AMATEUR RADIO

73

OCTOBER 1976
$1.50

26 Feature Articles

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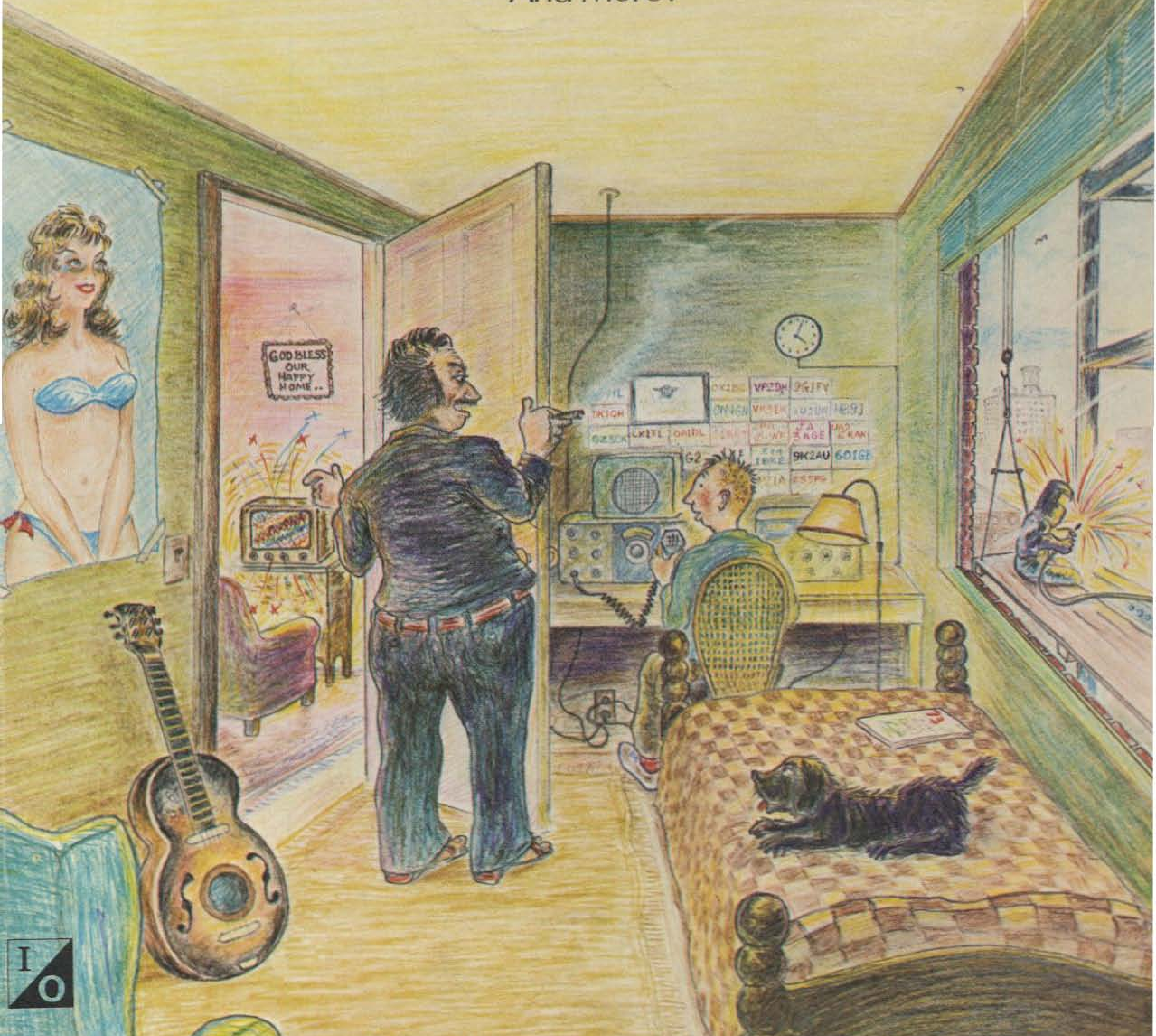
- *Counters*
- *Hybrid Quad*
- *Quickie Collinears*
- *Weird Mobile Antenna*
- *And More!*



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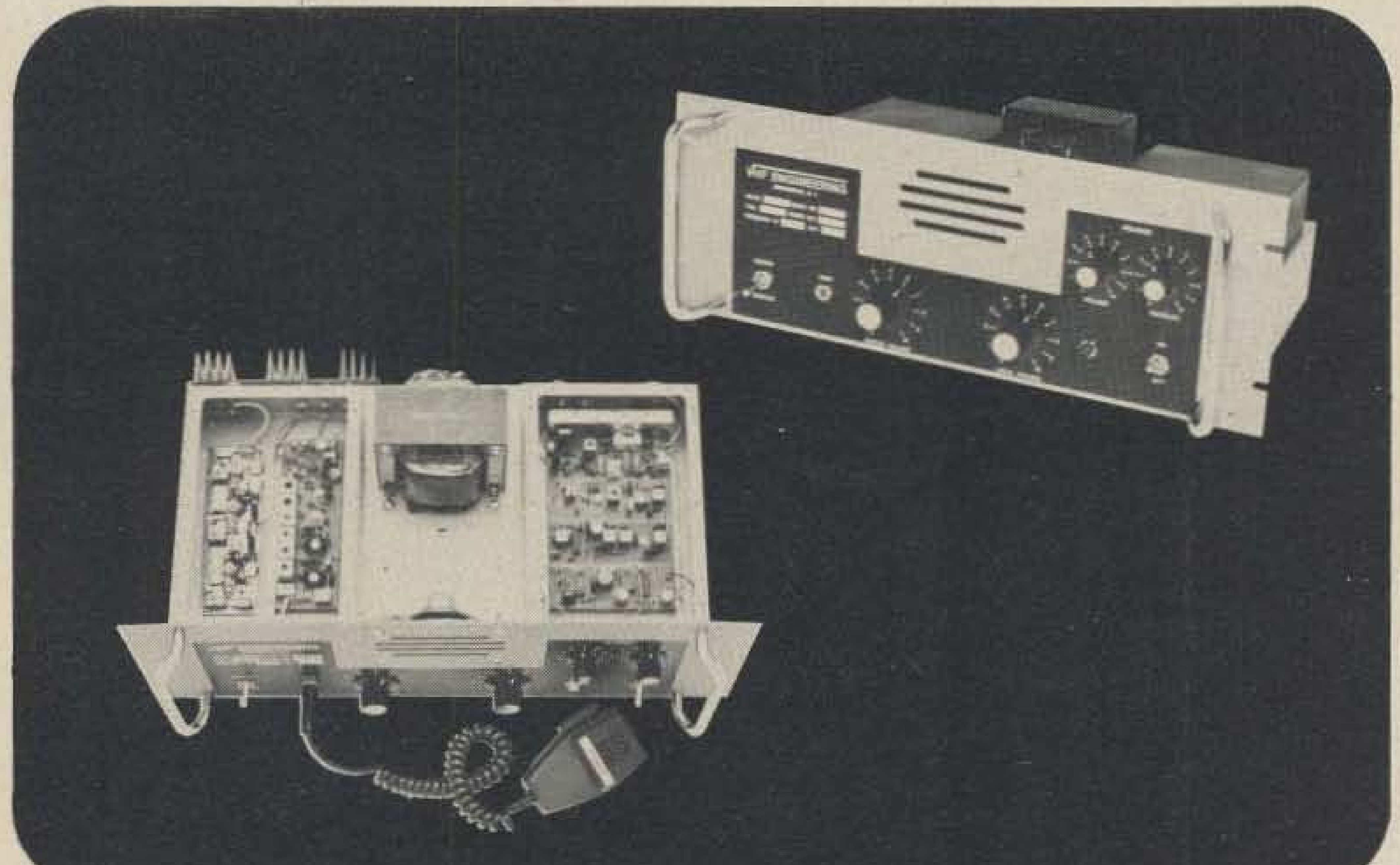

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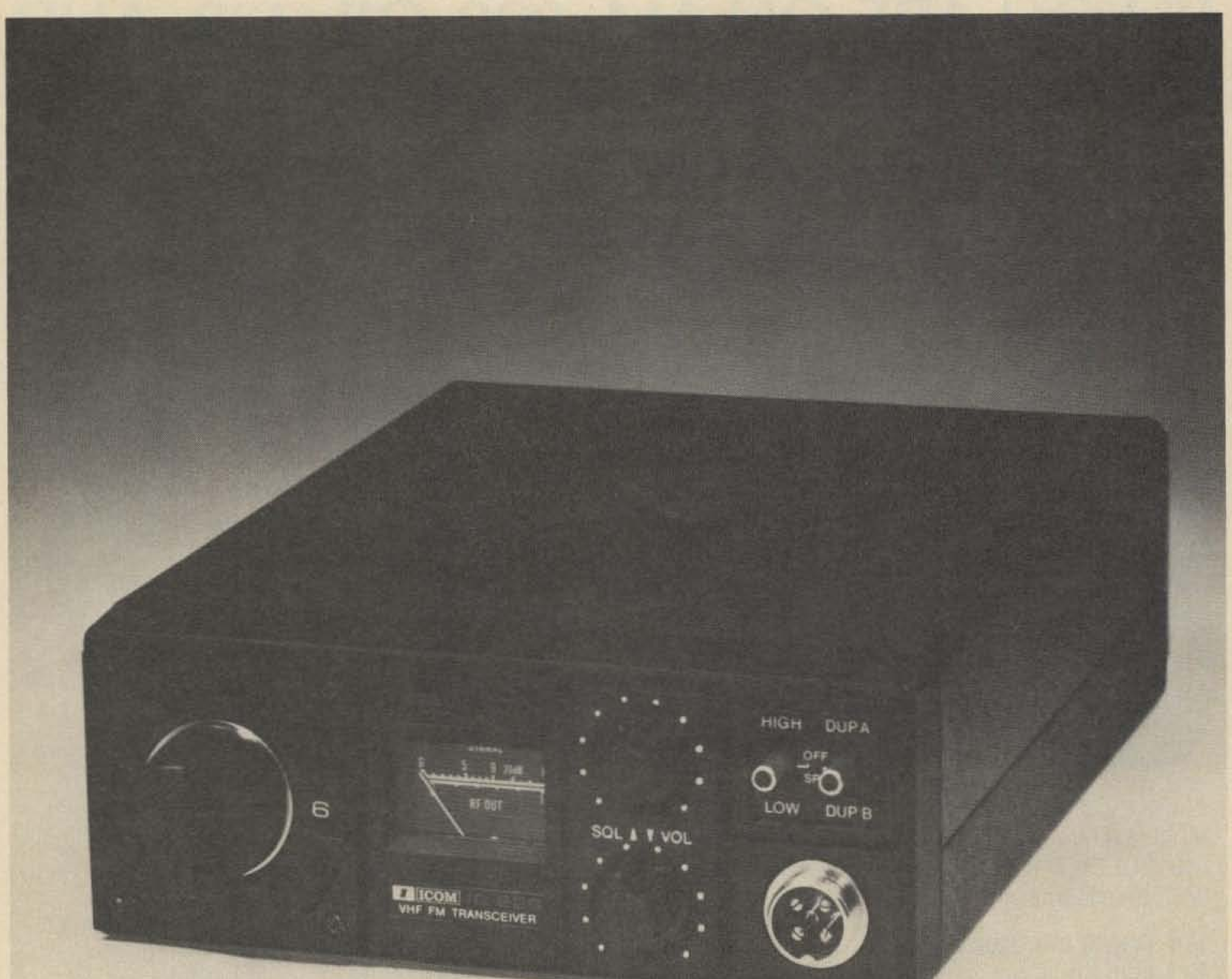
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73

#192 OCT 1976

COVER: Colored pencils on poster board, by John M. Murray W1BNN, Bloomfield CT.

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... de W2NSD/1

EDITORIAL BY WAYNE GREEN

WAYNE ON WARCC

You've probably heard about the preparations which are being made for the coming ITU conference. Committees are already at work on proposals for more ham bands . . . etc.

You probably haven't heard a lot about what happened at the last ITU meeting when amateur radio lost virtually all (99.8%) of its satellite bands. That was when the biggest part of the future of amateur radio went down the tubes. Just imagine what we could do with amateur satellites using the 1215-1300 MHz band . . . the 2300-2450 MHz band . . . and all the other bands above two meters! Amateurs anywhere in the world could have talked with any other just as we do via two meter repeaters. All that is no longer possible . . . and never will be possible, for those bands are gone and cannot ever be regained.

Now why were those satellite bands lost? You probably know the answer as well as I do . . . they were lost because we did not make adequate preparations for the conference. Have we learned from this? Possibly . . . but I have not yet seen *any* sign of it.

Before I lay more on you, let me cite my qualifications briefly. Firstly, I was one of the official delegates to the last ITU plenipotentiary conference in 1959, so I have a fair idea of how the ITU works and how the delegates from various countries interact. Since then I have made it a point to visit quite a few countries and talk with the heads of telecommunications. I'm up to 86 countries visited so far. All of this has given me a fair idea of how the world fits together as far as amateur radio is concerned.

Okay . . . if we really want to protect amateur radio and come out of the next ITU conference without more tragic losses, what do we have to do? We only have to look at the report on the satellite frequency losses to get a strong clue . . . and it was exactly what I have recommended in my editorials in the past . . . we need a ham with a good deal of background and the ability to speak well to visit foreign countries and do two major things. Firstly, he should find out what emotional blocks there are against amateur radio . . . and what, if anything, he or U.S. amateurs can do to counter these blocks. It may be that one of our DXpeditioners has left his mark there. Some of them visited countries and promised all sorts of things . . . propagation studies . . . medical help . . . tourists . . . etc. Some told just about any lie they could to get a license and permission to operate for a few days. Things like this may take a lot of ingenuity to overcome.

Other countries are still furious over U.S. amateurs who have been permitted to operate and who ignored the local rules. Some made phone patches home even though they knew they were forbidden . . . others ran illegal high power . . . etc. It was unresolved problems like this that shot us down the last time.

The other thing we can do is make sure that every country in the world understands the immense value of amateur radio to them. This is a story that I've written too many times, so I won't rehash it here. There is hardly a greater gift we can offer a small country than a healthy amateur radio group.

Once some sort of rapport has been established with the telecommunications leader of a country we then will have an opportunity to point out the benefits to the country of backing amateur radio at the ITU. We will also have an opportunity to discuss any position the country may already be considering with regard to frequencies now amateur or proposed for amateurs . . . and we might be able to come up with good alternates and a list of benefits to them for going the alternate routes. *This* is preparation for a conference.

Sitting in on committee meetings in Washington is important too, for if you don't have the U.S. behind you, you're in a poor spot. But the U.S. has one vote . . . and so have each of the African and Asian countries . . . and *these* are the countries that are now running the ITU.

What are our WARCC people doing? Little has been said. What are they planning? Even less has been said about that. I have a feeling that the ARRL will come up with some vague appeal for funds to be donated to either them or a front organization . . . but will these be used for anything positive — or will they be wasted on fun trips for ARRL officials as in the past? A few of us remember that $100,000 fund which was set up for the protection of amateur bands many years ago . . . and we also remember that no accounting to the members has been made of the expenditures from this fund. My own questions about those mysterious expenditures have gone unanswered . . . except in undercover calls from ARRL Directors who knew what had been going on, but were afraid to say anything in public. Yes, we have our own little Watergates, right here in amateur radio. Perhaps it is time for the ARRL to come clean on these things and set up their books so such things can't happen again.

SUPER SPEED CW

A small group of amateurs have been loafing along in the 80-100 wpm range with CW. You may be able to hear them chirping away if you check 7035 and 14035 kHz evenings. They're using codetyping keyboards for sending and copying in their heads.

Yes, I know that the record was set in the '40s by Ted McElroy at 73 wpm, but that was hard copy. As a matter of fact, I used to watch Ted at hamfests demonstrating his skill — it was amazing to behold. The sound was almost like a continuous tone. Ted would start up his code recording and let it play for a bit, talking genially with watching amateurs, then he would sit down at his typewriter and flay away at it, catching up with what had already been sent, continuing his joking with the watchers as he typed.

With a little practice you can join the gang . . . maybe that will take a lot of practice.

One of the benefits of high speed CW vs. RTTY is that full break-in is normally used. It makes it a lot more like talking. A make-break RTTY system could be evolved which would permit this, but as far as I know it hasn't been done yet. There are enough benefits to frequency shift keying, so RTTYers are not likely to chuck it. Amateurs using microprocessors to generate CW could have a

Continued on page 108

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BE MY GUEST
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Lila Howard WA2JIO, receiving a message from Mr. Smith, the harbormaster at Oyster Bay, for transmission to one of the patrol craft.

Larry Stanecker WA2OLP, on the bridge of the Pajo II *receiving messages from W2VL during the bicentennial celebration.*

Tall Ships Are Tall Order

Friday, July 2, 1976, a day like most other days. Yet a day that would go down in history as one of the major events in a great nation's birthday party. It would also be a day where the abilities of the radio amateur to provide public service would be tested and found more than equal to the task.

The place? Oyster Bay, Nassau County, L.I., N.Y.

The cast? Thousands of visitors and tourists, hundreds of small boats, and six "Tall Ships."

The Mission? To provide radio communications for the harbor patrol, V.I.P. launches, harbormaster's office, and anyone else who needed to get a message from here to there.

The communications team? Dedicated members of the Long Island Mobile Amateur Radio Club (LIMARC).

Prior to the events of this day, the authorities at Oyster Bay, along with others involved in the upcoming "OPSAIL," were fully aware of the problems that could be created by this massive influx of people, boats, and planes, and the varied and sundry things that could be expected as an offshoot of the massive overcrowding of this relatively small area. Conferences were held between the port authorities and Duke Harrison K2QPF, and a game plan was set up wherein LIMARC would provide backup radio communications for all port operations. We were soon to find that "backup" communications can quickly become "primary" communications. The basic plan provided for a base station, located at the harbormaster's office, operating on 146.94/34 in the basic configuration of a repeater. Hand-held units operated by LIMARC members would be scattered about and located on the two V.I.P. docks, aboard the volunteer launches, and aboard the harbor patrol craft normally stationed in Oyster Bay Harbor. Police boats would rely on their own communications gear. Operations would commence at twelve noon on the second and end at midnight. Arrangements were also made with the Port Chester, N.Y., repeater group to keep their 34/94 machine off the air during this period. This was the only machine that could cause local interference to the LIMARC operations, other than local operators using 94 direct.

Under the direction of K2LIO, a Station Master antenna was set up atop the harbormaster's office and two rigs were installed at a table on the shady side of the building. Commencing at twelve noon, W2VL (the LIMARC commemorative station) went on the air as the Oyster Bay command post station. Skillfully controlled by Lila WA2JIO, who was assisted by over twenty LIMARC members, the station began operating in earnest.

At first there was little to do – and then the deluge began. It appeared that the use of VHF marine radios in the harbor by the myriad small boats, all shouting at once, had rendered these channels totally useless.

CB radios located in the dockside office were also quickly jammed into a morass of 10-4s, 10-36s, 10-20s and Spaceman this is Beetle Buster. Our role as backup communications system had suddenly become that of being the only communications available. With consummate skill, Lila fielded the many calls coming from the launches and quickly set up an ordered net style pattern. With mounting rapidity, the messages came thick and fast: "Ice needed on the *Urania*" (her refrigeration had broken down); "Three crewmen from the *Magic Venture* to go ashore"; "There is a traffic jam of small boats near the Dutch ship *Eendracht*"; "Three V.I.P.s for a harbor tour at the northwest dock"; "Where is the captain of the *Urania*?" As these messages were coming in, the harbormaster had a constant flow of outgoing traffic for the patrol craft, the launches and the operators stationed at the docks. LIMARC members were riding around in Boston Whalers labeled "Harbor Patrol," luxury 28-32 foot skiffs, Bay constable cruisers, and anything else that could float. Out of this chaos came order and an orderly flow of traffic.

As a message handling exercise, it went off with textbook smoothness and great efficiency. As an example of amateur radio at work serving the public, there was no way that it could have been found wanting.

Without it, Oyster Bay harbor would have been a disordered maelstrom of boats, people and electronic noise.

It was best summed up by a harbor patrolman going off duty, who was asked by his replacement how the radios were working. "Well," he said, "the marine radio is no good and the CB is useless, but don't worry, the hams are here."

Harvey G. Hurwitz WA2HYS
Oceanside NY

Weisbaden Riding High

Having been together for more than a year, the Wiesbaden Amateur Radio Club from Wiesbaden, Germany, decided to do something different for a change. Having the usual club activities in high gear, we were in need of another unique activity to push new blood into this already solid and growing club. What better way than to go on a DXpedition!

The Wiesbaden Amateur Radio Club was formed over a year ago. It is comprised primarily of U.S. Air Force and U.S. Army personnel stationed in West Germany, along with several American, French, and German civilians. The club has a solid foundation, and although quite new at being a club, has successfully sponsored two hamfests among its other normal club activities. Perhaps it's the lure of adventure or perhaps it's the traveling blood in so many of us overseas, but we decided to partake of the excitement of being DX.

In order to get our feet wet in this new adventure, we arranged for a practice trip to the closest country available for a DXpedition – Luxembourg. The 3 hour drive to LX-land was a worthwhile trip, because we were able to learn many things pertaining to a DXpedition. Our U.S. Field Day experience sure came in handy, and we were then ready to embark to our primary target – Liechtenstein.

Gathering camping equipment, food, personnel, and radio equipment, the first group arrived for our week-long activity on May 24. The station was set up in a campground near Triesen with a beautiful view of the Swiss Alps to the West. A 50 meter endfed Hertz antenna was strung from one tent to a convenient tree with the aid of the campground owner, who proved to be quite intrigued with our intentions. Then our pride and joy was raised – a 2 element triband quad beamed stateside on top of a 10 meter high portable mast. The campground owner seemed a little hesitant at helping with the quad. Perhaps the awesome size of the antenna proved to be a bit too much for his imagination. We all had our moments of wonder as to whether that beast would ever get off the ground, but we managed to get it flying just before dusk. And, not to let an opportunity slip away to do some serious VHF DXing from such a beautiful mountainside QTH, we erected a 32 element long yagi for 2 meters between a power pole and the quad mast. The rope boom was a cool 25 meters long.

Having the antenna farm in place, we busied ourselves with the equipment. Two HF stations were set up – an SB-102 and SB-200 combination and an HW-101 and SB-200 setup. For VHF we had a Multi-2000 and home brew 200 Watt amplifier for FM and SSB.

Throughout the week we enjoyed many exciting hours of operation. Many local Swiss and Austrian hams came to visit our location. One fellow even brought us a 430 MHz station including the antenna. With that we enjoyed working many stations in Switzerland, Germany, and Austria, thus making our band coverage complete from 3.5 through 430 MHz. We even attempted some Oscar work, but couldn't seem to hook up with the satellite. Next time we'll be ready for Oscar.

We managed to contact 3000 stations throughout the week. We were a little disappointed not to work more Stateside stations, but conditions weren't the best that week. Our VHF operation also proved exciting, as we were able to work stations as far away as Belgium on 2 meters. On several occasions we rolled up the 2 meter long yagi and went to the mountaintop for some truly magnificent VHF mountaintopping.

With the week rapidly drawing to a close, we dismantled HBØXAA to embark on our 8 hour journey northward to Wiesbaden. It was good to get back to a real bed and real food, but what an exciting time being on the other end of DX! We thoroughly enjoyed the operation and found almost all operators to be courteous, thereby enabling us to work many stations with a minimum of QRM.

What's in store next for the Wiesbaden Amateur Radio Club? We have a solid core of DX blood in the group and we are now deciding which DX spot to invade next. There will undoubtedly be a trip in late September to another rare QTH here in Europe. The Weisbaden Amateur Radio Club will ride again. We hope to hear you.

Terry L. Huston DA1TH/WA8RYC
Weisbaden, Germany

Standing, left to right: Jean DCØHO, Gerry WB5LVT/DA2BA, Carl WA1LHW/DA1TT, Tom DA1LV. Kneeling, left to right: Paul WA2VMS/DA2PG, Terry WA8RYC/DA1TH, Mike K8WVZ/DA1BM.

Autobiography of an Ancient Aviator

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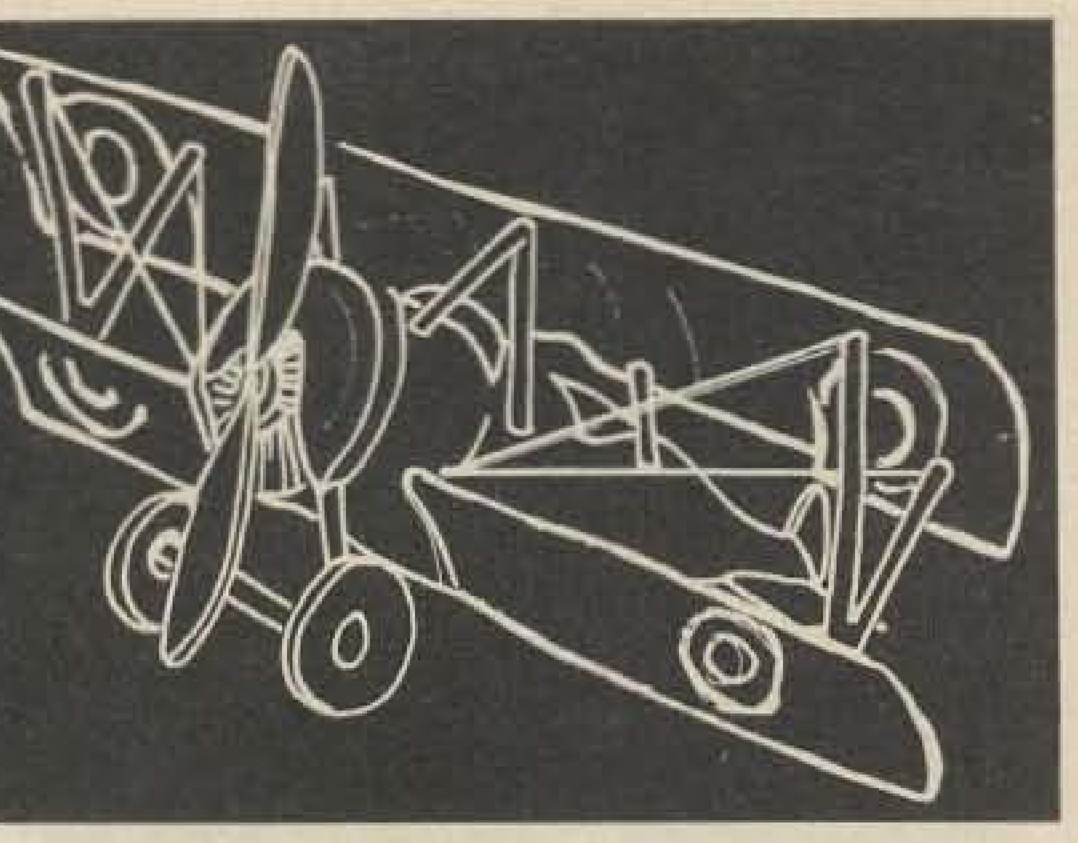


Here We Go Again

I told you last month about how, after years of hard work, Marine Airlines was quickly extinguished when the planes they were planning to use were "pulled out from under them." I also mentioned that Tommy Hitchcock, a partner in Lehman Brothers (bankers), had a situation he wanted to talk to Jim Eaton and myself about. Well, believe me, we wasted no time in getting over to Lehman Brothers to see what he had in mind.

It seems that Lehman Brothers had the controlling interest in the American Export Line, which operated steamships from New York to Mediterranean and Black Sea ports. In addition to some twenty-odd freighters, they operated four combination passenger and freight ships on a scheduled biweekly service to the more important ports. They called the latter the "Four Aces." Hitchcock's idea was that Export, with its well-established routes and connections with the countries touching on the Mediterranean, would be a fine vehicle with which to start and operate a transatlantic airline. Now, Tommy Hitchcock, as you may remember, was a top-notch polo player. One of his principal adversaries on the polo field was "Sonny" Whitney. Sonny was on the Pan American Airways board of directors. Although nothing was ever said on the subject, I have always thought that Hitchcock's enthusiasm with the American Export idea was partially due to his desire to have a go at Whitney in the airline business as well as on the polo field. Hitchcock himself was a good pilot, and owned and flew his own plane.

Talks with Hitchcock started about the first of November, 1936, and then gravitated to officials of American Export, William Coverdale, President, and John Slater, Vice President. Both were associated with the well-known New York engineering firm of Coverdale and Colpitts. All agreed that the days of volume transatlantic passenger transportation by boat were numbered, and, also, that although the "state of the art" had not yet produced aircraft capable of carrying an adequate payload over the transatlantic distances, it would not be too long before such equipment would be available. Export wanted to protect the passenger and light freight traffic on its Mediterranean routes by originating its own airline service. At that time, most American steamship companies were heavily subsidized by the federal government. Each had its own routes laid out by the Federal Maritime Commission. The U.S. Lines, for example, couldn't send ships into Mediterranean ports, and Export couldn't go to Cherbourg, Southampton or North Sea ports. So all their thinking was along the lines of their maritime routes.

Export intended to initiate its service by carrying passengers on the "Four Aces" between New York and the Azores (possibly Horta on Faial), and then to transport them on to the continent and Mediterranean destinations in large flying boats. The equipment for this service could be available in less than a year. The use of flying boats on the initial phase of the operation was made necessary because of the lack of adequate land planes and land plane airports in the Azores and around the Mediterranean. We all knew that, since there was very little difference in safety between flying boats and land planes when it came to a forced landing at sea, land planes would most likely be the ultimate vehicle for over-ocean travel.

Pan American Airways had been largely responsible for pushing American flying boat development. By mid-1936 they, and their associated air carriers, were operating scheduled services from Miami all through the Caribbean islands and around South America. They also flew from San Francisco to Hawaii and on to Manila. In addition, they operated routes in China and Alaska. For over-water routes they used Sikorsky S-42 and S-40 flying boats (32-39 seats) and Sikorsky S-38 and S-41 amphibians (7-22 seats); Ford tri-motors and Lockheed and Fairchild land planes were used in Alaska and over land.

At that time, the U.S. domestic airlines were flying Ford (tin geese), Fokker and Boeing trimotors. The new Douglas DC2 was just coming into use. All snails compared to the present-day jets. Douglas was working on the DC-3 for TWA and Boeing was starting on the development of its 314 flying boats for Pan Am. It took WW2 to speed up development of the four engine DC-4. These planes could make it across the North Atlantic to Northern Ireland by refueling at Gander (Newfoundland) and Reykjavik (Iceland).

Pan Am's ambition was to be the U.S. "chosen instrument" in international air commerce worldwide. They already had plans and equipment being designed for an around-the-world service. Quite an antagonist for American Export to take on. A few years later, after extended and bitterly contested hearings, the Civil Aeronautics Board perversely awarded Pan Am the routes sought by Export and gave Export the northerly route to England, Holland and the Scandinavian countries. More on this later.

My mission on this trip was to check on the availability of adequate flying boat facilities on American Export's route. I was instructed to confer only with Export and U.S. consular personnel and not with government or airline officials of any of the countries involved. Strictly tourist on the surface, camera and all.

After a couple of weeks discussion and briefing in New York, and before we quite realized what had happened, Eaton and I were scheduled to depart on November 24th on the *SS Excalibur* (flag ship of the "Four Aces") for a Mediterranean survey trip. Between conferences with the American Export people and putting Marine Airlines to bed, we had a very short time to update wardrobes, get shots, passports and visas.

Come sailing day, Cleo (my wife), my baggage and I arrived at Pier F, Jersey City, only to find that the poor downtrodden engine department was on strike for some nebulous reason. So we hauled everything back to Brooklyn. Evidently the deck and steward's departments didn't think the engineers had much of a beef, because on December 2nd the *Excalibur* finally set sail as a cargo-only vessel. Eaton and I were signed on as supercargoes. The Engine Department was made up of personnel on loan from various oil companies' ships. The Chief Engineer was fresh off a tugboat in Boston harbor. Since Eaton and I were the only passengers aboard, we were assigned the best cabins and got lots of service.

Everything went fine, good weather, etc., until the fifth day out. Then we started to get salt water in our showers and basins. Due to the engine crew's unfamiliarity with all the various valves, etc., most of our fresh water had been pumped overboard and the tanks filled with sea water. This resulted in corroding quite a few boiler tubes and causing leaks that put one boiler out of commission entirely. So they had to heave to, put out a sea anchor and spend two days replacing boiler tubes. This was no easy task, as only two of the borrowed engine crew were small enough to be able to crawl into the boilers to make repairs. We limped into Ponta Delgada and, after a couple of days of boiler refitting, we took on a supply of fresh water and sailed for Marseilles. I took advantage of the Ponta Delgada stop to go ashore and have a talk with our consul about our proposed operation. I could see that the Ponta Delgada harbor was not large or protected enough for our operation, so the consul suggested the Horta harbor on the island of Faial and furnished me with a detailed map of the islands.

When the *Excalibur* docked at Marseilles, Jim Eaton and I were taken before the U.S. consul, discharged from our supercargo duties and paid $1 each for our services. That was December 14th.

Budd & Co., the Export agents at Marseilles, got Eaton and I rail tickets to Nice for that afternoon. We stayed the night in Nice then went on to Genoa the next day. John Gehan, Export's Mediterranean V.P., met us at the station and settled us in at the Grand Miramare Hotel. This hotel was situated high on the hilly part of Genoa and had an excellent view of downtown Genoa and the harbor. The Miramare was a beautiful old hotel. It was built before the modern concept that every cubic foot must bring in its

Continued on page 15

CONTESTS

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

Please note the change in my mailing address and callsign. I'm now permanently located in southern New Jersey at the address shown above. All contest material should be sent to that address, preferably at least three months before the scheduled event. We will also continue to list results received as space permits.

1976 RTTY ART CONTEST
Starts: October 1
Ends: November 30

All worldwide licensed radio amateurs and members of their immediate families are eligible to participate in this contest. Each entry must be originated by means of manual inputs to a teleprinter using a standard communications keyboard, and may be submitted only by the originator of the art, or by the amateur on behalf of a family member. Submitted art may be of any subject suitable for transmission via amateur radio, but preference will be given to bicentennial subjects. Entrants may submit any number of entries, but each entry must be given a short title. Tapes of entries shall be formatted to permit a reasonably short running time, and to be compatible with machines which do and do not downshift on space. Compatibility with machines that do not interchange the bell and apostrophe is not required. At least 3 functions must be used between each line (normally CR, LF, and LTRS). Each line of the art shall be limited to 72 characters maximum (including spaces), but overline shading is permitted. Prints must be in one single part with no splices. Tapes must be limited to a maximum running time of 40 minutes at 60 wpm for the art itself, exclusive of any other information on the tape. Each entry must have been transmitted for the first time via amateur radio after October 1, 1976, and must be accompanied by a confirmation of at least one receipt of its transmission, identifying the title of the art and the call letters of the receiving and transmitting stations. All confirmations must be in writing (not by RTTY transmission), and must have been obtained by the entrant from the receiving station. Entrants may obtain necessary transmission of their entry by any amateur radio station. The tape and prints of each entry shall carry the full name of the author, call letters of the submitting station, and mailing address. This information shall be both written upon a beginning leader of the tape and also punched in the tape to appear on the page copy when reproduced. Entrants must submit one 5-level paper tape and five prints of each entry, and by such submission agree that the tapes and prints may be used, duplicated, and published for any purpose. Tape, prints, and transmission confirmation information should be securely packaged and sent to: RTTY Art Contest, c/o Don Royer WA6PIR, 18765 Santa Isadora St., Fountain Valley CA 92708. Entries must be postmarked on or before November 30, 1976. Entries will not be acknowledged or returned. Winners will be announced as soon as possible after the closing date. It is suggested that paper tapes be wound tightly upon a hard core to prevent mail damage!

Entries will be judged on the originality of the author in selection of subject matter, on excellence of technique in producing the art and formatting the tape, on overall appearance of the art when viewed from a distance, on suitability for publication, and on the entrant's compliance with the rules. A committee of judges, made up from those amateurs who have exhibited an interest in RTTY art, will select 1st, 2nd, and 3rd places, as well as honorable mention winners. Winning entrants will receive a plaque for 1st place and certificates for 2nd, 3rd, and honorable mention. Winning entries will be published in the *RTTY Journal* and other amateur radio magazines. The decisions of the judges will be final.

CARTG WORLDWIDE RTTY DX CONTEST
Starts: 0200 GMT Saturday, October 2
Ends: 0200 GMT Monday, October 4

Not more than 30 hours of operation are permitted. Non-operating periods can be taken at any time during the contest, but a summary of times on/off must be submitted with scores. Use all amateur bands, 80 to 10 meters. The ARRL country list will be used for country status, with KL7, KH6, and VO being considered separate countries. Classifications include: single operator (single transmitter), multi-operator (single transmitter), and SWL printer. Individual operators of multi-operator stations may submit their logs singly instead of in the form of a group log.

EXCHANGE:

Message number, time in GMT, and zone.

SCORING:

All two-way RTTY QSOs with own zone count 2 points. All others will receive points listed in Zone Chart (same as last year's chart). Stations may not be contacted more than once on any band. Multipliers are number of different countries worked on each band including one's own country. Each US and Canadian district will be considered as a separate country. Final score is total QSO points times number of countries worked, times number of continents worked (6 maximum). A Canadian Bonus Point is added last — 100 points for each VE/VO contact on all bands.

ENTRIES:

Use separate log sheets for each band. Log sheets and zone charts are available for SASE or IRCs. Logs must be received before December 1st to qualify. Send logs, summary, and scores to: Canadian Amateur Radio Teletype Group, 85 Fifeshire Road, Willowdale, Ontario CANADA M2L 2G9. Many various plaques, medallions and certificates will be awarded!

VK/ZL/OCEANIA JUBILEE DX CONTEST
Phone
Starts: 1000 GMT Saturday October 2
Ends: 1000 GMT Sunday, October 3
CW
Starts: 1000 GMT Saturday, October 9
Ends 1000 GMT Sunday October 10

WIA and NZART invite all ama-

CALENDAR

Oct 1 - Nov 30	RTTY Art Contest
Oct 2 - 3	VK/ZL/Oceania Jubilee DX Contest — Phone
Oct 2 - 4	CARTG Worldwide RTTY DX Contest
Oct 8 - 10	CD Party — Phone
Oct 9 - 10	VK/ZL/Oceania Jubilee DX Contest — CW
Oct 10	RSGB 21-28 MHz Contest — Phone
Oct 16 - 17	RSGB 7 MHz Contest — CW
Oct 16 - 17	WADM Contest
Oct 16 - 18	CD Party — CW
Oct 17 - 18	Manitoba QSO Party
Oct 19 - 20	YL Anniversary Party — CW
Oct 30 - 31	CQ Worldwide DX Contest — Phone
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 (see Sept. issue)
Nov 14	OK DX Contest
Nov 20 - 22	ARRL Sweepstakes — Phone
Nov 27 - 28	CQ Worldwide DX Contest — CW
Dec 4 - 5	ARRL 160 Meter 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

RESULTS

RESULTS OF THE 1975 MARTS SEANET WORLDWIDE DX CONTEST

Seanet Area Top Scorers —
Single band, single operator, Phone: 9V0SN — 188,421 points
Multi-band, single operator, Phone: 9V0SH — 530,784 points
Single band, single operator, CW: VS5PM — 14,418 points
Multi-band, single operator, CW: 9M2LN — 153,537 points

Outside Seanet Area Top Scorers —
Single band, single operator, Phone: LU2AFH — 4,293 points
Multi-band, single operator, Phone: IT9FKS — 5,400 points
Single band, single operator, CW: OH1QB — 609 points
Multi-band, single operator, CW: YZ4HA — 1,386 points

teurs to participate in the 1976 contest.

EXCHANGE:

RS(T) and consecutive serial number starting with 001.

SCORING:

For Oceania stations other than VK/ZL – score 2 points for each VK/ZL QSO on each band, 1 point for each QSO with the rest of the world on each band. For the rest of the world other than VK/ZL – score 2 points for each VK/ZL QSO and 1 point for each Oceania station QSO (other than VK/ZL) on each band. Final score is total QSO points multiplied by the sum of VK/ZL call areas worked on all bands. The same VK/ZL call area worked on different bands counts as separate multipliers!

AWARDS:

Attractive certificates will be awarded to each country (call area in USA, Japan, and USSR) on the following basis:

– Top scorer using all bands;

– Separate awards for phone and CW;

– Other certificates awarded depending on activity: 2nd, 3rd, and separate band awards.

ENTRIES:

Logs must show, in this order: date/time in GMT, callsign of station contacted, band, serial number sent and received. Underline each new VK/ZL call area contacted and make separate logs for each band used. Include a summary sheet showing callsign, name and address (block letters, please), details of equipment used, QSO points for each band, and total VK/ZL call areas worked on that band. Sign a declaration that all rules and regulations have been observed. All logs should be posted to be received before January 31, 1977. Send entries to: NZART Contest Manager, Box 489, Wellington, New Zealand, or NZART Contest Manager, 152 Lytton Road, Gisborne, New Zealand. Every log, even for only a few contacts, would be appreciated.

LISTENERS' SECTION:

A VK or ZL station only must be heard in QSO and the following details noted in the log – date/time in GMT, call of station heard (VK/ZL), callsign of station he is working, RS(T) of VK/ZL station heard, serial number sent by VK/ZL station, band, points. Scoring is on the same basis and the summary sheet should be included.

RSGB 21-28 MHZ CONTEST – PHONE
Contest period:
0700 to 1900 GMT,
October 10

Official rules were not received from England in time for this issue. However, last year's rules were as follows:

Work any British Isle station (G, GC, GD, GI, GM, GW) on 21 and 28 MHz only. The same station may be worked once on each band for QSO and multiplier credit. Use a separate log for each band. Entries are limited to single operators only.

EXCHANGE:

RS and progressive QSO number starting with 001.

SCORING:

Each QSO with a British Isle station counts 3 points. Multiply total QSO points from both bands by the sum of British Isle prefixes worked on each band for final score (GB does not count, giving a maximum of 36 prefixes on each band).

ENTRIES:

Logs should be sent to: D. J. Andrews G3MXJ, 18 Downsview Crescent, Uckfield, Sussex, ENGLAND.

WADM CONTEST
Starts: 1500 GMT Saturday,
October 16
Ends: 1500 GMT Sunday,
October 17

Use all bands between 80 and 10 meters on CW only. Stations outside DM call "CQ DM," while DM stations will call "CQ WADM."

EXCHANGE:

Stations outside DM send usual 6 digit number, RST and serial number starting with 001. DM stations will send a 5 digit number consisting of the RST and the number of their Kreiskenner.

SCORING:

Each station may be worked only once per band. Each completed QSO with a DM station counts 3 points, while incomplete QSOs or QSOs with log errors count 1 point. The multiplier is the total number of DM districts per band. The special stations (DM7, DM8 and DMØ) count for any missing district on the band on which they are worked. The maximum multiplier is 75. The DM districts are the last letter of the callsign (A through O). The final score is the sum of QSO points from all bands multiplied by the final multiplier.

ENTRIES:

Classifications: Single op stations all bands, multi-op stations all bands, and SWLs. Please use separate log sheets for each band and enclose a summary sheet showing the scoring and address. Logs must be sent not later than 30 days after the end of the contest period (postmarked) to: Radioclub of the GDR, DM Contest Manager DM2ATL, DDR 1055 Berlin, P.O. Box 30, German Democratic Republic. The decisions of the DM Contest Bureau are final and the right to change these rules is reserved.

AWARDS:

Certificates will be awarded. Applications for all DM awards (WADM, DMCA, DMDXC, DMKK) may be sent together with logs for the contest, but please use separate sheets for each award.

RSGB 7 MHZ CONTEST – CW
Starts: 1800 GMT Saturday,
October 16
Ends: 1800 GMT Sunday,
October 17

Again, official rules for this year's contest did not come in time for this issue, so the following are based on last year's rules. The contest is similar to the 21-28 MHz contest, except scoring is different.

EXCHANGE:

RS(T) and serial number starting with 001.

SCORING:

Score 50 points per BI QSO for non-European stations. An additional bonus of 20 points for each different British Isle country/number prefix worked is also available (36 maximum). NO BONUS FOR GB PREFIXES! Final score is total QSO and bonus points.

ENTRIES:

All entries should be mailed to: The HF Contests Committee, c/o John Bazley G3HCT, Brooklands, Ullenhall, Solihull, West Midlands, ENGLAND.

RESULTS

RESULTS OF THE 1976 BARTG RTTY CONTEST

Top 10 single operator stations –	
I8AA	282,624 points
I1PYS	281,506 points
K4GMH	192,520 points
I5WT	177,054 points
DJ6JC	176,364 points
PY2CYK	166,680 points
IT9ZWS	166,584 points
WA3JTC/ZP5	149,400 points
W4CQI	133,480 points
HB9AVK	131,152 points
Top 3 multiple operator stations –	
W1MX	156,240 points
SM6FUG	140,302 points
DL8VX	127,296 points
Top 4 shortwave listeners –	
H. Ballenberger (DL)	133,632 points
R. Giarnello (I3)	116,480 points
Cech Lubos (OK2)	105,258 points
Paul Menadier (USA)	80,276 points

MANITOBA QSO PARTY
Starts: 0001 GMT Sunday,
October 17
Ends: 0300 GMT Monday,
October 18

The third Manitoba QSO Party is sponsored by the Amateur Radio Clubs of Manitoba. The same station may be worked on each band and mode. VE4 to VE4 and 2 meter simplex QSOs are also permitted.

EXCHANGE:

RS(T), name, and QTH-municipality.

SCORING:

Each QSO counts 1 point. VE4s multiply number of QSOs by the number of US states, VE provinces, and DX countries worked. All others multiply the number of QSOs times the number of Manitoba municipalities, local government districts, provincial parks, and forest reserves (134 maximum).

FREQUENCIES:

SSB – 3770, 3905, 7195, 7230, 14190, 14285, 21245, 21355, 28600; CW – 3705, 7105, 14065, 21205, 28205.

AWARDS:

Certificates for the highest score in each province, state, and country. Plaques for highest VE4 and out-of-province station. Additional plaques awarded if warranted.

ENTRIES:

Send log data and signed declaration to: Doug Bowles VE4QZ, 1104 First Street, Brandon, Manitoba, CANADA R7A 2Y4. Mailing deadline is November 12, 1976.

CQ WORLDWIDE DX CONTEST
Phone
Starts: 0000 GMT Saturday,
October 30
Ends: 2400 GMT Sunday,
October 31
CW
Starts: 0000 GMT Saturday,
November 27
Ends: 2400 GMT Sunday,
November 28

Rules should be the same as last year's contest, barring any unforeseen changes (please check the September issue of *CQ Magazine*). The basic idea is to work as many other amateurs around the world in as many zones and countries as possible. Use all bands, 160 to 10 meters – on specified mode only. Classes of competition include: single operator single band and all band, multi-operator (all band only) single transmitter or multi-transmitter.

EXCHANGE:

RS(T) and zone.

SCORING:

Score a multiplier of one for each different zone and each different country contacted on each band. Remember, stations are permitted to contact their own country and zone for multiplier credits – so don't forget to work other US stations! The *CQ*

Continued on page 46

LETTERS

PERSONALLY INVOLVED

I appreciate your acceptance of kudos and brickbats for suppliers of electronic gear. It affords an opportunity nowhere else available, to my knowledge, to report on one's personal experience in this area. The purchase of a major piece of gear with most hams takes place every few years; some suppliers, therefore, do not see the need for purchaser satisfaction as an inducement for subsequent sales, and only consider the sale at hand.

I welcome, therefore, this opportunity to praise the service and personal interest in my needs by one of your advertisers, Slep Electronics Co. My initial concern of dealing with a supplier outside of my geographic area was allayed by my feeling that Bill Slep was personally involved.

Andrew J. Bartilucci W2NKC
Garden City NY

ABOUT TIME

In conjunction with this 1976 bicentennial year I am working with the Malden committee, who will plant a time capsule in Malden, to be opened in the year 2076.

I want amateur radio to be part of this capsule. Please arrange to send me one copy of your July, 1976, *73 Magazine*. I would like, if possible, Wayne's autograph across the front cover. This will be part of the capsule contents which will be buried on the grounds of the Malden Government Center.

Mel Dunbrack W1BHD
Malden MA

Well, Mel, while I'm flattered, it is difficult for me to believe that anyone much is going to be around in 2076. — Wayne.

RESURRECTION

I'm sending this to you with the idea that it might help someone with a similar problem. I have a 12 year old pre-Novice friend named Brian. Brian secured a 1948 vintage Hallicrafters S-53 receiver for $10 (he'll mow my lawn three times and have it paid for). The S-53 was perfect in every way but one — it didn't talk. After a few minutes of troubleshooting we found a bad audio output transformer. A quick search of the junk box produced no audio output transformer (thought I had one somewhere), but I *did* find a 120 V/6.3 V filament transformer — hmmm, why not? I connected the 120 V side to the 6V6 output and the 6.3 V side to the speaker voice coil. Ta-Da, it worked! And the transformer even fit the same holes in the chassis. Mismatch? If there is any, it certainly doesn't affect the performance of the receiver by any noticeable degree.

So what do we have? A previously "dead" receiver brought back to life, an idea for a different "source" for audio output transformers, a happy boy (soon to be a Novice) who will soon be on the air for a $10 outlay (will loan him a transmitter). Now I ask you, can any CBer match this for sheer satisfaction?

Bob May WA4DBG
Jonesboro TN

ENOUGH TO PAY FOR IT

There is a newsletter, *Dr. Dobb's Journal of Computer Calisthentics and Orthodontia*, whose sole purpose is to find good software through cooperative efforts and put it in the public domain. Subscription: $10/year. Vol. 1 numbers 1 and 2 are probably still available; they contain a complete octal and symbolic listing for a Tiny BASIC interpreter for the 8080. If you do not object to not paying royalties, these could be your first software tapes (although they would probably object to your making a profit). The *Dr. Dobb's Journal* people — People's Computing Company, Menlo Park CA, are software types, I think, who probably have much to give to a group of hardware types such as yourselves. They are planning a disk operating system for a micro.

I like your magazine (enough to pay for it). I am a non-ham into personal computing. I would be happy to share my knowledge of systems and scientific programming with someone who can help me learn how to build and design my own system. Initial uses would be text editing — I am an academic type — and later super cheap graphics.

As an old-fashioned computer user (who would never mention DEC and IBM in the same breath), let me suggest a piece of hardware computer hobbyists really need, although they may not know it: a cassette tape recording system which can move forward or backward under computer control, and which can read forward or backward (and possibly write forward and backward). A tape recorder with these simple properties could store data in discrete blocks and read them rapidly and randomly — thus acting like a slow floppy disk. A floppy disk costs $1000 minimum — this cassette could cost $100-$200. My model for this tape is DECtape™ or LINKtape which can be used by mini and large computers *just like a disk*, only slower. You don't always have to start reading at the beginning of the tape to know where you are, so getting information is much quicker. This type of storage would allow sophisticated macroassemblers and compiler languages and real operating systems which would allow your computer to do what computers do best, more than one thing at the same time (would you believe writing one program while another is being assembled — that is easily within the speed capacity of micros right now!!). In addition, software for a block-structured tape medium could be trivially converted for a floppy disk system (perhaps even vice versa). Enough of my showing off my need for a computer text editor.

I wish you and your magazine the best of luck. I would be interested in writing for you if you think I might have something to say. Now that I've paid my money, don't stop with the computer oriented articles.

Bill Pearson
Pasadena CA

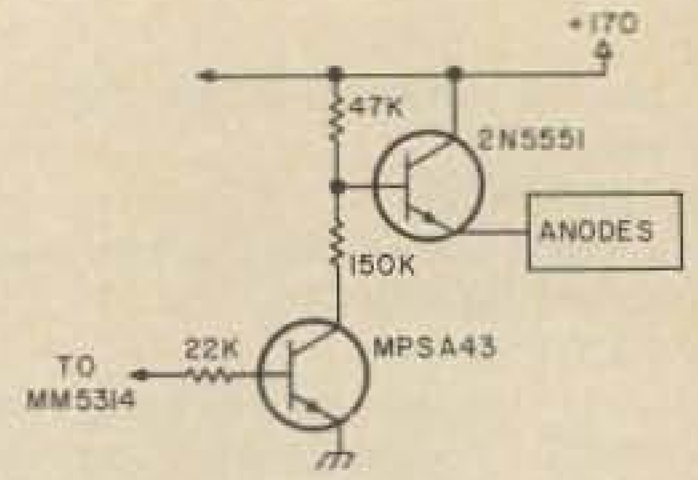
P.S. Computer Operations, Lanham Maryland 20801 sells a LINK tape for the PDP-11, LSI-11 and any 8 bit micro for $2k. Perhaps they could be convinced to make a kit for less, but the cassette idea is cheaper. If they can do it, you (we) can do it.

Love to have you write, but try to remember that I do not know what a macroassembler is, or block-structured tapes . . . and things like that. You'll have to bootstrap me to where I can understand what you are saying. — Wayne.

BRIGHTER DIGITS

Thank you so much for publishing "Behold The Giant Nixie Clock," by Jack Grimes W4LLR. I built it pretty much as per the article in your July issue, and it works just great! You wouldn't believe how many comments it has drawn from visitors in my lab.

I would like to make several suggestions that can result in much brighter digits. First, I built mine in a large metal box, so I had to use an isolation transformer. A transformer with a 6.3 volt and 125 volt secondary from a junked VTVM supplies the power. If you use this arrangement, you'll get over 170 volts B+, and brighter nixies. Also, I checked the transistors off the surplus boards on a Tektronix Curve Tracer, and found



that the UL624 units could handle only 24 to 72 volts, so beware! None of my SA480 units were any good, and none of my substitutes worked well, so I subbed the accompanying circuit, which replaces Q8-Q13.

The 2N5551 transistor may be any 50 to 60 volt NPN unit; it only switches 40 volts. The Motorola MPS-A43 may be nearly any 180 volt switching transistor. Finally, I changed the 3000 pF cap to 0.015 uF. The results are far superior to the original circuit using those ancient (ugh!) transistors!

Gary McClellan
La Habra CA

FIRE ONE

Chalk up another -1 for Trigger Electronics. About 1 year ago I placed an order and sent along my charge card number. Somehow the prices on items ordered went up an average of nearly 30% since the date on the catalogue I had just received. Some items nearly doubled! One that doubled I sent back and purchased locally for about the original (reasonable) price.

Thanks for providing a forum in which we can sort out reputable mail order suppliers.

Harrison K. Clark WB2YKH
Clifton Park NY

WHY BUILD IN AN ERROR?

The "Instant Counter Calibration" in the August issue describes a procedure I have used for some time, and it works well. The frequencies printed, however, are slightly in error.

Color horizontal frequency was originally selected so that, divided into the 4.5 MHz intercarrier, an integer would result, 286 yielding the closest to the original 15,750 Hz. In order to interweave the sideband clusters' horizontal-rate multiples from both visual carrier and color subcarrier, the subcarrier is centered between integral multiples, i.e., 227.5 times line rate, or 15,734.26573, yields 3,579,545.455 Hz.

This is all well and good, but in practice, horizontal, as all other pulses, is derived from a subcarrier frequency source, which the FCC has *defined* as 3,579,545 ± 10 Hz. The network rubidium standards output this center frequency, so the ".455" does not exist. As a result, the actual horizontal rate is 15,734.26374 rather than your published 15,734.265. While .08 ppm may seem insignificant, considering the potential accuracy of this reference, why build in an error?

Other notes: The old monochrome standard, using 15,750 Hz, is almost never used in broadcast stations. Any network program will be using color standard, regardless of program content. "Mini-cam" frequencies will be as accurate as other network sources if not a live pickup, as videotape machines will lock to the house standard, that being rubidium for networks. Even local programs will have sufficient frequency accuracy for most counters, as the FCC requires ± 10 Hz, or .000279%.

Dave Powell WA4BRI
Lexington KY

NO KEYER

I ordered 20 "recent" ('71-'75) back issues of your magazine. They made interesting reading. Boy, OM Wayne really gets nasty in some of his editorials. A friend who subscribes to your magazine and I found them enjoyable. I finally broke down and bought the June '76 issue in a radio store, and I couldn't pass up the three year subscription offer. I find the computer articles interesting, as I am a Navy data processing technician. Also found the "Glass Arm" article in the June issue enlightening, since I am a CW freak at heart and use a straight key in all my CW contacts. Adjusting the key as mentioned in the article really makes a difference. I might stick with my straight key and not even buy a keyer.

Martin S. Roe WBØJNV/KH6IOO
FPO San Francisco

THE HUMAN FACTOR

I am writing in reference to the clock article on page 70 of the July '76 issue of *73* describing a digital clock using Borroughs B7971 Nixie tube readouts. As a clock builder since the introduction of the MM5314 clock chip, I would like to call your attention to the following errors in the schematic diagram presented with this article:

1. Leave pin 1 (output enable pin) of the 5314 unconnected or connect it to pin 12. It is shown connected to ground/vdd, which will blank the display.

2. The capacitor labeled 3000 uF is a bit large for this application. This capacitor sets the multiplex frequency of the display, and should be 3000 pF (that is, smaller values of this capacitor *raise* the multiplex frequency — a 3000 mF as shown would blink slowly, if it would work at all!).

3. The emitter of transistor Q8 is not connected on the diagram. It should be connected to the emitter of Q9 (that is, the +150 volt supply line).

4. The SA480 transistor is a PNP type; your artist drew them as NPN types.

5. You might advise your readers that the pinouts for the MM5314 chip as shown on your diagram would be as you were looking from the bottom of the chip, and not from the top, as ICs are usually shown.

Mr. Grimes should be applauded for his excellent article, and, of course, his courage in experimenting with the "unknown" UL624s, and SA480s from the boards. The fact that no one knew how much these would stand has probably prevented the purchase of these board assemblies by a great many.

Gary Joe White WB9BUU
Pittsfied IL

Dear Gary Joe:

Your comments are appreciated. Some are correct, one not correct.

Two of the errors are my fault — as *73* simply copied my circuit and I was in error in copying my rough sketch.

These two errors are PNP transistors drawn as NPNs, and the lack of a connection on Q8 to the 150 V line.

Your no. 1 comment concerning pin 1 — look closely. It is *not* connected to ground. That is simply a tie point to connect pin 2 and the 100k resistor to vdd. There is *no* short connection over to pin 1. So this is no error, but one might have to look closely to realize there is no connection to pin 1.

My original sketch specified 3,000 mmfd (or pF) — which dates me as rather ancient to use mmfd. So this was probably an artist's error.

The schematic is drawn almost as the board is laid out.

I apologize for my part in the errors, but I guess that is the human factor.

Jack Grimes W4LLR
Memphis TN

FIRE TWO

I am writing to let you know of the troubles I have had ordering a Hy-Gain 18AVQ/WB vertical antenna from Trigger Electronics.

On December 12, 1975, I sent them a money order for $82.01 and received notice that they got my order. A month went by, so I wrote them and said either send the antenna within two weeks or return my money. A month later I received a postcard from "customer service" telling me I would receive my order within 4 weeks! Two months went by so I wrote again and begged them to return my money. A month later I got another postcard from "customer service" telling me to send back the card along with shipping instructions because my order was in! I sent back the card and again told them to return my money. I even wrote a letter to the owner, Irael Treger W9IVJ, but I have gotten no response. I am really mad now and am trying to get help from the Direct Mail Marketing Assn. and from "Mr. Fixit" of the Philadelphia *Evening Bulletin*. I wrote to you so you will not accept their advertising and for any possible help in this matter. I notice that Trigger used to advertise in *QST*. Thank you for your time and trouble and a very good magazine.

George Schmidt AA3NQY
Philadelphia PA

DRAMA

Send your most dramatic emergency ham experience for inclusion in my book, "Introduction to Ham Radio." Free copy if used.

Jerry Swank W8HXR
657 Willabar Drive
Washington Court House OH 43160

ONE OF THE BEST

I am not interested in ham radio, but do find *73 Magazine* has enough other material to be one of the best magazines.

Bill Trail
Guadalajara, Mexico

BOLT BELIEVER

J. K. Bach might, in reference to his article in the July, 1976, issue of *73*, like to have my corroboration of his statement that the diameter of a lightning bolt can be approximately eight inches.

Around 1940, I was working for Northwest Airlines as a radio operator, and was familiar with the evidence of lightning strikes on the aluminum shells of DC-3s. The metal was fused, in several cases, in about a 1/8" diameter circle, and the heated metal concentric to the fused spot was discolored out to the size of a quarter. In a freak incident, the aileron of a DC-3 in flight was in the path of a lightning bolt. The ailerons of a DC-3 are of linen, and the cloth had a hole approximately eight inches in diameter burned cleanly through it, with a very small ring of charring.

A picture was taken of the aileron by one of the mechanical crew at the Billings, Montana, service hangar, but it did not "turn out." So no record is available.

Kenneth G. Axvig W7EPL
Kremlin MT

TAKE MY ADVICE

For the past several years, I have been an avid ARRL supporter, and thought of *73 Magazine* as just a second rate magazine. Was I ever wrong! Our radio club subscribes to it, and I had a chance to read the club's copies of both *QST* and *73*. I have no choice but to subscribe to *73*.

Also, W8LWS was right. Don't build his world's smallest field strength meter. I didn't take his advice and went through a dozen of those 35mm film cans before I got one to work. The rf choke was $4.38 — the only part I didn't have in my junk box. It does look cute, but, *73* readers, wait for his next project. Take his advice, and mine.

Craig R. Schmidt WBØGFZ
Dickinson ND

NEW PROOFREADER

Well, I had better do it. I hereby request that you extend my present sub by an additional 3 years. I enclose a check for $17.76. Too bad I lacked the foresight (and the cash) to obtain a life subscription while they were only $37.00. Anyway, thanks for a tremendous magazine. (My dictionary defines tremendous as "huge, terrifying through great size or force" — close enough!)

In my article, "Build A Deluxe TTY Keyboard," published in the October and November/December 1975 issues, there are several errors. The basic keyboard described in Part I is OK, but the automatic function module in Part II contains some small errors and one large one. The following are the small errors:

1. Pin 2 of U213C should go to pin 8 of U213B, not pin 6.
2. Terminal A should go to pin 6 of U209, not pin 8.
3. U209 is a 74121.
4. There should be a 3.3 kΩ resistor in series with the base of Q203.
5. The diode connected to pin 13 of U213D must be reversed.
6. The 2 diodes connected to pin 4 of U203A must be reversed.

Now for the major error. The AFM (Fig. 2, Part II) connects to the wrong points in the basic keyboard (Fig. 5, Part I). In the basic keyboard schematic, terminals A and B are the connection points for AFM terminals 1 and 3 respectively. Well, that's wrong. Short terminals A and B permanently. Break the connection between U4A pin 5 and U7A pin 2. U214 contains a couple of spare inverters. One of those has to be used. Connect AFM terminal 1 to U4A pin 6. Connect AFM terminal 3 to U214 pin 9 (spare input). The output of that inverter (pin 8) should be connected to U7A pin 2. With the AFM connected this way, the serial input should be low when the keyboard register is empty (full of space coding).

As far as I know, that's it for errors. I'm sorry if anyone gave up on this project because of them. Next time I'll get a new proofreader for my author's proofs.

Bob Hart K7YGP/7
Medford OR

MICRO MAYDAY?

I am building an 8080-based microcomputer system, and would like to get in touch with other hams who are also interested in microcomputers. With the growing interest in computers and computing among your readership, I feel that a small space in *73* devoted to getting us together would be appreciated by many – something like "Ham Help," but for we hams who are interested in computers.

Scott C. Crumpton WB4JTB
Gainesville FL

AIRPLANE! AIRPLANE!

Your July issue arrived June 8 and after finishing my evening munchies I turned to my favorite author, W. Sanger Green. Yes, I know, the period he writes about is for oldtimers. But then how many youngsters had the experience of everyone rushing out of their homes when the cry, "Airplane! Airplane!" was raised in the neighborhood. (Background noises were low in the '20s.) I've had the thrill of seeing the zeppelins floating south to a place called Lakehurst, N.J. Mr. W. Sanger Green is doing us a great service by recording the past and helping us to appreciate the progress made for our benefit in a few short decades.

Seeing his picture with Amelia Earhart gives one thought as to why offspring never seem to benefit from the handsomeness of their parents. My mother always insisted children tend to resemble their grandparents. Apparently, she was right.

I like the new magazine format. The change from 2m repeaters to minicomputers is fine, too, since I have neither. But, please, don't forget to include the simple construction articles. Not all of us have the time and facilities for the major projects. Still, the smell of hot rosin is preferred to aftershave lotion and lawnmower exhaust.

Joe Lisanis
West Caldwell NJ

I/O, I/O, IT'S OFF TO WORK . . .

I enjoy the I/O articles very much. I am a field engineer with Burroughs and I find that they supplement very well. Good magazine. Keep up the good work.

Tom Lawrence WB4QLW
Danville VA

MOSTLY BOURBON

Just a note of thanks for your "buy centennial" offer. I'm half Scotch, quarter English and the rest is mostly bourbon I think, but a bargain of this kind cannot be ignored, especially since I just borrowed a current copy at *QST* to find out what the cat left in the tuna can.

Only four – count 'em, 4 – articles that I can even remember being in the issue (I just looked at it yesterday), and acres of contest results and advertising. More ads, it seems to me, than *73*, and less magazine. That's nonprofit?

The point I'm getting to is that I personally value *73* highly as 1) entertainment, 2) instructive literature, 3) reference material, and, yes, 4) inspirational enough to get me off my duff to build things I can't buy because nobody makes it, and 5) knowing you get your feet muddy by not living in an ivory tower. As a comedian (Dave Gardner) once quipped when referring to a preacher's sermon on sin, "How's he know so much about that if he didn't ever?"

You and the gang keep up the good work and I'll be pushing up daisies before my subscription expires. Thanks again.

Chester C. Childs W5HVJ
Metairie LA

THE HUMAN TOUCH

Many thanks for running the article by Anthony Curtis K3RXK, "What's Up on 156 MHz?" in the July, 1976, *73*. It was very well done, and sure filled a gap that I have long been curious about. I am sure that the fleet will find the article very handy!

By the way, I have done business with one of your advertisers, and find that John Meshna is everything that a businessman should be. I just wish more people could be like him. He certainly handled my small business with the human touch. I ordered just a small bit under $10, but he was out of stock of the item . . . but he did have a set of bristol wrenches I wanted. He sent me the $10 back, and also sent the bristol wrenches! You can't beat that!

Howard Ragan K7ATU/DA4AU
APO NY

CIRCLING PATTERN

I very much appreciated the article by Chester Brent WB4GVE, entitled "Aim Your Beam Right" (*73*, June, 1976). Chester is to be congratulated for finding a workable, short solution to great circle computation problems, despite his self-confessed "rusty" math.

While the method presented should be quite OK for most U.S. amateurs, a few will not be fully satisfied. The choice of positive signs for *east* longitude and negative signs for *west* longitude was unfortunate for users of the HP-65 computer who are used to precisely the opposite usage of designators for east and west longitude (all NAV PAC programs standardize on positive values for *north* latitude and *west* longitude, and on negative values for *south* latitude and *east* longitude). Also, the symbol used by Mr. Brent for latitude (λ) is the one used almost universally for *longitude*. Latitude is generally abbreviated as Lat or simply L.

HP-65 Program Form

BEAM HEADINGS AND DISTANCES

SWITCH TO W/PRGM. PRESS [f] [PRGM] TO CLEAR MEMORY

Page 1 of 1

KEY ENTRY	CODE SHOWN	COMMENTS	KEY ENTRY	CODE SHOWN	COMMENTS
DSP	21		RCL 6	34 06	
.	83		f	31	
1	01		COS	05	
E	15		×	71	
STO 4	33 04		−	51	
g x⇌y	35 07		RCL 6	34 06	
E	15		f	31	
STO 2	33 02		SIN	04	
RTN	24		÷	81	
LBL	23		RCL 2	34 02	
B	12		f	31	
E	15		COS	05	
STO 3	33 03		÷	81	
g x⇌y	35 07		f^{-1}	32	
E	15		COS	05	
STO 1	33 01		RCL 5	34 05	
f	31		f	31	
SIN	04		SIN	04	
RCL 2	34 02		0	00	
f	31		g x>y	35 24	
SIN	04		GTO	22	
×	71		1	01	
RCL 1	34 01		3	03	
f	31		6	06	
COS	05		0	00	
RCL 2	34 02		g R↑	35 09	
f	31		−	51	
COS	05		STO 7	33 07	
×	71		RTN	24	
RCL 3	34 03		LBL	23	
RCL 4	34 04		1	01	
−	51		×	71	
STO 5	33 05		+	61	
f	31		STO 7	33 07	
COS	05		RTN	24	
×	71		LBL	23	
+	61		E	15	
f^{-1}	32		f	31	
COS	05		→D.MS	03	
STO 6	33 06		EEX	43	
6	06		2	02	
0	00		÷	81	
×	71		f^{-1}	32	
STO 8	33 08		→D.MS	03	
RCL 1	34 01		RTN	24	
f	31		LBL	23	
SIN	04		C	13	
RCL 2	34 02		RCL 8	34 08	
f	31		RTN	24	
SIN	04				

REGISTERS
R_1 Lat_2
R_2 Lat_1
R_3 λ_2
R_4 λ_1
R_5 $\lambda_2 - \lambda_1$
R_6 D/60
R_7 Beam Heading
R_8 Distance (nautical miles)
R_9 used

LABELS
A
B
C
D
E
0
1
2
3
4
5
6
7
8
9

FLAGS
1
2

For those readers having access to the HP-65, here is a simple modification of the Great Circle Navigation program (NAV 1-10A) which will compute the beam heading between any two points on the globe. With this version, you only need enter your QTH latitude and longitude once. As an added bonus, the program automatically calculates the distance in nautical miles between any two terrestrial points.

The program accompanies. To use it you merely:

1. Key in your location using standard DDMM.m notation as follows (assume your QTH is Chicago, 41°52' N, 87°38' W):

   4152 Enter 8738 A

2. Key in desired location, say, Perth (32°00' S 115°54' E):

   3200 CHS Enter 11554 CHS B

3. The HP-65 will automatically calculate and display the beam heading in true degrees (290.2°). If you then want to know the distance to Perth, simply press C and it will be immediately displayed (9531.4 nautical miles).

For new locations, begin at step 2 above.

William H. Trayfors WA6CCA
Katmandu, Nepal

SUB TIME

Thanks for a great magazine. I've been buying it at the local electronics store for almost a year, and decided that it's time to get a subscription. I especially enjoy your computer artjcles. I've been a computer programmer for about 10 years, and it seems that we get further away from the machine all the time. This is great for getting a particular job completed, but not as much fun. I'm in the process of trying to decide which micro to buy.

I'm also buying a set of your code tapes in hopes that they will help overcome the mental block I have against learning code. Been trying since the Boy Scouts, with no success.

Richard R. Zeh
Dayton OH

LITTLE BROTHERS GROW UP

Right on baby, right on! Your editorial in the July '76 issue was more on the mark than all the so-called sophisticated comments I've read in the past five years put together. I think you hit the nail right on the head. Nothing gets changed unless someone stands up and yells, loudly. It does little if any good to stand in a corner and mumble about the bad old "them." If you feel like you have been wronged, scream, at the top of your lungs. True, the odds may favor that you will turn out to be the voice in the wilderness, but at least you will have discharged part of your responsibility to our 200 year old experiment in individual liberty and self-determination.

My on again off again relationship with *73* is now about six years old. No, I'm not a ham. As much as I would love to be a part of the fraternity, the code has baffled me for the better part of twenty years. But, I still enjoy tuning in your world on my R-4C and sharing some of the amateur achievements via *73*, and, yes, even *QST*. As somewhat of an outside observer, it strikes me that amateur radio and its headstrong little brother CB really represent the essence of what our American experience is all about – the freedom of people who think to communicate freely. Certainly, we will frequently disagree (wouldn't it be a pity if we didn't), but at least we can communicate, which is more than ¾ of our brothers on this globe are allowed to do. Most people forget, or don't know, that most everywhere else in the world you need a license for a receiver, let alone a transmitter.

Enough of my soapbox. Keep it up, Wayne. You may not win, but hopefully you will keep a few people thinking. After all, that's what it's all about. By the way, those hams willing to key a mike on (heaven forbid) Children's Band might notice something unusual – if you give your callsign in addition to your "handle," more than likely you will get a legal callsign back. Even little brothers grow up.

Doug Shear
Arlington TX

SOFTWARE SUPPORT

It's actually your excellent I/O section that I'm subscribing for. *Byte* has not lived up to its promise, and you have the vision and imagination – evidenced by the July editorial on the future of the home computer – to expand the I/O section wonderfully. Count on me to support your plan to distribute software. I'm in the market for anything entertaining that will run on my IMSAI with George Morrow's cassette board and PTCo's video board and BASIC and 20+K of RAM and still growing.

In the meantime, I'd like to have a copy of your tape of Ed Roberts' interview. I want it for my archives, but if it will make you feel better I will gladly share it with the North Texas Computer Hobbyists Group, to which I belong.

Dan Wingren
Dallas TX

. . . AND AS WE ARE!

Enclosed are the proof sheets for my article (*Upcoming. – Ed.*). They look good to me. Sorry to be a little slow but I just got back in town. Of all things, I was in the northern mountains making radiation measurements on a mutilated cow. A real weird deal. Some thing that flew in a vehicle with tripod landing legs and that walked all over the place leaving four inch circular foot prints, removed the lips, ear, tongue, and rectum of the animal. All this was done without leaving any blood or signs of bleeding.

Also the vegetation wilted and died near where the legs of the vehicle rested. Sounds like I am cracking up but I was working with the New Mexico State Police and other officials. They are as confused as I am.

Howard Burgess W5WGF
Albuquerque NM

TO ERR IS HUMAN

Regarding my article in the July, 1976, issue of *73*, "Perfect CW – drive 'em crazy with the Keycoder I":

In the Parts List, I neglected to give the part number of the recommended Amidon Associates' toroids. It is FT-50-75 (price: 65¢ each). These are the ferrite (not powdered iron), high permeability cores needed for this project – some others we tried didn't work.

Also, in the schematic: R9 (1k), that feeds pin 2 of F/F 7, should be connected to +5 V dc, and the Vcc connection to IC2 (the monitor) should be labeled pin 8.

Yes, I know you sent me the galleys to check, but "to err is human," and I hope you'll be divine and forgive these oversights.

I've had 3 congratulatory letters on the article to date, from one of which I quote: "Thanks again for the fine article of the type which keeps me a current Wayne Green subscriber."

Bob Way WA9VGS
Hales Corners WI

SOMEDAY

Haven't got very far into minicomputers yet, but am reading all the articles and maybe I'll be inspired to buy a few chips and experiment. (The prices of the complete units are beyond my means and I'm sure beyond most hams' pockets – but they will come down someday.)

Henry Pattee W5POH
Mountain Home AR

C(W) URCHIN

You won't believe the popularity of your code tapes. On vacation, I encountered a street urchin in New York who could not live without your 5 wpm cartridge. He was in such a hurry that he took the tape recorder it was in, too. Oh, well . . . enclosed is a check for a new one. Tape, that is. Don't know what to do for a tape recorder yet.

John Duffield KØKHZ/5
Plano TX

Ancient Aviator

from page 8

share of the revenue. Everything – lobby, dining room, guest rooms, etc. – was spacious. Eaton and I each rattled around in a large two room suite. The only bad feature was that it was too far from the Export office to walk – particularly on the uphill return trip. When Cleo and I were in Genoa in 1963, I drove up to what had been the Miramare hoping to stay there, only to find that it was by then a convent.

A week was spent in Genoa conferring with Gehan and his staff. Eaton and I had to get used to slowing down our working speed to half throttle. The Export offices were in an old palace on the Via Garibaldi. The palace had no central heating, but it did have high vaulted ceilings that were painted hundreds of years ago with biblical scenes. The days went something like this: Get to the office about 9:30 am, out for a capuccino at 11:00, then to the Union Club at 13:00 for a few drinks, a game of dice and lunch (excellent food). Then back to the office at 15:00 and work until cocktail time (19:00). Dinner was usually around 21:00 at someone's home or at the "Buca di Santa Matteo," "Gambrini's," or another fine restaurant. Then possibly a few rubbers of bridge and we were ready to "hit the sack."

After much discussion about procedure, it was decided that I should take a look at the possibilities for flying boat operations at Marseilles, Algiers, Oran, Casablanca and Tangier. Jim Eaton was to go to Paris and confer with our ambassador regarding French landing rights possibilities, for survey flights. So on December 23rd I flew to Marseilles in an Ala Littoria Savoia-Marchetti twin-hulled flying boat. That afternoon I went to Algiers in an Air France flying boat. The next morning was spent with the Export agent and the U.S. consul. The Algiers harbor seemed to be OK for flying boat operations. That evening I caught the wagons-lits for Oran, about 250 miles away.

Very, very early Christmas morning I debarked from the train at Oran and checked in at a hotel to get some more sleep and freshen up a bit. After looking over the harbor and deciding it wasn't our "cup of tea" I dispensed with the formality of disturbing the agent's holiday. Instead, I treated myself to a very fine roast goose and liebfraumilch dinner and got the afternoon train for Casablanca (about 500 miles via Oujda, Fez, Meknes and Rabat). A very comfortable journey with good accommodations and service. Of course, there was the usual commotion at the frontier. All very polite.

Before leaving Genoa, John Gehan advised me to live at the Hotel Excelsior while in Casablanca, so I checked in there on my arrival. Since it was Saturday, I phoned Toledano & Son (Export agent in Casablanca) and told them I was in town and would be in to see them Monday morning. They were expecting me and invited me to tea on Sunday. They were a very nice family and I enjoyed several fine meals with them. I spent over a week based in Casablanca. The port was entirely inadequate for our purposes, so I got Joseph Toledano to drive me up to Port Lyautey (about 85 miles). On the way we made a courtesy call on the U.S. minister at Rabat to advise him of our plans. Port Lyautey provided the only adequate place for a large flying boat base on Morocco's Atlantic coast. Its disadvantage was its distance from Casablanca (85 miles) and Rabat (25 miles).

On January 4th I was ready to return to Genoa, so I phoned the Export agent at Tangier to see if any passenger ship for Marseilles or Genoa was sailing in the next few days. They had a Rotterdam-Lloyd ship, the *Indrapoera*, departing for Marseilles on the morning of the 6th on her way to the Dutch East Indies. I asked them to arrange space for me to Marseilles on the *Indrapoera*, and, since I was coming up to Tangier on the evening train, to reserve a room for me at the El Minza Palace Hotel. Quincy Stanton, our consul in Casablanca, gave me a "laissez-passer" to get me through Spanish Morocco. They were having a good-sized revolution going on in Spain at the time between Franco and the communists, and I didn't want to get caught with my passport down (no Spanish visa). It was lucky I had this document, for when we got to the frontier the train filled with armed soldiers. They not only checked passports, but also examined all luggage and personal papers. They spoke no English and I no Spanish, but they were plainly not happy about my passport. Something that the "laissez-passer" corrected. I still don't know which side those fellows were on.

In the morning, I called on U.S. Ambassador Blake and obtained advice from him and information of value from his abstracts and files. The afternoon I spent sightseeing. Next morning, I boarded the *Indrapoera* at 8:30 for the trip to Marseilles. On the evening of the 7th they had a big party aboard to celebrate the wedding of Princess Juliana of Holland to Prince Bernhard of Germany. We arrived at Marseilles at 10:30 on the 8th and I was back in Genoa before midnight on the chemin de fer.

Next month, to Egypt.

Looking West

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

Many of you have asked how this column got started. Honestly, many times I have wondered this myself. Actually, the story is quite simple, and I hope it might be the kind of inducement necessary to get some of you interested in writing about the many diverse aspects of this wonderful world we call amateur radio.

"Looking West" began about three weeks before I left New York City in 1972. I had mentioned to Wayne that I would be driving cross-country, and the thought occurred to me that the seeds of an interesting article might be found in the fact that I was equipped for two meter FM. Anyway, about one month and three thousand miles later we arrived in the promised land, and I took out my notes about the trip and proceeded to write an article entitled, "Looking Back Ahead." To say the least — the very least — it was bad. After all, it had been exactly ten years since I had sat before a typewriter, that prior effort being a product review of the then-popular Clegg 99er six meter transceiver. At any rate, I do not blame old Never Say Die for turning down "LBA"; as I reread it now, I realize how lucky you all were to have been spared the agony.

Anyhow, earlier in 1972, *73*'s now long-gone *Repeater Bulletin* had carried an interesting article on Southern California FM by Bob Greenberg WB6INR. In fact, during August of '72 when I had ventured out here to seek employment, I had a chance to meet with Bob and his lovely wife Rene and learn a bit more about the Southern California FM community. Since Bob's article/letter had but scratched the surface of this interesting part of the nation, and being undaunted by my rejection notice on "LBA," I proceeded to write the first of what has since become a regular feature of this magazine: the only amateur radio FM column devoted to letting you know what's happening in this fascinating part of the country, with the technological advancements, the interesting people, and even the politics. This is all a part of the Southern California FM scene, a scene that I take great pride in being a part of, and even greater pride in sharing with you. Now, thanks to you, we are beginning to branch out a bit and are slowly getting into a position to bring you information of happenings elsewhere in the nation and the world. The column is finally developing into what I always hoped it would: a forum for developing lines of dialogue between amateurs of common interest everywhere. As I have said before, I consider "Looking West" your column. I may write it, but without you and your input the whole effort would be for naught. So thanks to all of you from a grateful writer, and I sincerely hope that in the future we will continue to serve you well. Now . . . on to DAYTON!

Ever flown on a Boeing 727? That's the aircraft with three engines mounted in the rear (one on either side, and the other as part of the tail just below the elevator assembly). Let me tell you, when that baby climbs out you know it . . . it's some moving machine. It was on such an aircraft that we departed New York's La Guardia Airport about 8:30 am for an hour or so breakfast flight to Dayton, Ohio. Two and a half hours later we were checked into our Holiday Inn. We hopped into the Avis rental for a nonstop trip to Dayton's Hara Arena, home of the 1976 Dayton Hamvention. (At this point I should digress for a moment and offer special thanks to TWA for a fantastic on-time flight, to Avis for having our rental car waiting promptly as we arrived, and to the folks at the downtown Dayton Holiday Inn for some good accommodations. I always hear people complain that big companies "don't really care." In my case, they sure did care, and this is a personal thank you to all three.)

With a smile like Sherry Smythe's, how could anyone resist buying a sub?

While I have been to a good number of amateur conventions in my time, including the biggie in Las Vegas called SAROC, what greeted me at my arrival at the Hara Arena was almost hard to believe. (Please refer to the August aerial photo cover on *73* if you do not believe this report; it will more than substantiate it.) Acres upon acres of vehicles sporting amateur callsign plates and/or other identification that proved them a part of the amateur community were in attendance at this unbelievable gathering. I had heard many stories about the Hamvention, especially from my buddy Fred Deeg K6AEH, but until I saw it firsthand I really did not believe all that I had been told.

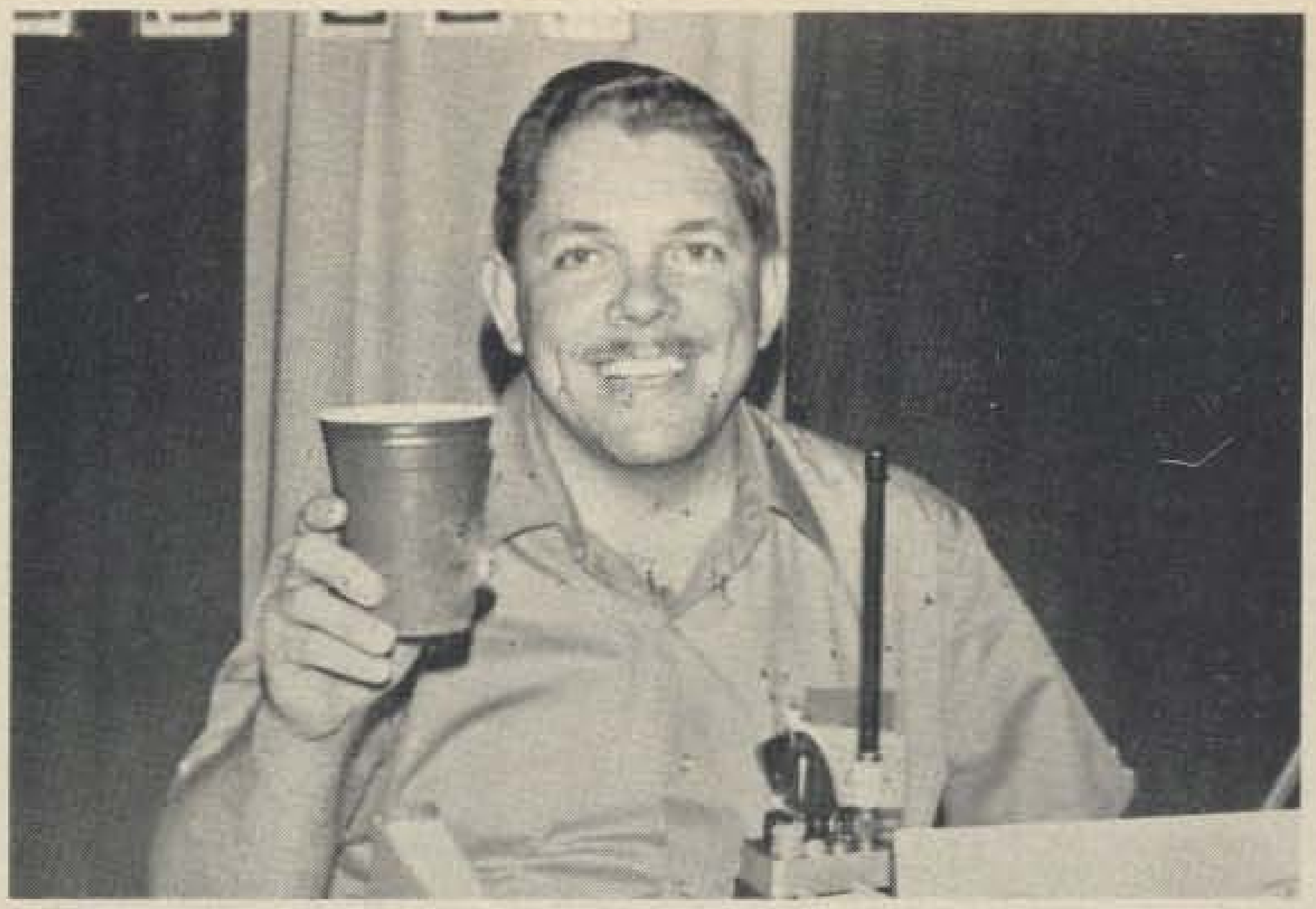
Somehow, Sharon and I made it to the ticket/information area, identified ourselves as being part of the *73* contingent and were given excellent directions as to where the booth was located and how to find it. About five minutes later we arrived and were quickly pressed into service. The place was a madhouse, with amateurs from all over the nation, and, as we found out later, all over the world, stopping by to say hello and buy subscriptions or other *73* goodies. To let you in on a secret, both Sharon and I were having the time of our lives. While it was work, for both of us it was a labor of love.

Since I had noted what seemed to be rain clouds moving in when we arrived, I excused myself for a while, and, after making the rounds to see the exhibits and say hello to many friends, I headed directly to the flea market, Bell & Howell Super 8 camera in hand. What I saw and also recorded on film was beyond my wildest imagination. If there were acres of autos in the parking area, there must have been as many acres of flea market. Standing as far away as I could and still be able to get an

W2NSD/1 eyeballs with WA2DHF.

WA6ITF (standing) and Advertising Director Bill Edwards WB6BED/1 hold the fort.

Larry Moldauer WA2PZI drops by to say hello.



A familiar face at many conventions, Fred Deeg K6AEH takes a break by relaxing at the 73 booth.

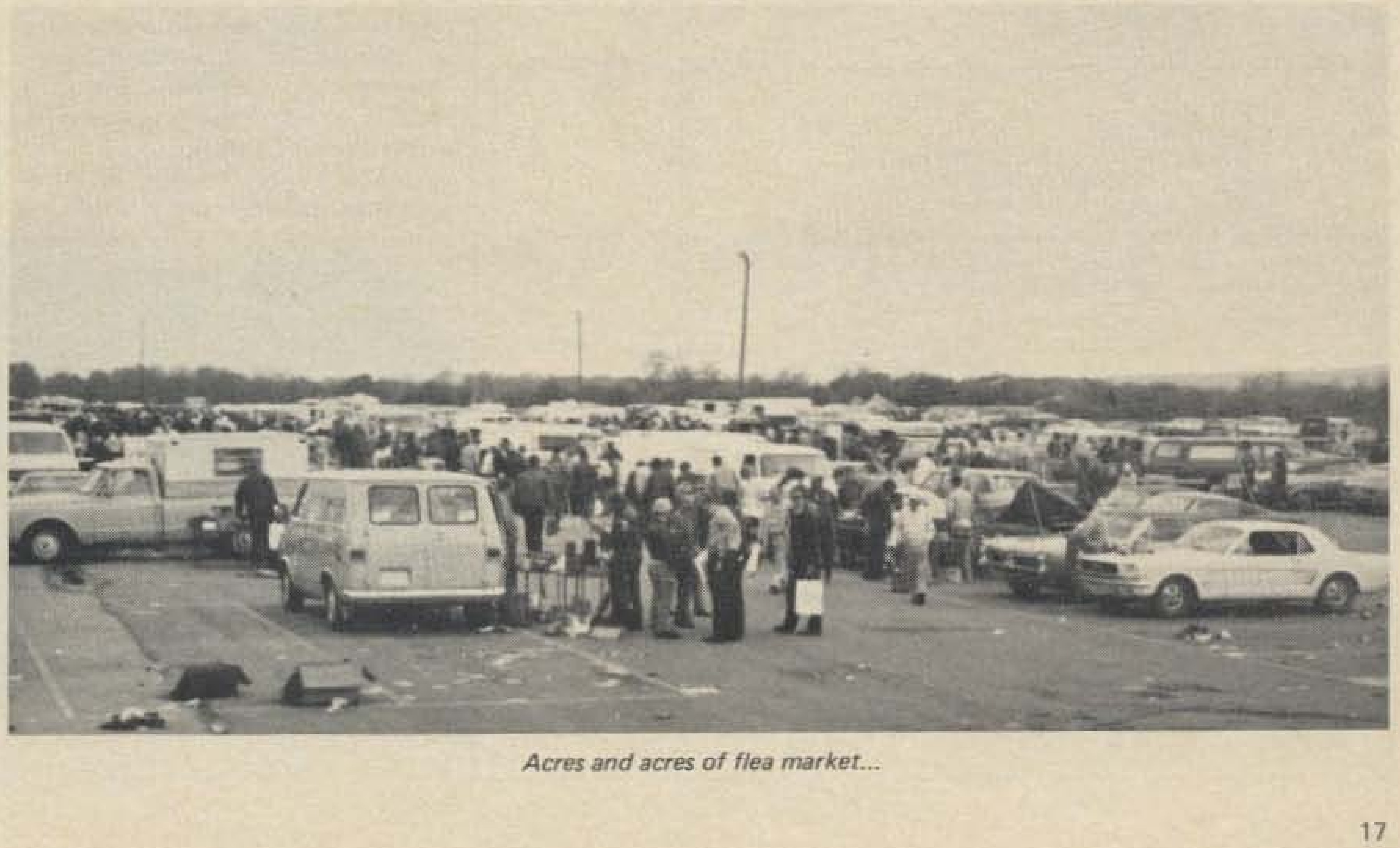
unobstructed view, and with the camera set at full wide angle (approx. 9 mm), it was impossible to photograph the entire flea market without resorting to the well known slow pan shot. It was also impossible to cover the entire flea market in the few short hours I could devote to it. I suspect that I got to see about a third of it firsthand that day. My only regret was that I had spent almost all my bread in NYC on such "unimportant" things as clothing and the like. Here I stood in the middle of "ham heaven" without a paltry farthing in my pocket. There were many goodies I would have loved to have carried home aboard that L-1011, but maybe I was smart in letting my better half handle the financial aspects of our Dayton stay.

No sooner had I arrived back at the *73* booth than I heard, "So this is where you have been hiding!" I turned around to be greeted by Steve Mendelson WA2DHF, long-time friend and now Secretary of the newly-formed Tri-State Repeater Council serving New York and vicinity. Now, you might find this hard to believe, but somehow, even though I had spent the previous week in the big apple, Steve and I kept missing each other. Now, about 900 miles west, we finally got to eyeball. Steve eventually took off (after we had made a dinner date), and I got back to work, but only for a minute or two. Up walked one of our closest east coast friends, Larry Moldauer WA2PZI. I cannot tell you how long this friendship goes back. I guess I've known Larry ever since I've been a ham. It's one of the beautiful friendships that develop from amateur radio and last a lifetime. Larry and I have flown airplanes together, sold and swapped ham equipment over the years, attended each other's weddings, worked contests, and done probably everything else that two friends with common interests can involve themselves in. Since time in New York had been short, we had not been able to drive to Jersey to see Larry and Linda. The time we had to spend was all too short, but I did get a promise that he and Lin would be out to visit again this summer. For me, the best part of Dayton was that it was a chance to renew old friendships such as those with Steve and Larry, with a myriad of other old "SUR" people, and with many LIMARC members that I have known for years.

Yes, the southland was more than well represented. Many of the people that you have come to know through this column, such as Fred Deeg K6AEH, Capt. Dick McKay K6VGP, and "Uncle" Earl Surad WB6MUQ, to name but a few, passed by the booth to say hi. Dayton to me signified something very special: a mingling of the minds and hearts of amateurs from all over, on a face-to-face basis. I sincerely think that this, more than anything else, accounts for the success year after year of this event. Dayton is the "ham convention of conventions" and you have but to attend once to realize why. If I were never to attend another convention, at least I could say I was a part of the better than 12,000 amateurs who were Dayton 1976. God willing, I will be there next year.

Any of you repeater owners ever consider circular polarization for your system? This is being tried by one of the major Los Angeles open repeaters, WR6ABE. When the Stationmaster that normally serves the system was taken down from its perch 200 feet above Mt. Wilson, it was replaced with a specially-manufactured JAN-PRO circularly polarized broadcast type antenna cut for 146.40 MHz. While CP is quickly becoming a trend in FM broadcast radio, I am told that to date very little experimentation has been tried in the use of CP for two-way FM communication, and therefore little is known as to how well it might work in comparison with the now standard and widely accepted vertical polarization. Burt Weiner K6OQK decided that 'ABE might be an excellent testbed for such experimentation, and therefore went from a 9 dB gain antenna to a 3 dB loss antenna. While no final conclusions have been drawn yet, my personal observations might interest you.

Most noticeable are two things. First, before power was raised to compensate for the 3 dB loss, though the average signal strength of the system was down, I found myself hearing the repeater in places I had never heard it before. Not well many times, but it was there and that amazed me. The rapid flutter normally encountered in poorer areas had now become something akin to "low band" fade, due, I suspect, to the minimization of multipath loss. While what users term overall system sensitivity (the ability to burp the system from 20 megamiles past normal coverage area) was obviously lowered, you could now walk around your living room, HT in hand, without having to look for that one special spot from which to talk. You could also turn your hand-held sideways and not lose the system. So while users on the fringes may have suffered a bit, and while many a user gripes that he can no longer use 'ABE twenty miles past Podunk, by and large the CP experiment does seem to have a lot of merit. Much valuable information is currently being gathered, thanks to the inquisitive mind of Burt Weiner K6OQK, owner of WR6ABE. After all, is not this the kind of experimentation within amateur radio that has accounted for many advances in the



Acres and acres of flea market...

world of communication? Again, an amateur has proven that you can do more with a repeater than just talk over it. Who knows what advancement this, as well as the earlier WR6AJP CP experiments, will lead to?

In the meantime, if you are interested in working with CP or possibly have some ideas or experiences to share with Burt, he can be reached by dropping a note to Burt Weiner K6OQK, c/o The Mt. Wilson Repeater Association, PO Box 10193, Glendale CA 91209. I suspect that Burt would be interested in hearing your ideas.

While on the subject of WR6ABE, we regret to announce the temporary (we hope) discontinuance of the weekly bulletin service. After better than two years of uninterrupted service, Bob Sudock WB6FDF has found it necessary to step down from the position of producer-editor-narrator of this weekly service. Speaking for many amateurs, I know that Bob will be missed. The true professionalism that he brought to this service will be long remembered by many of us here and in other parts of the country where the bulletin service was taken by tape delay. While the search is on for a replacement for Bob so that the bulletin service can again resume, I for one feel that he will be a hard act to follow. Thank you, Bob, for a job well done.

On the topic of amateur radio bulletin services such as this, Bill KH6IAF recently returned from the Island State with word (and tape) that a very similar service had been instituted there. Using a format similar to Mt. Wilson's, and the facilities of the interlinked Hawaiian repeater system, amateurs there now have a chance to get up-to-the-minute information on things that concern them. Congratulations to the KH6s who have taken the initiative on this worthwhile project!

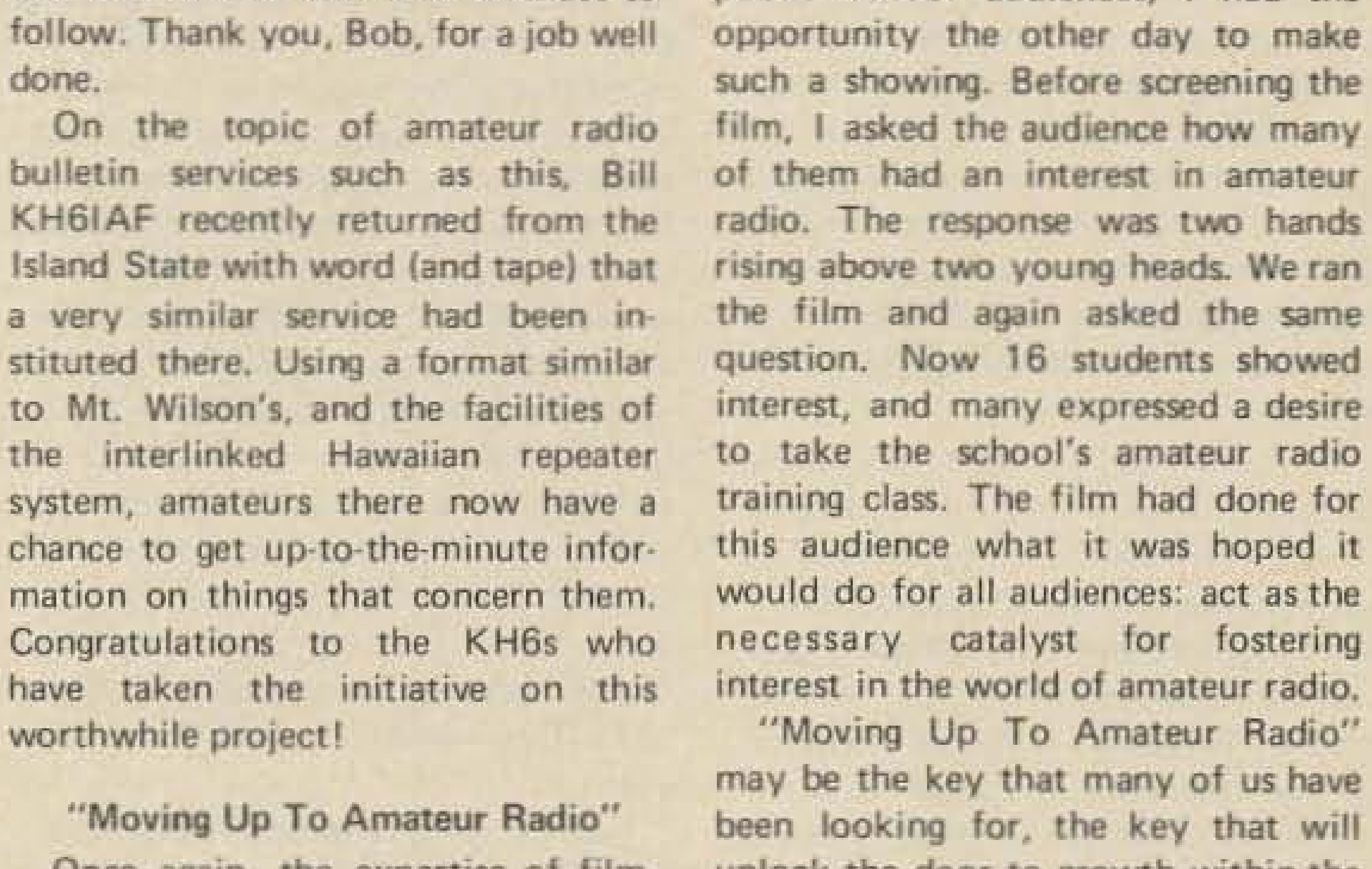
"Moving Up To Amateur Radio"

Once again, the expertise of filmmaker Dave Bell has brought forth a production of outstanding merit. However, unlike previous productions on the subject of amateur radio, "Moving Up To Amateur Radio" is the first such film that is intended for a non-amateur audience. It is an 11 minute experience designed to introduce the wonders of amateur radio to those who have in the past been exposed only to Citizens Band radio or to no form of two-way hobby radio at all.

