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- microprocessor repeater controller
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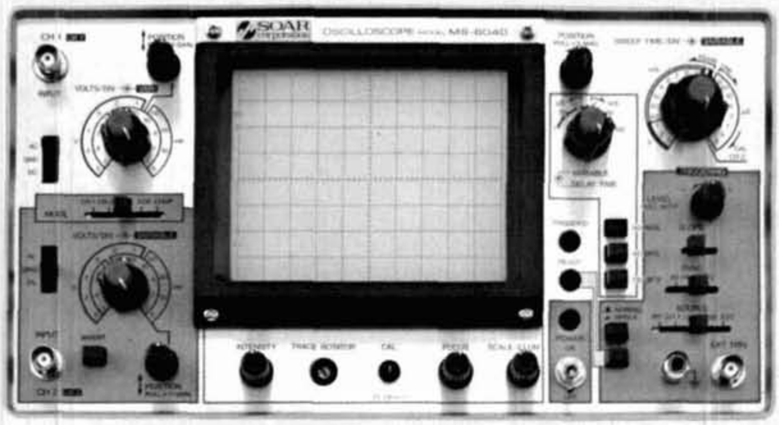

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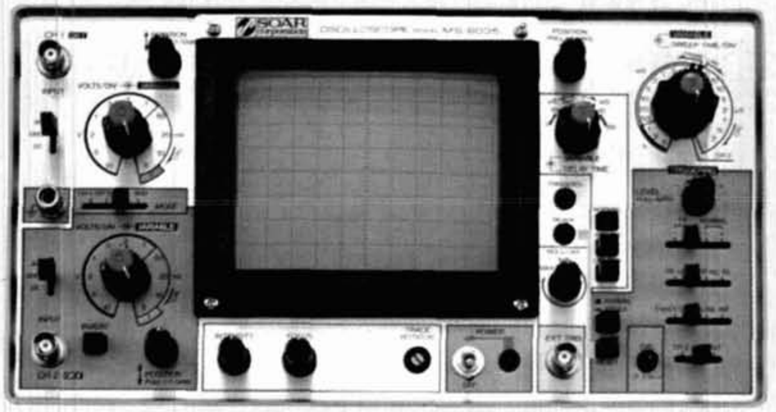

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- 21 new multi-function memory channels. Stores frequency, repeater offset, and optional sub-tone channels. Memory pairs for non-standard splits. "A" and "B" set band scan limits. Lighted memory selector knob. Audible "beep" indicates channel 1 position.
- Lithium battery memory back-up. (Est. 5 yr. life.)
- 45 watts or 25 watts output. HI/LOW power switch for reduction to 5 watts.
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- Scan resume selectable. Selectable automatic time resume-scan, or carrier operated resume-scan.
- Scan start/stop from up/down microphone.
- Programmable three sub-tone channels with optional TU-79 unit (encoder).
- Built-in 16-key autopatch enco[der] with monitor (Audible tones).
- Front panel keyboard control.
- Covers 142.000-148.995 MHz i[n] 5-kHz steps.
- Repeater reverse switch. (Locking)
- "Beeper" amplified through speaker.
- Compact lightweight design.

Optional accessories:

- TU-79 three frequency tone u[nit]
- KPS-12 fixed-station power supply for TR-7950.
- KPS-7A fixed-station power supply for TR-7930.
- SP-40 compact mobile speake[r]

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APRIL 1983

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contents

REFLECTIONS

On January 20, 1983, the FCC proposed the most important Amateur rules change in many years — the proposal to delegate the responsibility for Amateur license examinations to the Amateur community. Unfortunately, the emotion-laden issue of a no-code license has all but obscured this other crucial Notice of Proposed Rule Making.

In consideration of the ARRL's Petition for Rule Making on exam administration, the FCC has proposed a three-man team headed by an Extra Class licensee to administer individual exams. Examiners would have to be certified by one of several recognized supervisory organizations called Volunteer Examiner Coordinators. They would have to be over 18 years old and could not work for a manufacturer or distributor of Amateur equipment or a publisher of training materials. Questions would be chosen from a list made up by the Commission from submissions by individual Amateurs and groups of Amateurs.

There are a lot of hard questions that must be asked about this proposed system. Three-man examining teams (for all licenses except Novice) are fine for major urban areas like Los Angeles, Chicago, or Washington, D.C., but what happens to the would-be upgrader in remote parts of the country? Should there be a mechanism provided to deal with such cases, for example an examining team led by an Amateur but including non-Amateur examiners, such as elected public officials, when three licensed Amateurs aren't available? Should a formal procedure for giving exams at hamfests or in classrooms be included in the new rules?

What should the qualifications for a Volunteer-Examiner-Coordinator (VEC) be? There has been definite interest in this program shown by some non-Amateur groups. How should the long-term integrity of the VECs be ensured?

It seems that the FCC would prefer to have more than one VEC overseeing the exam-administration effort. How could anyone be sure that the different organizations all hew to the same standards? How would the overseeing groups finance their administration costs? The ARRL is already well aware of what this program is going to cost it, and it questions whether it's fair to the League's members to have them pick up the bill. Should there be a fee charged for giving Amateur exams? Who should set the fee, and to whom — the examiners, their overseeing group, or both — should it go?

Should the FCC include the Novice exam in this new overall program, instead of establishing the less demanding Novice exam program they proposed in an NPRM late last year? The ARRL wants Novices included, yet the Commission has indicated its approach would be simpler, faster, and cheaper. The Commission received very few comments on its Novice exam NPRM; does that mean Amateurs want the Novice exam a part of the larger program, or was the FCC's proposed Novice exam program simply overlooked in the concern generated by the no-code license proposal?

There are other considerations as well. It takes time to establish workable procedures (look how long the FCC had). Might not inordinate delays occur at every step of the process, resulting in longer delays in getting licensed? Right now it's a hot topic, but what about one or two years downstream? Might not interest wane among the exam administrators — with newcomers to the hobby being the losers? Most of all, we should be concerned about the possibility that the ham ticket might be devaluated by an unequitable, non-uniform examination procedure. How simple it seems now, to go down to the nearest FCC office and take the exam. Might not a small licensing fee underwrite the cost of FCC-administered exams?

Write the FCC with your opinions. Comments on the exam administration proposal, FCC PR Docket 83-27, are due at the Commission by April 8th. Address them to the Secretary, Federal Communications Commission, Washington, D.C. 20554. You'll need to send an original neatly typed with wide margins, plus five copies (eleven is better, since each Commissioner will receive one). Your name and the Docket number should appear on each page.

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ham radio

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comments

filters for Amateur use

Dear HR:

In his letter to the *ham radio* editor (February, 1983, page 8), Ed Marriner, W6XM, mentioned a problem the Radio Amateur too frequently ignores — the need to comply with the FCC requirement that transmitter harmonics be down by 40 dB or more from the fundamental. Ed further explained that to accomplish this on all bands a lowpass filter for each band is necessary. The customarily used 30-MHz lowpass filter, widely advertised by J.W. Miller, Drake, and B&W, is effective, he said only for the Amateur 10-meter band.

A "best solution" offered by Ed was for the Amateur to install lowpass filters designed to cut off just above the upper end of the band being used; however, the recommended designs were from the June, 1957, issue of *GE Ham News* — designs that are more than twenty-five years old!

During the past twenty-five years, the Radio Amateur has witnessed many changes, the most obvious being the transition from vacuum tube to solid state, and more recently the introduction of the personal computer to ham operation. Less obvious was the transition from filter design using the image-parameter-design procedure invented by Otto Zobel to the modern filter (network-synthesis) design procedure. The modern design filter has a simpler configuration and a more precise performance than the older image-parameter type. Modern lowpass designs (Chebyshev and elliptic) have been developed in which standard-value capacitors are used, thus making them simple for the Amateur to build. These designs have been widely published in the Amateur Radio handbooks, in trade handbooks, and in the Amateur and trade periodicals. I think Ed will agree that these designs are a better solution to the Amateur lowpass filtering requirements than are the old designs.

Ed also mentioned the problem of obtaining suitable high-voltage, low-loss capacitors for use in constructing lowpass filters for Amateur high-power applications. I, too, have experienced this problem, and I have continually been searching for a better high-voltage capacitor than the Centralab ceramic TVL type that Ed mentioned. I think I have finally found a suitable alternative to the TVL capacitor, but the manufacturer of the high-voltage capacitor, KD Components Inc. (3016 S. Orange Ave., Santa Ana, California 92707), sells only in quantities greater than ten and has a minimum billing of $50. Also, the maximum capacitance available in the 2-3 kV range is 100 pF, so several capacitors will have to be paralleled to get the larger capacities required by the filters for the lower Amateur bands. The approximate cost of the 2-kV, 100-pF, 10 percent capacitor in quantities of 10-99 is $4. In quantities above 500, the price drops to $1.44! Consequently, this capacitor type, although excellent for the application, appears to be financially practical only for a high-volume manufacturer of lowpass filters.

A filter designed from the data in reference 4 (*QST*, December, 1979) was constructed and operated at a 1-kW power level without a failure, but this is feasible only when the VSWR can be carefully controlled, otherwise the voltage rating of the capacitors may be exceeded and the filter damaged if the VSWR becomes excessive. For power levels below 500 watts, the polystyrene and mica capacitors seem suitable. So, contrary to Ed's concluding statement, there does seem to be hope, and I suggest that those not having a filter for each band should review the references included with this letter, and then construct any filters that may be required.

references

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Ed Wetherhold, W3NQN
Annapolis, Maryland

MFJ CW/SSB/Notch Filters

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More Details? CHECK—OFF Page 129

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LEGAL PROBLEMS WITH BOTH ANTENNAS AND RFI are continuing for a number of Amateurs in various communities, and should be of concern to Amateurs throughout the country. Cerritos, California, long a leader in antenna height restrictions, has resisted a suit brought by several Amateurs attempting to overturn a moratorium on new antennas. That city is in the process of drafting a new, more restrictive ordinance, but the judge ruled the suit was "premature," since the terms of the new ordinance haven't yet been decided. An appeal is being considered, and the ARRL Executive Committee has voted in favor of entertaining a request for the League to match local financial support. Other tower cases in Oklahoma City (N5SW), Farmington, Michigan (WD8BCM), and Burbank, Illinois, are still pending, but NØBCX's challenge of a Brighton, Minnesota, ordinance has been upheld and his 65-footer is still up.

WB2BZK's Appeal To The New Jersey Supreme Court of Winslow township's prohibition of RFI has been turned down. Efforts are continuing to get the township to review and perhaps rescind its ordinance, in view of the federal assumption of such regulation contained in Public Law 97-259 (the "Goldwater Bill").

TWO VITALLY IMPORTANT AMATEUR RULES CHANGES PROPOSED BY THE FCC are up for comments during April. The proposal to establish a volunteer examining procedure for all Amateur licenses, PR Docket 83-27, has a comment closing date of April 8, which leaves little time to consider its implications (see this month's Reflections, page 6). The no-code license proposal, PR Docket 83-28, is open for comments until April 29.

The ARRL's Adamant Position Against No-Code May Be Softening, according to some indications. It appears that the League membership may not be as solidly against a no-code license as was previously reported. With the strong pro no-code position apparent among the Commissioners, the ARRL now feels it may be prudent to support a form of no-code that the Amateur community can live with, rather than oppose it outright and have no say in its final form. The League Executive Committee has agreed informally to prepare a position paper outlining various no-code alternatives for the directors before their April board meeting, at which time the final League position will be determined and comments prepared.

Amateur Exam Administration At This Year's Dayton Hamvention had been sought by the Hamvention Committee, and initial FCC reaction had been positive. However, it now appears that, though exams will be given at the Hamvention, they will be administered under the supervision of the FCC. Barring unforeseen problems, the earliest a complete volunteer program could be put together and set in motion would be late next fall, leaving too many variables to be settled in time for even a dry run at this year's Hamvention.

RICH ROSEN, K2RR, HAS BEEN APPOINTED EDITOR-IN-CHIEF OF HAM RADIO effective February 5. Rich joined Ham Radio last fall, as Senior Technical Editor.

ARRL's New Technical Department Manager Is Paul Rinaldo, W4RI, who's replacing Doug DeMaw, W1FB, upon Doug's retirement in May. Paul currently edits QEX, the ARRL experimenters' newsletter, and is the president of AMRAD.

TEN SCHOLARSHIPS FOR GENERAL CLASS (OR HIGHER) AMATEURS planning to attend (or already attending) college or technical school are available through the Foundation for Amateur Radio. Full details and an application form can be obtained from Hugh Turnbull, W3ABC, 6903 Rhode Island Ave., College Park, MD 20740. May 31 is closing date for requests.

THE PHONE BAND EXPANSION IS STILL IN PROCESS within the Commission, with expectations that it will be finished and released by late spring. Just which bands will (and which won't) be changed isn't yet clear, though it seems very likely that 20 and 10 will both see some expansion of their phone subbands.

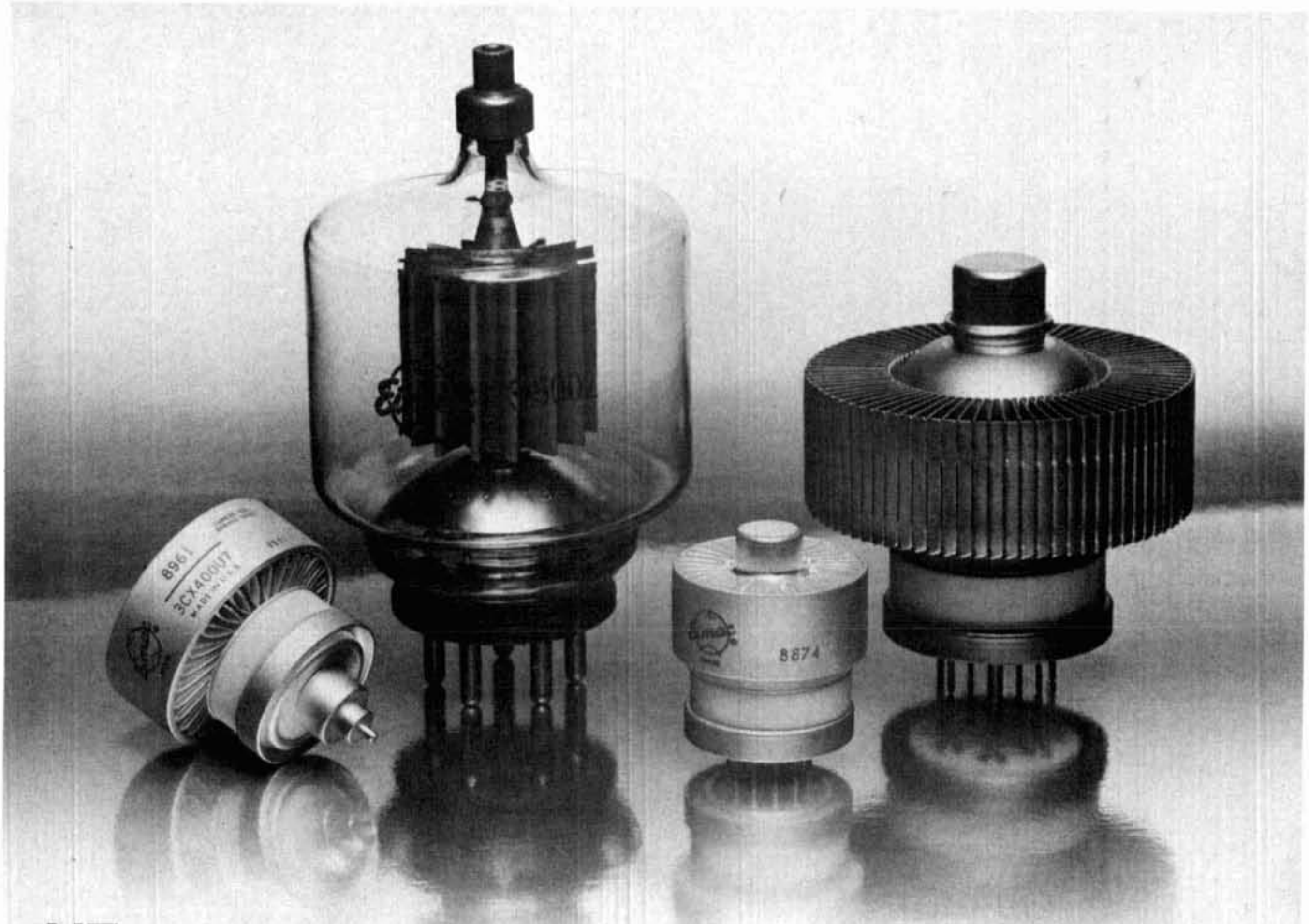
Deregulation Of The CB Service Is Also In The Mill, with the new rules (or non-rules) to be announced at about the same time as Amateur phone band expansion.

Extension Of Amateur License Terms To 10 Years from the present five is likely to surface soon. Though the FCC now has the authority to make the change, it will probably be introduced through a Notice of Proposed Rule Making to assess Amateur reaction.

PROFANE AND INDECENT LANGUAGE IS NO LONGER GROUNDS FOR REVOKING an Amateur's license, according to the FCC's Review Board. The license of N6BHU had been revoked last fall by an FCC Administrative Law Judge for such violations, but on January 26 that decision was overturned and his license reinstated. With a suburban Washington, D.C., broadcast station now airing uncensored "party" records, it appears the Commission concern with the content of transmissions may be a thing of the past. However, the ARRL is seeking a review of the subject with the FCC staff in hopes of restoring some standards for Amateurs.

THE SOLAR FLUX SLUMPED TO ITS LOWEST LEVEL SINCE JANUARY, 1978, at mid February, to give a hint of things to come as this sunspot cycle deepens. Solar activity remained low through CW DX Contest weekend, with 10 meters of little value and 15 spotty.

Deteriorating HF Band Conditions Highlight The Value of Beacons, particularly the new 14.100 MHz worldwide system sponsored by the Northern California DX Foundation. In addition, the many beacons in the 28.2-28.3 MHz portion of 10 meters and those operating between 50.0 and 50.1 MHz on 6 will continue to signal openings to users of those bands. See Technical Forum, page 46, for information on a beacon on 28.208 MHz.



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✓ 184

inexpensive video monitor

Bypassing rf and i-f sections to resurrect old TVs for modern use

The current interest in home computers, slow-scan and fast-scan TV, RTTY, and automatic CW keyboards — not to mention home video movies and games — creates a need for an inexpensive display device for the ham shack. Many commercial video products are designed to work with a standard TV, typically using channels 2, 3, or 4 with a video modulator. There are some drawbacks to this procedure, though; for one thing, the family TV is not likely to be located in the ham shack. And, more importantly, the performance of a TV set is less than optimum if high resolution is needed.

I first considered the problems of TV sets when I acquired a TRS-80 Model I microcomputer a few years ago. I figured I could save some money by converting an old black and white TV set for use as a monitor. Typical computer-grade monitors sell for $100 or more, but a flea-market TV can be found for next to nothing. And TV sets have a 15 to 20 inch screen, unlike the typical 12-inch monitor. Sounds like a bargain, but there's a hitch.

The problem is bandwidth, (or resolution, depending on your point of view). Commercial CRTs use an 80-character display, and many home computers settle for 48, 32, or even 24 characters per line. The resolution of TV is typically much less. The TRS-80 uses a sixty-four character display, which is why Radio Shack sells a dedicated monitor. Those sixty-four characters occupy roughly 80 percent of the horizontal scan line. Each character is five dots (pixels) wide, and there is a one-pixel space between letters. So, we have *6 × 64 = 384 pixels per line*. In a conventional (U.S.) TV scanning system, one line is scanned in 63.5 microseconds. Only 80 percent of this time is available for the letters, so the pixels are scanned at a rate of *(384 pixels/line)/(0.8 × 63.5 microseconds) = 7.6 million pixels/second*, or 130 nanoseconds/pixel! The situation is even worse for an eighty-character line. (The longer lines are desirable for RTTY — where seventy-two character machines are common — and word-processing.) Furthermore, in order that the pixels reach full brightness when on, and return to the black video baseline when off, the rise and fall times must be much less than the 130-nanosecond duration of a pixel. Otherwise they will run together in the bars on the letters T, E, B, and so on, and fade out in the vertical part of letters I, L, etc., as noted by W9CGI.[1] We require a bandwidth at least twice the pixel rate, or 15 to 20 MHz!

Broadcast TV uses a 6-MHz channel width. The i-f strip is designed to have sharp cutoff, to minimize adjacent channel interference. The video carrier is already 1.25 MHz above the lower band edge in the

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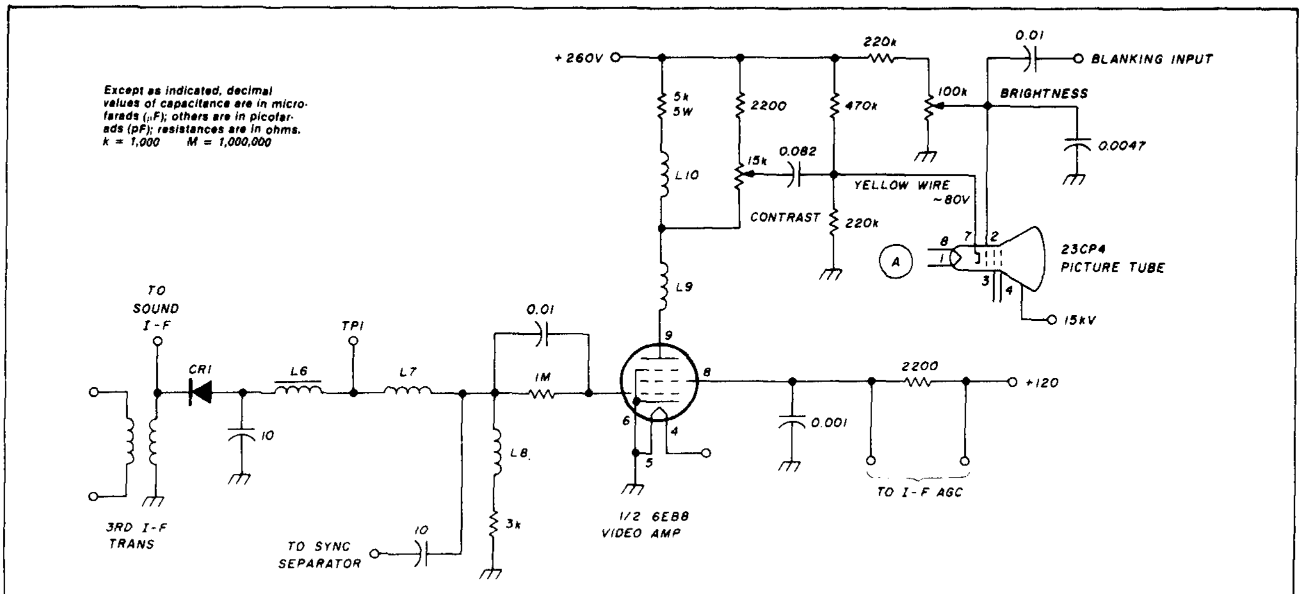

fig. 1. Partial schematic of black and white TV set showing video amplifier and picture tube connections. CR1 is a 1N60, 1N395, etc. L7-L10 are video peaking coils. Points TP1 and A are referred to elsewhere.

vestigial sideband system. The maximum available video bandwidth is a bit more than 4 MHz, if we use the video-modulated rf carrier approach. It should have been no surprise to me when my TRS-80 display was illegible unless I used the expanded (thirty-two character per line) display. The problem was compounded by snow (low signal to noise ratio) from the aging rf section.

How to remedy this? Several approaches are possible:

1. Slow down the scan rate. This method has two drawbacks in that it causes annoying flicker in the display, and requires major modifications to the TV and the video display-generating circuitry.

2. Pre-process the video signal, emphasizing high frequencies. This approach was used by W9CGI. But you can compensate for only so much high frequency roll-off. The match between compensation and i-f roll-off must be exact.

3. Bypass the problem by skipping the rf and i-f sections of the TV set. This is my approach; it is the simplest, the most effective, and potentially the cheapest, since you can use a TV with a defunct tuner.

Let's consider the modification of a typical tube-type TV set for use as a wideband video display. **Fig 1** shows the pertinent parts of the video amplifier stage. (The circuit is from my Setchell-Carlson set[3]). Note that the cathode of the picture tube is driven. **Fig. 2** shows the typical video signal level available from the computer, demodulator, or other source. Our problem is to match the two devices.

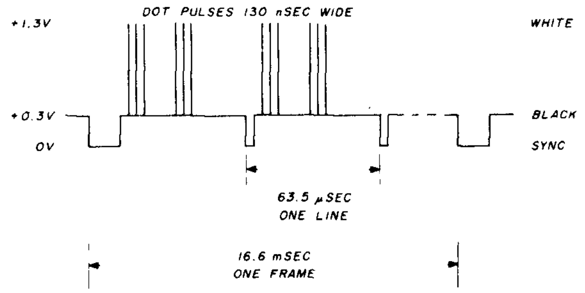

fig. 2. Typical video text display format. The actual picture is about 1.0 volt peak-to-peak with sync pulses 0.2 to 0.3 volt below black. The whole signal is usually positive, as shown. (Levels measured across 75 ohms.)

simplest approach

The first method uses the existing video amplifier and bypasses the rf and i-f stages. In my set, the detector output (TP-1) was brought out to a test point on top of the chassis. I determined that, since the typical detector level is a couple of volts peak-to-peak, the new video source could just be hooked in parallel here.

Fig. 3 shows the circuit. The signal comes from the computer, VCR, or other source, via the coax. Some 50 or 75-ohm cable is all right as long as it's not more than a few feet long. I used RG-174, which is a nice size — not too stiff. A blocking capacitor is needed since the 2200-ohm grid leak would otherwise be shorted by the 75-ohm video source. This capacitor must pass frequencies as low as the vertical sync pulses at 60 Hz. For 50- or 75-ohm systems this means $Xc = 50\ ohms$ (maximum), so $C = 1/(2 \times pi \times 60 \times 50) = 53\ microfarads$ (minimum). Note the polarity of the capacitor: the grid is negative. *Be cautioned: This circuit will not work on a transformerless TV with a hot chassis unless an ac isolation transformer is installed,* because there is no place to safely install the shield side of the video cable!

I installed this circuit (cost was less than $3.00 for cable, connectors, and capacitor) in my TV set, and was using my new computer in a day or so. I used it that way for about a year before I had time to try to improve the performance. There was still considerable blurring of pixels, the brightness and contrast needed continuous adjustment as the set warmed up, and the contrast was a bit low.

second approach

A note in *Byte* magazine suggested the solution.[2] A new video amplifier improves the high-frequency response, and provides the needed gain to get the desired contrast. Unfortunately, the circuit in the magazine had some drawbacks, and I finally came up with my own. The circuit in **fig. 4** has the following properties: no separate power supply needed; adequate gain; sufficient bandwidth to give well-formed characters at 80 per line; linear enough to use for a video-tape or ATV monitor; uses the existing brightness control circuit; no exotic devices required. (Any modern PNP and NPN transistor should work fine.)

circuit description

The video cable is terminated in a resistive pad,

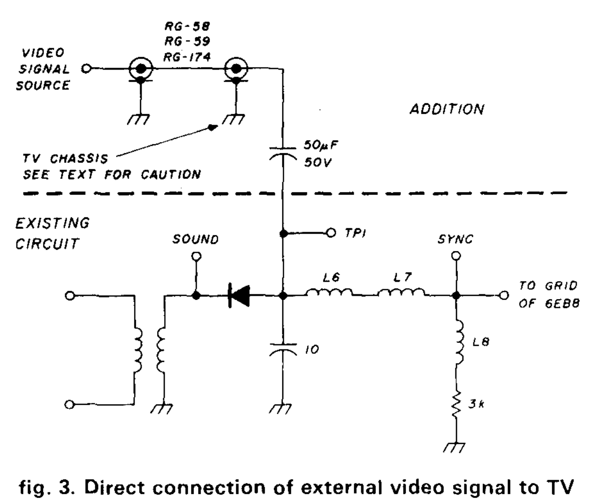

fig. 3. Direct connection of external video signal to TV set in fig. 1.

R1-R3, which also serves as part of the bias circuit for Q1. C1 passes the signal to the video amplifier (for the benefit of the sync circuitry only). Q1 operates as a linear common-emitter amplifier. The gain is about 5 at low frequencies. The emitter bypass (C2) boosts the gain above 5 MHz and compensates for the transistor's reduced beta. It is important to operate all the transistors in the linear region. Saturation of any transistor (clipping) will load the base with charge, requiring time to discharge, resulting in slow switching or reduced bandwidth.

Q2 acts as an inverter and level shifter. The gain is about 0.7. The level shifting is necessary since dc coupling is used to get wide bandwidth, and the gain need not be high since we have one more stage to go. Q3 is another common-emitter amplifier, with a gain of 3 at the collector. The signal has now been inverted three times, so it is inverted overall. The white peaks of the video input are negative peaks at the output (cathode) which drive off many more electrons and make a white spot on the screen.

The cathode of the picture tube is a low current point, so we can use a relatively small capacitor to couple the signal to it (C3). We also need dc here, but the value (+80 volts) is a bit high for the transistors, so I derived it from the existing bias circuit via a filter (R11-12 and C4). The filter removes the video information from the old amplifier, but passes the dc cathode current.

The overall gain is about −15, so a 1-volt peak-to-peak input yields about 15-volts peak-to-peak output. This means the power supply must provide considerably more than 20 volts. By trial and error, dropping resistors (R13-14) were found which gave an acceptable picture without overheating the transistors. (It is difficult to calculate the value, since the current drain of the amplifier varies with Vcc and the nature of the video signal.) C5 filters the resulting 40 volts or so and keeps it relatively constant during each frame. This unregulated supply is the least satisfactory aspect of the circuit, but the heat from the dropping resistors is hardly noticed in a tube-type set.

construction

This amplifier can be built in a breadboard format, since parts placement is not critical. I used a simple printed circuit board (cover the foil with masking tape and remove some with a knife, leaving large islands where the components are to be attached). The board was installed in the back of the set below the base of the picture tube. I just cut the yellow cathode lead in the middle (point A in **fig. 1**) and attached the two ends to the board. This is probably the only semi-critical item — it wouldn't do to go to all that trouble to get a sharp video signal and then

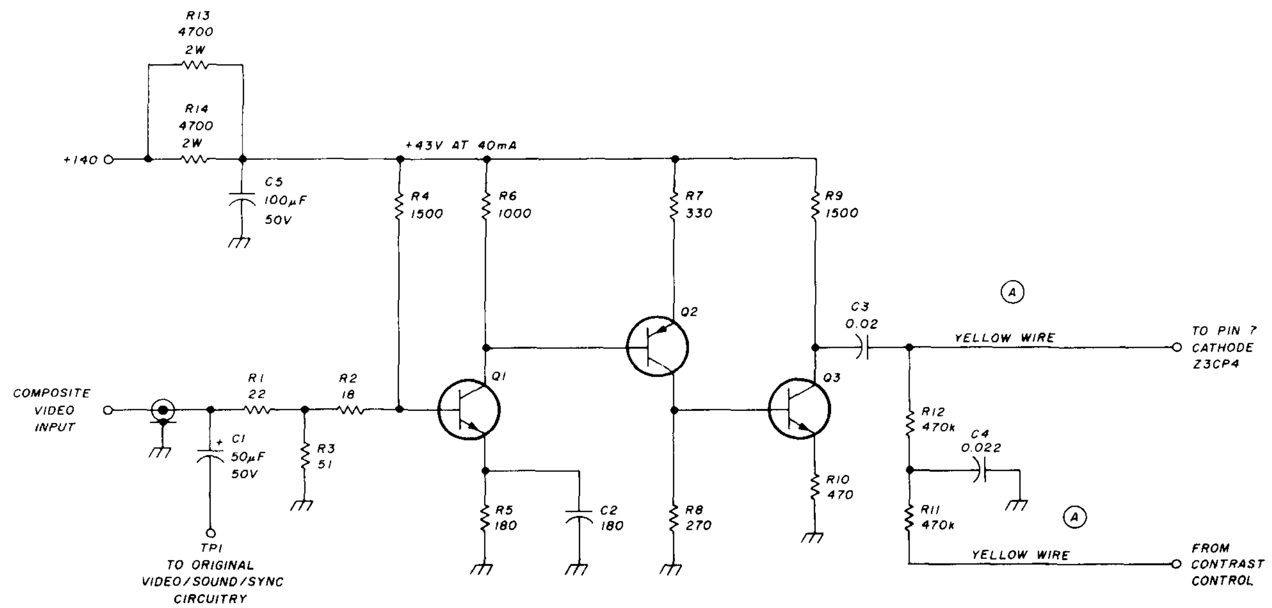

fig. 4. New broadband video amplifier for use with tube-type TV sets. For external connections refer to fig. 1. The cathode lead is cut at point A, and the amplifier is inserted as indicated. Q1, Q3 are 2N2222A and Q2 is a 2N3905.

run it through a long inductive lead. But 6 to 8 inches doesn't seem to hurt. *Caution: This circuit will not work on a transformerless TV with a hot chassis unless an ac isolation transformer is installed,* because there is no place to safely install the shield side of the video cable!

adjustment

There are no adjustments in the new video amplifier. However, we can improve performance a bit by adjusting the TV set. So far, only the video characteristics associated with the horizontal sweep have been discussed. Another problem with TV is that the scan is not necessarily linear. That is, the picture may be bunched up at one side or the top or bottom of the screen, and spread out elsewhere. This would be intolerable in a color set, but is common in old black and white sets. There should be a pair of pots for adjusting top and bottom vertical linearity, and there are two tabs mounted on the yoke which can be rotated independently to position the picture properly. It should be possible to find a combination in which the part of the picture you want to use the most is conveniently displayed.

Finally, you may find that the focus is not uniform over the screen. The focus control and those positioning tabs may interact, and it should be possible to get a reasonably crisp picture over the most important parts of the screen. (For use as a computer or RTTY display, the right side is less important than the left, for instance.)

I have been using the circuit in **fig. 4** with the TRS-80, and more recently with a homebrew S-100 system using an eighty-column display, for about a year now. It sure is nice to not have a lot of short, left-over lines on RTTY — you can see most of the last transmission all at once with the eighty-column display. The large screen is easy on the eyes, although the contrast is a bit low if the room is sunlit. And word-processing is handy, too; this article was written on the big screen. A test with a Panasonic portable VCR and camera showed an excellent picture of the shack. (Everything perfect except the color!)

An old TV set can be given a new lease on life as a modern video monitor for the shack at relatively low cost. The effort required will depend on the bandwidth needed for your application. I hope the principles presented here will save you a good deal of time and frustration as you attack that tube. This project is worthwhile for any experimenter on the more modern modes, such as RTTY, slow or fast-scan TV, or computer communications.

references

1. D.J. Brown, W9CGI, "CRT Character Enchancer," *ham radio,* August, 1982, page 66.
2. Timothy Loof, "Use Your Television Set as a Video Monitor," *Byte,* February, 1979, page 46.
3. Schematics for older TV sets can be obtained from your local TV-repair parts supplier. Ask for Howard W. Sams "Photofact" sheets by model number.

ham radio

Morse time synthesis

This software routine lets your micro speak the time in Morse code

Talking microcomputers are becoming common as more companies develop hardware modules for voice synthesis. Most are reasonably priced, starting from $100. If you want vocal feedback from your computer and need only a vocabulary limited to the decimal integers, you might consider a software alternative: voice synthesized telegraphy.

The program described here synthesizes a 24-hour clock which provides an audible read-out in Morse code characters. The clock produces Morse characters for the time in hours and minutes on demand, and automatically on the hour. It is especially useful to the blind or seeing-impaired. Even to those unfamiliar with Morse code, the numerals are easy to learn.

This program was conceived on a single-board computer based on the 1802 microprocessor, running at a frequency of 1.7897725 MHz. The program depends upon only a few hardware features: 256 bytes of RAM, a speaker amplifier on the Q line, and a push-button switch on the EF4 external flag line. All the routines in the program are straightforward, and they can be easily translated into machine code for other microprocessors.

the program

The main program begins by initializing registers to point to subroutines, locations for binary time, BCD time, and a table of Morse code patterns. The program then enters the time loop (**fig. 1**). This loop iterates until sixty seconds elapse, at which time binary minutes are incremented. During each iteration, the program checks to see whether the time has been requested by testing external flag EF4, and it checks to see whether sixty minutes have elapsed. In either case program control passes to register R3 for the out subroutine. The time loop also checks for twenty-four hours, at which point the clock is reset to 00:00.

The out routine (**fig. 2**) is the main subroutine, and produces the Morse code characters. It first clears the old BCD time. Then, after getting binary hours, the program jumps via R4 to the BCD subroutine. On return, the program gets binary minutes and again

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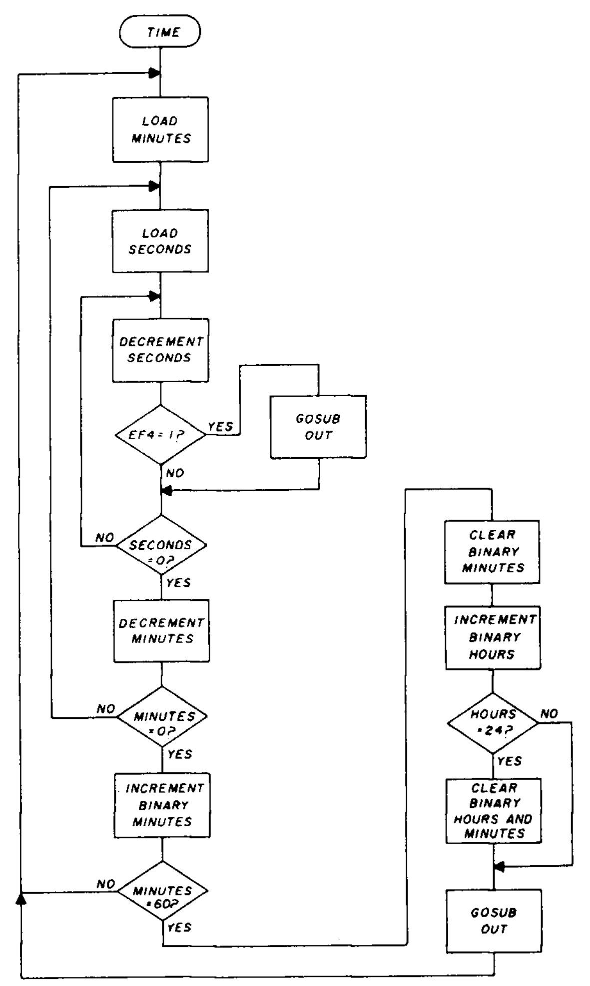

fig. 1. Flowchart of the time loop.

jumps to the BCD subroutine (**fig. 3**). Now that the program has the time in BCD, control passes to R5 for the Code routine, which converts the BCD digits into Morse characters. On return, program control reverts to R0 to resume the time loop.

BCD is a fairly conventional binary-to-BCD subroutine which converts by successively subtracting ten from the binary value. Every time it subtracts ten, it increments the BCD ten's value and retains the difference as the new binary value. If the subtraction yields a negative difference, the previous binary value is stored as the BCD one's value.

For each BCD digit the code subroutine (**fig. 4**) finds the bit pattern which corresponds to the appropriate Morse code digit. It then takes this bit pattern and ring-shifts it right, into DF (the 1802's carry flag) five times. After each shift, the code subroutine tests DF. If DF is 0, a dot is fetched; if DF is 1, it returns a dash. For instance, for the numeral 2 (·· — — —) the bit pattern fetched from the table will be XXX11100. (The higher-order three bits are not used.) The code routine will also generate a space between Morse digits.

The routine which produces the tones is called

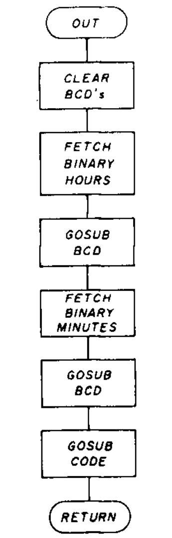

fig. 2. Flowchart of the out routine.

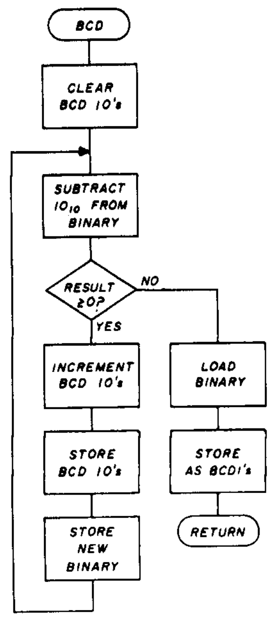

fig. 3. Flowchart of the BCD subroutine.

Program listing.

