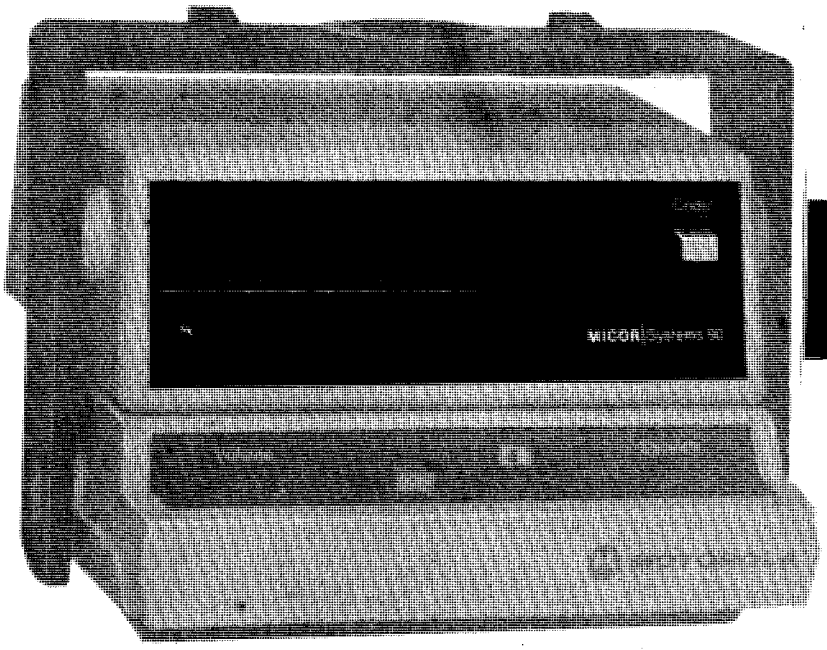
MICOR® | Systems 90

VOICE PRIVACY ADAPTER



MODEL TLN1400A

MOTOROLA INC. **Communications Division**

ENGINEERING PUBLICATIONS 1301 E. ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60172

3/12/73-UP

THIS MANUAL HAS BEEN DISCONTINUED

68P85900C35
Issue - C

PERFORMANCE SPECIFICATIONS

Model	TLN1400A
Operation	Simple inversion method
Current Drain: Clear Mode Coded Mode	 100 ma @ 13.6V dc 110 ma @ 13.6V dc
Power Consumption (Coded Mode)	1.5 watts
Operating Temperature Range	-30° to +60°C
Audio Frequency Range	300 to 3000 Hz
Carrier Rejection	More than 60 dB
Input Signal Feedthrough	Less than 40 dB
Undesired Sideband Rejection	More than 40 dB
Oscillator Stability	+0.6% to -0.2%
Nominal Impedance: Transmit Microphone Input Output to Transmitter Receive Input Output	 600 ohms 600 ohms 10K ohms 7K ohms
Weight	1/2 pound
Mounting	Under-dash housing

FOREWORD

68P81002E32-D

SCOPE OF INSTRUCTION MANUAL

This manual offers descriptive and service information for the radios described in it. Service diagrams, parts lists, and printed circuit board details are also included.

NOMENCLATURE

Motorola radio equipment is specifically identified by the model number on the nameplate.

NOTE

Be sure to use the entire model number when making inquiries about your equipment.

Identifiers have been assigned to chassis and kits. Use these identifiers when requesting information or ordering replacements.

PRODUCTION CHANGES

When production and engineering changes are incorporated into the equipment, a revision numeral is assigned to the chassis or kit affected.

Typical Example:
The Model TRD1432AA becomes
TRD1432AA-1 with the first revision.

This chassis number complete with revision numeral, if any, is stamped on the chassis at the time of production. The revision numeral becomes an integral part of the chassis identifier.

INSTRUCTION MANUAL REVISIONS

Changes which occur after an instruction manual is printed are described in the Instruction Manual Revision. These bulletins give the reader complete information on the change including pertinent parts listing data.

NATIONAL SERVICE ORGANIZATION

Motorola provides a nation-wide service organization. Through its maintenance and installation program Motorola makes available the finest service to those desiring reliable continuous communications on a contract basis.

The largest service organization specializing in mobile communications is Motorola's National Service Organization. Over 800 strategically located, adequately staffed and trained, independently owned and operated stations, manned with several thousand FCC licensed personnel constitute the sub-contracting force.

The administrative forces of area and district service managers and district service representatives are in the direct employ of Motorola.

For your contract service requirements, please contact your local Motorola representative or write to:

National Service Manager
Motorola Communications Division
1301 E. Algonquin Road, Schaumburg, Ill. 60172

CAREFUL USE OF THE INSTRUCTION MANUAL AND THE MANY SUGGESTIONS CONTAINED IN IT WILL FURTHER INSURE PROPERLY INSTALLED AND MAINTAINED RADIO EQUIPMENT.

THE EQUIPMENT DESCRIBED IN THIS MANUAL IS MANUFACTURED UNDER ONE OR MORE OF THE FOLLOWING MOTOROLA U.S. PATENTS:

RE-24,815	2,834,879	3,059,184	3,204,202	3,306,990	3,387,270
RE-26,079	2,883,521	3,061,785	3,205,455	3,307,051	3,400,219
RE-26,361	2,888,652	3,070,737	3,218,587	3,307,121	3,409,841
2,626,384	2,899,547	3,070,748	3,223,953	3,323,065	3,414,881
2,637,782	2,901,601	3,083,332	3,233,243	3,324,408	3,416,032
2,650,333	2,912,573	3,087,117	3,234,469	3,327,215	3,424,854
2,688,059	2,918,571	3,087,998	3,247,475	3,328,695	3,424,983
2,691,094	2,924,705	3,087,999	3,250,997	3,328,727	3,430,171
2,691,560	2,925,562	3,091,736	3,250,999	3,333,151	3,431,486
2,699,425	2,938,082	3,094,293	3,256,497	3,333,911	3,437,838
2,705,281	2,963,577	3,101,441	3,263,172	3,334,293	3,437,934
2,731,555	2,966,585	3,119,093	3,273,083	3,335,405	3,441,854
2,738,466	2,974,221	3,126,514	3,275,938	3,336,533	3,447,133
2,740,891	2,984,740	3,128,431	3,281,697	3,341,777	3,448,342
2,743,361	2,994,844	3,129,396	3,284,714	3,345,568	3,449,680
2,759,052	3,009,115	3,131,354	3,289,098	3,345,569	3,453,521
2,759,103	3,014,127	3,149,317	3,292,085	3,345,573	3,454,927
2,777,950	3,027,454	3,175,183	3,293,644	3,348,148	3,458,664
2,799,010	3,027,455	3,175,187	3,300,723	3,355,533	3,465,294
2,808,507	3,039,081	3,175,193	3,304,501	3,355,709	3,469,191
2,809,236	3,041,550	3,183,382	3,304,503	3,369,597	3,471,796
2,830,200	3,048,659	3,191,123	3,305,779	3,370,236	3,471,805
2,833,994	3,048,747			3,373,379	3,473,152

Other U.S. Patents Pending

PARTS AND SERVICE

REPLACEMENT PARTS ORDERING

ORDERING INFORMATION

Motorola maintains parts depots strategically located throughout the country. These facilities are fully equipped to give the finest service. Orders for all parts except crystals, channel elements, and "Vibrasender" and "Vibrasponder" resonant reeds should be sent to the nearest parts depot. Orders for crystals, channel elements and reeds should be sent to the factory address listed. Orders for instruction manuals should also be sent to the parts depot.

When ordering replacement parts, the complete number identification of the item must be used whether it be a component, kit or complete chassis. This will fix proper identification and assure delivery of the desired item. Complete number identification should also be used when requesting equipment information.

Crystal and channel element orders should specify the crystal or channel element type number, crystal frequency, carrier frequency, and the chassis model number in which the part is used.

Orders for "Vibrasender" and "Vibrasponder" resonant reeds should specify type number and frequency and should identify the owner/operator of the communications systems in which these items are to be used.

68P81001E43-H

PARTS DEPOT LOCATIONS

Motorola, Inc.
Communications Division Parts Depot

2333 Utah Ave. El Segundo, California 90245

1170 Chess Drive, San Mateo, California 94404

Lake Mirror Road, Forest Park, Georgia 30050

1313 E. Algonquin Road, Schaumburg, Ill. 60172

85 Harristown Road, Glen Rock, New Jersey 07452

12955 Snow Rd., Parma, Ohio 44130

3220 Belt Line Road, Dallas, Texas 75234

FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT AND RESONANT REED ORDERS

AIR MAIL ORDERS	REGULAR MAIL ORDERS AND CORRESPONDENCE
Motorola, Inc. Component Service Department P. O. Box 66191 O'Hare International Airport Chicago, Ill. 60666	Motorola, Inc. Component Service Department 4545 W. Augusta Blvd. Chicago, Illinois 60651

SERVICE

Motorola provides a nation-wide service organization. Through its maintenance and installation program Motorola makes available the finest service to those desiring reliable continuous communications on a contract basis.

NATIONAL MOTOROLA COMMUNICATIONS SERVICE

The largest service organization specializing in mobile communications is Motorola's National Service Organization. Over 800 strategically located, adequately staffed and trained, independently owned and operated stations, manned with several thousand FCC licensed personnel constitute the sub-contracting force.

The administrative forces of area and district service managers and district service representatives are in the direct employ of Motorola.

For your contract service requirements, please contact your local Motorola representative or write to:

National Service Manager
Motorola Communications Division
1301 E. Algonquin Road, Schaumburg, Ill. 60172

CONTENTS

1. INTRODUCTION

1.1 APPLICATION

The TLN1400A "Micor" Voice Privacy Adapter (mobile speech scrambler) is designed for use with Motorola "Micor" FM two-way radios. The solid-state voice privacy adapter employs frequency-inversion audio scrambling to provide speech inversion on radio communications channels. The same adapter provides both scrambling and unscrambling of messages, minimizing casual eavesdropping and providing a deterrent to the more sophisticated, undesired listener.

1.2 DESCRIPTION

All circuitry of the voice privacy adapter is contained on a single printed circuit board. The circuit board plugs into an accessories unit, supplied with the radio set, and operates from the A+ (+13.6V) supply of the radio set. In the receive condition, the voice privacy adapter is electrically inserted between the discriminator buffer output and the volume control in the audio output stages of the receiver. In the transmit condition, it is inserted in the microphone audio line. A cable kit is supplied for making all required interconnections.

1.3 MODEL COMPLEMENT

The TLN1400A "Micor" Voice Privacy Adapter consists of the following items:

1 - TLN4571A "Micor" Voice Privacy Adapter Board

1 - TKN6520A Cable Kit

1 - TLN4572A Hardware and Escutcheon Kit

2. INSTALLATION AND OPERATION

2.1 INSTALLATION

2.1.1 Inspection

Inspect the equipment immediately after delivery and report any damaged or missing items to the transportation company making the delivery.

