

**MOTOROLA**

"MT500" SERIES

"Handie-Talkie" Radios

"TOUCH-CODE" OPTION

SUPPLEMENT TO SERVICE MANUALS:**68P81012C56 (VHF), 68P81012C58 (UHF), AND 68P81017C55 (LOW BAND)****SPECIFICATIONS**

Current Drain Receive Mode Transmit Mode	100uA 30mA
Deviation Output Level	0.20mV variable
Microphone Muting Level	30dB
Sidetone Level	0.02W to speaker standard
Supply Voltage	+ 10 to + 18Vdc
Size	Standard front cover extended 0.23 in. (5.842 mm)
Tone Scheme	Standard touch-code high-low (DTMF)
Tone Accuracy	± 1.5%
Tone Duration	160ms ± 10ms standard
Temperature	- 30° to + 60°C
Weight (added to radio)	3.0 oz. (84 g)

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

OPTIONS

OPTION		ITEMS ADDED	
NUMBER	DESCRIPTION	NUMBER	DESCRIPTION
H713	"Touch-Code"	NLN5872 or NLN5826 or NLN5877 NLN5960	"Touch-Code" Carrier Squelch Front Cover "Touch-Code" Private-Line Front Cover "Touch-Code" Selective Call Front Cover Cable Kit Front Cover (Low Band Only)
H324	"Slim-line" "Touch-Code" Carrying Case	NLN5940	"Touch-Code" Carrying Case (Slim-line Models)
H325	"Omni" "Touch-Code" Carrying Case	NLN5941	"Touch-Code" Carrying Case (Omni Models)

BARCO

68P81019C70-D

SAFETY INFORMATION

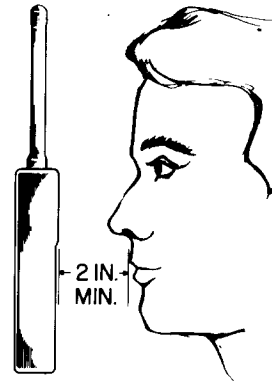
The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard which applies to this equipment. Proper use of this radio will result in exposure below the OSHA limit.

DO NOT operate the transmitter of a mobile radio when someone outside the vehicle is within two feet (0.6 meter) of the antenna.

DO NOT hold the transmit (PTT) switch on when not actually desiring to transmit.

DO NOT allow children to play with any radio equipment containing a transmitter.

DO NOT operate a transmitter near unshielded electrical blasting caps or in an explosive atmosphere unless it is a type especially qualified for such use.



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TEPF-11413-B

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1. DESCRIPTION

The MT500 "Touch-Code" option allows the transmission of standard "Touch-Code" Dual-Tone, Multi-Frequency (DTMF) signals, which have application in remote signaling and portable telephone use. The keyboard is mounted on the front cover of the radio for convenient operation; see Figure 1. The "Touch-Code" front cover and associated circuitry replaces the standard front cover normally supplied.