Register	Use
0	Main program counter
1	Not used
2	Not used
3	Pointer to OUT (0055)
4	Pointer to BCD (0076)
5	Pointer to CODE (0088)
6	Pointer to bit pattern for Morse digits.
7	Pointer to DOT/DASH (00B6)
8	Scratch pad
9	Pointer to Binary Hours (00D0)
A	Pointer to Binary Minutes (00D1)
B	Pointer to BCD Time (starting with 10's hours at 00D2
C	Counter for Minutes
D	Counter for Seconds
E	Morse character counter (low order)/Temporary code storage (high order)
F	Pointer to top of table of bit patterns for Morse digits (starting at 00D6)

Address	Code	Label	Mnemonic	Operand	Comment
0000	F800	INIT	LDI	00	Set high order of registers
0002	B3		PHI	R3	to 00.
0003	B4		PHI	R4	–
0004	B5		PHI	R5	–
0005	B6		PHI	R6	–
0006	B7		PHI	R7	–
0007	B9		PHI	R9	–
0008	BA		PHI	RA	–
0009	BB		PHI	RB	–
000A	BF		PHI	RF	–
000B	F855		LDI	55	R3 points to OUT (0055).
000D	A3		PLO	R3	–
000E	F876		LDI	76	R4 points to BCD (0076).
0010	A4		PLO	R4	–
0011	F888		LDI	88	R5 points to CODE (0088)
0013	A5		PLO	R5	–
0014	F8B6		LDI	B6	R7 points to DOT/DASH (00B6).
0016	A7		PLO	R7	–
0017	F8D0		LDI	D0	R9 points to Binary Hours (00D0).
0019	A9		PLO	R9	–
001A	F8D1		LDI	D1	RA points to Binary Minutes (00D1).
001C	AA		PLO	RA	–
001D	F8D2		LDI	D2	RB points to BCD Time (00D2).
001F	AB		PLO	RB	–
0020	F8D6		LDI	D6	RF points to Table of Morse
0022	AF		PLO	RF	digits.
0023	F83C	TIME	LDI	3C	Load minute count . . .
0025	AC		PLO	RC	in RC.0.
0026	F86D	SEC	LDI	6D	Load second count . . .
0028	BD		PHI	RD	in RD.1.
0029	2D	DECSEC	DEC	RD	Decrement second count.
002A	3F32		BN4	GETSEC	Anyone want the time?
002C	372C		B4		
002E	F855		LDI	55	If yes, set OUT sub pointer
0030	A3		PLO	R3	R3 to 0055 and . . .
0031	D3		SEP	R3	gosub OUT.
0032	9D	GETSEC	GHI	RD	Get second count.
0033	3A29		BNZ	DECSEC	If ≠ 0, go to DECSEC again.
0035	2C	DECMIN	DEC	RC	Decrement minute count.
0036	8C		GLO	RC	Get minute count.
0037	3A26		BNZ	SEC	If ≠ 0, go to SEC again.
0039	0A		LDN	RA	Get binary minutes.
003A	FC01		ADI	01	Increment binary minutes.
003C	5A		STR	RA	Store new binary minutes.
003D	FF3C		SMI	3C	Have 60 minutes elapsed yet?

Address	Code	Label	Mnemonic	Operand	Comment
003F	3A23		BNZ	TIME	If not, get another minute.
0041	F800		LDI	00	If yes, clear binary minutes
0043	5A		STR	RA	and . . .
0044	09		LDN	R9	increment binary hours.
0045	FC01		ADI	01	—
0047	59		STR	R9	—
0048	FF18		SMI	18	Have 24 hours elapsed yet?
004A	3A4F		BNZ	GONG	If not, output hourly gong.
004C	C4		NOP		—
004D	59		STR	R9	If yes, reset time to 00:00
004E	5A		STR	RA	—
004F	F855	GONG	LDI	55	Set OUT sub pointer R3
0051	A3		PLO	R3	to 0055 and . . .
0052	D3		SEP	R3	gosub OUT.
0053	3023		BR	TIME	Back to TIME.
0055	F800	OUT	LDI	00	Clear BCD 10's Hours.
0057	5B		STR	RB	—
0058	1B		INC	RB	Clear BCD 1's Hours.
0059	5B		STR	RB	—
005A	1B		INC	RB	Clear BCD 10's Minutes.
005B	5B		STR	RB	—
005C	1B		INC	RB	Clear BCD 1's Minutes.
005D	5B		STR	RB	—
005E	F8D2		LDI	D2	Restore BCD Time Pointer RB
0060	AB		PLO	RB	to 00D2.
0061	F876		LDI	76	Restore BCD sub pointer R4
0063	A4		PLO	R4	to 0076.
0064	09		LDN	R9	Get Binary Hours and . . .
0065	D4		SEP	R4	gosub BCD.
0066	F876		LDI	76	Restore BCD sub pointer R4
0068	A4		PLO	R4	to 0076.
0069	OA		LDN	RA	Get Binary Minutes and . . .
006A	D4		SEP	R4	gosub BCD.
006B	F8D2		LDI	D2	Restore BCD Time pointer RB
006D	AB		PLO	RB	to 00D2.
006E	F888		LDI	88	Restore CODE sub pointer R5
0070	A5		PLO	R5	to 0088.
0071	D5		SEP	R5	Gosub CODE.
0072	F8D2		LDI	D2	Restore BCD Time pointer RB
0074	AB		PLO	RB	to 00D2.
0075	DO		SEP	RO	Return to TIME.
0076	A8	BCD	PLO	R8	Put Binary in scratch pad R8.0
0077	FF0A	SUB10	SMI	OA	Subtract 10_{10} from binary.
0079	3B83		BNF	BCD1'S	Use Binary as BCD 1's if result
007B	A8		PLO	R8	≤0. Otherwise store result . . .
007C	OB		LDN	RB	and increment BCD 10's.
007D	FC01		ADI	01	—
007F	5B		STR	RB	—
0080	88		GLO	R8	Get new Binary and try to
0081	3077		BR	SUB10	subtract 10 again.
0083	1B	BCD1'S	INC	RB	Since Binary is less than
0084	88		GLO	R8	10 store it as BCD 1's
0085	5B		STR	RB	—
0086	1B		INC	RB	—
0087	D3		SEP	R3	Return to OUT.
0088	F830	CODE	LDI	30	Delay between Morse digits.
008A	B8		PHI	R8	—
008B	28	DECDEL	DEC	R8	Decrement delay value.
008C	98		GHI	R8	—
008D	3A8B		BNZ	DECDEL	Time up yet?
008F	8B		GLO	RB	Check to see if the last

Address	Code	Label	Mnemonic	Operand	Comment
0090	FFD6		SMI	D6	Morse digit has been output.
0092	C6		LSNZ		If it has, return to OUT.
0093	D3		SEP	R3	–
0094	C4		NOP		–
0095	0B		LDN	RB	Get BCD value.
0096	1B		INC	RB	–
0097	FCD6		ADI	D6	Add offset.
0099	A6		PLO	R6	Put result in R6 as Code pointer.
009A	F805		LDI	05	Put Morse character count in RE.0.
009C	AE		PLO	RE	–
009D	06		LDN	R6	Get Morse pattern via R6.
009E	BE		PHI	RE	Store it temporarily in RE.1.
009F	8E	CHR	GLO	RE	Have five Morse characters
00A0	3288		BZ	CODE	been output yet?
00A2	9E		GHI	RE	If not, get code pattern
00A3	2E		DEC	RE	out of temporary storage in
00A4	76		SHRC		RE.1 and shift character bit
00A5	BE		PHI	RE	into DF.
00A6	33AD		BDF	DASH	If bit = 1 load a dash.
00A8	F819	DOT	LDI	19	Otherwise load a dot.
00AA	A8		PLO	R8	
00AB	3BB0		BNF	EXIT	
00AD	F86B	DASH	LDI	6B	
00AF	A8		PLO	R8	
00B0	F8B6	EXIT	LDI	B6	Restore DOT/DASH sub pointer R7
00B2	A7		PLO	R7	to 00B6 and . . .
00B3	D7		SEP	R7	Gosub DOT/DASH.
00B4	309F		BR	CHR	Back for another character.
00B6	F835	DT/DSH	LDI	35	Load pitch value of tone.
00B8	7B		SEQ		"ON"
00B9	FF01	DECPT1	SMI	01	Decrement pitch value.
00BB	3AB9		BNZ	DECPT1	If "ON" time is not up, dec again.
00BD	F835		LDI	35	If it is, load pitch value again.
00BF	7A		REQ		"OFF"
00C0	FF01	DECPT2	SMI	01	Decrement pitch value.
00C2	3AC0		BNZ	DECPT2	If "OFF" time is not up, dec again.
00C4	28		DEC	R8	
00C5	88		GLO	R8	Has the character been sent yet?
00C6	3AB6		BNZ	DT/DSH	If not, go back for more.
00C8	F80A	SPACE	LDI	0A	Load value for space between
00CA	B8		PHI	R8	characters in R8.1.
00CB	28	DECSP	DEC	R8	Decrement space value.
00CC	98		GHI	R8	Is the space up yet?
00CD	3ACB		BNZ	DECSP	If not, decrement it again.
00CF	D5		SEP	R5	Return to CODE.
00D0	–	BINHRS			Binary Hours stored here.
00D1	–	BINMIN			Binary Minutes stored here.
00D2	–	10'sHR			BCD 10's Hours stored here.
00D3	–	1'sHR			BCD 1's Hours stored here.
00D4	–	10'sMN			BCD 10's Minutes stored here.
00D5	–	1'sMN			BCD 1's Minutes stored here.
00D6	1F	DIGIT TABLE			"0"
00D7	1E				"1"
00D8	1C				"2"
00D9	18				"3"
00DA	10				"4"
00DB	00				"5"
00DC	01				"6"
00DD	03				"7"
00DE	07				"8"
00DF	0F				"9"

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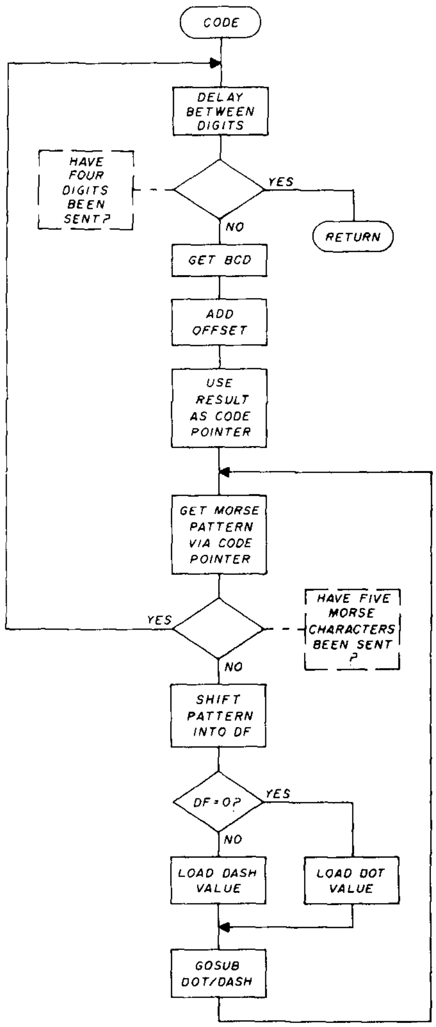

fig. 4. Flowchart of the code routine.

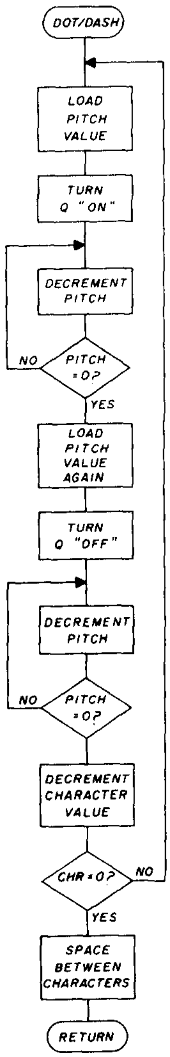

fig. 5. Flowchart of the dot/dash routine.

dot/dash (**fig. 5**). After the code routine fetches a dot or dash, this subroutine generates a tone of proper duration. (A dash is about three times longer than a dot.) The dot/dash routine also generates a space after each character. This space is a period of silence about as long as a dot.

operation and fine-tuning

Before running the program, set the clock by entering the time. To do this, convert the hours and minutes values to hexadecimal. Then enter the hours at location 00D0 and the minutes at location 00D1. Now execute the program from location 0000. The program will give the time whenever the EF4 flag is activated, and automatically on the hour.

Although the program should keep accurate time, you may have to adjust its speed if your microprocessor's clock frequency is different. Do this by varying the value at location 0027. Also, you can tune the pitch of the tone by changing the values at locations 00B7 and 00BE. You can alter the speed of the Morse characters by changing the values for dot, dash, and space at locations 00A9, 00AE, and 00C9. Finally, if you prefer a twelve-hour format, change the value at location 0049 to 0C.

summary

The basic feature of this program is the routine which converts BCD digits into Morse code characters, and in this case, the BCD digits represent time. However, the same routine with some modification could be used where the BCD digits represent something else, like temperature, pressure, voltage, or resistance. You would need more elaborate hardware in these cases, since they involve A/D conversion, but any measuring device could be made to talk with this method.

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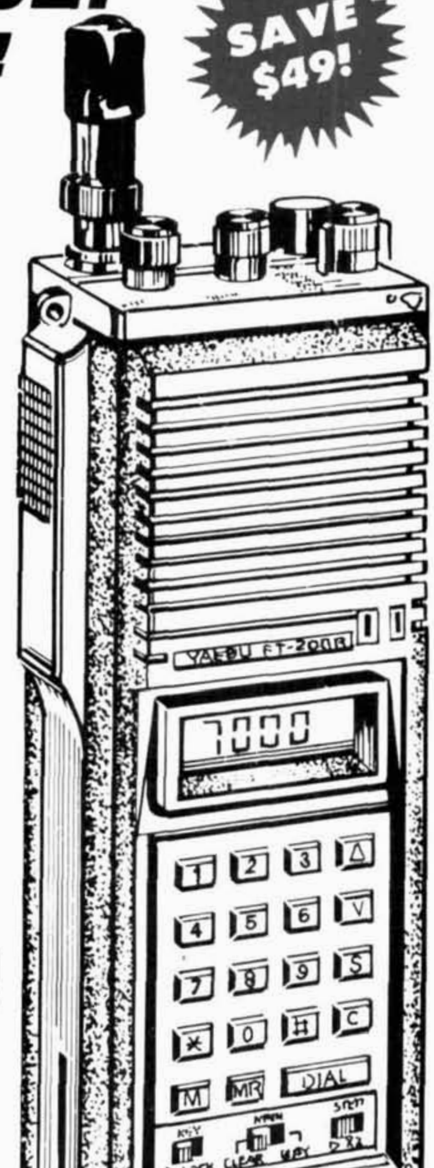

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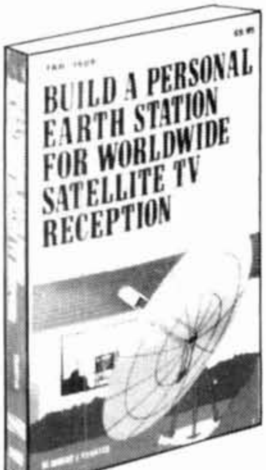

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a state-of-the-art Touchtone® decoder

Using Silicon Systems Inc.'s single-chip solution

Silicon Systems Inc.'s DTMF (dual-tone, multiple frequency) decoder IC is revolutionizing the way Amateurs use TouchTones®. With this device, it's possible to build a decoder with as few as three ICs, and the resulting circuit (see photo) is small, requires little power, and is very reliable.

a brief history

It wasn't too long ago that every DTMF decoder used and built by Amateurs was made with the NE567 phase-locked loop-tone decoder. At the time, that was the only way to decode dual-tone audio into a useful digital signal; it required tedious adjustment of a potentiometer for every frequency and that adjustment would rarely remain stable when temperature varied.

About five years ago, Mostek released a product that eliminated all the adjustments and made DTMF decoding relatively simple, but rather costly. In the Mostek system, the incoming audio signal is split into the two components of DTMF (i.e., the high-frequency group and the low-frequency group). These two components are then limited and squared before being applied to the Mostek DTMF decoder. Although the cost of the splitting filters is high, this remains a superior system to multiple 567s, as the dynamic range is tremendously improved and no adjustments are necessary.

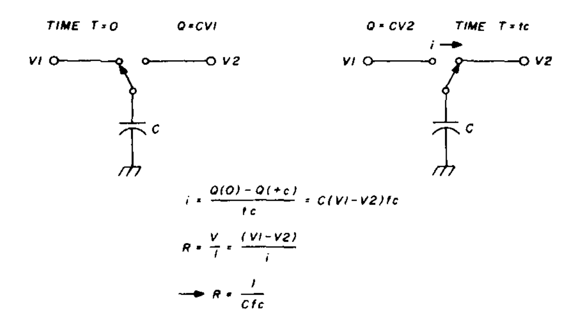


fig. 1. The switched-capacitor principle allows a small capacitor to be used in place of a large resistor. This has allowed the manufacturer to put filters and decoding circuits on one silicon chip.

The next logical step in DTMF decoders was to put the filters, limiters, and squarers on the same chip as the decoder. This was accomplished by Silicon Systems Incorporated (SSI) with their SSI201, a single-chip solution that requires only two small bypass capacitors and a 3.58 MHz color-burst crystal.

operation of the decoder

The major problem was to incorporate rather large capacitors and resistors needed for the filters onto the silicon chip. The largest size capacitor that can be integrated onto a chip is about 100 pF, and even this size requires a large area. Large resistors are not realizable for the same reason. However, a small capacitor can be made to perform, electrically, like a large resistor.

Fig. 1 illustrates the principle of a switched capacitor to realize a large resistor. At time zero, the capacitor is connected to voltage V_1 and the capacitor charges toward the value $Q = CV_1$. At some later time, t_c, the capacitor is switched to voltage V_2 and the value of the charge is $Q = CV_2$. The equations in the figure show the mathematics used to manipulate the values; the last equation is the most interesting: $R = 1/Cf_c$, in other words, a large resistor can be made (electrically) by just using a small capacitor and switching it between voltages at a very fast rate!

This led to the development of the switched-capacitor filtering used in the SSI201 DTMF decoder. (MOS transistors are used as the switches.)

The block diagram of the entire decoder is shown in **fig. 2**. As in the multiple-chip Mostek system, the audio is first split into upper and lower bands. These signals are further filtered to determine the two tones present. Next, the output-decoder circuitry converts this information to digital form, and produces BCD (binary-coded decimal), or optional 2-of-8 outputs. A 3.579545 MHz color-burst crystal is used for the frequency references as well as for the switched-capacitor filter networks.

By Mark Forbes, KC9C, 1000 Shenandoah Drive, Lafayette, Indiana 47905

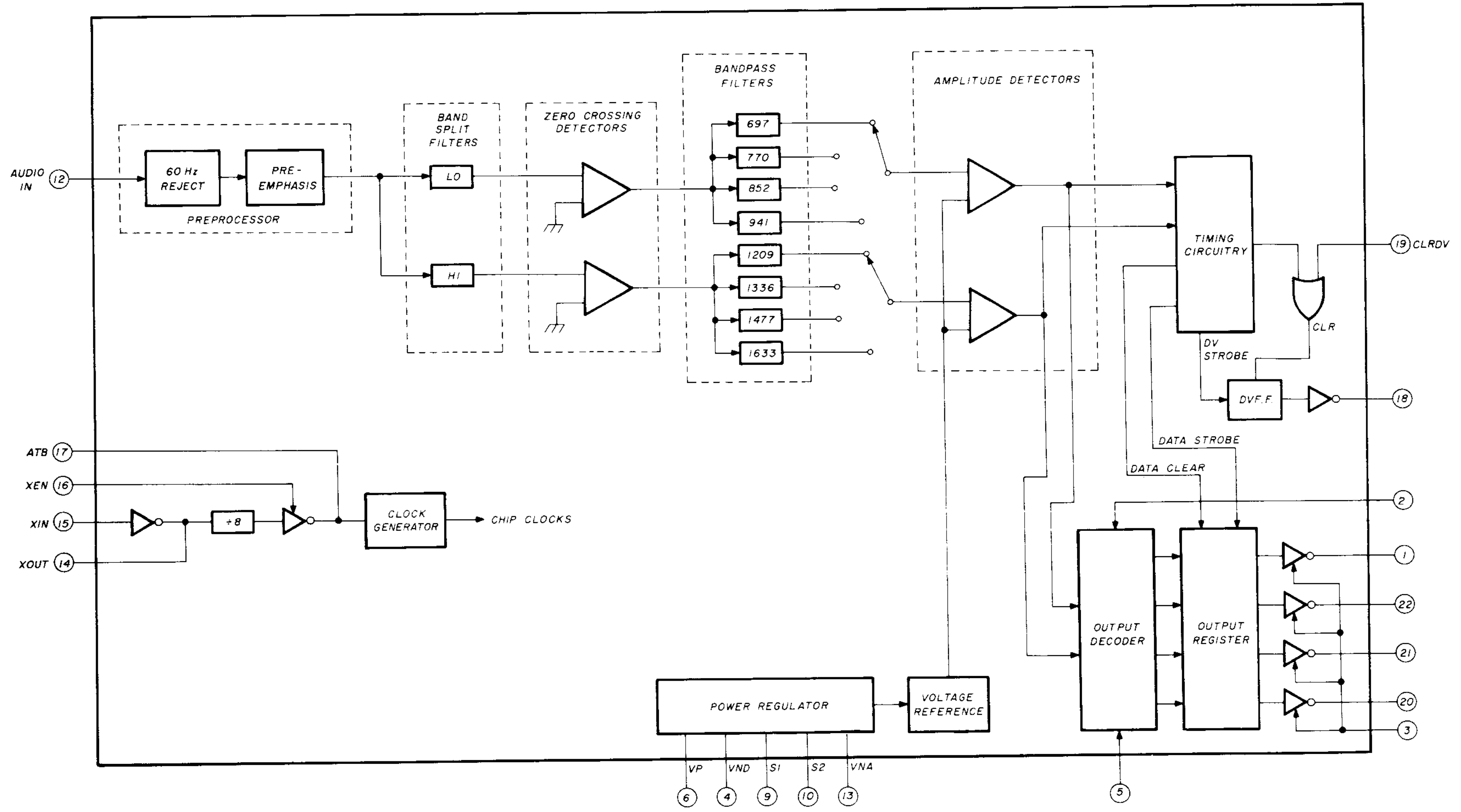


fig. 2. Block diagram of the Silicon Systems, Inc., SSI201 DTMF decoder.

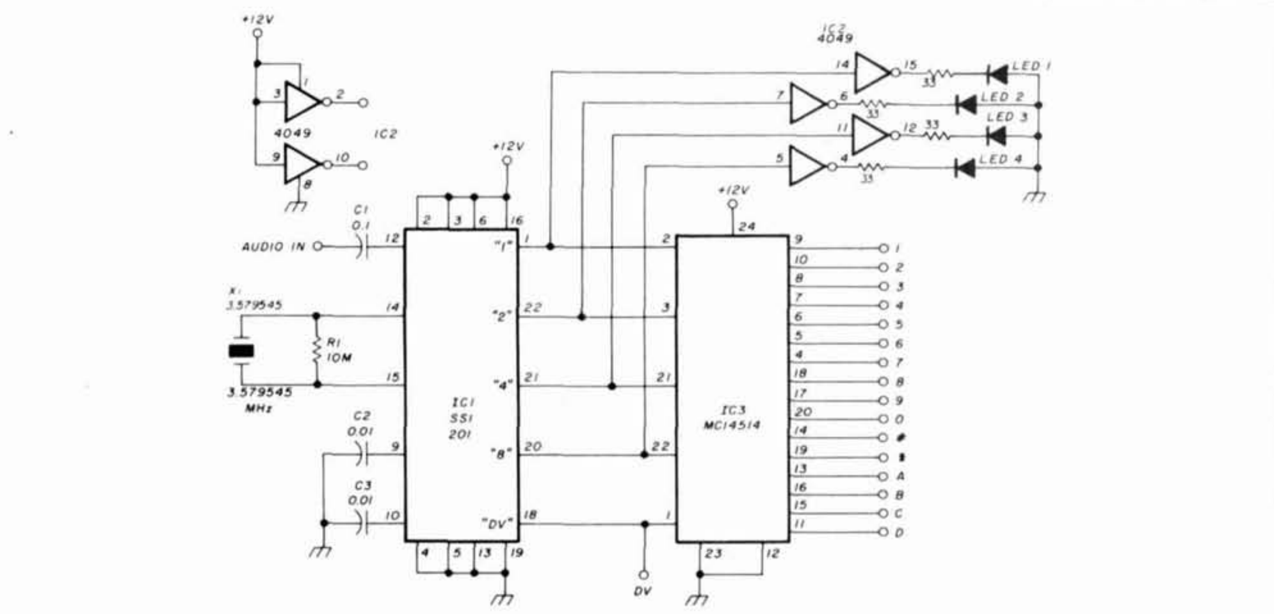


fig. 3. Schematic diagram of the author's completed decoder circuit. The CMOS signals are all 12-volt levels, so a converter is needed if the decoder must drive TTL.

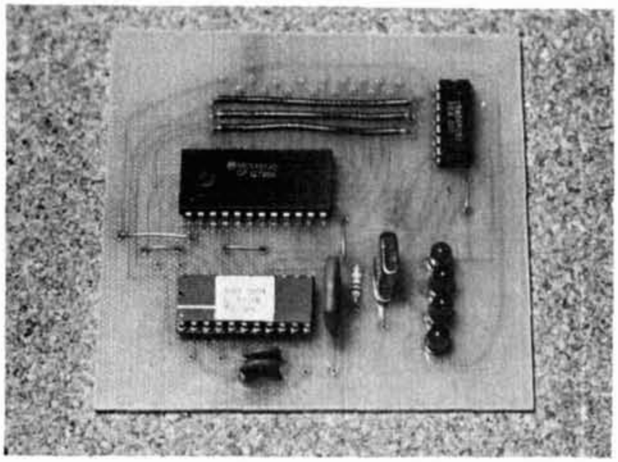
the complete circuit

To make the SSI201 easier to interface to remote-control and repeater circuits, I have added two IC and four LEDs in this DTMF decoder design. The schematic diagram is shown in **fig. 3**. Audio input is coupled to the SSI201 through a 0.1 μF disk capacitor. The BCD output of the decoder is further decoded into individual "tone-pad" digits by an MC14514B 4-to-16 line demultiplexer.

One useful signal available from the decoder is the DV (data valid) signal. This signal goes high when the output data is in a predefined window of time, and is useful in determining when to sample the outputs of the MC14514 (although these outputs are latched, so the last data remains on the outputs until new data is presented).

As a convenience, LEDs that show the binary value of the decoded output, are included (note: the values for *, Ø, and # are 11, 10, and 12, respectively). A CMOS 4049 inverting buffer is used to drive the LEDs and remove the load from the SSI201.

All the ICs in the project are powered from 12 Vdc. A note of caution here — the SSI201 requires 12 volts and *not 13.8 volts* as found on many power supplies. A small IC voltage regulator will provide the proper 12 volts if you don't have such a power supply (an LM340-12 is one such regulator). If the outputs are to be interfaced to 5-volt logic such as TTL, a voltage converter circuit such as that shown in **fig. 4** can be employed.



The DTMF decoder circuit.

Construction of the circuit is very simple, using the printed circuit artwork provided in **fig. 5**. All that is necessary is to solder the ICs and apply 12 volts. Sockets are recommended to keep the heat of soldering off the ICs and to facilitate replacement should any of the components fail.

applications

The applications of a DTMF decoder seem almost limitless, especially when no adjustments are necessary. The most obvious application is in repeater control. This circuit is highly reliable and not subject to degradation by temperature or variation of signal levels. These features, coupled with the compact size of this circuit, make it perfect for use in repeaters.

A reliable circuit like this one also opens the door to an underexplored facet of Amateur radio: remote control. Remote control of more than just repeaters is allowed by the FCC. In fact, almost anything can be remotely controlled via Amateur radio. Types of applications include remote HF stations, models, or even your house lights.

Another good use of the DTMF decoder is in autopatch circuits. Most autopatches couple the DTMF tones directly to the telephone line from the receiver.

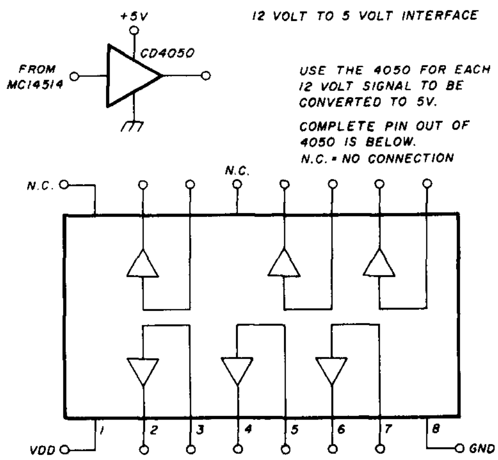


fig. 4. A CMOS to TTL signal-level converter.

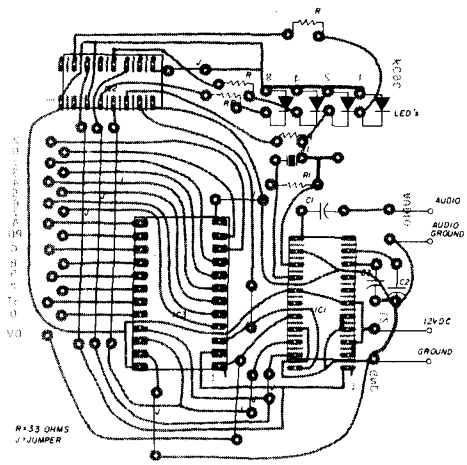


fig. 5. Printed-circuit board artwork

table 1. Parts and Prices List.

part	description	source	price
IC 1	SSI201 DTMF decoder	SAI Marketing*	60.00
IC 2	4049 inverter	Digikey	0.47
IC 3	MC14514 (4514B)	Digikey	1.99
LED 1-4	Light Emitting Diodes	Radio Shack	4 for 1.58
C 1	0.1 uF disk capacitor	Radio Shack	2 for 0.49
C 2,3	0.01 uF disk capacitor	Radio Shack	2 for 0.39
R 1	10 Megohm resistor	Radio Shack	2 for 0.19
X 1	3.579545 MHz crystal	Radio Shack	1.99
PCB	printed circuit board	Author	8.50
		Total Cost	67.10
		Total w/PCB	75.60

Note: Complete parts kits are available from the author for $75.60 plus $1.00 shipping. Or, the ICs and/or PCB may be purchased individually at the listed price plus $1.00 shipping.

*The address of SAI Marketing is: SAI Marketing, Attn. Jim Taylor, 5610 Crawfordsville Road, Indianapolis, Indiana 46224.

This results in two things: the user needing to adjust his TouchTone pad to tight telephone company specifications, and frequently misdialed numbers. By decoding the signal first, then re-encoding with a DTMF generator chip, the telephone line will always have a perfect and precise tone for dialing. And, with the wide dynamic range of the SSI201, adjustment of the user's tone pad is almost never necessary. An additional problem can also be solved: in areas where DTMF dialing is not yet available, a pulse dialer chip in conjunction with the SSI201 can provide autopatch functions.

conclusion

The parts list in **table 1** gives the price and availability of each of the parts at the time of writing. Additionally, I have complete parts kits available for the prices shown, so there should be no trouble in finding all the necessary parts.

The SSI201 is, in my opinion, the best DTMF decoder introduced to date. The Amateur press seems to be behind in the DTMF decoder field. In fact, one book on repeaters published in 1980 still showed 567 circuits for decoding DTMF. The switched capacitor has revolutionized the DTMF scene, and will soon find its way into other areas.

references

Jacobs, G.M., et. al., "Touch-tone decoder chip mates analog filters with digital logic," *Electronics Magazine*, February 15, 1979, McGraw-Hill, Inc.

Silicon Systems Incorporated, "Monolithic Dual-Tone Multi-frequency Receiver Application Note," May 1980.

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117	5 @ 9.75 A 29 KV Ins.	6x5x8	10	$29.95
115	6.6 @ 25 A	4x5x6	15	$19.95
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115	6.6 @ 10 A	3x4x6	8	$ 9.95
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208	3 phase with taps to allow sec. to be varied from 5900 to 7700 VDC @ 600 Ma out of rect.	11½x11½x13	100	$175.00
115	#1-600 CT @ 450 Ma #2-580 CT @ 220 Ma	5x4½x8	12	$19.95
208/ 230/ 240	5700 @ 1.2 A	9½x9½x13	75	$175.00
215/ 230/ 245	4,000/4,450 @ 26 KVA	38x16x24	845	$575.00
115	690 @ 450 Ma (Production quantities in stock)	4x5x6	12	$ 9.95
115/ 230	803 @ 735 Ma. Hypersil core. (Use two of these for a cool KW)	6x5x6½	17	$59.00

POWER TRANSFORMERS

115	#1-1,000 CT @ 220 Ma #2-5.1 @ 2 A #3-5.1 @ 4 A	4x5x6	15	$ 9.95
115	#1-840 CT @ 230 Ma #2-620 CT @ 25 Ma #3-5 @ 2 A #4-6.3 @ 5.5 A #5-6.3 @ 5 A #6-6.3 @ 5 A	5x6x7	10	$19.95
115	#1-45 @ 50 Ma #2-68 @ 3 A #3-34 CT @ 25 A #4-20 CT @ 2 A	7x6x6	43	$24.50
115	#1-105 @ 75 Ma #2-475 @ 200 Ma #3-6.5 @ 9 A #4-6.3 @ 3.3 A #5-6.3 @ 2A	4x5x3	7	$ 9.95

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2 H @ 130 Ma, DC resistance 155 ohms, 2,000 V ins. (Production quantities in stock)	1x1½x3	1	$2.95
5 H @ 500 Ma, 700 V ins.	4x5x6	15	$22.00
4 H @ 350 Ma, Collins	3x3x4	4	$3.95
1 to 1.5 H @ 1.2 A swinging choke, 18 KV insulation.	13x17x17	248	$125.00
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10	660 AC (2000 DC)	2x3x4	1	$ 6.95
45	330 AC (1000 DC)	2x3½x7	2	$ 5.95
4	4000	4x4x11	6	$ 29.95
2	10,000 Aerovox	13¼x4x17½	40	$ 29.00
.026	32,000 GE	16x7x20	40	$ 49.00

.01 1200 V mica	$1.95
.01 2500 V mica	$2.95
50 pf 15 KV or 40 pf 15 KV ceramic, Centralab type 857	$2.95

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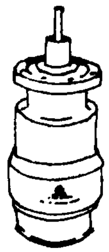

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remote control hf operation

An Apple II and Collins KWM-380 talk to each other via the telephone

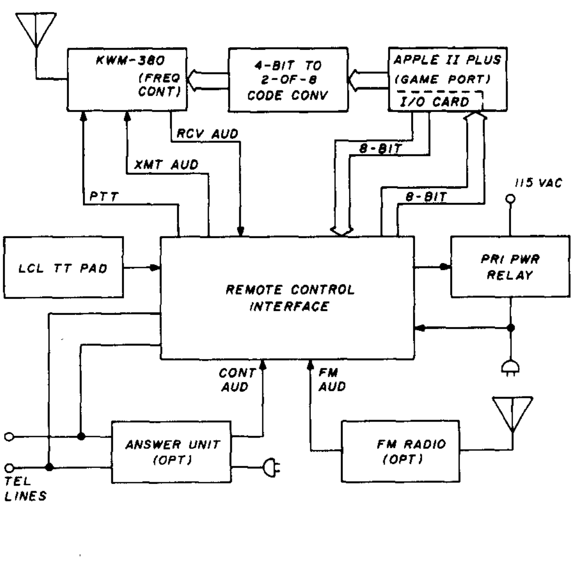


fig. 1. High-frequency remote-control system block diagram.

You can have remote high-frequency radio operation from a TouchTone™ telephone. In this article I explain this design, including the interface used to control the radio and computer; the interface plugs into the radio and computer without modification to either. A remote operator can thereby use a telephone to turn on and off primary power; use a private access code; tune the radio to any discrete frequency or scan up and down; transmit; and have optional fm radio capability. The interface has a safety shutdown feature in case the power or telephone is interrupted.

The remote system is illustrated by the block diagram in **fig. 1**. The center of the system is the interface control, which includes a phone patch, a dual tone multi-frequency (DTMF) decoder, audio amplifiers, and control logic. I use a Rockwell-Collins KWM-380 transceiver with the control interface option, and an Apple II Plus microcomputer with an eight-bit input/output card. A regular phone-answering unit detects the telephone ring. A ring-detection circuit could be incorporated into the interface control, but I prefer having a tape recorder tied to the system for logging. A twelve-button TouchTone™ keypad provides local control. A primary power relay, that includes transient protection, turns on the KWM-380 and the Apple. The phone-answering unit and interface control remain on at all times. An interface device that connects between the Apple's game port and the KWM-380's frequency-control interface connector provides frequency control. An optional fm audio-decoder is also included to provide additional system control and operation from a VHF/UHF fm radio.

By Dick Sander, K5QY, 110 Starlite Drive, Plano, Texas 75074

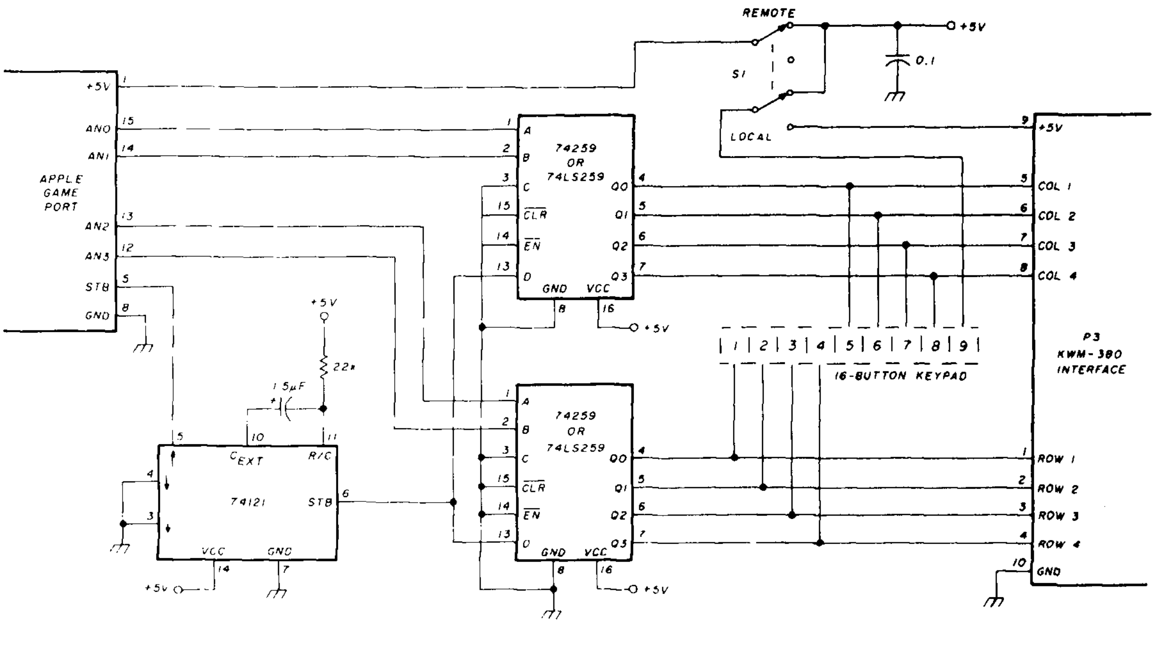


fig. 2. Apple II to KWM-380 interface schematic. It converts a four-bit binary code to a 2-of-8 code with a strobe to load the data into the radio.

The frequency-control circuitry is in a case that contains the KWM-380's sixteen-button keypad. The case also contains a switch that selects +5 volt power from either the radio or the Apple. There are two reasons for interfacing the frequency control separately: the first is that this portion can be a separate project; and the second is that fewer parts are required to build an interface compared to an I/O card to insert into one of the Apple's card slots. The purpose of the interface device is to convert the four binary-outputs and strobe available from the Apple's game port to an eight-bit two-of-eight code required by the KWM-380 (see **fig. 2** for the schematic diagram of the frequency interface). The output of each 74259 decoder is tied directly with the sixteen-button keypad to allow frequency input to the radio while the Apple is running. The negative strobe of the Apple triggers a 74121 one-shot and clocks the data into the radio. If only frequency control from the Apple II is going to be used, lines 2000 through 2650 of the program listing form a routine for operating only frequency control for the KWM-380; *delete lines* 2030 through 2070 and replace them with a **GET F** statement from the keyboard.

