REPEATER INTERFACE BOARD

TECHNICAL MANUAL

Circuit Description of RP3A Circuit Board

Schematic Diagram

Parts List

Outline Diagram

Modifications Available

Outline Diagrams for Modifications

Circuit Description of RP3A Circuit Board [and Modifications]

Encode of CTCSS tone

Microcircuit IC-107 on TSU-32 module * synthesizes CTCSS tone derived from crysal Y1. Tone frequency is customer selected at DIP switch SW-1 (which also determines decode tone) and converted at resistor network CSR202 from square wave to triangular wave. Triangular wave is shaped to sine wave by diodes D5, D6, filtered and amplified at op-amp IC-B-1, 2, 3, level-adjusted by trimmer R29, and delivered to R-Bd via spring socket contact. [Mod #9: encode tone eliminated at this point or turned down to zero at R29]. On the R-Bd the CTCSS tone is shunt-gated by the open-collector outputs IC-E-11 and 3, amplified by IC-K-5, 6, 7, op-amp, level-adjusted by trimmer R40, and delivered to TX exciter via connectors JJ1-12/J902R-9.

The CTCSS - shunting gates mentioned above are controlled from three sources:

- Local $\overline{\text{PTT}}$ low at connectors JJ3-2/JJ1-2 pulls NAND IC-E-13 input low (via double inverter IC-G-11, 10, IC-F-3, 4) to release IC-E-11 output (open collector) for encoding of local-mic-mode transmissions;
- patch $\overline{\text{PTT}}$ low at connector JJ2-3 similarly releases IC-E-11 for encoding of phone-patch mode transmissions;
- $\overline{\text{TOS}}$ low at Q1 pulls NAND IC-E-12 input low to release IC-E-11 output for encoding of repeat-mode transmissions;

---

* TSU-32 encode/decode/filter module, by Communications Specialists, Orange, California, is mounted by spring-socket connections on R-Bd.

Decode of RX CTCSS tone

Audio derived from S-8d Vol/Sq Hi via connectors P6R-4/JJ1-14/spring socket is fed to TSU-32 low-pass filter IC-A-1, 2, 3, which drives wave-form squaring amplifier IC-A-12, 13, 14, which drives RC filter network tuned by IC-107 programmed at SW-1. Audio of the required tone passes on to detector amplifier IC-A-8, 9, 10, then comparator IC-A-5, 6, 7, then inverter Q1 [Mod #5: and thru added 4.7K resistor Q2].

A decoded tone causes Q1-collector to go low [Mod #5: and Q2-collector to go hi, releasing tone filter to pass RX audio] pulling down $\overline{\text{TOS}}$- line input to two TTL gates:

- NAND IC-E-12 input is pulled low to release IC-E-11 output across encode line (see above).
- NAND IC-C-5 input is pulled low

causing IC-C-6 output, m-TOS line to go hi, lifting NAND IC-C-2 input hi; if IC-C-1 input is simultaneously hi, due to carrier activity lifting $\overline{\text{CAS}}$ - line hi via P912R/JJ1-4 from S-8d, then IC-C-3 output goes low pulling down $\overline{\text{TOS}}\cdot\overline{\text{CAS}}$ line to four other gates in repeater control logic (see below).

Logic of RX mute control

Mute line to MVP S-8d via connectors JJ1-1/P6R-5 is normally low to mute.

Unmute occurs when NAND IC-E-8 open-collector output is released by any of three lines:

- m-TOS line going hi, on any decode activity, pulls inverter IC-G-6 output low, which pulls both NAND IC-E-9, 10, inputs low and releases mute output;
- hook switch line from system cable via connector JJ1-3 going low pulls NAND IC-E-9 input low, to release mute output;
- CG disable line from Control-Panel SQUELCH switch via connectors JJ3-3/JJ1-3 going low pulls IC-E-9 input low, to release mute output;
- [Mod #6: Mute output normally hi (unmuted) regardless of IC-E-8 state].