NBC-TV News correspondent Roy Neal K6DUE is your host and guide. He starts by very tastefully comparing Citizens Band radio with amateur radio and explaining in the simplest of terms the differences between the two. He then takes the viewer further into the world of amateur radio by explaining how one goes about obtaining the necessary training to obtain an amateur ticket, and then on through a tour of the many diverse aspects that combine to make amateur radio one of the world's most interesting hobby services. The audience is allowed to glimpse such things as DXing, RTTY operation, slow scan TV, amateur satellite communication via the OSCAR satellites, and FM. The film ends with a two meter repeater QSO that truly epitomizes the fun of that aspect of amateur radio.

The main question is: "How well is the public going to respond to this film?" If my experience is any indication, I suspect that this vehicle by itself may bring many new members into the amateur radio community. Though the film was not intended for public school audiences, I had the opportunity the other day to make such a showing. Before screening the film, I asked the audience how many of them had an interest in amateur radio. The response was two hands rising above two young heads. We ran the film and again asked the same question. Now 16 students showed interest, and many expressed a desire to take the school's amateur radio training class. The film had done for this audience what it was hoped it would do for all audiences: act as the necessary catalyst for fostering interest in the world of amateur radio.

"Moving Up To Amateur Radio" may be the key that many of us have been looking for, the key that will unlock the door to growth within the amateur radio community. To that end I am happy to commend "Moving Up To Amateur Radio" to the non-amateur world — and especially to the members of the Citizens Radio Service. Through this film, those outside the amateur world can learn not only about us, but, also more important, how to become part of us.



WR6ABE's new JAN-PRO circularly polarized antenna, prior to installation, is shown by Bob Thornberg WB6JPI. Photo by Jerry Sullivan WA6AMD.

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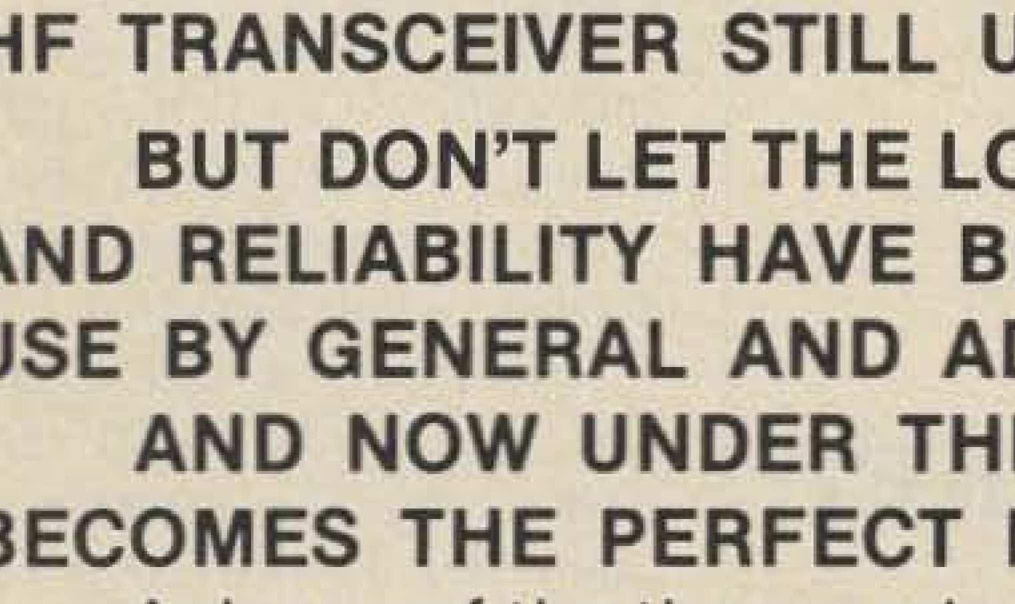

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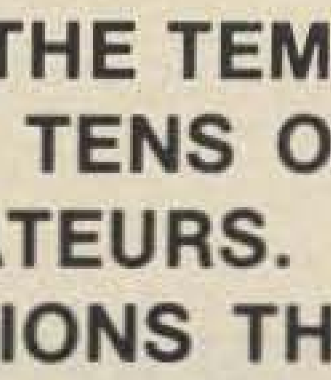

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Build a Weird 2 Band Mobile Antenna

--fantastic parking lot car locater

If you have operated 75 and 40 mobile, you are well aware of the problem of stopping (on a freeway?) to switch resonators on your antenna only to wish you had stayed on the other frequency. Wouldn't it be great if you could switch bands even more conveniently than in your home station . . . no levers, switches, sliders or moving parts?

Here is an electronically switched multiband mobile antenna that can be built with the minimum of parts that are available at the corner home improvement discount house.

I had been anxious for a no-nonsense, non-mechanical multiband mobile antenna for years. The final straw, however, occurred somwhat suddenly one stormy afternoon away from home in our travel trailer. I was talking to a long-time friend across a couple of states and without warning he suggested we shift from 75 to 40 and "click" – he was gone. Normally this would not have been a big deal, but under the circumstances it was downright inconvenient.

This was in 1969, and almost the first person I saw after returning home was Walt W6IJA. He came to our place sporting a three band antenna on his mobile.

Walt had all three of his resonators, 75-40-20, mounted fan fashion on a single base section fed with a single feedline. It was so stupidly simple and practical that I had carbon copies installed on my car and travel trailer within hours. Using just about any resonators available, most of the mobiles in the area were multiband from then on. See Fig. 1.

Not All Roses

Even with the W6IJA multiband antenna, I kept looking for that better mousetrap. Along the way there were plenty of failures. One that I think worth mentioning was what I thought was my greatest pride and joy.

By early 1971 I had a dual bander that looked just like a monobander going down the road. Simply, it was constructed with two insulated top whips laid side by side and held together with shrink tubing. One whip was attached to the top of the coil for 75 and the other brought down to a point where it would resonate on 40 meters (see Fig. 2).

The rig used was a small low powered 75-40 SSB transceiver. The antenna was used mobile for over six months and I was so convinced "this was it" that I submitted a patent disclosure.

Then one weekend I shifted it over to another vehicle with a higher powered rig. After the second syllable – nothing – complete failure. Looking outside toward the antenna, I saw a neat little smoke ring drifting across the canyon! Inspection revealed that the whips had arced through the insulation and they were shorted together at the center. Every type of available insulation was tried, but anytime anything but the little rig was tried . . . fireworks! Back to slaving over a hot soldering iron.

Mother of Invention

Then there was the time I completely demolished my W6IJA dual band antenna with no spare parts for miles around. I did salvage enough for a 75 meter resonator and a couple of top whips, and I was going to be content to get out and short out a few turns to get on 40.

The more I thought of this the less I liked it, having been spoiled by the dual band convenience, so I haywired together a modified version of the earlier "Ol' Smokey." See Fig. 3.

This worked the very first try, and the antenna noise bridge indicated a good match to the 50 Ohm coax on both bands using the old tried and true "Z" match at the base. A surprise bonus was several dB gain in signal strength over the monobanders.

Within a few months this model was cleaned up mechanically, using easy to obtain parts and far fewer of them. Also, the current model described in this article is a little easier on the eye. With a large number of them on the road for the past few years, it has exceeded all expectations. Mechanically it is rugged — none has been reported broken. It has been operated thousands of miles in ice, snow, mud, rain, hot and cold. Everyone has been pleasantly surprised with the performance.

During six months in 1975 the XYL and I traveled 15,000 miles to the four corners of the United States and we never missed our daily 75 meter schedule to the home base in California. Time, 1900 PST; frequency, 3830; rig, TR-3 with the big DK antenna.

No, This Is Not a Broadband Antenna

It may be redundant, but I have to repeat that, like any other good HF mobile antenna, this is not a broadband device. In my travels to clubs last year this was usually the first question that was asked. This appears to be a point that has eluded even a lot of the old-timers. Maybe it is just wishful thinking.

When you are messing with a high Q HF mobile antenna, twiddling the transmitter knobs will not make the antenna work any better. The antenna must be resonant and then matched to the feedline. The more abbreviated the antenna is in relation to the wavelength, the less the usable bandwidth. That's just the way it is! See Fig. 4.

For some of the hard to convince, I have tuned and matched their transmitters to good fifty Ohm dummy loads and then switched it over to the antenna to prove that twisting the transmitter knobs wasn't the secret to get the antenna to take the load. As a matter of fact, this is a very acceptable way to match your antenna to transmitter and feedline. Just switch off from the dummy load and then do all the adjusting to the antenna system to obtain maximum output. The big DK as shown will present a 50 Ohm load at the base on both 75 and 40. The swr will be less than 1.1 to 1.

Preparing the Coil Form

The loading coil is wound on a nineteen inch piece of one inch, schedule 40 PVC pipe. The 1" is the inside dimension. It's a little over an inch and a quarter on the outside. You should be able to bum this much pipe out of your friendly plumber's scrap box. When you cut off the ends, use a pipe cutter if possible to be sure they are square. Don't use too much pressure and crowd the cutter.

With a straightedge, lay a line the full length of the pipe along one side. Measuring from the bottom end, accurately mark points at 1", at 7

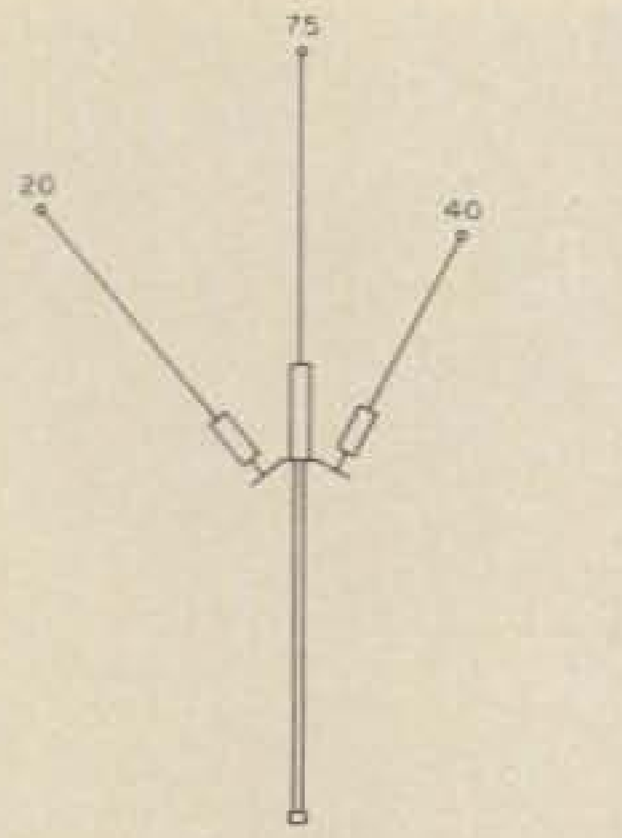


Fig. 1. The 1969 W6IJA special.

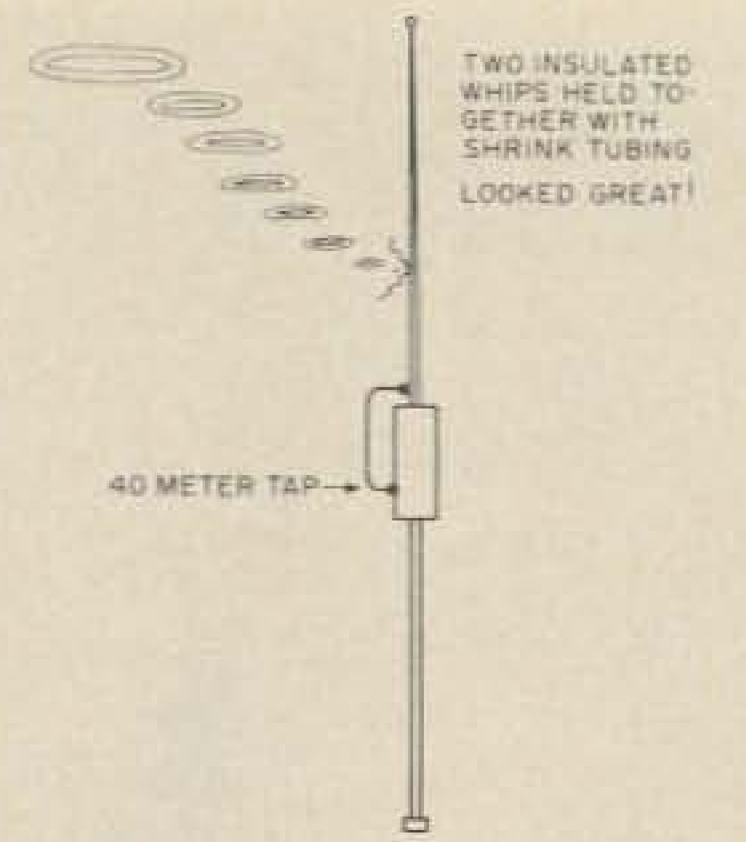


Fig. 2. Ol' Smokey.

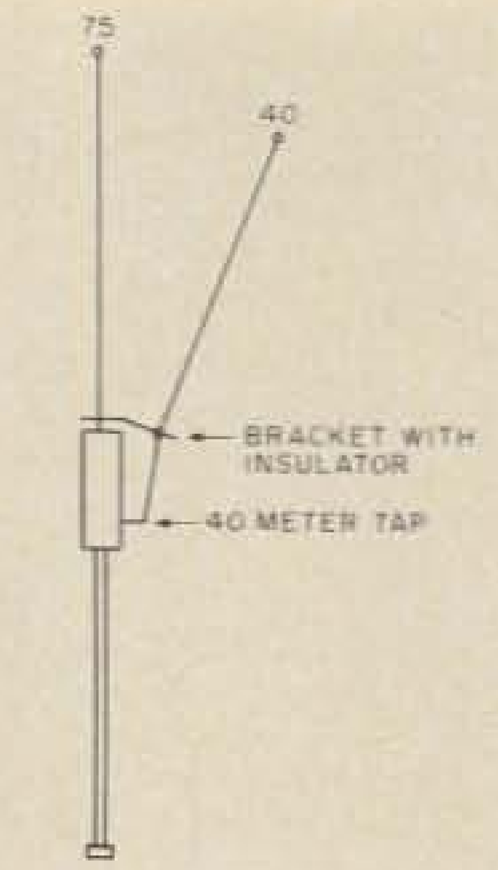


Fig. 3. The 1972 impromptu dual bander.

1/8" and at 17 5/8". Use a number 30 drill and drill holes through the side of the pipe at these points. At the 1" mark only, drill on through both sides of the pipe (see Fig. 5).

The next step is to install the bottom plug to provide the mechanical and electrical connection to the usual 3/8-24 stud that is found on mobile antenna base sections. If you dig around in the plumbing supplies, you can find a regular 3/4" to 1/8" pipe bushing that has a lot of threads both inside and out. The inside 1/8" pipe threads will be tapered and it may be necessary to run a 3/8-24 tap all the way through so it will screw all the way onto the bottom mast section. The cast bushings are not so good, but usually in the same bins there will be ones that appear to be machined and are also plated. A brass bushing would be dandy.

Screw this bushing into the bottom end of the pipe until all the outside threads disappear. Here's where a lathe would be great, because it is important to get this plug in straight so the antenna will stand at attention properly when it is finally mounted on the vehicle.

The pipe bushing will screw in very tightly and makes its own threads as it is turned in. Be sure the pipe is at room temperature so it won't crack. I have never used any glue or cement to hold the bushing in and have never had any reports of any coming loose. Believe it or not, this makes a really rugged mount. I have hit low obstructions with the coil hard enough to break off the bottom mast section with no damage to the coil.

When the bushing is in, drill and tap for an 8-32 screw on the side of the pipe, through the PVC and into the bushing. Do this directly below the 1" point where the number 30 drill came out opposite the penciled line. This screw will be used for the lower coil connection.

Winding the Coil

Winding the coil is really the most difficult part of construction, particularly if a lathe is not available. The coil is wound with 196 turns of #18 solid copper wire space wound to 12 turns per inch. The 40 meter tap will pass over the tap hole at the 71st turn. 85 feet of wire will be sufficient to wind the coil and leave plenty to play with on both ends.

Before you go at it the hard way, check with one of the local adult education classes where someone is taking shop and a lathe is available. Set up the lathe for 12 threads per inch, run the wire through a guide on the tool post, and it will take the operator about one minute to wind the entire coil. Note how the start and finish wire is dressed through the holes in the PVC coil form (see Fig. 6).

Also, if I am winding on a lathe, I spray a thin coat of adhesive on the pipe just ahead of the winding to help keep the wire in place. Sometimes when I am not in a hurry, and can leave it in the lathe for a while, I brush on a generous coat of fiberglass resin or varnish over the windings and let the coil keep turning while the stuff sets up. This makes a very attractive finish and it can even be painted to a color of your choice. Just be sure you are careful about the kind of paint used. No metallic particles, please! I have been that route.

If resin or varnish is used, be sure to put a toothpick or some similar plug in the 40 meter tap hole so it can be cleared later without damaging the wire.

Those of you who have shrink tubing available can go ahead and use it over the coil; it works fine. Also, it is advisable to drill a small drain hole on the side just above the bottom plug. I found this necessary as I unscrewed my coil one day to show it off. The coil holds exactly one coatsleeve full of water!

As I say, if you can get to a lathe, you have it made. I would certainly make every effort to locate one. If not, there are other tedious ways to space-wind coils, but one this size gets to be a problem. Our luck has been that when the XYL and I are very carefully winding one by hand, the phone will ring. The question is who drops what, or do you just start over only to have the whole thing "clunk" together at the very last turn?

A popular way, of course, is to select another piece of wire or a string that will give the correct spacing, and then

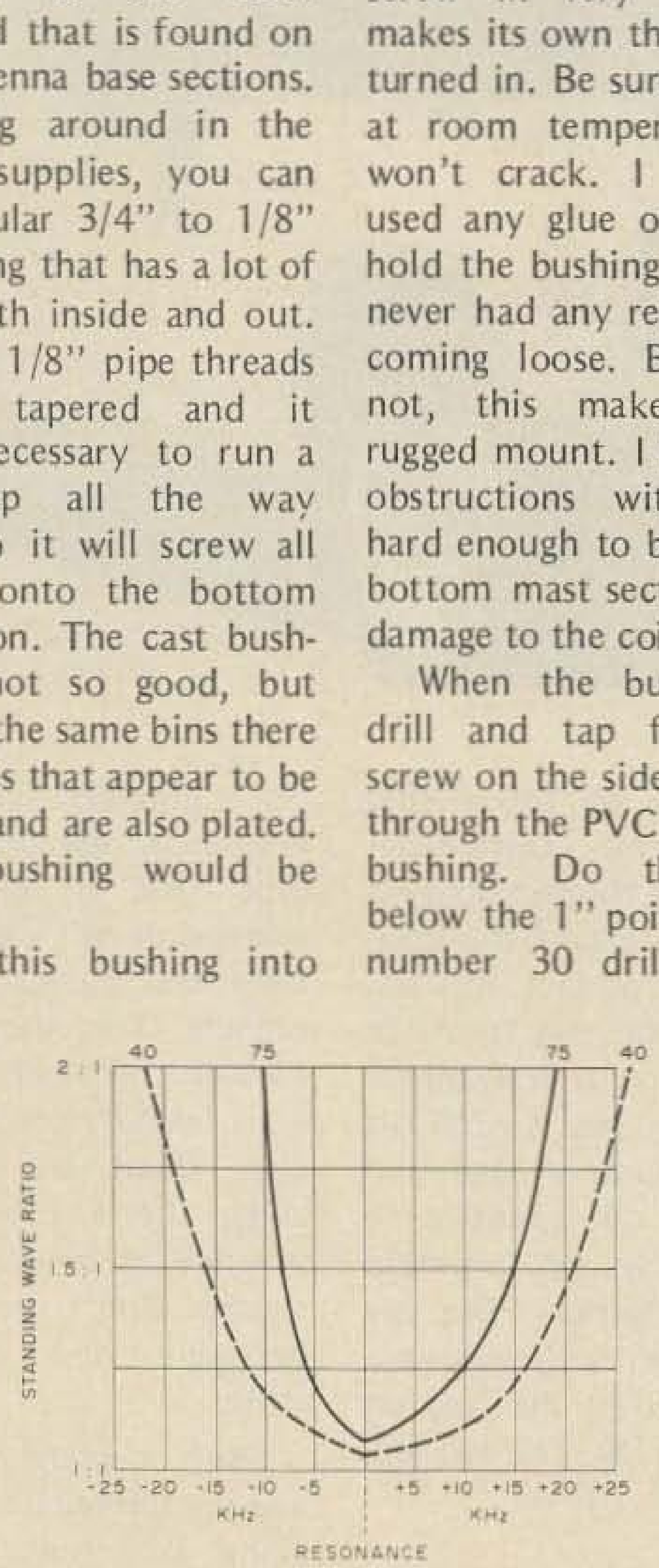


Fig. 4. Swr curves for typical big DK.

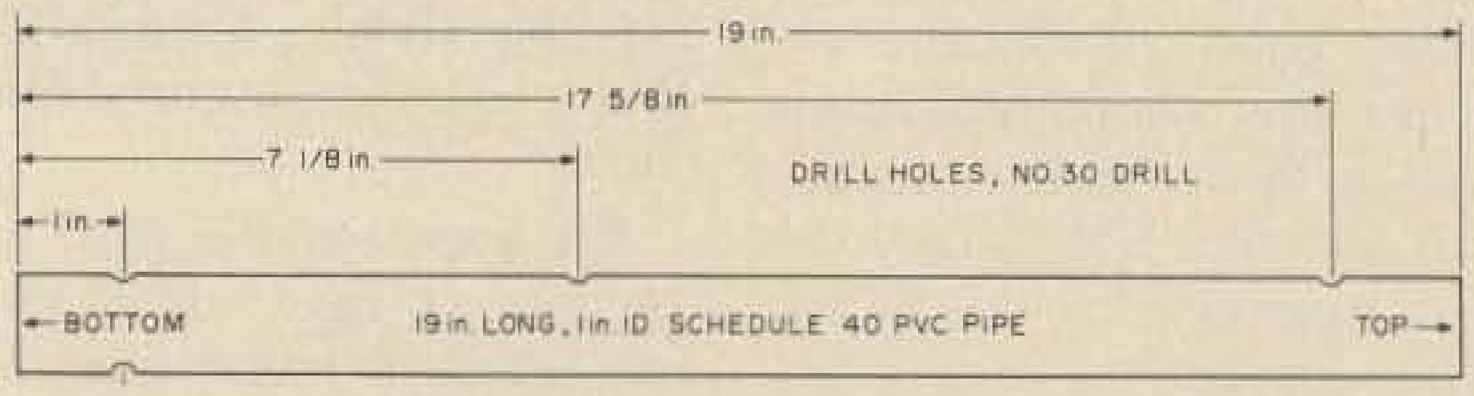


Fig. 5. Preparing the coil form.

wind it side by side with the coil wire. When the winding is completed and secured, the wire or string is carefully removed.

Preparing the Coil Wires

Remove the insulation from the end of the bottom coil wire and place it securely under the 8-32 screw that goes into the side of the 3/4" pipe bushing. I use a brass screw and then a dab of solder to be sure there is a good electrical connection. This is a low voltage point and it is wise to continually inspect all connections from here on down to the feedline to keep the I/R losses to absolute minimum. Dissimilar metals and constant exposure to the elements encourage trouble, causing corrosion in a very short time.

For the 40 meter tap I use an eighteen inch piece of the inner insulated conductor from stripped RG-58U or other similar small coax. Strip the insulation from this inner conductor 2" on one end and 3" on the other. Be sure there are no nicks in the wire.

Remove the insulation from the coil winding that passes directly over the hole drilled for the 40 meter tap (turn 71). Be sure you don't take any insulation off the adjacent windings. Clean out the hole under this wire.

Now shove the wire just prepared down through the inside center of the coil form from the top so that the bare end stripped 2" comes out through the 40 meter tap hole. This is not hard to do. Put a long 90° radius on the bare 2" end and then hold the pipe and wire in such a way that as you shove it down toward the tap hole you have a good chance of it coming out on the first try.

Pull this wire out so the insulation is tight up against the inside of the 40 meter tap hole. Use a small soldering iron and solder this wire to the winding that passes over the hole. Put a little bend or hook in the end of the tap wire to help hold it mechanically. Try applying a little pressure to this connection with the soldering iron, pushing it just below the outside surface of the PVC. Don't push too hard or you'll have a horrible mess. When soldered, carefully trim off the excess wire and examine closely to make sure there are no solder blobs or bitter ends touching the adjacent windings.

Cut off the wire coming out of the coil from the 75 meter hole so the wire extends three inches beyond the top end of the pipe. Remove two inches of insulation from the 75 meter wire. Tin both the 75 and 40 meter wires. Now your masterpiece should look like Fig. 6.

Preparing the Tee

The support for the two whips on top of the coil is a one inch PVC pipe tee that slips on the top of the completed coil. When obtaining this fitting, ask for a "slip-slip-slip" one inch PVC tee for 1" schedule 40 PVC pipe. No threads.

Drill two 5/16" holes, 1 1/4" each side of center, through the top of the tee for mounting the two whips (see Fig. 7).

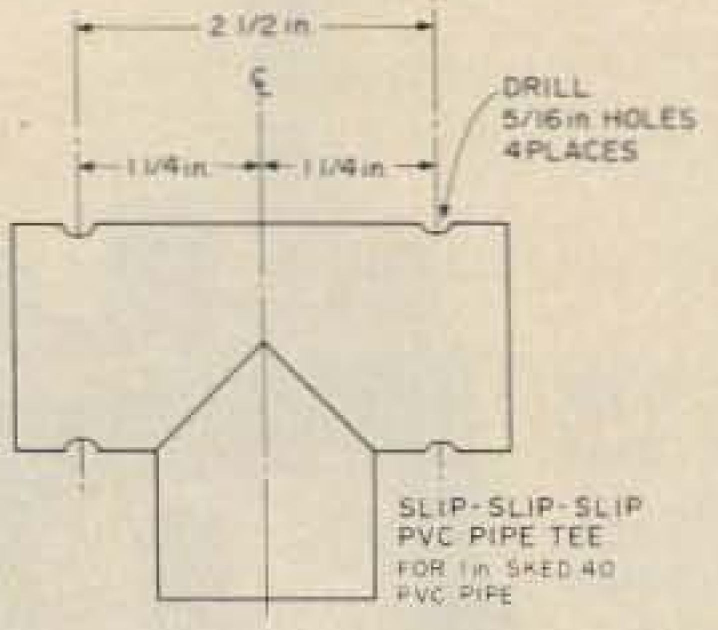


Fig. 7. Preparation of PVC tee for top whips.

It is important that these holes are absolutely parallel to both the sides and ends of the tee. A drill press is a big help here but it can be done with a hand drill if both sides are very accurately marked and caution is used while drilling. Don't let the drill or the tee wobble and make the holes egg-shaped because this will affect the proper installation of the whips. Of course where I drill a large number at a time, I have cheated and fabricated a fixture so if I make a mistake I have a box full of instant surplus!

Installing the Tee

Align one open end of the tee so that it will line up with the hole where the 75 meter wire goes through the side of the pipe. Place the 75 and 40 meter coil wires up into the tee and out their respective ends, and push the tee onto the coil end. Be sure that the open end selected is still lined up with the 75 meter wire hole. This is very important to provide maximum clearance between the 75 and 40 meter connections. Also be positive that the two wires are not crossing over each other inside the coil form or the tee. There are tremendously high voltages here and precautions must be taken to prevent arc-over. When the alignment of the tee is verified, tap it all the way down onto the coil form as far as it will go. I use a rawhide hammer.

Here again I have not found it necessary to use any PVC cement because this slip fitting is plenty tight and, if necessary, it can be driven off again. The coil now looks like Fig. 11.

The Top Whips

The top whips on mobile antennas usually take a pretty good beating from low branches and flourescent bulbs in service stations. They have to be flexible enough to give when an immovable object is struck, but still stiff enough to recover to the original position without taking a set.

The position that a top whip maintains determines the exact resonant frequency. It should not wave around too much while underway. This is why I do not use, nor recommend, a spring mobile mount. The mobile antenna must maintain the same relative position to the vehicle at all times to keep it at resonance. When you see someone tearing down the road with the antenna swinging wildly in the slipstream, you'd better get in contact quick, because by the time he gets down to the next corner he's going to be out of range!

Over the years I have tried various brands and combinations for top whips, but there was always something lacking. Many times the price bothered me. Currently I am using 1/4" diameter solid fiberglass poles covered with copper braid. The best source for these fiberglass poles in small quantities is the six foot bicycle safety flag. Cheap, too; less than a buck.

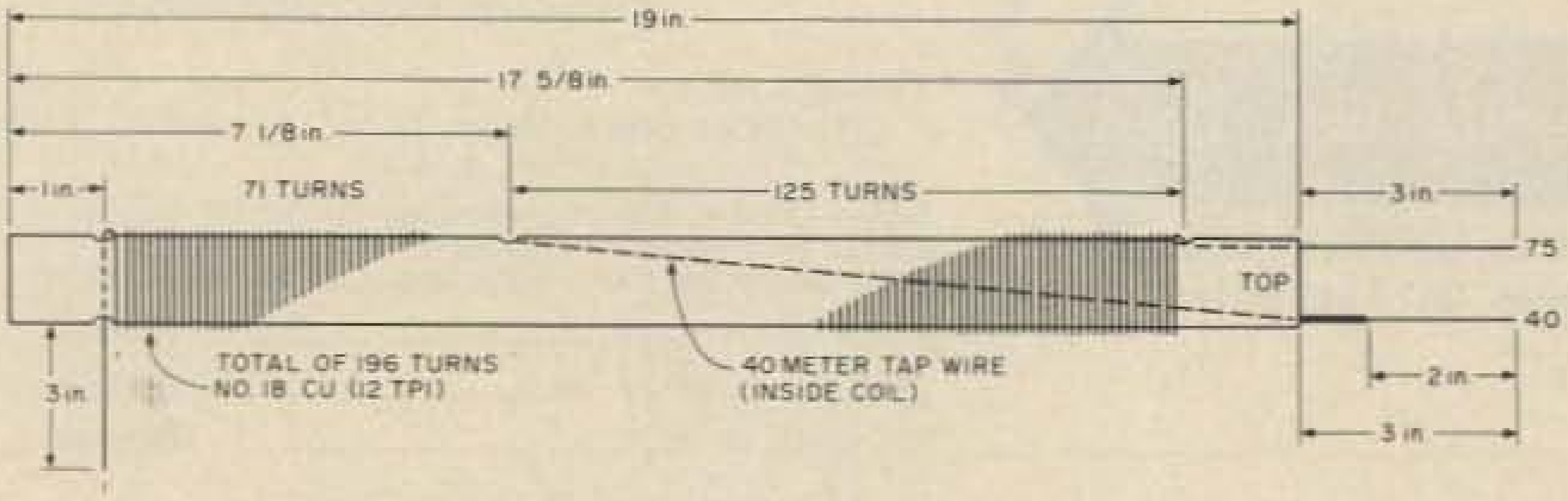


Fig. 6. Big DK loading coil.

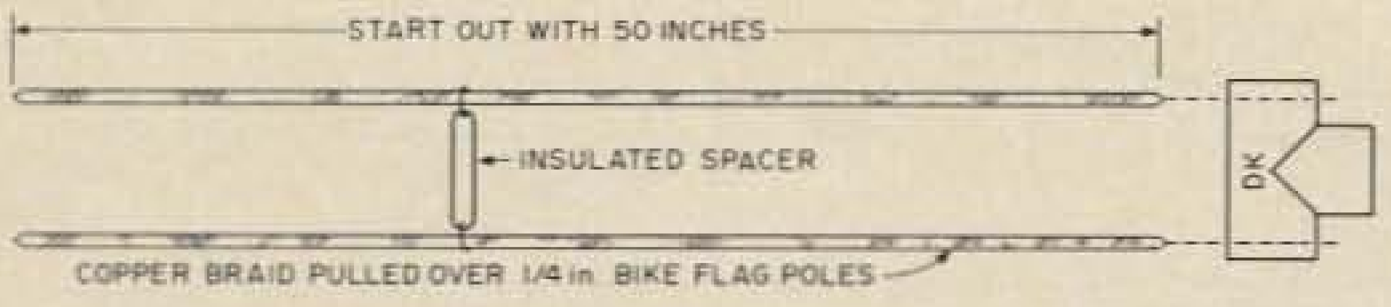


Fig. 8a. Fiberglass whips.

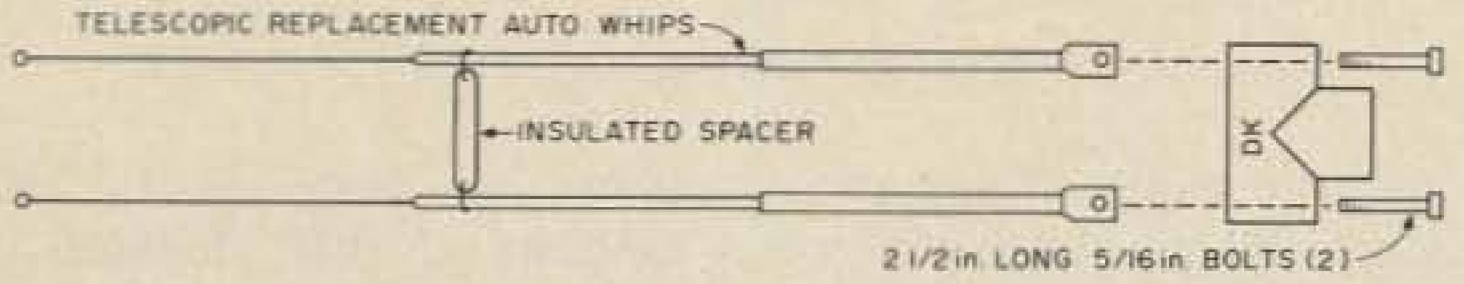


Fig. 8b. Adjustable auto replacement whips.

Fig. 8c. Adjustables on fiberglass whips.

Probably the best source for the copper braid to slip over the fiberglass poles is some old scrap coax. I found some old RG-6U and used the silver tinned braid. It looks real classy while it is new.

To make the whips using the fiberglass poles, cut two of them 50" each and slip the copper braid over them. Pull the braid up tight on both ends, give a good twist and cut off the excess (see Fig. 8).

Later on, the whips can be painted, doped or just left as is. My Sunday antenna is striped FAA orange and white. It gets a lot of attention. When the other driver hesitates for the second look, you get the jump on him at the traffic signal.

Alternate Top Whips

You might come up with some alternate top whips which will work as well as the cheapie bicycle flag poles. A couple of the local mobileers have used their retired fiberglass CB whips and just pruned them down to resonance. Another ex-fisherman used two of his old tapered hollow fiberglass fishing poles. For the conductor, he just merely shoved a #12 copper wire up through the center and, when it was trimmed to the proper length, he soldered a neat little corona ball on top.

Automobile Replacement Whips

I have also used a number of the automobile replacement whips (Fig. 8b). These are the type that slip over the 5/16" diameter auto whips that get ripped off. One source is the Ward TCFR-1; another is Radio Shack part #12-1309. These telescopic whips are not really the greatest for mobile use because when they hit something they normally bend and take a set which puts the antenna off resonance.

For the travel trailers and mobile homes and other stationary installations, the replacement whips work out just fine. The advantage, of course, is being able to vary the length easily if you have the urge to move around the band.

Installation of the Top Whips

Installation of the braid-covered fiberglass whips is relatively simple. With the braid pulled tightly over the 1/4" fiberglass poles, they will go into the 5/16" holes in the PVC tee with a very snug fit. Push the whips on through so the bottoms protrude out the bottom holes in the tee about an eighth of an inch (see Fig. 8).

Pull the 75 and 40 meter tinned coil wire leads around their respective whips. Take up all the possible slack from inside the coil form and then solder to the braid on the whips (Fig. 9). Be very careful that the PVC tee doesn't get too hot. It melts very easily. Cut off any excess wire and dress so that sharp ends are pointing toward the outside ends of the tee. If you have some Glyptal, it won't hurt to coat these connections. Don't leave any debris that might encourage corona inside the tee.

Use a piece of the leftover 1/4" fiberglass rod for a spacer to hold the two top whips parallel. Cut the spacer 2 1/4"; drill two small holes crossways close to both ends. Thread a 2" piece of bare wire through each hole. Place this spacer between the whips about 36" up from the tee, wrap the bare wires around the braid and then solder to hold it in place.

Be sure you can identify which whip is which, and then plug up the open ends of the tee. Cap-plugs that are often used to protect pipe threads can be modified to snap in. Maybe you have a couple of spare plastic shot glasses.

Finally glue, dope, epoxy, or what have you around the four holes in the tee where the whips fit.

Bottom Section

The bottom section of the mobile antenna should be installed to place the bottom of the antenna coil a minimum of 6" above the highest part of the vehicle. The length of the bottom section will vary with the location of the base mount on the vehicle. I have installed lower sections with lengths varying from 18" to 6 feet without degrading the efficiency of the antenna. Anytime any part of the loading coil is placed below the highest part of the vehicle, the radiated signal suffers considerably.

Bottom Section Fabrication

A very simple, sturdy and cheap antenna bottom section can be made from a piece of 1/2" EMT – thin wall conduit. Cut off the desired length and then in each end braze a 5/8" by 1/2" long hex-head bolt. Chuck this up in the lathe and drill and tap 3/8-24 both ends (see Fig. 10a).

If a lathe is not available, you'll have to come up with the old "drill a hole in the bolt trick," which could be to sneak it in on one of the local shop teachers while your coil is being wound.

Antenna Mount

While you are at it, you might as well go all the way and make your own base mount. This can be done with a 1" bolt and a few homemade insulating washers.

Dig out a bolt that has no threads within a couple of inches from the head. Make a very square cut and saw off the threaded end and discard. Using the same "drill a hole in the bolt trick," drill and tap a 3/8-24 hole 3/4" deep in each end. Cut out a few washers from some good insulating material and drill the

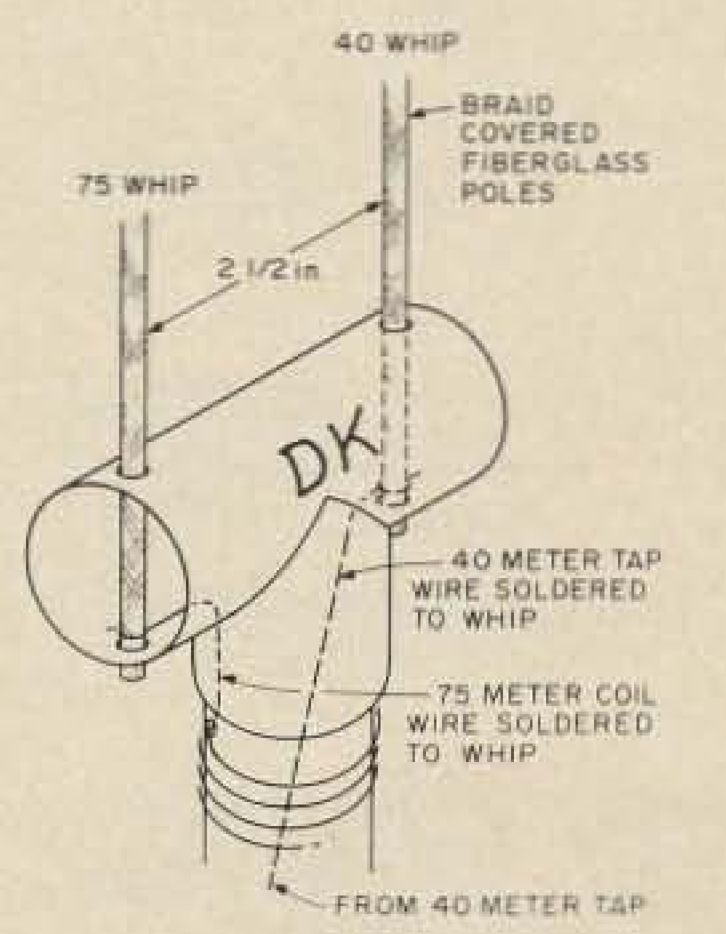


Fig. 9. Detail of coil wires' connection to whips.

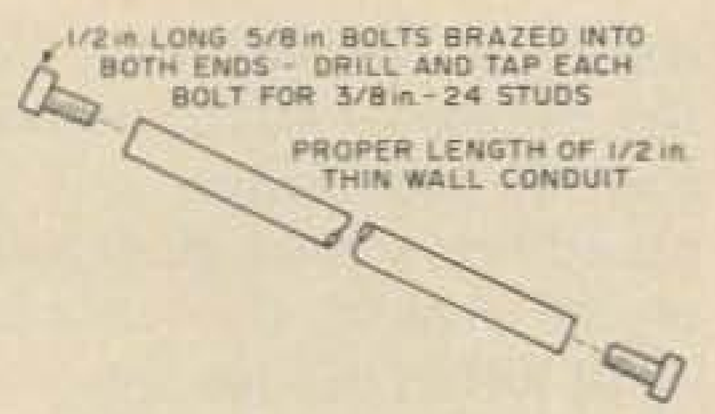


Fig. 10a. Lower mast section.

Fig. 10b. Homemade antenna mount.

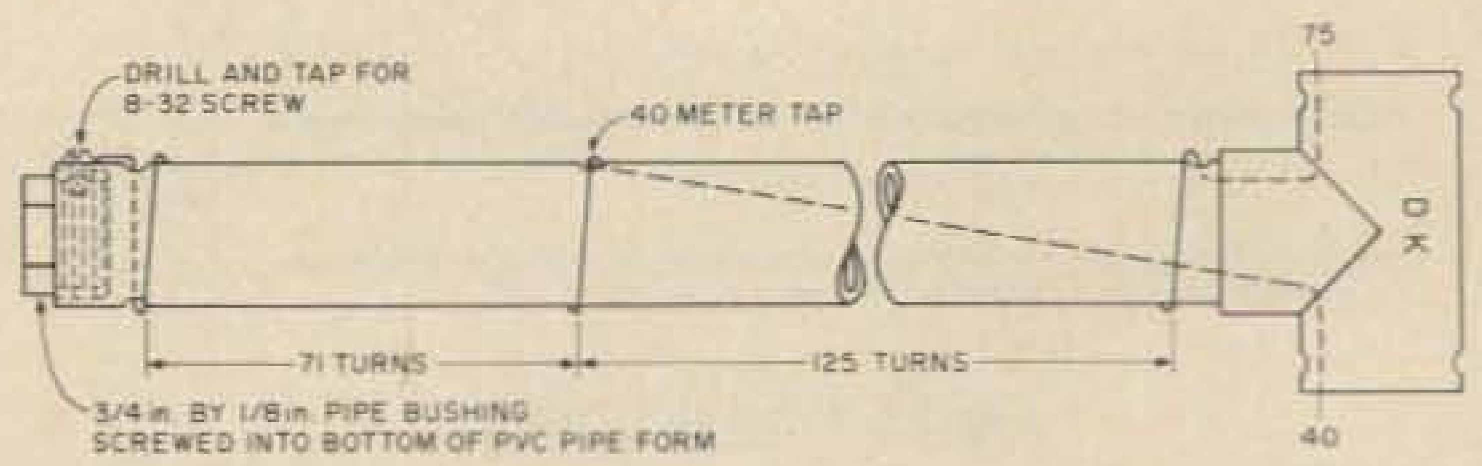


Fig. 11. Completed loading coil ready for whips.

centers of each with 3/8" hole. Assemble as in Fig. 10b.

Matching Capacitor

The capacitor across the antenna end of the feedline preferably should be a variable with a range that goes through 500 pF to 1500 pF. I was able to pick up a few compression screw driver adjusts, Arco part #310. These worked out very well and they could be put right on the money for a good match. The way to adjust the cap is to jump back and forth from one band to the other, readjusting the capacity for the lowest swr on both bands with the same setting. This will affect the resonant frequency of the antenna a small amount, so be sure you have the capacitor in place and adjusted close to the correct value before pruning the whips the last few kHz. See Fig. 12a.

If one of the adjustable trimmers cannot be located, start out with a fixed 820 pF silver mica. It is very possible the 820 pF will give an swr of 1.1:1 or less.

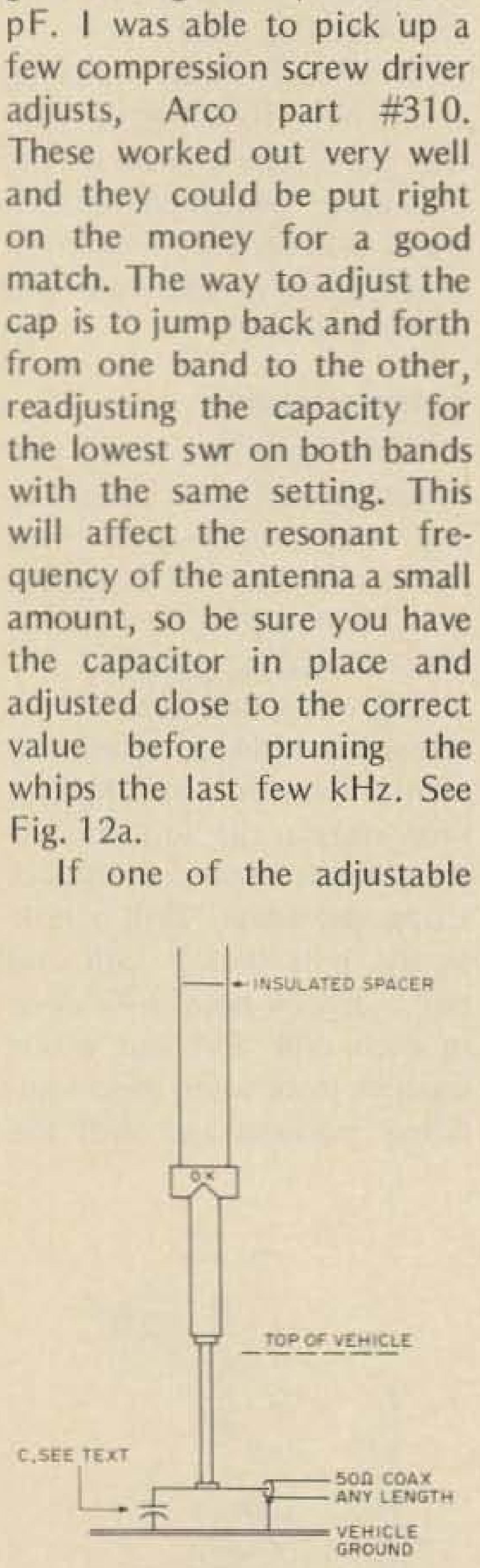


Fig. 12a. Installation.

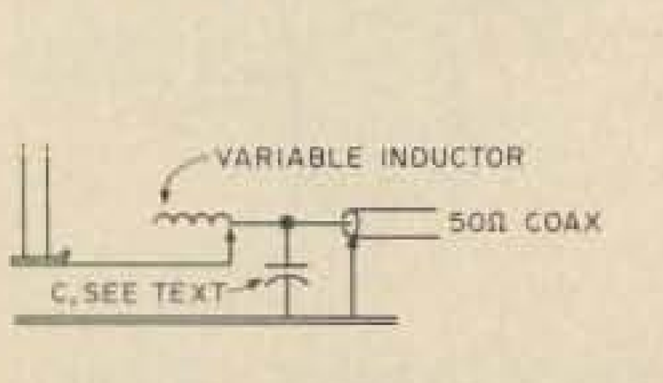


Fig. 12b. Installation of variable inductor.

Pruning the Top Whips

With the assembly installed on the vehicle as in Fig. 12, connect the antenna noise bridge in the line and look for the resonant point on both bands. Using the braid-covered bike whips, each 50" long, will place the antenna quite low on both bands. Thinner whips, however, will require lengths up to twenty percent longer.

First of all, if you are using a variable inductor at the base, as in Fig. 12b, be sure it is set at the minimum inductance before you start pruning and tuning.

If resonance cannot be located starting with the 50" whips, don't overlook the fact it may be so low that it is at a point below the frequency range of the receiver.

Slide the braid down on the whips, saw off one inch of the fiberglass, pull the braid back up tight, give it a twist and cut off the excess. Continue this, cutting off shorter and shorter pieces until the desired resonant point is reached. It is very doubtful that the whips will be much shorter than 46" each when the antenna is completed. Don't get confused; be sure the proper whip is being trimmed, because it gets embarrassing when one of the whips keeps getting shorter and the frequency does not change. After the last and final prune, pull the braid up tight again, give it a twist, put a bit of solder over the end and trim off smoothly.

Normally one inch removed from the 40 meter whip will raise the frequency 50 kHz. One inch removed from the 75 meter whip will raise the frequency 25 kHz.

Using the telescoping types of top whips will make tuning a lot easier, but you are not going to be happy with them mobile unless you have some of the exceptionally good ones made particularly for this type of service.

Random Info

This antenna has been developed in various other directions: 160 and 75 meters; some three banders, 160-75-40 and 75-40-20; two whips on the same band, permitting CW and phone band without retuning the antenna; MARS and amateur.

On mobile homes and travel trailers, a base section of approximately 14 feet, plus or minus a little, will permit operation on 20 in addition to 75 and 40 by just using the two whips. The big DK on the top appears as a top hat on the 20 meter 1/4 wave vertical.

With the antenna mounted on the rear of the vehicle, the resonant frequency on 75 will go down as much as 30 kHz when a travel trailer is hooked on behind. Likewise, if you have the antenna installed on a travel trailer and then connect the tow vehicle — zip — down the band it goes again. The amount of shift depends on the location of the antenna in relation to the added vehicle.

Don't expect any directivity from 75 or 40 mobile antennas. The pattern around a vehicle on a properly installed 75-40 meter antenna is very symmetrical. If someone says "I'm headed toward you now and I should be louder," — don't get sucked into agreeing with him.

A properly matched antenna presents a 50 Ohm load at the base, and the length of coax feedline has no effect on the resonant frequency of the antenna. Of course I would not recommend a couple of hundred feet under the front seat; it gets sort of lumpy.

It may be noticed that I did not mention "roller" inductors for the QSY variable coil at the base. There are other ways to produce a variable inductor, probably right out of the scrap box. Think about it.

Another way to lower the frequency of a fixed whip is to alligator clip a "stinger" on the whip right above the tee and let it trail aft (see Fig. 13). A clip and a piece of wire with an overall length of 8" will move the 75 meter resonant frequency down about 30 kHz.

One owner mounted a tiny telescopic antenna out of the 75 meter end of the tee. He can reach this adjustable whip out of the pickup window while underway. We call him "Hot Fingers Ralph."

Another mobileer starts out early in the morning, checking into a weather net, and then drops 25 kHz down the band. He installed his spacer at the very top of the whips. At the center he wedges in a 4" plastic spacer to bow the whips out from one another in the center. This four inch plastic temporary spacer is attached to a fishline leading into the car window. After he checks out of the weather net he jerks the spacer out and pulls it in the car. Presto! He's 25 kHz down the band. The next morning the spacer goes back in. This illustrates how important it is to keep the two whips in the same relation to each other at all times.

The bicycle poles with the braid covering are also doubling around Wireless Hill as 2 meter verticals, VHF and UHF beam elements. Uses around the station are limited only to the number of bicycles ripped off.

It is best to orient the tee on the antenna crossways to the vehicle. This allows for better fore and aft flexibility. Also it has been found that, with the tee aligned fore and aft, the turbulence from the leading whip creates a severe flutter to the trailing whip which causes the whole assembly to vibrate.

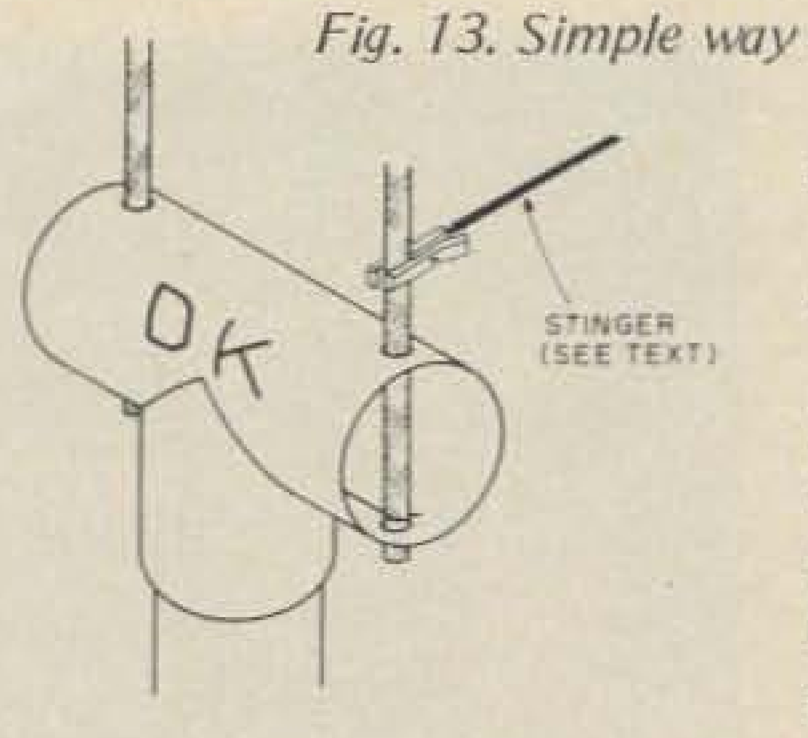


Fig. 13. Simple way to lower frequency in a pinch.

Acknowledgements

I want to thank the numerous amateurs who put up with my haranguing in addition to contributing their time, money, materials, ideas and field testing during the development of the big DK. They are all the greatest. This has certainly been a cooperative project and it is continuing. ■

New Products

HOW ELECTRONICS GOT FASTER AND EASIER TO WORK WITH THANKS TO MODERN SOLDERLESS BREADBOARDS

A P Products Incorporated of Painesville, Ohio, originated the modern solderless breadboard in 1968. Since then, tens of thousands of solderless breadboards have been used each month by electronics experimenters and designers in a wide variety of fields.

But just what is a solderless breadboard? How does it work? What advantages does it offer? Where can it be used? And how?

Before the era of modern solderless breadboards, designing and testing any given electronic circuit was an aggravating, tedious, time-consuming task. First a circuit would have to be designed on paper. Then the schematic diagram of the circuit would have to be translated into a circuit board parts layout for either point-to-point or printed circuit wiring. If a printed circuit were to be used, as was most often the case, the circuit layout would have to be transferred to a copper-clad board, the copper selectively etched, holes drilled, and components soldered in place. Then, if a component proved the wrong value, it would have to be desoldered and a new one soldered in place. If the printed pattern were in error, a whole new board would have to be laid out, etched, drilled, filled and soldered. A lot of time, a lot of work.

Then A P Products came up with the idea of arranging a breadboard with a matrix of interconnected holes. The interconnections are made by conductive spring clips that grip each component lead firmly to establish a good electrical connection without soldering. The matrix of holes was laid out in a tenth-inch spacing pattern to conform with standard component lead spacing.

The interconnection pattern was designed to provide ample access to each lead of each component, especially with modern transistor and integrated circuitry in mind. And distribution strips were designed to provide power and signal lines where needed.

Circuit designing now becomes plug-in-easy. ICs and/or discrete components plug into the solderless breadboard and ordinary 22 gauge solid wire jumpers are used to interconnect them.

A given circuit can now be prototyped in minutes rather than hours or days. Many designers work directly with component specification sheets, many with schematic diagrams. Changes in parts values are as easy as pulling out one part and plugging in another. And the geometry of the modern solderless breadboard translates into a printed circuit layout readily, once the circuit is ready to commit to hardware.

In addition, solderless breadboards can serve as a basis for semi-permanent circuits in applications where the need for a given circuit requires reliability but does not require longevity.

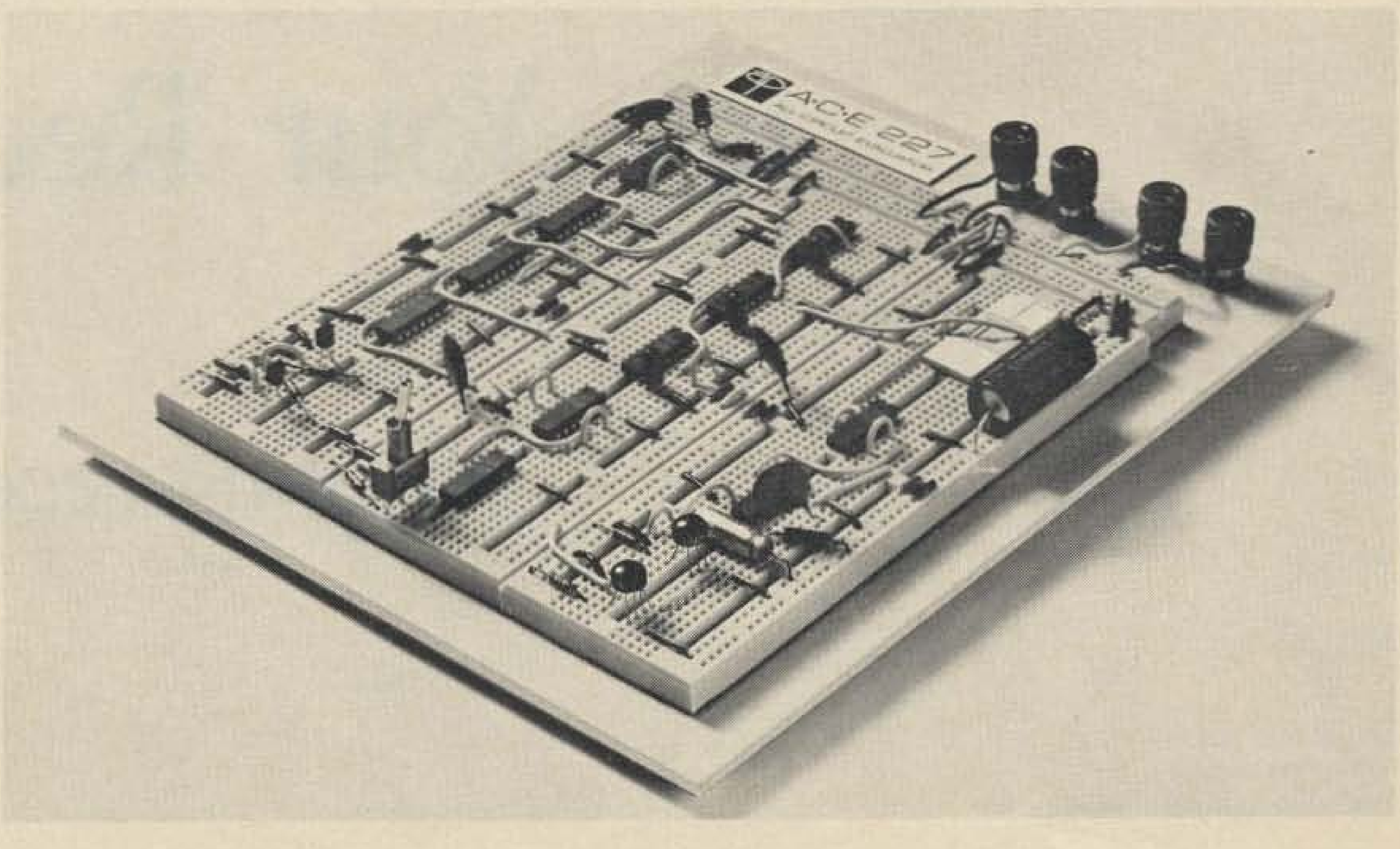
Applications for modern solderless breadboards are as wide as all of electronics. There are professional applications in machine control, data processing, test and measurement, device testing, prototyping and equipment adjunctive aids. There are hobby applications ranging from communications to photography to automotives to biofeedback to music to model railroading and more.

And, of course, solderless breadboards are perfect for educational and instructional applications.

Solderless breadboards and breadboarding aids come in many sizes and prices, capable of circuits as simple as you like or as complicated as a small computer.

A P Products continues to be a pioneer in the development and application of modern solderless breadboards. If you have questions about what solderless breadboards can do, how much they cost, or what's available, contact A P Products at Box 110, 72 Corwin Drive, Painesville OH 44077. A P Products has available a free catalog of their ACE All Circuit Evaluator solderless breadboards, Super Strips™, Terminal and Distribution Strips, IC Test Clips and accessories.

For more information, contact Robert J. Gabor, A P Products Incorporated, Box 110-P, Painesville OH 44077. Phone: (216)-354-2101; TWX: 810-435-2250. Direct all inquiries to Rita Mercer.



DRAKE RCS-4

Checked the price of RG8-U lately? Want to beat that price and clean up the unsightly mess of coax running down your tower? The boys at Drake have a real winning number for you.

The RCS-4 is a remote controlled switch that will switch 5 antennas from 1 feedline, ground those not in use — and will ground them all when not in use. Cheap lightning protection, right?

This unit will take full legal power, and operates up through 2 meters like a champ. Only 24 volts dc to motor — and has rain hat construction to prevent moisture damage.

This jewel works like a dream, with swr less than 1.5 to 1 even on 146.94. At $120.00 this has to be one of the top buys. We aren't easily impressed, but this got our attention. Switch 3 beams and a couple of inverted vees, all with only 1 up lead. Fantastic! Available at your dealers.

About 18 months ago, I sat down to design a simple digital dial for my receiver. I ended up building a deluxe, no-compromise received frequency counter. My reasoning was that with TTL IC and LED readout prices being so low, it would only cost a little bit more to go all the way. In retrospect, this appears to have been a wise decision. Component prices are still declining. During the development period, I had occasion to use the digital frequency readout with single, double and triple conversion receiving setups. All I ever had to do to change over to the new receiver was connect its oscillators to the counter and reprogram the count direction for each oscillator by means of a few wire jumpers.

The received frequency counter shown in place on top of my HRO-50T receiver. This chassis contains all of the circuitry described in the article except the crystal oscillator, power supply, and multiple radio interface. These are still in breadboard form and are not shown for aesthetic reasons.

The basic features of my digital frequency readout system are illustrated in Fig. 1. The multiplexed up-down counter principle is used. Since 4 inputs are available, the system is directly applicable to up to triple conversion receivers. The up-down controls for each input are made available as external connections. This facilitates reprogramming the unit for use with a different radio or with more than one radio. I found that tri-state logic buffers (8T97B, e.g.) are ideal for a multiple receiver interface.

The system has a 50 MHz

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guaranteed, 75 MHz typical maximum input frequency. Its error limits are ±¼ count times the number of counter inputs used, ± the timebase error. 100 Hz accuracy as well as resolution is readily achieved for a double conversion receiver with only a 6 digit counter. Since the counter updates its display at a rate equal to one twentieth of its resolution, 10 Hz resolution is still usable. I built a 7 digit counter with switch selected resolution. I don't employ the higher resolution in normal operation, but it comes in handy when aligning the timebase and when using the counter on the test and development bench. And, like I said before, it only cost a little bit more to add the extra digit.

Interface Design

The success of any digital frequency readout system hinges on the user's ability to connect it to his radios without upsetting their operation. Careful shielding and layout and avoidance of ground loops are necessary to ensure adequate isolation between the analog and digital circuitry. The biggest headache I had occurred when I created a logic signal from a bfo right on the receiver's chassis, then found I couldn't keep it out of the i-f. You can probably save yourself a lot of time by avoiding that mistake. An easily implemented and relatively foolproof interface is shown in Fig. 2. Use an FET buffer close to the oscillator tank circuit to isolate it from the logic circuits. Bring the buffered signal to the counter's chassis in coax with the shield grounded at only one end to avoid ground loops. If you have at least .6 V p-p at this point, an inverting tri-state buffer with resistor feedback will convert it to TTL levels. If gain is required, try a step-up transformer. If you've got a lot of signal, install a protective diode at the 8T98's input.

That's the circuit design. Systems considerations dictate a modular, expandable packaging approach. To prevent spurious responses in the receiver, we need to shield the high speed digital lines and to isolate the oscillator signals from each other. For these reasons, I put 2 sets of the interface circuits shown in Fig. 2 in a 2¼" x 1½" x 2" minibox. Female BNC connectors mounted to the minibox wall bring the oscillator signals in. Feedthrough terminals on the opposite wall couple the tristate TTL outputs to twisted pair lines daisy chained between the miniboxes. Each minibox contains a single 8T98 IC mounted in a wire wrap socket on a copperclad board. Isolated pads are cut to hold the discrete components. All of the interface miniboxes are enclosed in a larger metal box to shield the twisted pair lines. These lines are terminated, as shown in Fig. 3, and additional drivers send the signals to the counter chassis via coaxial cable.

While I haven't tried them all yet, several techniques are available for expanding this digital frequency readout system's versatility. By pre-

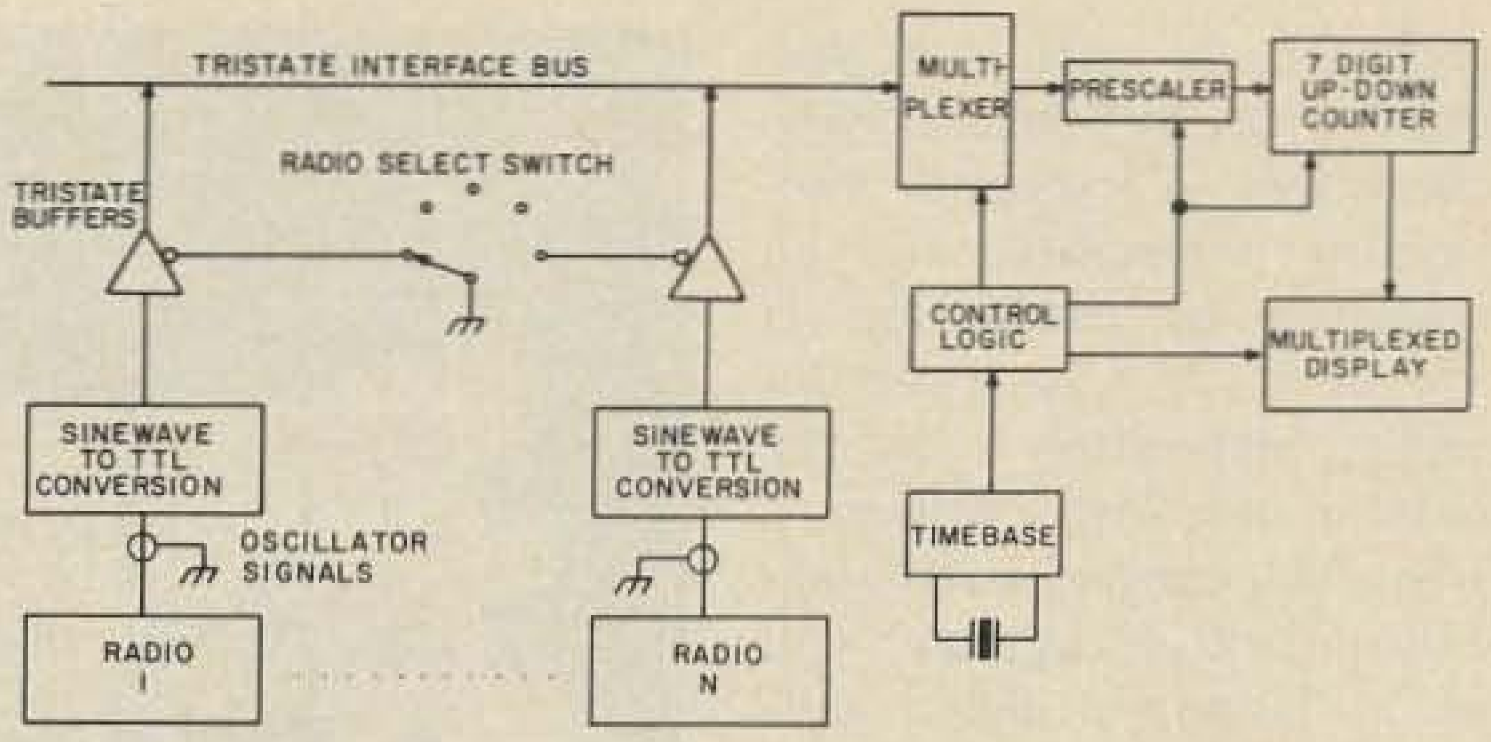


Fig. 1. Block diagram of digital frequency readout.

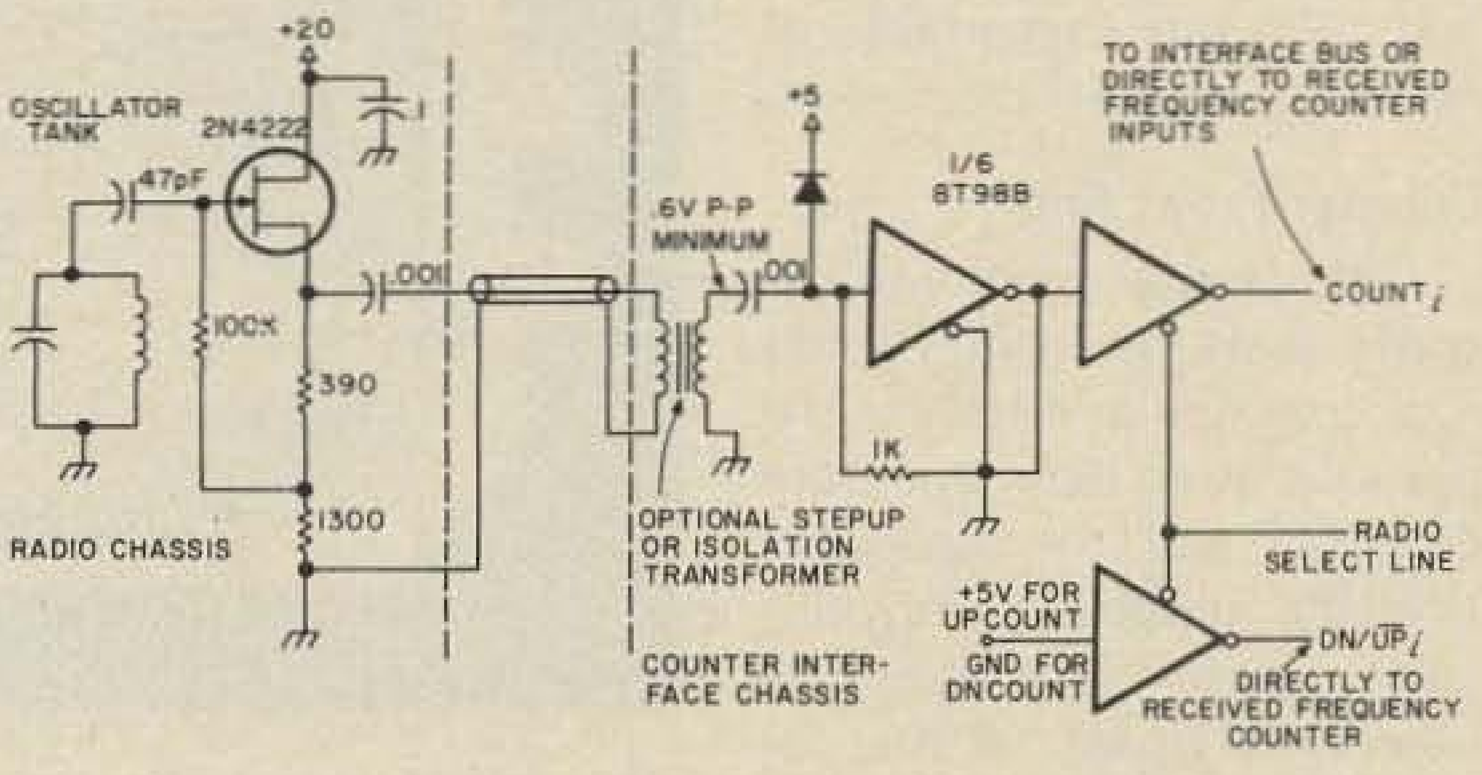


Fig. 2. Oscillator-counter interface details.

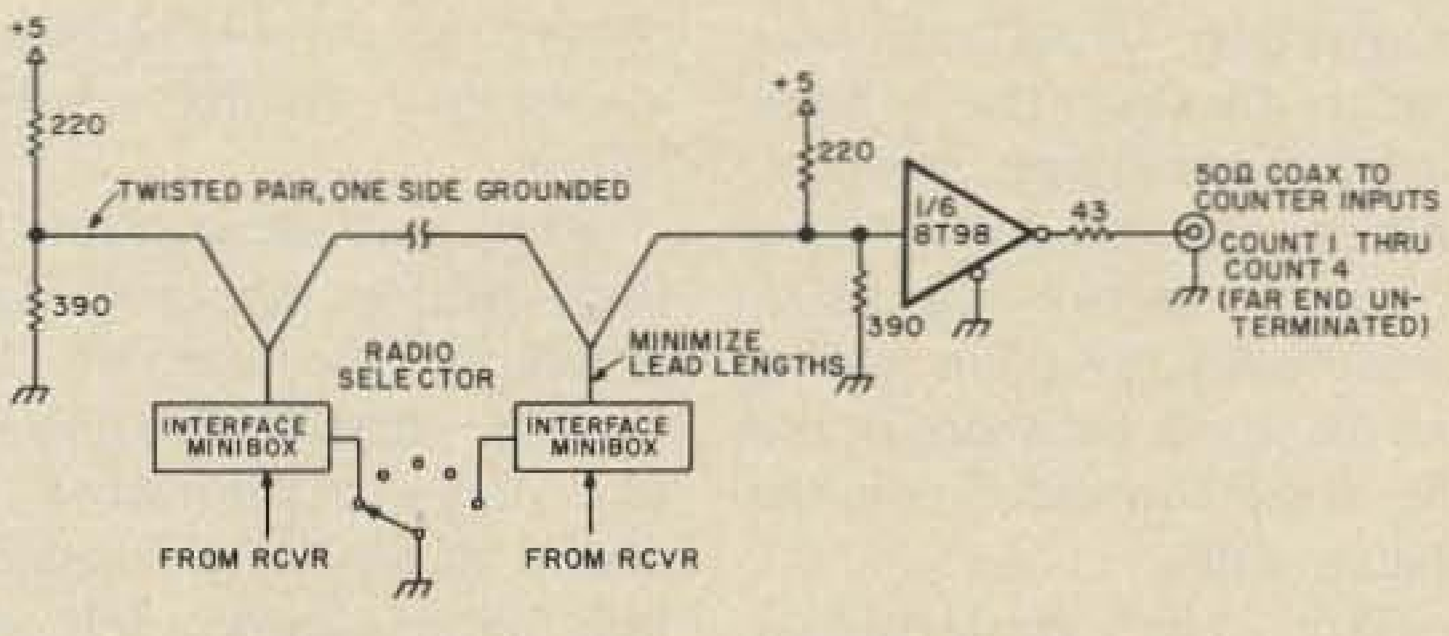


Fig. 3. Interface bus details.

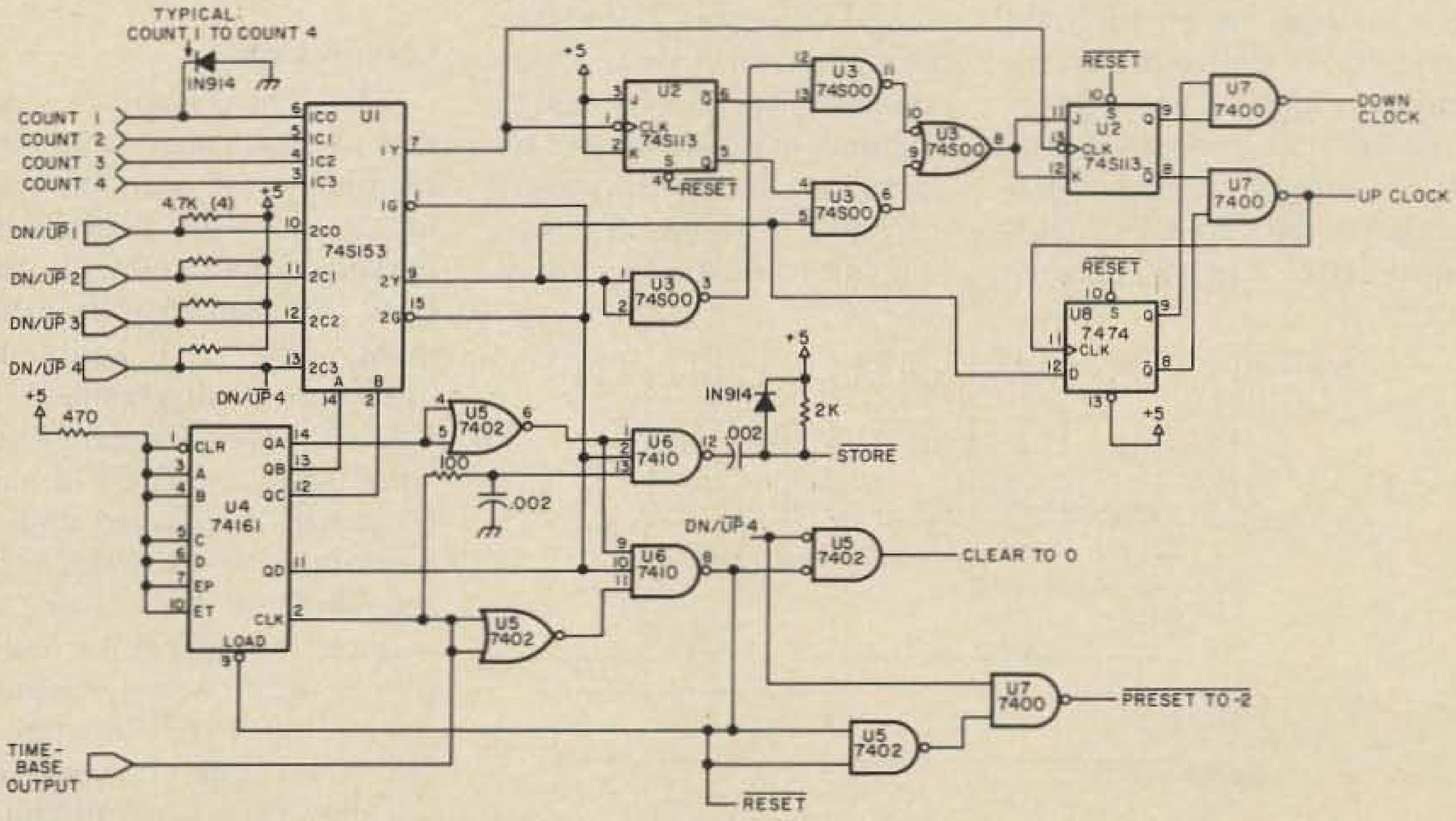


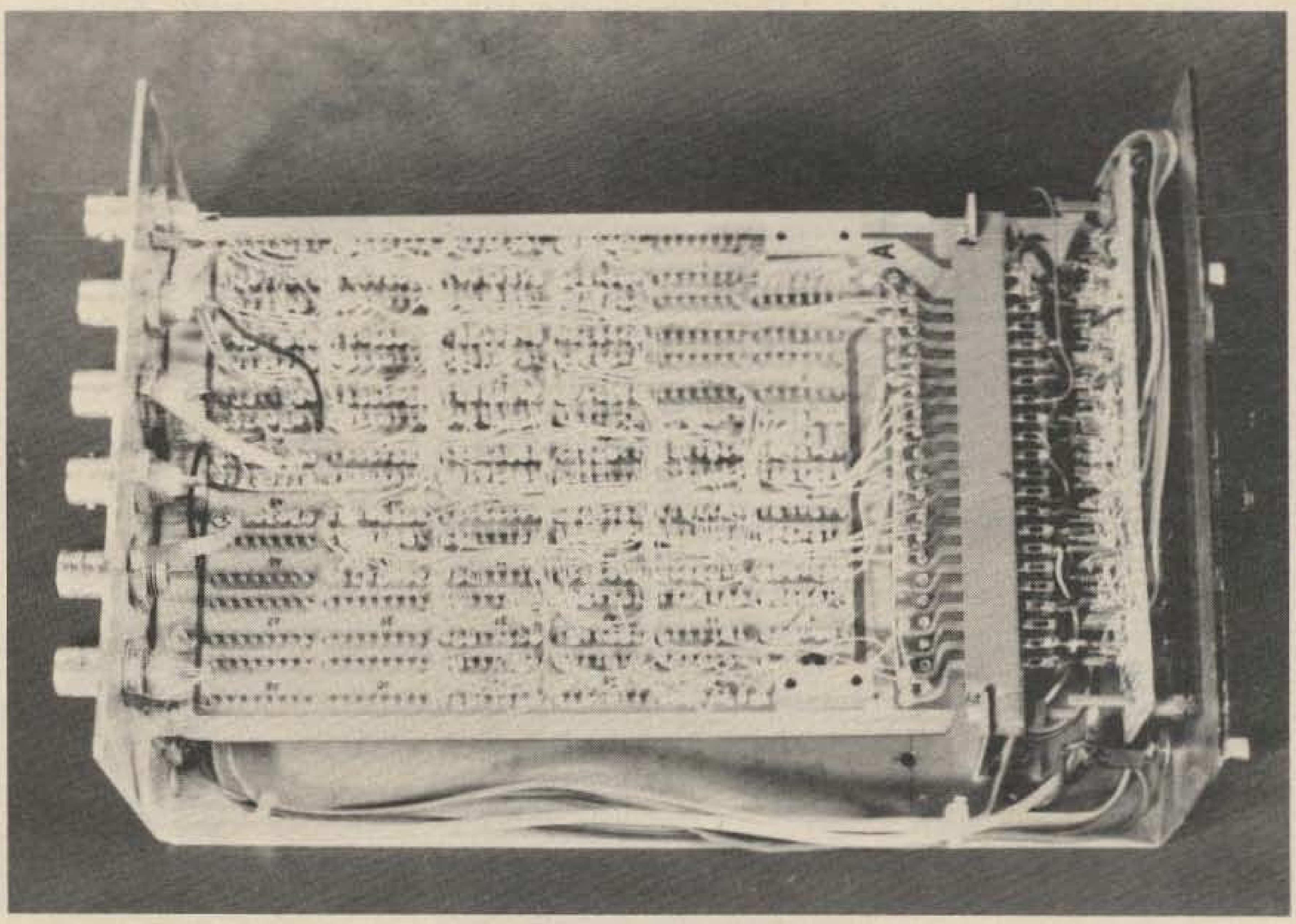
Fig. 4. Counter front end and control circuitry.

scaling every oscillator, you can use it with VHF and UHF converters. A frequency multiplying transmitter can be read out by connecting its vfo to 1, 2, 3 or 4 counter inputs, depending upon the band in use. With a voltage to frequency converter and additional control circuitry, you could fashion a digital voltmeter with automatic correction for offset voltage. Once you have the basic system built, I'm sure that additional uses will suggest themselves.

Counter Front End

The counter front end circuitry is shown in Fig. 4. IC1 is a dual 4:1 multiplexer. Its purpose is to scan the four COUNTi and the associated DN/UPi inputs, connecting each pair in ascending numerical order to the circuitry which follows. Short lead lengths and power distribution techniques are moderately important here due to the sharp rise and fall times of the signals involved. In particular, mount IC1 near a board edge so that short, direct point to point wiring can be used between it and the coax connectors on the chassis walls.

The top multiplexer output clocks a 2 stage up-down counting prescaler implemented with Schottky ICs for high speed. Its count direction is controlled by the bottom multiplexer output. The flip flop and NAND gates at the prescaler's output generate the separate UP CLOCK and DN CLOCK signals required by the 74192 decade up-down counters which follow.



This photo shows the methods used to mount the main logic and display boards. Note the direct wiring from 4 of the coax jacks to the multiplexer IC's inputs.

Note that the control flip flop (IC8A) changes state synchronously with the UP CLOCK output. This ensures error free operation when the count direction is changed, but requires some additional precautions in the unit's design and application. With this technique, the last up count that occurs should have been a down count. Unless corrected, the display will be 2 counts high. We correct the count in advance by starting it from -2 instead of 0 if there is going to be a down count. The unit assumes that if there is going to be a down count, then the fourth pair of counter inputs (labelled COUNT4 and DN/$\overline{\text{UP}}$4) will be set for a down count. It can only correct for a single change of count direction so ensure that all of your oscillators which require up counts are connected to lower numbered inputs than those requiring down counts.

Control Logic

The control logic provides the signals which cause the multiplexer to scan the four inputs, store the final count, initialize the counters, and start the frequency measurement cycle over again. Its operation is diagrammed in Fig. 5. The frequency of TIMEBASE OUTPUT should be at half the desired display resolution. It is divided by the 74161 (a 4 bit binary up counter) to control the multiplexer IC's "select" inputs. Qd of the 74161 is used as the count gate. It works by enabling (low) or disabling the multiplexer IC. The timing diagram shows that the frequency measurement cycle begins when a positive edge of TIMEBASE OUTPUT increments the 74161 to the all zero state. Subsequently, each count input and down-up control input is connected to the prescaler for precisely two periods of TIMEBASE OUTPUT. Qd then goes high, inhibiting further counts. This transition is followed by the $\overline{\text{STORE}}$ and $\overline{\text{RESET}}$ pulses.

$\overline{\text{STORE}}$ loads the received frequency count into the recirculating shift register memories that are part of the multiplexed display drive system and synchronizes them with the digit strobe circuitry.

$\overline{\text{RESET}}$ initializes the prescaler flip flops and sets up the 74161 for the next frequency measurement cycle. For reasons discussed previously, this signal is steered to $\overline{\text{CLEAR TO 0}}$ or $\overline{\text{PRESET TO -2}}$ depending on the state of DN/$\overline{\text{UP}}$4 to initialize the main up-down counter.

Don't omit the RC network at the input of the 7410. It's needed to eliminate

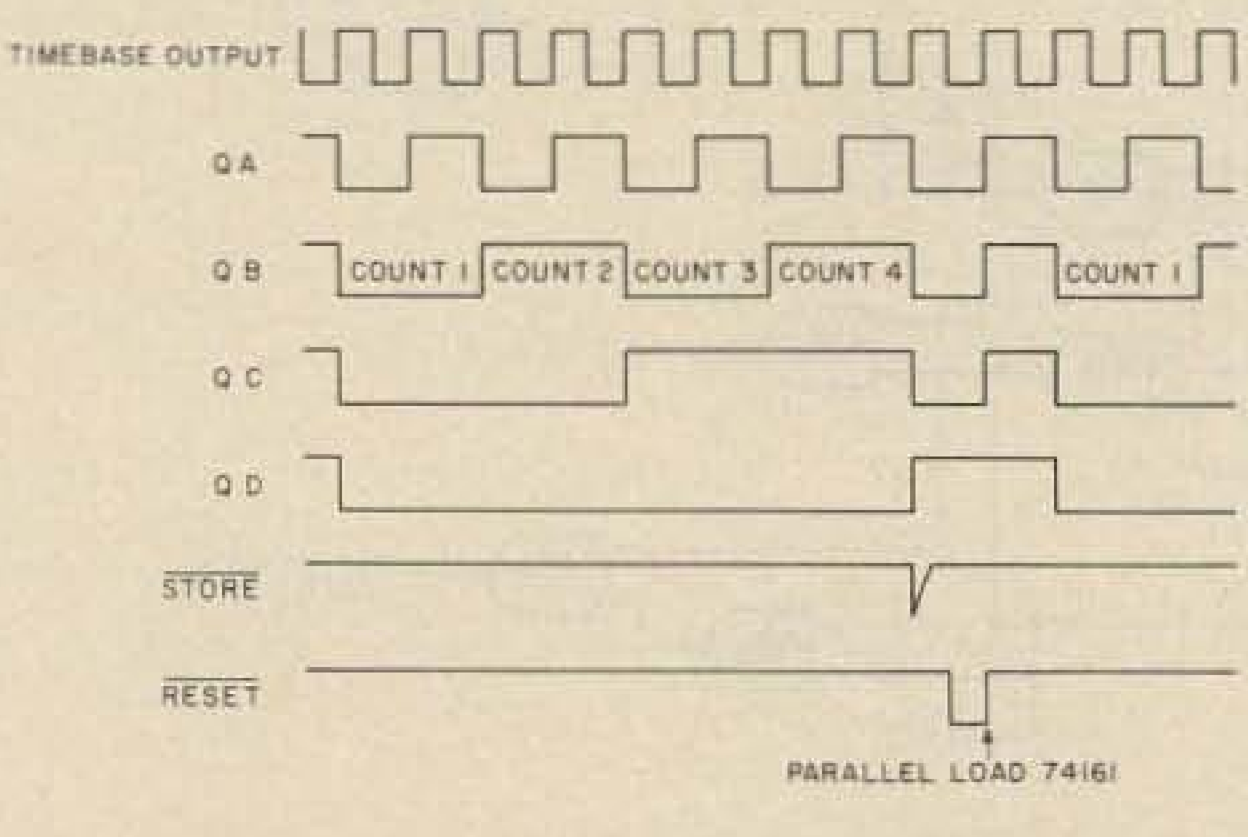


Fig. 5. Control logic timing diagram.

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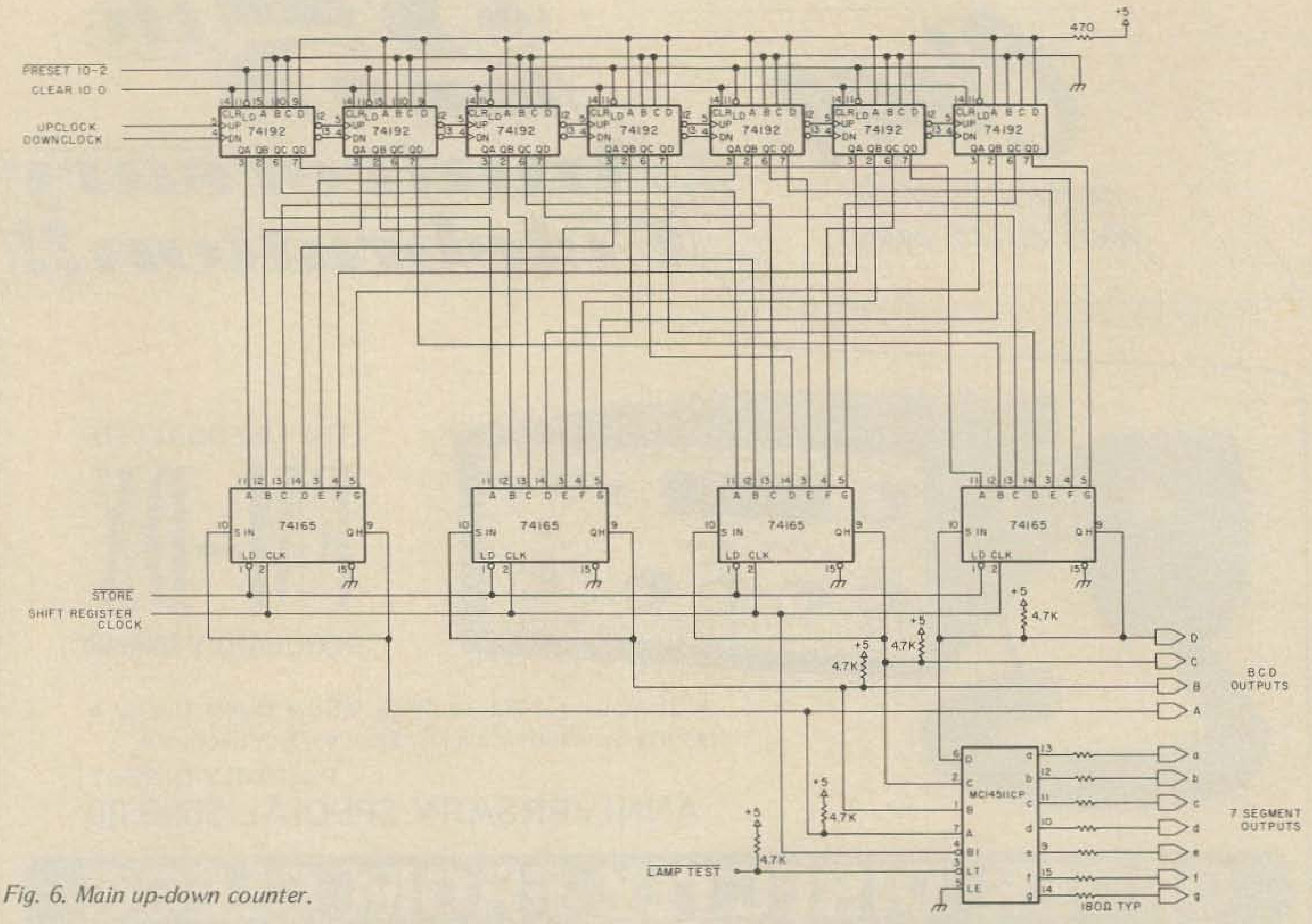


Fig. 6. Main up-down counter.

a glitch and adds to the delay provided for the last count to propagate to the final counter stage.

Main Counter

Seven (or as many as you want) 74192 dual clock up-down counters are used as shown in Fig. 6. Note that the clear function requires a positive pulse while preset needs a low going pulse. The data inputs of the counters are connected to represent 9999998 or -2 in BCD code. Their outputs are wired to the parallel load inputs of four 74165 8 bit shift registers.

Multiplexed Display Drive

Several advantages result from using a multiplexed display. These include minimum parts count, lower cost, fewer interconnects and lower power dissipation. With this technique it is often a simple matter to mount the display remotely in a window originally intended for a receiver's slide rule dial. The actual displays are easily wired up. Just connect like segments in parallel and run individual digit strobes to the common cathode or common anode of each digit. Radio Shack sells a universal multiplexed display PC board for this purpose which appears to be ideal for use with any of the larger LED digits.

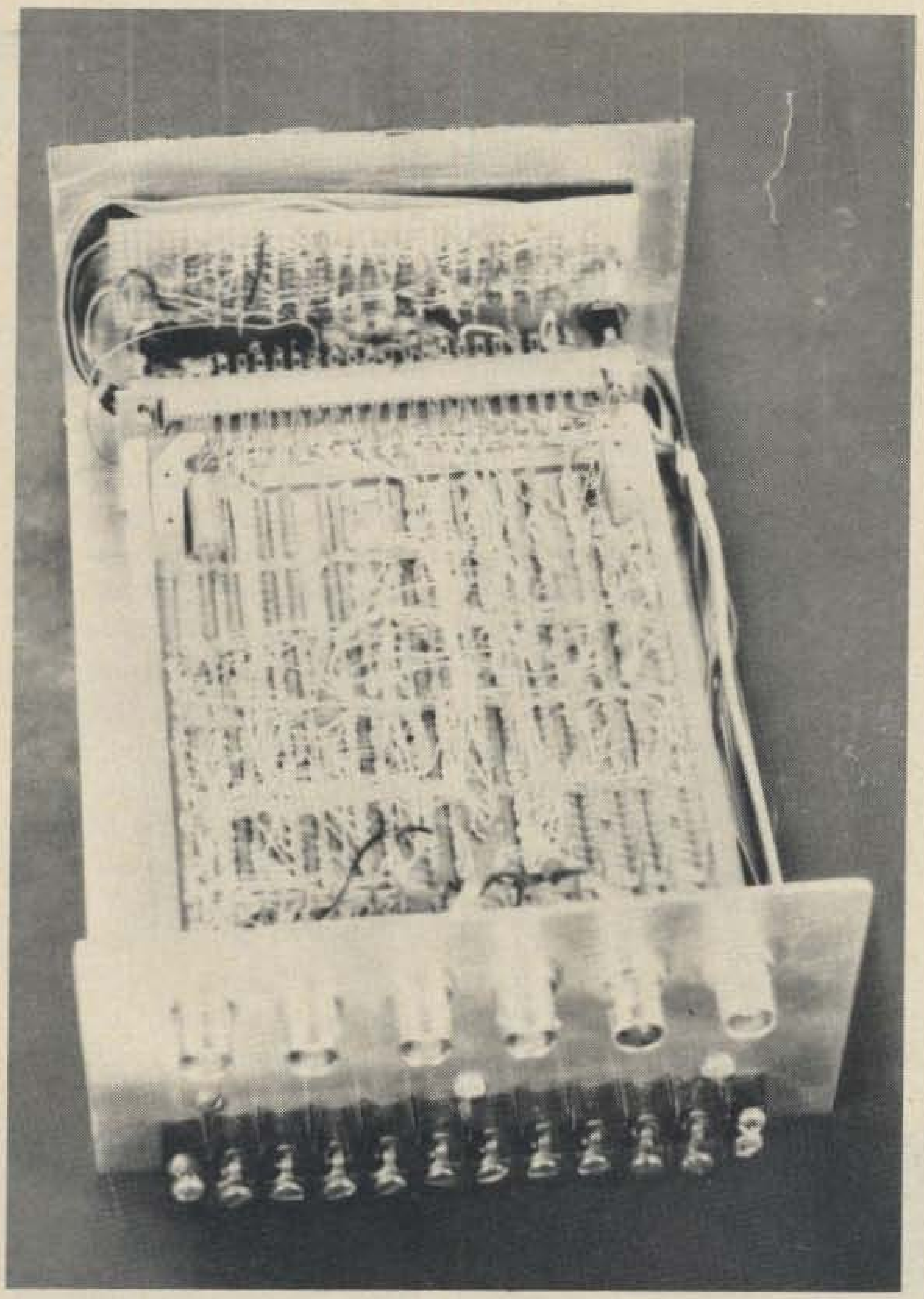
Using 8 bit shift registers for the display memory, rather than separate latches for each digit, helps keep the DIP count down. Data indicative of a received frequency is loaded into the registers shown in Fig. 6 by the STORE pulse at a 5 or .5 Hz rate depending on the resolution. Subsequently, each SHIFT REGISTER CLOCK pulse moves the data one place (actually one digit) to the right. The four bits for each digit appear in sequence, most significant digit first, at the inputs of the seven segment decoder driver IC and are recirculated by means of the serial inputs to the shift registers.

The digit strobes are generated in a fifth shift register, shown in Fig. 7. This IC contains a single "1" which is shifted down its length in synchronism with the received frequency data in the other shift registers. Simple buffers enable the "1" to turn on the LED digit corresponding to the data currently at the inputs of the 7 segment decoder/driver. High beta emitter followers with a pull-up resistor to +5 V at each shift register output will allow strobing of common anode displays. The buffer circuitry in Fig. 6 is for common cathode displays and features the use of an integrated digit driver. I'd better point out that for common anode displays you should change the 7 segment decoder to a 7446.

Interdigit blanking is incorporated by connecting SHIFT REGISTER CLOCK to the active low blanking input of the 7 segment decoder. This eliminates ghosting effects seen in multiplexed displays when one digit is not given sufficient time to turn off before the next digit is turned on. SHIFT REGISTER CLOCK can be as high as 10 or 20 kHz if necessary or convenient so display flicker needn't be a problem. Use a signal from the timebase divider chain that has a high duty cycle (a Qd of a 7490) for minimum loss in brightness due to the interdigit blanking.

Timebase

To operate the received frequency counter, we need a switch selected 5 or 50 Hz TIMEBASE OUTPUT signal



The rear panel connections are visible here. The coax jacks are for a direct input to a VHF prescaler, the 4 COUNTi inputs, and the 5 MHz frequency standard. The barrier strip is for power, count direction control, and outputs from the input selector switch.

as well as a SHIFT REGISTER CLOCK. To make the counter's resolution meaningful, these must be derived from a crystal oscillator of more than ordinary stability and accuracy. I chose a crystal oscillator frequency of 5 MHz for easy comparison to WWV. A cascade of 6 7490 decade counters yielded all of the required frequencies.

My timebase circuitry is shown in Fig. 8. The oscillator circuit is from an article by Kelley[1]. He described a circuit which employs a 4 MHz crystal and also provides all of the output frequencies we need here. A significant advantage of his circuit is that he made a circuit board available for it.

How important is timebase accuracy? It doesn't take much more than .3 ppm error at 30 MHz to cause a 10 Hz received frequency error. To obtain such accuracy you must adjust the oscillator to zero beat with WWV using a visual indication of zero beat, such as a Lissajous figure on an oscilloscope, or your receiver's S meter. The oscillator should be aged by at least a week's continuous operation with several hot-cold temperature cycles, then carefully temperature compensated. See Kelley's article for a good description of these procedures.

