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73 Magazine for Radio Amateurs

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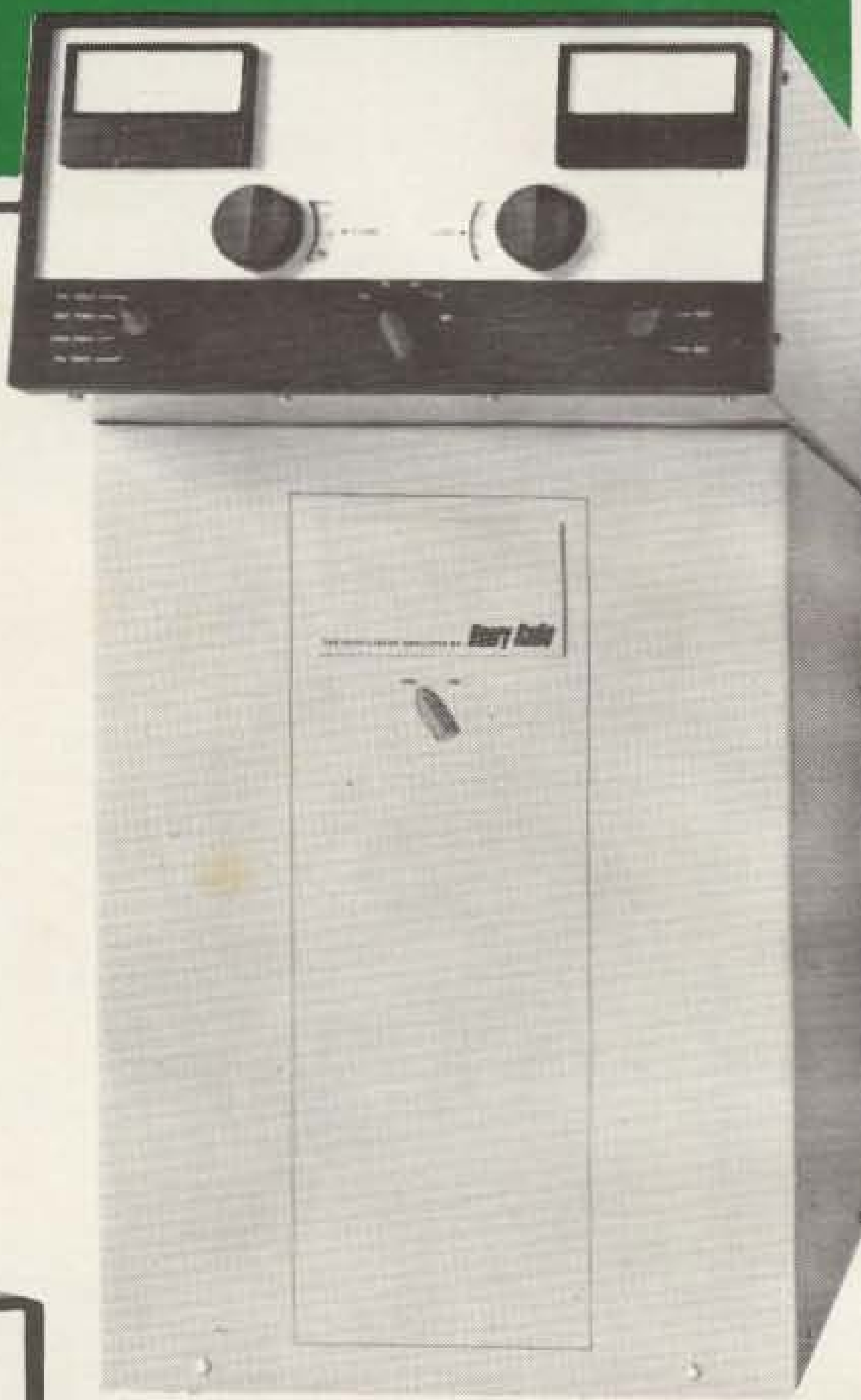

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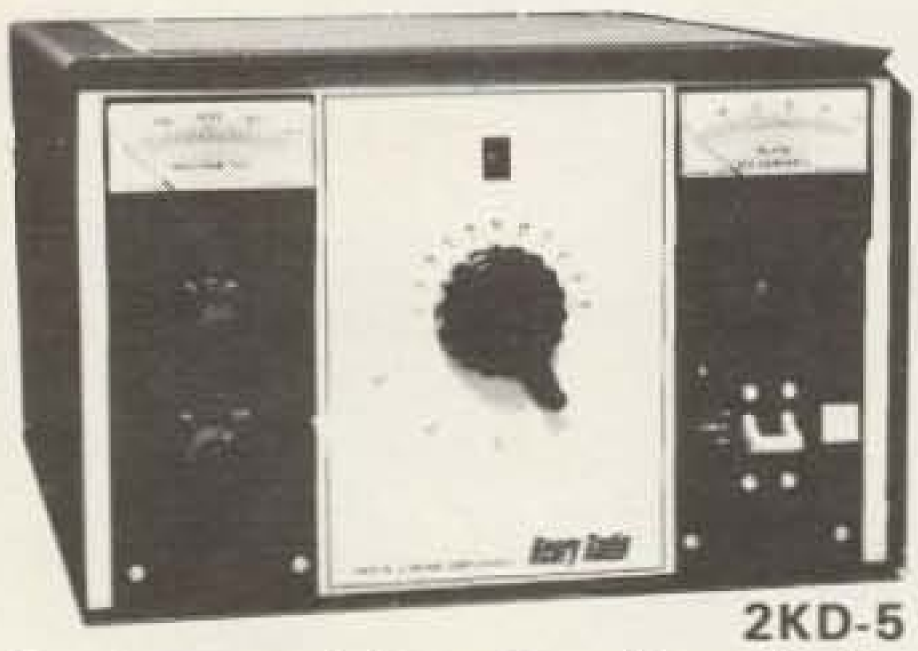

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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

WHAT WENT WRONG AT THE ARRL?

Yes, I can hear the sighs of resignation from ARRL devotees ... won't Wayne *ever* stop attacking the ARRL? ... and why is Wayne trying to kill off the *only* national organization representing amateur radio? What utter nonsense!

The ARRL could and should be an organization which is run for the benefit of radio amateurs everywhere, and one to which all of us should be able to point with pride. The fact is that it is a sorry mismanaged shambles. It is managing to lose money despite the highest membership in history, and despite the most advertising in history in its magazine. To be able to come up with a disastrous deficit in the face of such monumental prosperity indicates either extremely bad management or else a very heavy hand in the till. We're talking about *millions* of dollars.

If the board of directors had any real power to manage the League, one could lay the blame for the problems at their door. One or two fast meetings a year which are almost totally controlled by the headquarters "Mafia" hardly constitute much power to control. I don't think we can really blame the directors, other than to perhaps let them know that we think they should have recognized the problems and gotten together to really do something about them, even if it meant the immediate firing of Baldwin and his cohorts.

THE REAL PROBLEM

The seeds of the disaster presently befalling the League go back many years. The odd situation is that it is the success of the League in drawing in newcomers that has led to things coming apart.

Sometime in the early days of the League, it was decided that everything possible should be done to prevent any other organization ever getting a chance to get started. This would perpetuate a competition-free situation and allow the ARRL to be a dictator in the field. In order to get anything serious going in opposition to the League, it was believed that another group would have to have a publication to use as a medium for communication with its members and for drawing in new members, much as *QST* has been used by the League all these years. To discourage this possibility, the advertising rates of *QST* were set at such a low rate that it was thought no sane persons would try to buck the establishment (ARRL) by competing with them.

Not too long ago, I sat down with a list of the advertising rates of all of the magazines in the country (SRDS) and compared their advertising rates with those of *QST*. I found that few of them had ad rates less than three times those of *QST* for the same approximate number of readers, and most were four or more times the *QST* rates.

If this is true, how is it possible? And how come there *are* some competing ham magazines ... one of which obviously is doing rather well? The key to the legerdemain by which the ARRL was able to keep their ad rates so low was in their special second-class postage rates as a nonprofit organization. These rates are a tiny fraction of the rates paid by any regular magazine publisher. This means a saving of thousands of dollars a month, paid for by the U.S. government instead of *QST*, and substituted for the income which would normally be expected from advertising.

But, then, how can *73* compete against the low advertising rates and succeed in spite of the ARRL scheme? The secret to this, as anyone who has visited the *73* HQ can attest, is in efficient management. *73* is run from an extremely low-cost part of the country, from a very low-cost building, without the fantastic executive salaries of the ARRL, and almost all functions of the publication except printing are done in house.

No one knows for sure how much the head men at ARRL HQ make except the directors. You won't find it in the annual reports, nor will you even find any listed expenses which will give you a true hint of the salaries. I've been told that some go as high as $100,000 per year, but I doubt if they really are much over $75,000. At one time, the two top people at the League were making more than the entire staff of *73*.

THE CURE

A few years ago, before I got so involved with computers, the smartest thing the ARRL directors could have done would have been to make a deal whereby *73* and *QST* would amalgamate and I would manage the League. I guarantee you the organization would be in the black, our future would have been a lot more secure at WARC, we would have a lot more satellites up and running, and we would still have most of our ham satellite frequencies. The League needs a strong entrepreneurial type of person, not obfuscating bureaucrats who have come up through the ranks by never offending anyone.

Continued on page 170

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LETTERS

BLACK HAMS

The letter by Jack Chancellor W9SON in the November, 1978, issue raised some interesting questions. How many black Americans are hams? How are black hams responded to during QSOs and in amateur radio activities?

I'm a black American ham, licensed since 1954, and in spite of extensive travel in 27 states in the course of my professional activities, I've never met a black ham. I may have worked other black hams on the air, but I've never had a QSO where the other op identified himself as black. (Research shows that recognition of the race/creed/color of a speaker by voice alone is next to impossible.)

Reactions to me by hams here in my hometown who have learned that I'm black have been 100% positive, though I don't doubt that some anxiety has been aroused. One instance bears relating: My first affair with 2 meter FM was quite a mix-up until a local ham straightened me out on the 600-kHz difference between transmit and receive frequencies through the repeater. After many, many QSOs, he agreed to stop by my place to pick up some gear I was donating to the local amateur radio club. Naturally he discovered I was black. Then he had to withdraw an earlier invitation to my wife and I to be his guests at his club (which is a block from my QTH, by the way) because his club does not admit blacks, either as members or guests.

This same local radio club had several blacks enrolled in its Novice code/theory classes. Another local radio club urged my participation in a practice emergency net on 2 meter FM. Any number of individual local hams and I have chewed the fat at length, on and off the air, about every topic under the sun. Never has the question of my race arisen (except in discussions of racial problems in the United States).

Although I've never personally experienced racial prejudice as a ham, I'm confident prejudiced hams do exist who practice their prejudices with varying degrees of directness—from "pulling the plug" the instant they discover the other op is black to adding to their CQ calls "no lids, no kids, no blacks."

I'm equally confident that, as W9SON asserts, there are blacks who believe that amateur radio is not open to them. This is not true objectively, but most blacks perceive reality in terms of the history of the black man in America—slavery, discrimination, and prejudice. Why, they say, should I believe the amateur radio fraternity to be any different from others which are predominantly white and known to be discriminatory.

I don't quite agree with W9SON's suggestion that perhaps ham radio should mount a campaign to dispel such beliefs among potential black hams.

I do believe, however, that our fraternity can, through each of us as individuals, attract the support and participation of many blacks in America if we would act toward them, on and off the air, as we would have them act toward us.

Carlton D. Trotman W3BRX
York PA

SELF-CREATED DOOM

I am writing this letter not so much as a letter to the Editor, but as a message to all hams!

I receive all of the ham magazines. I occasionally read your editorials. I am not too outspoken. However, the more I read about WARC, I decided I would come forth as a loud minority, and not as a silent majority.

I am a black ham, but I have some ground to stand on: nine years in HF communications for the United States Army Signal Corps, in fixed station point to point, Acan Starcom Stratcom and DCA, along with one year at Ohio Bell, and four years at the R. L. Drake Company. My present position (for the past six years) is as a two-way and microwave technician at the Dayton Power and Light Company. I presently hold a First Class Radio Phone and Extra Class license. In addition, I am the past General Chairman for the Dayton Hamvention, and also past Technical Chairman for DARA.

So you see, communications is my business! I cannot sit back and fool myself about what is about to take place. What we should think about is that if the ship sinks, we all go down. Even that guy who claims there's nothing to it. Noah tried to tell people that God was going to destroy the world. They laughed at him until one day they woke up and saw the water rushing upon them.

The hams will sit down and discover there aren't any ham bands anymore! Someone will say, "What in the world has happened?"

I am not going to sit by and let ham radio die because of the lack of exposure in countries that are still using the drum for communications. I want you to know that I am beginning to see the storm clouds. I guess I am a militant ham operator. For what it's worth, this one time I am joining the loud minority.

Another important concern is that, while I don't know about other towns, Dayton has a great deal of deliberate man-made interference. It's outrageous! If the FCC cracks down on ham operators, it's the hams' fault. The ham is destroying himself and the services available to us.

For instance, a guy will walk right out of his office past a phone, enter his car, and use the autopatch to find out whether his wife needs anything from the store!

Ham operators will create their own doom!

Need I say more?

Wallace M. Wright, Jr. AD8N
Dayton OH

HOT TYPEWRITER

I read your editorial entitled "WARC Doom and Gloom" in the December, 1978, issue of *73* and boy, did it strike a nerve! I am one of those operators who still uses his old Novice 75-Watt rig, but many OMs and YLs I QSO with on the air are using new equipment into which they have sunk a considerable hunk of change. Imagine telling these ops that their bankroll has sprouted wings, their beautiful riceboxes are now illegal, and they can resort to the landline for DX!

You could have used half the editorial space for printing the names, addresses, and phone numbers of members of the ITU, the U.S. Congress, the FCC, the ARRL, and anybody else who can help prevent the WARC from becoming a disaster for hams.

Don't worry, the powers-that-be would get mail, radiograms, phone patch calls, personal visits, etc., by amateurs concerned about the future of ham radio.

I wish you would have limited your visions of gloom. Phrases like "if we lose everything" are unsettling breaches of the peace. You are going to get a lot of people riled up with that hot typewriter of yours.

Regarding the ARRL: I quit when incentive licensing came out. Why should we subsidize someone who is taking away our bands? If the ARRL helps us out at WARC, great. If they don't, then how can they justify their existence? We need some people in the ARRL with some common sense, not foolish vindictive mossbacks—without mentioning any names.

I have one last question for you, Wayne, How is *anybody* going to keep millions of low-power CB radios and hundreds of thousands of ham rigs out of reach of curious individuals who want to satisfy that age-old need to communicate?

Bob Wilk WA0OTV
Kansas City MO

A HELL OF A CONTEST

You may not publish this, but this is my opinion of contests: They can go straight to hell. I am referring to the contests of December 9, 1978. Never in my life have I heard a ruder bunch of people on the air. I couldn't carry on a QSO of any kind without some damn fool breaking in and hollering "CQ Contest, 5 by 9 in Oregon, QSL?"

Whoever authorizes this bull ought to be horsewhipped with a linear. If the ARRL is the authorizing source, then the authorizing person needs his or her you-know-what kicked. This isn't my opinion alone, but just one of a whole lot of people who feel the same way. If I want a signal report, I will ask for it during a QSO. While I am in a QSO, I don't want to hear some jerk hollering "CQ Contest."

If people are going to be rude, then they should go back to CB radio where being rude is part of it. Amateur radio doesn't need it, nor do the vast majority of hams I know.

Dale Dishon WD5JRF
Palestine TX

POLAROID POWER

I came across an idea and thought you might want to know, if you don't already.

My father bought a Polaroid SX-70 camera recently and, as you know, it takes the cartridge-type film with the battery built right in the film pack. Every time you put a new film cartridge in the camera, you are putting in a new battery.

I took one of those apart tonight just out of curiosity and discovered that it was a flat paper pack with chemicals sealed inside. I thought that the

Continued on page 203

ST2SA and K5YY.

son K5YY racked up some 6,000 QSOs from several of the rarer African spots including ST2SA, STØYY, 3B8YY, FH8, D68AD, and 5H1.

San's main objective was to activate some areas that had seen little or no CW action and to concentrate on the west coast areas of the United States that generally have poor propagation into the East African and Indian Ocean areas.

The results were 6,000 QSOs, of which 20% were on CW and 68% were with stateside stations. Twenty percent of the stateside contacts were with W6 and W7 stations, including 50% of the contacts made from FH8, where he was really concentrating on the west coast. Although limited to only short stays due to travel accommodations, San managed 800 QSOs from STØYY in six hours and some 400 QSOs each from FH8 and 3B8 in only four hours of operation at each stop.

An acute fuel shortage in Sudan cancelled all flights for over a week, but San was able to catch a charter flight to South Sudan which had to return to Khartoum the next day. Otherwise, he would have been stranded and the last half of the trip, including D68, FH8, and 3B8, would have been jeopardized. Luckily, it was a weekend and conditions were good.

Travel plans and itinerary had to be constantly changed and updated because of widespread airline flight cancellations. Getting a seat on another flight was nearly impossible and several tickets had to be repurchased because most places did not exchange tickets when flights were cancelled.

San's baggage was lost at FR7 and the last part of the trip was made with just bare toilet articles and only two pairs of shorts and socks. He wore the same clothes for twelve straight days. All his equipment was also lost.

Due to a food shortage at ST and D68, San lost twelve pounds. Upon returning home, he developed a subacute case of malaria, despite having taken all the proper anti-malaria drugs before departing. It was six weeks before he felt back to normal again.

On the bright side, the temperature in Sudan was only 105 to 110 degrees while he was there instead of the 130+ degrees just prior to his visit. Conditions at the Indian Ocean stops—3B8, D68, and FH8—were pleasant but very boring without ham radio.

San reports that the few good experiences included meeting some very nice people on the trip. Sid ST2SA and Alex 3B8DA were especially nice. 3B8CJ was not a big DXer, but he went out of his way to help San obtain the 3B8YY call instead of the 3B8Z calls which are usually issued to foreigners.

FH8OM and FH8YL were extremely nice and San reports that Beatrice FH8YL is very beautiful. Reiner FH8OM is the Honda and Yaesu dealer for the Comoro/Mayotte/Reunion area. Reiner was kind enough to take a day off and fly San from Mayotte to Kenya.

Robin D68AD is chief engineer of the Comoro Cable and Wireless and San says one of the nicest people he has ever met. San stayed with Robin while on Comoro and used his equipment. The FT-101E which had been donated by the Northern California DX Foundation had been left with FH8CY on Mayotte. All the other equipment was lost with his luggage.

San gives special thanks to Jack W2LZX for meeting him at the airport in New York both going and coming, and to Tony WA2EAN, who had finally managed to locate San's baggage which had been on Reunion all the time.

More special thanks to those who contributed equipment and money to the operation. The Northern California DX Foundation, whose contributions of an FT-101E and finances allowed San to go more places and stay longer, also provided the QSL cards. As mentioned before, the FT-101E was left with FH8CY in Mayotte to provide more operating time from that country. MFJ donated a keyer and antenna tuner and Butternut Electronics and Mor-Gain Electronics provided antennas.

Tired once more of the soft life and not one to rest on his laurels, San is planning to head out to more unconquered worlds later this summer or fall. Working once again with the Northern California DX Foundation, San has plans for three spots, all on the top ten needed list. Keep an eye on the DX bulletins for later information.

OBTAINING A VP2V LICENSE

We recently received a letter from Mr. A. M. Swain, Telecommunications Officer of the British Virgin Islands, explaining the procedure involved in obtaining a VP2V license. We are reprinting it here in case anyone might be interested in a vacation/DXpedition this summer.

1. You must possess a current U.S. amateur radio license of General Class or higher.
2. The annual license fee is $15.00, and each license or renewal expires on January 31st in the year following the one in which it was taken out.
3. Provided that a license is first granted after the first day of August, the fee shall be fifty percent of the fee specified.
4. Send a certified copy of your current license, along with a Postal Money Order made payable to the "Accountant General." No personal checks can be accepted. You must also include a 5¢ stamp to cover "stamp duty." Mail to: Ministry Of Telecommunications, Works

Continued on page 175

K5YY with FH8OM on the left and D68AD on the right.

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#D-146 Antenna, Rubber Duck, 146 MHz	$12.50
#RA-BNC Right-Angle BNC Adapter for Above Antennas	$ 2.95

PROBES:

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#P-102 HI-Z, 2X High impedance, general purpose	16.95

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Microcomputer Interfacing

Christopher A. Titus
David G. Larsen
Peter R. Rony
Jonathan A. Titus

Microcomputers are amazing devices, with an endless variety of useful applications. If you've followed the I/O articles in 73, you are probably aware that the key to using microcomputers for practical purposes is the ability to interface them to the real world. Computers are completely useless unless they can be made to accept inputs from devices like keyboards, temperature sensors, or receivers and generate output to devices such as video terminals, fire alarms, or Model 15s.

When we decided that a monthly column was needed to explore the important topic of microcomputer interfacing, we were pleased to learn that such a column was already being written by The Blacksburg Group, authors of the well-known Bugbook Series™. In recent years, the column has appeared in the scientific publication American Laboratory, where it's been quite popular.

While this column will not deal specifically with amateur radio, the interfacing techniques discussed here will benefit anyone who wants to get more out of his micro, including hams.—Jeff DeTray WB8BTH, Assistant Publisher.

INTERFACING DIGITAL-TO-ANALOG CONVERTERS

An *analog-to-digital converter* is an electronic device that converts analog signals to digital signals. Typical commercial converters are based upon the principles of successive approximation, dual-slope integration, staircase-ramp conversion, or voltage-to-frequency conversion.[1] The most common use for an ADC is to convert the output from an analog transducer or analog instrument into digital form suitable for direct observation on a digital display or as input into a computer. All digital panel meters and digital multimeters contain built-in analog-to-digital converters. Modern ADCs provide standard TTL outputs which may be coded in binary, binary-coded decimal (BCD), or perhaps other less frequently used codes.

To illustrate how you would interface an ADC to an 8080-based microcomputer, consider the generalized 10-bit ADC module shown in Fig. 1. In addition to the 10-bit output and analog input pins, our module also contains a START input and a DONE/$\overline{\text{BUSY}}$ output, whose functions will be discussed later. It is not possible to simultaneously transfer all ten bits from the ADC into an 8-bit microcomputer. For the 10-bit converter, the data transfer is accomplished by placing bits D0 through D7 (the ADC's eight least significant bits) in the first input byte and the remaining two bits, D8 and D9 (the ADC's most significant bits), in the second byte.

To gate data onto the data bus and into the 8080, 8212 eight-bit three-state buffer chips are used between the ADC's outputs and the 8080's data bus. A gating scheme is required so that the three-state buffers are enabled only during the time when the 8080 requests data. In the case of the 8212 buffer, the required gate is incorporated within the integrated circuit chip, so all that you must supply is a negative $\overline{\text{IN}}$ control signal and positive 065 and 066 decoded pulses derived from the address bug decoding logic.

The remaining control signals that are used include (1) a START pulse applied to the ADC that resets it and starts the internal conversion process, and (2) a DONE/$\overline{\text{BUSY}}$ ADC output flag which indicates that a conversion has taken place and that the 10-bit digital output is ready. These are important control signals since they synchronize the operation of the conversion process. Analog-to-digital converters are not generally "free-running" devices that continuously convert voltages into digital outputs. These conversions take a finite period of time. It is necessary to pulse or strobe the ADC to start each conversion, and you cannot expect a 10-bit binary value to be output by the converter immediately after the strobe pulse is applied. For the generalized converter in our figure, a 21-microsecond conversion time is required. Inside our ADC, a successive approximation technique is used that converges on the unknown voltage by making successively smaller tests and comparing the results of such tests to the unknown voltage.

The DONE/$\overline{\text{BUSY}}$ flag, which indicates that the converter is either DONE (logic 1) or $\overline{\text{BUSY}}$ (logic 0), is input into the microcomputer as a single bit. Since there are six unused bits at input port 066, bit D7 is assigned to the flag. The START pulse to initiate a conversion must be a short positive pulse. It can be obtained by gating the control signal $\overline{\text{OUT}}$ with a negative device address pulse, $\overline{037}$, using a 7402 2-input NOR gate.

A typical software subroutine used to perform a single conversion is shown in Table 1.[2] The 10-bit binary result of the conversion is left in the B and C registers of the 8080, with the least significant eight bits in register C and the most significant two bits in register B in bit positions D0 and D1. The microcomputer spends time in the TEST loop as it checks and rechecks the flag bit while the conversion takes place. The converter we chose took only 21 microseconds, so

Continued on page 203

```
                        *100 000
100 000 365  ADC,    PUSHPSW /SAVE REGISTER A & FLAGS
100 001 323          OUT     /STROBE THE ADC TO START A CONVERSION
100 002 037          037
100 003 333  TEST,   IN      /INPUT STATUS BIT AND 2 MSB'S
100 004 066          066
100 005 306          ADI     /ADD 1 TO THE FLAG BIT TO CAUSE AN
100 006 001          001     /TO CAUSE A CARRY IF IT IS SET
100 007 322          JNC     /NO OVERFLOW, CHECK IT AGAIN
100 010 003          TEST
100 011 100          0
100 012 107          MOVBA   /OVERFLOW, FLAG=1, SO SAVE MSB'S
100 013 333          IN      /INPUT THE 8 LSB'S
100 014 065          065
100 015 117          MOVCA   /STORE THEM IN REGISTER C
100 016 361          POPPSW  /RESTORE REGISTER A & FLAGS
100 017 311          RET     RETURN TO MAIN PROGRAM
```

Table 1. Typical ADC input routine for a 10-bit analog-to-digital converter.

```
                        *100 000
100 000 373  ADC,    EI      /ENABLE THE 8080'S INTERRUPT
100 001 323          OUT     /START A CONVERSION
100 002 037          037
100 003 311          RET     /RETURN TO MAIN PROGRAM

                      THIS IS THE ADC'S INTERRUPT SERVICE SOFTWARE

                        *000 070
000 070 365  ADCSVC, PUSHPSW /SAVE REGISTER A & FLAGS
000 071 345          PUSHH   /SAVE REGISTERS H & L
000 072 052          LHLD    /GET MEMORY POINTERS INTO H & L
000 073 000          POINT   /SO THE DATA MAY BE STORED
000 074 120          0
000 075 333          IN      /INPUT 8 LSB'S
000 076 065          065
000 077 167          MOVMA   /STORE THEM IN MEMORY
000 100 043          INXH    /INCREMENT MEMORY POINTER
000 101 333          IN      /INPUT 2 MSB'S
000 102 066          066
000 103 167          MOVMA   /STORE THEM, TOO
000 104 043          INXH    /INCREMENT MEMORY POINTER AGAIN
000 105 042          SHLD    /SAVE THE STORAGE AREA ADDRESS
000 106 000          POINT
000 107 120          0
000 110 341          POPH    /RESTORE REGISTERS H & L
000 111 361          POPPSW  /RESTORE REGISTER A & FLAGS
000 112 311          RET     /RETURN TO MAIN PROGRAM

                        *120 000
120 000 000  POINT,  000     /THIS IS WHERE THE ADDRESS OF THE ADC
120 001 020          020     /STORAGE AREA IS KEPT.  IN THIS PROGRAM
                             /THE STORAGE AREA STARTS AT
                             /ADDRESS 020 000.  YOU COULD PLACE YOUR
                             /OWN POINTER ADDRESS HERE, BUT THESE
                             /TWO LOCATIONS MUST BE IN R/W MEMORY
```

Table 2. Typical ADC subroutine for an interrupt-type converter interface. This assumes the converter will interrupt with an RST7 instruction vectoring to 000 070.

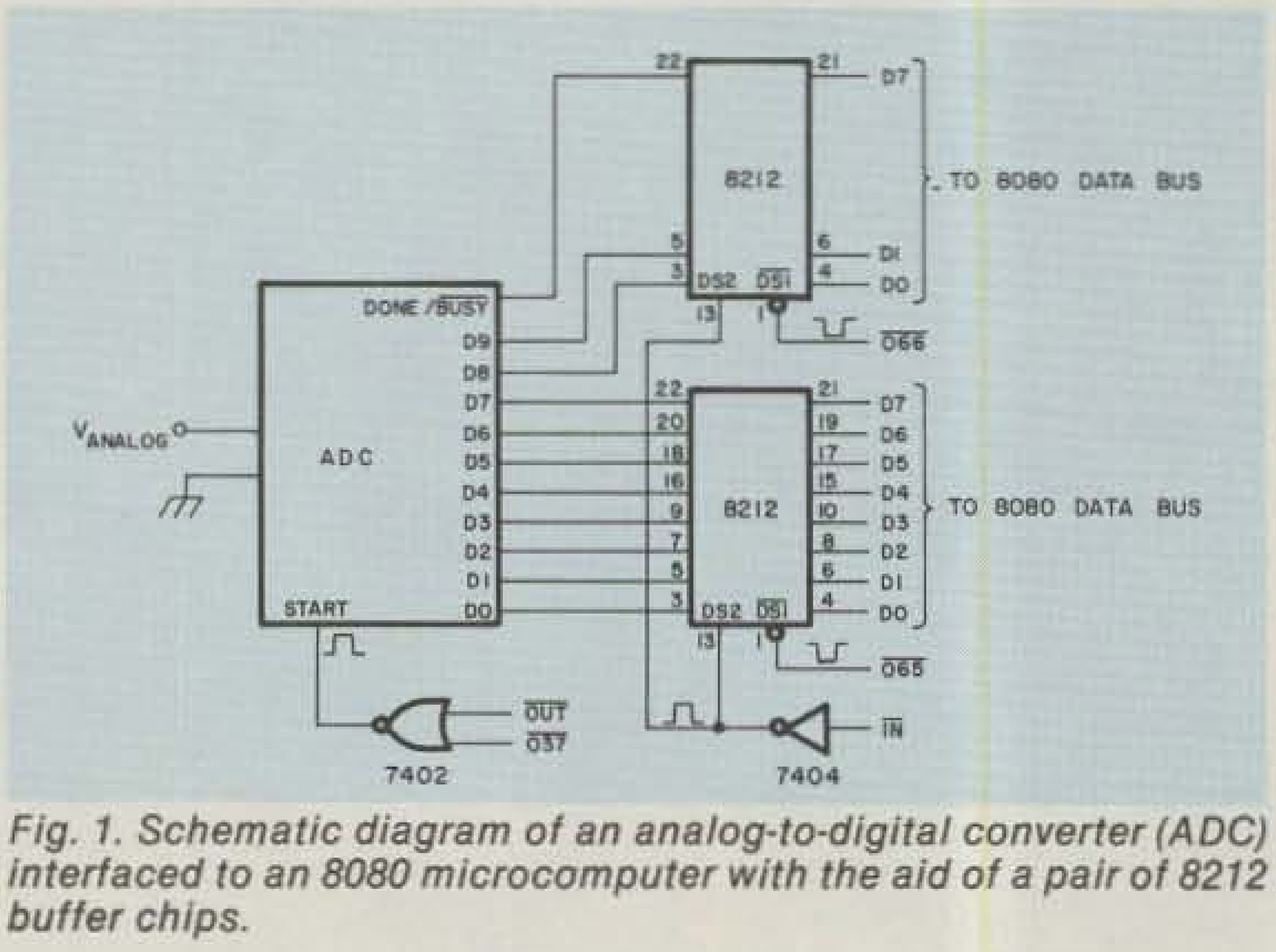


Fig. 1. Schematic diagram of an analog-to-digital converter (ADC) interfaced to an 8080 microcomputer with the aid of a pair of 8212 buffer chips.

New Products

DRAKE WH-7 WATTMETER/COUPLER

Drake's new WH-7 wattmeter/coupler is a through-line wattmeter designed to match the styling of the TR-7 and the rest of the 7-line, but it will make a most useful and attractive addition to your shack regardless of the rig you're using. The instrument has a large, easy-to-read meter with three calibrated scales to measure forward power. There's a 20-Watt scale for low power enthusiasts as well as the more usual 200- and 2000-Watt scales. A fourth calibrated scale provides direct reading of vswr, and is switch-selected from the front panel.

The WH-7 features a frequency coverage of 1.8-30 MHz. The line impedance is 50 Ohms resistive. The wattmeter accuracy is ±5% of reading + 0.2 Watts on the 20-Watt scale, ±5% of reading + 2 Watts on the 200-Watt scale, and ±5% of reading + 20 Watts on the 2000-Watt scale, throughout the 1.8-30 MHz range. Insertion of the wattmeter in the line changes the vswr no more than 1.05:1. The power capability is 2000 Watts, continuous duty.

The wattmeter is installed between the output of the transmitter (or amplifier) and the antenna. Ordinary PL-259 coax connectors will couple directly with the SO-239 receptacles on the sensing element. The sensing element is completely removable for placement in a convenient position. It can be removed by unscrewing the four machine screws on the bottom of the cabinet which hold it in place. In this manner, the sensing element can be installed behind the operating table so that bulky coax need not be brought up. Approximately 3 feet of small, flexible cable connects the sensing element to the meter, allowing a wide range of installation positions.

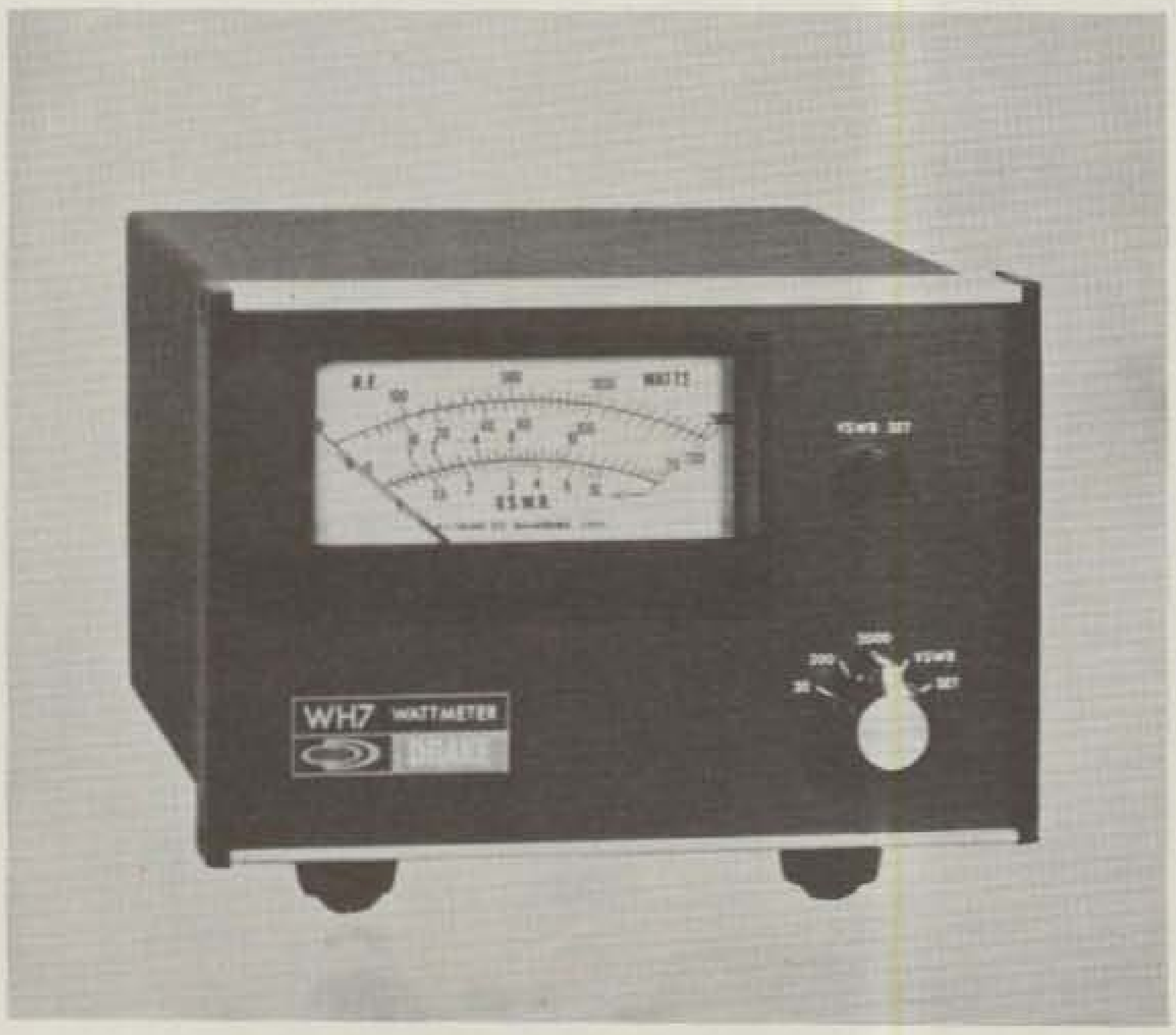
There are three different types of power to consider when using a wattmeter: forward, reflected, and radiated. The WH-7 reads the sum of the radiated and reflected power, or forward power. True radiated power may be determined with the vswr calculator supplied with the wattmeter. Simply lay a straight edge across the appropriate scales of "FORWARD" and "VSWR", and read "REFLECTED" power on the right-hand scale. Radiated power is calculated by subtracting the reflected power from the forward power.

Vswr measurements may be made easily and directly with the WH-7. Just turn the selector switch to the "SET" position (full CW) and adjust the "VSWR SET" control to align the meter pointer with "SET" at the full-scale position on the meter. Then turn the selector switch to the "VSWR" position and read the vswr directly from the vswr scale.

Once you discover the convenience of a wattmeter like the WH-7, you'll never want to be without it. Whether you're in the process of matching a new antenna, making a fast band change during a contest, or performing any other activity where fast and accurate measurement of rf power and vswr is needed, you'll find your wattmeter to be your biggest helpmate and worth every penny you spent for it.

The WH-7 wattmeter/coupler's main cabinet measures 5-5/16" high, 6-7/8" wide, and 7" deep. The removable sensing unit is 2-1/2" high, 3-3/8" wide, and 2-3/4" deep. Its weight is 2-3/4 pounds, and the selling price is $89.00. Available wherever Drake equipment is sold. *R. L. Drake Company, 540 Richard Street, Miamisburg OH 45342.* Reader Service number D11.

Morgan W. Godwin W4WFL
Peterborough NH



Drake's WH-7 wattmeter/coupler.

CSC OFFERS NEW 6-MODE MODEL 4001 PULSE GENERATOR

The 4001 offers independently-variable pulsewidth and spacing controls from 100 nanoseconds to 1 second in 7 overlapping decade ranges. Two single-turn verniers provide continuous adjustment in each range. The duty cycle is variable over a 10,000,000:1 range, continuously adjustable from 0.5 Hz to 5 MHz. The control settings are calibrated within ±5% at each end of the vernier ranges. Jitter is held to less than 0.1% + 50 picoseconds.

The six push-button-selectable modes are Run, Trigger, Gate, Single-Shot, Square Wave and Complement. (The pulse spacing control is not active in the Trigger or Single-Shot modes.)

The Run mode is frequency-settable from 0.5 to 5 MHz through the pulsewidth and pulse spacing controls. The Trigger mode accepts dc-to-10-MHz signals from an external source.

The Gate mode starts the generator synchronously with the leading edge of the gate signal. The last output pulse is independent of the falling edge of the gate signal. In addition, the "One-Shot" push-button can manually activate the gate mode.

The Trigger/Gate input is TTL-compatible. It accepts 2-V_{p-p} sine waves, 1-V_{peak} pulses (with a minimum width of 40 nanoseconds), and a maximum ±10-volt input. It also offers a dc-coupled 10k-Ohm input impedance.

The Single-Shot or One-Shot mode outputs a pulse each time the momentary manual push-button is depressed.

The Square Wave mode operates at up to 2.5 MHz. The square wave frequency is the reciprocal of twice the sum of the pulsewidth and pulse spacing control settings.

The Complement mode inverts the output signal.

A single-turn vernier adjusts the output amplitude over a 0.1-10-volt range. The output exhibits a maximum 400-Ohm impedance at full amplitude. Output rise and fall time is less than 30 nanoseconds.

The TTL output offers a fan-out of 40 TTL loads, and is capable of sinking 64 milliamps at a maximum of 0.8 volts. TTL-output rise and fall time is less than 20 nanoseconds.

A Sync output offers a minimum output amplitude of 2.4 volts and a fanout of 10 TTL loads, and will sink up to 16 mA at a maximum 0.8 volts. The output pulse is greater than 20 nanoseconds, with a rise and fall time of less than 20 nanoseconds. The sync pulse lead time is greater than 20 nanoseconds.

For additional information, contact *Continental Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509; (203)-624-3103.* Reader Service number C9.

CSC's new Model 4001 pulse generator.

THE 2 METER BROOMSTICK

Smithe's new fully self-contained 5/8-wave centerfed dipole for 2 meters is rather intriguingly named the Broomstick. Why Broomstick? Well, it does look strikingly like a

Memo from Drake

The 7-Line is a unique communications system

combining coordinated systems design with innovative engineering

When you select Drake products, you select designs that match visually and electrically — designs that work together as a complete unit.

Drake TR-7/DR-7 — Speaking of innovative engineering, did you know this transceiver re-introduces international shortwave listening to amateur radio? The receiver provides complete general coverage from 1.5 thru 30 MHz — no gaps and no range crystals needed. With the plug-in AUX-7 pc board, coverage can be extended from 1.5 MHz down to "0" MHz! Now that's general coverage!!

The TR-7 transmits on all amateur bands 160 thru 10 meters, and can be programmed on any 8 additional 500 kHz ranges in the hf spectrum for legitimate out-of-band coverage such as MARS, Embassy, future band expansions, etc. Up to four positions of independent receive selectivity, combined with full passband tuning, allow tailored reception of cw, RTTY, ssb and a-m. A special built-in low distortion a-m detector, with optional 6.0 kHz crystal filter, makes "SWL-ing" with stations such as BBC, VOA, etc, a genuinely pleasant surprise.

The special TR-7 receiver front end, with its high intercept point, means you can pick many weak amateur signals from amid the super-power shortwave broadcasters. These weaker stations could be completely lost with conventional receiver designs.

MATCHED ACCESSORIES — The 2 kW Drake MN-2700 Antenna Matching Network covers 160 thru 10 meters, features complete rf bypass and antenna selector switching, built-in rf wattmeter/VSWR bridge, and out-of-band coverage. With the B-1000 balun, balanced line and long wires may be accommodated along with coax feed systems. A 250 watt version is the MN-7. • The WH-7 Wattmeter has rf power scales from 20 to 2000 watts, and even a direct-reading VSWR scale. It's an accurate and convenient accessory for any-one's station. • The PS-7 Ac Power Supply can be switch-programmed for most primary voltages from 90 thru 264 volts. No soldering or jumpers necessary. It includes automatic protective circuitry for both voltage and current. Compare the weight of the PS-7 with other supplies, and you'll know it's real! • The RV-7 Remote VFO provides split frequency control for the TR-7 with a "spot" button for convenience. • Even tho the TR-7 has a built-in speaker, the addition of the MS-7 Speaker provides greater audio fidelity. • The custom-designed 7077 Dynamic Desk Mike provides proper impedance and audio characteristics for the TR-7; fully wired for VOX and PTT. • And don't forget the DL-300 /DL-1000 "Dry" Dummy Loads — they really are handy. • The FA-7 Cooling Fan can be installed on both the TR-7 and PS-7 for high ambient temperature environment or for continuous duty RTTY or SSTV applications.

Available soon — the new Drake L-7, 160 thru 10 meter*, 2 kW Wide Range Linear Amplifier.

*10-meter coverage on export units only

To receive a FREE Drake Full Line Catalog, please send name and date of this publication to:

Prices and specifications subject to change without notice or obligation.

R. L. DRAKE COMPANY DRAKE ®

✓D11

540 Richard St., Miamisburg, Ohio 45342
Phone: (513) 866-2421 • Telex: 288-017

✓ *Reader Service—see page 211*

broom with an SO-239 connector in place of the bristles.

The 2 meter Broomstick is 4½ feet long and an inch in diameter. There are no protruding radials, tuning rings, or appendages of any sort, and it needs no ground system. A small hook on one end enables it to be quickly and easily hung from a drapery rod, closet pole, or picture hook, so that it is unlikely to offend even the most particular XYL or other members of the family.

For the moment, my Broomstick is hung behind the drapes of one of the living-room windows, where it is completely out of sight but still enables me to key up several area repeaters and put out a very respectable signal on simplex frequencies.

The first location I tried with the Broomstick, an inside bedroom (no windows), produced pretty good results on receive but rather poor performance on transmit. Also, for some reason, I was unable to get the vswr to 2.1:1 maximum over the entire band as specified in the manufacturer's literature. However, moving the antenna to the position behind the drapes of one of the living-room windows produced a big improvement on both transmit and receive, and the vswr came down to within the manufacturer's specifications. Although I had no way of precisely measuring the antenna's gain, on-the-air checks support the 4 dBi figure given in the specs.

The 2 meter Broomstick is not only a versatile indoor antenna at home and away, but can be used outdoors as well—it's watertight and looks like it should stand years of rain and sun and whatever else Mother Nature is likely to throw at it. A mobile mounting clamp will be available shortly. If you've been stuck with using a telescoping whip or rubber ducky at home or from hotel and motel rooms when you travel, the Broomstick will give you a very useful signal boost.

Smithe's 2 meter Broomstick is priced at $19.95 and is sold and distributed by *Smithe Aluminum, Box 442, Laurel MD 20810.* Reader Service number S80.

Morgan W. Godwin W4WFL
Peterborough NH

DRAKE DRY DUMMY LOADS

If I were ever limited to a single accessory item for the shack, I'd unhesitatingly choose a dummy load. Whether I'm tweaking up a new piece of equipment I've just built, going through the neutralization process after changing the final amplifier tubes in my transceiver, or simply retuning after changing bands, I find a dummy load indispensible.

Now, with Drake's two new dry (no oil required) dummy loads, the DL-300 and DL-1000, it's easier and more convenient than ever to have a dummy load handy and ready to use whenever needed.

The DL-300 will handle 300 Watts of rf for 30 seconds, with derating curve to 5 minutes. Maximum vswr is 1.1:1 to 30 MHz and 1.5:1 from 30 to 160 MHz. Impedance is 50 Ohms resistive, nominal. Its small size (6.7" x 2.08") and light weight (11 oz.), plus built-in PL-259 coax connector for direct connection to transceiver or transmitter output, makes it perfect for portable, mobile, or fixed station use.

The DL-1000 is larger (14" x 3.6") and heavier (2 lbs.), but it handles 1000 Watts of rf for 30 seconds, with derating curve to 5 minutes. Maximum vswr is 1.5:1 over the 0-30 MHz range. Impedance is 50 Ohms resistive, nominal. When the Drake FA-7 cooling fan is added to the DL-1000 to provide forced air cooling to the resistive element, the unit's rating limitations are expanded, i.e., 90 seconds at 1000 Watts. The DL-1000 is provided with SO-239 coax connector and rubber feet for desk or bench use.

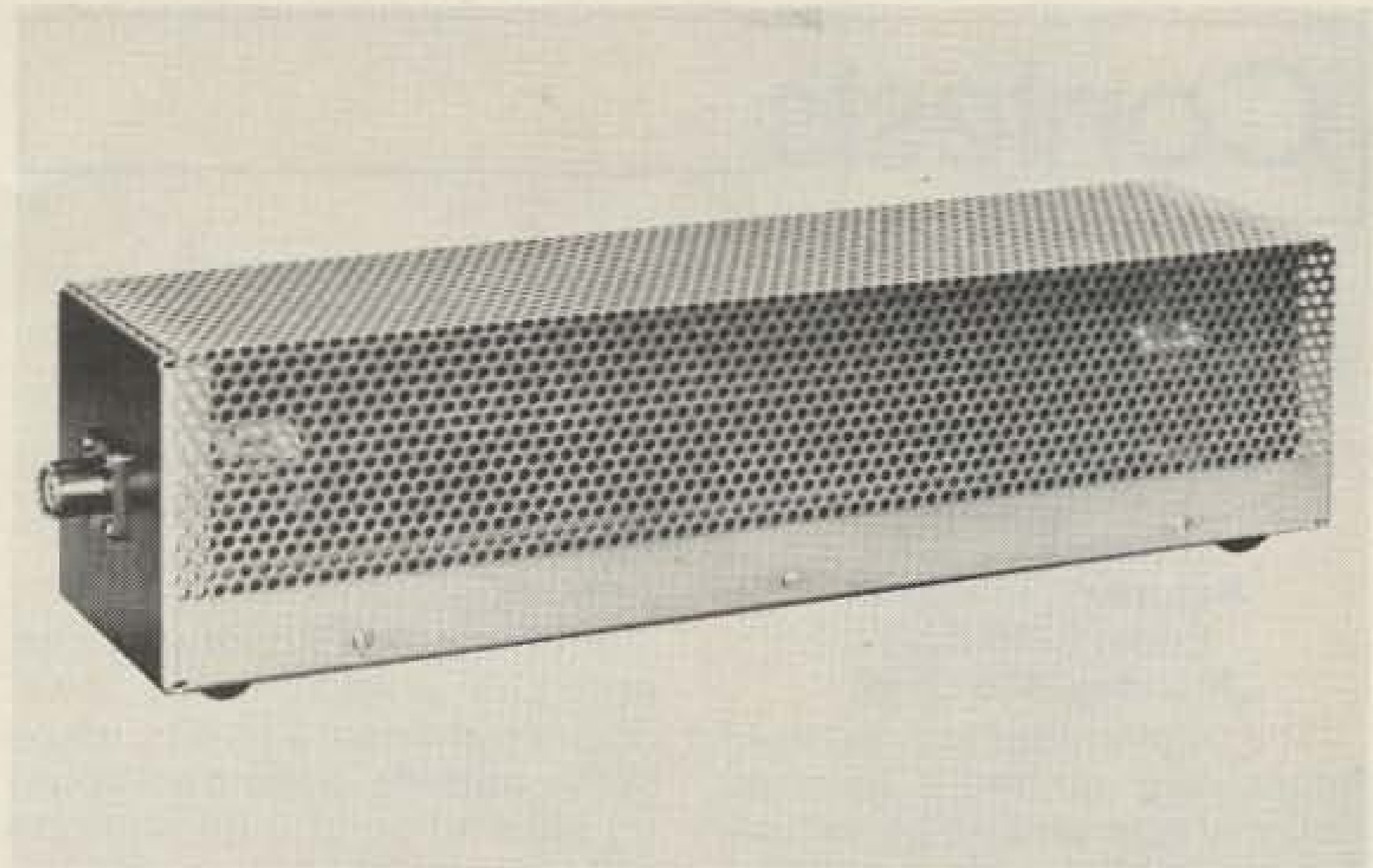
The DL-300/DL-1000 dummy loads should be used in conjunction with the derating curve which comes with the units if power is to be applied for a period exceeding 30 seconds. Allowance must be made for adequate cooling-off periods when needed, to prevent exceeding the rating dictated by the derating curve. Failure to do so will drastically reduce the life of the resistive element. A good rule to follow is to allow one-minute cooling-off periods between use.

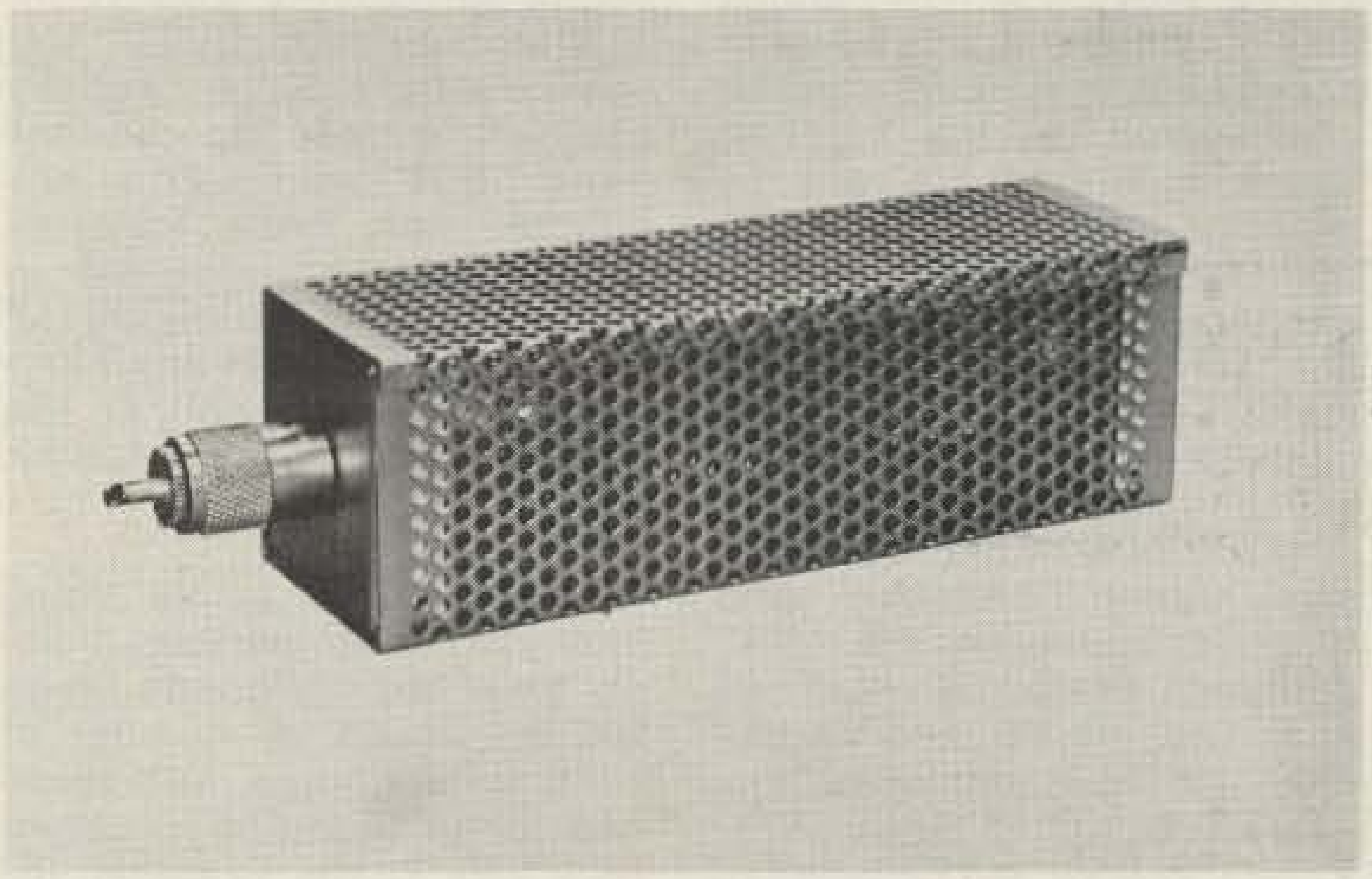
The DL-300 connects directly to an SO-239 connector, eliminating the need for an interconnecting coax cable. The DL-1000 should be connected to the transceiver or transmitter using a convenient length of coax cable.

With one or both of the Drake dry dummy loads in the shack, you'll find that servicing your gear is a lot easier and safer, and you'll be a lot more popular with your fellow amateurs if you use one when matching a new antenna or retuning after changing bands. If you haven't been using a dummy load, try one. You'll like it!

The DL-300 sells for $19.95, and the DL-1000 for $39.95. Available wherever Drake equipment is sold. *R. L. Drake Company, 540 Richard Street, Miamisburg OH 45342.* Reader Service number D11.

Morgan W. Godwin W4WFL
Peterborough NH





Drake's new DL-300 (top) and DL-1000 dummy loads.

NEW DVOM IS RUGGED, CONVENIENT, AFFORDABLE

A new 3½-digit pocket-sized digital multimeter has just been introduced by The Hickok Electrical Instrument Company for electrical/electronic test, calibration, and field service applications. The instrument, designated the LX 303, contains features generally found in more expensive units, including autopolarity, autozero and automatic overage indication. A rug-

Continued on page 173

Hickok's new LX 303 DVOM.

Contests

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

BARTG SPRING RTTY CONTEST
Starts: 0200 GMT
Saturday, March 24
Ends: 0200 GMT
Monday, March 26

The total contest period is 48 hours, but no more than 30 hours of operation is permitted. Time spent listening is counted as operating time. Off periods may not be less than 3 hours at a time and times on/off must be summarized on the log and score sheets. There will be separate categories for single operators, multi-operators, and shortwave listeners. Use all amateur bands from 80 to 10 meters. Stations may not be contacted more than once on any one band, but additional contacts may be made with the same station if a different band is used. Those on the ARRL countries list and in addition each W/K, VE/VO, and VK call area will be counted as separate countries (but W/K, VE/VO, and VK will be counted once only for QCA purposes).

MESSAGES:

Messages exchanged will consist of:

Time in GMT consisting of a full 4-figure group; the use of the expression "same" or "same as yours" will not be acceptable.

RST and Message Number—the message number must consist of a 3-figure group starting with 001 for the first contact made.

POINTS:

All 2-way RTTY contacts with stations within one's own country will earn 2 points, while those outside one's own country earn 10 points. All stations will receive a bonus of 200 points per country worked, including their own. NOTE: Any one country may be counted again if worked on another band, but continents are counted only once. Proof of contact will be required in cases where the station worked does not appear on any other contest logs received or the station worked does not submit a check log.

SCORING:

Multiply QSO points times total countries worked; multiply total country points times 200 multiplied by number of continents worked. Add these two totals together to obtain your final score. Example: exchange points (302 x countries 10) = 3020; country points 10 x 200 x continents 3 = 6000; final score = 9020 points.

LOGS AND SCORE SHEETS:

Use a separate sheet for each band and indicate all rest periods. Logs to contain: date/time in GMT, callsign of station worked, RST report and message number as sent, RST report and message number as received, exchange points claimed. The summary sheet should show the full scoring, the times off and on the air, and, in the case of multi-operator stations, the names and callsigns of all operators involved with the operation of the station. All logs must be received by May 31, 1979, in order to qualify. Send logs and check sheets to: Ted Double, 89 Linden Gardens, Enfield, Middlesex, England EN1 4DX. The judges' decision will be final and no correspondence can be entered into with respect to incorrect or late entries. All logs will remain the property of the British Amateur Radio Teleprinter Group. Certificates will be awarded to: leading stations in each of the

Calendar

Mar 3-4	**ARRL DX Competition—Phone**
	YL-OM CW Contest
Mar 10-11*	**QCWA QSO Contest—Phone**
	Virginia QSO Party
	Commonwealth Contest
Mar 17-18	**ARRL DX Competition—CW**
Mar 24-25	**CQ Worldwide WPX—SSB**
	BARTG Spring RTTY Contest
Mar 31-Apr 1	**North Dakota QSO Party**
	Tennessee QSO Party
	International 10-10 Net Canterbury Chapter QSO Party
	Wisconsin QSO Party
Apr 7-8	**ARRL Open CD Party—CW**
	QRP QSO Party
Apr 21-22	**ARRL Open CD Party—Phone**
	ARRL EME Contest
Apr 28-29	**PACC DX Contest**
May 12	**World Telecommunications Day Contest—Phone**
May 19	**World Telecommunications Day Contest—CW**
May 19-20	**ARRL EME Contest**
May 26-27	**CQ Worldwide WPX—CW**
June 9-10	**ARRL VHF QSO Party**
June 23-24	**ARRL Field Day**
July 4	**ARRL Straight Key Night**
July 14-15	**ARRL IARU Radiosport Competition**
Aug 4-5	**ARRL UHF Contest**

*** = described in last issue**

Results

RESULTS OF THE 1978 RHODE ISLAND QSO PARTY

RHODE ISLAND

COUNTY	CALL	QSO	PTS.	MULT.	SCORE
Bristol	*WB1DEU/N	57	300	26	7,800
Kent	*WB1DXE	418	844	52	43,888
Newport	*WA1OSL	19	46	7	322
Providence	*WB1EJI	632	1,288	85	109,480
Washington	*K1QFD	76	168	36	6,048
Providence	N1RI/1 multi-op	246	516	42	21,672
Bristol	N1RI	43	90	24	2,160

OUT OF STATE

COUNTY	CALL	QSO	PTS.	MULT.	SCORE
Alaska	*KL7IUM	4	8	2	16
Arkansas	*WA5DTK	5	18	3	54
Connecticut	*W1TEE	14	47	5	235
Georgia	*N4NX	23	62	5	310
Illinois	*WD9ADH	37	120	5	600
Iowa	*WB0UCP	13	42	5	210
Kansas	*W0ODT	6	20	3	60
Kentucky	*WA4QMQ	3	6	2	12
Louisiana	*W5WG	22	76	4	304
Maryland	*N3SL	11	38	4	152
Massachusetts	*N1NA	78	274	5	1,370
Minnesota	*W1GL/0	27	62	5	310
Nebraska	*N0WB	8	24	4	96
Nevada	*W7HI	9	34	4	136
New Jersey	*WB2HSG	5	18	2	36
New Mexico	*K5MAT	17	45	5	225
New York	*W2HAE	10	36	3	108
Pennsylvania	*WA3JXW	4	8	1	8
S. Carolina	*WB4HLC	15	38	5	190
Texas	*WB5PDQ	10	28	4	112
Virginia	*W4ZRJ	5	18	3	54
Washington	*K7EQ	4	16	3	48
Wisconsin	*WB9PVI	19	62	4	248
Ontario	*VE3KK	14	47	4	188
Kuwait	*9K2FX	15	38	5	190
Greenland	*K3KX/OX	1	2	1	2

TOP THREE—R. I.

*1. WB1EJI	109,480
*2. WB1DXE	43,888
*3. K1BV	8,118

Novice Winner: WB1DEU
Tech Winner: WB1AFQ
VHF Winner: W1EOF
Certificates of Merit Awarded to: K1UXS, N1DM, WB1EHO, and KA1AZ for their help in making the QSO Party a success.

TOP THREE OUT OF STATE

*1. N1NA	1,370
*2. W1FJI	1,345
*3. WD9ADH	600

*** denotes certificate winner**

three classes, the top stations in each continent, and each W/K, VE/VO, and VK call area.

If a contestant manages to contact 25 or more different countries on 2-way RTTY during the contest, a claim may be made for the Quarter Century Award issued by BARTG for which a charge of 3 dollars US or 15 IRCs is made. Make your claim at the same time as you send in your log. Holders of existing QCA awards will automatically have any new countries added to their records. However, in view of the high volume of work which the contest manager has to deal with, it will not be possible to prepare and send out new awards or update existing awards until the final results of the contest have been evaluated and dispatched.

If any contestant manages to contact stations on 2-way RTTY with all six continents and the BARTG contest manager receives a contest or check log from all of the operators in those six continents, a claim may be made for the WAC Award issued by the *RTTY Journal*. The necessary information will be sent on to the *RTTY Journal*, who will issue the WAC Award free of charge.

INTERNATIONAL 10/10 NET CANTERBURY CHAPTER QSO PARTY

Starts: 0000 GMT
Saturday, March 31
Ends: 1200 GMT
Sunday, April 1

Work each station only once; all contacts on 10 meters. Exchange callsign, name, QTH, 10X number if any, Canterbury Chapter number if held, and your own local chapter name and number if any.

SCORING:

Claim 5 points for working the Canterbury Chapter callsign ZL3ACA. This will be used on a roster basis throughout the party by committee members who will also be using their own station calls. Score 3 points for working a station holding a 10X number and also either full or associate Canterbury Chapter membership. For any station holding a 10X number, but who is not a Canterbury Chapter member, score 2 points. You only get 1 point for working any other station on 10 meters.

ENTRIES:

Logs must be received no later than May 15, 1979. Send to: C. J. Bramley ZL3ME, 198 Greers Road, Christchurch 5, New Zealand. Please write clearly; show your name and address with your 10X number if you have one.

AWARDS:

A handsome first-place trophy to the highest scorer. A pennant to the highest scorer in each US, Canadian, Australian, Japanese, and New Zealand call area; to each Central and South American country; to each European, African, and Asian country; and to three Pacific Ocean zones. Awards are free and will be sent airmail.

NORTH DAKOTA QSO PARTY

Starts: 1800 GMT
Saturday, March 31
Ends: 2400 GMT
Sunday, April 1

This contest is sponsored by the Fargo Repeater Association. Activity will be between North Dakota and out-of-state stations. The same station may be worked once per band and mode. North Dakota mobiles may be worked again with each county change.

EXCHANGE:

QSO number and county for ND stations; QSO number and state, province, or country for others.

FREQUENCIES:

3560, 3895, 7060, 7230, 14060, 14285, 21060, 21355, 28060, 28600, 29005. Novices and Techs will operate in the middle of their bands.

SCORING:

One point per QSO. ND stations multiply total QSOs by sum of states, provinces, and DX countries. Others will use ND counties for their multiplier (53 max.).

ENTRIES AND AWARDS:

Certificates to top scorers in each state, province, and DX country, the top 10 ND entries, and top 5 ND mobiles. Mailing deadline is April 20 and all entries should be addressed to: Fargo Repeater Association, WDØCCL, 2826 Evergreen Road, Fargo ND 58102. Include a large SASE for a copy of the results.

THE 73 BAND PLAN

Channel	Freq.(MHz)
1	28.965 . . . Listening & calling
2	28.975 . . . Autocall monitoring
3	28.985 . . . County hunting—not rag chew
4	29.005 . . . Beacon monitoring
5	29.015
6	29.025 . . . Rag chewing (lowest)
7	29.035
8	29.055
9	29.065
10	29.075
11	29.085
12	29.105
13	29.115
14	29.125
15	29.135
16	29.155
17	29.165
18	29.175
19	29.185 . . . Repeater channel
20	29.205 . . . RTTY
21	29.215 . . . Oscar coordination
22	29.225
23	29.255 . . . SSTV
24	29.235
25	29.245 . . . Repeater
26	29.265 . . . Repeater
27	29.275 . . . Repeater
28	29.285
29	29.295
30	29.305
31	29.315
32	29.325
33	29.335
34	29.345
35	29.355
36	29.365
37	29.375
38	29.385
39	29.395
40	29.405 . . . Oscar listening

TENNESSEE QSO PARTY

Contest Periods:
2100 GMT Saturday, March 31
to 0500 Sunday, April 1
1400 GMT to 2200 GMT
Sunday, April 1

The contest is sponsored by the Tennessee Council of Amateur Radio Clubs. You may work the same station on different bands, modes, or counties. Repeater contacts are not allowed. Mobiles compete against mobiles, portables against portables. Single-transmitter entries only. No county line operations for multiple contacts are allowed. Portable stations must use a portable antenna as on Field Day. Phone and CW are all one contest, combined score!

EXCHANGE:

TENN stations give RS(T) and county; others send RS(T) and state, province, or country.

FREQUENCIES:

Approximately 50 kHz up from the bottom of each CW band. Phone—3980, 7280, 14280, 21380, 28580. Novices operate authorized frequencies.

SCORING:

One point per contact: TENN stations multiply by sum of different states plus different VE provinces plus TENN counties. Others multiply by number of TENN counties for final score. Add bonus of 200 points for each county operated from outside of home county with a minimum of 10 contacts.

AWARDS AND ENTRIES:

Plaques to TENN top score, TENN mobile, TENN portable, and out-of-state. Certificates with results to every log showing 15 contacts. Logs must

THE 73 MAGAZINE 10 METER AWARDS

The return of vigorous solar activity means that 10 meters is once again a band to be reckoned with. Ol' Sol's 11-year cycle of sunspot production is about to hit a peak, with the result that QRP 10 meter DX is possible.

Now's the perfect time to convert that old CB rig to 10. American Crystal Supply makes a variety of simple and inexpensive conversion kits, or you can do-it-yourself from the articles in 73. True appliance operators can purchase ready-made rigs from Bristol Electronics or Standard Communications. To give you an added incentive, 73 is offering two nifty Certificates of Achievement for 10 meter channelized communications.

For domestic types, there is the 10-40 Award. This one should be pretty easy—just work 40 of the 50 states. The DX Decade Award goes to DXers who work 10 or more foreign countries with a channelized 10 meter rig. We have endorsement stickers, too—the whole bit.

To give everyone an equal shot at award #1, only contacts made October 1, 1978, or after will be valid.

Well, don't just sit there. Get out your soldering iron, order some crystals, and put that CB rig on 10. This is going to be fun, so don't miss out!

RULES

1) All contacts must be made in the 10 meter amateur band using channelized AM equipment. Both converted Citizens Band equipment and commercially-produced units may be used.

2) To be eligible for award credit, all contacts must be made October 1, 1978, or after.

3) The 10-40 Award is available to applicants showing proof of contact with stations in at least 40 of the 50 United States. A special endorsement sticker will be available to those working all 50 states.

4) The DX Decade Award is available to applicants showing proof of contact with at least 10 foreign countries. Endorsement stickers will be awarded for 25, 50, 75, and 100 countries.

5) A log of stations worked, with the date, time, and type of equipment used for each contact, must be submitted when applying for each award or endorsement.

6) Each application for an award or endorsement must be accompanied by a signed statement that all claimed contacts are valid. No QSL cards need be sent, but they must be in the possession of the applicant.

7) To cover costs, a fee of $5.00 must accompany each application for the 10-40 or DX Decade Award. The fee for endorsement stickers will be $2.00 each.

8) All award applications should be mailed to: Chuck Stuart N5KC, 5115 Menefee Drive, Dallas TX 75227.

show date/time in GMT, station worked, band, mode, exchange, and score. Use separate sheets for each band with over 25 contacts. Submit a cross-check sheet similar to ARRL operating aid #6 if you have over 200 QSOs. Logs must be legible to avoid disqualification. Mailing deadline is May 1. Send business size addressed envelope to: Dave Goggio W4OGG, 1419 Favell Drive, Memphis TN 38116.

WISCONSIN QSO PARTY
Starts: 2100 GMT March 31
Ends: 0300 GMT April 2

Maximum operating time is limited to 24 hours. Phone and CW are the same contest. Any station may be worked only once using all bands 160 to 10 meters. Novices or Technicians sign /N or /T.

EXCHANGE:

WISC stations send RS(T) and county; others send RS(T) and state or province.

SCORING:

Phone contacts count as one QSO point, while CW contacts count as two QSO points. WISC stations multiply QSO points by number of states plus WISC counties; others multiply QSO points by number of WISC counties. Foreign countries other than VE and VO count as additional states. Novices score as above, then multiply total by 2.5 to get final score.

FREQUENCIES:

3550, 7050, 14050, 21050, 28050, 3980, 7280, 14280, 21380, 28580, and 20 kHz up from the bottom of the Novice bands.

AWARDS:

Awards to the highest score per state and the highest club score. Awards to be presented at the Central Division Convention in June in Milwaukee.

ENTRIES:

Logs must show date/time in GMT, band, mode, call, report, and score. Logs must be legible or will be classified as check logs. Logs containing more than 100 contacts must also be submitted with ARRL or similar dupe sheet. All entries must be postmarked before May 1. Send results to: Wisconsin QSO Party, c/o West Allis RAC, PO Box 1072, Milwaukee WI 53201.

WORKED ERIE, PENNSYLVANIA AWARD

This certificate is sponsored by the Radio Association of Erie. In order to qualify for the certificate, an amateur must prove two-way contact with ten Erie amateurs on any band in any mode or combination thereof. A copy of his QSL cards or log entries will be required as proof. A self-addressed, stamped envelope will ensure a speedy return of the award. Send inquiries or information to: RAE, Box 844, Erie PA 16512, or John Lindvay WB3IFD, 908 West Ninth St., Erie PA 16502.

WARC 1979 CW DIPLOMA

On occasion of WARC 1979, the REF is making available the CW Diploma for contacts made between January 1 and December 31, 1979. Necessary are a minimum of 300 QSOs to include: 1 station of the city of Geneva—WARC 1979, 50 French stations dealing a code number with the RST, 10 cantons HB, 5 provinces ON, 25 provinces Italy, 8 districts EA, 5 provinces PA, 15 DOK of Federal Germany, 1 station of G, GI, GM, GW, and 15 other European countries. Apply before April 1, 1980, to REF (WARC 1979), Square Trudain 2, 75009 Paris, France. Include 10 IRCs and a verified list of QSOs. Per country, a rank will be established and the first will be honored with an additional award.

Results

1978 CAN-AM CONTEST RESULTS

TROPHY WINNERS—SINGLE OPERATOR

American Champion, Mixed—David Hachadorian K6LL/7
Canadian Champion, Mixed—Jim Bearman VE5DX
American Trophy, CW—John Hawkins K5NW
American Trophy, Phone—Jack Webb W5JW
Canadian Champion, CW—Lee Sawkins VE7CC
Canadian Trophy, Phone—Sid Kemp VE7BGK

Multi-Operator Champion—Walt Tillner CG3IXE
Club Competition Champion—BC Contest Club

Free one-year subscription to CANADX bulletin LONG SKIP winners are:

Rick Donelly WD5EEF; Gary Fosket W1ECH/1; ARC Urbana III W9YH; Phil Alman WD8DPB; Joe Picior WB4OSN.

MULTI-OP—CW

CG3IXE	ON	302400	607	175*
VE2FU	PQ	291088	633	161*
VE3HBX	ON	185148	470	139
W9YH	IL	137904	477	136*
N5TV	LA	71900	327	100*

MULTI-OP—PHONE

CG3IXE	ON	254184	729	119*
VE1AWN	PE	171304	633	92*
VE3HBX	ON	170646	493	119
N4UF	FL	101822	494	98*
WB3GPR	PA	60277	256	109*
WD5EEF	TX	29475	176	75*
VE3FEA	ON	27090	156	63
N5TV	LA	20944	165	56*

MULTI-OPERATOR
Mixed—Canada/U.S.

CG3IXE	556584*
VE3HBX	355794*
VE2FU	291088*
VE1AWN	171304*
W9YH	137904*
N4UF	101822
N5TV	92844
WB3GPR	60277
WD5EEF	29475
VE3FEA	27090

CLUB COMPETITION
Canada—U. S.

1. BC Contest Club 2683539
2. Toronto DX Club 1369143
3. 807 Contest Club 194184
4. Farout ARC 62399

* certificate winners

TOP TEN—CANADA
Mixed

1. VE5DX	1219884*
2. VE7CC	1134987*
3. VE7BGK	704217*
4. VE7CNY	517310*
5. CG4SW	435778*
6. VE3KZ	397308
7. VE7CMK	288673
8. VE6MP	262071
9. VE4OY	218151
10. CG3FFA	194584

CW

VE7CC	418964
VE5DX	403704
VE7CMK	288673
VE3KZ	238044
VE4OY	176900
VE1AIH	147030
VE1AJP	137475
VE7AV	106272
VE3DRB	105216
VE7DLM	101813

Phone

VE5DX	816180
VE7CC	716023
VE7BGK	704217
VE7CNY	517310
CG4SW	397458
VE6MP	210177
CG3FFA	194584
VE4IE	179634
VE3KZ	159264
VE6AGV	146787

TOP TEN—U. S.
Mixed

1. K6LL/7	727192*
2. W5JW	466150*
3. AA6DX	375756*
4. K5NW	335440*
5. K5UR	295104*
6. WB4SKI	269698
7. WA4HRG/7	186410
8. K8MO	173816
9. WAØLKL	164794
10. K1ZZ	164794

CW

K6LL/7	214240
K5NW	173404
WAØLKL	166995
K1ZZ	164794
W5JW	154624
WB4OSN	142737
AA6DX	109368
WA4HRG/7	109347
K4BAI	105664
WD8DPB	91542

Phone

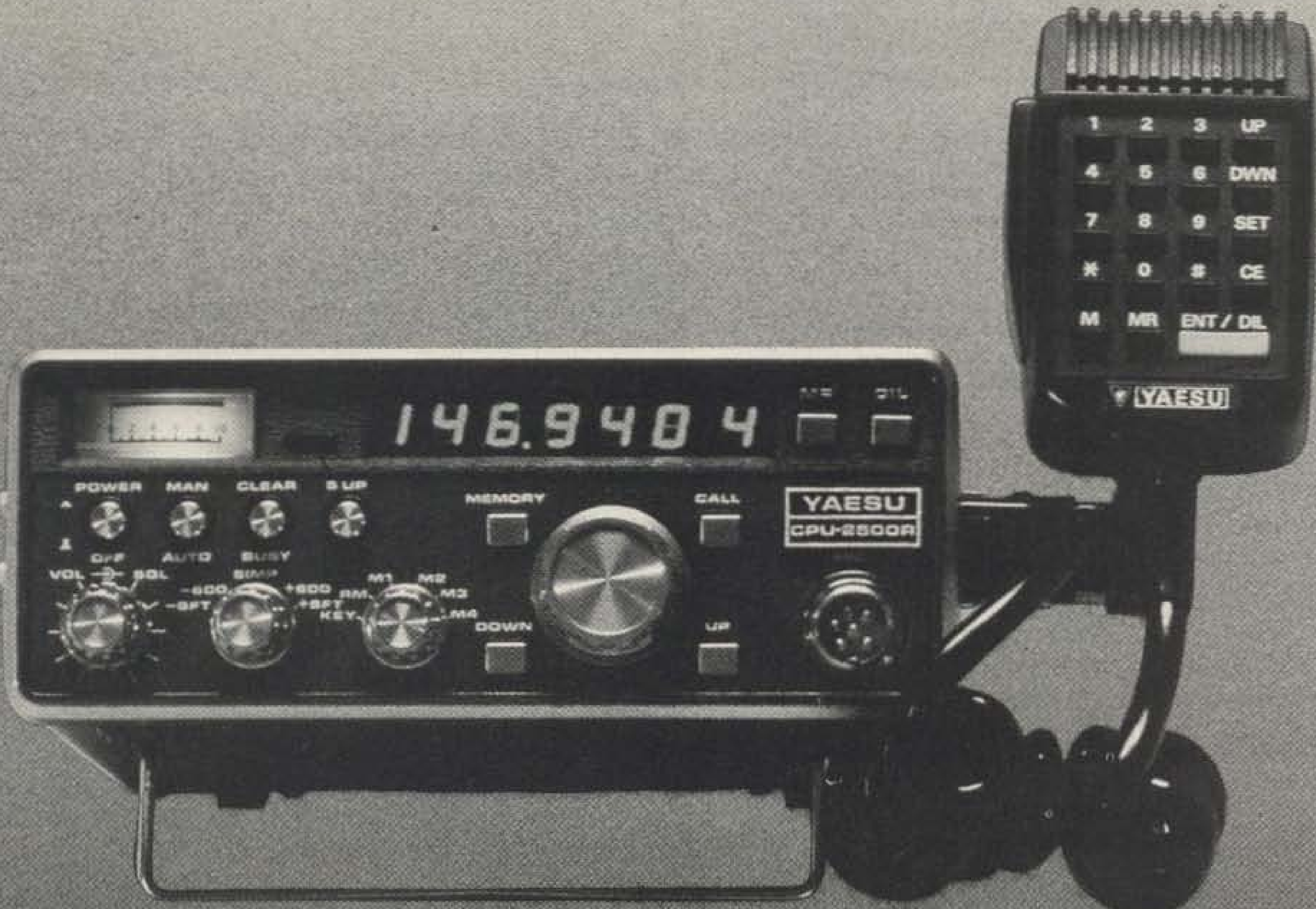
K6LL/7	512952
W5JW	311526
K5UR	295104
WB4SKI	269698
AA6DX	266388
K5NW	162036
WB6RDA	133245
WB7RFA	99246
WB5TAP	90474
K8MO	85176

Ham Help

I would appreciate it if any Canadian ham who is willing to take his portable rig to school or have about a half-dozen kids visit his shack to talk to students in another province would send a QSL card to me. On the blank side of the card, please list the bands you can use and the modes (AM, SSB, RTTY, OSCAR, SSTV), to help match you to the ham in the other province. Our Ministry of Education "school-to-school" coordinator seems quite interested in helping me match up classes and hams.

Bob Hulme VE3DNG
Box 430
Temagami, Ontario
Canada P0H 2H0

YAESU ANNOUNCES THEIR SENSATIONAL COMPUTER AGE CPU-2500R/K 2-METER 25 WATT TRANSCEIVER



Again, Yaesu, THE RADIO, takes a giant step forward with their computer age 4-bit Central Processor Unit controlling the Phase Locked Loop. It allows selection of 800 PLL channels with touch button station selection built into the optional keyboard mike . . . *PLUS* automatic scan, up or down across the entire 2 meter band . . . *PLUS* four memory channels . . . *PLUS* optional tone squelch encoding . . . *PLUS* tone burst . . . *PLUS* high SWR and reverse voltage polarity protection . . . *PLUS* 3/25 watts of power . . . *PLUS* fixed ±600 KHz offsets . . . *PLUS* programmable offsets . . . *PLUS* tone pad microphone option . . . *PLUS* bright 3/8" LED six digit frequency display and another LED for memory display . . . and much more.

The CPU-2500R/K is a space age radio for discriminating amateurs utilizing the latest solid state techniques and it's on your dealer's shelf today!

rice And Specifications Subject To
hange Without Notice or Obligation

YAESU
The radio.

YAESU ELECTRONICS CORP., 15954 Downey Ave., Paramount, CA 90723 ● (213) 633-4007
YAESU ELECTRONICS Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246

RTTY Loop

Marc I. Leavey, M.D. WA3AJR
4006 Winlee Road
Randallstown MD 21133

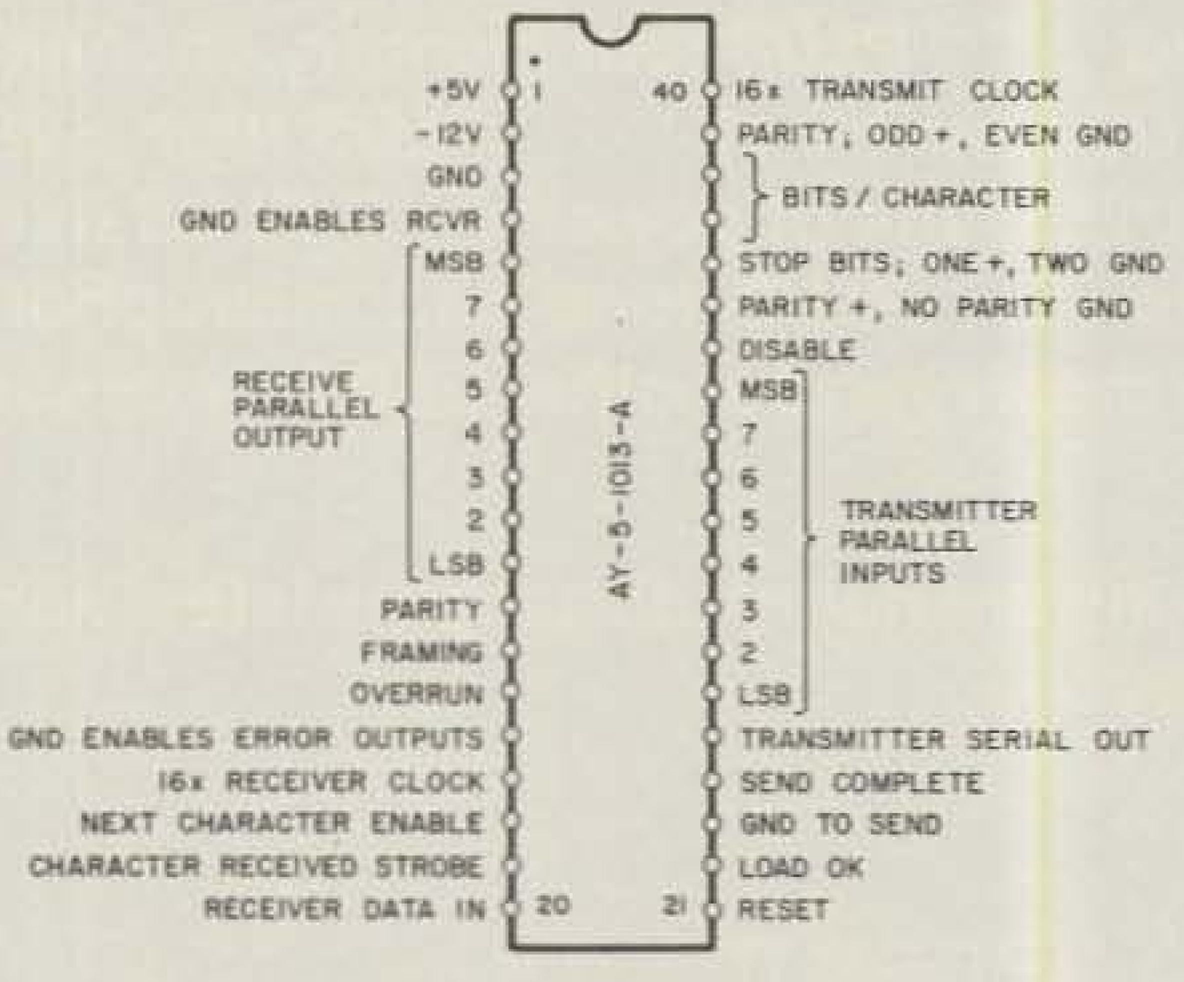
Allow me to make a rash assumption: You read *73*. Now, that is not quite so unfounded; I mean, you are reading this column, right? Right. Hello, out there! Unless this is your first issue of *73*, or you are a hopeless tube buff, by now you've read about a little device known as a UART. The reason that this chip (yes, Virginia, it is an IC) is important is the subject of this month's column.

Plunging right to the heart of the matter, Fig. 1 is a pinout diagram of a popular UART, the AY-5-1013-A. Available from several sources advertising in *73*, as well as Radio Shack and Jim-Pacs frequently found in electronic and computer stores, this chip is usually priced under seven dollars. Its rather long designation is frequently truncated to a "1013," and it is pin-compatible with several other UARTs on the market.

"UART" stands for "*U*niversal *A*synchronous *R*eceiver *T*ransmitter." Now before you get all lost in that sea of words back there, let's dissect it a bit and see if we can understand it. Starting from the rear, the first word we encounter is "transmitter." OK, we are all hams, so we know what that means, right? Let's see, the antenna must go here, the key, hmmm, where do you plug in the key? Hold up, hee-haw, WHOA! This ain't that kind of transmitter. This is a data transmitter which, when coupled with its companion receiver, will allow us to convert from serial data to parallel and back again. You remember serial and parallel, don't you? We covered that last year. As you may recall, the most efficient means for transferring data long distances is in serial format. Generation, however, is best done in parallel. Last month we looked into one such technique. But we digress.

Okay, so here we have generated some parallel data, five to eight bits long, and we wish to send it. Some fancy logic and a shift register could put the data out, appending the necessary START and STOP bits, and accomplish the task. But you know, a bunch of chips, all that wiring, and remember Murphy's Law as applied to circuit complexity. No, that would be too messy; let's use the UART. To send data is rather straightforward. The chip must be configured for the number of data bits, stop bits, and parity. Then a clock of sixteen times the baud rate is applied, and the data is presented to the transmitter parallel inputs. Grounding the "send" line momentarily begins the process and, lo and behold, the data flows serially out of the UART.

The *R* stands for receiver and, while basically similar to the transmitter, albeit backwards, there are a few hookers. The data comes into the receiver serially, is converted to parallel, and is presented to the receiver output. A pair of signals is also used to state that there is data ready to be picked up, and that the data has been picked up and new data may replace it. This is frequently termed "handshaking," for what seem to me to be obvious reasons.



PIN 37	PIN 38	BITS/CHAR
0	0	5
0	I	6
I	0	7
I	I	8

Fig. 1. AY-5-1013-A pinout diagram.

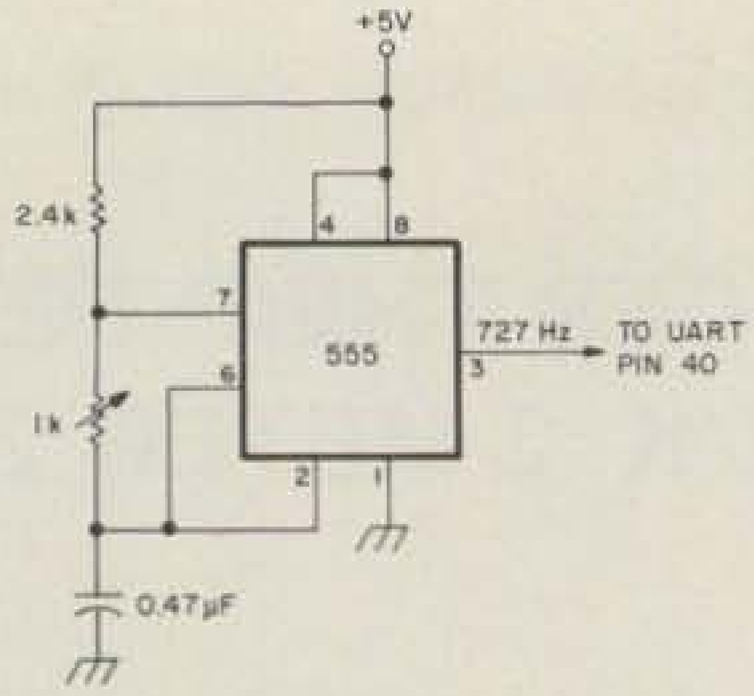


Fig. 2. 727 Hz clock.

This handshaking between the UART and the device using the data brings us to the *A*, standing for asynchronous. Realize if you will that, although the data is going by rapidly, and to your plodding visage continuously, it really is going in a start-stop fashion, with delimiters defining each character. Although bits within each character are being sent at a given baud rate, characters themselves may be sent as rapidly as the system will handle or whenever the operator decides to hit a key. This is asynchronous data flow. If the data were being sent at a known, constant rate, there would be no need for character delimiters. This is called synchronous data, and devices capable of generating either synchronous or asynchronous data are frequently termed USARTs. I'll let you figure that one out for yourself.

The *U*, of course, is for universal. I guess that means they can use them on the *Enterprise*. So that's the UART. At least you've got some idea now of what this multi-legged chip does. Let's see how to hook one up.

Remembering that we need a clock sixteen times the baud rate, dig out a 555 and look at Fig. 2. The baud rate for 60 wpm RTTY is about 45.45, and sixteen times that is roughly 727 Hz. The values shown in the diagram will give that frequency, with the variable resistor used to fine trim the output.

Fig. 3 shows how to hook up the UART itself. We are not using the receiver portion of the chip here, and that half may be safely ignored. The character to be sent is programmed by grounding the space bits on the transmitter. When the "send" line is grounded, the character will be sent out over the output line. Before we leave the UART, note that it requires not only +5 V, but also −12 V at a few mA. Although there are other UARTs not requiring this supply, we are showing it because the 1013 is the most widely available.

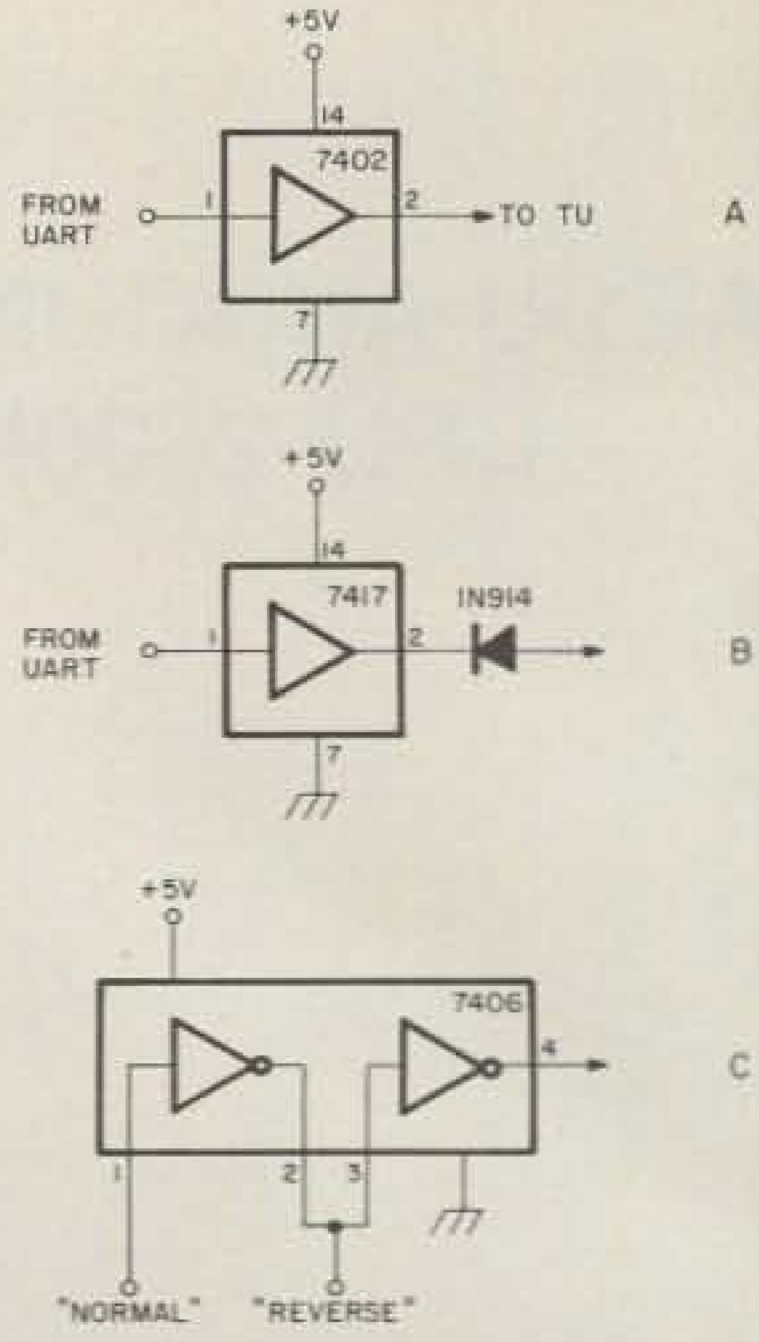


Fig. 4. Output buffers. (a) 7407. (b) 7417. (c) 7406.

The output from the UART is a TTL-compatible line that goes low on space and high on mark. Most keying schemes, including the one shown for the ST-6 a while back, use this convention. To prevent interaction with the TU's circuitry, however, one more chip will be used. A 7407 buffer, wired as in Fig. 4(a), will be used between the UART and the keyer. The 7407 is an "open-collector" buffer. That means that instead of giving a TTL high level during mark, it presents an open circuit. We then obviate the risk of feeding a voltage into a sensitive circuit, be it the ST-6 or a shift-pot keyer. A standard buffer, like the 7417, can be used with a blocking diode, shown in

Continued on page 180

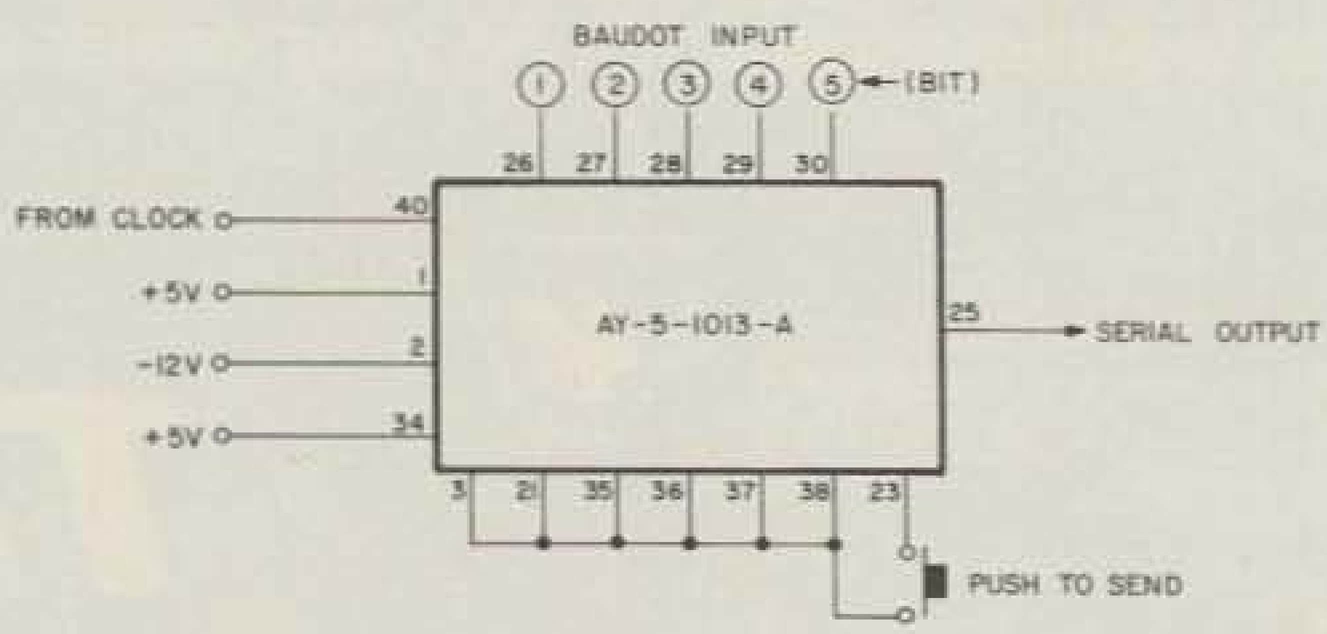


Fig. 3. UART hookup.

RAM Scan Your KDK

—amazing flexibility for $30

This mod was made for you and me.

Art Chapman WB2JHN
30 Cymbeline Dr.
Old Bridge NJ 08857

How would you like to program and scan up to 16 frequencies with your KDK, 7400, 2036 or other synthesized rig? Utilizing six readily-available ICs, this scanner will display the scanned frequencies on your KDK's readout, give you a programmable priority frequency, be no larger than a pack of king-size cigarettes, and cost you no more than $30. Sound interesting? Read on.

The idea struck me one day while reading an ad for the 1-4 MHz scanners for the KDK and 7400. I wondered how many times those scanners would stop at unwanted repeater input frequencies, noise, and other undesirable signals. Why couldn't there be a better solution for less than $100?

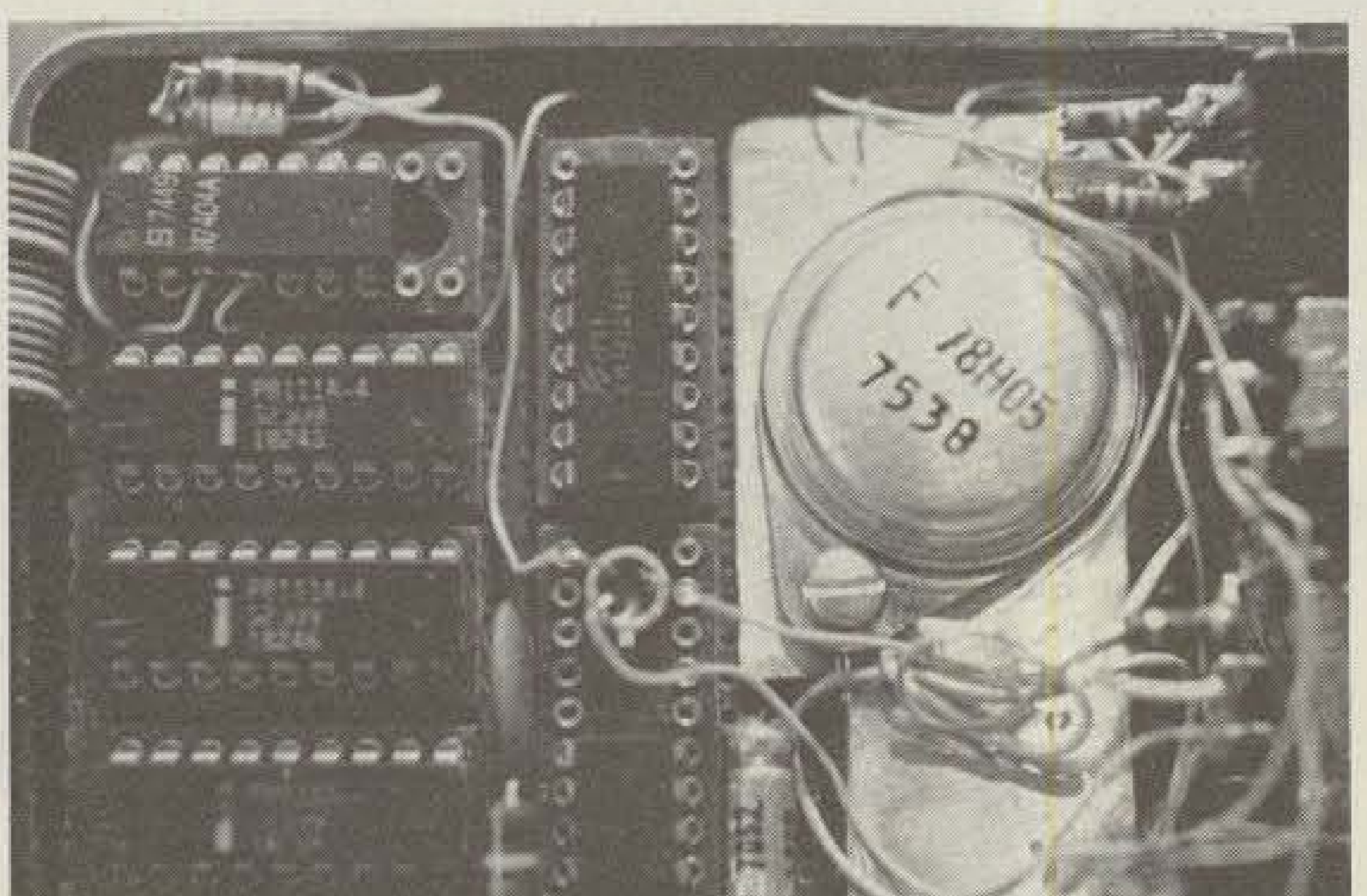
Although this article is geared to the KDK, the concepts and circuitry are adaptable to most other synthesized rigs. An understanding of the various stages I went through developing the scanner should help those with other than KDKs apply it to their radios.

Looking at the KDK's priority channel, which simply ties a set of diodes across the inputs of the decade counters, 146.52 would be connected as shown in Fig. 1.

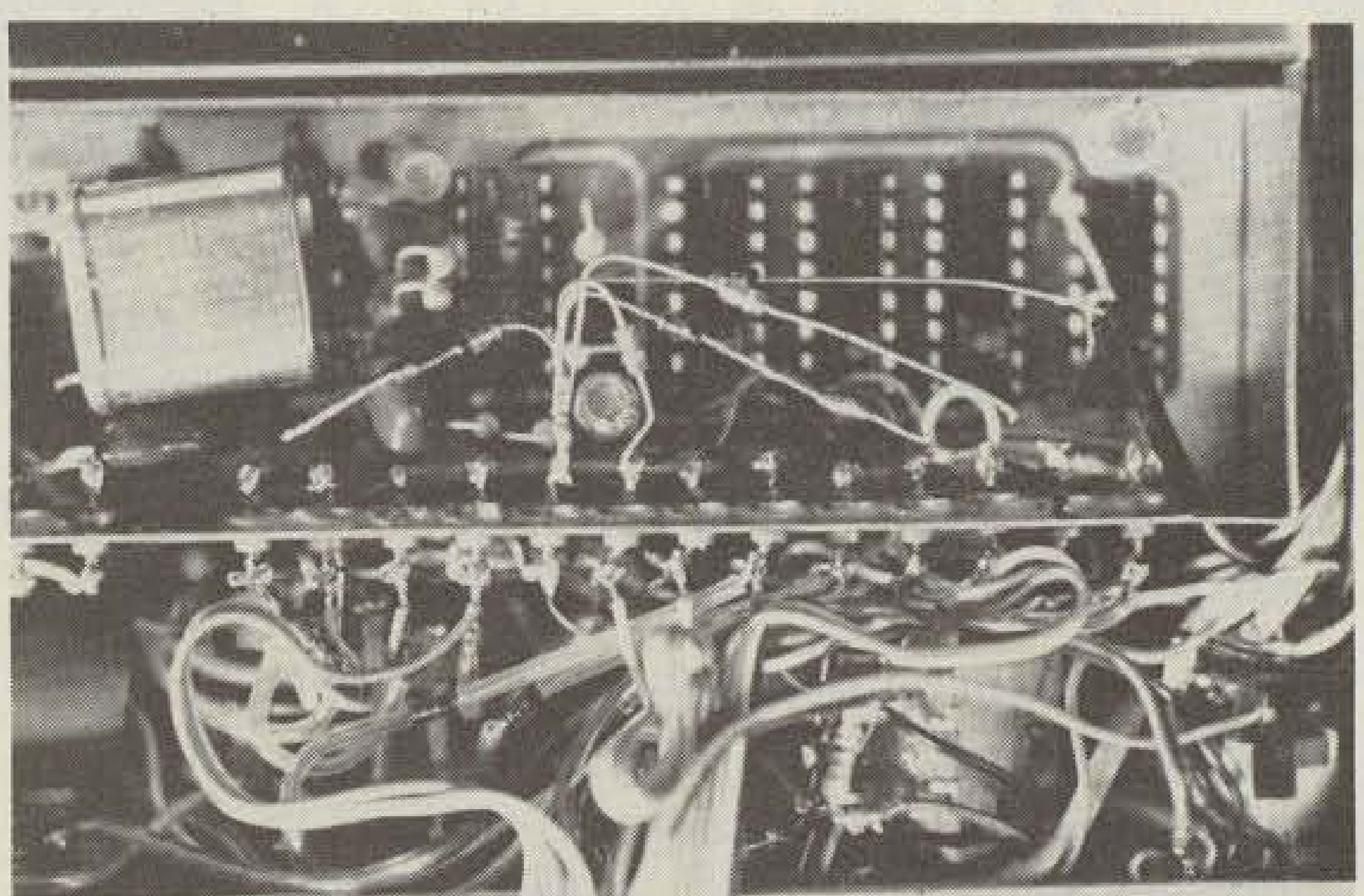
Why, then, couldn't we build a board with a series of diode arrays and scan them? A typical scanning circuit might look like Fig. 2.

With the circuit shown, IC-22S owners could easily scan their rigs. The problems with this scheme are that it takes gobs of diodes and a relatively large diode matrix board. But it still works and works well.

Photos by Jim Stansberry WA2HEN

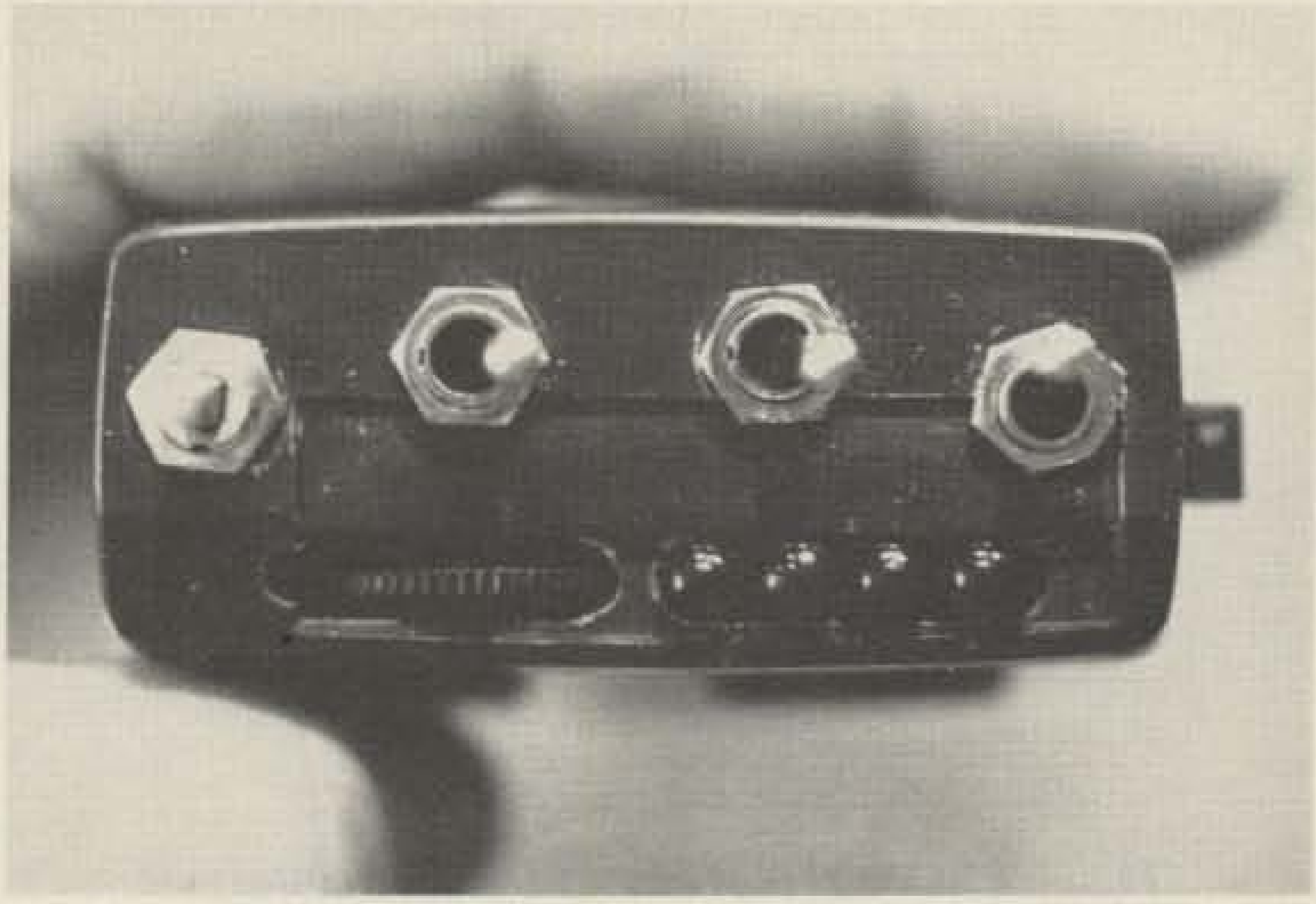


Close-up of the scanner hand-wired on vectorboard. The clump of components (upper left) and the transistor (center) were a last minute fix to use the KDK's busy light and unlock light for scanner control. Note the heat sink under the 5 V regulator.



View of the tie points for the twelve memory lines into the PLL section. Note the diodes hanging in midair. The common junction of the diodes does not have any wire soldered to it. Object (lower left) in shrink tubing is an ME-3 tone encoder.

The 16-conductor flat cable was routed around the side and through the case at the front molding. The light object at the point of entrance is a folded-over business card used to protect the cable from being pinched.



View of the scanner's front panel.

However, why use all the diodes when there is a unique device on the market called a PROM (programmable read only memory). The PROM, when properly programmed, can and does look like a diode array; however, we can put lots of those arrays into a 16-pin chip. Using the 8223 or 82S23 32 x 8 PROM, we could have up to 32 separate arrays. If we consider the 12 bits required to generate a frequency—4 for the MHz range, 4 for the 100 kHz range, and 4 for the 10 kHz range—this system will need 2 PROMs. See Fig. 3.

The PROM should be visualized as a matrix of 32 switch positions, each having 8 diodes (see Fig. 4).

By properly programming the PROM, you actually eliminate the diodes necessary to generate the desired frequency. The PROM must then be addressed in sequence (switched to the desired matrix) to connect the correct array to the 74192 decade counters. The scanner would now look like Fig. 5.

This system worked very well on a prototype, using LEDs to check out its capabilities. Although the 8223s were programmed for 32 frequencies, only 16 were used since the 74161 has 4 output lines and can address only 16 locations of the PROM.

The major drawbacks of this system are in the fact that the 8223 is a bipolar PROM and, once programmed, it cannot be changed. The scanner would now have fixed frequencies to be scanned. To change frequencies, you must replace the PROMs with another pair programmed to your new requirements.

The Final Solution

Enter the RAM (random access memory). The RAM, for those unfamiliar with this type of device, can be programmed like a PROM. However, unlike a PROM, it can be erased electronically and reprogrammed as desired. Its major disadvantage is its volatility—when power is shut off, it loses its program.

For the scanner, the Intel 2111 RAM was used. The 2111 is a 256 x 4 device, which one can again visualize as 256 switch positions of 4 diodes each. The application will use 3 of these devices to give us the 12 bits required. However, we will only employ 16 of the 256 positions. The block diagram can be seen in Fig. 6.

Construction

The final design was built on a 2" x 3" vectorboard using sockets and hand wiring. Layout should not be critical, but, for ease of construction, the memories should be side by side since much of the wiring is repetitive. The LM309 5 V regulator is kept in the scanner to keep the amount of work in the KDK to a minimum. Since the regulator is dropping approximately 7 volts at approximately 250 mA, it does get very warm and requires a heat sink. There are other ways of developing the +5 V, but this was the quickest and dirtiest—warmest, too, I'm sure.

Address	Frequency
0000	146.52
0001	146.55
0010	146.58
0011	146.67
0100	146.70
0101	147.12
0110	154.91
0111	155.19
Unlock light will go on	
1000	147.51—may be bypassed
1001	147.51—will now stop if previously busy
1010	147.54
1011	147.57
etc.	

Table 1.

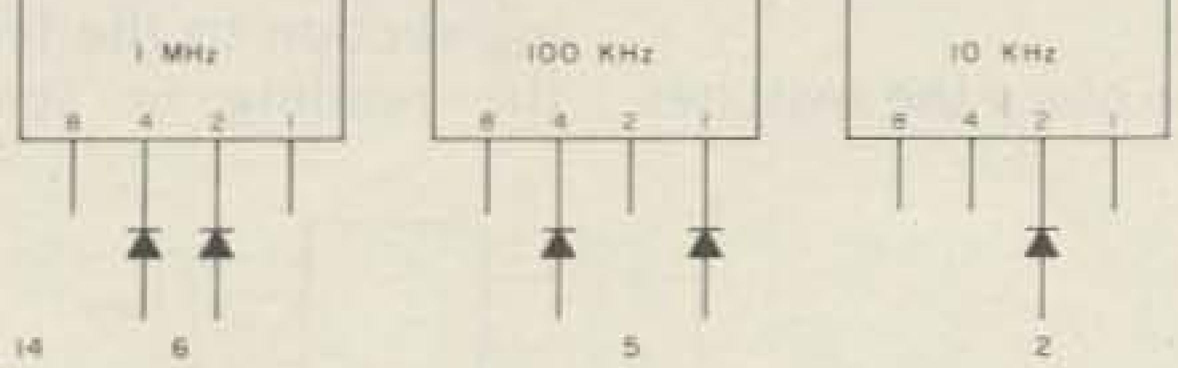


Fig. 1. Binary representation at 146.52.

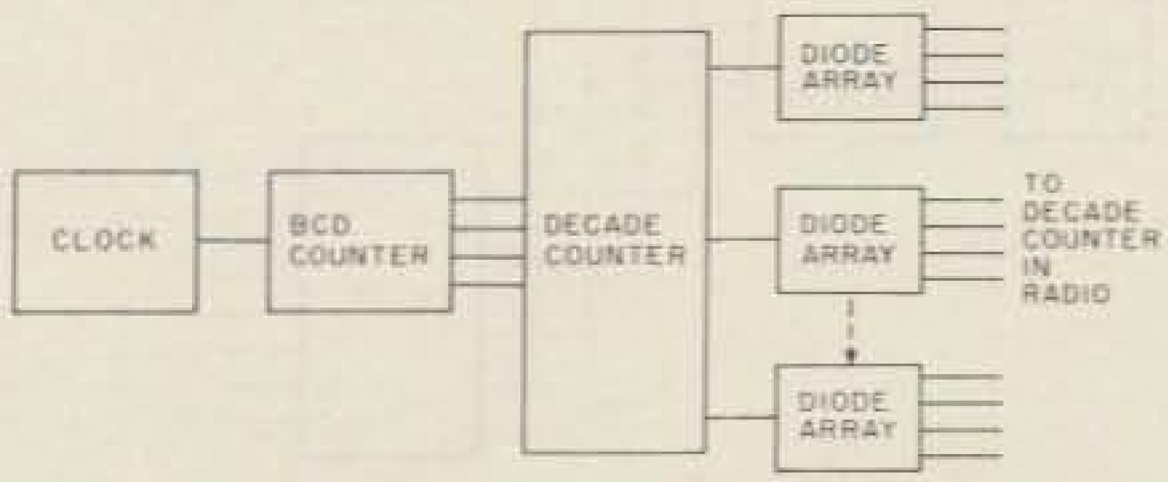


Fig. 2. Simple diode-array-type scanner.

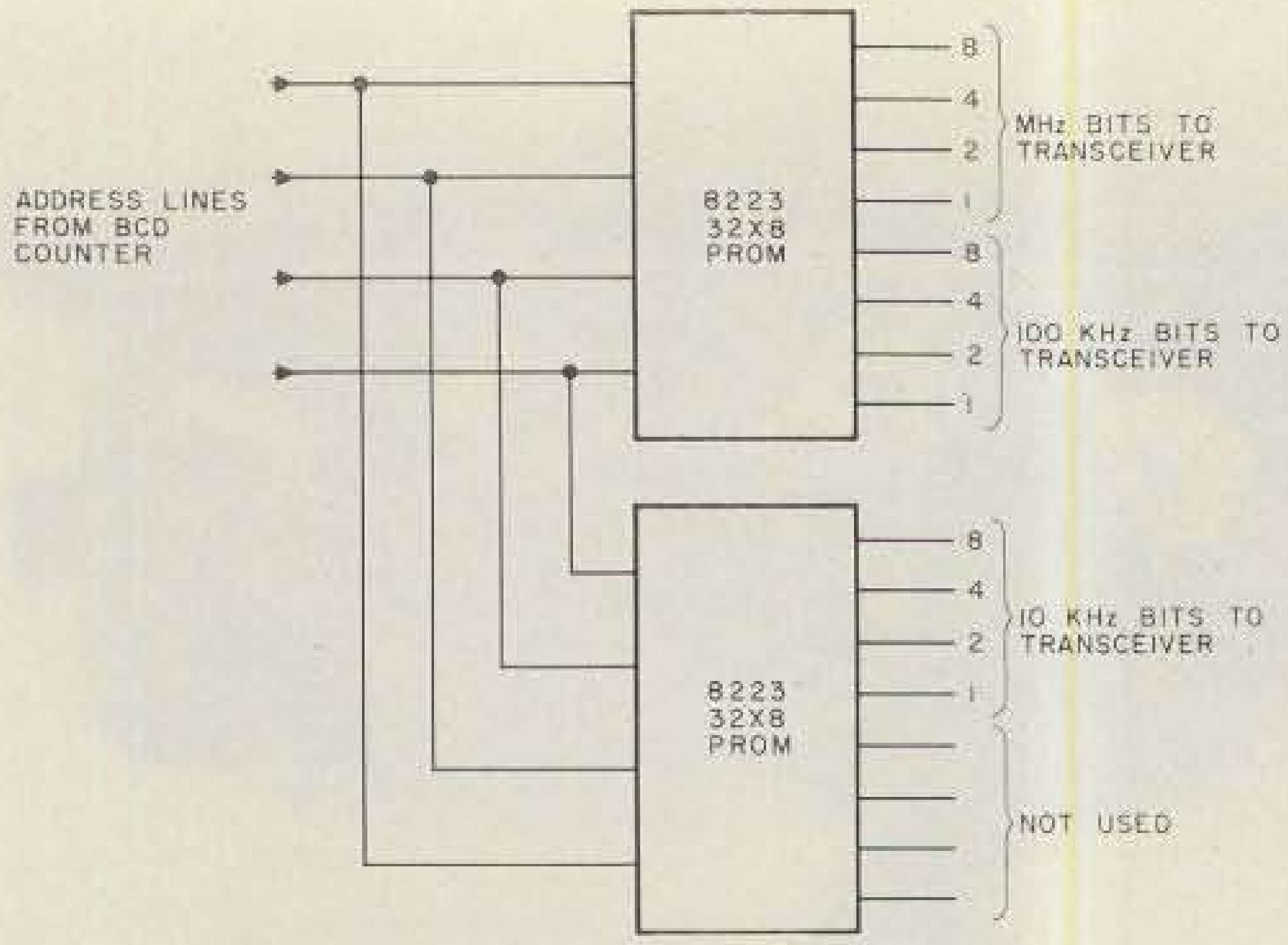


Fig. 3. PROM replacement for diode arrays.

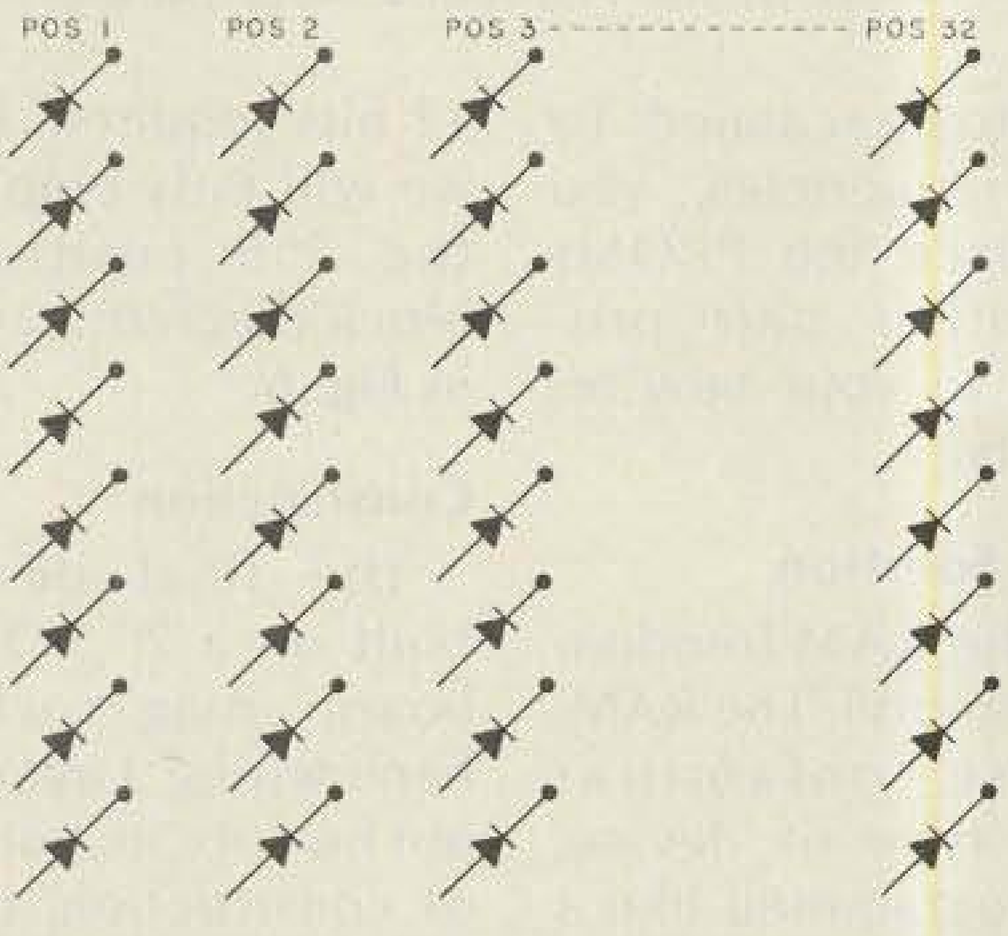


Fig. 4. Switch and diode representation of a 32 x 8 PROM.

For those of you who recognize it, the case is an old Radio Shack weather radio, the guts now serving as an audio amplifier somewhere else in the shack. With all due respect to Radio Shack, the scanner fits nicely into the case. I use the old volume switch for power on-off only. The other slot was filed out to make room for the address-indicating LEDs. Of course, any other case would work as well.

Try to place the switches in a convenient configuration so you will understand exactly what you are doing during programming and operation. My configuration can be seen in Fig. 7.

The program push-button and the write/read switch are together, since, to program, the write/read switch must be in the write position. To scan, it must be in the read position, thus there is an imaginary dividing line with the writing section to the left and the reading or scanning section to the right.

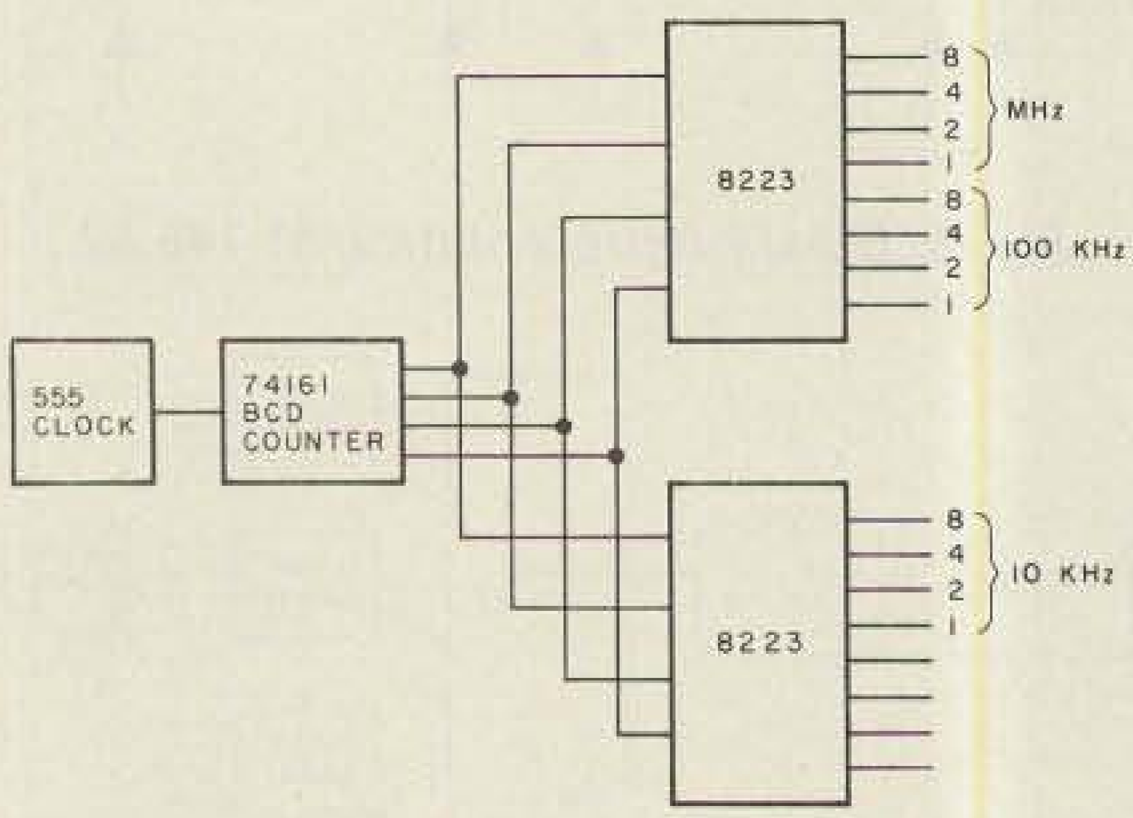


Fig. 5. Block diagram of a PROM-type scanner.

