BIOCOM, INC.

MAINTENANCE MANUAL
MODEL 3550
PARAMEDIC RADIO

12 WATT ..... MODEL 3550 - 12

2 WATT ..... MODEL 3550 - 2

1 WATT ..... MODEL 3550 - 1

7106 Alabama Ave.
Canoga Park, CA 91303

(818) 702-9515
Telex 216330

MODULES + USER SERVICABLE ITEMS	PART NUMBER
A/C line Charger - complete	3552
Telephone Coupler	3558
Receiver Pac	3550A0002
Transmitter Pac	3550A0003
Tone Pac	3550A0011
Med Pac	3550A0012
Battery Pac - (Housing & Batteries)	3550A0014
HandSet - with connector	3550A0019
Stub Antenna	3550A0024
Scope Cable (specify type)	3550A0025
One/half wave 3.5 dB Gain Stub Antenna	3550A0028
Patient Cable (3 lead)	3550P0116
Snap Electrodes (Set of 3)	3550P0117
Magnetic Mount High Gain Antenna	3550P0121
Vehicle Mount High Gain Antenna	3550P0122

SPARE PARTS	
Med Pac Board Assy.	3550A0001
Med Pac Interface Bd. Assy.	3550A0004
Audio Power Amp. Board Assy.	3550A0005
UHF Amp Assy.	3550A0006
CTCSS P.C. Board Assy.	3550A0007
Mother Board Assy.	3550A0008
Tone Interface Board Assy.	3550A0010
3550 Case with Lid and Battery Housing	3550A0013
1 + 2 Watt Battery Assy. (No housing)	3550A0015
12 Watt Battery Assy. (No housing)	3550A0016
Flex Circuit Assy (with Pot. & Switches)	3550A0018
DTMF- P.C. Board Assy.	3550A0023
Testing - Extenders with Connectors (25 pin)	3550A0205
Testing - Extenders with Connectors (37 pin)	3550A0204

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SECTION 1

GENERAL DESCRIPTION

1.1 SCOPE

This manual contains all the information necessary to operate and maintain the MCI Model 3550 paramedic radio.

1.2 INTRODUCTION

The MCI Model 3550 is a self-contained, portable, two-way UHF FM radio, used by paramedics, rescue squads, and ambulance services to communicate with hospital personnel from the scene of an incident. Transmissions include both voice and ECG as well as CTCSS and DTMF tone signaling.

1.3 SPECIFICATIONS

GENERAL

Dimensions: 10.5" W x 13.75"L x 4.5"H
Weight: 12.5 lb (1 or 2 watt), 15 lb (12 watt)
Battery: Nickel Cadmium
Battery Life: 1 hour 20 minutes
Battery Recharge Time: 30 minutes with AC Line Charger

TRANSMITTER

Frequency Range: 450-470 MHz
Number of Channels: 12
RF Output to Antenna: 1.0, 2.0 or 12 Watts into 50 ohm load
Duty Cycle: EIA continuous
Frequency Stability: $\pm$ .0005% (-30°C to +60°C)
Modulation: 16F3, 16F9
Spurious & Harmonics: -55dB
FM Hum and Noise: -40dB
Audio Response: Within +1 to -3dB of a standard 6 dB/octave Pre-emphasis curve from 300-3000Hz
Audio Distortion: 3% Max harmonic distortion @ +3KHz- deviation of 1KHz tone $\pm$10% Symmetry over rated audio response
CTCSS: 11 selectable tones

RECEIVER

Frequency Range: 450-470 MHz
Number of Channels: 12
Modulation Acceptance: +7.0KHz Min
Frequency Stability: +.0005% (-30°C to +60°C)
Sensitivity: 0.5uV (12dB SINAD Full Duplex)
Squelch Sensitivity: 0.25uV
Selectivity: -75dB Min. (EIA SINAD)
Intermodulation: -70dB Min.
Spurious & Image Rejection: -70dB Min.

RECEIVER continued

FM Hum and Noise, Squelched: -70dB Min from rated audio @ 1 KHz Ref.
Audio Output: 1.5 Watts
Distortion: 5%
CTCSS: 11 selectable tones

ECG

Input Circuit Type: Differential (Defibrillation Protected)
Input Impedance: 100 Megohms
Input Voltage: ±5mV
Subcarrier: 1400 Hz ± 2%
Subcarrier Deviation: 50 Hz/1mV input
Frequency Response: .1-100Hz±3dB
Calibration: 1mV ±5% square wave
Lead Check: Built in circuitry checks electrode contact and cable continuity automatically
Lead Select: Switch selects LEAD I, II, III
Multiplex Capability: Can transmit ECG in multiplex or non-multiplex format.

SECTION 2

OPERATION

2.1 FRONT PANEL DESCRIPTION

The following is a description of the front panel controls and connectors for the Model 3550.

POWER:

Turns on the Model 3550. Indicator lamp will illuminate continuously upon power up. A flashing lamp will indicate that the battery needs recharging.

CHANNEL:

Selects the transmitter and receiver operating frequency.

TONE:

Selects the CTCSS encode and decode tone frequencies. In the OFF position, all transmissions on the selected channel will be monitored. When TX Tone is ON, only transmissions on the selected channel with the selected tone will be monitored.

DTMF KEYPAD:

Sends standard DTMF signaling when transmitter is keyed. Automatic number identification, if installed, is activated by either the "*" or "#" key. The transmitter must be keyed for the tones to be transmitted.

VOL:

Adjusts the level of received audio to both the speaker and the earpiece.

SQUELCH:

Adjusts the sensitivity of the radio to incoming calls.

SPEAKER ON/OFF:

Mutes the speaker for privacy.

MODE:

Selects the mode of operation of the radio. In allmodes, messages can be received at any time. (Full duplex)

Voice: Transmission is continuous for voice. There is no need to press PTT.

FRONT PANEL DESCRIPTION continued

MODE:

PTT: The PTT switch located on the handset is used to key the radio. Press the PTT switch to transmit.

ECG: ECG is transmitted in this mode. For multiplex radios, ECG is transmitted along with filtered voice information, however, if the PTT switch is pressed, only unfiltered voice information will be sent. For voice priority radios, only ECG will be transmitted and when PTT is depressed, unfiltered voice will be sent.

RPT: This mode, on 12 watt radios, only, will turn the 3550 into portable repeater, i.e., received signals will be transmitted.

LEAD SELECT:

I: Selects LEAD I for ECG monitoring.
II: Selects LEAD II for ECG monitoring.
III: Selects LEAD III for ECG monitoring.
Lead Chk: Checks integrity of 3550 to patient connections. The appropriate LED lamp will flash indicating a faulty RA, LA, or LL connection.

ECG-CAL:

Injects a 1 mV square wave calibrate signal into the ECG amplifier to check the system.

TX:

Indicates when radio is transmitting.

TELE:

Connector used to couple the optional Model 3558 acoustic telephone coupler for transmission over phone lines.

ECG:

Input connector for patient cable.

ECG OUT:

Output connector for defibrillator/monitor. Output is low level. (1mv)

HANDSET:

Locking connector to couple handset to radio.

FRONT PANEL DESCRIPTION continued

PTT:

Located on the handset, this switch is used to key the radio. See MODE: ECG for other uses.

2.2 OPERATING PROCEDURE

The following is a typical step by step procedure for operating the Model 3550.

1. Open the front cover and flip up antenna.

2. Press Power Switch. Green lamp should illuminate. If green lamp is flashing, the battery should be recharged.

3. Set Mode Switch to PTT.

4. Select the desired channel and tone.

5. Set SPEAKER Switch to ON.

6. Set RX TONE Switch to OFF.

7. Set Squelch control for the best sensitivity by turning fully counter-clockwise and then back clockwise until hissing stops.

8. After monitoring the channel to be certain that it is clear, transmissions can be made. Various types of transmissions are outlined below. Note that all communications are full duplex, i.e., you can receive at all times.

   A. Voice - Depress the PTT Switch on the handset and speak into the mouthpiece. If a situation arises where it is inconvenient to depress the PTT Switch, the Mode Switch can be set to the VOICE position which will continuously key the radio.

   B. ECG Calibration - Set Mode Switch to ECG and press ECG CAL. A square wave calibration will be transmitted for as long as ECG CAL is depressed. ECG CAL Will be sent independent of the position of the LEAD SELECT Switch. When finished sending calibration, set MODE Switch back to PTT.

   C. Patient ECG - Plug patient cable in ECG connector and attach patient electrodes. Set LEAD SELECT Switch to LEAD CHK. If any of the lamps RA, LA, or LL start flashing, then there is a problem with the indicated electrode. The cause is most likely a dry electrode, broken wire, or loose connection. When all connections to the patient are acceptable for ECG transmission, all lamps (RA, LA, and LL) indicators will now function as a level meter indicating the amplitude of the ECG signal coming from the patient. When finished sending patient ECG, set MODE Switch back to PTT.

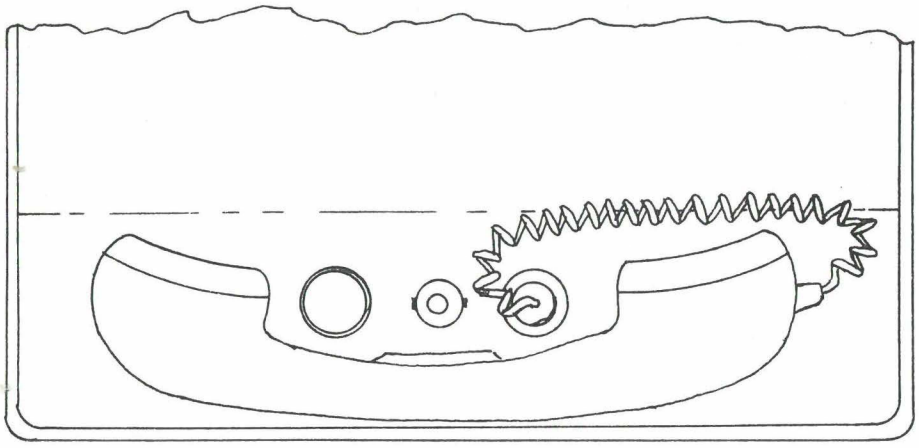
2.2 OPERATING PROCEDURE continued

* For multiplex radios, voice can be transmitted while sending ECG by simply speaking into the mouthpiece of the handset. If the PTT Switch is depressed while sending ECG then the ECG will cut out and voice only will be transmitted.

  For voice priority radios, when sending ECG, pressing the PTT Switch will always cut out the ECG and voice only will be sent.

D. DTMF - Depress the PTT Switch to key the transmitter and press the buttons on the 12 digit keypad. The tones will be heard through the speaker and the handset earpiece.

9. When communications are over, turn power off, place handset in storage compartment as shown below, and close front cover. Do not fold down antenna as the cover will do that for you.



2.3 CHARGING THE BATTERY WITH MODEL 3552 AC LINE CHARGER

1. Be sure power is off to 3550.
2. Connect the charger plug into battery charging receptacle, located on back of the 3550.
3. Plug in the AC line cord of the charger
4. Press the Full Charge Test Switch on the front of the charger.

SECTION 3

SERVICING

3.1 SERVICE OVERVIEW

The MCI Model 3550 was designed to minimize down time by utilizing completely modular construction. Nearly all of the circuitry is housed in the four modules (Tone Pac, Med Pac, Receiver, and Transmitter). Each of these modules can be removed and replaced in a matter of minutes. The following is a description of each of the blocks on the 3550 system schematic.

Note: Before removing or installing any of the Modules in the 3550, make sure that the power is off!

Transmitter Module:

This module contains a 12 channel frequency synthesized UHF FM transmitter. It features plug-in modular construction for most major circuit functions. A high isolation resistive mixer circuit is used to input DTMF, CTCSS, VOICE, and ECG Subcarrier signals. RF output is typically 2.5 watts into 50 ohms.

Receiver Module:

The 12 channel frequency synthesized UHF FM receiver is housed in this module. It also utilizes plug-in modular construction for most major circuit functions. The squelch gate is brought outside for the CTCSS tone decoder. Receiver sensitivity is typically .3 uV at the BNC port.

Med Pac Module:

The Med Pac Module contains audio switching and filtering, ECG amplifier and sub-carrier oscillator, battery low indicator, and transmitter keying circuitry.

Tone Pac Module:

This module contains CTCSS encode and decode circuitry, DTMF encode and decode circuitry, DTMF encode circuitry, and lead check circuitry. Both CTCSS encoder and decoder boards are programmed with a diode matrix on the Tone Program board which plugs into the main Tone Interface Board. All tones are crystal controlled and digitally synthesized.

Motherboard:

This circuit board functions as an interconnect between the four plug-in modules described above and the flex circuit as well as providing power distribution.

Front Panel:

A double side flexible circuit is used to provide interconnection

3.1 SERVICE OVERVIEW continued

Front Panel:

between the front panel components (switches, connectors, etc.) and the motherboard. The flexible circuit also interconnects the Audio Power Amp Board.

Audio Power Amp Board:

This board is a 1.5 watt audio power amplifier that drives the internal speaker as well as the handset earpiece.

UHF Power Amp Module:

Used in high power radios only (MCI Model 3550-12), this module boosts the typical 2.5 watt RF output of the Transmitter module to typically 17 watts.

Duplexer:

The duplexer acts as a filter providing the necessary isolation between the transmitter and receiver so that they can share a common antenna.

Battery Pack:

The battery pack is made up of eleven 4 Ahr nicad cells. With the Model 3550-12 drawing typically 3 Amps, the service life is one hour-twenty minutes for a fully charged pack. Recharge time using the 3552 AC line charger is approximately 30 minutes.

Battery Charger:

The Model 3552 AC Line Charger will completely charge a battery pack in approximately 30 minutes. The constant current design fast charges the battery to 90% capacity and then switches to a trickle charge rate using a voltage sensing technique. Hot battery protection is also built into the system.

Note: Do not turn on power to the 3550 while the battery is charging! Doing so may result in damage to the 3550.

3.2 GENERAL SERVICE INSTRUCTIONS

To service any of the four can modules, an extender card is necessary. Extender cards are available from MCI under the following part numbers:

25 Circuit Extender Card - 3550A0205

37 Circuit Extender Card - 3550A0204

Always make sure that the power to the 3550 is off before removing or installing any circuit modules.

3.2 GENERAL SERVICE INSTRUCTIONS continued

For complete disassembly procedures, see Section 4.

Recommended Service Equipment:

Communications Monitor
Oscilloscope with 10X Probe
Frequency Counter with HI-z input
Audio Signal Generator
Digital Voltmeter
RF Voltmeter
21.4 MHz and 26.4 MHz Signal Source

3.3 TRANSMITTER AND UHF POWER AMP

The following is a tuning procedure for the Transmitter Assembly 3550A0003. The transmitter RF output should be connected to the UHF Amp Input and Output of the UHF Amp connected to the watt meter or communications monitor.

Transmitter Alignment:

1. Select the channel with the lowest frequency.
2. Connect the voltmeter to Pin 1 of U1 and adjust R17 for 9.5 V $\pm$ .1V.
3. Connect the frequency counter to U1 Pin 5. Adjust C10 for 3.2 MHz $\pm$ 10Hz.
4. Connect the oscilloscope to TP2 on M6.
5. Adjust 6C6 for 5.5V $\pm$ .1V. A smooth, steady trace should be observed after tuning if completed.
6. Connect a RF Voltmeter to the trace from the output M6 Pin 4 to M10 pin 1A. Tune 6L4 and 6L5 for a maximum (about 100 mV).
7. Connect oscilloscope to TP4 on M10. Key the radio. Tune 10L5 with a non-metallic tool for 2.8V to 0.1V. Unkey and rekey transmitter and observe oscilloscope trace, which should be smooth at 2.8V. If not, repeat above, unkey.
8. Key PTT and tune 10L6, 8C7, 8C4, 8C12 for maximum power output.
9. Adjust C1 of the UHF Amp Assembly for maximum power.
10. Adjust 8R4 for 16W + 10% - 0.
11. Repeat steps 8, 9, and 10 until no further improvement is obtained.
12. Tune communication monitor to channel frequency minus 26.4 MHz. (Example - Channel frequency = 468 MHz. Monitor tuned to 468-26.4 =441.6 MHz) Connect signal probe from 26.4 MHz signal source to

3.3 TRANSMITTER AND UHF POWER AMP continued

point defined in step 6. Key transmitter. Tune 6L1 for "0" frequency error. Unkey PTT.

13. Tune communication monitor to channel frequency. Key PTT. Adjust 7L1 for "0" frequency error. Unkey PTT.

Transmitter Deviation:

1. Connect Audio Signal Generator to Handset Connector P19 as in Figure 1.

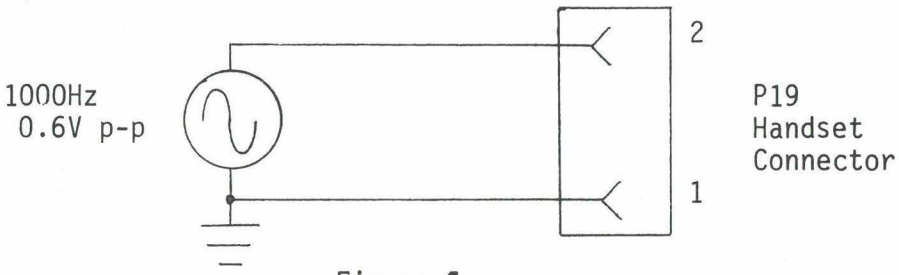


Figure 1

2. Check voltage at Pin 18 of P17 (25 pin D connector of Transmitter Assembly). It should be 2.7 Vp.p. If not adjust R7 Audio Deviation on MED PAC Filter Board Assembly 3550A0001.

3. Key transmitter using VOICE position of MODE switch and adjust R8 Deviation in Transmitter Assembly for ±4.0KHz on communication monitor.

4. Connect the handset and observe the audio deviation while speaking into the mouthpiece. Deviation should be limiting at ±5KHz at the peaks. If not, readjust R8.

3.4 RECEIVER

Use the following procedure to align the Receiver Assembly 3550A0002.

1. Select the channel with the lowest frequency.

2. Connect a voltmeter to Pin 1 of U1 and adjust R7 to 9.5 VDC ±.1V.

3. Using a 10X scope probe connected to the frequency counter, check the oscillator frequency on Pin 5 of U1. Adjust to C23 for 3.2 MHz ± 10 Hz.

4. Measure the DC voltage at TP2 on M6. Adjust to 5.5V ± .1V with 6C6, observing a smooth steady trace on the oscilloscope.

5. Connect the oscilloscope with a 10X probe to TP3 on M1 and tune 6L4, 6L5, and 1L9 for maximum DC output.

3.4 RECEIVER continued

6. Tune the signal generator to the selected channel frequency, with no modulation. Open the squelch and adjust the signal level until the noise in the speaker is slightly quieted. Couple the 21.4 MHz signal generator into the M3 module. Listen for the beat note. Adjust the reference oscillator tuning 6L1, if necessary, while listening for zero beat. Connect a sinadder to Handset Connector P9 as in Fig. 2.

7. Modulate the generator with 1 KHz @ ± 3kHz deviation. Adjust 1C4, 1C1, 1C4, 1C3, 1C9, and 1C12 for best sinad while reducing the generator signal level to maintain a noisy signal. After tuning, the signal level should produce 12dB sinad at 0.35 uV or better.

8. Increase the signal generator output to 100uV. Set the Audio Out level to 3V p-p using R2. Audio Out level is measured at Pin 18 of P16 (25 Pin D Connector in Receiver Assembly).

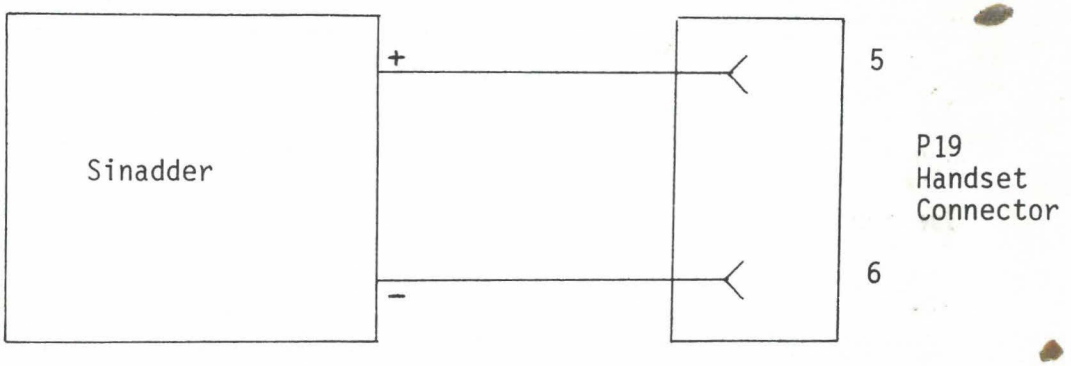


Figure 2

Sinadder Connection

3.5 MED PAC

The Med Pac 3550A0012 circuitry is made up of two P.C. boards, the Med Pac Interface Board Assembly (3550A0004) and the Med Pac Filter Board Assembly (3550A0001). The Med Pac Interface Board contains the ECG amplifier, voltage controlled oscillator, low battery indicator, calibration pulse generator, and transmitter keying logic circuitry. Audio filtering, mixing, and electronic switching is done on the Med Pac Filter Board.

ECG Amp Offset:

Using the set-up in Figure 3, adjust R213 for 0 VDC ± 5mV at TP 201 of Med Pac Interface Board Assembly.

ECG Amp Gain:

Using the set-up in Figure 4, adjust R211 for 1V p-p ± 50mV at TP201 of Med Pac Interface Board Assembly. This adjusts the ECG Amp voltage gain to 100.

VCO Frequency:

Using the set-up in Figure 3, adjust R221 for 1400 Hz ± 28 Hz at TP202 of Med Pac Interface Board Assembly.

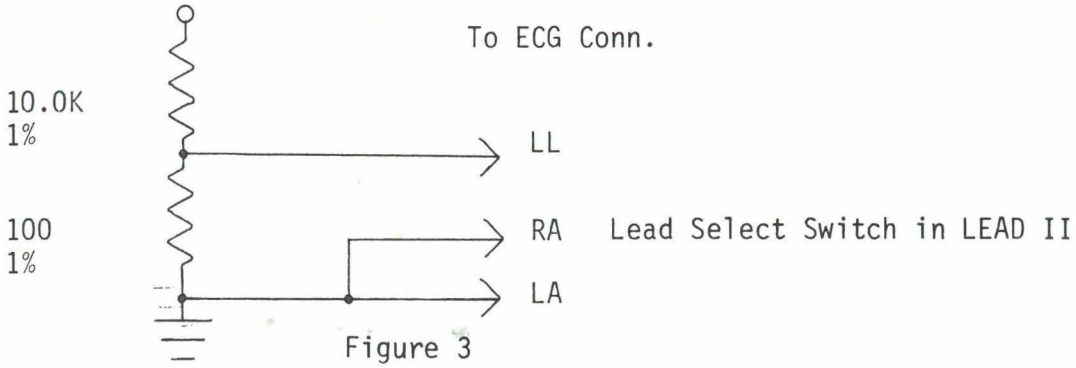


Figure 3

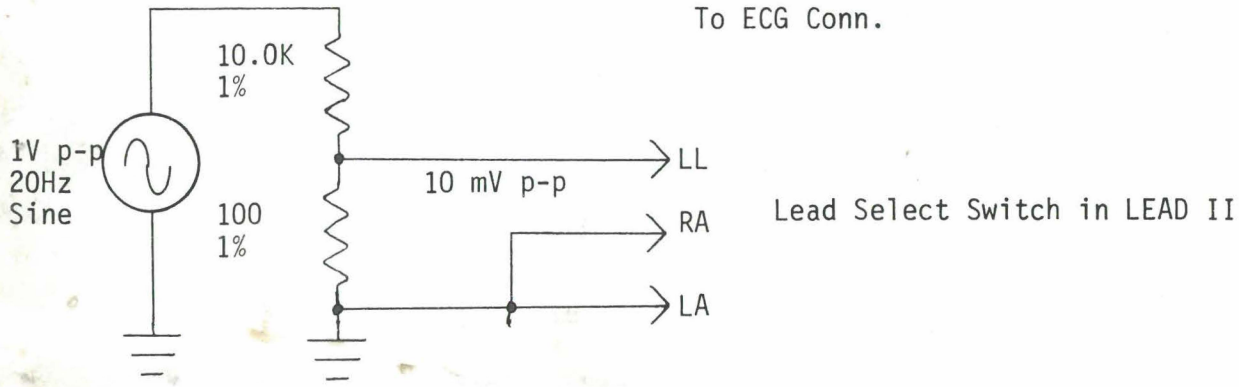


Figure 4

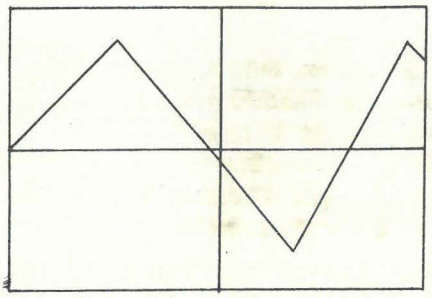


Figure 5

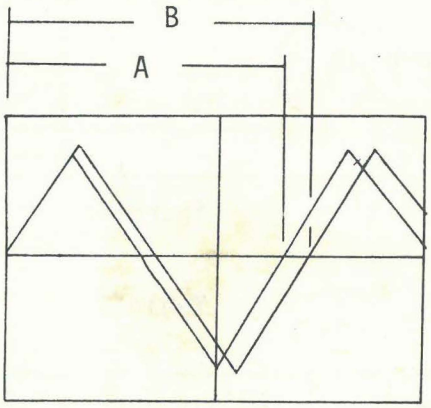


Figure 6

VCO Deviation:

The procedure below is used for 50Hz/mV deviation. Using the test set-up of Figure 3, connect an oscilloscope to TP202 on Med Pac Interface Board Assembly and adjust the scope for a stable display. It should appear as in Figure 5. Using the test set-up of Figure 4, but reducing the signal generator output to 300mV p-p will result in 3 mV p-p input signal and 150 Hz deviation. The scope wave form will look like Figure 6. Period A and Period B are measured and the deviation calculated using the following equation:

$$D = \frac{B-A}{BxA} \times 1000$$

Where D = Deviation in Hz and A and B = Measured periods in ms

After the deviation is properly adjusted, re-adjust the VCO frequency as in step 3.

Level (VCO Deviation of RF Carrier)

Multiplex - Transmitter deviation by the VCO is adjusted by R233 on the Med Pac Interface Board Assembly for $\pm$ 2 kHz.

3.5 MED PAC continued

Non Multiplex - The radio can be converted to non-multiplex operation by removal of R43 on the MedPac Filter Board Assembly. Transmitter deviation by the VCO is adjusted by R233 on the Med Pac Interface Board Assembly for ± 4 kHz.

Audio Filter Alignment:

Using the test set-up in Figure 7, follow the steps outlined in Table 1 to align the filter. Ex. In step 1, tune audio generator to 800 Hz and adjust R7 for 2V p-p @ TP1 on the Med Pac Filter Board Assembly.

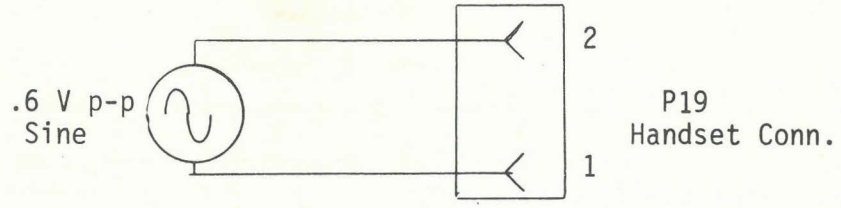


Figure 7

Table 1

Step	Frequency	Adjustment	For	@
1	1000	R7	2V p-p	TP1
2	1325	R9	Null	TP2
3	1100	R12	Peak	TP2
4	1475	R24	Null	TP2
5	1750	R27	Peak	TP2
6	1000	R46	2V p-p	Pin 1 of Tele Connection J23

When filter is properly aligned, a notch of 30 dB is typical. The -3 dB points are typically from 1150 Hz to 1650 Hz.

Audio Deviation:

Transmitter deviation by the audio is adjusted by R7 on the Med Pac Filter Board for ± 4kHz when in PTT mode. In the ECG mode on multiplex radios the deviation is automatically reduced to ± 2 kHz.

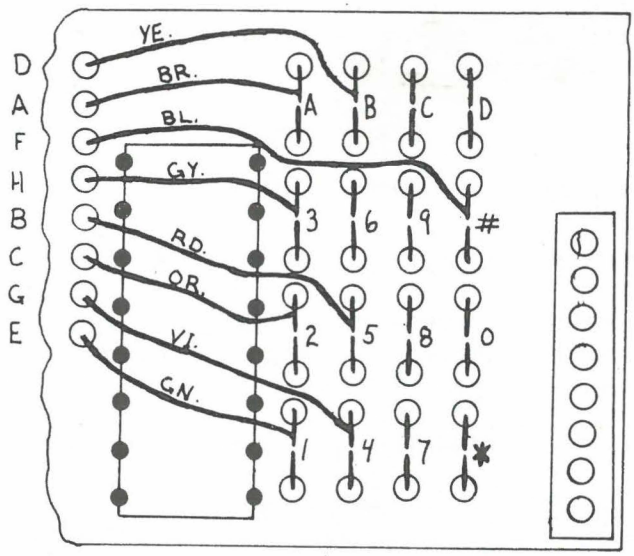
3.6 TONE PAC

The Tone Pac 3550A0011 contains the lead check circuitry, CTCSS encode, CTCSS decode, and DTMF encode boards. The CTCSS encode and decode boards plug into the Tone Interface Board Assembly and are programmed by diode matrix on the Tone Program Board Assembly. CTCSS encode tone can be programmed independently of CTCSS decode tone on the Tone Program Board Assembly. However, if the encode tones are identical to the decode tones, one CTCSS tone board can be installed in the decoder position of the Tone Interface Board provided JU1 is installed.

3.6 TONE PAC continued

The tones are then programmed in the decode positions of the Tone Program Board Assembly.

Up to 8 digits can be programmed in the ANI. Programming is accomplished with color coded jumper wires indicating sequence. See DTMF ANI Programming Figure 8 for programming instructions.



Example shows A52B1#43 programmed

Figure 8

The only adjustments in the Tone Pac are for the various optional tone encoders. Refer to Tone Pac Module Assembly for adjustment locations.

CTCSS Encode Level:

CTCSS encode tones are adjusted to deviate the RF carrier ± 800 Hz with this control.

DTMF Encode Level:

DTMF encode tones are adjusted to deviate the RF carrier ± 3.5 kHz with this control.

DTMF ANI Speed

The rate at which digits are dialed automatically is adjusted with this control. Factory set rate is 8 digits per second.

SECTION 4

DISASSEMBLY PROCEDURES

4.1 BATTERY PACK HOUSING REMOVAL

1. Remove the 2 large head screws from each side of the Battery Pack Housing.
2. Disconnect the battery cable plug from the receptacle mounted in the chassis sleeve.
3. Installation is the reverse of the above.

4.2 BATTERY ASSEMBLY REMOVAL

1. Remove the Battery Pack Housing from the unit.
2. Remove the screw from each side of the housing and the 2 screws near the battery cable access hole in the cover panel, and remove the cover panel.
3. De-solder and remove the 4 wires to the charge connector.
4. Remove the battery assembly.
5. Installation is the reverse of the above, following charge connector wiring table below.

Wire Color	Charge Conn. Terminal
White	A1
Black	A2
Green	2
Red	3

4.3 CHASSIS REMOVAL

1. Remove the Battery Pack Housing from the unit.
2. Remove the large head screw from each side of the unit.
3. Loosen the 2 set screws on the bottom front of the unit.
4. Open the lid and remove the screw at both ends of the bottom leaf of lid hinge.
5. Remove the antenna.

4.3 CHASSIS REMOVAL continued

6. Slide the chassis out of the rear of the case.

7. Installation is the reverse of the above.

4.4 TRANSMITTER AND RECEIVER MODULE REMOVAL

1. Remove the Battery Pack housing from the unit.

2. Removal of these modules is possible with the chassis in, or removed from the case.

3. Remove the flat head screw on the top and bottom of the chassis which secures the module.

4. Disconnect the BNC cable from the module.

5. Grasping the BNC receptable, pull the module straight out from the rear of the unit, disconnecting the interface connector.

6. Installation is the reverse of the above.

4.5 MED-PAC AND TONE-PAC MODULE REMOVAL

1. Remove the battery pack housing from the unit.

2. Removal of these modules is possible with the chassis in, or removed from the case.

3. Remove the flat screw on the top and bottom of the chassis sleeve which secure the module.

4. Grasping the pull cord, pull the module straightout from the rear of the unit disconnecting the interface connector.

5. Installation is the reverse of the above.

4.6 UHF POWER AMPLIFIER MODULE REMOVAL

1. Remove the battery pack housing from the unit.

2. Remove the chassis from the case.

3. Disconnect the 2 BNC cables from the UHF P.A. module.

4. Remove the 2 flat head screws, securing the UHF P.A. module, from the bottom of the chassis.

5. Remove the UHF P.A. module.

6. Snap the power connector out of its mounting hole.

7. Desolder and remove red wire from the fuse holder, the two black and red/black wires from the UHF P.A. Module.

4.6 UHF POWER AMPLIFIER MODULE REMOVAL continued

8. Installation is the reverse of the above.

4.7 DUPLEXER REMOVAL

1. Remove the Battery Pack housing from the unit.

2. Remove the chassis from the case.

3. Remove the 3 screws securing the flex circuit connectors (J10, J11) to the mother board and disconnect these connectors.

4. Holding the flex circuit clear, disconnect the BNC cable to the front panel antenna connector.

5. Disconnect the BNC Cables to the receiver modules and the UHF P.A. Module input. (For 1 or 2 watt version, disconnect cables to the receiver and transmitter modules.)

6. Remove the 4 flat head screws securing the duplexer from the top of the chassis sleeve and remove the duplexer.

7. Installation is the reverse of the above.

4.8 FLEX CIRCUIT REMOVAL

1. Remove the Battery Pack housing from the unit.

2. Remove the chassis from the case.

3. Remove the 3 screws securing the flex circuit connectors (J10, J11) to the mother board and disconnect these connectors.

4. Remove the front panel components which are part of the flex circuit.

5. Remove the screw securing the flex circuit connector J12 to the audio power amplifier board and disconnect.

6. Installation is the reverse of the above.

4.9 AUDIO POWER AMPLIFIER/SPEAKER ASSEMBLY REMOVAL

1. Remove the Battery Pack housing from the unit.

2. Remove the chassis from the case.

3. Remove the 3 screws securing the flex circuit connectors (J10 & J11) to the mother board and disconnect these connectors.

4. Remove the duplexer.

5. Remove the Tone-Pac, Med Pac, Receiver, and Transmitter modules.

4.9 AUDIO POWER AMPLIFIER/SPEAKER ASSEMBLY REMOVAL

6. Remove the 2 screws on each side of the chassis which secure the chassis sleeve to the chassis panel.

7. Slide the chassis sleeve back from the chassis panel approximately 2 inches.

8. Holding the circuit clear, remove the screw securing the flex circuit connect (J12) to the audio P.A. Board and disconnect this connector.

9. Remove the 2 nuts and 2 threaded standoffs securing the audio P.A./speaker assembly to the chassis panel and remove.

10. Installation is the reverse of the above.

    Note: When reinstalling the chassis panel align the LED indicators with panel holes.

4.10 MOTHER BOARD REMOVAL

1. Remove the Battery Pack housing from the unit.

2. Remove the chassis from the case.

3. Remove the duplexer.

4. Remove the Tone-Pac, Med-Pac, Receiver, and Transmitter Modules.

5. Remove the (3) screws securing the flex circuit connectors (J10 & J11) to the mother board and disconnect these connectors.