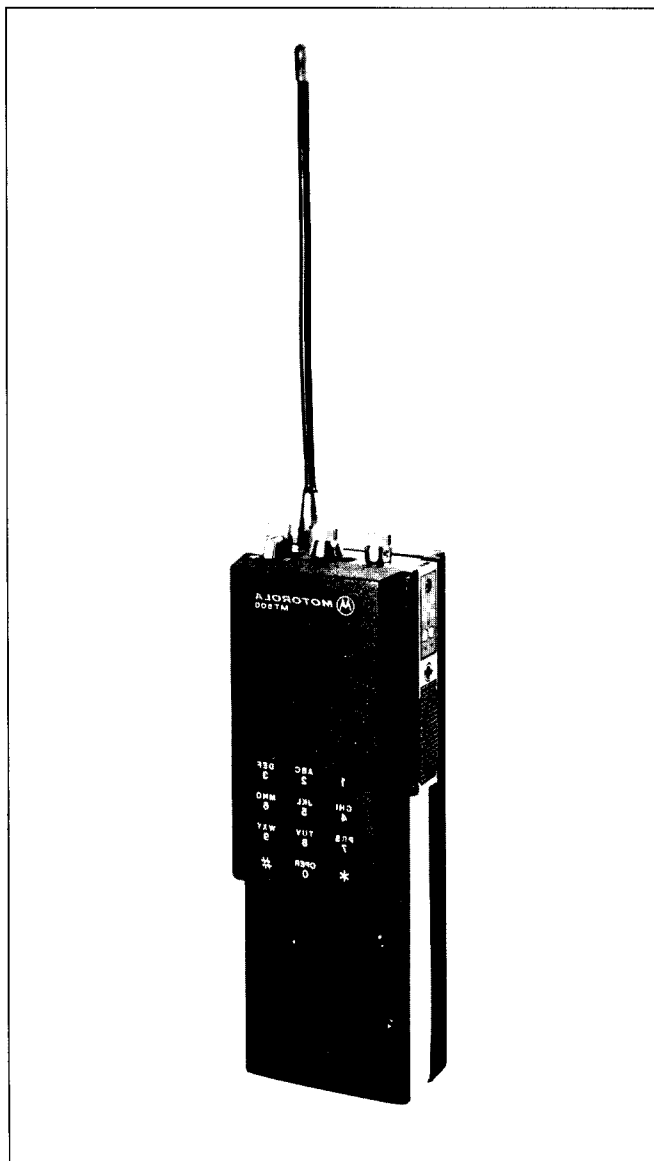


Figure 1. MT500 "Touch-Code" Option

The Touch-Code circuitry draws current from the battery only during the transmit mode. Standard tone duration is approximately 160 milliseconds, but may be modified to any length. The tones are also applied to the speaker (sidetones) for operator feedback. Also, during tone transmission, the microphone is disconnected from the transmitter, thereby eliminating background noise from interfering with the signaling tones.

2. OPERATION

With the push-to-talk (PTT) switch pressed, the digits of the operator's selected DTMF signal is entered through the keyboard by firmly pressing a finger on one key at a time. Each key must be held down for at least $\frac{1}{2}$ second to both transmit a tone and hear it through the speaker. Holding a key down for a longer time will not increase the tone duration. Fingernails or sharp objects should not be used for key entry, because they can damage the keyboard.

3. DETAILED CIRCUIT DESCRIPTION

Refer to the functional block diagram (Figure 2) and the Touch-Code schematic diagram. When the PTT switch is pressed, transmit 7.5 volts is applied to the base of transistor Q2 via pin 5 of front cover connector P201/J1. Transistor Q2 conducts, bringing the collector low and forward biasing CR2. Thus, the sidetone amplifier (U4) is at a low (or ground) potential. Transistor Q1 is also turned on by Q2 and provides switched 15 volts to the regulator (U3) and to the sidetone amplifier. Providing a separate ground and dc supply to the amplifier in this manner allows the amplifier to have a high output impedance when it is off, preventing receiver audio degradation. Diodes CR1 and CR2, along with transistors Q1 and Q2, isolate the amplifier when the radio is in the receive mode. Thus, the sidetone amplifier and regulator receive power during transmit. Regulated 5 volts is supplied to the rest of the circuit by pin 1 of U3.

The chip disable (\overline{CD}) input of tone generator U1 is held low by timer U2 when it is in its "off" state; the any-key-down (AKD) output will then be high.

When a keyboard entry is made, both the row and column inputs associated with that key are grounded, and the AKD output goes low. The timer is triggered by this low-going transition, which is coupled to the timer by capacitor C9. When the timer is triggered, capacitor C13 is allowed to charge through R14. During the charging period, the timer output, pin 3, is high. The tone generator \overline{CD} signal is thus high, enabling the generator. The pair of tones selected by the keyboard entry appears at pin 16, and goes to the sidetone amplifier and the "deviation adjust" potentiometer, R2. The timer output also turns on transistor Q3, which grounds the microphone output R16. Resistors R1 and R15 form a voltage divider with tones being fed to R1 from the deviation adjust control. The tones are then fed to the IDC input via C15, and the microphone is muted.

When the voltage on C13 reaches two-thirds of the supply voltage (3.3 volts), the timer output goes low and pin 6 discharges C13. With the timer output low, signal \overline{CD} goes low to stop tone generation, even if a keyboard button is held down. Transistor Q3 turns off, allowing microphone signals to pass through R16 and R15 to the IDC input. The timer is now ready to be triggered again when the AKD output of the generator goes back to the no-key-down state, then to a key-down state. The tone duration thus formed normally lasts 160 milliseconds, but longer, shorter, or continuous tones can be