If mute line is releases (unmuted) then local $\overline{\text{PTT}}$ line going low (active) will pull mute line low via double inverter IC-G-11, 10, IC-F-1, 2. [Mod #7: Local PTT activity does not pull down mute line.]

Logic of repeat timers

Drop-out timer IC-D-1 to 6 is triggered at pin 6 by $\overline{\text{TOS}\bullet\text{CAS}}$ going low, but is held off by the same line to reset pin 4 until $\overline{\text{TOS}\bullet\text{CAS}}$ again goes hi, allowing timer output at pin 5 to go hi for 2½ seconds. Drop out time is determined by C43, R44 trimmer, and R45 [Mod #2: R45 may be increased to extend timer range]. Drop-out timer output is inverted by IC-G-9, 8.

NAND IC-E-6 output is normally low unless either $\overline{\text{TOS}\bullet\text{CAS}}$ input 5 goes low or input 4 from inverter IC-G-8 goes low (drop-out timer going hi), in which case the time-out timer IC-D-8 to 13 is released to go high at output pin 9 for 2½ minutes. However, open collector inverter IC-F-5, 6, output pulls timing capacitor C47 low whenever $\overline{\text{TOS}\bullet\text{CAS}}$ goes hi, causing time-out timer to restart its timing (without resetting its output) each time $\overline{\text{TOS}\bullet\text{CAS}}$ goes low and will time out if $\overline{\text{TOS}\bullet\text{CAS}}$ held low for longer than 2½ minutes. Time-out time is determined by C47 and R46.

Logic of Repeat mode

Repeat-mode functions are controlled by NAND IC-C-11, 12, 13, whose output goes low (repeat mode on) if all these conditions are met:

- NAND IC-E-6 output goes hi (conditions described above),
- time-out timer IC-D-9 output goes hi (conditions described above),
- repeat-disable switch SIR not closed.

NAND IC-C-11 output turns on the repeat mode by providing a low to two other gates:

- NAND IC-C-8 output goes hi when its input 10 pulled low by repeat-mode activity, activating $\overline{\text{PTT}}$-out line via inverter Q4. [Mod #10: NAND IC-C-10 input pulled low by repeat-mode low coming, instead, from other repeater in back-to-back link].
- Inverter IC-F-9, 8 open-collector output goes hi if repeat mode goes low and inverter IC-F-12 open-collector output goes hi (due to $\overline{\text{TOS}\bullet\text{CAS}}$ line going low) [Mod #8: due to CAS going hi, pulling H18-2 low via IC-G-1, 2] and inverter IC-F-10 open-collector output remains hi (due to local $\overline{\text{PTT}}$ not pulled low). These inverters going or staying high release the repeat-audio line to accept RX audio from de-emphasis filter IC-K-1, 2, 3, and deliver it to TX audio amplifier/mixer Q5.

Logic of patch control line

Inverter Q3 open-collector output determines the state of the telephone-patch control line at JJ2-1. The polarity and source of the control-line state is determined by the soldered connection of R65 lead into H2 or 3 or 4 or 5. R-8d is factory wired with R65-lead connected to H4 ($\overline{TOS \cdot CAS}$ low = patch-control line low). See Modifications section, Mod #3 for alternate R65 connections, and Mod #1 for alternate use of Q3.

Logic of PTT control

Local $\overline{PTT}$ input, thru JJ3-2/JJ1-2, controls four logic functions:

- If NAND IC-E-8 output is hi (due to either input 9, 10 low - see above), then local PTT low will pull IC-E-8 low (described above), muting RX during local transmit.
- If repeat-audio line is unmuted (due to repeat mode on and carrier and tone decode present (see above), then local $\overline{PTT}$ low will mute the repeat audio (described above).
- Encode output will be enabled by local $\overline{PTT}$ low (described above).
- PTT output to S-8d via connectors JJ1-6/P11R will be pulled low by local PTT low via IC-G-11, 10, IC-F-3, 4, IC-C-9, 8, R48/Q4.