2.1.2 Control Head Modification

Minor modifications must be made to the control head before installing the voice privacy adapter. Modification consists of removing resistor R1103 from all control head printed circuit boards. For positive ground installations, also, remove jumper JU3 from printed circuit boards bearing part number 84E84571B03. If the control head has not been previously modified for use with the voice privacy adapter, perform the following procedure.

Step 1. Turn the radio off. Disconnect microphone, speaker, and radio set cables from the control head and remove the control head from its mounting trunion.

Step 2. Disengage two captive "Phillips" head screws located on the bottom outer edges of the control head housing and remove the upper half of the housing.

Step 3. Locate resistor R1103 on the control head circuit board and remove by cutting or unsoldering its leads. For positive ground installations, also remove jumper JU3 from the circuit board only if its part number is 84E84571B03.

Step 4. Replace the upper half of the control head housing and secure it with the two captive screws.

Step 5. Mount the control head on its mounting trunion. Reconnect microphone and speaker cables.

2.1.3 Installation of Voice Privacy Adapter

The voice privacy adapter board is installed in the accessory housing, either alone or in conjunction with other radio accessories. The installation instructions provided here apply to instances where the voice privacy adapter is used as the only accessory. (For instructions pertaining to multiple accessory installations, refer to the installation instructions supplied with the accessory housing assembly.) Refer to figure 1 or 2 and proceed as follows:

NOTE

The following procedure is for installation in negative ground systems, change connections as directed by the notes in figures 1 and 2.

Step 1. Modify the control head as described in paragraph 2.1.2 above.

Step 2. Slide the voice privacy adapter board completely into the accessory housing assembly.

Step 3. Install the rear housing cover and secure with the two captive screws.

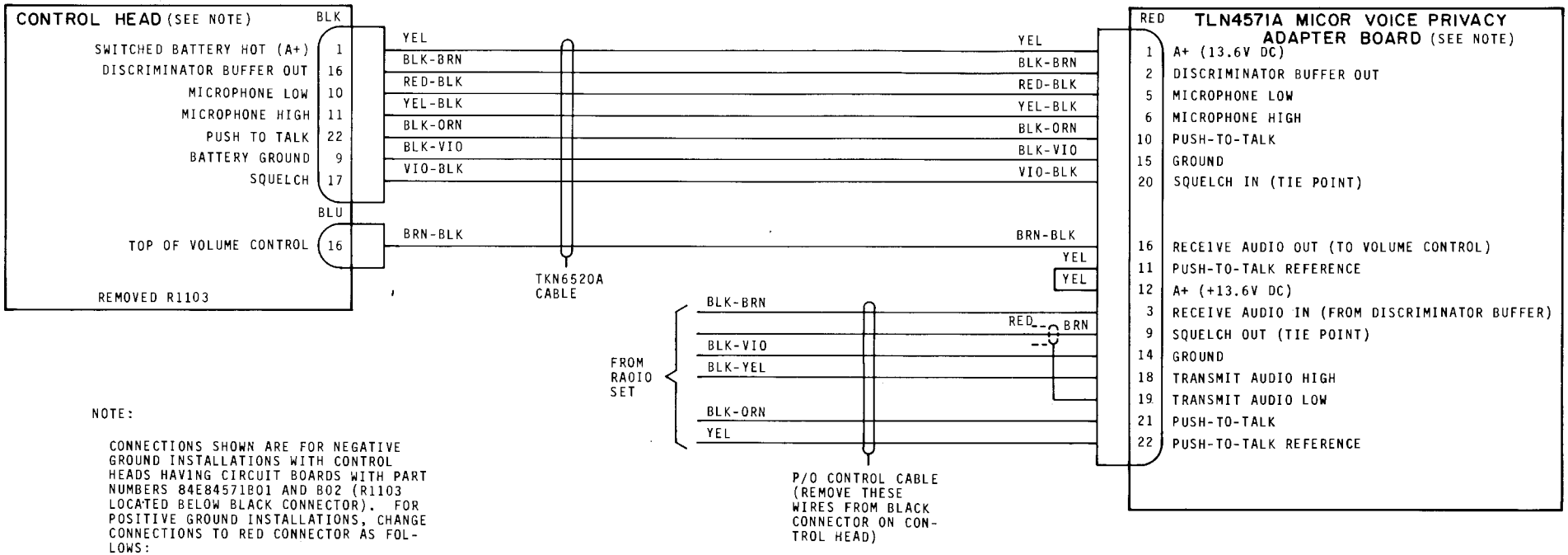
Step 4. Disconnect the black connector (P1101) and the blue connector (P1102, if used) from the control head.

Step 5. Using the contact removal tool supplied, remove seven wires, with pins attached, from black (P1101) connector as follows:

(1) Yellow wire from position 1.

(2) Black-violet wire from position 9.

(3a) Shield of red shielded cable (brown center conductor) from position 10 on control heads using circuit board 84E84571B01 or B02 only.



NOTE:

CONNECTIONS SHOWN ARE FOR NEGATIVE GROUND INSTALLATIONS WITH CONTROL HEADS HAVING CIRCUIT BOARDS WITH PART NUMBERS 84E84571B01 AND B02 (R1103 LOCATED BELOW BLACK CONNECTOR). FOR POSITIVE GROUND INSTALLATIONS, CHANGE CONNECTIONS TO RED CONNECTOR AS FOLLOWS:

COLOR	FROM PIN	TO PIN
YEL	1	15
BLK-VIO	15	1
YEL	12	14
BLK-VIO	14	12
BLK-YEL	18	19
SHIELD	19	18

CMPD 5055

Figure 1. "Micor" Voice Privacy Adapter, Interconnect Diagram (B01, B02 Control Head Circuit Boards)

(3b) Shield of triple shielded cable from position 21 on control heads using circuit board 84E84571B03 only.

(4) Brown center conductor of red shielded cable from position 17 on control heads using circuit board 84E84571B01 or B02 only.

(5) Black-yellow wire from position 11.

(6) Black-brown wire from position 16.

(7) Black-orange wire from position 22.

Step 6. Insert pins and wires (removed from black connector) into red connector of TKN6520A Cable Kit as follows:

(1) Yellow wire into position 22.

(2) Black-violet wire into position 14.

(3a) Shield or red shielded cable (brown center conductor) into position 19 for control heads using circuit board 84E84571B01 or B02 only.

(3b) Shield of triple shielded cable into position 19 for control heads using circuit board 84E84571B03 only.

(4) Black-yellow wire into position 18.

(5) Black-brown wire into position 3.

(6) Black-orange wire into position 21.

(7) Brown center conductor of red shielded cable into position 9 for control heads using circuit board 84E84571B01 or B02 only.

Step 7. Insert pins and wires of TKN6520A Cable Kit into black (P1101) connector as follows:

(1) Yellow wire into position 1.

(2) Black-brown wire into position 16.

(3) Red-black wire into position 10 for control heads using circuit board 84E84571B01 or B02; or into position 2 for circuit board 84E84571B03.

(4) Yellow-black wire into position 11.

(5) Black-orange wire into position 22.

(6) Violet-black wire into position 17 for control heads using circuit board 84E84571B01 or B02; or position 21 for circuit board 84E84571B03.

(7) Black-violet wire into position 9.

Step 8. If the radio control cable has a blue (P1102) connector, insert pin of brown-black wire (of TKN-6520A Cable Kit) into position 16. If the radio control cable does not have a blue connector, use the one supplied in the TLN4572A Hardware and Escutcheon Kit.

Step 9. Plug the black connector into J1101 and the blue connector into J1102 on the control head. Connect the red connector to the pins on the voice privacy adapter board through the access hole in the rear of the accessory housing.

Step 10. Remove the escutcheon backing and attach to the housing assembly front panel. Installation is complete.

2.2 OPERATION

Power is applied to the voice privacy adapter by turning the radio set on. To set for scrambled operation, depress the Clear-Coded switch (CODE lamp will light); for unscrambled operation depress to release the Clear-Coded switch (figure 3).

3. THEORY OF OPERATION

3.1 FUNCTIONAL DESCRIPTION

3.1.1 General

3.1.1.1 The voice privacy adapter is electrically inserted between the radio set discriminator output and the audio amplifier stages for reception; for transmission, it is inserted in the microphone audio line. The scrambling process affects the audio stages only.

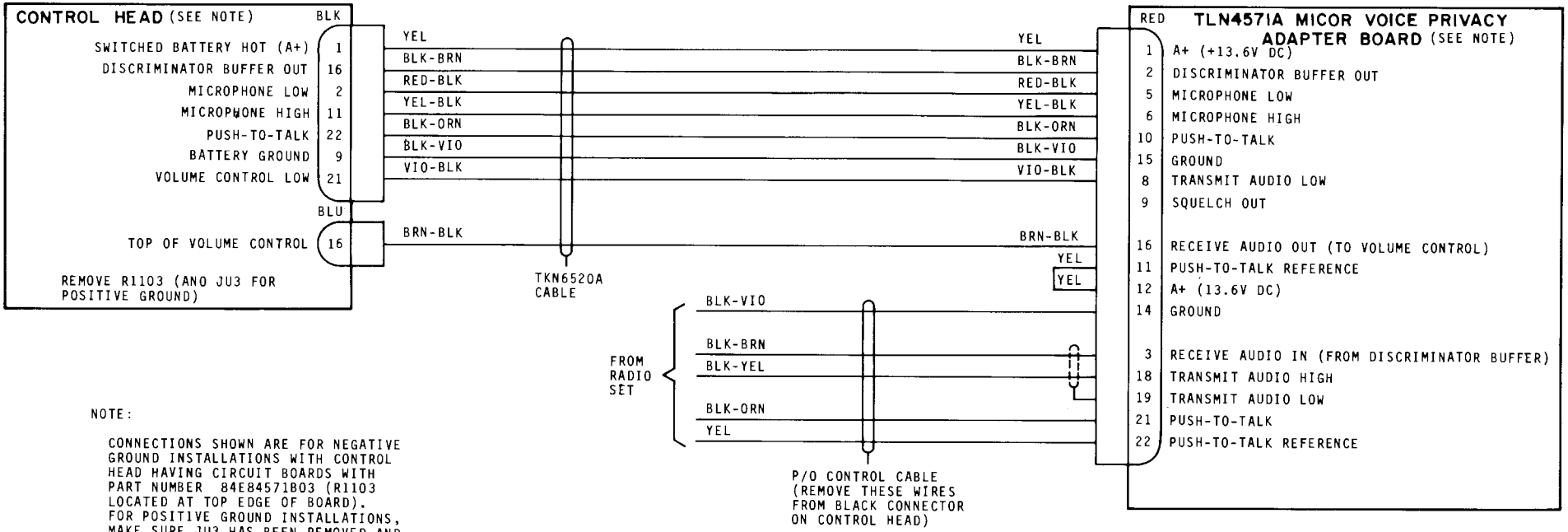
3.1.1.2 For transmission, the voice privacy adapter first converts the 300-3000 Hz audio signal into double-sideband, suppressed carrier information in a balanced modulator circuit. A low pass filter removes the upper sideband, leaving only the lower sideband of 500-3200 Hz for transmission. Because the difference frequency is used, audio in the lower sideband is inverted. This is the result of using a 3500 Hz modulating frequency, producing difference frequencies as follows:

3500 Hz (modulating signal)
-300 Hz (low audio range)
3200 Hz (difference)

3500 Hz (modulating signal)
-3000 Hz (high audio range)
500 Hz (difference)

3.1.1.3 As shown, the audio frequencies are now reversed in the audio spectrum thus becoming inverted images of the original audio signals. These inverted signals are referred to as scrambled audio frequencies.