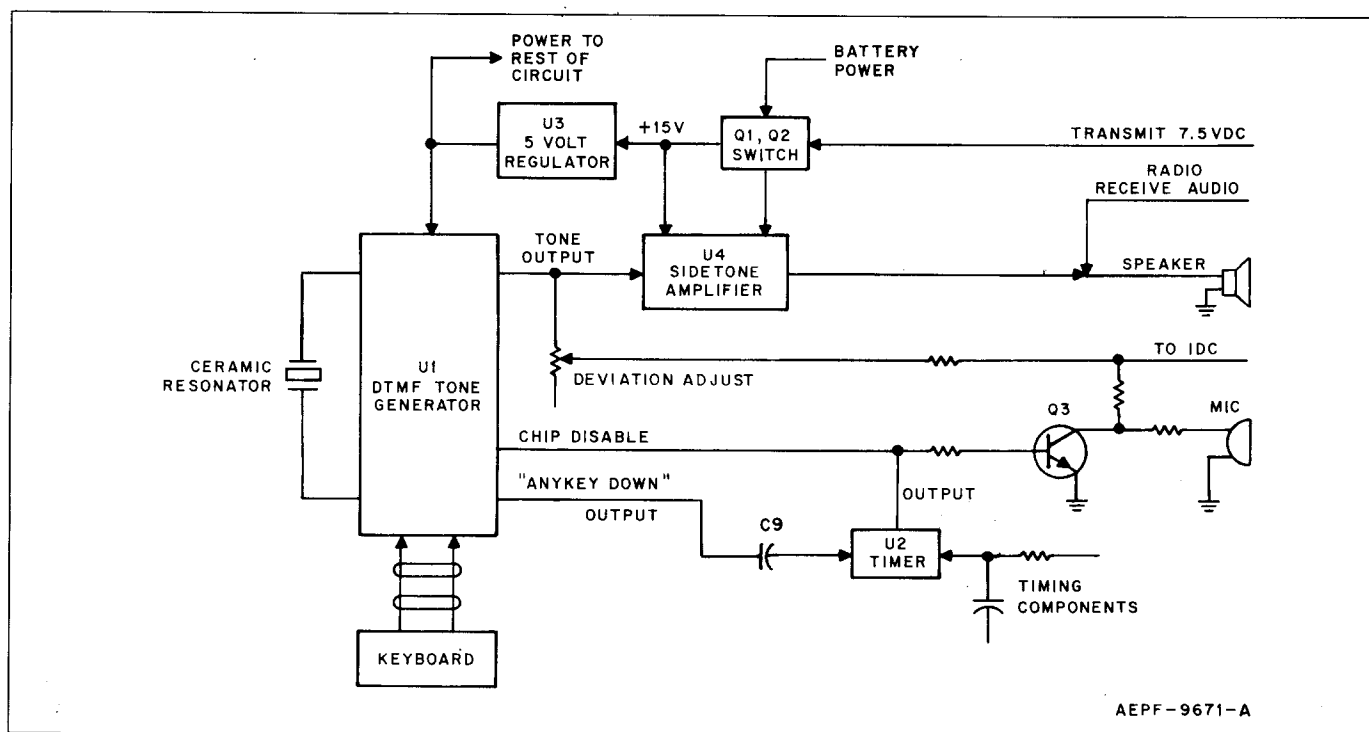


Figure 2. Functional Block Diagram

selected. Components C13 and R14 are precision parts to assure the accuracy of the tone duration.

Figure 3 illustrates the timing waveforms associated with the operation of the circuits. The AKD output changes state when a column input goes low. A short time may elapse between closure of the row and column switches, and the column closure will not necessarily occur first.

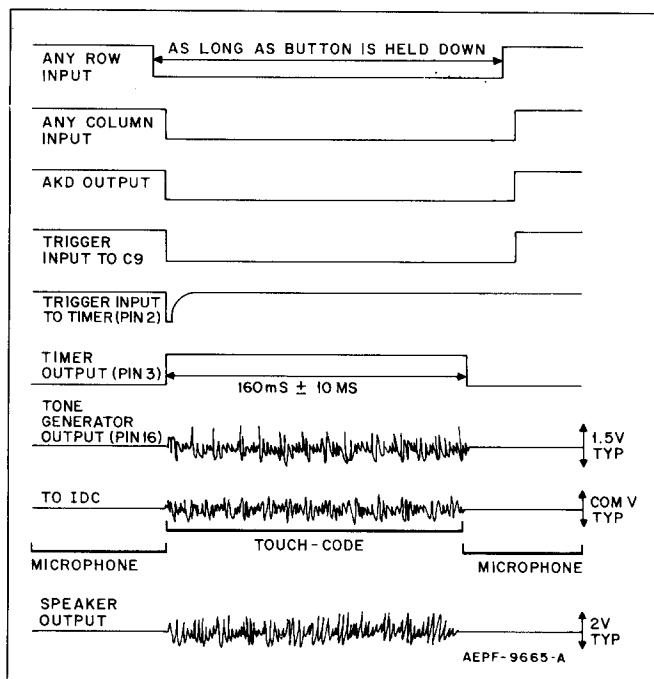


Figure 3. Timing Waveforms

4. MAINTENANCE

a. Introduction

While the Detailed Circuit Description section gives a complete overview of how this option functions, this section of the manual is intended for use as a service aid. By using the diagrams, troubleshooting guide, and deductive processes, the defective component(s) can be isolated and replaced.

