each character in the name to a number (there should be a built-in function called something like ASC which does that) and storing them one by one. (On most versions of Basic, *two* characters will fit in each numeric variable.)

DIM N(100,24),A(100,24), . . .

N(I,J)

	J=0	J=1	J=2	J=3	J=4	5	6	7	8	9	10	11	12	13	
I=0	J	O	S	E		A	L	C	A	L	A				. . .
I=1	S	A	N	D	Y		S	W	E	I	C	K	E	R	. . .
I=2	A	N	T	H	O	N	Y		T	E	M	P	L	E	. . .
I=3	S	U	S	A	N		B	U	R	G	E	S	S		. . .
I=4	B	I	L	L		M	E	K							
I=5	S	A	M	•											
I=6			•	•											
	•	•	•												
	•	•													

– If it doesn't allow string variables, you're out of luck, and will have to use assembly language.

– In assembly language, simply allocate 24 or so bytes per array location, and store the characters one per byte, filling in any unused bytes with blank characters.

Table 4.

Seven ways of cutting down on memory usage listed in order of decreasing disgustingness.

0. Give up.
1. Decrease your ambitions, throw away some of your program's capabilities.
2. Throw out REMarks and cram more than one statement onto each line. Note: Since both of these make your program harder for people to understand, be *sure* to keep good written records of what the program does and how it does it.
3. Use abbreviations in string data, or convert string values into numeric values. Note: The latter saves a little space — the space used to store string length information.
4. Cram more than one piece of data into a single variable. Note: Be sure to include packing and unpacking subroutines so users don't have to deal with conglomerated, messy values.
5. Revise the basic algorithm so that it (re-)computes values instead of relying on stored data. One example: Instead of storing calender dates and days of the week, look up and use an algorithm which computes them.
6. Use external storage devices.

Table 5.

write the code, but also to see whether it's really practical. In fact, with a system like our club's, our new plan *isn't* practical. Our cassette tape interface runs at 300 baud — about 25 characters a second. That means each memory-full of membership records (each 80 records) will take almost five and a half minutes to read in.

Suppose we have 200 members and one of them tells us that there's a mistake in his mailing address. Suppose further that he's a recent member and his record is near the end of the file. The way we have it now, the person using the program to do the required update will have to put on the first tape, sit there 5½ minutes, find (groan) that the desired record wasn't on that tape, get the next one, wait 5½ minutes, etc. It would be so gruesome that no one would ever want to do the updates that were supposed to be one of our system's big features.

Fortunately, there's a way out and it won't require any major changes to anything but our search algorithm. Unfortunately, we'll have to wait until next month to find out what it is so we can (finally) complete our club's record keeping program.

What have we accomplished so far? We've taken a realistic, fair-sized problem and broken it down into small manageable parts. We've stepped back (well OK, *fallen* back) and analyzed how the system will work in practice — and found our plan wanting. Along the way, we've seen techniques for using arrays, organizing data, and we've seen a search strategy that is useful when dealing with small amounts of data. We've seen some techniques for saving memory space. Most of all, we've had a mind's eye view of the agony and the ecstasy of developing software. ■

Hints about next month's search strategy:

— If telephone directories were organized like the scheme we've used so far (the names aren't in alphabetical or any other particular order), would you be willing to use one?

— If somebody asks you to guess a number from 1 to 100 that they're thinking of, and they tell you "high," "low," or "got it" after each guess, what's the most guesses you'd ever need?

OSCAR Orbits on Your Altair

-- the software you've needed

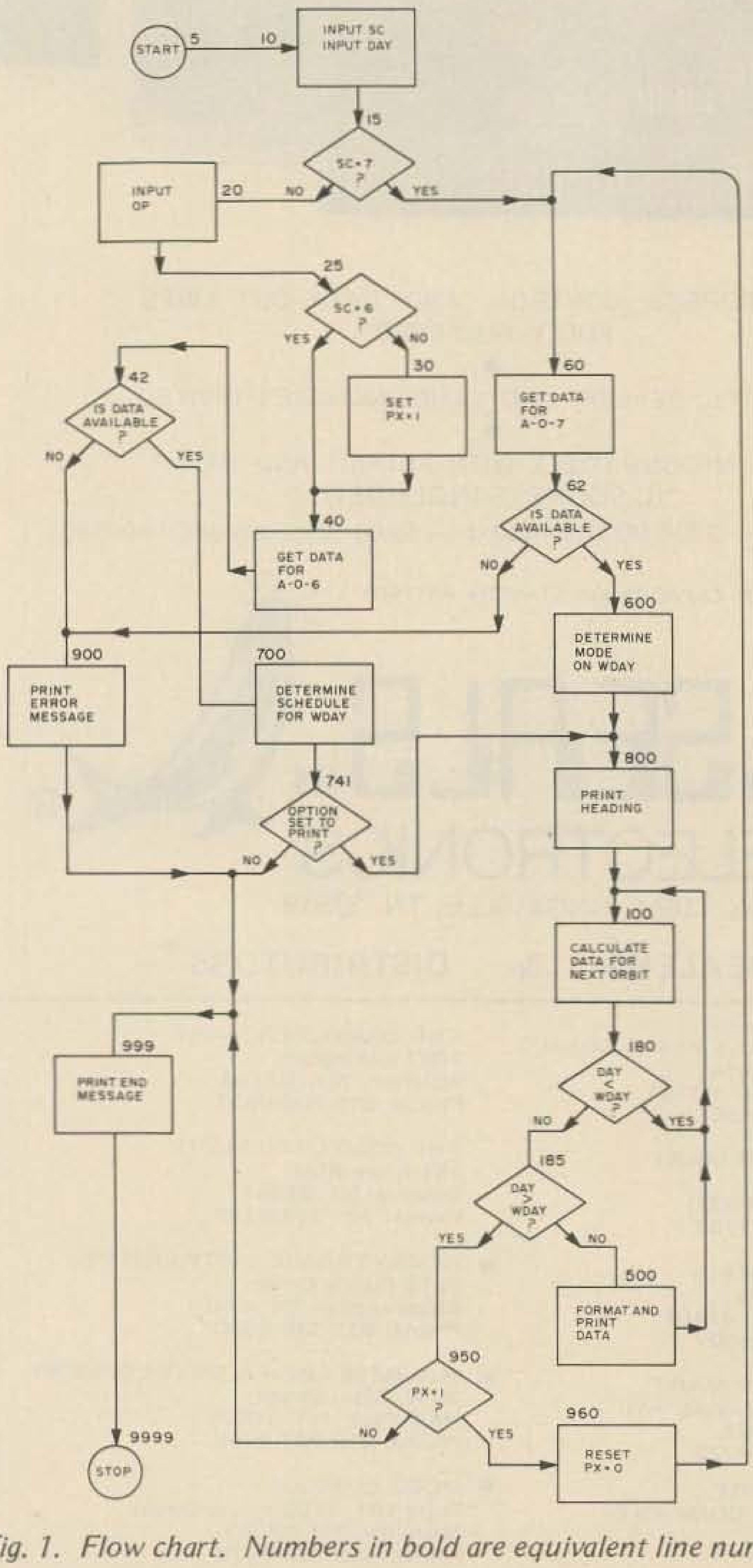

Fig. 1. Flow chart. Numbers in bold are equivalent line numbers.

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11532 Stewart Lane
Silver Spring MD 20904

Altair owners rejoice. You can now obtain individual orbital predictions for the AMSAT-OSCAR 6 and 7 spacecraft on your machine, for any day of the year, using the following program.

This program is written in ALTAIR BASIC (8K) and uses only about 1750 bytes of User Program Memory Area.

The program gives you the following options: spacecraft 6 – AMSAT-OSCAR 6 orbits only; spacecraft 7 – AMSAT-OSCAR 7 orbits only; spacecraft Ø – both spacecraft orbits.

If spacecraft 6 or Ø are chosen the following options are available: Ø – Print the orbits; 1 – Print the orbits only if the Spacecraft is scheduled for communications use that day.

The opening dialogue is as follows: The program asks for the day, spacecraft and if necessary the option. It then thinks about it for a while and prints out the required data. Several examples of such listings are shown.

The program works in the following manner, outlined in the flow chart of Fig. 1. The initial dialogue gives it the wanted day (WDAY) and the spacecraft (SC). Next it picks up the orbital parameters depending on the spacecraft chosen. The data for AMSAT-OSCAR 6 are stored in lines 40 and 45, and that for AMSAT-OSCAR 7 in lines 60 and 65.

A test is performed at line 42 or 62 to determine if data is available for the wanted day. If the "both spacecraft" option has been chosen, a "print" flag (PX) is set at line 30.

Next the condition of the

```
LIST

5     PRINT "OSCAR SPACECRAFT ORBIT PREDICTIONS V2.0"
8     C$="SPACECRAFT":E$=" SCHEDULED "
10    PRINT C$;:INPUT SC
12    PRINT "DAY";:INPUT WDAY
15    IF SC=7 THEN 60
20    PRINT "OPTION";:INPUT OP
25    IF SC=6 THEN 40
28    REM BOTH SC OPTION
30    SC=6:PX=1
35    REM OSCAR 6 DATA
40    RB=15682:TM=13.9:DAY=81:XS=57.9
42    IF WDAY<DAY THEN GOSUB 900
45    PD=114.99+0.0046076
50    GOSUB 700:GOTO 70
55    REM OSCAR 7 DATA
60    RB=6156:TM=101.48:DAY=81:XS=75.2
62    IF WDAY<DAY THEN GOSUB 900
65    PD=114.94+0.004834
68    GOSUB 600
70    GOSUB 800
75    PRINT "ORBIT","TIME(GMT)","LONG(DEG-W)","REF ORB(";RB;")"
100   RB=RB+1:XS=XS+PD/4
125   IF XS<360 THEN 140
130   XS=XS-360
140   TM=TM+PD
145   IF TM<1440 THEN 180
150   TM=TM-1440: DAY=DAY+1
180   IF WDAY>DAY THEN 100
185   IF WDAY<DAY THEN 950
500   TF=TM: HR=0
505   IF TF<60 THEN 515
510   TF=TF-60:HR=HR+1:GOTO 505
515   HR=HR*100: HR=INT(HR+TF)+(TF-INT(TF))
516   HR=INT(HR*100)/100
519   XP=INT(XS*100)/100
520   PRINT RB,HR,XP:GOTO 100
600   MODE=WDAY-INT(WDAY/2)*2
615   IF MODE=0 THEN 630
620   B$="A":GOTO 660
630   DB=WDAY+0
635   DB=DB-INT(DB/7)*7
640   IF DB=0 THEN 655
645   B$="B":GOTO 660
655   B$="X"
660   E$=" IN MODE "
670   RETURN
700   SDAY=WDAY+3:IF SDAY<7 THEN 720
710   SDAY=SDAY-7
715   IF SDAY>7 THEN 710
720   IF SDAY=1 THEN 750
725   IF SDAY=4 THEN 750
730   IF SDAY=6 THEN 750
740   B$="NOT AVAILABLE FOR USE"
741   IF OP=0 THEN 745
742   GOSUB 800:GOTO 950
745   RETURN
750   B$="AVAILABLE ON ASCENDING MODE PASSES"
760   RETURN
800   PRINT:PRINT:PRINT
810   PRINT "EQUATORIAL CROSSING TIMES FOR OSCAR";SC;"DAY";WDAY
820   PRINT C$;:PRINT E$;:PRINT B$:PRINT
830   RETURN
900   PRINT "SORRY, DATA VALID AS FROM DAY ";DAY
910   GOTO 9999
950   IF PX=0 THEN 999
960   PX=0:SC=7:GOTO60
970   PRINT"
999   PRINT TAB(40):PRINT "G3ZCZ"
9999  END
OK
```

spacecraft on WDAY is computed. For AMSAT-OSCAR 6, the actual day of the week that WDAY occurs on is calculated (SDAY) and compared with the spacecraft operational schedule in the subroutine starting at line 700, and the program ends if option (OP) zero was chosen and WDAY is an OFF (i.e., AMSAT-OSCAR 6 is not available for communications use) day.

Similarly, the mode that AMSAT-OSCAR 7 will be in on WDAY is computed by the subroutine starting at line 600.

The table headings are then printed (subroutine starting at 800 and line 75).

The main loop starts at line 100. The orbit (RB) is incremented and the equatorial crossing (XS) is updated by one progression amount at line 100. If the value of XS should become greater than 360°, it is fudged by the routine at lines 125 and 130. The time TM is

```
OSCAR SPACECRAFT ORBIT PREDICTIONS V2.0
SPACECRAFT? 0
DAY? 84
OPTION? 0

EQUATORIAL CROSSING TIMES FOR OSCAR 6 DAY 84
SPACECRAFT SCHEDULED NOT AVAILABLE FOR USE

ORBIT       TIME(GMT)     LONG(DEG-W)     REF ORB( 15682 )
15720       103.69        70.34
15721       258.69        99.09
15722       453.68        127.84
15723       648.67        156.59
15724       843.67        185.34
15725       1038.66       214.09
15726       1233.66       242.84
15727       1428.65       271.58
15728       1623.65       300.33
15729       1818.64       329.08
15730       2013.64       357.83
15731       2208.63       26.58

EQUATORIAL CROSSING TIMES FOR OSCAR 7 DAY 84
SPACECRAFT IN MODE X

ORBIT       TIME(GMT)     LONG(DEG-W)     REF ORB( 6156 )
6193        34.43         58.43
6194        229.38        87.17
6195        424.32        115.91
6196        619.27        144.64
6197        814.21        173.38
6198        1009.16       202.12
6199        1204.1        230.85
6200        1359.05       259.59
6201        1553.99       288.32
6202        1748.94       317.06
6203        1943.88       345.8
6204        2138.83       14.53
6205        2333.77       43.27
                                  G3ZCZ
OK
OSCAR SPACECRAFT ORBIT PREDICTIONS V2.0
SPACECRAFT? 7
DAY? 45
SORRY, DATA VALID AS FROM DAY 81

OK
RUN
OSCAR SPACECRAFT ORBIT PREDICTIONS V2.0
SPACECRAFT? 7
DAY? 82

EQUATORIAL CROSSING TIMES FOR OSCAR 7 DAY 82
SPACECRAFT IN MODE B
ORBIT       TIME(GMT)     LONG(DEG-W)     REF ORB( 6156 )
6168        40.81         60.03
6169        235.76        88.77
6170        430.7         117.5
6171        625.65        146.24
6172        820.59        174.97
6173        1015.54       203.71
6174        1210.48       232.45
6175        1405.43       261.18
6176        1600.37       289.92
6177        1755.32       318.66
6178        1950.26       347.39
6179        2145.21       16.13
6180        2340.15       44.86
                                  G3ZCZ

OK
RUN
OSCAR SPACECRAFT ORBIT PREDICTIONS V2.0
SPACECRAFT? 0
DAY? 83
OPTION? 1

EQUATORIAL CROSSING TIMES FOR OSCAR 6 DAY 83
SPACECRAFT SCHEDULED NOT AVAILABLE FOR USE

EQUATORIAL CROSSING TIMES FOR OSCAR 7 DAY 83
SPACECRAFT IN MODE A

ORBIT       TIME(GMT)     LONG(DEG-W)     REF ORB( 6156 )
6181        135.1         73.6
6182        330.04        102.34
6183        524.99        131.07
6184        719.93        159.81
6185        914.88        188.55
6186        1109.82       217.28
6187        1304.76       246.02
6188        1459.71       274.75
6189        1654.65       303.49
6190        1849.6        332.23
6191        2044.54       .96
6192        2239.49       29.7
                                  G3ZCZ
OK
```

```
RUN
OSCAR SPACECRAFT ORBIT PREDICTIONS V2.0
SPACECRAFT? 6
DAY? 85
OPTION? 1

EQUATORIAL CROSSING TIMES FOR OSCAR 6 DAY 85
SPACECRAFT SCHEDULED AVAILABLE ON ASCENDING MODE PASSES

ORBIT     TIME(GMT)     LONG(DEG-W)     REF ORB( 15682 )
15732     3.63          55.33
15733     158.62        84.08
15734     353.62        112.83
15735     548.61        141.57
15736     743.6         170.32
15737     938.6         199.07
15738     1133.59       227.82
15739     1328.59       256.57
15740     1523.58       285.32
15741     1718.58       314.07
15742     1913.57       342.81
15743     2108.57       11.56
15744     2303.56       40.31
                                        G3ZCZ
OK

RUN
OSCAR SPACECRAFT ORBIT PREDICTIONS V2.0
SPACECRAFT? 6
DAY? 84
OPTION? 1

EQUATORIAL CROSSING TIMES FOR OSCAR 6 DAY 84
SPACECRAFT SCHEDULED NOT AVAILABLE FOR USE

                                        G3ZCZ
```

incremented by adding the period (PD) at line 140. Note PD and TM are in minutes. If the new time is greater than 1440 minutes (24 hours), it is fudged and the day (DAY) count incremented at lines 145 and 150. Line 180 is the print control line, for if WDAY is greater than DAY, printing is inhibited.

This program calculates the orbital parameters for any wanted day (WDAY) by starting with a reference day and updating it by successive additions. Line 185 detects that all the orbits for WDAY have been printed and stops the program execution.

The routine beginning at line 500 formats the data for the printout at line 520. The value of TM in minutes is converted to hours and minutes and formatted to print out only two decimal places (the formatted value becoming TF). The equatorial crossing location (XS) is also similarly formatted (the formatted value becoming XP). After the data is printed, the program computes the parameters for the next orbit and so on.

After the day's orbits for AMSAT-OSCAR 6 have been printed or inhibited (depending on OP), the value of PX is tested. If it is Ø, the program exits. If it is 1, PX is reset and the orbits of AMSAT-OSCAR 7 for WDAY are calcuated and printed.

Spread out in the program are examples of string manipulation. At line 5 the strings C$ and E$ are set up. B$ is set to one of a number of possible states at lines 620, 645, 740 or 750, and E$ is changed at line 660. This allows the fixed "print string" function of line 820 to print a number of different messages depending on how the strings have been set up. This technique uses less memory space than routines that set up the strings individually and require separate print lines in the individual subroutines.

This is a pretty simple-minded program. It can be modified in many ways. Some suggested ones are as follows:

1. Only print orbits in range of station.
2. Print ascending mode orbits only in the case of AMSAT-OSCAR 6.
3. Add antenna pointing data.

If anyone is interested in a paper tape of the program listing, I can supply one for $1.00 and an SASE. ■

Now we're on TV!

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Wave Mate introduces Jupiter IIC, a complete computer system incorporating a monitor quality TV interface. This system provides everything you need to create and run application programs. Jupiter IIC includes a CPU with 8K dynamic RAM and 3K ROM memory, video terminal interface and keyboard, and dual audio cassette tape interface. The TV interface features upper and lower case and Greek character sets, and dot graphics. The dual audio cassette interface provides start/stop operation and operates at 300, 600, or 1200 baud. And of course we still provide these high-quality features: burn-in tested IC's, socketed IC's, complete documentation, and more.

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SOFTWARE

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THE JUPITER IIC KIT: $2200

The kit includes the CPU, software debugger and monitor module, 8K dynamic memory, module cage, power supply, front panel, video interface, cassette interface, and all the documentation required to assemble, run, and understand the system as well as modification instructions for a black and white TV set.

THE JUPITER IIC ASSEMBLED SYSTEM: $3200

All components of the Jupiter IIC kit plus two audio cassette units and a 12-inch black and white TV set. The complete system is shipped with all components assembled and tested.

SPECIFICATIONS

CPU

MC 6800; eight-level interrupt, prioritized and maskable by level; single-cycle and block DMA

DUAL AUDIO CASSETTE

Complete paper tape replacement; start/stop motor control; 300, 600, or 1200 baud (crystal controlled); error correction

VIDEO TERMINAL INTERFACE

64 x 16 lines (32 lines optional); Upper and lower case, plus Greek alphabet; 7 x 12 format, 128 dot (hor.) x 48 dot (vert.) graphics (96 dot optional)

MEMORY

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Generates full 128-character ASCII set

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Title ____________________
Company ____________________
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Champaign IL 61820

ASCII/Baudot Converter for Your TVT

- - series or parallel to boot

The schematic diagrams for the 3321 Baudot input option are shown in Figs. 1 and 2. The Baudot input option is used to receive serial Baudot, convert it to parallel, and make a code conversion to ASCII which can be used with the 3320 display unit. The three main circuits are a UART and two 8223 programmable read only memories (PROMs), which are programmed for the Baudot to ASCII conversion. The UART must be clocked at 16 times the baud rate. This clock, and therefore the baud rate, is dependent on the setting of the divide by N inputs of plug 2. The formula for setting the inputs to a one or a zero is:

$$256 - \frac{198{,}080}{16 \times \text{baud rate}} = \text{the setting of the jumpers}$$

Note that the setting of the jumpers must be converted to binary before the dip plug is actually wired to ones and zeros.

Example: For 100 baud (132 wpm),

$$256 - \frac{198{,}080}{16 \times 100} =$$

$$\frac{198{,}080}{1600} = 137$$

Note that 137 is (lsb) 1001 0001 (msb) in binary. The pins of the dip plug can be hardwired according to the above formula. Table 1 gives the settings and dip plug pin numbers for some common speeds. You could also run the wires from the plug to a switch so that you could have many speeds.

The output of these dividers (circuits 3 and 4) is pin 15 of 4 and is sent to the UART to clock the input data in. The input data can be either a 60 milliampere loop, RS-232, or TTL compatible. If it is TTL or RS-232, the data is buffered with Q1 and sent directly to the UART. To allow the transistor to switch from high to low, the output of the loop data in-

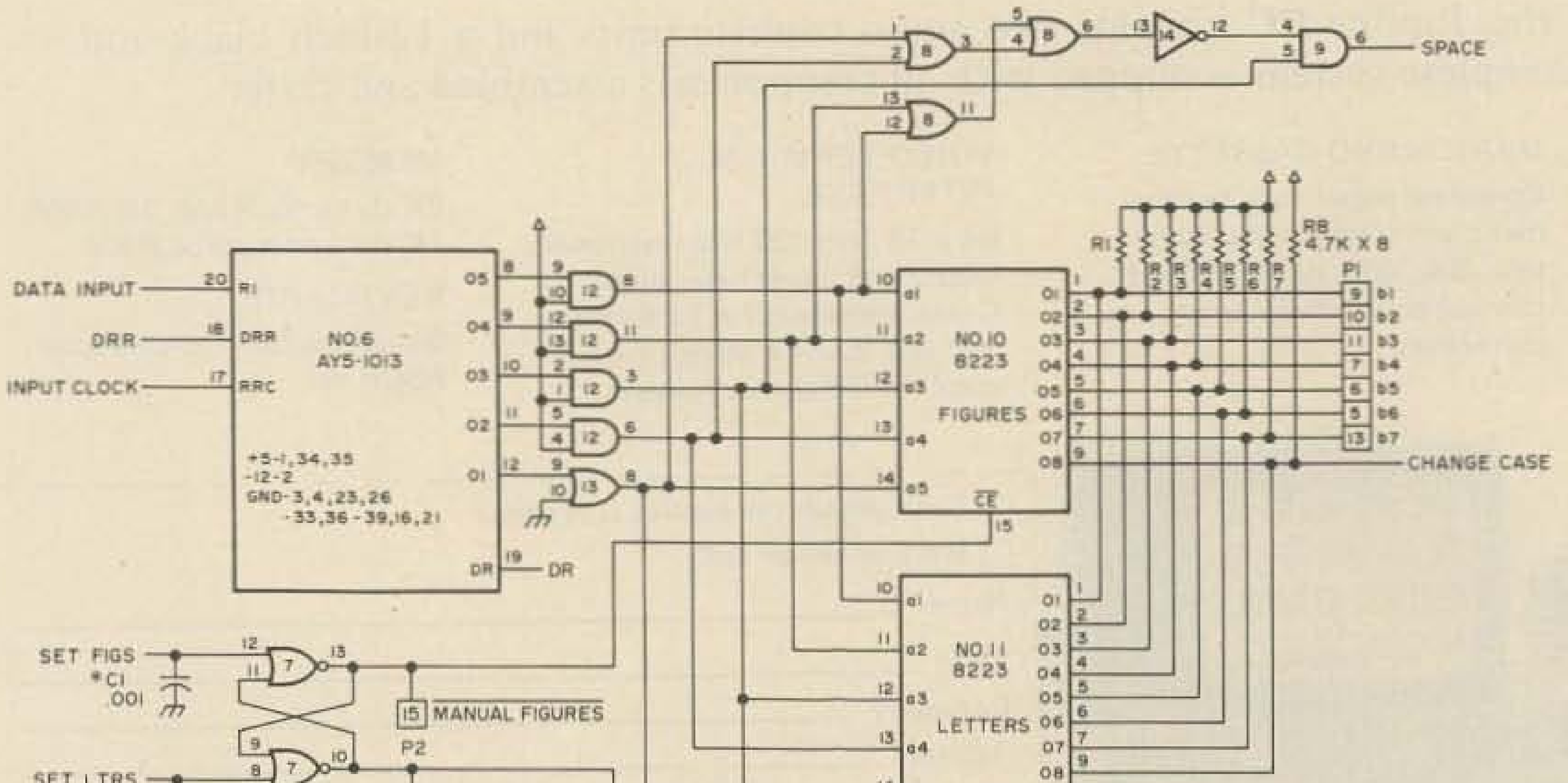


Fig. 1. UART and control. C1 and C2 are tack-soldered to the bottom of earlier boards. Newer boards have provisions for these capacitors in their artwork.

verter must be high. Therefore, the input is grounded if TTL or RS-232 is to be used. If the loop is used, diodes D1-D4 form a full wave rectifier whose output is regulated to 5.1 volts by D5. The 68 Ohm resistor limits the current through the LED inside the circuit (which is between pins 1 and 2). When this LED has current through it, it emits light which turns on a phototransistor, also inside the IC. This shorts pin 5 to ground, causing pin 10 of 14 to go high. Thus, with loop current flowing (mark condition), the input of the UART is high. The integrated circuit is an optically-coupled isolator, and is used to make sure that the high voltage loop does not get to the TTL circuits.

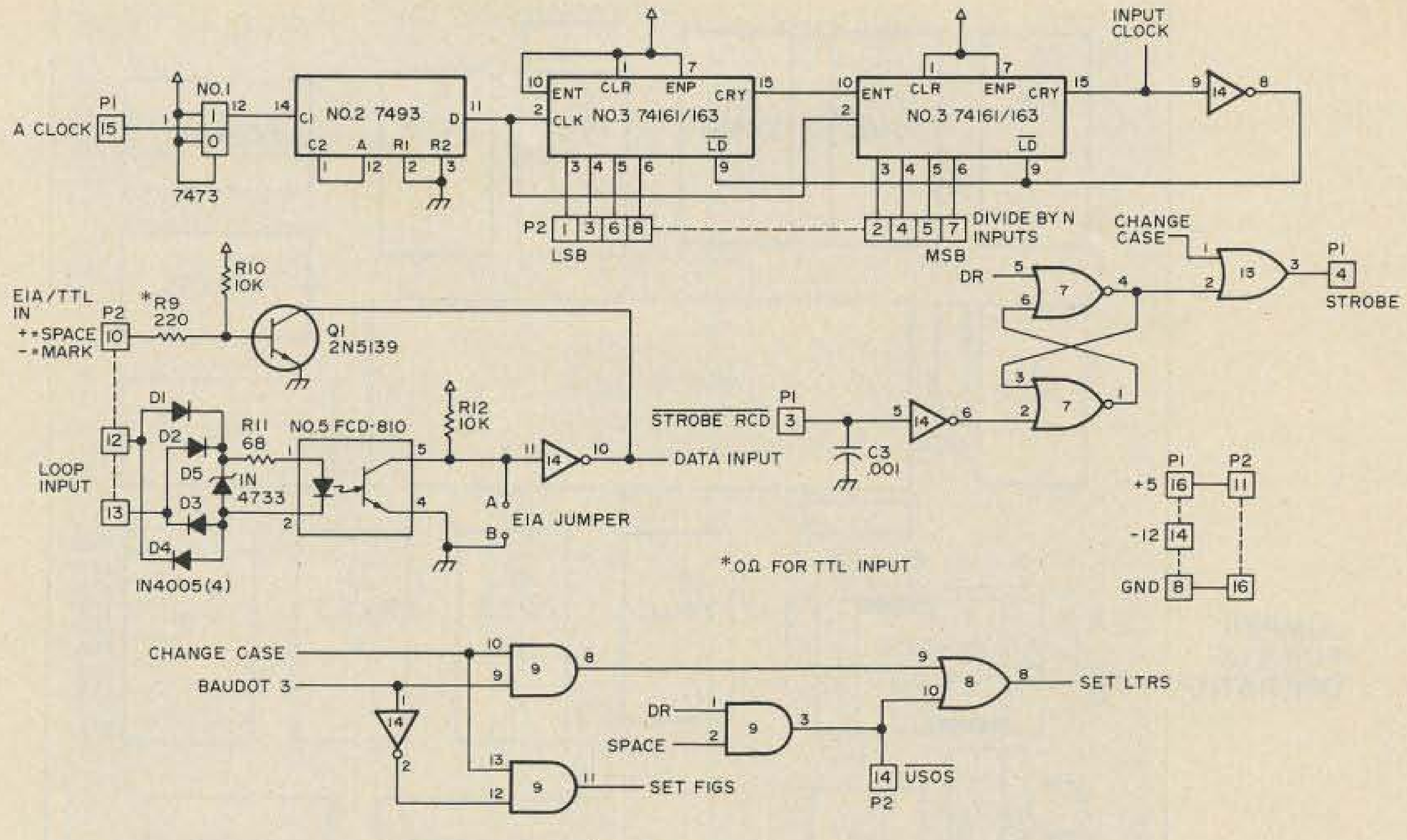


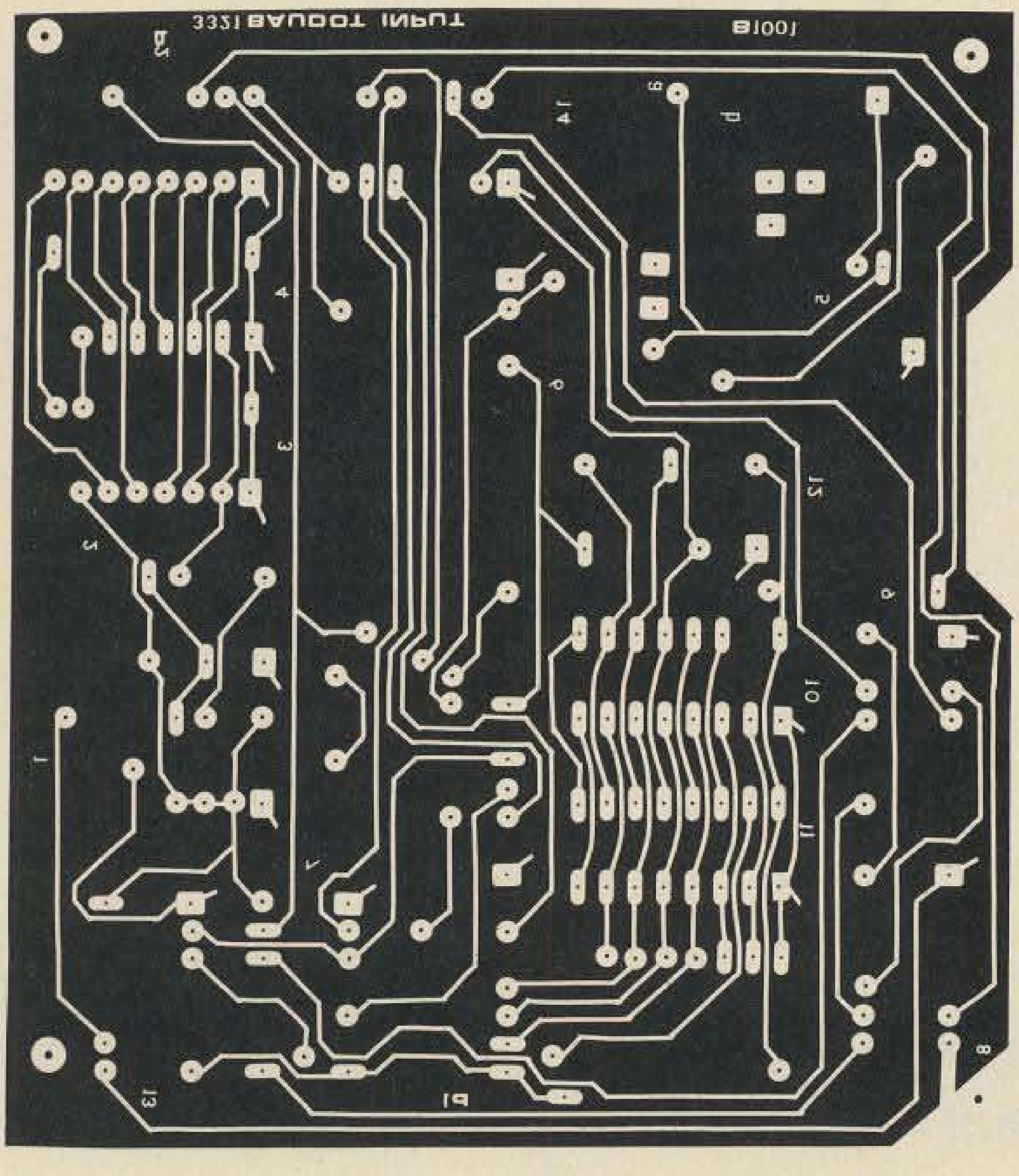
Fig. 2. Interfaces.

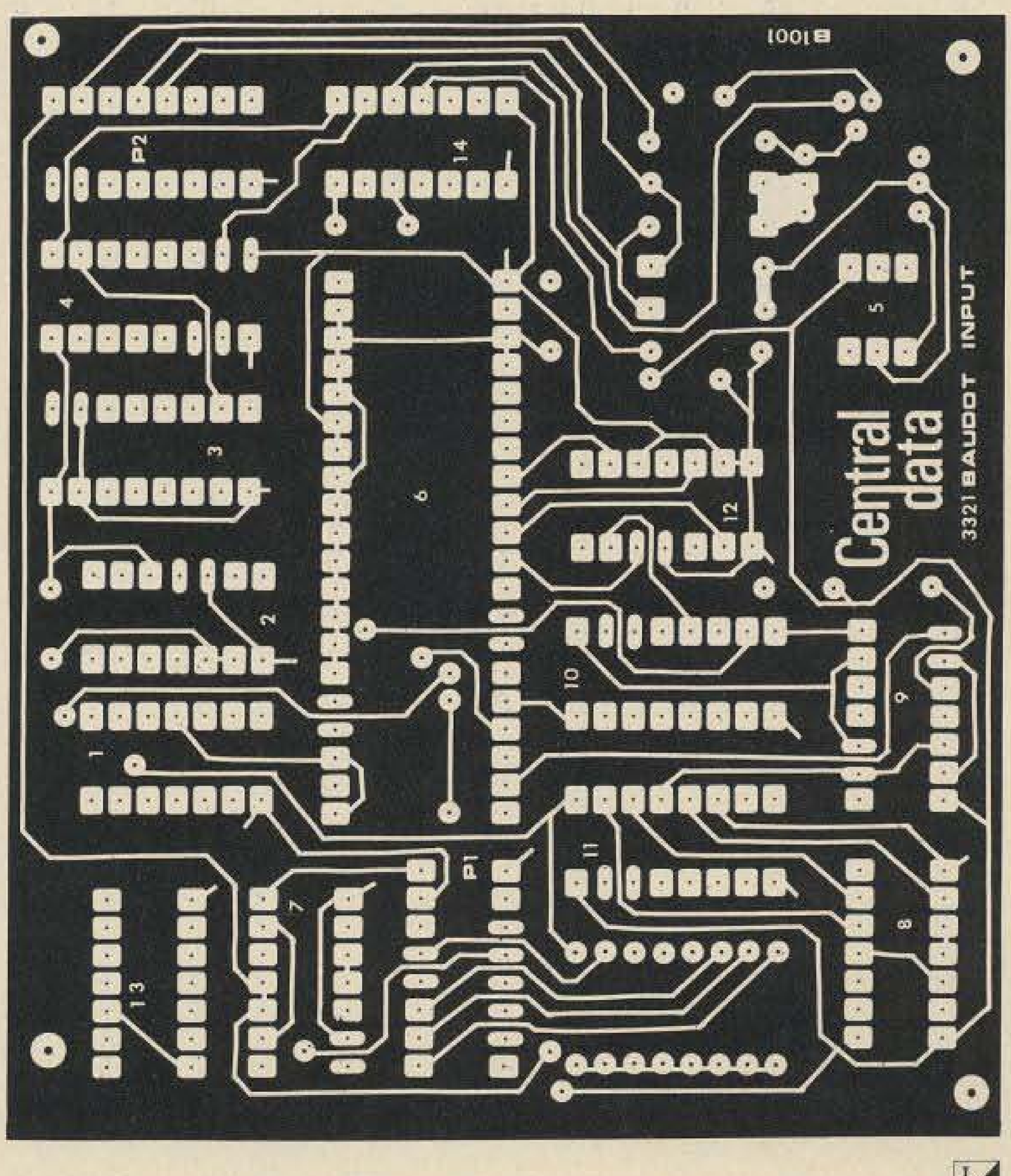
WPM	Baud	lsb	msb
P2 pins		1368	2457
132	100	1001	0001
100	73.7	1111	1010
75	57	1111	0100
66	50	0100	1000
60	45.5	0000	0000

Table 1. Settings of the divide by N inputs for common baud rates. The 60 wpm setting is not exact, but it is close enough such that no errors will be caused.

This input data is sent to pin 20 of the UART. When this data drops to a space condition (logical zero), the UART loads the data, one bit at a time, into its output register, and brings pin 19 (data ready) high. This sets a flip flop (circuit 7) whose $\overline{Q}$ output (pin 4) goes low. If the character was not a change case code, this becomes the strobe line to the 3320 display unit. As soon as the strobe has been received, a short strobe received is sent back to the UART board, which resets this flip flop. The $\overline{Q}$ output of the flip flop is also sent back to the UART to reset the data ready line. The data is still, however, available at the UART's outputs.

This data is sent to a buffer so that it can drive several TTL loads. From there it goes to the PROM code converter and to a circuit whose output (pin 6 of 9) goes high if the input data was a space. The outputs of the PROMs are open collector, and only one set of outputs is enabled at one time. One PROM is used if the unit is in the letters case. Likewise, the other one is used if it is in the figures case.





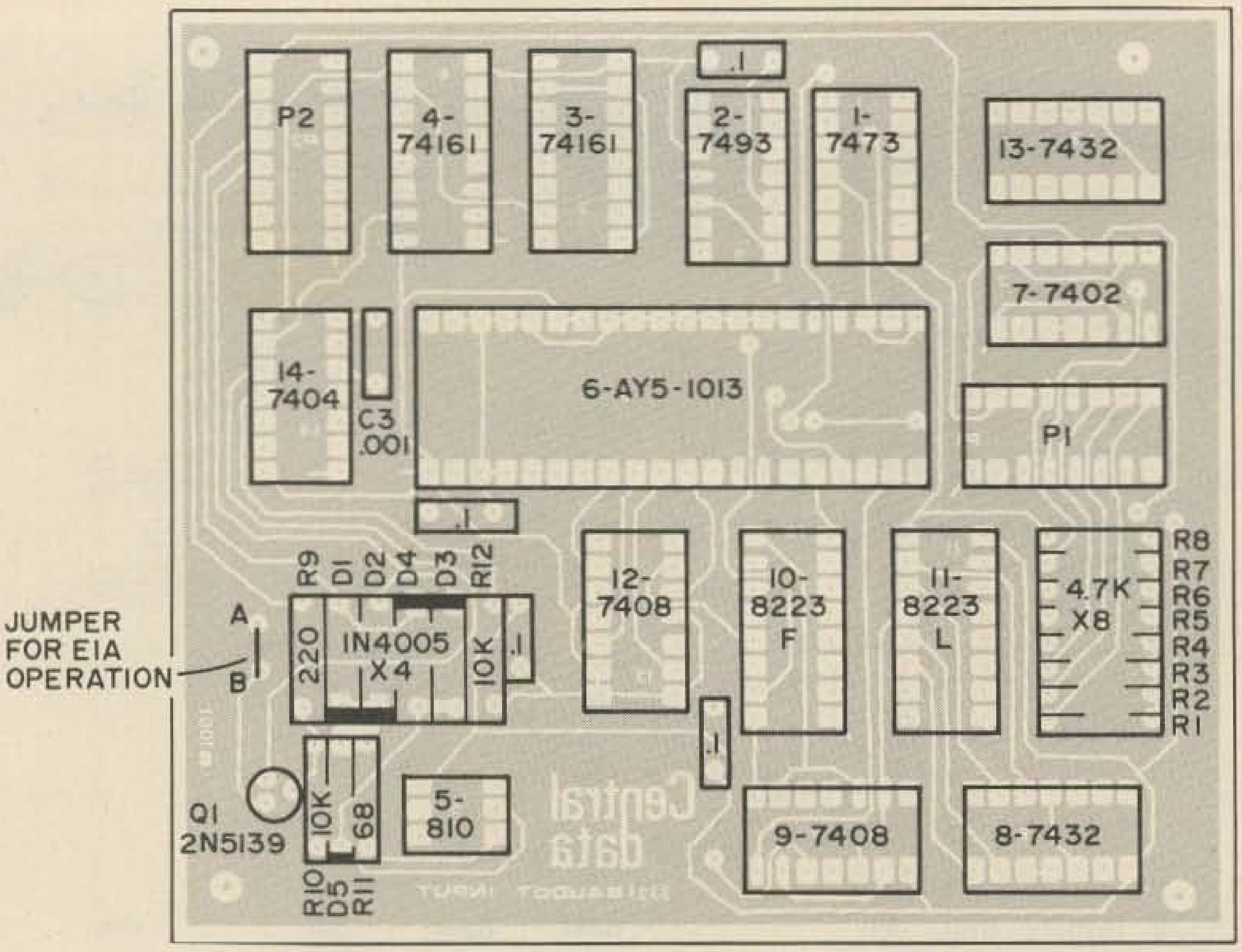


Fig. 3. PC board and parts layout.

The PROM that is enabled has pin 15 brought low by the other flip flop in circuit 7 (pins 13 or 10). The output of the code converter consists of 7 bits coded in ASCII and one bit that is high only if the case is to be changed. Table 2 has the ASCII and Baudot codes, as the PROMs convert them. The ASCII bits are sent to the 3320 display board through a buffer consisting of AND gates, but the change case bit is decoded with the Baudot data to decide whether to shift into figures or letters. If bit 3 of the Baudot data is high, the unit goes into letters shift, while if it is low it goes into figures shift. The unit can also go into letters if a space is received, and unshift on space is not inhibited (pin 3 of 9 is not grounded). If a figures shift command is received, pin 11 of 9 goes high, which sets a flip flop at pin 12 of 7. This brings 13 of 7 low, enabling the figures PROM. If a letters shift command is received, or if USOS is enabled and a space is received, pin 8 of 8 is high, which sets the flip flop at pin 8 of 7. This brings pin 10 of 7 low, which enables the letters PROM. The unit can be put manually into figures or letters by grounding the enable pins of the desired PROM. This will set the flip flop accordingly.

Assembly

Refer to the first four paragraphs of the main logic board's assembly procedure for basic information pertaining to the assembly of this kit. Fig. 3 is the placement drawing for all of the components on the Baudot Input Board. All parts have their type number and component number (as used on schematics) printed on the drawing.

1) Mount and solder all resistors and diodes to the board. The banded (cathode) ends of the diodes are marked by a square pad on the top of the board. Mount all resistors and diodes before soldering them, as a way to check your work.

2) Mount and solder the 40 pin socket and the two 16 pin sockets at the positions marked UART, P1, and P2, respectively.

3) Mount all the TTL integrated circuits on the board and, after checking their placement, solder them in. The placement of pin one is denoted by a small "flag" coming off of that pin's pad — along with a square pad on the top of the board.

4) Plug the 40 pin UART into the socket, being careful not to bend the leads.

5) Mount all capacitors and the transistor, being sure to polarize the electrolytic. The

CHAR	A_5	A_4	A_3	A_2	A_1	0_8	0_7	0_6	0_5	0_4	0_3	0_2	0_1
blank	0	0	0	0	0	0	0	1	0	0	0	0	0
T	0	0	0	0	1	0	1	0	1	0	1	0	0
CR	0	0	0	1	0	0	0	0	0	1	1	0	1
O	0	0	0	1	1	0	1	0	0	1	1	1	1
SPACE	0	0	1	0	0	0	0	1	0	0	0	0	0
H	0	0	1	0	1	0	1	0	0	1	0	0	0
N	0	0	1	1	0	0	1	0	0	1	1	1	0
M	0	0	1	1	1	0	1	0	0	1	1	0	1
LF	0	1	0	0	0	0	0	0	0	1	0	1	0
L	0	1	0	0	1	0	1	0	0	1	1	0	0
R	0	1	0	1	0	0	1	0	1	0	0	1	0
G	0	1	0	1	1	0	1	0	0	0	1	1	1
I	0	1	1	0	0	0	1	0	0	1	0	0	1
P	0	1	1	0	1	0	1	0	1	0	0	0	0
C	0	1	1	1	0	0	1	0	0	0	0	1	1
V	0	1	1	1	1	0	1	0	1	0	1	1	0
E	1	0	0	0	0	0	1	0	0	0	1	0	1
Z	1	0	0	0	1	0	1	0	1	1	0	1	0
D	1	0	0	1	0	0	1	0	0	0	1	0	0
B	1	0	0	1	1	0	1	0	0	0	0	1	0
S	1	0	1	0	0	0	1	0	1	0	0	1	1
Y	1	0	1	0	1	0	1	0	1	1	0	0	1
F	1	0	1	1	0	0	1	0	0	0	1	1	0
X	1	0	1	1	1	0	1	0	1	1	0	0	0
A	1	1	0	0	0	0	1	0	0	0	0	0	1
W	1	1	0	0	1	0	1	0	1	0	1	1	1
J	1	1	0	1	0	0	1	0	0	1	0	1	0
figs	1	1	0	1	1	1	0	1	0	0	0	0	0
U	1	1	1	0	0	0	1	0	1	0	1	0	1
Q	1	1	1	0	1	0	1	0	1	0	0	0	1
K	1	1	1	1	0	0	1	0	0	1	0	1	1
ltrs	1	1	1	1	1	1	0	1	0	0	0	0	0

Table 2(a). PROM coding, LETTERS PROM.

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01	0.36	27	0.38	132	1.50	169	1.87
02	0.36	30	0.36	138	1.38	175	1.35
04	0.42	32	0.38	139	1.38	221	1.38
08	0.38	37	0.53	155	1.38	258	1.38
10	0.36	38	0.53	157	1.25	273	2.25
11	0.38	42	1.25	160	1.85	367	1.00
20	0.36	74	0.56	162	1.85	368	1.00
21	0.38	75	0.85	163	1.85	377	1.88

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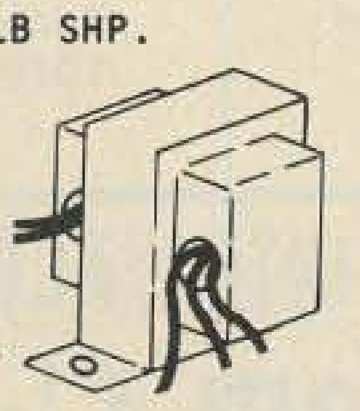

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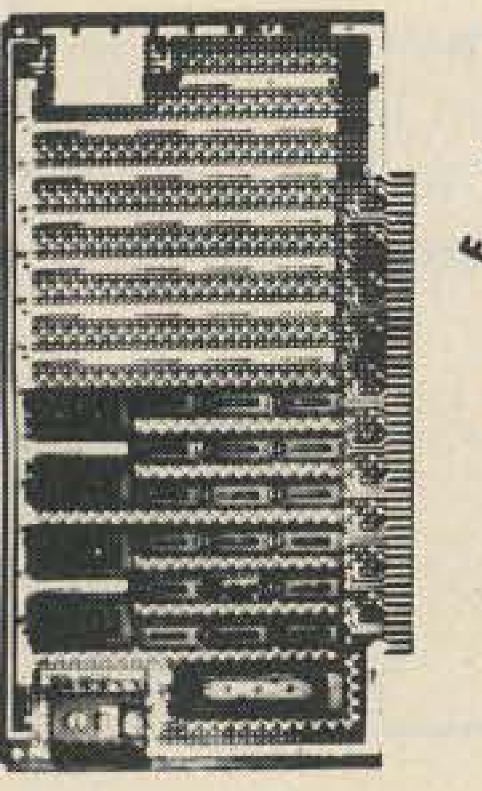

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Universal Prototype Board $19.95 +1 lb shp

This is one of the neatest Altair accessories we've seen. It accepts virtually any size IC package, has a power and ground plane on opposite sides of the board for extra capacitance. Room for 4 regulators, 1 heat sink provided with board. By the way, the sockets are shown only for illustration, but they get the point across that you can stuff a lot of ICs on here --- implement your own memory boards, I/O boards, etc.

CHAR	A_5	A_4	A_3	A_2	A_1	0_8	0_7	0_6	0_5	0_4	0_3	0_2	0_1
blank	0	0	0	0	0	0	0	1	0	0	0	0	0
5	0	0	0	0	0	0	0	1	1	0	1	0	1
CR	0	0	0	1	0	0	0	0	0	1	1	0	1
9	0	0	0	1	1	0	0	1	1	1	0	0	1
space	0	0	1	0	0	0	0	1	0	0	0	0	0
#	0	0	1	0	1	0	0	1	0	0	0	1	1
,	0	0	1	1	0	0	0	1	1	1	1	0	0
.	0	0	1	1	1	0	0	1	1	1	1	1	0
LF	0	1	0	0	0	0	0	0	0	1	0	1	0
)	0	1	0	0	1	0	0	1	0	1	0	0	1
4	0	1	0	1	0	0	0	1	1	0	1	0	0
&	0	1	0	1	1	0	0	1	0	0	1	1	0
8	0	1	1	0	0	0	0	0	1	1	1	0	0
Ø	0	1	1	0	1	0	0	1	1	0	0	0	0
:	0	1	1	1	0	0	0	1	0	1	0	1	0
;	0	1	1	1	1	0	0	1	0	1	0	1	1
3	1	0	0	0	0	0	0	1	1	0	0	1	1
"	1	0	0	0	1	0	0	1	0	0	0	1	0
$	1	0	0	1	0	0	0	1	0	0	1	0	0
?	1	0	0	1	1	0	0	1	1	1	1	1	1
bell	1	0	1	0	0	0	0	0	0	0	0	0	0
6	1	0	1	0	1	0	0	1	1	0	1	1	0
!	1	0	1	1	0	0	0	1	0	0	0	0	1
/	1	0	1	1	1	0	0	1	0	1	1	1	1
—	1	1	0	0	0	0	0	1	1	1	1	0	1
2	1	1	0	0	1	0	0	1	1	0	0	1	0
'	1	1	0	1	0	0	0	1	0	0	1	1	1
figs	1	1	0	1	1	1	0	1	0	0	0	0	0
7	1	1	1	0	0	0	0	1	1	0	1	1	1
1	1	1	1	0	1	0	0	1	1	0	0	0	1
(	1	1	1	1	0	0	0	1	0	1	0	0	0
ltrs	1	1	1	1	1	1	0	1	0	0	0	0	0

Table 2(b). PROM coding, FIGURES PROM.

square pad on the top of the board denotes the positive end of the capacitor and the emitter of the transistor.

Before attempting to operate this board, the main logic board must be completely working.

Operation

To hook the Baudot Input Board to the display board and to a TTY system, there are two 16 pin sockets and dip plugs that are used as connectors. The cable with two dip plugs that was shipped with the Baudot board is used to connect the large display board to the Baudot Input Board. This is accomplished by connecting the input socket of the main board to the P1 socket of the option board. To hook the system to your teletype system, the dip plug with cable contained in the main logic board's kit is used along with the P2 socket.

The pins of the P2 socket have the following designations:

1 – b1
2 – b2
3 – b3
4 – b4
5 – b5
6 – b6
7 – b7
8 – b8
9 – MANUAL LETTERS
10 – EIA, TTL input
11 – +5 V
12 – Loop input
13 – Loop input
14 – Unshift on Space
15 – MANUAL FIGURES
16 – Ground

The specifications for the input signals are:

TTL – 0-.8 V = mark
2.4-5 V = space

EIA – +3-+15 V = space
-3–15 V = mark

Loop – 0-2 mils = space
20-80 mils = mark

The pins marked b1-b8 represent the divide by N inputs and are used to set the speed of operation. These wires can be hardwired to one speed or can be run to a switch where many speeds can be selected. The procedure for figuring the correct jumpers is given in the theory of operation section.

Conclusion

If you decided to build all three boards, you now have a near universal display unit which can receive serial or parallel ASCII or serial Baudot. In any case, I hope that you enjoyed this project as much as I did. ■

Parts List (Baudot)

1 – 7404
1 – 7402
2 – 7408
2 – 7432
1 – 7473
1 – 7493
2 – 74161 or 74163
2 – 8223 (coded)
1 – AY5 – 1013 UART
1 – FCD – 810
4 – 1N4005
1 – 1N4735
1 – 2N5139
2 – 16 pin dip sockets
1 – 40 pin dip socket
1 – double ended dip plug
3 – .001 disc capacitors
4 – .1 disc capacitors
8 – 4.7k resistors
1 – 68 Ohm resistor
1 – 1k resistor
2 – 10k resistors
1 – 220 Ohm resistor
1 – Baudot Input circuit board

A kit of the above parts is available from: Mini Micro Mart, 1618 James Street, Syracuse NY 13203.

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HEY! This is like two transceivers in one! Fully synthesized covering 143.5 to 148.5 MHz in 5 kHz increments. Standard 600 kHz offsets up or down automatically. Reverse simplex and frequency split allow totally independent receive and xmit frequencies, and a priority channel guard that switches you back to it as soon as a signal is detected.

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- *Intermodulation, spurious and image 60 dB minimum*
- *10 pole xtal filter*
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- *S-meter speaker built-in*
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EDITORIAL BY WAYNE GREEN

from page 4

El Toro Crappo. After a couple days of driving all over the Bay Area, I have to report that you won't run into a nicer bunch of people. I never heard any bad language; I checked with one group after another on the channels and they said that, yes, a couple years ago they used to be annoyed with such characters, but they were long gone. I did hear someone jamming a channel for a bit, but the reaction of the others on channel made it apparent that this was unusual.

The one glaringly obvious aspect of CB in San Francisco was the low level of interference on most channels compared to many cities I have visited. There seem to be very few CBers in the Bay Area compared to back East. I was able to get on many channels and talk from my puny mobile setup (with a miniscule antenna) for many miles without being stepped on. I was absolutely amazed.

Even the highway channel (#18 there) was reasonably dead much of the time . . . it was so quiet that it took me a while to find out which channel was being used for traffic reports.

It is a pity that the FCC is so out of touch with their own services.

REPORT FROM DENVER

After getting thrown off the program, I decided not to bother with the expense of going to Denver . . . which turned out to be a shrewd decision, according to a report from an exhibitor.

This exhibitor drove a couple of days to get to Denver and found first off that his confirmed reservations were screwed up. After a lot of hassle, they finally gave him his room. Then he started looking for the material he had shipped out to be held for him at the convention . . . the stuff he was planning to sell and the reason he went all that way. After following a very difficult trail, he discovered that the firm he had been told to ship the stuff to had gone out of business three months earlier. The new firm received his shipment, held it ten days and then returned it. So all he had to sell was what he had brought with him in his car.

The booths were $300 each . . . and that is extremely high for ham convention booth space. He found his booth down in the cellar, not with the rest upstairs. There were a few others down there, too. Worse, there were no signs in the upstairs exhibit area to tell anyone about the cellar exhibits . . . and there was little light for some of the cellar booths. The convention committee refused to do anything about either problem, despite many tries at getting help.

Our hero took on the hotel again and finally managed to get them to get some lights set up so visitors, if any, would be able to see his booth. Then he tried again to get help getting some signs to let convention-goers know there were some exhibits in the cellar . . . no good. Finally, in desperation, he made some signs himself and put them near the elevators. This brought a few hardy souls to the remote area, but about half of the hams never found the place.

Not that things were going all that well with the regular exhibits. It was pretty lonesome there, and one manufacturer got so fed up that he gave up by Friday night and pulled out for home. Even the computer exhibits were empty most of the time . . . and computers have been pulling the best of all exhibits at conventions this year. Estimates by exhibitors put the attendance at a maximum of a bit over 1000 for Friday, and not much more than that on Saturday . . . and on Sunday virtually no one showed up so the exhibitors packed up and went home.

I'll be interested in how the show looked to the convention-goers . . . so drop a line to *73* with your views on what was good and what bad about the ARRL National Convention at Denver.

CB AND AMATEUR RADIO

As previously reported, ham clubs are now finding that about 80% of the new faces appearing for their Novice and General courses are coming from the CB ranks. This is natural . . . CB is an easy entry into radio two-way and a fellow would have to be a fool not to get his feet wet with it for starters. CB is fun, as about 20 million people have discovered. Of course we amateurs know that hamming is even more fun, but getting the word out is difficult.

In years gone by, I wrote a ham column for *Electronics Illustrated* as a way of enticing newcomers into amateur radio. That magazine evolved into *Mechanics Illustrated* and the ham column demised . . . pity. It seemed to me that we really needed a way to get hamming known to CBers . . . so I stewed about that for quite a while . . . and came up with an answer.

My column, "CB Radio Today," is being distributed nationally to newspapers. The column starts out telling about CB radio and then goes on to give the skinny on amateur radio. The results from the first few columns published (Boston, Galveston, and a few other cities) have been a massive influx of letters asking how people can get in touch with local ham clubs to get into the Novice classes.

WHAT CAN YOU DO?

You can help a lot with this . . . and in several ways. First, you can get after your local paper editor to run my column . . . he has nothing to lose for the paper advertising department should be able to get ads from Radio Shack and other CB dealers in the area to pay the freight. If you are willing to go see your local editor, drop me a note and I'll send you some sample columns to show him. The reader response has been fantastic . . . many write in to say they are saving the columns in a notebook for reference.

Secondly, you can make sure that your club has a Novice training program and that this is made known on a poster in all local radio stores. All I can do in my column, which is distributed nationwide, is to tell CBers to look up their radio distributors in the Yellow Pages and go there for info on classes.

The FCC admits that the club program for training Novices has already turned the tide and the number of amateurs is growing for the first time in twelve years (since "incentive licensing" was proposed). With large empty VHF bands, we need to keep plugging for more hams and more activity. You can do your bit by seeing that we get PR in your papers . . . and my CB column is the best way to keep this PR coming week after week.

Write to "CB Radio Today," Peterborough NH 03458 for sample columns and info.

TALK SHOW

It looked like a winner! A radio talk show with a ham MC, an active CBer, a representative from the FCC, an ARRL director, and Wayne Green on the telephone to talk about both CB and hamming. What a fantastic opportunity to help a few thousand more people get to know about hamming.

Things bombed out badly. The CBer had little background so couldn't add much to the pot. The FCC chap was an old time two letter call ham, so he and the ARRL director got into esoteric ham stuff of no possible interest to the general radio listeners. Instead of explaining about the *fun* of amateur radio and how to get started in radio communications via CB, the director got right into a long blast on how amateur radio was *not* a hobby, it was a *service* and was regulated by the ITU (whatever that was).

The FCC rep was about as anti-CB as hams come. I passed up the chance to ask him if he was active on CB because it was obvious he wasn't. CB was a bunch of law-breakers using bad language, period. Well, it might be okay back East, but where he was it was terrible. What can you say? I'll be in his city in a few days and I'll see for myself, for I will be bringing along a CB rig as well as my trusty 2m mobile. Like many other hams, I find CB invaluable for travel, though I seldom use it at home.

Since the general public is now aware of CB, but not really familiar with it, it seems to me that our best bet when we have a chance to get on radio or television is to let them know the benefits of CB . . . and then the further benefits of amateur radio . . . emphasizing that getting started in either is simple and not expensive. A lot of people have the idea that hamming takes huge investments in equipment, and they are surprised to find that amateur radio is really a very inexpensive hobby compared to most (like sports cars, boats, travel, blonds).

TRUMPET BLOWING

While at times I anguish over the time it takes for change, I suppose I should be satisfied that changes are (at last) going in what I consider a good direction . . . such as the recent granting of Novice privileges to Techs. The petition for that change was put into the FCC so many years ago that few of you probably have any notion of who was behind it . . . probably ARRL, right? To set the record straight, that was submitted by *me* around five or ten years ago . . . I forget when.

It is with some irritation I listen to tapes of ARRL officials going around to ham clubs saying that Wayne Green proposed "incentive licensing," without a doubt the most destructive rule changes in our history. It totally stopped the growth of amateur radio for over ten years! When ARRL proposed it, I fought it . . . when they petitioned the FCC, I fought it . . . and history, for whatever satisfaction there is in that, proved all of my arguments against it right. It was a bomb. I must admit that I feel a sense of achievement at the gradual veering away from the restrictions of incentive licensing.

The FCC is in the throes of trying to de-regulate amateur radio. This is a direct result of the hearing I organized a couple of years ago . . . the first of its kind ever put on by radio amateurs. Many of the particularly restrictive rules of which we complained have already been eased . . . the time, effort and expense of the hearing have been amply repaid. Yet we have, I feel, a long way yet to go. It is apparently so alien to a government agency to try and cut back on rules that every time they make a swing at it they go half way and falter.

One of my other petitions, which has been sitting at the FCC for several years, is the proposed Communicator license plan. I put that in to counter the EIA push to take our 220-225 MHz band as much as anything. It still remains to be seen whether this is going to work. While there is growing enthusiasm over my proposal, on the other hand we have Jerry Ford and the White House putting on the pressure for CB to get part or all of the ham band.

FORD IN OUR FUTURE?

When I got word that the renewed pressure for grabbing our 220 MHz band was coming from the White House, I got in touch with the Office of Telecommunications Policy there and pinned them down. They swore that they were not in favor of the grab, but that the pressure was coming from considerably above them in the White House. It was enough for me to go out and get a jar of Skippy and see if I could get the taste of things to come.

Yes, I know ARRL/*QST* has been very adamant that we not discuss religion or politics on the air . . . and it goes against many generations of hidebound Yankee Republican Conservatism for me to say it . . . but it sure looks to me as if a vote for Ford/Dole is a vote for CB on 220 MHz. From the polls and from my own reaction to Ford, I doubt if we have any serious worries. Apparently there are several million people who are just as enthusiastic about Jerry as I am. Pass the Skippy.

Evert Fruitman W7RXV
2308 West Rancho Drive
Phoenix AZ 85017

The Smoke Tester

- - power supply checker outer

This tester allows full power (smoke) testing of large or small power supplies *before* they are put on the rig. It will tell how many volts at how many Amps the supply can deliver, and what kind of voltage loss to expect under load. It can also help determine some of the attributes of low voltage power transformers, without having to wire them into a power supply.

It consists of 2 or 3 transistors, a pot, a couple of meters, a few diodes and some loose hardware. Don't forget the heat sink. If you wish to be formal about it, then add a chassis of some kind.

Fig. 1 shows the basic circuit. As the wiper is moved toward the plus, more current flows in the base circuit. The external circuit looking into the collector/emitter sees a lower and lower resistance. The ammeter and voltmeter give an idea of Watts cooking (sorry about that). The diode allows less than perfect attention to the polarity of the incoming voltage. The resistor in series with the base limits base current to a safe value.

Although the transistor manual indicates that the 2N3055 is a "15 Ampere" transistor, 2 or 3 of them cleared like fuses when the collector current was slowly increased above about 11 or 12 Amps. The 10 Amp fuse was put in the emitter, and collector current excursions were limited after that.

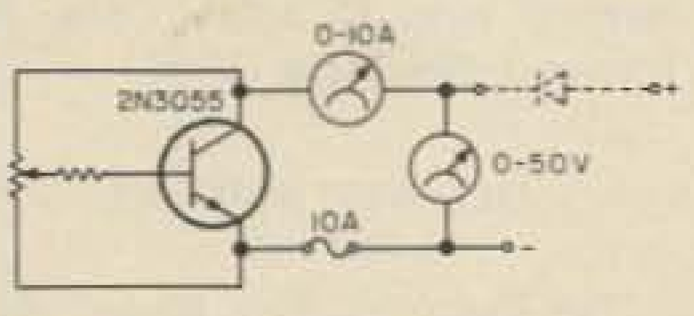


Fig. 1. Basic circuit.

Since power supplies capable of giving more than 20 Amps were to be tested, two 2N3055s were put in parallel. The fuses gave enough resistance in the emitters to help the transistors share the current in a more or less equal manner (at least there were no more creamed transistors).

A Darlington or piggyback configuration is used to reduce the power dissipation requirements of the pot. Ten Amps in the collector can require as much as ½ Amp in the base. Half an Amp times several volts equals several Watts. The Darlington system reduces the input current by as much as 50 times. That figures out to about 10-20 mA for 10-20 Amps in the collectors, and makes the system practical.

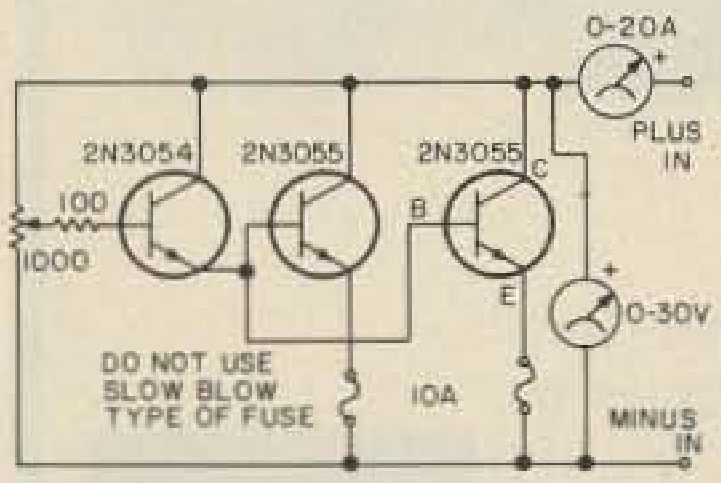


Fig. 2. Solid state resistor.

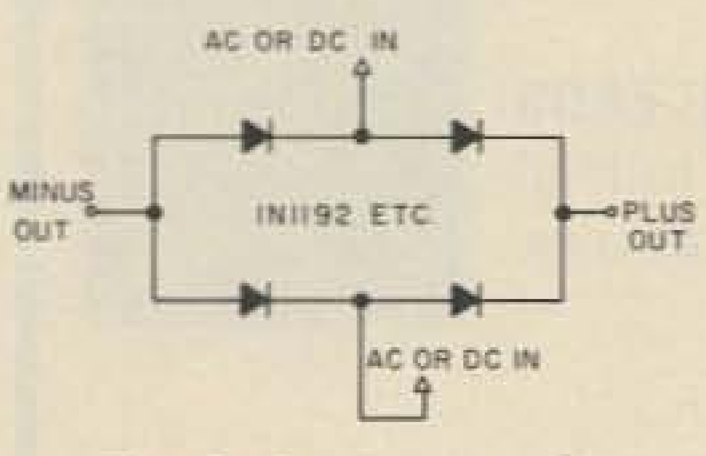


Fig. 3. Bridge rectifier.

Note that if the power supply is delivering 15 Amps at 13 volts, then something is going to have to dissipate 195 Watts. *Be sure* that the 2N3055s are on a large enough heat sink.

If a full wave bridge rectifier is placed in front of the tester, power transformers can be checked for voltage out versus current. That information would have saved a lot of time in the past.

Of course, there are single transistors around that meet the voltage, current, and power ratings of this tester.

If PNP transistors are used, reverse the polarity of the meters and diodes. ■

Social Events

ST PAUL MN
OCT 1-3

The '76 ARRL Dakota Division Convention will be held October 1, 2 and 3, 1976 at the new St. Paul Civic Center, 143 W. 4th Street, St. Paul, Minnesota. MARS, ladies' program, technical seminars, ARRL forum, FCC exams, Wouff Hong, W.A.M. Award. Large exhibit area with many new products, outstanding speakers, ARRL Headquarters personnel will be there, super full course banquet, and an ICOM IC-230 will be awarded to an advance registrant. Registration: $4.50 ($6 after Sept. 12). Among the featured speakers will be Wayne Green W2NSD/1, on "50 years of Ham Radio, 1936-1986."

LEXINGTON KY
OCT 3

The Central Kentucky Hamfest will be held on October 3, 1976 at the Countryworld Convention Center on I-75 between Lexington and Georgetown, Kentucky. Prices will be given away, including a special Novice grand prize. There will also be an indoor flea market. Talk-in on 146.16-76. Admission: $2.50 advance; $3.00 at the door; includes grand prize stub. Doors open at 8 am. For more information and advance tickets write: Hamfest, Box 4411, Lexington KY 40504.

WASECA MN
OCT 9

The Sixth Annual South Minnesota Swapfest — Minnesota's largest ham gathering — will be held Saturday, October 9, 9 am to 4 pm at Waseca Community High School. Talk-in on .94. Contact Viking Amateur Radio Society (VARS), Box 3, Waseca MN 56093, 507-835-2679.

ERIE PA
OCT 9

The Radio Association of Erie has just approved the date for its fall Hamfest and Flea Market on Saturday, October 9, 1976. This year's event will be held at the Kuhl Hose Company Grounds on Pennsylvania Route 8, 1½ miles south of I-90. Admission is free with a $1.00 per car charge for the flea market. The time will be from 10 am to 4 pm with a dinner to follow at 6 pm. For more information contact RAE, Box 844, Erie PA 16512.

SYRACUSE NY
OCT 9

The Radio Amateurs of Greater Syracuse will hold their annual Hamfest on Saturday, October 9, 1976 from 9 am to 6 pm at the Syracuse Auto Auction building on Route 11, 4 miles south of Syracuse. Tickets áre $1.50 if purchased before October 1st and $2.00 thereafter. Food will be available, as well as a breakfast menu for early comers. The Lafayette Apple Festival is being held the same day and there will be buses to it leaving from the hamfest gate. The program will feature Dave Sumner of the ARRL, Frank WB2MFF, on "Microprocessors and Amateur Radio," a UNYREPCO panel, and a Navy MARS meeting. For tickets or further information, write R.A.G.S., Box 88, Liverpool, New York 13088.

OLD WESTBURY NY
OCT 10

The Electronic Flea Market sponsored by L. I. Mobile Amateur Radio Club (LIMARC) will be held Sunday, October 10, 1976, from 9 am to 4 pm at the N.Y. Institute of Technology, Rte. 25A and Whitney Lane. Admission $1.25 per buyer; $2.50 per seller, per space. Information call Hank WB2ALW, 516-484-4322. Talk-in on 25/85.

GAINESVILLE GA
OCT 17

The Lanierland A.R.C. Hamnic will be held October 17, 1976, at the Lake

Lanier Islands Dogwood Pavilion. Prize tickets $1.00 each. There is no registration fee but Lanier Islands charges $2.00 entry fee per car. Plenty of room for flea market, picnic and use of island facilities. Talk-in on W4IKR/4 146.07/.67. For additional information contact Paul Watkins W4FDK, Route 11, Box 277, Gainesville GA 30501.

SHARON MA
OCT 17

Sharon A.R.A. Auction will be held Sunday, October 17, 1976. Doors open at 12 noon. Auction starts at 2 pm. Location: Sharon Community Center, Massapoag Ave., Sharon, Mass. Free refreshments. Club takes 15% commission.

TORONTO CANADA
OCT 22-24

The Radio Society of Ontario will hold its 9th Annual RSO Convention on October 22-24, 1976 at the Don Valley Holiday Inn, Toronto. Largest amateur radio convention in Canada. Includes Friday night eyeball buffet and dance, Saturday night banquet and dance, ladies' program, and many more social activities. Convention program includes Amateur Forum, Radio Propagation, Emergency Communications, Components, Flea Market, and much more. Registration before Sept. 30 non-member $8, member $7. Talk-in stations: 75 meters – ONTARS 3755 MHz Friday 1300-2300 hrs local time, Saturday 0800-1400 hrs. Sunday 0900-1200 hrs. 2 meter FM – VE3RPT – 146.46/147.94. Simplex – 146.51. The convention call will be VE3RSO – be sure to check in!

MARION OH
OCT 24

The Marion Amateur Radio Club's "Heart of Ohio Ham Fiesta" will be held October 24, 1976, at the National Guard Armory, Marion, Ohio. Pre-registration – $1.00. Send SASE for tickets or info to Earl Adey WB8EDO, 2697 Curren Drive, Marion, Ohio 43302.

VIENNA VA
OCT 24

The AMRAD COMPUTERFEST will be held on October 24, 1976 at the Vienna Community Center, 120 Cherry St., Vienna, Virginia, near Exit 11S of the Washington, DC Beltway.

NEW ORLEANS LA
OCT 30-31

The New Orleans Hamfest and Computer Fest, sponsored by the Jefferson Amateur Radio Club, will be held Oct. 30-31 at Archbishop Rummel High School, 1901 Severn Ave., Metairie LA (New Orleans suburb). Forums at the fourth annual event will include several on computers by the Crescent City Computer Club and others by or about AMSAT, MARS, emergency communications, RTTY, QRP, Novices and beginners and antennas. Reservations and latest details may be obtained by writing to Dominick "Nick" Tusa WA5RMC, Chairman, New Orleans Hamfest, PO Box 10111, Jefferson LA 70181. Talk-in frequencies will be 146.34-.94 and 3.95 MHz.

PLYMOUTH IN
OCT 31

The Marshall County Amateur Radio Club Swap-n-Shop will be held on Sunday, October 31, 1976, at the Plymouth, Indiana National Guard Armory located at 1220 W. Madison Street from 7 am to 4 pm. Free tables, no charge for set-up. Tickets $2 at door. Food, drink and door prizes. Talk-in on 146.07-67 and 146-94 simplex. For further information contact WA9INM, Route 3, Box 526, Plymouth, Indiana 46563.

McAFEE NJ
NOV 13-14

The 1976 Hudson Division Convention will be held November 13-14, 1976 at the Great Gorge Resort Hotel in McAfee, New Jersey. There will be ARRL and FCC forums, large indoor exhibit area with 40 booths, giant outdoor flea market, super raffle, free gifts, special features, indoor swimming, game room, and much more. Registration: advance $3, at door $4. For hotel registration: Al Piddington WA2FAK, 4 Acorn Drive, East Northport NY 11731.

J. H. Everhart WA3VXH
18D Lynnebrook Apts.
Millersville PA 17551

The Coffee Flipper

-- and executive decision maker

Twice a day, American industry grinds to a halt. Work stops as everyone leaves his bench or desk for a coffee break. It's the time when everybody relaxes, has a cup of coffee or other beverage and forgets work for a few minutes. Often, a small group will collect and flip coins to decide whose turn it is to buy.

But, hey! That's almost work itself. The whole idea of the coffee break is to cease one's labors and unwind. With this thought in mind, I set my creative juices flowing. Drawing upon my vast experience and unlimited talent, I cast about for some means of minimizing effort and s-t-r-e-t-c-h-i-n-g my coffee breaks by automating the coin toss.

Several methods floated by my mind's eye: How about a gated oscillator controlled by a push-button switch and feeding a flip flop? The two outputs of the flip flop could feed two lamps, one labelled "heads" and the other "tails." Pushing the button would turn on the oscillator which would start the flip flop going back and forth. If the rate was fast enough (10 Hz or so), it would be impossible to perceive the lamp states, so that when the button was released, heads or tails should come up randomly. Maybe for a multiple player version, I could use a shift register or ring counter somehow, so that only one light would come on at the end of the cycle, that corresponding to the lucky player who buys for the day.

Shucks! Pressing a button is almost as strenuous as flipping a coin, though. And using the ring counter could get complicated, not to mention the cries of "Foul!" since only one person would decide the fate of everybody playing. Then too, the gadget couldn't get too complicated 'cause I wanted to build it completely from my junk box.

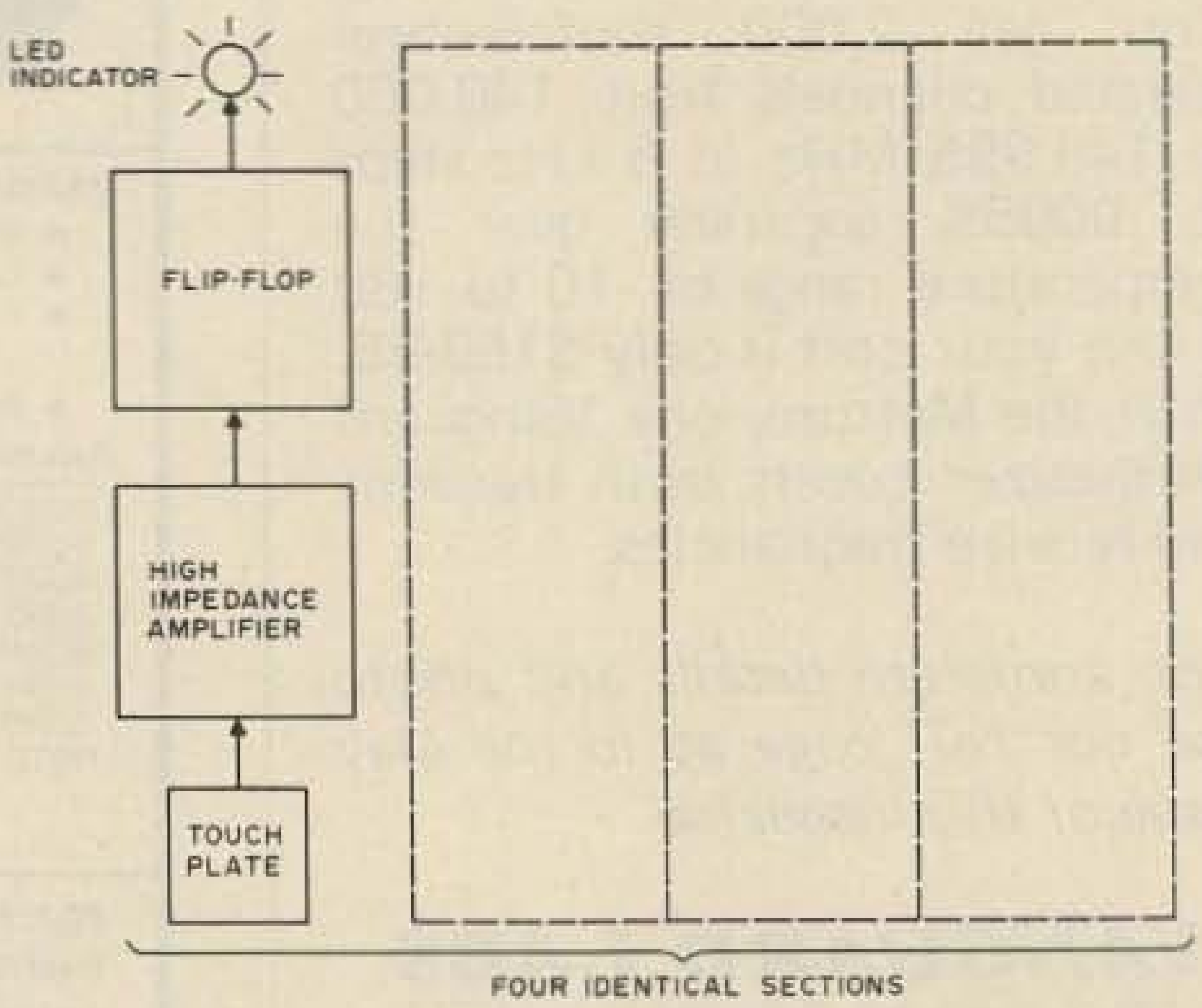


Fig. 1. Functional block diagram.