6. Remove the (2) screws on each side of the chassis which secure the chassis sleeve to the chassis panel.

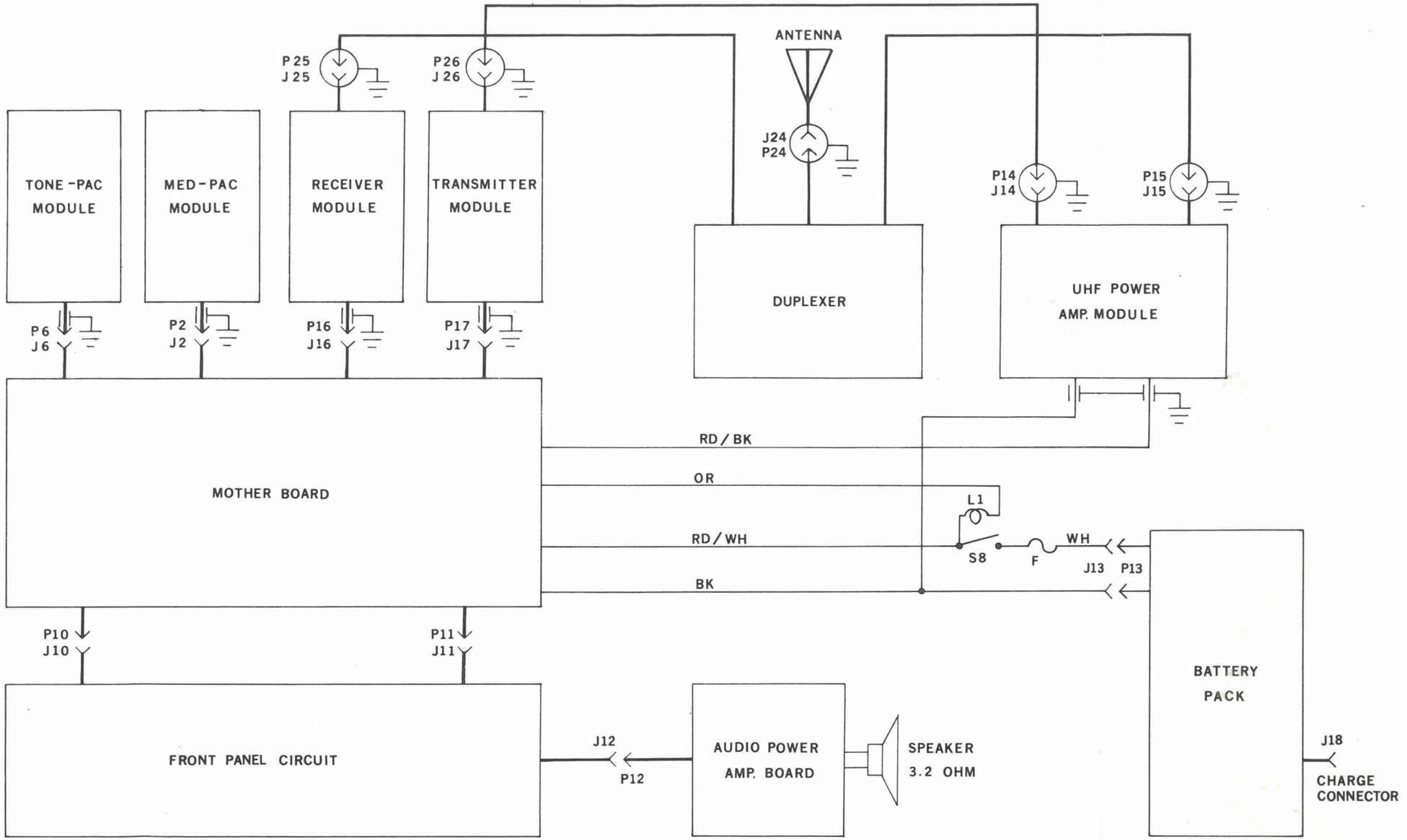
7. Slide the chassis sleeve back from the chassis panel approximately 2 inches.

8. Desolder and remove wires to mother board terminals.

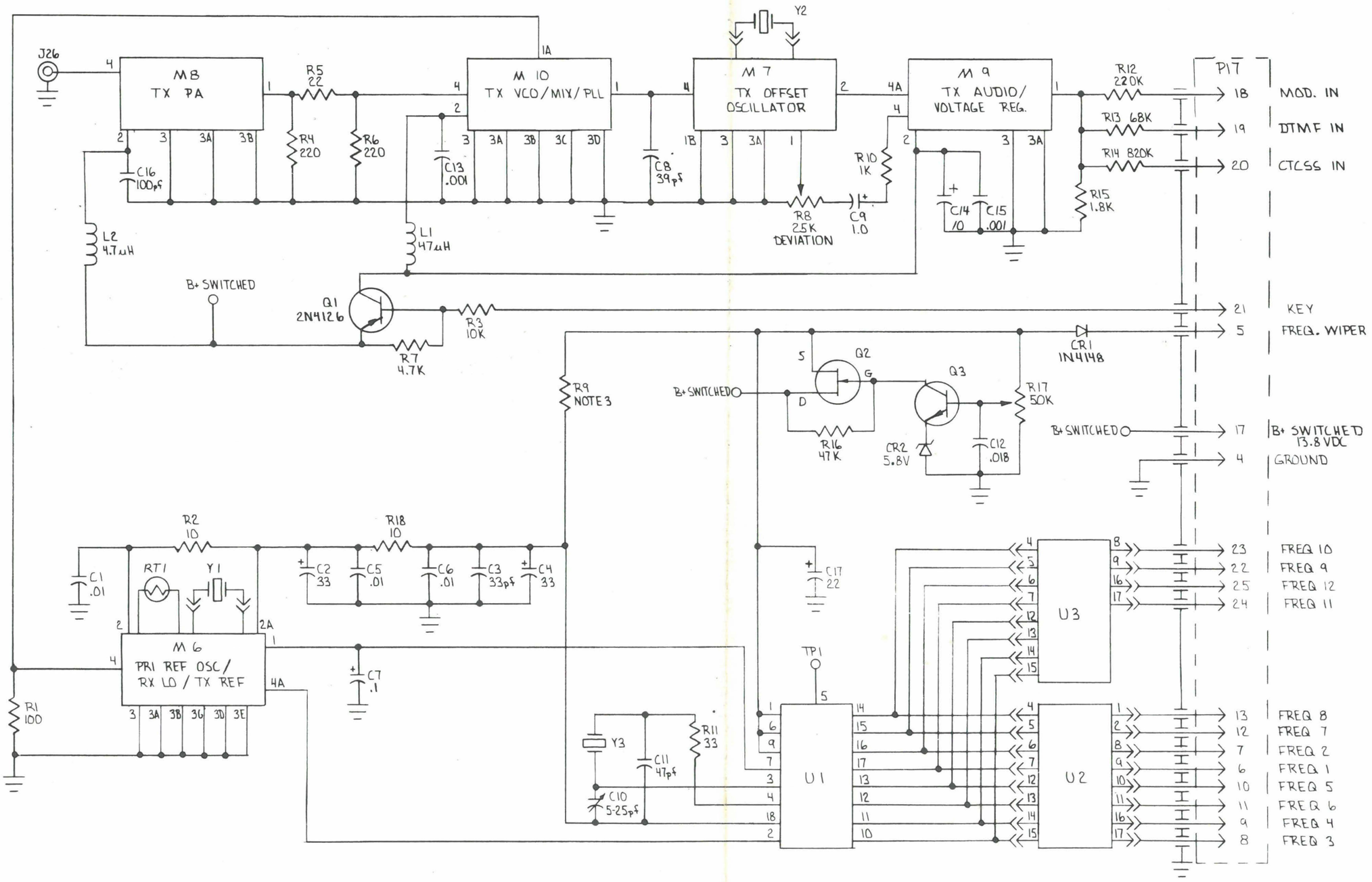
9. Remove (9) screws securing the mother board to the chassis sleeve and remove the mother board.

10. Installation is the reverse of the above.

    Note: When reinstalling the chassis panel align the LED indicators with the panel holes.



3550 SYSTEM SCHEMATIC

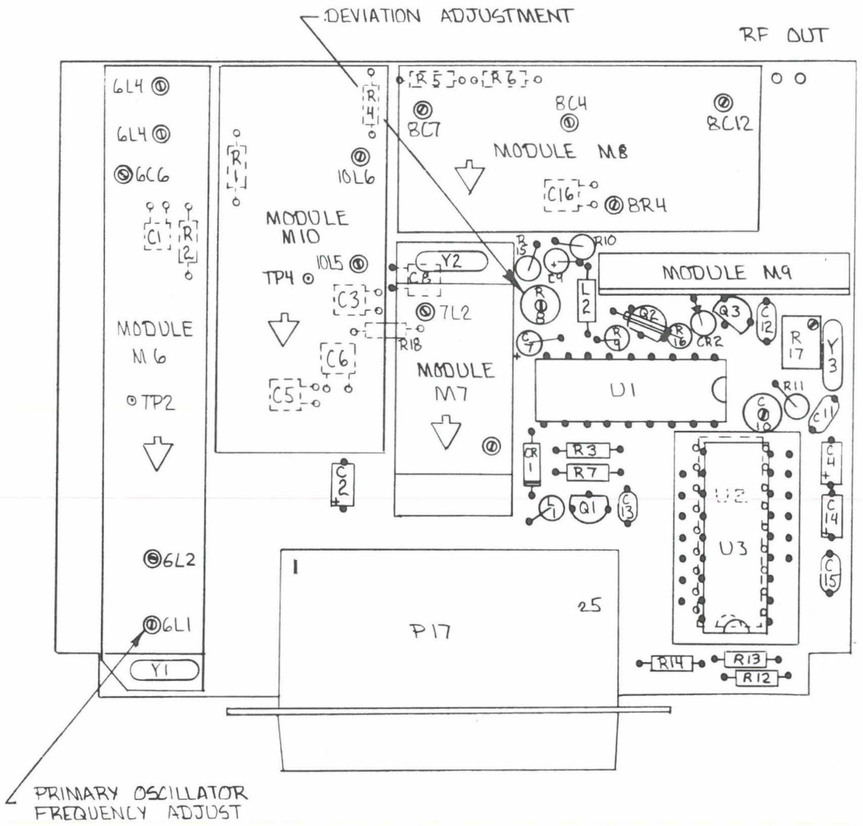


NOTES:

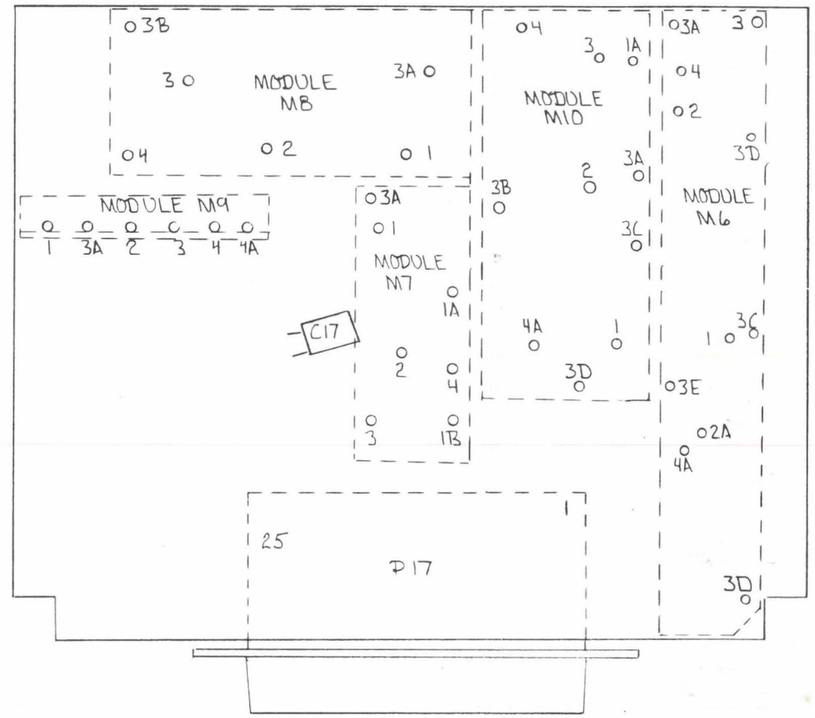
1. RESISTOR VALUES IN OHMS ±5%, 1/8 WATT, LAST USED R18.
2. CAPACITOR VALUES ARE IN MICROFARADS, LAST USED C17.
3. R9 IS FACTORY SELECTED.

TRANSMITTER P.C. BOARD

SCHEMATIC 3550S0007



COMPONENT SIDE



CIRCUIT SIDE

TRANSMITTER MODULE
ASSEMBLY 3550A0027

TRANSMITTER P.C. BOARD PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		---------- CAPACITORS ----------
C1,C5,C6	GC103LFRC	Ceramic: .01 uf -20 +80%, 50V.
C2,C4	GC336MCRT	Tantalum: 33 uf ±20%, 16V.
C3	GC330LFRC	Ceramic: 33 pf -20 +80%, 50V.
C7	GC104MCAT	Tantalum: .1 uf ±20%, 16V.
C8	GC390LFRC	Ceramic: 39 pf -20 +80%, 50V.
C9	GC105MCAT	Tantalum: 1 uf ±20%, 16V.
C10	3550P0182	Variable 5 - 25 pf.
C11	GC470LFRC	Ceramic: 47 pf -20 +80%, 50V.
C12	GC183LFRC	Ceramic: .018 uf -20 +80%, 50V.
C13,C15	GC102LFRC	Ceramic: .001 uf -20 +80%, 50V.
C14	GC106MCRT	Tantalum: 10 uf ±20%, 16V.
C16	GC101LFRC	Ceramic: 100 pf -20 +80%, 50V.
C17	GC220MCRT	Tantalum: 22 pf ±20%, 16V.
		------ DIODES AND RECTIFIERS --------
CR1	GS01N4148	Silicon: 1N4148.
CR2	GS0AP1013	Silicon, Zener: AP1013, 5.8V.
		---------- MODULES ----------
M6	3550P0176	Primary Reference OSC; VCLO/ Tx Ref.
M7	3550P0177	Tx Channel Offset OSC.
M8	3550P0178-2	Tx Power Amplifier, 4 W.
M9	3550P0179	Tx Audio / Voltage Regulator.
M10	3550P0180	Tx VCO / Mixer / PLL.
		---------- TRANSISTORS ----------
Q1	GS02N4126	Silicon: 2N4126.
Q2	GSTS30967	FET: !TS 30967.
Q3	GS	Silicon:
		---------- RESISTORS ----------
R1	GR1101J00	Carbon Comp.: 100 ohms ±5%, 1/8 W.
R2,R18	GR1100J00	Carbon Comp.: 10 ohms ±5%, 1/8 W.
R3	GR1103J00	Carbon Comp.: 10,000 ohms ±5%, 1/8 W.
R4,R6	GR1221J00	Carbon Comp.: 220 ohms ±5%, 1/8 W.
R5	GR1220J00	Carbon Comp.: 22 ohms ±5%, 1/8 W.
R7	GR1472J00	Carbon Comp.: 4,700 ohms ±5%, 1/8 W.
R8	GPO253CB0	Pot.: 25,000 ohms.
R9		Selected.
R10	GR1102J00	Carbon Comp.: 1,000 ohms ±5%, 1/8 W.
R11	GR1330J00	Carbon Comp.: 33 ohms ±5%, 1/8 W.
R12	GR1224J00	Carbon Comp.: 220,000 ohms ±5%, 1/8 W.
R13	GR1683J00	Carbon Comp.: 68,000 ohms ±5%, 1/8 W.
R14	GR1824J00	Carbon Comp.: 820,000 ohms ±5%, 1/8 W.
R15	GR1182J00	Carbon Comp.: 1,800 ohms ±5%, 1/8 W.
R16	GR1473J00	Carbon Comp.: 47,000 ohms ±5%, 1/8 W.
R17	GPO503CB0	Pot.: 50,000 ohms.
		------ INTEGRATED CIRCUITS ----------
U1	GSMM55126	PLL Freq. Syn.: MM55126N.
U2,U3	GSM101985	Prom: M1-0198-5.
		--------- MISCELLANEOUS ----------
	3550P0170	Printed Circuit Board.
P17	3550P0017	25 Pin "D" type, filtered.
L1	3550P0194	Inductor Coil: 47 uH.
L2	3550P0195	Inductor Coil: 4.7 uH.
for M6,M7,M8,M10	3550P0184	Socket, P.C. mount, spring type.
for M9,U2	3550P0185	Socket, P.C. mount, spring type.
for U3	3550P0186-6	Socket Strip, 6 circuit.
for U3	3550P0186-7	Socket Strip, 7 circuit.
	3550P0189	Spring contact finger, grounding lug.
for U3	3550P0190	Carrier P.C. Board.
Y1	3550P0192	Crystal: 25 KHz.
Y2	3550P0196	Crystal: 26.4 MHz.
Y3	3550P0193	Crystal: 6.4 MHz.
RT1	3550P0191	Thermistor.

TRANSMITTER MODULE PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
	3550A0027	Transmitter Board Assembly.
	3550P0005-2	Transmitter Shielding Can Base.
	3550P0006-1	Shielding Can Cover (top).
	3550P0006-2	Shielding Can Cover (bottom).
J26	3550P0034	Rt. Angle, flange mount, BNC Connector.
	3550P0008	Screw: 4-40 x 1" FH phillip, Nylock.
	GHSB04AD1	Screw: 4-40 x 1/4" FH phillip.
	GHSA06BD1	Screw: 6-32 x 1/4" PH phillip.
	GHSA04AE1	Screw: 4-40 x 5/16" PH phillip.
	GHND060B1	Nut: 6-32 x 1/4" Hex.
	GHND040A1	Nut: 4-40 x 1/4 " Hex.
	GHL0040D1	Solder Lug: #4.
	GWB18NNN0	Busswire: 18 AWG, 1/2"
	GWB18NNN0	Busswire: 18 AWG, 1"
	GWD240NN0	Sleeving Tube: teflon, 7/8".

TRANSMITTER
BOARD PARTS LIST 3550G0025
MODULE PARTS LIST 3550G0027

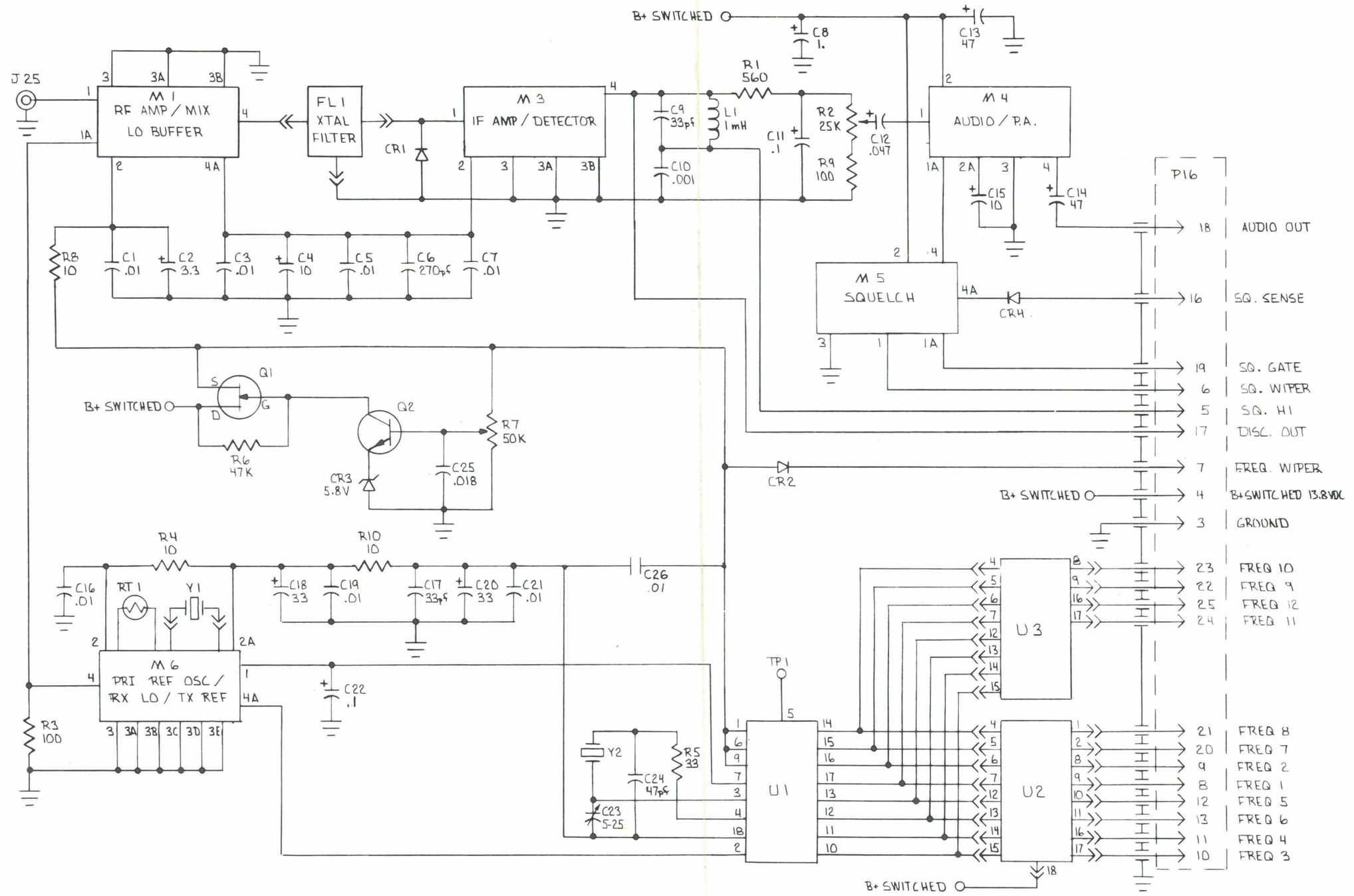
RECEIVER P.C. BOARD
PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		---------- CAPACITORS ----------
C1,C3,C5,C7,C16, C19,C21,C26	GC103LFRC	Ceramic: .01 uf -20 +80%, 50v.
C2	GC335MCAT	Tantalum: 3.3 uf ±20%, 16V.
C4,C15	GC106MCAT	Tantalum: 10 uf ±20%, 16V.
C6	GC271LFRC	Ceramic: 270 pf -20 +80%, 50V.
C8	GC105MCAT	Tantalum: 1 uf ±20%, 16V.
C9,C17	GC330LFRC	Ceramic: 33 pf -20 +80%, 50V.
C10	GC102LFRC	Ceramic: .001 uf -20 +80%, 50V.
C11,C22	GC104MCAT	Tantalum: .1 uf ±20%, 16V.
C12	GC473MCAT	Tantalum: .047 uf ±20%, 16V.
C13,C14	GC476MCAT	Tantalum: 47 uf ±20%, 16V.
C18,C20	GC336MCRT	Tantalum: 33 uf ±20%, 16V.
C23	3550P0182	Variable 5 - 25 pf.
C24	GC470LFRC	Ceramic: 47 pf -20 +80%, 50V.
C25	GC183LFRC	Ceramic: .018 uf -20 +80%, 50V.
		------ DIODES AND RECTIFIERS -------
CR1,CR4	GS01N4148	Silicon: 1N4148.
CR2	GS01N4536	Silicon: 1N4536.
CR3	GS0AP1013	Silicon, Zener: AP1013, 5.8V.
		---------- MODULES ----------
M1	3550P0172	RF Amp. / Mixer / Buffer.
M3	3550P0173	IF Amp.
M4	3550P0174	Rx. Audio.
M5	3550P0175	Rx. Squelch.
M6	3550P0176	Primary Reference CSC; VCLO / Tx Ref.
		---------- TRANSISTORS ----------
Q1	GSTS39067	FET: ITS39067.
Q2	GS	NPN:
		--------- INTEGRATED CIRCUITS ------
U1	GSMM55126	PLL Freq. Syn.: MM55126N.
U2,U3	GSM101985	Prom: M1-0198-5.
		---------- RESISTORS ----------
R1	GR1561J00	Carbon Comp.: 560 ohms ±5%, 1/8 W.
R2	GPO253CB0	Pot.: 25,000 ohms.
R3,R9	GR1101J00	Carbon Comp.: 100 ohms ±5%, 1/8 W.
R4,R8,R10	GR1100J00	Carbon Comp.: 10 ohms ±5%, 1/8 W.
R5	GR1330J00	Carbon Comp.: 33 ohms ±5%, 1/8 W.
R6	GR1473J00	Carbon Comp.: 47,000 ohms ±5%, 1/8 W.
R7	GPO503CB0	Pot.: 50,000 ohms.
		---------- MISCELLANEOUS --------
	3550P0171	Printed Circuit Board.
P16	3550P0017	25 Pin "D" type, filtered.
L1	3550P0183	Inductor Coil: 1000 uH.
for M1,M3,M6	3550P0184	Socket, P.C. mount, spring type.
for M4,M5,U2	3550P0185	Socket, P.C. mount, spring type.
for U3	3550P0186-6	Socket Strip, 6 circuit.
for U3	3550P0186-7	Socket Strip, 7 circuit.
for FL1	3550P0187	Socket, P.C. mount, spring type.
for FL1	3550P0188	Insulator.
	3550P0189	Spring contact finger grounding lugs.
for U3	3550P0190	Carrier P.C. Board.
RT1	3550P0191	Thermister.
Y1	3550P0192	Crystal, 25 KHz.
Y2	3550P0193	Crystal, 6.4 MHz.

RECEIVER MODULE
PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
	3550A0026	Receiver Board Assembly.
	3550P0005-1	Receiver Shielding Can Base.
	3550P0006-1	Shielding Can Cover (top).
	3550P0006-2	Shielding Can Cover (bottom).
J25	3550P0034	Rt. Angle, flange mount, BNC Connector.
	3550P0008	Screw: 4-40 x 1" FH phillip, Nylock.
	GHSB04AD1	Screw: 4-40 x 1/4" FH phillip.
	GHSA04AE1	Screw: 4-40 x 5/16" PH phillip.
	GHSA06BD1	Screw: 6-32 x 1/4" PH phillip.
	GHND06081	Nut: 6-32 x 1/4 " Hex.
	GHND040A1	Nut: 4-40 x 1/4 " Hex.
	GHW106001	Washer: #6 Internal tooth lock.
	GHI0040D1	Solder Lug: #4.
	GWB18NNN0	Busswire: 18 AWG, 1/2 ".

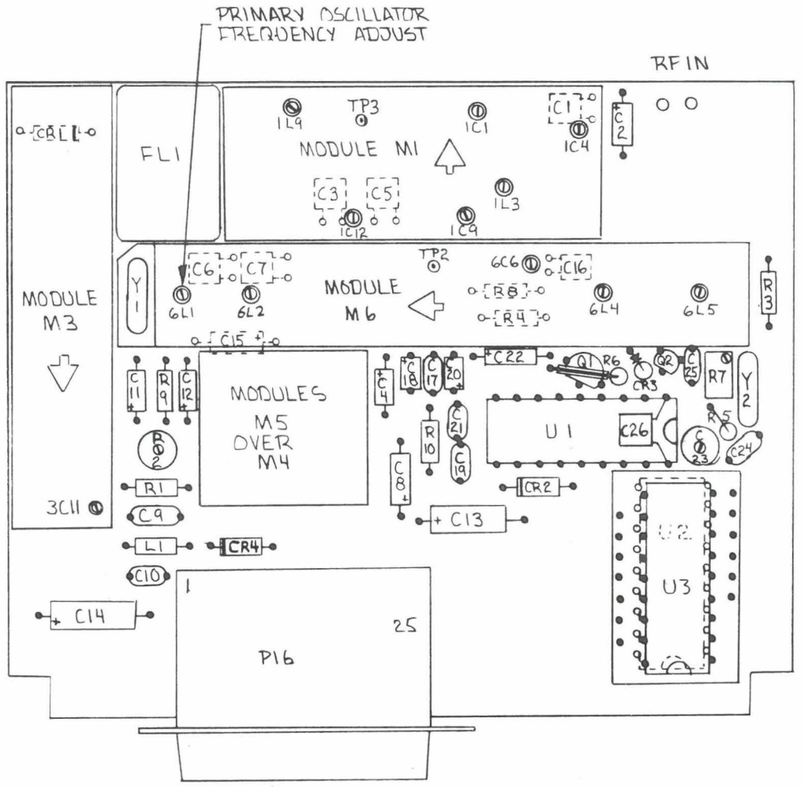
RECEIVER
BOARD PARTS LIST 3550G0024
MODULE PARTS LIST 3550G0026



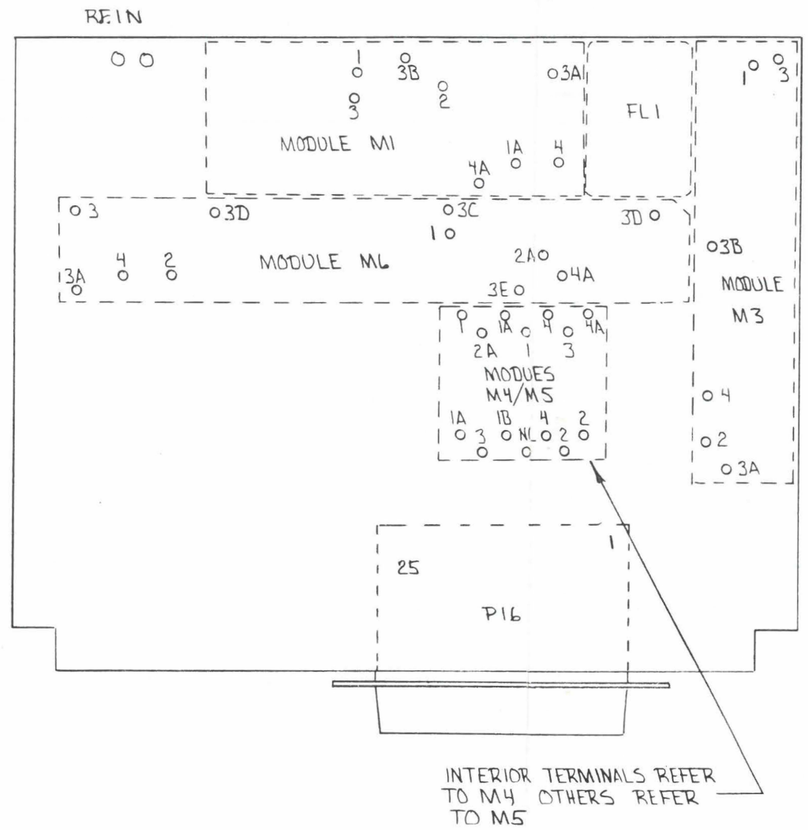
NOTES:
1. RESISTOR VALUES IN OHMS ±5%, 1/8 WATT, LAST USED R10.
2. CAPACITOR VALUES ARE IN MICROFARADS, LAST USED C26.

RECEIVER P.C. BOARD
SCHEMATIC

3550S0006

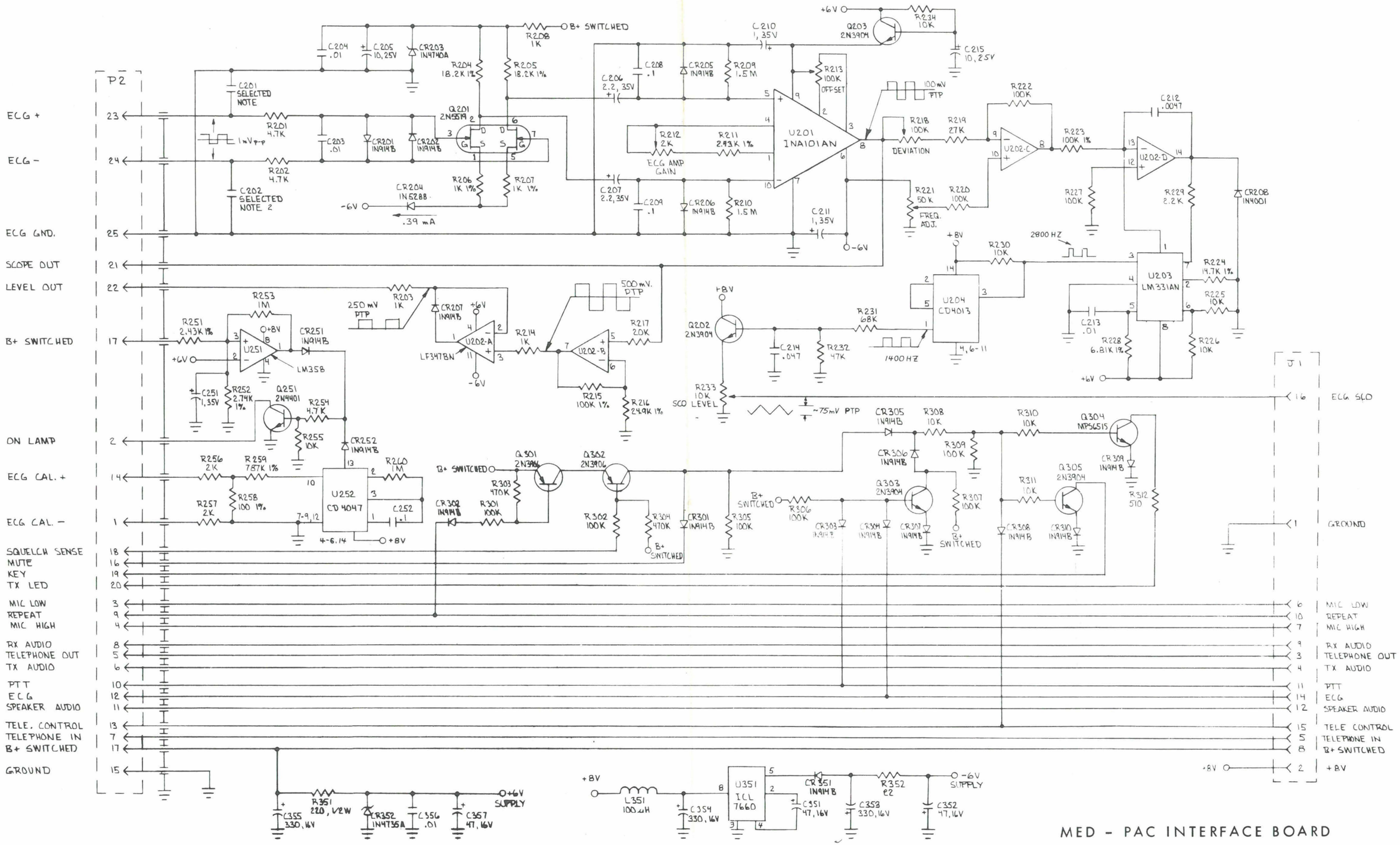


COMPONENT SIDE



CIRCUIT SIDE

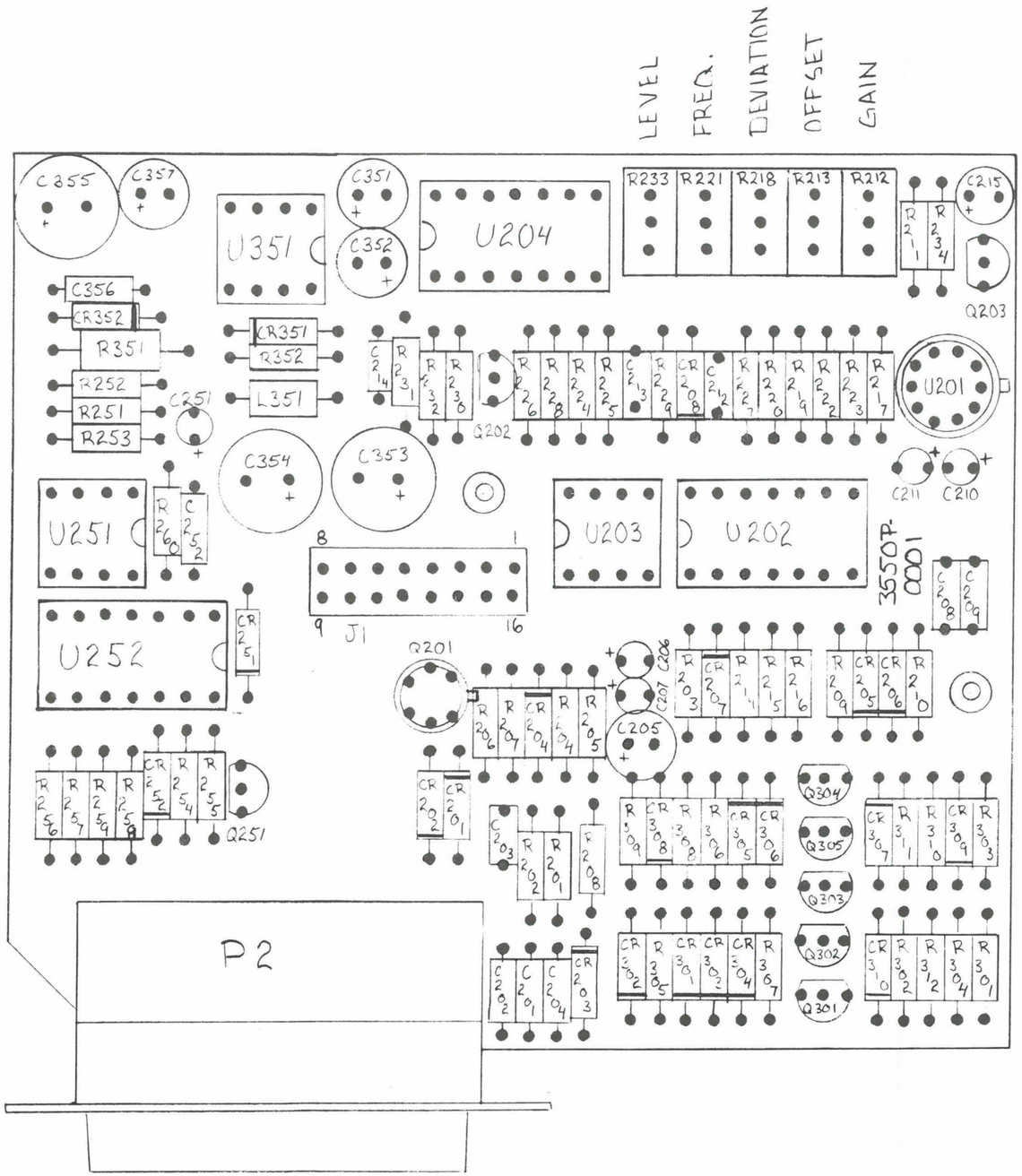
RECEIVER MODULE ASSEMBLY 3550A0026



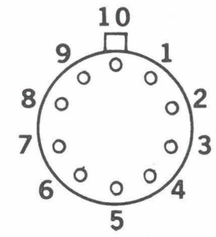
NOTES:

1. UNLESS OTHERWISE NOTED, RESISTOR VALUES ARE IN OHMS, ±5%, 1/4 WATT, CAPACITOR VALUES ARE IN MICROFARADS.
2. LAST USED: C357, CR352, Q305, R352, U351.
3. NOT USED: C216 - C250, C253 - C350
   CR208 - CR250, CR253 - CR300, CR311 - CR350
   Q203 - Q250, Q252 - Q300
   R235 - R250, R261 - R300, R313 - R350
   U205 - U250, U253 - U350.