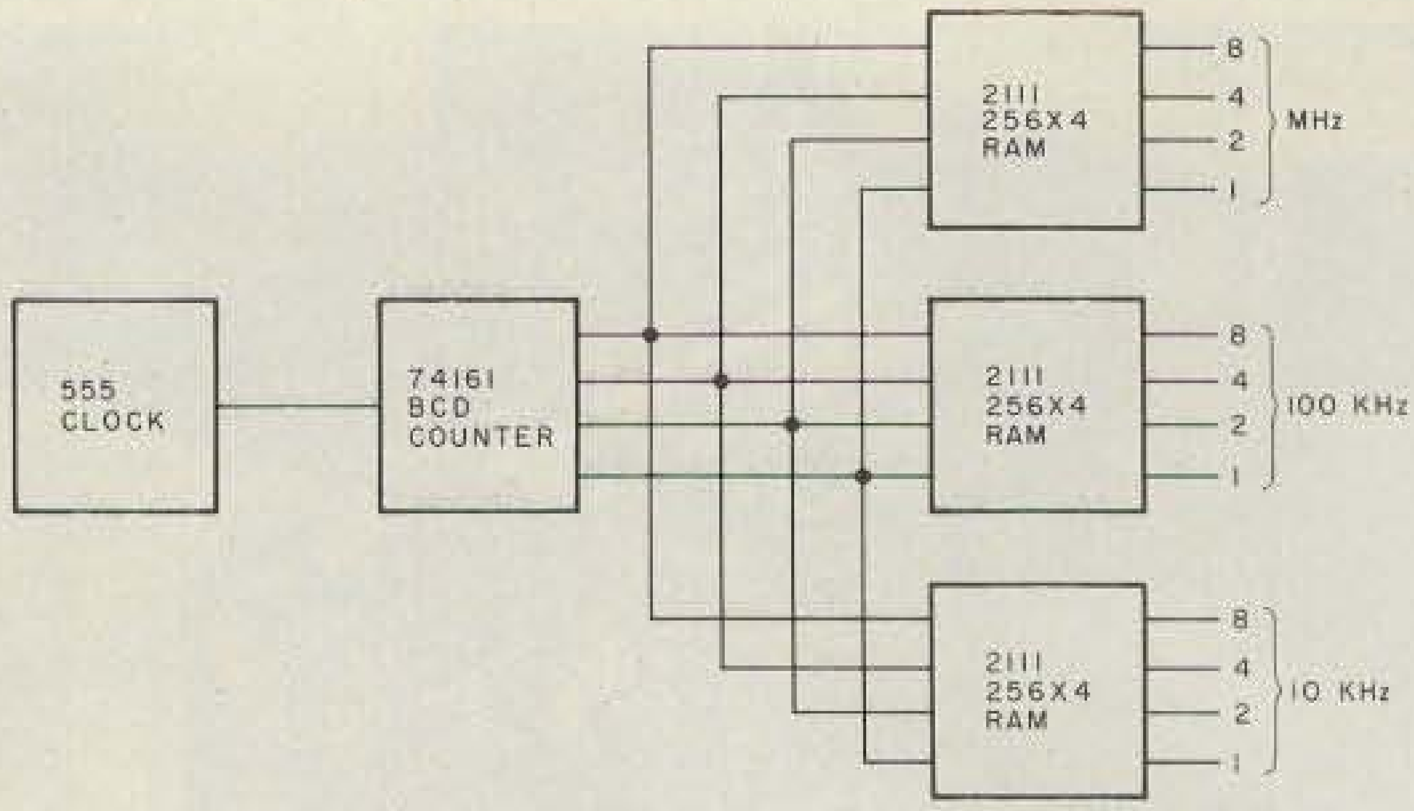


Fig. 6. Block diagram of a RAM-type scanner.

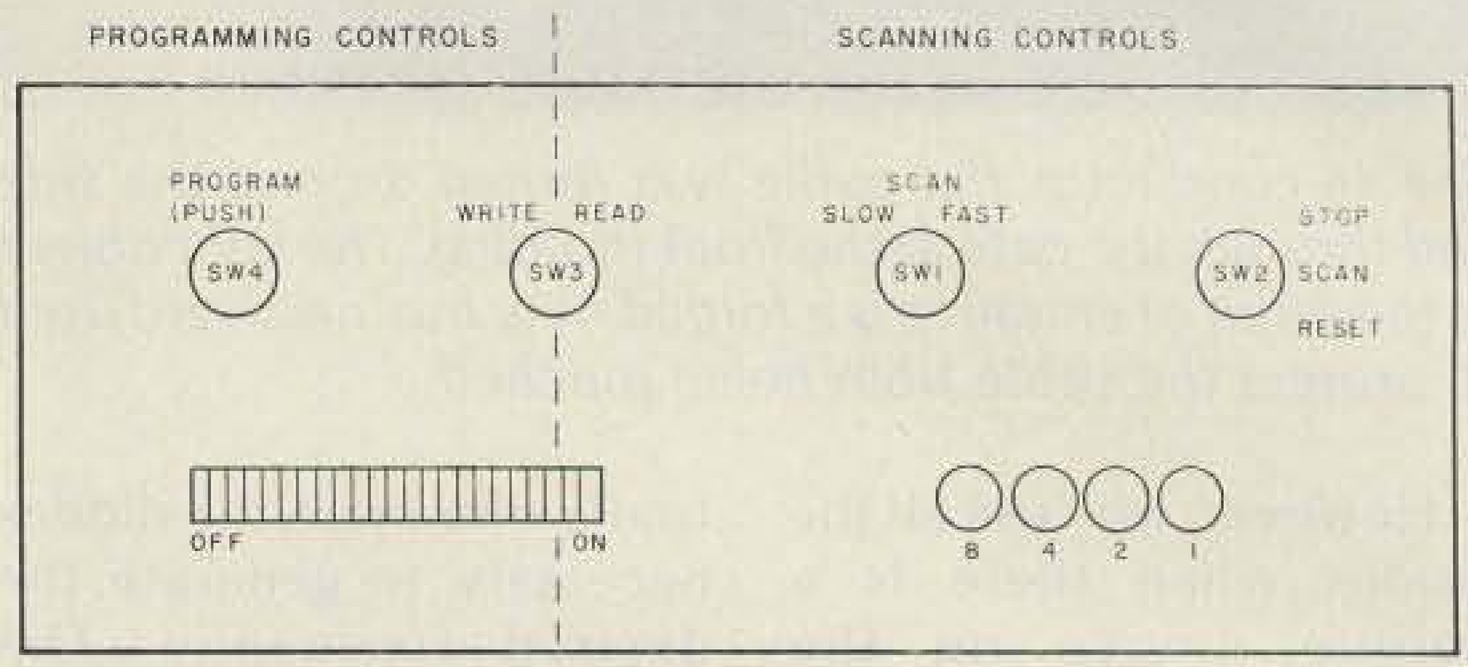


Fig. 7. Front panel layout.

The 555 timer, running as an astable oscillator, generates the clock pulses for the 74161 BCD counter. The BCD 16-bit count output steps through the address lines of the 2111 RAMs at approximately one step (frequency) per second in the slow rate or all 16 steps (frequencies) in approximately 1.5 seconds. The I/O lines (pins 11 through 14) on the 2111 are tied directly to the 74192 decade counters in the PLL section. When a frequency is dialed up, a corresponding binary count is found on the input lines of the 74192s (TTL level of 1s and 0s). When SW3 is in the read position, the RAMs are in a high impedance mode, therefore having no effect on the circuit. In the write position, data can then be loaded into an address by pushing the program button.

The 7404 hex inverter inverts the address information in order to allow the proper LEDs to light when the address lines are high. (Trying to keep track of the address with negative in-

View of the scanner on top of the KDK. Velcro™ is used to hold it in place.

dication on the LEDs can drive you bananas.)

Installation

For those of you who have never opened up your KDK, now's the time. First, find the PLL section. Remove or lift the priority diodes from the feedthrough posts. If you choose to leave them in, make sure road vibration won't allow them to move back and touch the tie posts.

Solder 12 wires of the 16-conductor cable to the 12 posts (on the outside of the PLL box) used for priority diode programming. Be sure you don't use the diode common tie point. Actually, the order of wires to the tie point is not critical, since what you put in the memory from a particular pin will come back out of the memory back to the same pin.

Solder one of the remaining wires to +12 V (the power-on switch is convenient). Solder another wire to a convenient ground. Solder another wire to the busy light (not the common line between the busy and unlock light).

Solder a wire to the unlock light (optional). Those of you who modified the KDK to high-band operation as per Al Klein W2PMX (73, Dec., 1977, pg. 177) will need this wire. When scanning the 144-148 MHz range, chances are you will never encounter a PLL unlock situation. However, when you scan up to 155 MHz and come back down to 146-147 again, the PLL takes approximately ½ second to lock up. During that ½ second or so, the scanner will bypass the programmed frequencies to follow the high-band frequencies. Thus, this option will stop the scanning automatically until the unlock light goes out, resulting in no bypassed frequencies.

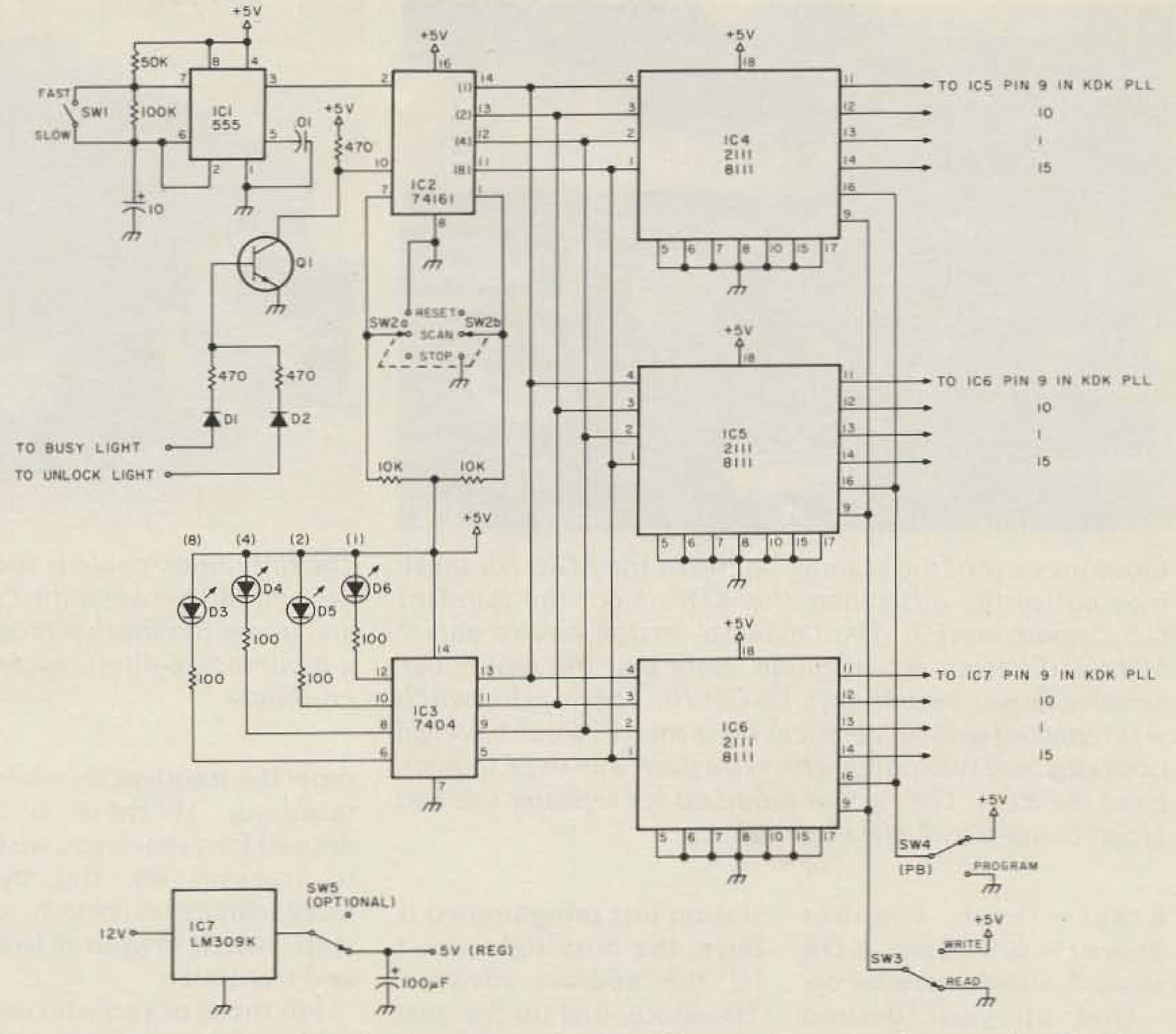


Fig. 8. KDK RAM scanner schematic. Switches are shown in scan mode. Numbers in ( ) are binary data.

Precheck

Prior to connecting the scanner to the KDK, you can power the scanner up and check the system in the following manner: Remove the 2111s from the sockets. Preset the switches: Write/Read—read; Stop/Scan/Reset—scan, Slow/Fast—slow. Turn the power on.

The LEDs should step through in a binary fashion. If not, check that the 74161 is getting a clock at pin 2. If not, check your 555 circuit.

If you're getting proper scanning at the LEDs, turn the unit off and plug in the 2111s. Use caution, as these are MOS devices and must be handled accordingly.

Operation and Programming

Preset the scanner controls to the following: Slow/Fast — slow; Write/Read—write; Stop/Scan/

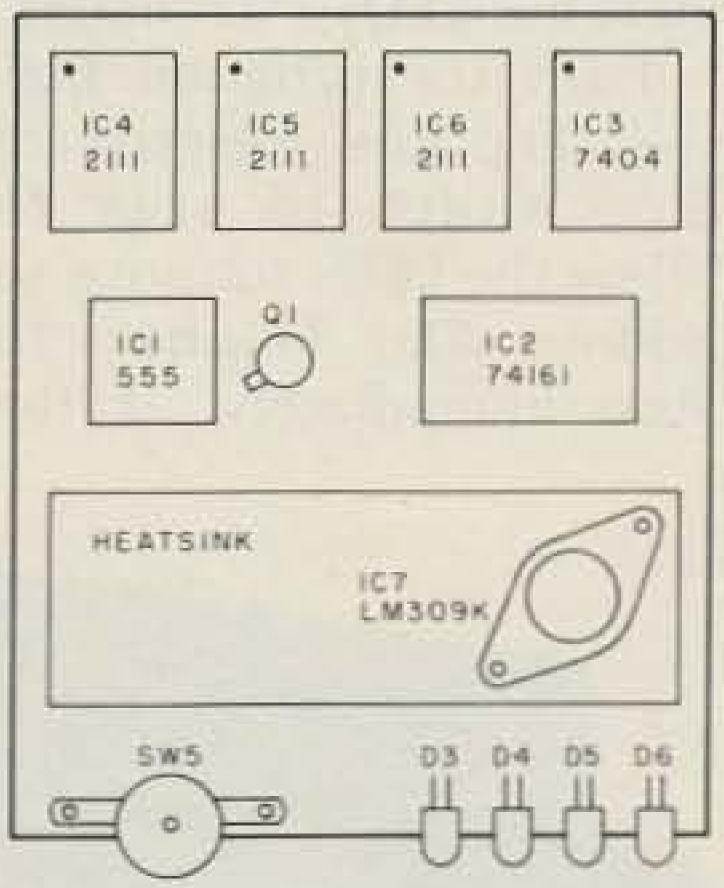


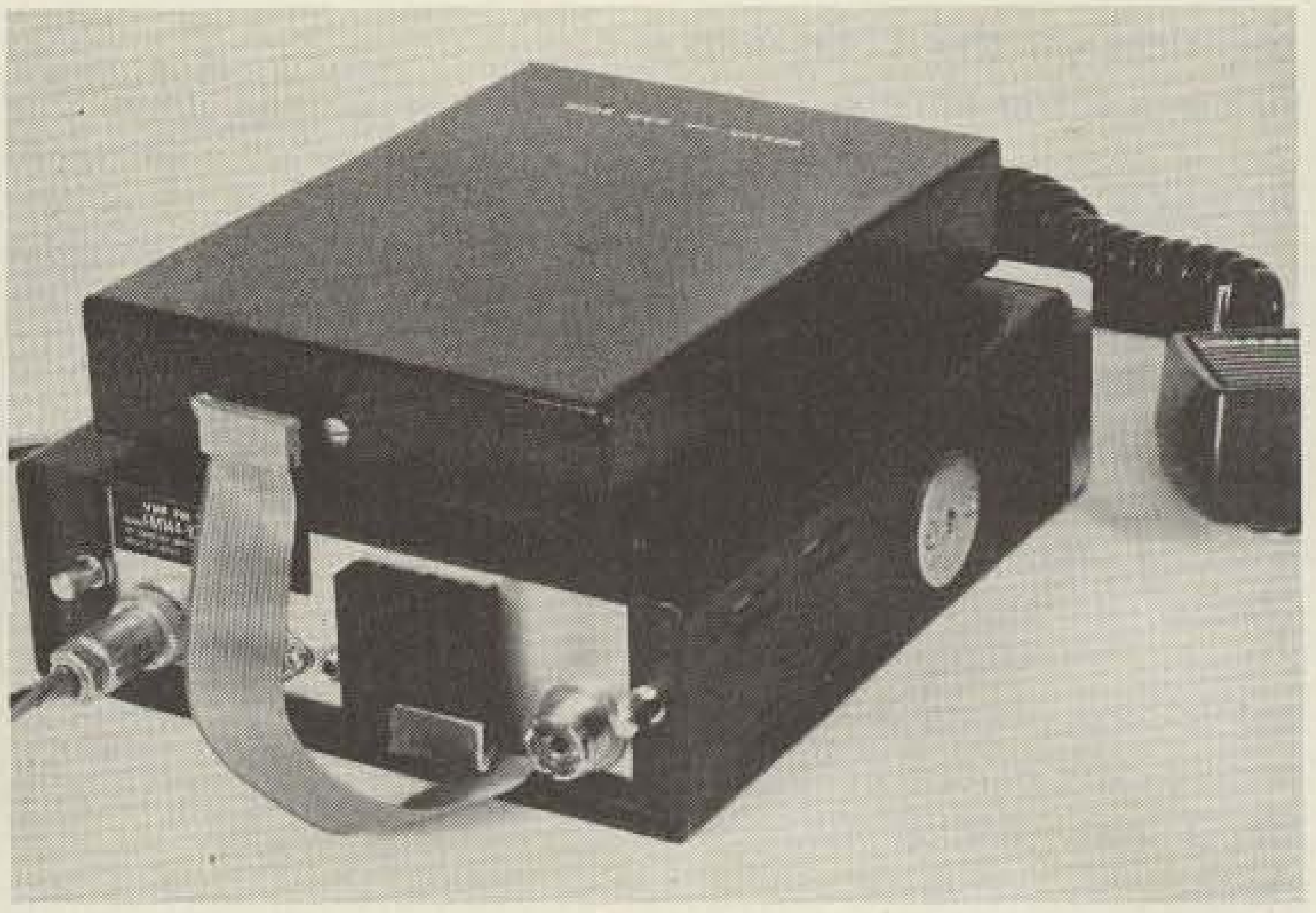
Fig. 9. Vectorboard layout of components.

Parts List

IC1	555 timer
IC2	74161 or 74LS161
IC3	7404
IC4-6	2111 RAM (may use 2111A, 8111, 8111A any speed)
IC7	LM309K +5 V regulator
D1, D2	General-purpose silicon diode
D3-6	Any LED
Q1	Any general-purpose silicon transistor
SW1	SPST
SW2	DPDT center-off
SW3	SPDT
SW4	SPDT push-button
SW5	SPST (on-off, optional)

Resistors and capacitors as required per schematic.
16-conductor ribbon cable as required for interfacing.
Printed circuit boards are available for $9.50 from: Circuit Works, 1118 7th Ave., Neptune NJ 07753, phone (201)-774-1811. 2111 RAMs are available for $3.50 from: Williams Electronics, 1863 Woodbridge Ave., Edison NJ 08817, phone (201)-985-3700.

Close-up view of the scanner on top of the KDK. For those who notice the difference, this KDK is not the standard U.S. import version. The Japanese version covers only 2 MHz and has no repeat mode. Note that the repeat Up-Simplex-Down switch says Lo-Off-Hi. The toggle switch was replaced with an identical MHz rotary switch having 6 positions and two poles. The extra pole was used to high-band the KDK. The rig was modified for repeater use and broad-banded to 4 MHz operation.



The flat ribbon cable is socketed on the back of the scanner and fed between the cover and the rear of the chassis and under the speaker mounting plate where it mates with a mounted 16-pin IC socket. The socket is then wired accordingly.

Reset—reset; scanner Power—on. The KDK squelch should also be on.

Dial up your desired priority frequency. Hitting reset will automatically reset the 74161 to address 0000 in the RAMs, thus giving you instant priority. Immediately flip the switch to stop, and note if address 0000 (no LEDs lit) remains.

Push the program button. Flip the Reset/Scan/Stop switch to scan to allow the LEDs to move to address 0001. Flip back to stop immediately. If the station just programmed is busy, the busy light won't let the address advance. Therefore, dial up the next desired frequency, push the button, and step the address. Continue until you complete all 16 frequencies, if desired.

Switch the control switches to the following: Write/Read—read; Slow/Fast—fast; Stop/Scan/Reset—scan. The KDK MHz switch—priority. The scanner should now begin scanning the KDK. The digital display will also show the frequencies while scanning. If there is a desired frequency you wish to transmit on, flip the Stop/Scan/Reset switch to stop, switch in your offset, and transmit.

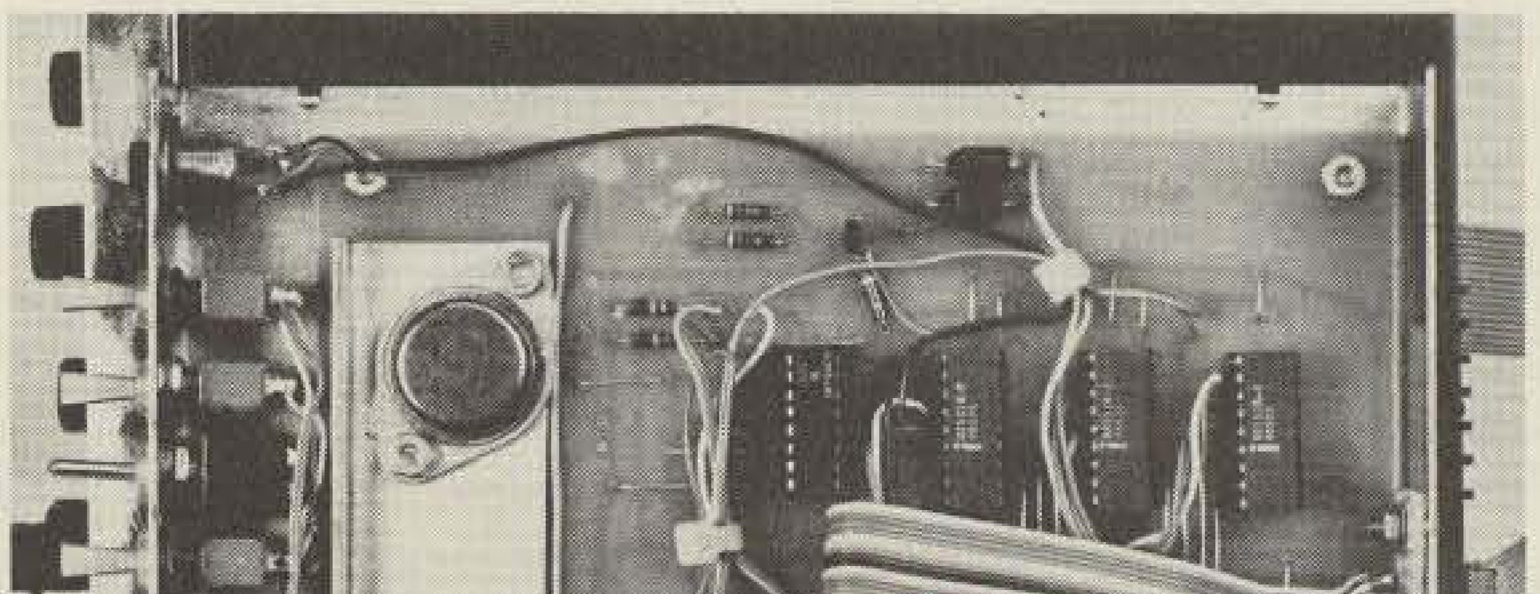
For those of you who use 5 kHz stations, program 5 kHz low—146.62 instead of 146.625. Instead of scanning in the priority mode, scan in the 144 MHz mode, making sure you are set to 000 on the kHz dials. If the scanner then stops on 146.62 (which it should), simply pull the 5 kHz knob if you desire to stop on that frequency and transmit.

Caution

If the station you just programmed is busy, the busy light will not allow the address to advance. Therefore, you will have to reverse the process for the next frequency by changing frequency first and then stepping the address. It's not as confusing as it sounds.

If you only choose to program a portion of the 16 positions, you will find erroneous data displayed at the unprogrammed addresses. Some of these positions will actually cause the receiver to scan frequencies between 140 and 155 MHz. If this happens and the vco has not been compensated properly, the unlock light will go on and the receiver will stop scanning. So, for all

The scanner built by Felix Foggia WA2OFD. Felix chose the PC board route and housed the unit in a 5" x 7" x 3" enclosure cut down to 5" x 7" x 1".



View of the PC board mounted in the chassis.

unprogrammed positions, program into memory an unused frequency such as 146.00.

An easy way to skirt this problem is to dial in 146.00 and scan at a fast rate while you're in the write position and the program button is pushed. The result will be all 16 addresses programmed in 1-2 seconds. Then proceed with normal programming.

If using W2PMX's high-band modification, which, incidentally, works beautifully with the scanner, you will find that, as previously mentioned, the unlock light may come on if you change too many MHz in one step. Even though the unlock light holds the scanner, I have noticed that the following frequency might not stop the scanner if busy. To resolve this condition, I program the frequency following the last high-band frequency for two addresses. See Table 1 for an example.

Basic Drawbacks

The unit as designed cannot program 5 kHz frequencies. If one really wants to get into the KDK and add a few more gates and another RAM chip, it could be done. I didn't think it was worth it.

There is no delay designed into the system. When a repeater with a short squelch tail drops, or a simplex transmission ceases, the scanner will continue immediately. A delay would add another IC and transistor plus associated circuitry. I have found that a scan rate of 16 channels in approximately one and one half seconds pretty much allows you to return to the dropped channel without missing much, provided no other channel is busy. I resolved this by always leaving the KDK in a simplex transmit mode. When a channel is busy and I want to scan past it, I just tap the mike button in low power. This causes the busy light to drop out and the scanner continues. Actually, the transmitter never gets to turn on, either, so there is no interference.

A final drawback is volatility—semiconductor RAMs lose data when power is disconnected. A nicad pack would eliminate this problem. However, at a current drain of approximately 250 mA, you'll need a hefty battery pack. The computer manufacturers face this same problem—you're not alone.

Applications to Other Radios

I have not had the opportunity to delve into the TR-7400, FM-DX, FM-28, HW-2036, etc., but, if you want to, look for some sort of BCD counters—3 sets, MHz, 100 kHz, and 10 kHz. Using a voltmeter at the inputs, dial up various frequency configurations, looking for TTL voltage level changes. If you have them, the scanner should work for you. The problems you then have to solve are:

1. How can you stop the scanner. If you don't have a busy light, maybe you could use the squelch circuit or S-meter.

2. Since there is no priority channel, you'll have to program your scanner as per the instructions and then dial up 144.00 to scan. The memory will then add data to the binary equivalent, thus giving you the proper frequencies.

Well, there you have it. You should encounter no problems if you wire it correctly. I had no problems getting mine to work during the prototype stages, once I understood what I was doing. Include an SASE with all correspondence, please. ■

The NCX-Match

— build something useful

Low cost and high flexibility.

Rick Ferranti WA6NCX/1
215 Herrick Road
Newton Centre MA 02159

The need for a good rugged transmitter matching device seems to be increasing almost daily. More and more advertisements have appeared in *73* and elsewhere detailing ultimate transmatches, miniature transmatches, and transmatches with other goodies thrown in (like swr bridges, power meters, antenna switches, etc.). The one thing that all of these devices have in common is a high price tag. Why should a simple thing like a coil and capacitor be so expensive? After all, it's an easy matter to home brew your own transmatch, and you'll have the joy of using a device you built yourself.

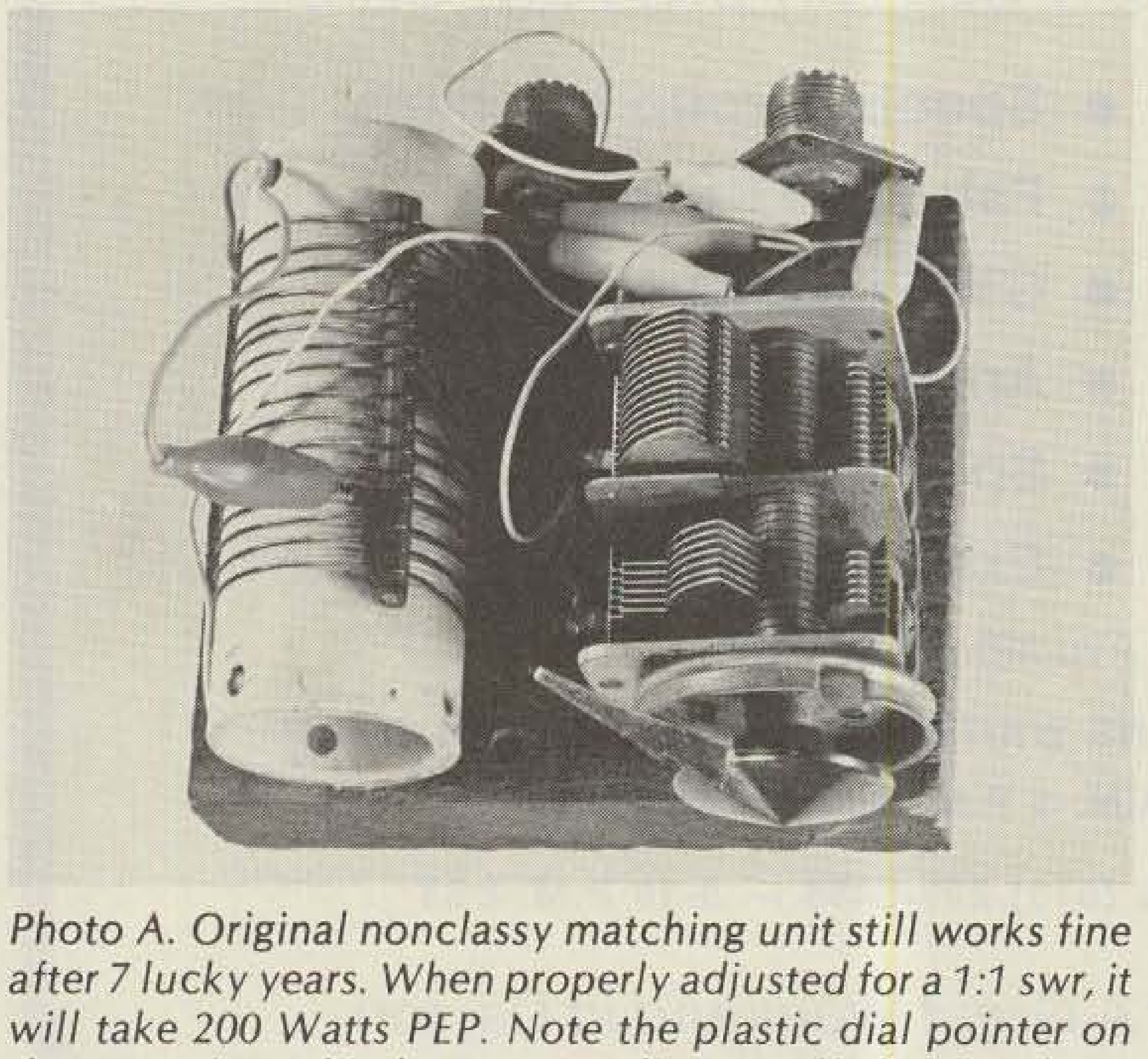


Photo A. Original nonclassy matching unit still works fine after 7 lucky years. When properly adjusted for a 1:1 swr, it will take 200 Watts PEP. Note the plastic dial pointer on the capacitor; this keeps your fingers off the rf voltage when you're tuning up.

The increasing popularity of transmitter matching equipment stems from a multitude of needs: Novices and Techs are on the increase, apartment dwellers need simple antennas requiring a proper match to the rig, solid-state finals require 50-Ohm impedances if they are to work at all, and frequency-limited antennas can often be coaxed beyond their normal bandwidth with a matchbox.

Two models of transmatch will be discussed here; the first is so easy to build that you can use it by the time you finish reading this article. The second is a bit more fancy and much more rugged, with a good deal more aesthetic value thrown in. Both have the following advantages: They'll match anything to anything, they'll take almost any barefoot rig (200-Watt class), they're low cost and the parts are easily available, and they are extremely flexible so that you can do all kinds of experimenting with tuned circuits and antennas.

Simple Beginnings

I'm still using the first transmatch I ever built—you can see this glorious contraption in Photo A. It's seven years old and still going strong. Small and easy to carry or ship, it works just fine. Basically, you wind a coil of wire on any available form (plastic pill bottle, cardboard or PVC tube, ceramic core as in the photo, etc.) and leave space between windings for an alligator clip to clamp to the wire. If you use insulated wire, scrape away the plastic or enamel at the tap points. A pencil or dowel of wood or plastic can be slipped under the windings as you go to raise them up so that the clip can firmly grip the wire. As you can see in the photo, I fit 16 turns of wire on the form, which is 1½ inches in diameter and 4 inches long.

The capacitor part of this simple device is a broadcast-band variable ripped from an old ac-dc tube set, with both sections in parallel, giving about 500 pF total capacity. Blow the dust from the plates so that they won't arc when you use it. If you can, save the plastic pointer which may have come with the radio or epoxy a plastic tube to the shaft—you don't want to touch the cap when you're tuning up!

The rest is easy. Mount the coil and capacitor on a piece of wood, add two SO-239s (with their grounds tied together), and use clip leads to connect the two components in various configurations. Everything should be clear from looking at the photo and Fig. 1.

Of course, this thing is very flexible. You can hook up various configurations of "L" matches, loading coil or series capacitor matches, or even series or parallel-tuned circuits and traps. Some suggestions are in Fig. 2. I've found that the basic "L" configuration, with the series coil and the cap from antenna to ground, works with almost any long- or random-wire antenna—see Fig. 2(a). Put the swr bridge in the transmitter side of the line, excite the antenna with a little rf (enough to get a reading on the meter—but *listen* before you tune up on the air), and run the capacitor quickly through its range. If you get a shallow dip in reflected swr, adjust the coil tap and try for a deeper null in reflected power while swinging the capacitor around again. Continue until your swr goes down to 1:1. Remember that a low swr will let you run higher power to the matcher without arcing (I've had no problems with my FT-101B), so tune the matchbox on low power first, and then pour on the juice.

Two other things: If you can't get a dip anywhere for any tap on the coil, change the configuration (move the cap to the other side of the coil, etc.) until you get a low swr. The other thing to remember is that no matching device increases the efficiency of your antenna. It only allows your transmitter to see the load it likes so that the thing operates properly. As such, it allows you to load the rig where otherwise you may not be able to do so.

Getting Classy

Of course, I wasn't satisfied with my first transmatch, since it isn't very rugged and doesn't look like anything particularly beautiful. I decided to build something really snazzy, but with little cash outlay. The design includes a sturdy metal case, an infinitely-variable roller inductor coil, high-voltage variable capacitors, a built-in swr bridge, a low-pass filter, a frequency counter or oscilloscope output, and provision for greater flexibility by the addition of external coils, capacitors, or other components. The result, a cross between the rack-mounted monsters of yesteryear and the sleek goodies of today, is shown in Photos B and C.

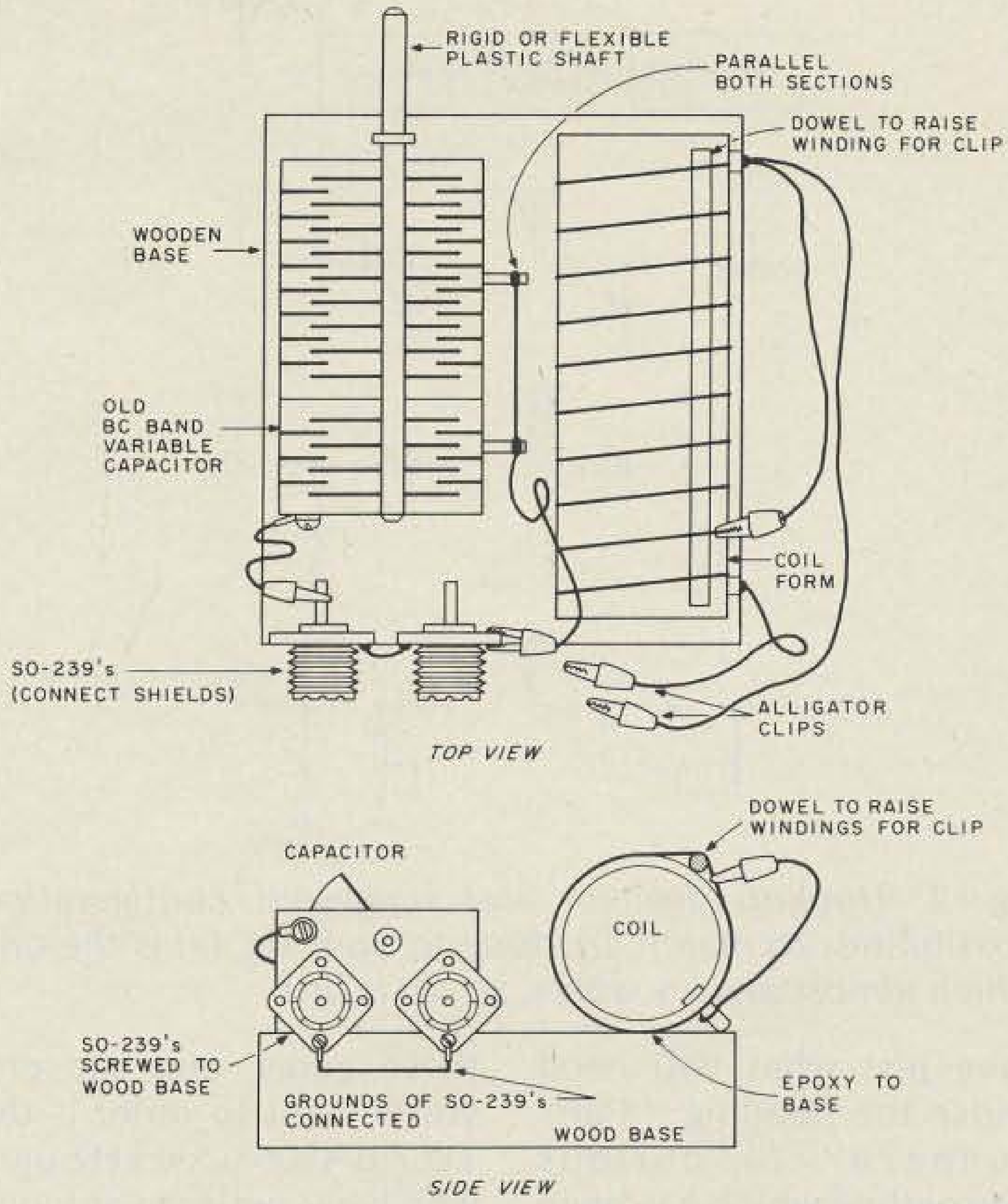


Fig. 1. Construction plans of the simple transmatch.

Parts

The perennial question for any builder is where to get the parts needed at a reasonable price. In this instance, fortunately, the case and many components are readily available on the surplus market. Write a note to Fair Radio Sales Co., P.O. Box 1105, Lima, Ohio 45802, and ask for their latest catalog. In it, they'll

Photo B. The NCX-Match. The swr meter need not be calibrated since you're tuning for a minumum at all times.

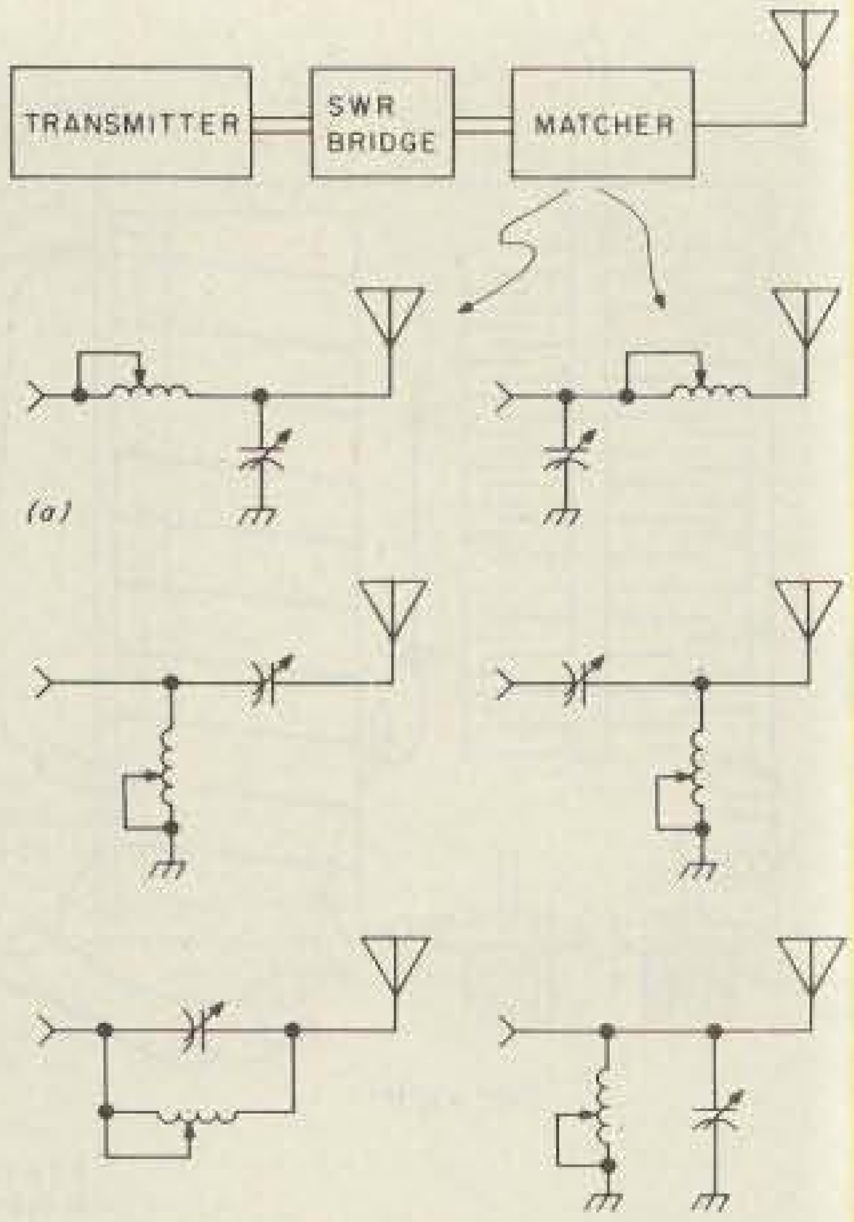


Fig. 2. Hookup diagram and suggested configuration possibilities to match anything to your rig. (a) is the one which almost always works, so try it first.

have just what you need under the heading "Parts Bonnaza" (a curious misspelling which has been in their catalog for years). On page 16 of catalog WS-77, you'll see the plug-in tuning units used in BC-191/BC-375 transmitters. I have a list of the parts in these gems, and the one you'll want to order is the TU-7-B 4500-6200 kHz unit, which has coils, an antenna switch, variable and fixed high-voltage caps, a vernier dial, a right-angle drive, and a beautiful outer case for $5.95 (brand new). It only weighs 15 pounds, so the UPS shipping charge will be around $3.00.

The tuning unit has the two large variables you'll need (each about 120 pF), and two 5000-volt, 400-pF fixed capacitors which you can save as auxiliary plug-in range extenders. Of course, you'll be using the inner case (save the outer one for another project, or use it to make a larger model of this matcher). The only other main components you'll need are the roller coil and a front panel piece.

Fortunately, Fair Radio Sales and local ham flea markets still have the incredible ARC-5 series "Command Set" transmitters. They must have built ten of these things for every man, woman, and child in the U.S.! If you can find the roller coil from the ARC-5 series (this is what I used), you're all set. If not, Fair Radio Sales has them, as well as other roller coils—check pages 9 and 16 of catalog WS-77 and page S77-37 of the catalog supplement. It doesn't matter if the rest of the transmitter is destroyed—all you need is the roller coil—so you may be able to get some junked chassis for a low price, particularly at a flea market table.

Besides the case and the roller coil, you'll also need a ¼-inch-thick aluminum panel for the front of the case. Check around at a scrap or sheet metal place and you should be able to find one and even have it cut to size for a reasonable price. The panel should be fairly thick so that the capacitors and roller-coil dials don't shift around with pressure.

Why do you need a front panel when you already have the case? Simply because you're going to strip all the parts out of the BC-375 unit, and that's going to leave its front panel full of holes. It does make a good template for the six screws which will hold the new panel to the case. By the way, save everything you take out of the tuning unit, including the screws. You need the capacitors and their mounting insulators, the handles, shaft couplings, and fixed capacitors, as well. If you want to do so, you can use that beautiful heavy-duty ceramic rf switch as an antenna switch in the matcher. It's a nice convenience which I probably should have added to my NCX-Match when I built it a few years ago.

You'll notice that the case's top and bottom panels are well ventilated with eight sets of holes drilled through them. I found that dust tends to settle on the caps and coil inside because of this unnecessary ventilation, so I glued thin clear plastic sheets under the holes to block out the dust. The top panel should be the one

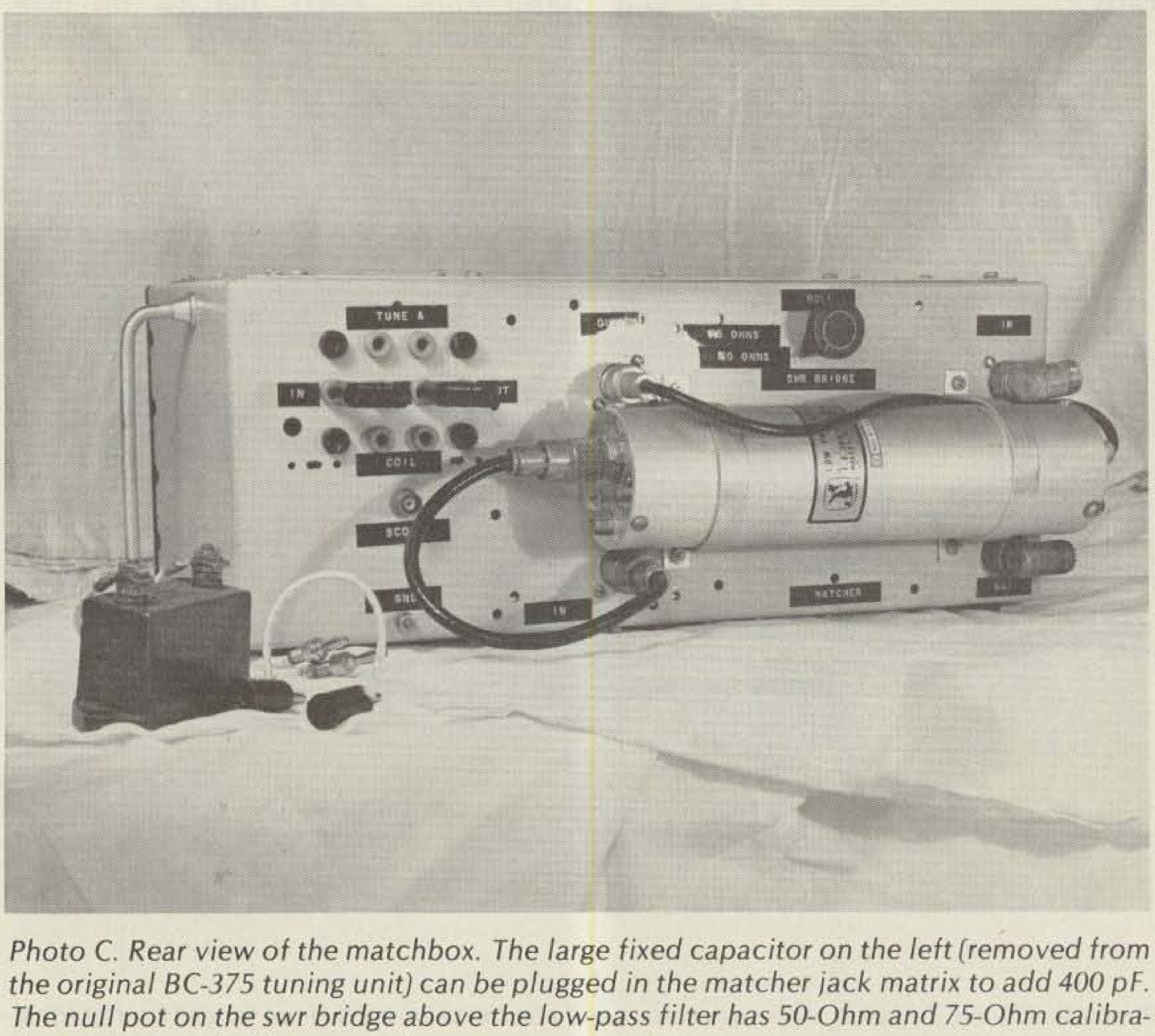


Photo C. Rear view of the matchbox. The large fixed capacitor on the left (removed from the original BC-375 tuning unit) can be plugged in the matcher jack matrix to add 400 pF. The null pot on the swr bridge above the low-pass filter has 50-Ohm and 75-Ohm calibration points marked for easy reference.

with the small notch cut in it, while the bottom panel has a long narrow cutout (originally for the plug-in connector).

You'll need a counter-type dial for the inductor. I found that big dial in the photos at a local surplus store for $2.00. If you can't get a counter dial per se at a reasonable price, just use a crank-type spinner knob. Then you can use a rubber pulley arrangement and the turns counter from an old tape recorder (they're advertised as surplus in *73*, or check out page 56 of the June, 1977, issue for more ideas on how to reset the roller coil quite accurately). The hardest part of building this whole contraption was the mechanical coil arrangement. As you can see in the photos, I used the gears from the original ARC-5 and drilled holes to match things up accurately. Take your time; you'll be rewarded with a smooth-running adjustable inductor.

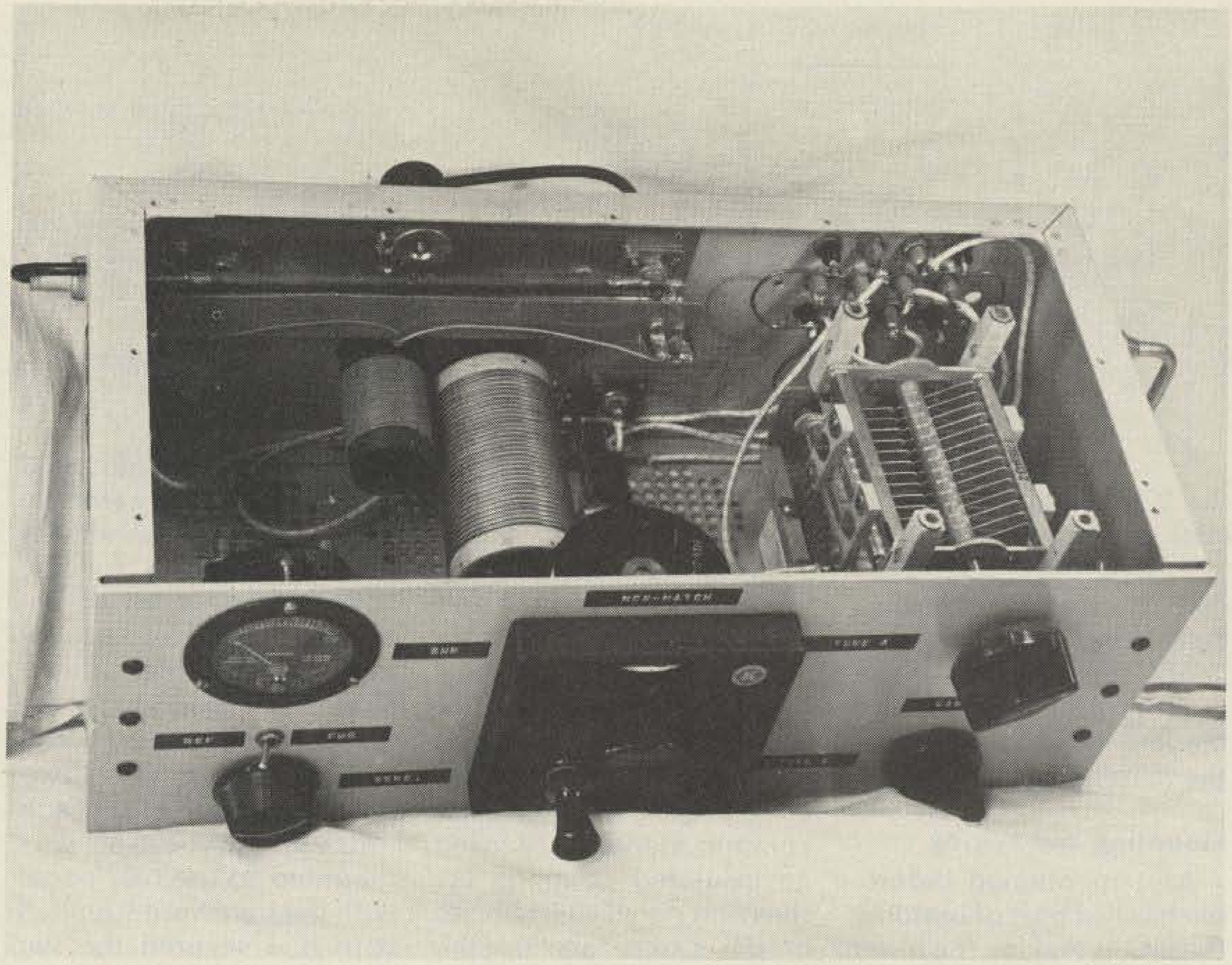


Photo D. Rear view of the matcher showing the swr bridge element, the roller and scope pickup coils, capacitor mounting, and the plug matrix.

I added an swr bridge to my unit, the details of which can be seen in Fig. 3 and Photos D and F. It's a version of the "Varimatcher" in *QST* for May, 1966. The sheet metal can be cut from a cookie sheet, and you can get the ¼-inch copper tubing from a plumbing supply house. Remember to keep things symmetrical and it'll work fine. The hardest part is taking the inner conductor of a piece of RG-58 or 59, soldering a thin wire to its center, and sliding it through the copper tube until the thin wire can be pulled out of the slot you've filed in the middle of the tube. This wire gets connected to the arm and one end of the 100-Ohm potentiometer (carbon—not wirewound!). The schematic in Fig. 4 should make construction a little clearer.

Calibration of the bridge is simple. Put a 50-Ohm dummy load or 51-Ohm, 2-Watt carbon resistor across one SO-239 and apply a Watt or so of power on 10 meters. With the bridge in the reflected position, adjust the null pot for the least indication on the meter. This is your 50-Ohm calibration point. If you want to use the bridge for 75-Ohm lines, simply replace the 50-Ohm resistor with a 75-Ohm unit. I calibrated my bridge for both impedances and can change them with a twist of the knob.

I liked the Varimatcher style because of its ruggedness and versatility. Alternately, other bridge

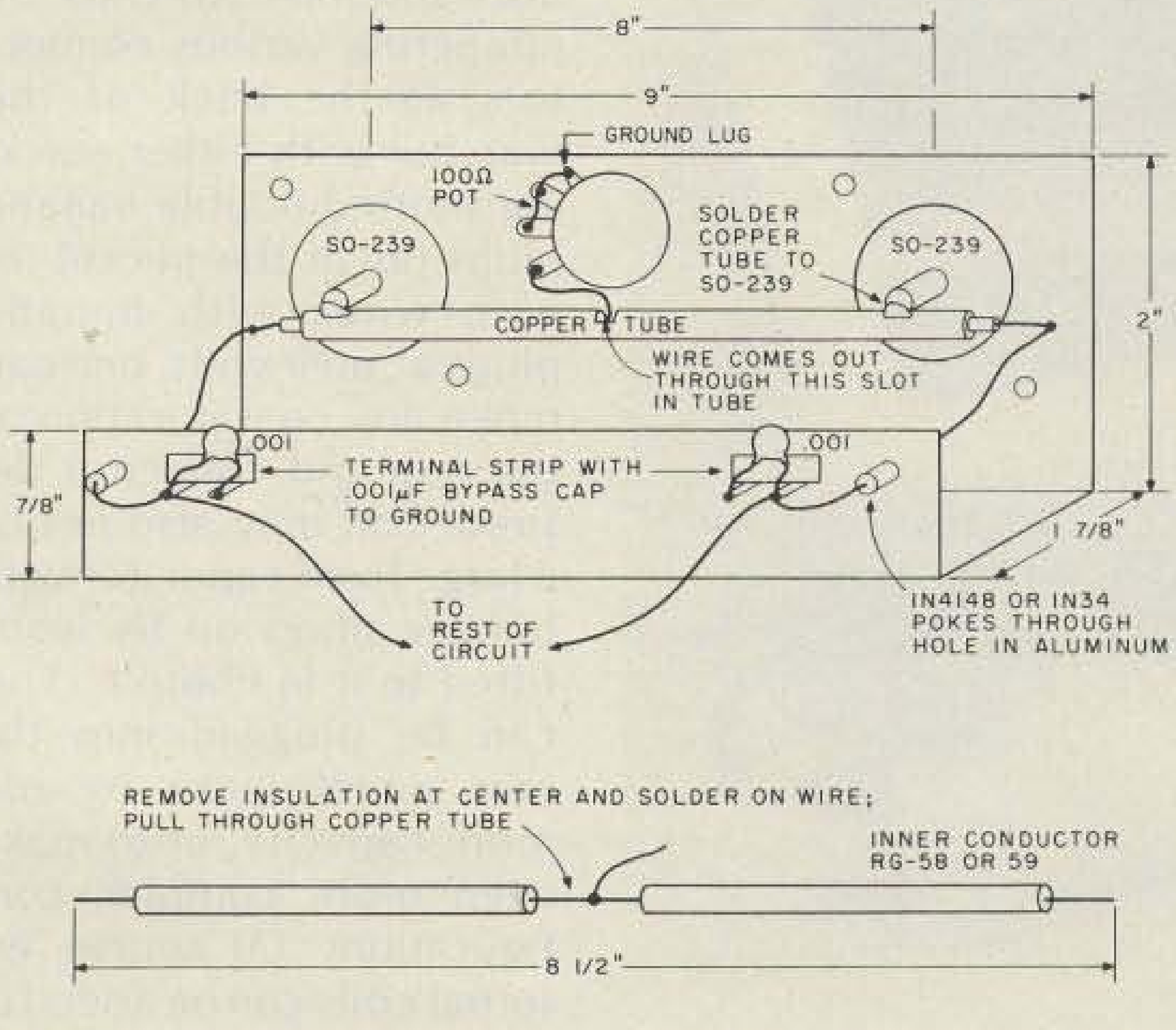


Fig. 3. Sheet metal layout and pickup element plans for the Varimatcher swr bridge.

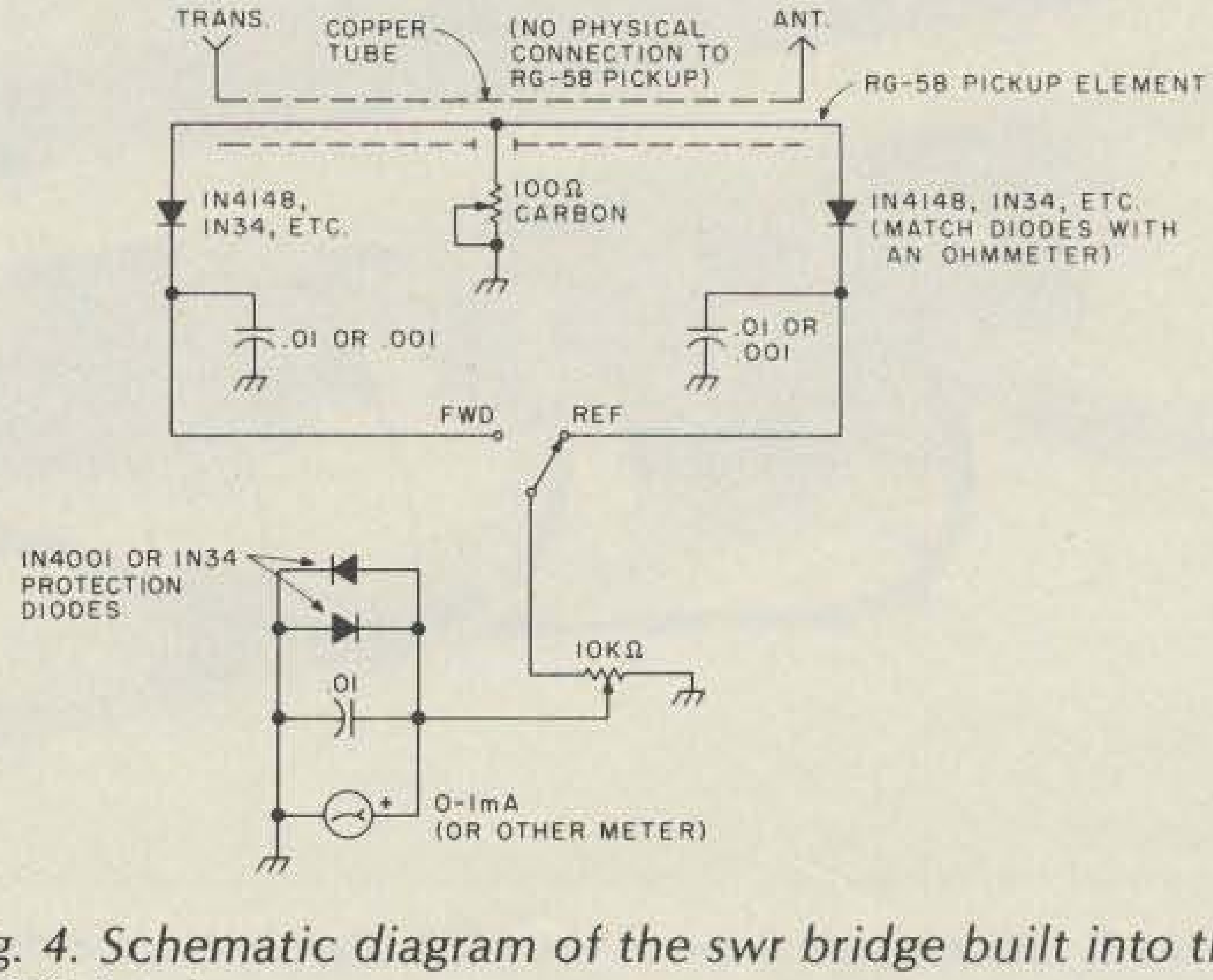


Fig. 4. Schematic diagram of the swr bridge built into the NCX-Match.

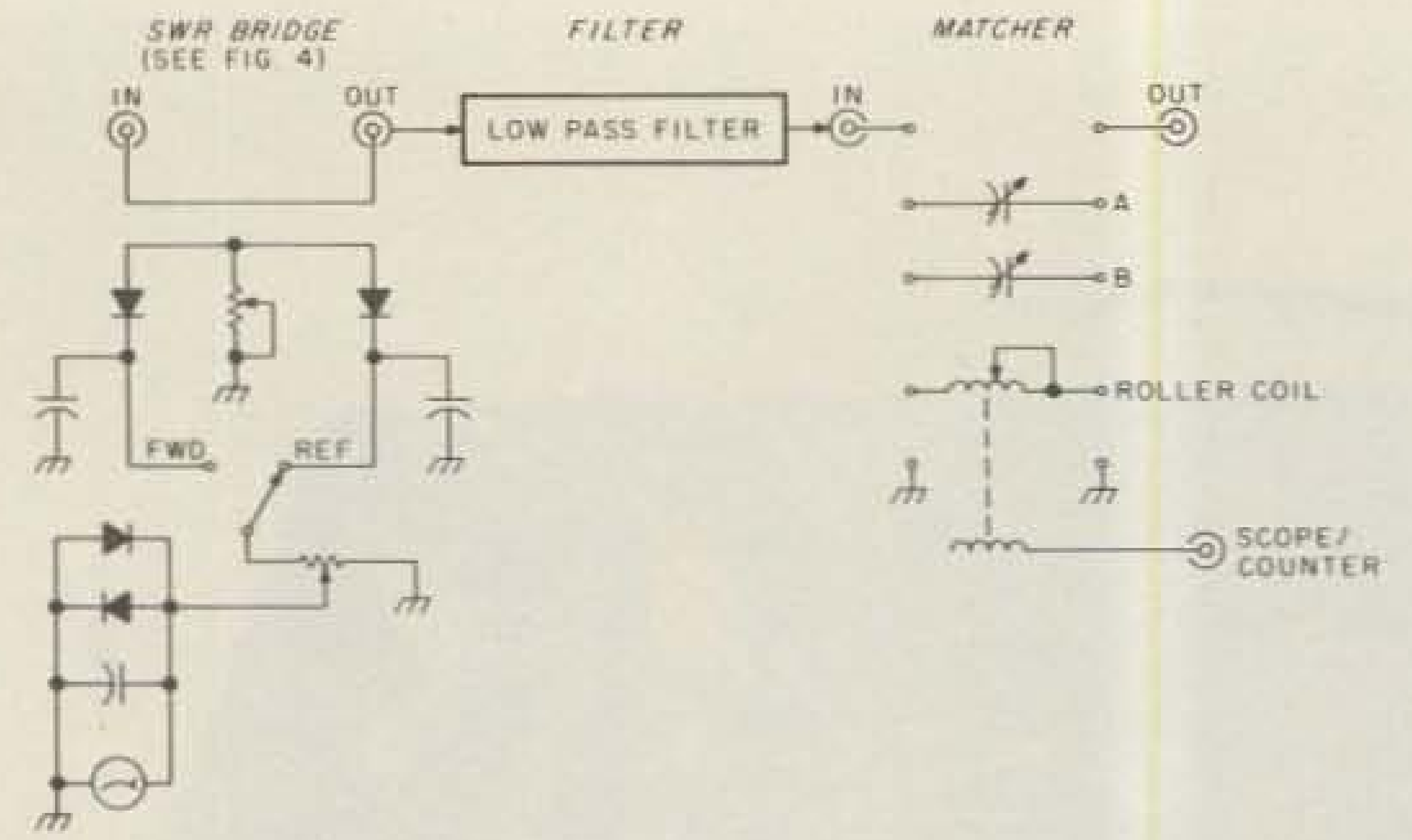


Fig. 5. Schematic of the entire matchbox showing independent swr bridge, filter, and matching elements.

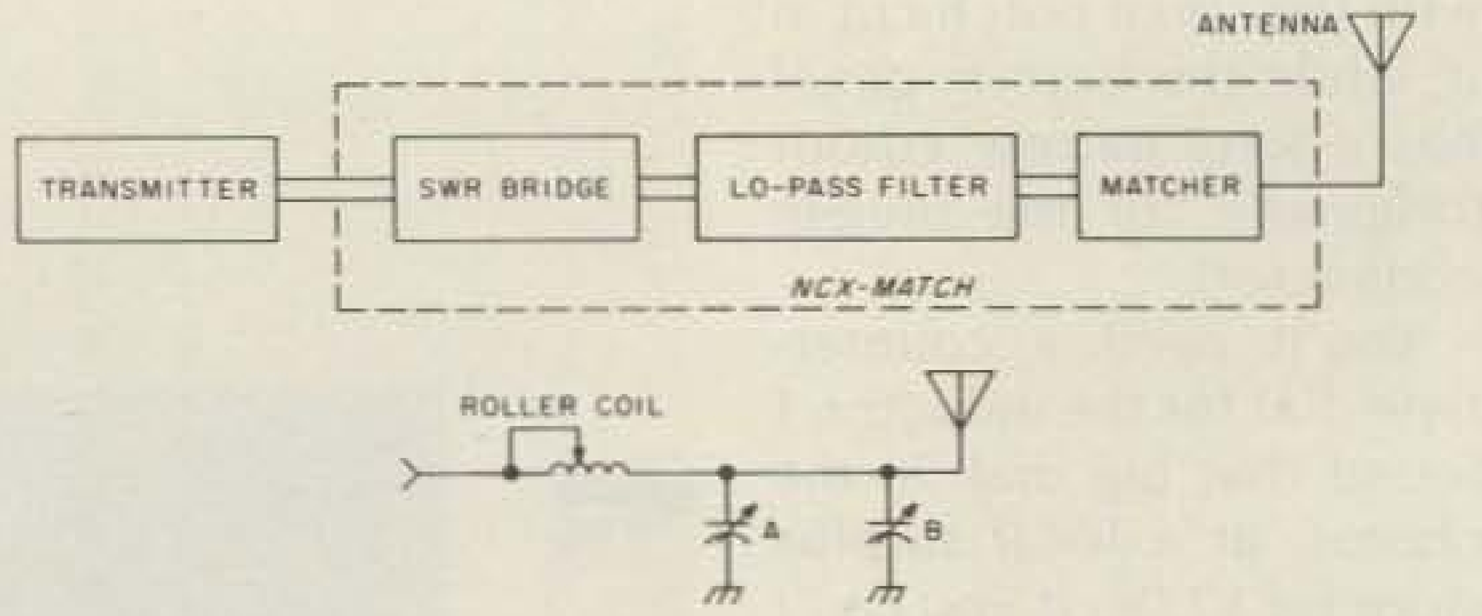


Fig. 6. Hookup diagram and suggested first configuration for the NCX-Match.

construction techniques could be used, or you could simply dismantle a commercial bridge and mount its innards inside the matchbox.

Mounting and Wiring

As I mentioned before, the hardest part of building the unit is making the roller coil merrily spin as you turn the front panel crank. As you can see from Photos E and G, I mounted the original ARC-5 gear on the shaft of the turn-counter crank and secured the actual roller coil and coil tap to the bottom plate of the case.

The large air-variable capacitors can be mounted to the top and bottom case covers with their original ceramic standoffs. I used an insulated coupling for the front panel shaft of one of the capacitors; on the other, a metal coupling and insulating fiber shaft was used. The point is to keep the rotors of the caps from shorting to the case or from giving you a jolt of rf while you tune up.

The meter was mounted in a large hole cut carefully with a coping saw, as was the counter dial for the coil. It takes a bit of patience to slowly saw through that thick aluminum plate, and the roller dial needed a very odd-shaped hole! The low-pass filter, an E.F. Johnson unit in this case, was mounted to the rear panel with the hardware supplied with it. I secured the swr bridge element to the case with long screws and lockwashers passed through the mounting holes of its SO-239s.

A useful added feature of this matchbox is the scope/counter output visible in Photo C. The smaller coil near the roller inductor and directly below the swr potentiometer in Photo F serves as the pickup element. I simply wound a coil of hookup wire on a Bakelite™ form and glued it near the roller coil so it would sniff a bit of the rf energy flying around inside the case. One end of the coil is connected to the BNC jack on the rear panel, the other end is simply left free on the coil form.

The means I used for switching various coils and capacitors in and out of the line is a matrix of 12 banana jacks spaced the standard 3/4 inches apart, as you can see in Photo C. The four corner jacks (black) are connected to ground, and two others are the input and output of the matcher. Two each down the center of the matrix connect to the two capacitors and the coil. Thus, by jumpering various connectors at the back of the matcher with either stacking shorted double banana plugs (as in the photo) or with wires with banana plugs at their ends, one can make any configuration of the coil and capacitor desired. You may also notice a large fixed capacitor with banana plugs on fly leads fitted to it in Photo C. This can be plugged into the rear panel jacks to add more capacity, or to make even more complex configurations. Of course, external coils can be added in the same manner. Thus, you can make pi networks,

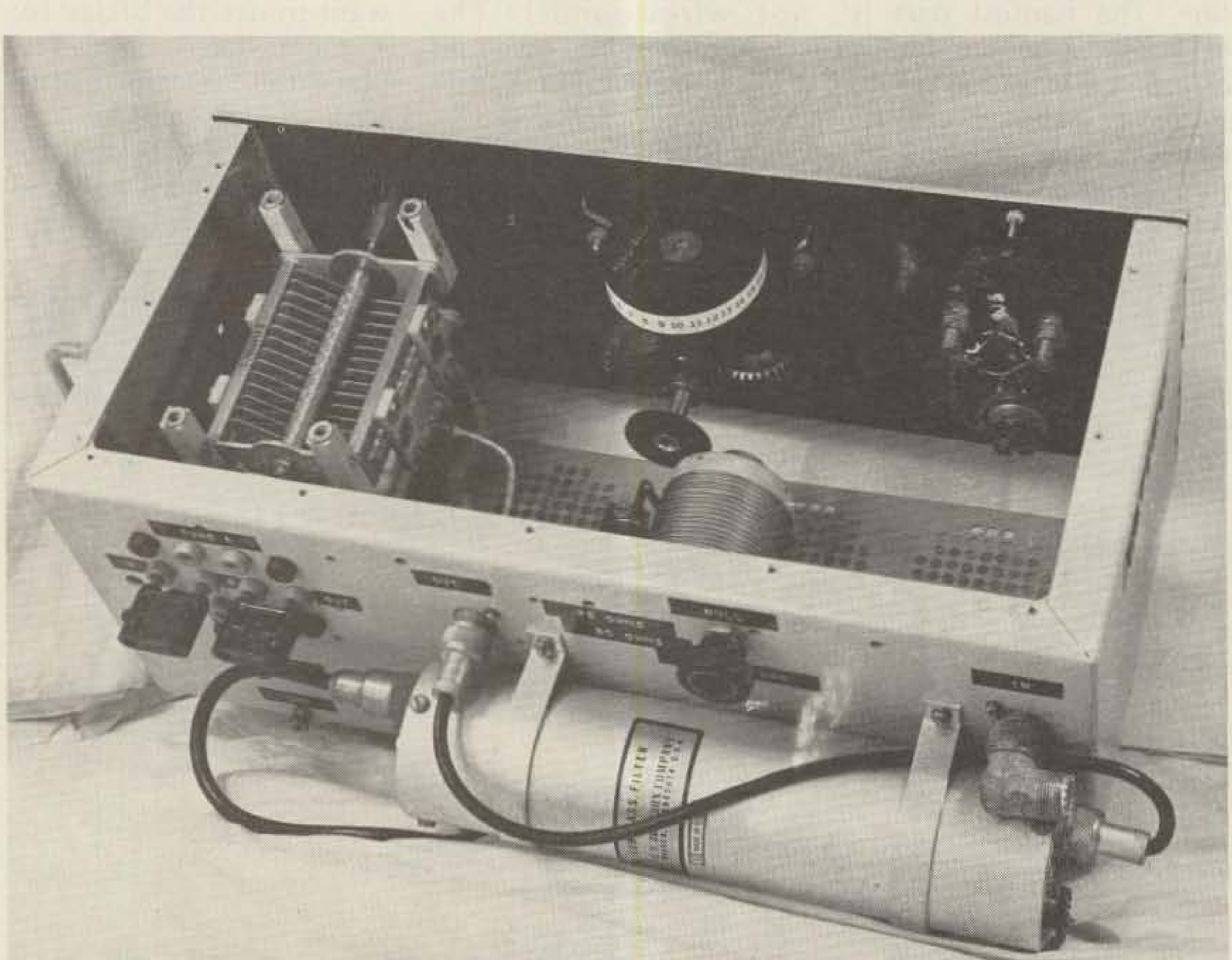


Photo E. Front inside view of the NCX-Match. Notice dual banana plugs installed on the matcher jack matrix (now configured for capacitor B to be in series with the antenna).

tuned circuits, differential capacitor circuits, and all kinds of configurations by simply plugging in jumpers. A glance at the schematic of the matchbox (Fig. 5) makes this clear.

I haven't had to use external components with the matcher since the "L" configuration with both internal tuning caps in parallel takes care of all the capacity needed for most random-length wire antennas. You'll probably find, as I have, that the roller coil has about five times more total inductance than you'll ever need, so external coils aren't necessary at all.

A few notes on the matrix of jacks may be helpful. Once, I was running 125 Watts AM (plate modulated, of course) with a DX-100 on 160 meters, and the insulation on one of the panel banana jacks started to bubble and smoke! I've long since sold that wonderful Heath monster rig, and SSB has since caused no insulation problems. However, if you worry about such things and run a lot of power on RTTY or another continuous mode, you can mount uninsulated banana jacks on a Bakelite™ or Teflon™ sub-panel and attach this so that it pokes through a large rectangular hole cut in the rear panel. Teflon™ or Bakelite™ will certainly solve any dielectric heating problems.

Wiring up the unit can be done two ways: Use heavy solid wire like in the original BC-375, or use stranded heavy wire with fiberglass insulation as I did. I chose the later method because it was easier to do, and because, when I was disassembling the tuning unit, I discovered a 40-year-old cold solder joint between the original solid heavy wire and a capacitor! Not wishing to duplicate such a feat (who were the poor guys who wired up these things anyway?), I used standard wire and a big soldering iron (100 Watts). I've had no problems with arcing with the fiberglass insulated wire.

Don't forget to save one of the original handles from the tuning unit to mount on your new matchbox. It's handy for carrying the thing around on field day. Also, do give the case a good coat of paint before assembly. When I built my unit almost five years ago, the only panel labels I had at my disposal were those embossed plastic jobs. Although they look decent with a symmetrical panel layout like the one you see in the photos, you can do better with rub-on lettering sets, particularly the kind with whole electronic terms already spelled out for you.

Tune-Up and Use

Connect up your matchbox, swr bridge, and low-pass filter between the rig and antenna as shown in Fig. 6, with the matcher configured as in the diagram. The reason for this hierarchy in element order is that the transmitter should be the one to see 50 Ohms as indicated by the swr bridge, and the filter should also see 50 Ohms to work properly. The matcher itself is the thing to fool all those other 50-Ohm devices into thinking that your weirdo antenna is really a dummy load. Hence, it goes closest to the antenna.

As you can see in Photo C, I simply used two short lengths of coax (with connectors attached) to connect the various elements in the matcher. The swr bridge, filter, and matching network proper can all be used independently if desired—an added bit of versatility.

This matchbox is tuned

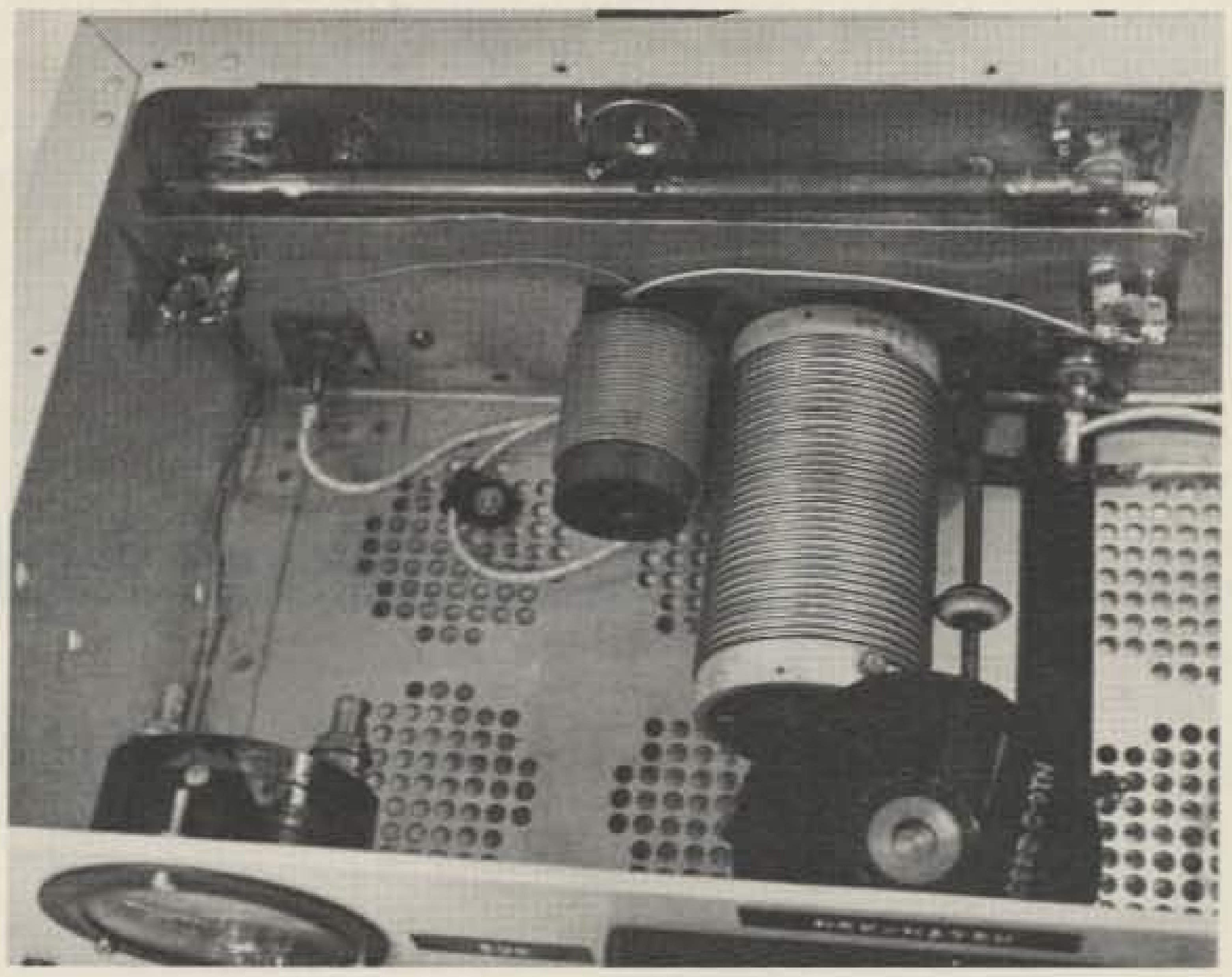


Photo F. Rear inside view with a close-up of the swr bridge and coils.

exactly as the previous unclassy model, with the extra convenience of a rotary coil as an infinitely-variable inductor element. Try the "L" configuration first, as suggested above, swinging the capacitors and coils through their ranges while applying low power. Look for a dip in reflected power and tune to minimize the reading. If you can't get a null, change the jumpers at the rear panel and try a new configuration. Soon you'll be able to load up everything from your window screen to a 1200-foot longwire.

This sturdy matchbox drew very flattering comments at a home brew club meeting some time back, and it still looks and works great. If you need a good rugged transmatch and don't want to spend a fortune on commercially available models, give this one a try. You'll have a good time building it up and will be rewarded with a fine piece of useful equipment. You may even want to modify your call so that it ends with an "X"—"X" for "trans"—hence the NCX-Match. ■

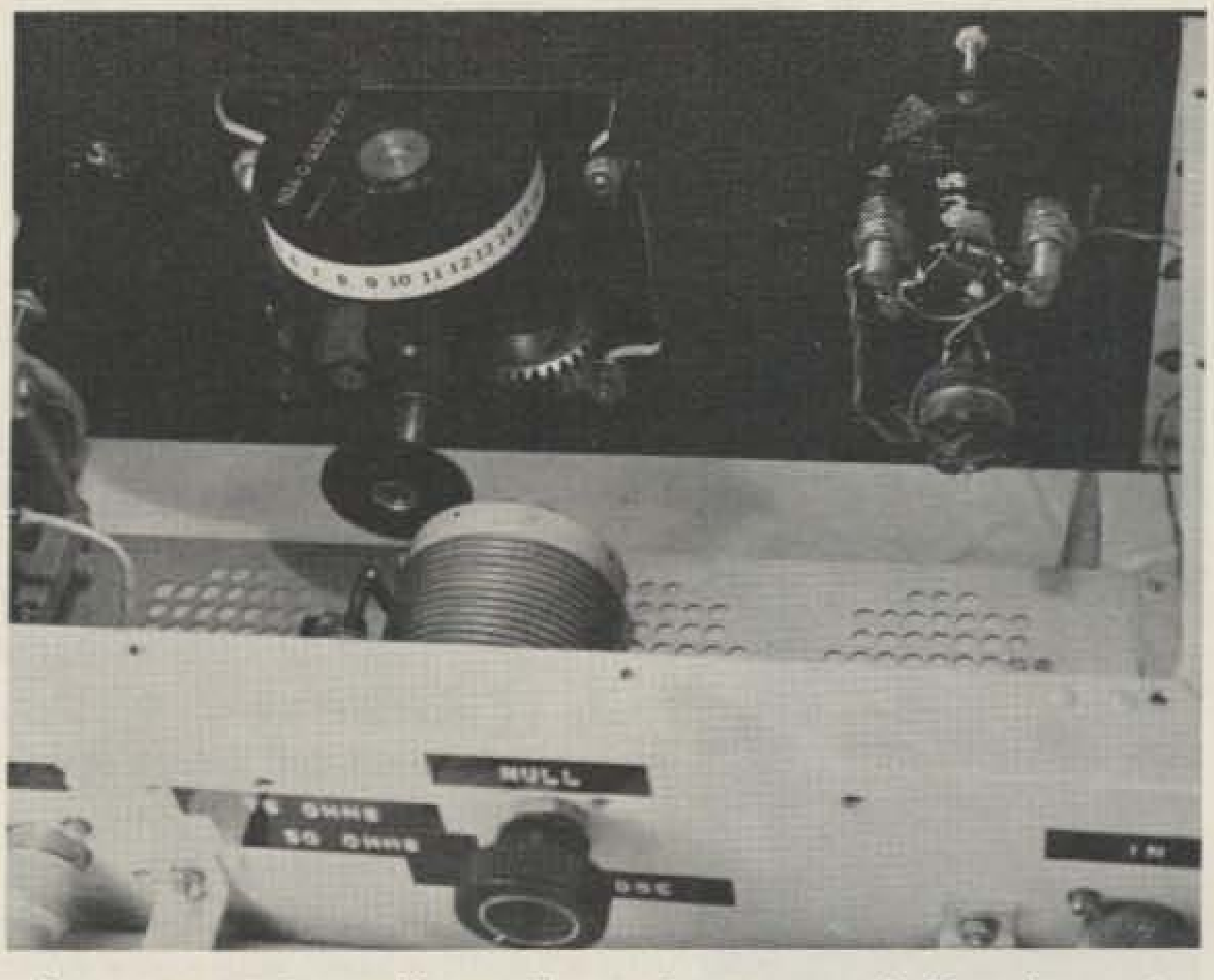


Photo G. ARC-5 roller-coil gear is mounted directly to the dial shaft. Note the protective diodes and bypass capacitor across the swr meter.

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The Memorizer Goes to MARS

—expanded frequency coverage

A step toward the perfect FM rig.

One of the newest offerings in the field of 2 meter FM is the Yaesu FT-227R Memorizer. This unit became available at local dealers in late December, 1977, and I purchased one on December 26 as a one-day-late Christmas gift, although I am normally a little slow to buy new products until they've been proven in the field.

As a member of Air Force MARS, I had hoped for a new rig that would permit operation on our local MARS repeater, but this was unlikely with the new Yaesu, although it did a beautiful job on the 144-148 MHz portion of the band for which it was designed. The rig was engineered to preclude operation out of the amateur band, which seemed like a fact I would have to live with.

The bright red display would clearly read out any frequency from 144 to 148 MHz, but nothing else. After carefully reading through the superb owner's manual, the needed information for a modification finally came to light on pages 18 and 19. The key paragraph states that Q711 (MC14081B) limits the high end of the rig and Q712 (MC14028B) limits the low end of the rig and cut off Q713 (2SC735Y) to prevent transmissions out of the amateur bands. By tracing the circuit through the diagram on page 19, it became apparent that changes were needed to pins 3 and 6 of Q712. The phase locked loop (PLL) board was noted as being on the top side of the rig.

I carefully removed the top of the rig and noted that the PLL board was under a cardboard cover at the front of the rig. This cardboard was lifted by the removal of three screws, and I was looking at the underside of the board. A red wire came from pin 3 and a blue wire from pin 6. These were removed from these pins and resoldered to an adjacent ground, which ends the modification.

Now the crucial test came—to see what had been accomplished. My rig now displays all frequencies from 142.000 through 149.995 MHz, though transmit is possible only from 143.05 through 149.995 MHz. This frequency spread allows me to operate on the AF MARS simplex frequency and to monitor the output of the AF MARS repeater. The modification allows full operation on the Army MARS repeater and should prove very useful to many MARS members.

This is my first Memorizer modification, but it should open the door to other ways to make this the perfect FM rig. I would welcome correspondence on other modifications or further expansion of this modification (enclose an SASE, please).■

✓ *Reader Service—see page 211*

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Build a Hybrid Capacity Meter

—digital circuitry, analog display

Test your junk box.

Like many other electronics enthusiasts, I like good buys on bits and pieces of electronic equipment and parts. I also accumulate a lot of "junk." Among these treasures are many unidentified capacitors. This identity problem makes them almost useless.

There are many good circuits for measuring capacity, but most of them use the same design theme—a generator with multiple frequency selecting components. If the tester has 5 ranges, there are 5 capacitors and 5 resistors, probably variable, and the switch to select the desired range. This is an acceptable method, but you may have many components that can change value and affect the accuracy of the measurement.

The circuit described here is similar in some respects to the well-known analog tester, but it uses a different method of frequency (range) selection. In this circuit, I have one clock frequency, approximately 200 kHz, that generates the necessary frequency for the ranges. Instead of using RC circuits for each range, I use 74LS90s for the decade change. The advantage of this is that there is only one frequency-determining RC network, and this is adjustable from the front panel. This means that the instrument can be calibrated on one range and be accurate for the other ranges. With the low cost of ICs, the price of this instrument compares favorably with the other types of instruments.

How It Works

The generator is a 555 oscillating at approximately 200 kHz. The frequency is adjusted by R2 when calibrating prior to use or during use, if a reading is doubtful.

The output of IC1 is used for the 0-to-100 pF range and is also used to clock the first 74LS90. The output of IC2 (pin 11) is the 555 frequency divided by 10. This frequency is used for the .001 full-scale range. The remaining 74LS90s operate similarly. Each division by 10 is the frequency for the next larger decade of capacity. The 74LS00 was added as a buffer. Since it would be wasteful with the other gates doing nothing, the LED circuit was added to give a visual indication that the clock and all dividers are working. There is a definite pulsating of the LED, so the user is sure that the circuit is working.

The accuracy of the instrument is very dependent upon the tolerance of the calibration capacitor, C3. Prior to use, C3 is switched into the circuit and the frequency of IC1 is adjusted by R2 until the meter reading is equal to the value of C3. The drawing shows C3 as being 5100 pF, 1% tolerance. Actually, any convenient value could be used, but the tap on the range switch would have to be changed to make sure the correct frequency is being applied through C3.

The condition of the battery can be checked by pressing S3. When making a battery test, ensure that there isn't a signal path through a capacitor to the meter, as this would give a higher battery voltage reading than really exists. The multiplier resistor will give a reading of .9 on a full scale of 1.

Construction

I like sockets. It makes troubleshooting easier if a chip must be removed, but sockets are not necessary. All 74LS90s are wired the same as IC2. The range switch is wired to make 5 ranges available. The additional position is used as the calibrate position. A separate switch can be used for calibration, but the user has the chance of damaging his meter if the calibration capacitor is a .005 and the range switch is in the 0-to-100 range position. The ICs can be replaced by 7490s and 7400s, but the current drain is rather high for a 9-volt battery. If a power supply is used, there is no problem using the TTL chips. The meter rectifiers are run-of-the-mill diodes. The meter is a 50 uA meter with a 0-to-1 scale marked off in .1 readings.

Use

Prior to use, the meter should be calibrated to compensate for those variables that cause errors. After calibration, the unknown capacitor is placed across the test terminals and read. A word of caution is offered: Use this meter as you would a voltmeter in a strange circuit. Start on the high range and work down until you get a reading. This prevents pegging the meter and possibly damaging it.

This circuit is easy to construct and use and should give many years of reliable use. ■

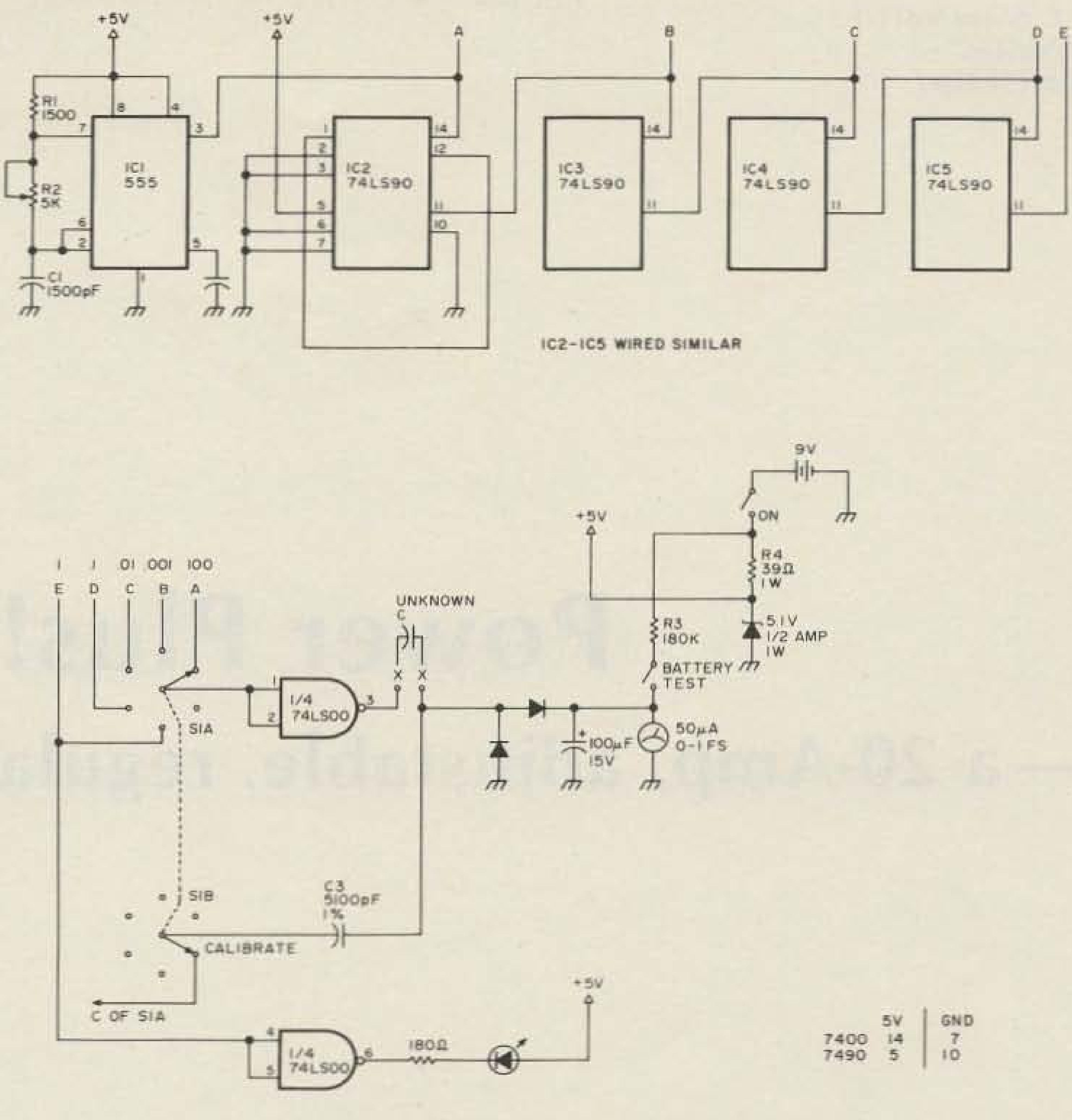

Fig. 1. All resistors are ¼ Watt except as noted.

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Power Plus!

—a 20-Amp, adjustable, regulated dc supply

Versatility personified.

What do you do for a base station regulated power supply after you discover that the amplifier you have just completed requires half again the current you anticipated? The supply described by George Schreyer WB6TOX in the December, 1972, *73 Magazine* is the heftiest I can recall to date described in either *73* or *Ham Radio* magazine. It will supply the 10 Amps as described. I built it with extra heavy-duty components, but could not get acceptable regulation beyond this level. My amplifier requires 17 Amps. After many modifications, many burned-out transistors, and much frustration in attempts not only to increase the current capability but to retain regulation, it was back to the proverbial drawing board.


Front view of power supply.

This, then, is an article meant to furnish information that you can add to your pet circuit notebook as well as to provide a circuit and construction ideas for the vast number of hams obtaining bigger and bigger solid state amplifiers. This supply is versatile in that one has a reasonable amount of control over the heat dissipation of the pass transistors despite the amplitude of voltage to be controlled.

Two paralleled power transistors are used as pass transistors; the 2N3772 and 2N3773 might be described as extra-heavy-duty 2N3055s. I use this as a comparison because the 2N3055 is the well-known workhorse. The 3772 and 3773 can dissipate 150 Watts, as compared to the 3055's 115-Watt capacity. These transistors can effectively control voltage amplitudes as low as 1.4 volts. Each 3772 can very safely handle currents to 15 Amperes. The 3773 handles 10 Amperes, again as com-

Left side view of power supply.

Right side view of power supply.

pared to the 3055's 5-Ampere safe capacity. These currents must, of course, be kept within the power dissipation capability of the unit. One would not, for example, attempt to drop 30 volts across a 3772 while pulling 15 Amperes, as this is a 450-Watt dissipation and the transistor has a rating of 150 Watts. Using two of these in parallel, the dissipation capability is increased to 300 Watts. (Even 300 Watts takes a lot of heat sinking to dissipate the heat.)

Refer to the schematic in Fig. 1. Let's examine some practical extremes. Say we wish to regulate 13.0 volts at 20 Amperes, and the input voltage (at the choke output) into the regulators, using the full secondary, is 35 volts; this would result in a drop of 22 volts across the regulators. 22 volts × 20 Amperes = 440 Watts. Obviously, things would start to melt after a very short operating period. Therefore, switches S1 and S2 have been incorporated so that one can obtain the required voltage and current and hold the dissipation within reasonable levels. Thus, setting S2 in the low position, we are only using ¾ of the secondary, or 22.5 V ac, possibly delivering 25 volts (loaded) to the pass transistors. 25 less 13 = 12 volts across the pass transistors, or a total of 240 Watts.

Following this same reasoning, it is apparent that the higher the regulated output voltage, the smaller the voltage drop across the pass transistors and the smaller the power dissipation.

Note that, when using multiple secondary transformers, one has the capability of choosing the appropriate voltages. The switching arrangement shown is the one I use. It may be convenient for some applications to tap the secondaries at other points, i.e., tapping at the 15-volt ac position will result in approximately a 60-Watt dissipation for the above stated example.

Selecting Components

The transformers I used were purchased from army surplus (WW II). They are hermetically sealed units and have an operating ceiling of 60,000 ft. The continuous operating current is called out as 10 Amperes. I have used the supply for over an hour of continuous service at 17 Amperes and the cases stayed at room temperature. The transformers each have two 7.5-volt secondaries. As can be seen in the schematic diagram, I use the windings in series and parallel configurations. The choke possibly can be eliminated with somewhat higher peak voltages being present. Any possible increase in ripple voltage will be smoothed out by the gain in the regulator chip. The

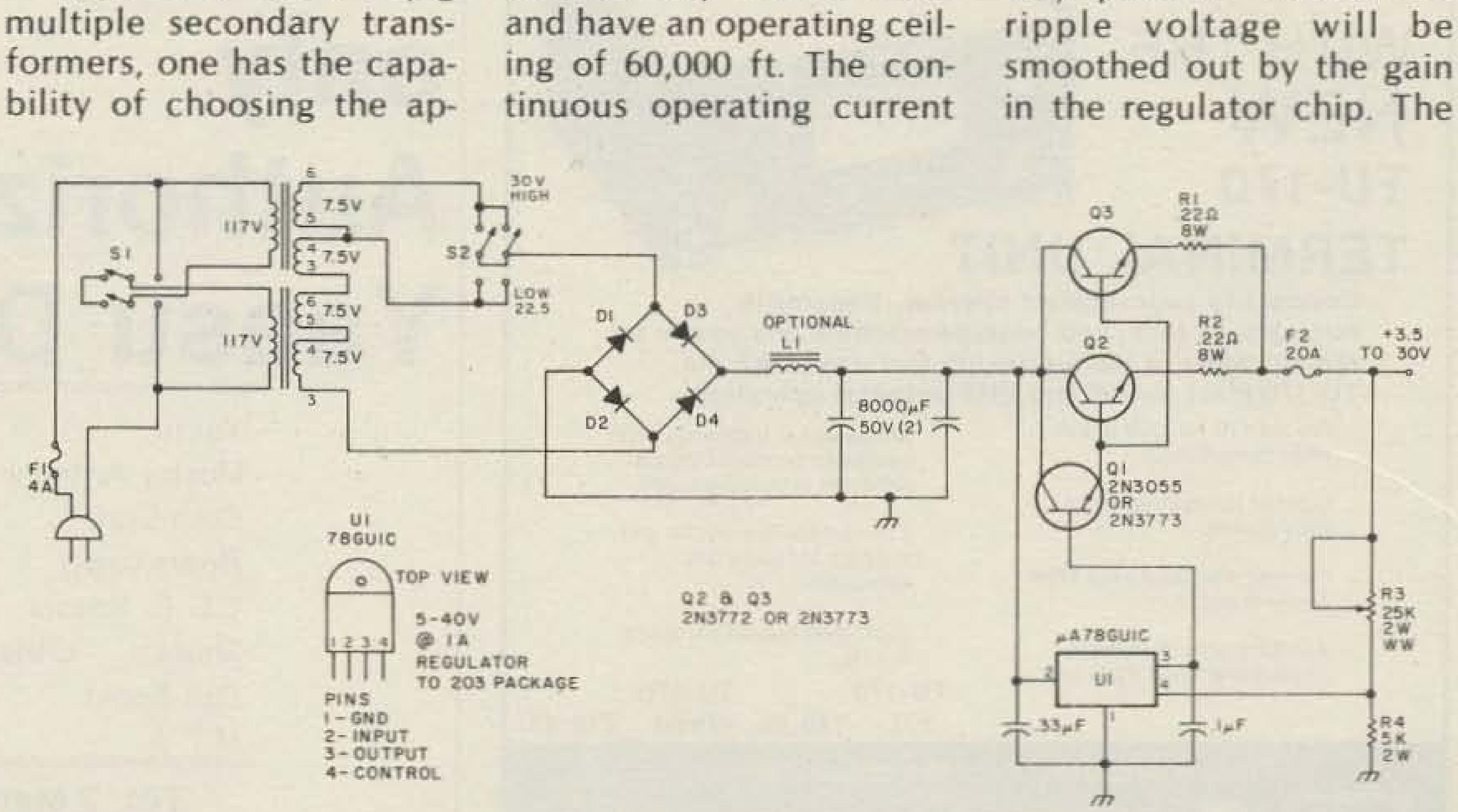

Fig. 1. 17-Ampere super-regulated low-voltage universal power supply —3.5-30.0 volts. S1 and S2—10 Amp contacts @ 120 V; D1-D4—50 V, 30 Amp or equivalent; Q2 and Q3—2N3772 or 2N3773; Q1—2N3055 or 2N3773; U1—μA78GUIC; R1 and R2—paralleled .44 Ω, 4 Watt or equivalent; R3—2.0 Watt, 20k to 25k wire-wound pot; R4—5k, 2 W.

choke was used in a previous unregulated power supply built on this same chassis; therefore, it was retained rather than removed. This choke was built from a Triad filament transformer I had on hand.

Originally, the transformer had four 6.3 V ac 4-Amp windings. The transformer was disassembled, the secondary winding removed, and about 3 or 4 layers of no. 10 or 12 wire wound onto the core. The laminations were reinserted with all of the "E"s in one direction and the "I"s placed at the end.

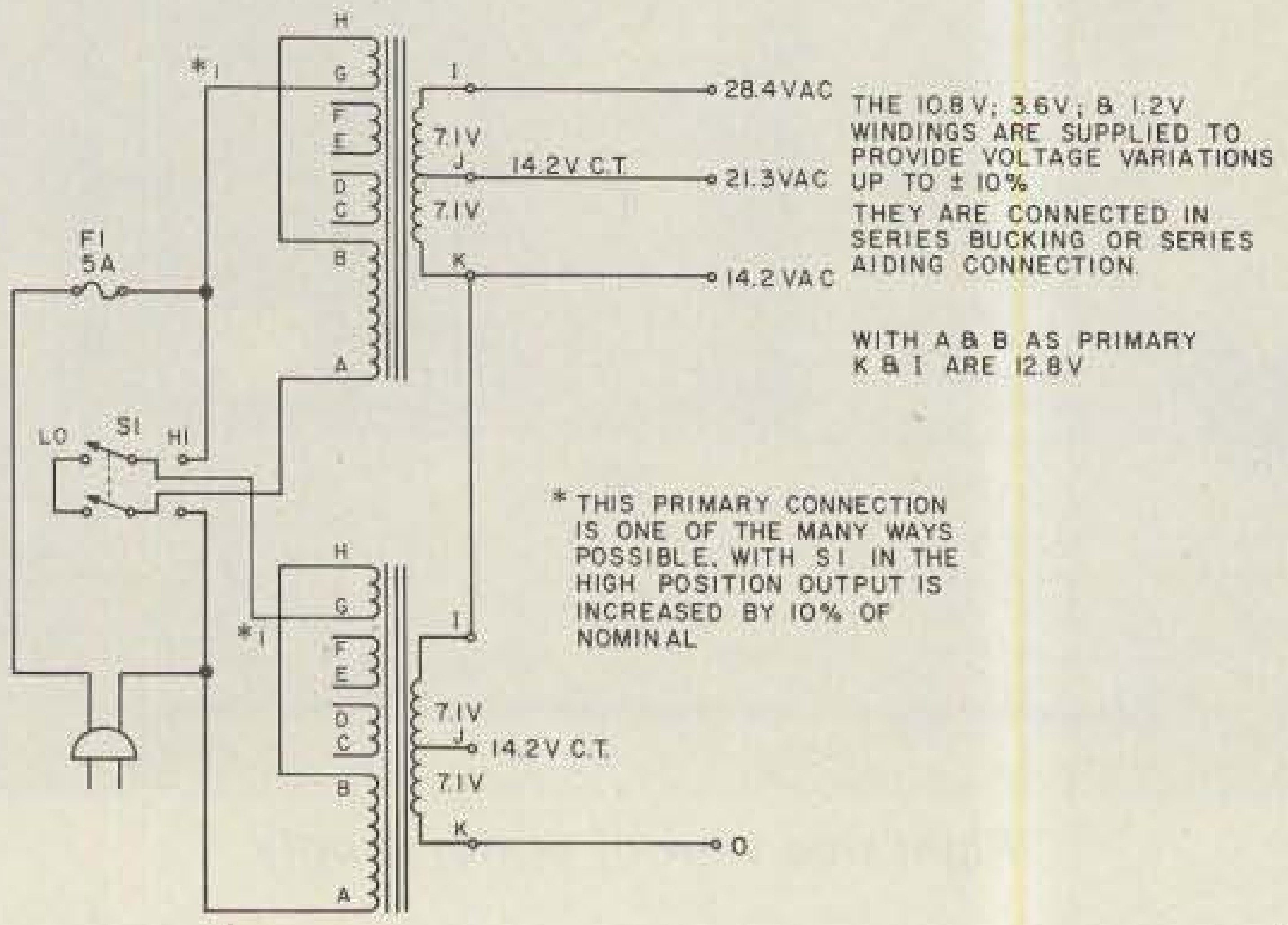

Fig. 2. ITC transformer, part #BP-6242, size 4.5" x 5.0" x 7.0", hermetically sealed, conservatively rated at 20.0 Amperes continuous operation. A pair of these can be substituted for the transformers in the text and offer even more versatility. They are available for $19.50 each from Hiway Company, 305 W. Wisconsin Ave., Oceanside CA 92054.

The regulator chip, a Fairchild uA78GUIC, is the whole key to the success of regulation. It drives a 2N3772; a 2N3773 or even a 2N3055 will work equally well. The rectifiers are 1N3209s, 100-volt, 15-Amp units. They happened to be something I had in my junk box—suitable substitutions can be used. Incidentally, they ran cool at 17 Amps; the heat sinks were cut from heavy aluminum heat sink rails. Two heat sinks were used side by side and isolated from each other, one section for the rectifiers, the other for the pass transistors. For better dissipation, the radiator fins should be vertical. However I have had no problems mounting them horizontally.

Refer to the schematic. The divider composed of R3 and R4 only requires about 1.0 mA of current as the control current to the regulator is only 5 to 8 μA under worst-case conditions. The control voltage is 5.0 volts. The fixed values for a given voltage output at pin 3 can be calculated from the formula Vout = [(R3 + R4)/R4] V, where V control on the 78GUIC = 5 V.

There you have it. Modify as you wish or duplicate as close as possible. The ideas are all there and the supply regulation is super, dropping about 2.0% at any setting up to 24 volts, no load to full load. ■

References

1. Fairchild Application Note μA78G, July, 1975.
2. "Versatile Variable Power Supply," W6SLP, *73 Magazine*, June, 1968.
3. "10 Amp Variable Power Supply," George Schreyer WB6TOX, *73 Magazine*, December, 1972.

✓ Reader Service—see page 211

Vhf engineering

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EFFECTIVE JANUARY 1979

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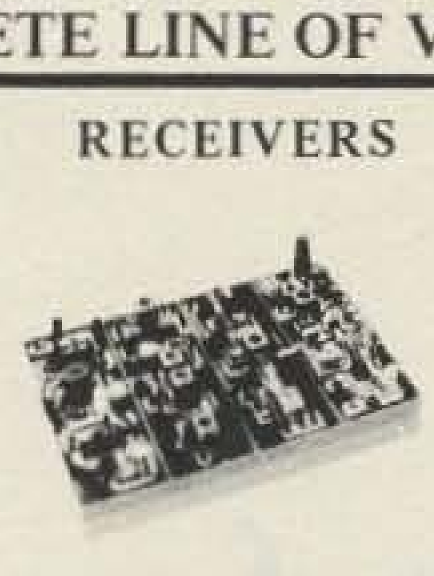
RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 MHz crystal filter	74.95
RX144C W/T	same as above—wired & tested	131.95
RX220C Kit	210-240 MHz rcvr w/2 pole 10.7 MHz crystal filter	74.95
RX220C W/T	same as above—wired & tested	131.95
RX432C Kit	432 MHz rcvr w/2 pole 10.7 MHz crystal filter	84.95
RX432C W/T	same as above—wired & tested	142.95



RXCF	accessory filter for above receiver kits gives 70 dB adjacent channel rejection	9.95
RF28 Kit	10 mtr RF front end 10.7 MHz out	13.50
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TX50 Kit	transmitter exciter, 1 watt, 6 mtr	44.95
TX50 W/T	same as above—wired & tested	71.95
TX144B Kit	transmitter exciter—1 watt—2 mtrs	34.95
TX144B W/T	same as above—wired & tested	65.95
TX220B Kit	transmitter exciter—1watt—220 MHz	34.95

TX220B W/T	same as above—wired & tested	65.95
TX432B Kit	transmitter exciter 432 MHz	49.95
TX432B W/T	same as above—wired & tested	87.95
TX150 Kit	300 milliwatt, 2 mtr transmitter	24.95
TX150 W/T	same as above—wired & tested	43.95

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PA50/25 Kit	6 mtr power amp, 1w in, 25w out, less case, connectors & switching	59.95
PA144/15 Kit	2 mtr power amp—1w in—15w out—less case, connectors and switching	49.95
PA144/25 Kit	same as PA144/15 kit but 25w	59.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	49.95
PA432/10 Kit	power amp—similar to PA144/15 except 10w and 432 MHz	59.95

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BLC 10/150	144 MHz	10W	150W	269.95
BLC 30/150	144 MHz	30W	150W	249.95
BLD 2/60	220 MHz	2W	60W	164.95
BLD 10/60	220 MHz	10W	60W	169.95
BLD 10/120	220 MHz	10W	120W	269.95
BLE 10/40	420 MHz	10W	40W	159.95
BLE 2/40	420 MHz	2W	40W	189.95
BLE 10/80	420 MHz	10W	80W	289.95

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PS25M Kit	same as PS25C with meters	159.95
PS25M W/T	same as above—wired and tested	189.95

O.V.P.	adds over voltage protection to your power supplies, 15 VDC max.	14.95
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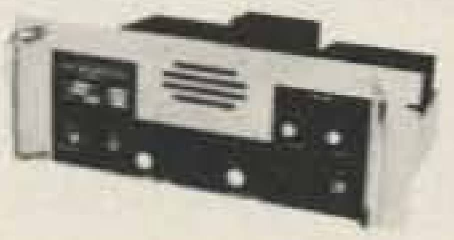
RPT50 W/T	repeater—6 meter, wired & tested	899.95
RPT144 Kit	repeater—2 mtr—15w—complete (less crystals)	599.95
RPT220 Kit	repeater—220 MHz—15w—complete (less crystals)	599.95
RPT432 Kit	repeater—10 watt—432 MHz (less crystals)	649.95
RPT144 W/T	repeater—15 watt—2 mtr.	899.95
RPT220 W/T	repeater—15 watt—220 MHz.	899.95
RPT432 W/T	repeater—10 watt—432 MHz.	949.95



DPLA50	6 mtr close spaced duplexer	680.00
DPLA144	2 mtr, 600 KHz spaced duplexer, wired and tuned to frequency	409.95
DPLA220	220 MHz duplexer, wired and tuned to frequency	409.95
DPLA432	rack mount duplexer	379.95
DSC-U	double shielded duplexer cables with PL259 connectors (pr.)	29.95
DSC-N	same as above with type N connectors (pr.)	34.95

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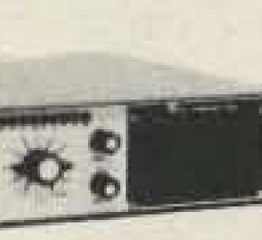
TRX220 Kit	same as above except for 220 MHz	259.95
TRX432 Kit	same as above except 10 watt and 432MHz	284.95
TRC-1	transceiver case only	34.95
TRC-2	transceiver case and accessories	54.95



SYNTHESIZERS

SYN II Kit	2 mtr synthesizer, transmit offsets programmable from 100 KHz—10MHz, (Mars offsets with optional adapters)	169.95
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CWID	wired and tested, not programmed	59.95
CWID	wired and tested, programmed	64.95
MIC I	2,000 ohm dynamic mike with P.T.T. and coil cord	13.95
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TS1 W/T	installed in repeater, including interface accessories	94.95
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HL144 W/T	4 pole helical resonator, wired & tested, swept tuned to 144 MHz ban	34.95
HL220 W/T	same as above tuned to 220 MHz ban	34.95
HL432 W/T	same as above tuned to 432 MHz ban	34.95

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Phillips Academy
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Amateur radio is in a period of flux these days. Of course, the solar flux index is increasing, a happy sign for propagation, but so is what we might call the regulatory flux index, which comes, not from "Old Sol," but from the puzzling FCC.

Detailed monthly in the pages of *73*, we find many changes in the rules by which our hobby is run. Logging requirements, repeater deregulation, and callsign assignments are examples of significant changes that the FCC has recently wrought. WARC '79, looming directly ahead, poses additional threats to the stability of amateur radio.

Although the future is clouded, some reasons for obtaining an amateur license above the Novice class now, or upgrading to a higher class, are clear. One reason is the very uncertainty of the present. Like the regulations, the amateur examinations are changing. Already in effect are two important changes in the code test.

First, the sending test has been eliminated (except for the Novice); that's one less thing to worry about. Second, the receiving test is not what it used to be. No longer is the subject matter strange stuff about farm statistics in Hawaii or specifications for Coast Guard installations. Now what you are asked to copy at 5, 13, or 20 wpm is one side of a typical amateur QSO. This makes for familiarity and a degree of comfort.

However, instead of copying clear, machine-sent code through headphones, as you may have done before, now you may have to copy from a cassette recorder. There might not be any headphones, and both room acoustics and outside noises may interfere. Adjust your practice accordingly.

You needn't copy one minute correctly any more; in fact, you can just take notes if you want. The examiner measures your comprehension by ten multiple choice questions; you must answer eight correctly. The questions are not tricky, but do thoroughly test whether or not you are able to copy the passage. Hams who have taken both the old and new kinds of code tests loudly praise the new one.

The FCC has indicated that it plans to change the written exam, too. Last year, it issued a new set of study questions. The new test may be easier, and may (like the new Novice tests) be harder. Take the old one if you still can.

If you are going for the Extra class, be advised that the 1 × 2 calls are running out. The new 2 × 1 calls will go fast, so get in there while there is still something left!

Comfort and Confidence

The two parts of an amateur exam, theory and code, vary in kind. You should study for them in different ways, but your goal should be the same for each part—comfort.

Comfort and ease come with mastery of the subject matter. Comfort in turn produces confidence, and confidence is the only weapon you have against that steely-eyed examiner (while others have praised the humanity of certain examiners, I found very little warmth in the last field office I visited).

Comfort and confidence come only with good hard work. You must invest some time—for most of us, quite a lot of time—in learning the code and theory for your test.

Of course, there is another way. For as long as the FCC has been giving exams, there have been people who have taken them in much the same spirit that animates the buyer of a lottery ticket: "Maybe I'll be lucky!" The person who thinks this way bolsters himself by studying a cram course or memorizing the answers in the old (not the new) ARRL *License Manual*. He copies a few W1AW code runs and then blithely strolls into the examination room to take his chances.

Very likely we'll see him in the same spot next month, and the following, but after awhile, it will work: Through practice, he'll finally pass. However, by this time he would have been better off doing it the right way from the start, thus gaining some useful knowledge to go with that new ticket.

Study Hard

So, study hard. But it shouldn't be purely a grind. After all, ham radio is a hobby, meant for enjoyment. Your enjoyment should increase as you learn about your hobby. You will not have to mumble when someone starts a modest technical discussion on 75 meters. The process of learning how a radio works should interest you, unless ham radio for you is simply the propagation of your ego across long distances.

Perhaps a class can help you learn more code and theory. More and more clubs are sponsoring classes, not only for prospective Novices, but also for those who want to upgrade. "Ham Help" in *73* or the ARRL can help you find a class.

If you are going for your Extra, or there is no class in your area at the needed time, you may have to go it alone—but don't despair. If you have the right materials, you can learn at least as efficiently on your own as you can in a class, which may move at the speed of the slowest learners. As you work by yourself, you should push yourself hard, but don't go so fast that you fail to learn.

If you, like me, have trouble with the math, check out the series "FCC Math" by WB6CKN, which began in the November, 1977, *73*. It will help.

Learning the Theory

There are two exceptionally useful books to help you learn the theory. One is the new ARRL *License Manual* (the one with the smiling faces on the cover). This has been wholly revised, and is now clearly written and sensibly organized. It follows the study questions released by the FCC. It also contains sample tests to check your knowledge. These tests are as difficult as the actual FCC exam, and therefore provide a pretty good measurement.

The ARRL *Manual* is not enough by itself, however. To get beyond the memorization of cloudy "facts" to a real understanding of radio theory, you need a book that goes more deeply into things.

The best of these books are the study guides (Novice class through Extra) which are available from *73*. These originally appeared serially in this magazine, and have helped many amateurs understand radio as they prepared for their tests.

If you are studying for the General class, you can use the *General Class Study Guide*. It is simply written and does a fine job of explaining basic electronic and radio principles to a layman.

But you might consider setting your sights a bit higher. Even if you think you're just General "material," buy the *Advanced Class Study Guide*.

I admit to a special bias toward this book. As a Novice who in real life was a high school English teacher, I saw myself as an anomaly in the ham ranks. I had no training in electronics and was poor at math. I despaired of going higher. On the other hand, my code speed was increasing slowly, and I certainly wanted that higher-grade license. I decided to try for the General.

On the advice of a friend, I bought the *Advanced* guide. Surprisingly, I found it easy to read, even pleasant. Moreover, I found that with some effort I could understand everything in it. What had seemed arcane and unattainable was now within my grasp. When I thought I had it down pretty well, I went into the FCC office in Philadelphia and passed both the General and the Advanced on the first try. Since this method worked so well, I later did the same for the Extra.

The *Extra Class Study Guide* is a superb piece of work. It tells you much more than you need to know for the test, but does it so clearly that you might as well learn it. It is very interesting: Haven't you wondered how TV really works, for instance?

Understanding the material in the *Extra* guide was so confidence-inspiring that I decided to warm up for the Extra exam by trying the commercial radiotelephone tests. I did some cramming on commercial regulations and on a few old concepts like electric motors (which are not covered in the *Extra* guide), using a question-and-answer manual. I passed the Third Class 'Phone easily, and then passed the 100-question Second 'Phone test, but failed the First 'Phone (my third test of the day) by one question.

I don't know what a mild-mannered English teacher will do with a commercial Second 'Phone ticket, but I mention it because it shows the level of preparation provided by the *Extra* guide. The Second 'Phone was much harder than the Extra exam, which I passed with confidence the next day.

Early to Bed

Cultivate regular habits as you study. Set aside a certain time to work. The best time to do this is early in the morning. Ideally, you should study as soon as you are properly awake, a time that varies for all of us. But of course there are other demands made on your time, perhaps by work, children, or school.

Try getting up an hour earlier than usual. Do some exercises. Maybe you will become healthy—a side effect not to be scorned. Then, study for 45 minutes or so.

The material you studied will travel around with you all day. Think about it. Jot down the things that are not clear. Ask yourself questions. At the end of the day, spend half an hour reviewing what you read that morning.

If you can't possibly study in the morning, do it when you can. But the brain becomes weary as the day wears on; learning becomes less efficient. At any rate, study some each day.

Try to put off taking the sample tests until you think you have really mastered the material. If you take them too soon, or too often, your studying will subconsciously aim at answering specific questions on the sample test, and you may miss things that will later appear on the real thing.

Learning the Code

Many articles have appeared on learning the code, and I won't go far into this. One recent article I can recommend is the one by K6DZY in the October, 1977, *73*. The point made there by Boyd is that International Morse Code is a language, and it is learned much as any foreign language is learned. Learning a new language demands exposure (listening) and practice (sending).

The great enemy in learning the code, or improving your speed, is anticipation: guessing what will be sent next. Anticipation causes errors. As speed increases, anticipation causes general confusion and lack of confidence, both of which are destructive to learning.

The way to beat anticipation is to learn to "copy behind." This puts a premium on listening before you write—you are always looking back at what was sent, not ahead at what might be sent.

In his article, Boyd mentions an acquaintance who copied 20 to 30 words behind! If you are trying for 13 wpm, or even 20, copying from one to three letters behind is usually enough. You will be able to recognize words and common prefixes and suffixes, and by concentrating on copying behind, you will prevent anticipation and also be able to correct minor errors.

Learn to copy behind by practicing with cipher groups, or randomly-sent letters, numbers, and punctuation. Wayne Green has made a series of tapes which give practice in this sort of copying. While some of the groups, particularly in the 20+ wpm tape, show evidences of extreme sadism, they are the best tool there is.

This sort of tape has three advantages over other methods of code practice. First, they prevent anticipation by their random nature, and with practice you will get totally out of the anticipation habit. Second, because they are random, you will not find yourself memorizing words in sequence, as you would do if you practiced with plain language tapes. (If you find you have memorized Wayne's tape, it's time for the test. You've mastered the tape, and you'll be able to handle the FCC code with ease.) Third, they are recorded at speeds faster than those required for the FCC test.

To improve at the code, you have to push yourself to a speed which is beyond what you can comfortably copy. Don't be discouraged if you copy very little of the practice tape at first. Begin by listening, and then practice copying what you can, always copying behind. You'll improve, and eventually you'll copy it all. I promise.

Practice the code regularly each day. It needn't take too much time. Half an hour of random groups, divided into four sessions at different times of the day, is plenty. Unlike theory, code can profitably be practiced at night. You'll get a good check of your speed under pressure, with your fatigue approximating your nervousness at an FCC exam. And maybe those "dits" and "dahs" will chase themselves around your subconscious all night.

Slow and Sure

Don't try to rush things. Give yourself all the time you need to study the theory and the code. It may take some time, but keep calm and determined. Remember, if you do it right, you won't miss. If you go into that exam with confidence, you'll walk out with a well-deserved "Interim XX" ticket, and the satisfaction of knowing that you've done a difficult thing well. Good luck! ■

✓ Reader Service—see page 211

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✓ Reader Service—see page 211

73 Magazine *Staff*

Universal Alarm Circuit

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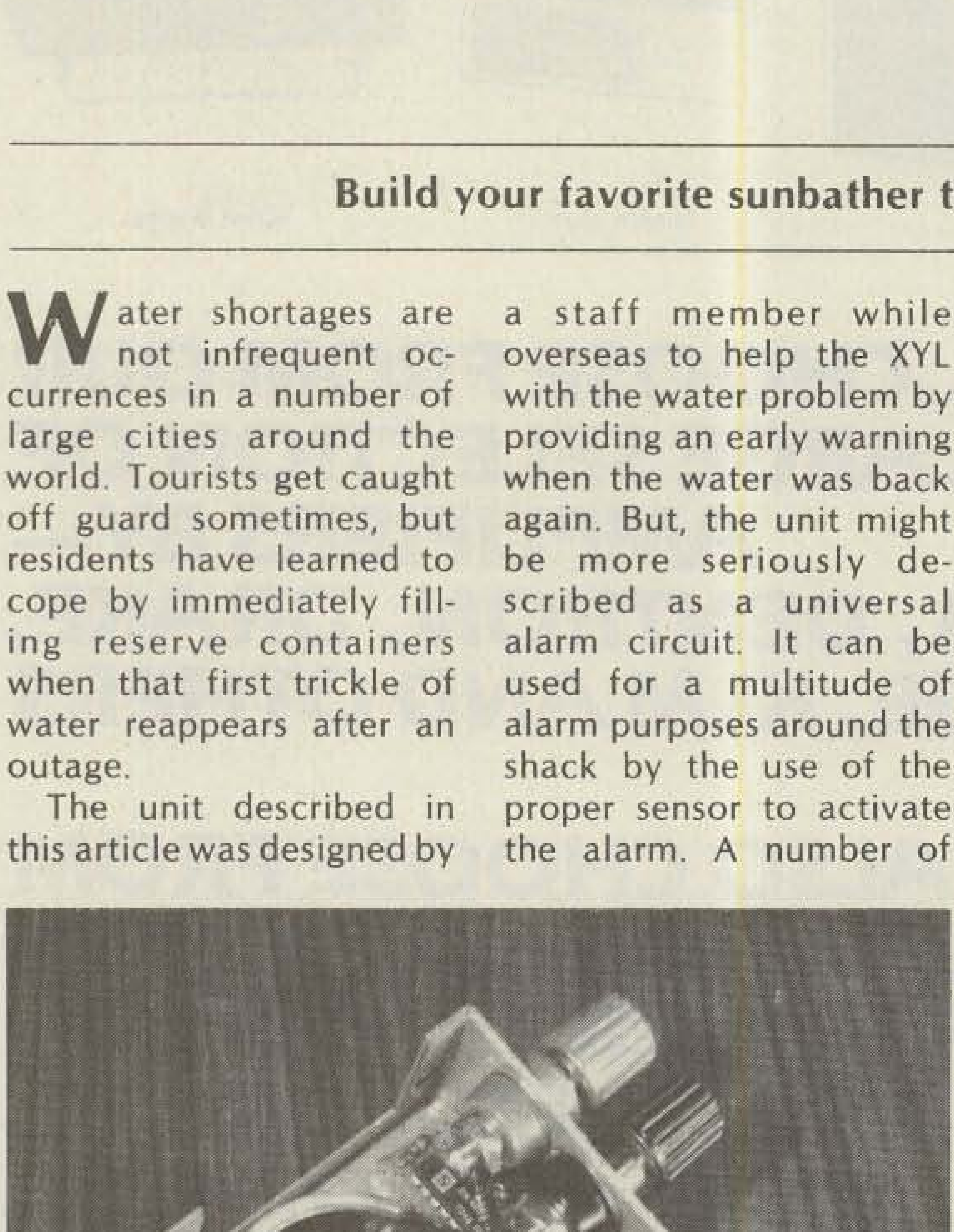
Build your favorite sunbather the ultimate in beach accessories.