Description

A block diagram of the final product is shown in Fig. 1. Since usually three or four players participate, there are four sections, one for each. Operation is simple. A finger placed on a touchplate conducts 60 Hz hum (courtesy of radiation from the ac power line) to the high gain amplifier. The amplifier takes this low level sort of sine wave and squares it up, feeding steep-sided pulses to the flip flop. The flip flop controls the readout – one LED per

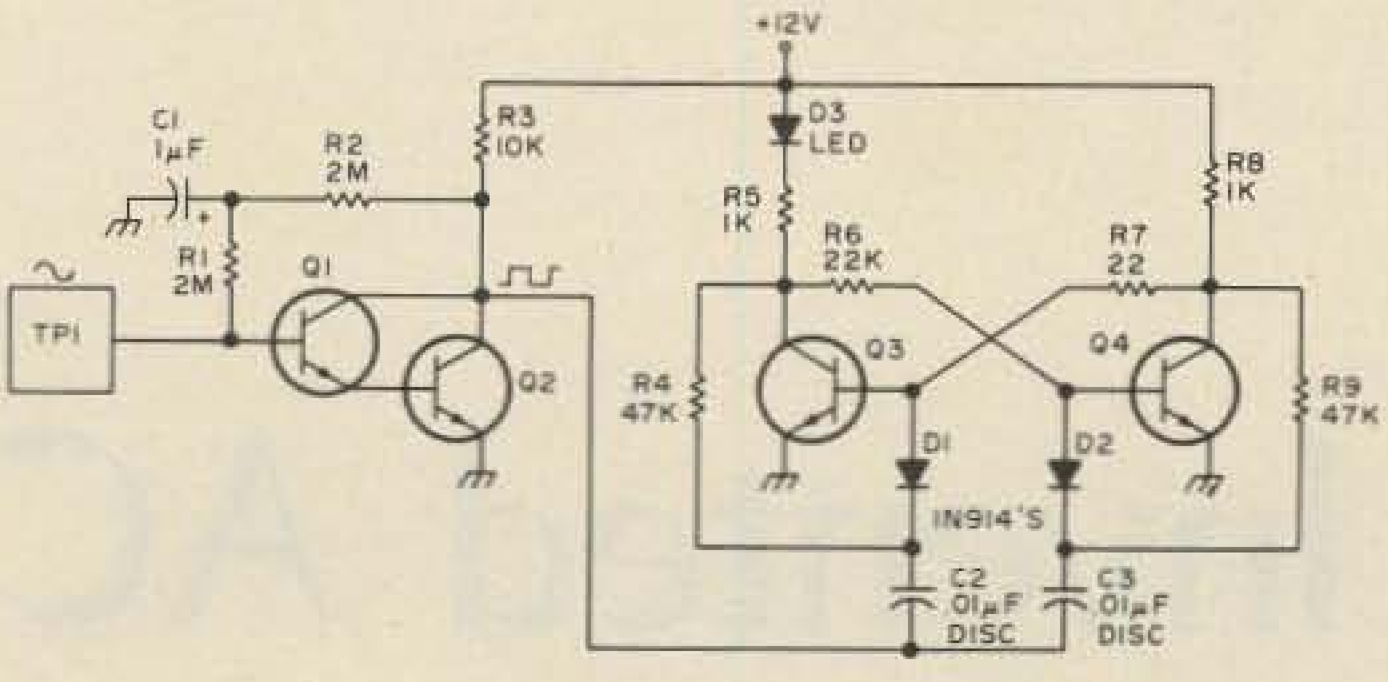


Fig. 2. Schematic diagram of "coin" block.

section. Simplicity and lack of effort are outstanding for this configuration. The touchplate control system exemplifies modern labor saving techniques similar to those used on the latest home appliances. Only one illuminated display element is required per stage, since one need not have heads or tails, just on and off. This saves the mental work of remembering heads and tails, plus it saves on parts – LEDs cost 20 cents apiece!

Refer to Fig. 2 for detailed operation. Touchplate TP1 is connected to the base of a Darlington pair composed of Q1 and Q2. R3 is the collector load, while R1 and R2 bias the pair in the active region. C1 bypasses ac feedback so that dc biasing is achieved with least effect on ac gain. The stage has a high input impedance and enough gain to "square up" sine waves impressed on the touchplate by a finger placed thereupon (remember checking a tube audio amplifier by putting a finger on the grid terminal?). The square waves are fed to a flip flop (a.k.a. bistable multivibrator), formed by Q3 and Q4. R5 and R8 are the load resistors, while R6 and R7 provide the cross-coupling required for flip flop operation. Gating diodes D1 and D2 are biased by resistors R4 and R9 so that incoming pulses are steered from C2 and C3 only to the stage which was conducting before the negative edge of the pulse occurs. This steering circuit assures reliable "toggling" of the flip flop so that it flips states only once for each incoming pulse. As mentioned earlier, there is only one readout per "coin" block. It can be connected in either load resistor leg to the positive supply voltage. In the circuit shown, the LED is connected to Q3 and R5 so that it lights when Q3 conducts.

It may appear that both the high impedance input amplifier and flip flop are slightly more complicated than necessary. Strictly speaking, this is so, if transistors of known types are used. However, this design can use darned near anything in the junk box.

Construction

The basic overall layout is shown in Fig. 3. The components were wired on a piece of vectorboard approximately 2.75" x 6.5". The four "coin" blocks were laid out so that the LED was placed closer to its corresponding touchplate than any other for ease of interpretation. Component to component wiring was done on the back side, with only the two power leads (+) and (-) brought out to Vector T-28 pins for external connection. To maximize cost effectiveness, no power supply was included. Any source of 9 to 15 volts at 40 mA will do. No cabinet was used both to save money and to impress everyone by having the "guts" showing. Since all signals are low frequency, wiring and layout are very non-critical.

As mentioned earlier, the circuit was designed so as to be intolerant to component variation. Values shown in the schematic were used because I "guesstimated" that they would work. If you use something else, it will probably work. To be on the safe side, use "symmetrical" parts substitution in the flip flop. For example, if you want to use a 27k at R6, be sure that you use the same resistance for R7. All transistors used were NPN silicons with squirrely "in-house" type numbers. If you want to buy new ones, MPS 5172 or 2N5172 types are fine. Actually any NPN silicon with an hfe of 50 or more and a breakdown voltage over 20 volts should work. The LED is a 5 for $1 type picked up at a hamfest. Since it runs at about 12 mA, almost anything will do. The touchplates used were about .5" x .5" pieces of thin copper attached to the vectorboard with bathtub caulk (Ge RTV). Naturally, they must be insulated from ground.

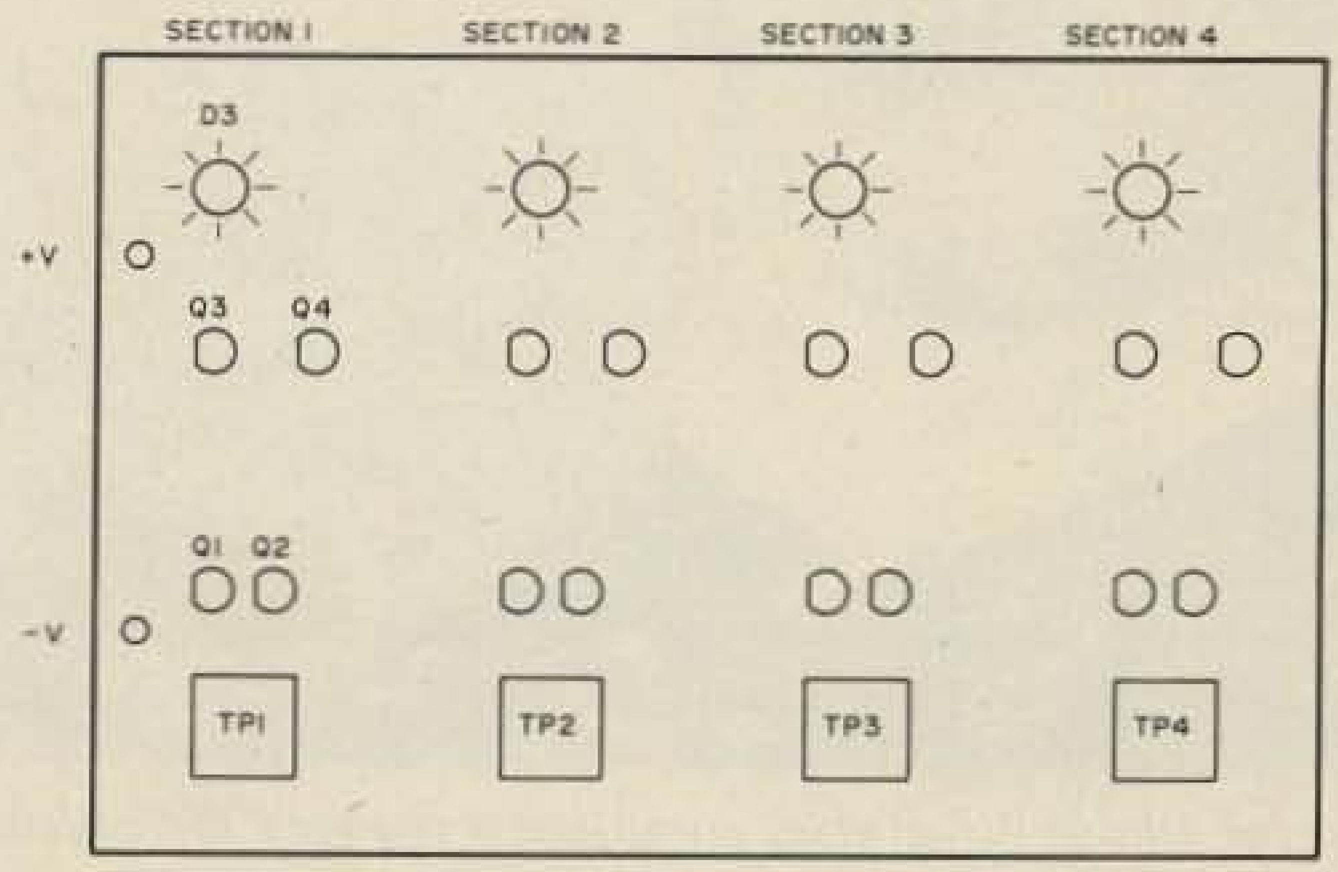


Fig. 3. Coffee flipper component layout.

Usage

The basic ground rules for using the flipper are like those for "matching pennies." For two people, both players place one finger on their individual touchplates. One says, "If they match – you buy" or "If they're alike, I buy." They count to three and at the count of three they remove their fingers from the plates and look at the two corresponding lights. For three or more players, you can play "odd-man-buys" or "odd-man-out." In the latter case, the odd man drops out and the remaining players continue. To be polite, we usually call the player who buys the "winner." After all, he wins the honor of buying!

Results

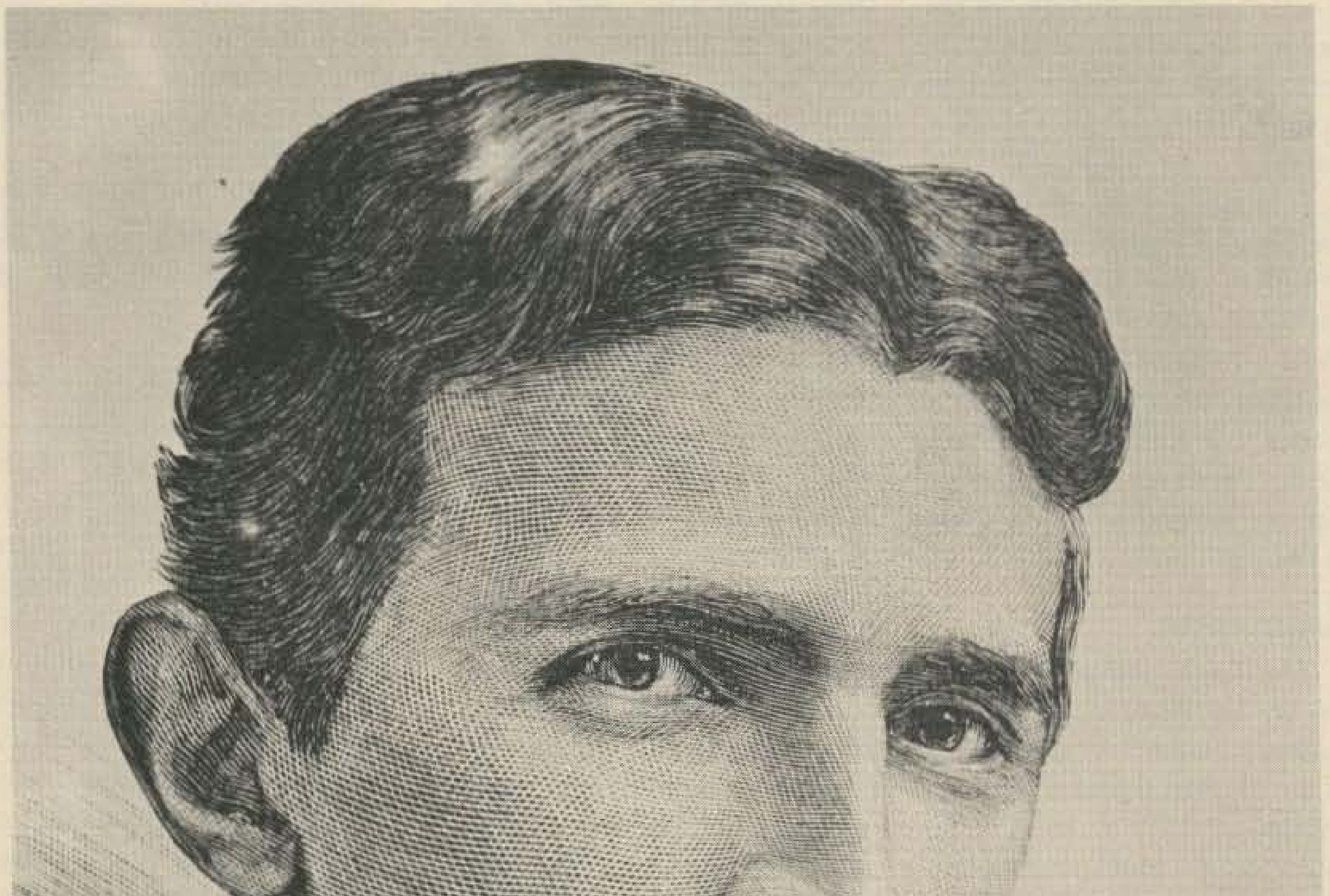
Some questions have been raised by frequent "winners" about the randomness of the results of my "coin." Even I wondered because I "won" the first six buys. Jim Shultz W3MYK said, "It's not gambling; with Joe playing it's a sure thing!" But several runs of 50 and 100 successive trials each have demonstrated an even distribution of results. You may buy six days in a row, but if you live long enough, the game is fair. The only signs of erratic operation have occurred in the presence of rf fields or near sources of electrical transients such as relays or electric motors.

Conclusion

Many hours of man-effort have been saved in using this device. The integrity of break time as a period of relaxation has been maintained. And, because even vending machine coffee tastes better when someone else buys, I must thank Jim Shultz, Vic Frey and Daryl Kane for countless gallons of that delicious brew! ■

The Man Who Invented AC

-- Tesla, the greatest pioneer of them all!



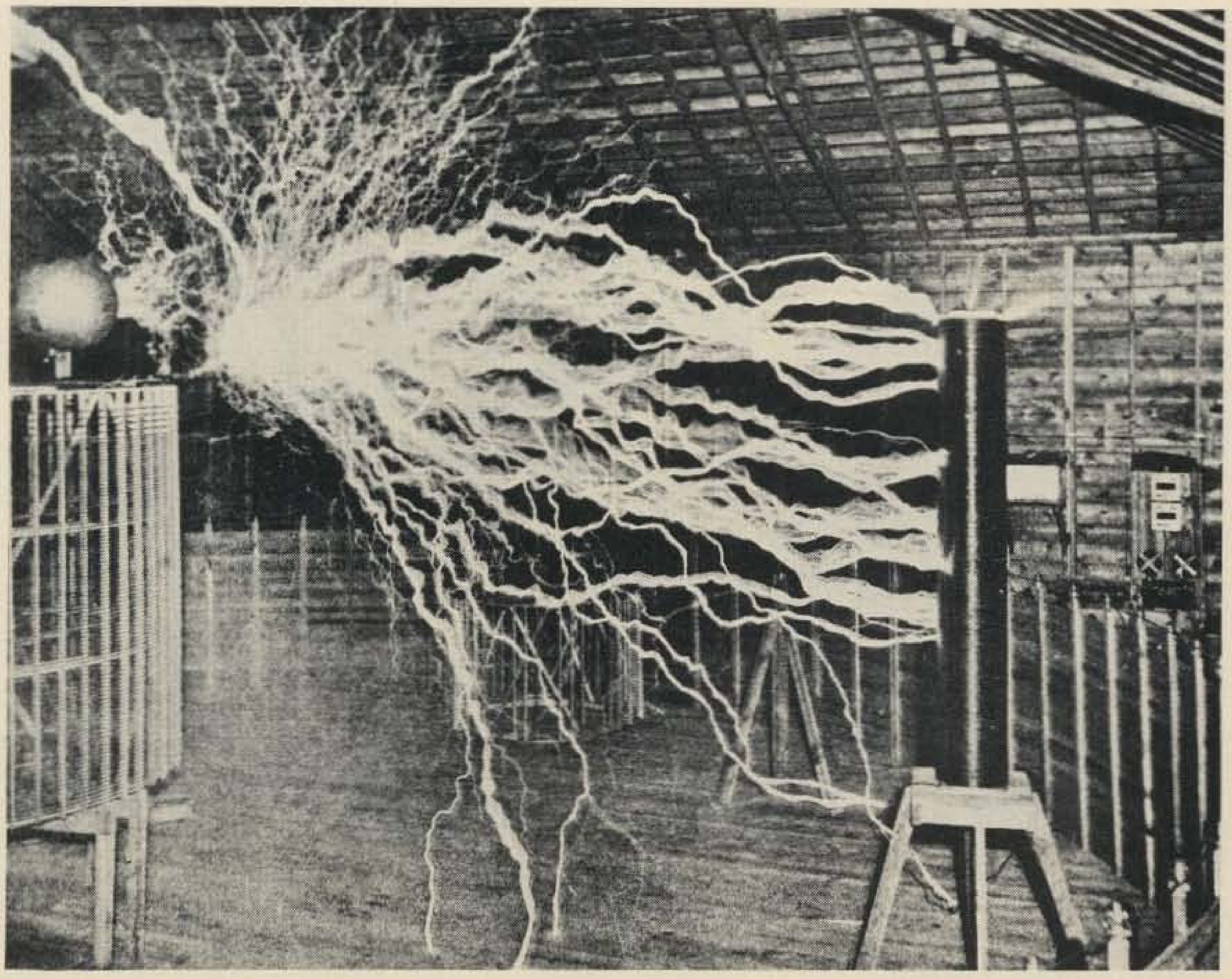
Nikola Tesla (1856–1943), the inventor whose discoveries completely changed the cadence of human progress, spent his entire life under the influence of an irresistible impulse for crossing frontiers and delving into the unknown.

Harry Goldman
34 Amy Lane
Glens Falls NY 12801

A young immigrant from Yugoslavia stirred the world of electrical engineering when, in 1888, he presented a paper, "A New System of Alternate Current Motors and Transformers," before the American Institute of Electrical Engineers (N.Y.). His discovery of the rotating magnetic field and its application to the generation, transmission and utilization of polyphase alternating currents for power and light brought electrification to the world. Every high-tension tower and transmission line bisecting the world's countrysides are lasting monuments to Nikola Tesla's genius. Not widely remembered, however, are his contributions to the establishment of early radio communications and broadcasting.

In 1889, the inventor commenced a series of investigations into the properties of high-frequency alternating currents. Except for his earlier work in low frequency ac and an occasional venture into incidental fields, high-frequency researches were to remain the dominant objective of his inventive career. Originally, it was his ambition to utilize these currents in developing a more efficient system of lighting. Shortly thereafter, Tesla inaugurated experiments which were to place him on a trail leading to communications, a goal which eventually evolved into an obsession.

Although it is not clear what force motivated Tesla in this direction, his intense interest in radio was probably initiated as a result of Heinrich Hertz's experimental work. Finding inspiration in James Clerk Maxwell's electromagnetic wave theory, Hertz was able to transmit, receive and measure radio waves. It is without question that Maxwell's mathematical treatise, "Electricity and Magnetism," initially announced in 1864, and Hertz's "Electromagnetic Waves in Air and Their Reflections," published in 1888, formed the genesis of radio engineering.



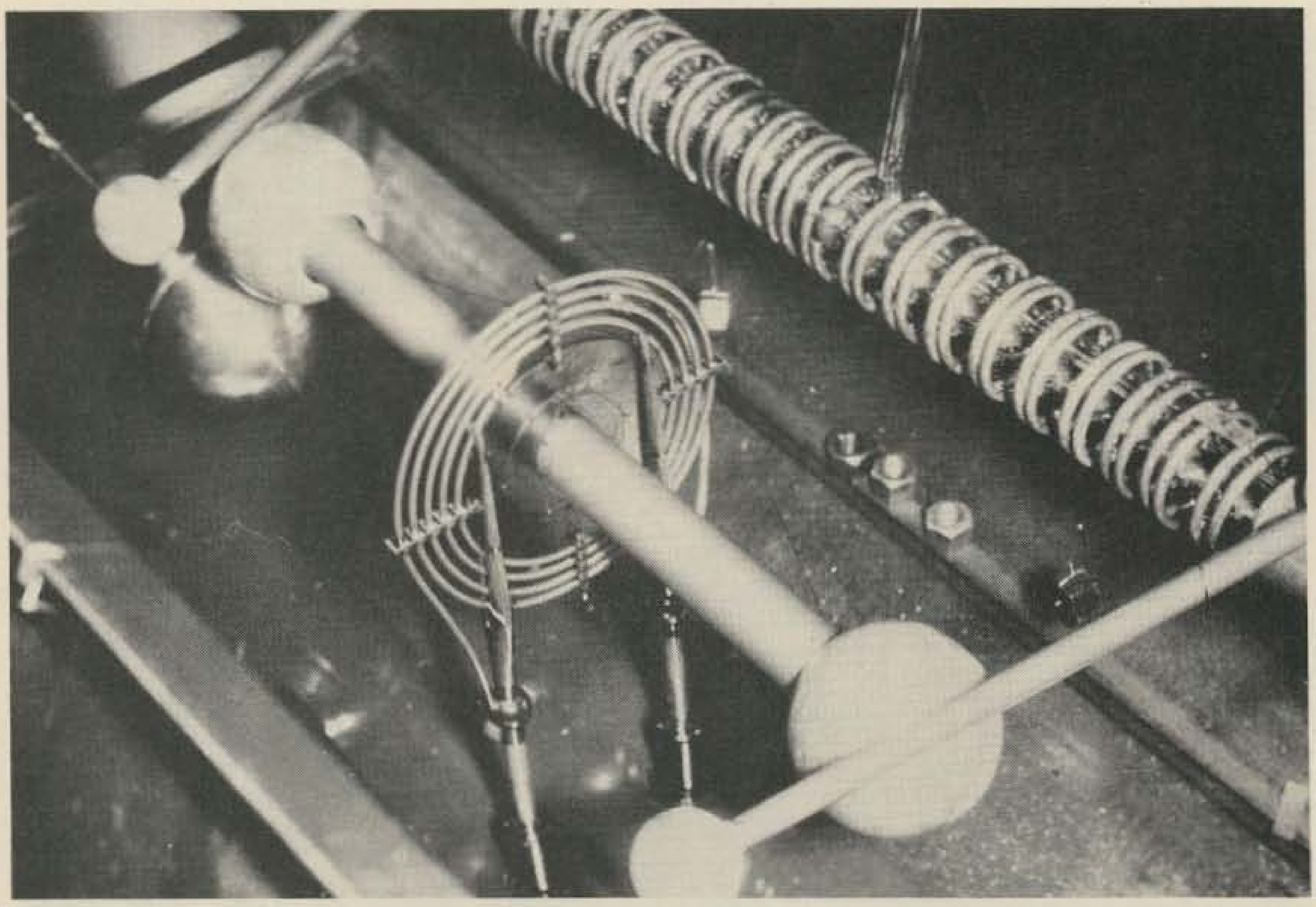
The Magnifying Transformer, the heart of Tesla's high voltage experiment for producing an immense resonant action. The cascading discharges shown here measure 22 feet and represent a potential of 12 million volts. (The Century Magazine, *June 1900)*

Although Tesla was among the earliest who foresaw the application of electromagnetic waves in point-to-point communications, he continuously contested the concept of radio transmission by Hertzian waves. He attributed communications between ground stations to earth conduction. Later, when challenged to explain transmissions between ground stations and airplanes, the inventor responded, "capacitor action." Tesla rarely wavered in this debate and it is probable that his persistent inflexibility retarded, if not prevented, proper recognition for his contributions.

By 1890, he had constructed alternators capable of producing undamped waves at 30 kHz. Some twenty years later, the radio industry, then beginning its embryonic stage, found undamped waves highly desirable. As a result, the high-frequency alternator became a sophisticated piece of equipment, holding a position of great significance in radio transmissions until the advent of the high-power triode in 1922. As a striking example of its import, it was possession of the Alexanderson alternator patents which gave RCA a nearly insuperable advantage in early global communications. Thus, Tesla's conception of employing continuous waves, and his design of apparatus for producing them, preceded the radio industry by at least two decades.

Tesla again aroused the attention of the scientific world in 1891 when he presented the first of a series of historic lectures revealing discoveries from experiments with radio frequencies.(1) Among these was the disclosure of a new kind of transformer. Better known as a "Tesla" coil, this device represented the first application of the oscillation transformer. The Tesla transformer provided a remarkable advancement in that it invoked the principle of inductively coupled tuned circuits. Consequently, in his initial approach to communications, Tesla stumbled upon another important facet, the principle of tuning. Time has not dimmed its importance.

One gains an insight into the inventor's experimental wisdom and prophetic vision through reference to a sensitive emission within his vacuum tubes. In the lecture of 1892, given before the Institution of Electrical Engineers in London, Tesla states, "I think that it may find practical applications in (wireless) telegraphy. With such a brush, it would be possible to send dispatches across the Atlantic with any speed . . ."(2) The advanced state of our present technology may blind us from sensing the impact of the inventor's declaration. At the time, several leading figures of the scientific world conceded the impossibility of traversing the Atlantic's prohibiting span with an electromagnetic wave. To Tesla, the Earth's magnitude was of little consequence. ". . . I would say a few words on a subject which constantly fills my thoughts and which concerns the welfare of all. I mean the transmission of intelligible signals or perhaps even power to any distance without the use of wires . . . we need not be frightened by the idea of distance. To the weary wanderer counting the mileposts, the Earth may appear very large; but to the happiest of all men, the astronomer, who gazes at the heavens, and by their standard judges the magnitude of our globe, it appears very small . . and so I think it must seem to the electrician . . . it certainly is possible . . . to produce some electrical disturbance



A 5 million volt Tesla coil developed for nuclear physics research in 1929 by G. Breit, M.A. Tuve, and O. Dahl. The multi-sectioned vacuum tube at the upper right was used to accelerate atomic particles. (Photo courtesy of T. Brown, Dept. of Terrestrial Magnetism, Carnegie Institution of Washington)

sufficiently powerful to be perceptible by suitable instruments at any point of the Earth's surface." (3)

In his final lecture of the "trio-series," Tesla suggested a system of radio communications employing synchronized aerial-ground elements at the transmitting and receiving stations.(4) In view of this disclosure, it would seem that he was the first to conceive the idea of using transmitting and receiving antennas tuned to the same frequency. Therefore, by 1893, some four years before contemporaries had made equally significant contributions to the art, it appeared that Tesla possessed both the technology and ambition as well as the visionary powers necessary for bringing radio communications to its fruition. What impediment barred him from achieving the honor?

On March 13, 1895, Tesla experienced a serious setback. The entire contents of an inventive career, as well as records, documents and a world's fair exhibit were lost when a fire destroyed his New York City experimental station. Undoubtedly, the tragedy barred Tesla from establishing priority in several fields. His position in the world of science was evaluated by an article in the *New York Sun*. "The destruction of Nikola Tesla's workshop with its wonderful contents is something more than a private calamity. It is a misfortune to the whole world. It is not in any degree an exaggeration to say that the men living at this time who are more important to the human race than this young gentleman can be counted on the fingers of one hand – perhaps on the thumb of one hand."(5)

Tesla opened a new laboratory. By 1897, he had carried out investigations in the field of x-ray, studies of the dynamics of mechanical vibrations, the invention of electromechanical isosynchronous alternating-current generators as well as experiments with radio-controlled devices. One of his important contributions of this period was a high-frequency patent containing the fundamental principles upon which the "four-tuned-circuit system" of radio transmission was to be founded.(6) Professor Adolph Slaby, Germany's leading authority in early communications, demonstrated an enthusiastic appreciation for Tesla's work. In declaring Tesla as the "Father of Wireless," he wrote, "I have been engaged for some time in investigations in telegraphy without wires, which you have first announced in such a clear and precise manner in your 'inventions.' It will interest you as the father of this telegraphy . . ."(7)

Restricted by the limits of his New York laboratory, Tesla left for Colorado Springs in 1899 to initiate experiments on a large scale. Communications was to be but one phase of his project. Another was the transmission of electricity without the use of power lines. He was of the conviction that resonant effects of huge magnitude would enable him to utilize the Earth as a conductor. "Not only was it practicable to send telegraphic messages to any distance without wires," stated Tesla, ". . . but also to impress upon the entire globe the faint modulations of the human voice; far more still, to transmit power in unlimited amounts to any terrestrial distance and almost without loss."(8)

There, in the shadows of Pike's Peak, he constructed a large barn-like laboratory. Extending through the roof was a 200-foot mast topped by a 3-foot copper ball. Within the mysterious construction was an array of apparatus reminiscent of a Jules Verne fantasy. It was Tesla's intention to employ the equipment in an attempt to alter the electrical charge of the Earth.

The concrete achievements of the Colorado adventure remain obscure. Except for a lecture, some scattered notes, and a few ambiguous articles, he never fully disclosed the outcome of the experiment. He announced the discovery of standing waves induced in the Earth's static charge by nature's lightning and was able to duplicate them by bringing about an immense resonant action. In an experiment which has not since been equaled, Tesla produced the longest point-to-point man-made lightning discharges (135 feet) with an absolute potential of 18 million volts and antenna currents of 1,100 Amperes. This, and his ability to operate Earth-connected motors and electric lamps at a distance of eighteen miles from the source of energy, must be recorded as remarkable feats of engineering.

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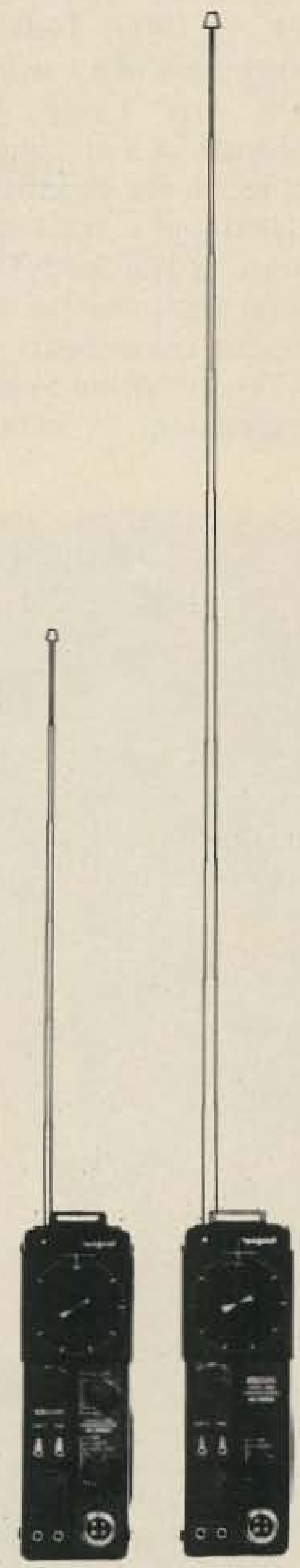

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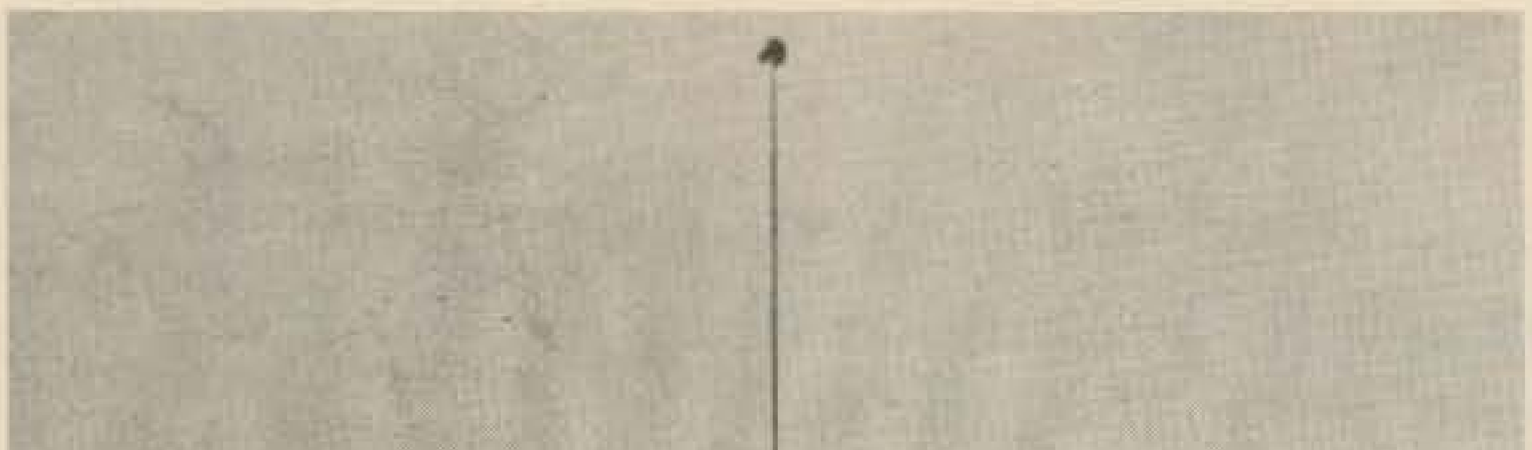
Tesla demonstrated the vision of a true prophet when he suggested the employment of standing waves as a means for detecting the position and movement of distant objects. ". . . By their use . . . we may determine the relative position or course of a moving object such as a vessel at sea . . ."(9) It wasn't until just before World War II that radar, as foretold by Tesla, became a working reality.

Upon his return to New York in 1900, Tesla began construction of a transmitting plant on Long Island. Residents of early Shoreham can recall the gigantic tower situated on a tract of land known as Wardenclyffe. The station was to be but one of a series of components making up Tesla's "World System" of broadcasting. In addition to the distribution of news, music and humanity services provided by today's communications media, the inventor promised a number of startling benefits. It was to establish a universal system of telephone, telegraph and stock ticker services; a precision clock system whereby all the world's timepieces would be accurately synchronized from a master station; a safe system of navigation enabling control of direction without compasses and an ability to determine exact location, hour and speed at a moment's notice. Also, it was to provide a world system of private communications allowing personal telephone connections between parties, regardless of distance, with a device small enough to be carried in one's pocket.



An external view of Tesla's mysterious experimental laboratory at Colorado Springs. Erected in 1899, the inventor undertook experiments to alter the electrical charge of the Earth. He produced discharges that rivaled nature's lightning bolts and revealed the presence of standing waves in the Earth. (The Electrical World and Engineer, *March 5, 1904)*

The Long Island plant was never completed. The cost of the project exceeded the inventor's available funds. The greater part of Tesla's endeavors were financed by private sources. John Jacob Astor, J. P. Morgan and Thomas Fortune Ryan can be cited as the most influential of Tesla's creditors. In addition, a demonstration of the feasibility of the "World System" principle was hampered by the complexity of a recurring illness. The tower remained intact for many years. Shrouded in an atmosphere of mystery, it proved to be but a landmark in evidence of the bold dreamer who had passed that way. The late John J. O'Neill, *New York Herald-Tribune* Science Editor, provided a description of its demise in his biography *Prodigal Genius, The Life of Nikola Tesla.* ". . . Heavy charges of dynamite were necessary in order to topple it, and even then it remained intact on the ground like a fallen Martian out of Wells' *War of the Worlds."*

In an objective which no other person had then dreamed possible, Tesla had visualized, and nearly created, broadcasting some twenty years preceding its eventuality. "Of course," stated Edwin H. Armstrong, radio pioneer and inventor of FM, "the instrumentalities for practicing broadcasting were not then in existence. Tesla was classed as a visionary and his prophecy was forgotten. What harsher terms might, with justice, be applied to many of us who helped produce the instrumentalities with which broadcasting was eventually accomplished! We applied them to point-to-point communications, failing completely to realize the significance of Tesla's words."(10)

In addition to the major goals mentioned herein, Tesla made an infinite variety of contributions to communications that remain generally unknown. The most striking example is a patent describing an invention for controlling moving objects by radio waves.(11) With this invention, Tesla singularly ushered in the age of radio-guidance systems. "We shall be able . . . to send a projectile at a much greater distance; it will not be limited in any way, weight or amount of explosive charge; we shall be able to submerge it at command, to arrest it in its flight and call it back, and to send it out again and explode it at will; and more than this, it will never make a miss . . ."(12) Spectacular demonstrations of his radio-controlled device were presented in a week-long display at Madison Square Garden (N.Y.) and again, later, in Chicago. But to Tesla, this was just the beginning. In a gesture true of his unlimited imaginative powers, he proposed radio-controlled robots capable of thinking for themselves. He coined them *automatons.* ". . . It will be able to follow a course laid out or to obey orders given far in advance; it will be capable of distinguishing between what it ought and what it ought not to do . . ."(13) Tesla's utterances raised more than the eyebrow of the scientific world. Resulting protests surpassed the discontent of indignation. The significance of Tesla's words, however, becomes more apparent when we consider today's vast industry of self-thinking machines as well as the huge arsenal of radio-guidance missiles poised at their stations throughout the world. These devices are able to perform exactly as Tesla had predicted.

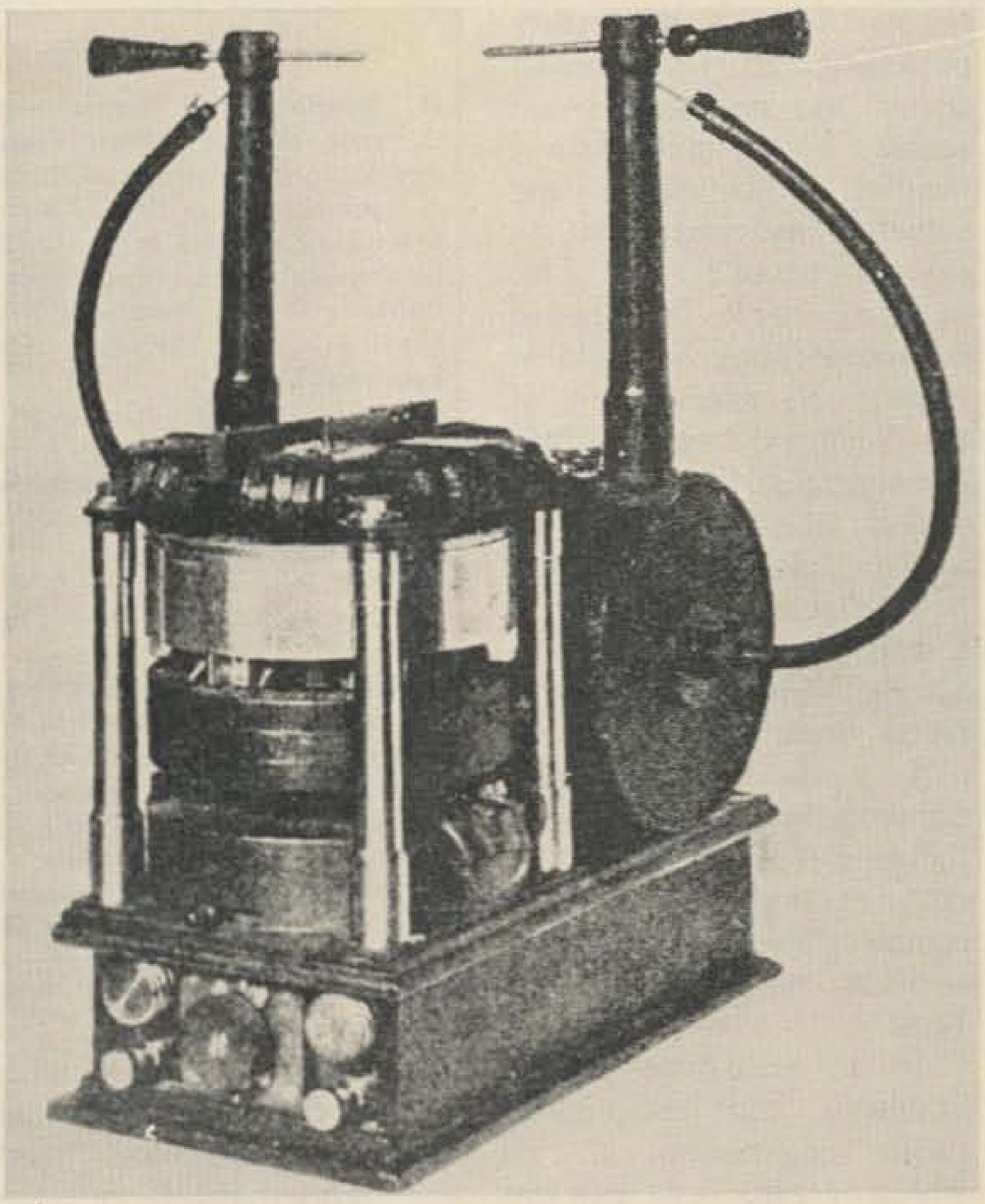
Among his incidental contributions to radio communications was the Tesla "ticker," a device for making continuous waves audible. This apparatus was a vital part of the Paulsen Arc stations until the heterodyne beat-note system was introduced to radio engineering. Several forms of Tesla's high-frequency spark apparatus were utilized by early transmitting stations for many years. His radio patents advanced the quarter-wave principle as well as antennas in the form of a loop. And it was Tesla who pointed out the importance of oil as an insulating medium in high-voltage equipment and who suggested the use of insulated stranded wire, later called Litzendraht, in high-frequency circuits.

Taking into consideration all that has been mentioned in the foregoing, why then is the name of Nikola Tesla not listed among the journals of radio engineering history? Several explanations are possible. For one, Tesla was a complex personality. "He was a strange figure in the rough-and-tumble field of pioneer wireless and electricity," wrote one who met Tesla. "Many considered him a plain snob. Some called him a nut while others referred to him as the 'genius' and were always making excuses for his actions ..."(14) Hampered by a grand-gesture personality and driven by an extraordinary ingenuity, his talents remained eternally subservient to a passionate and inexorable urge for stirring deep waters. Consequently, his mental capacities continually outraced his physical ability for bringing original ideas to a real existence. His pattern appears to have been to discover, and then move onwards leaving for others the benefits of its commercial application. And in his experimental processes, he was forever being diverted from the path of his major goals (as is evident by the variety of his inventive accomplishments) delaying, if not preventing, final achievement of his original destinations.

There should be little doubt concerning the inventor's faculties for establishing a communications system. Its reality, however, proved to be too great a task, both physically and economically, for the efforts of an individual. Had he been associated with talent similar to the likes of a David Sarnoff, that energetic personality who brought the "music box" (radio) into every home and who led the Radio Corporation of America to communications history, his objective might have been assured.

Fritz Lowenstein, an assistant in his high-voltage experiment, and who later produced some excellent work in radio communications, if given a chance, might have served Tesla to great advantage. Lee De Forest, an inventor whose contributions are well established in the glorious history of radio, pleaded to be taken in as a Tesla assistant. Without detracting from their brilliant work, it is known that the many successes of men such as Edison and Marconi resulted from their ability to attract the assistance of highly capable associates. Tesla, however, was unable by temperament to avail himself of this advantage. Essentially, he was a "loner" who stood aloof and out of reach of those with whom he mingled.

On December 12, 1901, while Tesla was constructing his 300,000 Watt Long Island broadcasting station, Guglielmo Marconi, with but a fraction of that power, scooped the scientific world by sending three dots from Poldhu, England, to Saint John's, Newfoundland. The scientific society hailed Marconi. Even Tesla sent a congratulatory note but it was quite evident that he had



An early Tesla coil, the only invention of his many contributions which still bears his name. Tesla used devices such as these to carry out researches with high frequency alternating current. His discoveries hastened the development of ac induction heating, diathermy, neon and fluorescent lighting, x-ray equipment and techniques, and radio guidance systems, as well as television and radio communications. (Electrical Experimenter, *July 1919, by permission of Hugo Gernsback)*

been struck a blow by Marconi's feat. A crushing defeat to Tesla's bid for radio immortality came about in 1915 when he battled Marconi over the fundamental issues upon which early radio had become established. The courts ruled against Tesla, a judgment which was to influence succeeding litigation as well as to provide Marconi the means with which to institute unmitigated assertions for the invention of radio.

In his book, *Marconi*, Orrin E. Dunlap, Jr., provides an interesting comment. "At the turn of the century it was remarked that it was difficult to invent anything basically new in radio, and still more difficult to invent anything which did not have some bearing on or had not been preceded by an invention of Nikola Tesla. In 1891, at Columbia University, Tesla demonstrated the principle of tuning. He obtained patents on tuned circuits and claimed more than 100 tuning inventions. Nevertheless, it is called Marconi wireless; not Tesla wireless."

Be all that as it may, Tesla's part in the evolution of communications was not to be denied completely. In the October sessions of 1942 and 1943, the Supreme Court declared the Marconi "four-tuned-circuit" patent, his most vital contribution, invalid because of prior disclosure by Tesla, Stone and Lodge.(15)

In summation, we find in

Nikola Tesla a personality possessing an experimental acuity and prophetic vision equaled by no more than a handful of colleagues and surpassed by none. That he contributed to the groundwork of radio communications is evident through an examination of his lectures, articles and inventions pertaining to the subject. Although once hailed as "Our Foremost Electrician . . . Greater Even Than Edison," Tesla's accomplishments have since faded from the indexes of printed matter.(16) Consequently, it is possible – though not probable – for an engineering student to complete a formal education without having heard of Tesla.

In an evaluation of the inventor's contributions to radio engineering, L. P. Wheeler credits Tesla with the independent discovery of the principle of inductive coupling between the driving and working circuits, the importance of tuning both circuits, that is, the idea of an oscillation transformer, and the employment of the capacitance loaded open secondary circuit. He describes Tesla as "... an immensely energetic personality possessing great skill in ac techniques and great ingenuity in their utilization ... his earlier accomplishments . . . together with the inspiration given to many through his public lectures, would seem to justify a place in the history of radio engineering not so very far below that due to his accomplishments in the field of low-frequency alternating currents." (17) ■

References

(1) Nikola Tesla, "Experiments With Alternate Currents of Very High Frequency and Their Application to Methods of Artificial Illumination." A lecture before the American Institute of Electrical Engineers, N.Y., May 20, 1891.

(2) Nikola Tesla, "Experiments With Alternate Currents of High Frequency." A lecture before the Institute of Electrical Engineers, London, February, 1892.

(3) Nikola Tesla, "On Light and Other High Frequency Phenomena." A lecture before the Franklin Institute, Philadelphia, February 1893, and before the Electric Light Association, St. Louis, March, 1893.

(4) Ibid.

(5) Charles A. Dana, *New York Sun*, March 13, 1895.

(6) Nikola Tesla, "Method of Regulating Apparatus for Producing Currents of High Frequency," United States Patent 568,178, September 22, 1896.

(7) Professor Adolph Slaby in a letter to Tesla, December 1, 1898. Original in Nikola Tesla Museum, Beograd, Yugoslavia.

(8) Nikola Tesla, "The Transmission of Electrical Energy Without Wires," *The Electrical World and Engineer*, March 5, 1904.

(9) Nikola Tesla, "The Problem of Increasing Human Energy," *The Century Magazine*, June 1900.

(10) Edwin H. Armstrong, "Tribute To Tesla," *Scientific Monthly*, April 1943.

(11) Nikola Tesla, "Method of and Apparatus for controlling Mechanism of Moving Vessels or Vehicles," United States Patent, 613,809, November 8, 1898.

(12) Nikola Tesla, "Tesla And His Work," *New York Sun*, November 21, 1898.

(13) Nikola Tesla, "The Problems of Increasing Human Energy," *The Century Magazine*, June 1900.

(14) Personal communication from John Oliver Ashton, October 15, 1954.

(15) *United States Reports, Marconi Wireless Telegraph Co. vs. United States*, Volume 320, October terms of 1942/1943.

(16) Arthur Brisbane, "Our Foremost Electrician," *The World* (N.Y.), July 22, 1894.

(17) L. P. Wheeler, "Tesla's Contribution To High Frequency," *Electrical Engineering*, New York, August 1943.

Baudot to ASCII

-- you want to learn programming?

Mark J. Borgerson
325 N.W. 9th, #3
Corvallis OR 97330

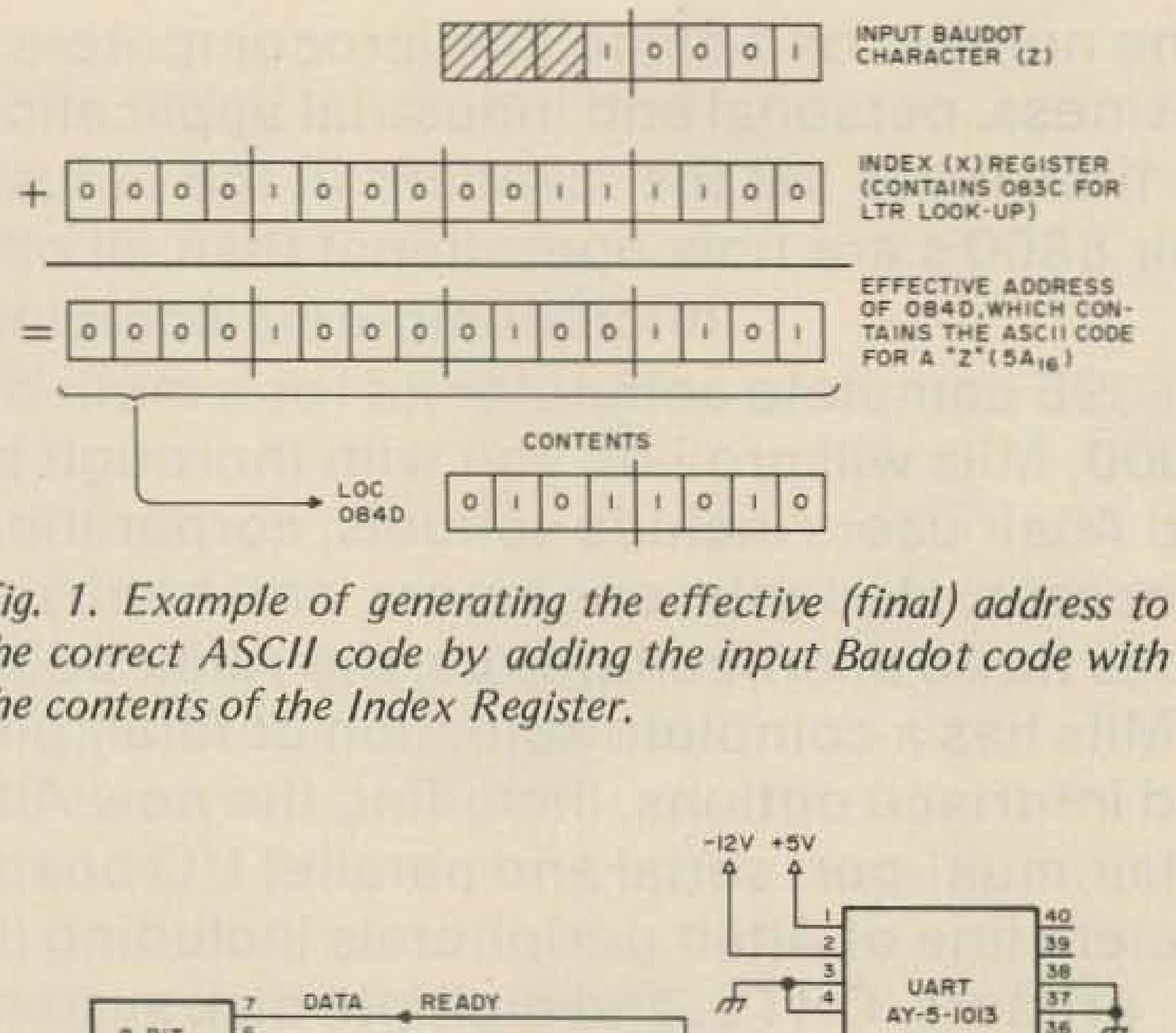


Fig. 1. Example of generating the effective (final) address to the correct ASCII code by adding the input Baudot code with the contents of the Index Register.

One of the most enlightening (but little used) methods for learning programming techniques is to read someone else's programs. Therefore, let us suggest you look over this article even if you aren't interested in Baudot to ASCII conversion. And if the symbolic coding in the listing seems to be a problem, don't let it be — simply analyze the machine language code. — Ed.

This program is used to convert 5-bit Baudot code from a parallel input into ASCII characters and display those characters. The program is written to run in a Southwest Technical Products 6800 microcomputer with a parallel interface located at memory location 8016 (hexadecimal notation). The program uses the output subroutine OUTEE, which is resident in the system's MIKBUG® operating system. Total program length, including the lookup table, is 123_{10} bytes. Because of the indexed lookup routine used, the routine is not suitable for permanent storage in ROM. The program may be located anywhere in memory space if the references to location LTRLOC and FIGLOC are changed to agree with the new locations.

The program operates by reading the parallel input port (after appropriate initialization) and looping until bit 7 goes high, indicating a character is present in bits 0-4. Bits 5-7 are masked out and the resultant 5-bit pattern is stored in location LOOKUP+1 where it becomes the displacement added to the index register. The index register contains either a pointer to the FIGURES or the LETTERS lookup table, depending upon which of

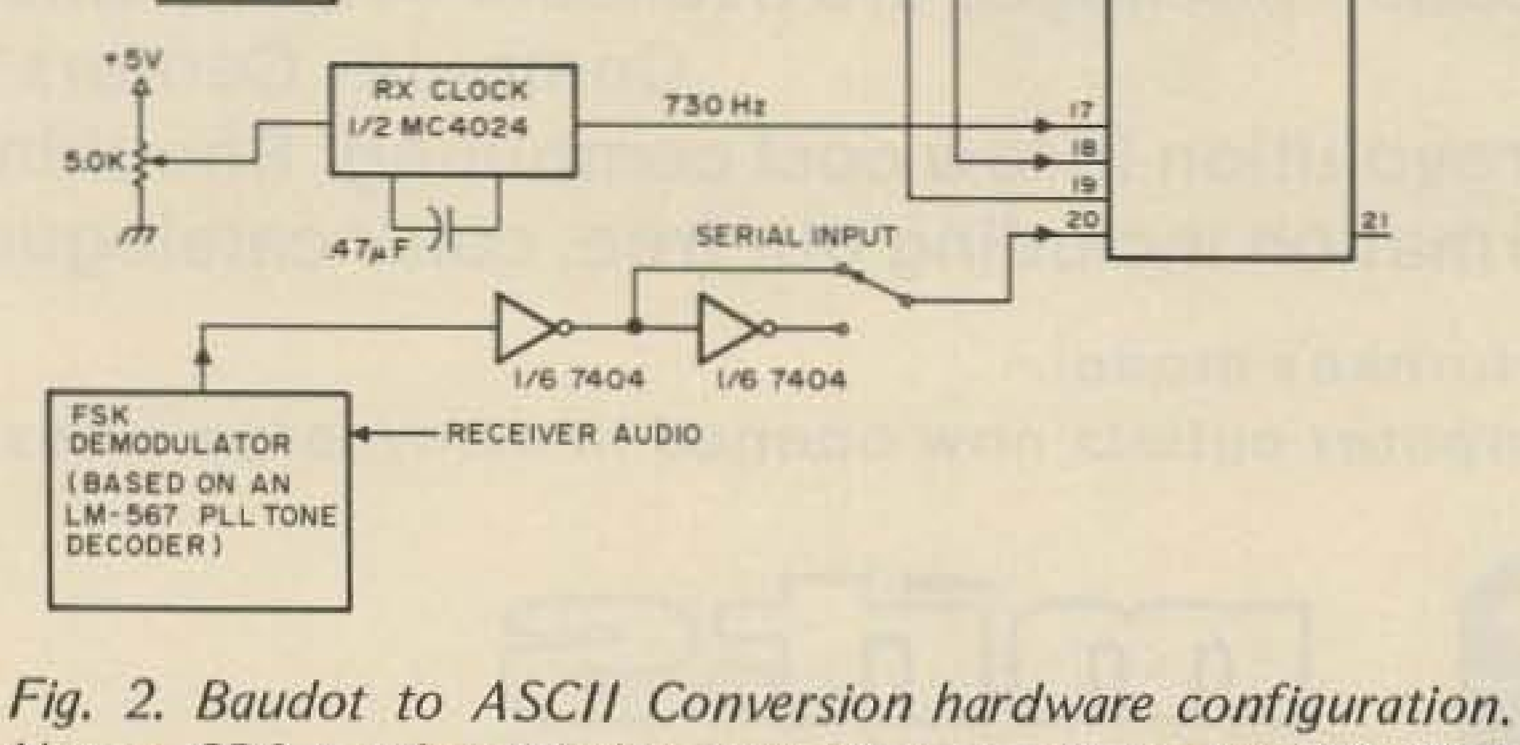


Fig. 2. Baudot to ASCII Conversion hardware configuration. Notes: CB2 is a handshake control output from the PIA. This output is under program control and is used to reset the UART after the word is read. Resetting the UART drives the DATA READY line low until the next complete data word is available.

LABEL	ADDRESS	CONTENTS	CHARACTER
LTRLOC	083C	00	NULL
	3D	45	E
	3E	0A	LF
	3F	41	A
	0840	20	SPACE
	41	53	S
	42	49	I
	43	55	U
	44	0D	CR
	45	44	D
	46	52	R
	47	4A	J
	48	4E	N
	49	46	F
	4A	43	C
	4B	4B	K
	4C	54	T
	4D	5A	Z
	4E	4C	L
	4F	57	W
	0850	48	H
	51	59	Y
	52	50	P
	53	51	Q
	54	4F	O
	55	42	B
	56	47	G
	57	00	FIGS
	58	4D	M
	59	58	X
	5A	56	V
	5B	00	LTRS

FIGLOC	085C	00	NULL
	5D	33	3
	5E	0A	LF
	5F	2D	–
	0860	20	SPACE
	61	27	'
	62	38	8
	63	37	7
	64	0D	CR
	65	24	$
	66	34	4
	67	00	BELL
	68	2C	,
	69	21	!
	6A	3A	:
	6B	28	(
	6C	35	5
	6D	22	"
	6E	29	)
	6F	32	2
	0870	23	#
	71	36	6
	72	30	0
	73	31	1
	74	39	9
	75	3F	?
	76	26	&
	77	00	FIGS
	78	2E	.
	79	2F	/
	7A	3B	;
	7B	00	LTRS

Table 1. Baudot to ASCII Lookup Table. Note: The locations corresponding to LTRS and FIGS contain NULLS (00) since these functions are taken care of outside the lookup table. The location for BELL is also a NULL since my terminal does not have this function.

these control characters was last received. The program automatically loads the location of the FIGURES table upon startup.

After the Baudot character has been read and stored, the reset subroutine outputs a short positive pulse to the UART used to convert the serial Baudot characters to parallel form. This pulse clears the UART parallel output register and readies it for the next word. The reset pulse is output via the CB2 control output of the parallel interface.

When the Baudot character has been stored as the index displacement, the appropriate ASCII character is fetched from the lookup table (using this index) and read into accumulator A (see Fig. 1). The program then outputs the character via the OUTEE subroutine to the computer control terminal (a CT-1024 TVT in my case). The program then branches back to the input step to wait for the next character.

The program does not incorporate an automatic "unshift on space or CR," so a missed LTRS command will result in a continued string of figures. This can be overcome by storing the program starting location at memory locations A006 and $A007_{16}$. These are the non-maskable interrupt vector locations. A push-button to ground on the computer's NMI line will cause the program to restart, automatically shifting to the LTRS lookup table. ■

```
MC6800 ASSEMBLER     V1.0     NONAME     76/05/15     10.38.03     PAGE 01

                                 * BAUDOT TO ASCII CONVERSION PROGRAM
                                 * FOR SWTPC 6800 COMPUTER.
                                 * ACCEPTS 5-BIT BAUDOT CODE IN PARALLEL FROM
                                 * UART AND CONVERTS TO ASCII AND DISPLAYS.
                                 *
                  0800                     ORG    $0800
         0800  8D 1C                       BSR    PINIT       INITIALIZE
         0802  CE 083C                     LDX    =LTRLOC     POINTER TO LTRS
         0805  8D 27             INPUT     BSR    CHARIN      GET CHARACTER
         0807  81 1B                       CMPA   =$1B        CHECK FOR "FIGS"
         0809  26 03                       BNE    NEXT
         080B  CE 085C                     LDX    =FIGLOC     SET PNTR TO FIGS
         080E  81 1F             NEXT      CMPA   =$1F        CHECK FOR "LTRS"
         0810  26 03                       BNE    LOOKUP      DO TABLE LOOKUP
         0812  CE 083C                     LDX    =LTRLOC     SET PNTR TO LTRS
         0815  A6 00             LOOKUP    LDAA   &00         INDEXED LOOKUP
         0817  BD E1D1                     JSR    OUTEE       OUTPUT CHARACTER
         081A  8D 07                       BSR    RESET       RESET UART
         081C  20 E7                       BRA    INPUT       START NEXT CHAR.
                                 * SUBROUTINE PINIT - INITIALIZES INTERFACE
                                 *
         081E  86 00             PINIT     LDAA   =00         SET UP 8-BIT INPUT
         0820  B7 8016                     STAA   PIADRB
         0823  86 3C             RESET     LDAA   =$3C        SET CB2 HIGH
         0825  B7 8017                     STAA   PIACRB
         0828  86 34                       LDAA   =$34        SET CB2 LOW
         082A  B7 8017                     STAA   PIACRB
         082D  39                          RTS
                                 *
                                 * SUBROUTINE CHARIN WAITS FOR CHARACTER
                                 * TO APPEAR AT INPUT. CHARACTER IS READY WHEN
                                 * BIT 7 OF INPUT GOES HIGH.
                                 *
         082E  B6 8016           CHARIN    LDAA   PIADRB      LOAD FROM UART
         0831  85 50                       BITA   =80         TEST BIT 7 SET?
         0833  27 F9                       BEQ    CHARIN      NO, LOAD AGAIN
         0835  84 1F                       ANDA   =$1F        REDUCE TO 5 BITS
         0837  B7 0816                     STAA   LOOKUP+1    STORE AS IDX DISP.
         083A  39                          RTS                RETURN TO
         083B  39                EXIT      RTS                RETURN TO PGM
         083C     0020           LTRLOC    RMB    32
         085C     0020           FIGLOC    RMB    32
                  E1D1           OUTEE     EQU    $E1D1
                  8016           PIADRB    EQU    $8016
                  8017           PIACRB    EQU    $8017
                                 * END PROGRAM.
+0001    087C                              END
SYMBOL TABLE
CHARIN     082E    EXIT     083B    FIGLOC     085C
INPUT      0805    LOOKUP   0815    LTRLOC     083C
NEXT       080E    OUTEE    E1D1    PIACRB L   8017
PIADRB L   8016    PINIT    081E    RESET      0823

FATAL ERRORS = 0   WARNING MESSAGES = 0
```

Table 2. Program. Notes on Assembler code: "=" before operand indicates immediate mode; "$" indicates hexadecimal number; default is decimal; "&" before number indicates indexed addressing mode.

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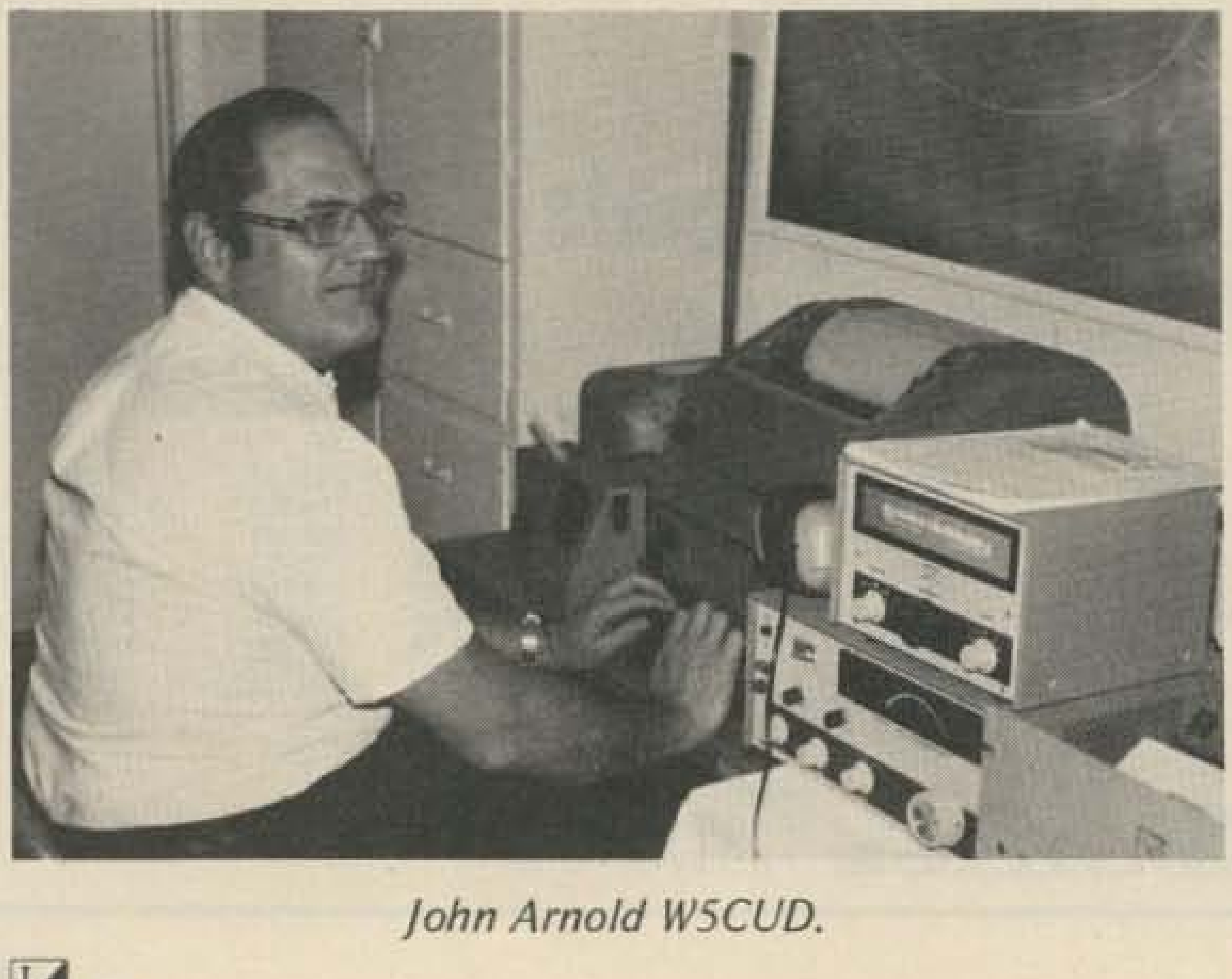
Baudot and BASIC

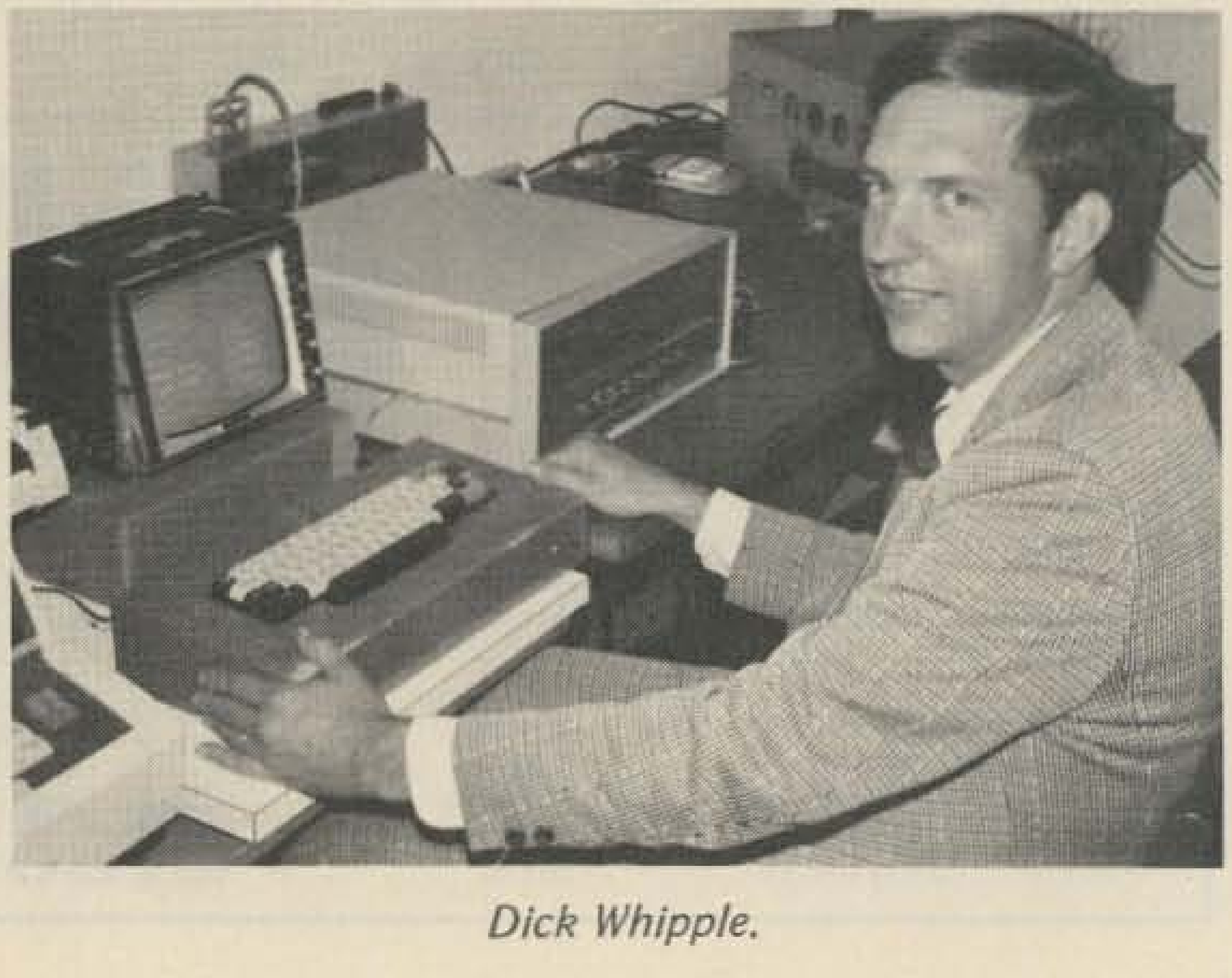
- - an interpreter for a Baudot computer

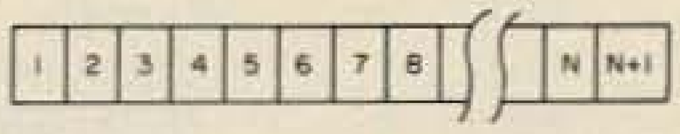
In previous articles of this series, we have attempted to demonstrate that Baudot teletype equipment can perform the input/output function in a hobby computer system. In the first article, a simple and inexpensive interface to bring a Baudot Model 19 on-line with an Intel 8080-based computer was described. The second article concerned the use of Baudot paper tape equipment for storage of data. In the third article, a system program called the Baudot Monitor/Editor (BM/E, for short) was presented. BM/E made it possible to enter, modify, and execute machine language programs via the Baudot printer/keyboard. Throughout, we have tried to keep hardware requirements to a minimum and thus encourage readers to get their old Baudot equipment up and running. As a further inducement along this line, we now present a high level language software system for use with Baudot equipment, but before we get the cart before the horse, perhaps we should back up and discuss computers and high level languages in general terms.

What is a High Level Language?

Computers are sometimes referred to as "thinking machines." In actual fact, the "thinking" is done by a human long before the computer is put to work. The computer merely performs a logical sequence of well-defined operations that are predetermined to achieve the desired results. On the lowest level, these operations consist simply of the computer's machine language instruction set. Working at this level requires an understanding of binary arithmetic, data encoding, I/O handling, memory allocation, and a number of other machine-related concepts. For those who do not have this specialized knowledge, or who simply want to avoid the intricacies of working at the machine level, a different approach is needed. Over the years, many efforts have been made to develop machine language programs to help humans achieve better working compatibility with computers. We might think of these programs as providing a computer/human interface. In most such software systems, decimal arithmetic is implemented to avoid the difficulties associated with machine level binary. In addition, ordinary words and alphabetic symbolism are adopted for use in directing


John Arnold W5CUD.


Dick Whipple.



Byte No.	
1 and 2	Binary value of label; most significant part in 1
3	Length of text plus 2 in binary
4 through N	Text of line
N + 1	CR (015 octal)

Fig. 1. A program line as stored by TBX.

```
:LST

00010 PR"## NUMBER GUESSING GAME ##"
00020 PR$PR
00030 LET A:RN
00035 LET C:O
00040 PR"I HAVE A NUMBER. TRY TO GUESS IT."
00050 PR"HERE WE GO . . . BY THE WAY THE NUMBER"
00060 PR"IS BETWEEN 1 AND 10000."
00070 LET C:C&1$PR"YOUR GUESS";$IN B
00080 IF B : A GOTO 150
00090 IF B ) A PR$PR"TOO LARGE. TRY AGAIN."$GOTO 70
00100 IF B ( A PR$PR"TOO SMALL. TRY AGAIN."$GOTO 70
00150 PR"THAT IS IT. YOU TOOK ";C;" TRIES."$PR
00160 PR"NEW GAME"$GOTO 20
```

Fig. 2. Listing of TBX number guess game.

the computer's operation. This relieves the need for using the machine's purely numerical instruction code. The authors of these software systems (through their choice of the words and symbolisms) created what is referred to as a high level language.

Many different languages of this type have been developed to meet the needs of different potential users. FORTRAN, with its mathematical orientation, has become the principal language for scientists and engineers. Another high level language, COBOL, has achieved stature in the business world because of its good file management capabilities. Still another language which has gained wide use is BASIC. As the name implies, BASIC was intended for people just getting started in computers. Its simple and convenient operational features make it a natural "learner's language." It would take pages to recount all of the high level languages that are in use – or have faded from the scene. But it's important to note that the existence of these software systems has done much to further the wide acceptance and use of computers.

Why Learn a High Level Language?

Although there are perhaps dozens of good reasons for learning a high level language, most derive from this one fact: High level languages are people-oriented, while low level languages are machine-oriented. People are far better able to utilize the capabilities of the computer if they are not burdened by the details of machine level operation. In addition, high level languages are not machine-dependent, as are low level languages. For instance, suppose you learn BASIC on a Data General Nova and then wish to use another machine like the Altair 8800. No problem. BASIC is fairly well standardized from machine to machine. Of course, on the machine level, the Nova and Altair are vastly different. But on your side of the software interface, both systems appear the same. Learning a high level language like BASIC will greatly extend the usefulness of your computer, and at the same time broaden your future capabilities!

What is a BASIC Program?

Humans perform tasks very often without clearly recognizing the steps involved. Computers, on the other hand, cannot perform even the simplest task without having the steps precisely set out beforehand. It is this fundamental weakness of present-day computers that make them need us! We call this step description process "programming." Contrary to what you might think, programming in a high level language does not require a massive learning effort on your part. A reasonably competent sixth grader will have already acquired the knowledge required to understand what a computer does. The problem simply reduces to learning how to make the computer do it! This is where BASIC comes in. BASIC consists simply of a group of commands or instructions that you arrange in a particular order to perform the required task. To become a good programmer, you must think through a task a step at a time, recognizing at each which BASIC command should be used to accomplish it. If you are unaccustomed to this type of problem-solving, you may find it difficult at first. However, as time goes on, you will no doubt find this careful point-by-point analysis of a given task a very satisfactory approach to problem-solving, both on and off the computer.

Where To Get the Basics of BASIC

People have written entire books describing the BASIC language. It would hardly be possible to adequately reduce such volumes to one or two paragraphs. The best we can do here is to list the names of some books that will provide detailed discussion. Table 1 includes a list of recommended books and their possible sources. For the real greenhorn, we highly recommend the small book entitled, *My Computer Likes Me When I Speak BASIC.* From this you can gradually work up to some of the more comprehensive books.

In addition to a book, you will need a BASIC operating system for your computer. That's where TINY BASIC EXTENDED comes in!

The TINY BASIC Project

In mid-1975, a project was started in the pages of *People's Computer Company* (PCC) *Magazine* to foster the creation of a small BASIC software system for hobby computers. The term "TINY BASIC" was coined for the system. The project culminated in the creation of a new software journal profusely entitled, *Dr. Dobb's Journal of Computer Calisthenics & Orthodontia.* Credit is due here to Bob Albrecht and others on his staff for encouraging the development of TINY BASIC and providing for its availability to hobbyists. We wrote the first version of TINY BASIC, and a complete description of the ASCII version appears in Volume 1, Numbers 1 and 2, of *Dr. Dobb's Journal.* Because our version had some features not included in the original design, we termed it TINY BASIC EXTENDED, or TBX for short. A Baudot version of TBX was also developed, and its description

1. *My Computer Likes Me When I Speak BASIC,* Bob Albrecht, 1972, $2.00.*,**
2. *BASIC,* Bob Albrecht and others, 1973, $3.95.*,**
3. *BASIC Programming,* Kemeny and Kurtz, 1971, $6.95.**
4. *BASIC BASIC,* James S. Coan, 1970, $3.95.**

Sources:

*73 *Magazine,* Peterborough NH 03458.
**PCC, PO Box 310, Menlo Park CA 94025.

Table 1. Books about BASIC.

```
:RUN

## NUMBER GUESSING GAME ##

I HAVE A NUMBER. TRY TO GUESS IT.
HERE WE GO . . . BY THE WAY THE NUMBER
IS BETWEEN 1 AND 10000.
YOUR GUESS ? 5000
TOO LARGE. TRY AGAIN.
YOUR GUESS ? 2500
TOO LARGE. TRY AGAIN.
YOUR GUESS ? 1250
TOO SMALL. TRY AGAIN.
YOUR GUESS ? 2000
TOO LARGE. TRY AGAIN.
YOUR GUESS ? 1600
TOO LARGE. TRY AGAIN.
YOUR GUESS ? 1400
TOO SMALL. TRY AGAIN.
YOUR GUESS ? 1500
TOO SMALL. TRY AGAIN.
YOUR GUESS ? 1550
TOO LARGE. TRY AGAIN.
YOUR GUESS ? 1525
TOO SMALL. TRY AGAIN.
YOUR GUESS ? 1535
TOO SMALL. TRY AGAIN.
YOUR GUESS ? 1545 THAT IS IT. YOU TOOK 11 TRIES.

NEW GAME

I HAVE A NUMBER. TRY TO GUESS IT.
HERE WE GO . . . BY THE WAY THE NUMBER
IS BETWEEN 1 AND 10000.
YOUR GUESS ?
```

Fig. 3. Execution of number guess game.