b. "Touch-Code" Deviation Adjustment

The Touch-Code option and radio have been factory adjusted to provide correct deviation. Readjustment may be required if either the radio transmitter or the option are serviced. The radio must be adjusted for proper Instantaneous Deviation Control (IDC) prior to adjusting Touch-Code deviation. If it is necessary to adjust Touch-Code deviation, perform the following procedures:

- (1) Disassemble the radio to obtain access to the front cover, as shown in the "Disassembly Procedure" in the Theory/Maintenance manual, 68P81012C55. Leave the interconnect board plug (P201) connected to the front cover.
- (2) Connect a dc power supply to the front cover battery contacts: negative lead to the negative battery contact and positive lead to the positive battery contact.
- (3) Adjust the power supply for 15 volts.
- (4) Adjust a service monitor (Motorola R-1200 or equivalent) to the radio transmitter frequency. Adjust the radio IDC as specified in the Service Manual supplement, 68P81012C56 (VHF), 68P81012C58 (UHF), or 68P81017C55 (Low Band).

(5) With the transmitter keyed, depress any button on the option front cover, and observe the Touch-Code deviation on the monitor.

(6) Adjust potentiometer R2 on the Touch-Code circuit board to obtain 3 to 4kHz deviation of the Touch-Code DTMF signal.

(7) Continuous tones may be transmitted, if desired, by jumpering C9 on the circuit board.

(8) After the adjustment is completed, turn off the power supply and disconnect it from the radio. Remove the jumper, if used, and reassemble the radio.

c. Troubleshooting

Refer to Table 1. The "Touch-Code" Troubleshooting Guide lists possible trouble indications and solutions for this option. To use the table, locate the indicated trouble in the left-hand column. Beside each trouble indication is a number of possible problem areas, which are listed in order of most probable to least likely. Simply perform the steps in numerical sequence. By using the information and procedures provided, faulty circuitry may be rapidly located and repaired.

d. Field Installation for Adding Option

Any "slim-line" extended or "omni"-extended MT500 series radio will accept the Touch-Code front cover. However, modifications to the radio's interconnect circuit board are necessary. When modifying a radio to accept the Touch-Code front cover, perform the following steps:

(1) Disassemble the radio as shown in the Disassembly Procedure in the MT500 series Theory/Maintenance manual (No. 68P81012C55).

(2) Remove the transceiver circuit board.

(3) Disconnect the black/white wire to P201 from ground or terminal B5 of the interconnect circuit board.

(4) The black/white wire will provide a source of transmit 7.5Vdc to the front cover. The wire must be connected to terminal B8 on the interconnect circuit board. This is a small two-hole "jumper" pad. If a red/white wire is already connected to B8, disconnect it and cut it short.

(5) A short jumper wire is used to connect the other hole in the jumper pad to transmit 7.5Vdc. This jumper should be placed on the inside (component side) of the transmit common (TC) frequency switch pad on the interconnect circuit board.

(6) Route the jumper wire as follows:

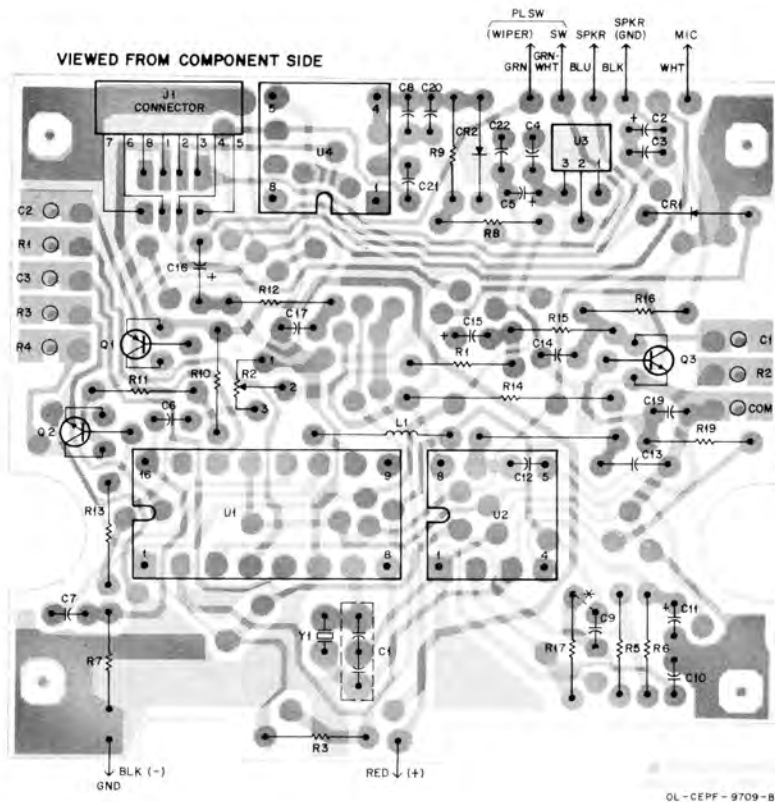
(a) UHF radios—directly toward the rf power amplifier (U12), then turn and pass between CR203 and pin 1 of CE104.