Power Supply

Thanks to three terminal voltage regulators, power supply design holds no mystery. The only problem is finding suitable components at reasonable cost. I spent less than $12 on the major power supply components at a local Radio Shack store. The received frequency counter requires 5 volts at at most 1.5 Amps. The transformer shown in Fig. 9 can supply twice that load. The second filter capacitor and regulator provide margin for powering the interface components and other equipment.

Construction

The major construction problem is how to interconnect all of the ICs. As discussed earlier, display and timebase PC boards are available. 21 other DIPs remain, plus whatever interface components you use. It's not too great a chore to use wire wrap or a similar technique using solder strippable enamelled wire for these interconnects. Indeed, if you're at all serious about experimenting with digital ICs, you shouldn't consider any other approaches. Economical alternatives to Gardner-Denver tools are available from Godbout Electronics. You can even make your own.[2] With wire wrap, you'll get your projects off the ground faster, be free to make changes at any time, and have an easier time debugging and troubleshooting because the ICs will be in sockets.

I make my own wire wrap boards by pushing the IC socket leads through holes in "P" pattern vectorboard. It's not necessary to solder them in place; the wrapped wires

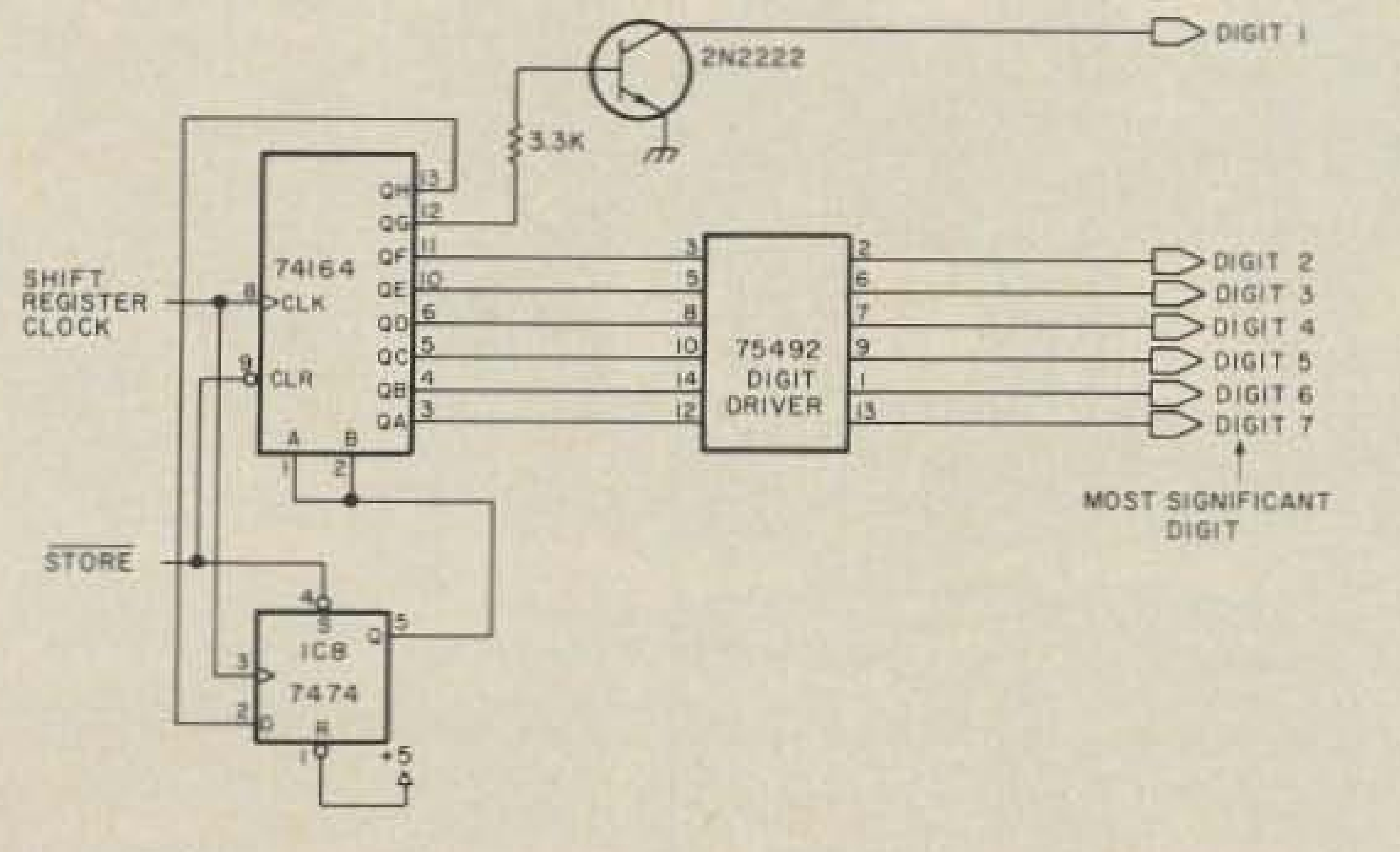


Fig. 7. Digit strobe circuitry for common cathode displays. Modification for common anode displays is discussed in text.

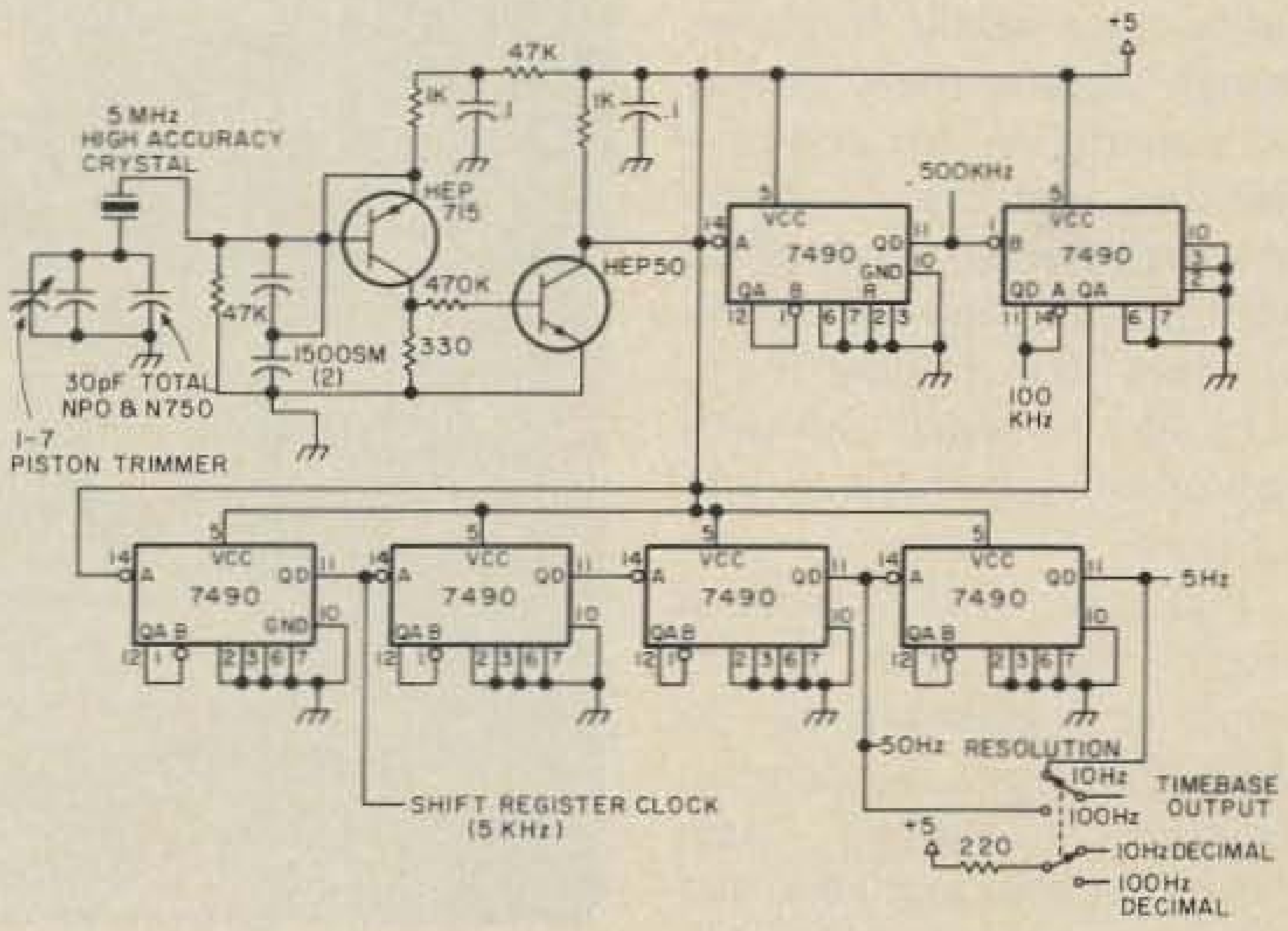


Fig. 8. Timebase schematic.

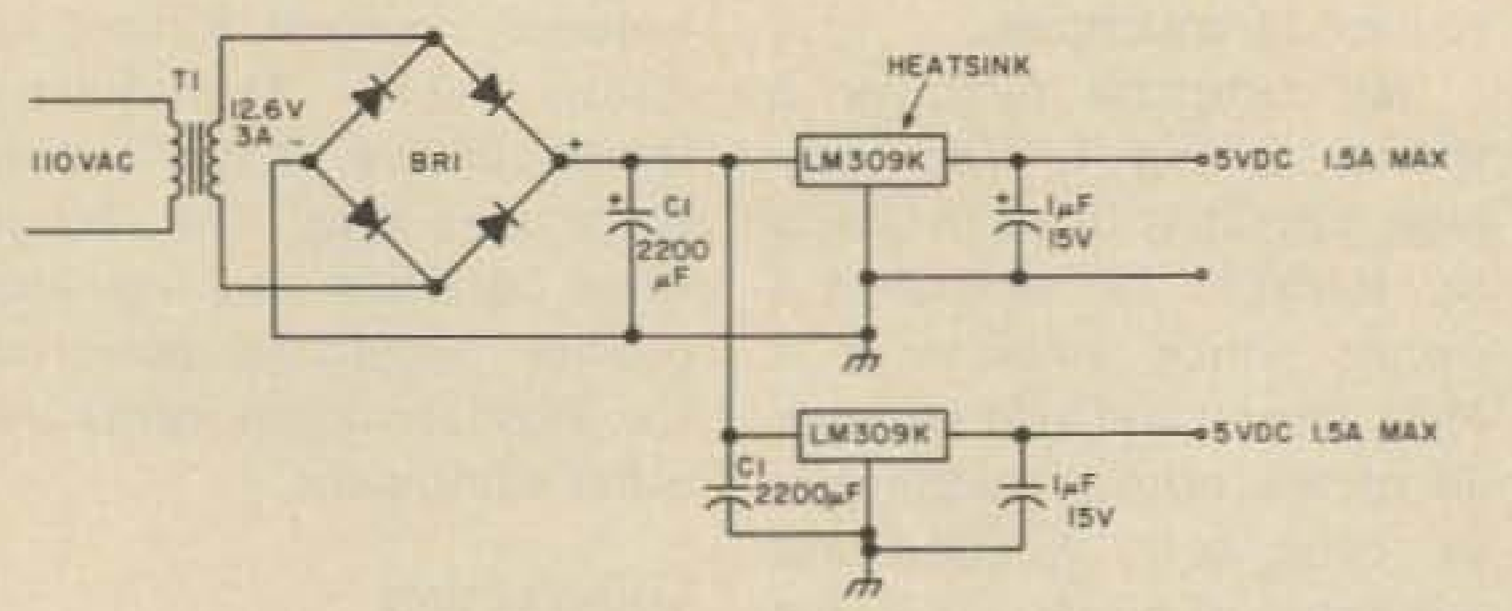


Fig. 9. Power supply. T1 — Radio Shack #273-1511; BR1 — Radio Shack #276-1146; C1 — Radio Shack #272-1020; heat sink — Radio Shack #276-1361.

will be sufficient to hold them in place. The leads of discrete components can also be pushed through the holes and wrapped to or soldered to other component or socket leads. Bus strips for power distribution can be fashioned from lengths of 3/8 inch wide, 1/16 inch thick double-sided copperclad board. These will just fit on edge between push-in terminals placed in alternate rows of holes in the board's grid at convenient tap-off points. The photograph shows the technique applied to a 8K x 8 bit dynamic RAM board. Hopefully, it will give you an appreciation for some of the details I've glossed over.

A word to neophyte wire wrappers: Limit yourself to 2 wraps per pin. Connect top wraps only to top wraps and bottom wraps only to bottom wraps so that entire chains don't have to be unwrapped in order to move a single wire. Keep your leads short and laid out neatly, but leave enough slack in them so that you can tug on one end of a wire and find the other end by noticing what moves when you tug. Avoiding mistakes is far easier than finding them, so be sure to pencil over each wire on the schematic as you put it in.

Packaging of the resulting circuit boards can be as simple or as elaborate as you choose. The woodgrain finished aluminum cases which became available too late for me to use seem ideal for this purpose. In my unit, separate display and counter boards are mounted at right angles to each other on adjoining chassis walls. The U-shaped chassis was bent up from a piece of scrap aluminum and a cover fashioned from a salvaged chassis bottom plate complete with ventilation slots. A can of blue spray paint and a silver on black escutcheon for the front panel added character to this most economical enclosure.

Checkout and Debugging

When you've got all the DIP sockets wired up, it's time to plug in the ICs, turn on the power and cross your fingers. Check each DIP with your fingertips. If one is painfully hot, it's probably defective. If it's more than ordinarily warm, it may have an output shorted to 5 V, ground, or another output. Don't jump to false conclusions here because counter and shift register chips run warmer than less complicated ICs.

After passing this "smoke test," it's advisable to check the power and ground bus noise levels. Greater than 200 mV p-p switching spikes or erratic operation that can't otherwise be explained may indicate a need for more power supply decoupling capacitors. You should use at least a 47 uF tantalum bypass where the power leads attach to the board and additional .1 uF disc ceramics for every 4 or 5 ICs. This will suffice for a low ac impedance power distribution technique such as that described earlier. Less ideal methods may require a .02 uF capacitor at each IC's power pins (except for the 7490s, the standard corner pins) for reliable operation.

Next, hook up and examine the display. With no COUNT inputs, you should be able to change the reading from 9999998 to 0000000 by grounding DN/UP4. Put in a signal of known frequency from the timebase divider chain and you should get a display that is correct to the last digit. Repeat this step with different frequencies and you can check out all of the main counter and display

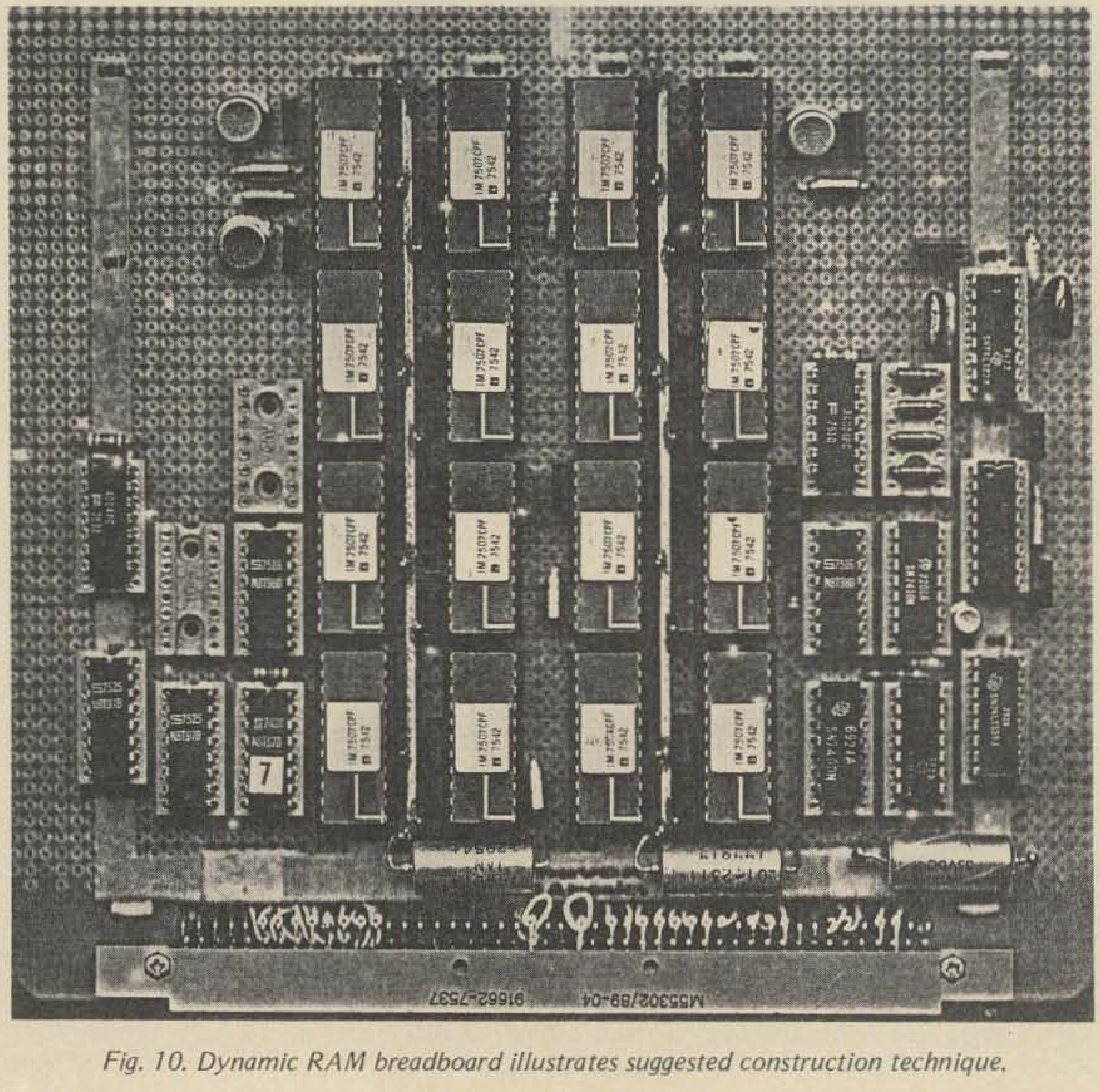


Fig. 10. Dynamic RAM breadboard illustrates suggested construction technique.

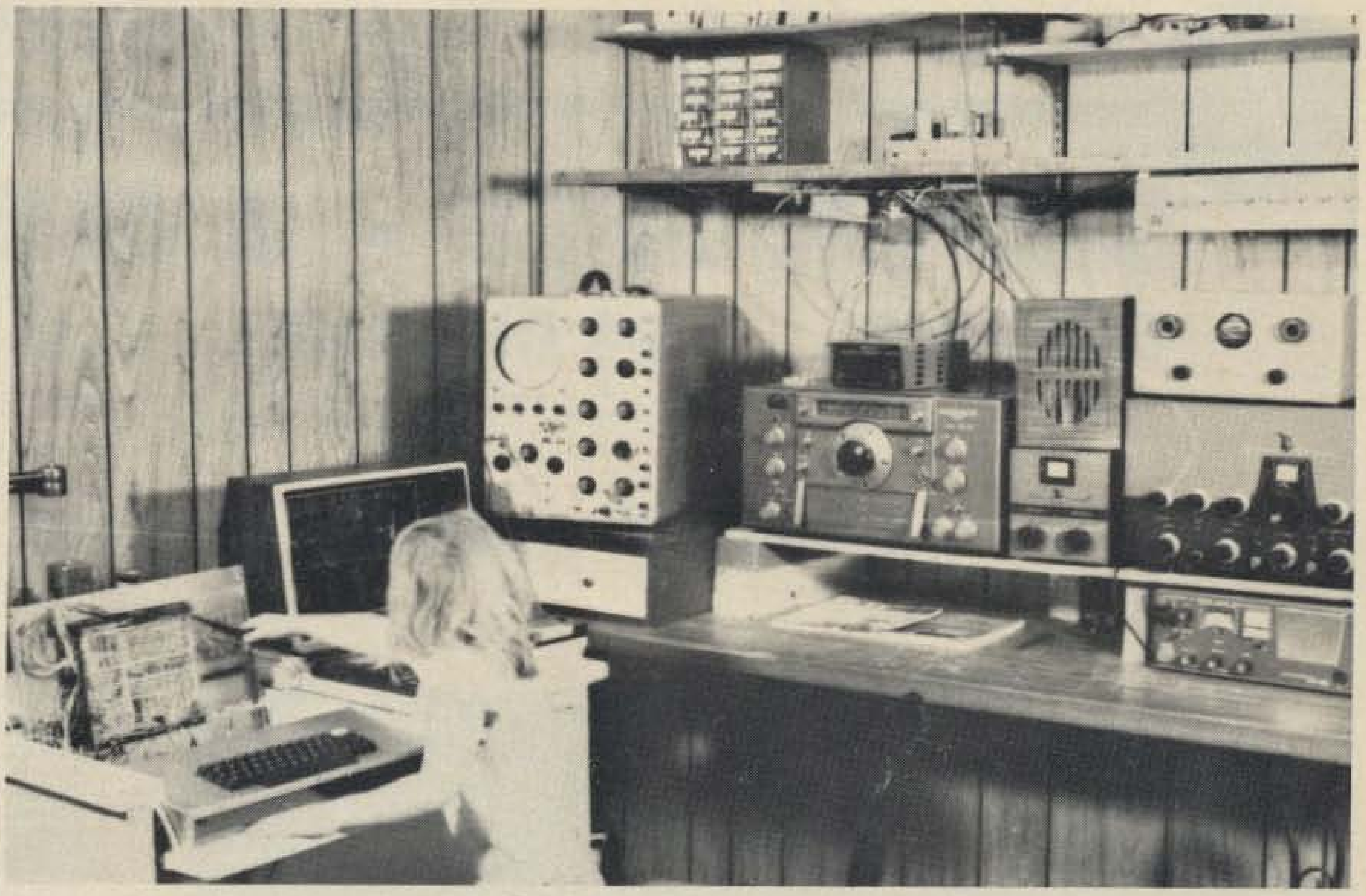
circuitry. Exercise each of the COUNT and DN/UP inputs and verify their proper operation. This will complete the checkout phase.

You can expect a problem or two during checkout. If one arises, try to isolate it to a functional circuit area. Check your wiring there and replace or swap any suspect ICs.

The control logic can be proved out by verifying its timing diagram given in Fig. 5. If you don't have a scope, substitute a debounced switch for the timebase output signal and measure the appropriate logic levels with a VOM or logic probe after each alternation of the switch. Measure $\overline{\text{STORE}}$ to the left of its coupling capacitor (Cl in Fig. 4) so as not to be misled by its narrow width.

Most problems in the counter chain can be located by signal tracing. With a high enough input signal frequency, simply look for logic level transitions at the counter's Q outputs and at the interconnections between counter stages.

Many display defects can be diagnosed from their visible symptoms. A digit driver stuck "off" will blank its digit. One stuck "on" will cause its segments to glow with perhaps unequal brightness. Wiring errors between the segment driver and the segments or between the shift registers and the 7 segment decoder/driver will cause some numbers to be displayed incorrectly.



View of the station with a junior operator helping debug my microprocessor/TV display system. The .19" MAN 4 display LEDs on the received frequency counter are too small to be seen from this distance.

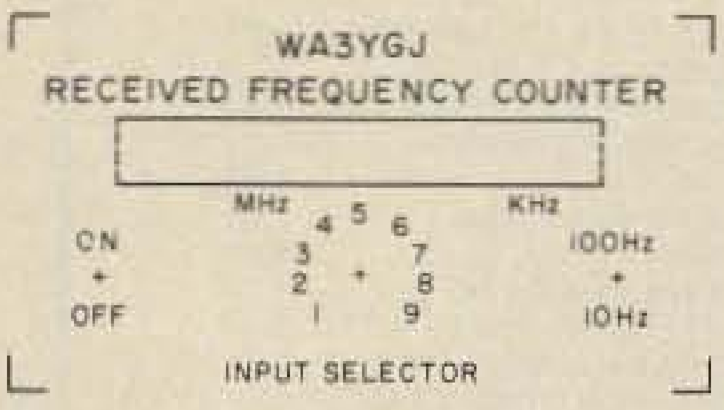


Fig. 11. Front panel screening artwork.

Conclusion

One must own and use a digital frequency readout in order to fully appreciate its value, so I won't expound on the subject. The received frequency counter is more complicated than a conventional frequency counter, but its added complexity adds more to its versatility than to its cost. It's not the simplest digital frequency readout available, but it's the only universal one I know of. To me, these points make it the obvious choice for construction by a radio amateur and I hope you agree.

All of the required ICs, with the possible exception of the Motorola MC14511CP and the Signetics N8T98B, can be purchased from *73 Magazine* advertisers. These two are readily available from their manufacturers' franchised distributors. In any case, I'm confident of being able to locate a parts source, so drop me a line if you have any problems.

I'd like to hear your comments on this article. If sufficient interest exists, a printed circuit board can be made available. ■

References

[1] A. A. Kelley K4EEU, "Universal Frequency Standard," *Ham Radio*, February 1974, p. 40.

[2] D. L. Holmes, "Wrapping and Unwrapping Tools Are Easily Made from Tubing," *Electronic Design* Nov. 8, 1975, p. 104.

The 7400 gate is the workhorse oscillator IC. There appear to be more circuits using this one IC than any other. It would seem the logical one to begin with.

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How Do You Use ICs?

-- part II

Its full name is quadruple two input NAND gate. As many of the ads will just list it as 7400 gate, let's leave it at that. You may also see it as SN7400N or something similar. The basic thing to look for is the number 7400.

This identifies it as the 7400 series of logic. This is the transistor transistor logic (TTL or T^2L) family you want to start working with. There are other devices in the 7400 family; it just happens that the first one, the 7400, is the particular one we want.

The name tells a few things about it. First it is a gate. A computer will make much of that, but for our use it's just an identifying name. There are four of them in the package. These are identical units. This is helpful. Helps account for all those pins.

It is a NAND gate. This is a specific digital logic function for a computer. At the moment it does nothing for us, so ignore it.

Its use as an oscillator was chosen to familiarize the experimenter with the 7400. In a frequency counter the device would also be used to perform various switching or signal routing functions. The device is also adapted for mixing, product detecting, and small signal amplification.

The oscillator circuits are more complex than many of these other uses, and easier to isolate and explain. Once the makeup of the device is learned, other uses and circuits with them should be no problem for you.

The first two questions are: Where does the voltage go and what are the other pin connections? Table 1 shows the various pin connections.

Voltage is simple. Pin 14 is the Vcc pin and gets the five volts regulated. Pin 7 is the ground connection. This stays the same for all circuits using the 7400 gate.

Each of the sections has an output pin. The output is between that and ground. The input, naturally, is between the input pins and ground. Here we have a slight problem, and embarrassment of riches, so to speak.

There are two input pins to each section. This is not just an oversight by the manufacturer. They are supposed to be there, but it can be a problem in some circuits.

The oscillator circuits seem to be quite tolerant in many respects. One of the simplest is shown in Fig. 1[1]. This type of oscillator uses two gate sections.

As all of the sections are identical, it makes no difference which two are used; however, physical layout may suggest using two on the same side of the IC package.

In this oscillator circuit, both input pins of each section are tied together. Usually one of the extra sections of the IC is used as a buffer for the oscillator as shown. Here too the extra input is tied to the other.

Fig. 2[2] shows a similar circuit. In this one the extra input is left floating. Notice that the crystal and the feedback capacitor have changed position in the circuit. A trimmer capacitor

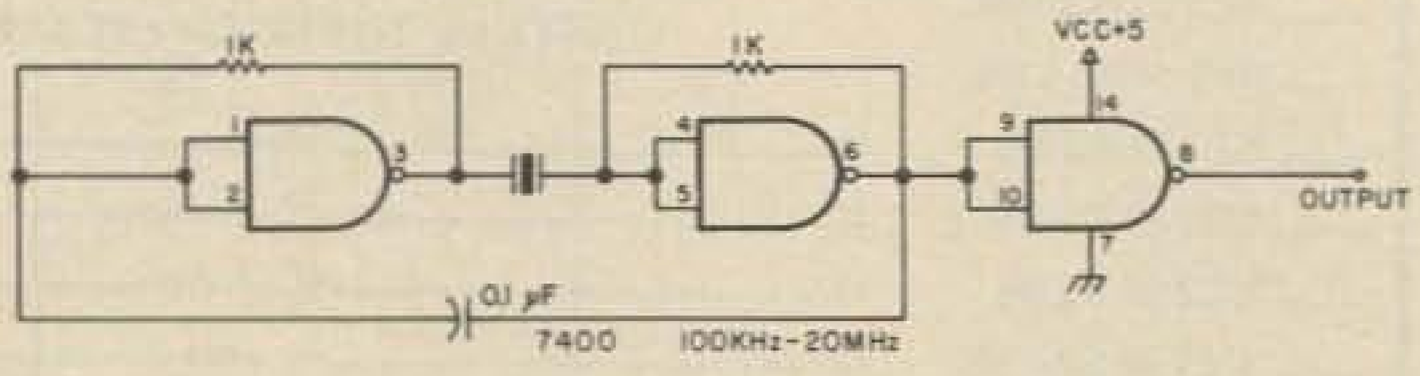

Fig. 1.

has been added to alter the crystal frequency. Notice also that the values of the two resistors are different.

There are a number of circuits which are quite similar to these two. From inspection it would appear that the circuit will operate over quite a wide frequency range. A trimmer capacitor may be added to change the crystal frequency, and the value of R1 and R2 is not too critical; values between 220 Ohms and 2.2k Ohms were common.

The original plan was to compare the performance of the various circuits and gather more definitive data about the operation and tolerances of the circuits.

Unfortunately, I quickly learned something, which none of the articles mention, that has a direct bearing in experimenting with IC oscillators.

WARNING: Testing IC oscillators can be extremely hazardous to your health! In all of the bench testing of experimental oscillator or other circuits I have done, I have never found any that caused as much or as severe TVI as IC oscillators.

Just the one little circuit powered by a transistor radio battery was enough to obliterate Walter Cronkite. It completely took out almost all stations, both sound and picture.

This meant that there was to be very little actual testing, and that confined to the more obscure hours. However, some data was obtained.

To understand why there was so much TVI, it is necessary to go a little bit

1. Gate One Input A
2. Gate One Input B
3. Gate One Output
4. Gate Two Input A
5. Gate Two Input B
6. Gate Two Output
7. Ground
8. Gate Three Output
9. Gate Three Input A
10. Gate Three Input B
11. Gate Four Output
12. Gate Four Input A
13. Gate Four Input B
14. Vcc +5 Volts (Regulated)

Table 1. 7400 pin connections (counted from top of device).

into the theory of what the circuit is doing. Normally when you build an oscillator, you are trying for a sine wave output as free from harmonics as possible.

The IC oscillator is not actually an oscillator at all. The nearest thing to it in tubes would be the multivibrator circuit. It is not actually oscillating, but switching at a rate determined by the crystal. The digital ICs were built for switching purposes, and this is an adaptation of their ability to switch at high speed.

The output is a form of square wave. It may not even be a pure square wave at that. What this means is that it is very rich in harmonic content. Also, the harmonic content is at about the same level as the fundamental.

The 7400 is supposed to be guaranteed to 20 MHz and the harmonics go even higher. The lower the initial frequency, for example, 100 kHz, the worse the TVI. There are so many subharmonics.

Using a higher frequency crystal helps slightly, but there was still awful trouble with a 3 MHz crystal. As far as a TV set goes, the interference is the worst on the lower channels and seems to drop off slightly with the higher channels.

Another fun thing about ICs is that they love to oscillate all by their lonelies. Take out the crystal and the circuit still oscillates and still generates TVI.

It was not possible to determine the frequency at which this was going on, as the oscilloscope wouldn't show it. This too is something of a problem. The 100 kHz oscillator used did not show the correct pattern on the scope. It appeared that there were so many subharmonics present that the trace could not be stopped to show just the fundamental.

This IC horror story has a slightly happy ending. In actual use there may not be too much trouble with them. The basic factor in the TVI problem occurs in testing. Any meter or scope lead looks like an antenna and the thing takes off.

They also have a tendency toward some form of spurious oscillation along with the desired one. Be generous with the bypassing. The test circuit bypassed both the input and the output of the regulator and, at the same time, the IC Vcc pin.

The IC seems to find the signal it wants in all that mess. The later divider circuits seem to function at the correct frequency. It just looks like testing is going to be trouble. The test leads themselves are going to broadcast the crud.

The problem with the oscilloscope might be solved by using a triggered scope. Then the waveform might hold still for viewing.

When the test circuit was set up inside a shield, the TVI problem disappeared. All well and good, but it may still be a problem when any cable is connected to the output, for example, of a frequency standard. You may still be broadcasting harmonics to more than just your receiver.

This should also be kept in mind for inside the equipment. While the IC seems to respond to the desired frequency, there may be many spurious signals generated that will be floating around inside of the IC equipment.

The square wave is inherently a harmonically rich signal. While the specific IC it connects to may not be affected, a stage designed as an rf amplifier or other linear signal handling stage may respond to this as easily as to the desired signal coming in from the antenna.

Be prepared for TVI problems if you are going to do much testing of circuits before you use them. ICs are such that there should not be too much need to test or experiment. If the circuit is in use in a similar piece of equipment, it should be what you need for your equipment and will probably work as well.

The two circuits shown so far are quite similar in configuration. A somewhat more complex type of circuit is shown in Fig. 3[3].

Instead of the two

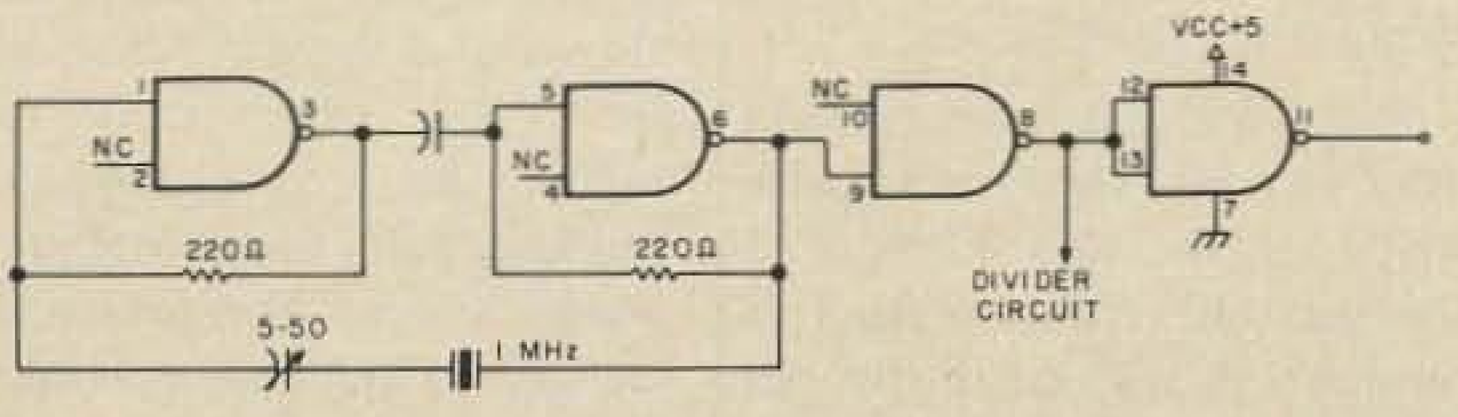

Fig. 2.

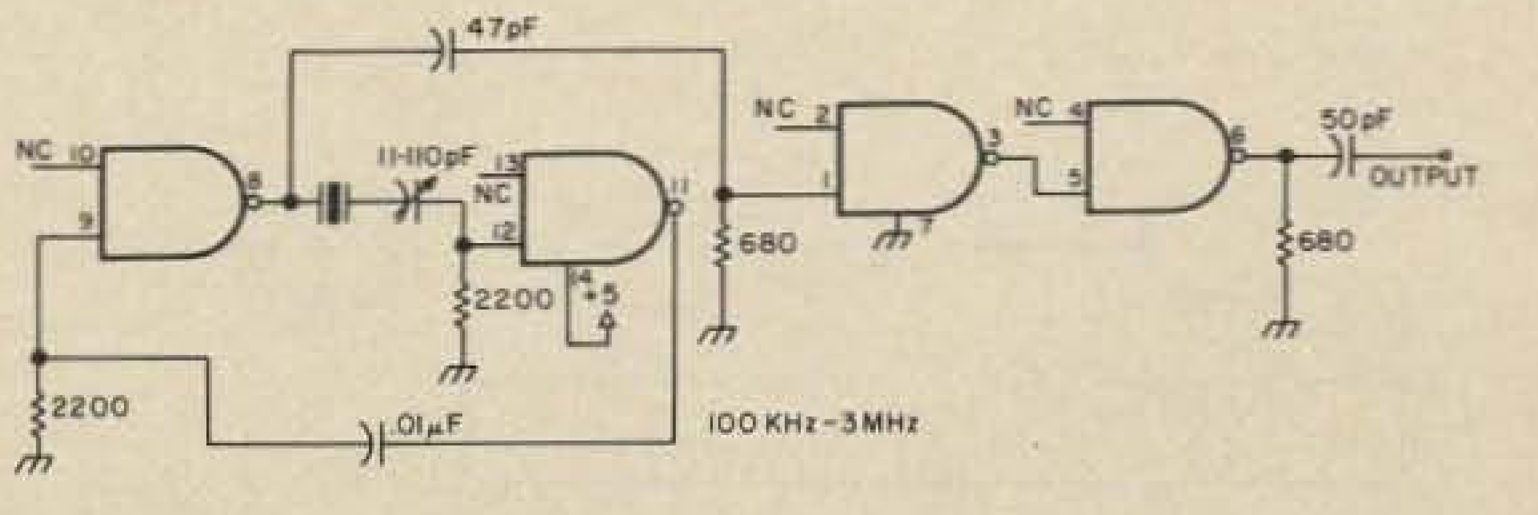

Fig. 3.

resistors being between input and output of the two sections used, the resistances are between gate input and ground.

The oscillator output is capacitor coupled to the two section buffer stage. The buffer input gate has a resistor to ground and the buffer output stage is resistively loaded and capacitor coupled.

This is another wide range circuit with a trimmer capacitor to change the crystal frequency. The only part which seemed to be critical was the 47 pF oscillator coupling capacitor. Other values around it worked, but not something like the .001 or .01 values used in some of the other parts of IC circuits.

Fig. 4[4] shows a circuit similar to Fig. 3. Here the gate outputs are connected to the Vcc pin through equal resistors. Another difference is the direct connection between the input of the first gate and the output of the second. The feedback (?) capacitor in this circuit goes to the Vcc pin. Notice the change in the usual value for this capacitor and the addition of the 150 Ohm resistor between the input and output of the second section.

The tolerance of this capacitor, while not critical, is not as broad as with some other circuits. The oscillator output is directly coupled to the following buffer stage.

While in detail these circuits do have differences in their configuration, an overall view shows that they are more similar than different. They have a number of features that are almost the same for all.

This allows us to generalize a bit about IC oscillator circuits, which will help to simplify them and make them more easily understood by inspection of the schematic.

The most common IC oscillator circuits use two gates for the oscillator section. The remaining gates are often used for buffers.

With the 7400 oscillator, it is common to leave the unnecessary gate input of each section floating. The two gate inputs may also be tied together.

Each gate section of the oscillator has a resistor of equal value. This may be between each gate input and its output pins, between input and ground, or between output and ground.

There is usually some sort of feedback or coupling capacitor of a value of .01 to .1 uF. The output of the oscillator is usually either directly coupled to the buffer stage or is capacitively coupled.

They normally operate over a wide frequency range and most circuits show a trimmer capacitor in series with the crystal for minor adjustments.

There are, of course, variations in the circuits. However, by the time these normal features are noted and looked for, what little remaining that is abnormal will be easily spotted and understood.

By thinking of these circuits as sections of this IC, it will not be long before you can recognize and place any sort of IC oscillator circuit of its type.

One thing to remember is that the circuits use two gate sections. The 7400 is a NAND gate. There are other gates that will also work and other families of ICs which will also work. The circuits will be much the same in configuration and the parts values will be similar.

There are circuits shown that are able to operate with one gate section instead of two. These should not be a problem to understand, as they are as simple as the others.

There was one example, Fig. 5[5], of a circuit that returned several of the unused gate inputs to the Vcc source pin. One gate input was used as a switch to turn the oscillator on and off by connecting or disconnecting to the Vcc source. This does not appear to be common, but it obviously can be done and might fit some requirement you have.

You will also see circuits drawn with the rectangular shape of the unit instead of the section symbols. All this requires is a look at the pin chart to figure out what goes where.

By now you should have little trouble redrawing the circuit in Fig. 6[6] to the sectionalized symbols and seeing how it resembles other circuits.

Which schematic representation is used depends on how the IC fits into the whole equipment. If it is sectionalized so that one gate may be applied to another circuit, it is more common that it be drawn that way and the sections labeled U1A, U1B, etc.

If the IC is completely used by the particular section of the equipment, it may take less schematic space to draw it as a rectangle and just put the pin numbers around the edge. There is no hard and fast rule.

The nice thing to remember is, for the most part, that you can take any of these circuits and simply drop them into the place you want them in your own equipment, with a high degree of certainty that they will work.

This leads to the next logical question: What if it doesn't work? Another nice thing about ICs is that the low voltage level and the general simplicity of the circuit make troubleshooting easier.

If you duplicate a known circuit you should have no trouble, but if you are making parts substitutions you may have to cut and try a bit.

If it doesn't work at all, the first thing to check is the supply voltage and then the wiring. Be sure you read the IC pins correctly and got the components to the right terminal.

If that isn't it, try varying the feedback capacitor value above and below what you are using. The next step would be to change the resistor pair to a higher or lower value. Be sure it is enough of a change to make a difference.

Testing the circuit

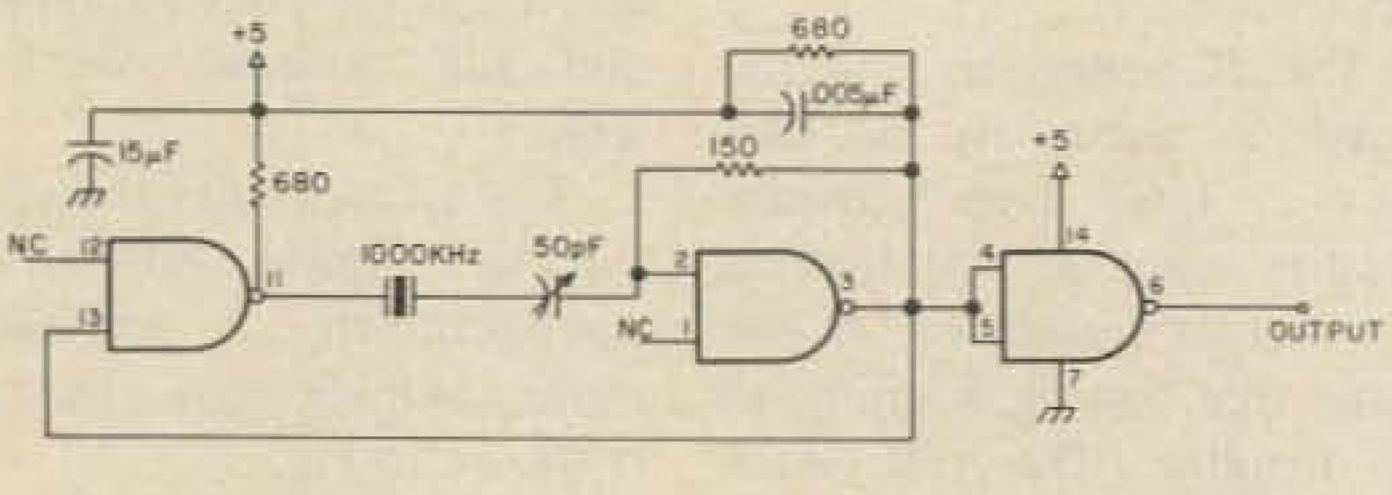

Fig. 4.

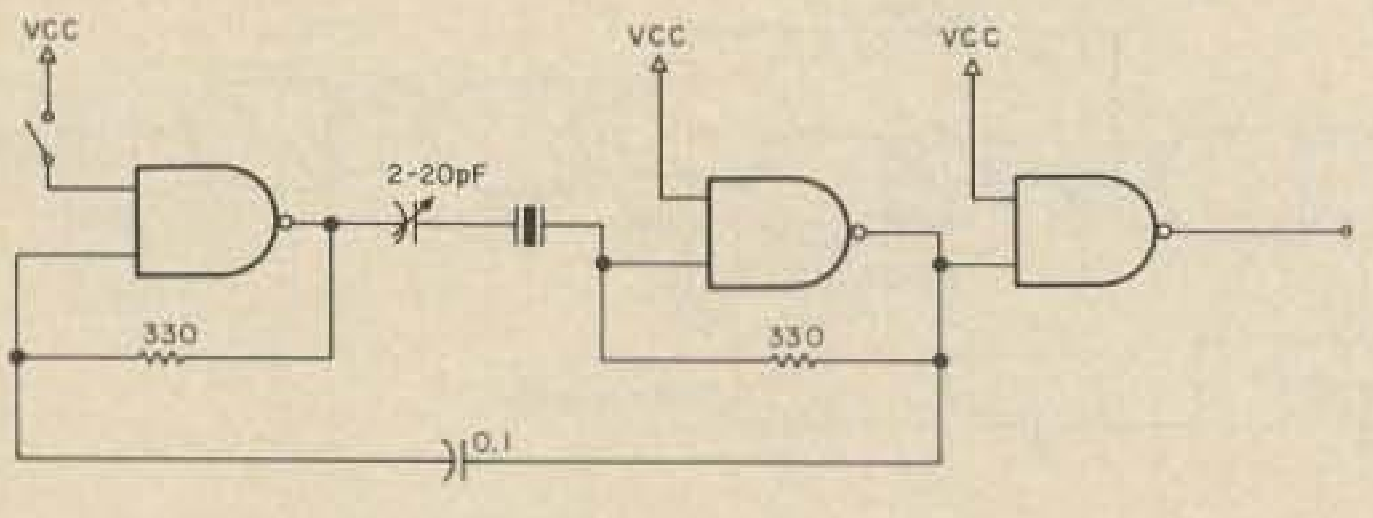

Fig. 5.

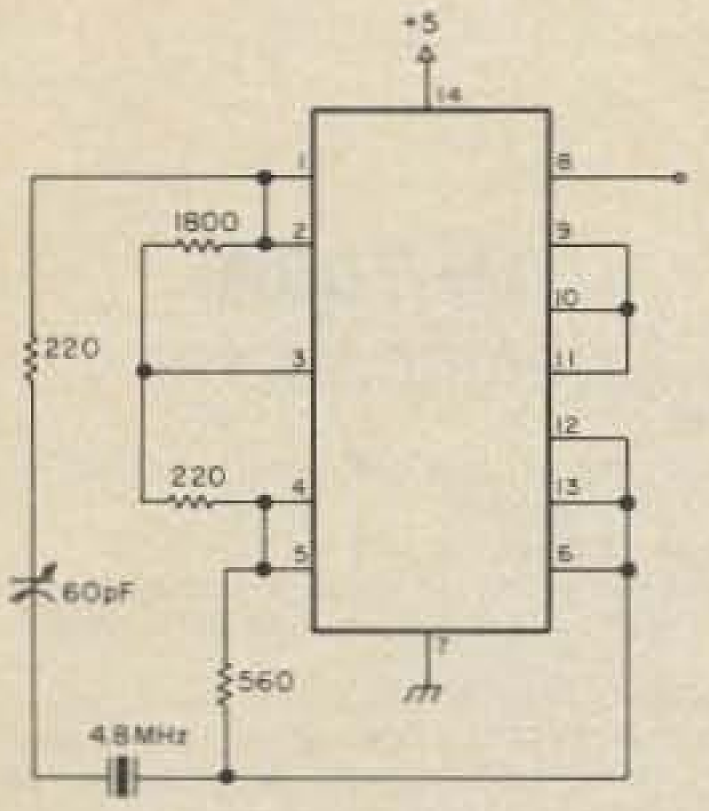

Fig. 6.

outboard is one way to get the bugs out. You might have a defective IC section which is easy to test by substitution before you solder the IC in. Sockets can be very handy.

It might be the crystal. Normally IC use will not damage a crystal, but some crystals are more active than others. Try another crystal in the circuit. The 7400 is designed for 20 MHz or lower so don't expect a high frequency overtone crystal to work well.

While you are breadboarding, it is not that hard to try one of the other circuit configurations. That might just solve the problem.

One of the more easily noticeable problems is a slow starting oscillator. If changing the crystal doesn't make a difference, it is most likely a question of wrong parts values. In this case, the resistances should be varied, although it might be the feedback capacitor.

As TVI is a problem, testing will have to be brief. IC oscillators are not shy about telling you if they work. A triggered scope would be the first choice, but any scope will show if oscillation is taking place, if the frequency is not too much higher than the scope will show.

You should be able to hear it on a monitor receiver, and it probably will show on your TV set. The TV set won't tell you if it is the correct crystal frequency or self-oscillation, though.

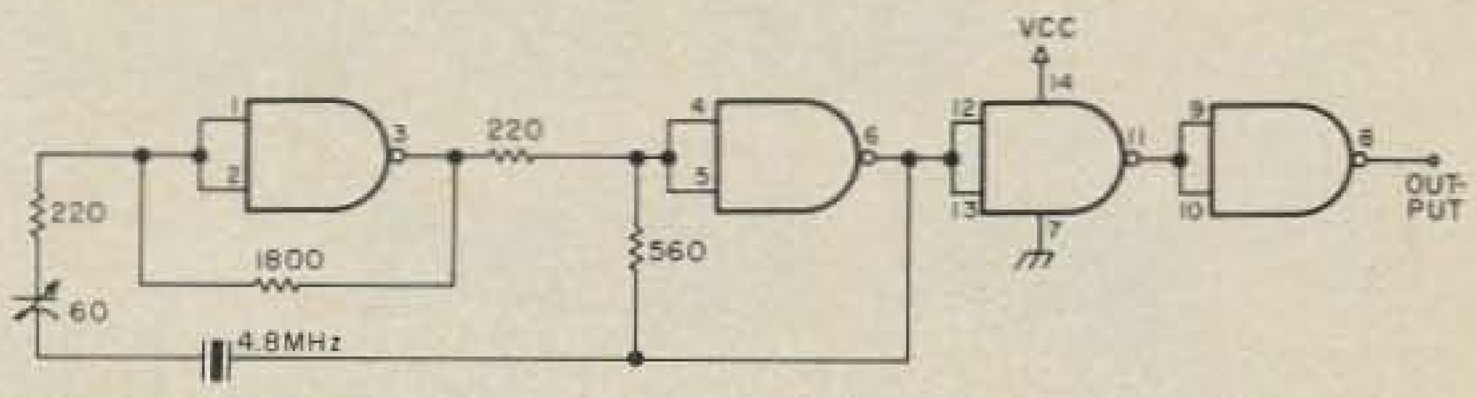

Fig. 7. (Fig. 6 redrawn.)

Most of the IC oscillators are designed for clock, counter or other continuously running circuits. You may have to experiment to find a circuit that works well when keyed fast, such as one used for a CW transmitter. Here the monitor receiver is first choice. If it sounds OK locally, it will probably work in the finished circuit.

With the circuits tried, it was hard to find one that wouldn't work over a wide range of parts values. Individual requirements would suggest some testing to see that all conditions are met by the oscillator before installation.

When the unit is finished, it's a fine time to find out that the oscillator won't key properly or doesn't work at all. ■

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[3] Jan Crystals Catalog #19, 1976.
[4] "How To Become A Troubleshooting Wizard," Carr, Joseph J., K4IPV, *73 Magazine*, January 1976, p. 138.
[5] "Gated Oscillator," Schmieskors, Doug WB9KEY, *Ham Radio*, July 1975, p. 59.
[6] "A Satellite FAX System You Can Build," Taggart, Ralph E. WB8DQT, *73 Magazine*, September 1975, p. 39.

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ANTENNA IMPEDANCE: 50Ω (unbalanced)
CARRIER SUPPRESSION: Better than 40 dB
SIDE-BAND SUPPRESSION: Better than 40 dB
SPURIOUS RADIATION: Less than -60 db
MAX. FREQUENCY DEVIATION (FM): ±5 kHz
REPEATER FREQUENCY SHIFT WIDTH: 600 kHz
TONE BURST TIME: 0.5-1.0 sec.
MODULATION: Balanced modulation for SSB. Variable reactance frequency shift for FM. Low power modulation for AM.
MICROPHONE: Dynamic microphone, 500Ω
AUDIO FREQUENCY RESPONSE: 400-2600 Hz, within -9 db
RECEIVING SYSTEM: SSB, CW, AM: Single-superheterodyne. FM: Double-superheterodyne.
INTERMEDIATE FREQUENCY: SSB, CW, AM: 10.7 MHz. FM: 1st IF: . . . 10.7 MHz. 2nd IF: . . . 455 kHz.
RECEIVING SENSITIVITY: SSB, CW: S/N = 10 dB or better at 0.25μV. 20 dB noise quieting = Less than 0.4μV. AM: S/N = 10 dB or better at 1μV.
IMAGE RATIO: Better than 60 dB
IF REJECTION: Better than 60dB
PASS-BANDWIDTH: SSB, CW, AM: More than 2.4 kHz at -6 dB. FM: More than 12 kHz at -6 dB.
RECEIVER SELECTIVITY: SSB, CW, AM: Less than 4.8 kHz at -60 dB. FM: Less than 24 kHz at -60 dB.
SQUELCH SENSITIVITY: 0.25μV
AUDIO OUTPUT: More than 2W at 8Ω load (10% distortion)
RECEIVER LOAD IMPEDANCE: 8Ω
FREQUENCY STABILITY: Within ±2 kHz during one hour after one minute of warm-up, and within 150 Hz during any 30 minute period thereafter.
POWER CONSUMPTION: Transmit mode: 95W (AC 120/220V), 4A (DC 13.8V), max. Receive mode (no signal): 45W (AC 120/220V), 0.8A (DC 13.8V).
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Nostalgia can do funny things to a ham. Recently, I recalled the one tube transmitter that first got me on the air as a Novice back in 1957. And before I knew it, I was doodling a schematic and looking through my junk box for parts to build a similar rig.

My first 6AQ5 oscillator was quite a peanut whistle. It put out enough rf to burn out the flashlight bulbs I link-coupled to the tank coil for tune-up. And that was enough power to work all states and some DX on 40.

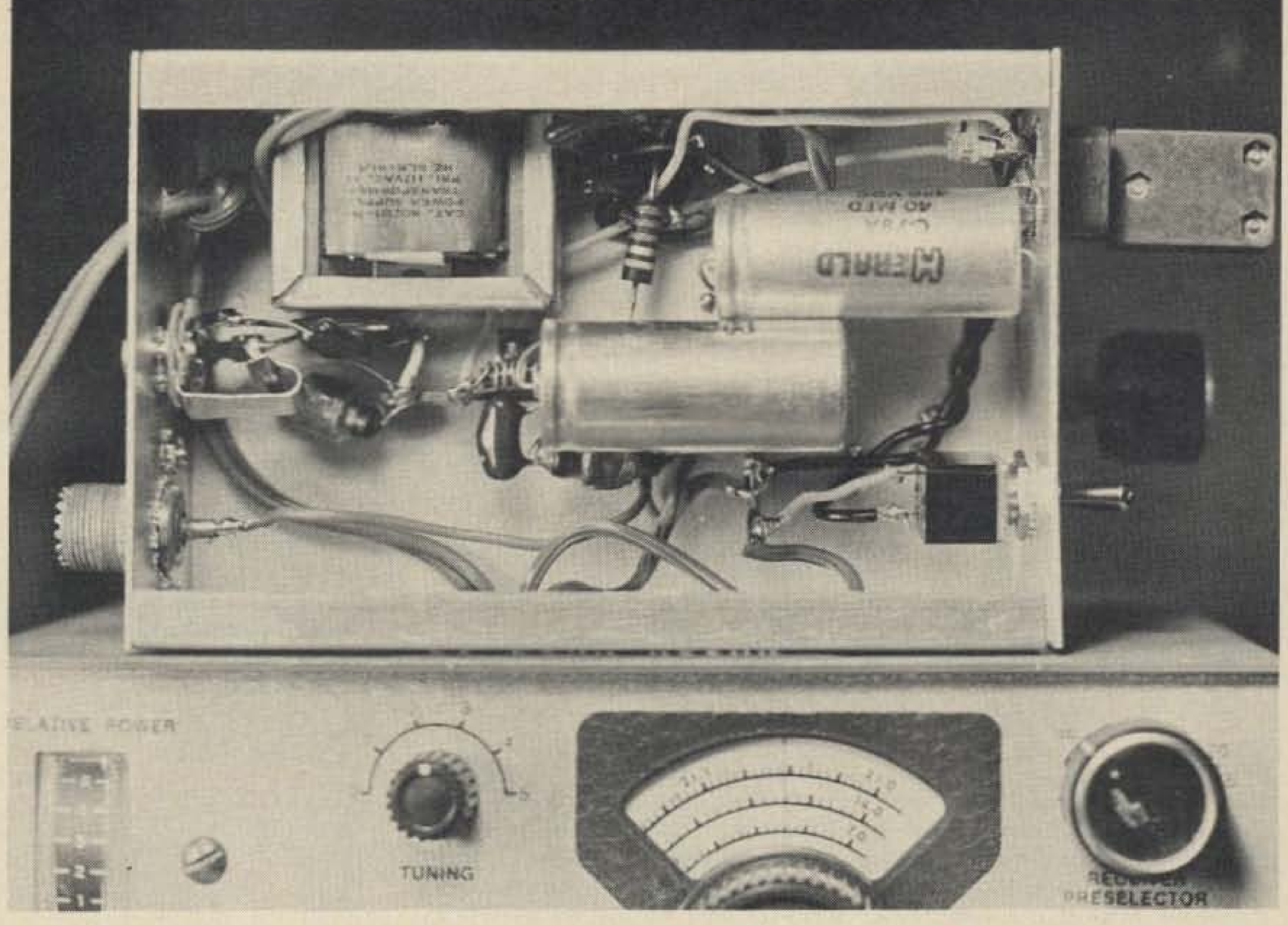
The transmitter described in this article has several applications: (1) its circuitry is simple, so many beginners and "appliance operators" should be able to build it and get it on the air in a matter of hours; (2) its 4 to 5 Watt input is ideal for QRP work; and (3) it's cheap – a good parts scrounger can build it for a few bucks at most. Even if everything has to be purchased new, the cost can be kept below $20.

I built mine straight out of the junk box and had it on the air in five hours, including the time spent in drilling and filing holes in the 4½ x 6½ x 2 inch aluminum chassis. Parts layout is not critical, but a beginner building his first rig might want to use a slightly larger chassis.

The power transformer used in this rig is rated at 15 milliamperes continuous service. However, I've experienced no difficulties while drawing 20-25 milliamperes on CW. Naturally, the key shouldn't be held down for more than a few seconds at a time while tuning up. A transformer with a slightly higher voltage and current rating could be substituted, with a corresponding increase in input power.

My third "CQ DE K5JRN QRP" brought a 579X report from a 500 mile daylight hop on 40 meters. Since then, this rig has given me hours of operating pleasure and many fine QSOs. A good antenna is desirable, but my dipoles are only 8 feet high.

While simpler transmitters can be built, this one is just about the bare minimum: no VFO, no meter and no bandswitch. Crystal control requires a bit more patience than VFO operation, but plenty of contacts can be made with just a couple of "rocks." With Novices now able to use VFOs, crystals can be picked up dirt cheap at hamfests and surplus stores.



Tune-up is simple. Connect the rig to a dummy load or to a 50 to 75 Ohm antenna. Temporarily slip a two turn link soldered to a 2 volt flashlight bulb over the tank coil, and tune for maximum brilliance. The full wave voltage doubler circuit delivers about 200 volts under load, and the 6AQ5 plate draws 20 to 25 milliamperes (four to five Watts input).

Tune-up also can be accomplished with a field strength meter, if you have one, or with the forward scale of an swr bridge. If you really want to get fancy, you can add a 0-50 or 0-100 milliampere meter between RFC2 and the B plus.

The plastic form for the tank coil is one and a quarter inches in diameter. I used a film container from a roll of 35mm Kodak film. A cardboard tube also would work, and so would a piece of broomhandle. A good home brewer makes do with what he's got. Don't be afraid to substitute parts of nearby values for the ones in this circuit.

The tank coil – 15 turns of #22 enameled copper wire – and the 365 pF variable (C2) resonate both on 80 and 40 meters. Care must be taken not to double an 80 meter crystal to a frequency outside the 40 meter band. Eighty will appear with the variable's plates meshed about 80 percent, and resonance on 40 will be with the plates about 40 per cent meshed.

Trimmer capacitor C1 is adjusted for best keying characteristics while listening to a harmonic of the transmitted signal.

Early morning is my favorite time for QRP work. At 5 or 6 am, many frequencies on 80 and 40 are

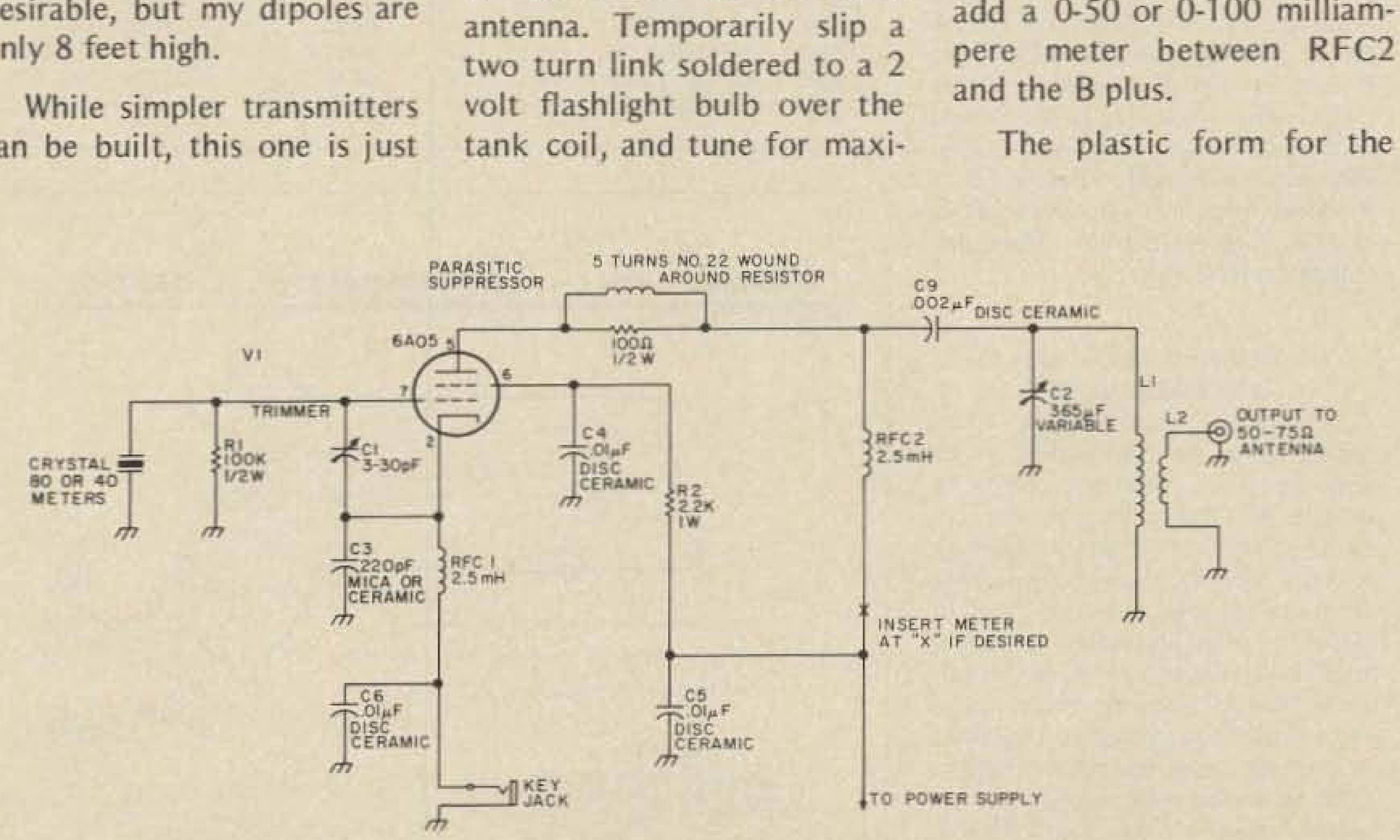


Fig. 1.

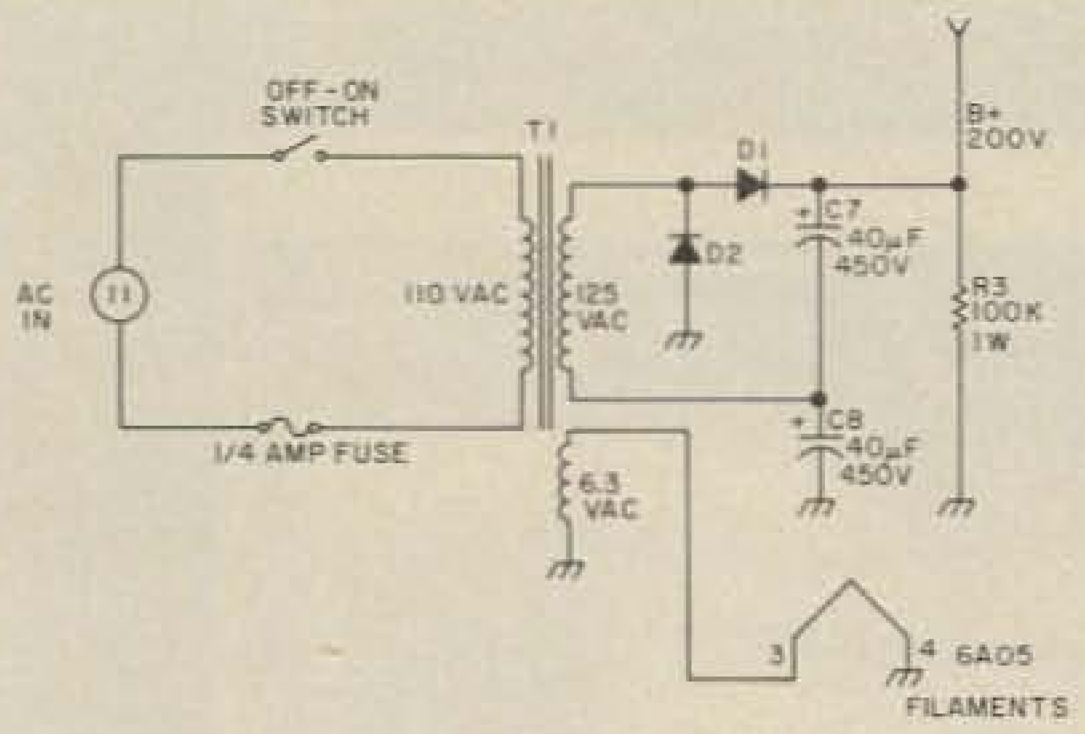


Fig. 2.

clear of signals and the skip is good for low power DXing. A short CQ and "QRP" usually results in a contact and a query: "How much power you running, OM?" ■

Parts List

Xtal — 80 meter or 40 meter fundamental crystal (Jan Crystals, 2400 Crystal Drive, Ft. Myers FL 33901)
R1 — 100,000 Ohm, ½ Watt
R2 — 2,200 Ohm, 1 Watt
R3 — 100,000 Ohm, 1 Watt
C1 — 3 to 30 pF trimmer (or similar value)
C2 — 365 pF broadcast band variable capacitor
C3 — 220 pF disc ceramic or mica
C4,5,6 — .01 uF, 600 volt disc ceramics
C7,8 — 40 uF, 450 working volt electrolytic capacitors
C9 — .002 uF disc ceramic, 600 volts.
RFC1,2 — 2.5 millihenry rf chokes
Parasitic suppressor — 5 turns #22 wire wound around 100 Ohm, ½ Watt resistor
L1 — 15 turns #22 enameled wire on 1¼ inch plastic form
L2 — 3 turns insulated hookup wire wound around cold end of L1
T1 — 110 V ac primary, 125 V ac 15 mA, and 6.3 V ac secondaries (see text)
D1,D2 — 800 PIV silicon diodes
V1 — 6AQ5, 6AQ5A or equivalent

CONTESTS

from page 11

Zone Map, DXCC country list, WAE country list and WAC boundaries are standards for the contest. QSO points are as follows: 3 points for QSO with station on different continent; same continent but different country counts 1 point, except between NA stations, which counts 2 points; contacts between stations in same country count 0 points per QSO. Final score is the result of the total QSO points multiplied by the sum of zone and country multipliers.

AWARDS:

Various certificates, plaques, and trophies will be awarded, and all scores will be published in *CQ Magazine*.

ENTRIES:

Logs must show all times in GMT, and use separate sheets for each band. Indicate zone and country multiplier only the first time worked on each band. LOGS WILL BE CHECKED! Each log must be accompanied by a summary sheet; official logs and summary sheet are available from *CQ* for a large SASE. All entries and requests for logs should be addressed to: CQ WW Contest Committee, 14 Vanderventer Avenue, Port Washington NY 11050.

SPECIAL EVENTS STATION WW9WWW

The Sheboygan County DX Association will once again operate special events station WW9WWW during the period from 0000 GMT, 12 September, 1976, through 2400 GMT, 18 September, 1976, in observance of Wonderful Wisconsin Week. Operation will be all bands 80-10, CW and SSB, on or close to the following frequencies: 3550, 7050, 14,050, 21,050, 28,050, 3810, 3910, 7175, 7280, 14,215, 14,285, 21,300, 28,550. QSL via WA9UEK, P.O. Box One, Plymouth WI 53073 USA. SASE or SAE and 2 IRCs is an absolute *must* for those wishing QSL.

WORKED ALL MANITOBA AWARD

The Worked All Manitoba Award will be issued for confirmed contacts with amateur radio stations in specific numbers of Manitoba municipalities, local government districts, provincial parks, forest reserves, and national parks in the following classes: Class E = 50, D = 75, C = 100, B = 125. A special honor plaque will be issued for Class A, all 134. All contacts must be made after January 1, 1976. Record book, application forms, maps, rules, and conditions are available for a $1.00 fee from: Doug Bowles VE4QZ, 1104 First Street, Brandon, Manitoba, CANADA R7A 2Y4.

WORKED ALL MASS COUNTIES AWARD

Submissions must include a log listing dates, stations worked, mode and frequency. No QSL cards required. All QSOs valid including contacts through repeater stations. Station worked must be operating from county claimed. Log must be signed by another amateur certifying that the applicant has made the contacts claimed. Awards will be issued for a single band or mode if requested. A self-addressed stamped envelope must be enclosed for the return of the award. Submit logs to WR1ACT, South Shore Repeater Association, Box 284, East Milton MA 02186.

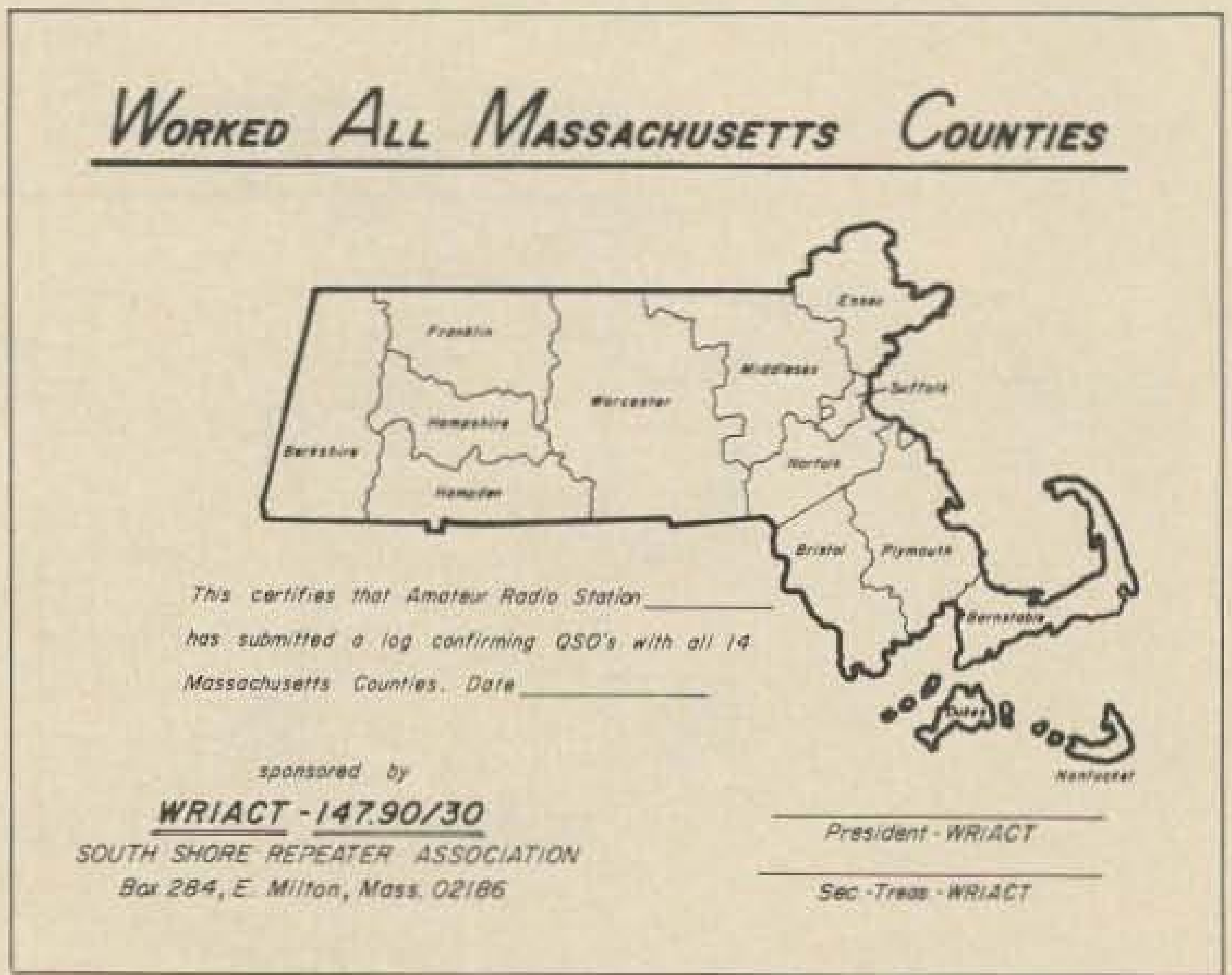
CORRECTIONS

"A Test Lab Bonanza — using a transistor radio," WA7SCB, *73*, September, 1976, pages 64ff.

• page 66, column 1, line 13 should read, "as 1.5, 5, 9, etc."
• page 67, column 2, line 18 should read, "19 and you will rejoice when".

Oscar Orbits

Oscar 6 Orbital Information					Oscar 7 Orbital Information			
Orbit	Date (Oct)	Time (GMT)	Longitude of Eq. Crossing °W	Mode	Orbit	Date (Oct)	Time (GMT)	Longitude of Eq. Crossing °W
18112	1	0130:26	79.8	A	8586	1	0057:25	64.1
18124	2	0030:22	64.8	B	8599	2	0151:42	77.7
18137	3	0125:18	78.6	A	8611	3	0051:02	62.6
18149	4	0025:14	63.6	B	8624	4	0145:19	76.1
18162	5	0120:10	77.3	A	8636	5	0044:40	61.0
18174	6	0020:06	62.3	BX	8649	6	0138:57	74.5
18187	7	0115:01	76.1	A	8661	7	0038:17	59.4
18199	8	0014:57	61.1	B	8674	8	0132:34	72.9
18212	9	0109:53	74.8	A	8686	9	0031:54	57.8
18224	10	0009:49	59.8	B	8699	10	0126:11	71.3
18237	11	0104:45	73.6	A	8711	11	0025:31	56.2
18249	12	0004:41	58.6	B	8724	12	0119:48	69.7
18262	13	0059:36	72.3	AX	8736	13	0019:09	54.6
18275	14	0154:32	86.1	B	8749	14	0113:26	68.2
18287	15	0054:28	71.1	A	8761	15	0012:46	53.0
18300	16	0149:24	84.8	B	8774	16	0107:03	66.6
18312	17	0049:20	69.8	A	8786	17	0006:23	51.4
18325	18	0144:15	83.6	B	8799	18	0100:40	65.0
18337	19	0044:11	68.5	A	8811	19	0000:00	49.8
18350	20	0139:07	82.3	BX	8824	20	0054:17	63.4
18362	21	0039:03	67.3	A	8837	21	0148:34	76.9
18375	22	0133:59	81.0	B	8849	22	0047:55	61.8
18387	23	0033:55	66.0	A	8862	23	0142:12	75.3
18400	24	0128:50	79.8	B	8874	24	0041:32	60.2
18412	25	0028:46	64.8	A	8887	25	0135:49	73.7
18425	26	0123:42	78.5	B	8899	26	0035:09	58.6
18437	27	0023:38	63.5	AX	8912	27	0129:26	72.2
18450	28	0118:54	77.3	B	8924	28	0028:46	57.0
18462	29	0018:30	62.3	A	8937	29	0123:03	70.6
18475	30	0113:26	76.0	B	8949	30	0022:24	55.4
18487	31	0013:22	61.0	A	8962	31	0116:41	69.0



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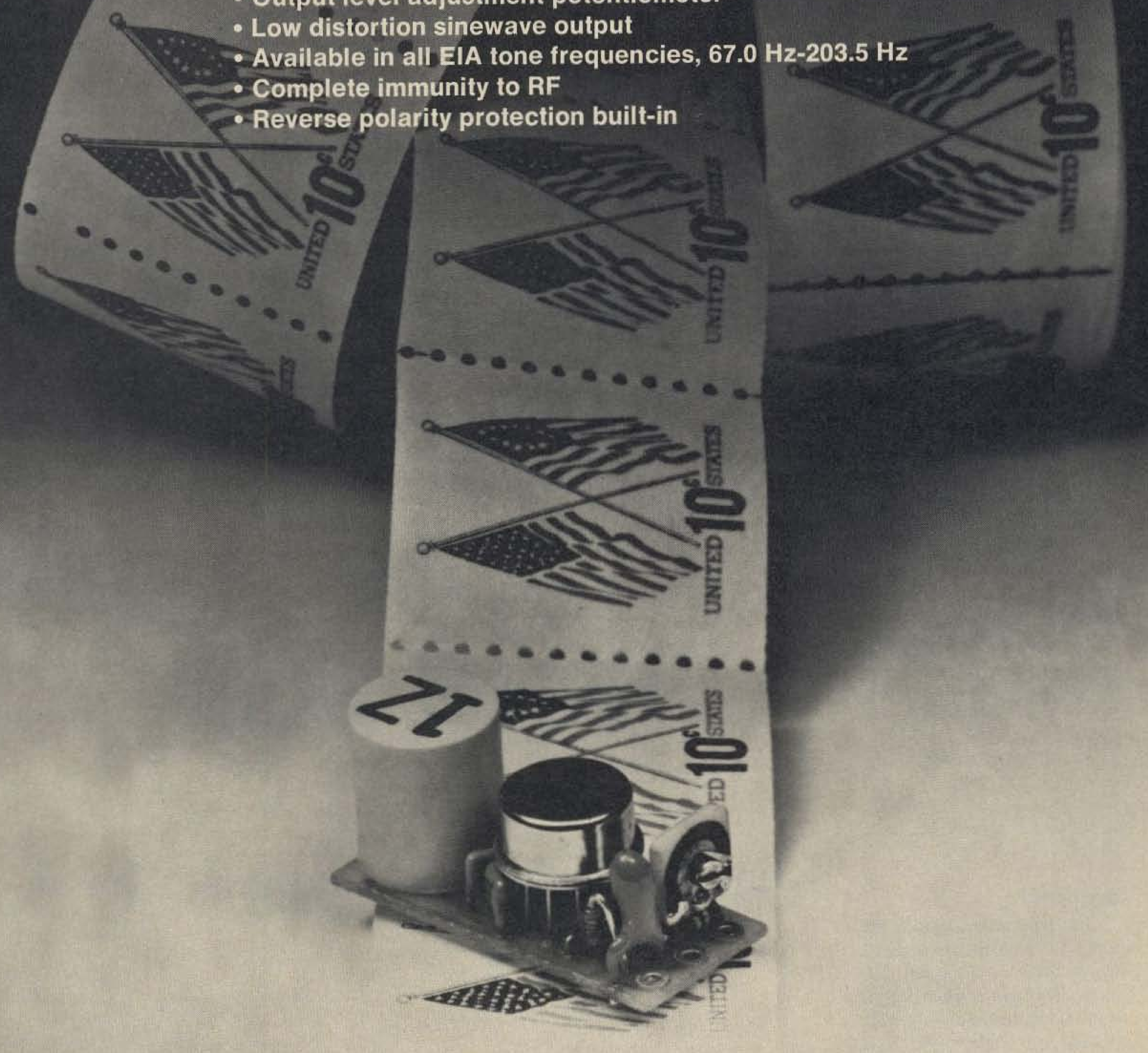

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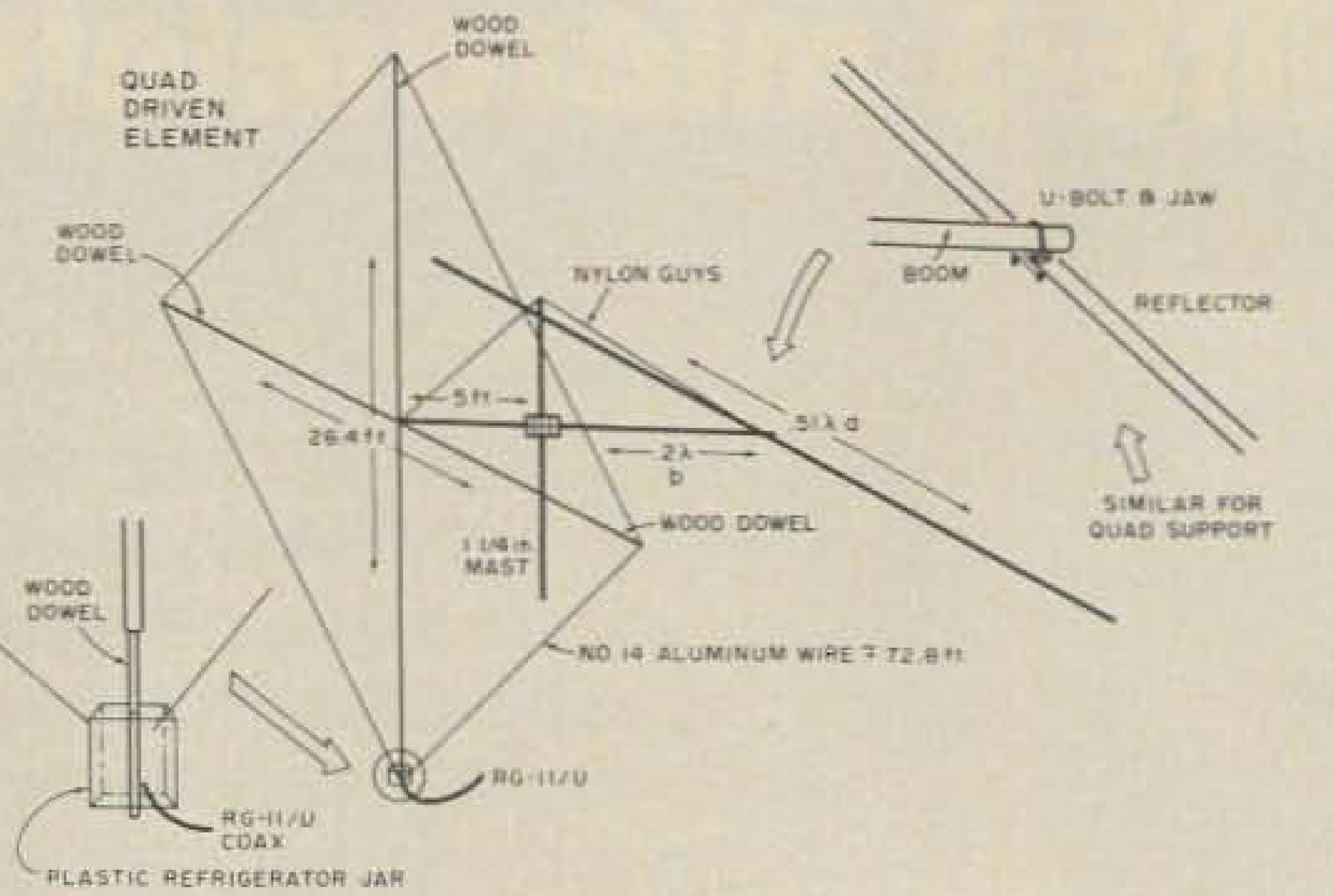

Fig. 1. a = 36', b = 13.85'. L = 1004/f(MHz). Note: Must be trimmed for lowest swr.

The Hybrid Quad

--has low windload, expense, hassle

Sgt. Ralph J. Volpe USAF WB8VCS/5
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San Antonio TX 78226

The hybrid quad is a little used, little discussed antenna design that has been largely neglected by the ham community. One reason may be the lack of data available from the various texts covering antenna design. Over the past few months, the number of amateurs that have shown interest in the antenna, and the requests I have received for the specifics of its construction, have given the incentive for writing this article.

It must be noted that the design I chose is not the only possible combination in an antenna of the hybrid quad design. I do feel that the rewards of building and operating with my particular antenna demonstrated to others and myself its particular qualities over other two element arrays, especially for those amateurs looking for performance on a budget. My antenna, complete and ready to use, cost under 150 dollars. This included all hardware, coax, rotor, and a ten foot tripod.

The parameters for the basic layout are determined from studying the important characteristics of the full wave loop and the half wave dipole in their individual arrays. The spacing for the elements, especially the determination of using a reflector instead of a director, came from design characteristics of the two element yagi array. The feedline impedance and connection is that of a full wave loop array. The ARRL *Antenna Book* furnishes these basics.

Description

The true advantages of the full wave element are realized when used as a driven element. Through comparison, it was found that the noise level is lessened while signal level increases over that of a dipole. The feedline of a quad may be directly connected without any matching devices. At my QTH, it was easy to make the one and only length adjustment, from the peak of the roof that the tripod is mounted on. The only test equipment needed is an accurate swr bridge. The loop makes an excellent match to RG-11/U. Judging from the standing wave, demonstrated in Fig. 2, the two element array interacts for a feed match impedance of approximately 70 Ohms.

In all probability, the two element quad will outperform the hybrid version. There are two reasons for the design compromise. The first is cost. When working out the original parts list, I found it was far costlier to make the reflector a full wave loop. The weight would increase. The balance point would also have to be changed, and in doing this the windload of the antenna would increase dramatically. The result – the necessity for much heavier hardware, boom, and a heavier duty rotor. All of this adds to the cost of the antenna. The second point to mention would be the added fragility of the full sized quad versus the hybrid quad.

Due to the probability of ice and heavy rainstorms, the quad is best built in the diamond configuration. The entire structure, including the boom, is assembled from lightweight aluminum. 1¼ inch tubing is used for the boom and mast sections. The quad supports and the reflector element are made from telescoping 1 inch to ¾ inch tubing. The wire for the driven element is number 14 aluminum. The insulators are wood dowels treated with lacquer for waterproofing. They are inserted into the ¾ inch tubing ends and clamped down.

Construction

The two pieces that make up the quad structure are

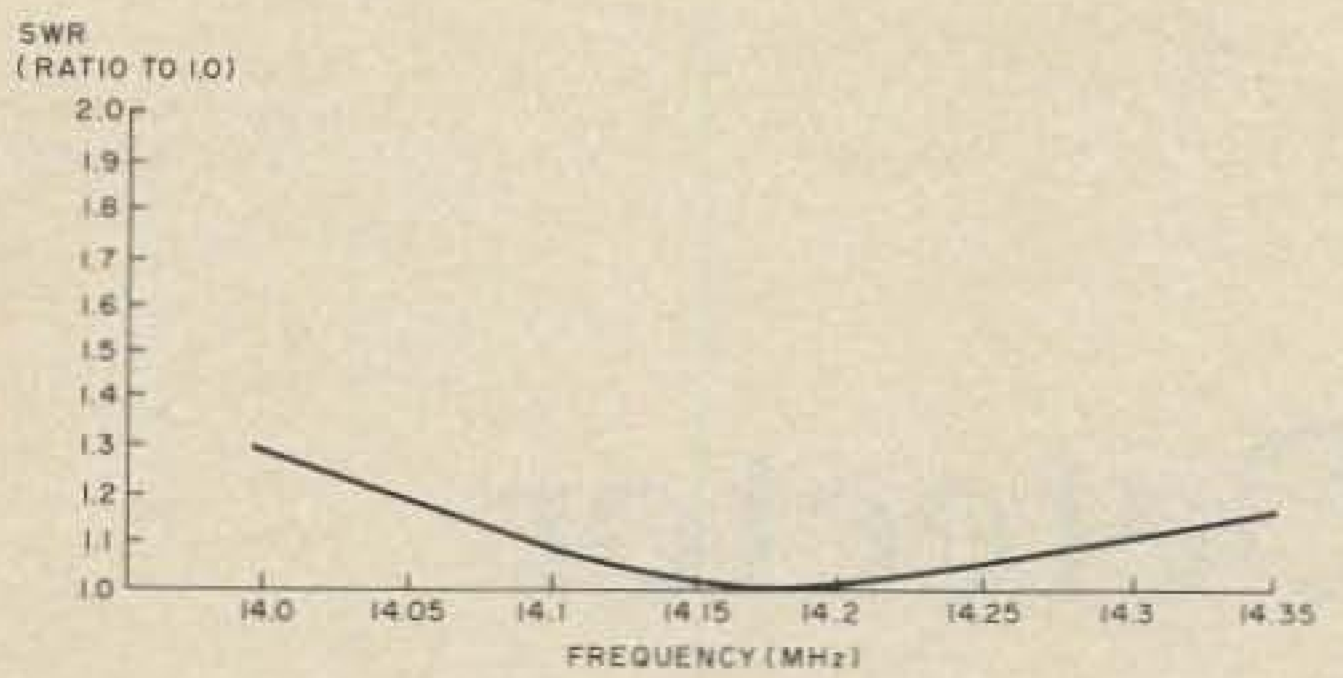

Fig. 2. Hybrid quad standing-wave chart, adjusted to 14.175 MHz.

made from telescoping aluminum sections to an approximate length of 26 feet. This can be accomplished by using a twelve foot tubing of 1 inch diameter. Into this tube you insert a section of 7/8 inch tubing. Finally, a 3/4 inch tubing can be inserted and all three adjusted for the appropriate length. Adjustable clamps used for plastic pipe can be used to make fast the sections of aluminum. See Fig. 3. The wood dowel insulators are telescoped into the end openings and clamped down. Small diameter holes are drilled in the wood dowels. The wire element is threaded through these during final assembly.

The reflector is similarly constructed. The ends of the reflector are capped with plastic furniture leg caps of appropriate size. The reflector is adjusted for the proper length and balance, then drilled in the center of the 12 foot section of 1 inch tubing. A TV type U bolt with jaw is inserted and fastened to the boom, as are the cross sections of the quad structure.

The measurements given are for 20 meter operation. They can be easily scaled for another band. If a director is used instead of a reflector, the actual spacing will be more critical. A director arrangement will show slightly more gain at its design frequency, with a more restricted bandwidth. Being more interested in ease of construction and total bandwidth, the director is ruled out and dimensions are calculated for a reflector.

A total spacing of .2 wavelengths with a reflector length of .51 wavelengths will give the best forward gain with an acceptable front-to-back ratio over the entire band, with the design frequency around 14.175 MHz. The actual gain of the array figures at 7.1 dB over a half wave dipole. This includes the gain of the full wave loop over a dipole as a driven element. The front-to-back ratio approximates 14 dB with the front-to-side ratio much larger. The Q of the antenna approximates 4.7.

The boom is made of 1¼ inch tubing 14 feet in length. As this will show some sagging, a strut type support is used from the mast to absorb the excess strain. The boom to mast bracket can be fabricated from a piece of aluminum stock with TV type U bolts and jaws. The mast is extended beyond the boom by 4 feet and nylon guys connect the elements at the ends of the boom.

A length of 36 feet is used for the reflector. The spacing from the driven element is 13.85 feet. This element should be tightened down while the array is on the ground.

For 20 meters, a length of 74 feet can be used for the wire loop for a start, trimmed for the appropriate operating frequency. If 14.175 MHz is used as the center frequency, the curve for standing waves will be very similar to the one shown in Fig. 2. The use of a 1 to 1 balun could be used to further balance the currents and flatten the swr. RG-11/U will match directly to the quad. The transmission line should be connected to the lower corner of the diamond. A plastic refrigerator container was used on my antenna to enclose the antenna to transmission line connections. A homemade toroid balun could also be enclosed in the container. If the builder would rather use 50 Ohm coax, an appropriate matching section could be employed.

The mast is connected more toward the quad element to balance the weight and windload on the antenna. A distance of from 4-6 feet may be determined by trial and error.

Operation

The moment of truth has come. The questions that arise are numerous; most can be answered by examing the reasons for its construction:

For simplicity and efficiency sake, the single band design is used.

Total cost of antenna materials and installation.

Efficiency and low angle of radiation at lower heights above ground; one specific advantage of the quad over the dipole.

A low Q design for a broad bandwidth for full twenty meter operation without prohibitive standing waves at band edges.

Possible ice and wind damage had to be considered in the structure design.

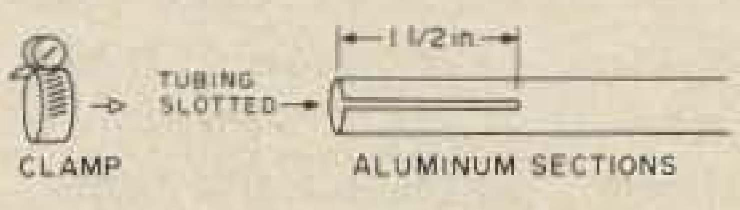

Fig. 3.

The design, construction and adjustment had to be within the capabilities of any simply equipped station.

In operation I have noticed the specific characteristics of the antenna. There is an excellent front-to-side ratio, of an average 30 or more dB in attenuation. This has been verified in reception and transmission. The front-to-back is more difficult to determine. The farther away the other QTH, the more noted is the directional attenuation. Averages range from 12 to as much as 20 dB. When short skip conditions are in effect, the front-to-back is noticeably less. Although I can only suppose, I feel this is due to a plain distance effect between the quad element and the reflector at varied radiation heights.

Conclusion

I work many DX stations with 30-100 Watts SSB. The reports I received from these amateurs are quite favorable. In the states, my signals are compared with those of stations using the full power limit. With 1000 Watts PEP I can very successfully compete in most of the DX pile-ups. My antenna is at a very modest height of 32 feet. The rotor I have been able to use without problem is an old TR-2.

I will not try to compare this antenna with those of larger design and complexity. My main desire is to open some thought to an antenna design that may be very useful to the do-it-yourself amateur. If you want an antenna that performs very well at low heights, is very efficient, easily built and adjusted, demonstrates exceptional directivity and broadbandedness, and all this at a cost most of us on a budget can afford, you may find this an antenna to strongly consider. ■

Warren L. MacDowell W2AOO
11080 Transit Rd.
East Amherst NY 14051

Frequency Detector for Your Counter

- - sounds alarm when set frequency occurs

Now that you have spent a small fortune on LED readouts, ICs, and assorted goodies, and countless hours to build that frequency counter, it is time to create another valuable addition for that basic tool.

What we are about to describe is an inexpensive device that will detect any frequency that your counter is able to display and activate an alarm of your choice (horn, gong, etc.). Even if the selected frequency occurs for only a fraction of a second, this device will trigger and lock until reset manually. The frequency desired is set with the use of inexpensive *decimal* (not BCD) type thumbwheel switches. Enough switches must be employed so as to cover the number of digits in your counter. In this manner, the desired frequency can be pre-dialed to the last cycle.

Even if the thumbwheel switches are not available, common garden variety single pole multi-position rotary switches can be pressed into service for this device.

When you are using your frequency counter to measure a transmitter VFO frequency or output frequency, an alarm such as this can be used to provide indication of an amateur band edge. Not only this, but a specific frequency can be "switched up" without even having to look at your counter or VFO dial, and the alarm will sound when you have arrived at the preset frequency. This feature would lend itself nicely for use by blind amateurs. By cutting a small notch in the "0" thumbwheel, the digits of the switch could be counted mentally by clicks until the desired digit was selected. This would make the average frequency counter usable by the blind, as he could "hear" the dialed frequency. In fact, a counter *without readouts* could be constructed for the blind amateur.

This device may be used with gadgets such as digital thermometers, clocks, etc., as an alarm. It is necessary only to have a BCD (binary coded decimal) system driving decoders for your particular type of readout. The conventional counter uses a 7490 decode counter driving a 7475 quad latch, which in turn may drive a 7441 (Nixie decoder) or a 7446 (7 segment decoder). The binary data may be taken from either the binary (BCD) output of the 7490 or the 7475. In some counters (el cheapo type), the 7475 memory is eliminated and the 7490 drives the 7441, etc., decoder directly. In these cases, the BCD information must be sampled at the 7490 BCD output. When the 7475 is included, sample at the 7475 latch BCD output. A typical counter stage is illustrated in Fig. 1. The BCD sample points are shown for both types of counters, with and without the 7475 latch.

Now that you have determined at what point BCD sampling can be made, it is necessary to obtain as many SN7441 Nixie decoder/driver ICs as your counter has digits. In other words, if you have a six digit counter, six 7441s must be used. Each decade of your counter will provide BCD data for each 7441 decoder. The 7441 decoder has a BCD input and 0-9 output. This integrated circuit translates the BCD incoming data to decimal notation by grounding the appropriate 0-9 pin. Basically what you are doing is adding an additional decoder separate from the one that is presently driving your readouts.

Rather than to feed a readout with the 7441 new

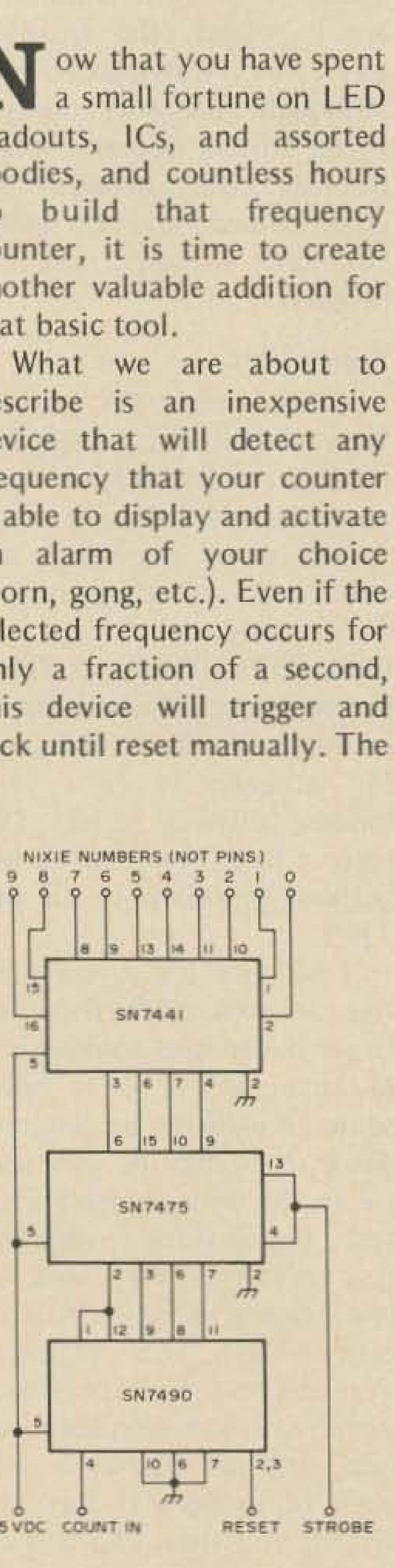

Fig. 1. Typical counter stage.