Standard BASIC	TBX	Example
LET	LET	LET A:B&C
PRINT	PR	PR"ANSWER", A;B
GOTO	GOTO	GOTO 100 GOTO A/B
GOSUB	GOSUB	GOSUB 5000
RETURN	RET	
IF	IF	IF A (: B GOTO 100
INPUT	IN	IN A,B,C
DIM(DIMENSION)	DIM	DIM A(10), B(10,C)
FOR,NEXT	FOR,NXT	FOR 1:1 TO B A = I NXT I
NEW	NEW	CLEARS PROGRAM AREA
LIST	LST	LISTS PROGRAM AREA LST ALL OF PROGRAM LST 100 Line 100 only LST 100,200 Line 100 Thru 200
RUN	RUN	Begins execution of Program
SIZE	SZE	PRINTS SIZE OF PROGRAM AND MEMORY REMAINING

Variables restricted to one letter of alphabet.

Table 2. TBX instruction set.

follows in the remaining sections of this article.

A General Description

TBX is a small BASIC interpreter for use on an Intel 8080-based hobbyist system. It occupies the lower 3.2K of memory, so that one 4K memory board provides enough room for TBX and a BASIC program. The BASIC program is stored by line number in source form, i.e., the BASIC text is stored directly in Baudot. When the program executes, TBX scans the lines in numeric order and interprets the Baudot code. By "interpret," we simply mean that the computer determines which instruction is represented by the stored Baudot character string and then proceeds to carry it out. Fig. 1 shows how a line of TBX is stored. Further discussion of how TBX works can be found in Volume 1, Numbers 1 and 2, of *Dr. Dobb's Journal*.

Table 2 summarizes the instruction set available with TBX. An example is given with each, to help you see how the instruction is used. If a TBX instruction follows a line number, it will be entered into memory for later execution as part of the overall program. An instruction entered without a line number is executed directly. You may want to use this direct mode to become familiar with the TBX instruction set. Note that all arithmetic is integer and modulo 2^{15}, which means numbers cannot exceed ±32,767. This may seem like a limitation, but you will be surprised at the tremendous variety of programs that can be written within the framework of integer arithmetic.

TBX – The Baudot Version

The use of Baudot poses a few problems which must be overcome before a system like TBX can be implemented. As we mentioned in an earlier article, the Baudot machine uses a mechanical flip flop to change case. This means that the Baudot code for upper and lower case characters is the same; the physical position of the typing basket determines which will be printed. This mode of operation is unsatisfactory for high level language application, because it would lead to a code ambiguity within the computer. To overcome this difficulty, it is necessary to use an additional bit to indicate the case of the teletype. This produces the so-called 6 level Baudot code. Our May, 1976, article included a table of this code. The computer is given the task of keeping up with the case and seeing that the proper code is set internally. The TBX user merely enters the characters on the keyboard using the FGS and LTR keys as required. The computer does the rest!

Another problem arises because of the limited character set available in Baudot. A standard Baudot keyboard does not include the important symbols like "-", "+", and "*", among others. Some allowance has to be made for this if TBX is to be useful for calculation purposes. Table 3 shows the equivalences accepted by TBX for the missing symbols. Where there is a possibility of ambiguity, the computer understands which symbol is meant by content.

Conventional Symbol		TBX
=	(Equal)	: (Colon)
<	(Less Than)	((Open Parenthesis)
>	(Greater Than)	) (Closed Parenthesis)
+	(Plus)	& (Ampersand)
*	(Asterisk: Multiplication)	# (Pound)
-	(Minus Sign – Subtraction and Negation)	Same
/	(Slash Sign – Division)	Same
$	(Dollar Sign – Strings)	$ (Same – Line Statement Separator)

Table 3. Baudot symbol equivalences.

TBX – An Operational Description

In line oriented language like BASIC, programs are stored as a collection of numbered lines and then executed in numerical order. One of the great features of BASIC (and TBX, too) is the convenient method of line entry and editing. A line is entered by simply typing the line number followed by the line text and a Carriage Return (CR). The line is placed numerically in the proper position with lines already in memory. You can enter lines in any order, but they will always be stored, and later executed, consecutively by line number. If a line is entered with the same line number as one already in memory, the previous line is deleted before the new line is stored. To delete a line entirely, you enter the line number, followed immediately by a CR. In writing programs, line numbers are generally chosen in increments of 5 or 10 so that later additional lines can be inserted as necessary.

In TBX, a colon is used as a system prompt. This helps keep you posted on the status of the system. To use the direct mode, simply enter the instruction immediately following the prompt. NEW, LST, SZE, and RUN instructions are generally used in the direct mode, rather than as part of a program. If a number is entered after the prompt, TBX assumes you want to enter or delete a line from storage – no execution takes place, as in direct mode.

One of the features of a high level language like TBX is that it is able to detect programming errors and take action to prevent the system from destroying itself. To assist in debugging, TBX will print an error message. The message takes the following form:

```
ERR A B
```

A is the error code (see Table 4) and B is the line number at which the error occurred. If B is 0000, the error occurred during a direct mode instruction.

How To Obtain TBX

Because of the length of TBX code, an octal listing in this article is not feasible. A complete octal listing with instructions can be obtained for $5.00. Both a cassette and Baudot paper tape are available for $15.00 postpaid. Please specify Suding cassette, Kansas City Standard cassette, or Baudot paper tape (binary encoded). Address all inquiries or orders to: TBX Tape – Baudot Version, 305 Clemson Dr., Tyler TX 75701.

Sample Program

To help you get started, we have included the listing of a program written in TBX. A few lines of execution follow the listing. Studying this program will help you get started in BASIC programming.

Just think about it! Who would ever suppose that an old Model 19 could speak BASIC? Well, it can, and so can yours! ■

1 Input line too long – exceeds 72 characters
2 Numeric overflow on input
3 Illegal character detected during execution
4 No ending quotation mark in PR literal
5 Arithmetic expression too complex
6 Illegal arithmetic expression
7 Label does not exist
8 Division by zero not permitted
9 Subroutine nestling too deep
10 RET executed with no prior GOSUB
11 Illegal variable
12 Unrecognizable statement or command
13 Error in use of parenthesis
14 Memory depletion

Table 4. Error codes.

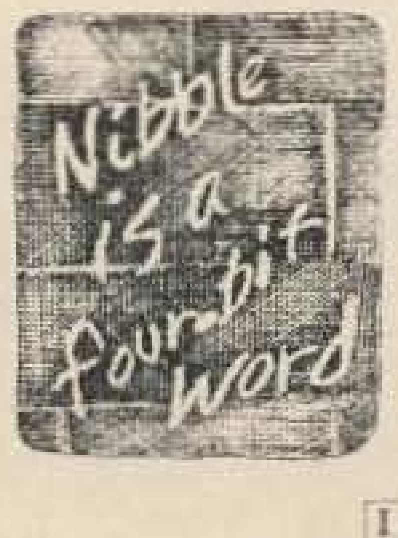
I/O REPORT

from page 132

address line. For example, locations ØE5A, B, and C contain a JUMP (4C) to location ØF4Ø. . . and with only the nine address lines used this will actually work out to be location 14Ø. The ØF4Ø is necessary, though, because address bit 11 is the enable for the PROM.

0E00	A2	0E30	85	0E60	30	0E90	09	0EC0	4A	0EF0	E6
01	7F	31	01	61	E9	91	C5	C1	85	F1	07
02	9A	32	46	62	A5	92	03	C2	02	F2	A9
03	D8	33	00	63	09	93	90	C3	18	F3	00
04	A9	34	4C	64	C5	94	29	C4	65	F4	AA
05	00	35	43	65	02	95	A9	C5	09	F5	E8
06	A8	36	0E	66	B0	96	01	C6	85	F6	8A
07	85	37	4A	67	1E	97	85	C7	03	F7	C9
08	08	38	EA	68	E6	98	00	C8	A9	F8	1F
09	A9	39	85	69	04	99	20	C9	00	F9	90
0A	80	3A	01	6A	A9	9A	F0	CA	85	FA	11
0B	85	3B	46	6B	07	9B	0E	CB	06	FB	8D
0C	00	3C	00	6C	C5	9C	E6	CC	A9	FC	50
0D	A9	3D	A5	6D	D4	9D	06	CO	07	FD	0F
0E	00	3E	00	6E	D0	9E	A9	CE	C5	FE	C5
0F	85	3F	09	6F	DA	9F	40	CF	05	FF	00
10	0A	40	80	70	A9	A0	C5	D0	B0	0F00	D0
11	85	41	85	71	D2	A1	07	D1	05	01	F3
12	09	42	00	72	85	A2	B0	D2	A5	02	8A
13	E6	43	EA	73	0F	A3	19	D3	09	03	0A
14	0A	44	EA	74	20	A4	A9	D4	0A	04	09
15	58	45	A9	75	90	A5	D0	D5	85	05	C0
16	EA	46	00	76	0F	A6	85	D6	02	06	85
17	EA	47	85	77	4C	A7	0F	D7	A9	07	0F
18	EA	48	09	78	09	A8	20	D8	03	08	20
19	EA	49	85	79	0E	A9	90	D9	C5	09	90
1A	EA	4A	0A	7A	A5	AA	0F	DA	06	0A	0F
1B	78	4B	E6	7B	09	AB	A9	DB	90	0B	60
1C	D0	4C	0A	7C	0A	AC	C4	DC	03	0C	A9
1D	F5	4D	58	7D	85	AD	85	DD	4C	0D	F6
1E	E6	4E	EA	7E	02	AE	0F	OE	09	0E	85
1F	09	4F	EA	7F	A9	AF	20	DF	0E	0F	0F
20	2C	50	EA	80	00	B0	90	E0	A5	10	20
21	00	51	EA	81	85	B1	0F	E1	09	11	90
22	04	52	EA	82	06	B2	A9	E2	0A	12	0F
23	10	53	78	83	4C	B3	FE	E3	85	13	A9
24	EE	54	D0	84	0D	B4	85	E4	03	14	00
25	EA	55	F5	85	0E	B5	0F	E5	4C	15	AA
26	EA	56	E6	86	A9	B6	20	E6	09	16	E8
27	EA	57	09	87	00	B7	90	E7	0E	17	8A
28	EA	58	D0	88	85	B8	0F	E8	00	18	C9
29	A5	59	03	89	04	B9	A9	E9	00	19	1F
2A	09	5A	4C	8A	E6	BA	00	EA	00	1A	90
2B	C6	5B	40	8B	05	BB	85	EB	00	1B	19
2C	01	5C	0F	8C	20	BC	07	EC	00	1C	8D
2D	B0	5D	2C	8D	F0	BD	4C	ED	00	1D	70
2E	08	5E	00	8E	0E	BE	D7	EE	00	1E	0F
2F	0A	5F	04	8F	A5	DF	0E	EF	00	1F	C5

0F20	00	0F50	00	0F80	04	0FB0	F0	0FE0	00	
21	D0	51	40	81	0A	B1	0E	E1	00	
22	F3	52	00	82	36	B2	A9	E2	00	
23	8A	53	A0	83	E4	B3	FF	E3	00	
24	0A	54	01	84	A2	B4	C5	E4	00	
25	09	55	10	85	0C	B5	0D	E5	00	
26	C0	56	20	86	FC	B6	F0	E6	00	
27	85	57	90	87	F4	B7	1F	E7	00	
28	0F	58	FF	88	7C	B8	4E	E8	00	
29	20	59	30	89	32	B9	0D	E9	00	
2A	90	5A	50	8A	54	BA	02	EA	00	
2B	0F	5B	E8	8B	00	BB	C6	EB	00	
2C	A9	5C	60	8C	AA	BC	08	EC	00	
2D	FE	5D	48	8D	4C	BD	4C	ED	00	
2E	85	5E	58	8E	56	BE	D3	EE	00	
2F	0F	5F	90	8F	00	BF	0F	EF	00	
30	20	60	C0	90	98	C0	98	F0	00	
31	90	61	38	91	AA	C1	AA	F1	00	
32	0F	62	28	92	85	C2	85	F2	00	
33	60	63	00	93	20	C3	20	F3	00	
34	EA	64	08	94	E8	C4	8D	F4	00	
35	A9	65	D8	95	95	C5	0D	F5	00	
36	D2	66	68	96	20	C6	02	F6	00	
37	85	67	88	97	CA	C7	A9	F7	00	
38	0F	68	F0	98	CA	C8	07	F8	00	
39	20	69	18	99	10	C9	85	F9	00	
3A	90	6A	70	9A	F7	CA	08	FA	AA	'AA' Interrupt vector
3B	0F	6B	00	9B	A5	CB	A9	FB	0F	'0F'
3C	4C	6C	E0	9C	0F	CC	FF	FC	00	'00' Startup vector
3D	2C	6D	98	9D	85	CD	95	FD	0E	'0E'
3E	0F	6E	88	9E	20	CE	20	FE	AA	'AA' Interrupt vector
3F	00	6F	00	9F	C8	CF	CA	FF	0F	'0F'
40	58	70	00	A0	60	D0	30			
41	A9	71	C4	A1	00	D1	01			
42	FF	72	00	A2	00	D2	88			
43	85	73	8C	A3	00	D3	68			
44	09	74	00	A4	00	D4	AA			
45	2C	75	00	A5	00	D5	58			
46	00	76	3C	A6	00	D6	40			
47	04	77	1C	A7	00	D7	8D			
48	30	78	00	A8	00	D8	10			
49	F8	79	00	A9	00	D9	02			
4A	78	7A	84	AA	48	DA	C6			
4B	4C	7B	7A	AB	8A	DB	08			
4C	62	7C	CE	AC	48	DC	68			
4D	0E	7D	00	AD	EA	DD	AA			
4E	00	7E	E2	AE	A5	DE	68			
4F	00	7F	66	AF	08	DF	40			



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Toward a More Perfect Touchtone Decoder

-- Ma's system can be made to work well

Bell labs really started something with their DTMF (Dual Tone Multi-Frequency) dialing system.[1,2,3] Developed for easy rapid dialing and bearing the fancy name "Touchtone"* it rapidly outgrew its original purpose as developed for the Bell System. Touchtone signaling is widely used now anywhere a voice-frequency communications link is available. It offers a rapid, inexpensive means of sending non-vocal information using small inexpensive encoding devices (Touchtone pads) and requiring relatively simple, cheap decoders. Commercial uses include bank account status reporting, computer input/output, remote control and selective calling on radio systems. And, as any FMer knows, Touchtone signaling is widely used by radio amateurs for repeater control functions, selective calling and autopatches.

Touchtone usage by hams saw only limited usage so long as the only decoders available were surplus (?) Ma Bell or expensive commercial types. Signetics then simplified the whole matter when they introduced their 567 phase locked loop (PLL) tone decoder IC. Using the 567 makes building a tone signaling system very easy. Of course, the semiconductor industry recognizes a winner very quickly, so now the 567 type chip is available from National Semiconductor, Exar, and others, as well as from Signetics. This competition has decreased prices drastically, so that now you can find these chips available through *73 Magazine* advertisers for as little as $1.50 apiece.

Now that all that introductory stuff is over, let me tell you what this article is about. In the course of working with PLL ICs to make practical Touchtone decoders, I've found some useful methods and suggestions. I don't mean to deride the semiconductor industry's applications staffs, but their general overall treatment of applications data is too general to be fully workable. It's very frustrating to find that applications info stops just short of giving me enough detail to make a fully working circuit. The first trial usually works after a fashion, but the "bugs" have to be worked out. My intent in writing is to fill the information gap and my work may help others in using PLL decoders, primarily over radio transmission links as used by radio amateurs.

Tone Decoder Block

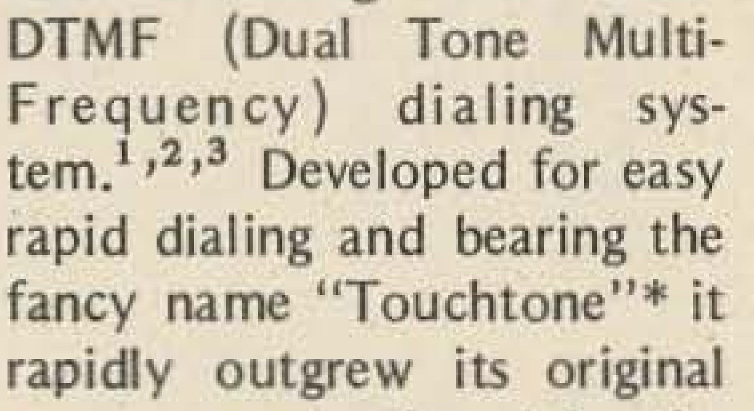
The basic PLL tone decoder building block is shown in Fig. 1(a). I won't give any detail about its inner workings or component values, since this information is well covered in several places.[4,5,6] The references also provide slightly differing circuitry, but the basic function remains the same. From now on, this decoder block will be shown as in Fig. 1(b). Basically, all the block does is provide a specific response to a predetermined range of frequencies. The 567 has an open-collector output which switches from a high resistance to ground to a low resistance state when the proper tone is applied to its input. Thus when the tone appears, current will flow through the load resistor R_L shown in Fig. 1(a).

In order to successfully decode a Touchtone signal, more than one such decoder block is needed. Each individual Touchtone symbol is transmitted as a pair of tones as shown in Fig. 2; for example, the digit "1" consists of a 697 Hz tone and one at 1209 Hz sent simultaneously. As you can see, these tones are arranged in two sets. The sets are called the high group (1209, 1336, 1477 and 1633 Hz)** and the low group (697, 770, 852 and 941 Hz). Each symbol or digit is sent with one high group and one low group tone. Thus a complete Touchtone decoder must have at least seven decoder blocks to

*AT&T Trademark.

**The fourth high group tone (1633 Hz) is shown for completeness, but not widely used by hams since 12 button pads don't generate it.

Fig. 1(a). Schematic diagram.



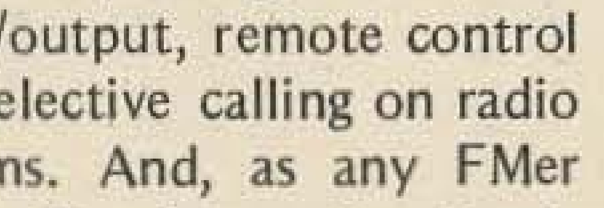


Fig. 1(b). Tone decoder block.

Fig. 2. Frequency pairs for Touchtone symbols. Two tones are transmitted simultaneously. For example, digit 1 is 697 and 1209 Hz, etc.

LO GROUP \ HI GROUP	1209Hz	1336Hz	1477Hz	1633Hz
697Hz	1	2	3	A
770Hz	4	5	6	B
852Hz	7	8	9	C
941 Hz	#	0	*	D

A,B,C,D NOT NORMALLY USED

detect the presence of any of the legitimate tones (see Fig. 3). The block indicated as LOGIC contains digital gates to convert the 2-out-of-seven decoder outputs to 0-9, # and * outputs (references 5 and 6).

Band-Splitting

The simple Touchtone decoders commonly used feed audio directly from the communications link (radio receiver, telephone line, etc.) to the inputs of the decoder blocks as shown in Fig. 3. If system audio level can be controlled, and if too many extraneous signals aren't present, this scheme works well. However, on a typical radio link (and especially on an amateur repeater) these conditions don't exist. First, there is usually an imbalance in tone levels between the high and low groups called "twist." Bell System compatible Touchtone pads emphasize high group tones to allow for attenuation of the higher frequency tones in telephone lines. Additional imbalance (twist) often occurs due to the imbalance of audio tailoring between transmitters and receivers, particularly in FM systems. Also, recovered audio varies depending on the amount of audio transmitted via the link. Secondly, on any link, and particularly amateur repeaters, a wide variety of squeals, whistles, grunts, clicks and other barnyard noises occurs frequently.

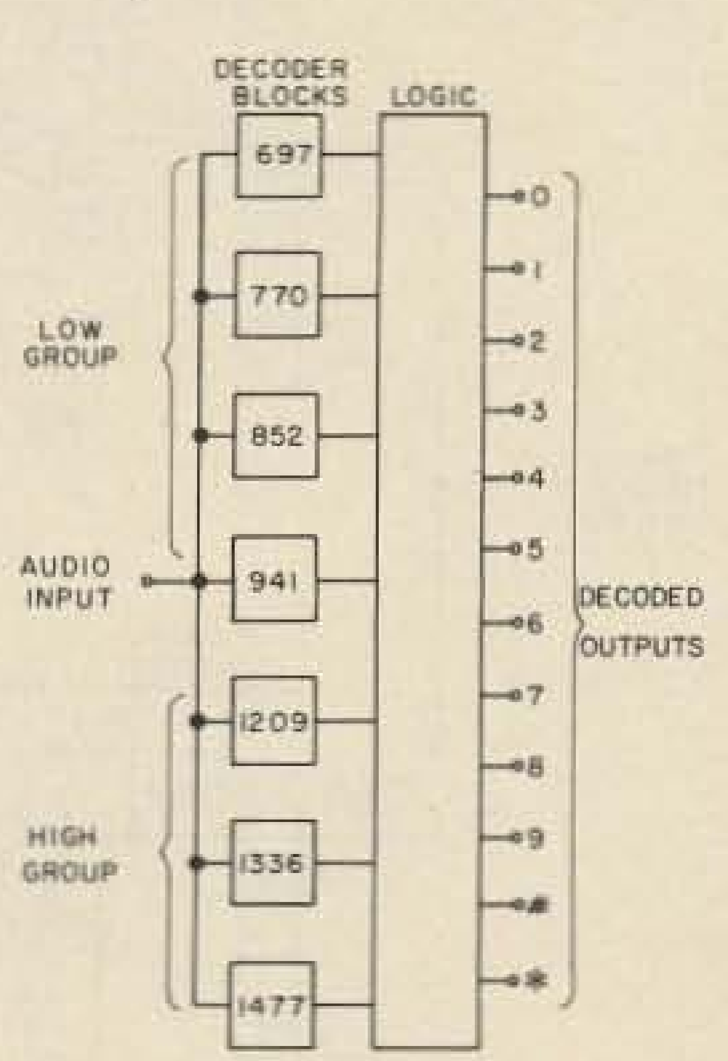
With these uncontrolled inputs, the Touchtone decoder can misbehave, causing "falsing," which can be either an output without any valid input signal, or non-recognition of a valid signal in the presence of unwanted noise. As described in the Signetics application literature, the PLL detection bandwidth varies as a function of signal amplitude applied to the chip. Thus, at low levels, a signal only slightly off frequency in one tone channel might be recognized, whereas at high levels, a tone well off the mark might cause a false response.

Obviously, some means of level control is needed to get around this problem. One commonly used method is a limiter (just like in an FM receiver). This is a fine idea, except that a limiter alone won't do the job for two reasons. First, a limiter exhibits "capture effect." This just means that if two signals of unequal amplitude are fed to a limiter, the stronger one predominates, further suppressing the weaker signal. This would make any "twist" even worse than it was without the limiter. Secondly, limiters, because they are nonlinear, generate spurious mixes and harmonics that could generate extra frequencies which can foul up decoder operation. The solution is easy — use two limiters, one for the high group and another for the low group. And to keep out spurious crud, feed each limiter with only those frequencies present within its respective group, as in Fig. 4. The bandpass filters make up what is called a band-splitting filter. Each passes only those frequencies required by the individual decoder group, so the problems of emphasizing "twist" and generating unwanted slop are circumvented.

Practical Band-Splitter

Fig. 5 shows the schematic diagram of an easy-to-duplicate band-splitting filter. Each half of the filter consists of two cascaded bandpass active filters (they act like LC tuned circuits) which are staggertuned, so that they pass one frequency group, while rejecting the other group. The bandpass sections are so-called multiple feedback active filters whose Q and center frequencies were empirically derived (fudged to fit). Anyone so inclined can design another filter, probably better, using the techniques outlined in Chapter 8 of reference 7 and Chapter 5 of reference 8. The filter circuit is simple and cheap to build, since all four operational amplifiers used are contained on one chip in the Motorola MC3401 or National LM3900 integrated circuits. The limiters which follow the band-splitters are very simple, consisting of a pair of back-to-back germanium diodes for each section. All in all, this may be pretty crude, but it works well. Construction of the filter is non-critical since it operates at audio frequencies. Several of them have been constructed using both vectorboard and PC board construction with no layout or parts placement difficulties encountered. For room temperature operation, all frequency determining components are non-critical, but refer to a later section for suggested extended temp range component types.

Fig. 3. Simplest 12 button pad Touchtone decoder.



Tune-up is relatively simple. It is best done by first separating the four individual bandpass sections by opening the A-B and D-E connections. Connect an ac voltmeter to A, and apply dc power. The meter should read 0 volts ac. Now connect a source of 697 Hz sine wave audio to the input line and set the input level to about .1 volts rms. Adjust R3 for resonance as indicated by maximum deflection of the ac voltmeter. (Although the schematic shows a potentiometer here, I selected a fixed resistor of proper value and soldered it in place — pots cost too much.) Now connect the meter to point C and a 941 Hz signal to B. Adjust R8 for maximum meter reading. The low group filter is now tuned, so reconnect A to B. Repeat the same procedure for the high group filter, observing the high group connection points. High group tune-up frequencies are 1209 and 1633 Hz.

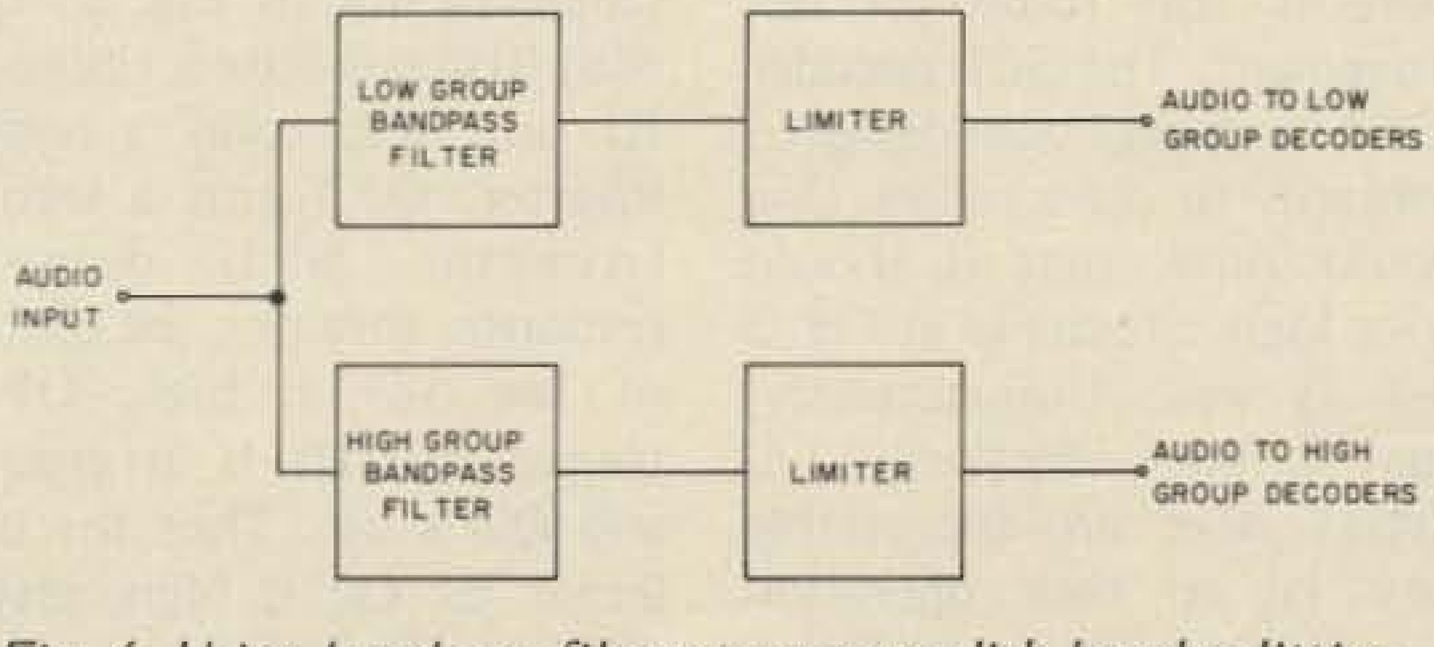


Fig. 4. Using bandpass filters to accomplish band-splitting.

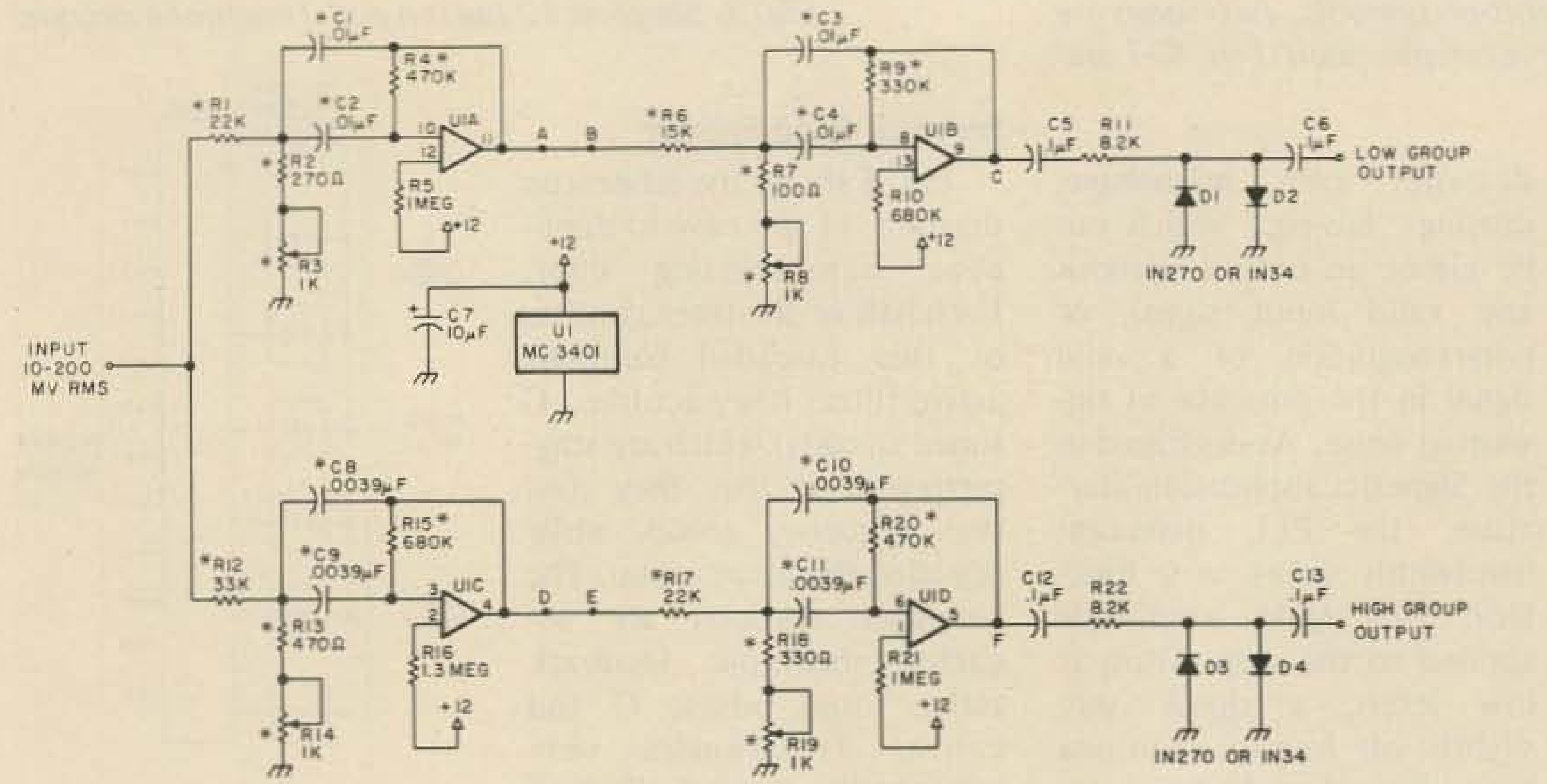


*Fig. 5. Band-splitting filters and limiters. Notes: 1. * indicates tuning components should be 5% tolerance. 2. Other components 10%. 3. +12 V can be 8 to 15 V dc but must be filtered.*

Idealized amplitude response curves are shown in Fig. 6. Almost 20 dB rejection of the opposite group and out-of-band frequencies is provided by each section. In-band ripple depends on accuracy of tuning. It has varied between 3 and 6 dB for the filters I built. You may notice that the high group filter extends beyond 1477 Hz.

Actually, there is another frequency used in some systems to expand the symbol set. Few available pads have the fourth group of buttons, although they can be added. Anyway, this lengthening of the high group filter will cause no harm in a 12 button pad system.

Further Improvements

Using the band-splitting filter and limiter combination vastly improves decoder operation as described above, but there is still room for improvement. The 567 decoder IC, it appears, was designed primarily to drive relays. One would think that it should drive logic circuits as in Fig. 3 just as well. Unfortunately, this is not necessarily so. Relays have an appreciable time lag in their operation due to their electromechanical structure. This delay can range from perhaps a millisecond to 100 milliseconds or so, depending on their size. The 567 needs this lag. Certain combinations of input signals or noise pulses can cause short duration chattering of the 567 output. Relays ignore these spurious outputs because they are usually only 100 microseconds to a millisecond long. However, TTL circuits take less than 100 *nanoseconds* to switch, so they pass on these phony outputs and can foul up system operation. Signetics has some hints for chatter prevention on their data sheet, but I never got them to work well enough to get rid of all of the hiccoughs and burps. My cure was to add a delay circuit between the 567 and logic gates.

Delay Circuit Operation

The delay circuit is shown schematically in Fig. 7. Q1, with its associated resistors, R1 and R2, form a logical inverter. Q2 forms a second inverter with delayed response. Initially, the output of the 567 is high, Q1 is turned on, C1 is at ground and Q2 is off. Thus the collector of Q2 is high, giving the same logical sense as the output of the 567. When a tone appears, the 567 output goes low, and Q1 turns off charging C1 through R2 and R3. When C1 charges to about 1.5 volts, Q2 turns on and its collector goes low. The time required to turn on Q2 is determined by the values of R2, R3 and C1. In this case, the time is about 7 milliseconds. When the tone stops, the 567 output goes high and Q1 collector goes low, discharging C1 through D1 and R4. Q2 turns off when C1 falls below 1.5 volts. Note that the discharge time constant of C1 with R4 is much shorter than the charging time constant of R2 and R3 with C1. This makes the delay time to turn Q2 off much shorter than its turn on time. This characteristic ensures that short pulses and chatter on the 567 output will not pass through the delay circuit, but valid signals longer than 7 milliseconds will. There are other means of getting the same effect, depending on the logic involved, as in references 9 and 10. I used what I believe to be a simple discrete component circuit because I have plenty of them. At any rate, the delay block helps clean up the decoder's output, however it is implemented. If using a 74121 one shot or a 555 timer turns you on – do it! Construction of the delay is super non-critical; even component tolerances matter little. Electrolytic capacitors and carbon composition resistors are fine; just be sure that the transistors used have a gain (HFE) of 150 or more.

By the way, using this delay circuit is not an original idea. Bell Labs designed a more complicated version into the station equipment described in reference 2. Besides getting rid of chatter, timing to determine signal validity is commonly used in tone signaling systems. It eliminates many falsing problems at the expense of slightly lengthened response times. For manual Touchtone use, this extra delay poses no handicap because users are hard-pressed (no pun intended) to punch buttons much faster than two a second. Some automatic calling systems run as fast as 10 digits a second, so care must be taken to tailor decoder response times to use them.

System Assembly

The complete decoder is shown in block form in Fig. 8. Each of the indicated blocks has been described earlier, although not all schematics have been fully described. For more detailed information, see the reference section where I have briefly

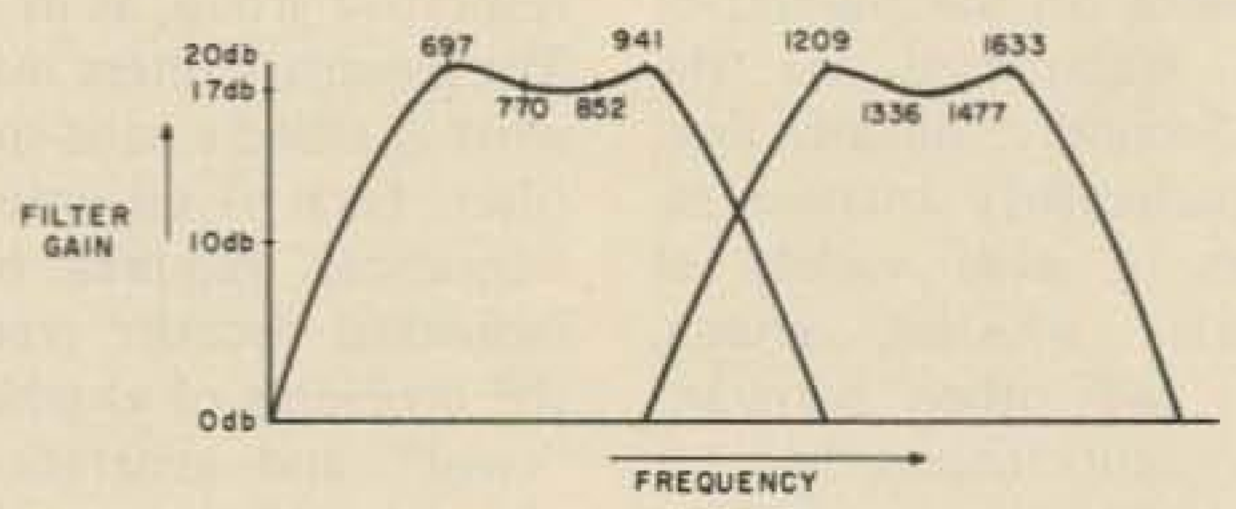


Fig. 6. Idealized band-splitting filter response curves.

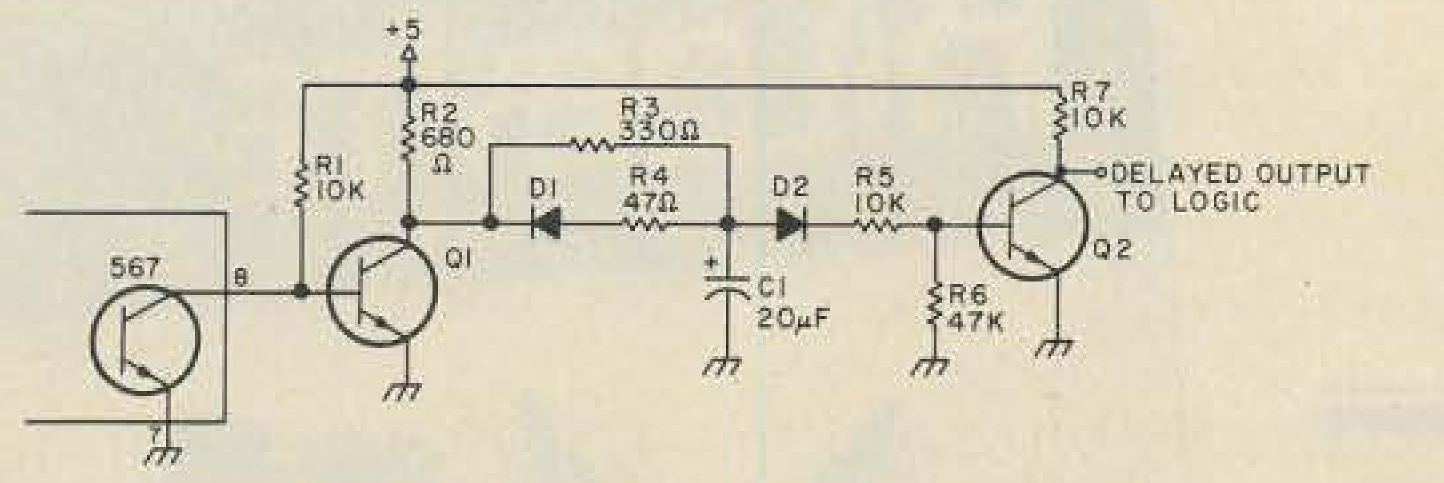


Fig. 7. Decoder delay circuit. D1, D2 — 1N914 or 1N4148. Q1, Q2 — MPS 5172 or other NPN silicon with β over 150.

summarized the content of each article. You can pick and choose the information desired to tailor your own system to individual needs. A more complete schematic diagram is not given here because I doubt that anyone would duplicate my system exactly.

Miscellaneous

Now for a few more tips. First of all, let's look at temperature stability. The Signetics data sheet shows very well how stable the 567 is with temperature, but outside the lab, the resistors and capacitors used to tune the chip can seriously degrade the stability of the IC. Sensitive parts are indicated as frequency-determining components in Figs. 1(a) and 5. Those used in the delay block of Fig. 7 are not at all critical. If the decoder is intended solely for room temperature use, ordinary carbon composition resistors and mylar capacitors are fine for critical components. For extended temp range operation, more stable parts will be needed to prevent degradation of the decoder's performance. Resistors should be of the precision film type. A good compromise between price and performance is the use of semi-precision Corning RL-07 or IRC Metal Glaze™ resistors. For tuning capacitors outside the range of 32 to 122° F, mylar capacitors are a poor choice. Better choices are capacitors with polystyrene or polycarbonate dielectrics. An excellent choice of polycarbonate capacitors is the Siemens B32540 series available from Newark Electronics in Chicago. They are ideal for printed circuit boards — they are small, relatively inexpensive and *very* temperature stable. I've used them from minus 65° F to plus 200° F with a total capacitance drift of less than two percent!

Finally, a word or two about tuning the individual 567 decoder blocks. Neither the application notes nor the data sheet give any clues as to the proper method. I once saw directions for adjustment in a decoder instruction book that said to apply signal and adjust the pot first in the clockwise direction until the output goes low, then adjust in the counterclockwise direction until it goes low. The builder was to note both potentiometer settings and set the pot midway between them. Great! The only thing they neglected to say was that the two settings were about 5° apart. You would need a microscope and a surgeon's steady hand to set the blasted thing that way.

I've had the most success with tuning the vco by adjustment of its internal free-running frequency. One way to do this is shown in Fig. 9(a). The frequency counter reads the frequency of the vco inside the 567. Simply adjust R2 for the frequency you want the decoder to respond to. If you don't happen to have a frequency counter, but you do have an oscilloscope and a signal source (such as a Touchtone pad), use the setup of Fig. 9(b). The oscilloscope is used to display a Lissajous figure. First set the signal source to the desired frequency, then adjust R2 on the decoder for a stable 1:1 Lissajous pattern (examples of Lissajous figures can be found in the ARRL *Radio Amateur Handbook*). In this setup the figure will not be a circle because the signal at pin 5 of the 567 is not a sine wave. A 1:1 pattern is easily achievable though, strange as it may appear. For either measurement method two precautions will ensure correct adjustment. Just be sure that (a) the input (pin 3) is grounded through a .1 uF or higher capacitor — stray signals on an ungrounded input will cause measurement error; and (b) the counter or oscilloscope must have a 1 megohm or higher input impedance, or circuit loading will affect the 567's frequency setting.

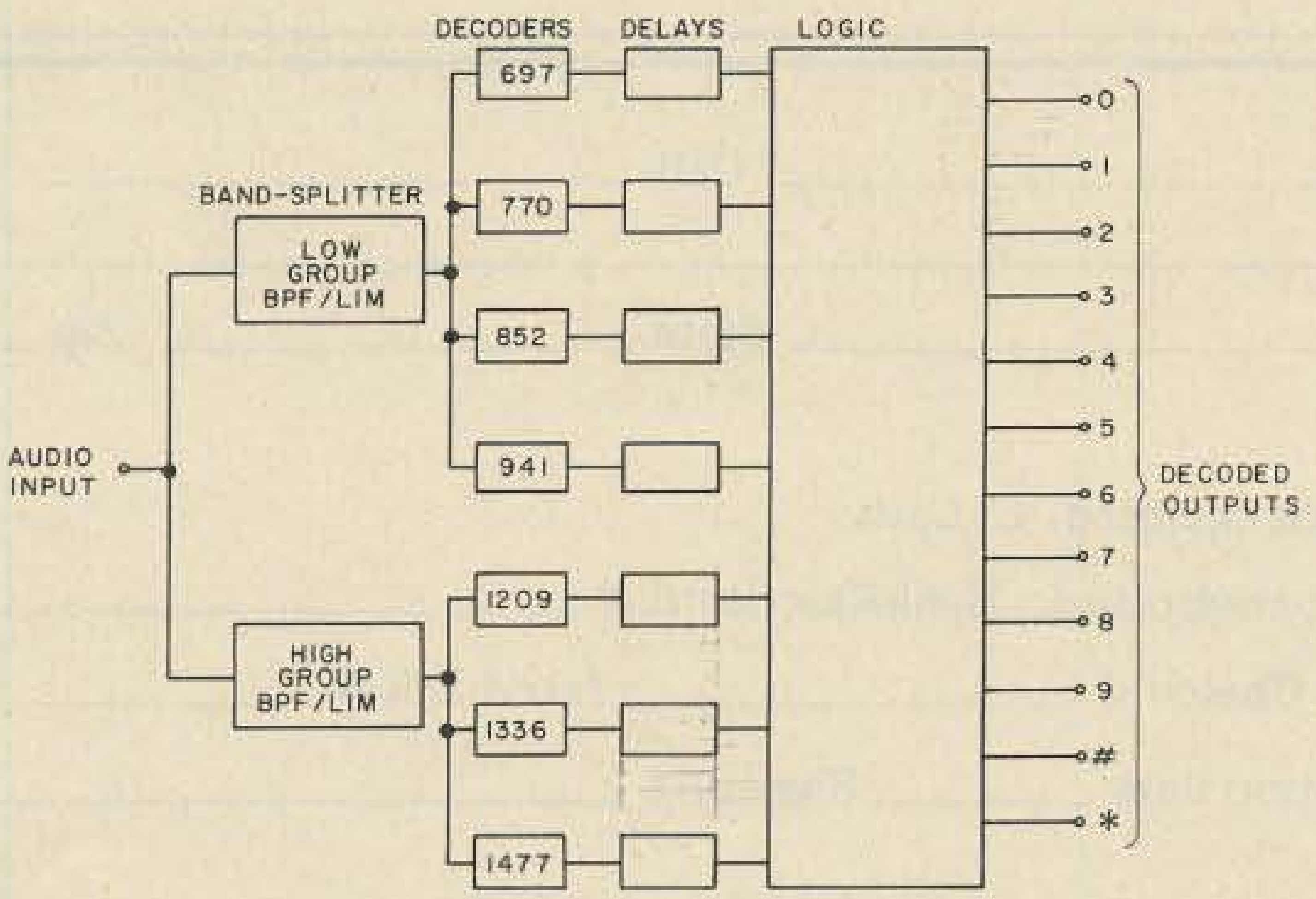


Fig. 8. Improved decoder including band-splitter and delay elements.

Conclusion

The PLL tone decoder ICs can be used to make a very good Touchtone decoder. The band-splitters and limiters described herein help clean up signals fed to them and the delay sections clean up their outputs. Simple adjustment techniques can be used to accurately set the decoders precisely on frequency. The circuits and methods given provide guidelines for setting up a practical working system. They have all been tested and duplicated to ensure their accuracy and repeatability. Use them and you'll avoid having to repeat my trials and errors. Good luck! ■

References

[1] M. L. Benson, F. L. Crutchfield, H. F. Hopkins, "Applications of Touch-Tone Calling in the Bell System," *Bell System Technical Journal*, New York, March, 1963, pages 1-4. General Touchtone system description.

[2] R. N. Battista, C. G. Morrison, D. H. Nash, "Signaling System and Receiver for Touch-Tone Calling," *Ibid*, pages 9-17. Excellent description of tone signaling receiver theory and Bell System station equipment.

[3] J. H. Ham, F. West, "A Touch-Tone Caller for Station Sets," *Ibid*, pages 17-24. Theory and construction of Bell System Touchtone pads.

[4] Signetics Applications NoteBook, Copyright 1974. PLL Applications section has design info and Touchtone decoder with output digital logic.

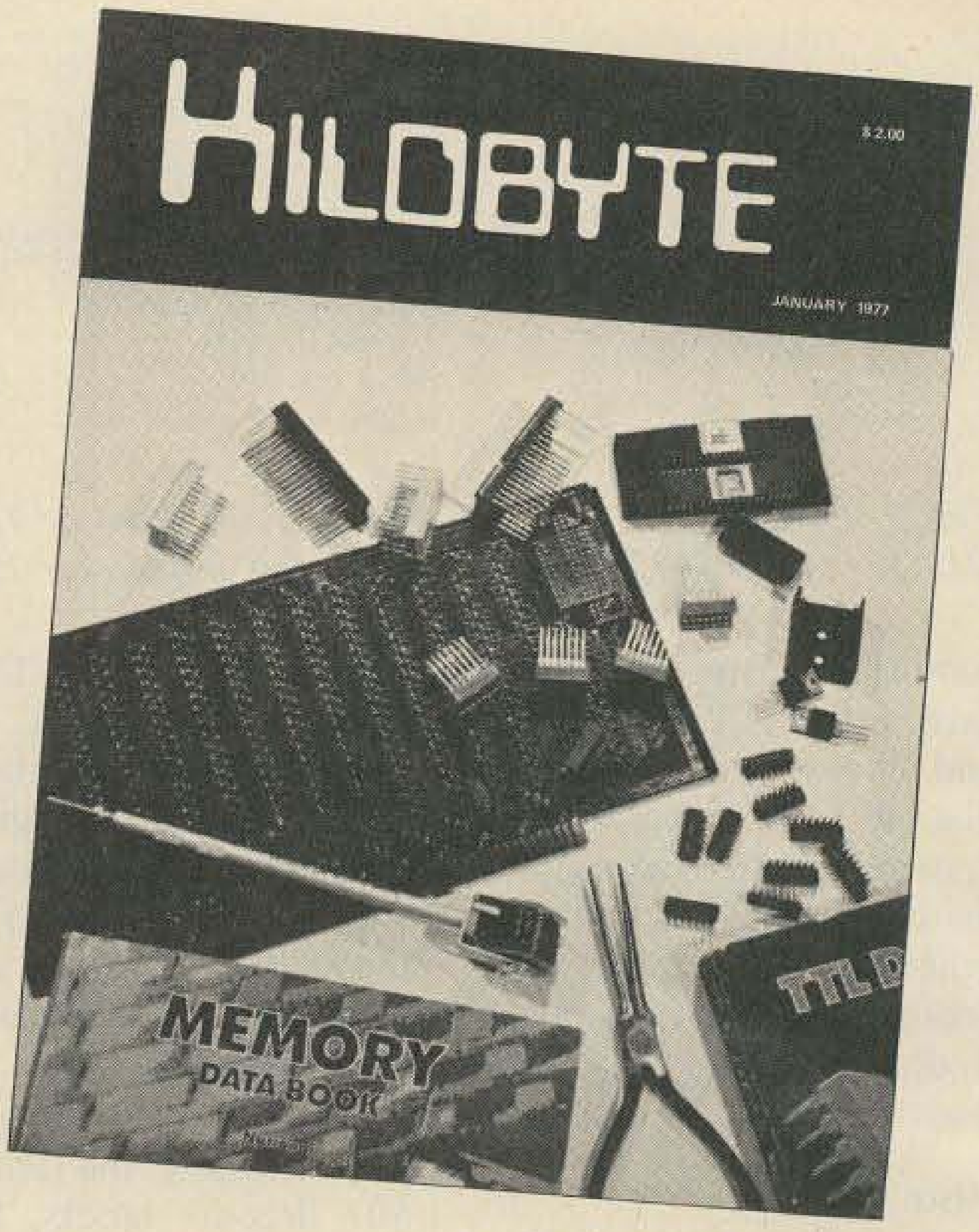
[5] Signetics NE/SE 567 Data Sheet. Lists characteristics and design data for using 567 tone decoder.

[6] "FM and Repeaters for the Radio Amateur," ARRL, 1972, pages 119-121. Basic 567 Touchtone decoder including digital logic.

[7] Toby, Graeme, Huelsman, "Operational Amplifiers, Design and Applications," McGraw-Hill, New York, 1971. Chapter 8 has excellent high level design information on a variety of active filters aimed at engineering level uses.

[8] D. Lancaster, "Active-Filter Cookbook," Howard W. Sams, New York, 1975. Entire book

QUIZ



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contains very useful techniques for design and use of active filters. Chapters 5 and 7 contain data on how to design bandpass active filters. You had best brush up on your algebra to use this book, but it is extremely valuable.

The following references have not been specifically called out in the text of the article, but give different approaches to building tone decoders.

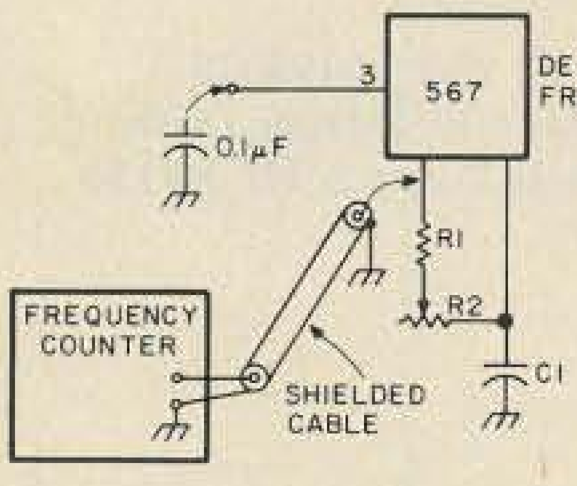
[9] R. B. Shreve W8GRG, "Sequential Switching for Touch-Tone Repeater Control," *Ham Radio*, June 1962, pages 22-29. Digit recognition logic to follow basic Touchtone decoder.

[10] W. E. Bretz WA6TBC, "Multi-function FM Repeater Decoder," *Ham Radio*, January, 1973, pages 24-32. Comprehensive Touchtone decoder and repeater controller article. Includes LC tuned band-splitter and sophisticated digital logic controller.

[11] J. F. Connors W6AYZ, "FM Touch-Tone Decoder," *Ham Radio*, December 1974, pages 37-41. LC Touchtone decoder with unique anti-falsing timers and control logic.

[12] C. Hoffman W1ELU, "Non-Falsing Tone Decoder," *73 Magazine*, June 1973, pages 83-84. 567 type single tone decoder with adjustable anti-falsing delay element.

Fig. 9(a). Tuning setup with frequency counter.



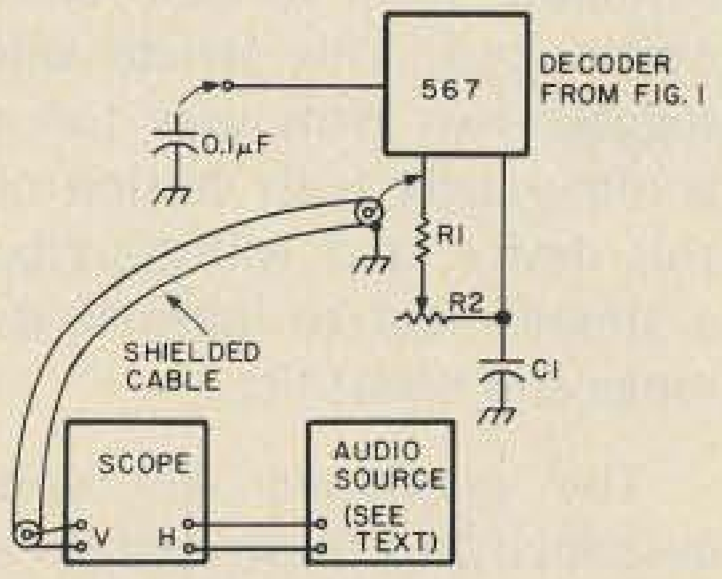


Fig. 9(b). Alternate setup using known signal source.

Using a Wireless Broadcaster

--two good ham uses

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Wireless broadcasters have been around a long time, but their uses in hamming seem to have been overlooked. This article will suggest two ham uses for a commercially built version of this device, and will describe a simple mod to increase its range and versatility.

The purchased AM unit described and illustrated here is marketed under the names "Vox Box" and "Soundcaster" and is distributed by Olson Electronics. It is intended to plug into the earphone jack of an inexpensive cassette tape player to broadcast the taped music into an AM radio to provide greater volume and better fidelity. The broadcaster is packaged in a plastic pyramid about 2-1/2 inches square and 1-3/4 inches high, and has a 2 foot connecting cord, a miniature phone plug for connection to the cassette player, and a 6 inch insulated wire projecting from the bottom (the device's antenna). It is powered by a 9 volt transistor battery, and draws about 10 mA in use (and only a few microamps when the driving device is shut off, so a battery should last for months).

The gadget's transmitting frequency can be set anywhere between about 1400-1620 kHz, by turning the adjustment screw shown in Fig. 1.

The first ham use for this device is for increasing the volume and improving the audio quality of a 2 meter FM mobile rig. This works especially well if your car has both front and rear seat speakers, but there is a significant improvement with only a front seat speaker. Fig. 2 shows the installation of a broadcaster with a Regency HR2-A. This rig has plenty of volume, but its speaker is mounted in the top of the case and, with the installation as shown, the sound is thrown up under the dashboard where it is largely absorbed by the dashboard's foam padding. The broadcaster-car radio arrangement gives much clearer audio, which can turn a "poor copy" weak signal into a "solid contact." Connecting your 2 meter radio to the broadcaster is accomplished via the rig's speaker leads and a subminiature phone jack. One of the rig's speaker leads can be disconnected from the set's speaker if you intend to use the broadcaster arrangement exclusively, or you can install either a 3-circuit jack or SPDT switch to give you the option of using either the 2 meter radio speaker or the car radio speaker.

Fig. 1. Bottom view of wireless broadcaster.

The broadcaster is placed on the dashboard near the car's AM radio antenna in the center of the windshield; its little wire antenna couples a very strong signal into the car

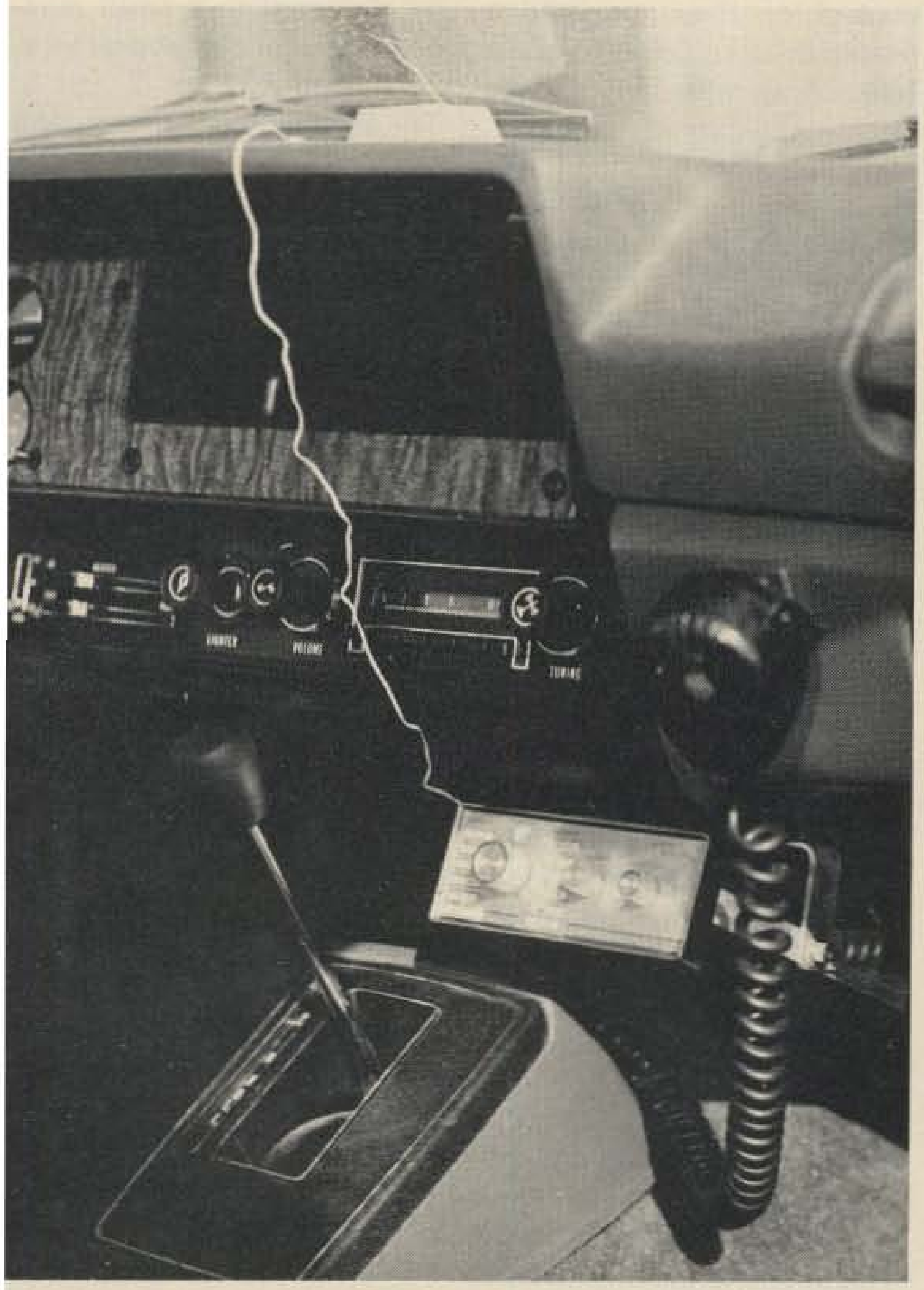


Fig. 2. Broadcaster used with 2 meter rig in car.

Fig. 3. His/hers arrangement.

ntenna, even from several nches away. If your car has a vhip antenna, of course, the roadcaster should probably e placed on the dashboard ide nearest the whip. Advance the volume control f the amateur rig just far nough to produce a clear ignal, and adjust the volume vith the car radio's volume ontrol; too much audio from he amateur rig will overdrive he broadcaster, causing listortion. The only minor lisadvantage of this setup is ome background noise from he car radio during transnitting. If this is objectionble, the only simple cure is o turn down the car radio olume control before reachng for the mike.

Fig. 3 shows a multiband ortable radio with broadaster in my wife's car. This is his/hers arrangement: montoring FM repeaters and aircraft calls for me, FM broadcast band music for her.

The broadcaster described normally has a range limited to 3-6 feet or so, depending upon obstructions in the signal's path, sensitivity of the AM radio, etc. By increasing the broadcaster's range, it can be used with an AM portable radio (preferably of the shirt pocket size variety) to remotely monitor any VHF or HF rig in your shack. It's nice to be able to listen in on an interesting roundtable QSO or net, or to monitor the mobile activity on a channel while going to the kitchen for a cool one, upstairs to answer the doorbell, and so forth. With the setup to be described you can just plug in the broadcaster, grab the AM portable, and monitor what's happening on frequency while going about other errands.

However, *carefully observe* the FCC's regulations regarding unlicensed transmissions in the broadcast bands: (1) transmitting power not to exceed 100 milliwatts; (2) antenna length not to exceed 10 feet; (3) no interference to be caused to broadcast band listeners. The first two of these conditions are no problem, but the third may be impossible to satisfy if you live in a crowded apartment building, or if you have any neighbors less than 25 feet from where you'll be using the broadcaster. So be a

Fig. 4. 8 foot antenna added to the broadcaster.

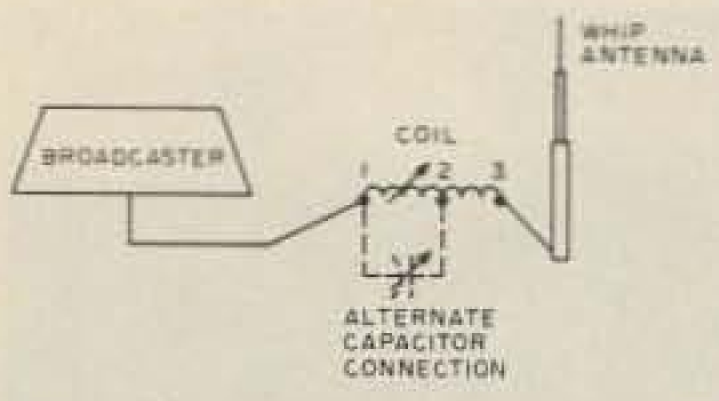


Fig. 5. Wiring diagram of broadcaster with whip antenna.

good neighbor, and *stay legal.*

The simplest method of increasing the broadcaster's range is to add a length of wire to its short antenna. Fig. 4 shows a portion of an 8 foot length of #22 hookup wire connected to a broadcaster with an RCA-type phono plug and jack. The wire is thumbtacked to the wall and across the ceiling. With this installation in my basement shack, the amateur rig can be heard clearly (on the little AM portable shown in the picture) throughout the upstairs of my ranch house. There are, of course, a few "dead spots" in the house where furnace ducts, house wiring, etc., interfere with reception. Adding any length of wire to the broadcaster's antenna will load the oscillator and change its operating frequency slightly, and you will have to move the frequency back to wherever you want to receive it on your AM radio. Also, as would be expected, the AM radio tuning is fairly broad when it is close to the broadcaster, but becomes quite sharp as the radio is moved further away.

A better method for increasing the broadcaster's range, that gives more precise control of the range and a neater installation, is to add a telescoping whip antenna to the broadcaster antenna, matching it with a slug-tuned ferrite loop antenna coil. These coils are sold as a replacement part for fixing portable radios; the one listed in the parts list should be widely available. Fig. 5 is the wiring diagram, and Fig. 6 shows the components wired together and mounted on a scrap of plywood for the initial try at this circuit.

Fig. 6. Broadcaster (with cover removed) connected to antenna coil and whip antenna.

Note that Fig. 5 shows a phantom capacitor connected between terminals 1 and 2 of the coil to resonate it to frequency. The notes on the coil package call for a 100-250 pF variable. However, I found that the broadcaster has better range and is easier to tune without a capacitor.

Tuning is accomplished by alternately varying the whip height and adjusting the coil slug for maximum signal strength at the desired range. This is best done in a series of steps, starting near the broadcaster, and progressively working out to maximum range. Again, these adjustments will slightly detune the transmitting frequency, and you'll have to either retune the portable radio, or tweak the broadcaster's oscillator to the desired frequency.

The whole assembly can be packaged in a small minibox for a neater appearance, as shown in Figs. 7 and 8. The box shown is plastic, and measures 6¼" by 3¾" by 2". It is larger than needed but was conveniently available. As shown in the close-up, the broadcaster was mounted with 2" screws and standoffs through the top of the box. The bottom of the broadcaster faces outward, for easy battery replacement. A bracket for mounting is provided with the coil, which should be mounted near one end of the box so that the slug adjustment screw can protrude through a hole drilled in that end.

This version of the broadcaster also provides "arm chair copy" of amateur band signals in my living room and throughout the house.

Other non-ham uses of the broadcaster suggest themselves: monitoring TV sound from another room (you'll always know when the commercial is ending and it's time to get back to the set), broadcasting music from your hi-fi to the garage while working on your car, and so forth. ■

Parts List

Wireless broadcaster — see text.
Telescoping whip antenna — any broadcast radio or TV replacement type.
Ferrite loop antenna coil — Calectro part no. D1-842.
Mini utility box — Radio Shack part no. 270-627.

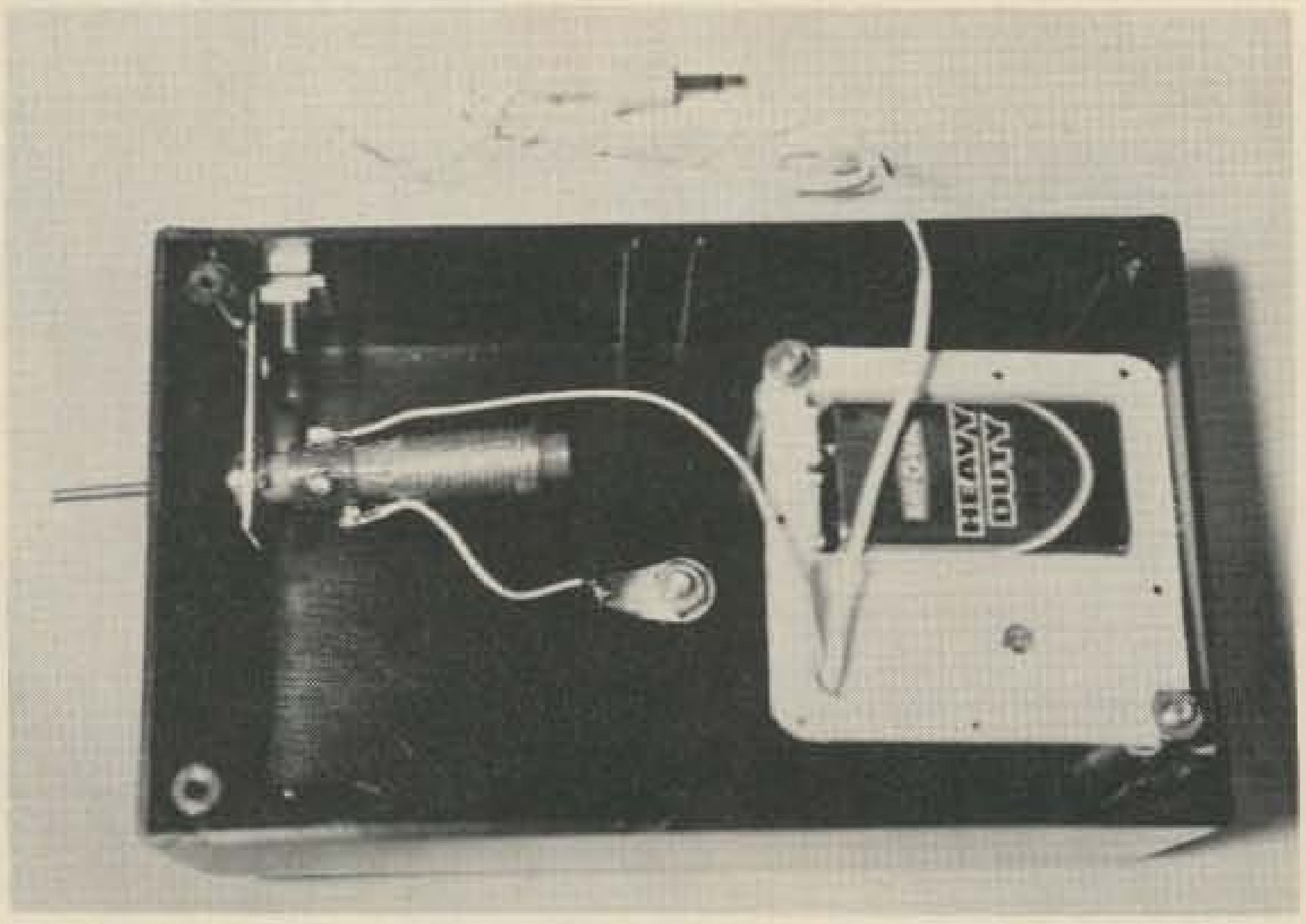


Fig. 7. Finished broadcaster assembly in minibox.

Fig. 8. Completed broadcaster with whip antenna in use.

I/O EDITORIAL

from page 130

which is well designed mechanically. They are working on final details and staying up nights to debug their software ... like everyone else in the field. I was impressed by what I saw and you'll be reading more about it.

Dennis Brown of Wave Mate had some excellent reasoning behind his use of wire-wrap for his system. His is the only system which uses one set of identical boards for every module ... and the only one which an experimenter can get into and make changes on with relative ease. We've been promised articles by Dennis on wire-wrap and the Wave Mate system concept.

Godbout was wringing out the software for the first 16-bit hobby system ... the PACE. This may turn out to be a winner when hobbyists get more into developing and selling small business systems. An article has been promised on the system, which should put it into perspective.

Just about everywhere I went I was first met with skepticism about the need for *Kilobyte Magazine* ... after all, with *Byte*, *Interface*, *Creative Computing*, maybe a *Microtreck*, and a bunch of club newsletters, who needs another big magazine? After explaining the philosophy behind *Kilobyte*, I found everyone enthusiastic. *Kilobyte* not only will be doing different things from the other publications, it will be providing a very valuable service. The reviews of hardware alone should pay every subscriber several times over in saved money and time. The software programs and routines should do the same.

Sphere, which has had a lot of management problems which have resulted in delays in filling orders, a BASIC emulator which crept along at a snail's pace, and other miseries in the past, has been reorganized and promises a better day to come.

MITS is still the biggest and the champ. We've been promised an article on their Zilog CPU system which is due out in a couple months ... and they have a lot of other fascinating things brewing which will intrigue the hobbyist and delight their growing network of sales outlets.

SWTPC in San Antonio has been doing very well with their 6800 kit and now is shipping 4K BASIC ...with 8K coming up. Their cassette interface and line printer are doing well and articles are scheduled from them on these.

I've some taped interviews with a few firms which might be of interest to computer clubs ... these will be duplicated and announced soon. I'll also have a more detailed report on the trip, complete with pictures in both *73* and *Kilobyte*. There is absolutely nothing like a personal visit to find out who is doing what ... which firms are for real and which are made up mostly of smoke.

BEGINNER'S COMPUTER MAGAZINE

There is just too much happening too fast in the small computer field for *73 Magazine* to cover it all without shoving amateur radio out almost entirely. Obviously a second magazine is needed to help readers keep up with this fantastic and growing field ... hobby.

It is a difficult decision because so much of hobby computing and amateur radio are tied together ... virtually *all* of the serious applications for hobby computers have so far been in amateur radio ... for exotic Teletype stations, control of amateur repeaters, control of amateur antennas for DXing and for Oscar amateur satellite predicting and antenna pointing ... etc.

Kilobyte Magazine will attempt to give you the most thorough coverage of new equipment and kits possible ... with no punches pulled. If you are into building your own computer, keep careful notes of what you have to go through ... problems with ordering, getting delivery, with getting missing parts and replacing defective parts, with instructions, with getting the equipment put together, with getting it working, with interfacing it, and so forth. Write up your report so your experiences can help others through the problems you met ... and hopefully conquered. Feedback like this will help manufacturers get their act together too ... and we sure could use a lot of that.

Kilobyte Magazine will be providing you with as much program info as possible. In addition to articles on programming, you'll have as many useful programs as we can get. If you've worked out some routines for any of the hobby computers, here is a way to cash in on them ... send the program to *Kilobyte*. It may be a program for checking memory, for generating random numbers, for playing a game, for aiming a beam antenna, for moving things around in memory, for checking your CPU, whatever. Your work can get you known ... and cash ... and will, most important of all, help a lot of newcomers.

Kilobyte Magazine will be checking out the newest equipment in the *73/Kb* lab ... which is growing every day. It presently has an Altair with disk, Imsai, Wave Mate, Ebka, Lear terminal, Southwest Tech TVT-II, Burroughs terminals, Viatrons, HAL terminal, all sorts of memory boards, and much more promised ... such as a 7 Meg disk for the Altair ... etc. *Kilobyte Magazine* is the *only* hobby computing magazine with its own test lab.

KEEP IT SIMPLE

Every effort will be made to keep as much as possible of the info in *Kilobyte* simple, as a way for the newcomer to hobby computing to bootstrap himself into the field. I am not unaware that just about all of the other computer hobby publications are alive with buzzwords and are more aimed at the PhD than the beginner. *Kilobyte* will even have a glossary of computer terms to help you get through the articles!

The first issue of *Kilobyte* will be the January issue, out in late November. If the demand for it is anything like that for the first issue of *Byte*, it may shortly be worth more than the charter subscription price of $12. All you have to do to miss out on the first issue is wait around to see how *Kilobyte* looks before you subscribe ... the way a few thousand very unhappy *Byte* readers did.

Single copies will be $2 and the regular subscription rate is $15, with a special Charter Subscription rate of $12 until the end of November.

WHAT'S A COMPUTER STORE?

While passing through Windsor Locks (CT) the other day, I stopped at the new computer store just off Route 91 to see what they were up to.

The Connecticut store is an offshoot of the Burlington, Mass. (Boston) computer store and features mostly MITS equipment. It is a place to get boards, see systems up and running, get some help in understanding what you may need for what you want to do, and get help in getting your own gear running. George Gilpatrick, shown in the photo, welcomes visitors at the Computer Store, 63 South Main.

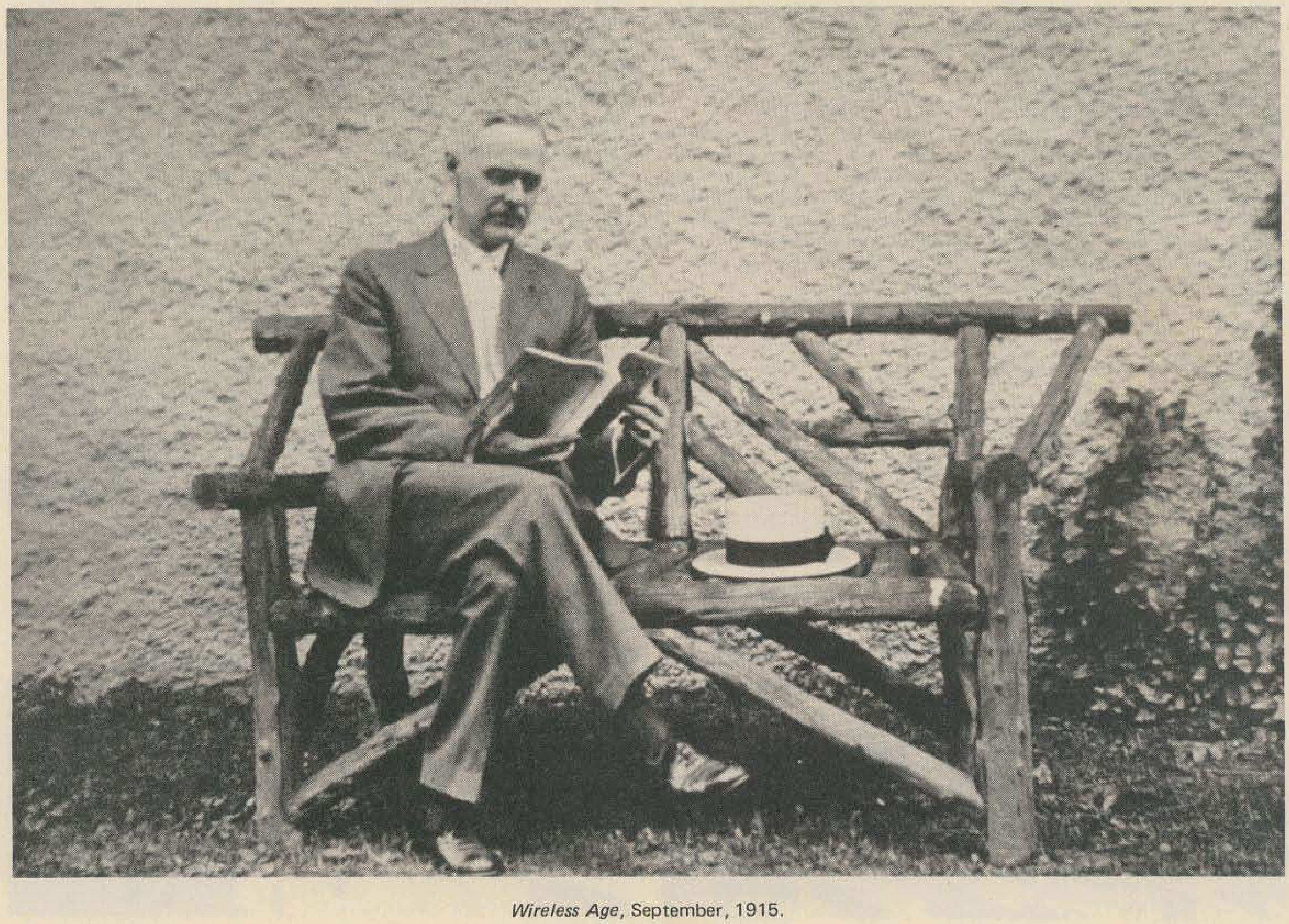
Rexford and Emelie Matlack
13443 First St. E.
Madeira Beach FL 33708

Charles Apgar didn't look much like a James Bond type of spy as he worked in the den of his Westfield, New Jersey home that June morning of 1915. A slight man, precise in speech and dress, he lived with his wife and two small children in this quiet suburban town. Intrigue had never played a part in his life. But the mail that day was to bring him a letter that would soon cast him in the role of a "super sleuth" for his government.