3.1.1.4 When the scrambled audio frequencies are applied to a radio set receiver equipped with a voice privacy adapter, similar inversion process takes place. This process unscrambles



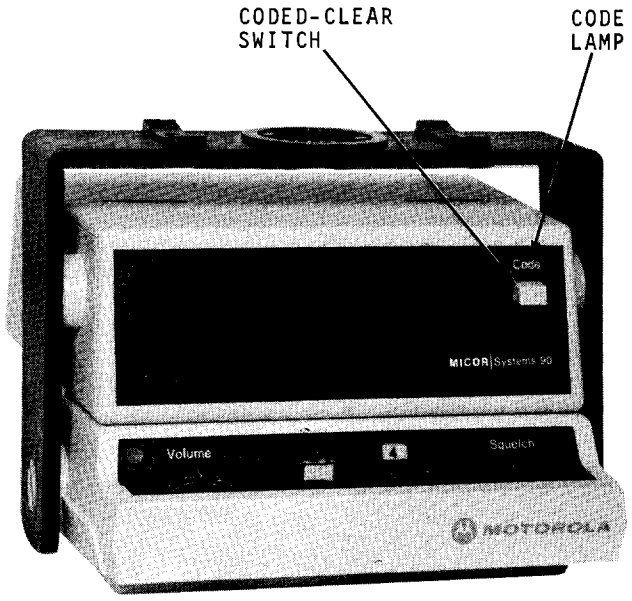
NOTE:

CONNECTIONS SHOWN ARE FOR NEGATIVE GROUND INSTALLATIONS WITH CONTROL HEAD HAVING CIRCUIT BOARDS WITH PART NUMBER 84E84571B03 (R1103 LOCATED AT TOP EDGE OF BOARD). FOR POSITIVE GROUND INSTALLATIONS, MAKE SURE JU3 HAS BEEN REMOVED AND CHANGE CONNECTIONS TO RED CONNECTOR AS FOLLOWS:

COLOR	FROM PIN	TO PIN
YEL	1	15
BLK-VIO	15	1
VIO-BLK	8	7
YEL	12	14
BLK-VIO	14	12
BLK-YEL	18	19
SHIELD	19	18
RED-BLK	9	2

CMPD 5056A

Figure 2. "Micor" Voice Privacy Adapter, Interconnect Diagram (B03 Control Head Circuit Board)



3000N61

Figure 3. "Micor" Voice Privacy Adapter, Front Panel Control and Indicator

the audio frequencies and returns them to their original orientation in the audio spectrum. Using a 3500 Hz modulating signal, as in the previous example, the difference frequencies are as follows:

3500 Hz (modulating signal)
-500 Hz (low lower sideband)
3000 Hz (difference)

3500 Hz (modulating signal)
-3200 Hz (high lower sideband)
300 Hz (difference)

3.1.2 Transmit Signal Flow (Coded)

3.1.2.1 (See figure 4.) The microphone output is applied through a pre-emphasis network and amplifier to one of two audio gates that are controlled by the output of a P-T-T circuit. During transmission, the P-T-T input turns on the transmit audio gate which is in series with the microphone input and turns off the receive audio gate. Microphone audio is pre-emphasized, amplified, and applied through the gate to a differential phase splitter which produces two 180-degree out-of-phase output signals. The output of the differential phase splitter is applied to the balanced modulator/chopper.

3.1.2.2 The balanced modulator accepts a 3500 Hz square wave input and produces upper and lower sidebands (sum and difference) which are first amplified and then applied to a low-pass active filter. The filter rejects signals that are outside the 300-3200 Hz audio spectrum, and the audio signal is then amplified, de-emphasized, and applied to the transmitter modulator.

3.1.3 Receive Signal Flow (Coded)

3.1.3.1 (See figure 4.) Received scrambled audio from the radio set discriminator is applied through the "PL" filter, de-emphasis circuits, and amplifier Q1 to the receive audio gate.

3.1.3.2 In the receive mode, since the P-T-T input is not present, the receive audio gate is turned on and the received scrambled audio is applied to the differential phase splitter. The differential phase splitter provides two out-of-phase signals to the balanced modulator, which mixes each of the two signals with a 3500 Hz signal from the bistable and sums the mixed signals.

3.1.3.3 The audio output from the modulator is applied through an amplifier to an active filter which passes only the frequencies within the 300-3200 Hz range. The filter audio is de-emphasized and applied to the volume control in the control head. Input and output de-emphasis capacitors C6 and C55 are switched in the circuit in the CODED mode only.

3.1.4 Normal Signal Flow (Clear)

When the radio is operated in the clear mode, the signal flow is identical to the previously described transmit and receive flow paths into the balanced modulator/chopper circuit. At this point, only the in-phase portion of the signal passes because the Clear position of the switch grounds the collector of Q14 in the bistable. This keeps the bistable from switching the outputs and prevents injection of the 3.5 kHz square wave into the balanced modulator for mixing.

3.2 DETAILED CIRCUIT DESCRIPTION (See schematic diagram.)

3.2.1 Receive Audio Input Circuit

3.2.1.1 The receive audio input circuit consists of a "PL" filter, input amplifier, de-emphasis, and mode equalization circuit.

3.2.1.2 The input from the radio set discriminator is applied to the "PL" filter through an impedance matching network consisting of R1, R2, R3, and C1. R1 provides proper load for the discriminator and R2 provides proper source impedance for the "PL" filter.

3.2.1.3 The "PL" filter, consisting of C2, C3, C4, L1, and L2, attenuates "Private-Line" tones used to selectively call Motorola "PL" equipped radios. Without this attenuation, the "PL" tones would be inverted and appear at the speaker as annoying tones in the upper portion of the audio spectrum. When the voice privacy adapter is in the clear mode, resistor R4 is switched into the circuit to equalize the output level between the two modes.

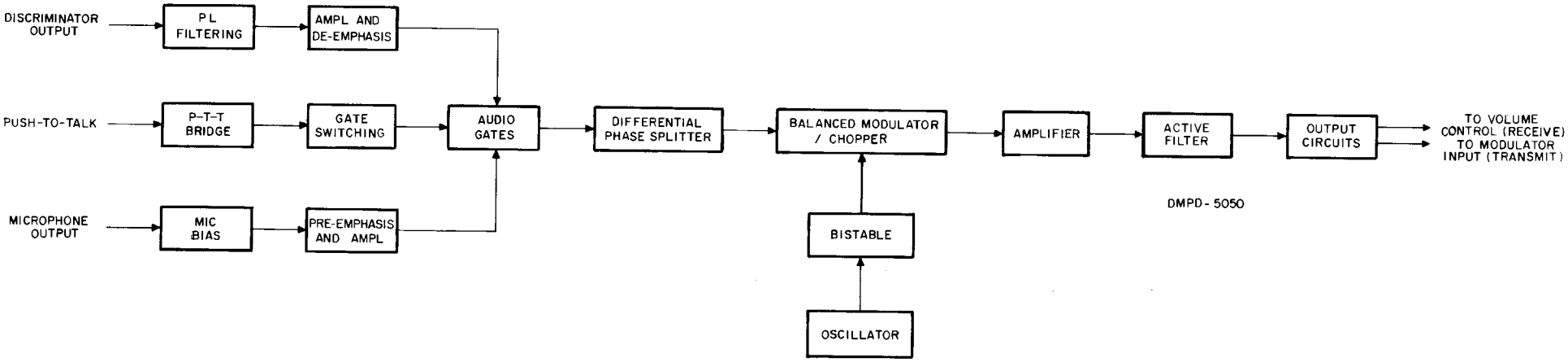


Figure 4. Functional Block Diagram

3.2.1.4 Input amplifier Q1 amplifies the audio signals to compensate for losses through the "PL" filter. In the coded mode, capacitor C6 is switched into the circuit to provide de-emphasis. The output of Q1 is applied to the receive audio gate.

3.2.2 Microphone Input Circuit

3.2.2.1 The microphone input circuit consists of a microphone bias circuit, a pre-emphasis network, and input amplifier Q3.

3.2.2.2 Rc coupling network R10, R11, and C9 provides dc bias to the microphone.

3.2.2.3 Pre-emphasis is provided by C8 and R12. The impedance of C8 varies with frequency; that is, it presents a high impedance to the low frequencies in the audio signal, but emphasizes the high frequencies.

3.2.2.4 Input amplifier Q3 amplifies the audio signal to compensate for the losses in the pre-emphasis network.

3.2.3 Audio Gates

The audio gates utilize the low "on" resistance and high "off" resistance characteristics of field effect transistors Q2 and Q4 to connect the audio signals from the receive input circuit or microphone input circuit (transmit) to the input of the differential phase splitter. Q2 and Q4 are operated such that only one signal is connected at a time. In the receive state, the output of amplifier Q1 is connected to Q9 and the microphone audio is blocked by the high resistance of Q4. In the transmit state this condition reverses (Q2 has a high resistance) thus blocking the radio set audio and connecting the microphone audio through Q4 to Q3. The control voltage for switching Q2 and Q4 is provided by the gate switching circuit.

3.2.4 Push-to-Talk (P-T-T) Bridge Circuit

The bridge provides source current to the gate switching circuits through Q5 whenever the P-T-T button is pressed. Although this system operates with negative ground, the bridge circuit provides an interface to equipment using positive ground (if required).

3.2.5 Gate Switching Circuit

Gate switch Q6 and Q7 provides the bias voltages that control audio gates Q2 and Q4. When the P-T-T button is pressed, the P-T-T bridge provides currents to the gate switching circuits that bias transmit audio gate Q4 to the on condition and receive audio gate Q2 to the off condition. When the P-T-T button is released, the gates reverse condition. The CR5, R23, and C12 network provides a 300-millisecond time delay before the audio gates return to the receive mode after the P-T-T button is released. The time delay complements the reverse burst delay incorporated into "PL" tone coded transmitters and thereby prevents the receiver output from being coupled to the modulator input. The coupling would otherwise result in a short audible tone at the speaker during this period.

3.2.6 Differential Phase Splitter Circuit

Differential phase splitter Q9 (A and B) is a differential amplifier that provides two audio signals with a 180-degree phase difference. Bias for both halves of Q9 is provided from the same source, and, with equal base resistors, both base-emitter junctions are maintained at the same operating point. The two output signal levels are set equally by balance potentiometer R38. Both signals are then coupled to the balanced modulator/chopper circuit.

