HAMTRONICS® COR-4 REPEATER CONTROLLER
ASSEMBLY, INSTALLATION, OPERATION, & MAINTENANCE

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FUNCTIONAL DESCRIPTION.

The COR-4 module is an all-in-one COR and CWID designed for operation with Hamtronics fm exciters and receivers to provide repeater operation. The unit may also be used with other makes of transmitters and receivers if the required interface signals are available.

The COR-4 offers many advantages. It uses very low current consumption CMOS logic; idling current is only 20 mA (3.5 mA with optional CMOS EPROM). It is designed to simplify wiring, with many on-board traces replacing earlier harness wiring for front panel controls and indicators. An EPROM is used for cwid programming to reduce assembly time, eliminate sources of wiring errors, and allow longer messages. Many adjustments have been eliminated and replaced by preset digital circuits. Circuitry is provided to interface a second receiver, either as an auxiliary input or to allow two repeaters to be cross-linked. All this, and it costs less, too!

ASSEMBLY.

Construction Methods.

Assembly is relatively straight forward. Use the parts list and component location drawing as guides.

During construction, orient the board right side up as shown in the component location diagram. The top is the side with the terminal numbers.

Numbered holes around the perimeter of the board are for wires connecting to the outside world, which are connected during installation.

Three holes between U2 and U3 do not have parts installed in them. They are provided for optional jumpers which normally are not installed.

Precautions.

Note that most of the ic's are static sensitive. The warranty does not cover static damage; so handle them with care. Leave them in their protective carriers until assembly is done; and then plug them in, using suitable static handling precautions. A grounded wrist strap should be worn whenever cmos parts are handled. Even after assembly, it is possible to damage cmos parts if static builds up from walking or sliding a chair on a carpet, etc. Always use precautions when handling a board with cmos parts.

The EPROM is light sensitive; excessive exposure to sunlight or even strong room light eventually may erase the chip. Normally it is not necessary; but if you expect the chip to be exposed to strong light, cover the window on the EPROM with a sticker of some sort.

Be careful not to confuse parts marked similarly, such as 150K and 510K resistors. Double check each part as installed. When done, if parts are short and others are left over, go back and check each part to be sure a wrong value didn't get installed somewhere.

Do not use an ic socket on the LM-380 audio output ic. The leads must be soldered to the board for proper heatsinking.

A few parts may short to the land areas on top of the board if pushed down tight. Be careful in such

locations to leave a small space between the part and the pc board. Otherwise, all parts should be installed flush with the board.

The pc board uses plated-through holes; so only the bottom of the board needs to be soldered. Because it is more difficult to remove parts from plated-through holes, be sure parts are correct before soldering. Traces are close together; so use a fine tip on the soldering iron.

Assembly Procedure.

a. Install ic sockets *except at U5,* which does not use a socket. All sockets should have notch pointing toward top of board. Solder leads carefully to prevent solder shorts.

b. Install transistors and voltage regulator U8, orienting as shown. Note tab position on power transistor Q3. *If leads on Q3 are a little too large to fit holes in board, use small pick or drill to enlarge holes, but be sure to solder leads on top as well as bottom of board if through-hole plating is disturbed.*

c. Install pots R4 and R24.

d. Install all capacitors, observing polarity on electrolytics.

e. Install all resistors. On vertically-mounted parts, the body of the part is indicated by a circle on the diagram.

f. Install the three diodes, observing polarity. The banded (cathode) ends must be oriented as shown.

g. Install a jumper wire (from scrap #22 bus wire) in the empty pads below R22 as shown. (Note: pads originally were designed for a fuse with wire leads. However, such fuses are now hard to find; so we recommend using a simple inline fuseholder with a 6 Amp fast acting fuse instead.)

h. Check over construction to be sure all parts are installed in proper places, with proper polarities, and check solder connections for any cold solder joints, solder splashes, etc.

i. Using suitable static protection described earlier, carefully unpack the ic's and install them in the sockets. Be sure to orient them with notches pointing up. If any conflict between notches and dots on an ic, the notch (which only appears on one end) takes precedence. Sometimes, RCA cmos ic's have a test dot of some color (eg. blue) on one end, and such dots can be confusing because they can appear on either end. Ignore such dots if the ic also has a notch or white bar on one end, which would indicate the pin 1 end.

Be careful that all the pins actually go into the sockets. It is easy for some to bend underneath or extend over the outside of the socket. Note that ic's made by Motorola have one extra digit in the part number, e.g., MC14584 instead of 4584.

Mod for Long ID's.

Note that a pcb mod is required to accomodate any id sequence over 12 characters. To allow a long sequence of characters, pin 10 of U2 should be connected to pin 14 of U3 instead of pin 15. This can be done by cutting the trace by pin 15 and using a short piece of bus wire to solder a jumper from the cut trace to pin 14.

INSTALLATION.

General.

The block diagram shows normal wiring for use with a basic repeater and for use with the DTMF Decoder and Autopatch modules. (When used with the REP-200V Repeater, the chassis does not allow room for these and other wiring options.)

The optional connections (shown in broken lines) may look confusing at first, but addition of the Autopatch simply means that wires from the receiver COS and audio lines must go through the Autopatch module to get to the COR-4; i.e., the Autopatch is in series with and processes the COS and audio signals before they get to the COR-4 board.

Note that panel mounted components, such as LED's, switches, etc., are not provided with the COR-4 module; however, those which are needed are supplied with the REP-200V Repeater Kit. If you are building your own chassis and panel, you can use any common type of LED and switch. Be sure to check out the polarity of LED's before connecting them.