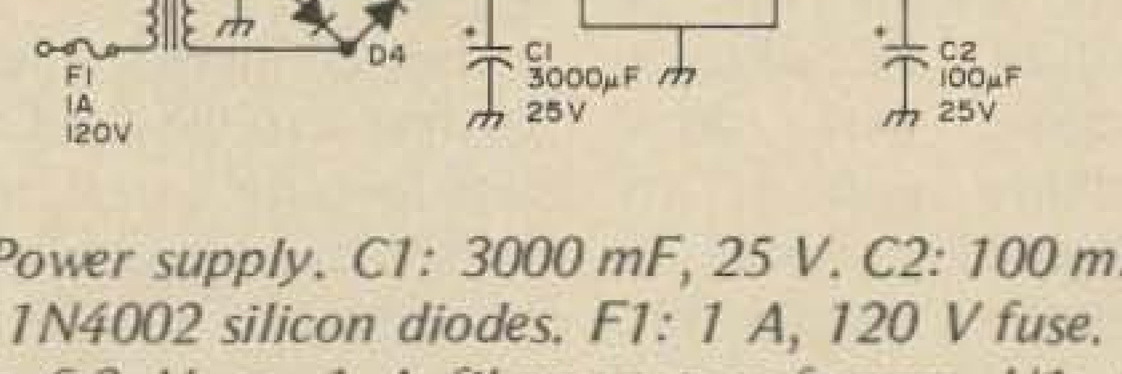

Fig. 2. Power supply. C1: 3000 mF, 25 V. C2: 100 mF, 25 V. D1-D4: 1N4002 silicon diodes. F1: 1 A, 120 V fuse. T1: 120 V ac to 6.3 V ac, 1 A filament transformer. U1: National LM309K 5 V regulator.

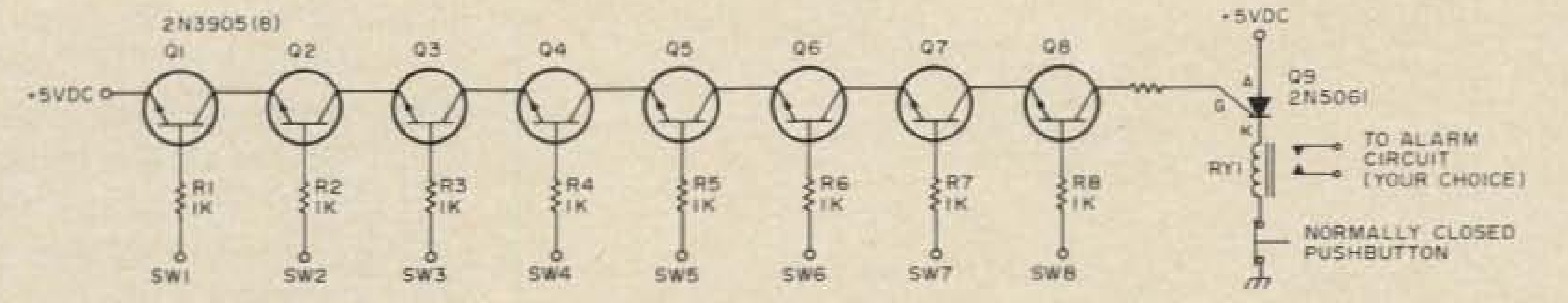

Fig. 3. Transistor-SCR alarm latch. Q1-Q8: 2N3905 PNP silicon transistors. Q9: 2N5061 sensitive gate SCR. RY1: 6 V dc, 335 Ohm coil relay (Potter and Brumfield RS5D); any sensitive 6 V dc relay will suffice. R1-R8: 1000 Ohm, ¼ Watt carbon resistors.

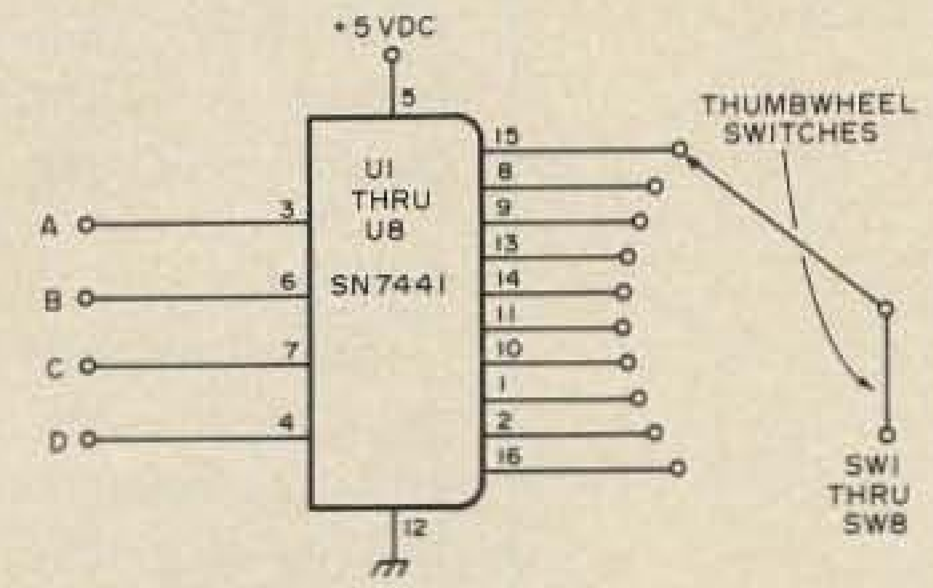

Fig. 4. 7441 drivers. U1-U8: SN7441 BCD to decimal decoders.

decoder, it now is used to "drive" the 0-9 pins of the decimal thumbwheel switch. As numbers are decoded by the 7441, a ground appears at the appropriate thumbwheel switch position. If the thumbwheel is set at this particular position, the ground will appear at the common or output of the thumbwheel.

The additional 7441s will also require plus 5 V dc for operation. This usually can be extracted from your present TTL 5 volt supply in the counter. If not, Fig. 2 illustrates a simple 5 V dc regulated supply.

Now that each of the digits in your counter chain has been sampled and is driving a thumbwheel switch, the alarm activation system comes into play. If all of the thumbwheel switches are set to a desired frequency and the counter displays this frequency, all of the thumbwheel switches will reflect a ground condition. By feeding the "common" of the thumbwheel switch to the base of a PNP switching transistor, a ground condition will cause the transistor to conduct. All of the transistors are placed in series so that when all of the thumbwheel switches reflect ground, all of the transistors will conduct, then completing the alarm circuit.

Our particular alarm circuit uses an SCR which has the ability to lock up or latch with a dc circuit (Fig. 3). The SCR will remain latched until the reset button (normally closed) is depressed, resetting the SCR. If the latch type of system is not desired, an ordinary reed type relay can be activated by the switching transistors. In this system, the alarm would sound when the counter frequency was achieved and then cease as a different frequency appeared.

Fig. 5 illustrates the pin numbers for the A, B, C and D outputs of a 7490 counter. If your particular counter does not have a 7475 quad latch (memory), these are the points at which the 7441 decoders would be attached for each digit of your counter.

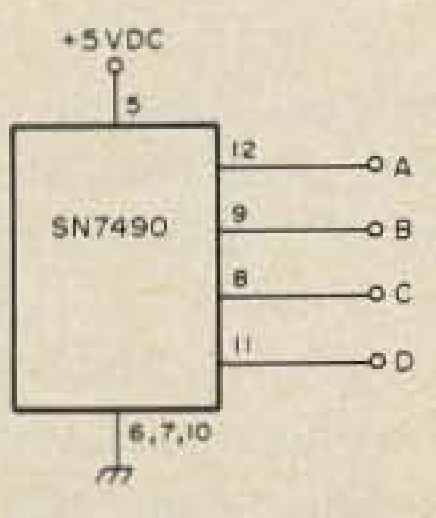

Fig. 5. 7490 wiring.

Fig. 6 illustrates the common SN7475 quad latch. If yours is of the more expensive type, the SN7475 quad latches will be employed. The SN7475 eliminates "flicker" or counting when the SN7490 counts up to its next set of figures. The SN7490 drives pins 2, 3, 6 and 7 (A, B, C and D respectively) and the outputs of the SN7475 are pins 16, 15, 10 and 9 (A, B, C and D respectively).

Once you have attached the SN7441 decoder to your particular counter, operation of this device is quite simple. All that is necessary is to dial up the desired frequency on the thumbwheel switches. When the counter arrives at this "dialed up" frequency, all of the PNP transistors (Fig. 3) will conduct also, causing the gate of the 2N5061 SCR to activate. The circuit from the anode to cathode of the SCR will also conduct, causing RT1 to close its contacts. Once an SCR "fires" it remains in this condition until the anode/cathode circuit is broken with direct current conditions. The normally closed push-button switch enables you to break the anode/cathode circuit of the SCR and "reset" the device.

Should the "latching" effect of the SCR be undesirable, an ordinary medium power NPN transistor can take the place of the 2N5061 SCR. Attach the base of the NPN transistor to the gate, the emitter to the cathode and the collector to the anode connections of the SCR placement. With this arrangement, the relay would only close momentarily as the desired frequency was detected. There would be no "latching" effect.

You will find that this device can be used with just about any binary counting device you may have built. Some common applications would be: (1) An amateur band edge detector; (2) A temperature alarm (with a binary digital themometer); (3) A pre-settable frequency detector; (4) An alarm for digital clocks; (5) A frequency counter for the blind; and, (6) A frequency limit detector for FM repeater transmitters. No doubt you will come up with many more applications for this device as digital electronics progress with amateur applications. ■

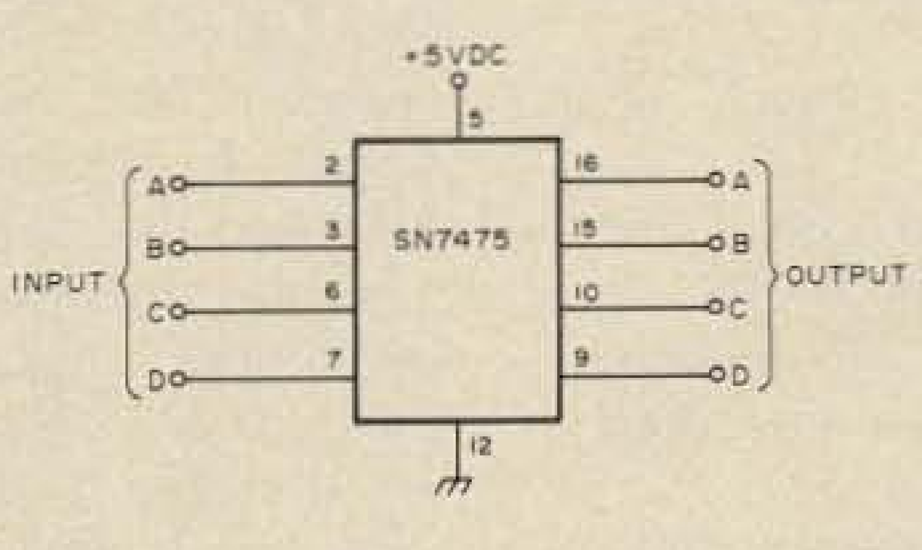

Fig. 6. SN7475 wiring. Note: There are four bistable latches in the 7475 package. The BCD binary code may be applied to any of the four latches desired. The BCD data to the 7441 decoders must correspond, however. In other words, there are no defined BCD inputs or outputs — they are up to you.

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Programmable CW ID Unit

--for RTTY, repeaters, mobile, etc.

There have been many articles published on the subject of automatic identifiers. One might wonder what new could be said on the subject. Read on, and discover a circuit with the following features:

1. Uses almost no power.
2. May be used for both CW and RTTY.
3. Can be reprogrammed in less then one minute.
4. Self-contained. Only requires power and start signal.
5. Uses only 4 standard D.I.L. ICs, and one optional 8 pin minidip.
6. Runs on a single unregulated voltage source.

This whole unit is made possible by the CMOS logic family. This circuit is built around the Motorola MC14562CP, a 128 bit shift register. To make things simple, its operation can be described by saying, "what goes into the input will come out of the output 128 clock pulses later." What goes in is a "1" (high level) or a "0" (low level). When an output device such as an audio oscillator is connected, and a stored code (series of 1s and 0s) is recirculated by connecting the shift register output back into the input, this will cause the oscillator to be keyed as the data are shifted by. This code may be a simple repeater ID, or maybe a teletype test pattern. The only difference is the type of code, and the speed at which is is stepped.

Clocking

The clock signal is generated by one half of IC4. If the enabling control signals allow, the clock oscillator will free run at a rate determined by the values of R2 and C1 (refer to Fig. 1). I have found .47 uF to be a good value for the needed range, which is obtained by varying the value of R2. R2 may be a fixed resistor if a variable speed is not required. This clock signal passes through a gate which ORs with the manual step circuit. The manual step circuit is used to step through the program slowly, to examine, modify, or reprogram the contents. The manual step circuit consists of one half of IC1 crosswired with IC4, as a switch debouncer. With this circuit, each time the step pushbutton is pushed the shift register will step only once.

Control

Since the shift register has no way to know a starting or stopping point, we must add this external control. This is done by adding IC3, a seven stage counter, and IC1, wired as a flip flop. Every time the flip flop is set by a positive pulse, or the start pushbutton, the flip flop has its output set high, enabling the clock oscillator to run. With the clock running, the shift register starts stepping and the counter (IC3) counts the steps. When the final stage of the counter toggles on the 128th clock pulse, the transition causes the control flip flop to toggle back to the waiting state, stopping the clock. Since the output side of the flip flop is high any time the unit is running, this term is brought out through Q1, and Q2, to provide an external key for a transmit relay (or other logic). If only logic or some other low current load is to be keyed, Q2 may be omitted, and the emitter of Q1 grounded.

Audio Oscillator

The audio oscillator is identical to the clock oscillator, except, of course, for the frequency of oscillation. When the input pin 1 of IC4 is high, the oscillator will run, producing a tone. This tone from pin 4 of IC4 may be connected directly to a high impedance circuit, such as a microphone input, or a buffer amplifier consisting of IC5, a

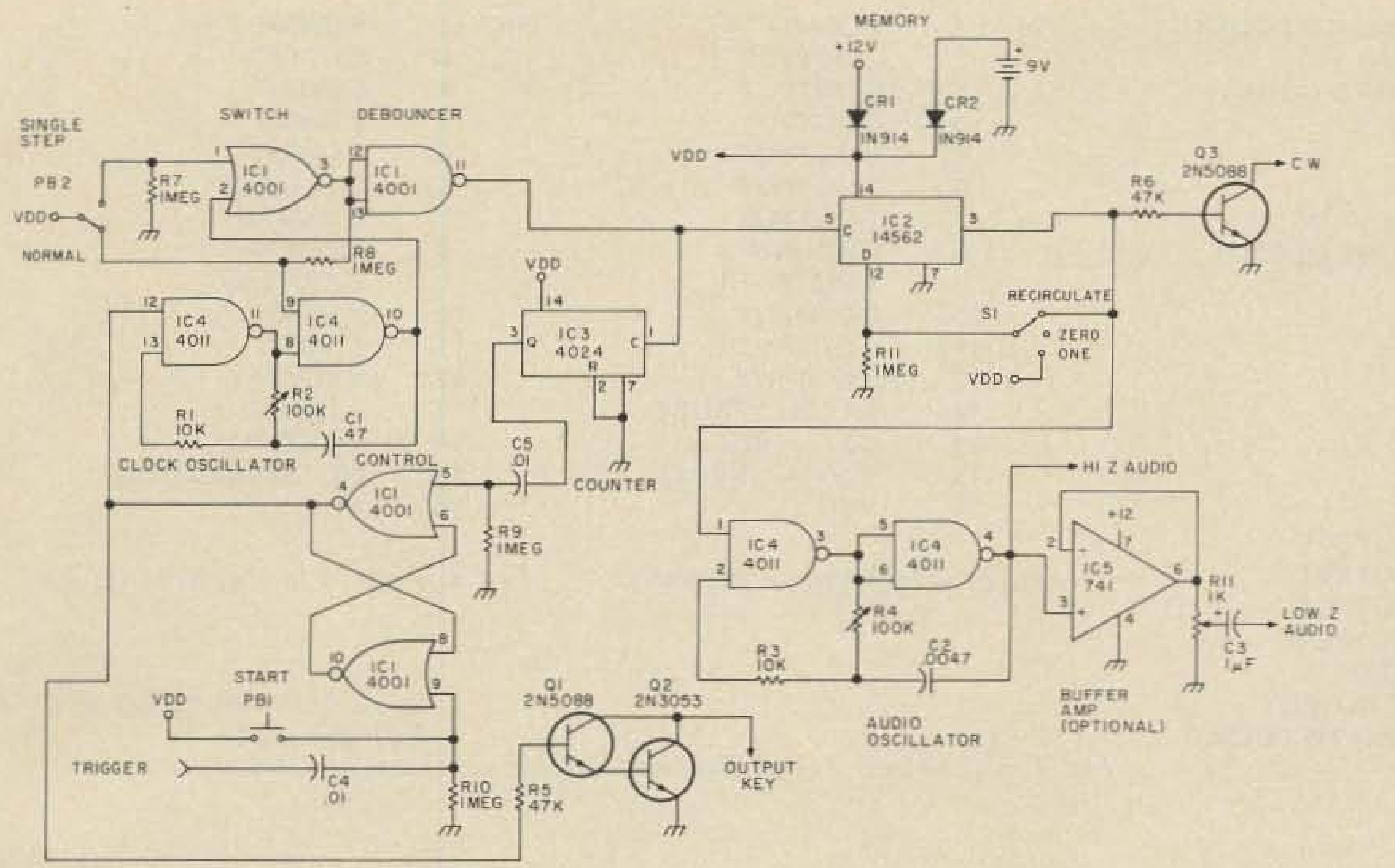

Fig. 1. VDD to power, pin 14; ground pin 7, all ICs. Standby current = 0 mA. Running current ≈ 1 mA (without buffer amp).

741 op amp. If the op amp is used, a low impedance audio line may be driven, or even a small speaker, without affecting oscillator pitch, or loading.

CW Output

If the direct CW output is desired, as would be needed in RTTY, the audio oscillator and buffer amplifier may be omitted and the output taken from the collector of Q3. A high level on the input of Q3 will turn it on, allowing the collector circuit to sink current. If the collector current to be keyed is to be more than a few milliamps, another transistor should be added in the same manner as was Q2.

Battery

It should be noted that a battery is connected to VDD through a 1N914 diode. The only purpose of this battery is to protect the contents of the shift register against loss of power. No power is drained from this battery since CMOS only draws power when it is running, and the circuit does not run without power. With power on and battery installed, the unit may be programmed and forgotten. Power may be turned off, and the unit transported, stored, or anything else, without fear of losing the program – and the battery will last for its shelf life. The entire unit may be run from a single 9 volt transistor radio battery, and, since only a few milliamps are required, the battery will last a very long time.

Programming

The best way to program the shift register is to "erase" memory by placing S1 in the program position, selecting the "0" position, and depressing the start pushbutton. This will dump the contents of the shift register into the proverbial bit bucket, leaving only zeros. Utilizing the program switch, select the desired "1" or "0" to be entered and depress the step push-button once for each step. When the entire program code has been stepped in, place switch S1 back into the recirculate position, and depress the start button, allowing the unit to cycle back to the start point. If an error has been made, it is not necessary to completely reprogram. Manually advance until error is reached, put S1 into the desired program position, step correction into the shift register, and return S1 to normal.

Many thanks to WA6CFA, who offered several constructive suggestions in the design of this circuit, and who is responsible for my switch to CMOS. ■

Parts List

- IC1 – CD4001a quad 2 input NOR gate
- IC2 – MC14562CP 128 bit shift register
- IC3 – CD4024A 7 stage binary counter
- IC4 – CD4011a quad 2 input NAND gate
- IC5 – 741 type op amp (optional)
- Q1, Q3 – 2N5088 NPN transistor
- Q2 – 2N3053 NPN transistor
- CR1, CR2 – 1N914 diode
- R1, R3 – 10k ¼ Watt resistor
- R2, R4 – 100k variable resistor
- R5, R6 – 47k ¼ Watt resistor
- R7-R11 – 1 meg ¼ Watt resistor
- R11 – 1k variable resistor (optional)
- C1 – .47 uF cap.
- C2 – .0047 uF cap.
- C3 – 1 uF cap.
- C4, C5 – .01 uF cap.
- S1 – Single pole double throw, center OFF toggle
- PB2 – Single pole double throw, momentary contact push-button
- PB1 – Single pole, momentary contact push-button
- PCB – Printed circuit board, available from author ($3.50)

Pin	1.	SCEI (GROUND TO COUNT)
	2.	CLOCK (INPUT)
	3.	CLEAR (HIGH TO COUNT)
	4.	RBI
	5.	BI
	6.	RBO
	7.	DECIMAL POINT INPUT
	8.	DECIMAL POINT OUTPUT
	9.	D OUTPUT
	10.	F OUTPUT
	11.	E OUTPUT
	12.	GROUND
	13.	G OUTPUT
	14.	C OUTPUT
	15.	A OUTPUT
	16.	B OUTPUT
	17.	Qa LATCH OUTPUT
	18.	Qb LATCH OUTPUT
	19.	Qc LATCH OUTPUT
	20.	Qd LATCH OUTPUT
	21.	LATCH STROBE
	22.	MAX COUNT OUTPUT
	23.	PCEI (GROUND TO COUNT)
	24.	VCC

Fig. 1. 74144 and 74143 pin connections.

Pin	1.	CLEAR
	2.	7 OUTPUT
	3.	6 OUTPUT
	4.	4 OUTPUT
	5.	5 OUTPUT
	6.	3 OUTPUT
	7.	2 OUTPUT
	8.	GROUND
	9.	1 OUTPUT
	10.	0 OUTPUT
	11.	8 OUTPUT
	12.	9 OUTPUT
	13.	$\overline{\text{LATCH}}$ STROBE
	14.	$\overline{\text{Qd}}$ OUTPUT
	15.	CLOCK (INPUT)
	16.	VCC

Fig. 2. 74142 pin connections.

Pin	1.	4 INPUT
	2.	5 INPUT
	3.	6 INPUT
	4.	7 INPUT
	5.	8 INPUT
	6.	C OUTPUT
	7.	B OUTPUT
	8.	GROUND
	9.	A OUTPUT
	10.	9 INPUT
	11.	1 INPUT
	12.	2 INPUT
	13.	3 INPUT
	14.	D OUTPUT
	15.	NO CONNECTION
	16.	VCC

Fig. 3. 74147 pin connections.

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New ICs for the Counter Culture

-- simpler counters with less used power

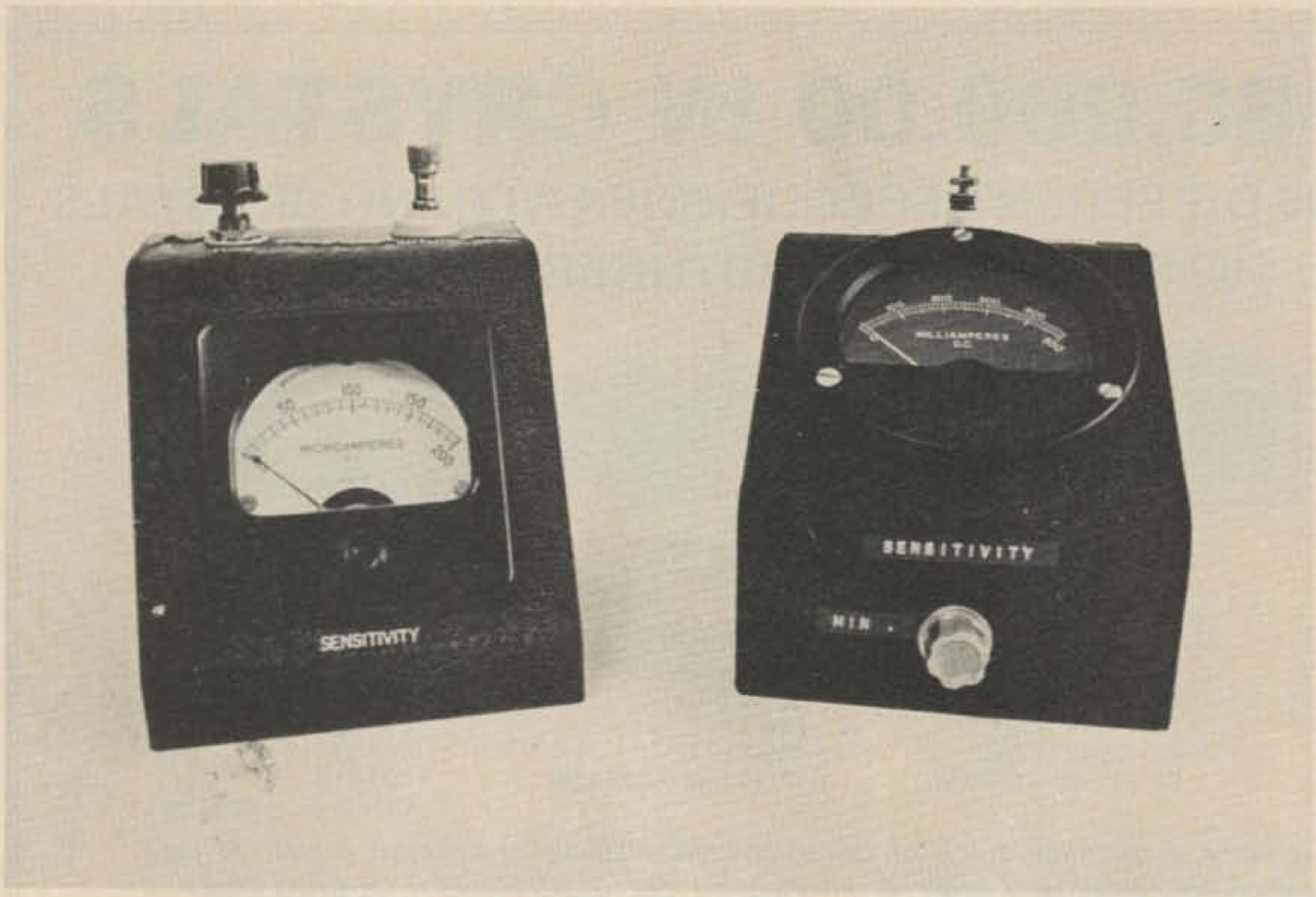
The continued evolution of the integrated circuit industry has led to some developments which are of interest to the average electronics experimenter. Over the past few years the 7490-7475-7447 counter-latch-decoder/driver combination has been the mainstay for the construction of readout modules using either LEDs or filament type seven segment readouts. Likewise, the 7490-7475-74141 combination has been the basis for readout modules using Nixie tube readouts. The cost of these ICs has continually declined resulting in a relatively inexpensive digital display. The major drawbacks for building such a module are the PC board layout for the three ICs and the rather high current requirements. The PC board layout is no big obstacle since many have been published in electronics magazines, but the high current requirement remains. As an example, suppose you want to build a frequency counter with a six digit display and using the simplest possible circuitry. For purposes of illustration, miniature seven segment incandescent readouts drawing 8 mA per segment will be used. In the worst case condition (all 8s on the display), the readouts will draw approximately 335 mA. The counter-latch-decoder combinations will draw approximately 750 mA. Total current requirements will then be 335 + 750 mA = 1.08 Amps. This is a pretty healthy load and would be operating a regulator such as the LM309K beyond its maximum limits. Thus anything that can be done to reduce this power requirement would be advantageous.

Once again the IC industry has come to our rescue. In their TTL *Data Book For Design Engineers,* Texas Instruments lists several ICs which are directly applicable to a construction project such as a frequency counter. The first IC to be discussed is the 74144. This device comes in a 24 pin DIP package and combines the features of the 7490-7475-7447 into one IC. All internal connections available from the three IC module are available from the 74144. For example, BCD outputs from the latch, RBO, RBI, latch strobe, carry output and look-ahead counting connections are all externally available. Other desirable features are relatively low current drain (65 mA) and simplified PC board layout. The one possible disadvantage is in the counting speed (typically 18 MHz), which may be a factor if high speed operation is needed. The seven segment outputs are "active low" and can handle 25 mA, thus making the 74144 suitable for driving incandescent readouts such as Numitrons (from RCA) and other filament type readouts in addition to LEDs. Using six 74144s in our counter would reduce the 5 volt current requirements from 1.08 Amps to 725 mA, which is well within the capability of the LM 309K regulator. A companion to the 74144 is the 74143. This IC has all the features of the 74144 plus current limiting outputs which are set at 15 mA. The 74143 is specifically designed for driving LED type displays. A base diagram for the 74144 and 74143 is shown in Fig. 1.

If your interest lies primarily with the use of Nixie tubes rather than incandescents or LEDs, TI has come to your rescue also. The 74142 contains the counter, latch and decoder/driver for cold cathode Nixie tubes and comes in a 16 pin DIP package. Only the necessary internal connections are brought out to pin connections, thus allowing use of the 16 rather than the 24 pin package. The base diagram is shown in Fig. 2. Again some savings in power consumption can be gained – typical current requirements for the 74142 are 68 mA versus 77 mA for the three IC combination. Maximum counting frequency for the 74142 is typically 20 MHz. This IC is also particularly attractive for frequency scanner applications.

Another IC which may be of interest to the experimenter is the 74147. This 10 line to 4 line encoder provides the capability of decimal to BCD decoding. In the past, if you needed a BCD code for some decimal number, either a diode matrix or a BCD switch was necessary. Both are relatively expensive and the diode matrix consumed a large amount of PC board space. Now, by using an ordinary single pole ten position switch and the 74147 IC, the BCD code can be derived directly from the equivalent decimal number. Fig. 3 contains the base diagram.

Most of the ideas presented herein were gleaned from the *TTL Data Book For Design Engineers* (CC-411) by Texas Instruments, and it is well worth the price. ■



Front view of "ERF" meters. Left: tuned input. Right: untuned input.

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Is My Rig Working or Not?

--build an effective radiated field meter and know!

How many times during a pileup or an unanswered CQ have you wondered, *am I really getting out?* Sure, you can check modulation, transmitter voltages and currents. And if you have a standing wave ratio meter, you can also check antenna match "swr."

But what about that rf field? After all, that's what counts! When you measure your rf field, you are in fact measuring total performance of your system. You may at first think such an instrument would be both expensive and complicated. It would be if you were interested in precise measurements. But we need only relative field measurements; therefore, adequate instrumentation can be both simple and inexpensive.

The circuits discussed are of two basic types: an untuned input and a tuned input. The untuned input provided no selectivity while the tuned input will measure the field and approximate frequency.

Construction

The construction of the meters is very basic and quite flexible. As you design rf meters for higher frequencies such as the VHF bands, you should place components so that lead lengths in the rf circuitry are as short as possible. The enclosures I used were Universal Meter Cases but most any type chassis or small cabinet will be adequate. The enclosure ought to be metal as the

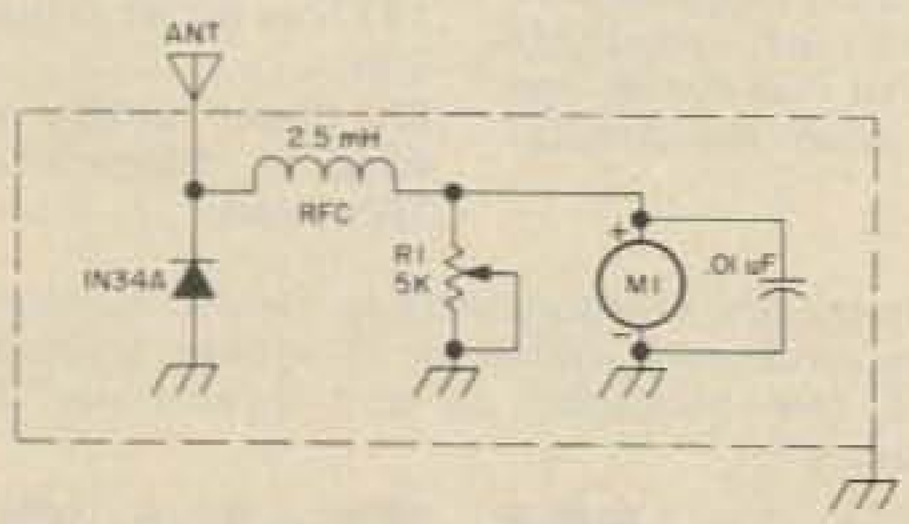


Fig. 1. Untuned circuit. M1 – Dc meter (see text). R1 – Sensitivity control.

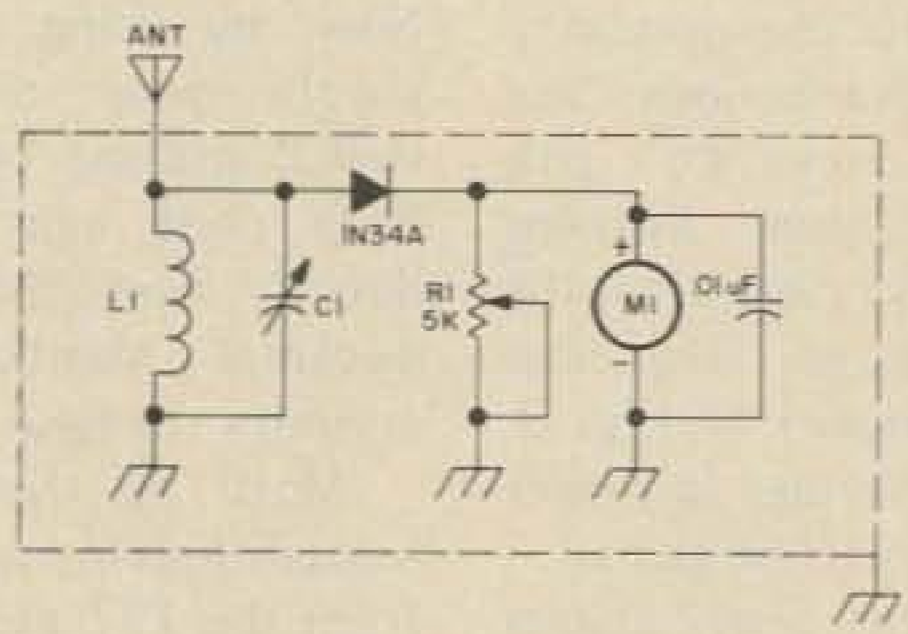
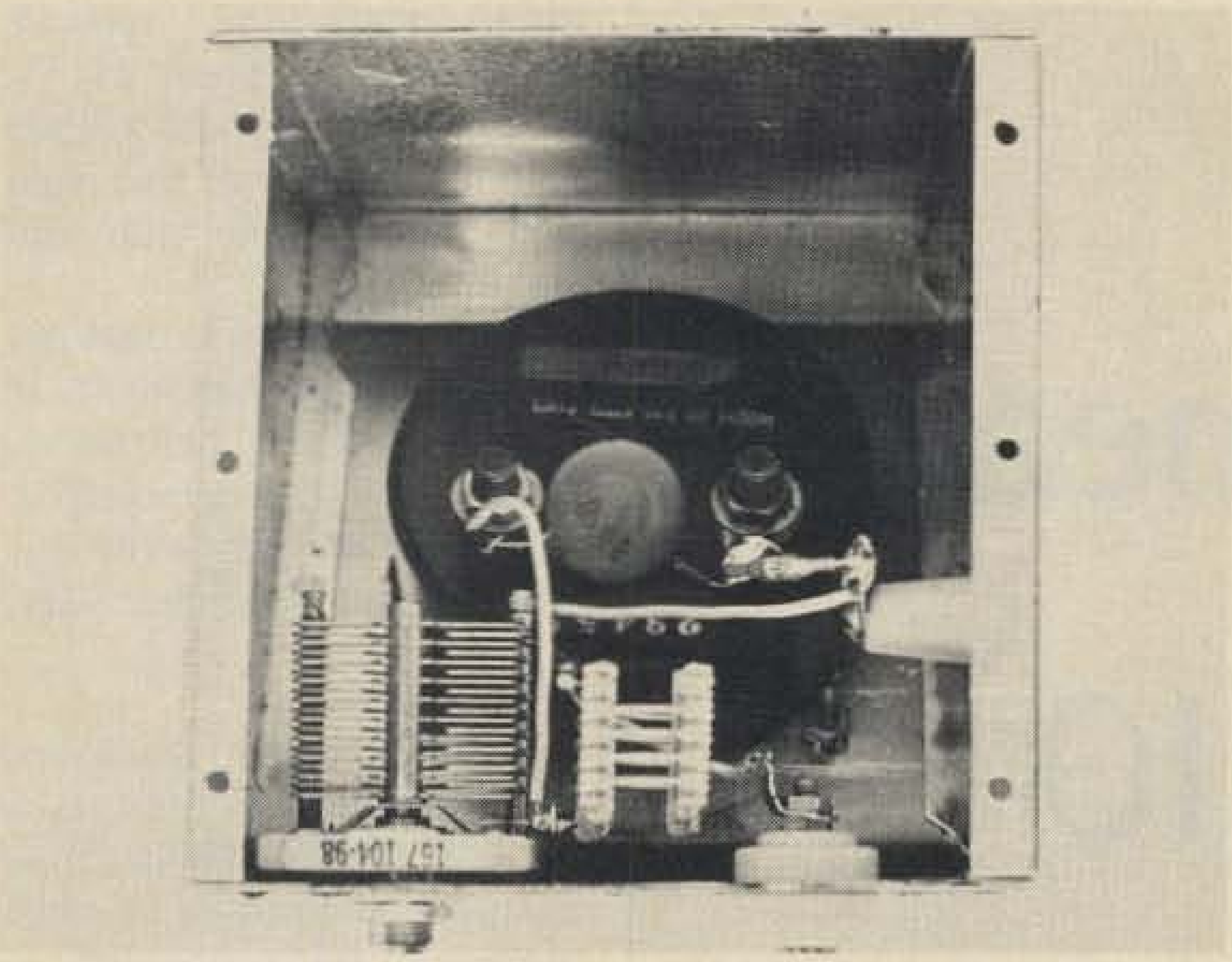
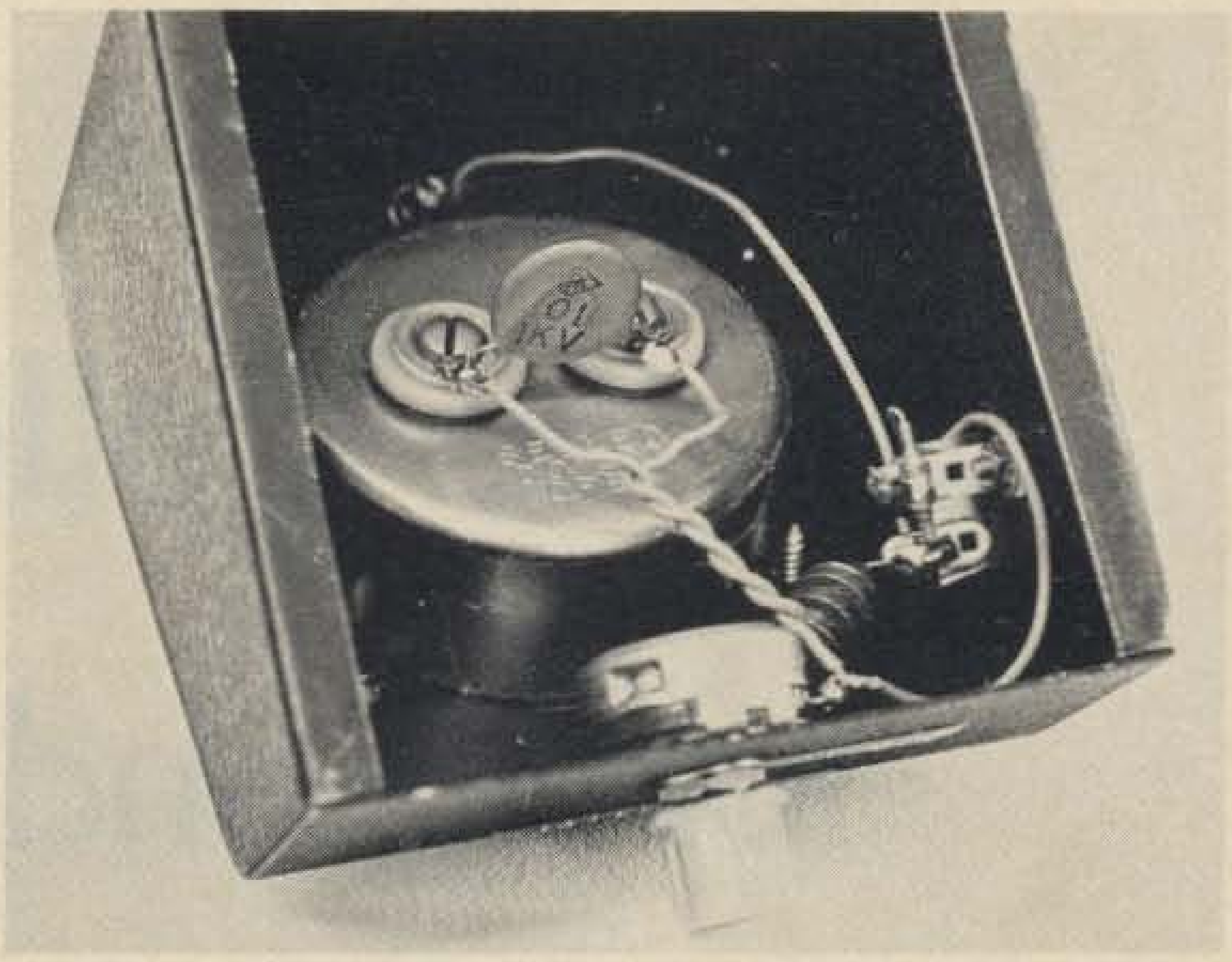


Fig. 2. Tuned circuit. M1 – Dc meter (see text). L1 and C1 – Resonant combination to cover frequencies you desire.



Internal view of tuned input meter.



Closeup internal view of untuned meter.

circuitry should be shielded. To shield the Universal Meter Case, I used some roof valley aluminum to enclose the rear opening. It can be easily cut to size with hand scissors. You will find this available at most lumber yards or hardware stores.

Instrument Sensitivity

Sensitivity of the instrument is determined by the full scale deflection of the meter chosen. The smaller the full scale deflection, the greater the sensitivity; for example, a 0-50 uA meter will be more sensitive than a 0-1 mA meter. I used a 0-1 mA meter for the untuned meter and a 0-200 uA meter for the tuned meter.

The length of your reference antenna will also affect sensitivity: the longer the antenna, the greater the sensitivity. Also, dc resistance of the rfc will affect sensitivity. Choose an rfc with low dc resistance for maximum sensitivity.

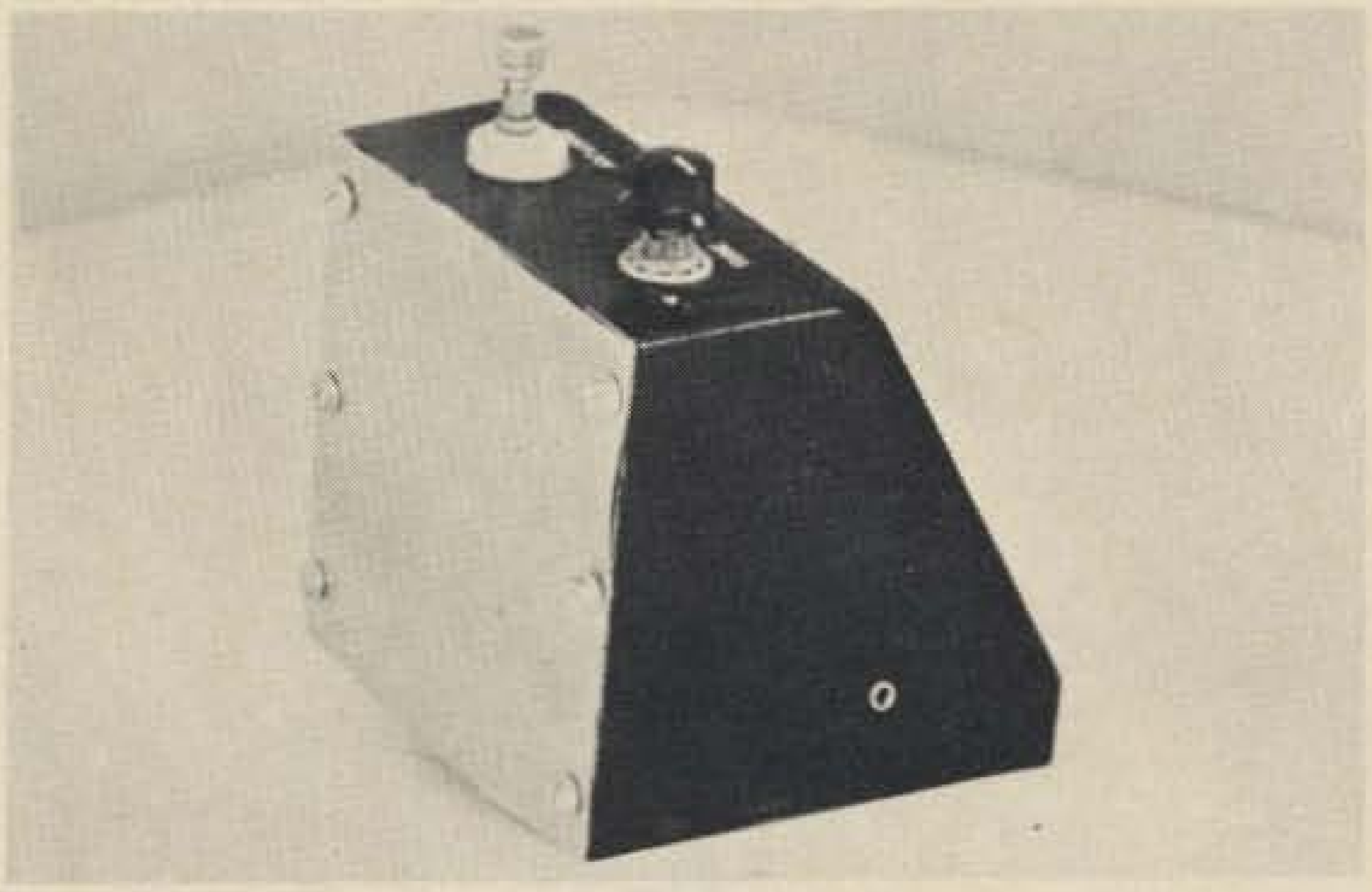
Instrument Application

Once you have your field strength meter constructed and operating, you can begin making some reference measurements for future use.

What I do is install a small reference antenna outside the immediate area of the transmitter; it does not have to be a great distance from it. The important item is not to change the location or length of the reference antenna once you start basic measurements.

For measurements with a beam, I note and record on paper degrees of rotation "direction" and power input into antenna transmission line. With a dipole or fixed array, direction need not be recorded, but you must record input. Next, I proceed to measure field strength with the meter. I record in my log the relative reading for future reference, and if I suspect a problem antenna or otherwise, I immediately go back to my original readings and make a measurement. If you have significant energy loss in your ERF, it will show.

You will also find the "ERF" meter a valuable instrument for mobile or portable operation. ■



Back shielding of meter. Constructed from roofing valley aluminum.

Quickie Collinears for 15 and 10

- - satisfaction guaranteed

John Skubick K8ANG
1040 Meadowbrook
Warren OH 44484

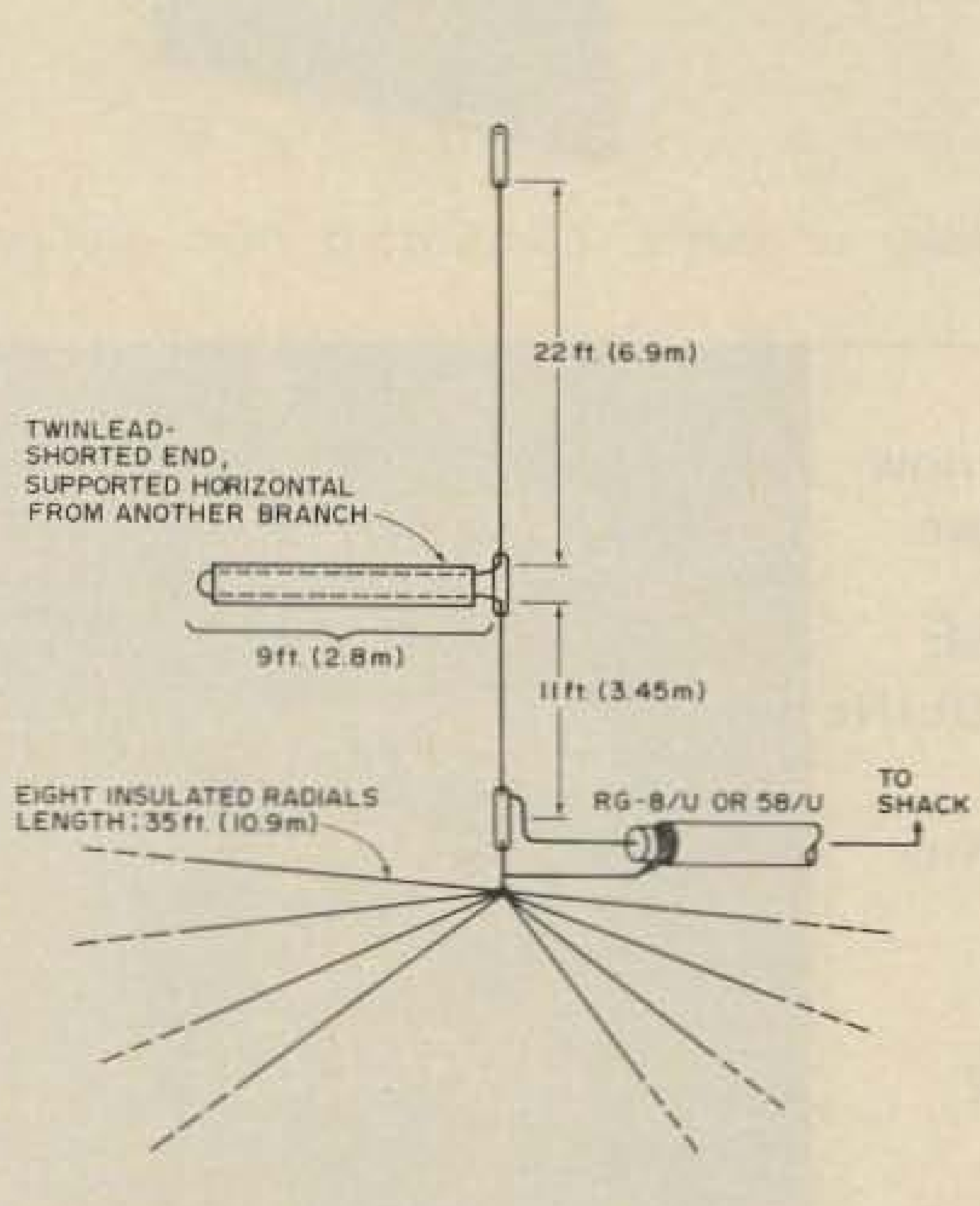


Fig. 1. 15m collinear.

I had just moved into another house. I needed two more continents for WAC, it was sleeting outside, and no antennas! This could only happen to a ham. I had to think of something!

The idea was to pack as much gain as possible into a simple antenna that I could quickly build with available leftover materials. The *ARRL Antenna Book* provided the initial data. I chose 15 meters, because my rig has only 80 Watts output. There were too many high powered boys on 20, and 10 meters was too sporadic. See Fig. 1.

Construction

The two vertical sections and the eight radials were made from carefully measured, 18 gauge, insulated, solid hookup wire. The quarter wave stub was cut (using the 0.82 velocity factor) from a piece of TV twinlead. Some old ribbed ceramic insulators I had were used at the base, stub and top.

The whole works was put together in my basement, in about one and a half hours. Then I coiled up everything, coax and all, and went out into the mid-November sleet.

Installation

One of my backyard maple trees was used as a "mast." I tied fishing line around the head of a small hammer, and proceeded to toss this up and over an estimated forty foot high branch. After about a hundred or so attempts, the line was over the branch and tied to the antenna's top insulator. This was then hoisted up until the antenna's bottom insulator (with coax and radials attached) was clear of the ground by about one foot. The bottom insulator was held in place with another piece of fishing line tied to a short stake pounded into the ground just below it. I then spread the insulated radials out along the ground, and placed rocks at their ends to keep them taut.

The RG-58 feed line was also left on top of the ground. I brought it into the basement through a small hole drilled into the metal window frame. Then I soldered a coax connector to the end.

Results

I warmed up the rig, attached it (along with the coax) to my swr bridge, and then switched it to "tune." *Horrors* – 4:1 swr! I looked outside. It was getting dark and still sleeting. I removed the swr bridge.

For the next three hours, I was working VKs, ZLs and JAs – for the first time. Just what I needed for my last two WAC continents! I left the antenna "as is" all winter.

Twinlead	Open wire
6.7 ft	7.7 ft
20 ft	23.2 ft
33.4 ft	38.7 ft
48.8 ft	54.2 ft
60.2 ft	69.7 ft
73.5 ft	85.2 ft
86.9 ft	100.7 ft
100.3 ft	116.2 ft

Table 1. Odd multiple lengths of balanced transmission line, using velocity factors of 0.82 for solid dielectric types, and 0.95 for open wire types. All lengths are subject to trimming for low swr.

I wanted to get on ten meters as quickly and as *cheaply* as possible with a gain antenna, using available materials in my junk box. After looking through my references, I reasoned that a wire-type two element collinear might just do the job. I was looking for performance at the low radiation angles. Also, I did not want to pump any rf directly into the ground from the transmission line. In other words, I wanted *no* messy, lossy (for practical amateur installations) radial system with this vertical.

Fig. 2 shows what my junk box yielded, as well as the dimensions. I used 450 Ohm TV open wire for the elements, to help broadband the system. I also decided to bring the balanced feeder all the way into the shack, because I was not about to do any outside tuning and pruning in the middle of winter. My twinlead feeder was the UHF oval-foam type. The important thing here is to use something with low loss. Open wire feed will have to be used for high power. You can use the TV or home brew variety of open wire lines.

My balun is a 4:1 toroid type. Possibly a 1:1 balun can also be used, because the feed line has to be trimmed for minimum swr anyway. If you have a tuner, no balun is needed, of course. The balanced feeder may still require a little trimming, if you are experiencing difficult loading, for 1:1 swr.

Construction and Installation

The elements were laid out on the basement floor, measured, and cut. I attached three ceramic insulators (top, middle and bottom), along with the twinlead feed line. All of this was then coiled up and taken outside. I selected one of my backyard maple trees and sighted on an estimated 35 to 40 foot branch. After the usual countless attempts at tossing a weighted fishline, I finally got it over the branch. A heavier cord was tied to this and to the top of the collinear, and then hauled up until the antenna's bottom insulator cleared the ground by about one foot. I tied the bottom insulator to a stake that was sledgehammered into the frozen ground directly below.

A "strain guy" made of fishing line was tied around the center insulator. This was to counteract the opposite pull of the (sort of) horizontally supported feed line. Some branches from another tree supported the feed line (more fishing line). At the house, the feeder was attached to TV standoff insulators (about every six feet) down to the basement window. I drilled and filed out an oversized hole in the window's metal frame, and inserted a large grommet. Purists take note. I then pushed the balanced twinlead feed line through this grommeted metal-surrounded hole.

(See Table 1, and make sure you have several feet of extra twinlead for trimming purposes.)

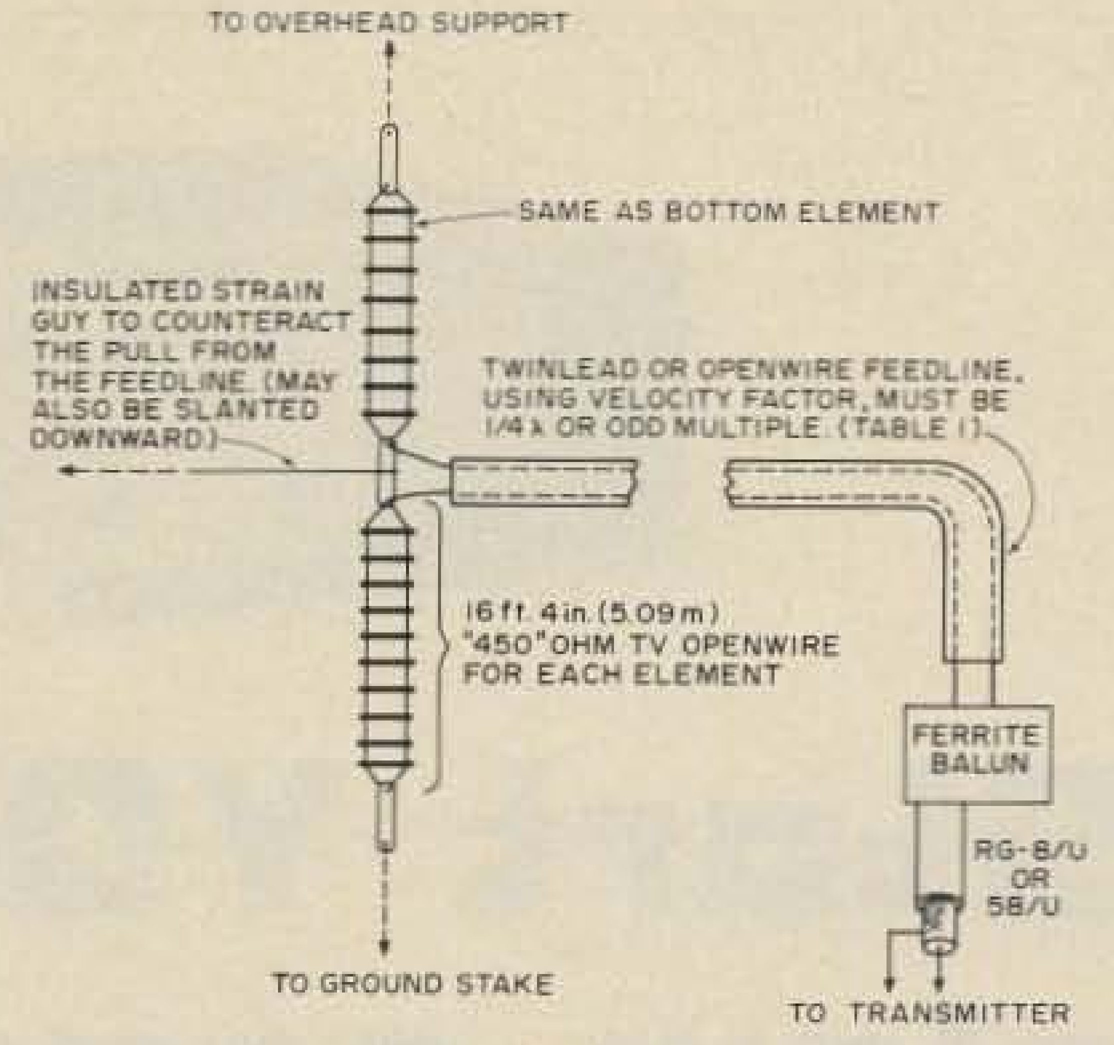


Fig. 2. Vertical collinear for ten.

The Tuneup

The rig was fired up into the swr bridge, with the balun and feed line attached. Reduced power was used at first, and a frequency sweep was made across the entire ten meter band. Well, how about that! The lowest swr (8:1 for my installation) occurred at 28.6 MHz! At that point of lowest swr, I then trimmed the twinlead for 1:1. Another frequency sweep was made. The swr was 1.8:1 at 28.005 and 2:1 at 29.65 MHz. The broadbanded construction paid off!

Results

The sporadic nature of ten meters made it difficult to evaluate. However, I was easily able to work the DX (when it was there) with my 260 Watts PEP transceiver. Needless to say, I was satisfied! ■

References

1. *Antenna Roundup Vol. 2*, Cowan Publishing Corp., pp. 16-17.
2. *ARRL Antenna Book* (1968), pp. 84, 138-140, 208.

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500 MHz Scaler

- - PC boards are available

Although integrated circuits for a 500 MHz frequency scaler have been available for a number of years, their price of $50 and up has been a stumbling block to the average ham. Recently, however, Fairchild introduced their 11C90 UHF decade counter which, at only $16 in single quantities, represents a real breakthrough for those needing a way of counting frequencies to 450 MHz and above. Although operation of this IC is only guaranteed to 550 MHz, the typical 11C90 will reach 650 MHz and beyond.

This article presents a simple and low cost prescaler using this IC which may be built for as low as $20. To ensure simplicity and low cost, an input amplifier is omitted and thus the scaler is a bit finicky as to the amount of rf it needs. In practice, it will accurately monitor the frequency of a 2 meter or 450 MHz 1 Watt walkie-talkie from a distance of about 3 feet away. Higher power transmitters can be located farther away.

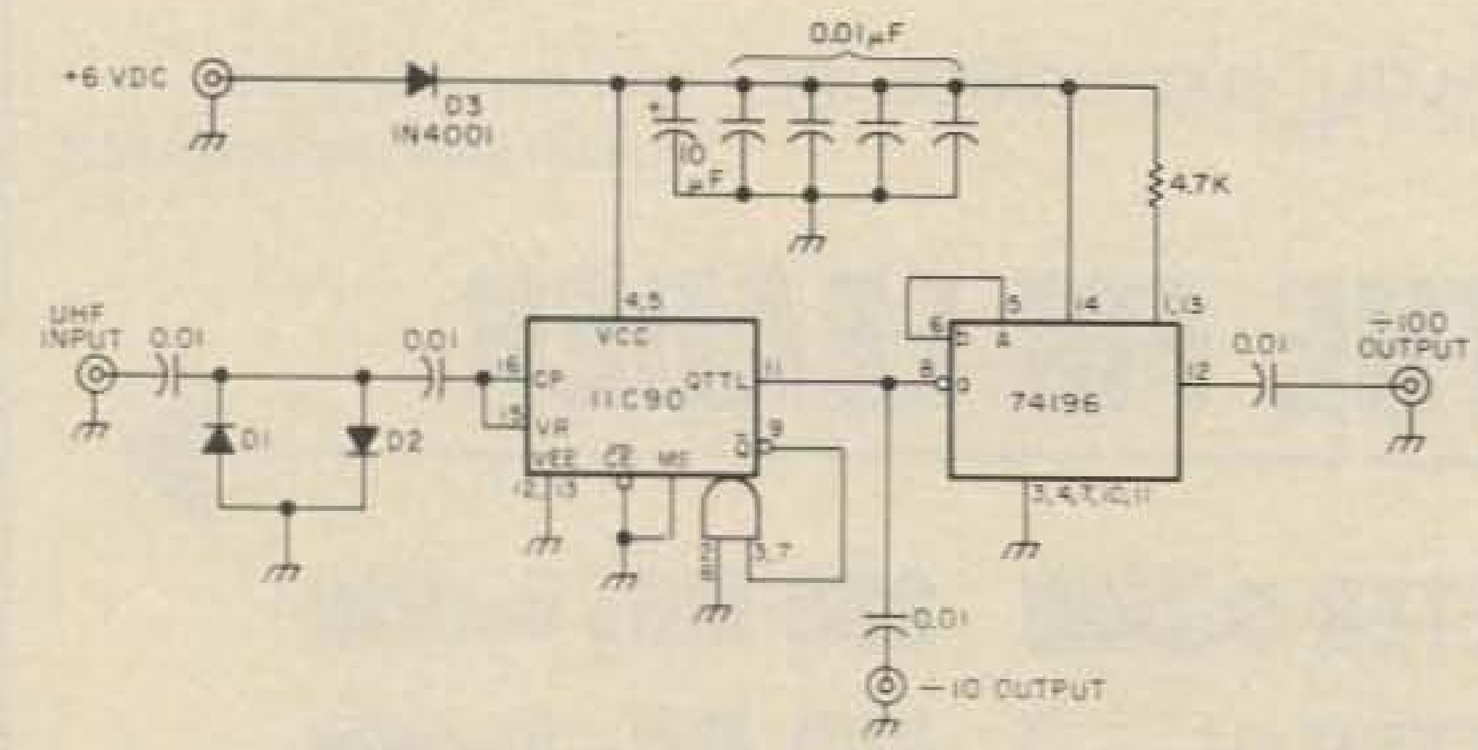


Fig. 1. 500 MHz scaler diagram.

Since the 11C90 divides by ten, the output will be in the range of about 45 MHz with an input frequency of 450 MHz. This is perfectly acceptable if you already have a counter or scaler which will cover that range. For example, the K2OAW VHF Scaler (see *73 Magazine* for June 1973) or the K2OAW VHF counter (*73 Magazine*, November 1974) make an ideal companion for this new scaler. But if your counter does not have a high enough frequency range, then this scaler design has room for an optional 74196 TTL decade counter which provides an additional division by ten. A 450 MHz input frequency will then be converted to 4.5 MHz.

Fig. 1 shows the circuit of the scaler. An input to be scaled is coupled to the CP input of the 11C90 through a simple protective circuit consisting of diodes D1 and D2. Fast switching diodes such as 1N914 or 1N4148 should be used. Actually, these two diodes don't furnish much protection at UHF; to work at UHF, special high speed diodes would have to be used. Such diodes are not only hard to get, but are also very fragile. When driven from a short antenna with a source resistance of 50-70 Ohms, they would probably burn out even before the 11C90 was in danger. Instead, we put in D1 and D2 mainly to guard against inadvertent low frequency overload, and rely on a little care on your part to avoid overload. The specified input sensitivity of the 11C90 is approximately 200 mV rms, and the maximum signal should be less than 1 volt at frequencies below 450 MHz, decreasing to less than 500 mV at 600 MHz.

The 11C90 has a built-in level converter which provides a TTL-compatible output at pin 11. If your counter covers a high enough frequency, this output can be used as is. If needed, you may add the 74196 as a second decade counter as shown.

A compact arrangement with short leads and a solid ground is needed. It is recommended that a printed circuit layout (such as Figs. 2 and 3) is used. (Etched and drilled boards are available for $7 each from Star-Kits, G.P.O. Box 545, Staten Island, N.Y. 10314.)

The entire scaler requires

less than 150 mA from a 5 volt power supply. Though a simple supply could be built, in practice a battery supply is an easier and better choice. Four D cells or a lantern battery will provide 6 volts dc, which will drop to about 5.25 volts after the 1N4001 diode. If you use four nicads, the diode is not needed as the nicads will supply 5 volts directly. But a good stiff supply is needed – penlight cells won't do.

Both ICs are very sensitive to extraneous signals on the power and ground lines. If you look at the diagram and at the circuit board layout, you will see four 0.01 uF capacitors bypassing the 5 volt line to ground. (One of these capacitors is not shown on the circuit board layout as it is soldered directly from pin 4 to pin 13 on the copper side of the board, under the 11C90.) Disc ceramics with very short leads should be used.

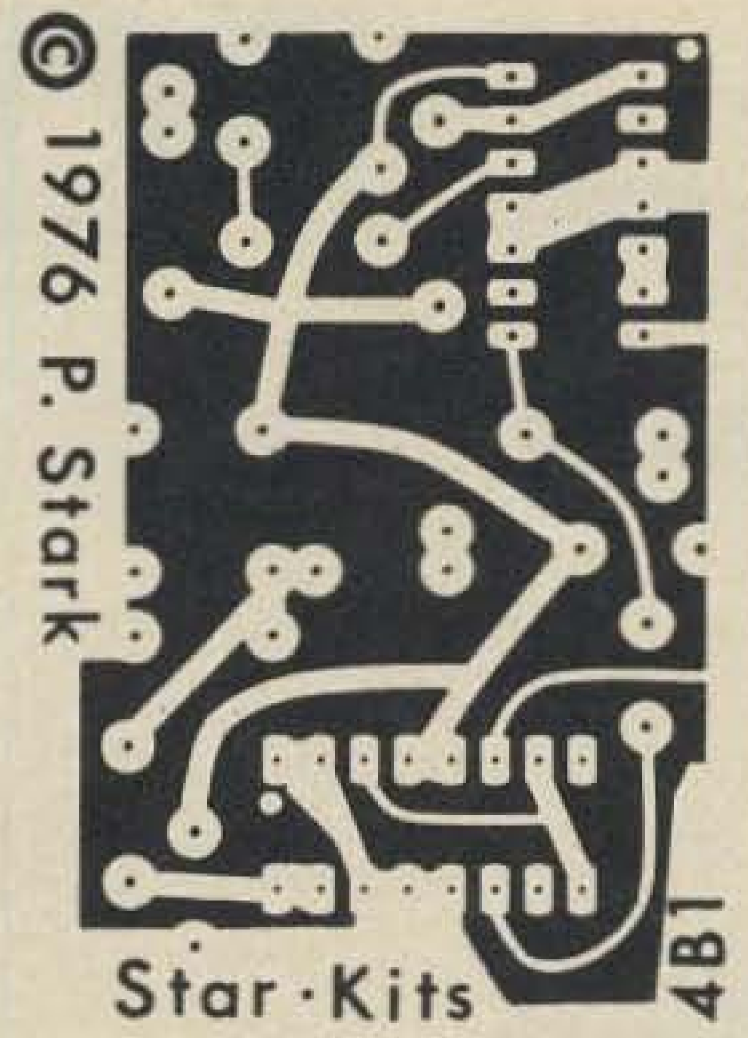


Fig. 2. PC board, foil side (full size).

The entire scaler should be enclosed in a metal cabinet with coax cable used for coupling to the counter. Batteries or power supply should also be in the cabinet to avoid stray rf on the power leads. If desired, the scaler can be mounted inside the counter cabinet.

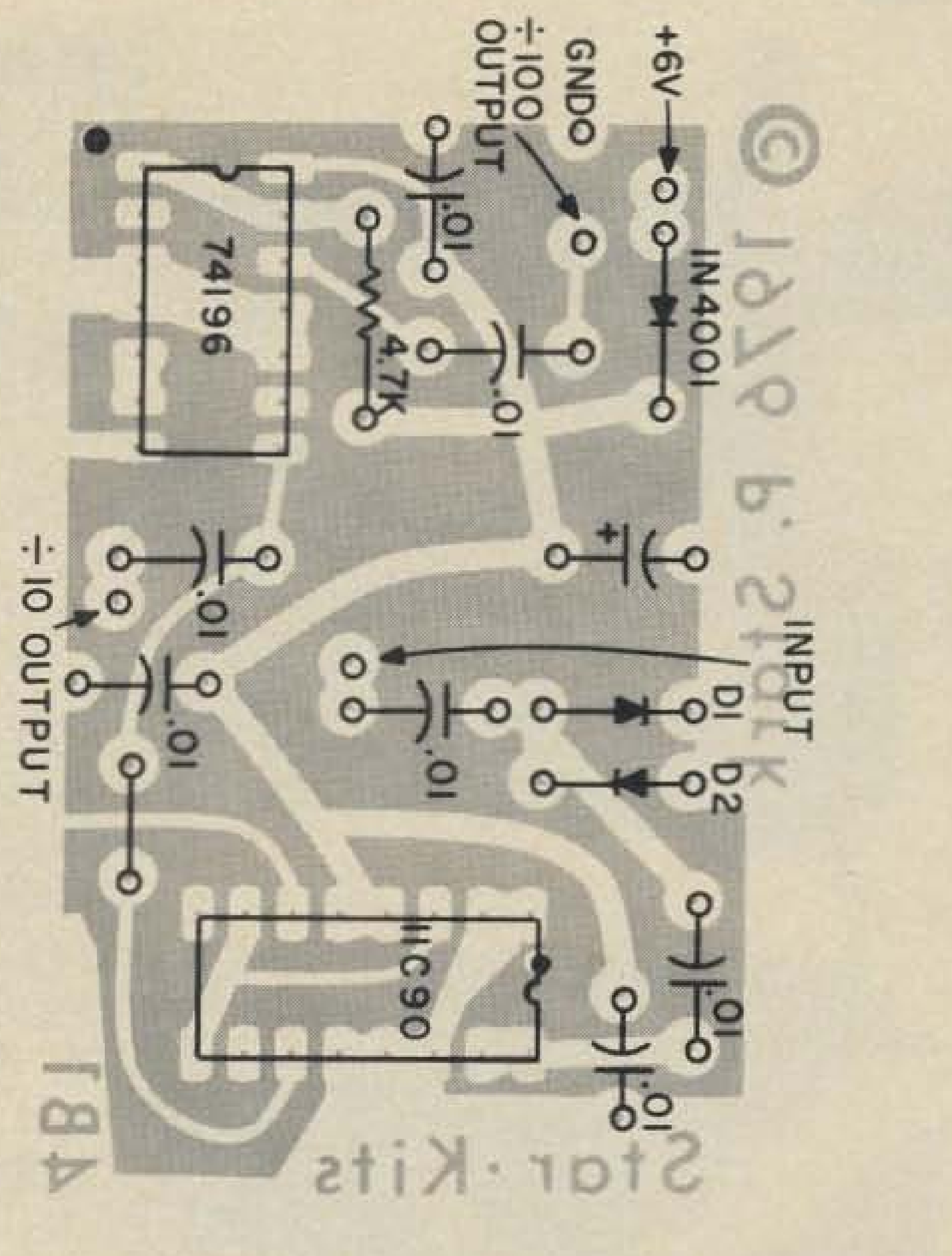
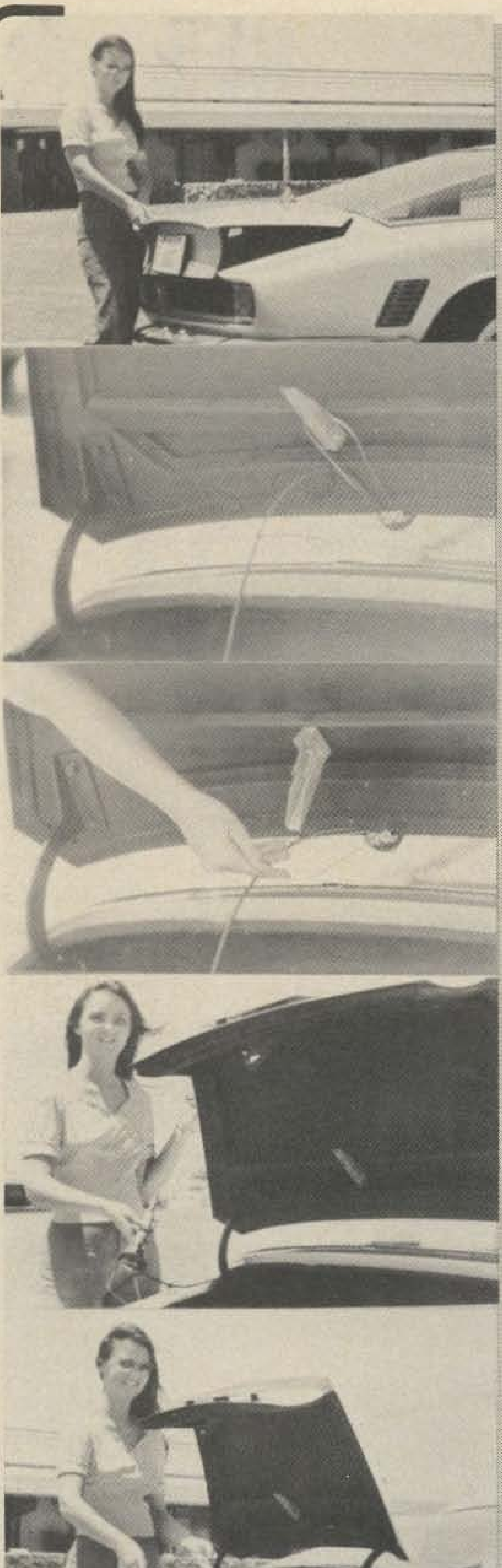
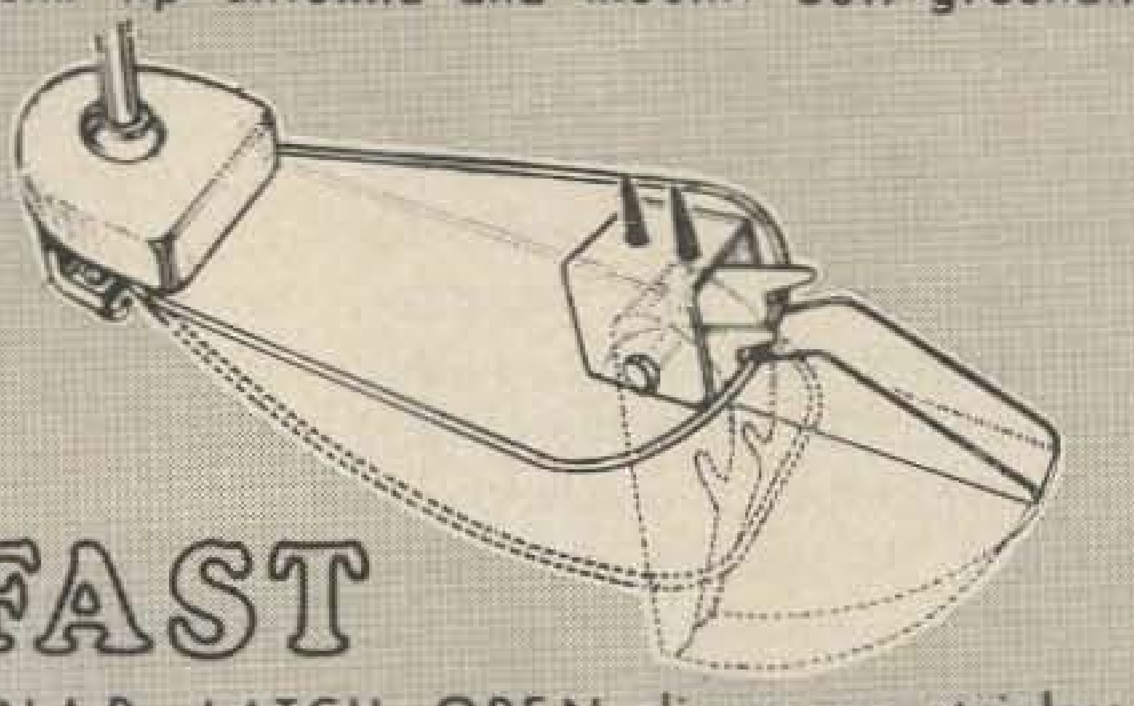


Fig. 3. Component layout.

Except for these simple precautions, this scaler is easy to build. My thanks go to Fairchild for the excellent – and cheap – scaler IC. At $20 for all the parts, this scaler circuit is an excellent value. ■





Build a Super Standard

- - goes right down to 1 Hz

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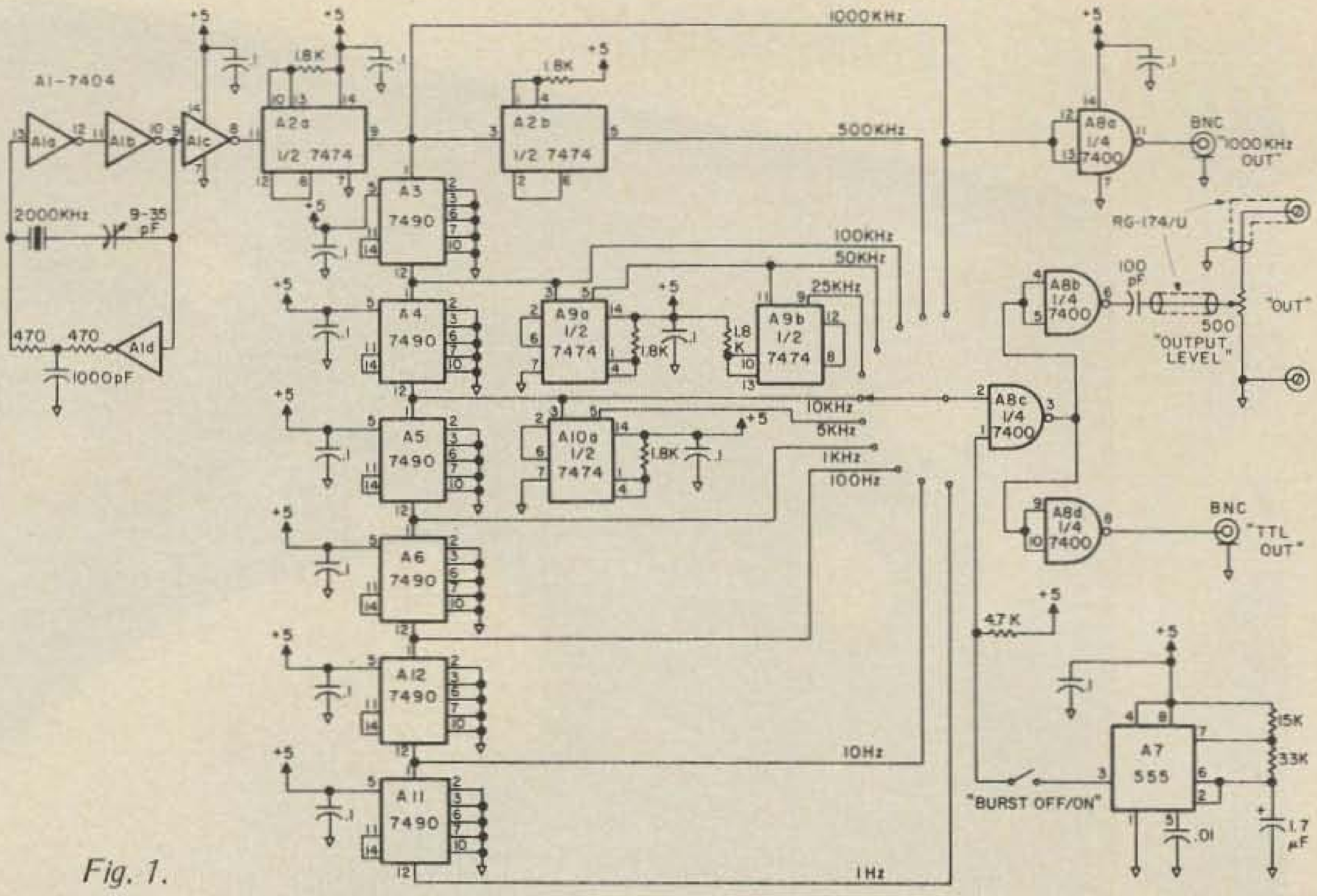
With the proliferation of subbands and interference-obscured net frequencies, the use of an accurate secondary frequency standard is both good operating procedure and also helps fill our legal requirements for frequency measurement capability under FCC regulations. In addition, such a standard can be used as a timebase or signal injector to test digital logic circuits.

The WA7VVC frequency standard was designed to be a low cost answer to the need for a good secondary frequency standard. It generates marker signals of 1000, 500, 100, 50, 25, 10, 5, and 1 kHz, and 100, 10, and 1 Hz. With harmonics usable well beyond 30 MHz, markers are available to denote subband edges, align receiver dials, find net frequencies, and measure the frequency of unknown signals. Should your latest logic circuit not perk properly, two TTL level outputs are available as substitute clocks or signal injectors.



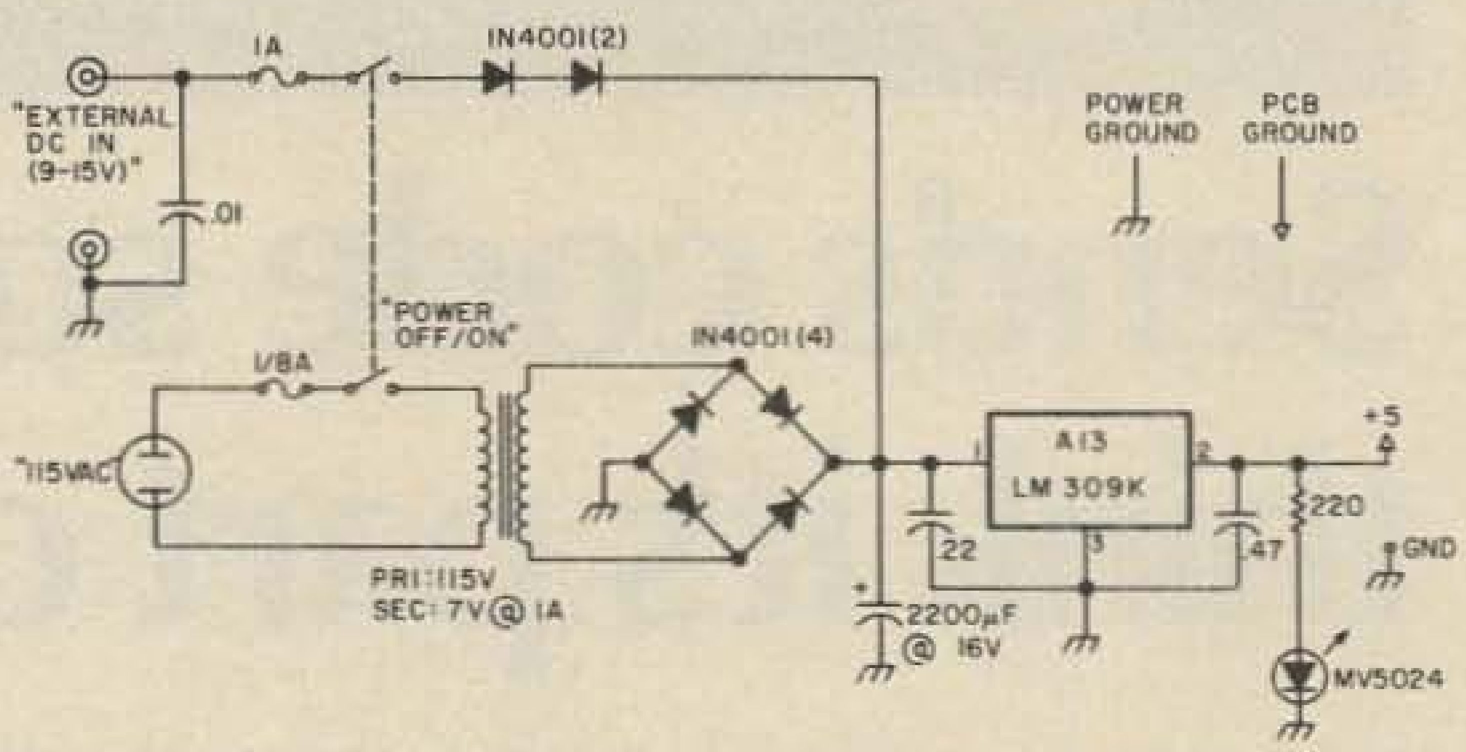


Fig. 1.

Short term accuracy is approximately 1 part in 10^6. The unit is easily aligned to WWV with a short wave receiver. An attenuator is included to permit matching signal strengths with the received signal so that a zero beat can be easily and accur-

ately identified. Only one trimmer need be adjusted to align the standard.

With the standard still attached to the receiver and providing an audible measure of its accuracy, a counter or other TTL-compatible device may be attached to either TTL output and that device's accuracy checked.

A frequency burst mode is provided to allow identification of the standard's markers in a crowded receiver passband. Enabling the burst turns the output on and off ten times per second, resulting in an easily recognized "beep-beep-beep." This burst is also available on one TTL output.

An external dc input makes operation in the field possible. 9-15 volts at 250 milliamps is all that you will need to have an accurate standard available for Field Day. This is cheap insurance against FCC out-of-band citations.

Circuit Description

The active devices in the frequency generation chain are 7400 series TTL. They are readily available, easy to use, inexpensive, and capable of the fast rise times necessary for high level high frequency harmonics.

The oscillator shown in the schematic of Fig. 1 uses a 7404 hex inverter, A1, with a 200 kHz crystal as the feedback element for frequency stability. This circuit provided the cleanest output of those I tried. I happened to have a 2000 kHz crystal on hand but the circuit will work with a surplus 1000 kHz crystal. In fact, you can eliminate one 7474 package by using a 1000 kHz oscillator.

Frequency division is accomplished by 7474 dual type D flip flops A2, A9, and A10, and 7490 decade counters A3-A6, A11, and A12 wired for division by ten. The 7474s are used as toggle flip flops by connecting $\overline{Q}$ to the data input. Preset and clear are not used and are tied high through 1.8k resistors. The 7490s are ripple counters and are prone to spikes and level changes in their output. Proper bypassing of all ICs is necessary to prevent these devices from putting spikes on the power buses. The .1 uF bypass capacitors are not superfluous – use one at each IC.

The various frequency outputs are selected by a rotary switch and fed to A8c, one section of a 7400 quad gate. The selected frequency can either be passed without change or gated with the 10 Hz output of A7, an NE555 astable oscillator, producing an easily identified frequency burst at the output terminals.

Should you not have a switch with enough positions to suit your needs or just wish something different in the way of frequency selection, try the electronic switch of Fig. 2.

The NE555 timer A14 is used as an astable oscillator whose output is a train of 24 millisecond low-going pulses with a period of .81 seconds. A15a inverts this to a train of positive-going pulses. A15b and A16a gate the pulse train under control of the STEP push-button switch.

On each low-going pulse edge at pin 14, the 7493 binary counter A17 increments by one. A16b forces a reset on a counter output of 1011, permitting outputs from 0000 through 1010 to select the eleven frequencies

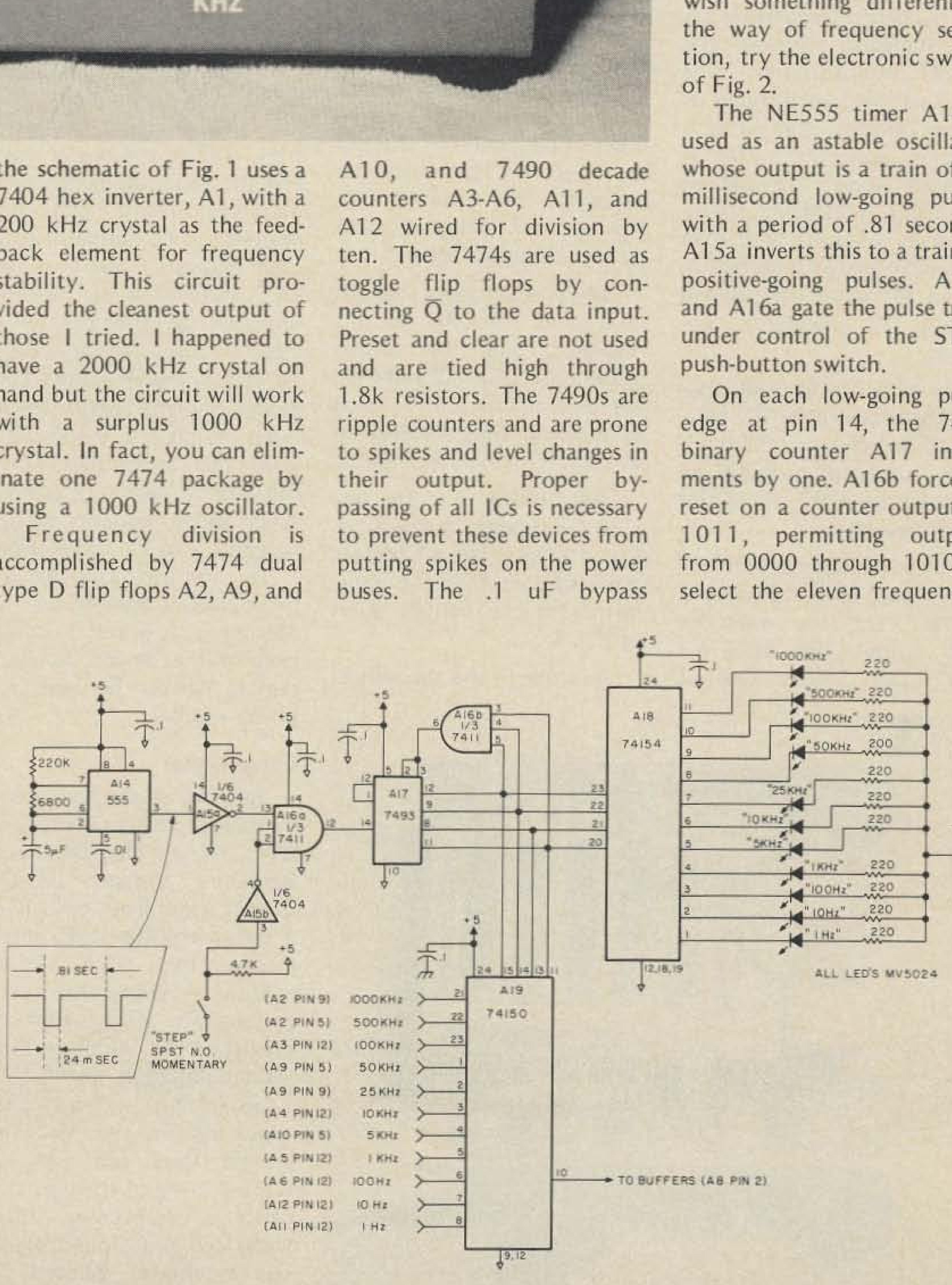


Fig. 2.

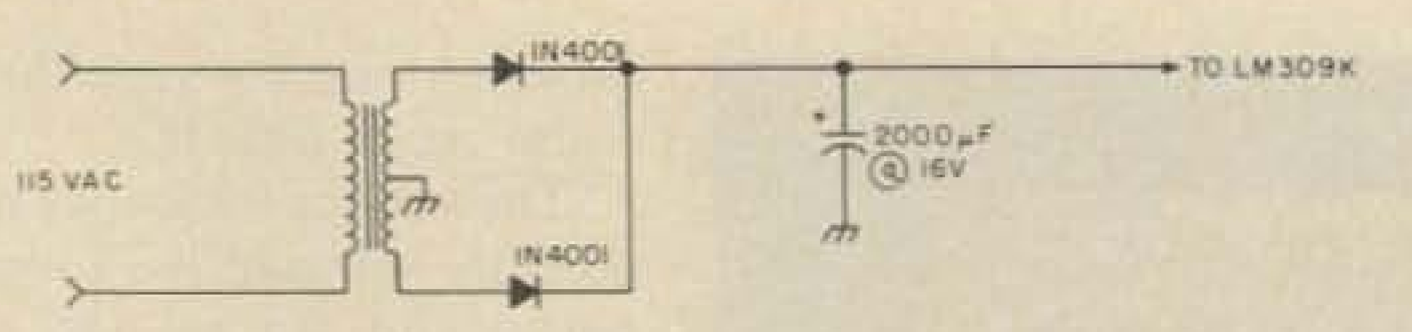


Fig. 3.

of the standard.

The binary output of A17 causes the 74150 multiplexer A19 to select a signal from its inputs to be fed to the standard's output buffers. A18, a 74154 binary to one of sixteen decoder, enables the corresponding LED.

To change frequencies on the standard, depress the STEP push-button. The standard will step through its eleven outputs, one every .8 seconds, until the button is released. When the desired frequency is reached, as indicated by its LED, you have three-quarters of a second in which to release the button before the standard steps again.

Because of the additional current required by the electronic switch, the 2200 uF filter capacitor should be changed to 4700 uF if this circuit is added.

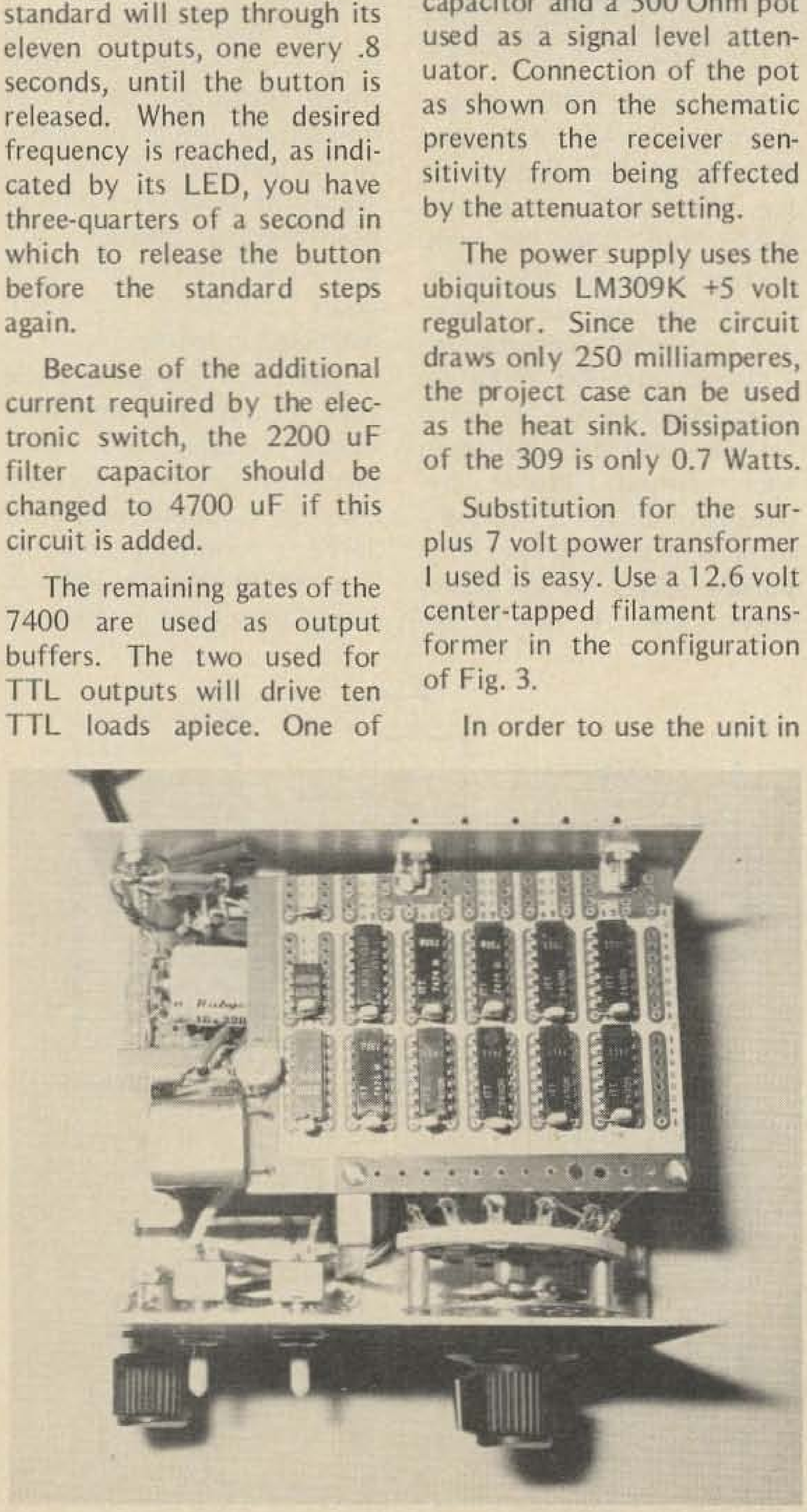
The remaining gates of the 7400 are used as output buffers. The two used for TTL outputs will drive ten TTL loads apiece. One of these gates buffers the 1000 kHz output of A2a and makes it available at a BNC jack on the rear panel. The other takes the output of A8c, which is controlled by the frequency selector and the BURST switch, and makes it available at a BNC jack.

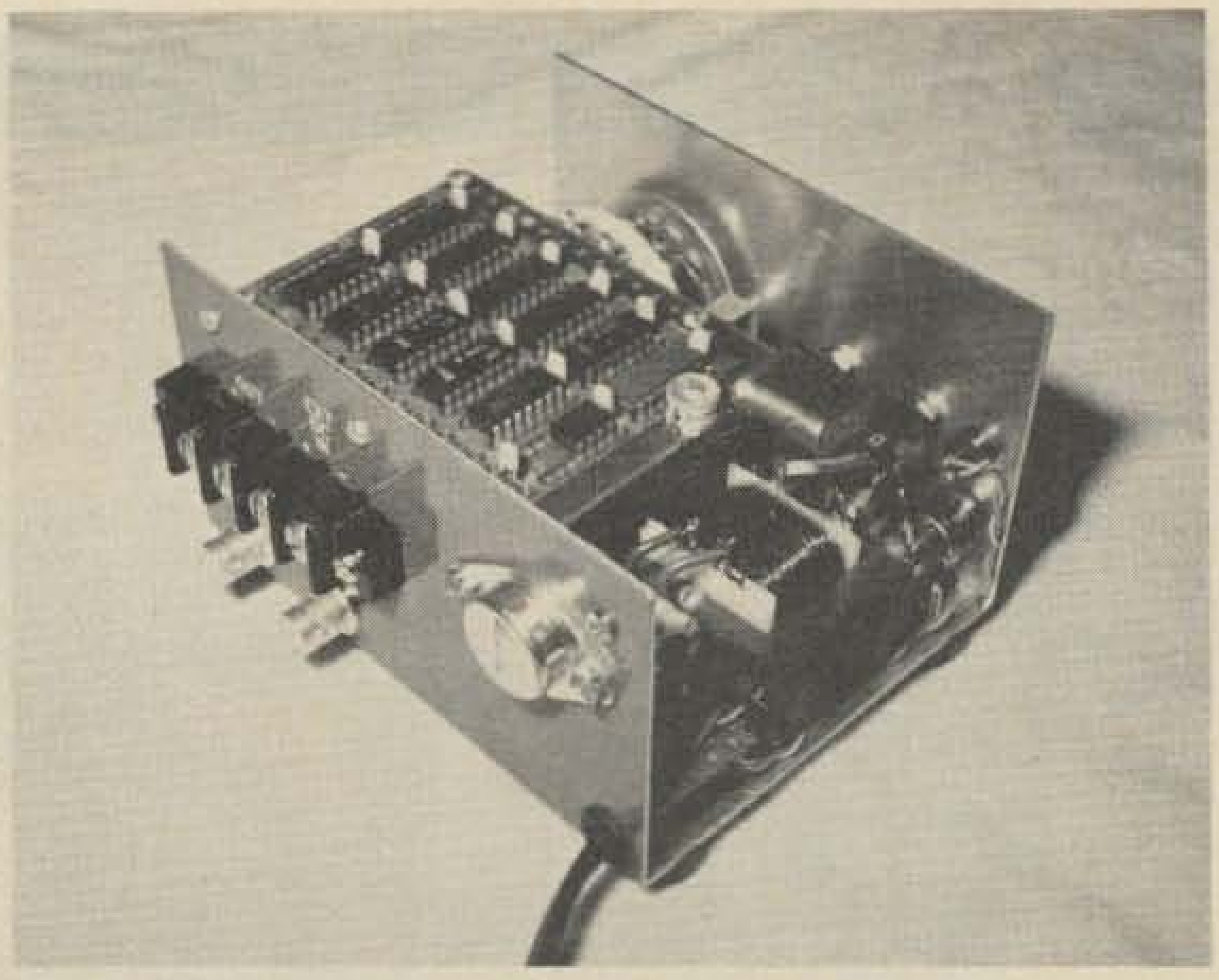
The output to a receiver is from A8b through a 100 pF capacitor and a 500 Ohm pot used as a signal level attenuator. Connection of the pot as shown on the schematic prevents the receiver sensitivity from being affected by the attenuator setting.