Water shortages are not infrequent occurrences in a number of large cities around the world. Tourists get caught off guard sometimes, but residents have learned to cope by immediately filling reserve containers when that first trickle of water reappears after an outage.

The unit described in this article was designed by a staff member while overseas to help the XYL with the water problem by providing an early warning when the water was back again. But, the unit might be more seriously described as a universal alarm circuit. It can be used for a multitude of alarm purposes around the shack by the use of the proper sensor to activate the alarm. A number of such uses are covered here. To turn to the lighter side of things, sunbathers can also use the unit to warn themselves that the tide is coming in and that they are about to be engulfed.



The tester assembles very compactly in a 2" x 3" x 1¾" enclosure. The IC and transistor are under the binding posts and the "speaker" is a 600-Ohm telephone receiver.

The basic circuit shown in Fig. 1 is relatively simple, but yet it has a number of significant advantages:

1. The standby current is less than 10 microamperes! This amount of current is so insignificant that no on-off switch is necessary, and the battery will last for about its shelf life while the circuit is in standby. About 60 mA is drawn from the battery when the alarm operates.

2. The input circuit is quite sensitive, but yet not touchy. For instance, in the water-alarm setup, the "probes" need only be two ordinary pieces of hookup wire. No elaborate interleaving pattern of conductors is required. The probes or sensors can be remotely located from the alarm over considerable distances—50 to 100 feet in many applications.

3. The alarm sounds off when it "sees" less than approximately 120k Ohms at its input terminals. The value of this resistance will vary a bit from alarm to alarm because of the tolerance of the components used for circuit construction. But, for any given alarm constructed, it will have a definite value that will remain constant over wide extremes of temperature. So any sensor can be used with the alarm that provides any resistance less than 120k Ohms when the alarm is to sound.

The heart of the circuit of Fig. 1 is the CD4001 quad NOR gate. The last two gates act as a multivibrator that is turned on when pin 8 goes low. The second gate is an inverter, and the first gate acts as an input stage. Normally, pin 3 is low and pin 4 is high. Activation of the first stage reverses this condition, and the multivibrator operates. The 2N1375 stage provides a bit of high-distortion amplification to drive a 600-Ohm telephone-type receiver unit to a very penetrating output level. A small speaker can be used instead, but then one has to experiment with some series resistance in the 2N1375 collector lead to limit the current. With the usual 4- to 8-Ohm speaker, something on the order of 47 to 220 Ohms should suffice.

The multivibrator frequency is a function of the 10k and 22k resistors and the .01 uF capacitor. A frequency of about 3,000 Hz appears to be produced, although it is difficult to tell because of the high distortion which makes it sound so penetrating. At any rate, one can scale these RC values up or down so different output frequencies are produced to allow sensing which alarm went off if a multiple alarm setup is used. In addition, one could place an LED or relay in the 2N1375 collector lead to activate a visual alarm.

As was mentioned before, any sensor which provides less than about 120k resistance can be used. Thermistors and photocells would be typical examples for temperature and light sensing. A series resistor can be added to the sensor circuit, so the alarm is activated at the desired point. The unit will function directly as a diode and transistor junction tester and, also, as a crude but effective ohmmeter to check relays, switches, etc.

Voltage and current sensing can be done by simple transistor switch circuits, such as shown in Fig. 2. When the transistor turns on, the alarm circuit will be activated. So one can build a variety of alarms which check for any over-limit condition (excessive swr, line voltage, modulation, etc.) by just sensing any dc voltage available in a transceiver or swr bridge which increases as the function desired to be monitored increases in amplitude. By choosing the resistance values carefully in Fig. 2, very little loading will be presented to the circuit being monitored.

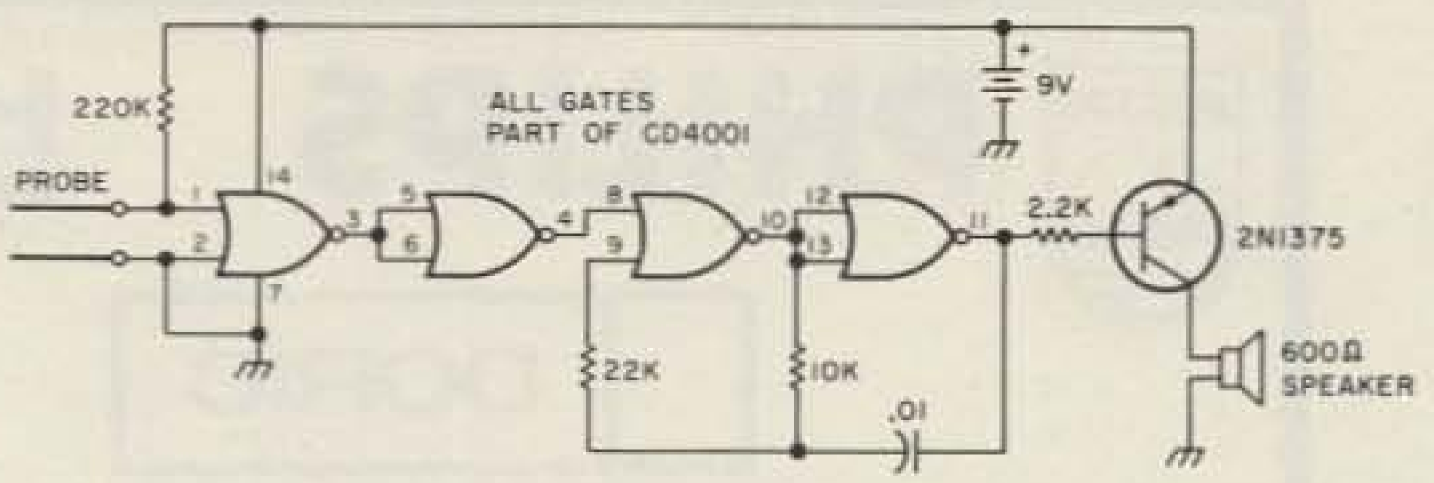


Fig. 1. One IC and one transistor make up a sensitive and loud alarm circuit.

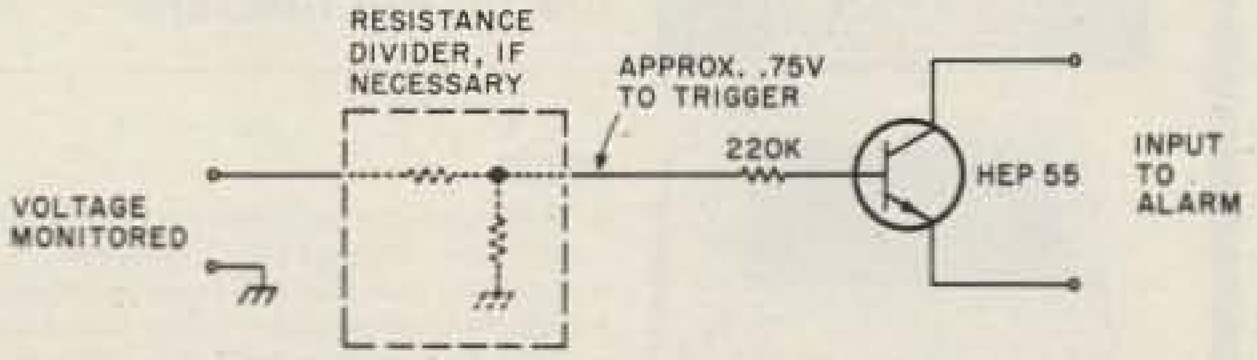


Fig. 2. Simple transistor switch addition allows alarm to monitor a wide variety of circuits for over- or under-limit conditions.

How about checking for under-limit conditions, such as low temperatures, low battery voltage, etc.? All of the foregoing applies. Just bypass the second gate in the CD4001. The alarm will now activate when any sensor presents a resistance which goes above about 120k Ohms. The same outstanding feature of the alarm circuit applies in this mode in that practically no current is drawn from the alarm battery supply until it is actually activated. ■

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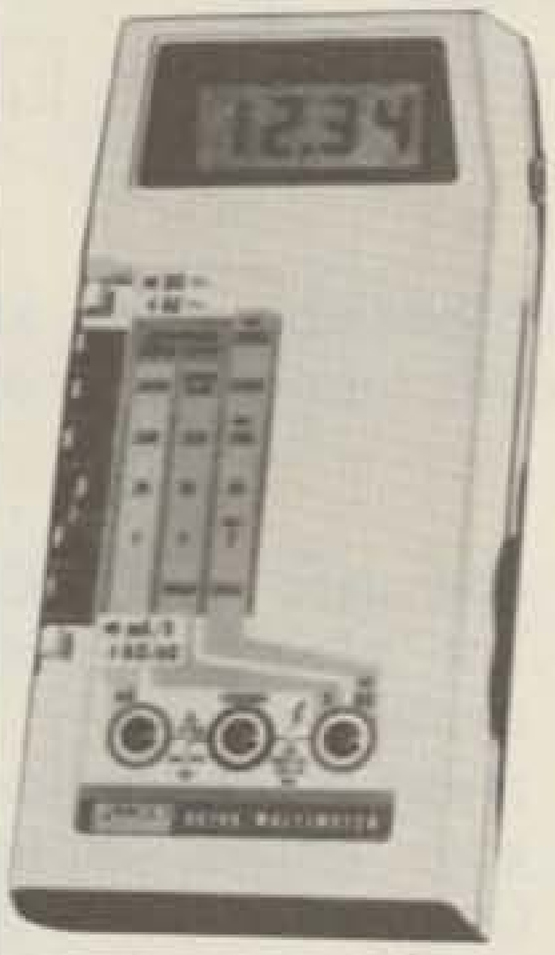

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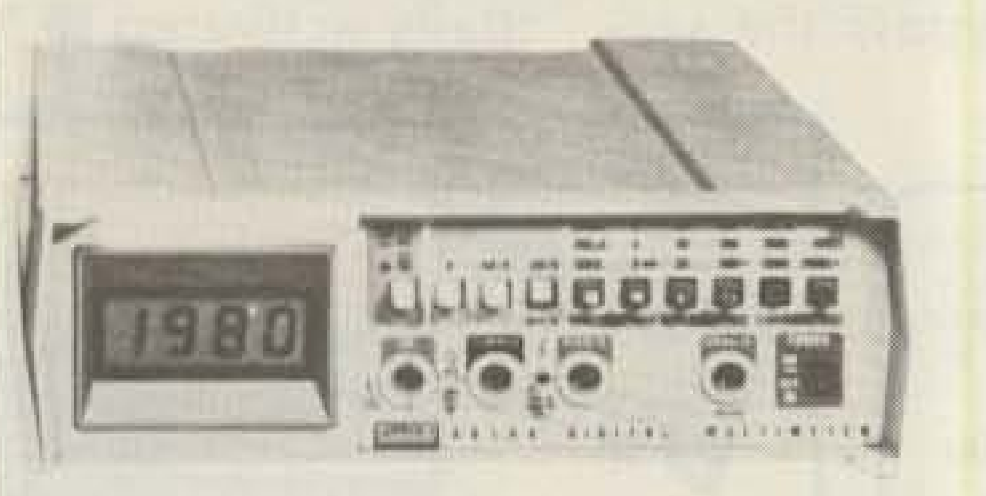

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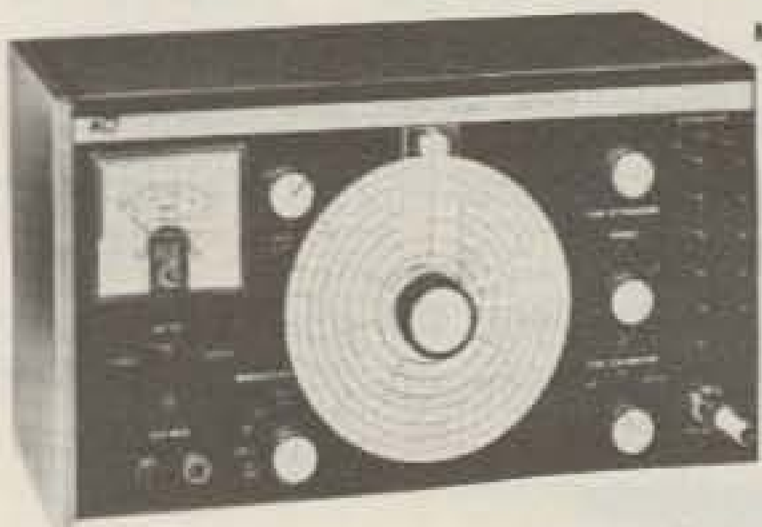

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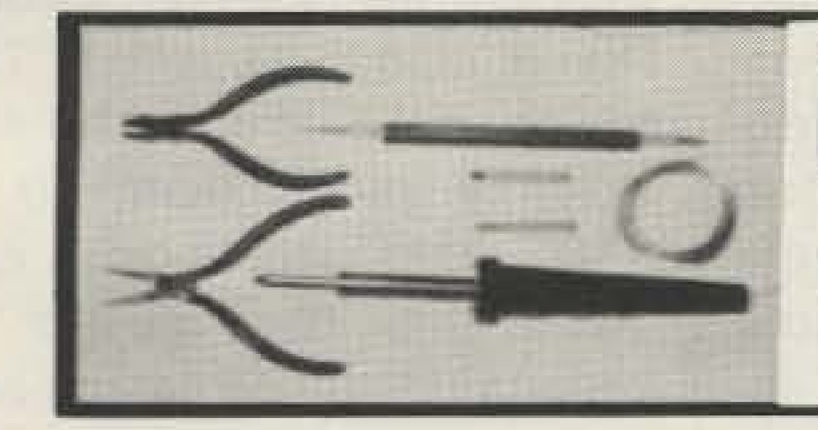

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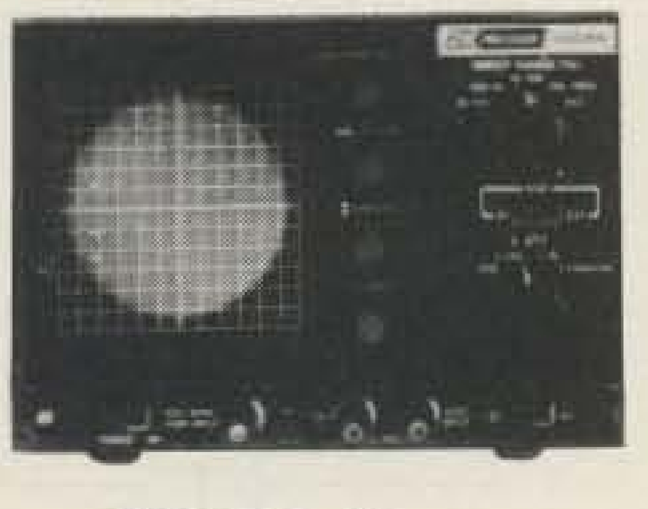

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— try coaxial stub filters

Put your problems to rest.

There are times when one might run into the problem of a specific spurious frequency being radiated by a transmitter and causing interference problems, or reception problems caused by a specific undesired signal. The usual approaches to these problems are various types of LC traps, filters, etc. However, there is another approach which is often very useful as well as economical. No involved construction of tuned circuits is necessary, and one can achieve 30 dB or more suppression of an undesired frequency in either the transmitting or receiving mode.

The basic idea of coaxial stub filters is very simple. As shown in Fig. 1, a section of transmission line which is ½λ-long and which is shorted at one end will reflect an electrical short to the other mechanically-open end of the transmission line. This will only occur at the frequency for which the transmission line is ½λ-long. So, if we have a transmission line going to a transmitter or receiver as in Fig. 2(a), and wish to suppress some frequency, we can insert a ½λ-long rejection stub for the frequency to be attenuated. At that frequency, the coaxial transmission line to the receiver or transmitter will electrically act as if it were shorted. Although there are some cases where only a rejection stub can be used, usually it has to be combined with a correction stub as shown in Fig. 2(b). This is because the rejection stub at the desired operating frequency will present some reactance across the main transmission line. The correction stub cancels this undesired reactance so that at the operating frequency the main transmission line acts electrically as though there were no stubs at all on it.

That is all there is to the theory of a coaxial stub filter. The rest of this article is mainly concerned with the practical aspects of determining the lengths of the stubs and special applications. The stub filter idea can be used over a very wide frequency range. The limitations to its application are mainly mechanical, in that at very low frequencies the rejection stub may become too long, and at UHF frequencies it may not be possible to dimension the stubs accurately enough. As was mentioned before, the rejection stub has to be ½λ-long at the frequency attenuated. The ½λ length must be an electrical length, so when you're dealing with coaxial cable it will differ from the physical length because of the velocity factor of the cable. Fig. 3 presents the actual physical length that a coaxial stub should have in order to be electrically ½λ-long at a given frequency. The graph is based on a velocity factor of 0.66, which is the usual one for all common coaxial cables (RG-8, -58, -59, etc.). The graph only covers the frequency range from 10 to 150 MHz, but one can calculate the length of coaxial stub needed at any other frequency from the formula:

$$\text{Length (inches)} = \frac{3897}{F\,(\text{MHz})}$$

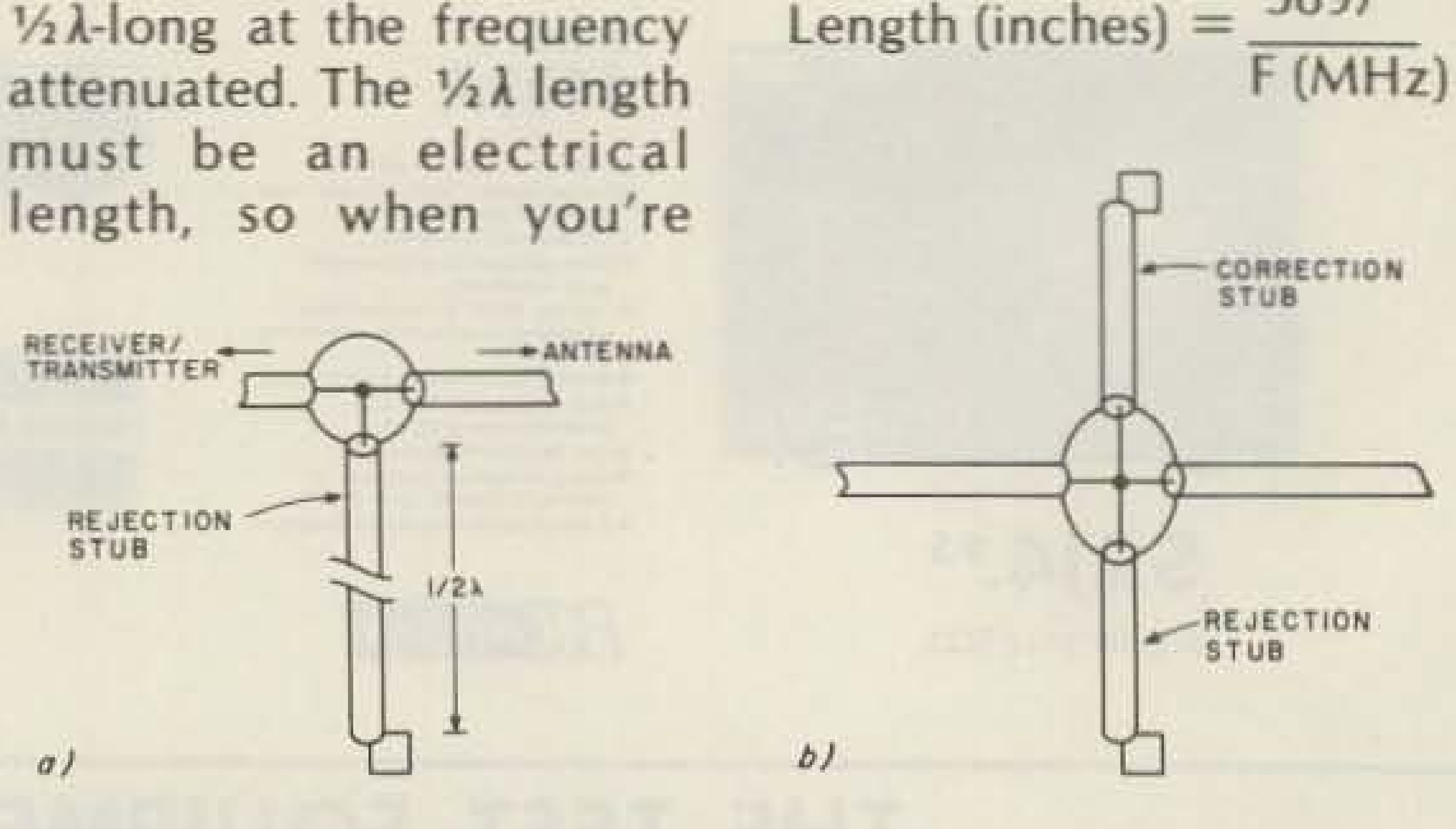

Fig. 2. Placement of rejection stub (a) and rejection stub with correction stub (b). The ends of both stubs are shorted. Although for clarity the shields are shown connected together by jumpers, they should, in reality, be directly soldered or otherwise connected together.

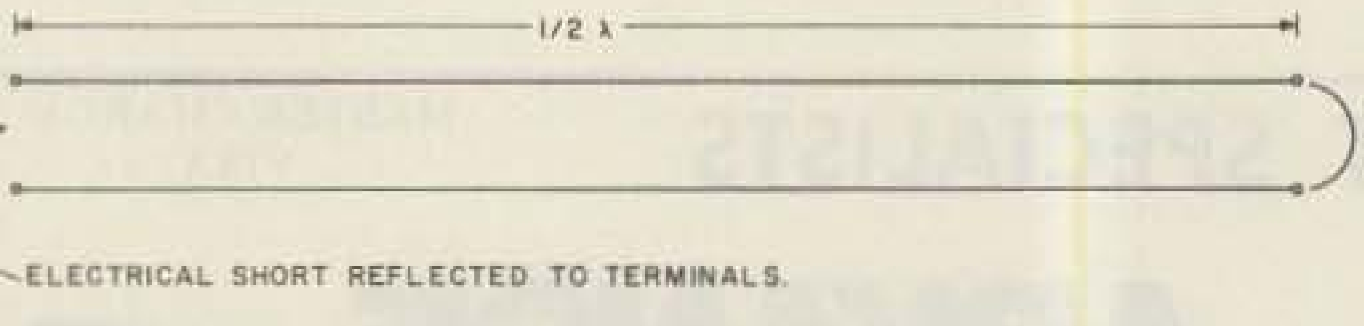

Fig. 1. Stub filters are based on characteristics of a ½λ transmission line.

Remember that the frequency involved in this case is the undesired one which one wishes to attenuate, and not the operating frequency.

In practice, one should cut the piece of coaxial cable several inches longer than called for to allow for pruning. Install the rejection stub reasonably close to the antenna terminals of the transmitter or receiver being used. Various types of coaxial connectors are available to interconnect the lines, but the interconnections can simply be soldered on without connectors for indoor usage. Using a pin or pick, short-circuit the outer shield of the rejection stub to the inner conductor at various points starting from the outer end of the stub until maximum attenuation of the undesired signal is achieved. When the best point is found, cut off the excess cable, fold the outer shield around the inner conductor, and solder them together.

The length of the correction stub will vary from zero to ½λ. Its length can be determined approximately from the graph of Fig. 4. In this case, by knowing the ratio of the undesired frequency to the operating frequency, one can determine the electrical length of the correction stub at the *operating* frequency. The physical length of the coaxial cable used can be determined from the formula previously given for a ½λ-length stub. As in the case of the rejection stub, the correction stub should initially be made longer than calculated. The correction stub is then experimentally shorted until the least attenuation is produced at the operating frequency. If a transmitter is being used, the correct stub length is easily determined by pruning the stub until an swr meter indicates a flat line.

As an example of the foregoing, say we were operating on 21 MHz but had problems with an interfering signal on 26 MHz (in the transmitting case, our operation on 21 MHz was producing some spurious radiation on 26 MHz). The length of the 26-MHz rejection stub would be approximately 150 inches. 26 MHz is about 1.25 F on the graph of Fig. 4, so the approximate length of the correction stub is 1/16λ at 21 MHz, or about 23 inches.

All of the foregoing may seem like a bit of work, but really all it takes is patience and a slight amount of math. The results that can be achieved by the simple application of stub filters are shown in Fig. 5. Those are not bad results for just the cost of lengths of coaxial cable.

There are several special cases that one should be aware of. If the frequency which is to be attenuated is 1/8, 1/4, or 1/2 of the operating frequency, the idea of coaxial stub filters will not work. This is because the rejection stub will turn out to be a wavelength or a multiple thereof at the operating frequency. Therefore, it will present an electrical short across the transmission line also at the operating frequency. Note that the graph of Fig. 4 is broken at several points, e.g., .75 F and 2 F. In these cases, the indicated length of the rejection stub would be ¼λ at the operating frequency. But, a shorted ¼λ stub represents an open circuit, so there is no need for the correction stub at all in these cases. The 2 F case is interesting, of course, since it would represent the second harmonic of a transmitter. By using only a rejection stub, therefore, one could get a nice bit of additional second harmonic attenuation. In fact, it will attenuate all even harmonics.

One can use more than one stub filter or different stub filters on various bands with a switching arrangement. Many combinations are possible, and in some cases only the correction stub may have to be switched on different bands. As a bonus feature of the stub filter idea, note that the shorted end of the rejection stub can be grounded if desired. Thus, one can provide a direct electrical connection to ground for lightning protection, static drain, etc., for an antenna system that does not have to be switched in or out when operating. In a multiple antenna system, one could have a grounded stub for each antenna so that each antenna is continuously protected. ■

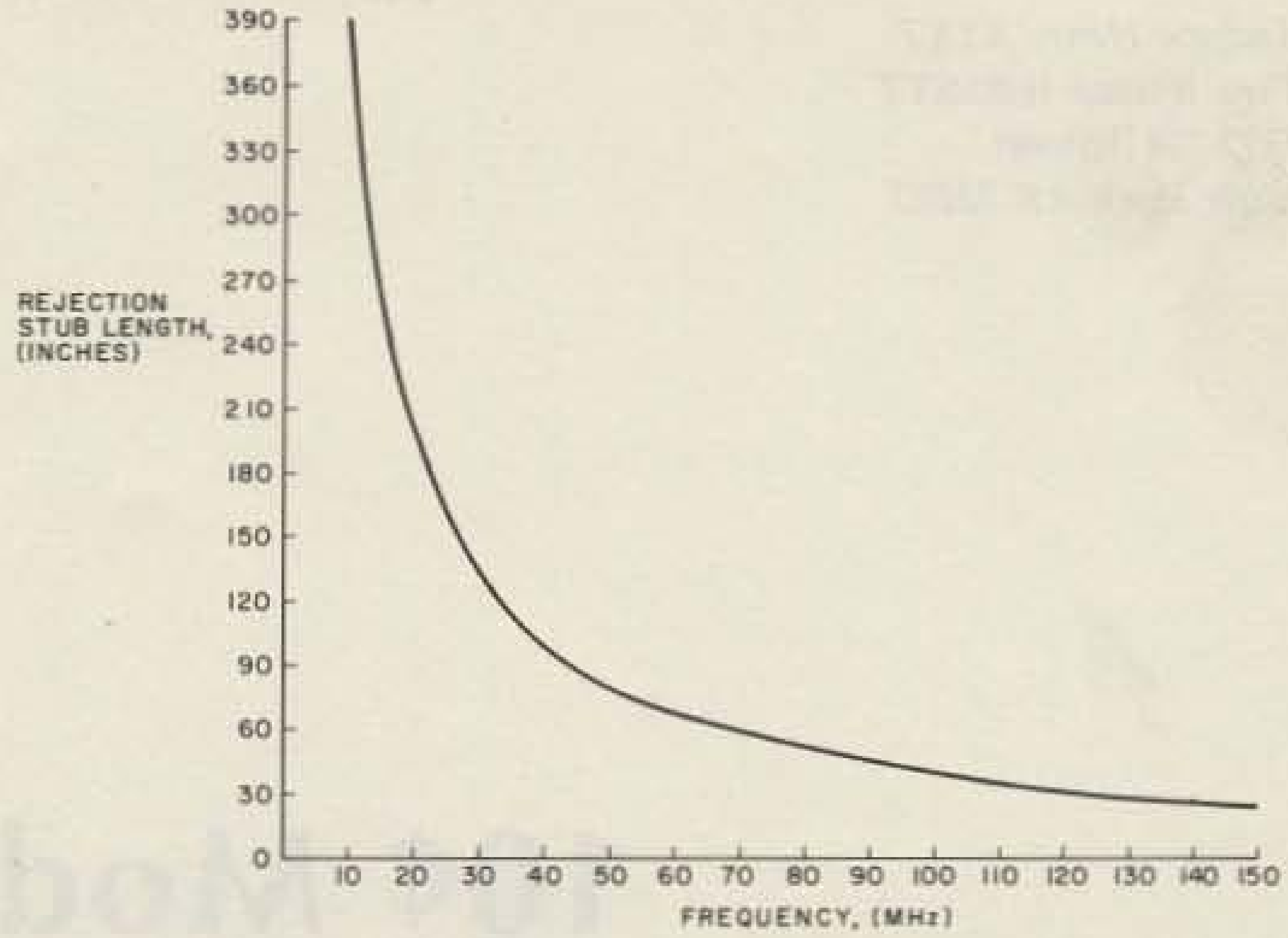

Fig. 3. Graph to determine approximate length of rejection stub.

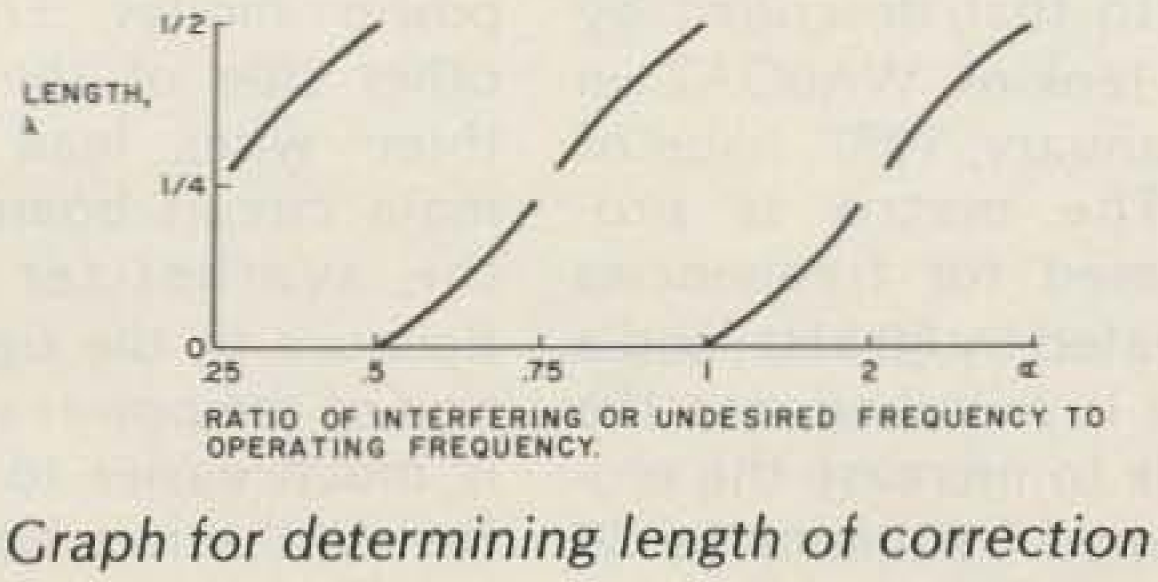

Fig. 4. Graph for determining length of correction stub.

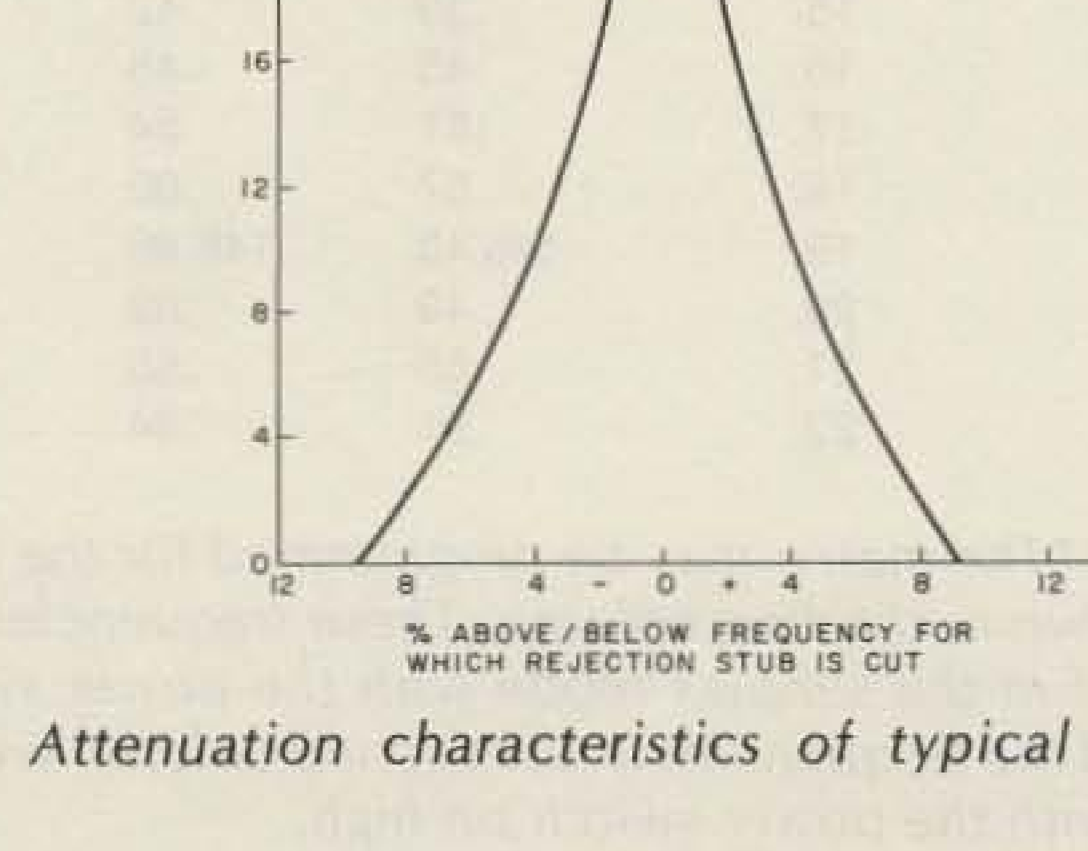

Fig. 5. Attenuation characteristics of typical rejection stub.

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10¢ Mod for the 22S

—extra channels for $.00455 each

Have you heard of an easier way?

By now you've probably heard of at least a dozen ways to increase the channel capacity of your Icom IC-22S. When we bought ours, we wanted expanded frequency coverage, but we also wanted coverage of all common repeater frequencies, no added switches or complicated gadgets, a system that could be used while driving, and a minimal investment of time, money, and energy.

Channel	Frequency*	
1.	146.01	146.04
2.	.07	.10
3.	.13	.16
4.	.19	.22
5.	.25	.28
6.	.31	.34
7.	.37	.40
8.	146.97	147.00
9.	147.03	.06
10.	.09	.12
11.	.15	.18
12.	.21	.24
13.	.27	.30
14.	.33	.36
15.	.39	.42
16.	.45	.48
17.	.51	.54
18.	.57	.60
19.	146.43	146.46
20.	.49	.52
21.	.55	.58
22.	.91	.94

*Table 1. *The matrix may be programmed for the frequencies shown in the first column. These frequencies will be obtained in the simplex mode with the power switch on low, and the frequencies in the second column will be obtained with the power switch on high.*

Now that everyone else has had his turn, here is the lazy man's approach to the problem. All it takes to convert your IC-22S to an "IC-44S" is a soldering iron, a ten-cent diode, and a spare hour or two. The only drawback to this scheme is that you must confine yourself to high-power operation only. Since our QTH has all the propagation characteristics of a black hole, this was an easy trade-off to make.

The basic principle of our modification is identical to that described by Don Jenkins WA6OAZ in the January, 1977, issue of *73*. The matrix is programmed for frequencies separated by 60 kHz, and a diode is switched into the matrix to increase the programmed frequency by 30 kHz when so desired. The difference is that the need for external switching is eliminated by using one-half of the power switch. Operation is straightforward: When the power switch is in the low position, the base frequency is the programmed frequency, and when the power switch is in the high position, the base frequency is the programmed frequency plus 30 kHz.

The first step in modifying the circuitry is to free the half of the power switch that controls the output level and to wire the circuit board for high-power operation. One side of this DPDT switch is used to supply 13.8 V dc to the rig in both the high and low power modes. From the other side of the switch, three wires lead to the main circuit board below the synthesizer board. Because of the tight location of the power switch, it is much easier to remove the synthesizer board and

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access these wires as they connect to the main board than it would be to unsolder them from the switch. This is easily done by removing the matrix board and the three screws and one threaded spacer that hold the synthesizer board and an underlying metal tray. With the synthesizer board set aside, find the brown wire leading from the center position of the lateral half of the power switch to the main circuit board at a point marked W15 on the foil. This point is in the right rear corner as the rig lies inverted and is viewed from the front. Next find the purple wire leading from the switch contact nearest the synthesizer board and the side of the rig to the main board at point W-16. Cut the brown wire so that the segment extending from point W-15 is just long enough to connect to the foil at point W-16. Unsolder the purple wire from the foil and solder the brown wire from point W-15 in its place. Now find the pink wire leading from the switch contact nearest the true top and the side of the rig to the main board at point W-17. Cut this wire at the foil and tape the end, as it will not be used. Now you should have a connection between points W-15 and W-16, two wires leading from the power switch that are shorted together when the switch is in the high position, and a third wire from the switch that is not used. Replace the metal tray and the synthesizer board, but leave the matrix board free.

The next step is to add one diode to the matrix board in the D1 file and to connect it so that 9 V dc is applied across it with the power switch in the high position. The diode, a 1N4148, 1N914A, or equivalent, is inserted cathode-first from the diode side of the matrix board into a hole in the D1 file in the rank corresponding to channel 1 or 2. Solder the purple wire to the anode of the diode. Connect the brown wire to the matrix board at the point marked 9 V dc. You may need to extend these wires a few inches to reach the matrix board. The circuit modifications are now complete.

The matrix can be reprogrammed for any frequencies as long as diodes are not used in the D1 file (as this would cause redundancy), and all 22 channels must be programmed. Mr. Jenkins points out that if the extra diode is switched into the circuit and the selector passes an unprogrammed channel, the rig will lock onto this blank channel until the power is momentarily switched off. I chose to program my rig in the same fashion as Mr. Jenkins demonstrated, and those channel frequencies are repeated here for any unfortunates having no back issue of *73*. This is only a guideline; you may wish to include 15 kHz split-channel repeater frequencies or your own clandestine frequencies. If you run short of diodes, a trip to Radio Shack with a dollar in hand will get you ten more.

In the time we have used the IC-22S with this modification, we have not heard of an easier way to increase the channel capacity of this versatile rig without drilling holes, adding switches, or constructing things more complex than we dare to try. We can't brag of access to all 133 possible channels, but we rarely need them all anyway. ■

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The 10-GHz Cookbook

— monster article

Stick to your Gunns.

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Photo A. The breadboard Gunn-diode oscillator. The waveguide flange is relieved to clear the 2-56 frequency adjustment screw. The positive supply connection is to the turret terminal of the diode mount.

The amateur 10 GHz band offers many fascinating opportunities for both communications and experimentation. Antennas of very high gain are of practical size so that many tens of miles may be spanned with good reliability. The band is a natural for linking of VHF and UHF repeaters, control of repeaters, or control of remote base stations. Activity in the band has been limited by the lack of a good low-cost rf source. A number of transmitters and receivers have been built using surplus klystron tubes, but since surplus items are not generally available to everyone, these designs are difficult to duplicate. In addition, the development of repeater command links or interties requires that the equipment be reliable and compatible with other solid-state gear. Klystron-based designs with the necessary high-voltage dc supplies are certainly not desirable. Gunn-diode oscillators offer an attractive alternative. Properly applied, they will provide up to several hundred milliwatts of stable low-noise rf power.

Gunn-diode technology has been with us for about ten years. In that time, the device has moved from a lab curiosity to a mainstay of microwave engineering. There has always been both commercial and military demand for an inexpensive solid-state microwave rf source. In response to this need, the technology has been pushed rapidly and the price of the diodes has fallen to the point where commercial applications such as radar intrusion alarms, speed meters, and door openers are common. The price of a 10 milliwatt X-band diode is now less than ten dollars. More powerful devices cost more but are still quite reasonable. Actually, some very practical systems may be built with a 10-milliwatt transmitter. Using a 3-foot dish with 36 dB of gain and a 10-milliwatt source, one obtains an effective radiated power of 40 Watts! That is more than ample for most applications.

My objective in writing this article is to create some interest in X-band operation and to show how easy it is to get started. I will describe the operation of Gunn diodes and present a practical oscillator design. The oscillator tunes the entire 10.0-10.5 GHz band with a power capability of more than 20 milliwatts. The oscillator is easily reproduced and is very reliable. One unit has been operating for almost three years and several others have been built. They all have worked perfectly, so I have a lot of confidence in the design.

This is a new area to many amateurs, so I will describe some tests and trade-offs that may be made to optimize a Gunn-diode oscillator for particular applications. The effects of load mismatch upon the power output and frequency of the oscillator were measured and data was taken for two diode types. I will describe both the tests and the results obtained. Afc or phase locking requires electronic tuning of the oscillator. The frequency of Gunn-diode oscillators may be controlled to a limited extent with the dc supply voltage. I made some tests to determine how useful this can be and will discuss the results. Applications for this design are numerous and my objective is to give as much practical data as possible to aid you in putting the circuit to work in your system.

So much for science! Making a Gunn oscillator is fun only if you can do something with it. Part of the article describes a simple transceiver which may be made by adding a mixer to the basic oscillator. This is an ideal device for getting started on the band. It has two immediate uses: as a simple transceiver for communications, and as a Doppler radar. A Doppler-radar processor is included. The processor turns the transceiver into an effective speed meter, door opener, kid watcher, intrusion alarm, or whatever.

The transceiver may be used as a wideband FM link by modulating the dc bias supply and using an FM tuner or receiver as an i-f strip. The basic oscillators are useful as transmitters or as receiver local oscillators in either wideband or narrowband FM systems. Hopefully, someone will use the design as a starting point for an operational repeater command link or other X-band system application.

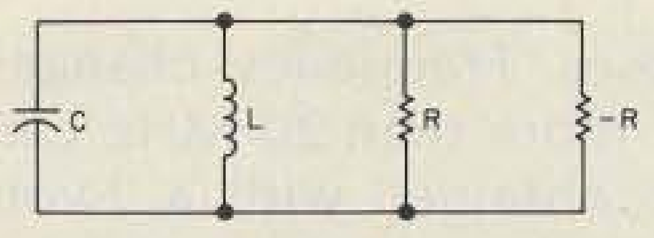


Fig. 1. Negative-resistance oscillator. L and C are the resonant circuit elements. R represents all losses, including output power. The negative resistance of the Gunn diode is represented by −R.

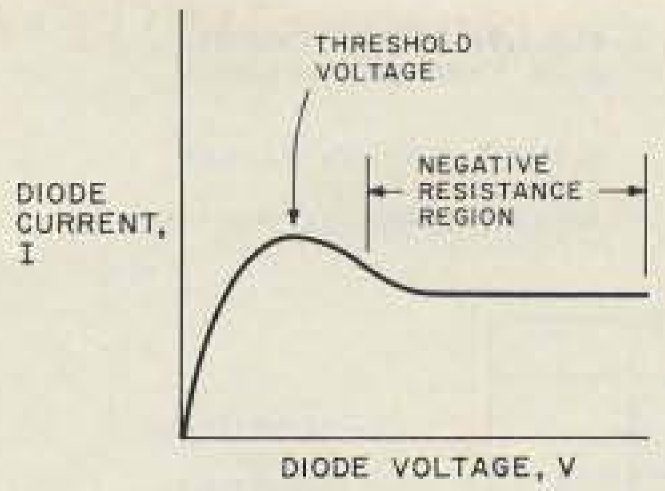


Fig. 2. Gunn-diode voltage-vs.-current plot. Above the threshold voltage, the curve reverses and the current decreases with increasing voltage.

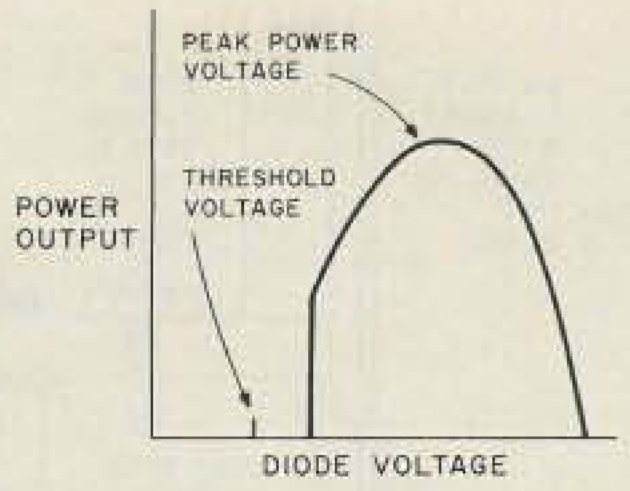


Fig. 3. Gunn-diode oscillator power vs. diode voltage. The peak power voltage will be different at different frequencies.

Gunn Oscillator Operation

Gunn oscillators are negative-resistance oscillators. Fig. 1 is a schematic of a negative-resistance oscillator modeled as a conventional LC oscillator. If the L and C were truly lossless and no power were taken from such a circuit, it would continue to oscillate once started. Real components do have losses and these are lumped into the loss resistance, R, of Fig. 1. Any output power taken from the circuit is also a loss, and that is also included in R. The effect of a negative resistor is to provide rather than consume power. This is a theoretical concept, but one that can be realized in practice. An LC circuit having more net negative resistance than positive loss resistance will provide sustained oscillations at the resonant frequency of the tank. In practical circuits, the negative R is supplied by tunnel diodes, Gunn diodes, Impatt diodes, and some transistor connections. A Q multiplier is an example of the negative-resistance concept. As the Q is increased, the circuit suddenly breaks into sustained oscillations; more negative R is being introduced into the circuit than there is loss and the circuit takes off.

A Gunn-diode oscillator is simply a microwave cavity resonator to provide the LC circuit and a negative resistance in the form of a Gunn diode.

Gunn diodes are made of gallium arsenide. The GaAs material can have electrons in either of two conduction bands. The electrons in one band happen to have much higher mobility than in the other band. Electron mobility is the measure to the rate of travel of electrons in the material. Greater mobility means higher velocity. In the absence of an applied electric field (voltage across the material), electrons are in the high mobility band. As the voltage across the material is increased, more move to the low-mobility band. The electron mobility in the material as a whole then becomes the average of the high and low mobilities. This means that the average velocity of an electron drops. Increasing voltage drops the velocity further.

Electric current is the measure of the number of electrons passing a point per second. In positive resistances, the current increases with increasing voltage. In other words, the average electron velocity increases with voltage. In GaAs, the velocity drops with increasing voltage. This means that the current also drops as the voltage is increased and we have a negative resistance.

The electric field intensity where the current begins to decrease is called the threshold field. Fig. 2 shows the current-vs.-voltage curve for a Gunn diode. The current initially rises as the voltage is increased. At the threshold voltage, the curve reverses and the current starts to fall. This occurs at a field intensity of 3200 volts per centimeter in GaAs.

This seems like a lot of voltage, but the active region of the diode is made quite thin and the threshold field occurs at applied voltages of only a few volts in actual diodes. The negative-resistance region occurs just above the threshold voltage, and somewhere above that point oscillations will start.

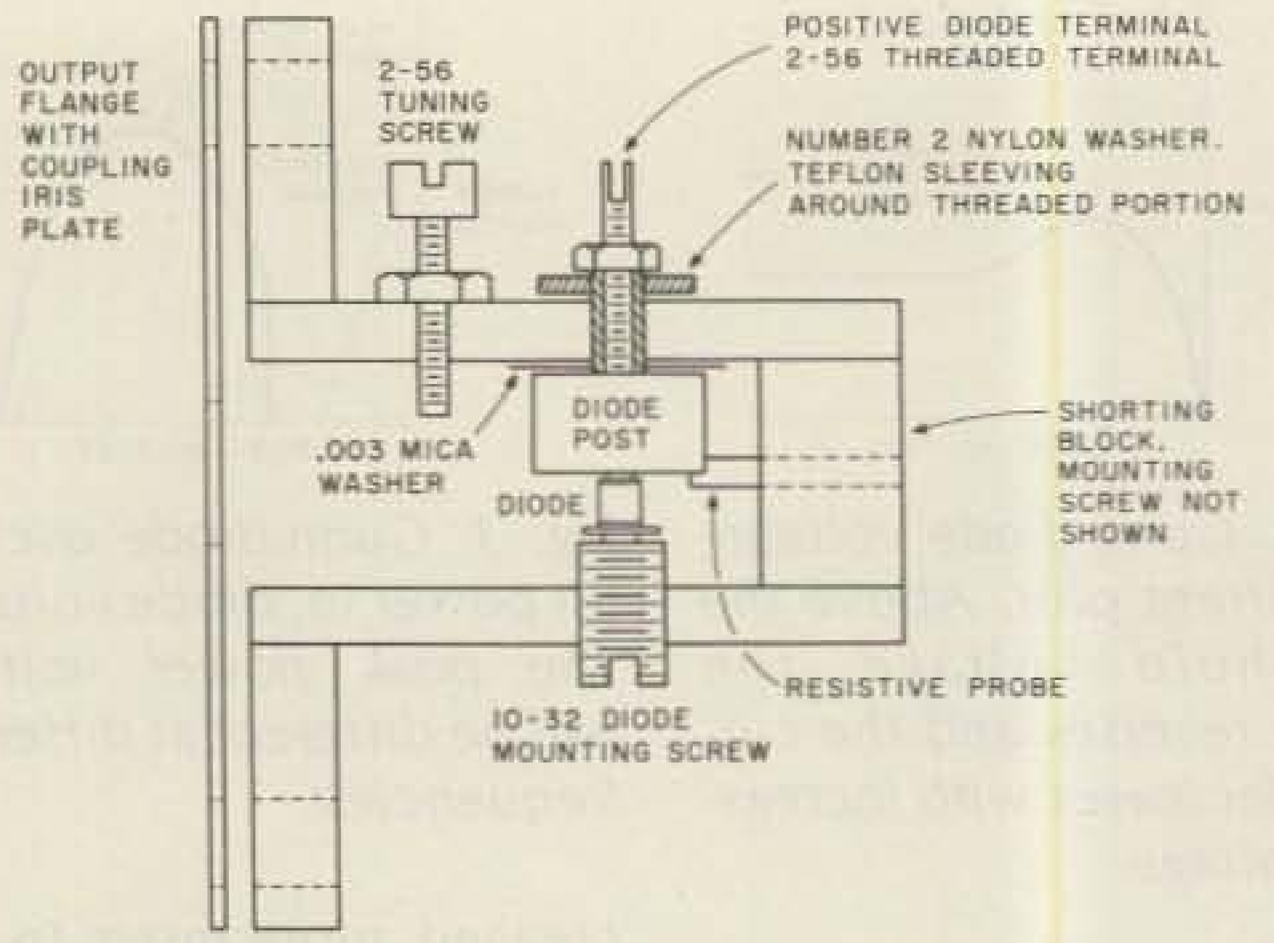


Fig. 4. The Gunn-diode oscillator assembly. Note that the flanged end of the diode (the cathode) is grounded by the diode-mounting screw.

There is one catch. The thickness of the diode must be made to match the travel time of the electrons at the desired frequency of oscillation. This is to ensure that the proper phase relations occur between the electric field and electric current. The diode thickness must be one "transit time length," so that the electron travels the length of the diode in one rf cycle. In other words, the diode thickness must be chosen with the operating frequency in mind, and not any diode will work at any frequency. This is not as bad as it seems. While diodes are characterized at a particular frequency, they will work over ranges of up to two to one.

As explained above, the applied voltage varies the electron velocity. Thus a diode of a given thickness may be voltage-tuned to optimize operation at a particular frequency. In effect, the transit time is changed by adjusting the electron velocity rather than the diode thickness. It is this mechanism which makes the Gunn oscillator tunable with supply voltage.

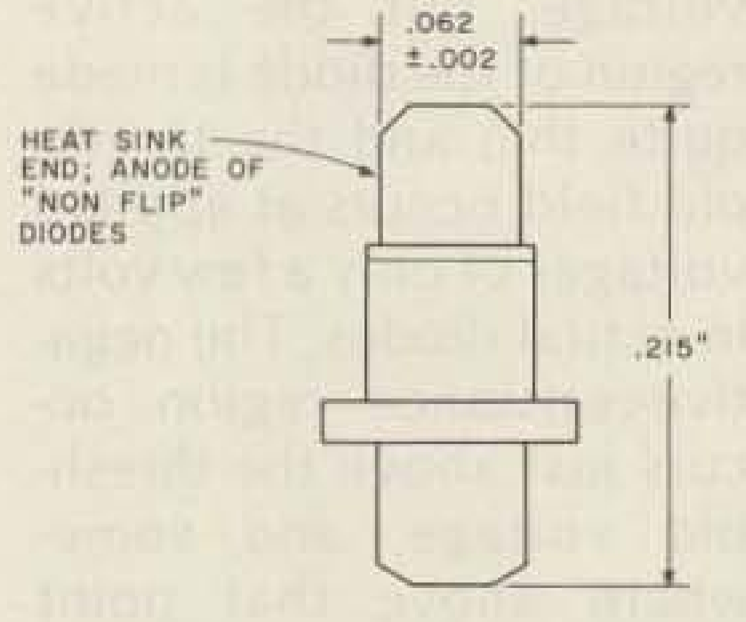


Fig. 5. Gunn-diode package.

Fig. 3 shows the effect of supply voltage upon the power output of the oscillator. At some voltage above the threshold, the electron velocity is appropriate to supply negative resistance to the tank circuit. Oscillations start. As the supply is increased, the optimum transit time velocity is obtained and a point of maximum power output occurs for that frequency. If the tank is tuned to another frequency, a slightly different supply voltage will yield maximum power output. Above the maximum power voltage, the power drops off and oscillations finally cease. A typical low-power X-band diode will have a threshold voltage of 3 or 4 volts and will operate from 6 to 10 volts.

Changing the transit time by adjusting the supply in effect "pushes" the resonant frequency of the tank circuit. The diode wants to make negative R at a different frequency than the tank, but the high Q cavity resonator dominates and only a slight frequency shift is obtained. This is enough to be practical for some afc purposes. Frequency changes of more than 20 MHz can be obtained with a 2-volt supply change. Some amplitude change also occurs, but most FM communications systems or mixer LOs can handle amplitude variations of up to 3 dB with no problem.

Gunn diodes have a problem with low-temperature starting. Both the power peak voltage and starting voltage increase as the diode temperature is lowered. Be sure to operate an oscillator well above the room-temperature starting voltage if low-temperature operation is intended.

Building a successful Gunn oscillator reduces to the essential problems of selection of an appropriate diode and installing it in a suitable resonator. Either coaxial- or waveguide-cavity resonators may be used. Low-stability designs having several GHz of tuning range are generally done in coax cavities. High-stability designs tend to use waveguide because of the higher cavity Q which may be obtained. One major factor in getting an oscillator to work is the suppression of spurious resonances in the cavity. The Gunn device has negative resistance over a wide bandwidth and will oscillate easily at resonances other than the desired one if care if not taken. Resonances in the bias chokes or feedthrough capacitor, higher-order waveguide modes, and coaxial modes involving the diode mount are all possible culprits. An effective cure for some of these problems is the inclusion of a lossy material in the cavity at a point where energy is dissipated only by the undesired resonance. This solution was applied to my oscillator in the form of a piece of pencil lead positioned to absorb energy from a coaxial resonance in the diode mount at 13 GHz. Without the loss material, the oscillator went weakly at 13 GHz and no output was obtained in the amateur band. With the parasitic suppressor present, it always works at the correct frequency and starts easily.

Oscillator Construction

The Gunn oscillator is constructed from standard 1.0" by 0.5" X-band waveguide. The EIA and JAN designations for this guide are WR-90 and RG-52/U respectively. The oscillator cavity is a one-half-wavelength resonator with a circular output-coupling iris. Fig. 4 is a side view of the internal oscillator assembly. The diode is mounted across the narrow dimension of the guide and is parallel with the electric field in the cavity. The diode and its mount effectively short the guide in the plane of the diode-mount centerline. Thus the resonant length of the cavity extends from the center of the diode mount to the plane of the coupling iris. The presence of the iris lowers the resonant frequency of the cavity slightly. To ensure that the band may be tuned, the cavity is made about 10 percent short. The cavity is then tuned to the desired frequency with the 2-56 tuning screw. This is located at a point one-quarter wave from the iris. The electric field intensity is greatest at that point and the screw has the most effect. The cavity tunes the 10.0- to 10.5-GHz band and several hundred MHz above and below with the dimensions given.

Gunn diodes come in a variety of package styles. Most use an internal "flip-chip" construction to make the heat sink the cathode. This permits use of positive-bias supplies with respect to the heat sink. This does, however, increase the package cost.

Low-power diodes can be made in "non-flip" packages provided a means is provided to remove heat from the anode. To do this, an effective but dc-isolated heat sink is required. This oscillator is designed to use "non-flip" diodes while having the desirable feature of a positive power-supply input with respect to waveguide ground. For "non-flip" diodes such as the Alpha type DGB-6844C or Microwave Associates type 49508 used in this oscillator, the anode is the heat-sink end of the package as indicated in Fig. 5. The cathode is the end with the sealing flange. Fig. 4 shows the cathode (flanged) end of the package inserted in the grounded diode-mounting screw. If other diodes are tried in the oscillator, be sure to determine which end of the package is the anode. Remember that unless a diode is designated a "non-flip" type, the cathode will most likely be the heat-sink end of the package.

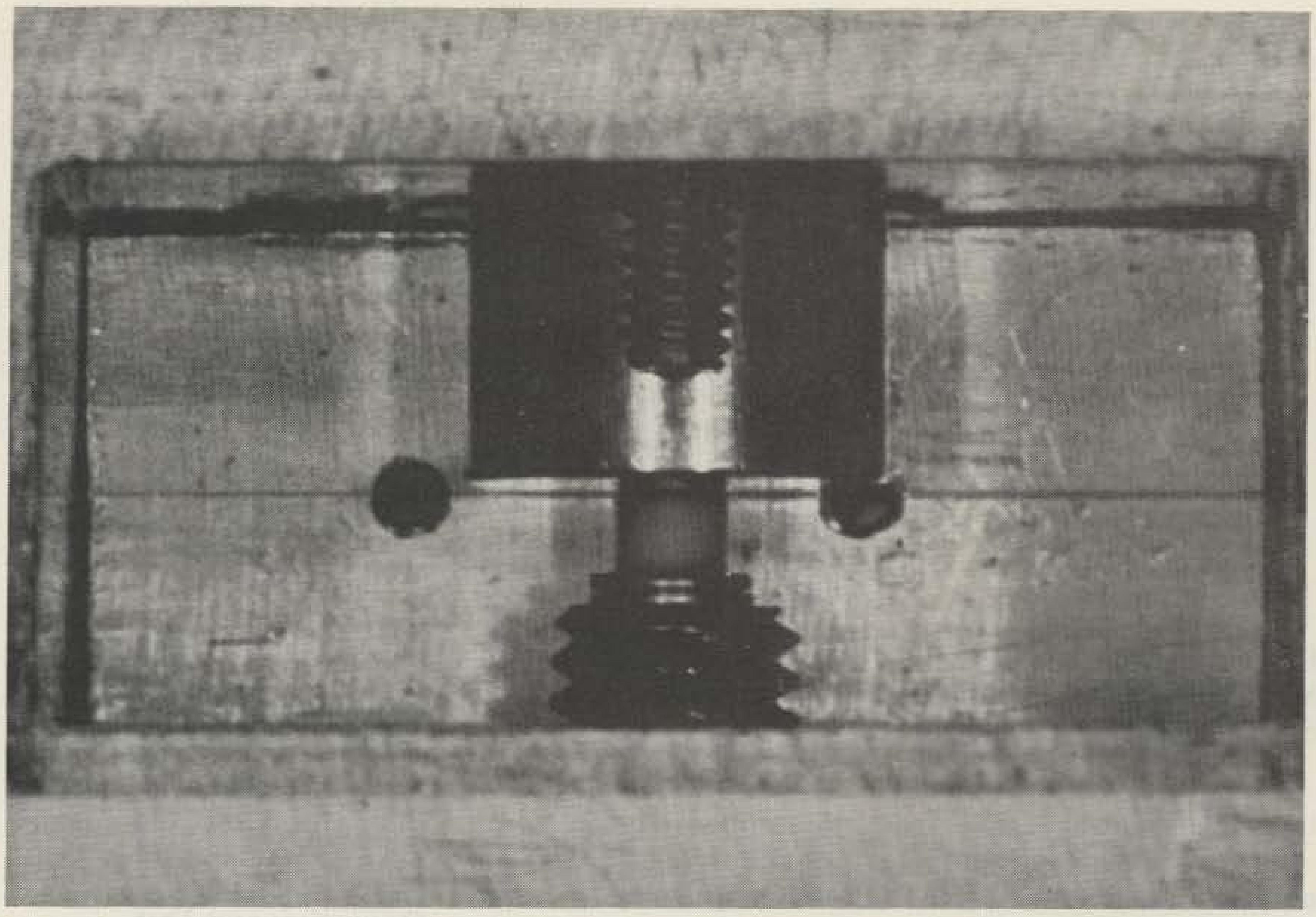


Photo B. Interior view of the oscillator cavity. The Gunn diode is mounted between the heat-sink post and the 10-32 diode-mounting screw. The end of the resistive probe is to the right of the mounting post. The 2-56 frequency adjustment screw protrudes into the cavity from above and in front of the diode-mounting post. The hole in the shorting block to the left of the diode mount is for a trial loss probe location.

Fig. 6(a) is a detailed drawing of the waveguide cavity. The diode mount is installed in holes B and C. Be sure to hold the dimension from these holes to the face of the flange to ensure that the cavity will resonate in the band. There are several varieties of waveguide flange. The intent of the cavity drawing is to use a flange such as a UG-39/U. The waveguide will pass through the flange and should be flush with the face. This will maintain the proper dimension from diode mount to the output iris.

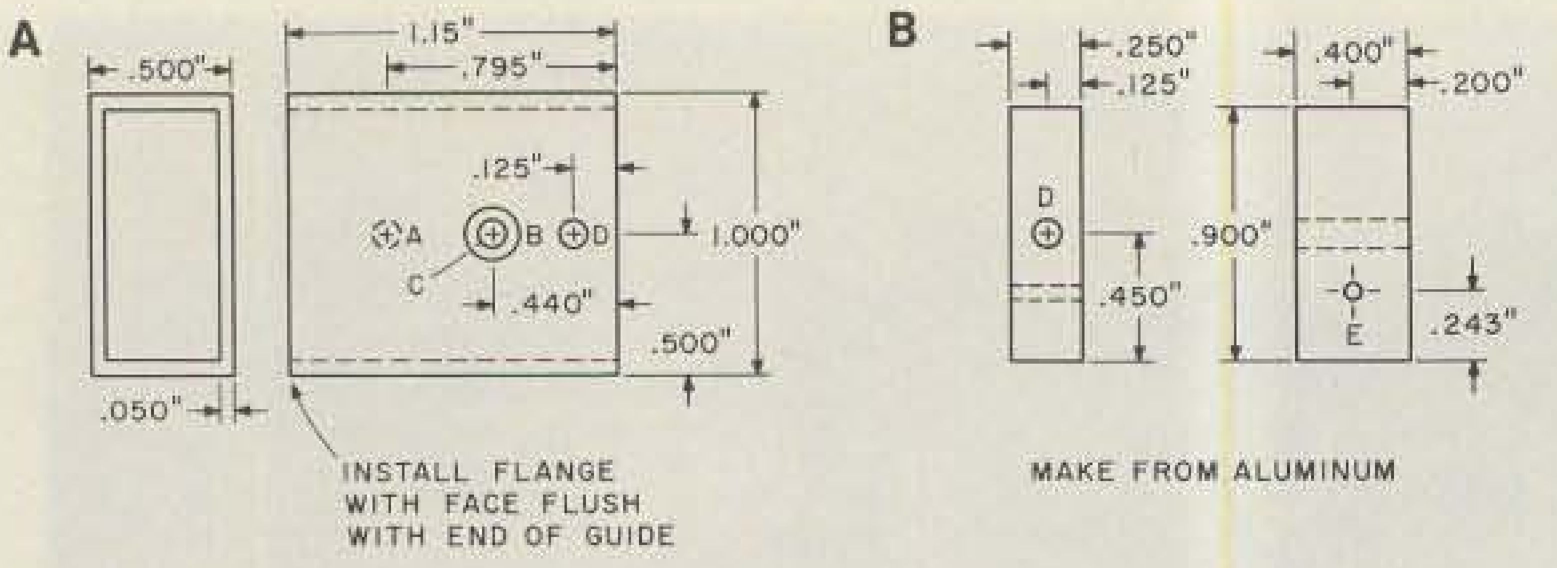
The shorting block, Fig. 6(b), is made from a piece of aluminum. The photo of the breadboard version of the oscillator shows a slightly longer shorting plug. This was to provide a handle for ease of adjustment during the initial design. Make your short as indicated in Fig. 6(b), as it is correct. Hole "E" in the shorting block is for insertion of a resistive probe of common mechanical-pencil lead, as shown in Fig. 4. This is the lossy material which suppresses the undesired spurious oscillation at 13 GHz. An alternative approach to the shorting block is to use a simple plate soldered in the plane of the inner surface of the block. This may be somewhat easier to build, but the probe installation is more difficult. This option applies to the oscillator only. The transceiver version described below requires that the short be removable and the block shown should be used.

The diode mount is shown assembled in Fig. 4 and the detail parts are sketched in Fig. 7. The mount has to do several things at once—match the low diode impedance to the cavity, dissipate heat from the diode, and apply dc bias to the diode while keeping the rf inside the cavity. The heat-sink post, Fig. 7(b), is made from 0.312-inch aluminum rod. It is first drilled through with a number 52 drill to clear the anode end of the diode. This gives a minimum clearance hole diameter for improved heat sinking. It is then drilled at one end only to a depth of 0.100 inch and tapped for a 2-56 thread.

The diode heat-sink post is mounted in the cavity with a 2-56 threaded turret terminal which will be the positive supply connection. Insulation is by means of a nylon washer on the exterior of the guide, Teflon™ sleeving on the threaded portion of the terminal, and a mica sheet insulator between the diode post and the interior wall of the waveguide. The mica forms the insulator of a parallel plate capacitor consisting of the diode post and the interior wall of the waveguide. I used .003-inch mica cut from a TO-3 transistor insulator. The capacitance is more than 20 pF and it is essentially a short circuit at 10 GHz. No rf leakage occurs. A small amount of heat-sink compound should be applied to each surface of the mica insulator. Clean off the excess after assembly as it could cause power loss or frequency drift if left in the cavity.

The 10-32 diode-mounting screw is made from either brass or aluminum. Brass is permissible from a thermal standpoint because most of the heat flow is from the anode end of the diode.

The waveguide output flange is soldered to the output end of the cavity waveguide. Take care that the surface of the flange is flush with the end of the waveguide. Spacing it back will increase the length of the cavity. One caution: Choke-style flanges should not be used on the oscillator. They will not properly clamp the output iris plate and this may change the effective cavity size. Flat



Hole Data

Hole	Data	Function
A	Tap 2-56 far side	Cavity tuning screen
B	Tap 10-23 near side	Diode-mount ground screw
C	Drill #35	Diode-mount dc input terminal
D	Drill #32	4-40 short mounting screw
E	Drill #60	Resistive probe

Fig. 6. Oscillator cavity details. (a) Waveguide cavity. Make from standard .500 x 1.00 X-band guide, EIA WR-90 or JAN RG-52/U. (b) Shorting block.

flanges should be used.

The intent of the removable output-coupling iris plate is to permit easy adjustment of the output coupling. Some applications, such as receiver local oscillators, require only a few milliwatts of power. The power may be reduced and stability greatly increased by using a smaller iris.

The iris plates may be made from ten- to forty-thousandths copper or brass sheet. I used 10-thousandths copper sheet. The iris hole is the waveguide centerline. The output hole diameter may be either .290 or .320 inches as discussed in the section on testing. Smaller diameters can be used to reduce power output. If the iris is much larger than .320, the cavity Q becomes very low and the oscillator does not work below 10.5 GHz.

Assembly of the oscillator should be done in the following order. First, solder the output flange to the cavity and remove all flux. Next, install the diode-mounting post as described above. Do not install the diode itself. Install a resistive probe of .040-inch soft pencil lead in the hole in the shorting block. It should extend into the cavity 0.150 inches. It may be held in place by means of tape on the outside surface of the block until the oscillator is tested. After testing, secure the probe with a drop of glue. The shorting block is next inserted into the cavity and fastened with 4-40 hardware. This hardware should be tightened to the final torque prior to installing the diode. If it is tightened after the diode is installed, the resulting deformation of the cavity may break the diode. Now install the diode. Put a tiny amount of heat-sink goo on the diode anode and cathode pins. Remember the heat-sink end goes to the capacitive mounting post. The flanged end is the cathode and goes to ground. Tighten the 10-32 screw so it is just snug. If a lock nut is used, hold the 10-32 screw from rotating while the lock nut is torqued. This will prevent crushing the diode package. The final steps are to install the tuning screw and the output iris. The iris is clamped between the output flange and the flange on the mating waveguide. Start out with the .290-inch-diameter iris. The oscillator is now ready for test.

Operation and Test

Upon completion of the oscillator, it may be put to use in your particular application. My objective in writing this article was to give an easily-reproduced design which could be used for a variety of applications from receiver LOs to simple transmitters. The test equipment to completely characterize a microwave oscillator is not all that complex, but it certainly isn't found at your corner electronics outlet. Some amateurs have access to commercial or surplus test gear which is of great aid in getting started on X-band. Others have only a scope and VOM and will build this oscillator or the transceiver version described later on as a first project in X-band.

In order to ensure that the design was sound and to obtain enough information to help others apply the circuit to their projects, I took a lot of data to characterize the circuit. With this information, the oscillator may be used with some advance knowledge of how it will behave. The description of the tests performed is provided in case others who can get ahold of the gear wish to repeat the tests or test their own oscillator designs, and to indicate to those who will just build the circuit how the data is obtained. Before getting into the rf testing, here are a few cautions with regard to dc power supplies for Gunn oscillators.

Dc power must be applied to Gunn diodes with some care. The negative-resistance effect extends down to dc, as illustrated in Fig. 2. This can cause dc supply regulators to misbehave. Generally, a series-pass regulator gets very confused when decreasing the voltage increases the current being drawn. The regulator may oscillate and overshoot. The Gunn device may well disappear in the ensuing excitement. Fig. 8 shows a safe method of powering the oscillator. A current-limited supply is used. In shunt with the supply is a husky zener diode which limits the maximum voltage which can be applied to the oscillator to a value of a volt or so above the operating voltage. This will prevent burnout on turn-on transients or if the

Minimum and Maximum Power into 2 to 1 vswr vs. frequency

Diode #	Current mA	10.0 GHz	10.1 GHz	10.2 GHz	10.3 GHz	10.4 GHz	10.5 GHz
1	140	15-29 mW	17-28 mW	18-32 mW	15-35 mW	20-34 mW	22-34 mW
2	150	18-34 mW	20-34 mW	20-34 mW	19-30 mW	18-34 mW	18-48 mW
3	150	17-25 mW	17-28 mW	20-35 mW	18-38 mW	21-37 mW	20-35 mW
4	100	9-22 mW	9-19 mW	10-25 mW	10-22 mW	10-22 mW	10-22 mW
5	125	9-20 mW	7-21 mW	9-18 mW	12-24 mW	14-25 mW	25-12 mW

Table 1. Oscillator performance vs. load vswr and frequency. This table indicates the oscillator power output for five different diodes at frequencies from 10.0 to 10.5 GHz. The load vswr was varied through all phases of a 2 to 1 mismatch. Diodes 1 through 3 are Alpha type DGB 6844C operated at 8 volts. Diodes 4 and 5 are Microwave Associates type MA 49508 operated at 7 volts.

supply oscillates. A series RC circuit consisting of a .1 µF capacitor in series with a 33-Ohm resistor keeps the supply impedance down in the low megacycle region and prevents low-frequency breakup of the oscillator output. With the diodes specified, the heat-sink end of the package is the anode and the diode is installed with this end inserted in the capacitive mounting post. The flanged end of the diode is the cathode and is grounded to the waveguide with the 10-32 mounting screw.

A word about current limiters. The threshold current of the Gunn device is much higher than the operating current. The current limiter on the supply should be set well above the threshold current. For the diodes used here, 500 mA is a good setting.

If the current limiter is set at the operating current, the supply will limit on the low-voltage side of the threshold voltage and the operating voltage will not be achieved. From Fig. 2 it may be seen that there are two points at which the diode will draw the same current, one above and one below the threshold voltage. Don't worry about protecting the diode from excessive current. In this case, lowering the voltage *increases* current, so a normal current limiter does not help. Just set up the supply for the proper voltage and make sure the current limit is set to 500 mA. Then connect the Gunn-diode circuit. If the current limiter is set as above, it is okay to just switch the supply off and on with the power switch. Do not turn up the voltage slowly because the diode will be subjected to more current than if power is suddenly applied. Using these methods, I have yet to lose a Gunn device. Supply oscillations may be checked by connecting a scope across the supply. If the dc line has only dc on it, you can assume that all is well. If oscillations are present, they are generally of high amplitude (several volts) and are easily detected. If this does occur, one fix is to adjust the R and C of Fig. 8. Reduction of the hole in the coupling iris plate may also help. No difficulty was encountered with supply oscillations for a variety of Gunn diodes tried in the cavity provided the circuit of Fig. 8 was used. Dc supplies included commercial and home-built bench supplies and the three-terminal regulators used in the Doppler processor described below.

To set up the oscillator for test, there are only three adjustments: the tuning screw to set the frequency, the output iris diameter which determines load stability and power output, and the depth of the parasitic suppression probe. The tuning screw should be set at minimum penetration of the cavity. The resistive probe should penetrate about .150 inches into the cavity. With the .290-inch iris installed, the oscillator should make at least 10 milliwatts of output. If it does not appear to be oscillating or if it is oscillating weakly (a −20 dBm output), insertion of the resistive probe to a greater depth is indicated because the diode-mount resonance at 13 GHz may be in the act. The three models of the oscillator worked fine with the probe at .150-inch penetration, so you should not have to adjust it. It is not very critical. Once oscillations are obtained, the tuning screw is used to set the operating frequency. The unit will easily tune the 10.0- to 10.5-GHz band with either diode installed.

The selection of output iris diameter depends upon application. To determine which diameter is best for your use, review the tests and test data I obtained.

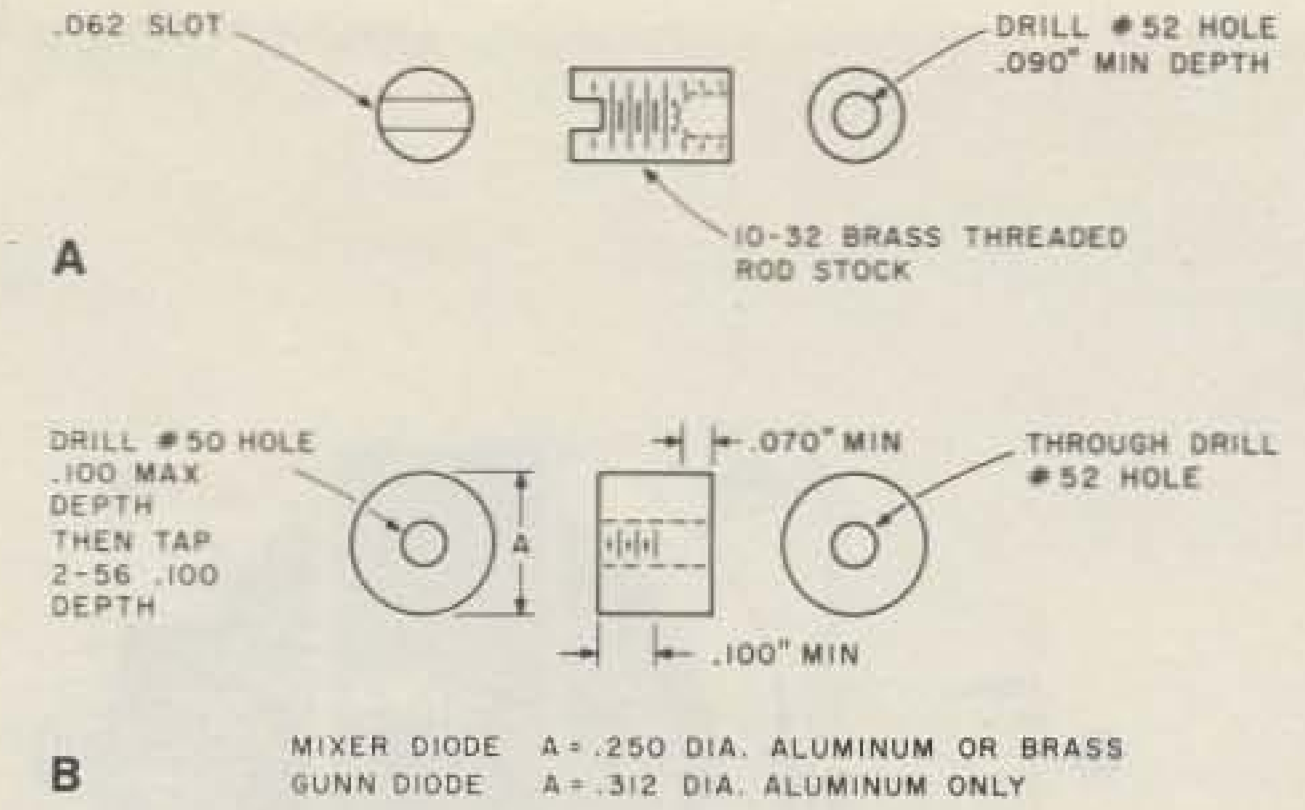


Fig. 7. Diode-mount details. (a) Diode-mounting screw. (b) Diode heat-sink post. The diode heat-sink post is first drilled through with a number 52 drill. The hole is then enlarged to a number 50 size and tapped for the 2-56 turret terminal. The number 52 diameter must be maintained for a depth of at least 0.070 inches to assure proper heat transfer from the diode.

A shift in load impedance will change both the frequency and power output of any oscillator, crystal, LC, or a microwave type. I made several tests to evaluate the effect of load shifts on this circuit. In addition, the ability to tune the frequency of the circuit with the supply was tested. I found that if the load vswr is less than 2 to 1 and its phase is stable, the frequency will pretty well stay put. If the vswr is controlled and it is less than 2 to 1, the supply may be used to make corrections in the oscillator frequency of up to 20 MHz.

Fig. 9 is a sort of schematic of the waveguide setup I used to test the oscillator. The setup allows the power output and frequency to be measured and a vswr of any desired magnitude and phase to load the oscillator. The oscillator is connected to the main line of a cascade of three directional couplers. The first coupler samples the output power and frequency. The power is detected and displayed on meter M3. A cavity wavemeter in the line absorbs power at its resonance and causes a "suck-out" or dip on M3 when tuned to the oscillator frequency. The next two couplers form a reflectometer which reads the forward and reflected power from the load as seen by the oscillator. M1 reads forward power and M2 reads reverse power.

At the output of the last coupler, a device called a slide-screw tuner is connected. This is followed by a matched waveguide load.

The slide-screw tuner is a simple way to get an adjustable vswr of any phase. It is useful in load tests such as this or as an impedance-matching device. The VHF equivalent is a single-stub tuner which may be moved along the line. Mechanically, the slide-screw tuner consists of a probe through the broad wall of the waveguide (often a screw) which travels in a slot in the waveguide wall. The probe is supported by a slide plate on the outside of the guide. The probe when inserted into the guide is equivalent to a capacitor, the value of which is proportional to the depth of penetration. The depth of penetration controls the magnitude of the imaginary part of the vswr thus created. The position of the probe along the guide controls the phase. The real part of the load is sup-

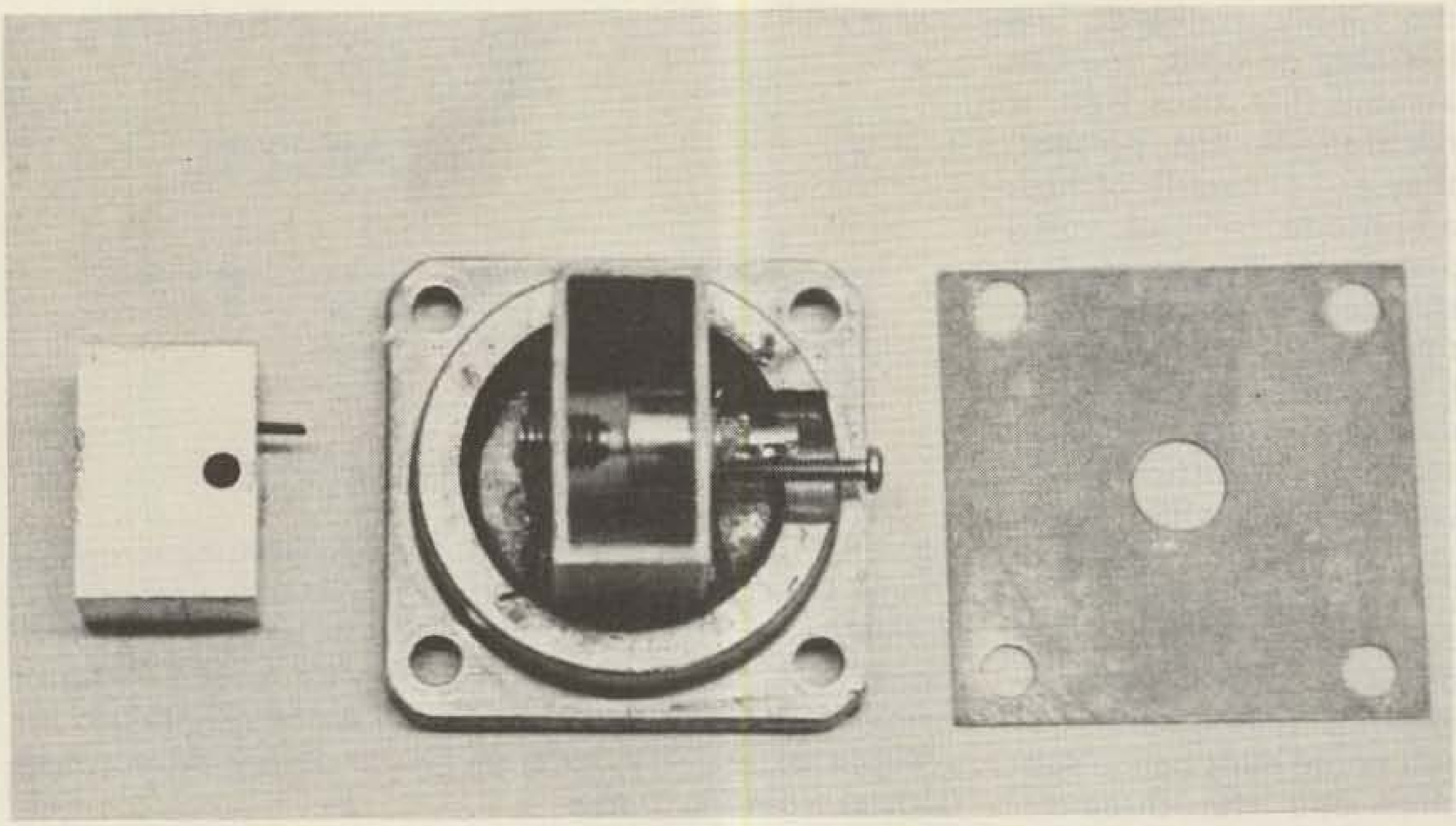


Photo C. The partially-assembled oscillator. The breadboard version of the oscillator is shown with the shorting block and iris removed. The lossy resistive probe extends from the shorting block into the cavity. The removable iris plate permits the output coupling to be easily adjusted.

plied by the waveguide load beyond the tuner. By moving the probe along the guide, a fixed vswr load is effectively rotated through all phases.

I tested my oscillator with load vswrs of 2 to 1. Most waveguide circuits into which such an oscillator will operate may be tuned below a 2 to 1 vswr without much difficulty. In addition, the phase of most loads will stay put. A 2 to 1 vswr of variable phase is probably the worst load that might be expected in most applications.

The first test I made was load pulling. This measures how much the power output and frequency shift as the load vswr is rotated through all phases. The setup of Fig. 9 is used. The oscillator was connected and the center frequency set by means of the tuning screw.

The slide-screw tuner was initially completely out of the waveguide, so the oscillator load was only the matched waveguide termination. To obtain a 2 to 1 vswr, the slide screw was inserted into the guide until the reflected power indicated by M2 increased to a level 9.5 dB below the forward power indicated by M1. A ratio of forward to reflected power of 9.5 dB corresponds to a 2 to 1 vswr.

The shift in load impedance caused the reading on M1 to change also as the probe was inserted into the line. The idea is to get the 9.5 dB difference with the probe inserted. The initial value of M1 is not of concern, as it will always change as the probe is inserted. I then had a 2 to 1 vswr load on my oscillator. The next step was to move the probe of the slide-screw tuner along the line and record the extremes of power and/or frequency. During these tests, a spectrum analyzer was often used in place of the wavemeter to speed the measurement process, but the wavemeter approach works fine. It just takes longer.

First, I measured the effect of load vswr on the oscillator power output for 5 different Gunn diodes. Three Alpha type DGB 6844C diodes were tested at their normal operating voltage of 8 volts. Then two Microwave Associates type 49508 diodes were tested at 7 volts. Table 1 shows the data for 10 to 10.5 GHz in 100 MHz steps. In my oscillator, the Alpha diodes gave slightly more power output. An average output was obtained of about 25 milliwatts for most Alpha diodes at most frequencies. The average for the MA devices was a bit less, about 15 milliwatts. Diodes could be substituted in the oscillator with no adjustment and the frequency would change only a few MHz. This data was taken with a .320-inch iris installed on the oscillator.

In order to determine the effect of various iris sizes, I next made a set of tests with different iris diameters and used the same diode. Iris sizes of .290, .320, and .380 inches in diameter were tried. The pulling was again tested with a 2 to 1 vswr. I found that the effect was considerable. Table 2 shows the results. Increasing the iris hole size increased the output power by about 2 dB. The effect on the frequency stability and cavity Q (determined from the amount the oscillator can be pulled) was significant. The pulling increased from 21 MHz with the small iris to 80 MHz with the large iris. In addition, the oscillator would not operate below about 10.4 GHz. At the heavy loading caused by the large iris, insufficient negative R was available and the oscillations stopped. This is because the optimum operating frequency for this diode was above 10.5 GHz for the particular dc voltage applied.

The .320-inch diameter turned out to be a good size. High power output and pretty fair stability were obtained. The data indicates how a little rf power can be traded for a lot of frequency stability. For low-power applications such as receiver local oscillators, I would use a small iris. The improvement in frequency stability for varying loads is certainly worth it.

The dc supply voltage may be used to adjust the oscillator frequency slightly. This is a simple way to make an afc system if done carefully. The tuning range is not as great as can be obtained by putting a varactor diode in the cavity, but it is an easy approach. The tuning range is limited by the amount the supply can be changed before the oscillator quits. For small diodes such as those used here, a variation of plus or minus 1 volt from the nominal supply of 7 or 8 volts seemed reasonable. Lower voltage increases the current and power drops. Increased voltage will also drop the power and the oscillator will eventually quit as the electrons are slowed from the optimum transit-time velocity.

I tested the oscillator into a matched load and measured the degree of frequency "pushing" that could be obtained. The smallest iris was used since an afc system would require that the best oscillator load-stability option be used.

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The three Alpha diodes were used for this test. I set the cavity to 10.5 GHz with the dc supply at 8 volts. The voltage was then changed plus and minus 1 volt in one-half steps and the frequency shift noted. The data is in Table 3. All diodes behaved the same. The frequency could be shifted down about 15 MHz and upward about 8 MHz. The power variation was only 4 milliwatts out of about 15 milliwatts average. This is quite acceptable for most applications.

After making this test, I began to wonder what effect the load vswr would have on the frequency "pushing" sensitivity of the oscillator. An especially unfortunate change in load could pull the oscillator so far that it could not be returned to the correct frequency by "pushing" with the dc supply. In order to cut down the time to take the data, only a single diode sample was tested. The great similarity of results for the other tests indicates that these results are probably valid for the other diodes. Alpha diode number 1 was used with the .290-inch iris on the cavity output. First, I varied the supply voltage as before and noted the frequency shift obtained with a matched load. Table 4 shows the data. Next, the vswr was increased to 2 to 1 and the frequency was pulled up the band as far as possible (the dc supply was returned to 8 volts during this adjustment). Next, I varied the supply again and noted the frequency relative to the *original* 8-volt center frequency. Finally, the oscillator was pulled down the band as far as possible with the load vswr and the data was taken again.

From the data, it may be seen that the range of adjustment with a matched load is −15 to +8 MHz. With the frequency pulled high with load vswr, the range is −25 to +17 MHz. The oscillator passed through the reference frequency somewhere between 7.0 and 7.5 volts. In this case, the supply could be used to afc the oscillator back to the starting frequency. With the oscillator pulled below the operating frequency, the range of adjustment with the supply was from −25 to −6 MHz. Nowhere in the range of supply-voltage adjustment did the oscillator return to the initial frequency. In this case, an afc loop could not correct the frequency shift due to load pulling. It could only approach within 6 MHz and would "hang up" on the low side as indicated in the fourth column of Table 4.

One other factor is evident from these results. The modulation sensitivity varies a lot as a function of load. For the matched load case, the shift for a 0.5-volt change from 8.5 to 9.0 volts is only 3 MHz. With the oscillator pulled high, the change in frequency as the supply is varied from 7 to 7.5 volts is 30 MHz. With the oscillator pulled low (column 4), the frequency change for the same supply-voltage shift is only 7 MHz.

My conclusion is that an afc or phase-lock system that uses the supply voltage is feasible, but with a few cautions. The load vswr that the oscillator sees should be low if at all possible, and it certainly should be controlled.

If this is not done, the loop may lose range or go unstable. When setting up an afc system, the oscillator should be mechanically tuned to the desired frequency while monitoring the supply voltage so that it may be centered with the loop closed. Because the amount of tuning that can be obtained is so limited, this approach will ensure that all of the range is available to cope with thermal drift. If the load changes significantly, the loop may well lose control.

The real key is to keep the load vswr as low as possible. This will minimize the effect of changes in load phase upon the oscillator frequency.

This concludes the test data I obtained. Hopefully, it is complete enough so that the oscillator may be put to use in your X-band command link or whatever.

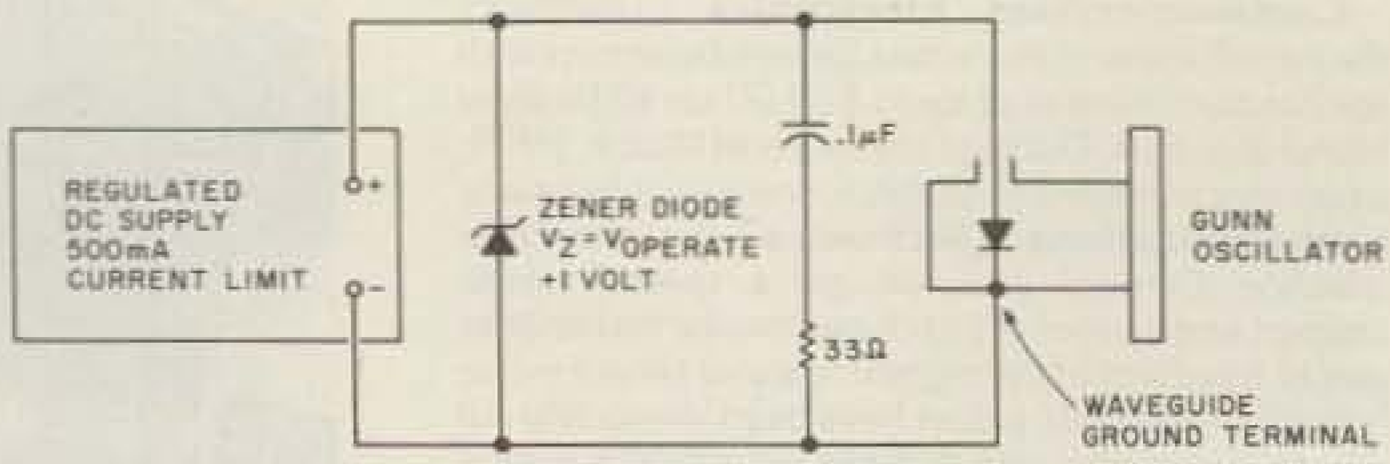

Fig. 8. Dc power-supply circuit for testing Gunn-diode oscillators. The zener-diode voltage should be about 1 volt more than the intended operating voltage for the oscillator.

X-Band Transceiver

I added a simple mixer to the basic oscillator to make an effective X-band transceiver. My application was for Doppler radar, but the device is equally useful for communications. When mated with the Doppler processor described in the next section, the unit will provide positive detection of man-sized targets at ranges up to 100 feet or so.

A number of the commercial Doppler radars used for door openers, speed meters, or intrusion detection use a simple "diode in the guide" mixer for reasons of cost. In this approach, a mixer diode is simply placed in a section of waveguide between the Gunn oscillator and the antenna-mounting flange. No ferrite circulator is used for transmit-receive signal separation. At best, this approach is 6 dB poorer in performance than if a circulator is used, but it is simple to make and works quite well for many applications.

In operation, a portion of the transmitted energy is intercepted by the mixer diode. For communications, this serves as the local oscillator, and in a Doppler system it serves as the zero-velocity frequency reference. The amount of energy that is coupled to the diode must be controlled so that there is something left to radiate. In my design, this was done by offsetting the diode from the centerline of the waveguide. The electric field intensity is maximum at the centerline of the guide and falls off toward

Iris Diameter Inches	Power Output Milliwatts	Frequency Pulling MHz peak to peak	Loaded Q
.290	15 to 32	21	250
.320	22 to 40	40	131
.380	35 to 45	80	65

Table 2. Effect of iris diameter. This table shows the effect of iris diameter upon the power output and frequency stability of the oscillator as the load is varied through all phases of a 2 to 1 vswr. The test frequency was 10.5 GHz. Diode number 3 was used for this test. The oscillator would not operate below 10.4 GHz with the .380-inch iris.

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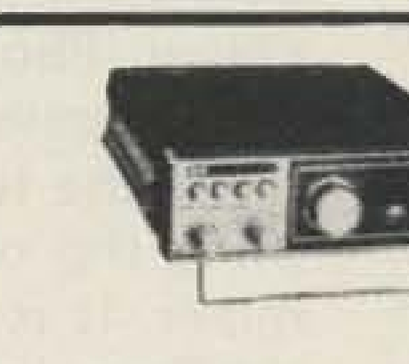

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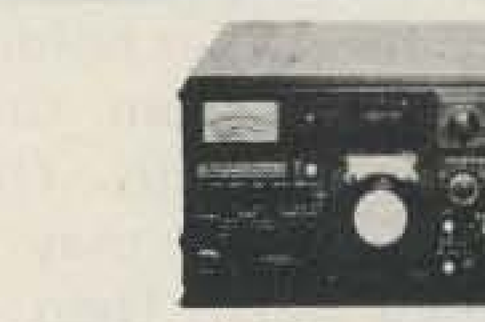

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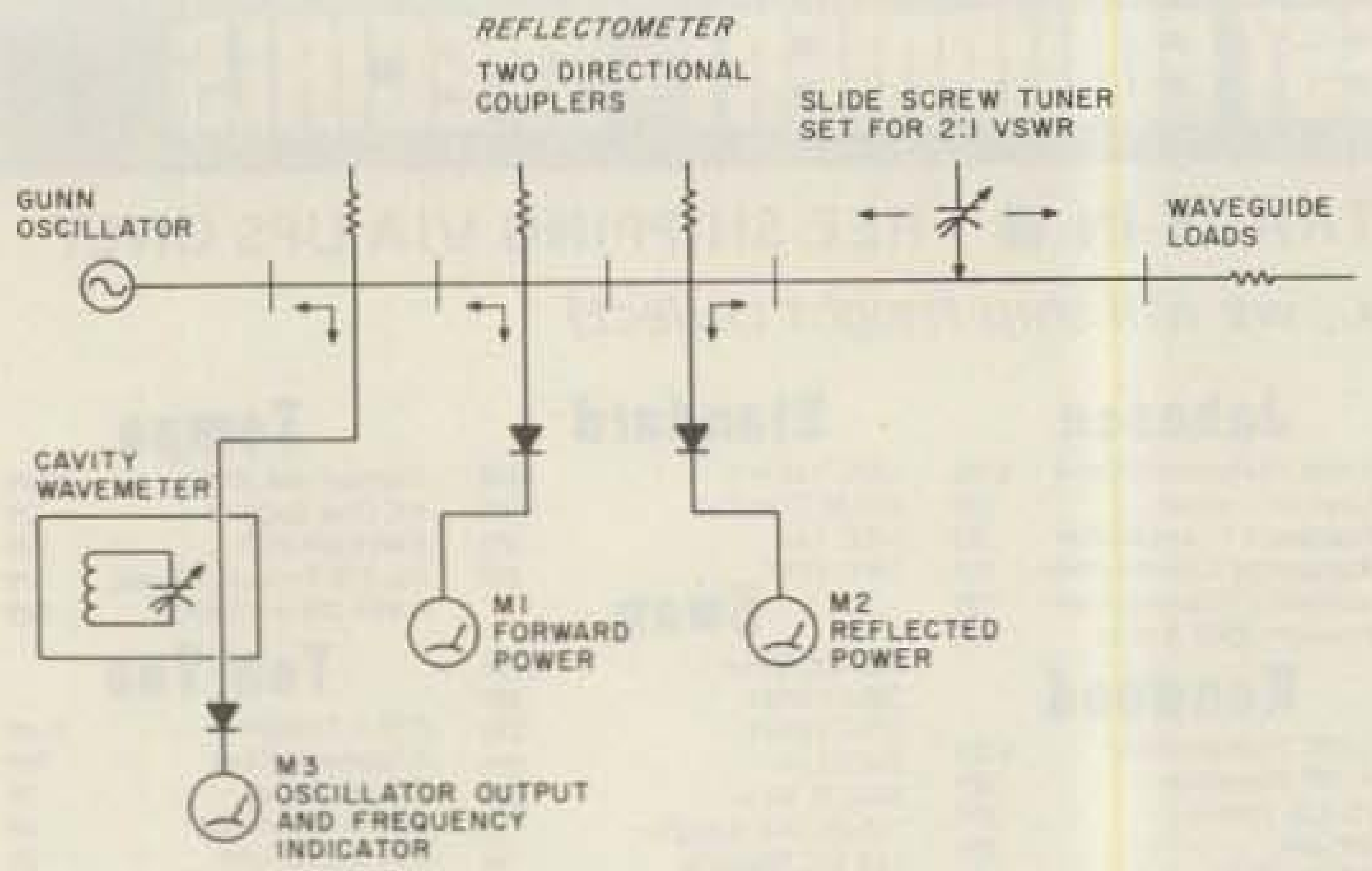

Fig. 9. Schematic of the Gunn-oscillator test setup.

the sides. It is zero at the side walls since they effectively short the field.

I positioned the diode mount 0.250 inches from the outer wall of the waveguide. At this location, about one-half of the energy from the Gunn oscillator is intercepted by the diode. The rest continues down the guide to the antenna.

The iris on the Gunn-oscillator output port is not a perfect short, but it does present a very high vswr to the guide. This is fine for the oscillator coupling because the goal is to mismatch the oscillator so that it is decoupled and the cavity Q remains high. It also effectively shorts the guide behind the mixer diode for energy entering the transceiver from the antenna. The presence of the iris means that the electric field will be maximum about one-quarter wave up the guide from the iris plate because it has to be nearly zero at the iris.

I placed the mixer diode three-quarters of a wavelength from the plate. Since impedances repeat every one-half wave, the three-quarter-wave position is equivalent to the quarter-wave location. This was done to put the diode far enough from the iris for the energy from the oscillator to return to the normal TE_{10} mode pattern. I was concerned that the desired coupling to the diode might be difficult to obtain near the iris and didn't want to spend a lot of time in optimization of the circuit.

The mixer diodes used in my transceiver were chosen because they are in a package similar to the ones housing the Gunn diodes. The same sort of mount is used and all of the pieces are the same with the exception of the post, which is smaller. I purposely avoided the 1N23 type of package because it is hard to mount and a second set of hardware would have to be designed for it.

	Diode #1		Diode #2		Diode #3	
Dc supply voltage	Freq. Shift	Pout mW	Freq. Shift	Pout mW	Freq. Shift	Pout mW
7.0	−15	14.2	−18	20	−15	19
7.5	−7	14	−10	17	−8	21
8.0	0	14	0	16	0	20
8.5	+5	15	+6	17	+6	19
9.0	+8	15.5	+10	18	+10	17

Table 3. Frequency pushing with supply voltage. This data shows the effect of supply voltage upon the oscillator frequency with a matched load. The iris diameter was .290 inches. The oscillator was tuned to 10.5 GHz with the supply at 8 volts to establish the initial reference frequency.

Diodes in the small (double prong or MQM) package are made by Microwave Associates, Alpha Microwave, and Hewlett-Packard, to name a few vendors. I used the H-P 5082-2711 diode in my transceiver. This is a Schottky barrier type. Other diodes which should work include the Alpha type DMF 6106 and the MA type 40006. These are also Schottky types. A point-contact type which may prove cheaper to buy is the Alpha type D5523C. The point-contact diodes will work as well as the Schottky diodes in most applications. Remember when ordering these diodes to get ahold of a data sheet because they are graded for noise figure. The numbers above I selected for worst noise figure and lowest cost. By changing a suffix or adding one, the noise figure gets better and the price gets worse. No diode listed above has a noise figure of more than 9 dB. You can get 6.5 dB, but boy, it will cost!

Transceiver Construction

Photo F shows the breadboard version of the transceiver. Photo D shows the final version which eliminates the two flanges coupling the oscillator to the mixer. It is mounted upon the Doppler processor box. The integrated version of the transceiver is made from a single section of X-band waveguide. The oscillator section is identical to the separate oscillator circuit just described. All of the internal details are the same with the exception of the coupling iris; it is soldered directly into the guide.

Two flanges are eliminated and a nicer assembly is achieved. To install the iris, first cut through three of the four walls of the waveguide, as indicated in Fig. 10. One broad wall and the two narrow walls are cut. Make up the iris plate from copper or brass sheet somewhat thinner than the saw blade. Install the iris in the saw cut and solder into place. Take some care in this. All four walls of the guide must be soldered to the iris plate on both sides. If not, you will create a truly marvelous slot antenna! Remove all flux after soldering.

The mixer diode is installed in a mount similar to the Gunn-diode mount. The mount parts are as indicated in Fig. 7. The mixer post is made from 0.250-inch rod stock rather than the .312-inch-diameter stock used for the Gunn diode. The mixer-mount parts are assembled into the guide in exactly the same manner as the Gunn-diode mount. There is one difference. No heat-sink goo is required for the mixer diode. Hole A on the mixer side of the iris is for a ground lug to return the mixer load resistor to the guide. This resistor is used to prevent static burnout of the mixer diode during initial testing.

In assembling the transceiver, first cut the guide to length and then drill and deburr all holes. Tap holes as required. Make the saw cut and install the iris. Solder the output flange to the mixer section as indicated in Fig. 10. Use a large C-clamp to heat sink the iris area when installing the output flange. This will prevent the solder holding the iris plate from running. Remove all flux. The two diode mounts may be installed next. Then install the shorting block with lossy probe in the end of the oscillator cavity. Install the tuning screw. Install the Gunn diode. Connect a 5k resistor from the mixer-diode output terminal to the ground lug. Now install the mixer diode using care not to damage it with static. Pick up the transceiver body with one hand while holding the diode in the other. This will put the transceiver and the diode at the same potential. Then install the diode in the transceiver. The Gunn diode is more rugged and may be handled normally, so these cautions do not apply to it. In my version of the Doppler radar, I located the .1 μF capacitor and 33-Ohm resistor components of the Gunn-diode dc supply circuit on a small tie strip. This tie strip is mounted to the waveguide by the same screw that holds the shorting block in place. These parts are visible in the photo.

The transceiver is now ready to be tested.

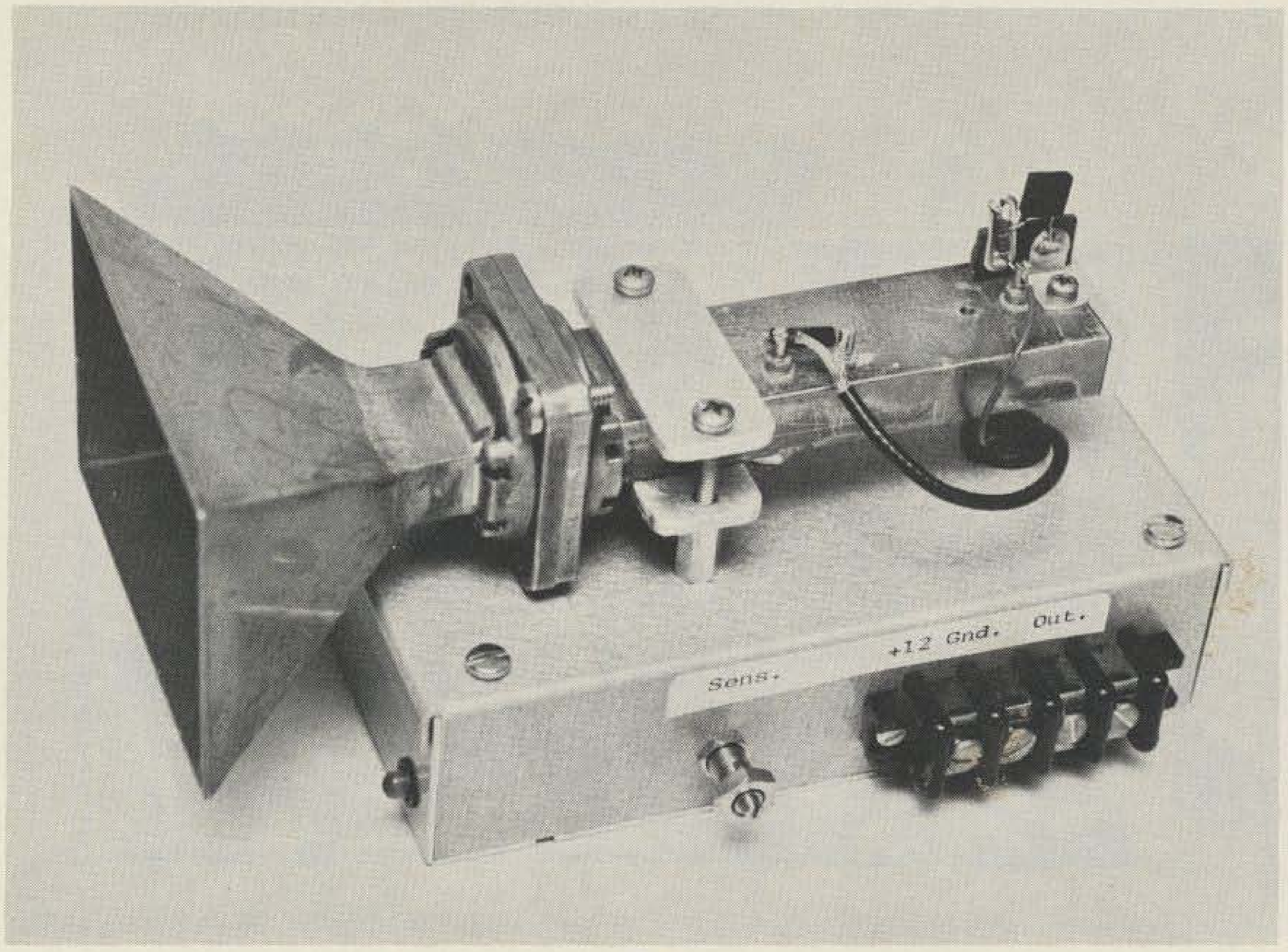

Photo D. The Doppler radar assembly. The final version of the X-band transceiver is mounted to a box which contains the Doppler processor to form a self-contained Doppler radar. The 10k-diode load resistor may be seen to the rear of the coax cable which connects the mixer output to the processor card. The 33-Ohm resistor and 0.1 μF capacitor are mounted on the small terminal strip and connected to the Gunn-oscillator dc input terminal. The 2-56 cavity frequency adjustment screw is not installed in this photo. One of the two LEDs used for adjustment is visible under the horn antenna.

Transceiver Test

Arrange a power supply for the Gunn diode as described previously. Apply power and test for supply stability with a scope. If everything is okay, the oscillator should be operating. Connect a voltmeter (20,000 Ohms/volt) to the mixer-diode output. Do this with care. Ground both meter leads to the waveguide and then connect the positive lead to the diode output. The diode should be rectifying some of the rf energy and a voltage of a few tenths of a volt will be present. If the diode voltage is negative with respect to ground, the diode is in backwards. This is of no concern in most applications.

If no voltage is measured, there are three possibilities: The diode is no good, the Gunn is going at 13 GHz and no power is coming out of the oscillator, or perhaps the tuning screw is in too far and is shorting the cavity. First, back out the tuning screw until it is out of the guide. Next, try another mixer diode. If this doesn't help, remove the shorting block from the cavity and verify the pencil-lead probe insertion. If it is okay, then make sure that it is soft pencil lead, which has more carbon in it. Reassemble the oscillator without the probe. Set up as before and apply power. Observe the voltmeter on the mixer diode and slowly insert the lossy pencil-lead probe into the cavity through the hole in the shorting block. If a diode-mount oscillation was the problem, the mixer diode will suddenly indicate the presence of rf when the probe kills the spurious oscillation.

Once things are going, some interesting tests can be made. The open waveguide flange is not a bad antenna. The gain is about 5 dB! Point the business end of the transceiver out into the room and connect a scope across the mixer-diode output. With the scope gain at 10 to 100 millivolts per division and ac coupling, the Doppler shift on moving people is quite readily seen. Adding a good antenna will greatly increase the return. Hooking the mixer output into a hi-fi amplifier with a good low-frequency speaker is also entertaining. People, fans, and cars make really strange Doppler noises.

If you build two transceivers or an oscillator and transceiver, the following test is interesting. Set them up about 6 feet apart with the waveguides pointed at each other. Observe the mixer output of one unit on a scope while tuning it across the frequency of the other. The diode-mount capacitance measures about 13 pF, so a bandwidth from dc to several megacycles is obtained without tuning the mount at i-f. As the frequency of one unit approaches that of the other, the beat may be seen on the scope. This is the i-f frequency created by mixing the two X-band signals. As the frequencies are brought closer, the beat frequency drops and then it will suddenly vanish. This happened at about one MHz with my units. At first this seems strange, since the mixer mount will work down to a dc i-f frequency.

The answer is that the two oscillators have locked together and are now on the same frequency. Further tuning will eventually pull them apart. This is an example of injection phase locking. In some high-power sources, injection locking is used to obtain more power than a single diode will supply by locking several units together. As you can see, not much power needs to be injected to lock one to another.

Communications

The transceiver may be used for communications.

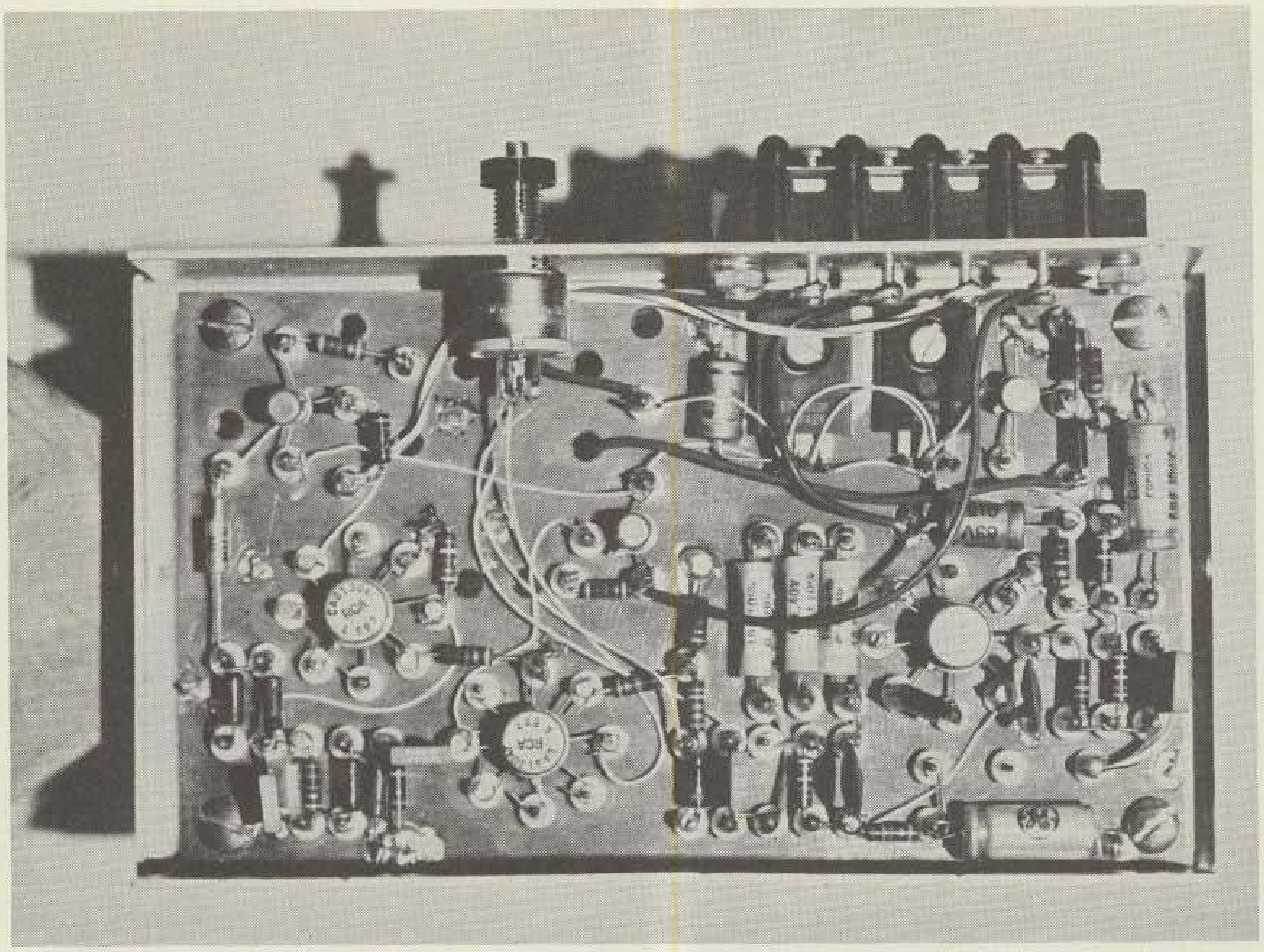

Photo E. The Doppler processor card. Signal flow is from right to left across the bottom of the card. U1 is located at the lower right, U2 in the center, and U3 at the left of the card. The analog pulse-counter circuitry is in the lower left-hand side of the card below U3. The voltage-regulator circuits are at the upper right near the input/output terminal block.

An FM tuner makes a good i-f strip for getting started. Most of the tuners have a pretty fair noise figure, but getting a proper match to the mixer is also important if good results are to be achieved. Most modern microwave receivers solve this problem by putting a preamplifier right at the mixer. I recommend doing the same. A good low-noise dual-gate FET preamplifier will overcome any deficiencies of the FM radio and will enable the mixer to be matched to a well-controlled amplifier input impedance. The preamplifier can then drive a cable to the receiver.

The i-f impedance of the mixer will be a function of the diode current and will be from 200 to 500 Ohms. The diode mount has a capacitance of about 13 pF. This should be tuned out with an inductor which also serves as the dc return for the diode, as in Fig. 11. The inductor and diode-holder capacitance should be resonant at the i-f frequency. The resulting real impedance is then matched into the preamplifier.

FM modulation of the Gunn diode is simply a matter of modulation of the power-supply voltage. Be sure to limit the peak-to-peak excursion of the supply to prevent damage to the diode. A good modulator approach would be to ac couple the audio into the reference source for the dc regulator. This will offset the reference and force the dc voltage from the supply to follow the audio. The supply must be capable of moving at audio rates. This means that giant filter capacitors on the output cannot be used. In addition, some form of modulation limiting should be provided so that deviation is controlled. Remember, the oscillator can be deviated several MHz per volt of supply change. If a standard FM radio is used as your i-f strip, only 75 kHz of peak deviation is needed. So only a few hundred millivolts of audio are required on the dc supply.

The communications range that you can get with this transceiver is very much dependent upon the antennas used. The noise figure is fairly decent, and, with a 200 kHz bandwidth FM tuner for an i-f strip, sensitivities of −100 dBm or so should be obtained. The path loss at 10 GHz for 10 miles is 136 dB.

As an example, consider the use of a pair of 20 dB gain horns and about 10 milliwatts of power. The power at the receiver mixer and output carrier-to-noise ratio are:

Transmitter output:	+10 dBm
Transmitter antenna gain:	+20 dB
Receiver antenna gain:	+20 dB
Path loss (10 GHz & 10 miles):	−136 dB
Power at the receiver mixer:	−86 dBm
Sensitivity:	−100 dBm
Output carrier-to-noise ratio:	+14 dB

The actual signal-to-noise ratio will be somewhat better because of the FM improvement resulting from the high modulation index if the full 75 kHz deviation is used. By going to a pair of 3-foot dish antennas, a gain of about 36 dB is obtained. This will improve each end of the link by 16 dB for a total gain in SNR of 32 dB over the case above. Of course, the improved SNR can be traded for greater range at the rate of an additional 6 dB of loss for each doubling of the distance.

Doppler Processor

The X-band transceiver may be used as an effective Doppler radar for protecting the goodies in your ham shack from burglars by adding the Doppler processor section described next. Doppler radars respond only to moving reflectors, and, if properly employed, can provide nearly foolproof protection against intruders. The trick is to achieve a very low false-alarm rate so the circuit is not continually "crying wolf."

The Doppler effect refers to an apparent shift in the frequency of a radio signal which occurs if the transmitter is moving relative to the receiver. The amount of frequency offset that occurs is determined by both the transmitter frequency and the velocity of the transmitter relative to the receiver. The frequency shift is given by the simple formula: $F = f_o \times V/C$. F is the shift. f_o is the transmitter frequency. V is the velocity difference and C is the speed of light. The frequencies are in Hz and the velocities in meters per second. In the radar case, the signal experiences the Doppler effect in both directions of propagation, to and from the target. Here, the resulting shift is doubled from the values given by the formula.

The Doppler effect is used in a variety of radar applications where measurement of speed or separation of moving from stationary targets is desired. The police speed meters are one example, of course, but others include air search radars which use Doppler to reject ground clutter (ground doesn't move) and accept airplanes (which always move).

If an intrusion-detection radar operates at 10 GHz, the maximum Doppler shift obtained with a walking person as a target is about 40 Hz. The lower end of the Doppler range extends to very low frequencies. I used 4 Hz as the lower band edge of the processor after observing the Doppler output of the transceiver on a scope and determining that there is a lot of energy near dc; some of us don't move all that fast! In any event, the 4-40 Hz processing bandwidth seems to work well in practice.

The objective in the processor design is to obtain positive target detection with a low false-alarm rate. The circuit has to have some "smarts" so that it does not trip on the first cycle or two of 4-40 Hz audio to come out of the Doppler mixer. In order to obtain an alarm output, the processor requires that a large number of cycles of Doppler occur within a relatively short span of time and that more recent events be given greater weight than those which occurred many seconds earlier. This feature prevents noise from causing single-event false alarms, and, as a consequence, the circuit almost never produces a false output. An alarm output on a real person is obtained in about 2 seconds.

The processor has four major sections: an input preamplifier, a squaring amplifier, a pulse counter, and an output threshold detector. It also contains a power supply for the processing circuits and a regulator for the Gunn-diode oscillator. Two LED indicators are provided to aid in setting the circuit sensitivity. One blinks when Doppler is present; the other indicates an alarm-decision output. Fig. 12 is a schematic diagram of the circuit.

The input preamplifier has a 4-40 Hz bandpass which is obtained by RC rolloffs in the input and feedback networks. The op amp, U1, is an RCA type CA 3130 FET input op amp. I used this part in all three stages of the processor because it has a number of advantages for this type of circuit. The high-input impedance permits good low-frequency response with small (0.1 μF) capacitors. If a 741-type amplifier were used, some truly huge values would be required to obtain response to 4 Hz. The FET input stages also permit the CA 3130 to run from a single-ended supply with the common-mode input voltage at the inputs as much as one-half volt below ground. This was handy in the last stage. Finally, the output section of this chip is a CMOS inverter used as an amplifier. This permits the output to swing within 50 millivolts or so of the supply voltages. Thus the circuit will interface directly with CMOS and, in the case of the squaring amplifier stage, will provide an output swing equal to the supply voltage. This saved some parts.

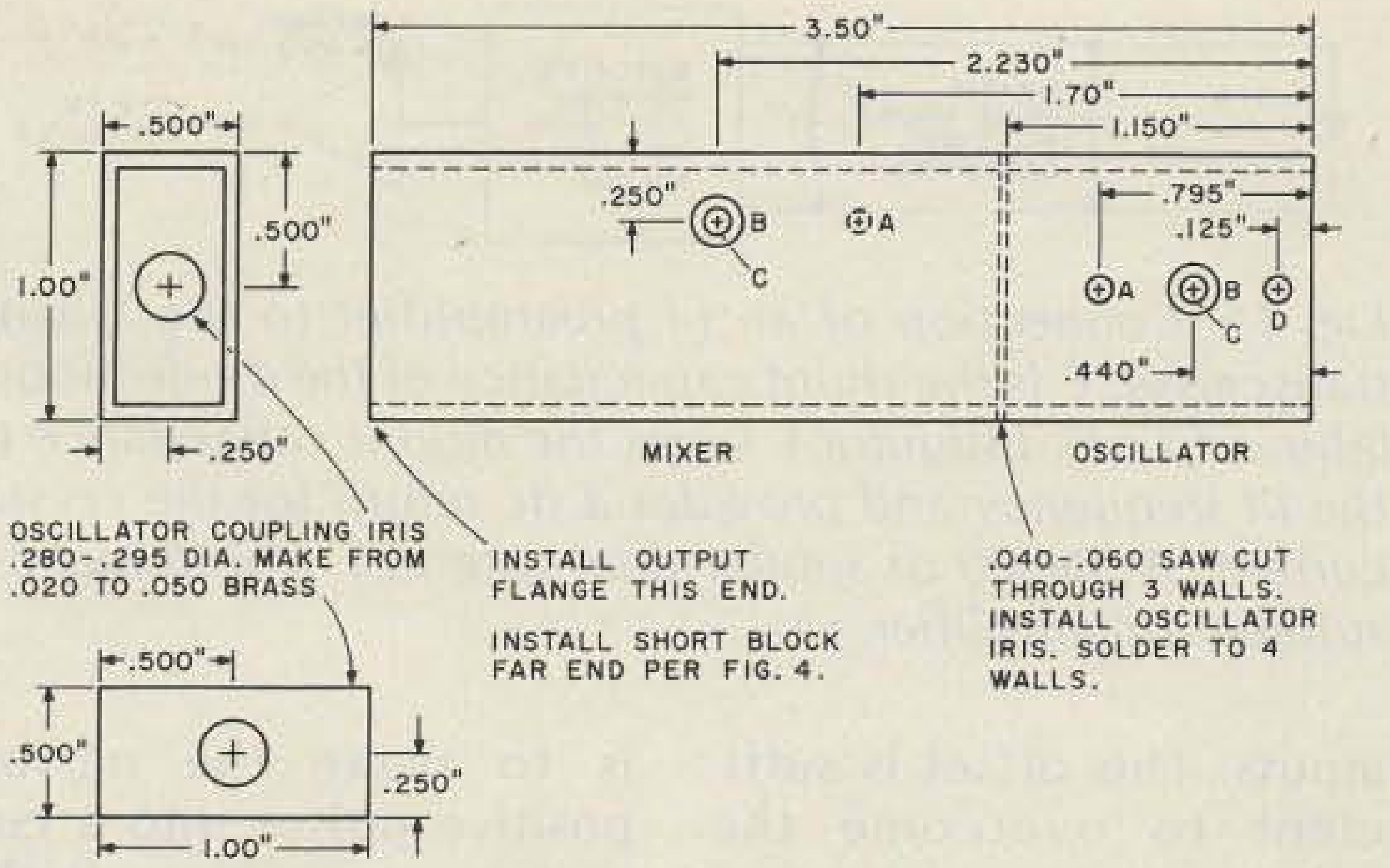

Fig. 10. X-band transceiver waveguide. The function and size of the lettered holes are the same as in the table in Fig. 6.

The noninverting input of U1 is biased at +5 volts by the voltage divider, R3 and R4. Input capacitor C1 and resistor R1 form a high-pass filter with a 4-Hz corner frequency. R2 and C2 form a 40-Hz low pass. The amplifier gain is set to 60 dB by feedback resistors R5 and R6. Capacitor C5 is used to obtain a 40-Hz high-pass rolloff in the feedback network. The 68 microfarad capacitor, C4, in conjunction with R6, causes the gain to decrease below 4 Hz. The amplifier gain is unity at dc so the output sits at the input bias point of +5 volts in the absence of an input signal. High-frequency compensation of the preamplifier requires a 100 pF capacitor from pin 1 to pin 8 as indicated.