Power Source.

Power for the repeater should be obtained from a voltage regulated power supply, rated for +13.6Vdc at 4 Amp. *(The repeater normally draws about 4-5 Amp at full power.)*

Care should be taken that the power supply has no transients, for instance at turn on. Be careful on battery-operated systems that the charger does not put transients or heavy ripple on the power line. Also be sure that any inductive devices, such as relays, that operate on the same power source have transient-suppression reverse diodes connected directly across the coil.

For short circuit protection, we recommend that you use some sort of inline fuseholder in the positive lead with a 6 Amp fast acting fuse.

Harness Wiring.

The COR-4 board uses plated through holes, and the numbered terminal pads around the edge of the board are specially designed to allow easy solder connection of cable harness wires going to the rest of the repeater. The holes are oversize; so the wires can be easily inserted even after the holes are filled with solder.

The easiest way to attach wires is to strip them about 1/4 inch. Then, bend a small "Z" in the end of the wire so that it stays in the hole until soldered. In this way, you can install many wires and solder them all at once.

An alternate method is to preload all the terminal pads with solder. Then, melt the solder at each pad when the wire is inserted. This latter method requires care that solder and flux remains in good condition until the wire is bonded.

Terminal Functions.

Following is a general description of the function of each terminal, along with expected signal voltages. Information in the *OPTIONS* section which follows tells how to adapt various functions for different installations. (Note that a bar over the name of a signal on the diagrams indicates that the active condition of that function is a ground instead of a positive voltage.)

Terminal 1 is the input terminal for +13.6Vdc from the power supply via the front panel *POWER* switch.

Terminals 2-5 provide fan-out of fused +13.6Vdc power for the other modules in the repeater, as shown in the diagram. Note that the power amplifier and crystal oven option in the transmitter compartment operate from this source of constant B+.

Terminal 6 provides switched B+ for the exciter. All power for the exciter other than the crystal oven, is obtained from this terminal. The switching transistor is rated to switch up to 700 mA, which more than the 500-600 mA which Hamtronics exciters draw. *Do not exceed that limit*

if another exciter is used. We recommend that all the exciter stages be keyed on and off and that the class-C pa, which draws no current when undriven, be powered up all the time.

Terminals 7-9 drive the *anodes* of the status indicator LED's on the front panel. The cathodes are tied to ground. (The cathode of an led usually is indicated by a long lead or a flat on the case.) Cable harness wires normally extend these connections to the led's by splicing the LED leads to the ends of the wires and covering the junctions with shrink tubing.

Terminal 10 is the output for an optional external speaker. A separate speaker amplifier is provided in the COR-4 to drive an external speaker so fewer leads need to be brought out of the shielded receiver compartment. The audio amplifier is rated at 2W maximum into an 8-ohm load, (which is the impedance of the speaker used in our repeater kits). Do not use speakers of lower impedance.

Terminal 11 provides the audio to the microphone input of the exciter. The output of the mixer circuit has a large value dropping resistor, which works in conjunction with the input resistance of the exciter to drop the relatively high level of audio in the mixer down to about 30 mV p-p for the exciter input. This value is selected for Hamtronics TA51 vhf exciters. For a TA451 uhf exciter, clip the top lead of R14 to remove it from the circuit to drop the signal voltage even more.

For other than Hamtronics exciters, you may have to experiment to find the appropriate value of resistor to use, depending on the input resistance and sensitivity of the exciter. The easiest way to do this is to connect it as is and try it. If the level is too high, try cutting out R14. If still too high, try adding resistance externally until the correct value is found, and then install the appropriate value permanently on the board. Refer to *ADJUSTMENTS* section for details of audio level setup, which must be done exactly as specified for tone levels to be correct.

Terminal 12 normally is the audio input from the speaker output line on the receiver. The level must be 1.5V p-p with 5 kHz deviation on the receiver input signal (full modulation). A 1.2K load resistor is provided on the COR-4 board to load the line to a relatively low impedance for noise suppression. *This input is not intended for connection to the discriminator output of receivers.*

When an autopatch is used, the receiver audio is processed through the Autopatch board before connection to the COR-4 (see block diagram). In such installations, the receiver volume control is adjusted for proper level for signals coming through the receiver, and a separate level control on the Autopatch board sets the audio level of telephone signals transmitted over the air. (See the Autopatch instruction manual for details.)

Terminal 14 is the COS input from the squelch circuit in the receiver. (When the Autopatch is used, the COS signal is processed in the Autopatch before application to the COR board.) The input resistance is fairly high (over 100K) so that it doesn't load down the receiver. The threshold is set at about +3V; so that any level above that keys the repeater transmitter and any level near ground unkeys it. When a CTCSS (subaudible tone decoder) module is used, it can be connected to short this line to ground (usually in the receiver compartment) to prevent transmission. The *OPTIONS* section describes changes to the COS input circuit to allow other signal levels and polarities to be used.

Terminals 13 and 15 provide auxiliary audio and COS inputs for a second receiver, either an auxiliary input receiver or for cross-linking two complete repeaters. Resistors on the COR-4 board provide isolation from the main receiver circuits. See *OPTIONS* section for more information.

Terminal 16 provides a method of inhibiting the repeater transmitter by remote control from the DTMF (touch-tone) Decoder/Controller board. Ground on this line effectively blocks the signal to the keying transistors on the COR-4.

Terminals 17 and 18 provide connections for the push-to-talk (ground) and microphone element of a low-impedance dynamic microphone. This normally is not used; however connections are provided in case you wish to use a local mic for testing. The shell of the jack normally is grounded through the panel and chassis, but terminal 19 may be used if the mounting method does not provide a good ground return.