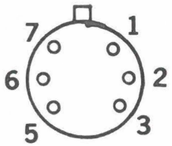
MED - PAC INTERFACE BOARD
SCHEMATIC 3550S0002



LEAD IDENTIFICATION
LEAD SIDE VIEW



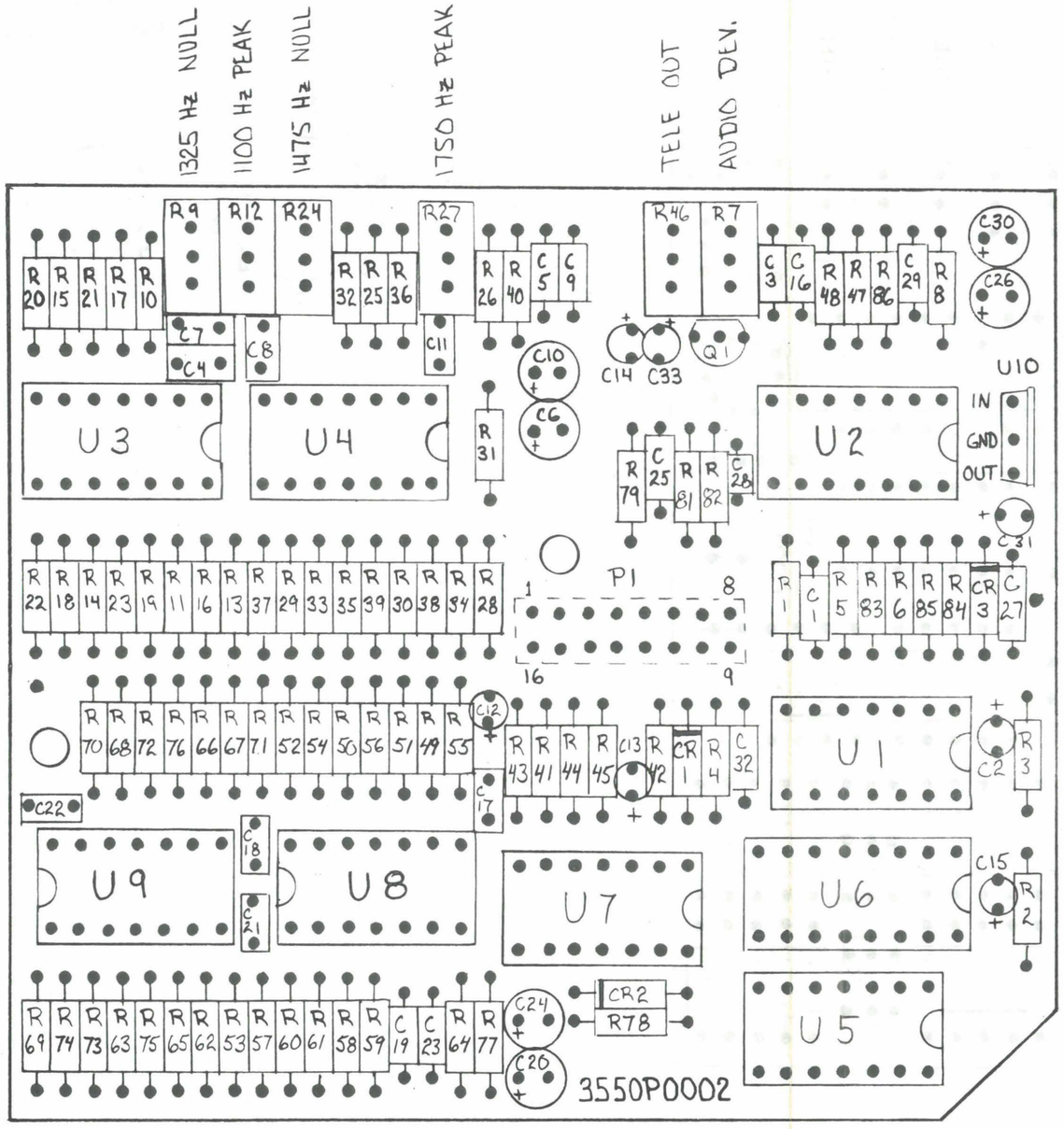
U201



Q201

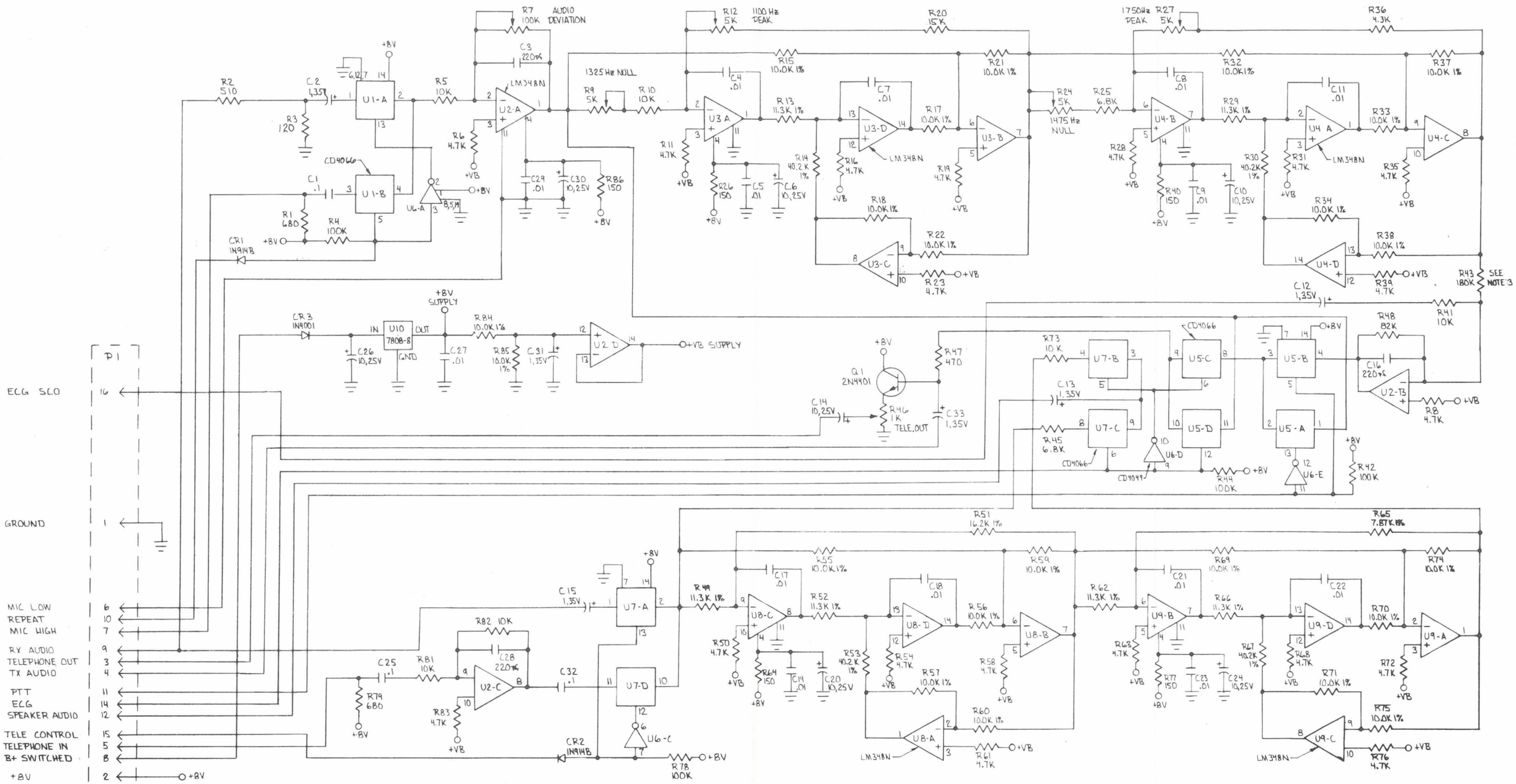
Q202, Q203,
Q251, Q301-Q305

MED - PAC INTERFACE BOARD
ASSEMBLY 3550A0004



LEAD IDENTIFICATION
LEAD SIDE VIEW

MED - PAC FILTER BOARD
ASSEMBLY 3550A0001



NOTES:

1. UNLESS OTHERWISE NOTED, RESISTOR VALUES ARE IN OHMS, ±5%, 1/4 WATT, CAPACITOR VALUES ARE IN MICROFARADS.
2. LAST USED: C33, R85, CR3, Q1, U10.
3. REMOVE R43 FOR NON-MULTI PLEX OPERATI ON.

MED - PAC FILTER BOARD

SCHEMATIC 3550S0003

PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		---------- CAPACITORS ----------
C201,C202		Ceramic: Selected.
C203,C204,C356	GC103LFRC	Ceramic: .01 uf -20 +80%, 50V.
C205,C215	GC106LDRE	Electrolytic: 10 uf -20 +80%, 25V.
C206,C207	GC225MERT	Tantalum: 2.2 uf ±20%, 35V.
C208,C209,C252	GC104JGRF	Polyester: .1 uf ±5%, 100V.
C210,C211,C251	GC105MERT	Tantalum: 1 uf ±20%, 35V.
C212	GC472JGRF	Polyester: .0047 uf ±5%, 100V.
C213	GC103JGRF	Polyester: .01 uf ±5%, 100V.
C214	GC473JGRF	Polyester: .047 uf ±5%, 100V.
C351,C352,C357	GC476LCRE	Electrolytic: 47 uf -20 +80%, 16V.
C353 - C355	GC337LCRE	Electrolytic: 330 uf -20 +80%, 16V.
		------ DIODES AND RECTIFIERS --------
CR201,CR202, CR205-CR207, CR251,CR252, CR301-CR310, CR351	GS01N914B	Silicon: 1N914B.
CR203	GS1N4740A	Silicon, Zener: 1N4740A, 10V.
CR204	GS01N5288	Silicon, Current Regulator: 1N5288.
CR208	GS01N4001	Silicon: 1N4001.
CR352	GS1N4735A	Silicon, Zener: 1N4735A, 6.2V.
		------ JACKS AND RECEPTACLES -------
J1	3550P0027	Receptacle: (8 x 2) .1 centers, rear entry.
		---------- INDUCTORS ----------
L351	3550P0035	Inductor Coil: 100 uH.
		---------- PLUGS ----------
P2	3550P0017	Pins: 25 circuit "D" type, filtered.
		---------- TRANSISTORS ----------
Q201	GS02N5519	Dual FET: 2N5519.
Q202,Q203, Q303,Q305	GS02N3904	Silicon: NPN 2N3904.
Q251	GS02N4401	Silicon: NPN 2N4401.
Q301,Q302	GS02N3906	Silicon: PNP 2N3906.
Q304	GSMPS6515	Silicon: NPN MPS6515.

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		---------- RESISTORS ----------
R201,R202,R254	GR2472J00	Carbon Film: 4,700 ohms ±5%, 1/4 W.
R203,R208,R214	GR2102J00	Carbon Film: 1,000 ohms ±5%, 1/4 W.
R204,R205	GR2183F20	Metal Film: 18,200 ohms ±1%, 1/4 W.
R206,R207	GR2102F00	Metal Film: 1,000 ohms ±1%, 1/4 W.
R209,R210	GR2155J00	Carbon Film: 1,500,000 ohms ±5%, 1/4 W.
R211,R251	GR2242F30	Metal Film: 2,430 ohms ±1%, 1/4 W.
R212	GPO202CB0	Cermet Pot.: 2,000 ohms sim. to VRN 752.
R213,R218	GPO104CB0	Cermet Pot.: 100,000 ohms sim. to VRN 752.
R215,R223,R258	GR2104F00	Metal Film: 100,000 ±1%, 1/4 W.
R216	GR2243F90	Metal Film: 24,900 ohms ±1%, 1/4 W.
R217	GR2203J00	Carbon Film: 20,000 ohms ±5%, 1/4 W.
R219	GR2273J00	Carbon Film: 27,000 ohms ±5%, 1/4 W.
R220,R222,R227, R301,R302,R305, R306,R307,R309	GR2104J00	Carbon Film: 100,000 ohms ±5%, 1/4 W.
R221	GPO503CB0	Cermet Pot.: 50,000 ohms sim. to VRN 752.
R224	GR2143F70	Metal Film: 14,700 ohms ±1%, 1/4 W.
R225,R226,R230, R234,R255,R308, R310,R311	GR2103J00	Carbon Film: 10,000 ohms ±5%, 1/4 W.
R228	GR2682F10	Metal Film: 6,810 ohms ±1%, 1/4 W.
R229	GR2222J00	Carbon Film: 2,200 ohms ±5%, 1/4 W.
R231	GR2683J00	Carbon Film: 68,000 ohms ±5%, 1/4 W.
R232	GR2473J00	Carbon Film: 47,000 ohms ±5%, 1/4 W.
R233	GPO103CB0	Cermet Pot.: 10,000 ohms sim. to VRN752.
R252	GR2272F40	Metal Film: 2,740 ohms ±1%, 1/4 W.
R253,R260	GR2105J00	Carbon Film: 1,000,000 ohms ±5%, 1/4 W.
R256,R257	GR2202J00	Carbon Film: 2,000 ohms ±5%, 1/4 W.
R259	GR2784F70	Metal Film: 787,000 ohms ±1%, 1/4 W.
R303,R304	GR2474J00	Carbon Film: 470,000 ohms ±5%, 1/4 W.
R312	GR2511J00	Carbon Film: 510 ohms ±5%, 1/4 W.
R351	GR3221J00	Carbon Film: 220 ohms ±5%, 1/2 W.
R352	GR2220J00	Carbon Film: 22 ohms ±5%, 1/4 W.

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		-------- INTEGRATED CIRCUITS ------
U201	3550P0114	Instrumentation Amplifier: 1NA101AN.
U202	GSLF347AN	Quad Operational Amplifier: LF347AN.
U203	GSLM331AN	Voltage to Frequency Converter: LM331AN.
U204	GS0CD4013	Dual D Flip-Flop: CD4013.
U251	GS00LM358	Dual Operational Amplifier: LM358.
U252	GS0CD4047	Monostable / Astable Multivibrator: CD4047.
U351	GSICL7660	Voltage Converter: ICL7660.
		--------- MISCELLANEOUS ----------
	3550P0002	Printed Circuit Board.

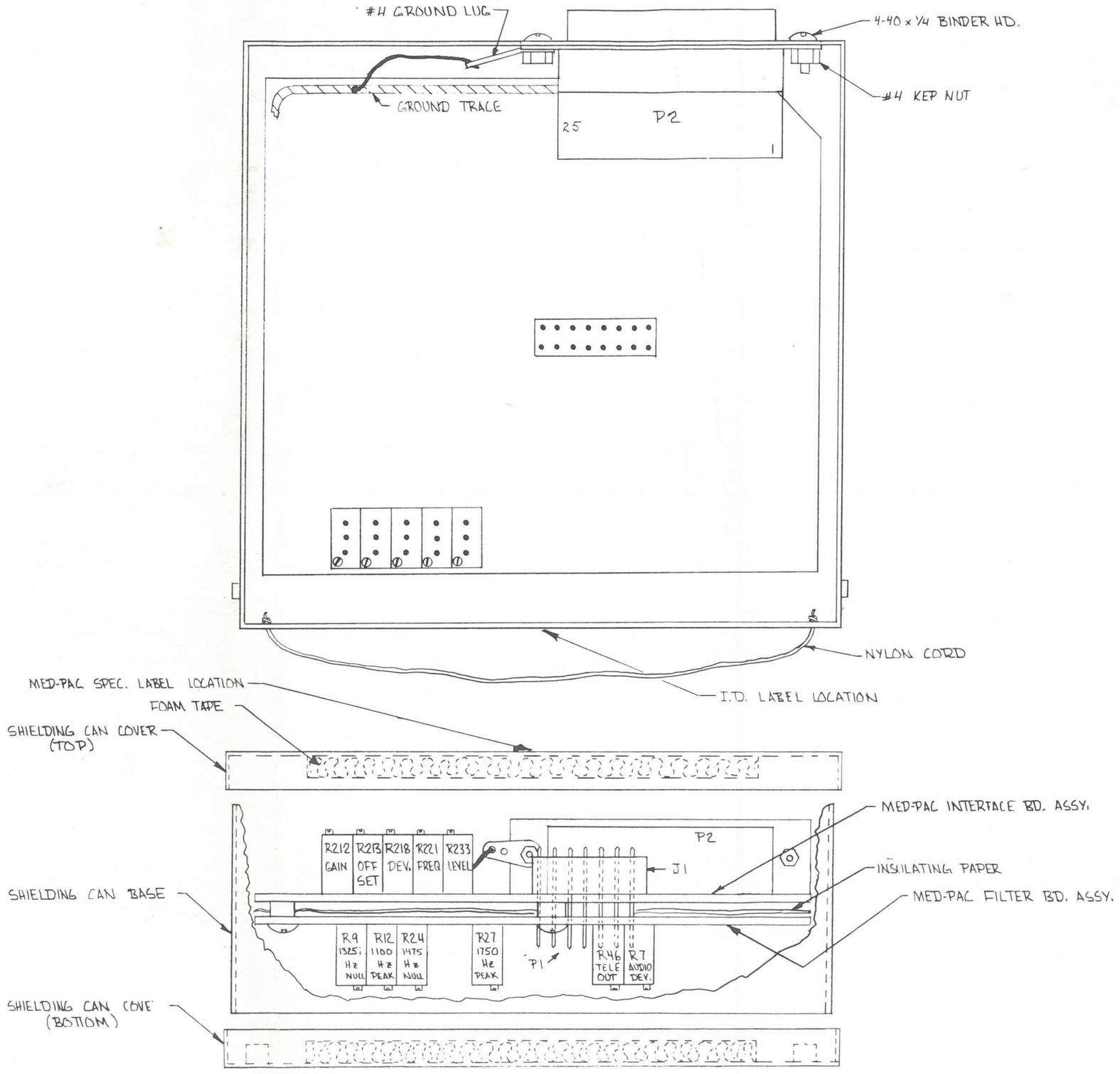
MED - PAC INTERFACE BOARD
PARTS LIST 3550G0001

PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		---------- CAPACITORS ----------
C1,C25,C32	GC104LFRC	Ceramic: .1 uf -20% +80%, 50V.
C2,C12,C13,C15, C31,C33	GC105MERT	Tantalum: 1 uf ±20%, 35V.
C3,C16,C28	GC221KFRC	Ceramic: 220 pf ±10%, 50V.
C4,C7,C8,C11, C17,C18,C21,C22	GC103JGRF	Polyester: .01 uf ±5%, 100V.
C5,C9,C19,C23, C27,C29	GC103LFRC	Ceramic: .01 uf -20% +80%, 50V.
C6,C10,C14,C20, C24,C26,C30	GC106LDRE	Electrolytic: 10 uf -20% +80%, 25V.
		------ DIODES AND RECTIFIERS --------
CR1,CR2	GS01N914B	Silicon: 1N914B.
CR3	GS01N4001	Silicon: 1N4001.
		---------- PLUGS ----------
P1	3550P0024-8	Pins: (8 x 2) .025 square, .10 centers.
		---------- TRANSISTORS ----------
Q1	GS02N4401	Silicon: NPN 2N4401.
		---------- RESISTORS ----------
R1,R79	GR2681J00	Carbon Film: 680 ohms ±5%, 1/4 W.
R2	GR2511J00	Carbon Film: 510 ohms ±5%, 1/4 W.
R3	GR2121J00	Carbon Film: 120 ohms ±5%, 1/4 W.
R4,R42,R44,R78	GR2104J00	Carbon Film: 100,000 ohms ±5%, 1/4 W.
R5,R10,R41,R73, R81,R82	GR2103J00	Carbon Film: 10,000 ohms ±5%, 1/4 W.
R6,R8,R11,R16, R19,R23,R28,R31, R35,R39,R50,R54, R58,R61,R63,R68, R72,R76,R83	GR2472J00	Carbon Film: 4,700 ohms ±5%, 1/4 W.
R7	GPO104CB0	Cermet Pot.: 100,000 ohms, sim. to VRN #752.
R9,R12,R24,R27	GPO502CB0	Cermet Pot.: 5,000 ohms, sim. to VRN #752.
R13,R29,R49,R52, R62,R66	GR2113F30	Metal Film: 11,300 ohms ±1%, 1/4 W.
R14,R30,R53,R67	GR2403F20	Metal Film: 40,200 ohms ±1%, 1/4 W.
R15,R17,R18,R21, R22,R32-R34,R37, R38,R55-R57,R59, R60,R69-R71,R74, R75,R84,R85	GR2103F00	Metal Film: 10,000 ohms ±1%, 1/4 W.
R20	GR2153J00	Carbon Film: 15,000 ohms ±5%, 1/4 W.
R25,R45	GR2682J00	Carbon Film: 6,800 ohms ±5%, 1/4 W.
R26,R40,R64,R77, R86	GR2151J00	Carbon Film: 150 ohms ±5%, 1/4 W.
R36	GR2432J00	Carbon Film: 4,300 ohms ±5%, 1/4 W.
R43	GR2184J00	Carbon Film: 180,000 ohms ±5%, 1/4 W.
R46	GPO102CB0	Cermet Pot.: 1,000 ohms, sim. to VRN 752.
R47	GR2471J00	Carbon Film: 470 ohms ±5%, 1/4 W.
R48	GR2823J00	Carbon Film: 82,000 ohms ±5%, 1/4 W.
R51	GR2163F20	Metal Film: 16,200 ohms ±1%, 1/4 W.
R65	GR2782F70	Metal Film: 7,870 ohms ±1%, 1/4 W.
		------ INTEGRATED CIRCUITS --------
U1,U5,U7	GS0CD4066	Quad Bilateral Switch: CD4066.
U2,U3,U4,U8,U9	GS0LM348N	Quad Operational Amplifier: LM348N.
U6	GSCD4049C	Hex Inverting Buffer: CD4049C.
U10	GSMC7808C	Voltage Regulator: MC7808C 8V.
		--------- MISCELLANEOUS ----------
	3550P0001	Printed Circuit Board.

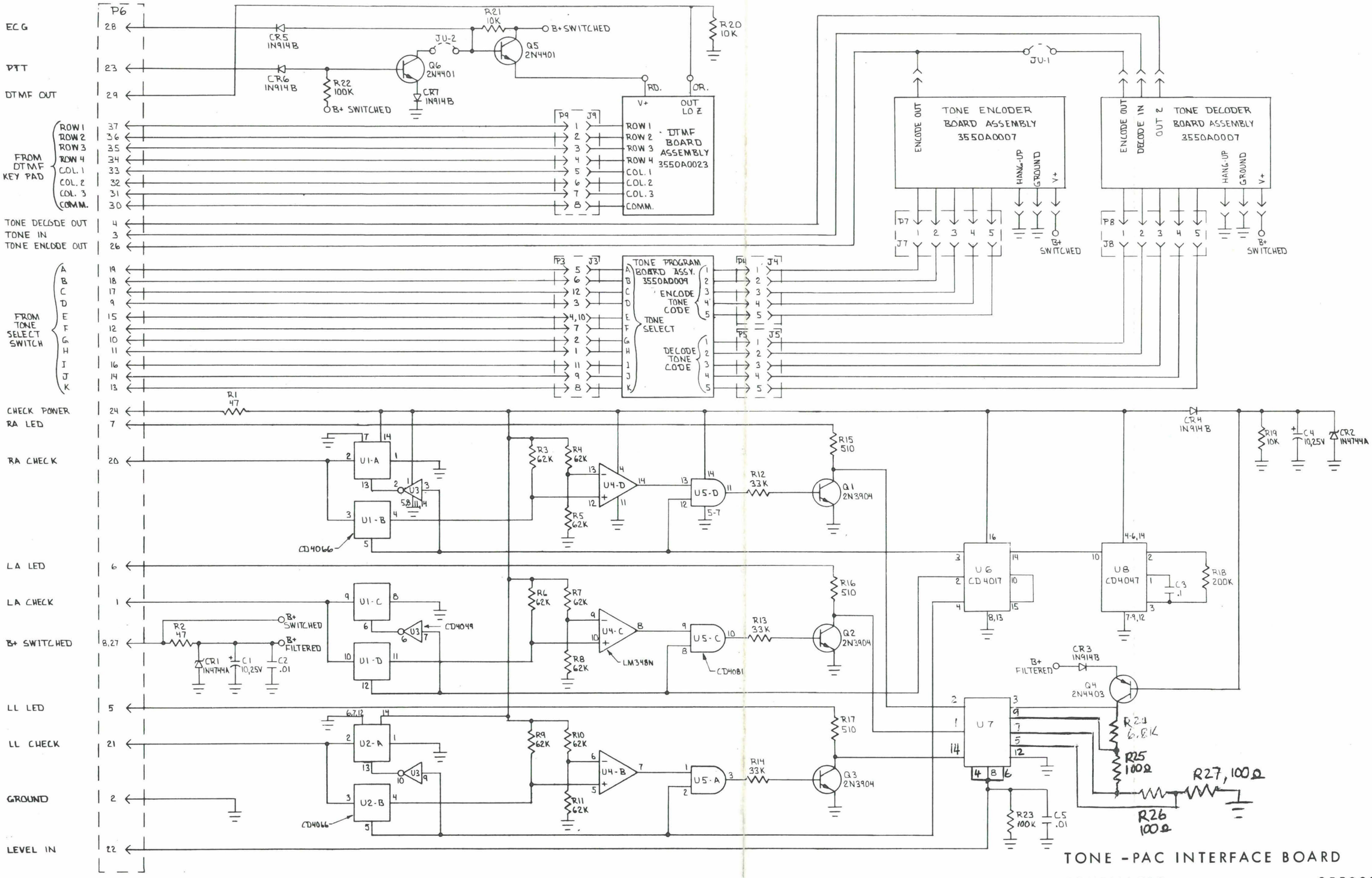
MED - PAC FILTER BOARD
PARTS LIST 3550G0002

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
	3550A0004	MED - PAC Interface Board Assembly.
	3550A0001	MED - PAC Filter Board Assembly.
	3550P0003	Shielding Can Base.
	3550P0004-1	Shielding Can Cover.
	3550P0004-2	Shielding Can Cover.
	3550P0014	Foam Tape: 3" x 3" x 1/8".
	3550P0149-1	Module Identification Label.
	3550P0015	Screw: 4-40 x 1.5" FH phillip, Nylock.
	3550P0106	Screw: 4-40 x 1/4" PH phillip, Nylock.
	GHSA04AD1	Screw: 4-40 x 1/4" PH phillip.
	GHNJ040A1	Nut: 4-40 x 1/4" Hex, Kep.
	GHL0040N2	Solder Lug: #4.



MED - PAC MODULE ASSEMBLY

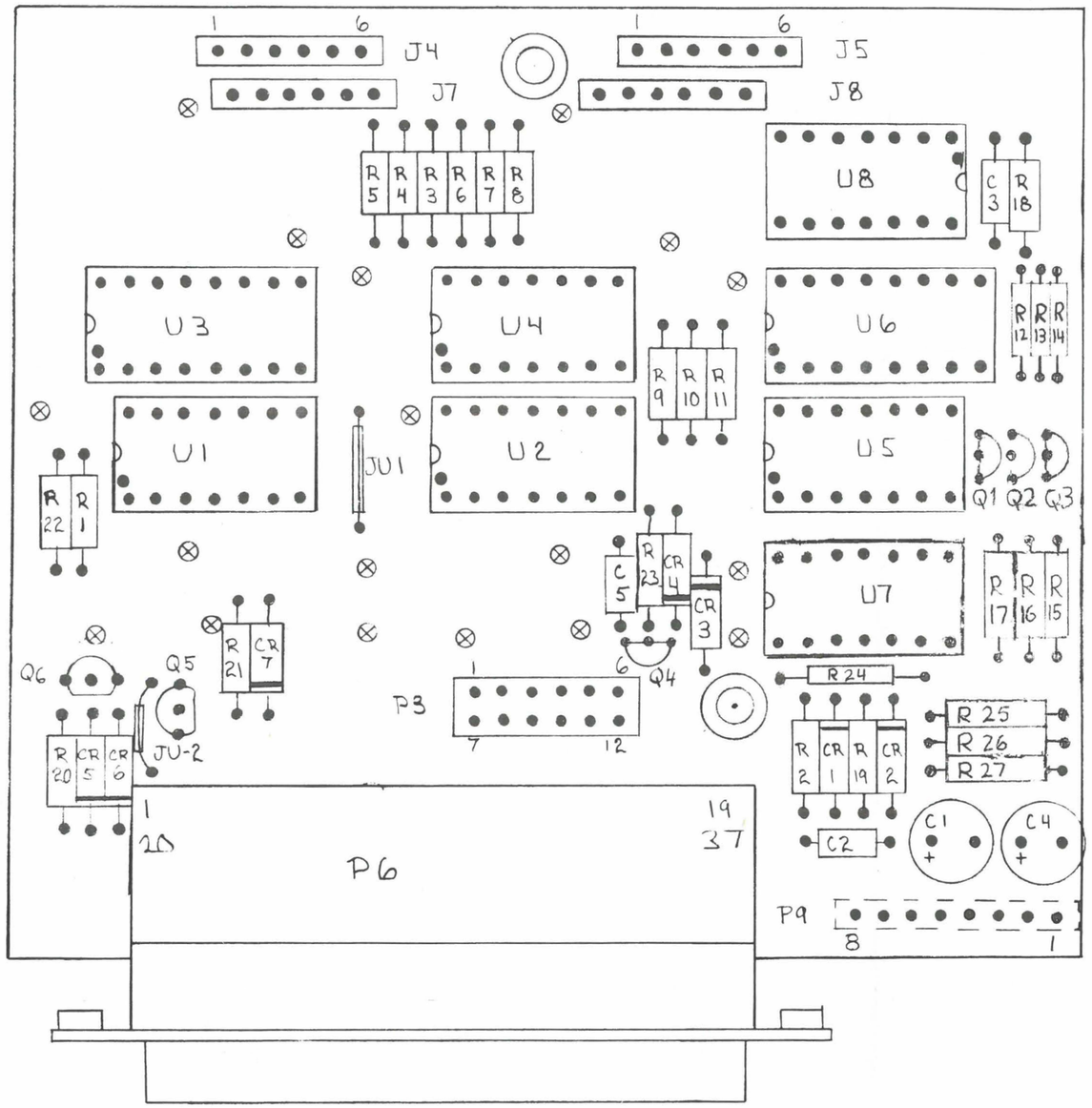
3550A0012



NOTES:

1. RESISTORS VALUES ARE IN OHMS ±5%, 1/4 WATT.
2. CAPACITOR VALUES ARE IN MICROFARADS.
3. LAST USED: C5, CR7, Q6, R23, U8.
4. WITH JU-2 REMOVED DTMF IS NOT DISABLED BY NO PTT.

TONE-PAC INTERFACE BOARD
SCHEMATIC 3550S0004



LEAD IDENTIFICATION
LEAD SIDE VIEW

Q1 - Q6

TONE - PAC INTERFACE BOARD
ASSEMBLY 3550A0010

PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		---------- CAPACITORS ----------
C1,C4	GC106LDRE	Electrolytic: 10 uf -20 +80%, 25V.
C2,C5	GC103LFRC	Ceramic: .01 uf -20 +80%, 50V.
C3	GC104LFRC	Ceramic: .1 uf -20 +80%, 50V.
		------ DIODES AND RECTIFIERS --------
CR1,CR2	GS1N4744A	Silicon, Zener: 1N4744A, 15V.
CR3-CR7	GS01N914B	Silicon : 1N914B.
		------ JACKS AND RECEPTACLES -------
J4,J5	3550P0021	Receptacle: (6 x 1) .1 ctc, top entry.
J7,J8	3550P0022	Receptacle: (6 x 1) .1 ctc, bottom entry.
	3550P0140	Receptacle: P.C. mount spring contact
		---------- PLUGS ----------
P3	3550P0024-6	Pins: (6 x 2) .1 ctc, .025 square.
P6	3550P0018	37 circuit "D" type, filtered.
P9	3550P0025-8	Pins: (8 x 1) .1 ctc, .025 square.
		---------- TRANSISTORS ----------
Q1-Q3	GS02N3904	Silicon: NPN 2N3904.
Q4	GS02N4403	Silicon: PNP 2N4403.
Q5,Q6	GS02N4401	Silicon: NPN 2N4401.
		---------- RESISTORS ----------
R1,R2	GR2470J00	Carbon Film: 47 ohms ±5%, 1/4 W,
R3-R11	GR2623J00	Carbon Film: 62,000 ohms ±5%, 1/4 W.
R12-R14	GR2333J00	Carbon Film: 33,000 ohms ±5%, 1/4 W.
R15-R17	GR2511J00	Carbon Film: 510 ohms ±5%, 1/4 W
R18	GR2204J00	Carbon Film: 200,000 ohms ±5%, 1/4 W.
R19-R21	GR2103J00	Carbon Film: 10,000 ohms ±5%, 1/4 W.
R22,R23	GR2104J00	Carbon Film: 100,000 ohms ±5%, 1/4 W.
		--------- INTEGRATED CIRCUITS -------
U1,U2	GS0CD4066	Quad Bilateral Switch: CD4066.
U3	GS0CD4049	Hex Inverting Buffer: CD4049.
U4	GS0LM348N	Quad Operational Amplifier: LM348N.
U5	GS0CD4081	Quad 2-Input AND Gate: CD4081.
U6	GS0CD4017	Decade Counter / Devider: CD4017.
U7	GS0TL489C	Analog Level Detector: TL489C.
U8	GS0CD4047	Monostable / Astable Multivibrator: CD4047.
		--------- MISCELLANEOUS ----------
	3550P0010	Printed Circuit Board.
JU1,JU2	GWB22N000	Jumper Wire: 22 AWG.