The second stage of the processor, U2, also uses the CA 3130. Positive feedback around the amplifier is employed to obtain a squaring amplifier. The objective is to turn the complex sine-wave Doppler audio into a series of 10-volt peak-to-peak square waves. The input circuit of U2 is a bit novel and requires some explanation. The voltage divider consisting of R7, R8, and R9 forms the reference for both the inverting and noninverting inputs. This reference voltage is about 5 volts. The 6.8-Ohm resistor, R8, ensures that the voltage at the inverting input is always about 34 millivolts more positive than the noninverting input. In the absence of an audio input signal (which is ac coupled), the op amp is always driven to ground potential because of the intentional 34 millivolt offset introduced between the inverting and noninverting

Dc supply voltage Volts	Frequency shift matched load vswr 1.1 to 1	Frequency shift osc. pulled high with 2 to 1 vswr	Frequency shift osc. pulled low with 2 to 1 vswr
7.0	−15 MHz	−25 MHz	−25 MHz
7.5	−7 MHz	+5 MHz	−18 MHz
8.0	0 MHz	+10 MHz	−14 MHz
8.5	+5 MHz	+13 MHz	−7 MHz
9.0	+8 MHz	+17 MHz	−6 MHz

Table 4. Effect of load vswr on frequency pushing. This table indicates the effect of load vswr upon the center frequency and tuning sensitivity of the oscillator. Note that when the frequency was pulled low, the initial frequency could not be restored with supply voltage. Diode number 1 was used with a .290-inch diameter iris.

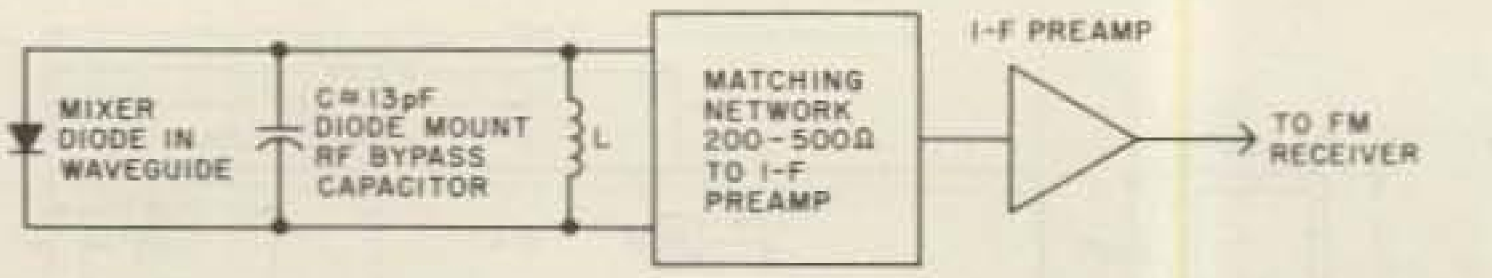

Fig. 11. Connection of an i-f preamplifier to the X-band transceiver. C is the shunt capacitance of the diode mount (about 13 pF). Inductor L tunes the mount capacitance to the i-f frequency and provides a dc return for the crystal current. A 3N200 or similar dual-gate FET would make a suitable preamplifier.

inputs. This offset is sufficient to overcome the worst case input offset of the op amp and ensures that the output voltage always swings to ground. This is done so that the LED driver, Q1, is normally off.

The particular configuration used was chosen because it is independent of both supply-voltage and resistor variations. No precision parts are required.

The Doppler signal is coupled into the squaring amplifier input from the preamplifier stage via capacitor C6 and gain control R10. When R10 is set to full gain, less than 50 millivolts of Doppler at the input to the squaring amplifier is sufficient to obtain a 10-volt peak-to-peak square wave output from U2. The presence of Doppler causes LED −1 to flash at the Doppler rate.

The circuitry following U2 is the heart of the processor. It is here that the low false-alarm rate is obtained. In effect, the circuit is an analog pulse counter with a short memory. The first section, consisting of C7, R13, and CR1, is a rectifying differentiator. It converts the square waves from U2 into a series of short positive-going pulses. The shunt diode rectifier clips all negative-going edges so only the positive pulses remain.

These positive pulses charge C8 through R14. The series 1N914, CR2, prevents the accumulated charge from discharging back through R13 to ground. The effect of R14 is to make the narrow positive pulses into a current source. As a result, the voltage accumulated in C8 is a function of the number of input pulses. The circuit is essentially a pulse counter with an analog voltage output.

This approach is simpler and cheaper than a digital counter and can be made to "forget" at any rate desired. The objective is to have the circuit slowly reset itself if an insufficient number of pulses are counted. This is a way to give more recent events more weight in determining if there is an intruder present. Two groups of pulses separated by a short interval in time should set off the alarm. Similar groups spaced widely apart in time (several minutes apart) should not. The "forget-it" function is obtained by R17, which slowly discharges C8. Adjustment of R17 allows the circuit to have any memory time required.

The output of the analog pulse counter is applied to U3, another CA 3130 op amp. U3 functions as both a high-impedance comparator and as a one-shot multivibrator. The inverting input of the amplifier is referenced to +2 volts by R15 and R16. The voltage from the analog pulse counter is applied to the noninverting input. When this voltage is less than +2 volts, the output of U3 is 0 volts. When the input exceeds +2 volts, the output of the CA 3130 goes to +10 volts and the circuit becomes a one-shot.

The one-shot functions as follows: C9 is initially discharged via CR4. CR3 is reverse biased, which effectively disconnects C9 from the input to U3. Thus, the only capacitor in the pulse counter circuit is C8. When the output of the CA 3130 goes to +10 volts, CR3 becomes forward biased, and since C9 is essentially discharged, the voltage at the noninverting input of U3 is nearly 10 volts. This positive feedback holds the output of U3 at +10 volts. C9 starts to charge through R17 and the voltage at the noninverting input falls toward ground at a rate determined by the R17 and C9 time constant. C8 is also in the act, but to a lesser extent because of its lower capacitance relative to C9. Eventually, the voltage at pin 3 drops below +2 volts and the circuit resets. The output voltage from U3 then returns to ground potential. The output pulse width is more than one second with the values shown. The arrangement of the circuit is convenient in that longer pulse widths may be obtained by increasing the value of C9 without any effect upon the analog pulse counter. In one version of the circuit, the output pulse width was increased to 3 minutes by increasing C9 to about 60 μF. In this application, the output pulse operated an alarm circuit directly for a 3-minute interval.

The LED drivers, Q1 and Q2, are 2N2222 or similar NPN transistors connected as emitter followers. Just about any LED will work. I used the high-efficiency HP 5082-4650 types which make a lot of light from only 10 mA of current. If lower-efficiency LEDs are used, the 820-Ohm resistors, R18 and R19, may be reduced in value to obtain more current. Note that the LED driver collectors are returned to the unregulated +12-volt line and not to the +10-volt regulated supply. This is intentional. The current pulses created by the LED drivers could get back into the low-level input stages and cause an oscillation via the +10 supply line. By using the connection indicated, the voltage regulator isolates the low-level stages from these current pulses.

The Doppler processor operates from a nominal 12- to 15-volt dc input. Higher voltages can be used if the heat sinking of the supply regulators is improved. A 10-volt supply was chosen for the op amps to ensure sufficient "overhead" to maintain the voltage regulator in regulation. The CA 3130s require at least 8.5 volts to really work well. The regulator for the Gunn-diode oscillator supplies +7 volts and is compatible with the Microwave Associates Gunn diodes. The 8-volt Alpha parts will also work from this voltage.

The regulator circuit was designed to supply the 7- and 10-volt requirements using standard 5- and 8-volt 3-terminal regulators of the MC7800 series. Seven volts is obtained by offsetting the common terminal of U4, a MC7805 CP, 2 volts above ground. This is accomplished with emitter follower Q3, which has its base referenced to a divided sample of the 7-volt regulator output. The sample is derived from divider R22-R24. Resistor R24 is a select in test value and is used to adjust the circuit to exactly 7 volts of output. The divider cannot be fixed because of the wide output-voltage tolerance of U4 and the variations of V_{be} of Q3. The +10-volt regulator is made by referencing the common terminal of an 8-volt three-terminal regulator chip to the +2-volt source at the emitter of Q3. The current from the common terminal to ground for both chips runs through Q3. An emitter follower was used rather than a simple resistive divider to provide a low-impedance constant voltage sink for this current and to avoid the necessity for high-dissipation low-value resistors in the voltage-divider network.

Doppler Radar Construction

The complete Doppler radar is packaged in a 5.5" x 1.5" x 3.0" minibox as indicated in the photos. The X-band transceiver is mounted to the top exterior surface of the box with a clamp which grips the waveguide. The Doppler processor card is mounted inside the box and attached to the same surface as the waveguide. The card is mounted with number 6 screws and spacers. This arrangement makes it possible to remove the bottom cover for test or servicing without disturbing any wiring. The sensitivity control and input/output terminal strip are mounted on one side of the box. The LED indicators were mounted on one end of the bottom cover and connected to the circuit card with long leads to permit easy removal of the cover.

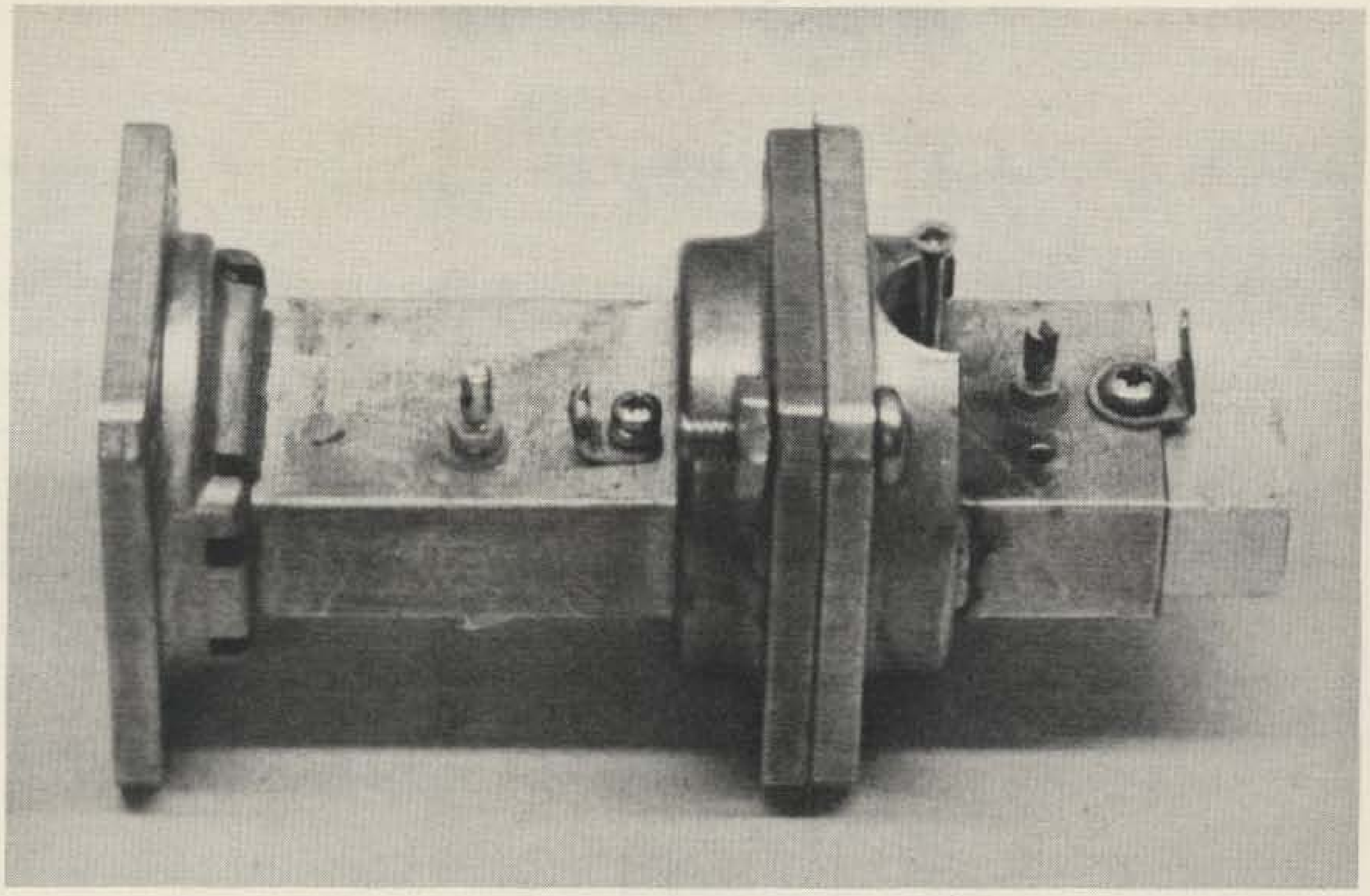

Photo F. X-band transceiver breadboard. The X-band transceiver was developed by adding a simple "diode in the guide" mixer assembly to the breadboard oscillator. The coupling iris is clamped between the mating waveguide flanges.

The Doppler processor card is constructed using copperclad PC board and push-in standoff terminals. Wiring is all point-to-point. There is no particular magic in the layout except to keep the signal flow in one direction. The circuit does have a lot of gain, but no difficulty with oscillation was encountered. Just keep the output portions of the circuit from being routed near the preamplifier input. Signal flow is from right to left in the photo of the circuit card. U1 is in the lower right-hand corner of the card and U3 is in the lower left-hand corner. The three large parts to the left of U1 are capacitors for a 120-Hz notch filter that was deleted from the circuit. They are not required and are not indicated on the processor schematic. The voltage regulator chips, U3 and U4, are mounted to the circuit card. This arrangement provides sufficient heat sinking for the power dissipated at input voltages up to 15 volts.

The output from the Doppler mixer is connected to the processor input at terminals T5 and T6. Shielded cable is used to prevent noise pickup. The mixer diode on the X-band transceiver has an output terminal and a ground terminal. A 10k resistor should be connected from the output terminal to ground. This serves two purposes: It provides a dc return for the Doppler mixer and it serves to ensure discharge of the coupling capacitor, C1, in the Doppler-processor preamplifier. The output terminal of the mixer is connected to input terminal T5 on the processor via the shielded center conductor of the input cable. The ground terminal on the mixer is connected to T6 on the processor with the coax cable braid.

The connections to the mixer from the preamplifier should be made prior to final installation of the mixer diode. This is done to reduce the danger of diode burnout during the soldering operation.

The Gunn-diode oscillator portion of the X-band transceiver is powered from terminal T7, the 7-volt output of the processor voltage regulator.

Doppler Radar Operation and Test

Some initial testing of the Doppler processor may be performed independently of the X-band circuitry. This is useful to isolate any problems with the processor.

After checking the wiring, apply 12 to 15 volts dc to the processor supply input terminal, T3. Load the +7-volt regulator with a 50-Ohm, 1-Watt resistor. This will draw 140 mA from the oscillator supply and will simulate the Gunn-oscillator load. Measure the +7-volt regulator output. It will not be exactly 7 volts. Adjust the select in test resistor, R24, to obtain 7 volts within a tolerance of plus or minus 250 millivolts. The voltage at the output of the +10-volt regulator should be checked and will be pretty close. 9.5 to 10.5 volts is acceptable. Voltages less than 9.5 will cause performance of the op amps to degrade. If all is well, the voltage at the emitter of Q3 will be just about 2 volts. If this is the case and the 10-volt supply is wrong or inoperative, the problem is with U3. If both supplies are wrong, the problem is with U4 and Q3.

Once the dc supply is operating, the rest of the circuit may be tested. When power is first applied, the large capacitors, C3 and C4, must charge. U1 will be inoperative for about 20 seconds, so do not worry if things don't work immediately after power-up.

Apply a 20-Hz audio signal to the preamplifier input. Use plenty of attenua-

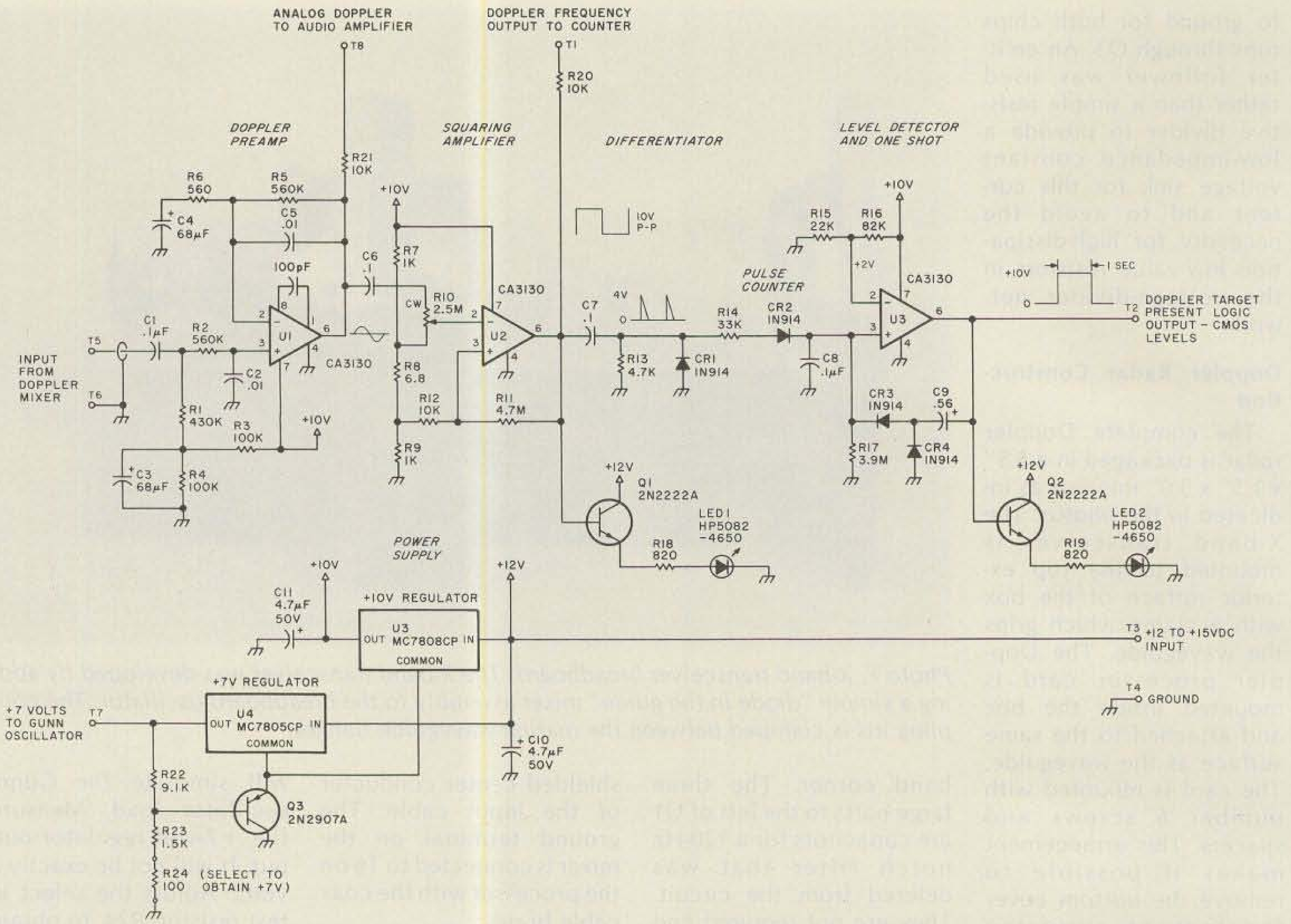

Fig. 12. Doppler-signal processor schematic. This circuit provides a 10-volt CMOS-compatible logic output when a Doppler return is received. The output stage will provide up to 2 mA of output current to an external load.

tion. 50 or 100 microvolts rms should be sufficient. U1 has a gain of 1000 (60 dB) and will easily provide the 50 millivolts of input required to drive U2 to full output.

Increase the input to U1 until 50-100 millivolts is obtained at test point T8. Set R10 for maximum sensitivity and check for a square wave at terminal T1. The amplitude should be 10 volts peak-to-peak.

At this point, LED indicator 1 should be illuminated. Removal of the audio input or a decrease in gain adjustment will cause the LED to go out. If it remains on, check to see if pin 6 of U2 has returned to ground. If pin 6 is at +10 volts instead of ground, then there is a problem in the input bias/offset circuit of U2.

With the square wave present at T1, a series of sharp pulses should be observed at the junction of C7 and CR1. The pulses should be positive-going and have an amplitude of several volts. The pulse will be in phase with the positive edge of the squaring-amplifier output. A small negative-going pulse will occur in phase with the falling edge of the square wave, but will be clamped to −0.8 volts by CR1.

If all of this is working, then U3 will have decided that a target is present and will have a +10-volt output at T2.

Remove the audio input. T2 should go low in a few seconds. Apply the audio input. T2 will go high in about 2 seconds. If the voltage at pin 3 of U3 is observed on a scope or very high impedance meter, it will be seen to rise slowly upon application of audio input. If the input is removed prior to reaching the +2-volt threshold, it will be seen to decay as R17 discharges C8.

If the 2-volt threshold is reached, the monostable trips and the voltage at pin 3 will jump up to nearly 8 volts as the positive feedback is coupled from C9 via CR3.

LED 2 should be illuminated whenever a signal has been applied for more than 2 seconds.

Upon completion of testing, the processor may be operated with the X-band transceiver. When first connecting the transceiver to the processor, be sure to observe the cautions with regard to connection of the mixer diode. Do ensure that C1 is discharged and make the mixer-diode connections with the diode removed from the mount or with the mount shorted. Also, be sure to check for oscillation of the Gunn-diode supply regulator. I encountered no difficulty as long as the .1 μF capacitor and 33-Ohm resistor oscillation suppression network was used at the Gunn-oscillator power terminals.

Place the unit in operation and connect a scope to T8 and a dc VTVM to pin 3 of U3. Walk in front of the waveguide output and observe the Doppler waveform on the scope. The dc voltmeter will indicate the charge and discharge of the pulse-counter circuit. LED 1 will blink whenever there is motion and LED 2 will be illuminated when enough Doppler cycles have been counted to give an alarm indication.

Reader Service—see page 211

For these tests, the open-ended waveguide is sufficient antenna. The gain is about 5 dB. A range of 10 feet or so will be obtained with this antenna.

The Doppler frequency may be counted by connecting a frequency counter to T1. Use a gate time of one second. The count accumulated will be the total number of Doppler cycles averaged over the one-second interval. Observation of the scope will confirm that the Doppler waveform is complex and is not a single frequency.

The processor output is a CMOS-compatible logic level that goes from 0 to +10 volts when a target is detected. In my application, CMOS logic was used to process inputs from a number of sensors. The output may also be interfaced directly with other devices. The CA 3130 output stage will source or sink 5 milliamperes, which is sufficient to drive an output buffer or relay driver for higher current loads. Fig. 13 is a suggested buffer for loads of up to 2 Amperes.

If the radar is to be used as an intrusion detector, set it up for a couple of weeks in the intended location. Connect an electromechanical counter to the output to record false alarms. This will permit optimization of the sensitivity setting and installation without creating a lot of bothersome false alarms. The circuit has plenty of sensitivity and will see a person at up to 100 feet with a 20 dB gain antenna.

Avoid installations which look directly at a street. Autos have a large radar cross section (as most of us know by now) and are detected at a greater distance than people. What you definitely do not need is a noisy device which informs you that your neighbor is backing out his car!

The unit may be installed in a wood cabinet and will work right through materials such as one-quarter-inch paneling or plywood. Wallboard and plaster attenuate the signal and tend to mitigate the effects of passing autos if the unit is properly positioned.

Antennas

I use a small horn having a length of 2.5 inches and an aperture of 2.3 and 3.0 inches. This is not an especially good horn design from a sidelobe standpoint, but it serves the purpose. Horns are easy to make and have the advantage that their gain and beamwidth are easily calculated. You can make a horn which will almost exactly cover the area to be protected.

Conclusion

In writing this article, I have tried to inspire interest in X-band microwave projects at several levels. The theory of Gunn-oscillator operation and a basic oscillator design are there for those who want the "how-to" information to build one into a communication system of their own design.

The X-band transceiver presented is far from an optimal gadget (especially in terms of noise figure), but it does provide a simple and inexpensive vehicle for experimentation in both X-band communications and Doppler radar. I would like to see someone mount two transceivers at the focus of a pair of 3-foot dishes and have a QSO or two. A number of years ago, a friend sent fast-scan TV over a 1000-foot path using a similar arrangement. By adding attenuators at the receiver, a 10-mile path was simulated with good results. X-band offers plenty of opportunity for TV experiments and for truly secure command links for repeaters.

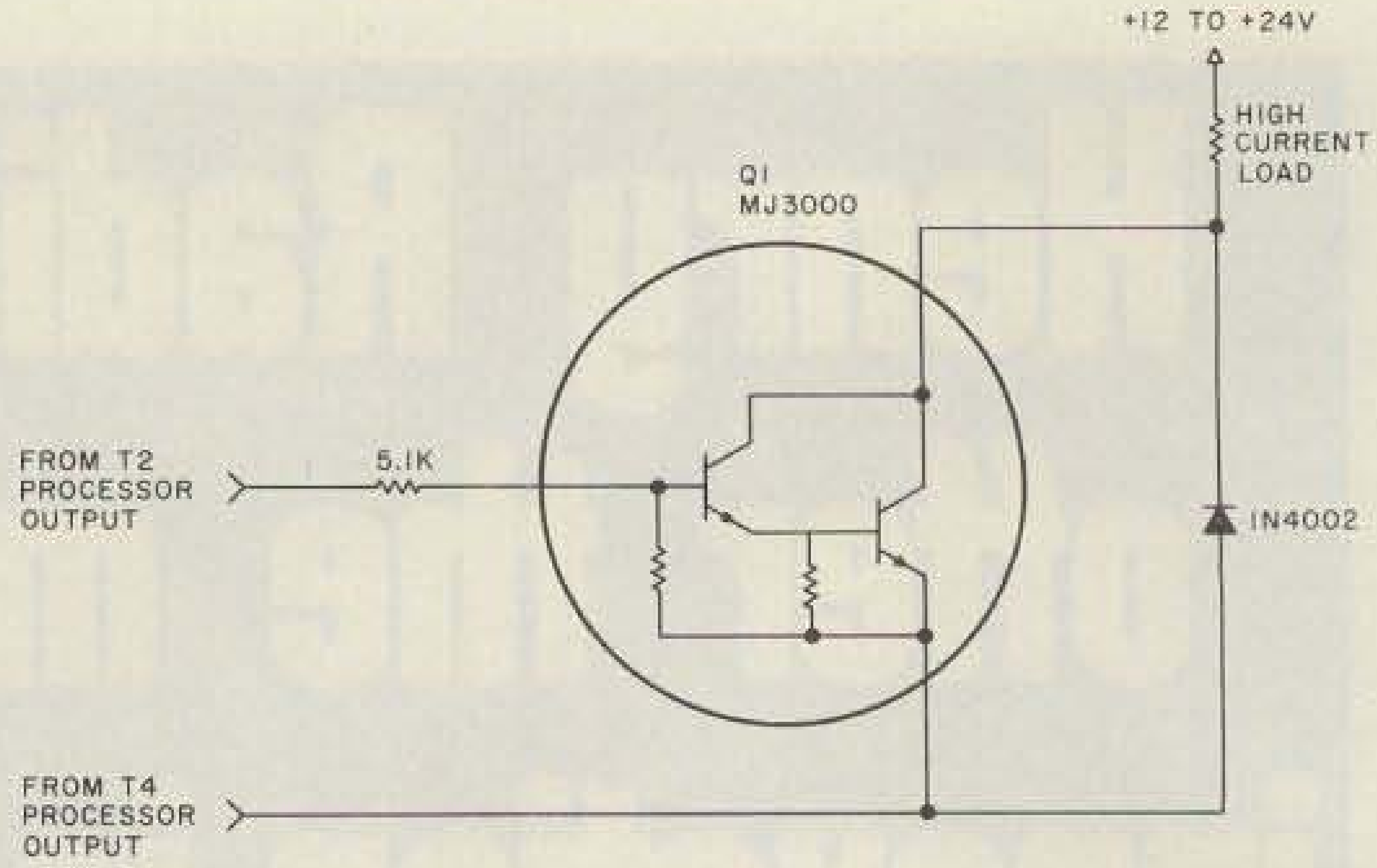

Fig. 13. High-current driver. This circuit uses a high-current Darlington power transistor (Motorola MJ 3000) and will boost the output capability of the Doppler processor such that loads up to 2 Amps at 24 volts may be driven. The diode is to prevent inductive kickback damage to the transistor if inductive loads are connected. The two unlabeled resistors are included on the monolithic Darlington chip.

Doppler radars are interesting projects in themselves. The Doppler processor presented in this article is a practical design I developed to deal with real intruders. Two such units have been in operation for several years with satisfactory results. I am sure that someone will find other uses for this handy form of motion detection.

This article would not be complete without a word with regard to the "radiation hazard." Much has been written of late which alleges a "microwave radiation hazard." A lot of this is uninformed speculation. It has been known for years that microwaves (and lower-frequency rf) cause heating of tissue and that high-power sources such as radars are hazardous.

A major difficulty occurs in attempting to extrapolate the observations for short exposure to high-power sources to long exposure to low-power sources. At present, the permissible level for *continuous* exposure to microwaves or low-frequency rf is not known. Certain standards have been proposed (10, 1, or 0.1 milliwatts/sq. cm) in an attempt to be super safe until more data is accumulated.

Conservative standards are one thing. The real question is this: What precautions should be observed in amateur microwave activities? I apply the same rules that I have used and observed as a working microwave engineer in industry for the past 15 years. They apply equally to microwave projects as to your 2 meter kilowatt. Do not stay in situations of high-power density for long periods. Do not stare into the output of a waveguide source for any period of time at short distances. The level falls off rapidly with distance and is negligible beyond several inches for low-power X-band sources. Remember that a high-power VHF transmitter is equally hazardous if you insist in holding the antenna or standing within a wavelength of it. Time is also a factor. The low-power density recommendations assume exposure on a continuous basis. This is seldom the case in a hobby activity. In short, use common sense.

I hope that this article has provided a starting point for some interesting projects. I will look forward to hearing from anyone who either builds the equipment or who has further questions. ■

Legalized ASCII! The Quad-S System!

— even the FCC approves

At last.

Editor's Note:

Ed Sommerfield W2FJT developed this clever techinque for sending ASCII signals via SSTV back in 1977. Naturally, there was some doubt as to the legality of the scheme, since Section 97.69 of the FCC Rules and Regulations permits only five-level (Baudot) radio teleprinter signals. Ed began a long correspondence with the FCC concerning his development, and in October, 1978, his efforts finally bore fruit. Below is an excerpt from a letter dated October 12, 1978, written to George Enuton of the FCC's Personal Radio Division:

> **Regardless of the type of information transmitted under this scheme, the actual modulation of the transmitter and subsequent transmitted signal is classified as an F5 emission and legal for transmission in the amateur service, subject to the . . . restrictions (of Sections 97.61 and 97.65).**
> **(signed) John A. Reed**
> **(approved) Julian T. Dixon, Chief, Research and Standards Division, FCC**

For reference, Section 97.61 is the table of authorized frequencies and emissions while Section 97.65 deals with (among other things) the bandwidth of F5 emissions.

So here we have it: a technique for transmitting ASCII on the ham bands which carries the FCC stamp of approval. Now, let's get some systems on the air.

E. H. Sommerfield W2FJT
49 Spring Road
Poughkeepsie NY 12601

The FCC does not permit amateur radio Teletype™ transmission of other than five-level Baudot start/stop code. I have not been able to find any restriction, however, on the content of an SSTV picture. Of course, alphanumeric characters are presently being sent via SSTV. These characters are formed by many lines of white/black information, which is the same method I am using to transmit ASCII.

The problem with the existing SSTV character transmission system is that, although displayed characters are easily interpreted by humans, they are absolutely not interpretable by another machine, be it a computer, TTY, or otherwise. A need exists today, and that need will grow tomorrow, to transmit 8-level binary and ASCII data. Nothing in the present FCC rules, however, says that binary or ASCII cannot be translated into single lines on an SSTV picture and sent as FSK video.

This article describes how I translated 8-level ASCII code into crystal-controlled SSTV pictures. Also described are some easily-achieved transmission standards.

Overview

The Quad-S (Slow Scan Start Stop) adapter was designed to accept a character of up to 8 bits (byte), from sources such as an 8-bit Teletype™ or microcomputer, and to translate these bits into a single line of an SSTV picture. The picture is transmitted via FSK (Frequency Shift Keying) FM, line by line (character by character), and detected by either a standard SSTV monitor from which the binary signal can be extracted, or by a microcomputer cassette interface modified for the appropriate mark and space frequencies. Use of

	Frequency	Duration
Horizontal sync	1,200 Hz	greater than 5 ms but less than 30 ms
Vertical sync	1,200 Hz	greater than 30 ms
Maximum white	2,300 Hz	
Maximum black	1,500 Hz	

Table 1. SSTV standards.

fb/20,480 (÷ 16 ÷ 16 ÷ 16 ÷ 5)	= 15 Hz line freq.
fb/8	= 38,400 Hz
38,400 Hz/18 (÷ 9 ÷ 2)	= 2,133 Hz mark
38,400 Hz/24 (÷ 12 ÷ 2)	= 1,600 Hz space
38,400 Hz/32 (÷ 16 ÷ 2)	= 1,200 Hz sync
fb/2,048 (÷ 16 ÷ 16 ÷ 8)	= 150 Hz serial-out (10 bits)

Table 2.

the recovered binary data depends upon the application. In my application, the binary data was fed into a special UART for computer processing. A block diagram of my ASCII/SSTV transmitting system is shown in Fig. 1.

Generating the Transmitting Signals

The selection of SSTV modulating frequencies was determined by the following factors: 1. Are there existing standards? 2. Can crystal control be applied? SSTV satisfies the first requirement; reasonable standards do exist. See Table 1. Now that we know the range of frequencies from which the sync, mark, and space frequencies can be chosen, let's examine two ways controlled frequencies can be generated.

A vco (voltage-controlled oscillator) requires adjustment. A crystal oscillator does not require adjustment. I selected the crystal method since not all readers have the necessary equipment for precise frequency adjustment. The basic crystal frequency selected was 307,200 Hz, which we will call fb. The various frequencies derived from fb are shown in Table 2. All frequencies except 2,133 Hz and 1,600 Hz are derived from repeated divisions by 2, and therefore will be locked in phase with the 150-Hz serial-out clock. Both mark and space can be viewed on any SSTV monitor, and this can be helpful for signal checking.

Now that the mark, space, and sync frequencies have been assigned, let's discuss duration. We're going to use one of the crystal subfrequencies to define the number of pulse groups per SSTV line. At least eight are needed for a binary byte. The nearest exact crystal subfrequency for this purpose is 150 Hz, or ten times the line frequency of 15 Hz. Thus, the SSTV line time of 66.66 ms will be divided into 10 equal segments of 6.66 ms. Since we only need eight segments, the

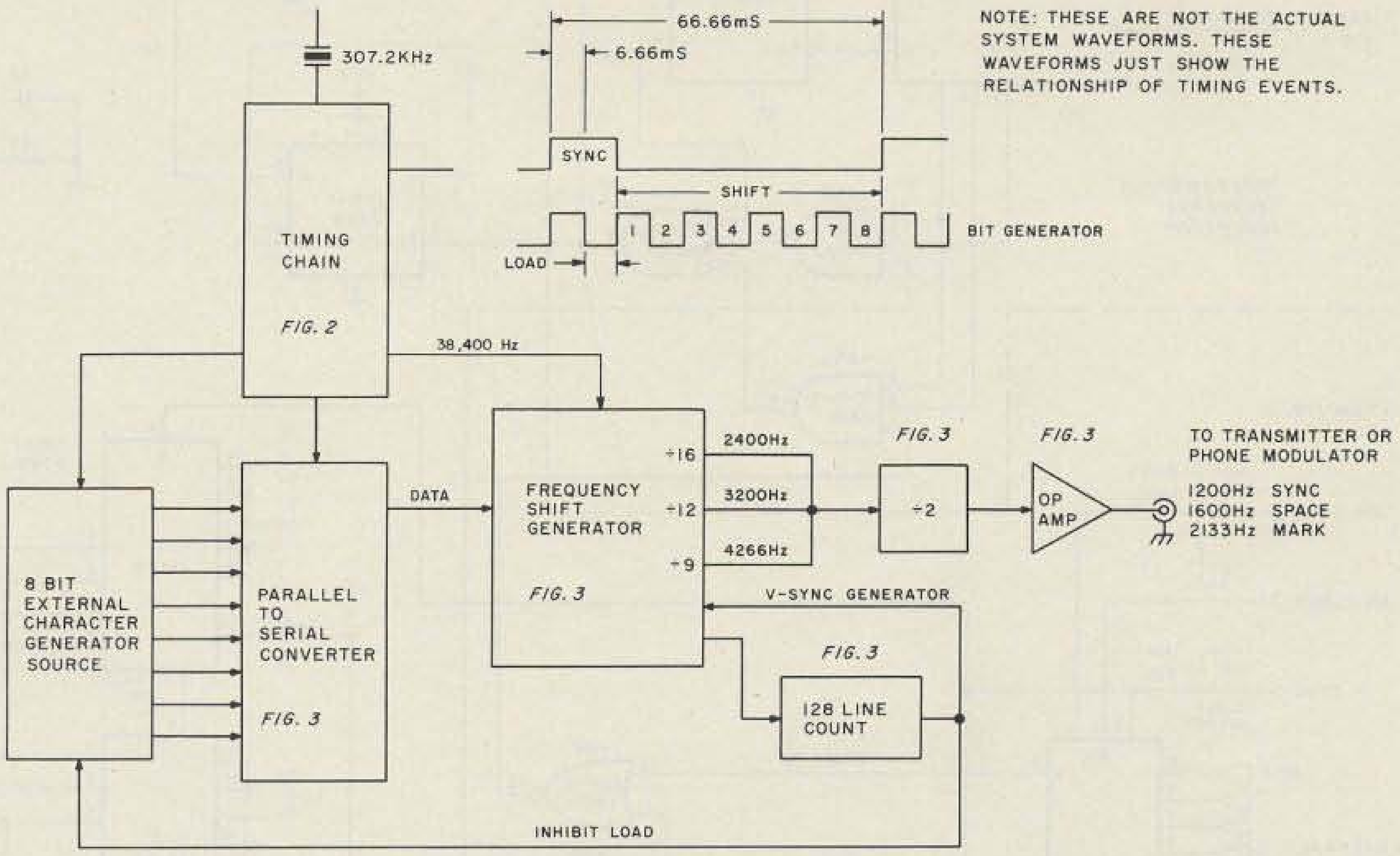

Fig. 1. Overview of the transmitting system.

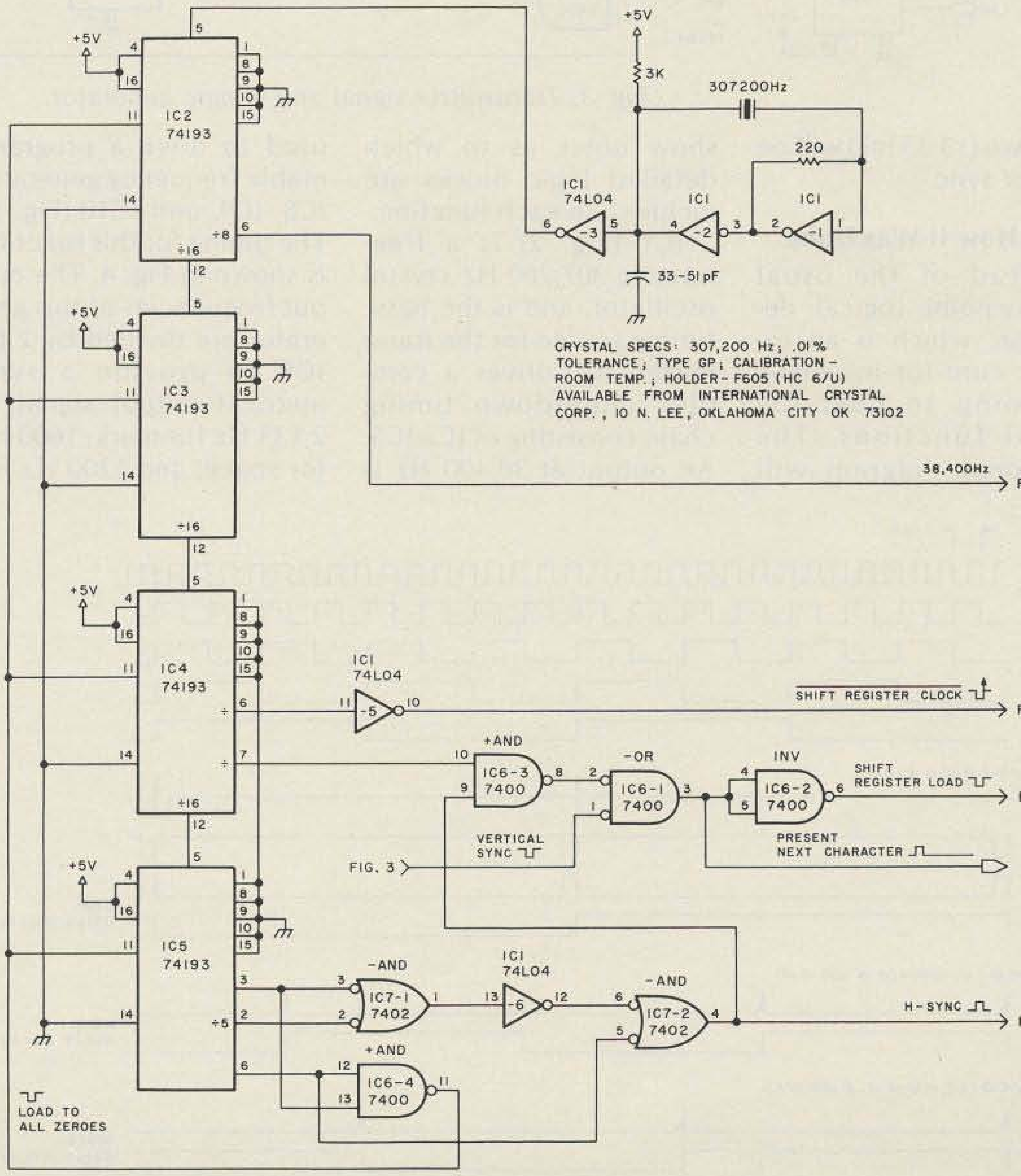

Fig. 2. Transmitter bit-timing chain.

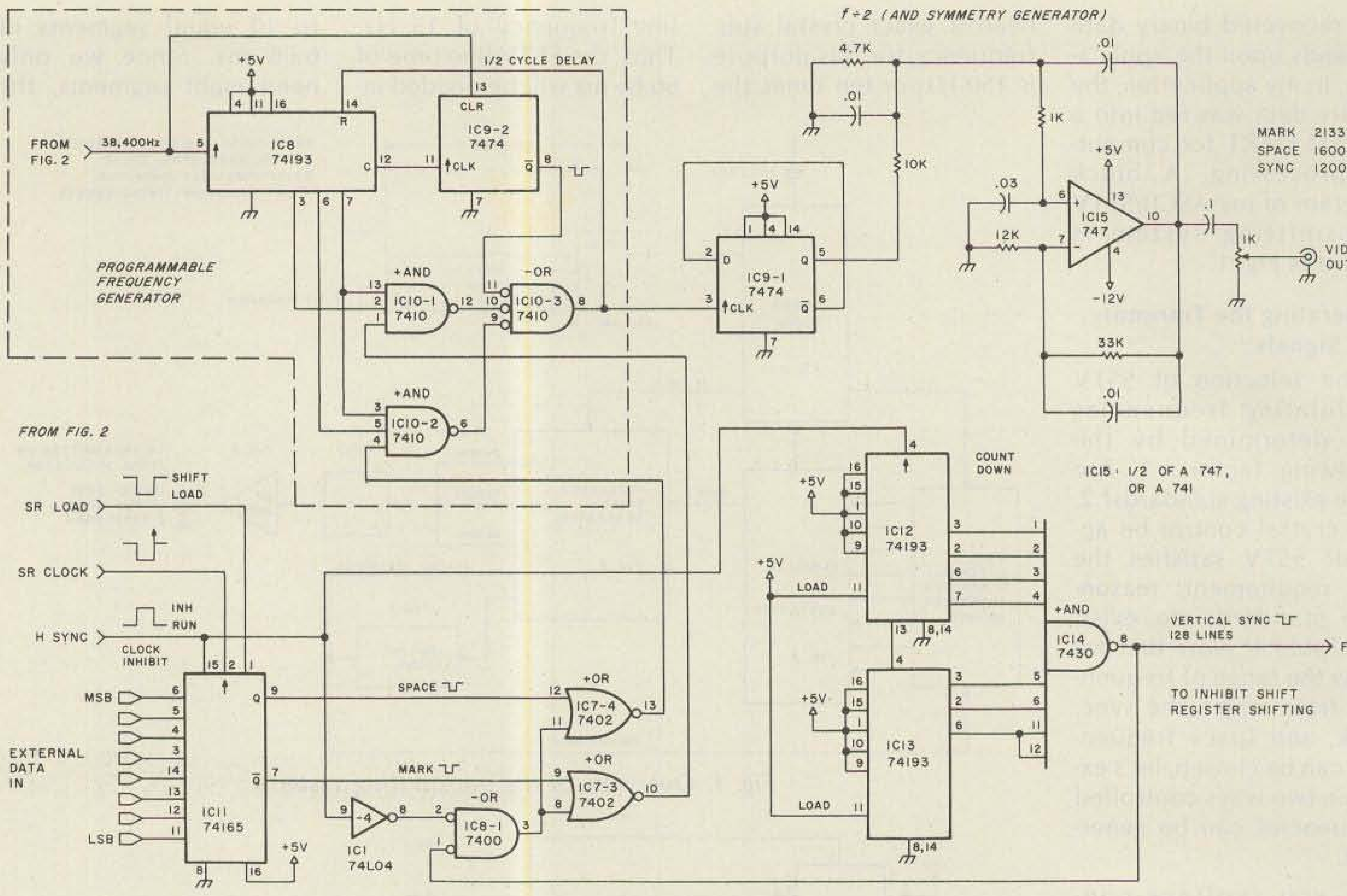

Fig. 3. Transmitter signal and V-sync generator.

other two (13.33 ms) will be used for sync.

Here's How It Was Done

Instead of the usual point-by-point logical description, which is an excellent cure for insomnia, I'm going to describe logical functions. The functional diagram will show notes as to which detailed logic blocks are included in each function.

IC1 (Fig. 2) is a free-running 307,200 Hz crystal oscillator, and is the basic timing source for the transmitter. IC1 drives a complex countdown timing chain consisting of IC2-IC5. An output at 38,400 Hz is used to drive a programmable frequency generator IC8, IC9, and IC10 (Fig. 3). The timing for this function is shown in Fig. 4. The output frequencies of this generator are divided by 2 by IC9 to provide a symmetrical output signal at 2,133 Hz for mark, 1600 Hz for space, and 1200 Hz for sync. IC15 is a bandpass output amplifier/driver with a cutoff of about 3.0 Hz.

Another pair of outputs, described by timing waveform rather than frequency, are obtained from IC4 and IC5 to provide the bit timing logic signals for the parallel-to-serial converter.

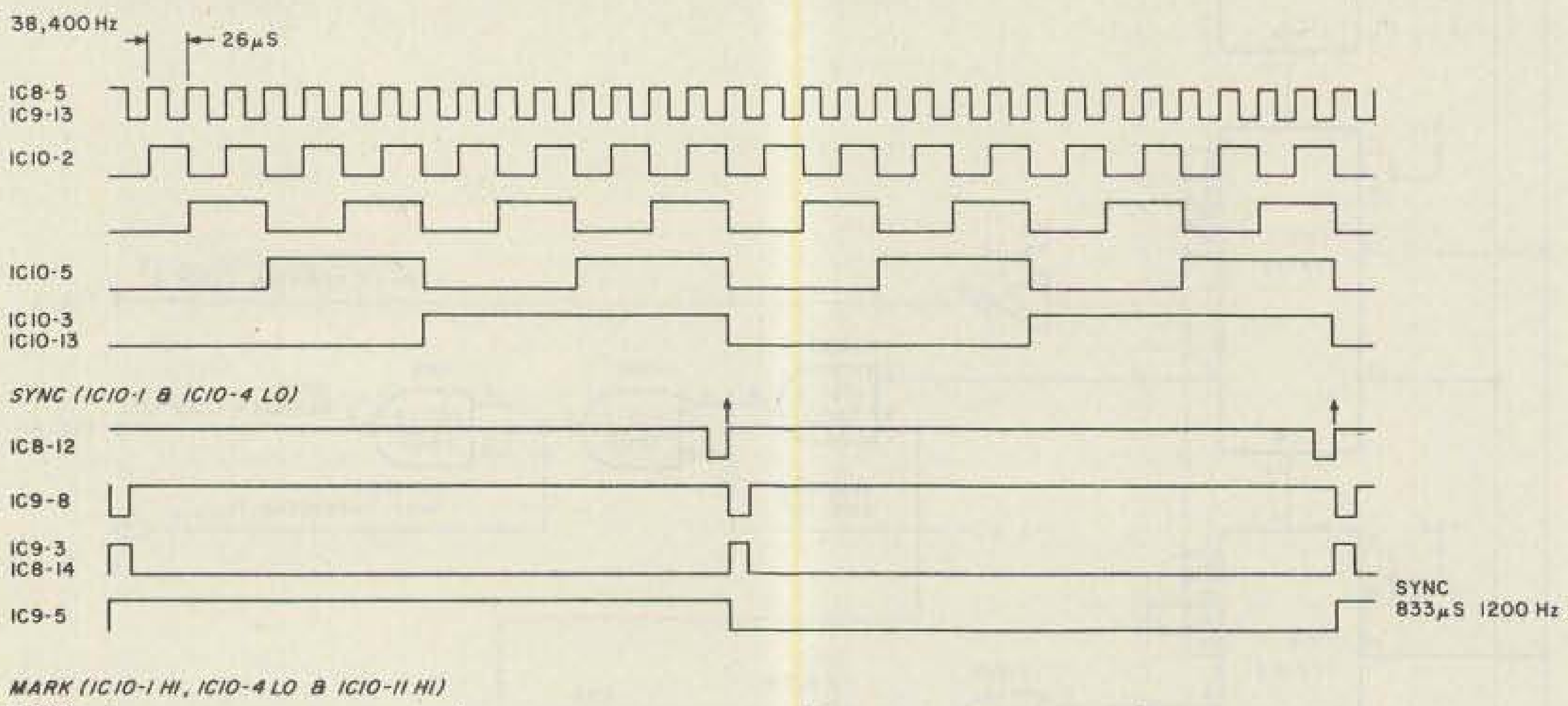

Fig. 4. Programmable frequency generator waveforms.

Signal Conversion and Frame Definition Logic

Control of the timing chain is based upon a 66.67 ms line and an 8 second, 128 line frame. Let us refer to a typical line sequence and its significant timing points (Fig. 5) and line events. The sequence is as follows:

1. Horizontal (H-sync) begins.

2. The parallel-to-serial shift register is loaded, but not shifted out.

3. H-sync ends.

4a. Signals are shifted out of the parallel-to-serial shift register. These serial signals are applied to the variable-count timing gen-

erator (IC8-10) to generate an FSK FM signal.

4b. While signals are being shifted out, a control line is made active to the external source to present the next character. Vertical sync (V-sync) is generated when IC7 pin 10 (Fig. 3) is held low by IC14 pin 8. This causes a continuous sync frequency of 1200 Hz to be transmitted. Pin 10 is allowed to go low for 67 ms to generate a V-sync pulse. At the beginning of each line, IC12 and IC13 are decremented. When 128 countdowns are reached, IC14 provides a negative pulse to IC7 pin 10 (through IC8) and a vertical-sync pulse is generated. During V-sync time, IC11 is held in a load state. Its bits are not shifted out until the beginning of line 1.

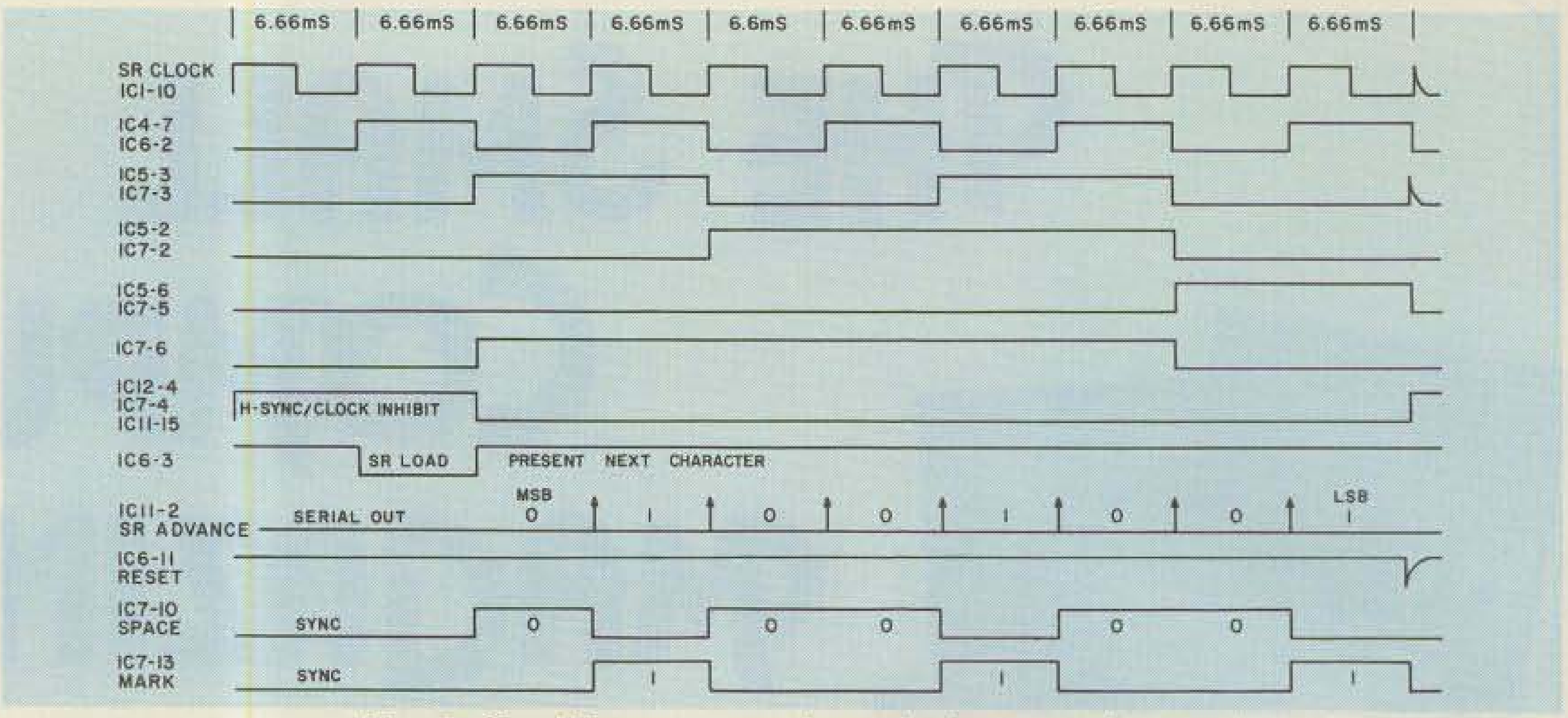

Fig. 5. Significant transmitter timing waveforms.

Test Configuration (Fig. 6)

In order to test the system, a binary pattern consisting of ASCII characters @A-O was generated by temporarily connecting the vertical line counter, IC12, to the low-order data input bits of IC11. The high-order bits of IC11 are fixed at 0100. Thus, the repetitive pattern shown in Fig. 7 consists of:

0100	0000
0100	0001
.	.
.	.
.	.
.	.
0100	1110
0100	1111
0100	0000

The FSK output (Fig. 7) was tested by viewing it on a standard SSTV monitor, recording it on an audio cassette, and then playing it back through the same SSTV monitor. This was done in order to ascertain whether the bit time lengths were sufficient to accommodate variations in tape recorder speeds.

Modifying the Original Design

After using Quad-S for a time, it became apparent that certain changes could be made to the hardware that might make it possible to use a UART at a later date. Also, changes to the format of the frame could be made to make it easier for the receiving station, including the FCC, to determine the nature of the data being sent.

By Quad-S line definition, we will always send a fixed line format of 10 bits that will be designated as shown in Fig. 7. In order to make it easier to detect errors when data is received, the data is put together in a manner so as to be self-checking. In other words, one part of the data is used

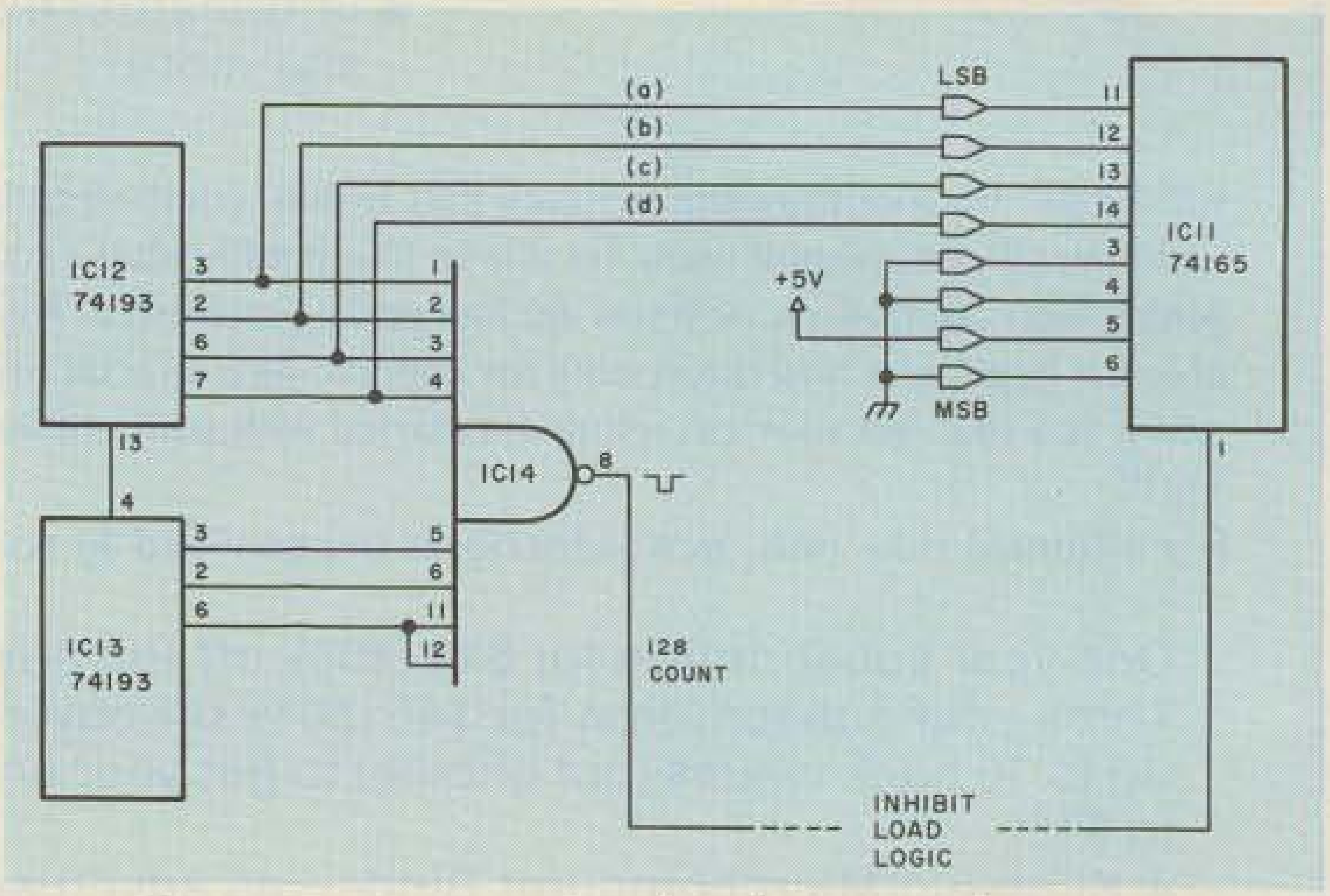

Fig. 6. Test generation hardware configuration.

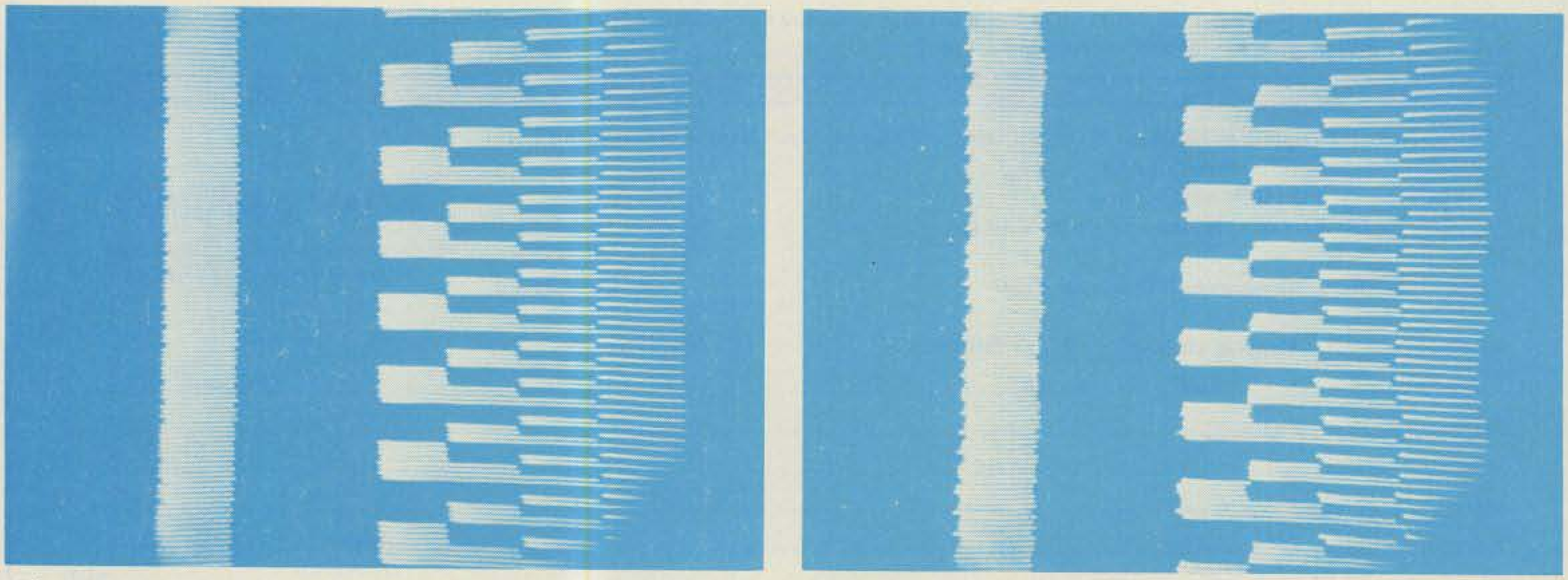

Fig. 7. FSK output as viewed on an SSTV monitor. Photo at left shows Quad-S transmitter output to cassette tape input. Photo at right was produced from cassette tape output. Both photos show SSTV FSK uppercase ASCII @A-O (40-4f hex.).

to check the other part. There are many ways to do this; one easy way is the parity method. Error detection via parity states simply that the sum of all "1" bits (bits at the "1" level) in a word must *always* be either even or odd (see Fig. 9). Even is defined as 0, 2, 4, 6, or 8 bits. Odd is defined as 1, 3, 5, 7, or 9 bits. The choice of even or odd parity may appear to be optional, but odd parity is actually the better choice for the following important reason: If no bits are received, this would be equal to a bit sum of 0—even. Even parity demands that the sum of all "1" bits, including the parity bit, be even. 0 bits *is* even and is also an error condition which would pass the test for good data. Odd parity, on the other hand, demands that the sum of all "1" bits, including the parity bit, be odd; 0 bits is even and therefore is an error condition that would always be detected. How do you make the *sum* of all bits which are sent odd? Refer to Fig. 9. Notice that if the sum of all bits, not including the parity bit, is even, uppercase ASCII letter "A" for example, then the parity bit is turned on to make the sum odd. Conversely, if this sum is already odd, uppercase ASCII letter "J" for example, then the parity bit is left in the off condition to retain an odd sum. Thus the sum of all "1" bits in a word is always odd for odd parity. The sender must generate this parity bit through the use of either hardware (74180 module), or by programming, if a microprocessor is used. The other important hardware specification is that the lsb (*l*east *s*ignificant *b*it) will immediately follow the sync bit on each line. If there are only 7 bits, as in ASCII, then the lsb will follow the sync bit and there will be 1 bit position open (usually forced to zero) just before the parity bit. This line format is shown in Fig. 8.

These changes will, of course, require some method of frame format

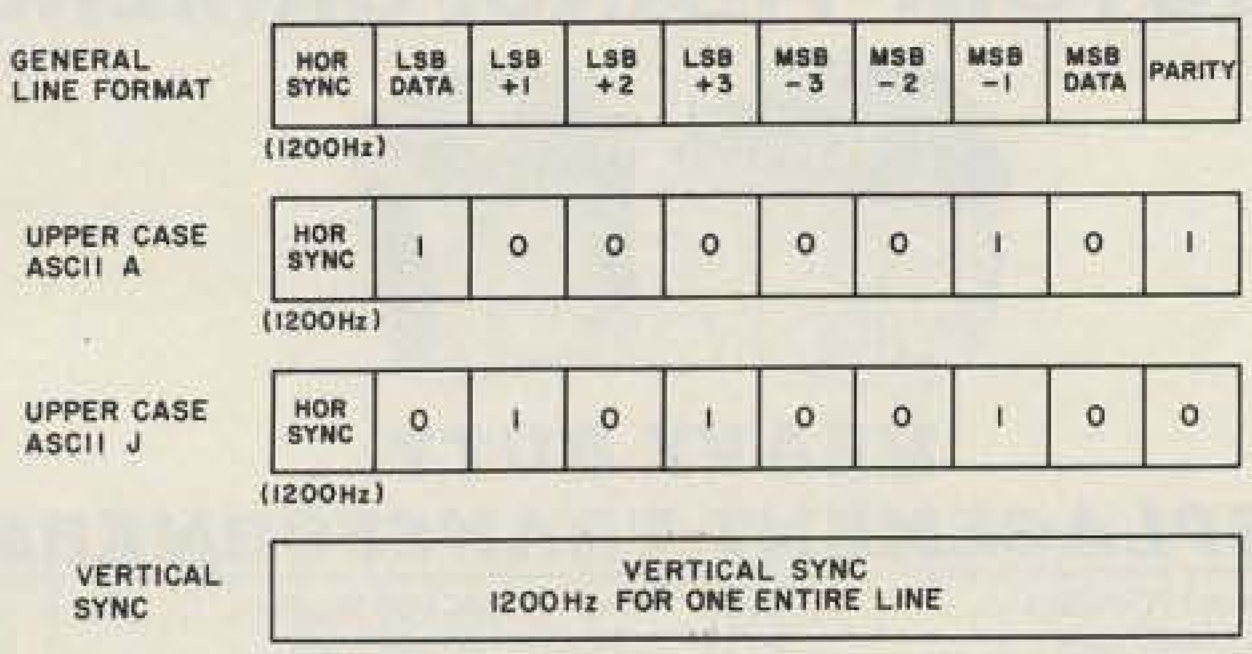

Fig. 8. Quad-S line formats.

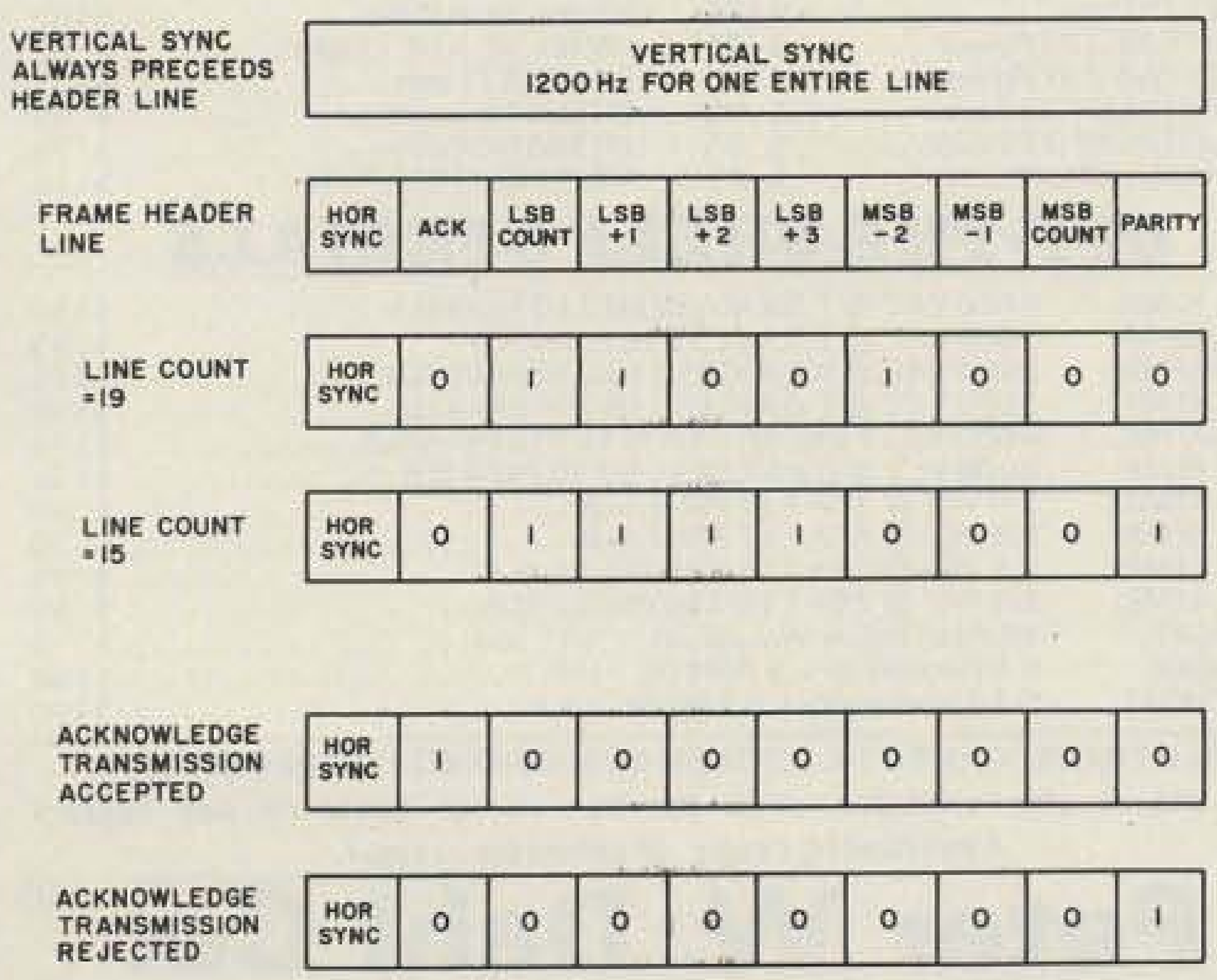

Fig. 9. Quad-S header formats for both transmission and acknowledgement.

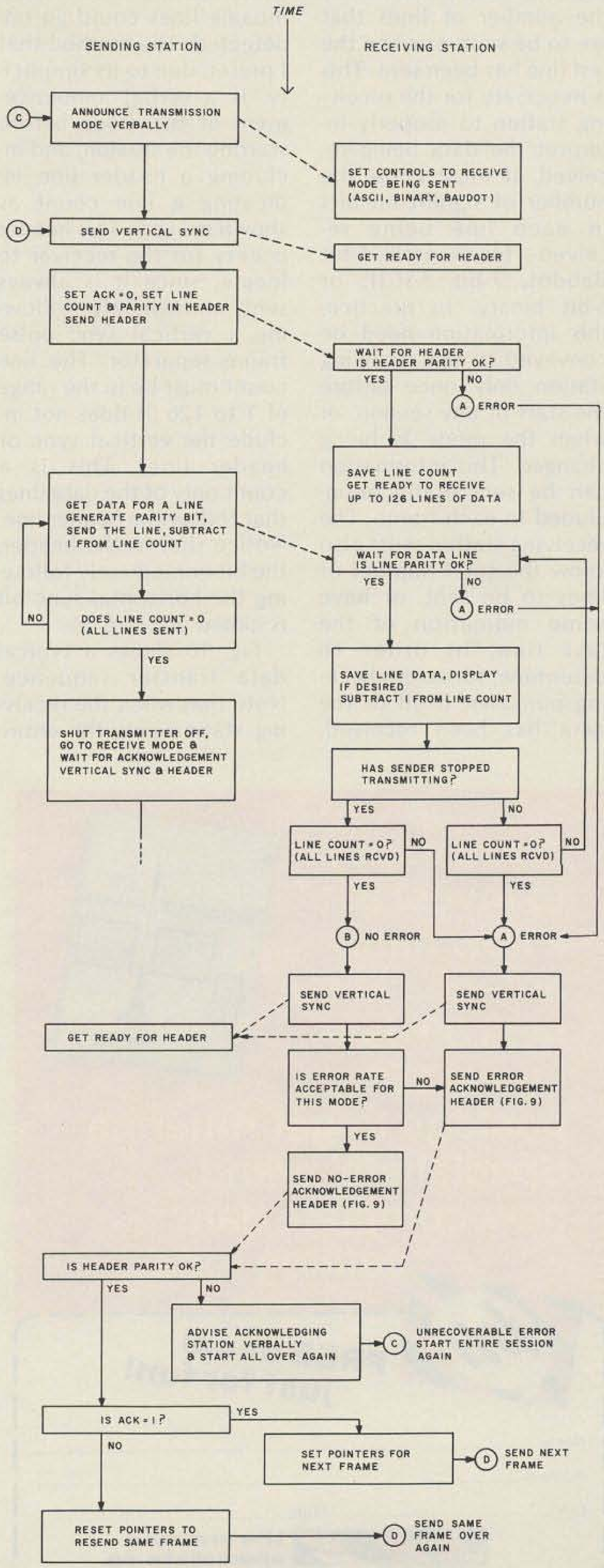

Fig. 10. Suggested Quad-S handshaking sequence for header, data, and acknowledgement.

designation to convey to the receiving station what length code we are sending, and some indication of the number of lines that are to be sent, or when the last line has been sent. This is necessary for the receiving station to properly interpret the data being received. It must know the number of significant bits in each line being received—for example, 5-bit Baudot, 7-bit ASCII, or 8-bit binary. In practice, this information need be conveyed to the receiving station only once before the start of any session, or when the mode is being changed. This information can be sent orally or included in each frame. The receiving station must also know the total number of lines to be sent, or have some indication of the last line, in order to determine, for error-checking purposes, if all of the data has been received. The "end" designator method, unfortunately, does not indicate a line count to the receiver, so missing lines could go undetected. The method that I prefer, due to its simplicity, is a verbal announcement of the mode before starting the session, and including a header line indicating a line count as shown in Fig. 9. This header is easy for the receiver to locate, since it is always sent immediately following a vertical sync pulse frame separator. The line count must be in the range of 1 to 126 (it does not include the vertical sync or header line). This is a count only of the data lines that follow the header line. Notice that in the header, the bit immediately following the horizontal sync bit is called ack (Fig. 9).

Fig. 10 shows a typical data transfer sequence. Note that when the receiving station gets the entire transmission, determined by the header line count, it counts the number of errors (bad lines or missing lines), and if this number is less than the error rate suggested for the particular mode (0% for binary, and up to 20% for Baudot or ASCII), then the receiving station transmits back to the sending station a positive acknowledgement. This is done by sending a vertical sync pulse followed by a header with ack = 1 and line count = 0 (Fig. 9).

This probably should be repeated a few times in case of off-tune conditions. If the error rate is determined to exceed the suggested values, then the header sent back should have ack = 0. When this occurs, the sending (originating) station can retransmit the data. Fig. 10 shows a typical sequence.

I am presenting these "handshaking" conventions primarily because they are simple and easy to implement. I would hope that further improvements could be made as the Quad-S mode of communication becomes more widely used.

Conclusion

I have described what Quad-S is, and detailed how it works. Now, here is why I think that it's better than the regular start/stop code:

1. Quad-S has an unambiguous sync pulse to indicate the start of a character.
2. Quad-S provides crystal-controlled mark and space signals.
3. Quad-S signals can be visibly debugged using a standard SSTV monitor.

It is my hope that the material presented in this article will provide a foundation upon which to build more sophisticated and reliable communications systems. ■

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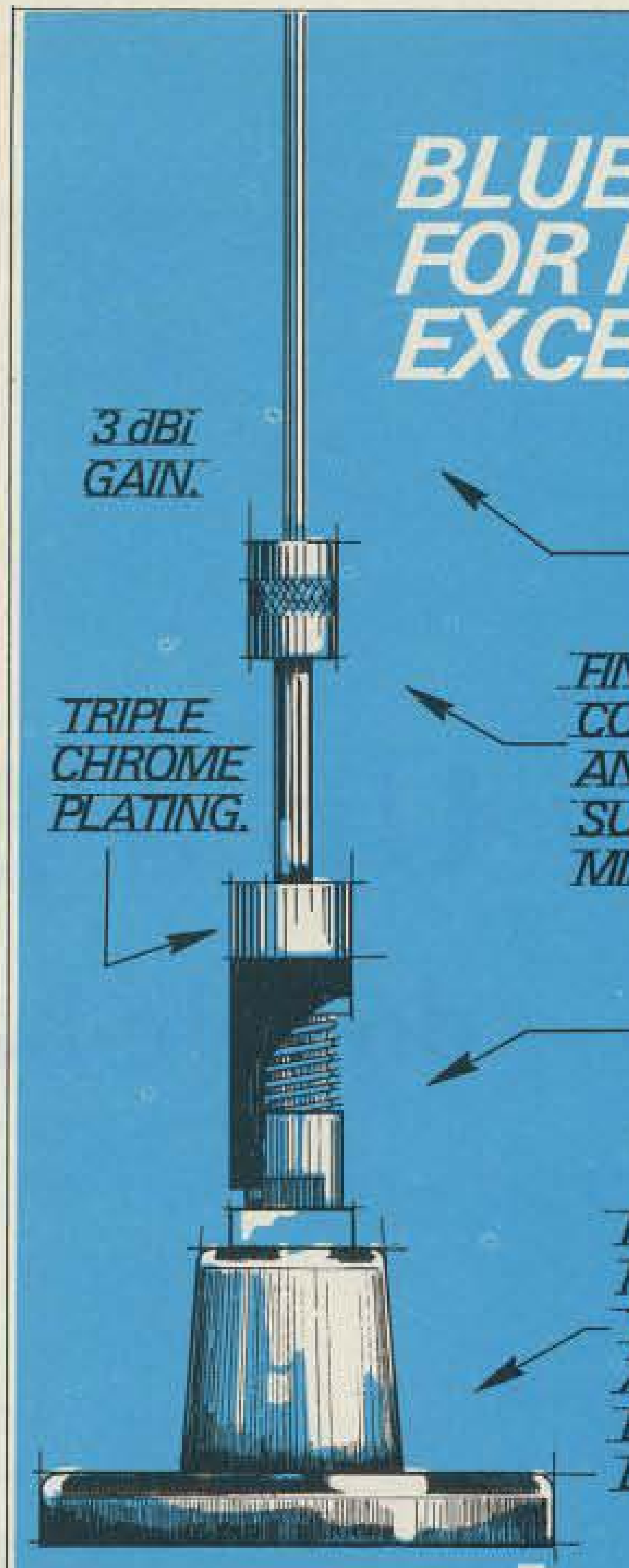

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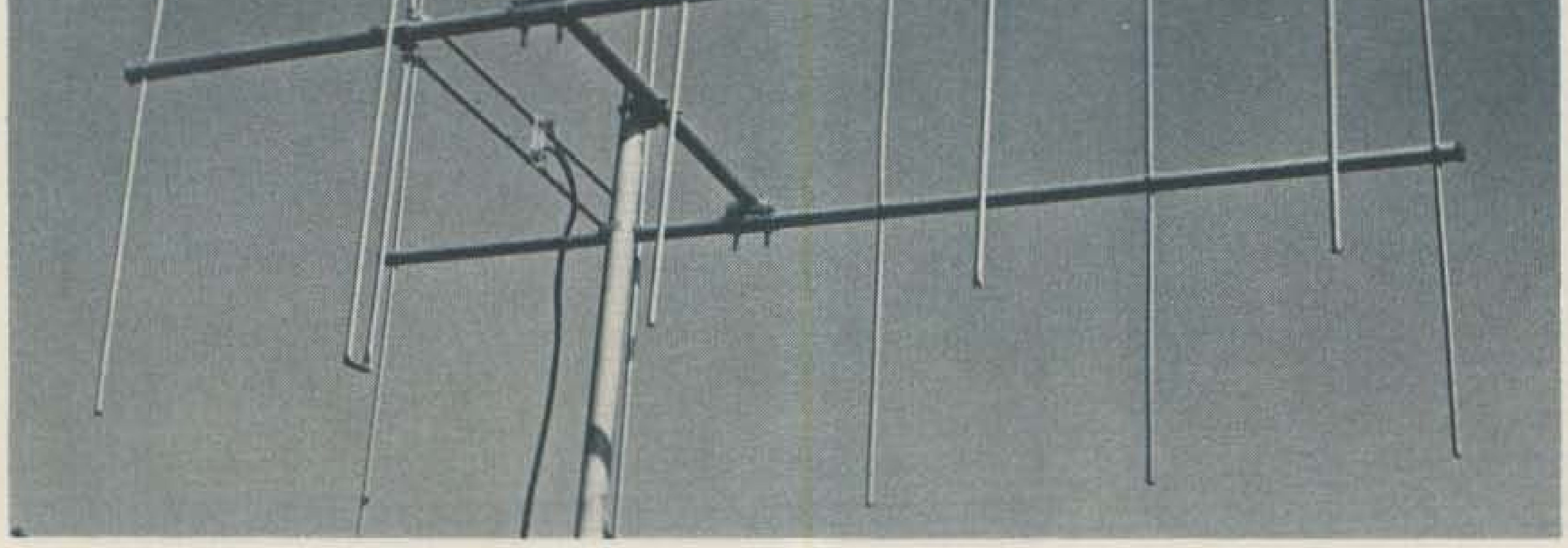
It was rugged enough to stand 3 inches of ice with no ill effects during last winter's ice storm. There are many of these in use in this area. I have two pairs of these up at 50 feet, the top pair vertical, and 40 inches below, another pair horizontal. With my IC-22 I have worked a great many DX stations on 2 meters in the last five years. In this area, there are many repeaters and many on the same frequency, so it is important to be able to work the one you want and not bother the others.

Photo by Elmer Hamilton



I recently made checks with the antenna you see in the picture, taken in Sarina, Ontario, 35 miles away at the VE3SM QTH. It is up 38 feet, and the front lobe read 20 over 9; the ends of the elements on me were S1 while the back was S4, so that would make the gain about 30 dB. Stan is using an IC-22S with 10 Watts out.

Ordinary hand tools are all you need to make it up. Use plated bolts and nuts, and aluminum for the brackets. The U-bolts are from Radio Shack, and the booms and elements are from old TV antennas. The cross boom is ¾-inch aluminum conduit. The insulators are ¼-inch clear plastic. I use Belden feedline UHF no. 9085. It has low loss even when wet, and I put the balun at the transceiver. It is quite broadband with the center at 146.52 and works either lower or higher with very little difference in swr.

I have a similar pair of 4-element beams that I take camping with me, with four sections of masting that go together with thumbscrews. It all goes in the trunk of my car. They, too, give me excellent coverage on the 2 meter band. So spend a few hours and get one together; you'll like it. ■

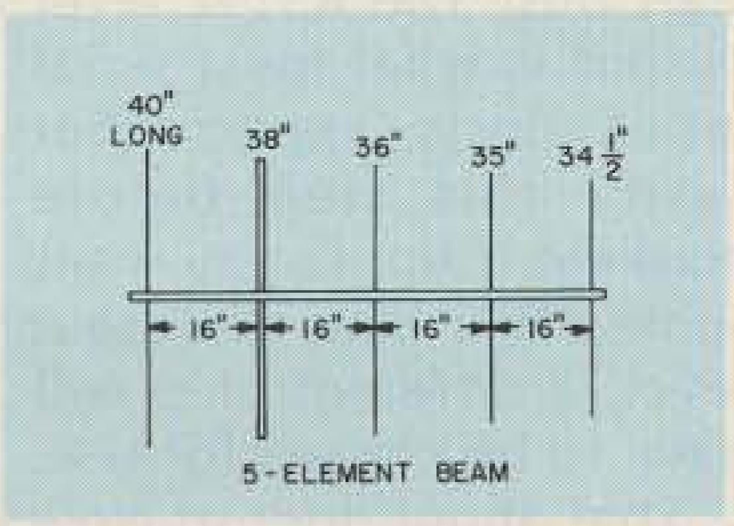


Fig. 1. The 5-element beam (2 required) with about 13 dB gain.

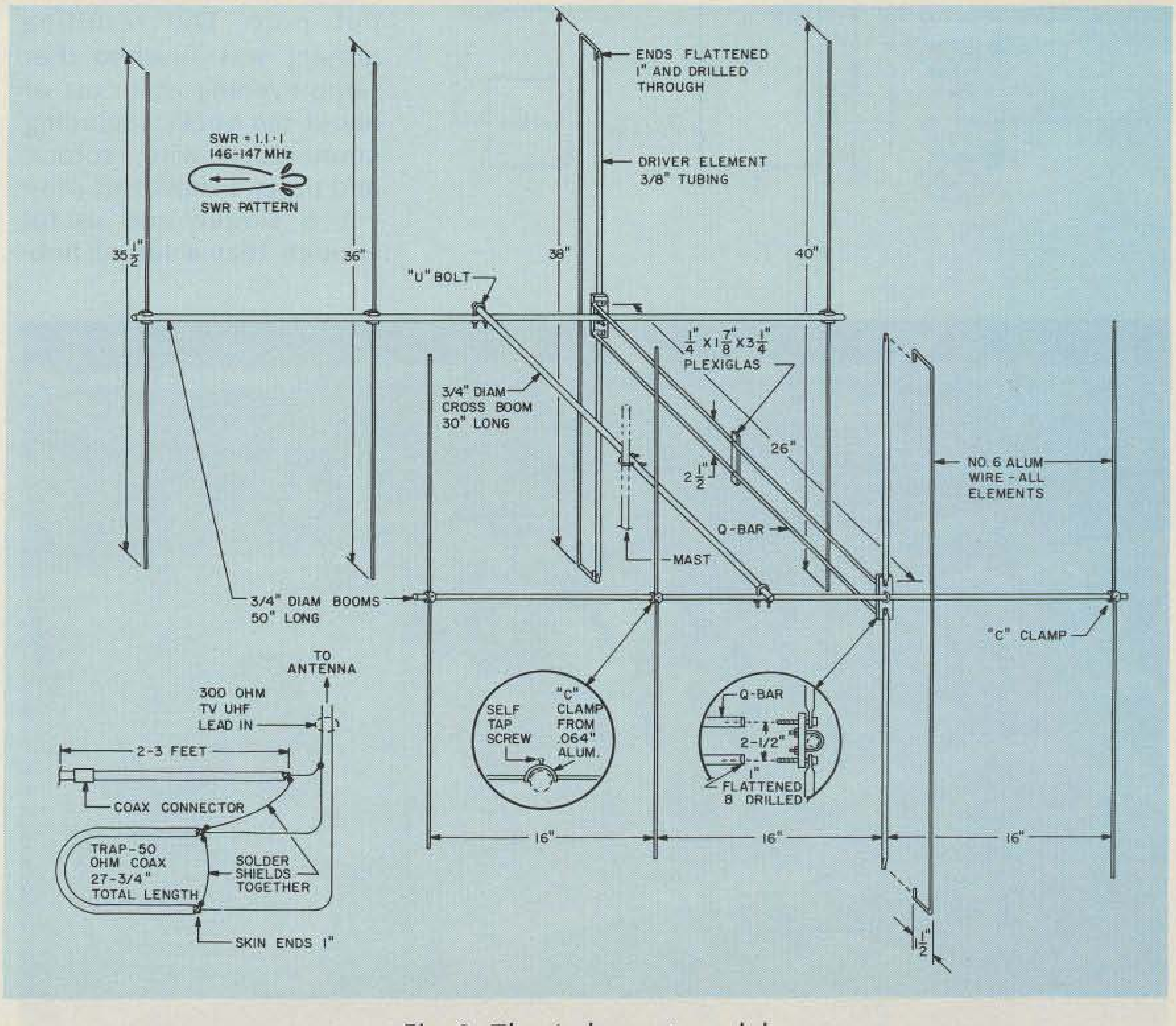


Fig. 2. The 4-element model.

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Keyboard Serialization

—when parallel isn't enough

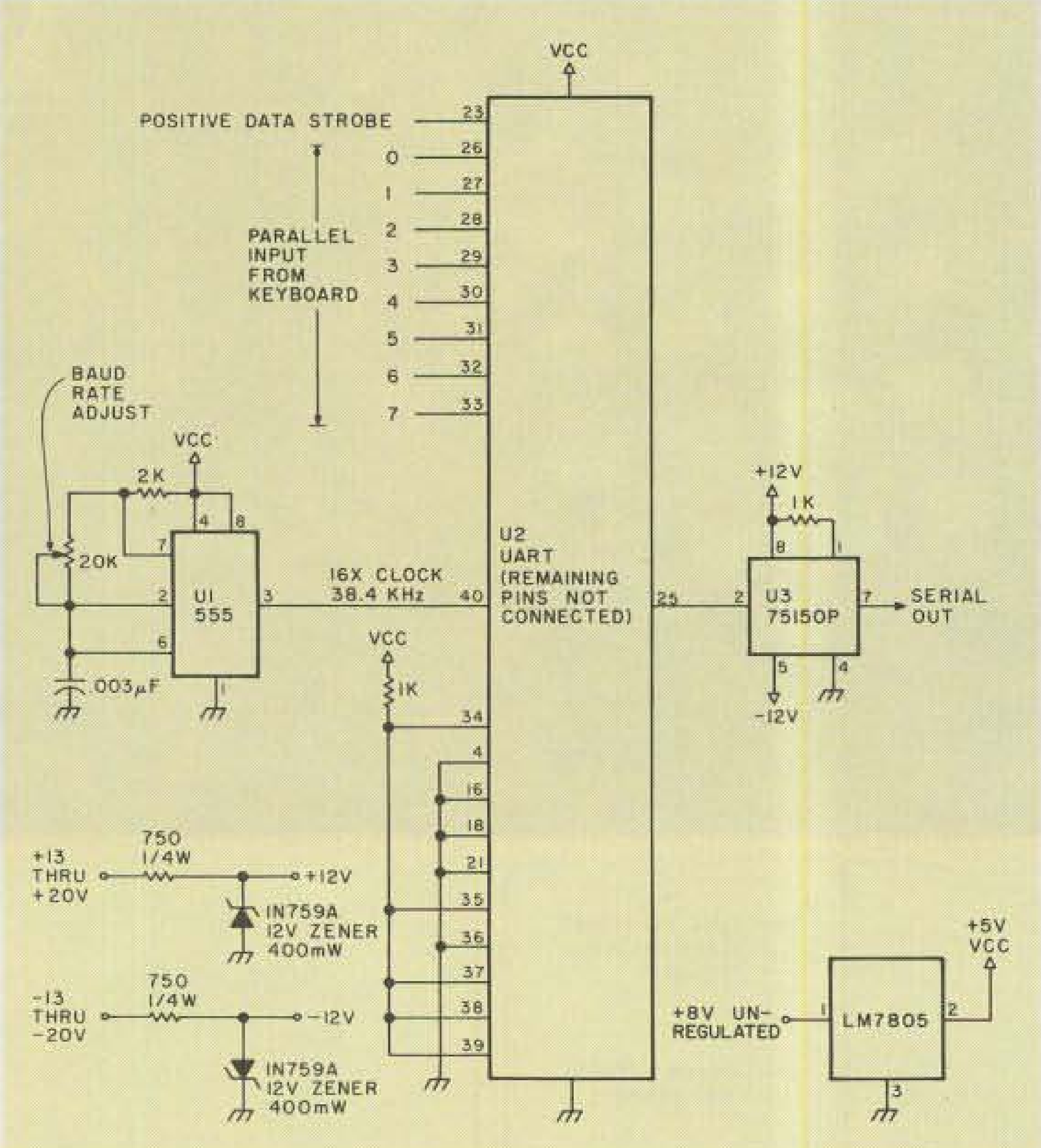
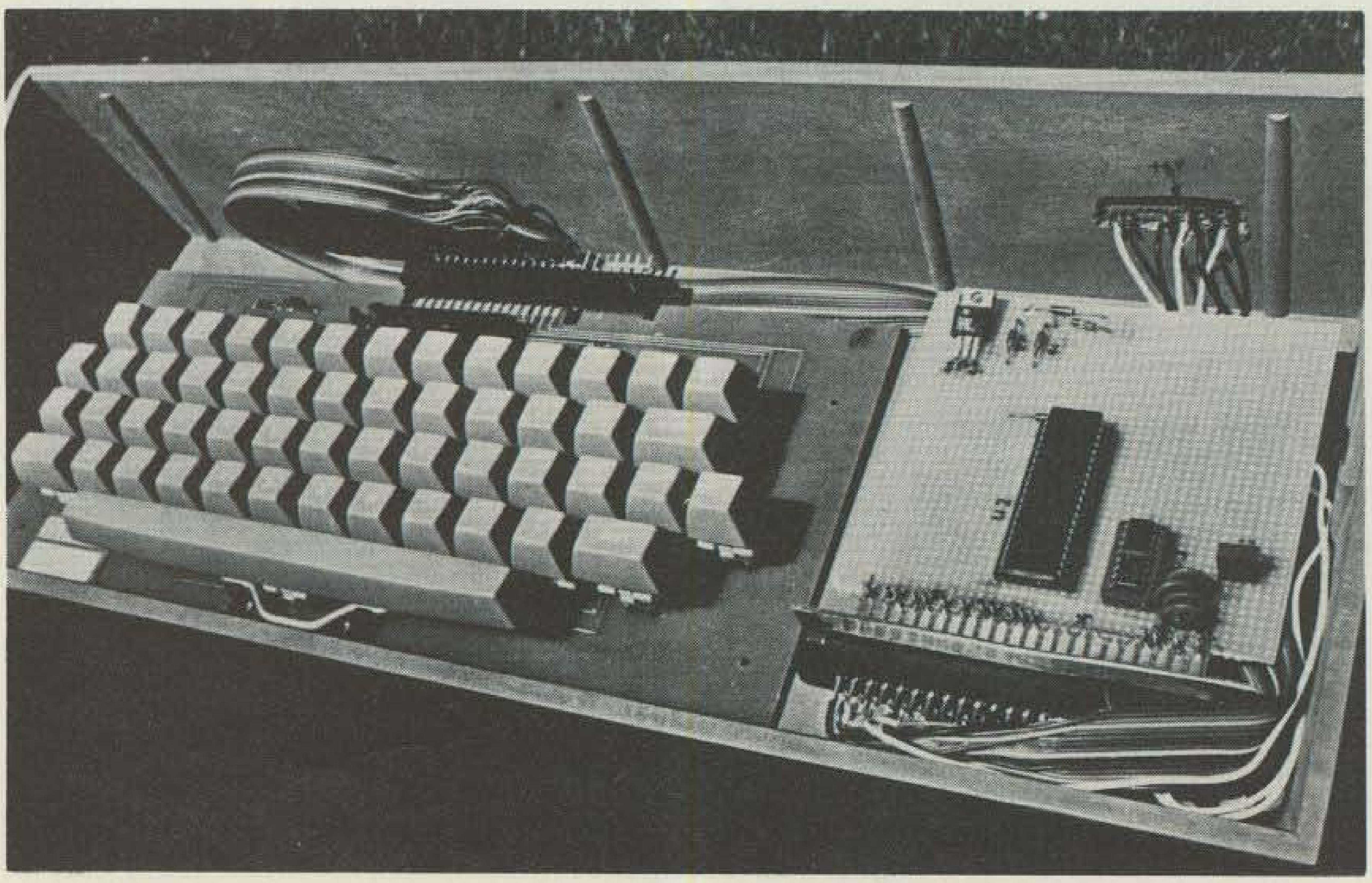


Fig. 1.

Here's a project that you can throw together with three chips and that you will find useful if you have more serial input ports than parallel ones. It will also solve a few software hassles for you if you've been feeding your VDM or TV typewriter with parallel bytes because programmers always seem to expect you to do it serially.

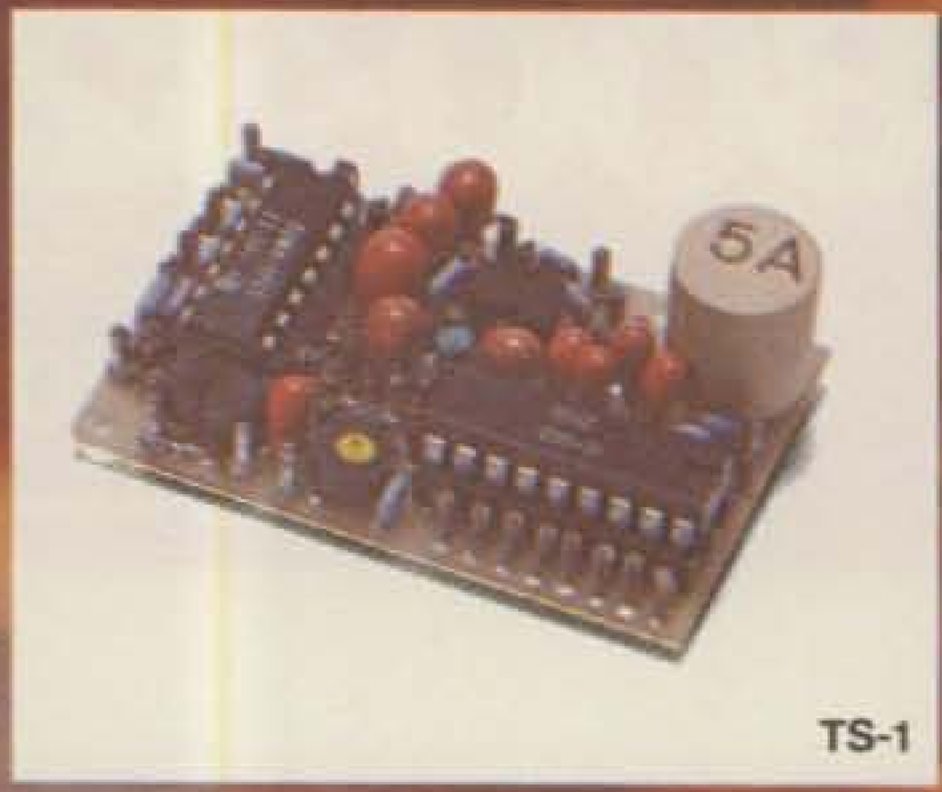
When I found myself with those two minor problems, I decided to build a simple parallel-to-serial converter to take advantage of an unused serial input port. The resulting project was finished that same evening at a cost of about ten bucks, including connectors, wire, solder, and parts. I think this project is simple and useful enough that a lot of hobbyists may want to use it to break into hardware. I think you'll find it painless.

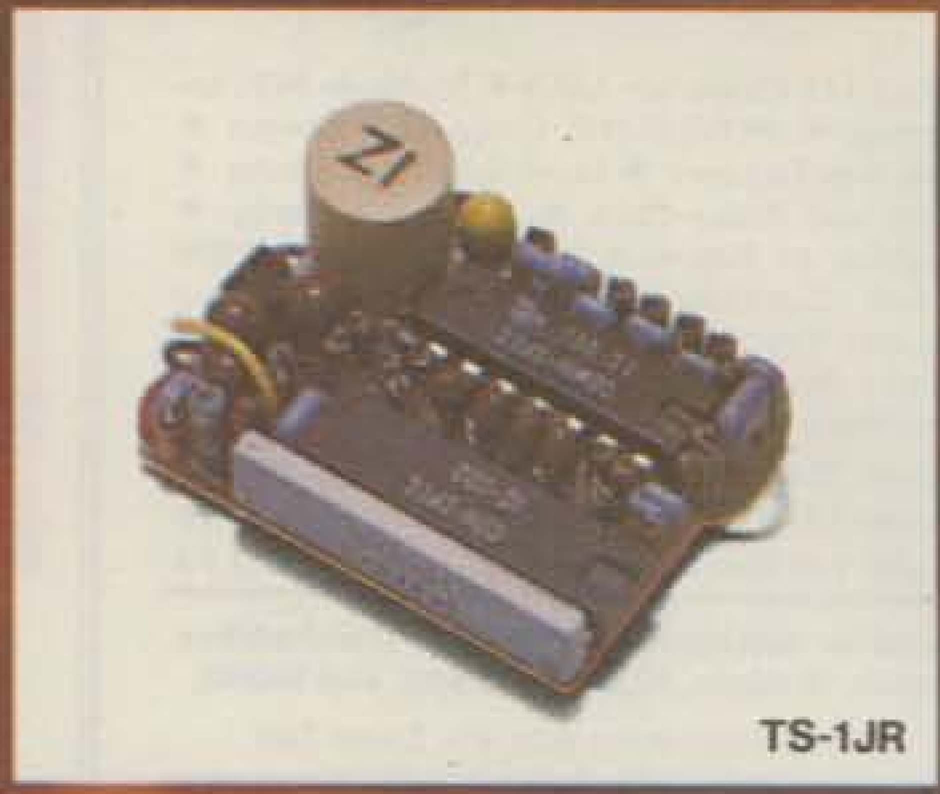
Take a look at the schematic in Fig. 1. As you see it, this is a minimum implementation which could be complicated quite a bit. For the purposes of this article, I decided to eliminate everything but the bare necessities and leave the fun of designing frills like repeat keys, flashing lights, and spelling corrections up to you. The values on components are pretty flexible, but, as shown, will work at 2400 baud quite nicely. For a detailed understanding of the circuit, it's probably better for you to look up the individual chips in a manufacturer's catalog than for me to take up space for the simple theory here.

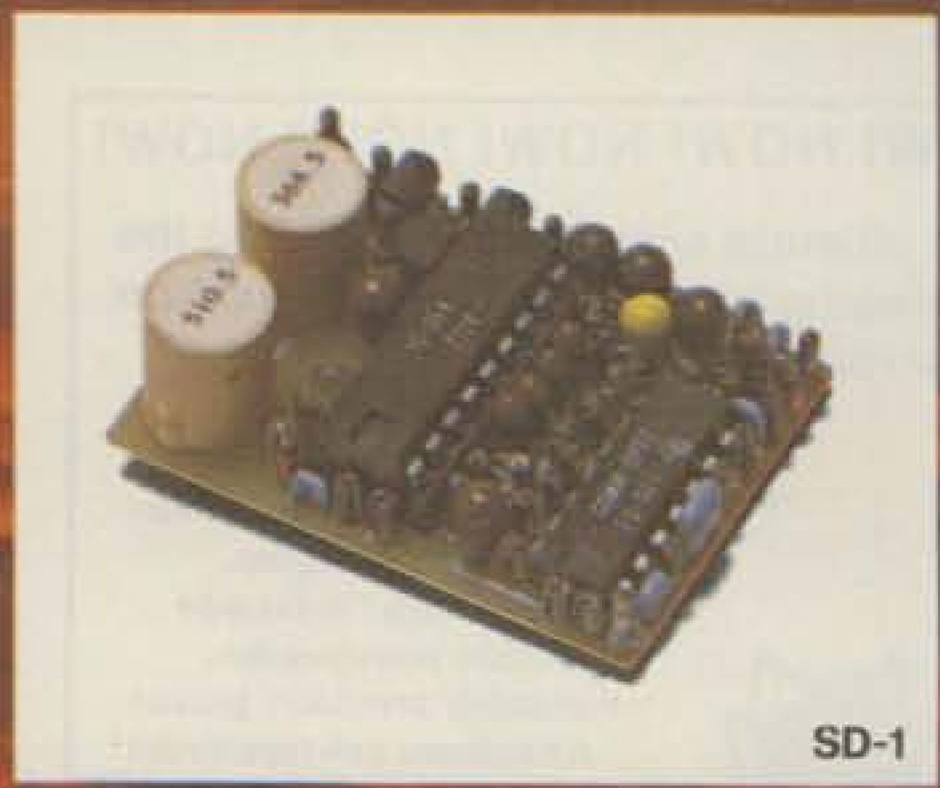


When you get the circuit built, you will have to hook it up to a power supply providing +18 to +20 and −18 to −20 volts, and adjust the pot for the desired baud rate. If you don't have a scope, you can do it by the trial and error method, but don't be too disappointed if you don't finish the same day you start out! The RS232 level output is what most serial input ports expect, but verify this step before hooking it up. If you want some other kind of output level, a different chip will have to be chosen for U3.

That about does it! Now . . . let's see what we can do with that spare parallel input port . . . ■







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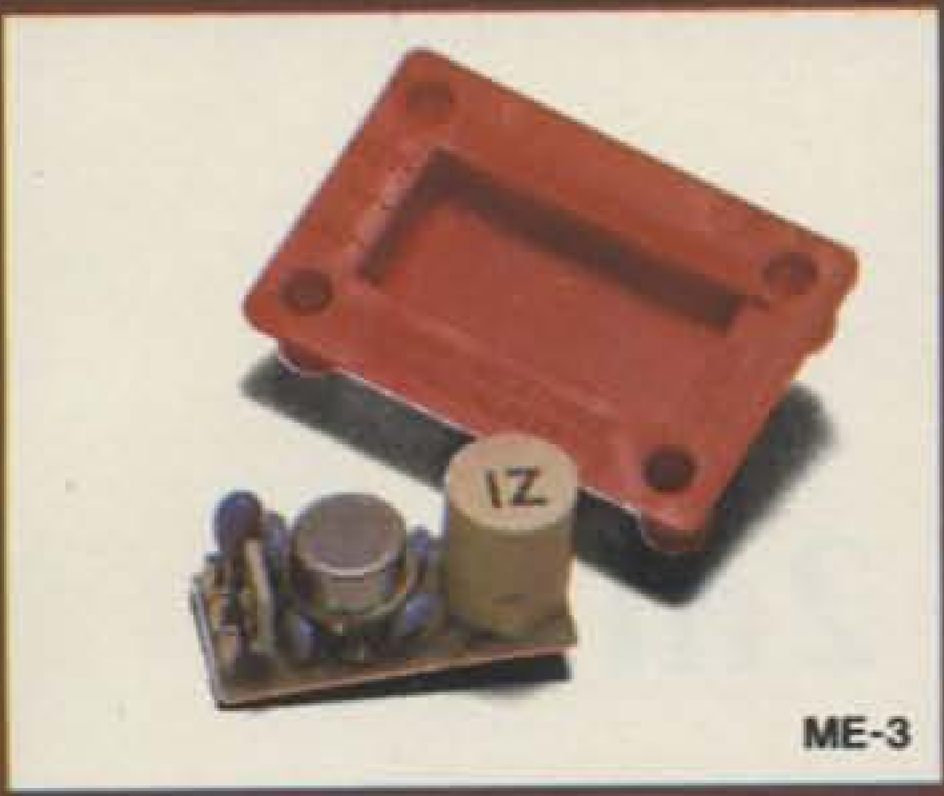
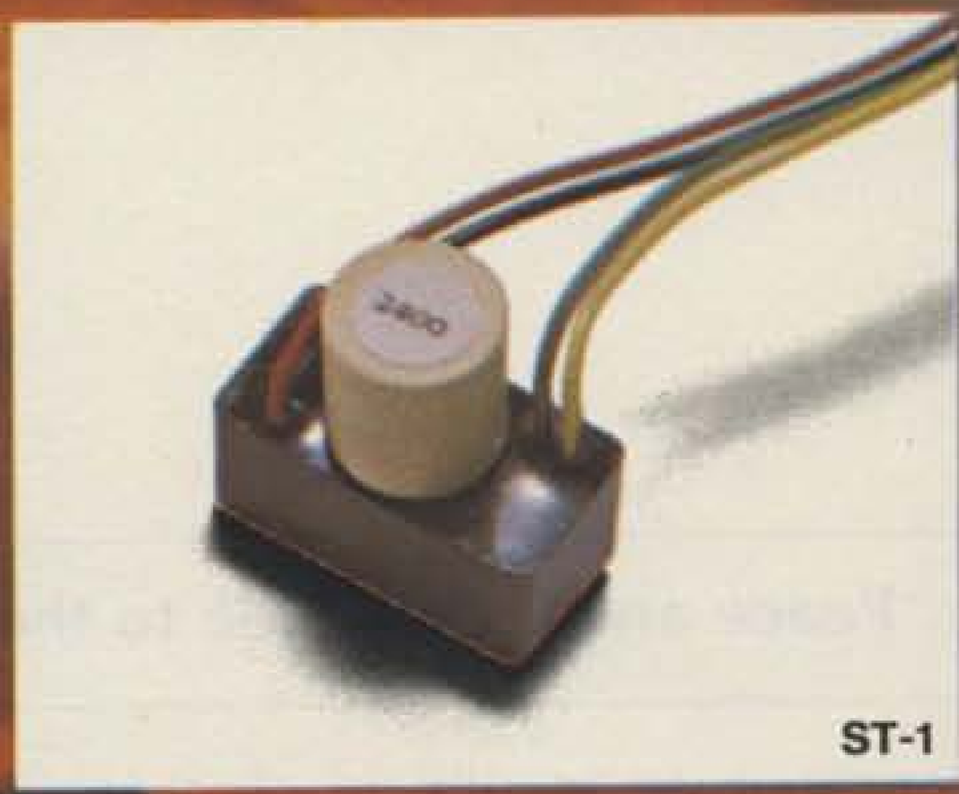

ME-3


TE-8


TE-12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Recent frustrations with radio noise prompted me to write this article. After purchasing my 1976 280Z, I set about installing a 2 meter FM transceiver. Upon completion, it was observed that a great deal of noise was picked up when the engine was running (except when receiving the strongest of local stations). The intensity and frequency of these noise pulses are directly proportional to engine speed. Since resistance-type spark plug wire has been used in the engine compartment, and reception on the Z's AM-FM radio is clean, you'd hardly expect such a problem, especially since FM reception has a natural noise rejection advantage over standard AM. Regardless, the noise persists!

I began by performing some basic cures. Using short lengths of ½-inch tinned copper braid, the engine was grounded to the body, the tailpipe to the body, and the hood to the body. No help! Next, the coil primary and alternator were treated with filter capacitors. Again, no help. Perhaps the noise could still be coming in through the dc supply line from the car's battery. The radio was then powered by a separate battery. This did not help. Evidently, the noise is radiated through the air from ignition to radio rather than conducted by the dc line. Now a small portable AM radio was used as a detector to sweep over suspected areas such as under the dash, front car exterior, rear car exterior, under the hood, etc. As suspected, the predominant noise source is under the hood. When the hood is closed, noise even leaks through the seams where the hood meets the fenders (and also through the grill and out under the engine).

At this point, I chanced upon an article by the spark plug engineers at GM (AC). It compared various techniques such as resistance plugs, resistance wire, inductance wire, complete ignition shielding, etc. I decided to use resistance plugs in addition to the resistance wire already in the 280Z. Installation of AC plugs (R43XLS) reduced noise somewhat. The combination of resistance plugs and wire does reduce spark slightly, and it is important to keep plugs clean and properly gapped and to check the ignition wire periodically. Otherwise, some missing may be experienced at high RPMs.

The final episode: A friend of mine told me about a certain brand of inductance wire stocked at a nearby store. Information from GM (AC) indicated that improvement would be slight. I bought a model 12-72 ignition wire kit made by C. E. Niehoff & Co. (4925 Lawrence Ave., Chicago, Illinois 60630). They don't make a set for the Z but the 12-72, a V-8 set, can be used. Since the coil wire is too short, a leftover long plug wire had to be substituted. I carefully removed the metal clips from the short wire, cut the long wire about 1½ inches longer than necessary, and, with a knife, ¾ of an inch of insulation was stripped from each end. The center conductor was folded back alongside the rubber insulation. The metal clips were crimped on, and the excess center conductor was removed.

With the R43XLS plugs and the inductive wire, noise has been virtually eliminated in the 2m FM rig (perhaps resistance plugs are no longer necessary). An HF rig, which is AM, may still pick up some noise with this modification, but there should still be a substantial improvement. Let me know how you make out. ■

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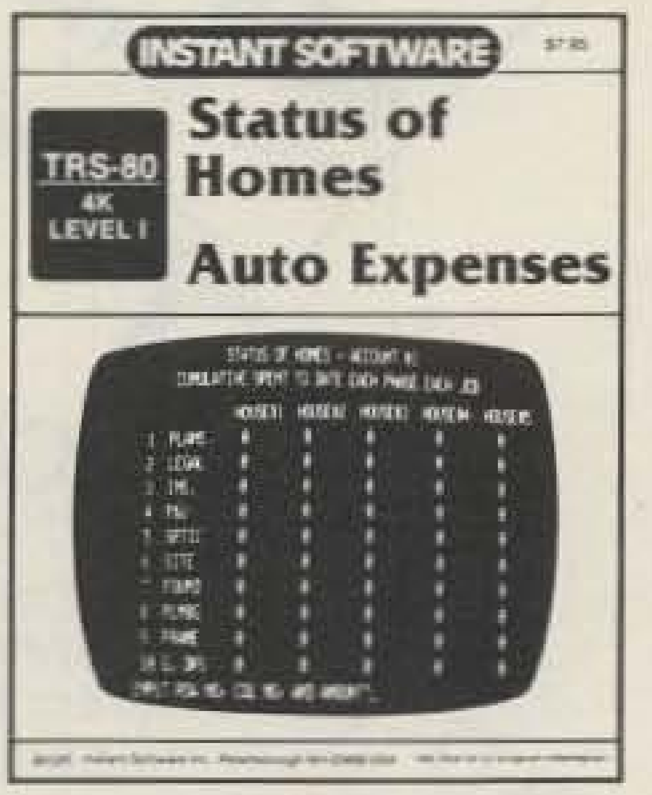

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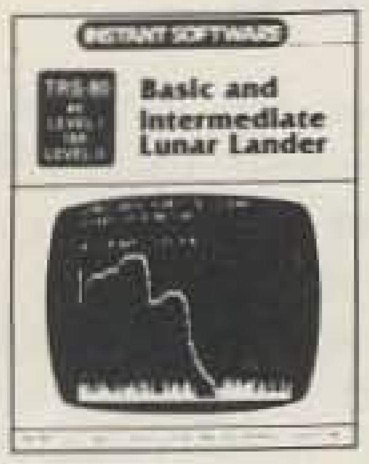

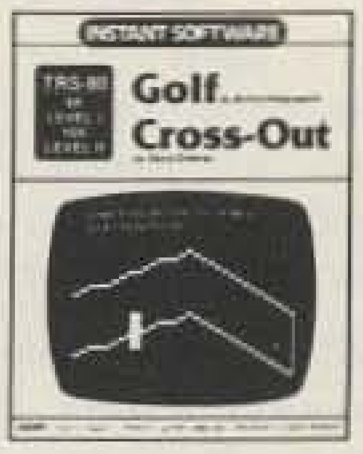

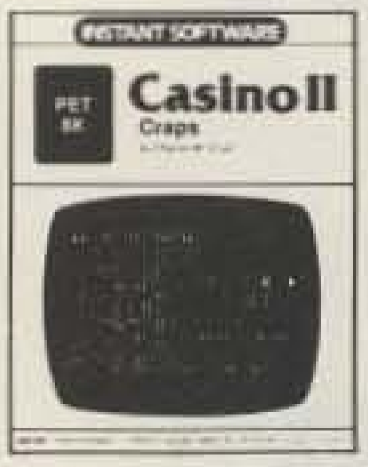

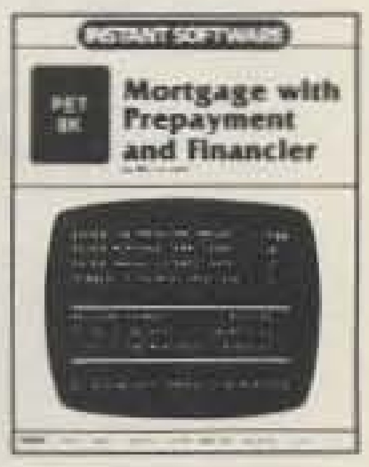

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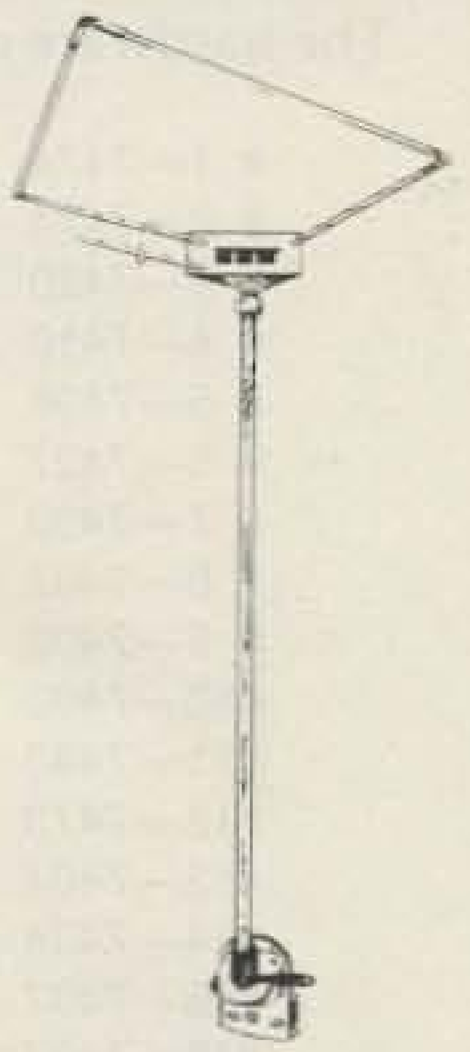

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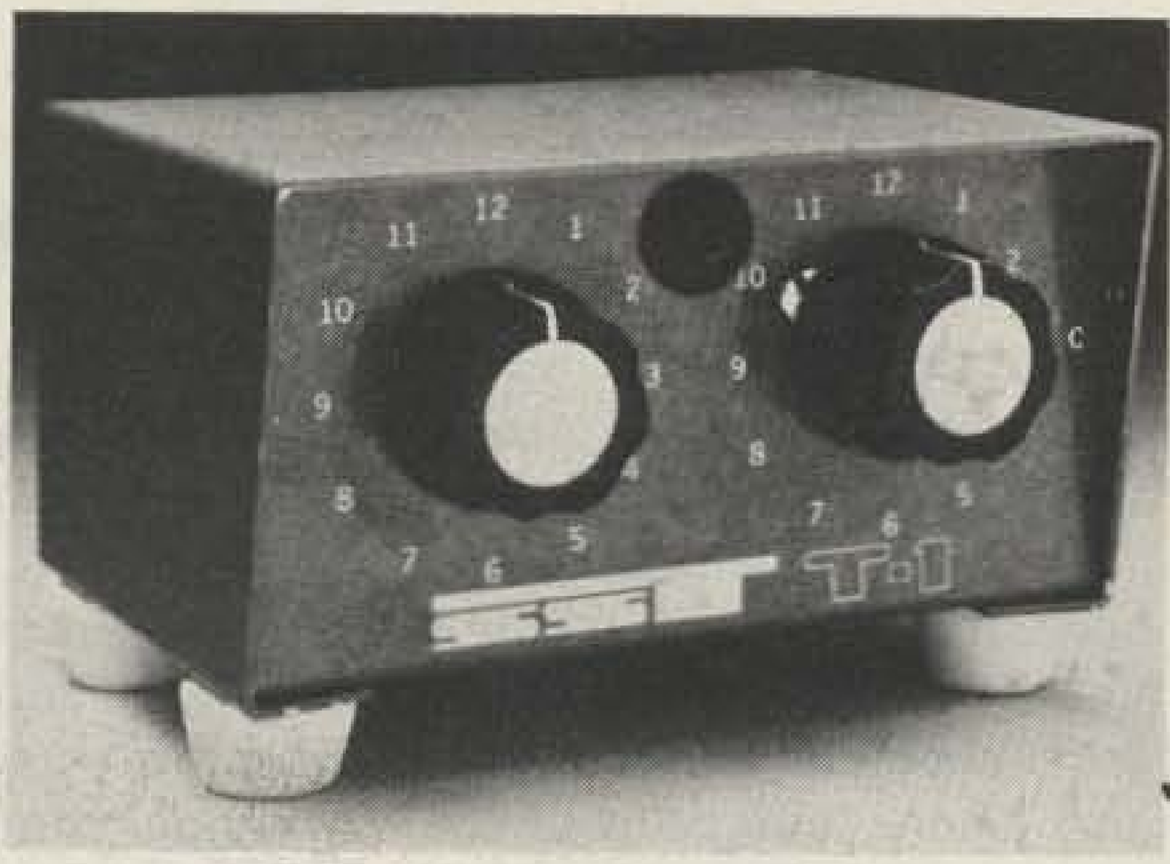

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An 8080 Repeater Control System

— part II: hardware

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Robert Glaser N3IC
3922 Algiers Road
Randallstown MD 21133

The control system is built on a 19-inch rack panel. The touchtone™ decoder and power supply are on the rear of the panel. The tape loop, amplifiers, touchtone pad, and main board are on the front of the panel. The main board is a Vector #169P84-062WE 8½- × 17-inch board. The circuitry is assembled using wire-wrap techniques. I recommend the Vector battery-operated Slit-N-Wrap tool. This permits daisy-chaining connections and is invaluable when wiring buses. Discrete components are mounted using Vector T49 pins. The parts are soldered on the top, and the connections are wire-wrapped on the bottom. The board layout is shown in Fig. 1. The circles in the center of the board are LEDs. The relays are on the right side, and LEDs in series with the relay coils are mounted adjacent to the relays. The oblong objects are printed-circuit-board-mount miniature potentiometers. The left half of the board consists of the microprocessor components. Since the board is built with wire-wrap, most sensible layout arrangements will work, but I present my layout to save you from the head-scratching I did in deciding upon an arrangement.

Every connection to the main board is through standard DIP plugs. This permits wire-wrapping to the connectors on the board. Each of the connectors is 16-pin (except the power connector, which is 14-pin). Fig. 3 gives the pinouts. The dummy sockets permit the repeaters to be placed on the air for testing with no control system.

Bypass capacitors (.1 uF) are placed liberally on the power supply lines. At the power supply connector, 100-uF capacitors are placed on each voltage.

Circuit Description

The hardware consists of

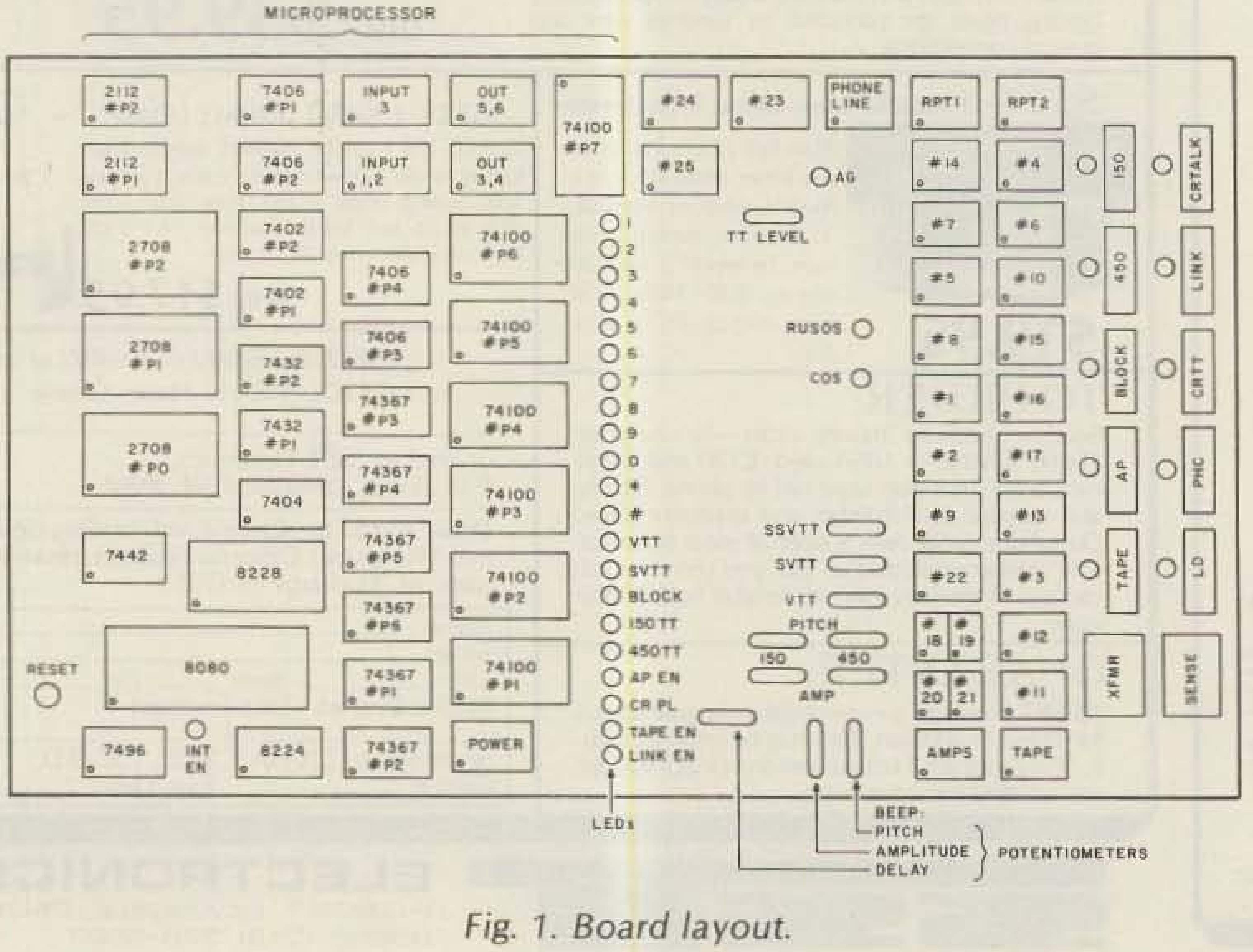
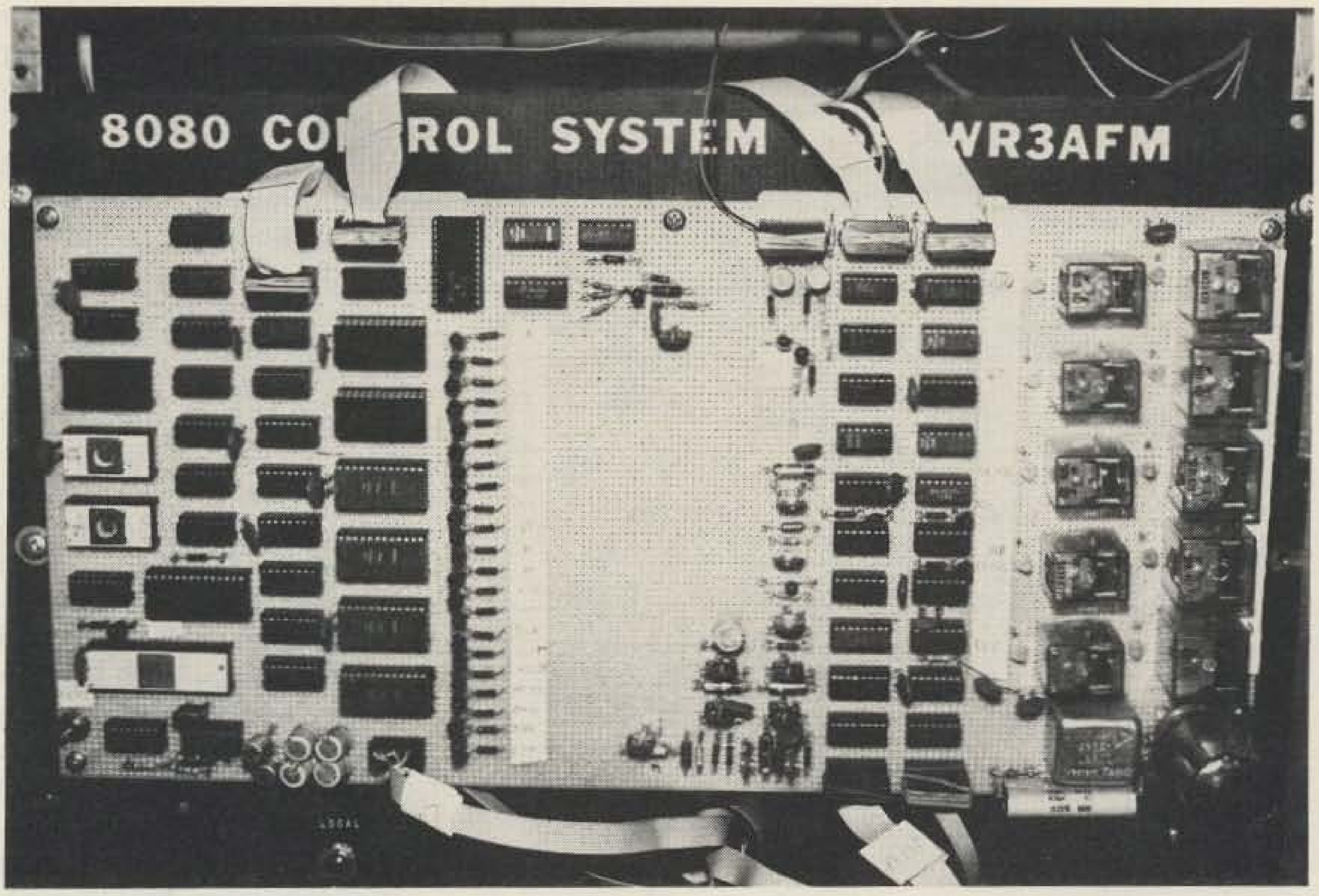


Fig. 1. Board layout.