Terminals 20 and 21 are for connection of a *transmit inhibit* switch, if desired. When the switch is closed, the ground blocks the keying circuit to prevent transmission in the same way as described for the DTMF decoder for terminal 16.

Terminals 22 and 23 are for connection of a *speaker volume* control for the optional external speaker. It adjusts the local speaker on the front panel. This is an operator control, not a setup adjustment like the volume control on the receiver module. The circuit in the COR-4 allows simple connection of just two wires: the ground of terminal 22 to the CCW lug of the control and the wiper to terminal 23. A resistor on board is designed to give proper volume control action when used with a 100K linear pot.

Terminals 24 and 25 provide connections for the *POWER* led on the front panel. The cathode (ground) lead usually has a long lead or flat on the case for identification. Several inches of hookup wire must be spliced to the led leads for extension over to the COR-4 board, as explained for terminals 7-9.

EPROM.

EPROM U4 is light sensitive; excessive exposure to sunlight or even strong room light eventually may erase the chip. Normally it is not necessary; but if you expect the chip to be exposed to strong light, cover the window on the EPROM with a sticker of some sort.

We can provide a replacement EPROM, programmed with any message you want, for $30. If you need to order, please specify clearly how it is to be programmed, and specify that it is for model COR-4.

OPTIONS.

Optional Connections for Autopatch and DTMF Decoder.

The block diagram shows connections for use with the AP-3 Autopatch and TD-2 DTMF Decoder/Controller modules. The primary difference in the wiring of the COR-4 is that the receiver audio and COS lines are routed through the Autopatch module instead of being connected directly to the COR-4 board. Refer to the Autopatch manual for details of audio adjustments for the system, which supplement the instructions given in this manual.

Disable Courtesy Beep.

If you do not want a courtesy beep

tone, break the pcb trace at pin 6 of U7-B, and connect pin 6 to ground with an added jumper wire.

Option for No CWID.

If the cwid function is not needed, the unit is supplied without ic's U1-U4. Please contact us if you decide to add the cwid function in the future.

Auxiliary Receiver.

Terminals 13 and 1+5 allow for audio and COS connections for an auxiliary receiver, either as a second input receiver or to cross-link two repeaters. The levels are the same as for the basic receiver, and isolation resistors are provided on the COR-4 board.

If you want to selectively make the connection for the auxiliary receiver, you can add a relay to break both the COS and audio lines when you don't want the secondary receiver in line. The relay can be turned on and off with an extra latching output of the TD-2 DTMF Decoder/Controller.

Other COS Input Voltages.

The COS inputs are set up for an active high (over +3V) when the squelch is open and ground when the squelch is closed. The threshold can be changed. It is set simply by the ratio of the voltage divider resistors (R19/R20 and R18/R20) times the base-emitter turn-on voltage of Q1 (about 0.7V).

If you need an input of inverted sense, i.e., squelch open = ground instead of high, you can either add an extra inverter transistor like Q1 (off the board) or disconnect Q1 and bring the COS signal directly into pin 11 of U6-E.

ADJUSTMENTS.

General Information.

There are only two adjustment pots on the COR-4 board: *TONE* control R4 and *TAIL* control R24. The audio levels are adjusted by means of external controls. All other parameters are preset by fixed component values or jumpers etched on the board; so setup is very simple.

There are provisions to change all of the parameters if the default conditions are not suitable for your application.

Audio Level Setting.

The cwid and courtesy beep tone is applied to the mixer with a fixed level. The deviation of the transmitter is set with the exciter mic gain control for the desired tone level. The receiver volume control then sets the level of the repeated receiver audio relative to the tone level. This minimizes the number of adjustments and makes it less likely that the system will be misadjusted.

We normally recommend that the deviation limiter control in the exciter be set fully cw unless an autopatch is in the system. The mic gain control sets the required gain, and the maximum deviation levels are limited automatically by the crystal filters in the receiver and the tone generator in the COR-4. This eliminates any distortion which might result from clipping in the limiter.

If an autopatch is used, the limiter should be set to provide limiting on telephone audio going into the transmitter. That allows the gain of the telephone audio to be set a little higher, in the autopatch module, to provide some compression, thereby improving phone patch audio on weak telephone signals.

If you do not have an autopatch, proceed as follows.

a. Set the deviation limiter in the exciter fully clockwise.

b. Use a service monitor or some other method of monitoring transmitter deviation.

c. Turn the repeater power off, wait about 20 seconds, and then turn it back on each time you want to force the cwid to run.

d. Set the deviation of the cwid tone to 3 kHz, or whatever level you prefer, by setting the mic gain control in the exciter.

e. Obtain fully modulated audio through the receiver, and adjust the volume control on the receiver for 5 kHz deviation. When the input signal deviation is increased much beyond 5 kHz, you should notice the deviation being compressed on the transmitter output; this is due to bandwidth limit of the crystal filter in the receiver. (We assume you have a receiver with a sharp filter as one of our receivers has.) The level of audio from the receiver with full modulation like this should be about 1.5V p-p, which is a fairly low level to minimize distortion. This means that the receiver volume control setting will be relatively low.

If you are using an exciter which is very sensitive, and the mic gain control must be set very close to minimum, the top lead of resistor R14 on the COR-4 module can be clipped out of the circuit to reduce the level of audio applied to the exciter. That will allow the mic gain control to be set more easily.