If you had glanced around his den-workshop, you would

The Quiet Spy

-- amateur uncovers spy ring in U.S.!



Wireless Age, September, 1915.

have seen the results of a remarkably inventive mind. Ever since that windswept day in January, 1903, when Guglielmo Marconi sent the first wireless message from Cape Cod across the Atlantic to King Edward in England, Apgar had been interested in the new art of wireless. By 1910 he was patterning his experiments along the lines of work being done by Marconi and DeForest.

On one side of the room was a complete receiving and sending station with wires radiating out into the yard and up to the treetops. Against another wall sat his latest invention, just perfected after two years of work. It was a device for transferring messages sent through the air onto wax cylinders, which could be played back on a Edison phonograph. No one had ever done this before, and the experts had said no one ever could, but that statement was only a challenge to Apgar and it had spurred him along to the completion of his project.

The momentous letter that arrived that day was from Lawrence J. Krumm, Chief Radio Inspector, Department of Commerce of the Port of New York, and read:

"My dear Mr. Apgar: Will you be kind enough to call me up Monday morning from your place of business? I am very desirous of getting in touch with you immediately, as I believe you can be of considerable service in a good cause."

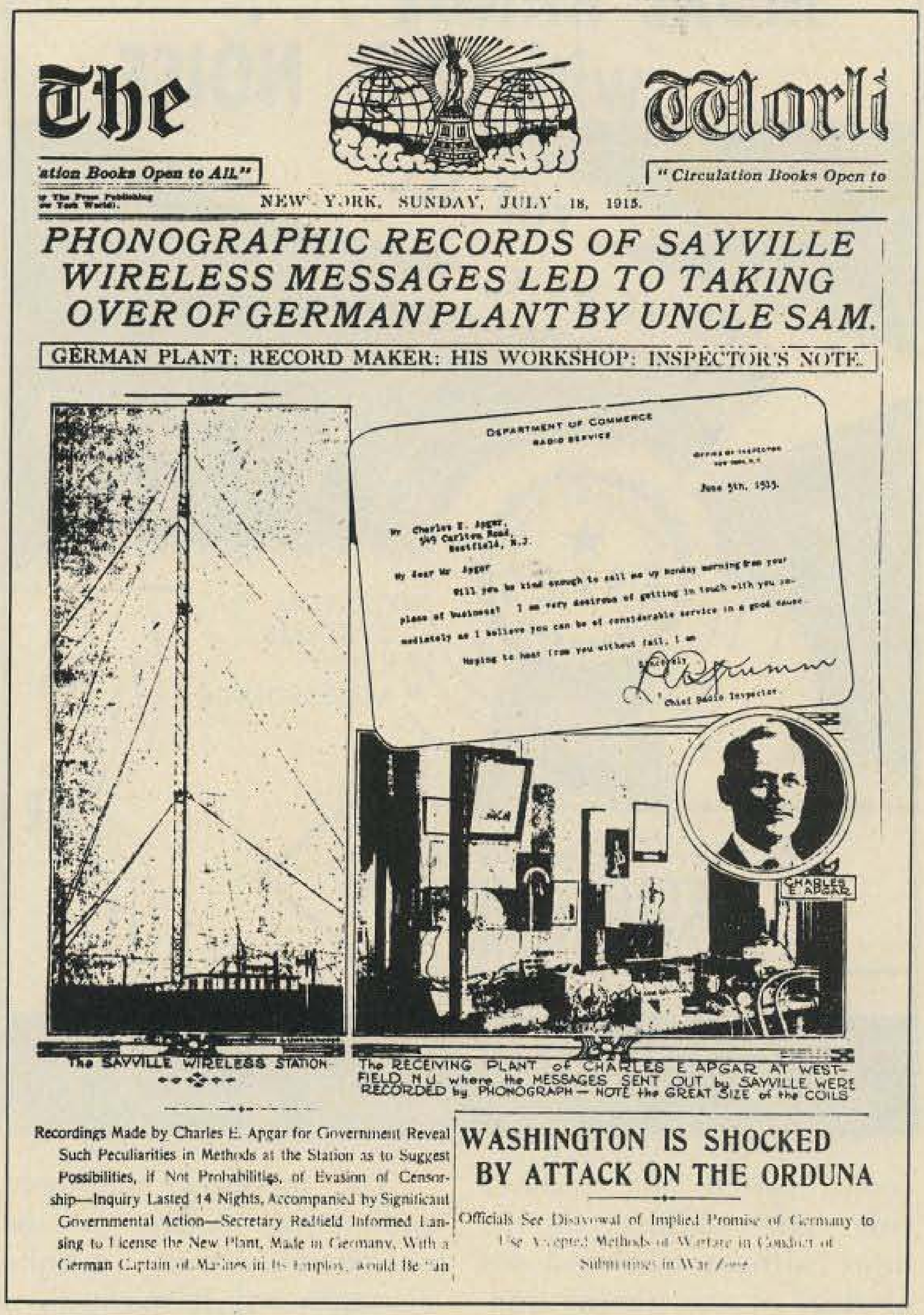
You may imagine Apgar's thoughts as he read, and re-read, the letter. In what way could he be of "considerable service in a good cause," he wondered. He decided it surely must have something to do with Krumm's visit to his home several evenings before. Knowing the Chief Inspector's interest in radio, Apgar had invited him to come and see his completed recording device demonstrated. It had been a pleasant evening, with Krumm more than enthusiastic about the invention.

Next morning Apgar called the Chief Inspector's office from the Franklin Automobile Company in New York where he was employed, and agreed to come right over. Once there, it was suggested that they leave immediately for an interview with William J. Flynn, Chief of the United States Secret Service. Now Apgar was indeed mystified, as this service was the FBI of those days, and he could not think of any way he would be involved with it.

On the way, Krumm explained why he had written to him. As both men were aware, two powerful trans-atlantic stations had been constructed by the Germans in this country, one at Sayville, Long Island, the other at Tuckerton, New Jersey. Although World War I flamed in Europe, the United States was still neutral, so these stations had been granted temporary licenses for sending commercial messages to be received by POZ Nauen, Germany.

Krumm went on to tell him how the supposedly innocent messages were suspected of conveying word to German submarines and cruisers based in the Atlantic. Accusations were flying fast; Washington was deluged with complaints from the English and French ambassadors. Too often allied ships were sunk by submarines obviously well informed as to the ships' sailing dates and sea lanes. The problem was to prove this. But so far the Navy monitoring stations at Fire Island, New York Harbor and at Arlington, Virginia had been able to find no differences between what was filed with them and what was sent.

Now Flynn, as head of the Secret Service, was ordered to find out what was "going


The World

"Circulation Books Open to All."

NEW YORK, SUNDAY, JULY 18, 1915.

PHONOGRAPHIC RECORDS OF SAYVILLE WIRELESS MESSAGES LED TO TAKING OVER OF GERMAN PLANT BY UNCLE SAM.

GERMAN PLANT: RECORD MAKER: HIS WORKSHOP: INSPECTOR'S NOTE.

Recordings Made by Charles E. Apgar for Government Reveal Such Peculiarities in Methods at the Station as to Suggest Possibilities, if Not Probabilities, of Evasion of Censorship—Inquiry Lasted 14 Nights, Accompanied by Significant Governmental Action—Secretary Redfield Informed Lansing to License the New Plant, Made in Germany, With a German Captain of Marines in Its Employ, would Be "an

WASHINGTON IS SHOCKED BY ATTACK ON THE ORDUNA

Officials See Disavowal of Implied Promise of Germany to Use Accepted Methods of Warfare in Conduct of Submarines in War Zone

on." His knowledge of wireless being slight (as was that of most people in 1915), he had called on Chief Inspector Krumm to see if he had any suggestions to improve monitoring done by the Navy censors. By chance (and how often great happenings depend on such a twist of fate), his call on Krumm was the next day after the Inspector had been at the Apgar home. Of course the recording device was described and Flynn had asked for an interview with Apgar as soon as possible. So the letter was sent.

The meeting with Inspector Flynn was brief. He knew that Krumm had told Apgar of the problem, so he came at once to the point. Would he be willing to transcribe on his recording machine all messages sent out by the Sayville station over a period of two to three weeks? As they only transmitted at night, it would mean a long, tiresome process for Apgar, but there was no one else in the country who could perform this service.

Apgar didn't hesitate to accept the commission. This was a field in which he was at home and he looked forward to applying his invention to the "good cause" he finally understood. Besides, as he recorded later, he thought it would be a pleasure to "aid in taking the say out of Sayville."

He wasted no time in assuming his role as a spy for his government. The interview at the Secret Service office was at eleven in the morning and he began work the same evening. According to his private papers, he first scoured the city for blank cylinders. That meant some "tall hustling." Hurrying back to Westfield, he set up two Edison phonograph machines in his home. In that way he

Nov 1976

could switch the receiver from one machine to the other without missing a dot or dash of the transmission. Promptly on the night of June 7, and into the morning of June 8, he recorded on cylinders the messages sent out by WSL Sayville. Early the next day he transcribed them and personally delivered them to the Secret Service office to be turned over to the Navy Department for comparison with the ones filed and received by the monitors.

This went on for fourteen consecutive nights, starting at eleven and often running as late as three or four in the morning. Chief Flynn had not exaggerated. It was a long vigil. By June 21, he had filled 175 cylinders and transcribed 25,000 words. He confessed in a radio interview with WJZ New York in December 1934 that he did become quite tired and lost considerable weight during that time, but he was buoyed by the excitement and the results.

The messages monitored and those taken on the cylinders showed definite discrepancies. It might be a word repeated or numbered messages not in sequence – variations that conveyed a special word to the receiving station in Germany. The cylinders, with their slower and faithful reproductions, picked up what the Navy monitors had not been able to do. Chief Flynn turned all recordings over to Secretary McAdoo of the Treasury Department, where their contents by specific statute became inviolate. However, Apgar, in this same interview with WJZ, gave some examples of the original messages and the information they really gave.

"Send always invoice before shipping knives." signified instructions to POZ Nauen to be relayed back to German submarines in the Atlantic.

"Is our office running as usual with Sampler alive and attending? Please wire." was giving information on dates and routes of Allied ships leaving the ports of New York and Philadelphia.

These recorded messages proved that the station had indeed been violating the neutrality of the United States. As a result, both Sayville and Tuckerton were taken over by our Navy Department: Sayville on July 8, 1915 and Tuckerton shortly afterward.

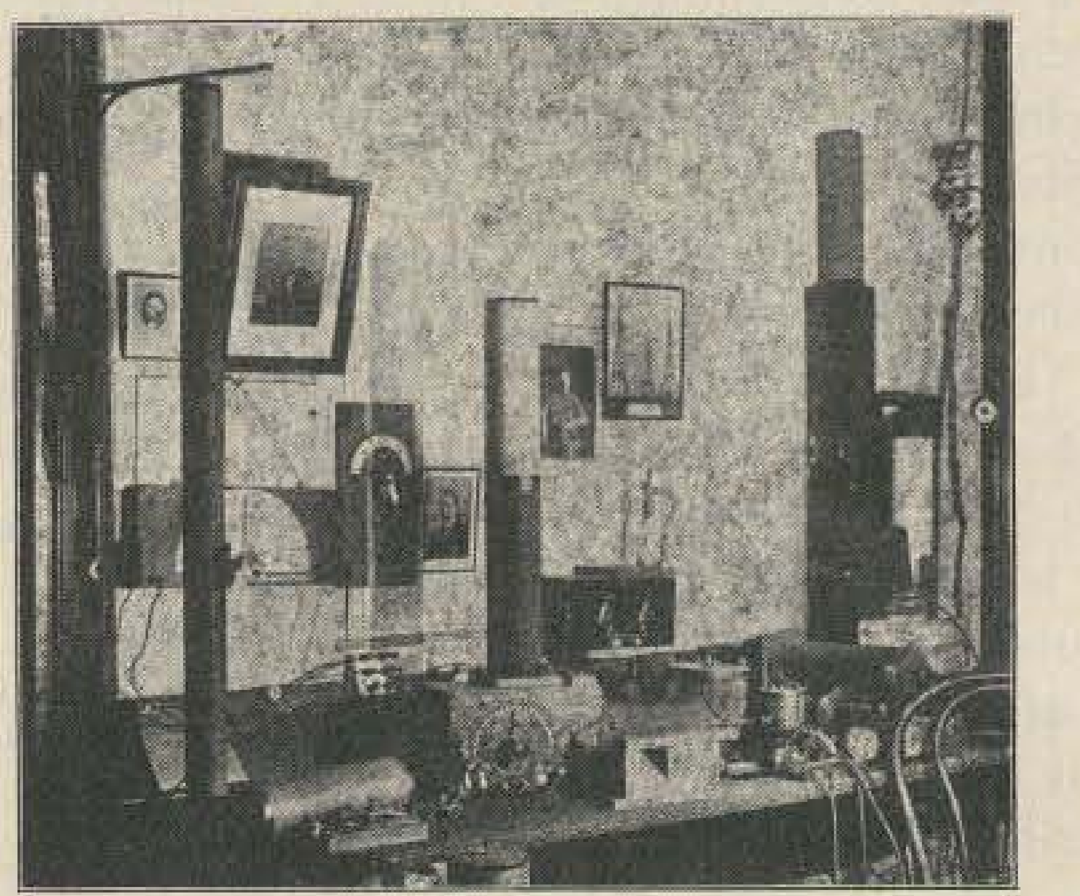
At first the seizure of Sayville was spoken of in the press as a precautionary measure, according to an article in the *Wireless Age* of September 1915, but ten days later New Yorkers were surprised to read in the *World* that Sayville had been closed after investigation by the Secret Service, and that the phonograph recordings made by Charles E. Apgar of Westfield, New Jersey had established the true nature of the messages sent by the German station.

The press described his work for the Navy Department as "the most valuable ever rendered by a radio operator to his country." Apgar was pleased by this citation, and others, but he also spoke of a statement made in an interview by Dr. Karl Frank, the disgruntled manager of the WSL Sayville. After the closing of his station, the manager said, "That Mr. Apgar can record messages on a phonograph cylinder is hardly worth discussing. That is physically impossible. I have never heard of its being done."

We suspect that Apgar, the experimenter and inventor, was as well honored by this "citation" as by any he received. ■

WESTFIELD, NEW JERSEY, WEDNESDAY, AUGUST 1, 1934

Local Amateur Wireless Station Began Work Which Made It Invaluable to Government, Twenty Years Ago Today



The wireless of Charles E. Apgar to which the accompanying article refers. It was this station which later did the secret service work for the United States Government during the investigation of W. S. L. During June, 1915, Mr. Apgar made phonographic records of all messages sent out from Sayville. The apparatus with which he did the work is shown in the photograph.

Twenty years ago this afternoon, Col. Leigh M. Pearsall phoned Chas. E. Apgar of 549 Carlton road and asked "Do you think there will be any wireless news sent out tonight, definitely on war possibilities?" Mr. Apgar replied, "Come over about 7 o'clock and we will 'listen in' for anything that may come through." This conversation began a chain of events which catapulted Mr. Apgar's amateur wireless set at his home into world prominence and government aid.

That morning Germany had warned Russia about the mobilization of her troops, but Germany's intentions were plainly indicated by the wireless instructions sent out the next few hours that evening and "picked up" by Mr. Apgar.

A few of the messages received follow:

"dgc, dgc, dgc
"msg nr 1 wds 27 N. Y. 1st
"To Capt. S. S. Graecia WSL. If upon receipt of this message it is nearest return to Norfolk or Philadelphia instead N. Y. Beware of cruisers. Confirm receipt of this message. (Sig.)"
"dkk, dkk, dkk
"Rdo msg nr 1 wds 19 N. Y. to German cruisers Dresden and Karlsruhe received messages in code that same and the following nights from the Sayville station. Both forms of code were used—grouping of 10 letters and numbers of 5 figures, e.g.

"To German cruiser Karlsruhe—Sayville, N. Y.
"derglichon emkojanubi
"albafiacus ricupagale
"ajuffedibi, etc. Also
"To German cruiser Karlsruhe
"28312, 45924, 47168, 12275
"44140, 27049, 45924, etc."

From the foregoing it was plainly evident that Germany would declare war the next day—which she did—but first endeavored to take care of her shipping interests.

Many other wireless messages, personal and otherwise, came through at the outbreak of the war. Of special interest are the warning and instructions wirelessed as follows:

"Erin, erin, erin
"Rdo msg. nr 1, wds 17 N. Y. to
"Captain Pascoe steam yacht Erin via Sayville.
"Tow Shamrock nearest friendly port and await instructions.
"Thomas Crane."

Then later:

"Great Britain now at war with Germany. Permission granted tow Shamrock remaining distance. Good Luck.
"Thomas Crane."

Not many months later when it was definitely certain that the Sayville wireless station was non-neutral in its operation the U. S. Secret Service——Chief W. J. Flynn in charge—was called on to make the investigation and the amateur wireless station on Carleton road furnished the evidence by making phonographic records of all messages sent out for several weeks—at that time believed to be an impossible feat. In fact, when the general manager of the Sayville station, Dr. Carl G. Frank, was advised of what had been accomplished he commented, "The statement that Mr. Apgar can record messages sent out by wireless on a phonographic cylinder is hardly worth discussing. That is physically impossible. I never heard of its being done."

In a General History of Amateur Radio, to be published in the near future by ARRL (QST), will be given the essential details of construction which made it possible—by the use of one tube, only—to hear over 600 feet from the set, as well as a

"Sidetone" is used in amateur circles to denote a tone from a CW keying monitor. But the term comes, of course, from the telephone industry, where a certain amount of the voice energy feed into the microphone unit of a telephone handset is deliberately coupled to the receiver unit in the headset so a person can barely hear himself talk. It was determined that transmission efficiency was improved by this scheme and a person using a telephone tended to maintain a steadier, more level talking level — especially in a slightly noisy environment. The method must have some value, since, besides in the telephone system, one will find audio sidetone employed in various commercial radio transceivers, military transceivers and aircraft communications transceivers. This is *in spite of* the fact that these transceivers also employ various advanced forms of speech processing designed to keep the average modulation level as high as possible.

73 Magazine *Staff*

The Benefits of Sidetone Monitoring

- - and how to do it

Amateurs might also consider the value of using audio sidetone in both mobile and fixed station installation. The use of such sidetone is mainly possible where a handset is used or a microphone/headset combination is employed. Otherwise, there is the possibility of audio feedback taking place unless a good directional microphone is used while the audio sidetone is monitored via a loudspeaker.

Simple Methods

A few simple methods for making the necessary audio sidetone interconnection in a station setup are as follows:

1. If a separate transmitter and receiver are used, one can make an interconnection between the microphone amplifier stage in the transmitter and the audio preamplifier stage in the receiver. This should be done after the volume control in the receiver and utilizing a separate potentiometer to control the level from the microphone amplifier output in the transceiver. Fig. 1 shows the basic idea. The audio stages in the receiver must remain activated during transmit periods for this scheme to work or the receiver transmit/receive function suitably rewired to accomplish this. A relay is used to break the audio sidetone circuit when in the receive mode, since feedback can easily result if the high receiver loudspeaker output level in the receive mode gets back into the microphone circuit.

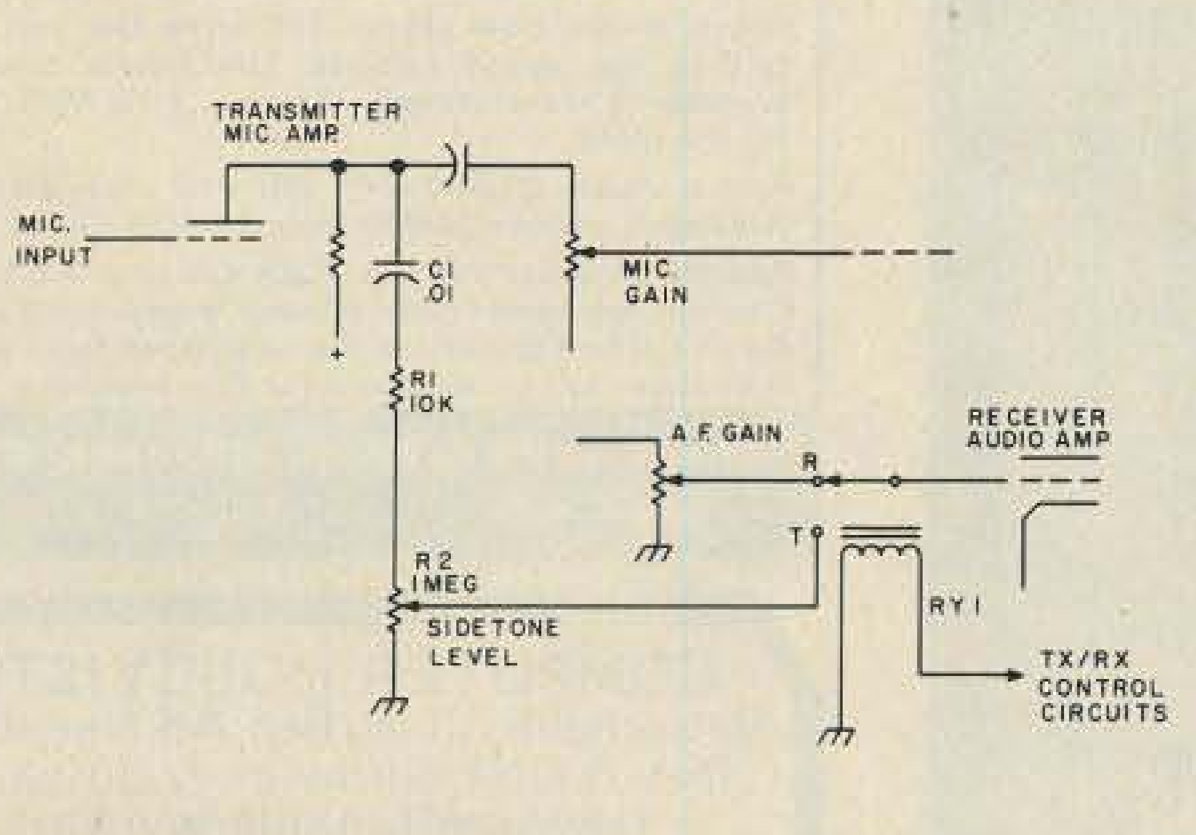


Fig. 1. Typical audio sidetone interconnection between separate transmitter and receiver or sections of a tube-type transceiver. The only added components are C1, R1, R2, and RY1.

2. If a transceiver is used, it may or may not be possible to utilize a scheme similar to the above between the receiver and transmitter portions of the transceiver. Some transceivers utilize complicated switching schemes for transmit/receive functions and the dual use of the low level audio stages both in the transmit function (as microphone amplifiers) and in the receive mode (as preamplifier after the product detector stage). In most transceivers, however, these functions are kept separate and one can switch the receiver section audio amplifier stages, via a relay, to pick up the output of one of the microphone preamplifier stages on transmit. A separate potentiometer should be used to control the level being fed into the receiver section audio amplifier stages and this potentiometer serves as the audio sidetone level adjustment.

3. The simplest scheme to

achieve audio sidetone monitoring is via a separate small amplifier which is used between the microphone and the station loudspeaker or headset and is energized only during transmit periods. Any one of the number of simple amplifiers can be used, such as the solid state PA amplifier modules available from Lafayette Radio or Radio Shack for about three dollars. Although called "PA" modules, these modules will not exactly create enough undistorted volume to disturb the household. However, they are very suitable for audio sidetone purposes since they have a high impedance input which can be bridged across any microphone output without greatly affecting it, and their low impedance output can be used to drive either a loudspeaker or a low impedance headset connected across a receiver's output. At the low levels needed for audio sidetone monitoring, their distortion is very low. They require 6 volts for operation, and this can be obtained in tube-type transceivers by a simple half wave rectifier and filter across the filament line. Fig. 2 shows a typical arrangement. For mobile transceivers they can be powered via a dropping resistor directly from the battery line.

The secret to obtaining maximum benefit from audio sidetone monitoring is in the adjustment of the sidetone level. You have to trick yourself, the same as the telephone company people do! Pick up your telephone and listen for the audio sidetone level as you speak to another party. It has been carefully chosen, as you will be inclined to "speak up" consistently rather than whisper into the handset. If the sidetone level were too loud, you would be inclined to speak more softly. If it is too comfortable to hear, you would be inclined to become intrigued with the reproduction of your voice, but not necessarily inclined to maintain a steady voice level. The sidetone level has been deliberately chosen so you *can just hear it*, and this is the adjustment to make for monitoring the audio sidetone level in a station. After a while, you will become unaware of the sidetone level, but you will try to speak at a consistent output level that allows you to detect the presence of the sidetone.

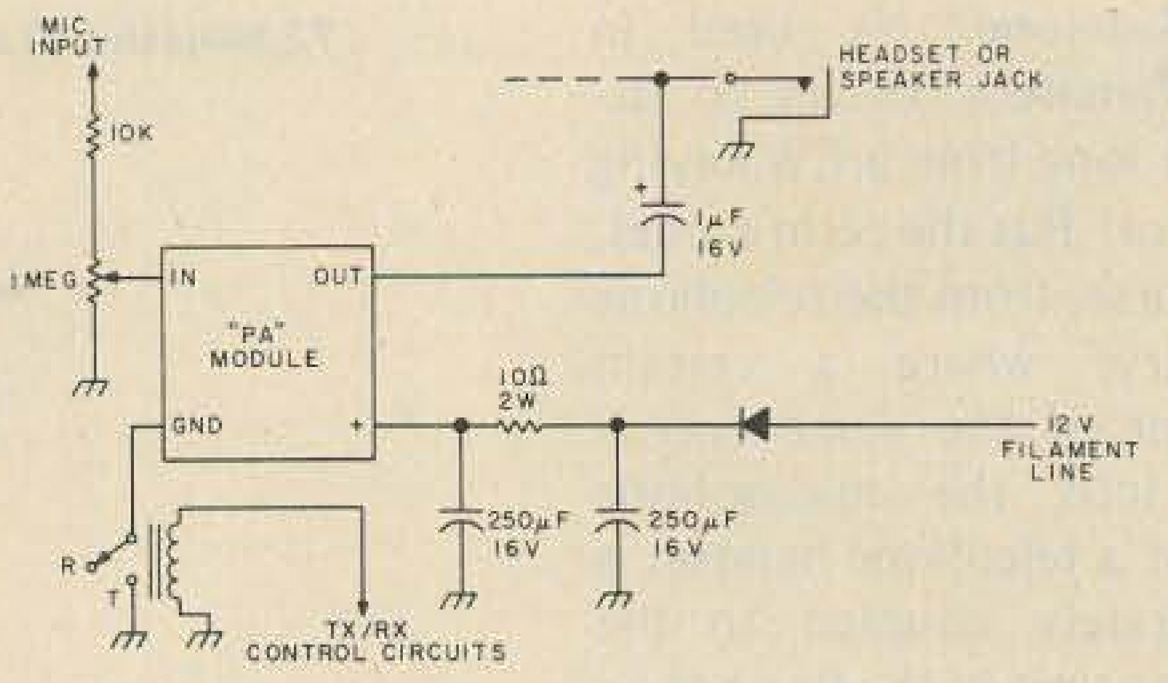


Fig. 2. Use of an inexpensive PA module amplifier provides audio sidetone with a minimum of circuit modifications.

Audio sidetone monitoring is a relatively simple accessory to add to any station. The simplicity of the idea has probably been obscured by the usage of so many other speech processing devices such as audio compressors and clippers. However, if one can add only 1 or 2 dB more effective transmission efficiency to a station by audio sidetone monitoring and completely without any added distortion of the modulated signal, the idea seems worthy of a try. ■

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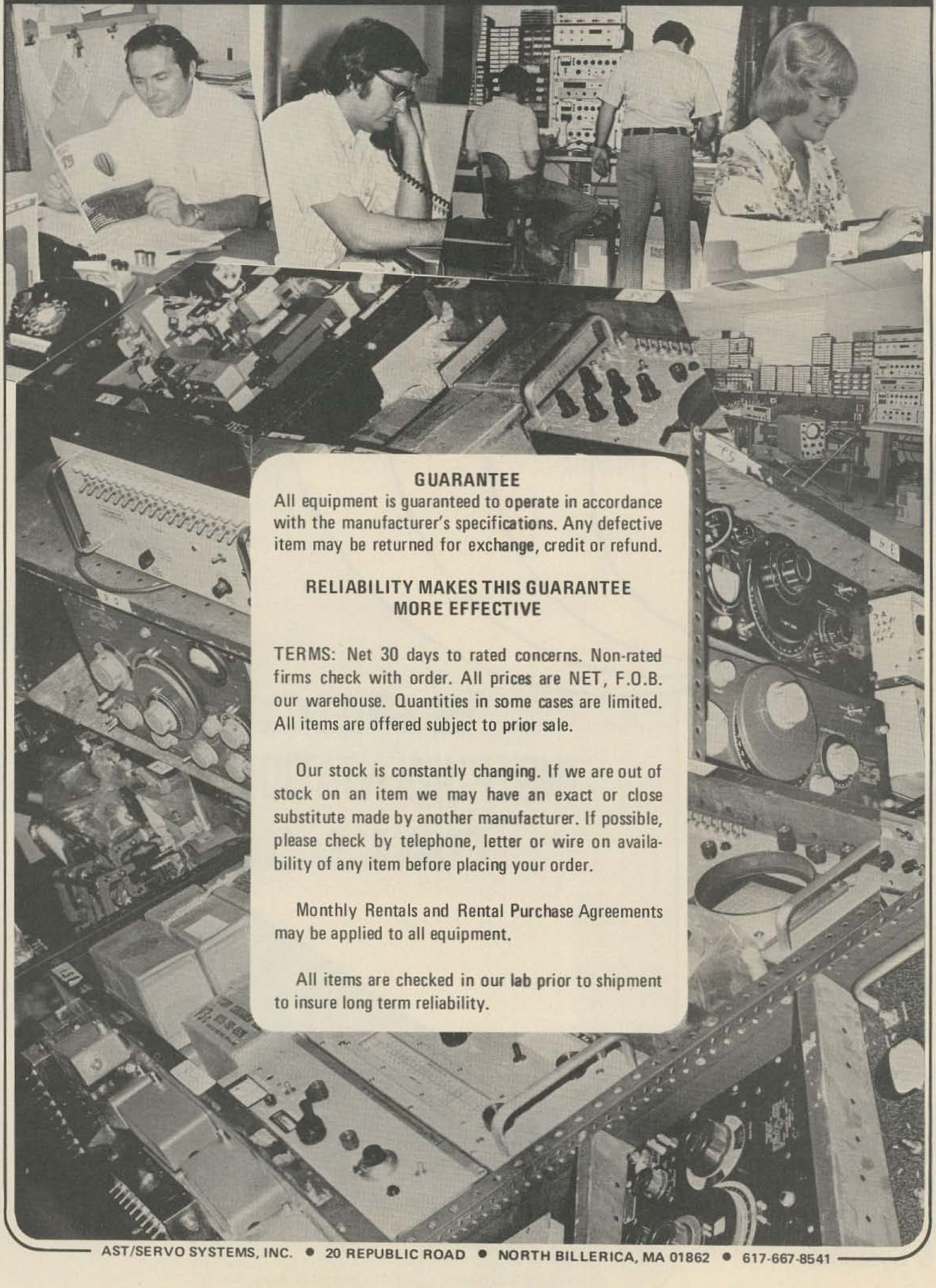

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ELECTRONIC INSTRUMENTS

BALLANTINE 302C
Battery Operated VTVM **$99.00**

Measures from 100 uV-1000 V full scale at 2 Hz-150 kHz. Accuracy is ±3% of reading from 5 Hz-100 kHz, ±5% elsewhere.

BALLANTINE 305A
Peak Voltmeter **$255.00**

Range: 3.5/10/35/100/350/1000 mV, 3.5/10/35/100/350/1000 V. Accuracy: 20 cps, -200 rc ±2%; Peak to Peak, Read Positive and Negative.

BALLANTINE 310A
Wide Range VTVM **$125.00**

Measures from 100 uV-100 V full scale at 10 Hz to 2 MHz. Accuracy is ±3% of reading from 15 Hz to 1 MHz, ±5% elsewhere. When used as a null detector bandpass is 5 Hz to 4 MHz.

BALLANTINE 317
Vacuum Tube Voltmeter **$99.00**

300 mV to 300 V, 10 Hz to 1 MHz with Cathode Follower Probe.

Bausch & Lomb ABB73

BAUSCH & LOMB AVB-73
Stero Zoom Microscope **$350.00**

Variable Zoom Power: .7X thru 3X. Eye pieces supplied with this unit. 15X giving a total of 10X thru 45X. This unit also supplied with an illuminator.

BATRON 3KA-40/3.4
Directional Coupler **$160.00**

Frequency: 26.5 to 40 Gc.

BAYTRON 3KA-90
Tuner **$150.00**

E & H Plane Tuner. Frequency: 26.5 to 40 Gc. Locking-type precision micrometer, driving an insulated, noncontacting, circular, double choke plunger. Travel is greater than one half wave length at the lowest operating frequency of the band.

BECKMAN HP2
PH Meter **$75.00**

BECKMAN 1201-A
WWV Receiver **$85.00**

Receives bands 2.5/5/10/15/20/25 MHz. Front panel controls: RF Gain, Oscillator tuning, Limiter, Audio Gain, also A.V.C. Switch.

BECKMAN 6020
Frequency Counter **$399.00**

Versatile 2 MHz EPUT meter with variable period time base from 1 to 100,000.

BEHLMAN-INVAR R161A-700
Invertron Power Supply **$495.00**

AC Power Source. Output: 0 to 125 V @ 160 VA. Plug-In Selectable.

Biddle Test Set

BIDDLE 220015
Dielectric Test Set **$525.00**

Output Test Voltage: 0 to 15 kV in 2 ranges; Output Current: 2 to 5 mA measured on 4 range meter; Unit has indicating lamps and guarded safety features.

ELECTRONIC INSTRUMENTS

BIDDLE 8684
"Meg" Megger **$95.00**

Range: 100k Ohms to over 1,000 megohms; Test Voltage: 500 V; Input Power: 115 V ac; Some units also have a 1000 V test voltage position.

BIRD 8130
Termaline RF Coaxial Load Resistor **$35.00**

Frequency: DC thru 4.0 GHz with VSWR of 1.1 to 1.2.

BLUE M ESP-300A-1X
Oven (No OVT) **$249.00**

Input: 115 V, 1 Ø, 60 Hz, 0° to 204° C.

BLUE M ESP-350A-1X
Oven/OVT **$249.00**

Input: 120 V, 1 Ø, 60 Hz, 0° to 204° C.

BLUE M OV18A
Oven/OVT **$189.00**

Input: 115 V, 1 Ø, 60 Hz, 38° to 288° C. Height: 15"; Width: 19"; Depth: 18".

BLUE M OV500C-2
Oven/OVT **$385.00**

Input: 240 V, 1 Ø, 60 Hz, 38° to 260° C.

BLUE M POM-400 A
Oven **$299.00**

Range: Ambient Temperature to 205° C.

Boonton 71A

BOONTON ELECTRONICS 71A
Capacitance Inductance **$599.00**

0 to 1000 pF, 0 to 1000 uH, Test Frequency 1 MHz.

BOONTON 75-B
Bridge **$1050.00**

1 MHz. DC Bias Option, 0.0002 pF to 1000 pF (three to two terminal), measures resistance (1000Ω to 100 MΩ) and conductance (0.01umho to 1000 umho) capacitance accuracy to ±0.25%.

Boonton 75B S8

BOONTON 75B-S8
Capacitance Bridge **$1050.00**

Scale Range: 0 to 200 V. With DC Bias Option, 0.0002 pF (three or two terminal) measures resistance (1000Ω to 100MΩ) and Conductance (0.01 umho to 1000 umho), Capacitance Accuracy to ±.25%; Test Frequency: 1 MHz.

BOONTON 91 CR
Voltmeter **$279.00**

Rack Mount. Ranges from 1 mV to 3 V full scale in 7 ranges, 20 Hz to 1.3 GHz range.

BOONTON 91DA
Sensitive RF Voltmeter **$395.00**

Volt Range: 0.001 V to 3 V (8 ranges, 1-3-10 increments); Volt Sensitivity: 300 uV; Power Sensitivity: 0.0018 uW; Freq. Range: 20 kHz to 1200 MHz; dB Range: 81 dB (70 dB in 10 dB increments and 11 dB on meter scale); DC Output: 1 V at least; Accuracy: ±2% (±4% on 0.001 V range), 150 kHz to 100 MHz, ±5% (50 kHz to 150 kHz), ±5% (100 MHz to 400 MHz), ±10% (20 kHz to 50 kHz) ±10% (400 MHz to 1.2 GHz).

ELECTRONIC INSTRUMENTS

BOONTON RADIO 160A
"Q" Meter $195.00

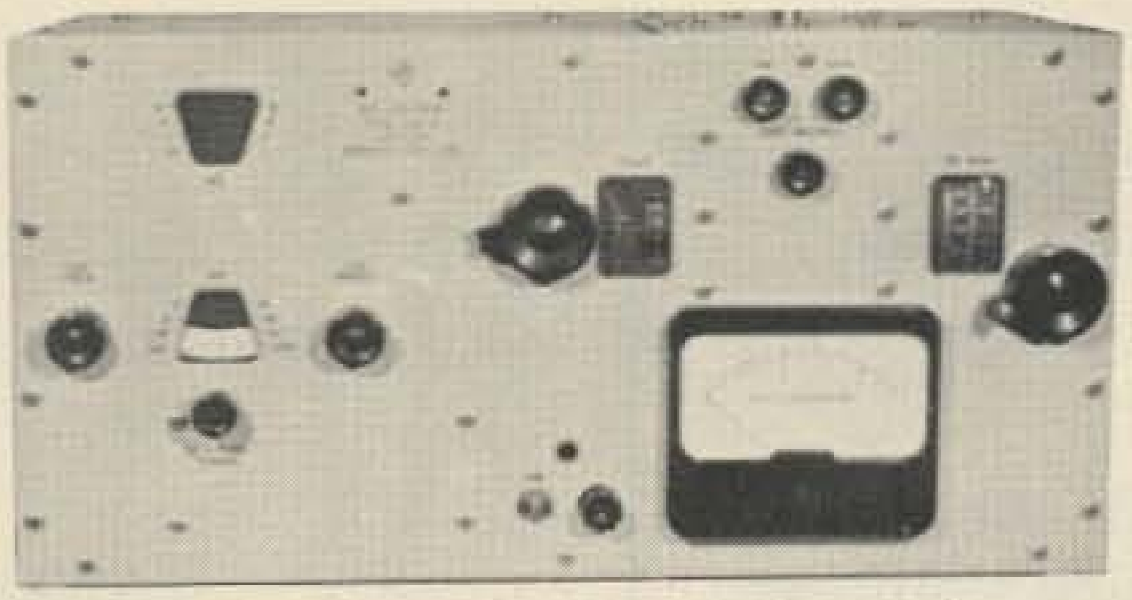
Measures Qs of 20 to 625. Frequency Range of 50 kHz to 75 MHz. Cs 30 uF to 450 uF, Ls .9 to 13 uH.

BOONTON RADIO 202B
FM Signal Generator $450.00

54-216 MHz in 2 bands. FM deviation: 0-240 kHz. 8 internal modulation frequencies between 50 Hz – 15 kHz. AM modulation (0-50%). Calibrated RF output.

BOONTON 207-E
Univerter $165.00

Frequency Range: 100 Kc to 55 Mc; Output: 1 uV to 0.1 V; Modulation: FM – 0 to 240 Kc. AM – 0 to 50%.



Boonton 250A

BOONTON RADIO 250A
RX Meters $995.00

Resistance range: 15 to 100,000Ω. Capacitance range: 0.001 uH to 100 mH. Test voltage level: 0.05 to 0.75 V.

BOONTON RADIO 260-A
"Q" Meter $895.00

50 kHz to 50 MHz; Q Range: 10 to 625. Inductance Range: 0.09 uH to 130 mH. Capacitance Range: 30 to 460 uF.

CALIFORNIA INSTRUMENT R123A
AC Power Supply $479.00

Output: 0 to 120 V; 3 Phase 120 VA. Fixed Frequency: 400 Hz.

CARTER B1030CP
Rotary Converter $149.00

Input: 12 V @ 45 Amps DC. Output: 115 V; 60 Hz @ 2.6 Amps (.300 KVA).

CHRONETICS PG11
Pulse Generator $295.00

Output: ∓10 V in 50 Ohms. Frequency: .2 Hz to 20 MHz. Pulse Width: .1 usec to 10 msec. Delay .1 usec to 10 msec.

CLAROSTAT 240-C
Power Decade Box $65.00

Range: 1 Ohm to 999,999 Ohms in 1 Ohm steps. 225 Watts Max.

CMC 1376C
Integrated Counter $199.00

A Preset Counter with 1 to 999,999. Count & Reset. Automatic Recycling.

COHU 510, 512-110
Digital Voltmeter $175.00

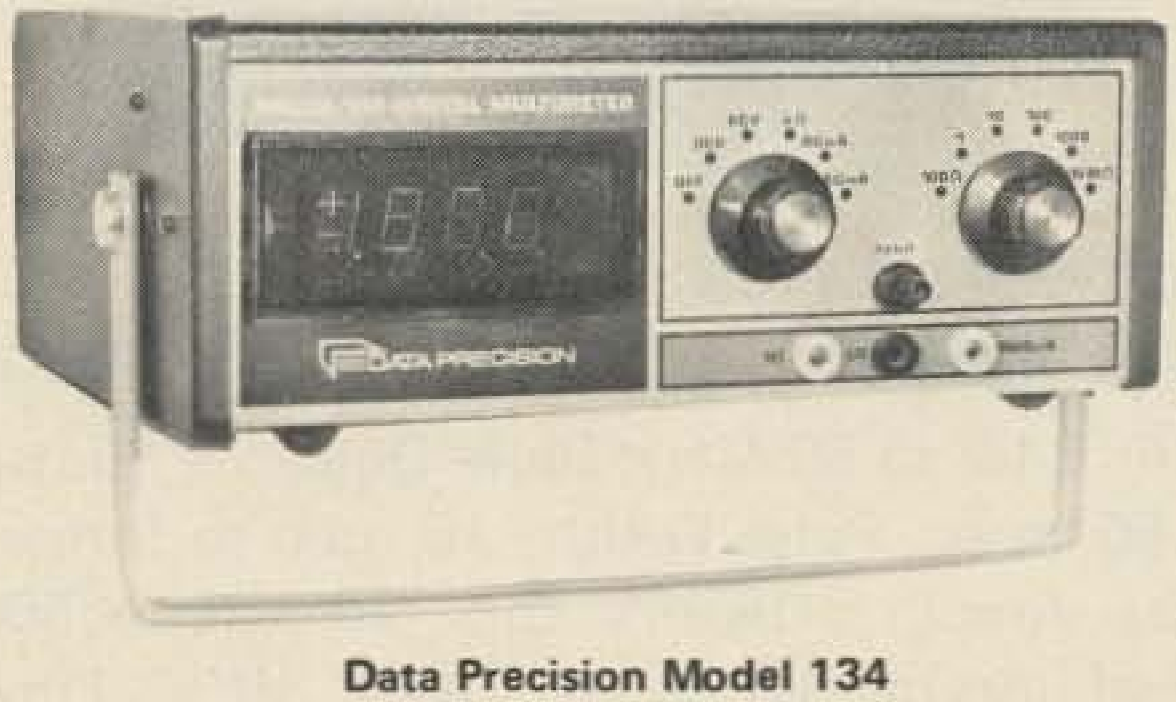
3½ Digit DC & Ohms Voltmeter.

CORNELL DUBLIER CDA-5
Decade Capacitor $10.00

Maximum Voltage: 220 V ac. Capacitance: .011 mfd in 100 mmfd steps. Range Selector: 2 rotary switches.

CORNELL DUBLIER CDC-3
Decade Capacitor $10.00

1.0 to 10 mfd in steps of 1.0 mfd ±3% Accuracy.



Data Precision Model 134

DATA PRECISION 134
Digital Multimeter $169.00

ELECTRONIC INSTRUMENTS

Data Precision 2540

DATA PRECISION 2530
Digital Voltmeter **$849.00**

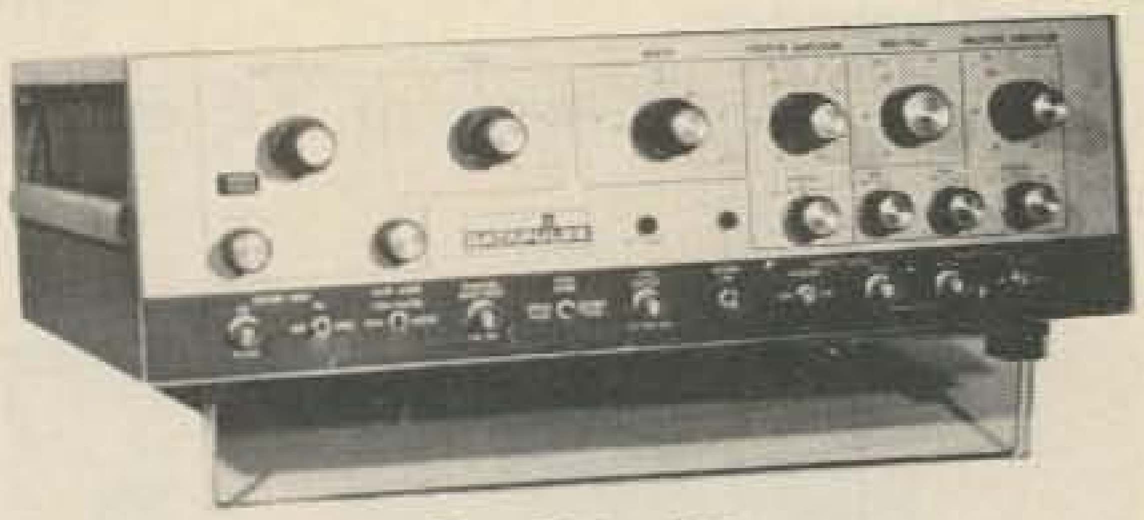
DATA PRECISION 2535
Digital Voltmeter **$829.00**

DATA PRECISION 2540
Digital Voltmeter **$885.00**

DATA PRECISION 2540
A1 Digital Voltmeter **$895.00**

DATA PRECISION 134
Digital Multimeter **$169.00**

DATA PULSE 106A
Pulse Generator **$495.00**
Solid state unit, repetition rates from 10 Hz to 12 MHz. Pulse amplitudes of ±12 volts into 50 Ohms with single or double pulse output. Delay less than 40 ns to 5 ms, rise and fall times of 10 ns to 1 ms.



Data Pulse 110B

DATAPULSE 110B
Pulse Generator **$775.00**
PRF: 5 Hz to 50 MHz, Pulse Delay: ≈ 15 nsec to 50 msec, Pulse Width: 10 nsec to 5 msec, Pulse Ampl: < 10 mV to > 10 V into 50Ω Offset Ampl: I2 V to ±10 V, Rise Time: < 4.5 nsec (4 typical) to > 0.5 msec, Fall Time: < 6 nsec to > 0.5 msec.

DAVEN CO. 750-M
Decade Resistor Box **$85.00**
In 5 Steps; .1 Ohms to 1 megohm; .05%.

DEL ELECTRONICS
Power Supply **$175.00**
Range: 5 KVA @ 100 mA.

DEL ELECTRONICS 4PK-100-1
Power Supply **$159.00**
0 to 4000 V @ 100 Milli Amps.

DE MORNAY BONARDI DBG-400
X-Band Variable Attenuator **$49.00**
Remote control step attenuator. Frequency: 8.2 to 12.4 Gc. Attenuation: 0 to 40 dB. Steps are infinitely variable and preset at factory. VSWR is 1.15 max. Insertion loss 0.5 dB max. Solenoi Remote Control Operation 28 V dc.

M.E. DICKERMAN
Height Gauge **$65.00**
12" Height Gauge with a Federal Indicator.

DIGITEK 251A
Digital Voltmeter **$200.00**
3½ Digit DVM; Ranges: 0 to 10 V/100 V/1000 V.

DIGITEK 252
Digital Voltmeter **$200.00**
3½ Digit DVM; Ranges: 0 to 2 V/ 20 V/200 V/1000 V.

DIGITEK 262A
Multimeter **$275.00**
4½ Digit DMM; Ranges: DC volts .2/2/20/200/1000. AC volts 2/20/200/1000. Ohms 200 to 1000 in 5 Steps. DC Current: 200 u Amps thru 1000 Mills.

DUMONT 302
Oscilloscope Camera **$145.00**
Lens: 75mm. f/1.9 stops down to f/16; Shutter Speeds: 1 sec to 1/100 sec plus bulb

& time; Object/image Ratio: 2.25:1; Film Back: Accepts Polaroid roll up to 6000 speed/10 sec development.

DUMONT 304A
Universal Oscilloscope **$125.00**
Frequency response: DC to 300 kHz. Vertical sensitivity: 25 mV/inch. Risetime: 2 usec. Recurrent and driven sweeps from 2 Hz to 30 kHz.

DUMONT 322A
Dual Beam Oscilloscope **$195.00**
Displays 2 waveforms on separate or common time basis. Frequency response: DC to 350 kHz. Vertical sensitivity: 0.025 volt/inch. Horizontal frequency range: 2 to 30 kHz.

DYMEC 2411
Data Amplifier **$199.00**

DYMEC 2901
Input Scanner **$199.00**

DYMEC 2902
Input Scanner **$199.00**

DYTRONICS 613
Telemetry Calibrator **$199.00**

EDNALITE 150-A
Magnifying Glass **$85.00**
On Stands.

EH RESEARCH 120D
Pulse Generator **$495.00**
100 Hz to 20 MHz rep rate, 20 V into 50Ω with 3:1 Vernier. 1.3 ns rise at 20 V, pulse width adjustable 10 to 100 ns, dual pulse output.

ELECTRONIC MEASUREMENT PV32-30
Power Supply **$325.00**
Output: 0 to 32 V @ 0 to 30 Amps. Regulation less than .25%. Input: 115 V or 220 V; 60 Hz.

ELECTRONIC MEASUREMENT T0-36-10
Regatron Semiconductor
Power Supply **$179.00**
DC Volt Range: 0 to 36 V. DC Amp Range: 0 to 10 A. Metered. Input: 115 V, 60 Hz.

ELECTRONIC MEASUREMENT T060-5
Power Supply **$159.00**
Output: 0 to 60 V @ 0 to 5 Amps. Regulation 10 mV Line or Load. Input: 115 V, 60 Hz.

EMCO A-603N
Attenuator **$29.00**
N Type 3 dB Attenuator

E & M LABS XM73
X-Band Ferrite Isolator **$15.00**

E & M LABS XM105
X-Band Ferrite Isolator **$15.00**

E & M LABS C115LCS
Coax Switch **$29.00**

EMPIRE NF-105/T1
RFI Plug-In **$375.00**
20 MHz to 200 MHz. To be used in NF-105 Receiving System.

Epply Standard Cell

EPPLEY 100
Unsaturated Standard Cell **$20.00**
Calibrated traceable to NBS, ±0.01% accuracy.

ELECTRONIC INSTRUMENTS

E.S.I. DB-62
Decade Resistance Box **$125.00**

6 decade unit, choice of one from following ranges. 11.1111KΩ (0.01Ω/step); 111.111KΩ (0.1Ω/step); 1.11111M (1Ω/step). Nominal accuracy 0.02%.

E.S.I. 250 DA
Impedance Bridge **$399.00**

Self-contained ac operated unit measures R (0.1%), L (0.3%), C (0.2%) at dc and audio frequencies. Also measures D & Q.

E.S.I. DV-411
Dekavider **$125.00**

Three step decade plus vernier pot. Resistance Value: 10,000 Ohms total. Linearity: 20 ppm. These units are mounted on a base.

EXACT ELECTRONICS 100
Voltage Calibrator **$99.00**

Voltage Calibrator frequency: dc to 1 kHz. Voltage Ranges: 0.01, 0.05, 0.1, 0.5, 1, 5, 10, 50, 100 V.

FAIRCHILD 766H
Oscilloscope/Dual Plug-In **$595.00**

DC to 100 MHz.

E.A.I. 1120
X-Y Recorder **$695.00**

Chart size: 8½" x 1". Input: DC. Sensitivity: .05 mV/inch to 400 V/in. Slew speed: > 20IPS. Adjustable: Zero offset. Weight: 25 lbs. Power: 115 V, 60 Hz. Accuracy: .05%.

FAIRCHILD F296
Camera for Oscilloscope **$139.00**

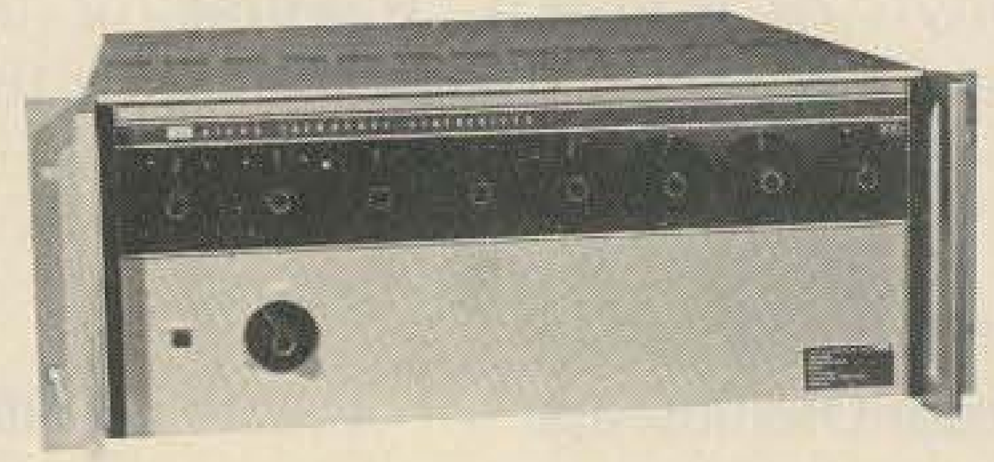
Polaroil Type for 5" CRT.

FAIRCHILD DVM-7100 (7142)
Digital Voltmeter **$450.00**

5 Digit DVM; DC volts and Ohms: Accuracy .01% of reading. Ranges: 100 mV thru 1000 V.

FERRIS 20-4
Signal Generator **$99.00**

Output Frequency Ranges: 455, 530, 540, 610, 1000, 1400, 1600, 1630 KC – 10.7 MHz; RF Output Voltage: .05 uV to 100,000 uV.



Fluke 6160A

FLUKE 6160A/DX
Frequency Synthesizer **$1695.00**

Frequency Range: 4 MHz to 29.999999 MHz in 1 Hz Increments; Spectral Purity: Harmonics: Greater than 25 dB below Fundamental. Spurious Signals: Greater than 80 dB below Fundamental (Hum, AM & FM). Noise: Greater than 90 dB below Fundamental (measured in 1 Hz Bandwidth at offsets). Output Voltage: 4 MHz to 30 MHz, 1 Volt rms ±1 dB into 50 Ohms, VSWR less than 2:1; Internal Standard: 5 MHz, ±1 part in 10^8 per 24 hrs. after 72 Hr Warm-Up; Auxiliary Outputs: 1 MHz, 0.1 MHz; Power Requirements: 115 V/230 V, 60 Hz.

FLUKE 803
AC/DC Differential Voltmeter **$325.00**

Input Volt: 0 to 500 V, AC or DC/4 ranges Acc (% of input); DC ±0.05% (0.1 V to 500 V dc); ±(0.05% ±50 uV), (below 0.1 V dc); AC (20 Hz to 10 kHz) ±0.2% from 0.5 V to 500 V ac ±(0.2% + 25 uV). From 0.001 to 0.5 V ac (10 Hz to 20 Hz) ±0.5% + 25 uV) from 0.001 V to 500 V ac; (5 Hz to 10 Hz) ±(3% + 25 uV) from 0.001 V to 500 V ac.

FLUKE 873-AB
AC/DC Differential Voltmeter **$695.00**

0 to 1100 V ac/dc in four ranges ±0.02% dc and ±0.2% ac with 10 uV Resolution. Battery Powered Option.

ELECTRONIC INSTRUMENTS

FLUKE 8100A
Digital Multimeter **$495.00**
1 V dc/ac f.s. to 1 kV dc/ac, 1 kΩf.s. to 10 MΩ, 4½ Digit Display.

FREED 1115
Inductance Bridge **$385.00**
Inductance range: 111.1 h to 100 uh in 5 decades, .11 h to .1 uh in 2 decades; Conductance range: .15 umho — 1000 mho; Frequency Range: 20 Hz to 10 kHz; DC Current: up to 15 Amps; Accuracy: ±1% to 5 kHz, ±3% to 10 kHz.

F.X.R. AD-C09
Attenuators **$25.00**
Coaxial/15 Watt, 50 Ohm, 10 dB attenuator. Frequency Range: DC to 4 GHz; TNC connectors at both ends.

F.X.R. AF-5
Attenuator **$19.00**

F.X.R. AV-20N
Switch Attenuator **$69.00**
Coaxial Turret Attenuator; Frequency Range: DC to 2 GHz; Attenuation Steps: 0, 2, 4, 6, 8, 10.

F.X.R. C-410-A
Frequency Meter **$115.00**
Frequency Meter Range: 5.85 to 8.2GC.

F.X.R. HA-10N
Filter **$39.00**
Hi Pass; Cut Off Frequency: 1000 MHz; Average Power: 50 Watts.

F.X.R. H501B
Waveguide Termination **$25.00**
Frequency Range: 3.95 to 5.85 GHz; Flange: UG/149A/U, VSWR: 1.025; Average Power: 5 Watts.

F.X.R. N-410A
Frequency Meter **$295.00**
Frequency: 1 to 4 GHz; Accuracy: .1%.

F.X.R. TA-5MN
Termination **$10.00**
DC to 12.4 GHz; Power Rating: 2 Watts Average.

F.X.R. TD-5FN
Termination **$29.00**
Frequency Range: 0.9 to 12.4 GHz/100 Watts.

F.X.R. XA-0040
Crystal Detector **$25.00**
Coaxial Detector; Frequency Range: 0 to 13 GHz.

F.X.R. XB-1000
Detector **$19.00**
Coaxial Detector; Frequency Range: 0 to 13 GHz.

F.X.R. XP-1040
Detector Mount **$25.00**
Frequency Range: 10 to 5000 MHz; 20 dB Padded VSWR less than 1.2.

F.X.R. X311-A
Slide Screw Tuner **$110.00**
Frequency Range: 8.2 to 12.4 GHz. Carriage Travel: 1.4″. Wave Guide Flange: WR90.

F.X.R. Z116A
X-Band Slotted Line **$75.00**
Universal Carriage for Slotted Sections.

F.X.R. Z819B
Klystron Power Supply **$99.00**

GAERTNER
Autocollumnator **$200.00**

GENERAL ELECTRIC
Thermocouple Vacuum Gauge **$49.00**
Cat. No. 5797633G1. Meter Range: 0 to 1000 Microns, 0 to 50 Milliamps.

GENERAL ELECTRIC CG-60AB0
Wavemeter **$59.00**

ELECTRONIC INSTRUMENTS

GENERAL ELECTRIC DP-2
A.C. Voltmeter $45.00

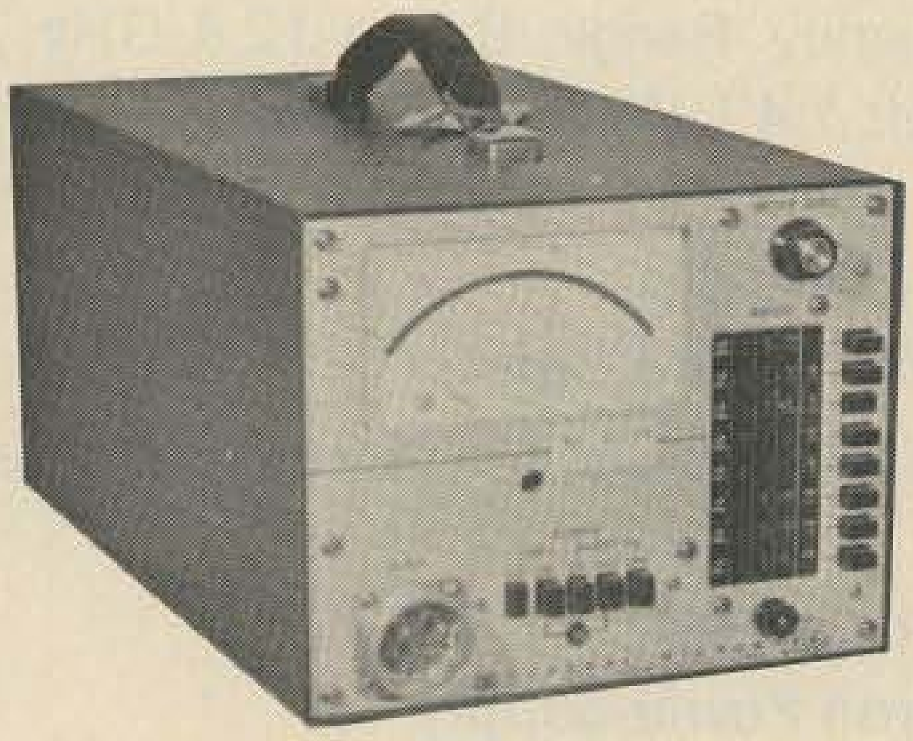
Range: 0 to 10/50/150 ac volts (100 scale division). To be used with external multiplier only.

GENERAL ELECTRIC R200A (4ARS200G002)
Tape Reeler $129.00

This is a modular paper tape handler capable of supplying and re-reeling tape at 60 ips. When operated with the Omni-Data PTR-80 Tape reader and the ETR-7, ITR-7 and ATR-7 Tape Printers, the unit is under control of the Reader or Printer feeding tape from the right reel to the left reel. Reel size: NAB 8" dia.; Speed: 60 ips; Controls: on-off, forward-rewind; Power: 115 V, 60 Hz, 170 Watts; Dimensions: 19" rack mount, 10½" high, 9½" deep, 30 lbs. Condition – New.

GENERAL MICROWAVE N401A
Bolometer Mount $99.00

Resistance 200 Ohms; N Type Connector; Barr. 4.5 mA or 8.75 mA (pos.); Therm. 13 mA (neg.) selectable.



General Microwave 460B

GENERAL MICROWAVE 460B
Power Meter $325.00

Ranges: 0.3u Watts (-35 dBm) to 3 Watts (+35 dBm) in 31 ranges.

GENERAL MICROWAVE N608
Reaction/Transmission Wave Meter $179.00

Coaxial Input; Frequency: 3.96 to 8.2 GHz.

GENERAL RADIO W5MT
Variac $25.00

Input Voltage: 120 V; Output Voltage: 0 to 140 V at 5 Amps.

GENERAL RADIO W-8G3
Variac $45.00

Output Voltage: 0 to 140 V; Rated Current: 25.5 Amps (open mounting).

GENERAL RADIO W10
Uncased Variac $35.00

Output Voltage: 0 to 140 V; Rated Current: 10 Amps.

GENERAL RADIO 50-A
Variac $145.00

Output Voltage: 0 to 135 V; Rated Current: 40 Amps; (5 KVA).

GENERAL RADIO 107N
Variable Inductor $59.00

22.5 to 125 mH.

GENERAL RADIO 274-LMR
Patch Cord $.79

Single-Plug Patch Cord (red); Length: 18"; Stackable Connections.

GENERAL RADIO 274-LSB
Patch Cord $.79

Single-Plug Patch Cord (black); Length: 9"; Stackable Connections.

GENERAL RADIO 274-LSR
Patch Cord $.79

Single-Plug Patch Cord (red); Length: 9"; Stackable Connections.

GENERAL RADIO 274-NLS
Patch Cord $2.00

Shielded Double-Plug (banana) Patch Cord; Length: 12"; Connections in Aluminum Shielding.

ELECTRONIC INSTRUMENTS

GENERAL RADIO 274-NPM
Patch Cord **$1.75**
Double-Plug Patch Cord; Right Angle Cord; Length: 24"; Stackable (banana) Plugs.

GENERAL RADIO 274-NPS
Patch Cord **$1.50**
Double Plug Patch Cord; Right Angle Cord; Length: 12"; Stackable (banana) Plugs.

GENERAL RADIO 274-NQM
Patch Cord **$1.50**
Double Plug Patch Cord In-Line; Length: 24"; Stackable (banana) Plugs.

GENERAL RADIO 509F
Standard Capacitor **$25.00**
0.001 uF.

GENERAL RADIO 509-T
Standard Capacitor **$25.00**
Capacitance: 0.1 uF; Peak Volts: 500; Frequency: 40 kHz; Accuracy: 0.25%.

GENERAL RADIO 509L
Standard Capacitor **$25.00**
0.01 uF.

GENERAL RADIO 716C-S1
Capacitance Bridge **$385.00**
Modified 716C designed for high frequency operation. Measurement range is 100-1150 pF direct reading, 1-1050 pF substitution. Frequency range is .1-3 MHz (useful to 5 MHz). Accuracy is .1% of reading at 1 MHz.

GENERAL RADIO 722-D
Precision Capacitor **$75.00**
25 to 1150 uuF in 2 ranges. Accuracy: ±0.1%.

GENERAL RADIO 777-Q1
Adaptor **$.99**
Double (banana) Plug to Phone Plug.

GENERAL RADIO 777-Q2
Adaptor **$.99**
Phone Jack to Double (banana) Plug.

GENERAL RADIO 821-A
Impedance Measuring Circuit **$425.00**
Twin-T-Bridge; Frequency Range: 460 kHz to 40 MHz; Capacitance Range: 100 to 1100 pF; Susceptance Range: -6000 umho to +6000 umho @ 1 MHz; Conductance Range: 0 to 3000 umho; Accuracy: 0.1% cap, 2% cond.

GENERAL RADIO 1001A
Standard Signal Generator **$395.00**
5 KC to 50 MC in 8 ranges. Accuracy: +1%, two outputs: 0.1 uV to 200 mV @ 50 Ohms. Amplitude modulation, internal 400 cycle adjustable 0 to 80%.

GENERAL RADIO 1160
Cabinet **$15.00**

GENERAL RADIO 1160
Cable/1160-RDI-1 **$15.00**

GENERAL RADIO 1160
Cable/1160-RDI-2 **$15.00**

GENERAL RADIO 1160
Cable/1160-RDI-4 **$15.00**

GENERAL RADIO 1160-9791
Cable/1160-RDI-1B **$15.00**

GENERAL RADIO 1201-CQ18
Unit Power Supply **$79.00**
Output: 300 V dc, 6.3 ac; Input: 230 V. This Power Supply used in conjunction with all Unit Oscillators and Signal Generators.

GENERAL RADIO 1203-B
Unit Power Supply **$25.00**
Unregulated power supply for use with GR unit oscillators.

GENERAL RADIO 1203-BQ18
Unit Power Supply **$79.00**
Output Voltage: 300 V dc @ 50 mA, 6.3 V ac @ 3 Amps; Input Voltage: 210 to 250 V.

ELECTRONIC INSTRUMENTS

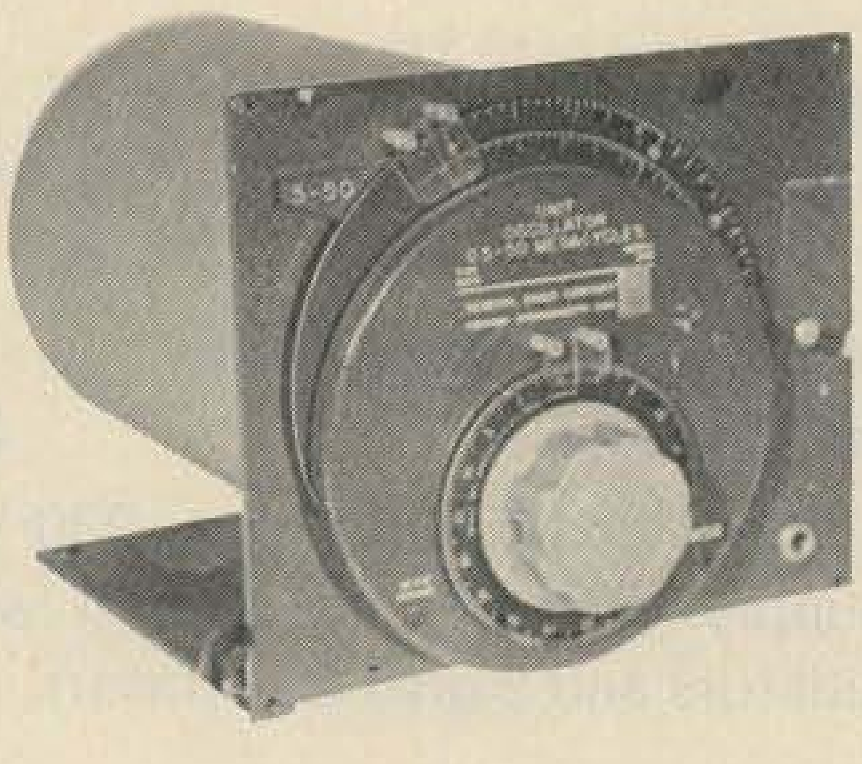
GENERAL RADIO 1208-C
Unit Oscillator **$150.00**
Latter Model of 1208-B 65 to 500 MHz range; 100 mW output; ±2% Accuracy.

GENERAL RADIO 1209-A
Unit Oscillator **$135.00**
Frequency: 250 to 920 MHz; Output: 200 mW.

GENERAL RADIO 1209-B
Unit Oscillator **$150.00**
250 to 920 MHz, range. 200 mW output. ±1% Frequency Accuracy.

GENERAL RADIO 1210C
R C Oscillator **$139.00**
Frequency Range: 20 to 500,000 Hz; Accuracy: 3%; Output: Sine & Square Wave; Output Voltage: 0 to 30 V. To be used with 1203 B Power Supply.

GENERAL RADIO 1211-B
Unit Oscillator **$195.00**
Frequency Range: 0.5 to 50 MHz in 2 Ranges; Output Power: 400 mW to 1500 mW. To be used with 1201 or 1203 Power Supply.



1211C

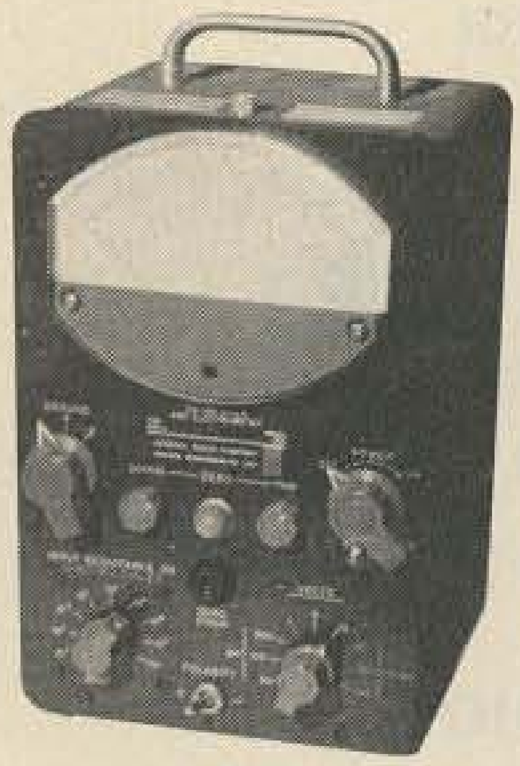
GENERAL RADIO 1211C
Unit Oscillator **$195.00**
Frequency: 0.5 to 50 MHz; Output 400 mW.

GENERAL RADIO 1215-B
Unit Oscillator **$195.00**
Frequency Range: 50 to 250 MHz in 1 Range; Output Power: 60 mW or greater. To be used with 1201 or 1203 Power Supply.

GENERAL RADIO 1217A
Unit Pulser **$99.00**
Pulse duration: 0.2 to 60,000 usec in 4 ranges. Pulse repetition rate: 30 and 60 Hz. Output voltage: 20 volts.

GENERAL RADIO 1217-P2
Pulse Trigger **$12.50**

GENERAL RADIO 1218-A
Unit Oscillator **$225.00**
900 to 2000 MHz range. Power output of 200 mW across band.



1230A

GENERAL RADIO 1230-A
DC Amplifier-Electrometer **$325.00**
High input resistance, high sensitivity and excellent stability. ±30 mV to ±10 V full scale voltage ranges. $\pm 3X10^{-3}$ A full scale. Resistance ranges from 300KΩ to 10^{13} Ohms.

GENERAL RADIO 1232-P1
RF Mixer **$75.00**
To be used with G.R. 1232-A.

GENERAL RADIO 1263-A
Regulating Power Supply **$175.00**
For use with unit oscillators whose output can be controlled by varying plate voltage.

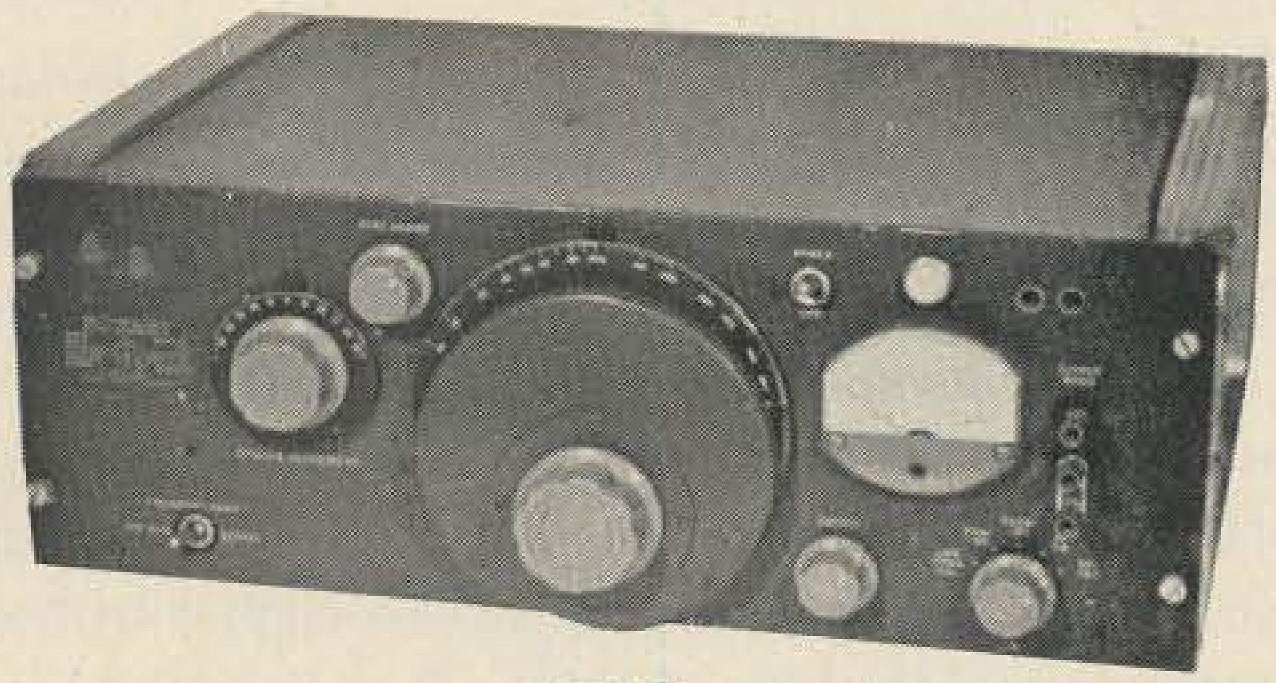
GENERAL RADIO 1269A
Power Supply **$69.00**
Output: 300 V @ 50 mA; Ripple less than 80

ELECTRONIC INSTRUMENTS

mV rms at full load; Also, 6.3 V ac @ 3 Amps. To be used with unit oscillators.

GENERAL RADIO 1302-A
Audio Oscillator **$195.00**

Wide range unit with excellent stability for use as source for bridges and other measurement applications. 10 Hz to 100 kHz with up to 20 V output. ±1% distortion.



1304B

GENERAL RADIO 1304-B
Beat Frequency Audio Osc. **$475.00**

20 Hz to 20 kHz in one logarithmic range. 1 Watt output into 600Ω. 80 dB metered output. Used with GR 1521 recorder in automatic frequency response test sets.

GENERAL RADIO 1340
Pulse Generator **$325.00**

Pulse Period: 0.2 Hz to 20 MHz; Pulse Duration: 2.5 sec to 25 nsec; Risetime: 5 nsec; Output: 10 V with ±1 V offset.

GENERAL RADIO 1346
Audio Frequency Voltmeter **$149.00**

AC output 0.1 uV to 10 V, dc output 1 uV to 10 V, from external dc to 100 kHz source.

GENERAL RADIO 1390-A
Noise Generator **$135.00**

30 Hz to 5 MHz. 1 volt output. 800Ω load impedance.

GENERAL RADIO 1391-P2
Power Supply **$39.00**

Power Supply for 1391.

GENERAL RADIO 1401-B
Fixed Air Capacitor **$30.00**

Standard: 200 pF; Accuracy: 0.1%.

1422CE

GENERAL RADIO 1422-CE
Precision Capacitor **$159.00**

Capacitance Range: 0.005 to 1.1 pF (2 ranges); Accuracy: 0.02% of Full Scale; Scale Divisions: 0.0002 on Scale 1 and 0.00002 on second scale.

GENERAL RADIO 1432-J
Decade Resistance Box **$99.00**

Resistance: 1 Ohm to 11,110 in 4 Decades; Accuracy: 0.05%.

GENERAL RADIO 1432-K
Decade Resistance Box **$99.00**

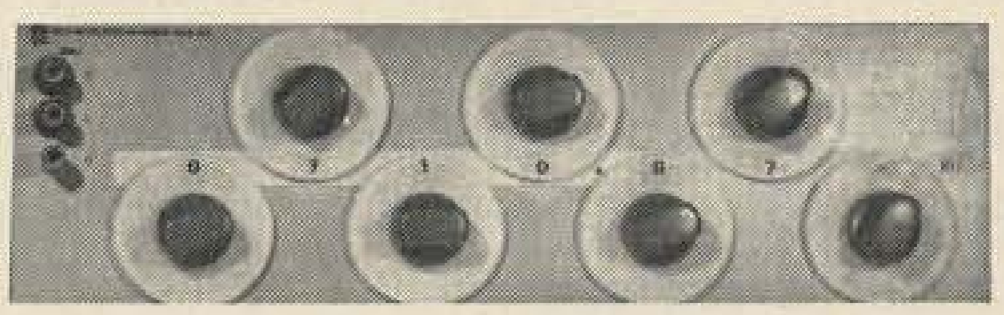
Resistance: 0.1 Ohms to 1,111 in 4 Decades; Accuracy: 0.15%.

GENERAL RADIO 1432-L
Decade Resistance Box **$99.00**

Resistance: 10 Ohms to 111,100 in 4 Decades; Accuracy: 0.05%.

GENERAL RADIO 1432-X
Decade Resistance Box **$99.00**

Resistance: .1 to 111,110 in 6 Decades; Accuracy: 0.5%.



1433H

GENERAL RADIO 1433-H
Decade Resistor **$225.00**

Resistance: 1 Ohm to 11,111,110 in 7 Decades. Accuracy: 0.02% + 2 mohms.

GENERAL RADIO 1434-M
Decade Resistor **$89.00**

Resistance: 1 Ohm to 111,110 in 5 Decades. Accuracy: 0.05%.

GENERAL RADIO 1454-A
Decade Voltage Divider **$99.00**

Voltage Ratio: .0001 to 1.0000 in steps of .000100; Accuracy: 0.05%.