The remote control interface is the heart of the system; **fig. 3** is its functional block diagram and **fig. 4** is its schematic. The phone-answering unit has an earplug that I use to connect the telephone audio to the interface control. After the unit hooks onto the telephone line and sends its outgoing message, it

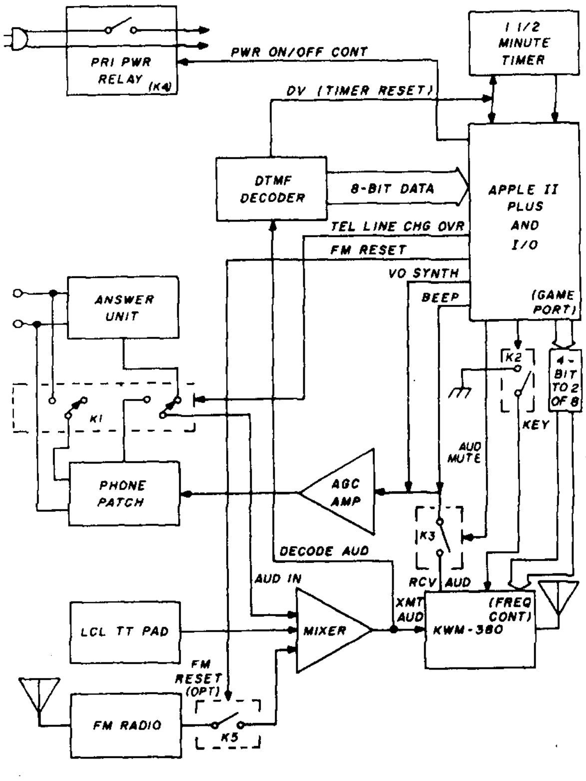


fig. 3. High-frequency remote-control functional block diagram. Each relay function is shown as a dotted line box.

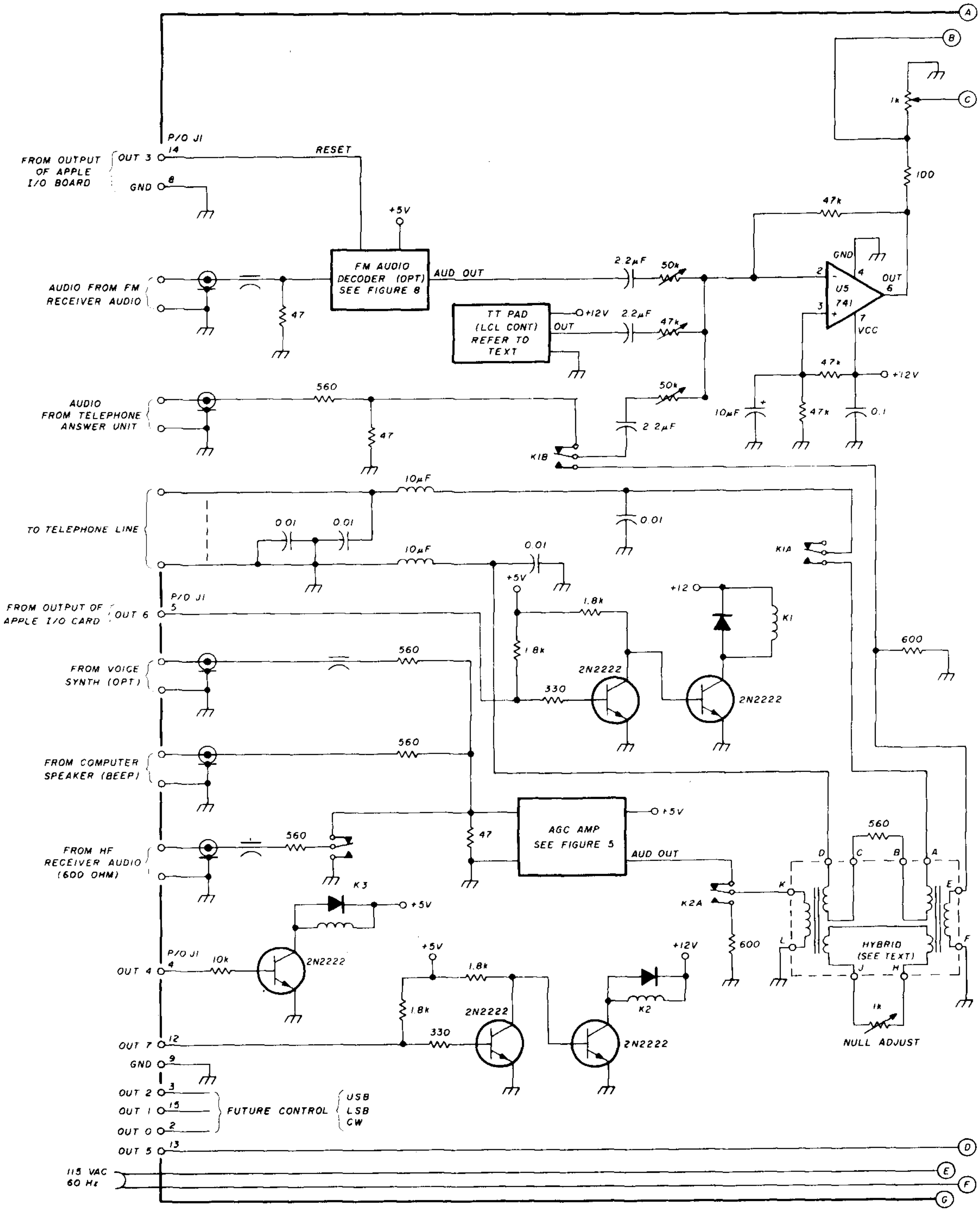
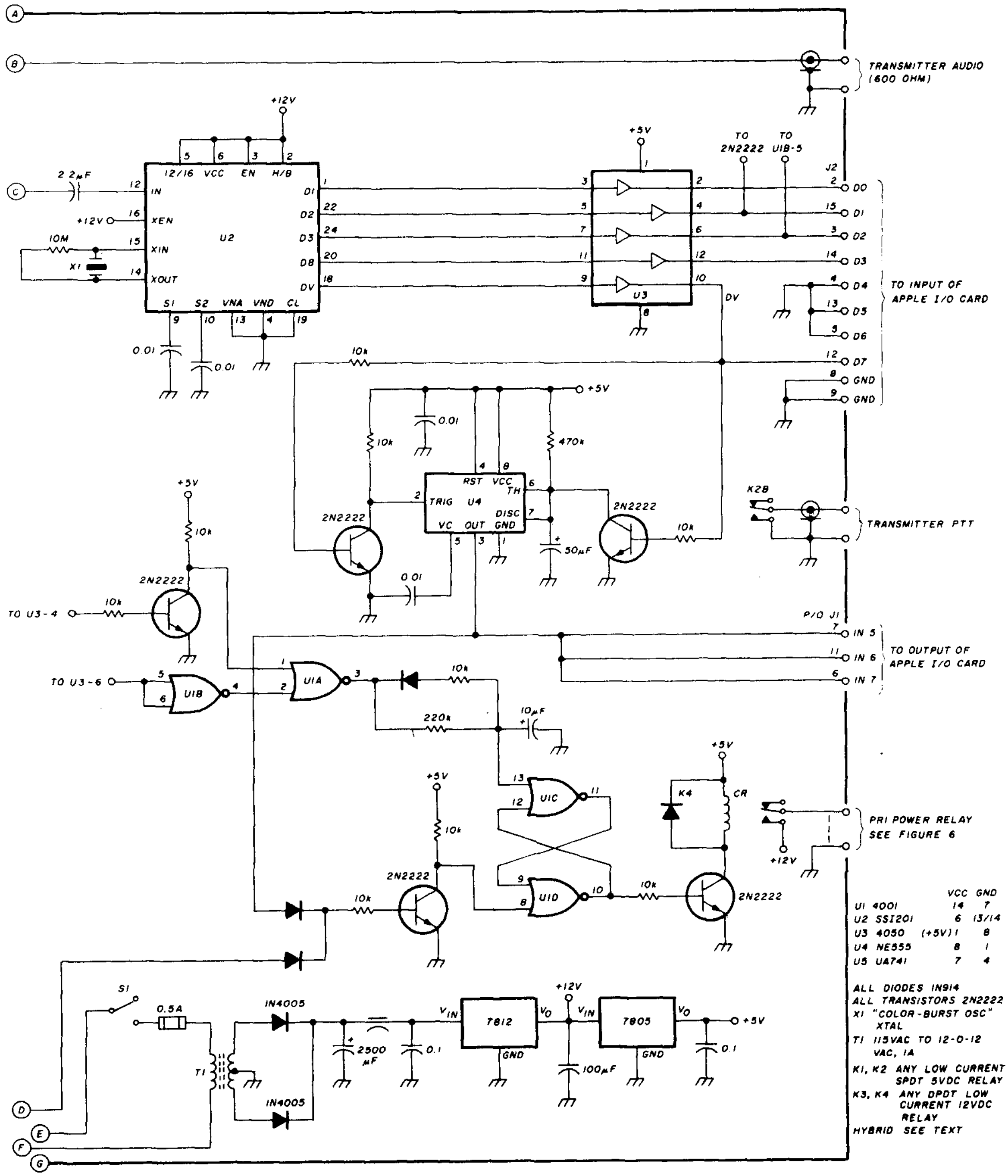


fig. 4. The interface-control schematic diagram. Note that the AGC amplifier and optional fm audio decoder schematic are shown separately.


TRANSMITTER AUDIO (600 OHM)
TO INPUT OF APPLE I/O CARD
TRANSMITTER PTT
TO OUTPUT OF APPLE I/O CARD
PRI POWER RELAY SEE FIGURE 6
U1 4001 14 7
U2 SSI201 6 13/14
U3 4050 (+5V)1 8
U4 NE555 8 1
U5 UA741 7 4
ALL DIODES IN914
ALL TRANSISTORS 2N2222
X1 "COLOR-BURST OSC" XTAL
T1 115VAC TO 12-0-12 VAC, 1A
K1, K2 ANY LOW CURRENT SPDT 5VDC RELAY
K3, K4 ANY DPDT LOW CURRENT 12VDC RELAY
HYBRID SEE TEXT

(fig. 4 cont'd)

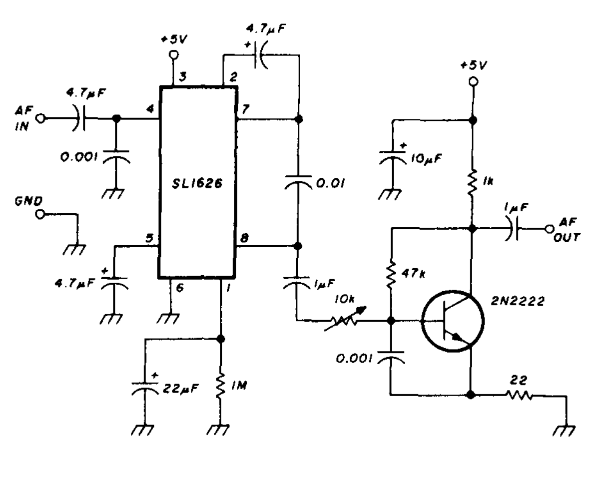


fig. 5. AGC amplifier schematic diagram. This circuit maintains a constant audio level to the phone patch.

allows twenty seconds for an incoming message. During this time you must access the system. The incoming audio is tied through the normally closed contacts of relay K1B directly to U5, a 741 operational-amplifier. U2 is an SSI 201 DTMF CMOS receiver that decodes the incoming audio tones, and U3, a CMOS-to-TTL buffer that passes the data to the eight-bit TTL input of the Apple's I/O card. If the proper access code is present, the output of the Apple pulls in relay K1 and connects the telephone line to the phone patch. The answering unit will drop off by now.

The phone patch contains a transformer-type hybrid with a balancing network. The hybrid transformers that I used were surplus, and no part number is available; the builder must decide upon his own transformers. I'm using a 1-kilohm pot for null adjustment. Some situations may require some series capacitance to null out the telephone line inductance; the system will not work without proper balance. The DTMF decoder requires at least a 12-dB signal-to-noise ratio, which is why a null is important. An AGC amplifier is needed to maintain a constant level to the hybrid. If you were to measure the output of your receiver, you would find the audio level varies by as much as 20 dB. **Fig. 5** is the schematic diagram of the AGC amplifier I'm using. It uses an SL1626 voice-operated gain adjusting device (VOGAD) that drives a simple 2N2222 transistor amplifier. The output is extremely constant and maintains proper audio level. Because the VOGAD operates at low levels, resisting dividers are used to reduce the input to the proper levels. The AGC amplifier controls only outgoing audio, which includes the hf received, the beeps, and possibly a voice synthesizer. Throughout the program, beeps from the Apple's speaker tell the operator where he is during operation. For connecting audio to the system, I couple to the Apple using a 0.47-μF capacitor wrapped between the audio high side of the speaker connector and the interface. For audio low, I connect the grounds together. In the Apple, the speaker is dc-coupled to +5 volts, so be careful when connecting to the Apple's speaker connector (refer to the Apple II reference manual). Incoming audio (tones and voice) from the phone line via the hybrid, the local TT keypad, and optional fm control go to U5, the audio mixer. The output of U5 goes to the DTMF decoder and to the KWM-380 transmit audio.

The control-logic portion of the interface control consists mainly of a timer, a latch, and four control relays. Timer U4, a 555, stays on for one and one-half minutes. It is reset from the data valid (DV) output of U2. If there isn't any key activity before timeout, relays K1 (phone line) and K2 (transmit/receive) drop off. Latch U1, a 4001 quad NOR gate, enables relay K4 (primary power) and turns on the radio and Apple. A shut-off command from data-out 5 causes relay K4 to drop out when U4 times out, and the radio and the Apple will turn off. Relay K3 mutes the high-frequency-received audio when a command from data-out 4 appears. Muting is used when you wish to hear only the beep or voice synthesizer (if used). Relay K2 is the transmit key relay; it sends a ground to the KWM-380's keyline and maintains a 600-ohm load across the input side of the hybrid during transmit. **Table 1** gives a detailed description of each data line and its address (I/O card in slot 4) from BASIC.

Fig. 6 is the schematic for the primary power-relay. It contains varistor transient suppressors and

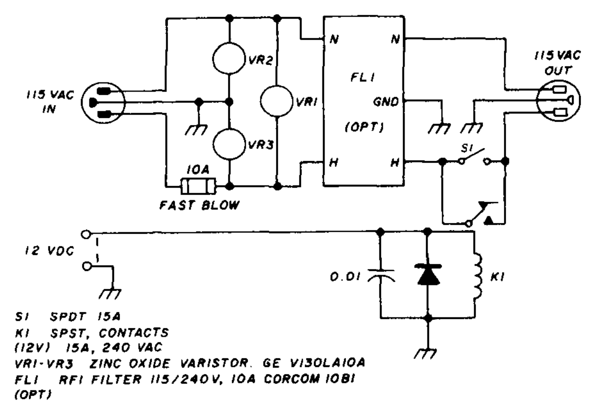


fig. 6. Primary power-relay schematic diagram. This relay box includes additional transient protection (optional). Switch S1 bypasses the relay if remote switching is not desired.

table 1. This table lists the I/O data lines used to interface the KWM-380 and Apple II and gives a description and address from BASIC of each.

data line	description	computer address (slot 4) from BASIC	
input: D0-D7	Parallel eight-bit binary input, MSB is data valid (DV)	PEEK (50176)	
output			
out 7	Pulls in transmit/receive relay K2	POKE 49359,1	on
		POKE 49351,0	off
out 6	Pulls in telephone relay K1	POKE 49358,1	on
		POKE 49350,0	off
out 5	Sets input bit to latch U1C	POKE 49347,0	on
	and U1D to turn off primary power relay K4	POKE 49355,1	off
out 4	Pulls in high-frequency receiver mute relay K3	POKE 49356,1	on
		POKE 49348,0	off
out 3	Resets the fm decoder	POKE 49349,0	
out 2-out 0	Future control to be used to change the KWM-380 mode, between USB, LSB, and CW		
game port:			
AN0		POKE 49241,0	on
		POKE 49240,0	off
AN1	Parallel four-bit binary	POKE 49243,0	on
	code to the two-of-eight	POKE 49242,0	off
AN2	code converter to drive	POKE 49245,0	on
	the KWM-380	POKE 49244,0	off
AN3		POKE 49247,0	on
		POKE 49246,0	off
STROBE	Clocks data into the KWM-380	PEEK (-16320)	

an EMI filter. These aren't necessary, but I had them in my junk box, so I used them. Power is switched on when K4 supplies +12 volts to relay K1, located in the primary power-relay box. When the system is on and I'm away from home, I feel secure knowing there is some protection. Not shown is a 115-Vac antenna change-over relay that grounds the input to the receiver when power is off; when power is on, the antenna is ungrounded. The power supply uses 7812 and 7805 voltage regulators. The entire interface control operates from +12 volts and +5 volts. **Fig. 7** is the diagram of the interconnection between the interface control and the Apple's eight-bit I/O card. An optional goodie is the fm audio-decoder, whose schematic is shown in **fig. 8**. It allows direct access to the computer through the DTMF decoder via fm radio. This is used in case you want to operate remotely from VHF or UHF. The tone decoders are 567s and can be adjusted to detect any dual tone; I'm using tones from my keypad. It is activated by holding the proper key for eight seconds; both the telephone and fm radio operate the system, or the fm radio can operate alone. A command from data-out 3 resets the decoder (turns the fm audio off).

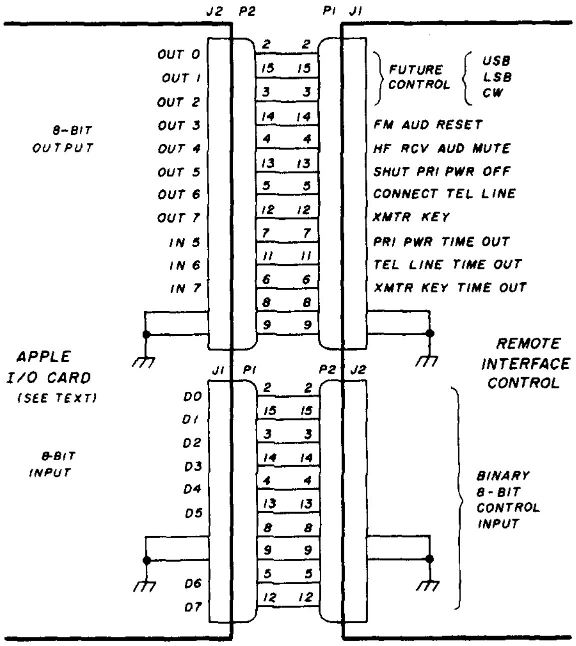


fig. 7. Wiring diagram from the Apple II to the remote interface control.

system operation

For testing, replace the telephone line with a 900-ohm resistor to provide balance to the hybrid. **Fig. 9** is the BASIC program. The program as listed will not autoboot; after the program is typed in and saved, insert a new disk and type: **INIT HELLO**. Apple DOS will create an autoboot disk. If the radio and Apple are off, push the digit 6 on the local TT keypad for five seconds. This allows U1A to charge the 10-μF delay capacitor to set latch U1C and U1D and enable relay K4. System power will now be on. Line 70 is the three-digit access code; this can be changed at will. I use 789 in this program.

Enter the access code and the program menu, which give prompts to each of the functional subroutines that will appear. This portion of the program is lines 400 through 540. There are six

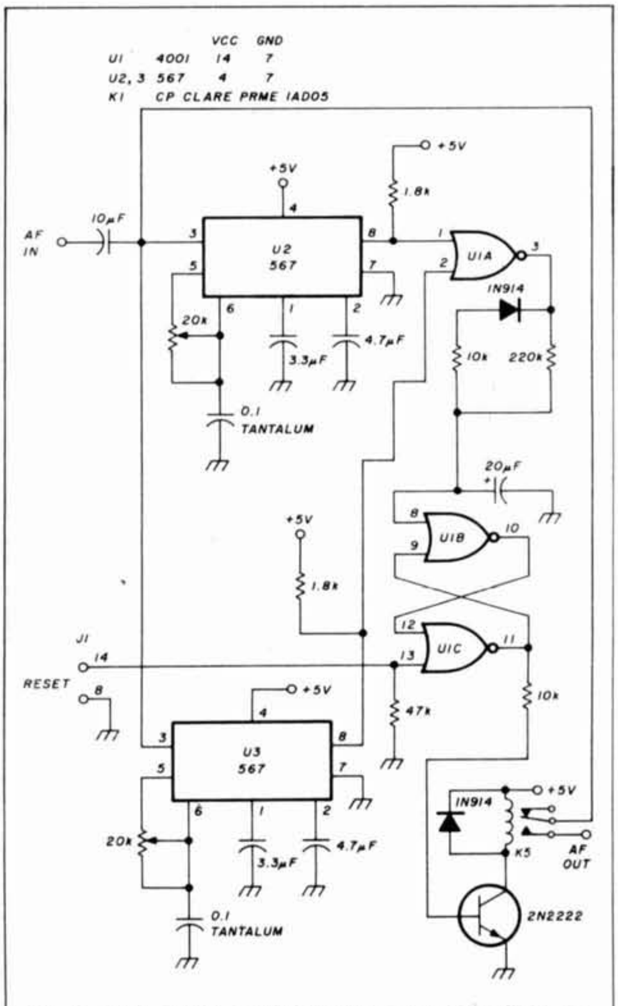
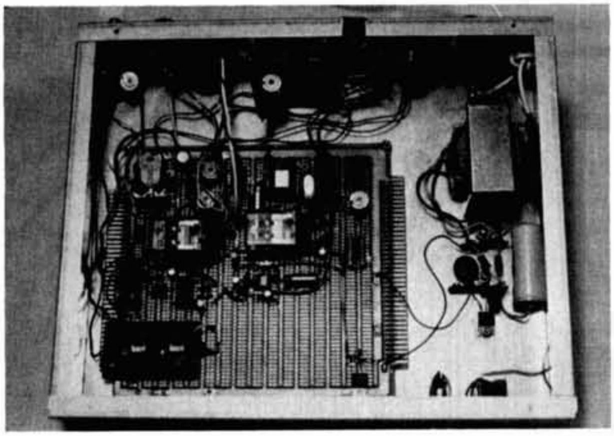
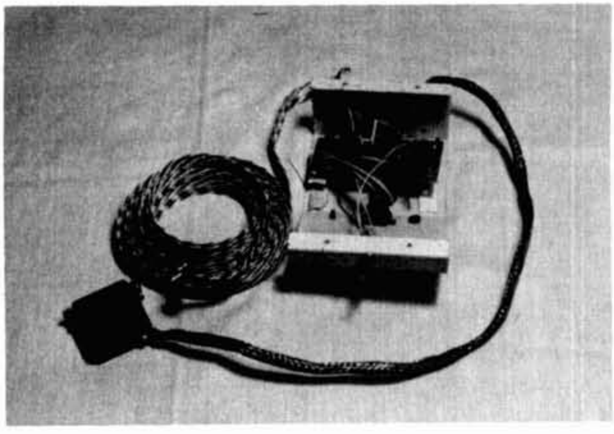


fig. 8. Optional fm audio-decoder schematic diagram. Any pair of tones can be selected. The tones must be held on for about eight seconds before relay K1 pulls in. This permits the system to be operated by an fm radio or telephone link.

This picture shows all the components that compose the high-frequency remote-control system. See fig. 1 for the block diagram.



This picture shows the remote control interface. This unit contains a phone patch, a DTMF decoder, level amplifiers, control logic and relays. See fig. 4 for its schematic. Note that space is available on the circuit board to fully remote the KWM-380.



This picture shows the frequency interface. It connects between the KWM-380 control interface connector and the Apple game port. See fig. 2 for its schematic.

subroutines, each of which can jump to its particular function when called. Lines 7000 through 7050 show how the Apple gets incoming data that is not from the keyboard.

For the Mute subroutine, enter 1; one beep sounds. This allows the # key to silence the KWM-380 or * key to return the audio. The subroutine will automatically return to the menu.

For the Frequency Enter subroutine, enter 2; two beeps sound. This subroutine allows the operator to enter any frequency. A * is used for the decimal place and # loads the KWM-380 and returns to the menu. An example for entering 14.225 MHz is **14*225#**.

For the Scan subroutine, enter 3; three beeps sound. Entering 1 makes the radio scan up. Entering 2 stops the radio from scanning. Entering 3 starts the radio scanning down. Entering * bumps the radio up 1 kHz; 7 bumps it up 100 Hz. Entering # bumps the radio down 1 kHz; 9 bumps it down 100 Hz. To return back to the menu, enter **0**.

For the Control Option subroutine, enter 4; four beeps sound. The Control Option subroutine allows # to reset the fm radio or * to shut off the primary power after you exit the program. This subroutine automatically returns to the menu.

fig. 9. BASIC program listing.

```
10  HOME : VTAB 12
20  PRINT "  <<<<<     REMOTE CONTROL    >>>>>"
30  HTAB 10: PRINT "WRITTEN BY DICK SANDER"
35  POKE 49358,1
40  FOR D = 1 TO 50: NEXT D
45  CALL  - 198
50  POKE 49350,0
52  HOME
54  REM  UNKEY:POKE 49357,1
56  POKE 49356,1: POKE 49347,0
60  PRINT "INPUT ACCESS CODE (3 DIGITS)"
70 AX = 7:AY = 8:AZ = 9
75  PRINT : PRINT "ACCESS CODE IS:": PRINT : PRINT
80  PRINT AX,AY,AZ
90  GOSUB 7000
100  IF B < AX OR B > AX THEN  GOTO 90
110  GOSUB 7000
120  IF B < AY OR B > AY THEN  GOTO 90
130  GOSUB 7000
140  IF B < AZ OR B > AZ THEN  GOTO 90
150  POKE 49358,1
160  POKE 49357,1
170  REM   MUTE:POKE 49356,1
180  REM  PWR ON:POKE 49347,0
400  REM  MENU
410  HOME
420  VTAB 3: HTAB 18: PRINT "MENU": PRINT
430  PRINT : HTAB 10
440  PRINT "1. ENABLE RECEIVER"
450  PRINT : HTAB 10
460  PRINT "2. ENTER FREQUENCY"
470  PRINT : HTAB 10
480  PRINT "3. SCAN FREQUENCY"
490  PRINT : HTAB 10
500  PRINT "4. CONTROL OPTIONS"
510  PRINT : HTAB 10
520  PRINT "5. TRANSMIT"
530  PRINT : HTAB 10
540  PRINT "6. EXIT"
690 A =  PEEK (50176)
700  IF A < 128 THEN 690
710 A = A - 128
720  IF A = 10 THEN A = 0
730  IF  PEEK (50176) > 127 THEN 730
740  IF A < 1 OR A > 6 THEN  CALL  - 198: GOTO 690
750  IF A = 1 THEN  GOTO 1000
760  IF A = 2 THEN  GOTO 2000
770  IF A = 3 THEN  GOTO 3000
780  IF A = 4 THEN  GOTO 4000
790  IF A = 5 THEN  GOTO 5000
800  IF A = 6 THEN  GOTO 6000
1000  REM   ENABLE RCVR
1010  CALL  - 198
1020  HOME : PRINT "* ENABLES RCVR - # DISABLES RCVR "
1030  GOSUB 7000
1040  IF B = 11 THEN  POKE 49356,1: CALL  - 198: GOTO 410
1050  IF B = 12 THEN  POKE 49348,0: GOTO 410
1060  IF B > 12 THEN  GOTO 1000
1070  IF B < 11 THEN  GOTO 1000
2000  REM  INPUT FREQUENCY
2010  CALL  - 198: CALL  - 198
2020  HOME : PRINT "ENTER FREQUENCY"
2025 SF$ = ""
2030 F =  PEEK (50176)
2040  IF F < 128 THEN 2030
2050 F = F - 128
2060  IF F = 10 THEN F = 0
2070  IF  PEEK (50176) > 127 THEN 2070
2080  IF F = 0 THEN  GOSUB 2250:SF$ = SF$ + "0"
2090  IF F = 1 THEN  GOSUB 2280:SF$ = SF$ + "1"
2100  IF F = 2 THEN  GOSUB 2310:SF$ = SF$ + "2"
2110  IF F = 3 THEN  GOSUB 2340:SF$ = SF$ + "3"
2120  IF F = 4 THEN  GOSUB 2370:SF$ = SF$ + "4"
2130  IF F = 5 THEN  GOSUB 2400:SF$ = SF$ + "5"
2140  IF F = 6 THEN  GOSUB 2430:SF$ = SF$ + "6"
2150  IF F = 7 THEN  GOSUB 2460:SF$ = SF$ + "7"
2160  IF F = 8 THEN  GOSUB 2490:SF$ = SF$ + "8"
2170  IF F = 9 THEN  GOSUB 2520:SF$ = SF$ + "9"
2180  IF F = 11 THEN  GOSUB 2580:SF$ = SF$ + "."
2190  IF F = 12 THEN  GOTO 2220
2200  PRINT F
2210  GOTO 2030
2220  GOSUB 2550
2230  GOTO 400
```

```
2240  GOTO 2030
2250  POKE 49241,0: POKE 49242,0: POKE 49245,0: POKE 49247,0
2260  GOSUB 2610
2270  RETURN
2280  POKE 49240,0: POKE 49242,0: POKE 49244,0: POKE 49246,0
2290  GOSUB 2610
2300  RETURN
2310  POKE 49241,0: POKE 49242,0: POKE 49244,0: POKE 49246,0
2320  GOSUB 2610
2330  RETURN
2340  POKE 49240,0: POKE 49243,0: POKE 49244,0: POKE 49246,0
2350  GOSUB 2610
2360  RETURN
2370  POKE 49240,0: POKE 49242,0: POKE 49245,0: POKE 49246,0
2380  GOSUB 2610
2390  RETURN
2400  POKE 49241,0: POKE 49242,0: POKE 49245,0: POKE 49246,0
2410  GOSUB 2610
2420  RETURN
2430  POKE 49240,0: POKE 49243,0: POKE 49245,0: POKE 49246,0
2440  GOSUB 2610
2450  RETURN
2460  POKE 49240,0: POKE 49242,0: POKE 49244,0: POKE 49247,0
2470  GOSUB 2610
2480  RETURN
2490  POKE 49241,0: POKE 49242,0: POKE 49244,0: POKE 49247,0
2500  GOSUB 2610
2510  RETURN
2520  POKE 49240,0: POKE 49243,0: POKE 49244,0: POKE 49247,0
2530  GOSUB 2610
2540  RETURN
2550  POKE 49240,0: POKE 49243,0: POKE 49245,0: POKE 49247,0
2560  GOSUB 2610
2570  RETURN
2580  POKE 49240,0: POKE 49242,0: POKE 49245,0: POKE 49247,0
2590  GOSUB 2610
2600  RETURN
2610  REM  STROBE ROUTINE
2620 ZZ =  PEEK ( - 16320)
2650  RETURN
3000  REM  SCAN FREQ
3125  CALL  - 198: CALL  - 198: CALL  - 198
3130  HOME : PRINT "STARTING FREQUENCY? "
3135  PRINT : PRINT
3140  HOME : VTAB 24: HTAB 20: PRINT SF$
3145  VTAB 5: HTAB 10
3150  PRINT "PUSH 1 TO INCREASE FREQUENCY"
3155  VTAB 7: HTAB 10
3160  PRINT "PUSH 2 TO STOP SCANNING"
3165  VTAB 9: HTAB 10
3170  PRINT "PUSH 3 TO DECREASE FREQUENCY"
3175  PRINT : PRINT
3180 T =  PEEK (50176)
3185  IF T < 128 THEN 3180
3190 T = T - 128
3195  IF T = 10 THEN T = 0
3200  IF T = 1 THEN  GOTO 3225
3205  IF T = 2 THEN  GOTO 3180
3210  IF T = 3 THEN  GOTO 3285
3211  IF T = 7 THEN  GOTO 3750
3212  IF T = 9 THEN  GOTO 3750
3213  IF T = 11 THEN  GOTO 3750
3214  IF T = 12 THEN  GOTO 3750
3215  IF T = 0 THEN  CALL  - 198: GOTO 410
3220  IF T > 3 THEN  CALL  - 198: GOTO 3180
3225  REM  SCAN UP
3230 X =  VAL (SF$)
3235 Y = X + 100
3240  FOR U = X TO Y STEP .00030
3245  REM   CHECK FOR NEW KEY
3250  IF  PEEK (50176) < 128 THEN 3260
3255  IF  PEEK (50176) - 128 = 2 THEN  HOME : CALL  - 198: GOTO 3140
3260  VTAB 20: HTAB 10
3265  PRINT U:J = U: GOSUB 3695
3270 SF$ =  STR$ (U)
3275  NEXT U
3280  GOTO 3140
3285  REM  SCAN DOWN
3290 X =  VAL (SF$)
3295 Y = X - 100
3300  FOR DN = X TO Y STEP  - .00030
3305  REM  CHECK FOR STOP KEY
3310  IF  PEEK (50176) < 128 THEN  GOTO 3320
3315  IF  PEEK (50176) - 128 = 2 THEN  HOME : CALL  - 198: GOTO 3140
3320  VTAB 20: HTAB 10
3325  PRINT DN:J = DN: GOSUB 3695
3330 SF$ =  STR$ (DN)
3335  NEXT DN
3340  GOTO 3140
3345  FOR I = 1 TO 9
3350  IF I = 1 THEN  IF  LEFT$ (C$,1) = "." THEN B$ = "0": GOSUB 3375
3355 B$ =  MID$ (C$,I,1): GOSUB 3375
3360  IF B$ = "E" THEN 3370
3365  NEXT I
3370  RETURN
3375 K =  VAL (B$) + 1
3380  IF K <  > 1 THEN 3395
3385  IF B$ = "0" THEN 3395
3390  GOTO 3405
3395  ON K GOSUB 3440,3455,3470,3485,3500,3515,3530,3545,3560,3575
3400  RETURN
3405  IF B$ = "A" THEN  GOSUB 3590
3410  IF B$ = "B" THEN  GOSUB 3605
3415  IF B$ = "C" THEN  GOSUB 3620
3420  IF B$ = "D" THEN  GOSUB 3635
3425  IF B$ = "E" THEN  GOSUB 3650
3430  IF B$ = "." THEN  GOSUB 3665
3435  RETURN
3440  POKE 49241,0: POKE 49242,0: POKE 49245,0: POKE 49247,0
3445  GOSUB 3680
3450  RETURN
3455  POKE 49240,0: POKE 49242,0: POKE 49244,0: POKE 49246,0
```

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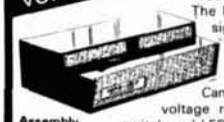

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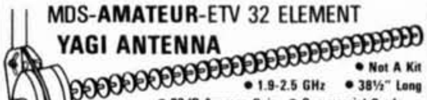

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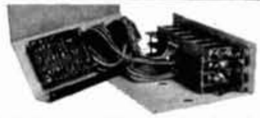

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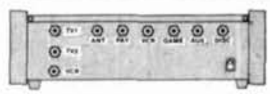