Patch PTT input will turn on both the on-R-8d encode output and the $\overline{PTT}$ output, similar to the local $\overline{PTT}$ explained above, but entering at JJ2-3. However, patch $\overline{PTT}$ does not mute RX audio nor repeat audio.

Conditioning of RX audio

Tone-reject filter IC-B-5, 6, 7, of TSU-32 module accepts RX audio of 1 volt rms/3KHz modulation deviation (reference) via connectors P6R-4/JJ1-14/spring-socket contact. The tone-reject-filter output feeds the Control-Panel volume pot (disconnected from Vol/Sq Hi at S-8d) with a 1-volt-rms level signal via connectors JJ1-13/J5R-1. The tone-reject-filter output also feeds the de-emphasis filter IC-K-1, 2, 3, on the R-8d via spring-socket contact and C60. The de-emphasis filter output supplies 6db/octave, low-pass-filtered audio (e.g. 1.2 volt rms @ 500Hz, .5 volt rms @ 1000Hz) to the repeat-audio line at R49/trimmer R50 (see below), and to the phone-patch RX-audio line at JJ2-9 via R61 and C61. [Mod #4: C61 must be bypassed to interface with a patch input resistance below 2.2K ohm (patch input circuit must be able to sync 10 ma dc)]

Amplifier Q5 combines audio inputs (all at 125 mv rms/3KHz-TX-Mod-dev. level) from four possible sources:

- RX audio from filter IC-K-1 output via trimmer R50 and repeat-audio line, when unmuted (conditions described above), to Q5 base [Mod #10: audio coming instead from repeat-audio line of other repeater in back-to-back link];
- hand-mic audio via connectors JJ3-1/JJ1-11, when $\overline{\text{PTT}}$ low, to Q5 collector;
- desk-mic audio via JJ3-4/JJ1-8 to Q5 base.
- patch-cable audio via JJ2-10 to Q5 base.

Collector of Q5 delivers 125 mv rms/3KHz dev. to exciter via connector JJ1-4/J902R-4.

Priorities over TX audio are wired such that:

