An 8080 Repeater Control System

— part II: hardware

You're on your way.

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

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

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

Circuit Description

The hardware consists of

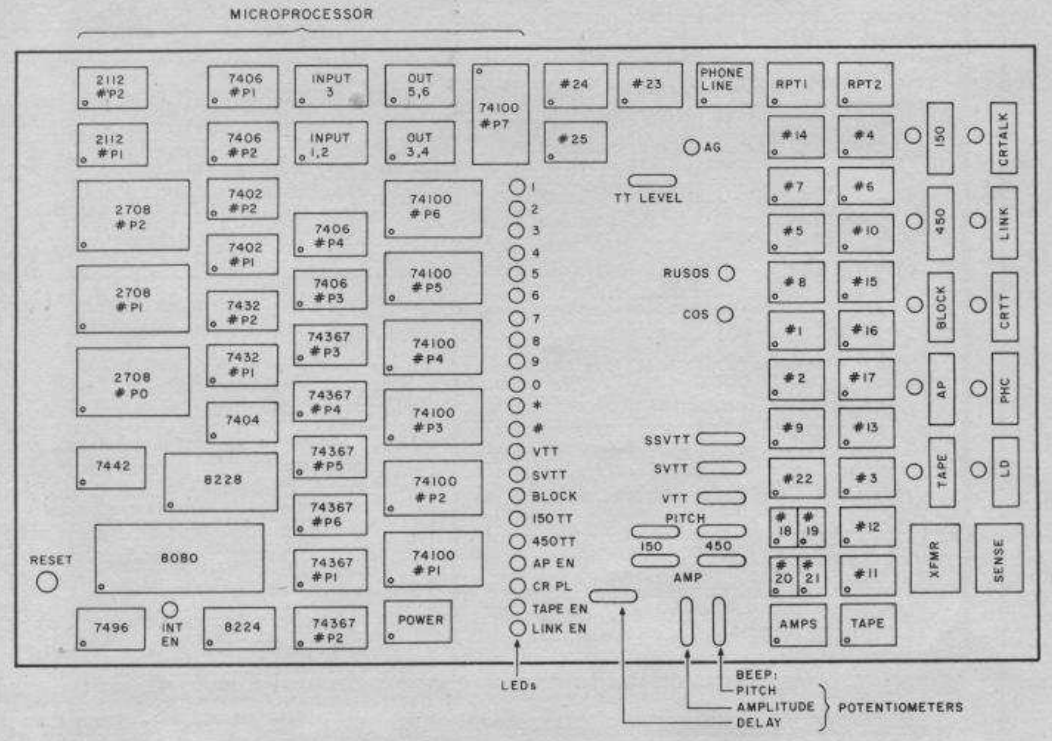


Fig. 1. Board layout.

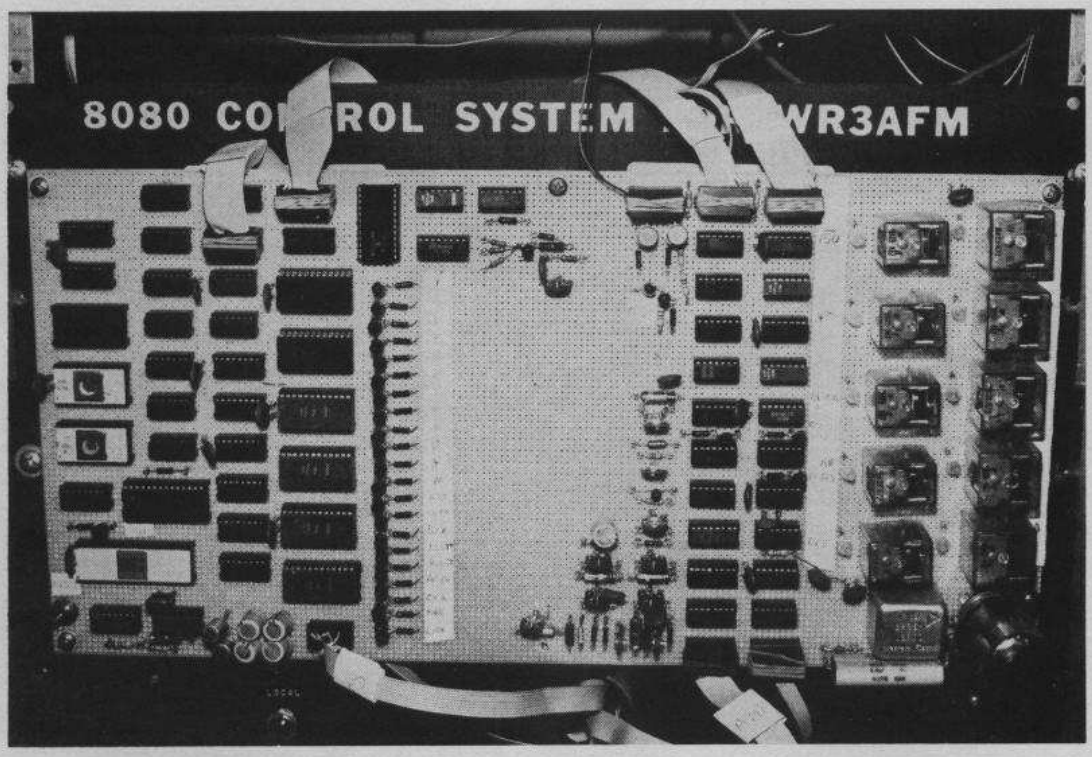
1—7474
2—7474
3—7420
4—7410
5—7408
6—7427
7—7432
8—7402
9—7400
#10—7400
#11—7493
#12—7473
#13—7404
#14—7404
#15—7407
#16—7407
#17—7406
#18—555
#19—555
#20—555
#21—555
#22—CD4050
#23—7405
#24—7473
#25—MC14410