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```
3460  GOSUB 3680
3465  RETURN
3470  POKE 49241,0: POKE 49242,0: POKE 49244,0: POKE 49246,0
3475  GOSUB 3680
3480  RETURN
3485  POKE 49240,0: POKE 49243,0: POKE 49244,0: POKE 49246,0
3490  GOSUB 3680
3495  RETURN
3500  POKE 49240,0: POKE 49242,0: POKE 49245,0: POKE 49246,0
3505  GOSUB 3680
3510  RETURN
3515  POKE 49241,0: POKE 49242,0: POKE 49245,0: POKE 49246,0
3520  GOSUB 3680
3525  RETURN
3530  POKE 49240,0: POKE 49243,0: POKE 49245,0: POKE 49246,0
3535  GOSUB 3680
3540  RETURN
3545  POKE 49240,0: POKE 49242,0: POKE 49244,0: POKE 49247,0
3550  GOSUB 3680
3555  RETURN
3560  POKE 49241,0: POKE 49242,0: POKE 49244,0: POKE 49247,0
3565  GOSUB 3680
3570  RETURN
3575  POKE 49240,0: POKE 49243,0: POKE 49244,0: POKE 49247,0
3580  GOSUB 3680
3585  RETURN
3590  POKE 49241,0: POKE 49243,0: POKE 49244,0: POKE 49246,0
3595  GOSUB 3680
3600  RETURN
3605  POKE 49241,0: POKE 49243,0: POKE 49245,0: POKE 49246,0
3610  GOSUB 3680
3615  RETURN
3620  POKE 49241,0: POKE 49243,0: POKE 49244,0: POKE 49247,0
3625  GOSUB 3680
3630  RETURN
3635  POKE 49241,0: POKE 49243,0: POKE 49245,0: POKE 49247,0
3640  GOSUB 3680
3645  RETURN
3650  POKE 49240,0: POKE 49243,0: POKE 49245,0: POKE 49247,0
3655  GOSUB 3680
3660  RETURN
3665  POKE 49240,0: POKE 49242,0: POKE 49245,0: POKE 49247,0
3670  GOSUB 3680
3675  RETURN
3680  REM  STROBE ROUTINE
3685 ZZ =  PEEK ( - 16320)
3690  RETURN
3695 C$ =  STR$ (J) + "000000000"
3700  IF J < 1 THEN X = 6: GOTO 3715
3705  IF J < 10 THEN X = 7: GOTO 3715
3710 X = 8
3715 C$ =  LEFT$ (C$,X) + "E"
3720  GOSUB 3345
3725  RETURN
3750  REM  BUMP FREQ UP OR DOWN
3755 ST =  VAL (SF$)
3760  IF T = 11 THEN DL = .001
3765  IF T = 12 THEN DL =  - .001
3770  IF T = 7 THEN DL = .0001
3780 J = ST + DL
3785 SF$ =  STR$ (J)
3790  GOSUB 3695
3795  GOTO 3140
4000  REM  CONTROL OPTIONS
4010  CALL  - 198: CALL  - 198: CALL  - 198: CALL  - 198
4020  HOME
4025  PRINT "CONTROL OPTIONS:": PRINT : PRINT
4027  PRINT "   ENTER * TO MUTE FM RADIO"
4028  PRINT "   ENTER # TO SHUT OFF POWER"
4030  GOSUB 7000
4105  IF B = 11 THEN  GOTO 4110
4107  IF B = 12 THEN  GOTO 4140
4109  IF B < 11 THEN  GOTO 400
4110  POKE 49349,0
4120  FOR D = 1 TO 10: NEXT D
4130  POKE 49357,1
4135  CALL  - 198: GOTO 400
4140  POKE 49355,1
4170  CALL  - 198: GOTO 400
5000  REM  ENABLE XMTR
5010  CALL  - 198: CALL  - 198: CALL  - 198: CALL  - 198: CALL  - 19
5020  HOME : PRINT "* KEYS XMTR - # UNKEYS XMTR"
5030  GOSUB 7000
5040  IF B < 11 THEN  POKE 49351,0: CALL  - 198: GOTO 410
5050  IF B = 11 THEN  GOSUB 5090
5060  IF B = 12 THEN  GOSUB 5120
5070  IF B > 12 THEN  GOTO 410
5080  IF B = 11 THEN 5020
5085  IF B = 12 THEN 5020
5090  HOME
5100  POKE 49359,1
5110  RETURN
5120  HOME
5130  POKE 49351,0
5140  RETURN
6000  REM  EXIT
6010  REM  DISCONNECT RCVR & PHONE
6020  POKE 49350,0
6030  REM  UNKEY XMTR
6040  POKE 49351,0
6050  REM   10 MHZ WWV
6060  GOSUB 2280
6070  GOSUB 2250
6080  GOSUB 2580
6090  GOSUB 2550
6100  GOTO 75
7000 B =  PEEK (50176)
7010  IF B < 128 THEN 7000
7020 B = B - 128
7030  IF B = 10 THEN B = 0
7040  IF  PEEK (50176) > 127 THEN 7040
7050  RETURN
```

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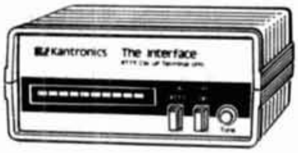

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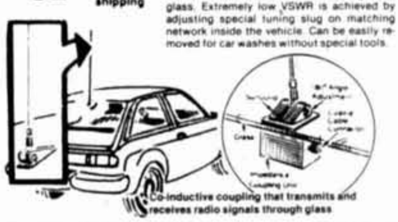

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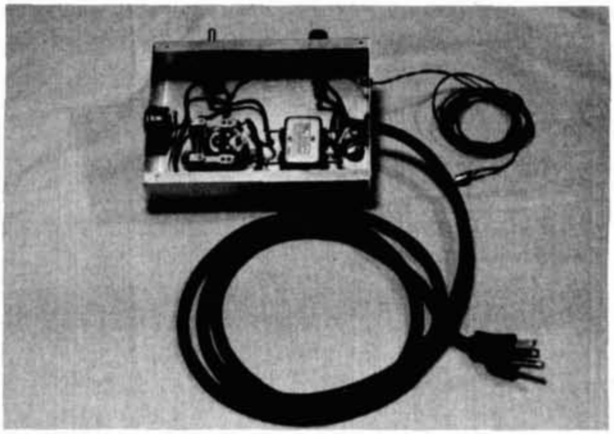
More Details? CHECK—OFF Page 129



This picture shows the primary power relay. Note the transient protection varistors and rfi filter. Relay K4, located inside the remote interface, controls power relay K1. See fig. 6 for its schematic.

For the Transmit subroutine, enter **5**; five beeps sound. Entering * keys the transmitter; # unkeys the *transmitter. Any digit will return to the menu.*

For the Exit subroutine, enter **6**; the interface control will disconnect the telephone line, tune the radio to WWV, and wait for another call; and turn off power if the control option sets power to off.

There are several smaller projects within this project. I have just touched on each, but I feel there is enough information here to reconstruct my system. The program listing does not contain any voice synthesizer coding; my system does, and it also contains the proper card. I use the voice talker to echo back the frequency after I've entered it, or when I stop scanning.

The system described in this article works reliably without a voice synthesizer. The KWM-380's remote interface allows frequency control only; so for now, I only operate 10/15/20 meters USB with the antenna connected to my tri-band beam. Fortunately, the engineers at Collins left the door open for full remote-control.

I'd like to mention what the future holds for this system. I will add mode selection for the KWM-380, to switch USB, LSB, or CW, along with the proper filter and passband tuning. Also, as an addition to this system or as a stand-alone project for the Apple, I will have an interface to my rotator for beam-heading control.

I really enjoy operating during my breaks at work; so far I've worked about twenty countries remotely. I've found one DX-pedition by using the scan mode.

I would also like to thank Tom McDermott, N5EG, for his technical assistance in this project.

ham radio

technical forum

Welcome to the *ham radio* Technical Forum. The purpose of this feature is to help you, the reader, find answers to your questions, and to give you a chance to answer the questions of your fellow Radio Amateurs. Do you have a question? Send it in!

diesel generator repair

Our organization has a government-surplus 10-kW diesel generator in need of repair. The battery recharging circuitry has been completely destroyed. The unit bears the following markings and information.

Unit markings:
Fermont Engine Generator plant
Division Dynamics Corp. of America
Bridgeport, Conn.
Model # J-141-1   Contract # J-141
Serial # J-141-0018
10 kW   12.5 KVA
PF   .80   120/208 V   35 A
60 cy.   3 phase   1800 RPM
Temp. rise 70°
Generator markings:
General Electric #
LC7470B16   Type 6J
Model # 5SJ4254P22Y12   Figure 2 generator
Dia/cen. 2261   Frame 254Y
Damaged unit markings:
Fermont # 6064-0001

Please contact us if you have a unit like this. We are in great need of any schematics, manuals, or other information on this unit, and will gladly make arrangements to obtain copies of this information.

The Division of Disaster and Emergency Service is a volunteer search-and-rescue group. We would greatly appreciate any assistance that can be supplied by the readers of *ham radio*.

Wayne Richardson
Lebanon Junction Area Coord.
Bullitt Co. Div. Disaster & Emergency Services
Main Street
Lebanon Junction, KY 40150

another 10-meter beacon

I am writing to inform you that I have designed and built a beacon controller and transmitter and that it is currently in (what I hope will be) permanent operation on 28.208 MHz. The beacon runs twenty-four hours a day, seven days a week, with an input power of 75 watts CW. QSL information is transmitted along with the beacon transmission.

I hope that *ham radio* readers will find this a propagation aid; and the presence of this signal should indicate when the band is open into New England. The antenna is a ground plane at a height of 20 feet (6.1 meters) with 16 one-wavelength long radials.

(I am presently looking for donations of old Novice transmitters which might make a suitable replacement for my current transmitter, should the need arise. Keeping a transmitter on the air continuously can be quite taxing to transmitters designed for Amateur use. I would particularly like to find a Drake 2NT or a DX-60A.)

Leonard J. Umina, WA1IOB
607 Sudbury Street
Marlboro, MA 01752

I am considering transistorizing my old Drake TR-3 transceiver. I do not wish to build or buy the plug-in units that operate from the 250-volt supply in the TR-3. I propose to rectify and filter the 12.6-volt ac originally used for the heaters.

The TR-3's i-f stages use 12BA6 tubes, with plate resistance of 1 megohm and transconductance of 4400 micromhos. I haven't found any single transistor which will match these characteristics, along with high input impedance. Of course I would like to use a single transistor, but I am willing to use two per stage if necessary. Can you help? — Farrell A. Buckley, AK7N

One solution to your question is to use the Solid State Tubes sold by Sartori Associates, P.O. Box 2085, Richardson, Texas 75080. They offer a replacement for the 12BA6. Other solutions are no doubt possible. Perhaps one of our readers can offer a suggestion?

ham radio

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More Details? CHECK—OFF Page 129

ham radio TECHNIQUES

Bill Orr W6SAI

More and more Amateurs are faced with the problem of getting on the air from a location where a full-size antenna cannot be erected. What's the answer? Stay on 2 meters and work the local repeater? If only the high-frequency antenna could be magically reduced in size!

Mini-antennas have been used on the high-frequency bands for a long time, the most compact type being the loaded whips for mobile service. While these ultra-short antennas do work, their efficiency is very low (of the order of one or two percent) and their bandwidth is very restricted. As the antenna shrinks in size, compared to the length of the radio wave, efficiency drops and bandwidth decreases. However, it is possible to strike a compromise and achieve good efficiency in an antenna that is smaller than the classic half-wave dipole.

the loaded antenna

Serious investigation of the coil-loaded short antenna started about 1933 when the General Electric Company developed experimental radios for the new mobile police communications system working on the "ultra-high" frequency of about 35 MHz. A summary of the results appeared in the September, 1934, issue of *QST*. The investigation was continued in 1940 by the National Park Service. The N.P.S. wanted 2-4 MHz mobile operation for the mountainous regions of the National parks, many of which exhibit VHF blind spots.[2]

```
100 REM PROGRAM FROM CQ MAG DEC 1981 BY DICK SANDER,  K5QY
200 REM PUT ON TRS-80 AND EXPANDED BY W6EDE FOR W6SAI
400 CLS
500 PRINT"          **   LOADED DIPOLE DESIGN PROGRAM   **"
510 PRINT
520 PRINT "THIS PROGRAM REDUCES ANTENNA TO 1/2 ACTUAL SIZE AND"
525 PRINT
530 PRINT "INSERTS THE COIL IN THE CENTER OF EACH SIDE"
600 PRINT
700 INPUT"HOW MANY FREQ ARE YOU GOING TO INPUT (10 MAX)";Z
710 FOR I=1 TO Z
720 PRINT "FREQ #";I;: INPUT F(I)
730 NEXT
740 FOR I=1 TO Z
750 F=F(I)
900 A=234/F
1100 B=58.5/F
1300 X=((234/F)-B)
1400 Y=((A/2)-B)
1450 IF D)0 THEN 2100
1500 INPUT"DO YOU WANT TO USE THE WIRE TABLE ( Y OR N )";Y$
1600 IF Y$="Y" THEN GOSUB 3000
1700 IF Y$="N" THEN GOSUB 4300
1800 IF Y$="Y" THEN 2100
1900 IF Y$="N" THEN 2100
2000 GOTO 1500
2100 S1=1.E+6/(68*3.1415+2*F+2)
2200 S2=1/X*(LOG(24*X/D)-1)
2300 S3=(1-F*B/234)+2-1
2400 S4=1/Y*(LOG(24*Y/D)-1)
2500 S5=(Y*F/234)+2-1
2600 S6=S1*(S2*S3-S4*S5)
2650 IF I=1 THEN 2700
2660 GOTO 2703
2700 LPRINT" FREQ","TOTAL","CENTER","COIL","WIRE"
2701 LPRINT" MHZ","LENGHT","TO","IND","DIAM."
2702 LPRINT,"FEET","COIL","UHY","INCHES"
2703 LPRINT
2705 LPRINT F,A,B,S6,D
2900 NEXT I
2901 END
3000 PRINT
3100 INPUT "WIRE GAUGE (#10 TO #22)      ";D
3200 IF D=10 THEN D=.101:RETURN
3300 IF D=12 THEN D=.081:RETURN
3400 IF D=14 THEN D=.064:RETURN
3500 IF D=16 THEN D=.058:RETURN
3600 IF D=18 THEN D=.040:RETURN
3700 IF D=20 THEN D=.032:RETURN
3800 IF D=22 THEN D=.025:RETURN
3900 PRINT
4000 PRINT"WIRE GAUGES MUST BE AN EVEN"
4100 PRINT"NUMBER IN THE RANGE 10-22"
4200 PRINT:PRINT: GOTO 3000
4300 PRINT
4400 INPUT"WHAT IS THE ELEMENT DIAMETER IN INCHES";D
4500 RETURN
```

fig. 1. Loaded dipole program for the TRS-80.

The conclusions of both these investigations point up that a very short, loaded antenna could be made to work well provided it was properly designed. One of the main requirements of proper design was that a high-*Q* loading coil be used, and that it be placed near the center of the antenna section.

It was there that the matter rested until Jerry Hall, K1PLP, published a classic article in the September, 1974, issue of *QST*, giving a procedure for determining the inductance of a loading coil no matter where it was placed in an antenna.[3] Jerry's example used a dipole instead of a mobile whip. This interesting mathematical exercise was converted into a computer program by Dick Sander, K5-QY, and published in the December, 1981, issue of *CQ*.[4] The short, loaded antenna had finally arrived.

loaded dipole program for the TRS-80

Dick's program was designed to be

used with an Apple II computer, but my good friend Dick Rasor, W6EDE, easily converted it for use with the TRS-80 (**fig. 1**). A little work with the program showed up some interesting aspects of the loaded dipole which previously had been obscured by the difficulty of the mathematics. These difficulties were now reduced to punching a few computer keys!

An illustration of the loaded dipole is given in **fig. 2**. For simplicity, the loading coils are located midway down the arms of the dipole: early experiments indicated this was the best place to put a loading coil if the assembly was to avoid becoming mechanically too complex.

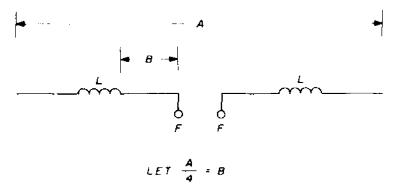


fig. 2. Loaded dipole with loading coils placed one-half the distance from the feedpoint (F-F) to the end. Distance A is one-quarter wavelength.

A computer run of the antenna design shows why coil placement is critical. **Fig. 3** plots coil placement against coil inductance. One limit on where the coil can be placed is seen at point 1, the feedpoint of the antenna. A feedpoint-loaded dipole places the coil at the point of maximum current, where the stored magnetic energy is high. A minimum value of inductance is required to establish resonance there, but — unfortunately — the portion of the antenna that does the most radiating is the portion with the maximum current. Winding it up into a coil reduces the radiation resistance, reduces bandwidth drastically, and leads to high antenna losses, principally because the coil will have relatively high loss no matter how well it is built.

Farther out along the antenna, the stored magnetic energy decreases and the inductance required in any coil placed there increases. At the same time, more of the high-current center section of the antenna is permitted to radiate. Antenna efficiency rises and the radiation resistance increases. Good!

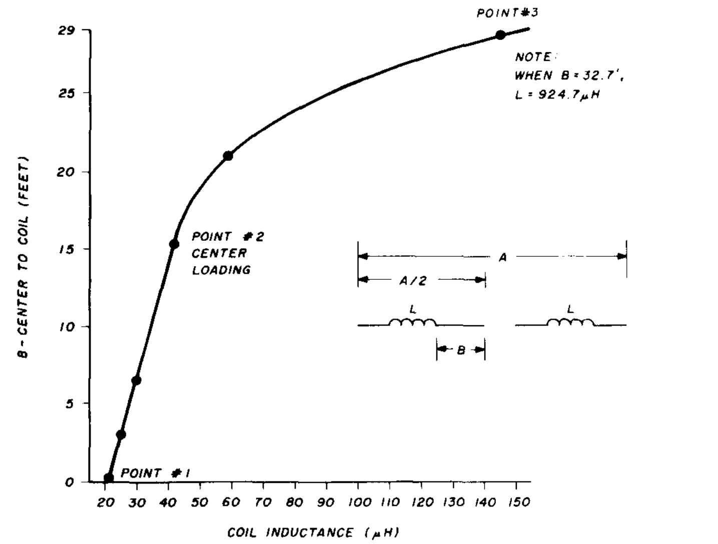


fig. 3. Inductance increases as the coil moves outward from the center of the loaded element. The increase in inductance is linear until coil reaches the center point of the element, and then it increases rapidly approaching the tip. If the coil is placed at the tip, inductance would theoretically have to be infinite. Coil loss increases with inductance, and point 2 on curve represents a practical compromise. Point 1 is for base loading.

But observe what happens when the coil passes the center point of the dipole leg (point 2). Now instead of increasing somewhat linearly with distance, the coil inductance increases rapidly. When the coil is placed near the end of the antenna (0.3) the required inductance value is more than seven times the value required for center (base) loading, and more than three times the value required when the coil is placed near the midpoint of the element.

It is tempting to place the loading coil near the tip of the antenna element; then, the whole element section has a high value of current in it, and this is thought best for antenna efficiency. But imagine a 925-µH inductor at 3.5 MHz. It would be four inches in diameter and have nearly two-hundred turns on it. The length would be over a foot, depending upon wire size. Placing such a coil at a high potential point in an antenna would result in fireworks: corona and brush discharge would occur with but a few watts of power applied. (And the coil would probably burn up after dust and dirt collected on it. In fact, all that would be required to do the job would be fog or rain.)

Fig. 4 shows the inductance of coils needed to make a half-size dipole for the various high-frequency bands. Although the antenna is not thereby reduced to its theoretically smallest size, this will show how an antenna can be cut fifty percent in size and still do a good job.

The computer printout that derived **fig. 4** was based on an antenna using No. 16 wire for the coils and flattop. If a larger size wire is used, the tip sections of the antenna should be shortened a few inches (this is not critical).

With this data, a short dipole for 3.8 MHz works out to be about 61 feet 6 inches (18.94 m) long. The loading coils are each 40.1 μH, and they are placed 15 feet 4½ inches (4.69 m) from the center of the insulator.

How do you wind a 40.1-μH coil? There's a computer program for that, no doubt, but I don't have one at hand. However, the simple formula shown in **fig. 5** will do the job.

feeding the loaded dipole antenna

With a portion of the antenna wound up into a loading coil (L_1), the radiation resistance of the antenna drops drastically. For this design, the feedpoint resistance (composed of the radiation resistance plus the loss resistance of the coils) is about 22 ohms. This figure varies with height of the antenna above ground. Taking this value as par, the inductor-match system (hairpin match) developed by Gootch, Gardner, and Roberts will do the job.[5] For this antenna design, an inductor of about 44-ohms reactance (L_2) is placed across the antenna feedpoint. At 3.8 MHz, this corresponds to a coil of 1.86 μH. The reactance of the coil is derived from the graph in **fig. 6**.

Since the inducto-match is a simple L-network, the capacitive portion of the circuit is achieved by slightly shortening the antenna. Four inches off each end is about right, and the completed antenna is shown in **fig. 7**.

complete TRS-80 program for all bands

Using this information as a starting point, some smart computer programmer can develop a complete TRS-80 program which includes the design of the inducto-match coil. And, in addition, the program might be further expanded to include large-diameter elements. This will permit vertical antennas composed of aluminum tubing to be quickly designed for the lower frequency bands. I'll be happy to hear from anyone who completes this task.

no-code ham license?

A lot of flak is flying around about the so-called no-code license proposed by the FCC. The arguments against a no-code license seem to fall into two categories:

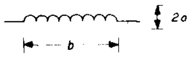
1. I had to pass a code test, so why shouldn't the next guy?

2. A no-code license will open the door to CB operators, who will ruin the ham bands.

I won't comment on the first argument, or the accompanying argument over tradition; others can fight that battle. But I would like to discuss the second argument that a no-code license would open the door to CB operators, who will ruin the ham bands.

frequency	total length feet	center to coil feet	coil inductance μH	wire diameter inches
1.82	128.57100	32.14290	91.88680	0.058
3.51	66.66670	16.66670	43.87170	0.058
3.80	61.57900	15.39470	40.10240	0.058
7.15	32.72730	8.18182	19.53040	0.058
10.11	23.14540	5.78635	13.12140	0.058
14.17	16.51380	4.12844	8.88137	0.058
18.11	12.92100	3.23026	6.67597	0.058
21.20	11.03770	2.75943	5.55306	0.058
24.95	9.37876	2.34469	4.58680	0.058
28.60	8.18182	2.04545	3.90515	0.058

fig. 4. Computer-derived table of the inductance values of coils needed to make a half-size dipole.



$X_L = 2\pi fL$

WHEN f = MHz AND L = μH, THEN

$$L = \frac{X_L}{6.281}$$

$$L(\mu H) = \frac{a^2 n^2}{9a + 10b}$$

n = NUMBER OF TURNS

fig. 5. Formula for calculation of small close-wound coils for a given value of reactance, when f in MHz is known.

Perhaps this is true. But perhaps the CBers don't want to work in a VHF ham band! How about that!

It is very instructive to tune across the hf spectrum with an "all-wave" receiver. Anyone who does will note that there's a tremendous amount of illegal sideband activity between 26.2 MHz and 27.99 MHz. I believe there are more unlicensed stations in this portion of the spectrum than there are licensed stations in all the ham bands, at any one given time. This portion of the spectrum is jammed with thousands of signals.

These pirate operators are called "CBers." Perhaps this is an inaccurate epithet. I doubt if the majority of them have a CB license, and I prefer the term *pirate*. That does not imply CB operation. Be that as it may, the point I am bringing out is that these pirates operate wherever they wish, using modified ham gear. If they want to work on 144 MHz, or 220 MHz, they will do so — regardless of whether or not a no-code license exists.

When the sunspot count drops and the MUF falls, the 11-meter region will be barren of long-distance contacts. What will the tens of thousands of pirate operators do then? Go to the new no-code ham license? I doubt it.

Already many pirate operators in Europe are using the 6.6 to 6.8 MHz portion of the spectrum for SSB operation. The pirates tend to avoid the ham bands. They operate in the large

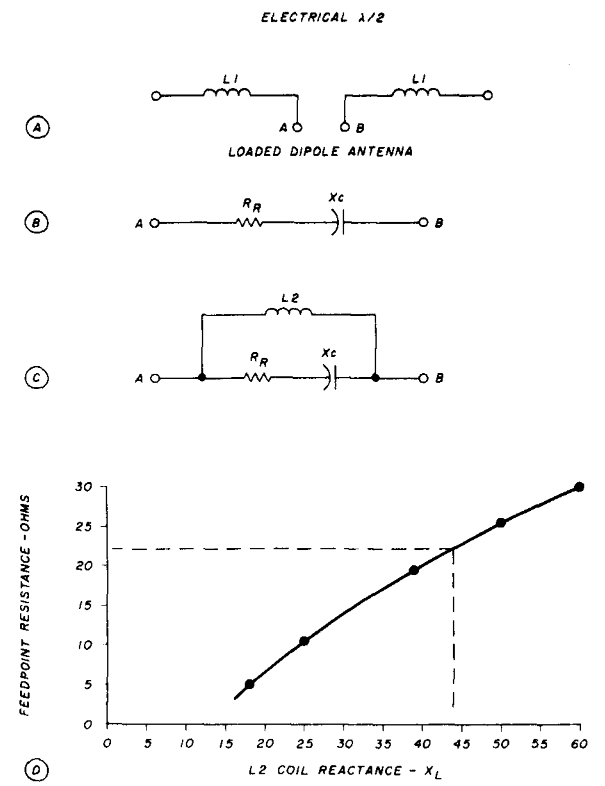


fig. 6. The coil-loaded dipole forms a portion of a network whose input impedance over a small frequency range is close to 50 ohms. The loaded dipole, *A*, has a low value of radiation resistance and loss resistance, which appears at feedpoint A-B. This low impedance can be made part of an equivalent parallel resonant circuit in which the total feedpoint resistance appears in series with the reactive branch of the circuit. *B*: The input impedance of such a circuit varies nearly inversely with the radiation resistance of the dipole, thus the low value of feedpoint impedance can be transformed to a larger value to match the line impedance. *C*: The dipole appears as a capacitive reactance by shortening the element past its resonant length. The inductor L2 consists of a small coil placed across the terminals of the dipole. The reactance of the matching coil is a function of the feedpoint resistance of the antenna. *D*: The dashed line is the example given in the text. Apply reactance value to formula given in *fig. 5*.

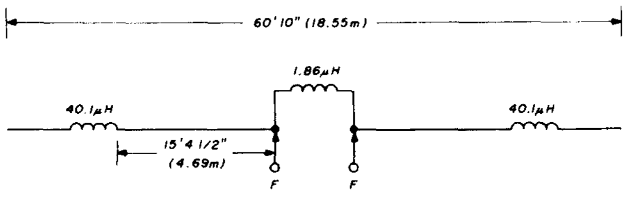


fig. 7. Compact, coil-loaded dipole for 3.80 MHz. Tip length is adjusted for minimum SWR at design frequency. Coil is wound with No. 16 (M1.3) wire per data in *fig. 5*.

spaces in the commercial and point-to-point regions, where few if any signals exist.

I say that the fear that pirates might invade ham radio via the no-code license is unfounded. They will come in only if they want to, regardless of the license structure, and my prediction is that there are more attractive places in the radio spectrum for them to occupy than a ham band. So I don't see the foundations of ham radio crumbling because a no-code license is introduced.