3.2.7 Balanced Modulator/Chopper

3.2.7.1 The balanced modulator/chopper circuit consists of three basic circuits – an oscillator, a bistable, and a chopper.

3.2.7.2 Oscillator Q8 is a Clapp series-tuned oscillator that provides a stable 7-kHz output. Frequency-determining components L4 and C17 have complementary temperature coefficients to maintain frequency stability over the operating temperature range. The output of Q8 is converted into square waves by Q10 to provide the fast fall time required to trigger bistable Q13, Q14.

3.2.7.3 Bistable multivibrator Q13, Q14 operates when the unit is in the coded mode (S1 set to Coded). The bistable divides the 7-kHz input by two and provides two 3500-Hz square wave outputs which control the chopper circuit. The bistable output alternately turns on either Q11 or Q12. When S1 is set to the Clear position, the collector of Q14 is clamped to circuit ground, holding Q13 collector at circuit supply potential.

3.2.7.4 The chopper circuit consists of NPN transistors Q11 and Q12 connected in a common collector configuration. The emitter of each transistor is connected to the junction of two series connected precision resistors. One end of each pair of resistors is connected to one of the two differential phase splitter outputs. The other end of each pair is tied together to provide a summing point. Transistors Q11 and Q12 are alternately switched from saturation to cutoff by the bistable circuit outputs at the 3500-Hz rate. The signal produced at the summing point is a double-sideband suppressed carrier.

3.2.8 Amplifier

Amplifiers Q15 and Q16 provide the necessary gain to drive the active filter circuit.

3.2.9 Active Filter Circuit

The active filter circuit, Q17 through Q26, is a five-stage filter that attenuates the upper sideband and bistable frequencies. The first and

fourth stages are band rejection stages. The remaining three are low pass filter stages. The combined response of the stages is flat from 300 Hz to 3000 Hz and frequencies above 3500 Hz are attenuated. The filter output consists of only the lower sideband output of the balanced modulator/chopper.

3.2.10 Output Circuits

3.2.10.1 Receive Audio Output Circuit

Receive audio output from the filter is coupled through C54, R105, and R106 to the volume control in the radio set control head. In the coded mode only, capacitor C55 is switched into the circuit to provide de-emphasis.

3.2.10.2 Transmit Audio Output Circuit

Transmit audio output from the filter is coupled through C49, R97, and C50 to output amplifier Q27. R98 is switched into or out of Q27 input circuit to provide level equalization between modes. The output of Q27 is direct coupled to buffer stage Q28. Capacitor C51 provides de-emphasis of the transmit audio signals. Q28, an emitter follower, provides a low impedance output to transformer T1, which presents a balanced output to the transmitter modulator.

3.2.11 Power Supply Decoupling Circuit

The power supply decoupling circuit removes high frequency noise components from the dc input. Further decoupling is used to prevent undesired interstage coupling of high-level signals from some parts of the circuit to other low-level, high sensitivity portions of the circuit.

4. MAINTENANCE

4.1 SERVICING

4.1.1 Removal and Replacement of Voice Privacy Adapter

4.1.1.1 Removal

Step 1. Turn the radio set off and disconnect connectors from rear of accessory housing in which the voice privacy adapter is installed.

Step 2. Remove the accessory housing from its mounting trunion.

Step 3. Loosen two captive screws on bottom of accessory housing and remove accessory housing rear panel.

Step 4. Slide voice privacy adapter out of the accessory housing.

4.1.1.2 Replacement

Step 1. Slide voice privacy adapter into guide slots and into accessory housing.

Step 2. Replace accessory housing rear panel and secure by tightening the two captive screws.

Step 3. Reinstall accessory housing on its mounting trunion.

Step 4. Connect red connector to voice privacy adapter. If another accessory equipment is installed in the accessory housing, reconnect its connector.

4.1.2 CODE Lamp Replacement

Step 1. Remove voice privacy adapter from accessories case (paragraph 4.1.1.1 above).

Step 2. Note position of lamp over the coded-clear switch.

Step 3. Unsolder the two lamp assembly pin connections from the circuit board and remove lamp assembly. Remove all solder from holes in connection pads on circuit board.

Step 4. Place replacement lamp over coded-clear switch and insert connection pins of lamp in holes of the connection pads on circuit board. Solder the connections.

Step 5. Replace voice privacy adapter in accessory housing (paragraph 4.1.1.2 above).

4.2 TROUBLESHOOTING

Troubleshooting data for the voice privacy adapter is contained in the accompanying Troubleshooting Charts (figures 5, 6, and 7). The charts are designed to locate defective stages using signal tracing techniques. The defective components can then be located using voltage readings, waveforms and stage gain measurements shown on the schematic diagram. Filter stage responses are shown on Filter Frequency Response curves (figures 8 and 9).

NOTE

The filter should be checked in the clear mode.

4.2.1 Test Equipment

The following Motorola test equipment, or equivalent, is recommended for troubleshooting the unit.

TEK-23	Dc Power Supply
S1067A	Solid-State Audio Oscillator
T1038A	General Purpose Oscilloscope
S1051C	Solid-State Ac Voltmeter
S1052B	Solid-State Dc Multimeter

4.2.2 Initial Procedure

4.2.2.1 The first step in troubleshooting is to check the interconnections for obvious faults. The coded-clear switch should be checked for proper operation. Then the procedures on the Troubleshooting Chart should be followed.