Fig. 2. IC list.

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

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

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



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

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

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

Phone Line:
1—Tip
3—Ring

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

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

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

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

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

Dummy Socket for RPT1:
1—3
2—4
5—7

Dummy Socket for RPT2:
1—5
2—6

Fig. 3. Connector pinouts.

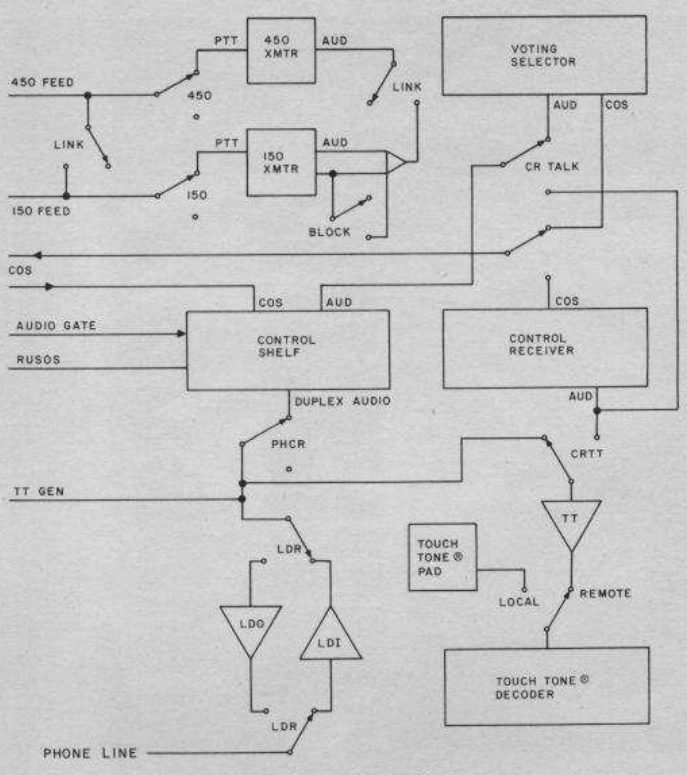


Fig. 4. System flow diagram.