The power supply uses the ubiquitous LM309K +5 volt regulator. Since the circuit draws only 250 milliamperes, the project case can be used as the heat sink. Dissipation of the 309 is only 0.7 Watts.

Substitution for the surplus 7 volt power transformer I used is easy. Use a 12.6 volt center-tapped filament transformer in the configuration of Fig. 3.

In order to use the unit in





the field, provision is made for an external dc input. The .01 uF capacitor removes stray rf from the power lines and the series diodes prevent damage from polarity reversal. Two diodes were used because I feel that the 14.5 volts of a car battery under charge come perilously close to the filter capacitor's 16 volt rating. With the two diodes shown, applicable dc input voltage is 9-15 volts. With the appropriate filter capacitor voltage rating and a single diode, voltages in the range of 8 to 25 can be used.

Do not leave out the .22 uF bypass capacitor on the 309 input. It prevents oscillation of the device should a remote battery be used as a power source.

Construction

Because of the high speed switching characteristics of TTL and the high frequency harmonic content of the output waveforms, each IC is a transmitter and each interconnecting wire is an antenna. A thoughtful layout and careful construction are important to minimize unwanted radiation.

Switching transients appearing on the Vcc and ground lines can add unwanted noise to the output. I used a prototyping board with Vcc and ground planes to minimize glitches. A printed circuit board would be even better. If you wish to build the circuit with wire wrap sockets on vectorboard, use bus wire for the power leads to the sockets. An effective technique is to interleave Vcc and ground bus wires for each row of IC sockets, with a row not containing more than a half-dozen ICs.

Bus wire should also be used to connect the board directly to the 309. Do not invite problems by grounding the board to the chassis. Connect the chassis to the 309 case, the board to the 309 case, and the rectifier ground to the 309 case. This prevents the board ground from rising above the power ground and developing noise problems.

Asynchronous TTL devices such as the 7490 generate plenty of switching transients. Put a .1 uF bypass capacitor between Vcc and ground at each device socket and another at the power input to the board. Bypass the 309 input and output as shown in the schematic to prevent spikes and oscillation.

The leads connecting the frequency divider ICs and the selector switch make excellent antennas, so shield the output from the board to the attenuator pot and from the pot to the output terminals with RG-174 coax to reduce unwanted pickup. Long unshielded leads will reduce the effective control range of the pot.

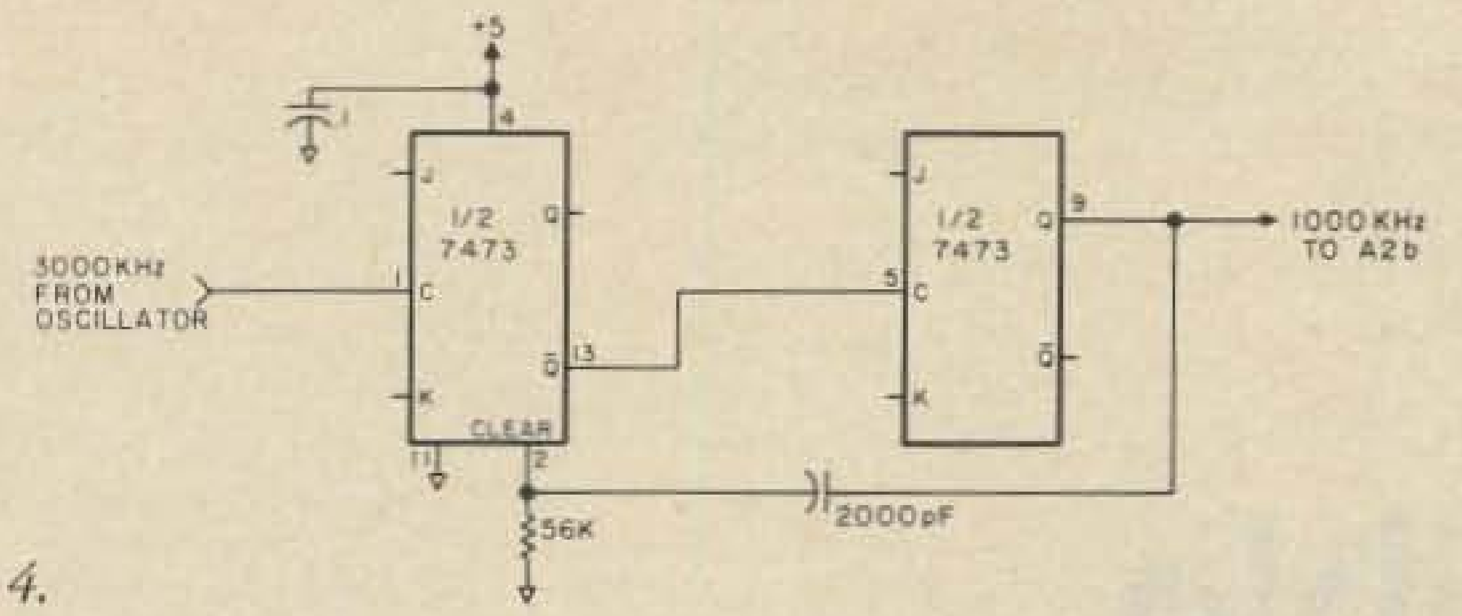


Fig. 4.

Mechanical stability will be reflected in electrical stability. Rigidly mount the crystal and trimmer capacitor close to the 7404 oscillator.

Changes

For those who would like accurate channel markers for 2 meter FM, try a 3000 kHz crystal in the oscillator. This frequency can be divided by two 7490s to 30 kHz for standard channels and then by half of a 7474 to cover splinter channels. The divide by three circuit of Fig. 4 replaces A2a to retain the outputs of the present standard.[1]

With CMOS prices falling and use of these devices increasing, you may wish to provide an output compatible with CMOS logic circuits. A 7406 open collector hex inverter package with a 2k pullup resistor could be added to interface with CMOS logic levels. Such an arrangement will have a deleterious effect on high frequency harmonic content, but will be fine for signal injection to a CMOS circuit. ■

Reference

[1] Ed Noll, "Circuits and Techniques: Digital IC Oscillators and Dividers," *Ham Radio*, August, 1972, p. 66.

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The Incredible Lambda Diode

-- you can even make it yourself!

Do you remember the Tunnel Diode of days gone by? You may have seen it used in various oscillator and converter circuits and in other types of high frequency applications. The main reasons for using these devices were low power consumption, good frequency stability, and extremely simple circuitry. In addition to these features, it is also possible to use the Tunnel Diode as a voltage controlled oscillator well up into the VHF range. With all of these features and the availability of low cost devices, it would seem that Tunnel Diodes would find their way into a lot of circuits, right? Wrong. For one reason or another, the Tunnel Diode has not been used to a great extent in everyday electronic circuits. Perhaps they were not sophisticated enough for some designers or maybe the device was not suited for the application at hand. But for whatever the reasons may have been, we have turned to other devices, such as the FET, for oscillator circuits and other high frequency applications.

Just recently, a new circuit device has been developed that behaves like a Tunnel Diode, but has all of the advantages of field-effect transistors. The new device is called a Lambda Diode, for reasons which will become apparent later, and is the subject of this article.

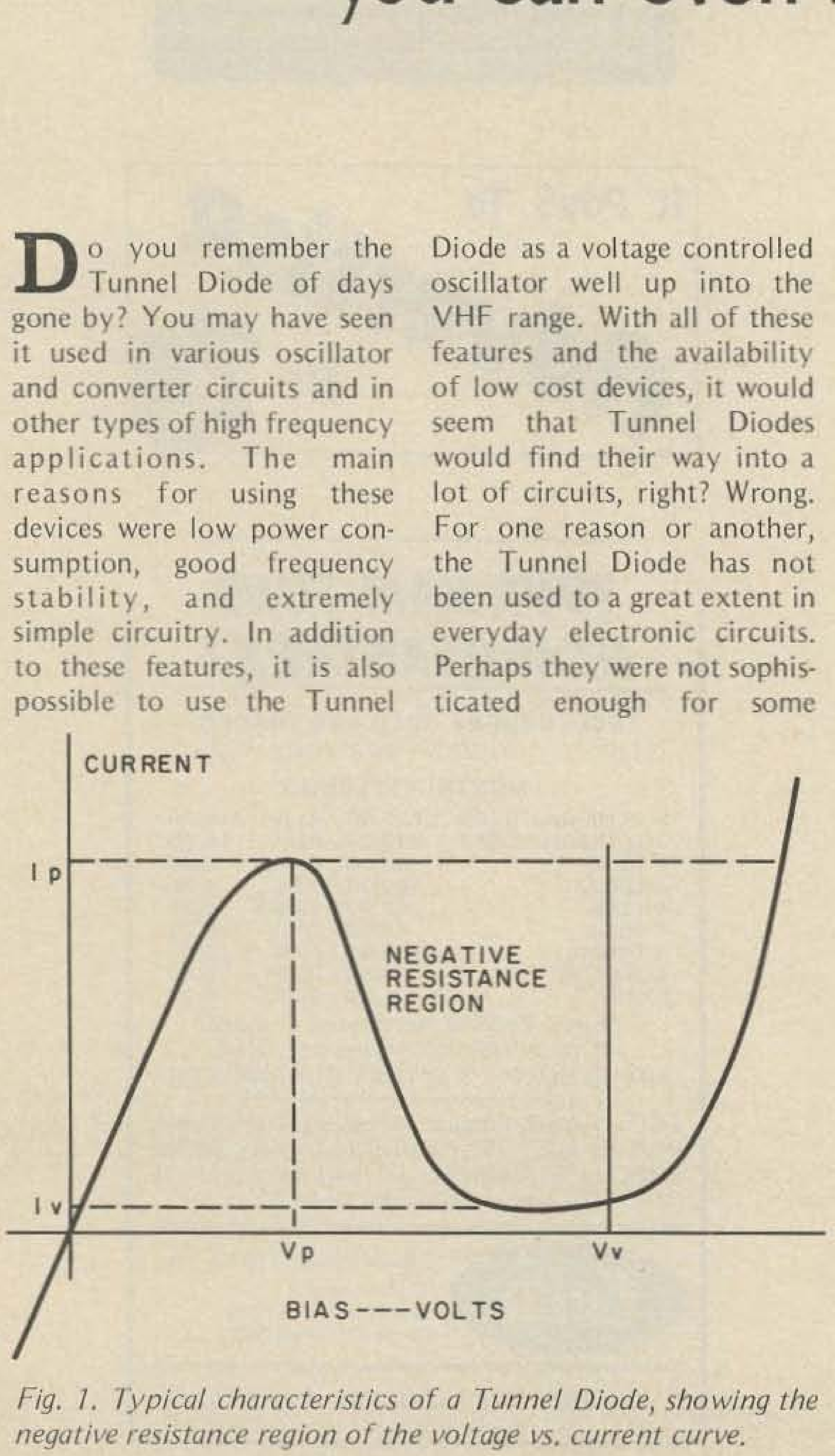


Fig. 1. Typical characteristics of a Tunnel Diode, showing the negative resistance region of the voltage vs. current curve.

Background

Before leaving the Tunnel Diode completely, perhaps a review of its characteristics will help in understanding how the Lambda Diode works and how to apply it properly.

The Tunnel Diode is a basic two terminal device that exhibits a negative resistance at certain voltages. What this means is that as the voltage across the device is increased, the current will also increase up to a point. When the voltage reaches this particular value, the current through the device will level off. Then any further increase in voltage will result in a proportional decrease in current through the device. This characteristic is illustrated in Fig. 1.

The negative resistance is the result of the diode having a small p-n junction with a high concentration of impurities in the p-type and n-type semiconductor materials. Having a high impurity density makes the junction depletion region narrow so that the electrical charges can transfer across the region at almost the speed of light. This effect is called "tunneling" and was first discovered in 1957 by Dr. Leo Esaki when he announced the results of his experiments dealing with highly doped p-n junctions. This was the first time a negative resistance device was produced, although the tunneling effect was predicted mathematically as early as 1929 by three physicists.

It is this tunneling effect in the negative resistance region on the characteristic curve of the device that makes it possible to achieve amplication, pulse generation, and rf energy generation.

While the Tunnel Diode held great promise when it was first introduced, it seems to have been sidestepped in our race for better and more efficient devices. Perhaps it deserves a closer look by many of us who have forgotten how easy it is to use in designing electronic circuits. Coming to our aid in this regard is a new device that brings the negative resistance circuit element into a new realm of activity. The new device is called the Lambda Diode and it appears to have a very exciting future.

The Lambda Diode

Like its tunnel diode counterpart, the Lambda Diode is also a two terminal device, but it is constructed with a pair of complementary depletion-mode junction-field-effect transistors connected as shown in Fig. 2. According to manufacturers of the device, it is easier to fabricate than conventional devices and it can be produced on one chip along with other devices. However, unlike Tunnel Diodes, Lambda Diodes are not limited to a narrow resistance region and consequently can be produced with a wide range of characteristics.

Although these devices are too new to be available on the surplus market, it is possible to build your own Lambda Diode from a complementary pair of JFET transistors. Fig. 3 shows the general layout for the Lambda Diode constructed from an n-channel and a p-channel JFET available from Radio Shack and other suppliers.

The name for the device is derived from the shape of its voltage-current characteristic curve, as shown in Fig. 4. Like the Tunnel Diode, when a positive voltage is applied to the anode of the Lambda Diode, the current through the device increases until the applied voltage reaches the pinch-off voltage of one of the devices. At this point on the curve, the voltage is called the peak voltage, Vp, and the peak current is Ip. Increasing the voltage further will cause the current to decrease until the applied voltage is equal to the sum of the pinch-off voltages of both JFETs. At this point, the voltage is referred to as the valley voltage, Vv, and both of the JFETs are cut off. Current draw in this state is low (in the order of a few nanoamps) and this feature makes the device a good choice for low power consumption applications. This minimal current will be limited for further increases in voltage until breakdown of one of the gates occurs.

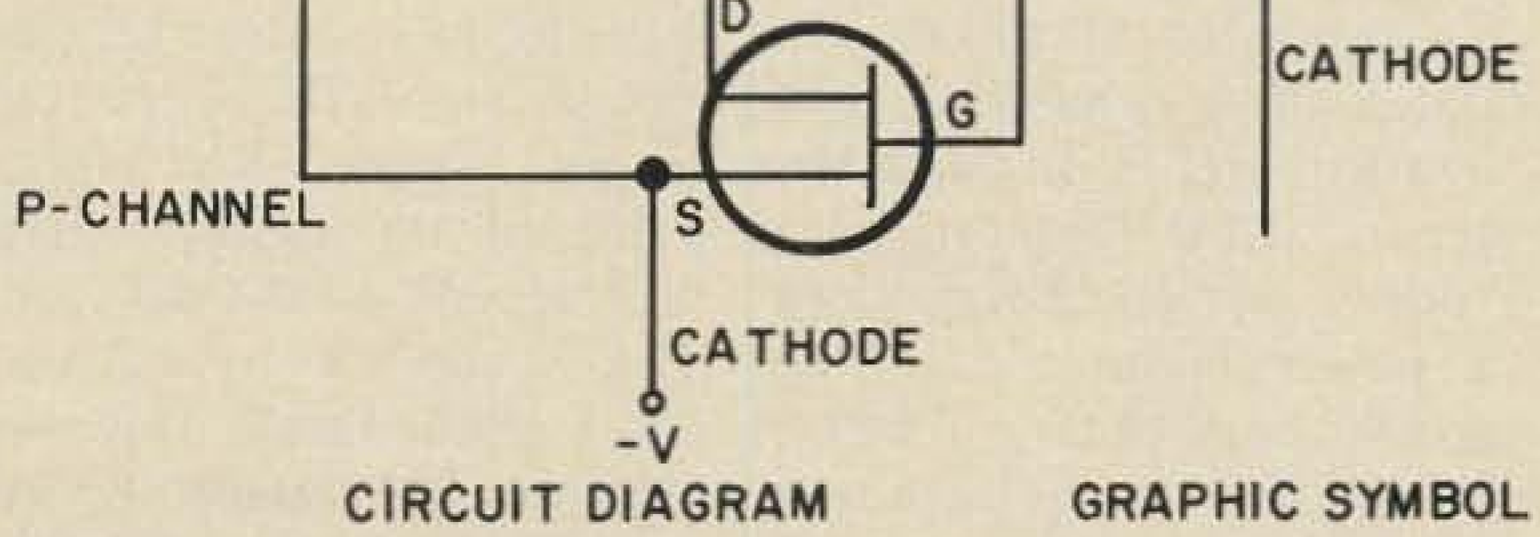


Fig. 2. The Lambda Diode is a two terminal device consisting of a pair of complementary depletion-mode junction-field-effect transistors connected as shown.

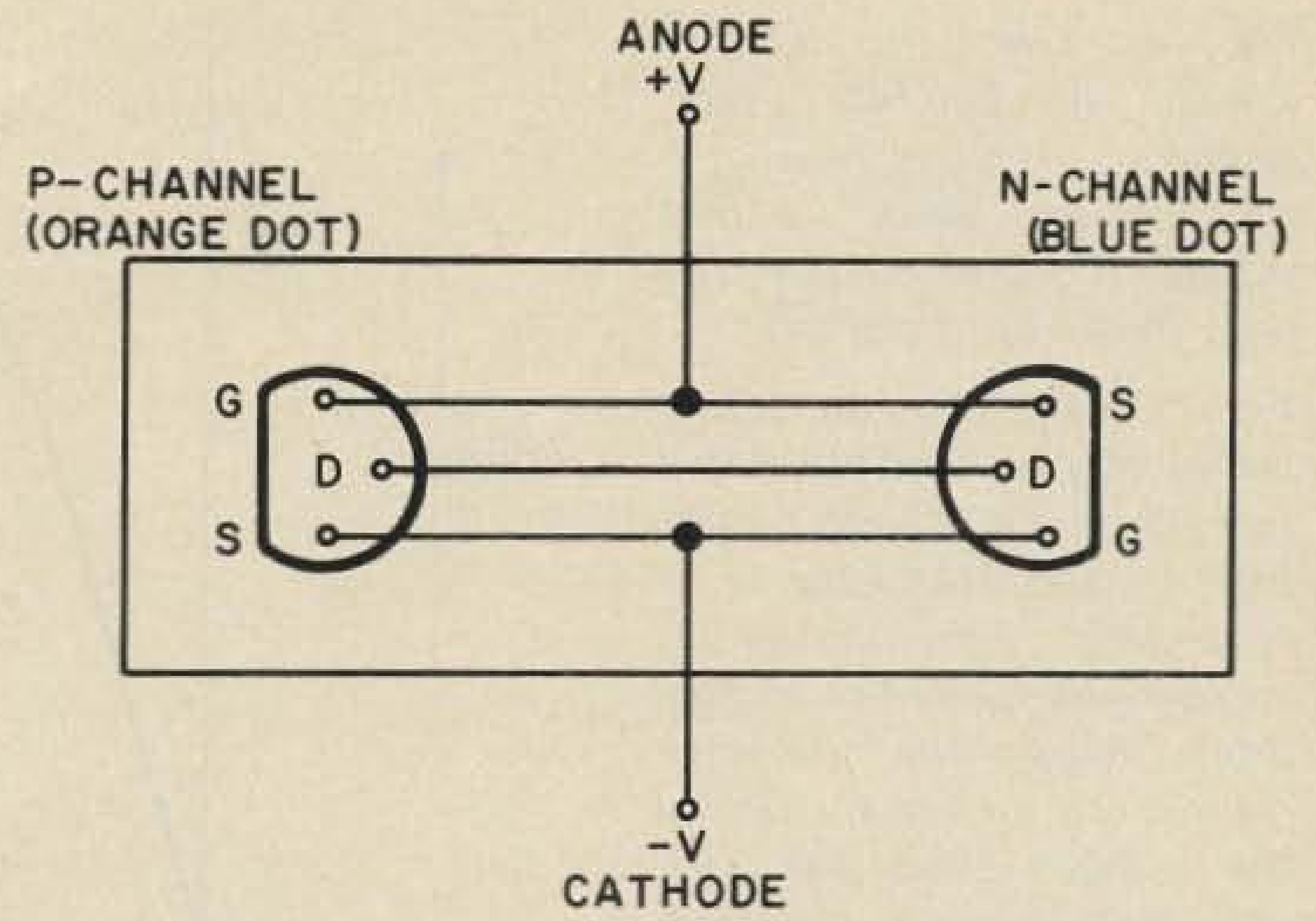


Fig. 3. This is a top view showing how two complementary transistors are connected to form a Lambda Diode. JFETs from Radio Shack (276-112) were used in this instance, although a 2N4360 or similar could be used for the p-channel and a 2N3819 or similar could be used for the n-channel.

The basic characteristics of this diode make it useful for many applications including oscillators, transistor protective circuits, battery monitors and many other circuits requiring low "off" states at high voltages.

Lambda Diode Applications

One useful application for the Lambda Diode is an electronic fuse that is non-destructive, fast acting and provides low current protection. Three such protective circuits are shown in Fig. 5. When an abnormally high voltage is applied to the power transistor, the diode will move into its negative resistance region, effectively cutting off bias to the transistor and allowing it to turn off and protect itself. For higher current applications, the diode can be connected in Darlington fashion as shown in Fig. 5(b). Similarly, for higher voltages, it can be connected as a sensing element to control a particular transistor as shown in Fig. 5(c).

Battery Voltage Monitor

Since the diode displays a bistable switching characteristic with almost zero standby current draw, it also makes a good battery voltage monitor. Simply connect the Lambda Diode as shown in Fig. 6, using a 2N2222 transistor and any LED as a low voltage indicator. Voltage measurements on the two JFETs I used resulted in the LED being switched on at 8.7 volts. This "switch on" voltage was found to be ideal for devices powered by a 9 volt transistor battery. However, you can change this transfer point by selecting JFETs with higher or lower pinch-off voltages than the ones I used.

In this particular circuit, as long as the battery stays in its normal operating range, the device will not draw any current due to its excellent "off" state characteristics. For this reason, the Lambda Diode makes an ideal battery voltage monitor.

Power Failure Monitor

Another application for the Lambda Diode is a power failure monitor as shown in Fig. 7. This particular circuit

Fig. 4. Like the Tunnel Diode, the Lambda Diode displays a negative resistance characteristic when its bias voltage is increased past the peak shown on the graph.

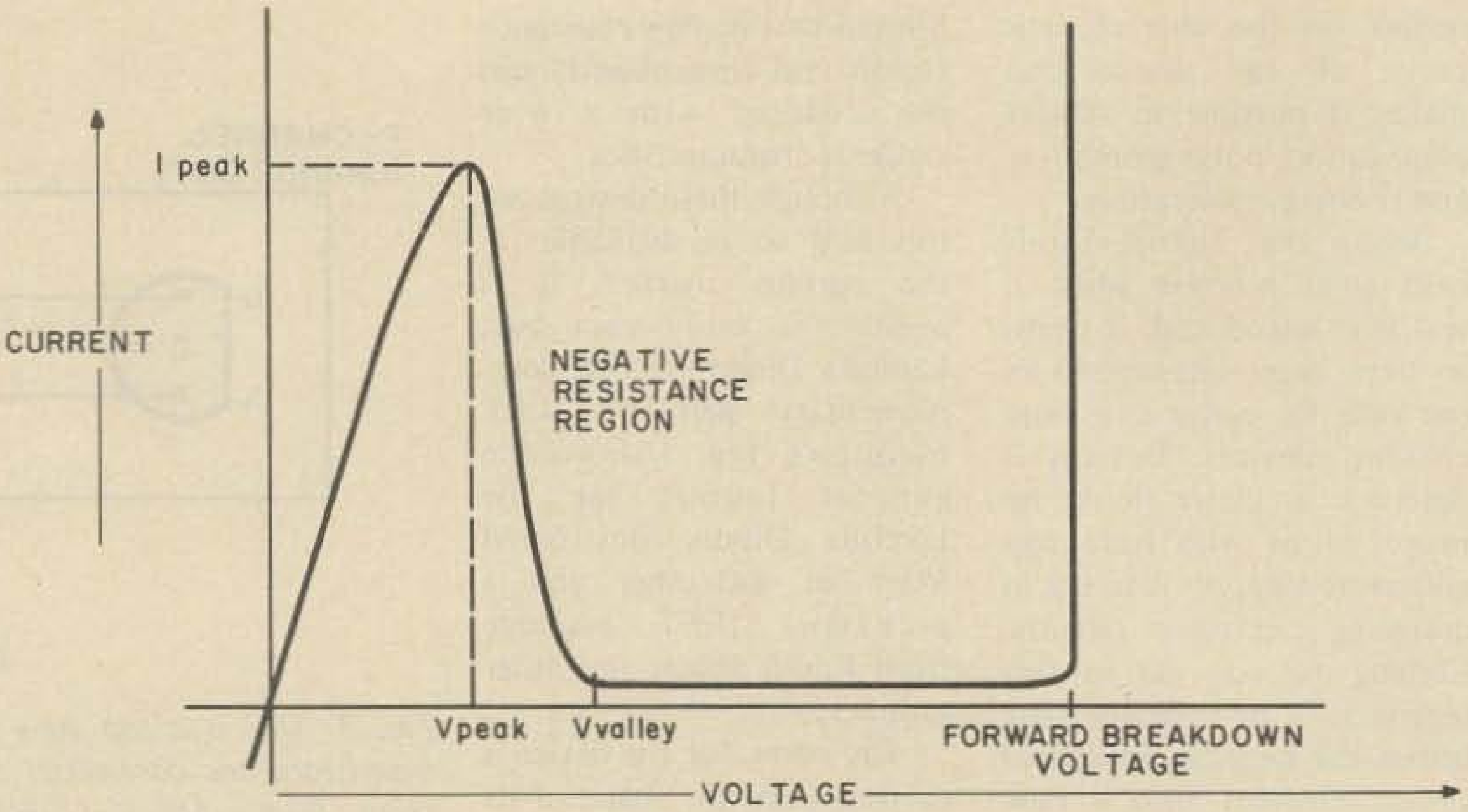
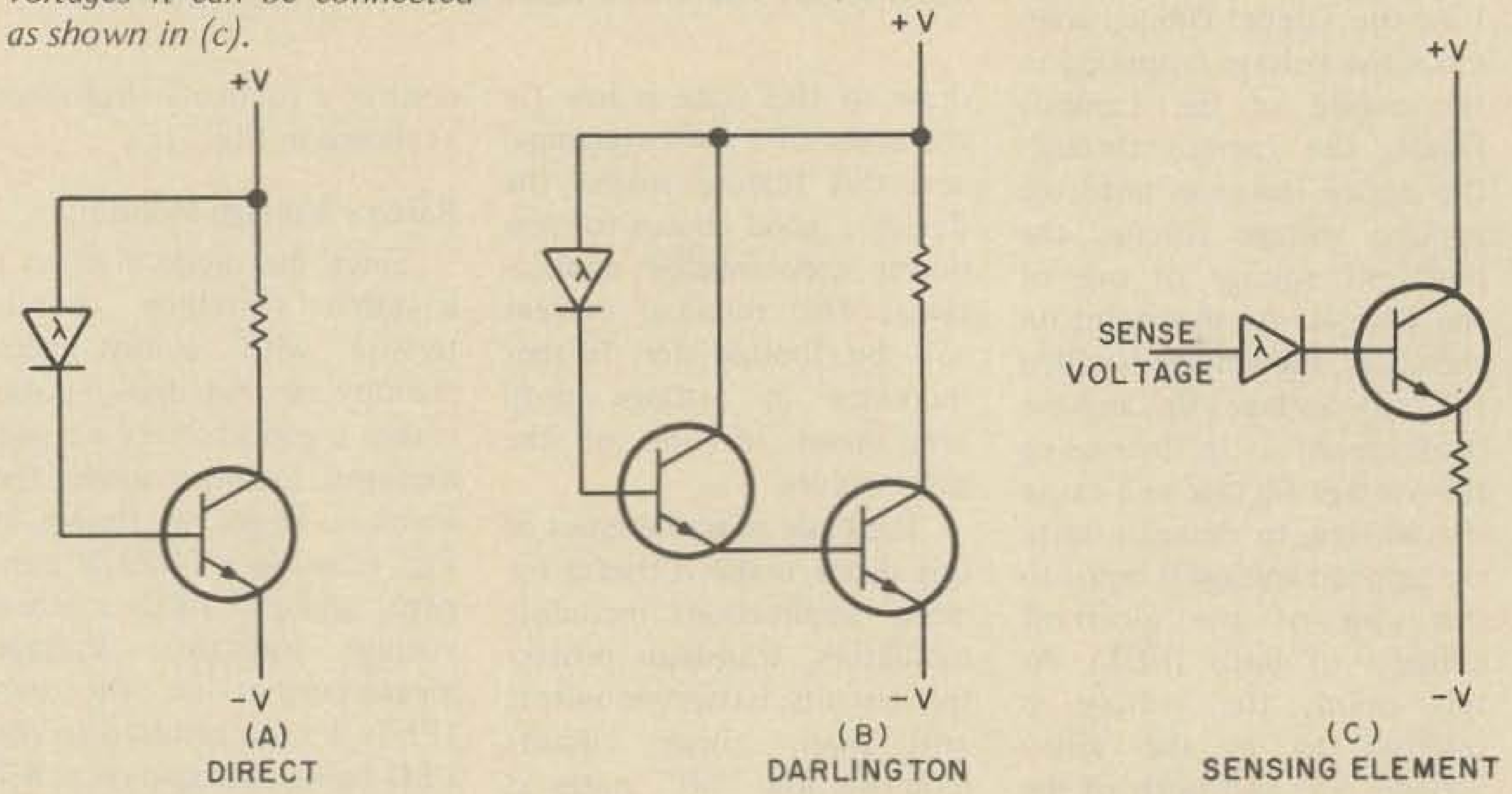


Fig. 5. The Lambda Diode makes an excellent electronic fuse when it is used to supply bias to the transistor it is protecting. An increase in current will cause the voltage drop across the collector resistor to increase, turning the Lambda Diode off. This will in turn cause the transistor to stop conducting. For higher current capabilities, it can be connected in Darlington fashion, and for higher voltages it can be connected as shown in (c).



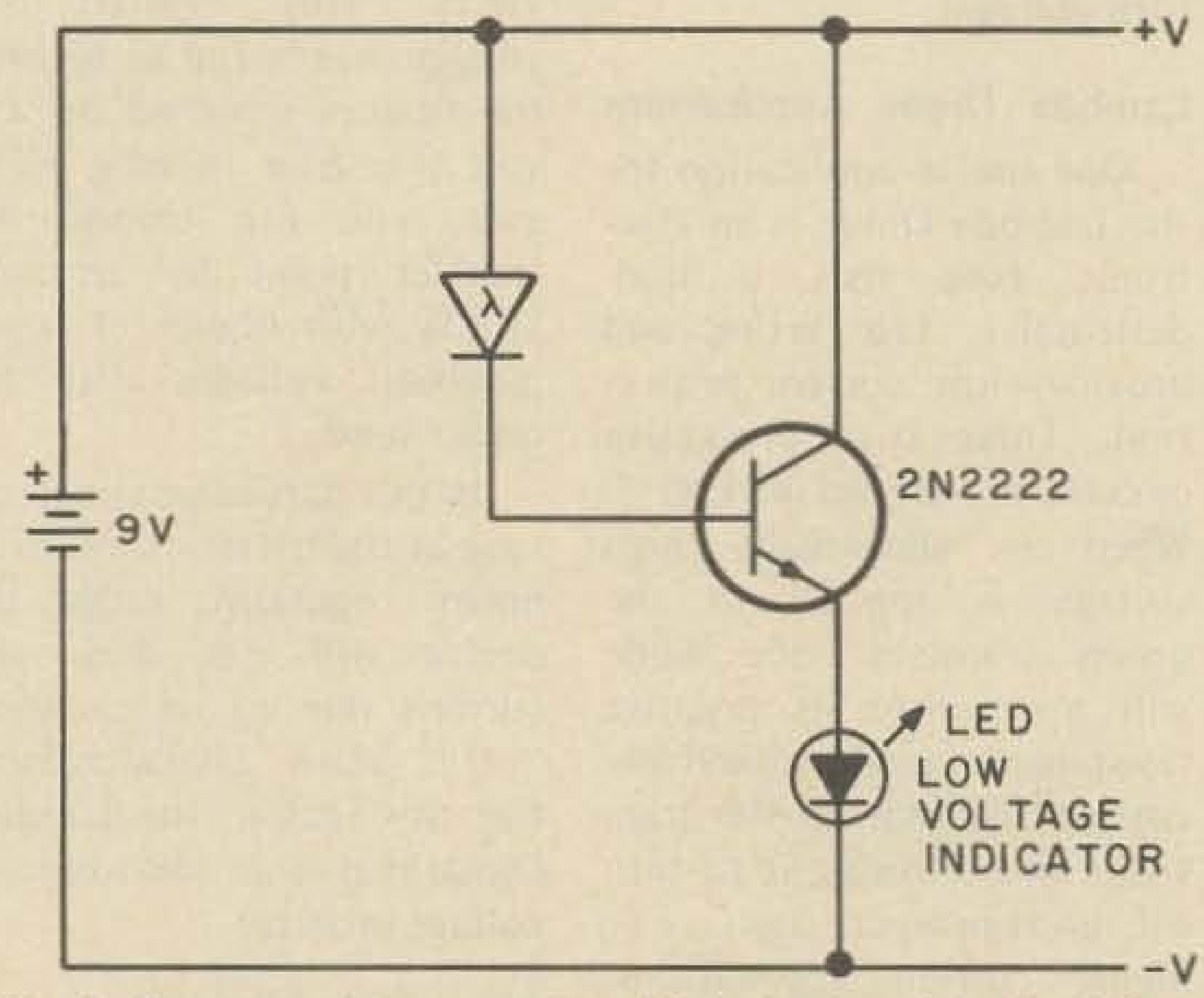


Fig. 6. Battery voltage monitor. With the Lambda Diode I was using, the LED would turn on at 8.7 volts, which makes it ideal for a 9 volt transistor battery. However, by using other JFETs with different pinch-off voltages, it may be possible to raise this transition voltage to monitor other power supplies.

will find application in products such as digital clocks, security systems, and computer operations. Basically, two transistor drivers are connected to LED indicators, with one transistor biased by the Lambda Diode. Under normal operating conditions, the diode is off, keeping transistor #1 turned off. Under these conditions, only transistor #2 is on, with the green LED indicating a "power on" condition. When a power failure occurs, of course, both LEDs will be off for the duration of the power failure. Then when power is restored, the Lambda Diode will be "on" causing the red LED to come on, indicating a power failure has occurred, and the green LED will be off. After the reset button is pushed, the red LED will go off and the green LED will turn on. Since the diode is fast acting, this circuit will also detect momentary outages in the nanosecond range.

Basic Oscillator

Being similar to the Tunnel Diode in many respects, the Lambda Diode will also find many applications as an oscillator in af, rf, and dc-to-ac converters as shown in Fig. 8. Since the diode is so efficient, it draws very little current and consequently there is very little internal heating of the device. This results in excellent temperature stability, and it's a natural as the basic active element in a vfo or local oscillator.

Building a basic oscillator circuit is simple — all you have to do is add an LC tank circuit and a 6 to 12 volt power supply. The actual value of the supply voltage will depend on the particular JFETs you use to make up the Lambda Diode. However, the actual voltage is not critical as long as you bias the device in the negative resistance region of its characteristic curve.

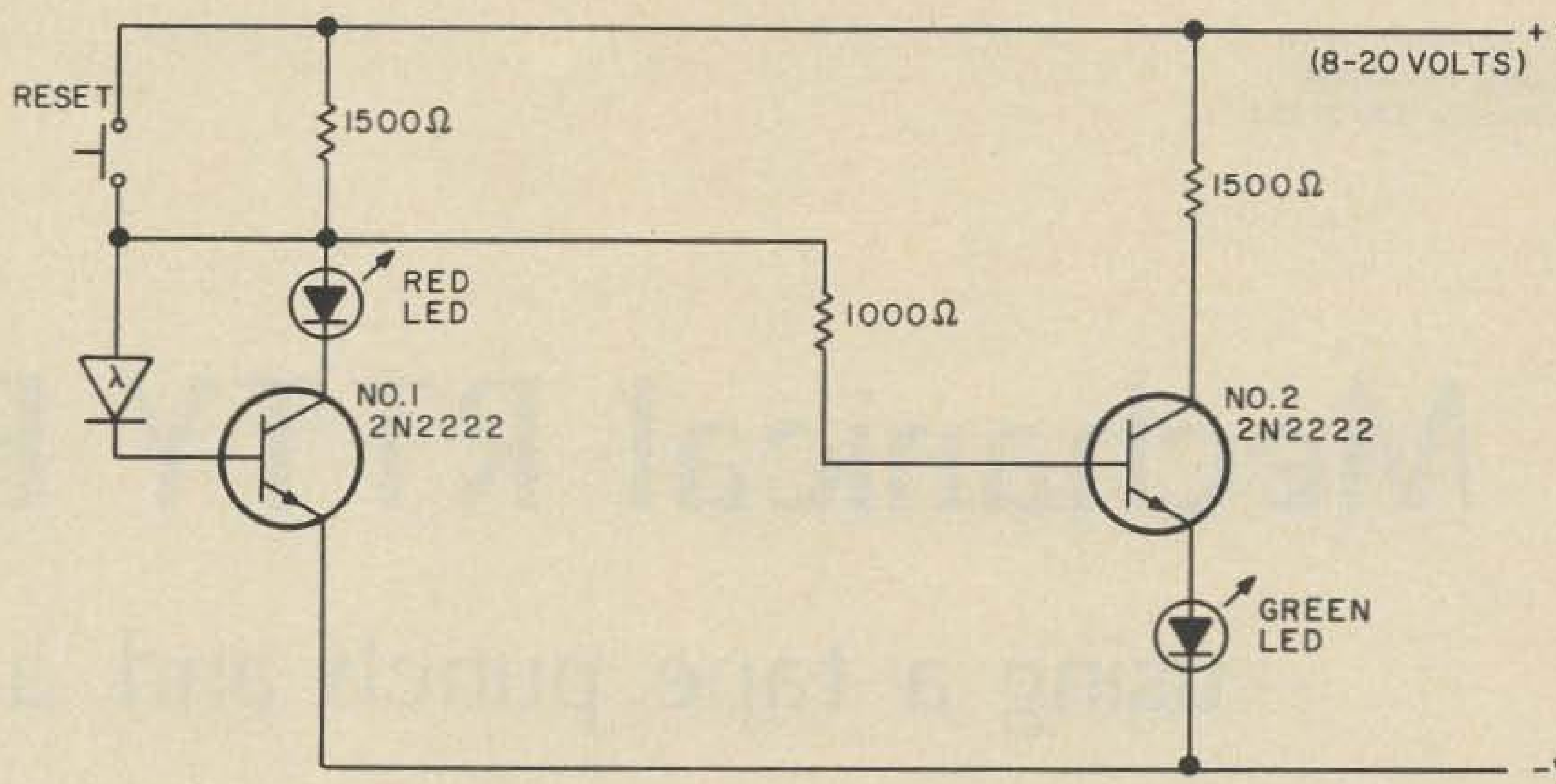


Fig. 7. Power failure monitor. This circuit will indicate a power failure on a bus between 8 to 20 volts. As long as this voltage is maintained, only the green LED will be on. If the power fails and is later restored, the green LED will turn off and the red LED will remain on until the reset button is pressed.

There are many applications for a simple oscillator of this type, from QRP transceivers to dip oscillators, signal generators, antenna testing devices, radio control applications and whatever you want to dream up. It's also possible to amplitude modulate the device, with a tone or voice, with excellent results. Although I have not tried SSB or FM with the device at this time, I feel reasonably sure that the oscillator will work here, too.

Since the Lambda Diode maintains an almost infinite impedance in its valley region, very little energy will be absorbed from the tank circuits. This is the basic reason why the Lambda Diode is so efficient as an oscillator and can produce an output amplitude voltage of twice the supply voltage. Also, because of its efficiency, the output amplitude will remain constant over its operating frequency range, even when the capacitance in the tank circuit is varied to change the frequency. This feature alone would make the device an excellent choice for a dip oscillator circuit.

Future Possibilities

Being a relatively new device, the potential applications are just beginning to emerge. Experimentation is presently being conducted on combining the Lambda Diode with other devices, as well as connecting two devices in series with similar polarity orientation (and also with opposing polarity orientation). The characteristics produced by such circuits are proving to be very interesting.

There is also the possibility of using the diode as the basis of a new memory cell which is only two-thirds the size of conventional CMOS memory cells. Since the Lambda Diode operates as a flip flop, only one bit line is required to activate the cell. By incorporating two additional MOSFETs, a new CMOS memory cell can be made using a total of four transistors as opposed to the six now required for conventional memories.

Regardless of how the Lambda Diode is used, it is evident that this versatile device is capable of performing many useful tasks. How well we use it will depend on our own ingenuity. ■

Reference

Kano, Iwasa, Takagi, Teramoto, "The Lambda Diode: A Versatile Negative Resistance Device," *Electronics*, June 26, 1975, page 105.

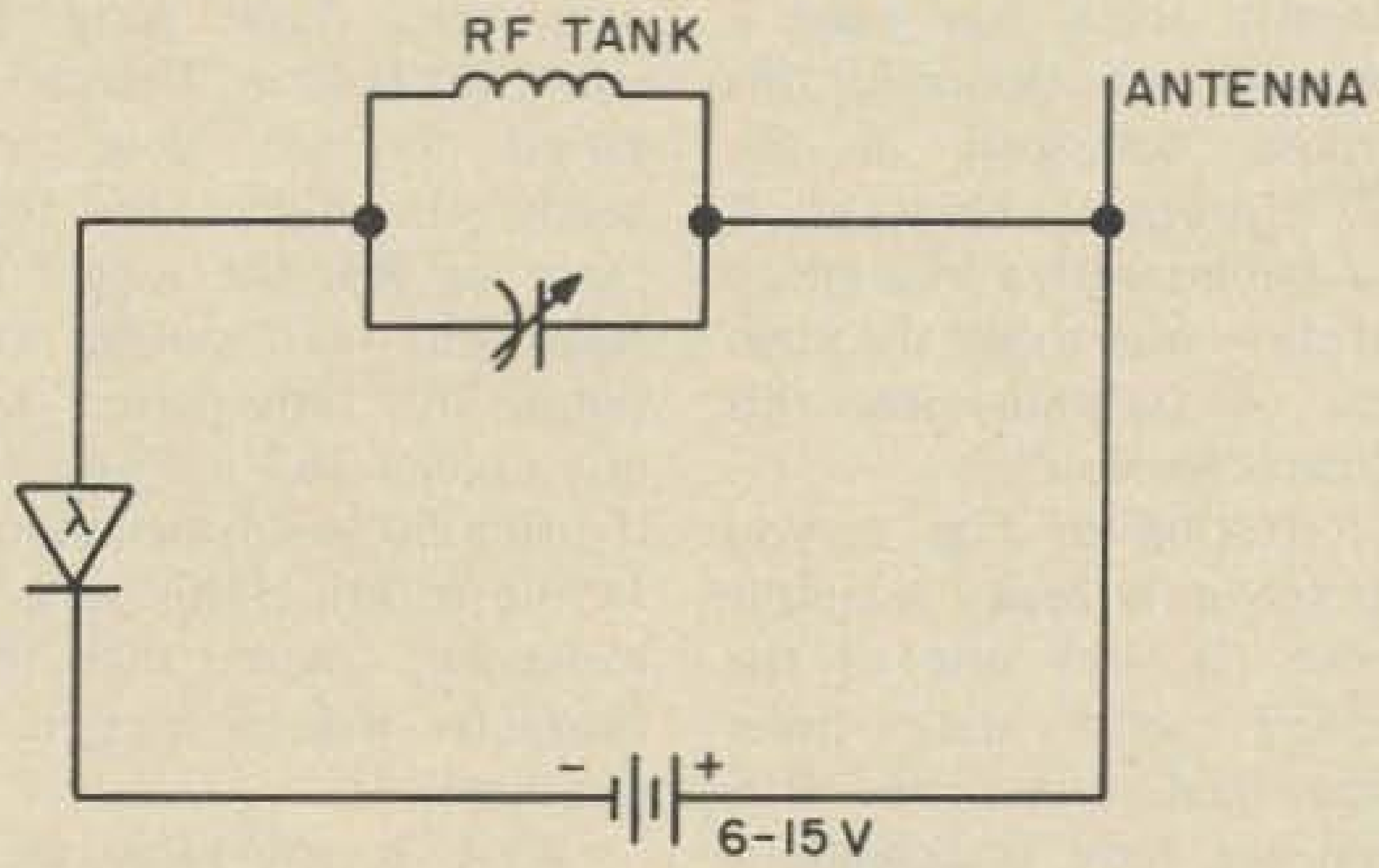


Fig. 8. Basic oscillator. To construct a small, low-powered signal source, all that is required is the Lambda Diode, an LC circuit tuned to the proper frequency, and a power supply. The oscillator may also be tone-modulated with excellent results.

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Mechanical RTTY Buffer

-- using a tape punch and a clock

If you are active at all on amateur radio teletype, it is almost certain you have seen someone sending with that nice, even tempo which usually means he is using a buffer of some sort between his keyboard and transmitter. Recently there has been a fine solid state device for this purpose described in the *RTTY Journal*.[1] However, if you are interested in a cheap and dirty way to get the same type of transmissions, this article is for you.

Referring to Fig. 1, you can see it is really a simple device. It uses one of the NE-555 solid state timer chips, and very little else. What we have is actually a free running multivibrator, the speed of which can be varied. The one I built will go down to about one character every fifteen or twenty seconds, all the way up to full machine speed. There are provisions made for bypassing the buffer entirely, also.

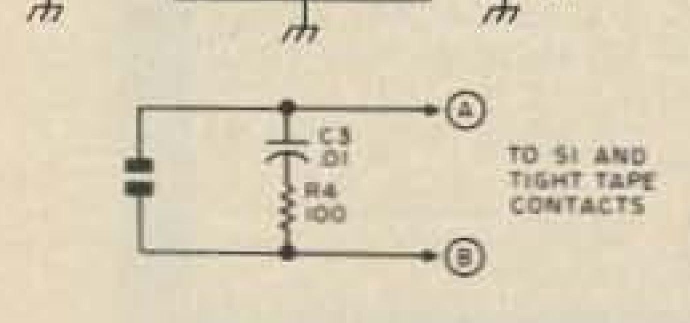

Fig. 1.

R1 is the speed control, R2 is necessary to prevent exceeding the voltage rating of pins 6 and 7, and R3 determines how long the relay will hold in. This can be varied to suit your own needs; the higher the resistance of R3, the longer the relay will hold during each pulse. This time period must not exceed 163 milliseconds, if using 60 words per minute (45.45 baud). If this period is exceeded, more than one character will be tripped off at a time.

RY-1 is any relay which will operate on the voltage you are putting on the NE-555. In my case, it is a six volt dc, single pole, single throw relay – a cheap one I had in the junk box. The filter across the contacts of the relay is used to cut down on the arcing while the buffer is in use. Since you are switching 115 V ac, there is quite a bit of arcing if this is not used, and the contacts will not last as well.

The output of the buffer is connected in series with the tight tape contacts in your transmitter-distributor (T.D.). This allows these to remain in the circuit just in case you set the speed of the buffer too high and the T.D. catches up with the tape you are sending.

Construction is by no means critical. I built mine on perfboard, but a small printed circuit could easily be fabricated. Mine is bolted to the inside of the model 19 table, using standoffs, with the control switch and speed control pot through the side of the table where they are easily accessible.

This unit can be used with any automatic send-receiver (ASR) machine. Set the keyboard for "tape only," and get enough slack in your tape to feed the end into the T.D., under the tight tape control rod. Turn on the switch which activates the pulser and set the speed control to a point where you can at least keep up with the sending rate. If you are far enough ahead, you can backspace and correct errors before they are sent. Your machine will now transmit smoothly and steadily, and your printer will show what is sent, and when.

By using this method you have one advantage over the solid state unit. That is, you have a tape of what you have sent in case QRM takes out a lot of it, and it can be sent again, either slowly or at full machine speed. The mechanical buffer is a bit noisy, but it does the job. Mine has been in operation for several months without any problems.

Fig. 2 is the simple power supply I am using. The NE-555 only requires about 3 milliamps, so the rating of the transformer is almost entirely dependent upon the current requirements of the relay you use.

My thanks to Bob Crumley K4DXR, who gave me the original idea for this unit, and for his encouragement to build it. ■

Reference

[1] "UART," Hoff and Nurse, April 1974, *RTTY Journal*, and "Using the UART," Hoff and Nurse, May 1974, *RTTY Journal*.

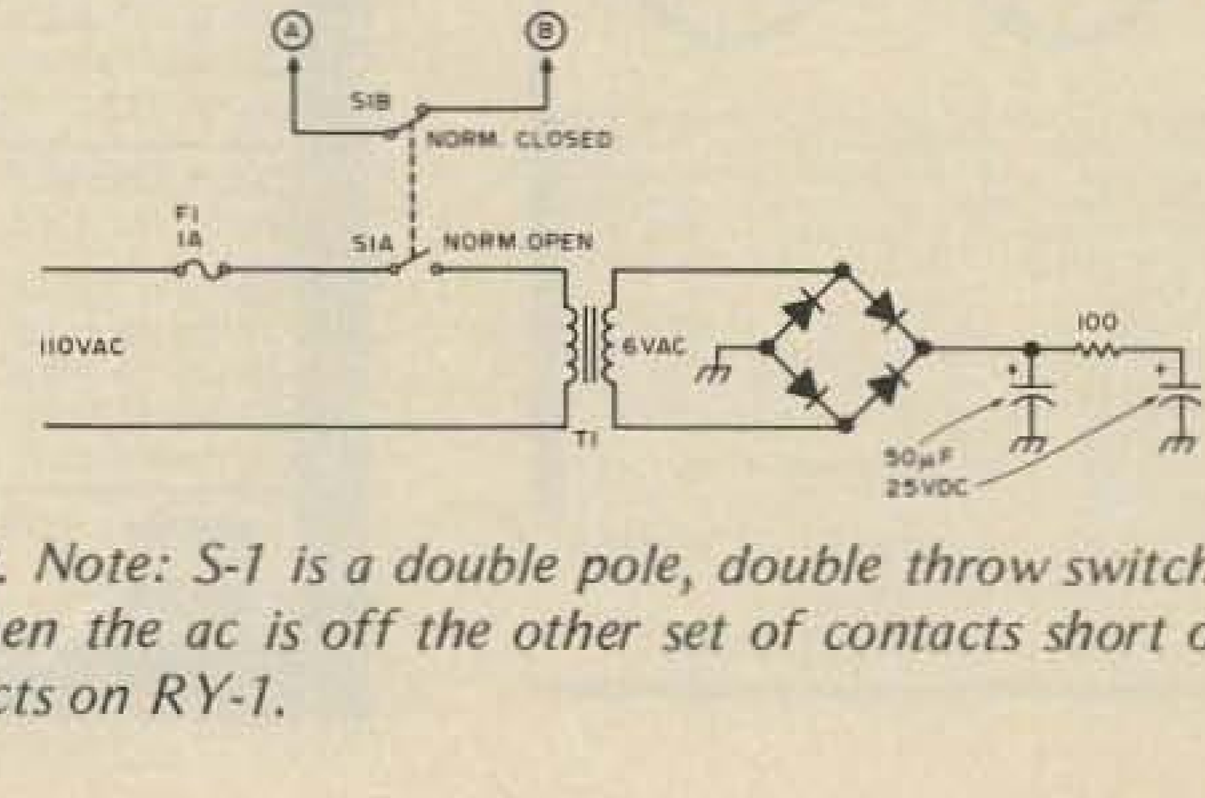

Fig. 2. Note: S-1 is a double pole, double throw switch wired so when the ac is off the other set of contacts short out the contacts on RY-1.

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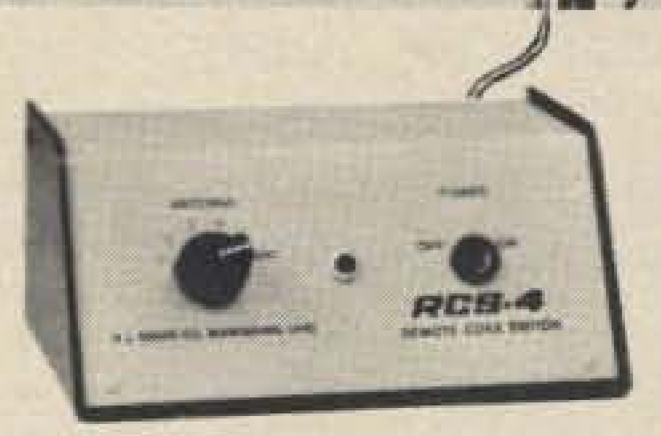

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Have You Used a Triac Yet?

-- nifty solid state ac relay gadget

P. Scott Smith WB9JSE
7723 W. Bender Ave.
Milwaukee WI 53218

It's easy to switch dc off and on with a transistor, but what do you use to switch ac? A relay would work, but this is bulky, and consumes power to perform its work. An SCR would work, except that it can only conduct for about half the applied sine wave, resulting in half voltage being applied to the load. Or you could use two SCRs, connected back to back. However, this configuration is already available in one package known as a triac.

A triac is much like an SCR, except that it will conduct for very near 360 degrees. Triacs have three terminals, normally called Main Terminal One, Main Terminal Two, and Gate. MT1 and MT2 can be considered the normally open contacts of a relay, and the gate the coil of that relay. (Figs. 1 and 2.)

To activate the triac, trigger current is applied to the gate. This current can be either polarity dc or ac. Once the triac has turned on, current on the gate can be reduced to a much smaller value, called holding current. MT1 and MT2 will remain "closed" as long as gate current is at least this value. If gate current is removed, MT1 and MT2 are again isolated.

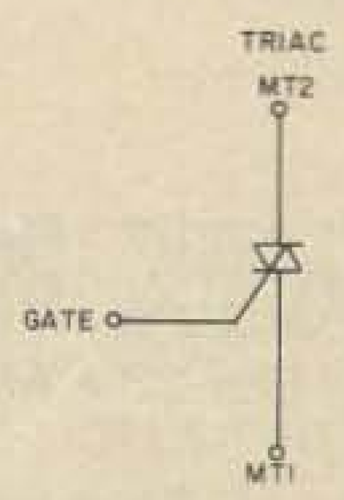
To operate a triac as a switch, we want it to be on for 360 degrees of the applied sine wave ac. For this condition, gate current must be at least the value required to operate in mode III positive. For instance, the RCA type 40668 is rated at 8 Amps, 200 volts rms, and requires 80 mA gate current for this mode.

Let's suppose we have built a high power linear amplifier, complete with safety interlock switches. These could be small microswitch types, wired as in Fig. 3. Resistor R is found by dividing gate current into gate voltage. Before the switch is closed, gate voltage will be 120 volts. Using 80 mA for gate current, we get a value of 1500 Ohms for R. To be on the safe side, use five to ten times the required gate current, or one fifth to one tenth the value of R. In actual use, any value from 100 to 500 Ohms will work well.

If R is replaced with a photocell, the triac can be turned on with a beam of light. When the cell is dark, its resistance is high, typically 1-3 megohms. When in bright light, the cell resistance drops to somewhere around 150 Ohms. A small lamp, taped tightly to the cell, will allow full isolation of the signal voltage from the triac and ac being switched. Any CdS cell will do, and suitable small lamps, called grain-of-wheat lamps, can be found at most hobby shops. See Fig. 4.

The lamp could be driven by a small signal transistor in your terminal unit, and the triac could directly switch ac to the TTY motor, for auto-start. A switch could parallel the photocell to allow running the motor as in a local loop.

Fig. 1. Triac symbol.



It is generally a good idea to put a resistor and capacitor in series across the main terminals of a triac to suppress any transients caused when the triac fires. Those transients could cause the triac to switch on or off randomly, or give sporadic operation. Ten Ohms and a .01 cap will do quite well, although these values aren't critical. These are only a

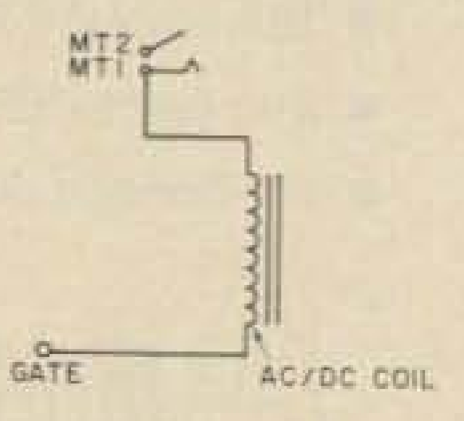


Fig. 2. Electro-mechanical equivalent.

couple applications for triacs. They can be used anywhere a relay could be used, and are priced low enough to be competitive with a relay capable of handling an equivalent current. Of course, they have no moving parts, are small and light, and are well suited for printed circuit board applications.

For much more detailed information on theory of operation, and ideas for zero voltage switching and light dimmer circuits, consult the RCA manual, "Thyristors, Rectifiers, and other Diodes." ■

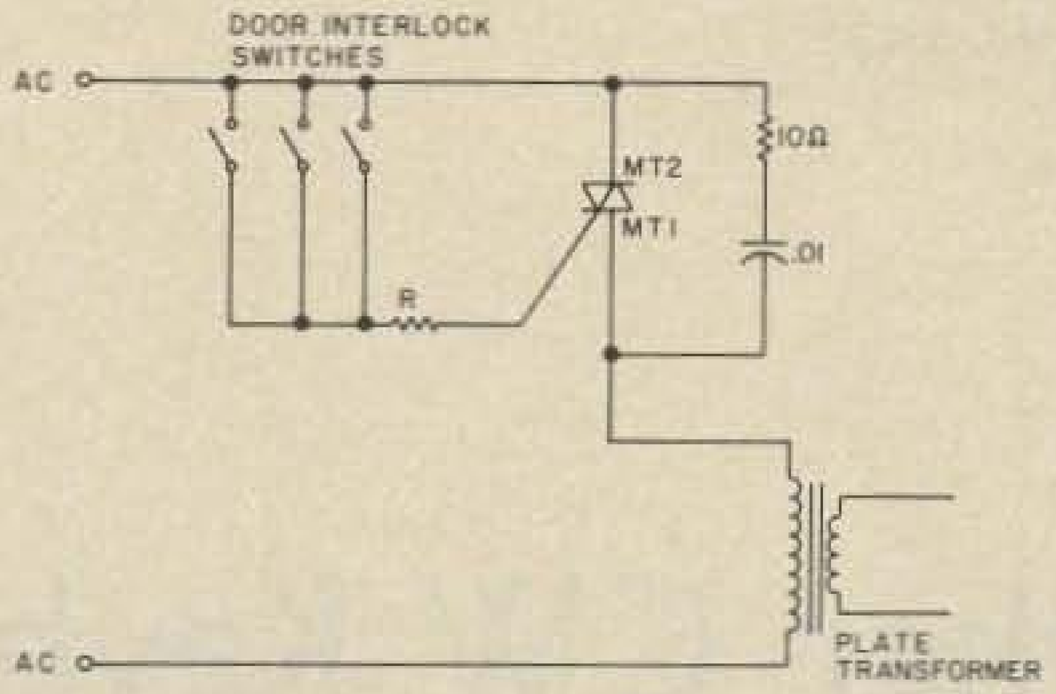


Fig. 3. Door interlock using triac.

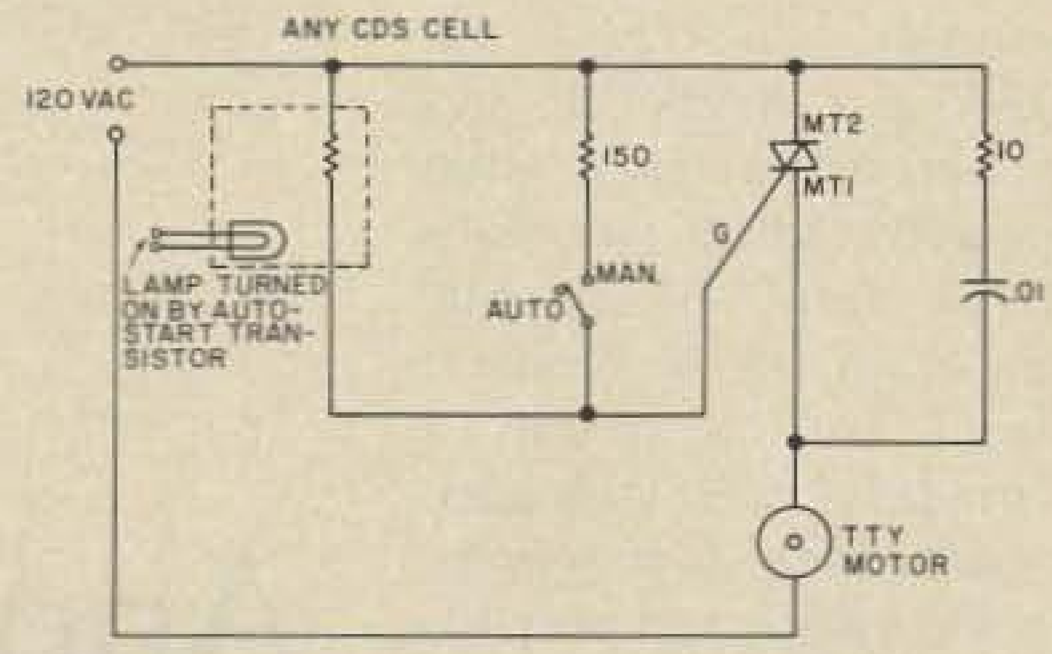


Fig. 4. Optically-isolated switch for TTY.

Ham Help

I am greatly frustrated!!! You and the locals in Lafayette, Ind., are always trying to increase the numbers of amateur radio operators. Well, I used to be a Chicken Bander with bootlegging capabilities using a Siltronix 1011C and a Tempo One that had been converted for CB band. Those days are over with; all I have now is a Yaesu FR-101S receiver with all the bands plus 2 & 6 meters. So I did two more things. They are as follows:

1. Subscribed to your funky magazine.
2. Bought a U.S. callbook.

After monitoring 80 and 2 meter bands and logging a lot of local ops, I looked them up in the callbook. Then I would match the list with the local telephone book. And I was shocked to find with a lot of them that they were too busy, not at home, etc., etc. Excuses, excuses; wake up Lafayette, Ind. This kid wants to join the ranks of an amateur. I think I am getting the point across, but I guess the point is not motivating the amateurs in Lafayette, Ind. With Godspeed, I hope I can say that I am an amateur in the near future.

William A. McQueen
1419 South Street
Lafayette IN 47905

I will shortly be receiving my Novice license and I would like to hear from other hams concerning indoor antennas to be used in apartments where no balcony is available. I am not allowed to string any outdoor antenna systems. I would appreciate a sketch of any appropriate antenna capable of working on 80, 40, 15, and 10 meters.

I will be running 180 Watts and will have a transmatch available for matching to my transceiver. I hope someone has some good suggestions for me.

I would also like to be added to the list of ham helpers. I will give anyone help in code or theory. I have a B.S. in electrical engineering and my code speed is about 15 wpm.

Thank you very much. I think Ham Help is a very good idea.

Bob Hajdak
1834 Paisley St. Apt. 12
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Another CW Keyboard Keyer

-- CMOSed for ultra low power consumption

The TTL mechanized keyboard keyer previously described by W9UBA and WA9VGS* has been carried a giant step forward by K6BS (formerly W9HI). Ern liked the simplicity of the Keycoder I design, but wanted a completely self-contained unit with very low battery drain for mobile and portable CW use. So he remechanized Keycoder I with inexpensive and readily available CMOS logic elements and obtained the following results: 7-8 microamps of power dissipation during keyer operation, and a few tenths of a microamp during the quiescent state (there's no "on-off" switch in his unit). Ern reports that he's still using the same 9 volt transistor battery that he installed in October, and that it's still reading 9 volts (mid-March). Useful battery life should about equal the shelf life of the battery.

The elimination of an ac power supply in this CMOS keyer, of course, means less weight, less space required, less building time, and, most important, fewer dollars to build. Also, with no ac leads coming into the unit there is even greater immunity to rf interference (K6BS operates a kilowatt and has had no rf problems).

As shown in the schematic diagram, the circuit operation is practically identical with that of Keycoder I, so only the differences will be commented upon here. Observe that pins 4, 5, and 6 of U7 (top left of diagram), and pins 11, 12, and 13 of U7 (to the right of the SCR Q1), are shown as inverters. Actually, these are 2 NAND gate sections of a quad 2-input NAND gate element (CD4011); they function as inverters in this circuit (the inputs of each section are tied together), so are shown as inverters.

*73, July, 1976.

The 22k and 10k resistors and the 0.22 uF capacitor in series with each other across the 9 volt transistor battery provide a bit of transient filtering for the 9 volts, and the resistors also serve to limit current through the SCR. The diode connected to the junction of the resistors gives a small amount of feedback around the SCR, and may not be needed, depending upon the particular SCR and R and C values you use.

The dot generator is a relaxation oscillator consisting of two sections of U7 (top left of schematic) with RC feedback. It works like this: In the quiescent condition, the logic states are as shown on the schematic, and the 0.27 uF capacitor is fully charged. When pin 1 goes high, pin 3 goes low, and pin 4 (the dot generator output) goes high, starting the first dot. With pin 3 low, the capacitor starts to discharge toward that point, but does so relatively slowly due to the large resistances in the discharge path. When the capacitor has discharged sufficiently, the voltage at pin 2 falls below the input threshold of the gate, causing

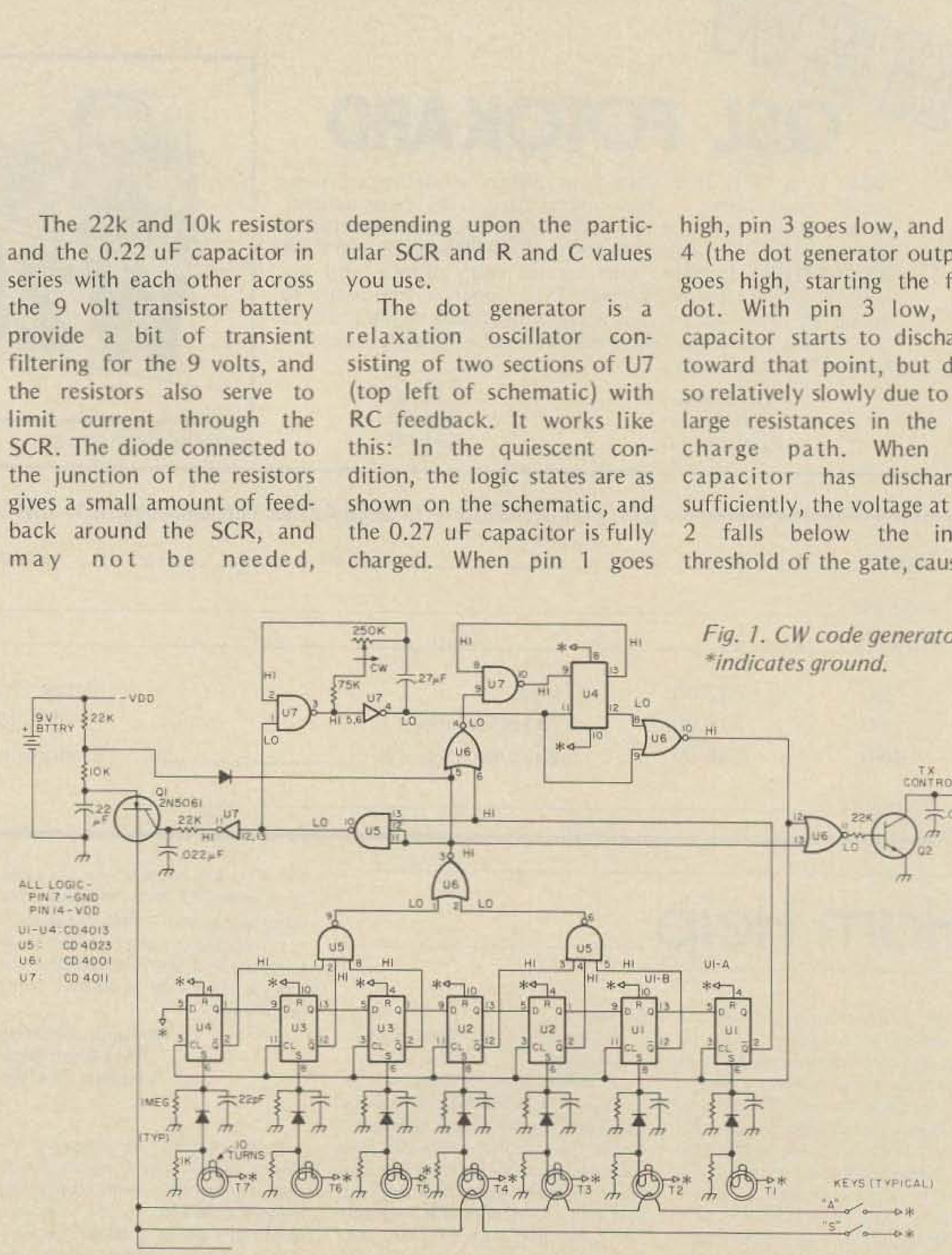

Fig. 1. CW code generator. *indicates ground.

pin 3 to go high, and pin 4 to go low, completing the first dot. With pin 3 high, the capacitor starts to charge again, but again takes a finite time to do so because of the large R. When the capacitor charge reaches the input threshold of the gate, pin 3 goes low again, and the cycle repeats, as long as pin 1 is high.

In order to further conserve microamps, and because all his rigs have sidetones, K6BS did not include a monitor in his CMOS keyer, but the above dot generator circuit could easily be duplicated, with appropriate changes in R and C values, to provide a code monitor; only one additional 29¢ element would be required.

The core matrix circuitry is a little different than that in the TTL Keycoder. First of all, the logic is reversed since CMOS flip flops are set with a logic "1", rather than with a "0". Hence, the core secondaries are connected to ground, and phased such that a positive spike is generated when a key is closed and the SCR fires. As with the original Keycoder, the phasing of the cores can be determined experimentally during construction. The 1k resistors from the core secondaries to ground are for loading, and 1k is simply a nominal value. Because of the extremely high input resistance of CMOS elements, all pins must be terminated to prevent self-oscillation and resultant thermal runaway. Therefore pins 6 and 8 of the CD4013 flip flops (U1-U4) are connected to ground through 1 M resistors. The 22 pF capacitors stretch the extremely rapid input spikes from the cores into 10 usec wide pulses to set the shift register flip flops.

NPN transistor Q2 can be selected with sufficient drive to work with either of the output schemes discussed in the previous article. ■

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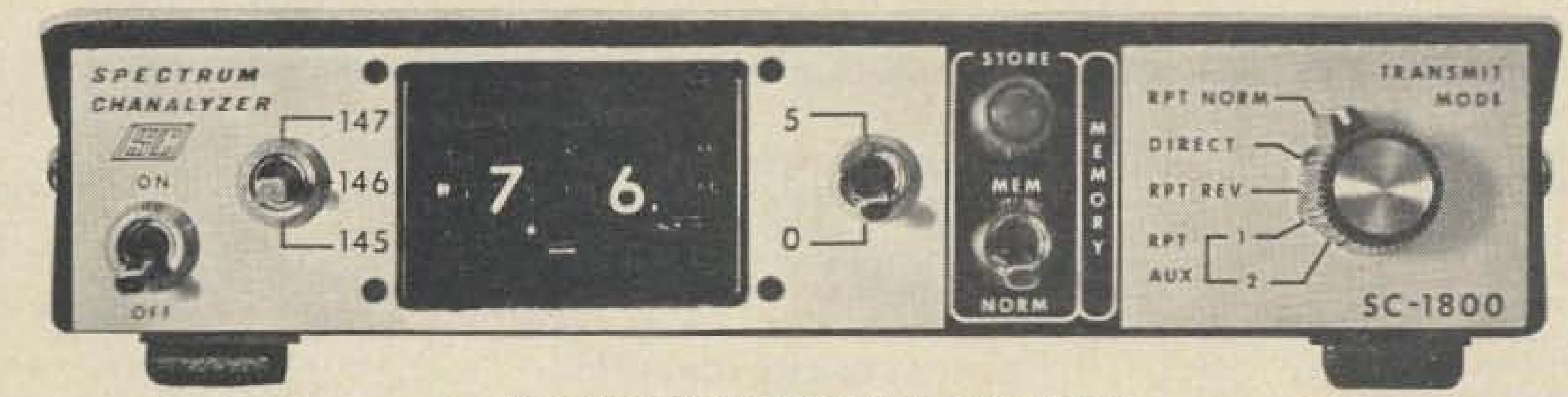

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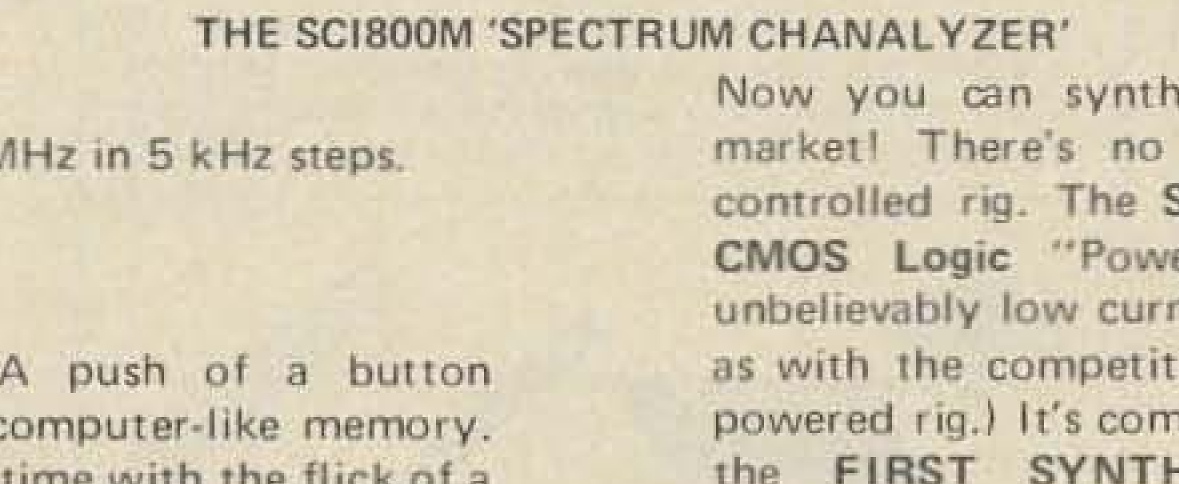

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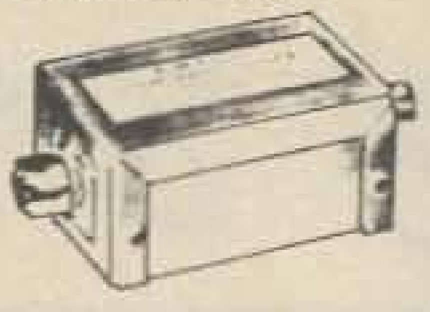

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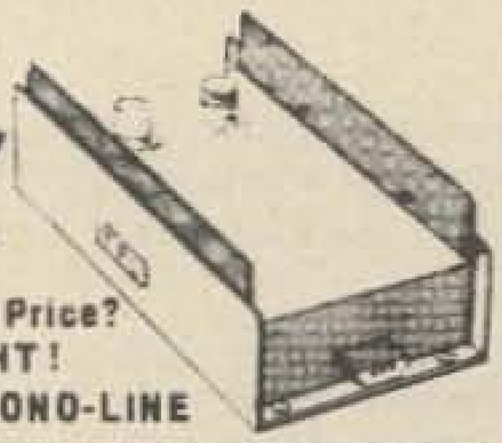

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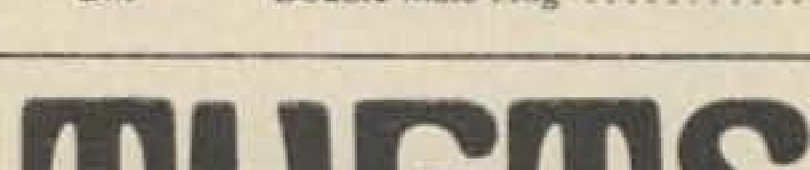

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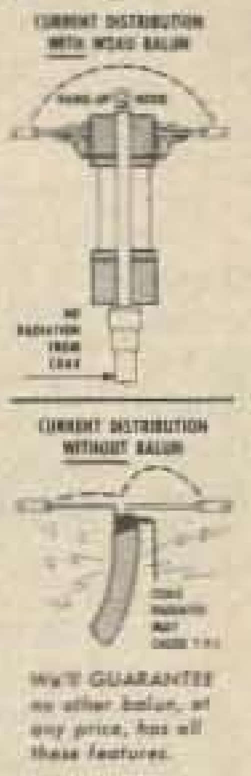
The originator of the Balun with a built-in lightning arrester and hang up hook.



WE'LL GUARANTEE no other balun, at any price, has all these features.

Now...more than ever--- the TEMPO line means solid value

Tempo VHF/ONE

the "ONE" you've been waiting for

No need to wait any longer — this is it! Whether you are already on 2-meter and want someting better or you're just thinking of getting into it, the VHF/ONE is the way to go.

• Full 2-meter band coverage (144 to 148 MHz for transmit and receive. • Full phase lock synthesized (PLL) so no channel crystals are required. • Compact and lightweight — 9.5" long x 7" wide x 2.25" high. Weight — About 4.5 lbs. • Provisions for an accessory SSB adaptor. • 5-digit LED receive frequency display. • 5 KHz frequency selection for FM operation. • Automatic repeater split — selectable up or down for normal or reverse operation. • Microphone, power cord and mounting bracket included. • Two built-in programmable channels. • All solid state. • 10 watts output. • Super selectivity with a crystal filter at the first IF and E type ceramic filter at the second IF. • 800 Selectable receive frequencies. • Accessory 9 pin socket. • $495.00

TEMPO SSB/ONE. SSB adapter for the Tempo VHF/One. * Selectable upper or lower sideband. * Plugs directly into the VHF/One with no modification. * Noise blanker built-in. *RIT and VXO for full frequency coverage. * $225.00.

ASTATIC MICROPHONES

SILVER EAGLE

T-UG8-D104, transistorized	$48.60
T-UG9-D104, "Golden Eagle," transistorized	$95.40
T-UG9-D104, "Silver Eagle," transistorized	$54.60
UG-D104, ceramic or crystal	$42.60

— TUFTS LIBRARY —

Foreign Radio Amateur Callbook	$12.95
U.S. Radio Amateur Callbook	$13.95
A.R.R.L. Radio Amateur Handbook	$ 6.00
A.R.R.L. Radio Amateur License Manual	$ 1.50
A.R.R.L. Antenna Book	$ 4.00

— TAB PUBLICATIONS —

Ameco Commercial Operator Theory Course	$ 5.95
Ameco Amateur Radio Theory Course	$ 4.95
Amateur Radio Novice Class License Study Guide	$ 5.95
Amateur Radio General Class License Study Guide	$ 7.95
Amateur Radio Advanced Class License Study Guide	$ 5.95
Amateur Radio Extra Class License Study Guide	$ 5.95

73 PUBLICATIONS

1976 FM Repeater Atlas	$ 1.95
Weather Satellite Handbook	$ 2.95
Code Tapes – 5,6,14&21 wpm	$3.95 ea./4 for $13.95

• come in and see other 73 publications in stock •

mounts - leads - accessories

STANDARD GAIN MOBILES

Two Meters

- 5/8 wavelength — 3.4 db gain over 1/4 wave mobile
- Frequency coverage—143 to 149 MHz
- Power rating—200 watts FM

MODEL BBLT-144

47" antenna complete with easy to install, no holes to drill, trunk lip mount, impact spring and 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $28.75

MODEL BBL-144

47" antenna mounts on any flat surface, roof, deck or fender in 3/8" hole. Includes impact spring, 17' MIL SPEC RG-58-U and PL-259. Antenna removable from mount. $26.95

BBLT-144 BBL-144 BMH

HUSTLER "BUCK-BUSTER"

MODEL SF-2

51" two meter, 5/8 wavelength, 3.4 db gain over 1/4 wave mobile. Designed with 3/8"-24 base to fit your mount or a wide selection of Hustler mobile mounts. (Mount or cable not included). $12.75

SF-2

HEAVY DUTY BUMPER MOUNT FITS ANY SHAPE BUMPER

MODEL BMH

New design is rugged for supporting Hustler antenna with standard or Super resonators. Includes Model SSM-2 ball mount and strap from stainless steel. $24.95

SUPER GAIN MOBILES

Two Meters

- 5.2 db gain over 1/4 wave mobile antenna
- Frequency coverage—143-149 MHz
- SWR at resonance—1.1:1 typical
- Power rating—200 watts FM

TWO AND SIX METERS— TRUNK LIP MOUNT

MODEL HFT

Four section telescopic antenna permits separate adjustment for simultaneous resonance on two and six meters. Operational height: 40". Complete with trunk lip mount, 17' MIL SPEC RG-58-U and factory attached PL-259. $21.45

HFT CGT-144 CG-144

MODEL CGT-144

Get big signal performance, superior receiving capability with this 85" colinear antenna. Easy installation on side or edge of trunk lip without drilling — complete with 17' MIL SPEC RG-58-U and PL-259. $39.95

MODEL CG-144

Same characteristics as CGT-144 supplied with 3/8"-24 base to fit all mobile ball mounts — Length is 85". Mount and cable not included. $26.75

VHF/UHF ANTENNA— ROOF MOUNT

MODEL UHT-1

Field trimmable radiator for 1/4 wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Mounts on any flat surface, roof, deck, fender in 3/8" hole. Includes 15' RG-58-U. $10.15

VHF/UHF ANTENNA— TRUNK LIP MOUNT

MODEL THF

Field trimmable radiator permits quarter wave operation on any frequency from 140 to 500 MHz. Cutting chart included. Complete with trunk lip mount, 17' RG-58-U and PL-259. $15.95

UHT-1 THF SSM-2 QD-1

DELUXE MOBILE MOUNTS

For medium length, light weight antennas with 3/8" — 24 base

TLM HLM GCM-1

MODEL TLM

Trunk lip mount for no holes installation on side or edge of trunk lid. Includes 17' RG-58-U connectors attached. $12.05

MODEL HLM

Deluxe trunk lip mount with 180 degree swivel ball for positioning antenna to vertical. Easy — no holes — installation. Includes 17' RG-58-U cable and connectors attached. $14.85

MODEL GCM-1

Rain gutter mount fits all shapes, angles even latest trim line gutters. Includes 180° swivel ball. $7.50

MM-1 TGM-1 C-32

MODEL MM-1

Cowl mount installs in 1" hole. Includes 180° swivel ball and SO-239 connectors. $ 6.45

MODEL TGM-1

Truck groove mount installs in hidden area of groove under trunk lid. Mounting hardware included. $7.50

MODEL C-32

Ball mount complete with mounting hardware. $5.75

HUSTLER

RESONATOR SPRING— STAINLESS STEEL

MODEL RSS-2

Installs between Hustler mast and resonator. Absorbs shock when antenna strikes overhanging obstructions. Supplied ready for easy installation. $ 5.95

RSS-2

FCC Accepted for Repeater Application

L-14-240

MODEL G3-144 — 5/8 wave, two-meter antenna. Includes radials for complete decoupling. SWR at resonance 1.5:1 or better. Height: 48". Power rating: 200 Watts FM. $21.95

G3-144 G6-144A

STAINLESS STEEL BALL MOUNT FOR DECK, FENDER OR ANY FLAT SURFACE

MODEL SSM-2

Heavy 2" reinforced stainless steel 180° adjustable ball mount easily supports any amateur mobile antenna. Includes cycolac base, steel back-up plate and mounting hardware. $13.50

QUICK DISCONNECT— 100% STAINLESS STEEL

MODEL QD-1

Remove antenna from mount with easy press and twist release. Compression spring and all parts 100% stainless steel. 3/8"-24 threads—female one end, male the other. $11.75

FEED LINE MODEL L-14-240

Get known performance, maximum shielding for minimum noise pick-up in this MIL SPEC 20' length of RG-58-U cable. Supplied with connectors attached for use with ball or bumper mount and transceiver. $ 7.45

MODEL G6-144A — Deluxe, Two Meter Colinear for Repeater or any fixed station operation. 6 db. gain over a 1/2 wave dipole. Maximum radiation at the horizon! Shunt fed with D.C. grounding. Radiator 5/8 wave lower section, 1/4 wave phasing, 5/8 wave upper section. Height 117". SWR at resonance: 1.2:1 or better. Power rating: 1,000 Watts FM. Wind survival: 100 MPH. Installs on vertical pipe up to 1 1/2" O.D. SO-239 coax connector. $52.95

HUSTLER RESONATORS

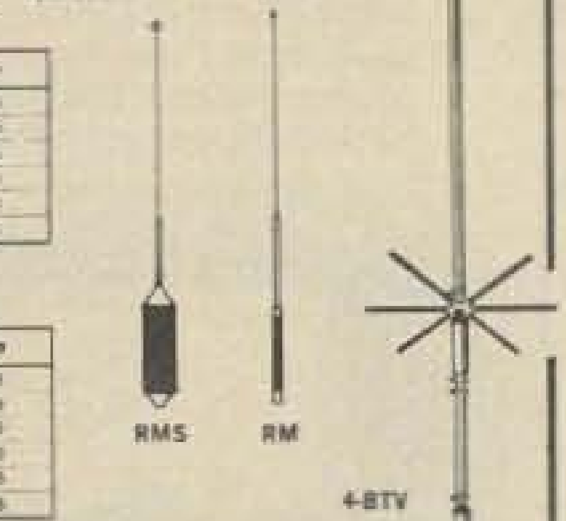
All resonators are precision wound with optimized design for each band. Assembly includes 17-7 PH stainless steel adjustable tip rod for lowest SWR and band edge marker. Choose for medium or high power operation.

STANDARD HUSTLER RESONATORS— Power Rating: 400 watts SSB

Model	Band	Price
RM-10	10 meters	$10.75
RM-15	15 meters	$11.75
RM-20	20 meters	$12.75
RM-40	40 meters	$15.95
RM-75	75 meters	$16.95
RM-80	80 meters	$16.95

SUPER HUSTLER RESONATORS— Power Rating: Legal Limit SSB. Supers have widest band-width

Model	Band	Price
RM-10-S	10 meters	$13.95
RM-15-S	15 meters	$16.95
RM-20-S	20 meters	$19.25
RM-40-S	40 meters	$23.50
RM-75-S	75 meters	$28.95
RM-80-S	80 meters	$28.95



Covers 10 - 15 - 20 - 40 Meters

Only Hustler Gives One Setting for Whole Band Coverage

MODEL 4-BTV

- Lowest SWR—PLUS.
- Bandwidth at its broadest! SWR 1.6 to 1 or better at band edges.
- Hustler exclusive trap covers "Spritz" extruded to otherwise unattainable close tolerances assuring accurate and permanent trap resonance.
- Solid one inch fiberglass trap forms for optimum electrical and mechanical stability.
- Extra heavy duty aluminum mounting bracket with low loss—high strength insulators. Mounting hardware included.
- All sections 1¼" heavy wall, high strength aluminum.
- Stainless steel clamps permitting adjustment without damage to the aluminum tubing.
- Guaranteed to be easiest assembly of any multi-band vertical.
- Antenna has 3/8"-24 stud at top to accept RM-75 or RM-75-S Hustler resonator for 75 meter operation when desired.
- Top loading on 75 meters for broader bandwidth and higher radiation efficiency!
- Feed with any length 50 ohm coax.
- Power capability—full legal limit on SSB or CW.
- Mounting: Ground mount with or without radials, or roof mount with radials.

Length: 21' 5" Weight: 15 lbs.

MODEL 4-BTV $79.95

For 6 - 10 - 15 - 20 - 40 - 75 - 80 Meters

Fold over mast for quick and easy interchange of resonators or entering a garage. When operating, mast is held vertical with shakeproof sleeve clutch. 54" mast also serves as 1/4 wavelength 6 meter antenna. Stainless steel base has 3/8"-24 threads to fit mobile ball mount or bumper mount.

HUSTLER MASTS

The Majority Choice of Amateurs Throughout the World!

MODEL MO-2

For bumper mounting—Fold is at roof line 27" above base. $15.95

MODEL MO-1

For deck or fender mounting—Fold is at roof line 15" above base. $15.95

MO-1 MO-2

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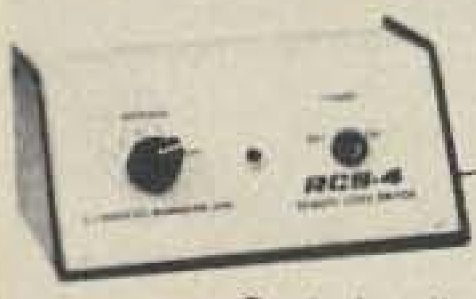
Radio Electronics

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

master charge BANKAMERICARD



- *Remote*
- *Motor Controlled*

RCS-4

COAX ANTENNA SWITCH

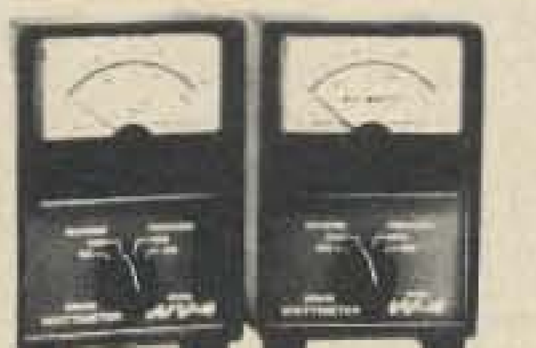
- Control unit works on 110/220 VAC, 50/60 Hz, and supplies necessary DC to motor.
- Excellent for single coax feed to multiband quads or arrays of monobanders. The five positions allow a single coax feed to three beams and two dipoles, or other similar combinations.
- Control cable (not supplied) same 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.



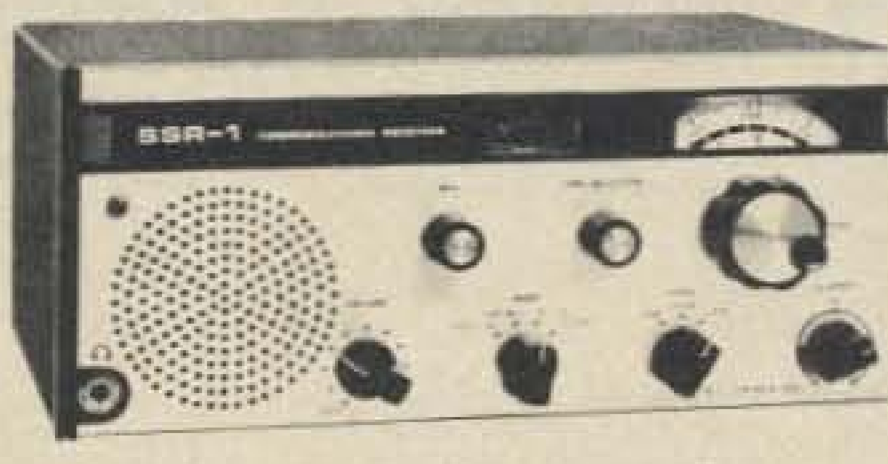
RF WATTMETERS

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.**

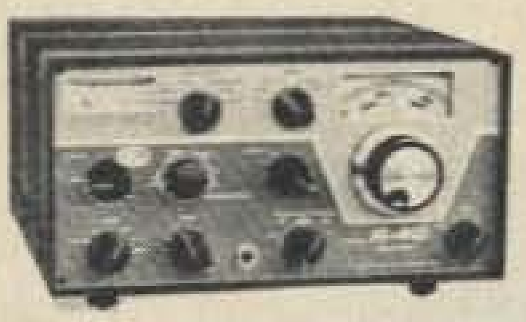
RECEIVE: • **Sensitivity** better than ⅓ μV for 10 dB S/N • **I.F. Selectivity** 2.1 kHz @ 6 dB, 3.6 kHz @ 60 dB, • **AGC** full on receive modes, variable with RF gain control, fast attack and slow release with noise pulse suppression • **Diode Detector** for AM reception. Price: $599.00

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.

L-4B LINEAR AMPLIFIER

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

Drake Amateur Low Pass Filters

. . . have four pi sections for sharp cut-off and to attenuate xmtr harmonics falling in any TV channel and the FM band. 52-ohm.

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 connectors 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

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Phone: 617-395-8280

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

BANKAMERICARD

master charge

YAESU
The radio.

FT-101E		LIST
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.

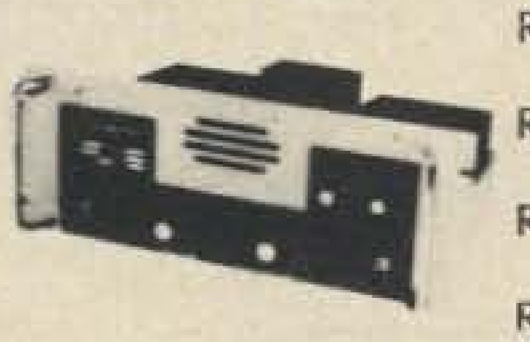
TUFTS Radio Electronics

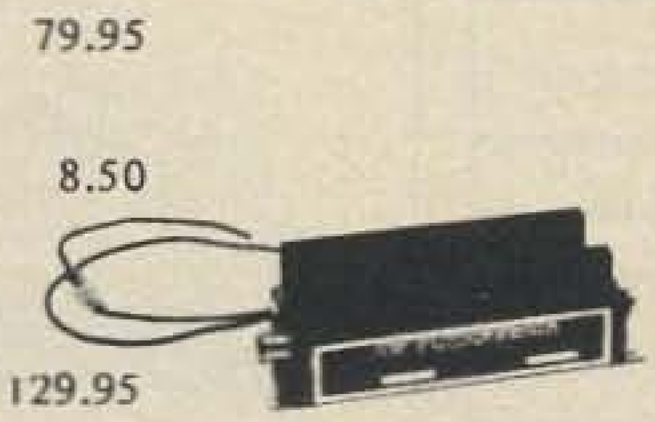
386 Main St., Medford MA 02155
Phone: 617-395-8280

Vhf engineering

MINI-CATALOG 1976
The World's Most Complete Line of VHF-FM Kits and 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

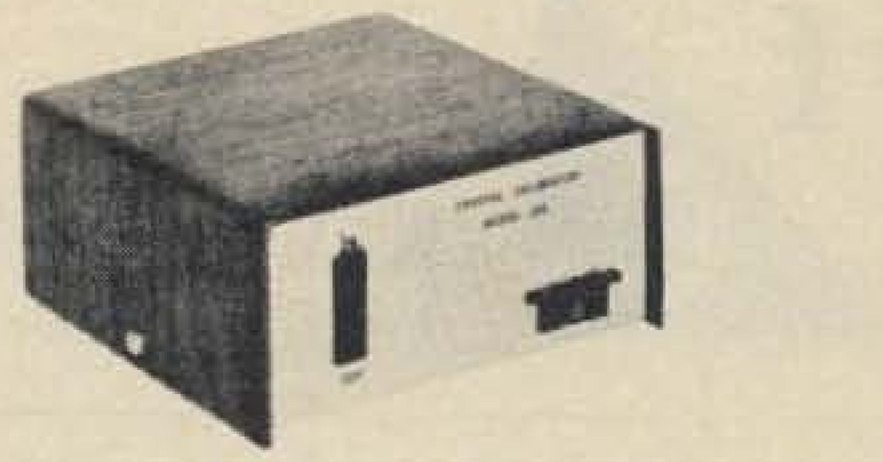
OTHER PRODUCTS BY VHF ENGINEERING

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

ARGONAUT, MODEL 509 AMPLIFIER, MODEL 405

TRITON IV

Model 206



TEN-TEC

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.

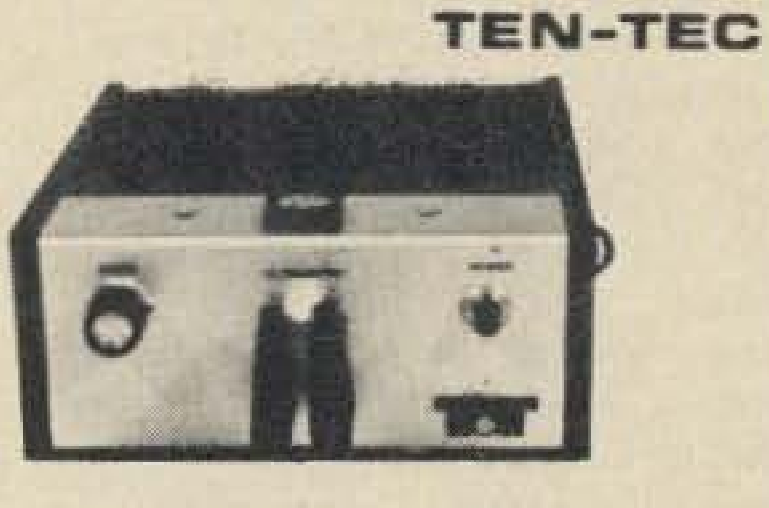
Memories provided for both dits and dahs but either may be defeated by switches on the rear panel. Thus, the KR50 may be operated as a full iambic (squeeze) keyer, with a single memory or as a conventional type keyer. All characters are self-completing.

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 8¼"
Weight: 1¾ lbs.

TEN-TEC



KR50A

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

310-003

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.

322-001

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

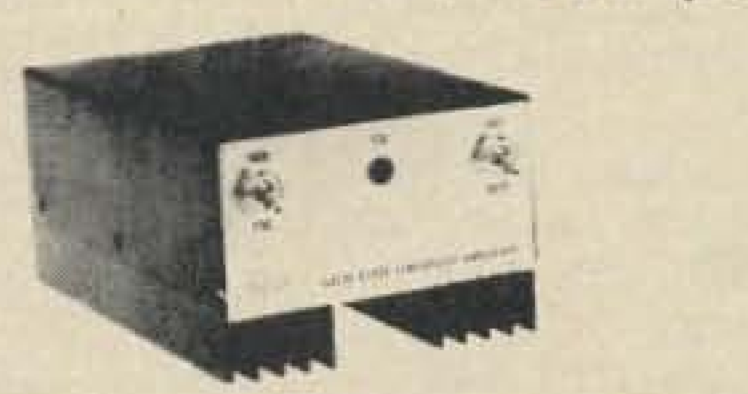
SSK-1

Model 404-002 SSK-1: Chrome Plated - $29.95; Black Wrinkle Finish - $23.95.

404-002

Code Practice Set with Key- $18.50.

Mobile Amplifiers With Versatility



- Fully VSWR & reverse voltage protected
- No tuning required across band
- Switchable Class C or AB operation
- Built-in TR switching, w/increased delav for SSB
- Fully compatible with all 1-15W FM/SSB/AM/CW rigs
- All solid-state and microstrip construction

SCS SPECIALTY COMMUNICATIONS SYSTEMS, INC.