If you do have an autopatch installed, proceed as above, except that before the receiver volume control is set to its final position, turn it up about twice as high as normal to produce overdeviation on the transmitter. Then, adjust the deviation limiter in the exciter for about 5-1/2 or 6 deviation. Finally, turn the *receiver volume* control down to get 5 kHz deviation with an input signal modulated 5 kHz.

The result of this procedure is to set up the deviation limiter so that it doesn't limit on normal receiver audio but it will limit if telephone audio exceeds 5 kHz deviation.

Finally, bring up the autopatch, and adjust the telephone audio gain control on the autopatch module. Set it for full deviation on dial tone. After using the autopatch, if you find that some telephone call audio is a little weak, you can increase the telephone audio gain setting in the autopatch module, and the limiter in the exciter will prevent severe over-deviation on louder phone calls. Refer to instructions in the autopatch manual for more information.

Tail Length.

The length of tail after the courtesy beep is set with *TAIL* pot R24 in the lower center of the COR-4 module. The adjustment range is 0-7 seconds.

Cw Tone.

The cwid and courtesy beep are the same tone, and its pitch is adjustable with *CW TONE* pot R4 at the lower-left corner of the COR-4 module. Its adjustment range is about 300-1500 Hz.

Cw Speed.

Cw speed is fixed at about 15 wpm, which is the speed most commonly used on repeaters. The speed is determined by R1/R2/C1 in clock circuit U6-A. Two resistors are connected in parallel to allow fine adjustments to be made. If you prefer a speed just a little slower, you can clip the top lead of R1, which will set the speed at about 13 wpm. If you want a larger change, it is necessary to replace R1 or both resistors. A lower value of parallel resistance will make the speed higher, and more resistance will slow it down.

This clock also operates the cwid interval timer; so any change made in the speed also affects the amount of

time before the id runs again. If you just clip R1 out, the id interval will be about 10 minutes instead of 9. If you speed up the id, the interval will be less than 9 minutes. The interval can be re-adjusted digitally as explained below.

To force the cwid to run for testing, simply turn off the repeater power, wait about 20 seconds for all the capacitors to discharge, and then turn the power back on. The repeater id's whenever power is first applied as a part of the start up routine.

Cw Interval.

The length of time between id's is determined by cwid interval timer U1-A. The cwid should occur only after the receiver squelch is dropped (polite id'er) and the interval timer says it's time to id, which includes when the repeater is first turned on. The pc board has a fixed jumper which resets the interval timer at about 9 minutes after the unit id's. The length of time is also affected by the values of resistors used in the cwid clock, as explained above; so if you have altered the clock speed, the interval will be slower or faster than 9 minutes.

The timer can be reprogrammed in binary increments (doubled or halved) by changing the jumper arrangement. To do this, first use a knife or Dremel tool to cut the pc trace at the marked point on the top of the board as indicated on the component location diagram next to U2. Then, install a jumper wire between the *"COM"* pad and either the *"4"* or *"18"* pad. These markings refer to the approximate length of time interval, assuming the original clock speed.

Beep Delay.

Most users find that two seconds delay before the courtesy beep is about optimum, and since the tail after the beep is adjustable, normally, the beep delay never needs to be adjusted. The values of R21 and C17 establish this delay. If you must change the delay time, the value of R21 may easily be changed.

Time-out Time.

The time-out timer length is preset close to 3 minutes with the time constant of R26/R27/C22, and normally there is no reason to adjust this length. Two resistors are used in series to allow fine degrees of change to be made with standard resistor values. Should it be necessary to make small changes, R27, the smaller value, may be changed. For large changes, you may want to adjust both values.

Audio Tone.

The mixer on the COR-4 is transparent, and assuming the transmitter and receiver are designed with the normal EIA response curve, the audio through the repeater should be transparent with regard to tone response. However, there may be installations where alteration of tone coloring is desired to compensate for some component in the system or to suit individual taste. Some degree of tone control can be achieved by increasing the value of bypass capacitor C11 to reduce the high end response. If you need to do this, try .001 uF to .01 uF in place of the normal 220 pF rf bypass value. Since the bypass capacitor is only included as a precaution, you can probably use the pads on the board for a tone control value of capacitor instead.

OPERATION.

Operation of the COR-4 module is fairly typical of what you would expect in a repeater controller. When the receiver squelch opens, the transmitter is keyed. When the squelch closes, the cor circuit waits for 2 seconds to see if anyone wants to break in; if not, the courtesy beep sounds and the time-out timer is reset. If no user captures the receiver after the courtesy beep, the cor circuit waits for a predetermined time (tail), and then it shuts off the transmitter.

If the squelch remains open for more than 3 minutes, or if users do not wait for the courtesy beep to announce that the timer is reset (at least once in three minutes), the time-out timer shuts the transmitter down until the squelch closes, and then the timer is reset.

The cwid is polite; so it is heard only after the squelch closes and the two-second delay to allow for break-ins. It is triggered in this way the first time there is repeater activity after an extended period and every 9 minutes after that as long as there is repeater activity.

LED's on the front panel indicate when the power is on, when the transmitter is on, when the receiver squelch is open or the beep delay is in progress, and when the time-out timer has shut down the transmitter.

If you have included a local monitor speaker and local volume control in your repeater, the front panel speaker volume is set separately from the volume control on the receiver. The separate local speaker volume control is used to adjust the speaker level, not the volume control on the receiver, which adjusts the level of audio applied to the transmitter.

A low-impedance dynamic microphone can be used for local transmissions for testing. However, since the mic gain control in the transmitter is not really set up for microphone operation but for repeater operation, the deviation may not always be correct for all microphones. If your microphone has more than the normal amount of output, it may be necessary to speak a little quieter, or if used extensively, to install some sort of volume control resistor in series with the microphone to equalize its output.