GENERAL RADIO 1521-SL
Modified Recording Device **$950.00**

Chart Recorder; Sensitivity: Adjustable from 0.05 to 2 mV Full Scale; Frequency: 990 Hz; Bandwidth: 35 Hz; Paper Speed: Adjustable from 2.5 to 75 inches per minute; Originally designed to be used in the 1640 System.

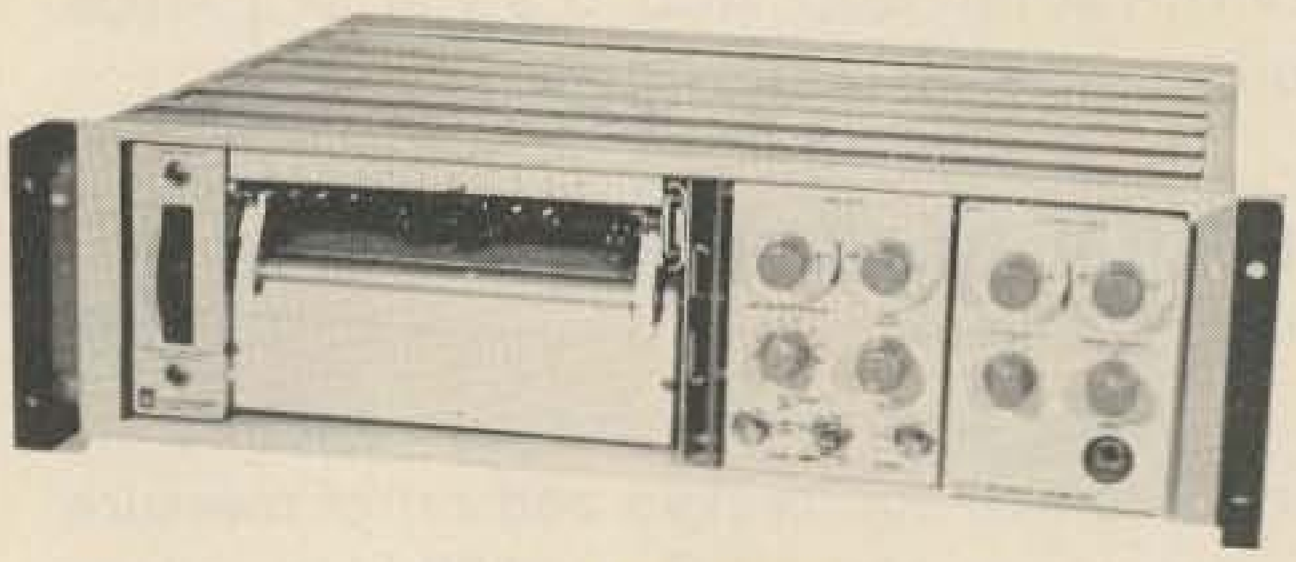
GENERAL RADIO 1522
Extender Board Kit **$15.00**

Service Extender for 1522 Recorder.

1522

GENERAL RADIO 1522
DC Recorder **$895.00**

Writing Speed: 0.5 to 60 in./sec; Chart Speed: 0.5, 1, 2, 5, 10, 20 sec, min., hrs./inch; 18 Speeds; Supplied with 1522-P2 Differential Preamplifier; Ranges: 2 mW to 100 V/inch in 15 Ranges, 1-2-5 Sequence, 0.2 u Amps to 100 mA/inch. 18 Ranges.



1522P2

GENERAL RADIO 1522-P2
Differential Preamplifier **$129.00**

Ranges: Controlled by range switches, polarity switch, and continuous control with calibrated position that operates on all ranges. Voltage: 2 mV/in. to 100 V/in; 15 Ranges, 1-2-5 sequence. Current: 0.2 A/in. to 100 mA/in; 18 Ranges, 1-2-5 sequence. Accuracy: ±0.5% of full scale. Linearity: ±0.25% of full scale. Input resistance between high and low terminals; Voltage: 1 MΩ. Current: 0.11 to 50.05Ω depending on scale as follows: Input Isolation: >10" Ω from Guard terminal to ground, in parallel with <500 pF. Voltage: V dc or Peak ac. Common Mode Rejection: 160 dB dc, 80 dB 60 Hz, Undriven Guard, typical; 180 dB ac up to 20 kHz, Driven Guard, typical.

GENERAL RADIO 1525
Data Recorder **$795.00**

Frequency Response: 15 Hz to 16 kHz; Reel to Reel Type Recorder. Audio Correction Filters with Metered Input & Output.

GENERAL RADIO 1552-B
Sound Level Calibrator **$75.00**

Calibration Frequency: at 400 Hz; Requires 400 Hz source.

GENERAL RADIO 1554-A
Sound and Vibration Analyzer **$650.00**

Frequency Range: 2.5 to 25,00 cps in 4 ranges. Accuracy: ∓%; Input Impedance: 100 kilohms, unbalanced. Input Voltage Range: 100 uV- 30 V.

ELECTRONIC INSTRUMENTS

GENERAL RADIO 1556-B
Noise Impact Analyzer **$165.00**
Measures electrical and acoustical noise peaks, 5 Hz to 20 kHz, 50 us rise time response.

GENERAL RADIO 1558-A
Oct Band Noise Anal Port **$450.00**
115 Volts: Input: Sound-Pressure Level: 44 to 150 dB re 20 uN/m^2 in any band; Band Filters: conforms to USASI-Z24.10-1953; Output Read in RMS via Front Panel Meter. With both Slow and Fast Response. Please write for complete specifications.

GENERAL RADIO 1558-A
Oct Band Noise Anal Port **$450.00**
Same as above with 230 V Input.

GENERAL RADIO 1560-P31
Carrying Case **$5.00**

GENERAL RADIO 1560-P32
Tripod/Microphone Adaptor **$39.00**
To be used for support of external microphone in field applications.

GENERAL RADIO
Accessories For Sound Level System
1560-P72 Cable 25 ft. $18.75, 1560-P72C Cable 4 ft. $9.50, 1560-P73B Cable 100 ft. $25.00, 1560-P95 Cable Adaptor $4.00, 1560-P96 Adaptor $20.00, 1560-P98 Adaptor $20.00, 1560-P99 Adaptor Cable $12.00.

GENERAL RADIO 1560-P95
Cable **$4.00**
Accessories for Sound Level System.

GENERAL RADIO 1560-9632
Microphone Tripod **$30.00**
To be used with 1560-P40 Preamplifier.

GENERAL RADIO 1560-4100
Power Supply **$125.00**
Battery Eliminator for 1560-P40 Pre-amplifier.

GENERAL RADIO 1565-A
Sound Level Meter **$245.00**
44 to 140 dB range, built-in ceramic microphone, hand-held portable, A, B and C.

GENERAL RADIO 1570-ALS
Voltage Regulator **$149.00**
Input: 115 V, 60 Hz; Output: 115 V nominal @ 50 Amps. Percentage of Correction: 90% to 110%.

GENERAL RADIO 1570-ALS-3
Voltage Regulator **$149.00**
Same Specifications as above.

GENERAL RADIO 1570-ALS-9
Voltage Regulator **$149.00**
Same Specifications as above.

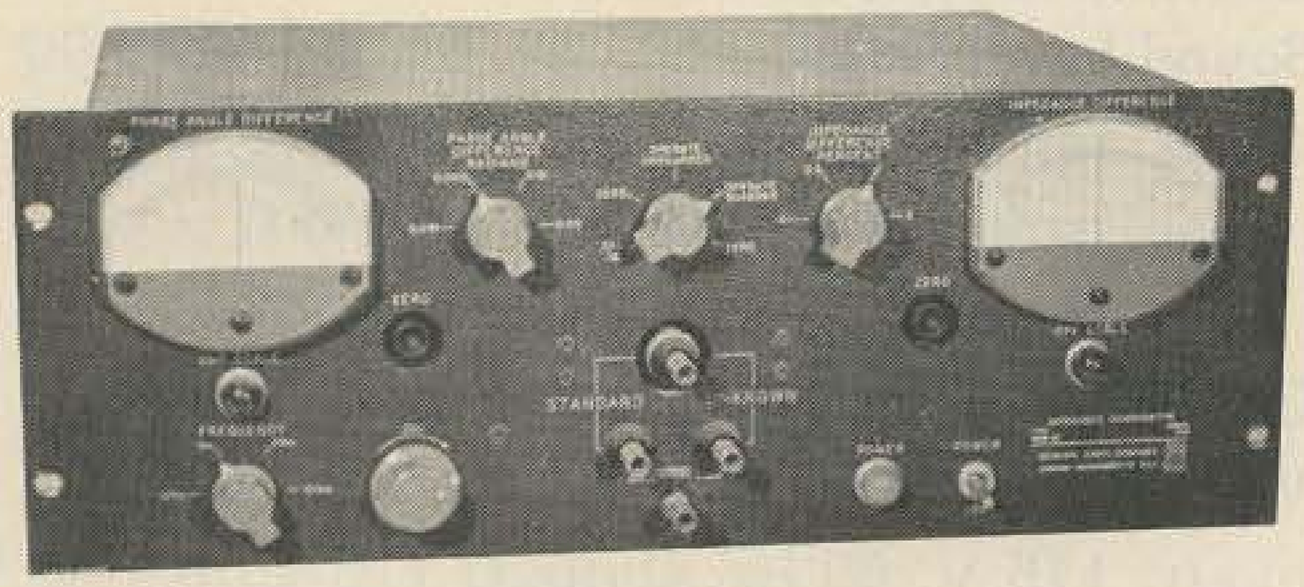
GENERAL RADIO 1570-ALS-15-P2
Voltage Regulator **$125.00**
Militarized Version of above. Will operate in both 50 and 60 Hz.

GENERAL RADIO 1571-AH
Automatic Voltage Regulator **$195.00**
Input: 230 V ∓10%; Output: 230 V @ 20 Amps; (4.6 KVA). Correction Range: 90 to 110%.

GENERAL RADIO 1582-ALR-2
Automatic Voltage Regulator **$399.00**
Input: 115 V, Output: 115 V, ±10% @ 25 Amps (2.9 KVA). Correction Range: 82 to 124%.

GENERAL RADIO 1583-LJ
Automatic Voltage Regulator **$195.00**
3 Phase Voltage Regulation; Input: 115 V (Line to Line) 400 Hz. Output: 115 V @ 42 Amps, 8.5 KVA. Correction Range 90 to 110%.

GENERAL RADIO 1583-LMJ
Automatic Voltage Regulator **$195.00**
Same as above only Bench Model.



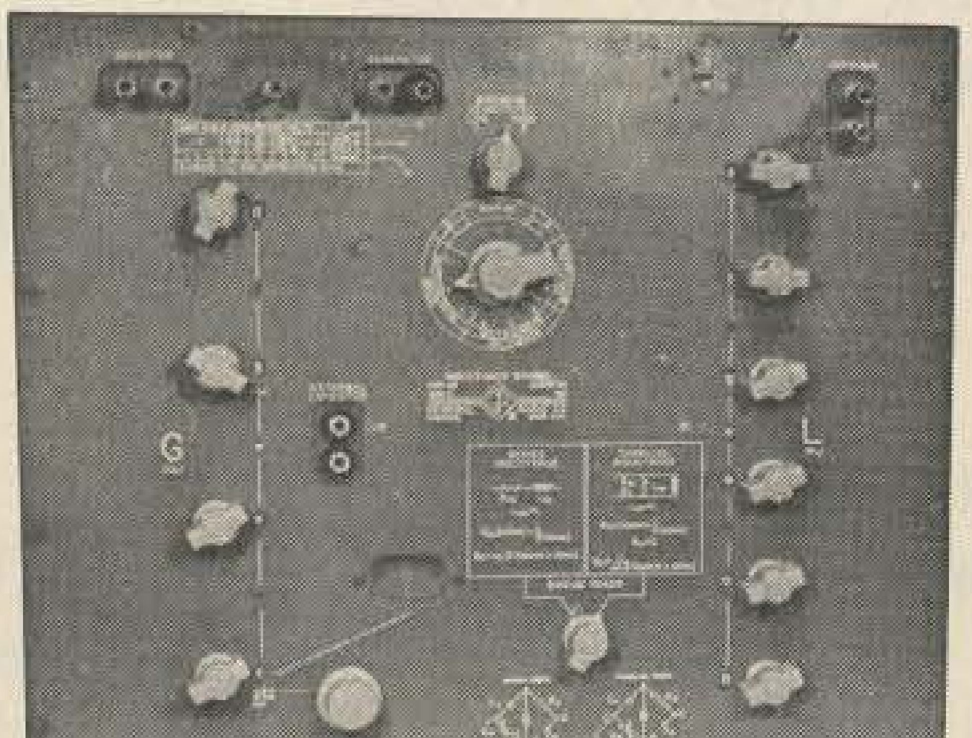
1605A

GENERAL RADIO 1605-A
Impedance Comparator **$375.00**

100 Hz to 100 kHz, 2 Ohm to 20 megohm.

GENERAL RADIO 1620-A
Capacitance Bridge **$1895.00**

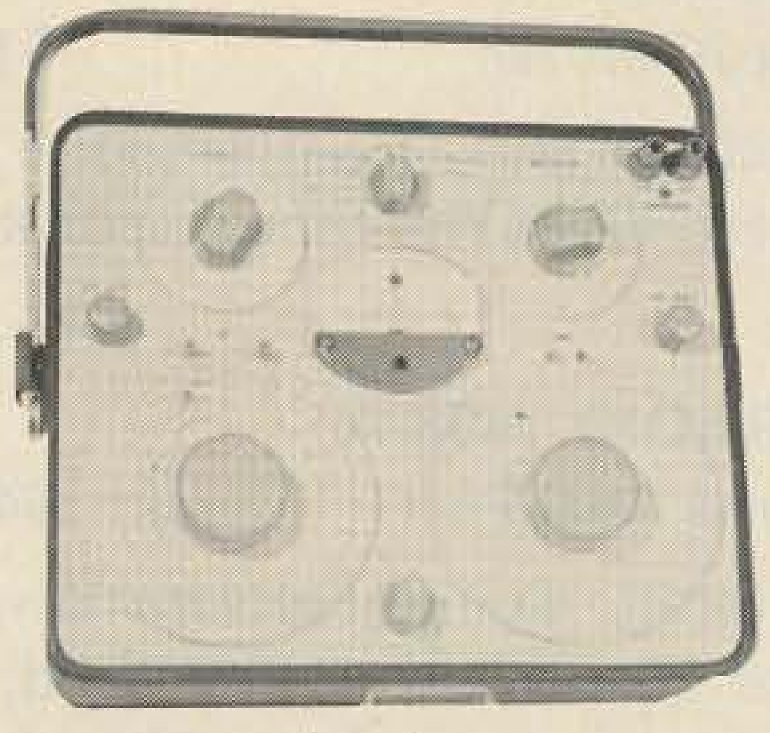
High precision capacitance bridge for direct measurement of capacitors or intercomparison of standard capacitors and others. Range extends from less than 1 pF to 1 uF. Accuracy: ±.01% at 1 kHz. Supplied with 1310A Oscillator and a 1232A Null Detector Amplifier.



1632-A

GENERAL RADIO 1632-A
Inductance Bridge **$995.00**

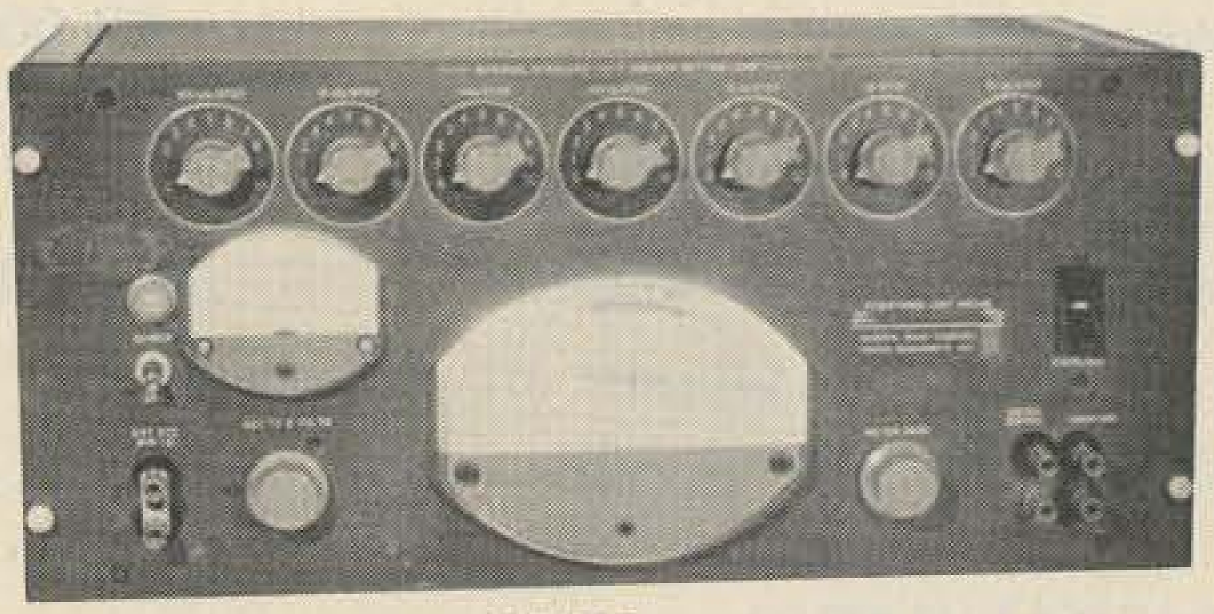
Precision inductance bridge for direct measurement of inductors or intercomparison of standard inductors and others. Range .1 mH to 1111 H; Accuracy: ±.1% direct reading. Also measures Q. Requires external generator and detector such as GR 1310A and GR 1232A.



1650-B

GENERAL RADIO I650A
Impedence Bridge **$475.00**

Direct reading bridge for R, L, C measurements. Built-in 1KHz oscillator and detector. Also measures dissipation and storage factor.



1652A

GENERAL RADIO 1652-A
Resistance Bridge **$225.00**

Production testing of resistors by indicating deviation from standard. Also measures resistance from 1Ω to 1MΩ±0.5%.

GENERAL RADIO 1681-A
Impedance Comparator **$895.00**

R, L, C to 0.005% accurate comparison. Digital Readout. 0.001% resolution. Three terminal connections. BCD output.

GENERAL RADIO 1682
1 MHz Automatic Capacitance Bridge **$2895.00**

Range: 0.001 pF to 0.02 uF; Basic Accuracy: .1%; Up to 20 measurements per second. Built-in bias 0 to 100 V; Capacitance: Range:

00.001 to 1999.9 pF; Accuracy: .2% ±.005% fs; 02.00 to 19.99 nF; Accuracy: 5% ±,05% fs; Conductance: Range: 00.01 to 1999 uΩ; Accuracy: 1% ±1 count; 02.0 to 19.9 mΩ; Accuracy: 5% -.5% fs; Display 5 digits capacitance nixie type and 4 digits for conductance. Units supplied less P1, 2, or 3 fixture (optional at extra cost).

GENERAL RADIO 1750-A
Mechanical Sweep Drive **$45.00**

Adjustable over 9 turnrange with sweep arc from 30-300°. Sweep rate from 0.5 to 5 per second.

GENERAL RADIO 1806-P2
Range Multiplier **$10.00**

Multiplication Ratio: 10:1. The Range Multiplier is a 10:1 capacitive voltage divider that screws onto the probe in place of the regular probe tip. It permits use of the probe (desirable above 150 kHz) for voltages from 150 to 1500 volts.

GENERAL RADIO 1808
AC Millivolt Meter **$245.00**

Range: 150 uV to 150 V in 6 Ranges. Input Impedance: 10 megohms/10 pF. Accuracy: 1%. The GR 1808 is an average reading voltmeter calibrated to read the rms value of sign waves. Its bandwidth is 10 Hz to 10 MHz.

1822

GENERAL RADIO 1822
Digital Voltmeter Calibrator **$995.00**

100 mV to 1000 V dc output, 10 ppm stability, automatic steping, programmable, an excellent mobile secondary standard for dvm calibration.

GENERAL RADIO 1840A
Output Power Meter **$375.00**

Power Range: 0.1 mW to 20 W; Freq. Range: 20 Hz to 20 kHz; Input Impedance: 0.6Ω to 32 kΩ. Provides a total of 48 different input impedances; Accuracy: 0.3 dB to 1.5 dB over frequency range.

GENERAL RADIO 1862-A
Megohmeter **$165.00**

.5 – 2,000,000 Megohms. Test voltage of 50 and 500 volts.

G.H.S. 5613
Megpot **$79.00**

Ranges: 1-40 megohms @ 200 volts, 2.5-100 megohms @ 500 volts meter scales. Multipliers: 1X-100X in 6 steps. This unit is both a HiPot Tester and a Megohmeter.

GERTSCH CRB-1
Complex Ratio Bridge **$750.00**

These self-contained instruments provide the means to measure comples ratios of transformers, synchros, resolvers, networks, etc. Measures phase angles as small as .001°. Six place resolution. 30 to 400 Hz, 2.5F or 200 V max.

GULTON INDUSTRY 102-1
Voltage Control Assembly **$39.00**

Unit to be used in Microwave Switching Systems. Inquire for Specifications.

HARRISON 810B
Low Voltage Power Supply **$285.00**

0 to 60 Volts @ 7.5 Amps; Regulation 0.02%.

HARRISON LABS 814-A
Regulated Power Supply **$245.00**

Output: 0 to 36 V @ 0 to 25 Amps.; Load Regulation: Less than 0.03%. Line Regulation: Less than 0.03%. Ripple & Noise: Less than 1 mV. Input: 115 V @ 60 Hz.

ELECTRONIC INSTRUMENTS

Harrison Lab 6201A

HARRISON LABS 620I A
Power Supply **$125.00**
Output: 0 to 20 V at 1½ Amps; Load Reg.: .01%; Line Reg.: .01%; Ripple and Noise: .2 mV RMS.

HARRISON 6224B
Power Supply **$245.00**
0 to 24 volts; 0 to 3 Amps.

HARRISON LABS 6242-A
Power Supply **$179.00**
Output: 0 to 32 V @ 2 Amps or 0 to 64 V @ 1 Amp. Regulation: Better than 0.03%. Ripple & Noise: Less than 200 mV. Input: 115 V @ 60 Hz.

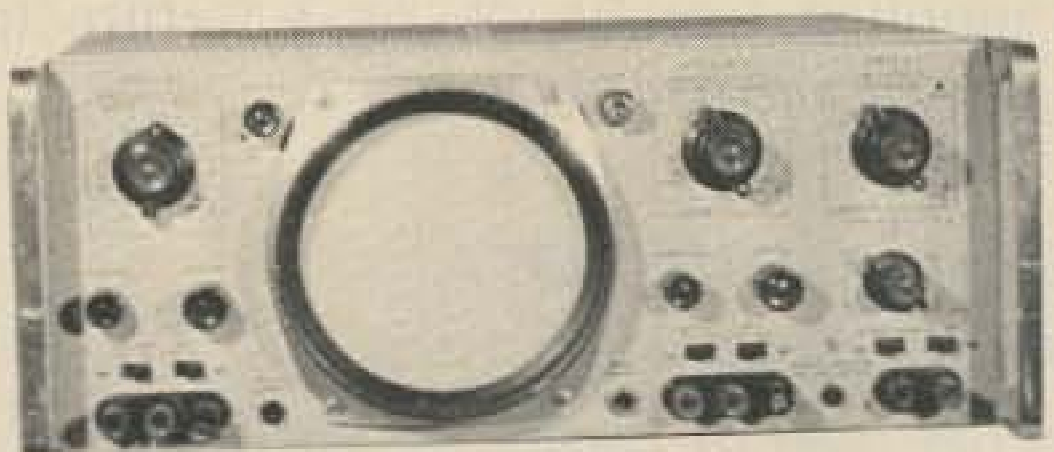
HASTINGS B-22
Precision Air Meter **$159.00**

HEWLETT PACKARD 120AR
Oscilloscope **$295.00**
DC to 200 kHz, Dual Trace, Sensitivity: 10 mV/cm to 10 V/cm in 4 ranges; Sweep Range: 5 usec to 200 ms/cm; Differential Input: Auto. sync. Ract Mount. Mod. C55.

HEWLETT PACKARD 122A
Oscilloscope **$385.00**
Vertical Bandwidth and Sensitivity: DC to 200 kHz, 10 mV to 10 V/cm; Range of Timebase: 5 usec to 200 ms/cm plus X5 Magnifier; Dual Trace Version of 120A.

HEWLETT PACKARD 130A
Oscilloscope **$345.00**
Vertical Bandwidth and Sensitivity: 1 mV-20 V/cm DC-300 kHz; Timebase Sweep Time In cm/sec or cm/div: 1 sec-5 sec, also DC-300 kHz from External Sweep Signal; High Gain Unit. 5" CRT.

HEWLETT PACKARD 130 BR
Rack Mount Oscilloscope **$189.00**
DC to 300 kHz, 1 mV to 125 V/cm: 0.2 usec to 12.5 sec/cm plus X5 Magnifier: X-Y Scope Feature, 5" CRT.



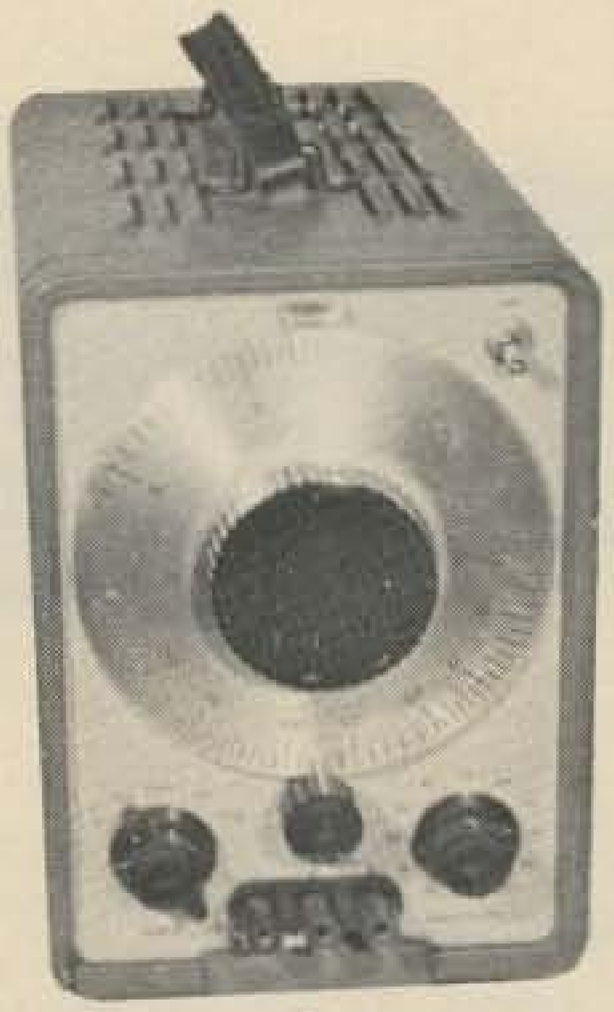
130C

HEWLETT PACKARD 130C
Oscilloscope **$425.00**
DC to 500 kHz, 200 uV to 125 V/cm: 1 usec to 5 sec/cm plus X5 Magnifier: X-Y Scope Features 5" CRT.

HEWLETT PACKARD 140A
Oscilloscope **$359.00**
Requires 1400 Series Plug-In: 5" CRT, Mainframe.

HEWLETT PACKARD 141A
Oscilloscope **$695.00**
Storage Oscilloscope, Variable Persistance 5" CRT. Requires 1400 Series Plug-Ins.

HEWLETT PACKARD 200AB
Audio Oscillator **$125.00**
20 Hz to 40 kHz in 4 bands. 1 Watt output (24.5 volts) into 75 Ohms.



200CD

HEWLETT PACKARD 200 CDR
Wide Range Oscillator **$165.00**
Same as above in Rack Mount Version.

ELECTRONIC INSTRUMENTS

HEWLETT PACKARD 200 CR
Audio Oscillator **$99.00**

Output: 20 Hz to 200 kHz, 10 volts of output.

HEWLETT PACKARD 201 B
Audio Oscillator **$115.00**

Output: 20 Hz to 20 kHz @ 3 Watts into 600 Ohms.

204B

HEWLETT PACKARD 204B
Test Oscillator **$195.00**

Frequency range: 5 Hz to 560 Hz in 5 ranges; Dial accuracy: ±3% of setting. Frequency response: ±3%, 600Ω. Output: 10 mW into 600Ω; 5 V rms open circuit. Distortion: Less than 1%. Noise: Less than 0.05% mat output. Battery operated.

HEWLETT PACKARD 205-AG
Oscillator **$195.00**

20 Hz to 20 kHz ranges. 5W output into 50, 200, 600 or 5000. Built-in attenuators, input/output meters.

HEWLETT PACKARD 211A
Square Wave Generator **$95.00**

Range: 1 Hz to 1 MHz; Output: -3.5 V p-p across 75 Ohms. -7 V p-p across 600 Ohms.

HEWLETT PACKARD 212A
Pulse Generator **$125.00**

Pulse with continuously variable from 0.07 to 10 usec. Amplitude 50 V peak positive or negative into 50 Ohms load. 50 dB attenuator in 10 dB steps. Pulse rise and delay time 0.02 usec. Rep. Rate: 60 to 5000 cps, external sync to 5000 pps.

HEWLETT PACKARD 250B
R.X. Meter **$1595.00**

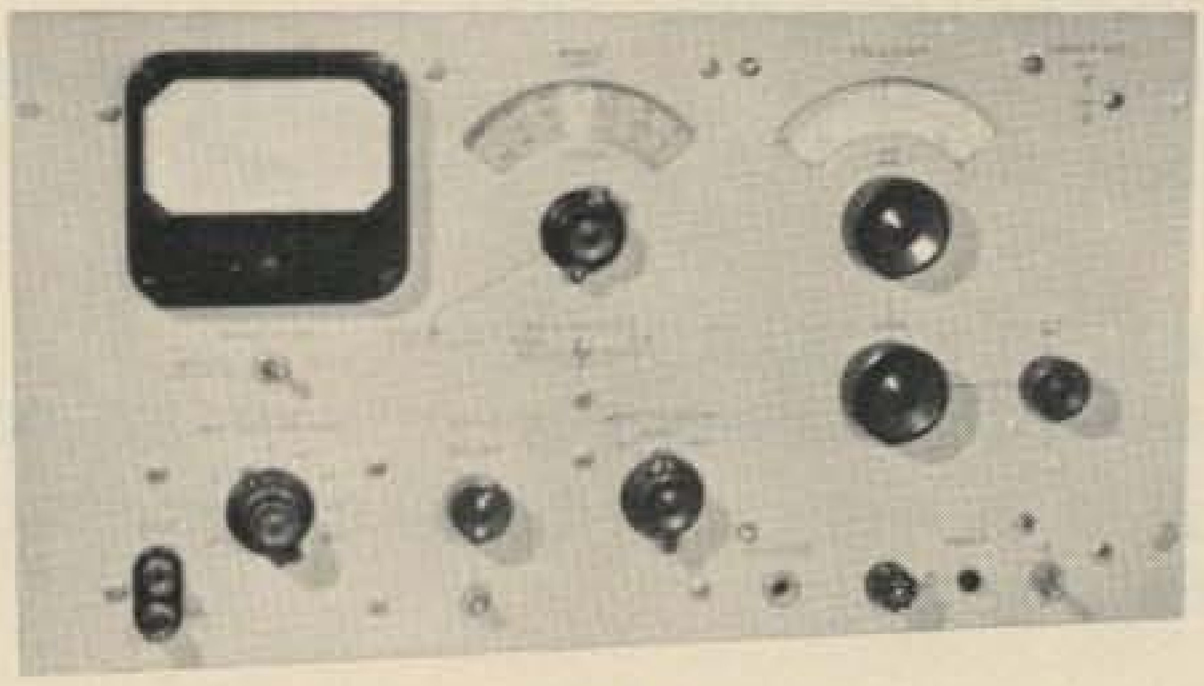
500 kHz to 250 MHz, 15Ω to 0.1 MΩ, 0 to 20 pF, 0.001 uH to 100 mH.

HEWLETT PACKARD J-281A
Adaptor **$25.00**

Frequency: 5.30 to 8.2 GHz; SWR 1.25.

HEWLETT PACKARD X-281A
Adaptor **$29.00**

Frequency: 8.2 to 12.4 GHz; SWR 1.25.



302A

HEWLETT PACKARD 302A
Wave Analyzer **$1175.00**

20 Hz to 50 kHz, voltage 30 uV to 300 V.

310A

HEWLETT PACKARD 310A
Wave Analyzer **$1495.00**

1 kHz to 1.5 MHz, bw 200 Hz, 1 kHz and 3 kHz, range 10 uV to 100 V.

ELECTRONIC INSTRUMENTS

HEWLETT PACKARD 330D
Distortion Analyzer **$225.00**

20 to 20,000 Hz frequency range. Measures distortion down to .1%. Voltmeter indicating meter has VU ballistic characteristics to meet FCC requirements for broadcasting. Also an AM detector: 500 kHz to 60 MHz.

HEWLETT PACKARD 350B
Attenuator Set **$69.00**

Range of 0-110 dB in 1 dB steps. Response: 0-150 kHz, 600 Ohm impedance levels. 5 Watts power.

HEWLETT PACKARD 350D
Attenuator Set **$115.00**

DC to 100 kHz, 110 dB in 1 dB steps.

HEWLETT PACKARD 355A
Precision Coax Attenuators **$75.00**

0-12 dB in 1 dB steps, DC to 500 MHz, 50 Ohms, BNC (F/F).

HEWLETT PACKARD 355B
Precision Coax Attenuator **$75.00**

0-120 dB in 10 dB steps, DC-500 MHz, 50 Ohms, BNC (F/F).

HEWLETT PACKARD 355C
Precision Coax Attenuator **$95.00**

0-12 dB in 1 dB steps, DC to 1 GHz, 50 Ohms, BNC (F/F).

355D

HEWLETT PACKARD 355D
Precision Coax Attenuator **$95.00**

Same as 355C but 0-120 dB in 10 dB steps.

HEWLETT PACKARD X-370 A
Fixed Attenuator **$40.00**

8.2 to 12.4 GHz. 3 dB.

HEWLETT PACKARD X-370B
Fixed Attenuator **$40.00**

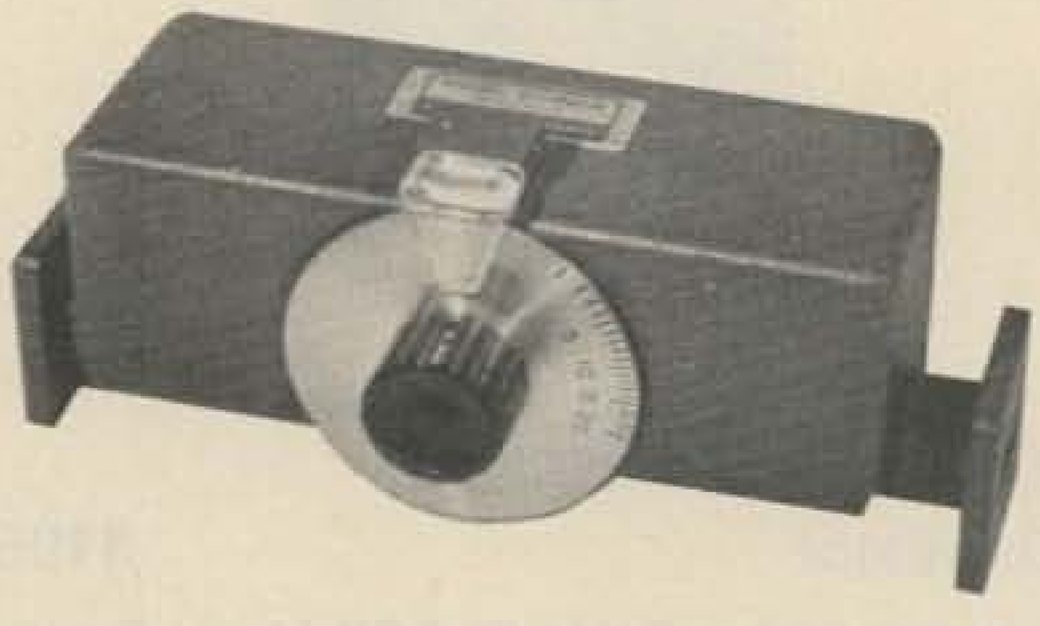
8.2 to 12.4 GHz. 6 dB.

HEWLETT PACKARD K-375A
Variable Attenuator **$195.00**

18.0 to 26.5 GHz. 0 to 20 dB.

HEWLETT PACKARD R-375A
Variable Attenuator **$130.00**

8.2 to 12.4 GHz. 0 to 20 dB.



X375A

HEWLETT PACKARD X-375A
Variable Attenuator **$165.00**

8.2 to 12.4 GHz. 0 to 25 dB.

HEWLETT PACKARD 400AB
AC Voltmeter **$85.00**

3 mV-300 V in 11 ranges. 20 Hz-1 MHz response. Similar physical design as HP400D.

HEWLETT PACKARD 400D
AC Voltmeter **$149.00**

Wide range AC measurements. High sensitivity. Also has direct-reading dBm. 10 Hz to 4 MHz. 0.0001 to 300 V in 12 ranges. 10 megohm input impedance. Accuracy 2%.

HEWLETT PACKARD 400E
AC Voltmeter **$280.00**

Voltage Range: 3 mV to 300 VRMS full scale; Freq. Range: 10 Hz to 10 MHz; Input Resistance: 10 MΩ; Accuracy: (40 Hz to 400 kHz), full scale ±1%.

ELECTRONIC INSTRUMENTS

400EL

HEWLETT PACKARD 400EL
AC Voltmeter **$280.00**

Volt Range: 1 mV to 300 V, Frequency Range: 10 Hz to 10 MHz, Accuracy 1%. Also has a Linear dB Scale -10 dB to +2 dB (10 dB between ranges).

400F

HEWLETT PACKARD 400F
AC Voltmeter **$280.00**

100 uV to 300 V to full scale in 14 ranges, 20 Hz to 4 Hz with 4MΩ input impedance.

HEWLETT PACKARD 400-H
VTVM **$195.00**

AC 1 mV to 300 V; 10 Hz to 4 MHz.

HEWLETT PACKARD 400HR
Vacuum Tube Voltmeter **$175.00**

Rack Mount. Wide Range AC measurements 10 Hz to 4 MHz; 0.0001 to 300 V in 12 ranges, 10 megohm input impedance; accuracy 1%.

HEWLETT PACKARD 410B
Vacuum Tube Voltmeter **$125.00**

20 Hz to 700 MHz, 1 V dc/ac to 300 V ac or 1,000 V dc 0.2Ω to 500 MΩ.

HEWLETT PACKARD 411AR
RF Millivoltmeter **$285.00**

10 mV – 10 V rms full scale in 7 ranges. Frequency range 500 kHz – 1 GHz, accuracy ±3% of full scale.

HEWLETT PACKARD 412A
DC Meter **$285.00**

Measures volts (1 mV -100 V), Amps (1 uA-1 A) and Ohms (1 Ohm-100 Megohm).

HEWLETT PACKARD 413AR
DC Null Voltmeter **$79.00**

Zero centered ranges of 1 mV-1000 volts. Input resistance (10-200 megohm). Accuracy of 2%.

HEWLETT PACKARD 415E
VSWR Meter **$385.00**

Range 70 dB, acc ±0.05 dB/10 dB step, sens 0.15 u VRMS f.s.

HEWLETT PACKARD 420A
Crystal Mount Detector **$45.00**

0.01 to 12.4 GHz, N(M)/BNC(F).

HEWLETT PACKARD X-421A
Crystal Detector **$59.00**

Frequency: 8.2 to 12.4 GHz.

ELECTRONIC INSTRUMENTS

HEWLETT PACKARD 423A
Crystal Detector **$95.00**
0.01 GHa to 12.4 GHz, low-level sens >0.4 mV/uW.

HEWLETT PACKARD 425A
DC Microvolt-Ammeter **$345.00**
11 voltage ranges from ±10 uV to 1 V. 18 current ranges from ±10 pA to 3 mA. DC amplifier feature with 10 dB gain, 0-1 V output.

HEWLETT PACKARD 425AR
DC Microvolt Ampmeter **$299.00**
Positive and Negative voltage from 10 uV-1 V in 11 ranges. Positive and Negative current from 10 pA-3 mA in 18 ranges ±3% of end scale. Also can be used as a DC amplifier with 100 dB max gain, 0-1 V output.

HEWLETT PACKARD 431B
Power Meter (H34) **$275.00**
Solid State unit with 1 uW to 10 mW ranges, 10 MHz to 40 GHz with appropriate thermistor mounts.

HEWLETT PACKARD H01-431B
Power Meter **$125.00**
Same as HP 431B except above unit has 5 inputs for thermistors.

HEWLETT PACKARD 444A
Crystal Detector **$69.00**
2.6 GHz to 18.0 GHz.

HEWLETT PACKARD 456A
AC Current Probe **$125.00**
Sen: 1 mV/mA at 1 kHz. Frequency Response: 25 Hz to 20 MHz. Can be used with conventional voltmeters/oscilloscopes.

HEWLETT PACKARD 457A
AC/DC Converter **$79.00**

HEWLETT PACKARD 477-B
Thermistors Mount **$45.00**
200 Ohms negative 10 MHz to 10 GHz. To be used with 430-C Power Meter.

HEWLETT PACKARD X-485B
Detector Mount **$99.00**
Frequency: 8.2 to 12.4 GHz.

HEWLETT PACKARD P-486A
Thermistor Mount **$119.00**
Frequency: 12.4 to 18.0 GHz.

HEWLETT PACKARD X-486A
Thermistor Mount **$139.00**
Frequency: 8.2 to 12.4 GHz.

HEWLETT PACKARD H-487B
Thermistor Mount **$59.00**
Frequency: 7.05 to 10.0 GHz.

HEWLETT PACKARD P-487B
Thermistor Mount **$110.00**
Frequency: 12.4 to 18.0 GHz.

HEWLETT PACKARD R-487B
Thermistor Mount **$99.00**
Frequency: 26.5 to 40.0 GHz.

HEWLETT PACKARD X-487B
Thermistor Mount **$110.00**
Frequency: 8.2 to 12.4 GHz.

HEWLETT PACKARD K-487C
Thermistor Mount **$110.00**
Frequency: 18.0 to 26.5 GHz.

HEWLETT PACKARD 521C
Electronic Counter **$89.00**
Measures frequency, speed. Frequency Range: 1 cps to 120 kHz. Direct reading, Accuracy within ±1 count ±.01%, 5 place registration.

HEWLETT PACKARD 523B
Counter **$195.00**
Frequency Range: 10 Hz to 1.1 MHz. 6 Digit Readout.

ELECTRONIC INSTRUMENTS

HEWLETT PACKARD 524C
Frequency Counter **$139.00**

Measures frequency (10 Hz to 10.1 MHz) and period (0 to 100 kHz) with basic unit. Plug-Ins extend range of unit to 510 MHz plus time interval and phase measurements. Timebase stability of $5/10^8$ per week. 8 Digit "Nixie" Readout.

HEWLETT PACKARD 525A
Frequency Converter **$39.00**

Plug-In for 524 Series Counters (10 to 100 MHz).

HEWLETT PACKARD 525B
Frequency Converter **$49.00**

Plug-In for the 524 Series Counters (100 to 220 MHz).

HEWLETT PACKARD 525-C
Frequency Convertor **$125.00**

100 to 500 MHz. To be used in a 524 Counter.

HEWLETT PACKARD 526A
Video Amplifier **$49.00**

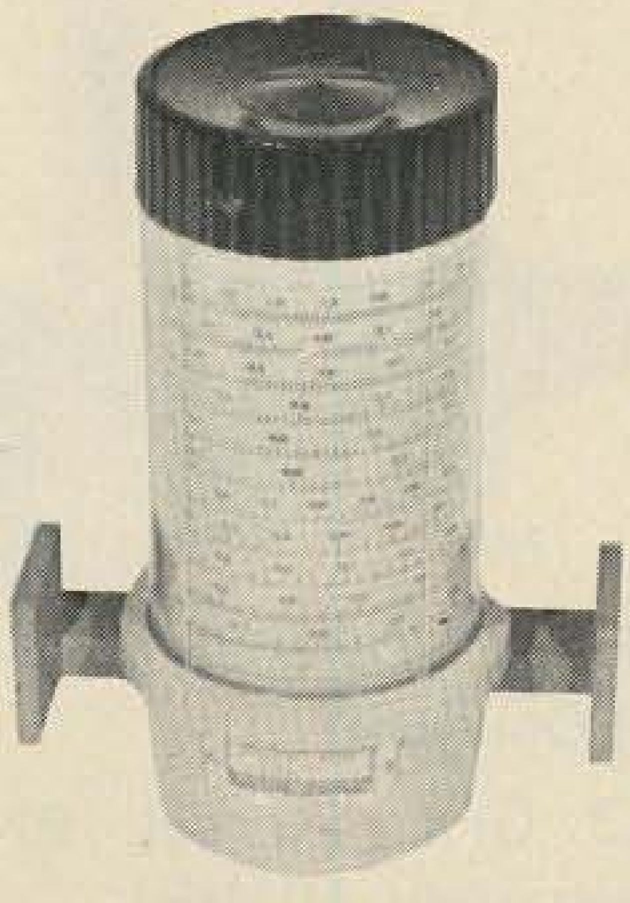
Plug-In for 524 Series Counters.

HEWLETT PACKARD 526B
Time Interval Unit **$59.00**

Plug-In for 524 Series Counters.

HEWLETT PACKARD 526D
Phase Unit **$49.00**

For use with 524 Series Counters. Measures 0 to 360° lead or lag, ±.1° Accurcy.



P532A

HEWLETT PACKARD P-532A
Frequency Meter **$350.00**

Frequency Range: 12 GHz to 18 GHz; Accuracy: 0.068%; Conn: WR62; Scale Division: 5 MHz.

HEWLETT PACKARD K-532A
Frequency Meter **$395.00**

Frequency: 18.0 to 26.5 GHz; Accuracy: 0.068%; Scale Division: 5 MHz.

HEWLETT PACKARD 540B
Transfer Oscillator **$395.00**

10 MHz to 12.4 GHz range of frequency measurements when used with counter covering 100-200 MHz.

HEWLETT PACKARD H25-562A
Digital Recorder **$329.00**

To Print columns 1 through 10 from a HP Counter "1" State Positive, No Storage.

HEWLETT PACKARD 606A
Signal Generator **$925.00**

50 kHz – 65 MHz in 6 bands ±1%. Output level adjustable 0.1 uV to 3 V into 50 Ohms. Built-in crystal calibrator, 400-1000 Hz modulation.

HEWLETT PACKARD 608B
Signal Generator **$475.00**

Frequency Range: 10-410 MHz in 5 bands. Emission: CW, AM, Pulse (external). Output Voltage: .1 V to .8 V Calibrated. Output Impedance: 50 Ohms: Modulation: 400, 1000 Hz internal (0-90%); Frequency Calibration: ±1 dB.

HEWLETT PACKARD 612A
Signal Generator **$995.00**

450 MHz to 1230 MHz output 0.1 uV to 0.5 V.

HEWLETT PACKARD 650-A
Oscillator **$245.00**

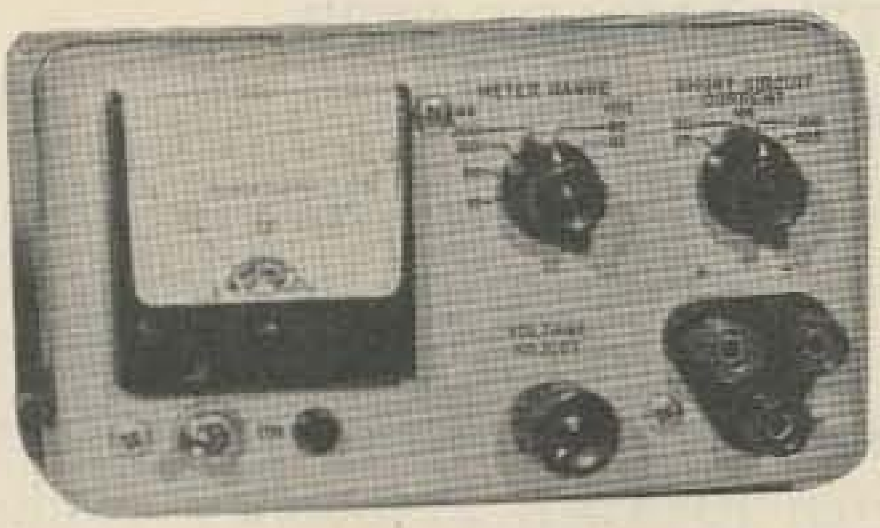
Frequency: 10 Hz to 10 MHz; Output: 15 mW or 3 V into 600 Ohms.

687C

HEWLETT PACKARD 687C
Sweep Generator **$495.00**
Frequency: 12.4 to 18 GHz. VSWR: 3.0. Similar to 686C.

HEWLETT PACKARD 710
Power Supply **$125.00**
Output: 180 to 360 V dc @ 75 mA, 6.3 V Filament.

HEWLETT PACKARD 712B
Power Supply **$99.00**
0-500 V dc at 100 mA, 50 mV regulation, 300 V dc bias at 50 mA, 0-150 V dc bias at 5 mA, 6.3 V ac at 10 Amps. Meters for both voltage and current.



721A

HEWLETT PACKARD 721A
Power Supply **$99.00**
Voltage: 0 to 10, 0 to 30, 0 to 300 V.

HEWLETT PACKARD 724BR
Power Supply **$89.00**
Automatic solid state unit provides up to 48 hours standby operation for HP103AR 104AR or similar units.

HEWLETT PACKARD 739AR
Frequency Response Test Set **$299.00**
Provides 300 kHz to 10 MHz with provisions for external input below that range. Has a set level monitor whose accuracy and repeatability is ±5%.

HEWLETT PACKARD 741-A
AC/DC Differential Voltmeter **$995.00**
DC Standard: 0 to 1000 V in 4 ranges; Accuracy: ±0.001% of range. Differential Voltmeter: 4 ranges from 1 to 1000 V ac/dc, dc Accuracy: ±0.004% of range, dc to 100 kHz. DC Source: 0 to 1000 V with currents up to 20 mA.

HEWLETT PACKARD X-750D
Directional Coupler **$59.00**
8.2 to 12.4 GHz. 20 dB.

HEWLETT PACKARD R-752D
Directional Coupler **$149.00**
26.5 to 40.0 GHz. 20 dB.

HEWLETT PACKARD X-752C
Directional Coupler **$125.00**
8.2 to 12.4 GHz. 10 dB.

HEWLETT PACKARD X-752D
Directional Coupler **$125.00**
8.2 to 12.4 GHz. 20 dB.

HEWLETT PACKARD 766D
Dual Directional Coupler **$75.00**
940 – 1975 MHz, 20 dB, N(M/F) with N(F) secondary.

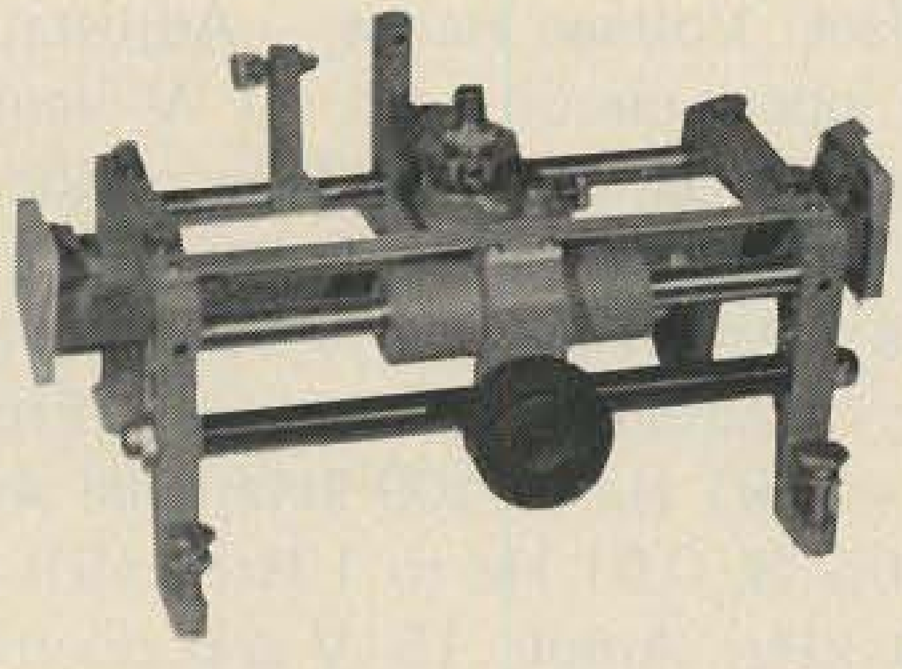
788C

HEWLETT PACKARD 788C
Directional Detector **$195.00**
3.7 to 8.3 GHz, 20 dB, BNC(F) crystal detector secondary, N(M/F).

ELECTRONIC INSTRUMENTS

HEWLETT PACKARD 767D
Dual Directional Coupler **$75.00**
1.9 to 4.0 GHz, 20 dB, N(M/F), with N(F) secondary.

HEWLETT PACKARD 802B
Power Supply **$325.00**
Twin Outputs. Output: 0 to 36 V @ 0 to 1½ Amps. Regulation: Less than 0.01%. Ripple and Noise: 200 uV. Input: 115 V, 60 Hz.


809B

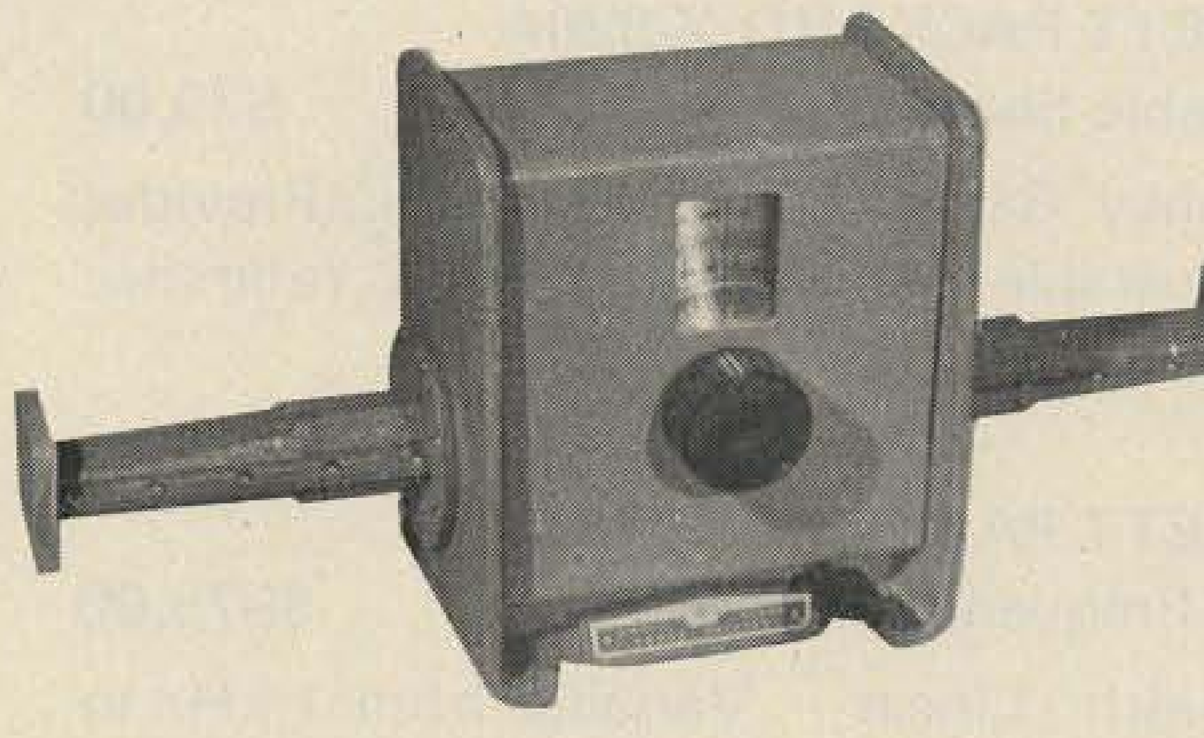
HEWLETT PACKARD 809B
Universal Carriage **$100.00**
To be used with slotted sections from 3 GC to 18 GC.

HEWLETT PACKARD X810-B
Slotted Section **$85.00**
Mounts in 809B Hewlett Packard Carriage.

HEWLETT PACKARD 855B
Power Supply **$119.00**
0.1% Regulation 0 to 18 V @ 0 to 1.5 Amps; Constant current and voltage.

HEWLETT PACKARD X-870A
Slide Screw Tuner **$169.00**
Frequency: 8.2 to 12.4 GHz.

HEWLETT PACKARD X-880A
E H Tuner **$75.00**
Frequency: 8.2 to 12.4 GHz.


885A

HEWLETT PACKARD X-885A
Phase Shifter **$449.00**
Frequency Range: 8.2 to 12.4 GHz. Phase Range: -360 to + 360 Electrical Degrees.


G-910A

HEWLETT PACKARD G-910A
Waveguide Termination **$25.00**
Frequency: 3.95 to 5.85 GHz.

HEWLETT PACKARD P-932A
Harmonic Mixer **$260.00**
Frequency Range: 12.4 to 18 GHz. To be used with 540A or 540B, mixing generated harmonics with the unknown waveguide frequency.

HEWLETT PACKARD X-910A
Termination **$25.00**
Frequency: 8.2 to 12.4 GHz.

HEWLETT PACKARD X-910B
Termination **$25.00**
Frequency: 8.2 to 12.4 GHz.

ELECTRONIC INSTRUMENTS

HEWLETT PACKARD X-920A
Adjustable Short $79.00

Frequency Range: 8.2 to 12.4 GHz. Provides an adjustable short circuit as a reference point.

HEWLETT PACKARD 1416A
Swept Frequency Indicator $575.00

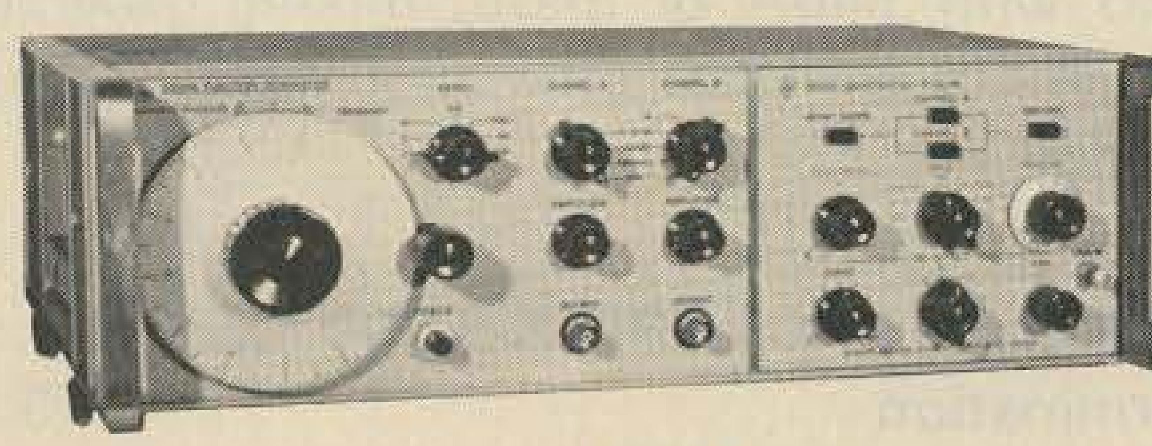
Bandwidth: Linear – Variable from 1 kHz to 30 kHz; Logarithmic – Varies with input; Deflection Factor (Sensitivity): Linear – 50 uV/div to 10 mV/div; Logarithmic – 0.5 dB/div to 10 dB/div; Recorder Outputs: Vert – Gain adjustable from 0 to approx 200 mV/div; Horiz – gain adjustable from 0 to approx 100 mV/div; Inputs: Vert – Input impedance 75 kΩ; Horiz-Amplitude between 7.5 V and 20 V.

HEWLETT PACKARD 2401A
Digital Voltmeter $150.00

Voltage Range: 0.1 V to 1000 V dc fs in 4 ranges, Input Impedance: 10 meg Ω on 10, 100, 1000 V ranges, 1 Meg Ω on 1 V range, 100 kΩ on 0.1 V range: < pF on all ranges; Absolute Accuracy: 0.01% of reading ±0.005% fs ±1 digit; Frequency Range: 5 Hz to 300 kHz; Display: 6 digit in line digital-tube readout; Noise rejection: > 140 dB.

HEWLETT PACKARD 2410B
AC Ohm Converter $500.00

Set with 2401 or 2402 DVMS; 0.1 to 750 V ac rms; 50 Hz to 100 kHz; ±0.05%; Resistance readings to 10 Megohms ±0.015%.



3300A

HEWLETT PACKARD 3300A
Function Generator $425.00

0.01 Hz to 100 kHz, output 15 V p-p into 600Ω, waveforms sine, square, and triangle.

HEWLETT PACKARD 3302A
Trigger/Phase Lock Plug-In $175.00

Trigger Requirements: Single cycle-manual or external, DC coupled; Requires 0.5 V external trigger. Multiple cycle-manual or external start/stop, DC coupled; requires 0.5 V to start, 0 V to stop. Phase lock – 10 Hz to 100 kHz, DC couples; Phase Dial Accuracy: ±10° from 10 Hz to 10 kHz; ±20° from 10 kHz to 100 kHz on X 10 range. Used in Hewlett Packard 3300 Generator.

HEWLETT PACKARD 3304A
Plug-In $150.00

DC Offset: Voltage Range – Adjustable 0 to ±16 V open circuit and ±1 V venier; DC Stability – ±50 mV over 24 hr period; Offset Square Wave: Output Polarity – Positive or negative; Amplitude – >15 V p-p open circuit; Sawtooth Waveform: Frequency Range – 0.01 Hz to 100 kHz; Dial Accuracy – <±10% fs, 0.01 Hz to 1 Hz; <±5% fs, 1 Hz to 100 kHz; Ampl: 15 V p-p open circuit; Freq. Response: <2%, 0.01 Hz to 10 kHz; <5%, 10 kHz to 100 kHz; Sweep Width: 0 to at least 1 decade on any one range.

HEWLETT PACKARD 3430A
Digital Voltmeter $179.00

3½ Digit; 100 mV to 1000 Volts in 5 Ranges. Accuracy ±.1%.

HEWLETT PACKARD 3439A
Digital Voltmeter $400.00

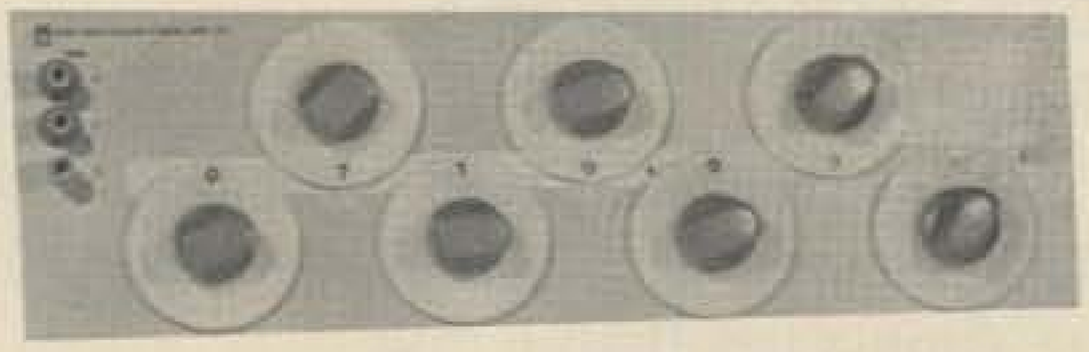
Voltage Range: up to ±999.9 V ac/dc; Accuracy: ±.05%. Fixed Sample Rate: 2-3/sec. 4 digit readout in line nixie tubes.

HEWLETT PACKARD 3440A
Digital Voltmeter $399.00

Four digit Nixie readout with DC voltage range from 100 mV to 1000 V ±.05% accuracy.

HEWLETT PACKARD 3441A
Digital Voltmeter Plug-In $25.00

DC Range Selector: Ranges 9.999 V, 99.99 V, or 999.9 V; Accuracy: ±0.05% of reading; ±1



3441 and 3439A

digit; Used with 3439A/3440A DVM 4 digit presentation.

HEWLETT PACKARD 3442A
Digital Voltmeter Plug-In **$99.00**

Automatic Range Selector maintains the "3441A" manual range and adds automatic and remote range features; Accuracy: ±0.05% of reading ±1 digit; Used with "3439A"/"3440A" DVM 4 digit presentation.

HEWLETT PACKARD 3445
Auto Ranging Plug-In **$299.00**

Voltage Range AC and DC, 9.999, 99.99, 999.9 V, Voltage Accuracy; AC - 2 counts; Voltage Accuracy: DC 0.05% of reading 1 digit.

HEWLETT PACKARD 3460B
Digital Voltmeter **$1695.00**

1 V f.s. to 1 kV, acc ±0.004%, range 1 V dc f.s. to 1 KV dc, acc ± 0.004%, 5 digit display.

HEWLETT PACKARD 5244L
Electronic Counter **$675.00**

Frequency Range: 0 Hz to 50 MHz. Seven Digits, BCD output, Timebase: $2/10^7$/month. Gate Times: 1 s-10s. Measures: Frequency, Period, Multiple Period Average, Ratio, Multiple Ratio.

5253 B

HEWLETT PACKARD 5253B
Frequency Plug-In

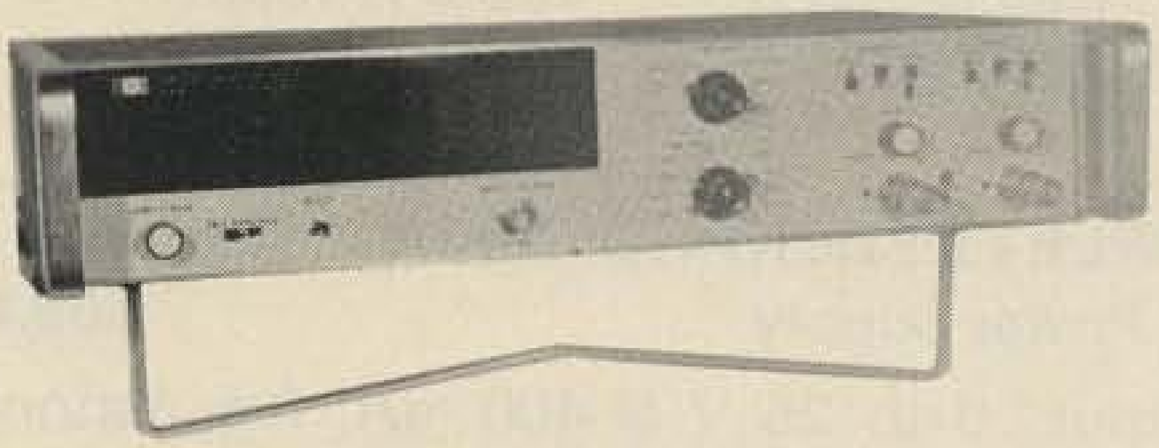
Increases frequency range of 5245L to 500 MHz.

HEWLETT PACKARD 5300A
Modular Counter System **$625.00**

Depending on "Plug-On" module used in conjunction with "5300A"; Frequency: 10 MHz to 525 MHz; Time Interval Resolution 100 ns; Auto-ranging; Time Interval Holdoff; 6 Digit LED Display; AC or Batter Operation; Weight: 3½ lbs. Supplied with 5302A Plug-In DC to 50 MHz.

HEWLETT PACKARD 5325B
Universal Counter **$675.00**

Range: DC coupled – 0 to 20 MHz, AC coupled – 10 Hz to 20 MHz; Sensitivity: 0.1 VRMS sine wave, 0.3 Vp-p pulse, 50 nsec min pulse width; Impedance: 1MΩ shunted by 30 pF; Overload Level: 1.5 VRMS X atten settings.



5326A

HEWLETT PACKARD 5326A
Timer/Counter **$895.00**

Frequency: 0 to 50 MHz (DC coupled); Period Average, Totalize, Ratio Scaling and Time Interval Averaging. 7 Digits Display; Display Storage, Internal 10 MHz clock.

5360A

HEWLETT PACKARD 5360A
Computing Counter **$5850.00**

Supplied with: 5379A, 5365A, 5375A. Accuracy: 1 part in 10 per usec; Input Channel B: Range: 1 kHz to 320 MHz, AC coupled; Impedance: 50Ω nominal, VSWR, 1.3 or less; Maximum Sensitivity – 20 mVRMS; Level Control – Continuously adjustable; Input Channel A: Range: 0.01 Hz to 10 MHz, DC coupled, 100 Hz to 10 MHz, AC coupled; Impedance: 1 MegΩ shunted by 20 pF; Sensitivity: 100 mVRMS sine wave; Level Control: Adjustable over ±3 V dc multiplied by Sensitivity Multiplier position; Display: 12 digits, in-line, Nixie digital readout; Timebase: Crystal Frequency (internal) 5MHz; Stability Aging Rate: 5 parts in 10^{10} per 24 hours after warm-up; Load Stability: <± 2 parts in 10^{11} for open, short, 50Ω resistive, 50Ω inductive, 50Ω capacitive.

HEWLETT PACKARD 6203B
DC Power Supply **$125.00**

Output: 0 to 7.5 V @ 0 to 3 Amps. Regulation: Better than 0.03%. Ripple and Noise: 200 uV. Input: 115 V; 48 to 440 Hz.

HEWLETT PACKARD 6213A
Power Supply **$69.00**

Output: 0 to 10 V @ 1 Amp. Regulation: 4 mV. Ripple and Noise: 200 uV. Input: 115 V, 48 to 440 Hz.

HEWLETT PACKARD 6215A
DC Power Supply **$69.00**

Output: 0 to 25 V @ 400 mA; Regulation 4 mV; Ripple and Noise: 200 uV.

HEWLETT PACKARD 6253A
Power Supply **$325.00**

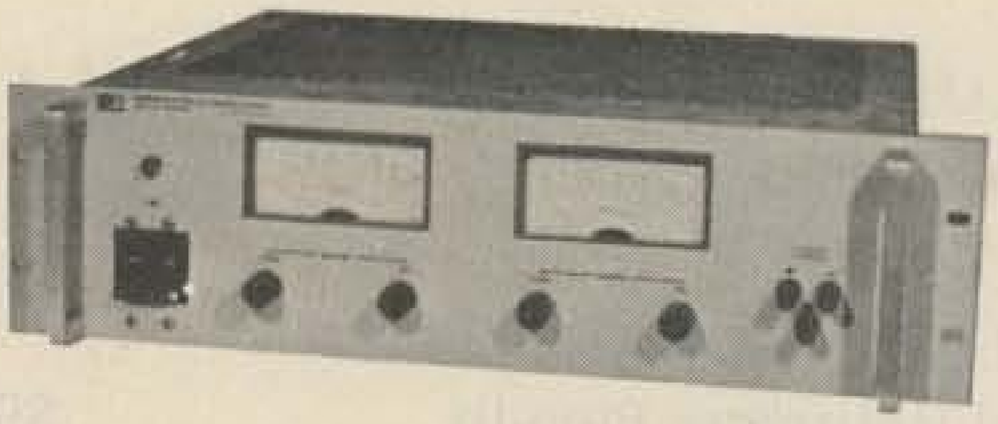
(No K Bar) Dual Output: 0 to 20 V at 3 Amps; Reg.: .01%. Ripple and Noise: 200 uV RMS. Remote programming. Metered.

HEWLETT PACKARD J09-6255A
Power Supply **$400.00**

Voltage Range: 0 to 40 V dc; Current Range 0 to 1.5 A; Load Regulation: 0.01% plus 2 mV (CV); 0.01% plus 250 uA (CC); Line Regulation: 0.01% plus 250 uA (CC), 0.01% plus 2 mV (CV); Ripple and Noise: 200 u VRMS/1 mV p-p (CV), 500 uA RMS (CC); Meter Accuracy: 3%.

HEWLETT PACKARD 6265A
Power Supply **$315.00**

(No K Bar) Output: 0 to 36 V at 3 Amps; Reg: .01% Metered with Voltage and Current Controls. Ripple less than 5 mV.



6274A

HEWLETT PACKARD 6274A
DC Power Supply **$459.00**

Output: 0 to 60 V @ 0 to 15 Amps. Regulation: 0.01%. Ripple and Noise: 200 uV. Input: 115 V 57 to 63 Hz (15 Amps).

HEWLETT PACKARD 6289A
Power Supply **$195.00**

Output: 0 to 40 V. 1½ Amps; Reg: .01%; Ripple and Noise: 1 mV p-p; Voltage and Current Controls Metered.

6384A

HEWLETT PACKARD 6384A
Power Supply **$150.00**

Output: 4-5.5 V at 8 Amps; Reg: 1 mV; Ripple and Noise: 5 mV p-p; Voltage and Current Controls Metered.

3474 A

ELECTRONIC INSTRUMENTS

HEWLETT PACKARD 34740A
Digital Multimeter **$599.00**

Supplied with: 34720, 34702A. AC & DC: ±1 V to ± 1 kV in 4 ranges; Overrange: 100% except 20% on 1 kV range; Input Impedance: 10 MΩ on ± 100 V and ± 100 kV, 11.1 MΩ on ± 1V and ±10V range; Frequency: 45 Hz to 100 kHz; Ohms ranges: 100Ω to 10 MΩ in 6 ranges; Current through unknown: 10 mA on 100Ω decreasing one decade for each range increase; Overload Protection: ±350 V Peak (250 RMS).

HEWLETT PACKARD 11519A
Adaptor **$35.00**

Tapered Section; Frequency: 18 to 26.5 GHz.

HEWLETT PACKARD 11520A
Adaptor **$35.00**

Tapered Section; Frequency: 26.5 to 40 GHz.

HEWLETT PACKARD 11521A
Mixer **$30.00**

Mixer for X-Band Waveguide. Frequency: 8.2 to 12.4 GHz.

HICKOK DP100
DC Plug-In **$89.00**

For DMS 3200; 0.1 mV to 1500 V; Accuracy 0.1%.

Hickok DP170

HICKOK DP170
Resistance Plug-In **$139.00**

For DMS 3200; 1 mohm to 1000 Megohm; Accuracy 0.1%.

HICKOK DP200
Capacitance Plug-In **$139.00**

For DMS 3200; 1 pF to 10 mF with accuracy of 0.1%.

HIPOTRONICS HDA3
Hipot Tester **$169.00**

Output Voltage: 0 to 3 KV-AC (Metered); Indicators: Arcing and Leakage.

Hipotronics HA5

HIPOTRONICS HDA5
AC Hipot Tester **$199.00**

Output Voltage: 0 to 3 KV-AC (Metered); Indicators: Arcing and Leakage.

HONEYWELL
Standard Conductance Bridge **$325.00**

Measurement Range: 10^{-3} to 10^{-15} mhos. Similar to the 1700 Bridge; Please write for complete specifications.

HONEYWELL 104WIG
Galvanometer **$89.00**

Null Detector Range: -4 to 0 to +4 Volts.

HONEYWELL 1622
Kelvin Resistance Bridge **$325.00**

Ranges: 0 to 0.00101, 0 to 0.0101, 0 to 0.101, 0 to 1.01, 0 to 10.1 Ohms; Limit of Error: 0.05%; Current Capacity up to 10 Amps; Built-in Galvanometer.

HONEYWELL 2732
Potentiometer **$139.00**

Range: 0 to 161 mV; Dial Reading: 0 to 11 mV; Multiplier: 10 thru 150 in steps of 10; Built-in Null Detector and Galvanometer.

HONEYWELL 2745
Rubicon Potentiometer **$159.00**

Range: 0 to 1.61 V in 3 Ranges; Accuracy: 0.25%; Built-in Null Detector and Galvanometer.

HONEYWELL 2779
Microvolt Potentiometer **$479.00**

Ranges: High – 0 to 2111.0 uV in steps of 0.1 uV; Low – (X0.1) o to 211.10 uV in steps of 0.01 uV.

ELECTRONIC INSTRUMENTS

HUGGINS LABS 146E
Low Noise TWT Amplifier $975.00
2 to 5 Gc, 1 Watt.

INDUSTRIAL INSTRUMENT DR1
Decade Box $55.00

INDUSTRIAL INSTRUMENT L-6B
Megohmeter $145.00
Range: 1 to 100 Megs (Meter Scale). Multiplier: 1, 10, 100, 1000 Meg Ohms; Test Voltage: 100 to 500 Volts Variable.

INDUSTRIAL INSTRUMENT RN-3
Wheatstone Bridge $139.00
Range: .1/1.011 Meg Ohms; 5 Dial.

IRCON DATA SYSTEM "T"
Digital Temp-Meter $129.00
Type T Thermocouple with Nixie Readout.

JENNINGS W15-40D229
Precision Air Capacitor $35.00

JERROLD AV50
RF Attenuator $25.00
Attenuation: 0 to 62.5 in .4 dB Steps; Frequency Range: 0 to 500 MHz; Useful to 800 MHz.

JERRODL 900-C
RF Sweep Generator $895.00
500 kHz to 1200 MHz, sweep width 10 kHz to >40%, output >0.25 VRMS.

JERROLD LA-5100
Precision Log Amplifier $325.00
80 dB dynamic operating range with ±1.5 dB flatness. Four calibrated switchable ranges of 0 to 20 dB linear and 0 to 40, 60, 80 dB logarithmic log expanded control. X-Y Recorder Output.

KEY ELECTRIC 40-0
Attenuator $25.00
Attenuation: 0 to 119 dB in 1 dB Steps; Frequency: DC to .5 GHz.

KAY ELECTRIC 154C/PM7650B
Marka Generator/Plug-In $95.00
Frequency: 50 kHz to 110 MHz; Output: 1 Volt into 50 Ohms, Metered. Supplied with Marka Plug-In.

KEITHLEY 149
Milli-Micro Voltmeter $349.00
Range: 0.1 uV to 100 mV in 13 Overlapping Ranges; Accuracy: 3% of Full Scale; Noise: Less than 0.6 nanovolts rms; Drift: Less than 0.01 uV/fr.

Keithley 150A

KEITHLEY 150-A
Microvolt-Ammeter $275.00
28 DC voltage and current ranges 1 mV to 1 V, 10^{-3} to 10^{-10} A. 2% accuracy with high input resistance.

KEITHLEY 150-B
Microvolt-Ammeter $650.00
0.3 mV full scale to 1 V; 300 picoampers full scale to 1 milliampere; Similar to 150-A except the 150-B is transistorized. B unit can be operated from AC line or internal battery pack that is rechargeable.

KEITHLEY 412
Micro-Micro Ammeter $245.00
Range: 10^{-13} to 10^{-7} on a single log scale. Positive currents only. Accuracy: ±.2 decade with source voltage greater than 1 V.

KEITHLEY 502
Milliohmeter $159.00
13 full scale ranges from 0.001 Ohms to 1000 Ohms; ±3% full scale accuracy.

ELECTRONIC INSTRUMENTS

KEITHLEY 503
Milliohmeter **$99.00**
0.0001Ω to 1,000Ω, acc. 1% (meter), 0.5% (output terminals).

KEITHLEY 660
DC Differential Voltmeter **$199.00**
Range: 0.1 to 500 V; 5 dial readout 0.02% error for a year.