As time goes on the number of pirate stations will increase, because the various communications authorities throughout the world seem powerless to stop them. A few pirates will inevitably invade the ham bands from time to time, but this will have nothing to do with the Amateur Radio licensing structure. The problem has been swept under the rug up to now, yet it increasingly involves all the radio services. Pirate radio includes illegal broadcasting on medium and shortwave and VHF. In Europe, pirate broadcasting clogs the fm band and the quieter broadcast band channels. There are pirate television stations in operation in Europe, and Central America is full of illegal broadcasting. So far, radio hams are lucky; little of this trash has fallen in their bands. The pirates prefer to go where they can operate under less scrutiny than in a busy ham band.

So don't worry about a VHF no-code license. The pirate operators have more alluring possibilities open to them than competing with hams in a short-range, line-of-sight service.

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2. Hilgedick and Morgan, "Raising the Efficiency of Short Vertical Radiators," *QST*, December, 1940, pages 30-33.
3. Hall, "Off-Center Loaded Dipole Antennas," *QST*, September, 1974, pages 28-34.
4. Sander, "A Computer Designed Loaded Dipole Antenna," *CQ*, December, 1981, page 44.
5. Gootch, Gardner, and Roberts, "The Hairpin Match," *QST*, April, 1962, pages 11-14.

ham radio

a microprocessor repeater controller

A versatile controller for two repeaters

Our radio club recently relocated its 2-meter repeater to a site with a much higher antenna. The repeater committee decided to make major improvements in the control system to accommodate this move. We had a 220-MHz repeater also under construction, and would need a controller for that system as well.

The original controller was a small, wire-wrapped board using 556 timers, some counters, and a ROM for the CW identification. Remote control was by phone line and was not sophisticated. Past experience with this system indicated that adding any simple function would be a major task. Microprocessor enthusiasts in the club had the solution: build *one* microprocessor-based controller for both bands!

The final design may be expanded upon easily. In addition to the hardware description, I would like to

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share some of our thoughts and decisions that went into creating the final design.

the design approach

Deciding to use a microprocessor as a controller was easy. In the long run it would be cheaper, and it's easier to add features by reprogramming than to add separate pieces of specialized hardware. Some new circuitry would be needed as features were added, but such circuitry would be simple interfaces.

Reliability would be good, thanks to the high reliability of digital circuits and the lower parts count per function (compared with standard small and medium-scale integrated circuits). Two decisions had to be made: which microprocessor to use, and what features to include in the new controller.

selecting a microprocessor

The microprocessor we finally decided on would have to be easy to program in assembly language, have a simple input/output (I/O) structure, and be supported by good development software. The microprocessor instruction set should be able to handle reentrant programming, allowing one program module to share multiple data sets.

The Intel 8080, Zilog Z80, Motorola 6800, and Texas Instruments 9900 microprocessors were all candidates for our application. The 8080 or Z80 at first appeared to be the best choice. A friend had built an 8080 controller six years ago for the WR8ANW repeater in Columbus, Ohio. The program listing used for that controller was available and could have been converted for our needs. Several club members had 8080 systems that they used for software and hardware development. A major drawback of the 8080 was its I/O structure and the difficulty of writing clean, reentrant code for it.

The Z80 has few of the shortcomings of the 8080. It can set and test single bits in operands, has an indexed addressing mode, and allows I/O port addresses to reside in one of its internal registers. Reentrant programming is easier with it. Unfortunately, none of the club members had Z80 support software at that time.

The 6800 was not really in the running. None of the club members were familiar with it; we would be starting from scratch. This doesn't mean the 6800 won't work for this application. The WR8ANW repeater group, mentioned earlier, has completed a 6800-based controller.

The TMS9980 was our final choice. It is easy to write reentrant code for the 9900 family since any register may be an index. Interrupts are easily handled. Since all general purpose registers are in memory, the only registers saved on interrupt are the program counter, status register, and workspace pointer. These three restore automatically after interrupt servicing, reducing the programming load. And, support software which became available to the club on a larger 990 minicomputer proved to be a valuable tool when it came time to assemble and edit the controller programs.

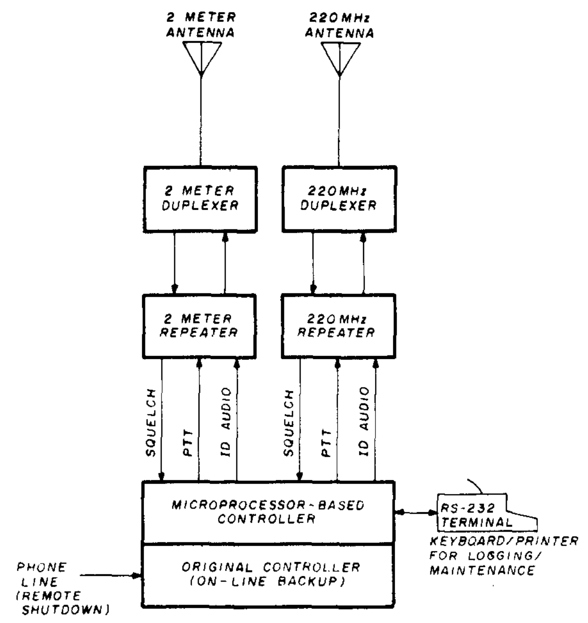

fig. 1. Overall system block diagram of the K5OJI double-frequency VHF repeater. New controller includes a keyboard/printer terminal for logging and maintenance. Original controller on-line for backup. Telephone remote shutdown disables entire system.

table 1. CRU address decodes in TMS9901 PSI. Addresses are in hexadecimal.

CRU hardware address	R12 contents	device
00	00	–
20	40	–
40	80	9902(A)
60	C0	9902(B)
80	100	9901
A0	140	–
C0	180	–
E0	1C0	–

a choice of features

A list of the minimum functions required for our application was drawn up. These included CW identification, a variable time-out timer, a beep to indicate time-out, timer reset, and a status-logging rou-

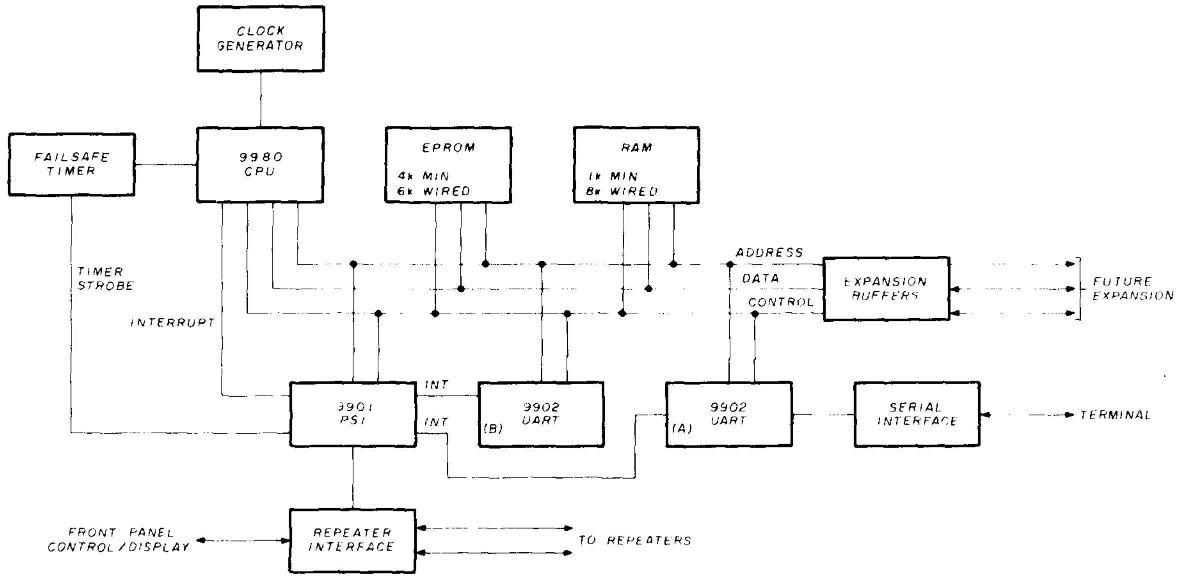

fig. 2. Block diagram of new microprocessor controller. Architecture allows expansion for future functions.

tine to print hourly status reports on a terminal. The time of day was added to the CW ID since there would be a counter keeping track of time in the program.

Keeping the original controller, modified to operate as a backup, would retain telephone line shutdown with the ability to disable the repeaters regardless of which controller was operational.

Fig. 1 is the repeater system block diagram. It was constructed so that adding new features would cause only a few hours of downtime. New programming may be installed while the backup controller handles the repeater. Some of the new features include a tone decoder, a modem for RTTY I/O and control, and even a voice synthesis module.

We had defined the general system; features were chosen and the microprocessor would use TMS9900 family components. This left only the hardware details to design.

build or buy?

Texas Instruments makes several single-board microcomputers. The TM990/100 and TM990/180 boards have a small prototyping area where additional interface circuitry can be built. Each has plenty of onboard EPROM and RAM for program operation.

The final program would be burned in the EPROM, but I wanted to put the program in RAM first to do the final debugging and possible patching. The temporary RAM test-space would be free after program verification. The free RAM could then be used for other functions, perhaps as a message storage area for RTTY users. The only way to get enough check-out RAM with the TM990 boards is to add at least one additional board.

Designing and wire-wrapping a single board with enough memory and I/O components to meet the basic criteria seemed the best way to proceed. It would include enough circuitry to bring address, data, and control lines off the board for later additions. Later features could be added using separate boards.

Fig. 2 is the single-board controller block diagram. Memory and I/O addressing are similar enough to the TM990 board series to allow using the TIBUG™* monitor ROM for program check-out, and also allow the final debugged control program ROMs to be installed and run on the TM990 board.

solidifying the design

Figs. 3, 4, and **5** are the schematics for the controller board. Signal mnemonics connect the three main schematic groups. Two edge connectors, P1 and P2, connect the controller to the rest of the system. Details begin with **fig. 3**. The controller chassis is seen in **photo 1**.

The Central Processor Unit (CPU) is a TMS9980 with an 8-bit data bus and addressing to 16K (16,384) bytes, more than sufficient for this application. CPU clock frequency is 10 MHz, from the crystal-controlled inverter oscillator in U8. External device clocking is available at U20-22, marked $\overline{\text{Ø3}}$.

The CPU resets by interacting with peripheral interfaces, shown in **fig. 5**. Power-on reset for these in-

*TIBUG is the Texas Instruments debugging utility.

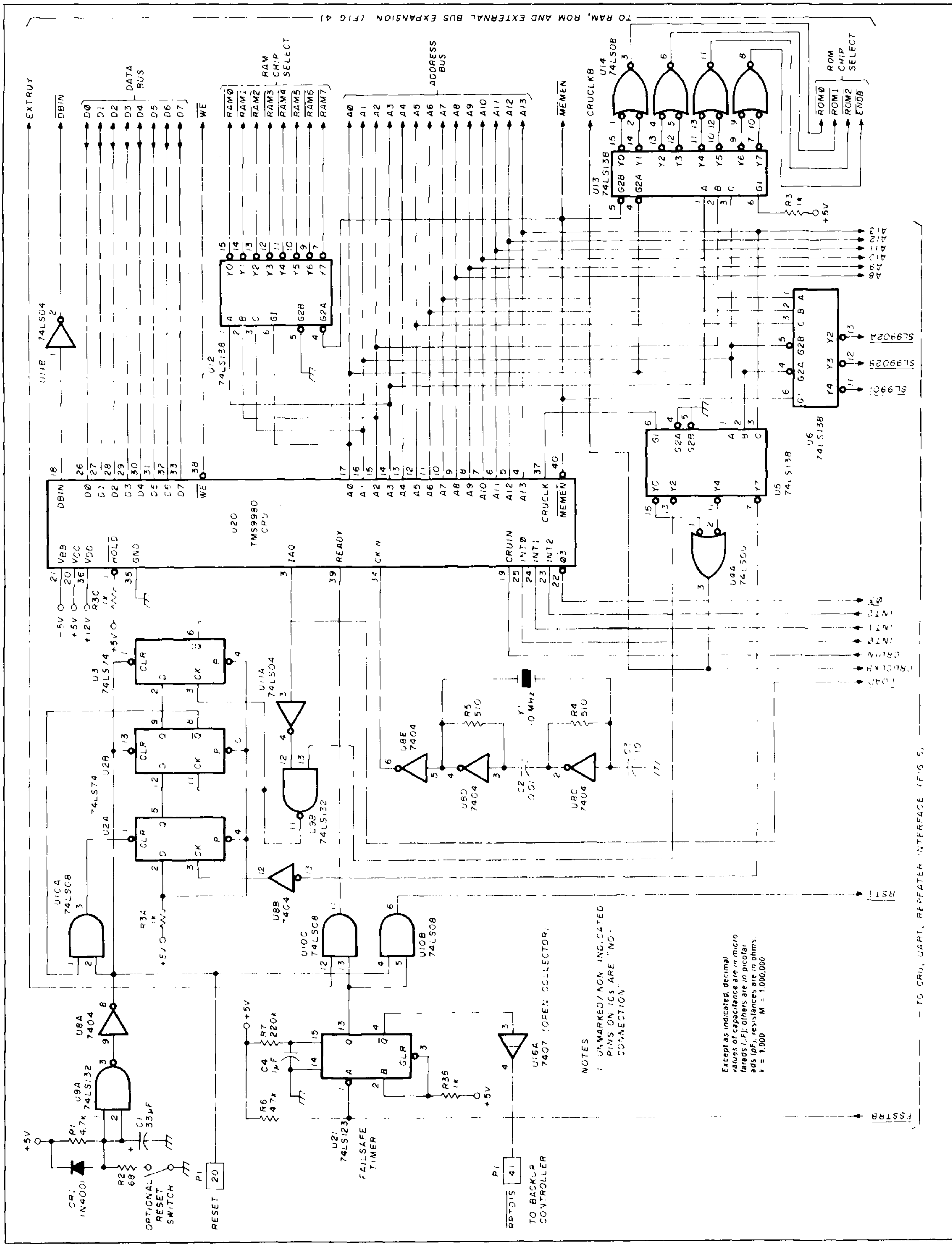

fig. 3. Schematic of central processor, address decoder, clock and reset circuitry. P1-4 face in fig. 5.

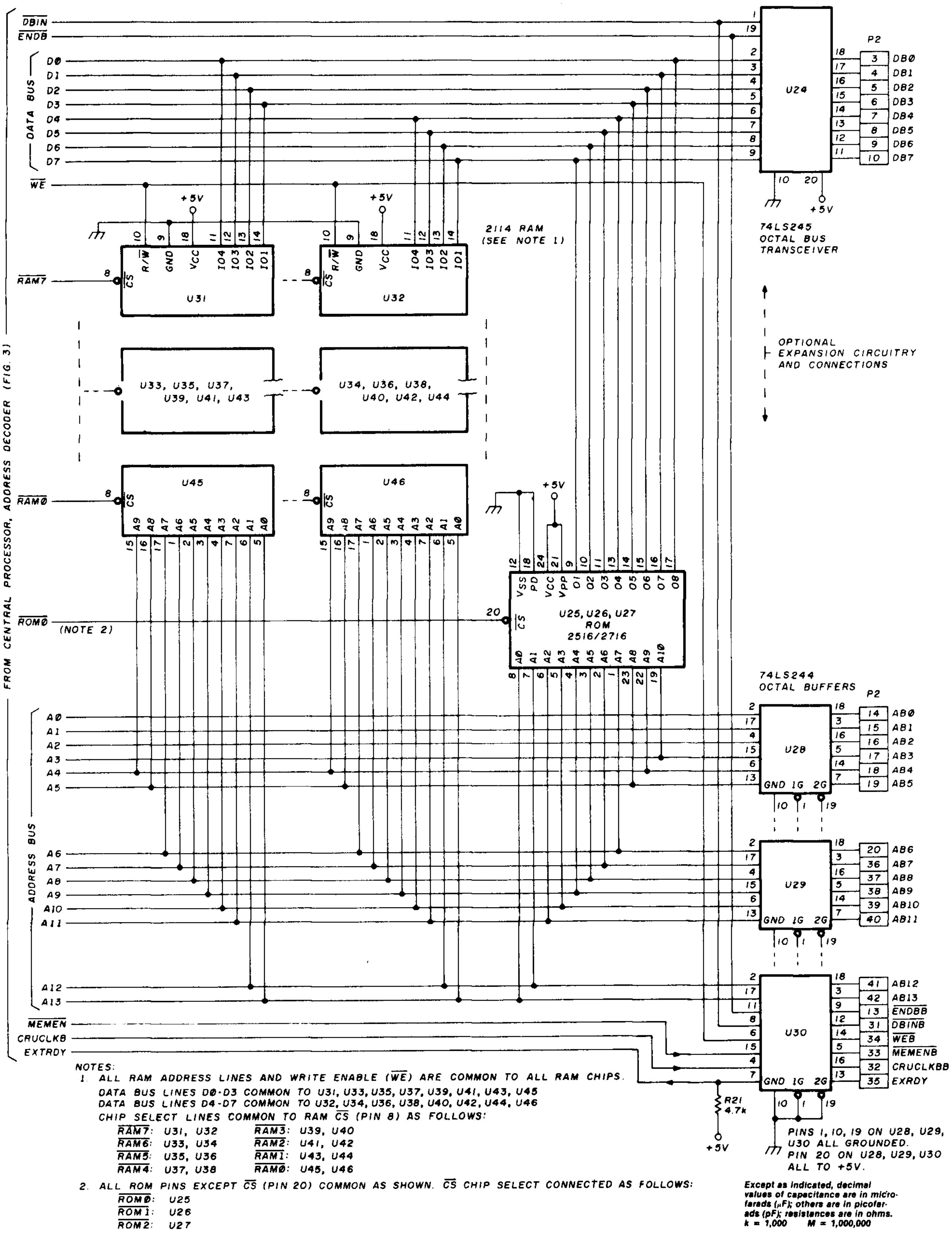

fig. 4. Memory and expansion bus interface. Bus buffers and transceiver may be added later. U31 and U32 are minimum requirements for RAM, U25 and U26 minimum for ROM.

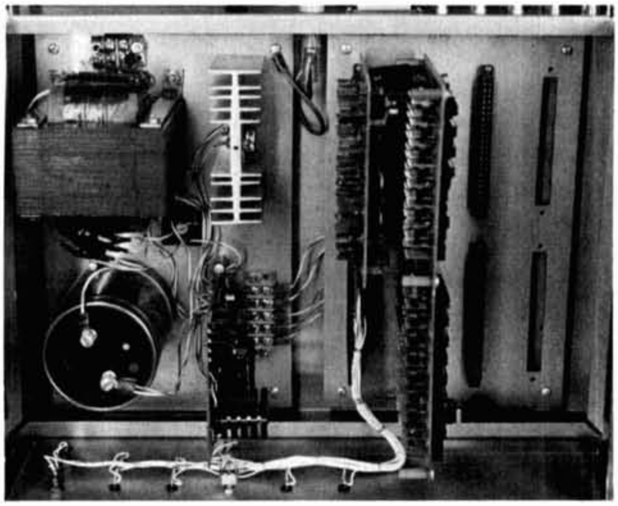

photo 1. Top view of controller chassis with power supply. New controller is long board in second slot. Stand-offs protect wire-wrap pins on IC sockets. First slot contains old controller, smaller board toward chassis rear. Small board in first slot toward front panel contains LED resistors and wire connections to front panel. Empty slots are for future expansion. Edge-connector socket pairs wired in parallel with P1/S1 toward front.

terfaces is provided by Schmitt-input gate U9A, R1, C1 through U8A and U10B to the RSTI line. A normally open reset switch may be added for testing. RESET at P1-20 to reset future external circuits.

The failsafe timer one-shot at U21 is re-triggered by the program through FSSTRB every 16.7 milliseconds. As long as the controller is operational, RPTDIS at P1-41 remains low and disables the backup controller. Controller failure will make RPTDIS high and enable the backup; a TTL pull-up resistor is located in the backup controller.

Flip-flops U2 and U3 generate proper LOAD timing for the interface chips with the help of decoder U5 and gate U9B. The ready signal input to the CPU (U20-39) must be high for normal operation with memory; the low state causes a CPU wait mode, to allow for access with slow memory. AND gate U10C keeps the ready signal high via the failsafe one-shot and expansion signal EXTRDY.

RAM is organized in 1K banks, chip-pairs selected by U12. ROM is in 2K banks, selected by U13 and U14. ENDB is a fourth 2K bank select for expansion. U6 selects the interface chips and is wired for selecting one of three 32-bit CRU I/O bit groups. Addressing is detailed in the last section.

memory and bus expansion

Fig. 4 is a simplified memory schematic. Static RAM uses 2114 devices having a 1K by 4-bit structure. Address lines A4 to A13 and write enable WE are common to all RAM chips, but data bus lines must be split as indicated. RAM chip select lines RAMØ to RAM7 must be common only to a pair of 2114s.

All ROM pins except chip selects ROMØ to ROM2 are common. Either a 2516 or 2716 EPROM may be used for ROM, but there is a slight programming difference between the two. Both RAM and ROM may use 450 nanosecond access time devices.

A minimum system must have U25, U26, U31, and U32 installed. All memory sockets are wired for ease of check-out. The board in **photo 2** shows 4K RAM installed for program verification. The memory map is seen in **fig. 4A**.

Bus transceiver U24 and bus buffers U28 to U30 are needed only if expansion is considered. R21 must remain to hold EXTRDY high if U30 is removed.

talking to the rest of the system

The TMS9901 Programmable Systems Interface (PSI) is the key device in **fig. 5**. It provides interrupt masking, priority encoding, I/O ports, and an interval timer in one package. It also handles interrupts from the TMS9902 Universal Asynchronous Receiver/Transmitter (UART) at U17 and U18.

The 9901 communicates with the CPU through the CPU's communications register unit (CRU), an internal serial interface within the 9980. (The CRU operation is covered briefly later in this article, but the reader is referred to the reference for detail.)

The open-collector buffers to the repeaters and

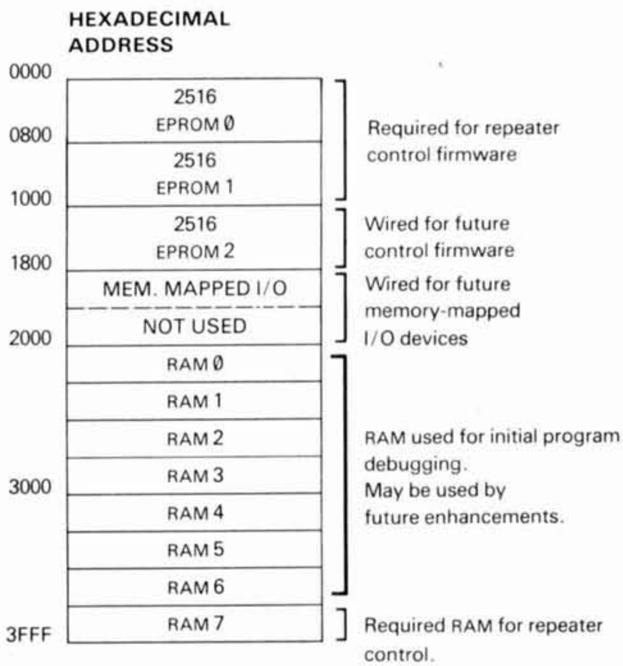

fig. 4A. Memory map of controller. Monitor ROM located in $0000 to $07FF address. Minimum RAM in address location $3D00 to $3FFF ($ = hexidecimal).

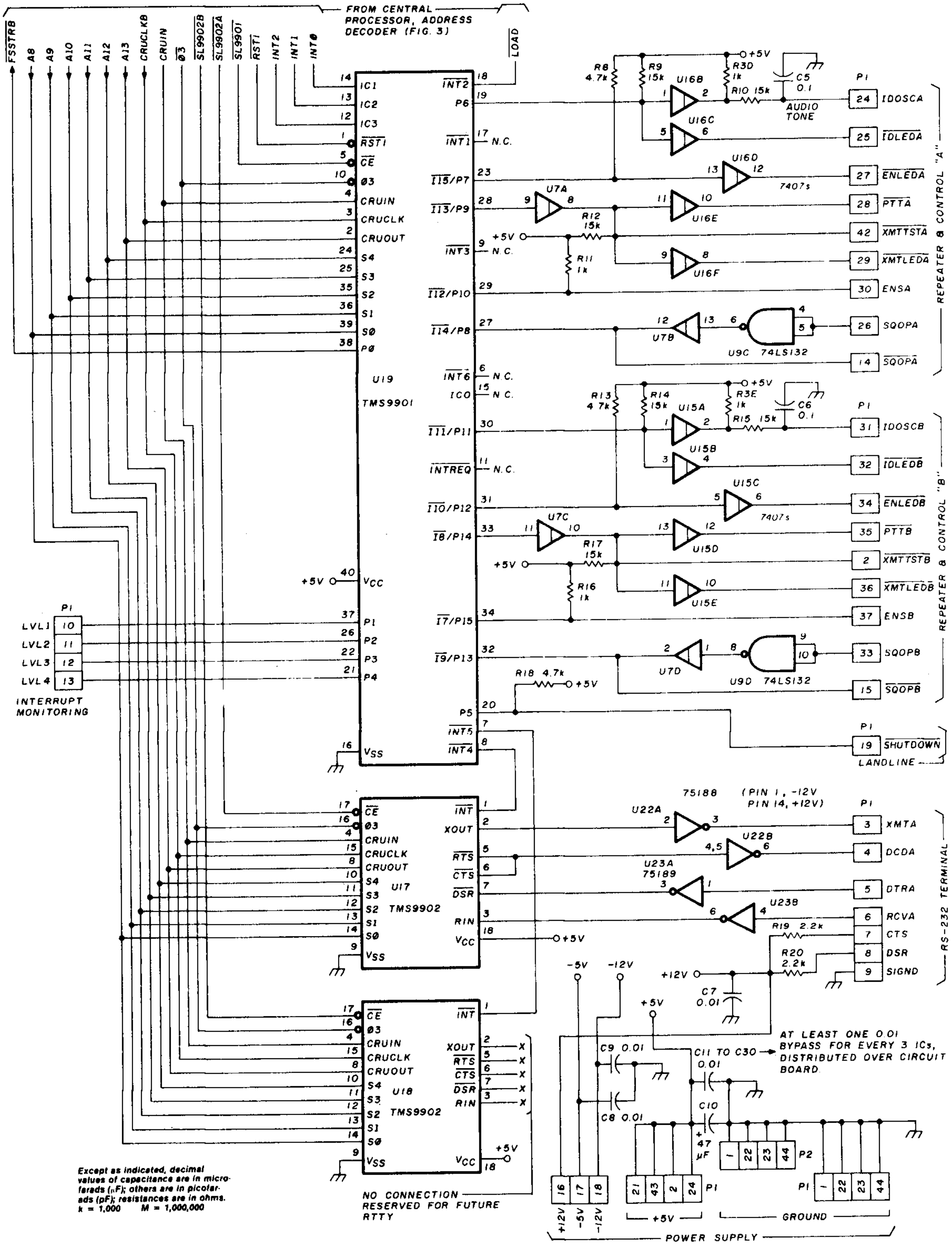

fig. 5. Interface circuitry and power supply connections. UART in U18 used mainly for internal timer. RC filter for CW ID tone (IDOSC) should be isolated to minimize digital noise. A minimum of one 0.01 μF bypass per three ICs is recommended on entire board.

front panel controls are identical circuit groups to each repeater. Mnemonics for the signals have an A suffix for the 2-meter repeater, a B suffix for the 220-MHz repeater. Direct repeater controls are $\overline{PTT}$ (push to talk), IDOSC (ID tone or 'oscillator'), and SQOP (squelch open). Other signal lines in each group refer to the front panel controls and indicators shown in **fig. 6A** and in **photo 3**.

$\overline{PTT}$ is low to transmit. Pull-up for the open-collector buffers (U16E and U15D) is provided within the repeater chassis. The CW identification tone is provided by programming the first-level interrupt period of 512 microseconds for a square-wave frequency just under 1 kHz. RC filtering at the IDOSC output produces a triangular waveform with an amplitude of about 5 volts peak-peak.

Remote shutdown is common to both controllers, but the direct telephone interface is within the old controller. Two rings on the landline will cause $\overline{SHUTDOWN}$ to go low, disabling the main controller. $\overline{SHUTDOWN}$ is TTL-compatible but requires R18 to hold U19-20 high when the backup controller is removed.

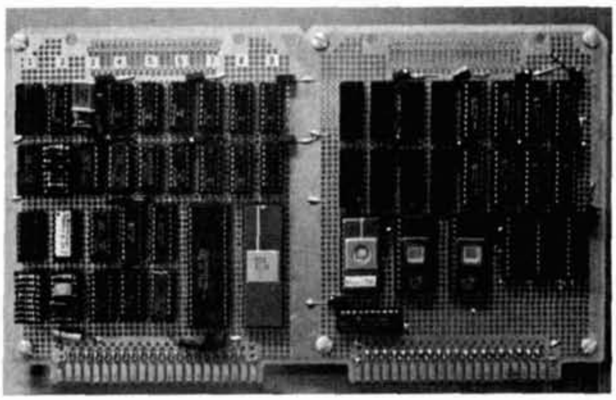

photo 2. Photo of controller board made just before final circuit freeze. All ICs are socketed on prototype board. Except for supply bypass capacitors, all discrete components mounted on DIP plugs. Number labels were construction references.

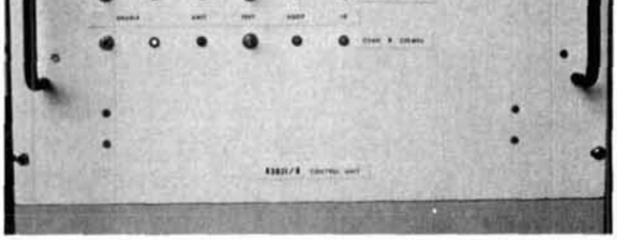

photo 3. Front view of front panel controls and indicators.

The RS-232 terminal connections (completed in **fig. 6C**) use high-voltage buffers in U22 and U23 for an ASR-733 terminal. Other devices can be used to interface the UART at U18. The terminal is connected directly to the new controller, and not used in the backup.

The power demand of the single-board controller is 3 A at +5 Vdc, 2 mA at −5 Vdc, 0.2 A at +12 Vdc, and 0.1 A at −12 Vdc. The +5 Vdc supply demand is dependent on the amount and type of memory. A well-regulated supply should be used, but the current should be calculated for your own configuration.

manual control and indication

The front panel controls are not an absolute requirement, but do provide local control for testing and a quick indication of operation.* The 2-meter control and indication is shown in **fig. 6A**; the 220 MHz arrangement is identical except for interconnecting pins.

The condition of the ENABLE switch is periodically read by the program. Switch status, shutdown signal, and a flag in memory will determine if the particular transmitter should be turned on when requested. The ENABLE status is displayed by the program as a check of all conditions.

The XMIT display lights up whenever a repeater is transmitting. The TEST switch controls two methods of transmit: manual — without microprocessor control — if the switch is held to the left, or simulation of squelch-open with processor control if it is held to the right. The SQOP display indicates the latter simulation, or normal squelch-open condition, of the repeater.

The ID LED is driven from the same source as the audio tone. Since this signal is a fifty-percent duty cycle, the current limiting resistor is smaller, creating a more uniform brightness.

Four keyboard commands are recognized. An operator can type U on the terminal to update the time, T to print current program time, M to modify the clock, and S to print the current system status. Other entries are ignored. The time correction is the number of seconds to be added to the internal clock each day; there is no provision for tweaking the system clock frequency.

construction

The controller was wire-wrapped on a prototype board, as shown in **fig. 7** and **photo 2**. Bypass capacitors for the +5 V supply line were soldered directly on the board, one for every three ICs and one

*User-friendly controls and terminal commands benefit the non-computerist in your repeater committee.

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Model	Tunable Freq Range	Noise Figure	Gain	Price
LNA 28	20-40	0.9 dB	20 dB	$39.95
LNA 50	40-70	0.9 dB	20 dB	$39.95
LNA 144	120-180	1.0 dB	18 dB	$39.95
LNA 220	180-250	1.0 dB	17 dB	$39.95
LNA 432	380-470	1.0 dB	18 dB	$44.95

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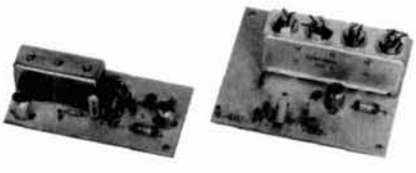
- P30K, VHF Kit less case $14.95
- P30C, VHF Kit with case $20.95
- P30W, VHF Wired/Tested $29.95
- P432K, UHF Kit less case $18.95
- P432C, UHF Kit with case $24.95
- P432W, UHF Wired/Tested $33.95

P432 also available in broadband version to cover 20-650 MHz without tuning. Same price as P432; add "B" to model #.

HELICAL RESONATOR PREAMPS



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Model	Tuning Range	Price
HRA-144	143-150 MHz	$49.95
HRA-220	213-233 MHz	$49.95
HRA-432	420-450 MHz	$59.95

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	Antenna Input Range	Receiver Output
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Kit $44.95	50-52	28-30
Less Case $39.95	50-54	144-148
Wired $59.95	144-146	28-30
	145-147	28-30
	144-144.4	27-27.4
	146-148	28-30
	144-148	50-54
	220-222	28-30
	220-224	144-148
	222-226	144-148
	220-224	50-54
	222-224	28-30
UHF MODELS	432-434	28-30
Kit $54.95	435-437	28-30
Less Case $49.95	432-436	144-148
Wired $74.95	432-436	50-54
	439.25	61.25

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	Exciter Input Range	Antenna Output
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Model XV2	28-29	145-146
Kit $79.95	28-30	50-52
Wired $119.95	27-27.4	144-144.4
(Specify band)	28-30	220-222
	50-54	220-224
	144-146	50-52
	50-54	144-148
	144-146	28-30
For UHF,	28-30	432-434
Model XV4	28-30	435-437
Kit $99.95	50-54	432-436
Wired $149.95	61.25	439.25
	144-148	432-436*

*Add $35 for 2M input

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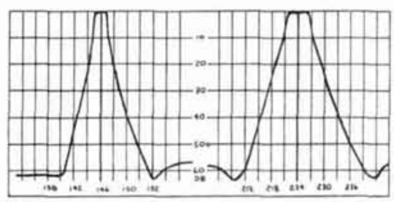
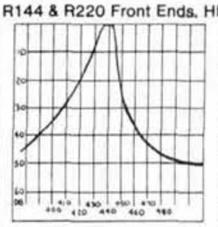
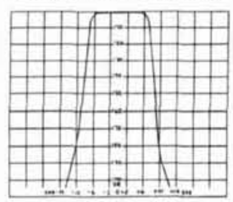


R144 & R220 Front Ends, HRA 144/220, & HRF-144/220



R451 Receiver Front End



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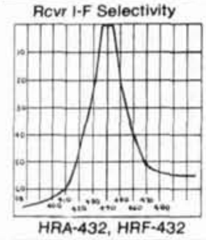

HRA-432, HRF-432

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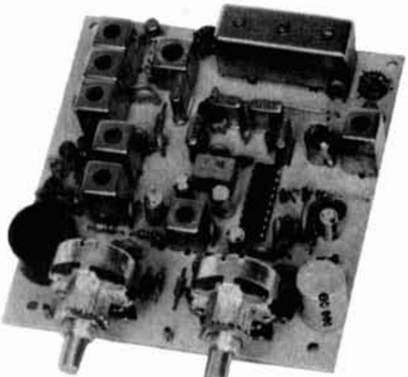

R144 Shown

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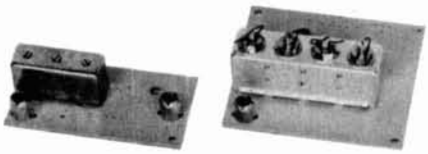

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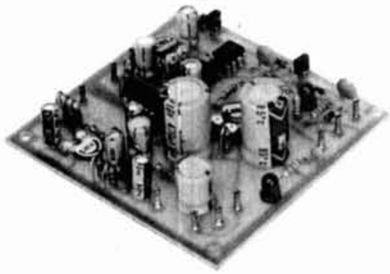

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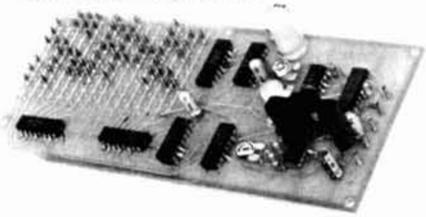

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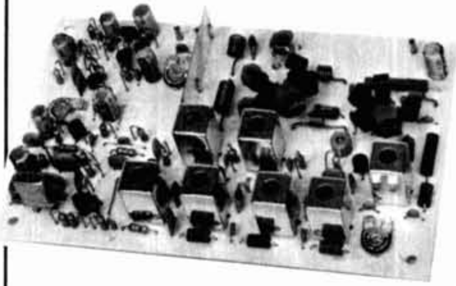

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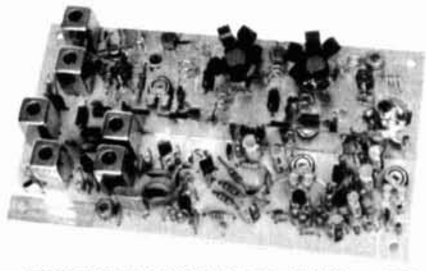

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for every two memory chips. All other discrete components mount on DIP plugs.

A 12 × 17 × 2 inch (30 × 43 × 5 cm) Bud chassis is bracket-mounted to the rack panel. Two 7 × 11 inch (18 × 28 cm) aluminum plates hold the power supply and four pairs of card edge connectors. All interface connectors, the line fuse, and switch are mounted on the rear face of the chassis.

programming and checkout

The program was coded in short routines, most containing less than fifty lines. The code is heavily commented to facilitate debugging and to provide good documentation. Documentation is essential if you want anyone, even the programmer, to understand the program at a later date.

The program was initially programmed into the EPROM and installed on the board. A short routine was executed to move the program from ROM into RAM. Execution from RAM was under control of the monitor, allowing correction and patching. The monitor used was TIBUG™.

The EPROMs are re-programmed after checkout so the program can execute from a ROM address area rather than RAM.

Hardware and system checkout procedure used the front panel TEST switch to simulate the receiver squelch-open signal until most of the program bugs were found. Later, the $\overline{\text{PTTA}}$ line was jumpered to SQOPB and $\overline{\text{PTTB}}$ was jumpered to SQOPA; with both channels enabled, the controller would alternately transmit on 2 meters and 220 MHz. We ran the controller only in this mode for several days in the presence of the club's HF and repeater equipment to verify that the controller was rf compatible. No interference was observed. A typical printout is seen in **fig. 8**.

history

Total construction time for this project was approximately four months. Most of the board wiring and program design was completed during a two-week vacation. The most time-consuming task was packaging the controller.

The controller was installed in the K5OJI repeater in January, 1981. Up to the time of this writing,

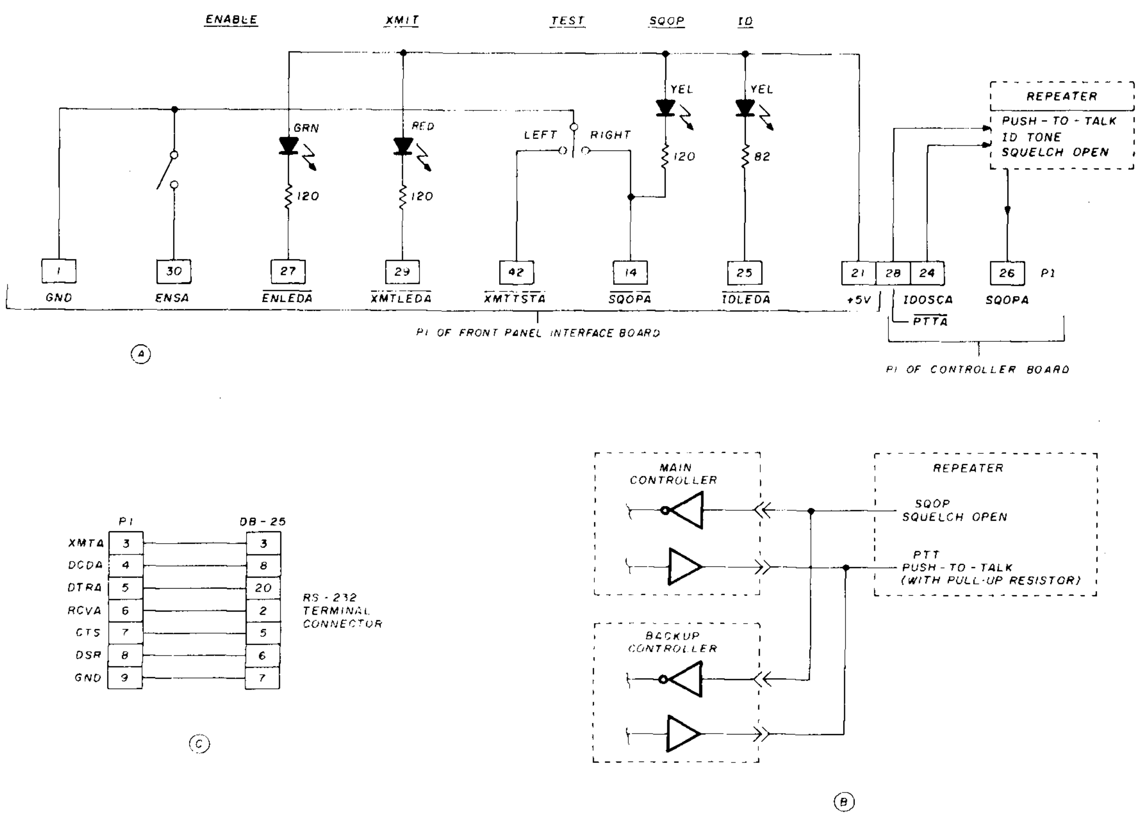

fig. 6. Front panel controls and indicators for 2-meter repeater in A. 220 MHz front panel and repeater connections are identical except for pin numbers. Underlined names are identical to front panel photo. B indicates parallel connection scheme for backup controller. C gives RS-232 serial interface pin connections to main controller.

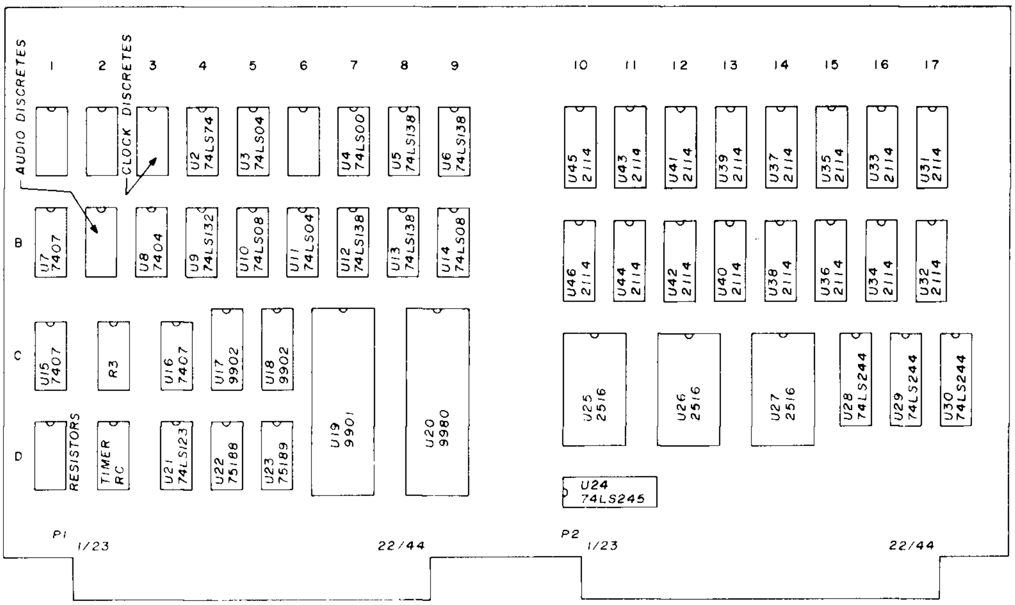

fig. 7. Location of ICs on controller board. Edge connections are double side, and pins etched in board. Letters and numbers used for construction reference. Two RAM chips in U31, U32 is the minimum requirement but photo indicates 4K RAM population up to U38 for development purposes.

about two years, we had only one failure due to bad memory chips. Since the backup controller picked up when the main unit failed, the repeater was never off the air. The bad chips were quickly located and replaced.

The controller is reliable, expandable, and relatively simple. It can be made on a prototype board or it may be an adaptation of commercially available microprocessor boards. Hardware and software is designed so other features may be added easily.

Based on observation of microprocessor loading, the controller should be able to control three repeaters simultaneously. The Level 1 interrupt is the heaviest CPU load and provides the ID tone; a separate hardware oscillator will relieve much of the first-level interrupt handling.

This project would not have been possible without the help of WB8CEB for most of the program editing and N5JS and AJ5L who maintained the rf portions of the repeaters.

A listing of the control program is available on an 8-inch CPM™ compatible disk available from the author for $15.00. This disk contains the program listing and an object file for programming EPROMs. The disk is single-sided, single-density and the program uses 26 sectors at 128 bytes per sector.