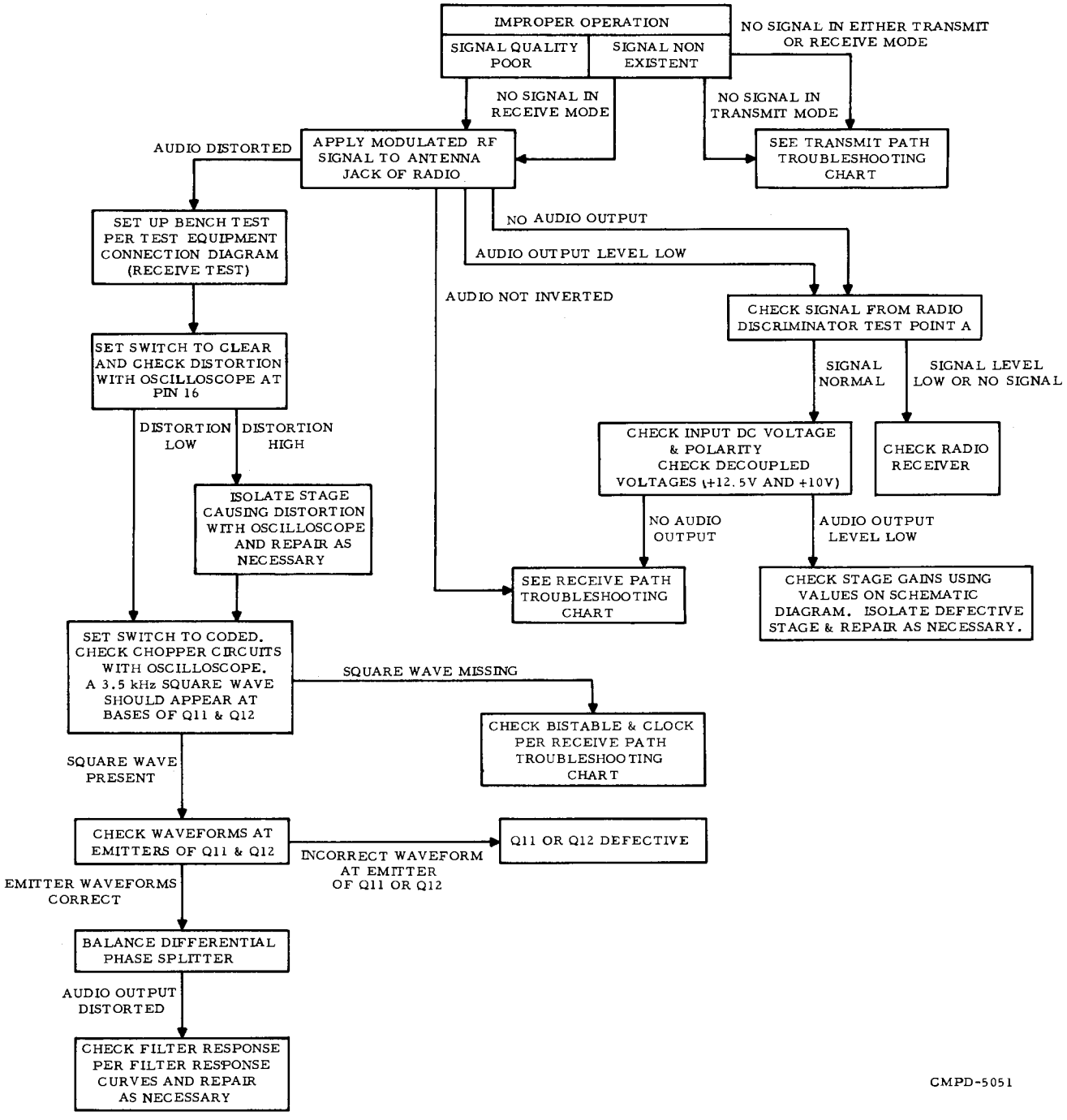


Figure 5. Overall Troubleshooting Chart

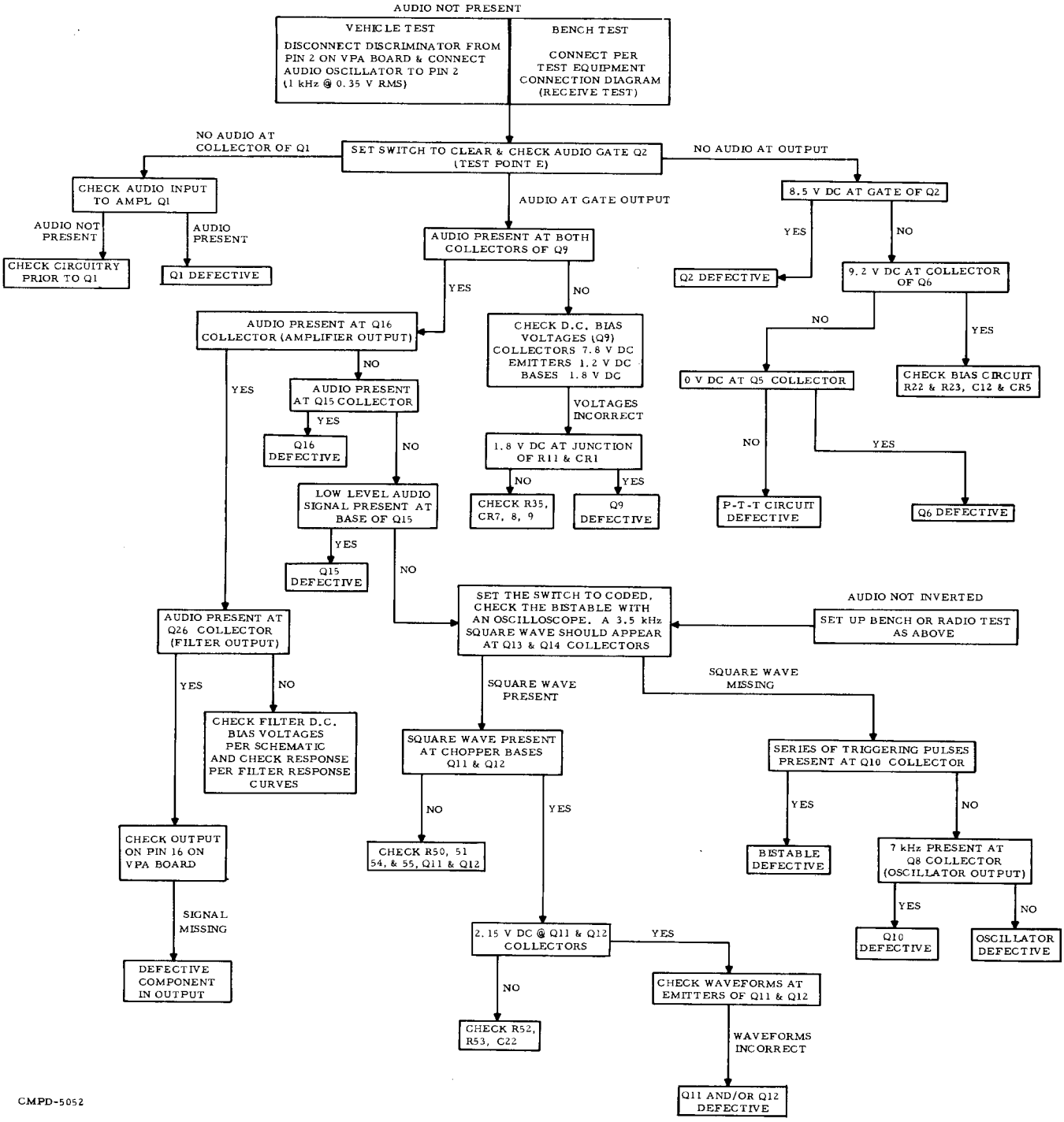


Figure 6. Receive Path Troubleshooting Chart

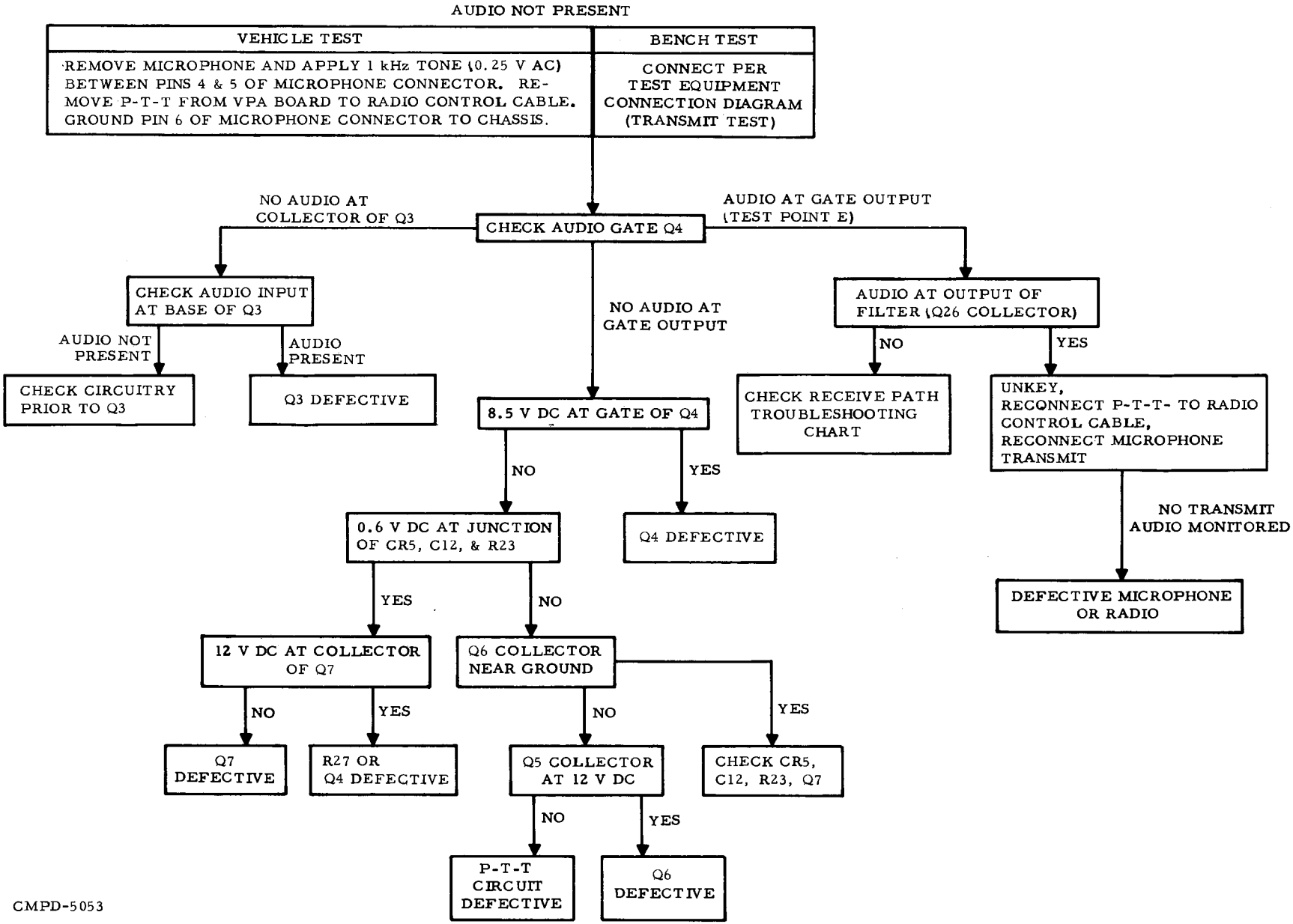


Figure 7. Transmit Path Troubleshooting Chart

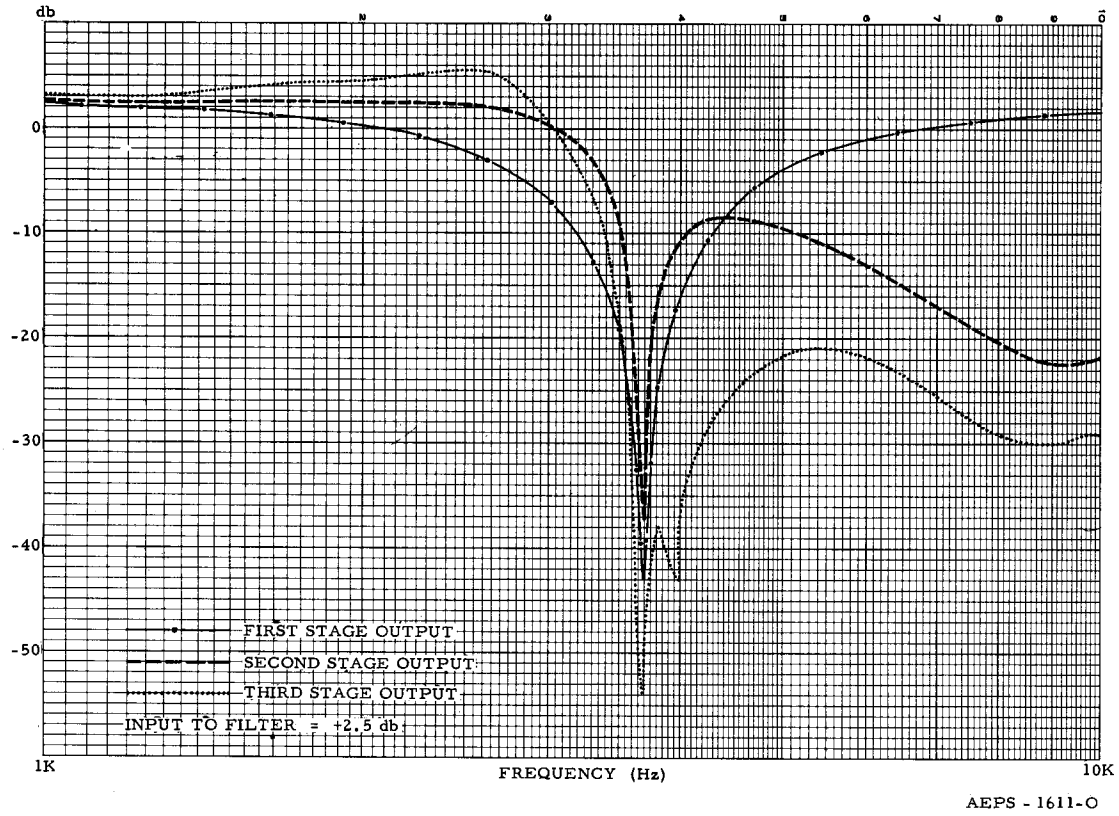


Figure 8. Filter Response Curves Stage 1 (Q18), Stage 2 (Q20), and Stage 3 (Q22)

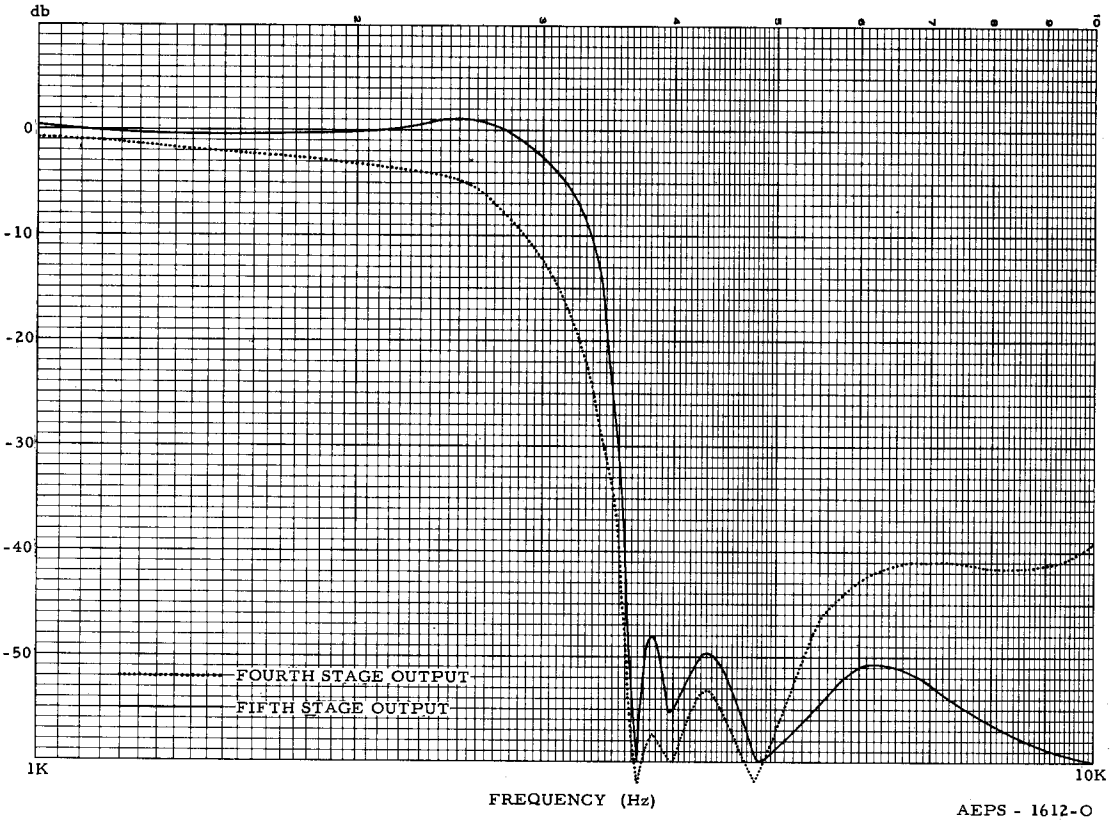


Figure 9. Filter Response Curves Stage 4 (Q24) and Stage 5 (Q26)

NOTE

Circuits or stages may operate normally even if measured dc voltages vary considerably from the typical values shown on the schematic diagram. Proper operation can usually be presumed if there is a distinct difference in the readings between the "clear" and "coded" state of the stage.