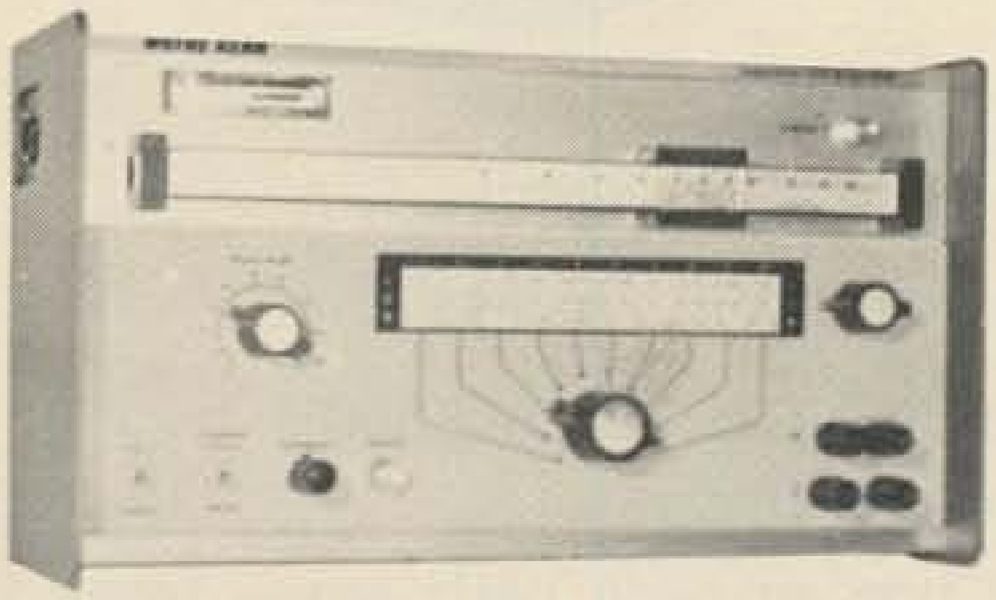
KEPCO KS-36-15M
Regulated DC Power Supply **$385.00**
Output: 0 to 36 Volts, 0 to 15 Amps. Regulation: 0.01% or Better. Noise and Ripple: Less than 1 mV. Metered, Voltage and Current Controlled.

KEPCO PRM2 x 15-10-10
New Power Supply **$99.00**
Output: (Dual) 15 V @ 0 to 10 Amps; Load Regulation: 0.7%; Ripple: 0.3 Volts rms.

KEPCO P.R.38-5M
Power Supply **$199.00**
Output: 0 to 19 – 38 V @ 0 to 5 Amps; Ripple: 1 mV or less; Metered, 19" Rack Type Supply.

KEPCO SC-3672-1M
Power Supply **$139.00**
Output: 36 to 72 V @ 1 Amp. Ripple: 1 mV or less. Metered, 19" Rack Type Supply.

KEPCO SM-36-5M
Power Supply **$199.00**
Output: 0 to 36 V @ 5 Amps; Regulation: Less than 0.05%; Ripple: Less than 1 mV; Metered, 19" Rack Type Supply.



Kerr B500

WAYNE KERR B500
Logrithmic LCR Bridge **$299.00**
Overall Ranges: L-10 nH to 16 kH, C-10 fF to 16 mF, R-100 uOhm to 160 MOhms. Test Frequency: 1 kHz (Internal). Overall Accuracy: 1%.

KINTEL 204A
Galvanometer **$85.00**
Input: 10 uV to 10 V in 7 Ranges. .001 uA to 1 mA in 7 Ranges. Input: 10,000 Ohms. Output: ± 1 V Full Scale @ 1 mA max.

KMC 9613
X-Band Adaptor **$39.00**
X-Band to OSM Male.

KMC 9615
X-Band Adaptor **$29.00**
X-Band Choked to OSM Male.

KMC 9619
KU-Band Adaptor **$49.00**
KU-Band Choked to OSM Male.

KROHN-HITE DCA-10R
Wide Band Amplifier **$179.00**
Rack Mount; DC to 1 MHz with 10 W output ±1 dB; Harmonic distortion less than 0.1% and gain stability ±0.05 dB.

KROHN-HITE DCA-50 R
Power Supply **$550.00**
50 VA continuous output, 100 VA instantaneous peak, DC to 500 kHz, Maximum input 13 V with gain of 10. Rack Mount.

KRONE-HITE 430-AB
Oscillator **$145.00**
Range: 4.6 Hz to 520 kHz; Output: 5 mW; Open Circuit Voltage: 10 V into 1000 Ohms; Distortion 1%.

KROHM-HITE 420A
Low Frequency Oscillator **$119.00**
Output: .35 cps to 52Kc, 100 mW; Distortion: 1%; Accuracy: 2%.

ELECTRONIC INSTRUMENTS

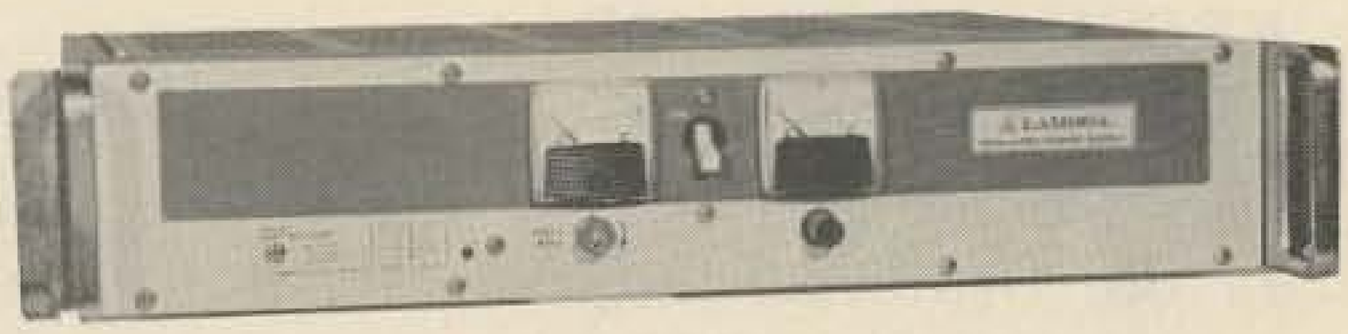
KROHN-HITE 3202
Electronic Filter **$499.00**
20 Hz to 2 MHz, atten slope 24 dB/oct (each chan), max atten 80 dB, selectable bandpass, band-reject, low-pass, high-pass modes.

LAMBDA 28
Power Supply **$29.00**
200 to 325 V dc at 100 mA.

LAMBDA 29
Power Supply **$29.00**
100 to 200 V dc at 100 mA; 1% regulation.

LAMBDA 32
Power Supply **$59.00**
Output: 200 to 325 V @ 300 mA.

LAMBDA LMD5
Power Supply **$79.00**
Output: 5 V, ±5% @ 12.5 Amps; Regulation: 0.05%; Ripple: 1 mV rms.



Lambda LMF 24 OVM

LAMBDA LMF24-OVM
Regulated Power Supply **$369.00**
DC Range 0 to 40 Volts, 0 to 20 Amps.

LAMBDA LM-G24-039
Power Supply **$179.00**
Input: 105 to 132 V ac @ 55 to 65 Hz. Output: 24 V dc, 25 Amps.

LAMBDA LM220
Power Supply **$59.00**
30 to 60 V dc, 0.7 Amps.

LAMBDA LM-225
Power Supply **$79.00**
Output: 0 to 7 V @ 4 Amps.

LAMBDA LM257
Power Supply **$59.00**
0 to 14 V dc, 250 mA.

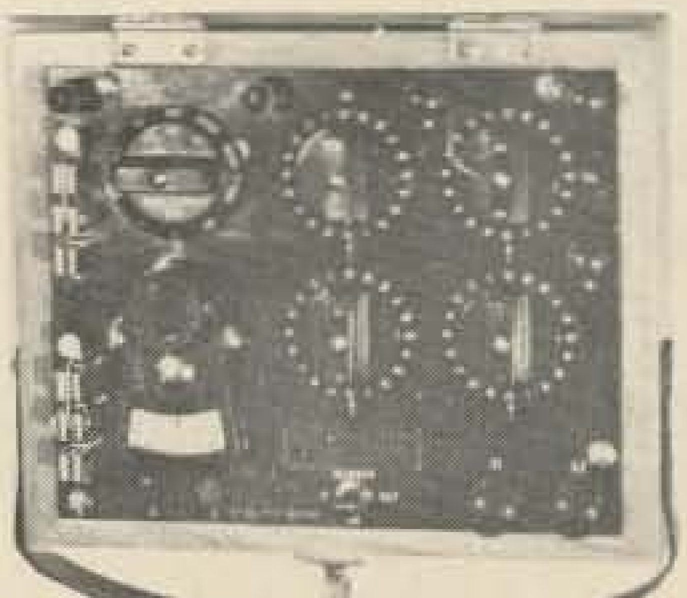
LAMBDA LK362-FM
Power Supply **$349.00**
Input: 188 to 238 V @ 57 to 63 Hz. Output: 0 to 60 V dc, 25 Amps.

LEEDS & NORTHROP
Resistance Primary Standards **$35.00**
Type 4020 thru 4030 Series. 100, 1000 Ohms.

LEEDS & NORTHROP
Wooden Case Kelvin Bridge **$150.00**
Model 4285. Range: 0.0001 Ohms to 26.6 Ohms. Accuracy: Better than .5%. Unit has built-in Galvanometer and Battery Supply.

LEEDS & NORTHROP 4286
Kelvin Bridge **$139.00**
0.0001 to 11 Ohms in 5 ranges with ±1% Accuracy.

LEEDS & NORTHROP 4395
Precision Voltage Divider **$75.00**
1 ppm Resolution. Three ratio dials adjustable in fixed steps of 9x10,000, 9x1000, and 9x100.



Leed & Northrop

LEEDS & NORTHROP 5300
Wheatstone Bridge **$135.00**
Fault finding type with range from 1Ω to 9.999MΩ and accuracy of -0.15% -0.01Ω.

ELECTRONIC INSTRUMENTS

LEEDS & NORTHROP 7591
Divider **$65.00**

Fixed Steps of 3, 7.5, 15, 30, 75, 150, 300 and 750 volts.

LEEDS & NORTHROP 8657C
Millivolt Potentiometer **$99.00**

0 to 64 mV in two ranges. Thermocouple junction compensating feature.

LEEDS & NORTHROP 8658
Temperature Potentiometer **$125.00**

Range of 0 to 300° C. Calibrated for use with cc thermocouples. Accuracy ±0.5%.

LEEDS & NORTHROP 8686
Millivolt Potentiometer **$225.00**

Ranges: -10.100 to +100.100 mV, +1010.000 to +1020.000 mV. Reference Junction Compensator, Standard Cell Adjustment, Galvanometer.

MARCONI TF-1060
UHF Signal Generator **$775.00**

Range: 450 to 1250 MHz in one continuous band. Output: Power Level from -130 to at least 0 dBm. Voltage Level from 15 V to 447 mV. Impedance: 50 Ohms. Modulation: Internal am 1 kHz.

McINTOSH MC-30
Audio Amplifier **$79.00**

Output: 30 Watts, Load Distortion, AC Amplifier.

MCS 6"
X-Band Waveguide **$7.00**

MCS X-146
X-Band Twist **$10.00**

MCS X-225
Variable Attenuator **$49.00**

Attenuation: 0 to 5 dB (Helipot Readout).

MCS X-226
Variable Attenuator **$49.00**

Attenuation: 0 to 5 dB (Helipot Readout). With 6" Waveguide Section.

MCS X-354
Attenuator **$29.00**

MCS X-6104
Switch Attenuator **$29.00**

Attenuation: 0 or 50 dB, Flanges are Choked.

MCS X-6106
X-Band Termination **$25.00**

Same as Hewlett Packard 910A.

MDL
X-Band Variable Attenuator **$19.00**

Screw Driver Type Attenuator for In Line Systems.

MEASUREMENTS CORP 82
Signal Generator **$295.00**

20 Hz to 50 MHz. 0 to 50 V into 7500Ω. 0-50% internal modulation from 20 Hz to 20 Hz. Less than 3% harmonic output.

MEASUREMENT CORP. 111B
Crystal Calibrator **$59.00**

Frequency: 100 kHz to 1 GHz.

MECA 402-1
Termination/"N" Connector **$19.00**

50 Ohm, 1 Watt Termination.

ELECTRONIC INSTRUMENTS

MERRIMAC RA-1.389
Phase Shafter **$25.00**

MICROWAVE ASSOCIATES MA8R33
Miniature Waveguide Isolator **$39.00**

Type: Uniline; Rating: 10 Watts average power, 1 kW Peak.

MICROWAVE ASSOCIATES MA8M211
Waveguide Junction Circulator **$49.00**

Frequency: 8.4 to 10 GHz; Minimum Isolation: 26.0/40.0 dB. Power Rating: 100 Watts Average, 10 kW Peak. Flange Mounting UG51/u.

MICROWAVE ASSOCIATES MA562C-930
X-Band to "N" Connector **$19.00**

Frequency: 8.2 to 12.4 GHz; Flange Type WR-90.

MICROWAVE ASSOCIATES MA-663A
Directional Coupler **$19.00**

Frequency: 8.2 to 12.4 GHz; Nominal Coupling: 20 dB. Flange Type WR-90.

MICROWAVE ASSOCIATES MA1109A-1TE
Sidewall Hybrid Balance Mixer and Modulator **$69.00**

Frequency: 9.5 to 10.6 GHz; Diode Type: 1N23; Flanges: WR-90; Output Connectors: PNC.

MICROWAVE ASSOCIATES MA1190-3
SSB Generator **$59.00**

Frequency: 9.83 GHz; Bandwidth: 100 MHz; IF Frequency: 100 MHz; Max Power Output: 1 mW.

MICROWAVE ASSOCIATES 5130
Crystal Mount **$125.00**

MICROWAVE ASSOCIATES 7509
TYM 4 Port X-Band Switches **$19.00**

Frequency: 8.2 to 12.4 GHz; Max. Average Power: 500 Watts. Isolation: 60 dB. VSWR, Max 1.10:1. Above Unit Manually Operated.

MICROWAVE ASSOCIATES MA68847-1
X-Band Termination **$15.00**

Similar to MA684; Frequency: 8.2 to 12.4 GHz; Dissipation: 5 Watts (CW); Flange Type WR-90.

MILLIVAC RM-28-B
RF Microvolt Meter **$225.00**

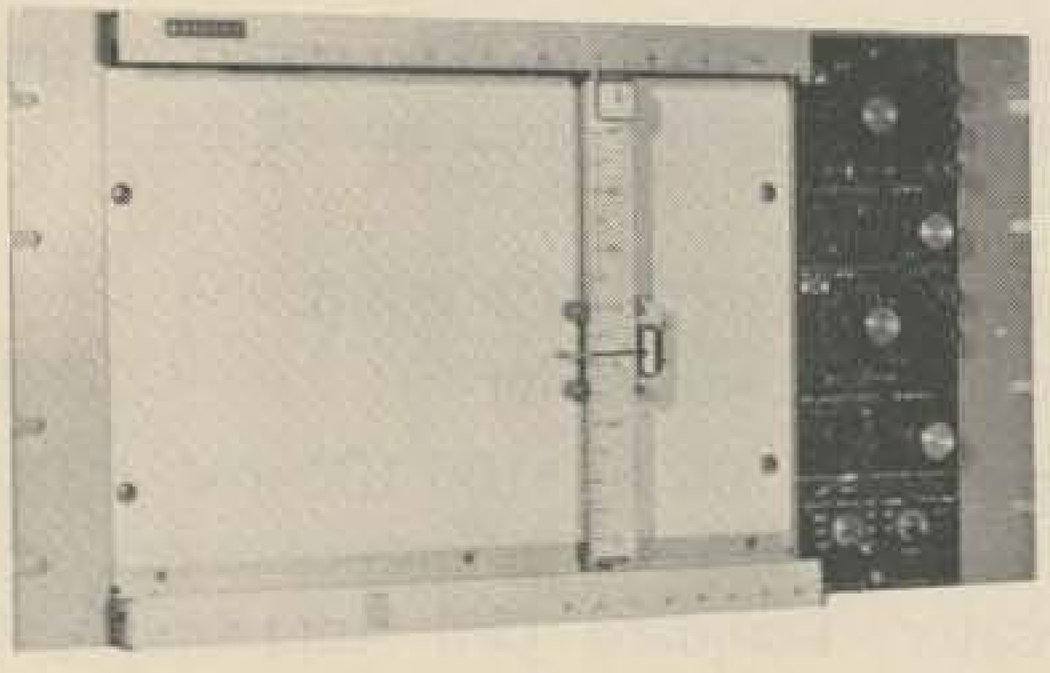
20 kHz to 1.2 GHz, 1 mV to 3 volts full scale, also has logarithmec dB scale, 6" knife mirror meter.

MONSANTO 504A
Digital Comparator **$99.00**

Capability: For both High and Low Limits, 5 Digit Setability; Polarity: Set from Front Panel; Indicators: Low – Go – High; Input Format: 8, 4, 2, 1 BCD Code, Positive True; Comparison Time: 1 usec.

MOSELEY 2-D
X-Y Recorder **$549.00**

Range: .1 to 25 volts ac/inch; 0 to 50 volts dc/inch; .5 to 50 mV/inch/second.



Moseley 135X-Y

MOSELEY 135
X-Y Recorder **$489.00**

Small size, solid state. **Plotting Surface:** 8½ x 11" (7" x 10" recording). **Sensitivity:** .5mV/div. (inch) to 50V/div., 16 steps, calibrated. **Time Sweep:** X Axis, .5 to 50 sec/div., 7 ranges. **Accuracy:** .2% f.s., repeatability .1%, timebase 5%. **Recording Speed:** ½ sec. full scale, each axis. **Power Requirement:** 115 V, 60 Hz, 80 Va. **Dimensions:** 16-1/8" x 10-1/2" x 4-1/2", 20 lbs. Used, excellent and overhauled.

AST/SERVO SYSTEMS, INC. • 20 REPUBLIC ROAD • NORTH BILLERICA, MA 01862 • 617-667-8541

ELECTRONIC INSTRUMENTS

NARDA 369NM
Power Termination $149.00
175 Watts, 0.7 to 12.4 GHz.

NARDA 757
Attenuator $29.00
DC to 12.4 GHz; 3.10, 20, 30 dB; 2 Watts, 50 Ohms.

NARDA 777
Attenuator $39.00
DC to 12.4 GHz; 3, 6, 10, or 20 dB; 2 Watts, 50 Ohms.

NARDA X-2108-20
Directional Coupler $85.00
Frequency: 4 GHz to 8 GHz. Coupling: 20 dB.

NARDA 3001-30
Directional Coupler $75.00
Frequency: 460 MHz to 950 MHz. Coupling: 30 dB.

NARDA 3002-10
Coaxial Directional Coupler $89.00
Frequency: 0.95 to 2 GHz. 10 dB N(F).

NARDA 3002-30
Directional Coupler $85.00
Frequency: 950 MHz to 2 GHz. Coupling: 30 dB.

NARDA 3003-20
Directional Coupler $85.00
Frequency: 2 GHz to 4 GHz. Coupling: 20 dB.

NARDA 3003-30
Directional Coupler $85.00
Frequency: 2 GHz to 4 GHz. Coupling: 30 dB.

NARDA 3032
Coaxial Hybrid $99.00
Frequency: .95 to 2 GHz, Coupling: 3 dB, Isolation: 20 dB.

NARDA 3042-20
Coaxial Directional Coupler $99.00
Frequency: .95 to 2 GHz, Coupling: 20 dB.

NARDA 3042B-20
Coaxial Directional Coupler $99.00
Frequency Range: 2.0 GHz to 4.0 GHz; Coupling: 20 dB; Directivity: 20 dB; Insertion Loss: 0.2 dB, Max; Frequency Sensitivity: 0.2 dB; Power (Max); 10 kW, peak.

NARDA 3043B-10
Coaxial Directional Coupler $99.00
Frequency: 1.7 to 4.2 GHz, Coupling: 10 dB.

NARDA 3044-20
Directional Coupler $110.00
Frequency: 3.7 GHz to 8.3 GHz. Coupling: 20 dB.

NARDA 3044B-20
Coax Directional Coupler $110.00
4 GHz to 8 GHz, coupling 20 dB, directivity > 17 dB.

NARDA 4055-10
Directional Coupler $99.00
Frequency: 7.5 to 16 GHz, Coupling: 10 dB, Miniature Strip Line Type.

NARDA 4055-30
Directional Coupler $99.00
Frequency: 7.5 to 16 GHz, Coupling: 30 dB, Miniature Strip Line Type.

NARDA 4601
Adaptor $29.00
Frequency: 8.2 to 12.4 GHz, Flange Type UG/135/U, Coaxial Connector Output: SMA Female.

NARDA 22397
Microline $149.00
Attenuation: 45 to 135 dB, Dial divided into 1 dB divisions; Similar to Model 785.

ELECTRONIC INSTRUMENTS

NARDA 22539A
Microline Directional Coupler **$99.00**

NARDA 22886
Directional Coupler **$99.00**
High Directivity; Frequency: 3.7 to 8.3 GHz; Coupling: 10 dB; Same as 3094-10.

NARDA 22908
Directional Coupler **$99.00**
High Directivity; Frequency: 1.7 to 4.2 GHz; Coupling: 10 dB; Same as the 3093-10.

NATIONAL RESEARCH 831
Vacuum Ionization Gauge **$275.00**

Nikon 66079

NIKON 66079
(Zoom) Binocular Microscope **$499.00**
Total Magnification 8X-40X.

NJE QR15-20

NJE CORP. QR15-20
DC Power Supply **$229.00**
Output: 0 to 15 V @ 0 to 20 A; Regulation: 0.01% or 1 mV. Noise & Ripple: 3 mV or less. Metered with both Voltage and Current Controlled.

N.J.E. CORP. SR150-1
Power Supply **$125.00**
Output: 140 to 160 V @ 0 to 1 Amp. Regulation: Better than 0.01%. Ripple: 1 mV rms.

NORTH ELECTRIC PEC-3350
Power Supply **$12.50**
Input: 103 to 127 V, 60 Hz. Output: 24 V dc, 4 Amp. Ferroresonant Regulation, 2.5% line. Max p-p Ripple 500 mV, full load, 100 mV, no load. Dim. 3½" W x 5" H x 10" D.

NY TRANSFORMER 213
Inductance Standard **$30.00**
Ranges: 0 to 1 Henry in .1 Steps. 0 to 10 Henry in 1 Steps.

PANORAMIC RADIO SB-12A (T-100)
PS-12 Analyzer/Plug-In **$495.00**
Designed for narrow band spectrum analysis. 500Kc input center frequency. Serves also as a Panadapter for communication. Receivers, narrow band and single sideband communication channels. Similar to AN/URM-135.

PANORAMIC RADIO SB-15A
Ultrasonic Spectrum Analyzer **$399.00**
Frequency Range: 100 Hz to 600 kHz; Sweep Width: 1 to 2000 kHz; IF bandwidth resolution of 100 Hz – 4 kHz. Sensitivity: 200 uV to 100 V. Log Amplitude Scales 0 to 40 dB. 60 dB dynamic range.

PHILLIPS PM 3200/Q3
Oscilloscope **$239.00**
Vertical Bandwidth: DC to 10 MHz; Vertical Sensitivity: 2 mV/div. to 20 V/div. Risetime: 35 ns; Timebase: .1 usec/div to .5 sec/div.

POLARAD RG53/u
Adaptor **$45.00**

POLARAD RG91/U
K Band to Mixer **$45.00**

POLARAD RG96/U
Adaptor **$45.00**

ELECTRONIC INSTRUMENTS

Power Design 630

POWER DESIGN 630
Power Supply **$129.00**
Output: 0 to 6 V @ 3 Amps, Metered.

POLARAD 2992/3815
Spectrum Analyzer/Stabilizer **$1995.00**
Write for Complete Specifications.

POWER DESIGN 1210S
Regulated Power Supply **$179.00**
Output: 0 to 12 V @ 0 to 10 Amps; Regulation: 0.01% or better. Ripple and Noise: Less than 500 uV rms. Voltage and Current Controlled, Metered.

Power Design 1515B

POWER DESIGN 1515B
Transistorized Power Supply **$139.00**
Output: 0 to 15 V @ 1.5 Amps. Regulation Better than 0.01%. Ripple and Noise Less than 1 uV. Metered with both Current and Voltage Controlled.

POWER DESIGN 1515A
Transistorized Power Supply **$129.00**
Output: 0 to 15 V @ 0 to 1.5 Amps; Regulation: Better than 0.01%. Ripple and Noise Less than 500 uV; Metered Output, Current and Voltage Controlled.

Power Design 2050

POWER DESIGN 2050
Transistorized Power Supply **$169.00**
Output: 1 to 20 V dc @ 0 to 5 Amps. Regulation: Better than 0.01%. Ripple and Noise Less than 500 uV; Metered Output, Current and Voltage Controlled.

POWER DESIGN 3240
Transistorized Power Supply **$189.00**
Output: 1 to 32 V dc @ 0 to 4 Amps; Regulation: Better than 0.01%. Ripple and Noise less than 500 uV; Metered Output, Current and Voltage Controlled.

Power Design 3650

ELECTRONIC INSTRUMENTS

POWER DESIGN 3650S
Regulated Power Supply **$189.00**
Output: 0 to 36 V @ 0 to 5 Amps. Regulation: Better than 0.01%. Ripple and Noise less than 500 uV. Metered, Current and Voltage Controlled.

POWER DESIGN 5005S
Power Supply **$119.00**
Output: 0 to 50 V @ 0 to 500 mA; Regulation: Output changes less than 0.005% plus 1 mV for a 100% change in rated load or line changes; Noise and Ripple: Less than 350 micro volts rms; Current and Voltage Controlled, Metered.

POWER DESIGN 5010P
Power Supply **$95.00**
Output: 1 to 50 V @ 0 to 1 Amp. Metered and Voltage Controlled; 19" Rack Mount Type.

POWER DESIGN 5015
Transistorized Power Supply **$139.00**
Output: 0 to 50 V @ 0 to 1.5 Amps. Regulation: Better than 0.01%. Ripple and Noise less than 500 uV; Metered, Voltage Controlled.

POWER/MATE ICX-8B
Power Supplies **$29.50**
Modular Power Supply. Output: 7 to 9 V at 8 Amps.

POWER MATE BP118
Power Supply **$149.00**
Output: 0 to 34 V @ 0 to 1.5 Amps. Regulation: ±0.01%; Ripple: Less than 250 Micro Volts, Voltage and Current Controlled, Metered.

POWER MATE RB6-3.0
Power Supply **$29.00**
Output: 5 to 7 V @ 3 Amps; Regulation: ±0.05%. Ripple: Less than 0.002%, Modular Type.

POWER MATE RB6-6.0
Power Supply **$39.00**
Output: 5 to 7 V @ 6 Amps. Specifications same as above.

PRD 613
Detector **$35.00**
Frequency: 1 to 12 GHz; Type: Coaxial Crystal; Connector Type "N" Input, "BNC" Output.

PRD 618
Detector **$35.00**
Frequency: 12 to 18 GHz; Bolometer Type.

PRD 809
Klystron Power Supply **$99.00**

PRD 1100C
Attenuator **$29.00**
Frequency: 0 to 4 GHz; Attenuation: 10 dB VSWR 1.2; "N" Type Connector, 1 Watt Maximum.

PRECISE MEASUREMENT
DC Power Supply **$475.00**
Output: 0 to 5 kV, 0 to 500 mA. Metered and Regulated.

PRECISION 28
Thelco Oven **$199.00**
Oven Size: 18"H x 18"D x 23"W. Temperature: Ambient to 200°C.

RADIO SHACK
5 Amp Variable Transformer **$20.00**
0-120 V ac.

RANTEC CA409
Coupler **$59.00**

RCA
1" X-Band Waveguide **$10.00**

RCA
90° X-Band Waveguide **$12.00**

ELECTRONIC INSTRUMENTS

RCA WV-98B
Vacuum Tube Voltmeter **$29.00**
AC/DC Volts and Ohms.

RFL 889A
Magnetreater **$149.00**

ROYAL 92070
Dummy Load **$149.00**
Frequency: 0.7 to 12.4 GHz. Power Average 175 Watts, Peak 10 kW. VSWR less than 1.20. "N" type Connector. Same as Narda Model 369.

ROYAL MCBEE 514
Paper Tape Punch **$49.50**
10 column, with supply and take-up reels. 115 Volts, 60 Hz; New.

RUSTRAK 88
DC Milliamp Recorder **$59.00**
Scale 0 Center. ± .5 mA Full Scale.

SAGE LABS 535
TNC Detector **$29.00**

SAGE LABS 701R
Coupler **$39.00**

SAGE LABS 1131
X-Band Detector **$30.00**

SAGE LABS 9316
Attenuators 3, 6, 20 dB **$10.95**

SENSITIVE RESEARCH "C"
DC Voltmeter **$59.00**
Ranges: 0, 3, 7.5, 15, 22.5, 75.

SENSITIVE RESEARCH "N"
DC Voltmeter **$49.00**
Range: 0, 10, 20, 50.

SENSITIVE RESEARCH "NSI"
AC Voltmeter **$39.00**
Range: 0, 300.

SENSITIVE RESEARCH "U"
DC Voltmeter **$59.00**
Range: 0, 3, 15, 75, 150, 300.

SENSITIVE RESEARCH "U"
DC Voltmeter **$59.00**
Range: 0, 15, 30, 75.

SENSITIVE RESEARCH "U"
DC Voltmeter **$49.00**
Range: 0, 1.5, 7.5, 15.

SENSITIVE RESEARCH "U"
DC Meter **$49.00**
Range: 0, 5, 7.5, 50 Short.

SENSITIVE RESEARCH "UP"
DC Meter **$59.00**
Range: 0, 30, 75, 150.

SENSITIVE RESEARCH "UP"
DC Voltmeter **$49.00**
Range: 0, 3, 15, 30.

SENSITIVE RESEARCH "UPP"
DC Meter **$59.00**
Range: 0, 30, 75, 150, 300, 750.

SENSITIVE RESEARCH
"University" DC Voltmeter **$49.00**
Range: 0, 150, 300, 750.

SENSITIVE RESEARCH
"University" Wattmeter **$69.00**
Range: 1.5, 3, 6 Watts. Scale Divisions 60.

SHALCROSS 817A
Decade Resistance Box **$99.00**
Range: 0.01 to 100 Ohms in .01 steps. 4 Dial Decade.

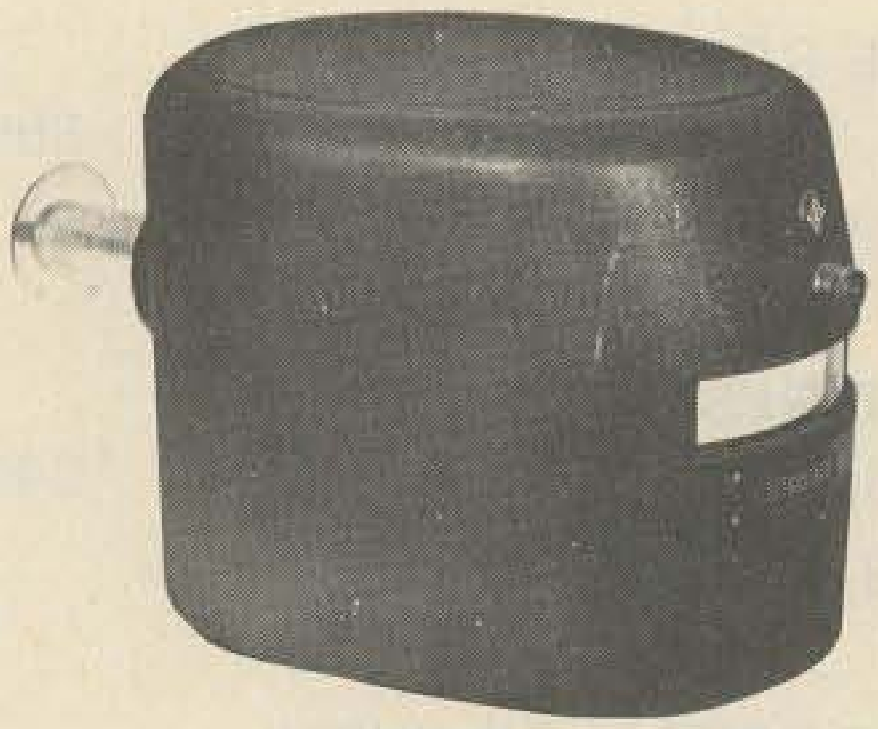
SHALCROSS 833
Decade Resistance Box **$99.00**
Range: 10 Ohms to 10 megohms in 10 Ohm steps. 6 Dial Decade.

ELECTRONIC INSTRUMENTS

SIERRA Z-99
Watt Meters **$125.00**
Range: 0 to 120 Watts; Frequency: 50 to 600 MHz; Input Impedance: 52 Ohms.

SIMPSON 260
Volt-Ohm-Milliammeter **$30.00**
Voltage Range: 0 V to 1000 V dc/ac; Current Range: 0 to 500 mA dc, 0 to 10 A dc; Resistance Range: 0 to 20 MegΩ.

SINGER EMPIRE T-2/NF-105
Tuning Unit **$259.00**
Frequency Range: 200 to 400 MHz. To be used with the NF/105 Mainframe.


Singer Metric

SINGER METRICS
ESH Electrostatic Voltmeter **$175.00**
Range: 0 to 5, 15, 30, 50 kV.

SINGER LP-1A AZ; PC-1C; RC-3A/15A; LP-1A
Panoramic Recorder Analyzer **$399.00**
This unit is a direct reading swept band voltmeter with 500 uV sensitivity that covers the Frequency Range of 20 Hz to 22.5 kHz.

SLAUGHTER CO. 122-2.5 EG
HiPot Tester **$245.00**
Range: 0 to 2500 V ac (test ranges 400/2500), Maximum Short Circuit Current: 10 mA, Leakage Ranges: 0 – 100/1000 uA.

SOLA ELECTRIC 22-481
Constant Voltage Transformer **$19.00**

SOLA ELECTRIC 50106
Transformer **$35.00**

SORENSON DCR 40-10A
Power Supply **$495.00**
40 V/10 A, reg 0.075%.

SORENSON DCR 40-35A
Power Supply **$425.00**
Metered, regulated Power Supply, Input: 115 V, 60 Hz, Output: 0 to 40 V dc, 0 to 35 Amps, Regulation Line and Load .075%, Ripple .4%, Current Regulation ±35 mA. (38 to 0 V) Remote sensing and programming.

SORENSON DCR 40-60
Power Supply **$395.00**
40 V/60 A, reg 0.075%.

SORENSON DCR 300-8
Power Supply **$535.00**
300 V/8 A, reg 0.075%.

SORENSON DCR 600-18A
Power Supply **$1250.00**
Input: 0 to 600 V @ 18 Amps; Current Limited, Metered. Output: 0 to 600 V @ 18 Amps; Current

SORENSON QRB20-4
Power Supply **$145.00**
0 to 20 Volts @ 4 Amps; 0.01% Regulation, Ripple less than 0.2 mV.

SORENSON QRE 7.5-10
Power Supply **$189.00**
Output: 0 to 7.5 V @ 10 Amps. Regulation: ±.01%. Ripple: 250 micro Volts rms. Current & Voltage Controlled, Metered. Input: 60 Hz. 19" Rack Mount Type.

SORENSON QSA 5-6.4
Power Supply **$69.00**
Output: 3 to 7 V @ 7 Amps. Regulation: ±.01%. Ripple: 300 micro Volts rms. Overload Protection, Modular Type.

ELECTRONIC INSTRUMENTS

SORENSON QSA 10-1.4
Power Supply **$69.00**
Output: 0 to 10 V @ 1.5 Amps; Regulation: ±.005%. Overload Short Circuit Protected. Ripple: 300 micro Volts rms. Modular Type.

SORENSON QSA 10-2.2
Power Supply **$69.00**
Output: 0 to 10 V @ 2.4 Amps. Regulation: ±.005%. Overload Short Circuit Protected. Ripple: 300 micro Volts rms. Modular Type.

SORENSON QSA 10-3.7
Power Supply **$99.00**
Voltage Range: 0 V dc to 10 V dc; Current Range: 0 to 4.0 A; Voltage Regulation (Line and Load): ±0.005% or ±0.2 mV; Voltage Ripple: 300 u VRMS, 3 mV p-p; Transient Response Time: 220 usec.

SORENSON QSA 12-1.3
Power Supply **$59.00**
Output: 8 to 14 V @ 1.4 Amps. Regulation: ±.005%. Overload Short Circuit Protected. Ripple: 300 micro Volts rms. Modular Type.

SORENSON QSA 18-1.1
Power Supply **$99.00**
Output: 14 to 22 V @ 1.2 Amps. Regulation: ±.005%. Overload Short Circuit Protected. Ripple: 300 micro Volts rms. Modular Type.

SORENSON QSB 6-30
Power Supply **$159.00**
Input: 105 to 125 V, 6 Amps; Output: 6 Volts, 30 Amps.

SORENSON QB 50-1
Power Supply **$129.00**
Output: 40 to 60 V @ 1 Amp. Regulation: ±.01%. Metered & Voltage Controlled. 19" Rack Mount Type.

SOUTHWESTERN INDUSTRIAL ELECT.
C-6 Megohmeter **$95.00**
Resistance Range: 1 to 10^3 Ohms in 4 steps, with 1.5 V. 0.1 to 10^4 megohms in 6 steps, with 50 V. 1 to 10^5 megohm in 6 steps, with 500 V.

SPECIALTY ASSEMBLING TS-382A/U
Oscillator **$125.00**

STABILINE E5101R
Voltage Regulator **$129.00**
Input: 95 to 135 V ac. Output: 115 V ac 60 Hz 1 KVA.

STANDARD CORP. DC-100BR
Precision Differential Voltmeter **$89.00**
4 Digit Readout, .05% Accuracy.

STANDARD ELECTRIC 500B
Variac **$20.00**

H STICHT CO. 5768
Megohmeter **$129.00**

STODDART NM10A
Field Intensity Meter **$775.00**
Measures RFI in the 10 to 250 kHz Frequency Range. Consists of calibrated receiver and power supply.

SUPERIOR ELECTRIC
Slo-Syn Preset Indexer **$79.00**

SUPERIOR ELECTRIC 136 BUM-3
Variable Auto Transformer **$149.00**

SUPERIOR ELECTRIC 146
Power State Power Supply **$65.00**

SUPERIOR ELECTRIC 1156-2P
Motorized Variac **$159.00**

Systron Donnel 8150

SYSTRON DONNER 8150
Time Code Generator/Reader **$1495.00**
Display: Days, Hours, Minutes, Seconds; Code

ELECTRONIC INSTRUMENTS

Format: IRIG B. Input: Modulated Codes from 30 Hz to 500 kHz; Forward, Reverse and Hold Commands Available; Output: Pulse Rates, Simultaneous Rates of 1 pps, 10 pps, 100 pps, 1000 pps; also Paralleled BCD in 8-4-2-1.

TEKTRONIX "B"
Plug-In **$80.00**

Bandwidth and Sensitivity: 5 mV to 50 mV/CM. 2 Hz to 12 MHz, 50 mV to 20 V/CM. DC – 20 MHz. Wideband High Gain.

TEKTRONIX
CA Dual Trace Scope Plug-In **$165.00**

Bandwidth: DC to 24 MHz; Sensitivity: 50 mV/CM.

TEKTRONIX C-70/C-50
Oscilloscope Camera/Pack Film **$425.00**

To be used with 5000 and 7000 Series Oscilloscopes.

Type D

TEKTRONIX "D"
Plug-In **$95.00**

Deflection Factor: 1 mV to 50 V/CM; Bandwidth: dc to 2 MHz.

TEKTRONIX "E"
Differential Plug-In **$80.00**

50 mV to 10 V/CM; 0.6 Hz to 60 kHz.

TEKTRONIX H
Wide-Band Calibrated Pre-Amp Plug-In $85.00

Bandwidth: DC to 15 MHz; Sensitivity: 5 mV/CM to 20 V/CM.

TEKTRONIX "K"
Plug-In **$55.00**

Bandwidth and Sensitivity: 50 mV to 20 V/CM, dc to 30 MHz. Fast Rise DC.

TEKTRONIX M
Four Trace Pre-Amp Plug-In **$299.00**

Bandwidth: DC to 20 MHz; Sensitivity: 20 mV to 10 V/CM.

TEKTRONIX "P"
Test Pulser Plug-In **$49.00**

Amplitude: 0 to 3 graticule divisions. Repetition rate: 240 pulses per second. Rise time: approx. 4 nsec.

Type W

TEKTRONIX W
High Gain Differential Amplifier **$240.00**

DC to 23 MHz, 1 mV to 50 V/cm Sensitivity. Modes: A-VC, A-B, VC-B; Resolution: 100u V/minor division.

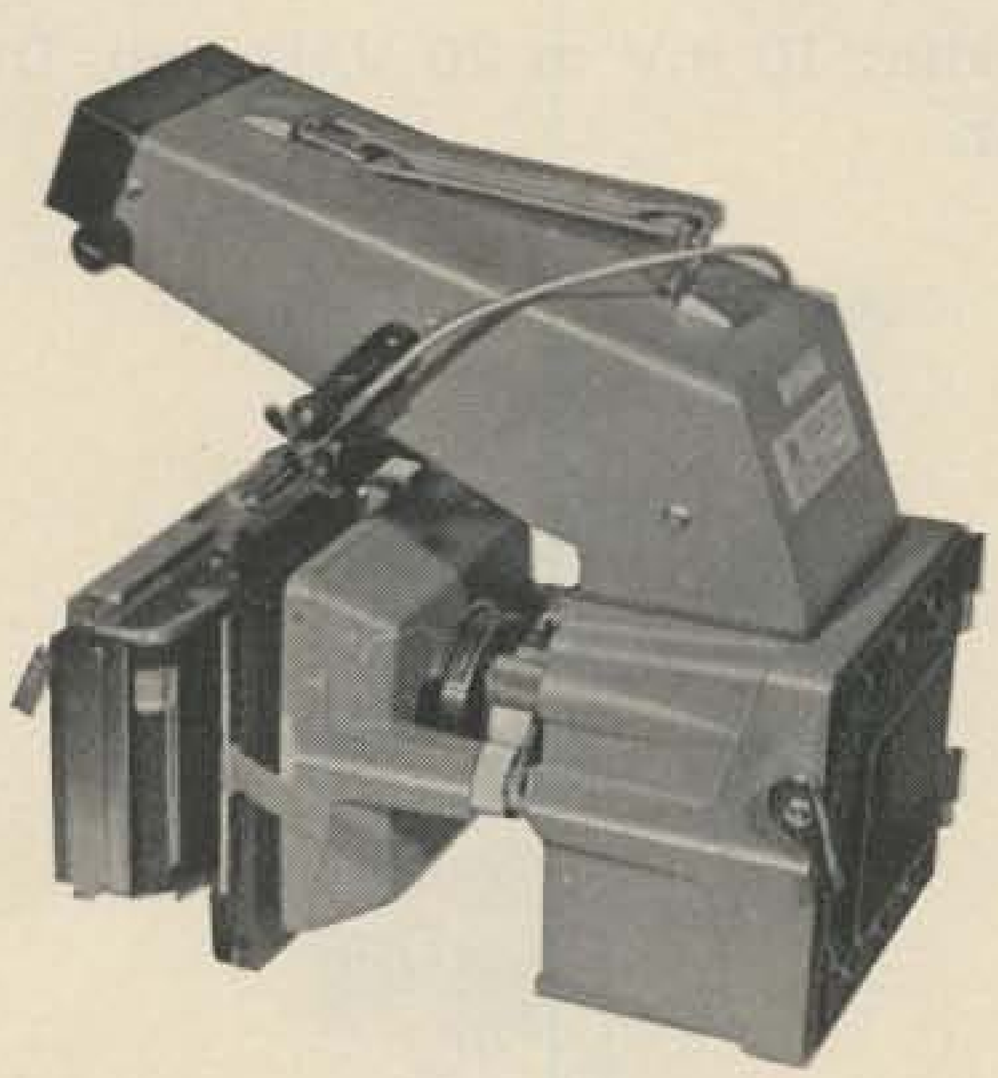
TEKTRONIX "Z"
High Gain Differential Plug-In **$250.00**

Bandwidth: DC to 13 MHz; Sensitivity: 0.05 V/CM to 25 V/CM.

TEKTRONIX "C-12"
Oscilloscope Trace Recording Camera$385.00

Lens: 75mm, f/1.9 stops down to f/16; Shutter Speeds: 1 sec to 1/50 sec plus bulb & time; Object/Image Ratio: 1:0.85. Records 8 x 10 cm, graticule on 3¼ x 4¼ Polaroid film;

ELECTRONIC INSTRUMENTS



C-12

Film Back: Polaroid pack film back accepts 3000 speed film/10 sec development time.

TEKTRONIX C-27
Oscilloscope Trace Recording Camera $385.00

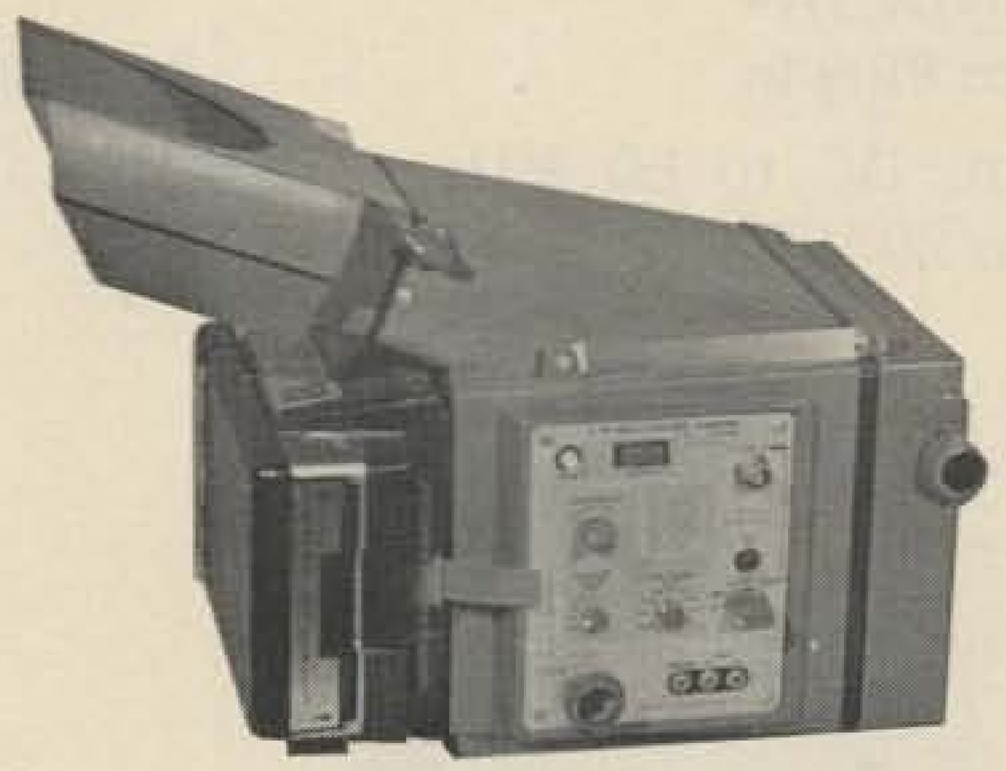
Lens: 75mm. f/1.9 stops down to f/16; Shutter Speeds: 1 sec to 1/50 sec. plus bulb & time; Object/Image Ratio: 1:0.85, records 8 x 10 cm., graticule on 3-1/3 x 4-1/4 Polaroid film; Film Back: Polaroid pack film back accepts 3000 speed film/10 sec. development.

TEKTRONIX "C-30"
Oscilloscope Trace Recording Camera $350.00

Lens: 56mm. f/1.9 stops down to f/16; Shutter Speeds: 1 sec. to 1/50 sec. plus bulb and time; Magnification: Variable in indexed steps of 1.5, 1.4, 1.3, 1.2, 1.1, 1.0, 0.9, 0.85, 0.8, 0.7; Film Back: Polaroid film back accepts 3000 speed film/10 sec. development time; Direct Mount: 422, 432, 434, 453, 454, 465, 475 & 491 Oscilloscopes.

TEKTRONIX C-30A
Oscilloscope Camera $225.00

f/1.9 lens, 1.5 mag, 1 to 1/60 sec shutter speed, used with 422, 453A, 454A, 485, 491, uses pack film.

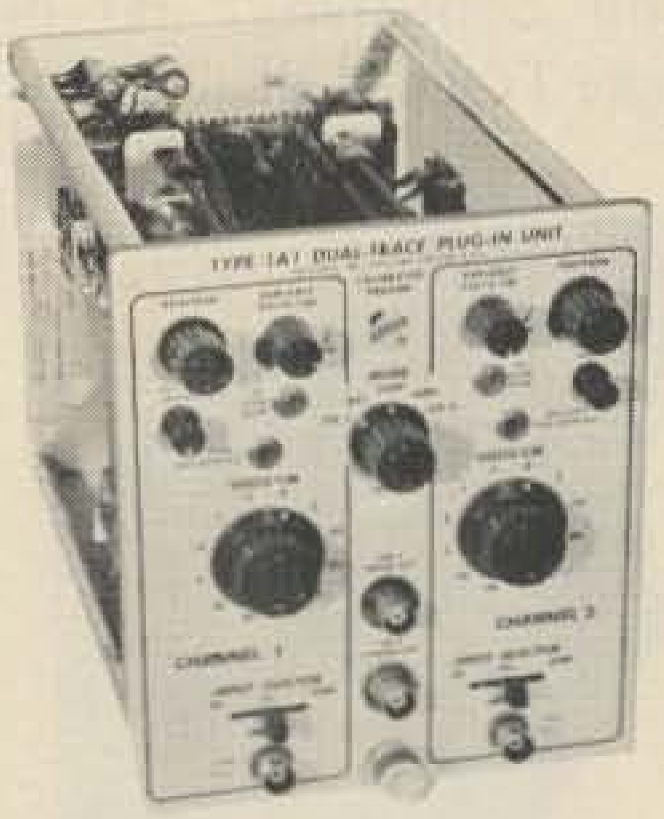


TEKTRONIX C-70
Oscilloscope Camera $425.00

Supplied with C-50 Pack Film Back; to be used with 5000 Series Oscilloscopes. Lense: f/1.9-1:0.7; this unit also has an electronic shutter accuator.

TEKTRONIX TU-2
Test Load Plug-In $25.00

Test Load Plug-In for 530, 540, 550 Mainframes.



1A1

TEKTRONIX 1A1
Dual Trace Plug-In $475.00

Bandwidth: DC to 50 MHz; Sensitivity: 5 mV/CM to 25 V/CM.

TEKTRONIX 1A2
Dual Trace Plug-In $225.00

Bandwidth: DC to 50 MHz; Sensitivity: 50 mV/CM to 20 V/CM.

ELECTRONIC INSTRUMENTS

TEKTRONIX 1A4
Four Trace Plug-In **$695.00**

Bandwidth: DC to 50 MHz; Sensitivity: 10 mV/CM to 20 V/CM.

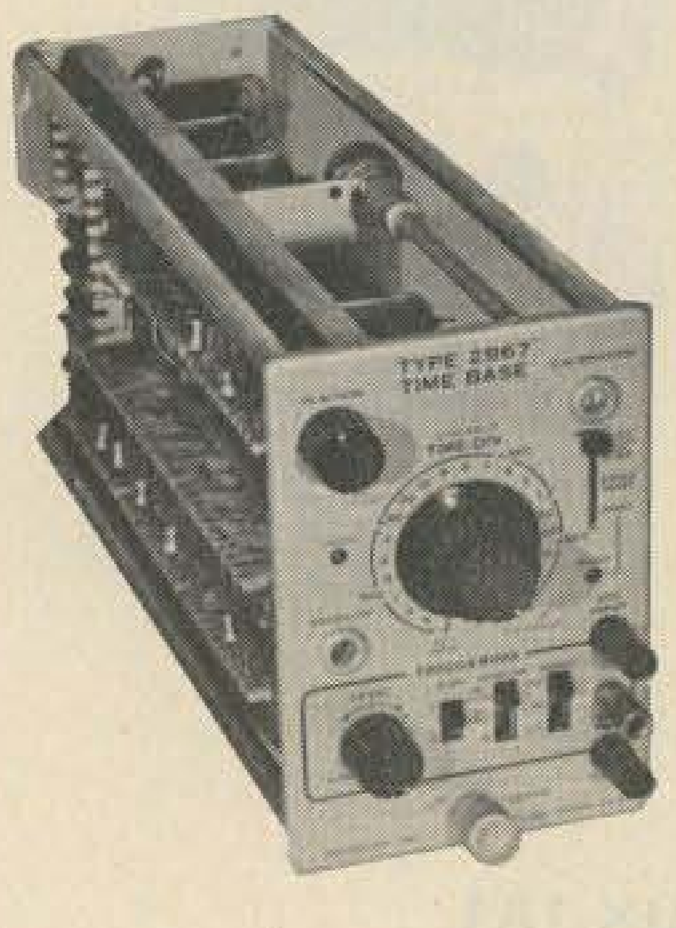
1A5

TEKTRONIX 1A5
Differential Amplifier **$425.00**

DC to 50 MHz, 1 mV/cm, 20,000:1 CMR, FET Inputs.

TEKTRONIX 2A60
Plug-In **$99.00**

Bandwidth and Sensitivity: 50 mV to 50 V/div. DC Single Trace Unit.



2B67

TEKTRONIX 2B67
Timebase Plug-In **$195.00**

Calibrated Timebase: 1 usec/div to 5 sec/div; 5X Magnifier; Single Sweep Operation; External Horiz Input: 1 V/div. DC to 750 kHz at -3 dB; Modes: Manual, Automatic or Free-run; Coupling: AC Slow, AC Fast or DC.

TEKTRONIX 3A1
Dual Trace Plug-In **$325.00**

Bandwidth: 10 mV to 20 V/division, DC to 10 MHz.

3A2

TEKTRONIX 3A2
Dual Trace Plug-In **$399.00**

Bandwidth: DC to 500 kHz; Deflection: 10 mV/div to 10 V/div (10 steps). Operating Modes: CH1, CH2, Chop, Alt, Add either channel may be inverted; Use with digital Display Oscilloscope.

3A72

TEKTRONIX 3A72
Plug-In **$199.00**

Deflection Factor: 10 mV to 20 V/div; Bandwidth: DC to 650 kHz; Dual Trace. For use with Tektronix 560 Series Oscilloscope Mainframes.

TEKTRONIX 3B1
Timebase Plug-In **$350.00**

Same as 3B3 without Helidial Readout on Delaying Sweep.

ELECTRONIC INSTRUMENTS

3L10

TEKTRONIX 3L10
Spectrum Analyzer **$795.00**

Bandwidth: 1 MHz to 36 MHz; Operates with 560 Series Oscilloscope.

TEKTRONIX 3A74
Amplifier Unit **$595.00**

Bandwidth: DC to 2 MHz at 3 dB down. AC coupled low frequency response in 2 Hz, 0.2 Hz with 10 X probe; Risetime: ≈0.17us; Deflecting Factor: 0.02 V/div to 10 V/div in 9 cal. steps, 1-2-5 sequence; Accurate within 3%. Uncalibrated, continuously variable between steps & to ≈25 V/div; Input RC: 1 MΩ paralleled by ≈47 pF; Max Input Voltage: 600 V combined DC + peak AC; Operating Modes: Any one of 4 chan separately (normal or inverted; alternate, chopped; Multiple X-Y Displays: Obtained using 2 type 3A74 plug-in units; both synch and auto pairing provided; Internal Trigger Signal (for timebase).

3B3

TEKTRONIX "3B3"
Plug-In **$375.00**

Sweep Rate: .5 usec to 1 sec plus timebase "B". .5 usec to 10 sec plus 5 X Magnifier. Delaying Sweep Unit.

TEKTRONIX 3S76
Dual Trace Sampling Plug-In **$425.00**

Bandwidth: DC to 875 MHz; Sensitivity: 2 mV to 200 mV/div. To be used with 560 series oscilloscopes.

TEKTRONIX 7A13
Differential Comparator Plug-In **$995.00**

DC to 105 MHz, 1 mV/div to 5 V/div. To be used in 7000 series mainframes.

TEKTRONIX 10A2A
Dual Trace Amplifier **$350.00**

Versatile Plug-In for 647A Scope; Bandwidth: DC to 100 MHz; Deflection Factor: 10 mV/CM to 20 V/CM; Risetime: 3.5 ns.

TEKTRONIX 53/54B
High Gain Plug-In **$59.00**

Deflection Factor: 0.005 to 20 V/CM in 12 steps. Two Inputs, AC or DC Coupled.

53/54C

TEKTRONIX 53/54C
Dual Trace Plug-In **$125.00**

Bandwidth: DC to 24 MHz; Sensitivity: .05 to 20 V/CM.

ELECTRONIC INSTRUMENTS

TEKTRONIX 53/54D
High Gain Dif. Plug-In $95.00

Bandwidth: DC to 2 MHz. Sensitivity: 1 mV to 50 V/CM.

TEKTRONIX 53/54E
Low Level AC Dif. Plug-In $80.00

Bandwidth: .06 to 60 kHz; Sensitivity: 50 uV to 10 mV/CM.

TEKTRONIX 53/54G
Wideband DC Dif. Plug-In $95.00

Bandwidth: DC to 18 MHz; Sensitivity: .05 to 20 V/CM.

TEKTRONIX 53/54L
Fastrise Plug-In $85.00

Deflection Factor: DC, 0.05 to 20 V/CM; AC, 0.005 to 2 V/CM. Preamp Risetime: Approximately 0.006 usec.

TEKTRONIX 60
Plug-In Amplifier $99.00

Same as the 2A60.

TEKTRONIX 75
Plug-In Amplifier $125.00

Same as 3A75.

TEKTRONIX 81
Plug-In Adaptor $125.00

Letter and 1 series plug-in to Tek 580 series.

TEKTRONIX 82
Dual Trace High Gain Plug-In $475.00

Bandwidth: DC tp 80 MHz; Sensitivity: 100 mV to 50 V/CM. To be used in Tektronix 580 series Oscilloscopes.

TEKTRONIX 105
Square Wave Generator $155.00

100 Volts Maximum in 52Ω; 25 Hz to 1 MHz.

TEKTRONIX 106
Signal Wave Generator $495.00

Risetime: ≤1 nsec into 50Ω Load; Repetition Rate: 10 Hz to 1 MHz; Symmetry: Duty Cycle Variable from 45% to 55%; Hi-Amplitude or Fastrise Outputs; Sync Input: 5 V to 100 V p-p Sinewave, 2.5 V to 50 V pulse or square wave, 100 Hz to 1 MHz; Trigger Output: Risetime is 50 nsec and Ampl is >0.1 V into 50Ω.

114

TEKTRONIX 114
10 nsec Pulse Generator $285.00

Pulses or Symmetrical Square waves; ≤10 nsec Risetime and Falltime; Variable Pulse Period, Width and Ampl, ±10 V into 50Ω; External Trigger Input Req: > +2 V to + 20 V having a Risetime of 1 usec or less, Signals up to 2 MHz; Trigger Output: > 2 V, open circuit, 0.5 V into 50Ω Load.

115

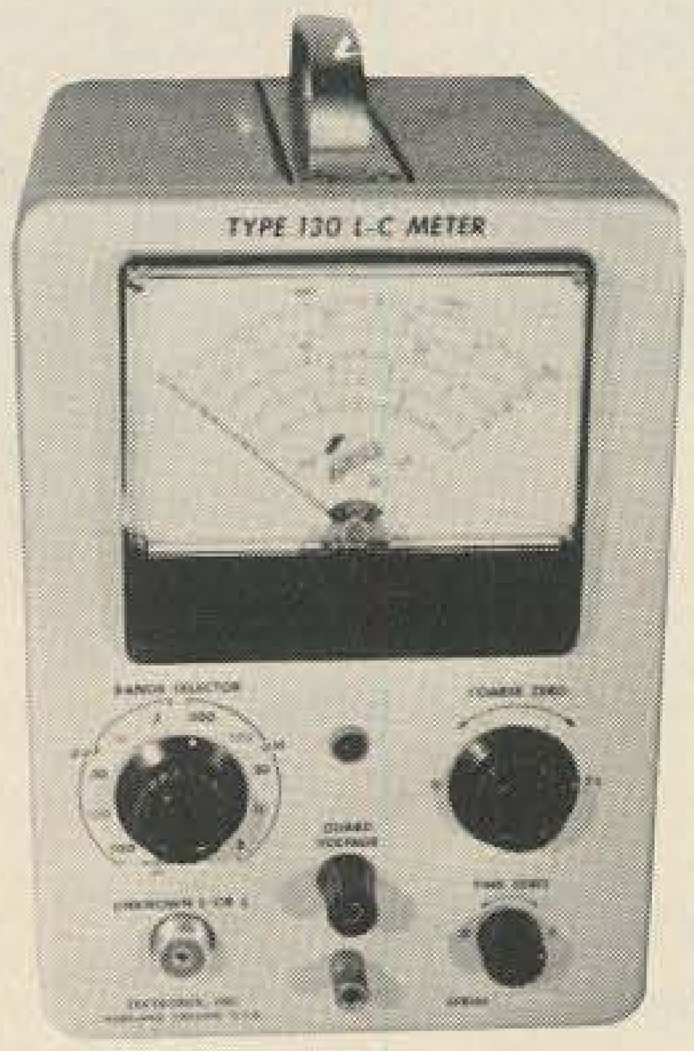
TEKTRONIX 115
Pulse Generator $750.00

Repetition Rate: 100 Hz to 10 MHz; DC Offset: Variable: Variable Risetime and Falltime: 10 nsec to 100 usec; and Pulse Width 50 nsec to 500 usec. Variable amplitude from ±20 mV to ±10 V into 50Ω Load.

ELECTRONIC INSTRUMENTS

TEKTRONIX 122
Low Level Preamplifier **$125.00**

Voltage Gain: 1000 Frequency Response: 0.16 Hz to 40 kHz Output Voltage: 20 V max. p-p. Battery operated.



130

TEKTRONIX 130
LC Meter **$229.00**

Microhenries: 0 to 3, 10, 30, 100, 300. Picofarads: 0 to 3, 10, 30, 100, 300. Accuracy: 3% of Full Scale.

TEKTRONIX 131
Current Probe Amplifier **$65.00**

To be used with Tektronix P6016 Probe Model 4.

TEKTRONIX 132
Plug-In Power Supply **$159.00**

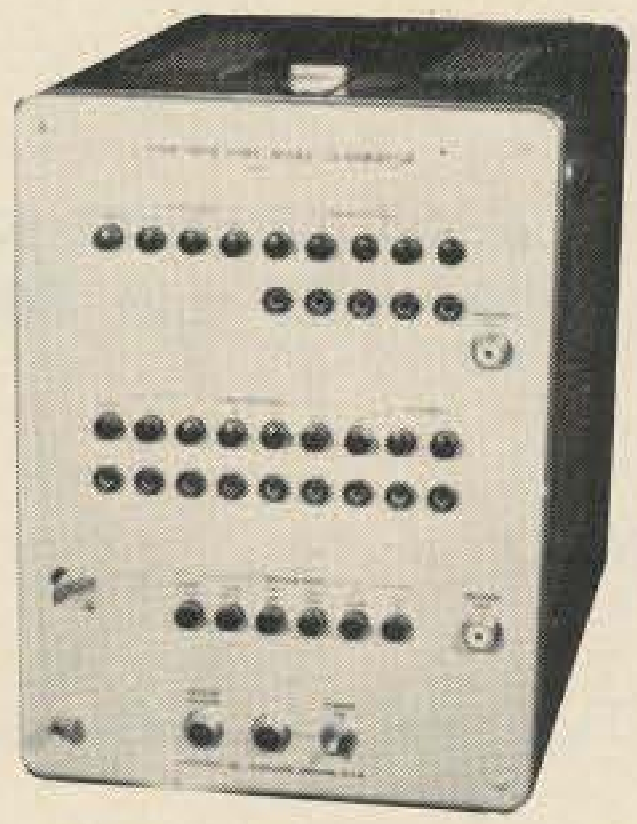
Unit provides an electronically regulated power supply and amplifier for all Tektronix Type A to Z Plug-In.

TEKTRONIX 180
Time Mark Generator **$145.00**

12 Time Mark Intervals; 1 usec to 500 msec; 5, 10 and 500 MHz Sine Wave.

TEKTRONIX 180-A
Time Mark Generator **$199.00**

14 time mark intervals 1 us to 5 s; 5, 10, & 50 MHz sine wave.



180A

TEKTRONIX 190A
Constant Amplitude Generator **$145.00**

Sine wave oscillator for Oscilloscope calibration with 6 ranges of output from 350 kHz to 50 MHz and amplitude from 40 mV to 10 V.

TEKTRONIX 191
Constant Amplitude
Signal Generator **$475.00**

Frequency Range: 350 kHz to 100 MHz/7 ranges; Ampl Ranges: 5 mV to 5 V peak/3 ranges; Ampl Reference: 50 kHz; Harmonic Content: Typically less than 5%.

TEKTRONIX 422
Dual Trace
Oscilloscope/Batter Pack **$1075.00**

Bandwidth: DC to 15 MHz; Risetime: 23 nsec; Cal. Deflection Factor: 10 mV/div to 10 V/div; Horizontal Cal. Timebase 0.5 usec/div to 0.5 sec/div x 10; Magnifier: Extends fastest timebase to 0.05 sec/div; External Input: 1 V/div to 130 V/div; DC, 500 kHz.

TEKTRONIX 200-1
Scope Cart **$69.00**

For Tektronix Type 453, 454, and 491 Oscilloscopes.

TEKTRONIX 201-2
Scope Mobile **$79.00**

To be used with Tektronix 560 Series Oscilloscopes.

TEKTRONIX 202-2
Scope Cart $79.00

For Tektronix Type 507, 530, 540, 580 series and 551, 555, 575, 576, and 661 Oscilloscopes.

TEKTRONIX 204-2
Scope Cart $79.00

For Tektronix Type 7704A, 7504, and 7904 Oscilloscopes.

453

TEKTRONIX 453
Portable Oscilloscope $1495.00

Bandwidth: DC to 50 MHz; Risetime: 7 nsec Cal; Deflection Factor: 5 mV/div to 10 V/div; 50 mV/div to 100 V/div with "6010" Probe; Horizontal Cal. Timebase: 0.1 usec/div to 5 sec/div X 10; Magnifier: Operated over full timebase, increases fastest rate to 10 nsec/div Cal; Sweep Delay: 1 usec to 50 sec; External Input: 270 mV/div to 2.7 V/div, on Channel 1 can drive horizontally.

TEKTRONIX 454
Portable Oscilloscope $1975.00

Bandwidth: DC to 150 MHz; Risetime: 2.4 nsec Cal; Deflection Factors: 5 mV/div to 10 V/div in 11 steps; 50 mV/div to 100 V/div with "P6047" Probe; Horizontal Cal. Timebase: 0.05 nsec/div to 5 sec/div in 24 steps; Triggering: DC to 150 MHz; X10 Magnifier: Operates over full timebase, increases fastest time rate to 5 nsec/div, X-Y Operation: 5 mV/div to 10 V/div; DC to 2 MHz.

R454A

TEKTRONIX RM454-A
Oscilloscope $1850.00

Same as 454A, Rack Mounted Version.

TEKTRONIX 465
Dual Trace Oscilloscope $1595.00

DC to 100 MHz, sens 5 mV/div to 5 V/div.

TEKTRONIX 500-A
Scope Mobile $59.00

To be used with all Tektronix 500 Series Scopes.

TEKTRONIX 502
Dual Beam Oscilloscope $299.00

Frequency range: DC to 100 Kc increasing to DC to 1 mc. Risetime: 3.5 nsec diminishing to 0.35 nsec. calibrated deflection factor: 200 mV/CM to 20 V/CM calibrated sweep range: 1 nsec/CM to 5 sec/CM magnifier: 2.5, 10 and 20x. Sweep rate: 1 nsec/CM accel potential: 3 kV.

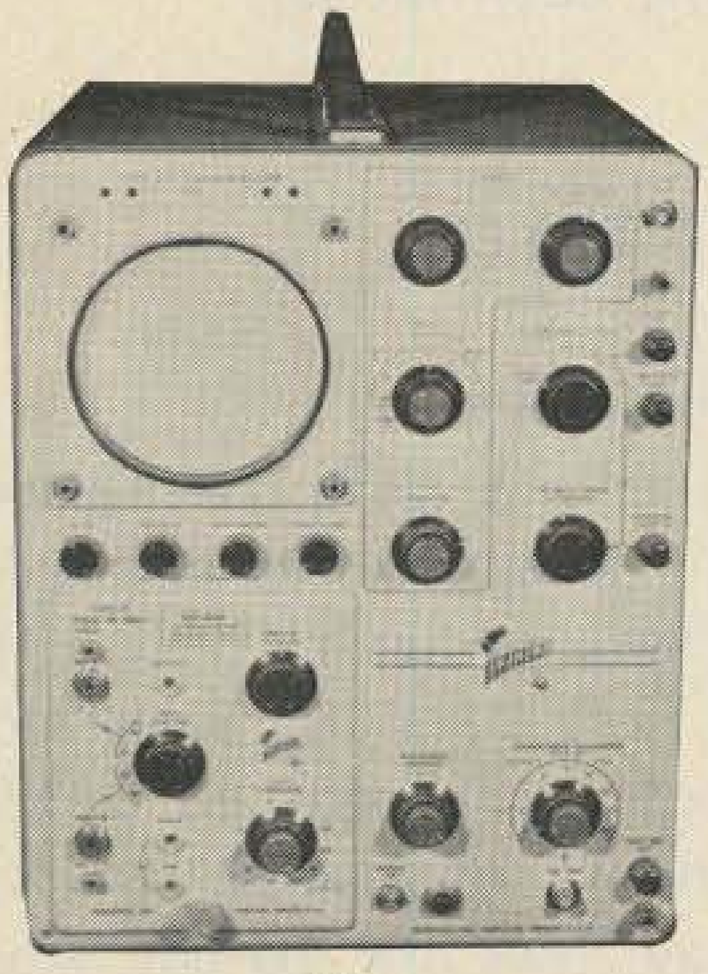
TEKTRONIX 503
X-Y Display Oscilloscope $475.00

V&H Bandwidth: DC to 450 kHz; Cal. Deflection Factor: 1 mV/CM to 20 V/CM; Common Mode Rejection: 100:1/1 mV/CM, DC to 50 kHz; Sweep Generator: Cal. Timebase: 1 usec/CM to 5 sec/CM; Sweep Magnifier: X2, X20, X50.

ELECTRONIC INSTRUMENTS

TEKTRONIX 515A
Oscilloscope **$575.00**

General purpose unit with DC-15 MHz response. Vertical Bandwidth and Sensitivity: 50 mV to 20 V/CM; Range of Timebase: .2 usec to 2 sec, 5 X Magnifier. 5" CRT.



531

TEKTRONIX 531
Oscilloscope **$399.00**

DC to 15 MHz; Vertical: Takes A to Z Plug-Ins; Sweep Ranges: 0.1 usec/CM to 5 sec/CM in 24 steps; Sweep Magnifier: 5X, extends rate to 20n sec/CM.

TEKTRONIX 531A
Oscilloscope **$475.00**

Bandwidth: DC to 15 MHz; Vertical Deflection: Characteristics are extremely flexible through use of the 1 Series & Letter Series Plug-Ins; Horizontal Cal. Timebase: 0.1 usec/CM to 5 sec/CM; X5 Magnifier; Extends timebase to 20 ns/CM; External Input: 0.2 V/CM to 2 V/CM, DC to 350 MHz.

TEKTRONIX 533
Oscilloscope **$429.00**

DC to 15 MHz; Vertical: A to Z Plug-Ins. Sweep Range: 0.1 usec/CM to 5 sec/CM in 24 steps; Sweep Magnifier: 2, 5, 10, 20, 50 and 100X.

TEKTRONIX 535A
Oscilloscope **$675.00**

Bandwidth and Sensitivity: DC to 15 MHz, requires "1" or letter series plug-in; Range of Timebase: 0.1 usec to 5 sec/CM plus delayed sweep.

TEKTRONIX 541
Oscilloscope **$499.00**

Bandwidth and Sensitivity: DC to 30 MHz, requires "1" series or letter plug-ins. Range of Timebase: 0.1 sec to 12 sec/CM plus X5 magnifier.

TEKTRONIX 541A
Oscilloscope **$665.00**

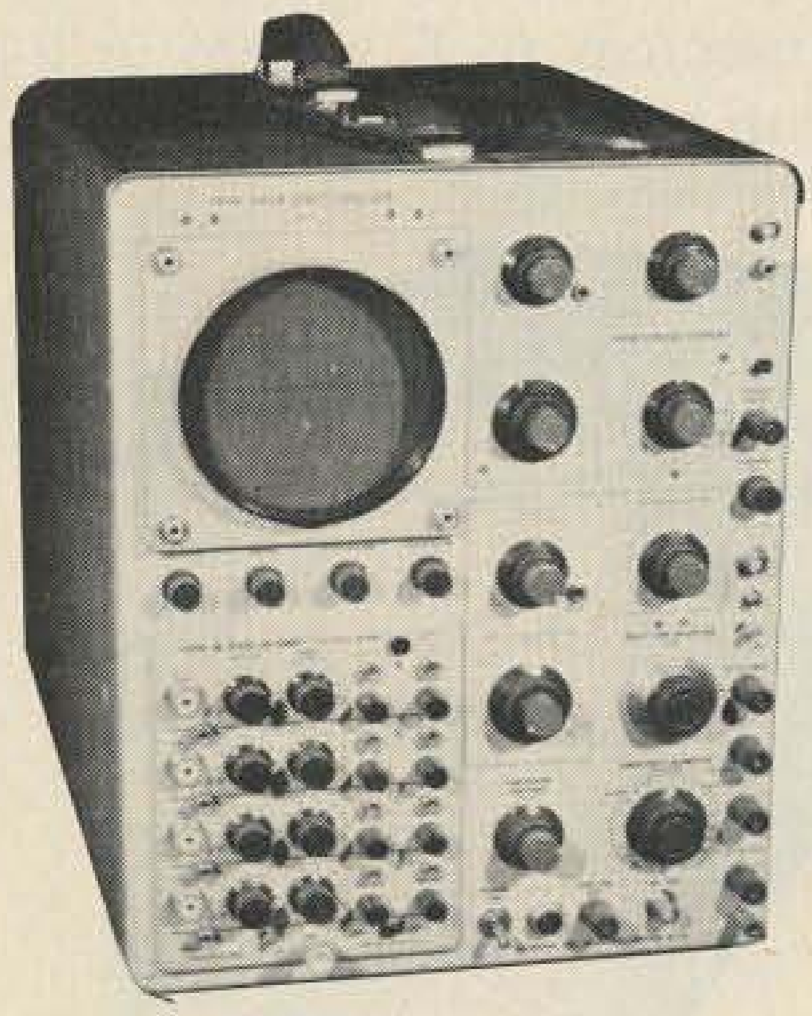
DC to 30 MHz; Vertical A to Z plug-ins Sweep range: 0.1 usec/CM to 5 sec/CM in 24 steps; Sweep magnifier: 5X less plug-ins.

TEKTRONIX 545
Oscilloscope **$695.00**

Frequency: DC to 30 MHz; Timebase A: .1 usec to 1 sec/CM; Timebase B: 2 usec to 10 msec/CM with X5 Magnifier.

TEKTRONIX 545A
Oscilloscope **$699.00**

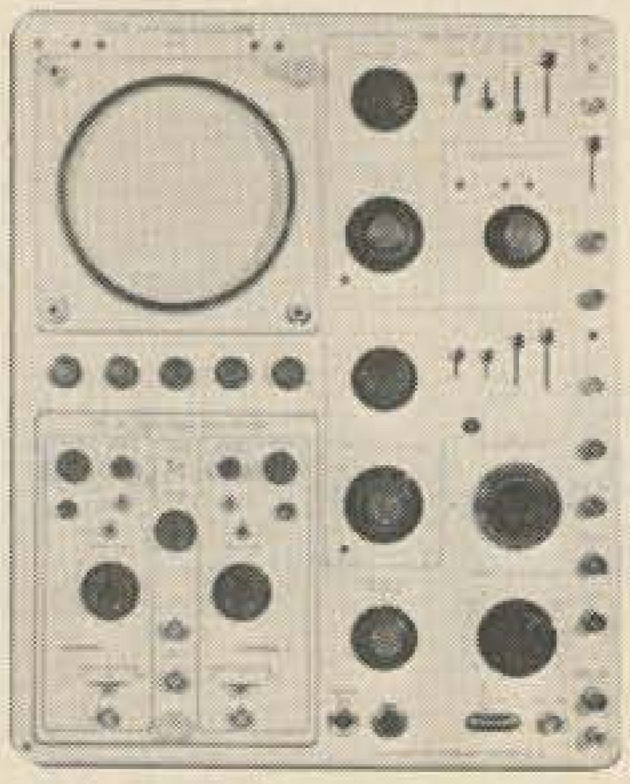
DC-30 MHz passband. Two time base generators with provisions for sweep delay and single sweeps. 4 x 10 cm display. 10 kV accelerating potential. Dual trace blanking and amplitude calibrator provided.



545-B

TEKTRONIX 545B
Sweep Delay Oscilloscope **$895.00**

Bandwidth: DC to 33 MHz; Vertical Deflection: Deflection characteristics are extremely flexible through use of all 1-Series & Letter Series Plug-Ins; Horizontal Cal. Timebase: 0.1 usec/cm to 5 sec/cm; Timebase B, 2 usec/cm to 1 sec/cm; X5 Magnifier: Extends timebase to 20 ns/cm; Cal. Sweep Delay: 2 usec to 10 sec; External Input: 0.2 V/cm, DC to 350 kHz.


547


564B

TEKTRONIX 547
Oscilloscope $1095.00

Bandwidth and Sensitivity: DC to 50 MHz, requires "1" or letter series plug-in; Range of Timebase: Dual Timebase 0.1 usec to 5 sec/cm with X10 Magnifier.

TEKTRONIX 555
Dual Beam Oscilloscope $995.00

Vertical: A to Z Plug-Ins for either channel. Sweep Range: Two timebase generators each cover 0.1 usec/cm to 5 sec/cm in 24 steps. Supplied with power supply.


561A

TEKTRONIX 561A
Oscilloscope $299.00

Bandwidth and Sensitivity: DC to 10 MHz mainframe requires "2" or "3" series plug-ins. Range of timebase: Requires "2" or "3" series plug-ins.

TEKTRONIX 561-B
Oscilloscope $395.00

Same as 561A, Later Model.

TEKTRONIX 564-B
Split-Screen
Storage Oscilloscope $775.00

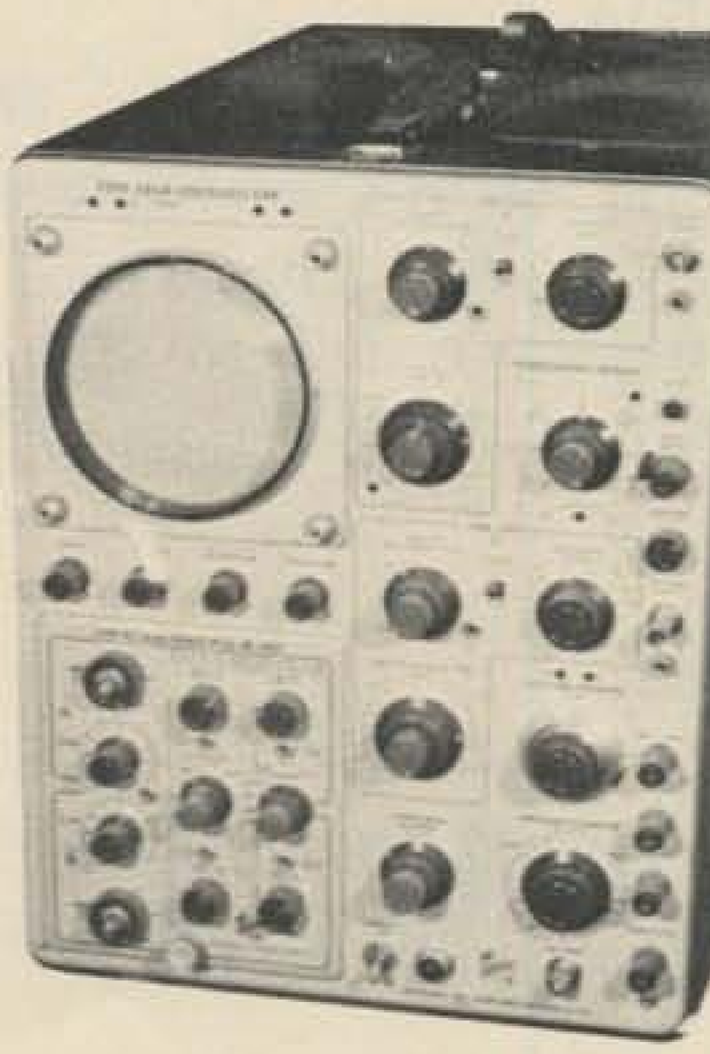
Vertical Deflection: Vert. Def. Characteristics are extremely flexible through use of 2-Series & 3-Series Amp. Plug-In Units; Horizontal Deflection: Hor. Def. Characteristics are extremely flexible through use of 2-Series & 3-Series Amp. & Timebase Units; Storage CRT: Display area 8 x 10 cm; Accelerating Volt: 3.5 kV; Split-Screen Storing: Store on either upper or lower half of screen with non-storage on other half, store on entire screen or non-store on entire screen; Viewing Time: Up to one hour; Erase Time: Approximately 0.25 sec; Writing Specs: Up to 500 cm/msec.