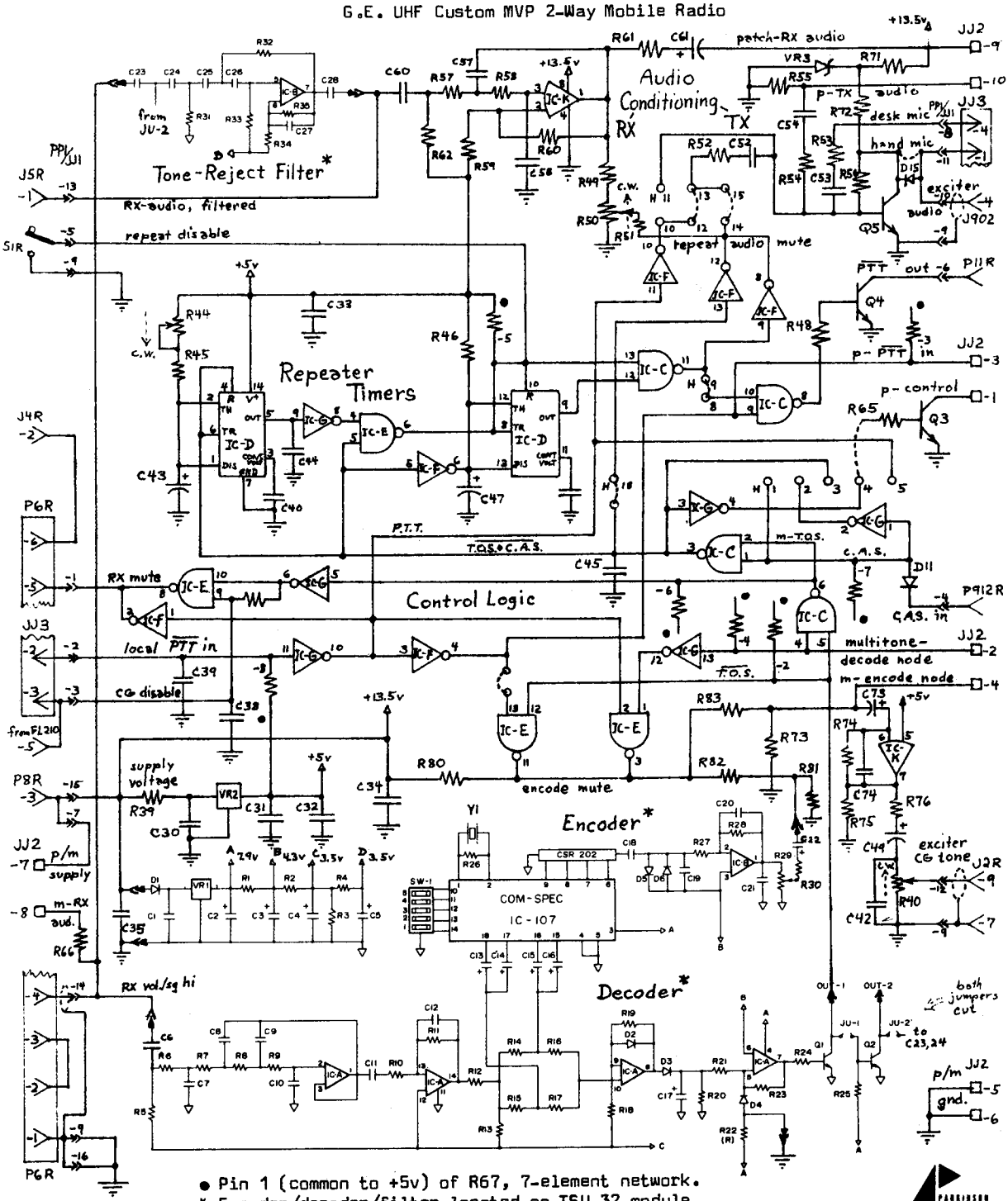
- Hand-mic $\overline{\text{PTT}}$ will completely mute repeat audio and reduce patch audio, if present;
- desk-mic $\overline{\text{PTT}}$ will completely mute repeat audio and mix with patch audio, if present;
- repeat audio and patch audio will mix if both present.

Power supplies

All supply voltages on R-8d and patch or multitone cable are derived from the radio's +13.5 volt switched supply line at S-8d via connectors P8R-3/JJ1-15, 7.

The audio conditioning circuits draw 12 ma directly form +13.5 volt. The TTL logic draws 70 ma at +5 volts regulated by VR2 and despiked by C30, 31, 32, 33. The TSU-32 module draws 8 ma at +7.9 volts regulated by VR1. The total current drain on the 13.5-volt power supply is approximately 90 ma plus the current drawn by the phone patch