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

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

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

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

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

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

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

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

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

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

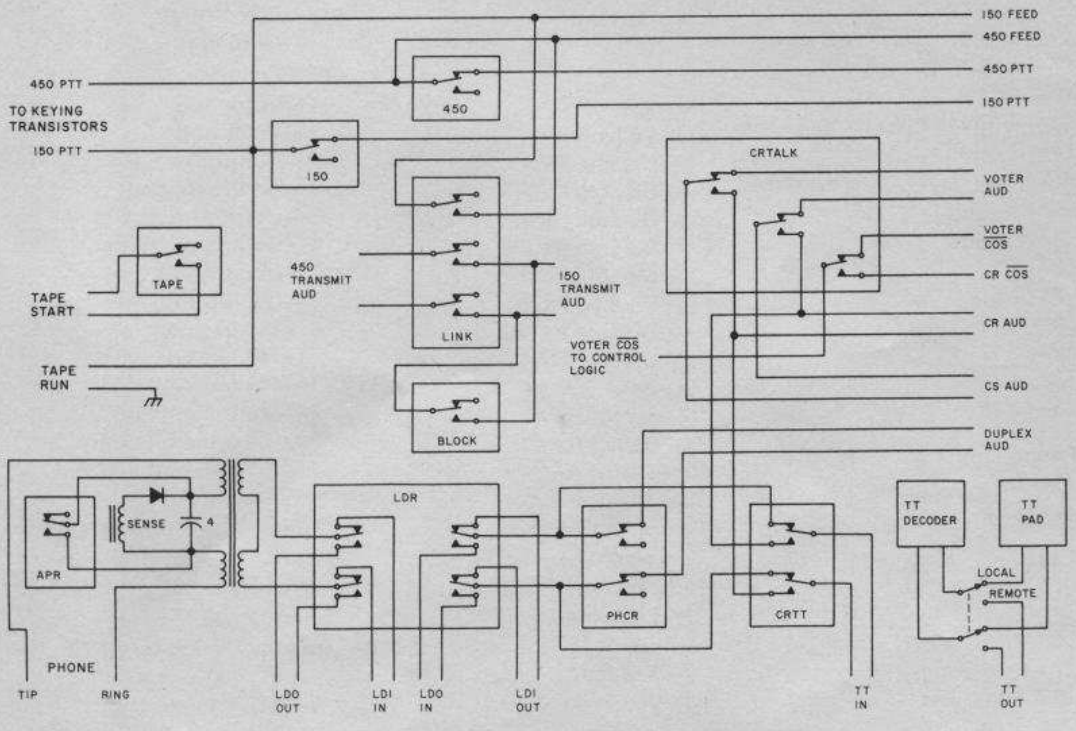


Fig. 5. Relay switching.

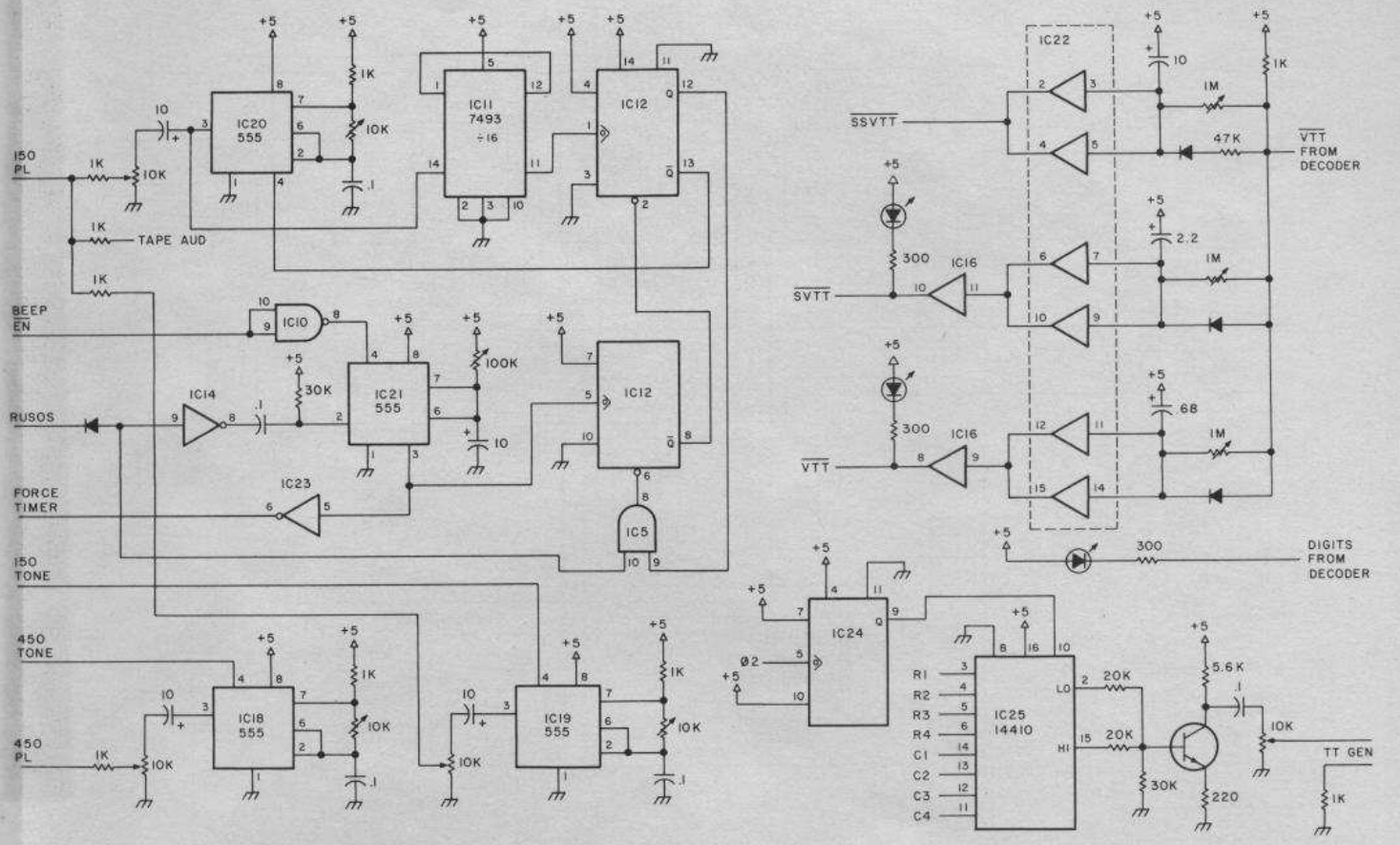


Fig. 6. Audio circuits.