575

TEKTRONIX 575
Transistor Curve Tracer $850.00

Function: Base or Emitter Step, Generator, Voltage or Current and Either Pos. or Neg., also Collector Sweep Generator, runs at 120/240 cps, Variable 0 to 20 V at 1 Amp or 0 to 200 V at 1 Amp.

ELECTRONIC INSTRUMENTS



585A

TEKTRONIX 585-A
Oscilloscope **$1075.00**

With 80 MHz bandwidth and 50 nsec to 2 sec/cm calibrated timebase. Requires Tek 80 series plug-in to operate.

R647

TEKTRONIX R-647A
Oscilloscope **$775.00**

Frequency: DC to 100 MHz; Takes 10A1 or 2 and 11B1 or 2 Plug-ins (no plug-ins supplied).

10A2

TEKTRONIX 10A2A
Dual Trace Amplifier **$350.00**

Versatile Plug-In for 647A Scope; Bandwidth: DC to 100 MHz; Deflection Factor: 10 mV/CM to 20 V/CM; Risetime: 3.5 ns.

TEKTRONIX P6006
Test Probe **$20.00**

Attenuation: 10X. Bandwidth: DC to 35 MHz.

TEKTRONIX P6008
Test Probe **$25.00**

Attenuation: 10X. Bandwidth: DC to 100 MHz.

TEKTRONIX P6010
Test Probe **$25.00**

Attenuation: 10X. Bandwidth: DC to 50 MHz.

TEKTRONIX P6011
Test Probe **$15.00**

Attenuation: 1X. Bandwidth: DC to 33 MHz.

TEKTRONIX P6013
High Voltage Probe **$165.00**

Attenuation: 1000X; Input Resistance: 100 MΩ; Voltage Rating: 12 kV dc.

TEKTRONIX P6015
High Voltage Probe **$150.00**

Attenuation 1000X, peak V 40 kV dc max, bw 75 MHz.

TEKTRONIX P6021
Current Probe **$89.00**

12 Hz to 35 MHz, Peak Pulse to 15 A.

TEKTRONIX P6028
Test Probe **$15.00**

Attenuation: 1X. Bandwidth: DC to 33 MHz.

TEKTRONIX P6035
Test Probe **$25.00**

Attenuation: 100X. Bandwidth: DC to 1.7 GHz.

AST/SERVO SYSTEMS, INC. • 20 REPUBLIC ROAD • NORTH BILLERICA, MA 01862 • 617-667-8541

ELECTRONIC INSTRUMENTS

TEKTRONIX P6038
Test Probe $75.00
Cathode Follower Probe; To be used with Sampling Type Plug-Ins.

TEKTRONIX P6045
Probe $325.00
Attenuation: 1X, 10X, 100X; Bandwidth: (-3 dB) DC to 230 MHz; Input Z: 10 MΩ shunted by 5.5 pF; Max. Input Voltage: 12 V, derated with frequency. The "P6045" is designed primarily for use with Tektronix 454A Oscilloscope and conventional oscilloscopes with 1 MΩ input resistance.

TEKTRONIX 067-0502-00
Calibration Fixture $289.00

TEKTRONIX 067-0523-00
Test Plug-In $85.00
To be used in the calibration of 580 Series Oscilloscope. Has built-in Pulser and load capabilities.

TELETRONICS MA-259
Diode Tester $45.00
Current Ranges: .01, .1, 1, 10, 100, 1000 DC uA; Internal Battery Powered.

TELEQUIPMENT
Type "A" Amplifier $49.00
For use in S43, D43, RD43, and D53 Mainframe. Bandwidth: DC to 15 MHz. Attenuation: 100 mV to 50 V.

TELEQUIPMENT S-31
Oscilloscope $129.00

TELONIC TA-50A
Attenuator $39.00
Frequency Range: DC to 900 MHz, usable to 1250 MHz; Attenuator Steps: 0, 10, 20, 30, 40, 50 dB. VSWR 1:1.25. Power Rating 1 Watt.

TELONIC TAB-50A
Attenuator $89.00
Attenuation: 0 to 59 dB in 1 dB Steps. Through use of a dual concentric knob arrangement. Frequency: DC to 900 MHz, usable to 1250 MHz. VSWR 1.35:1. Power Rating: 1 Watt.

TELONIC TG-950
Attenuator $39.00
Attenuation: 0 to 102 dB in 1 dB Steps. Frequency Range: DC to 300 MHz. Power Rating: ½ Watt.

TELONIC TBP 162-40-4BA1
Filter $29.00

TENNY "JR"
Chamber $795.00

TRANSISTOR DEVICES
Model TDM OV Protected $59.00
Output: 4.5 V to 5.5 V, 5 A; Input: 115 V, 60 Hz; Line Regulation: -.01% plus 5 mV; Load Regulation: -.01% plus 5 mV; Ripple: .001% RMS plus 200 microvolts; Current Limiting Adjustment and Voltage Adjustment.

TRANSPAC SV250
Power Supply $39.00


Triplett 630

TRIPLETT 630
VOM $89.00
Voltage Range: 0 V to 5000 V dc/ac. Current Range: 0 to 100 uADC; 0 to 10 to 100 max, 0 – 10 ADC: Resistance: 1000, 10,000, 1M & 100M scales; Decibels: -20 to +11, 21, 35, 49, on 600Ω line. Mirror Scale Accuracy: DC: 1½%, AC: 3%, Resistance: 1½%.

ELECTRONIC INSTRUMENTS

TRIPLETT 801
Volt/Ohm Meter **$129.00**
FET Multimeter. Ranges: .05 V to 1500 V. Ohms Ranges: 0 to 1000 Megohms. AC Volt Ranges: .005 to 1500 V. AC/DC Microamps: 0 to 5/500. AC/DC Milliamps: 0 to 500.

TRYGON HR20-1.5
Power Supply **$139.00**
Output: 0 to 20 V @ 1.5 Amps; Regulation: 0.1%. Ripple and Noise less than 0.5 mV rms. Metered, Constant Voltage and Current; Adjustable Current Limited.

TRYGON HR40-750
Power Supply **$115.00**
Output: 0 t- 40 V @ .75 Amps. Regulation: 0.1%. Ripple and Noise less than 0.5 mV rms. Metered, Constant Voltage and Current. Adjustable Current Limited.

TRYGON MS36-50V5 358
Power Supply **$99.00**
Output: 4 to 36 V @ 5 Amps.

TRYGON ELECTRONICS T50-2
Power Supply **$129.00**
Output: 0 to 50 V @ 2 Amps; Metered, Current, and Voltage Controlled.

UNIVERSAL VOLTRONICS BAP22-5.5
Portable Power Supply **$199.00**
Output: 0 to 22 kV @ 5.5 mA.

VARIAN G-10
Strip Chart Recorder **$159.00**
Fixed span unit 0 to 10 mV, 5" paper, 8"/minute and 4"/hour chart speeds, 0.1 megohm input impedance. Ink writing.

VARIAN G-11-A
Temperature Recorder **$229.00**
Portable, Null Balance Type Servo Recorder. Range: .01 to 100 V, 9 steps; F.S. Balancing Time: 1 sec. Limit of Error: 1% of span; Sensitivity: ¼% of span. Chart Width: 6"; Power Req: 115 V, 60 Hz, 55 VA.

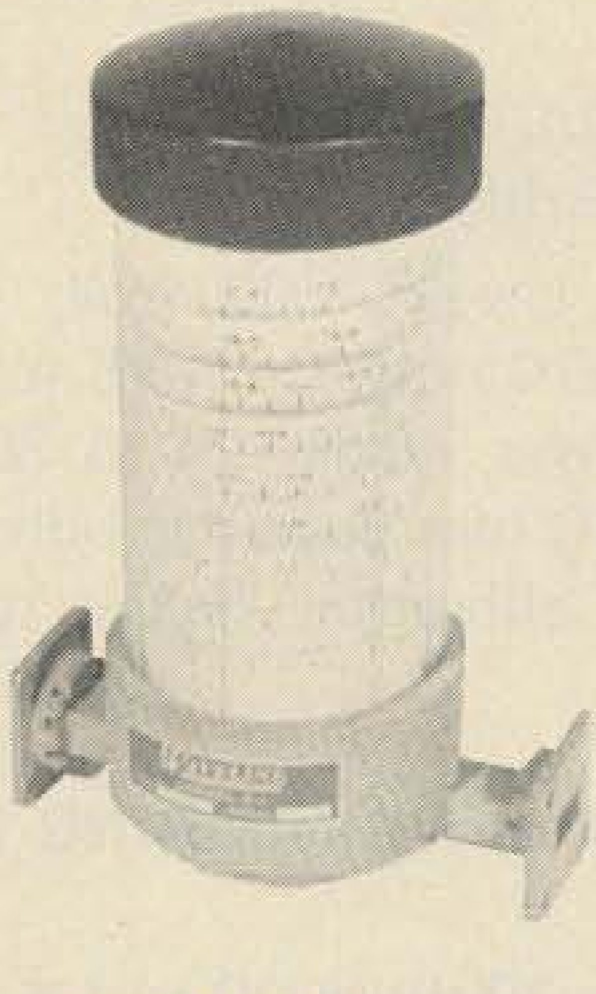
WAVELINE 642
X-Band Waveguide **$20.00**
Straight Waveguide Section 6" Long.

WAVELINE 741
3" KU Band **$20.00**
Waveguide Straight Section.

WAVELINE 741-1
3" KU Band **$20.00**
Same as above with choke to choke combination.

WAVELINE 754
Termination **$39.00**
Fixed Termination with a maximum VSWR of 1.02.

WAVELINE 767
KU Band Pressure Unit **$45.00**



Wave Line 798 DR

WAVELINE 798 DR
Frequency Meter **$250.00**

WAVELINE 812DR
Variable Precision Attenuator **$99.00**
Range 0 to 40 dB. VSWR 1.15 Max. Insertion Loss 0.5 dB Max.

WAVELINE 822
Variable Attenuator **$195.00**
Frequency: 18 GHz to 26 GHz; Attenuation: 0 to 60 dB.

ELECTRONIC INSTRUMENTS

Wayne Kerr B500

WAYNE KERR B500
Logrithmic LCR Bridge **$299.00**
Overall Ranges: L-10 nH to 16 kH, C-10 fF to 16 mF, R-100 uOhm to 160 MOhms. Test Frequency: 1 kHz (Internal). Overall Accuracy: 1%.

WEINSCHEL ENGINEERING BA-1B; BA-5; ND-1
Attenuator Calibrator
Lot Price **$750.00**
Please write for complete specifications.

WEINSCHELL TB-2A
Thermistor Bridge **$475.00**
RF Power Level: 1.00 mW; Accuracy of substituted DC power; ±.15% for bias power; DC bias power range: 24 to 36 mW, 11 to 13.5 mA. DC bias power stability: less than 1 u w/min. Calibration factor range: .85 to 1.05.

WEINSCHELL ENGINEERING 10-20
Attenuator **$49.00**
Attenuation: 20 dB @ DC to 1.5 GHz.

WEINSCHEL ENGINEERING 210-10
Coax Attenuator **$35.00**
Attenuation: 10 dB. Frequency Range: 1 to 12.4 GHz. Nominal Impedance: 50 Ohms.

WESTERN MICROWAVE 13B 2040
3 Port Circulator **$49.00**

WESTON
300 Amps/50 mV Meter Shunt **$20.00**

WESTON 2 Amps/50 mV Meter Shunt 20.00

WESTON
1 DC Voltmeter **$59.00**
0, 150, 300, 750 Amps

WESTON Model 4
Standard Cell **$20.00**
Unsaturated Standard Cell, Electromotive Force of 1.01 – measured before shipment.

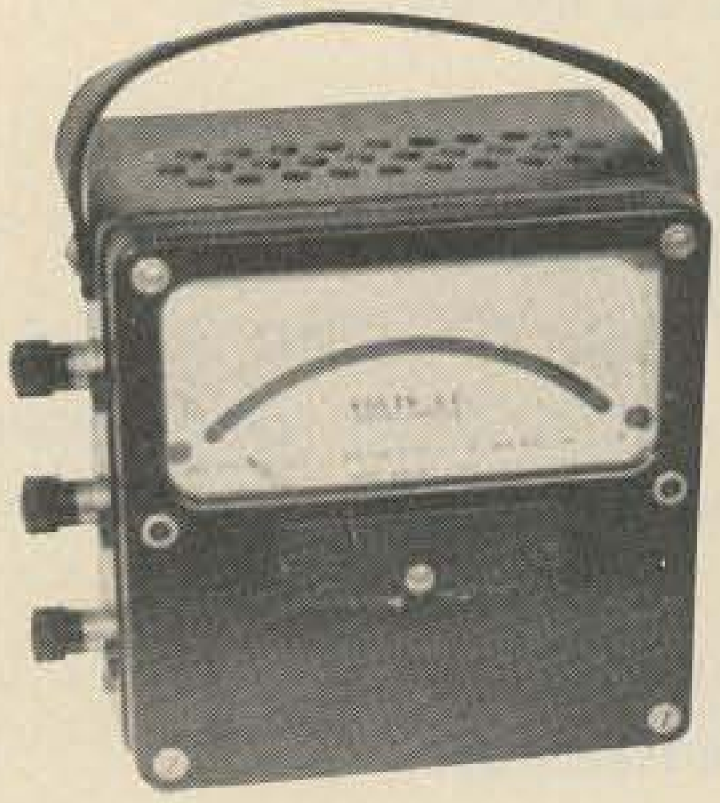
WESTON 155
AC Ammeter **$49.00**
Range: 0 to 150 Amps. Frequency: 25 to 500 Hz.

WESTON 327-2
Current Transformer **$99.00**
Ranges (Amps) 1200, 600, 400, 300, 200, 100, 50, 20, 10. Primary to 5 Secondary.

WESTON 341
High Frequency Voltmeter **$89.00**
0, 7.5, 15; 0, 150, 300, 600; 0, 75, 150; 0, 30, 75 Volts.

WESTON 432
AC/DC Wattmeter **$59.00**
Range: 0-375, 0-700, 0-1400 Watts.

WESTON 432
AC/DC Killiwatt Meter **$59.00**
Range: 0-.75, 0-1.5, 0-3 Killiwatts.



931-433

WESTON 433
AC Voltmeter **$39.00**
0, 300 Volts

ELECTRONIC INSTRUMENTS

WESTON 433
AC Ampmeter $39.00
0, 5 Amps.

WESTON 433
AC Voltmeter $49.00
0, 5, 10; 0, 10, 20; 0, 30, 60; 0, 150, 300; 0, 150, 300, 750 Volts.

WESTON 433
AC Ampmeter $49.00
0, 1, 5, 10; 0, 2.5, 5; 0, 10, 20; 0, 2, 5, 20 Amps.

WESTON 433
AC Meter $49.00
0, 50, 100; 0, 75, 150 Volts.

WESTON 455
AC/DC Voltmeter $59.00
0 to 75, 150, 300 Volts.

WESTON 455
AC/DC Voltmeter $45.00
0, 7.5, 15, 30 Volts.

WESTON 461-1
Current Transformer $85.00
Ranges (Amps) 1000, 500, 250, 100, 50, 25, 10. Primary to 5 Secondary.

WESTON 622
DC Meter $89.00
0, 50, 100, 200, 500, 1000 Volts.

WESTON 756
Illumination Meter $299.00
Ranges: 0 to 6, 12, 60, 120, 600 Foot-Candles.

WESTON 901
DC Voltmeter $49.00
0, 15, 75, 150. 0, 15, 75, 150, 300 Volts.

WESTON 904
AC Voltmeter $39.00
0, 10, 20 Volts.

WESTON 901
DC Voltmeter $59.00
0, 3, 150, 300 Volts.

931

WESTON 931
DC Voltmeter $49.00
0, 3, 15, 150. 0, 3, 150, 300; 0, 7.5, 30, 75; 0, 150, 300, 750 Volts.

WESTON 931
DC Voltmeter $39.00
0, 50; 0, 75, 150; 0, 300 Volts.

WESTON 931
DC Meter $49.00
0, .03, .30, 30; 0, .15, 1.5, 15 Amps.

WESTON 932
AC Voltmeter $49.00
0, 25, 250 Volts.

1251

WESTON 1251
Frequency Counter $229.00
Compact, lightweight time measuring device for measuring time intervals, period average, events (totalizing), scaled events and frequency ratio. Both start (A) and stop (B) inputs are internally switch-selected to allow for measuring zero-crossing or TTL level signals. **Input Impedance:** 1 megohm shunted by less than 50 pF. **Maximum Input Voltage:**

±50 V dc referenced to ground for either or both sides of input. **Sensitivity:** Zero crossing mode, 100 mV rms; TTL/relay mode, TTL compatible. **Minimum Pulse Width:** Zero crossing mode, 100 nsec at 300 mV p-p; TTL/relay mode, 50 nsec at TTL levels. **Range:** Time A-B, 0.1 usec to 9999.9 sec; period average, 50 nsec to 9999.9 sec; events, 1 to 99999. **Resolution:** Time A-B, 100 msec to 100 nsec; period average, 100 nsec/number of periods averaged. **Accuracy:** ±1 count ± timebase accuracy ± trigger error (start/stop). **External Oscillator Input Range:** DC to 12.5 MHz. **Readout:** Five 7-segment LEDs plus 3 incandescent lamps and 2 decimal points for range indication and overrange. **Timebase:** Frequency, 10 MHz; aging rate, less than 5 ppm/yr.: line voltage stability, less than ± 1 part in 10 million for 10% line variation: temperature stability, ± 5 ppm 10° C to 40° C ambient referenced at 25°C. **BCD Output:** Rear panel connector for 5 digits of BCD; overrange flag; completion flag; 5 volt reference (at 1000 Ohms); ground and range programming inputs; max. cable length, 18". Connect a TTL compatible digital printer to back for automatic recording. **Fuse:** 125 volt, ¼ Amp slow blow; 250 volt, 1/3 Amp slow blow. **Power Required:** 105-125 volts, 50/60 Hz, 23 Watts (210-250 volts by changing internal switch and fuse). **Size:** 6-1/4"W x 9-1/16"D x 2-1/4"H. Weight, 4½ lbs.

WESTON 1252
Frequency Counter **$259.00**

Compact, lightweight counter designed for frequency measurements from less than 5 Hz to beyond 30 MHz. Front panel range switch allows selection of two preset gate intervals and Auto-Range. This unique function automatically determines the correct range for maximum resolution without overranging the instrument. In two manual range positions LSD remains valid even though MSD is out of display range. All solid state IC design. Automatic blanking of redundant zeros. **Input Frequency Range:** 5 Hz to 30 MHz min. **Input Sensitivity:** 10 mV rms. **Input Impedance:** 1 megohm shunted by greater than 15 pF. **Maximum Input Voltage:** 200 V rms. **Oscillator Frequency:** Timebase, 1 MHz: external, DC to 2 MHz. **Oscillator Settability (Timebase):** ±0.1 ppm. **Timebase Oscillator Temperature Stability:** ± 10 ppm max. 0 to 40° C ambient. **External Oscillator Sensitivity:** TTL or 2.5 V rms from 50 Ohm source. **External Oscillator Protection:** -5 V peak to +10 V peak. **Manual Ranges (Gate Interval):** kHz, 1 sec; MHz, 10 msec. **Auto Ranges (Gate Interval):** kHz, 10 sec; kHz, 1 sec; MHz, 100 msec; MHz, 10 msec (dependent on incoming signals). **Display Time:** 200 msec plus gate interval. **Fuse:** 125 volt, ¼ Amp slow blow: 250 volt, 1/8 Amp slow blow. **Power Required:** 105-130 V, 50/60 Hz, 20 Watts max. (210-260 volt, 50/60 Hz by changing internal jumper wires). **Size:** 7¼"W x 10½"D x 2¾"H (less handle). Weight: 4¾ lbs. Rugged compact design and exceptional design make Model 1252 ideal for scientist, engineer, hobbyist, service technician or for field use. Carrying handle converts to tilt stand for convenience.

1253

WESTON 1253
Frequency Counter **$379.00**

Model 1253 provides accuracy and stability enough for most general design and testing applications. Seven digits of easily read LEDs plus automatic leading zero blanking makes the 1253 a leader in its price class. **Frequency Range:** "A" input, 1 Hz to 65 MHz; "B" input, 10 MHz to 200 MHz (1 Hz to 230 MHz typical). **Timebase Type:** 1 MHz crystal. **Long Term Stability:** One part in million/mo.; 7.5 parts in million/yr. Front panel rotary switch allows fast selection of timebases. Carrying handle quickly locks into any of three positions, providing a handy tilt stand.

WESTON 1254
Frequency Counter **$399.00**

Model 1254 features the same high input sensitivity and wide frequency range of Model 1253, together with very high stability TCXO (temperature controlled) timebase allowing precise measurements. Model 1254 also incorporates complete remote programming capability. Inputs allow total external manual or computer control of range, input select (either high or low impedance input), reset or count inhibit, using standard TTL-level logic. Outputs are seven digits of BCD frequency information. Overrange flag, decimal points, print command and 5 volt reference and ground to drive all remote programming inputs. Internal 5 volt supply eliminates the need for external TTL-level supply in remote programming mode. **Frequency Range:** "A" input, 1 Hz to 65 MHz; "B" input, 10 MHz to 200 MHz (1 Hz to 230 MHz typical). **Long Term Stability:** 1 part in 10 million/mo.; 1 part in million/yr. **Timebase Type:** 1 MHz TCXO. TCXO is factory set to ±0.1 Hz and can easily be field recalibrated to this tolerance. Carrying handle quickly locks into any of three positions, providing a handy tilt stand.

WESTON 1257
Frequency Counter **$269.00**

1259

WESTON 1259
Frequeny Counter **$199.00**

Model 1259 extends the useful range of any counter with more than 100 kHz capability. Includes hybrid circuit amplifier for good response and high sensitivity, 600 MHz decade counter and emitter coupled logic circuit. Built-in power supply with integrated circuit regulator for improved reliability. No sensitivity adjustment and push-button selected scales make Model 1259 extremely easy to use. **Input Frequency Range (Divided By 1):** Sine or square wave of 10 MHz to 100 MHz. **Input Frequency Range (Divided By 10):** Sine wave, 40 MHz to 600 MHz (typical 15 MHz to 600 MHz); square wave, 10 MHz to 600 MHz. **Input Frequency Range (Divided by 100):** Sine wave, 40 MHz to 600 MHz (typical 15 MHz to 600 MHz); square wave, 10 MHz to 600 MHz. **Input Amplitude:** 50 mV rms minimum; 2 volts rms maximum (to maintain 2:1 VSWR); protected to 5 volts rms. **Input Impedance:** 50 Ohms with less than 2:1 VSWR from 10 MHz to 600 MHz and less than 2 volts rms input voltage, AC coupled. **Output Amplitude:** 1 volt peak-to-peak. **Output Impedance:** 50 Ohms, AC coupled. **Power Required:** 120 volts, 50/60 Hz, 7 Watts. May be changed to 240 volts with internal switch and change of fuse. **Size:** 6-3/4"W x 9-1/16"D x 2-1/4"H.

4449

WESTON 4449
Digital Multimeter **$149.00**

3½ digit. Solid state. Dual slope high impedance bi-polar A/D converter. Auto-blanking and polarity. Single chip for logic circuitry. Overload protection. **Ranges:** DC Volts: 0-199.9 mV – 1.999 V, .05% rdg ±1 digit. 0-19.99 – 199.9-1000 V, .1% rdg ±1 digit. AC Volts: 0-99.9 mV – 1.999-19.99-199.9 V, .3% rdg ±1 digit. 40 Hz – 10 kHz. 0-1000 V .5% rdg ±1 digit, 40 Hz – 2 kHz. 199.9 mV – 1.999-19.99-199.9 V, .6% rdg ±1 digit, 10 kHz – 20 kHz, 0-1000 V, 1% rdg ±1 digit, 2 kHz – 10 kHz. DC Current: 0-199.9 uA – 1.999 mA, .2% rdg ±1 digit. AC Current: 0-99.9 uA, .4% rdg ±1 digit, 40 Hz – 10 kHz. 0-1999 mA, .75% rdg ±1 digit, 10 kHz – 20 kHz. **Resistance:** 0-199.9Ω – 1.999 K, 1 mA @ 0.2 + 2 V, .25% rdg ±3 digits. 0-19.99 K – 199.9 K, 10 uA @ 0.2 + 2 V. .1% rdg ±1 digit. 0-1.999 M, 1 uA @ 2 V, .2% rdg ±1 digit. 0-19.99 M, .1 uA @ 2 V, .5% rdg ±1 digit. Specifications: **Conversion Rate:** 4 per sec. CMR: 80 dB. NMR: 38 dB. Power Req: 115 V, 50 – 400 Hz. Temp: 25° C 3° C, 0° C-50° C at derated acc. Size: 2.25"H x 5.45"W x 7"D. Weight: 2½ lbs.

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At LAST

a full range, 5-function 3½ digit multimeter

Data Precision's new Model 134 is the least expensive full function digital multimeter you can buy.

A real workhorse.

Designed as the first real alternative to analog meters, the Model 134 delivers digital precision at analog prices.

Measurements appear on a bright, 7-segment planar gaseous display, a full half inch tall and 3½ digits wide.

And they're precise measurements. Approximately 5 to 10 times more accurate than what you'll get from an analog meter. And a great deal easier to read.

Model 134 measures DC and AC volts, DC and AC current and resistance through a total of 22 range scales. No interpolations are necessary.

And the specs speak for themselves: basic accuracy of ±0.2% reading ±0.2% f.s. with auto-polarty, auto-decimal positioning and 100% over-range. Optional isolation and High Voltage Probes available.

SALE PRICE

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Data Precision...Years Ahead 5½ Digit TRI-PHASIC™ Digital Multimeter.

SUPERIOR PERFORMANCE AND LOWER COST

Three exclusive circuit innovations, TRI-PHASIC™ A/D conversion, ISOPOLAR™ reference and RATIOHMIC™ resistance measurement utilized in this "years ahead" series of digital instruments dramatically reduces cost while significantly enhancing performance.

EVERY 2500 SERIES DMM INCLUDES . . .

- ☐ FLASHING OVER-LOAD INDICATION
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- ☐ LOW POWER, 12 WATTS
- ☐ SMALL SIZE, 3½" x 8½" x 12"
- ☐ OVERLOAD 1000V, ALL VOLTAGE RANGES
- ☐ OVERLOAD 100V, ALL RESISTANCE RANGES
- ☐ CMRR: DC 160db, 60 Hz 120db
- ☐ NMRR: 60db AT 10 Hz AND ALL MULTIPLES
- ☐ TRI-PHASIC™, A/D CONVERTER
- ☐ ISOPOLAR™ REFERENCE
- ☐ RATIOHMIC™ RESISTANCE MEASUREMENT
- ☐ AUTO-RANGING
- ☐ AUTO-POLARITY
- ☐ LOW COST
- ☐ ISOLATED BCD OUTPUT, DTL/T²L COMPATIBLE
- ☐ REMOTE TRIGGERING
- ☐ REMOTE RANGING

DATA PRECISION 2530 Digital Voltmeter $849.00

DATA PRECISION 2535 Digital Voltmeter $829.00

DATA PRECISION 2540 Digital Voltmeter $885.00

DATA PRECISION 2540 A1 Dig. Voltmeter $895.00

DC VOLTS ● Ranges (4): ±1.00000 to ±1000.00 ● Basic accuracy, 6 mos., 23°C ±5°C ±0.001% f.s. ±0.007% rdg ±1 l. s. d. ● Resolution: 10μV-10 mV. **AC VOLTS** ● Ranges (4). 1.00000 to 1000.00 ● Frequency 30 Hz-100 kHz ● Basic accuracy, 6 mos., 23°C ±5°C: ±.02% f.s. ±0.05% rdg.
RESISTANCE: ● Ranges (5) 1.00000 kΩ-10.0000 megΩ ● Configuration: True 4-wire ● Basic accuracy, 6 mos., 23°C ±5°C: ±0.001% f.s. ±0.007% rdg ±1 l. s. d. **DC RATIO** ● Ranges (4): 1-1000 ● Input: 0 to ±1000V ● Reference: +1V to +11V ● Basic accuracy, 6 mos., 23°C ±5°C: (±0.007% rdg ±1 l. s. d.) x

$$\frac{10}{\text{Actual Ref. Voltage}}$$

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ELECTRONIC INSTRUMENTS

WESTON 4449
Digital Multimeter

FAST!

LIGHT!

DEPENDABLE!

SPECIAL $149.

3½ digit. Solid state. Dual slope high impedance bi-polar A/D converter. Auto-blanking and polarity. Single chip for logic circuitry. Overload protection. **Ranges:** DC Volts: 0-199.9 mV – 1.999 V, .05% rdg ±1 digit. 0-19.99 – 199.9-1000 V, .1% rdg ±1 digit. AC Volts: 0-99.9 mV – 1.999-19.99-199.9 V, .3% rdg ±1 digit. 40 Hz – 10 kHz. 0-1000 V .5% rdg ±1 digit, 40 Hz – 2 kHz. 199.9 mV – 1.999-19.99-199.9 V, .6% rdg ±1 digit, 10 kHz – 20 kHz, 0-1000 V, 1% rdg ±1 digit, 2 kHz – 10 kHz. DC Current: 0-199.9 uA – 1.999 mA, .2% rdg ±1 digit. AC Current: 0-99.9 uA, .4% rdg ±1 digit, 40 Hz – 10 kHz. 0-1999 mA, .75% rdg ±1 digit, 10 kHz – 20 kHz. **Resistance:** 0-199.9Ω – 1.999 K, 1 mA @ 0.2 + 2 V, .25% rdg ±3 digits. 0-19.99 K – 199.9 K, 10 uA @ 0.2 + 2 V. .1% rdg ±1 digit. 0-1.999 M, 1 uA @ 2 V, .2% rdg ±1 digit. 0-19.99 M, .1 uA @ 2 V, .5% rdg ±1 digit. Specifications: **Conversion Rate:** 4 per sec. CMR: 80 dB. NMR: 38 dB. Power Req: 115 V, 50 – 400 Hz. Temp: 25°C 3°C, 0°C-50°C at derated acc. Size: 2.25"H x 5.45"W x 7"D. Weight: 2½ lbs.

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BURROUGHS model D8565 computer display terminal

THE TERMINALS WE OFFER ARE NEW AND UNUSED, IN ORIGINAL CARTONS.

This display terminal has an integral controller, B/W cathode ray tube and keyboard. The system has a serial I/O interface for communication and an I/O interface for a printer. These units employ standard Motorola RTL Technology.

DISPLAY (P/N 4802-1095-501) FEATURES:
- 17" B/W CRT
- 41 lines of data
- 52 characters per line
- Characters are generated by a diode matrix "graphic" technique
- 21 special push-buttons wired for a program call up
- Brightness Control
- Self-contained power supply

KEYBOARD (P/N 4802-1115-501) FEATURES:
- Reed switch technology
- 54 data keys
- 28 special keys detachable with cable

LOGIC UNIT (P/N 4802-1157-502) FEATURES:
- 1024 by 6 bit core memory
- Printer I/O interface
- Communication I/O interface

POWER: 115V, 50/60 Hz, 500 Watts

WEIGHT: 210 lbs. (including logic unit keyboard, display and cables.)

SHIPPING WEIGHT: 238 lbs. F.O.B. oui warehouse.

SPECIAL PRICE:

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With complete documentation

INSTRUMENTS & COMPONENTS

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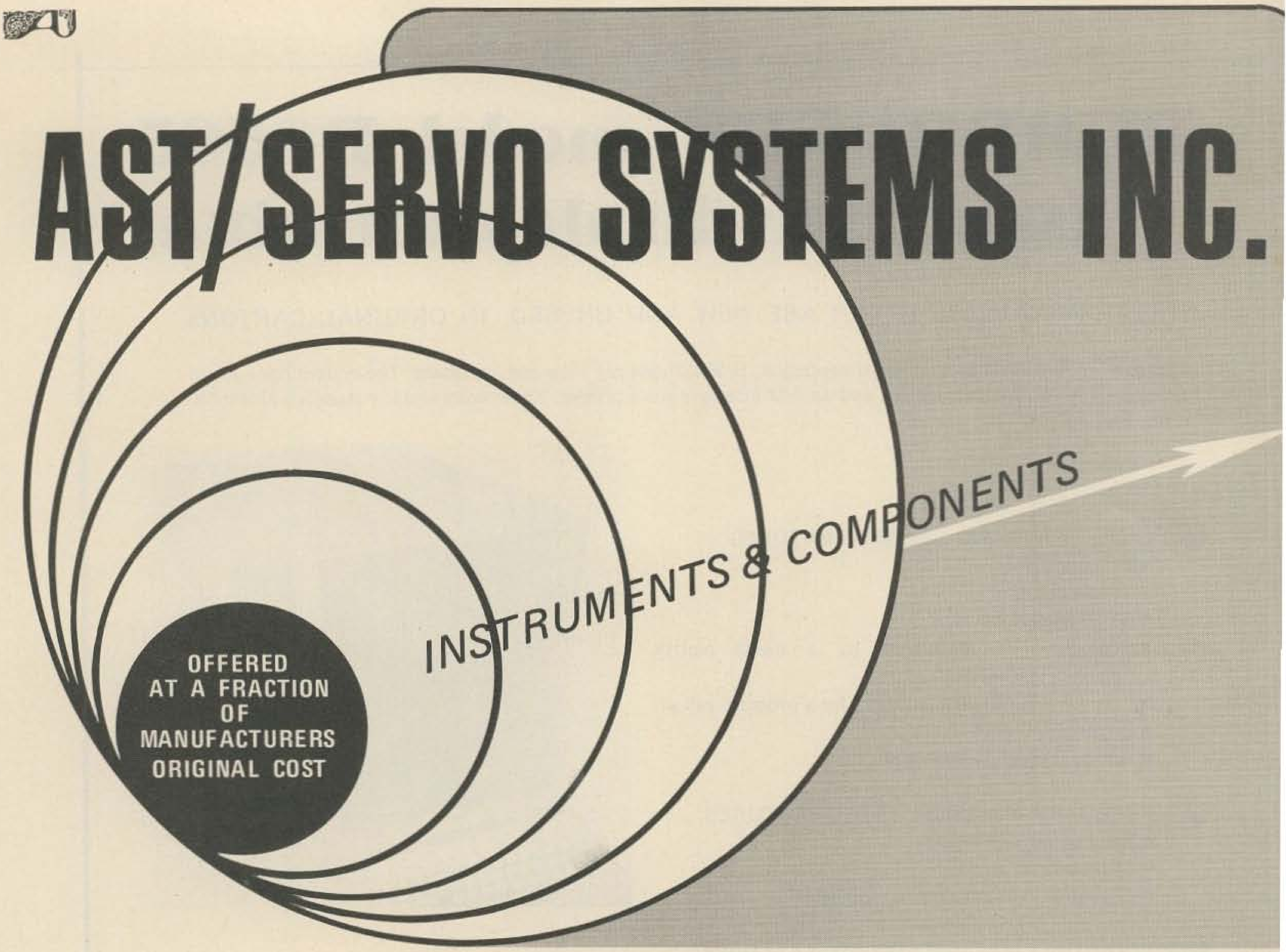

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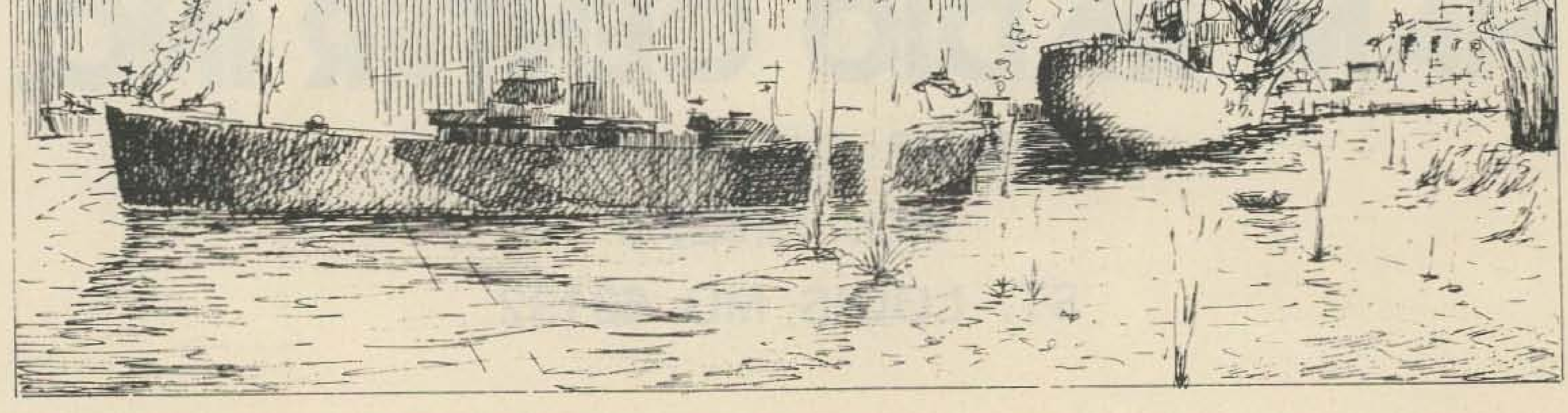
Paolo

Amateur radio is a rewarding hobby; one dividend is a wider window on the world, and another is technical expertise, but I think that most important is the friends we make. Some we keep, but the currents of life eddy and some drift away — until a page in a logbook or a card in a file brings them back and we are caught in a net of memories. Recently I came across a memento that sent the years spinning — a phony British pound note.

Illustrations by Carl Jackson

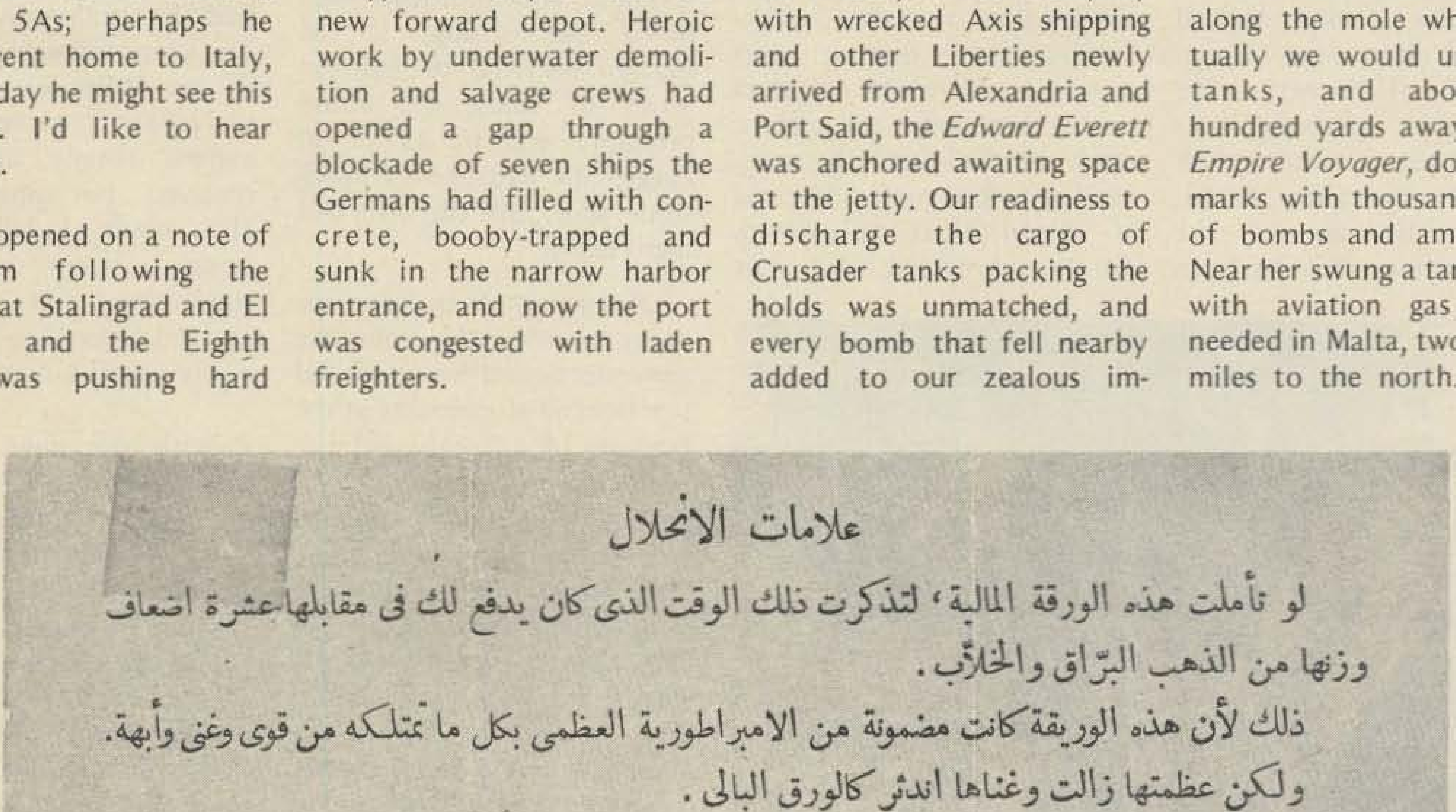


Paolo never told me his last name, and I forgot his call many years ago. It wouldn't do to mention it even if I could remember, not without knowing first how he arranged his life after the war. I'm satisfied that he isn't one of the few dozen licensed Libyan 5As; perhaps he finally went home to Italy, and one day he might see this magazine. I'd like to hear from him.

1943 opened on a note of optimism following the victories at Stalingrad and El Alamein, and the Eighth Army was pushing hard against the rear guard of the Afrika Korps. Steady pressure was essential to deny Rommel any opportunity to pause and exploit the defenses of Tunisia's Mareth Line. Montgomery required thousands of tons of supplies daily, and Tripoli was the new forward depot. Heroic work by underwater demolition and salvage crews had opened a gap through a blockade of seven ships the Germans had filled with concrete, booby-trapped and sunk in the narrow harbor entrance, and now the port was congested with laden freighters.

Along the Spanish Mole, on the seaward side, jetties were being worked around the clock, but the cargo handling facilities were limited and soon after sunset every evening the Luftwaffe arrived from Sicily. In the center of the harbor, in close company with wrecked Axis shipping and other Liberties newly arrived from Alexandria and Port Said, the *Edward Everett* was anchored awaiting space at the jetty. Our readiness to discharge the cargo of Crusader tanks packing the holds was unmatched, and every bomb that fell nearby added to our zealous impatience. So did the photo plane which checked the situation every afternoon and sped back to Sicily with tattletale negatives and our hearty wishes for a crash at sea.

Between us and the jetties along the mole where eventually we would unload our tanks, and about three hundred yards away, lay the *Empire Voyager*, down to the marks with thousands of tons of bombs and ammunition. Near her swung a tanker filled with aviation gas urgently needed in Malta, two hundred miles to the north. We paid



علامات الانحلال

لو تأملت هذه الورقة المالية، لتذكرت ذلك الوقت الذى كان يدفع لك فى مقابلها عشرة اضعاف وزنها من الذهب البرّاق والخلاّب.

ذلك لأن هذه الوريقة كانت مضمونة من الامبراطورية العظمى بكل ما تمتلكه من قوى وغنى وأبهة.

ولكن عظمتها زالت وغناها اندثر كالورق البالى.

فما هى قيمة الورق اليوم؟ لابد انك ملمّ بذلك.

ان كل يوم قد مرّ من ايام هذه الحرب التى اثارتها انكلترا، قد مزّق من قوى الامبراطورية الانكليزية وكل معركة خسرتها انكلترا كانت سبباً فى تدهور النقد البريطانى.

ان اليوم قد قرب الذى سيرفض فيه الشحاذ المتسوّل على قارعة الطريق قبول الجنيه الانكليزى وان كنت ستعطيه اياه كهبة منك.

ان الله قد اراد انحلال بريطانيا وسوف يكون...

homage to their courage with compassionate respect, and wished they weren't there.

Toward the west, where the root of the mole curved and joined the low profile of the city, were anchored more freighters and a destroyer. A minesweeper that kept us company on the trip from Alex, *H.M.S.A.S. Treen*, lay to the south between us and the city seawall. Next to it, and closest of the Allied vessels, a small coaster swung on one hook. Closer still, in fancy camouflage and obviously badly battered, the Italian motorship *Agostino Bertani* held our speculative gaze with her Latin grace. Displaying her raked funnel, low superstructure and seductive sheer in the midst of our motley flotilla, she looked like a badly used Maserati surrounded by old family Fords. A pelagic queen. Through the glasses we could see blast damage, twisted steel and scorched paint, but she was riding evenly and to the casual glance looked ready to depart for Genoa, her port of registry. The embarkation gangway was stowed, but a rope ladder hung from the stern, probably because of the barrage balloon floating from a cable secured on the fantail. In legal jargon the *Bertani* constituted an "attractive nuisance," for seamen are traditionally fond of visiting anything floating nearby. Besides, we were positive Italian vessels were fitted with enormous wine lockers. We had to find a way to go aboard.

Following the nightly raids, the British army would send a launch around the harbor, stopping at each anchored ship to pick up any wounded, and a friendly corporal thought of a way a skiff could be managed. There was no sign he thought it curious that anyone would want to go punting among the debris and oil slicks floating around us, and his only comment was, "Mind you don't bump into something wicked." This referred to a report that the bombers were dropping a new harbor torpedo which knew better than to miss a target and then continue to pointless self-destruction on the beach. Failing to bag a ship promptly, it would run mad circles just under the surface until the fuel was exhausted, then a ballast tank filled and it would float tail down, barely submerged, and wait for the unwary. So we would row very carefully.


W7IDF and Paolo (identity concealed).

The next afternoon the engine department cadet and I climbed the rope ladder to the fantail of the *Bertani* and made our way along the main deck and up to the bridge. The damage was worse than we had guessed, but the R.A.F. had pounded the harbor before the fall of Tripoli and now the Germans were taking their turn, so it was a miracle the ship was still afloat. Debris blown back and forth by dozens of raids obstructed passageways, and everywhere were bent shards of steel plate and twisted and severed stanchions. Fire had gutted the chart room, wheelhouse and radio room, and one deck below a bomb had exploded immediately after penetrating the midship deckhouse. The blast had torn everything apart just aft of the stack and down through the engine room, but a fast fuse had spared the hull. The foredeck and afterdeck were holed but strong; if the *Bertani* survived the current series of raids she would probably end up as an oil barge. She had been a handsome ship, and the visit was depressing.

Returning aft to leave, we remembered the putative wine stores and found several undamaged storerooms at the bottom of a companionway from the main deck. It was getting late, but we opened one more door, and there they were. Five or six large wine casks in a heavy timber rack along a thwartship bulkhead, and they were empty. The number is dim in my memory, but I recall clearly that they were a light-colored wood, which surprised me, and there was a small table in front of them. On the table lay a neatly folded pair of German army trousers, and beside them a half-empty tin of English cigarettes. We eyed these with speculation, and the drained casks with regret. "Time we got back," I said, and we left.

Later, as we were sitting in the saloon and conscientiously testing what was left of a case of Scotch retrieved earlier from longshoremen who had pinched it from army stores taken aboard at Port Said, the captain returned from a meeting ashore with the depressing news that we couldn't go alongside and discharge for another day or two. "Never mind the days," the messman said, "it's the nights that give me fits." Captain Miller just nodded and muttered his favorite expletive, "Got them!" A stocky Finn who looked like a nice Hermann Goering with muscles instead of fat, he spoke infrequently and with a thick accent that left us mystified about the ethnic roots of his name. "Got them!" sufficed for most occasions that called for comment, and began or ended the sentences demanded by special circumstances. We were amused by the phrase until events certified it as eminently apposite. The crew respected him, and to me Miller was the ideal skipper: professionally expert, totally unflappable, reserved but approachable. His silent kindliness and courage were importantly supportive, and I was to regret I lacked the wit to find a way to tell him so.

With the news that our idle status would continue, my thoughts turned to something I had noticed in a corner of the *Bertani*'s shattered radio room. It appeared to be the remains of an FuG 16, the 38 to 43 MHz wireless used in German fighter aircraft. Wary exploration of riddled Messerschmitts abandoned on Castel Benito airfield just outside the city had turned up nothing worth carrying away. Shards of canopy Perspex for shaping into bug paddles, and still in use today, but no FuG 16 for conversion to ten meters. Also, I wondered who was living on a bombed-out freighter anchored at target

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center.

Promptly at seven-thirty that evening, while cargo was being worked under a few lights on the jetty, the alarm went. Within minutes the dark edge of the city reflected the cracking white flashes of antiaircraft batteries along the breakwater, the thunderous red blooms planted by sticks of bombs, and then, in the dark heart of the harbor, a ballooning ball of yellow flame from a tiny coaster hit squarely amidships. Suddenly the raid was over, the convulsive thud and crash of explosives sucked instantly into a stunning silence. Slowly hearing recovered, and a familiar hissing rose from the water as spent shrapnel fell back from the sky, now and then rattling on our steel. After another minute there was only the distant sound of burning, and from the dark anchored shapes faint hails as the medical launch called for wounded. As they came alongside, we were saddened to learn that the matey crew of an antiaircraft battery had been wiped out, a singularly cheery and nerveless mob of Londoners who had found entertainment in teaching us cockney slang. They had called themselves "The Tophatters" and were perversely amused to hear that their painted insignia was identical to that displayed by a Staffel of 109s the Luftwaffe sent to Spain in 1937. Now they were gone. In the city, apartment buildings had been hit as usual, and the coaster between us and the *Bertani* was still smoking and low in the water. Preparing for a visit to the *Bertani*'s radio shack in the morning, I put together a thief's kit of sidecutters, screwdrivers and small wrenches.

The next day began chilly and clear, with a cloudless blue sky and a steady breeze. In the harbor the chop was low, but to seaward the spray rose regularly and fell sparkling on the breakwater. Inshore small puffs of spume floated up from the old gray seawall fronting the low bone-white profile of Tripoli's villas. I was still astonished that the Mediterranean could be so cold, even in midwinter. North Africa had been a surprise from the first: windy and raw at Alex, and then barren brown hills curving from Tobruk down to Benghazi. Wondering what the Afrika Korps thought of their palm tree insignia, I put on a heavy wool mackinaw and a watch cap, and I suppose that's why I met Paolo.

Before noon, but later than I had planned because I had listened to the sexy lady news announcer from Radio Sofia and her report, rather premature as it turned out, of a conclusive *Bestrafung* of Tripoli harbor, I was again aboard the *Bertani*, alone this time, with a bag of tools and, just in case, a bottle from our store of liberated Scotch. Everything looked the same as before, but somehow there was a subtle difference. Three hundred feet in the air the balloon weathervaned into a cold north wind, and three or four miles above it the daily photo plane was a tiny speck, returning home with negatives showing a small coaster still afloat but down by the stern and perhaps a crater where our cockney friends had nightly stood watch to protect us.

The battered box lying on the deck in the radio room was indeed an FuG 16, but it was in bad shape. Neither of the two bandswitches would budge, and a look at the back showed why they wouldn't. Apparently the deadlight blown from the porthole opposite had struck the rear panel and crushed the insides. No hope. Some earlier scrounger had better luck, judging from the vacant mounting brackets and empty spares lockers. Stubs of severed copper tubing protruded from the antenna lead-in bowl insulators, but a half dozen Pyrex standoffs had been left on one bulkhead. I was unscrewing one of these when I got a message that I wasn't alone and turned around.

Captain Miller.

In the doorway a young man of medium height was smiling at me. Dark curly hair, khaki sweater and pants. At first I assumed his motives were mine: curiosity and larceny. "Hi," I said, "somebody didn't leave us much." For a moment he just looked at my coat. Still smiling he said, "Buon giorno." Oh dear, I thought, The Enemy. "Buon giorno," I replied. "You speak English?" He shook his head. Why hadn't I studied my Italian phrase book? Only one sentence came to mind, and after a thoughtful pause I said, "Un biglietto per Milano, per favore." A ticket to Milan, please. He laughed and put out his hand. Amenity established, I removed my coat and from the game pocket carefully drew out the bottle of Scotch, wondering how many of Mussolini's finest were tucked away in the *Bertani*.

In an effort to communicate, we discovered common ground in German and Spanish, with Paolo favoring one and I the other, and in a loony patois we told each other who we were, traded souvenir recollections of life at home, and confided some of our hopes for the halcyon days of peace we foresaw with naive certainty. While we talked, I unscrewed the standoffs, and Paolo, an active ham for years and more lately a radio technician in the Italian army, applied himself expertly to the FuG 16 and filled my coat pockets with parts. Sensing my curiosity, he talked about his life before the war, pausing now and then to find the right phrase, silent at times for a minute or two when memories crowded and blocked the flow.

Paolo's father, a politically active civil servant, ardently Fascist, insisted that his son postpone his university studies and volunteer for service in Spain. That was in 1937, when Paolo was nineteen. Training was brief, with emphasis on parading, and he soon embarked for the Spanish Civil War with General Roatta's Black Flame Division. Before the year was out he was thoroughly disillusioned and when, during the Italian attack from Algora toward Guadalajara, a bomb fragment sent him home for recuperation and discharge, he thought himself lucky. Working again on his own equipment instead of military signals gear raised his spirits;

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The Agostino Bertani.

soon he was fit and bearing down hard on electrical engineering texts. He recalled this as "the happiest time of my life." It was a short reprieve. Putting Franco in power had been an easy first step, and soon German boots were marching through one country after another. The Italian army told Paolo his technical skills were very highly regarded and issued him a new uniform. He was grateful to miss out on Mussolini's glorious calamities in Albania and Greece, but those defeats guaranteed him a ticket to Tripoli. The Germans, appalled by the Italian fiasco in Greece, moved in swiftly, and their success drew a gallant but sacrificial counterattack by a British expeditionary force from Egypt, critically draining an army which had just chased the Italians back across the Western Desert. To exploit this weakness the Germans promptly invested armor in North Africa, and soon the Afrika Korps was leading a revitalized Italian army toward the Nile. Paolo would spend more than a year nursing its radios.

His first assignment was months of easy depot duty at Tripoli, thanks to the German he had learned in Spain, but in the summer of 1941 Rommel pressed hard against the British and Paolo was posted to the Ariete Armored Division and the delights of front line maintenance of poor radio equipment in obsolete M.13 tanks. There were about a hundred and fifty of these and many of them weren't fitted with radios, but this made it all the more important that in those that had them the radios worked. Keeping the mobile gear operational in spite of the dust, heat, concussion and constant vibration was a maddening task.

Paolo's stories of equipment failure, troubleshooting and repair soon brought up the subject of ham gear and our personal preferences and experiences. We argued the advantages of our favorite antennas and agreed that CW was far more satisfying than phone. Before long we were comparing DX notes, recalling more or less accurately the best of the miracles recorded in our logbooks at home, and in cordial competition modestly attributing our feats to luck rather than technical prowess. Paolo scored heavily when he mentioned that his first West Coast contact was W7CSF. The call has been reissued but my good friend Dick Rose held it then, and I remembered clearly his announcing one evening that he had just worked the first Italian he had ever heard. Probably I responded with rude noises indicating disbelief, and I could foresee his smile when I confirmed the contact with a report of this meeting. I didn't tell Paolo Dick had never received his QSL.

Suddenly I realized that the sunlight from the porthole had moved from the deck into the passageway, and it was time to leave. Paolo had volunteered nothing about his present circumstances, and as I collected my tools, I tried without success to think of tactful questions. We shook hands and he asked me if I would come back the next day. I said I would. Together we made our way through the battered passage, but Paolo wouldn't come out on the open afterdeck, and as I left him I asked if he needed anything. He shrugged and smiled. "I have food," he said.

There was hardly a ripple on the water. As I rowed I kept the transom centered on a tall palm behind the seawall, where peddlers hawked triangular paper packets of dates and almonds. The late sun on the low white buildings made sharp silhouettes of the trees – a travel poster view of friendly Tripoli. Halfway back I was pleased to retrieve two floating empty bottles as a present for my corporal friend who had asked if we had any on his first visit to the *Everett*. The Afrika Korps had charitably left behind an impressive stock of German hops and Hungarian barley at the Oea brewery (Oea was the old name of Tripoli), but bottles were in short supply and everyone was on the alert for empties. Minutes after I boarded the *Everett*, the gunnery officer knocked on my door and spotted the empty bottles. He hadn't believed my report of the empty wine casks on the *Bertani*, but something else was on his mind. "Churchill sent his apologies," he said, "and they'll take our tanks off tomorrow."

That night the Luftwaffe ignored us and the following morning the Crusader engines were roaring and backfiring in the holds, ready to go as soon as they were landed and the bridles freed. It was noisy and exiting but I left early, allowing for the longer trip from the breakwater against a low chop in the harbor. The wind had shifted and there was a suggestive haze in the southern sky. Torrents of rain and rotten visibility would be nice, I thought, rowing steadily, my feet pushing against a carton packed with old copies of "*QST*," British ration "V" cigarettes, a flashlight and a box of spare batteries. In memory of the *Bertani's* vanished wine stores there were two bottles of vile Australian sherry.

Paolo was waiting for me in the radio shack, obviously pleased to have company again. It struck me that he was impressively neat and clean and his manner rather blithe and easy for a lonely fugitive, truant from a retreating army. In your shoes, I thought, I'd be wary and glum and look very scrubby. Stacking the magazines on the deck, I put the flashlight and batteries next to them and held up one of the bottles of wine. "For emergency use only," I said, thinking of his Italian palate. "Thank you very much," Paolo said, dismissing my deference with a smile. Opening one of the cigarette packs, he took two out, and after we lighted them he brought a small bundle from a corner of the room. Turning back a fold of canvas he handed me an Italian helmet. Inside was a Beretta automatic, and on top of it a British pound note. "For the emergencies," he laughed, and turned the note over to show me the back was covered with Arabic. "German counterfeit. Propaganda. It says here that the word of England is as good as this money, but I am very sure that they will both

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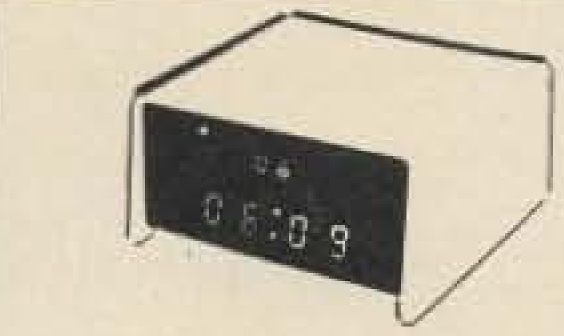

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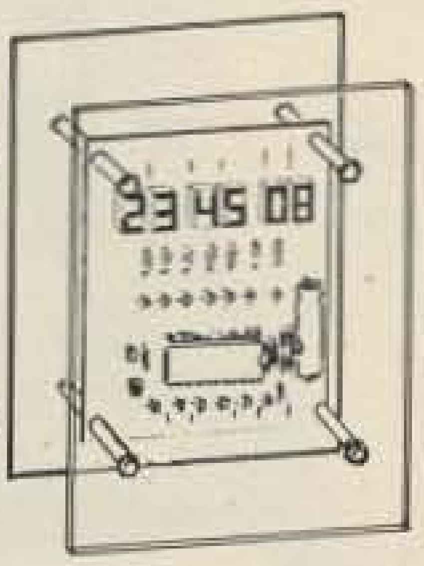

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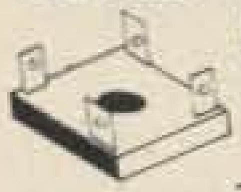

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be worth more, pretty soon, when this war is over." "Agreed," I replied, "Unless the English try exporting this tobacco."

I thanked Paolo for his gifts, and, after a brief explanation of Beretta design, disassembly and cleaning, he withdrew to silent concentration on the circuits and advertisements in the magazines. I fiddled with the gun for a while, but then my curiosity overcame qualms about prying and I asked him why he was waiting out the war in the center of a harbor where a night without a raid was an exception. He kept flipping the pages and smiled without looking up. The antiaircraft fire was so intense, he said, that hits on shipping were unlikely. The center of the target was the best place to be and the worst was the outside ring, from the jetties into the harbor side of the city. The latter was believable; during every raid we saw bombs bursting among the apartment and office buildings, and there were piles of rubble along the main streets, gaps and debris where there had been villas and shops, and every afternoon at four or five o'clock a flow of people into the countryside where those who couldn't find shelter slept in the fields. But the safety of the harbor center was relative and poor consolation, and Paolo's reply hadn't answered my question. He put down the magazine and gravely inspected the flashlight. Long minutes of silence. Sadness touched his face and I regretted my curiosity.

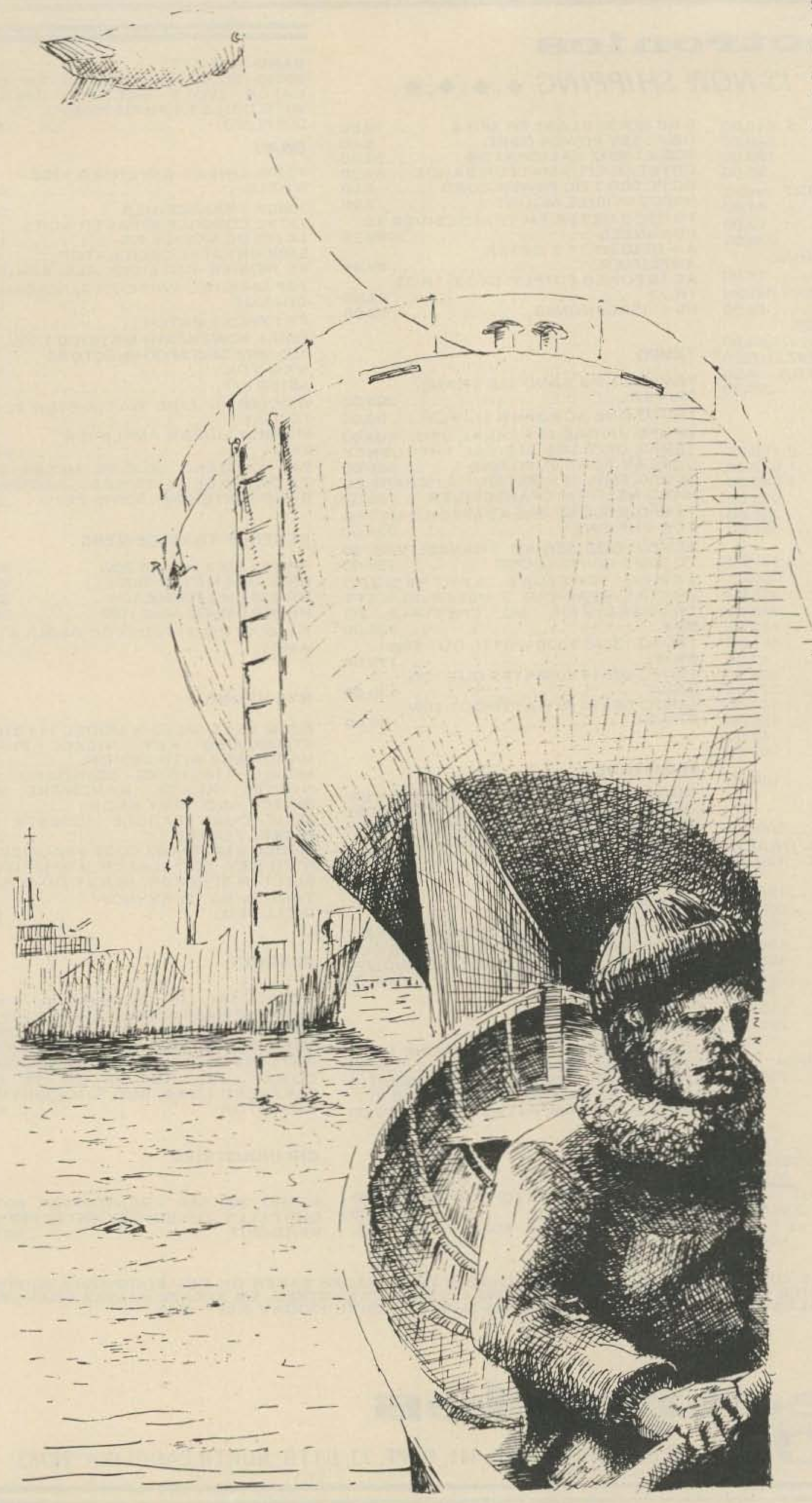
"Spain," he said, speaking very slowly, "was reality, and we had been prepared for it with lies. Germans fought Germans there, and Italians fought Italians. It was a bad time, and we understood nothing. Afterward, in the engineering school, I was just glad to study and not think about politics. Then, in 1940, suddenly Italy was in the war. Many people, like my father, said Mussolini acted to protect us from Hitler because France and England betrayed us during the Austrian Anschluss. They told each other that the fighting would soon be over, that Germany already had all of Europe except Italy, and that it would be our turn next if we didn't agree to a military alliance. Our first easy victories here in Africa left us foolishly optimistic, but before long the English pushed us back, things got very bad quickly, and defeat was close. We were ready to give up when the Germans arrived in February of '41, here in Tripoli. Now they are gone and I think it will soon be over."

Paolo stood up, stared out the porthole for a moment and lit another cigarette. "I am talking too much." I said nothing. "Rommel was too much for the English, but he should have been here in the beginning. Even before El Alamein I knew we would have to turn back. Supplies weren't getting through from Italy. The sinkings were increasing at the same time that Montgomery was getting more and more through Suez from America. Marshal Cavallero kept promising that fuel for the tanks would arrive immediately, but we knew he was lying. Less and less got through. It was hopeless."

During one of Rommel's efforts to stiffen Axis morale by mixing Panzer units with the Italian regiments, Paolo's combination of language and technical skills were noted and he found himself in a liaison assignment untying communication knots. Access to all Italian and German radio nets confirmed his feeling that disaster was inevitable.

"After Alamein," he continued, "I stayed with the 15th Panzer. There wasn't nearly enough transport for the retreat, so I rode with the Germans. Otherwise, I would have been in the bag and spent the rest of the war in a stockade in Egypt. I knew if I got back to Tripoli my friends here would help me."

Rommel hardly slowed for Tripoli. At Castel Benito, Paolo walked away from the war. He unbuttoned a shirt pocket, drew out a leather folder and opened it to show me a picture of a very pretty dark-haired girl standing with him in the Piazza Italia. She was wearing a white dress and smiling at the sun dial on the wall of Tripoli Castle. "I'm going to stay here," Paolo said. "We are going to be married some day. When I came here from Italy I was billeted with Antonia's parents, and now they are helping me as much as they can. An English civil administration officer is living in the room I had, and he brings



them extra food for me."

"She is very attractive," I said. "I hope everything goes well." I carefully printed my name and address on a scrap of cardboard and held it out. "When you can, write to me about the wedding."

"I promise," he said. "Soon now, the planes will be bombing Sfax instead of Tripoli, and it will be quiet here. Then the Germans will be defeated in Tunisia and the war in Africa will be over. It won't be long."

"And then?" I asked.

"Then the Mediterranean will belong to the English navy. Italy will surrender, and before long," Paolo smiled, "Antonia and I will be living on a small farm outside Tripoli."

"What do you know about farming? I thought you grew up in a city."

"I lived in a city, but I grew up in Spain and Africa." He shrugged his shoulders. "Anyway, Italians are all good farmers. Good builders and good farmers."

Years later I recalled Paolo's remark as I read of a letter Rommel wrote to his son, Manfred. Referring to the Italians, he said, "Certainly they are no good at war, but one must not judge everyone in the world only by his qualities as a soldier — otherwise we would have no civilization."

"Goodbye, Paolo," I said. "We may leave tomorrow. Good luck, and don't forget to write. When we're on the air again we'll arrange a schedule."

"Of course! With a farm there is plenty of room for antennas, you know." He was silent for a minute. "That is in the future. Today I am a deserter from the Italian army in time of war; I am engaged to a Jewish girl and being fed by an enemy officer while I wait for my country to surrender. I wonder what my father would think. Well, this will soon be over. Now, goodbye."

He waited in the shadow at the end of the passageway

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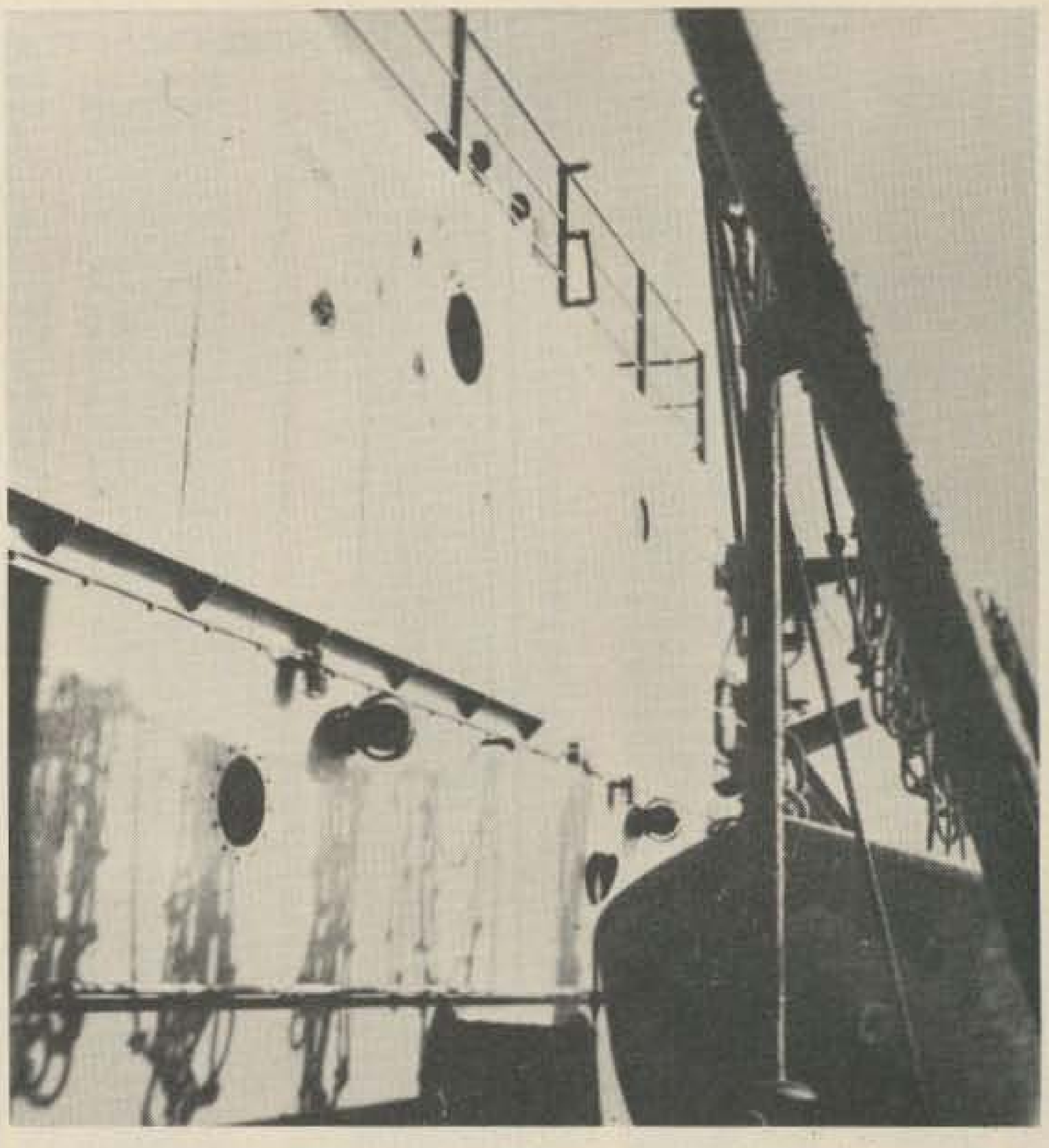
1576 Rand Ave. Vancouver, B.C. Tel. (604) 261-1335 until I waved from the stern and climbed down the ladder. As I rowed away, I wondered why Paolo hadn't found a safer place to await the surrender he expected in a few months (seven, it turned out), but I thought I knew. There were many Italians still in the area, but they were not men of military age or inclination. They were middle class, middle-aged or older, merchants and colonial farmers. They weren't on the streets much during the week, but leaving the Cattedrale di Sacro Cuore after Sunday morning mass they were surprisingly cheery, friendly, quite willing to converse with the strangers who had taken over their city. With unexpected candor, some would even defend Mussolini, insisting that he had been deceived by his ministers, and most agreed that the best chance for a happy solution lay with Prince Umberto and the diplomat Dino Grandi. And at some point in every conversation the lament would be repeated: "If only Marshal Italo Balbo were still alive!" In defeat, their fervent nationalism was as important as the fat on a hibernating bear. We listened to them with surprise, and then with dismay and a certain uneasiness. No, I didn't think that Paolo, a deserter, could have found much compassion in them. Probably they would promptly have turned him in and with relish sent the bad news to his family.

As I boarded the *Everett*, the last of our Crusaders was ashore, and the booms were being topped. The hatch covers dropping into place between the strongbacks made a very pleasant noise, rather like a gangway lowered smartly to the dock in some neutral port ablaze with nightclubs. The pretty balloon I was inflating promptly was pricked by a news bulletin from the deck cadet, and I went into the saloon for coffee and sympathy. The messman was humming "Sheik of Araby" and wiping the tables with special flourishes. "My prayers have been answered," he said. "One more night on the hook and tomorrow back to the fleshpots of Egypt!" "Well," I said, "you didn't pray hard enough. The latest word is a quick turnaround at Alex and back to Sfax with a full load of cased gas." He whimpered plaintively and lifted a corner of his apron to his eyes. "Boo hoo, and I'll never see my dear family again." Bathos was acceptable. "My hearfelt congratulations," I said. He poured our coffee and we sat in silence. I was thinking that I still wouldn't want to trade places with Paolo.

When we had pulled out and anchored again near the *Treen*, there was an hour of winter daylight left. We expected a visit from Sicily at the regular time, and perhaps a little something extra saved for us from last night's break in the routine. With this in mind, I went into the wheelhouse to experiment with an aircraft warning device H.M. Signals had installed during a shuttle to Beirut for the Ministry of Sea Transport when the area was being harassed by planes from Crete. We had heard about radar, of course, and observation of the bedspring antennas on battleships and cruisers gave us a clue to the frequencies, but we couldn't guess the secret of generating power pulses adequate to provide useful reflections from targets at fifty or a hundred miles. The magnetron was an enigma well-guarded. And the Royal Navy desperately needed more radar, so none was allotted to merchant ships; however, a British Marconi had come up with a jury rig warning system. In essence this consisted of a tuned amplifier driving an alarm bell noisy enough to alert any pilots who hadn't already spotted us, fed by two masthead microphones separated by an acoustical baffle. Theoretically, shipboard noise was picked up by both mikes and canceled, leaving only the bad news to excite the amplifier. The passband was narrow and tuned, according to the skeptical, to guttural German. The optimistic among us assumed the peaking frequency had something to do with audio quality common to BMW, Daimler-Benz, Jumo and Gnome-Rhone engines. In fact, the only time it went off was when the saloon messman climbed atop the wheelhouse and blew patiently into a beer bottle. He was promised that a second demonstration would ensure his disappearance at sea.



The near miss at Miller's porthole. Note hole in lifeboat bow.

Now it was dark. The sun had set after a brief pink illumination of thin webs spun high overhead by a slow shifting of upper winds. I could sense prayers for cloud cover rising like smoke in the still surface air. Cargo was being worked on a ship already secured in the berth we had left, and bright lights along the mole silhouetted the *Empire Voyager*, still at anchor, low in the water and showing no lights. In the southern sky stars glittered, but none were visible to the north; there was a light drizzle and I wondered if the weather people on Sicily were forecasting a low ceiling at Tripoli.