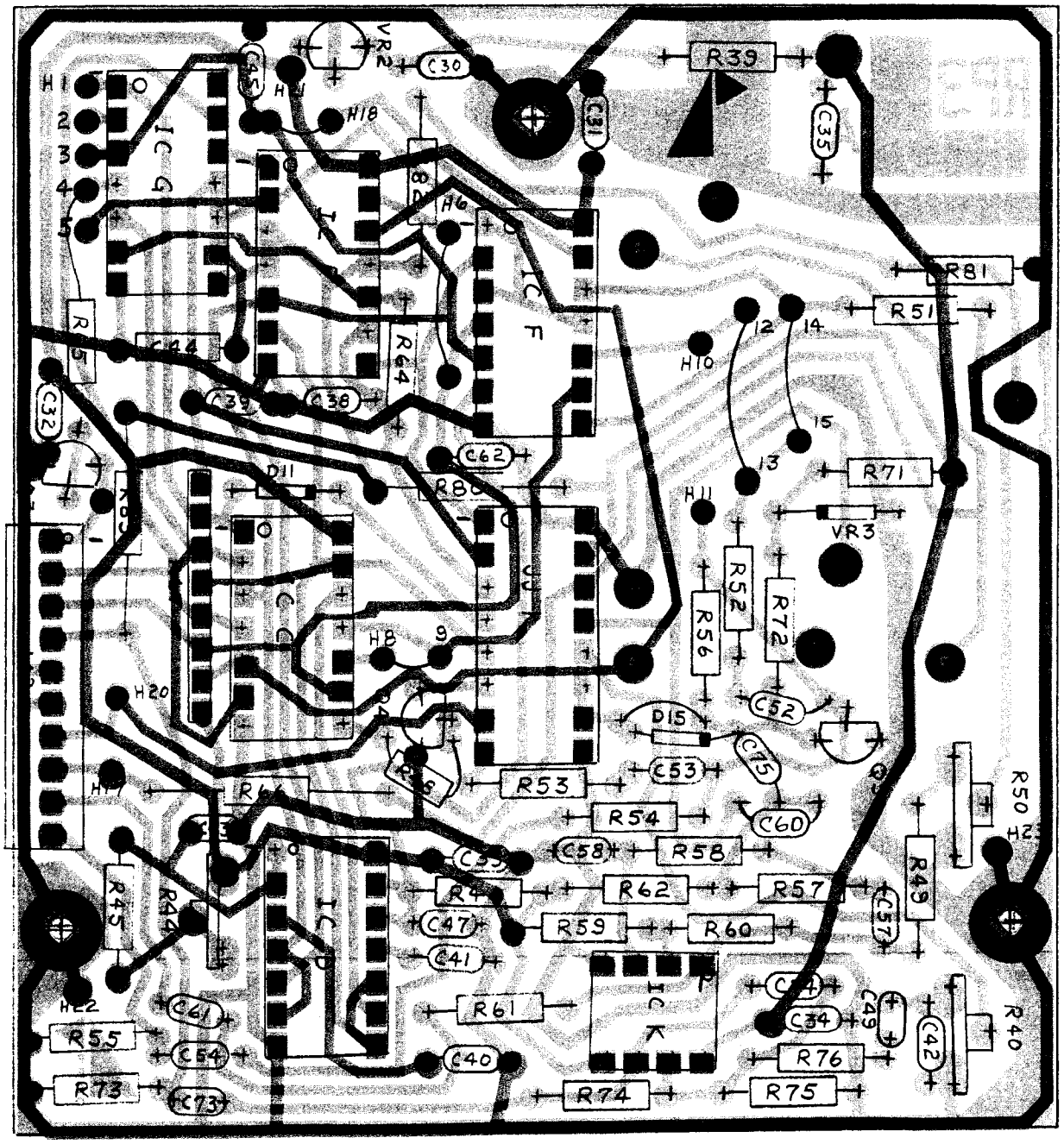
Repeater-Control/Encode/Decode Board for
RP3A Modification Kit to
G.E. UHF Custom MVP 2-Way Mobile Radio



- Pin 1 (common to +5v) of R67, 7-element network.
* Encoder/decoder/filter located on TSU-32 module (product of Communications Specialists, Orange, Ca.).
For IC-C,D,E,F,G: +5v supply to pin 14, ground to pin 7.

Dec '82

PARKINSON ELECTRONICS COMPANY
Drawer 8
LEVELLAND, TEXAS 79336



TE1542

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

REPEATER CONTROL BOARD
RP3A

MODIFICATIONS AVAILABLE TO RP3A KIT

1. Using spare open-collector inverter: transistor Q3 is normally used to provide control signal to telephone patch (see Mod # 3 instructions, below). If no phone patch is used, Q3 is available to provide an inverted, open-collector version of any one of the five signals, available from holes H1 thru H5, to periferal equipment. To do so:

   a. select signal source using chart in Mod # 3 instructions, below, for H1 thru H4, or select hole H5 to allow local-mic-PTT activity to cause Q3 collector to go low;

   b. connect R65 lead to hole selected;

   c. pick off inverter output from connector JJ2, pin 1.

2. Extending range of drop-out-timer trimmer adjustment: replace R45 of R-Bd with ¼-watt resistor of selected value, e.g.