The microphone circuit is designed to automatically mute the repeater receiver audio when the local microphone is in use. Therefore, it is necessary either to have a microphone with a ptt switch which disconnects the microphone element when the switch is not depressed or to unplug the microphone when normal repeater operation is expected. Otherwise, the microphone will load down the repeater audio, and it will not be heard.

THEORY OF OPERATION.

Basic COR Circuit.

An electronic carrier-operated relay provides operating power to the exciter in the transmitter enclosure whenever the receiver squelch is open. Q1 is a threshold detector, which senses the presence of a COS signal from the receiver and keys the first timer, U6-E, which provides the courtesy wait period after the COS signal is removed (receiver squelch closed). That trips timer U6-D, which provides the silent repeater tail after the courtesy beep. That timer, in turn, keys Q2/Q3, which switches the actual B+ to the exciter.

Tail and Time-out Timers.

Many of the timing circuits in the COR-4 employ the schmitt trigger inverters of U6, which rapidly change state when a predetermined schmitt trigger voltage is reached on their input gates. Capacitors connected to the input gates either charge or discharge under circumstances when

the timer is to run.

If the receiver should be held on for longer than the legal transmit period, (e.g., 5 minutes), time-out timer U1-C automatically shuts down the transmitter until the receiver is released. While the transmitter is keyed, the ground from U6-E pin 10 is released, which allows the voltage on C22 to slowly charge. When it reaches the schmitt trigger voltage, U6-F output turns on U7-A, which blocks the keying signal at U7-D.

LED Drivers.

Four LED's normally are provided on the front panel of the repeater. The *POWER* led is driven by resistor R22 connected to the power supply circuits. The *XMIT* led is driven from keyed B+ switch Q3 through R35. The *TIMEOUT* and *RCV* led's are driven by switches Q4 and Q5 through current limiting resistors R32 and R34.

CWID Timers.

The cwid sequence is initiated either by turning on the power to the repeater or by the receiver squelch dropping. The id will run only if enabled by its timers. If so enabled, either by receiver activity after a long period of silence or by the 9 minute interval having elapsed, then the id begins when a pulse from one-shot U6-C clocks cwid interval timer flip-flop U1-A.

When the id is tripped like this, U1-A removes the reset from binary ripple counters U2 and U3, allowing the counters to run. U1-B provides a chip enable to EPROM U4 and holds the transmitter keyed by applying a signal to Q2.

U3 is clocked from 1000 Hz oscillator U6-A. This provides a 15 WPM code speed. U2 is clocked by one of the output stages of U3, which provides a pulse every 2 seconds. Thus, U2 acts like an extension of U3, allowing very long timing sequences to occur. *Note that unused output stage pins of U2-U4 are not shown.*

Two of the lower outputs of U2 drive the high order address lines of the EPROM. Pins 13, 12, and 14 provide outputs which rise at roughly 4, 9, and 18 minutes, respectively. The 9 minute output normally is connected to the reset input on cwid interval timer U1-A. Thus, 9 minutes after the id runs, the timer is reset to allow the id to run again if tripped. Shorter or longer time periods can be set by breaking the normal connection and adding a jumper to one of the other counter outputs.

Since the lower ten address lines from U3 and U2 repeat several times during the 9 minute interval, some means must be provided to disable the id output signal for all but the first time the addresses are presented to the EPROM. This is done by cwid run enable flip-flop U1-B.

Our computer program, which generates the EPROM pattern for the Morse code on bit-0 of the EPROM, also sets bit-7 of the byte following the last part of the id message to provide a high to reset the cwid run enable flip-flop. When the EPROM is clocked past the end of the message, U1-B thereby is reset. In turn, it removes the chip enable from the EPROM to disable any further cw output pulses, and it removes the transmitter keying signal from Q2.

Cwid Signal Circuit.

EPROM U4 is organized as 8 bits x 4K. We only use bits 0 and 7. The cw message is stored as sequential Morse code elements on bit 0 of each byte. Bit 7 is used to reset the cwid run enable flip-flop at the end of the message.

The cwid sequence is enabled by cwid run flip-flop U1-B at the time cwid interval timer U1-A begins running. Eight stages of U3 and two stages of U2 provide outputs to step the addresses of EPROM U4 through the cwid code stored inside on bit-0.

The cw message, in binary form, is used to key the id tone through or-gate U7-B and tone gate U7-C. The cwid tone is mixed into the audio path for the transmitter through a low-pass filter, which converts the square-wave signal to almost a sine-wave.

Up to 1024 bits of cw data can be stored in the utilized address range of A0-A9. The limit on the length of the message depends on the Morse code elements needed for each character, but it is approximately 100 characters.

Courtesy Beep.

The courtesy beep forces operators to wait 2 seconds after the previous user releases the receiver squelch before picking up the repeater or else run the risk that the time-out timer may shut them down. This provides a psychological incentive to be courteous.

Each time the receiver squelch closes, U6-E times for 2 seconds; then, one-shot U6-C is triggered, which produces a 100 mSec pulse. This pulse keys tone gate U7-C, which generates a tone burst in the same way the cwid tone is keyed.

Audio Mixer.

Audio from the main receiver enters the audio mixer at E12, and audio from an auxiliary receiver, if used, enters at E13. R10 and R13 are load resistors, which simply present a relatively low impedance to the lines to prevent hum and discharge any dc leakage through the large output capacitors on the receiver speaker output lines.