4.2.2.2 The troubleshooting charts provide setup information for both in-vehicle testing and bench testing. Test setup for bench testing is shown in figure 10.

4.3 ADJUSTMENTS

4.3.1 Oscillator Drift

The oscillator requires adjustment if it deviates from the +0.6, -0.2% limits listed in the Performance Specifications. Oscillator drift is usually detected when a change in pitch is heard in the coded mode. To adjust, remove the potting compound from the adjustment slug hole in L4 and adjust the oscillator to the correct frequency.

NOTE

Use General Electric RTV-102 silicon rubber or equivalent for potting L4.

4.3.2 Balance Adjust (coded mode)

The adjustment of balance adjust R38 is accomplished by inserting a 0.35V rms, 1000 Hz audio tone to connector pin 2 and adjusting for the sharpest sinewave (i.e., single waveform, see figure 11) at the filter output (collector of Q26). R38 has a knurled wheel that allows fingertip adjustment of the control.

4.4 PRINTED CIRCUIT BOARD REPAIR

4.4.1 General

4.4.1.1 The voice privacy adapter circuit is contained on a printed circuit board with special eyelets in all component mounting holes. The eyelets act as mechanical strain relief members,

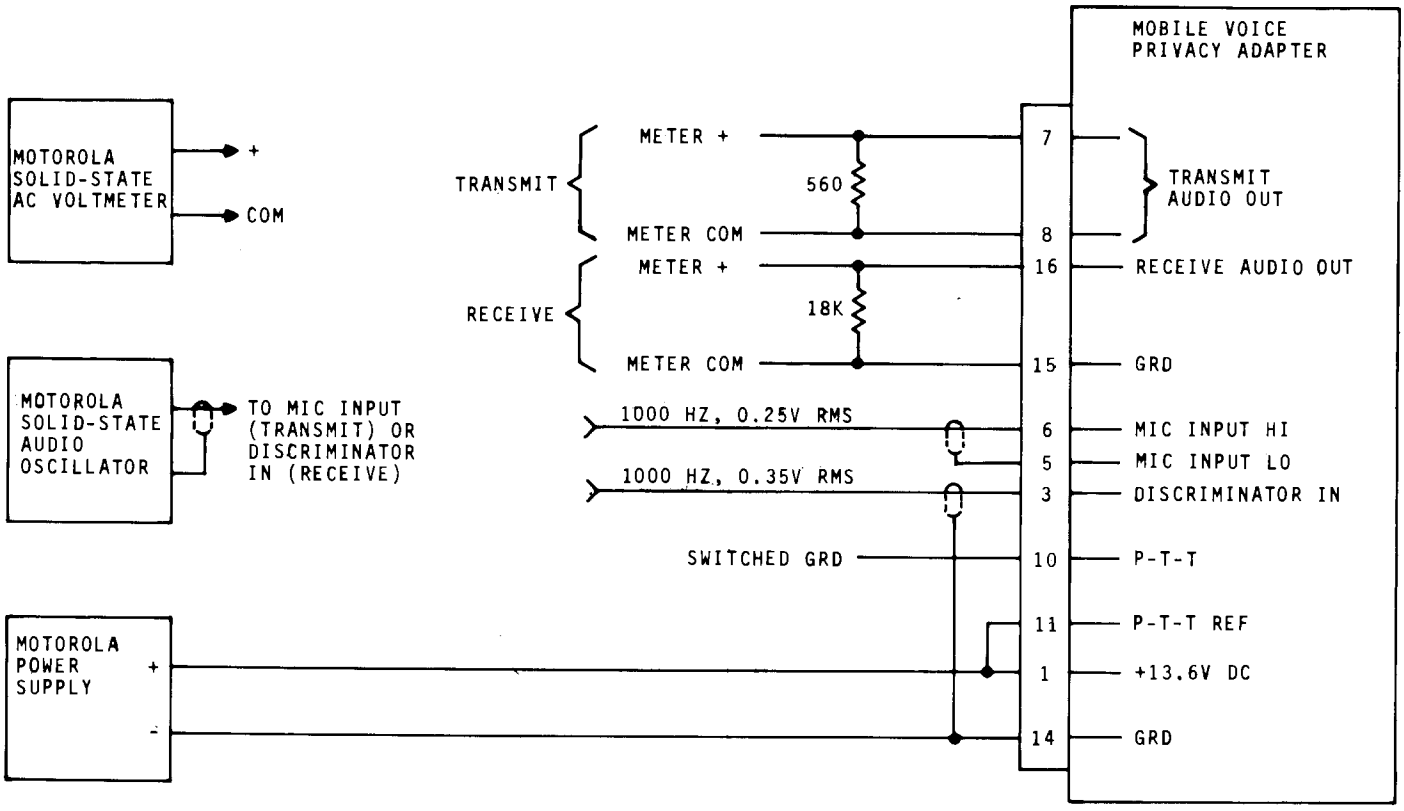


Figure 10. "Micor" Voice Privacy Adapter, Bench Test Setup

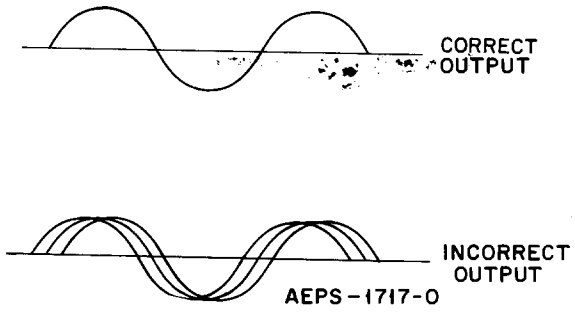


Figure 11. Active Filter Output Waveforms

thereby removing strain from the actual printed circuit.

4.4.1.2 In the past, servicemen have been led to believe that a low wattage soldering iron should be used to prevent damage to the printed circuit board. This is a misconception. Experience has shown that using a low heat iron has, in many cases, caused the damage the serviceman was trying to prevent. The temperature of the connection must be raised until the solder flows freely around the board eyelet. This usually takes a considerable length of time with a low wattage soldering iron. During this period, heat is conducted away from the eyelet by the printed wiring causing them, in some instances, to break away from the board. Therefore, it is preferable that a high-heat iron be used which will heat the connection rapidly to the point where the solder flows freely. Obviously, an iron this hot should not be held on the connection longer than necessary. The soldering iron supplied with the Motorola ST639 Printed Circuit Repair Kit is recommended for most work on these boards.

4.4.1.3 Breaks in the printed circuit wiring can be repaired by bridging the gap with solder. Remove the residual coating covering the printed wiring with solvent before soldering. Areas of damaged circuitry that cannot be practically repaired with a solder bridge can be replaced with a piece of hook-up wire. The hook-up wire should be routed along the original path of the printed circuit to avoid any lead dressing problems in critical areas.

4.4.2 Component Removal

4.4.2.1 Special care should be taken during troubleshooting to be as certain as possible that the suspected component is the faulty one. This special care will eliminate unnecessary unsoldering and removal of parts which may weaken or damage the eyelet board.

4.4.2.2 When removing resistors, capacitors, and similar components, heat the connection to be loosened until the solder is molten. Then brush away, or shake off as much of the molten solder as possible. If the leads are bent over, use a soldering aid tool or a knife to straighten them. It may be necessary to apply the soldering iron while doing this. While applying the soldering iron, wiggle the component gently to free it, then lift it from the board. Be sure the component lead is free before trying to remove it or the eyelet circuit board might be damaged. Install the new component and solder it in place. Use solvent to remove excess flux after soldering.

REVISIONS

38C16-C

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION	REFER TO CIRCUIT BOARD
TLN4571A-1	CR13	Added 48B82256C38	P.S. DECOUPLING	VPA BOARD EMPD-5049-A
	CR1 thru 4	FROM 48C82392B03 TO 48D82420C01	PUSH-TO-TALK BRIDGE	
	CR11, 12	FROM 48C82392B03 TO 48C83654H01	BISTABLE	
	L1, 2	ADDED ALTERNATE PART NO. 24C84003A02	RECEIVE AUDIO INPUT AMPL.	
TLN4571A-2	C8	FROM 8K857474, .001 uF TO 8K868594 0.22 uF	MIC INPUT AMPL (Q3)	EMPD-5049-B
	R16	FROM 6S10401A35, 270 OHMS TO 6S129819, 3.9K		
	C51	FROM 8D82905C04, .068 uF TO 8D82905G02, .022 uF	OUTPUT AMPL BUFFER (Q27, Q28)	
	R98	FROM 6S10401A67, 5600 OHMS TO 6S129668, 10K		
	R99	FROM 6S10401B04, 180 OHMS TO 6S131446, 120K		
	R101	FROM 6S10401A73, 10K TO 6S129819, 3.9K		
	R102	FROM 6S10401A49, 1K TO 6S129818, 820 OHMS		
	R103	FROM 6S10401A49, TO 6S129779, 560 OHMS		