   2.2 K ohm: $0 < T < 2\frac{1}{2}$ seconds
   20 K ohm: 1 second $< T < 3\frac{1}{2}$ seconds
   120 K ohm: $5\frac{1}{2}$ seconds $< T <$ 8 seconds

   Note: R45 must be greater than 2 K ohm to avoid damage to timer IC.

3. Controlling telephone patch from tone decode and/or carrier activities: the lead connection of R65 on R-Bd to holes H1 thru H4 determines the source and polarity of the control signal sent to the phone patch by way of JJ2-cable orange wire; connect as suits phone patch used:

connecting R65 to hole	allows	to cause patch control line to go
H1	carrier activity (hi at J912 on S-Bd)	low (ground)
H2 (inv. H1)	carrier activity	hi (open)
H3	tone decoded (low-out of Q1 on TSU-32) AND carrier activity	hi
H4 (inv. H3)	tone decoded AND carrier activity	low

The factory-wired connection is to H4.

4. Matching patch-RX-audio line (JJ2, pin 9, yellow wire) to Low-input-resistance telephone-patch circuits: The op-amp output IC-K-1 of R-Bd is capacitively coupled and designed to work into 2.2 K ohms or greater input resistance of phone patch audio circuit. To match, instead, to a phone patch with lower input resistance (e.g. 600 ohm) replace capacitor C61 with a jumper wire. This direct coupling will avoid cross-over distortion from the op-amp, but requires that the phone-patch input sync 10 ma of dc current.

5. Adding tone squelching of telephone-patch RX-audio line (JJ2, pin 9, yellow wire): as factory wired, the patch RX audio line is not squelched regardless of carrier or tone activity -- the phone patch itself normally responds to RX-audio line as per control signal supplied by radio via patch-control line (JJ2, pin 1, orange wire) as tabulated in Mod #3 above. If, however, phone patch requires external tone squelch, modify TSU-32 module on R-Bb as follows:

   a. reconnect jumperwire JU2;

   b. clip R25, 10K resistor top lead;

   c. add a 4.7K resistor across open JU1 holes.

   Note that this modification will also add a second tone-squelching to the repeat-audio lines of the R-Bd.

6. Disabling CG-decode muting of RX audio to speaker: to allow RX audio to be heard at repeater regardless of presence of decoded tone or of swich setting on Control Panel, clip jumper wire H6-H7 on R-Bd.

7. Disabling of local-mic-PTT muting of RX audio to speaker: to allow RX audio to be heard at repeater even when local-mic PTT is mashed:

   a. temporarily remove IC-F (7406N) IC chip;

   b. bend pin 2 up to horizontal position;

   c. return IC-F to its socket (noting key orientation!) with pin 2 not engaged.

8. Removing CG-decode muting of repeat audio: to allow repeat-audio line to be muted by loss of carrier (squelch-tail muting) but not by loss of tone decode: remove short jumper wire at H18 and add jumper wire from hole H18 to H2.

9. Removing all CG control to radio: (1st method) to allow RX and repeater to respond to carrier activity regardless of tone, and to encode no tone, but to pass received tones to speaker and (weakly) over repeat-audio line:

a. remove TSU-32 module from R-8d (prying carefully with narrow tool to avoid bending pins).

b. plug in an 18 AWG solid-wire jumper connecting spring socket near VR3 and spring socket near R50;

c. plug in an 18 AWG solid-wire jumper connecting the two spring sockets located close together between JJ1 and R56;

Note: if preferred, to allow repeat-audio line to pass received CG tones with fidelity, change capacitor C60 to 1.5 mf tantalum and capacitor C52 to 0.1 mf ceramic on R-8d; similarly, on exciter board, increase values of capacitors C1 on U101 and C109.

(2nd method) to allow RX and repeater to respond to carrier activity regardless of tone, to encode no tone, yet to leave CG-tone filter intact:

a. (leave TSU-32 module in place);

b. temporarily remove PP1 conector from JJ1 to move harness out of the way;

c. solder wire from OUT-1 terminal on TSU-32 module to ground at H23;

d. re-connect PP1 into JJ1;

e. turn trimmer R29 on TSU-32 module all the way down (full C.C.W.)