```
ENTER CURRENT TIME HHMM: 2040
K5DJI RPT TIME IS 2041
TIME=2100 XMT=1409 QSO=06 TMO=01 IDS=13 KCT=07
TIME=2200 XMT=0112 QSO=05 TMO=00 IDS=07 KCT=00
TIME=2300 XMT=0044 QSO=01 TMO=00 IDS=03 KCT=01
TIME=0000 XMT=0000 QSO=00 TMO=00 IDS=00 KCT=01
TIME=0100 XMT=0031 QSO=01 TMO=00 IDS=02 KCT=00
TIME=0200 XMT=0000 QSO=00 TMO=00 IDS=00 KCT=00
TIME=0300 XMT=0000 QSO=00 TMO=00 IDS=00 KCT=00
TIME=0400 XMT=0000 QSO=00 TMO=00 IDS=00 KCT=00
TIME=0500 XMT=0000 QSO=00 TMO=00 IDS=00 KCT=00
TIME=0600 XMT=0000 QSO=00 TMO=00 IDS=00 KCT=00
TIME=0700 XMT=1660 QSO=04 TMO=00 IDS=09 KCT=03
TIME=0800 XMT=0277 QSO=09 TMO=00 IDS=14 KCT=03
TIME=0900 XMT=0837 QSO=05 TMO=00 IDS=09 KCT=00
TIME=1000 XMT=0000 QSO=00 TMO=00 IDS=00 KCT=00
TIME=1100 XMT=0000 QSO=00 TMO=00 IDS=00 KCT=00
```

fig. 8. Typical printout of part of one day's operation.

for the computer technician

Computer technology is a specialized area. Some explanations and technical arguments follow which will serve the needs of the computer specialist who undertakes this project. ham radio *cannot take sides in programming techniques, but a strong relationship between hardware and software is integral to the successful design of this system, and the computer technician should be aware of this before beginning the project. Editor.*

Reentrant programming is sometimes confused with recursive programming; we offer the following abbreviated definition from Granino Korn's *Microcomputers for Scientists and Engineers*:

"A special case occurs where a subroutine is inter-table 2. TMS9901 PSI bit assignments.

select bit	CRU read data	CRU write data
0	Control bit (1)	Control bit
1	INT1-/CLK1 (2)	MASK1/CLK1 (3)
2	INT2-/CLK2	MASK2/CLK2
3	INT3-/CLK3	MASK3/CLK3
4	INT4-/CLK4	MASK4/CLK4
5	INT5-/CLK5	MASK5/CLK5
6	INT6-/CLK6	MASK6/CLK6
7	INT7-/CLK7	MASK7/CLK7
8	INT8-/CLK8	MASK8/CLK8
9	INT9-/CLK9	MASK9/CLK9
10	INT10-/CLK10	MASK10/CLK10
11	INT11-/CLK11	MASK11/CLK11
12	INT12-/CLK12	MASK12/CLK12
13	INT13-/CLK13	MASK13/CLK13
14	INT14-/CLK14	MASK14/CLK14
15	INT15-/INTREQ	MASK15/RST2- (4)
16	—	Fail-safe strobe
17	—	LEVEL 1 INTERRUPT INDICATOR
18	—	LEVEL 2 INTERRUPT INDICATOR
19	—	LEVEL 3 INTERRUPT INDICATOR
20	—	LEVEL 4 INTERRUPT INDICATOR
21	Remote shutdown	—
22	ID Ch A	ID Ch A
23	—	ENABLE Ind Ch A
24	SQ OP Ch A	—
25	—	XMIT Ch A
26	ENABLE SW Ch B	—
27	ID Ch B	ID Ch B
28	—	ENABLE Ind Ch B
29	SQ OP Ch B	—
30	—	XMIT Ch B
31	ENABLE SW Ch B	—

(1) 0 = interrupt mode, 1 = clock mode
(2) Data present on INT pin (or clock value) will be read regardless of mask value.
(3) In interrupt mode writing a 1 into mask will enable interrupt; a 0 will disable the interrupt.
(4) Writing a zero to bit 15 while in the clock mode executes a software reset of the I/O pins.

rupted and the interrupt calls the *same* subroutine. A program may fail on return from interrupt. Subroutines designed to work properly on interrupt and restoration from interrupt are called 'reentrant.' A good way to obtain reentrant subroutines is to provide temporary storage of addresses and register contents in 'stack' storage. Real-time computation with many interrupt-driven segments make reentrant programming desirable."

When many repeaters need be controlled, the only additional software necessary should be new parameter tables and calls to the routines handling data in these tables. Not only should the data manipulation instructions be reentrant, but so should I/O instructions; controlled devices will not always have the same I/O addresses.

The I/O structure of the 8080 does not lend itself to reentrant programming. I/O routines must be programmed once for each channel, and you must decide which piece of code to execute, or the code must be written to be self-modifying: the program modifies the instruction set about to be executed before entering the set. The instruction must reside in RAM to be self-modifying. The I/O of the 8080 must transfer eight bits at once, which requires extra logical instructions. This means that the bits which control the repeater must be set, reset, and tested, or only one function can be assigned to each I/O port.

While you need subroutines to load and test an 8080 memory location, a single 9900 instruction performs the same function. The 9900 I/O structure lends itself to reentrant programming. The 9900, through its CRU, may transfer from one to sixteen bits with a single instruction. This makes it suitable for multiple-control applications.

The address bus I/O address is generated by adding the CRU bit address in the instruction to the contents of the CRU base register, one of the user-accessible registers. By setting base register contents differently for each channel, the same I/O instructions can be used to control the same function on different channels.

Since all general purpose registers are in memory, only the CPU program counter, status register, and workspace pointer need be saved during an interrupt. These are saved and restored automatically. The programmer does not have to keep track of which registers to save or restore.

The TMS9980 CPU is part of the 9900 family and uses the same instruction set. This class of processor differs from earlier designs and readers should refer to the reference material for exact details. The following will help you understand the CRU and how it is used in the K5OJI repeater.

understanding the CRU

The communications-register-unit uses a dedicated bit-addressable interface for I/O between the CPU and 9901, 9902 devices. The CRU interface in the system is the address bus and three signal lines: CRUCLK, CRUIN, and CRUOUT (multiplexed with address line A13 on the 9980). The 9901 and 9902s are enabled via U6 by address lines A0, A1, A5, A6, and A7 while address lines A8 through A12 select the single bit to be input or output. The CRU transfers data one bit at a time, serially, on the CRUIN and CRUOUT lines.

For output, the address lines are set to point to the desired output bit and that bit of data is put on the CRUOUT (A13) line. CRUCLK then clocks the data into the selected device. For input, the address lines are set to point at the desired input, then clocked into the CRU through the CRUIN line. There is no external signal to indicate when an input is read.

Table 1 lists the hardware and software addresses for the CRU. The 9901 occupies thirty-two bits of CRU input/output space and assignments are given in **table 2**. **Table 3** is a complete parts list for the controller.

Table 2 needs further explanation: bit 0 controls the mode of bits 1 to 15. If bit 0 is logic 0, the 9901 is in interrupt mode. Writing to bits 1 to 15 sets an internal mask for passing or ignoring an interrupt level.

The 9901 is in clock mode (internal interval timer) if bit 0 is logic 1. Writing to bits 1 to 14 loads a value into the timer's count decrementer. As the timer counts down to zero, an interrupt is issued and the timer resets to decrement value. Reading bits 1 to 14 will read the current value of the decrementer. Reading bit 15 inputs the status of the interrupt request while writing to bit 15 initiates a reset of input/output pins.

table 3. Controller parts list.

quantity	type	
1	TMS9980	U20
1	TMS9901	U19
2	TMS9902	U17, U18
2 min., 16 max.	2114	U31 to U46
2 min., 3 max.	2516	U25 to U27
1	74LS00	U4
1	74LS04	U11
1	7404	U8
3	7407	U7, U15, U16
2	74LS08	U10, U14
2	74LS74	U2, U3
1	74LS123	U21
1	74LS132	U9
4	74LS138	U5, U6, U12, U13
3	74LS244	U28, U29, U30
1	74LS245	U24
1	75188	U22
1	75189	U23
	resistors (all resistors are ¼ W, 10% unless otherwise specified)	
1	220 K	R7
1	68 ohm	R2
2	82 ohm	front panel
6	120 ohm	front panel
2	510 ohm (5%)	R4, R5
2	2.2 K	R19, R20
6	4.7 K	R1, R6, R8, R13, R18, R21
6	15 K	R9, R10, R12, R14, R15, R17
2	1 K	R11, R16
1 DIP array	1 K	R3 (Beckman 899-1-1.0 K)
1	220 K	R7
	capacitors (all capacitors are disk, 25 V min unless other specified)	
24	0.01 μF	C2, C7, C8, C9, C11 to C30
2	0.1 μF	C5, C6
1	1.0 μF	C4
1	10 pF mica	C3
1	33 μF	C1 (electrolytic, 10 V min.)
1	47 μF	C10 (electrolytic, 10 V min.)
1	CY-18 crystal, 10 MHz	Y1
1	1N4001	CR1
2	LED, green	front panel
2	LED, red	front panel
4	LED, yellow	front panel
2	switch, SPDT, momentary-off-momentary	front panel
2	switch, SPST	front panel

Bits 16 to 31 are for I/O, the majority directly interfacing with the repeaters. Writing a 0 and then a 1 to bit 16 will re-trigger failsafe one-shot U21. Re-triggering must occur at a 60 Hz rate.

Bits 17 to 20 are monitor output which indicates the level of interrupt processing. Entering an interrupt routine sets the appropriate bit for that interrupt level. Completing an interrupt resets the bit. Oscilloscope monitoring verifies the interrupt and indicates CPU loading for each interrupt time. The first three interrupt levels are used here with the fourth level reserved for future use.

Bit 21 is an input for remote shutdown via telephone line through the old controller. The old controller will shut down through its own interface circuitry and a low state of SHUTDOWN will disable the new controller.

Bits 22 to 26 are I/O control for the 2-meter repeater ("A" suffix mnemonics) while bits 27 to 31 are identical in function for the 220 MHz repeater ("B" suffix).

Interrupt level 3 is internal to the 9901. Interrupt levels 4 and 5 are hardwired to the interrupt outputs on both 9902s. The 9901 will prioritize interrupts, outputting an interrupt code of 0 for highest priority and 15 for lowest priority. The 9980 CPU interprets levels 3, 4, and 5 as interrupt levels 1, 2, and 3, respectively.

Each 9902 UART is assigned thirty-two bits of CRU and each may cause an interrupt from four separate events. Repeater control uses only the interval timer interrupt. The second 9902 (U18) is used solely for the timer, but could be used for a second serial interface.

software

Author Warner claims that packaging the controller was the most time-consuming task and that software design was second. Judging from the 51 pages of program listing available, we might reverse that statement. The final excerpt contains some details on the program package.

The software design was to include as many features as possible and to break the program into small, easy-to-follow modules. These modules can be called by the appropriate interrupt processor module, depending on the desired frequency of execution. It would not be difficult to add modules for new features.

Modules communicate with each other (on the same and different interrupt levels) via semaphores, flags set in specific memory locations. Seven extended-operation (XOP) instructions are included for I/O with a keyboard/printer. The hardware will support a total of 16 XOPs, so users may add their own XOP routines.

Hardware reset causes an entry into the initialization section of the program. This initializes certain memory locations, I/O interfaces (including all interval timers), and the interrupt mask register in the 9901. Once accomplished, the program enables interrupts and begins execution of the program's polling loop.

The following program names are those included in the program. The interrupt level routines handle all the repeater control functions. Three levels of interrupts are used. Level 1 is highest and occurs when the 9901 interval timer decrements to zero. Program segment C04 generates the CW ID tone on a Level 1 interrupt. This will generate a 1 kHz tone for each repeater.

Interrupt handlers are similar. First the appropriate CRU output bit is set to indicate initiation of processing at the particular interrupt. Register 1, used as an index register, is loaded with the address of the parameter table for one repeater. The proper routines for that repeater are then called to operate on the parameters. When processing for one repeater is complete, Register 1 is re-loaded with the address of the parameter table for the other repeater, and the same routines are called again. When all processing for the interrupt level is complete, interrupt hardware is enabled for the next interval timer decrement-through-zero. The CRU bit, indicating process in operation, is reset and control returns to the interrupted routine.

Level 2 interrupt is caused by the interval timer in the 9902 at U17. This timer is set to decrement through zero every 4.7 milliseconds. The routine labelled C01 is executed on a Level 2 interrupt and forms the ID tone length and beep.

Main repeater timing occurs at Level 3, generated every 16.7 milliseconds. Some system functions, such as time of day and checking for remote shutdown, are executed only once per interrupt. All other repeater routines must be executed once for each channel. Routines R00, R07, and R09 are called only once while repeater routines R01 through R05, R08 are called twice.

When no interrupts are being serviced, the polling loop at I03 is operating. This loop checks for keyboard inputs and checks flags that indicate printout of an hourly repeater status. Once each hour the interrupt level routines move the hourly status for each repeater to a print buffer, clear the next hour's status, and set a print request flag. The polling loop checks this flag and, if set, lists the status from the print buffer on the terminal. If both repeaters are enabled, 2-meter status is printed first.

Each status line printout includes the hour, the number of seconds of total transmission, the number of QSO periods, timeouts and IDs issued. For status purposes, a QSO is defined as a period of exchanges separated by no more than thirty seconds. The last printout column is the number of receptions too short to bring up the repeater.

reference

1. *9900 Family Systems Design*, publication LCC4400, Texas Instruments, Incorporated.

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6-meter amplifier

A companion unit to the 2-meter and 1 ¼-meter amplifiers

This six-meter amplifier is a companion unit to the 2-meter and 1-1/4-meter amplifiers previously described in *ham radio* articles.[1] All three amplifiers are built using the same chassis configuration originally described by K2RIW for a stripline kilowatt for 432 MHz.[2] The 50-MHz version uses a conventional pi-network output with inductive tuning, and a coil simulated half-wave line for its input section. Both the tetrode (**fig. 1**) and the triode (**fig. 2**) versions will be discussed. Like its predecessors, the 50-MHz amplifier uses parallel combinations of any of the 4CX250 type tetrodes, the 8930 tetrodes, or the 8874 triodes. Metering and power supply connections are identical to the 2-meter and 1-1/4-meter amplifiers. Using a standard design for VHF/UHF amplifiers, a single power supply can be switched from one amplifier to another. Remote operation with a separate metering unit at the operating position or built into the power supply is another adaptation, useful particularly at 432 MHz.

These four 12 × 6 × 8 inch (30.5 × 15.2 × 20.3 cm) power amplifiers for the four popular VHF/UHF

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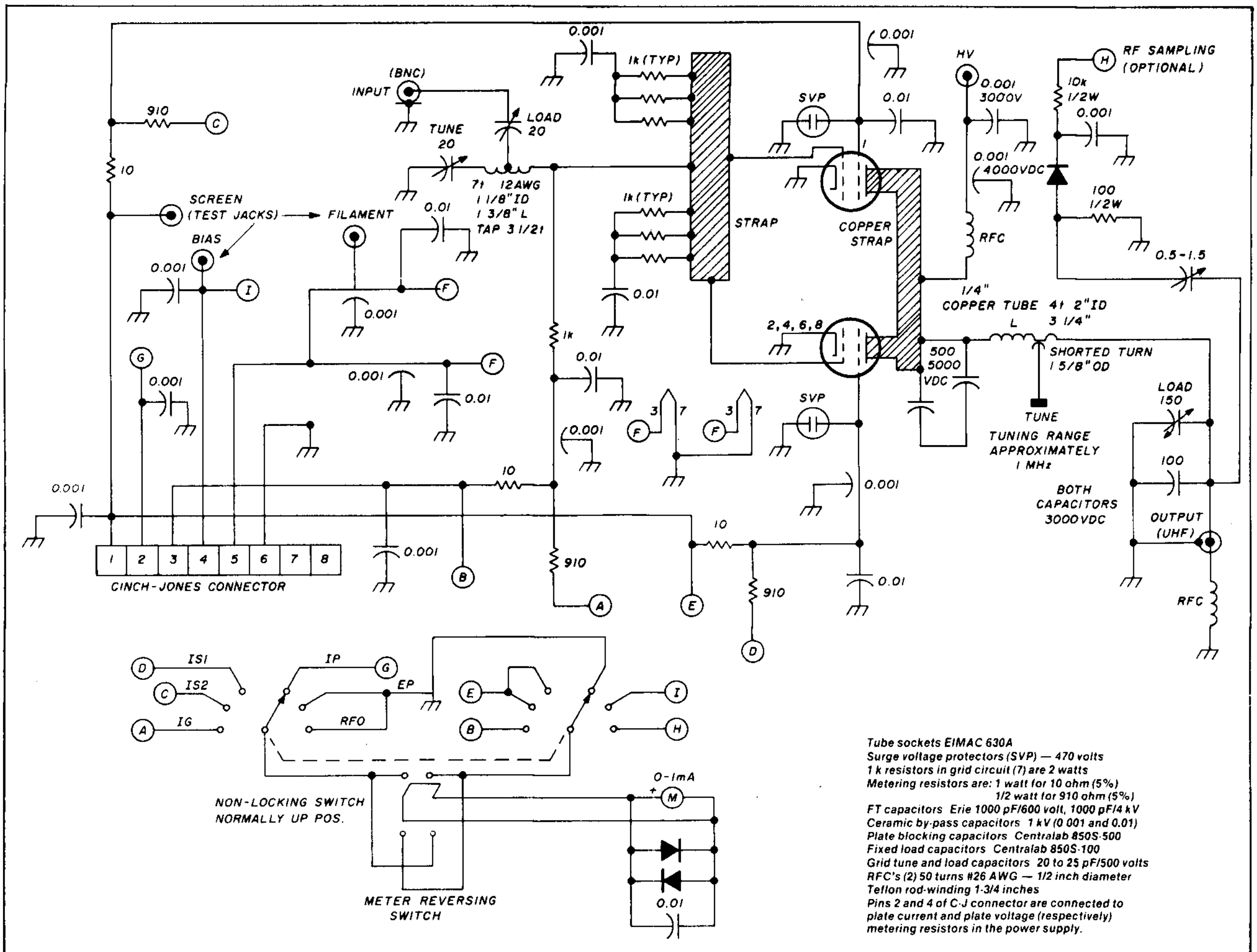


fig. 1. Tetrode amplifier schematic.

Amateur bands have been successfully duplicated hundreds of times. They are rugged and offer a proven performance developed by thousands of hours of testing and use over the past eight years. They provide flexible and reliable high-power operation.

By initially drilling and punching a set of chassis boxes for all four models (432, 220, 144, and 50 MHz), an amplifier can be converted from one band to another. This might be achieved by using a quick-change mechanical procedure for the four separate frequency-sensitive circuit elements.

construction details

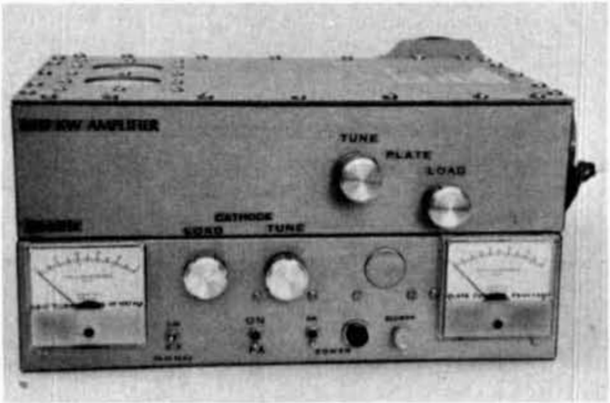
The essential dimensions for chassis drilling and punching are contained in the articles listed in reference 1. This article covers only construction details peculiar to the 50-MHz amplifier.

Referring to the schematic of the 50-MHz tetrode amplifier (**fig. 1**), notice that the two grids are connected by a copper strap between the sockets. The two anodes are paralleled by a brass or copper plate assembly which uses fingerstock for connection to the anodes, providing a mounting for the plate blocking capacitors and a connection point for the high-voltage RFC. The dc circuitry is similar to that found in the previously described amplifiers.

In the triode amplifier (**fig. 2**), the rf section is exactly the same as that shown in **fig. 1** except that rf chokes are used in the filament leads and in the cathode bias lead. The cathode bias and metering circuitry is conventional for a grounded grid amplifier. Two meters are used with the grid current meter on a non-locking switch to read plate voltage.

control and safeguard options

The optional circuitry shown in **fig. 2** provides examples of control and safeguard features which can be added to these amplifiers. The blower option provides 120 Vac on pins 2 and 4 of the cable connector. This permits powering the blower from a receptacle on the amplifier chassis, rather than running a lead



Tetrode amplifier — front view.

back to the power supply. An air switch is mounted in the blower air stream and connected via the blower connector to two power switches (one locking and one non-locking) and to pin 7 of the amplifier connector. Pin 7 is the power relay operate lead in the power supply.[1]

To turn the amplifier on, the locking-type power switch is switched to the on position and the non-locking (push-button type-momentary) switch is pressed to operate the power relay. The power relay energizes the power supply and provides 120 Vac on pins 2 and 4 to start the blower. With the blower up to speed, the air switch keeps the power relay actuated. Once the push button is released, the power supply relay is under the control of the air switch.

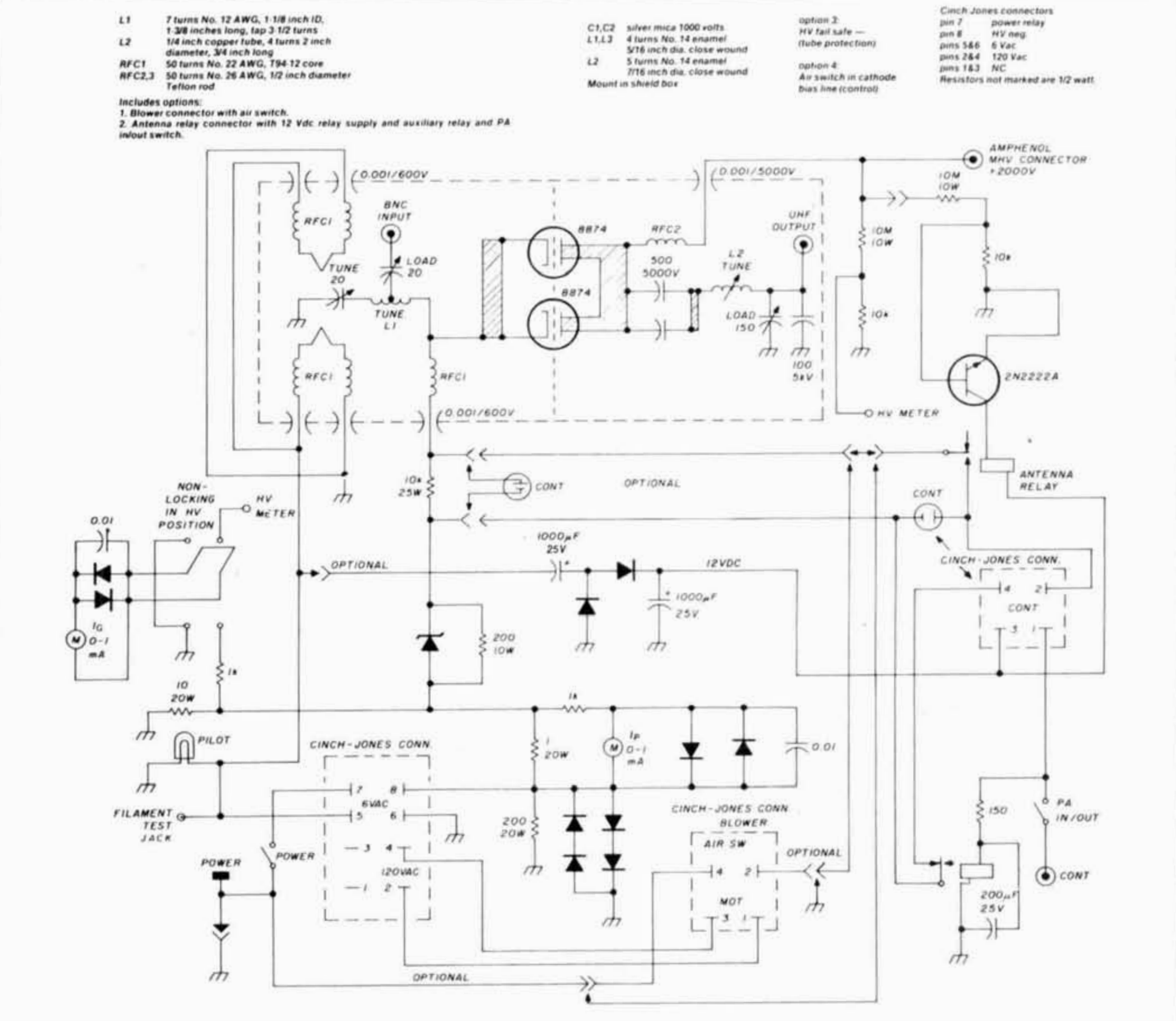
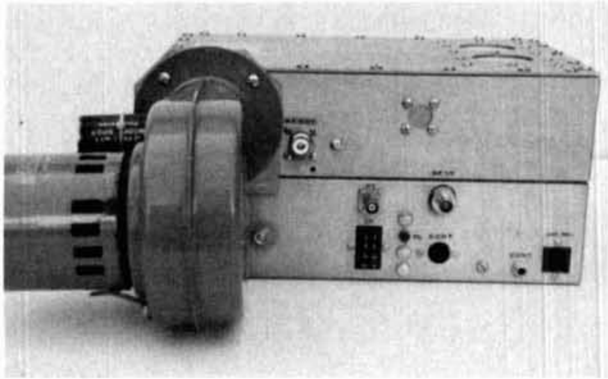
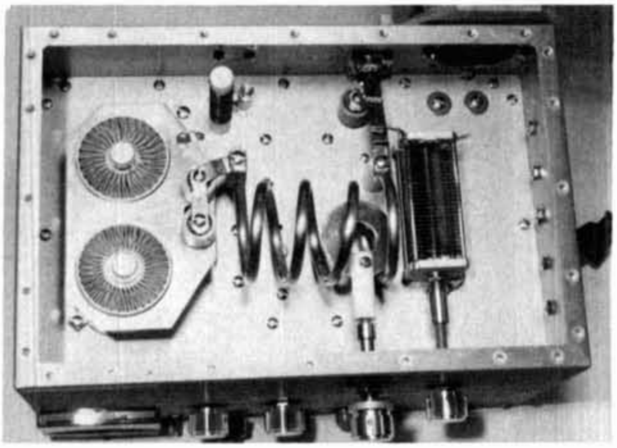


fig. 2. Triode amplifier schematic.



Tetrode amplifier — rear view.



Tetrode amplifier — upper chassis.

Should the blower fail or not come up to speed, the power supply will automatically shut down, an important safeguard considering the two hundred dollar price tag on 8874s.

If excitation is applied with no plate voltage on the tubes, damage to the grid structure may result. The high-voltage fail-safe option provides a safeguard by using a transistor and a relay to open the bias control circuit if high voltage is not present. A 12-volt power supply for this feature is provided by a voltage doubling circuit from the filament line.

The remaining option, shown in **fig. 2**, is used to operate a DPDT coaxial relay which can be mounted (with a coaxial adapter) on the output connector of the amplifier. The coil of the relay and a set of auxiliary make-contacts are connected to the amplifier chassis via a four-contact connector. The 12-volt supply, auxiliary control relay circuitry, a power amplifier (PA) in/out switch, and a control jack complete this feature. Note that a ground on transmit to the amplifier control jack will apply operating bias to the amplifier only if the antenna relay is operated and the auxiliary relay (in this optional circuit) is released. In receive, 12 volts is applied through the winding of the antenna relay to the auxiliary relay winding. The auxiliary relay operates, but the antenna relay, which requires more current than the auxiliary relay, does not operate with the PA switched to the in position. A ground on transmit from the exciter causes the antenna relay to operate immediately and the auxiliary relay to release after a slight delay. This prevents the amplifier from being "hot switched" and provides additional protection for the rf amplifier in the receiver. A layer or two of cellophane tape on the pole piece of the antenna relay is usually required to guarantee release. More sophisticated antenna relay-control circuitry is desirable, however, for EME amplifier applications.

Construction and mounting arrangements for the various options are covered in the construction infor-

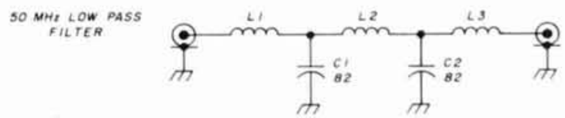


fig. 3A. 50 MHz low-pass filter.[3]

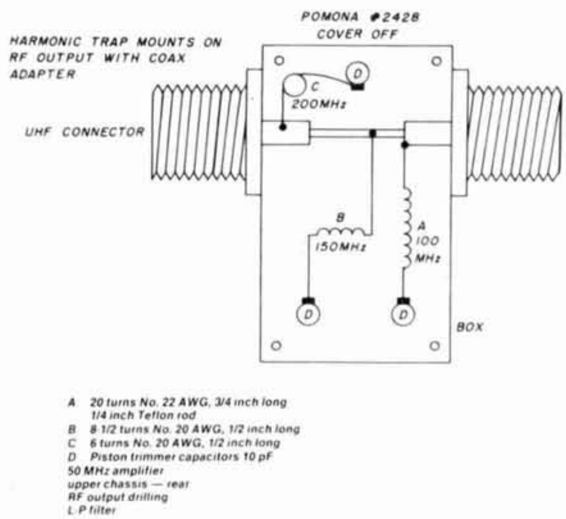
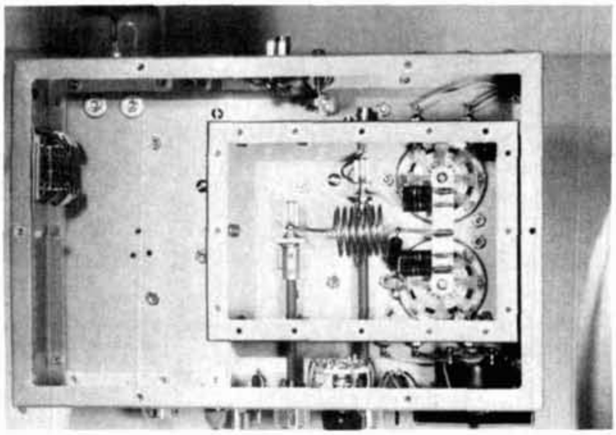


fig. 3B. Trap filter.



Tetrode amplifier — lower chassis.

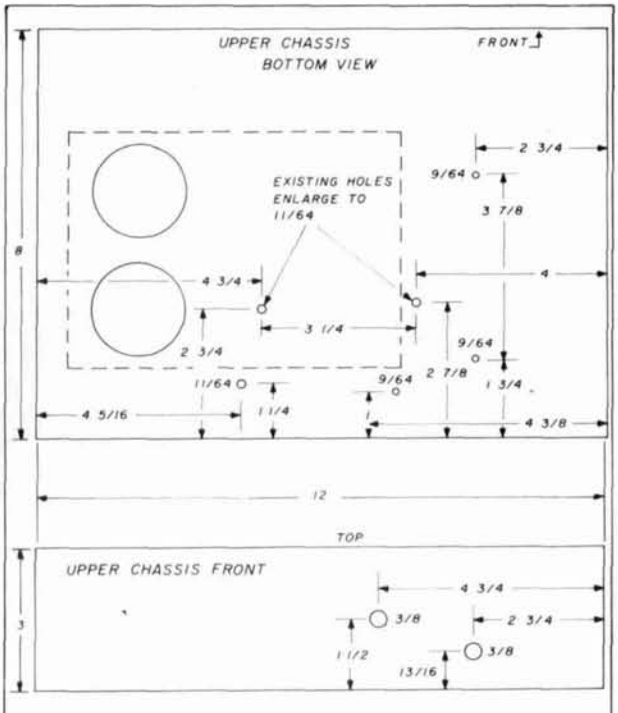


fig. 4. Upper chassis drilling chart.

mation for the triode amplifier. Which options are chosen, and whether they are mounted inside or outside the amplifier, is determined by the intended application and the builder's inclination. These options are also applicable to the 50-MHz *tetrode* amplifier version as well as to the other models of these amplifiers, already described.

A lowpass filter or harmonic trap circuit is needed in the rf output to attenuate harmonics in the amplifier output. These amplifiers, even when operated in the linear mode, may have harmonic components no more than 40 dB down from the fundamental, a level of harmonic attenuation which no longer meets modern RFI design requirements. A suitable LP filter design for this 50-MHz amplifier is shown in the 1981 *ARRL Handbook*, pages 7-11 (**fig. 3A**). Harmonic trap circuit construction is shown in **fig. 3B**.

Information on the triode and tetrode amplifier power supplies has already been provided in the 220-MHz amplifier article.[1]

construction — tetrode amplifier

If you do *not* intend to use the chassis for the 50-MHz amplifier on any of the other VHF/UHF bands, *omit* the following in its construction: five holes (11/64 inch or 4.4 mm) in the right side of the upper chassis used for mounting the 2-meter plate line, four holes (7/64 inch or 3 mm) and one hole (5/8 inch or 15.9 mm), on the rear of the upper chassis for mounting the rf output connector; two holes (7/64 inch or 3 mm), one hole (3/8-inch or 9.5 mm) for the plate load control in the top plate, and the hole in the front of the lower chassis for the plate tune control. The remaining holes not used for 50 MHz can be drilled and disregarded or filled with 6-32 (M3.5) hardware.

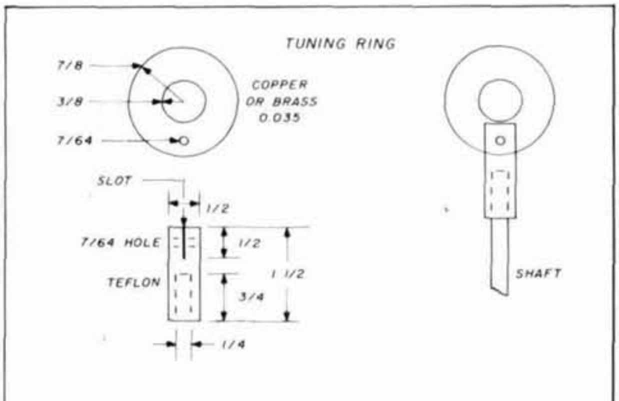
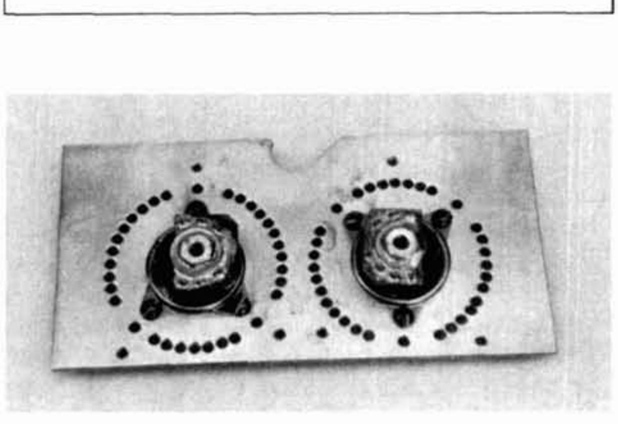


fig. 5. Inductive tuning ring details.



Triode amplifier socket plate assembly — bottom view.

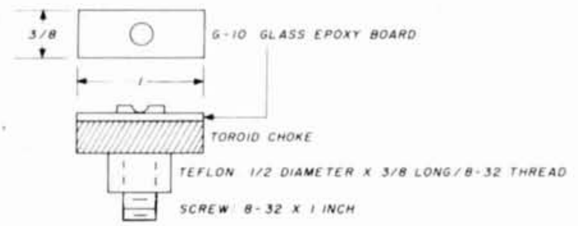
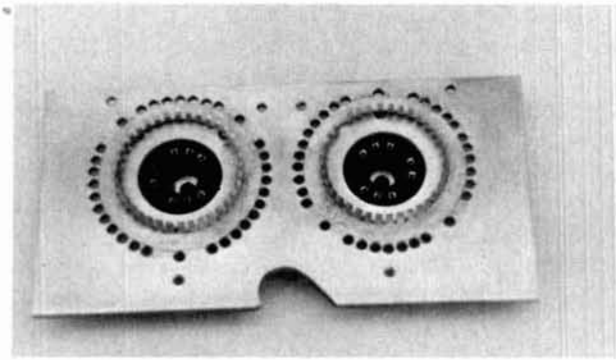


fig. 6. Toroid choke mounting detail.



Triode amplifier socket plate assembly — top view.

Fig. 4 shows the upper chassis drilling required for mounting the plate coil, variable load capacitor, rf choke, fixed load capacitor, and tune and load controls. **Fig. 7** shows the drilling and punching for the rf output connector. This completes the chassis preparation.

Details of the inductive tuning ring are shown in **fig. 5**. **Fig. 8** gives the dimensions for the plate line. **Fig. 9** provides information on the plate rf choke.

The plate coil is wound with 1/4-inch (6.3-mm) copper tubing, four turns, 2 inches (50 mm) ID, 3-1/4 inches (8.3 cm) long. The ends of this coil are flattened, bent and drilled 11/64 inch (4.4 mm), to mount the coil on 1-1/2-inch (3.8-cm) Teflon pillars midway between the top and bottom of the upper chassis. When construction is completed, the spacing between the turns of the plate coil is adjusted to provide the required tuning range. The tuning range with the inductive ring is in excess of 1 MHz. An accurate grid dip meter is useful for preliminary adjustment of turns spacing for the desired frequency range. The final adjustment of coil size to the desired range is made during the final rf testing.

The assembly and wiring may be done in the same sequence used for the 144- and 220-MHz amplifier, by first assembling and wiring the lower chassis and then assembling the upper chassis and grid box. Mount the sockets and install the plate line parts. Finally, join the upper and lower chassis, make filament and grid bias connections, and install the grid box parts to complete the assembly.

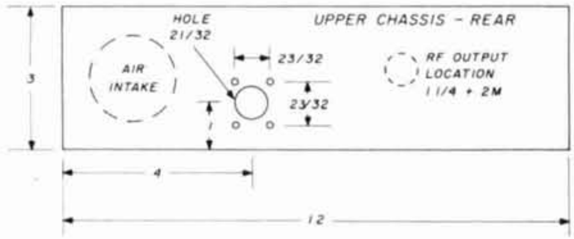
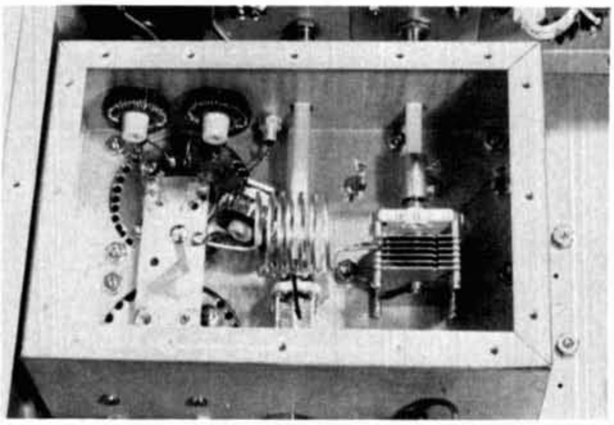
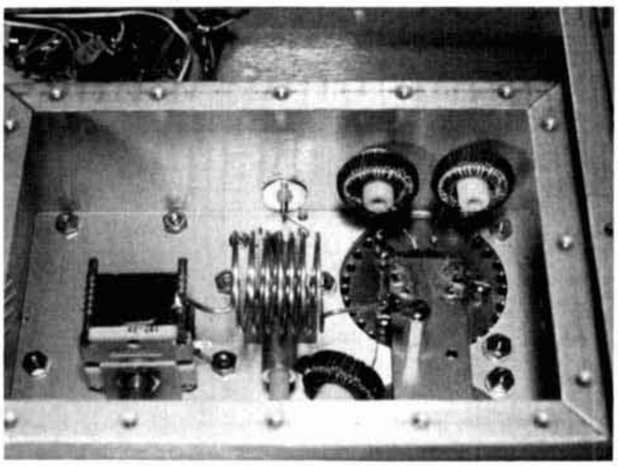


fig. 7. Upper chassis drilling for rf output connector.



Cathode box of triode amplifier viewed from rear of amplifier (toward front of amplifier). Note that toroid choke mountings are not exactly the same as *fig. 6*.



Bottom view of cathode box of triode amplifier.

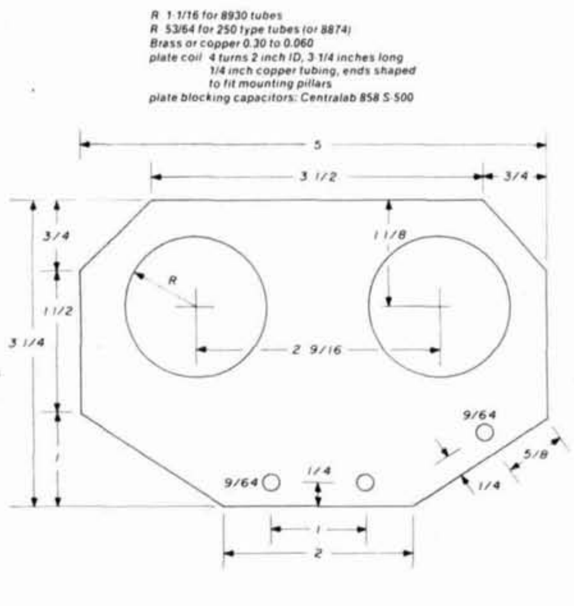


fig. 8. Plate line.

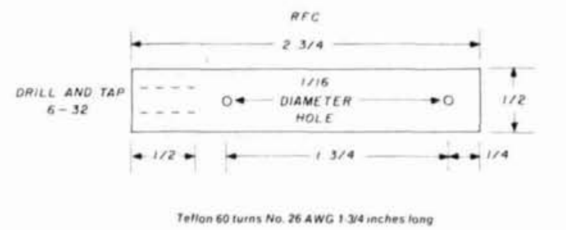


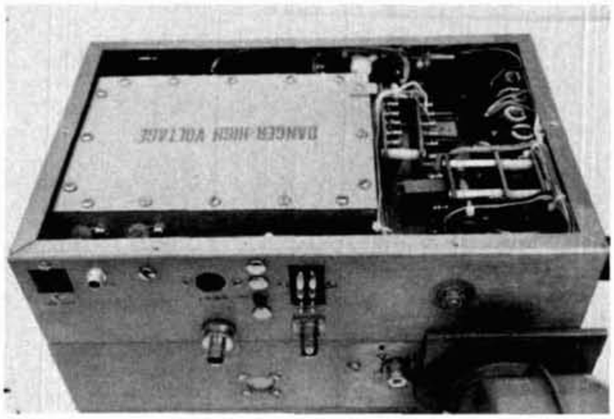
fig. 9. Plate choke.

construction — triode amplifier

Follow the directions for the tetrode amplifier construction for chassis drilling and punching, for the plate line and plate coil. The cathode tuned circuit for the triode amplifier is the same as that described for the grid circuit of the tetrode version. The holes in the grid box for the filament feed-through capacitors are relocated toward the bottom of the box to accommodate the toroid chokes (**fig. 6**). An additional meter hole is punched in the lower chassis front on the right side.

The tube sockets are mounted on a brass plate, as described for the 220-MHz triode amplifier. This assembly (**fig. 10**) lets you solder the grid collet (EIMAC part #882931) in position. Vent holes are provided around the base of the tube; it's a good idea to have this assembly silver plated. The assembly is bolted in place in the same position as the two 630A sockets used for the tetrode amplifier. A brass strip (**fig. 11**) may be used to connect the cathode pins of the two sockets together. This strap is soldered in place after the socket plate has been mounted. Its position is such that the cathode socket pins protrude through the holes about 1/8 inch (3 mm).

Alternatively, a small brass plate mounting a brass bushing (tapped 10-32) may be soldered to the cathode pins of each socket. This method of construction is more involved, but avoids soldering the grid strap in place after the socket plate is mounted. The grid strap is fastened by the 10-32 screws on each mounting plate.



Triode amplifier bottom view to illustrate mounting of optional circuit features on terminal boards in lower chassis.

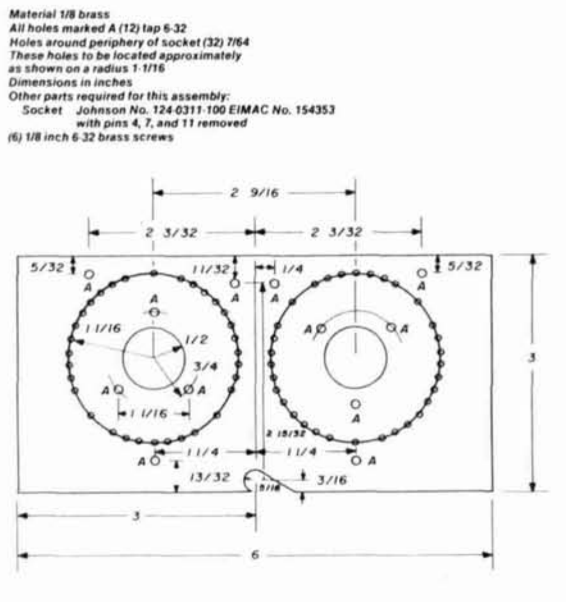


fig. 10. Triode socket mount.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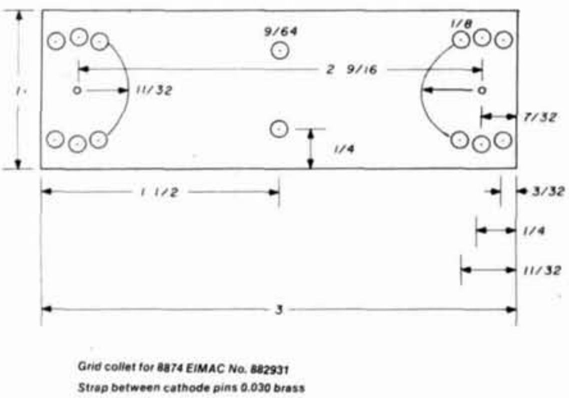
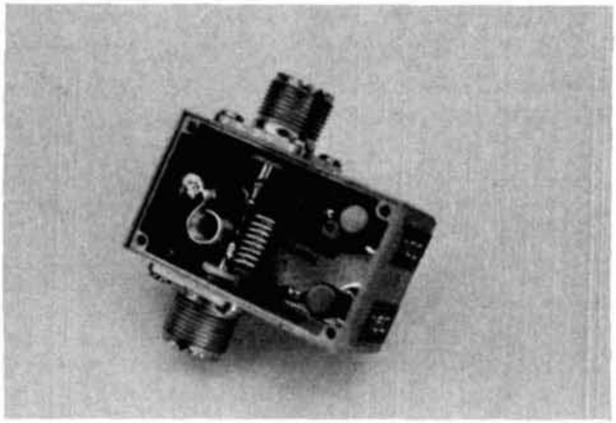


fig. 11. Cathode strap.



Output harmonic trap assembly. Three series traps — 100 MHz, 150 MHz, and 200 MHz. Piston capacitor adjustment screws (3) protrude out the bottom of the box.

Metering and other circuitry is mounted in the lower chassis, as shown in the photos. The vitreous-type resistors are mounted to the chassis wall. Other resistors and parts are mounted on terminal boards secured to the chassis with mounting spacers.

The options shown on the triode amplifier schematic (**fig. 2**) are mounted as follows:

The antenna relay connector is located on the right side of the lower chassis (rear). The small relay associated with this option is located in any convenient spot in the lower chassis. The various resistors, capacitors, and other parts for the antenna relay control circuit, the 12-Vdc supply, and the high voltage fail-safe circuitry are on terminal strips which are located in the lower chassis.

The blower connector is located on the left (side) rear of the lower chassis.

The PA in/out switch, the power switch, and the non-locking switch to start the blower are located on the front of the lower chassis.

In assembling and wiring the triode amplifier, follow the same pattern described for the tetrode amplifier — lower chassis parts mounting and wiring first — upper chassis and cathode box, tube socket assembly, plate circuit parts, joining upper and lower chassis, cathode parts, and the final wiring steps.

automatic load control

An ALC circuit (**fig. 12**) has been added as an option to the triode amplifier. The parts within the grid box are mounted close to the rf input connector. A bias winding is required on the high-voltage transformer, or a separate small transformer is required to provide the +56 volts threshold control voltage. The bias voltage parts can be mounted in the power supply chassis on a terminal board.

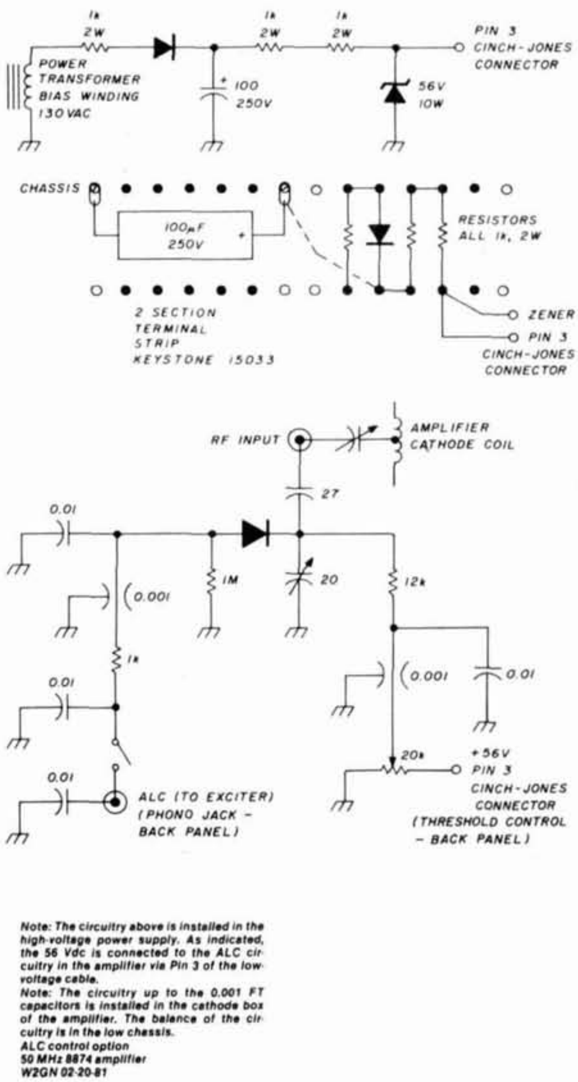


fig. 12. ALC circuit.

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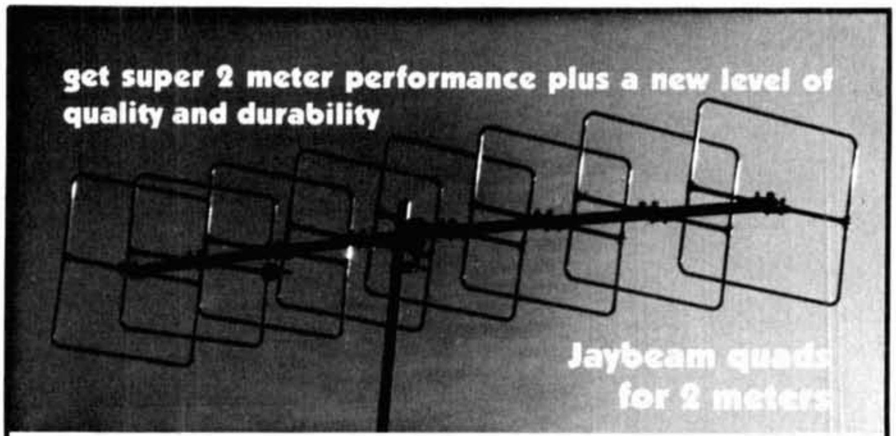

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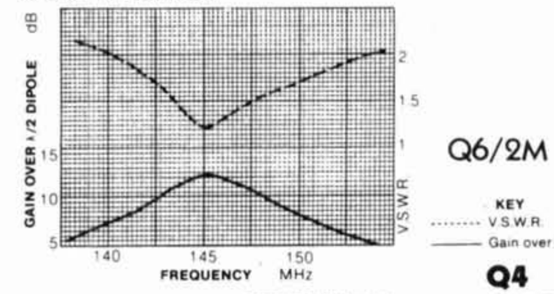

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FRONT TO BACK RATIO	20dB	22dB	25dB
3dB BEAMWIDTH	E48° H50°	E40° H42°	E37° H38°
BOOM LENGTH	4.92'	8.2'	11.6'
LONGEST ELEMENT	24.4"	24.4"	24.4"
TURNING RADIUS (APPROX)	2.6'	4.2'	5.87'
DESIGN IMPEDANCE	50 Ohms	50 Ohms	50 Ohms
POWER RATING (PEAK)	1 kw P.E.P.	1 kw P.E.P.	1 kw P.E.P.
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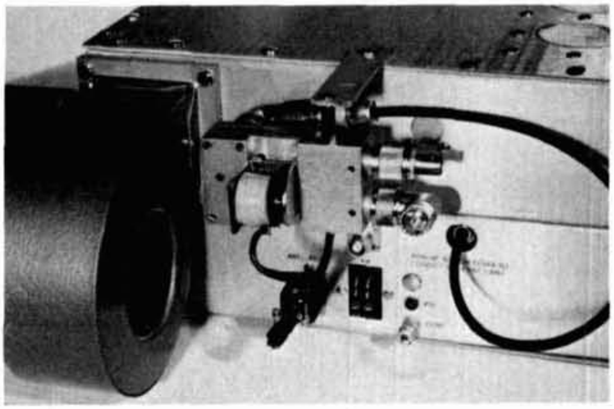

Mounting of double-pole coaxial relay on output connector.

table 1. Typical operation tetrode amplifier.

drive power	grid current	screen current	plate current	plate voltage	power output
0	0	0	0.100	2150	0
2.5	0	0	0.260	2010	177
5.0	0	−0.003	0.430	2000	470
10.0	0.002	0.027	0.600	2000	800

filament volts = 6.07 grid volts = 64 screen volts = 315

table 2. Typical operation triode amplifier.

drive power	grid current	plate current	plate voltage	power output
0	0	0.040	2300	0
2.5	0.002	0.210	2100	140
5.0	0.004	0.300	2050	285
10.0	0.025	0.380	2050	540

filament volts = 6.12

Note: The triode amplifier may be driven to an output level of 1 kW (SSB).

operation

The 50-MHz amplifiers tune and load in a conventional manner. Make initial adjustments with low drive power. Final adjustment of the grid (or cathode) tuning is made for lowest SWR toward the drive source. Final adjustment of the plate tuning must be done at full power output in order that the load control may be set at its optimum position.

Tables 1 and **2** show typical operation of the tetrode and triode amplifiers.

references

1. Fred Merry, W2GN, "Stripline Kilowatt For Two Meters," *ham radio*, October, 1977. Also, "Stripline Kilowatt for 220 MHz," *ham radio*, April, 1982.
2. Richard T. Knadle, Jr., K2RIW, "A Stripline Kilowatt for 432 MHz," *QST*, April, 1972, page 48; May, 1972, page 59.
3. *ARRL Handbook*, 1981, pp 7-11.

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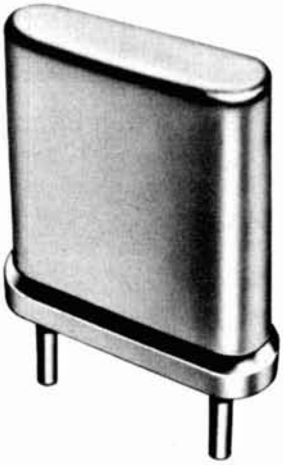

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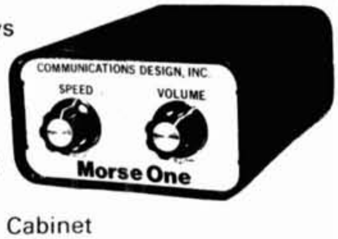

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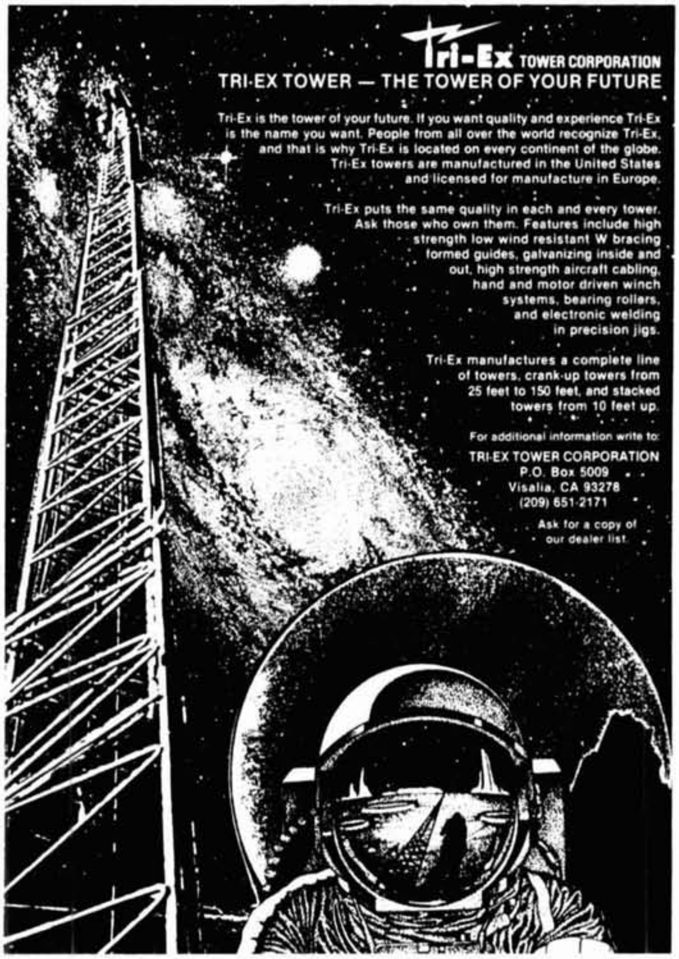

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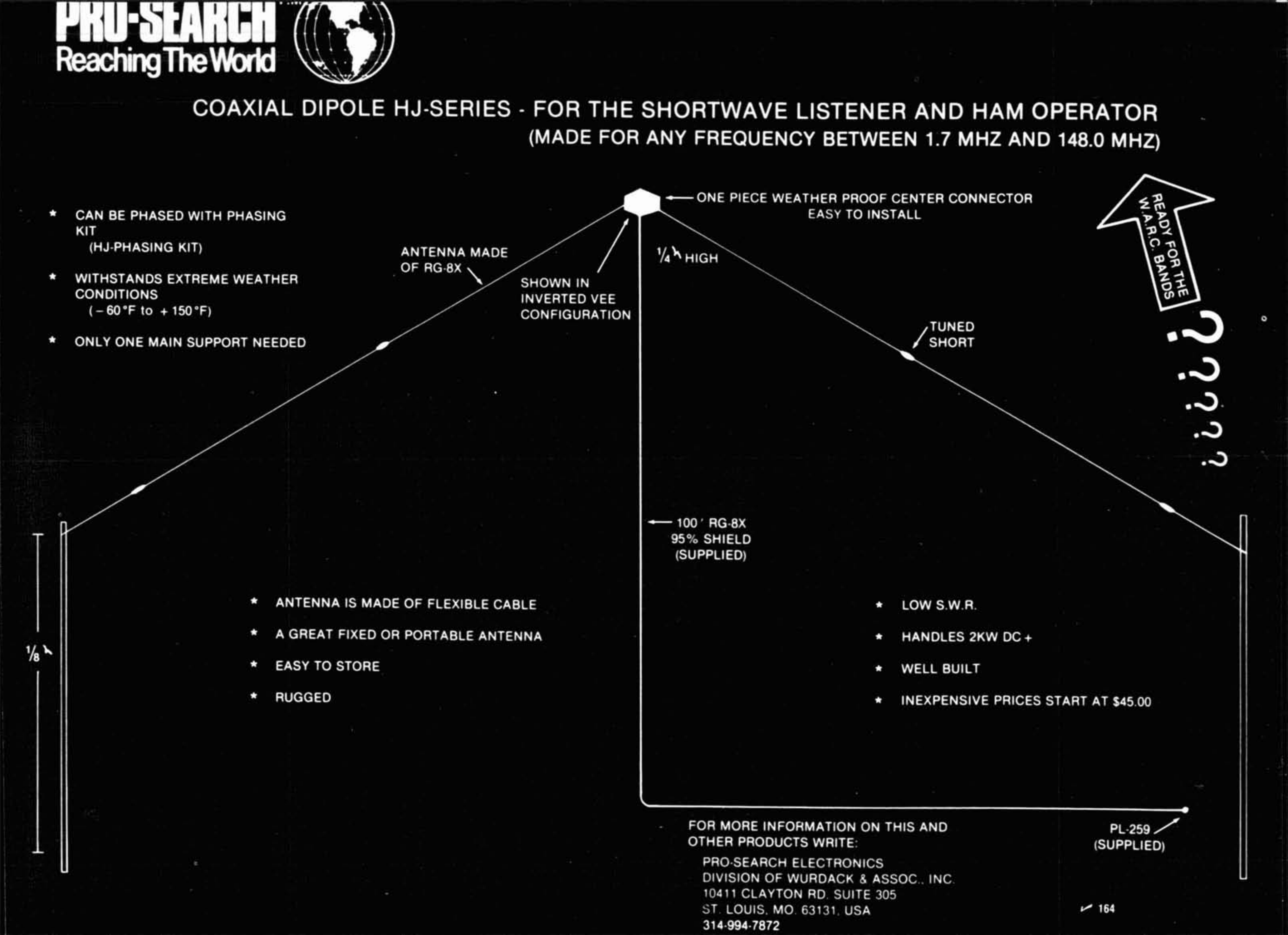
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the ham notebook

FSK tone generator using an integrated tone dialer

Have you ever thought about redesigning or building an FSK (frequency shift keying) tone generator? If so, you are not alone. How many FSK