FREQUENCY MHz	MODEL	INPUT POWER NOM.W	OUTPUT POWER NOM.W	OPERATING CURRENT @13.6VDC	SIZE CM HXWXL	RETAIL PRICE
50-54	6M10-100L	10	100	12	7.1X10.2X22.9	$169.95
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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NEW ENGLAND'S FRIENDLIEST HAM STORE

Open 9 AM to 9 PM Mon. — Sat.

by Wayne Green W2NSD/1

I/O EDITORIAL

HALF A COMPUTER

Most of the ads for computers are written for knowledgeable computer fanatics, not beginners. Thus there is a certain lack of candidness as far as the software involved is concerned. Newcomers may be vaguely aware that software is needed for computers, but not really understand just how important it is . . . particularly for the neophyte . . . to have some sort of operating system available.

Like several thousand others, I read the early MITS ads and envisioned myself sitting down to a small computer system (golly, the board is only $425 in kit form!) to play games, keep track of DX stations worked, find out when Oscar would come into range, and things like that. Naive Wayne.

For several months my Altair 8800 microcomputer was a fantastic $2000 coffee table conversation piece. I could hold visitors spellbound with tales of the marvels of this great device and the things it would be able to do. Note that "would be able." About eight months into my ownership of the 8800 I received a cassette with BASIC language on it . . . and a brief instruction manual. About three months later I cheered one night when, after a great many tries, the system suddenly came to life and BASIC loaded and was usable. Now I could start to learn programming.

This is not to in any way put the Altair down, for the ignorance was mine about the importance of software for almost any applications of the system. And while MITS was optimistic about when it would have a BASIC interpreter ready for delivery, their optimism has been a model of rectitude as compared with some other microcomputer manufacturers. In case there is any question in your mind, I think the rule of thumb is that hardware takes about twice as long to get into production as expected by the manufacturer and software about four times . . . if they are lucky.

One of the more frustrating things about reading ads for microcomputer systems is trying to figure what configuration you will need and what programming is really honestly available right now for it. For instance, when I visited Sphere back in August, 1975, they were expecting to ship hardware within a few weeks and were certain they would have BASIC available for it in the same time slot. I think the hardware finally got out in about four months (complete systems, I mean) and to my knowledge they have not yet shipped BASIC in any good usable form.

Sphere did have a version of BASIC which they started to send out, but my understanding was that it was one which had been written for a minicomputer system and had then been adapted via an interpreter to the Sphere. The result was a verrry slooow system. Back to the drawing board.

The last I checked there was no BASIC available as yet for the Wavemate (Jupiter) system.

Southwest Tech has come up with 4K BASIC and an 8K BASIC. The 4K is free with the M6800 system and the 8K costs about $10 extra . . . not a bad deal at all. At first SWT wasn't going to get involved with programs, but now they are sending the 4K BASIC to all owners.

Imsai does have BASIC available . . . either on paper tape at $4 for the 4K version or $8 for the 8K version. Both are available on PROM, and this has an advantage of being in such a configuration that it can be used right from the PROM without having to take it off into a RAM memory before it can be used as the new Altair PROM BASIC requires. The cost is not inconsiderable, however . . . about $500 for the 4K BASIC with PROM and board and double that for the 8K system.

Having the program on a PROM is a big time-saver, because then you don't have to sit and wait for BASIC to be loaded into the system every time you start it up. With RAM memory you either leave the system turned on permanently or else you go through the long loading procedure every time. PROM looks very good to you along about the twentieth time you have to load up.

Speaking of prices, the Altair BASIC on cassette, if you buy your memory from MITS, costs about $75. Bargain. Oh, you pay a little more for their memory boards, but then you can't do much without that BASIC, so the extra expense seems reasonable.

If you are into computers and programming, you may not care whether BASIC (or any other high level language) is available. Not that any others are really available as yet, practically speaking. I've seen ads for FORTRAN for the Altair, but since the ad was from a software house I'll bet they want an arm and a leg. I note that Dick Whipple (you've been reading his articles) programs in machine language and likes it. Of course, most of his programs have been process and haven't really called for the time savings of a higher level language. I suspect if he wanted his system to sit there and compute the square root of a long list of numbers that he might want to insert BASIC or FORTRAN.

If any readers have more information on this whole subject, their articles will be appreciated. There are thousands out there who know many times as much as I do about it, and I'm ready at any time to step off my podium and make space for them.

The thrust of this message is to read the fine print carefully when you are shopping for a computer system. I think you are going to want BASIC for your system, so make sure you know where you can get it . . . and how much it is going to cost.

If any readers think that they are going to order hardware and get a computer system up and working without learning a lot, they have another think coming. These are in no way black boxes as yet. Even brand new assembled boards from the factory may sit there and not work, and you will have to be able to troubleshoot them. You'll have to find out which chips or parts of chips on your memory boards are not remembering. You'll have to find out why in the devil the program you have so painstakingly put together gets dumped into nowhere when you thought you were merely putting a copy of it on a cassette and saving the original in memory. Etc10.

Have fun.

BEEFS

A letter from WA3LWR in Scranton is typical of perhaps a half dozen received in recent weeks. It will come as no news flash that I am oversensitive to criticism and feel that I have to justify myself. This is no exception. Bob complains that *73* was once a ham radio magazine, but now is filled with computers and too few general interest articles. Possibly.

If you happen to feel likewise, I would appreciate not only hearing from you, but getting a detailed review of your reaction to the articles chosen for each issue. Take the August issue, which apparently sparked Bob's complaint . . . it starts out with an article on ICs (p. 24) – I assume there are still amateurs who are so locked into tubes that they are trying not to learn about ICs, but since ICs are one of the most fundamental building blocks for most current ham circuits and virtually all in the future, would *73* be a responsible publication if it turned down articles such as this? The DDRR antenna (p. 28) – isn't that hammy enough for you? The keyer (p. 38) might not have interested you before July 23rd if you are a Tech, but now that you have Novice frequencies you'll be wanting to build a good keyer, and this is a good one. The breadboard article (p. 52) would not interest you if you don't build, but since over 80% of the hams today build . . .? The audio generator (p. 56) would interest those into FM, RTTY, SSTV and control circuits, and hopefully that includes a lot of hams. Golly, you *must* be interested in *something* other than rag chewing! If you don't build, the Logic Grabber would not interest you (p. 60). And the DX article (p. 68) would be of most interest to DXers. I love DXing, don't you? The counter calibrator (p. 70) should interest any builder or counter user . . . how can you get along without a counter? I use mine virtually every day of the week for something. The 450 rig doesn't grab you? A lot of chaps are active on the band . . . and ATV is flourishing with the pioneers. Now, even if you are not a pioneer type, you recognize your dependence on them to keep amateur radio going. Are you going to try to force magazines not to publish articles to spur pioneering? That seems counterproductive. If you are too busy to do the work, at least don't try to prevent others . . . okay? Now we're into the so-called I/O or computer section, starting with a fantastic story by WA8VNP, a youngster who is the epitome of what amateur radio is all about. Oldsters with firmed up minds would do well to read Don's article. What was *your* reaction to it? (p. 82) The chip (p. 90) and languages (p. 98) and arithmetic (p. 108) are an effort to provide fundamentals in this new field . . . and they are difficult to get *anywhere* else. Baudot (p. 102) is for RTTYers mostly. The Logic Probe (p. 106) is needed in almost every ham shack these days. Satellite orbits (p. 113) . . . hammy? Only if you are into Oscar . . . and you *should* be. A couple more RTTY articles (pp. 122 and 150) . . . one on logic (p. 116) . . . a signal tracer (p. 148) . . . true, there isn't much for the rag chewer and we did antennas so much in June that many readers are still in wire shock.

What do *you* think about the content of *73*? I know that only a small percentage of readers are yet into microprocessors, just as very few readers were into FM back in 1969 when I started making information available on repeaters. I don't see how uP can have any less impact on hamming than FM . . . and FM is the single most active mode today in amateur radio. I'd appreciate your opinions . . . but please be specific and cover every article in an issue, not just a general impression . . . okay?

I/O REPORT

by John Craig

The New Magazine

The machinery has been set in motion for starting a new computer-oriented magazine later on this year. I should point out that it isn't going to be just another magazine in the field, either . . . it's going to be the *best!* Our main thrust will be in the area of *applications*. We're going to have articles on both hardware and software, and they'll be written with examples and applications we can all relate to.

I'm sure that everyone who has become involved in personal computer systems has heard (time and again) the question, "What are you going to do with a home computer?" My standard reply to that question is, "It's my toy, and I have a lot of fun playing with it." Deep down inside I know full well that it's destined to be more than a toy.

Someday, in the not too distant future, there are going to be a lot of people taking a second look at the "monsters" they've created and realize these computer systems could be *making some money*, too. (Extra cash is something most of us don't find objectionable, right?) If you think you've heard some good application ideas so far, just wait until the small business ideas start flying around! And just wait until you see how our new magazine covers those (and many more) applications!

Speaking of Money-making Ideas . . .

The other day a friend of mine, who is a professional programmer, stopped by for a chat and came up with an interesting proposal. He suggested that the two of us pool our resources and go into a part-time business doing accounts receivable, inventory, and payroll for doctors' offices. (He felt it would be best to concentrate on just one type of business in the beginning.) His proposal was this: He would develop the software to make such a system possible and I would provide the hardware for running it. The system would be cassette-oriented, in that the doctors' offices would have a data-entry terminal for entering all transactions, inventory flow, etc. The purpose of the terminal would be to record all of these transactions onto the cassette . . . which we would pick up each evening for processing at home.

At the moment there are two or three obstacles to be overcome before such an idea could become a reality. A floppy disc would be most desirable, to say the least. (Or would you believe a 52 megabyte IBM cartridge-type disc for $375.00??) The item which is really holding things back is a low cost key-to-tape data-entry terminal. I sure wish someone would get busy and develop it. It wouldn't have to be very sophisticated; the main thing would be to provide a display (perhaps just three or four lines by 32 characters) so the operator could check the entry before writing it out to the cassette. A keyboard, display, cassette recorder, and the interface electronics would be the basic elements. (And how about for under $150??) Just think about it for a moment . . . this little terminal could be used in just about *any* business! Sound interesting? Good. Why doesn't somebody get busy on it . . . line up a manufacturer to put out a kit . . . and we'll publish it all in *73*?

The Sherick DG System.

Responsible Applications

We all get junk mail. As a matter of fact, some of the junk mail we get these days is generated by computers. I don't have anything against this stuff . . . it's simply too easy to throw it away if I don't want it. I recently heard about a computer application involving *junk phone calls*, and that *does* bother me. Something like that is getting very close to what I would call "invasion of privacy," and I have the feeling a lot of other people will feel the same way.

The idea centered on the development of a system which would generate "sales pitch" phone calls for a real estate company. Using an optical reader, the computer would scan through pages of the phone book and call prospects within the immediate area of the real estate. It was estimated that if only a small percentage of the calls resulted in sales the system would pay for itself.

A lot of people either have a fear or a distrust of computers, and I would hope that the evolution of the home system might help to eliminate this somewhat. Receiving junk phone calls from a computer will probably turn some of that fear and distrust to anger. This isn't going to help us in promoting personal computer systems, and, who knows, it might even lead to legislation prohibiting such activities. And, as someone else pointed out, "The biggest problem here is that I'd have to go to the trouble to program my computer to answer your computer!"

The June SCCS Meeting

Erich A. Pfeiffer (Ph.D. and WA6EGY) gave a very interesting talk on the history of computers and microprocessors. (Be sure to catch his article in the August *73* on building the MINI-MOS Keyer.)

As usual, the meeting was attended by several hundred (two or three, at least) computer enthusiasts. The exhibitions, displays, and selling areas took up three full rooms. The rest of the country has to wait around for the next computer convention . . . we have one here in Southern California every month!

The Talking Computer

One of the second prize winners (there were two) at the MITS convention back in March was Wirt Atmar and his talking computer. He has since decided to market the hardware/software package and has made some interesting discoveries as a result of his efforts.

It seems that his machine has somewhat of a "computer accent" and is most easily understood by young children and people who have traveled and been exposed to different dialects and accents. The talking also seems to be easier to understand when it is being used during the playing of games. But perhaps the most interesting point was the fact that a person had to *want* to understand the machine. Those who approach it with a negative attitude in the beginning seem to be the ones having the greatest difficulty understanding it.

Wirt is going to be selling the package for around $400. They're going to be sold only through computer stores around the country. That way a person will be able to go in and hear it before he buys it. He could build a unit that would sell for around a thousand dollars, and would be more easily understood than the present one, but he feels that is out of the range of the average hobbyist.

Writing for 73

Wayne and I mention writing articles so often that it must seem like we're really in a rut. Not so. We just know a good thing when we see it. And I mean a good thing from your angle. To heck with the fame and recognition . . . we pay out large quantities of U.S. currency for good articles.

If you don't care about the money or fame, then let me appeal to your "responsibility" to share some of the things you've been doing with your system that others may not have the know-how to accomplish. There are a lot of people out there doing a lot of exciting things. Unfortunately, they aren't taking a little time to tell the rest of us about them. If you are one

DIGITAL DATA RECORDER
for Computer or Teletype Use
Up to 4800 Baud

Uses the industry standard tape saturation method (NRZ) to beat all FSK systems ten to one. No modems or FSK decoders required. Loads 8K of memory in 17 seconds. This recorder enables you to back up your computer by loading and dumping programs and data fast as you go, thus enabling you to get by with less memory. Great for small business bookkeeping. Imagine! A year's books on one cassette.

Can be software controlled. Comes complete with a software program used to test the units in production (8080). Manual includes software control hook up data and programs for 8080 and 6800.

NEW – 8080 I/O BOARD with ROM Permanent Relief from "Bootstrap Chafing"

This is our new "turnkey" board. Turn on your Altair or Imsai and go (No Bootstrapping). Controls one terminal (CRT or TTY) and one or two cassettes with all programs in ROM. Enables you to turn on and just type in what you want done. Loads, Dumps, Examines, Modifies from the keyboard in Hex. Loads Octal. For the cassettes, it is a fully software controlled Load and Dump at the touch of a key. Even loads MITS Basic. Ends "Bootstrap Chafe" forever. Uses 512 bytes of ROM, one UART for the terminal and one USART for the Cassettes. Our orders are backed up on this one. #2SIO (R) Kit form \$140. Fully assembled and tested \$170.00.

SPECIFICATIONS: Model CC7 \$149.95

A. Recording Mode: Tape Saturation binary (NRZ). This is not a FSK or Home type recorder. No voice capability. No Modem. Runs at 2400 baud or less Asynchronous and 4800 baud Synchronous. Runs at 3.1"/sec. Speed mechanically regulated ±.5% or better.

B. Two channels (1) Clock, (2) Data. Or two data channels providing four (4) tracks on the cassette. Can also be used for Bi-Phase, Manchester, etc.

C. Inputs: Two (2). Will accept TTY, TTL or RS 232 digital.

D. Outputs: Two (2). Board changeable from TTY, RS232 or TTL digital.

E. Erase: Erases while recording one track at a time. Record new data on one track and preserve three or record on two and preserve two.

F. Compatibility: Will interface any computer using a UART or ACIA board. (Altair, Sphere, IMSAI, M6800, etc.)

G. Other Data: 110-220 V – (50-60) Hz; 3 Watts total: UL listed; three wire line cord; on/off switch; audio, meter and light operation monitors. Remote control of motor optional. Four foot, seven conductor remoting cable provided.

H. Warrantee: 90 days. All units tested at 300 and 2400 baud before shipment. Test cassette with 8080 software program included.

Also available – MODEL CC7A with variable motor speed which is electronically regulated. Runs 4800 baud Synchronous or Asynchronous. Recommended for quantity users who require tape interchangeability. Comes with speed calibration tape to set exact speed against 60 cycle line. \$169.95.

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.... Data Recorder CC-7 @ \$149.95

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Please enclose \$2.00 Shipping & Handling on each Recorder or I/O Board.

.... Operating & Technical Manual (Schematics) includes Software & Hookups for 8080, 6800, and I/O. @ \$2.00

N.J. Residents add 5% Sales Tax

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Signature ________

Total enclosed \$ ________

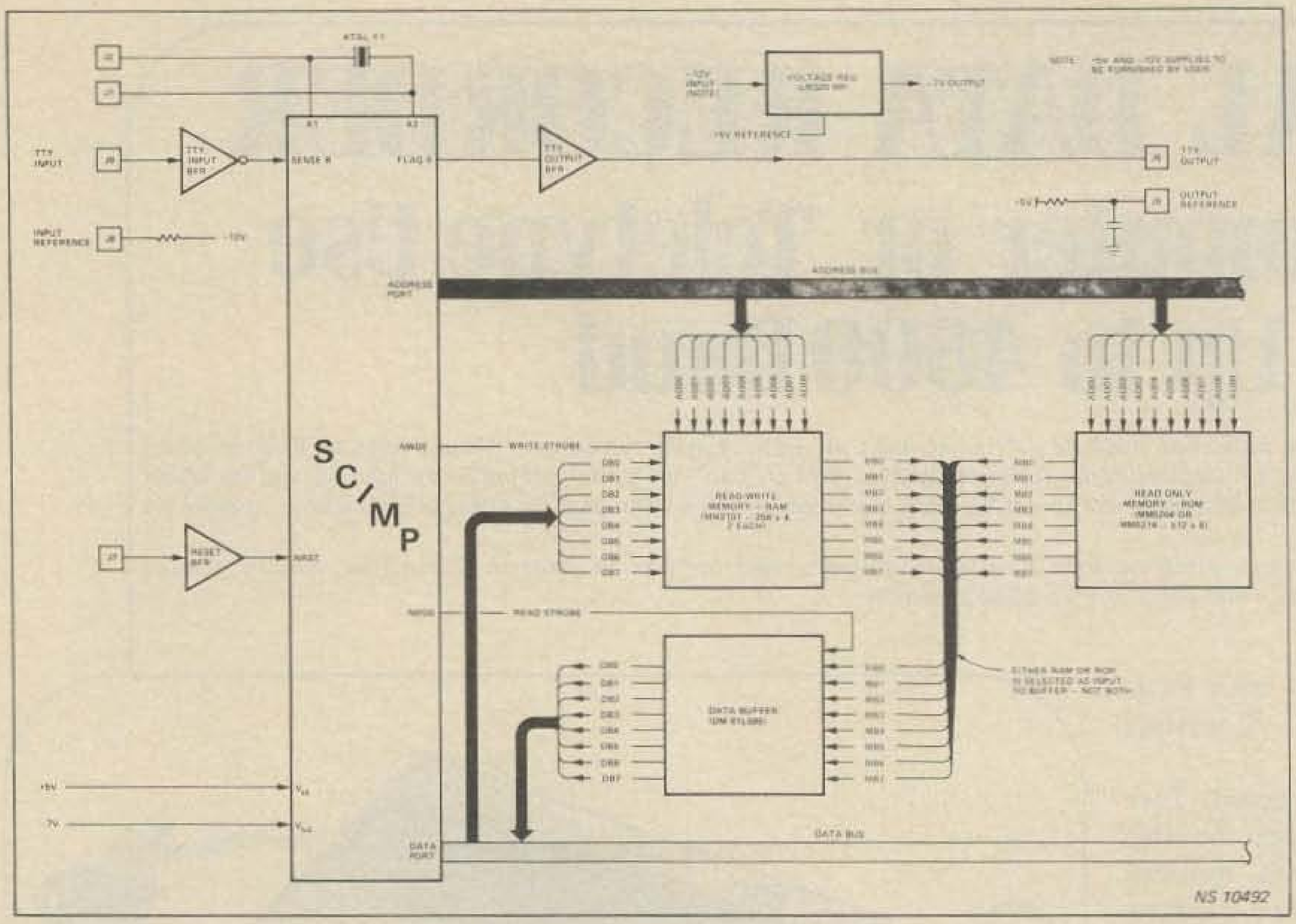

Fig. 1. SC/MP kit block diagram.

of those people . . . give it some thought, OK?

What would happen if . . .?

Here's something for you to think about. What do you suppose would happen to this home computer "movement" if some large company with a lot of advertising bucks came out with a *system* and began advertising it on nationwide television? I'm thinking in terms of a "turn-key" home system. The average layman could purchase it at his local computer store (or local Radio Shack outlet?), cart it home, plug it in, load a program into it from cassette, and have it start doing things. (Actually, that last point may be the big stumbling block for this whole scheme. Are there that many practical *things* the home computer can now do that would make it appeal to the average layman?)

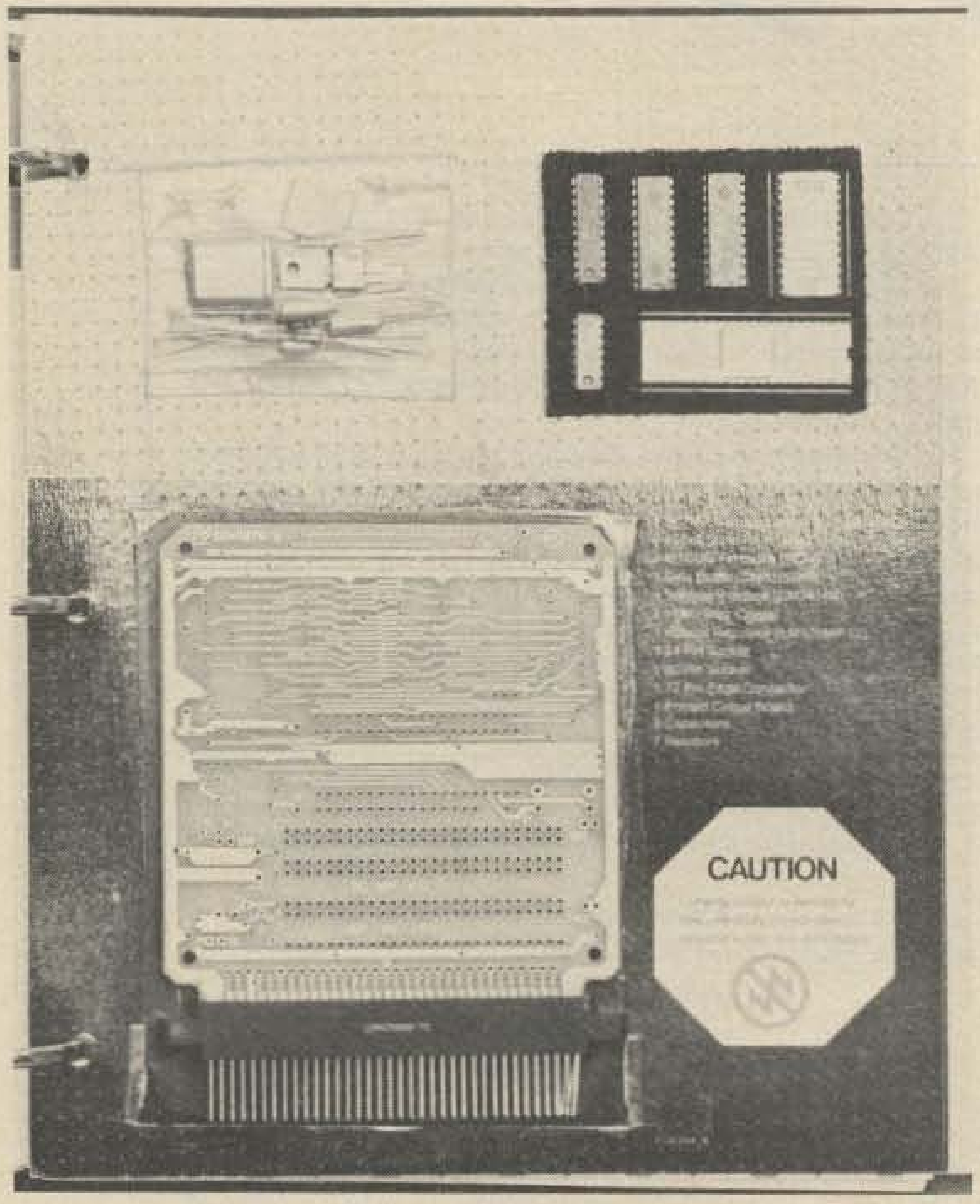

Photo 1. The SC/MP kit upon arrival.

Let's assume that a salable software package was developed by some company, such as Radio Shack. I'm sure you've all seen some of Radio Shack's impressive ads on TV for their CB and stereo units. What if they used that same tasteful (and sophisticated) approach for convincing Mr. and Mrs. America that the "Realistic Home Computer System" was something they couldn't live without?

If the price were right and people started buying their package, the spin-offs would be incredible. Most importantly, the entire country would be aware of the coming of the home computer . . . and a lot of people would do some shopping around. And even if the Radio Shack system were built around a little-used chip like the Fairchild F-8, there would soon be a lot of companies jumping on the bandwagon developing and marketing memory and peripherals for the system. Also, as more people become involved in this thing, it should mean a lot more software being developed for everyone (at least, I sure hope it turns out that way).

The Sherick DG System

Mike Sherick, of Vandenberg AFB, California, was only recently bitten by the bug. After attending several meetings of the local computer club (Central California Computer Users' Group . . . at the Cabrillo Computer Center . . . home of the *Micro-8 Newsletter*), he decided on a Digital Group System. He chose the Digital Group System for a couple of good reasons. The first was the fact he had seen how easily a friend's (Sam Daniels') unit was brought up and became operational with very little difficulty. The second reason was that Sam is an extrasharp programmer type, and the two of them decided to team up and work to their mutual benefit.

Mike is a professional photographer with a long-standing interest (and involvement) in electronic experimentation. The "experimenting" has certainly carried over into some of the things he is doing with his home computer system, too. For example, that front panel is far from being a standard item from the Digital Group (they provide the plans for it, but that's all). Mike became convinced of the value of a good front panel for hardware debugging and development (and software debugging) and set forth to build a real beaut.

Notice the bottom center switch on the front panel. It's labeled "PROM," "RAM," and *"PRAM."* Mike built an interesting modification into his system, which allows him to have page zero as the DG operating system PROM, or as RAM in the form of 2102s, *or both at the same time* (PRAM). The purpose of this mod is to allow loading of programs into page zero (which is normally occupied by the PROM). Through software manipulation, the two areas are operated in "simultaneously", i.e., the loading program is being accessed in PROM (page 0), and the new program is being loaded into the RAM in page 0. Whew! I wasn't sure I was going to be able to explain that! Future plans include the building of a variable step and examine rate feature, and mounting the entire unit into a modern brushed aluminum cabinet which is going to make us all drool. (We'll have to be sure to get a photo of that one, too.)

Mike got into this hobby because he has a curiosity and a desire to learn about computers. It's just a shame that his lack of experience has inhibited him so much!

We would like to see other systems from around the country in *73*. Take a picture of it (8 x 10, B/W) . . . with you, too . . . send along a little write-up . . . and we'll let the world know what you're doing. OK? And I'd especially like to see some good ham applications.

NEW PRODUCTS

National's 8-bit Microprocessor Kit – SC/MP

National Semiconductor has made the plunge! Their 8-bit SC/MP (originally called "SCAMP") microprocessor has been out for some time now, but apparently some new marketing strategy has developed and they're now offering it in a package for $99.00. That price, and what it buys, is something for the hobby community to sit up and take notice of, too.

When the SC/MP kit arrived, we opened the box and the only thing in there was a notebook! The first reaction was that somebody goofed and forgot to include the computer. But, it turns out they have a rather neat packaging scheme and the components are mounted on cardboard and located in the notebook (under, of all places, a section entitled "Components"). See Photo 1. The notebook contains a very thorough collection of manuals covering the kit and its construction, technical description, and programming.

The kit itself consists of a printed circuit board, 72-pin edge connector, discrete components (resistors, capacitors, crystal, and voltage regulator), and the SC/MP microprocessor and support chips (see Fig. 1 for a block diagram of the SC/MP kit). The support chips include a pre-programmed 512 byte Read-Only Memory which contains KITBUG (a monitor/editor for program development), and 256 bytes of RAM. A TTY interface is also included on the board (a $99 computer . . . and a $1500 TTY!).

The SC/MP microprocessor has a complement of 46 instructions (both single and double byte). The chip has an internal clock generator which requires only an external capacitor or crystal. A serial input and serial output port are provided, along with two sense inputs (one which doubles as the interrupt input) and three control outputs. These control outputs can be used for external control of such things as relays, solenoids, external lights, and alarms. The chip requires +5 volts and -7 volts (which is derived, in the kit, from -12 volts being applied to an LM320 voltage regulator).

Fig. 2 illustrates how the separate serial and input lines can be used to implement parallel-to-serial (and vice versa) transfers under SC/MP control. This is just one of several application diagrams included in the documentation. They also provide circuits for building a front panel and a hexadecimal keyboard interface (which would be considerably less expensive than a TTY).

One of the interesting possibilities offered by the SC/MP is its use as a central I/O controller in a microcomputer system. Imagine having small routines in PROM which would handle data transfers to and from a cassette, to and from your TV Typewriter, and output to a low cost printer. These routines could be developed using RAM memory, and after dubugging could then be transferred into PROMs (with appropriate address modifications made . . . which hopefully, would not lead to further debugging being needed). The SC/MP PROM (a 5204) can be programmed by your local National distributor, Bill Godbout Electronics, or Morrow's Micro Stuff for a nominal fee. (See the Godbout and Morrow's ads in this issue of *73*.)

Programming the SC/MP is accomplished using the KITBUG monitor/editor. KITBUG has a grand total of three commands: T, for "typing" out the contents of memory (i.e., a memory dump); M, for "modifying" individual memory locations; and G, for "go" (begin program execution).

We happened to have a power supply (which provided the necessary +5 and -12 volts) mounted in a small cabinet. There was just enough room for mounting the SC/MP kit, and Photo 2 shows the neat package we came up with. The "system" consists of a master reset switch (top center), power on/off switch ("operate"), four connections to the ASR/33, and the +5, -12, and ground connections. Note that space is provided on the PC board for mounting additional components for a particular application.

The SC/MP kit does not lend itself to much in the way of memory or I/O expansion. However, National does offer three application modules for those with a desire to build a larger system around the SC/MP. These include a CPU PC board, RAM memory board, and a ROM/PROM board.

National offers applications and programming training for the SC/MP (and their other microprocessor systems, including PACE) at their training centers in Santa Clara CA, Dallas TX, and Miami FL. They also sponsor COMPUTE (Club of Microprocessor Programmers, Users, and Technical Experts) which is "a user

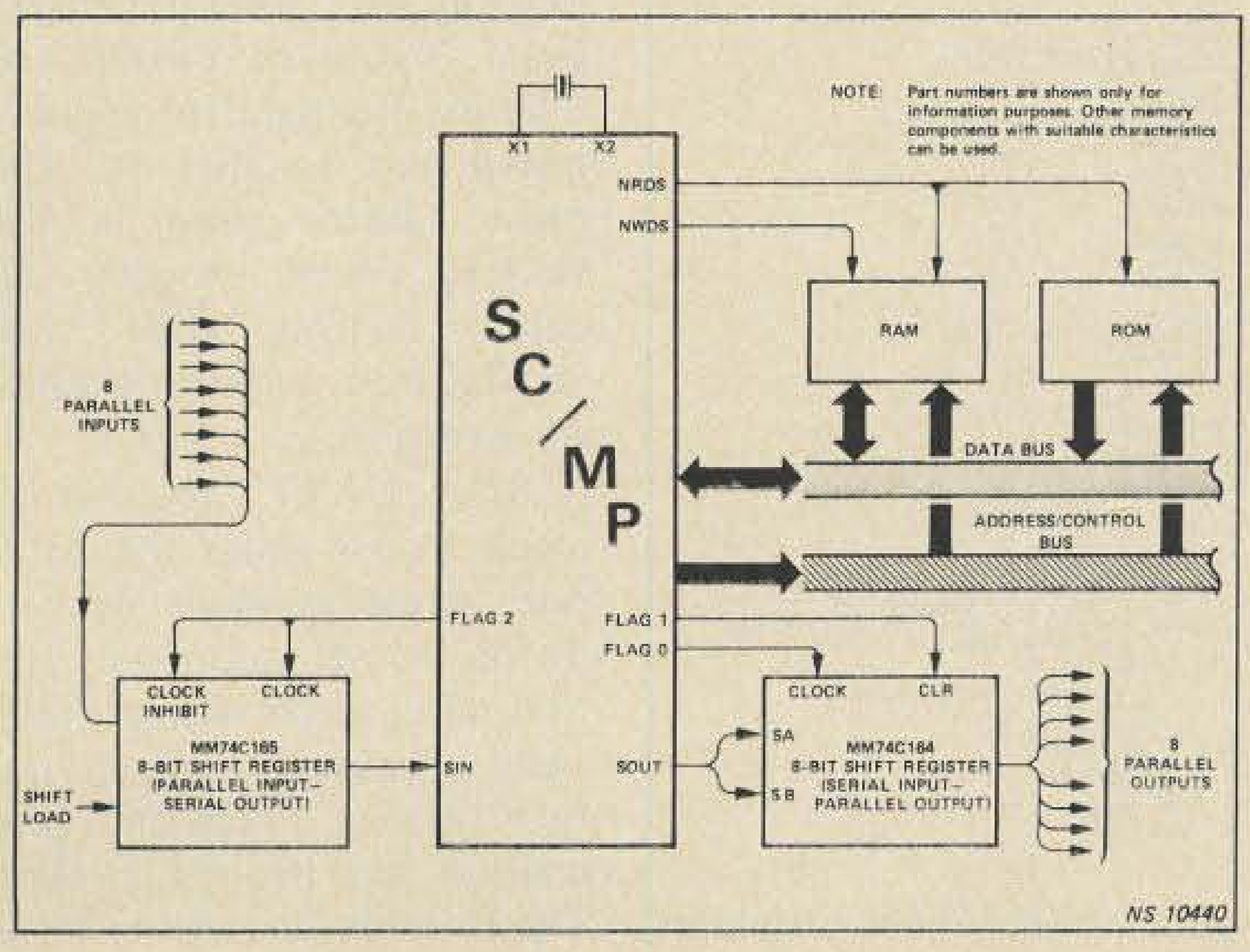

Fig. 2. Using SC/MP with a simple serial interface.

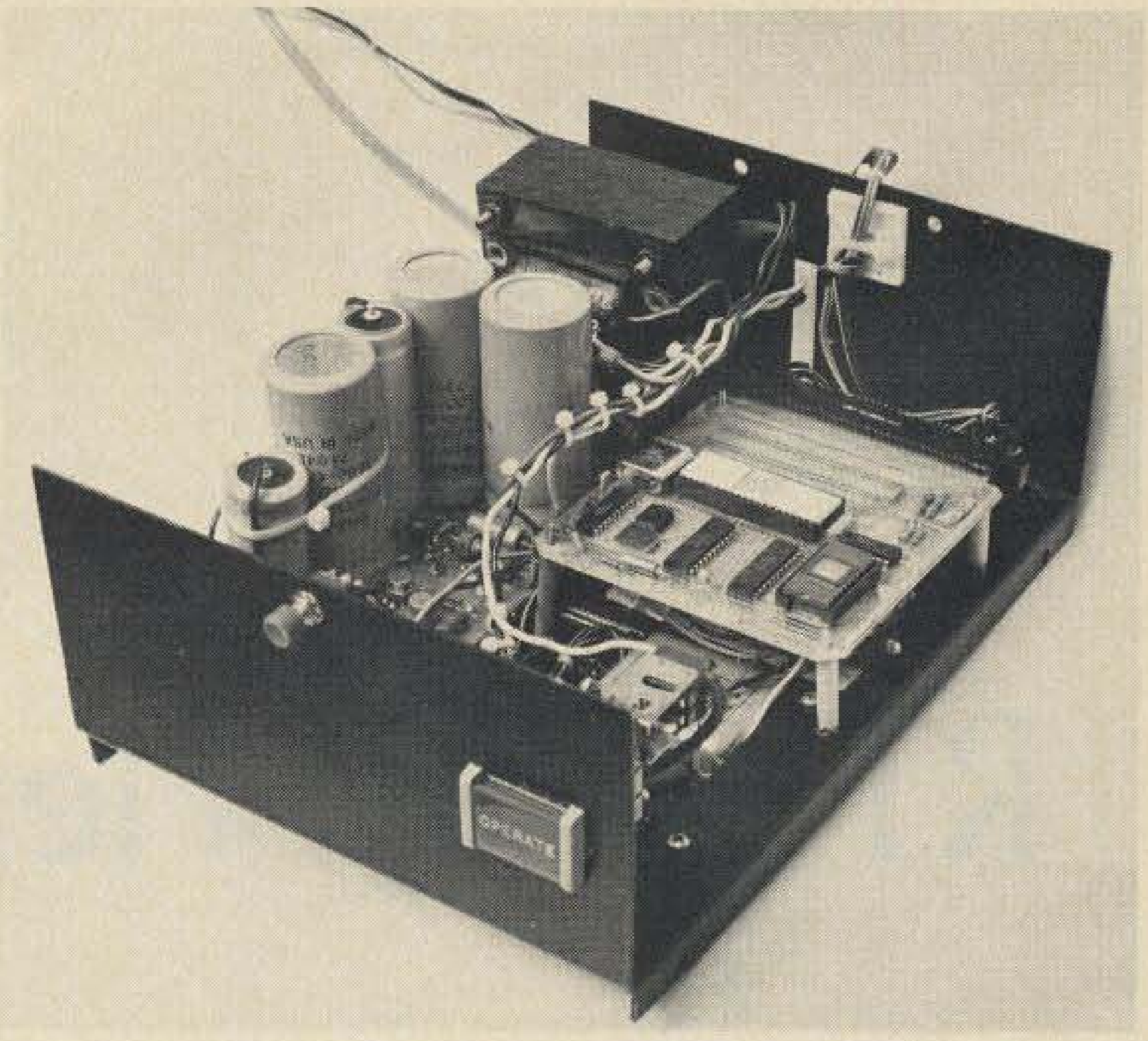

Photo 2. The completed SC/MP kit "system."

group dedicated to the worldwide distribution of ideas and techniques relating to the use of microprocessors." Members communicate through the *Bit Bucket*, a newsletter published by National Semiconductor. One of the neat things about COMPUTE is the user-submitted software library which has contributions published regularly in the *Bit Bucket*. It's a pretty good bet that it won't be too long before some user contributes a SC/MP version of Tiny BASIC!

The SC/MP kit single unit price is $99.00. To order, or obtain further information, contact: National Semiconductor Corporation, Mail Stop 520, 2900 Semiconductor Drive, Santa Clara CA 95051.

The Tarbell Cassette Interface

There have been a lot of companies in recent months that have jumped on the bandwagon in providing plug-compatible accessories and options for the Altair 8800. Tarbell Electronics should be put up toward the top of the list of those providing *quality* units.

The unit can be purchased either in kit form or assembled. Audio and ribbon cable is provided for the Altair and cassette recorder interfacing, and a sync tape is included for initial checkout. The manual supplied with the unit contains a wealth of information. Aside from the assembly and checkout instructions, circuit theory of operation, operating tips, troubleshooting, and application ideas, there is an abundance of software. Routines are included for input and output transfers, cassette bootstrap, and sync code generation; most importantly, modifications to MITS 8K and 12K BASIC are also included, so either one can be loaded or saved using the Tarbell interface. Another significant offering in the software area is a mini-operating system (Processor Technology Software Package #1), which has file handling capabilities (SEARCH for a particular file, MOVE it from one area of memory to another, COPY from one cassette to another, SKIP a file, and more). The cassette also includes an assembler and text editor. It is available free with a $5 handling charge for listings and instructions (if you desire them also).

The interface was designed to achieve speeds up to 540 bytes per second (2200 bits per inch), but the normal operating speed is 187 bytes per second. This corresponds to the ANSI standard of 800 bits per inch. By modifying the oscillator frequency and performing a parallel-to-serial conversion in software, the interface can also be used for program exchange using the Kansas City standard. The manual makes the point that, "Since the standard is fairly slow, it suggests that many people will want to have two methods available: one which provides for program exchange with other hobbyists around the country, and another which is much faster, so that program loading and development can be speeded up." Since a great deal of time is going to be spent saving and loading data, programs, and other text, the speed will definitely become an important consideration. You need to decide if you want to have enough time to stand up and stretch while loading BASIC at 187 bytes/second (40 seconds) or have time to jog around the block while loading at 30 bytes/second (*4 minutes*).

The encoding technique used in the Tarbell interface is quite simple and has been in use throughout the industry for quite some time. You can visualize this technique if you imagine a shift register filled with data. The register is clocked with a square wave and the output data is exclusive-ORed with this square wave. This results in a

Continued on page 116

Oct 1976

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RTTY/uP Flexibility

-- Baudot/ASCII serial/parallel I/O

The next two construction articles in this series allow your RTTY/Computer Display System to be hooked to serial data lines, either ASCII or Baudot, rather than having to accept parallel ASCII. This feature can prove very useful if the display unit is very far away from the data sending unit (keyboard or computer).

Both projects fit on a small (less than 4" x 4") board and connect to the main board with a dual ended DIP plug. They allow simple selection of a crystal controlled baud rate by setting eight inputs to the board high or low according to a formula. Each uses a UART, which makes reliability high and keeps the number of components low.

With the main board and either one of these optional input boards, you have a very powerful display terminal easily switchable between different codes and formats.

This month the ASCII input will be discussed, while next month the Baudot article will be presented.

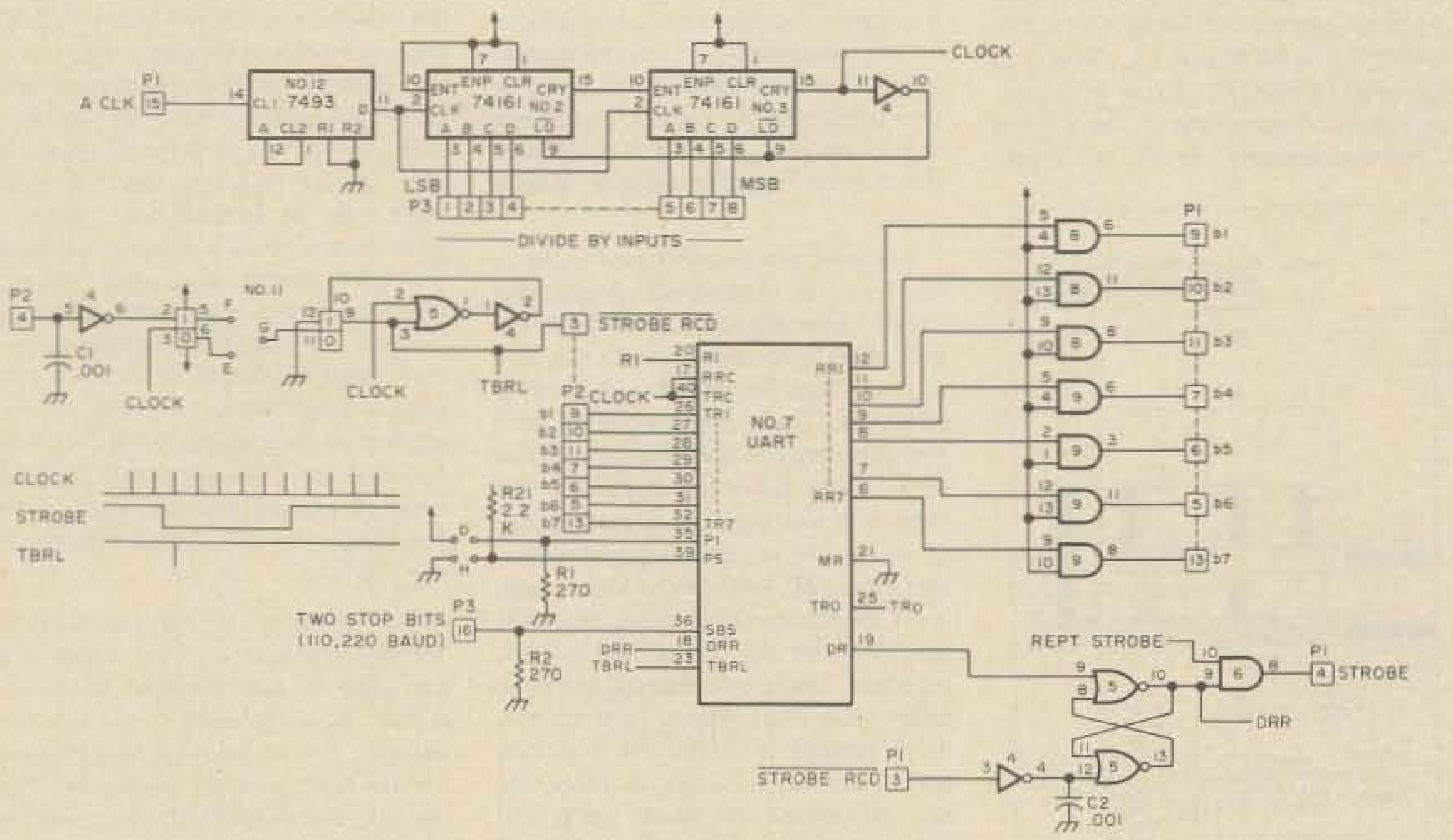


Fig. 1. Jumpers: D — parity inhibit; H — odd parity; E-G — positive strobe, F-G — negative strobe.

Figs. 1 and 2 are the schematic diagrams for the serial ASCII input option. This option is used to convert serial ASCII to parallel, or take parallel data from a keyboard and serialize it. The major device used is the UART, which changes the data's format while converting from serial to parallel (or vice versa).

The UART requires a clock at 16 times the baud rate, which is made by two divide by N counters. The counters each have four inputs, which control the number of divisions the counter has (from 1 to 16). The formula for setting these inputs is:

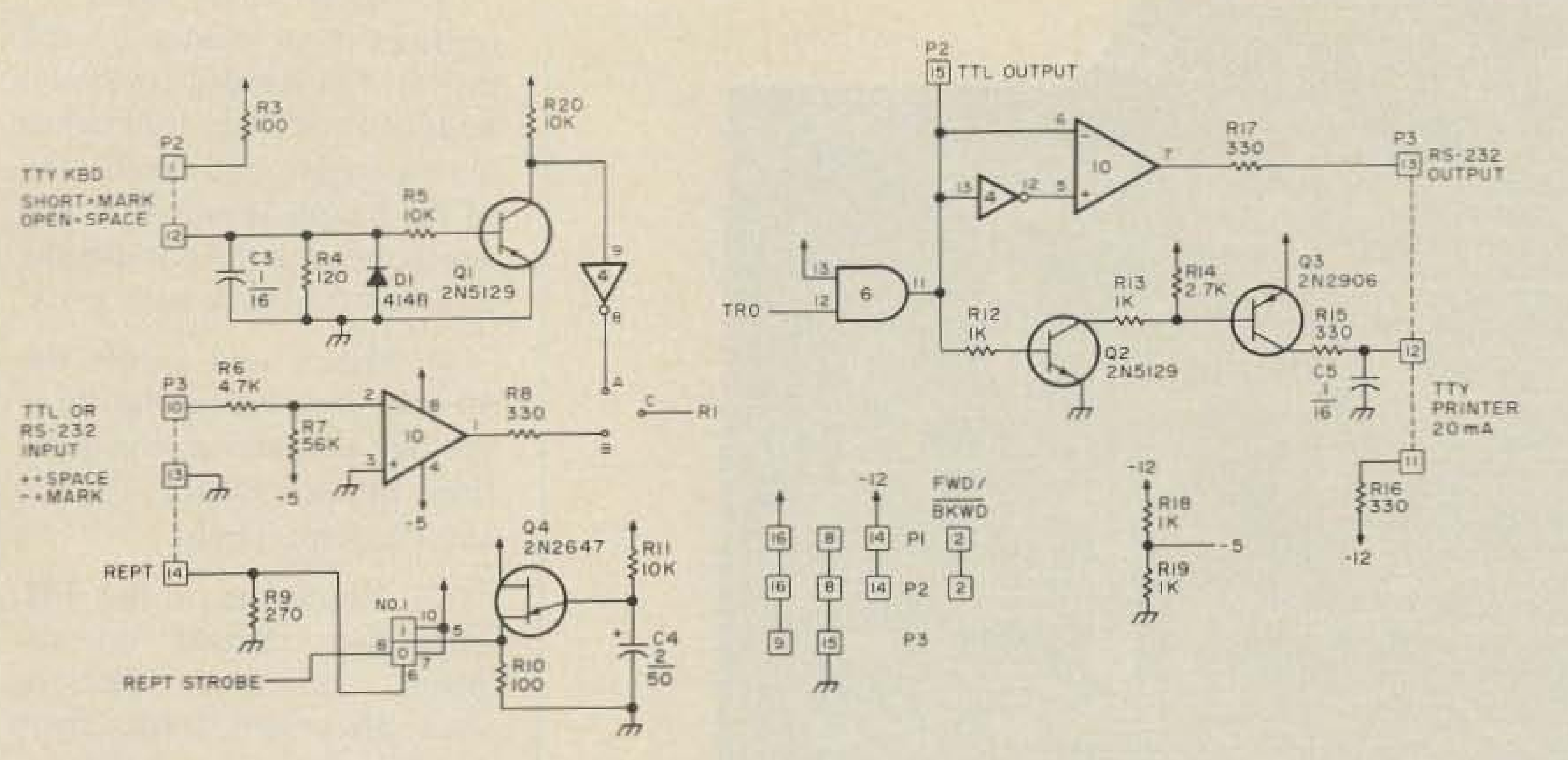


Fig. 2. Jumpers: A-C – TTY keyboard operation (input); B-C – RS-232 input.

$$256 - \frac{380{,}160}{16 \times \text{baud rate}}$$

Note that the number must be converted to binary to set the inputs. Therefore, for 110 baud the setting would be:

$$256 - \frac{380{,}160}{1760} = 40 =$$

0010 1000
msb lsb

The inputs to the two counters appear at eight pins of the P3 plug, and can be hardwired to the determined setting or run to a switch where several speeds can be selected. Jumper settings for several common baud rates can be found in Table 1.

The output of these dividers (circuits 2 and 3) is pin 15 of circuit 3, and is sent to the UART clocks, pins 17 and 40.

The serial input data can take any of three forms: TTL, EIA, or 20 mil loop. If it is TTL or RS-232 (EIA), it is fed into an operational amplifier which inverts it. If a 20 mil loop is used, the outside world simply opens and closes the circuit between pins 1 and 12 of plug P2.

If these contacts are shorted, current flows through the 100 and 120 Ohm resistors, causing a voltage drop across the 120 Ohm. This voltage drop is fed through a resistor to turn transistor Q1 on, grounding its collector. This brings pin 8 of circuit 4 high – which is a mark condition to the UART. If the two terminals are open, no voltage drop will appear across the 120 Ohm resistor, and the transistor will stay turned off. This will bring 8 of 4 low – a space condition to the UART. Either the output of the op amp or the inverter can be jumpered to the UART serial input, with B-C being the op amp and A-C being the loop input.

This data is fed into the UART, and is converted to parallel there. The parallel output is buffered by circuits 8 and 9, and the data ready line (pin 19) goes high when the output data is stable. This line sets a flip flop (pin 9 of 5) which brings 10 of 5 low. This is sent through an AND gate to the display unit as the strobe line. It also goes directly back to the UART to acknowledge the data ready line.

When the display unit receives the strobe, it enters the data into memory and sends back a strobe received pulse. This resets the flip flop, causing strobe to go away. The UART is now ready to receive another byte of data.

If data from a keyboard is to be serialized, the parallel data is presented at the UART, pins 26-32. If you don't want parity sent with the data, jumper D. Likewise, if you do want parity sent, don't jumper points D. Then jumper or leave H if you want odd or even parity, respectively. The strobe pulse from the keyboard is debounced by the .001 disc capacitor and the first half of circuit 11. The output of this flip flop is sent to the clock of the next one. When this goes high, the second flip flop's output goes low. This is ORed with the clock, so that the next time the clock goes low, the flip flop will be preset. The series of events for the strobe input is shown in Fig. 3.

Pin 9 of 11 is the strobe received pulse sent back to the keyboard, and also loads the data into the UART. After the load pulse goes away, the data is sent out pin 25 serially.

This output is buffered at pin 12 of 6 and is sent to the three different outputs. It is sent directly to the TTL output, but is buffered to +5 and -5 volt swings at the other half of the operational amplifier (circuit 10) for the EIA signal. The signal is also sent to a 20 mil loop switch, transistors Q2 and Q3. With the output high (mark), transistor Q2 is conducting, which grounds its collector. This turns on transistor Q3, which allows loop current to flow. If the output is low, Q2 is cut off leaving the base of Q3 high – also cut off. No loop current flows.

The -5 volt supply to the op amp is derived from a resistor divider from -12 V to ground, since -5 V is not sent from the main board to the ASCII input.

If "rept" is brought high, the clear line of circuit one is brought high, allowing its output to oscillate. This output is fed to the AND gate used for the strobe pulse – causing the strobe line to the display unit to oscillate. It should be noted here that even though the data ready line of the UART may have been reset before, the outputs are still available.

Assembly

Refer to the first four paragraphs of the main logic board's assembly procedure for basic information per-

Speed (Baud)	Divide By	
	Decimal	Binary
		msb lsb
110	40	00101000
220	148	10010100
300	177	10110001

Table 1.

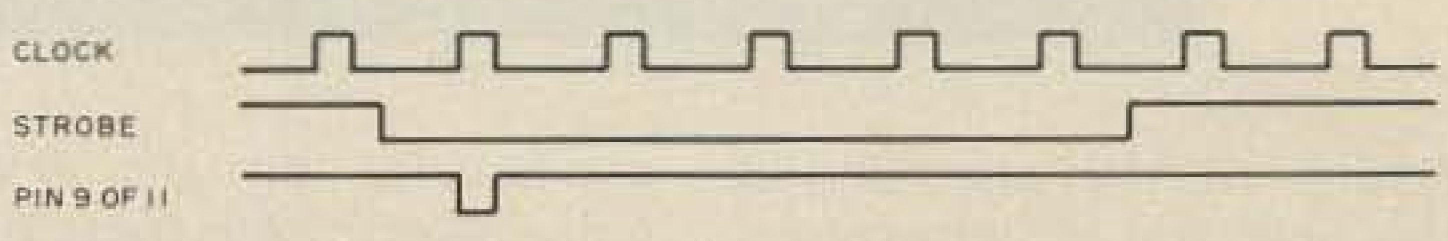


Fig. 3.

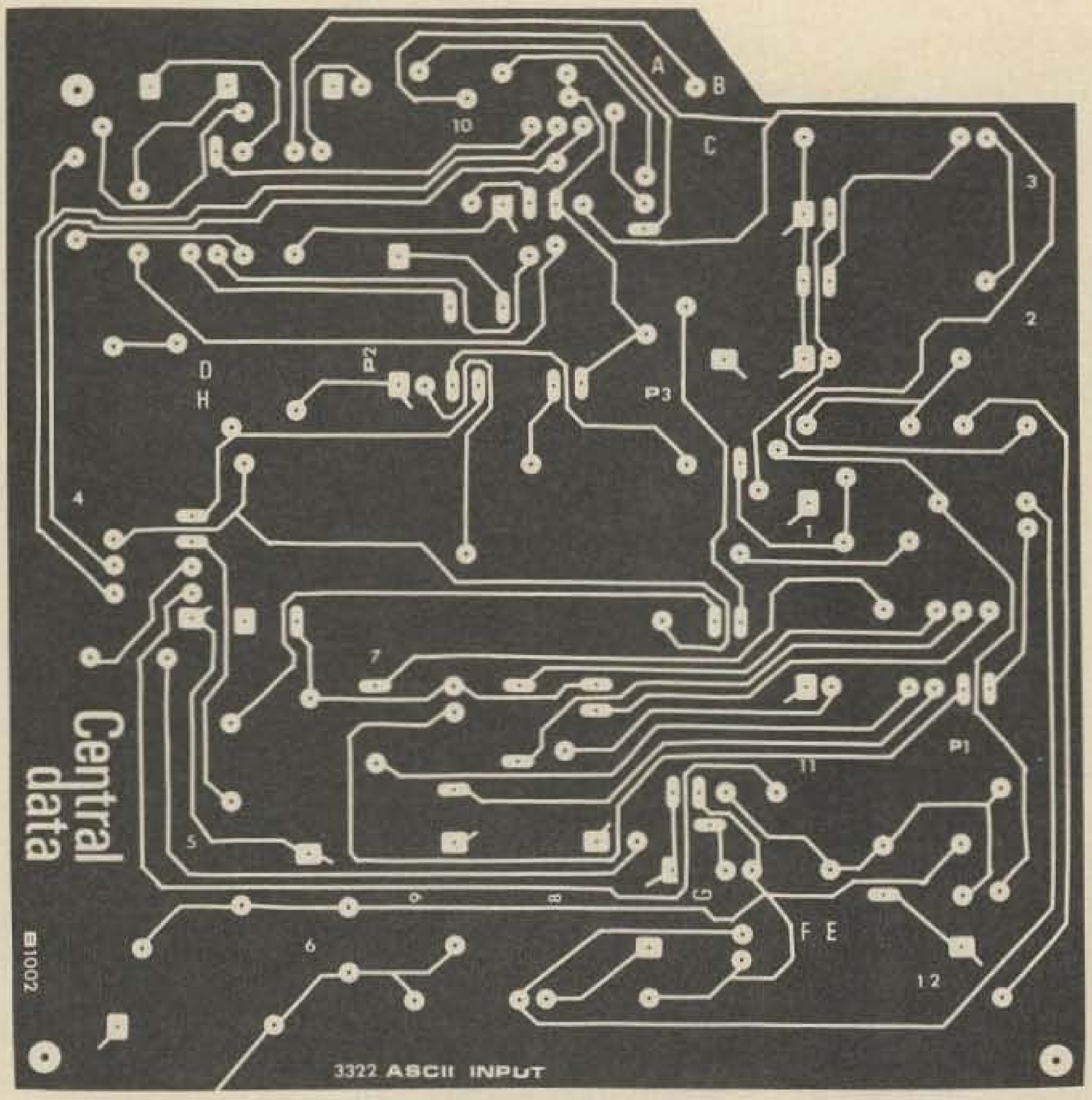
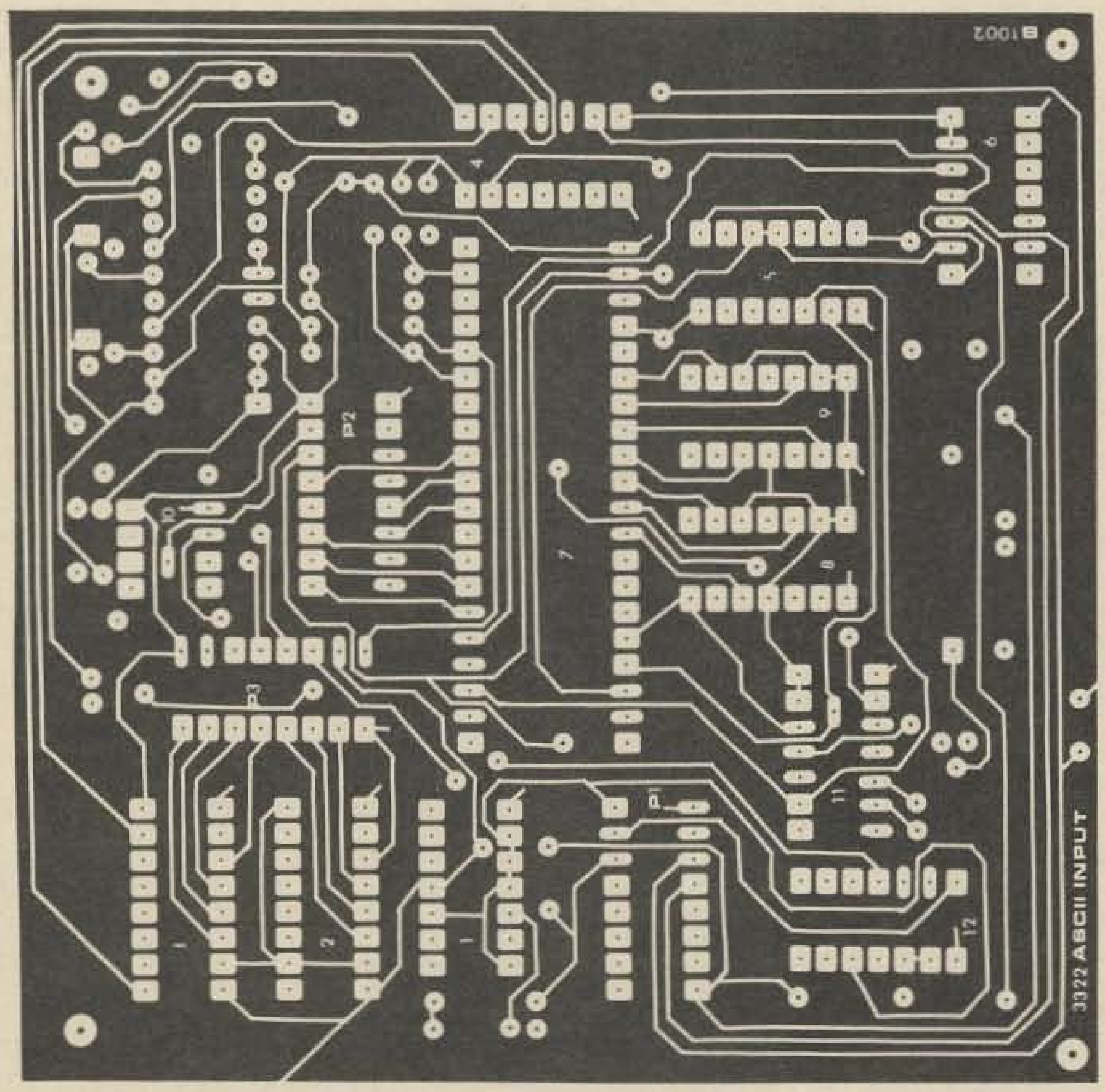


Fig. 4. PC board.



taining to the assembly of this unit. Fig. 6 is the placement drawing for all of the components on the ASCII input board. All parts have part numbers and component numbers (as used in the 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 with a square pad on the top of the board. Mount all of the components before soldering, as a way to check your work.

2. Mount and solder the 40 pin socket and the three 16 pin sockets at the positions marked UART, P1, P2, and P3, respectively.

3. Mount all of 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 transistors, being sure to polarize the electrolytics. The square pad on the top of the board denotes the positive end of the capacitor and the emitter of the transistor.

6. If parity is not to be sent, jumper D. If you want to send parity with the serialized keyboard data, jumper or leave H depending on whether you want odd or even parity, respectively.

7. Jumper E-G if your keyboard strobe pulse is negative going. If it is positive going, jumper F-G.

8. If you are using TTL or EIA RS-232 inputs, jumper B-C. If, however, you use the loop input, jumper A-C.

Operation

Connection of the serial ASCII input board to an external keyboard, modem, and main logic board is done by way of 16 pin DIP sockets and associated plugs. The cable with two DIP plugs is used to connect the two boards together, the input socket of the main board to P1 of the option board. There are two remaining cables, one shipped with both the main and the option boards.

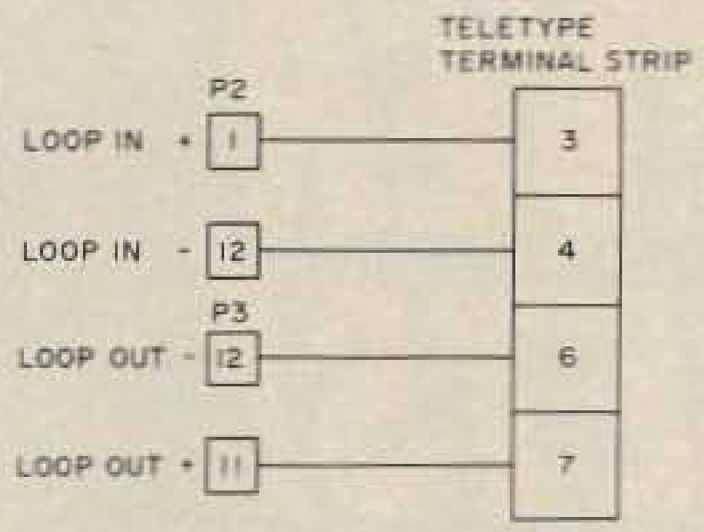


Fig. 5.

Parts List

Integrated Circuits		Other
1-7402	1-2N2646	7-.1 disc capacitors
1-7404	1-1N4148	1-2 uF/15 V electrolytic capacitor
3-7408	**Resistors**	1-.001 disc capacitor
1-7473	1-120 Ohm	1-40 pin DIP socket
1-7474	4-330 Ohm	3-16 pin DIP sockets
1-7493	3-1k	1-DIP plug with cable
2-74161 or 74163	1-2.2k	1-double ended KIP plug
1-1458	1-2.7k	1-circuit board
1-AY5-1013 UART	2-100 Ohm	
Semiconductors	3-270 Ohm	
2-2N5129	1-680 Ohm	
1-2N2906	4-10k	
	1-4.7k	

A kit of the above parts is available from:
Mini Micro Mart
1618 James Street
Syracuse NY 13203

One of these cables goes from P2 to a parallel ASCII keyboard and/or the circuits associated with the loop input and the TTL output. The pin designations for plug P2 are:

1 – loop input +
2 – fwd/bkwd (to P1)
3 – strobe received
4 – strobe
5 – b6 (keyboard data)
6 – b5
7 – b4
8 – Ground
9 – b1 (keyboard data)
10 – b2
11 – b3
12 – loop input –
13 – b7 (keyboard data)
14 – -12 V
15 – TTL output
16 – +5 V

The other cable goes from P3 to the circuits associated with the TTL or EIA input, the repeat key, the EIA output, the loop output, and the speed selection switch (if any). The pin designations for plug P3 are:

1 – b1 (divide by N)
2 – b2
3 – b3
4 – b4
5 – b5
6 – b6
7 – b7
8 – b8
9 – +5 V
10 – TTL or EIA input
11 – -loop output
12 – +loop output
13 – EIA output
14 – repeat
15 – Ground
16 – Two stop bits

Fig. 9 of the main article shows the colors of the flat cable as they relate to the pins of the DIP plug.

The specifications for the input signals are:

Loop input: Mark = terminals shorted; Space = terminals open.

Loop output: Mark = 20 mil current flowing; Space = 0 mil current flowing.

TTL or EIA input: Mark = .8- -15 V; Space = 2.4-15 V.

TTL output: Mark = 0-.8 V; Space = 2.4-5 V.

EIA output: Mark = -3- -15 V; Space = +3-+15 V.

To connect the ASCII input board to a full duplex, 20 mil loop teletype (KSR-33 or ASR-33), follow the schematic in Fig. 5. ■

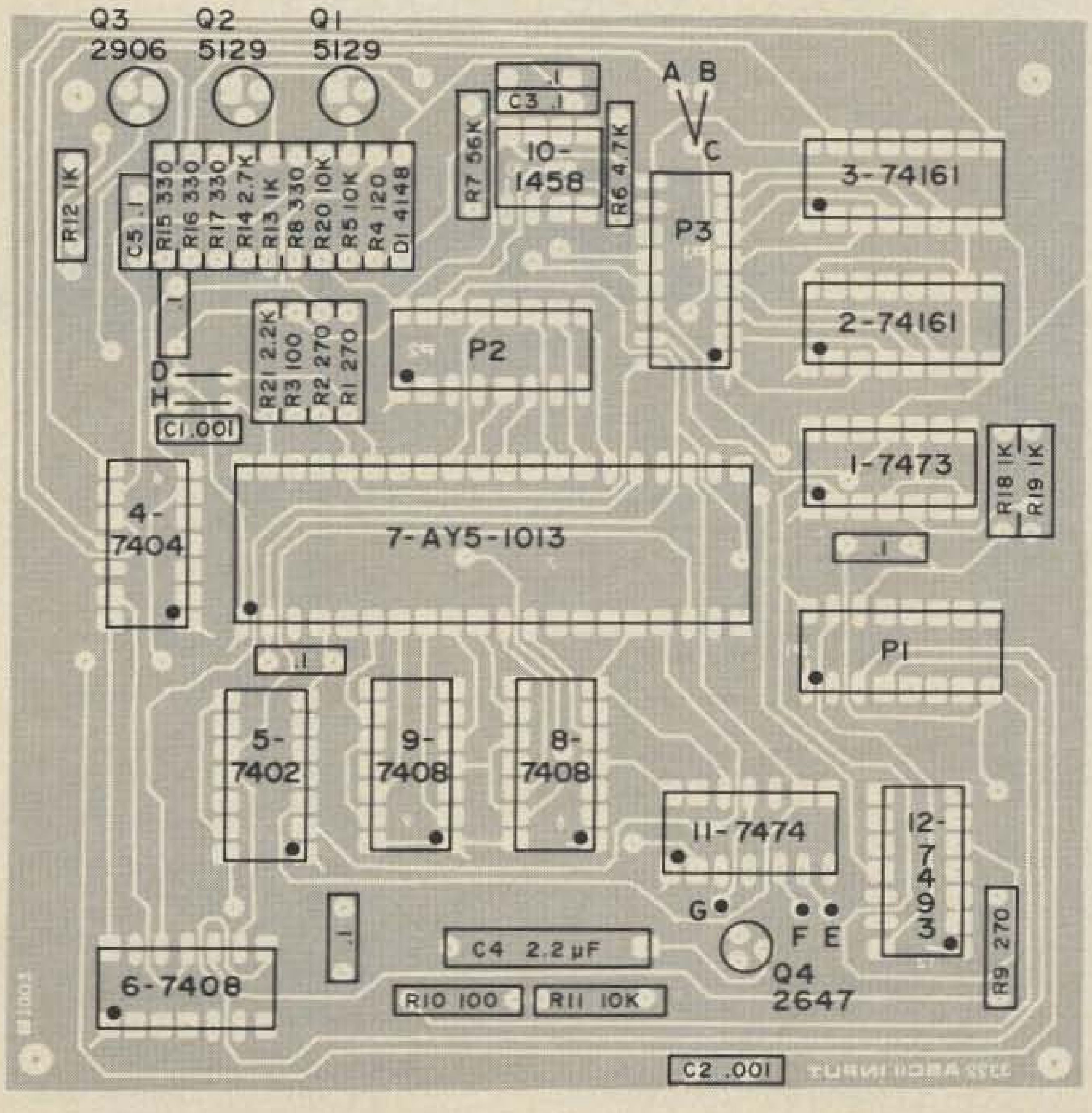


Fig. 6. Parts placement.

Pete Walton VE3FEZ
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L9G2Z9

Blowtorch Your ICs

-- a bonus from computer surplus

Have you ever tried to remove 14 or 16 pin DIP ICs from surplus computer boards? Sometimes this can be a very exasperating job, and you may even pass up some good bargains because you don't want to go through all the trouble of removing them.

There are many ways to remove ICs. You can use a special tip that heats all the pins at once, you can clean the solder off the pins one at a time, you can use a special tip with a vacuum line attached, or you can even use a special tip with a blower attached. All these methods are slow, cumbersome, and expensive, and you will usually end up wishing you had three hands to accomplish very much.

The method that I use may shock you a bit at first, but believe it or not, it really works well.

I remove ICs from surplus computer boards with a blowtorch. That's right, a propane torch that can be obtained in just about any ham's workshop.

I turn the flame on the pins from the circuit side of the board and yank the IC out (fast) from the component side of the board using an IC puller or just a plain old pair of pliers. Even when using the torch running full blast, I have yet to damage an IC due to excessive heat. Excessive heat seems to be an old wive's tale on some of these modern ICs. Of course you can't reuse the boards. ■

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England SN6-7NG

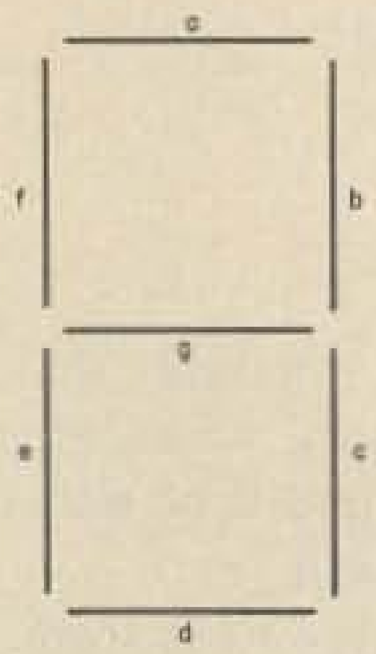


Fig. 1.

How to Interface a Clock Chip

- - Baudot, BCD or ASCII conversion

This circuit was developed as the result of a need to interface a clock chip to some other hardware. Unfortunately, the clock chip available had only 7-segment output, and was not equipped with BCD outputs. The first solution required a relatively large number of gates, and because of space restrictions, was inconvenient for the project in hand. To overcome this problem, the gating was replaced with a 32 x 8 PROM, addressing the PROM from the 7-segment output of the clock, with the BCD stored in the appropriate locations of the PROM. Fig. 1 illustrates the segment designations of a 7-segment display.

Since the PROM is 32 x 8 bits, it has only 5 address lines, and it is therefore impossible to use all the clock outputs. But if the 7-segment coding for the numerals 0-9 is considered (Table 1), it can be seen that it is still possible to obtain a unique code for each numeral, by using only segments a, b, e, f and g. If segment a is considered as the most significant bit, and segment g as the least significant bit of a 5 bit natural binary code (used to address the PROM), then the ten locations listed in Table 1 will be addressed for the numerals 0-9. These locations contain the BCD code.

Although the solution was satisfactory, there is a considerable amount of unused space in the PROM, and since it was desired to link the clock to a microprocessor-based RTTY system at a later date, it was decided to see if any of the remaining locations could be used to contain ASCII or Baudot coding for the numerals 0-9. The first to be dealt with is Baudot. If BCD and Baudot are compared (Table 2), it is very clear that element "B" of the BCD is identical to element "E" of the Baudot, except for the numeral 1. If it were not for this one difference, it would be possible to store the BCD (4 bits) and the Baudot (5 bits) in the 8-bit word of the PROM. This problem was overcome by the addition of a 7410 triple 3-input NAND to the output of the PROM, as shown in Fig. 2. Then, in any given word of the PROM, the BCD is stored in bits 0-3, and elements A, B, C and D of the Baudot are stored in bits 4-7. Thus all the BCD and elements a-D of the Baudot are directly available at the output of the PROM, and element E of the Baudot is obtainable from the extra gating, which works as follows. If the output of U1 is high, then the output of U3 will follow the input of U2 (element B of the BCD). But if at any time the output of U1 should be low (which will happen for numerals 1 and 7), then the output of U3 will be forced high. The output of U3 can then be used as element E of the Baudot. Thus the aim of encoding both BCD and Baudot is achieved, and they are available simultaneously.

Obtaining the conversion to ASCII was accomplished in a totally different way. It was necessary to modify the address inputs in some way,

Numeral	a	b	c	d	e	f	g	PROM location addressed with segments a, b, e, f, g. (Decimal)
0	1	1	1	1	1	1	0	30
1	0	1	1	0	0	0	0	8
2	1	1	0	1	1	0	1	29
3	1	1	1	1	0	0	1	25
4	0	1	1	0	0	1	1	11
5	1	0	1	1	0	1	1	19
6	0	0	1	1	1	1	1	7
7	1	1	1	0	0	0	0	24
8	1	1	1	1	1	1	1	31
9	1	1	1	0	0	1	1	27

Table 1. 7-segment code.

BCD				Baudot					Numeral
D	C	B	A	E	D	C	B	A	
0	0	0	0	0	1	1	0	1	0
0	0	0	1	1	1	1	0	1	1
0	0	1	0	1	1	0	0	1	2
0	0	1	1	1	0	0	0	0	3
0	1	0	0	0	1	0	1	0	4
0	1	0	1	0	0	0	0	1	5
0	1	1	0	1	0	1	0	1	6
0	1	1	1	1	1	1	0	0	7
1	0	0	0	0	1	1	0	0	8
1	0	0	1	0	0	0	1	1	9

Table 2. BCD and Baudot.

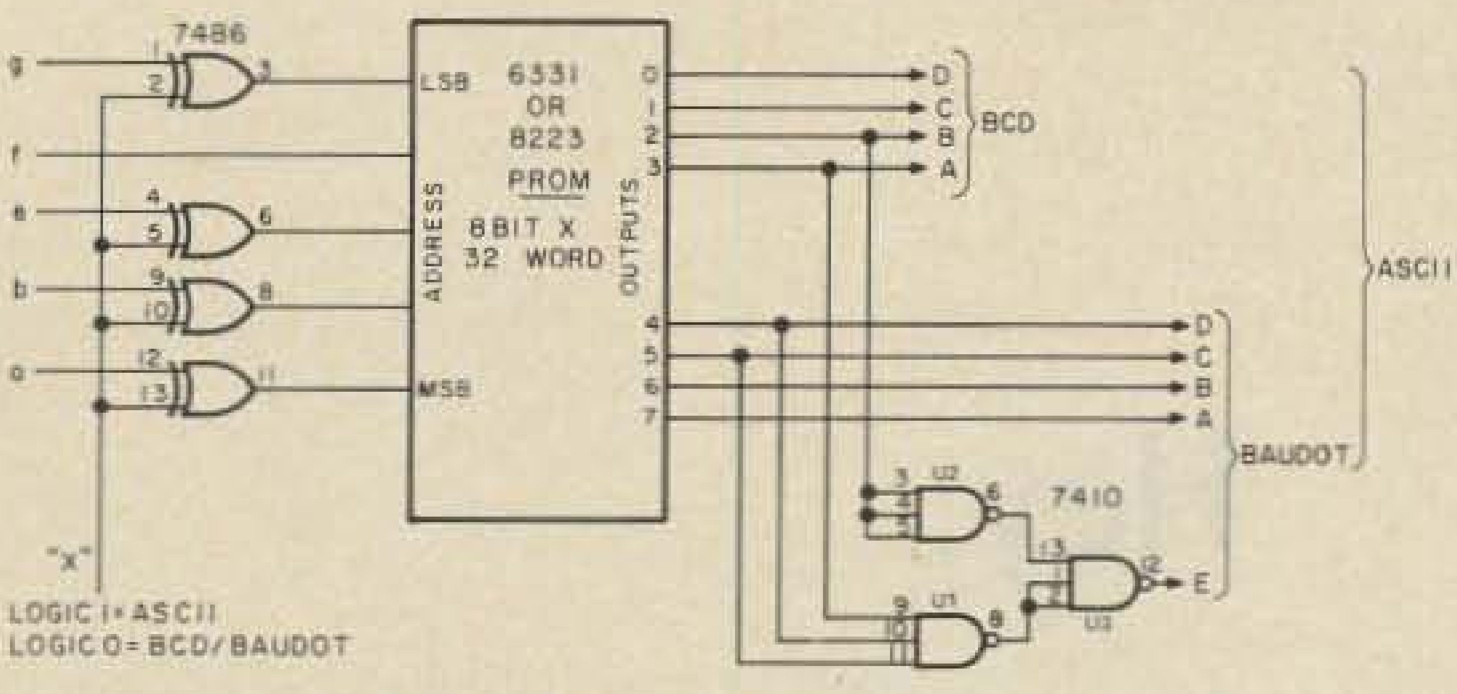


Fig. 2. Conversion circuit.

Numeral	a	b	e	f	g	PROM location addressed with segments a, b, e, f, g. (Decimal)
0	0	0	0	1	1	3
1	1	0	1	0	1	21
2	0	0	0	0	0	0
3	0	0	1	0	0	4
4	1	0	1	1	0	22
5	0	1	1	1	0	14
6	1	1	0	1	0	26
7	0	0	1	0	1	5
8	0	0	0	1	0	2
9	0	0	1	1	0	6

Table 3. 7-segment code, with a, b, e and g inverted.

so that the 7-segment would address another set of unique store locations. The only modification of the address inputs which can be done easily is controlled inversion. With the aid of a computer, all the possible combinations of inversion of the address inputs were checked, from which it was discovered there were two. And for reasons which will be given later, the following was chosen. By inverting segments a, b, e and g from the clock, the locations listed in Table 3 can be addressed, and it is in these locations that the ASCII (or any other code) is stored. The inversion is carried out with a 7486 quad exclusive OR, as shown in Fig. 2. If point X in Fig. 2 is brought high, then segments a, b, e and g of the clock are inverted, and ASCII can be obtained from the outputs of the PROM; if X is at logic low level, then the outputs obtained from the PROM will be Baudot/BCD.

The circuit given will function perfectly well with any 7-segment coding which produces a 6 without a top, and a 9 without a tail. Since some clock chips produce the 6 with a top, and a 9 with a tail, this was also given consideration. And this is the reason that of the two possible combinations of inversion of the input to the PROM, the one given was chosen. Since the tail of a 9 is given by segment c, it will have no effect anyway. But the top of the 6 will affect the most significant bit of the PROM address line, and it is necessary to allow for it. All that is required is to repeat the BCD/Baudot for the numeral 6 in another location of the PROM, and the same for the ASCII coding of the numeral 6. This information is given in Table 4.

Thus it can be seen that with the addition of 2 extra packages to the PROM, it is possible to cater for the conversion of 7-segment to ASCII/BCD and Baudot, with or without topped 6s and tailed 9s. A complete summary of the layout of the PROM is given in Table 5.

Although this conversion was designed for use with a clock chip, it could be equally well used to convert the output of other chips, such as digital voltmeters, to another code.

The PROM used was a 6331 from Monolithic Memories, but a Signetics 8223, which is easily obtainable, can be used instead. Instructions for programming the 8223 are given in the January 1976 edition of *73*, in the article "The Computer QSO Machine," by B. D. Lichtenwalner. ■

References

Monolithic Memories 6331 Data Sheet.

"The Computer QSO Machine," B. D. Lichtenwalner, *73 Magazine*, January 1976.

	a	b	e	f	g	
7-segment	1	0	1	1	1	Location 23
a, b, e, & g inverted	0	1	0	1	0	Location 10

Table 4. Allowance for topped 6s.

Address (Binary)	Address (Decimal)	Content
00000	0	ASCII Numeral 2
00001	1	Empty
00010	2	ASCII Numeral 8
00011	3	ASCII Numeral 0
00100	4	ASCII Numeral 3
00101	5	ASCII Numeral 7
00110	6	ASCII Numeral 9
00111	7	BCD/Baudot Numeral 6
01000	8	BCD/Baudot Numeral 1
01001	9	Empty
01010	10	ASCII Numeral 6
01011	11	BCD/Baudot Numeral 4
01100	12	Empty
01101	13	Empty
01110	14	ASCII Numeral 5
01111	15	Empty
10000	16	Empty
10001	17	Empty
10010	18	Empty
10011	19	BCD/Baudot Numeral 5
10100	20	Empty
10101	21	ASCII Numeral 1
10110	22	ASCII Numeral 4
10111	23	BCD/Baudot Numeral 6
11000	24	BCD/Baudot Numeral 7
11001	25	BCD/Baudot Numeral 3
11010	26	ASCII Numeral 6
11011	27	BCD/Baudot Numeral 9
11100	28	Empty
11101	29	BCD/Baudot Numeral 2
11110	30	BCD/Baudot Numeral 0
11111	31	BCD/Baudot Numeral 8

Table 5. Summary of layout of information in PROM.

Hey, Look What My Daddy Built!

-- six TV game chip can make you a hero

Steve Ciarcia
124 Hebron Ave.
Glastonbury CT 06033

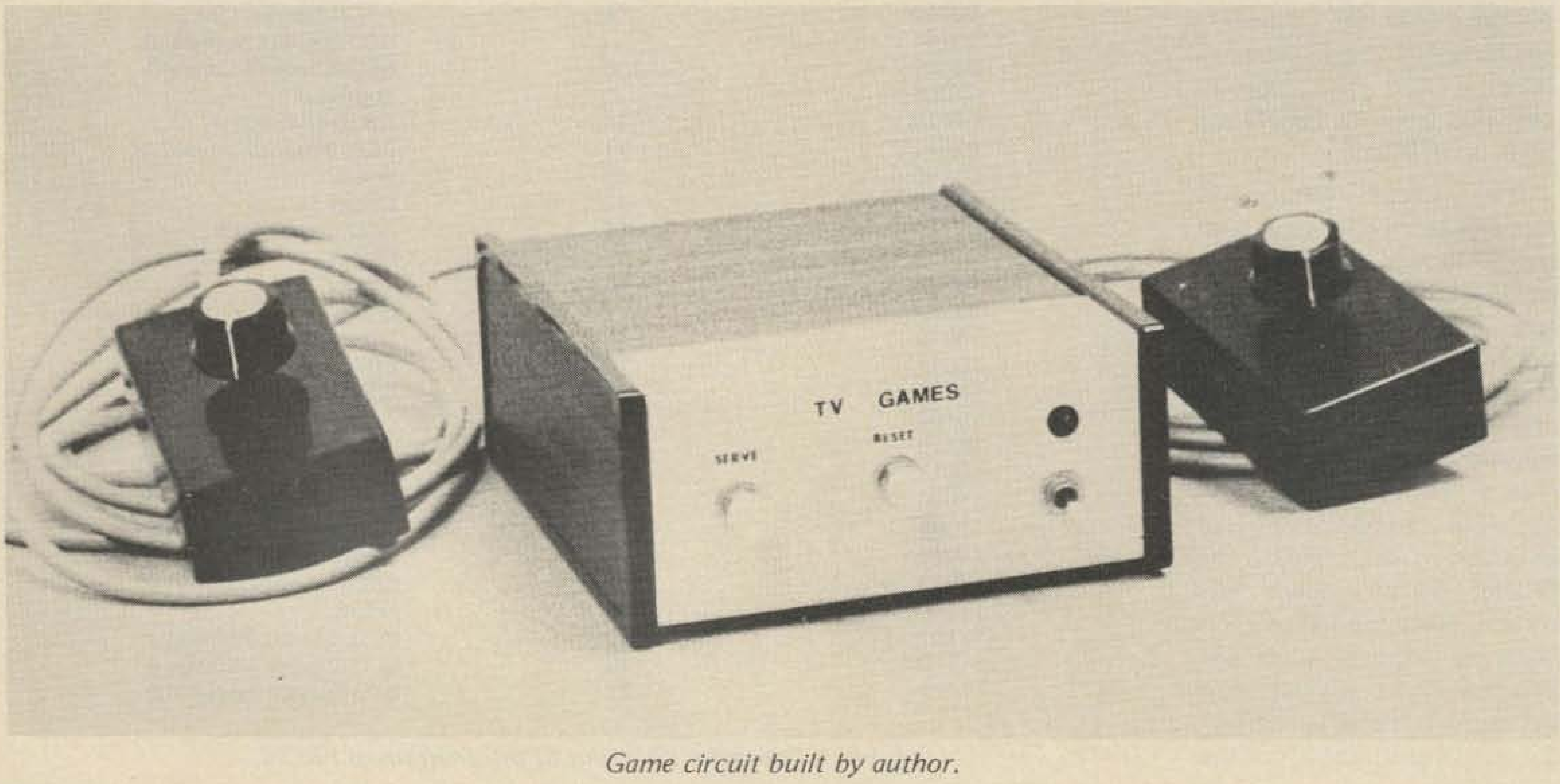
"Wilbur, can't you keep those damn kids quiet while I'm making dinner?" How many American husbands have heard that? If this were the opening block on the "wordless workshop" home improvement cartoon feature found monthly in *Popular Science* magazine, the next six cartoon blocks would illustrate the construction of a giant bird cage or ski jump for the backyard to entertain the kids. This is a nice idea, but there are very few things which are universally entertaining to children, or adults for that matter – except maybe the boob tube. Today's generation of children has grown up spending more time in front of a television than in school. The TV has become a cheap babysitter and the primary source of entertainment for most American families.

Wilbur, trying to keep peace in the family, scans the TV listings and sees that he has a choice of Peyton Place reruns, a subtitled movie in Swahili and Jimmy Durante doing impressions of Walter Cronkite. His only wish at this point is that the TV set would show something that he wanted rather than what Smell-o Deodorant or Slippery Lip Ice Cream was willing to sponsor.

Wilbur checks his *Popular Science* and considers the cartooned suggestions, but decides that he might enjoy the bird cage idea too much and the ski jump would attract more noisy kids. In his continuing search through the magazine rack, he spies an article describing the construction of a TV ping pong game and decides this may be the answer to his problem. Such a system would use his existing TV – no re-education necessary – and all parts are available from a supplier listed in the article.

Wilbur spends his $140 and obtains a kit by mail a month later. He carefully lays out all the parts for the basic game plus the optional scoring board and power supply: 90 TTL ICs, assorted resistors, capacitors and hardware. His wife surveys this and pipes in with, "Do they sell that junk by the pound?"

Completely undaunted, Wilbur spends the next week, three telephone calls to the kit manufacturer, and one very expensive and frustrating visit to a TV repairman for him to set and align all the timing circuits. The kids have been thoroughly entertained in the meantime watching



Game circuit built by author.

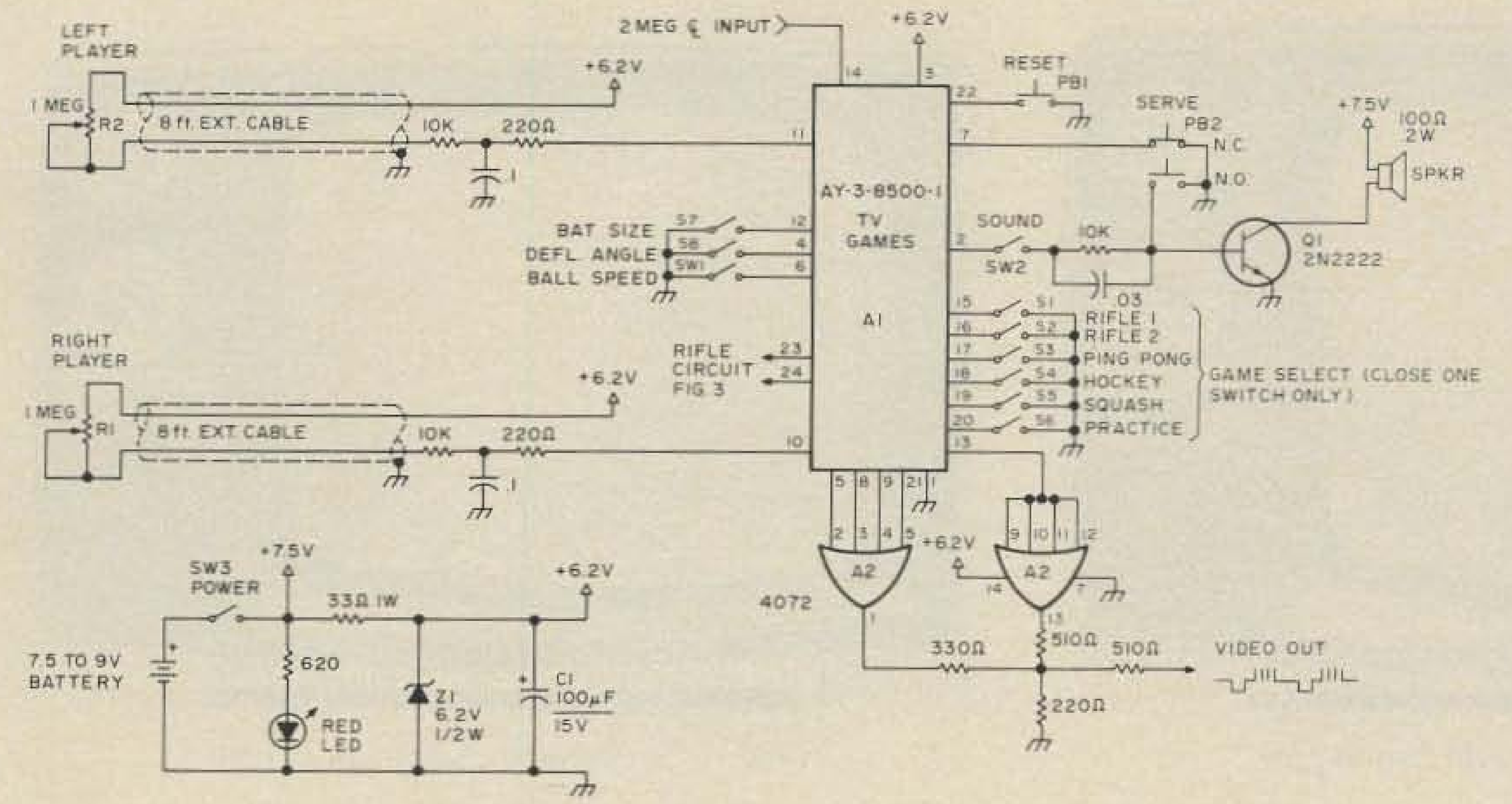


Fig. 1. TV game schematic.

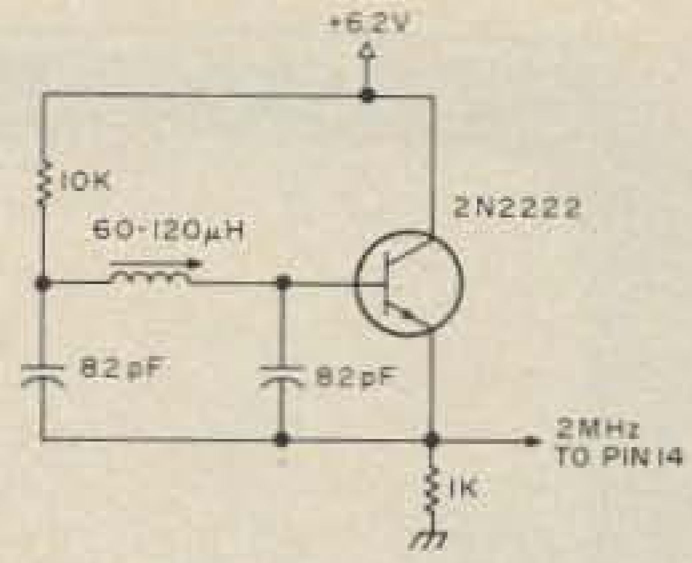


Fig. 2. 2 MHz oscillator. Miller 9055 miniature slug-tuned coil; all resistors ¼ W 5%; all caps min. 25 V ceramic.

Daddy cuss each individual component as he assembled the massive board.

Then came the moment of truth. Power on. It would be unfair to say that it didn't work. It did work and the kids were completely occupied for about three weeks. They then got tired of just bouncing the ball back and forth in the same ping pong game all the time. "Wilbur, can't you keep those kids quiet while I'm making dinner?" ARRRRG!

This painfully familiar story serves as our introduction to the world of TV games. There are TV games sold in every discount store and almost every major electronics periodical has had a construction article on them. The commercial units cost between $75 and $100 and the construction kits are about the same cost, but there are considerable differences among them. Some may be using older designs which may have as many as 100 chips to perform only one game, or at the other extreme one chip to perform six games. Obviously, Wilbur would have been better off buying a unit which performed more than one game and allowed variations within each. Fewer parts would necessarily mean a lower price and increased reliability.

The ultimate in perfection (so far) is the subject of this article: the AY-3-8500-1 made by General Instruments. This is a 24 pin MOS integrated circuit TV game chip capable of playing six different TV games. The features are as follows:

1. Six selectable games — tennis, hockey, squash, single player practice, and two rifle shooting games
2. Automatic scoring
3. Score display on TV screen: 0-15
4. Selectable bat size
5. Selectable ball speed
6. Selectable deflection angles
7. Automatic or manual ball service
8. Realistic sounds
9. Shooting forwards in hockey game
10. Visually defined playing area for the four ball games

Game Descriptions

TENNIS:

The tennis game picture on the TV screen will be as shown in Fig. 5. There will be one bat or player per side, a playing field boundary and a center net. Scoring position is as illustrated. After reset is applied, the score is 0 to 0 and the ball will serve arbitrarily from one side toward the other. It is the opposing player's objective to intersect the path of this ball and deflect it back toward his opponent. If no intersection occurs, a point will be automatically scored against the erring player and the ball will again be automatically served toward him again. Serve will not change until he scores a point and gains the advantage. A game concludes when one player's score totals 15 points.

The exact details of the game are a function of the optional speed, size, and

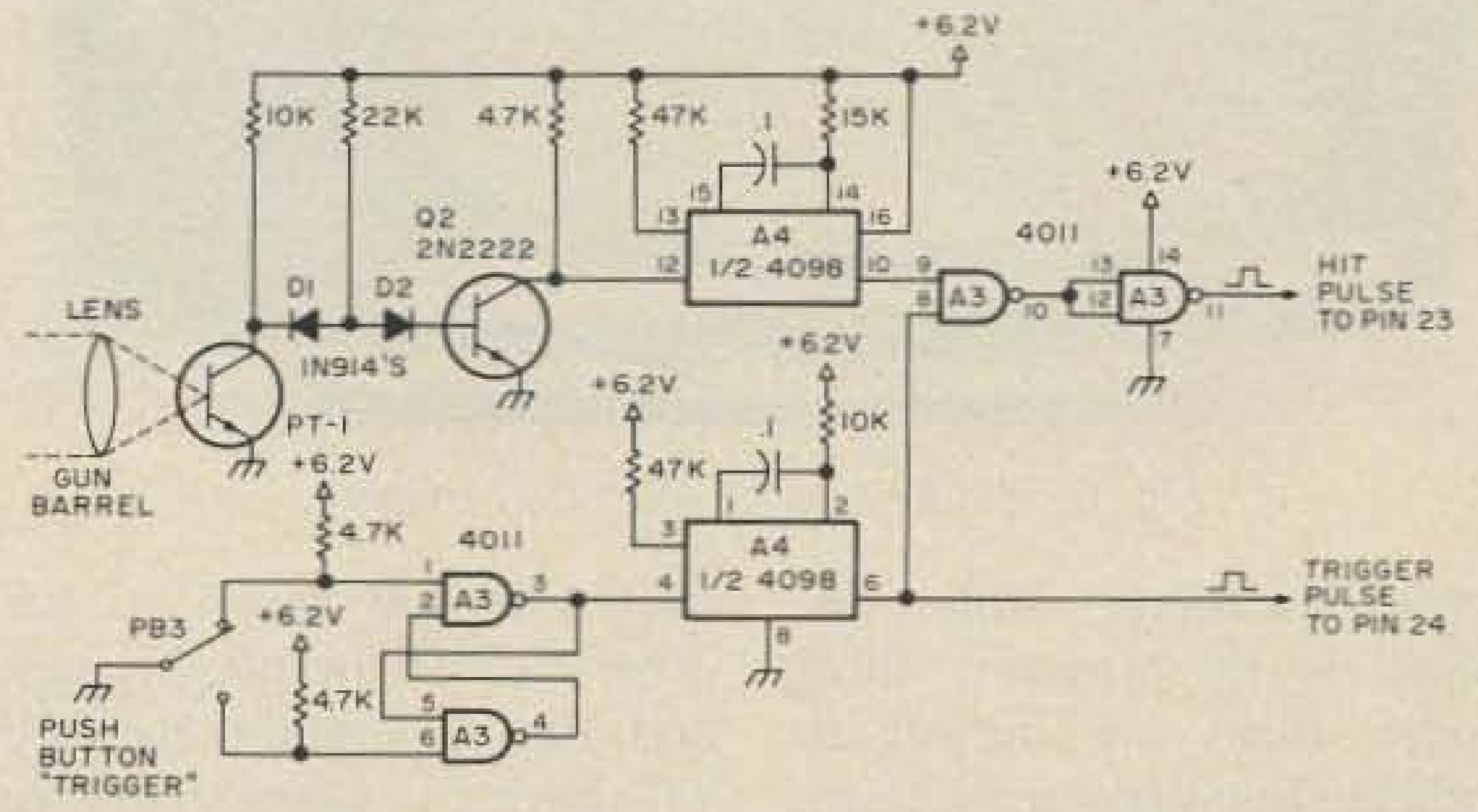


Fig. 3. Rifle circuit. PT-1 — phototransistor TIL64 or equiv.; 4098 — dual monostable; 4011 — quad 2 input NAND; all resistors ¼ W 5%; all caps min. 25 V dc ceramic.