PARTS LIST

DIAGRAM 38C16-C
"Micor" Voice Privacy Adapter TLN1400A

REF SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Voice Privacy Adapter Board TLN4571A
		CAPACITOR, FIXED:
C1	23K865137	tant., 4.7 uf, ±20%, 25 vdcw
C2	8D82905G08	mylar, 0.033 uf, ±10%, 50 vdcw
C3	8D82905G02	mylar, 0.022 uf, ±10%, 50 vdcw
C4	8D82905G07	mylar, 0.1 uf, ±10%, 50 vdcw
C5	8D82905G07	mylar, 0.1 uf, ±10%, 50 vdcw
C6	8D82905G07	mylar, 0.1 uf, ±10%, 50 vdcw
C7	23K865137	tant., 4.7 uf, ±20%, 25 vdcw
C8	8K868594	mylar, 0.22 uf, ±10%, 100 vdcw
C9	23D83214C02	tant., 15 uf, ±20%, 25 vdcw
C10	23K865137	tant., 4.7 uf, ±20%, 25 vdcw
C11	23D83214C21	tant., 6.8 uf, ±20%, 20 vdcw
C12	23D83214C21	tant., 6.8 uf, ±20%, 20 vdcw
C13	23D82783B04	tant., 100 uf, ±20%, 25 vdcw
C14	23K865594	tant., 68 uf, ±10%, 15 vdcw
C15	8C82095G16	mylar, 0.056 uf, ±5%, 200 vdcw
C16	23D83214C04	tant., 1 uf, ±20%, 15 vdcw
C17	8D83445B18	polystyrene, 0.0015 uf, ±5%, 400 vdcw
C18	8D82905G07	mylar, 0.1 uf, ±10%, 50 vdcw
C19	23K865137	tant., 4.7 uf, ±20%, 25 vdcw
C20	8D82905G11	mylar, 0.22 uf, ±10%, 50 vdcw
C21	8D82905G11	mylar, 0.22 uf, ±10%, 50 vdcw
C22	23D84669A25	alum., 15 uf, -10+150%, 25 vdcw
C23	21D82187B08	ceramic, 220 pf, ±10%, 500 vdcw
C24	21D82187B08	ceramic, 220 pf, ±10%, 500 vdcw
C25	21D82428B23	ceramic, 1200 pf, ±10%, 100 vdcw
C26	21D82428B23	ceramic, 1200 pf, ±10%, 100 vdcw
C27	8D82905G07	mylar, 0.1 uf, ±10%, 50 vdcw
C28	21K863949	mica, 2520 pf, ±1%, 500 vdcw
C29	21K863949	mica, 2520 pf, ±1%, 500 vdcw
C30	21K863949	mica, 2520 pf, ±1%, 500 vdcw
C31	21K863949	mica, 2520 pf, ±1%, 500 vdcw
C32	21K873269	mica, 820 pf, ±2%, 300 vdcw
C33	21K859936	mica, 15 pf, ±5%, 500 vdcw
C34	21E82537B38	mica, 1000 pf, ±3%, 100 vdcw
C35	21K840713	mica, 120 pf, ±5%, 500 vdcw
C36	21K82537B38	mica, 1000 pf, ±3%, 100 vdcw
C37	21K847091	mica, 80 pf, ±2%, 300 vdcw
C38	21E82537B38	mica, 1000 pf, ±3%, 100 vdcw
C39	21K865446	mica, 100 pf, ±3%, 500 vdcw
C40	21D82187B21	ceramic, 820 pf, ±10%, 200 vdcw
C41	21K863949	mica, 2520 pf, ±1%, 500 vdcw
C42	21K863949	mica, 2520 pf, ±1%, 500 vdcw
C43	21K863949	mica, 2520 pf, ±1%, 500 vdcw
C44	21K863949	mica, 2520 pf, ±1%, 500 vdcw
C45	21E82537B38	mica, 1000 pf, ±3%, 100 vdcw
C46	21E82537B38	mica, 1000 pf, ±3%, 100 vdcw
C47	21K840713	mica, 120 pf, ±5%, 500 vdcw
C48	21D82187B21	ceramic, 820 pf, ±10%, 200 vdcw
C49	23K865137	tant., 4.7 uf, ±20%, 25 vdcw
C50	23D83214C04	tant., 1 uf, ±20%, 15 vdcw
C51	8D82905G02	mylar, .022 uf, ±10%, 50 vdcw
C52	23D83214C02	tant., 15 uf, ±20%, 25 vdcw
C53	23D83214C02	tant., 15 uf, ±20%, 25 vdcw
C54	23K865137	tant., 4.7 uf, ±20%, 25 vdcw
C55	8D82905G21	mylar, 0.018 uf, ±10%, 100 vdcw
		SEMICONDUCTOR DEVICE, DIODE:
CR1 thru 4	48D82420C01	silicon
CR5 thru 10	48C82392B03	silicon; type RD1343
CR11, 12	48C83654H01	silicon
CR13	48B82256C38	silicon; Zener type; 9.1 V

PARTS LIST

DIAGRAM 38C16

REF SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		LAMP ASSEMBLY:
DS1	65B84326C01	white
		COIL:
L1	24C84003A01 or24C84003A02	6.0 h 6.0 h
L2	24C84003A01 or24C84003A02	6.0 h 6.0 h
L3	25C82878A03	70 mh
L4	24C84200A02	330 mh
L5	24C83961B01	coded brown
L6	24C83961B01	coded brown
L7	24C83961B01	coded brown
		TRANSISTOR:
Q1	48R869570	NPN, type M9570
Q2	48R869652	unijunction, type M9652
Q3	48R869570	NPN, type M9570
Q4	48R869652	unijunction, type M9652
Q5	48R869571	PNP, type M9571
Q6	48R869570	NPN, type M9570
Q7	48R869570	NPN, type M9570
Q8	48R869570	NPN, type M9570
Q9	48R869670	dual NPN, type M9670
Q10 thru Q18	48R869570	NPN, type M9570
Q19	48R869571	PNP, type M9571
Q20	48R869570	NPN, type M9570
Q21	48R869571	PNP, type M9571
Q22	48R869570	NPN, type M9570
Q23	48R869570	NPN, type M9570
Q24	48R869570	NPN, type M9570
Q25	48R869571	PNP, type M9571
Q26	48R869570	NPN, type M9570
Q27	48R869570	NPN, type M9570
Q28	48R869570	NPN, type M9570
		RESISTOR, FIXED, COMPOSITION: ±5%, 1/4w; unless otherwise specified
R1	6S10401A73	10K
R2	6S10401A77	15K
R3	6S10401A63	3900 ohms
R4	6S10401A49	1K
R5	6S10401A75	12K
R6	6S10401A51	1200 ohms
R7	6S10401A61	3300 ohms
R8	6S10401A27	120 ohms
R9	6S10401B18	680K
R10	6S10401A59	2700 ohms
R11	6S10401A43	560 ohms
R12	6S10401A85	33K
R13	6S10401A89	47K
R14	6S10401A67	5600 ohms
R15	6S10401A57	2200 ohms
R16	6S129819	3.9K
R17	6S10401A47	820 ohms
R18	6S10401A39	390 ohms
R19	6S10401A81	22K

PARTS LIST

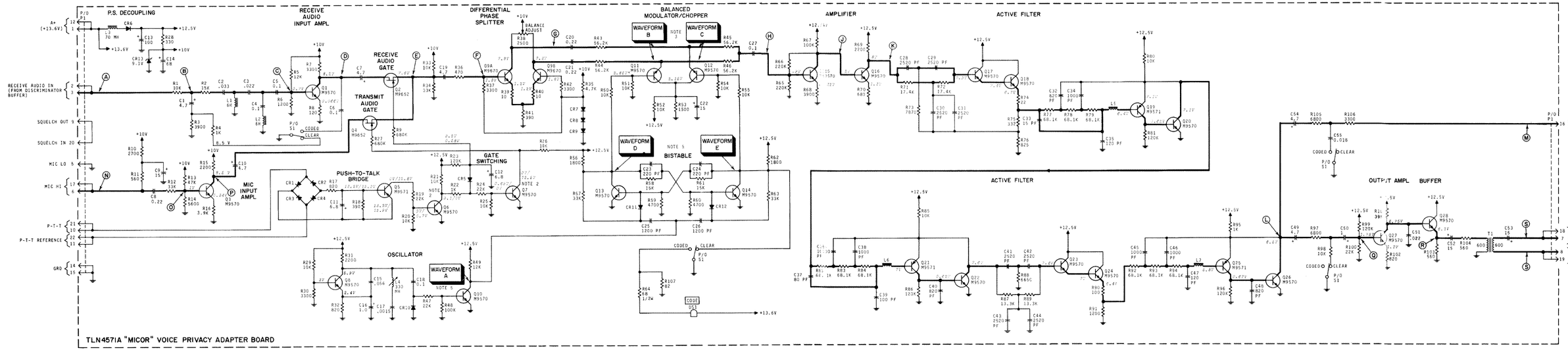
DIAGRAM 38C16

REF SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R20	6S10401A73	10K
R21	6S10401A73	10K
R22	6S10401A49	1K
R23	6S10401A99	120K
R24	6S10401A81	22K
R25	6S10401A73	10K
R26	6S10401A73	10K
R27	6S10401B18	680K
R28	6S10401A37	330 ohms
R29	6S10401A73	10K
R30	6S10401A61	3300 ohms
R31	6S10401A57	2200 ohms
R32	6S10401A47	820 ohms
R33	6S10401A73	10K
R34	6S10401A85	33K
R35	6S10401A65	4700 ohms
R36	6S10401A41	470 ohms
R37	6S10401A61	3300 ohms
R38	18C83083G11	variable, 2500 ohms, ±10%
R39	6S10401A01	10 ohms
R40	6S10401A01	10 ohms
R41	6S10401A39	390 ohms
R42	6S10401A61	3300 ohms
R43 thru R46	6D83175C81	met. film, 56.2K, ±1%
R47	6S10401A81	22K
R48	6S10401A97	100K
R49	6S10401A75	12K
R50	6S10401A73	10K
R51	6S10401A73	10K
R52	6S10401A73	10K
R53	6S10401A53	1500 ohms
R54	6S10401A73	10K
R55	6S10401A73	10K
R56	6S10401A55	1800 ohms
R57	6S10401A85	33K
R58	6S10401A77	15K
R59	6S10401A65	4700 ohms
R60	6S10401A65	4700 ohms
R61	6S10401A77	15K
R62	6S10401A55	1800 ohms
R63	6S10401A85	33K
R64	6S10402A21	68 ohms, 1/2w
R65	6S10401B06	220K
R66	6S10401B06	220K
R67	6S10401A97	100K
R68	6S10401A63	3900 ohms
R69	6S10401A57	2200 ohms
R70	6S10401A45	680 ohms
R71	6D83175C22	met. film, 17.4K, ±1%
R72	6D83175C22	met. film, 17.4K, ±1%
R73	6D84444A04	met. film, 7870 ohms, ±1%
R74	6S10401A09	22 ohms
R75	6D84444A01	met. film, 332 ohms, ±1%
R76	6D84444A02	met. film, 825 ohms, ±1%
R77	6D83175C68	met. film, 68.1K, ±1%
R78	6D83175C68	met. film, 68.1K, ±1%
R79	6D83175C68	met. film, 68.1K, ±1%
R80	6S10401A73	10K
R81	6S10401A99	120K
R82	6D83175C68	met. film, 68.1K, ±1%
R83	6D83175C68	met. film, 68.1K, ±1%
R84	6D83175C68	met. film, 68.1K, ±1%