*Board Revision A

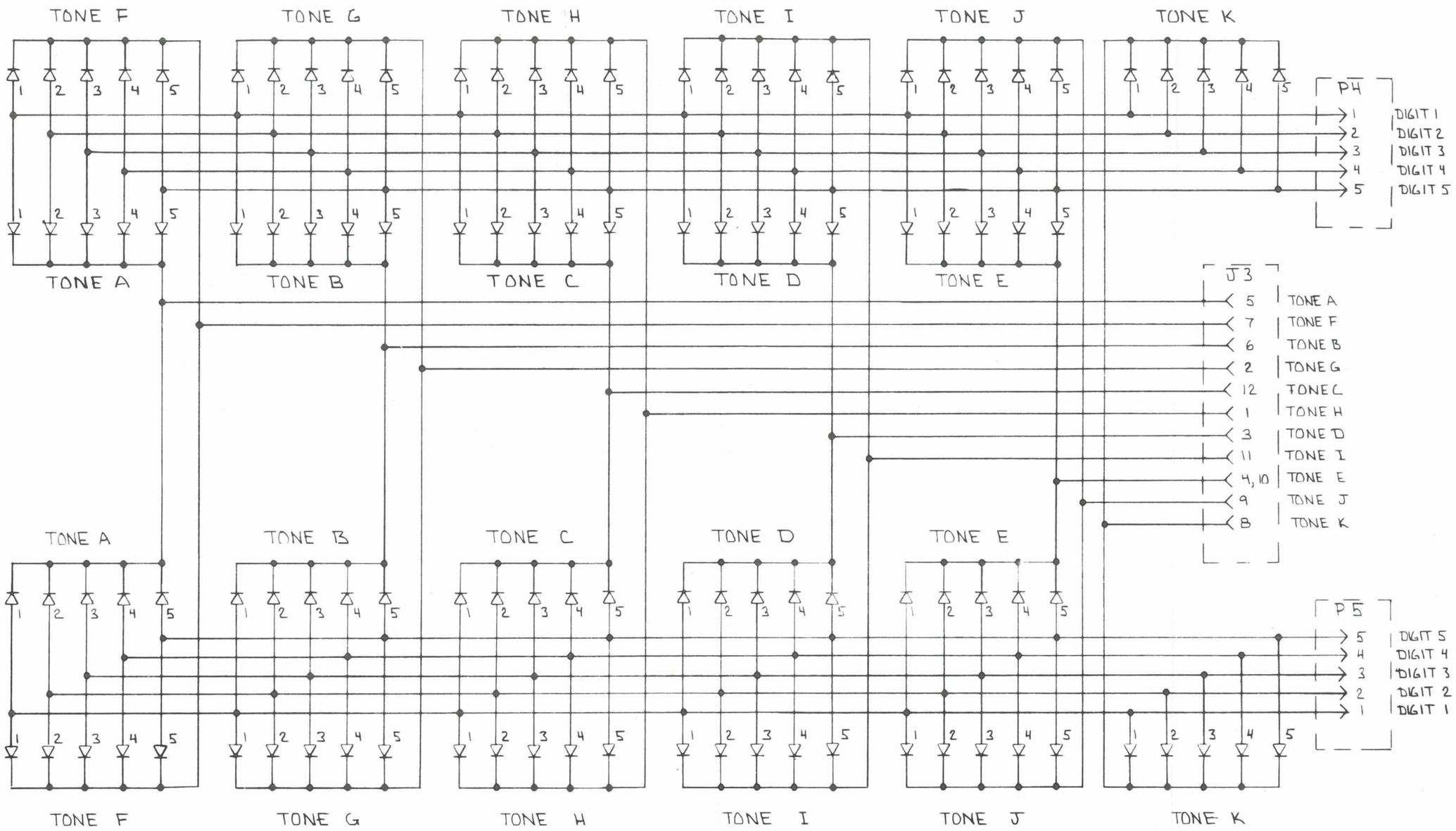
Change U7 to LM339

Additions:

R24	6.8K
R25	100 ohms
R26	100 ohms
R27	100 ohms

TONE - PAC INTERFACE BOARD

PARTS LIST 3550G0010



NOTES

1. ALL DIODES, AS REQUIRED, ARE 1N914B.

TONE PROGRAM BOARD
SCHEMATIC 3550S0013

PARTS LIST

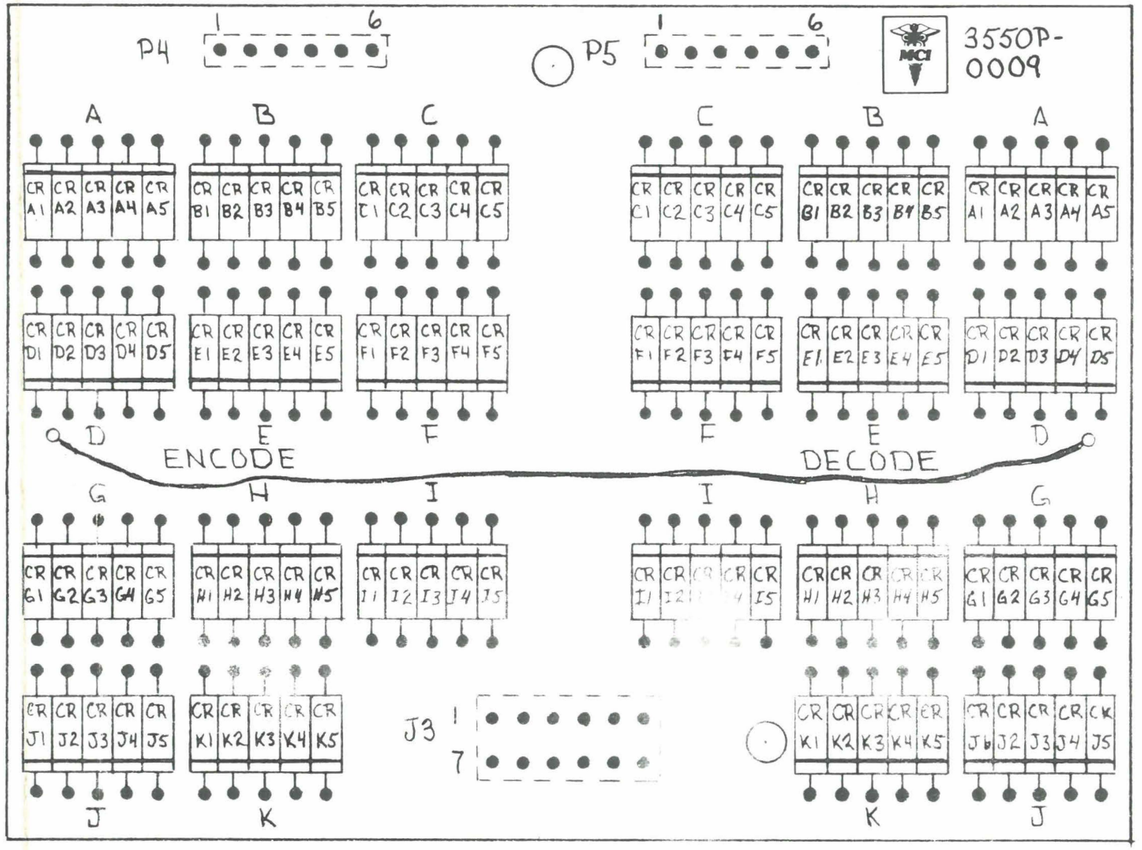
REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		------ DIODES AND RECTIFIERS --------
CR A1 - CR K5	GS01N914B	Silicon: 1N914B (as required).
		------ JACKS AND RECEPTACLES -------
J3	3550P0023	Receptacle: (6 x 2) .1 ctc, top entry.
		---------- PLUGS ----------
P4,P5	3550P0025-6	Pins: (6 x 1) .1 ctc, .025 square.
		--------- MISCELLANEOUS ----------
	3550P0009	Printed Circuit Board.
	GWF0H0NN0	Nylon Lacing Cord, 5".

TONE CODES

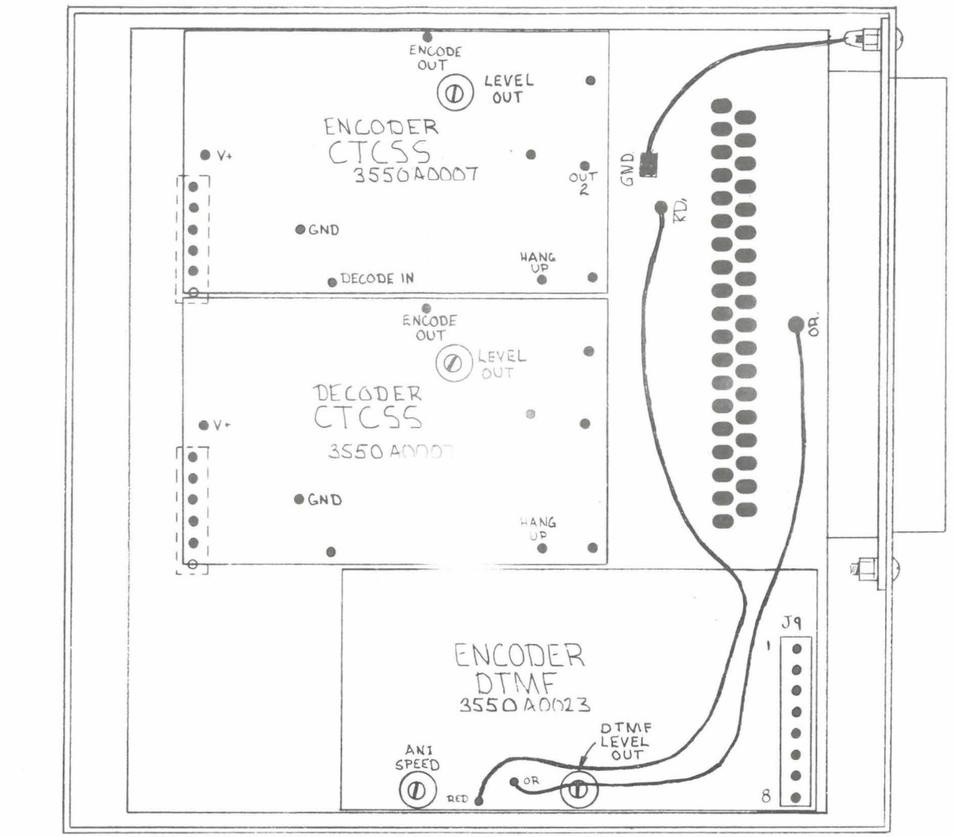
FREQ.	CR 1	CR 2	CR 3	CR 4	CR 5
67.0	0	0	0	0	0
71.9	1	0	0	0	0
74.4	0	1	0	0	0
77.0	1	1	0	0	0
79.7	0	0	1	0	0
82.5	1	0	1	0	0
85.4	0	1	1	0	0
88.5	1	1	1	0	0
91.5	0	0	0	1	0
94.8	1	0	0	1	0
97.4	0	1	0	1	0
100.0	1	1	0	1	0
103.5	0	0	1	1	0
107.2	1	0	1	1	0
110.9	0	1	1	1	0
114.8	1	1	1	1	0

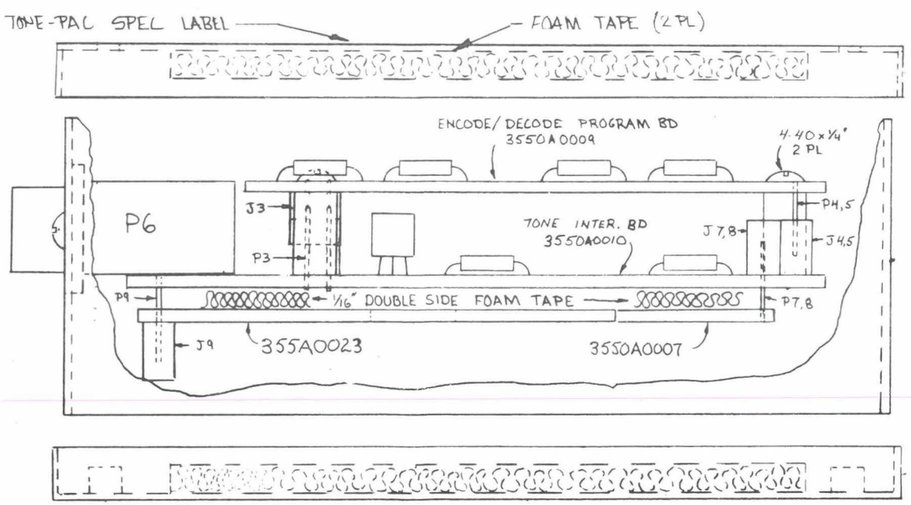
FREQ.	CR 1	CR 2	CR 3	CR 4	CR 5
118.8	0	0	0	0	1
123.0	1	0	0	0	1
127.3	0	1	0	0	1
131.8	1	1	0	0	1
136.5	0	0	1	0	1
141.3	1	0	1	0	1
146.2	0	1	1	0	1
151.4	1	1	1	0	1
156.7	0	0	0	1	1
162.2	1	0	0	1	1
167.9	0	1	0	1	1
173.8	1	1	0	1	1
179.9	0	0	1	1	1
186.2	1	0	1	1	1
192.8	0	1	1	1	1
203.5	1	1	1	1	1

FOR 0 - INSTALL DIODE (1N914B)
FOR 1 - NO CONNECTION



TONE PROGRAM BOARD
PARTS LIST 3550G0009
ASSEMBLY 3550A0009





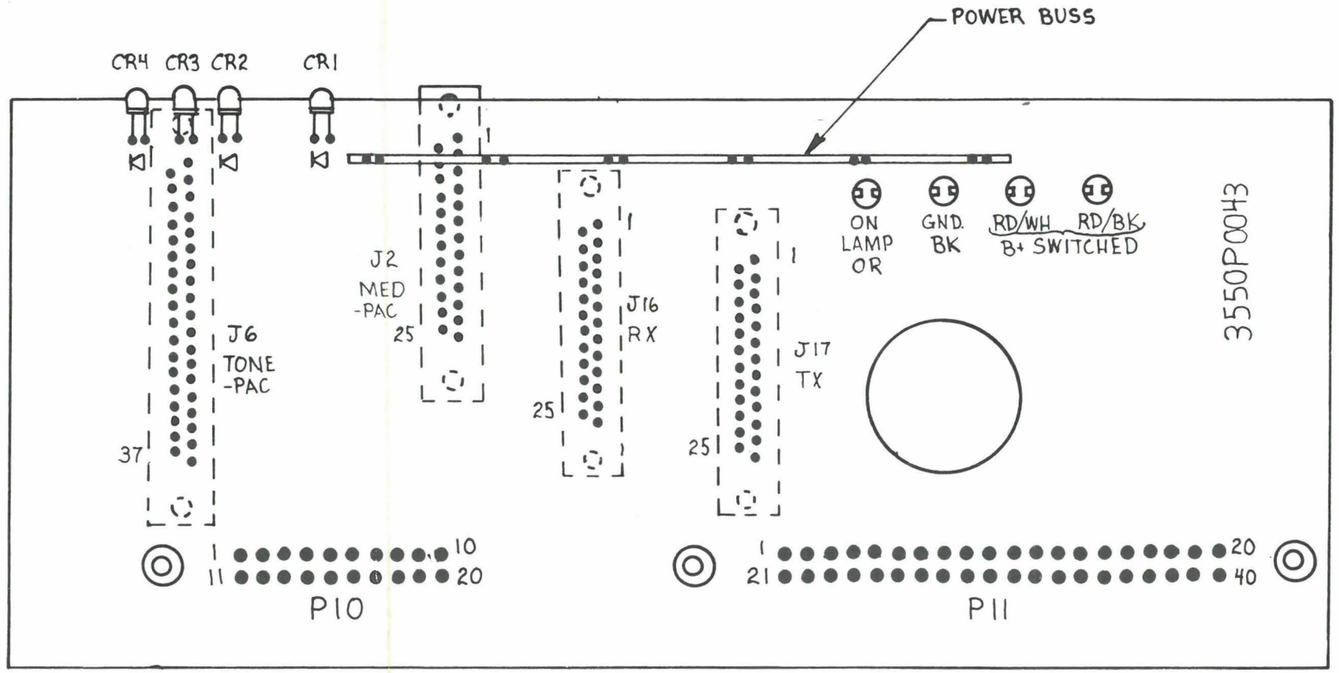
REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
	3550A0010	TONE - PAC Interface Board Assembly.
	3550A0009	Tone Program Board Assembly.*
	3550A0007	CTCSS Board Assembly.*
	3550A0023	DTMF Board Assembly.*
	3550P0007	Shielding Can Base.
	3550P0004-1	Shielding Can Cover.
	3550P0004-2	Shielding Can Cover.
	3550P0165	Foam Tape: 3" x 3" x 1/4".
	3550P0149-2	Module Identification Label.
	3550P0016	Tone - Pac Specification Label.
	3550P0015	Screw: 4-40 x 1.5" FH phillip, Nylock.
	3550P0106	Screw: 4-40 x 1/4" PH phillip, Nylock.
	GHSA04AD1	Screw: 4-40 x 1/4" PH phillip.
	GHNJ040A1	Nut: 4-40 x 1/4" Hex, Kep.
	GHL0040N2	Solder Lug: #4.

* Optional

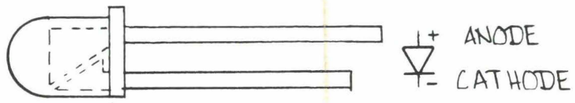
CTCSS Encode and Decode tones can be programmed independently. However, if the Encode and Decode tones are identical one CTCSS Tone Board Assembly can be installed in the Decode position of the Tone Interface Board Assembly provided JU-1 is installed. The tones are then programmed in the Decode positions of the Tone Program Board Assembly.

PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		------ DIODES AND RECTIFIERS -----
CR1	3550P0108	LED: Red, sim. to IEE #LL221R.
CR2-CR4	3550P0107	LED: Yellow, sim. to IEE #LL251Y.
		------ JACKS AND RECEPTACLES ------
J2,J16,J17	3550P0019	Receptacle: 25 circuit "D" type.
J6	3550P0020	Receptacle; 37 circuit "D" type.
		---------- PLUGS ----------
P10	3550P0112-10	Pins: (10 x 2) .025 square, .15 centers.
P11	4550P0112-20	Pins: (20 x 2) .025 square, .15 centers.
		--------- MISCELLANEOUS ----------
	3550P0043	Printed Circuit Board
	3550P0134	Power Buss Bar.
	GWA180NN0	Wire: 18 AWG B/U, Bk. , 8"
	GWA1820N0	Wire: 18 AWG B/U, Rd./Bk. , 8"
	GWA243NN0	Wire: 24 AWG B/U, Or. , 8"



LED LEAD IDENTIFICATION



MOTHER BOARD
PARTS LIST 3550G0006
ASSEMBLY 3550A0008

TO FLEX CIRCUIT

P11: GND (23), SQ. HI (1), SQ. WIP. (22), SQ. GATE (2), FREQ. WIP. (16), FREQ. 1 (11), FREQ. 2 (32), FREQ. 3 (12), FREQ. 4 (33), FREQ. 5 (13), FREQ. 6 (34), FREQ. 7 (14), FREQ. 8 (35), FREQ. 9 (15), FREQ. 10 (30), FREQ. 11 (10), FREQ. 12 (31), TONE OFF (24), TONE A (4), TONE B (25), TONE C (5), TONE D (26), TONE E (6), TONE F (27), TONE G (7), TONE H (28), TONE I (8), TONE J (29), TONE K (9), ROW 1 (36), ROW 2 (17), ROW 3 (37), ROW 4 (18), COL. 1 (38), COL. 2 (19), COL. 3 (39), TONE DECODE OUT (3), SPK. AUDIO (21), MIC. HI (40), MIC. LO (20)

P10: DTMF (19), CHK. POWER (2), RA CHK. (3), LA CHK. (4), LL CHK. (14), ECG (1), PTT (11), ECG GND. (7), ECG OUT (17), ECG - (9), ECG + (10), MUTE (20), TELE. CONT. (16), REPEAT (12), TELE. IN (5), TELE. OUT (6), ECG CAL + (8), ECG CAL - (15), B+ SWITCHED (13), GND (18)

RECEIVER J16

SQ. HI	5
SQ. WIP.	6
SQ. GATE	19
FREQ. WIP.	7
FREQ. 1	8
FREQ. 2	9
FREQ. 3	10
FREQ. 4	11
FREQ. 5	12
FREQ. 6	13
FREQ. 7	20
FREQ. 8	21
FREQ. 9	22
FREQ. 10	23
FREQ. 11	24
FREQ. 12	25
AUDIO OUT	18
SQ. SENSE	16
DISC. OUT	17
B+ SWITCHED	4
GND.	3

B+ SWITCHED

TRANSMITTER J17

FREQ. WIP.	5
FREQ. 1	6
FREQ. 2	7
FREQ. 3	8
FREQ. 4	9
FREQ. 5	10
FREQ. 6	11
FREQ. 7	12
FREQ. 8	13
FREQ. 9	22
FREQ. 10	23
FREQ. 11	24
FREQ. 12	25
MOD. IN	18
KEY	21
DTMF IN	19
CTCSS IN	20
B+ SWITCHED	17
GND.	4

B+ SWITCHED

CR2 RA (YL.)
CR3 LA (YL.)
CR4 LL (YL.)
B+ SWITCHED

TONE-PAC J6

LL LED	5
LA LED	6
RA LED	7
TONE DECODE IN	3
TONE ENCODE OUT	26
TONE A	19
TONE B	18
TONE C	17
TONE D	9
TONE E	15
TONE F	12
TONE G	10
TONE H	11
TONE I	16
TONE J	14
TONE K	13
ROW 1	37
ROW 2	36
ROW 3	35
ROW 4	34
COL. 1	33
COL. 2	32
COL. 3	31
TONE DECODE OUT	4
DTMF OUT	29
CHK. POWER	24
RA CHK.	20
LA CHK.	1
LL CHK.	21
ECG	28
PTT	23
LEVEL IN	22
B+ SWITCHED	8,27
GND.	2,30

B+ SWITCHED

MED-PAC J2

B+ SWITCHED	
MIC. LO	3
MIC. HI	4
SPK. AUDIO	11
ECG CAL -	1
ECG CAL +	14
TELE. OUT	5
TELE. IN	7
REPEAT	9
TELE. CONT.	13
MUTE	16
ECG +	23
ECG -	24
ECG OUT	21
ECG GND.	25
RX AUDIO	8
SQ. SENSE	18
TX AUDIO	6
KEY	19
PTT	10
ECG LEVEL OUT	12
	22
B+ SWITCHED	17
GND	15
TX LED	20
ON LAMP	2

B+ SWITCHED — (CR1) TX (RD.)

E1 — OR

B+ SWITCHED — E2 — RD/WH — LI — OR. — SB — RD — WH — WH — BATTERY PACK +

E3 — RD/BK

E4 — BK. — BK — BK — J13 — P13

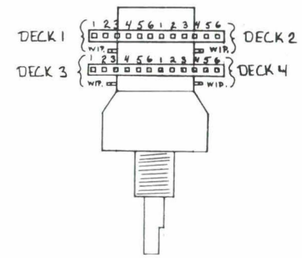
UHF AMP. (OPTION)

MOTHER BOARD
SCHEMATIC 3550S0012

PARTS LIST

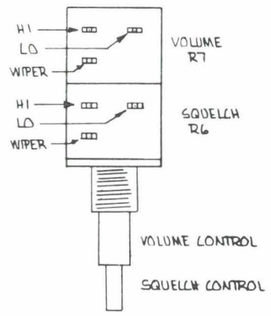
REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		------- DIODES AND RECTIFIERS -----
CR1,CR2,CR3	GS1N4740A	Silicon ,Zener: 1N4740A, 10V.
		------ JACKS AND RECEPTACLES -------
J10	3550P0047	Receptacle: (10 x 2) .15 ctc, top entry.
J11	3550P0048	Receptacle: (20 x 2) .15 ctc, top entry.
J12	3550P0049	Receptacle: (10 x 1) .10 ctc, top entry.
J23	3550P0098	Tele Receptacle Housing, 8 circuit.
for J23	3550P0099	Tele Receptacle Contacts, crimp type.
J21	3550P0102	ECG OUT Connector, BNC.
J22	3550P0103	ECG Connector.
		---------- PLUGS ----------
P19	3550P0100	Handset Receptacle Housing, 8 circuit.
for P19	3550P0101	Handset Receptacle Contacts, crimp type.
		---------- RESISTORS ----------
R1-R3	GR2103F00	Metal Film: 10,000 ohms ±1%, 1/4 W.
R4	GR2102F00	Metal Film: 1,000 ohms ±1%, 1/4 W.
R5	GR2100F00	Metal Film: 10 ohms ±1%, 1/4 W.
R6,R7	3550P0090	Pot.: 10,000 ohms Volume / Squelch Cont.
		---------- SWITCHES ----------
S1,S2,S6	3550P0085	12 position, 30° rotary, Mode,Tone,Freq.
S3,S4	3550P0088	SPDT Toggle, Rx tone, Speaker.
S5	3550P0086	DPDT momentary, ECG Calibrate.
S7	3550P0081	4P 4T rotary, Lead Select.
		--------- MISCELLANEOUS ----------
	3550P0029	Flex Circuit.
	3550P0080	DTMF Key-pad.

S7
LEAD VIEW SHOWN

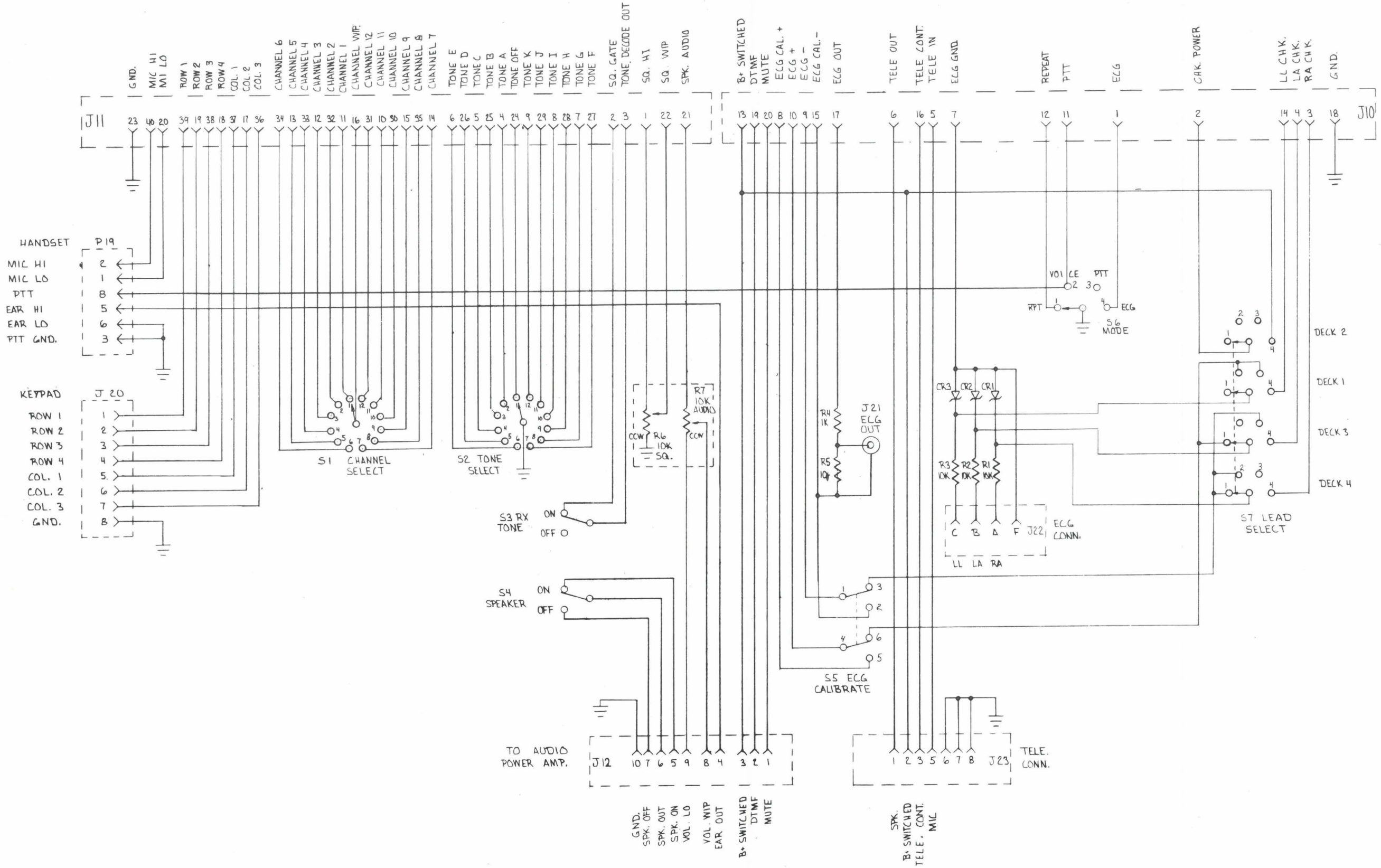


SWITCH POS.	FUNCTION
1	LEAD I
2	LEAD II
3	LEAD III
4	LEAD CHECK

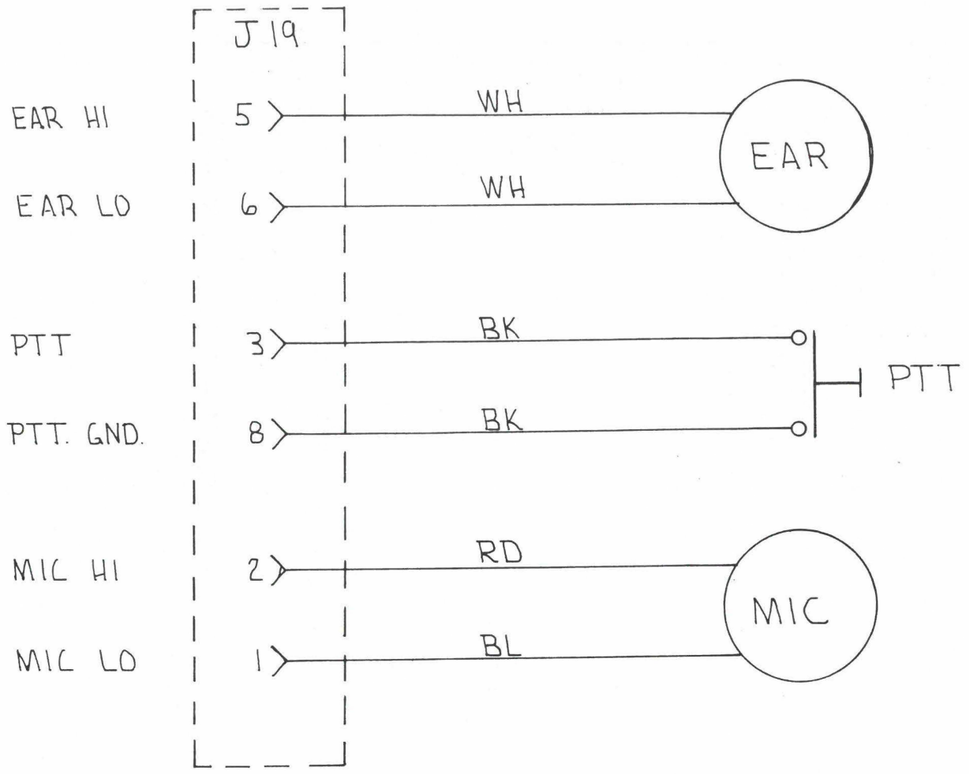
VOLUME (R7)/ SQUELCH(R6) CONTROL
LEAD SIDE VIEW



FRONT PANEL
PARTS LIST 3550G0014



FRONT PANEL
SCHEMATIC 3550S0011



PARTS LIST

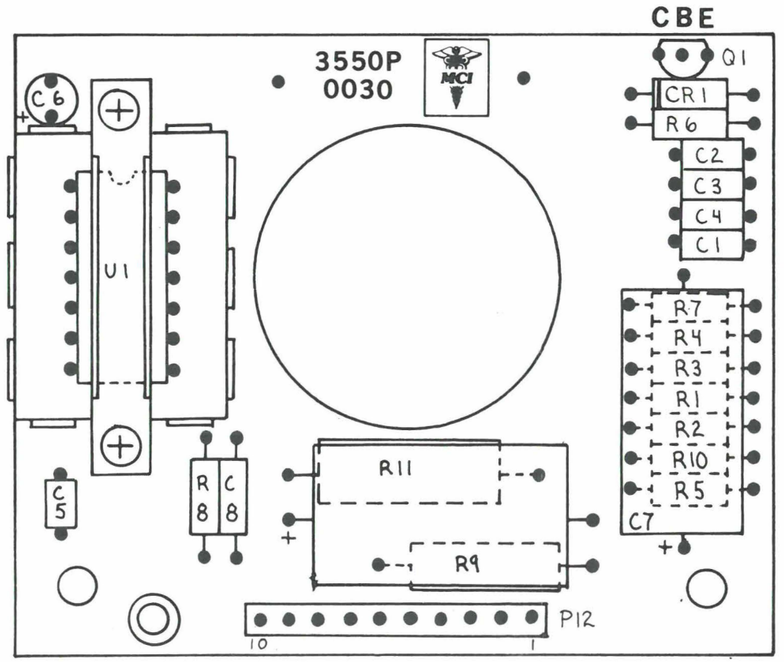
REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
	3550P0118	Handset, w/ PTT, Cord.
J19	3550P0137	Handset Receptacle Housing.
for J19	3550P0138	Handset Receptacle Crimp Contacts.
	3550P0096	Handset Receptacle Strain Relief.