(b) VHF radios—toward the frequency switch, near the frequency switch pads T1 through T8 on the interconnect circuit board. It should then route toward pad B8 by passing between pin 1 of CR106 and R214.

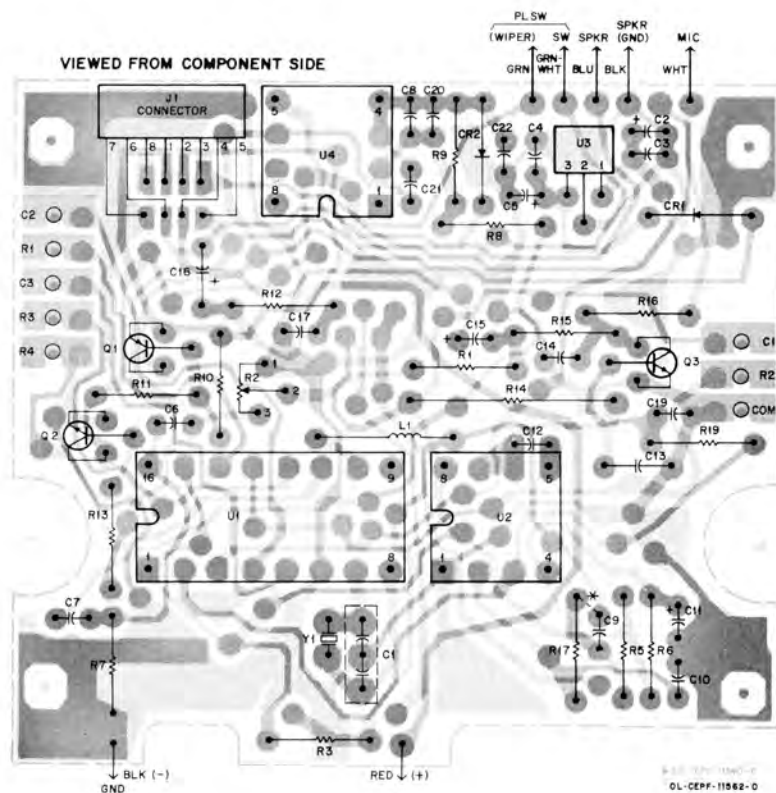
Table 1. TOUCH-CODE Troubleshooting Guide