10. Interconnecting two MVP/RP3A repeaters as back-to-back relay link (this may be done by interchanging the exciter boards and TX boards between the two radios to achieve the required frequency pairings; an alternate method is): to link two repeaters so that one retransmits what the other receives and vice-versa, and local mic will operate the TX of, and mute the RX of the radio it is physically attached to, and RX will be heard on its own speaker, and the repeat-disable switch will disable the link between its RX and the other radio's TX.

a. temporarily remove TSU-32 module (prying care fully with narrow tool to avoid bending pins) in each radio;

b. remove jumper wire H14-H15 in each radio and cross-link the repeat-audio lines by connecting H14 of one radio to H15 of the other, and vice-versa, using shielded audio cables;

c. replace TSU-32 module;

d. similarly, remove jumper wire H8-9 in each radio and cross-link the repeat-timer-PTT activation lines, connecting H8 of one radio to H9 of the other, and vice-versa using stranded hook-up wire.

13. Controlling CG-encode gating with repeater-timer activity, rather than with CG-decode activity:

    a. cut PCB copper run that comes from IC-E pin 12; cut this run on top side of R-Bd near R82 - 47K resistor;

    b. add a jumper wire from IC-E pin 12 to the jumper-loop sticking up at H8-9.

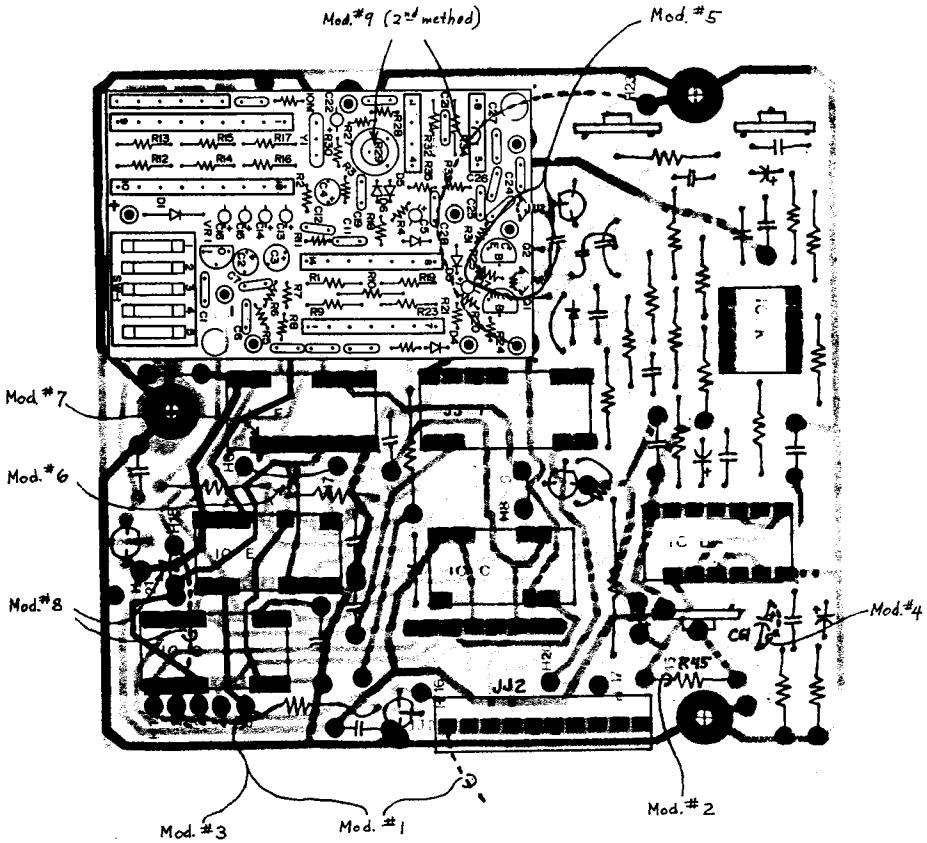
GENERAL ELECTRONICS COMPANY
Drawer B
LEVELLAND TEXAS 79336