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

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

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

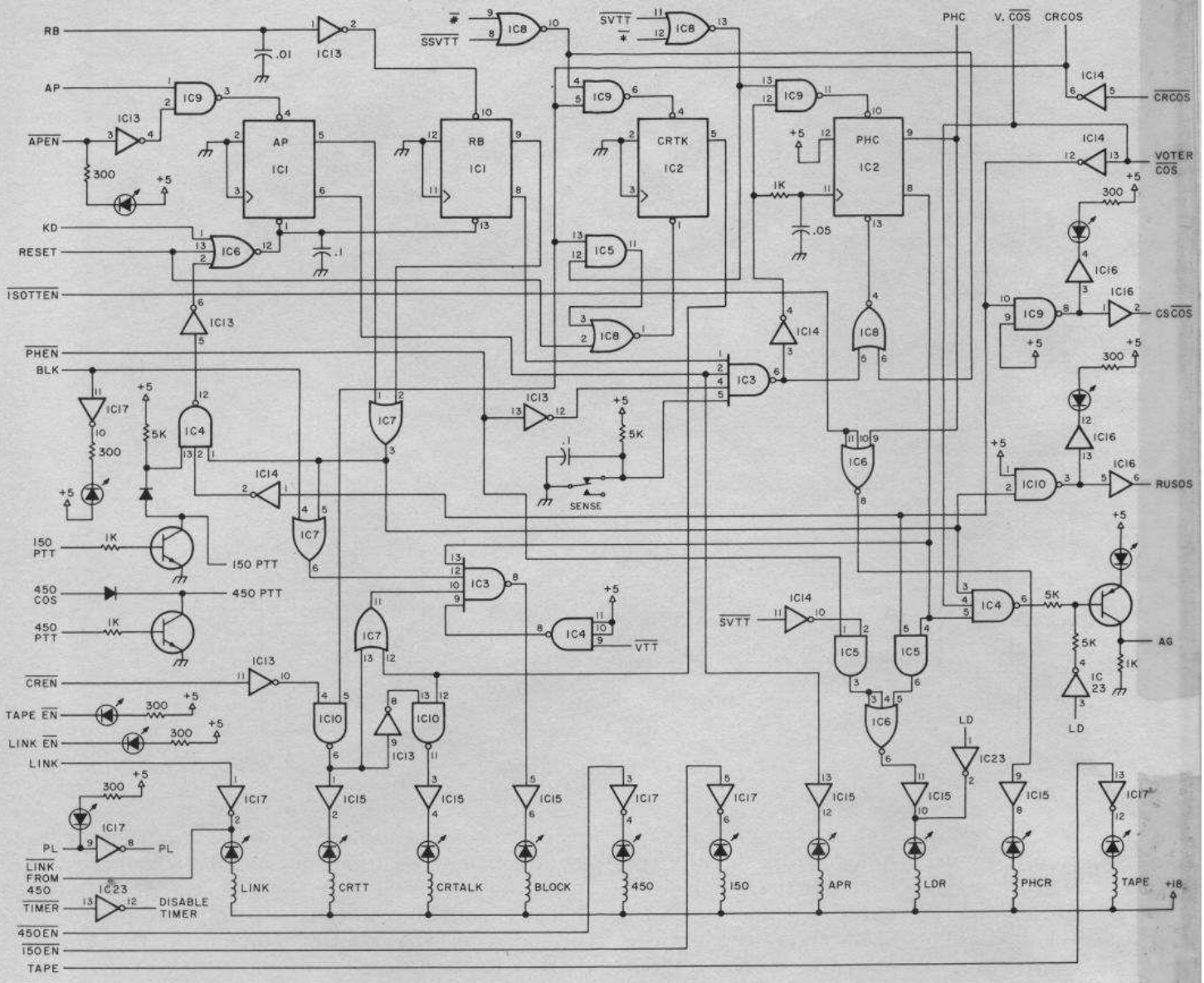
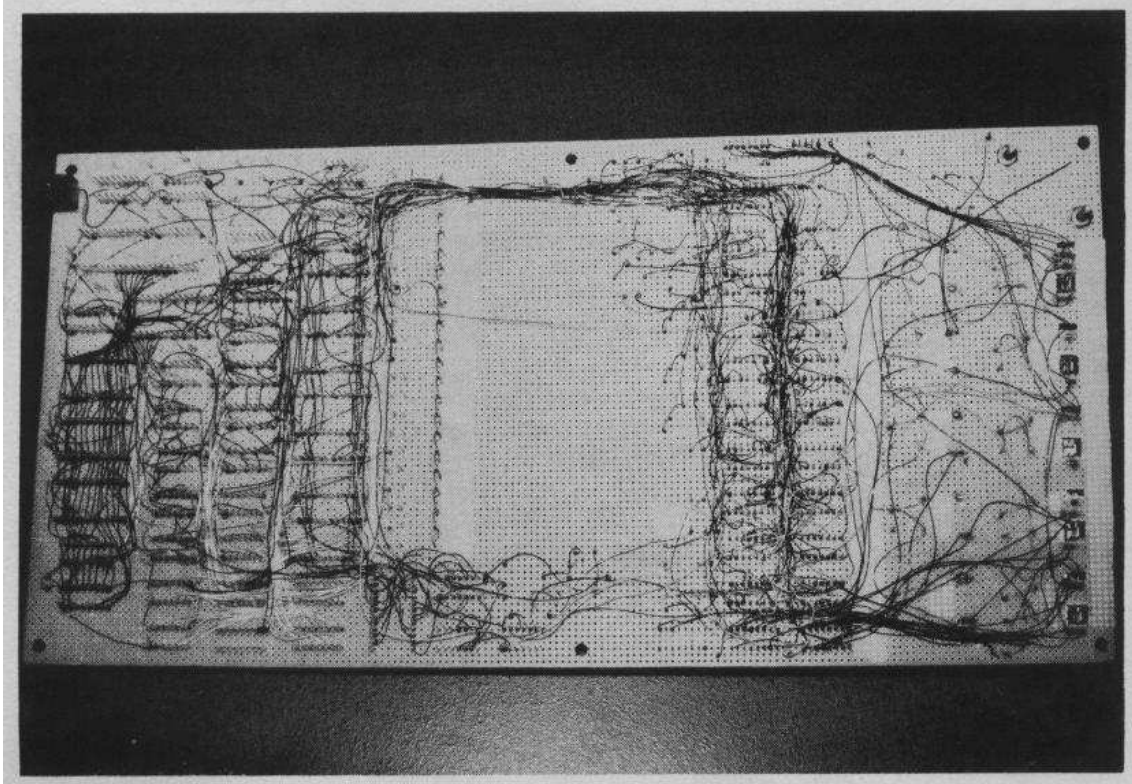