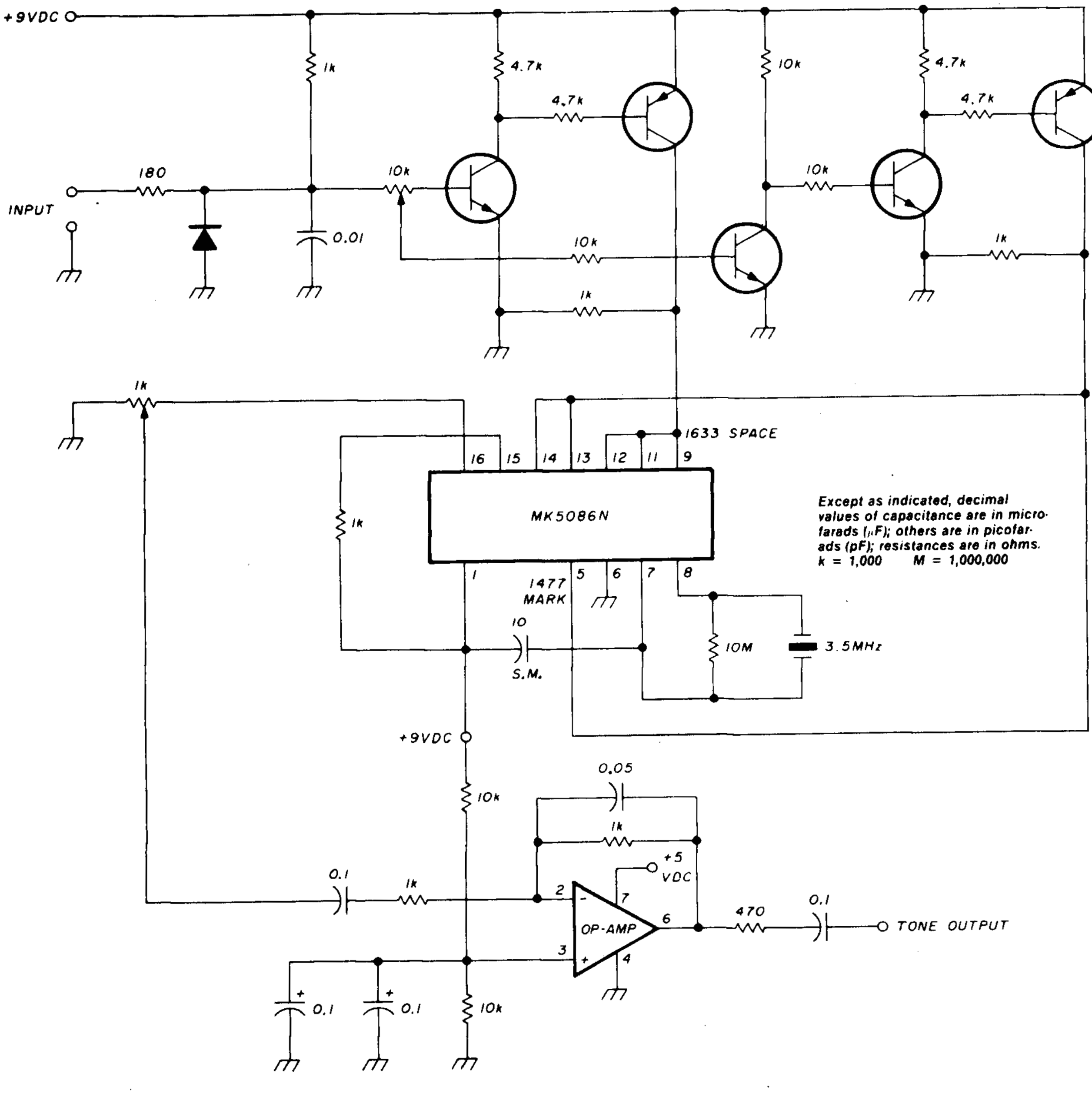


fig. 1. Schematic for the FSK tone generator.

generators have you seen that use an integrated circuit? To my knowledge there aren't very many.

Here is an easy way to build a circuit using a TouchTone™ chip which generates the frequencies needed for FSK. This circuit is connected between the teleprinter and transmitter. There are four main areas in constructing this circuit: the integrated tone dialer chip, switching circuit, filter, and amplifier. See **fig. 1**.

frequencies

Both frequencies are generated by a Mostek MK 5086N IC chip. Pin 9 is used for space at 1.633 kHz, and pin 5 as mark at 1.47 kHz. A 3.579545 MHz television color-burst crystal is the frequency-determining element for the chip. To simulate keyboard operation, tie pins 14 and 13 to pin 5 and pins 12 and 11 to pin 9. This makes the Mostek think it is being switched by a keyboard.

Transistors in a switching circuit determine if a space or a mark is sent.

filter and amplifier

An op amp provides a small amount of needed gain. A lowpass filter is used to reduce the harmonic content generated by the Mostek IC chip. This filter can be made by placing a capacitor across pins 2 and 6 of the op amp.

This circuit was constructed by Charles Aron, Ney Vew, and David Nagel at Northern Montana College in Havre, Montana. Special thanks are also given to Lee Barrett; without his time and advice this project would not have been possible.

David Nagel
Havre, Montana

capacitive-reactance meter multiplier

Recently I saw a large commercial type 0-150 Vac voltmeter in mint condition — just what I needed for my station control panel to monitor line voltage. However, the external series resistance was missing. Well, the owner sold it to me for $2.50, as he admitted it didn't have too much value as it was. I discovered it would need an external 15-watt series resistance of about 1500 ohms. I decided to use a capacitor of the same reactance instead of using a resistance; reactances do not dissipate power and I would save energy.

The calculation for finding the required reactance is:

$$C = 1{,}000{,}000/(6.28)(f)(X_C)$$

where f is the line frequency, in this case 60 Hz, X_C is the desired reactance in ohms equal to 1500 ohms, and C is the required capacity in μF:

$$C = 1{,}000{,}000/(6.28)(60)(1500) = 1.77\,\mu F$$

The theory and application worked fine. I used a good accurate ac voltmeter as my calibration standard. By paralleling a few small non-electrolytic fixed condensers from my junk box, it was easy to make my meter read the same. The real advantage of using condensers is that the power drain on the line is practically negligible. Naturally, the calibration is good only for the 60 Hz line voltage you are monitoring.

William Vissers, K4KI

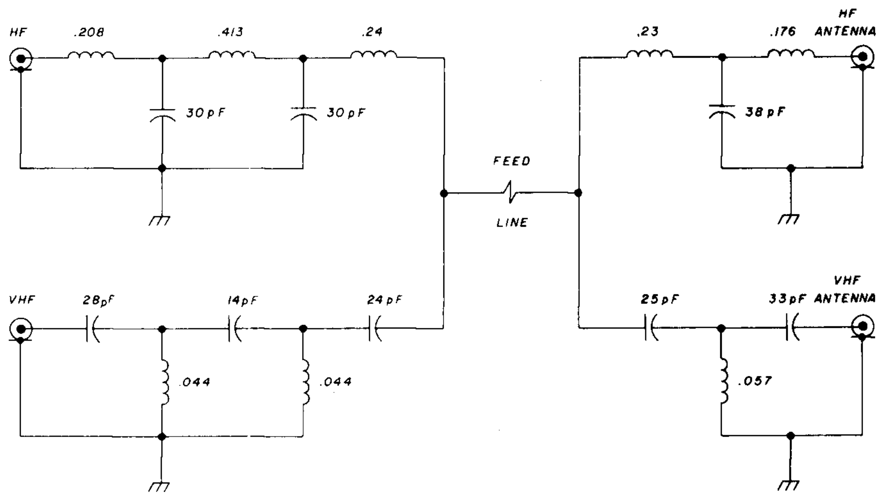


fig. 2. The capacitor changes to the N6RY diplexer mods.

diplexer mods

You can diplex high frequency to go above 28 MHz (refer to N6RY's article on page 71 in the December, 1980, issue of *ham radio*). By building up the VHF part of the two boxes and changing a couple of the capacitors in the high frequency side of the boxes, you can operate 10 and 2 or 10 and 220, or 6 and 2 or 6 and 220 meters at the same time. You can also add 6 or 10 meters to your 2 or 220 repeater by adding a box and an antenna on top and a box and a repeater or remote base on the bottom. All additions use the same feed line. The capacitor changes are shown in **fig. 2**.

If you have a 6-meter rig and want to go mobile, but can't find a spot to mount another antenna, try a 5/8 wave 2-meter antenna and check the SWR. If it is low on 6, just add the box between the 6 and 2-meter rigs and connect it to the same antenna.

Robert McWhorter, K5PFE

simple diode tester

I recently had to check the peak inverse voltage of some surplus diode units. Searching for a suitable device, I decided to use a high-resistance transformer acquired at a flea market sale. This particular unit had a high resistance secondary (over 600 ohms) which precluded its use for service in a power supply unit supplying more than minimal power. This was hooked up as shown (**fig. 3**), in a simple full-wave doubler circuit, and provides over 1,000 volts dc from a secondary rated 400 volts ac.

There are two methods for checking diodes for PIV. One method is to increase the test voltage until there is 10 μA of reverse current (for a 1-ampere diode) and then to rate the diode at a safe peak inverse voltage of 20 percent lower. The method I prefer is to calibrate for a PIV of that value attained when 5 μA of reverse current flows. Either way gives a satisfactory rating for diode breakdown voltage, see **fig. 4**.

Any multimeter with a basic sensitivity of at least 5,000 ohms per volt can provide the needed test current, since the basic limiting resistance is present in the meter's multiplier resistance. A convenient method of checking voltage at the same setting is to simply short out — with an insulated screwdriver — the terminals across the diode being tested. The high-resistance secondary precluded the need for any limiting resistors in the circuit, and the low-capacity filter capacitors cause the output voltage to drop sharply under load, tremendously reducing the hazard of testing with high voltage sources.

Neil Johnson, W2OLU

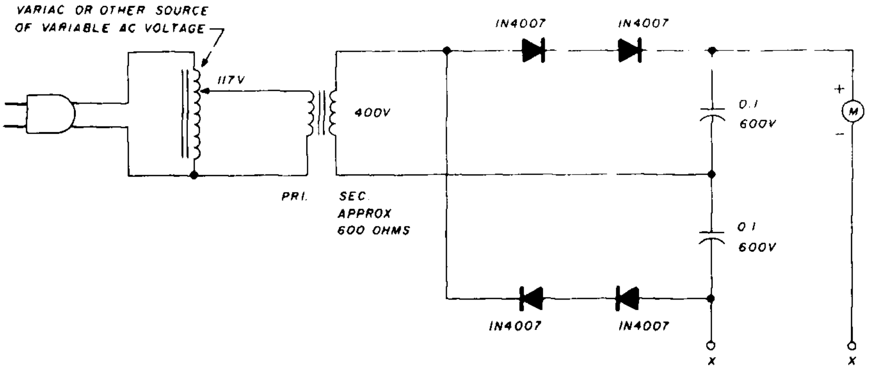
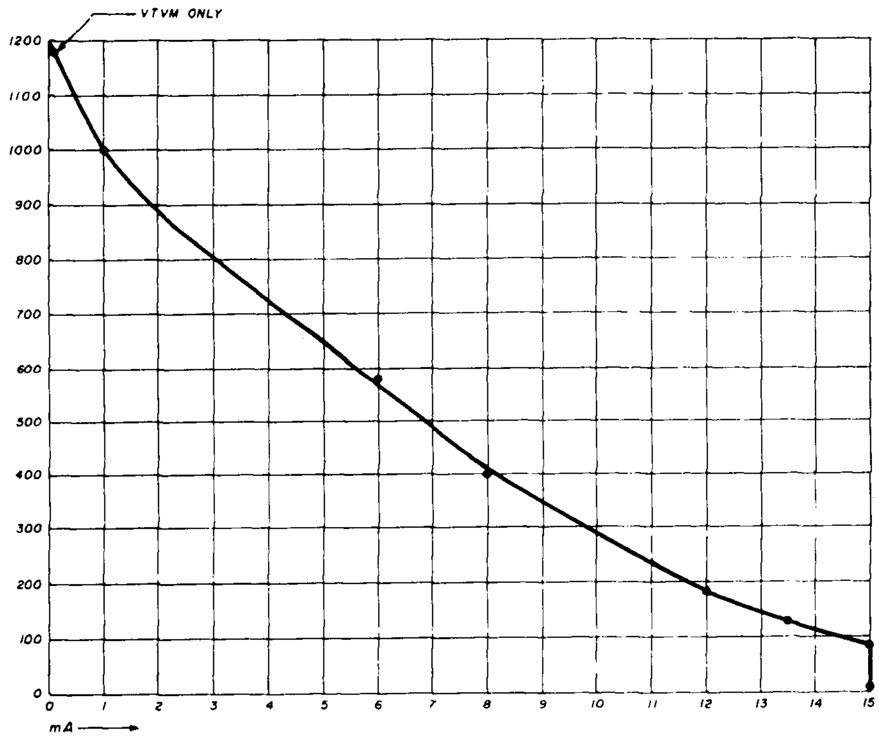


fig. 3. Simple tester for checking silicon diodes. To test diode, insert in circuit at x, and then raise input voltage from zero. Meter M is any sensitive voltmeter on 1,000 volt scale, having sensitivity of 5,000 ohms per volt or more. Alternate method is to utilize a 0-200 microammeter and 5 megohms of resistance.



1175 V	VTVM
1000 V	2 mA
590 V	6 mA
400 V	8 mA
195 V	12 mA
135 V	13.5 mA
75 V	15 mA
15 V	15 mA

fig. 4. Sample rating chart. Safety is enhanced by limiting current by high impedance supply.

improved logic probe

I was considering buying or building a logic probe to complement my dual channel scope when troubleshooting my homemade microcomputer. The August, 1980, issue of *ham radio* finally convinced me to build my own version.

The following specs were essential: indication of high-low-open conditions; capture-stretching short-positive or negative pulses; operation at TTL (5V) and at CMOS (5-15V) levels; high and low should be indicated at the specified levels for each logic family and every voltage, that is, 0.8 and 2.5V for TTL and 1/3 V_{CC} and 2/3 V_{CC} for CMOS.

I took two ideas from N6UE's article[1] in the August issue on page 38: using the 555 timer and voltage regulation for the display LEDs[2] I met the requirements of the first, third, and last specs by using National Semiconductors' 339 quad, single supply comparator[3] I obtained the required reference levels from a voltage dividing network and a switch, which modifies the resistor values to suit TTL-CMOS levels. See **fig. 5**.

Comparators a and b serve as a window detector, both being high inside the forbidden voltage region, while going low at a high or low input. A low from comparators a and b is used to drive the high (red), and the low (green) LEDs. The negative transitions are differentiated and ORed by the remaining two comparators, and applied to the 555 for stretching. The timer drives the pulse (orange) LED. An LM309 TO-5 voltage regulator provides protection for the LEDs against voltage rise.

I wired the prototype on a piece of Veroboard. As I lack a PC board production capability at home, I decided to stay with the prototype.

Tests indicate that the probe operates as required up to about 250 kHz square wave input. The minimum captured pulse width is about 4 μs. These results are close enough to the specified delay through the comparators to indicate that speed-pulse width limitations could be reduced by using faster comparators.

references

1. R.S. Isenson, N6UE, "Digital Logic Probe," *ham radio*, August, 1980, page 38.
2. Signetics NE555V data sheet.
3. National Semiconductors LM339A data sheet.

J. Rozenthal

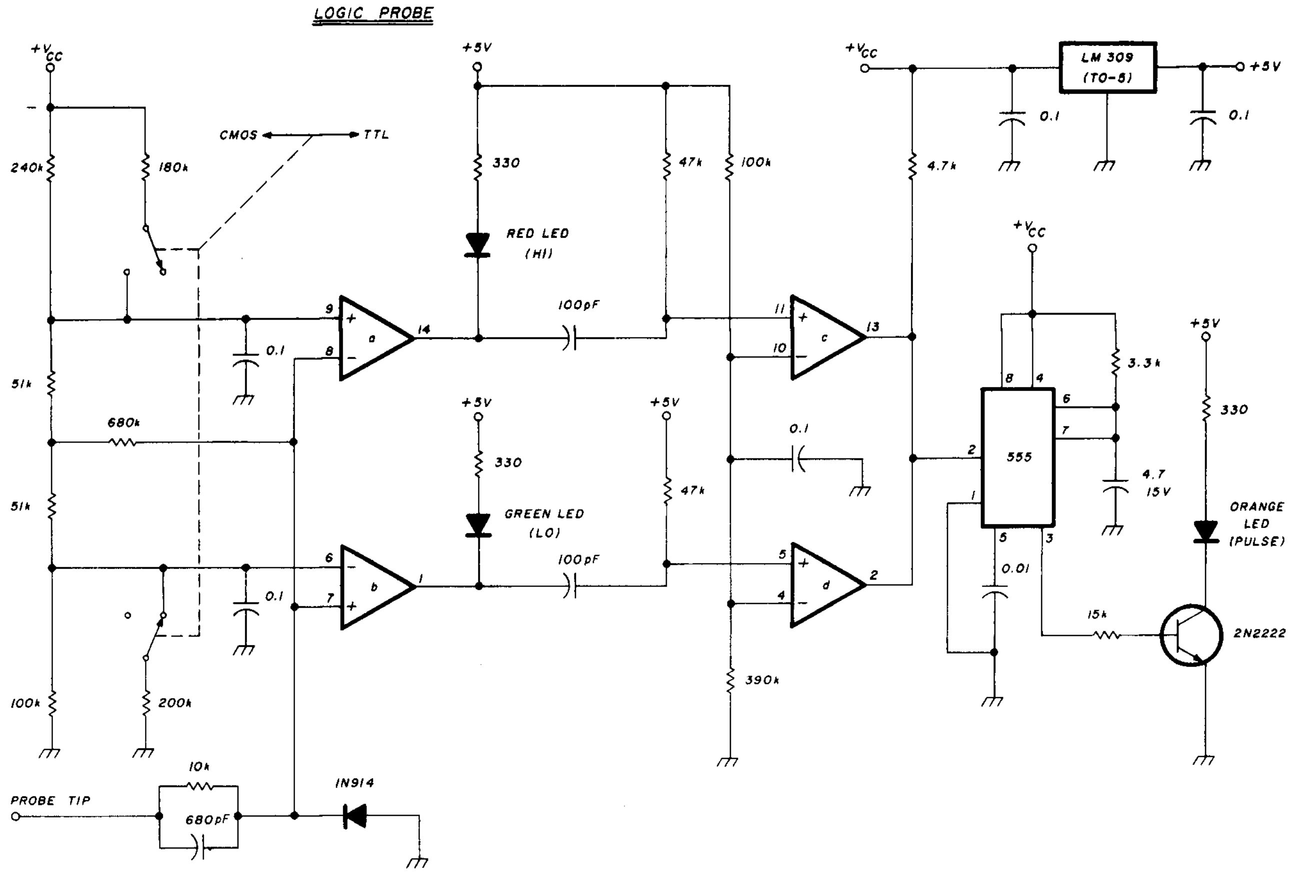


fig. 5. The improved logic probe.

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Garth Stonehocker, K0RYW

DX FORECASTER

spring DX

The powerful DX months (around the equinox) are here for us to try again. Over the years March and April have provided excellent 6-meter openings on transequatorial (TE) paths. Using 6-meter openings as a criterion for the higher-frequency-band DX, last year didn't have as many openings as 1981, but the opening on March 4 was acclaimed the best in years in *Westlink Report*. The March 4 opening was a period of high solar flux and geomagnetic disturbance, which probably influenced the TE (one-long-hop) propagation. April was also roaring with TE openings from the southern U.S. to South Africa, South America, New Zealand, and Australia. The other openings in April were not so pronounced, as the solar flux was lower. However, four large disturbances (April 2, 11, 25, and 29) and two smaller disturbances (April 17 and 21) increased the ionization near the geomagnetic equator for high maximum-usable frequencies for TE.

This year's 6-meter openings may be fewer in number since we are already near the half-way point on the down-side of cycle 21. The sunspot number should be about 75 (123 flux units). The second maximum 1981-82-83) period of geomagnetic-ionospheric disturbance in cycle 21 is expected to be the dominating factor for openings this year. These disturbed periods during April are expected around the 5th, 15th, and 23rd. The latter is the longer recurrent type (see February, 1982 DX Forecaster).

last minute forecast

The higher segment of the h-f bands (6-30 meters) will probably be best during the middle of the month. Watch for the high radio flux and disturbance numbers from WWV at 18 minutes after the hour. On the lower bands (30-160 meters)* night DX will be best during the first and last weeks of the month, particularly in-between the springtime frontal thunderstorms when QRN should be low. Your favorite TV weather forecaster will show these fronts moving across your QTH.

The perigee of the moon's orbit (for moon-bounce DX) is on the 21st at 2100 hours; the moon will be at full phase on the 27th at 0631 hours. There will be a short meteor shower, the Lyrid, on April 20-22. The rate is five per hour, hardly a real help for *meteor-scatter* DX. But a bigger shower, the Aquarid, starts before the end of the month, peaks on May 5, and ends by mid-May. Its rate is 10 to 30 per hour.

band-by-band forecast

Six meters may provide occasional band openings with a peak during the late afternoon hours. Transequatorial north/south paths will be the best. Your guide to good conditions are strong openings on 10 meters with high values of solar flux and A and K geomagnetic indices.

Ten and fifteen meters will be open to many areas of the world from morning until early evening hours most days. Times of geomagnetic disturbances will limit the number of signals heard, but listen carefully — they can be from very unusual places. Fifteen meters should stay open later in the day than 10 meters. Operate 10 first and move down to 15. More hours of daylight means earlier band openings and longer periods of operation.

Twenty meters will be the main daytime DX bands, as it is almost always open to some part of the world. It opens to the east as the sun rises and extends into the late evening hours to the west. Geomagnetic disturbances do not affect this band as much as the higher ones, but look for unusual transequatorial DX propagation once in a while. One-hop transequatorial DX of 5,000 to 7,000 miles (8,000 to 11,200 km) may be possible in the late evening hours during some of these unusual conditions.

Thirty meters is a day and night band. The day portion should be like 20 meters except the signal strengths may decrease during midday on some days. Days of decreasing strength should be those with high solar flux values. This band will also work well into the night, often through the night. Nights this doesn't hold true will most likely follow a day with a very high solar flux value. The problem time is usually the hour or so before dawn. The workable distance may be expected to be greater than 80 DX at night and less than 20 during the day.

Forty and eighty meters will exhibit short skip conditions during daylight hours and lengthen after dark. The bands will open to the east just before your sunset, swing more to the south toward Latin America about midnight, and end up in Pacific areas during the hour or so before dawn. On some nights these bands will be as good as during the winter DX season. The coastal regions usually have the edge for working rare DX on these bands.

One-sixty meters will probably bring many nights that will remind you of last summer's noise. However, many good nights are left for working DX before this summer's noise comes to stay. Propagation on 160 meters will approximate a shortened 80-meter condition.

ham radio

*Editor's note: 30 meters because of its unique place in the h-f spectrum and characteristics is discussed in both sections (higher/lower segments) of the h-f band forecast.

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APRIL																									
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PST	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	
ASIA FAR EAST	15	15	15	15	15	15*	20	—	—	—	—	—	—	—	—	—	—	—	20	15	15	15*	15	15	N
EUROPE	20	20*	20*	20*	20*	20*	20	20	—	—	—	—	—	—	—	—	40	40	20	20	20	20	20	20	NE
S. AFRICA	15	15	15	15	10	10	10	15	20	20	—	—	—	—	—	20	20	30	30	20	20	20	20	15	E
S. AMERICA	10	10	10	10	10	10	15	15*	15	20	20	—	—	—	20	20	20	20	15	15	15	10	10	10	SE
ANTARCTICA	15	15	15	15	20	—	—	—	—	—	—	—	30	20	20	20	20	20	20	15	15	15	15	15	S
NEW ZEALAND	10	10	10	10	15	15	15	15	—	—	—	20	20	20	15	15	15	15	10	10	10	10	10	10	SW
OCEANIA AUSTRALIA	10	10	10	15	15	15	15	—	—	—	20	20	20	20	20	15	15	15	15	10	10	10	10	10	W
JAPAN	10	10	15	15	—	—	—	—	—	—	—	—	—	20	20	20	20	20	15	15	15	15	10	10	NW

MID USA

MST	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	
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S. AMERICA	10	10	10	10	10	10	10	10	15*	15	15	20	—	—	20	20	20	20	15	15	15	10	10	10	SE
ANTARCTICA	15	15*	15	15	—	—	—	—	—	—	—	—	—	20	20	20	20	20	20	20*	20*	15	15	15	S
NEW ZEALAND	10	10	10	10	15	15	15	—	—	—	—	—	—	20	20	20	20	15	15	15	10	10	10	10	SW
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JAPAN	10	15	15	15	—	—	—	—	—	—	—	—	—	—	—	20	20	20	20	15	15	15	10	10	NW
CST	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	

EASTERN USA

EST	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	6:00	5:00	4:00	3:00	2:00	1:00	12:00	11:00	10:00	9:00	8:00	7:00	
ASIA FAR EAST	20	20	—	—	—	—	20	15	20	20	—	—	—	—	—	—	—	20	20	20	15	15	15	15	N
EUROPE	20	20	15	15	15	15	15	15	15	20*	15	—	—	—	—	20	20	20	40	40	40	20	20	20	NE
S. AFRICA	15	15	10	10	10	10	10	10	15	15	—	—	—	—	—	20	15	15	30	30	20	20	15	15	E
CARIBBEAN S. AMERICA	10	10	10	10	10	10	10	10	10	—	—	—	15	20	20	20	20	15	15	15	15	15	10	10	SE
ANTARCTICA	15	15	15	15	15	15	—	—	—	—	—	—	—	—	20	20	20	20	20	20	20	20	20	20	S
NEW ZEALAND	10	10	10	10	15	20	20	—	—	—	—	—	—	—	20	20	20	20	15	15	15	10	10	10	SW
OCEANIA AUSTRALIA	10	10	10	10	15	15	15	15	—	—	—	—	—	—	—	20	20	20	20	15	15	15	10	10	W
JAPAN	10	15	15	20*	—	—	—	—	—	—	—	—	—	—	—	20	20	20	20	20*	15	15	10	10	NW

*Look at next **higher** band for possible openings.

NEW products

REVIEW: Daiwa CN520 SWR and power meter

About the only time we had a chance to use a dual needle SWR meter was when we used the TMC transmitter at W1AW. That was, until MCM (distributors for selected Daiwa products), sent us their CN520 SWR and power meter.

The Daiwa meter comes in four different models: the CN150 for 1.8-60 MHz 20/200 watts, the CN520 for 1.8-60 MHz 200/2 kW, the CN530 for 50-150 MHz 20/200 watts, and the CN540 for 140-250 MHz 20/200 watts. Each of these units measures just 2.83 × 2.83 × 3.62 inches (72 × 72 × 96 mm) and weighs less than a pound. Rf connectors on each are SO-239 and accuracy is listed at ± 10 percent.

Installing the SWR bridge is a matter of connecting it in-line between your transmitter and load. Setting the meter to the correct power position ensures that you will get an accurate SWR reading. Two needles are used to measure SWR: the left needle measures forward power, the right needle measures reflected power. The point at which the two needles cross is the SWR reading. SWR is clearly marked on the meter face by a series of red lines. This is quite handy and allows the operator to know instantly how well his line is matched between transmitter and antenna.

The meter case has two brackets on the side for possible use as a mobile or remote mount.

This is a nice meter. When compared to a lab-type meter, its accuracy is quite good, well within the rated specifications. We find the CN520 to be a breeze to use and a very valuable addition to our ham shack. In fact, after using the dual reading meter it is very hard to use any other kind of unit.

Price is $69.95 retail. For more information, contact your local dealer or MCM direct at 858 E. Congress Park Drive, Centerville, Ohio 45449. Reader Service Number 301.

N1ACH

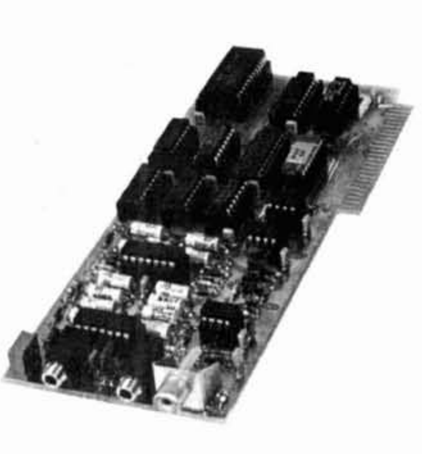
slow-scan TV system

Commsoft has developed PhotoCaster™, a slow-scan television system for the Apple II computer. PhotoCaster provides an easy way for hams who own Apple computers to get started on SSTV with a full-featured black and white and color system. PhotoCaster includes a circuit board to interface an Apple to a TV camera and a receiver/transmitter, plus a two-disk software package.

PhotoCaster can also add titles and graphics, create video special effects, enhance images, retrieve and store pictures on disk, and print high resolution pictures with an MX-80 printer.

Black and white pictures are processed with a resolution of 128 by 128 pixels and sixteen levels of gray. In the color mode, eight colors are available with sixteen saturation levels. Color pictures are taken with an unmodified black and white TV camera using a three-frame RGB sequence. Standard RGB transmission formats are available in addition to a unique Apple-to-Apple single-frame color mode which takes eight instead of the usual twenty-four (or more) seconds to transmit a color picture.

PhotoCaster requires an Apple II or Apple II Plus computer with 48K RAM and one disk drive. The price of the PhotoCaster is $499.95 for the basic system, including an assembled and tested circuit board and software. A complete system, consisting of a Panasonic WV1400 camera, board and software, is available for $749.95.



For more information, contact Commsoft, Inc., 665 Maybell Avenue, Palo Alto, California 94306. Reader Service Number 302.

radio teletype and CW

With the Super-Ratt radio teletype and CW program for the Apple II, you can have your own Radio Bulletin Board System (RBBS) station on-line quickly and easily.

The program will operate in ASCII as well as Baudot at any speed from 40 to 300 baud. CW speeds range from 5 to 100 WPM, with an automatic speed adjust on receive.

The program may be run in either manual or RBBS modes. Extensive use of disk files permits storage of canned material for manual operation. In the RBBS mode, the system automatically saves nearly one hundred user messages to the disk. There are thirty-five different, simple English word commands on the RBBS.

Almost any modern terminal unit or converter can be used with Super-Ratt, as well as devices such as the RADCOM card by AF6W. The program is not protected against copying. The BASIC portion may be listed and modified to suit your tastes. (The registered owner's call is installed in the machine code by the factory.)

A free one-year subscription to the user newsletter, *The Ratt's Nest*, is included in the purchase price of $54.95. For more information, contact Universal Software Systems, Inc., 9 Shields Lane, Ridgefield, Connecticut 06877. Reader Service Number 303.

helical resonator amplifiers

Hamtronics, Inc., has developed a new line of low-noise receiver preamps with helical resonator filters built in. The HRA-144, HRA-220, and HRA-432 units cover the three major VHF and UHF ham bands. The combination of a low-noise amplifier and the sharp selectivity of a three or four section helical resonator increases receiver sensitivity and reduces cross-band interference. The unit has a low 0.6 to 0.95 dB noise figure and 50 to 60 dB rejection of any signals out of the ham band.

The amplifier circuit uses some of the new microwave transistors developed for satellite TV service. Nominal gain is 26 dB on 2 meters, 22 dB on 220 MHz, and 16 dB on 420-450 MHz. A three-section helical resonator is used in the output circuit of the VHF units, a four-section resonator is used in the UHF unit. The VHF unit is only 1½ × 3 inches, and the UHF unit is only 2½ × 3 inches.

The HRA-144 or HRA-220 costs $49.95, and the HRA-432 is $54.95.

For further information contact Hamtronics, Inc., 65 Moul Road, Hilton, New York 14468-9535. Reader Service Number 304.

Ameco multimeters

Ameco Equipment Company announces preliminary specifications of its new line of Ameco multimeters. Multimeter Model M-300 (available immediately) features highly sensitive 20K ohms/Vdc and 10K ohms/Vac; gold-plated switching contacts; overload protection by diodes and fuse; and carrying handle that can be used as adjustable stand.

Ranges for dc voltage: 0-0.25, 1, 2.5, 10, 25, 100, 250, 1000 V; ac voltage: 0-10, 25, 100, 250, 1000 V; dc current: 0-50, 500 μA, 5, 50, 500 mA; resistance: 0-6K ohms, 60K ohms, 600K ohms, 6M ohms. Volume level: − 22 dB to + 22 dB to + 62 dB in five ranges. Size and weight: 5.5 inches high × 4.3 inches wide × 1.6 inches deep.

Model M-300 is a high quality, highly sensitive, laboratory-type instrument. Its large, easy-to-read scale and excellent damping are usually found only in expensive meters. Parallax errors are eliminated by a mirror arc. This meter comes complete with battery, spare fuse, test leads, and instruction manual. Model M-300, completely wired and tested, $28.95.

Ameco LCD digital multimeter, Model D-200, features high-contrast, large 1/2 inch, 3-1/2 digit LCD display; automatic polarity;

automatic zero adjustment; over-range indication on all ranges; low-battery indication; full overload protection; 10-megohm input impedance; rugged anti-slip case with stand.

Ranges for dc voltage: 0-200 mV, 2V, 20V, 200V, and 1,000V; ac voltage: 0-200V, and 750V; dc current: 0-200 μA, 2 mA, 20 mA, 200 mA, and 10 A; resistance: 0-200 ohms, 2K ohms, 20K ohms, 200K ohms, 2000K ohms, and 20M ohms. Size and weight: 7 inches high × 2.7 inches wide × 1.6 inches deep.

The latest IC and display technology insure reliability, accuracy, and stability. Dual slope integration provides fast, accurate, noise-free measurements. The same two jacks are used for all functions and ranges (except 10A dc). Model D-200 comes complete with battery, spare fuse, test probes, instruction manual, and an optional carrying case. Model D-200, completely wired and tested, $69.95; optional carrying case, $3.75.

For further information, contact Ameco Equipment Company, 275 Hillside Avenue, Williston Park, Long Island, New York 11596. Reader Service Number 305.

RT-1100 receive terminal

DGM Electronics has just introduced the RT-1100 Receive Terminal for Baudot, ASCII, and Morse. The RT-1100 converts the audio from your receiver, decodes it, and displays the words on a video monitor or TV set (using rf modulator). The RT-1100 incorporates an active filter demodulator with scope tuning outputs. It will copy 170, 425, 850 Hz shift RTTY signals at speeds of 60, 66, 75, and 100 WPM on Baudot and 110 baud on ASCII. The unit will copy 6-60 wpm Morse signals using automatic or manual speed tracking.

The RT-1100 has a parallel ASCII printer output for hard copy. The video output provides sixteen lines of thirty-two characters per line with two pages. The second page is stored in memory and can be recalled by using the page 1-2 switch on the front panel. The unit has a built-in 110 Vac power supply and is housed in an attractive 3 × 10 × 10-inch case with brushed, anodized front and rear panels. The cover is a grey wrinkle finish. The unit comes with a one-year warranty on parts and labor.

For more information, contact DGM Electronics, Inc., 787 Briar Lane, Beloit, Wisconsin 53511. Reader Service Number 306.

encoder with ultra thin keyboard

Midian Electronics, Inc., has introduced the TTE-1 TouchTone™ encoder with ultra-thin keyboard. The unit features the thinnest available keyboard/DTMF encoder assembly with automatic PTT and side tone. The keyboard mounts virtually flush on a flat surface. DTMF encoder on the back of the keyboard fits into a 1 × 1-1/2 inch hole for flush mounting. It produces digitally synthesized tones for accuracy and stability with adjustable audio output level and generates twelve standard Bell System TouchTones. Options include keyboard only, without encoder, and LED indicating when automatic PTT is activated.

For more information, contact Midian Electronics, Inc., 5907 East Pima Street, Tucson, Arizona 85712. Reader Service Number 307.

interchangeable antennas

Antenna Incorporated has recently introduced a complete line of interchangeable antennas for use on hand held transceivers and scanners. The Portasuader antennas let the user replace only the radiator section of the antenna while continually reusing the mounting-adapter fitting for the transceiver. The radiators are all internal threaded (No. 10-32) to accept the male thread of the interchangeable mounting adapter. The outer portion of the

NEW products

socket is etched with the frequency range for that particular radiator. Ten mounts are available to be used with the five different radiator styles.

The short 8-inch whips for 25-54 MHz incorporate a wire-wound base-loading coil and helical-style radiator in six different frequency steps. Tuning has been eliminated and fragile temperature-sensitive ferrite cores have also been eliminated. A distinct feature is the antenna length which is less than 8-inches long, measured from mount to tip. In the 118-174 MHz frequencies, Portasuaders are available in standard tuned helical units, extra-fat helical units and 1/4-wavelength stainless steel whips incorporating a spring section. The advantage of the fat Portasuader is its shorter length (about 2 inches shorter than helical). A secondary benefit in using the fat antenna is its lower Q, broadening the resonance curve and thus achieving a better match over the frequency range.

Also available is a 1/4-wavelength 0.046 inch diameter 17-7PH stainless steel whip incorporating a novel spring construction above the base fitting. This spring allows the whip assembly to bend when the user sits down with his radio attached to his belt. The 1/4-wavelength Portasuader was designed to replace the telescopic antennas, which bend or break or simply do not telescope properly. As a further advantage, the 1/4-wavelength Portasuader antennas exhibit a practical 10 dB gain over the helical or fat helical antennas.

The frequency range is covered in seven frequency steps, thus again removing the need for field tuning. UHF stubby helical whips and 1/4-wavelength speedometer cable antennas are available as radiators in five frequency ranges between 406-512 MHz. An 800 MHz 1/4-wavelength speedometer cable antenna is currently available.

These Portasuaders are constructed from heavy copper-plated spring steel that is screwed onto the base fitting and then soldered to ensure electrical contact. Both helical and speedometer styles are insulated by coating in a multi-stage process. The special process guarantees a solid section of material with minimum voids and high finish gloss. The coating is designed to remain flexible, retain its resilience at −40 degrees F and not to soften at 200 degrees F.

For further information, contact Randy Friedberg, Vice President, Antenna Incorporated, 26301 Richmond Road, Cleveland, Ohio 44146. Reader Service Number 308.

high resolution SSTV converter

High resolution slow scan television (SSTV) is available with the Videoscan 1000 by Microcraft Corporation. The unit is completely compatible with Amateur-standard SSTV and first-generation equipment. Videoscan can convey high-resolution eight-second, 128-line SSTV pictures to first generation scan converters using current standards. In two separate high resolution modes, the TV picture uses the full 256 TV lines and 256 picture elements (pixels) per line, resulting in pictures that rival commercial TV quality. The pixels are quantized to 64 levels of gray, four times better than first generation units. No contouring (false edges) is introduced to detract from the picture.

Some features of Videoscan are: Split-mode, a special mode that enables viewing four regular 8.5-second SSTV pictures at one

time on the TV monitor as they are received; Stop motion, a single frame of video may be grabbed into memory from a TV camera manually or automatically, thus stopping motion; Cursor, a cursor dot appears on the screen to indicate the current line being transmitted; Gray scale, Call Sign, mode selector activates a gray scale and optional call sign which are superimposed on the picture in memory; Station switching, all necessary switching between transmitter, microphone, and tape recorder is included in Videoscan.

Microcraft is presently working on a computer input/output port and a color conversion of the Videoscan 1000.

✓ 146

✓ 158

✓ 126

NEW products

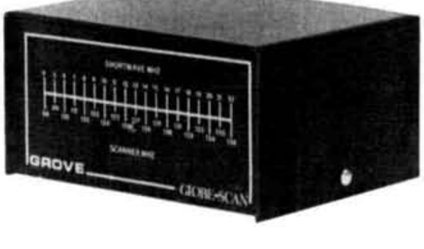
The Videoscan 1000 is available as a complete kit for $595.00 or wired and tested for $795.00 plus $6.00 for shipping.

For more information, contact Microcraft Corporation, P.O. Box 513, Thiensville, Wisconsin 53092. Reader Service Number 309.

improved 225-400 MHz scanner converter

The CVR-1B Scanverter includes a built-in preamplifier for increased sensitivity. It allows complete coverage of the 225-400 MHz military/federal government aircraft band when used with a standard aircraft band scanner. "Bandstacking" allows the entire 175-MHz-wide UHF aircraft band to be compressed into the 118-136 MHz range tunable on any scanner capable of standard aircraft reception. No tuning or adjustments are necessary with the fully automatic converter.

Reception for hundreds of miles is possible when an outside antenna is used. Additional features include high sensitivity, low noise microstripline circuit; all-metal cabinet for superior shielding; double-balanced mixer to reduce images; nine-pole filter to suppress out-of-band interference; crystal oscillator to provide high stability; and Zener diode voltage regulation to limit drift. The scanner is powered by convenient 12 Vdc.