1—7474
2—7474
3—7420
4—7410
5—7408
6—7427
7—7432
8—7402
9—7400
#10—7400
#11—7493
#12—7473
#13—7404
#14—7404
#15—7407
#16—7407
#17—7406
#18—555
#19—555
#20—555
#21—555
#22—CD4050
#23—7405
#24—7473
#25—MC14410

Fig. 2. IC list.



Close-up of processor board. The empty socket on the left is for a third ROM.

two sections: the processor and related circuitry, and circuitry external to the processor which accomplishes audio and control path switching as well as interfacing to the repeater.

To understand how the system operates, examine the path flow diagram in Fig. 4. All of the switches shown are relays in their relaxed position. There are two types of signals: audio pairs, which are shown as one line only, and dc control lines. Relays are used for switching the audio lines and some control lines. Solid-state replacements could be made, but there is nothing easier to interface than switched contacts. Using relays also prevents many problems due to possible idiosyncrasies of audio balancing, impedances, and levels of different repeaters. (I admit that it does hurt to use the ancient relay.) The feed from each transmitter control shelf passes through the repeater enable relay to the PTT line. The feeds are grounded during IDs. The 150 and 450 relays, when activated, positively isolate the PTT lines and prevent the transmitters from keying. If the LINK relay is closed, the two transmitter feeds are shorted, ensuring that both transmitters are activated simultaneously. The audio pairs are shorted together as well, placing the same audio on both transmitters. When the BLOCK relay is energized, the 150 transmit audio is shorted out. This relay is activated to prevent repeating touchtones.

In normal operation, the CRTALK relay is relaxed. In this condition, the audio and COS lines from the voter are passed to the 150 control shelf. The COS lead goes out to the control circuitry and returns to the control shelf. When the CRTALK relay is activated, the voter is removed from the system and is replaced with the control receiver. When the CRTALK relay follows the control receiver COS, the end result is that the control receiver is given priority over the two meter inputs to the repeater. When voltage is placed on the audio gate line to the control shelf, any audio present on the duplex audio input goes to

Input 1,2 (touchtone decoder):
1—digit 1
2—digit 2
3—digit 3
4—digit 4
5—digit 5
6—digit 6
7—digit 7
8—digit 8
9—digit 9
10—digit 0
11—digit *
12—digit #
13—VTT (valid touchtone)
14—Ground

Power Supply:
1—Ground
3—Ground
5— +5
7— −5
9— +12
11— −12
13— +18
15— −18

Phone Line:
1—Tip
3—Ring

Tape:
1—Start
3—Start
5—Run
7—Run
9—Audio low
11—Audio high

Amplifiers:
1—LDI in
2—LDI in
3—LDI out
4—LDI out
5—LDO in
6—LDO in
7—LDO out
8—LDO out
9—TT in
10—TT in
16—Ground

Out 5,6 (voter):
1—Disable Rx #1
2—Disable Rx #2
3—Disable Rx #3
4—Disable Rx #4
5—Disable Rx #5
6—Disable Rx #6
7—Disable Rx #7
8—Disable Rx #8
9—Select Rx #1
10—Select Rx #2
11—Select Rx #3
12—Select Rx #4
13—Select Rx #5
14—Select Rx #6
15—Select Rx #7
16—Select Rx #8

RPT1 (dc lines):
1—150 feed
2—440 feed
3—150 PTT
4—440 PTT
5—Voter $\overline{COS}$
6—Control rx $\overline{COS}$
7—Control shelf $\overline{COS}$
8—RUSOS
9—AG (audio gate)
10—Control Rx PL enable
11—Link (from 440 rpt)
12—Disable timer
13—Force timer
16—Ground

RPT2 (audio):
1—Voter aud
2—Voter aud
3—Control rx aud
4—Control rx aud
5—Control shelf aud
6—Control shelf aud
7—Duplex aud
8—Duplex aud
9—150 ID aud
10—440 ID aud
11—440 transmit aud
12—440 transmit aud
13—150 transmit aud
14—150 transmit aud
16—Ground

Dummy Socket for RPT1:
1—3
2—4
5—7

Dummy Socket for RPT2:
1—5
2—6

Fig. 3. Connector pinouts.

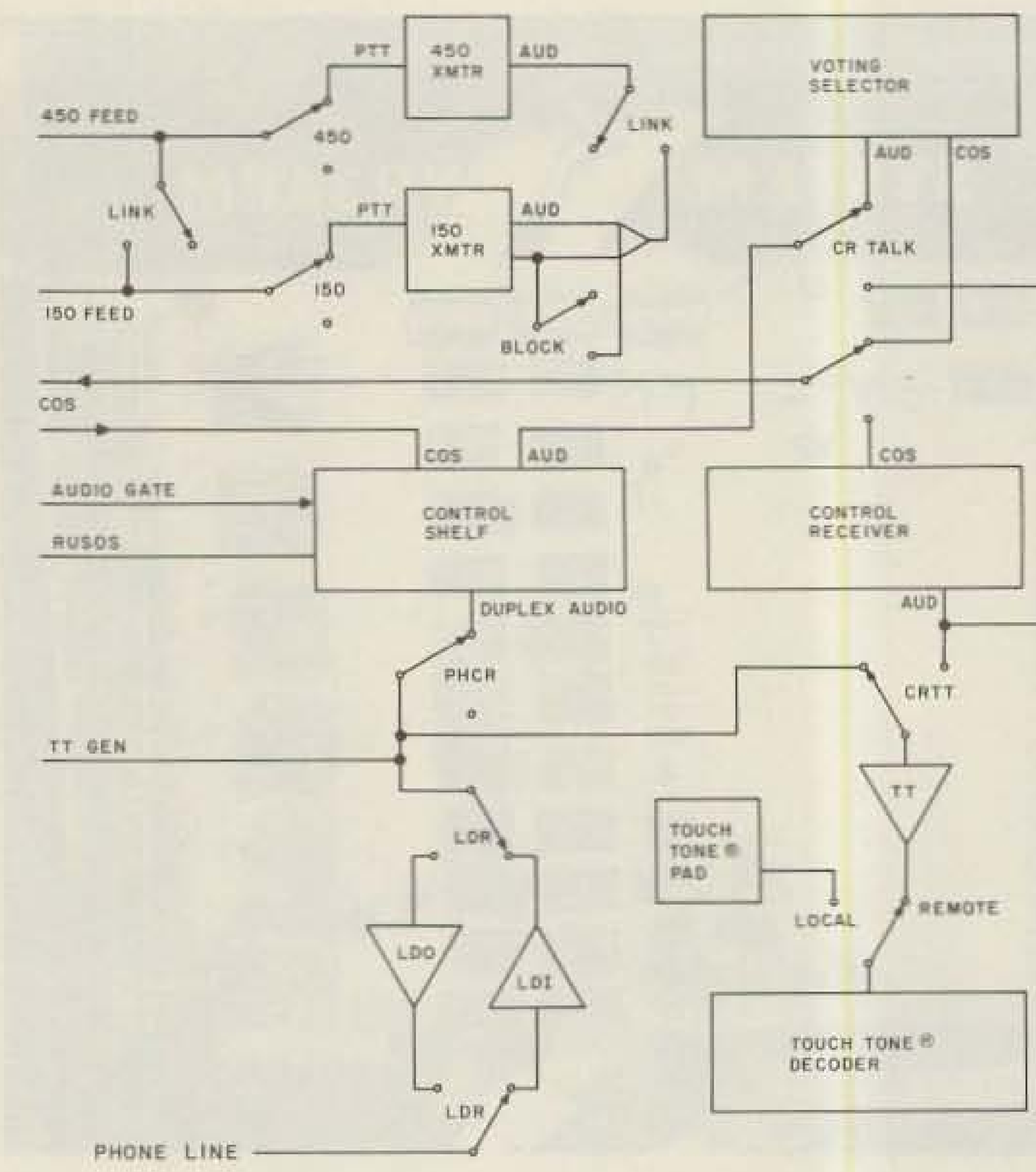


Fig. 4. System flow diagram.

the transmitter. When the RUSOS lead is grounded, the transmitter remains on the air.

Next, consider the path to the telephone line. LDR (line direction relay) determines whether audio is being fed into the line or taken from it. Normally, LDR follows the COS signal. When no received signals are present, LDR is off and audio from the telephone line goes into the system. During autopatches, this places the party on the telephone on the air. When the COS goes low, LDR activates and the audio coming from the duplex audio output goes into the phone line. During autopatches, this permits the party on the telephone to hear the transmitting station. The audio fed into the control shelf on the AUD lines comes out on the duplex audio pair when the audio gate is not enabled.

With the local/remote switch in the local position, the touchtone decoder is driven solely by the on-site pad. When placed in the remote position, the touchtone amplifier drives the decoder. If CRTT (control receiver touchtone) is relaxed, the decoder is fed from the duplex audio pair or the telephone line. The path for two meter users is through the duplex audio pair, and for control operators on the telephone line it comes from that source. If PHCR (phone control relay) is activated, the two meter input is isolated from the decoder. If CRTT is on, the control receiver has absolute command over the decoder. From this arrangement, it can be seen that the hierarchy of control access is the control receiver at the highest priority, the telephone next, and the two meter input last. By controlling the logic driving the relays, any of these modes of access to the decoder may be precluded. The touchtone generator injects audio at a point where it can drive both the telephone line and the repeater. The latter permits hearing the processor dialing users' numbers. It consequently also drives the decoder, which is not of any particular importance except that it allows the locally generated tones to be blocked from repeating. It may seem that placing tones on the repeater while at the same time blocking them is a silly procedure. However, the end result is that you hear short blips of tones, pleasing to the ear.

Due to the arrangement of the switching paths, level adjustments must be made in the following order:

1) The audio from the control receiver and the voter must be equalized. Place a meter at the output of the decoder amplifier. Adjust the audio output of the control receiver so that equal tone deviation on the two meter input and the control input results.

2) Adjust the gain of the touchtone amplifier for the required input for your decoder. For the decoder specified, this is about two volts rms.

3) Adjust the gain of the LDI (LD input) amplifier so that tones arriving from the telephone line are of equal amplitude with the other two inputs at the decoder.

4) Adjust the LINE IN control on the control shelf so that proper deviation results when talking through the repeater from the phone line.

5) Adjust the gain of the LDO (LD output) amplifier to the required level of your telephone line interface when talking on two meters.

6) Adjust the output level of the touchtone generator for the required level at the telephone line.

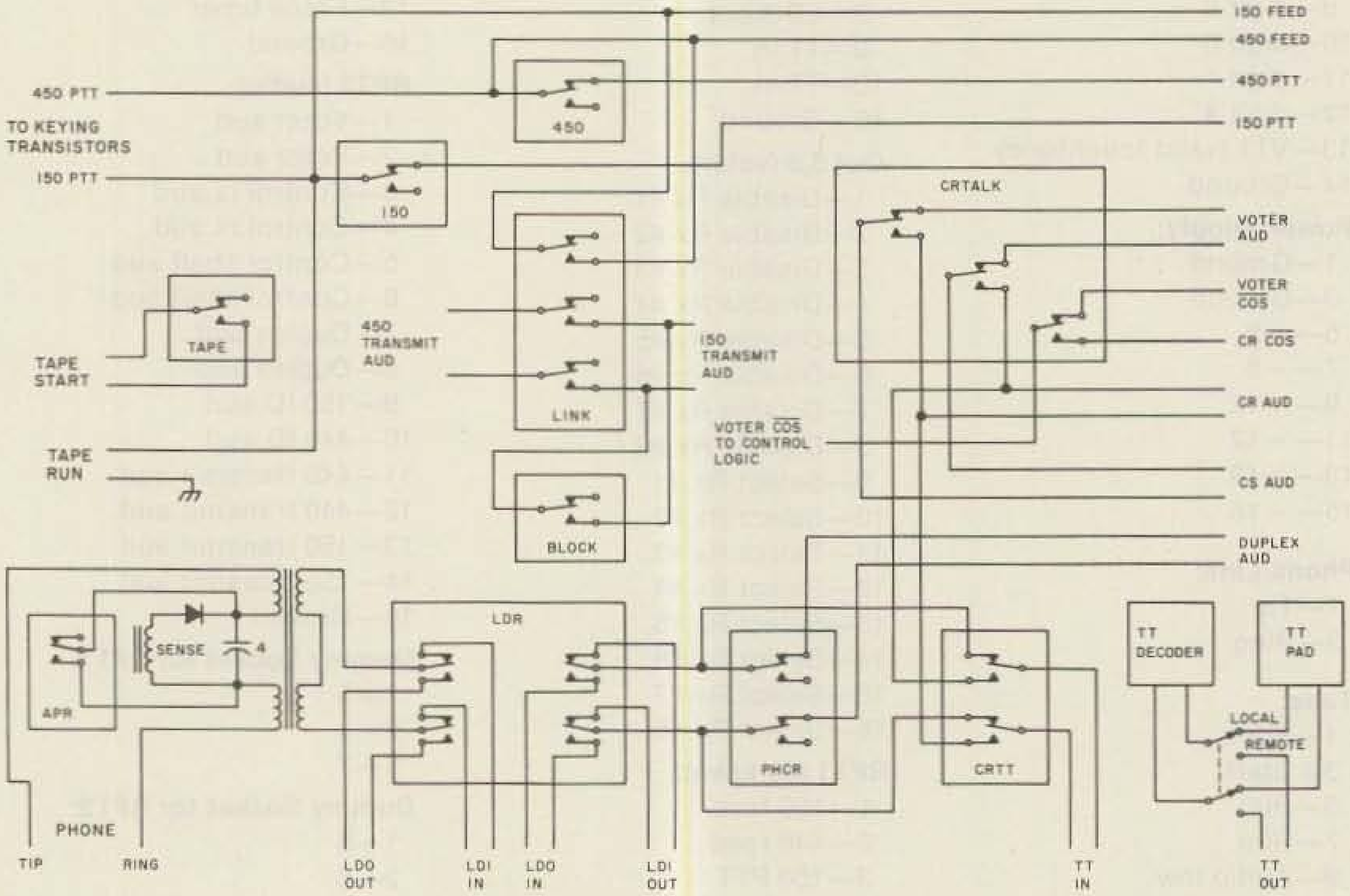


Fig. 5. Relay switching.

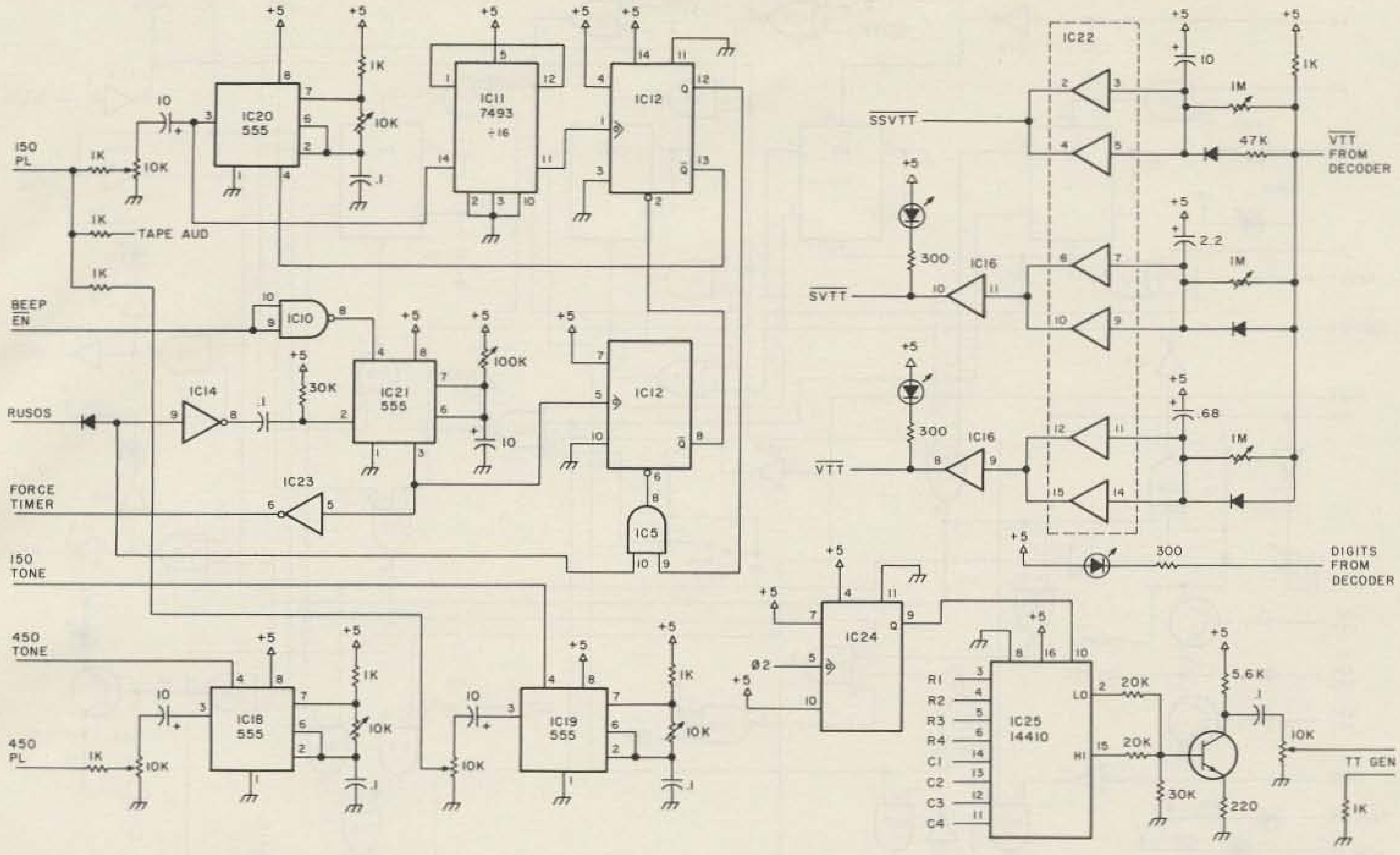


Fig. 6. Audio circuits.

Fig. 5 shows the relay and autopatch connections. Most of the lines go to connectors defined in Fig. 3. The PTT lines from the keying transistors and the voter COS to the control logic are picked up in Fig. 7. The TAPE relay pulses to activate the tape loop. A shorted pair is available from the tape loop while the tape is running and is connected at TAPE RUN. The relay wiring should be self-explanatory.

The autopatch interface circuitry may need to be modified to fit a particular coupler. The line transformer isolates the telephone equipment from the repeater circuitry. A suitable transformer is made for the MASTR line and is available from General Electric (part number 19A116736P1). During an autopatch, APR (autopatch relay) is closed. In our system, the line current is sensed at the other end, and the dial tone is requested. If a coupler is installed at the repeater site, APR may be directly connected to the coupler to request a dial tone. The SENSE relay is a sensitive relay which detects the dc line current. In our system, there is always current present in the line. A quick measurement of line current at the other end ensures the integrity of the line. When an incoming call is made, the line current is reversed. The diode in series with the SENSE relay distinguishes the difference between an idle condition and an incoming call. The SENSE contacts are normally closed and open when an incoming call is made. The contacts remain open until the line is disconnected. This relay is necessary to determine who initiates a call. If a call is initiated from the telephone line, a control access is assumed and PHCR activates. A telephone coupler at the repeater site simplifies some of the circuitry. Any contact pair which opens when the line is in use may be used in place of the SENSE relay, because suitable gating is provided in the control logic to produce the logical equivalent to our system.

The audio circuits are shown in Fig. 6. There are two separate oscillators for the 150 and 440 CW identifier tones. ICs 18 and 19 are simple 555 oscillators. They each have tone and amplitude controls. Pin 4 is the keying input; the 150 tone and 450 tone lines come from the processor output ports. ICs 11, 12, 20, and 21 generate the "beep" tone. Perhaps this is too elaborate an arrangement for such a simple function, but it does provide a distinctive, pleasing sound. It is best described as the "bounce" sound in TV Pong games. It is noticeable, but not objectionable. When the RUSOS lead goes from low to high (carrier release), IC21, a one-shot, fires. The time delay is adjustable and is nominally half of a second. When the pulse falls, IC12 is triggered, placing a low on pin 8. This clears the other half of IC12, putting a high on pin 13, enabling the oscillator, and clearing the first half of IC12. IC20 oscillates and generates the tone. The pitch is variable, and a variety of sounds can be formed by adjustment. The pulses are counted by IC11. At the fall of the sixteenth pulse, the top half of IC12 is set, the oscillator is turned off, and all returns to the rest condition. All of this generates exactly sixteen pulses shortly after the carrier release, providing the "beep" sound. The beep, ID, and tape audio are summed and fed to the transmitter. While IC21 is high, the repeater timeout timer is tricked into believing that the signal is still present. If the user does not wait for the "beep," then the timer is not reset because of the overlapping

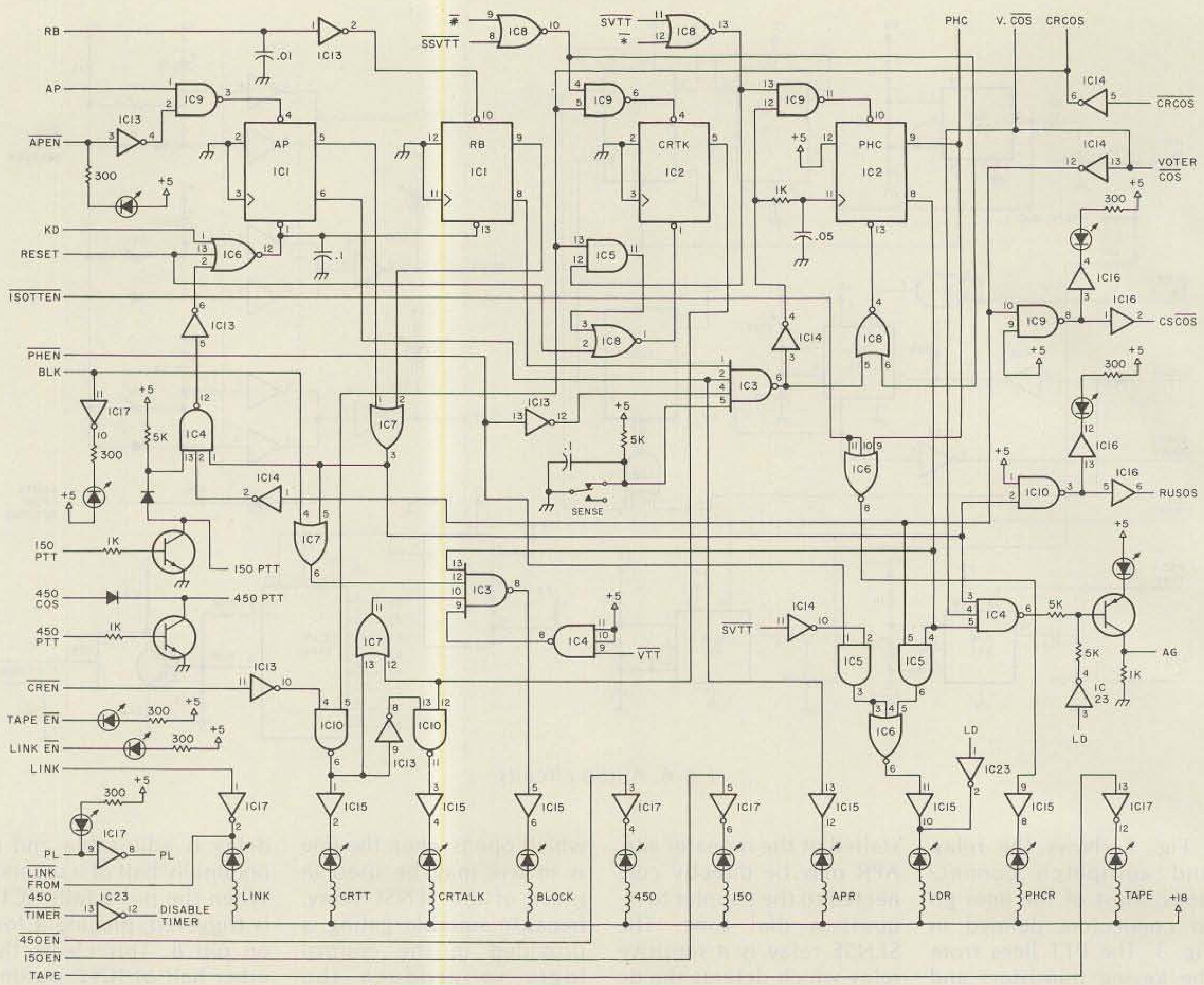
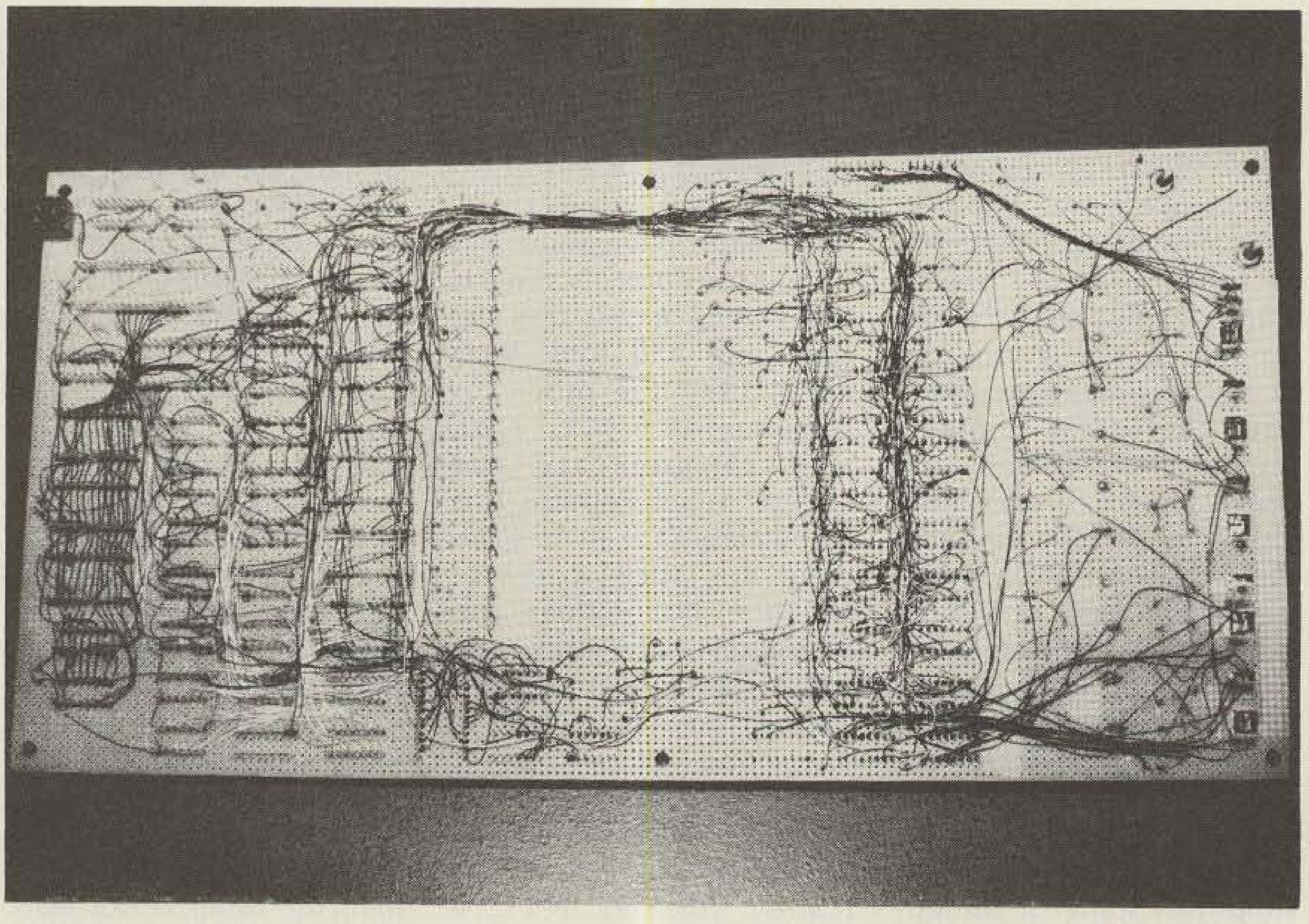


Fig. 7. Control logic.



Bottom of board. Reset switch at upper left. Microprocessor circuitry on left.

of the incoming signal and the one-shot. If a signal is present when IC21 falls, then the "beep" is inhibited via IC5. If the beep is disabled, IC21 is prevented from firing by IC10, and carrier release immediately resets the timer. This seems like a lot of trouble to go through for a silly beeper. The system permits a long (3-second) drop delay on the repeater transmitter. In normal QSOs, the transmitter stays keyed continuously, each participant merely waiting for the beep. This saves a lot of wear and tear on the transmitter and amplifier, both of which otherwise are constantly being turned on and off. This is of particular importance for busy repeaters; WR3AFM logs about 13 hours of uptime per day. The users *do* learn to wait for the beep, leaving time for breakers; if not, they time out.

IC24 divides the master 2-MHz clock by two, supplying the required 1-MHz clock for IC25, the touchtone generator. The rows and columns are selected by the processor at output port #7. The low and high group tones are summed and sent to a transistor amplifier.

Each of the digit outputs from the touchtone decoder has an LED which serves the dual purpose of giving an indication of what is going on and providing a pull-up for input to the processor input ports. The decoder outputs are normally open and go low when active. The VTT (valid touchtone) signal must be processed. IC22, a CMOS buffer, permits high-impedance timer resistors to be used. Each of three sections requires digits to be held a certain amount of time before they are recognized. The VTT output is just a debounced output set for a delay of about 50 milliseconds. The SVTT (slow VTT) output is adjusted for a delay of one second. This sets the amount of time the first digit of 3-digit codes must be held. The SSVTT (slow slow VTT) output is adjusted for 5 seconds. This sets the amount of time required to enter the telephone listen and control receiver talk modes.

The circuitry which performs the switching functions is shown in Fig. 7. The outputs of this section are the relays and the CS COS, RUSOS, AG, DISABLE TIMER, PL, and PTT lines. There are four state flip-flops. The AP (autopatch) flip-flop goes high during an autopatch, and the RB (remote base) flip-flop is high during a remote base operation (reverse autopatch, limited to control operators). The CRTK (control receiver talk) flip-flop may be left in either state, but by operating convention is normally left low. If it is set, any signals coming from the control receiver will be repeated. The PHC (phone control) flip-flop is normally clear and is set when a call-in is made on the phone line. The gating of these flip-flops will now be described.

The clear inputs of AP and RB are driven from IC6. If any of the three inputs to that gate go high, IC1 is cleared. A KD (knockdown) pulse from the processor will do so. When the knockdown digit is received, the processor pulses the KD output high. The master RESET pulse also clears the flip-flops, setting the initial states correctly after power on. The third input comes from an AND gate made up of ICs 4 and 13. If all three inputs of IC4 go high, then the flip-flops will be reset. This input provides for these functions to be killed should the repeater time out. If either function is up, pin 3 of IC7 is high. Whenever these functions are on, the RUSOS lead is grounded to keep the transmitter on the air. If the RUSOS lead is low, and the 150 PTT is high, sensed by pins 13 and 1 on IC4, then the repeater must be timed out. The last input to the AND gate is the voter COS. This only allows the AP and RB functions to be killed from a timeout if the incoming signal is released. During autopatches, if the repeater times out, the party on the telephone hears the last transmission made even after the repeater drops off the air. At that point, all three inputs to IC4 are high, and the function is killed.

The processor pulses the RB input line, setting the RB flip-flop when a remote base function is requested. When an autopatch is requested, the AP input is pulsed. If the APEN (autopatch enable) input is low, IC9 passes the request and the AP flip-flop is set. Otherwise, the patch is not permitted to start. This autopatch defeat is easily done in software, but this method allows visual indication when at the site that the autopatch function has been disabled.

The CRTK flip-flop is set when both inputs of IC9 are high. Pin 5 goes to the CRCOS (control receiver COS), so this can only be enabled by a signal present in that receiver. Both inputs of IC8, which feeds the other input of IC9,

150 = $\overline{\text{150EN}}$
450 = $\overline{\text{450EN}}$
TAPE = TAPE
$\overline{\text{APR}}$ = AP
$\overline{\text{CSCOS}}$ = $\overline{\text{COS}}$
CRTT = (CRCOS) (CREN)
CRTALK = (CRTK) (CRTT)
PHCR = PHC + $\overline{\text{150TTEN}}$
LDR = (COS) ($\overline{\text{PHC}}$) + (SVTT) ($\overline{\text{PHEN}}$) + LD
BLOCK = (VTT) (BLK + AP + RB) ($\overline{\text{PHC}}$) (CRTK + $\overline{\text{CRTT}}$)
LINK = LINK + LINK FROM 450
AG = (AP + RB) ($\overline{\text{COS}}$) ($\overline{\text{PHC}}$) + LD
$\overline{\text{RUSOS}}$ = (AP + RB)

150: 150 repeater off
450: 450 repeater off
TAPE: Start tape loop
APR: AutoPatch Relay
CSCOS: Control Shelf Carrier Operated Switch input
CRTT: Control Receiver Touchtone access
CRTALK: Control Receiver TALK through 150 with priority
PHCR: Phone Control Relay
LDR: Telephone Line Direction Relay
BLOCK: Audio tone Blocking relay
LINK: Linkup of 150/450 repeaters
AG: Audio Gate—audio to transmitter
RUSOS: Timed transmit input
150EN: 150 repeater enable from processor
450EN: 450 repeater enable from processor
TAPE: Tape activate from processor
AP: AutoPatch flip-flop
COS: Carrier Operated Switch from voter/control receiver
CRCOS: Control Receiver COS
CREN: Control Receiver ENable
CRTK: Control Receiver Talk flip-flop
PHC: Phone Control flip-flop
150TTEN: ENable Touchtone access from 150
VTT: Valid Touchtone
SVTT: Slow Valid Touchtone
SSVTT: Slow Slow Valid Touchtone
PHEN: ENable telePHone control access
LD: Line Direction from processor
BLK: Block signal from processor
RB: Remote Base flip-flop

Fig. 8. Control logic functions.

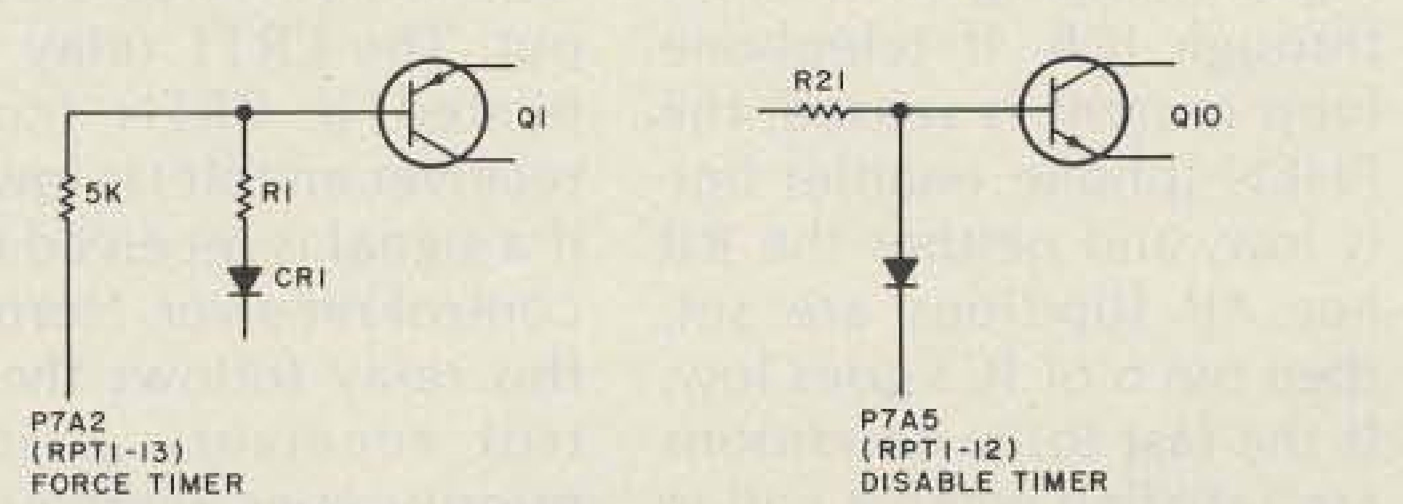


Fig. 9. Modifications to repeater control board 19D416675.

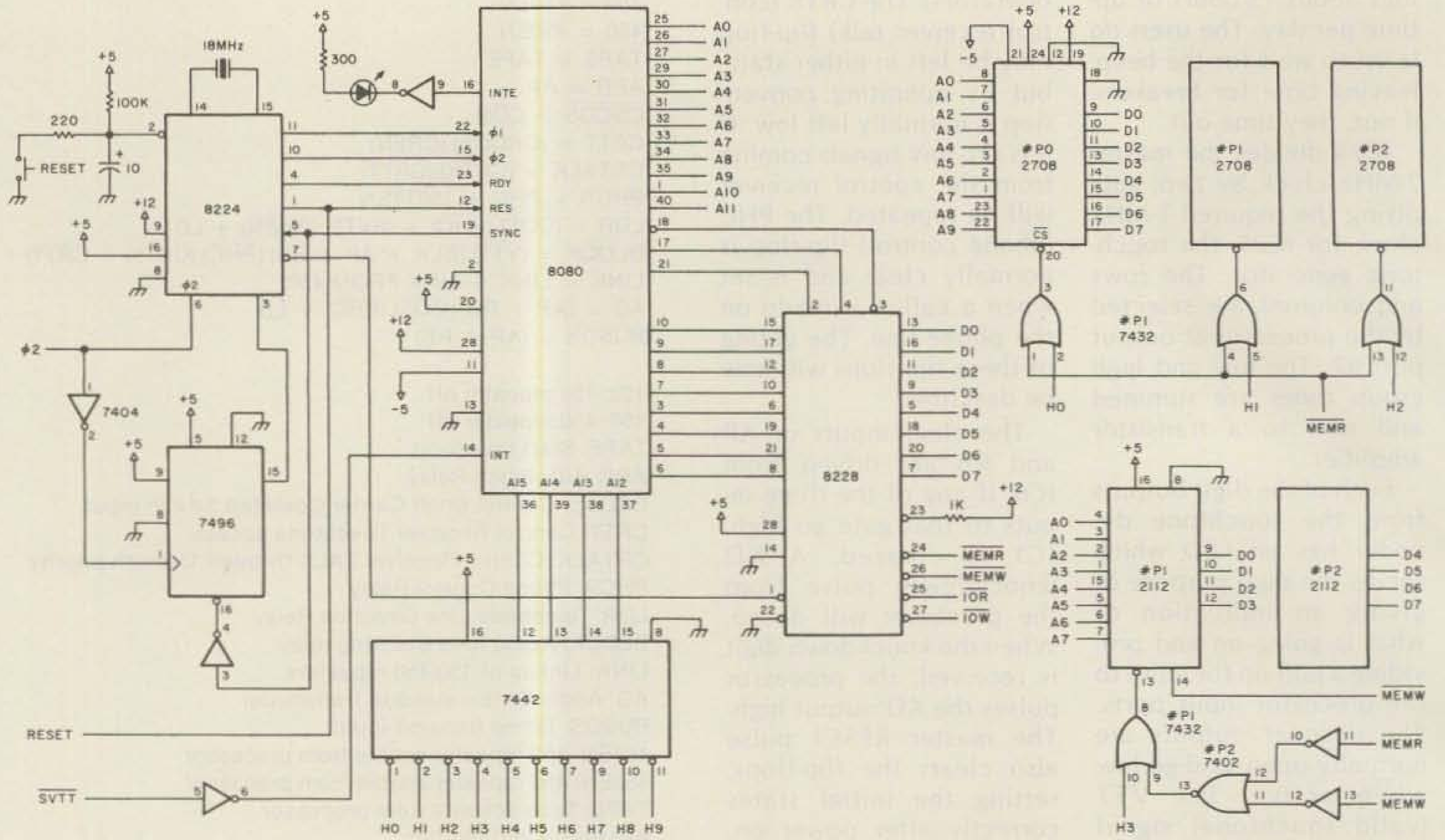


Fig. 10. Processor and memory.

must be low as well. The # digit and the SSVTT signals must be present. Therefore, the # must be held for 5 seconds while transmitting on the control frequency in order to enable the CRTK mode. CRTK is cleared by IC8. The RESET pulse goes to pin 2, clearing CRTK on power-up. Otherwise, the two inputs of IC5 must go high. One input goes to the CRCOS, so it can only be killed on the control frequency. The other input comes from pin 13 of IC8, which goes high when a one second * is received.

The PHC flip-flop is controlled in part by IC3. If any of the four inputs to this gate are low, the output is high, clamping PHC clear through IC8. If telephone loop current is sensed, the PHEN (phone enable) line is low, and neither the RB nor AP flip-flops are set, then pin 6 of IC3 goes low. If the last three conditions are satisfied when a call-in is made on the phone line, the transition clocks PHC high, placing the system into the telephone control access mode. Pin 6 of IC8 is driven from the five-second # gate, so PHC can be cleared in this manner, permitting the repeater input signals to be heard on the phone line. Via pin 13 of IC9, a one-second * sets PHC again.

The rest of the circuitry is combinational. Rather than give a detailed description of how each gate operates, I have shown the Boolean logic functions in Fig. 8, from which the circuitry can be easily understood. The 150, 450, and TAPE outputs are directly driven from the processor outputs. APR is directly driven from AP. The CS COS is a buffered COS output. The CRTT relay is activated if CREN (control receiver enable) is low, and if a signal is received in the control receiver. Normally, this relay follows the control receiver, giving it priority over anything else for access to the touchtone decoder. The CRTALK relay follows the CRTT relay if the CRTK flip-flop is set. PHCR is activated when PHC goes high. If 150TTEN (150 touchtone enable) is high, PHCR is also on. This totally isolates the decoder from two meter inputs.

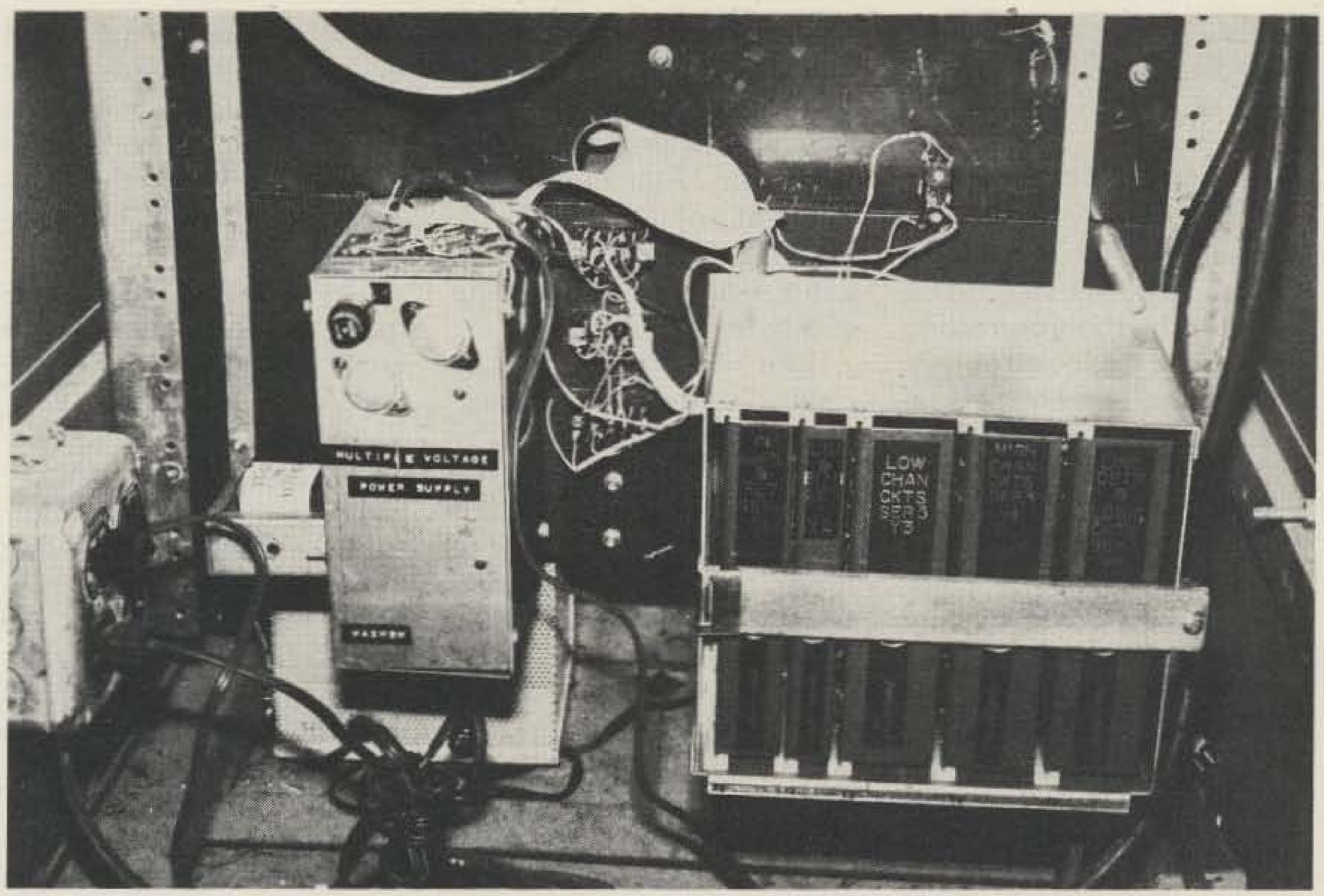
Normally, LDR follows the COS. If PHC is high, it stops following the COS, giving the control operator total control from the telephone line. Otherwise, whenever an incoming signal is present, the line direction gets turned around, and tones from the telephone never reach the decoder. If PHEN is low, LDR follows the SVTT signal. This is used to remove control access from the telephone line. Every time an attempt is made to send a tone down the line in this mode, the line is turned around, cycling the relays and removing the tone from the system. It is a clumsy but simple way to accomplish the task. The LD output from the processor also activates LDR, to ensure that the locally-generated touchtones produced when redialing a number go down the telephone line.

When in the blocking mode, BLOCK follows VTT. To be in the blocking mode, the BLK signal must be present from the processor, or an autopatch or remote base function must be in progress. The blocking mode is left for two special cases: when controlling the repeater on the phone line or the control receiver when it is not repeating. If these exceptions were not made, when a control operator was executing functions, users talking on the repeater would have their voices blotted out every time a tone was sent by the control operator. This would limit control to when the repeater was free. The PHC bar in the BLOCK formula stops the blocking for telephone control, and the CRTK + CRTT bar removes the blocking for silent control on the control frequency.

LINK normally follows the output from the processor, but a link request from 450 also activates it.

AG is activated during autopatch or remote base functions when the incoming signal is released, placing the telephone audio on the air. The LD output from the processor also activates AG so that the redialing of telephone numbers can be heard on the air. The RUSOS lead is grounded during autopatches and remote base operations.

ICs 15, 16, and 17 are open collector buffers used to drive the relay coils and external inputs. The AG input requires +10 volts. A PNP switching transistor, through an LED which drops a couple of volts, accomplishes this. The PTT outputs from the processor feed NPN driver transistors to keep the transmitters on the air during IDs. The keying transistors should be hefty enough to sink the current of the PTT lines of the particular transmitters used.



Rear of control system rack, showing power supply and touchtone decoder. The amplifier sockets are also visible.

Depending upon the repeater timer control methods used, the FORCE TIMER and DISABLE TIMER inputs may or may not already be present. Fig. 9 shows the necessary

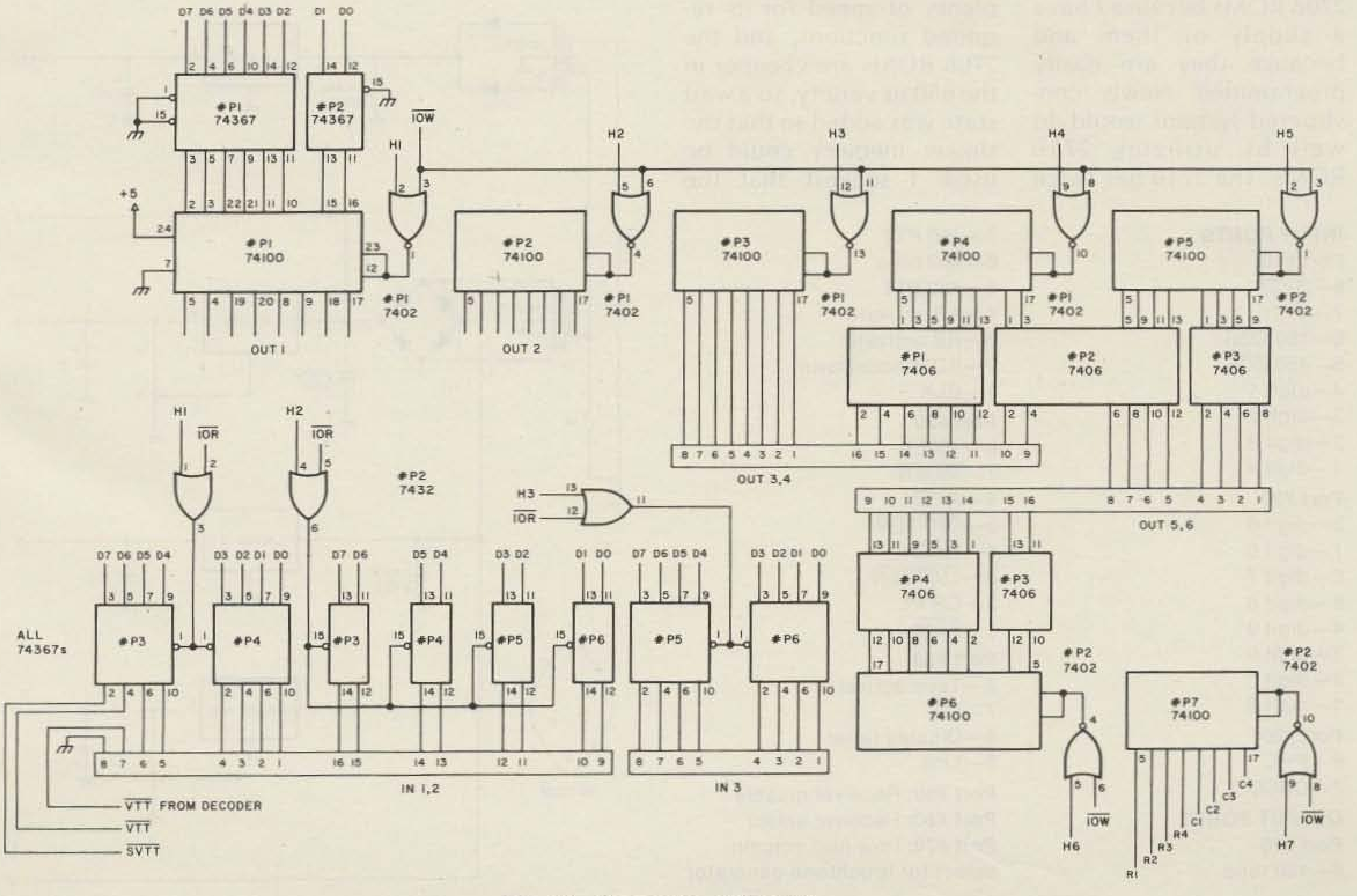


Fig. 11. Processor I/O ports.

modifications if a General Electric MASTR control shelf is used.

The Microprocessor

There are scores of microprocessor chips on the market. Many could be selected as the controlling element in a control system. A single interrupt is required. Barring other considerations, the RCA Cosmac would be a good choice because it is fabricated from CMOS technology, causing it to draw very little current and to have high noise immunity. The major consideration when selecting a microprocessor chip is support. I chose the Intel 8080 family for three reasons: I am extremely familiar with it, I have a supply of spare chips for that family, and I have the needed software support. The software support is most important.

There are a number of memory chips which can be used. I decided to use 2708 ROMs because I have a supply of them and because they are easily programmed. Newly constructed systems would do well by utilizing 2716 ROMs. The 2716 has twice the capacity of the 2708, and in this application, only one is required. The 2716 is even easier to program than the 2708. A minimal amount of RAM is required. Two 2112s, each 256 x 4, are used, providing 256 bytes of RAM.

The microprocessor components are considered separately from the rest of the hardware. The integrated circuits are not numbered, except where more than one of a particular number is used (where the letter "P" is attached to indicate that the IC belongs to the processor). The processor and memory schematic is shown in Fig. 10. The 8224 support chip provides the clock signals to the 8080 using an 18-MHz crystal. It also is the source of the power-up RESET pulse. Pushing the reset switch also generates a RESET pulse. The 7496 shift register introduces one memory wait state. The 8080 has plenty of speed for its required functions, and the 2708 ROMs are cheaper in the 650 ns variety, so a wait state was added so that the slower memory could be used. I suggest that the 18-MHz clock and wait state be retained for duplication, for the simple reason that otherwise the timing loops in the program will have to be readjusted.

The SVTT signal interrupts the processor. There are several reasons for using SVTT rather than VTT. Voices tend to be momentarily detected as touchtone. Using VTT to interrupt the 8080 would result in the processor frequently being interrupted for no purpose. This is bad, because when interrupted it stops counting time and initiates tone blocking, resulting in unintentional blocking of voices. Operationally, SVTT requires the first digit of any code to be held for a second; this gives control operators a chance to respond to unidentified stations attempting to access the system. The INTE (interrupt enable) is monitored by an LED, showing if the interrupt program has been exited, since after exit the interrupt is always re-enabled.

The four high address lines feed a 7442 decoder to provide the memory and I/O port selects. The rest of the address bus goes directly to memory. An 8228 bus controller buffers the data bus and produces the memory and I/O read and write signals. The pull-up resistor on pin 23 lets the 8228 perform the single interrupt instruction.

The program is stored in 2708 1K x 8 ROMs. The addressing is set by the H0, H1, and H2 lines. The ROMs are selected only during a memory read operation. Three sockets are provided for 2708s, and currently only two are needed, leaving room for an expanded program. It is simple to add up to six more 2708s by paralleling all lines and using the H4 through H9 lines. The RAM

INPUT PORTS

Port #10
8—$\overline{\text{SVTT}}$
7—$\overline{\text{VTT}}$
6—150 $\overline{\text{COS}}$
5—450 $\overline{\text{COS}}$
4—digit 1
3—digit 2
2—digit 3
1—digit 4

Port #20
8—digit 5
7—digit 6
6—digit 7
5—digit 8
4—digit 9
3—digit 0
2—digit *
1—digit #

Port #30
8—PHC
7—CRCOS

OUTPUT PORTS

Port #10
8—150 tone
7—150 PTT
6—450 tone
5—450 PTT
4—AP activate
3—RB activate
2—KD (KnockDown)
1—BLK

Port #20
8—$\overline{\text{150EN}}$
7—$\overline{\text{450EN}}$
6—$\overline{\text{APEN}}$
5—$\overline{\text{CRTTEN}}$
4—$\overline{\text{PHEN}}$
3—$\overline{\text{150TTEN}}$
2—CR PL
1—$\overline{\text{Beep}}$

Port #30
8—Tape activate
7—LD
6—Disable timer
5—Link

Port #50: Receiver disable
Port #60: Receiver select
Port #70: Row and column select for touchtone generator

Fig. 12. I/O ports.

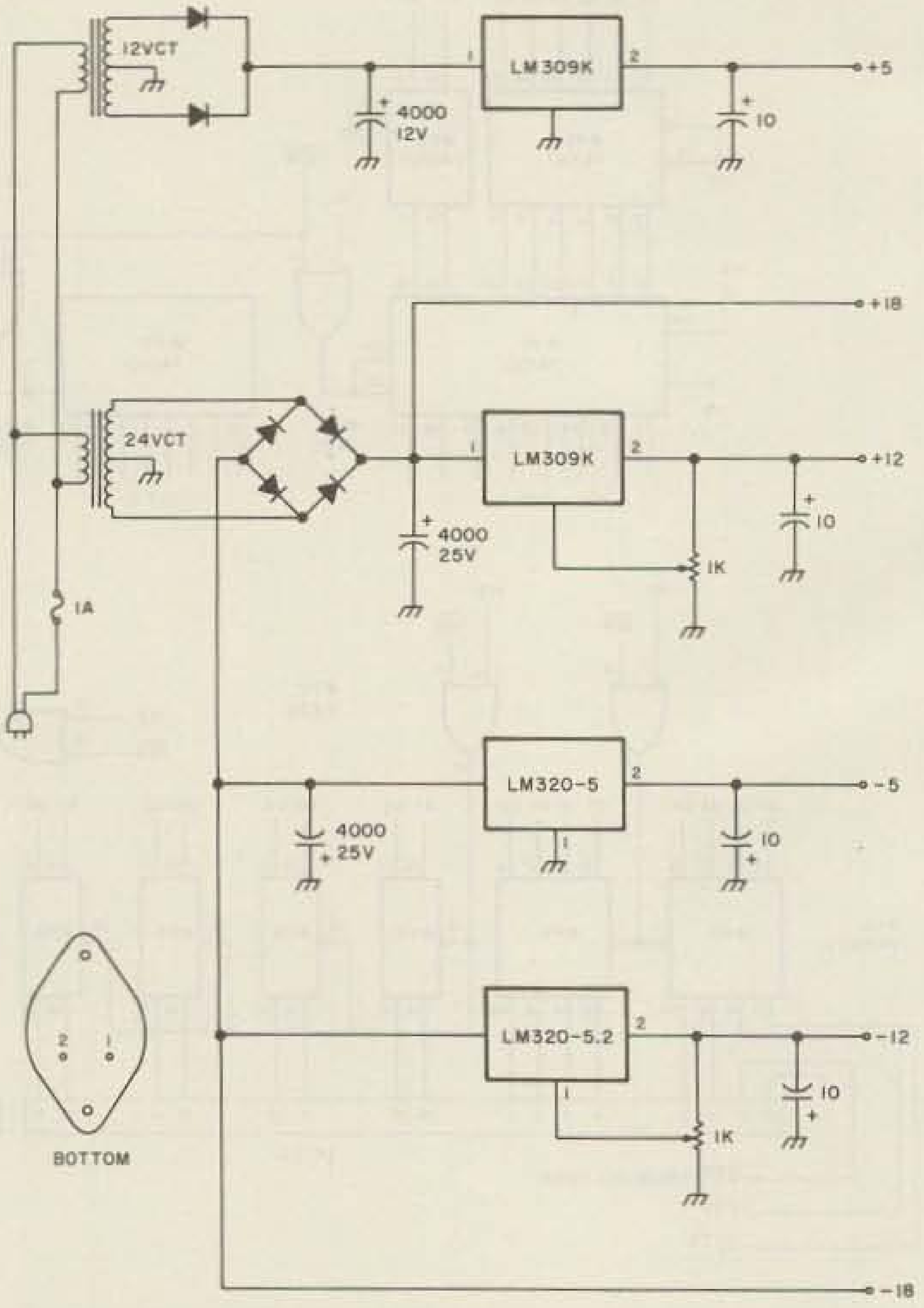


Fig. 13. Power supply.

consists of two 2112 256 x 4 chips. They are selected during memory read or write operations. On the memory chips, all pins not shown are paralleled with the other chips.

The input/output ports are shown in Fig. 11. 74100s are used for output ports because they are inexpensive. 74367s (8097) are used for input ports and buffers. 74367 #P1 and part of #P2 are used to buffer the data bus from the output ports. The H1 through H7 lines are used to select the port addresses, which correspond to 10, 20, ... hexadecimal port numbers. The input lines for 74100s #P2 through #P7 are paralleled with those lines on 74100 #P1. Output ports 1, 2, and 7 go directly to the rest of the hardware. The port and bit designations are shown in Fig. 12. Ports #3 through #6 go to output connectors. The input ports are as shown. Ports #1 and #2 come from the touchtone decoder, the VTT and SVTT conditioned outputs, and the two repeater COS lines. The decoder plugs into IN1,2. The pins which do not connect to the decoder are left open and wired over to the RPT1 connector. Two of the inputs on port #3 are used, and the remaining six may be used for expansion.

The power supply must provide +5, +12, and −5 volts for the circuitry. Other voltages may be required for your choice of amplifiers, decoder, and pad. Up to 2 Amps is required for the +5 supply, and 1 Amp is sufficient for the rest of the voltages. A power supply schematic is shown in Fig. 13. An LM309 regulator is used for +5, and it works—but this is on the close side. ■

DX Fantasy

—a moment in the sun

What you don't know can't help you.

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Woodstock, Ontario
Canada N4S 5T1

It was official: Effective 0001 GMT, all VEs could use the CJ prefix. I relished what lay before me. After years of chasing DX, for the first time (before the world discovered that CJ = VE, a fact that would hardly impress anyone), I would be the chased. Of course, I wouldn't disguise this detail; I simply wouldn't advertise it.

At the appointed hour, I ran to the rig and aimed the beam east. "CQ DX CQ DX from CJ3FLE."

They were there in an instant; the band exploded with Europeans clamoring to work me.

I imitated the best DXer's style I had heard and started to work them: "G2ZZ from CJ3FLE. Fifty-seven."

Back came the reply: "CJ3FLE from G2ZZ. 59, break."

"Roger; thanks for the report. QSL to VE3FLE. QRZ DX from CJ3FLE?"

"CJ3FLE from DL2XX."

"DL2XX, you're 58, from CJ3FLE."

"QSL. Thanks for the contact. What's the QT—"

"—roger, roger. QSL to VE3FLE. QRZ the G-station?"

And on I went. The stations were characteristically weak—they were no doubt in confusion as to where to point their antennas. But I was concerned with giving everyone the opportunity to work CJ, so I kept the QSOs short.

One French station was pounding in. "F2XX, you're 58 from CJ3FLE."

"QSL, you're five nine plus. Nice signal. What's the QTH?"

"Thanks for the report. QSL to VE3FLE. QRZ DX from CJ3FLE?"

"CJ3FLE. What's the QTH, old man? F2XX."

"Oh, sorry old man. We're in Canada. VE-land," I whispered, and then turned the amplifier back on, "CQ DX from CJ3FLE?"

The band began to shift and Asia came rolling in. I was ecstatic. It seemed as if all of Japan were calling at once. What a feeling!

As I worked the JAs, I could hear the stateside stations trying to break. One particular strong W7 kept calling, with such a strong signal I was having trouble hearing the JAs under him.

"W7XYZ from CJ3FLE. Fifty-eight."

"Thanks, old man." He came back sounding very pleased. "Didn't think I was going to get through. Beautiful signal here, even though I know you're beaming north. You're 5 and 9 plus. Name here is Bud."

"Thanks, Bud. Nice signal yourself. QSL to VE3FLE if you want a card ... 73 for now. QRZ DX from CJ3FLE?"

"By the way," it was the W7 again, "is there an award for working that special Canadian prefix? I've already worked a dozen of you and was wondering if there might be a certificate."

I felt crushed. "Ah, no, I don't think so," I replied.

"Okay; 73 and thanks for the contact."

"73. QRZ DX from CJ3FLE?" I said and glanced at the clock—less than an hour had elapsed.

I continued to call for DX but over the next hour managed only a handful of contacts. Finally I shut off the rig and leaned back and pretended the band had folded. ■

Try a Log Periodic Antenna

— with a computerized design

Bring in the big ones with your frequency-independent LPDA.

Fig. 1. Sample run.

```
RUN
LOG PERIODIC DIPOLE ANTENNA DESIGN PROGRAM
1: INPUT THE LOWEST OPERATING FREQUENCY IN MHZ
? 13
2: INPUT THE HIGHEST OPERATING FREQUENCY IN MHZ
? 30
3: INPUT THE CONSTANT TAU (.8 <= TAU <= .99 )
? .9
4: INPUT THE CONSTANT SIGMA (.05 <= SIGMA <= .1662 )
? .05
5: DO YOU WANT A SPECIFIC NUMBER OF ELEMENTS
? 2
THE LENGTH OF THE BOOM IS 27.05162 FEET
THE NUMBER OF ELEMENTS IS 13
DO YOU WANT A LIST OF ELEMENT  LENGTHS AND SPACINGS
? 1
TAU= .9 SIGMA= .05
LENGTH (FEET) SPACING (FEET)
 37.84615      3.784615
 34.06154      3.406154
 30.65538      3.065538
 27.58985      2.758985
 24.83086      2.483086
 22.34778      2.234777
 20.113        2.0113
 18.1017       1.81017
 16.29153      1.629153
 14.66238      1.466238
 13.19614      1.319614
 11.87652      1.187652
 10.68887
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 6
1: INPUT THE LOWEST OPERATING FREQUENCY IN MHZ
? 14
2: INPUT THE HIGHEST OPERATING FREQUENCY IN MHZ
? 14.35
3: INPUT THE CONSTANT TAU (.8 <= TAU <= .99 )
? .95
4: INPUT THE CONSTANT SIGMA (.05 <= SIGMA <= .1791 )
? .05
5: DO YOU WANT A SPECIFIC NUMBER OF ELEMENTS
? 1
6: INPUT THE NUMBER OF ELEMENTS
? 8
THE LENGTH OF THE BOOM IS 21.31978 FEET
THE NUMBER OF ELEMENTS IS 8
DO YOU WANT A LIST OF ELEMENT  LENGTHS AND SPACINGS
? 1
TAU= .9522999 SIGMA= .05
LENGTH (FEET) SPACING (FEET)
 35.14286      3.514285
 33.46654      3.346653
 31.87818      3.187817
 30.34997      3.034996
 28.90227      2.890226
 27.52363      2.752362
 26.21875      2.621874
 24.96845
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 3
INPUT THE NUMBERS
? 1
? 2
? 6
1: INPUT THE LOWEST OPERATING FREQUENCY IN MHZ
? 13.95
2: INPUT THE HIGHEST OPERATING FREQUENCY IN MHZ
? 14.4
6: INPUT THE NUMBER OF ELEMENTS
? 5
THE VALUES YOU HAVE CHOSEN WILL NOT WORK.  INPUT NEW DATA
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 1
INPUT THE NUMBERS
? 6
6: INPUT THE NUMBER OF ELEMENTS
? 7
THE VALUES YOU HAVE CHOSEN WILL NOT WORK.  INPUT NEW DATA
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 1
INPUT THE NUMBERS
? 6
6: INPUT THE NUMBER OF ELEMENTS
? 8
THE VALUES YOU HAVE CHOSEN WILL NOT WORK.  INPUT NEW DATA
DO YOU WANT TO CONTINUE
? 1
HOW MANY VALUES DO YOU WANT TO CHANGE
? 2
INPUT THE NUMBERS
? 3
? 6
3: INPUT THE CONSTANT TAU (.8 <= TAU <= .99 )
? .92
6: INPUT THE NUMBER OF ELEMENTS
? 7
THE LENGTH OF THE BOOM IS 18.21714 FEET
THE NUMBER OF ELEMENTS IS 7
DO YOU WANT A LIST OF ELEMENT  LENGTHS AND SPACINGS
? 1
TAU= .9399989 SIGMA= .05
LENGTH (FEET) SPACING (FEET)
 35.26882      3.526882
 33.15265      3.315265
 31.16345      3.116345
 29.29361      2.929361
 27.53596      2.753596
 25.88377      2.588377
 24.33871
DO YOU WANT TO CONTINUE
? 2
```

Christopher Johnson WA1ZAC
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If you must ask yourself, "What would I want with a log periodic dipole array (LPDA)?" then, obviously, you are unaware of the benefits of this amazing antenna. The main advantage of an LPDA is that it is frequency-independent. The gain, front-to-back ratio, swr, and other electrical characteristics remain fairly constant within the design limits.

Unlike a parasitic beam, whose performance deteriorates as the operating frequency is moved away from the design frequency, the array is not tuned to a single wavelength. The array has elements which are resonant at various points within the passband of the antenna. Very simply stated, at a given frequency, there is a group of elements which are near resonance; these act as driven elements. The nonresonant elements in front of the "driven" elements act as directors, and those behind act as reflectors. Hence, the antenna has many combinations of "driven," "directing," and "reflecting" elements.

When faced with the task of designing an LPDA the old-fashioned way, you can look forward to grinding out the numbers with pencil, paper, and calculator. It can be very boring and time-consuming. If you are not fortunate enough to get the results you require on the first attempt, your only alternative is to repeat the entire tedious process. However, in this age of microcomputers, you have only to type in a few numbers, wait a few seconds, and, miraculously, out pop the element lengths and spacings for your LPDA.

After examining the program, the results should seem a little less miraculous. An antenna can be designed in one of two modes. In both modes, you enter the frequency limits and two constants. In mode one, the computer will calculate the number of elements and their lengths and spacings. In mode two, you may also enter the number of elements. The computer will then design an antenna with these specifications.

This program is tailored to work on almost any computer processing BASIC which is equipped with higher math and radian trig functions. If optimized for your computer, the program can be condensed considerably. It was written on a Digital Equipment PDB 8/e minicomputer. For all inputs, yes is one, and no is two.

To use mode one, you must enter the higher and lower frequency limits (lines 190-220). You must also input the two constants tau and sigma (lines 250-300). Tau must be in the range of .8 to .99, and sigma must be in the range of .05 to sigma optimum (sigma optimum is equal to .258 x tau = .066). If you answer no to line 310, the computer will calculate the values for an LPDA with the characteristics which were entered. If you answer yes to line 310, you may enter a specific number of elements. If possible, the computer will optimize the constant tau for the highest gain and the smallest array with the characteristic input. If no antenna can be designed for the values encoded, you will be blamed for entering unacceptable data (line 590).

After the computer has sweated over the figures, it will print out boom length and number of elements (lines 730-740). You are then able to either accept these and get a printout, or reject them and change the inputs (lines 750-780). Just enter the number of each item to be changed (lines 680-700). The entire process will repeat itself, and you will soon be staring at a new set of data. How easy can designing an antenna be?

All of the computations are performed on lines 360-580. On line 360, the cotangent of alpha is

Fig. 2. Program listing.

```
10 PRI"LOG PERIODIC DIPOLE ANTENNA DESIGN PROGRAM"
20 H=6
30 I=0
40 T1=0
50 U=2.302585
60 FORV=1TOH
70 IFI=0THE90
80 GOT100
90 W(V)=V
100 IFW(V)=1THE190
110 IFW(V)=2THE220
120 IFW(V)=3THE250
130 IFW(V)=4THE280
140 IFW(V)=5THE310
150 IFQ=2THE330
160 PRI"6: INPUT THE NUMBER OF ELEMENTS"
170 INPN
180 GOT330
190 PRI"1: INPUT THE LOWEST OPERATING FREQUENCY IN MHZ"
200 INPF1
210 GOT330
220 PRI"2: INPUT THE HIGHEST OPERATING FREQUENCY IN MHZ"
230 INPF2
240 GOT330
250 PRI"3: INPUT THE CONSTANT TAU (.8 <= TAU <= .99 )"
260 INPT
270 GOT330
280 PRI"4: INPUT THE CONSTANT SIGMA (.05 <= SIGMA <=".258*T-.066")"
290 INPE
300 GOT330
310 PRI"5: DO YOU WANT A SPECIFIC NUMBER OF ELEMENTS"
320 INPQ
330 NEXV
340 F=F2/F1
350 W=984/F1
360 C=4*E/(1-T)
370 R=(((ATN(1/C))/.017452)↑E)/T↑2
380 S=R*F
390 L=(1-(1/S))/4*C*W
400 IFQ/2<>INT(Q/2)THE460
410 N=1+(LOG(S)/U)/(LOG(1/T)/U)
420 IFN-INT(N)>=.5THE450
430 N=INT(N)
440 GOT460
450 N=INT(N)+1
460 D=492/F1
470 P=(D-D*T)/2*C
480 IFQ<>1THE730
490 IFT1>=TTHE580
500 FORT1=TTO.99STE.0001
510 C1=4*E/(1-T1)
520 B=T1↑(3-N)/(((ATN(1/C1))/.017452)↑E)
530 IFINT(1000*B)>INT(1000*F)THE580
540 IFINT(1000*B)<INT(1000*F)THE590
550 T=T1
560 Q=3
570 GOT360
580 NEXTT1
590 PRI"THE VALUES YOU HAVE CHOSEN WILL NOT WORK.  INPUT NEW DATA"
600 PRI"DO YOU WANT TO CONTINUE"
610 INPJ
620 IFJ=1THE640
630 GOT940
640 PRI"HOW MANY VALUES DO YOU WANT TO CHANGE"
650 INPH
660 IFH=6THE20
670 PRI"INPUT THE NUMBERS"
680 FORV=1TOH
690 INPW(V)
700 NEXV
710 I=1
720 GOT40
730 PRI"THE LENGTH OF THE BOOM IS"L"FEET"
740 PRI"THE NUMBER OF ELEMENTS IS"N
750 PRI"DO YOU WANT A LIST OF ELEMENT LENGTHS AND SPACINGS"
760 INPM
770 IFM=1THE790
780 GOT600
790 PRI"TAU="T"SIGMA="E
800 PRI"LENGTH (FEET) SPACING (FEET)"
810 FORA=1TON
820 PRID,
830 IFN<>ATHE850
840 GOT860
850 PRIP
860 D=D*T
870 P=P*T
880 NEXA
890 PRI
900 IFQ=3THE920
910 GOT930
920 Q=1
930 GOT600
940 STOP
950 END
```

E = sigma
T = tau
R = bandwidth active region
L = length of boom
N = number of elements
C = cotangent of alpha
D = length of element
P = spacing of element
B = operating bandwidth (should be approximately equal to F)
F = upper frequency over lower frequency

Table 1. List of variables.

calculated. Line 370 computes the bandwidth of the active region. The length of the boom is calculated on line 380. If the number of elements is predetermined, lines 490-580 will optimize tau for any given sigma. The loop increments tau by .001 at each pass and checks to see if the results are acceptable.

The element lengths and spacings are listed with lines 810-880. After listing these items, you are allowed the choice of continuing or packing up the inch-thick pile of printouts you already have and going off to begin work on your antenna. Now that you have enough data to design a thousand antennas, you can choose the one best suited to your needs.

The log periodic dipole array is a truly versatile and useful antenna. And, since one is so utterly simple to design, you have no excuse not to type in this program, punch in a few figures, and prepare for the construction of your personal, computer-designed LPDA. ■

New Coax Cable Designations

—watch for them

Upgraded standards since 1977.

Carl C. Drumeller W5JJ
5824 NW 58 Street
Warr Acres OK 73122

For years, ever since the Hitler War, radio amateurs have placed their trust in coaxial cables bearing RG- designations. For good cause, too, as they were manufactured to strict military standards. As of 15 March 1977, a new set of standards was introduced and made mandatory. This new standard closes some loopholes in the former specifications.

Most manufacturers of coaxial cable turned out products of which they could be justifiably proud. Some scrimped. Even the best products were made to specifications that unwittingly omitted important factors. Now, though, all such cable made to current requirements, as spelled out in MIL-C-17E, will have certain additional desirable characteristics.

For instance, cable approved under MIL-C-17E will have tightly controlled adhesion between inner conductor and dielectric. If you've ever had, in cold weather, the inner conductor contract enough to pull back the male prod on a type N connector, you'll appreciate this requirement!

In another pair of specifications, the outer jacket must have dimensional stability. It must not shrink back from a connector, nor may it crack and pull away from the shield when stressed.

How do you spot the new and desirable cables? Look for the stamped-on identification. For what used to be RG-58C/U, for instance, look for M17/028-RG58. Note carefully that there is no hyphen between RG and 58.

Incidentally, I did not find a new version of the old stand-by, RG-8/U. It must have been replaced by one of the new three-numeral series.

Cable marked with the old designations still will be manufactured. Be thoroughly aware, though, that it very probably will not be of the high quality that characterized such cable when it was made to military standards. In fact, already some quite inferior cable is being sold. It looks like the "real" thing; it's the same size and of the same exterior appearance. When rf is piped into it, it's quite another matter. It may leak rf like a sieve; it may have high attenuation per unit length; it may have "suck-out" points. "Suck-out" points are narrow frequency bands at which the cable displays very high attenuation although passing other frequencies with only nominal attenuation.

So, if you want the best, look for (and pay dearly for) the newer MIL-C-17E series of coaxial cables. Keep in mind that a penny saved on coax cost may be a dollar lost in precious rf dissipation. ■

NEW!

"INDUSTRIAL" WIRE-WRAPPING TOOL

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$49.95

BATTERIES NOT INCLUDED
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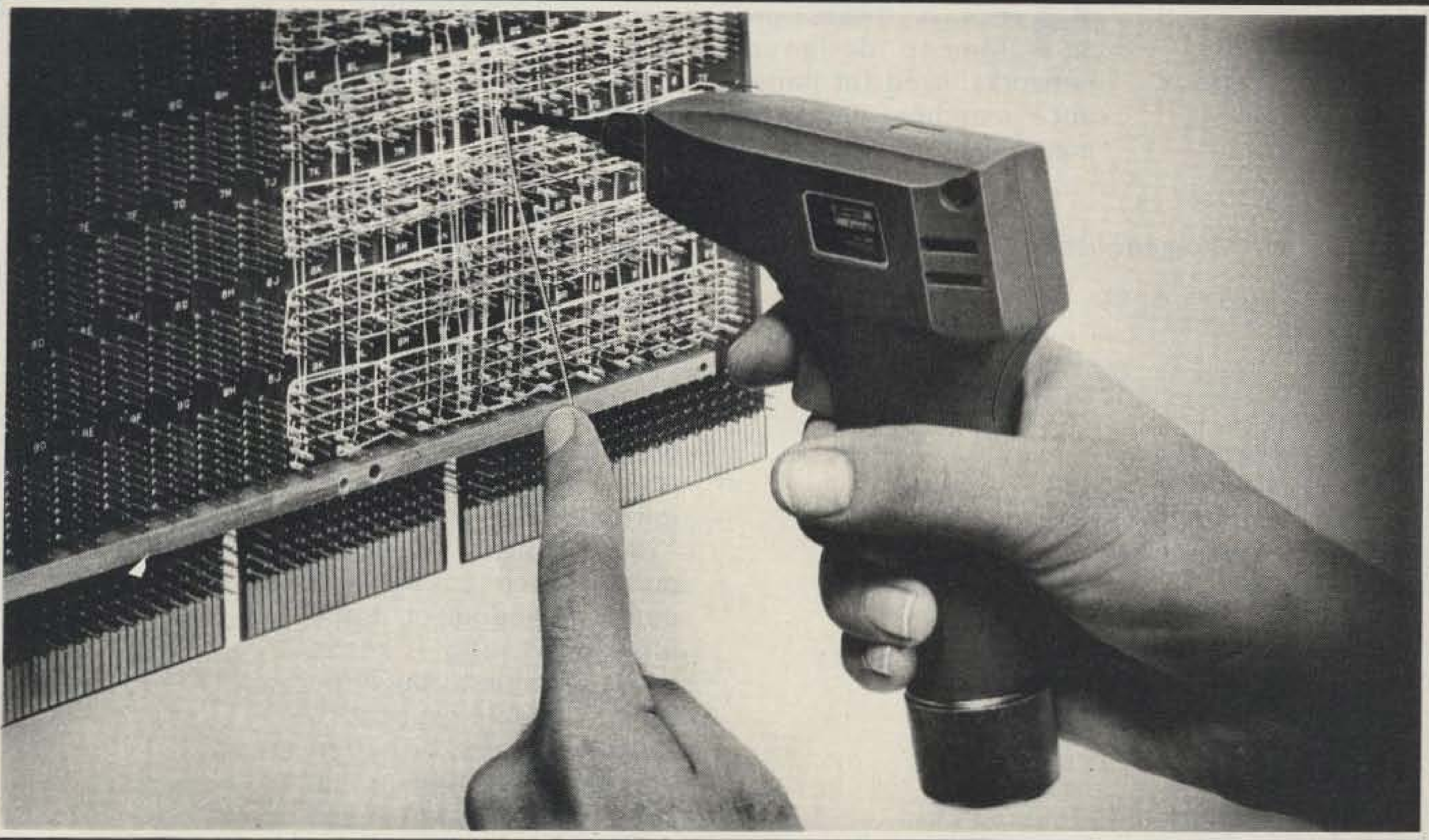

- **BATTERY OPERATED**
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The Micro Magic Pi Designer

— figure networks with a minimum of fuss

A bulletproof program.

Gil Boelke
505 Main St.
West Seneca NY 14224

Here's a BASIC program to design pi-networks, used for impedance matching and filtering. A feature of the program is that it makes a smooth transition to the degenerative case of minimum Q—the L-network.

When the primary function is to transform impedance with minimum loss and not to provide filtering action, the L-network is the way to go. For a given impedance ratio, it provides the broadest bandpass of any resonant network, and the lowest loss.

If filtering action is required, such as for harmonic rejection, or if the impedance ratio is to be made variable through the use of variable capacitors, a pi-network may be better. Q may be chosen as desired and a range of impedance ratios can be accommodated without changing the inductor value. A pi-network is nothing more than back-to-back L-networks. Since an L-network always steps impedance either up or down, a pi-network can be used to provide filtering action with equal impedances at both source and load, as well as transformations up or down. If the two L-networks have equal ratios, the first steps impedance down and the second one steps it back up to the

Program listing.

```
100 REM PI-NETWORK DESIGN PROGRAM
110 REM Copyright GLB ELECTRONICS 1977
120 REM G. BOELKE  7-26-77
130 REM
140 REM CHR$(12) IS TO CLEAR SCREEN AND HOME UP CURSOR
150 PRINTCHR$(12):PRINT"PI NETWORK DESIGN"
160 INPUT"FREQUENCY (MHZ)";F:IFF<=0THEN160ELSEF=F*1E6
170 PRINT:INPUT"INPUT Z";R1
180 INPUT"LOAD Z";R2
190 Y1=0:IFR2>R1THENSWAPR1,R2:Y1=1
200 Q0=SQR(R1/R2-1)
210 Q0=INT(Q0*1E5+.5)/1E5
220 PRINT"Q VALUE (MIN "Q0")";:INPUTQ$
230 Q=VAL(Q$)
240 PI=3.1415926
250 IFQ$="MIN"ORQ=Q0THENQ=Q0:GOTO640
260 IFQ<Q0THEN220
270 REM CALCULATIONS
280 IFQ=0THENX1=1E38:GOTO260
290 X1=R1/Q
300 X2=Q*Q+1-R1/R2
310 IFX2<=0THENPRINT"UNREASONABLE PROBLEM":GOTO170
320 X2=SQR(R1*R2/X2)
330 X3=Q*R1+(R1*R2/X2)
340 X3=X3/(Q*Q+1)
350 C1=1/2/PI/X1/F
360 C2=1/2/PI/X2/F
370 L=X3/2/PI/F
380 REM SCHEMATIC
390 PRINT
400 PRINT"O------UUUUU------O"
410 PRINT"  |        L"TAB(16)"|"
420 PRINT"  |              |
430 PRINT" ---            ---"
440 PRINT" --- C1";TAB(15)"--- C2"
450 PRINT"  |              |"
460 PRINT"  |              |"
470 PRINT"O------------------O"
480 IFY1>0THENPRINTR2;TAB(16)R1:GOTO500
490 PRINTR1;TAB(16)R2
500 IFL>=1E-6THENPRINT"L="INT(L*1E9+.5)/1E3"UH":GOTO520
510 PRINT"L="INT(L*1E9+.5)"NH"
520 PRINT"C1="INT(C1*1E12+.5)"PF"
530 PRINT"C2="INT(C2*1E12+.5)"PF"
540 PRINT
550 INPUT"ANOTHER Q VALUE";A$
560 IFASC(A$)=89THEN190
570 INPUT"IMPEDANCE CHANGE";A$
580 IFASC(A$)=89THEN170
590 INPUT"ANOTHER FREQ";A$
600 IFASC(A$)=89THENINPUT"F";F:IFF<=0THEN600ELSEF=F*1E6:GOTO200
610 INPUT"MORE";A$:IFASC(A$)=89THEN160
620 END
630 REM MIN Q YIELDS AN L NETWORK
640 IFQ=0THENPRINT"USE A DIRECT CONNECTION!":GOTO220
650 X3=Q*R2
660 X1=R1/Q:C1=0:C2=0:X2=X1
670 IFY1=1THEN360
680 C1=1/2/PI/F/X1
690 GOTO370
700 END
```

Sample run.

```
READY
RUN

PI NETWORK DESIGN
FREQUENCY (MHZ)? 150

INPUT Z? 50
LOAD Z? 300
Q VALUE (MIN  2.23607 )? 12

O------UUUUU------O
  |       L       |
  |               |
 ---             ---
 --- C1          --- C2
  |               |
  |               |
O-----------------O
 50              300
L= 37 NH
C1= 42 PF
C2= 102 PF

ANOTHER Q VALUE? YES
Q VALUE (MIN  2.23607 )? MIN

O------UUUUU------O
  |       L       |
  |               |
 ---             ---
 --- C1          --- C2
  |               |
  |               |
O-----------------O
 300             50
L= 119 NH
C1= 8 PF
C2= 0 PF

ANOTHER Q VALUE? NO
IMPEDANCE CHANGE? YES

INPUT Z? 25
LOAD Z? 1000
Q VALUE (MIN  6.245 )? 10

O------UUUUU------O
  |       L       |
  |               |
 ---             ---
 --- C1          --- C2
  |               |
  |               |
O-----------------O
 25              1000
L= 118 NH
C1= 11 PF
C2= 52 PF

ANOTHER Q VALUE? NO
IMPEDANCE CHANGE? NO
ANOTHER FREQ? NO
MORE? NO

READY
```

same value.

In each L-network, the transformation ratio increases with higher Q values. For a Q of zero, the component values diminish to zero; thus the program specifies a piece of wire as the answer to this problem!

When you give it a problem, it always calculates the minimum Q required to do the job. (Remember: The lowest Q is the lowest loss and the least critical in parts values.) If you need a higher Q for filtering action, you simply enter it. On the other hand, if an L-network is desired, just enter "MIN" and the computer will use the value it already has, saving you the trouble of re-entering it.

It then prints out the circuit and gives parts values. Afterwards, you have a chance to change the frequency or the impedance ratio, or to enter a new problem before leaving the program.

An effort was made to "bulletproof" the program by filtering out negative values and divide-by-zeros and by providing for the accommodation of impedance values without regard to whether the first is greater or less than the second. The schematic always labels the impedances of each port so you don't get them mixed up.

The program was written for MITS extended BASIC with multiple statements per line, plus some functions such as "PRINT USING" and "SWAP," but these are easily purged for running it on other BASICs.

Finally, my apologies to those who have much memory in their system. The statements are not separated by spaces for those who do not! ■

Bill Howard KG6JIF
74 Golden Shower, NCS
FPO San Francisco CA 96630

A Better Micoder™

—no more battery woes

Good-bye to mushy audio.

If you are one of the many who own a Heath HW-2036 synthesized 2 meter rig with the Micoder™, here is a way to eliminate that 9-volt battery for good. Not only is the modification simple,

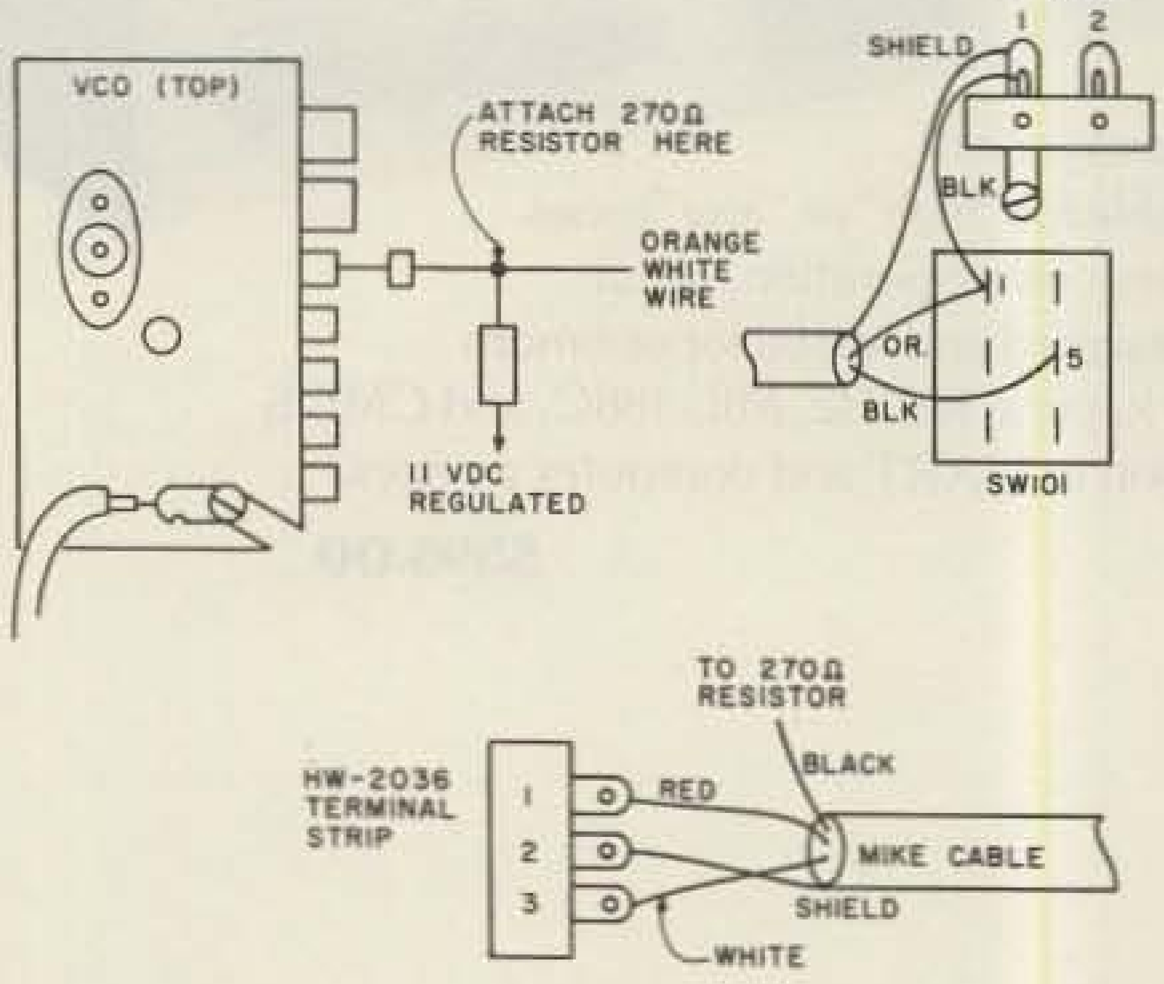

Fig. 1. After modification. It doesn't matter whether the shield goes to pin 1 of SW101 or to the terminal strip, as long as both pin 1s are tied together.

but you end up with a much lighter microphone along with an end to those embarrassing moments when you hear, "Your audio sounds real low and kinda mushy." Here's how to do it:

1. Open up the microphone case and remove the case from your HW-2036. Locate both ends of the black wire in the mike cable (one end goes to terminal 1 on the terminal strip inside the mike and the other end goes to terminal 2 on the three-terminal strip inside the rig) and clip them free.

2. Clip out the battery connector inside the microphone and remove it. The red wire should be removed from pin 5 of SW101 and the black wire comes off terminal 1 of the two-terminal strip.

3. Solder the free black wire inside the mike to pin 5 of SW101.

4. Solder a 270-Ohm resistor to the wire (WHT-ORG) going to C515 on the vco assembly. The resistor should be soldered to the WHT-ORG wire near the ferrite bead.

5. Cover the resistor and leads with spaghetti or some other insulating cover and connect the free end of the resistor to the free black wire inside the rig. After carefully checking that all leads are properly insulated, put everything back together and get back on the air. ■

Winning the QSO Name Game

—sure beats 3 x 5 cards

Put your info on the tip of your tongue.

Charles E. Thomas WA3MWM
7022 Blackhawk
Pittsburgh PA 15218

Would you like to have a fantastic memory with everyone's name on the tip of your tongue (keyboard)? Whether you are running for office, trying to borrow equipment, or just want to appear to be on the ball, this program will fill that need.

The number of newcomers appearing on the repeater scene increases every day. It is extremely difficult to remember everyone's name. Using my program, all you have to do is type in the call of the operator. The computer supplies you with his call and his name. A small piece of information can be included if you so desire.

I wrote this program using SWTPC 8K BASIC to run on my 6800-based machine. Southwest BASIC reserves 32 bytes for a string variable. This would allow 6 bytes for the call and 1 byte for a space. This leaves 25 spaces (bytes) available for the operator's name and a key word of information pertaining to that particular operator. If your memory is small, you might consider limiting the length of the string variables by adding DIM statements.

String variables in Southwest BASIC may be named any single alphabetic character or a subscripted letter. The subscripts permitted are 0 through 9 only.

```
10 REM ** 3 X 5 CARD UPDATE **
20 REM ** AMATEUR RADIO NAME DIRECTORY **
30 PRINT "ENTER THE AMATEUR CALL ";
40 INPUT C$
100 LET A$(1) = "WA3AOQ  BILL"
101 IF C$ = LEFT$(A$(1),6)  PRINT A$(1)
200 LET B$(1) = "K3BD  MIKE"
201 IF C$ = LEFT$(B$(1),4)  PRINT B$(1)
300 LET C$(1) = "K3CHD  DON"
301 IF C$ = LEFT$(C$(1),5)  PRINT C$(1)
400 LET D$(1) = "WB3DHB  PHIL"
401 IF C$ = LEFT$(D$(1),6)  PRINT D$(1)
500 LET E$(1) = "WA3ENU  RICH"
501 IF C$ = LEFT$(E$(1),6) PRINT E$(1)
• • •
• • •
900 LET I$(1) = "K3IXB  JOHN"
901 IF C$ = LEFT$(I$(1),5)  PRINT I$(1)
• • •
• • •
2500 LET Z$(1) = "W3ZCO  KEN"
2501 IF C$ = LEFT$(Z$(1),5)  PRINT Z$(1)
9000 FOR D = 1 TO 50
9010 NEXT D
9020 PRINT
9030 PRINT
9040 PRINT
9050 GOTO 30
```

Program listing.

When adapting my program for your own use, be sure to keep some type of line number organization to avoid confusion when adding new calls to memory. Assuming you are using the program for local 2 meter operation data, the call area will probably be the same for the majority of the entries. Therefore, concentrate on the last three letters of the operator's call. In my program, I assigned the line numbers as follows: 100-190 to the calls whose last three (or two as the case may be) letters begin with the letter A, 200-290 to those whose last three letters begin with the letter B, and so on through the rest of the alphabet. Those amateur calls contained in statement lines 100-190 would be assigned the string variables A$(0) through A$(9). Those in lines 200-290 (beginning

```
READY
#RUN

ENTER THE AMATEUR CALL ? K3IXB

K3IXB  JOHN

ENTER THE AMATEUR CALL ?
```

Sample run. User input is underlined.

with B) would be assigned B$(0) through B$(9) and so on. Line 9000 is inserted as a slight delay loop.

"WA3MWM, WA3MWM —this is K3IXB calling."

Now, let's see, what is that guy's name? I know that I have worked him before! ■

L. E. Harrington W0LM
585 S. Alton Way — 11C
Denver CO 80231

A New Approach To Nicad Care

—charges up to ten at a time

Is this going to be cheap? How about $1.75 for the two components required, besides the usual transformer, rectifier, and filter capacitor needed for any charger? Is it perfect? Connect any reasonable number of nicad cells (0-10) between the charging terminals, and the current will vary only a small fraction of a milliampere. The design is so simple that I think my brother-in-law could handle it.

Fig. 1 shows the schematic. The circuit and design data are given in the National Semiconductor *Voltage Regulator Handbook*, available at Radio Shack stores. Don't rush out and buy the book for this information, though. Herewith I will save you $2.25 on the cost of building your charger. Besides, using the data in the book requires a lot more time and measuring than using the cut and try system, if you have some idea of just what you are doing.

Your dc supply will have to furnish the following: the maximum voltage of the bank of cells you will want to charge and the rated voltage of the voltage regulator you will use plus its dropout voltage. Figure on approximately 30 volts for use with 10 nicads, but don't forget that the maximum you can use with the voltage regulator is probably 35 volts. Also, when using a voltage regulator, you must watch $I(V_{in} - V_{out})$, the power dissipated in the regulator. With a nominal 1 Amp regulator and the current you will draw, there will be no problem here.

I use a small power transformer rated 25.2 volts at .3 Amps, a silicon diode rectifier, and a 220 uF filter capacitor. Under the load you will use, the voltage is 31 volts. With R1 at 300 Ohms, the charging current is 45 mils exactly, when charging anything from one to ten cells. The transformer gets pretty warm, but not too warm. Everything else gets just barely warm. If you intend to charge at 100 mils, use a larger power transformer — everything else can be the same. I suppose you could incorporate a pot and a meter to make an adjustable-rate charger, but be sure to use a limiting resistor if you do use a pot in place of R1. I use a 220-Ohm shunt across the 300-Ohm R1 for a couple of batteries that can use a 100 mils charge. The transformer has to be "heat sinked," too. ■

Parts List

T1	25.2 V at 0.3 Amp (Radio Shack 273-1386)
D1	1 Amp silicon rectifier
C1	220 uF, 50 V (Radio Shack 272-1045)
VR	12 V at 1 Amp (Radio Shack 276-1771)
R1	selected to adjust charge rate (in the 300 Ω range for 0.05 A)
M1	suitable for charging rate desired (optional)

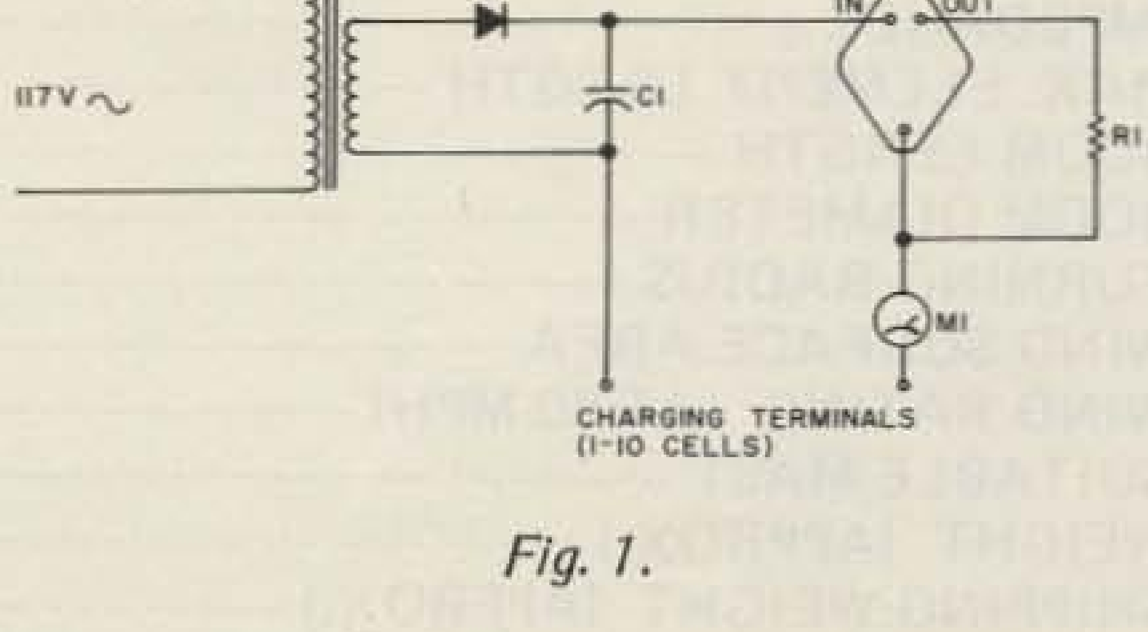

Fig. 1.

TET ANTENNA SYSTEMS

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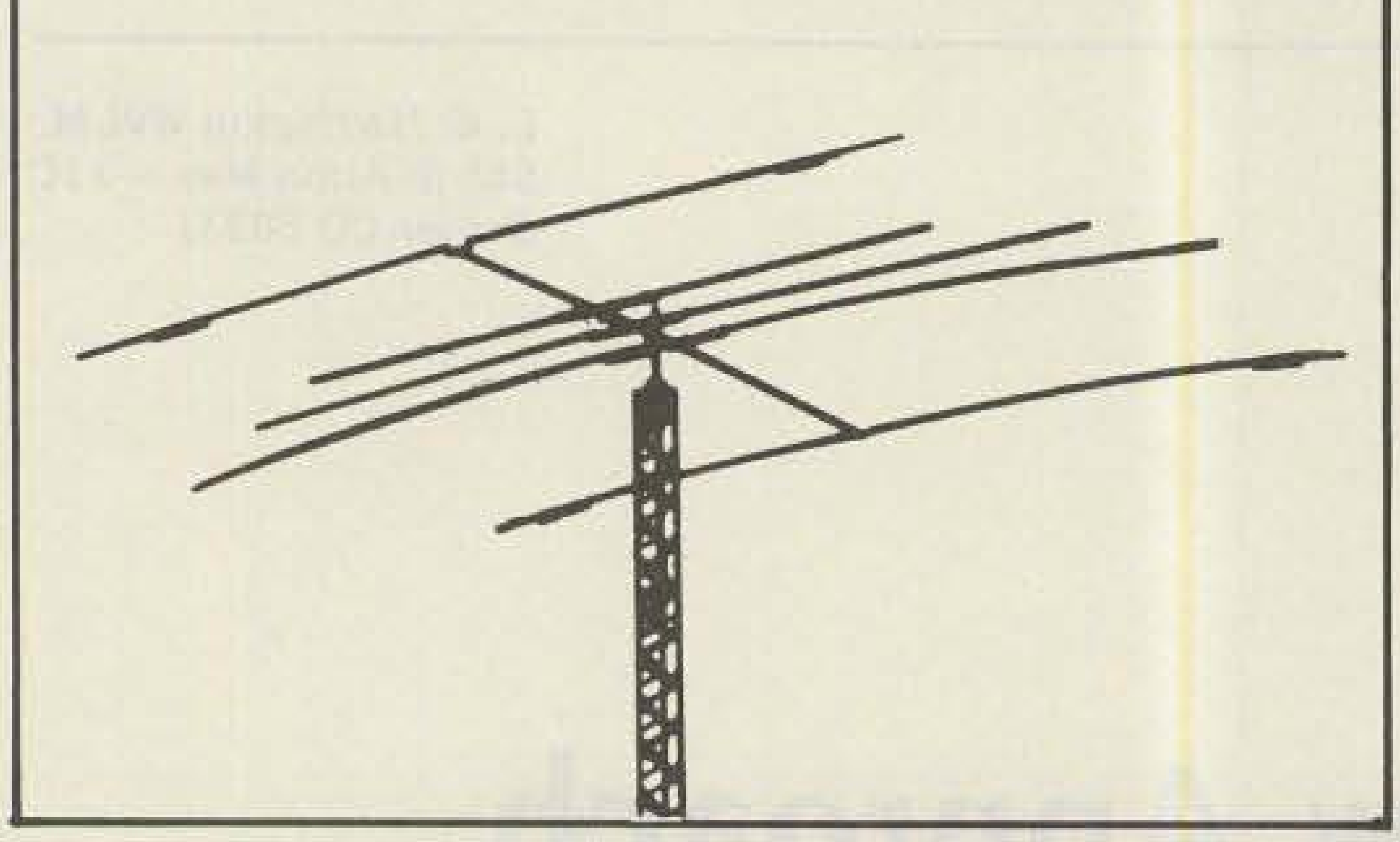
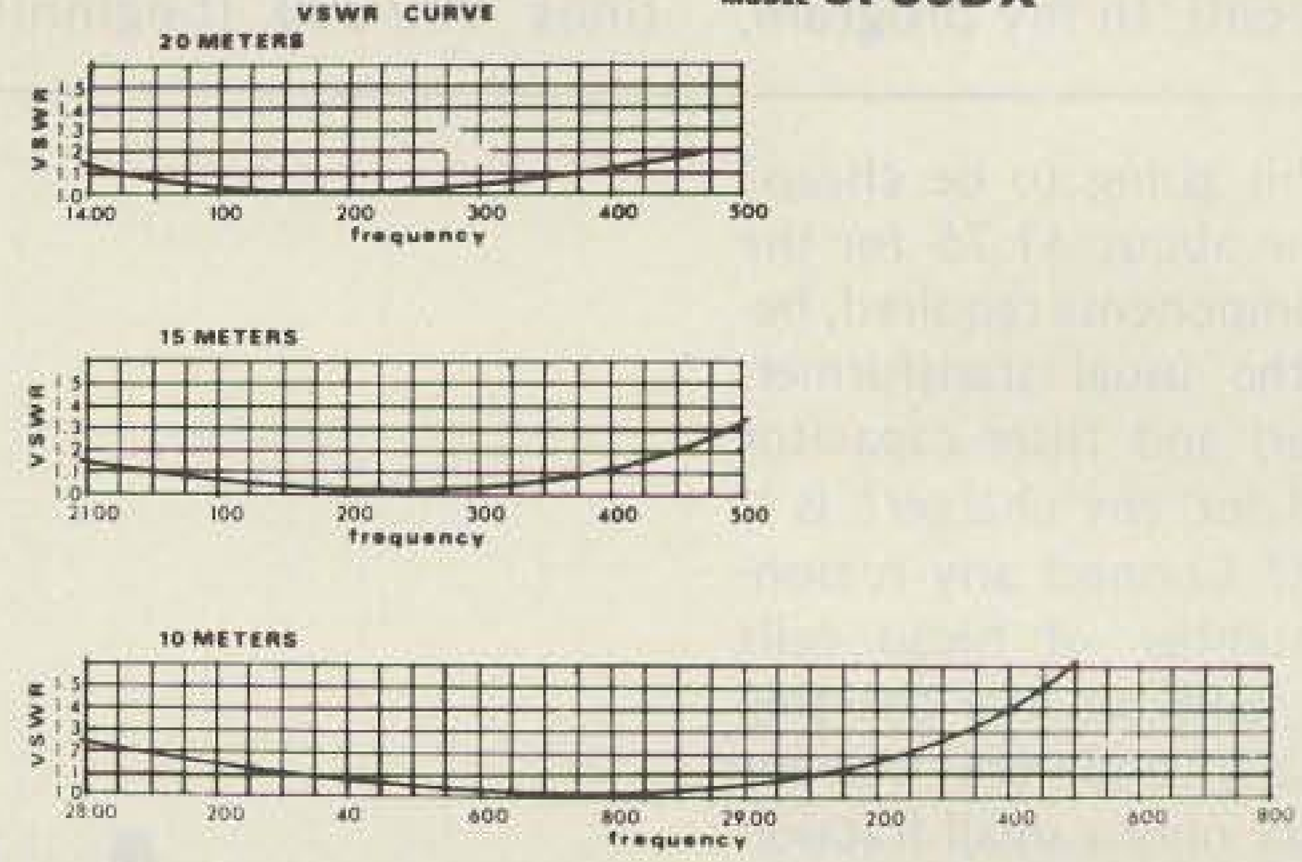
for the 10/15/20 meter amateur bands

USING PARALLEL-FEED, FULL SIZE INDIVIDUAL DRIVEN ELEMENTS, NOT USED BY ANY OTHER AMATEUR ANTENNA MANUFACTURER.

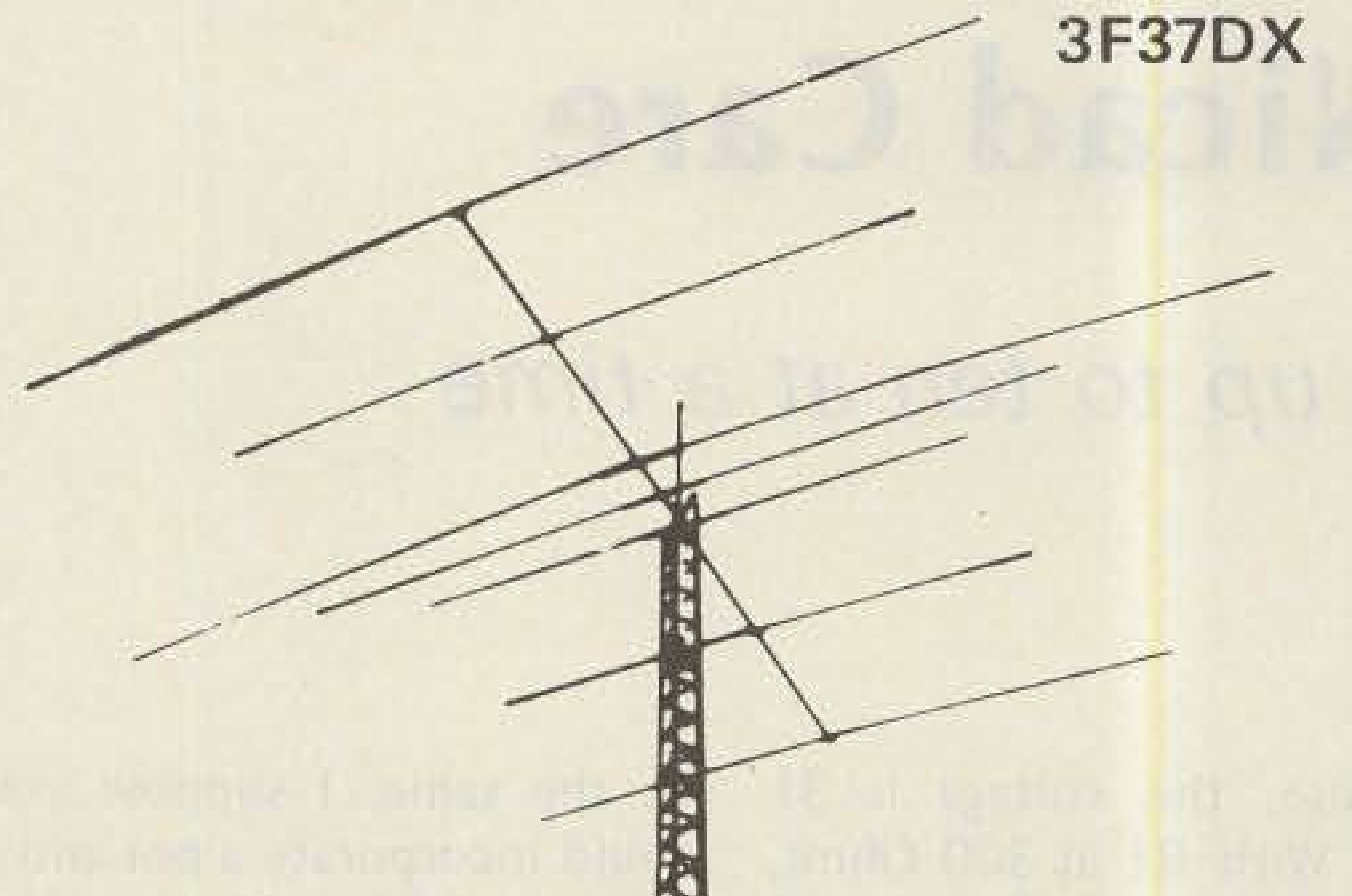
3F35DX



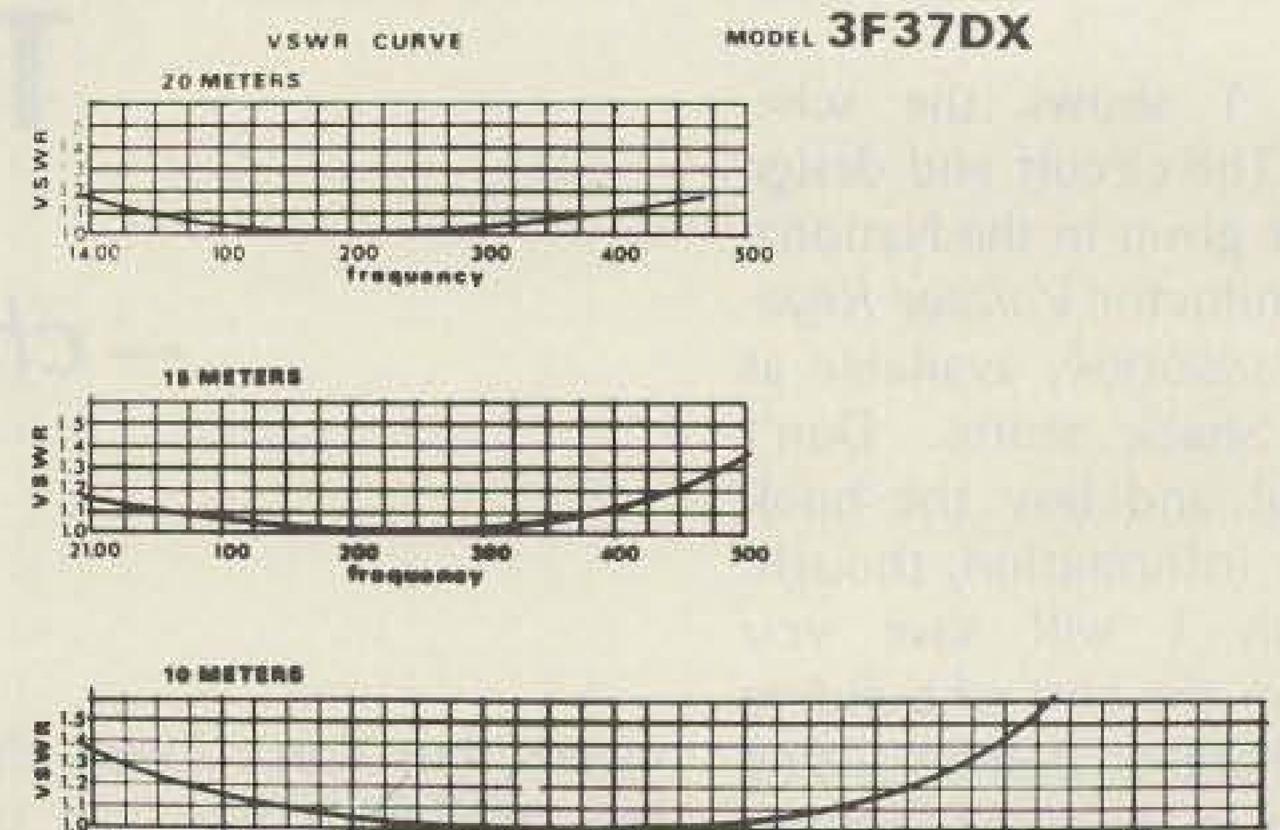
MULTI BAND BEAM DX SERIES MODEL 3F35DX



3F37DX



MULTI BAND BEAM DX SERIES MODEL 3F37DX



MODEL	3F37DX	3F35DX
BAND	10/15/20	10/15/20
ELEMENTS	7	5
ELEMENTS PER BAND, 10 METERS	5	3
15 METERS	5	3
20 METERS	3	3
ANTENNA GAIN/FRONT-TO-BACK RATIO	EXCELLENT	
MAX. POWER INPUT (PEP)	3 KW	3 KW
VSWR	1.5: 1 OR BETTER	
IMPEDANCE	52 OHMS	52 OHMS
MAX. ELEMENT LENGTH	35 FEET	34 FEET
BOOM LENGTH	24'8" FEET	16'5" FEET
BOOM DIAMETER	2 IN OD	2 IN OD
TURNING RADIUS	17.5 FEET	17.4 FEET
WIND SURFACE AREA	11.08 SQ. FT.	8.29 SQ. FT.
WIND RATING (AT 80 MPH)	127.1 LBS.	95.0 LBS.
SUITABLE MAST	2 IN OD	2 IN OD
WEIGHT (APPROX.)	55 LBS.	42 LBS.
SHIPPING WEIGHT (APPROX.)	62 LBS.	49 LBS.

Reader Service—see page 211

On the Razor's Edge

—it could happen

Hams, home-brewing, and hamburgers.

Ike Rodman W5WY/1
PO Box 19, Station No. 2
Amherst MA 01002

On a country hillside outside Oklahoma City, George in one tree and Jerry in another tugged a dipole antenna up between them. Besides the two young men in the trees, other signs that this was a weekend could be seen in the distance where, although it was 8:30 in the morning, light traffic moved along the interstate highway—a few cars and a short caravan of army-green trucks. The day seemed to portend nothing headier than a satisfying hilltop QRP contact. The sun would not be too warm, and the breeze not too cool.

The boys were classmates. George was WD5XZF, and Jerry was an unlicensed CBer. George wanted to convert to real radio. From the center of the antenna, a length of coax dangled to the ground near their bicycles. In the basket of George's bike, wrapped in a cloth for protection, nestled an HW-8 transceiver which he was going to demonstrate to Jerry, and a pair of lantern batteries to power it.

The boys were so engrossed in centering the antenna between the trees so no leaves would touch the wires that they did not notice a black limousine leaving the road down at the edge of the field and starting up the grassy hill trailing a wake of flattened grass sweeping across the field towards them. They did notice when the car stopped by their bicycles. The driver got out and opened a rear door. A big man in a dark suit emerged from the rear and stood by the door.

"Jerry?" the big man called. "Gerald William Williams?" He spoke in exaggeratedly polite tones. Jerry climbed down from his tree. "Yes?" he asked.

"Your father has been hurt," the big man said. "He wants you to come right away." George had tied his guy rope and hurried down from his tree. He was standing by Jerry's side. "Excuse me," George said, "but who are you?"

"Come on, kid. We don't have all day." The hissing voice came from another man inside the car.

"George!" Jerry shouted. "It's my father. He's been hurt. Don't stand around asking questions. Let's go." He was already scrambling into the back seat of the huge automobile.

"You don't know these men," George started to say; then he felt himself held firmly and pushed toward the car. He began to resist, but then he saw that inside the car the small man held a pistol aimed roughly at Jerry's right eye. George let himself be shoved into the car. The big man threw himself into the seat next to George and slammed the massive door. The small man sat on a jump seat facing Jerry. The car started to move.

The windows had heavy curtains across them. A thick sheet of glass separated the rear seat area from the front. The small man reached out and flicked another curtain closed behind the driver.

"Like a snake striking," George thought. The small man was thin and dressed in a tight plaid suit that reminded George of snakeskin. The rear seat area was now a dark, closed compartment. The boys could not see out.

George considered diving for the door to get away. He looked at the door, then looked again. He looked at the other door. The big man saw his glance and smiled. The door handles and window handles had been removed. The doors could not be opened from the inside.

The men took off their neckties, then George and Jerry felt their arms pulled behind their backs and their wrists tied with the neckties. The big man lit a cigar, then spoke.

"You might as well relax," he said, puffing on his cigar and settling back into his seat. "We're going a long way. You're going so far from anywhere there won't be any point in trying to escape. Har-har," he laughed and puffed on his cigar. "Karaff-hack," he coughed, sputtering smoke.

They drove and drove. The ride was so smooth the boys could not tell if they were going slow or fast. The minutes flowed into an hour or two. George wanted to see outside.

Making believe the long ride had made him sleepy, he slumped over, leaning against the bear of a man, who obligingly moved over. Soon George was almost lying down on the wide seat. He had enough room. He lashed out his leg and pushed the curtain open with his foot. Quickly he sat up and looked out.

He saw open fields, fence wire, and a telephone pole slipping backward. He saw these briefly, as if he were inside a large camera and the shutter has clicked open and shut once. A big hand threw the curtain shut.

"Don't try anything like that again," the big man growled. "You'll be sorry. I mean it."

George believed him. He was already sorry he had not learned more from his glimpse outside.

Finally the car's smooth motion stopped. The door swung open. The bright sun dazzled the boys' eyes.

The three men had a brief conversation next to the car. "The little one is more trouble than he's worth," the slender man hissed. "Williams is the one we want. Why don't I just blow the other one away?"

The driver took time to consider this suggestion. He looked into the car at George, then said, "No. Keep them both as long as they don't make any trouble. His old man may be worth something, too."

George felt they were just acting out this little skit to scare him into a cooperative mood. But, of course, he was not sure.

"Put them in the barn," the snake hissed to the bear.

Locked inside the barn, the boys struggled back to back and finally succeeded in untying each other's hands. Then Jerry sat down on a bale of hay and hit it with his fist. The bale was firmer than he had expected. He rubbed his hand and looked around to see what George was doing.

George walked around the barn, looking at everything in the dim light which sifted through the pigeonholes high up in all the walls. There was a hay door high above the loft. Slowly, George climbed an old ladder, testing each rung gingerly with more and more weight before finally trusting his balance to it. He reached the high door. "It's nailed shut," he called down just loud enough for Jerry to hear but not loud enough to be heard outside. "There are about a hundred ten-penny nails driven through to a couple of two-by-twelves I can see through the cracks. We'd never get through that."

Jerry's head sank lower and lower in his hands. George kept on searching. The pigeonholes and the locked main door were the only ways out. Jerry, feeling the minutes drag by, hit the hay bale again and again. George came back and reported on his explorations.

"No way out," he said, "but I found an old door buzzer installed in the back by the dairy stalls. The wires run all the way up to the rafters and then out the main door, but they're not connected to anything any more. The ends just dangle by the door."

"Wonderful," Jerry said sadly.

"But that's not all," George said with a smile. "I also found these." He held up an almost-empty paper towel roll and an almost-empty aluminum foil dispenser, left over, perhaps, from some picnic which had been forced by rain into the barn. "And I found a damp book of matches and put them in the sunshine by the crack of the door to dry."

"Wonderful," Jerry repeated. "I may cry."

"And there's some interesting junk in that barrel over there," George went on, pointing.

Jerry looked up through darker and darker eyes. He did not lift his chin from his hand. He did not answer.

"But best of all," George concluded happily, "this!" He stepped back and carefully picked up, from an old stone sink, one more prize: a rusty old razor blade.

Jerry looked from the razor blade in George's hand to George's eyes. Jerry's expression was so woebegone that George had to smile. "Here we've been kidnapped," Jerry began slowly, "we're locked in this barn without a hope of getting out, and even if we got out, we'd be a hundred miles from anywhere . . . "

"If you believe them," George interrupted, with a jerk of his thumb down toward the house.

"If you believe them," Jerry agreed. "But right now I do believe them. We're stuck out here without a hope, and our parents are probably worried sick right now because some strange hood is calling them demanding ransom for us, and you're gathering junk. If you're wondering why your enthusiasm depresses me, it's because I don't believe you're playing with a full deck."

"Wait," George said. "This may not be just ordinary junk. This may be . . . well, I have heard you can use these old blue steel razor blades for a detector in a crystal set instead of a crystal. It requires delicate adjustment of the cat's whisker, but they say it can be done, and I believe it. After all, any imperfect connection may rectify rf. That's why some people can hear local broadcast stations in their rain gutters or in their bedsprings."

"So?" Jerry asked.

"So," George said, pointing proudly to his little collection, "this junk might turn out to be radio junk."

Jerry groaned. "George, you have lost your mind," he stated judiciously. "Ham radio is all you can think about." He sagged forward and cradled his chin in his palms.

"Easy, buddy," George said. "This radio junk might give us an idea of where we are."

"You have a plan?" Jerry asked. He tried to sound sarcastic, but he couldn't help letting a little optimism creep into his voice.

"Yes, a plan—sort of," George went on. "If we know where we are, we might know what direction to go in if we get a chance. And besides, we don't have anything else to do right now."

"So what do we do?" Jerry no longer looked depressed.

"Well, we see if we can make a DF set, and . . . "

"DF?" Jerry asked.

"Direction-finding," George answered. "A direction-finding set is a radio receiver with a directional antenna. If we can hear stations in known locations, we might be able to locate ourselves in reference to them. We can try to make a crystal set out of the stuff we have; then we might be able to use it as a DF set by making a loop antenna out of the wire from the buzzer."

"Wow," Jerry said. Then he shook his head and hit the hay bale again. "And we do all this," he said, "with a piece of aluminum foil, a few paper towels, and an old razor blade?"

"Yes," said George. "And the bell wire from the door buzzer, this old jar lid, and a few more parts. We'll build it on the counter of this sink."

"Oh, no," Jerry groaned. "I remember what we needed when we made the crystal set at home: a variable capacitor and a coil, earphones, not to mention a crystal and holder, and an antenna and a ground system."

"You're right," George said. "But if we can use this razor blade as a detector, making the earphone will probably be the trickiest part. The rest shouldn't be too difficult. We'll make the coil variable instead of the capacitor. We can use the wire that runs through the rafters to the old buzzer for our antenna, and this cold water pipe will be our ground."

"Okay," Jerry agreed. "We might as well try it."

"Good. Do you have any tools with you? I left all mine back with our bikes."

"I just have my pocketknife," Jerry said.

"Good. That should let us get to work."

"What should I do?"

"Well, to start the earphone, we'll need to find a couple of nails. And we'll need something to hold the razor blade steady."

"Good. What size nails?"

"Two-penny finishing would probably be good," George said. "I'm just guessing. We'll be happy with anything you can find that isn't too big or too rusty."