Fig. 7. Control logic.



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

of the incoming signal an
the one-shot. If a signal i
present when IC21 falls
then the "beep" is in
hibited via IC5. If the bee
is disabled, IC21 is pre
vented from firing by IC1(
and carrier release im
mediately resets the time
This seems like a lot o
trouble to go through for
silly beeper. The syster
permits a long (3-second
drop delay on the repeate
transmitter. In norma
QSOs, the transmitter stay
keyed continuously, eac
participant merely waitin
for the beep. This saves
lot of wear and tear on th
transmitter and amplifie
both of which otherwis
are constantly bein
turned on and off. This is o
particular importance fo
busy repeaters; WR3AFN

logs about 13 hours of uptime per day. The users *do* learn to wait for the beep, leaving time for breakers; if not, they time out.

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

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

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

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

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

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

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

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

Fig. 8. Control logic functions.

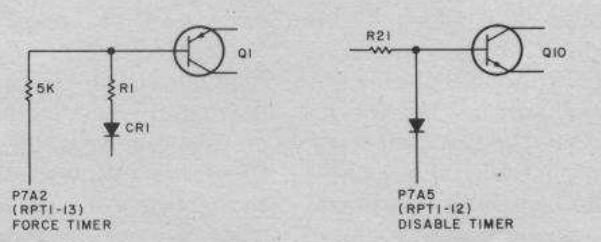


Fig. 9. Modifications to repeater control board 19D416675.