TROUBLE INDICATION	POSSIBLE PROBLEM AREA
No sidetones, no transmitted DTMF tones for any button	<ol style="list-style-type: none"> 1. Verify power during transmit by checking: radio side of R13, transmit 7.5V; collector of Q2, less than 1.0V; pin 4 of U4, less than 1.5V; emitter of Q1, 15V; collector of Q1, 14.8V; input of U3, 14V, output of U3, 5.0V. Locate defective area of power distribution. 2. AKD output of U1 (pin 10) at 5.0V when no button pressed, to less than 1.0V when button pressed. 3. Verify that only one row input (pin 11, 12, 13, or 14) and one column input (pin 3, 4, or 5) are pulled low by the keyboard for each button pressed; e.g., pins 3 and 14 go low when "1" is pressed. 4. Check proper placement of C1-Y1 pair and for solder shorts, etc., in this area. No U1 outputs will result if oscillator does not run. 5. If step 3 checks OK and step 2 does not, U1 or C1-Y1 is defective. If step 3 does not check OK, keyboard or connectors may be defective. 6. Check proper placement of C9. 7. U2 receives trigger pulse from C9. Pin 2 of U2 should be 5.0V and pulsed low. This pulse lasts about 1ms and should go below 1.0V. 8. U2 output (pin 3) should go to 5.0V for approximately 160ms when U2 receives trigger pulse. If not, and trigger pulse is present, U2 or associated components are defective, wrong, or missing. 9. If pin 3 of U2 goes high, verify that U1 pin 2 goes high also. 10. If U1 pin 2 goes high and previous steps are OK, 160ms tone burst (amplitude approximately 1V p-p) should appear at U1 pin 16. If not, check R7 and for shorts on tone output line. 11. Check for approximately 50mV p-p tone burst at U4 pin 2. If absent, check C7, R8, R9, C8 and C20. 12. If tone burst present, check output of U4 pin 5 for 2V p-p tone burst. If absent, and U4 voltage is OK per step 1, U4 is defective unless C16 is shorted or a solder short exists on the output line. 13. Further absence of sidetones is caused by a wiring error or broken printed-circuit board runner. 14. Verify tone burst at top of deviation control R2. 15. Check placement of R1. 16. If radio will transmit microphone audio, remainder of components are OK.
Sidetones absent, OK otherwise.	Follow steps 11 through 13 above.
No transmitted DTMF tones, OK otherwise.	Follow steps 14 through 16 above.
Some buttons work, others do not.	<ol style="list-style-type: none"> 1. Try to determine if problem is row or column related. 2. Check the corresponding pin at U1 for the defective row or column. Refer to step 3 above. 3. Most likely areas are defective keyboard, connectors, or printed-circuit board runners. Partial failure of U1 is unlikely. 4. U1 will not produce any tones if more than one row or column input is grounded.
Tones off frequency.	<ol style="list-style-type: none"> 1. Y1 and/or C1 defective. 2. Foreign material or solder short in Y1/C1 or U1 area. 3. U1 defective (not likely).
No microphone audio, DTMF tones are transmitted.	<ol style="list-style-type: none"> 1. Check pin 3 of U2. Should be less than 0.5V. If pin 3 is high, check pin 2. Pin 3 will go high if pin 2 is held low. Also, check R14 and C13 area. 2. Check base of Q3. Must be less than 0.5V. 3. Check value and placement of R15 and R16. 4. Q3 shorted; an emitter-collector short will mute the microphone. 5. Check value and placement of R1. 6. Use oscilloscope to trace microphone audio from microphone to IDC line.
No microphone audio, DTMF tones are NOT transmitted.	<ol style="list-style-type: none"> 1. C15 wrong, defective, or missing. 2. Solder short or broken printed-circuit board runner.
Tone duration wrong.	<ol style="list-style-type: none"> 1. R14 and/or C13 defective or wrong value. 2. Foreign material or solder short around U2.
Sidetones and/or DTMF tone distorted.	<ol style="list-style-type: none"> 1. Check pin 16 of U1 for tone quality. Trace tones there with oscilloscope to determine where distortion begins. If U1 is distorted, check pin voltage. Also check value and placement of R7, C6 and C7 can be removed to isolate loads on U1, or to localize a solder short which could be loading pin 16 of U1. 2. If sidetones only are distorted, check polarity of C16 and its dc voltage, as C16 may be leaky.
Deviation too high for DTMF tones.	<ol style="list-style-type: none"> 1. R1 too low in value. 2. R15 too high in value. 3. Q3 not operating properly. 4. R2 defective. 5. Solder short in R1, R2, R15, Q3 area.
Deviation too low for DTMF tones.	<ol style="list-style-type: none"> 1. R1 too high in value. 2. R15 too low in value. 3. R2 defective or wrong part. 4. C6 defective or wrong part. 5. Output of U1 (pin 16) too low. Also, check R7.