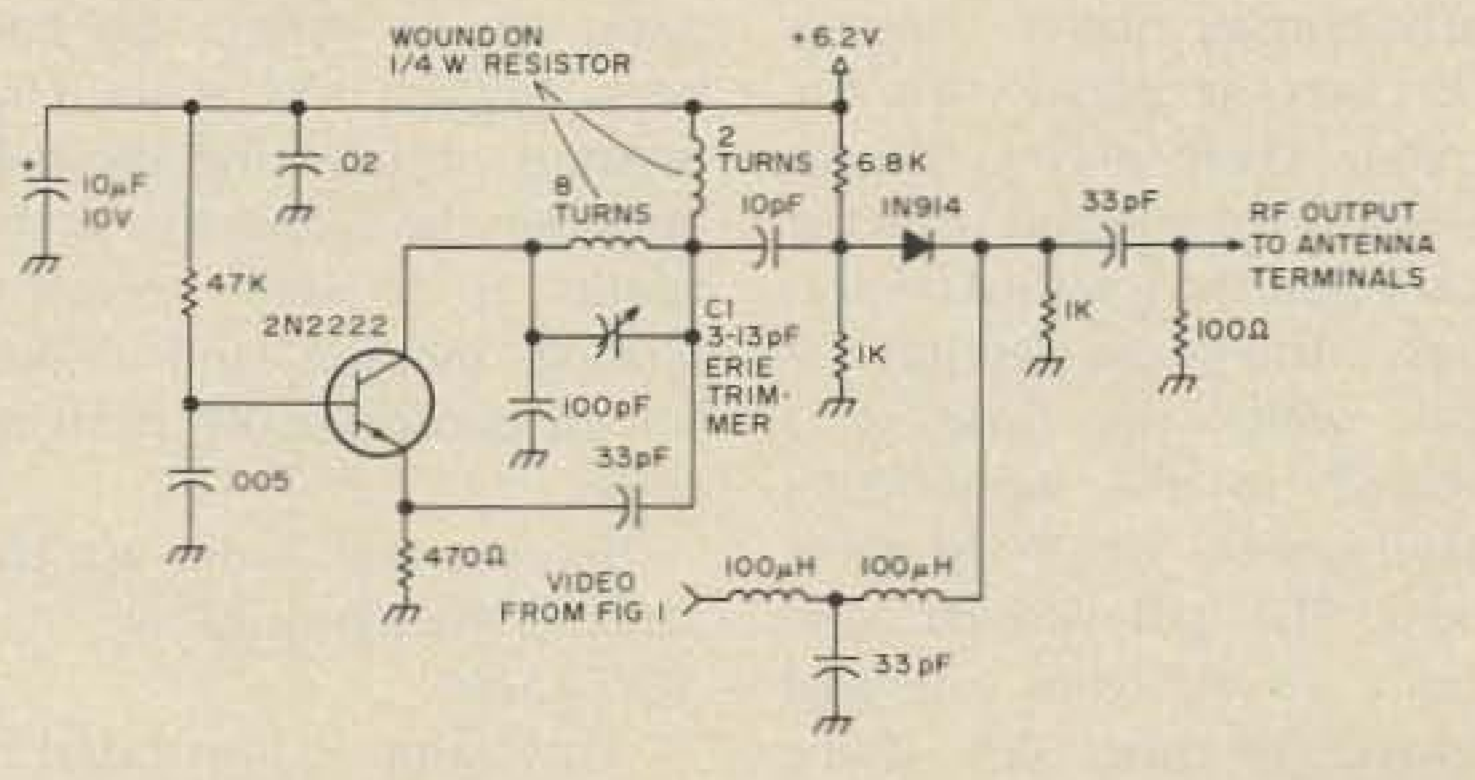


Fig. 4. VHF modulator sample circuit. All resistors ¼ W 5%; all caps min. 25 V ceramic unless otherwise noted. NOTE: THIS IS AN ILLUSTRATION OF A SAMPLE VHF MONITOR. THIS CIRCUIT HAS NOT BEEN APPROVED BY THE FCC.

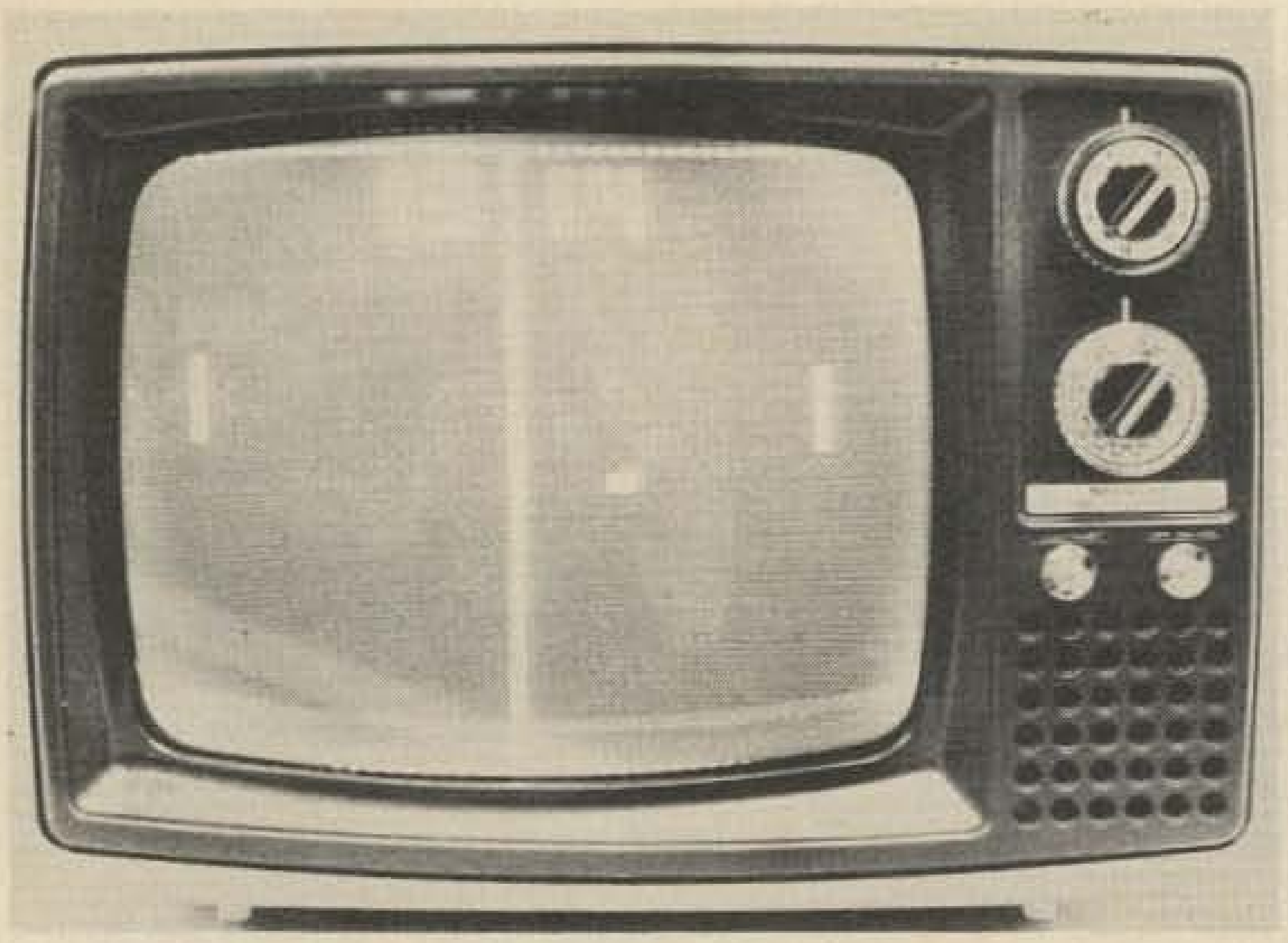


Fig. 5. Tennis game with ball in play.

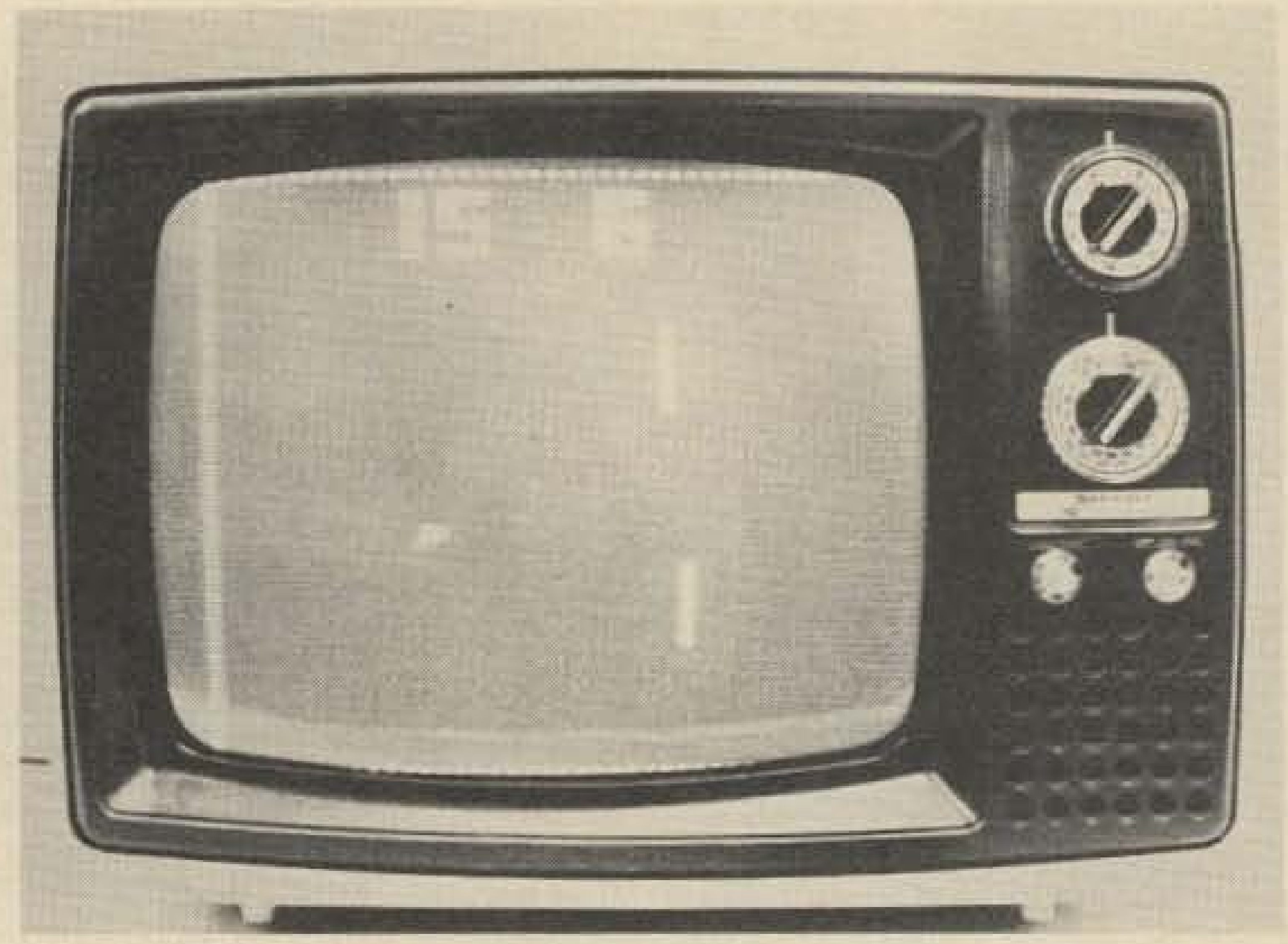


Fig. 7. Squash game with ball in play.

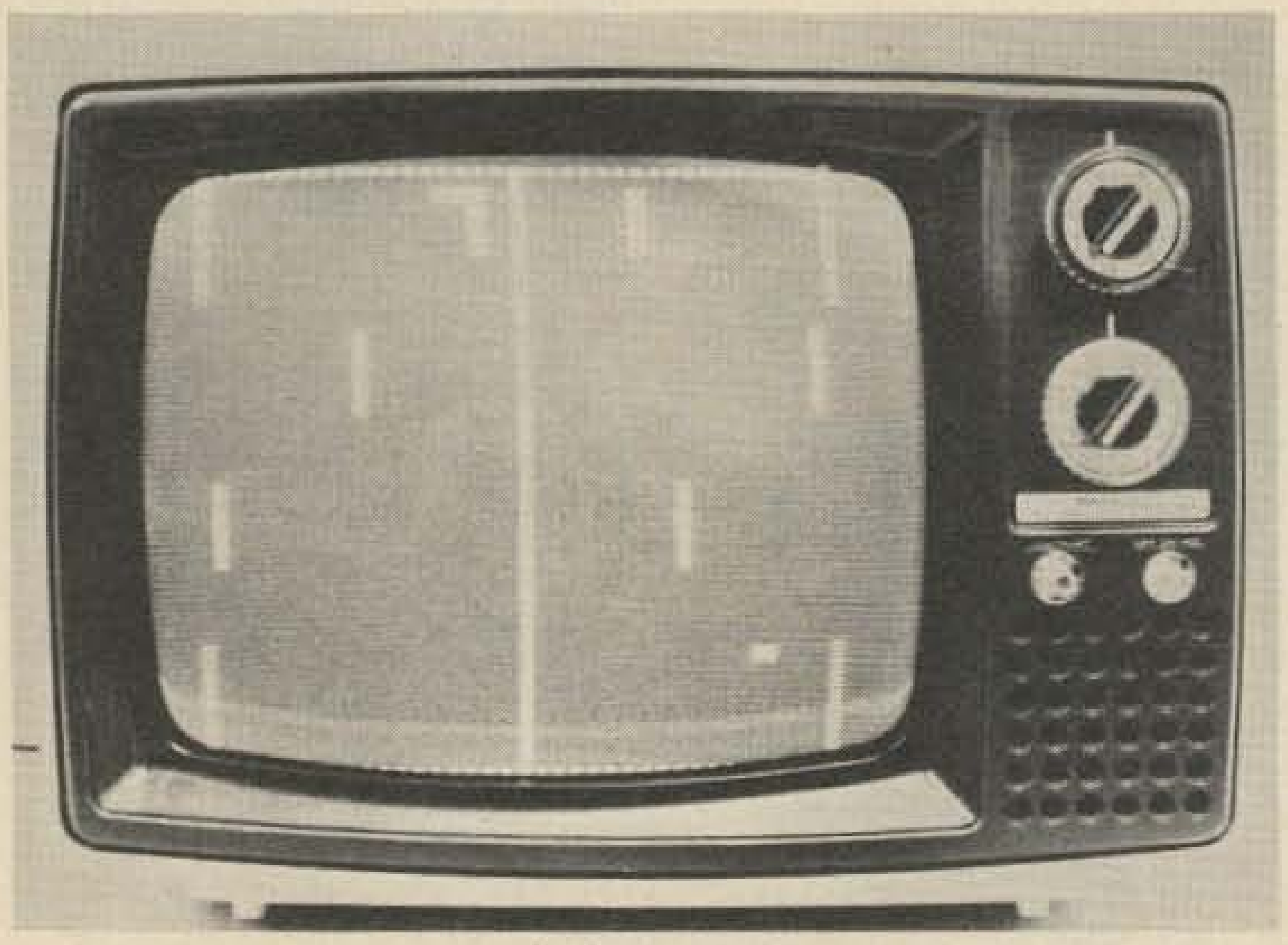


Fig. 6. Hockey game with ball in play.

angle selections. While the game is in progress, three audio tones are output to indicate boundary reflections, bat hits and scores.

HOCKEY:

The rules of the hockey game are exactly the same as the tennis game except that each human player controls two bats or players on the screen. These players shown in Fig. 6 are referred to as the goalie and the forward respectively. The goalie defends the goal, while the forward is located in the opponent's playing area. When the game starts, the ball will be arbitrarily served from one goal toward the other side. If the opponent's forward can intercept the ball, he can shoot it back toward the goal and score a point. If the ball is missed it will travel to the other half of the playing area and the opponent's forward will have the opportunity to deflect the ball toward the goal. If the ball is "saved" by the goalie or it reflects from a boundary, the same forward will have an opportunity to again try to deflect the ball back toward the goal. This method of jamming the ball between the forward and the goalie is a very effective scoring method and makes for an exceptionally exciting game.

Scoring and audio are the same as the tennis game.

SQUASH:

This game is illustrated in Fig. 7. There are two players who alternately hit the ball against a back court boundary.

Scoring and audio are the same as the tennis game.

PRACTICE:

This game is illustrated in Fig. 8 and is similar to squash except that there is only one player.

RIFLE:

The rifle game is illustrated in Fig. 9. Rifle 1 game results in a large target which randomly shoots across the screen while Rifle 2 requires that the target bounce around within the area defined by the TV screen. External circuitry listed in Fig. 3 conditions optical input to a photocell located in the barrel of a toy pistol or rifle which is aimed at this random target. When the trigger (PB3) is "pulled," the shot counter is incremented. If the rifle is on target, the hit counter is incremented.

After 15 shots the score is displayed.

Circuit Description

The simplest circuit utilizing this game chip is illustrated in Fig. 1 and shown in the photo. A DIP switch (S1-S8) is used for rarely changed functions such as game selection, rebound angle and bat size. A $2.00 eight section switch such as this serves to lower overall costs by replacing about $8.00 worth of toggle and rotary switches while maintaining miniaturization. S1 through S6 are the game selection switches. Only one of the switches is enabled or placed in the ON position. The others must be left open or the game chip will try to play more than one game simultaneously. The correct procedure for selecting a game is to turn the currently programmed game off (all six switches open) and then close the particular switch for the desired game. Switches 1 through 6 will select the following games respectively: Rifle 1, Rifle 2, tennis, hockey, squash, and practice.

Bat size and ball deflection angle are controlled by DIP switch sections S7 and S9 respectively. With S7 open the larger bat size is selected. On a 21" television screen this will appear to be about 2". When this switch is in the closed position, small bats of approximately half the previous size will be displayed. All paddle game photos in this article illustrate the large bat selection.

When first playing a TV game, a player may want to find his bearings and fine tune his eye-hand coordination. For just this reason General Instruments provided for selectable bounce, or deflection angles. When S8 is open, three rebound angles are enabled – plus and minus 20 degrees and straight back

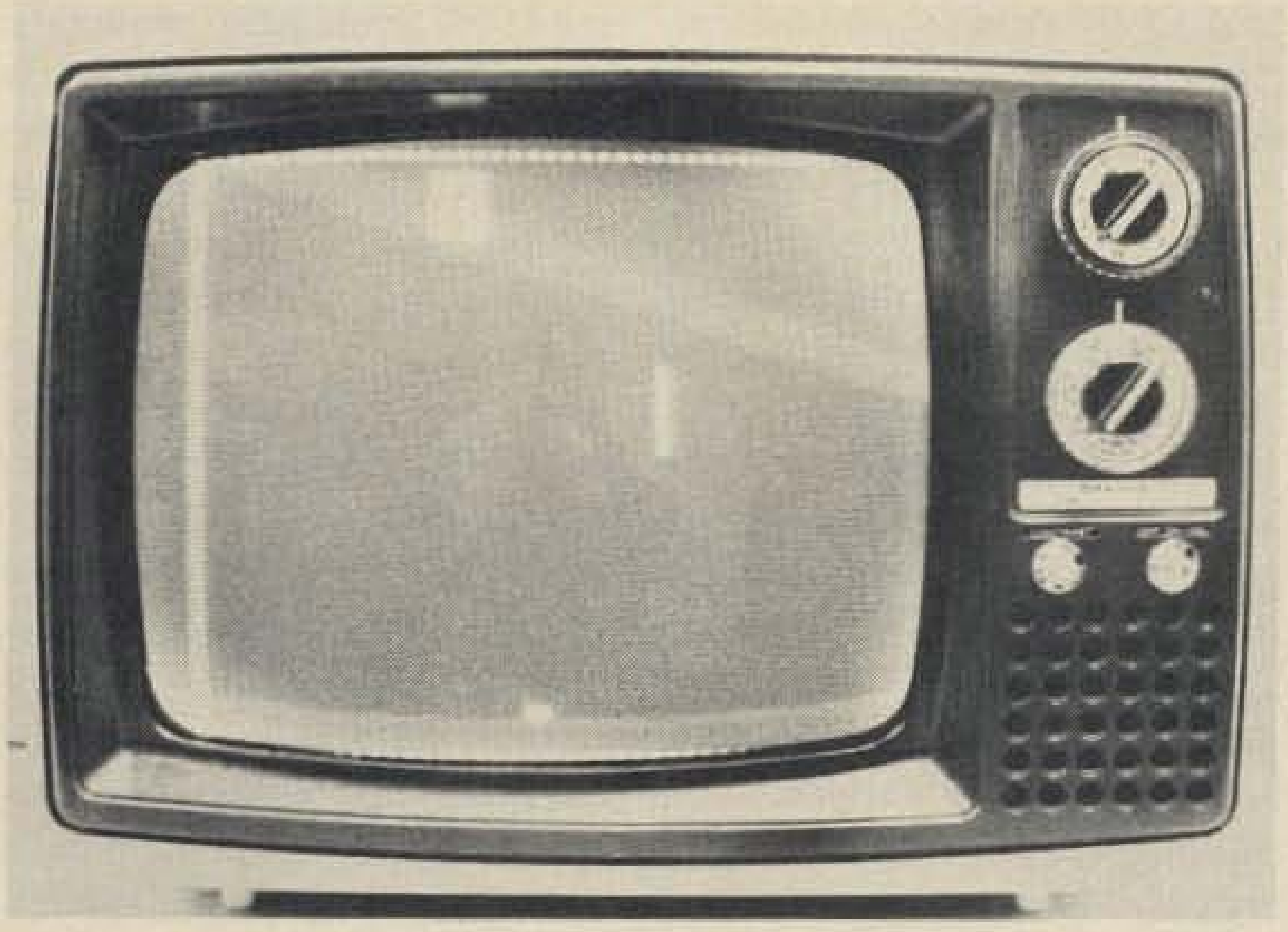


Fig. 8. Practice game with ball in play.

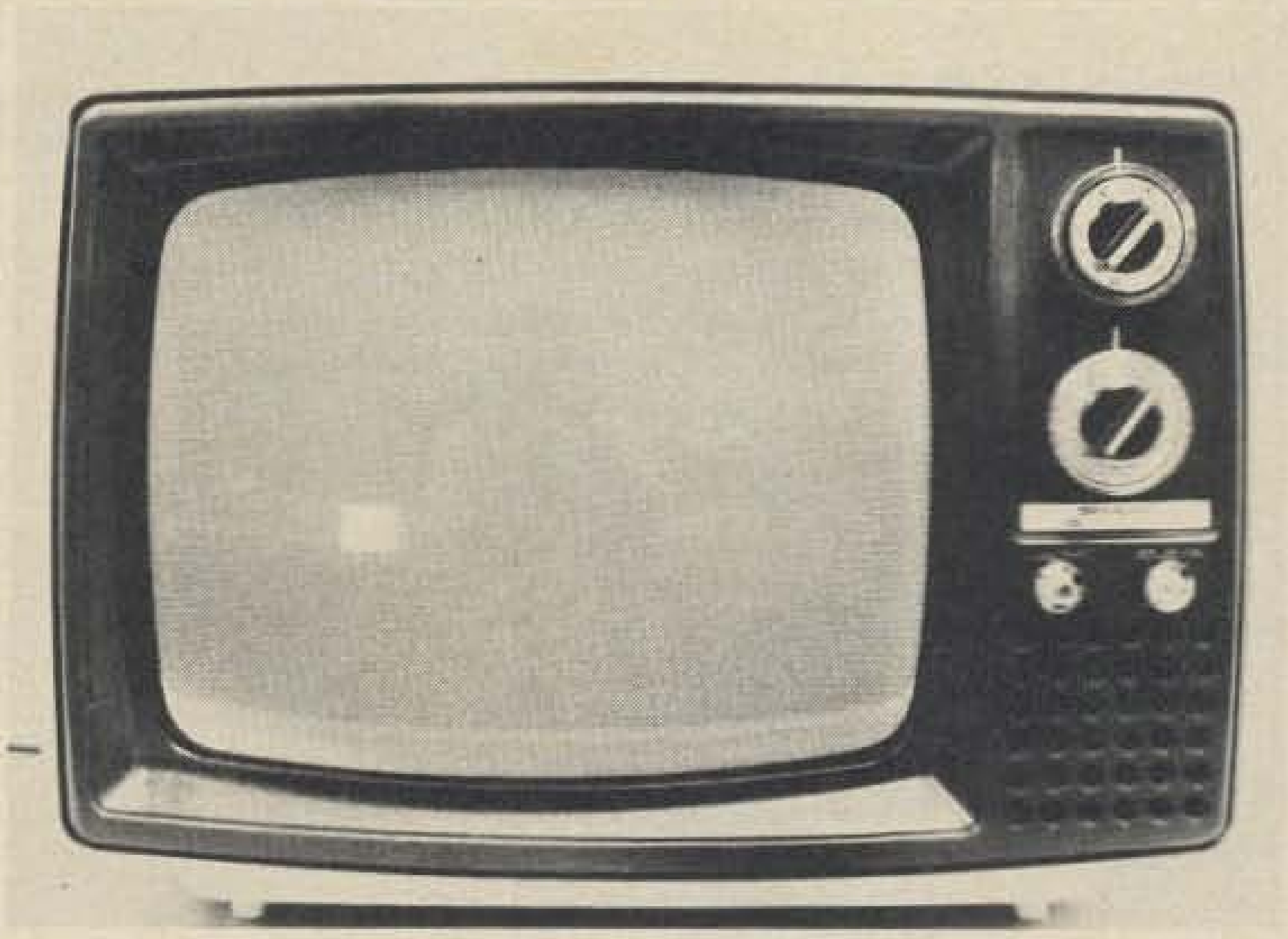
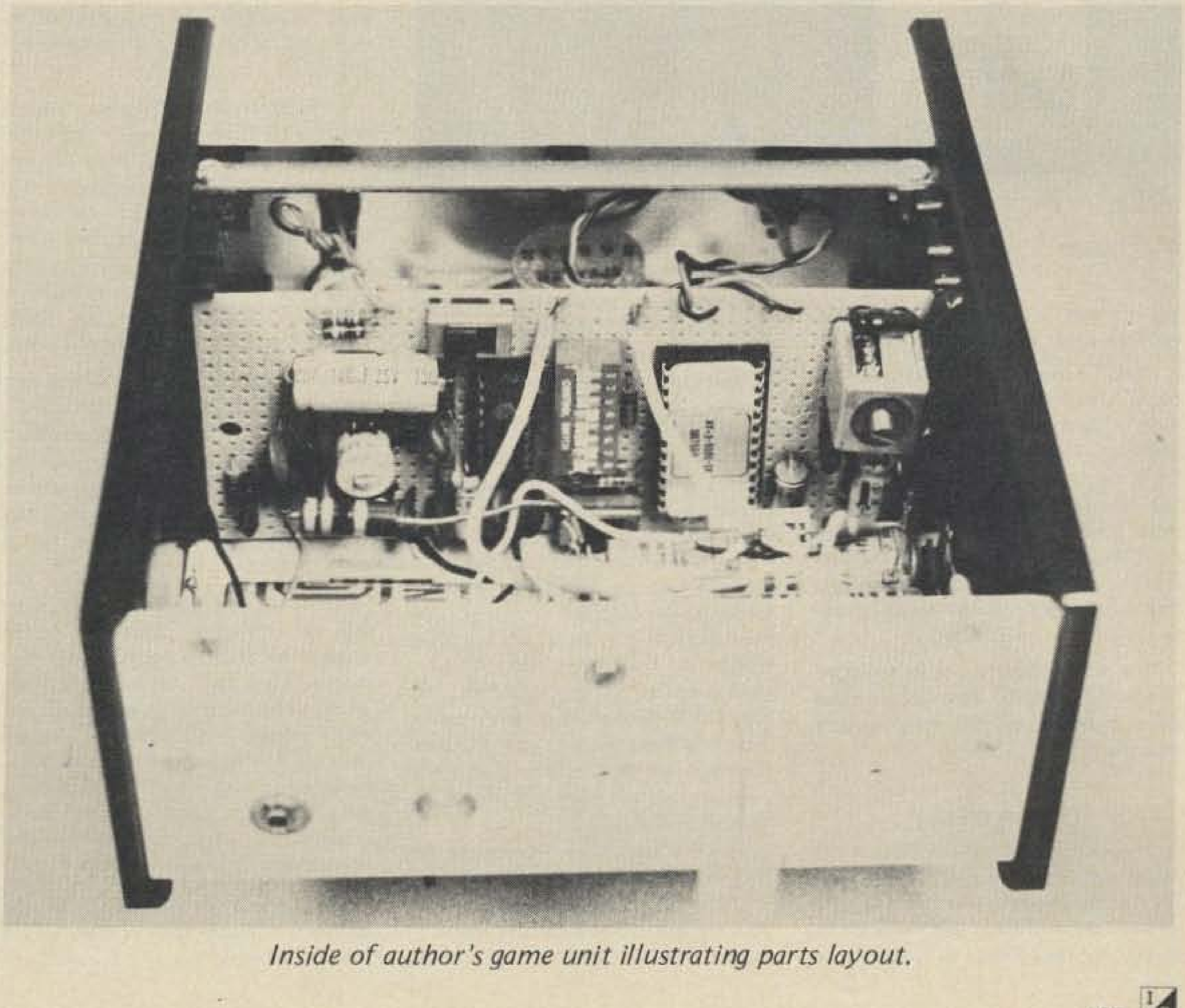


Fig. 9. Rifle games 1 and 2 target.

at 0 degrees. With S8 closed, five rebound angles are possible – plus and minus 20, plus and minus 40, and 0 degrees. This latter selection requires considerable player skill and dexterity and adds new dimensions to otherwise repetitious games. If that were not enough, selectable ball speed is also available. The ball speed switch SW1 is used more often than the game select switches and therefore should be a more easily used slide switch. When this switch is open, low speed is selected. In this mode the ball takes 1.3 seconds to traverse the screen. When the switch is closed, high speed is chosen and the ball will dart across the screen in .65 seconds. There is a complete understanding of the concept of human fallibility after playing a game which combines small bat size, full rebound angles, and a fast ball speed. With this combination, the cure for boredom becomes electronically induced insanity.

If these features were not sufficient, there are more – realistic sound and automatic scorekeeping. All games consist of 15 points with both players starting with a score of zero after pushing the game reset button (PB1). With pin 7 grounded through the manual serve push-button (PB2), play will resume automatically upon the release of the reset button. Automatic start is signified by the game ball being arbitrarily served into the playing area, and each time a point is scored, the ball will come into play into the court defended by the player having scored the point. If automatic start is not desired, the reset and serve buttons should be pressed simultaneously when resetting a game. The reset button is then released while still depressing the serve button. This will allow complete player readiness and will only put the ball in play when the serve button is finally released. Score is incremented (up to a high of 15) each time a player fails to deflect a ball away from goal.

All of this rebounding and scoring results in some very interesting game sounds. A ball hit upon a paddle results in 32 milliseconds of 976 Hz tone. A boundary reflection is 32 milliseconds (msec) of 488 Hz tone and score is 160 msec of 1.95 kHz tone. This square wave oscillation is amplified by a 2N2222 transistor and applied to a 100 Ohm .2 Watt speaker. (An 8 Ohm speaker may be used with proper current limiting in the collector circuit.) SW2 is provided to switch off the sound without having to shut off the game. Player positioning is remotely controlled through cables attached to pins 10 and 11 of the game



Inside of author's game unit illustrating parts layout.

Parts List for Figs. 1 and 3.

A1	AY-3-8500-1 MOS game chip General Instruments
A2	4072 Dual 4 input OR gate CMOS RCA
A3	4011 Quad 2 input NAND CMOS RCA
A4	4098 Dual monostable CMOS RCA
Q1, Q2	2N2222 or equiv.
S1-S8	8 position DIP switch Gray Hill or equiv.
PB1, PB3	SPST momentary push-button C & K Subminiature
PB2	DPST momentary push-button C & K Subminiature
SW1, 2	SPST slide switch Alco Subminiature
SW3	SPST toggle switch C & K Subminiature 3 A 115 V ac
PT-1	TIL 64 phototransistor or equiv. Texas Instruments
D1, D2	1N914 diode Texas Ins.
C1	100 uF electrolytic 15 V dc
Z1	1N753A or equiv.
R1, R2	1 meg composition potentiometer 2 Watt Allen-Bradley or equiv.
SPK	100Ω .2 Watt speaker
LED	NSL5053 LED or equiv.
All resistors are ¼ Watt 10% unless otherwise indicated.	
All capacitors are ceramic type with min. voltage ratings of 25 V dc unless otherwise indicated.	
MISC	extension cable, batteries, box, hook up wire, etc.

chip. Each player control consists of a 1 meg pot and .1 microfarad capacitor which combines to form a variable time constant utilized by internal timing circuitry. Longer or shorter time constants will result in relatively different vertical player positions. To reduce noise, this extension cable should be shielded; otherwise, a display malady referred to as "herringbone effect" will result.

For a TV game to be properly displayed on a raster scan television, the proper video signal, similar to that of any commercial TV station, must be applied to the antenna. Such a video signal results from synchronized dividers inside A1, which divide the 2 MHz master clock (Fig. 2) and output the required 60 Hz vertical and 15750 Hz horizontal sync signals. These signals from pin 13 are combined with those of the ball output, right player output, left player output, and score and field output (pins 5, 8, 9, and 21 respectively) in a two bit digital to analog converter formed with a 4072 CMOS dual 4 input OR gate. This type of video output is referred to as composite video output and is suitable only for use on video monitors and not standard televisions. This video output may in turn be used to amplitude modulate an rf carrier suitable for a standard television receiver. Fig. 4 illustrates a sample circuit of this basic type of modulator. With the components chosen, the frequency is approximately that of VHF channel five. (This circuit is intended for illustration only and acceptability by the FCC as a proper class 1 rf modulator is not inferred.) The modulator output is connected directly to the TV antenna terminals, with the antenna disconnected, and adjusted for the best reception.

This game is a marvel of engineering ingenuity through which General Instruments has succeeded in enlightening the average American to the latest advances in electronic technology. It is easy to overlook 16K bit RAMs and microprocessors, but it is hard to ignore such a marvelously exciting TV game when presented on your own home television. ■

EDITORIAL BY WAYNE GREEN

from page 4

system that is just like RTTY, but with the break-in feature.

If RTTY operators wanted to, they could have break-in just by setting up their systems on two different frequencies. Then they could use a split CRT display such as Don Alexander has developed (August, page 82), to show both what they are sending and what they are receiving on the top and middle of the tube. If anyone gets into this I'd like to know about it, and so would a lot of RTTYers.

Not a few readers would probably like some hints on how to get their code speed up to 100 wpm . . . any volunteers?

UNEMPLOYED?

The politicians are talking a lot about jobs, yet here at *73* we have jobs going begging. We need help in several departments and would be absolutely delighted to have some hams come up here to fantastic New Hampshire to join us.

If you read *Newsweek*, you know that New Hampshire has one of the lowest tax rates in the country, yet provides very good services for the people. It has one of the lowest accident rates in the country on its roads. This despite the large influx of visitors who come to New Hampshire on vacation . . . four seasons of the year. We have large vacation crowds in summer when it is cool and beautiful. We have them in the spring when it is fantastically colorful and fresh. We have them in the fall to see the finest foliage in the world (except for a small part of Northern China where they have similar acid earth which generates these colors) . . . and winter! Winter is the best season of them all . . . not too cold, but with snow for the many ski slopes.

For the ham, New Hampshire has two major advantages . . . one is rarity . . . New Hampshire has few people so you are almost like DX on many of the ham bands. And, if you are into FM, the myriad of mountaintop repeaters throughout the state will keep you busy. You will be hard put to keep from finding a mountain for yourself.

In southern New Hampshire we are not too far from Boston . . . for plays and concerts . . . and a major airport for travel. Yet we are in the country. Peterborough is one of the most beautiful towns in New England. Even though it is very small, it is a shopping center for this part of the state, with downtown shopping and two shopping centers on the outskirts of town.

We have grown considerably during the last year at *73* . . . with circulation up over 30% since January and headed for a 50% increase by the end of the year. Advertising has increased almost 50% in the past year. The staff has almost doubled and there is still a need for more.

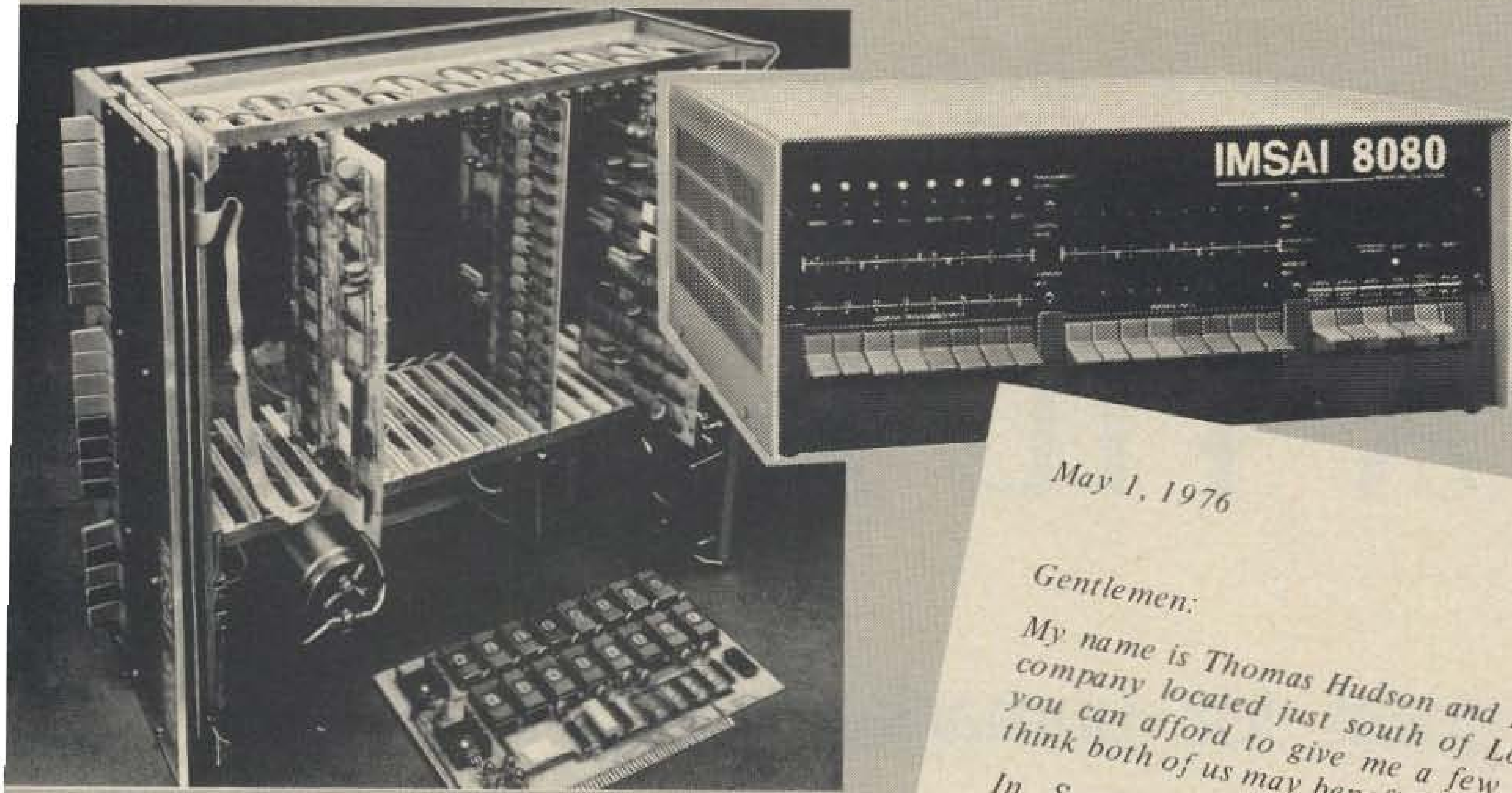
While we can use people with printing or magazine experience, the biggest demand is for editors. We need two or three more, at least, if we are going to continue to grow and put out more books and magazines. We are looking for hams with as much experience in hamming as possible . . . hopefully with good technical backgrounds . . . who are into working more than clock-watching.

We have a dozen books in the works for release soon and we would like to increase this to a hundred . . . if only we had the hams to help get them ready for printing. We'll need help with getting a new CB magazine started . . . and with a new hobby computer magazine. We need a lot more help in getting *73* out each month. We need help in marketing the books, magazines and tapes . . . through direct mail, dealers, newsstands, reps, etc. The more readers we get, the more people will be able to enjoy the magazine every month.

If you have the background, a bunch of enthusiasm, are a self-starter and don't have to be told what to do . . . if you like working in a very unusual and relaxed atmosphere, . . . if you are work-oriented . . . if you would like to live in a beautiful part of the country . . . you can do worse than let us know about it.

A GOOD BOOK

A good book indeed is the *Handbook for Electronic Engineering Technicians*, for $19.50. The price is high, but this is an excellent book and well worth the investment. The material is a bit brief for the book to be used strictly as a study guide, but as a handbook . . . as a reminder of how just about everything you'll run into in electronics works, it is superb. The math is kept to an absolute minimum and every subject is covered concisely. McGraw-Hill. If you are at all serious about understanding electronics, you just can't do without this new book.



May 1, 1976

Gentlemen:

My name is Thomas Hudson and I am President of a small company located just south of Los Angeles, California. If you can afford to give me a few minutes of your time, I think both of us may benefit.

In September of 1975 I decided to attempt to sell microprocessor-based computing systems to the commercial market. I visited every microprocessor-based kit manufacturer in the United States, and questioned numerous people in the industry. For many reasons, all of which hold true today, I decided on the Intel 8080 family of microprocessors as the best hardware choice. In November of 1975 we decided on a product offered by a company in San Leandro, California, IMS ASSOCIATES INC. Before Christmas we had 3 IMSAI 8080 kits on the way, and they have operated flawlessly ever since we turned on the power. We still use these original kits as development tools and for some really neat games. The IMSAI 8080 microprocessor kit is of the highest quality available. Company management is excellent, the engineers are first-class, deliveries are almost on time (within days, not months), and the ability to run DEC derived BASIC and FOCAL is a powerful not to be overlooked advantage. Once over the usual arguments for and against various chips, assuming you decide (wisely) on the 8080, the obvious best choice is IMSAI. I feel from experience that you cannot buy a better microprocessor-based kit.

IMSAI 8080 Kit, $540.00
IMSAI 8080 Assembled, $829.00
IMSAI 4K Low Power Memory Board, $125.00

OTHER PRODUCTS OF EXCEPTIONAL MERIT

The I/O board and printer were developed for our in-house commercial products. They are extremely well-built, of high quality and are excellent for the discriminating hobbyist.

MMI Model I/O PENER

6 PORTS of parallel which can be any combination of in and out (software control)
5 PORTS in and 1 out, 2 in and 4 out,etc.
2 PORTS serial interface, or 20 mil current loop and one R5 232 or both PORTS either type.
Board select 110 to 9600 baud.
Kit price $219.95/each
DECWRITER LA 36 II 30 CPS printer brand new in box from factory, air shipped to your door $1776.00

MMI Model 40P

5 x 7 dot matrix impact type

40 column alphanumeric printer w/PS, case and interface to IMSAI/MITS
Double size print under software control — 1.25 lines per second.
Assembled price $599.00/each
Introductory price $519.00/each

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A TTL Tester

- - great for unmarked bargain ICs

Being economically minded by necessity, I have often purchased unmarked, untested semiconductors at really bargain prices. This practice has necessitated the construction of special test equipment.

One such piece of test equipment was designed to test TTLs. This TTL tester is an expanded version of a very simple diode tester. The simplicity of this diode tester should not be allowed to downgrade its usefulness. See Fig. 1.

Using this diode tester, the breakdown or zener voltage of a diode or transistor can be quickly determined. Transistors can be classified, after some experience in using this simple tester, into small or large signal, low or high voltage, oscillators, amplifiers, switching, high or low leakage, etc. It also indicates an open or short which makes it useful for a continuity tester.

A built-in calibration source can be added with the addition of one or more zener diodes and switches. See Fig. 2.

The TTL tester is this same basic diode tester with a few more components and a 5 V source (Fig. 3). Any 5 V dc power supply can be used but should be protected from overload by a fuse or current limited output because of a TTL short or human error. Phone tip jacks are used for test points, with external test connections being made by jumper wires with phone tips. See Fig. 4.

Operation

For an unknown TTL, place the TTL into the test socket and turn power on. The vertical probe is inserted into the CAL TP and the scope adjusted as in Fig. 5a. Use an educated guess or flip a coin to choose a TP that would ordinarily be ground, such as TP4 or TP7. Say, for example, that we choose TP7.

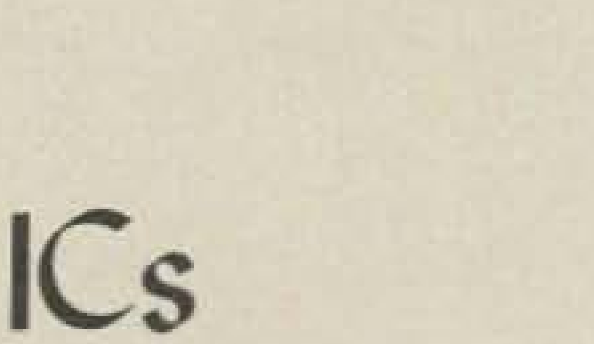

Fig. 2.

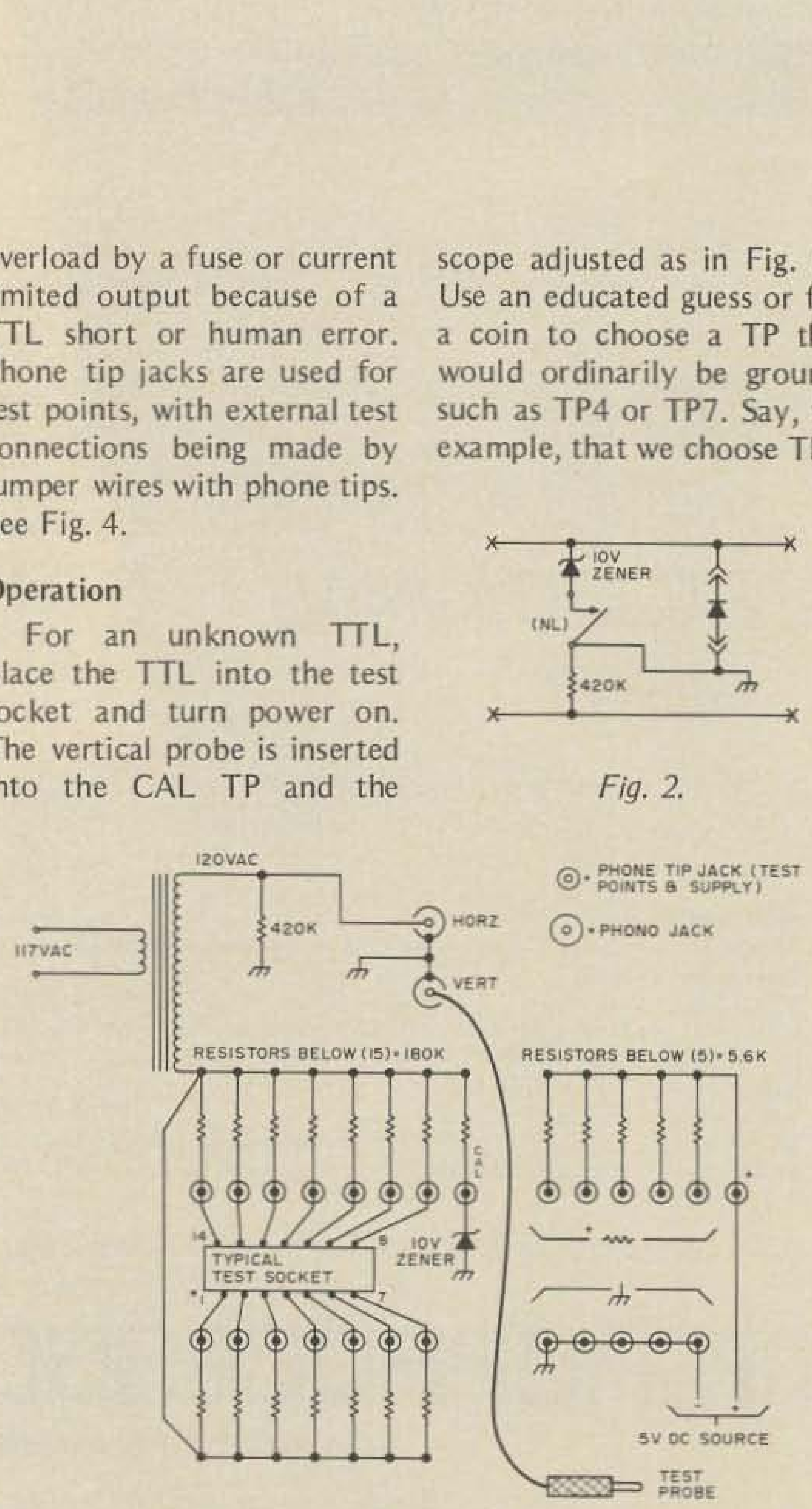

Fig. 3.

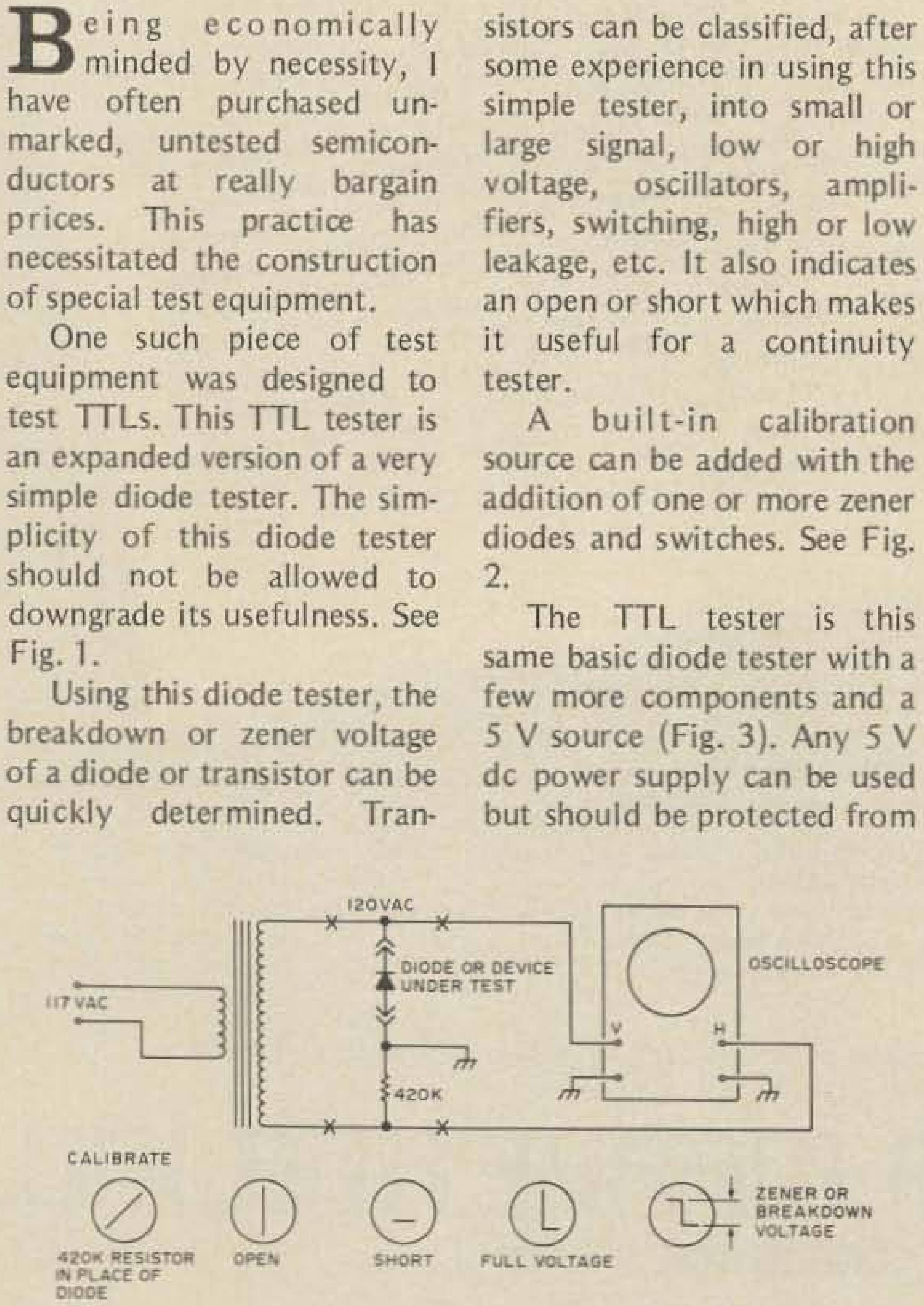

Fig. 1.

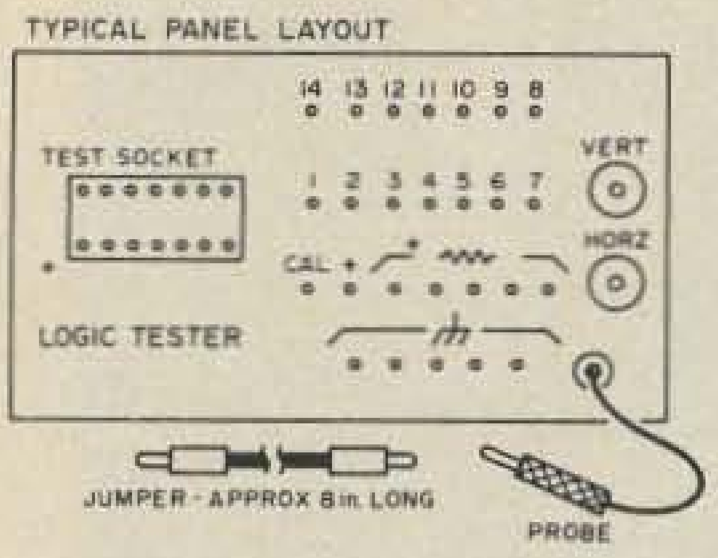

Fig. 4.

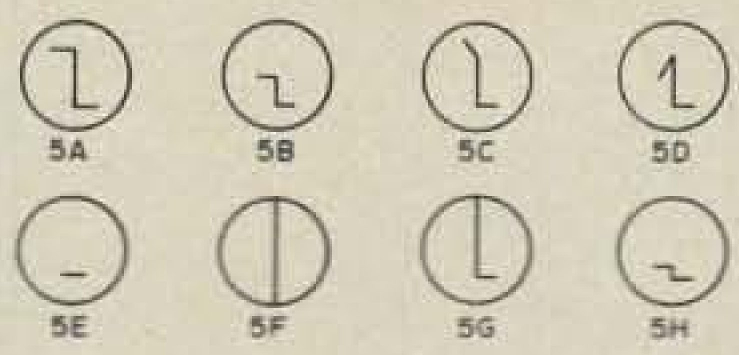

Fig. 5.

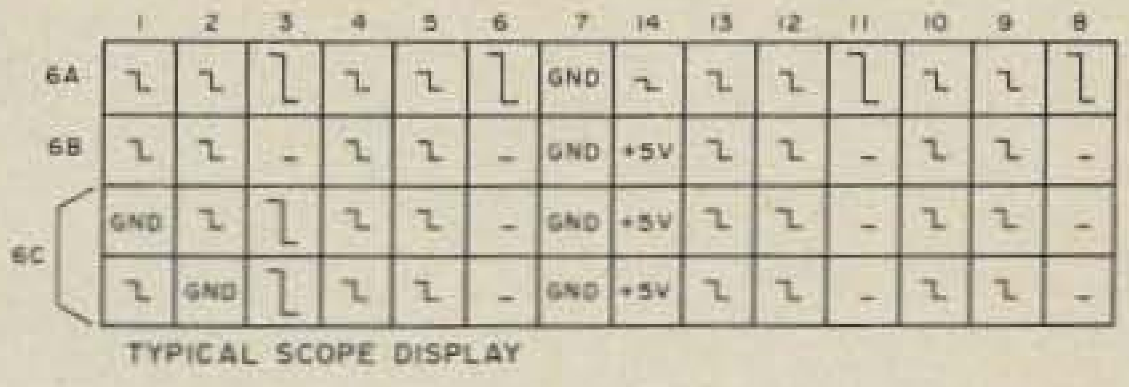

Fig. 6.

A jumper would then be placed from a ground TP to TP7. The vertical probe is then moved to each TP, TP1 through TP14. The display on the scope (Fig. 6a) may be similar to any figure of Fig. 5, but we are looking for one that is decidedly different, or the oddball. Say in our example we have only one that looks like Fig. 5h on TP14. It would appear that we have made a wise choice of TP7 for our ground because + and - are usually on 14 and 7 as one combination for TTLs. Reasonably sure that TP7 is our ground, we once again take the vertical probe through TP1 to TP14 with a ground on TP7. A record (mental if you like) can be made of each TP test as in Fig. 6. Connect +5 V to TP14 with a jumper. This will operate all gates, etc. Check each test point again with the vertical probe. A change of state will be noted as in Fig. 6b. In our example, a change of state occurred at test points 3, 6, 11 and 8 for a total of four changes; thus we may have a quad device. Next we monitor the points of change using the vertical probe. The first in this example is TP3.

A single jumper lead from ground is moved to each test point of no change. In our example, the ground jumper lead of TP1 changes the state of TP3. See Fig. 6c. Removing the lead from TP1 restores the state of TP3. Placing the jumper of TP2 changes the state of TP3, etc. (Fig. 6c). Moving on to TP4, 5, 13, 12, 10, 9, we note no change on TP3. In our example, we find the same relationship between TP4, 5, 6 and TP13, 12, 11 and TP10, 9, 8. The example was a 7400 TTL (Fig. 7) which is a quad 2 input NAND gate TTL. A study of several known TTLs will give you the experience necessary to use this simple tester. The number and type of jumpers will of course depend upon the TTL under test. The 7451 TTL for instance requires two jumpers.

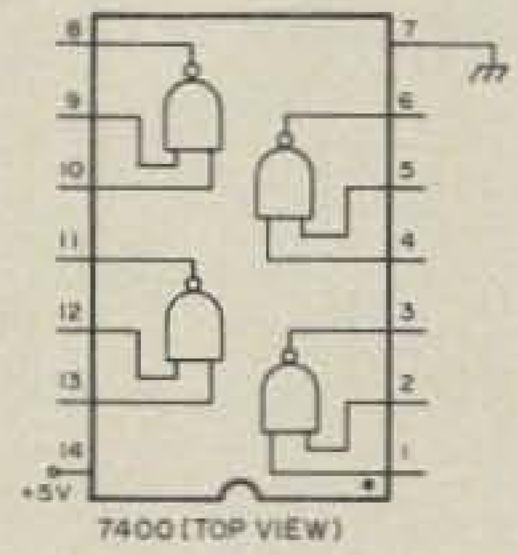

Fig. 7.

In the end we will know what the circuit is and its maximum breakdown voltage (Figs. 5b, c, d, g) as well as whether it is an open collector (Fig. 5d) or if the circuit is open or shorted (Figs. 5e, h) and most importantly, whether it is working properly. ■

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How to Check Memory Boards

-- use this simple program

While the computer hobbyist faces many trials and tribulations during his quest to get his fabulous (and complex) new toy "up and running," one of the most frustrating problems that he can encounter involves debugging a troublesome memory board. This article describes a simple memory diagnostic program, and illustrates its use in tracking down problems in memory. While not a "cure-all" for all memory related problems, especially those that render the complete board inoperable, it will allow the hobbyist to "exorcise" those gremlins responsible for such irritations as memory locations which refuse to store the exact data which you load into them, and addresses which appear to change their contents as though they had a mind of their own.

The two problems which are presented for illustrative purposes are real-life "bugs" which cropped up following the recent assembly of two 4K memory boards. Note that the program and associated debugging technique which evolved were developed for an Altair 8800 (but should be applicable, with appropriate modifications, to other systems).

At this point, a few words concerning the memory diagnostic program (Table 1) are in order. (Ignore those parts of the program in parentheses, for the time being.) The program, as presented, resides on page 2, address 000-041 (octal). This address was chosen because I already had a simple "MONITOR" residing on pages 0 and 1, and I was certain that page 2 had no "bugs," due to the fact that other small programs which resided there from time to time performed their appointed duties without difficulty. The program can be placed on any other page (change memory references accordingly), assuming that you are certain that the chosen page has no "bugs" which would interfere with the program's operation. Needless to say, the program can be placed on a correctly operating board, and used to debug all 4K of other appropriately addressed boards. The only restriction concerning placement of the program is that the page(s) to be tested must be different from that page on which the program resides ... hence, my choice of page 2.

The program also assumes that you have an octal conversion and print subroutine ("OCTOUT") which it can call. Since this is generally a part of most monitors, it is not included here.

Operation of the program is straightforward. The program loads the value of an address, as data, into that address. For example, address 000 contains data 000, address 001 contains 001, etc. Then the computer compares the contents of the address with the numerical value of the address; if they differ, the program will print out the address and its incorrect contents. Since this method is not infallible, those parts of the program in parentheses are utilized to load and compare specific patterns of data in memory, if necessary. To employ this modification, simply substitute the parts of the program in parentheses for the existing parts. The

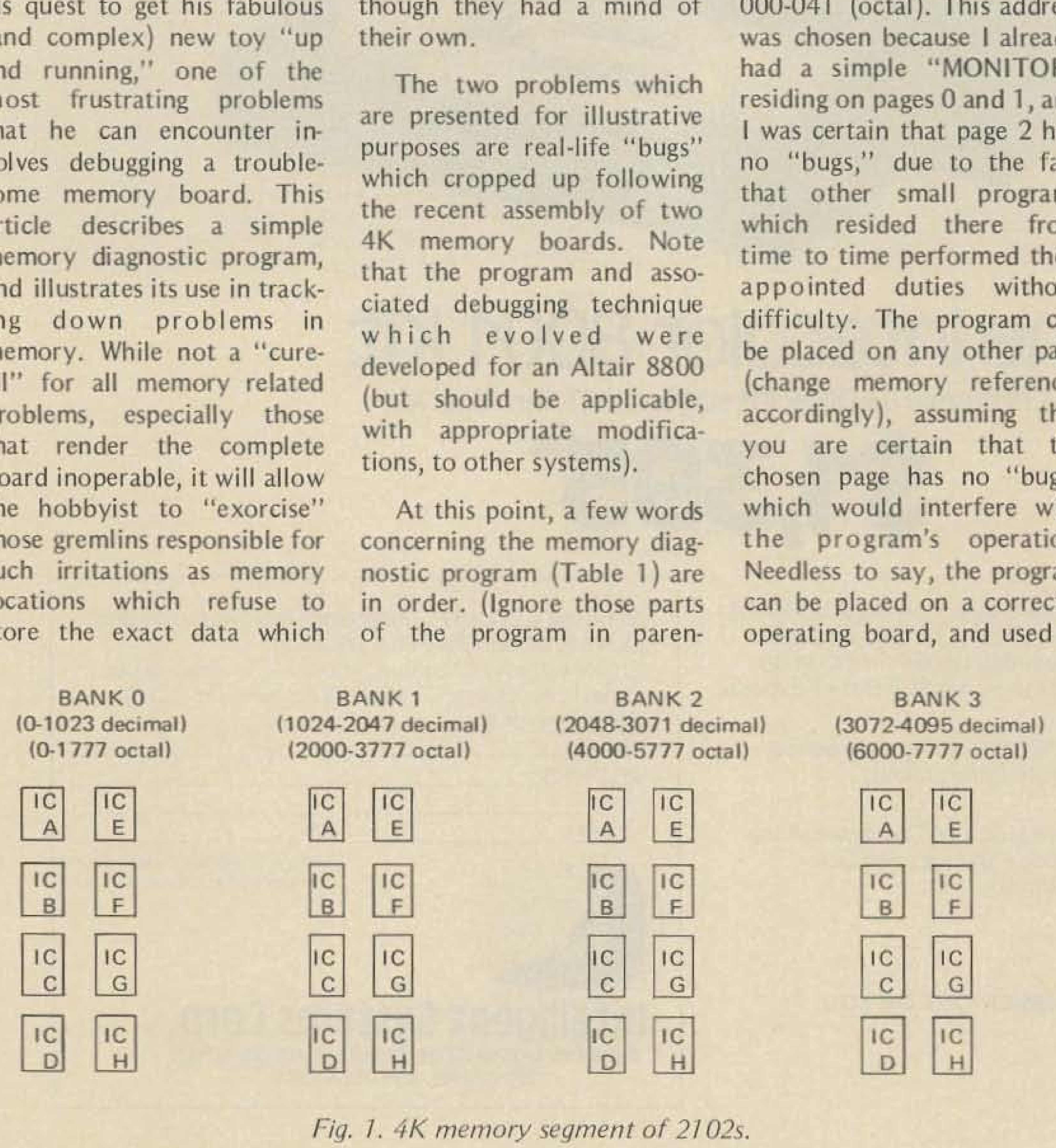


Fig. 1. 4K memory segment of 2102s.

need for the modified program will be made clear in due course.

DEBUG	002-000	046		MVI H	Load H & L registers with starting address of memory segment to be tested
	002-001	XXX		Page to tested	
	002-002	056	MV	MVI L	
	002-003	000			
	002-004	000	(006)	NOP (MVI B)	Store pattern into entire memory page
	002-005	000	(YYY)	NOP (RAND NUM)	
NEXT	002-006	165	(160)	MOV M,L (MOV M,B)	
	002-007	054		INR L	
	002-010	302		JNZ	
	002-011	006		NEXT	
	002-012	002			
AGAIN	002-013	176		MOV A,M	Compare routine (& jump to "dump" if error found)
	002-014	275	(276)	CMP L (CMP B)	
	002-015	302		JNZ	
	002-016	027		DUMP	
	002-017	002			
CONTIN	002-020	054		INR L	Continue comparisons
	002-021	302		JNZ	
	002-022	013		AGAIN	
	002-023	002			
	002-024	303		JMP	Execute program again
	002-025	000		DEBUG	
	002-026	002			
DUMP	002-027	117		MOV C,A	Print out error address & contents
	002-030	315		CALL	
	002-031	237		OCTOUT	
	002-032	000			
	002-033	115		MOV C,L	
	002-034	315		CALL	
	002-035	237		OCTOUT	
	002-036	000			
	002-037	303		JMP	Continue comparisons
	002-040	020		CONTIN	
	002-041	002			

Table 1. Memory diagnostic program.

Some Basics

Before proceeding further, a general discussion of a 4K memory board is in order. These boards usually employ 2102s or a reasonable facsimile thereof, and have the chips arranged in 4 banks of 8 chips each (see Fig. 1). The particular bank chosen is a function of a two-to-four decoder, which decodes address lines 10 and 11. Fig. 2 is a schematic and truth table of a typical circuit.

The active output of the decoder circuit pulls down the eight pin 13s of the particular bank of 2102s being addressed, thus enabling that particular bank.

Table 2 illustrates the address decoding with regard to each bank and the associated 256 word pages therein. The particular page in a bank is a function of the state of address lines A8 and A9. Remember, to activate a given page or address, the appropriate address pins on the chip are pulled down.

Each chip within a bank corresponds to a particular bit, 0-7.

Case 1

Symptoms ... program data loaded into pages 6 and 7 was full of errors when dumped. Testing of pages 6 and 7 with the unmodified program produced the results illustrated in Table 3. Since errors resided in pages 6 and 7, we can localize the difficulty to bank 1 (refer to Table 2). Notice that the contents of the addresses which contain errors are augmented by 004. This points to a problem with bit 2 (chip C) in block 1. The fact that the problem showed up only on pages 6 and 7 seems to indicate that whenever address bit A9 was active, chip C on bank 1 contained a 1 ... producing the 004. Perhaps an internal short in that chip. Substitution of the identified chip corrected the problem.

Case 2

Symptoms ... interaction between pages 4 and 5; specifically, data entered into page 4 changed some ... only some ... data in page 5. Initial use of the memory diagnostic program as in case 1 indicated no errors, although it was known that the pages were interacting. At this point, pages 4, 5, 6 and 7 were loaded with 000 using the modified memory diagnostic. An octal dump of these pages indicated that all were zeroed. The next step consisted of loading the pattern of 144 into page 4. The memory diagnostic and octal dump confirmed that page 4 contained all 144s. However, an octal dump of page 5 revealed that, although it had not been reloaded, it now contained 040s (i.e., bit 5 was always set). Since it is page 5, our problem resides in bank 1 (refer to Table 2), and because it is 040, the problem is associated with chip F in bank 1 (see Fig. 3). Now, since the error popped up on page 5 although page 4 was the one being addressed, it

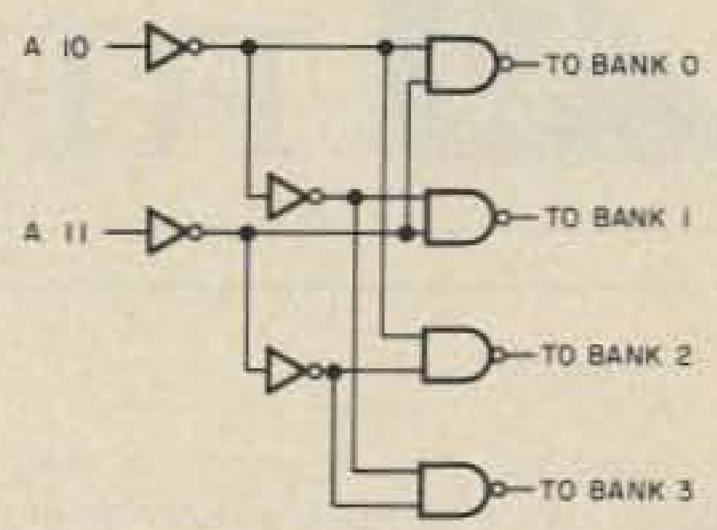


Fig. 2. Typical decoder circuit (and truth table) for decoding address lines A10 and A11 to choose the appropriate bank of 2102s.

Address Lines –	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
Decimal Weight –	2048	1024	512	256	128	64	32	16	8	4	2	1

	A11	A10		
Bank 0	0	0	–	0 – 1023_{10} – pages 0-3_8
Bank 1	0	1	–	1024 – 2047_{10} – pages 4-7_8
Bank 2	1	0	–	2048 – 3071_{10} – pages 10-13_8
Bank 3	1	1	–	3072 – 4095_{10} – pages 14-17_8

Table 2. Address decoding with regard to bank and page selection.

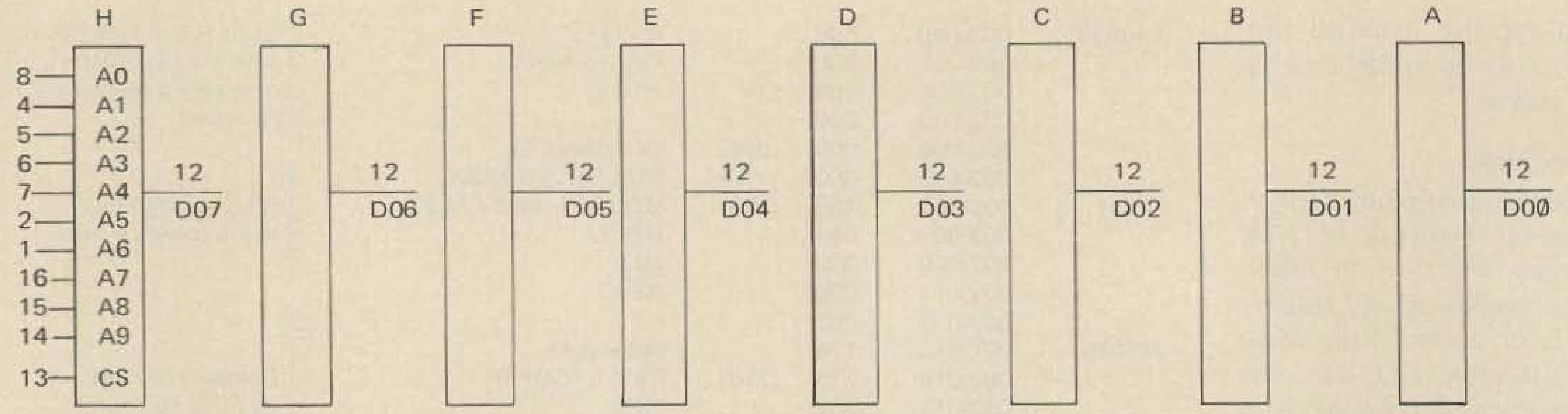


Fig. 3. The logic state of each 2102 in the bank of 8 contributes to the value of the data word at a given address. Note that each 2102 corresponds to one bit in an 8 bit word.

would suggest that A8 on chip F in bank 1 was going low (remember A8 and A9 determine the particular page in a bank that is being addressed). Manual addressing

000	004	010	014
001	005	011	015
002	006	012	016
003	007	013	017

Table 3. Typical readout from "DEBUG," illustrating address and errors (partial) of Case 1.

of page 4 from the display/control board and activation of the examine switch, indeed, showed that A8 on chip F in bank 1 was low. The corresponding pins of other chips in this bank were high. It turned out to be a case of the pin not making contact in the socket. Removal of the chip revealed that pin A8 had been bent underneath upon insertion. Straightening the pin and reinserting the chip (with care) corrected the problem.

Conclusion

The above procedure is relatively straightforward and best of all does not require any sophisticated equipment. In fact, you already possess the two most important pieces – the computer itself and "ham ingenuity."

The program also is relatively simple as memory diagnostic programs go. I would recommend that a number of patterns be tried with the modified program to ensure that all possible bits and consequently all possible chips in a bank be tested. Embellishments such as these could be built into the program by the software connoisseurs among us. Space doesn't permit elaborating upon other possible sources of memory problems. However, the technique of isolating the bank, the chip, and the appropriate pins has been presented and, hopefully, will be of value when a memory problem occurs. Happy troubleshooting. ■

I/O REPORT

from page 95

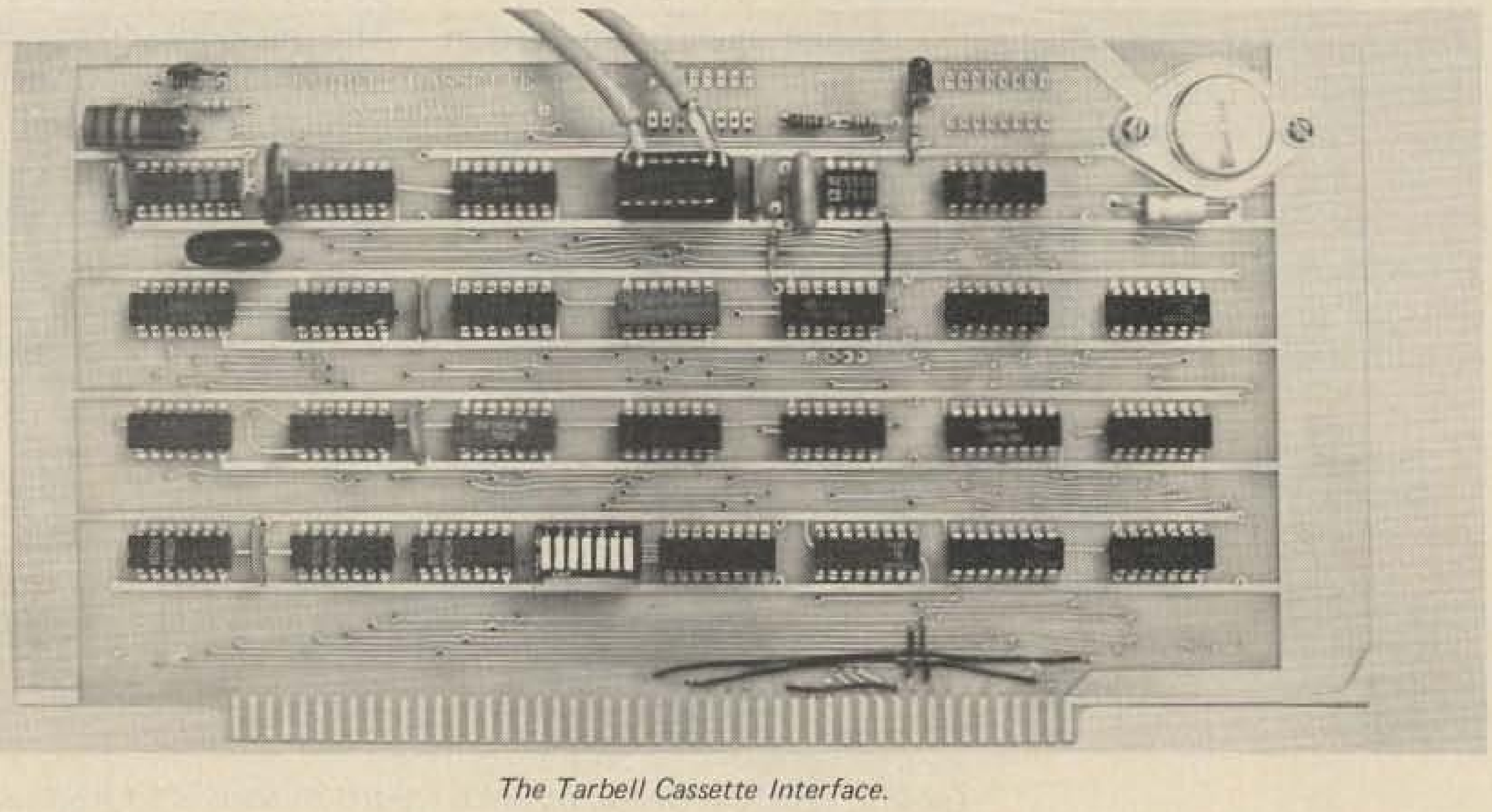
bi-phase data signal, which is then applied directly to the recorder input. The high reliability of this technique stems from the fact the data and clock are recorded together and recovered together. Therefore, speed variations in an inexpensive recorder are essentially ignored.

The dip switches mounted at the bottom center of the board (see photo) are set up for the device select code ("device address"). The audio cables to the recorder are soldered to the board via the dip plug located in the top center of the board. There are two empty sockets provided for expansion and/or modification. The LED located at the top of the board is used for adjusting the read level (in conjunction with the volume control on the recorder) and eliminates the need for an oscilloscope for initial adjustments.

It's always a pleasure to plug something into a system and have it work the first time. That is exactly what happened when we plugged the Tarbell unit into our Altair. The only "problem" we encountered was toggling the read and write routines into the Altair by hand (since a terminal wasn't connected at the time) using the HEX listings provided in the manual. (Toggling hexadecimal into an octal front panel does require a few mental adjustments on the part of the toggler!)

Don Tarbell, the owner of Tarbell Electronics, is one of the pioneers in this hobby, inasmuch as he designed and built his home system from scratch back in 1972. (He also developed a BASIC interpreter, assembler, text editor, operating system, and some sophisticated artificial intelligence software for the system.) He is one of the founders of the Southern California Computer Society, and is currently serving on the board of directors. In other words, it would appear that Tarbell Electronics is in tune with the hobby community and its needs. (Incidentally, his next offering for the Altair community will be a Universal I/O and ROM board.)

Contact: Tarbell Electronics, 144 Miraleste Drive #106, Miraleste CA 90732. Phone: (213)-832-0182. $120 for complete kit or $175 assembled and checked out. The 22-page manual is available at $4, which is deductible from your order. Suggestion: Go ahead and order the Processor Technology software package at the same time you order the cassette – it's worth it!



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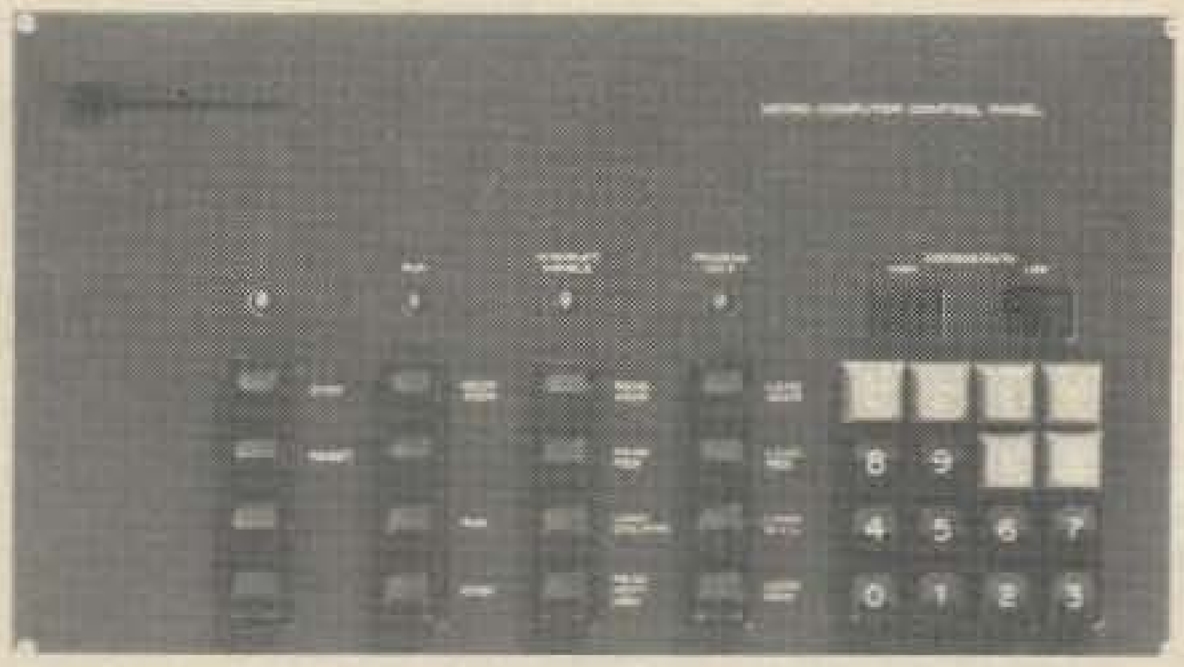

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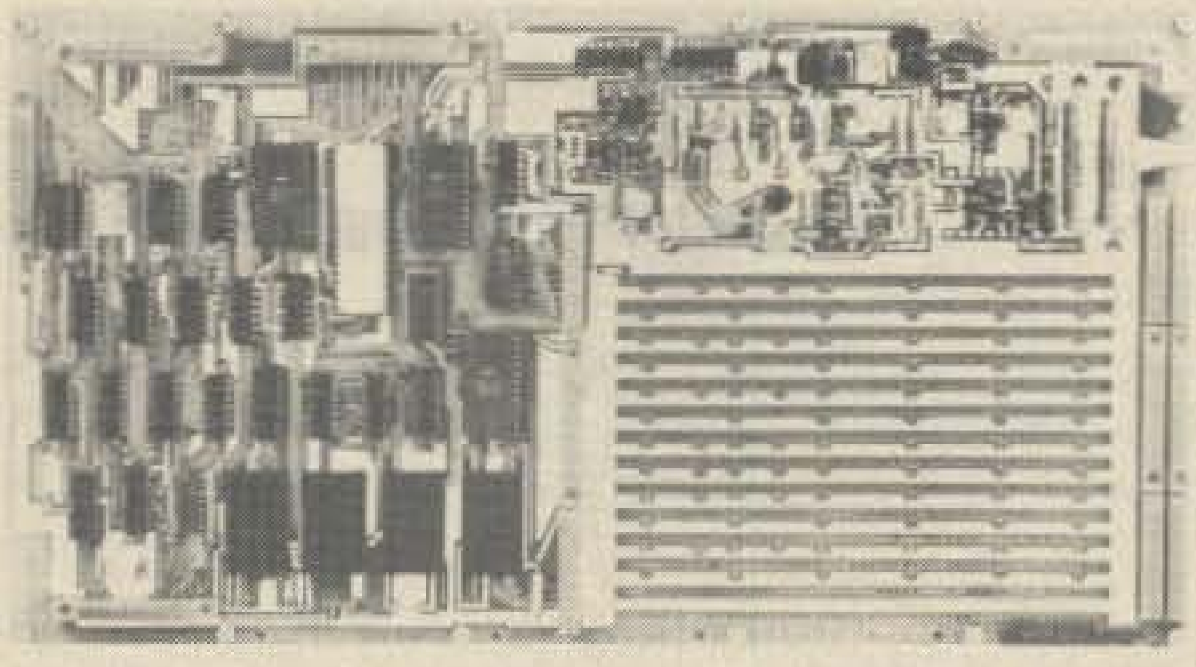

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The New Ham Programmer

-- making those confounded uPs work

Can today's amateur radio operators program one of the microprocessor systems that are so much in vogue? Are these microprocessor systems worth anything to today's amateur? This article is about computer programming. There are a number of fundamental concepts involved in programming today's computers; these fundamental concepts apply to the under-fifty-dollar microprocessor, to an IBM 370 and to just about everything in between. The concepts behind programming a computer are really very simple, and the amateur radio operator is already familiar with the basic ideas. In order to clarify the concepts and relate them to ideas with which we are familiar, this article will go through an exercise examining a typical ham radio contest summary sheet, with the goal of finally writing a computer program which will calculate the contestant's score.

In the 1st Annual Hypothetical Contest, your score is determined by multiplying your total number of QSOs by one (1) if your power input is greater than 100 Watts, or by two (2) if your power input is less than or equal to 100 Watts.

For this contest, the summary sheet shown in Table 1 has been provided to simplify the contestant's scoring.

This summary sheet illustrates some of the important concepts of computer programming. Though not really a concept, the first observation which must be made is that the summary sheet is easy to follow, simple-minded and somewhat tedious.

A computer operates under the control of a *stored program;* in this example, the summary sheet presented is analogous to the stored program which controls the computer. The *CPU* (Central Processing Unit) interprets the program instructions just as our hypothetical contestant reads and interprets the instructions on the summary sheet. In a computer, both the program and data are stored in a memory; the summary sheet is the memory upon which the printer has stored the program, and the contestant stores his data within the boxes provided. The contest summary sheet analogy illustrates one more important concept upon which the usefulness of modern computers is built: *transfer of control* based upon a logical operation (as illustrated in line 2 of the summary sheet). On this line, the contestant's power input (a previous calculation) is compared with 100 Watts, the contest rule for determining the QSO multiplier. Based on this comparison, the contestant is directed to go to either line 5 or, by implication, to continue to the next sequential line. As a general rule, the organization of CPUs is such that the program is executed one step at a time, sequentially, in the order in which the instructions appear, until a transfer of control operation is encountered (the "go to" on line 2), which changes the order in which the instructions are executed.

Flow Charts

A flow chart is a graphical method of describing a process. The process we are concerned with is programming a computer, and a flow chart can be used as an aid in the design and documentation of computer programs. There are a number of standard flow charting symbols which are universally understood in the computer programming community. Since this article is not meant to be a course in flow charting, I will introduce just two flow charting symbols (Fig. 1) and present a flow chart (Fig. 2) which describes the process of calculating the score for the Annual Hypothetical Contest.

The flow chart in Fig. 2 is one of many possible representations of the summary sheet process. In this chart we see the introduction of the idea that the variables in the calculation can be given names: POWER, PLATE.VOLTS, PLATE.CURRENT, SCORE and QSOs. The names chosen have some meaning to the reader who has followed through the contest scoring example. Quite a few details have intentionally been left out of the flow chart; the flow chart is designed to give an overall idea of what is to be accomplished. It is worthwhile to note at this point that we could just as well have started with the flow chart and evolved the summary sheet as an implementation of the process described by the flow chart. With reference to our summary sheet, the value PLATE.CURRENT is entered in the box on line b, the value of SCORE is entered in the box on line 10, etc. On the summary sheet, the instruction on line 2 is the implementation of the decision block in the flow chart.

Before we can consider how the Hypothetical Contest summary sheet calculations can be done with a program in a computer, we must take a few minutes to describe the computer itself. For this discussion, the INTEL 8080 will be our CPU. The INTEL 8080 is probably the most popular of the 8-bit microprocessors; however, the programming ideas presented here apply generally.

The INTEL 8080 is a very simple device; it can add, subtract, make logical comparisons and transfer control. The 8080 has seven 8-bit *registers,* a 16-bit *stack*

1. Calculate your final input POWER (see lines a-c)
2. If your POWER is less than or equal to 100 go to line 5
3. Take the number of QSOs (line 9) and put this number in SCORE (line 10)
4. STOP
5. Take the number of QSOs (line 9)
6. Multiply the number of QSOs by two
7. Enter the product in SCORE (line 10)
8. STOP
9. Number of QSOs
10. SCORE

Power Calculation:

a. Multiply the PLATE CURRENT (entered in line b) by the PLATE VOLTAGE (entered in line c), return to the next line in the Summary Sheet
b. PLATE CURRENT
c. PLATE VOLTAGE

Table 1. First Annual Hypothetical Contest summary sheet.

pointer and a 16-bit *program counter*. The stack pointer, though very important to making full use of the power of the 8080, will not be discussed here. The program counter is quite simply a pointer to the instruction to be executed. Relating to the summary sheet example, the program counter may be thought of as your index finger pointing to each line of the instructions as you read the line. Before our program is started, the program counter register must be initialized to point to the first instruction in the program; from then on, the program counter will automatically go through each instruction of the program as it is executed.

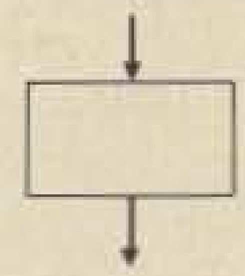
The seven 8-bit registers are named A, B, C, D, E, H and L. The A register is also called the *accumulator* and is used in the arithmetic operations such as addition and subtraction; typically, numbers in other registers are added to or subtracted from what is in the accumulator with the result being left in the accumulator. The other registers have various uses; in our program we will use only the B and C registers. All of the registers may be used to save results of computations. Since most computations change the A register, it is convenient to be able to save results in other registers which may be referred to in subsequent steps of the program; in our program, we will use the C register to save the result of the POWER calculation.

An instruction for the 8080 is made up of an operation code *(OP code)* and an *operand*. For example, an addition instruction would be coded for the 8080 as ADD C. The OP code is ADD and the operand is C. From INTEL's documentation we find that the instruction ADD C adds the contents of the C register to the contents of the accumulator and leaves the result in the accumulator. Generally, the operand can be either a register or a storage location; the instruction, LDA 0400, *loads* the contents of storage location 0400 into the accumulator.

The 8080 program used to compute contest scores is shown in Table 2. The left-hand column is the address (in hexadecimal) where each instruction or variable is stored in the computer's memory. The second column from the left shows the contents of each memory location in hexadecimal. In the case of instructions, the content of the memory location is the operation code which the CPU decodes to determine what instruction is to be executed. You may notice that the memory addresses in the left-hand column seem to increment in some random manner. The reason for this strange progression of address locations is that instructions for the 8080 occupy from one to three storage locations. The very first instruction in the MAIN PROGRAM starts at memory location 0100. This instruction is a CALL instruction which transfers control to a *subroutine;* the operation code for this instruction is "CD" and the starting address of the subroutine is location 0250. A pair of hexadecimal digits occupy one storage location, so the operation code "CD" occupies location 0100 and the address 0250 occupies locations 0101 and 0102.[1] The next instruction, MOV C,A, will therefore start in the next available location, namely 0103.

The third column from the left lists the computer instruction in a more readable way than the hexadecimal notation in the second column. MOV is a move instruction, LDA is load the accumulator, STA is store the accumulator, etc. In truth, this program was written as seen in column three and subsequently translated into the machine instruction codes shown in column two.

The fourth column contains comments about the program and indicates the use



Process Block — *This block describes a process or operation such ad addition, multiplication or the like. The process flow is thought of as entering the top of the block and leaving the bottom.*

Decision Block — *This block describes a decision (such as "is something greater than something else") which is made in the process. The process flow is thought of as entering the top of the block; a decision is made within the block which determines from which of the output legs the process will continue.*

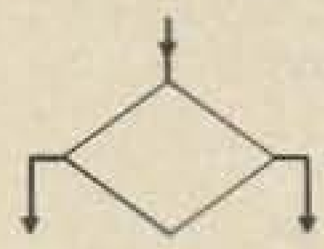


Fig. 1.

[1] The architecture of the 8080 requires the low order address of the operand in the location immediately following the OP code, and the high order address in the second location following the OP code. Here, location 0101 will contain 50 and location 0102 will contain 02.

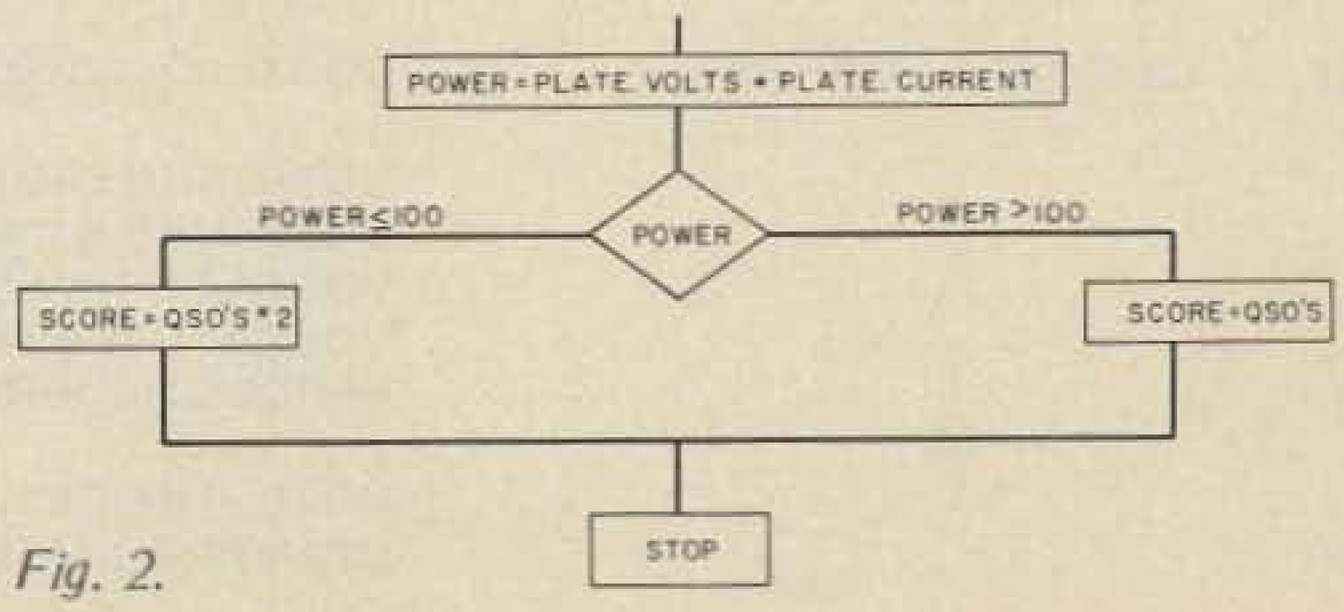


Fig. 2.

MAIN PROGRAM:

0100	CD 0250	CALL 0250	CALL SUBROUTINE TO CALCULATE POWER
0103	4F	MOV C,A	MOVE POWER FROM A REG TO C REG
0104	3A 0207	LDA 0207	GET THE VALUE 100 (THE VALUE 100 IS STORED IN LOCATION 0207)
0107	91	SUB C	100 (IN REG A) – POWER (IN REG C)
0108	FA 0113	JM 0113	JUMP ON MINUS TO 0113 JUMP IF POWER GREATER THAN 100
010B	3A 0209	LDA 0209	GET #QSOs IN REG A FROM LOCATION 0209
010E	87	ADD A	MULTIPLY BY 2 BY ADDING THE #QSOs IN REG A TO ITSELF
010F	32 0208	STA 0208	STORE RESULT IN 0208 WHICH HAS BEEN ALLOCATED TO SAVE THE SCORE
0112	76	HALT	
0113	3A 0209	LDA 0209	GET #QSOs IN REG A FROM LOCATION 0209
0116	32 0208	STA 0208	STORE IN LOCATION 0208 WHICH HAS BEEN SET ASIDE TO SAVE THE SCORE
0119	76	HALT	

DATA AREA:

0201	00	CURRENT (TO BE FILLED IN WITH CONTESTANT'S PLATE CURRENT)
0202	00	VOLTAGE (TO BE FILLED IN WITH CONTESTANT'S PLATE VOLTAGE)
0207	64	100 DECIMAL
0208	00	SCORE CALCULATED BY PROGRAM
0209	00	#QSOs (TO BE FILLED IN WITH CONTESTANT'S NUMBER OF QSOs)

POWER SUBROUTINE:

0250	3A 0201	LDA 0201	GET CURRENT
0253	4F	MOV C,A	PUT CURRENT IN REG C
0254	3A 0202	LDA 0202	GET VOLTAGE
0257	47	MOV B,A	PUT VOLTAGE IN REG B
0258	3A 0201	LDA 0201	GET CURRENT
025B	05	DCR B	DECREMENT REG B (REG B STARTED OUT WITH THE VOLTAGE WHICH WILL BE THE NUMBER OF TIMES CURRENT WILL BE ADDED TO ITSELF TO FORM THE PRODUCT CURRENT*VOLTAGE)
025C	C8	RZ	RETURN IF ZERO . . . DONE
025D	81	ADD C	ADD THE CURRENT IN REG C TO THE SUM BEING ACCUMULATED IN REG A
025E	C3 025B	JMP 025B	GO TO LOCATION 025B

NOTE: THE PRODUCT CURRENT * VOLTAGE IS FORMED BY ADDING CURRENT TO ITSELF VOLTAGE TIMES. FOR EXAMPLE, IF THE VOLTAGE IS 5 AND THE CURRENT IS 3, THE PRODUCT CURRENT * VOLTAGE = 3+3+3+3+3 = 15

NOTE: THE RESULT IS RETURNED TO THE MAIN PROGRAM IN THE A REGISTER

Table 2.

of storage locations in the data area of the program (locations 0200 – 0209).

NOTE: The values used in this program are *decimal.* In reality, the values stored in memory would be in hexadecimal or octal. A conversion routine and an output routine would be necessary if it were desired to output these numbers in decimal to a TTY or TVT. Therefore, the decimal values are used for simplicity.

The computer program is just about as straightforward as possible, but it is worth the time to go through each instruction examining what each does and why it is there.

The first instruction in the *main program* is a call to a subroutine. A subroutine is simply another part of the total program which does some function; in this case, the subroutine calculates the power of the contestant and saves the result in the accumulator (A register) of the computer. The call instruction essentially transfers the execution of the program to a specified location in the computer memory; in this program, the subroutine to calculate power is at memory location 0250. When we get into the discussion of the power subroutine we can consider the calculations in more detail; at this point it is sufficient to note that the CALL 0250 will do the desired calculation and continue on to the next instruction. The idea behind the notion of subroutines is similar to the first instruction on the summary sheet. The precise instructions for calculating power are not part of the summary sheet; rather, these instructions are set apart in lines a-c just as the instructions for calculating power in the computer program are set aside at memory locations 0250 through 0260.

Having calculated the contestant's power, the next thing which must be done is to check whether the contestant's power is greater than one hundred Watts in order to determine the multiplier; the three instructions starting at location 0103 do just this. First, the power calculated by the subroutine is moved to register C for safekeeping (MOV C,A); then the accumulator is loaded from storage location 0207. Since location 0207 was set up to contain the number 100 decimal (64 in hexadecimal), the accumulator now has 100 in it; SUB C subtracts the contents of the C register from the contents of the accumulator. Recalling that register C contains the contestant's power, the accumulator, after the SUB C instruction, contains 100-POWER. Notice that if the power is greater than 100 Watts, the above calculation will result in a minus number. The instruction JM 0115 at location 0108 completes the test on the contestant's power; this Jump-on-minus instruction (JM) will jump (transfer control) to location 0115 if the previous subtraction resulted in a minus number. The Jump-on-minus instruction is an implementation of the transfer of control from the decision block in our flow chart; just as the decision block had two different exit paths depending upon the results of the decision, the JM instruction controls the flow of the program: either to the next sequential location (010B) if not minus, or to location 0115 if minus.

If the contestant's power was less than or equal to 100, the next instruction executed is the LDA 0209 at location 010B. This instruction loads the accumulator with the contents of location 0209. Location 0209 is set aside to hold the number of QSOs, so the accumulator will be loaded with the number of QSOs that our contestant had during the contest. Since we are now considering the case where the final score is determined by doubling the QSO count, we can accomplish the desired doubling by simply adding the accumulator (number of QSOs) to itself; ADD A adds the contents of the accumulator to the contents of the accumulator, effectively multiplying the contents of the accumulator by two. Finally, the contestant's score is saved in memory location 0208 which has been set aside to save the SCORE; STA 0208 stores the contents of the accumulator in storage location 0208.