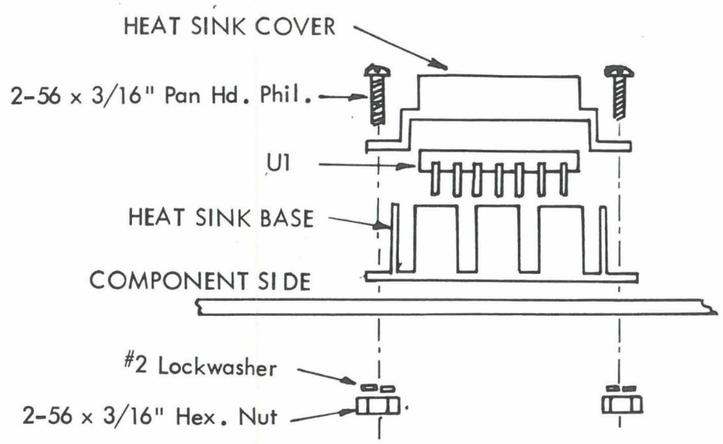
HANDSET

PARTS LIST	3550G0017
SCHEMATIC	3550S0014

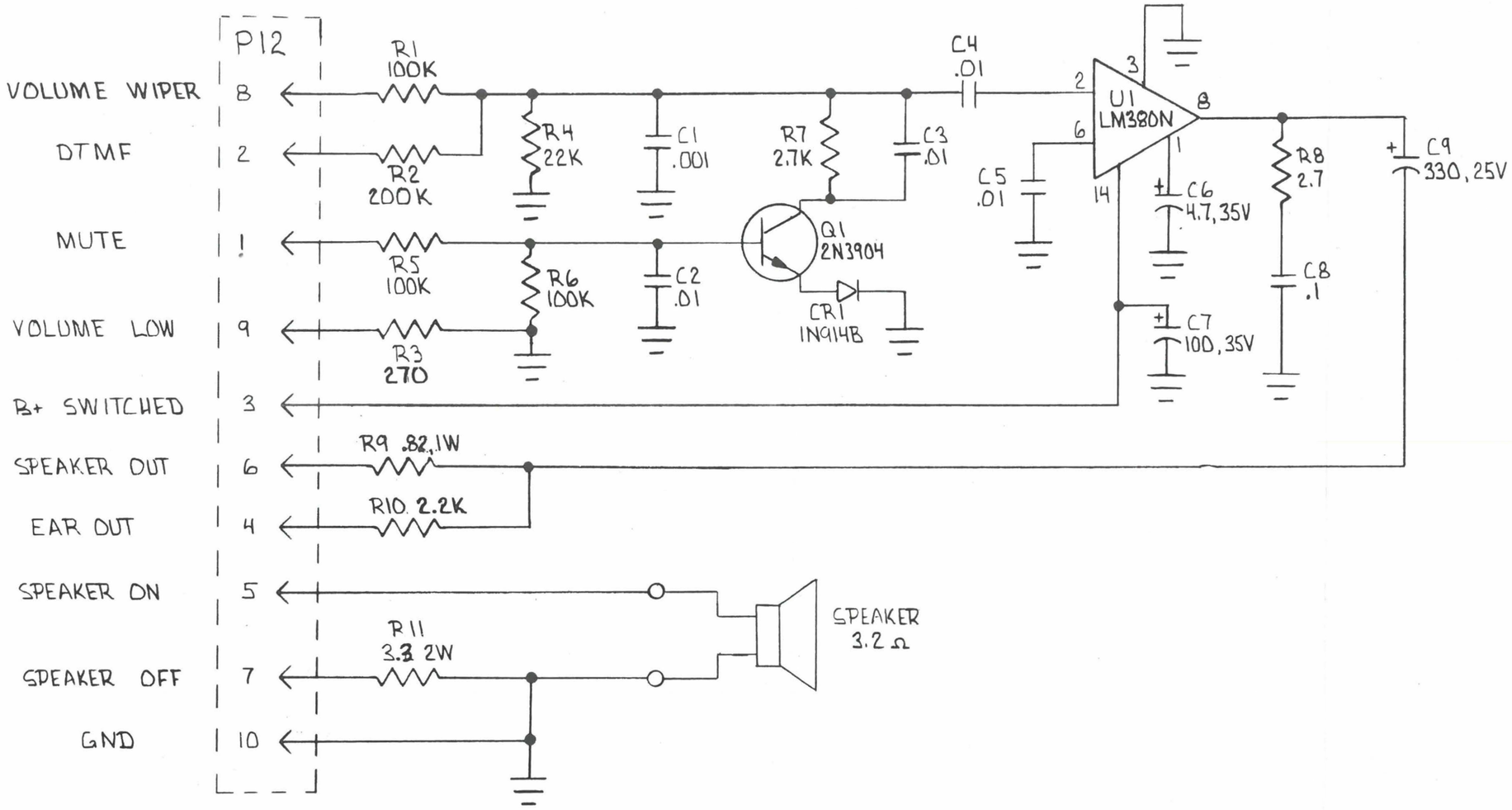
PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		---------- CAPACITORS ----------
C1	GC102JGRF	Polyester: .001 uf ±5%, 100V.
C2,C4,C5	GC103LFRC	Ceramic: .01 uf -20% +80%, 50V.
C3	GC103KFRF	Polyester: .01 uf ±10%, 50V.
C6	GC475MERT	Tantalum: 4.7 uf ±20%, 35V.
C7	GC107SEAE	Electrolytic: 100 uf -10% +100%, 35V.
C8	GC104LFRC	Ceramic: .1 uf -20% +80%, 50V.
C9	GC337SDAE	Electrolytic: 330 uf -10% +100%, 25V.
		------ DIODES AND RECTIFIERS ------
CR1	GS01N914B	Silicon: 1N914B
		---------- PLUGS ----------
P12	3550P0025-10	Pins: (10 x 1) .025 square, .10 centers.
		---------- TRANSISTORS ----------
Q1	GS02N3904	Silicon: NPN 2N3904.
		---------- RESISTORS ----------
R1,R5,R6	GR2104J00	Carbon Film: 100,000 ohms ±5%, 1/4 W.
R2	GR2204J00	Carbon Film: 200,000 ohms ±5%, 1/4 W.
R3	GR2271J00	Carbon Film: 270 ohms ±5%, 1/4 W.
R4	GR2223J00	Carbon Film: 22,000 ohms ±5%, 1/4 W.
R7	GR2272J00	Carbon Film: 2,700 ohms ±5%, 1/4 W.
R8	GR22R7J00	Carbon Film: 2.7 ohms ±5%, 1/4 W.
R9	GR4R82J00	Metal Film: .82 ohms ±5%, 1 W.
R10	GR2222J00	Carbon Film: 2,200 ohms ±5%, 1/4 W.
R11	GR53R3J00	Metal Film: 3.3 ohms ±5%, 2 W.
		------- INTEGRATED CIRCUITS -------
U1	GS0LM380N	Audio Power Amplifier: LM380N.
		--------- MISCELLANEOUS ----------
	3550P0030	Printed Circuit Board.
	3550P0074	Heat Sink (used with U1).
	GHSA02EC1	Screw: 2-56 x 3/16" PH phillip.
	GHWI02001	Washer: #2 Internal Tooth .
	GHNC020E1	Nut: 2-56 x 3/16" Hex.
	3550P0155	Thermal Compond.





AUDIO POWER AMPLIFIER BOARD
PARTS LIST 3550G0005
ASSEMBLY 3550A0005



NOTES:

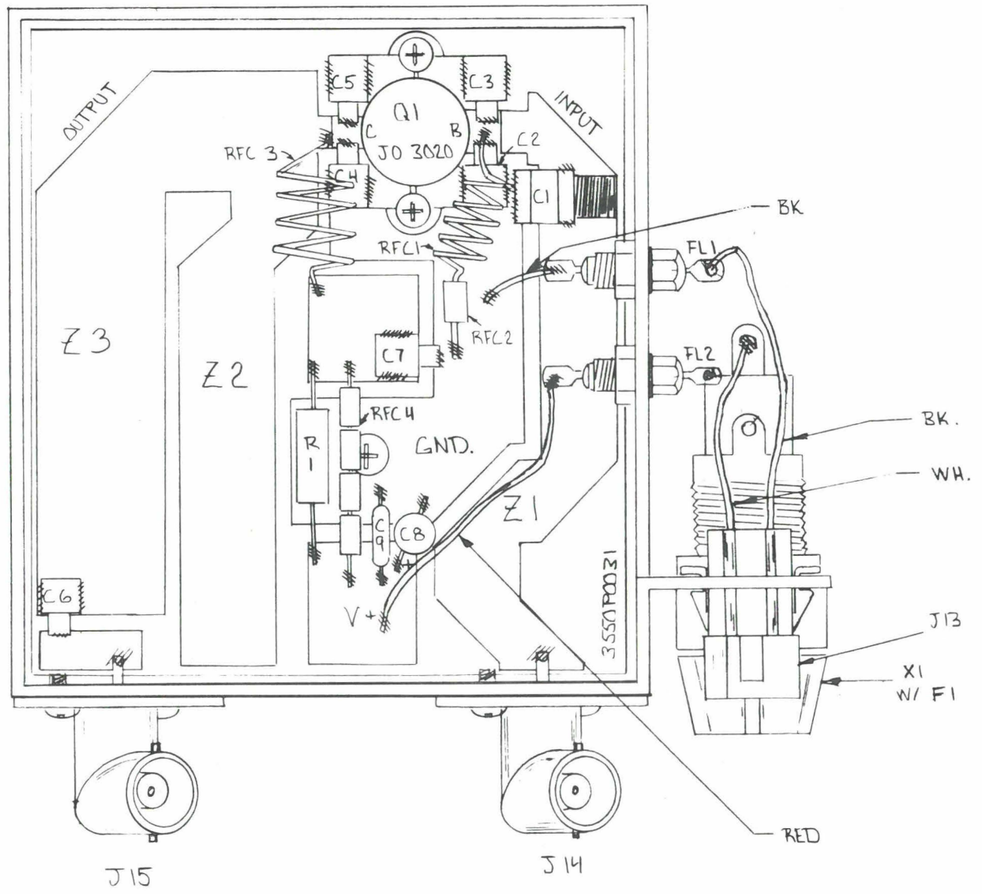
1. UNLESS OTHERWISE NOTED, RESISTOR VALUES ARE IN OHMS, ±5%, 1/4 WATT, CAPASITOR VALUES ARE IN MICROFARADS.
2. LAST USED: C9, CR1, Q1, R11, U1.
3. PINS 3,4,5,7,10,11,12 OF U1 ARE COMMONED TO GROUND.

AUDIO POWER AMPLIFIER BOARD

SCHEMATIC 3550S0001

PARTS LIST

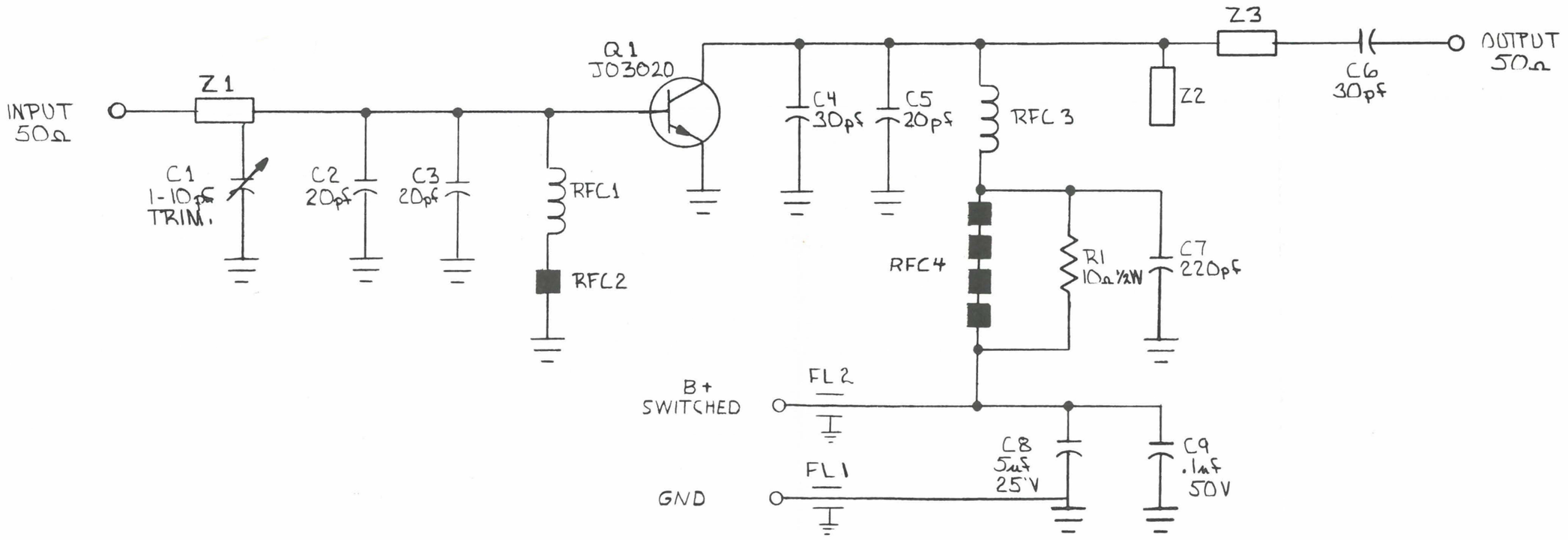
REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		---------- CAPACITORS ----
C1	3550P0126	Variable: 0 - 10 pf.
C2,C3,C5	3550P0128	Mica, uncased: 20 pf.
C4,C6	3550P0127	Mica, uncased: 30 pf.
C7	3550P0130	Mica, uncased: 220 pf.
C8	GC505SDRE	Electrolytic: 5 uf -10 +100%, 25V.
C9	GC104LFRC	Ceramic: .1 uf -20 +80%, 50V.
		---------- FUSE ----------
F1	3550P0041	Quick blowing cartridge: 5 amp. sim. to Bussmann AGC-5.
		------ JACKS AND RECEPTACLES -------
J13	3550P0039	2 circuit plug housing, sim. to Molex # 02-06-1022.
for J13	3550P0037	Crimp type plug terminal, sim. to Molex # 02-06-1103.
J14,J15	3550P0034	Rt. Angle BNC, flange mount, sim. to Kings # UG-535.
		---------- TRANSISTORS ----------
Q1	3550P0125	UHF Power Amplifier: NPN J-Zero-3020.
		---------- RESISTORS ----------
R1	GR3100J00	Carbon Film: 10 ohms ±5%, 1/2 W.
		---------- FILTERS ----------
FL1,FL2	3550P0042	Feed through: sim. to AMP 859617-3.
		---------- CHOKE COILS ----------
RFC1	3550P0131	18 AWG 1/4" dia. 1/2" long 6 turns.
RFC2	GHM000004	Ferrite bead: 4 on 18 AWg.
RFC3	3550P0132	18 AWG 3/8" dia. 1/2" long 4 turns.
RFC4	GHM000004	Ferrite bead: 1 on 18 AWG.
		--------- MISCELLANEOUS ----------
	3550P0031	Printed Circuit Board.
	3550P0032	Case Base.
	3550P0033	Case Cover.
X1	3550P0040	Fuse Holder: sim. to Bussmann HTA.
	3550P0156	Case Label.
	GHSA04AF1	Screw: 4-40 x 3/8" PH phillip.
	GHSA04AD1	Screw: 4-40 x 1/4" PH phillip.
	GHSB04AD1	Screw: 4-40 x 1/4" FH phillip.
	GHND040A1	Nut: 4-40 x 1/4" Hex.
	GHWI04001	Washer #4 Internal Tooth.
	GHWS04001	Washer: #4 Split Lock.
	GHL0040N2	Solder Lug: #4.



UHF AMPLIFIER ASSEMBLY

PARTS LIST 3550G0004

ASSEMBLY 3550A0006

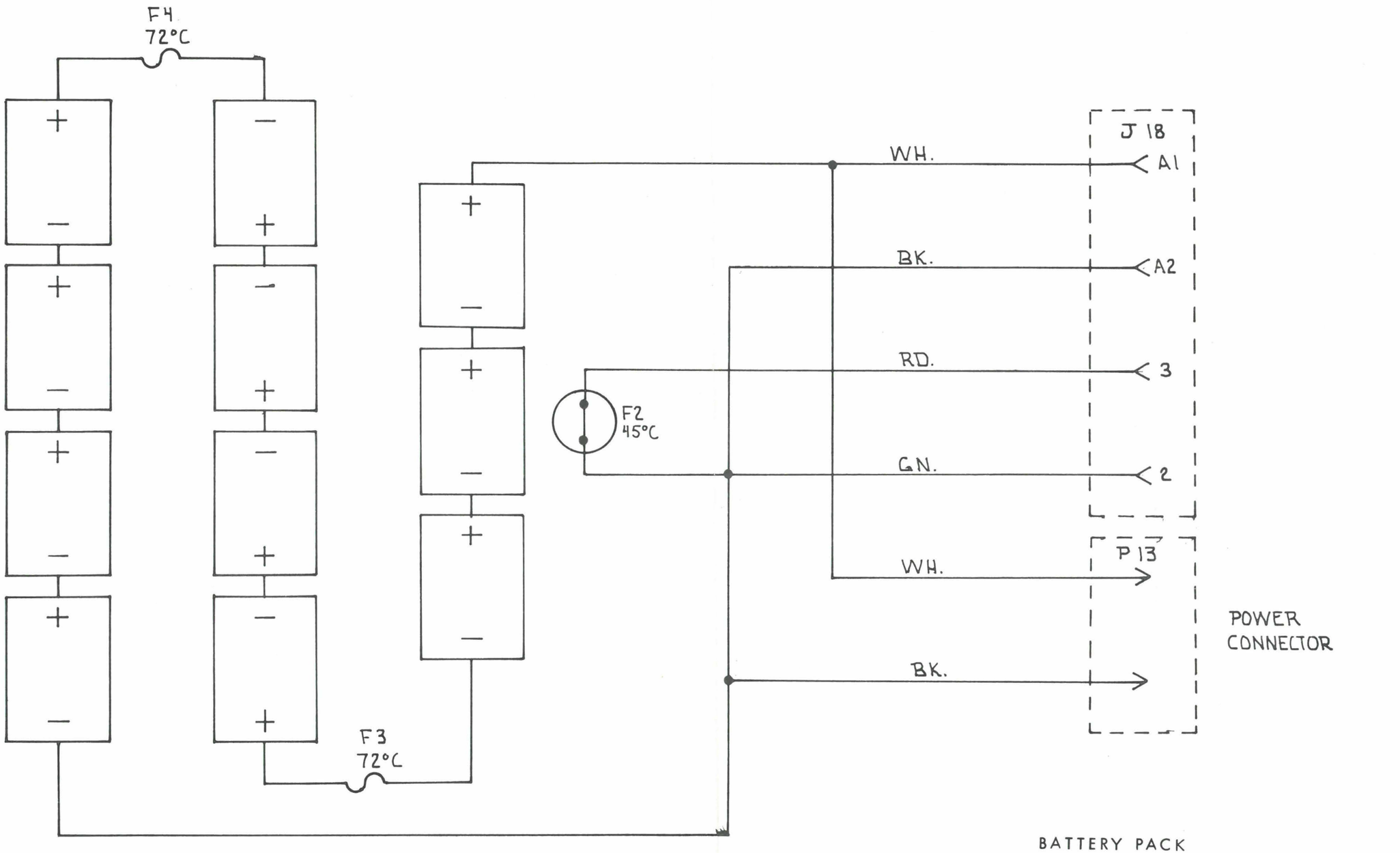


NOTES:

1. MICROSTRIPLINES VALUES AS FOLLOWS:
   Z1 = 30 ohms
   Z2 = 24 ohms
   Z3 = 20 ohms

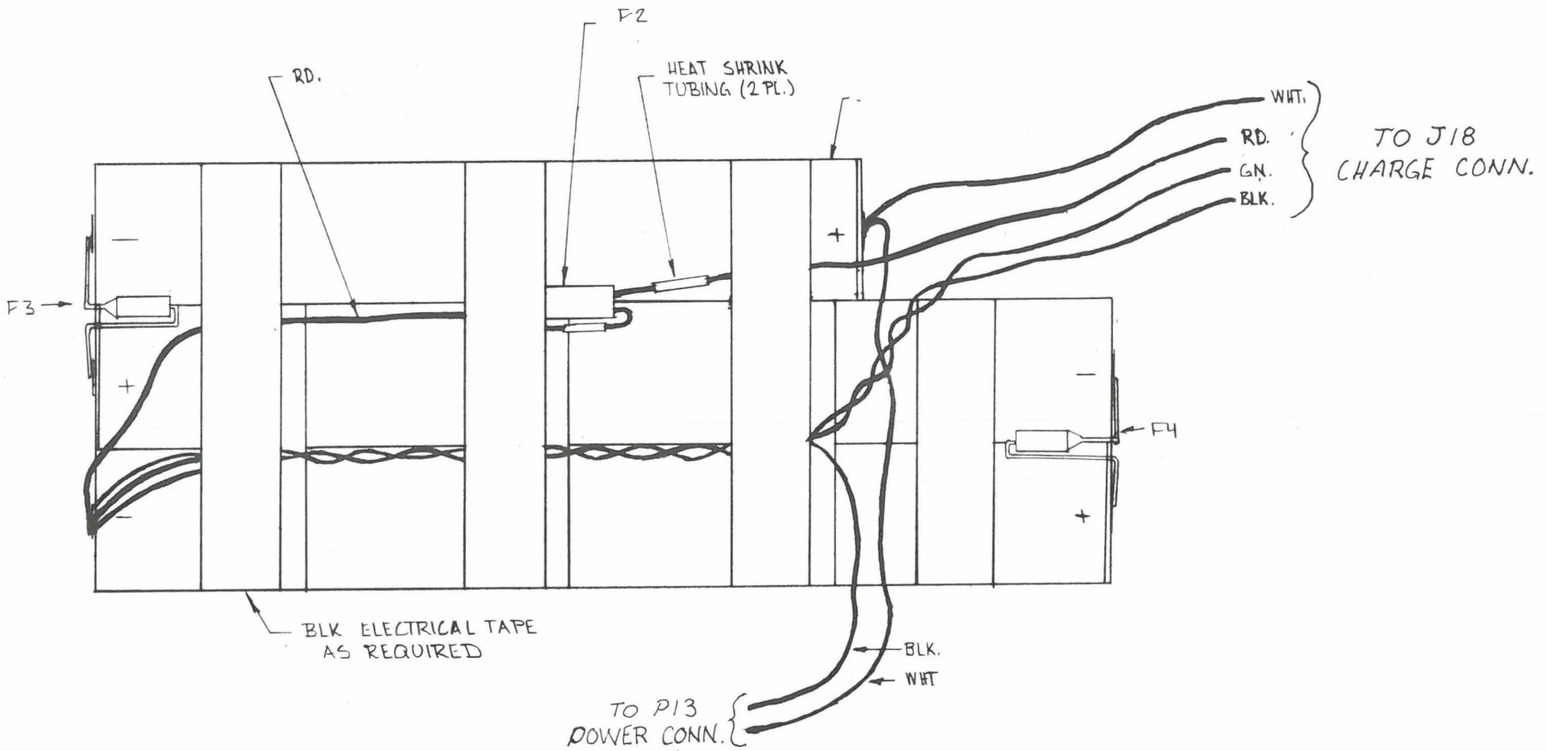
UHF AMPLIFIER ASSEMBLY

SCHEMATIC 355OS0010



BATTERY PACK
SCHEMATIC

3550S0008



BATTERY PACK
ASSEMBLY 3550A0014

BATTERY ASSEMBLY
PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
BT1	3550P0136	Battery: 3 Cell Stick, Sanyo #3N-4000D.
BT2,BT3	3550P0135	Battery: 4 Cell Stick, Sanyo #4N-4000D.
F2	3550P0145	Thermostat, 45° C.
F3,F4	3550P0144	Thermal Fuse, 72° C.
	3550P0160	Vinyl Plastic Tape (black).
	3550P0159	Thermal Cement.
	GWA180NN0	Wire: 18 AWG B/U Bk. 17".
	GWA180NN0	Wire: 18 AWG B/U Bk. 14".
	GWA245NN0	Wire: 24 AWG B/U Gn. 14".
	GWA189NN0	Wire: 18 AWG B/U Wh. 12".
	GWA242NN0	Wire: 24 AWG B/U Rd. 8".
	GWA242NN0	Wire: 24 AWG B/U Rd. 6".
	GWA189NN0	Wire: 18 AWG B/U Wh. 5".

BATTERY PACK ASSEMBLY
PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
	3550P0053	Battery Pack Housing.
	3550P0061	Battery Pack Cover Panel.
	3550P0163	Rubber Grommet.
J18	3550P0141	Charge Connector.
for J18	3550P0142	Charge Connector Contacts.
	3550P0143	Charge Connector Mounting Plate.
P13	3550P0038	Power Connector Housing.
for P13	3550P0036	Power Connector Crimp Terminals.
	3550A0016	Battery Assembly.
	3550P0161	Screw: 4-40 x 3/8" PH phillip, Black Oxide.
	3550P0106	Screw: 4-40 x 1/4" PH phillip, Nylock.
	GHSA04AH1	Screw: 4-40 x 1/2" PH phillip.
	GHSA06BH1	Screw: 6-32 x 1/2" PH phillip.
	3550P0162	Standoff: 4-40 x 1-1/8" x 1/4" Hex.
	GHNJ060B1	Nut: 6-32 x 5/16" Hex, Kep.
	GHWF06001	Washer: #6 Flat.
	GHWI04001	Washer: #4 Internal Tooth Lock.
	GHWF04001	Washer: #4 Flat.

BATTERY PACK
PARTS LIST 3550G0013
PARTS LIST 3550G0019

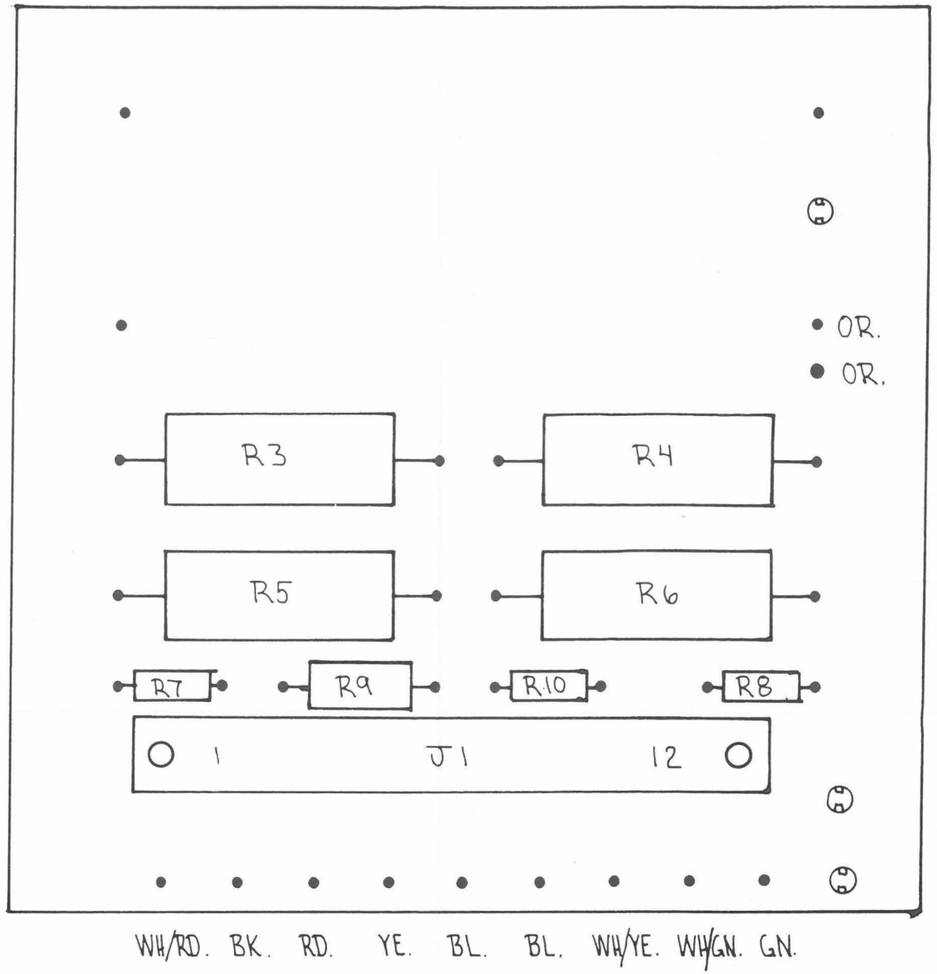
REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
	3550A0013	Case Assembly.
	3550P0069	Chassis.
	3550A0003	Transmitter Module Assembly.
	3550A0002	Receiver Module Assembly.
	3550A0012	Med - Pac Module Assembly.
	3550A0011	Tone - Pac Module Assembly.
	3550P0124-1,-2	Duplexer. (-1, 12 Watt, -2, 1 or 2 Watt)
	3550A0006	UHF Power Amplifier Module Assembly.
	3550A0005	Audio Power Amplifier Board Assembly.
	3550A0008	Mother Board Assembly.
	3550A0018	Flexible Circuit Board Assembly.
	3550A0014	Battery Pack Assembly.
	3550A0019	Handset Assembly.
	3550A0024	Antenna Assembly, Stub.
	3550P0076	Power Switch.
	3550P0077	Power Switch Lens.
	3550P0078	Power Switch Lamp.
	3550P0079	Speaker.
	3550P0158	Speaker Grill.
	3550P0075	Antenna Connector.
	3550P0148	DTMF Key-pad Retaining Plate.
	3550P0169	Fuse and Power Connector Mounting Bracket.
	3550P0150	Case Gasket.
	3550P0082	Knob, Lead Select, Mode.
	3550P0091	Knob, Squelch.
	3550P0093	Knob, Volume.
	3550P0110	Knob, Tone, Frequency.
	3550P0084	Knob Cap, Lead select, Mode, Tone, Freq.
	3550P0094	Knob Cap, Volume.
	3550P0083	Nut Cover, Lead Select, Mode.
	3550P0092	Nut Cover, Squelch.
	3550P0028-1	Figure Dial, Frequency.
	3550P0028-2	Figure Dial, Tone.
	3550P0087	Dress Nut, ECG Cal.
	3550P0111	SwitchCap (red), ECG Cal.
	3550P0089	Rubber Boot, Rx Tone, Speaker On/Off.

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
	3550P0106	Screw: 4-40 x 1/4" PH, phillip, nylock.
	3550P0157	Screw: 4-40 x 1/4" FH, phillip, nylock.
	GHSA04AD1	Screw: 4-40 x 1/4" PH, phillip.
	GHSA04AH1	Screw: 4-40 x 1/2" PH, phillip.
	3550P0105	Screw: 6-32 x 1/4" FH, phillip, nylock.
	GHSB06BE1	Screw: 6-32x 5/16" FH, phillip.
	3550P0153	Screw: 10-32 x 3/8" FH, phillip, nylock,Blk.
	3550P0154	Screw: 10-32 x11/16"TH, phillip, Blk.
	GHND040A1	Nut: 4-40 x 1/4" hex, kep.
	3550P0104	Standoff: #4 x 1/4" nylon, through hole.
	3550P0139	Standoff: 4-40 x 1/2" x 3/16" hex, threaded.

NON-REFERENCED PARTS LIST

PARTS LIST

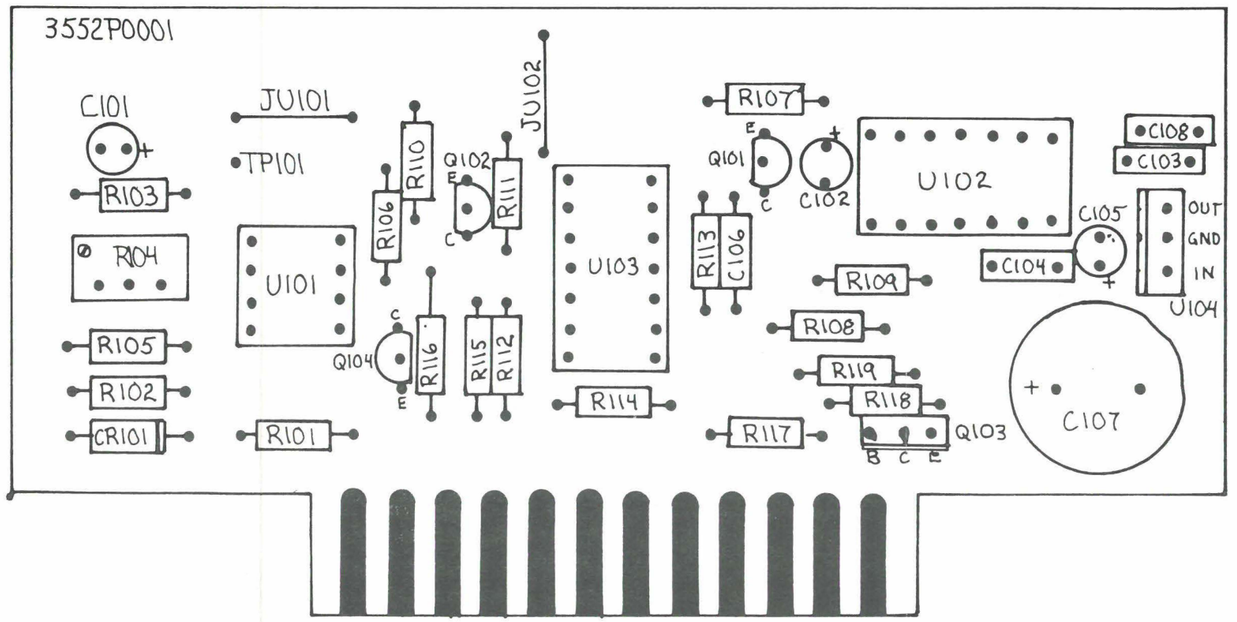
REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		------ DIODES AND RECTIFIERS -------
CR1	3552P0013	LED: Red, sim. to IEE #229R.
CR2	3552P0014	LED: Yellow, sim. to IEE #229Y.
CR3	3552P0015	LED: Green, sim. to IEE #229G.
		---------- RESISTORS ----------
R3,R4	3552P0017	40 ohms ±5%, 5 W.
R5,R6	3552P0018	100 ohms ±5%, 5 W.
R7,R8	GR2101J00	100 ohms ±5%, 1/4 W.
R9	GR3511J00	510 ohms ±5%, 1/2 W.
R10	GR2181J00	180 ohms ±5%, 1/4 W.
		---------- MISCELLANEOUS --------
	3552P0002	Printed Circuit Board.
J1	3552P0004	Edge Card Connector (12 x 2).



BATTERY CHARGER MOTHER BOARD
PARTS LIST 3552G0002
ASSEMBLY 3552A0002

PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		---------- CAPACITORS ----------
C101,C102,C105	GC105MERT	Tantalum: 1 uf ±20%, 35V.
C103,C104,C108	GC103LFRC	Ceramic: .01 uf -20% +80%, 50V.
C106	GC104LFRC	Ceramic: .1 uf -20% +80%, 50V.
C107	GC108SERE	Electrolytic: 1000 uf -10% +100%, 35V.
		------ DIODES AND RECTIFIERS ------
CR101	GS1N4744A	Silicon, Zener: 1N4744A 15V.
		---------- TRANSISTORS ----------
Q101	GS02N3906	Silicon: PNP 2N3906.
Q102,Q104	GS02N3904	Silicon: NPN 2N3904.
Q103	3552P0010	Silicon: NPN MJE 801.
		---------- RESISTORS ----------
R101	GR2632F40	Metal Film: 6,340 ohms ±1%, 1/4 W.
R102,R105	GR2103F00	Metal Film: 10,000 ohms ±1%, 1/4 W.
R103	GR2342F80	Metal Film: 3,480 ohms ±1%, 1/4 W.
R104	GPO502CB0	Cermet Pot.: 5,000 ohms, sim. to VRN 752.
R106	GR2102J00	Carbon Film: 1,000 ohms ±5%, 1/4 W.
R107,R108,R110, R114,R115,R118	GR2104J00	Carbon Film: 100,000 ohms ±5%, 1/4 W.
R109	GR2334J00	Carbon Film: 330,000 ohms ±5%, 1/4 W.
R111,R112,R117	GR2103J00	Carbon Film: 10,000 ohms ±5%, 1/4 W.
R113	GR2105J00	Carbon Film: 1,000,000 ohms ±5%, 1/4 W.
R116	GR3681J00	Carbon Film: 680 ohms ±5%, 1/2 W.
R119	GR2820J00	Carbon Film: 82 ohms ±5%, 1/4 W.
		-------- INTEGRATED CIRCUITS -------
U101	GSLM741CN	Cperational Amplifier: LM741CN.
U102	GSLM556CN	Dual Timer: LM556CN.
U103	GSCD4001B	Quad 2 - Input NCR Gate: CD4001BCN.
U104	3552P0011	Voltage Regulator: MC7815CT 15V.
		--------- MISCELLANEOUS ----------
	3552P0001	Printed Circuit Board.
JU101,JU102	GWB22NNN0	Buss Wire: 22 AWG.
TP101	GWB22NNN0	Buss Wire: 22 AWG.



BATTERY CHARGER CONTROLLER BD.