There was no warning. A Ju88 appeared over the breakwater, framed by the Voyager's masts, cannon and machine guns winking orange and yellow. Then there were three more, wingtip to wingtip, and bombs were already bursting ashore and in the water as I ran for shelter, portside and down the ladder. At once there was a furious rattling as bullets raked the *Everett*, along with a sharp bang when a 20mm shell exploded against the concrete facing outside the captain's quarters, missing his porthole by inches. From the breakwater around the harbor and on into the city, bomb hits glowed red at neatly spaced intervals, and as the storm of noise died away, fire bloomed from a small vessel on our starboard bow. A quick check indicated we had only superficial damage from gunfire, and none of the bomb explosions in the harbor had been close enough to hurt the hull. Even in the dark it was obvious that we came close to qualifying as bullet-riddled. Perforations in

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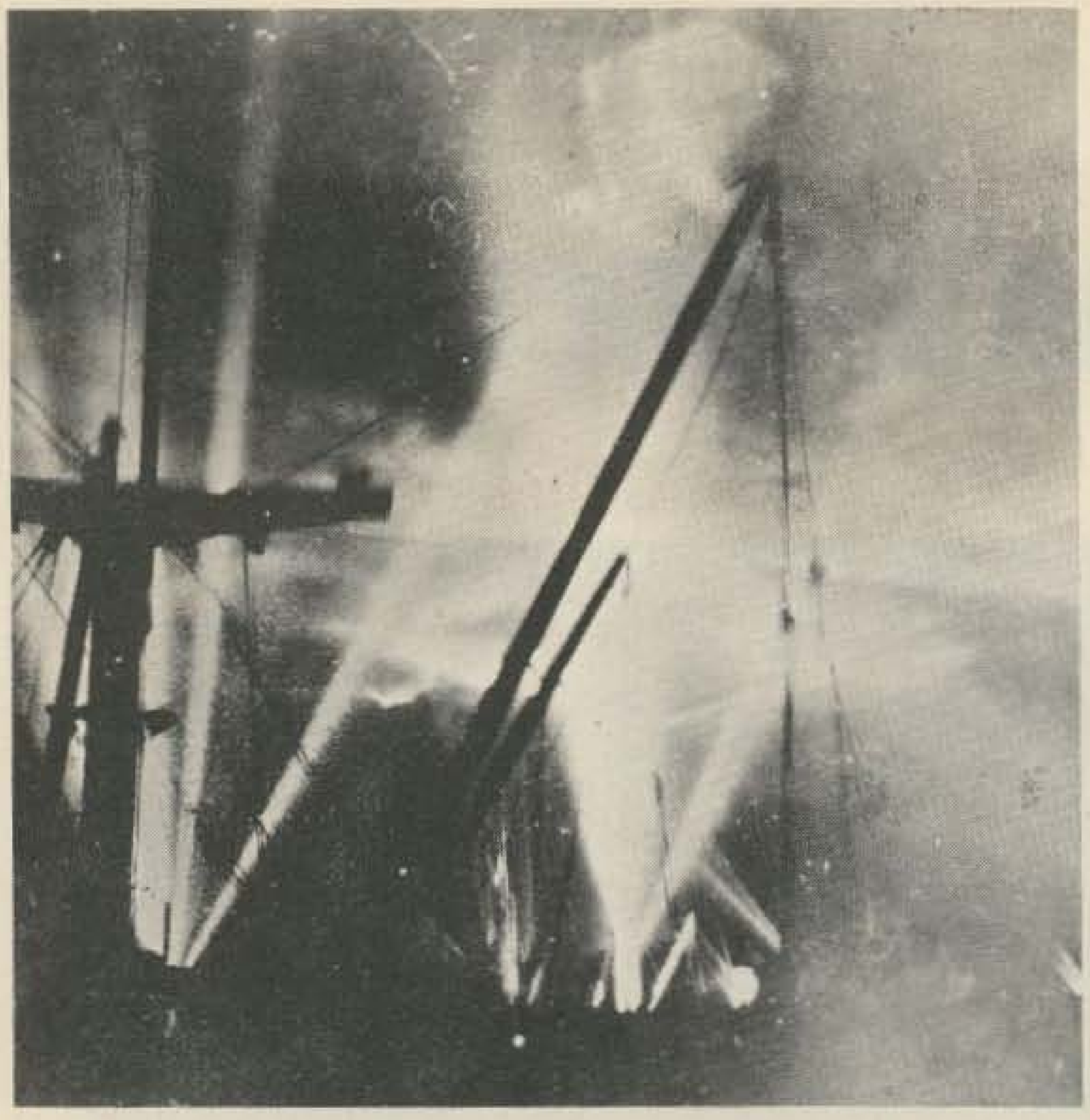


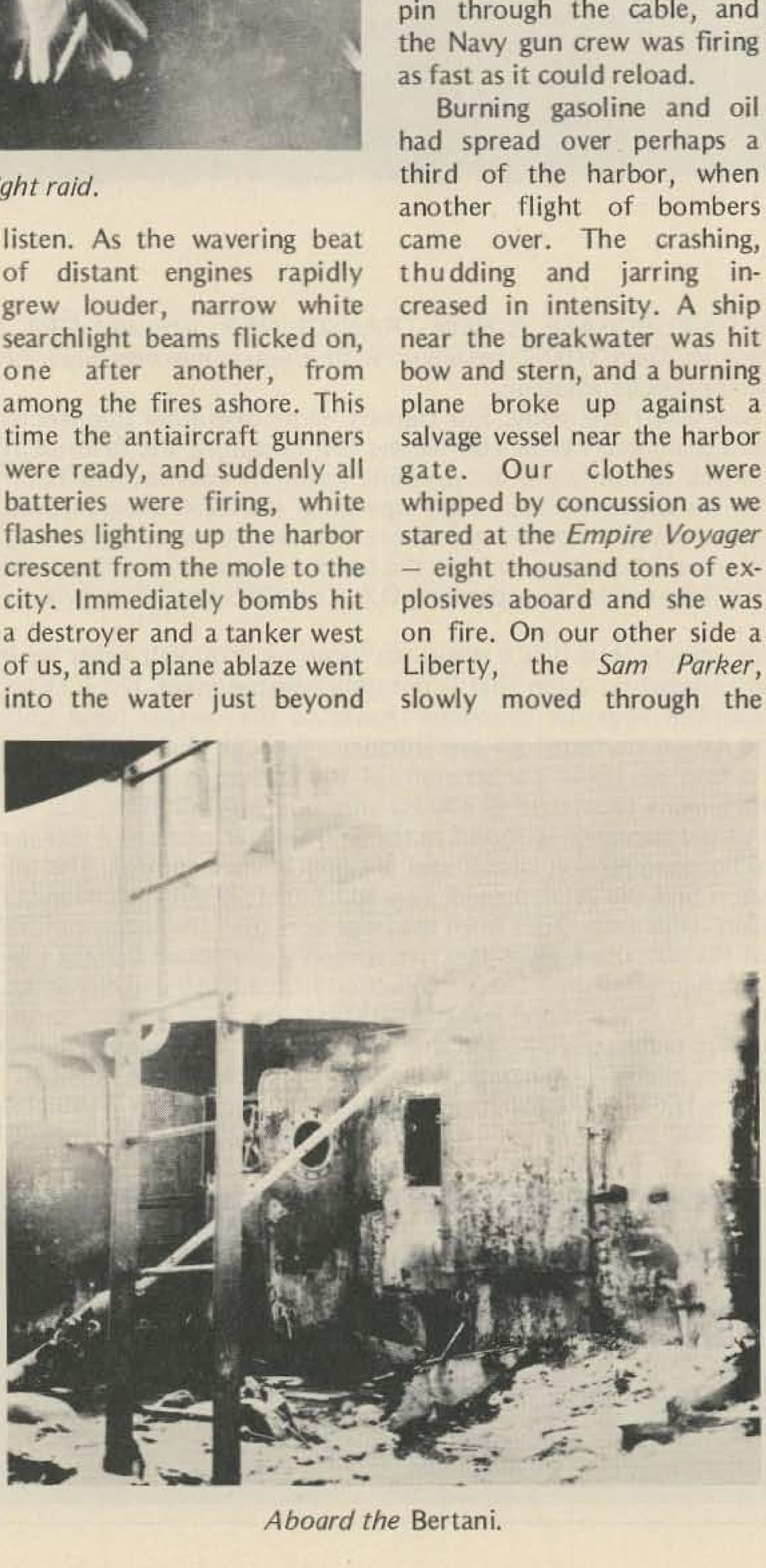
Tripoli: night raid.

the deck ventilators were back-lighted rubies, and from inside the holds the starboard side looked like a planetarium, but most of the hits were high. Ahead lay a painstaking survey of all the running gear; it wouldn't do for a nicked winch runner to drop a tank down a hatch. Luckily, no one had been on deck on the wrong side, but a visitor from another ship had a leg wound from a ricochet that entered a passageway, and I had steel splinters in one knee. The *Bertani* wasn't visible and I hoped Paolo had been below, shining his flashlight on a magazine.

After a short coffee session in the saloon, the messman was clearing away the cups and we were alone. "Got them!" he said, quoting the captain. "The old man thinks those brave lads must have flown right on the water for the last fifty miles. He said they probably had orders to light a beacon here and we'll get it again in a few minutes." I agreed. It was the first really low level attack since our arrival and, in view of the drizzle and broken ceiling, probably a pathfinder.

Returning to my room, I paused on the boat deck to listen. As the wavering beat of distant engines rapidly grew louder, narrow white searchlight beams flicked on, one after another, from among the fires ashore. This time the antiaircraft gunners were ready, and suddenly all batteries were firing, white flashes lighting up the harbor crescent from the mole to the city. Immediately bombs hit a destroyer and a tanker west of us, and a plane ablaze went into the water just beyond the *Bertani*. Overhead, white in the probing searchlights, bombers seemed to hang in the sky, unconcerned and irrelevant to the turmoil below. Our 20mm Oerlikons, which with a minute's warning might have scored against the first low attack, were useless now, but a sharp crack from the three inch gun on the bow told us that events had exhausted its crew's patience with the harbor rule that merchant ships were not to fire without orders. The battle phone circuit forward was dead, later found to be shorted by a pin through the cable, and the Navy gun crew was firing as fast as it could reload.

Burning gasoline and oil had spread over perhaps a third of the harbor, when another flight of bombers came over. The crashing, thudding and jarring increased in intensity. A ship near the breakwater was hit bow and stern, and a burning plane broke up against a salvage vessel near the harbor gate. Our clothes were whipped by concussion as we stared at the *Empire Voyager* — eight thousand tons of explosives aboard and she was on fire. On our other side a Liberty, the *Sam Parker*, slowly moved through the smoke between us and the *Bertaini*, headed for the harbor gate and open sea. Soon other ships, backlighted by fires and then hidden by smoke, were making their way carefully out of the harbor. The antiaircraft guns stopped firing, gun by gun, but explosions continued around us and orange tracers arced away from the *Voyager* as heat set off ammunition on deck. She was aflame from stem to stern.



Aboard the Bertani.

I had just left the port wing of the bridge for my room to get a flashlight, with some idea of blinking it at Paolo, when the *Voyager* exploded. A brilliant orange flash lighted the passageway and our ship lifted, trembled and fell back, rolling to port and then righting. The sound was something more than noise, a tremendous sharp thud that made my head hurt and left me deaf for a moment. Then a mixture of sounds — everything that could move was clattering, knocking against something else. After a bit, I ventured out on the boatdeck. Debris was hissing into the water and rattling onto the decks, and now and then a heavy piece from the *Voyager* rang on our steel. The air was filled with muck blown up from the bottom of the harbor, but soon it cleared and in the glow from burning oil I could see the *Bertani* was still afloat. Poor Paolo, I thought; you could be in a nice safe POW camp at Ismailia with a view of the canal.

The rest of the night was spent collecting our wits, drinking coffee and checking for serious damage. Below the waterline the hull was whole, but the oil burning where the *Voyager* had been showed our starboard side to be well scarred. The decks were littered with iron from the sky, and coated with slime from the bottom of the harbor. Dents showed where heavy pieces had struck and bounced over the side; the gun tubs were badly chewed and one lifeboat was holed,

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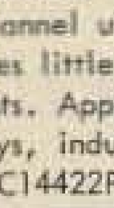

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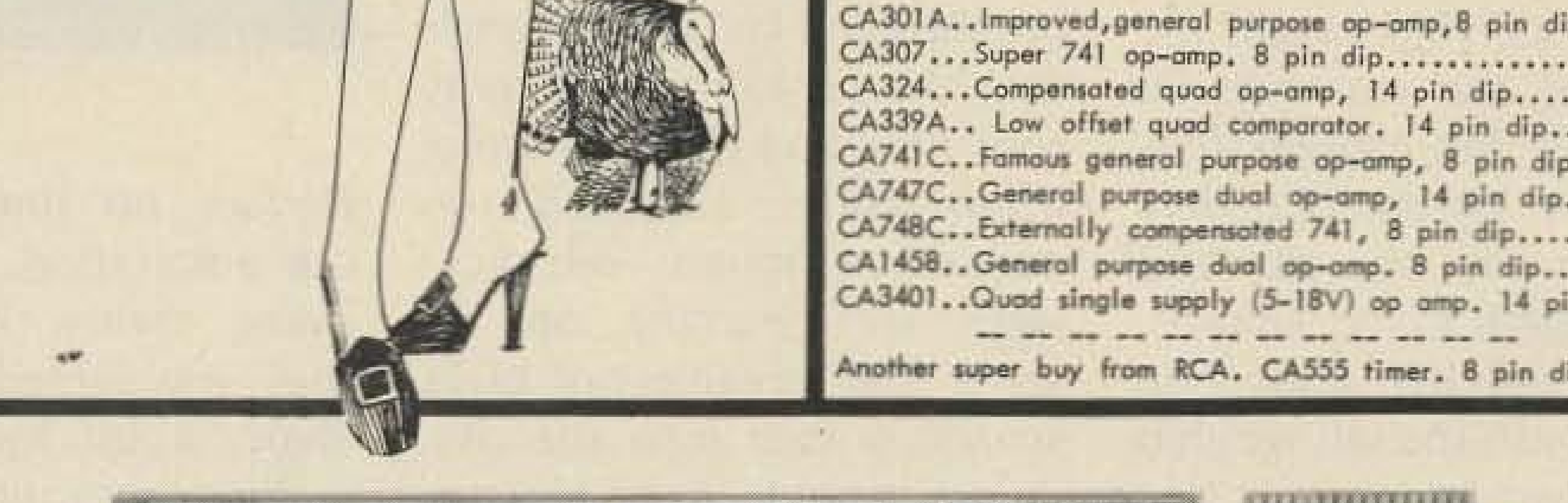

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but all the wounds we found were superficial. "Got them!" the captain muttered, meaning he was mystified by our good fortune, and so were we all.

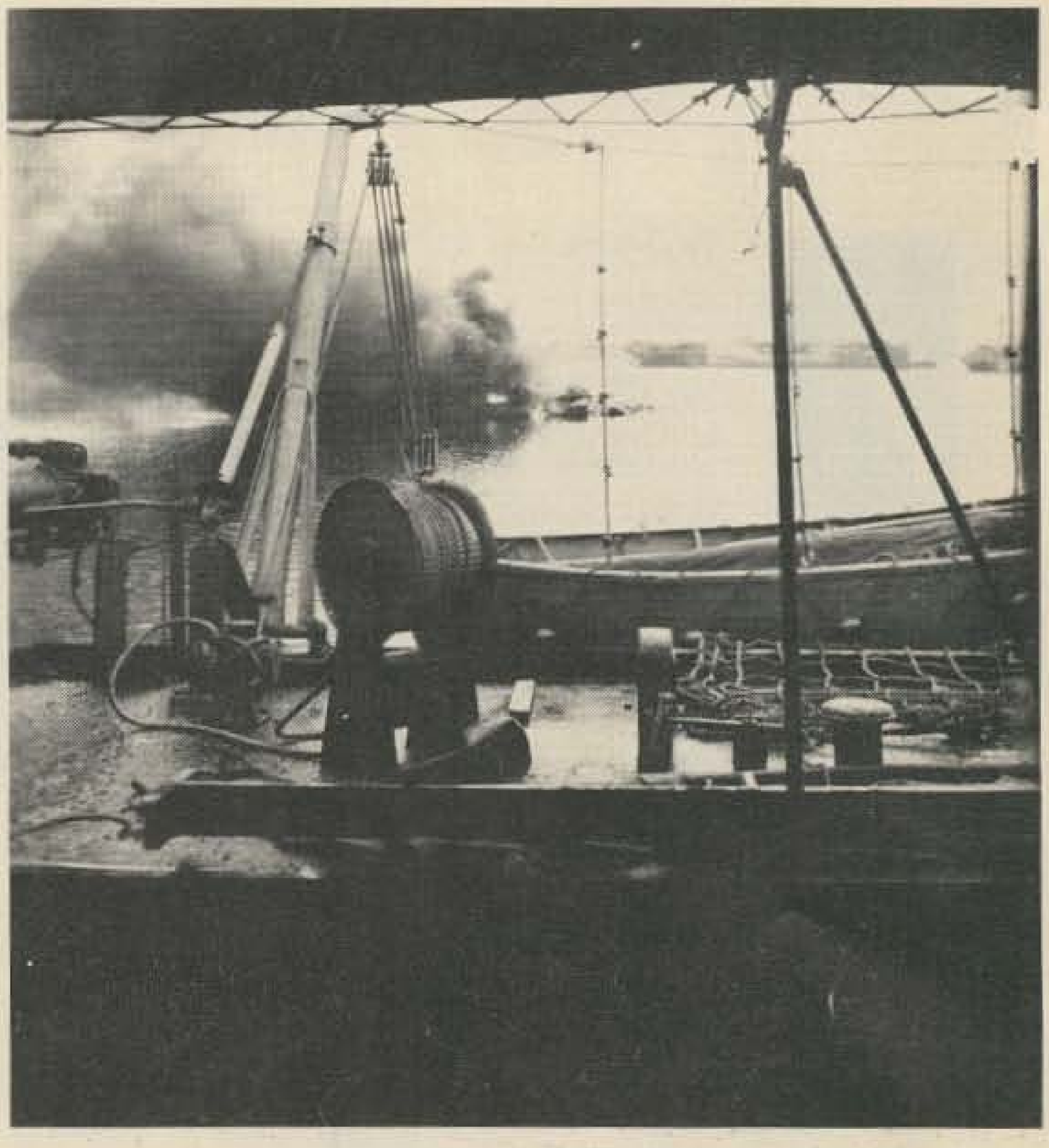
It was nearly dawn when orders were brought aboard for departure for Port Said, and I tried again to raise Paolo with the light. I had decided that if I saw no blinking reply the possibility that Paolo was hurt and needed aid would justify confiding in the corporal. Minutes passed and no luck. The launch would be leaving soon. I had just about given up when the answer came: "OK OK OK god luck god luck." The misspelling struck me as inspired.

Hurrying with our last bottle of Scotch, I caught the corporal at the ladder as he was telling the captain that one of the *Voyager*'s boilers had flown over the city and come to earth in the suburbs, and one of her guns had dropped onto the salvage ship at the harbor gate. "Got them!" Miller said, rubbing his nose thoughtfully. "Ta," the corporal smiled as he took the bottle, "come again soon."

The wind was picking up from the north, sweeping away the clouds and fanning fires around the harbor, and the first gray light revealed that the *Bertani*'s barrage balloon had pulled free during the night. I thought of its passage, a spectral mystery in the sky blocking out the stars as it sailed noiselessly over the Sahara, and then in the sunshine a delight to the Tuaregs who would turn it into tents and a fable.

In a couple of hours we were under way, leaving behind us a dispiriting scene. The destroyer had been beached and lay at a sad angle near the seawall; near it spray rose now and then, as demolition crews exploded torpedoes or mines; oil slicks were still burning on the water and streamers of black smoke drifted into the city. As we moved slowly past the *Bertani*, her lines again drew our admiration. She was still riding evenly, but the foremast was canted aft at a new angle, a bit rakish but not really inappropriate. From a wing of the bridge I waved goodbye.

Soon Tripoli was just a line on the horizon. It could have been Boston or Sydney.■



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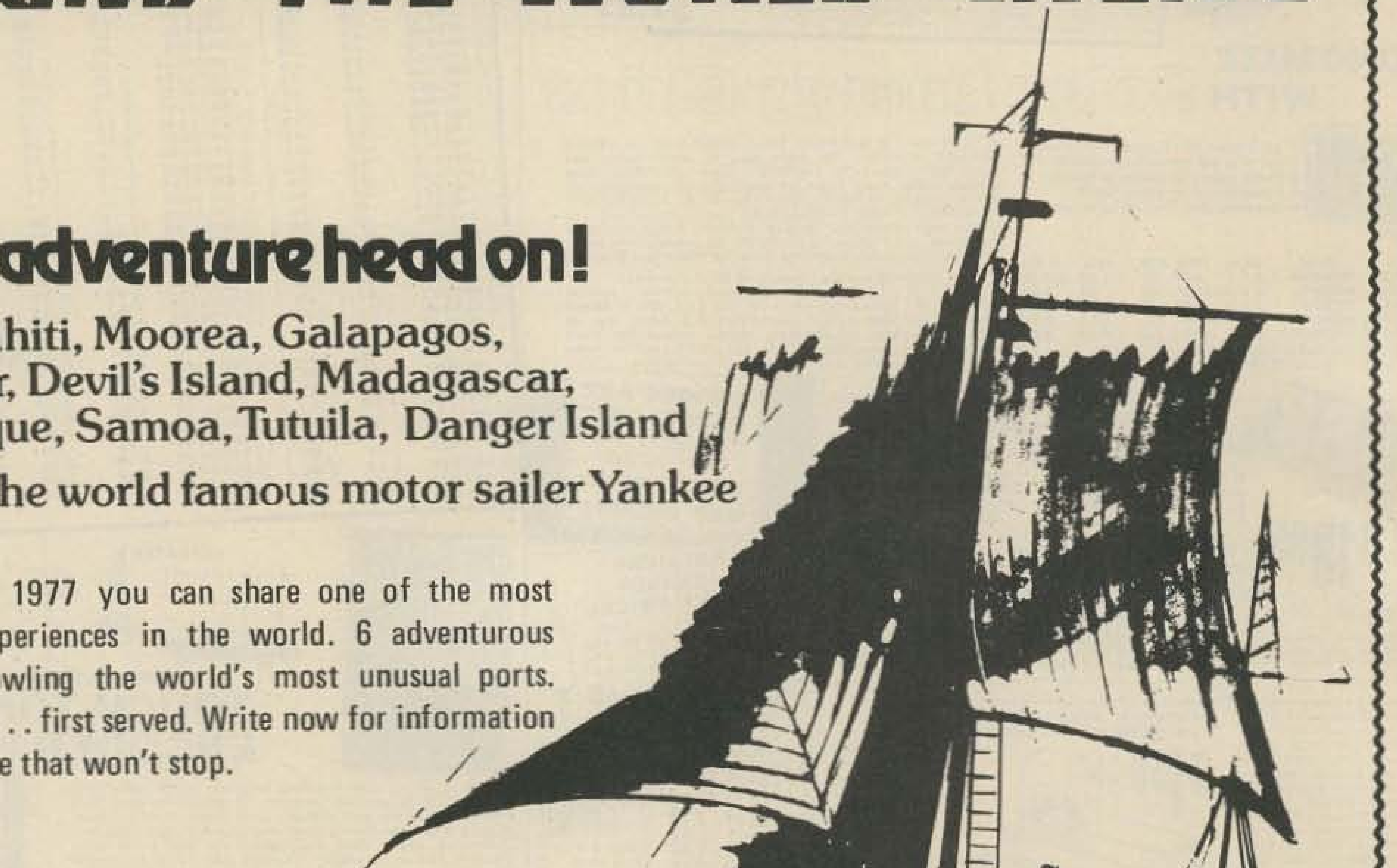

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CD4012	.25	CD4050	.79	74C95N	2.00
CD4013	.47	CD4051	2.95	74C107N	1.25
CD4016	.56	CD4053	2.95	74C151	2.90
CD4017	1.35	CD4060	3.25	74C154	4.00
CD4019	.55	CD4066	1.75	74C157	2.15
CD4020	1.49	CD4069	.45	74C160	3.25
CD4022	1.25	CD4071	.45	74C161	3.25
CD4023	.25	CD4081	.45	74C163	3.00
CD4024	1.50	CD4511	2.50	74C164	3.25
CD4025	.25	CD4518	2.50	74C173	2.60
CD4027	.69	74C00N	.39	74C193	2.75
CD4028	1.65	74C02N	.55	74C195	2.75
CD4029	2.90			MC4044*	4.50
CD4030	.65			MC14016*	.56

LINEAR

LM300H	.80			LM1310N	2.95
LM301H	.35			LM1351N	1.65
LM301CN	.35			LM1414N	1.75
LM302H	.75			LM1458C	.65
LM304H	1.00	LM370N	1.15	LM1496N	.95
LM305H	.95	LM373N	3.25	LM1556V	1.85
LM307CN	.35	LM377N	4.00	LM2111N	1.95
LM308H	1.00	LM380N	1.39	LM2901N	2.95
LM308CN	1.00	LM390CN	1.05	LM3065N	.69
LM309H	1.10	LM381N	1.79	LM3900N	.55
LM309K	.99	LM382N	1.79	LM3905N	.60
LM310CN	1.15	NE501K	8.00	LM3909*	1.25
LM311H	.90	NE510A	6.00	LM5556N	1.85
LM311N	.90	NE531H	3.00	MC5558V	1.00
LM318CN	1.50	NE536T	6.00	LM7525N	.90
LM319N	1.30	NE540L	6.00	LM7535N	1.25
LM320K-5	1.35	NE550N	.79	8038B*	4.95
LM320K-5.2	1.35	NE555V*	.45	LM75450	.49
LM320K-12	1.35	NE560B*	5.00	75451CN	.39
LM320K-15	1.35	NE561B*	5.00	75452CN	.39
LM320T-5*	1.75	NE562B*	5.00	75453CN	.39
LM320T-5.2	1.75	NE565H*	1.25	75454CN	.39
LM320T-8*	1.75	NE565N*	1.75	75491CN	.79
LM320T-12*	1.75	NE566CN*	1.25	75492CN	.89
LM320T-15	1.75	NE567H*	1.95	75494CN	.89
LM320T-18*	1.75	NE567V*	1.50	**RCA LINEAR**	
LM320T-24	1.75	LM703CN	.45	CA3013	2.15
LM323K-5*	9.95	LM709H	.29	CA3032	2.56
LM324N	1.80	LM709N	.29	CA3035	2.48
LM339N	1.70	LM710N	.79	CA3039	1.35
LM340K-5	1.95	LM711N	.39	CA3046	1.30
LM340K-6	1.95	LM723H	.55	CA3059	3.25
LM340K-8	1.95	LM723N	.55	CA3060	3.25
LM340K-12	1.95	LM733N	1.00	CA3080	.85
LM340K-15	1.95	LM739N	1.00	CA3081	2.00
LM340K-18	1.95	LM741CH	.35	CA3082	2.00
LM340K-24	1.95	LM741CN	.35	CA3083	1.60
LM340T-5	1.75	LM74114N	.39	CA3086	.85
LM340T-6	1.75	LM747H	.79	CA3089	3.75
LM340T-8*	1.75	LM747N	.79	CA3091	10.20
LM340T-12	1.75	LM748H	.39	CA3123	2.15
LM340T-15	1.75	LM748N	.39	CA3130	1.39
LM340T-18*	1.75	LM1303N	.90	CA3140	1.25
LM340T-24	1.75	LM1304N	1.19	CA3600	1.75
LM350N	1.00	LM1305N	1.40	RC4194	5.95
LM351CN	.65	LM1307N	.85	RC4195	3.25

74LS00 TTL

74LS00	.39	74LS55	.39	74LS151	1.55
74LS02	.39	74LS73	.65	74LS153	1.89
74LS03	.39	74LS74	.65	74LS157	1.55
74LS04	.45	74LS75	.79	74LS162	2.25
74LS05	.45	74LS76	.65	74LS163	2.25
74LS08	.39	74LS83	2.19	74LS164	2.25
74LS10	.39	74LS86	.65	74LS181	3.69
74LS13	.79	74LS90	1.25	74LS190	2.85
74LS14	2.19	74LS92	1.25	74LS191	2.85
74LS20	.39	74LS93	1.25	74LS192	2.85
74LS26	.49	74LS95	2.19	74LS193	2.85
74LS27	.45	74LS96	1.89	74LS194	2.25
74LS28	.49	74LS107	.65	74LS195	2.25
74LS30	.39	74LS112	.65	74LS257	1.89
74LS32	.45	74LS132	1.55	74LS260	.55
74LS40	.49	74LS136	.65	74LS279	.79
74LS51	.39	74LS138	1.89	74LS670	5.95

DATA HANDBOOKS

7400 Pin-out & Description of 5400/7400 ICS **$2.95**
CMOS Pin-out & Description of 4000 Series ICS **$2.95**
Linear Pin-out & Functional Description **$2.95**
ALL THREE HANDBOOKS $6.95

100 PER STRIP **MOLEX PINS**

Intended for use as an inexpensive substitute for IC sockets. Also perfect for use as board connectors and in subassemblies.

SPECIAL — 100/1.49 — 1000/12.00

CONSUMER ELECTRONICS

PONG SINGLE GAME **$59.95**
SUPER PONG 4 GAMES IN ONE **$89.95**

PONG FOR YOUR HOME TV

GAMES INCLUDED IN SUPER PONG ARE:
- PONG
- CATCH
- SUPER PONG
- HANDBALL

FEATURES OF PONG AND SUPER PONG
- Incremental speed on volleys increases excitement.
- Playing field adjusts to any size screen.
- Game appears in color or in black & white, depending on television set.
- Unmistakable "PONG" sound accompanies each volley.
- Digital scoring flashes on the screen between each point.
- 2 player challenge or Solitaire
- Hooks up simply to any model television set; the screen actually becomes the playing field.
- English and other techniques can be used to make any member of the family a Pong champion.
- Battery operated by 4 size "D" flashlight batteries included with the Unit.

AC Adaptor (Eliminates Batteries) **$9.95**

ATARI

DISCRETE LEDS SPECIAL SALE!

.125" dia.
XC209Red 10/$1
XC209Green 4/$1
XC209Yellow 7/$1
XC209Orange 4/$1

.190" dia.
XC111Red 8/$1
XC111Green 4/$1
XC111Yellow 4/$1
XC111Orange 4/$1

.200" dia.
XC22Red 5/$1
XC22Green 4/$1
XC22Yellow 4/$1
XC22Orange 4/$1
SSL-22RT 8/$1

.185" dia.
XC526Red 10/$1
XC526Green 7/$1
XC526Yellow 4/$1
XC526Orange 4/$1
XC526Clear 7/$1

.200" dia.
XC556Red 10/$1
XC556Green 7/$1
XC556Yellow 7/$1
XC556Orange 7/$1
XC556Clear 7/$1

.085" dia.
MV50
.085" dia. Micro red LED
6/$1

DISPLAY LEDS SUPER SAVINGS!

MAN 7 $.99 — DL33B $.99

TYPE	POLARITY	HT		TYPE	POLARITY	HT	
MAN 1	Common Anode	.270	2.49	MAN 3620	Common Anode-orange	.300	.99
MAN 2	5 x 7 Dot Matrix	.300	4.95	MAN 3640	Common Cathode-orange	.300	.99
MAN 3	Common Cathode	.125	3/1	MAN 4710	Common Anode-Red	.400	.99
MAN 4	Common Cathode	.187	1.95	DL701	Common Anode-red	.300	.99
MAN 7	Common Anode	.300	.99	DL707	Common Anode	.300	1.50
MAN 7G	Common Anode-green	.300	1.95	DL 728	Common Cathode	.500	1.99
MAN 7Y	Common Anode-yellow	.300	1.95	DL 747	Common Anode	.600	2.25
MAN 52	Common Anode-green	.300	.99	DL 750	Common Cathode	.600	2.49
MAN 64	Common Anode-red	.400	.99	DL 338	Common Cathode	.110	.99
MAN 72	Common Anode	.300	.99	FND70	Common Cathode	.250	.50
MAN 74	Common Cathode	.300	1.15	FND503	Common Cathode	.500	1.29
MAN 82	Common Anode-yellow	.300	.99	FND507	Common Anode	.500	1.29
MAN 84	Common Cathode-yellow	.300	.99				

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	.16	.15	24 pin	$.38	.37	.36
14 pin	.20	.19	.18	28 pin	.45	.44	.43
16 pin	.22	.21	.20	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.37	.36	.35				

SOLDERTAIL STANDARD (TIN)

14 pin	$.27	.25	.24	28 pin	$.99	.90	.81
16 pin	.30	.27	.25	36 pin	1.39	1.26	1.15
18 pin	.35	.32	.30	40 pin	1.59	1.45	1.30
24 pin	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

8 pin	$.30	.27	.24	24 pin	$.70	.63	.57
14 pin	.35	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.75	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	.41	.37	24 pin	$1.05	.95	.85
14 pin	.39	.38	.37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	.41	36 pin	1.59	1.45	1.30
18 pin	.75	.68	.62	40 pin	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

		10 OHM	12 OHM	15 OHM	18 OHM	22 OHM	
ASST. 1	5 ea.	27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	1/4 WATT 5% — 50 PCS.
		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM	
ASST. 2	5 ea.	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1/4 WATT 5% — 50 PCS.
		470 OHM	560 OHM	680 OHM	820 OHM	1K	
ASST. 3	5 ea.	1.2K	1.5K	1.8K	2.2K	2.7K	1/4 WATT 5% — 50 PCS.
		3.3K	3.9K	4.7K	5.6K	6.8K	
ASST. 4	5 ea.	8.2K	10K	12K	15K	18K	1/4 WATT 5% — 50 PCS.
		22K	27K	33K	39K	47K	
ASST. 5	5 ea.	56K	68K	82K	100K	120K	1/4 WATT 5% — 50 PCS.
		150K	180K	220K	270K	330K	
ASST. 6	5 ea.	390K	470K	560K	680K	820K	1/4 WATT 5% — 50 PCS.
		1M	1.2M	1.5M	1.8M	2.2M	
ASST. 7	5 ea.	2.7M	3.3M	3.9M	4.7M	5.6M	1/4 WATT 5% — 50 PCS.

5 EACH MINIMUM PER VALUE ON ANY RESISTORS FROM 2.2 OHM TO 5.6M
5-25 PCS. .05 ea. 30-95 PCS. .04 ea. 100-495 PCS. .03 ea. 500-995 .0275 ea.

SINGLE TURN 3/8" CERMET POTENTIOMETER

- Resistance Tolerance ± 20%
- High Power –0.5 Watt at 70°C
- Wide Operating Temp. Range –55°C to +125°C

$.89

STANDARD RESISTANCE VALUES
50Ω 100Ω 500Ω 1K 2K 5K 10K 20K 50K 100K 200K 500K 1 MEG

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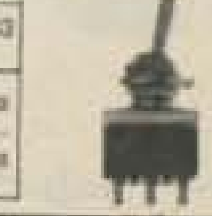
MINIATURE TOGGLE

DPDT				JMT	1	2-9	10-29	30-99
	ON	OFF	ON	221	2.95	2.55	1.87	1.70
	ON	NONE	ON	223	2.95	2.15	1.58	1.43
	ON	OFF	ON	121	2.25	1.95	1.43	1.30
	ON	NONE	ON	123	2.05	1.65	1.21	1.10



PUSH BUTTON

SPDT – SERIES PB, PB1
Maintained Action Switch Push To Make Contact. And Push Again To Reverse Action
Momentary Action Switch Normally Open or Normally Closed. (For N.C. circuit use terminals 2 & 1; for N.O. 2 & 3; for N.C and N.O. 1, 2 & 3)

PB-123 $1.75
PB-126 $1.75

5 AMP RATINGS

THUMBWHEEL SWITCHES

THUMBWHEEL SWITCH ONLY
SF – Front Mount SR – Rear Mount

Part No.	Description	Price
SF 12	Single Pole 10 Position	$2.50
SR 12	Decimal	3.00
SF 21	10 Position BCD only	2.50
SR 21	" "	3.00

Ordering: Order desired switch or switches and add necessary accessories for your particular application.

SERIES SF Front Mount Assembly

ACCESSORIES

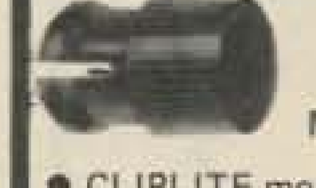
Part No.	Description	Price
SF EP	End Plate (Pair)	$.50
SF DP	Divider Plate (each)	.40
SF BB	Blank Body (each)	.40
SF HB	Half Body (each)	.40

SERIES SR Rear Mount Assembly

ACCESSORIES

Part No.	Description	Price
SR EP	End Plates (pair)	$.50
SR DP	Divider Plate (each)	.40
SR BB	Blank Body (each)	.40
SR HB	Half Body (each)	.40

CLIPLITE!! 4/$1.00



NEW LED MOUNTING SYSTEM

- CLIPLITE mounts from the front of the Panel in a .250 hole on 3/8" centers. Panel thickness from 1/16" to 1/8".
- CLIPLITE equalizes and increases the brightness of commonly used wide beam LEDS.
- CLIPLITE is to be used with XC556 LEDS only. Specify red, green, amber or yellow CLIPLITES when ordering.

ZENERS—DIODES—RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4005*	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006*	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007*	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	8/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4734	5.6	1w	28
1N5232	5.6	500m	28	1N4735	6.2	1w	28
1N5234	6.2	500m	28	1N4736	6.8	1w	28
1N5235	6.8	500m	28	1N4738	8.2	1w	28
1N5236	7.5	500m	28	1N4742	12	1w	28
1N456	25	40m	6/1.00	1N4744	15	1w	28
1N458	150	7m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N485A	180	10m	5/1.00	1N1184	100 PIV	35 AMP	1.70
1N4001	50 PIV	1 AMP	12/1.00	IN1185	150 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	IN1186	200 PIV	35 AMP	1.80
1N4003	200 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00
1N4004	400 PIV	1 AMP	12/1.00				

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR	$1.95
C38M	35A @ 200V	SCR	1.95
2N2328	1.6A @ 200V	SCR	.50
MDA 980-1	25A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	25A@ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

MPS A05	3/$1.00			PN4249	4/$1.00
MPS A06	5/$1.00			PN4250	4/$1.00
2N2219A	3/$1.00	PN3567	3/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	PN3568	4/$1.00*	2N4401	4/$1.00
2N2222A	5/$1.00	PN3569	4/$1.00	2N4402	4/$1.00
2N2369	5/$1.00	2N3704	5/$1.00	2N4403	4/$1.00
2N2369A	4/$1.00	2N3705	5/$1.00	2N4409	5/$1.00
PN2415	5/$1.00	2N3706	5/$1.00	2N5086	4/$1.00
2N2484	4/$1.00	2N3707	5/$1.00	2N5087	4/$1.00
2N2906A	4/$1.00	2N3711	5/$1.00	2N5088	4/$1.00
2N2907A	5/$1.00	2N3724	$.65	2N5089	4/$1.00
2N2925	5/$1.00	2N3725	$1.00	2N5129	5/$1.00
2N3053	2/$1.00	2N3903	5/$1.00	2N5138	5/$1.00
2N3055	$.89	2N3904	4/$1.00	2N5139	5/$1.00
MJE3055	$1.00	2N3905	4/$1.00	2N5209	5/$1.00
MJE2955	$1.25	2N3906	4/$1.00	2N5951	5/$1.00
2N3392	5/$1.00	2N4013	3/$1.00	C106B1SCR	2/$1.00
2N3398	5/$1.00	2N4014	3/$1.00	2N5432	$2.00
		2N4123	10/$1.00		

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075
100 VOLT MYLAR FILM CAPACITORS							
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22
+20% DIPPED TANTALUMS (SOLID) CAPACITORS							
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40
MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS							
Axial Lead				**Radial Lead**			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.15	.13	.10	1.0/16V	.15	.13	.10
4.7/25V	.16	.14	.12	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

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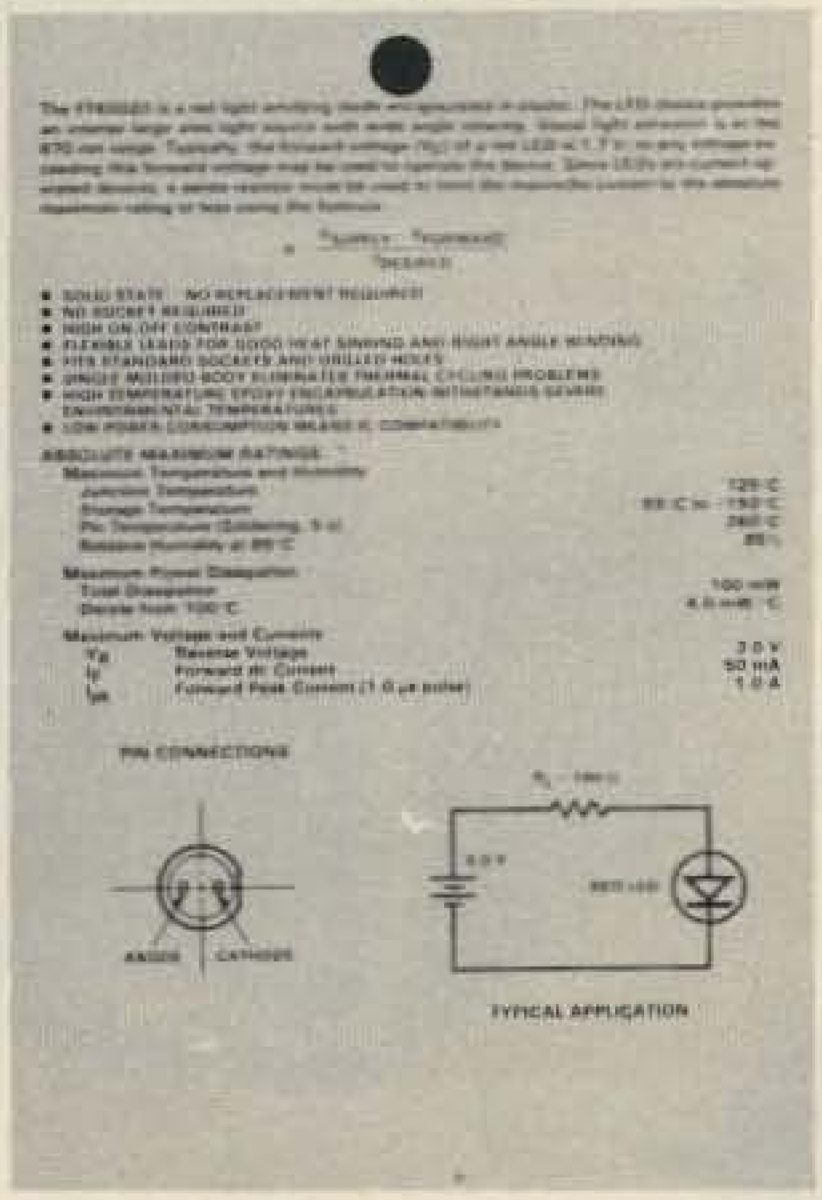
- FOR THE EXPERIMENTER WITH TASTE FOR "STATE OF THE ART" PRODUCTS
- COMPLETE SPECIFICATIONS ARE PRINTED ON THE BACK OF EACH TECHNOLOGY KIT

FTK0020

CARD FRONT

FTK0020



CARD BACK

FTK0011

CARD FRONT

DIGITS

TK0001	0.5" High Common Cathode Digit	$1.00
TK0002	0.5" High Common Anode Digit	1.00
TK0003	.357" High Common Cathode Digit	.75
TK0004	0.8" High Common Cathode Digit	2.00
TK0005	0.8" High Common Anode Digit	2.00

0.8" HIGH DISPLAY ARRAYS

TK0010	12 Hour, 3½ Digit Clock Display	7.00
TK0011	24 Hour, 4 Digit Clock Display	8.00

LED LAMPS

TK0020	10 Red LED Lamps	1.00
TK0021	5 Mixed Colored LED Lamps	1.00
TK0022	10 LED Mounting Clips	1.00
TK0023	5 Three Piece LED Mounting Adapters	1.00

PHOTO TRANSISTORS

TK0030	5 Flat Lens Photo Transistors	1.00
TK0031	5 Round Lens Photo Transistors	1.00
TK0032	3 Flat Lens Photo Darlingtons	1.00
TK0033	3 Round Lens Photo Darlingtons	1.00

PHOTO ARRAYS

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FTK0041	12-Element Card Reader Array	24.00
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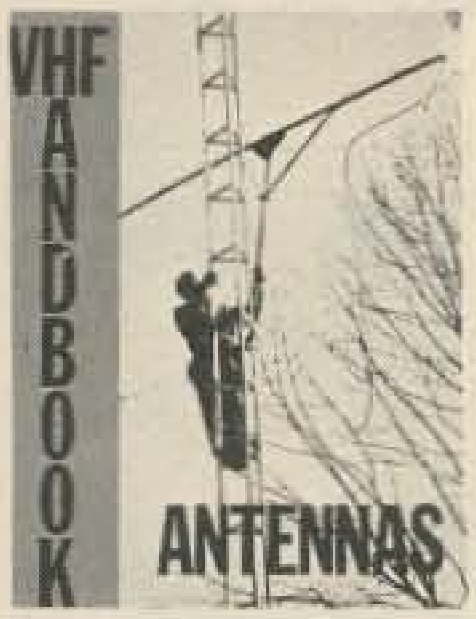

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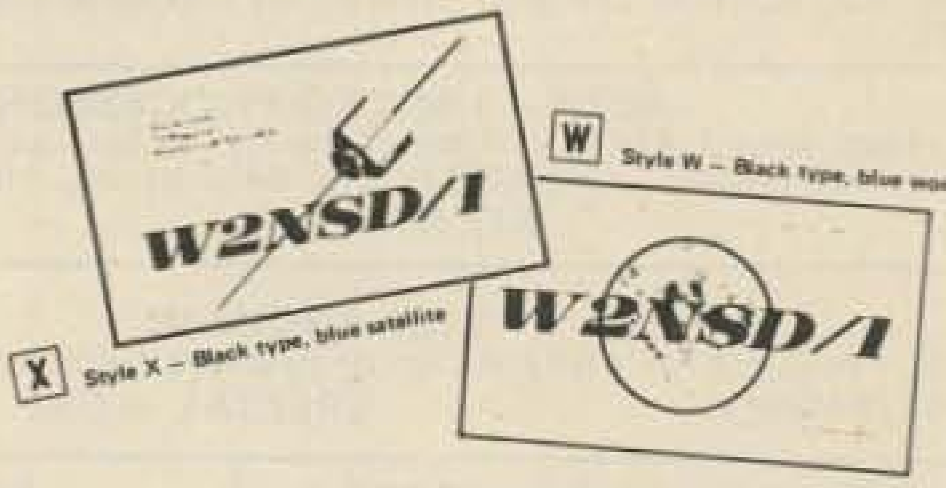

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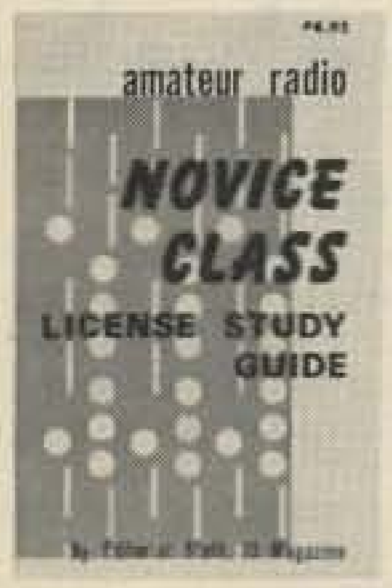

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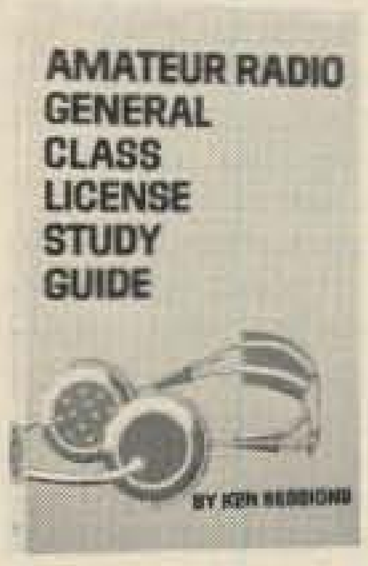

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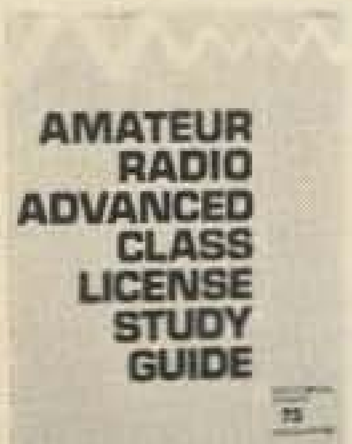

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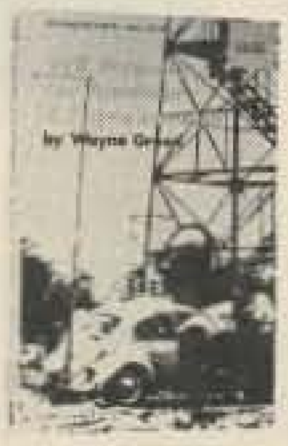

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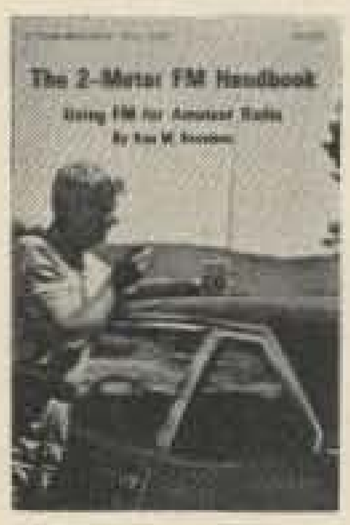

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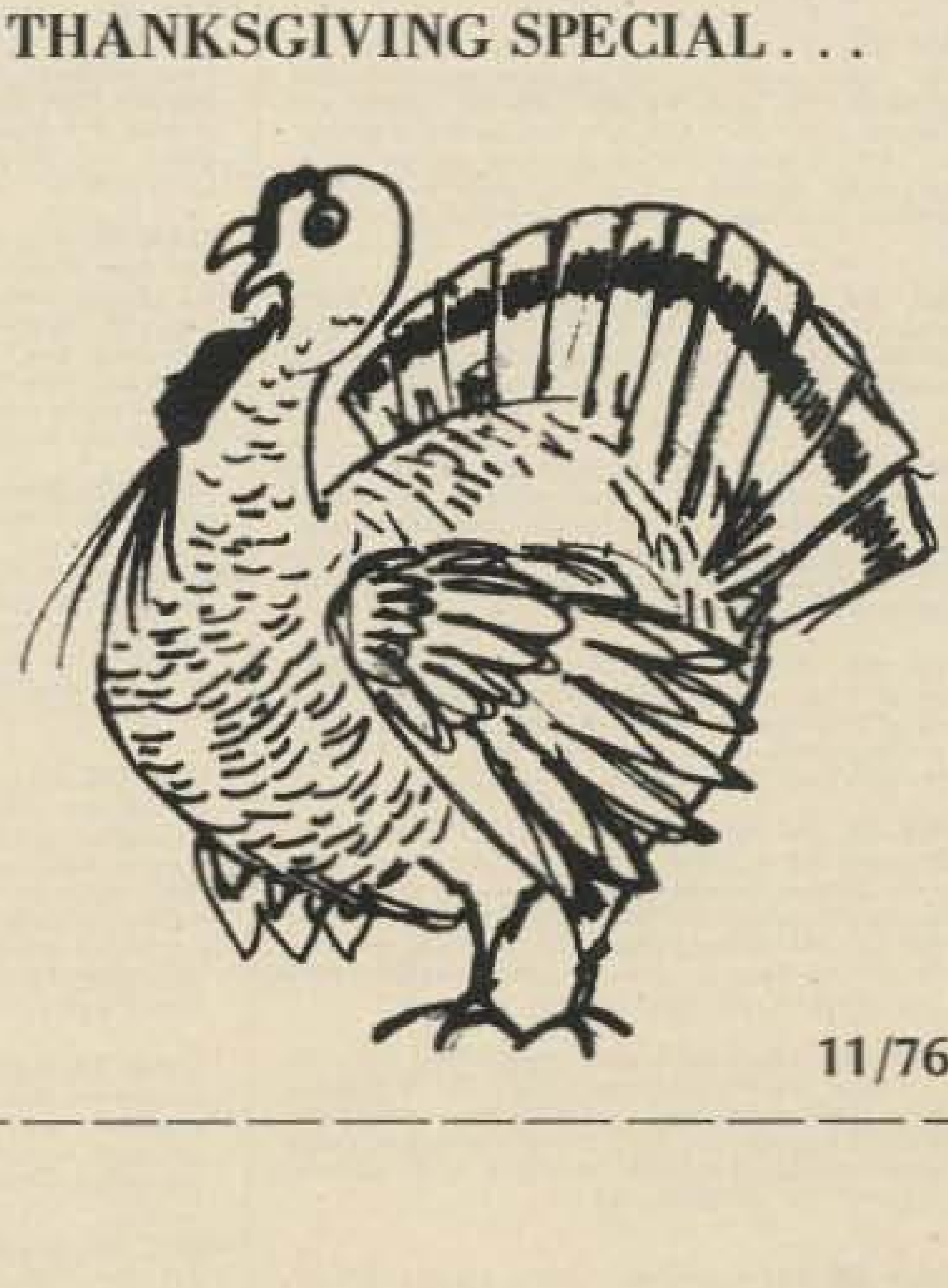

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JUNE 63. Surplus Issue: DMQ-2 Beacon Tx on 220, increasing ARC-2 transceiver selectivity, PE-97A pwr supply conversion, BC-348 band-spread, inductance tester, converting BC-230 tx, beginner's rx using BC-453, recvr motor-tuning, transistor cw monitor, BC-442 ant relay conversion, mobile loading coils, increasing Two-er selectivity, TV with the ART-26 tx, TRC-8 rx on 220, ARC-5 hf rx & tx, ARC-3 tx on 2M.

AUG 63. Battery-op 6M stn, diode noise gen, video modulation, magic T-R switch, ant gain, halo mods, cw breakin, VEE beam design, coax losses, RF wattmeter, TX Tube Guide, diode pwr supply, "Lunchbox" squelch, SWR explanation, vertical ant info, info on Windom ant.

OCT 63. WBFM transceiver ideas, HF propagation, cheap fone patch, remote-tuned Yagi, construction hints, ant coupler, S5 Vertical, filament xformer construction, 2M nuvistor converter, Lafayette HE-35 mods, Buyer's Guide to Rx & Tx, product detector, novel Hi-C VFO, radio astronomy, panadaptor "if" converter, compact mike amp.

FEB 64. 2M multichannel exciter, rx design ideas, majic t/r switch, loudspeaker enclosures, 40M 2W tx, look at test equipment, radio grounds, 40M ZL Special ant, neutralization.

MAY 67. Quad Issue: 432 Quad-quad-quad, expanded HF quad, Two el quad, miniquad, 40M quad, quad experiments, half-quad, three el quad, 20M quad, tiltover quad, easy-to-erect quad, Quad Bibliography, FET vfo, tube troubleshooting, HF dummy load, understanding "dB," HF SSB/cw rx, geometric circuit design, GSB-201 transceive, FET converter for 10-20M, hi-pass rx filters.

JULY 67. VE ham radio, VEØ hams, dsb adaptor, home brew tower, transistor design, '39 World's Fair, gnd plane ant, G4ZU beam, SSTV monitor, UHF FET preamps, IC "if" strip, vertical ant, VHF/UHF dipper, tower hints, scope monitoring, operating desk, S-Line crossband, hi-school ham club, Heath HR-10 mods.

OCT 67. HF solid state rx, rugged rotator, designing slug-tuned coils, FET converter, SSTV pix gen, VHF log-periodics, rotatable dipole, gamma-match cap, old-time dxing, modern dxing.

JUNE 68. Surplus Issue: Transformer tricks, BC-1206 rx, APS-13 ATV tx, low voltage dc supply, surplus scopes, FM rig commercial xtal types, Wilcox F-3 rx, restoring old equipment, 75A1 rx mods, TRA-19 on 432, freq counter uses, transceiver pwr supply, uses for cheap tape recorders, Surplus Conversion Bibliography, RT-209 walkie on 2M, ARC-1 guard rx, RTTY tx TU.

JULY 68. Wooden tower construction, tiltover towers, erecting a telephone pole, IC AF osc, "dB" explained, ham club tips (Part 1).

SEPT 68. Mobile vhf, 432 FET preamps, converting TV Tuners, xtal osc stability, parallel-Tee design, moonbounce rhombic, 6M xciter (corrections Jan 69), 6M transceiver (corrections Jan 69), 2M dsb amp, ham club tips (Part 3).

NOV 68. SSB xtal filters, solid state troubleshooting, IC freq counter (many errors & omissions), "cv" transformers, space comm odyssey, pulsar info, thin-wire ants, 40M transistor cw tx/rx, BC-348M double conversion, multifunction tester, copper wire specs, thermistor applications, hi-voltage transistor list, ham club tips (Part 5).

JAN 69. Suppressor compressor, HW-12 on 160, beam tuning, AC voltage control, 2M transistor tx, LC power reducer, spectrum analysis info, 6M transistor rx, operating console, RTTY autostart, calculating osc stability, lo-pwr 40 cw tx, sequential relay switching, sightless operator's bridge, ham club tips (Part 7).

FEB 69. SSTV camera mod for fast-scan, tri-band linear, selective af filter, unijunction transistor info, Nikola Tesla biography, mobile installation hints, extra-class license study (Part 1).

MAR 69. Surplus issue: TCS tx mods, cheap compressor/amp, RXZ calculations, transistor keyer, better balanced modulator, transistor oscillators, using blowers, halfwave feedline info, Surplus Conversion Bibliography, extra license study (Part 2).

APR 69. 2-channel scope amp, rx preamp, Two-er PTT, variable DC load, SWR bridge, 100 kHz marker gene, some transistor specs, SB-610 monitorscope mods, portable 6M AM tx, 2M converter, extra license study (Part 3).

MAY 69. 2M Turnstile, 2M Slot, rx attenuator, generator filter, short VEE, quad tuning, using antennascope, measuring ant gain, phone patch regs, SWR indicator, 160M short verticals, 15M antenna, HF propagation angles, FSK exciter, KW summy load, hi-power linear, extra license study (part 4), all-band curtain array.

JUNE 69. Microwave pwr generation, 6M ssb tx, 432-er tx/rx, 6M converter, 2M 5/8 wave whip, UHF tv tuners, ATV video modulator, UHF FET preamps, RTTY monitorscope, extra license study (part 5), building uhf cavities, mini-VEE for 10-20M, vhf vfo.

JULY 69. AM modulator, SSTV sig gen, 6M kw linear, 432 KW amp, 432-er tx/rx, 6M IC converter, radio-controlled models, RTTY IC TU, audio notch filter, VRC-19 conversion, tube substitution, 2M transistor xciter, extra license study (part 6), hf FET vfo.

AUG 69. FET regen for 3.5 MHz up, FM crystal switching, 5/8 wave vertical, introduction to ICs, RTTY tone gen, good/bad transistor checker, 2M AM tx, measure transistor Ft, 160M propagation, triac applications, simple IF sweep gen, transistor keyer, SB-100 on 6M, xtal freq measurement, extra license study (part 7), FM deviation meter, qrp am 6M tx, circular quads, FM noise figure, transistor parameter tracer.

SEPT 69. Tunnel diode theory, majic tee, soldering techniques, wave travel theory, cable shielding, transistor theory, AM noise limiter, AFSK gen, transistor amp debugging, measure meter resistance, diode-stack pwr supply, transistor testing, 2½W 6M tx, HX-10 neutralizing, capacitor useage, radio propagation, AM mod percentage, extra class license study (part 8), 3-400Z linear, ATV vidicon camera, 2 transistor testers, FET compressor, rf plate choke.

OCT 69. Super gain 40M ant, FET chirper, telephone info, scope calibrator, thyrector surge protector, slower tuning rates, identify calibrator harmonics, FM adaptor for AM tx, CB sets on 6M, proportional control xtal oven, xtal filter installation, Q-multiplier, transceiver pwr supply, extra class study (part 9).

NOV 69. NCX-3 on 6M, IF notch filters, dial calibration, HW32A external VFO, 6M converter, feedline info, rf z-bridge, fm mobile hints, umbrella ant, 432-er tx (part 1), pwr supply tricks with diodes, transistor keyer, transistor bias design, xtal vhf sign gen, electronic variac, SB33 mods, extra class study (part 10), SB34 linear improvements.

DEC 69. Transistor-diode checker, dummy load/attenuator, tuned filter chokes, band-switching Swan 250 & TV-2, 88mh selectivity, match exercizes, rtl xtal calibrator, transistor pa design, hv mobile p.s., 1-10 gHz freqmeter, CB rig on 6M, extra license study (part 11), 1970 buyer's guide.

JAN 70. Transceiver accessory unit, bench power supply, SSTV color method, base-tuned center-loaded ant, 6M bandpass filter, extra license study (part 12, rectifier diode useage, facsimile info.

FEB 70. 18-inch 15M dipole, 6M converter, high-density pc board, camper-mobile hints, 2M freq synthesizer, encoding/decoding for repeaters, DX-35 mods, panoramic vhf rx, variable-Z HF mobile mount, extra license study (part 13), linear IC info, qrp 40M tx, IC Q-multiplier.

MAR 70. Gdo applications, charger for drycells, FM freq meter, pc board construction, ham fm standards, cheap rf wattmeter, multifreq fm osc, "IF" system modules (part 1), Six-er mods, gdo dip lite, Motorola 41V conversion, cw monitor, buying surplus logic, SSQ-23A sonobuoy conversion, GRC-9 rx/tx conversion, extra class study (part 14), intro to vhf fm.

APR 70. Noise blanker, 2M hotcarrier diode converter, repeater controller, understanding COR repeater, 7/8-wave 2M ant, extra class study (part 15), inexpensive semiconductors, removating surplus meters, linear amp bias regulator, hi performance if amp & agc system, SSB bfo for shortwave radio, vacuum tube load box, general fm dope & repeater guide, megger-ing your ant.

MAY 70. Comments on "fm docket" #18803, future of cw, fm-am rx aligner, 5/8-wave verticals, using 2M intelligently, auto burglar alarms, pwr supplies from surplus components, "IF" system modules (part 2), vhf FET preamps, educated "idiot" lites, postage-stamp 6M tx, extra class study (part 16), Bishop IFNL, low-band police monitor, mobile cw tx, Wichita auto-patch.

JUNE 70. DDRR ant, vfo circuit, remote SWR indicator, indoor hf vertical, two rx on one antenna, environment & coax loss, 2-el trap verticals, buying surplus, two 40M qrp tx, 21dB 2M beam, extra class study (part 17).

DEC 70. Solid-state vhf exciter, delta fre control for SSB, 2M transistor FM tx, HW100 offset tuning, "little gate" dipper, 3-500Z hf linear, general class study (part 5), "transi-test" (no good — errors!), transistor p.s. current limiter.

JAN 71. Split fones for dxing, Heath Ten-er mods, cw duty cycle, repeater zero-beater, HEP IC projects, 10-15-20M parabolic ideas, lightning protection, IC rx accessory, attic ants, double-balanced mixers, permanent marker tool, ham license study questions.

FEB 71. Metal locator, varactor theory, AFSK unit, SSTV patch box, ATV hints, RTTY tuning indicator, tone encoder/decoder, 220 MHz converter, SSTV magnetic deflection, IC code osc, 6M tx beeper, general class study (part 6), RTTY intro, perf-board terminal, low-ohmmeter.

MAR 71. IC audio filter, IC 6M converter, trap vertical ideas, digi counter info, surplus equipment identification, hf linear, simple fone patch, repeater audio mixer, digi RTTY accessories, coathanger gndplane, general class study (part 7).

APR 71. Intro to fm, noise blanker, repeater problems, Motorola HT mods, microwave repeater linking, digital ID unit, tuneable 2M fm rx/tx, repeater directory, fm marketplace, meter evaluator, varactor modulator, simple sig gen, touchtone hookup, hf preselector, 10M 12W tx.

MAY 71. 75M mobile whip, 2M preamp, transistor amp design, 10M dsb tx, portable fm transceiver directory, audio compressor-clipper, transistor LM freqmeter, 450 MHz link tx, simple af filter, 1-tube 2M transceiver, surplus 2M power amp, general class study (part 8).

JUNE 71. 2M beam experiments, 3-el 2M quad, multi-band dipole patterns, weather balloon vertical, pocket-pager squelch, two-er vfo, tuning mobile whips, transistor pwr supply, capacity decade box, 40M gain ant, general class study (part 9).

JULY 71. IC audio processor, audio sig gen, cw filter, 2M fm osc, 2M collinear vertical, FM supplier directory, Motorola G-strip conversion, transistor beta tester, general class study (part 10).

AUG 71. Ham facsimile (part 1), 500 Watt linear, dimensions for July collinear, 4-tube 80/40 station, vfo digi readout, Jupiter on 15M, general class study (part 11), pink ticket wave-meter.

SEPT 71. Transformerless power supplies, solid state tv camera, IC substitution, two rf wattmeters, IC compressor-agc, multichannel HT-200, ham facsimile (part 2), causes of manmade noise, vfo with tracking mixer, general class study (part 12), transistor heat-sinking, IC pulse gen, fone-patch isolation, hcd wattmeters.

OCT 71. Emergency repeater cor, transceiver power supply, predicting meteor showers, digi switching, reverse-current battery charger, passive repeaters, earth grounds, audio "tailoring" filters, Swan 350 mods.

NOV 71. 3-el 75M beam, motor-tuned gnd-plane, 2M gain vertical, transistor biasing, split-site repeater, fox-hunting, audio filter, transistor/diode tester, xtal tester, 6M kw amp, 10-15-20M quad, transistor pi-net final, ant feedline, communications dbs, 2300 MHz exciter.

AUG 72. SSTV intro, speech processor, fm repeater info, test probe construction, GE progline ac supply, 432 rf testing, preamp-compressor, Six-er mods, fone patch, Two-er info, solar info, SCR regulator for HVPS, "ideal" xtal osc, fm rx adaptor, auto theft alarm.

SEPT 72. Plumbicon tv camera, WWVB 60 kHz rx, cigartube sig gen, cw active filter, rf testing at 1296-3500 GHz, balun ant feed, transistor power supply, IC 6M rx, IC fm/am detector (part 2), active filter design (part 3), K2OAW freq counter (part 3), 2M freq synthesizer (part 1).

OCT 72. Corrections for Aug. fm rx adaptor, 2M freq synthesizer (part 2), 6M transistor vfo, nano-ampere meter, time-freq measurement (part 1), active filter design (part 4), repeater timer, extra-class Q&A (part 3), balloon vertical, ID gen, time delay relay, 432 filter ideas, DC-AC inverter, hc-diode converter, rtl decade and nixie driver, plus-minus supply for ICs.

NOV 72. Hf transistor power amps, RTTY selcal, IC trf rx, transistor keyer, emergency power, 220 MHz preamp, double-delta ant, simple converter using modules, hf RF tester, "lumped line" osc, 2M freq synthesizer (part 3), K2OAW counter errata, 2M preamp, extra class Q&A (part 4), hi-Z voltmeter, Nikola Tesla story, vhf swr meter, transistor regen rx, 432 SSB transverter, AC are welder, intro to computers, hybrid am modulator, HR10 rx mods, 10M transistor am tx, 40M gndplane, IC logic demonstrator, overload protection, if/rf sweep generator, digi freq counter, aural tx tuning.

DEC 72. SSTV scope analyzer, 2M fm rx, tone burst encoder and decoder, universal if amp, autopatch hookup, LM380N info, voltage variable cap info, 2M 18 watt amp, SSB modulation monitor, xtal freq/activity meter, 10A var. dc supply, transmission line uses, radio astronomy, inductance meter, 75 to 20M transverter, LED info, 40M preamp, transistor vfo, 1972 index, 2M preamp.

JAN 73. HT-220 touchtone, 3-el 20M yagi, 50 MHz freq counter, speech processor, 2-tone gen, fm test set, tilt-over tower, 6M converter using modules, tuneable af filter, six band linear, 10M IF tuner, diode noise limiter, cw/ssb agc, HW22a transceiver 40M mod, HAL ID-1 mod.

FEB 73. CW id gen, tone operated relay, toroidal quadrature ant, active filter, time freq measurement (part 2), repeater timing control, SSTV circuits (part 1), 2M converter using modules, multifunction metering, FET biasing, freq counter preamp, TR22 hi-power mod, transistor rf power amps (part 1), light bulb rf power indicators, 75A4 filters, capacitance measurement, Gonset 201 mod, world time info.

APR 73. FM deviation meter, 2M FET preamp, two 2M power amps, repeater control (part 1), repeater licensing, European 2M fm, fm scanner adaptor, RCA CMU15 mods, lightning detector, cb alignment gadget, transistor rf power amps (part 2), repeater economics.

JUNE 73. 220 MHz sig gen, uhf power meter, repeater licensing info, RTTY autoswitch, 40M hybrid vfo tx, ant polar mount, 10-15-20M quad, K2OAW counter mods, double coax ant, ham summer job, tone decoder, field strength meter, nicad battery pack, ohm meter, FCC regs (part 1).

AUG 73. Log-periodics (part 1), tone burst gen, rf power amp design, transistor radio intercom, 160M ant, SSTV monitor, low cost freq counter, VOM design, qrp 40M tx, 432 MHz exciter, fm audio processing, FCC regs (part 3).

SEPT 73. Repeater control system, log periodics (part 2), 2M rx calibrator, PLL ic applications, TT pad hookup, Heath HW7 "s" meter, Oscar-6 doppler, 2M coaxial ant, 2M converter, IC keyer, measure ant Z, FCC regs (part 4).

OCT 73. GE Pocketmate mods, microwave freq measurement, CA3102E 2M frontend, 2 kw hf linear, rf wattmeter, meter repair, 60/40 dipole, IC "hi" gen, vhf freq multiplier, FCC regs (part 5).

NOV 73. 450 MHz exciter, intro to ATV circuits, nicad voltage monitor, autopatch connections, IC meter amplifier, TR22 ac supply, indoor vertical, IC af filter, momentary power failure protection, 160M ant acoupler, Motorola HT info, SSTV-ISB, Class-B af amp, FCC regs (part 6).

DEC 73. Code speed display, 2M kw amp, IC keyer, 8038 waveform gen, helical resonato design, sensitive rf voltmeter, proximity contro switch, IC tester, sequential tone decoder, 2M portable beam, electronic calculator math, c filter design, FCC regs (part 7).

FEB 74. SSTV monitor info, IC audio amp scope sweep gen, 15/20M vertical, telephon line control system, pc board constructio var-Q af filter, blown-fuse indicator, 40m c stn with Ten-Tec modules, simple pream compressor, single-IC rx, "432-er" final assem bly, transistor keying circuit, 7-segment readou with nixie driver.

APR 74. Vox for repeaters, tone-operate relay, hf transverter, 10-to-2m tx converte remote control panel for scanner, RCA fm tuning, subaudible tone gen, FCC regs (part 9 Repeater Atlas.

MAY 74. Cd car ignition, audio compress info, interference suppression for boats, au burglar alarms, 2m ic preamp, 10m fet co verter.

JULY 74. 4-1000A linear, universal freq g universal afsk gen, 555 IC timer, 80M phas array, 135 kHz-432 MHz preamps, 10M qrp tx, 3000 vdc supply, how to read diagrams.

AUG 74. Toroidal directional wattmeters, 4 MHz FET preamp, use gdo to find " Trimline tt pad hookup, R390 & R392 mods, tracking cw filter, aural voltmeter, u versal regulated supply, sstv scan converter, logic problems, ID timer.

SEPT 74. MOSKEY electronic keyer (part ex warning system, Heath 10-103 scope mo qrp 6M am tx, rf speech clipper, audio n limiter, wx satellite on SSTV monitor, unive IC tester, miniature rig construction, to construction, infinite rf attenuator, electr

(Mor

Since there's little to get stale in back issues of 73 (our magazine is not padded . . . like others . . . with reams of activity reports), you'll have a fantastic time reading them. Most of the articles are still exciting to read . . . and old editorials are even more fun for most of the dire predictions by Green have now come to pass. Incentive licensing was every bit the debacle he predicted . . . and more. You'll really get a kick out of the back issues.

photo-flash ideas, IC "select-o-ject."

OCT 74. Microtransistor circuits, synthesized HT-220 (part 1), repeater government, regulated 5 vdc supply, fm selcal, removeable mobile ants, Motorola metering, 2M vertical collinear, Motorola model code, 2M coaxial dipole, 1.6 MHz if strip, MOSKEY electronic keyer (part 2), carbon mike circuit, hi-power lo-pass filter, 6M preamp, 3-wire dipole, ATV sync gen, NCX-5 mods, mobile whip for apartment dwellers, sstv auto vertical trig.

NOV 74. K2OAW counter update, regulated 5 vdc supply, wind direction indicator, synthesized HT-220 (part 2), 20M 3-el beam, autopatch pad hookups, double-stub ant match, novice class instruction, digi swr meter (part 1), 6M converter (1.6 MHz if), "C-bridge," MOSKEY electronic keyer (part 3), Aug. sstv scan converter errata, repeater off-freq indicator.

DEC 74. Care of nicads, wind speed/direction indicator, wx satellite video converter, electronic keyer, hints for novices, unknown meter scales, SSTV tape ideas, TTL logic probe, public service band converter, tuned-diode test receivers, digi swr meter (part 2), telephone pole beam support, rhombic antennas, 1974 Index

FEB 75. Heath HO-10 scope mod for SSTV, electronic keyer, digital satellite orbital timer, Oscar-7 operation, satellite orbital prediction, Heath SB-102 mods, comparing FM & AM, repeater engineering, Robot 80-A sstv camera mod, neutralizing Heath SB-110A, "Bounceless" IC switch, tape keyer for cw tx.

APR 75. $50 walky for 2M, 2M scanning synthesizer, 88 mH toroid info, 8-function repeater controller, nicad battery precautions, TR22C preamp, telephone attachment regs, Guide to 2M Hand-held Transceivers, 2M 7-el beam, basic telephone systems (part 1), 10 min ID timer, modified hf Hustler mobile ant for 2M, 15M quad modified for 20M, 2M collinear beam, R-11A surplus rx conversion, 5/16-wave 2M ant, Hallicrafters SX-111 rx mods, 160M cw tx.

AUG 75. 146/432 MHz Helical ants (part 2), 10 min ID timer, digi swr computer (part 1), debugging rf feedback, DVM byer's guide, wx satellite monitor, cmos "accu-keyer," pc board method, sweep-tube final precautions, compact multiband dipoles, small digital clock, accessory vfo for hf transceiver, modern non-Morse codes, multi-function gen, 2M scanning synthesizer errata, KP-202 walky charger, 10M multi-element beam.

SEPT 75. Calculating freq counter, wx satellite FAX system (part 1), IC millivoltmeter, three-button TT decoder, troubleshooting sstv pix, 40M dx ants, 146/432 MHz helical ants (conclusion), digi swr computer (conclusion), reed relay for cw bk-in, NE555 preset timer, power-failure alarm, portable qrp rig power unit, precision 10 vdc reference standard, 135 kHz if strip, telephone handsets with fm transceivers, Motorola T-44 tx mod for ATV, 0-60 MHz synthesizer (part 10, ham radio PR).

BACK ISSUES

73 MAGAZINE CLASSICS

issues containing hundreds of articles & projects

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Charge: □ BankAmericard # ____________

□ Master Charge # ____________

Master Charge Interbank # ________ Expiration date _____

Date ________ Signature ____________

LETTERS

from page 57

corder, and digital call counter. It's a beauty!

I built the identifier from the Robert Glaser article in last April's issue ("A Reprogrammable ID"), and it works like a charm. I made some changes in the timer and I am using only two buttons to do the programming.

Another two projects I built from the April issue are the "5 Dollar 100 Watt Amplifier," a nice 2 meter antenna, and the "Mighty TR-22/15" little amplifier, which is now the afterburner of my VHF Engineering rig base station.

Now I am putting together "MINI-MOS – The Best Keyer Yet?" by WA6EGY, on page 38 of the August issue.

There is no doubt that *73* is the leading magazine in the business.

Congratulations, again, and keep the good work and the stream of good stories coming.

Albert H. Coya WB4SNC
Miami FL

BUG VII

An error was spotted in my "Fun Counter" article (July issue). The leads on IC3, pins 5 and 6, should go to pins 6 and 7 respectively in Fig. 6(a).

A. E. Plavcan
Anaheim CA

CURRENT?

First, keep up the logic and computer articles. I'm a computer freak and really enjoy them. The people who complain about computer articles are like the League people who fought transistor articles in *QST*. You can't stop progress. It's only up to you whether you stay current or not.

Dick Murphy WA1SPI
Marlboro MA

GOOD STUFF

As soon as I received the July issue, and read Bob Way WA9VGS's article on the Keycoder I, I said I had to have one. So, I collected the parts and got to work. Since Bob had not specified the precise Amidon part number, I fired off a message to him about it. Got my answer and got it built. And that is one of the things I really like about your magazine – the articles are reasonable things to build without a machine shop or microwave lab, are useful or interesting gadgets, use parts that can be found, and, based upon my huge sample of one, work. The Keycoder is the very first thing I have ever built from a magazine, so maybe you can imagine my joy in getting it to work properly and well.

Now that you have my money to extend my subscription for three years, please keep the good stuff coming.

Ralph Jay Frisbie WB6GNS
Camarillo CA

ENDBUG

Just a note to call your attention to a mistake in the parts list of the "12 Inexpensive Volts" article on page 60 of the September, 1976, *73*. In regard to T1, the list calls for a 2731510 12 V 3 A transformer. This particular Radio Shack number, however, is for a 6.3 V 3 A transformer. The correct part number is 273-1511.

Doug McArtin WA2AUJ
Yonkers NY

GEORGE

On June 9, youthful thieves entered the locked car of George Keys WA6KAA, which was parked overnight in the driveway of his home. They snatched a two meter rig that George had purchased only two weeks earlier.

George took action.

The Santa Maria *Times* of June 12 carried an ad offering to exchange a Johnson CB rig for the stolen 2 meter rig – with no questions asked. That evening a telephone call cinched the trade. The next morning George had his HA 146 returned and the two young men left with the Johnson CB rig.

George had their description.

It was circulated to members of the Satellite club. One member related the description to an incriminating conversation someone he knew had overheard. It was sufficient for Sheriff's deputies to make the two arrests, breaking up a CB theft ring and recovering a number of stolen CB rigs in the process.

Lee J. Delworth WB6RDW
Lompoc CA

propagation

by
J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7A	7	7	3	3	3	3	3A	7	14	14	14
ARGENTINA	7A	7	7	7	7	7	14	14	14A	14A	14	14
AUSTRALIA	14	7B	7B	7B	7	7	7	14	14	14	14	14A
CANAL ZONE	7A	7	7	7	7	7	14	14	21	21	14	14
ENGLAND	7	7	7	3	7	7	14	14A	14A	14	7B	7
HAWAII	14	7B	7	7	7	7	7	3A	7	14A	14A	14
INDIA	7	7	7B	7B	7B	7B	14B	14	7B	7B	7	7
JAPAN	14B	7B	7B	3B	3	3	3	3B	7	7B	7B	14
MEXICO	14	7	7	7	7	3A	7	14	14	14A	14	14
PHILIPPINES	14B	7B	7B	7B	7B	7	7	7	7	7B	7B	7A
PUERTO RICO	7	7	7	7	7	3	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7B	7A	14	14A	14A	14A	14	14
U. S. S. R.	7	7	3	3	7	7B	14	14	14	7B	7	7
WEST COAST	14	7	7	7	7	7	7	14	14	14A	14A	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	3	3	3	3	3	7	14	14	14
ARGENTINA	14	7A	7	7	7	7	7A	14	14A	14A	14	14
AUSTRALIA	14A	14	7B	7B	7	7	7	7	14	14	14	14A
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	14	14
ENGLAND	7	7	7	3	7	7	7B	14	14	14	7B	7
HAWAII	14	14	7	7	7	7	7	3A	7	14A	14A	14
INDIA	7	7	7B	3B	7B	7B	3B	7A	7A	7B	7B	7B
JAPAN	14	7B	7B	3B	3	3	3	7	7	7	7B	14
MEXICO	14	7	7	7	7	3	3	7A	14A	14	14	14
PHILIPPINES	14	14B	7B	3B	3B	7	3	7	7	7	7B	14
PUERTO RICO	4	7	7	7	7	3A	7A	14	14A	14	14	14
SOUTH AFRICA	7A	7	7	7	7B	7B	7A	14A	14A	14	14	14
U. S. S. R.	7	7	3	3	7	7	7B	14	14	7B	7B	7

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	3	3	3	3	3	7	14	14	14
ARGENTINA	14	14	7	7	7	7	7	14	14	14A	14A	14
AUSTRALIA	14A	14A	14	7B	7	7	7	7	14	14	14	14
CANAL ZONE	14	7A	7	7	7	7	7	14	21	21	14	14
ENGLAND	7	7	7	3	7	7	3B	7B	14	14	7B	7B
HAWAII	21	14	7A	7	7	7	7	3	7A	14	14A	14A
INDIA	7	14	7B	3B	3B	7B	3B	3A	7	7	7	7B
JAPAN	14A	14	7B	7	3	3	3A	3	7	7	7B	14
MEXICO	14	7A	7	7	7	7	7	7A	14A	14	14	14
PHILIPPINES	14A	14	7B	7B	7B	7	7	3	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14A	14	14
SOUTH AFRICA	14	7	7	7	7B	7B	7B	14B	14A	14A	14	14
U. S. S. R.	7	7	3	3	3	3	3	7A	7A	7B	7B	7B
EAST COAST	14	7	7	7	7	7	7	14	14	14A	14A	14

A = Next higher frequency also may be useful
B = Difficult circuit this period
N = Normal
U = Unsettled
D = Disturbed

1976 NOVEMBER 1976

SUN	MON	TUE	WED	THU	FRI	SAT
	1 U	2 D	3 D	4 U	5 U	6 U
7 D	8 U	9 U	10 N	11 N	12 N	13 U
14 D	15 U	16 N	17 N	18 N	19 N	20 N
21 N	22 N	23 N	24 N	25 U	26 U	27 U
28 N	29 N	30 N	FULL MOON	LAST QUARTER	NEW MOON	FIRST QUARTER

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- Indicator light for internal VFO operation
- Provision for optional RF speech processor
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