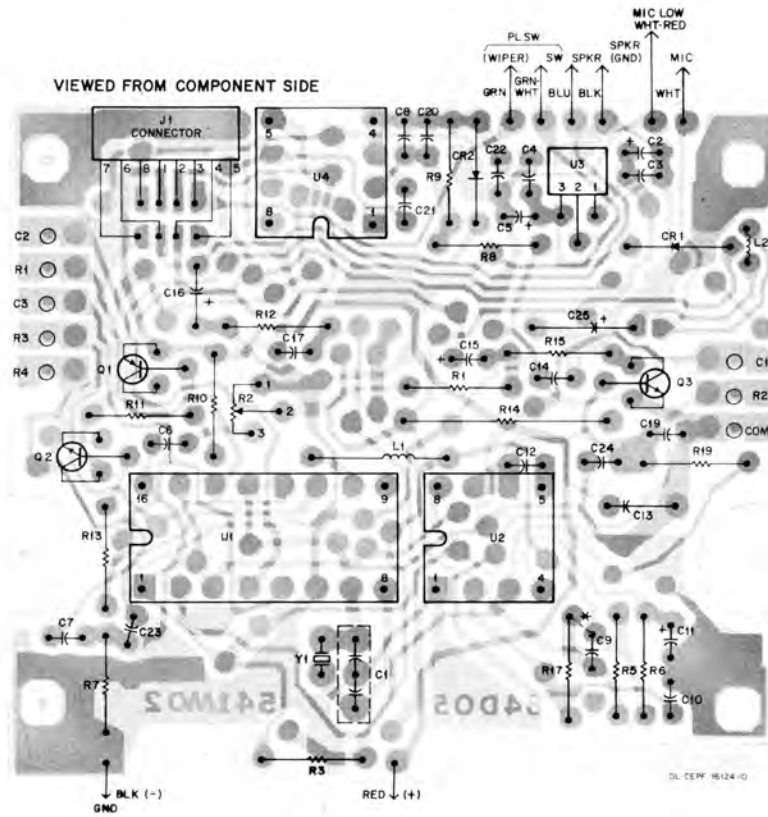
FOR EARLY VERSION RADIOS



FOR LATER VERSION RADIOS NLN5872A, 5826A, 5877A PRIOR TO SUFFIX 4



FOR NLN5872A, 5826A, 5877A SUFFIX 4 AND LATER



**"TOUCH-CODE" OPTION CIRCUITRY
COMPONENT LAYOUT DIAGRAM**

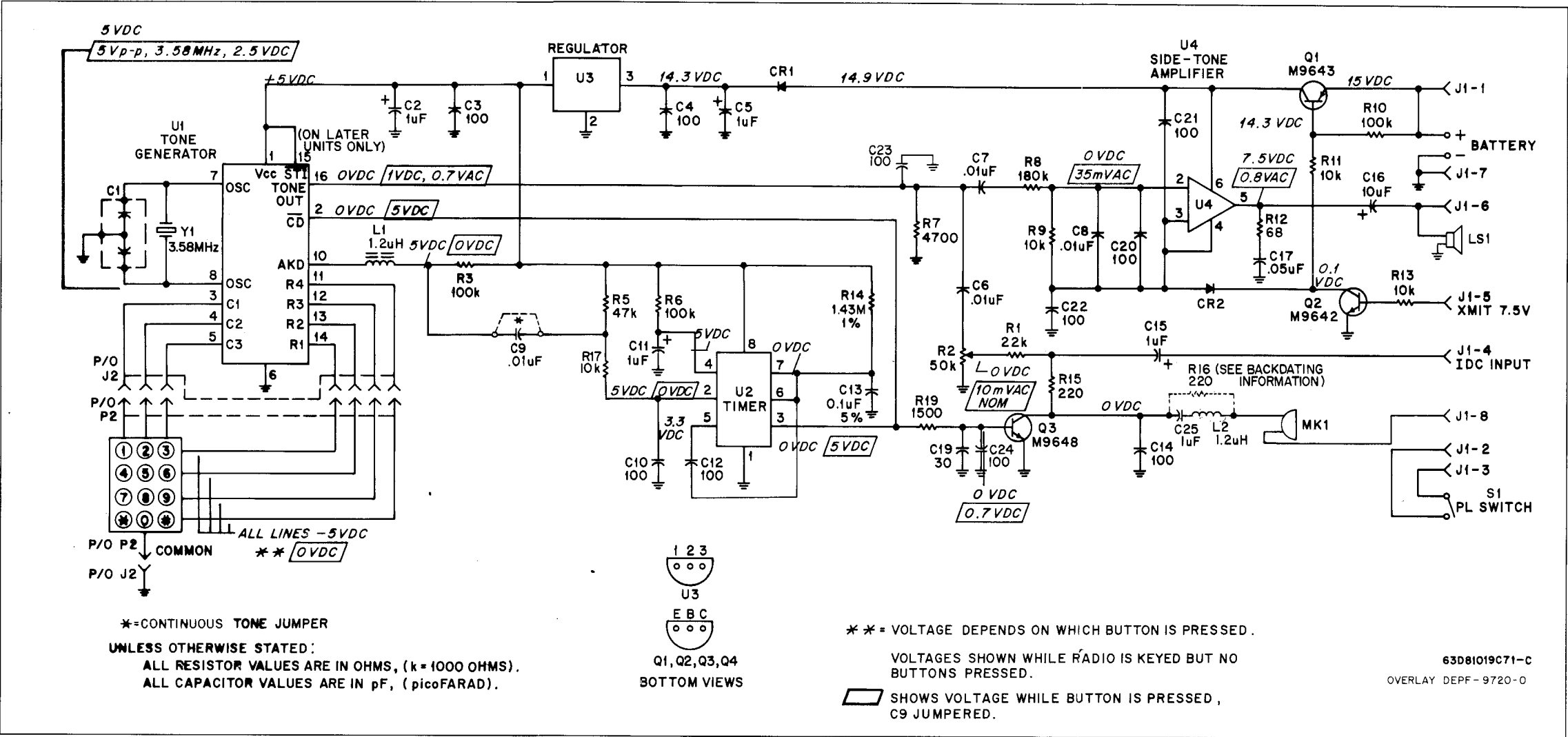
Electrical Parts List

TPLF-1635-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1	-----	CAPACITOR, Fixed: pF $\pm 10\%$;
C2	2382397D36	75V unless stated
C3, 4	2182358G94	part of Y1 (Note II)
C5	2382397D36	1uF $\pm 10\%$; 20V
C6, 7, 8, 9	2184008H24	100; N2200
C10	2182358G94	1uF $\pm 10\%$; 20V
C11	2382397D36	0.01uF $\pm 20\%$; 25V
C12	2182358G94	100; N2200
C13	2184008H27	0.1uF $\pm 5\%$; 25V
C14	2182358G94	100; N2200
C15	2382397D36	1uF $\pm 10\%$; 20V
C16	2382397D15	10uF $\pm 20\%$; 20V
C17	2184008H13	0.05uF $\pm 20\%$; 25V
C19	2182358G95	30; N750
C20 thru C24	2182358G94	100; N2200
C25	2382397D36	1uF; 20V
CR1, 2	4882363E03	DIODE: See Note I
CR203	4882466H13	Silicon
F1	6505214E01	FUSE:
L1, 2	2482723H27	2-Amp
LS1	5005334D01	COIL, RF: unless stated
		1.2uH choke
MK1	5982575J02	SPEAKER:
		Dynamic, 2"; frequency response: 300 to 3500Hz
J1	2805419H01	MICROPHONE:
		Cartridge, res: 700 Ω $\pm 20\%$
Q1	4800869643	Impedance: 5000 Ω $\pm 30\%$
Q2	4800869642	PLUG:
Q3	4800869648	Connector Plug
R1	0660075A81	TRANSISTOR: See Note I
R2	1805501C04	PNP; type M9643
R3	0660075A97	NPN; type M9642
R5	0660075A89	NPN; type M9648
R6	0660075A97	RESISTOR, Fixed: Ω $\pm 5\%$;
R7	0660075A65	1/8W unless stated
R8	0660075B04	22k