Receiver audio is added to the audio from the courtesy beep/cwid tone gate in a resistive mixer, consisting of R11, R12, R9, and R14/R15. The level of the tone signal through the low-pass filter and mixer is set so that transmitter deviation on tone will be about 3 kHz if the receiver audio level is set to 1.5V p-p for full 5 kHz deviation.

The level at the output of the mixer is reduced to the relatively low level (about 30mV p-p) required at the input of the exciter by the voltage divider formed by output resistors R14/R15 and the input resistor on the exciter, which is 2K in the Hamtronics exciters. Two resistors are used in parallel to allow R14 to be clipped out of the circuit when an exciter of audio greater sensitivity, such as our TA451 UHF exciter, is used.

Audio for the local speaker is provided by speaker driver U5. Its input is derived from the audio mixer through R16, which acts with the front panel *SPKR VOL* control as a voltage divider so that only two wires need be connected to the pot on the from panel. R17/C15 is a parasitic suppressor.

Power Supply Circuits.

+13.6Vdc to operate the entire repeater is applied to E1 through the front panel power *ON/OFF* switch. Power is distributed to other modules in the repeater through E2-E5. It also powers some circuits on the COR-4 board directly, and it powers logic circuits through 5 volt regulator U8.

TROUBLESHOOTING.

Procedures.

Having read the Theory of Operation, you have a good understanding

of how the circuits work. The best way to troubleshoot is to trace signals from stage to stage to check the operation of each circuit, starting with the function you believe is not working properly.

Digital circuits have signal levels near ground for a lo logic level and near +5V for a hi logic level. On the schematic diagram, a bar over the function name at an ic indicates the active logic level is lo; if no bar, the active level is hi (majority of signals are active-hi). In some of the circuits in the cor section, where the lines have no particular names, we have noted the signal level with a small pulse symbol next to the line to indicate if the signal goes hi or lo during the active condition. This helps to keep the sense of the signal clear in your mind as you glance through from one circuit to the next.

The most common troubles in all kits are interchanged components, cold solder joints, and solder splashes. Another common trouble is blown transistors and ic's due to reverse polarity or power line transients. Remember if you encounter problems during initial testing that it is easy to install parts in the wrong place. Don't take anything for granted. Double check everything in the event of trouble.

Relative audio signal levels for full modulation are shown for the mixer circuit on the schematic diagram. To help troubleshoot audio output stage U5, the following dc levels were measured with an 11 megohm fet vm on a sample unit with 13.6 Vdc B+ applied. All voltages may vary considerably without necessarily indicating trouble. The audio output stage is rated for 2W output into an 8-ohm load.

U5 Pin	1	6	8	14
	+7 V	+.03 V	+6 V	+13.6 V

Current Drain.

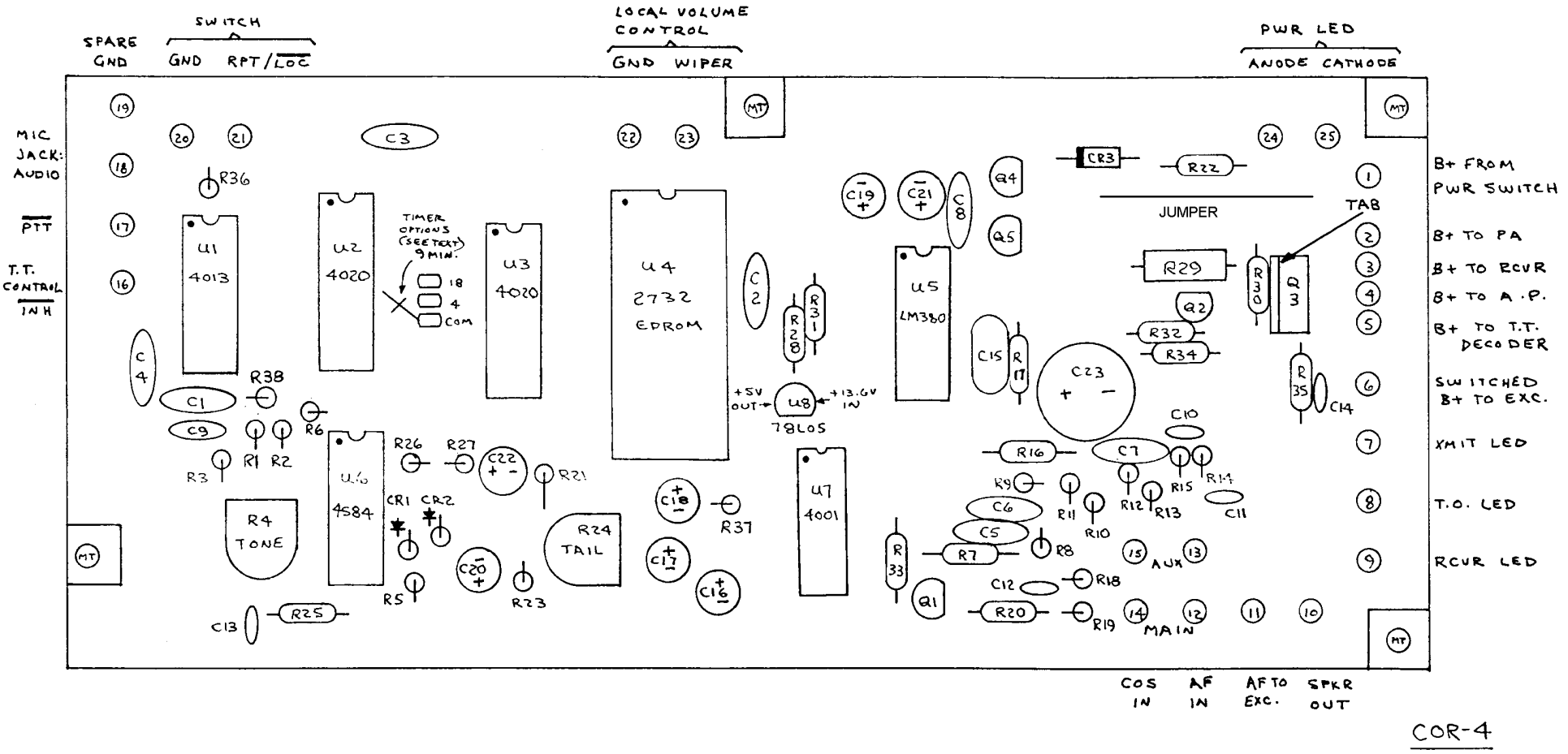
Current drain is relatively low at idle; and even with the cwid running, which is the maximum current condition, the current drawn by the circuitry on the COR-4 module is much less than the current drawn by the exciter through the B+ switch on the COR-4 module. I.e., the current drain quadruples with the exciter connected to the COR-4.