"Great," Jerry said happily, because he didn't know a two-penny finishing from a two-bit starting, whatever that might be. While Jerry searched, George stripped bell wire off the door buzzer magnets and wound it around the cardboard tube from the aluminum foil package. Using the pocketknife, he made slits in the tube to hold the wire. Then he stripped insulation from a path down the coil where the slider would contact the windings.

"How do we know how long to make the coil?" Jerry asked.

"We don't. We'll just have to make it as long as we can, and we'll make as much capacitor as we have foil and towel. Then we'll just hope for the best," George confided.

"Oh, I see," Jerry said. He was beginning to sound discouraged again. "Here's a couple of shiny nails," he went on. "And I found this." It was an old coffee can with a plastic cap.

"What's inside it?"

"It seems to be white flour, and the cap seems to have kept it fresh and dry. Should we throw out the flour and keep the can in case it might come in handy?"

"You seem to be getting into the spirit of scrounging," George said. "Yeah, you can if you want, but I don't really think we'll have any use for it."

Jerry began to tip the can to pour the flour into the barrel, then he stopped. "We can use this," he said smiling, almost beaming for the first time since he had clambered into the limousine. "I'll tell you about it later. What's next for the radio?" He soon found a large antique, and now rusty, C-clamp to hold the razor blade, then asked, "What next?"

"Let's see. You make the capacitor," George said. "Tear the aluminum foil in two and make a double sandwich with three paper towels. Put the sandwich flat on the sink counter and weigh it down with that big board over there. Scrape some insulation from the ends of some lengths of bell wire and make a lead from each plate. Scrape back six inches or more and we'll hope the pressure of the sandwich is enough to make contact. I'll try to make an earphone by pounding these nails a little way into a piece of wood and winding lots of bell wire around them. Later, we'll place the jar lid over the nails and hope there's enough energy in the coils to make the lid vibrate sound waves we can hear."

While they worked, Jerry said, "Did you know flour can be explosive? If it's dispersed in air, there's so much surface area that it can explode. My science teacher demonstrated that last year. He put some flour in the end of a rubber tube and a lighted candle under an inverted coffee can. Then he blew into the other end of the tube, blowing the flour around in the can. There was a loud boom, and the can flew in the air."

"Huh," George answered.

"And there's a stub of a candle in the trash can and a garden hose in the loft."

"Hmm," George said. They made their plans.

Later, the boys were ready to test what was perhaps the largest, roughest-looking crystal-less crystal set in the world. The homemade capacitor lay under its board. Wires ran from it to either end of the coil on the cardboard tube. Antenna wire dropped from the rafters and connected to one end of the tuner, the other end of which was connected to the cold water pipe. From the antenna end, another wire ran to the antique C-clamp Jerry had found, which held the razor blade upright. All electrical connections consisted of about a foot of scraped bell wire wound around and around the desired point. The cat's whisker touching the blade was a piece of bell wire anchored under a rock for stability. From there a wire disappeared under the jar lid, the diaphragm of the earphone. Another wire crept from under the lid to the cold water pipe.

"Well," George said. "That's our amazing crystal set."

"The amazing thing will be if it works," Jerry responded. He leaned over so his ear was over the jar lid. George moved the slider up and down the coil and looked questioningly at Jerry.

"Nothing," Jerry said.

George moved the cat's whisker to another part of the blade, then moved the slider again.

"Nothing," Jerry repeated. "Oh, why did we waste time with this thing anyway? Just look at it," he said in disgust. He reached out and, before George could stop him, slammed his fist down on the capacitor sandwich. Both boys heard a tiny tinny clink in the earphone.

Jerry bent over the earphone again and moved the slider along the coil. "There's something here," he said, "but I can't hear it well enough to understand."

"I was afraid of that," George said. He began to pace; the orbit of his pacing widened. Then his eye fell on an old oatmeal box in the trash barrel. "Hold this over the lid," he told Jerry.

Jerry then lowered his ear to the open mouth of the box. "That's it," he said happily, careful to keep his voice low. "It's a radio. It works. There's music."

"Great. Let me listen," George said. "Super!" he announced in his most judicious tones. "It's stronger than I dared to hope—which means you can just about hear it." While holding the oatmeal box earphone, he moved the slider. "There's another station," he said. He moved the slider up and down the coil slowly. "That's it," he said, "two stations, both fairly strong.

The boys shook hands triumphantly. Then Jerry leaned back over the oatmeal box. He listened in silence a while, then said, "Here, this is it. They're going to identify." He leaned close to the mouth of the box and held his breath so as not to miss the announcement. "Hey, it's KTOK!" he reported.

"KTOK?" George echoed. "That's Oklahoma City. That's home!"

Jerry started to shout, but then caught himself so quickly it would have sounded like little more than a sneeze to anyone outside. He tuned down to the other station and listened. He started humming with the music. "Wait," he said. "It's over now. The DJ's talking. Wait. It's . . . yes. This is KNOR."

"KNOR—Norman!" George said. "That's a good sign. We can't be far from home. KNOR is at 1240, and KTOK is about one megahertz. I guess our radio only tunes the high end of the broadcast band. Let's make our DF loop."

They pulled all the stiff wire down from the rafters and wound it in a big loop, tying the loop to a board they could use for a handle. "Now let's see if we can hear anything at all," George said. He stood with the loop in front of him. "Do you hear anything now?"

Jerry, bent over the earphone, answered, "Nothing. Nothing at all."

George turned slowly, holding the loop in front of him. "Nothing, nothing," Jerry said.

"Tune it again," George suggested. "The different antenna could make a difference in the tuning."

Jerry moved the slider all the way down the coil, then slowly all the way back up. He tried the whole range of the coil again. "Nothing," he said. The boys looked at each other for a long minute while neither thought of anything to try or say. Then Jerry, perking up somewhat, said he would try one more time. He held his breath, and slowly slid the slider down the coil. "Nothing," he said. "No. Wait! There is . . . something . . . here, you'd better listen to this."

Jerry took the antenna from George, who put his ear to the oatmeal box. He heard a rhythmic hissing. He realized why Jerry had wanted him to listen. When his ear adjusted to the strange hiss, he could copy CW strong and clear: "OLZ OLZ OLZ DE W5RB QNI K."

"Well, I'll be," he said. "We can tune the 80 meter band. That's Gil calling the Oklahoma Traffic Net."

Jerry took a step toward George. The signal George was again copying became weaker. "No," George said. "Turn the other way. That's it. More. More. No, now it's getting weaker again. That's right, back this way a little. Right. Right there, I guess. He's due west of us."

"Wow," Jerry said. "Do you know this guy Gil?"

"I've contacted him on the net. I know he has a farm somewhere south of the city. His signal is really strong. We can't be very far from him."

"Okay," Jerry said, his voice quavering with eagerness and apprehension. "Let's get on with the plan. Step two."

"HEY! SNAKE! BEAR! DRIVER! COME QUICK! HEY, YOU THUGS, ON THE DOUBLE!" The boys yelled at the tops of their lungs, then they subsided and hid behind a wall of hay bales.

Soon they heard the crossbar moving on the main door, then the door opened a little—just a little. Nothing else happened. The boys watched the door. Jerry held one end of a water hose. The hose lay across the floor under the hay and ran under a dividing wall and into the stalls at the rear of the barn.

Into the strip of light at the door, first Snake's head appeared, then, over his, Bear's. They looked around, did not see the boys, and then looked at each other. George nudged Jerry to indicate "Now." Jerry blew into the hose.

BOOM!

From the back of the barn, a small explosion roared. The men at the door looked at each other, then ran past the boys, around the partition. George and Jerry burst from behind the hay and sprinted for the door. Outside, they pushed the door shut and locked it with the four-by-four crossbar.

"The driver," Jerry said. "Should we do step three?"

George hesitated a moment before answering. "Guess we'd better," he said. They ran to the limousine and opened both rear doors and the driver's window. George reached in and started blowing the horn while Jerry hid behind the car. He blew it again and again. The driver came out of the house and saw George.

"Hey, what are you doing out here?" the driver shouted and started to sprint to George. As he ran, he looked up at the barn and back at George, who turned deliberately and sat in the rear seat of the car. The driver reached the car and dived in after George. In another moment he would have grabbed George, but Jerry came out from behind the car and hurried around behind the man.

"Hey, you!" Jerry shouted. The driver hesitated for just the necessary moment. George got away.

The driver looked back at Jerry. "Hi there," Jerry said and slammed the door. The driver's face seemed to show in this moment that he understood what was happening but knew he couldn't react quickly enough to stop it from happening. George slammed the other door. The driver was trapped in the rear of the car with no inside door handles.

The boys started running west up a long slope as hard as they could go. Behind them they heard pistol shots from the barn. "They may be able to shoot their way out," George said. "Let's give it all we've got." Jerry, not wasting his energy talking, was passing George.

Cresting the hill, looking into a valley under the setting sun, the boys saw a tall tower with a large beam antenna on top. The house below the tower was strung with various wire antennas. The two boys ran about 200 yards from the crest of the hill to the door of the house. They knocked on the door, then banged on it.

The door opened. A thin man with grey hair and friendly eyes stood in the doorway.

"You're Gil W5RB, right?" George gasped, between gulping air. "I'm George WD5XZF. We were kidnapped and we escaped. Please let us in."

Gil stepped out of the way. Breathless, the boys ran in, and, while Gil closed and locked the door, relaxed for a moment in the luxuriance of repeated deep breaths.

"It's good to meet you," Gil said, and shook George's hand. George introduced Jerry while Gil picked up the telephone, and Jerry also felt the firm handshake.

"Uh-oh," Gil said, looking at the telephone receiver in his hand. He jiggled the cradle up and down, listened again, then lowered the receiver to its cradle.

"The phone just went dead, boys," he said, his face serious. "That means your friends are out there."

"And they have guns," Jerry said.

"Pistols," George said.

"So I guess we're just sitting ducks," Jerry said sadly. "They can push their way in here and . . ."

"I doubt if they'll rush us right away," Gil said. "They probably expect a farmer to be armed. They'll feel the situation out for a while. And we have another card to play." He turned toward the rear of the house.

The boys followed into a

back room full of radio equipment: cabinets and racks of meters, dials, knobs, and switches. "Uh-oh," Jerry said. "Your clock has stopped."

"They found the main power switch in the barn," Gil said. "But I wasn't going to use the big rig anyway." He picked up a small handie-talkie, pressed the button, and talked into the grill.

"K5VJO, this is W5RB."

After a minute's pause, the answer came loud from the grill on the little instrument. "W5RB from K5VJO. It took me a while to get back to the jeep, Gil. What's up?"

"Jeep?" Jerry asked.

"Jeep," Gil affirmed with a smile, then pushed the mike button. "Al, this is a Mayday. Repeat, Mayday. Two young men were kidnapped this morning and taken to the abandoned farm next to me. They escaped to my house. The kidnappers are outside right now, armed with pistols."

"Okay, Gil," the voice from the radio said. "We'll take care of it. Hang loose, now."

"Thanks, Al," Gil said. He turned to the boys. "I heard Al on the air earlier today. He's on weekend drill with the National Guard around Edmond."

"I'd feel a lot better if . . ." Jerry began.

"Let's try not to worry," Gil said. "I think we've done all we can for now. Would you boys like something to eat?" He carried his handie-talkie into the kitchen, and of course the boys followed.

"You talked to Edmond with that little thing?" Jerry asked.

"That's right," Gil said. "Our club has a repeater up on the channel 9 tower. We're just one of hundreds of repeater clubs around the country. The repeater picks up our handie-talkie and automobile-mobile transmissions and retransmits them from its high, central location, covering the whole metropolitan area. I heard Al say he was going to monitor the repeater during his Guard drill. He's Emergency Coordinator with the Air Cavalry unit."

Gil put a big frying pan on the stove and took some hamburger patties from the refrigerator. Soon the patties were sizzling in the pan and the boys were spreading catsup, mayonnaise, and mustard carefully to the edges of their sliced hamburger buns. They were pouring three glasses of milk when the house began to shake in a violent flapping thunder. They ran to the window, cautiously parted the drapes, and looked outside. Five giant army-green helicopters circled and swooped toward the house from five different directions. As the boys watched, the kidnappers ran out of the barn toward the limousine. One chopper landed in a terrible cloud of dust next to the car. Four Guardsmen, dressed in fatigue uniforms and combat boots and armed with M-14 rifles, jumped to the ground and faced the kidnappers, who stopped, looked astounded, shook their heads in disbelief, and then threw their pistols to the ground and raised their hands.

The ground fell away dizzyingly. The boys felt their insides pressing down. The earth below tipped and rotated. It was their first ride in a chopper. In all the excitement they had forgotten their hamburgers. They were eager to get back to their hillside, back to their bicycles, and then to get home to supper. ■

✓ Reader Service—see page 211

73 Magazine *Staff*

Tips for VOM Users

—current topics

Put some meaning into your measurements.

Most amateurs, when they learn about test instruments, particularly multimeters, understand that such instruments must not be used in such a manner that they "load" the circuit being tested. Otherwise, readings will be obtained which do not truly indicate the parameter one is trying to measure. In the case of multimeters when measuring voltage, the Ohms/volt rating of the multimeter can be used to determine the loading effect the multimeter will have on a circuit when the meter is used on any given voltage range.

However, a point that is often neglected when using multimeters is to evaluate what effect the meter is having on a circuit when measuring current. This point was not stressed when many old-timers learned radio, but today, with the widespread use of low-voltage, high-current circuits, due to the use of solid-state devices, it can take on considerable significance.

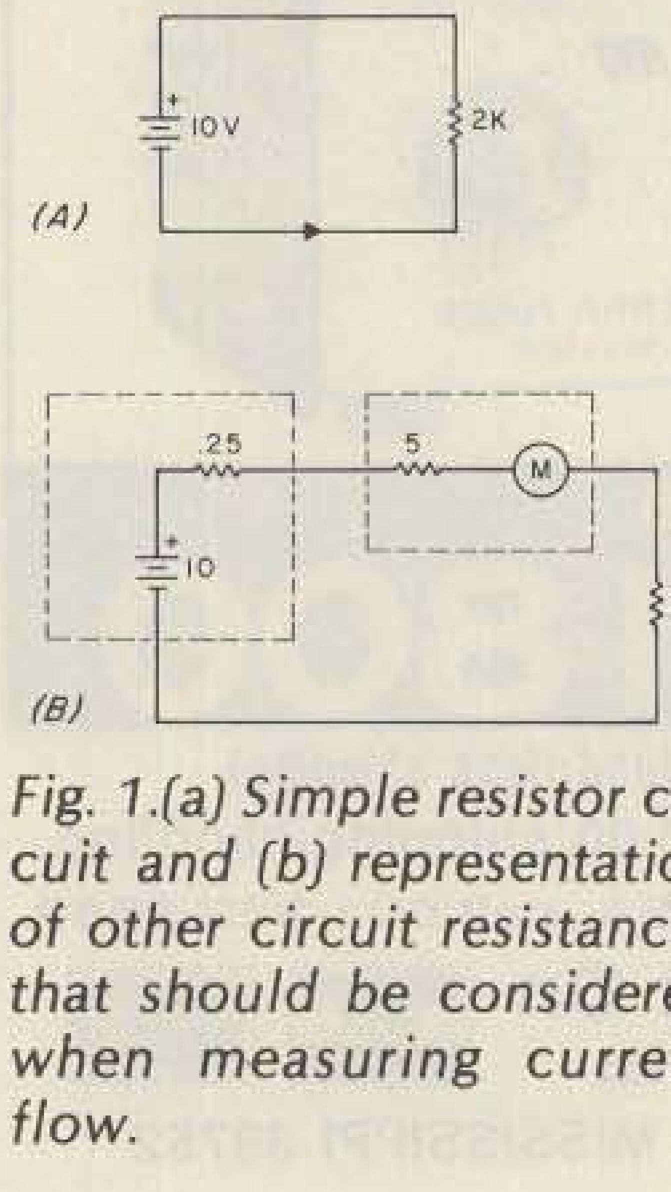


Fig. 1.(a) Simple resistor circuit and (b) representation of other circuit resistances that should be considered when measuring current flow.

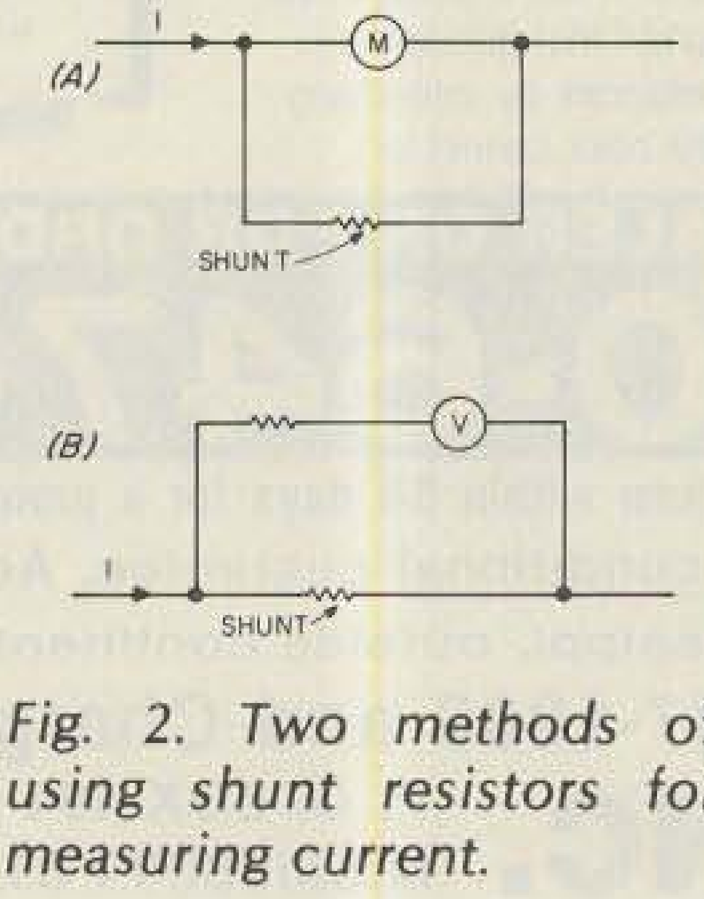


Fig. 2. Two methods of using shunt resistors for measuring current.

There are two points to watch in making current measurements. One is the relationship of the resistance of the meter being used to measure current in comparison to the other resistances in a given circuit as far as it affects the current reading. For instance, in Fig. 1, we have a circuit represented by the 2,000-Ohm resistance powered by a 10-volt battery, and want to measure the current flow.

If we insert a milliampere meter in the circuit, as shown in Fig. 1(b), two other resistances actually have to be taken into account. One is the internal resistance of the battery, and the other is the internal resistance of the meter. These are represented by the 0.25-Ohm and 5-Ohm resistors, respectively. If we had just the elements of Fig. 1(a), a 5.0-milliampere current would flow. With the added resistances of Fig. 1(b), one can easily enough calculate, using Ohm's Law, that 4.99 milliamperes flows in the circuit.

Since this certainly checks out closely enough, let's consider the other point to be careful of in making current measurements—how the the relationship of the resistance of the meter being used to measure current flow in comparison to the other resistances in the circuit changes the operating voltage across the circuit. Remember that the circuit was represented by a 2,000-Ohm resistor. In reality, of course, many circuits are not linear in their loading characteristics across a supply voltage. That is, the apparent resistance will change according to the supply voltage used. So, if a meaningful current measurement is to be made, the process of taking it must not significantly change the voltage across a circuit. For the case of Fig. 1(b), it does not take too much exercise of Ohm's Law to calculate that the actual voltage across the 2,000-Ohm resistor is practically unaffected at 9.97 volts.

One may ask why the foregoing should be worried about when taking current measurements if the meter's effect on the circuit is so insignificant. The example cited does represent realistic values. That is, 5 Ohms resistance for a 5- or 10-milliampere instrument would represent the coil resistance of a good quality d'Arsonval-type meter movement. However, in reality, one usually doesn't use a basic milliampere meter, but, rather, the current ranges on a multimeter. The usage of the latter brings about a new set of conditions.

Classic ammeter circuits are usually formed by using a basic meter movement and then placing shunts across it as shown in Fig. 2(a). However, in most of the imported multimeters which abound in ham shacks, the meter in the multimeter is actually used as a voltmeter when current measurements are being made, as shown in Fig. 2(b). The meter has a resistance in series, and then the voltage is measured across a current shunt. The reason for doing this is that many multimeters use quite sensitive meter movements (as low as 10 microampere movements) in order to achieve good sensitivity on voltage measurements, or, said in another way, to achieve a high Ohms/volt characteristic so loading effects when taking voltage measurements are minimized. To use these meters directly in the current measuring scheme of Fig. 2(a) would require extremely close tolerance and, hence, expensive shunts. This is particularly true for the higher current ranges, since the percentage of the total current that can flow through the meter becomes very small.

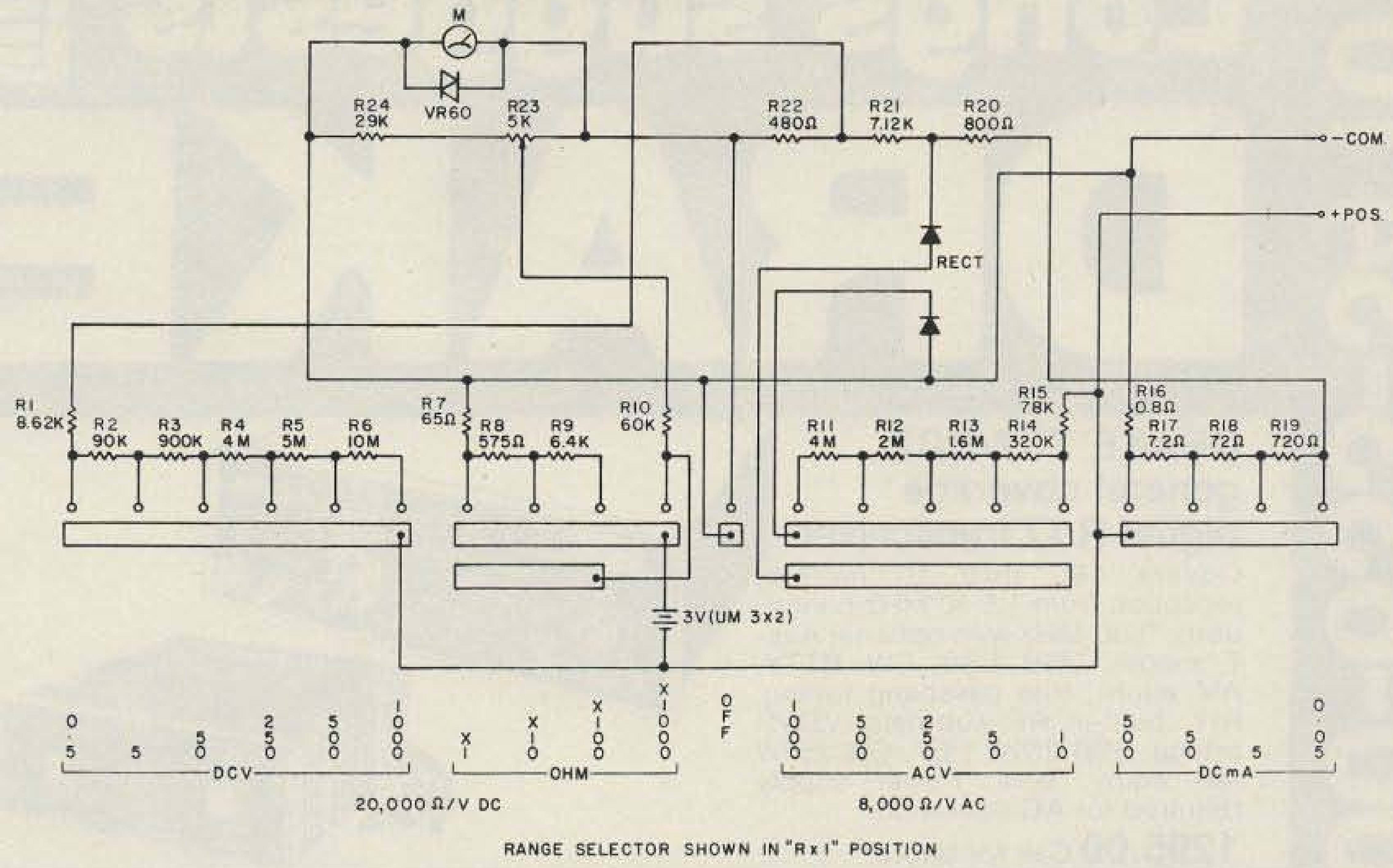


Fig. 3. Typical schematic of moderately-priced ($15-35) multimeter. Note the arrangement of the resistors for the current ranges on the right side.

Fig. 3 shows the diagram of a typical medium-quality multimeter. Note that, for the current ranges, the meter is set up to measure the voltage across current-shunt resistors of approximately 80, 8, or 1 Ohm. The voltage drops that were measured across the terminals of the multimeter when it was used for different current measurements are shown in Table 1.

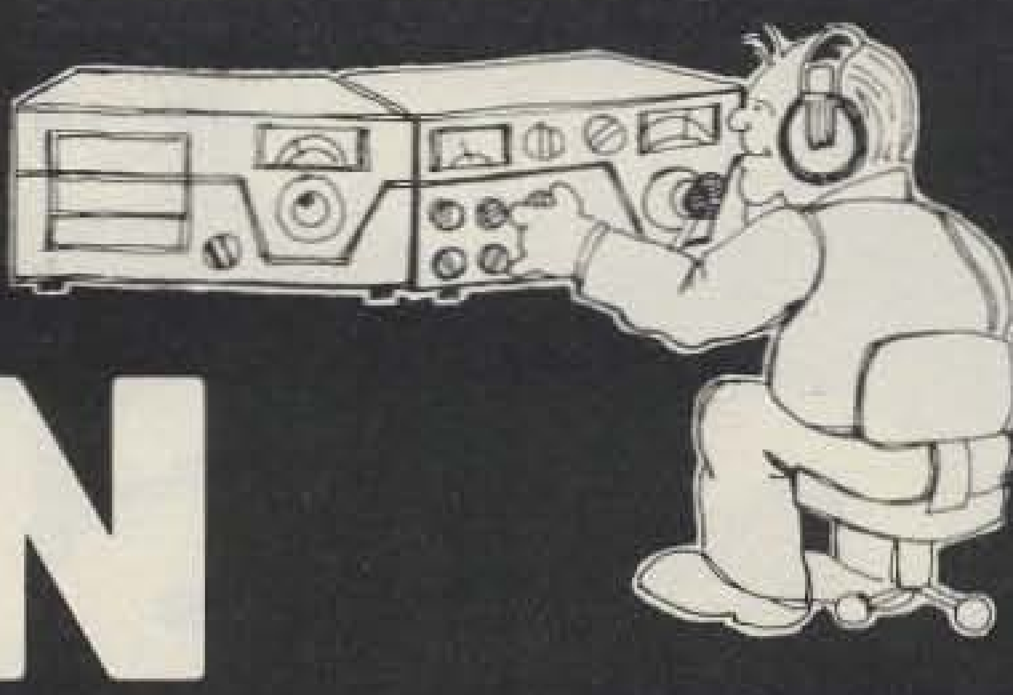
If one looks at the voltage drops across the meter terminals for full-scale deflection on any of the milliampere ranges, the message should be getting clearer. Up to ½ volt lost across the meter terminals can be very significant when trying to measure the current drawn by some low-voltage battery-operated circuit or some high-current IC circuit. The ½ volt represents 17% of the supply voltage for a 3-volt circuit and 11% for a 4.5-volt circuit. But one cannot relate these percentages directly to the error in the current being measured. As was mentioned before, circuit loading is often not linear. So a small increase in the actual voltage across a circuit may increase the current drawn from a supply by a significant amount. Therefore, the real error in current measurement might be several times greater than the basic percentage error might indicate. This can have significant effects when trying to troubleshoot equipment, evaluate what sort of batteries to use for a circuit, check the power dissipation of a low-voltage circuit, etc.

The foregoing tabulation also indicates how one can overcome the situation. Namely, by measuring current on a range which produces minimum meter deflection so as to reduce the voltage drop in the multimeter. Of course, one sacrifices accuracy of measurement in this manner, but that is the compromise required with moderately-priced multimeters. It would be a good idea to check the actual voltage drops on the current ranges on a multimeter using another instrument and affix a small label to the multimeter giving the values. Who knows? Maybe someday even the manufacturers will do this along with the Ohms/volt figures they seem more eager to advertise. ■

Range	Current	V. Drop	Current	V. Drop
50 A	10 A	.025	50 A	.075
5 mA	1 mA	.075	5 mA	.4
50 mA	10 mA	.08	50 mA	.4
500 mA	100 mA	.16	500 mA	.5

Table 1.

Longs suggests DENTRON



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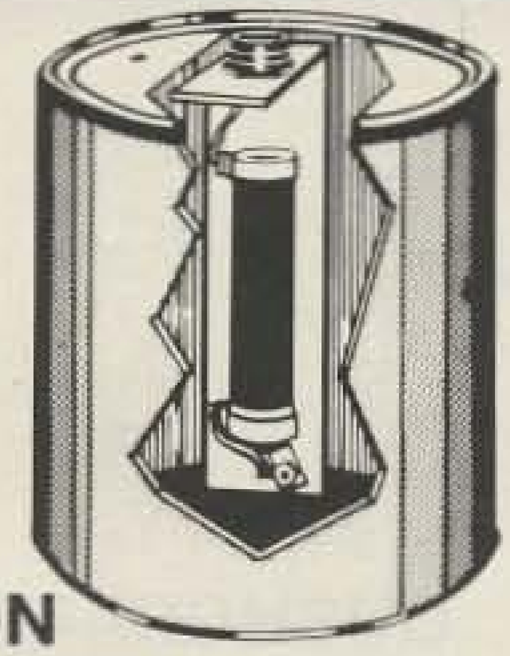

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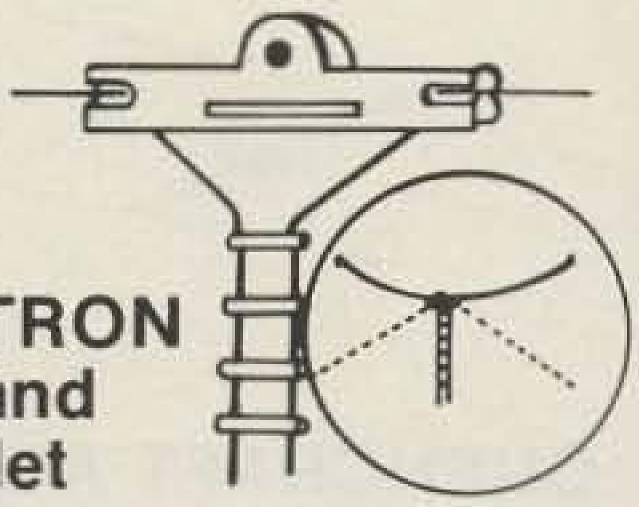

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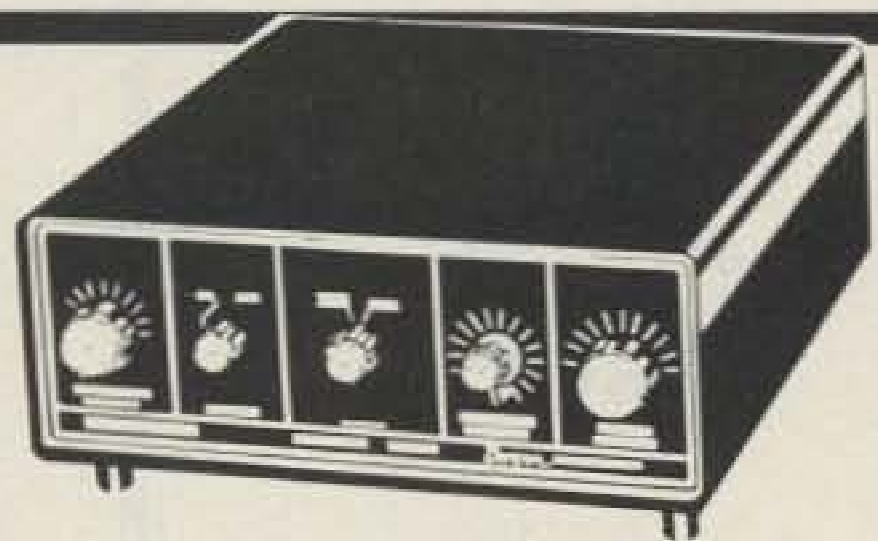

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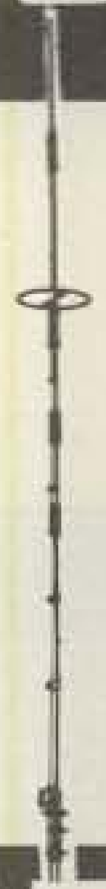

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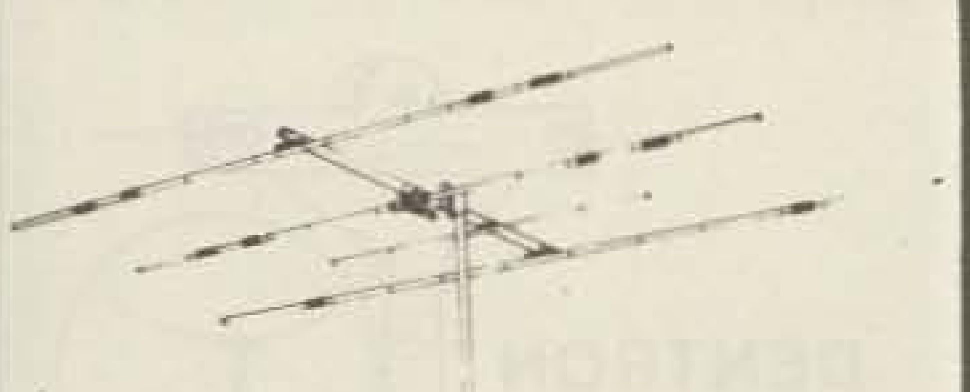

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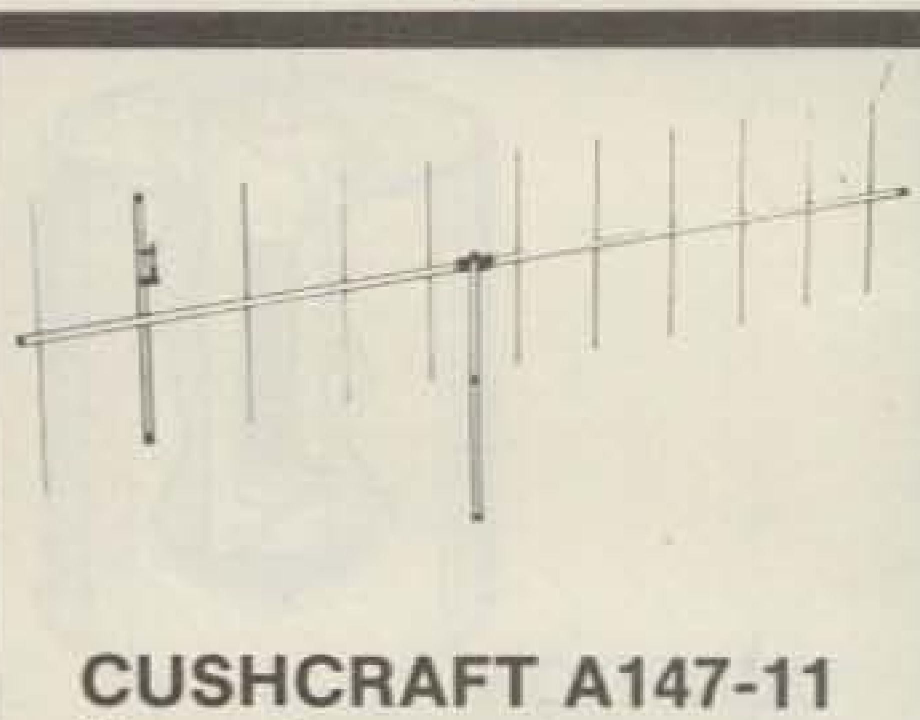

CUSHCRAFT A147-11 2m antenna

The II-element antenna is rated at 1000 watts with direct 52 ohm feed and PL-259 connectors. Boom length 144 ins. Longest element 40 ins. Gain/F/B ratio dB: 13.2/28. Freq. 146-148 MHz. Wind area 1.21 sq. ft.

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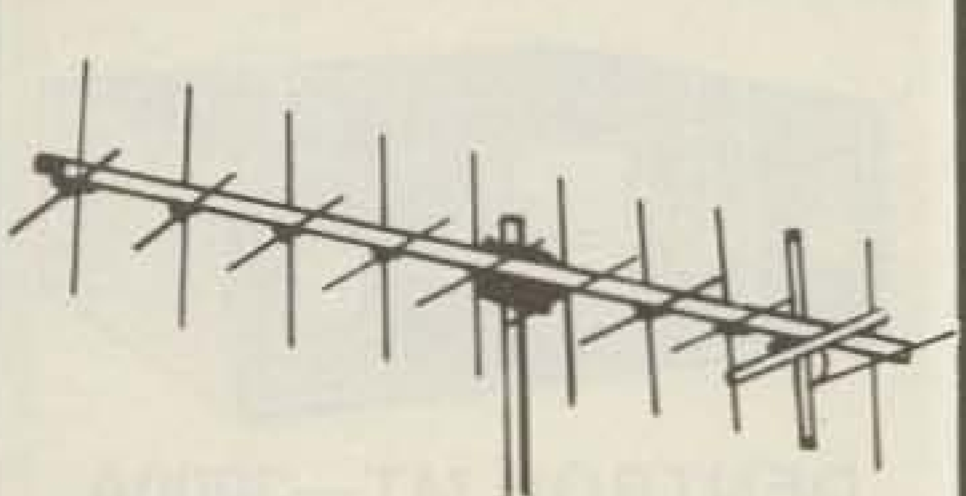

CUSHCRAFT A144-20T 20 element twist

Freq. range 135-150 MHz. 10 elements horizontal, 10 elements vertical. Has 12.4 dB gain horizontal, 12.4 dB gain vertical, 13.6 dB gain circular polarization. F/B ratio 22dB. Boom length 144". Weight 6 lbs.

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Freq. range 50-54 MHz. Power capability 100 watts. 3.75 dB gain over ¼ wave whip. with low angle of radiation. SO-239 connector.

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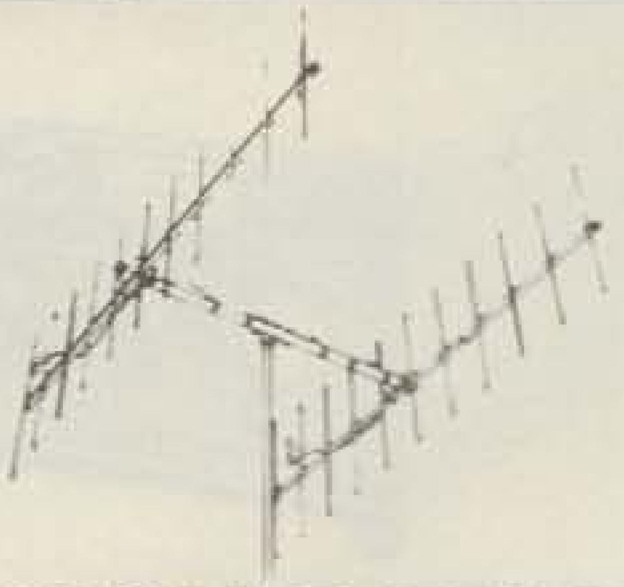

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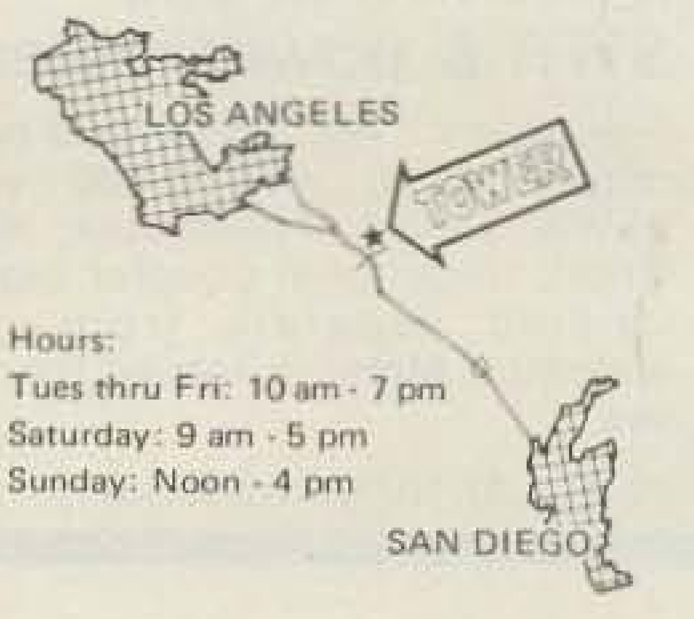

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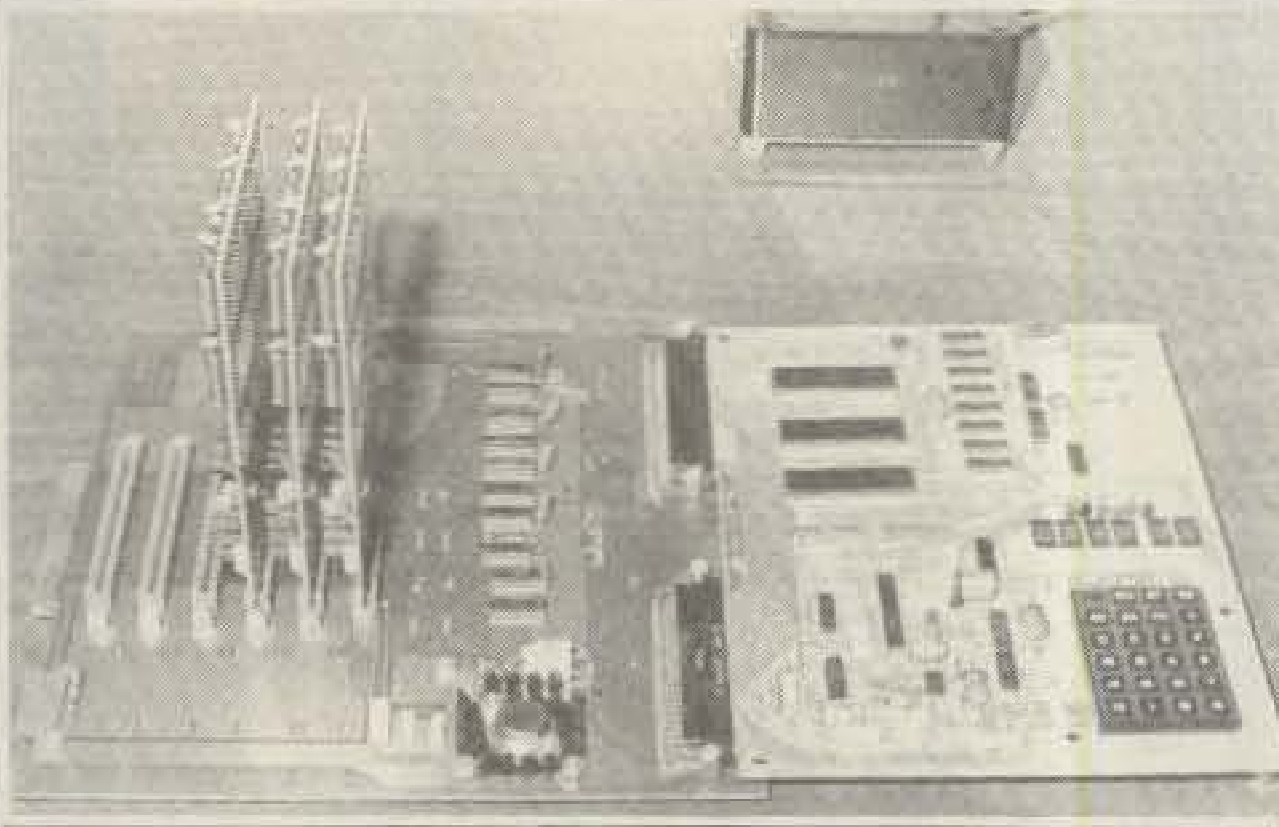

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Reader Service—see page 211

Social Events

CIRCLEVILLE OH
MAR 4

The King of the Pumpkin Ham Fiesta, sponsored by the Teays Amateur Radio Club, will be held from 9:00 am to 5:00 pm on Sunday, March 4, 1979, at the fairgrounds coliseum, Circleville, Ohio. There will be an indoor flea market, new and used equipment, door prizes, refreshments, and free parking. Table spaces are available at $3.00 each. Advance admission is $1.00; $2.00 at the door. For advanced reservations and information, contact Dan Grant W8UCF, 22150 Smith Hulse Road, Circleville OH 43113; (614)-474-6305.

STERLING IL
MAR 4

Sterling Rock Falls Amateur Radio Society will hold its annual hamfest on March 4, 1979, at the Sterling High School Fieldhouse, 1608 4th Avenue, Sterling, Illinois. Tickets are $1.50 in advance; $2.00 at the door. A large indoor flea market is restricted to radio and electronic items only. There is plenty of free parking available, including an area to accommodate campers and mobile trailers. There will be no advance sale of tables. We will take reservations for commercial enterprises only. There will be bargains, miscellaneous prizes, and food. Talk-in on 146.94. For tickets, write Don VanSant WA9PBS, 1104 5th Avenue, Rock Falls IL 61071. Make checks payable to Sterling Rock Falls Amateur Radio Society. Please include an SASE.

DEMAREST NJ
MAR 10

The Chestnut Ridge Radio Club will hold its flea market on March 10, 1979, at the Demarest Methodist Church, 109 Hardenburg Road, Demarest, New Jersey. Tables are $5.00, and tailgating is $3.00. There is no admission fee for buyers. There will be hot dogs, soda, and door prizes. For more information, contact Jack Meagher W2EHD at (201)-768-8360, or Andy Woerner K2ETN at (201)-261-1047.

FLEMINGTON NJ
MAR 17

The Cherryville Repeater Association will hold its annual hamfest on March 17, 1979, from 10:00 am to 5:00 pm, at the Field House of Hunterdon Central High School, just north of Flemington, New Jersey, on Route 31. Admission is $2.50 per person. There is plenty of space, with over 200 sellers' tables, and displays from major manufacturers. There will be seminars and door prizes.

VERO BEACH FL
MAR 17-18

The Treasure Coast Hamfest will be held on March 17-18, 1979, at the Vero Beach Community Center, Vero Beach, Florida. Activities will include prizes, drawings, and a QCWA luncheon. Admission is $3.00 per family. Talk-in on 146.13/.73, 146.52/.52, and 222.34/223.94. For information, write PO Box 3088, Vero Beach FL 32960.

MIDLAND TX
MAR 18

The Midland Amateur Radio Club is having its annual swapfest on Sunday, March 18, 1979, at the Midland County Exhibit Building, Midland, Texas. There will be door prizes. Preregistration is $4.50; $5.00 at the door. Talk-in on 146.16/146.76. For information, write Midland Amateur Radio Club, Box 4401, Midland TX 79701.

JEFFERSON WI
MAR 18

The Tri County ARC Hamfest will be held on March 18, 1979, at the Jefferson County Fair Grounds, Jefferson, Wisconsin. Advance tickets are $1.50. Reserved 6-foot tables are $2.00 in advance, while 6-foot space is $1.00. For information, send an SASE to Glenn Eisenbrandt WA9VYL, 711 East Street, Fort Atkinson WI 53538.

LAWTON OK
MAR 23-25

The Lawton-Fort Sill Amateur Radio Club, Inc., will hold its 33rd annual hamfest at the Montego Bay Motel Complex at Lawton, Oklahoma, the weekend of March 23-25, 1979. There will be the usual large flea market, ARRL officials, technical programs, QCWA breakfast, and activities for the ladies.

EAST RUTHERFORD NJ
MAR 24

The Knight Raiders VHF Club, Inc., will hold its world-famous flea market at St. Joseph's Church, East Rutherford, New Jersey, on Saturday, March 24, 1979. Doors open at 10:00 am. There will be free admission and free parking. Refreshments will be available. Flea market tables are available for: $5.00/full table or $3.00/half table, in advance; $6.00/full table or $3.50/half table, at the door. Talk-in on 146.52 and 144.65/145.25. For further information, call Bob Kovaleski at (201)-473-7113 or Jack Mandelberger at (201)-857-0016 (evenings only). Send reservations to: R. Wetzel, 419 Union Ave., Rutherford NJ 07070, and make checks payable to: Knight Raiders VHF Club, Inc.

FT. WALTON BEACH FL
MAR 24-25

The Playground Amateur Radio Club will hold its ninth annual North Florida Swapfest on Saturday and Sunday, March 24-25, 1979, at the Ft. Walton Beach City Fairgrounds, Ft. Walton Beach, Florida. Advance registration is $1.00; $1.50 at the door. Swap tables and meetings are all under cover. There will be QCWA, MARS, and ARES seminars. Talk-in on 52 and 19/79. For more information, write PARC, Box 873, Ft. Walton Beach FL 32548.

WAUKEGAN IL
MAR 25

The Libertyville and Mundelein Amateur Radio Society will hold its second annual Lamarsfest on Sunday, March 25, 1979, at the J. M. Club, 708 Greenwood Ave., Waukegan, Illinois. Doors will open at 7:00 am.

Reader Service—see page 211

There will be plenty of free parking, door prizes, and a large indoor flea market for radio and electronic items. Tables will be available at $4.00 each. Advance tickets are $1.50; $2.00 at the gate, with children under 10 free. Hot lunch will be available and there will be plenty of commercial exhibits and demonstrations. Talk-in on 146.94. For further information, write LAMARS (include SASE, please) at 1226 Deer Trail Lane, Libertyville IL 60048, or call (312)-367-1599.

MAUMEE OH
MAR 25

The Toledo Mobile Radio Association will hold its 24th annual auction and hamfest on March 25, 1979, at the Lucas County Recreation Center, Maumee, Ohio. Tickets are $2.00 in advance, $2.50 at the door. Parking is free. Prizes include a Kenwood TS-520, a Yaesu CPU-2500R/K, a Wilson Mark IV, and a Bearcat 210 Scanner. Talk-in on 146.52/.52 and area repeaters on 146.01/.61, .19/.79, .34/.94, .87/.27, and .975/.375.

MUSKEGON MI
MAR 30-31

The Muskegon Area Amateur Radio Council is sponsoring the ARRL Great Lakes Division Convention and Hamfest at the Muskegon Community College in Muskegon, Michigan, on March 30-31, 1979. This event will feature manufacturers' exhibits, technical forums, and a large swap shop. Ample parking and dining facilities are available. Friday evening at the Muskegon Ramada Inn, there will be a "Ham Hospitality" with libation courtesy of the MAARC and a Wouf Hong initiation. For additional information, contact MAARC, PO Box 691, Muskegon MI 49443, or H. Riekels WA8GVK, (616)-722-1378/9.

ST. LOUIS MO
MAR 31

Mayor Conway of St. Louis has proclaimed March 31st as Amateur Radio Day, and, in conjunction with this, the Gateway Amateur Radio Association is sponsoring a hamfest which promises to be a good one. Hamfest hours are 8:00 am to 6:00 pm at the H. J. Cervantes Convention Center. Scheduled events include: Wayne Green on microcomputers, an antenna forum by Hy-Gain, an FM and repeater forum by Motorola and VHF Engineering, FCC Q & A, a station-design forum by Drake, a low-cost transceiving forum by Atlas, a linear amplifier forum by ETO, a DX forum featuring the Navassa group and N9MM, a revolutionary method of learning Morse code, and an

OSCAR forum. There will be special meetings for teenage hams, Ten-Ten members, Breakfast Clubbers, SWOT members, YLRL members, and others. Activities for YLs include a fashion show, a cosmetic display, and a tour of St. Louis. Talk-in on .34/.94, .37/.97, and .52. Admission is $3.00. For further information, please contact Bob Heil K9EID, PO Box 68, Marissa IL 62257, or phone (618)-295-3000.

WORCESTER MA
MAR 31

The WPI Wireless Association will sponsor its first annual Spring Flea Market on Saturday, March 31, 1979, from 9:00 am to 4:00 pm, at the WPI campus in Worcester, Massachusetts. For more information, write WPI Wireless Association, Box 2393, Worcester Polytechnic Institute, Worcester MA 01609.

COLUMBUS GA
MAR 31-APR 1

The Columbus Amateur Radio Club will hold its first annual hamfest from March 31-April 1, 1979, at the Columbus Municipal Auditorium, US 27 & 280, Columbus, Georgia. Donation is $1.00 at the door. There will be plenty of free parking and overnight free RV space. Exhibitors and flea market will be inside, with a free flea market outside. Talk-in on 28/88. For advance registration and details, write Bob Glasgow N4BGN, 1503 Layard Drive, Columbus GA 31907; (404)-561-7746.

NATCHEZ MS
APR 1

The Old Natchez ARC Hamfest will be held on Sunday, April 1, 1979, at the Natchez Convention Center, Natchez, Mississippi. The event will be indoors and air-conditioned. There will be free admission and swap tables. Talk-in on 146.31/.91 and 146.52. For information, write ONARC, 1226 Magnolia Avenue, Natchez MS 39120.

PAINESVILLE OH
APR 1

The Lake County A. R. A. will hold its 1st annual Lake County Hamfest on April 1, 1979, from 8:00 am to 4:00 pm, at the Lake County Armory, located next to the N. E. corner of the Painesville Fairgrounds, Rt. 20, Painesville, Ohio. There will be indoor space for exhibitors, a flea market, and an auction. Reserved tables are $2.00 for a full table and $1.00 for a half table. Admission is $2.00 with children under 12 free. Talk-in on 52/52 and 147.81/147.21. For information, write L'CARA, PO Box 868, Painesville OH 44077, or call (216)-257-4486.

PHILADELPHIA PA
APR 1

The Penn Wireless Association will hold its Tradefest '79 from 8:00 am to 4:00 pm at the National Guard Armory, Southampton Road at Roosevelt Blvd. (Rt. 1), ½ mile south of turnpike exit 28. General admission is $2.00. Setup is at 7:00 am. Sellers may rent a 6' x 8' space for $3.00; you must bring your own table. Some tables are available for $1.00, and a minimum number of power connections are available for $2.00. There will be refreshments, displays, and a rest area. Talk-in on 146.37/.97 and 146.52. For more information, contact Chuck Miller AD3X, (215)-943-3973.

TOWSON MD
APR 1

The Greater Baltimore Hamboree will be held on Sunday, April 1, 1979, beginning at 8:00 am, at Calvert Hall College, Goucher Blvd. and LaSalle Road, Towson, Maryland. The college is located south of Exit 28, Beltway (Interstate 695). There will be food, prizes, and a giant flea market. Admission is $3.00. There will be tables available inside the gym and the cafeteria. For information and table reservations, contact Bro. Gerald Malseed W3WVC at Calvert Hall College, 8102 La Salle Road, Towson MD 21204, or call (301)-825-4266.

ROCHESTER MN
APR 7

The Rochester Amateur Radio Club and the Rochester Repeater Society will hold their Rochester Area Hamfest on Saturday, April 7, 1979, at St. John's School Gymnasium, 490 W. Center St., Rochester, Minnesota. Doors will open at 8:30 am. There will be a large indoor flea market for radio and electronic items, prize raffles, refreshments, and plenty of free parking. Talk-in on 146.22/.82. For further information, contact RARC, c/o KØTS, 2514 N.W. 4th Ave., Rochester MN 55901.

MADISON WI
APR 8

The Madison Area Repeater Association, Inc., will hold its seventh annual Madison Swapfest on Sunday, April 8, 1979, at the Dane County Exposition Center Forum Building in Madison, Wisconsin. Doors will open at 7:00 am for sellers and exhibitors and at 8:00 am for the public. The Forum Building has over 20,000 feet of space for exhibitors and the flea market. There will be plenty of space for parking, with overnight camping available. Hotel accommodations are also available within walking distance of the Swapfest. There will be door prizes, an all-you-can-eat pancake breakfast, and a Bar-B-Q lunch, as well as free movies throughout the day. Admission is $1.50 in advance and $2.00 at the door. Tables are $3.00 in advance and $3.50 at the door. Children twelve and under are admitted free. Talk-in on WR9ABT, 146.16/.76. For reservations or information, write M.A.R.A., PO Box 3404, Madison WI 53704.

KANSAS CITY MO
APR 21-22

The P.H.D. Amateur Radio Association, Inc., of Liberty, Missouri, will sponsor the tenth annual Northwest Missouri Hamfest on Saturday and Sunday, April 21-22, 1979, from 11:00 am to 5:30 pm on Saturday, and from 10:00 am to 5:00 pm on Sunday, at the Kansas City Trade Mart. The Trade Mart is located at the Kansas City Downtown Airport, with easy access to all area interstate highways, with unlimited parking adjacent to the 45,000 sq. feet of exhibition space. Display booth spaces are available at a minimal cost of $15 for a single and $25 for a double. For further information, contact L. Charles Miller WAØKUH, 7000 Northeast 120th Street, Kansas City MO 64166, (816)-781-7313.

TRENTON NJ
APR 22

The Delaware Valley Radio Association and the Lawrenceville Amateur Repeater Group will hold their annual flea market on Sunday, April 22, 1979, from 8:00 am to 4:00 pm, at the New Jersey National Guard 112th Field Artillery Armory on Eggerts Crossing Road off Route 206 in Lawrence Township, Trenton, New Jersey. Advance registration is $2.00; $2.50 at the gate with tailgating $4.00 additional—bring your own table. The selling area is indoors and protected from the weather. There will be ample parking, refreshments, and restroom facilities. Talk-in on 146.52, 146.07/.67, and 147.84/.24. For further information and reservations, write D.V.R.A., PO Box 7024, West Trenton NJ 08628.

DIXON IL
APR 22

The Rock River Radio Club will hold its 13th annual hamfest on Sunday, April 22, 1979, at the Lee County 4-H Center, 1 mile east of the junction of Rts. 52 & 30, south of Dixon, Illinois. Advance tickets are $1.50; $2.00 at the gate. There will be indoor facilities, a camping area, free coffee and donuts from 7:30 am to 8:30 am, prizes, and breakfast and dinner available. Talk-in on 146.52 and 146.37/.97. For advance tickets, mail to RRRC Hamfest, Chuck Randall W9LDU, 1414 Ann Ave., Dixon IL 61021.

WORCESTER MA
APR 27

The Central Massachusetts Amateur Radio Association, Inc., will hold its auction and ham flea market on April 27, 1979, at the Main South American Legion Post 341, Main Street at Webster Square, next to Atamian Motors, Worcester, Massachusetts. The doors open at 6:00 pm, with the auction beginning at 7:30 pm. At the auction, 15% of the profits will go to CMARA. The flea market tables are $5.00 (items $5 and less only). Dealers are welcome. There will be door prizes, raffles, and refreshments available. Talk-in on 146.37-146.97 and .52. For more information, contact Rene Brodeur WA1LEA, (617)-753-7480, or Dave Penttila K1COW, (617)-885-4995.

WILLIAMSPORT PA
APR 29

The West Branch Amateur Radio Association will hold its 15th annual Penn Central Hamfest on Sunday, April 29, 1979, from 11:00 am to 5:00 pm at the Woodward Township Fire Hall, Rt. 220 south from Williamsport. For more information, write Richard Sheasley K3QDA, RD 1, Box 454, Linden PA 17744, or call Tony at (717)-322-6017.

SHREVEPORT LA
MAY 4-5

The Shreveport Amateur Radio Association will hold its annual hamfest on May 4-5, 1979, at the Louisiana State Fairgrounds. Pre-registration is $3.00; $4.00 at the door. This is an ARRL sanctioned hamfest.

NEENAH WI
MAY 5

The 3-F Amateur Radio Club will hold its annual swapfest on Saturday, May 5, 1979, from 8:00 am to 3:00 pm, at the Neenah Labor Temple, 157 S. Green Bay Road, Neenah, Wisconsin, just off Highway 41 at the Highway 114 or 150 exit. Facilities include a large parking area and a large indoor swap area with a free auction at the end of the day. Food and beverage will be available. Advance admission for tickets

Ham Help

I would like to contact any hams who practice transcendental meditation and would like to form a TM net—international, if possible.

Lee Ryan KB6IJ
1229 Park Row
La Jolla CA 92037

I am looking for information on the Level II BASIC kit for the TRS-80. I use the TRS-80 on RTTY and CW. I need the schematic points for the four-wire ribbon on the CPU board, the dip-shunt position after installation, and also for use of the enclosed resistor. I have the technical manual. I will gladly pay any postage or reproduction costs.

Jon J. Kilcoyne N8ACD
12824 Clyde Road
Fenton MI 48430

I am a high school teacher at the Stoneleigh-Burnham School in Greenfield MA, an independent boarding school for girls in grades 9-12. Many students here have expressed great interest in communications and are quite anxious to establish a ham radio club of their own. Many of the girls are avid shortwave listeners and are ready now to move up and get their Novice licenses.

If there is any individual or organization with extra or unused ham gear who would be able to make a tax-deductible donation to the school to start such a club, we would appreciate it if they would please write. We would like to pay all shipping and packing costs. Many thanks.

Jerry Nevins
Stoneleigh-Burnham School
Greenfield MA 01301

and tables is $1.50; $2.00 at the door. Talk-in on 52/52. For reservations, write to Mark Michel W9OP, 339 Naymut Street, Menasha WI 54952.

DEKALB IL
MAY 6

The Kishwaukee Radio Club and the DeKalb County Amateur Repeater Club will hold their 21st annual indoor/outdoor hamfest on Sunday, May 6, 1979, from 8:00 am to 3:00 pm at the Notre Dame School, 3 miles south of DeKalb between highway 23 and South 1st St. on Gurler Rd., DeKalb, Illinois. Tickets are $1.50 in advance; $2.00 at the door. Indoor tables are available or you may bring your own. The outdoor setup is free. Talk-in on 146.13/.73 and 94. For tickets and directions, send an SASE to Howard Newquist WA9TXW, PO Box 349, Sycamore IL 60178.

WARMINSTER PA
MAY 6

The Warminster Amateur Radio Club will hold its fifth annual "Ham-Mart" flea market and auction on Sunday, May 6, 1979, from 9:00 am until 4:00 pm, at the William Tennent Intermediate High School, Street Road (Route 132), two miles east of York Road (Route 263), Warminster, Bucks County, Pennsylvania. A registration fee of $1.00 per car includes one ticket for door prizes. Tailgating is $2.00 additional. Indoor tables are available for $3.00 each. Talk-in on 146.16/76 and 146.52. For further information, please write Horace Carter K3KT, 38 Hickory Lane, Doylestown PA 18901, or phone (215)-345-6816.

FRESNO CA
MAY 11-13

The 37th annual Fresno Hamfest will be held on May 11-13, 1979, at the Sheraton Inn, Clinton and Highway 99, Fresno, California. The program includes technical talks, swap tables and flea market, transmitter hunt on 2 meters (146.52), QLF contest, ARRL CD appointees meeting, ARRL-FCC forum, commercial exhibits, prizes, eyeball QSOs, prime rib banquet, and more. For full registration and eligibility for pre-registration prize, send in $17 before April 27, 1979; it's $19 and no pre-registration prize after that date. Talk-in on 146.34 /146.94. For more information, contact the Fresno Amateur Radio Club, Inc., PO Box 783, Dept. HF, Fresno CA 93712.

DEERFIELD NH
MAY 12

The Hosstraders Net will hold its 6th annual tailgate swapfest on Saturday, May 12, 1979, at the Deerfield Fairgrounds, Deerfield, New Hampshire. There will be covered buildings, in case of rain. Admission is $1.00, with no commission or percentage. Commercial dealers are welcome at the same rate. Excess revenues will benefit the Boston Burns Unit of the Shriners' Hospital for Crippled Children. Last year we donated over $1100.00. Talk-in on .52 and 146.40-147.00. For more information, send an SASE to Joe DeMaso K1RQG, Star Route, Box 56, Bucksport ME 04416, or Norm Blake WA1IVB, PO Box 32, Cornish ME 04020, or check the Hosstraders Net on Sundays at 4:00 pm on 3940 kHz.

SALINE MI
MAY 13

The ARROW Repeater Association will hold its annual Swap and Shop on Sunday, May 13, 1979, at the Saline, Michigan, fairgrounds. Admission, including parking on the fairgrounds, is $1.50 in advance and $2.00 at the door. There will be food, prizes, and a covered area for trunk sales, as well as indoor tables. Because of Mother's Day, wives will be given free admission. Talk-in on 146.37/97, 223.18/224.78, and 448.5/443.5 MHz. For additional details, write ARROW, PO Box 1572, Ann Arbor MI 48106, or call George Raub AD8X at (313)-485-3562.

CADILLAC MI
MAY 19

The Wexaukee ARA will hold its 19th annual swap and shop on Saturday, May 19, 1979, from 9:00 am until 4:00 pm at the National Guard Armory, 415 Haynes Street, Cadillac, Michigan. Tickets are $2.00. There will be free parking and lunches available. Talk-in on 146.37/.97. For more information, contact Robert Bednarick WD8RZL, Publicity Director, Wexaukee ARA, Cadillac MI 49601.

BIRMINGHAM AL
MAY 19-20

The Birmingham Amateur Radio Club will hold Birminghamfest '79 and the Alabama State Convention on May 19-20, 1979, at the Birmingham-Jefferson Civic Center Exhibition Hall, Birmingham, Alabama. There will be many of last year's exhibitors, including most major manufacturers and distributors. There will also be a huge indoor flea market, lots of exhibit space, meetings, forums, activities, and plenty of free parking. Plans are being made to again offer on-site FCC exams on Saturday morning. Prizes will feature at least three complete HF stations, several VHF rigs, and a home video tape recorder system. The Saturday night banquet will feature the nationally known comedian and Grand Ole Opry member Jerry Clower. Banquet tickets will be available in advance, by mail, while they last. For more information, write Birminghamfest '79, PO Box 603, Birmingham AL 35201.

DURHAM NC
MAY 19-20

The Durham F.M. Association will hold its annual Durhamfest on Saturday and Sunday, May 19-20, 1979, at the South Square Mall, Durham, North Carolina. Plenty of prizes, exhibits, and programs will be offered, and the XYLs can enjoy shopping. Ladies' bingo will be held on Sunday. Free tailgating spaces, under a covered, drive-in-and-sell flea market, come with a one-time $3.00 general registration ticket, with vendors and dealers included. Electrical power will be available. Harmonics and unlicensed XYLs are admitted free. Talk-in on 147.825-.225, 146.34-.94, 222.34-3.94. For more information, write DFMA, Box 8651, Durham NC 27707.

BURLINGTON KY
MAY 20

The Kentucky Ham-O-Rama will be held on May 20, 1979, at the Boone County Fairgrounds, Burlington, Kentucky, For easy access, take the Burlington exit off I-75 south. There will be a chance for prizes included with the $3.00 gate ticket. There will also be hourly drawings, exhibits, a flea market, and refreshments. Talk-in on 146.19/79 and 52/52. For more information, contact NKARC, Box 31, Ft. Mitchell KY 41017.

UPPER HUTT NZ
JUNE 1-4

The 1979 Annual Conference of the New Zealand Association of Radio Transmitters will be held on June 1-4, 1979, at Upper Hutt, New Zealand. Visitors are welcome to attend this conference. For registration forms, contact the Secretary, 1979 Conference Committee, PO Box 40-212, Upper Hutt NZ.

WEST HUNTINGTON WV
JUN 3

The Tri-State ARA will hold its 17th annual hamfest and family picnic on June 3, 1979, starting at 10:00 am, at the Camden Amusement Park, West Huntington, West Virginia. There will be a planned program for the XYL and kids, or you can enjoy the amusement park if you prefer. There is a possibility the FCC will administer amateur exams. There will be major prizes, a large flea market, exhibitors, and displays. Dealers are always welcome to space in the covered pavilion. Talk-in on 34/94 or 16/76. For more information, write TARA, PO Box 1295, Huntington WV 25715.

MANASSAS VA
JUN 3

The Ole Virginia Hams A.R.C., Inc., will hold the Manassas Hamfest on Sunday, June 3, 1979, at the Prince William County Fairgrounds, ½ mile south of Manassas, Virginia, on Route 234. There will be indoor and outdoor exhibit areas, dealers and manufacturers, and tailgaters. Also, included will be plenty of parking, prizes, an FM clinic, breakfast and lunch, a YL program, and children's entertainment.

SENATOBIA MS
JUN 9-10

The fourth annual Tri-State Hamfest will be held on June 9-10, 1979, in the coliseum of Northwest Junior College, Senatobia, Mississippi. Indoor air-conditioned space will be available for manufacturers, dealers, and distributors. For information, contact Joel P. Walker, 1979 Hamfest Chairman, PO Box 276, Hernando MS 38632; (601)-368-5277.

BELLEFONTAINE OH
JUL 1

The Champaign Logan Amateur Radio Club, Inc., will hold its annual hamfest on Sunday, July 1, 1979, at the Logan County Fairgrounds, South Main Street and Lake Avenue, Bellefontaine, Ohio. There will be free admission and door prizes. Trunk and table sales are $1.00, and there will also be a bid table. Talk-in on 146.52. For more information, contact John L. Wentz W8HFK, Box 102, West Liberty OH 43357, or Frank Knull W8JS, 402 Lafayette Ave., Urbana OH 43078.

Corrections

In addition to the corrections on page 171 of this month's issue, it is felt that a further clarification is in order. Also in "Light Up Your Life" (December, 1978, page 137, column 2, lines 36-38), the pin connections might have been better explained this way: Connect *readout* pins 3 and 14 and *IC* pins 16 to 5 volts. Pin 8 of the ICs should go to ground.

Gene Smarte WB6TOV
News Editor

Chamber of Horrors

— a true story

"We'll never see him again."

Stanley O. Coutant WB6WFI/LB
248 San Gabriel Ct.
Sierra Madre CA 91024

This was the summer I was going for the amateur Extra. It had been put off far too long. Besides, the new comprehensive code test would make it easy. Wait—that can't be me talking. Or have I finally cracked under the strain? That must be it—to even think the Extra could be easy.

After two weeks of daily study, the situation looks a bit more promising. Maybe I will try after all. At least I'll see what it's like, in preparation for the second attempt.

Okay, this is it. Do or die. Now or never. The cliches don't provide any comfort. The car seems colder than usual. The sky gloomier. My pulse rate is definitely increasing. The car's clock shows 6:05; the sun barely clears the mountains to the east as I back out of the driveway.

I arrive at 7, and already three or four others are either sitting in their cars or pacing out in front of the building. At 7:30 the street-level doors are unlocked, and a brief elevator ride brings us to the fateful floor where we set up camp to await the arrival of 8:00 am.

At 7:55, a lady sticks her head out of a certain doorway we have been studying and says, "All right, I want all the 20-word-per-minute people... those going for Extra Class only." I look around at the growing group of about 15. No one moves. I am the only one!

I steady myself against the wall, telling my rubber knees they'll have to do better, and follow her into the reception area amidst comments of "Been nice knowing you," and "We'll never see him again."

The lady and I stand in the still-dark reception lobby. She re-locks the door. I swallow hard. She walks around the desk, turning on the lights in the process. After opening the log at the appropriate page, she asks me to sign in. I am number one. The page is clean, except for the date at the top and the figures down the left margin. I can barely write. I am thankful I had typewritten my Form 610 application the night before.

After the paperwork is complete, the receptionist presses a button and a nasty 60-Hz buzz fills the room. I expect the floor to open beneath my feet, and I try to recall what I know about crocodiles. When the floor remains solid, I decide it is only the locking device on the door to the inner sanctum. I enter. There at the first desk is another lady, sharpening her fingernails. At the second desk is . . . a stranger! The fellow who administered my General and Advanced Class exams is nowhere to be seen! This ferocious-looking fellow is limbering up his "FAILED" rubber stamp with one hand and sorting through a box of cassette tapes labeled "Fast," "Faster," and "Ridiculous" with the other.

I take a seat in the still-empty glass chamber—the first seat, nearest the door.

The buzzer sounds again, and the other applicants begin filing in. And filing in. And still more, until the room is filled— 61 of us in all! Amidst all this humanity are two other Extra Class applicants who have turned up—one a General, the other a Novice of three months!

The examiner appears, grinning diabolically, with three sets of wireless headphones in his hands. "Who are the Extra Class applicants?" he asks. We foolishly raise our hands. He distributes the aforementioned instruments of torture.

"All right, you will hear one minute of practice code which you may copy if you wish but it won't count on the exam followed by five minutes which is the test after which you will hear the procedure signal AR at which time I will hand out questionnaire booklets with five multiple-choice answers per question from which you will select the correct answer and indicate your choice on the answer sheet in the proper box corresponding to the question number. Make no marks in the questionnaire booklets, only on the answer sheets. Are there any questions?"

The receiving test

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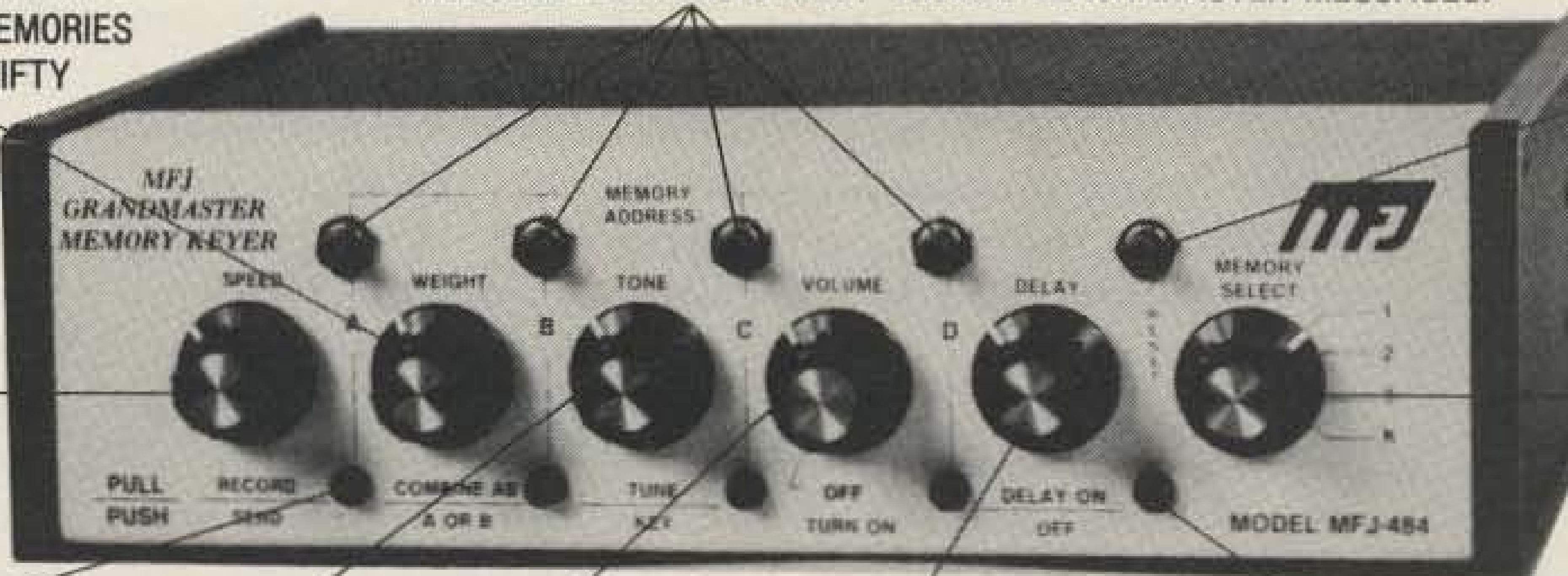

SPEED CONTROL, 8 TO 50 WPM. **PULL** TO RECORD.

MEMORY SELECT: POSITIONS 1, 2, 3 ARE EACH SPLIT INTO MEMORY SECTIONS A, B, C, D (UP TO TWELVE 25 CHARACTER MESSAGES). SWITCH COMBINES A AND B. **POSITION K** GIVES YOU 100, 75, 50, OR 25 CHARACTERS BY PRESSING BUTTONS A, B, C, OR D.

LEDs (4) SHOW WHICH MEMORY IS IN USE AND WHEN IT ENDS.

TONE CONTROL. PULL TO TUNE.

VOLUME CONTROL. POWER ON-OFF.

DELAY REPEAT CONTROL (0 TO 2 MINUTES). **PULL** FOR AUTO REPEAT.

LED INDICATES DELAY REPEAT MODE.

NOW YOU CAN CALL CQ, SEND YOUR QTH, NAME, ETC., ALL AUTOMATICALLY.

And only MFJ offers you the MFJ-484 Grandmaster memory keyer with this much flexability at this price.

Up to twelve 25 character messages plus a 100, 75, 50, or 25 character message (4096 bits total).

A switch combines 25 character messages for up to three 50 character messages.

To record, pull out the speed control, touch a message button and send. **To playback,** push in the speed control, select your message and touch the button. That's all there is to it!

You can repeat any message continuously and even leave a pause between repeats (up to 2 minutes). **Example:** Call CQ. Pause. Listen. If no answer, it repeats CQ again. To answer simply start sending. LED indicates Delay Repeat Mode.

Instantly insert or make changes in any playing message by simply sending. Continue by touching another button.

Memory resets to beginning with button, or by tapping paddle when playing. Touching message button restarts message.

LEDs show which 25 character memory is in use and when it ends.

Built-in memory saver. Uses 9 volt battery, no drain when power is on. Saves messages in memory when power loss occurs or when transporting keyer. Ultra compact, 8x2x6 inches.

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All controls are on front panel: speed, weight, tone, volume. Smooth linear speed control. 8 to 50 WPM.

Weight control lets you adjust dot-dash-space ratio; makes your signal distinctive to penetrate QRM.

Tone control. Room filling volume. Built-in speaker.

Tune function keys transmitter for tuning.

Ultra reliable solid state keying: grid block, cathode, solid state transmitters (−300 V, 10 ma. max., +300 V, 100 ma. max.). CMOS ICs, MOS memories. Use 110 VAC or 12 to 15 VDC. Automatically switches to external batteries when AC power is lost.

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THIS MFJ-482 FEATURES FOUR 25 OR A 50 AND TWO 25 CHARACTER MESSAGES.

- **Speed, volume, weight, tone controls**
- **Combine memory switch**
- **Repeat, tune functions**
- **Built-in memory saver**

$99.95

Similar to MFJ-484 but with 1024 bits of memory, less delay repeat, single memory operating LED. Weight and tone controls adjustable from rear panel. 6x2x6 inches. 110 VAC or 12 to 15 VDC.

THIS MFJ-481 GIVES YOU TWO 50 CHARACTER MESSAGES.

- **Repeat function**
- **Tune function**
- **Built-in memory saver**

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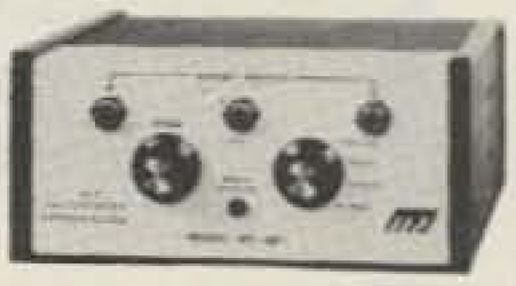

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✓ Reader Service—see page 211

begins. VVV VVV Got it. Solid copy so far. Hmmm. Sounds like a QSO I had the other night on 80 meters. Nice fist. Not bad at all. What? AR already? I don't believe it. The test is over? There must be some mistake. The examiner must have hooked us up to a receiver on 40 meters instead of the tape machine.

Here he comes, questionnaire booklets in hand, ready to be distributed. The 58 other applicants look on; expressions of sympathy and compassion are evident.

I read the first question. Easy. I've heard of these "buffer question" techniques. The answer is right there. The second question is equally simple. Two buffer questions out of 10? What is the Commission coming to? The third . . . the fourth . . . so obvious! I must be going to wake up soon, at home in my own bed.

The questions have all been answered. A double-check turns up no problems. Oh, well, I probably put the wrong letters in the boxes on the answer sheet.

Here comes the examiner again. Our papers vanish. So does he. The three of us look at each other, not daring to speak. I want to say, "Howdja do?", but nothing happens.

The examiner reappears. "Would the three people who took the code test meet me at the back table, please." It is not a question. We cower on our way to the back of the room, as 116 eyes follow our feeble progress.

The examiner leans close. He whispers: "All three of you aced the receiving test. Under the circumstances, I think we can skip the sending test." Three jaws drop. The examiner smiles. "Congratulations." He shakes our hands.

We float back to our seats. Our smiles must be obvious, as the remainder of the group breathes a collective sigh of relief on our behalf.

But why am I smiling? The theory test. . . the examiner was only playing with us—toying with our emotions! His smile must have been due to what he remembered was yet to come, that which I had momentarily forgotten.

The written exams are distributed. The ordeal begins anew. Only 49 questions after this one. 48 . . . 47 . . . Wait a minute—this is familiar—a lot like what I studied the past two weeks. Not too shabby!

I'm finished—one way or the other. I submit my materials. "Wait in the lobby, please, until your name is called."

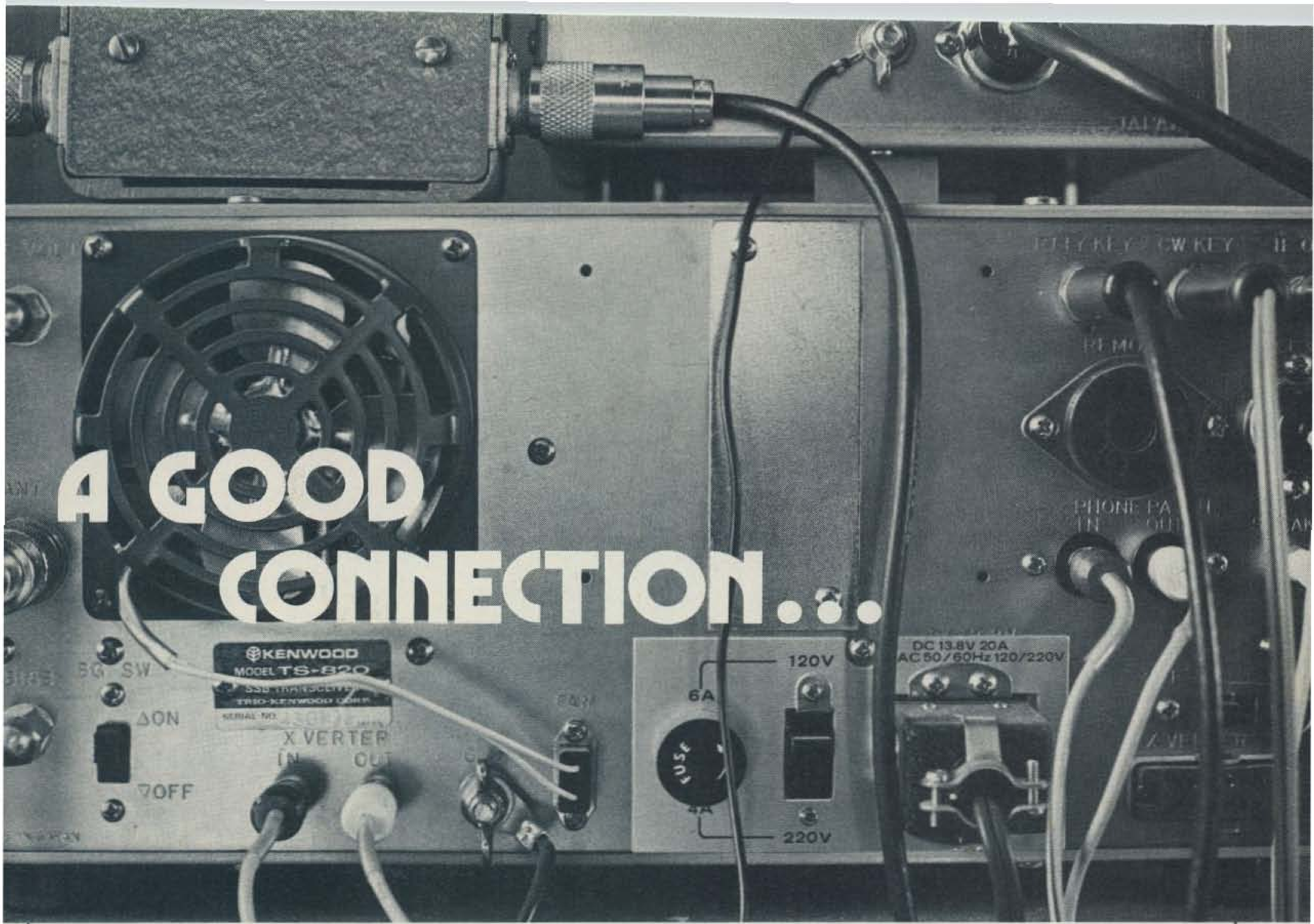
The lobby is filled with people! The receptionist is telling a recent arrival, "There are over a hundred applicants so far this morning. Please take a seat and wait to be called."

One hour and 20 minutes later, a clerk appears. She's the one who was sharpening her fingernails earlier. She is carrying a handful of exams and application forms. "Anderson, you passed the Technician. Fill this paper out. Baker, you passed the Advanced. Fill this out, please. Coutant. . . let's see, yours was an Extra Class. . . hmmm. . . oh, here it is—you passed."

As she hands me my interim permit, I can't help but notice her smooth, nicely rounded manicure. She continues through the stack of papers, and we learn my fellow aspirants have both passed as well.

Outside, the sun, now high in the sky, has returned to its usual warm, bright self. It's a spectacular day! ■

✓ Reader Service—see page 211



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An Intelligent Scanner for the HW-2036

— it's programmable

Unique versatility.

Lawrence D. Schuldt WA9TAH
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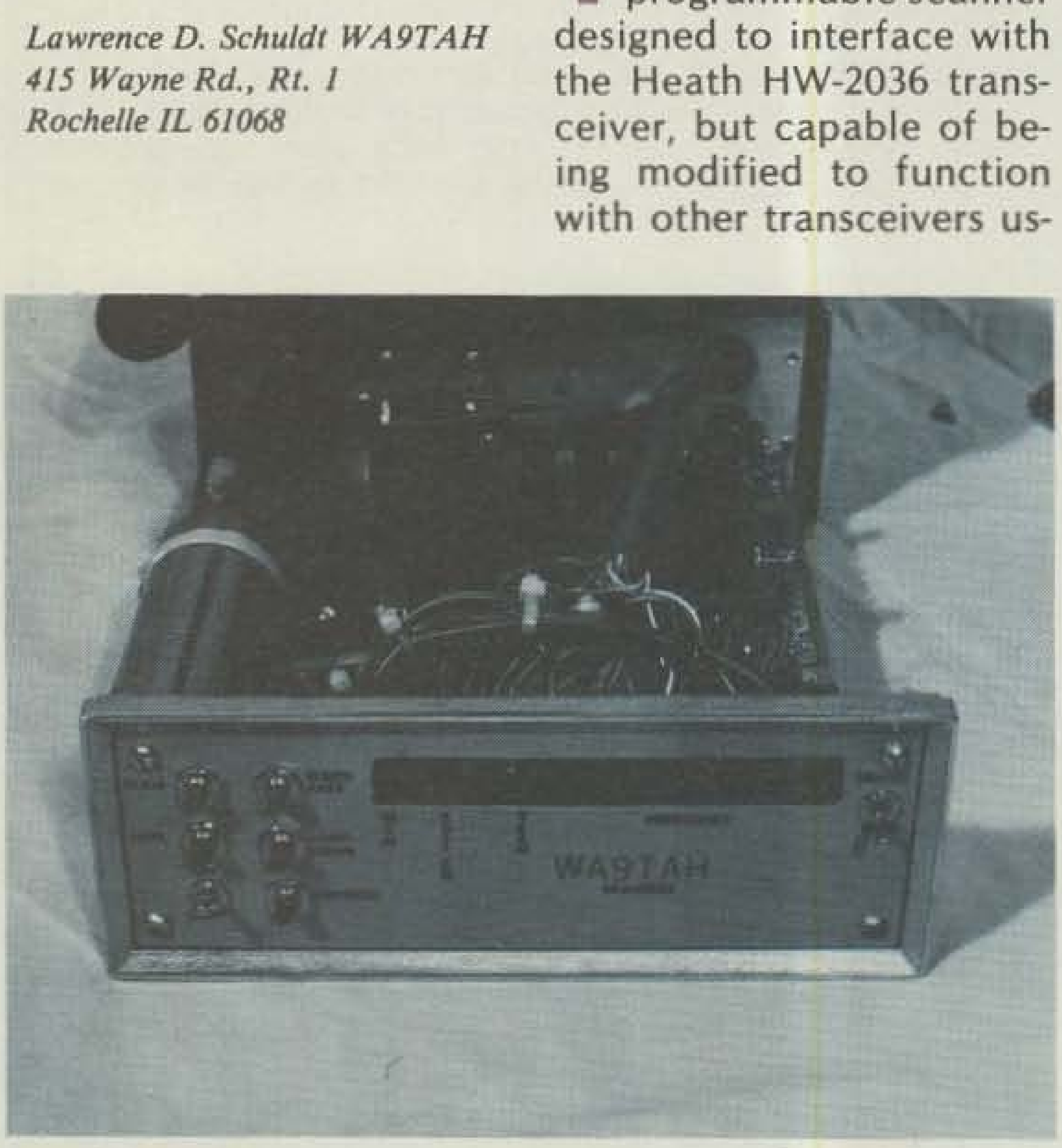
This article describes a programmable scanner designed to interface with the Heath HW-2036 transceiver, but capable of being modified to function with other transceivers using binary-coded-decimal synthesizer frequency control. This scanner also has a small instruction set to increase its versatility, a feature which I believe is unique.



View from front of scanner showing front panel layout with all indicators illuminated.

Overview

Frequency and channel number, along with other information, are presented to the user on an LED display. When the scanner's memory has control of transceiver frequency, the memory contents are displayed. When the thumbwheels control frequency, the LED display follows the thumbwheels. This has been found to be a

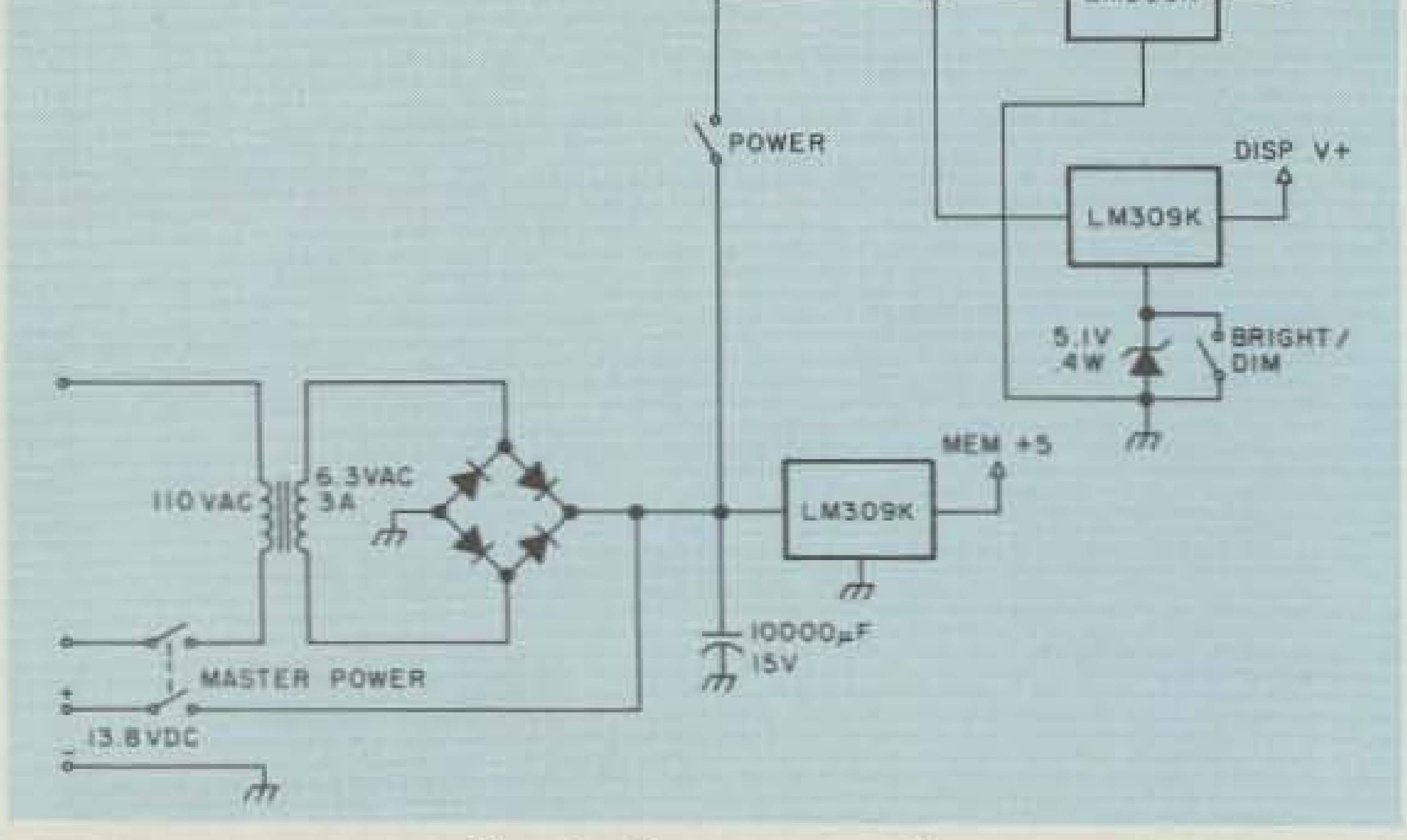


Fig. 1. Power supply.

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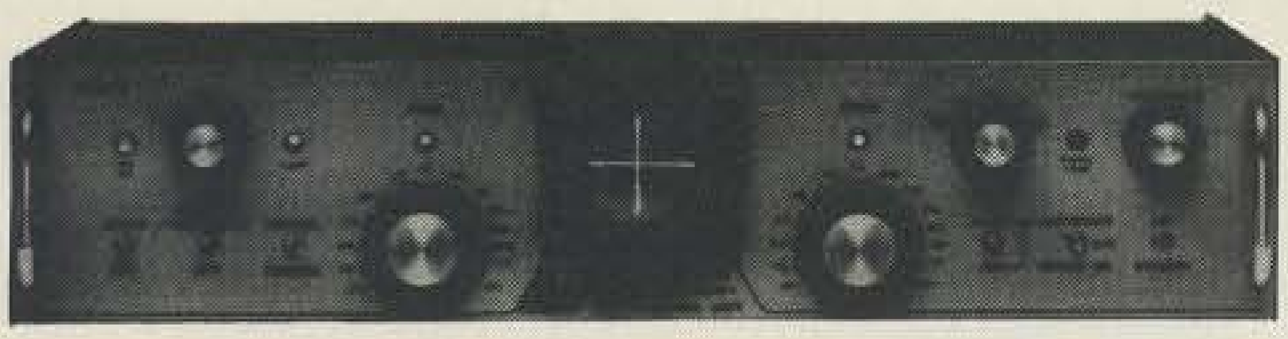

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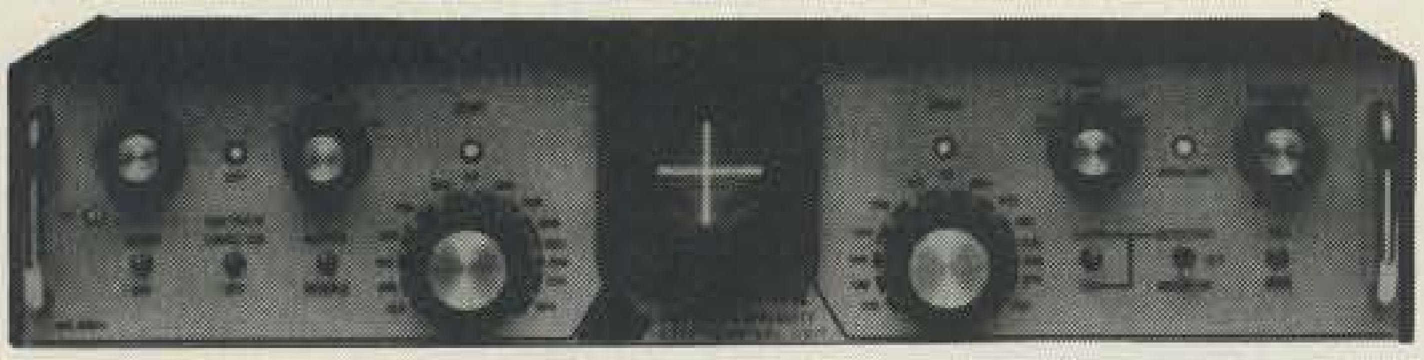

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***The MPC-1000R is also available without a TSR assembly and functions as a MPC-1000C with a Triple Tone-Pair AFSK Tone Keyer. This "Basic-R" permits future expansion with a TSR-100, TSR-200, TSR-200D or TSR-500 by simply lifting the lid and plugging in the appropriate TSR assembly: Amateur Net (Basic-R): $595.00**

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Reader Service—see page 211

Note on logic diagrams:
Total IC package count is 27. The numbering scheme is as follows. Comp‿nents with numbers 100 and above are mounted on the display panel. Components numbered E1-E4 are in the first row on the board, E11-E14 in the second row, E21-24 in the third row, etc.
Not shown on logic diagrams are decoupling capacitors.

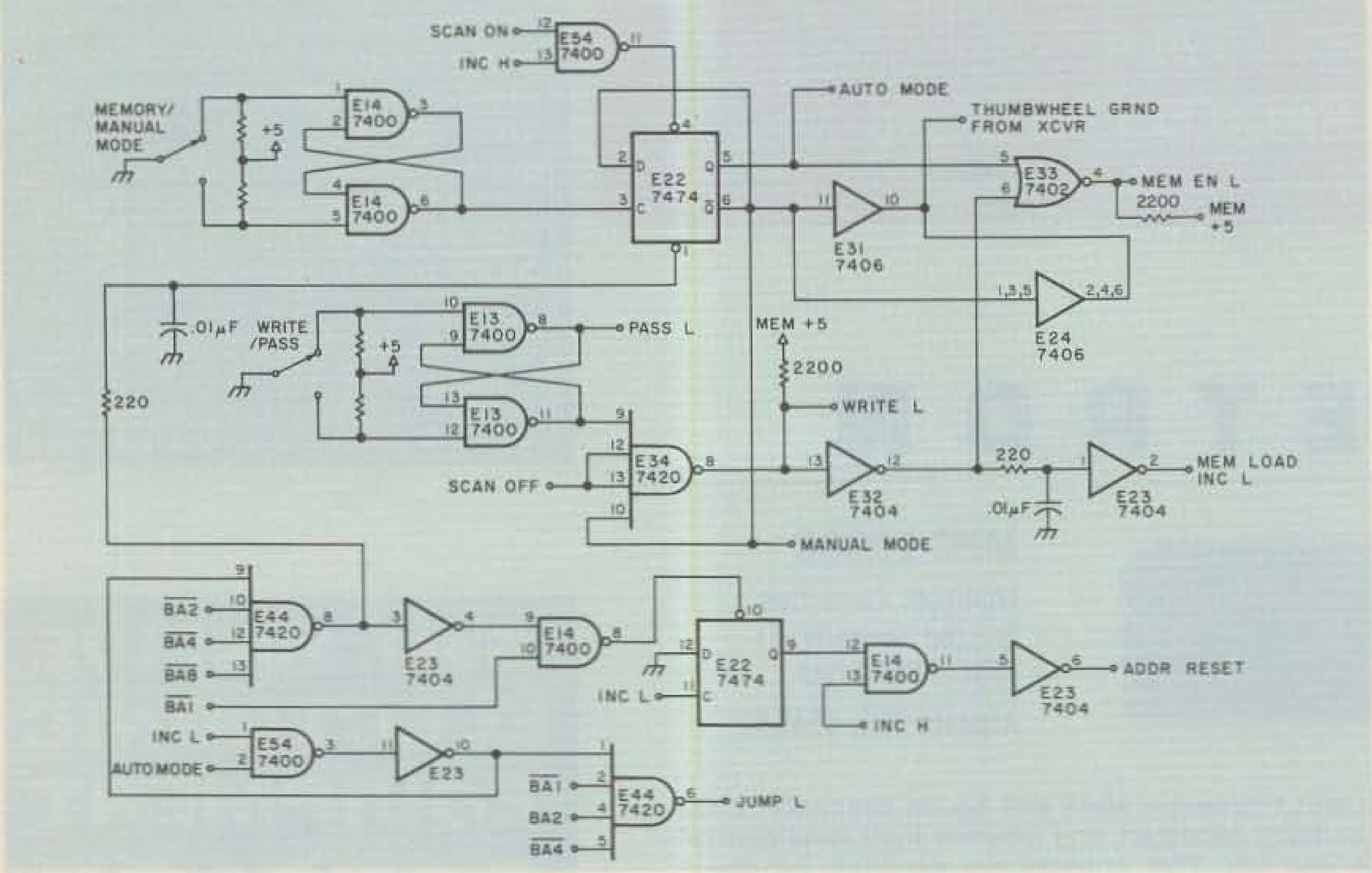

Fig. 2. Memory control and instruction logic. Resistors at E14-1, 5 and E13-10, 12 = 2200 Ohms.

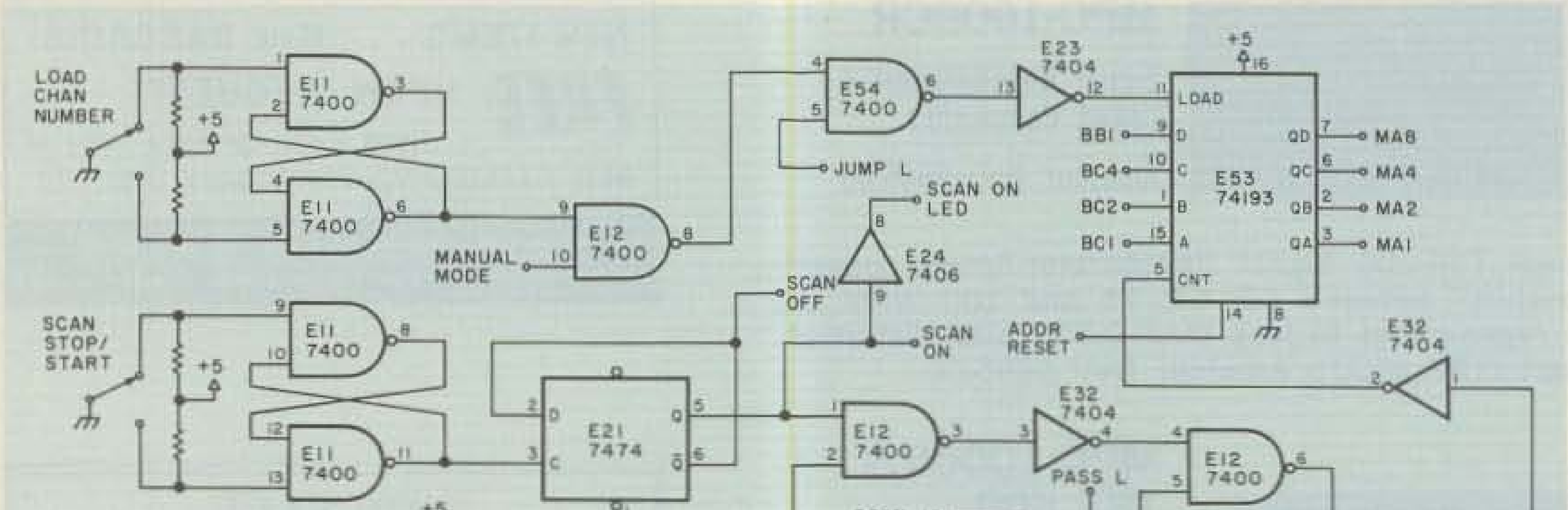

Fig. 3. Scan control logic. Resistors on E11 are 2.2k Ohms.

great convenience when driving at night, since the thumbwheels on the transceiver are not illuminated, which makes it difficult to read the frequency or to QSY without turning on the dome light. Other information displayed in the LED display is whether the scanner memory or the thumbwheels have control of transceiver frequency, whether scanning is turned on, and whether the fast or slow squelch delay is selected.

The scanner's memory is capable of storing 16 words. This memory data can be interpreted as either frequencies or instructions to be executed.

The instruction set consists of three instructions. Since all frequencies entered into the scanner will have either a 4, 5, 6, or 7 in the megahertz position, it was decided to use some of the unused digits as instructions. Therefore, the numbers 0, 1, and 2 are decoded and executed as instructions by the scanner.

The instruction set is as follows:

A zero in the megahertz position will cause the scanner to reference the thumbwheels for its frequency to be scanned, after which it will reset the channel counter to zero and begin scanning again from channel zero.

A one in the megahertz position will cause the scanner to read the thumbwheels for the frequency, but have no effect on the channel counter.

In this and in the previous instruction, the numbers in the 100 kHz and 10 kHz positions are irrelevant.

A two in the megahertz position will cause the scanner to execute a jump to the channel number specified in the 100 kHz and 10 kHz positions. If the memory contents were 204, the scanner would jump to channel 4. This instruction is used for storing more than one set of frequencies in memory. By simply starting the scanner in the appropriate set of frequencies, you have a choice of frequencies that can be scanned without reprogramming.

The instructions that reference the thumbwheels have been found to be very useful, since this gives you one channel that can be changed without reprogramming.

Examples of how the in-

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struction set is used will be given later in the section entitled "Operation." It's not as complicated as it sounds.

The scanner can operate either from the 13.8 V dc mobile power or from its own internal ac supply. The Heathkit supply for the HW-2036 is not capable of supplying the current requirements for both the transceiver and the scanner, so a separate supply is required for the scanner.

The scanner was built to provide a reasonably close match to the Heath transceiver, but, of course, the builder can change packaging to suit himself. The cabinet and bezel are ordered from Heath and the chassis is the chassis from the HW-2036-3 power supply. The front panel is fabricated from a piece of scrap aluminum.

There are five push-buttons on the front panel which function as follows:

The SCAN push-button turns scanning on and off. Status is indicated by an LED on the front panel.

The MEM push-button gives you the option of memory-controlled frequency when not scanning Memory is automatically activated when scanning is started, so it is not necessary to press MEM at the start of scanning. Status of memory or manual frequency control is also indicated by an LED on the front panel.

The LOAD CHAN button causes the value placed into the two right-hand digits of the thumbwheels to be transferred to the channel counter. This lets you address any location in memory for modification or for starting a scanning sequence. As has been previously mentioned, more than one scanning sequence can be stored in memory. The correct sequence is activated simply by starting the scanner at the first address (channel number) of the desired sequence. The channels are numbered octally (base 8) from zero to seventeen. The number sequence is, therefore, 0, 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17. This is done because binary-to-octal and octal-to-binary conversions are much easier to do than binary-to-decimal and decimal-to-binary conversions.

The SQUELCH push-button selects one of two delays, after which scanning resumes when a carrier drops out of the receiver. The two delays are approximately 13 seconds and about .2 seconds. The 13-second delay is sufficiently long to prevent the scanner from resuming scanning before a reply is received. However, if you wish to resume scanning between exchanges of a QSO you are monitoring, switching to the .2-second delay lets you do so. The .2-second delay is long enough, however, that the scanner will not resume scanning if the signal drops momentarily because of mobile flutter.

The WRITE/PASS button serves, as the name implies, a dual function. When the memory and scanning are off, pressing this button will cause the contents of the thumbwheels to be written into memory. When the button is released, the channel counter will increment, ready for the next write.

When scanning, the WRITE/PASS button is used to cause the scanner to bypass a signal. In other words, when the receiver is locked on a signal and you wish to resume scanning, pressing this button will increment the channel counter and cause scanning to resume.

In addition to the five buttons, there are three switches associated with operation. The BRIGHT-DIM switch varies the intensity of the LED display from a low intensity suitable for

Overall view of the author's 2 meter FM setup with Heath power supply, WA9TAH scanner, and HW-2036 transceiver.

indoor use or mobile use at night or a not particularly bright day, to a high intensity that the sun at noon is hard put to wash out when operating mobile.

The power switch on the front panel removes power from the displays and all logic except for the memories. This way, as long as power is available, the RAMs retain their data.

The master power switch is located on the back of the scanner and removes all power within the unit.

Since momentary contact switches are used, some indicator system is required to display the key information on scanner status. For this purpose, the decimal points of the two digits in the channel indicator are used, plus one additional LED. The decimal point labeled MEM is used to indicate that the memory has control of the frequency. When this LED is lit, it is impossible to do a write into memory, since the thumbwheels are disabled.

The other decimal point in the channel indicator display is labeled FAST SQ. When this indicator is on, the squelch delay is set for the .2-second time.

An additional LED is located between the channel counter and the frequency display and is illuminated when scanning is turned on. The write function is disabled when this LED is lit also, so, in order to write into memory, both the SCAN and the MEM LEDs must be off.

One additional feature is built into the scanner; its function is to prevent the transceiver from scanning if you decide to QSO. The first time the push-to-talk button on the microphone is pressed, scanning is turned off. This is reflected on the display panel; when PTT is pressed, the SCAN LED goes out. Scanning can be restarted after the QSO by pressing the SCAN button.

Channel	Contents	Comments
0	6.94	scan 146.94
1	6.52	scan 146.52
2	6.73	scan 146.73
3	6.61	scan 146.61
4	6.79	scan 146.79
5	7.12	scan 147.12
6	7.24	scan 147.24
7	6.22	scan 146.22
10	6.85	scan 146.85
11	1.XX	scan the frequency dialed into the thumbwheels. XX indicates irrelevant digits.
12	6.11	scan 146.11
13	6.22	scan 146.22
14	6.33	scan 146.33
15	6.44	scan 146.44
16	6.55	scan 146.55
17	6.66	scan 146.66

Table 1. All 16 channels used as frequencies. With this sequence programmed in, the scanner will cycle through all memory locations repeatedly, starting again at channel 0 at the end of a sequence.

Operation

The following are some examples of how the scanner may typically be used.

The startup sequence is as follows:

With power on, the LED displays should light. The SCAN, FAST SQ, and MEM LEDs may be on.

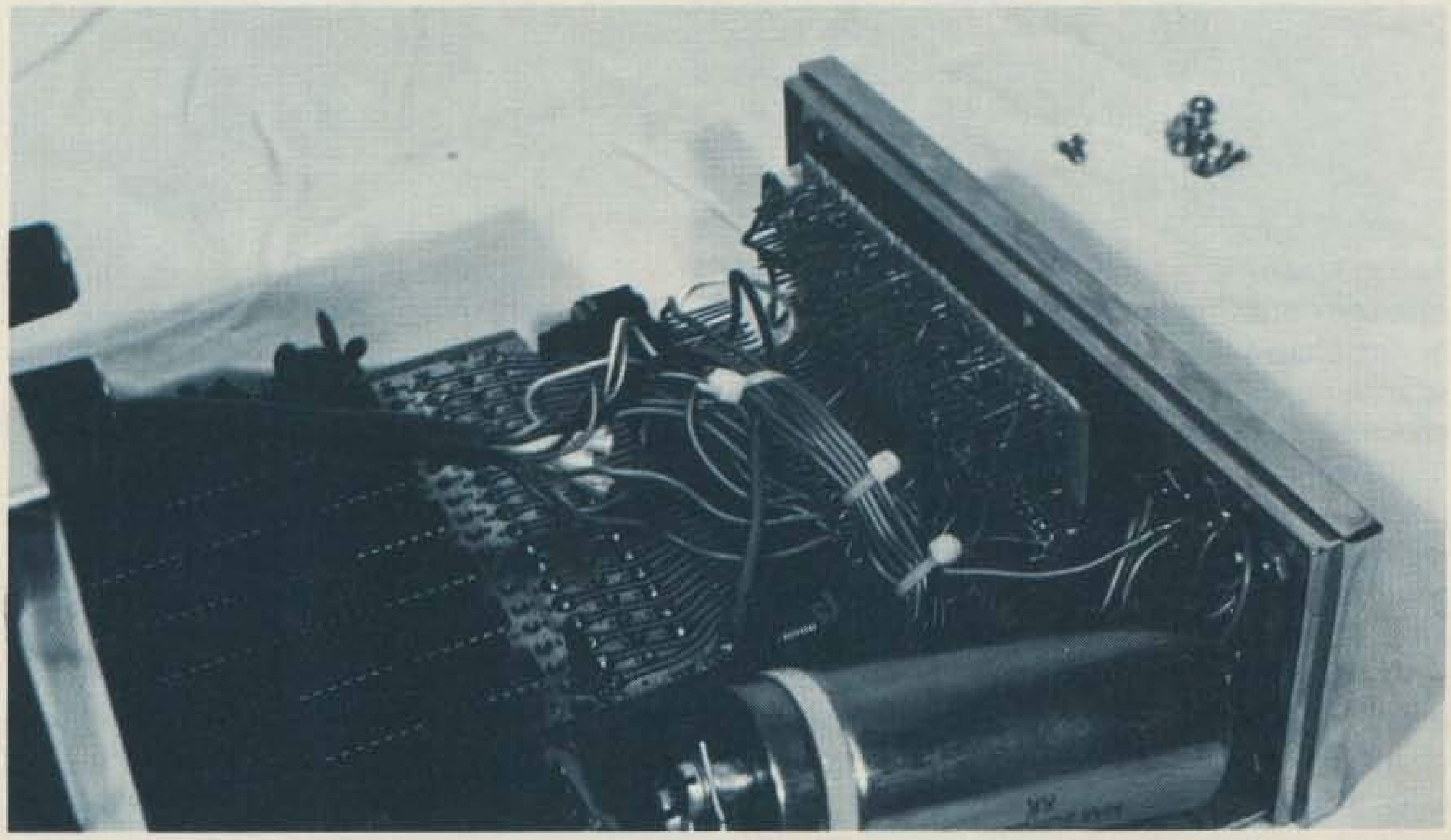
If the SCAN LED is on, press the SCAN button to turn it off.

If the MEM LED is lit, press the MEM button to turn it off.

Dial up the number of the first channel you wish to program in the two right-hand digits of the thumbwheels. Press LOAD CHAN, and the channel counter display should now read this value.

At this time, the scanner is ready for programming. To program, simply dial in the desired digits in the thumbwheels, and press the WRITE/PASS button. Each time the button is released, the channel counter should increment, awaiting the next write cycle.

When all frequencies and instructions are loaded into memory, dial the desired starting channel number into the two right-hand digits and press LOAD CHAN. The channel counter LEDs should display the number in the thumbwheels. Press SCAN and the scanner will begin scanning, changing frequencies, and executing instructions as it reads the memory information. If the programming included an instruction to read the thumbwheels, dial up a frequency in the thumbwheels. As you watch the LED frequency display, you will see the frequency in the thumbwheels being scanned, and the MEM LED will blink out, indicating that, at that time, frequency is being controlled by the thumbwheels.



Close-up view showing construction of front panel and some of the switch wiring.

Tables 1 through 3 are some typical programming examples, with explanations of what the scanner will do.

Logic

An attempt has been made to divide the logic diagrams into easily digestible (and drawable) units. These will be covered individually here.

The frequency display logic diagram consists of the LEDs for the MHz, 100 kHz, and 10 kHz digits, their 7447 decoder-drivers, and the 7404 inverter-buffers. The double inversion on each bit is not a mistake; it is there to reduce loading on the lines between the thumbwheels and the synthesizer board.

Fig. 7 shows the channel display logic for the two digits of the channel display, the SCAN LED, the FAST SQ LED, the MEM LED, and the two most significant digits of the frequency display, which are hard-wired to display a 1 and a 4.

The 7406 IC is a hex inverter-driver with open collector outputs. Four sections of E31 are used here to turn on segments in the left-hand channel display digits.

The heart of the scan control logic (Fig. 3) is the 74193 programmable up-down counter. In this case, only the count up input is used. The counter can be preset to any desired value by applying data to pins 1, 9, 10, and 15 and pulsing pin 11 low. This is how the jump instruction and the load channel functions are performed.

The count pulses for the 74193 are generated by E51, a 555-type timer IC wired in the astable configuration. This produces a string of clock pulses with a period of about 350 milliseconds.

Application of pulses from the scan clock to the counter is enabled by the scan enable flip-flop, E21-6, and the signal RCV SIG SCAN STOP L, which stops the scanner in the presence of a signal. E21 can be set or cleared by pressing the SCAN pushbutton, and E21 can be cleared by voltage at the transmit relay going to zero, as it does when PTT is pressed.

Two other signal sources for incrementing the channel counter are included. They are PASS L, which is asserted when the WRITE/PASS button is pressed and memory or scanning are turned on, and MEM LOAD INC L, which is asserted when the WRITE/PASS button is pressed and memory and scanning are turned off. This causes the channel counter to increment after the write is performed.

Fig. 2 shows the memory control and instruction decoding logic. The main element in the memory control logic is flip-flop E22-5, 6. This is the memory/manual mode control. When the flip-flop is set, a ground for the thumbwheels is broken, removing them from control of the synthesizer, and the signal MEM EN L is generated to the memory, turning it on and giving the memory control of the synthesizer input lines. This flip-flop can be set and cleared by the MEM push-button on the front panel. It is also set by the signal INC H, which is derived from the scan clock when scanning is turned on. It can be cleared by either a 0 or a 1 instruction, which tells the scanner to scan the frequency in the thumbwheels.

Another part of the memory control logic is the WRITE/PASS logic. PASS L is generated whenever the WRITE/PASS button is pressed, but is inhibited from doing anything unless scanning is on or memory is on. This in-

Channel	Contents	Comments
0	6.94	scan 146.94
1	6.73	scan 146.73
2	6.52	scan 146.52
3	0.XX	read thumbwheels for the frequency, then start scanning again from channel 0

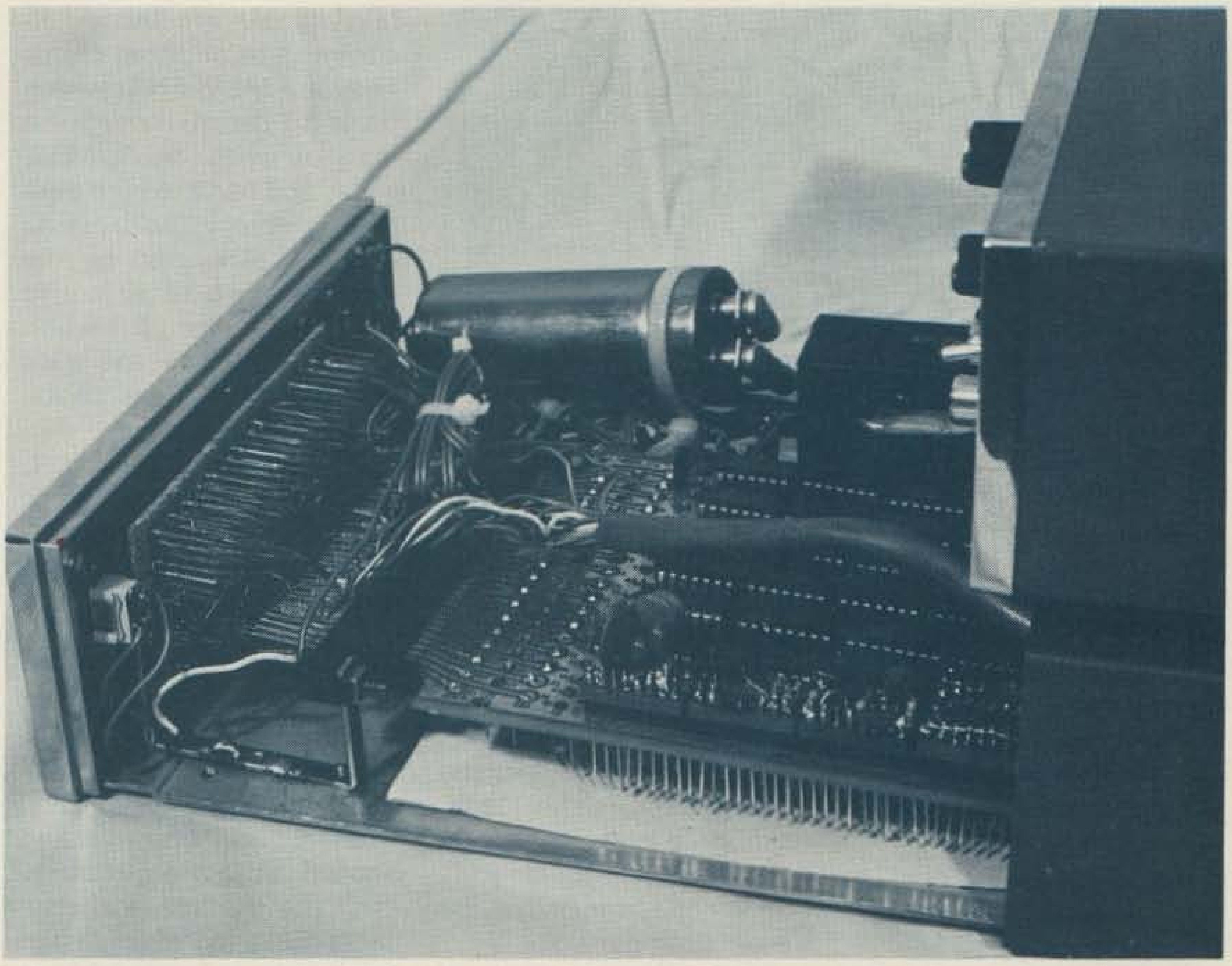
Table 2. Only a few channels are used.

Channel	Contents	Comments
0	6.94	scan 146.94
1	6.52	scan 146.52
2	6.73	scan 146.73
3	0.XX	scan the frequency in the thumbwheels, then set channel counter to zero
4	7.12	scan 147.12
5	7.24	scan 147.24
6	6.79	scan 146.79
7	6.85	scan 146.85
10	2.04	jump to channel 4. The 2 in the megahertz position specifies the jump instruction; other digits specify channel number.
11	6.94	scan 146.94
12	1.xx	read thumbwheels
13	6.79	scan 146.79
14	6.73	scan 146.73
15	6.61	scan 146.61
16	6.52	scan 146.52
17	2.11	jump to channel 11

Table 3. Multiple sets of frequencies, each of which can be individually selected. This sequence contains three separate groups of frequencies and instructions. Starting the scanner at channel 0, 1, 2, or 3 activates the scanner in the first loop. Similarly, starting the scanner at channel 4, 5, 6, 7, or 10 activates the second loop. If the scanner is started at channel 11, 12, 13, 14, 15, 16, or 17, the third loop is entered.

When a signal is encountered, the scanner will stop scanning. When the signal drops, the scanner will resume scanning after either the 13-second or the .2-second delay. If you wish to engage a station heard in a QSO, simply make sure that the offset switch on the transceiver is set to the appropriate offset, pick up the mike, and go. Transmit frequency also follows the scanner.

There is one limitation on the instruction set. Do not follow a jump instruction with another instruction, only a frequency. For example, if a memory location contains 2.04, channel four should not have a 1.XX, a 0.XX, or another jump instruction in it. If this is attempted, the instruction following the jump may not decode reliably. Putting a frequency, which requires no decoding, after the jump instruction is perfectly legal, however.



Close-up view of scanner interior from the left. Discrete components are shown mounted on 16-pin DIP plugs.

hibit gating is on the channel counter logic diagram, E54-8. When scanning is off and the thumbwheels are in control of the synthesizer lines (also used as the memory input/output bus), it is possible to do a write into memory. In this condition, E54-8 inhibits the PASS L signal from incrementing the channel counter. E34-8 is enabled when the WRITE/PASS button is pressed and the signal WRITE L is generated. This signal is also used to generate MEM EN L, which turns on the memory without giving it control of the synthesizer lines. In this manner, the thumbwheels retain control of the synthesizer lines, and what is dialed into the thumbwheels is written into memory.

Shortly after WRITE L returns to a high condition, MEM LOAD INC L goes low, causing the channel counter to increment for the next write cycle.

The only portion of the logic in this diagram not discussed so far is the instruction decoding logic. Instruction decoding is enabled at E54-3, requiring that we must be in auto mode, that is, the memory must have synthesizer control in order to decode an instruction. This prevents any attempts by the scanner to execute instructions when merely dialing a 0, 1, or 2 into the thumbwheels. The instruction must be read from memory to execute. Instructions are also inhibited from executing until the signal INC L returns to a high state. Since data is brought out from memory on the negative-going edge of INC L, this ensures adequate setup time for proper decoding.

Decoding for the jump instruction is the simplest. E44-6 examines the data from the most significant digit of memory, and, if it is 2, generates JMP L. Note that this instruction executes immediately upon INC L going high. This means that after the jump instruction is executed, there will not be another INC L pulse. Thus, if another instruction is present, there is no setup time available, and an instruction will execute as soon as it is marginally decoded. This can lead to very erratic performance, and I have found it best simply not to follow a jump with another instruction.

E44-8 examines the most significant digit in memory and asserts a low if a 1 or a 0 is detected. Since both of these instructions are used to cause the scanner to read the frequency in the thumbwheels, this signal is used to clear the memory/manual mode flip-flop. This places the thumbwheels in control of the frequency until the next INC H pulse.

Additionally, if the instruction decoded is a 0, this will be detected by E14-8. This will set flip-flop E22-9, which serves as a memory for this instruction during the time that the thumbwheels have control of the synthesizer. When INC H goes high, the output of the flip-flop is enabled through E14-11 to become the signal ADDR RESET, which clears the channel counter. At the same time, INC L goes low. When INC L returns to the

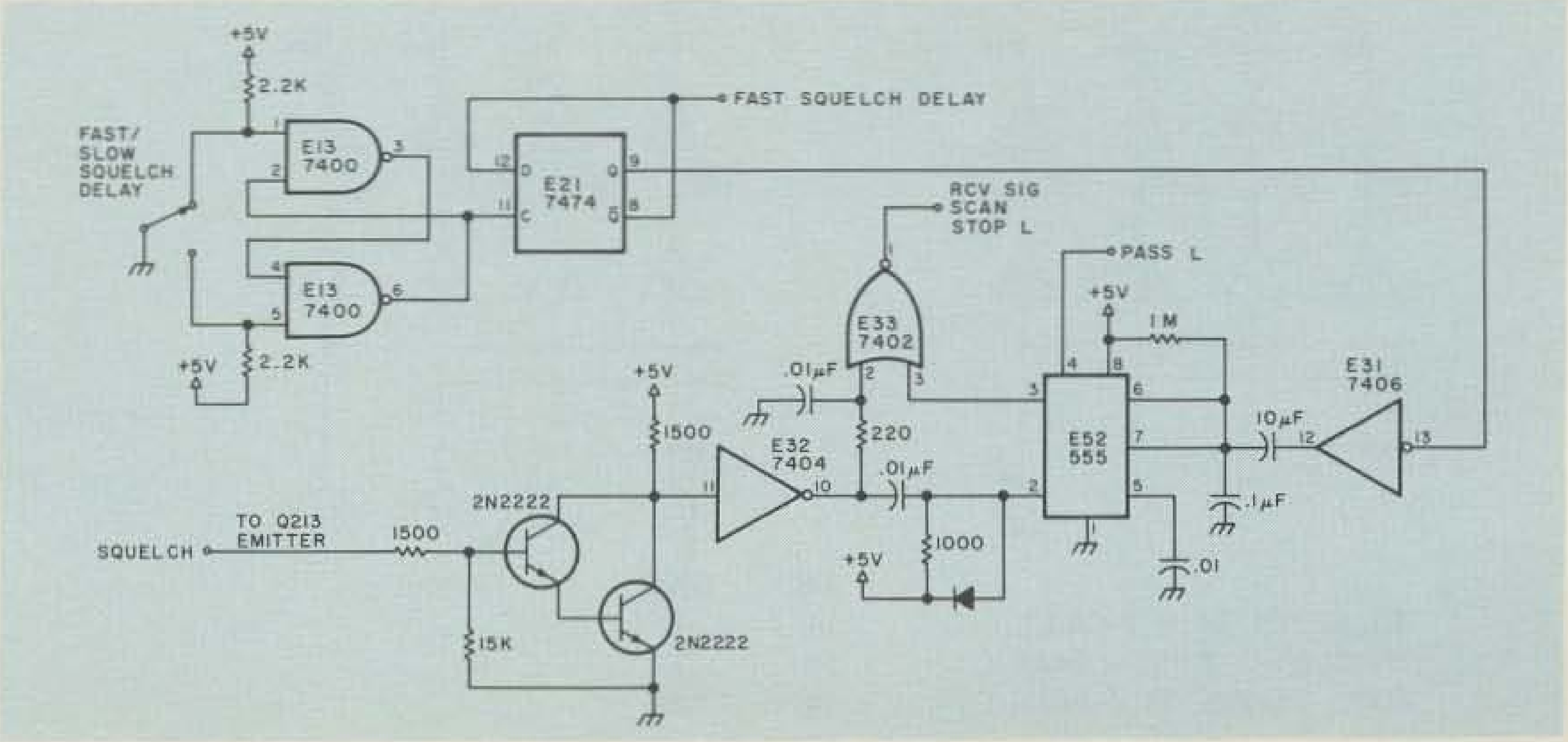


Fig. 4. Fast/slow squelch.