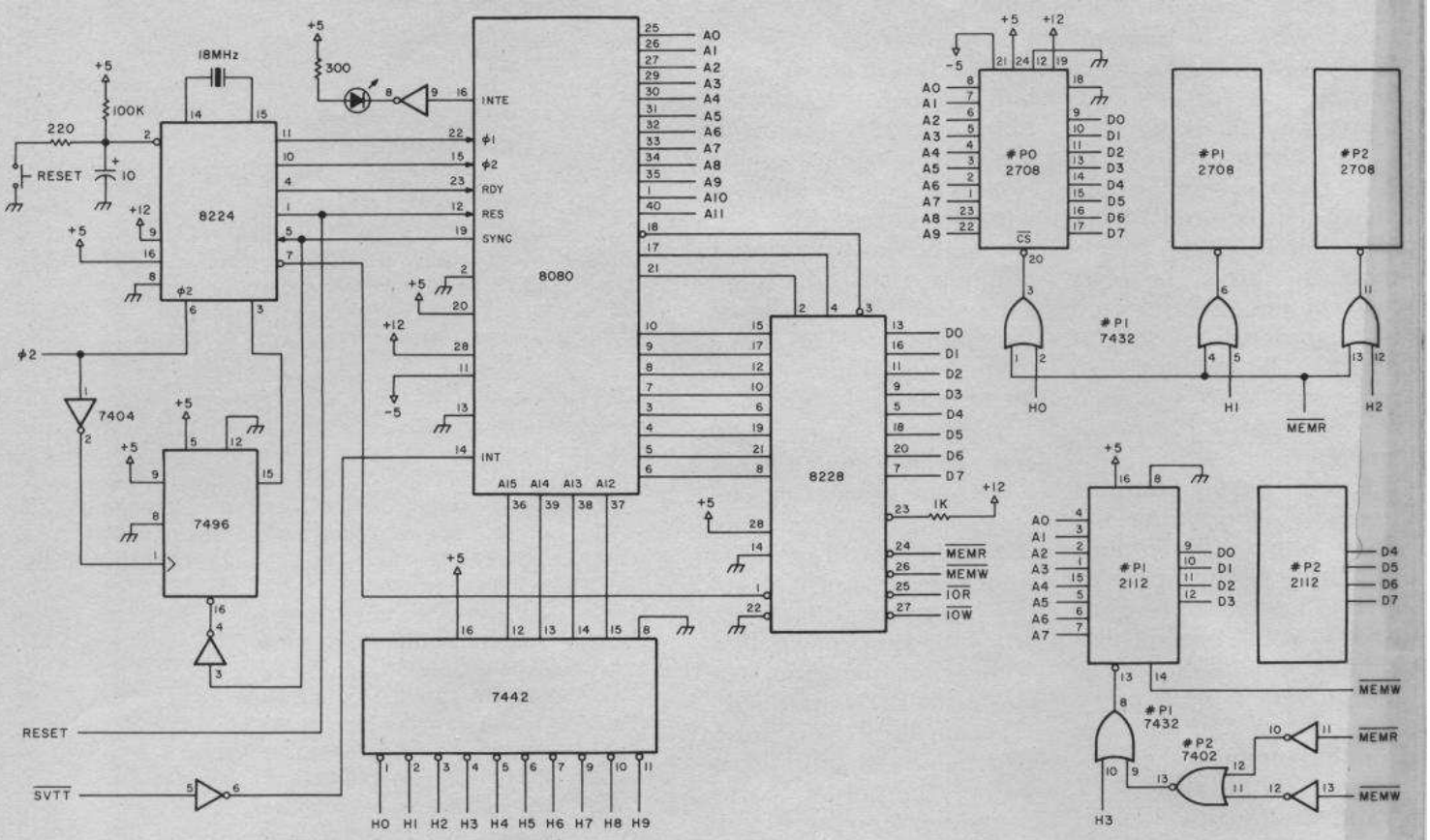


Fig. 10. Processor and memory.

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

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

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

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

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

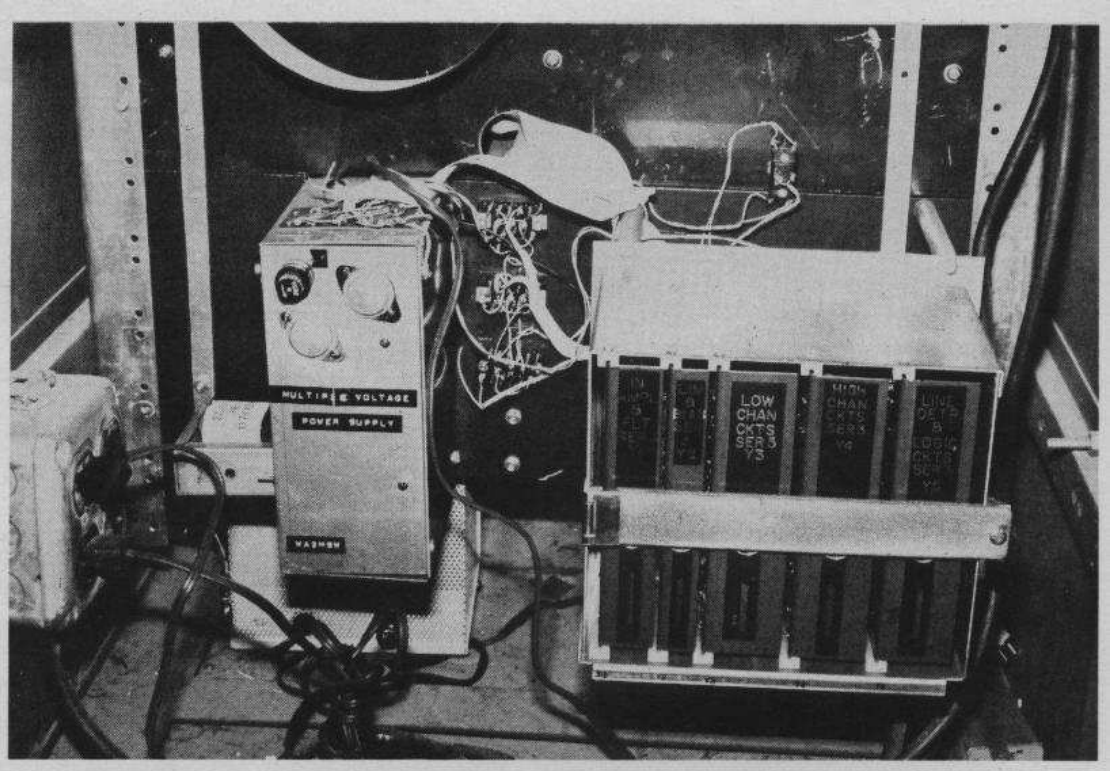
trol frequency.