The following current drain conditions are typical for a COR-4 board with the exciter disconnected for troubleshooting. Current drain depends on the mode the module is in at any given time, and the current drain during cwid cycle and the current drain during voice reception varies with the setting of the *SPKR VOL* control.

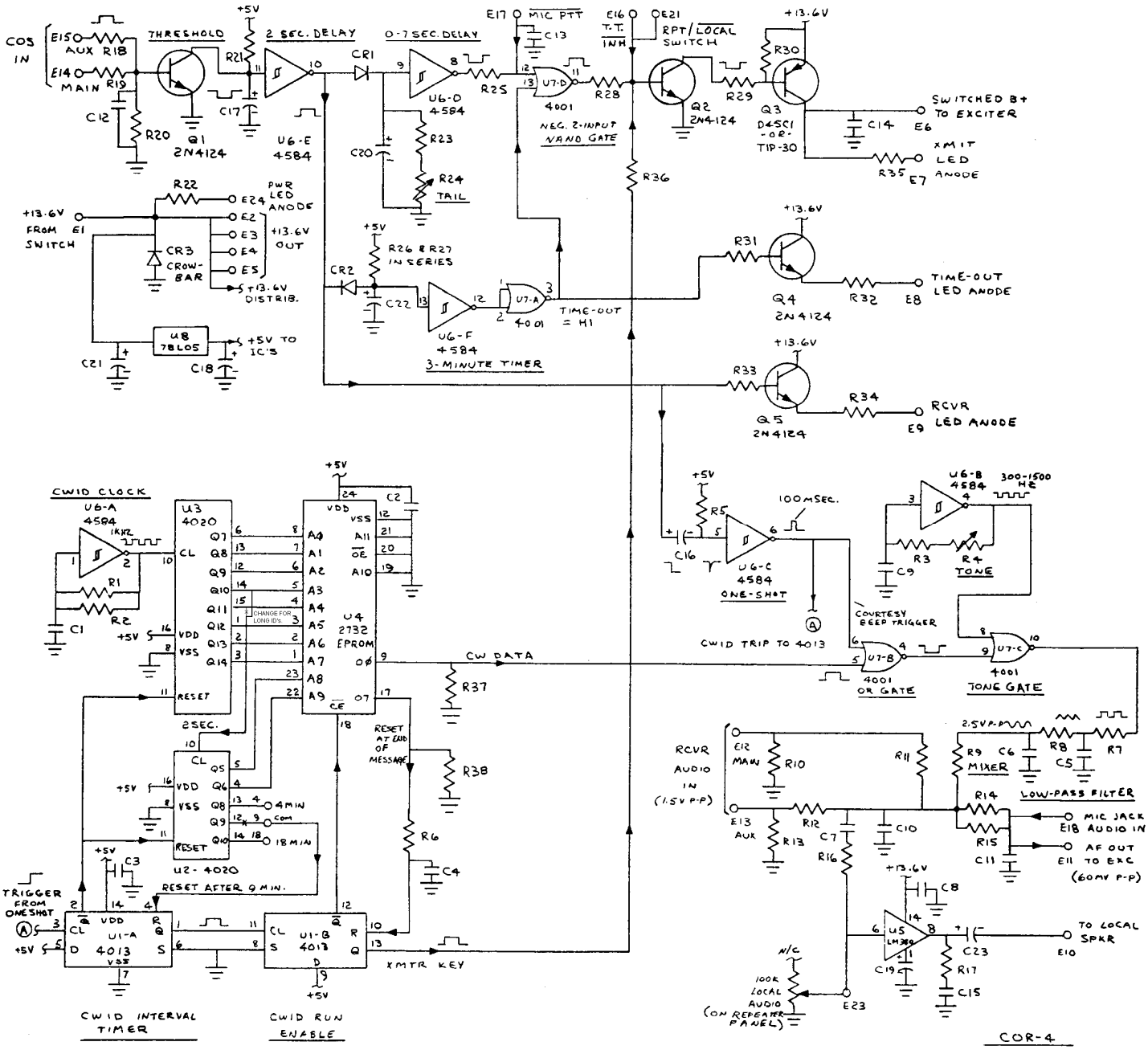
EPROM Type	2732A	27C32
Idle	19 mA	3.5 mA
Keyed	60 mA	45 mA
Cwid Cycle	115-150mA	100-135mA