The Scanverter, CVR-1B, costs $89.00 plus $2.00 for shipping. Contact Grove Enterprises, 140 Dog Branch Road, Brasstown, North Carolina 28902. Reader Service Number 310.

the Z-Dubber

The Sinclair ZX81/Timex 1000 is a popular personal computer. One drawback is the difficulty experienced in loading cassette programs. Bytesize Computer Products has introduced the Z-Dubber, an interface between the Sinclair computer and its cassette recorder, which helps even the most difficult cassette program to load easily. Additionally, the Z-Dubber allows you to connect two cassette recorders together to create perfect back-up copies of your Sinclair programs. The Z-Dubber operates on two AAA cells, and is packaged in an attractive black case. It is available for $29.95 plus 3 percent for shipping.

For more information, contact Bytesize Computer Products, P.O. Box 21123, Seattle, Washington 98111. Reader Service Number 311.

Amateur data display, DTU-12

Get a clean, crisp computer-quality data display for your next ham project with a DTU-12 from Dotronix, Inc., available in kit, chassis, or chassis/ac power versions, either P4 (white) or P31 (green) phosphor. It requires only 12 volts at 1.5 amperes, and standard TTL horizontal and vertical control signals with 2.5 volts video drive. The scan rate is 15,750 Hz. Interface is made through ten-pin edge-card connector.

The kit costs $85.00 (CRT/circuit only); chassis $95.00; ac supply $35.00 (for chassis version).

For additional information, contact Dotronix, Inc., 160 First Street S.E., New Brighton, Minnesota 55112. Reader Service Number 312.

programmable CTCSS encoder

A miniature encoder has been introduced by Ferritronics, Inc., featuring quartz-accurate stability and all thirty-seven EIA tones. Two variations are available: the FT303A, which is programmed by cutting wire loops; and the FT303B, which uses a dipswitch for programming. The encoder measures 0.9 × 1 × 0.4 inch and draws less than 7 mA. Mounting holes and color-coded lead set make installation simple.

For further information, contact Tom Whitney at Ferritronics, Inc., 222 Newkirk Road, Richmond Hill, Ontario L4C 3G7, Canada. Reader Service Number 313.

two-meter mobile transceiver

The TR-7950 and TR-7930 are identical in features except for rf output: 45 watts for the TR-7950, and 25 watts for the TR-7930. Their

NEW products

notable features include 21 multi-function memories, automatic offset, programmable priority channel, memory and band scan, long-life lithium battery memory back-up, built-in 16-key autopatch.

The TR-7950 has a factory-suggested retail price of $399.95; the suggested retail price for the TR-7930 is $359.95.

Additional information may be obtained by contacting Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220. Reader Service Number 314.

3½-digit true rms DDM

John Fluke Mfg. Co., Inc., announces the addition of a 3½-digit true rms meter to its 8020B-series of handheld DMMs, called the 8026B. It's an eight-function handheld model featuring true rms ac capabilities while retaining all of the functions of the 8020B.

For further information, contact Frank Partin, John Fluke Mfg. Co., P.O. Box C9090, Everett, Washington 98206. Reader Service Number 315.

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flea market

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QSLS'S: NO STOCK DESIGNS! Your art or ours; photos, originals, 50. for samples & details (refundable). Certified Communications, 4138 So. Ferris, Fremont, Michigan 49412.

QSL CARDS: 500/$12.50 ppd. Free catalog. Bowman Printing, 743 Harvard, St. Louis, MO 63130.

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SELL: Icom 701 w/PS $550.00; Icom 211 $250.00; Bearcat scanner 250 $150.00. All mint condition. Prices firm. KB4XU. (803) 766-2831.

CHASSIS and cabinet kits. SASE K3IWK.

YAESU FT-ONE General coverage transceiver with every option including FM, Curtis keyer and scanning microphone. List $3700. Tax sale $2250. Yaesu FL2100Z, 80-10 meter linear $350. Dentron MT2000A 3KW Ant/Tuner $200. N6ABE (415) 881-5429 any time.

KT5B Multi-Band Antenna 160-80m (WARC) $59.95, instruction manual $3.00, 2 KW + center connector $8.50. Kilo-Tec, PO Box 1001, Oak View, Cal. 93022. Tel (805) 646-9645.

FOR SALE: Atlas 210X. Best offer gets it. Works good. Jerry Bayless, 316 S. Delmar, Decatur, IL (217) 428-8218.

VIDEOSCAN 1000 Slow Scan TV — High resolution (Amateur, phone line, surveillance, teleconferencing). Code*Star — decode Morse, RTTY, ASCII. Large LEDs or connect computer/printer. Morse-A-Keyer — CW keyboard. Tri-voltage power supply. Kits/assembled. Free brochures. Microcraft Corporation, Box 513-HR, Thiensville, WI 53092. (414) 241-8144.

ELECTRON TUBES: Receiving, transmitting, microwave . . . all types available. Large stock. Next day delivery most cases. Daily Electronics, 14126 Willow Lane, Westminster, CA 92683. (714) 894-1368.

BUY SELL TRADE — Next 6 issues $2.00. WA4OSR's Rigs & Stuff, Box 973-H, Mobile, AL 36601.

COLLINS 75S3-B w/500 Hz CW filter, 32S3 Xmtr, 516-F2 power supply. Good condition, round emblem. N3CCW, Larry Caracciolo, 1515 Lakeview Drive, Germansville, PA 18053.

PRE-1946 TELEVISION SETS wanted for substantial cash. Finder's fee paid for leads. Also interested in spinning disc, mirror in-the-lid, early color sets, 9AP4 picture tubes. Arnold Chase, 9 Rushleigh Road, West Hartford, Conn. 06117 (203) 521-5280.

WANTED: Old bugs for my key collection. Need Vibroplex, Martin, Bunnell, McElroy, Electro, etc. Also need Spark keys, military, homebrew, and keys of historical significance. K5RS, Neal McEwen, 1128 Midway, Richardson, TX 75081.

WANTED: Highest prices paid for Harris RF 301 and associated equipment. Call collect (212) 925-6048.

BUMPER STICKER — "My favorite radio station is (your call sign here)." Display anywhere! $3.00. Arpress, 380(H) Wilbanks, Rome, GA 30161.

RTTY AND ASCII for Atari. Plans and a drilled PC board to build your own modem. ASCII and RTTY programs on disk all for $25. Robert Holsti, K7ZJD/KH2, Box 4426, AAFB Br. Yigo Guam 96912 (USA).

WANTED: Polarad schematics or copying privileges LPU-1, LKU-1, LDU-1, LTU-1,2,3. Maintenance manuals, if available. 9108 New Delaware Rd., Mt. Vernon, Ohio 43050. W8PEN (614) 392-0841.

TUBES, TUBES wanted for cash or trade. 304TL, 4CX1000A, 4PR60C, WE300, 7F7, 7N7, 53, 6L6M. Any high power or special purpose tubes of Eimac/Varian. DCO, 10 Schuyler Avenue, No. Arlington, NJ 07032. (800) 526-1270.

WANTED: National HRO-50, HRO-60, wkg. condx. W8PEN, 9108 New Delaware Rd., Mt. Vernon, Ohio 43050. (614) 392-0841.

SATELLITE TELEVISION INFORMATION. Build or buy your own earth station. $4.00 to Satellite Television, RD #3, Oxford, NY 13830. Parabolic antenna construction book also available. Send SASE for details.

WILL SELL to highest reasonable offer. Weston Model 537 AC and DC Radio test set. With original book and test leads. Have QST from January 1968 through December 1972. Otto Cordray, 801 N. Temple St., Caldwell, Texas 77836.

MARCONI WIRELESS TELEGRAPH CO. Stock Certificates. Authentic 1914 certificates, from the pioneering days of radio, are rare antiques and valuable investments. Suitable for framing. Only $38.95 including historical pamphlet. Satisfaction Guaranteed. Free information: Tarlen, Box 7554-M, N. Kansas City, MO 64116.

MOBILE IGNITION SHIELDING. Estes Engineering, 930 Marine Dr., Port Angeles, WA 98362.

RTTY-EXCLUSIVELY for the Amateur Teleprinter. One year $7.00. Beginners RTTY Handbook $8.00 includes journal index. PO Box RY, Cardiff, CA 92007.

MX330 Motorola factory touch tone pad with mother board and daughter board, all interconnecting wiring. Nothing to cut or glue. Complete $100.00. N6GFE, 980 Wildcat Canyon Road, Berkeley, CA 94708. (415) 843-5253.

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MANUALS for most ham gear made 1937/1970. Send $1.00 for 18 page "Manual List", postpaid. HI-MANUALS, Box R802, Council Bluffs, Iowa 51502.

SATELLITE TELEVISION — Howard/Coleman boards to build your own receiver. For more information write: Robert Coleman, Rt. 3, Box 58-AHR, Travelers Rest, SC 29690.

WANTED: Schematics-Rider, Sams or other early publications. Scaramella, P.O. Box 1, Woonsocket, RI 02895-0001.

WANTED: Early Hallicrafter "Skyriders" and "Super Skyriders" with silver panels, also "Skyrider Commercial", early transmitters such as HT-1, HT-2, HT-8, and other Hallicrafter gear, parts, accessories, manuals. Chuck Dachis, WD5EOG, The Hallicrafter Collector, 4500 Russell Drive, Austin, Texas 78745.

RUBBER STAMPS: 3 lines $3.25 PPD. Send check or MO to G.L. Pierce, 5521 Birkdale Way, San Diego, CA 92117. SASE brings information.

WANTED: New or used MS and coaxial connectors, synchros, tubes, components, military surplus equipment. Bill Williams, PO #7057, Norfolk, VA 23509.

VERY in-ter-est-ing! Next 5 issues $2. Ham Trader "Yellow Sheets", POB356, Wheaton, IL 60189.

CB TO 10 METER PROFESSIONALS: Your rig or buy ours — AM/FM/SSB/CW. Certified Communications, 4138 So. Ferris, Fremont, Michigan 49412; (616) 924-4561.

HAMS FOR CHRIST — Reach other Hams with a Gospel Tract sure to please. Clyde Stanfield, WA6HEG, 1570 N. Albright, Upland, CA 91786.

"WEST COAST 160 METER BULLETIN" devoted to, for and by top band operators. Edited and published 6 times a year by N7CKD. Subscriptions $7.00 U.S. and U.S. Possessions. Canada and Mexico $7.00 U.S. Overseas rate $8.50 U.S. dollars. To 4248 "A" St. S.E., Box 609, Auburn, WA 98002.

WANTED: Diagram for TPL VHF-FM 120W, 2 meter Amp. — 1002-S. It uses TRW-PT8780 which I have been unable to find. Any help would be appreciated. WAØOFO.

WANTED: Micor and Mstr II Base Stations 406-420 and 450-470 MHz. Also 2 and 6 GHz solid state microwave equipment. AK7B, 4 Ajax Place, Berkeley, CA 94708.

FOR SALE: *Ten-Tec Argonaut 515, mint, $280.00;* Kenwood TR-7800, exc., $235.00; Icom R-70 receiver, mint, $630.00; R-392, exc., extras, $145.00; add. UPS. Ham mags: SASE for list, details. WA7ZYQ. (208) 245-2070.

PLANS, CIRCUIT BOARDS, AND KIT PARTS (author approved) for Leach's construction projects. Power *amps, preamps, pre-preamps and loudspeakers.* Send SASE for information. Custom Components, Box 33193, Decatur, GA 30033.

DXPREDICTOR: Computes MUF, FOT, LUF between any two QTHs. Documented; Easy to Use; Nice Graphical/Tabular output. Adapted from Algorithms currently used *by USG agencies. Available for:* Apple II +/IIe (48kmin) plus DOS 3.3 or cassette); PET/CBM (16kmin, 8050 disk or cassette); VIC20 (16k RAM Card, cassette); CBM 64 (cassette only). Program + Documentation: $40.00 all except VIC20 ($30.00). Documentation only: $5.00 (refundable upon purchase of software). Checks to K.J. Flynn, PO Box 903, Mountain View, CA 94042. (CA *residents add 6.5% tax).*

SLEP SPECIALS, HP608F late model signal generator, 10 MHz thru 455 MHz, 19" panel with blue/gray cabinet, excellent for precision laboratory work $375.00, URM-25 signal generator 10 kHz thru 50 MHz $285.00, URM-26 signal generator 4 MHz thru 405 MHz $245.00, USM-140 *oscilloscope* DC-25 MHz, dual trace, triggered sweep $295.00, GRM-46 test set for ARC-27, ARC-55, $40.00, Tektronix 3S76 dual trace plug-in $75.00, Tektronix 1L30 spectrum analyzer plug-in 925 MHz thru 10.5 GHz $495.00, military SG-66/ARM-5 aircraft VOR signal generator equivalent to ARC H-14, perfect for aircraft radio repair $295.00. Add shipping. We accept M/C, Visa or check. *Phone 704-524-7519, Slep Electronics Company,* Highway 441, Otto, N. C. 28763.

Coming Events

ACTIVITIES

"Places to go..."

CALIFORNIA: The 34th annual International DX Convention, a joint effort of the Northern California and Southern California DX Clubs, Friday, Saturday and Sunday, April 22, 23 and 24, at the Visalia Holiday Inn Hotel, Visalia. DXpedition reports, technical presentations, awards, contests, dining and hospitality rooms, slides, movies

More Details? CHECK — OFF Page 129

and videotapes, open forums. Many overseas visitors expected. Manufacturers and distributors showing the latest in radio gear. For further information: Northern California DX Club, PO Box 608, Menlo Park, CA 94025.

COLORADO: The Grand Mesa Repeater Society's fourth annual Western Slope Swapfest, Saturday, April 2, 10 AM to 4 PM, Plumbers and Steamfitters Union Hall, 2384 Highway 6 and 50, Grand Junction. Free admission. Swap tables $5.00 each. Auction and refreshments. Talk in on 146.22/.82. For information SASE to Bill Brown, KØUK, 582 So. Maple St., Fruita, CO 81521 or call (303) 858-9661.

GEORGIA: Kennehoochee Hamfest, Sunday, April 17, 8 AM to 4 PM, Civic Center, Marietta, GA.

ILLINOIS: The 17th annual Rock River ARC Hamfest, Sunday, April 10, Lee County 4-H Center, one mile east of jct. 52 and 30, south of Dixon. Doors open 6:30 for dealers; 7:30 general public. 6 ft. tables available $5.00. Advance ticket donation $2, at gate $2.50. Food. Camping available at nominal charge. Talk in on 37/97 repeater. For information and advance tickets: Ed Webb, WD9CJB, 618 Orchard St., Dixon, IL 61021. (815) 284-3811.

LOUISIANA: The Baton Rouge Amateur Radio Club's annual Hamfest, Saturday, May 7 and Sunday, May 8, Catholic High School, 855 Hearthstone Drive, Baton Rouge. Swap tables, dealers, tech forums and activities for non-hams and children. Talk in on 19/79 and 52 simplex. For further information: BRARC, PO Box 4004, Baton Rouge, LA 70821.

MASSACHUSETTS: The Framingham Amateur Radio Association's 8th annual Spring Flea Market, Sunday, April 10; the largest indoor Ham Flea Market in New England, Framingham Civic League Building, 214 Concord St. (Route 126) in downtown Framingham. Doors open at 10 AM, sellers setup starting at 8:30. Admission $2. Tables $10 (pre-registration required). Talk in on 75/15 and 52 direct. Radio equipment, computer gear, bargains galore. For information, tables: Ron Egalka, K1YHM, 3 Driscoll Drive, Framingham, MA 01701.

MASSACHUSETTS: The Wellesley Amateur Radio Society's annual auction, Saturday, April 16, First Congregational Church of Wellesley Hills, 207 Washington Street, Wellesley Hills, intersection of Routes 9 and 16. Doors open 9 AM; auction starts 10 AM. (15% commission, $1.00 minimum, $30.00 maximum). Talk in on 04:64; 63:03; and 52. Contact: Kevin P. Kelly, WA1YHV, 7 Lawnwood Place, Charlestown, MA 02129.

MICHIGAN: S.E.M.A.R.A., The Southeastern Michigan Amateur Radio Association's 25th annual Hamfest Swap and Shop, April 10, 8 AM to 3 PM, Grosse Point North High School, Vernier Road between Mack and Lakeshore. Admission $1.00 advance; $2.00 at door. Good food, free parking. Talk in on 147.75/.15. For information: SEMARA Swap, PO Box 646, St. Clair Shores, MI 48083 or phone Ray Ninness, WD8KXN (313) 777-0119.

MINNESOTA: The Arrowhead Radio Amateur Club's annual swapfest, Saturday, May 7, 10 AM to 3 PM, Holiday Inn, 207 West Superior St., downtown Duluth. Admission $2.50 advance, $3.00 door. Reserved 4 ft. tables $3.50 advance, $4.00 at door. Food, free parking, enclosed shopping mall. Talk in on 34/94. For information, reservations SASE to Jerry Frederick, NØBNG, 1127 - 104th Avenue West, Duluth, MN 55808.

NEBRASKA: The 1983 Midwest ARRL Convention, April 15, 16 and 17, Marina Inn, South Sioux City. Seminars, displays, exhibits and large flea market all indoors. Fine entertainment during Saturday night banquet. QCWA breakfast, 3900 Club luncheon and an outstanding ladies' program Saturday. Convention costs $6.00 for 3 days. Saturday night banquet $10.00 advance; $12.00 at door. To reserve flea market table contact Al Smith, WØPEX, 3529 Douglas St., Sioux City, IA 51104. Exhibitors contact Jim Boise, KAØGZY, 22 LaSalle St., Sioux City, IA 51104. For general information contact Dick Pitner, WØFZO, General Chairman, 2931 Pierce St., Sioux City, IA 51104. For advance banquet tickets and motel reservations contact Jerry Smith, WØDUN, Akron, IA 51001.

NEW ENGLAND: The Hosstraders will hold their tenth annual Tailgate Swapfest, Saturday, May 7, sunrise to sunset, at Deerfield, NH, Fairgrounds. Admission $1.00, including tailgaters and commercial. Friday night camping for self-contained rigs at nominal fee. None admitted before 4 PM Friday. Profits benefit Boston Burns Unit of Shriners' Hospital. Last year's donation $2622.75. Questions or map to northeast's biggest ham flea market? SASE to Norm, WA1IVB, RFD Box 57, West Baldwin, ME 04091 or Joe, K1RQG, Star Route, Box 56, Bucksport, ME 04416 or Bob, W1GWU, North Walton Road, Seabrook, NH.

NEW JERSEY: The 8th Trenton Computer Festival, Saturday and Sunday, April 16 and 17, 10 AM to 5 PM, Trenton State College, Trenton. Exhibits, electronics flea market, technical sessions, free short courses on Sunday. Admission $5. ($3 students). For further information: TCF-83, Trenton State College, Hillwood Lakes CN550, Trenton, NJ 08625. (609) 771-2487.

NEW JERSEY: Annual Flemington Hamfest, Saturday, April 9 from 8 AM to 4 PM at the Hunterdon Central High School Field House. 20,000 square feet of heated indoor area. Gigantic flea market, 200 tables, major manufacturers and more. Bring the family and your friends. Flemington is located between NYC and Philadelphia at the intersection of routes 202 and 31 just 10 miles south of I-78, and is a tourist area. Talk-in 146.52, 147.375, 147.015, 224.12 and 224.54 MHz. Admission $3.00 donation. For *reservations or information call* (201) 788-4080 or write: Cherryville Repeater Association c/o W2FCW, Box 76, Fairview, Dr., Annandale, NJ 08801.

NEW YORK: The Suffolk County Radio Club's indoor Flea Market, Sunday, May 1, 8 AM to 3 PM, Republic Lodge No. 1987, 585 Broadhollow Road, Melville, Long Island. Admission $2.00 (spouses and children under 12 free). Sellers tables $7.00, includes one admission. Free parking. Refreshments. Talk in on 144.61/145.21 and 146.52. For information: Richard Tygar, AC2P. (516) 643-5956 evenings.

NEW YORK: The 24th annual Southern Tier Amateur Radio Club's Hamfest, Saturday, May 7, the Treadway Inn, Oswego. Flea market opens at 8 AM. Vendor displays and sales; tech and non-tech talks; refreshments. Advance tickets only for a dinner at 6:30 PM. Talk in on 22/82, 16/76 or 146.52 simplex. *For further info* SASE to KF2X, C. England, RD #1, Box 144, Vestal, NY 13850.

NORTH CAROLINA: The Raleigh Amateur Radio Society's 11th annual Hamfest, Sunday, April 17, Crabtree Valley Mall, U.S. 70 West, starts 8 AM. Admission $4.00 includes tailgating. Tables *available for rent. Covered* Flea Market. CW and homebrew contests, special interests meetings. Talk in on 04/64, 28/88. For information: RARS Hamfest, PO Box 17124, Raleigh, NC 27619.

OHIO: The 14th annual B*A*S*H Friday night of Dayton Hamvention, *April 29, Convention Center, Main and Fifth* Streets. Adjacent parking. Free admission. Refreshments and entertainment. Two exciting top awards and more. For further information contact the Miami Valley FM Association, PO Box 263, Dayton, Ohio 45401.

OHIO: *The Athens County ARA annual Hamfest, Sunday,* May 15, Athens City Recreation Center, U.S. 33 and 50. 8 AM to 4 PM. Setup 7 AM. Outdoor paved flea market space $2.00. Some indoor space available $3.00. Food, free parking, restaurants and recreation area within walking distance. Athens Mall next door. Tickets $1 advance, $2 at gate. Talk in 146.34/.94. Tickets and *info:* ACARA, PO Box 72, Athens, Ohio 45701. Or call Joe, WB8DOD (614) 797-4874.

PENNSYLVANIA: The first annual Southern Alleghenies Hamfest, April 10, 8 AM to 5 PM, Bedford County Fairgrounds, intersection of Routes 30 and 220. Sponsored by the Bedford ARC; Altoona (Horseshoe) ARC; Cumberland, MD, ARC; Somerset ARC and the Blue Knob Repeater Association, this Hamfest features computer demonstrations, displays, ARRL booth, refreshments and more, all in a large heated building. Talk in on the Bedford repeater 145.49 and 146.52 simplex. Admission $3.00. Inside tables $5.00. For information: Tom Gutshall, W3BZN (814) 942-7334 or on the 147.75/15 Blue Knob Repeater.

ROCHESTER HAMFEST: Atlantic Division/New York State Convention. Saturday, May 21, Monroe County Fairgrounds. Hotel headquarters, Rochester Marriott Thruway. More info? Write or call Rochester Hamfest, 300 White Spruce Blvd., Rochester, NY 14623 (716) 424-7184.

SOUTH CAROLINA: The Blue Ridge Amateur Radio Society's Hamfest, Saturday, April 30 and Sunday, May 1, at the American Legion Fairgrounds, White Horse Road, Greenville. Admission $3.00. Talk in on 146.01/61 and 223.46/224.06. For information: Phil Mullins, WD4KTG, Hamfest Chairman, PO Box 99, Simpsonville, SC 29681. For advance sales: Mrs. Sue Chism, Rt. 6, 203 Lanewood Dr., Greenville, SC 29607.

TEXAS: TARS, The Tidelands Amateur Radio Society's Springfest 1983 at the fairgrounds in League City, Saturday, April 16. Auction, displays, demonstrations, good food and fellowship. Free admission. Refreshments available from 7 AM. Activities start 9 AM to 4 PM. For information: T.A.R.S., PO Box 73, Texas City, TX 77590.

WASHINGTON: The Central Washington State Hamfest sponsored by the Yakima Amateur Radio Club, W7AQ, *Saturday*, May 14, 9 AM to 5 PM, lunch available, and Sunday, May 15, 8 AM to 2 PM, breakfast and lunch, the Hobby Building, Central Washington State Fairgrounds, Yakima. Combination ticket $4.00 advance; $5.00 door. Additional tickets 2/$5.00. Regional dealer displays and FREE swap and shop with plenty of tables. Talk in on 146.01/61. *For tickets and information:* Dan Haughton, PO Box 9211, Yakima, WA 98909.

WISCONSIN: The Madison Area Repeater Association's 11th annual Swapfest, Sunday, April 10, Dane County Exposition Center Forum Building, Madison. Doors open *8 AM for commercial exhibitors and flea market sellers;* 9 AM for general public. Admission $2.50 advance and $3.00 door. Children twelve and under free. Flea market tables $4.00 each advance and $5.00 door. Reserve early. Exhibitors and flea market sellers will have equipment and components for hams, computer hobbyists and experimenters. An all-you-can-eat pancake breakfast and a Bar-Bar-Q lunch will be available. Talk in on WR9ABT, 146.16/.76. For information and reservations write M.A.R.A., PO Box 3403, Madison, WI 53704.

WISCONSIN: The 3F ARC Swapfest, May 7, 8 AM to 3 PM, Neenah Labor Temple. 4 ft. tables $1.50 advance; $2.00 at door. Talk in on 144.61/145.21. For advance registration: Mark Michel, W90P, 339 Naymut St., Menasha, WI 54952.

WISCONSIN: The Ozaukee Radio Club's 5th annual Swapfest, Saturday, May 7, 8 AM to 1 PM, Circle B Recreation Center, Highway 60, Cedarburg, 20 miles north of Milwaukee. Admission $2.00 advance, $3.00 door. 8 ft. tables $3.00 each. Food and refreshments. Sellers admitted at 7 AM for setups. For tickets, tables, maps or information SASE to Ozaukee Radio Club Swapfest, PO Box 13, Port Washington, WI 53074.

OPERATING EVENTS

"Things to do..."

APRIL 6, 7 AND 13, 14: DX-YL to North American YL Contest. CW: Wednesday, April 6, 1800 UTC to Thursday, April 7, 1800 UTC. Phone: Wednesday, April 13, 1800 UTC to Thursday, April 14, 1800 UTC. All licensed women operators throughout the world are invited to participate. DX YL call "CQ North American YL", N.A. YL call "CQ DX YL". All bands may be used. No cross band operation. Net contacts, repeater contacts and contacts with OMs do not count. Stations may be worked/counted once on each band and mode. Exchange: Station worked, QSO number, RS(T), state or country. Entries in *log must show time, band, date and xmitter power.* Phone and CW scored as separate contests. Submit separate logs for each contest. DX-YLs incl. Hawaii and Alaska, may contact all N.A. continent which includes 48 cont. states and Canadian Provinces. Contestants on N.A. continent may contact DX stations to include *Hawaii and Alaska. A station may be counted once on* each band for credit and one point is earned for each station worked once on each band. Multiply number of QSO's by number of different states and provinces or countries worked. A multiplier is counted once in contest, NOT on each band. Contestants running 150 watts or less on CW and 300 watts *PEP or less on SSB, may* multiply results by (E) by 1.25 (low power multiplier). Logs must be signed by operator and postmarked by April 28, 1983 and received NLT May 23, 1983. Send logs to YLRL Vice President.

APRIL 17 AND 18: *The Central Massachusetts Amateur* Radio Association will commemorate Patriot's Day, honoring the Minutemen and other patriots who fought during the American Revolution. Club station W1BIM will operate Sunday, 1700 UTC to 2200 UTC; and Monday, 1500 UTC to 2200 UTC from the Worcester, Mass. Science Center, approx. 20 kHz up *from the General phone* band edge, 40-10 meters. For a special certificate send QSL card and business SASE to: Alan Freeman, KA1XL, 83 Newton Avenue North, Worcester, MA 01602.

APRIL 22-24: A special events station, KØTIK, will operate from the Nebraska State Arbor Lodge, former home of Arbor Day founder, J. Sterling Morton, in Nebraska City, NE, Tree City U.S.A. during the annual Arbor Day celebration. This station plus other club member stations will operate in the general portion of phone and CW bands, 80-10 meters, 2400 UTC Friday to 0600 UTC Sunday. All Amateurs contacting this or any other club member station will be eligible to receive an Arbor Day commemorative certificate. Send one dollar and business SASE to N.C. A.R.C., Box 8, Nebraska City, NE 68410.

APRIL 23 AND 24: TSRAC Scavenger Hunt Contest, 0000Z, April 23 to 2359Z, April 24, sponsored by the Triple States Radio Amateur Club. Two trophies to be awarded; one to General Class and above licensee with highest score and one to Novice or Technician Class operator with highest score. Second and third place certificates awarded also. Modes: CW and phone. Exchange: QSOs or "CQ TSHT TEST", 20 kHz ± above bottom of any General or Novice band. Open to all Amateurs. Submit entries to contest chairman: David M. Kinney, KC8YR, RD #1, Mingo Jct., OH 43938 by May 25.

APRIL 23 AND 24: The Independent Amateur Radio Group of Delaware will operate from atop the U.S. Geological Survey marker at the point where Pennsylvania, Maryland and Delaware meet, Mason and Dixon's Stone Number one, from 1500Z to 2300Z each day. Rain date April 30 and May 1. 10 through 40 meters in lower ends of General segments. 2M activity announced on local repeaters. ARRL assures QSL cards will count for any or all three states. Each operator will use own call with a "/3/3/3" identifier. Special QSL card for SASE to operator worked.

APRIL 23 AND 24: QRP Amateur Radio Club International Spring QSO Party, Saturday, 1200 UTC to Sunday, 2400 UTC. Exchange: Members give RS(T), state/province/country and QRP ARCI membership number. Nonmembers give RS(T), state/province/country and power output. QSO points (total all bands) times total number of *states/provinces/countries (may be worked on more than one band)* times power multiplier times bonus multiplier (if any) equals claimed score. Send large SASE or IRCs to contest chairman for scoring summary sheet in advance of contest. Send full log data plus separate worksheet showing details and time off air. No logs returned. For results and scores send large SASE with one ounce of U.S. postage or IRCs. Logs must be received by May 21, 1983. QRP ARCI Contest Chairman, William Dickerson, WA2JOC, 230 Mill St., Danville, PA 17821.

APRIL 23 AND 24: The Missouri Valley Amateur Radio Club's fourth annual Pony Express Day, 1000 CST to 1900 CST (Saturday) and 0900 CST to 1200 CST (Sunday). This event commemorates the original running of the Pony Express from St. Joseph, Missouri to Sacramento, Calif. Operating frequencies: 10 kHz from bottom of the general phone bands on 15, *20, 40* and *75 meters. On 10* meters — 28.575. CW: 10 meters — 28.150; 15 meters — 21.150; 40 meters — 7.125. Anyone contacting Club station WØNH is eligible for a special Pony Express certificate. Just send two first-class postage stamps and a QSL card to: Missouri Valley Amateur Radio Club, 401 N. 12th Street, St. Joseph, MO 64501.

APRIL 29-MAY 1: The first International VHF/UHF Conference to be held as part of the Dayton Hamvention. Activities span all three days and include tech talks and forums; *noise figure and antenna gain measuring contests*, a hospitality suite get-together with refreshments. All this along with the rest of the Hamvention features. For further information and to advise of participation in contests contact: Jim Stitt, WA8ONQ, 311 N. Marshall Road, Middletown, OH 45042. (513) 475-4444 business or (513) 863-0820 home.

MAY 7: Harry's Haydays. The Southside Amateur Radio Club will operate KAØHXU to commemorate President Harry Truman's 99th birthday. The station will operate at or near the old Truman farm home in Grandview, MO from 1500Z to 2400Z on 21.355, 14.290 and 7.230. Commemorative QSL's will be sent via the bureau unless otherwise requested. For information: Southside ARC, PO Box 412, Grandview, MO 64030.

WORKSHOP: *Personal Computer Interfacing and Scientific Instrument Automation.* $395.00. Charlotte, NC, June 2-4; Reston, VA, June 16-18; Charleston, SC, July 14-16; Williamsburg, VA, Aug. 11-13; and Greensboro, NC, Sept. 8-10. These are hands-on workshops with each participant wiring and testing interfaces. For more information, call or write Dr. Linda Leffel, C.E.C., Virginia Tech, Blacksburg, Virginia 24061. (703) 961-4848.

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Ft Gain Bandwidth Product at Vce=8v, Ic=10ma. GHz 4 Min. 6 Typ.
Vcbo 25v Vceo 11v Vebo 3v Ic 50ma. Pt. 250mw

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Peak Pt. Voltage mv.	Vp	95Typ. 120max.	75Typ. 90max.
Projected Peak Pt. Voltage mv.	Vpp Vf=Ip	480min. 550Typ. 630max.	440min. 520Typ. 600max.
Series Res. Ohms	rS	2.5Typ. 4max.	2Typ. 3max.
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Valley Pt. Voltage mv.	VV	370Typ.	350Typ.

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2N1562	25.00	2N6095 /M9623	12.00	CA4101 (TRW)	25.00
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2N2857JAN	2.55	2N6097	17.25	CA4600 (TRW)	25.00
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2N3950	25.00	2SC1251	12.00	HEPS3003	30.00
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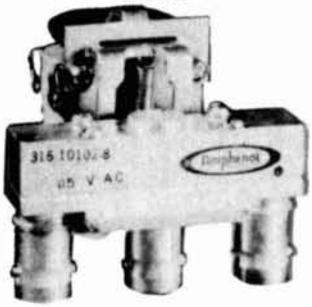

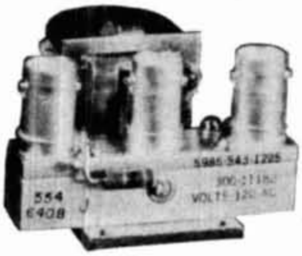

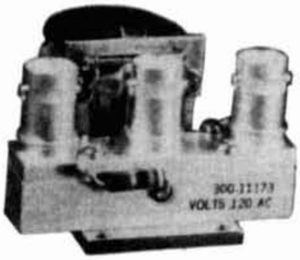

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3B28/866A	7.50	592/3-200A3	144.00	6907A	75.00
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4CX250F/G/8621	55.00	5894/B	60.00	8462	100.00
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4CX250R/7580W	69.00	6080	10.00	8533W	92.00
4CX300A/8167	140.00	6083/AX9909	89.00	8560/A	65.00
4CX350A/8321	83.00	6098/6AK6	14.00	8560AS	90.00
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