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

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

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

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



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

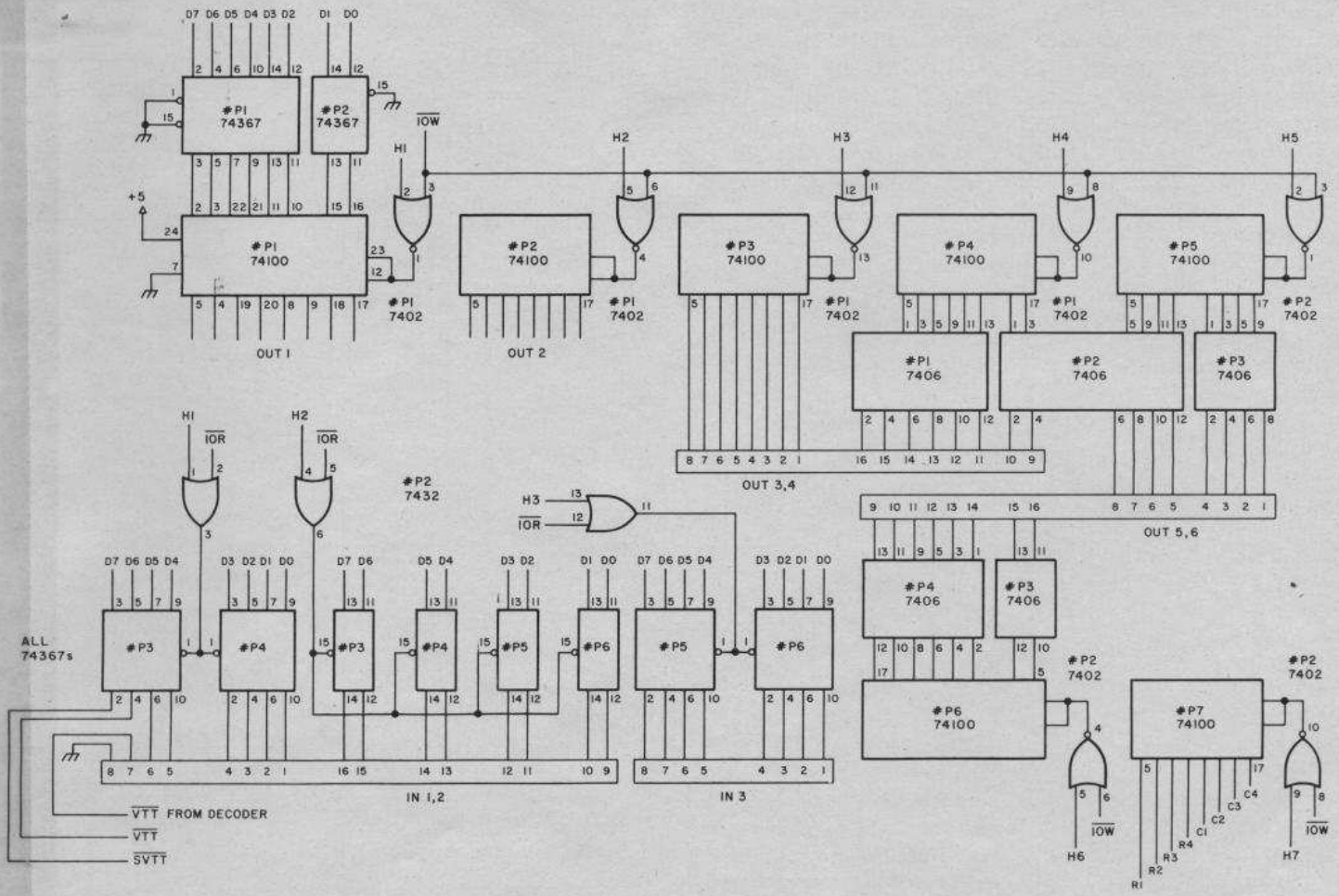


Fig. 11. Processor I/O ports.

modifications if a General Electric MASTR control shelf is used.