PARTS LIST 3552G0001

ASSEMBLY 3552A0001

CHASSIS & MOTHER BOARD
(3552A0002)

CONTROLLER BOARD
(3552A0001)

NOTE: R104 ADJUSTED FOR 10 VDC AT TP101

117V AC IN 60 Hz
GN
BK.
WH.
F1
T1
CR4
OR.
J1 P1
3
R119 82
U104 MC7815 IN OUT GND
+15V
C107 1000 50V
C108 .01
RD.
CR1 RED (FAST)
WH/RD
R9 510 1/2 W
R2 1.88W
R8 100
R7 100
R1 1.88W
R10 180
R4 40 5W
Q2 D45H8
R6 100, 5W
R5 100, 5W
Q1 D45H8
R3 40, 5W
GN
CR3 GRN. (TRICKLE)
WH/GN
SW1
BL.
6
5
R113 1M
C106 .1
R114 100K
U103 C
10
8
9
+15V
R107 100K
C102 1
Q101 2N3906
R108 100K
R106 1K
U102 LM556CN
R110 100K
R109 330K
C105 1
C104 .01
C103 .01
U101 LM741CN
TP101
R104 5K
R103 3.48K 1%
R105 10.0K 1%
C101 1
2
Q103 MJE801
R118 100K
R117 10K
U103 D
11
12
13
Q102 2N3904
R111 10K
R112 10K
U103 B
U103 A
CD4001B
R116 680 1/2 W
Q104 2N3904
R115 100K
R101 634K 1%
R102 10.0K 1%
CR101 1N4744A
4
YE
CR2 YEL. (HOT BAT.)
9
WH/YE
BATTERY PACK
F4 72°C
BATTERY
F2 45°C
F3 72°C
J18 P2
2 GN
3 RD
A1 WH
A2 BK
10
8
11
1
7
12

BATTERY CHARGER
SCHEMATIC 3552S0001

PARTS LIST

REFERENCE DESIGNATION	MCI INC. PART NO.	DESCRIPTION
		------- DIODES AND RECTIFIERS ----
CR4	3552P0008	Bridge Rectifier: MDA 2501-8146.
		---------- TRANSISTORS ----------
Q1,Q2	3552P0009	D 45 H8.
		---------- MISCELLANEOUS ---------
	3552P0005	Charger Base.
	3552P0006	Charger Cover.
	3552P0003	Charger Heat Sink.
	3552A0001	Charger Controller Board Assembly.
	3552A0002	Charger Mother Board Assembly.
F1	3552P0021	Fuse: slow blowing, MDL-2.
X1	3552P0032	Fuse Holder: panel mount.
TR1	3552P0007	Transformer.
	3552P0023	AC Line Cord 16 / 3.
	3552A0003	Charge cord with Connector.
S1	3552P0020	Switch: momentary .
for S1	3552P0030	Dress nut.
for S1	3552P0026	Switch Cap, red.
	3552P0034	Case Handle.
	3552P0022	Cable Strain Relief.
	3552P0033	Rubber Feet.
for Q1,Q2	3552P0012	Insulators.
	3552P0019	LED Retainers.
	3552P0027	Standoff: 4-40 x 2" x 1/4" Hex.
	3552P0035	Screw: 4-40 x 3/8" Nylon.
	3552P0037	Screw: 6-32 x 1/4 " PH phillip, Blk. Oxide.
	3552P0037	Screw: 6-32 x 1/4" PH phillip, Blk. Oxide.
	3550P0106	Screw: 4-40 x 1/4" PH phillip, Nylock.
	GHSA08BH1	Screw: 8-32 x 1/2" PH phillip.
	GHSA06BM1	Screw: 6-32 x 3/4" PH phillip.
	GHSA06BH1	Screw: 6-32 x 1/2" PH phillip.
	GHSB06BF1	Screw: 6-32 x 3/8" FH phillip.
	GHSA04AM1	Screw: 4-40 x 3/4" PH phillip.
	GHNJ080B1	Nut: 8-32 Kep Nut.
	GHNJ060B1	Nut: 6-32 Kep Nut.
	GHL0080F1	Solder Lug: #8.
	GHWI06001	Washer: #6 Internal Tooth.
	GHWF06001	Washer: #6 Flat.
	GHWI04001	Washer: #4 Internal Tooth.

BIOCOM INC., dba
MEDICAL COMMUNICATIONS AND INSTRUMENTATION

TEST PROCEDURE - TRANSMITTER

1. Remove the Transmitter Module from the unit, remove the cover and re-install using 25 Pin extender card (3550P0167).

2. Select the lowest frequency with the channel selctor switch.

3. Connect a voltmeter to Pin 1 of U1 and adjust R17 for 9.5 V± .1 V.

4. Connect a frequency counter to Pin 5 of U1 and adjust C10 for 3.2 MHz ±10 Hz.

5. Connect a oscilloscope to TP2 on Module 6, connect a wattmeter to the RF Out connector J26, and adjust 6C6 for 5.5 V ±.1 V. A smooth steady trace should be observed after tuning is compleated. If TP2 is not available use Pin 7 of U1.

6. Connect a RF voltmeter to the trace from the output of Module 6 to the input of Module 10, with the voltmeter ground on the Transmitter can, and tune 6L4, and 6L5 for maximum indication (about 100 mV).

7. Connect a oscilloscope to TP4 of Module 10. Key the PTT and tune 10LS with a non-metallic tool for 2.8 V ±.1 V. Unkey and rekey the transmitter while observing the oscilloscope trace, which should be smooth at 2.8 V. If not repeat the above.

8. Key the PTT and tune 10L6, 8C7, 8C4, 8C12 for maximum power output.

9. Adjust 8R4 for 2 W + 10% - 0% power output.

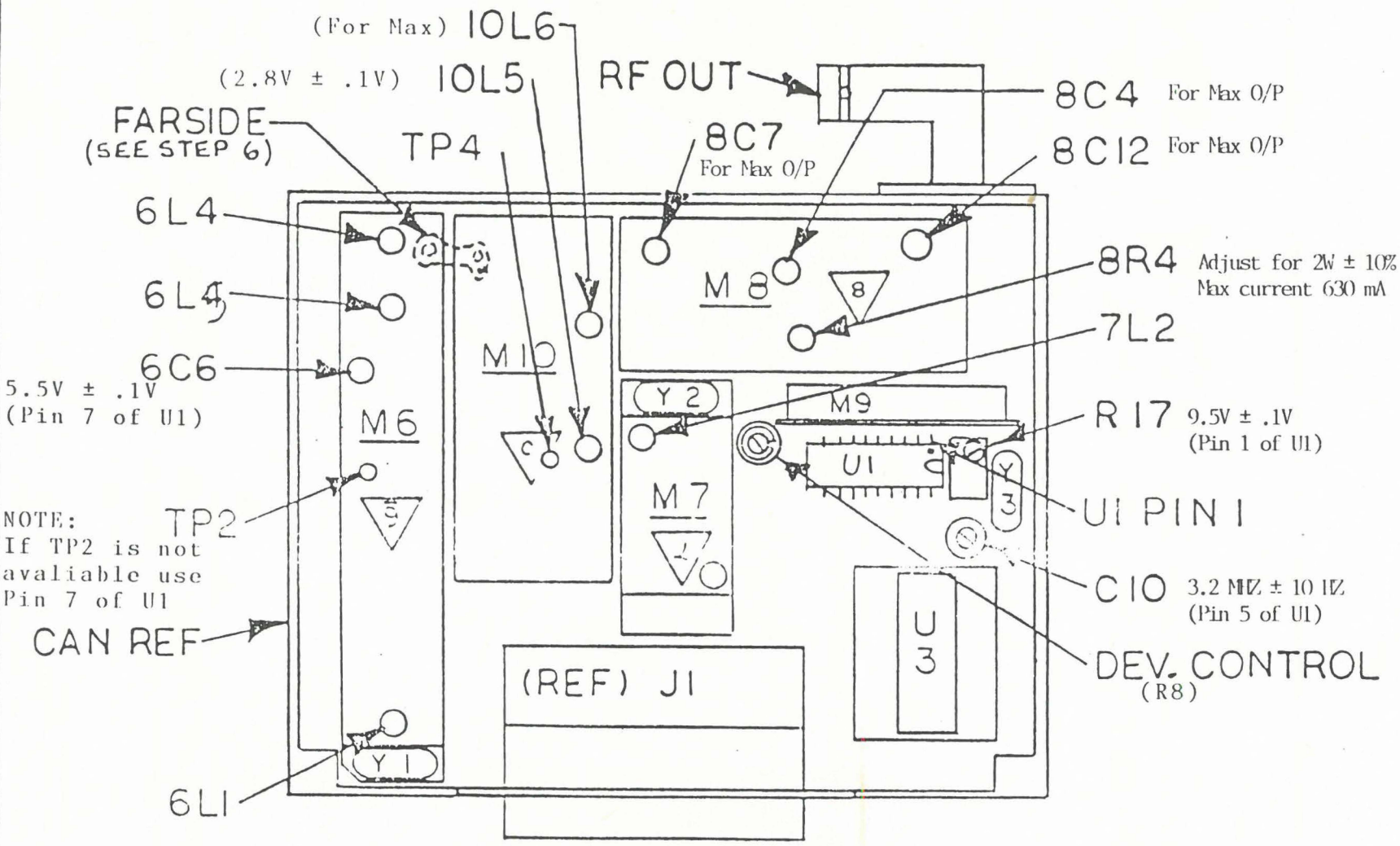
10. Repeat steps 8 and 9 until no further improvement is noted.

11. Check the current during transmission, which should not exceed 630 mA for 2 W.

12. Connect the handset and observe the audio deviation while speaking into the mouth piece. Deviation should be limited to a max of ±5 KHZ at the peak, if not, readjust R8, can also adjust R7 of Med--Pac filter board.

13. Key transmitter using EKG position of MODE Switch and adjust R8 deviation in transmitter assembly for ±4.0 KHZ on the communication monitor, if not, readjust R233 in the Med-Pac Interface board.
    NOTE: For multiplex radios, the deviation should be ±2 KHZ.

CORPORATE HEADQUARTERS 7106 Alabama Avenue • Canoga Park, CA 91303 • (818) 702-9515 • TLX 216330



Repco ORLANDO FLORIDA

1A

RECEIVER ALIGMENT AND TEST PROCEDURE

Use the following procedure to align the Receiver Assembly 3550A0002.

1. Select the channel with the lowest frequency.

2. Connect a voltmeter to Pin 1 of U1 and adjust R7 to 9.5 VDC ±.1V.

3. Using a 10X scope probe connected to the frequency counter, check the oscillator frequency on Pin 5 of U1. Adjust to C23 for 3.2 MHz ± 10 Hz.

4. Measure the DC voltage at TP2 on M6. Adjust to 5.5v ± .1V with 6C6, observing a smooth steady trace on the oscilloscope.

5. Connect the oscilloscope with a 10X probe to TP3 on M1 and tune 6L4, 6L5, and 1L9 for maximum DC output.

6. Tune the signal generator to the selected channel frequency, with no modulation. Open the squelch and adjust the signal level until the noise in the speaker is slightly quieted. Couple the 21.4 MHz signal generator into the M3 module. Listen for the beat note. Adjust the reference oscillator tuning 6L1, if necessary, while listening for zero beat. Connect a sinadder to Handset Connector P9 as in Fig. 2.

7. Modulate the generator with 1 KHz @ ± 3kHz deviation. Adjust 1C4, 1C1, 1C4, 1c3, 1C9, and 1C12 for best sinad while reducing the generator signal level to maintain a noisy signal. After tuning, the signal level should produce 12dB sinad at 0.35 uV or better.

8. Increase the signal generator output to 100uV. Set the Audio Out level to 2V p-p using R2. Audio Out level is measured at Pin 18 of P16 (25 Pin D Connector in Receiver Assembly.)

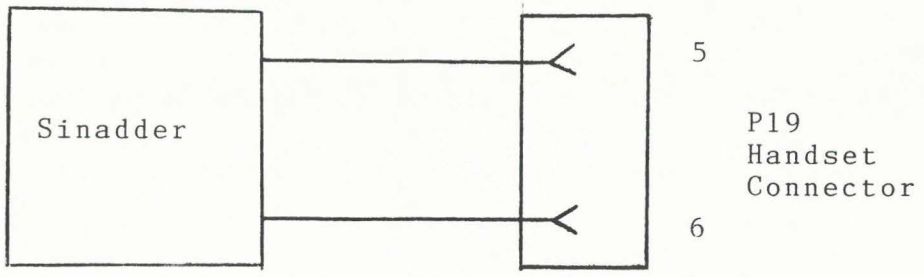


Figure 2
Sinadder Connection

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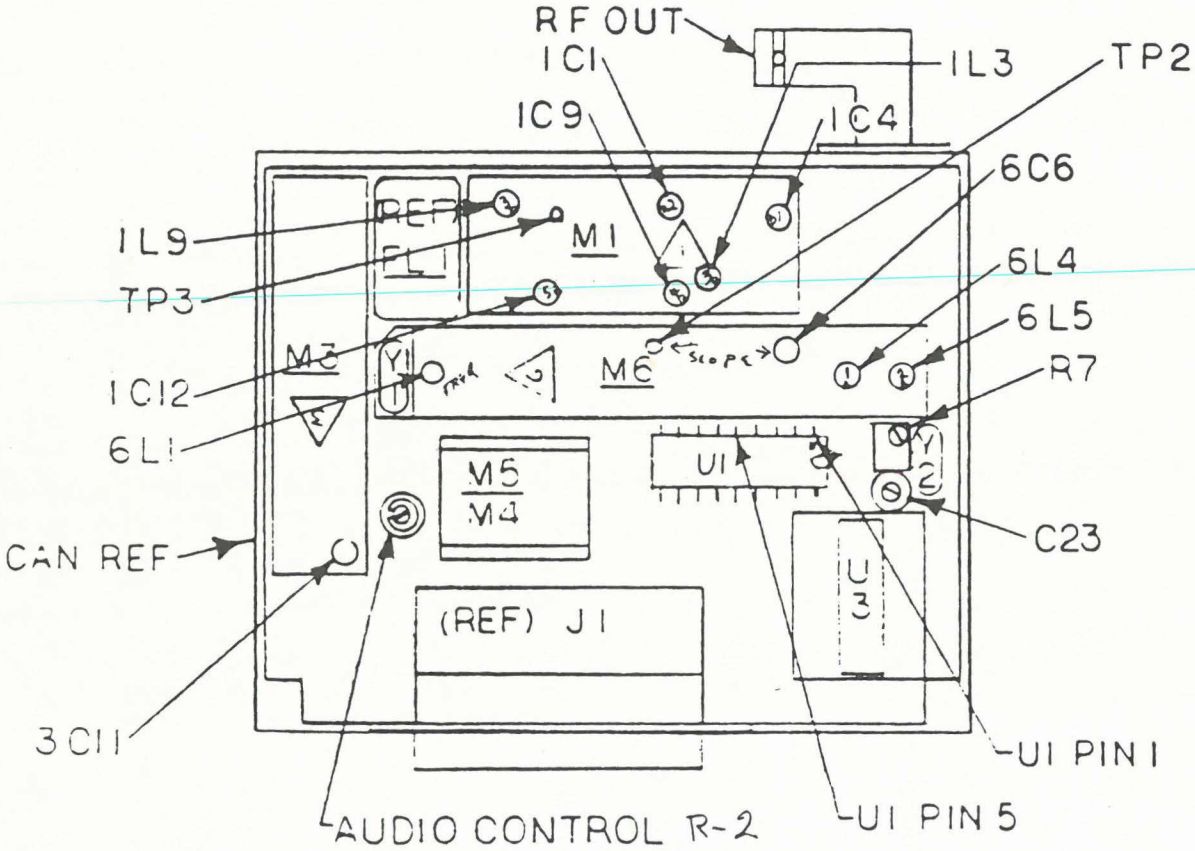

RF OUT
1C1
1L3
TP2
1C9
1C4
6C6
1L9
REF
M1
6L4
TP3
6L5
M2
Y1
M6
R7
1C12
6L1
M5
M4
U1
Y2
C23
CAN REF
U3
(REF) J1
3C11
U1 PIN 1
AUDIO CONTROL R-2
U1 PIN 5

TEST PROCEDURE FOR MED-PAC INTERFACE BOARD

The Med-Pac interface board houses the ECG instrumentation amplifier (U201), integrator (U202), voltage to frequency convertor (U203), frequency devider (U204), the 1mV caliberation signal generator (U252), low power indicator (U251), and transistors switches Q301, Q302, Q304, Q305.

The ECG amplifier consists of a FET high input impedance differential amplifier Q201 with a set gain of 10. It drives a differential to single ended instrumentation amplifier U201. The Burr-Brown instrumentation amplifier has a high CMRR, low offset voltage and high input impedance. The difference between the two input signals is amplified by a gain of 10 set by Pot R212. The overall gain for the two stages is 100 for each 1mV ECG input signal.

This output signal then drives the inverting amplifier U202-C, the inverting amplifier gain (or ECG deviation) is set by R218 for either 100HZ per/mV or 50HZ per/mV depending on the telemetry system design.

R221 sets the output DC offset voltage or subcarrier frequency adjustment (1400HZ ± 28HZ).

The integrator U202-D then drives the necessary voltage to generate the 2800HZ subcarrier oscillator frequency out of U203 which then is split to 1400HZ by U204.

The SCO level is finally set by R233.

TEST PROCEDURE

Unscrew Med-Pac can covers, plug module to the unit using the 25 Pin extender card. Leave mode switch on PTT. Switch power on.

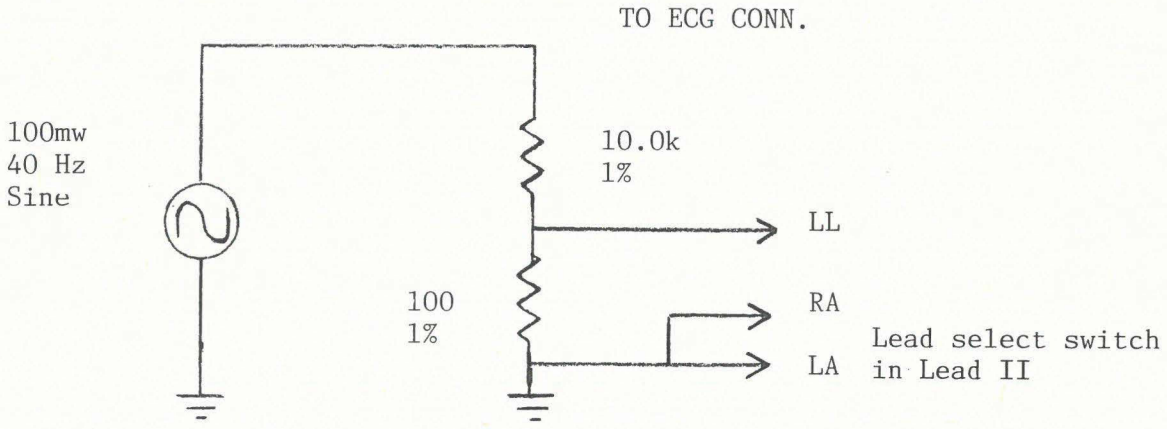
STEP 1 **ECG AMP OFFSET:**
When input voltage of an op amp is zero, the ideal output voltage is also zero. However, this ideal condition cannot be achieved because of D.C. offset caused by the internal input offset and input bias currents of the device. Offset should then be adjusted to minimum. Place scope probe at Pin 8 of U201 and adjust R123 for 0 to ± 5mV.

STEP 2 **ECG AMP GAIN:**
The gain of U201 instrumentation amp is set by R212. Inject a 1mV input signal by depressing the ECG caliberation button on the front panel and check for 100mV output at Pin 8 of U201.

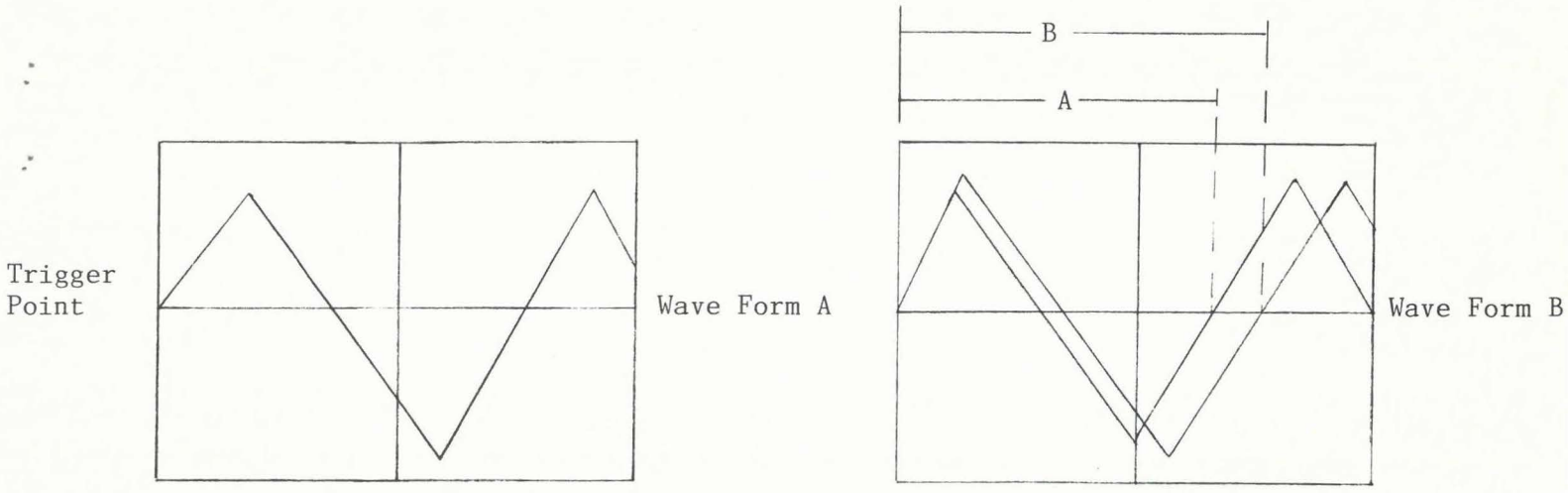
STEP 3 **SCO FREQUENCY:**
Place digital frequency counter probe at Pin 1 of U204 and adjust R221, subcarrier oscillator frequency for 1400 ± 28HZ.

STEP 4 **SCO LEVEL:**
Adjust R233 Pot for 2.6V p/p at Pin 7 of U2 (on filter board) for non-multiplex radio. For multiplex radio, adjust R233 for 800 mV p/p at Pin 7 of U2. This corresponds to ± 2KHZ deviation on communication monitor for multiplex and ± 4KHZ for non-multiplex.

STEP 5 **SCO DEVIATIONS:**
Using the test set-up in the figure below:



Input 1mv p/p signal from set-up into Med-Pac through patient lead input (use patient cable). Connect the oscilloscope to Pin 16 of J1 Med-Pac interface board, and adjust the scope for stable display. It should appear as in figure below.



ECG deviation is set by R218 for either 100HZ/mV or 50HZ/mV.

Deviation is calculated by using the formula:

$$\text{Deviation} = \frac{B - A}{B \times A} \times 1000$$

D = deviation in HZ

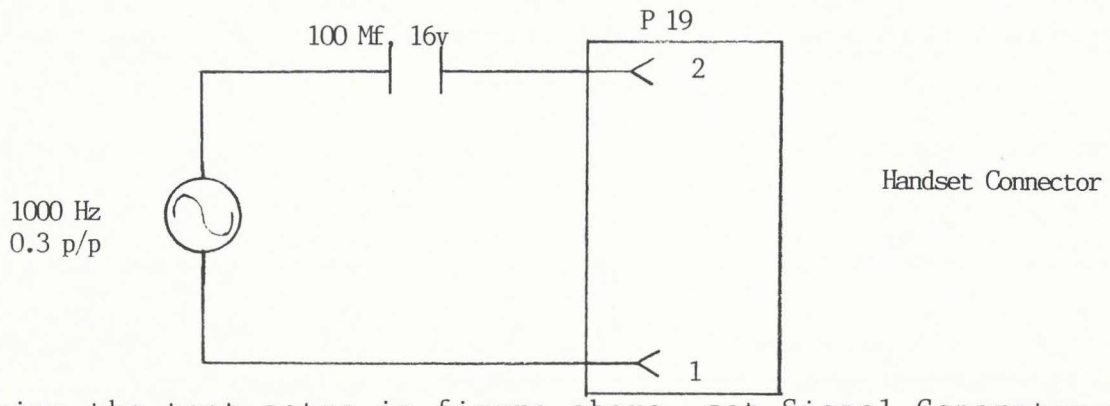
A and B = measure periods in ms

At 100Hz/ms Deviation
A = .681 ms
B = .73 ms

At 50HZ/ms Deviation
A = .695 ms
B = .72 ms

Readjust the VCO frequency for 1400HZ $\pm$ 28HZ in Step 3.

TEST PROCEDURE FOR MED-PAC FILTER BOARD



Using the test setup in figure above, set Signal Generator for 0.3v p/p sinwave at 1000HZ.

AUDIO DEVIATION

STEP 1 Set the mode on PTT. Adjust R7 (Audio Deviation) for 2v p/p measured at TP1 of the Filter Board Generator Signal from 1KHZ Thru 2KHZ checking that there is no clipping.

FOLLOWING IS FOR ALIGNING THE NOTCH FILTER FOR MULTIPLEX OPERATION

STEP 2 Set Signal Generator at 1325HZ. Adjust R9 for a Signal Null at TP2.

STEP 3 Set Signal Generator at 1100HZ. Adjust R12 for a max peak at TP2.

STEP 4 Set Signal Generator at 1475HZ. Adjust R24 for minimum at TP2.

STEP 5 Set Signal Generator at 1750HZ. Adjust R27 for a max peak at TP2.

STEP 6 Set mode to ECG. Set Signal Generator at 1000HZ. Adjust R46 for max at Pin 1 of J23 Tele Connector on the front Panel.

SIGNAL GENERATOR	POT	OUT PUT	TEST POINT
1000HZ	R7	2v p/p	TP1
1325HZ	R9	NULL	TP2
1100HZ	R12	PEAK	TP2
1475HZ	R24	NULL	TP2
1750HZ	R27	PEAK	TP2
1000HZ	R46	MAX	Pin 1 of Tele Conn J23

NOTE: Remove R-43 for non-multiplex operation

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TEST PROCEDURE FOR TONE PAC ASSEMBLY

Use 35 pin extender card. Turn power switch "on".

Lead Check

Set lead select switch on lead check. Each LED should cycle "on" in sequence.

CTCSS Encode Level

Set mode switch on voice, set tone switch on any selected tone. ajust the POT on CTCSS encode tone board to deviate RF carrier for ± 800 Hz.

CTCSS Encode Tones

Connect your CTCSS generator to the HORZ input of the monitor. Select the sub-tones from the corresponding tones. Tone switch i.e. A,B,...ect. generate RF signal with no voice modulation.

A circle should appear on the generator scope, when the selected tone matches the tone frequency of the CTCSS generator.

Repeat the same procedure for all the tones.

CTCSS Decode Tones

Generate a CTCSS signal, to the monitor, set RX tone switch on "on" position on the front panel of the 3550.

Select a tone switch i.e. A,B,...etc.. You should receive the signal at selected tones.

DTMF Encode Level

Adjust the POT on DTMF Encode to deviate the RF carrier for 3.5KHz by depressing any digit while the radio is keyed.

DTMF ANI Speed

The rate at which digits are dialed automatically is adjusted with this control. Factory set rate is 8 digits per second. ANI sequenced is initiated by depressing "*".

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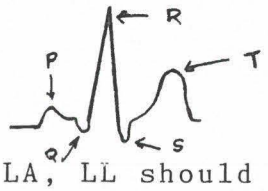
ECG Simulator Test

Connect the oscilloscope to ECG out on the panel. Connect the ECG simulator to ECG (patient input) on the front panel. Key the radio, lead select switch on position I. Should show an output as below. RA, LA light should flash.



Set lead select switch on position II. RA, LA, LL should flash. The amptitude in this position should be bigger then lead I.

Set lead select switch on position III. Only RA should flash. This should be the smallest amptitude.

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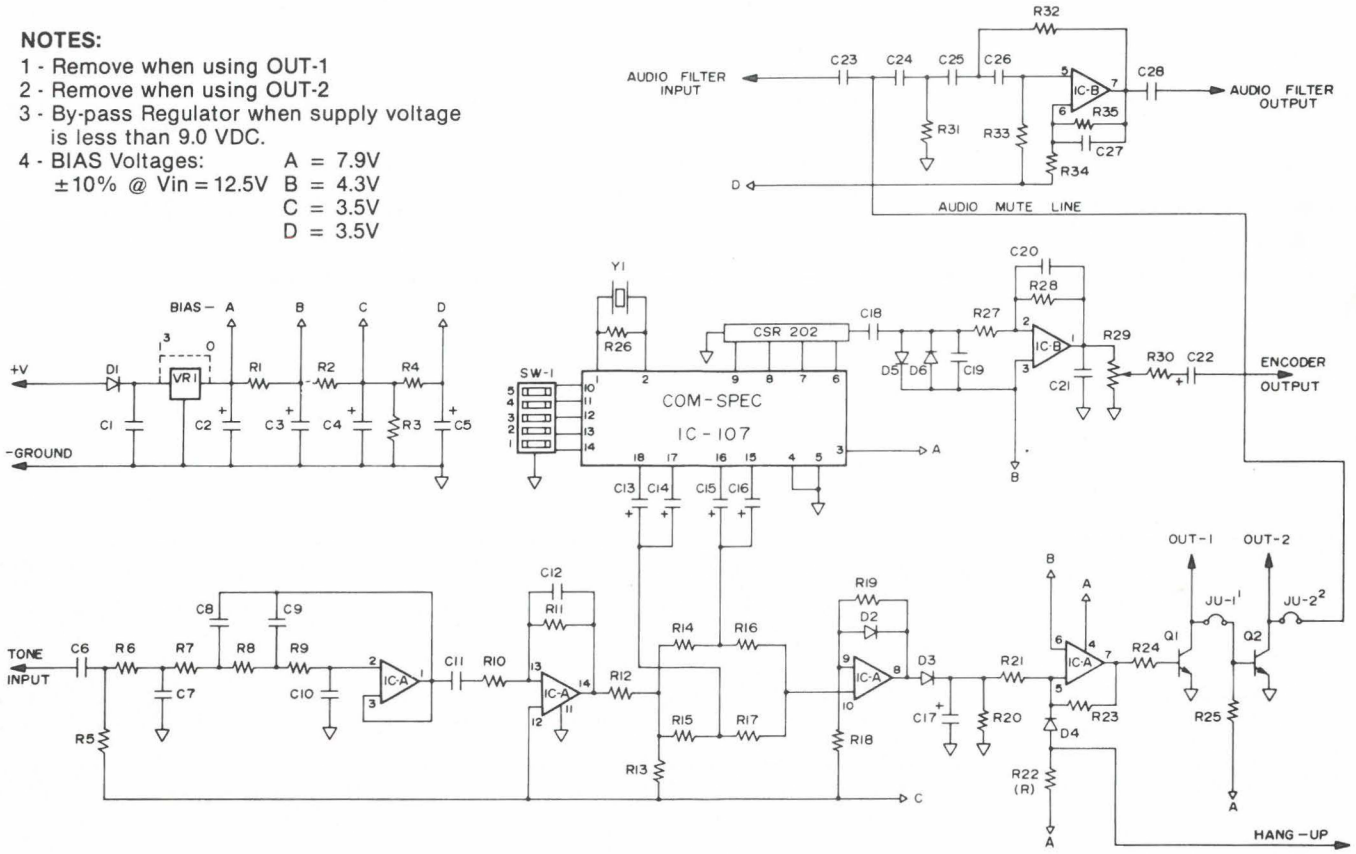
TS-32 INSTRUCTION SHEET

COMMUNICATIONS SPECIALISTS, INC.
426 West Taft Avenue • Orange, CA 92665-4296
Local (714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. 1-800-854-0547

NOTES:

1 - Remove when using OUT-1
2 - Remove when using OUT-2
3 - By-pass Regulator when supply voltage is less than 9.0 VDC.
4 - BIAS Voltages: ±10% @ Vin = 12.5V
A = 7.9V
B = 4.3V
C = 3.5V
D = 3.5V

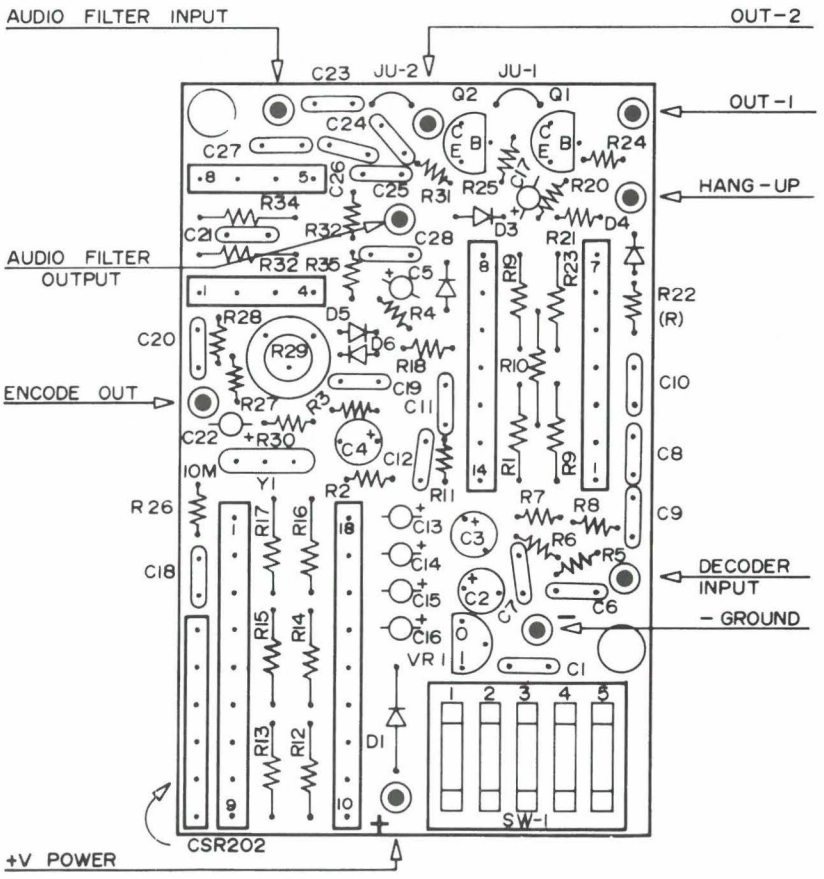


DIP SWITCH PROGRAMMING

(FOR CTCSS PRODUCTS)

#	FREQ.	CODE	SWITCH NUMBER* 5	4	3	2	1
1	67.0	XZ	0	0	0	0	0
2	71.9	XA	0	0	0	0	1
3	74.4	WA	0	0	0	1	0
4	77.0	XB	0	0	0	1	1
5	79.7	SP	0	0	1	0	0
6	82.5	YZ	0	0	1	0	1
7	85.4	YA	0	0	1	1	0
8	88.5	YB	0	0	1	1	1
9	91.5	ZZ	0	1	0	0	0
10	94.8	ZA	0	1	0	0	1
11	97.4	ZB	0	1	0	1	0
12	100.0	1Z	0	1	0	1	1
13	103.5	1A	0	1	1	0	0
14	107.2	1B	0	1	1	0	1
15	110.9	2Z	0	1	1	1	0
16	114.8	2A	0	1	1	1	1
17	118.8	2B	1	0	0	0	0
18	123.0	3Z	1	0	0	0	1
19	127.3	3A	1	0	0	1	0
20	131.8	3B	1	0	0	1	1
21	136.5	4Z	1	0	1	0	0
22	141.3	4A	1	0	1	0	1
23	146.2	4B	1	0	1	1	0
24	151.4	5Z	1	0	1	1	1
25	156.7	5A	1	1	0	0	0
26	162.2	5B	1	1	0	0	1
27	167.9	6Z	1	1	0	1	0
28	173.8	6A	1	1	0	1	1
29	179.9	6B	1	1	1	0	0
30	186.2	7Z	1	1	1	0	1
31	192.8	7A	1	1	1	1	0
32	203.5	M1	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)