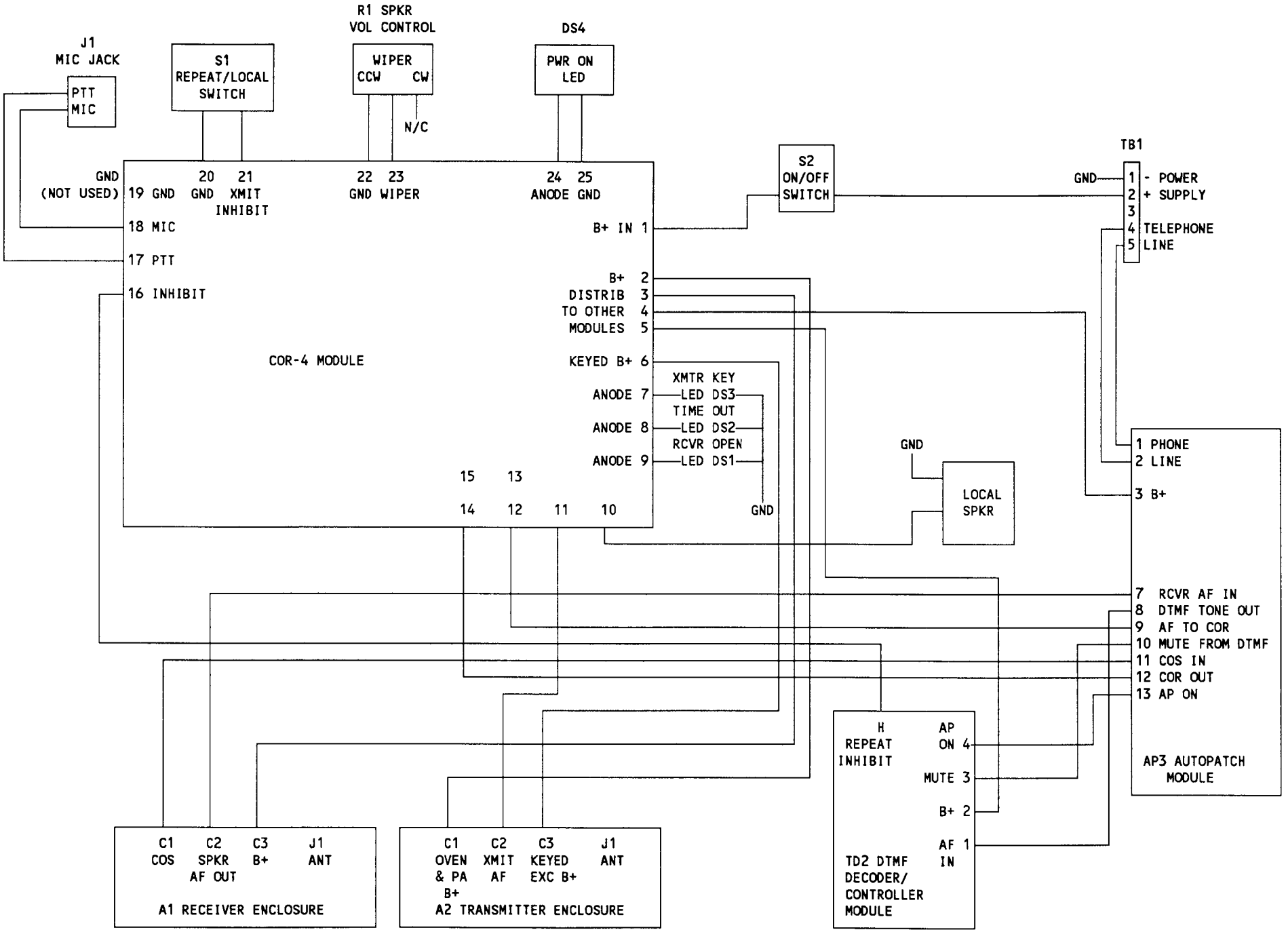
PARTS LIST.

Ref #	Value (marking)
C1-C3	.01 uf (103)
C4	not used
C5-C9	.01 uf (103)
C10-C14	.001 uf (102, 1nM, or 1nK)
C15	0.15 uf mylar (red)
C16-C20	4.7 uf electrolytic
C21	4.7 uf electrolytic
C22	47 uf electrolytic
C23	470 uf electrolytic
CR1-CR2	1N4148 switch diode
CR3	1N4003 power diode
Q1-Q2	2N3904
Q3	D45C1 or TIP-30, 1A PNP
Q4-Q5	2N3904
R1	2 meg
R2	330K
R3	100K
R4	1 meg pot
R5	27K
R6	100K
R7-R8	15K
R9	27K
R10	1.2K
R11-R12	10K
R13	1.2K
R14	10K
R15	330K
R16	510K
R17	3.3Ω (orn-orn-gold-gold)
R18-R19	100K
R20	27K
R21	330K
R22	680 ohms
R23	10K
R24	1 meg pot
R25	10K
R26	3.9 meg
R27	330K
R28	4.7K
R29	330 ohms, 1/2 watt
R30	27K
R31	10K
R32	180 ohms
R33	10K
R34	180 ohms
R35	680 ohms
R36	4.7K
R37	100K
R38	1 meg
U1	4013B, static sensitive!
U2-U3	4020B, static sensitive!
U4	2732 EPROM, STATIC!
U5	LM-380 2W Audio Ampl
U6	4584B, static sensitive!
U7	4001B, static sensitive!
U8	78L05 Voltage Regulator



COR-4





REP-100 REPEATER WITH AUTOPATCH, BLOCK DIAGRAM