Statement Number	Command (Instruction)	Comment
10	INPUT P	Input power (P) value from TTY or TVT
20	INPUT Q	Input number of QSOs (Q) from TTY or TVT
30	IF P = >100 GOTO 50	Decision statement regarding power (100 Watts or greater?)
40	PRINT "SCORE= " Q	If the value for Q (#of QSOs) were 1,632 (decimal, mind you), the printout on the TTY or TVT would be: SCORE = 1,632
45	GOTO 99	Go to end of program
50	Let S = 2 * Q	Calculate score (S) if power less than 100 Watts (2 times Q)
60	PRINT "SCORE=" S	Printout of score (same as in statement number 40)
99	END	End of program

Table 3.

Remember the JM instruction at 0108? This instruction transferred control to location 0115 if the power was greater than 100. Now we must consider what must be coded for the computer to execute at location 0115. In this case, the power was greater than 100; all we want to do is take the number of QSOs as the SCORE. LDA 0209 loads the accumulator from the location set aside for the contestant's QSO total, and STA 0208 stores the contents of the accumulator in the storage location set aside for the SCORE.

The calculation of the contestant's power is done by the subroutine at storage location 0250. The INTEL microprocessor does not have a multiply instruction, so another approach must be taken by the programmer who wants to perform the calculation, POWER = CURRENT*VOLTAGE. Multiplication may be thought of as the summation of the multiplicand, with the multiplier specifying the number of times it is to be summed. For example, to multiply 10 by 6 we can add 10 together 6 times: 10*6 = 10 + 10 + 10 + 10 + 10 + 10 = 60. We shall use this approach to multiply current by voltage to get the power. Register B will be loaded with the value of the voltage, and every time we add the current to the sum being accumulated in register A, we shall also decrement register B. When register B becomes zero, we have added the current together voltage times.

Rather than going through each instruction as we did in the main program, let us look at the new instructions introduced in the subroutine code. MOV B,A moves the contents of the A register into the B register; since the A register had just been loaded with the voltage, MOV B,A moves the voltage into the B register. As mentioned above, the B register will be decremented each time the current is added to the A register; DCR B does just this.

The return instruction, RZ at location 025C, transfers control to the storage location immediately following the CALL instruction in the main program when register B is decremented to zero. Special hardware in the CPU keeps track of where the CALL instruction was executed so that the return instruction can return to the instruction which follows the call. With this call and return facility, it is possible to call the power calculation subroutine from any other program which may want to make such a calculation. Admittedly, this subroutine is not very sophisticated, but envision the possibility of writing more sophisticated subroutines which calculate logarithms, trigonometric functions, etc. Once such subroutines have been written once, other programs can take advantage of them by simply calling them. Many higher level languages such as FORTRAN are implemented with a library of subroutines; a FORTRAN statement such as A = SQRT(47.667) is executed by calling a subroutine which calculates the square root of the arbitrary value 47.667.

By now you are surely convinced that computer programmers must be a weird bunch to put up with such a dumb animal as the computer. The program so laboriously presented will make the calculations required for the contest scoring problem, but it has some severe restrictions. To point out just one of these, notice that one storage location has been allocated to save the contestant's score. One storage location is 8 bits in length; this allows our contestant to accumulate a total score of only 255. This is, of course, a limitation, but not one which can't be overcome. It involves having another subroutine which will receive the value and convert it into a fixed or floating point value occupying more than just a single storage location. A better way to get around all of these problems is the use of a *higher level language*. Several references have been made to FORTRAN (which is a higher level language), but let's take a look at how BASIC can solve some of the above problems. BASIC can also very easily take care of some of the problems mentioned earlier, such as hex-to-decimal, or octal-to-decimal conversion, and input and output routines. For example, the BASIC program in Table 3 will perform the same functions as our earlier program, and also take care of the "problems."

It's quite evident from this program that BASIC is an easy language to use, and did a very satisfactory job of solving the task (and in very few statements). The disadvantage (if you want to call it that) is that we are now somewhat removed from the machine. The previous machine language program required that we get to know the machine, its operation, and architecture in order to program it. This can certainly be more challenging at times and also allow you to do some things you can't with a higher level language such as BASIC.

Yes, today's ham radio operator can program a microprocessor. The real challenge lies in finding applications which are well suited to the microprocessor's capabilities. ■

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The Soft Art of Programming

-- getting started with BASIC

Here are some interesting and worthwhile ideas for the beginning programmer, and some reminders (or review) for the experienced. – Ed.

Okay. So my microcomputer kit finally showed up in the mail, and I put it together. I watched the panel lights blink for a few days, then I had some friends over to look at it. They looked at me with sort of a funny smile and said, "But what are you going to *do* with it?" I grabbed for a copy of *73* and riffled through it searching frantically for Wayne's editorial, mumbling, "You know, anything you, uh . . .", but they were already out the door, smiling and saying they had to get back because "Mary Hartman, Mary Hartman" was going to be on in a few hours.

I knew it wasn't my breath, and I was wearing a clean shirt. There was no way around it; I was going to have to learn how to program.

Actually, programming a computer can be tremendous fun. Also tremendously rewarding and, let's face it, tremendously frustrating if you go about it wrong. In this article, I'm going to give some tips about learning to program, in the hopes of keeping you on the fun side instead of the hair pulling side. I'm not going to try to teach you to program – that would take a whole book. No, I'm going to give you some things to try, suggest a few books that will be useful, outline some important ideas to keep in mind, and give some examples of how to write programs. You'll get the most out of this if you read it again every so often as you get farther and farther into programming. Don't take anything I say as gospel – try to prove me wrong! Above all, have a good time.

Programming is like planning a task. The idea is to figure out how to express some overall action that you want the computer to do in terms of elementary building blocks, just as circuit design consists of putting together simple components to do a complex overall process. All the examples here assume that the building blocks are the legal statements and forms of BASIC, but the *ideas* apply to any computer language, including machine language.

Let's assume that you have enough hardware to run 8K Altair BASIC or the equivalent, and that you've been able to decipher the manuals well enough to get the BASIC system loaded into your machine. The first thing to do is learn what the basic building blocks are, and to start seeing how they can be fit together.

Phase I: Building Blocks

The key to learning to program is to keep having fun. Keep tinkering! Start with a one or two line programs, say

```
100 PRINT "GREETINGS!"
200 END
RUN
```

(Remember to hit the "RETURN" key at the end of each line.)

Keep RUNning it and adding in new statements to see what happens.

Variable	Type	Use
M$	string	name of magazine
I	numeric	number of issues per month
Y	numeric	length of subscription in years
C	numeric	cost of subscription
P	numeric	per issue cost
A$	string	answer to "any more" question.

Table 1.

```
100 PRINT "GREETINGS!";
150 PRINT A
200 END
RUN
```

(Look in your manual to find legal statements and to find what keys to hit to wipe out mistakes.)

Every time you find something that works, keep playing around with it.

```
100 PRINT "GREETINGS!";
120 LET A=1
150 PRINT A
200 END
```

Loops are very important ways to get a short program to do a lot of work. Start writing some infinite loops like the one below and watch what happens. Of course, you'd better find out how to stop one "by hand" (in Altair BASIC and many others, holding down the "CONTROL" key and a "C" together will stop your program).

```
100 PRINT "GREETINGS!";
120 LET A=1
140 LET A=A+1
150     PRINT A
170     REM: GO BACK
171     REM: FOREVER
180     GO TO 140
200 END
```

(Notice how indenting the statements in the loop makes them stand out.)

Write programs that fill up your screen or printout with crazy, wild patterns:

```
10 PRINT "GARBAGE";
20 GO TO 10
30 END
```

Fairly soon you'll get a feeling for how the basic units work and you'll want to have more control over what your programs do and write bigger programs that do definite tasks. A good book will help a lot.

Phase II: Book Learning

Books written specifically for home computer users will be coming out soon – in the meantime, here are some that seem pretty good.

My Computer Likes Me (When I Speak in BASIC) by the crew at the People's Computer Company (also available from *73*): a nice, mellow, friendly, encouraging but very brief introduction. If you're starting completely from scratch, begin here, then move on to a book that covers more material.

BASIC by Samuel L. Marateck, Academic Press, 1975: moves at a very patient pace, and has lots of examples. Unfortunately, a lot of the early examples are obviously just made up on the spur of the moment and don't demonstrate how to use the statements in the context of meaningful problems. Recommended if you find that one of the other books goes too fast for you.

BASIC by Michel Boillet and Lister Horn, West Publ. Co., 1976: moves a little faster, has nice question and answer sections, and has loads of good problems at the end of each chapter. Many of the problems and examples are business oriented (accounting, interest payments, etc.), so if that's one of your interests, this may be the book for you.

Computers: Their Impact and Use: Basic Languages by Robert Lynch and John Rice, Holt, Rinehart, and Winston, 1975: The first half has a broad overview of computing – history, applications, future projections. The second half covers programming in BASIC, moves fairly rapidly, and includes quite a few nice, real world examples.

BASIC Programming by John Kemeny and Thomas Kurtz, John Wiley, 1971: the "old standard" (Kemeny and Kurtz invented BASIC). The book moves quickly and may be hard to follow if your high school math is too rusty, but it has lots of really clever examples. If you can get through it, you'll get a lot out of it.

More are coming out all the time, so keep your eyes open for one that suits your needs.

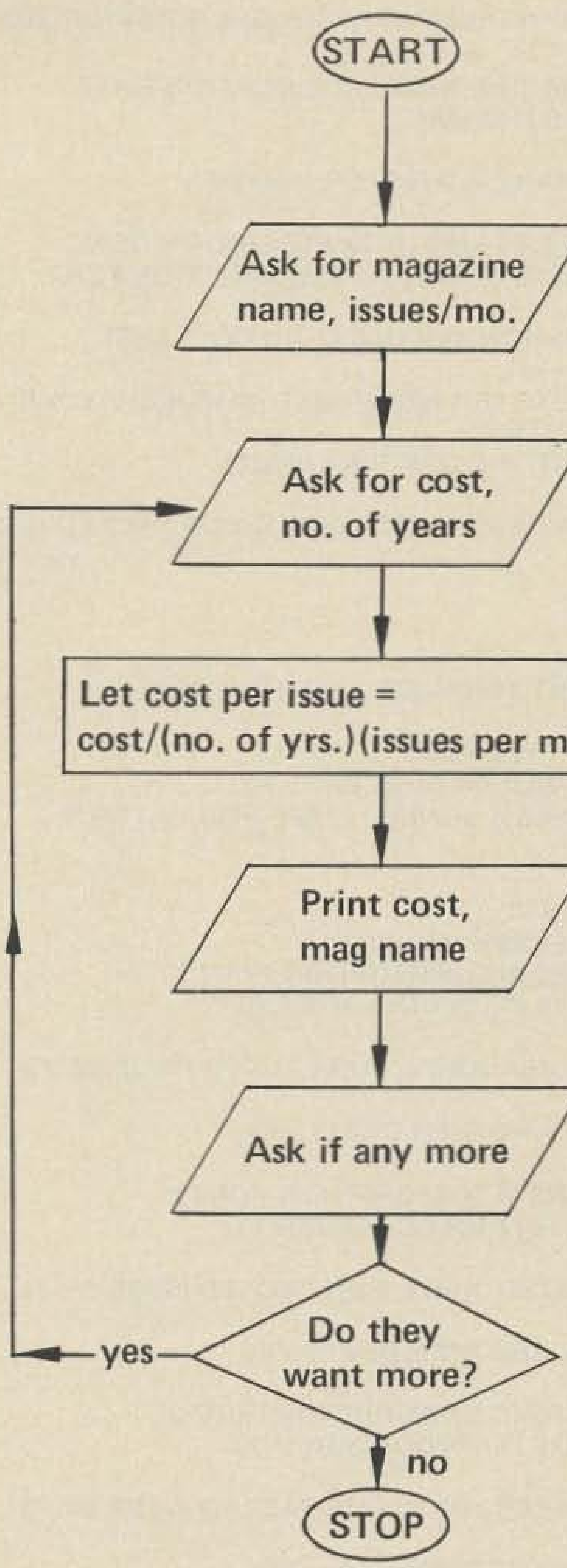

Fig. 1.

In using these books, there are three main problems. First, all except *My Computer Likes Me* are written for classroom use. This means that they have a fairly formal style (you have to get *teachers* to like it if you want to sell a textbook), and that they go fairly fast (they assume your teacher will explain what's going on sometimes). If you take your time, try everything out on your home system as you go, and ask a friend for help when you get really stuck, you'll be able to get loads of useful, fun ideas from any of them. Well worth the effort.

Second, since there are no agreed upon standards for BASIC (they're coming soon, thank grid!), you'll find that you have to translate some of the little details before programs in the book work on your system. Your manual will tell you what symbol to type to wipe out the last character, whether to type "NEW" or "SCR" or whatever to start entering a new program, etc. Usually you'll find that your system allows some statements and commands the book doesn't and vice versa. Fortunately,

```
10 REM:PROGRAM TO COMPARE VARIOUS SUBSCRIPTION
11 REM: DEALS.
20 REM:GET MAGAZINE NAME, PUBLICATION RATE.
30 PRINT "WHAT'S THE MAG";
40 INPUT M$
50 PRINT "HOW MANY ISSUES PER MONTH";
60 INPUT I
70 REM:NOW GET DETAILS OF SUBSCRIPTION DEAL.
80 PRINT "HOW MANY YEARS IS SUBSCRIPTION FOR";
90    INPUT Y
100   PRINT "AND HOW MUCH IS IT (IN DOLLARS)";
110   INPUT C
120   REM:COMPUTE PER ISSUE COST (#ISSUES=I*Y*12)
130   LET P=C/(I*Y*12)
140   REM:OUTPUT THE COST PER ISSUE
150   PRINT " "
160   PRINT "THAT'S $"; P; "PER JUICY, FUN-PACKED ISSUE
                                              OF ";M$
170   PRINT " "
180   PRINT " "
190   REM:MORE?
200   PRINT "WANT TO CHECK ANOTHER DEAL";
210   INPUT A$
220   IF A$="YES" THEN 80
230 REM: DONE. MAKE A GRACEFUL EXIT.
240 PRINT "THANKS A BUNCH . . . SEE YOU LATER."
250 END
RUN
WHAT'S THE MAG? 73
HOW MANY ISSUES PER MONTH? 1
HOW MANY YEARS IS SUBSCRIPTION FOR? 1
AND HOW MUCH IS IT (IN DOLLARS)? 10

THAT'S $ .833333 PER JUICY, FUN-PACKED ISSUE OF 73

WANT TO CHECK ANOTHER DEAL? YES

HOW MANY YEARS IS SUBSCRIPTION FOR? 2
AND HOW MUCH IS IT (IN DOLLARS)? 17

THAT'S $ .708333 PER JUICY, FUN-PACKED ISSUE OF 73

WANT TO CHECK ANOTHER DEAL? YES

HOW MANY YEARS IS SUBSCRIPTION FOR? 3
AND HOW MUCH IS IT (IN DOLLARS)? 20

THAT'S $ .555556 PER JUICY, FUN-PACKED ISSUE OF 73

WANT TO CHECK ANOTHER DEAL? NO
THANKS A BUNCH . . . SEE YOU LATER.
```

Table 2.

these are mainly advanced features and you'll be in shape to figure them out yourself by the time you get to them.

Third, the books concentrate more on specifics of BASIC than on the more general, problem-solving aspects of programming. That is, they treat a program as an end in itself, without much concern for the facts that when you write a program you're really going to *use* it, that you'll want it to be easy to debug (correct), easy to upgrade later, easy to use in conjunction with other programs, easy to share with other people, etc. All these things mean that it's crucial to be able to write well-organized programs, programs that are easy for *human beings* to understand.

Phase III: Structured Programming

The ideas here will be more understandable after you've written a number of programs. The goal is to make your programs easier for humans (including yourself, of course) to understand by getting you to think about organizing them clearly right from the start.

The general sequence of events in writing a program should be:

1. Make a clear statement (in English) of the problem.
2. Make a flowchart and/or write a verbal description showing the main subparts of the solution and how they fit together.
3. Make a more detailed flowchart or verbal description of each subpart.
4. Once you're sure what each subpart is to do, translate the flowcharts or descriptions into BASIC (or whatever language you're using this week), inserting your descriptions at the beginning of each subpart as comments (REMark statements). This aspect of the programming process is often called *coding*. Note the analogy with coding in radio work – you do want to be able to go from a verbal description (message) to BASIC (Morse) and back quickly and easily, but you don't try to *think* in BASIC (Morse).
5. Don't be satisfied with your first version of a program. Make an extra effort to precede each INPUT or READ statement by a PRINT or REMark which tells exactly what the values will be used for.

Make sure the flow of control is as easy to follow as possible. Indenting groups of statements makes them stand out in the listing, and makes it easier for people to identify important subparts of a program.

Often you will find that rewriting a few statements to straighten out the flow of control will help. People usually find that GO TO statements break their concentration as they look at a program, so if you can find a clear way to redo part of your program so it uses fewer GO TOs, you'll be better off. Here are two examples. The first versions do the same thing as the second ones, but seem easier to follow. See what you think.

```
100 LET X=X+1
110 IF X<=N THEN 50
    :
130
```

```
100 IF X>=N THEN 130
110 LET X=X+1
120 GO TO 50

130
    :
```

```
100 REM: A=POSITIVE(X)
110 LET A=X
120 IF X>=0 THEN 150
130    LET A=0
       :
150
```

```
100 REM: A=POSITIVE(X)
110 IF X<0 THEN 140
120    LET A=X
130    GO TO 150
140    LET A=0
150
       :
```

The main idea is to be patient, and keep refining your program. You'll make fewer mistakes as you go, your program will be easier to modify, easier to use and easier to understand.

You might think that these suggestions go overboard in asking for neatness and tidiness, that just sitting down at the old keyboard and bashing your program out would be faster and more fun. Try it! Keep track of how long you spend debugging a program compared to how long you spent designing it. Even when you've been very careful, you'll probably find that more time goes into debugging. If your program was a real mess to begin with, you may even find that you *can't* debug it without doing the design phase over again!

Now that we've got all those guidelines under our belts, let's follow through a simple example from start to finish.

Problem Statement:

Figure out the price per issue of a magazine for a number of different subscription offers.

First refinement:

Ask user for magazine name and number of issues per month. Deal: Ask for details of subscription. Figure out cost/issue, print answer. Ask if any more deals to be considered, if so, go to Deal; otherwise, stop.

Second refinement:

See Fig. 1.

(In a program this small, one refinement is probably enough, but the more the merrier.)

In a large program, it's easy to forget what you're doing and use the same variable name for different purposes, sometimes with disastrous results. It's a good idea to make a list of each variable, its type, and what you think you're using it for (see Table 1).

After I coded the flowchart in BASIC, entered it into my computer, corrected a few misspellings, LISTed it and ran it, what I got is shown in Table 2.

You might find it fun to copy this program and modify it. Put in another loop (driven by an appropriate question to the user) which goes back to statement 30 so rates for a different magazine can be checked. Add in wilder messages to the user. Have fun!

As your programs get bigger and bigger, the organizational principles I mentioned become more and more important, and a number of other guidelines become useful. Also, since most of our home computers don't have very much memory to spare, ways of saving space while leaving programs understandable become important. In Part 2 we'll see some of these ideas and we'll go over the design and coding of a bigger program. Meanwhile. happy programming! ■

BASIC? What's That?

-- the basics of BASIC

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This magazine is loaded with ads for beautiful computers you can own for the price of a better transceiver. Most have keyboards, CRTs, and tape and disk capabilities. These machines are truly computers. What you can do with them is limited only by your ingenuity. Computers can compute, and store and retrieve data. Tape and disk storage is extremely inexpensive, and you can keep mountains of information on your bookshelf. It would be a shame to pass up getting one of these computers just because you think you'll never be able to program it. Most of these minis use the BASIC language, one of the easiest of all computer languages. My aim in this article is to show you how easy it is to program in BASIC, and to start you off, so that when your new computer arrives you'll be able to make sense out of the manual and start right off having fun.

BASIC was well named. It is very basic, and also very simple. It has a minimum of rules, and is practically the same on every computer that uses it. The differences usually are very slight. For example, one manufacturer requires LIST 200,300 to display program statements 200 to 300 on the screen, while another has you type LIST 200-300. Most of the differences are really added capabilities that one computer has, and that others don't have. So you should still look over the manual before starting to program.

Like any language, BASIC has language elements – components that make up the language. They are *statements, variables, literals, functions,* and *statement numbers.*

Statements are commands which tell the computer to perform a specific task, such as PRINT, or READ.

Variables are items which are assumed to contain a value which can change. They are not necessarily the same each time the program runs. These correspond to the letters used in algebra, like x, y, and z. Their value is usually unknown before the program is started, but, whatever their value is, the program handles a *variable* the same way whenever it is encountered. So, in a program to print a series of addresses, there may be a *variable* to represent zip code. Each address may have a different zip code, but the program does not know, and does not care. It does the same thing with each one. BASIC has two kinds of variables: *numeric* and *string.*

Numeric variables are used to hold numbers to be used in arithmetic. You can add, subtract, multiply, and divide numeric variables. They can contain up to 16 digits. BASIC will not let you put anything but numbers into numeric variables. Numeric variables are represented in BASIC by a letter, or a letter followed by a number. Examples are S or Z1. S can stand for salary, sum, or whatever you want. Z1 could mean zip code or oranges.

Not all data is numbers, however. You may need to represent data containing letters, or numbers, or both. BASIC uses *string variables* for this. They can contain anything. They cannot be used in arithmetic. You represent them by a letter and a dollar sign (e.g., Y$). So N$ could mean *name* in your program, A$ could mean address, and Z$ could be zip code, since it is unlikely you will ever use zip code in arithmetic. There usually is some kind of limit to the number of characters a string variable can contain, but 64 is typical.

Literals are easy. They do not represent anything except themselves. They are taken literally. So "Hi there" means the string of characters "Hi there." Just as there are two kinds of variables, there are two kinds of literals: *string* – letters and/or numbers, and *numeric. String literals* must be enclosed in quotation marks. Everything between the quotation marks is the literal – even spaces. This is the only place where BASIC pays any attention to spaces. *Numeric literals* are never enclosed in quotation marks, and they can be used in arithmetic (for example, 3.14 or 73).

Functions are short cuts built into the language to accomplish things that would be difficult to program (for example, the square root function SQR). Every time you need the square root of a number you say SQR(X) and you get its square root without further ado.

Every line of a BASIC program has a *statement number.* Just put any number from 1 to 999 in front of a basic statement – as, for example, 100 PRINT "THIS IS LINE 100". Remember that BASIC will execute the program statements in order, so statement number 100 will get done before 1020. Usually you number the very first statement 100 and number each line 10 greater than the previous.

When BASIC sees a numbered statement, it assumes it is program code, checks it for correct syntax, and enters it into memory. If there is something wrong with it, BASIC will print it on the CRT and point out the error. When you correct it, it is entered into memory.

Let's look at some BASIC and identify the elements found in it.

```
100 LET S$ = "THE SQUARE
    ROOT OF 25 IS"
110 LET A = 25
120 LET D = SQR(A)
130 PRINT S$, D
```

100, 110, 120, 130 are statement numbers. S$, A, and D are variables. You tell me which are numeric and which are string. "THE SQUARE ROOT OF 25 IS" and 25 are literals. You should be able to tell which is numeric and which is string.

You must be eager to start writing your first program. We will be doing that shortly, but we have to learn what the pieces are before we can put them together. We just have to look at some statements, and then it's on to our first program.

PRINT. You have already seen the most useful statement, PRINT. PRINT displays the value of a variable, or a literal, on the CRT.

```
90 PRINT "PROGRAM
   STARTS"
100 PRINT B
110 PRINT "PROGRAM ENDS"
```

LET. LET does more than you would expect. Use it to give a value to a variable.

```
100 LET P = 3.14
110 LET S$ =
    "THE VALUE OF PI IS"
120 PRINT S$, P
```

LET also lets you do arithmetic.

```
100 LET X = 73 + SQR(83)
```

You can make two variables equal with LET.

```
100 LET X = B
110 LET Z$ = B$
```

You cannot mix types. 100 LET X = Z$ is illegal.

LET can even be left out.

```
100 X = B
110 Z$ = B$
```

IF and GOTO. Modifying the sequence of your program can be accomplished through the use of the IF and GOTO statements. You can use IF to test the value of a variable, or to see if it is equal to, greater than, or less than another variable, or an expression. Depending on the outcome of the test, you can skip to another statement in the program. The symbol for "equal to" is =. "Greater than" is >, "less than" is <, and "not equal" to is <>. So if you want to go to statement 5100 if A$ contains "END," write 100 IF A$ = "END" THEN 5100. To go to statement 5700 if A$ and B$ are unequal, write 2100 IF B$ <> A$ THEN 5700. Here is a short segment of a program that will divide R into 4, and print the answer, unless R is zero.

```
100 IF R = 0 THEN 200
(Program sequence modified
using IF and GOTO)
110 B = 4/R
120 PRINT B
130 GO TO 300
(Program sequence modified
using IF and GOTO)
200 PRINT "DIVISION BY
    ZERO IS IMPOSSIBLE"
300 END
```

You are almost ready now. Consult your computer's manual to find out how to get things started. On a BASIC-only computer you may have to do only one thing before keying in your program. You will have to turn on the power. On bigger computers with other languages you may have to type in something like EXEC BASIC before starting. BASIC tells you it is ready to accept program statements by printing "READY" or "OK" on the screen. Then you type in line numbers and program statements. If you type one in that is wrong, simply retype the whole line. To delete a line, type in the line number — nothing more. When satisfied, type RUN and your program will execute.

Here is a short program to try out as soon as your mini arrives. It is called "OHMS LAW." If you give it any two of the three variables, E, I, or R, it computes the unknown.

```
100 PRINT "ENTER E IN
    VOLTS, Ø IF UNKNOWN"
110 INPUT E
120 PRINT "ENTER I IN
    AMPS, Ø IF UNKNOWN"
130 INPUT I
140 PRINT "ENTER R IN
    OHMS, Ø IF UNKNOWN"
150 INPUT R
155 IF E + I + R = 0
    THEN 600
160 IF E = Ø THEN 300
170 IF I = Ø THEN 400
180 IF R = Ø THEN 500
190 GO TO 600
300 E = I*R
310 PRINT "E = ";E
320 GO TO 600
400 I = E / R
410 PRINT "I = ";I
420 GO TO 600
500 R = E / I
510 PRINT "R = ";R
600 PRINT "WANT TO DO
    ANOTHER? Y/N";
620 INPUT R$
630 IF R$ = "Y" THEN 100
640 END
```

Here's a rundown on the few BASIC statements that we haven't talked about yet.

DIM. DIM has nothing to do with the console lights on your computer. It sets up the dimensions (size) of a variable. Most computers establish a default size for each type of variable. Check your manual to find out what it is. You can change the size of a variable with DIM. DIM A$ 30 means that the size of A$ is now 30 characters.

If you have a variable representing a name, and need it to be large enough to hold 30 characters, you had better tell BASIC about it. You do this by using a DIM statement in the following form: 10 DIM N$ 30. DIMs have to come at the beginning of the program, so give them the lowest line numbers.

You can also use DIM to define arrays. An array is a multiple occurrence of a variable. So, if you want N to have 10 different values, you must define N as an array. Use a DIM with the number of times you want the variable repeated in parentheses. DIM N(10) establishes 10 variables in memory, called N(1) through N(10). In the body of your program you can refer to any one of the 10 by putting its number in parentheses after the variable (i.e., a *subscripted variable*). So, to print the fifth value of N, code 10 PRINT N(5). For example:

```
50 N(1) = 3.95
60 N(2) = 7.25
```

This sets the first value of N to 3.95 and the second to 7.25. The numbers in parentheses are subscripts, or indices. Variables can also be used as indices.

```
100 A = 1
110 B = 2
120 N(A) = 3.95
130 N(B) = 7.25
```

This will give the same results as the preceding example.

Here's a short program which stores a series of numbers in an array, then does some computation on each one, and prints out the result.

```
10 DIM F(6)
100 DATA 3.95, 7.25, 14.32,
    28.6, 50.3, 144.4
110 FOR X = 1 TO 6
120 READ F(X)
130 L = 468 / F(X)
140 PRINT L
150 NEXT X
999 END
```

READ. The way data files are set up depends very much on the particular computer. You had better read the manual on this one. There is a simple form of READ, however, which is common to all machines. You include the data to be read in your program, with the DATA statement. Place the DATA statement and its data anywhere in the program; for example:

```
980 DATA 28.6, 21.37, 14.28,
7.25, 3.95, 146.79
```

Then, to read each item of data, use the READ statement. Each time READ is executed you get the next item in the list.

```
READ F
```

Every time you reach this READ statement, you get the next value in the list placed in the variable F.

You can only reach the READ statement as many times as there are items in the DATA statement. Therefore, in the above example you can only execute the READ 6 times. If you do it 7 times the program comes to a premature end — it aborts.

FOR . . . NEXT. FOR and NEXT go together. For every FOR there must be a NEXT. In combination the two are used to execute a section of your program repeatedly (in other words, set up a loop).

```
100 FOR X = 1 TO 20
110 PRINT X
120 NEXT X
130 END
```

FOR in this example sets X equal to 1. Then control drops through to the PRINT and the NEXT. NEXT adds 1 to X. If X = 20, then control falls through to statement 130; otherwise it goes back to 110. In this example, statement 100 is done 20 times, each time with X being incremented. You can set X to any beginning or ending value (well, almost any value). If you want some number other than 1 to be added to X each time the NEXT is encountered, add the word STEP and the number added to X. So, to set X equal to 32, adding 3 each time, and stopping when X is equal to 73 (or greater) code:

```
100 FOR X = 32 TO 73 STEP 3
110 PRINT X
120 NEXT X
```

The X, or whatever variable you use here instead of X, can be used as an index with an array. This is a handy and efficient way of getting at all the values in an array.

```
10 DIM F(5)
100 FOR X = 1 TO 5
110 PRINT F(X)
120 NEXT X
```

This will print each value of F, one after the other.

INPUT. To get information into the program from the keyboard, use the INPUT statement. Use PRINT to tell the operator what to type in.

```
100 PRINT "ENTER
    VOLTAGE"
120 INPUT E
130 PRINT "ENTER
    RESISTANCE"
140 INPUT R
```

There are some very useful functions in BASIC. However, some of the smaller machines may not have all the possible functions: *RND* to get a random number; *INT* to get the whole-number value of a number; *SIN* to get the sine of a number; *COS* to get the cosine of a number; *TAN* to get the tangent value of a number; *ATN* to get the arc tangent; *LOG* to get the logarithm of a number; *ABS* to get the absolute value of a number. For example, 100 PRINT COS(R) prints the cosine of whatever R is.

BASIC is not only *the* language for the home system, but it is also definitely *the* language for the computer-controlled ham station. In a short time you should be able to develop programs which will keep track of all contacts made to and from your station (date, band, power, rig, etc.), handle mailing lists for your club, compute great circle bearings, convert to and from metric, and on and on . . . the list of applications is limited only by your imagination. Define a problem, and then sit down and write a BASIC program to solve it. Happy computing, and 73s! ■

73 Magazine *Staff*

Is It the Band or My Receiver?

-- the microvolter will tell!

Probably one of the most frustrating aspects of amateur operation for the amateur who does not use his station daily for several hours is to know when his station is functioning properly. That a transmitter is functioning properly can be verified by an in-line wattmeter for power and with a monitor receiver for modulation, at least to see that the rig is basically functioning. An swr check is a good basic check for an antenna system. But, what about the station receiver? An operator who uses his equipment frequently can pretty well judge band conditions on HF and knows that a band is "out." But, the infrequent or weekend operator often checks a band and finds signal levels low and then starts to wonder if it is the band or the receiver. Obviously, various checks can be made to see what the real situation is like. If the receiver can tune outside the amateur bands, stations like WWV or selected shortwave broadcast stations can be used as a quick reference to conditions. If a second receiver of equal quality is available, it can be used for verification of the main receiver's condition. But, many amateurs' entire stations consist of a transceiver confined to tuning only the amateur bands.

In this case, some other means of checking receiver performance is necessary. A signal generator providing a calibrated output down to the microvolt level would be ideal, but few amateurs have such test equipment.

This article presents a different approach in terms of the "microvolter." Basically, it is a simple gadget — just an oscillator and a carefully made attenuator network to generate a signal of approximately one microvolt. It is compact, battery powered and uses a single transistor. But, it can almost instantly remove all doubt and confusion as to whether a receiver is "out" or the band is "out." It was intended to be used by plugging it into the receiver's antenna terminals to make a check. However, it could be placed remotely and connected to its own antenna to see if an entire receiving system were functioning on any given band. Admittedly, there are pitfalls to this latter approach, since when a signal source is close to an antenna system, good signal pickup may occur even though something has happened to the antenna system to change its directional properties.

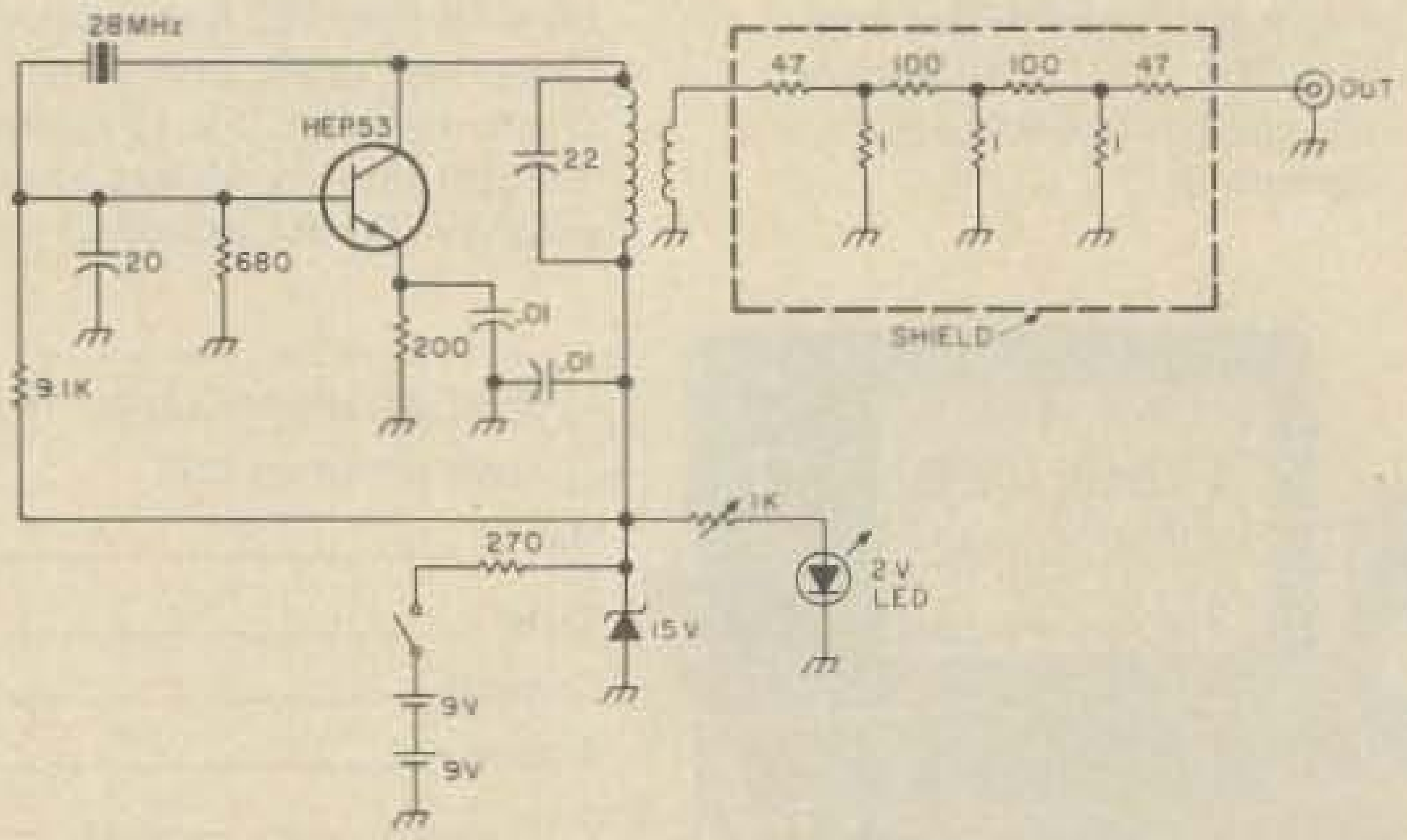

Fig. 1. Oscillator and attenuator network. Oscillator may be used on any band down to 6 meters by proper choice of LC circuit components. Coil: CTC LS5 form, 15 turns #22 enam., with 2 turn link.

The oscillator circuits presented here are mainly for the 20 through 2 meter bands since activity is usually great enough on the lower frequency bands that it is readily obvious if a receiver is functioning. However, if desired, the gadget may be designed to work on any amateur band.

As was mentioned, the microvolter consists of an oscillator and an attenuator network. Many circuits are possible which will work. However, the oscillator must be stable as regards battery voltage, and construction of the attenuator network, while not critical, must be carefully

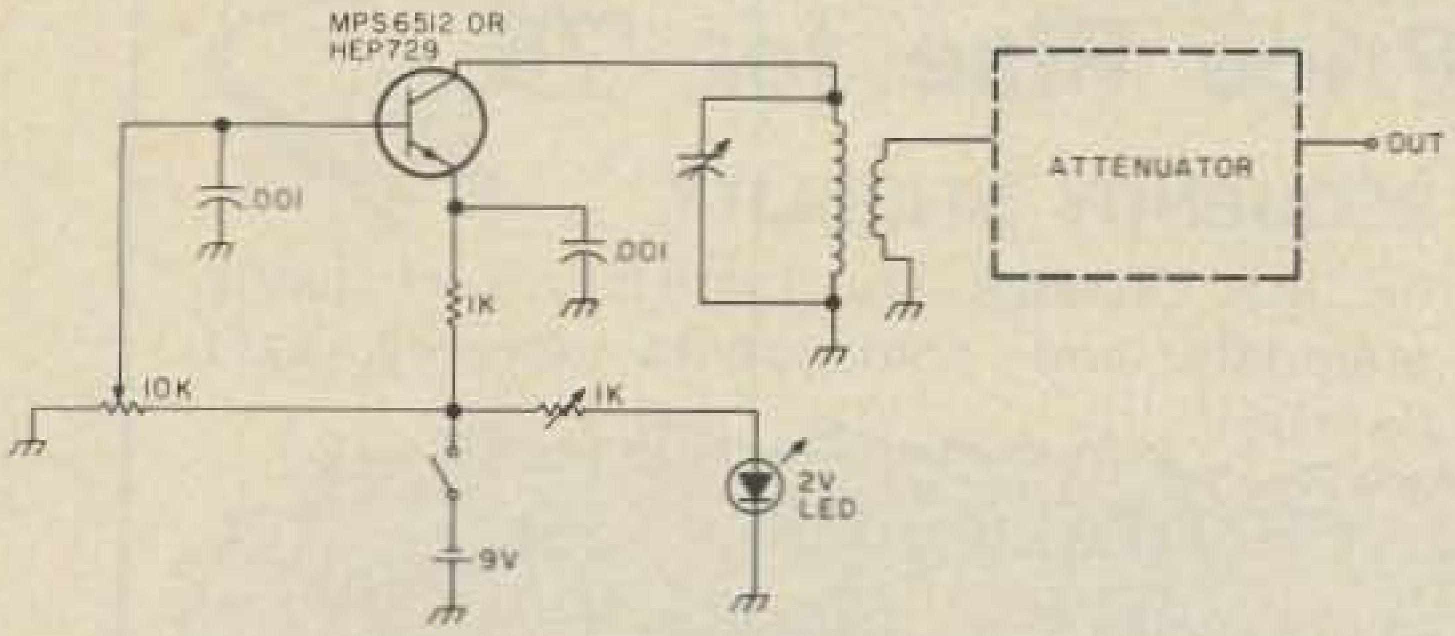

Fig. 2. Extremely simple VFO will work down to 2 meters by choice of proper tank circuit to resonate in desired band.

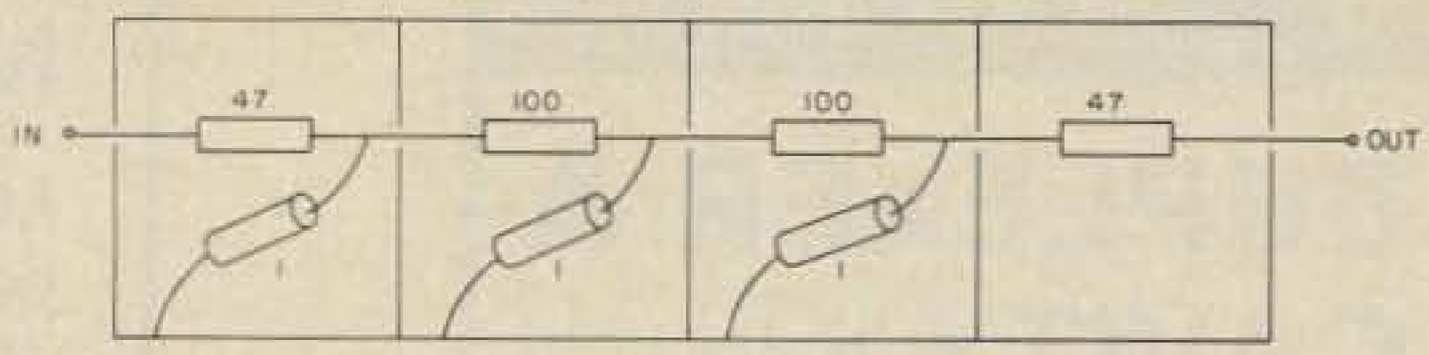

Fig. 3. Attenuator must be separately shielded. The output connector should be mounted on the attenuator shield.

done to avoid leakage signal paths.

Fig. 1 shows a typical oscillator circuit which can be used and, by proper adjustment of the components, will work from 20 to 6 meters. It is crystal-controlled for simplicity, and the typical component values for 10 meters are shown. Note that the crystal does not have to have any particular frequency, as long as it falls within the band of interest, so advantage can be taken of the various surplus or odd-frequency crystals available at low prices from such outlets as JAN crystals. The output is about ½ volt across 50 Ohms, although this will depend on crystal activity and circuit tuning. The resistor attenuator network shown will bring the output down to about 1 microvolt across 50 Ohms. The output of the oscillator has to be verified in some manner. The best is, of course, to measure it directly if good instrumentation is available. An alternative is to construct the generator and see what response the entire unit provides on a receiver that is known to be in good shape. After all, the main purpose of the instrument is to provide a quick, relative indication that a receiver has not lost sensitivity. If it can be accurately calibrated as to output it could be used to make direct sensitivity measurements on a receiver in conjunction with a VOM to check audio level changes, in dB, with and without the test signal being applied. A simple LED circuit is included both to indicate that the generator is on and to approximately indicate a low battery voltage condition. The pot in series with the LED is adjusted so the lens of the LED is just barely fully illuminated. The difference between this point and no noticeable illumination of the LED is .15 to .2 volts for a typical LED. So, it can serve as a battery voltage indicator better than even a cheap meter.

Other crystal oscillator circuits can be used. K1CLL in the August 72 issue of *73* describes in detail a very good oscillator which, among other things, features a simple variable output level scheme by means by varying the emitter bias. For those who do not prefer to make their own oscillator, the International Crystal OX oscillator kits are very suitable. They cost only $3 with a tuned output circuit. The Lo kit takes crystals from 3 to 20 MHz and the Hi kit covers 20 to 60 MHz.

Simple VFOs can be used as the oscillator element but here, of course, the problem is that their output will vary with frequency. Nonetheless, if their output variations can be measured, there is no reason not to use them. For the purpose at hand, ultra frequency stability is not needed, so very simple circuits can be used. Fig. 2, for instance, is about as simple a VFO circuit as can be desired. The frequency of oscillation is determined by the single LC combination. By choosing combinations which resonate in the various amateur bands, the circuit will work down to at least 2 meters. Leads should be kept short and the oscillator enclosed in a metal enclosure to avoid hand capacity effects.

The attenuator network was shown in Fig. 1. Its construction is not critical, but it must be separately shielded even if the oscillator is enclosed in a metal enclosure. The easiest way to do this is by constructing it within a divided enclosure as shown in Fig. 3. The enclosure can be of brass sheet, available at many hobby shops, or of copper sheet, or even of sheeting salvaged from old tin cans. The only objective is to completely "button up" the attenuator network so signal leakage does not occur around it to the output jack of the oscillator.

The unit described has been kept as simple as possible. There are various ways to embellish it, if desired. For instance, three output attenuator networks with different attenuation characteristics might be built: one as a microvolt output, one as an S9 output (usually taken as 30 microvolts), and one as a 40 dB over S9 output. ■

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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 $1.25 PER ASST.

ASST. 1	5 ea.	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	1/4 WATT 5% — 50 PCS.
ASST. 2	5 ea.	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	1/4 WATT 5% — 50 PCS.
ASST. 3	5 ea.	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	1/4 WATT 5% — 50 PCS.
ASST. 4	5 ea.	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	1/4 WATT 5% — 50 PCS.
ASST. 5	5 ea.	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	1/4 WATT 5% — 50 PCS.
ASST. 6	5 ea.	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	1/4 WATT 5% — 50 PCS.
ASST. 7	5 ea.	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	1/4 WATT 5% — 50 PCS.

ALL OTHER RESISTORS FROM 2.2 OHMS — 5.6M AVAILABLE IN MULTIPLES OF 5 ea. 5-25 PCS .05 ea. 30-95 PCS .04 ea. 100-495 PCS .03 ea. 500-995 .0275 ea.

14 PCS. POTENTIOMETER ASSORTMENTS

ASST. A 2 ea: 10 OHM-20 OHM-50 OHM-100 OHM-200 OHM-250 OHM-500 OHM
ASST. B 2 ea: 1K, 2K, 5K, 10K, 20K, 20K, 50K
ASST. C 2 ea: 50K, 100K, 200K, 250K, 500K, 1M, 2M

$9.95 Per Asst.

Each assortment contains 14 pcs of 10 turn pots. All pots are available in single unit quantities. $.99 ea.

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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

MINIATURE TOGGLE

DPDT				JMT	1	2-9	10-25	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	2.35	1.95	1.43	1.30
	ON	NONE	ON	122	2.05	1.85	1.21	1.10

PUSH BUTTON

SPDT — SERIES PB, PB1

	Model Number	1 Each	2-9	10-29	30-99
Maintained Action Switch. Push To Make Contact And Push Again To Reverse Action	PB-123	$2.35	$1.95	$1.47	$1.30
Momentary Action Switch. Normally Open or Normally Closed	PB-126	$2.35	$1.95	$1.47	$1.30

Quantity net prices
3 AMP RATINGS

THUMBWHEEL SWITCHES

ACCESSORIES

8 POSITION ROTARY SWITCH 2 FOR $1.00

These switches are a 7 position, one position open, rotary switch enclosed in a TO-5 can. They have a standard 8 pin configuration and will mount perfectly on printed circuit board.

ZENERS—DIODES—RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
IN746	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
1N965B	15	400m	4/1.00	1N4154	35	10m	12/1.00
1N5232	5.6	500m	.28	1N4734	5.6	1w	.28
1N5234	6.2	500m	.28	1N4735	6.2	1w	.28
1N5235	6.8	500m	.28	1N4736	6.8	1w	.28
1N5236	7.5	500m	.28	1N4738	8.2	1w	.28
1N456	25	40m	6/1.00	1N4742	12	1w	.28
1N458	150	7m	6/1.00	1N4744	15	1w	.28
1N485A	180	10m	5/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1186	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				

TRANSISTORS

MPS A05	5/$1.00	PN3567	3/$1.00	PN4249	4/$1.00
MPS A06	5/$1.00	PN3568	4/$1.00	PN4250	4/$1.00
2N2219A	3/$1.00	PN3569	4/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	2N3704	5/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00	2N3705	5/$1.00	2N4402	4/$1.00
2N2369	5/$1.00	2N3706	5/$1.00	2N4403	4/$1.00
2N2369A	4/$1.00	2N3707	5/$1.00	2N4409	5/$1.00
PN2415	5/$1.00	2N3711	5/$1.00	2N5086	4/$1.00
2N2484	4/$1.00	2N3724	$.65	2N5087	4/$1.00
2N2906A	4/$1.00	2N3725	$1.00	2N5088	4/$1.00
2N2907A	5/$1.00	2N3903	5/$1.00	2N5089	4/$1.00
2N2925	5/$1.00	2N3904	4/$1.00	2N5129	5/$1.00
2N3053	2/$1.00	2N3905	4/$1.00	2N5138	5/$1.00
2N3055	$.89	2N3906	4/$1.00	2N5139	5/$1.00
MJE3055	$1.00	2N4013	3/$1.00	2N5209	5/$1.00
MJE2955	$1.25	2N4014	3/$1.00	2N5951	5/$1.00
2N3392	5/$1.00			C106B1SCR	2/$1.00
2N3398	5/$1.00			2N6432	$2.00

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	.25

C&S MARKETING ASSOCIATES

If you are PLANNING TO PURCHASE A NEW TRANSCEIVER, why not GET THE BEST? You should give serious consideration to the new Hy-Gain 3750 Transceiver. With it you can expect superior performance that will surpass the demands of even the most experienced amateur.

The advantages of the new 3750 are many. For starters, more operating frequencies to choose from means more operating fun for the serious radio amateur. With 160 meters fast becoming the favorite of more operators each day, the addition of this band to your shack can only add to your enjoyment of your favorite hobby. Not only more frequencies, but also the greater accuracy of the digital readout make operating the 3750 a real pleasure. With readout to 100 Hz and WWV receive for calibration, you always know exactly where you are. As an added bonus, there is also a memory circuit which will allow you to return to an interesting spot on the band without writing down the frequency. With the optional 3855 VFO you can split TX/RX frequencies for operating DX. The 3855 also has provision for adding up to seven crystal controlled channels.

The 3750 is a pleasure to operate, but it is a dream to listen to. You will never again be annoyed by the roar of a cooling fan. The three tubes are cooled by a fan that is not only whisper quiet, but is also standard equipment. And, you can forget about image and spurious response problems thanks to the narrow band SSB crystal filter in the first i-f. Intermodulation and cross modulation performance are enhanced through the use of dual-gate MOS FETs at all critical rf amplifier and mixer stages. To help cut down the strength of the OM using the California kW, a handy rf attenuator is included. For CW operators, the selectivity is -6 dB @ 400 Hz and -66 dB @ 1.8 kHz.

The same high standard of performance is found in the Transmitter section! Average power output is kept at a high level through the use of an audio compression circuit and automatic level control. The microphone compression circuit gives 20 dB of audio compression and the ALC provides an additional 20 dB to prevent "flat topping" and transmitted adjacent channel splatter. To help reduce the QRN from the neighbors over the subject of TVI, a low pass filter is included in the output state. Speaking of the output stage, it uses two specially developed S-2002 tubes for high peak power output with maximum plate dissipation characteristics. The VFO section of the 3750 delivers an exceptionally stable signal. Drift is less than 500 Hz from turn-on to 10 minutes and less than 100 Hz after a 30 minute warm-up.

Other features include a noise blanker, VOX, and side-tone circuits. All stages have been by-passed and tightly sealed to improve performance and reduce internally generated "birdies" to the minimum possible.

The advanced features of the HY-GAIN 3750 make it quiet a bargain at only $1895.00. For more information, or to place an order, call TOLL FREE 800-251-6771. In Tennessee, call 800-262-6706. Master Charge and BankAmericard are welcome.

C&S MARKETING ASSOCIATES

P.O. Box 165
Algood TN 38501
Call Toll Free 800-251-6771
In Tennessee call 800-262-6706

Social Events

EL PASO TX
SEPT 4-5

The ARRL Hamfest will be held September 4-5 at the elegant Vista Motor Inn. Seminars, solar power, exotic modes, OSCAR and flea-market. Write PO Box 24050, El Paso TX 79914. Visit us on Labor Day weekend!

YORK PA
SEPT 5

The 21st Annual York County Hamfest will be held September 5th, rain or shine, 10 miles west of York PA; ½ mile west of York Airport, turn south off Rt 30 to Elickers Grove. Registration begins at 9 am – fee $3.00. All adults and amateurs are expected to register, XYLs and children free. A limited number of flea market tables are available inside by advance reservations *only*. Contact hamfest committee. There will be a $5.00 charge for using electric power. Talk-in 146.04-64; 28-88; 52-52. For more information write or phone Leroy Frey K3POR, 170 S. Albemarle St., York PA 17402, phone 854-1203.

DANVILLE IL
SEPT 5

The Danville Hamfest will be held at Douglas Park, Danville, Illinois September 5. Downstate Illinois' largest. Great prizes. Advance tickets $1.75 ea., 3/$5 with an SASE to Jim Wilson, 308 First, Ridgefarm IL 61870. Talk-in 22/82 and 3910.

BOSTON MA
SEPT 10-12

This year's big New England ARRL Convention has moved back to Boston and will be held September 10, 11 and 12 at the Statler Hilton Hotel. Featuring a bicentennial theme, the convention will cater to the whole ham family, with many committee wives in authentic period costumes helping direct the dozens of special bicentennial events featured in Boston for 1976. The city is extending the welcome mat with special features and exhibits that can only be seen during 1976.

Friday's activities are informal and will enable the ham to relax and "do his or her own thing." They include an FM hospitality suite and a square dance. Saturday and Sunday are crammed with activities from dawn to dusk. FCC exams for General, Advanced and Extra will be given Saturday – by appointment *only*. Application must be made three weeks in advance on FCC form 610 (available from the Boston office of the FCC), accompanied by a check made payable to the FCC for $4. Both check and form 610 must then be sent to Exam Chairman Michael Goldberg K1LJN, 40 Isabella St., Melrose MA 02176 – *not to the FCC*. Applicants will be notified by mail of their exam time.

The New England convention this year will have an emphasis on computer technology and how it affects ham radio. There will be a formal computer seminar on Friday and Saturday, a running computer display by DEC, and forums on computer technology. The FCC will have a booth at the show, along with leading manufacturers and distributors of ham gear. A banquet, show and dinner dance will feature the presentation of the Ham of the Year award on Saturday night.

Special YL activities include a bicentennial fashion show featuring period costumes, a hospitality suite, and a bus tour of historic Boston (OMs welcome too!). A duplicate bridge tournament will also be a new feature this year.

The extensive speakers' program will feature top personalities, antenna experts such as Walter Maxwell W2DU of RCA, Jerry Sevick W2FMI of Bell Labs, inventor of the strobe light, Harold Edgerton of MIT with Loch Ness monster(!) films, SSTV and computer designer Robert Suding WØLMD, plus special guest speakers on 2 meter FM, DX, SSTV, MARS, an FCC forum, and of course the ARRL forum. There will be talks on solid state, a special program by Fr. Daniel Linehan W1HWK director of the Weston Observatory, net meetings, etc.

One of the most popular events is the flea market — this year it will be indoors, so weather will not dampen the spirits or the equipment!

Early birds can register for $3 (required of all OMs 12 and over); at the door it's $4. Banquet tickets including show and dancing are $12. Send check made payable to F.E.M.A.R.A. and SASE to ticket chairman George Stewart W1ZQQ, 17 Barnes Avenue, East Boston MA 02128, before September 1st.

BEREA OH
SEPT 11

The '76 Cleveland Hamfest presented by the Cleveland Hamfest Association will be held Saturday, September 11 at 8 am to 6 pm at the Cuyahoga County Fairgrounds, Berea, Ohio. Eastland Road entrance only to County Fairgrounds with easy access from Hopkins Airport, Interstate I-71, I-90 or Ohio Turnpike. Tickets $1.50 before August 31; $2.00 at 0800 for all 12 or over when gates open. Asphalt quad flea market parking $1 additional per space at 0700. Bring your own tables and shade. Registration: $1.50 tickets by mail before August 31 with check or money order to: Cleveland Hamfest Association, P.O. Box 43413, Cleveland, Ohio 44143.

MENA AR
SEPT 11-12

The Queen Wilhelmina Hamfest 1976 is Saturday and Sunday, September 11 and 12, at Queen Wilhelmina State Park, Rich Mountain, Mena, Arkansas. Excellent accommodations and food at the newly restored historic Queen Wilhelmina Castle. Door prizes hourly, grand prize, new equipment displays, flea market, camping area with utilities and rest rooms, amusements for harmonics. Talk-in 146.52. For more information write WB5CXX, P.O. Box 5191, Texarkana TX or phone (214) 838-0625.

MELBOURNE FL
SEPT 11-12

The 11th annual Melbourne, Florida hamfest will be held Saturday and Sunday, September 11-12, 1976, from 9 am to 5 pm each day in the air conditioned Melbourne Civic Auditorium located on Hibiscus Boulevard. Donation is $2.50 per adult. Full program includes forums, meetings, auction, swap tables, commercial exhibits, awards, prizes, etc. Talk-in on 25/85 and 52/52. Sponsored by Platinum Coast Amateur Radio Society. For more info write PO Box 1004, Melbourne FL 32901.

FCC exams in Ramada Inn Saturday at 8 am for General, Advanced, and Extra. Form 610 and $4 fee must be filed with FCC, Room 919, 51 S.W. First Avenue, Miami, no later than August 31, 1976.

WICHITA KS
SEPT 12

The Wichita Amateur Radio Club Hamfest will be held on September 12, 1976. Registration begins at 8 am at Edgemoore Park (9th & Edgemoore), Wichita KS. Flea market, door prizes, food and beverages on site. Speaker from ARRL Board of Directors. Practice hamfest on evening of Sept 11 at Heritage House in Wichita. Talk-in on 34/94 and 3920 MHz.

Contact KØCFM for further information.

MALAGA NJ
SEPT 12

The South Jersey Radio Assn. 28th Annual Hamfest will be held September 12, 1976, 10 to 5 pm, at Molia Farms, Malaga, New Jersey. Lake, picnic grounds and food available. Tailgate sales, swap shop and door prices. Family tickets: advance sales – $2.50, gate sales – $3.50. Advance sales send SASE to Jack Koch, Box 103, Cherry Hill NJ 08002. Talk-in 146.52.

FINDLAY OH
SEPT 12

The 34th Annual Findlay Hamfest will be held on Sept. 12 at Riverside Park, Findlay, Ohio. Talk-in 146.52. For advanced tickets and/or info write: Clark Foltz W8UN, 122 W. Hobart St., Findlay, Ohio 45840. Please send SASE with request for fewer than 5 tickets.

HAMBURG NY
SEPT 18

The Hamburg International Hamfest will be held September 18, 1976 at the Erie County Fairgrounds in Hamburg, New York. Directions: Take the New York State Thruway to the Blasdell Exit (Exit 56). Recreational vehicles will turn right on Mile Strip Road and turn left on Route 62 South (first major intersection). Follow the signs to the Erie County Fairgrounds entrance. All other vehicles turn left on Mile Strip Road and turn right on McKinley Parkway (first major intersection). Hamfest will include giant flea market, technical forums, picnic facilities, excellent programs, non-amateur displays, code contest, women's programs, organization meetings, equipment displays and FM hospitality room, and thousands of dollars in awards. Admission: $3 at gate, $2.50 in advance. $1 for flea market parking. Children under 12 admitted free. Talk-in stations will be on the WR2ABU repeater (146.31 in, 146.91 out), 146.52 simplex, 7.255 (ECARS), and 3.925. For more information contact Bert Jones W2CUU, 143 Orchard Drive, Kenmore NY 14223, tel. 716-873-3984.

CHICAGO IL
SEPT 18-19

Radio Expo '76 will be held Saturday, Sept. 18 and Sunday, Sept. 19th at the Lake County, Illinois, Fairgrounds, Routes 45 and 120 north of Chicago. Featured this year are an exhibit hall with dozens of displays by amateur manufacturers and distributors, forums with the FCC's John Johnston, *73*'s Wayne Green, ARRL, OSCAR and more. There's a giant flea market with both indoor and outdoor space, plus plenty of room for campers and trailers on the grounds. No waiting in line – the flea market opens Friday night for set-up. No extra charge, either. Talk-in on WR9ABY, 146.16/76, Chicago. Accommodations reserved at the Holiday Inn in Mundeline, Ill., a few minutes south of the fairgrounds. Mention Radio Expo. Advance tickets, $1.50 from Box 1014, Arlington Heights, Ill. 60006.

MADISON WI
SEPT 19

The 4th Annual Madison Swapfest sponsored by Madison Area Repeater Association will be held at Dane Co. Expo Center Youth Building, rain or shine, Sunday, September 19. Doors open at 8 am. All-you-can-eat pancake breakfast, free old-time movies all day long, and lots of prizes. Advance tickets & tables $1.50 – $2.00 at door (XYLs and kids free). Overnite trailer and camper accommodations available at swapfest site. Directions: next door to Dane Co. Coliseum. Just follow "Coliseum" Highway signs to Dane Co. Expo Center, approximately 6 miles west of I-90 and 12 and 18 interchange to "MC" exit. Then turn right on "MC." Coliseum and Sheraton Inn clearly visible ½ mile north of 12 & 18 & "MC" exit. Talk-in on 94. For advanced reservations: M.A.R.A., Box 3403, Madison WI 53704.

HARRISBURG PA
SEPT 19

Hamfest sponsored by the Central

Pennsylvania Repeater Association will be held on Sunday, September 19, 1976 at the Park-N-Shop Parking Garage, 200 Block Walnut Street, Harrisburg PA. Gates will open at 9 am. Registration: $3 per ham, XYLs free – no charge for tailgating. Food available. Note: no vehicle over 7 feet high will fit into the garage. Talk-in 146.16/.76 WR3ABV .94/.94. For more information contact W3ABF or WA3AVX.

MOUNT CLEMENS MI
SEPT 19

The Fourth Annual L'Anse Creuse ARC Swap & Shop will be held on September 19, 1976 at the L'Anse Creuse High School in Mount Clemens, Michigan. Doors will be open from 0900 to 1500 EDST. First prize $200 cash. Talk-in on 146.52 and 146.94. Admission $1.50 at door, $1 in advance. For tickets enclose $1 and SASE and send to Robert Harder WB8ILI, 51769 Base, New Baltimore MI 48047.

NEW KENSINGTON PA
SEPT 19

The Skyview Radio Society's Swap & Shop will be held on Sept. 19, 1976 at the Skyview Radio Club, New Kensington PA. Registration $1. Talk-in 52-52 and 04-64.

McLEAN VA
SEPT 25-26

The National Capitol DX Association (NCDXA) and the Amateur Radio Research and Development Corporation (AMRAD) are teaming together to provide a DXciting weekend – DXPO 76. The 1976 ARRL DX Technical Symposium will present a comprehensive technical session geared to the DXer. Contact Paul Rinaldo K4YKB, 1524 Springvale Avenue, McLean, Virginia 22101 for details. It will be held at the newly constructed Ramada Inn at Tysons Corner near McLean, Virginia. Easy access from Interstate 495 (Capitol Beltway).

NEW BERLIN IL
SEPT 26

The Sangamon Valley Radio Club Hamfest will be held September 26 at the Sangamon County Fairgrounds, New Berlin, Illinois, twelve miles west of Springfield (Illinois state capital) on Route 36. There will be food, programs, covered pavilion, and nearby camping. See Lincoln shrines. Talk-in 28/88 AF9AFA. Tickets $1.00. Write: K9HDZ, 622 Magnolia, Rochester, Illinois.

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.

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 are $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.

VIENNA VA
OCT 24

The AMRAD COMPUTERFEST will be an exposition of microcomputers for computer amateurs, radio amateurs and the general public. It is being sponsored by the Amateur Radio Research and Development Corporation (AMRAD), a non-profit scientific and educational organization.

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.

The exposition will be almost entirely devoted to small computers of the type suitable for home use. There will be displays of microcomputer systems by various manufacturers' representatives as well as tables for used or surplus equipment, circuit boards and parts. Peripheral devices including video terminals, teletypewriters and RTTY equipment will be shown. Forums will run throughout the day on subjects of interest to the serious hobbyist, students, and the general public. There will also be an opportunity to talk to representatives of various computer clubs and magazines.

Admission will be $4.00 at the door ($3.50 advance registration by mail for pickup at the door). Make checks payable to AMRAD. Write: COMPUTERFEST, P.O. Box 682, McLean VA 22101.

For reservations, contact any of these nearby motels directly: Vienna Wolf Trap Motel, 430 Maple Ave E, Vienna VA 22180, (703) 281-2330; Tysons Corner Holiday Inn, 1960 Chain Bridge Rd, McLean VA 22101, (703) 893-2100; or Tysons Corner Ramada Inn, 7801 Leesburg Pike, Falls Church VA 22043, (703) 893-1340.

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.

Tracking the Hamburglar

RUSTLED: TR22-C s/n 120816. Contact Glenn Packard K3ZOT, 836 Mason Avenue, Drexel Hill PA 19026.

TAKEN: Icom IC22A s/n 3402547. Contact Steve Bauer, PO Box 162, Goleta CA 93017.

HIJACKED: Drake TR-72 2 meter FM and locked bracket s/n 750228. Stolen from car in Arvada, Colorado on June 18, 1976. Contact Ron Bradley WBØOES, Arvada, Colorado, 303-421-3549.

ROBBED: Regency HR2 s/n 04-04279, ssn 313-40-1690 on inside frame. $50 reward. Contact Bob Walker W4LPU, 4713 N.W. 3rd Ct., Plantation FL 33317, 305-792-7015.

NEW!
FM144-10SXR-II

All Solid State-PLL digital synthesized — No Crystals to buy! 5KHz steps — 144-148 MHz-LED digital readout.

Introducing the standard of comparison for years to come. No other unit begins to compare with the superb engineering and superior commercial avionics grade quality and construction of the FM144-10SXR-II

FM144-10SXR-11

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VALUE $599.00

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Regulated AC/PS
MODEL FMPS-4R . . . $49.00
NEW! Touch-Tone Pad $59.00

- **FREQUENCY RANGE:** Receive: 144.00 to 148.995 MHz, 5KHz steps (1000 channels). Transmit: 146.00 to 147.995 MHz, 5KHz steps (400 channels).
- **FULL DIGITAL READOUT:** Six easy to read LED digits provide direct frequency readout assuring accurate and simple selection of operating frequency.
- **AIRCRAFT TYPE FREQUENCY SELECTOR:** Large and small coaxially mounted knobs select 100KHz and 10KHz steps respectively. Switches click-stopped with a home position facilitate frequency changing without need to view LED'S while driving and provides the sightless amateur with full Braille dial as standard equipment.
- **FULL AUTOMATIC TUNING OF RECEIVER FRONT END:** DC output of PLL fed to varactor diodes in all front end R-F tuned circuits provides full sensitivity and optimum intermodulation rejection over the entire band. **No other amateur unit at any price** has this feature which is found in only the most sophisticated and expensive aircraft and commercial transceivers.
- **TRUE FM:** Not phase modulation – for superb emphasized hi-fi audio quality second to none.
- **FULLY REGULATED INTEGRAL POWER SUPPLIES:** Operating voltage for all circuits, i.e., 12v, 9v and 5v have independently regulated supplies. 12v regulator effective in keeping engine alternator noises out and protects final transistor from overload.
- **MONITOR LAMPS:** 2 LED'S on front panel indicate (1) incoming signal-channel busy, and (2) un-lock condition of phase locked loop.
- **DUPLEX FREQUENCY OFFSET:** 600KHz **plus** or **minus**, 5KHz steps. Plus simplex, any frequency.
- **MODULAR COMMERCIAL GRADE CONSTRUCTION:** 6 unitized modules eliminate stray coupling and facilitate ease of maintenance.
- **ACCESSORY SOCKET:** Fully wired for touch-tone, phone patch, and other accessories.
- **RECEIVE:** .25 uv sensitivity. **9 pole filter** as well as monolithic crystal filter and **automatic tuned** LC circuits provide superior skirt selectivity.
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- **HIGH/LOW POWER OUTPUT:** 15 watts and 1 watt, switch selected. Low power may be adjusted anywhere between 1 watt and 15 watts.
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- **OTHER FEATURES:**
  Dynamic microphone, mobile mount, external speaker jack, and much, much, more. Size: 2⅛ x 6½ x 7½. All cords, plugs, fuses, mobile mount, microphone hanger, etc., included. Built in speaker.

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Repeat of a sellout! A $30 item, made by ECC famous for semiconductors, designed and built this speed control for XEROX. Controls home, shop and industrial lighting too. Rated at 1200 watts. A very elaborate circuit for controlling many electrical and electronic devices. Easily controls speeds of electric drills, brush type motors, etc. Built with heavy duty aluminum framing. Complete with external 50K pot, for variable speed control, and series resistor. Heavy duty colored wires for 115VAC 60 cycles, and item to be controlled. 10/32 mounting stud. Outperforms our previous sellout. With hookup diagram. Use as temperature controller too. Wt. 2 lbs. **Cat. No.10A3392**

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- Uses Encoder MOS ROM
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- **Double sided PC board**

Outputs — standard ASCII 7 bits plus strobe

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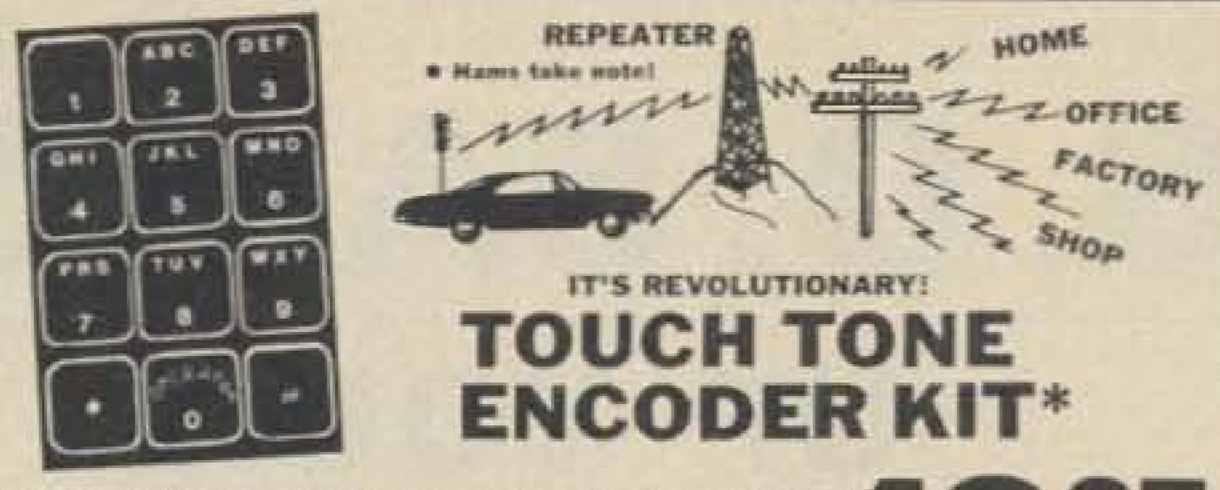

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☐ SN7403	.22	.23	☐ SN74125	1.29	1.30
☐ SN7404	.24	.25	☐ SN74126	1.29	1.30
☐ SN7406	.36	.37	☐ SN74132	1.95	1.96
☐ SN7407	.46	.47	☐ SN74141	1.12	1.13
☐ SN7408	.22	.23	☐ SN74145	1.69	1.70
☐ SN7409	.52	.53	☐ SN74148	3.25	3.26
☐ SN7410	.22	.23	☐ SN74150	1.12	1.13
☐ SN7411	.27	.28	☐ SN74153	1.10	1.11
☐ SN7417	.62	.63	☐ SN74154	1.53	1.54
☐ SN7420	.22	.23	☐ SN74157	1.09	1.10
☐ SN7421	.55	.56	☐ SN74158	1.55	1.56
☐ SN7423	.47	.48	☐ SN74160	1.59	1.60
☐ SN7425	.37	.38	☐ SN74163	1.50	1.51
☐ SN7430	.22	.23	☐ SN74164	1.79	1.80
☐ SN7432	.36	.37	☐ SN74165	1.79	1.80
☐ SN7440	.22	.23	☐ SN74173	1.69	1.70
☐ SN7442	.97	.98	☐ SN74174	1.42	1.43
☐ SN7445	.97	.98	☐ SN74175	1.45	1.46
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60 HZ CRYSTAL TIME BASE – FOR DIGITAL CLOCKS S. D. SALES EXCLUSIVE!

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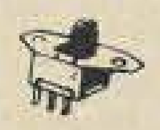

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JUNE 63. Surplus Issue: DMO-2 Beacon Tx on 220, increasing ARC-2 transceiver selectivity, PE-97A pwr supply conversion, BC-348 band-spread, inductance tester, converting BC-230 tx, beginner's rx using BC-453, recvr motor-tuning, transistor cw monitor, 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, $5 Vertical, filament xformer construction, 2M nuvistor converter, Lafayette HE-35 mods, Buyer's Guide to Rx & Tx, product detector, novel Hi-C VFO, radio astronomy, panadaptor "if" converter, compact mike amp.

FEB 64. 2M multichannel exciter, rx design ideas, majic t/r switch, loudspeaker enclosures, 40M 2W tx, look at test equipment, radio grounds, 40M ZL Special ant, neutralization.

MAY 67. Quad Issue: 432 Quad-quad-quad, expanded HF quad, Two el quad, miniquad, 40M quad, quad experiments, half-quad, three el quad, 20M quad, tiltover quad, easy-to-erect quad, Quad Bibliography, FET vfo, tube troubleshooting, HF dummy load, understanding "dB," HF SSB/cw rx, geometric circuit design, GSB-201 transceive, FET converter for 10-20M, hi-pass rx filters.

JULY 67. VE ham radio, VEØ hams, dsb adaptor, home brew tower, transistor design, '39 World's Fair, gnd plane ant, G4ZU beam, SSTV monitor, UHF FET preamps, IC "if" strip, vertical ant, VHF/UHF dipper, tower hints, scope monitoring, operating desk, S-Line crossband, hi-school ham club, Heath HR-10 mods.

OCT 67. HF solid state rx, rugged rotator, designing slug-tuned coils, FET converter, SSTV pix gen, VHF log-periodicals, 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 trouble-shooting, 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 wavemeter.

SEPT 71. Transformerless power supplies, solid state tv camera, IC substitution, two rf wattmeters, IC compressor-agc, multichannel HT-200, ham facsimile (part 2), causes of manmade noise, vfo with tracking mixer, general class study (part 12), transistor heat-sinking, IC pulse gen, fone-patch isolation, hcd wattmeters.

OCT 71. Emergency repeater cor, transceiver power supply, predicting meteor showers, digi switching, reverse-current battery charger, passive repeaters, earth grounds, audio "tailoring" filters, Swan 350 mods.

NOV 71. 3-el 75M beam, motor-tuned gnd-plane, 2M gain vertical, transistor biasing, split-site repeater, fox-hunting, audio filter, transistor/diode tester, xtal tester, 6M kw amp, 10-15-20M quad, transistor pi-net final, ant feedline, communications dbs, 2300 MHz exciter.

AUG 72. SSTV intro, speech processor, fm repeater info, test probe construction, GE progline ac supply, 432 rf testing, preamp-compressor, Six-er mods, fone patch, Two-er info, solar info, SCR regulator for HVPS, "ideal" xtal osc, fm rx adaptor, auto theft alarm.

SEPT 72. Plumbicon tv camera, WWVB 60 kHz rx, cigartube sig gen, cw active filter, rf testing at 1296-3500 GHz, balun ant feed, transistor power supply, IC 6M rx, IC fm/am detector (part 2), active filter design (part 3), K2OAW freq counter (part 3), 2M freq synthesizer (part 1).

OCT 72. Corrections for Aug. fm rx adaptor, 2M freq synthesizer (part 2), 6M transistor vfo, nano-ampere meter, time-freq measurement (part 1), active filter design (part 4), repeater timer, extra-class Q&A (part 3), balloon vertical, ID gen, time delay relay, 432 filter ideas, DC-AC inverter, hc-diode converter, rtl decade and nixie driver, plus-minus supply for ICs.

NOV 72. Hf transistor power amps, RTTY selcal, IC trf rx, transistor keyer, emergency power, 220 MHz preamp, double-delta ant, simple converter using modules, hf RF tester, "lumped line" osc, 2M freq synthesizer (part 3), K2OAW counter errata, 2M preamp, extra class Q&A (part 4), hi-Z voltmeter, Nikola Tesla story, vhf swr meter, transistor regen rx, 432 SSB transverter, AC arc welder, intro to computers, hybrid am modulator, HR10 rx mods, 10M transistor am tx, 40M gndplane, IC logic demonstrator, overload protection, if/rf sweep generator, digi freq counter, aural tx tuning.

DEC 72. SSTV scope analyzer, 2M fm rx, tone burst encoder and decoder, universal if amp, autopatch hookup, LM380N info, voltage variable cap info, 2M 18 watt amp, SSB modulation monitor, xtal freq/activity meter, 10A var. dc supply, transmission line uses, radio astronomy, inductance meter, 75 to 20M transverter, LED info, 40M preamp, transistor vfo, 1972 index, 2M preamp.

JAN 73. HT-220 touchtone, 3-el 20M Vagi, 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 resonator design, sensitive rf voltmeter, proximity control switch, IC tester, sequential tone decoder, 2M portable beam, electronic calculator math, cw filter design, FCC regs (part 7).

FEB 74. SSTV monitor info, IC audio amps, scope sweep gen, 15/20M vertical, telephone line control system, pc board construction, var-Q af filter, blown-fuse indicator, 40m cw stn with Ten-Tec modules, simple preamp-compressor, single-IC rx, "432-er" final assembly, transistor keying circuit, 7-segment readout with nixie driver.

APR 74. Vox for repeaters, tone-operated relay, hf transverter, 10-to-2m tx converter, remote control panel for scanner, RCA fm tx tuning, subaudible tone gen, FCC regs (part 9), Repeater Atlas.

MAY 74. Cd car ignition, audio compressor info, interference suppression for boats, auto burglar alarms, 2m ic preamp, 10m fet converter.

JULY 74. 4-1000A linear, universal freq gen, universal afsk gen, 555 IC timer, 80M phased array, 135 kHz-432 MHz preamps, 10M qrp am tx, 3000 vdc supply, how to read diagrams.

AUG 74. Toroidal directional wattmeters, 450 MHz FET preamp, use gdo to find "c", Trimline tt pad hookup, R390 & R392 rx mods, tracking cw filter, aural voltmeter, universal regulated supply, sstv scan converter, ttl logic problems, ID timer.

SEPT 74. MOSKEY electronic keyer (part 1), ex warning system, Heath 10-103 scope mods, qrp 6M am tx, rf speech clipper, audio noise limiter, wx satellite on SSTV monitor, universal IC tester, miniature rig construction, tower construction, infinite rf attenuator, electronic

(More)

photo-flash ideas, IC "select-o-ject."

OCT 74. Microtransistor circuits, synthesized HT-220 (part 1), repeater government, regulated 5 vdc supply, fm selcal, removeable mobile ants, Motorola metering, 2M vertical collinear, Motorola model code, 2M coaxial dipole, 1.6 MHz if strip, MOSKEY electronic keyer (part 2), carbon mike circuit, hi-power lo-pass filter, 6M preamp, 3-wire dipole, ATV sync gen, NCX-5 mods, mobile whip for apartment dwellers, sstv auto vertical trig.

NOV 74. K2OAW counter update, regulated 5 vdc supply, wind direction indicator, synthesized HT-220 (part 2), 20M 3-el beam, autopatch pad hookups, double-stub ant match, novice class instruction, digi swr meter (part 1), 6M converter (1.6 MHz if), "C-bridge," MOSKEY electronic keyer (part 3), Aug. sstv scan converter errata, repeater off-freq indicator.

DEC 74. Care of nicads, wind speed/direction indicator, wx satellite video converter, electronic keyer, hints for novices, unknown meter scales, SSTV tape ideas. TTL logic probe, public service band converter, tuned-diode test receivers, digi swr meter (part 2), telephone pole beam support, rhombic antennas, 1974 Index.

FEB 75. Heath HO-10 scope mod for SSTV, electronic keyer, digital satellite orbital timer, Oscar-7 operation, satellite orbital prediction, Heath SB-102 mods, comparing FM & AM, repeater engineering, Robot 80-A sstv camera mod, neutralizing Heath SB-110A, "Bounceless" IC switch, tape keyer for cw tx.

APR 75. $50 walky for 2M, 2M scanning synthesizer, 88 mH toroid info, 8-function repeater controller, nicad battery precautions, TR22C preamp, telephone attachment regs, Guide to 2M Hand-held Transceivers, 2M 7-el beam, basic telephone systems (part 1), 10 min ID timer, modified hf Hustler mobile ant for 2M, 15M quad modified for 20M, 2M collinear beam, R-11A surplus rx conversion, 5/16 wave 2M ant, Hallicrafters SX-111 rx mods, 160M cw tx.

AUG 75. 146/432 MHz Helical ants (part 2), 10 min ID timer, digi swr computer (part 1), debugging rf feedback, DVM byer's guide, wx satellite monitor, cmos "accu-keyer," pc board method, sweep-tube final precautions, compact multiband dipoles, small digital clock, accessory vfo for hf transceiver, modern non-Morse codes, multi-function gen, 2M scanning synthesizer errata, KP-202 walky charger, 10M multi-element beam.

SEPT 75. Calculating freq counter, wx satellite FAX system (part 1), IC millivoltmeter, three-button TT decoder, troubleshooting sstv pix, 40M dx ants, 146/432 MHz helical ants (conclusion), digi swr computer (conclusion), reed relay for cw bk-in, NE555 preset timer, power-failure alarm, portable qrp rig power unit, precision 10 vdc reference standard, 135 kHz if strip, telephone handsets with fm transceivers, Motorola T-44 tx mod for ATV, 0-60 MHz synthesizer (part 10, ham radio PR).

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.

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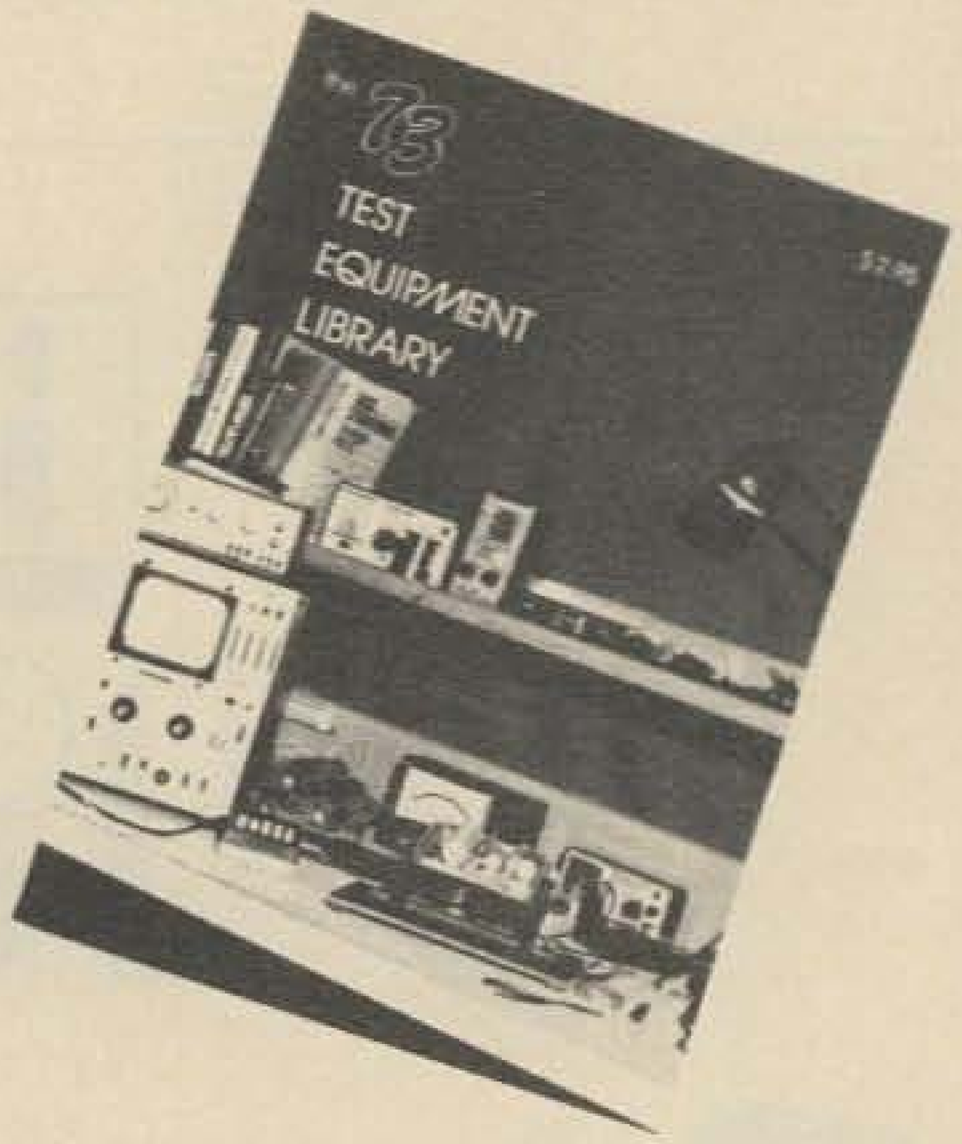

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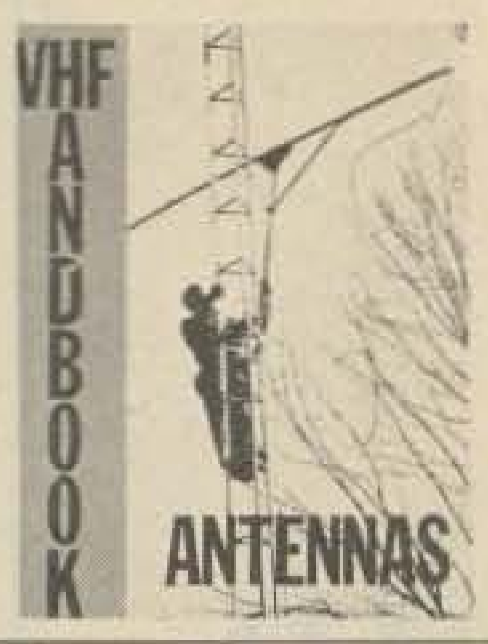

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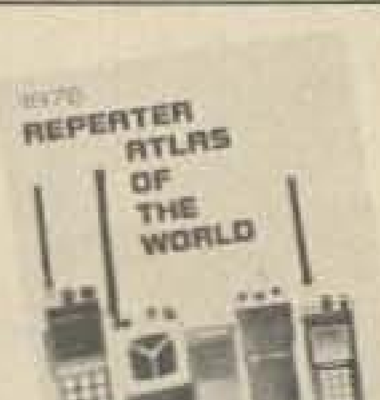

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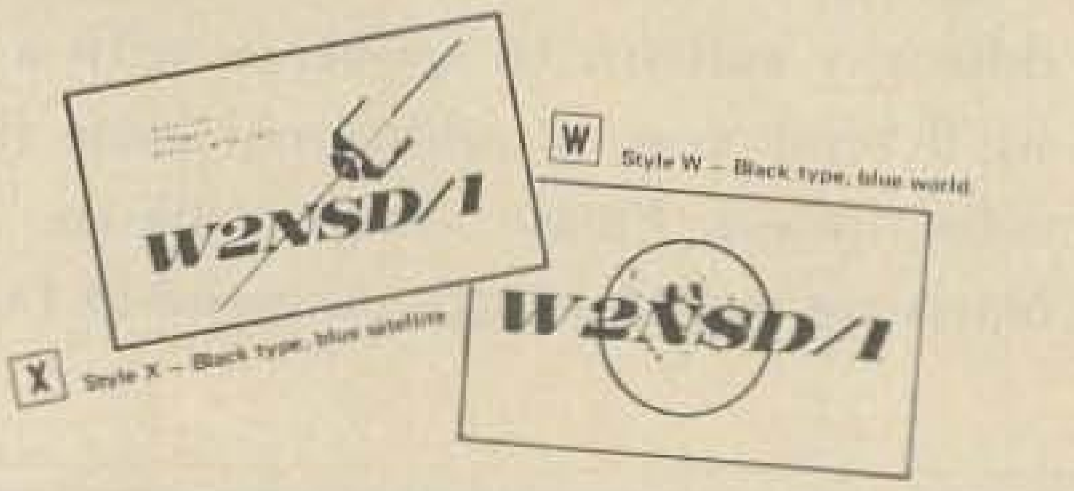

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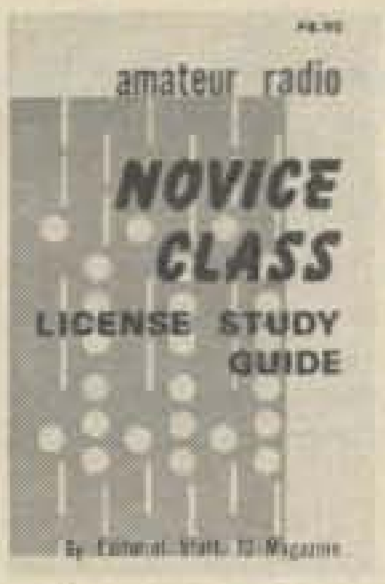

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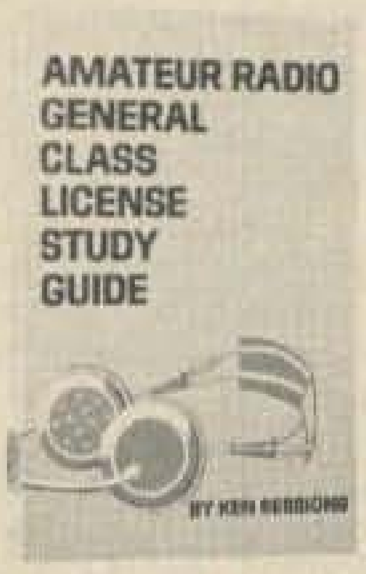

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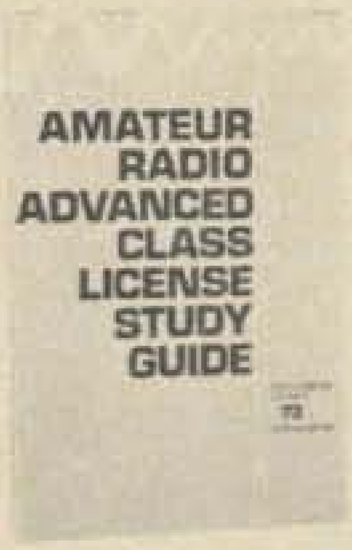

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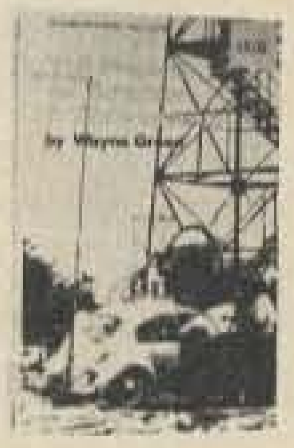

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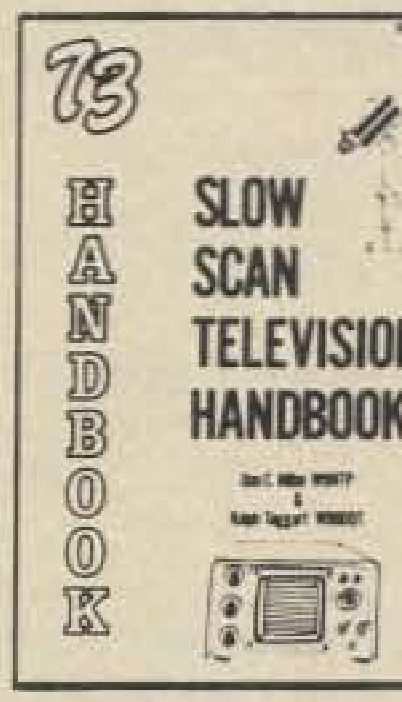

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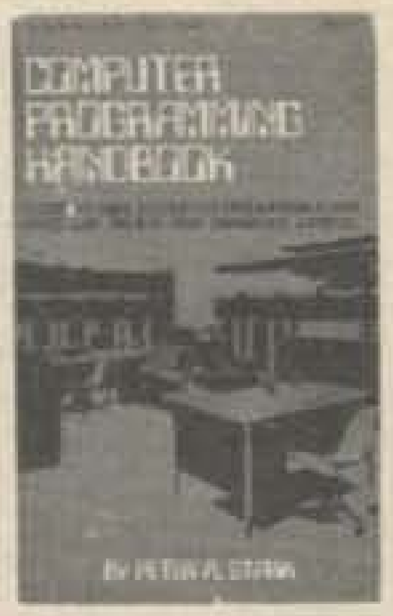

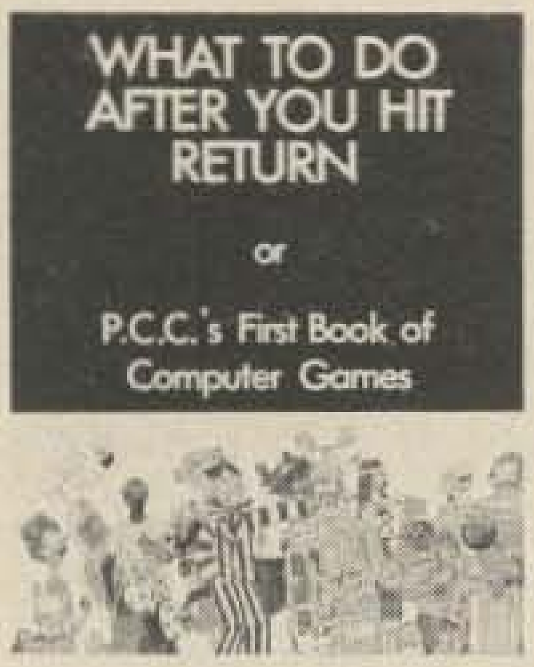

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AUSTRALIA	14	7B	7B	7B	7	7	7	14	14B	14B	14	14A
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JAPAN	14	7B	7B	7B	7	3	7	7	7	7B	7B	14
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U. S. S. R.	7	3	3	3	7	7B	14	14	14	14B	7B	7
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AUSTRALIA	14A	14	7B	7B	7	7	7	7	14B	14B	14	14A
CANAL ZONE	14	7	7	7	7	7	7	14	14	21	21	14
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PUERTO RICO	14	7	7	7	7	7	7A	14	14	14	14A	14
SOUTH AFRICA	7	7	7	7	7	7	7A	14	14	14A	14	14
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AUSTRALIA	14A	21	14	7B	7	7	7	7	7	14B	14	14A
CANAL ZONE	14	7A	7	7	7	7	7	14	14	14	21	21
ENGLAND	7B	7	3	3	3A	3	3B	7	14	14	14B	7B
HAWAII	21	14	14	7	7	7	7	7	7A	14	21	21
INDIA	7A	14	7B	7B	3B	3B	3B	7	7	7	7	7
JAPAN	14	14	14B	7B	3	3	3	7	7	7B	7A	14
MEXICO	14	7A	7	7	7	7	3	7A	14	14	14	14A
PHILIPPINES	14	14	7B	7B	3B	7B	7	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14	14A	14
SOUTH AFRICA	7A	7	7	7	7B	7B	7B	14B	14	14	14A	14
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EAST COAST	14	7	7	7	7	3	7	14	14	14	14	14A

A = Next higher frequency also may be useful
B = Difficult circuit this period
N = Normal
U = Unsettled
D = Disturbed

1976			OCTOBER			1976
SUN	MON	TUE	WED	THU	FRI	SAT
					1 U	2 U
3 U	4 D	5 D	6 U	7 U	8 U	9 D
10 U	11 N	12 N	13 N	14 U	15 U	16 U
17 D	18 U	19 N	20 N	21 N	22 N	23 U
24/31 N/N	25 N	26 N	27 N	28 U	29 N	30 N

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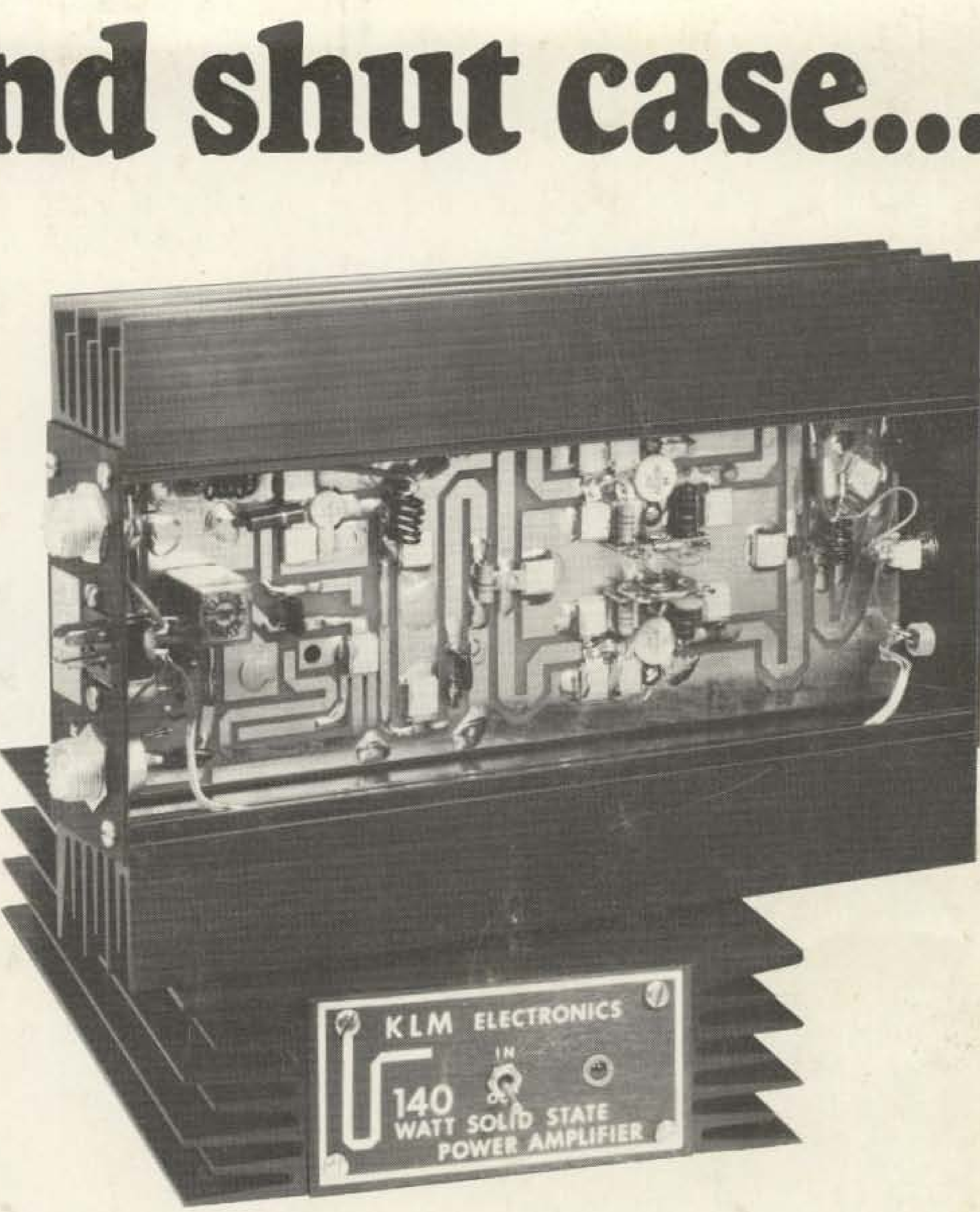

FREQ. (MHz)	MODEL NUMBER	PWR INP. (watts)	NOM. PWR OUTPUT (watts)	NOM. CUR. (amps.)†	SIZE	PRICE
144-148	PA2-12B	1-4	12	2	A*	44.95
"	PA2-70B	1-4	70	10	C*	149.95
"	PA2-70BL◇	1-4	70	10	C*	159.95
"	PA2-140B◇	1-4	140	20	D*	219.95
"	PA10-40B	5-15	40	5	B*	79.95
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"	PA10-70B	5-15	70	8	C*	129.95
"	PA10-70BL◇	5-15	70	8	C*	139.95
"	PA10-80BL◇	5-15	80	10	C*	149.95
"	PA10-140B	5-15	140	18	D*	189.95
"	PA10-140BL◇	5-15	140	18	D*	199.95
"	PA10-160BL◇	5-15	160	22	D*	209.95
"	PA30-140B	15-45	140	15	D*	169.95
"	PA30-140BL◇	15-45	140	15	D*	179.95
219-226	PA2-70BC	1-4	70	10	C*	169.95
"	PA10-60BC	5-15	60	8	C*	149.95
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SIZES: Inches: ***A.** 2.25×5×2. ***B.** 6.5×5×2. ***C.** 6.5×7.5×2. ***D.** 6.5×10×2.
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