The Microprocessor

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

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

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

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

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

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

INPUT PORTS
Port #10
8—$\overline{\text{SVTT}}$
7—$\overline{\text{VTT}}$
6—150 $\overline{\text{COS}}$
5—450 $\overline{\text{COS}}$
4—digit 1
3—digit 2
2—digit 3
1—digit 4
Port #20
8—digit 5
7—digit 6
6—digit 7
5—digit 8
4—digit 9
3—digit 0
2—digit *
1—digit #
Port #30
8—PHC
7—CRCOS
OUTPUT PORTS
Port #10
8—150 tone
7—150 PTT
6—450 tone
5—450 PTT
4—AP activate
3—RB activate
2—KD (KnockDown)
1—BLK
Port #20
8—$\overline{\text{150EN}}$
7—$\overline{\text{450EN}}$
6—$\overline{\text{APEN}}$
5—$\overline{\text{CRTTEN}}$
4—$\overline{\text{PHEN}}$
3—$\overline{\text{150TTEN}}$
2—$\overline{\text{CR PL}}$
1—$\overline{\text{Beep}}$
Port #30
8—Tape activate
7—LD
6—Disable timer
5—Link
Port #50: Receiver disable
Port #60: Receiver select
Port #70: Row and column select for touchtone generator

Fig. 12. I/O ports.

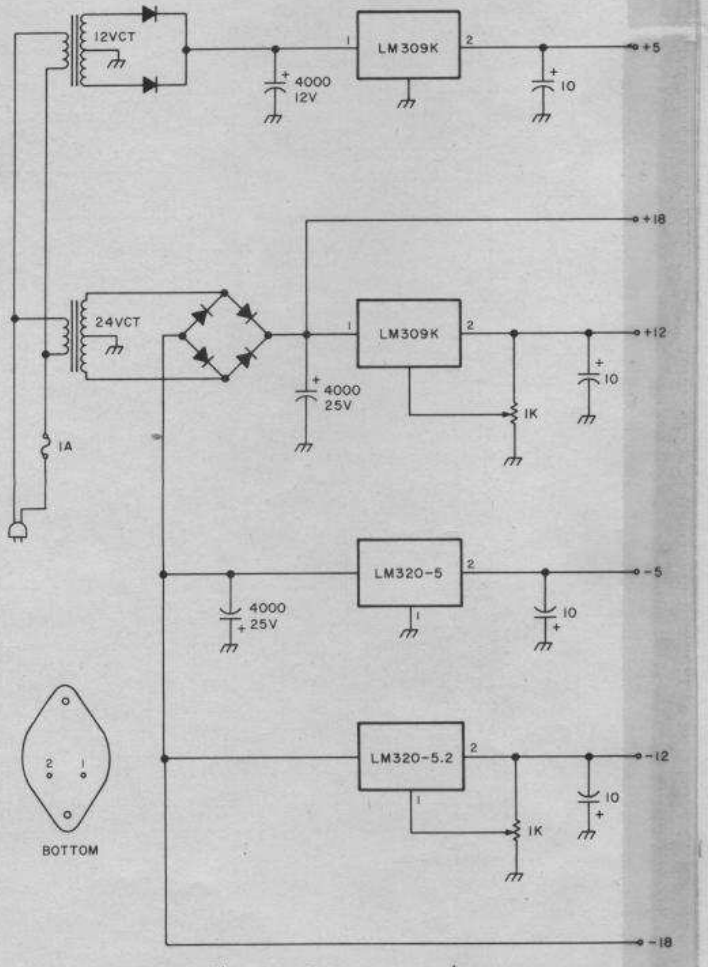


Fig. 13. Power supply.

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

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

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

DX Fantasy

—a moment in the sun

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

L. Foord VE3FLE
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Woodstock, Ontario
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It was official: Effective 0001 GMT, all VEs could use the CJ prefix. I relished what lay before me. After years of chasing DX, for the first time (before the world discovered that CJ=VE, a fact that would hardly impress anyone), I would be the chased. Of course, I wouldn't disguise this detail; I simply wouldn't advertise it.

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

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

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

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

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

"CJ3FLE from DL2XX."

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

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

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

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

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

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

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

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

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

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

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

"W7XYZ from CJ3FLE. Fifty-eight."

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

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

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

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

"Okay; 73 and thanks for the contact."

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

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