PARTS LIST

DIAGRAM 38C16

REF SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R85	6S10401A73	10K
R86	6S10401A99	120K
R87	6D83175C13	met. film, 13.3K, ±1%
R88	6D84444A03	met. film, 6650 ohms, ±1%
R89	6D83175C13	met. film, 13.3K, ±1%
R90	6S10401A25	100 ohms
R91	6S10401A51	1200 ohms
R92	6D83175C68	met. film, 68.1K, ±1%
R93	6D83175C68	met. film, 68.1K, ±1%
R94	6D83175C68	met. film, 68.1K, ±1%
R95	6S10401A49	1K
R96	6S10401A99	120K
R97	6S10401A69	6800 ohms
R98	6S129668	10K
R99	6S131446	120K
R100	6S10401A81	22K
R101	6S129819	3.9K
R102	6S129818	820 ohms
R103	6S129779	560 ohms
R104	6S10401A43	560 ohms
R105	6S10401A69	6800 ohms
R106	6S10401A61	3300 ohms
R107	6S10401A23	82 ohms
		TRANSFORMER:
T1	25C84883B01	af interstage, 600/600 ohms
		SWITCH, PUSHBUTTON:
S1	40D84324C10	4 pole, push-push
		NON-REFERENCED ITEMS:
	29C84269C01	connector, male
	29C84269C02	connector, male
	14C84360C01	insulator, push-button switch
		Cable Kit TKN6520A
		NON-REFERENCED ITEMS:
	14C84556B04	connector housing, red
	9C84151B01	receptacle contact
		Hardware and Escutcheon Kit TLN4572A
		NON-REFERENCED ITEMS:
	14C84556B02	connector housing, blue
	66C84699B01	tool, contact removal
	13D84319C03	escutcheon
	38C84321C02	button, push (org)
	40D84324C06	insulator, switch
	14C84006D01	spacer, switch



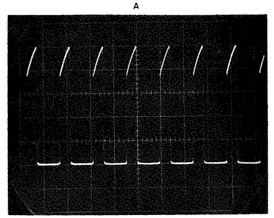
NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS, 1/4 WATT AND CAPACITORS ARE IN MICROFARADS.
2. WHEN TWO TRANSISTOR VOLTAGES ARE GIVEN (I.E., 9.5V/0.7V) THE VOLTAGES INDICATE RECEIVE AND TRANSMIT MODES RESPECTIVELY.
3. TYPICAL EMITTER WAVEFORM AT Q11 OR Q12 SHOWS 1 kHZ INPUT AT PIN 2 AS MIXED WITH 3.5 KHZ CHOPPER OUTPUT. WAVEFORM B IS WITH SCOPE SYNC TO BOTH SIGNALS, WAVEFORM C IS WITH SCOPE SYNC TO 3.5 KHZ CHOPPER SIGNAL ONLY.
4. * INDICATES DC VOLTAGE AT Q11 BASE WITH S1 IN CLEAR POSITION ONLY.
5. SET OSCILLOSCOPE SENSITIVITY TO 2 VOLTS/DIVISION AND TIME BASE TO 0.1 MILLISECONDS/DIVISION.

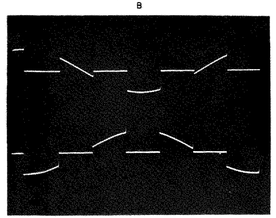
68/81938C16-C

TABLE 1. NOMINAL SIGNAL LEVELS AND GAIN MEASUREMENTS FOR VPA BOARD

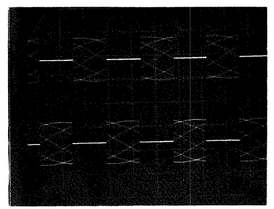
MEASURING POINT	REC MODE SIG LEVEL (MVAC)		XMIT MODE SIG LEVEL (MVAC)		GAIN MEASUREMENTS POINTS	GAIN (DB)	
	CLEAR	CODED	CLEAR	CODED		CLEAR	CODED
A	350	350	N/A	N/A	A-B	-22.8	-11.8
B	26	92	N/A	N/A	B-C	-24.5	-24.5
C	1.55	5.5	N/A	N/A	C-D	+20	+17.5
D	15	40	N/A	N/A	D-E	-0.5	-0.5
E	14.2	38	24.5	24.5	N-O	-31.8	-31.8
F	17.2	33	21	21	O-P	+11.8	+11.8
G	222	580	370	370	P-E	-0.5	-0.5
H	24	63	40	40	E-F	-1.3	-1.3
J	230	620	395	400	F-G	+25	+25
K	770	1800	1290	1180	G-H	+19.5	+19.5
L	580	1000	960	650	H-J	+19.5	+19.8
M	365	370	N/A	N/A	J-K	+10.2	+9.2
N	N/A	N/A	250	250	K-L	-2.5	-5.2
O	N/A	N/A	6.5	6.5	L-M	-4	-8.8
P	N/A	N/A	25.5	25.5	L-O	-8.5	-3
Q	N/A	N/A	370	470	Q-R	+6.8	-1.2
R	N/A	N/A	790	400	R-S	-8	-7.8
S	N/A	N/A	320	165			



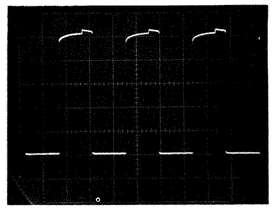
SENSITIVITY: 2V PER DIVISION
TIME BASE: 0.1 MSEC PER DIVISION



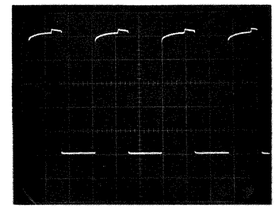
SENSITIVITY: 0.5V PER DIVISION
TIME BASE: 0.1 MSEC PER DIVISION



SENSITIVITY: 0.5V PER DIVISION
TIME BASE: 0.1 MSEC PER DIVISION



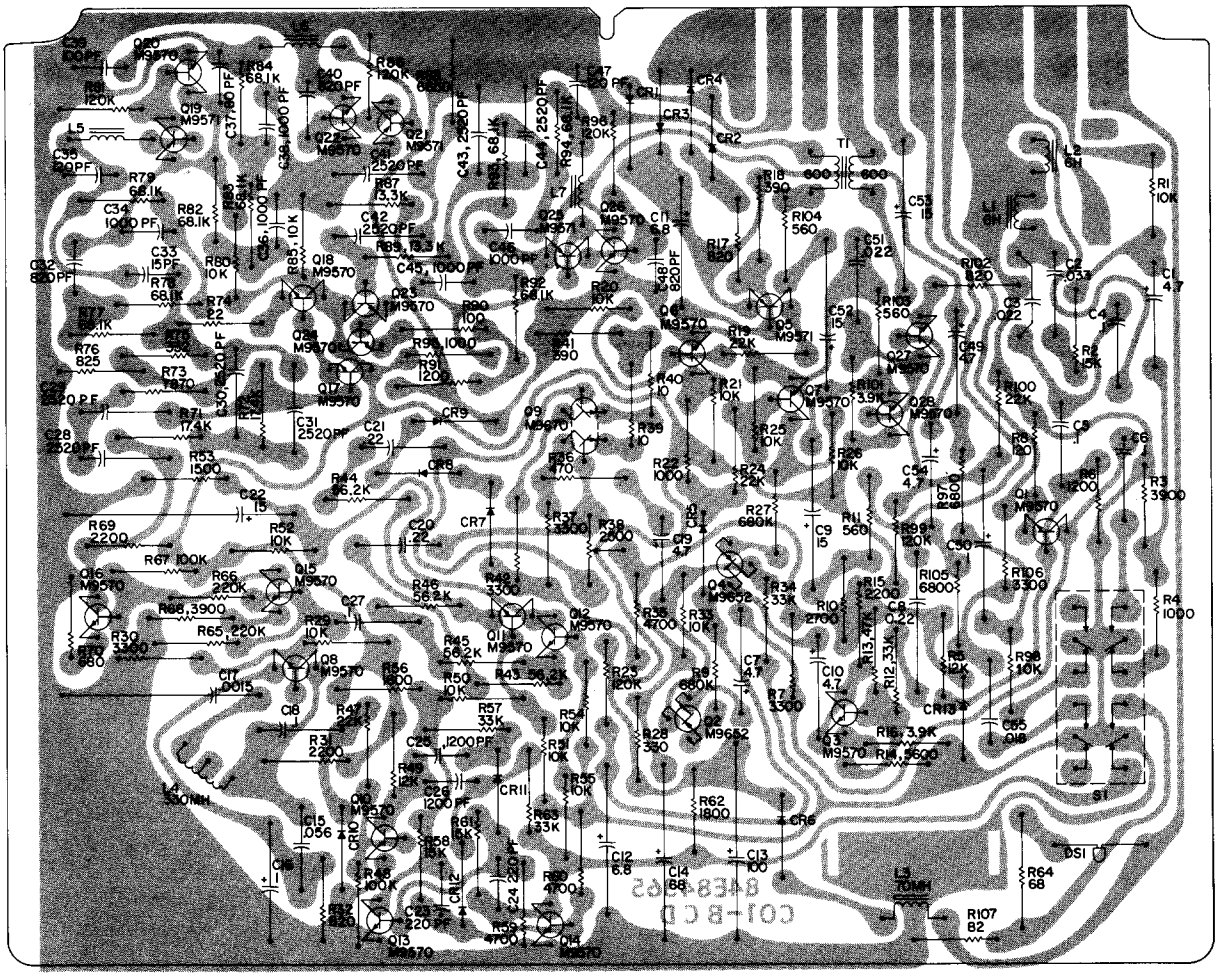
SENSITIVITY: 2V PER DIVISION
TIME BASE: 0.1 MSEC PER DIVISION



SENSITIVITY: 2V PER DIVISION
TIME BASE: 0.1 MSEC PER DIVISION

PREVIOUS REVISIONS AND PARTS LIST
SHOWN ON FRONT OF THIS DIAGRAM

TLN1400A "Micor" Voice Privacy Adapter
Schematic Diagram
Motorola No. 38C16-C
3/12/73-UP



OL-EMPD-5049-B

REVISIONS

EMPD-5049-B

BOARD AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TLN4571A-1		PLATED CIRCUITRY REVISED AND MISC. COMPONENTS RE-LOCATED (NO CIR-CUIT CHANGE)	
	CR13	ZENER DIODE ADDED	LOWER RIGHT OF BOARD
TLN4571A-2	C8	FROM .001 TO 0.22	RIGHT SIDE OF BOARD
	R16	FROM 270 TO 3.9K	
	C51	FROM .068 TO .022	
	R98	FROM 5600 TO 10K	
	R99	FROM 180 TO 120K	
	R101	FROM 10K TO 3.9K	
	R102	FROM 1K TO 820	
	R103	FROM 1K TO 560	

TLN4571A "Micor" Voice Privacy Adapter Board
Component Location Detail
Motorola No. EMPD-5049-B
3/12/73-UP

END OF DOCUMENT