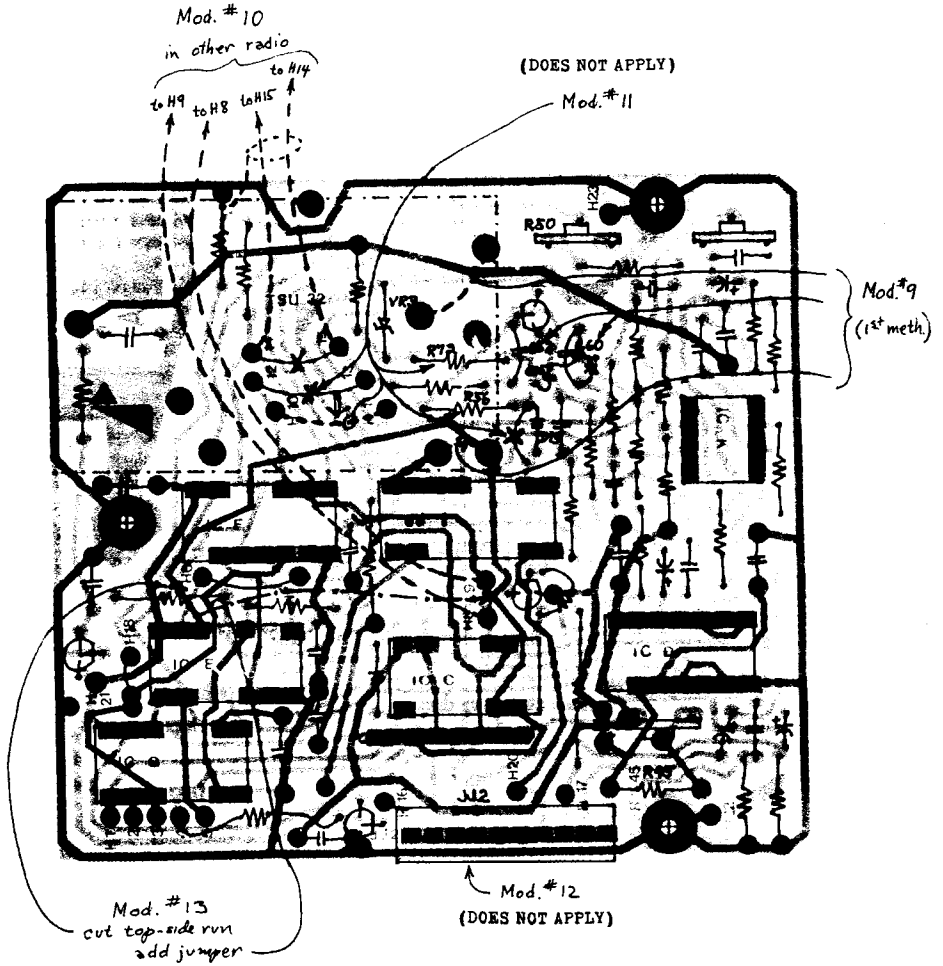
13. Controlling CG-encode gating with repeater-timer activity, rather than with CG-decode activity:

    a. cut PCB copper run that comes from IC-E pin 12; cut this run on top side of R-Bd near R82 - 47K resistor;

    b. add a jumper wire from IC-E pin 12 to the jumper-loop sticking up at H8-9.

PARKINSON ELECTRONICS COMPANY
Drawer B
LEVELLAND TEXAS 79336


Mod. #9 (2nd method)
Mod. #5
Mod. #7
Mod. #6
Mod. #8
Mod. #4
Mod. #3
Mod. #1
Mod. #2
JJ2


Mod. #10
in other radio
to H14
to H9
to H8
to H15
(DOES NOT APPLY)
Mod. #11
R50
Mod. #9
(1st meth.)
JJ2
Mod. #13
cut top-side run
add jumper
Mod. #12
(DOES NOT APPLY)