TS-32 ENCODER/DECODER PARTS LIST

R1 - 06-1038	10K	1/8 watt	5%	carbon film resistor	$.22 ea.
R2 - 06-2228	2.2K	"	"	" " "	.22 ea.
R3 - 06-1038	10K	"	"	" " "	.22 ea.
R4 - 06-1048	100K	"	"	" " "	.22 ea.
R5 - 06-1058	1Meg	"	"	" " "	.22 ea.
R6 - 06-1058	1Meg	"	"	" " "	.22 ea.
R7 - 06-4748	470K	"	"	" " "	.22 ea.
R8 - 06-5648	560K	"	"	" " "	.22 ea.
R9 - 06-4748	470K	"	"	" " "	.22 ea.
R10 - 06-5628	5.6K	"	"	" " "	.22 ea.
R11 - 06-2758	2.7Meg	"	"	" " "	.22 ea.
R12 - 06-1148	110K	"	"	" " "	.22 ea.
R13 - 06-1538	15K	"	"	" " "	.22 ea.
R14 - 06-1048	100K	"	"	" " "	.22 ea.
R15 - 06-1048	100K	"	"	" " "	.22 ea.
R16 - 06-4748	470K	"	"	" " "	.22 ea.
R17 - 06-4748	470K	"	"	" " "	.22 ea.
R18 - 06-5628	5.6K	"	"	" " "	.22 ea.
R19 - 06-1548	150K	"	"	" " "	.22 ea.
R20 - 06-4748	470K	"	"	" " "	.22 ea.
R21 - 06-1248	120K	"	"	" " "	.22 ea.
R22 - 06-4738	47K	"	"	" " "	.22 ea.
R23 - 06-1058	1Meg	"	"	" " "	.22 ea.
R24 - 06-1038	10K	"	"	" " "	.22 ea.
R25 - 06-1038	10K	"	"	" " "	.22 ea.
R26 - 06-1068	10Meg	"	10%	" " "	.22 ea.
R27 - 06-1538	15K	"	5%	" " "	.22 ea.
R28 - 06-1048	100K	"	"	" " "	.22 ea.
R29 - 18-5020	5K	Mepco	potentiometer		1.39 ea.
R30 - 06-1228	1.2K	1/8 watt	5%	carbon film resistor	.22 ea.
R31 - 06-4748	470K	"	"	" " "	.22 ea.
R32 - 06-2248	220K	"	"	" " "	.22 ea.
R34 - 06-1058	1Meg	"	"	" " "	.22 ea.
C1 - 21-2240	.22uf	50v	CZ20	ceramic	.23 ea.
C2 - 23-1000	10uf	16v	alum. elect.		.30 ea.
C3 - 23-1000	10uf	"	" "		.30 ea.
C4 - 19-1060	10uf	"	tantalum elect.		1.40 ea.
C5 - 19-1050	1uf	35v	" "		1.05 ea.
C6 - 21-1030	.01uf	50v	CW15	ceramic	.14 ea.
C7 - 21-3320	3300pf	"	"	"	.15 ea.
C8 - 21-3320	3300pf	50v	CW15	ceramic	.15 ea.
C9 - 21-3320	3300pf	"	"	"	.15 ea.
C10 - 21-2210	220pf	"	CN15	"	.18 ea.
C11 - 21-2240	.22uf	"	CZ20	"	.23 ea.
C12 - 21-2710	270pf	"	CN15	"	.18 ea.
C13 - 19-1050	1uf	35v	tantalum		1.05 ea.
C14 - 19-1050	1uf	"	"		1.05 ea.
C15 - 19-1050	1uf	"	"		1.05 ea.
C16 - 19-1050	1uf	"	"		1.05 ea.
C17 - 19-1050	1uf	"	"		1.05 ea.
C18 - 21-2240	.22uf	50v	CZ20	ceramic	.23 ea.
C19 - 21-1010	100uf	"	CN15	"	.15 ea.
C20 - 21-1030	.01uf	"	CW15	"	.14 ea.
C21 - 21-1010	100pf	"	CN15	"	.15 ea.
C22 - 19-1050	1uf	35v	tantalum		1.05 ea.
C23 - 21-1520	1500pf	50v	CW15	ceramic	.15 ea.
C24 - 21-1030	.01uf	"	"	"	.14 ea.
C25 - 21-1520	1500pf	"	"	"	.15 ea.
C26 - 21-1520	1500pf	"	"	"	.15 ea.
C28 - 21-2240	.22uf	"	CZ20	"	.23 ea.
D1 - 48-4148	1N4148	silicon	diode		.15 ea.
D2 - 48-4148	1N4148	"	"		.15 ea.
D3 - 48-4148	1N4148	"	"		.15 ea.
D4 - 48-4148	1N4148	"	"		.15 ea.
D5 - 48-4148	1N4148	"	"		.15 ea.
D6 - 48-4148	1N4148	"	"		.15 ea.
Z1 - 51-1217	CSR202	resistor	network		.81 ea.
Y1 - 48-1000	1.000Mhz	crystal			7.50 ea.
SW-1 - 40-1005	5 code	switch			2.45 ea.
VR-1 - 48-3636	78L08	regulator			.75 ea.
Q1 - 48-4401	2N4401	transistor			.21 ea.
Q2 - 48-0042	MPSA42	"			.30 ea.
IC-B - 51-0062	TL062				2.20 ea.
IC-A - 51-0001	LM324 microcircuit				.90 ea.
1 - 51-0107	IC-107 Com-Spec microcircuit				17.50 ea.
2 - 09-4504	4 pin strip sockets				.35 ea.
2 - 09-4507	7 pin strip sockets				.37 ea.
2 - 09-4509	9 pin strip sockets				.39 ea.
9 - 05-1007	bead chassis pins				.02 ea.
1 - 84-1003	Printed circuit board				6.00 ea.
	33 pos. Binary Switch (for remote operation)				9.95 ea.

MOUNTING

Mount the unit with the mounting items supplied. Do not mount the unit with silicon seal or any other type glues as this will void warranty.

If mounting with a 90° angle bracket, be sure to use the fiber washers supplied to avoid any circuit board shorts. Use the push-on wire kit supplied with the unit. **DO NOT** solder the wires to the board.

PROGRAMMING

This programmable line of products uses a five position DIP switch to select the frequency desired. When the switches are in any particular position, this binary code tells the integrated circuit on which one of the coded tones the system will operate. For instance, if 1Z (100.0Hz.) is desired, the code rquired is located on the instruction sheet and the switches are programmed accordingly. For example, the code for a 1Z is "11010", thus switch #1 is turned OFF (corresponding to a "1"), switch #2 is turned OFF, switch #3 is turned ON (corresponding to a "0"), switch #4 is OFF, and switch #5 is turned ON. By selecting the variable combinations of switch positions, all 32 tones can be accessed. Special tones are available also by using a different frequency crystal.

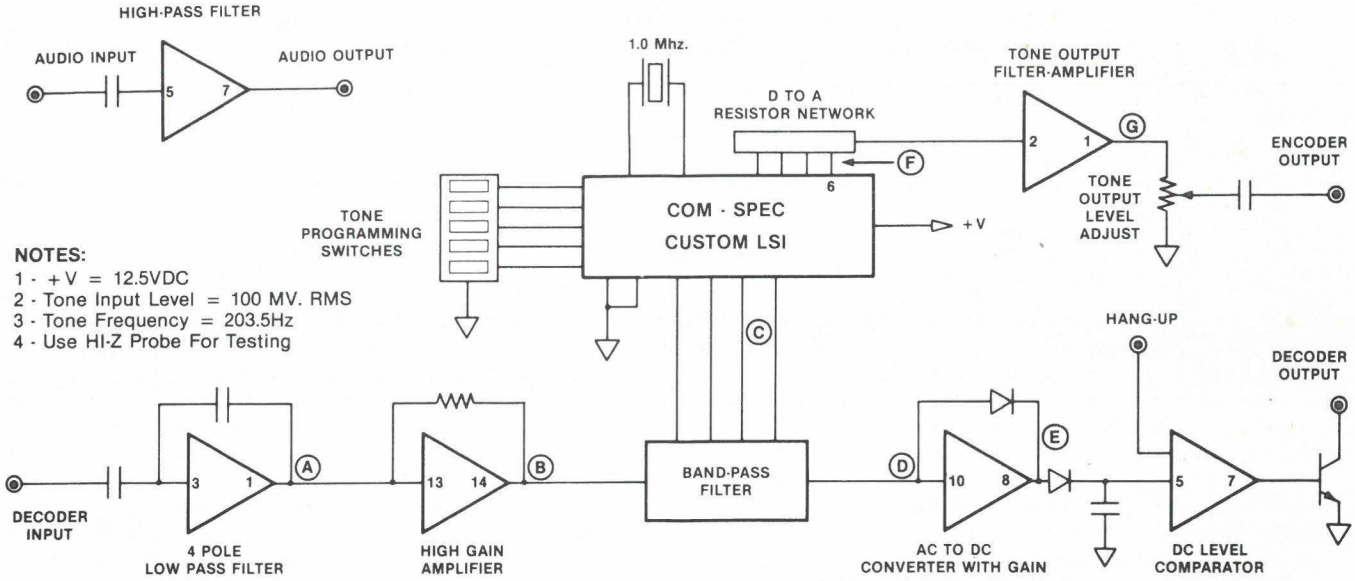
POWER AND GROUND CONNECTIONS

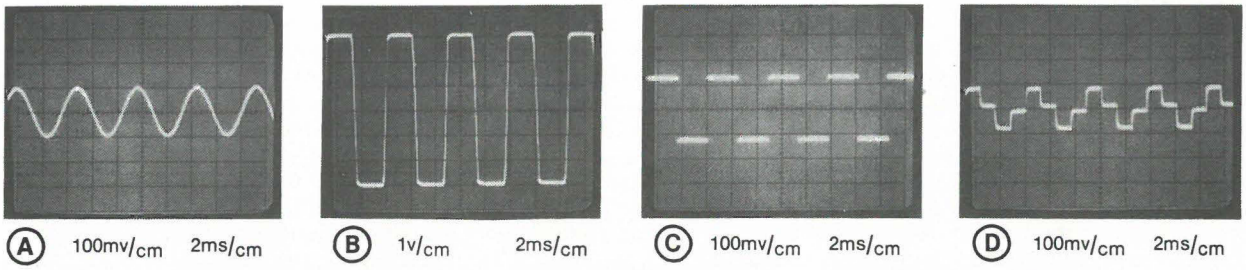
The ground connection is typically very straight forward. The main ground foil on the printed circuit foil works well, or a connection to the chassis. Be careful of a radio which has multiple grounds, such as a chassis ground and a true vehicle ground. A GE Mastr Pro is a good example.

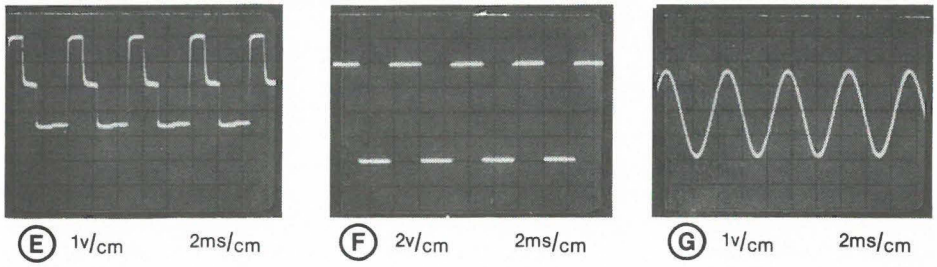
The power connection can be any unregulated positive D.C. voltage from +6.0 to +30.0V. Use a regulated voltage if it is conveniently available. However, with voltages below 9.0VDC, place a wire jumper across the regulator (VR-1) on the circuit board. See the circuit board pictorial for the placement of the jumper. This allows the board to work better at low voltages since the regulator only operates above 9.0V. Higher voltage can also be used, however an external limiting resistor will be required so the input does not exceed 30VDC. To determine the approximate value of the resistor (in Kohms) use the following formula: R = (V - 22) / 8. A two watt resistor should be sufficient for voltages up to 200VDC. Refer to figures 1, 2, 3 for additional information. If polarity is reversed to the unit, it will not operate but will not be damaged. Use the following as a guide for obtaining proper operating voltage in different environments:

Mobiles, 12V negative ground—standard hook-up (see above).
Mobiles, 12V positive ground—reverse board +V and GND connections, return mike hang-up to +V instead of ground on decode models.
Mobiles, 6V pos. or neg. ground—use B+ dropping method.
Bases—use appropriate figure 1, 2, 3.
Portables, 9V or less—by-pass regulator, VR-1.

TROUBLE-SHOOTING THE TS-32







THEORY OF OPERATION

ENCODE SECTION

The desired encoder output signal is derived from a highly stable 1.000MHz. quartz crystal oscillator. This oscillator is contained inside the IC-107, which is a custom LSI consisting of in excess of 1000 CMOS gates. The output of the oscillator is divided and synthesized to the proper sub-audible frequency according to the programmed setting on the external 5 position DIP switch. This lower frequency is then fed to the resistor network in digital form. The resistor network combines all the outputs from the IC-107, and produces a triangle wave on its output. This output is shaped into a low distortion sinewave by diodes D5 and D6. The sine wave is then filtered and amplified by the op-amp producing a high level sine wave output.

DECODE SECTION

The decoder input is processed through a 4 pole low pass filter to eliminate all frequencies passing into the decoder except the desired sub-audible tone. This filtered output is then amplified and fed into the bandpass filter. The low level output of the filter is then re-amplified and converted to a DC level which is compared to a reference in the last stage of the op-amp. If the DC input level exceeded the level of the reference voltage, then the output of this stage (pin 7) will switch high and activate the switching transistors. Thus, the decoder action can be verified by probing pin 7 of the LM 324.

AUDIO FILTER SECTION

This is a 3 pole High Pass Filter which attenutates all frequencies below 300Hz. The frequency selective components determine the cutoff frequency, and the rate of attenuation. The audio mute line controls the audio passing through the filter. If no decoded tone is received, then this line is at ground potential. When the proper tone is received, then OUT-2 ungrounds the line and releases control of the audio filter.

TROUBLE-SHOOTING HINTS

1. Verify all waveforms shown on the block diagram above.
2. Check all bias voltages shown on the schematic diagram.
3. To test OUT-1 or OUT-2, connect a 10K resistor from +V to OUT-1 or OUT-2 respectively.
4. When testing OUT-1 or OUT-2 be sure the proper jumpers are removed.

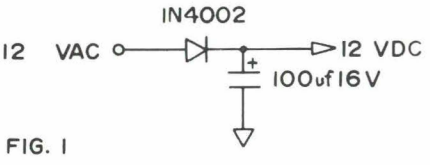


FIG. 1

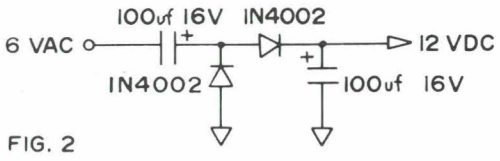


FIG. 2

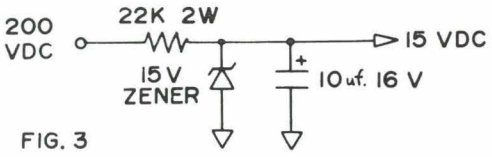


FIG. 3

PROCEDURE FOR CONNECTING SUB-AUDIBLE ENCODER TONE TO TRANSMITTER

The encoder tone output is typically connected just prior to the modulator stage. Typical connections would be to the center of the deviation control, to the input of the final audio driver, to the varactor modulator diodes or to the manufacturer's normal connection point. This connection point varies with each different model radio, and you must determine which provides the best results. In a tube type transmitter, the grid of the modulator is often used, or a varactor kit should be used to modulate the crystal directly in a tube type or solid state transmitter, see figure E1. The VARACTOR (transistor base to collector junction of an NPN silicon transistor) changes A.C. voltage into changing capacitance which truely FM modulates the transmitter. No intermoding or distortion of the voice will be noted with this method. Various values of coupling capacitors are shown for different frequency ranges of the transmitter. A higher value of capacitance will increase the deviation level, however if the capacitance is too high, it may be difficult to set the transmitter on frequency. Varactor Kits are available from us for $3.00 each. Use this method if other connection points prove unsuccessful.

DO NOT connect the encoder tone to the microphone input as this invariably causes excessive tone and harmonic distortion due to the frequency response of the transmitter's speech amplifier. The speech amplifier has a typical response of 300Hz to 3000Hz and does not permit the fundamental tone to be transmitted. This is the usual cause of a distorted tone output as monitored on a deviation scope.

The output of our encoder is low Z, so it is capable of driving low Z loads. Insufficient level output should never be a problem. However, if you are driving a high Z load such as 100k deviation pot, then a series isolation resistor should be used so the encoder will not load down the normal voice modulation. This resistor value must be determined experimentally, but a 100k resistor would be a good starting point. This value could change from 10K to 1 meg depending on the radio used.

If tone distortion continues to be a problem, then a capacitor can be placed on the tone output to provide additional filtering where required, see figure E2. This is most noticeable in phase modulators since the frequency response seems to be quite poor at the low end of the audio range. If you are using a deviation scope, then little spikes will be riding on the sine wave output, and this will sound like a buzz. The additional filtering will cure the problem. True FM modulators do not have this problem and are very easy to work with and interface very well with sub-audible encoders. These modulators can be identified quite easily since the audio is fed into a varactor which is often connected in parallel with the crystal. If the purity of the encoder output is in question, look at the output of the encoder with an oscilloscope.

Most UHF transmitters interface quite well with sub-audible encoders. This is primarily due to the high multiplication factor from the modulator to the final amplifier stage. Because of the lower number of multiplication stages in low band transmitters, sufficient deviation level can sometimes be difficult to obtain.

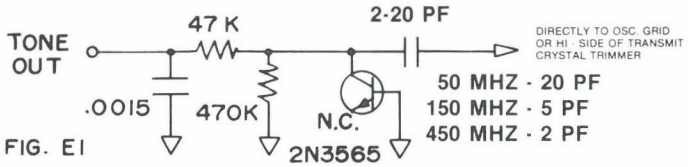


FIG. E1

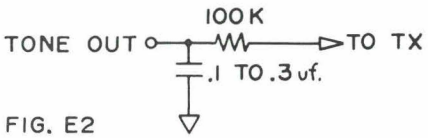


FIG. E2

DECODER TONE INPUT

Hook tone input on board directly to the discriminator of the receiver forward of any metering resistance going to the discriminator jack. Some receivers provide amplified audio which is used to drive factory installed tone decoders. If your receiver has such an amplifier in it, it may be used. In tube type receivers, shielded wire may be necessary.

If decoder input level appears to be a problem, check for square waves on pin 14 of the LM324 using an oscilloscope with tone input applied. If square waves are not present with tone input, then a higher level input will be required. Try the next audio amplification stage after the discriminator. **Do not use** the speaker output or the final audio amplifier for the tone input, as the frequency response is attenuated below 300Hz and provides insufficient tone for decoding.

HANG-UP

In normal operation (tone squelch), the hang-up lead is grounded by the mike hookswitch until the mike is removed from the hanger. In order to get a decoded output, the **hang-up must be grounded.** Ungrounding the hang-up pin allows the switching circuit to unmute the receiver to simulate a decode condition for monitoring of the channel prior to transmitting. If a hookswitch is not provided, then a S.P.S.T. switch should be used to enable and disable the decoder. Resistor R22 (47K) is cut out if +V is supplied to the hang-up as in the RCA type of radios. Some mikes have the hang-up wire in the mike cord going to the rear mounting of the mike so no extra hang-up hookswitch is required.

RECEIVER MUTING (Squelch Gating)

The TS-32 has two options for muting the circuitry in the receive audio chain. The easiest way is to use the muting option in the high pass audio filter. This is enabled by using JU-2 on the TS-32 PCB as shipped from the factory. When a signal of the proper frequency is decoded, the decoded output from OUT-2 turns on the audio being passed through the audio filter by controlling the mute line. When the tone input stops, OUT-2 returns to ground and mutes the audio. By using this method, no connections are necessary to the squelch circuitry.

The other method of receiver muting is to use one of the two decoder control outputs labeled OUT-1 and OUT-2. OUT-1, open collector transistor pulls OUT-1 to ground upon receipt of proper tone. OUT-2, open collector transistor pulls OUT-2 away from ground upon receipt of proper tone.

OUT-1 is used mainly for driving relays. A relay that draws less than 120ma. (100ohm coil) should be used. Be sure to put a diode across the relay to prevent damage to the 2N3390 transistor. The other side of the relay should be connected to the supply voltage of less than 30vdc. This output is used to mute the audio in some receivers also, but in most cases, OUT-2 will always be used. Also, **be sure** to remove JU-1 when using OUT-1.

OUT-2 is the control output to use if the automatic muting feature in the audio filter is not desired. If using OUT-2, **be sure** to remove JU-2.

The OUT-2 transistor is a high voltage device and is therefore capable of muting even tube type receivers when required. The normal connection point in this type of receiver is to the plate of the squelch tube through a 1 meg. resistor as in a GE Progress Line. For solid state receivers, the normal connection point is to the collector of the squelch switch transistor. Where this point is not easily identified, the following procedure can be used to identify the proper point for the OUT-2 Connection:

1. Using a clip lead, connect one side to ground.
2. Connect 100 ohm resistor to the other end.
3. Using the open end of the resistor, probe around in the receiver **with the squelch open** to locate a point which will mute the receiver audio when the resistor is connected to that point. This point may be in the squelch circuitry, or possibly in the audio stages. When an IC is used for the audio section, often one pin on the IC will mute the audio.

AUDIO HIGH PASS FILTER CONNECTIONS

The audio filter is used to remove the sub-audible tone from the received audio. The filter is not always required since the frequency response of most receivers is limited to 300HZ to 3000Hz. If the level of the tone is not objectional at normal listening levels then chances are that the filter will not be required.

In those cases where the filter is required, it will attenuate the encoded tone quite well with the attenuation down more than 35db at 100Hz.

The filter should be connected to a point in the receiver where the audio level is less than 1.5v RMS, and the power level is low. The speaker path would **not be** the place to connect the filter. Typical connection points would be in series off the center of the volume control, or directly off the discriminator output. Thus, the audio path off these points should be cut, then hook up the input and output wires in series with that broken path. Make sure the audio passing through this point is A.C. coupled to the next stage, or the bias could be changed when the filter is connected in the circuit.

Automatic muting for the receiver is provided in the audio filter if desired. This is accomplished by JU-2 which connects the decoder output to the audio mute line coming from the audio filter. If this feature is not required then be sure to remove JU-2. See Squelch Gating for additional information.

If signal feed through is noticed when the filter is muted, then one of the alternate methods of audio muting should be used, or the filter should be connected in a different location in the receiver. This should not be necessary since the filter can mute the audio with up to 60db of attenuation.

RF INTERFERENCE

Although our encoders are not susceptable to RF, care must be taken when locating the unit, and how the wires are routed. In most cases of RF interference it has been found that the RF is coupled into the leads of the encoder and then fed back into the radio itself where the RF upsets the bias conditions in the transmitter. This causes distortion and other unusual effects. But under these conditions it will be noted that the encoder is still working properly. This is most common in portable hand held radios, since often the circuitry is compromised slightly to achieve the small size required. Often a small by-pass capacitor such as a 100pf. on the radio's circuit board works quite well. Also, keeping all leads as short as possible or re-routing the wires helps.

MULTI-TONE APPLICATIONS

By adding a little additional circuitry, our programmable line of products may be frequency programmed by remote means. Since these products all use DC signals for switching, any number of tones may be switched in or out without being concerned with additional lead length, or stray capacitance affecting the frequency. This is a typical problem associated with tunable type units and also those using reeds.

There are a number of ways of changing frequencies from a remote location. The easiest way is to use a 33 position binary switch (available from us) which connects in parallel with the 5 position DIP switch on the circuit board. Thus all 32 tones may be accessed by rotating through all positions on the switch, with the first position on the switch being the off condition (see figure M1). When connections are made in this manner, position ONE will be the off condition, and the path from "G" to "H" will be open thereby removing power from the programmable board. Position TWO would be 67.0Hz (Group A), position three would be 71.9Hz, and so on up to position 33 which would be 203.5Hz. When using the binary switch be sure all five positions on the DIP switch are in the **OFF** condition.

The other method for adding additional frequencies is to use a single pole rotary switch with as many positions as the number of different frequencies required. Using this method, a diode for line isolation must be used in each leg of the program code which requires a "0" or a ground for programming (see figure M2). In this example, three frequencies are required to operate a three site repeater system. The sub-audible tones required to access all three sites are 5Z (151.4Hz), 4B (146.2Hz), and YZ (82.5Hz). The frequency code is located on the programming chart for each of the three frequencies and these codes are converted to the appropriate diode array for each frequency. For example, position number two on the rotary switch must be 146.2Hz. This corresponds to "10110" on the program chart. By looking at this code, it is determined that 2 diodes will be required on the locations containing a "0", and no connection is required in the locations containing a "1". Thus the lines from pin 11, and pin 14, on IC-107 are pulled to ground through the series diodes when the rotary switch is in position number two. This method works quite well where space is a factor, and is best when only a few frequencies are required. Be sure all five positions on the DIP switch are in the **OFF** condition when changing frequencies remotely.

FIGURE – M1

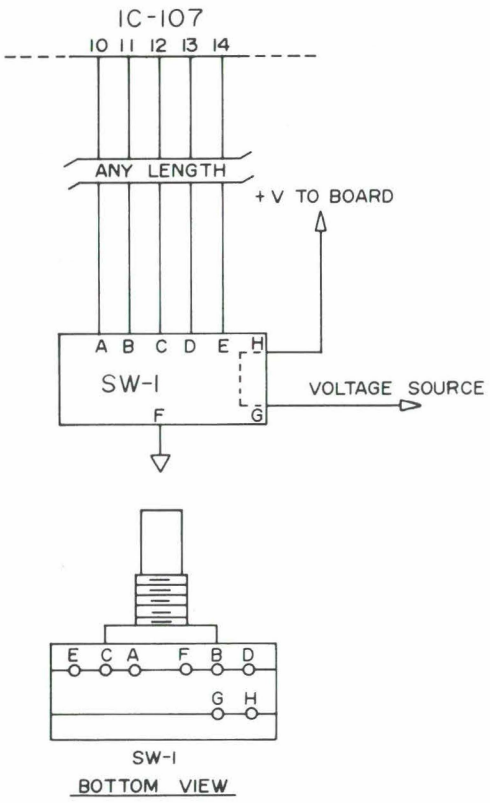
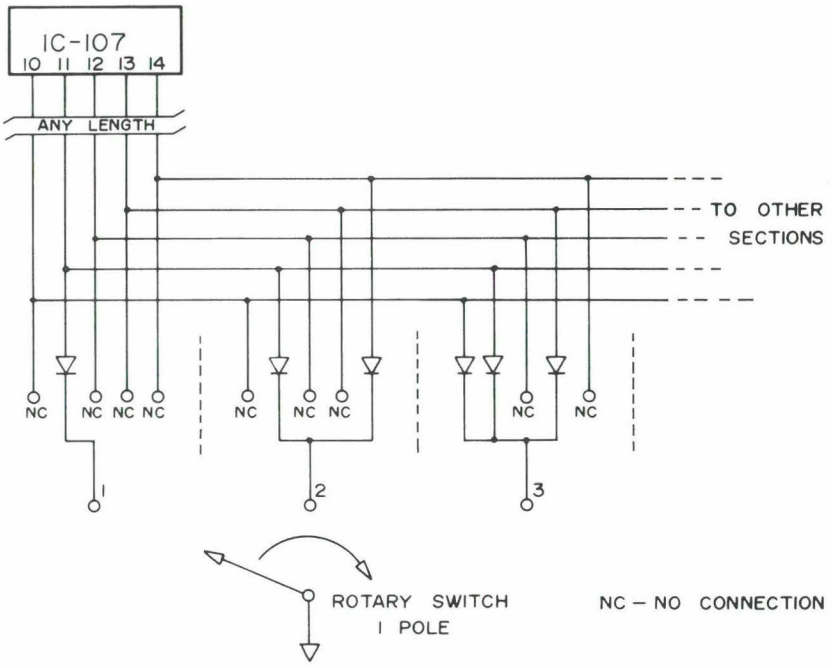


FIGURE – M2



MIDIAN ELECTRONICS INCORPORATED

SPECIALISTS IN TONE SIGNALING EQUIPMENT

2302 EAST 22ND STREET (602) 884-7981 TUCSON, ARIZONA 85713

ANI 2 INSTRUCTION SHEET

The ANI 2 is a subminiature Touch Tone * Encoder and Automatic Number Identifier capable of generating the 16 Standard Bell System Touch Tones *. This synthesized tone encoder employes a ceramic controlled master oscillator for high accuracy and stability.

The keyboard and scanned diode matrix provides a logic low (ground) to the proper column and row inputs on IC 4. This programs the internal divide by N counters so that the proper high and low tone groups are generated. The synthesized high and low group tones are output on Pin 16 of IC 4 and fed to level pot R 16. Any high frequency components generated by the digital to analog converter are filtered out by R 5 and C 7. The high tones are pre-emphasized 3db over the low tones. This is an internal feature of IC 4 and can be reduced by increasing the value of C 7. Pre-emphasis helps compensate for the high frequency roll-off which occurs on the phone lines and in the modulator circuitry. The audio is brought out on the orange lead where it is then fed to the microphone input of the transmitter. Transmitter deviation can be set to 3.3 KC by adjusting R 16.

Single tones can be generated by simultaneously pressing two buttons in the same column or row. The tone frequency generated will be the one associated with the column or row in which both buttons were pressed. This may be helpful in setting transmitter deviation or systems levels.

Diode Matrix (D 9 - D 40) is sequentially scanned by a ground signal from the eight output multiplexer chip IC 3. The scan starts at "A" and ends at "H". When the scan is complete, IC 3's outputs A through H tri-state to an open condition. IC 2 provides a three line binary address to IC 3. When IC 2 reaches a count of 8, that is when the fourth address line (pin 6) goes high, the clock circuit IC1E and F is inhibited leaving IC 2 with Pin 6 high and IC 3 tri-stated.

The ANI is activated by applying a reset pulse to IC 2 on Pin 7 as a result of hitting ★, # or PTT. When IC 2 resets, the clock is no longer inhibited and IC 3 is no longer tri-stated. After a short time delay, usually about 50 msec, IC 2 starts counting, generating a new ANI sequence until an 8 count is reached again.

The clock IC1E and F controls the speed of the ANI. The speed can be varied to suit your particular requirements by adjusting R 12.

The ANI sequence can be activated by pressing the ★ or # or by the transmitter push to talk circuit. When using the ★ or # to activate the ANI, the ★ or # tone can go out ahead of the ANI or can be muted so that only the ANI is sent out. This feature is selectable by cutting JU 1.

IC1B decodes the ★ or # from the keyboard. IC1A inverts the output of IC1B and mutes IC 4 when the ★ or # is depressed, provided JU 1 is installed. With JU 1 installed, no ★ or # tone will be outputted when the ★ or # is depressed. 60 MS after the ★ or # key is released, the ANI sequence will start. If it is desired to send the ★ or # tone when the ★ or # key is depressed, simply cut JU 1, which is located on the solder side of the board.

Activation of the ANI sequence by the ★ key can be defeated by cutting the run at "S" on the solder side diagram. Activation of the sequence by the # key can be defeated by cutting the run indicated at "P" on the solder side diagram.

If the ★ or # **is used in the ANI sequence**, it **cannot** be used to **activate** the ANI sequence.

AUTOMATIC PTT

When using the transmitter push to talk circuit to activate the ANI, you may select either ground PTT or positive PTT. For ground PTT, the brown lead can usually be tied in at the radio's PTT switch. For positive PTT, the yellow lead can usually be connected to the transmitter switched B+ circuit. The PTT circuit also features a delay circuit so that the ANI does not go out every time the transmitter is keyed. It can prevent the ANI from occuring during an 18 second interval following the end of the last transmission. This feature can be defeated by removing the timing capacitor C 10.

The automatic push to talk circuit consists of D 44, R 1, R 2, C 1, Q 1 and RL 1. When a key is depressed, Pin 10 of IC 4 pulls to ground, instantly charging C 1. This turns on Q 1 which can be used to key the transmitter. The time constant of R 2 and C 1 keeps Q 1 on for about 2 seconds between key entries. An optional LED can be installed on the keyboard to indicate when Q 1 is activated. The white lead from Q 1 is a pull to ground, and can be used for automatic keying of the transmitter. The green leads of optional relay RL 1 (ANI 2B) can also be used for automatic keying of the transmitter or Mike Mute, etc. The black lead should be connected to ground while the red lead usually can be connected to the on/off switch.