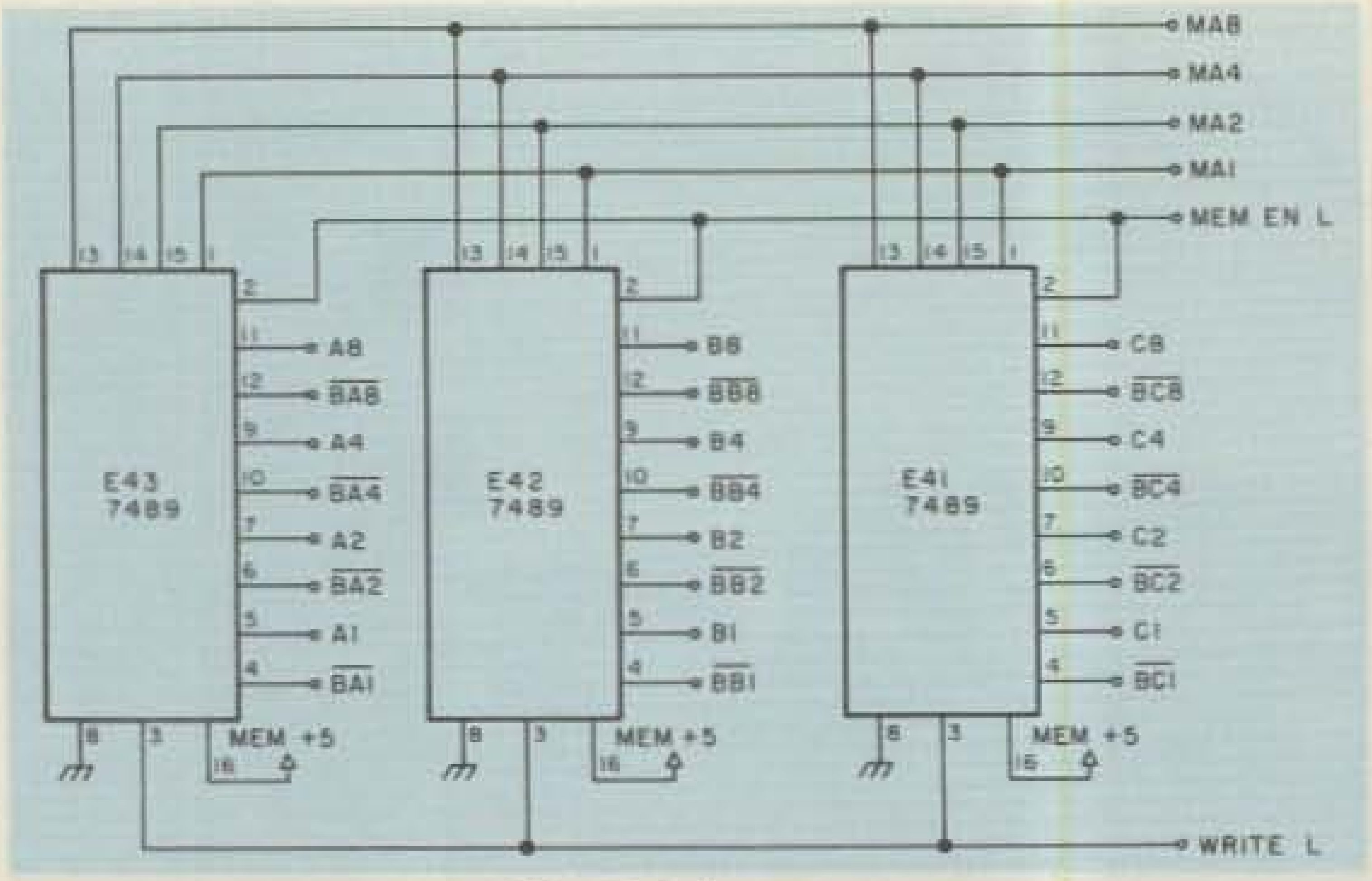


Fig. 5. Memory.

high state, it clocks and clears the flip-flop, restoring it to its original clear condition.

The squelch control logic is relatively simple. The squelch voltage is converted to a TTL logic level* and is used to generate the signal RCV SIG SCAN STOP L. When the squelch voltage returns to the squelch state, this triggers the 555, E52, wired as a monostable. This holds RCV SIG SCAN STOP L asserted for an additional time interval. The selection of the 13-second or the .2-second time delay is performed simply by using E31-12 to switch in additional capacitance for the longer time period.

After the amount of logic required to support it, the memory itself is anticlimactic. There are three memory ICs, each storing 16 words 4 bits long. Certain signals are bussed in common to all three chips. They are MEM EN L, which turns on the memory for a read or write, MA1, MA2, MA4, and MA8, which control memory addressing and are generated by the channel counter, and WRITE L, which, when asserted, causes the data on the input lines to be written into memory.

As can be seen in Fig. 1, there is nothing fancy about the power supply, and it shouldn't cause anyone any problems.

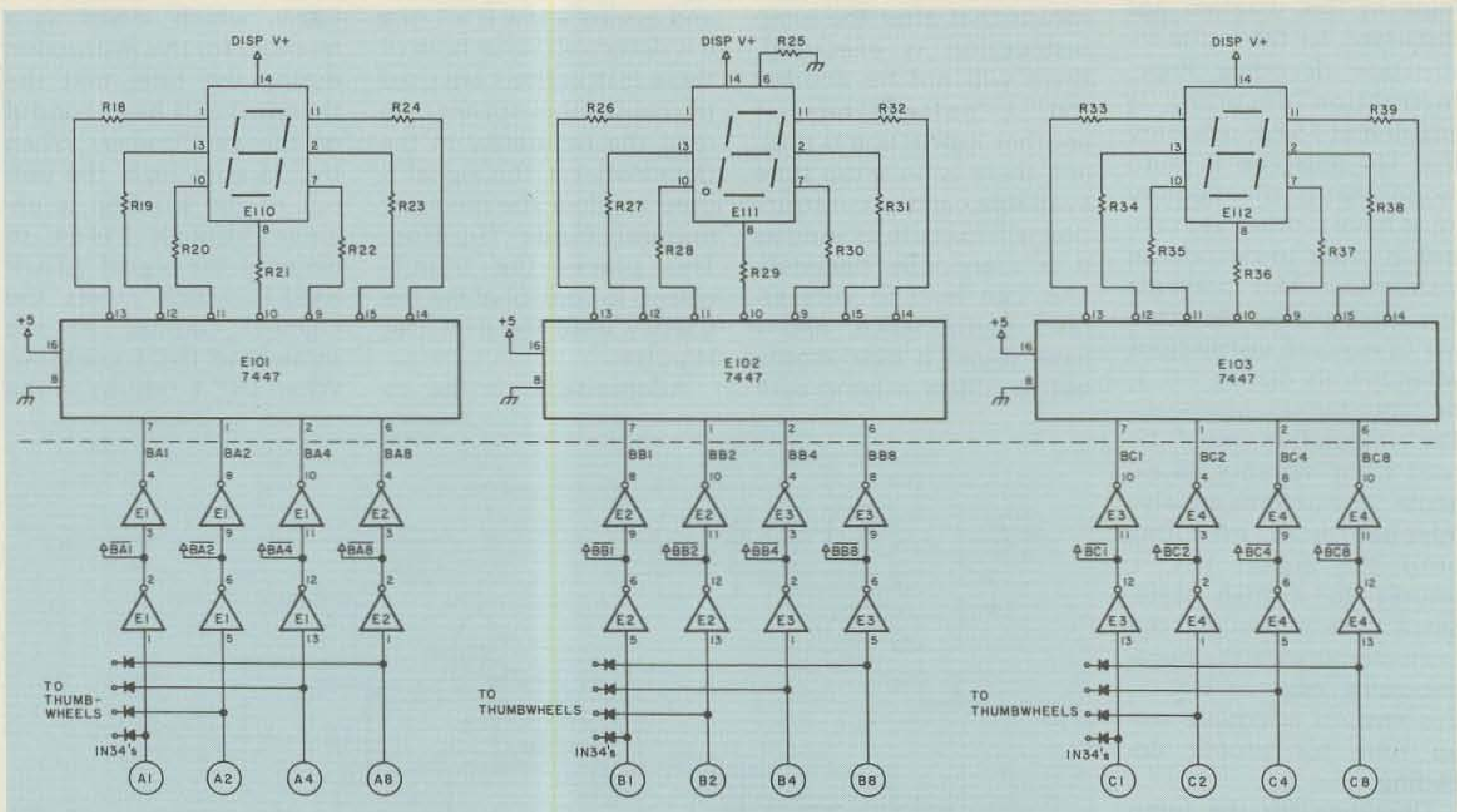
Transceiver Modifications

In order to interface this scanner with the transceiver, a few minor modifications are necessary. They are quite simple and should pose no problem. First the thumbwheel contacts must be isolated from each other. To do this, a diode is placed in series with each wire from the thumbwheels to the synthesizer board. The cathode ends of the diodes are connected to the thumbwheels and the anode ends are connected to the synthesizer board. This isolates the switch sections so that, when the memory has control of the bus, data bits are not shorted together by the switches. I recommend germanium diodes for this purpose because of their lower forward voltage drop. For the Heathkit transceiver, this will require 12 diodes.

The ground wire from the thumbwheels must also be lifted and extended into the scanner. This becomes the signal THUMBWHEEL GND on the logic diagrams. When this is grounded, the thumbwheel data is asserted onto the bus. When this is broken, all data inputs to the synthesizer go to a high state and the memory can then assert control.

Two other wires are required. One goes to the cold side of the transmit/receive relay coil. In the receive position, this is at

*Eugene R. Zobel, "The Synthascanner," *QST*, Vol. LX, No. 11, November, 1976.



	+5	GND
E1, E2, E3, E4 = 7404 IC	14	7
E101, E102, E103 = 7447 IC	16	8
E110, E112, E111 = MAN-1	14	N/A

Fig. 6. Frequency display. All resistors are 330 Ohms, ¼ Watt.

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13.8 volts. When transmitting, it is grounded. The other wire is a pickoff for squelch voltage and, in the Heath transceiver, goes to the emitter of Q213. For other transceivers, it may be necessary to vary component values, add a zener diode in the squelch line, or eliminate the inverter at E32-10. This will vary from one make and model to another, so no specifics for other rigs are offered here.

There are a total of 15 conductors between the scanner and the transceiver, not including ground, which is made through the cases.

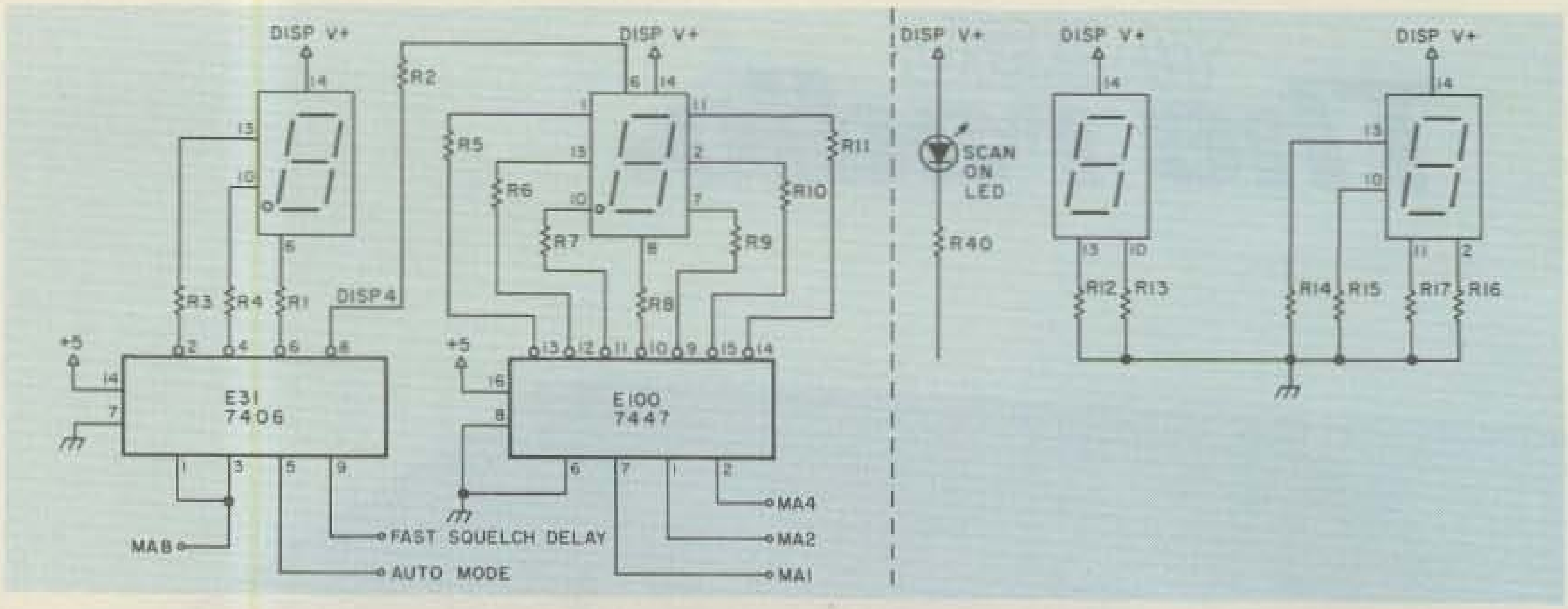


Fig. 7. Channel display.

Construction

The logic is built with wire-wrap techniques on a scrounged wire-wrap board. The display panel is built on a piece of perfboard with the 40 current-limiting resistors for the LEDs epoxied to it. Discrete components are mounted on DIP plugs which then plug into sockets on the wire-wrap board. I will be happy to answer any questions anyone may have that are accompanied by an SASE.

Possible Modifications

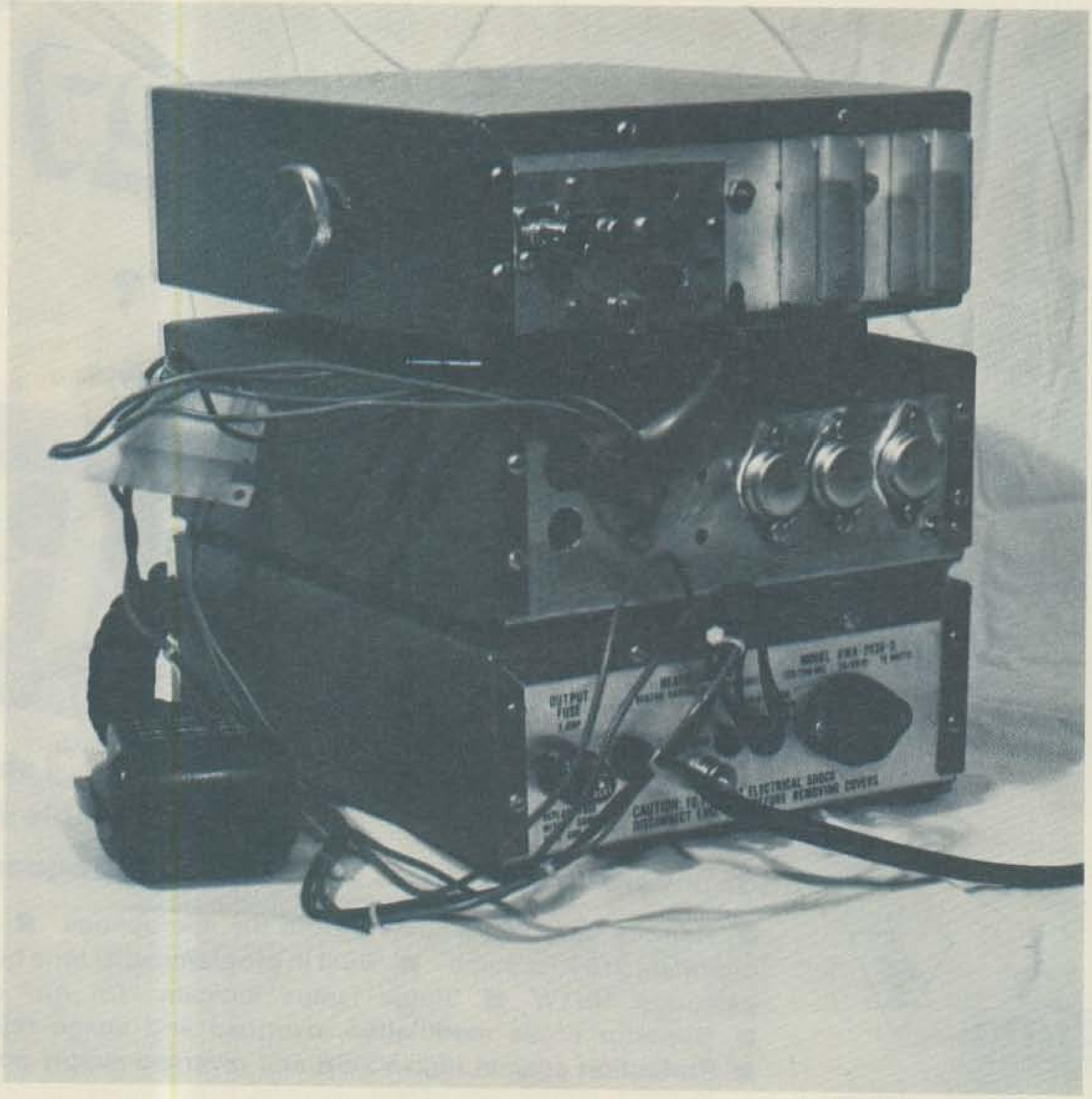
There are a number of possible ways a builder may wish to customize this circuit, so I'll mention a few. Scan rate could be made variable by using a pot. It could also be made asynchronous so that the channel counter would increment, wait for the synthesizer to achieve lock, time out a specified delay — maybe 50 to 100 milliseconds — and then increment again. Scan rate would then depend on how fast the synthesizer locks up rather than a fixed rate.

The builder may also consider putting pots on the squelch delay and in the LED brightness circuits. I didn't because most of my operating is mobile and I didn't want any more knobs to twiddle than necessary.

You may want to use a reed relay to tie thumbwheel ground to ground. I used four sections of a 7406 IC paralleled so that I could get the voltage drop as low as possible. Remember that the synthesizer board has to be able to detect a logic 0, and there are a diode and the 7406 IC producing voltage drops in series. I've had no problem with ambiguous voltage levels in this respect, but, if you have a reed relay in the junk box, there's a good place to use it.

Acknowledgement

I'd like to acknowledge the assistance of Tom Cronick WB9YVY for his help in fabrication of some of the parts of this scanner, and Brian Herzog WD5GYS for the photography. ■



Rear view of scanner showing locations of the three LM309K regulators.

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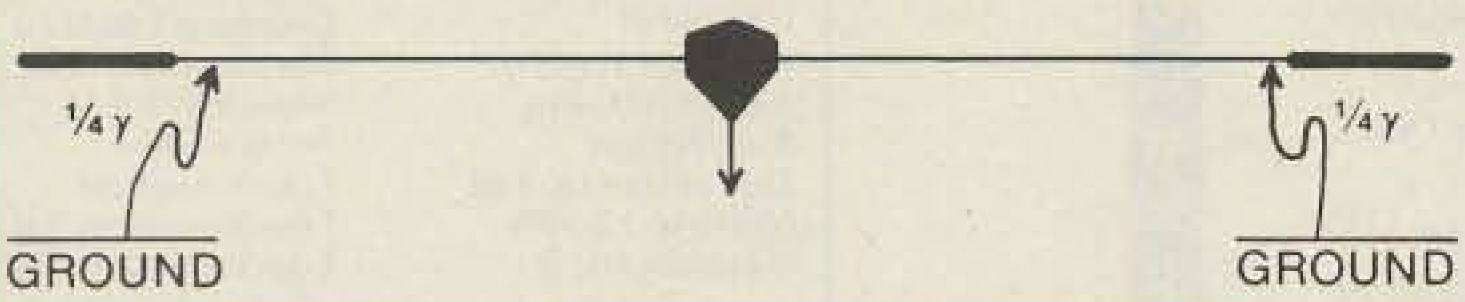

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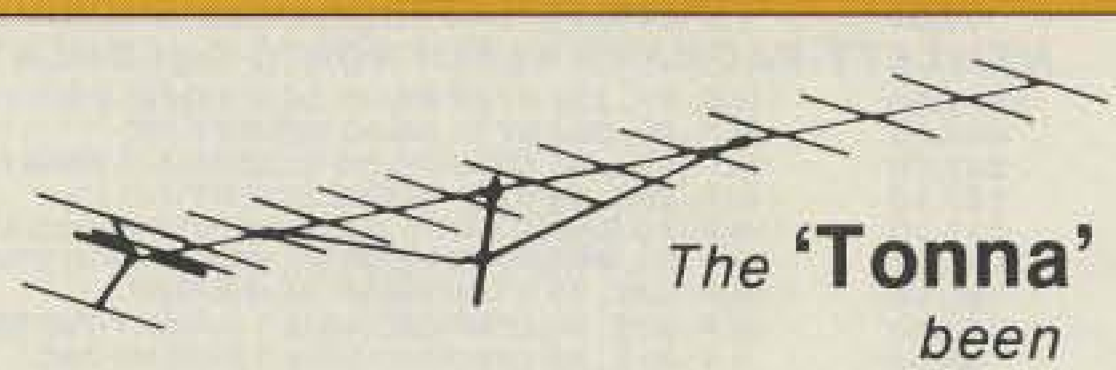

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1947 revisited.

Carl C. Drumeller W5JJ
5821 NW 58 St.
Warr Acres OK 73122

A catchy title, huh? What it really means is that you can build a trickle charger for just about zero cost. This one was for a 12-V lead-acid storage battery in a recreational vehicle that sits idle for considerable periods. It belongs to one of my sons, and one day he came up with, "Hey, Dad, do you remember that trickle charger you built for the Mercury back in 1947? Could you build me one like it?" What a memory that boy has!

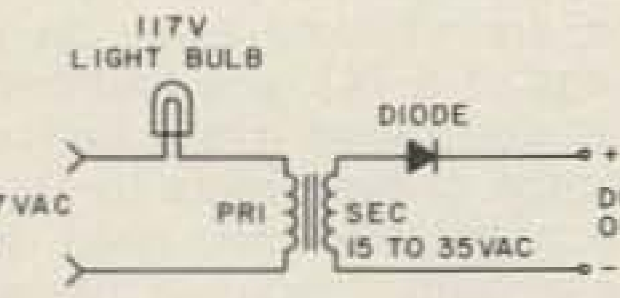

Fig. 1.

Yes, I remembered it . . . and yes, I could build one like it. The original was a zero-cost project, and the reproduction would fall in the same category.

A bit of pawing through what remains of my once extensive junk collection (I've given away two truck loads!) revealed a transformer with three 5-volt windings. There's nothing sacred about the total voltage needed from the transformer. Anything above about 15 volts and below about 35 volts can be used. The hyper-simple method of controlling the charge rate can cope with a wide range of ac voltages.

The three windings were hooked in series-aiding. Yes, there's "polarity" to ac. . . use a voltmeter to ensure series-aiding and not series-bucking! A bit more digging in the junk heaps produced an ancient base-mount socket for a light bulb. Sniffing through my diode collection nosed out one with a 3-A rating; one with a lesser capability would have served quite well.

Now for the circuit.

What could be more simple! All that remains is to ascertain the size of the light bulb you'll need for the desired charge rate. Here my multimeter came into use. Starting with the 10-A range and with a 25-W bulb in the socket, the charger was hooked across a 12-V battery. The meter barely moved. A milliampere meter was substituted. It showed about 35 mA, a bit on the light side. Other light bulbs were tried, revealing that the charge rate could be varied from a few milliamperes to over an Ampere just by swapping bulbs. The size bulb you might need will depend upon what voltage your transformer produces plus what charging rate you desire. A few moments of trial-and-error will show just what you need. Be sure you start with a low-wattage bulb, or you might end up with a popped diode or a bent needle!

Other than that small precaution, it's a foolproof project, one providing a useful product at a very minimum cost. Try it!■

✓ Reader Service—see page 211

Looking West

from page 6

No one can hurt you there. In fact, you stayed away from purchasing a 220 radio because of all the ongoing hoopla over 220 CB. Why should you give a damn about what happens to 220?

You have got to care. If this theft of 220 is successful, then your days of sanctity are numbered. A very evil precedent has been set here, one with far-reaching implications. If maritime mobile can be successful in convincing the military to give up spectrum, it would open the door for other services to do likewise. It's no secret that aircraft would love 144 to 148 MHz and remote broadcasting would be overjoyed to procure 420 to 450 MHz. The door is now open for them to lobby to that end. Even the low bands are not safe since there are always more services wanting spectrum than spectrum available. Do not be surprised to see the amateur media in the near future filled with just such stories. That is, unless the current situation can be beaten down in a way that will make the next spectrum thief think twice about going up against us.

WHAT MIGHT BE DONE

In gathering input for a Westlink item on this story, I placed calls to several coordination councils to gather reaction and input. Normally I wait for such calls to come to me, but this time the story seemed to warrant the expense. The reactions I got ranged from resignation that 220 was lost, to "we had better start moving repeaters off the band now so that there is no real crunch later," to "fight it to the wire" and beyond. These were the upfront emotional responses, but in most cases they were given with a sense of commitment.

Constructively, what can you as an individual do to stop this theft? Letters are important, as are petitions. Write your congressman and senators. Explain your feelings on the matter, and back this up with facts about amateur radio's projected growth and use of the spectrum over the next few years. To a politician these numbers mean votes, and every vote lost means less chance of his or his party's reelection to that office. Letters directly to the President might not hurt either.

Petitions hold the same or a greater value. Each signature is a potential vote, so if you circulate a petition, be liberal on the matter and get support from the general public as well as your fellow hams. The effect that a couple million signatures would have on the politicos would amaze you.

One avenue which is being explored is going on the offensive rather than staying on the defensive. There is talk of taking the initiative and going after 216 to 220 MHz as an addition to 220 to 225 MHz, in light of the fact that the government no longer has interest in its utilization. The rationale here is that (at least in southern California) 220 to 225 MHz is overflowing with activity and the 216-to-220-MHz spectrum would be able to handle the overflow from both 220 and two meters. At least one amateur I know is writing a direct request for rulemaking to the FCC on that very topic.

Finally, there is one more thing you can do. If you have been thinking of getting on 220 and now again fear the loss of the band, do not let this latest attempt at spectrum theft deter you. Now, more than ever before, it is important to populate 220 to the bursting point. Make the band overflow with activity. There is still time to make 220 into a band that would be very hard to change. 220 radios of the crystal-controlled variety are not expensive, and with the overall low noise floor of the band, the point-to-point simplex range will amaze you. You do not need a repeater to enjoy the advantages of this band.

REHAB RADIO DEPARTMENT

April Moell is a physical therapist at St. Jude's Hospital in Fullerton, California. She also happens to be a licensed amateur with the callsign WA6OPS. If you are fortunate enough to meet April in person, one thing becomes immediately evident: she loves people and loves being a ham. I guess it had to happen that April would eventually find a way to combine her two vocations into a new type of therapy: "rehab radio."

April is not trying to make her patients into amateur operators. I doubt if she would mind that happening, but if it ever does, it will be but a welcome by-product of the rehab radio program. You see, the basic purpose of rehab radio is to give severely ill or injured persons who must be hospitalized for long periods of time a "will" to recover. As it was explained to me, many times a person who is in the hospital for a prolonged stay loses track of the world outside the hospital walls. The hospital is a "safe" place, and it is easy for someone seriously ill or injured to retreat within himself in that environment. Rehab radio tends to counter that by placing the patient in contact with those outside his place of confinement. Being able to speak with a total stranger whose tone of voice says "I care" can have remarkable results.

It is the text of the QSO which is important—not the basic contact itself. To quote April: "Do not worry about chasing DX. Patients are not impressed by waiting through pileups to hear a signal report from the Isle of Yap. Also, you must keep in mind the third party agreement. Patients are quite impressed by working someone on the other side of the United States or someone in a state where the patient used to live. It is the person who is at the other end who is important, not his or her QTH."

On the day that I was there, a contact was made with a station in Alaska. I do not remember that station's call at this time. After establishing contact, April explained to the station exactly what was going on and then introduced each patient to the station at the other end. Our friend in Alaska spent quite a bit of time giving his greetings to each patient. As he did, each one either smiled or expressed an obvious sense of joy in some way. When "radio time" was about over, April again passed the mike around so that each patient could bid farewell to his newfound friend in Alaska.

If this interests you, you can get more information on the rehab radio concept by sending an SASE to April Moell WA6OPS, c/o St. Jude's Hospital and Rehabilitation Center Amateur Radio Association, 101 E. Valencia Meas Drive, Fullerton CA 92635. April has prepared a two-page information sheet that outlines the major points of how to get a rehab radio project started and lists related activities and how they can help patients. Please don't forget the SASE. You might also include a QSL card, since the rehab radio patients at St. Jude's really enjoy receiving them.

FLYING 220 AND OTHER PLACES REVISITED DEPARTMENT

As a result of publishing the story of one amateur's cross-country flight while SWLing on 220 MHz, we have received quite a bit of mail. Most of it had a Xerox® copy of an editorial written by Jim Fisk W1HR which appeared recently in *Ham Radio* magazine. Mr. Fisk pointed out the many hazards of operating an amateur transceiver while in a commercial airliner. He also went deeply into the legalities or illegalities of such operation, and quoted the experience of one amateur who wished to operate while airborne. In that case, the amateur did receive permission to operate, but only after exhaustive tests of the radio by the airline and then only for that particular flight on that specific aircraft.

This interested me, since I have been told by a number of amateurs over the years that they had operated "air mobile" by obtaining the consent of the particular captain in command of a given flight. Had they been breaking the law unknowingly? I did a little of my own exploring into the federal regulations governing air-carrier operation. It turns out that the regulations specifically state that, other than certain exempted devices such as tape recorders and hearing aids, the use of electronic devices aboard aircraft in commercial air-carrier service is forbidden. Amateur equipment is *not* on the exempted list.

How about asking the captain for his permission? He is the man in command, isn't he? Not in this case. The regulations are very clear on this. He does not have the authority to permit you to use your radio. Only the carrier has that authority, and in this case "carrier" signifies the airline itself rather than "rf." Therefore, if you feel that you must operate from the wild blue yonder the next time you are whisked away on the wings of a 747, you had better plan well ahead. It may well take months or even years to obtain the permission you need, and the amount of red tape may well boggle your mind. I suggest that anyone giving consideration to such operation first obtain a copy of the October, 1978, *Ham Radio* and read Jim Fisk's editorial on page 4. It does tell it like it is.

My thanks to all who wrote and brought this matter to my attention. It's just this kind of interaction which makes LW what it is. Without you, it would not mean very much. With you, it means a lot. Thanks.

Ham Help

I need a schematic for a Measurements 80 signal generator and a service manual for an Icom 22A 2m transceiver. I will copy and return.

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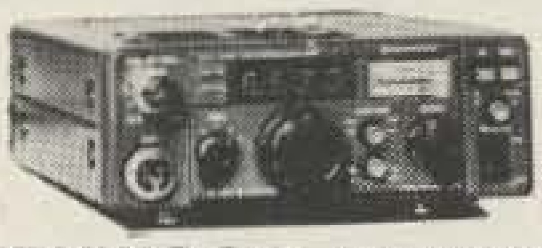

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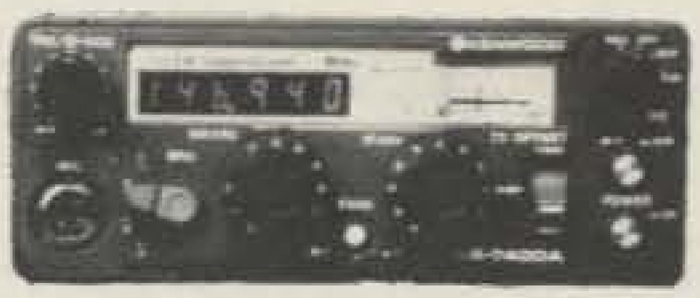

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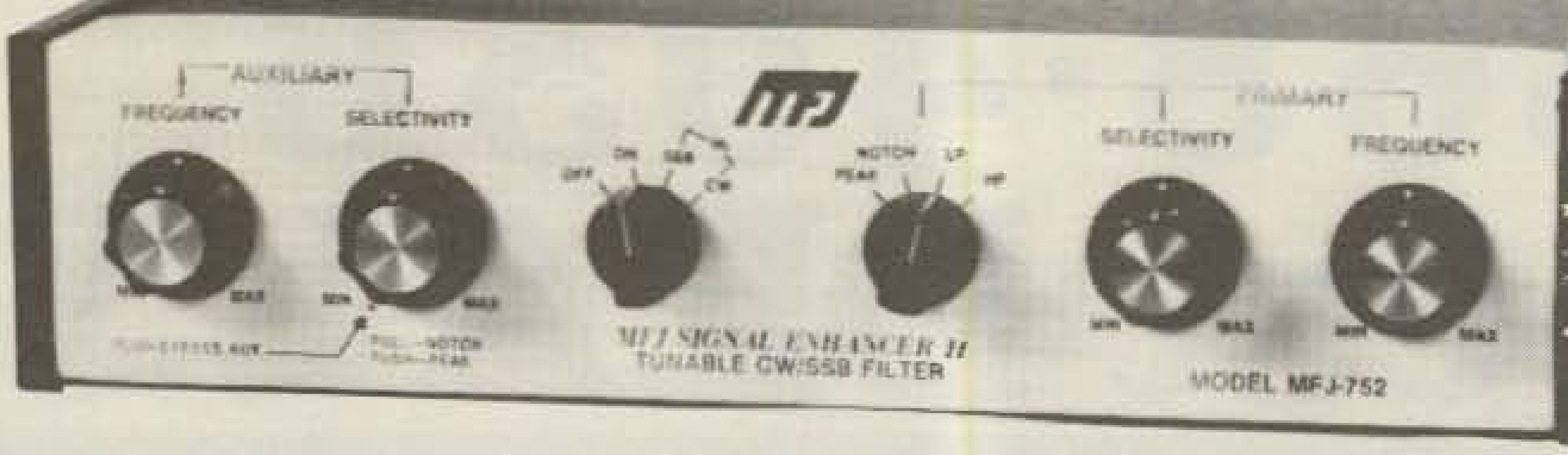

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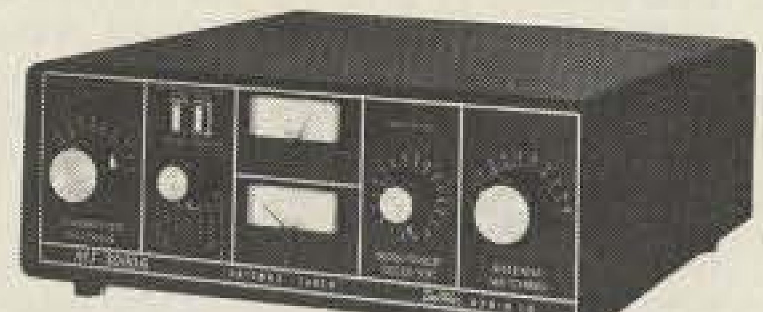

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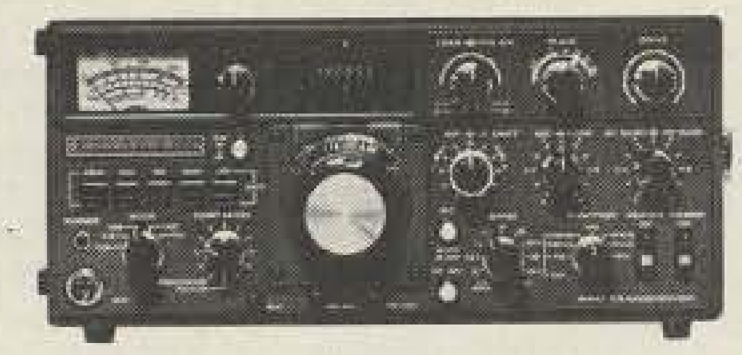

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FCC

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ITU 1979 WORLD ADMINISTRATIVE RADIO CONFERENCE (WARC)

Announcement of Proposals

The FCC adopted yesterday[1] a *Report and Order* announcing its proposals to amend the international Radio Regulations to be considered at the general World Administrative Radio Conference in September 1979.

The FCC's *Report and Order* in this proceeding comes at the end of four years of inquiries in preparation for the general World Administrative Radio Conference (WARC). The Department of State will now use this *Report and Order* to prepare United States proposals which will be delivered to the International Telecommunication Union (ITU) in January 1979 for circulation among the nations of the world.

The ITU is an international organization of 154 member nations and has a history dating back to 1865. It is headquartered in Geneva, Switzerland. Through the ITU, nations cooperate in the use of telecommunications of all kinds to prevent interference, to provide common standards, and to promote the development of efficient technical facilities. It does this by several means, the most significant of which are: agreement among the member nations on a common set of international regulations [the function of Administrative Conferences]; agreement on common technical recommendations [the function of the International Consultative Committees (CCIR and CCITT)]; and registration of radio stations to avoid harmful interference [the function of the International Frequency Registration Board (IFRB)]. Each country participates on an equal basis.

The purpose of the 1979 (WARC) is to amend nearly the entire set of international Radio Regulations. These regulations consist of various definitions and operational and administrative requirements. The most extensive provisions are contained in a Table of Allocations which proceeds from one end of the radiofrequency spectrum to the other, and allocates various bands to defined "services." The Table is divided into three world regions. The Americas are contained within Region 2; Europe, Africa, and the Soviet Union within Region 1; and Asia, Australia, and the South Pacific within Region 3. Past General Administrative Radio Conferences were convened in 1927, 1932, 1937, 1947, and 1959. Numerous specialized Conferences have been held since the 1959 General Conference.

The FCC's Conference preparatory effort began in January 1975, with the issuance of a notice of inquiry, and establishment of a supporting Commission staff, including a Steering committee having overall management responsibility, and several specialized Functional Committees. In addition, the FCC created a number of industry advisory committees to serve as advocates for the various radio user groups through the preparation of reports and the filing of comments in this proceeding. During these past four years, the notices of inquiry have not only served to elicit public comment, they have also represented successive revisions in a process of refining FCC proposals.

Because the Radio Regulations affect all radio users, the Commission has coordinated all of its preparatory activities with the Department of Commerce/National Telecommunications and Information Administration (NTIA) [formerly the Executive Office of the President/Office of Telecommunications Policy (OTP)]. NTIA has the responsibility for coordinating U.S. government use of radio, which is managed by the Interdepartment Radio Advisory Committee (IRAC). IRAC established a 1979 (WARC) preparatory structure similar to that of the Commission's. Because of this ongoing coordination, the proposals adopted by the FCC are consonant with those of IRAC.

During this proceeding, thousands of United States citizens contributed their work and thoughts to the effort. Nearly 2,000 individual comments occupy almost 10 feet of file space. They range from those of a private citizen who saw his life impacted, to the massive reports of corporations and industry groups who saw their businesses potentially affected. The Commission is grateful for all these comments which, large or small, were considered and appreciated for the unique perspective which they afforded. Although the envisioned needs for radio spectrum exceeded the amount available, the FCC believes that in each case it has suggested a position which is equitable, in the public interest, and capable of being accepted by most of the ITU member nations.

The resulting Final Acts of the Conference will be in the form of a multilateral treaty and, in order to be binding, must proceed through the U.S. ratification process. Where the ITU Regulations impose a new affirmative obligation, the Commission will amend its Rules and Regulations to reflect the obligation. Where the ITU Regulations allow new allocations flexibilities, the Commission will, in appropriate future proceedings, consider the available options and offer them for public comment.

After the 1979 GWARC, there will be additional ITU Conferences which will also be of substantial importance to the U.S. Among them, the Plenipotentiary Conference [the equivalent of a constitutional convention] in 1982 has the power to consider and modify all major ITU institutional features. The Region 2 [Western Hemisphere] Broadcasting-Satellite Conference in 1983 will review the 12 GHz band allocations.

The FCC's underlying policy goal throughout this proceeding has been to minimize the international constraints placed upon the FCC in its domestic regulatory activities. Thus, it should be noted that merely because the FCC's GWARC position provided for the possibility of implementing a service in some band in the frequency spectrum, the Commission is not required in any future domestic proceeding to actually implement it.

Many of the FCC's proposals advocate increased sharing of frequency bands among radio services, as well as minimal administrative restraints on availability of radio spectrum and geostationary orbit allotments. This position of flexibility is particularly appropriate during the period of dramatic technological change which is foreseeable during the next two decades. The FCC believes that such a posture benefits not only the United States, but all ITU members.

Some of the highlights of the FCC's proposals include:

Proposing the expansion of the AM broadcasting band. The expansion would create a band at 1615-1800 kHz which is shared between broadcasting and various other services, and a band at 1800-1860 which is exclusively allocated to broadcasting. This change could result in approximately 14 new channels [or approximately 700 new AM stations]. Because most of the available broadcasting channels have been alloted to licensees, this would provide new channels for potential diversities in broadcasting and minority ownership. However, it will require that changes in the design of AM radio receivers be made. These new receivers should not be more costly than existing ones, although a significant number must obviously be in use for the new allocations to be economically viable.

Proposing that the UHF band be internationally allocated equally among most communications services. Because communications technology is rapidly changing and the demand for local communications is increasing, it is highly desirable to minimize international restraints in this band. Therefore, the FCC is proposing to add the fixed and mobile communications services in nearly the entire band between 470 and 890 MHz which is presently allocated exclusively to broadcasting. This will give the Commission the flexibility to apportion this spectrum among these three services in whatever manner it deems appropriate in future domestic proceedings. This posture does not indicate a lessened committment to domestic UHF broadcasting, but rather a recognition of the great value of the radio spectrum resource, and a desire to make it available for use where appropriate.

Proposing that HF (shortwave) band allocations be adjusted to increase frequencies available to broadcasting, maritime and amateur communications. A number of interests have sought to use the band between 3 and 30 MHz, because of its ability to furnish inexpensive, long-range communications. The Commission has concurred in an NTIA proposal to increase the spectrum available for short-wave broadcasting because of White House interests in increasing the international flow of information, to increase spectrum for maritime communications to accomodate growth in maritime industries, and to increase spectrum for amateur radio to as to accomodate the growing amateur community. With only four broadcasting licensees in the international broadcasting service, the Commission would not appear to have a substantial interest in this matter, and has largely relied on NTIA to reach a compromise among the various affected government agencies.

Proposing to double the available radio/orbital resource available for advanced satellite communication systems at 12 GHz. Because many of our country's technologically advanced, domestic communication systems will be introduced in the 12/14 GHz bands during the next decade, this issue is considered by many to be one of the most significant for the U.S. at the 1979 (WARC). In light of a number of factors, the Commission is proposing to make the entire range of the geostationary orbit available in the Western Hemisphere equally to fixed and broadcasting services; and at the same time, separating into individual 500 MHz segments the frequency bands within which the services must operate.

Proposing amendments which would allow introduction of large-scale, user-oriented satellite systems in a number of bands. Such satellite systems are those which will employ a number of emerging technologies to provide highly efficient, two-way communication capabilities (electronic mail service, voice, facsimile, slow-scan TV) directly to large numbers of very low-cost earth stations. They are systems which can bypass existing terrestrial communications systems to provide interconnection among themselves or with regional information service facilities. From the array of options available, the Commission is proposing that certain allocation and technical specification changes be made to allow appropriate introduction of these satellite systems in the 2.5/6, 10, and 12/14 GHz bands as the technology is developed.

Proposing the protection of certain frequencies for scientific uses. The Commission is proposing the allocation of certain bands, and the application of certain technical limitations, to enable the use of satellite sensing of natural microwave emissions for environmental and weather studies. This technique, known as "passive sensing," allows the determination of things such as the moisture content of the soil, the surface temperature, ice thickness, water vapor, and other data of universal benefit to mankind. Most of the needs of radio astronomy have been met, as have those for the research of the physical characteristics of space.

Proposing an amendment which would allow future consideration of a land mobile-satellite service in the 806-890 MHz band. This amendment allows the implementation of land-mobile satellite service in some 20 MHz segment in the 806-890 MHz band. Such a service could provide inexpensive two-way voice and data communications to a wide variety of local, state, and federal government users in mountainous or rural areas where such systems are not presently feasible.

Proposing allocations to various radio services between 40 and 275 GHz. The present international Table of Allocations ends at 275 GHz. In the spectral region between 40 and 275 GHz, only a few allocations have been made. The Commission said that specific allocations would encourage experimentation and development, and certain bands associated with natural microwave emissions must be protected for the scientific community.

Proposing a number of changes to transmitter technical standards which would improve the efficiency of spectrum use. These changes include additional limits on unwanted signals of radio transmitters, on the requirement that a transmitter stay within a certain frequency range, the eventual conversion to single sideband equipment in the short-wave broadcasting service, and improved control over the pointing of satellite antennas.

The text of the FCC's *Report* and *Order* has been released publicly December 28, 1978. The document consists of 437 pages. Because of the cost of printing so voluminous a text, it will not be published in the FEDERAL REGISTER. However, the FCC has prepared a limited number of copies that are available upon request (*Report* and *Order* FCC 78-849, Docket No. 20271, adopted December 5, 1978, "An Inquiry relative to preparation for a General World Administrative Radio conference of the International Telecommunication Union to consider revision of the International Radio Regulations.") at its Information Office, Room 202, 1919 M Street, N.W., Washington, D.C. 20554. The *Report* and *Order* is also available for inspection at the Commission's Docket Reference Room.

FEDERAL COMMUNICATION COMMISSION.
WILLIAM J. TRICARICO,
Secretary.

STATEMENT OF CHAIRMAN CHARLES D. FERRIS

DECEMBER 6, 1978.

RE: Docket 20271, 1979 (WARC) Proposals.

For over four years the Federal Communications Commission has examined literally hundreds of issues related to the 1979 general World Administrative Radio Conference (WARC). This Conference, which will begin next September, will review the international Radio Regulations and make decisions about use of the airwaves for the next twenty years.

The Commission's proposals will be forwarded to the Department of State which is responsible for forwarding the final U.S. proposals to the ITU. The *Report and Order* represents a careful and in-depth examination of thousands of comments and an expert determination of the future needs of the non-governmental users of the radio spectrum in the United States.

Throughout this process, I have sought, as Chairman, to have the Commission's recommendations reflect several important themes. The first is that our recommendations be based on the public comments of the thousands of interested individuals and groups who petitioned the Commission.

The second is that our proposals provide the United States—and every other nation—with the greatest possible flexibility in deciding how to use the available spectrum. Too often, international and national regulations are inflexible—restricting innovation, dramaticaly increasing communication costs, or even precluding development. If the Commission's recommendations are adopted at the Conference, each

Continued on page 180

[1] January 12, 1979.

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- **SCT110 Transmitter Assembly.** SCT110 mounted in shielded housing. . . . $199.95 (30 Wt. Amp. + $68.00)
- **CTC100 COR/Timer/Control Bd.** $35.00
- **ID250 CW ID/AF Mixer Bd.** Programmed $65.00
- **SCAP Autopatch Bd.** $225.00
- **RPCM "Reverse Patch" & Control Bd.** $79.95
- **TTC100 Touch Tone Control Bd.** 3 digit ON, 3 digit OFF. $85.00
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- **WP641 Duplexer.** . . . $539.95

(Add $3.75 ship/handling. PA residents add 6% tax.)

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Reader Service—see page 211

W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

from page 4

For over twenty years I have been pointing out that the key to the future of amateur radio is a political one. Providing service is great, but it won't buy us anything with politicians. Politics are centered in Washington, and this is why all the other users of radio frequencies have strong organizations in Washington to lobby for their interests. Lacking any such power, amateur radio has been pushed around by the FCC and any other group almost at will. The recent ridiculous 220 MHz grab by the maritime interests should prove this point clearly even to the most iron-headed ARRL supporter. The saving of the 220 band from the CB interests and the EIA had little to do with any ARRL efforts, despite their bragging about it . . . they just don't have any clout in Washington.

An efficient manager of an organization first makes sure that his books balance. This means that income and outgo should be brought together, with income slightly exceeding outgo. That sounds simple, but when you have a fundamental policy of keeping ad rates low to try to make life miserable for other publishers, you have an artificial hold on income. I don't think the chaps who worked out that scheme ever expected someone like me to come along, someone who would start a magazine and not even take any salary for several years, someone to whom the money or lack of it was no serious problem, someone who wanted to provide a magazine to help get hams building at any personal cost.

The first "employees" of *73* were college dropouts who worked more for the fun of it than money, getting $20 a week plus keep. I cooked the meals and we had a ball. Most of them went back to school and we gradually were able to hire local people at more reasonable wages.

To get on a firm financial footing, *QST* should first increase their advertising rates to match those of other magazines with their claimed circulation. Then they should increase their membership fees to a more reasonable rate, comparable to those of other organizations. With the added income, they could set about actually providing some of the services hams think they've been getting, and perhaps providing us with some protection against the FCC, the ITU, and other frequency users.

To give you an idea of how off-base the advertising rates for *QST* are, they claim nearly twice the circulation of *73* and yet have lower advertising rates! How is this possible? And how in the world, under these circumstances, can *73* consistently have more ad pages than *QST*? The answer is simple enough: The ads in *73* pull far better than those in *QST* . . . manufacturers and dealers find the readers of *73* are far more active and buy a lot more ham equipment than *QST* readers.

Part of that situation has to do with the high percentage of older ARRL supporters who get *QST* but obviously don't read it, or at least don't read the ads. They already have their Collins equipment . . . indeed, they've had it for many years, so they look over the articles, note that many of them use transistors, and put the magazine on the shelf. The readers of *73* are a different breed, fed on a barrage of articles on the latest techniques and many simple construction projects. About 90% of the *73* readers are into building to some degree. This explains the many pages of ads for parts . . . a heavier percentage of such advertising than was in *QST* even in the supposed heyday of ham building in the '30s.

QST needs a new crew. They need to come out of the dark ages and fill their magazine with projects which will inspire people to build and enjoy amateur radio. They should cool some of the excessive contest coverage and the endless self-congratulation. They should get their directors to stop being messengers from HQ to the members and get traffic moving the other direction so the official journal of the club can inspire clubs to greater efforts and fun. Do I really have to set up such a section of *73* just to show the League what they should be doing in *QST*?

I'll tell you what . . . let's try it. If your club has a building project, make sure that you have a PR officer whose job it is to document what is happening. Have him write an article for *73*; include good photographs of the item being built, the people who organized the project, and those who participated. Let's run some good solid picture stories in *73* and show what is being done by clubs.

Then there are public service events . . . emergency or otherwise. Have the PR officer take pictures and quickly write up the story, and don't forget good pictures of the people, the important people. I want not only group shots of workers, but also good close-ups of the faces. Let's show who is doing what.

The next time you have a hamfest, picnic, or other group event, try to get a big poster or banner with the club name or call on it and line the whole group up for a mass photograph. Have someone with a good camera take the picture . . . none of your 35mm for this . . . at least 6 x 7 cm . . . black and white, please. If you can get a good color shot, do that, too, but black and white comes first in publishing. It's a whole lot less expensive. Field Day is incomplete without the group photo. Send it quickly to *73* and let's get this going. Please be sure to identify every person in the pictures so our captions will be accurate.

DXpeditions all too often go unheralded. Let's be sure we have someone along on important DXpeditions whose main job is to handle the PR. He must have a camera and take a lot of photos. You've seen the job I did on my trip to Navassa and Jordan. Now, with larger pages to work with and more money for color, we can do even better. Color shots should be taken with good equipment, not with Instamatics.

WOULD IT WORK ?

Instead of people leaving the ARRL like rats from a sinking ship and the rest of the employees living in fear of being fired, the League could meet the world as it is today and do the job that is there to be done. They could easily solve their economic problems, even without selling their million dollars worth of stocks and bonds which they've squirreled away over the years.

Do they really need to put nearly a million dollars into building more offices now that many of them are empty? They don't even have the staff to put out decent books anymore. When we needed more room for people to work in our computer program business, we looked long and hard, finally acquiring a local motel which provides us with room for at least 100 more people to work . . . and at a relatively low cost, less than half what it would cost to build something.

THE ADVISORY COUNCIL

Word was released recently that in a panic over the failing fortunes of the League, the executive committee had formed an ARRL National Advisory Council. Named as honorary chairman was Senator Barry Goldwater. Acting chairman was Buzz Reeves K2GL. Many of the well-known gentlemen announced as council members are millionaires. Council members named were Dave Nurse of Heath, Art Collins, Bill Leonard of CBS, Walt Henry of Henry Radio, Bob Cushman of Cushcraft, Bill Muller of Icom, and John White of Cooper Union. I know most of these men personally and hold them in the highest regard.

Soon after the initial announcement, there was a second one saying that Art Collins had bowed out of the council with the explanation that he felt that "more constructive measures should be found to meet the total needs of the ARRL." I think Art has something there. The problems which have brought the League to this stage of disintegration cannot be solved by passing the hat again for another membership collection. The problems are managerial and are deep rooted.

If there was any simple way to get new management for the League, the directors would have done it long ago. The fact is that once a group gets well entrenched, it is very difficult to blast 'em out.

We'll all be watching to see what powers the Advisory Council has, if any. The word in the title is "advisory," so the assumption is that they have merely the power to advise. I suspect that this limitation may have had a lot to do with Art quitting the group. The men listed are spread all around the country, so it is doubtful if they will be able to get together in a group to tackle the situation. They are certainly as busy as I and won't be able to just drop everything and spend the needed time for an investigation of the many factors which brought on this disaster.

Since the heart of the problem apears to be the little HQ clique running the ARRL, people who for the most part have little background in trying to run an organization of that size and complexity, the committee may have its hands full trying to get cooperation in their investigations. How much help will HQ give to a committee which they see as being organized primarily to bring about their demise?

The gentlemen on the committee are hard-working men, but they can afford to take on outside projects such as this only as long as they get a lot of cooperation and don't have to spend too much time fighting management. I devote some of my time to working with the local Chamber of Commerce and I enjoy having a hand in governing what is happening in my town. I also spend some time working to make my old submarine crew have a little better yearly reunion. If I can take a bit of time off from running *73*, *Microcomputing*, *Microcomputing Industry*, Instant Software, etc., then most businessmen can do the same . . . if it seems worthwhile.

BULLET BITING

The position some of the Advisory Council members are in is not enviable. The needed increase in advertising rates could directly affect their own businesses. The current *QST* ad rates are around $1,500 per page and should, to be consistent with those of other similar magazines, run around $4,500. This would increase the cost of a full-page ad by about $36,000 per year and have to be reflected in higher equipment costs to amateurs. This change alone would bring up ARRL income by about $2.5 million a year and eliminate the necessity for increasing membership fees. It would certainly get the League out of the financial hole the present management has gotten it into.

HOW ABOUT THE IoAR?

Several longtime readers of *73* responded to my December editorial with the question as to why I have not resurrected the Institute of Amateur Radio, particularly in view of the problems with WARC. That deserves an answer.

First, for new amateurs, let me explain what an IoAR is . . . or was. Back in 1963, when *73* was just about three years old, I got the foolish notion of promoting ham-to-ham friendship through a ham tour of Europe. Oh, the idea was good, but the work involved was monstrous. The idea was to get groups of amateurs together and visit amateur groups in Europe.

In order to qualify for a group fare on the airlines, it was necessary to have a formal group. I formed the Institute of Amateur Radio with the primary purpose being the organizing of ham trips to visit DX hams. I advertised the idea in *73* and gathered together a group of 73 for the tour. Odd number.

I made all of the arrangements for airline travel, ground transportation, hotels, etc., including a hamfest in most of the places we would visit. I did all this in addition to editing and publishing the magazine, selling the ads, helping with the subscriptions, etc.

The first place we visited was London. The RSGB (Radio Society of Great Britain) refused to do one damned thing to greet or offer a friendly hand to the 73 visiting U.S. hams and their families. Despite that, a nice dinner was arranged and our group was able to get together with the local amateurs.

The frigid reception from RSGB may have been more of a reaction against the ARRL than U.S. hams in general, since we found the British amateurs to be very willing to put themselves out to show our group around. One of the high points was a visit to the British Science Museum, where the restrictions against third-party traffic had been waived and many of us were permitted to make phone patches back home.

The next stop was Paris and a fantastic reception organized by Pierre Catala F2BO, the local representative of the then quite active Ham Hop Club (a club which organized places for visiting hams to stay with other hams in foreign countries). I'd met Pierre on my first visit to Paris in 1958, so we were old friends by this time. In 1964, Pierre came to the U.S. and worked for *73* as long as Immigration would permit. Then he went to college in New Hampshire and graduated from the University of New Hampshire. He's now in Haiti working for the ITU.

The French amateurs pulled out all the stops and we had a beautiful visit to Paris. We all got together for a big hamfest and most of the group had French homes to visit.

The next stop was Geneva, where an international hamfest had been organized by the ITU hams. There we had a dinner with hundreds of hams from all over Europe who had come in for the occasion. Just about everyone got to operate 4U1ITU and we all had a ball.

From Geneva, we flew to Rome, where we had an audience with the Pope. From Rome, we flew to Berlin and another great hamfest-dinner, getting together with just about every active Berlin ham. We arranged bus tours of the east and west sections of the city, and it was a memorable visit.

How much did I charge for all this? The complete price for the trip, including round-trip airfare, ground transportation, hotels, all breakfasts, tours of some cities, and a hamfest in most cities with dinner, came to $550 per person. Not bad for a three-week trip to five major cities. The regular tourist round-trip fare to Rome alone was $625 at that time.

Everyone had a fantastic time. I still meet people at hamfests and conventions who were on the trip and say they wish we could do it again. It was a memory all of us will carry with us.

At $550, we obviously didn't make any money, But then, despite the claims of my critics, money has never been anything more to me than a way to get things done, so I have tended to just scrape by.

The tour was in October, 1963, just at the time that the League petitioned the FCC for what they amusingly called "incentive licensing." This beaut, for those of you who were not there, called for throwing most of us off the phone bands we had been using and forcing us to take a new license exam to get back our previous privileges. It went over like a lead balloon. Sales of ham equipment dropped from $35 million in 1963 to under $5 million in 1965, largely in response to this fiasco. Ham growth stopped in its tracks, not going into the plus column for over ten years after this bomb.

The reaction of many hams was to look desperately elsewhere for some organized support. Suddenly my little travel club was being pushed to become a national organization. The $1 membership fee was increased to $10 and the IoAR was up and running. The purposes of the Institute were to do the things which the ARRL could not or would not do, such as lobby in Washington, furnish cash for hams fighting legal battles which could affect us all, etc. It was set up so as not to challenge the ARRL in any of the activities it was actually doing.

This is not the place to cite all of the dirty tricks the ARRL cooked up to try to scuttle the Institute. Several ARRL directors bragged to me that the League would spend *any* amount of money to shoot down the Institute and it didn't take long before I realized that this was a fact. Directors rushed around to every club in their divisions denouncing any

Corrections

Two errors exist in "Light Up Your Life" (December, 1978). First, the PC board layout (Fig. 2) should be replaced with the one shown here. The original Fig. 2 shows, incorrectly, the component side, rather than the foil side. Second, the pin numbering scheme for the 5th digit readout (Fig. 1) contains *two* pin 11s. The *lower* pin 11 should be labeled 7.

We regret the trouble that these errors may have caused.

Gene Smarte WB6TOV
News Editor

Since the time that I wrote the article for the WR7AEK battery charger, Tri-Tek has stopped advertising in *73*. Please print their address as follows: Tri-Tek, Inc., 7808 N. 27th Ave., Phoenix AZ 85021, 995-9352. Please send your money to them and not to me. Specify you want the "WR7AEK battery-charger kit," not "the thing by WA7DPX in *73 Magazine*." For Mr. R. B. Hintenoch and others who have written (or called)—no SASE, no answer. I have enough bills without making the post office rich. Thanks to those who have written letters to me about the article.

James Wyma WA7DPX
Casa Grande AZ

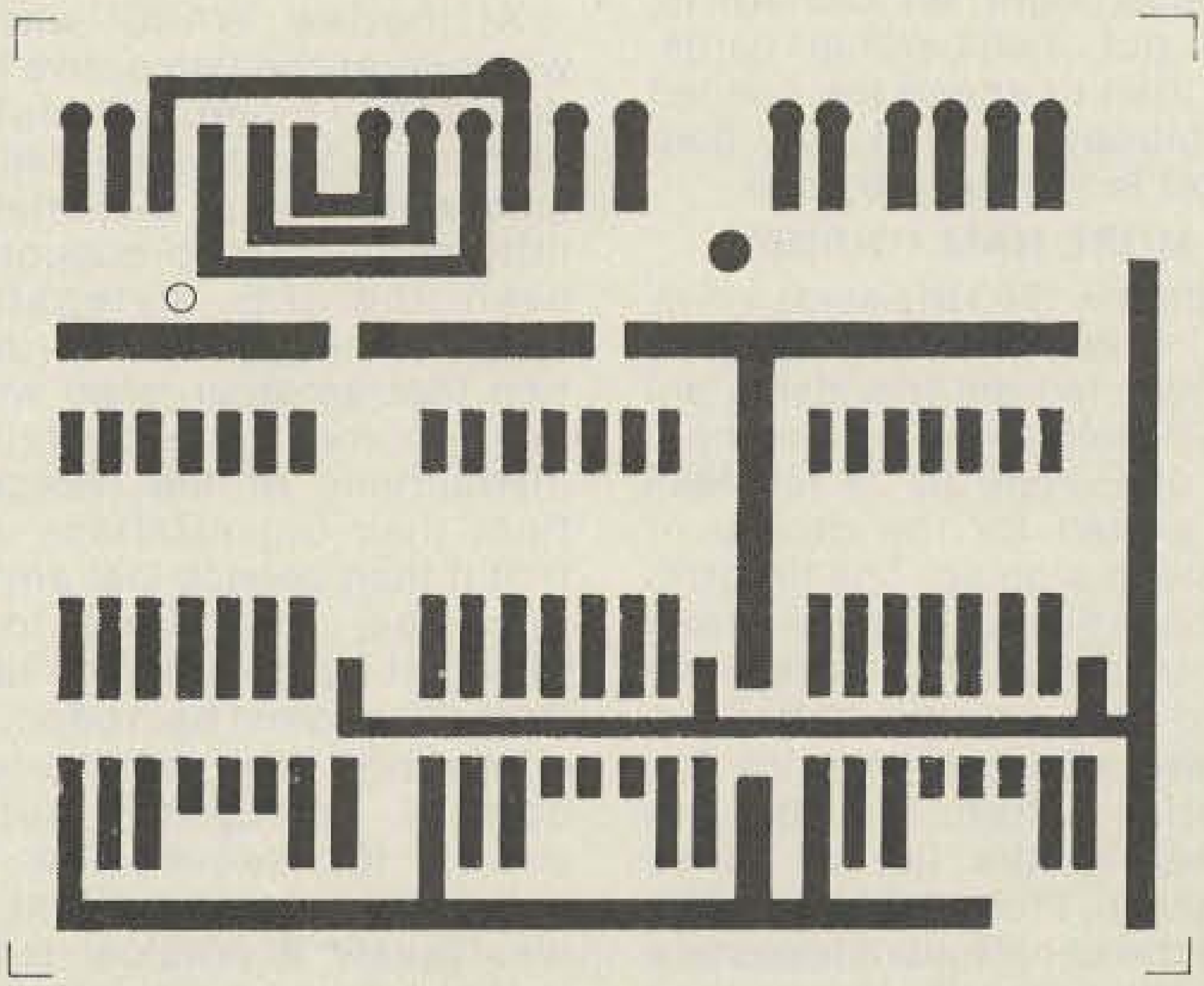


Fig. 2, "Light Up Your Life." PC board.

ham supporting the Institute as a traitor to amateur radio. A newsletter began being sent to clubs everywhere and to every member of the Institute (I published their calls) telling them, month after month, that I was a crook, that everyone involved with the Institute was a crook, that I was going to kill amateur radio, etc. Dick Cowan dutifully helped with some similar comments in *CQ*.

In the midst of this increasing war, I got involved with a really miserable divorce. Unless you've been through something like that, you don't know what it is. It stopped me more than anything else for quite some time. I realized this and got together with the board of directors of the Institute and insisted that they find someone else to act as secretary for the organization until I could get back into better working shape.

The board tried hard to find someone to work for the same price I did . . . nothing. They finally settled on Dave Middelton W7ZC, who would do the work but insisted on a very nice salary for his time, even though he was retired. This resulted in the funds which I had built up for the Institute being spent for his salary and little else, finally running out completely. My main expenses had been for publishing and mailing newsletters to Congress telling them about the good things radio amateurs had been doing . . . such as helping get medicine to remote parts of the world and the amateur radio service during the Alaska earthquake.

By the time I had managed to get back into some sort of good working shape, the Institute had collapsed from the attacks of the ARRL and the internal bleeding by the secretary. I decided to sign up again as secretary, but instead of soliciting members, I decided to do the needed work myself. It was more trouble to get memberships, fight off the ARRL, send out membership cards, etc., than to spend the needed PR money out of my own pocket to get the job done.

MORE HAM TOURS?

With the 1963 trip such a success, I wanted to do more of this ham-to-ham friendship activity. I announced another ham tour of Europe in *73* for 1965 and waited for the deluge of people to sign up. The first trip had been so much fun for everyone involved that I felt we would have an even better trip the second time. Imagine my surprise when, on looking closely at the list of those signed up, I found that virtually all of the people were repeaters from the first trip. It was then that I realized that there was a very limited number of hams with $550 and the time for such a trip. I called it off.

We did try it again in 1968 and had a very nice tour of Europe, visiting Madrid, Amsterdam, Paris, Copenhagen, etc., but the smaller crowd involved confirmed again that the number of hams able to participate in such a tour is very limited. Hams are, for the most part, middle and lower-middle income people, and not many can afford the luxury of a three-week vacation in Europe with the XYL. Better to put the money into a new rig, I suppose.

WHITHER THE INSTITUTE?

In view of the present growing disenchantment with the League over their bumbling of the WARC planning and other recent problems, is there a need for a second national amateur organization? Right now I don't see any serious need for one. There is no question that with the usual 20-20 hindsight, we can see that we sure should have had one last year to get the WARC situation covered in Africa.

If we do manage to come through WARC with enough ham bands to survive as a hobby, then we will definitely need a second national ham society. The key to the whole situation facing us is a political one, and this means that if we are going to cope with the government, the FCC, the ITU, etc., we must have a strong lobby in Washington. That's where the power is, and that's where we need to be covered.

A good lobby can not only put pressures on the FCC to prevent gross miscarriages of justice like the recent linear amplifier ban and the 220 MHz maneuvering by CB and the maritime interests, but it could also help us get things through Congress and put pressure on other government agencies to support amateur radio, which we need desperately at WARC.

At the last WARC, where I was one of the two active ham delegates, I found that this lack of clout in Washington had resulted in amateur radio having little more than lip support by even the U.S. delegation. Despite the official U.S. position that amateur radio would be supported 100%, the private instructions of the delegates from their organizations were that if their service lost any frequencies, they were to be replaced by frequencies taken from the nearest ham band. Our allocations were considered a sort of emergency supply source for frequencies. The delegates pointed out that this was purely a political matter that the service with the least clout was bound to be the loser. Just about every other user of radio frequencies maintains a strong lobby in Washington, so they come first.

NOVICES ON 220?

The Canadians are all upset over an ARRL proposal to open the 220 MHz ham bands to Novices. Frankly, if I already didn't have a petition on file with the FCC for this band to be opened for Communicator use, I'd probably get upset, too. Not very much, though.

The ARRL has, in the past, endorsed the Communicator idea for 220 and not a few of the major manufacturers are quite convinced that such a new class of license is inevitable . . . and soon. For my part, I think I could get up in front of a large group of amateurs and argue effectively either for or against a Communicator license. There are many benefits to be derived from such a plan . . . and there are many drawbacks.

I filed the original petition so long ago that I forget just when it was . . . about ten years ago, I think. My scheme in filing it was to present a viable alternative to taking the band away for CB use and hopefully to divide the manufacturers enough so that CBers wouldn't take our band. I figured that if the Communicator Class license actually did go through, it would have more benefits than drawbacks, although I felt that the two proposals might just defeat each other with the result that there would be no major change in 220.

The League surprised me with a historic first . . . they supported the Wayne Green petition. They really had little other choice. With the CB manufacturers pushing hard through the EIA (Electronic Industries Association), the ARRL *had* to come out with a positive move. To just try to hold the status quo was far too weak an argument and would obviously lose the 220 MHz band for amateurs. To come out with a third proposal would split the ranks too much for success . . . so they had to support my proposal, much as they hated the idea. I had a good laugh with several of the directors over this.

As a passing matter and off the point, I am on good terms with some of the ARRL directors and hold a few of them in great respect. I'm not personally at war with anyone at the ARRL and hold no personal grievances. I'm neither in awe of nor afraid of the men running the show. They don't seem to feel the same about me, so we do have difficulty in getting together. That's a pity, for I've found that even the widest differences can usually be overcome if people will sit down and discuss things. This presumes that those participating are honestly motivated.

At any rate, now that the 220 threat to CB has finally been laid to rest, I think the ARRL wanted to put a stop to the proposed Communicator Class license and felt that the safest way to do this, while still appearing to support the manufacturers, was to put in a counterproposal. This would in all probability stall things for a few more years and permit the whole matter to eventually be washed away.

I see no real point in taking up any argument for or against releasing tens of thousands of Novices on 220 MHz since I don't think the ARRL is serious about it.

ST. LOUIS, MARCH 31

Mark off March 31 on your calendar and plan to come to St. Louis for one of the most fun hamfests yet. It'll be worth the trip. I'll be there to talk about hamming and also about microcomputers and answer any questions you have. Sessions like this are great because there are a lot of things that I can tell you in person that I wouldn't dare to write.

What started out as a simple visit by Wayne Green to St. Louis has been escalated into a full-fledged hamfest. It will be at the H. J. Cervantes Convention Center and there will be forums on many aspects of amateur radio all through the day. Planned are sessions on OSCAR-AMSAT, repeaters, RTTY, 10/10 International, YLRL International, SWOT, linear amplifiers, DX with Father Moran 9N1MM from Nepal, SSTV by Robot, antennas by Hy-Gain, and some special sessions for the XYLs, etc.

Exhibits? You bet. So far the following are signed up or expected: Yaesu, Kenwood, Robot, VHF Engineering, Hy-Gain, MFJ, HAL, ETO, Kantronics, Ham Radio Center, Henry Radio, Cushcraft, Tennalab, Sinclair, Telrex, Rohn, Southwest Technical Products, CB Products, Ten-Tec, DSI, Info Tech, Microlog, Radio Shack, Drake, DenTron, Icom . . . and there will be a lot more. Dealers will be coming with some fantastic special prices.

Just to get the show off to a good start, I'll be in a day ahead and will be on the radio and television stations through a good deal of Friday drumming up interest in the hamfest for Saturday.

The event is going to be called "ARCH MARCH" . . . ARCH for the famous St. Louis Arch and MARCH for Midwest Amateur Radio and Computer Hobbyists. The show will be put on by an amalgamation of 22 clubs in the area, led by Bob Heil K9EID.

The idea for the hamfest grew out of a phone call to me from Bob Heil. He wanted to get me out to talk to the Marissa Amateur Radio Club (Marissa, Illinois). The more we talked, the bigger it grew. On December 15, Bob met with representatives of nine area ham clubs and the show was on the road.

There has been a need for a hamfest in the St. Louis area and I'm delighted to see this shaping up so quickly and so well. The idea is to make this a yearly event. If you can possibly make it to the hamfest, please come and help make this a winner. Bring all the hams that you can.

Since, as far as I know, I'm not on the program to speak at either Dayton or Atlanta, this may be the *only* place where you will have an opportunity to find out what is really going on . . . and to ask the questions you wish you could get answered.

SWISS REPEATER

They may not have as many repeaters in Europe as we do, but you can't fault them on innovations. A Swiss repeater has a very sophisticated receiving system . . . it uses a microprocessor to check the direction from which a received signal is coming and switches the receiving antenna to that bearing from an omnidirectional pattern. It can also be used to check the location of the station and compare that with the callsign. Does that give you repeater owners any ideas? The Swiss repeater is so effective that it is able to cover virtually all of France.

HELP YOUR LIBRARY

Presumably you enjoy *73 Magazine* and realize that if more hams would read it, they would get a lot more enjoyment out of amateur radio. The articles are also top-notch for getting newcomers fired up with an interest in amateur radio. You can help enrich some lives by making sure that *73* is in your local library. Oh, it won't cost you anything except the time to check and ask.

If you find that it is not in your library, please make sure that the head librarian knows that you think it should be there. You might point out that *73* is the largest of the ham magazines and has more articles than any other . . . indeed, more than all the others combined some months! *73* is more of an ongoing encyclopedia of amateur radio than just a ham magazine.

In most cases, by the time two or three people have asked that *73* be in your local library, and they know where to write, we'll be getting a purchase order from them. And what school library is adequate without this reference? Let's see what you can do.

NOVEMBER WINNER

Dr. Ralph E. Taggart WB8DQT will be receiving our $100 bonus check for the November issue's most popular article, "Be A Weather Genius." Keep those Reader Service card ballots coming in!

COINCIDENCE

During the recent Aspen ham industry conference, we had quite a group sitting around a table at one of the nicest restaurants in town. I had just handed out some brochures by a ham advertising agency promoting the use of a ham-run ad agency for advertising and marketing when the waiter asked if I was a ham. I said sure, and he asked my call letters. Just to be smart, I turned my belt buckle with my call engraved on it up and looked at it . . . and read off W2NSD/1. The waiter gave a laugh and introduced himself as Fred WB0FOR, and said that he was the one who had made the belt buckle for me.

I'd tried to get in touch with him the year before, but he'd been away during our conference. Colorado Silver, located in Aspen, had been advertising in *73* and turning out extraordinarily good belt buckles for hams who are proud of their calls. The buckles come in bronze for $13.50 and have to be one of the nicer gifts a wife can give a ham. I wear mine a lot and it gets noticed. I remember once in Berne, Switzerland, when a woman saw it and said that her son was a ham . . . etc. For a bit extra they are available in solid silver. You can look up their ads during 1978 in the April and June issues.

New Products

from page 19

ged, compact unit which fits easily into the palm of the hand, the LX 303 features a large, ½-inch, angle-mounted LCD readout for high readability indoors and out, even in bright sunlight. A reading rate of 3 readings per second makes accurate reading fast and convenient. Battery life is 200 hours minimum (300 hours typical) from a single 9-V alkaline battery. Handy battery check capability is also provided.

Ruggedness is achieved in the LX 303 by combination of light weight (12 oz., including battery), compact size, a high-impact thermo-plastic case, and glass-epoxy PC board construction. Ruggedness is further enhanced by a snap-on cover which protects the entire front panel during storage or transmit, whether in a briefcase, toolbox, or storage bin. The snap-on cover can also be used to store the test lead set included to effect a totally self-contained, protected instrument. All input jacks are recessed for operator safety.

Reliability is assured by the use of LSI circuitry and laser-trimmed thin-film resistor networks for low parts count. The excellent overload characteristics provide 1000-volt protection on all dc voltage ranges except the 200 mV range (which is protected to 500 V). All ac ranges are protected to 600 V. All Ohms ranges are protected to 120 V. Maintainability is also excellent, due to the use of sockets for the major components (including the display) and the extensive use of standard components. The unit is covered by a 1-year warranty.

A full complement of accessories is also available, including an ac adapter (115 V ac and 220 V ac versions), a padded vinyl carrying case, a 10-A dc current shunt, a x10 dc V probe adapter which protects the input to 10 kV, and a x100 40-kV dc probe. For further information, contact *The Hickok Electrical Instrument Company, 10514 DuPont Ave., Cleveland OH 44108; (216)-541-8060.* Reader Service number H35.

PALM-SIZE CSC MAX-550 MHZ COUNTER

The newest and most capable frequency counter in the "Max" line from CSC is the MAX-550, a new, palm-size frequency counter which boasts a 1-kHz-to-550-MHz range. This counter is no bigger than most pocket calculators.

The counter's 50-Ohm input (via a BNC connector) has a sensitivity in the milliwatt range. Its 6-digit LED display features 1-kHz resolution. Any of several sources of 7-12 V dc can be connected through the counter's coaxial power connector. And a number of accessories—including cables, a case, alternate power sources, and so on—will be offered.

Additional information is available from *Continental Specialties Corporation, 70*

CSC's MAX-550.

Fulton Terrace, New Haven CT 06509; (203)-624-3103. Reader Service number C9.

NDI ANNOUNCES 800-CHANNEL 2 METER TRANSCEIVER

NDI, Inc., has announced the HC-1400, a new high-performance 2 meter FM mobile transceiver. This microprocessor-controlled, digitally-synthesized unit has 800-channel capability within the amateur 144-148 MHz band, and offers 5- or 10-kHz channel spacing. A fast-acting single knob selector shifts LED digital frequency readout in 10-kHz steps, and the rig also has a 100-kHz "speed-up" button. Transmit offsets are preprogrammed and switchable to plus or minus 600 kHz. Simplex operation is also available. This set can be programmed to hold three Tx-Rx pairs in memory, and has capability for instant recall. The receiver uses an FET front end with three coax resonators, a crystal lattice filter and multi-tuned circuits in a dual i-f. The FM transmitter delivers 25 W output at 13.8 V dc. Power is reducible to 5 W. Size: 7.1" W x 2.6" H x 10.1" D. A mounting bracket and a detachable microphone are also supplied. For further information, contact *NDI, 22125½ South Vermont, Torrance CA 90502; (212)-320-3312.* Reader Service number N19.

TEMPO 800-CHANNEL HAND-HELD TRANSCEIVER

The amazing pocket-sized Tempo S1 SYNCOM offers the first fully-synthesized 800-channel 2 meter miniature amateur hand-held transceiver. Other units which are larger, heavier, and similarly priced (by the time you add crystals, batteries, chargers, and antennas) can offer only 6 channels. The S1's price of $349 *includes* the battery pack, charger, telescoping antenna—and 800 channels!

Top-panel thumbwheels allow selection of the receive frequency to 10 kHz. The +5-kHz slide switch offsets to 5 kHz if desired. Then you have the choice of transmitting simplex, +600 kHz, or −600 kHz.

The S1's separate speaker and microphone are both built-in. Rf output is better than 1.5 Watts nominal. A matching 30-Watt output amplifier is available for mobile or fixed operation. The dual-conversion receiver section has a sensitivity of better than 0.5 microvolts nominal for 20 dB of quieting, and spurious and harmonic attenuation is 60 dB nominal below the carrier power level. Measuring 2.5" wide x 6.5" long x 1.6" deep, the unit weighs 16 ounces with batteries.

The Tempo S1T is the S1 with a factory-installed 12-button touchtone™ pad ($399). Accessories for the S1 and S1T include the TS-CC heavy leather holster with snapped belt loop ($16), the S30 matching 30-Watt amplifier ($89), the TS-MC cigarette-lighter-plug mobile charger ($6), the TS-HA rubber-coated flexible antenna ($8), and a full line of tone accessories, all types of touchtone pads, many different amplifiers, and power supplies.

The Tempo S1 and S1T and accessories are available from dealers throughout the US and all over the world. *Henry Radio, 11240 West Olympic Boulevard, Los Angeles CA 90064; (213)-477-6701.* Reader Service number H3.

Morgan W. Godwin W4WFL
Peterborough NH

HUSTLER INTRODUCES NEW 2 METER MAGNETIC-MOUNT ANTENNAS

The new Hustler Model BBLM-144A 2 meter magnetic-mount antenna was recently announced by New-Tronics. The base-loaded 52" antenna offers a unique magnetic-mount design with much stronger grip per square inch of magnetic surface than is normally available in magnetic mounts.

The HC-1400, NDI's new 2m transceiver.

Careful design of the shunt-fed matching system guarantees maximum signal radiation at the point of lowest swr. The tapered stainless steel radiator provides maximum protection against flutter and detuning at freeway speeds. The power capacity exceeds 200 Watts. The BBLM-144A includes 17' of top-quality RG-58 coaxial cable with factory-installed connectors.

The SFM 2 meter mobile antenna with magnetic mount also inlcudes 17' of RG-58 coaxial cable with factory-installed connectors. The 54" tapered whip is ground of 17-7 PH stainless steel. A bandwidth of 6 MHz and better than 2:1 vswr can be expected. The power capacity is 100 Watts.

For further information, contact: Sales Department, *New-Tronics Corporation, 15800 Commerce Park Drive, Brookpark OH 44142.* Reader Service number N2.

NEW BEARCAT® THIN SCAN™ IS WORLD'S SMALLEST SCANNER RADIO

A new portable scanner radio, just 2¾ inches wide and 1 inch thick, has been introduced by Electra Company. Named the "Bearcat Thin Scan," it is described by Electra as the "world's smallest scanner radio." Because of its exceptionally small size and light 10-ounce weight, the radio is a truly practical pocket portable unit. Featuring a rugged all-metal case with a polished, anodized aluminum front cover, the radio is expected to be especially popular with professionals and others who require a scanner in demanding on-the-go situations.

The new Bearcat Thin Scan has 4 channels and receives both "low band" (36-44 MHz) and "high band" (152-164 MHz) with excellent 0.6-microvolt sensitivity. Each channel is provided with a lockout control for bypassing when desired. The radio can be operated from external power as well as internal batteries. Also contributing to the radio's versatility are provisions for plugging in an external battery charger, headphone, and external speaker. A flexible "rubber ducky" antenna is supplied, but the radio can also be used with wire antennas.

For further information, contact *Electra Company, PO Box 29243, Cumberland IN 46229.* Reader Service number E40.

The new Bearcat® Thin Scan™.

YAESU'S FT-7

I've owned my FT-7 low-power mobile rig for a year now and have really enjoyed it. I bought it on Okinawa while with the US Navy, so I have the Japanese version instead of the US one. The main difference is the language of the manual.

The FT-7 covers 500 kHz of the 80-15m amateur bands, plus one 500-kHz portion of ten meters (28.5 to 29.0 MHz). The FT-7 operates on USB, LSB, and CW, with a choice of vfo, RIT, or fixed channel operation. The rear panel has provisions for a standard SO-239 rf connector, a ground post with butterfly nut, subminiature jacks for key and external speaker, a six-prong plug for power, and a multi-pin jack for an external vfo (although they don't make a vfo specifically for this radio).

The FT-7 input power is 20 Watts dc. The receiver is rated at .5 uV sensitivity for a 20-dB S/N ratio. It has an audio bandwidth of 2.4 kHz − 6 dB and 4.0 kHz − 60 dB. The audio output is 3 Watts with 10% THD into 4 Ohms. The FT-7 requires .4 Amps on receive and 3 Amps on transmit of 13.8 V dc. It measures 9" W x 3" H x 12" D.

The FT-7 came well-packed and included a hand mike, 3 subminiature connectors, a fused power cable, an rf connector, a phone-plug-to-subminiature-connector adapter, and a mobile mounting bracket.

My personal impressions are very favorable. The audio is clear and crisp, and the styling is smart and functional. I've had no trouble working the world with just the FT-7 and a trap vertical. My only two complaints are the lack of a CW filter and the inconvenience of only having one ten meter position on the radio. Overall, it is a very nice radio.

Yaesu will soon be coming

out with the FT-7B, which is basically the same radio with the addition of all of the ten meter band and with the power having been raised to 50 Watts input. Reader Service number Y1.

John Price WD8OPE/KA6JP
Warren OH

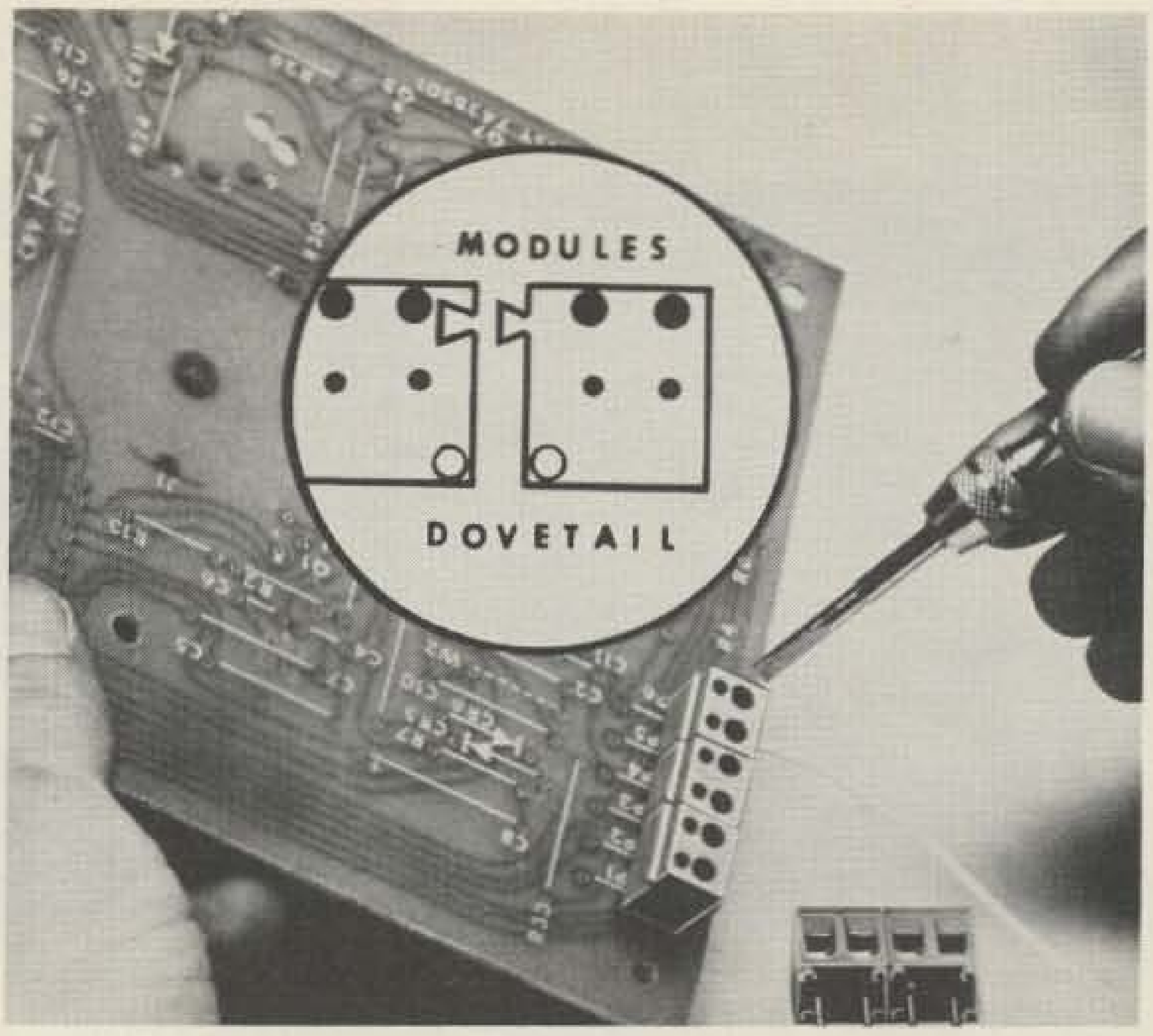
MODULAR TERMINAL STRIPS

TS-6MD terminal strips are 2-position modules which are end-stackable via interlocking dovetails to create strips of any desired length. Each module consists of two screw terminals on .200-inch (5.08mm) centers, each terminated with a .197-inch (5mm) long x .039-inch (1mm) diameter pin for easy soldering to the PC board. Screw terminals feature corrosion-protected tubular clamp contacts and captive, self-locking, vibration-proof screws for secure clamping of solid or stranded wires 16-26 AWG without solder. Bodies are molded of durable high-dielectric nylon and are unaffected by severe environments. Electrical rating is 5 Amps at a nominal 50 V dc. TS-6MD are available from stock at your local electronics store or directly from *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.* Reader Service number O5.

WIRE-WRAPPING KIT

OK's new wire-wrapping kit features selected items of particular value to the prototype engineer and hobbyist alike. It includes a unique new wire-wrapping tool, a roll of wire-wrapping wire, and pre-stripped wire in 4 popular lengths.

The tool, Model WSU-30, is a combination one which wraps *and* unwraps 30 AWG wire on .025" square pins, plus strips 30 AWG wire using a handy built-in stripper. The wire is top-quality, Kynar-insulated, silver-plated copper. Supplied in the kit are a 50-foot roll, as well as pre-cut and stripped wire in insulated lengths from 1-4 inches, stripped 1 inch on each end. Available with blue wire as Model WK-2B, white wire as WK-2W, yellow wire as WK-2Y, and red wire as WK-2R, the kit can be purchased from your local electronics dealer or directly from *OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475.* Reader Service number O5.



OK's TS-6MD modulator terminal strips.

NEW HUSTLER FIVE-BAND TRAP VERTICAL FIXED STATION ANTENNA

Hustler recently introduced the new Model 5-BTV, a five-band trap fixed station antenna. The unit covers 10, 15, 20, 40, and 80 meters (tuneable to 75 meters). The 5-BTV consists of the popular Hustler Model 4-BTV and RM-80-S resonator and spider assembly.

In restricted or unlimited space locations, the Hustler 5-BTV delivers top signal performance, consistent contacts, five-band operation, and complete coverage. Switching or matching devices are not required.

The total antenna length is 25'5". It is constructed of the finest-quality heat-treated seamless aluminum and all-stainless-steel hardware. The antenna mounts to any 1¾"-o.d. vertical support. Vswr is better than 1.6:1 at all band edges. The power capability is the full limit on SSB and CW.

For further information, contact: Sales Department, *New-Tronics Corporation, 15800 Commerce Park Drive, Brookpark OH 44142.* Reader Service number N2.

DX

from page 12

and Industry, Government of the British Virgin Islands, Tortola, British Virgin Islands, B.W.I.

Mr. Swain doesn't say if the license will be mailed to you or you must pick it up. Apply early just in case and bon voyage.

NOVICE CORNER

Some have written to complain about the name of this section. The term "novice" doesn't necessarily apply only to Novice license holders. It just means one who is inexperienced. You may be an old-timer with an original two-letter call and still be a novice when it comes to DX. This part of the column receives more comment than any other, but with more than 100,000 new licenses issued since 1975, I guess there really are a lot of newcomers active on the DX bands today.

A few weeks ago, I was calling a C5 station when someone called me and asked where the C5 was located. He needed to know so he would know in which direction to point his beam.

If you really intend to be a serious DXer, one of the first things you need to learn is the different prefixes used by each country and where these countries are located. Any DXer worth his bandwidth should be able, when he hears a station, to instantly know what country is calling and where that country is located. I realize that with over 300 countries on the DXCC countries list, that seems like a formidable task, but it really isn't that hard and it comes naturally with experience.

You should always have within fingertip reach at the operating position a copy of the ARRL DXCC countries list, a world atlas, and a Great Circle beam direction chart centered on your QTH.

The DXCC countries list can be obtained by writing to the ARRL and requesting a copy of Operating Aid #7. If you use an ARRL logbook, then you can use the countries list in the back of the logbook. Every time you hear a call that you don't recognize, look it up in the countries list and try to remember where it is from. Also, study the calls of the countries you need so when you hear one, you'll immediately recognize where it is.

If you're not sure where a country is located, look it up in a world atlas. It's always interesting to locate the various countries on a map. You can see what countries they border and find other information on a map. The people that publish the *Callbook* also publish a very good world atlas showing the call letter prefixes, zones, continents, etc., of every country in the world.

A Great Circle beam direction chart centered on your QTH will show you the exact direction to point your antenna in order to work any country on the DXCC countries list. Order one from Interproducts, 2377 Pollard Ct., Los Gatos CA 95030.

With these tools to work with and a little practice and experience, you should soon be able to recognize any call you hear on the bands and know exactly which direction to point your beam for maximum signal strength.

HEARD ON THE BAND

Due to a problem with the local MARS station and a desire to relax for awhile, WA4YVG/VQ9 on Diego Garcia has gone QRT. QSL to 102 Schoolfield Drive, Danville VA 24541.

That EU prefix being heard is White Russia. Replace it with UC and you have the correct call.

YI1BGD's signal has definitely improved. Word has it that the FT-560 supplied by the NCDXF is now on line.

A9Z was a special prefix to mark National Day in Bahrein.

Bhutan has begun a program of training wireless operators in the hopes of becoming self-sufficient in that area. It is hoped that some of these will become hams.

ZS6DN has a two meter beacon on 144.13 MHz. He would like reports from anyone hearing it.

In the Pacific area, the Gilberts go independent in July and will thereafter be known as Kiribati.

If you are looking for some old XW8 QSLs, this might help. XW8FN is Lloyd Gruhn, 1640 South Parfet Court, Lakewood CO. XW8AL is now FØDAJ. XW8LA is now in Pakistan and can be reached at the U.S. State Department. W3HNK is reported to have the old XW8FN logs.

VP8PL left South Georgia in January.

Beata Island, off the southern coast of the Dominican Republic. This island is the site of the HI1RCD DXpedition.

Some JAs are looking at an island a few hundred miles from Okino Torishima which they feel would be a new one because it is under separate administration.

That HD0E heard during the CQ WW Contest was from the Kingdom of Chaullabamba Nudist Camp. A special QSL is available that should rekindle your interest in QSL card collecting. QSL to WA8TDY/K9LJG with usual SASE.

FY7BC was on from Devil's Island. Ron plans to submit documents to the DXCC desk showing that Devil's Island is administered from France and should be considered as a separate country.

DX NOTEBOOK

Aves Island YV0

A big operation by K1MM, YV5DFI, YV5ANF, and YS1RRD is being planned for the March/April period. Initial thinking calls for three stations and an allband around-the-clock operation.

Malpelo HK0

Early plans are being made by the Colombian Radio Club for a 1980 effort. Plan ahead.

Jan Mayen

LA7JO keeps the following skeds with JX4GN and JX9WT: each Wednesday/Thursday at 1700Z on 14270 or 14240 kHz, same time Saturday on 14270 kHz, earlier at 1100Z on 28570 kHz, 0900Z on 14270, Sunday at 1400Z on 28570 kHz.

Navassa

The recent Navassa operation was a huge success with over 22,000 QSOs. SSB accounted for 62% of the total and the special push toward Asia netted 902 JA contacts. Thirty-three OSCAR contacts were made and one six meter contact.

QSL INFORMATION

3Y0BZ to VE7ZQ
3Y1VC to LA1VC
3Y5DQ to LA5DQ
4X4CW to WB0YHG
5T5ZR to Box 202, Nouakchott
9L1CA to WA3NCT
9X5AL to SM5HHJ
9X5P to PO Box 1035, Kigali
9Y4VT to N6AA
A7XAH to DJ9ZB
A9XBD to Box 14, Bahrein
C5AAO to OZ6MI
C6A/N4UM to N4BP
CE9AH/AI/AM to Antarctic Dept., FACH, Comando De Combate, Ministry of Defense, Santiago, Chile
FG0/F0ANY to DJ0UP
FM7AV to F6BFH
FY7BC to F9LM
GJ5CIA/GU5CIA to N6MA
H44CB to PO Box 332, Honiara
HC8A to PO Box 289, Quito
HD0E to WA8TDY/K9LJG
HH2CQ to W4ORT
HS1ABD to K3EST
HS1AIV to W1YRC
HZ4GNA to WB4LFM
J3AAG to K1DBA
J4JH to DJ9ZB

Thanks to the *West Coast DX Bulletin*, the LIDXA newsletter, and *WorldRadio Magazine* for much of the preceding information.

WCDXB NEEDED COUNTRIES LIST

Although several "Most Needed" lists have appeared in the past, the list in Table 1 compiled by W1AM from the personal lists of over 900 subscribers worldwide to the *West Coast DX Bulletin* is the most extensive and complete. The poll was based on the 150 top countries from the 1977 list plus additions of a few new countries which have come on the scene in the past year. The list as printed in Table 1 represents the overall U.S. need on a mixed mode basis. The entire list runs to 153 countries, but we have included only the top 25.

The biggest loser was Clipperton, which dropped from #4 last year all the way down to #152 this year. The biggest gainer was FW8-Wallis Island, which jumped from #126 to #67. This should give you a clue as to where to plan your next DXpedition.

1978 Rank	Country	% need	1977 Rank
1	3Y Bouvet	85	2
2	BY China	84	6
3	8Z Neutral Zone	82	5
4	VS9K Kamaran	81	7
5	XZ Burma	78	8
6	ZA Albania	76	9
7	1S Spratly	76	12
8	VK0 Heard	75	11
9	Laccadives	72	14
10	Abu Ail	71	15
11	7J1 Okino Torishima	70	25
12	South Yemen	69	10
13	Mt. Athos	66	27
14	Bhutan	65	22
15	Annobon	64	23
16	Crozet	64	19
17	Qatar	64	20
18	Congo Rep	63	16
19	Cambodia	63	30
20	Central African Rep	58	29
21	Andamans	58	35
22	Guinea	57	31
23	Somalia	56	13
24	Geyser Reef	55	18
25	Glorioso	55	41

Table 1.

Ham Help

I have been an avid reader of your magazine since 1973, when I discovered it on a newsstand at the PX at Ft. Jackson SC. I have been in the Air Force fourteen years as an electronics technician. Now I am stationed in Germany and am so tired of waiting for Stars & Stripes bookstores to stock your latest issues every month that I just gotta subscribe! You put out the best magazine I have seen.

I have been poring over all the back issues of every electronics magazine I have and have not found a good general-coverage receiver project anywhere. I sure would like to build my own from scratch! It would be nice if it was PLL circuitry, covered 0.5 to 50 MHz AM, CW, and SSB, with possible provisions for the later addition of either Hi or Lo VHF/UHF scanner or FM band converters. If it is the latest technology, it should include digital readout and possibly a clock! Power requirements should be 120/240 V ac and 12 V dc.

Well, got anyone working on such a gizmo for possible future inclusion in *73 Magazine*?

Patrick T. Berry
Box 222
APO NY 09692

Corrections

In "Time-Domain Reflectometry," January, 1979, Fig. 6 shows a 74S104, which is not only difficult to find, but also incorrect. The correct IC should be a 74S140.

Gene Smarte WB6TOV
News Editor

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- In the scanner off mode the TR7400A behaves normally, in the scanner on mode the scanner locks up on an occupied frequency, pauses for a preset time (3-30 seconds) and then resumes scanning, this means you can eavesdrop all over the band without lifting a finger, when you hear something interesting you flip the switch to the lock mode and the rig is ready to transmit.
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RTTY Loop

from page 24

Fig. 4(b). This prevents the chip from sourcing current and looks like the open collector at the expense of a 1N914. If you need a circuit that keys "upside down," then use the 7406, shown in Fig. 4(c). In fact, by using two inverters and feeding one or both, a normal/reverse mode can be implemented.

To get this single character stunt box working, hook up the clock, UART, and buffer chip of your choice as shown in the diagrams. Again, be sure to provide a negative twelve-volt supply for the UART in addition to the normal TTL 5 volts. If you have a frequency counter, set the clock to 727 Hz. If not, program in an R and use your TTY machine to tell you when you've got the right speed. The table from last month can be used to program in any letter or character you desire.

I'll give you all a month to play with this one. Next month we'll hook up the matrix to give a real purpose to all this dilly-dallying. A look into the crystal (FT-243 style) ball shows some more programming in store for you computer buffs. A full transmitting program, with buffers and a true FIFO, is under way for the 6800. Watch for it in RTTY Loop.

OSCAR Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes.

To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-.95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

Oscar 7 Orbital Information				Oscar 8 Orbital Information			
Orbit	Date (Mar)	Time (GMT)	Longitude of Eq. Crossing °W	Orbit	Date (Mar)	Time (GMT)	Longitude of Eq. Crossing °W
19623	1	0105:56	78.3	5026Abn	1	0032:18	51.1
19635	2	0005:16	63.1	5040Abn	2	0037:30	52.4
19648	3	0059:33	76.7	5054Jbn	3	0042:42	53.7
19661	4	0153:50	90.3	5068Jbn	4	0047:54	55.1
19673qrp	5	0053:10	75.1	5082Abn	5	0053:05	56.4
19686	6	0147:27	88.7	5096Abn	6	0058:17	57.7
19698X	7	0046:48	73.6	5110X	7	0103:29	59.0
19711	8	0141:05	87.2	5124Abn	8	0108:41	60.3
19723	9	0040:25	72.0	5138Abn	9	0113:53	61.6
19736	10	0134:42	85.6	5152Jbn	10	0119:05	62.9
19748	11	0034:02	70.5	5166Jbn	11	0124:17	64.2
19761qrp	12	0128:19	84.0	5180Abn	12	0129:28	65.6
19773	13	0027:39	68.9	5194Abn	13	0134:40	66.9
19786X	14	0121:56	82.5	5208X	14	0139:52	68.2
19798	15	0021:17	67.3	5221Abn	15	0001:50	43.7
19811	16	0115:34	80.9	5235Abn	16	0007:02	45.0
19823	17	0014:54	65.8	5249Jbn	17	0012:13	46.3
19836	18	0109:11	79.4	5263Jbn	18	0017:25	47.6
19848qrp	19	0008:31	64.2	5277Abn	19	0022:37	49.0
19861	20	0102:48	77.8	5291Abn	20	0027:48	50.3
19873X	21	0002:09	62.6	5305X	21	0033:00	51.6
19886	22	0056:26	76.2	5319Abn	22	0038:12	52.9
19899	23	0150:43	89.8	5333Abn	23	0043:23	54.2
19911	24	0050:03	74.7	5347Jbn	24	0048:35	55.5
19924	25	0144:20	88.3	5361Jbn	25	0053:47	56.8
19936qrp	26	0043:40	73.1	5375Abn	26	0058:58	58.1
19949	27	0137:57	86.7	5389Abn	27	0104:10	59.5
19961X	28	0037:17	71.6	5403X	28	0109:22	60.8
19974	29	0131:34	85.1	5417Abn	29	0114:33	62.1
19986	30	0030:55	70.0	5431Abn	30	0119:45	63.4
19999	31	0125:12	83.6	5445Jbn	31	0124:56	64.7

FCC

Reprinted from the Federal Register.

from page 168

national administration will be able to choose how to best meet its national communications needs. This flexibility will aid the less developed nations, as well as the U.S., in communications planning, and will facilitate the development of innovative services which may radically restructure the way we communicate as we approach the 21st Century. For example, new uses for communications satellites, new systems for electronic message distribution, should benefit from this flexibility.

A third principle underlying the Commission recommendations is that detailed analyses of the policy choices in communications planning are required. Even given the flexibility of U.S. proposals, the available spectrum is simply insufficient to meet all possible communications needs. Our recommendations make clear our policy choices.

A fourth and related principle is that every effort must be made to conserve the spectrum. The spectrum is one of our most valuable resources. Recommendations that encourage inefficient use of the spectrum will only lessen our ability to communicate—a precious ability in an interdependent world such as our own. As technology develops we must be able to utilize it to increase spectrum efficiency.

Finally the Commission's recommendations seek to provide our country with increased diversity in the electronic media. Adoption of the Commission's expansion in the AM broadcast band could provide hundreds of new stations which would allow those who have traditionally been excluded from our electronic media to enter into the communications mainstream. In another example, the adoption of our recommendations would preserve the possibility of direct broadcast satellites providing new channels across the United States.

The Commission's formal work is over with the adoption of this *Report and Order*. I look forward to following the proceedings of the 1979 Conference with great interest. Because of its fundamental importance, I hope all concerned citizens will also be watching.

JOINT SEPARATE STATEMENT OF COMMISSIONER ABBOTT WASHBURN AND COMMISSIONER JAMES H. QUELLO

DECEMBER 5, 1978.

RE: Docket 20271, WARC 1979 Proposals.

President Carter has enunicated a policy of increasing the international flow of information and, for this purpose, has adopted a policy of increasing the use by the United States of international shortwave broadcasting * * * primarily by the *Voice of America, Radio Free Europe*, and *Radio Liberty*. The frequency allocations for international broadcasting contained in today's Report and Order—totaling an increase of 865 kHz—reflect but one alternative now under active consideration within the Executive Branch of the Government. This total falls some 800 kHz short of the proposals that have been made by the International Communications Agency and the Board by International Broadcasting.

Inclusion here of the 865-kHz alternative was not based on any independent analysis by the Commission. The FCC has merely deferred judgment in this matter to other agencies of the Executive Branch.

In the interest of accuracy, we believe it should be brought to the attention of all interested parties, here and abroad, that at the time of the Commission's action (December 5, 1978) there has yet been no decision within the Executive Branch as to a final figure for a U.S.-proposed frequency allocation for international broadcasting.

This is the purpose of our joint separate statement.

Ham Help

I need assistance in setting up a Kenwood TS-520S and HAL ST-5 for RTTY.

Charles E. Martin AB4Y
PO Box 3370
Bowling Green NY 42101

I would like to obtain information and/or manuals for the following pieces of gear: RT-159/URC-4 military surplus hand-held transceiver (especially power supply voltages required), Eico model 425 oscilloscope, and the Sentinel Electronics ME-26D/U multimeter (possibly a military version of the HP-410B). I will gladly pay any reproduction or postage costs.

Frank Latos AC8P
11251 Chicago Rd.
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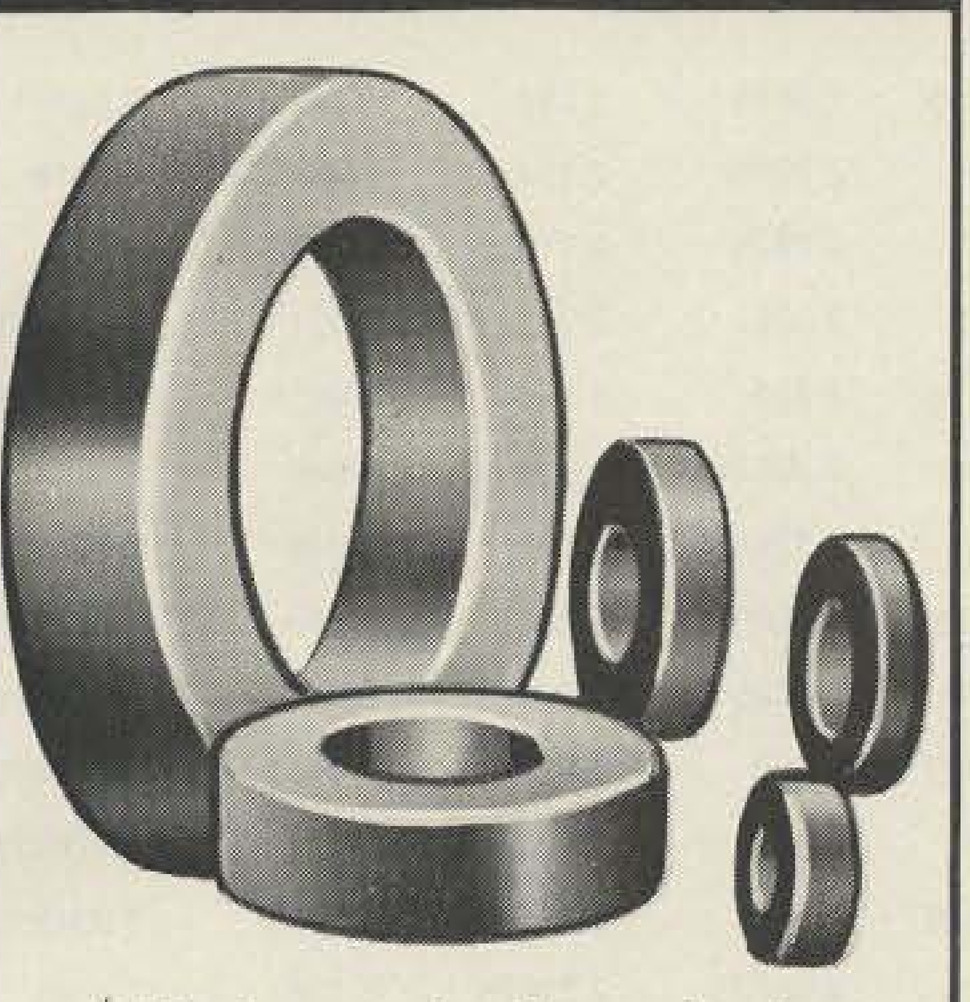

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T-68	57	47	21	.68	.65
T-50	51	40	18	.50	.55
T-25	34	27	12	.25	.40

RF FERRITE TOROIDS:

CORE SIZE	MIX Q1 u=125 1-70 MHz	MIX Q2 u=40 10-150 MHz	SIZE OD (in.)	PRICE USA $
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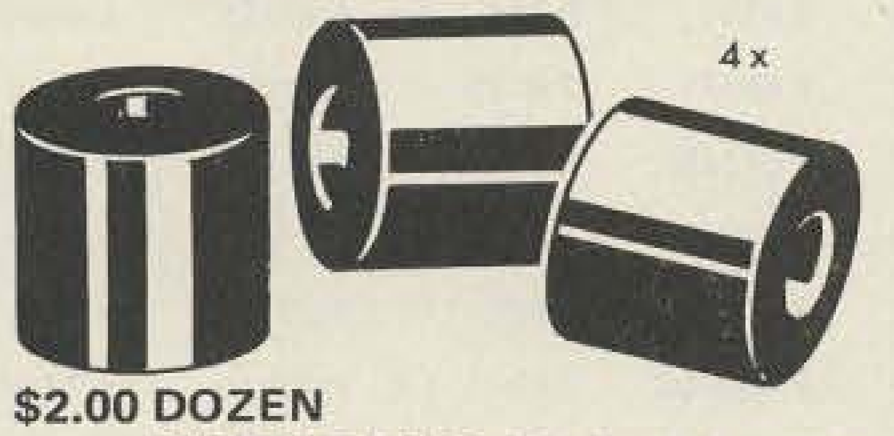
F-125	900	300	1.25	3.00
F-87	600	190	.87	2.05
F-50	500	190	.50	1.25
F-37	400	140	.37	1.25
F-23	190	60	.23	1.10

Chart shows uH per 100 turns.

FERRITE BEADS:



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2N2322	SCR	TO-5	25V	1 AMP	.2ma gate I			.30	2.50
2N2324	SCR	TO-5	100	1 AMP	.02ma "			.40	3.50
2N2325	SCR	TO-5	150	1 AMP	.2ma "			.45	4.00
2N2907	PNP	TO18	40	.6	.4	200	52	.35	3.00
2N3440	NPN	TO-5*	250	1.0	10.0	50	S3021	.60	5.00
2N3565	NPN	TO106*	30	.2	.3	40	55	.15	1.00
2N3639	PNP	TO92	12	.1	.2	350	57	.20	1.50
2N3640	PNP	TO106#	15	.2	.2	400	57	.15	1.00
2N3646	NPN	TO106#	15	.2	.2	400	50	.15	1.00
2N3704	NPN	TO92	30	.8	.3	100	735	.40	3.50
2N3903	NPN	TO92	40	.2	.3	300	736	.20	1.50
2N3904	NPN	TO92	40	.2	.3	300	736	.20	1.50
2N4248	PNP	TO92	40	.1	.2	40	715	.15	1.00
2N4250	PNP	TO92	40	.1	.2	50	57	.25	2.00
2N4400	NPN	TO92	40	.2	.3	200	736	.15	1.00
2N4437	NPN	TO106	30	.5	.2	250	736	.20	1.50
2N5138	PNP	TO106	30	.1	.2	30	52	.20	1.50
2N5172	NPN	TO92	25	.1	.2	120	56	.25	2.00
2N5210	NPN	TO92	50	.05	.3	80	728	.30	2.50
2N5910	PNP	TO106	20	.1	.3	700	52	.30	2.50
2N5964	NPN	TO92	150	.1	.5	100	S0005	.25	2.00
D16P1	NPN	TO98	12	(high gain lo-pwr DARL.)				.20	1.50
D40C1	NPN	TO220#	30	.5	6.	DARLINGTON		.30	2.50
D41D1	PNP	TO220	30	1.0	6.	150	S3027	.35	3.00
D44H8	NPN	TO220	60	10.0	50.	50		.50	4.50
RCA105	PNP	TO220						.35	3.00
MJE1091	"	TO220	60	5.0	70	PWR DARLINGTON		1.25	10.00
MJE1100	NPN	TO220	60	5.0	70	PWR DARLINGTON		1.25	10.00
TIP31A	NPN	TO220*	60	3.0	40W			.40	3.50
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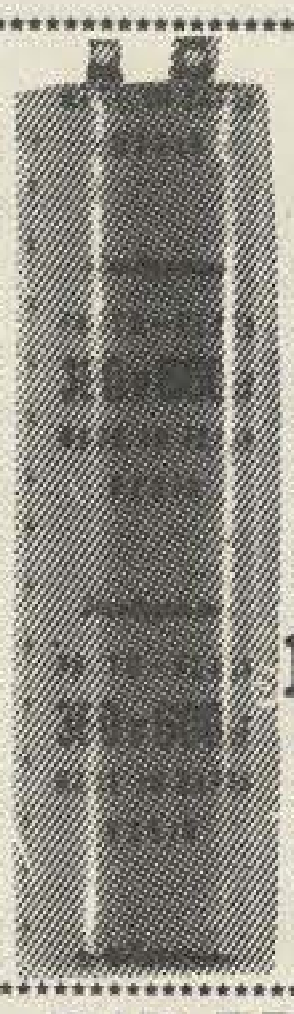

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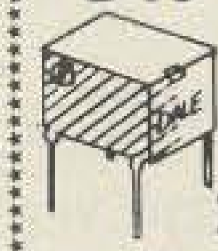

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PRIME TO-92 PLASTIC TRANSISTORS FROM A MAJOR SEMI CONDUCTOR MANUFACTURER. THESE ARE FIRST QUALITY DEVICES MADE FOR A COMPUTER FIRM. THE NPN's HAVE CUT AND FORMED LEADS (TO-5 SHAPE), AND THE PNP ARE FULL LENGTH LEADS.SPECIFY NPN OR PNP- 50 PER TYPE MINIMUM--------

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TRIACS

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4.65A	54.50	5894	39.00
4-125A	68.75	6146A	5.25
4-250A	80.00	6146B	6.25
4-400A	81.50	6360	7.95
4-1000A	255.00	6907	35.00
4CX250B	24.95	6939	9.95
4CX250F	15.00	7360	10.60
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Sweep signal generator
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MC1568G	5.31	MC1568L	5.00
MC1569R	8.15	MC1590G	6.50
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96	2.133275	2.3525	2.7315	3.053	3.268625
100	2.13505	2.35256	2.73225	3.062	3.271125
225	2.136825	2.368	2.732625	3.067	3.273625
250	2.1425	2.374	2.733	3.074	3.276125
285.714	2.144625	2.375	2.737MC	3.1125	3.3345
500	2.14675	2.38725	2.73975	3.126	3.4045
576	2.148875	2.395	2.742125	3.137	3.4115
720	2.151	2.396875	2.7425	3.13975	3.4325
1.2288	2.153125	2.42	2.744	3.1435	3.4535
1.229	2.15375	2.4375	2.7445	3.144	3.4675
1.239	2.155	2.44275	2.74475	3.145	3.4815
1.248	2.15525	2.4495	2.746875	3.151	3.5
1.269	2.157375	2.45	2.751	3.1545	3.579545
1.289	2.1595	2.4585	2.754	3.158	3.721666
1.297	2.16375	2.46125MC	2.75525	3.1585	3.7735
1.299	2.165875	2.482	2.762375	3.1615	3.805
1.309	2.170125	2.486	2.7735	3.1625	3.803
1.33245	2.17225	2.5	2.776625	3.166	3.901
1.455	2.174375	2.51375	2.78	3.16975	3.908
1.689600	2.1765	2.581	2.814	3.177	3.9168
1.7	2.17925	2.604	2.817	3.181	4.0000
1.76375	2.18475	2.6245	2.8225	3.1825	4.011
1.77125	2.18575	2.618	2.835	3.18475	4.126666
1.773125	2.194125	2.62825	2.854	3.1885	4.26
1.78675	2.207063MC	2.633125	2.865	3.2035	4.3
1.81875	2.208313	2.639	2.868	3.20725	4.6895MC
1.8275	2.209563	2.63575	2.8725	3.2105	4.6965
1.845125	2.210812	2.64325	2.876875	3.2165	4.7
1.84375	2.210813	2.646	2.887	3.2175	4.7175
1.845625	2.212063	2.647	2.889	3.2315	4.7245
1.84575	2.214562	2.650750	2.894	2.23275	4.7315
1.846	2.214563	2.6545	2.910	3.2365	4.765
1.8425	2.215625	2.65825	2.920	3.23775	4.89
1.84975	2.217938	2.660	2.925450	3.2385	5.0000
1.8575MC	2.21975	2.662	2.92545	3.238875	5.348400
1.908125	2.222125	2.66575	2.931	3.23925MC	5.426636
1.925	2.22325	2.6695	2.94375	3.24	5.436636
1.927	2.22675	2.677	2.945	3.24025	5.4990
1.932	2.22875	2.68075	2.94675	3.2405	5.4675
1.982	2.23725	2.681	2.952	3.241	5.5065
1.985	2.2395	2.6845	2.966	3.2425	5.515
1.9942	2.24075	2.68825	2.973	3.244	5.5215
1.995975	2.241	2.69575	2.980	3.248875	5.544
1.964750	2.246	2.7	2.981	3.24925	5.5515

CRYSTALS (Con't)

5.559	6.582	8.8285	11.3565	19.100	36.0000	90.833MC
5.5665	6.612	8.837MC	11.535	19.55416	36.21750	93.1346
5.574	6.6645	8.8455	11.69626	21.99965	36.6666	93.535
5.5815	6.673	8.854	12.80902	22.99966	36.66666	93.9353
5.589	6.693	8.8625	13.102	23.25	36.66667	94.3
5.604	6.723	8.871	13.2155	23.575	37.0000	95
5.619	6.7305	8.879500	13.2455	25.47667	38.0000	95.35
5.6115	6.738	8.888	13.2745	25.99961	38.77777	102
5.6265	6.75125	8.905	13.2845	26.66667	38.77778	106.850
5.6415	6.753	8.9305	13.2945	26.8965	38.88889	123.5
5.6715	6.7562	8.939	13.3045MC	26.958	39.0000	146.4
5.675	6.7605	8.956	13.3145	27.77778	39.160	146.64
5.680	6.7712	9.0265	13.3345	28.728	40.0000	147.09
5.695	6.77625	9.65	13.3445	28.88889	48.97222	165.5
5.7	6.880000	9.7	13.3545	29.896	49.95	
5.7105	6.910	9.75	14.315	30.0000	50.14166	
5.733333	6.940	9.8	15.016	31.0000	53.45	
6.110	7.35	9.85	15.036	31.11111	54.95	
6.210	7.390	9.9	16.80417	31.66667	55.45	
6.258333	7.423	9.95	17.2800	32.0000	57.45	
6.321458	7.443	9.999	17.8710	32.22222MC	58.45	
6.424583MC	7.473	10.0000	17.9065	33.0000	59.45	
5.425	7.81	10.021	17.9165	33.33333	60.45	
6.427083	8.00764	10.20833	17.9265	34.0000	61.95	
6.45	8.00824	10.311	17.9365	34.4	72.855	
6.47	8.075	10.5	17.9465	34.4444	75	
6.47111	8.12	10.80375	17.9665	34.44444	75.185	
6.510	8.15571	11.1805	17.975	35.0000	82.75	
6.537	8.364	11.228	17.9935	35.25000	83	
6.567	8.64	11.2375		35.55555	84	
	8.820	11.2995			85.833330	

LATE ADDONS

1.3047, 1.4, 1.5, 1.80224, 2.3MC, 2.56, 2.854285, 200KC, 3.2, 3.3, 3.64, 3.75, 3.80, 5.456, 7.15, 7.26, 7.5, 11, 22, 29

MHZ ELECTRONIC KITS:

kit #1

Motorola MC14410CP CMOS Tone Generator

CMOS Tone Generator uses 1MHZ crystal to produce standard dual frequency dialing signal. Directly compatible with 12 key Chomeric Touch Tone Pads. Kit includes the following:

1 Motorola MC14410CP Chip
1 1 MHZ Crystal
1 PC Board

And all other parts for assembly. **NOW ONLY $15.70**

Kit #2

Fairchild 95H90DC Prescaler 350MHZ.

95H90DC Prescaler divides by 10 to 350 MHZ. This kit will take any 35MHZ Counter to 350 MHZ. Kit includes the following:

1 Fairchild 95H90DC Chip
1 2N5179 Transistor
2 UG-88/U BNC Connectors
1 PC Board

And all other parts for assembly. **NOW ONLY $19.95**

General Radio UHF standard signal generator
Model 1021A 250 to 920 MHz
.5uV to 500 mV into 50 ohms — $299.95

Polorad Model 1206 1.95 to 4.20 GHz signal source — $400.00
Model 1107 3.8 to 8.20 GHz signal generator — 550.00

FAIRCHILD VHF AND UHF PRESCALER CHIPS

95H90DC	350MHZ Prescaler Divide by 10/11	$ 8.95
95H91DC	350MHZ Prescaler Divide by 5/6	8.95
11C90DC	650MHZ Prescaler Divide by 10/11	15.95
11C91DC	650MHZ Prescaler Divide by 5/6	15.95
11C83DC	1GHZ Divide by 248/256 Prescaler	29.90
11C70DC	600MHZ Flip/Flop with reset	12.30
11C58DC	ECL VCM	4.53
11C44DC	Phase Frequency Detector (MC4044P/L)	3.82
11C24DC	Dual TTL VCM (MC4024P/L)	3.82
11C06DC	UHF Prescaler 750MHZ D Type Flip/Flop	12.30
11C05DC	1GHZ Counter Divide by 4	74.35
11C01FC	High Speed Dual 5-4 Input NO/NOR Gate	15.40

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3 db bandwidth 15khz minimum 20 db bandwidth 60khz minimum 40 db bandwidth 150khz minimum. Ultimate 50 db: Insertion loss 1.0db Max. Ripple 1.0db Max. Ct. 0 + – 5pf. Rt. 3600 Ohms.

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2N1561	$15.00
2N1562	15.00
2N1692	15.00
2N1693	15.00
2N2857JAN	2.45
2N2876	12.35
2N2880	25.00
2N2927	7.00
2N2947	17.25
2N2948	15.50
2N2949	3.90
2N2950	5.00
2N3287	4.30
2N3294	1.15
2N3302	1.05
2N3307	10.50
2N3309	3.90
2N3375/MM3375	7.00
2N3553	1.45
2N3818	6.00
2N3866	1.09
2N3866JAN	2.70
2N3866JANTX	4.43

2N3924	3.20
2N3925	6.00
2N3927	11.50
2N3950	26.25
2N3961	6.60
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2N4427	1.09
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2N5913	3.25
2N5922	10.00
2N5942	46.00
2N5943	1.75
2N5944	7.50
2N5945	10.90
2N5946	13.20
2N6080	5.45
2N6081	8.60
2N6082	9.90
2N6083	11.80
2N6084	13.20
2N6094	5.75
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2N6096	19.35
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2N6439	43.45
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MM1550	10.00
MM1552	50.00
MM1553	56.50
MM1601	5.50
MM1602/2N5842	7.50
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MM1661	15.00
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MRF8004	1.44
HEP76/S3014	4.95
HEPS3002	11.30
HEPS3003	29.88
HEPS3005	9.95
HEPS3006	19.90
HEPS3007	24.95
HEPS3010	11.34
HEPS5026	2.56
MMCM918	1.00
MMT72	.61
MMT74	.94
MMT2857	1.43

TYPE	PRICE
MMT3960A	$ 6.25
PT3539B	3.00
PT4186B	3.00
PT4571A	1.50
PT4612	5.00

PT4628	5.00
PT4640	5.00
PT8659	10.72
PT9784	24.30
PT9790	41.70
PT9847	26.40
SD1043	5.00
SD1116	3.00
SD1118	5.00
SD1119	3.00
40281	10.90
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40290	2.48
TA7994	50.00

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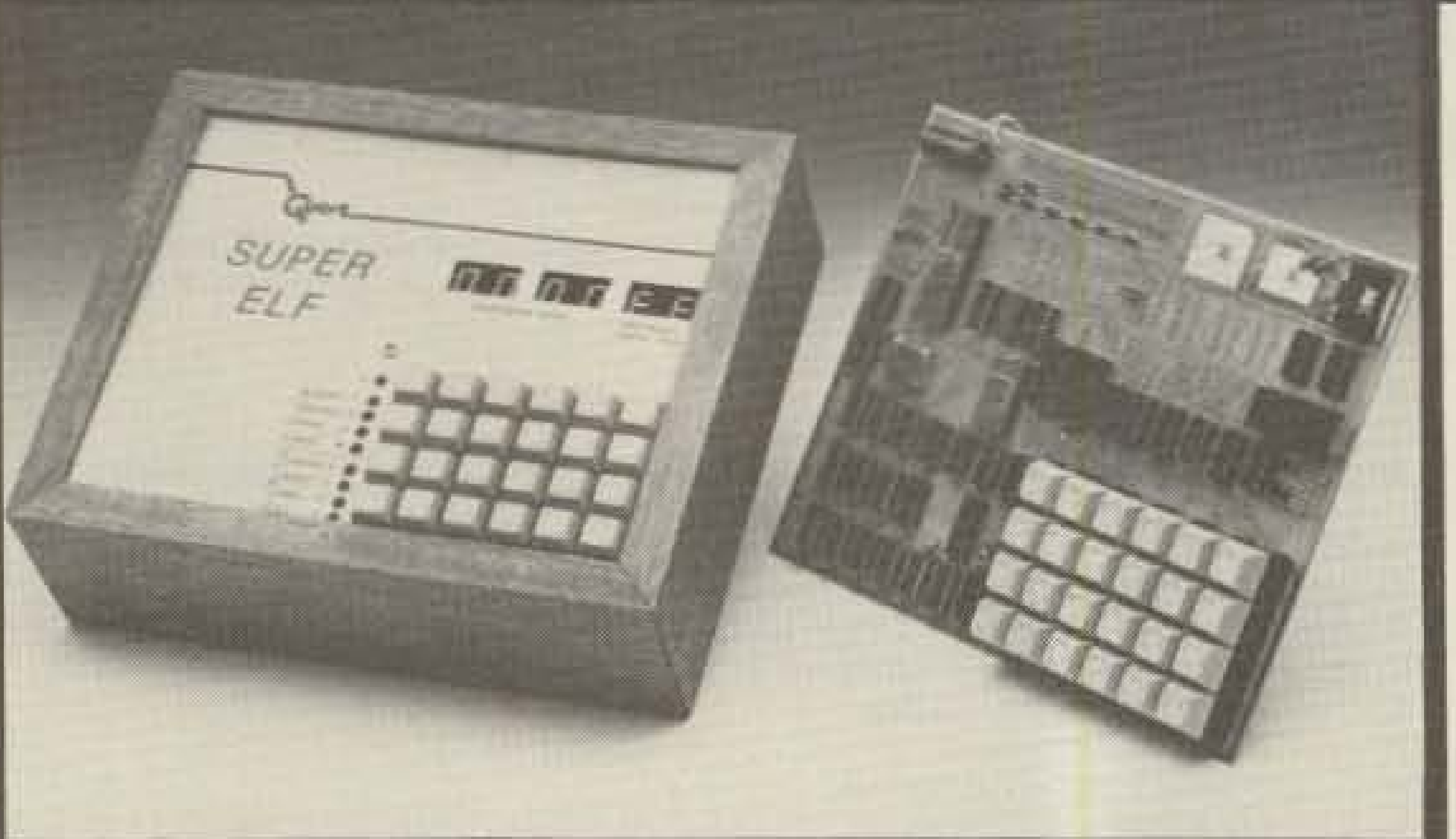


QUEST Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded with additional memory, Tiny Basic, ASCII Keyboards, video character generation, etc.**

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are shown on several LED indicator lamps.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, input, memory protect, memory select, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector for PC cards and a 50 pin connector for the **Quest Super Expansion Board**. Power supply and sockets for **all** IC's are included in the price plus a detailed 90 page instruction manual.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Hardwood Cabinet** with drilled and labelled front panel **$24.95. NiCad Battery Backup Kit $4.95.** All kits and options also come completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year. New 100 page software manual Vol.1 $4.95.

Tiny Basic for ANY 1802 System

Cassette $10.00. On ROM Monitor $38.00. Super Elf owners, 30% off. **Object code listing or paper tape with manual $5.50. Original ELF Kit Board $14.95.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed** ($12.00 value). EPROM can be used for the monitor and Tiny Basic or other purposes.

A IK Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatible cassette file) another exclusive from Quest. It includes register save and readout, block move capability, and video graphics driver with blinking cursor. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. A Godbout 8K RAM board is available for $135.00. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $12.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

The **Power Supply** for the Super Expansion Board is a 5 amp supply with + 8v ± 18v + 12v − 5v. Regulated voltages are ±5v & +12v $29.95. −12 volt optional. Deluxe version includes the case at $39.95.

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

7400TTL	
7400N	.17
7402N	.17
7404N	.19
7409N	.23
7410N	.17
7414N	.63
7420N	.17
7422N	1.39
7430N	.20
7442N	.50
7445N	.69
7447N	.60
7448N	.69
7450N	.17
7474N	.29
7475N	.49
7485N	.88
7489N	2.00
7490N	.43
7492N	.43
7493N	.43
7495N	.69
74100N	.90
74107N	.29
74121N	.34
74123N	.59
74125N	.39
74145N	.69
74150N	.95
74151N	.69
74154N	1.00
74157N	.69
74161N	.87
74162N	.87
74163N	.87
74174N	.96
74175N	.90
74190N	1.15
74192N	.87
74193N	.85
74221N	1.55
74298N	1.65
74365N	.66
74366N	.66
74367N	.66

74LS00 TTL	
74LS00N	.25
74LS02N	.25
74LS04N	.25
74LS05N	.25
74LS08N	.25
74LS10N	.25
74LS13N	.40
74LS14N	.90
74LS20N	.25
74LS22N	.25
74LS28N	.41
74LS30N	.25
74LS33N	.39
74LS38N	.38
74LS74N	.35
74LS75N	.47
74LS90N	.51
74LS93N	.51
74LS95N	1.89
74LS107N	.35
74LS112N	.35
74LS113N	.35
74LS132N	.72
74LS136N	.35
74LS151N	.67
74LS155N	.67
74LS157N	.67
74LS162N	.91
74LS163N	.91
74LS174N	.95
74LS190N	1.06
74LS221N	1.95
74LS258N	.67
74LS367N	.69

LINEAR	
CA3045	.90
CA3046	.67
CA3081	1.80
CA3082	1.90
CA3089	2.95
LM301AN/AH	.35
LM305H	.87
LM307N	.35
LM308N	.89
LM309H	1.15
LM309K	.95
LM311H/N	.90
LM317T/K	2.92
LM318	1.33
LM320K-5	1.20
LM323K-5	6.95
LM320K-12	1.35
LM320K-15	1.35
LM320T-5	1.60
LM320T-8	1.60
LM320T-12	1.50
LM320T-15	1.60
LM324N	1.15
LM339N	1.55
LM340K-5	1.10
LM340K-8	1.10
LM340K-12	1.10
LM340K-15	1.10
LM340K-24	1.10
LM340T-5	1.10
LM340T-8	1.10
LM340T-12	1.10
LM340T-15	1.10
LM340T-18	1.10
LM340T-24	1.10
LM343H	4.50
LM370	1.15
LM377	4.50
LM379	5.00
LM380N	1.00
LM381	1.60
LM382	1.60
LM703H	.40
LM709H	.28
LM723H/N	.50
LM733N	.67
LM741CH	.35
LM741N	.25
LM747H/N	.62
LM748N	.35
LM1303N	.82
LM1304	1.10
LM1305	1.27
LM1307	2.00
LM1310	2.75
LM1458	.47
LM1800	1.75
LM1812	7.50
LM1889	3.00
LM2111	1.75
LM2902	1.50
LM3900N	.60
LM3905	1.75
LM3909N	.81
MC1458V	.50
NE540L	2.89
NE550N	.65
NE555V	.43
NE556A	.79
NE565A	1.00
NE566V	1.50
NE567V	1.20
NE570B	5.00
NE571B	5.00
78L05	.60
78L08	.60
79L05	.70
78M05	.95
75108	1.75
75491CN	.50
75492CN	.55
75494CN	.89

A to D CONVERTER	
8038B	4.50
8700CJ	13.95
8701CN	22.00
8750CJ	13.95
LD130	9.95
9400CJV/F	7.40
ICL7103	9.50
ICL7107	14.25

CMOS	
CD34001 Fair	.50
CD4000	.16
CD4001	.21
CD4002	.21
CD4006	1.10
CD4007	.21
CD4008	.21
CD4009	.39
CD4010	.39
CD4011	.21
CD4012	.21
CD4013	.36
CD4014	.86
CD4015	.86
CD4016	.36
CD4017	.94
CD4018	.94
CD4019	.21
CD4020	1.02
CD4021	1.02
CD4022	.86
CD4023	.21
CD4024	.75
CD4025	.21
CD4026	1.51
CD4027	.36
CD4028	.79
CD4029	1.02
CD4030	.21
CD4035	1.02
CD4040	1.02
CD4042	.71
CD4043	.63
CD4044	.63
CD4046	1.67
CD4049	.36
CD4050	.36
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	.40
CD4071	.21
CD4072	.21
CD4073	.21
CD4075	.21
CD4076	1.75
CD4078	.40
CD4081	.21
CD4082	.21
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02
CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79
CD4553	5.75
CD4566	2.25
CD4583	4.50
CD4585	1.10
CD40192	3.00
74C00	.28
74C04	.33
74C10	.28
74C14	2.10
74C20	.28
74C30	.28
74C48	1.95
74C74	.75
74C76	1.40
74C90	1.15
74C93	1.40
74C154	3.00
74C160	1.44
74C175	1.35
74C192	1.65
74C221	2.00
74C905	3.00
74C906	.75
74C914	1.95
74C922	5.50
74C923	5.50
74C925	6.95
74C926	6.95
74C927	6.95

INTERFACE	
8095	.65
8096	.65
8097	.65
8098	.65
8T09	1.25
8T10	4.50
8T13	3.00
8T20	5.50
8T23	3.10
8T24	3.50
8T25	3.20
8T26	1.69
8T28	2.75
8T97	1.69
8T98	1.69

MOS/MEMORY RAM	
2101-1	3.95
2102-1	.95
2102AL-4	1.60
21F02	1.25
2104A-4	4.95
2107B	4.95
2111-1	3.75
2112-2	3.95
2114	8.50
4116	12.95
2513B	6.30
21L02-1	1.29
MM5262	.40
MM5280	3.00
MM5320	9.95
MM5330	5.94
PD411D-3	4.00
PD411D-4	5.00
P5101L	13.95
4200A	9.95
82S25	2.90
91L02A	1.75
HD0165-5	6.95
MM57100	4.50
GIAY38500-1	9.95
MCM6571A	9.95
9368	3.50
4100	10.00
416	16.00

CLOCKS	
MM5309	3.00
MM5311	3.60
MM5312	4.80
MM5313	3.60
MM5314	3.90
MM5315	4.00
MM5316	5.00
MM5318	3.60
MM5369	2.10
MM5841	14.45
MM5865	7.95
CT7001	5.80
CT7002	8.95
CT7010	8.95
CT7015	7.25
MM5375AA/N	3.90
MM5375AB/N	4.90
7205	16.50
7207	7.50
7208	15.95
7209	4.95
DS0026CN	3.75
DS0056CN	3.75
MM53104	2.50

MICROPROCESSOR	
6800	17.50
6802	24.95
8080A with data	8.95
8085	27.00
Z80A	24.50
8212	2.90
8214	8.00
8216	2.90
8224	2.90
8228	5.35
8251	8.50
8253	10.00
8255	9.25
8257	19.50
8259	19.50
CDP1802CD	19.95
CDP1802D	25.00
CDP1861	12.95
6820	9.95
6850	12.95
6502	12.50

IC SOCKETS
Solder Tin Low Profile

PIN	1 UP	PIN	1UP
8	.15	22	.30
14	.18	24	.35
16	.20	28	.42
18	.27	36	.58
20	.29	40	.57

2 level wire wrap gold 14 pin .25
2 level 14 pin ww .25

WIRE WRAP LEVEL 3

PIN		PIN	
14	.25	24	.86
16	.33	28	1.00
18	.57	40	1.23

UART/FIFO	
AY5-1013	5.50
AY5-1014	7.50
3341	6.95

PROM	
1702A	3.95
N82S23	2.95
N82S123	3.50
N82S126	3.75
N82S129	3.75
N82S131	3.75
N82S136	8.75
N82S137	8.75
2708	10.50
DM8577	2.90
8223	2.90
2716T1	22.50
2716 Intel	48.00

CRYSTALS	
1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
18 MHz	3.90
20 MHz	3.90
32 MHz	3.90
32768 MHz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50

CONNECTORS	
44 pin edge	2.00
100 pin edge	4.50
100 pin edge WW	4.50

KEYBOARD ENCODERS	
AY5-2376	$12.50
AY5-3600	13.50
74C922	5.50
74C923	5.50
HD0165-5	6.95

IC Test Clips

	1	10
Red	.55	.47
Black	.55	.47

Keyser 8043 14.50 comp. w/spec. sock.

TRANSISTORS	
2N1893	.40
2N2222A	.18
2N2369	.30
2N2904A	.20
2N2907A	.25
2N3055	.40
2N3638	.25
2N3643	.25
2N3904	.18
2N3906	.18
2N3055	.69
2N4400	.25
2N4401	.25
2N4402	.20
TIP31	.60
TIP33A	1.00

CLOCK MODULES Complete alarm clocks ready to hook up with transformer and switches. Very compact with .50" and .84" digits.

MA1002A, C or E .50"	8.95
102P3 Transformer	2.25
MA1010A, C or E .84"	11.95
102P2 Transformer	2.25
Special transformer and six switches when purchased w/module	2.95
MA1003 car module .3" green fluor. display	15.95

RESISTORS ¼ watt 5%
10 per type .03 — 1000 per type .012
25 per type .025 — 350 piece pack
100 per type .015 — 5 per type 6.75

KEYBOARDS
56 key ASCII keyboard kit $62.50
Fully assembled 72.50
53 key ASCII keyboard kit 55.00
Fully assembled 65.00 Enclosure 14.95

LEDS
Red TO18 .15
Green, Orange, Yellow TO18 .20
Jumbo Red .20
Green, Orange, Yellow Jumbo .25
Cliplite LED Mounting Clips 8/$1.25
(specify red, amber, green, yellow, clear)

CONTINENTAL SPECIALTIES in stock
Complete line of breadboard test equip.
MAX-100 8 digit Freq. Ctr. $129.95

OK WIRE WRAP TOOLS in stock
Portable Multimeter $18.00

DIGITAL THERMOMETER $48.50
Batt. oper. General purpose or medical 32°-230°F. Disposable probe cover ± 2° accuracy. Comp. Assy. in compact case. Switches from F° to C°.

COMPUTER BOARD KITS

8K RAM Board Kit	$134.95
4K EPROM Kit	114.95
I/O Board Kit	44.50
Extender Board w/connector	12.50
Video Interface board kit	125.00
16K EPROM board kit w/o PROMS	74.50
16K Static RAM board kit	395.00
North Star Floppy Disk Kit	$665.00
Additional Drive Kit	415.00

SPECIAL PRODUCTS
MM5865 Stopwatch Timer 9.00
PC board 7.50
Switches Mom. Pushbutton .27
3 pos. slide .25
Encoder HD0165-5 6.95
3 Digit Universal Counter Board Kit
Operates 5-18 Volt DC to 5 MHz typ. .125" LED display **10.50**
Voice activated switch .50

Paratronics 100A Logic Analyzer Kit $224.00
Model 10 Trigger Expander Kit $229.00
Model 150 Bus Grabber Kit $369.00

TRANSFORMERS

6V 300 ma	3.25
12 Volt 300 ma transformer	1.25
12.6V CT 600 ma	3.75
12V 250 ma wall plug	2.95
12V CT 250 ma wall plug	3.50
24V CT 400 ma	3.95
10V 1.2 amp wall plug	4.85
12V 6 amp	12.95

DISPLAY LEDS

MAN1	CA	.270	2.90
MAN3	CC	.125	.39
MAN72/74	CA/CA	.300	1.00
DL704	CC	.300	1.25
DL707/DL707R	CA	.300	1.00
DL727/728	CA/CC	.500	1.90
DL747/750	CA/CC	.600	1.95
DL750	CC	.600	1.95
FND359	CC	.357	.70
FND500/507	CC/CA	.500	1.35
FND503/510	CC/CA	.500	.90
FND800/807	CC/CA	.800	2.20
3 digit Bubble			.60
4 digit bubble			.80
DG8 Fluorescent			1.75
DG10 Fluorescent			1.75
5 digit 14 pin display			1.00
NSN69 9 digit display			.60
7520 Clairex photocells			.39
TIL311 Hex			9.50

COMPUTER GRADE CAPS

1800	mfd	200V	4.50
2000	mfd	45V	2.50
3200		50V	2.50
5500		25V	2.50
5800		40V	3.00
6100		40V	3.00
6100		50V	3.00
7700		50V	2.50
8000		55V	2.50
9400		65V	3.00
10000		20V	2.50
12000		30V	3.50
35000		25V	5.00
55000		25V	5.00
82000		15V	6.00
160000		10V	6.00

Auto Clock Kit $15.95

DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

RCA Cosmac VIP Kit $229.00

Video computer with games and graphics. Fully assem. and test. **$249.00**

Not a Cheap Clock Kit $14.95

Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instrucs. Green and orange displays also avail. **Same kit w/.80" displays.** Red only. **$21.95 Case $11.75**

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, IC, crystal, resistors, capacitors and trimmer.

Digital Temperature Meter Kit

Indoor and outdoor. Switches back and forth. Beautiful. .50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure −100° to +200°F, tenths of a degree, air or liquid. Very accurate. **$39.95**
Beautiful woodgrain case w/bezel **$11.75**

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

PROM Eraser

Ultraviolet, assembled **$34.50**

Clock Calendar Kit $23.95

CT7015 direct drive chip displays date and time on .6" LEDS with AM-PM indicator. Alarm/doze feature includes buzzer. Complete with all parts, power supply and instructions, less case.

Sinclair 3½ Digit Multimeter

Batt./AC oper. 1mV and .1NA resolution. Resistance to 20 meg. 1% accuracy. Small, portable, completely assem. in case. 1 yr. guarantee. Best value ever! **$59.95**

Video Modulator Kit $8.95

Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

2.5 MHz Frequency Counter Kit

Complete kit less case **$37.50**

30 MHz Frequency Counter Kit

Complete kit less case **$47.75**
Prescaler kit to 350 MHz **$19.95**

1978 IC Update Master Manual

1978 IC Update Master Manual **$19.50**. Complete IC data selector, 2175 pg. Master reference guide. Over 42,000 cross references. Free update service through 1978. Domestic postage **$3.50**. Foreign **$5.00**. 1979 IC Update available late Jan. **$35.00.**

Stopwatch Kit $26.95

Full six digit battery operated. 2-5 volts. 3.2768 MHz crystal accuracy. Times to 59 min., 59 sec., 99 1/100 sec. Times std., split and Taylor. 7205 chip, all components minus case. Full instructions.

D Connectors RS232

25 Pin Subminiatures

DB25P	2.95	DE9P	1.50
DB25S	3.95	DE9S	1.95
Cover	1.50	DA15P	2.10
RS232 Complete Set	6.50	DA15S	3.10

S-100 Computer Boards

8K Static RAM Kit	$135.00
16K Static RAM Kit	265.00
24K Static RAM Kit	423.00
32K Dynamic RAM Kit	310.00
64K Dynamic RAM Kit	470.00
8K/16K Eprom Kit (less PROMS)	**$89.00**
Video Interface Kit	**$139.00**
Motherboard **$39.**	Extender Board **$8.99**

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax. BankAmericard and Master Charge accepted. Shipping charges will be added on charge cards.

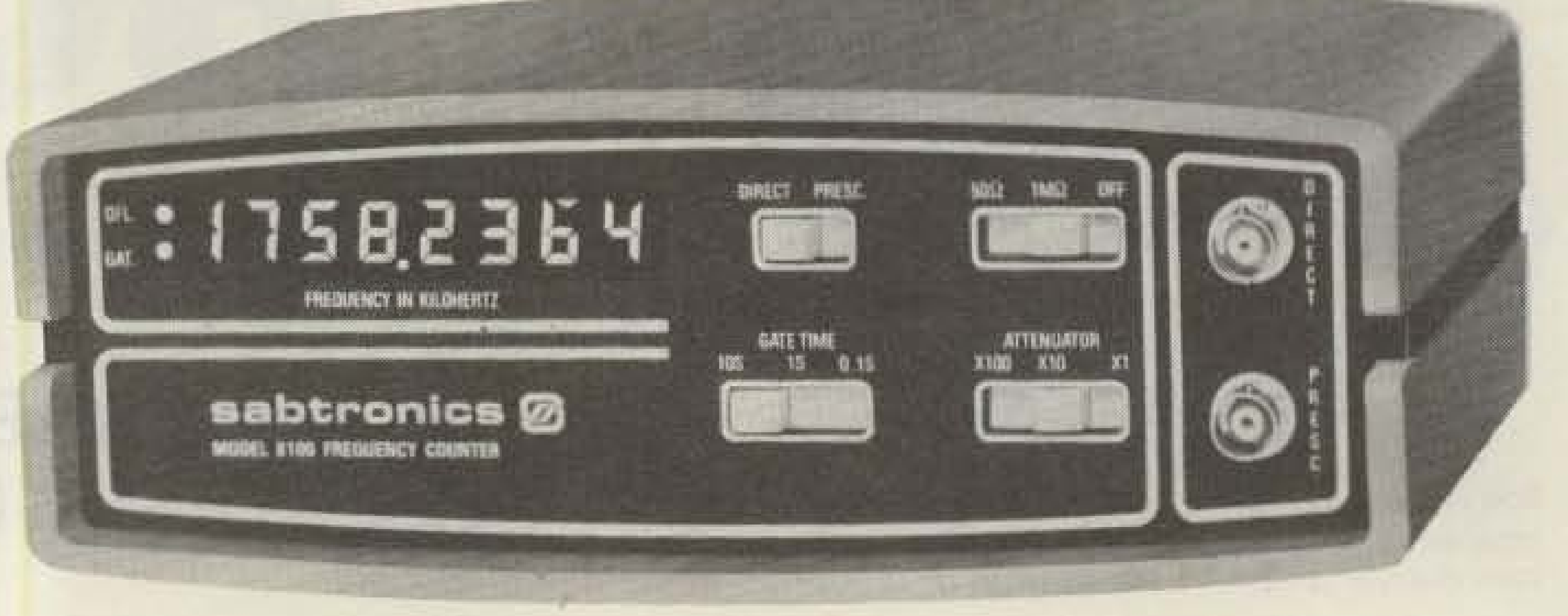
FREE: Send for your copy of our NEW 1978 QUEST CATALOG. Include 28¢ stamp.

✓ *Reader Service—see page 211*

SAVE $25.00

Model 8100 Frequency Counter Kit

- **Range: 20Hz to 100MHz**
- **High Sensitivity**
- **Resolution to 0.1Hz**



Now you can forget about price/performance trade-offs when you select a frequency counter. In Sabtronics' Model 8100 kit you get all the characteristics of superior performance at a low, affordable price.

This frequency counter, employing LSI technology, has the performance and input characteristics you demand: guaranteed frequency range of 20Hz to 100MHz (10 Hz to 120MHz typical); selectable hi/lo impedance; superior sensitivity; selectable resolution and selectable attenuation. Plus an accurate time base with excellent stability.

An 8-digit LED display features gate activity indicator, leading zero suppression and overflow indicator. You would expect to find all these features only on high-priced instruments — or from Sabtronics' advanced digital technology.

BRIEF SPECIFICATONS:
• Frequency Range: 20Hz to 100MHz guaranteed. (10Hz to 120MHz typical) • Sensitivity: 15mV RMS, 20Hz to 50MHz (10mV typical); 25mV RMS, 50MHz to 100MHz (20mV typical) • Selectable Impedance: 1MΩ /25pF or 50Ω • Attenuation: X1, X10 or X100 • Accuracy: ±1Hz plus time base accuracy • Aging Rate: ±5ppm/yr. • Temperature Stability: ±10ppm, 0°C to 40°C • Resolution: 0.1Hz, 1Hz, 10Hz selectable • Display: 8-digit LED, overflow indicator, gate activity indicator • Overload Protection • Power Requirement: 9-15 VDC @ 330mA

Model 2000, 3½ Digit DMM Kit

- **5 Functions, 28 Ranges**
- **Basic DCV Accuracy: 0.1% ±1 Digit**

The amazing Sabtronics 2000 is the choice of both professionals and hobbyists. It's the only portable/bench DMM that offers so much performance for such an astonishing low price.

You get basic DCV accuracy of 0.1% ±1 digit; 5 functions giving 28 ranges; readings to ±1999 with 100% overrange; overrange indication; input overload protection; automatic polarity; and automatic zeroing.

The all-solid-state Model 2000 incorporates a single LSI circuit and high-quality components. Our clear, step-by-step manual simplifies assembly. Complete kit includes a rugged high-impact case ideal for both test-bench and field use.

BRIEF SPECIFICATIONS:
• DC volts in 5 ranges: 100 μV to 1kV • AC volts in 5 ranges: 100 μV to 1kV • DC current in 6 ranges: 100 nA to 2A • AC current in 6 ranges: 100 nA to 2A • Resistance: 0.1Ω to 20MΩ in 6 ranges • AC frequency response: 40 Hz to 50kHz • Display: 0.36" (9.1mm) 7-segment LED • Input Impedance: 10MΩ • Size: 8"W × 6.5"D × 3"H (203 × 165 × 76 mm) • Power requirement: 4.5-6.5 VDC-4 "C" cells (not included).

BY POPULAR DEMAND
SPECIAL OFFER EXTENDED TO MARCH 31, 1979

Special Offer! Save $25.00*

If you order both the frequency counter and DMM kits now, you pay only $144.90 including shipping and handling. *You save $25.00* off the combined regular low price of $169.90. Order both kits now. This special offer good for a limited time only.

*Special offer good in USA only.

Making performance affordable.

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Please send ______ Model 8100 Frequency Counter kit(s) @ $89.95 ea. $ ______
Shipping and handling $ 5.00/unit* $ ______

Please send ______ Model 2000 DMM kit(s) @ $69.95 ea. $ ______
Shipping and handling $ 5.00/unit* $ ______

Texas residents add sales tax $ ______
Total enclosed $ ______

☐ Check ☐ Money Order ☐ Charge my Master Charge ______ Visa ______
Acc. No. ______ Exp. Dt. ______

Name ______

Address ______

City ______ State ______ Zip ______

*USA only. CANADA: $6.50. FOREIGN: $19.00 AIRMAIL.

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KDK

FM2016A

All Solid State-CMOS PL digital synthesized - No Crystals to Buy! 5KHz steps - 144-149 MHz-HUGE ⅜" LED digital readout PLUS MARS-CAP and MULTIPLE OFFSET BUILT IN. ● 5 MHz Band Coverage - 1000 Channels (instead of the usual 2 MHz to 4 MHz-400 to 800 Channels) ● 4 CHANNEL RAM IC MEMORY WITH SCANNING AND AUTO TRANSMIT ● MULTIPLE FREQUENCY OFFSETS ● ELECTRONIC AUTO TUNING - TRANSMIT AND RECEIVE ● INTERNAL MULTIPURPOSE TONE OSCILLATOR ● RIT ● RF ATT ● DISCRIMINATOR METER - 16 Watts Output-Unequaled Receiver Sensitivity and Selectivity - 15 POLE FILER, MONOLITHIC CRYSTAL FILTER AND AUTOMATIC TUNED RECEIVER FRONT END, COMPARE! ● Superb Engineering and Superior Commercial Avionics Grade Quality and Construction Second to None at ANY PRICE.

INTRODUCTORY PRICE

$359.00

Regulated AC/PS Model FMPS-4R . . . $39.95

SHOWN WITH OPTIONAL μP-800 MICRO-PROGRAMMER*

FMMC-1* Microphone with Built-in Touch Tone Pad.

WHY BUY LESS? THE FMMC-1 HAS IT *ALL!*

- New! Auto key up
- Snap-Action Keyboard
- Adj. level and tone balance
- Use with any transceiver
- Only 3¾" x 2" $39.95

- **FREQUENCY RANGE**: Receive and Transmit: 144.00 to 148.995 MHz, 5 Khz steps (1000 channels) + MARS-CAP and MULTIPLE OFFSET BUILT IN.
- **HUGE ⅜" LED DIGITAL READOUT.**
- **4 CHANNEL RAM SCANNER WITH IC MEMORY AND AUTO TRANSMIT:** Program any 4 frequencies and reprogram at any time using the front panel controls—search for occupied (closed) channel or vacant (open) channels. Internal Ni-Cad included to retain memory (no diode matrix to wire or change).
- **MULTIPLE FREQUENCY OFFSETS: NO CRYSTALS TO BUY - EVER** - Any offset any split! "Odd Ball" splits accomplished by digital programming. Never any need for crystals!
- **INTERNAL MULTIPURPOSE TONE OSCILLATOR BUILT IN**: Sine Wave 1750 Hz tone burst for "whistle on operation" and sub-audible tone operation. Internal 2 position switch for automatic and manual operation, tone burst or sub audible tone PL - adjustable 60-203 Hz (100 Hz Pre-Set).
- **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 Frequency Selection as standard equipment.
- **FULL AUTOMATIC TUNING OF RECEIVER FRONT END AND TRANSMITTER CIRCUITS**: DC output of PLL fed to varactor diodes in all front end RF tuned circuits provides full sensitivity and optimum intermodulation rejection over the entire band. APC (AUTO POWER CONTROL) - Keeps RF output constant from band edge to band edge. NO OTHER AMATEUR UNIT AT ANY PRICE has these features which are 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.
- **RIT CONTROL**: Used to improve clarity when contacting stations with off frequency carrier.
- **MONITOR LAMPS**: 2 LED's on front panel indicate (1) incoming signal-channel busy, and (2) Transmit.
- **FULLY REGULATED INTEGRAL POWER SUPPLY**: Operating voltage for all 9v circuits independently regulated. Massive Commercial Hash Filter.
- **MODULAR COMMERCIAL GRADE CONSTRUCTION:** 3 Unitized modules eliminate stray coupling and facilitate ease of maintenance.
- **ACCESSORY SOCKET**: Fully wired for touch tone, phone patch, and other accessories. Internal switch connects receiver output to internal speaker when connector is not in use.
- **MULTI-PURPOSE METER**: Triple Function Meter Provides Discriminator Meter, "S" Reading on receive and Power Out on Transmit.
- **RECEIVE**: Better than .25uv sensitivity, 15 POLE FILTER as well as monolithic crystal filter and AUTOMATIC TUNED LC circuits provide superior skirt selectivity - COMPARE!
- **HIGH/LOW POWER OUTPUT**: 16 watts and 1 watt, switch selected. Low power may be adjusted anywhere between 1 and 16 watts. Fully protected - short or open SWR.
- **RF ATT**: Live right next to King Kong Repeater and can't operate? With the 2016A You Can - Just flick the RF ATT switch. Only the 2016A has this feature.
- **OTHER FEATURES**: Dynamic Microphone, built in speaker, mobile mounting bracket, external 5 pin accessory jack, speaker jack, and much, much more. Size 2½ x 7 x 7½. All cords, plugs, fuses, microphone hanger, etc. included. Weight 5 lbs.

Manufactured by one of the world's most distinguished Avionics manufacturers, Kyokuto Denshi Kaisha, Ltd. First in the world with an all solid state 2 meter FM transceiver.

Regional Sales & Service Centers

East: Sanford Communications, Inc. Colonia, N.J. (201) 574-3003
Northeast: Buzzards Bay Electronics Buzzards Bay, Mass. (617) 759-3376
West: The Radio Shop Riverton, Utah (801) 254-0991
Northwest: Action Supply, Inc. Boise, Idaho (208) 344-5084
Midwest: Universal Service Columbus, Ohio (614) 866-4267
South: Electronic Communications Highland Springs, Virginia (804) 737-5100

AMATEUR-WHOLESALE ELECTRONICS

8817 S.W. 129th Terrace, Miami, Florida 33176
Telephone (305) 233-3631 ● Telex: 51-5628
U.S. DISTRIBUTOR

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M-M Electronic Sales
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A division of **united products** Corporation

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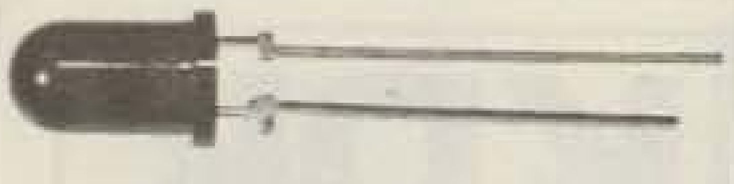
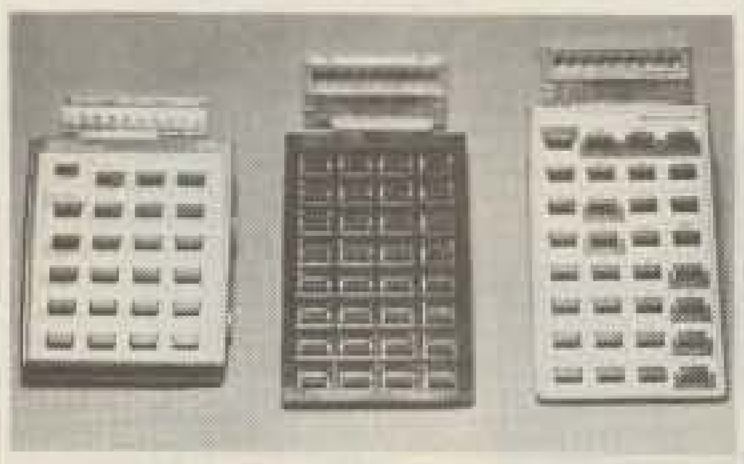


GALLIUM PHOSPHIDE L.E.D. Provides Higher Intensity Than Regular LED's; T1-3/4 Dome (Red Diffused) AND Part #114R 1-99 . . .22¢ 100+ . . . 20¢ **We stock the full line of AND L.E.D.'s**

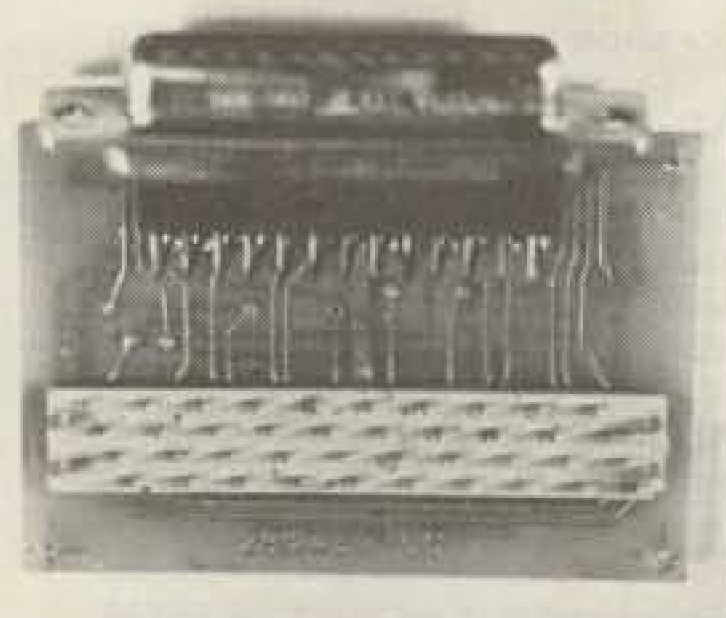
MOTOROLA 4 MHZ XTAL OSCILLATOR 14 pin dip pkg., 5 VDC in, 4 MHz out. TTL compatible. **$5.95 ea.**

NATIONAL SEMICONDUCTOR—6 DIGIT CLOCK MODULE A 12-hr. clock featuring alarm and snooze alarm function. Comes complete with everything. All you add is a power cord and switches. Each module utilizes discreet components and is ready for you to mount in your enclosure. Display is 6 each seven segments, .3 inches high, clocktip is MM5375. Can easily be mounted in either of our instrument clock case kits. **$14.95.**



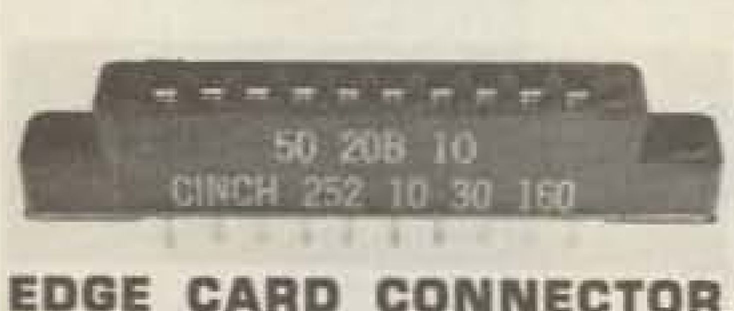
CALCULATOR GUTS Experimenter's delight. Each keyboad includes a monolithic calculator chip and a display. These are rejects. It might be something simple to repair or it could be very nasty. At this price, who cares! 9 volt. **$1.50 ea. 3/$3.00.**

HOBBY BAGS An assortment of misc. electronic parts. A genuine value and savings. **Only $2.99.**

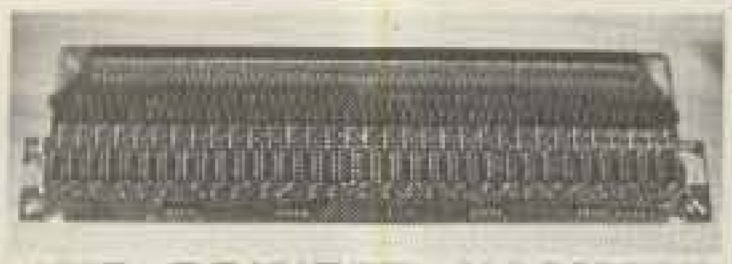


DB-25 FEMALE CONNECTOR A unique assembly originally adapting the RS232 Type Connector to flat cable. **$1.50 each or 2/$2.50.**

INSTRUMENT/CLOCK CASE KIT Perfect for your opto projects. Solid aluminum construction with real walnut sides. O.D. 5-3/8" by 5-3/8" by 2". $6.95 ea.



EDGE CARD CONNECTOR Cinch Jones 10/20 Pins .156 Spacing PC Mount **85¢.** Burndy 22/44 Pins, .156 spacing PC Mount, **$1.40 each.**

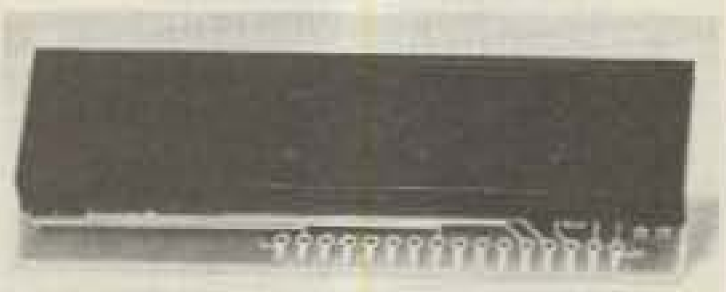


LINE PRINTER HAMMER DRIVER BOARD Each board contains approx. 130 each #MJE800 (Silicon Darlington NPN hfe 750, 1.5A). About $130.00 worth, over 100 1N4001 diodes, plus support chips. The whole package is yours for only **$14.95.**

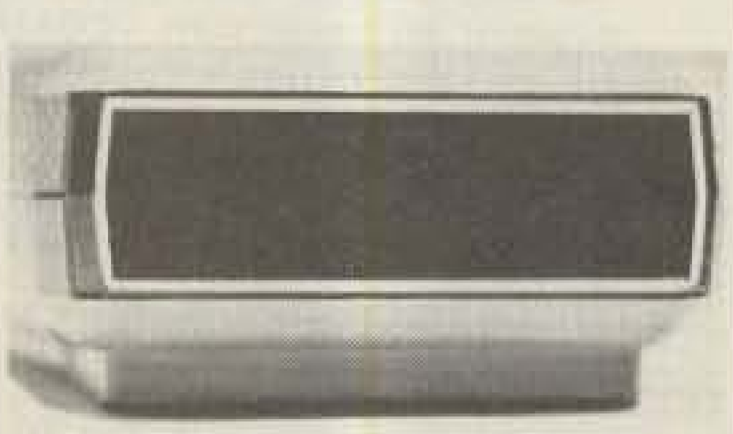
HURRY, WE DON'T EXPECT THESE TO LAST VERY LONG!

TRANSFORMER Pri. 110 VAC Sec. 11.2 and 5 VCT @ 1 amp. **95¢ ea.**

TRANSFORMER P-C mount. pri. 110 VAC Sec. 12:6 @ 1 amp. **$1.25 ea.**



CLOCK DISPLAY National Semi. 6 Digit Multiplexed Display; .33" Characters (Common Cathode). **A REAL BUY AT JUST $1.00.**



INSTRUMENT CLOCK CASE KIT A real jewel for those smaller projects. Hinged top door allows you to hide your control area. O.D. 4½" x 4" x 1¾". **$1.99 each.**

AMPHENOL #17-20250-1 (db-25) Male chassis mount. **$2.50 ea.**

MINIATURE DBDT (PUSH BUTTON) momentary, rated 6A/125 VAC, microswitch part #8N2021. **Only $1.54.**

FLAT CABLE CONNECTOR Female 34 Pin Socket **50¢ each**

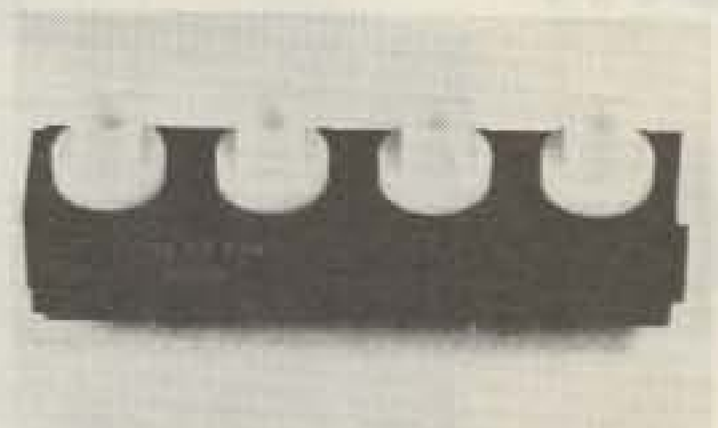
PLASTIC PARTS BOX A nice little hinged-top box for storing all your small parts. O.d. 6¾" by 3¾" by 2". **75¢ ea. 10/$5.00.**

COMPUTER POWER SUPPLY TRANSFORMER PRI. 110/220 Vac; SEC. 12.1 V @ 9 A, 44.0 V @ 2.5 A, 12.9 V @ 2.0 A, 12.9 V @s 3.2 A. **Only $14.95 ea.**

EDGE METER 100-0-100 ua 1/2" by 11/16". Compare with other meters costing $6.00. **ONLY $2.00 ea.** Why pay more?

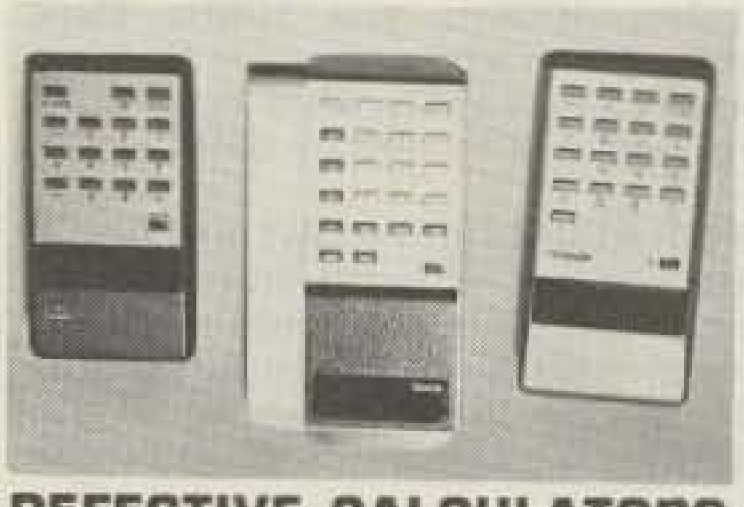
CALCULATOR BUBBLE DISPLAY BRAND NEW pocket calculator displays. Ranging from 6-9 digit. Your luck **$1.25 ea. 3/$3.00**

KEYBOARD HOBBY BAG Compare, then really save with our calculator hobby bag assortment. Each one contains 3 calculator keyboards. All this for **only $1.75.**



KEYBOARD SWITCH ASSEMBLIES Spring contact type 6/$2.00 (Which enables you to re-assemble 3 complete groups of 4 switches.)

REPEAT OF A SELL-OUT A complete 12 hour digital clock. Some are manufacture line rejects, some are returns, and some are just scratched. Features: hours- minutes- alarm- snooze alarm. Parts value alone would equal $20.00, you pay **only $6.00 ea.**



DEFECTIVE CALCULATORS Well, some are and some are not. We can't afford the time to test them. **$2.50 ea.** Batteries not included. **2/$4.00**

#30 KYNAR Blk., Brn., Red., Or., Yel., Grn., Blu., Vio., Gry., Wh. We will do our best to ship the color you specify. To ensure prompt delivery of your order we will substitute colors should we be temp. out, unless you specify otherwise. **$2.36 per hundred foot spool; $14.16 per thousand foot spool; Multiples of 100' only.**

Call us for quotes on larger quantities.

PARTS BOARDS A great way to buy parts on a budget. We guarantee your money's worth. **ONLY $1.00 ea.**

CAPACITORS

Capacitance	Voltage	Style	Price
1000uf	25 VDC	P-C	25¢
220uf	25 VDC	P-C	25¢
2000uf	25 VDC	AXIAL	50¢
40/40	150 VDC	AXIAL	45¢
1uf	15 VDC	AXIAL	19¢
.018	100 V	MYLAR	25¢
.001	100 V	MICA	11¢
.01		DISC	7¢
.02		DISC	6¢
.1		DISC	9¢

CLAIREX PHOTO CELLS These have a real USEFUL range to them. Any project involving control from ambient light levels will utilize this photo cell. Light resistance 1K. Fast response. .156 Diameter. **75¢ each or 2/$1.00.**

ROTRON WHISPER FAN #WR2H1 3 Blade 4" Diameter 75CFM 115VAC. NET $17.00 **YOUR PRICE $9.95** Wait now, these are not pull-outs or something like that, these are new!

10 STATION PUSH BUTTON SWITCH ASSEMBLY 4 Push-On/Push-Off, 6 Ganged Push-On/Push-Off DPDT **$2.50 Each.**

SELECTED VALUES

These items are chosen from our vast inventory of industrial quality components:

Extruded heat sink 10 7/8" by 2 1/4" by 5/8" . . . $1.49
500 Ohm P-C mount trimmer . . . 20¢
Line cord #18 ga 6' . . . 25¢
74LS175 Quad D flip-flop . . . 50¢
S.P.D.T. sub-min slide switch . . . 40¢
S.P.S.T. P-C SWITCH . . . 20¢
ACID BRUSH . . . 10¢
2 cond. #24 spiral wrap shld. cable . . . 10¢
14 PIN DIP HEADER . . . 35¢

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Terms: All orders shipped promptly. Minimum order $5.00. Telephone orders accepted. All orders shipped UPS or PP. Add 5% extra for shipping & handling. Washington state residents add additional 5.4% sales tax. Master Charge & Visa cards accepted. Money orders & your personal or company check are welcome. Funds made payable in U.S. currency only. No C.O.D. orders. Your satisfaction is guaranteed on all merchandise purchased. All merchandise subject to prior sale. Open account to govt. agencies & publicly funded schools.

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FREQUENCY COUNTER KIT

Outstanding Performance

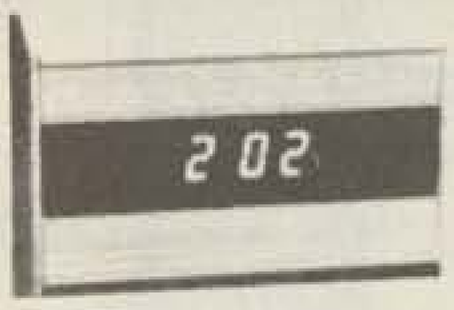
CT-50 Incredible Price $89.95

SPECIFICATIONS:
Frequency range: 6 Hz to 65 mHz, 600 mHz with CT-600
Resolution: 10 Hz @ 0.1 sec gate, 1 Hz @ 1 sec gate
Readout: 8 digit, 0.4" high LED, direct readout in mHz
Accuracy: adjustable to 0.5 ppm
Stability: 2.0 ppm over 10° to 40° C, temperature compensated
Input: BNC, 1 megohm/20 pf direct, 50 ohm with CT-600
Overload: 50VAC maximum, all modes
Sensitivity: less than 25 mv to 65 mHz, 50-150 mv to 600 mHz
Power: 110 VAC 5 Watts or 12 VDC @ 400 ma
Size: 6" x 4" x 2", high quality aluminum case, 2 lbs
ICS: 13 units, all socketed

The CT-50 is a versatile and precision frequency counter which will measure frequencies to 60 mHz and up to 600 mHz with the CT-600 option. Large Scale Integration, CMOS circuitry and solid state display technology have enabled this counter to match performance found in units selling for over three times as much. Low power consumption (typically 300-400 ma) makes the CT-50 ideal for portable battery operation. Features of the CT-50 include: large 8 digit LED display, RF shielded all metal case, easy pushbutton operation, automatic decimal point, fully socketed IC chips and input protection to 50 volts to insure against accidental burnout or overload. And, the best feature of all is the easy assembly. Clear, step by step instructions guide you to a finished unit you can rely on.
Order your today!

CT-50, 60 mHz counter kit	$89.95
CT-50WT, 60 mHz counter, wired and tested	159.95
CT-600, 600 mHz scaler option, add	29.95
CB-1, Color TV calibrator-stabilizer	$14.95
DP-1, DC probe, general purpose probe	12.95
HP-1, High impedance probe, non-loadin	15.95

CAR CLOCK

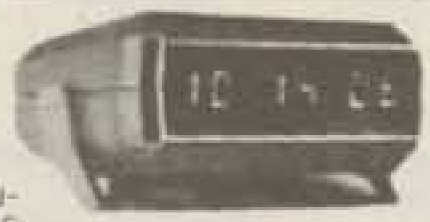


The UN-KIT, only 5 solder connections

Here's a super looking, rugged and accurate auto clock, which is a snap to build and install. Clock movement is completely assembled—you only solder 3 wires and 2 switches, takes about 15 minutes! Display is bright green with automatic brightness control photocell—assures you of a highly readable display, day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify).

DC-3 kit, 12 hour format	$22.95
DC-3 wired and tested	$29.95
110V AC adapter	$5.95

Under dash car clock



12/24 hour clock in a beautiful plastic case features: 6 jumbo RED LEDS, high accuracy (1min/mo.), easy 3 wire hookup, display blanks with ignition, and super instructions. Optional dimmer automatically adjusts display to ambient light level.

DC-11 clock with mtg. bracket	$27.95
DM-1 dimmer adapter	2.50

PRESCALER

Extend the range of your counter to 600 mHz. Works with any counter. Includes 2 transistor pre-amp to give super sens, typically 20 mv at 150 mHz. Specify ÷10 or ÷100 ratio.

PS-1B, 600 mHz prescaler	$59.95
PS-1BK, 600 mHz prescaler kit	49.95

OP-AMP SPECIAL

741 mini dip	12/$2.00
B1-FET mini dip, 741 type	10/$2.00

VIDEO TERMINAL

A completely self-contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Two units available, common features are: single 5V supply, XTAL controlled sync and baud rates (to 9600), complete computer and keyboard control of cursor. Parity error control and display. Accepts and generates serial ASCII plus parallel keyboard input. The 3216 is 32 char. by 16 lines, 2 pages with memory dump feature. The 6416 is 64 char. by 16 lines, with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation.

RE 3216, terminal card	$149.95
RE 6416, terminal card	189.95
Lower Case option, 6416 only	13.95
Power Supply Kit	14.95
Video/RF Modulator, VD-1	6.95
Assembled, tested units, add	60.00

CALENDAR ALARM CLOCK

The clock that's got it all: 6-.5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup, and lots more. The super 7001 chip is used. Size 5x4x2 inches.
Complete kit, less case (not available)
DC-9 $34.95

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain: 1 W in for 8 out, 2 in for 15 out, 4 W in for 30 out. Max. output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit	$22.95
TR-1, RF sensed T-R relay kit	6.95

FM MINI MIKE KIT

A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 kit	$12.95
FM-3 wired and tested	16.95

CLOCK KITS

our Best Seller your Best Deal

Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, bronze, black, blue (specify).

Clock kit, 12/24 hour, DC-5	$22.95
Clock with 10 min. ID timer, 12/24 hour, DC-10	27.95
Alarm clock, 12 hour only, DC-8	24.95
12V DC car clock, DC-7	27.95

For wired and tested clocks add $10.00 to kit price.

Hard to find PARTS

LINEAR ICs		**REGULATORS**	
301	$ .35	78MG	$1.25
324	1.50	723	.50
380	1.25	309K	.85
380-8	.75	7805	.85
555	.45	78L05	.25
556	.85	7905	1.25
566	1.15	7812	.85
567	1.25	7912	1.25
1458	.50	7815	.85
3900	.50	**TTL ICs**	
CMOS ICs		74S00	.35
4011	.20	7447	.65
4013	.35	7475	.50
4046	1.85	7490	.50
4049	.40	74196TI	1.35
4518	1.25	**SPECIAL ICs**	
5369	1.75	11C90	13.50
TRANSISTORS		10116	1.25
2N3904 type	10/1.00	4511	2.00
2N3906 type	10/1.00	5314	2.95
NPN 30W Pwr	3/1.00	5375AB	2.95
PNP 30W Pwr	3/1.00	7001	6.50
2N3055	.60	4059 ÷ N	9.00
UJT 2N2646 type	3/2.00	7208	17.95
FET MPF102 type	3/2.00	**LEDs**	
UHF 2N5179 type	3/2.00	Jumbo red	8/1.00
MRF-238 RF	11.95	Jumbo green	6/1.00
SOCKETS		Jumbo yellow	6/1.00
8 pin	10/2.00	Mini red	8/1.00
14 pin	10/2.00	Micro red	8/1.00
16 pin	10/2.00	BiPolar	.75
24 pin	4/2.00	**FERRITE BEADS**	
28 pin	4/2.00	With info, specs	15/1.00
40 pin	3/2.00	6 hole balun	5/1.00

Ramsey's famous MINI-KITS

FM WIRELESS MIKE KIT

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.
FM-1 kit $2.95 FM-2 kit $4.95

COLOR ORGAN/MUSIC LIGHTS

See music come alive! 3 different lights flicker with music. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300W. Great for parties, band music, nite clubs and more.
Complete kit, ML-1 $7.95

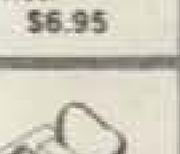
LED BLINKY KIT

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts.
Complete kit, BL-1 $2.95

VIDEO MODULATOR KIT

Converts any TV to video monitor. Super stable, tunable over ch. 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market!
Complete kit, VD-1 $6.95

TONE DECODER



A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.
Complete kit, TD-1 $5.95

WHISPER LIGHT KIT

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Completely self-contained, includes mike, runs on 110VAC, controls up to 300 watts.
Complete kit, WL-1 $6.95

SUPER SLEUTH

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker.
Complete kit, BN-9 $5.95

POWER SUPPLY KIT

Complete triple regulated power supply provides variable ±6 to 18 volts at 200 ma and +5V at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3V @ 1 A and 24 VCT.
Complete kit, PS-3LT $6.95

SIREN KIT

Produces upward and downward wail characteristic of a police siren. 5W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.
Complete kit, SM-3 $2.95

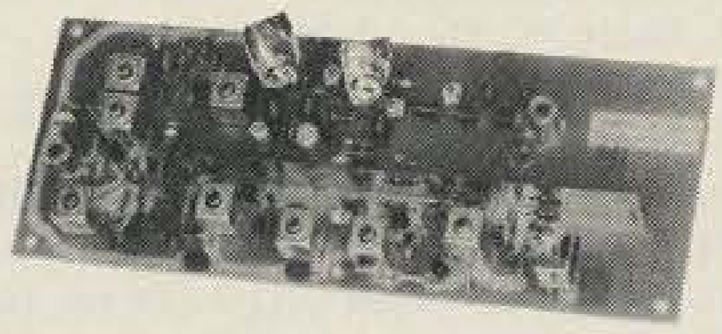
ramsey electronics
BOX 4072, ROCHESTER, N.Y. 14610

PHONE ORDERS CALL
(716) 271-6487

TERMS: Satisfaction guaranteed or money refunded. COD, add $1.50. Minimum order, $6.00. Orders under $10.00, add $.75. Add 5% for postage, insurance, handling. Overseas, add 15%. NY residents, add 7% tax.

hamtronics, inc. H16 **OSCAR HEADQUARTERS** ★ ***Quality VHF & UHF Kits At Affordable Prices***

SSB TRANSMITTING CONVERTERS



FEATURES:

- Linear Converter for SSB, CW, FM, etc.
- A fraction of the price of other units
- 2W p.e.p. output with 1 MW of drive
- Use low power tap on exciter or attenuator pad
- Easy to align with built-in test points

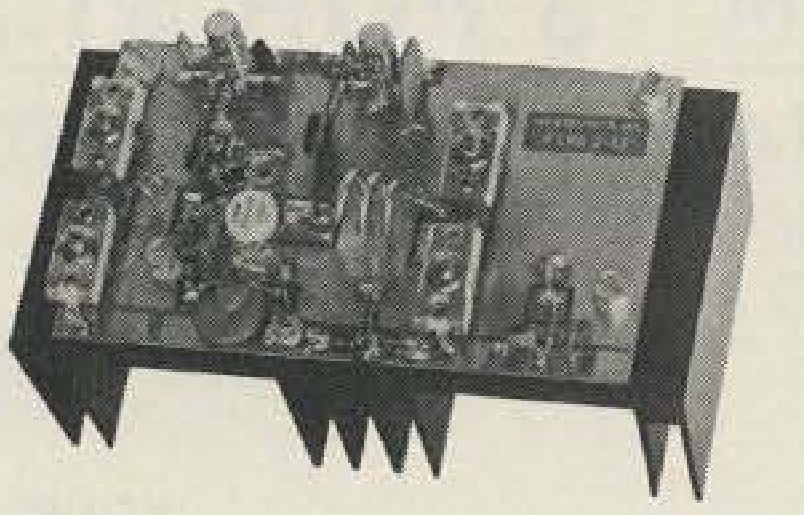
Frequency Schemes Available:

MODEL	INPUT(MHz)	OUTPUT(MHz)
XV2-1	28-30	50-52
XV2-2	28-30	220-222
XV2-3	28-30	222-224
XV2-4	28-30	144-146
XV2-5	28-29	145-146
XV2-6	26-28	144-146

ONLY $59.95!

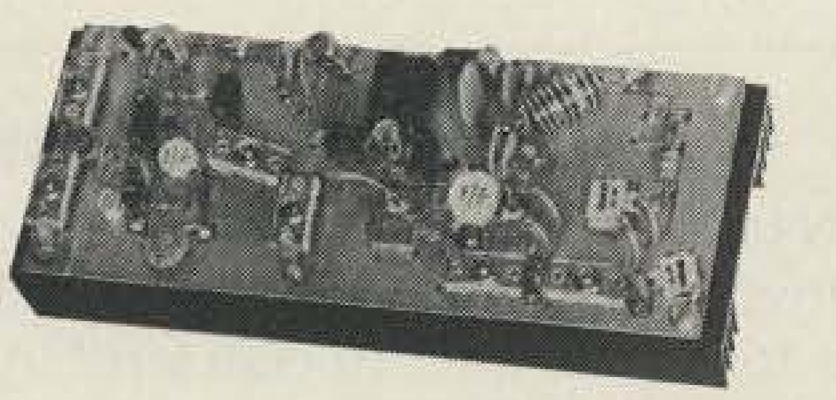
VHF Linear PA's

- Use as Linear or Class C PA's
- For XV-2 Xmtg Converters, T50 Exciters, or any 2W Exciter



LPA 2-15 Kit $59.95

- 15W out (linear) or 20W (class C)
- Solid State T/R Switching
- Models for 6M, 2M, or 220 MHz



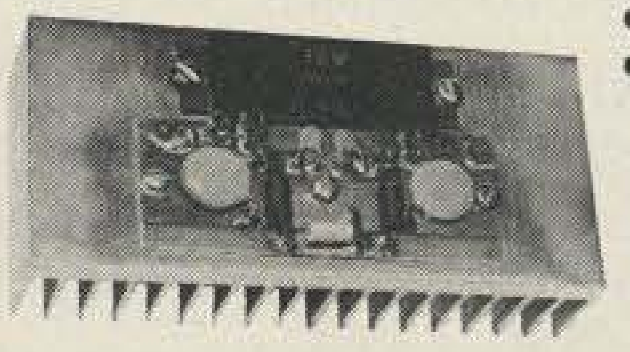
LPA 2-45 Kit $109.95

- 45W out (linear) or 50W (class C)
- Models for 6M or 2M

LPA 8-45 Kit $89.95
For 2M, 8-10W in, 45W out

T80 UHF POWER AMP

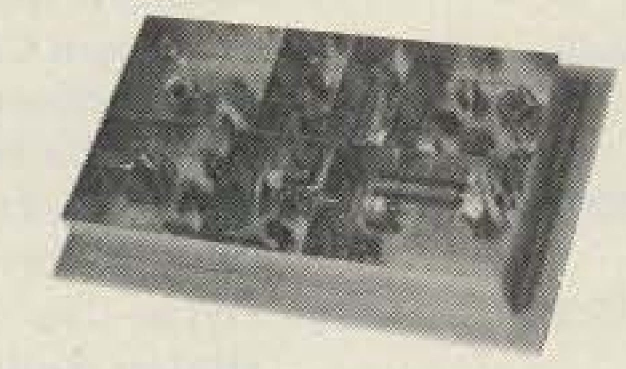
- Broadband PA
- No Tuning Required
- Class C PA
- 430-470 MHz
- 13-15W Out
- 200 mW Drive



Model T80-450
$79.95
Wired & Tested

VHF RECEIVING CONVERTERS

LET YOU RECEIVE OSCAR AND OTHER EXCITING SIGNALS ON YOUR PRESENT HF RECEIVER!



MODEL	RF RANGE	I-F RANGE
C28	28-32MHz	144-148MHz
C50	50-52	28-30
C144	144-146	28-30
C145	145-147	28-30
C146	146-148	28-30
C110	Aircraft	26-30
C220	220-222	28-30
C222	222-224	28-30
Special	Inquire About Other Ranges	

ONLY $34.95

UHF RECEIVING CONVERTERS

MODEL	RF RANGE	I-F RANGE
C432-2	432-434	28-30MHz
C432-4	432-436	144-146
C432-5	435-437	28-30
C432-7	427.25	61.25
C432-9	439.25	61.25
Special	Inquire About Other Ranges	

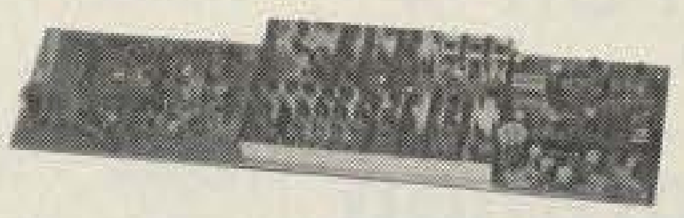
ONLY $34.95

A9 Extruded Alum Case with BNC's for above Converters (Optional) ... $12.95

VHF & UHF FM RECEIVERS

- *NEW GENERATION RECEIVERS
- *MORE SENSITIVE *MORE SELECTIVE (70 or 100 dB)
- *COMMERCIAL GRADE DESIGN
- *EASY TO ALIGN WITH BUILT-IN TEST CKTS
- *LOWER OVERALL COST THAN EVER BEFORE

R70 6-channel VHF Receiver Kit for 2M, 6M, 10M, 220 MHz, or com'l bands........... $69.95
Optional xtal filter for 100 dB adj chan 10.00



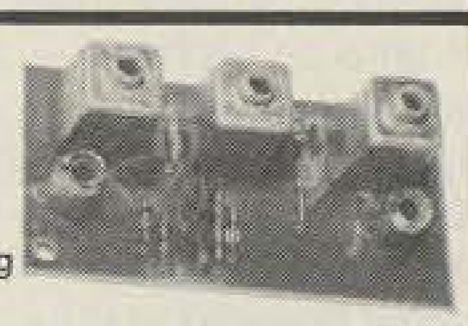
R90 UHF Receiver Kit for any 2 MHz segment of 380-520 MHz band................ $89.95

FAMOUS HAMTRONICS PREAMPS

let you hear the weak ones!

Great for OSCAR, SSB, FM, ATV. Over 10,000 in use throughout the world on all types of receivers.

P9 Kit $12.95
P14 Wired $24.95
Specify Band When Ordering

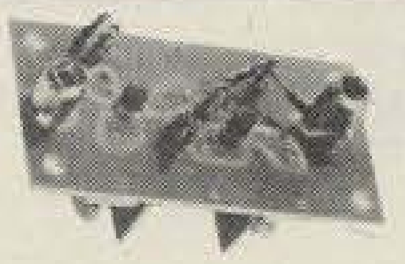


- Deluxe vhf model for applications where space permits
- 1-1/2 x 3"
- Models avail to cover any 4 MHz band in the 26-230 MHz range
- 12 Vdc
- 2 stages
- Ideal for OSCAR
- 20 db gain
- Diode transient protection
- Easily tunable

P8 Kit $10.95
P16 Wired $21.95
Specify Band

- Miniature vhf model for tight spaces - size only 1/2x2-3/8
- Models avail to cover any 4 MHz band in the range 20-230 MHz
- 20 db gain
- 12V

P15 Kit $18.95
P35 Wired $34.95



- Covers any 6 MHz band in UHF range of 380-520 MHz
- 20 dB gain
- 2 stages
- Low noise

NEW FM/CW EXCITER KITS

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T50 Six Channel, 2W Exciter for 2M, 6M, or 220 MHz (Specify band).............. $49.95

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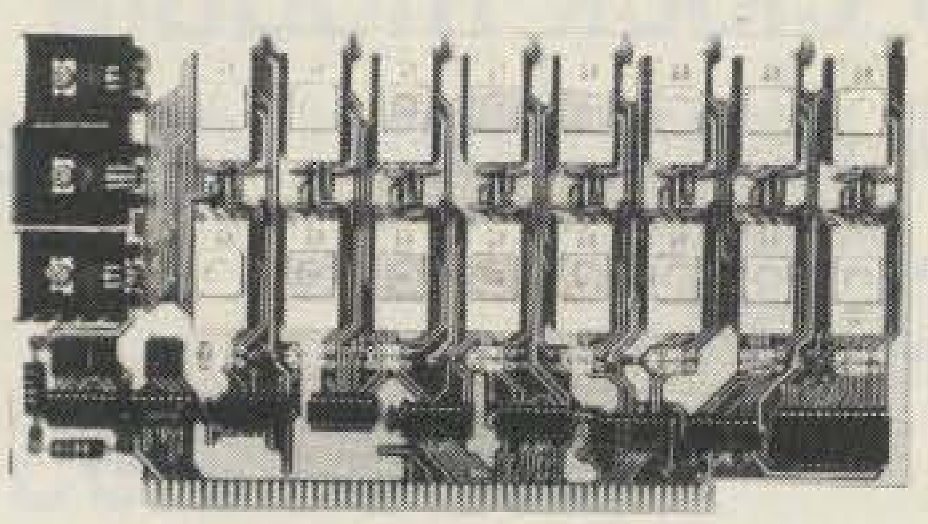
--Dealer Inquiries Invited--

✓ Reader Service—see page 211

March 1979

16K EPROM CARD-S 100 BUSS



$59.95 KIT

OUR BEST SELLING KIT!

USES 2708's!

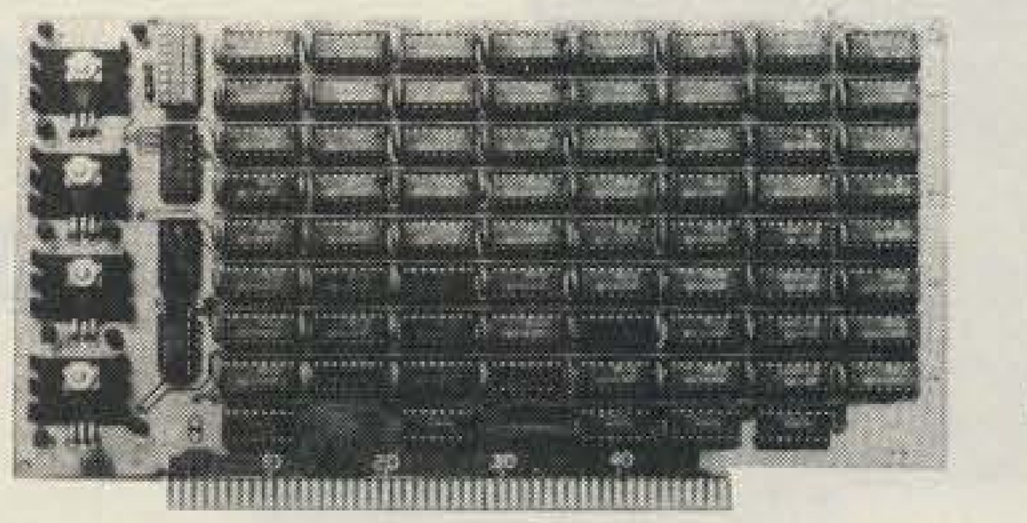
Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. All parts (except 2708's) are included. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450NS 2708'S ARE $8.95 EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD $25

8K LOW POWER RAM KIT-S 100 BUSS

250 NS SALE!



ADD $5 FOR 250NS!

$129 KIT

Use 21L02 450 NS RAMS!

Thousands of computer systems rely on this rugged, work horse, RAM board. Designed for error-free, NO HASSLE, systems use.

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

Blank PC Board w/Documentation **$29.95**

Low Profile Socket Set...**13.50**

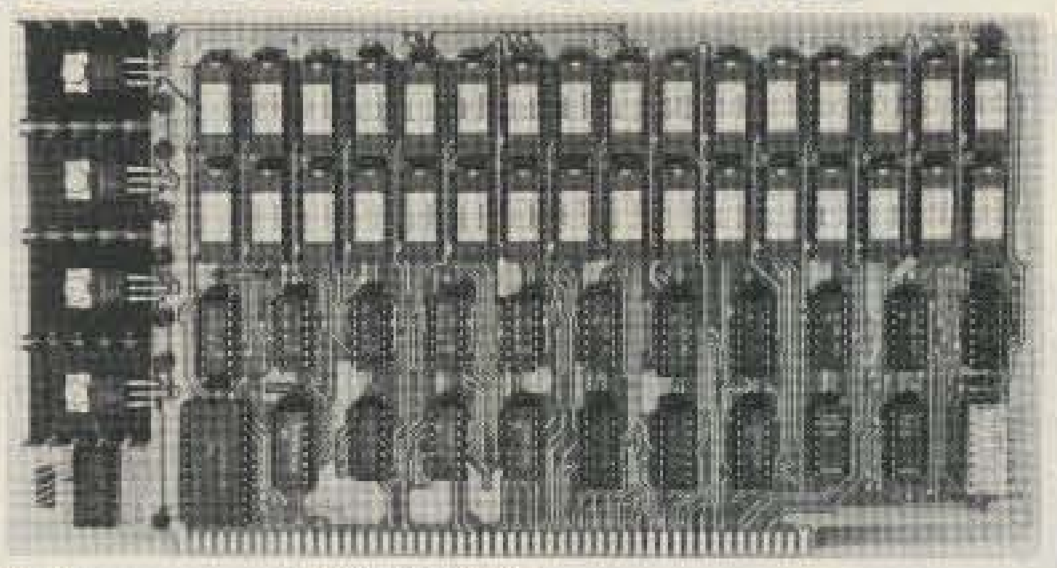
Support IC's (TTL & Regulators) **$9.75**

Bypass CAP's (Disc & Tantalums) **$4.50**

ASSEMBLED AND FULLY BURNED IN ADD $30

16K STATIC RAM KIT-S 100 BUSS

$295 KIT



FULLY STATIC, AT DYNAMIC PRICES

WHY THE 2114 RAM CHIP?

We feel the 2114 will be the next industry standard RAM chip (like the 2102 was). This means price, availability, and quality will all be good! Next, the 2114 is FULLY STATIC! We feel this is the **ONLY** way to go on the S-100 Buss! We've all heard the HORROR stories about some Dynamic Ram Boards having trouble with DMA and FLOPPY DISC DRIVES. Who needs these kinds of problems? And finally, even among other 4K Static RAM's the 2114 stands out! Not all 4K static Rams are created equal! Some of the other 4K's have **clocked** chip enable lines and various timing windows **just as critical** as Dynamic RAM's. Some of our competitor's 16K boards use these "tricky" devices. But not us! The 2114 is the ONLY logical choice for a trouble-free, straightforward design.

KIT FEATURES:

1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 2 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA—**$33**

LOW PROFILE SOCKET SET—**$12**

ASSEMBLED & TESTED—**ADD $30**

SUPPORT IC'S & CAPS—**$19.95**

2114 RAM'S—**8 FOR $69.95**

60 Hz CRYSTAL TIME BASE

$4.95 (Complete Kit)

Uses MM5369 CMOS divider IC with high accuracy 3.579545 MHZ Crystal. Use with all MOS Clock Chips or Modules. Draws only 1.5 MA. All parts, data, and PC Board included.

100 HZ CRYSTAL TIME BASE

$5.95 (Complete Kit)

Same as above, except it uses a special MM5369. Perfect for frequency counter time bases, etc. Also use with MOSTEK MK50397 timer chip.

16K DYNAMIC RAM CHIP

16K X 1 Bits. 16 Pin Package. Same as Mostek 4116-4. 250 NS access. 410 NS cycle time. Our best price yet for this state of the art RAM. 32K and 64K RAM boards using this chip are readily available. These are new, fully guaranteed devices by a major mfg. **VERY LIMITED STOCK!**

8 FOR $89.95

NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

2708 EPROMS

450 NS!

Now full speed! Prime new units from a major U.S. Mfg. 450 N.S. Access time. 1K x 8. Equiv. to 4-1702 A's in one package.

~~$15.75 ea.~~ **$9.95** ~~4 FOR $50.00~~

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JUMBO CLOCK MODULE

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2 FOR $13

(AC XFMR $1.95)

FEATURES:

- FOUR JUMBO ½ INCH LED DISPLAYS
- 12 HR REAL TIME FORMAT
- 24 HR ALARM SIGNAL OUTPUT
- 50 OR 60 Hz OPERATION
- LED BRIGHTNESS CONTROL
- POWER FAILURE INDICATOR
- SLEEP & SNOOZE TIMERS
- DIRECT LED DRIVE (LOW RFI)
- COMES WITH FULL DATA

ASSEMBLED! NOT A KIT!

ZULU VERSION!

We have a limited number of the 24 HR Real time version of this module in stock.

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PERFECT FOR USE WITH A TIMEBASE.

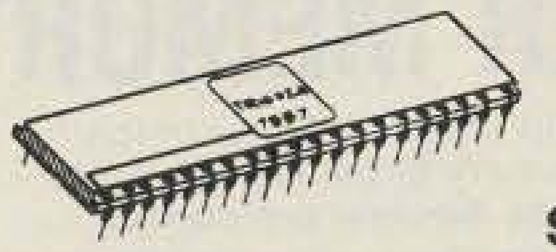
COMPARE AT UP TO TWICE OUR PRICE!

MANUFACTURER'S CLOSEOUT!

WESTERN DIGITAL UART

TR1602A. PIN FOR PIN SUB FOR AY5-1013 AND TMS6011.

FOR SERIAL I/O



$2.99 EACH

SURPLUS SPECIAL

SALE!

1N4148 DIODES. SILICON. Same as 1N914. New, factory prime, Full Leads.

100 FOR $2

1000 FOR $17.50

New! REAL TIME Computer Clock Chip

N.S. MM5313. Features BOTH 7 segment and BCD outputs. 28 Pin DIP. **$4.95 with Data**

Z-80 PROGRAMMING MANUAL

By MOSTEK, or ZILOG. The most detailed explanation ever on the working of the Z-80 CPU CHIPS. At least one full page on each of the 158 Z-80 instructions. A MUST reference manual for any user of the Z-80. 300 pages. Just off the press.

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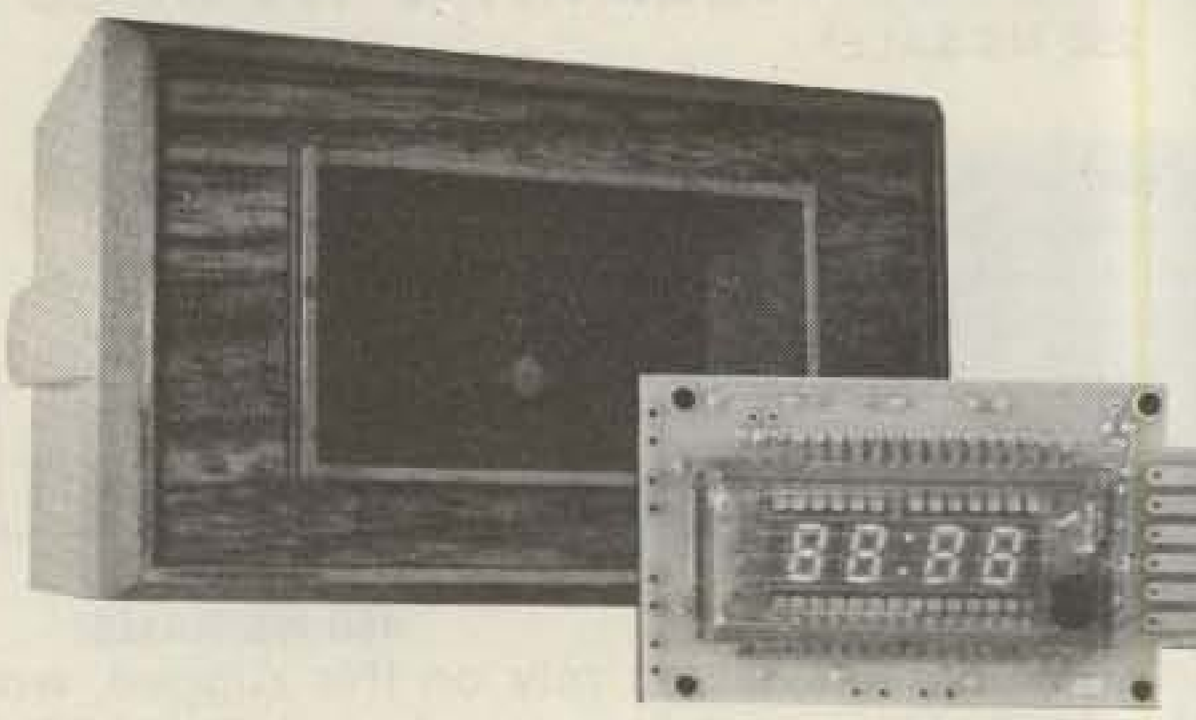
THE GODBOUT COMBINATION SPECIAL:

1- MA1003 clock module
1- MA1003 matching case



NOW GET BOTH
FOR $19.95!

The MA1003 is a popular clock module that features our blue-green flourescent readouts (won't wash out in daylight, a highly accurate built-in timebase (excellent for mobile/portable operation and battery backup applications), and really easy assembly . . . add time setting switches, + 12V DC, and you're ready to go. So simple, it makes a great one evening project; so inexpensive, you can afford to have accurate, electronic timekeeping not only in your home but in your car, truck, or van.

Our matching case has a simulated woodgrain front, mounting bracket and hardware, and a blue filter that really brings out the best in the MA1003 readouts. Best of all, it's compact . . . and even has pilot holes pre-drilled for 2 time-setting switches and an optional display switch. Comes complete with applications data.

We can't imagine why you'd want to pass up our combination special, but if you do, the clock is available separately for $16.50 each (3/$46), and so is the case ($5.95).

It's about time someone came up with a simple, inexpensive, easy to assemble clock . . . here it is.

SN76477 COMPLEX SOUND GENERATOR FROM TI — FROM US, ONLY $2.75!

We break the price barrier on another state-of-the-art chip from TI. This IC includes two wide-range audio oscillators, white noise source and filter, digitally controlled mixer, output amplifier controlled by a multistage envelope generator, one-shot for specifically timed sounds, internal regulator . . . and more. Parameters are programmed by either resistors, capacitors, or digital logic depending on the function. One of our people has already designed drum sythesizers, environmental sound generators, complete instruments, and random control voltage generators around this remarkable part . . . **wait 'til you see what you can do with it!**

12V 8A POWER SUPPLY

$44.50

This kit has sold consistently since we introduced it back in '73, and it's no wonder: hams and CBers use it for powering mobile transceivers in the home, techs use it for a bench supply, computer owners use it to power bunches of floppy discs, and a major hi-fi chain even bought several of them for powering auto tape players in their stores. Handles 12A with 50% duty cycle, and features crowbar overvoltage protection, foldback current limiting, adjustable output 11-14V, custom wound heavy-duty transformer, RF suppression, and simplified assembly (all parts except transformer, filter caps, and diodes mount on circuit board). With complete assembly instructions. Does not include case.

WANT A HAPPY COMPUTER? GIVE IT STATIC CompuKit™ MEMORY!

Our Econoram™ family represents cost-effective, low power, highly reliable memory that retains full compatibility and is backed with a 1 year limited warranty. Available as **unkits** (sockets, bypass caps pre-soldered in place for easy assembly), **assembly/tested**, or qualified under the **Certified System Component (CSC)** program. CSC boards are burned-in for 200 hours and immediately replaced if failure occurs within 1 year of invoice date.

Name	Storage	Design	Buss	Guar. Speed	Unkit	Assm	CSC
ECONORAM II™	8K X 8	static	S-100	2 MHz	**$139**	**$159**	N/A
ECONORAM IV™	16K X 8	static	S-100	4 MHz	**$295**	**$329**	**$429**
ECONORAM VI™	12K X 8	static	H8	2 MHz	**$200**	N/A	N/A
ECONORAM VII™	24K X 8	static	S-100	4 MHz	**$445**	**$485**	**$605**
ECONORAM X™	32K X 8	static	S-100	4 MHz	**$599**	**$649**	**$789**
ECONORAM IX™	32K X 8	static	DigGrp	4 MHz	**$649**	N/A	N/A
ECONORAM XI™	32K X 8	static	SBC	4 MHz	N/A	N/A	**$1050**

OTHER MEMORY PRODUCTS:

TRS-80 CONVERSION KIT $109 (3/$320) — Includes dip shunts, 250 ns chips for 4 MHz operation, and 1 year guarantee. Upgrades 4K TRS-80 to 16K, populates Memory Expansion Module — our novice level instructions show you how. **Also expands memory in Apple and Exidy Sorcerer computers.**

"BARE BOARD" H8 MEMORY SPECIAL $35 — **Don't need the full 12K of our Econoram VI? Then we'll sell you the bare board, mounting bracket, edge connector, and print separately. Populate it with a few support ICs and the popular, low cost 2102 type 1K RAMs to build your memory board up to the desired capacity.**

2101-L1 1K STATIC RAMS $0.99 — **These are low power, high speed parts. Sorry, price only good on order of 10 or more.**

FREE CATALOGUE: We used to advertise our free flyer, but we have so much stuff we've promoted it to a catalogue. If you're looking for bargains, this is the place . . . send us your name and address, we'll take care of the rest. For 1st class delivery add 41¢ in stamps.

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G4

Reader Service—see page 211

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A PENNY MORE GETS YOU TWO *

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□ 3 MICROPROCESSOR/SUPPORT CHIPS, asst. MM5780-90 series, 24-28 pin (#5639A)	1.29	6 for 1.30
□ 5 CLOCK/CALCULATOR CHIPS, asst. MM5378, 75, 5737 etc. (#5638A)	1.29	10 for 1.30
□ 25 DTL FAIRCHILD IC's, gates and flip flops, Dip, 100% (#3709)	1.29	50 for 1.30
□ 1-24 VOLT 50 MIL. TRANSFORMER, 115 V input, open frame, 1" x 1" x 3/4" (#5631)	1.29	2 for 1.30
□ 10-2N3704 TRANSISTORS, silicon, TO-92 case, hfe-300, 100% (#5625)	1.29	20 for 1.30
□ 10-2N3705 TRANSISTORS, silicon, TO-92 case, hfe-150, 100% (#5626)	1.29	20 for 1.30
□ 10 D33021 TRANSISTORS, low power, silicon, hfe-60, TO-92 (#5627)	1.29	20 for 1.30
□ 1 ALLEN BRADLEY POT, 10K, 2-1 4 watts, type-J, 2" x 1/4" shaft (#1748)	1.29	2 for 1.30
□ 50 ASST. RED LEDS, 20% or better, various styles and types (#5624)	1.29	100 for 1.30
□ 10 G.E. POWER TAB TRANSISTORS, D40N1, N2, some N5, TO-202 (#5629)	1.29	20 for 1.30
□ 4-1/4" BLOCK TRIM POTS, 200K (#2535)	1.29	8 for 1.30
□ 1-12VDC 5MIL REED RELAY, spst, N.O, 2200 ohms, 7/8" x 5/16" x 5/16" (#5515)	1.29	2 for 1.30
□ 50 TEMP. COEFFICIENT VOLTAGE REF. DIODES, asst. volt. +50% (#5647)	1.29	100 for 1.30
□ 12 LM-380 IC's, 2 watts, dip, 50%+ yield, U-test (#1975)	1.29	24 for 1.30
□ 50 RED BLOCK DISC CAPS, assorted values, 50% material (#1698)	1.29	100 for 1.30
□ 50 SHOCKLEY DIODES, most popular switching diode, hobby & untested (#1072A)	1.29	100 for 1.30
□ 6 OPTO-COUPLER, 1500V isolation, hobby material, U-test (#2629A)	1.29	12 for 1.30
□ 4 CHERRY MICRO SWITCH, 125 VAC, 15A, N.C. screw terminals (#5525)	1.29	8 for 1.30
□ 5 SPST PUSHBUTTON MOMENTARIES, rt. angle, pc mt, on-on' (#5635)	1.29	10 for 1.30
□ 25 TTL's, with 7400's, U-test, dips (#2415A)	1.29	50 for 1.30

Item	Price	1¢ Sale
□ 100-CAPACITOR SPECIAL, discs, mylar, lytics, more (#2738)	2.49	200 for 2.50
□ 10-VOLTAGE REGULATORS, hobby LM320, 340, TO-3 (#3330)	2.49	20 for 2.50
□ 30-PANEL SWITCHES, slides, rotaries, mod, etc (#3268)	2.49	60 for 2.50
□ 200-RESISTOR SPECIAL, 1/4 to 1W, carbon, metal (#3054)	2.49	400 for 2.50
□ 200-HALF WATTERS, resistors, carbon, metal (#3046)	2.49	400 for 2.50
□ 100-NATIONAL IC BONANZA, linears, 7400s ROMS (#2860)	2.49	200 for 2.50
□ 15-LM340T VOLTAGE REGULATORS, 5 to 24V, TO-220 (#2635)	2.49	30 for 2.50
□ 100-POLYSTYRENE CAPS, asst'd values, voltage, hi-Q (#2729)	2.49	200 for 2.50
□ 50-THERMISTORS, resistors that change with temp (#4089)	2.49	100 for 2.50
□ 20-BRIDGES, untested, 2, 4, 6, amp, full wave (#4022)	2.49	40 for 2.50
□ 15-MIXED READOUTS, hobby, untested, .127, .3, .5, etc. (#3619)	2.49	30 for 2.50
□ 150-QUARTER WATTERS, resistors, metal film, marked (#3413)	2.49	300 for 2.50
□ 100-PLASTIC TRANSISTORS, untested, TO-92 (#2604)	2.49	200 for 2.50
□ 200-PREFORMED RESISTORS, 1/4, 1/2, 1W, marked, asst'd (#2608)	2.49	400 for 2.50
□ 150-PRECISION RESISTORS, 1/2, 1W, 1%, 2% marked (#2428)	2.49	300 for 2.50
□ 60-DIPPED MYLARS, shiny finish, asst'd values (#2597)	2.49	120 for 2.50
□ 30-VOLUME CONTROLS, audio, linear, asst'd values (#2421)	2.49	60 for 2.50
□ 300-SILICON SIGNAL DIODES, micro, glass, zeners tool 50% yield (#2628)	2.49	600 for 2.50
□ 15-CLOCK-CALCULATOR, may include MM5378, MM5375 (#5638)	2.49	30 for 2.50
□ 10-PUSH SWITCHES, push-to-break, spst, alarms (#5289)	2.49	20 for 2.50
□ 12-MICROPROCESSORS, and support IC's. (#5639)	2.49	24 for 2.50
□ 150-GLASS ZENERS, 400 MW, untested, better than 50% yield (#2740)	2.49	300 for 2.50
□ 75-CARBOFILM RESISTORS, 1/4, 1/2 watt, 5 & 10%, marked, asst's (#3534)	2.49	150 for 2.50
□ 250-UNMARKED CAPACITORS, polystyrene, molded, pop values (#3805)	2.49	500 for 2.50
□ 100-1N4148/914 SWITCHING DIODES, 50%+ yield. Untested! (#2418)	2.49	200 for 2.50
□ 30-PC TRIM POTENTIOMETERS, thumbwheel, screwdriver ass't. (#3345)	2.49	60 for 2.50
□ 15-SLIDE VOLUME CONTROLS, asst'd values, duals, singles (#3057)	2.49	30 for 2.50
□ 75-4" CABLE TIES, plastic, like "Ty-wrap" (#5218)	2.49	150 for 2.50
□ 10-CRYSTALS, may include CB, Ham & more (#3250)	2.49	20 for 2.50
□ 100-TERMINAL STRIPS, from 2 lugs up (#3136)	2.49	200 for 2.50
□ 30-NE-2NEON LAMPS, all 100% good (#2613)	2.49	60 for 2.50
□ 40-ft. SHIELDED CABLE, 1 cond, mikes, phones, (#3577)	2.49	80 ft. for 2.50
□ 3-SOUND TRIGGERS, sound triggers scr w/amp (#3625)	2.49	6 for 2.50
□ 10-CB CRYSTALS, for phase lock loop, HAM, HC/18 (#5050)	2.49	20 for 2.50
□ 50-4 LAYER SHOCKLEY DIODES. Asst. pop. voltages (#1072)	2.49	100 for 2.50
□ 75-SN7400 TTL ICs, untested 50%+ yield, pop types (#2415)	2.49	150 for 2.50
□ 100-MINI DIP ICs, linears, untested 50%+ yield, pop types (#3245)	2.49	200 for 2.50
□ 30-LM380 AUDIO IC's, 2 watts on-a-dip 50%+ yield (#5314)	2.49	60 for 2.50
□ 75-LINEARS, OP AMPS, untested 50%+ yield, amps-dips-minidips (#2416)	2.49	150 for 2.50
□ 100-TTLs & LINEAR MIXED, with 7400s, 50%+ yield (#2431)	2.49	200 for 2.50
□ 150-PREFORMED DISC CAPACITORS, mark-d values, asst'd (#2605)	2.49	300 for 2.50
□ 10-CALCULATOR KEYBOARDS, 20 keys and up. (#3524)	2.49	20 for 2.50
□ 2000-FACTORY REJECT DIODES, zeners, rect, signal, untested (#5369)	2.49	4000 for 2.50
□ 40-AXIAL ELECTROS, asst'd values & capacitance. (#3227)	2.49	80 for 2.50
□ 40-UPRIGHT ELECTROS, asst'd values & capacitance. (#3226)	2.49	80 for 2.50
□ 150-RED DISC SPECIAL, Erie, mostly marked, pop values (#5341)	2.49	300 for 2.50
□ "WATCH GUTS", LED, who knows how good (#5267)	2.49	2 for 2.50
□ 10 1000V 1 AMP RECTIFIERS, 1N4007 (#2383)	2.49	20 for 2.50
□ 150 MOLEX IC connectors, for 14, 16, 18, 40 sockets (#3324)	2.49	300 for 2.50
□ 25 POWER TAB TRANSISTORS, TO-202, 30 watts (#2425)	2.49	50 for 2.50
□ 10 PUSH MICRO TOGGLE SWITCHES, spst (#5635)	2.49	20 for 2.50
□ 10 MICRO TOGGLES, spst, dpdt, for panel, etc. (#5636)	2.49	20 for 2.50
□ 50 2 AMP METAL CASE AXIAL RECTS, up to 1KV (#4006)	2.49	100 for 2.50
□ 100-MINI BLOCK CAPACITORS, Erie, Red sq disc style. (#3528)	2.49	200 for 2.50
□ 20 PLESSEY 0.1MF 100 VDC 1" SQUARE CAPS (#5581)	2.49	40 for 2.50
□ 10 TV-FM 300 OHM TWIN LEAD SPLICERS (#5547)	2.49	20 for 2.50
□ 2.9V NICAD BATTERY CHARGER 110vac in (#4098)	2.49	2 for 2.50
□ 4 MIKE HOLDERS, for CB's and other mobile rigs (#5634)	2.49	8 for 2.50
□ 10 PLESSEY CAPS, 1MF 100V 1" sq. CERAMICS (unmarked) (#5633)	2.49	20 for 2.50
□ 100 PLESSEY CAPS, mixed values marked and unmarked (#5613)	2.49	200 for 2.50

Item	Price	1¢ Sale
□ 50 IF TRANSFORMERS, asst sizes (#35A9)	1.29	100 for 1.30
□ 30 RADIO AND TV KNOBS, asst styles, sizes (#B217)	1.29	60 for 1.30
□ 50 TUBULAR CAPACITORS, asst volts and sizes (#B219)	1.29	100 for 1.30
□ 50 LOW NOISE RESISTORS 1/4, 1/2W, HiFi, etc (#220)	1.29	100 for 1.30
□ 40 POWER RESISTORS, 3,5,7 w. axial, pop sizes (#B228)	1.29	80 for 1.30
□ $25 SURPRISE. all kinds of parts in a pak (#B294)	1.29	50 for 1.30
□ 12 PANEL SWITCHES, rotary, slide, toggle, etc (#B295)	1.29	24 for 1.30
□ 50 COILS AND CHOKES, rf, parasitic, if, etc (#B297)	1.29	100 for 1.30
□ 50 TERMINAL STRIPS, up to 4 solder lugs (#B334)	1.29	100 for 1.30
□ 50 PRECISION RESISTORS, 1/2W, 1%, axial (#B363)	1.29	100 for 1.30
□ 50 MICA CAPACITORS, asst values (#B373)	1.29	100 for 1.30
□ 10 SETS RCA PLUGS AND JACKS, phono (#B402)	1.29	20 for 1.30
□ 50 DISC CAPACITORS, asst values long leads (#B437)	1.29	100 for 1.30
□ 20 TRANSISTOR ELECTRO'S, asst up and ax (#B453)	1.29	40 for 1.30
□ 75 HALF WATTERS, resistors, color coded, asst (#B454)	1.29	150 for 1.30
□ 35 SILVER MICAS, red backs, axial, asst. (#B455)	1.29	70 for 1.30
□ 5-50 AMP RECT, asst volts up to 25, stud (#L717)	1.29	10 for 1.30
□ 100 GERMANIUM DIODES, axial leads, u test (#L642)	1.29	200 for 1.30
□ 100-STABISTORS, Regulator, sensing and computer. Axial, excellent yield (#3140)	1.29	200 for 1.30
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□ 30 MOLEX CONNECTORS, nylon, asst. sizes (#5642)	1.29	60 for 1.30
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□ 20 1N4148 SWITCHING DIODES, 4 nsec. axial (#U3000)	1.29	40 for 1.30
□ 6-10 AMP QUADRACS, w/trigger diode up 600V (#U3620)	1.29	12 for 1.30
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□ 40 SQUARE DISC STYLE CHOKES, color coded (#U3203)	1.29	80 for 1.30
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□ 1-MM5202 ERASABLE PROM, 100% (#3459)	1.29	2 for 1.30
□ 3-10 AMP 25V BRIDGE RECT, comb style (#2447)	1.29	6 for 1.30
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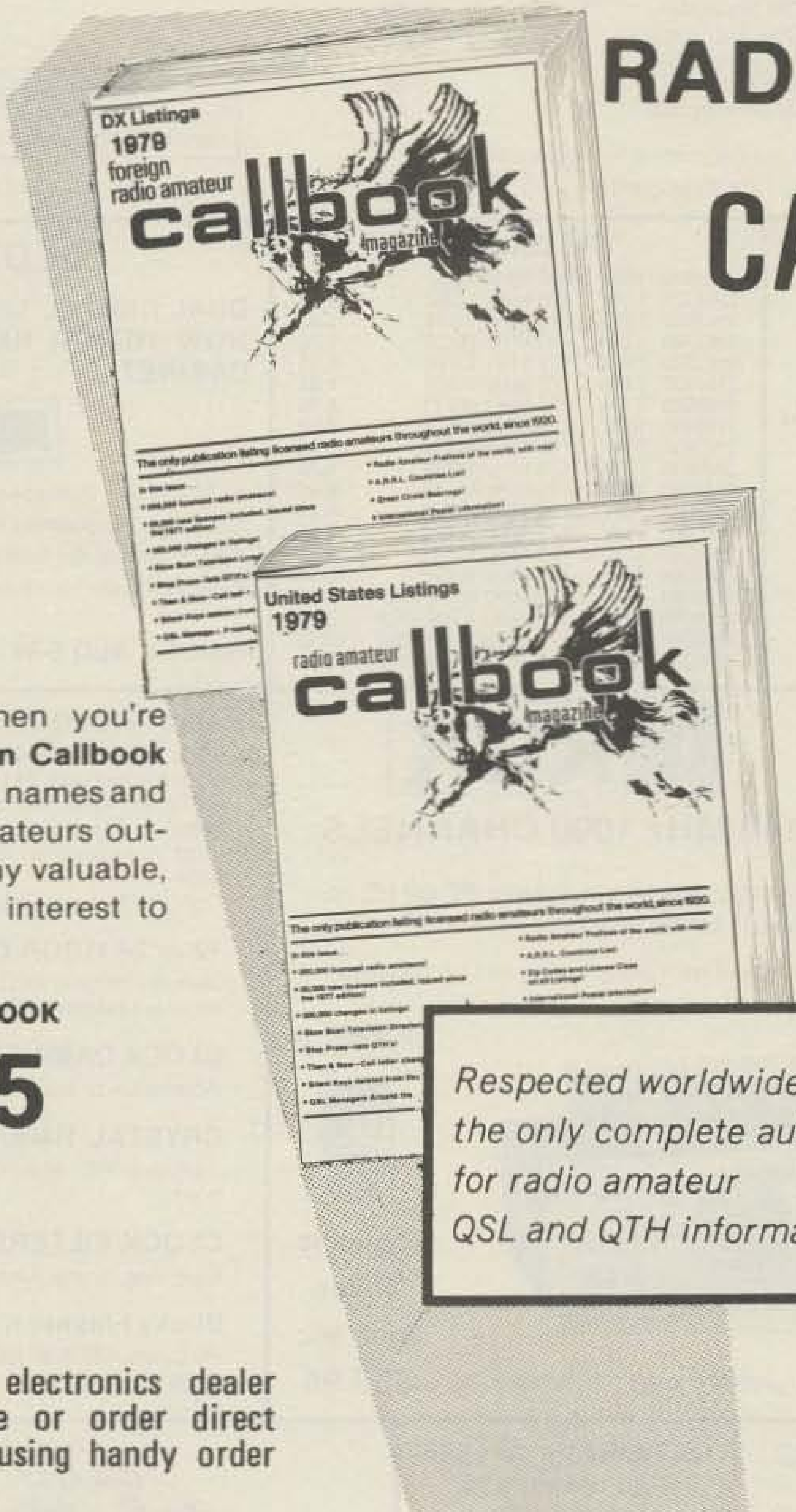

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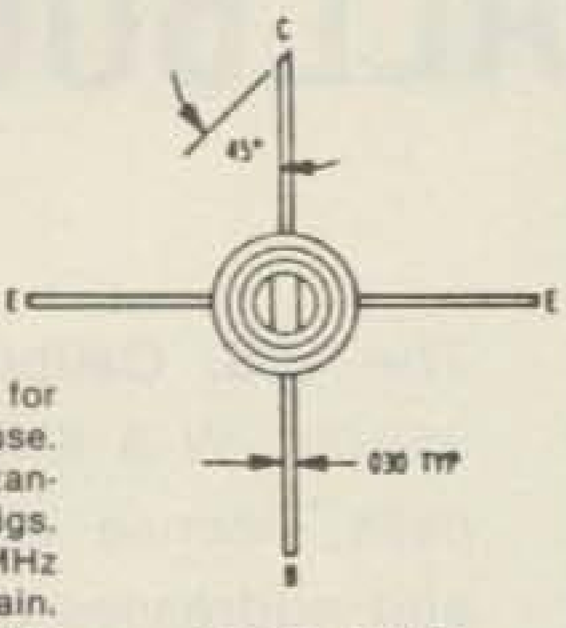

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2N5591	25W	175 MHz	MT72	10.25
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2N6081	15W	175 MHz	MT72	8.45
2N6082	25W	175 MHz	MT72	10.95
2N6083	30W	175 MHz	MT72	12.30
2N6084	40W	175 MHz	MT72	16.30
2N6094	4.0W	175 MHz	X106 PNP	6.60
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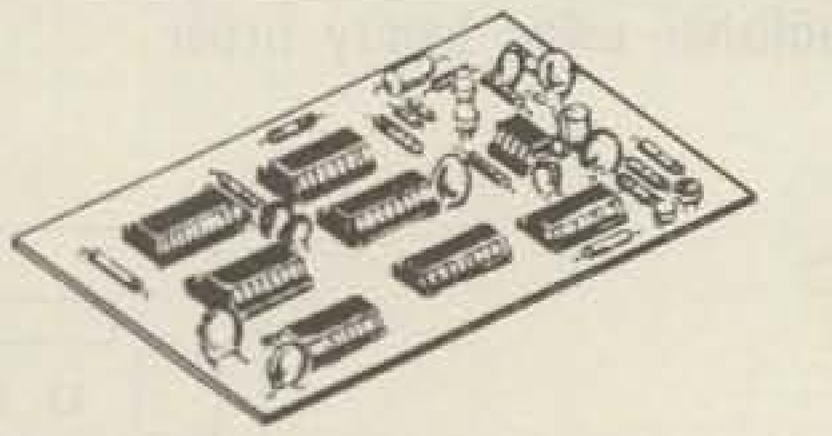

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2N3819M	N-Channel RF FET 100MHz Amp	.35
2N4020	PNP Dual Transistor 5mV Match β250	5.00
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Microcomputer Interfacing

from page 14

the computer is only dedicated to the loop for a short period. For other types of converters, the conversion time may take much longer, perhaps milliseconds or even hundreds of milliseconds for a digital multimeter. In such a case, the microcomputer would spend considerable time waiting for the ADC to "flag" the 8080, indicating that the conversion was complete.

An alternative approach is to use the DONE/BUSY flag as an interrupt input to the 8080. After initiating a conversion by outputting a START pulse, the microcomputer goes to some other software task while the conversion is proceeding. When the conversion is complete, the ADC interrupts the computer and points it to the ADC's service software, which, in this case, is located at 000 070. A software example is provided in Table 2.[2] In this example, the ADC subroutine is used only to start the conversion process. The subroutine at 000 070 is called by the interrupt with the aid of a jammed RST7 instruction byte. The ADC interrupts the 8080 only when it has finished a conversion. The software starting at 000 070 inputs the ten bits of data and stores them in a data file. Interrupts should be used with caution.

References

1. *Analog-Digital Conversion Handbook*, Analog Devices, Inc., Norwood, Massachusetts 02062. Copies may be still available for $3.95.
2. The assembly-language format shown is that of the resident editor/assembler developed by Tychon, Inc., for 8080 systems.

LETTERS

from page 8

thing couldn't be that dead after taking only ten pictures. So, anyway, I put it on a VOM and discovered that it is a little better than six volts.

I temporarily put a 12-volt light bulb on the contacts and was surprised to find that it lit up quite brightly.

The next thing I did was put a motor on it that came from an HO electric train, and it ran quite well.

It seems to me that if someone were to lower the voltage a bit and use it to power things like LEDs, it would last quite a while. I had no way of telling how long it would have lasted with this continued use. I'll try that next.

However, it says on the film pack not to take the thing apart, but to throw it away.

If one were careful, you could put it to some use, after, of course, taking ten pictures with your Polaroid.

I wish you would try one out on something and let me know how it worked or if it is a good idea.

Jerry Smith WA2QEL
Port Crane NY

THANKS, UNCLE!

My main comment is about the letter in the September issue of *73* by KA2RF. I held the callsign WA2UUV for about seventeen years. I moved to California and received orders to the *USS Midway* CV-41 homeported in Yokosuka, Japan. Meanwhile, tiring of having to sign portable after my callsign, I applied for a counterpart callsign for the sixth call area (K6UUV was open) and received KA6CGF instead. My ticket has my home QTH on it, but the envelope was addressed to my military address aboard ship. So what do I do—sign portable in Japan or in the States? Head for the CPO club and put away a few 807s or take up knitting in my spare time? Can I legally operate in JA-land or what? As you see, once again Uncle has put me between a rock and a hard place.

I enjoy your tilts with the ARRL; sometimes trying to get the point across to them is like trying to get the attention of a Missouri mule—it takes a few raps with a verbal 2x4, but eventually you get its attention.

Bill Fulling KA6CGF
FPO San Francisco CA

COLLINS

Although Collins continues to offer only their vacuum-tube line of transmitters, receivers, and transceivers on the amateur radio market, they have introduced a solid-state line for commercial use. Two of the new transceivers, the HF-281 and the HF-282, have an output of 125 Watts. For commercial use, they are channelized but can be adjusted to any frequency between 1.6 MHz and 30.0 MHz in 100-Hz increments. A "clarifier" control permits excursions 150 Hz above or below the established frequency.

With the HF-281, the user may select among six preset channels. The HF-282 offers 20 channels as well as a plug-in PROM IC to permit additional 20-channel ranges to be readily available.

Each of the two models includes a built-in ac power supply for 50- or 60-Hz 115- or 230-volt operation. In addition, either may be operated from a 12-volt dc power source. Optional features include VOX, squelch, and a noise blanker.

For operation with a variety of antennas, a companion antenna coupler, the HF-280, enables use of antennas ranging from a short whip to random-length "longwires." It is not stated whether this matching device tunes automatically or must be manually retuned for major frequency changes.

It is not known whether Collins has any plans for putting similar equipment on the amateur radio market.

Carl Drumeller W5JJ
Warr Acres OK

THE RIGHT TO RULE

I read K7UL's letter in the September issue of *73*. I am really disappointed with his and apparently your opinion about the USA and other countries in the ITU.

Indeed, the US is a first-rate power (economic, military, etc.), but this does not give it the right to rule the world.

Because you live in a democracy, you know better than I that everybody's vote is equal. Otherwise, why not give Mr. Rockefeller or Mr. Kennedy more votes than Mr. Joe Smith in a US election?

Sorry for the bad English, but I am from an underdeveloped country that does not speak your language.

Jose Ribeiro Pena Neto
PY4VTU/2
Sao Paulo, Brazil

VE3TEN

On December 29, 1978, on a frequency of 28.172, station VE3TEN did QRM this frequency from 1600 GMT to 1715 GMT. It laid down a carrier and every 15 seconds or so IDed as VE3TEN. Look this one up in the *Callbook*. It belongs to the Canadian branch of the ARRL. What gives them special license to QRM the band? I feel this was in bad taste and I would like to have *73* find out just what they had on their minds. I called the ARRL in Connecticut and got a real pleasant runaround. They sure did make an impression on future hams.

Name submitted but withheld by request

Ham Help

I would like to make some contacts on the Novice bands. I just got out of the hospital and live alone, and making Novice contacts would be a godsend to me. I am 86 years old. Thank you.

Glenn N. Crawford WB0SLV
207 5th Ave. N.
Humboldt IA 50548

I am searching for the following back issues of *73*: January '61—April '61, November '61, January '65, January '66, June '66, July '66. Any help in obtaining these would be greatly appreciated.

Dr. G. Puggioni
Via Salvo D'Acquisto No. 12/7
16035 Rapallo (Genova)
Italy

I would be very grateful if someone could send or loan me a service manual, schematic, or any other info regarding signal generator PP-1322/URM-25 F.

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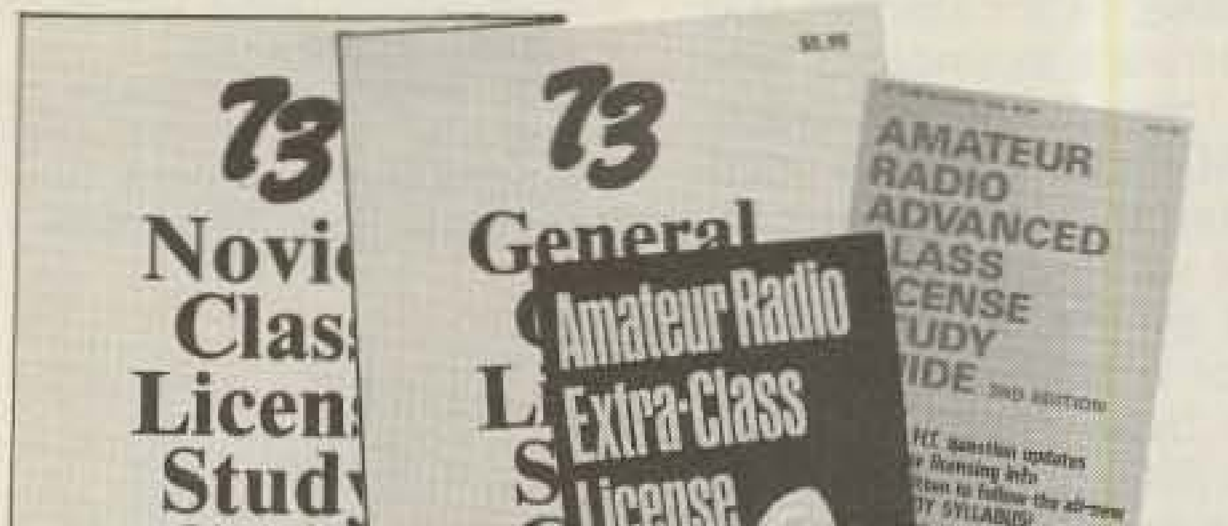

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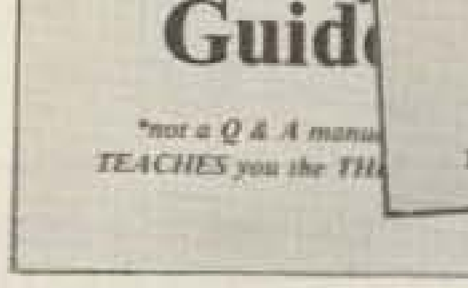

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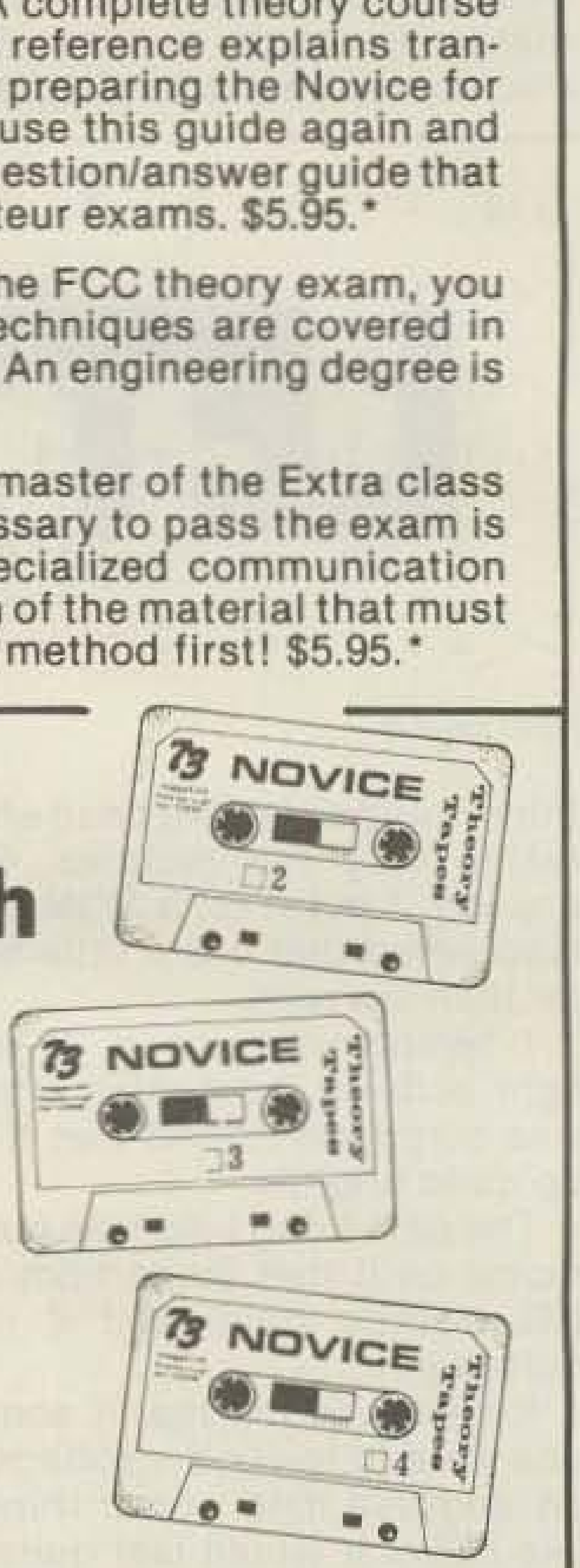

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5 WPM—CT7305—This is the beginning tape for people who do not know the code at all. It takes them through the 26 letters, 10 numbers and necessary punctuation, complete with practice every step of the way using the newest blitz teaching techniques. It is almost miraculous! In one hour many people—including kids of ten—are able to master the code. The ease of learning gives confidence to beginners who might otherwise drop out.

"THE STICKLER"

6+ WPM—CT7306—This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly—under pressure—faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five.

"THE CANADIAN"

10+ WPM—CT7310—73 hasn't forgotten the Canadian hams—our 10 WPM tape prepares you to breeze through your country's licensing exams. Like the other code groups, the tape is not memorizable and, once mastered, provides a margin of safety in the actual text situation.

"BACK BREAKER"

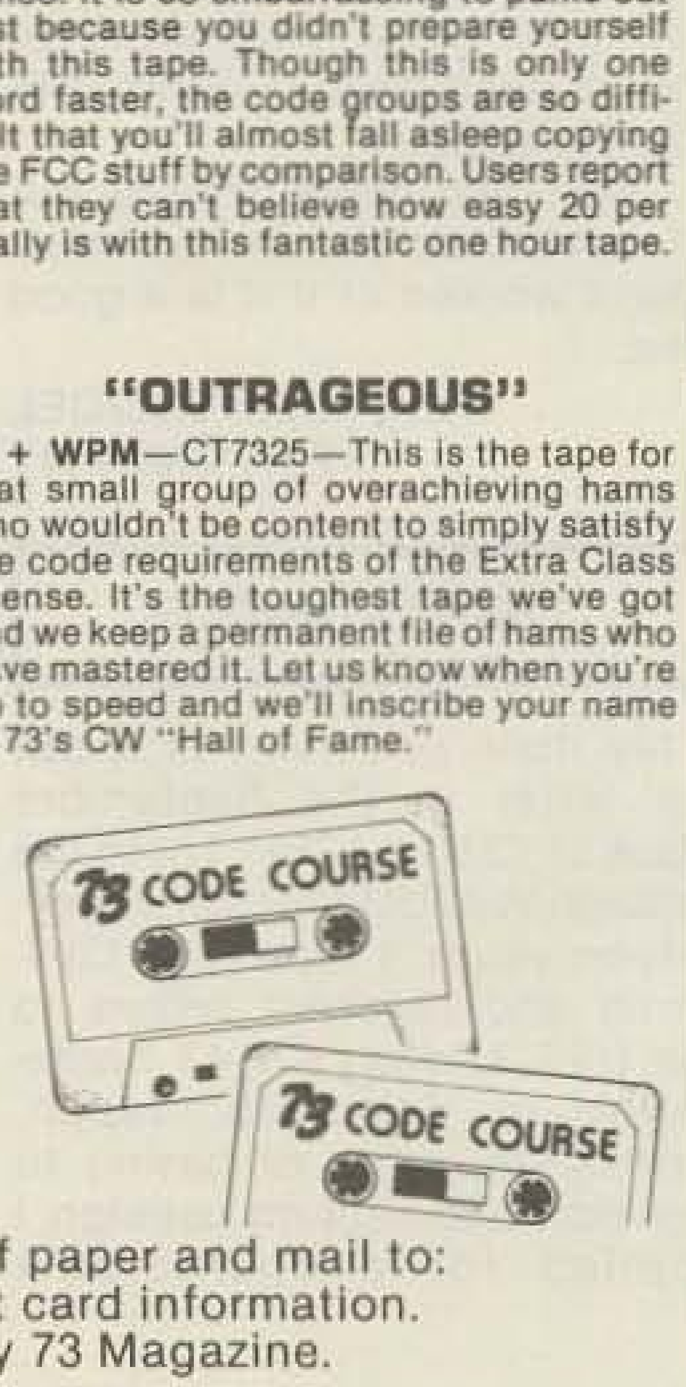
13+ WPM—CT7313—Code groups again, at a brisk 13 per so you will be at ease when you sit down in front of the steely-eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test, you'll thank heavens you had this back-breaking tape.

"COURAGEOUS"

20+ WPM—CT7320—Code is what gets you when you go for the Extra class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape.

"OUTRAGEOUS"

25+ WPM—CT7325—This is the tape for that small group of overachieving hams who wouldn't be content to simply satisfy the code requirements of the Extra Class license. It's the toughest tape we've got and we keep a permanent file of hams who have mastered it. Let us know when you're up to speed and we'll inscribe your name in 73's CW "Hall of Fame."



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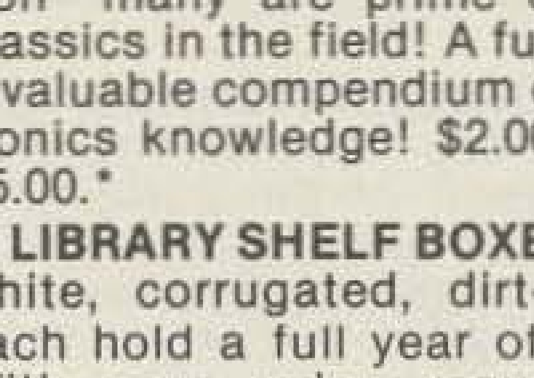
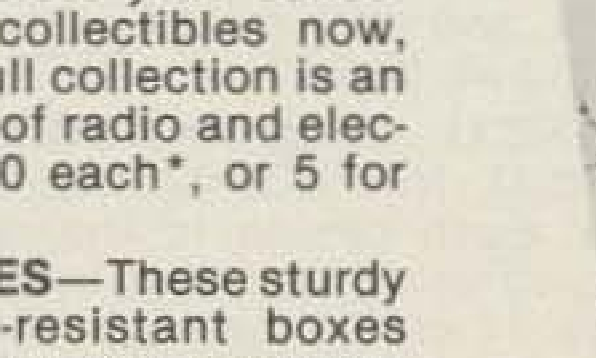


Style X



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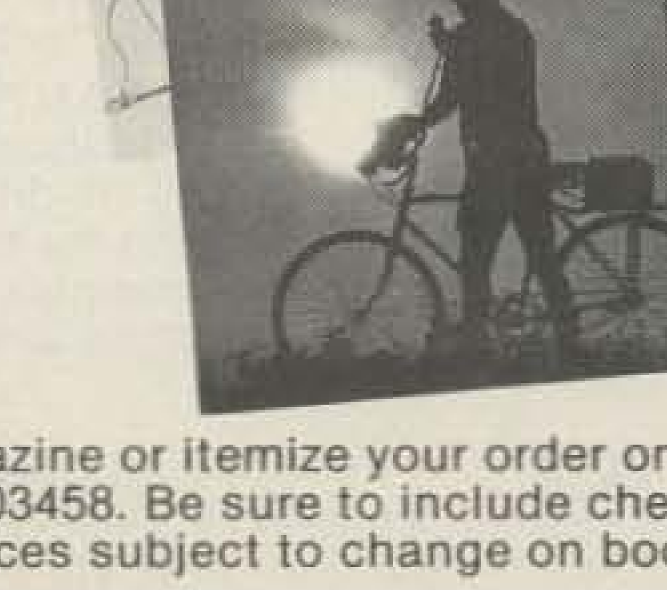

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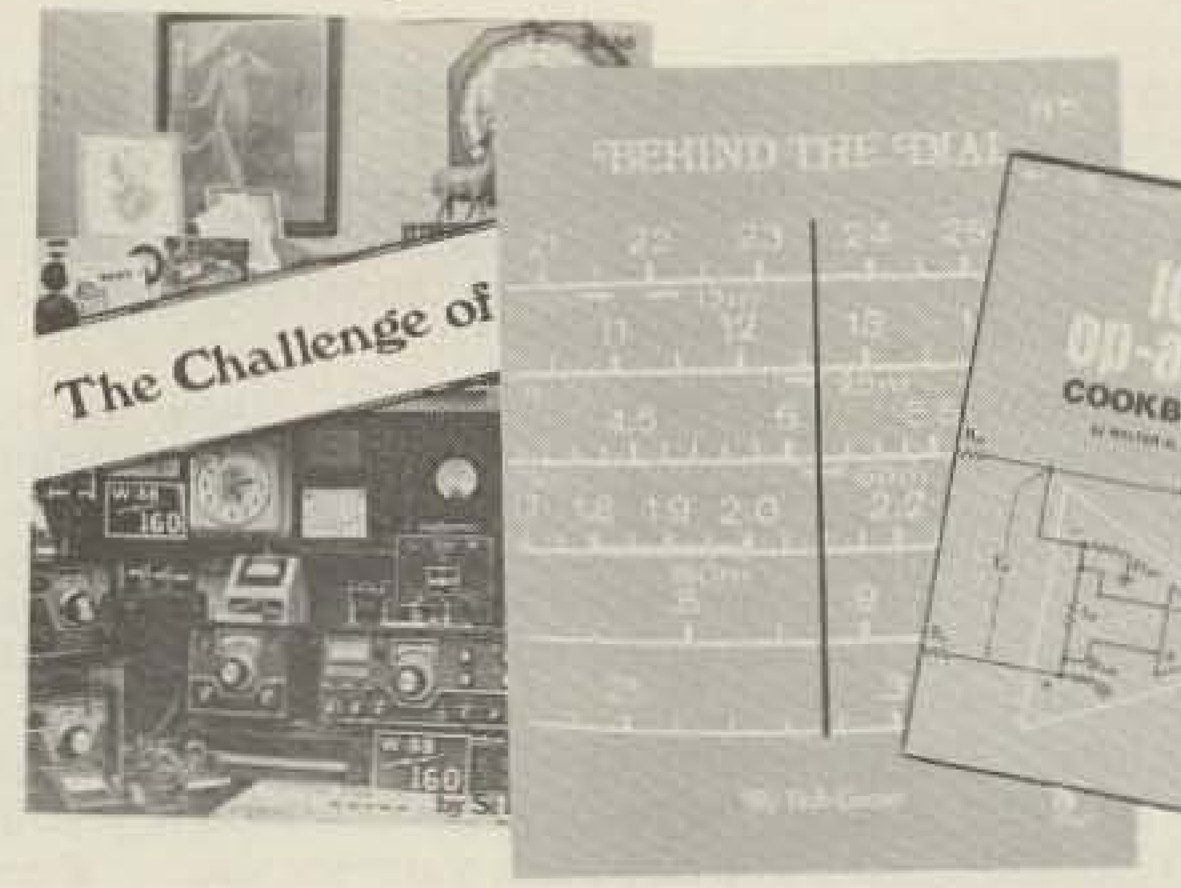

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propagation

by
J. H. Nelson

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	14	14	21	14A
ARGENTINA	21	14	14	7A	7	7	14	21A	21A	21A	21A	21
AUSTRALIA	21	14	7A	7B	7B	7B	7B	14	14	14	21A	21A
CANAL ZONE	14	14	7	7	7	7	14	21	21A	21A	21A	21
ENGLAND	7A	7	7	7	7	7B	14	21A	21A	21A	21	14
HAWAII	21	14	14B	7	7	7	7	7B	14	21	21A	21A
INDIA	7	7	7B	7B	7B	7B	14	21	14	14	14	14B
JAPAN	14A	14	7B	7B	7B	7	7	7	7B	14B	14	21
MEXICO	21	14	7	7	7	7	7A	14	21	21A	21A	21
PHILIPPINES	14A	14	7B	7B	7B	7B	7B	14B	14	14	14B	14
PUERTO RICO	14	7A	7	7	7	7	14	21	21	21A	21A	21
SOUTH AFRICA	14	14	7	7B	7B	14	21	21A	21A	21A	21	21
U. S. S. R.	7	7	7	7	7	7B	14	14A	21A	14	14B	7B
WEST COAST	21	14	7A	7	7	7	7	14	21	21A	21A	21A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	14	7	7	7	7	7	14	14	21	21
ARGENTINA	21	14	14	7A	7	7	14	21A	21A	21A	21A	21
AUSTRALIA	21A	21	14	7A	7B	7B	7B	14	14	14	21A	21A
CANAL ZONE	21	14	14	7A	7	7	14	21	21A	21A	21A	21A
ENGLAND	7A	7	7	7	7	7	7B	14	21	21A	14	14
HAWAII	21A	21	14	7	7	7	7	7B	14	21	21A	21A
INDIA	14	14	7B	7B	7B	7B	7B	14B	14	14	14	14B
JAPAN	21	14A	14	7B	7B	7	7	7	7	14B	14	21
MEXICO	21	14	7	7	7	7	7	14	21	21	21A	21
PHILIPPINES	21	14	14	7B	7B	7B	7B	7	14	14	14B	14A
PUERTO RICO	21	14	7A	7	7	7	14	21	21	21A	21A	21
SOUTH AFRICA	14	14	7	7B	7B	7B	14	21	21A	21A	21A	21
U. S. S. R.	7	7	7	7	7	7B	7B	14	21	14	14B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	21	14	7	7	7	7	7	7A	14	21	21
ARGENTINA	21	21	14	7A	7	7	7B	14	21A	21A	21A	21A
AUSTRALIA	21A	21A	21	14	14	7	7	7B	14	14	21	21A
CANAL ZONE	21A	21	14	14	7	7	7	14	21	21A	21A	21A
ENGLAND	7B	7	7	7	7	7	7B	14B	21	21A	14	14
HAWAII	21A	21A	21	14	14	7	7	7	14	21	21A	21A
INDIA	14	14A	14	7B	7B	7B	7B	7B	14	14	14	14B
JAPAN	21A	21A	21	14B	7B	7	7	7	7	14B	14	21
MEXICO	21	21	14	7	7	7	7	14	21	21	21A	21A
PHILIPPINES	21A	21A	21	14	7B	7B	7B	7	14	14	14B	14A
PUERTO RICO	21A	14	14	7	7	7	7	14	21	21	21A	21A
SOUTH AFRICA	14	14	7	7B	7B	7B	7B	14	21	21A	21A	21
U. S. S. R.	7B	7B	7	7	7	7B	7B	7B	14	14	14B	7B
EAST COAST	21	14	7A	7	7	7	7	14	21	21A	21A	21A

A = Next higher frequency may also be useful
B = Difficult circuit this period
F = Fair
G = Good
P = Poor
SF = Chance of solar flares

march

sun	mon	tue	wed	thu	fri	sat
				1 P/SF	2 F/SF	3 F
4 F	5 G	6 G	7 G	8 G/SF	9 P	10 P
11 G	12 G	13 F/SF	14 F	15 F	16 G	17 G
18 G	19 G/SF	20 F/SF	21 F	22 F	23 G	24 G
25 G	26 G	27 G	28 G	29 G	30 G	31 G

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