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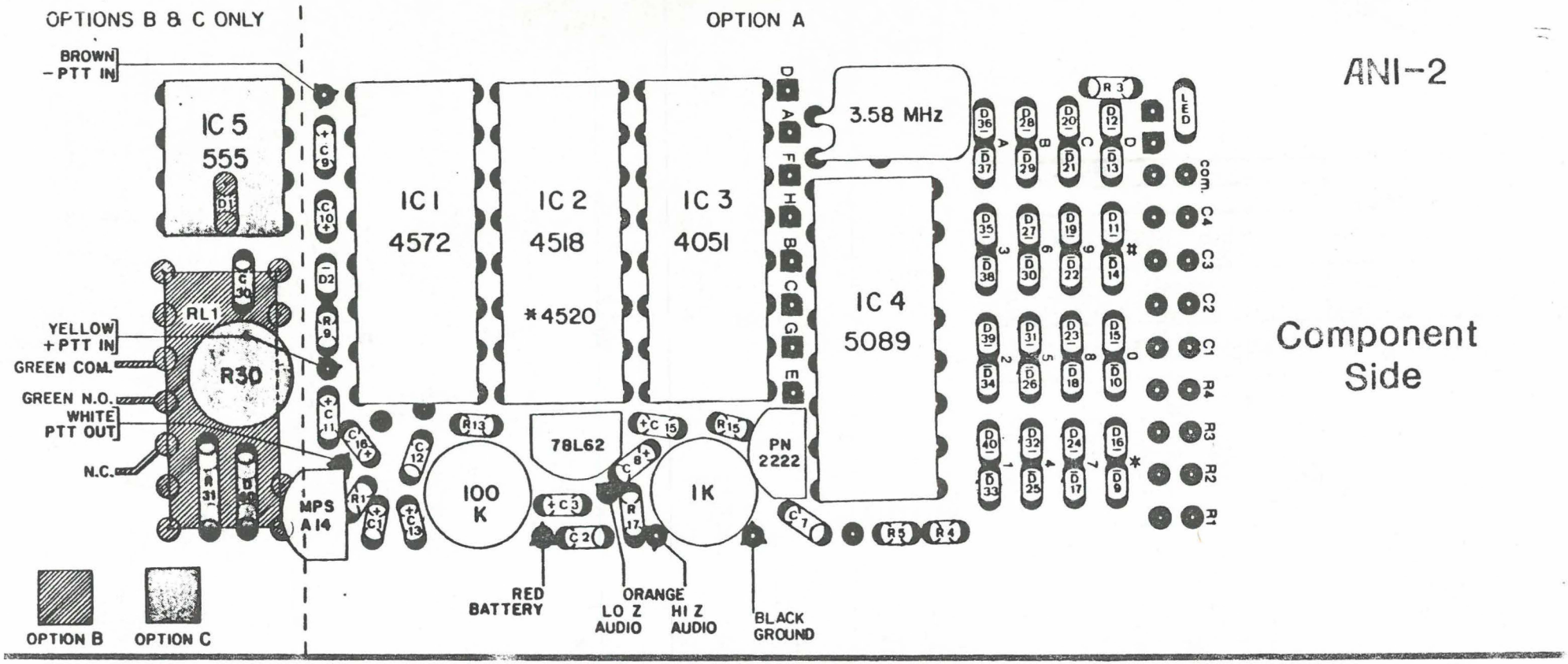
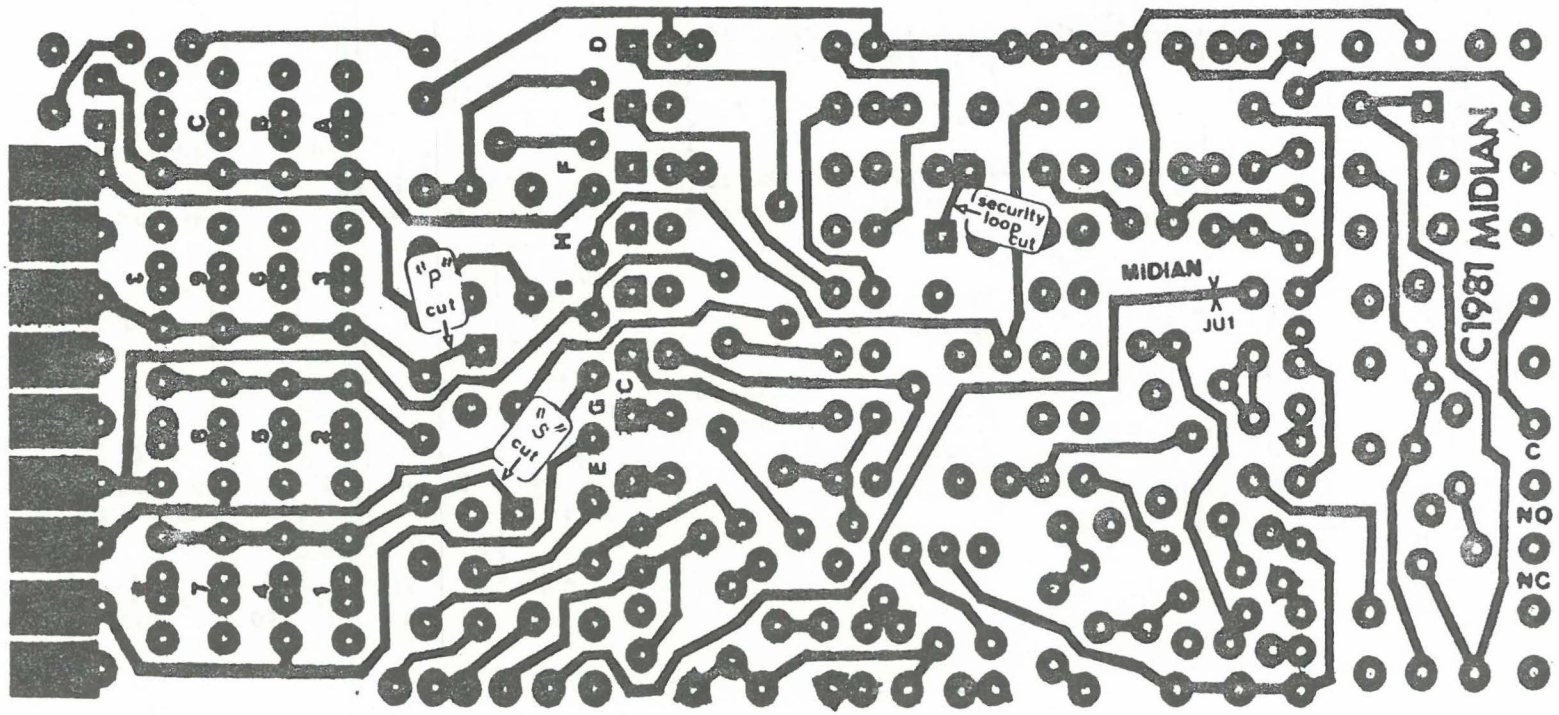
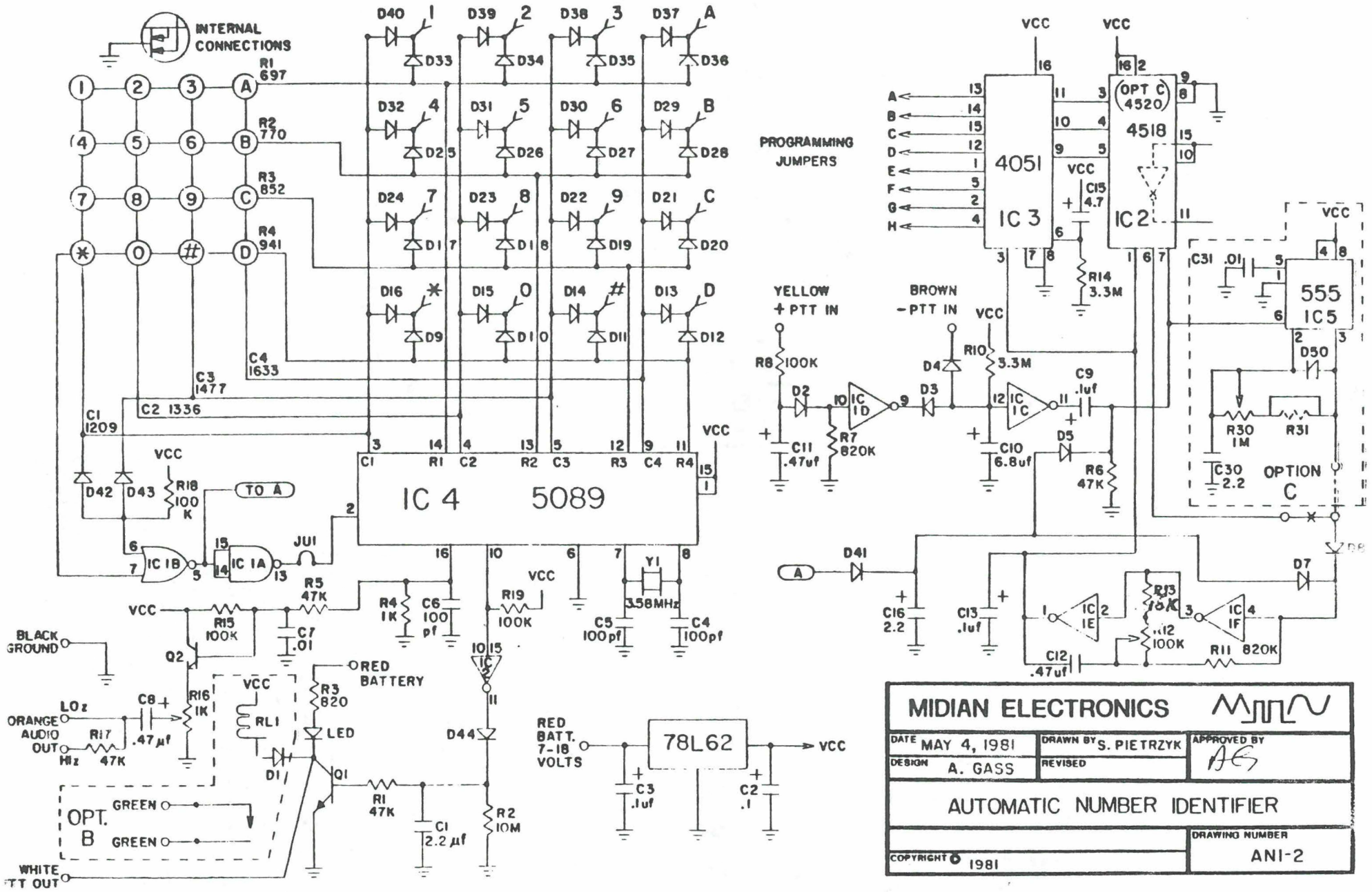


FIG 1

Solder
Side





MIDIAN ELECTRONICS			
DATE MAY 4, 1981	DRAWN BY S. PIETRZYK	APPROVED BY AG	
DESIGN A. GASS	REVISED		
AUTOMATIC NUMBER IDENTIFIER			
		DRAWING NUMBER ANI-2	
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5C-3

REPETITIVE ANI

There is a foil run between two square pads marked "security loop cuts" on the solder side layout. By cutting this run it is possible to install a wire loop in its place. Any time the loop is broken, a continuous ANI will be generated until the loop continuity is restored or the power is removed from the ANI 2.

The ANI 2C will transmit the ANI code more than once per activation. The number of repeats is set with R 20. More repeats may be obtained by cutting the run at "R" on the component side diagram, and installing a 1 Megohm (or greater) resistor at "R".

KEYBOARDS

When the ANI is used with Digitran keyboard, it can be mounted right on the pins of the keyboard with the solder side of the encoder against the keyboard. When using with a 12 button Digitran Keyboard, leave foil run in between X and Y; when using with a 16 button keyboard, cut foil run between X and Y and then jumper X to Z. The foil run between X and Y is on the component side of the board.

When mounting the Digitran keyboard with the ANI encoder, Midian's Spacer can be used to mount the unit to the front of most handheld or mobile units.

When using the ANI with other types of keyboards, color coded leads can be attached to the ANI encoder module, as shown on the board layout. The leads can be connected to the Chomerics, KB Denver or various other types of keyboards.

NUMBER PROGRAMMING

The ANI number can be set from 1 to 8 digits and is programmed by tiny jumpers on the component side of the board. To strap the assigned ANI number, the letter A must be connected to the first number of the sequence on the diode matrix, B must be connected to the second number and so on. Take the ANI number of A683 for example:

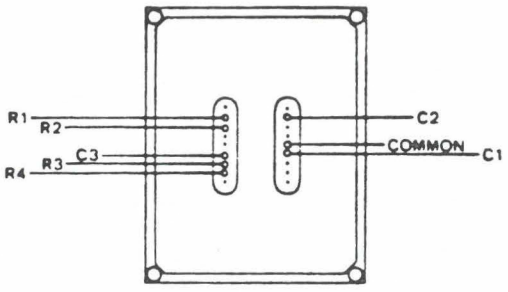
Install a jumper from A to A	(Pin 13 of IC 3 to A on diode matrix junction of D 36 & D 37)
Install a jumper from B to 6	(Pin 14 of IC 3 to 6 on diode matrix junction of D 30 & D 27)
Install a jumper from C to 8	(Pin 15 of IC 3 to 8 on diode matrix junction of D 23 & D 18)
Install a jumper from D to 3	(Pin 12 of IC 3 to 3 on diode matrix junction of D 35 & D 38)

The remaining letters E through H should remain disconnected.

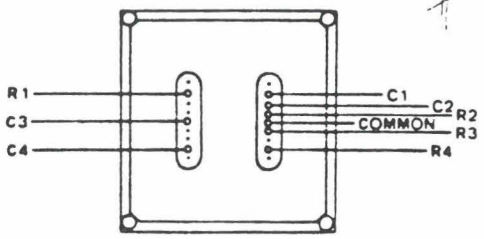
The row and column positions as well as the number locations 0 through 9, A, B, C, D, ★ and # are shown on the board layout sheet, component side.

941 - *
1209 -
#941
477

12 and 16 BUTTON CHOMERICS KEYBOARDS



12 BUTTON



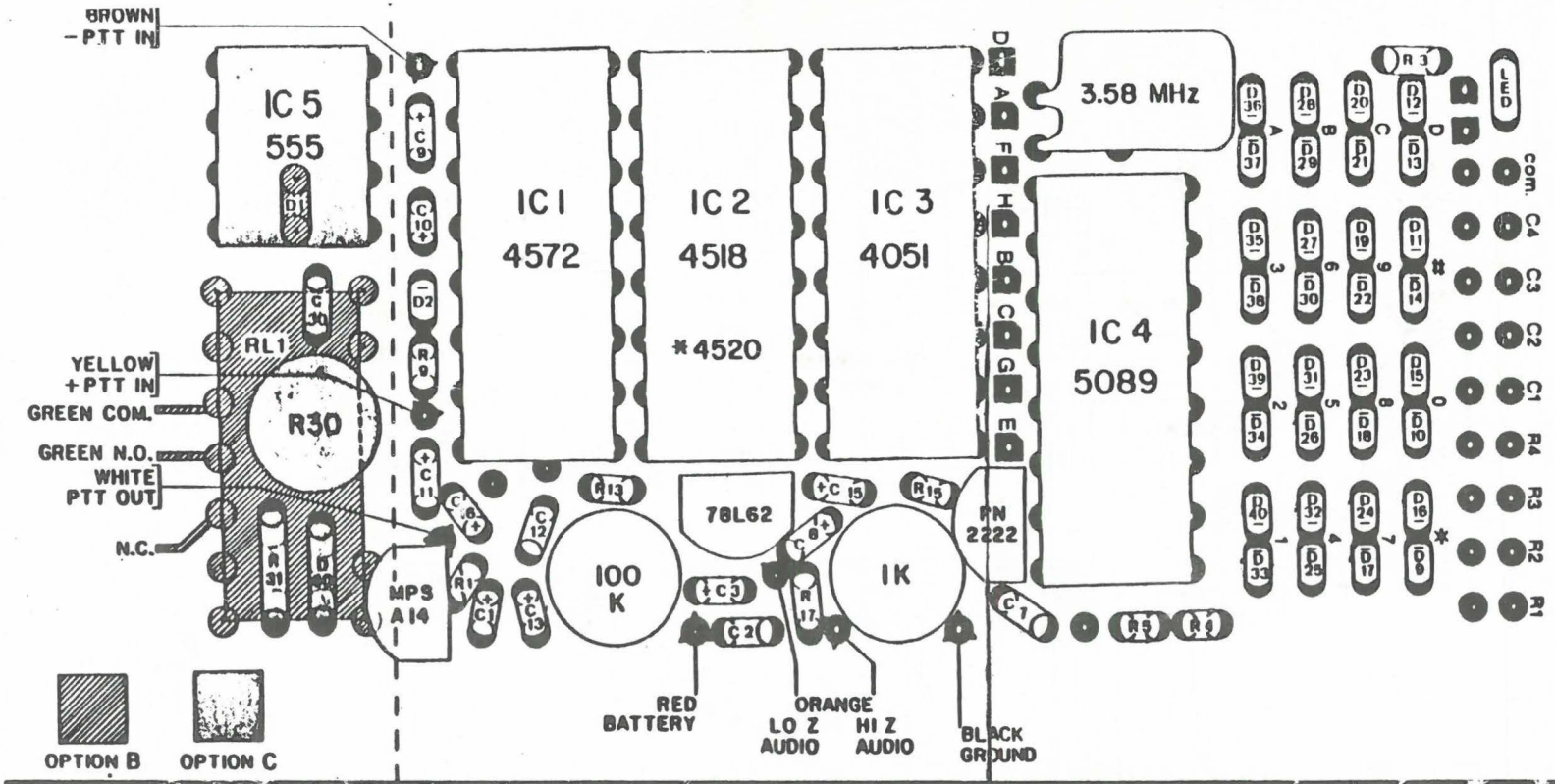
16 BUTTON

12 and 16 BUTTON DIGITRAN KEYBOARDS

12 BUTTON

16 BUTTON

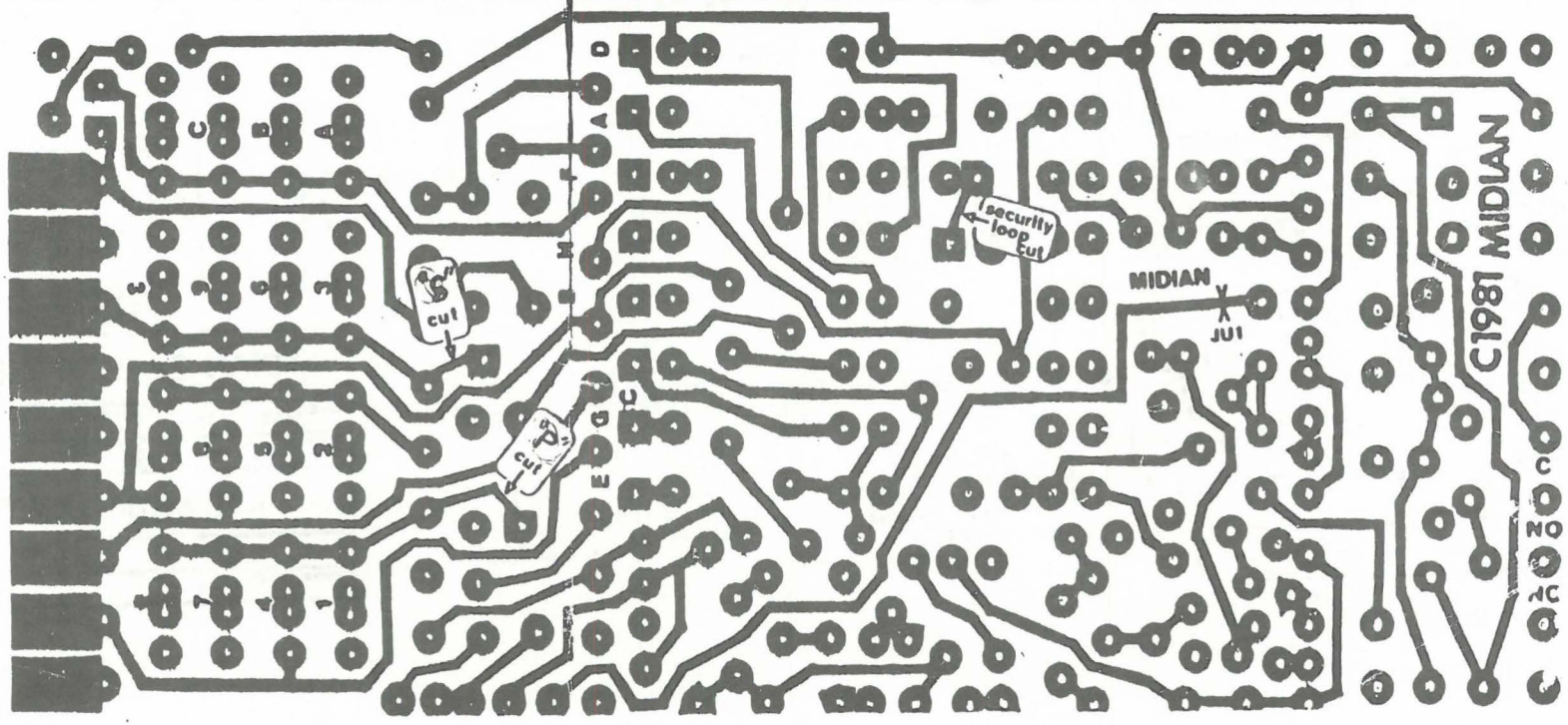
ANI-2

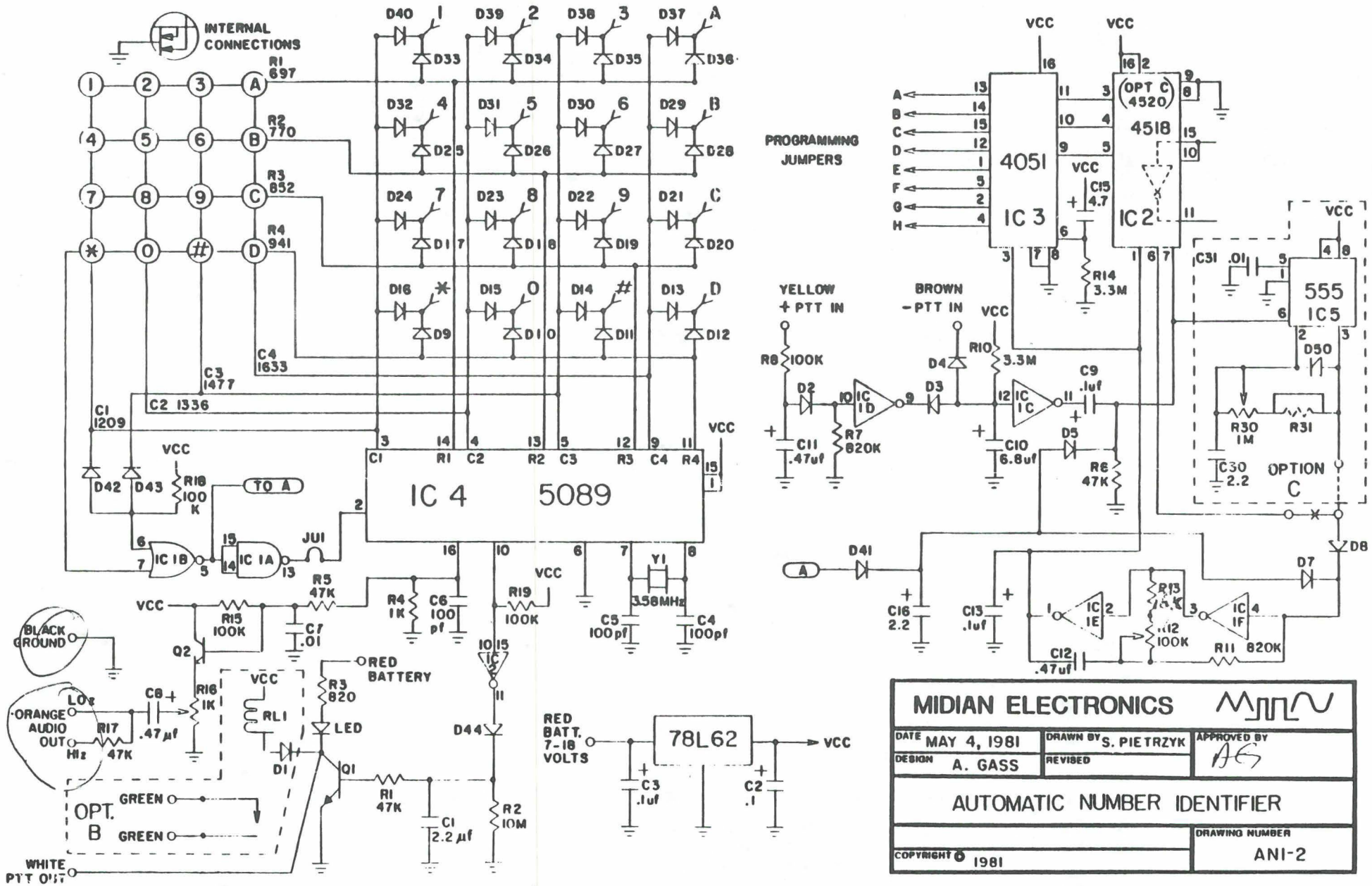


Component Side

5C-5

Solder Side





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DATE MAY 4, 1981	DRAWN BY S. PIETRZYK	APPROVED BY AG
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MIDIAN ELECTRONICS INCORPORATED

THE INNOVATORS IN TONE SIGNALING EQUIPMENT

2302 EAST 22ND STREET (602) 884-7981 TUCSON, ARIZONA

ANI 2 REV-B INSTRUCTION SHEET

The ANI 2 is a subminiature TOUCH TONE® Encoder and Automatic Number Identifier capable of generating the 16 Standard Bel System TOUCH TONES®. This synthesized tone encoder employs a crystal controlled master oscillator for high accuracy and stability.

The keyboard and scanned diode matrix provides a logic low (ground) to the proper column and row inputs on IC4. This programs the internal divide by N counters so that the proper high and low tone groups are generated. The synthesized high and low group tones are output on pin 16 of U4 and are fed to level pot R16. The high (column) tones are pre-emphasized 3db over the low tones at the output of U4. This is an internal feature of U4, and can be reduced, by increasing the value of C6. Any high frequency components generated by the digital to analog converter are filtered out by R9 and C6. The standard values of R9 and C6 also reduce the high tone pre-emphasis to approximately .5 db. It may be desired to increase the pre-emphasis in situations where high frequency roll-off occurs in phone lines(decrease the value of R9). The ANI output is on the GREEN lead and it is then fed to the microphone input of the transmitter. The transmitter ANI deviation can be adjusted by turning R16.

Single tones can be generated by simultaneously pressing two buttons in the same column or row. The tone frequency generated will be the one associated with the column or row in which both buttons were pressed. This may be helpful in setting transmitter deviation or system levels.

Diode matrix (D1 - D16) is sequentially scanned by a ground signal from the eight output multiplexer chip U3. The scan starts at "A" on U3, and ends at "H". When the scan is complete, U3's outputs A through H tri-state to an open condition. U2 provides a three line binary address to U3. When U2 reaches a count of 8, pin 6 goes high, and depending on which jumper is installed (JU2, JU3, or JU4), the ANI will "repeat" 0, 2, or 4 times respectively. JU2 is a PC board run that must be cut if JU3 or JU4 are used. When pin 6 of U2 goes high, the clock circuit U1E and U1F is inhibited leaving U2 with pin 6 high, and U3 tri-stated.

The ANI is activated by applying a reset pulse to U2 on pin 7 as a result of hitting *, # or PTT. When U2 resets, the clock is no longer inhibited and U3 is no longer tri-stated. After a short time delay, usually about 50ms, U2 starts counting, generating a new ANI sequence until an 8 count is reached again.

The clock U1E and U1F controls the speed of the ANI. The speed can be varied to suit your particular requirements by adjusting R13.

The ANI sequence can be activated by pressing the * or # or by the transmitter push to talk circuit. When using the * or # to activate the ANI, the * or # tone can go out ahead of the ANI or can be muted so that only the ANI is sent out. This feature is selectable by cutting JU1.

U1B decodes the * or # from the keyboard. U1A inverts the output of U1B and mutes U4 when the * or # is depressed, provided JU1 is installed. With JU1 installed, no * or # tone will be output when the * or # is depressed. 60ms after the * or # key is released, the ANI sequence will start. If it is desired to sent the * or # tone when the * or # key is depressed, simply cut JU1, which is located on the solder side of the board.

Activation of the sequence by the * key can be defeated by cutting the run indicated at "S" on the component side diagram. Activation of the sequence by the # key can be defeated by cutting the run indicated at "P" on the component side diagram. If the * or # is used in the ANI sequence, it cannot be used to activate the ANI sequence.

AUTOMATIC ANI

When using the transmitter push to talk circuit to activate the ANI, you may select either ground PTT or positive PTT. For ground PTT, the BROWN lead can usually be tied in at the radio's PTT switch. For positive PTT, the YELLOW lead can usually be connected to the transmitter switched B+ circuit. The PTT circuit also features a delay circuit so that the ANI does not go out every time the transmitter is keyed. It can prevent the ANI from occuring during an 18 second interval following the end of the last transmission. This feature can be defeated by removing the timing capacitor C3. The automatic push to talk circuit consists of D23, R18, R19, C11, Q3, and RI-1. When a key is depressed, pin 10 of U4 pulls to ground, instantly charging C11. This turns on Q3 which can be used to key the transmitter. The time constant of R19 and C11 keeps Q3 on for about 2 seconds between key entries. An optional LED can be installed on the keyboard to indicate when Q3 is activated. The WHITE lead from Q3 pulls to ground, and can be used for automatic keying of the transmitter. The VIOLET/WHITE leads of optional relay RL-1 (ANI-2B) can also be used for automatic keying of the transmitter of mike mute, etc.. The Black lead is connected to ground and the RED lead is attached to the on/off switch.

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ANI2 REV-B

NUMBER PROGRAMMING

The ANI2 Rev-B is programmed using jumpers on the top side of the board. The jumpers are connected from the points labeled A, B, C, D, E, F, G, and H shown on the solder side of the board. The side of the wire that is connected to "A" thru "G" is always left in place. The other side of the wire is moved to the number, "*", or "#" to produce the desired ANI.

EXAMPLE: (ANI = *7654321)

Jumper point "A" To "*"
Jumper point "B" To "7"
Jumper point "C" To "6"
Jumper point "D" To "5"
Jumper point "E" To "4"
Jumper point "F" To "3"
Jumper point "G" To "2"
Jumper point "H" To "1"

LEAD IDENTIFICATION

RED(V+)----------Power input lead, connect to switched battery input (+7 to +24Vdc).

BLACK(Ground)----------Connect to circuit ground buss.

GREEN(ANI output)----------Connect to the modulator circuit of a transmitter in the area of the microphone. High and low Z outputs are available (see the customer pictorial).

YELLOW("+" PTT input)----------Connect to a point in the radio transmitter that goes "high" when the PTT is depressed.

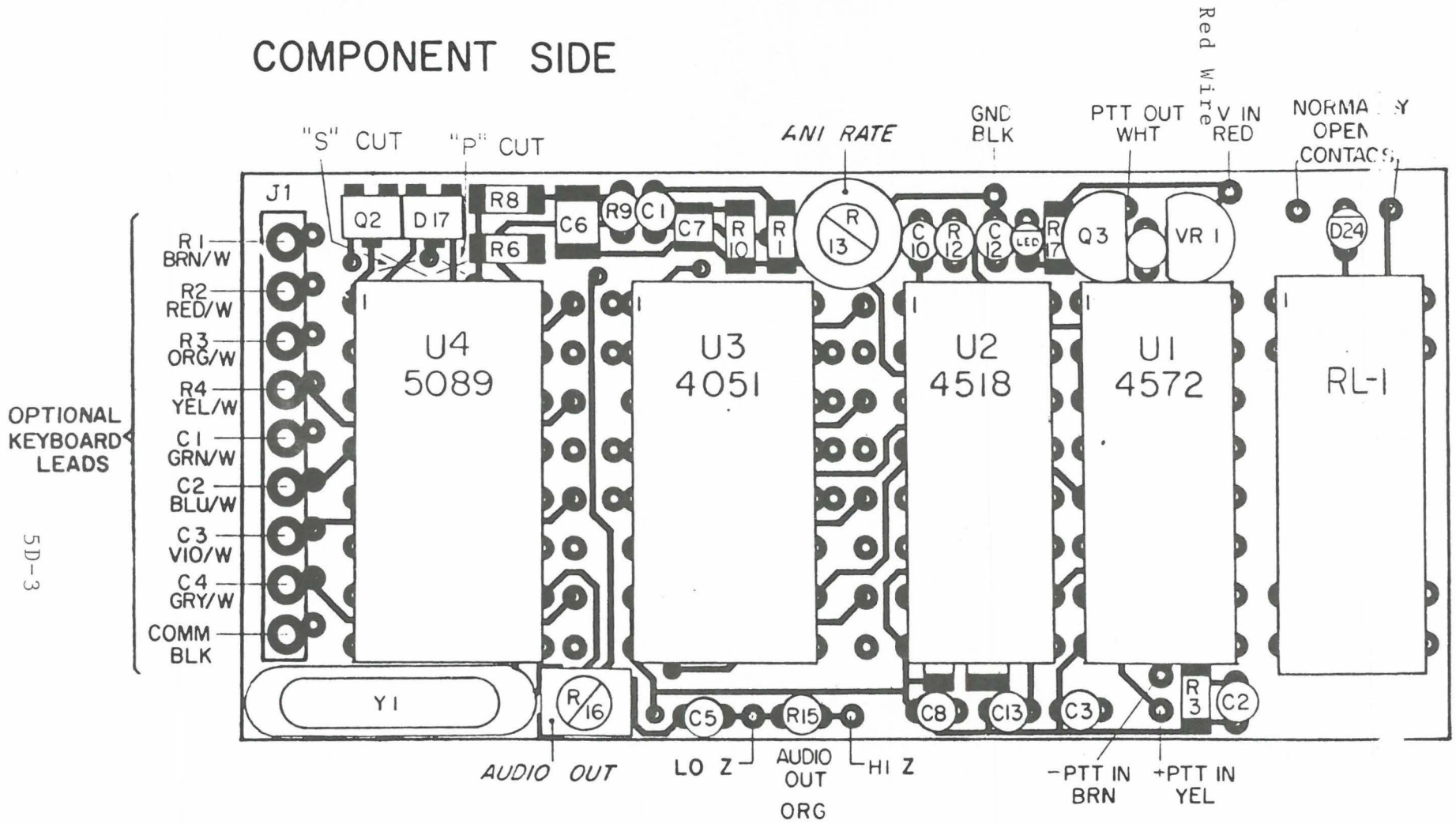
BROWN("-" PTT input)----------Connect to a point in the transmitter that goes "low" when the PTT is depressed (usually the PTT pulls low when it is engaged).

NOTE: Use either the BROWN input or the YELLOW input but not both.

WHITE/[illegible] PTT output)----------Connect to the "circuit side" of the radio PTT switch (Goes "low" when the ANI is being output)

VIOLET/WHITE(PTT output relay (2ea))-Provides a SPST relay output.

COMPONENT SIDE



5D-3

ORANGE WIRE

"CUT AT MARK "I

MIDIAN ELECTRONICS			
DATE 8·5·86	DRAWN BY HF	APPROVED BY	
DESIGN AB	REVISED		
ANI-2 REV-B			
CUSTOMER PICTORIAL		DRAWING NUMBER CP-057	
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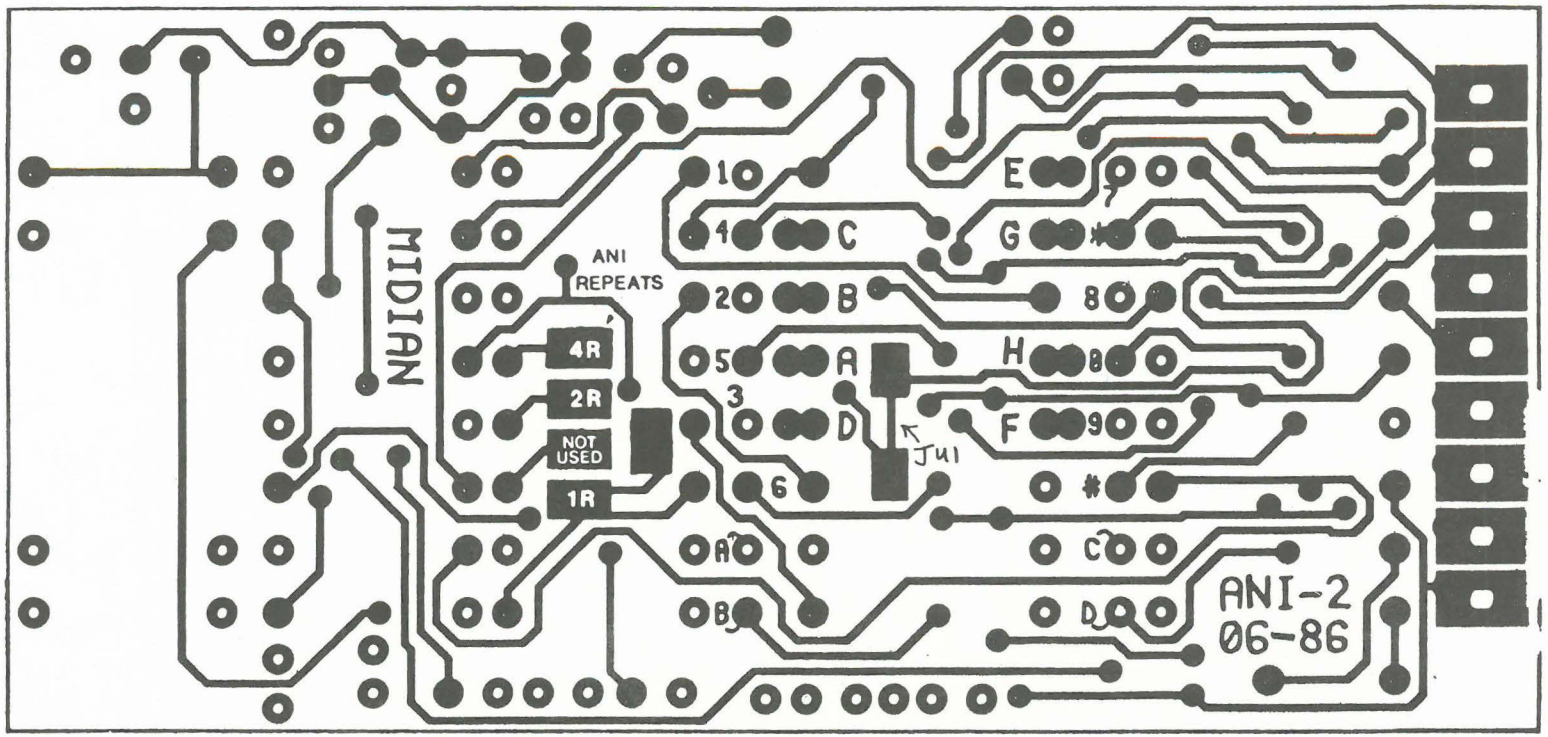
SOLDER SIDE


MIDIAN
ANI
REPEATS
4R
2R
NOT
USED
1R
1
C
2
B
5
A
3
D
6
J1
E
G
8
H
F
9
#
0
A
B
C
D
ANI-2
06-86