R9	0660075A73	Pot., 50k; deviation adjust
R10	0660075A97	100k
R11	0660075A73	47k
R12	0600185B65	100k
R13	0660075A73	4700
R14	0605886D94	180k
R15	0600185A33	10k
R17	0660075A73	10k
R19	0660075A53	1500
S1	4005061E01 or 4005255F01	SWITCH:
		Toggle, SPDT, "PL" (NLN5826A)
U1	5105461G02	Momentary (NLN5877A)
U2	5184320A35	INTEGRATED CIRCUIT: See Note I
U3	5105469E01	Tone Generator
U4	5105469E04	Timer; type NE555V
		Regulator; type M6901
		Audio Amplifier
Y1	4805719G01	CERAMIC RESONATOR:
		See Note II and III
		3.58MHz (includes C1)

NOTE:

- I. For optimum performance, order replacement diodes, transistors, and integrated circuits by Motorola part number only.
- II. When ordering ceramic resonator, specify frequency and Motorola part number.
- III. Y1 and C1 are selected together and must be replaced as a matched pair.



BACK-DATING INFORMATION

ITEM NO.	REF. SYMBOL/CHANGES	LOC.	CHANGED TO
NLN5872A NLN5826A NLN5877A	R14 WAS 0684640C79, 825k $\pm 1\%$		NLN5872A-1 NLN5826A-1 NLN5877A-1
NLN5872A-1 NLN5826A-1 NLN5877A-1	R12 WAS 0600185A01, 10 Ω $\pm 5\%$		NLN5872A-2 NLN5826A-2 NLN5877A-2
NLN5872A-2 NLN5826A-2 NLN5877A-2	R14 WAS 0605886D93, 787k $\pm 1\%$		NLN5872A-3 NLN5826A-3 NLN5877A-3
NLN5872A-3 NLN5826A-3 NLN5877A-3	C23, 24, 25 Added L2 Added R1 WAS 0600185A81, 22k R3, 6, 10 WAS 0600185A97, 100k R5 WAS 0600185A86, 47k R7 WAS 0600185A65, 4700 R8 WAS 0600185B04, 180k R9, 11, 13, 17 WAS 0600185A73, 10k R16 Deleted, WAS 0600185A33, 220 (replaced by C25 and L2) R19 WAS 0600185A53, 1500		NLN5872A-4 NLN5826A-4 NLN5877A-4
NLN5872A-4 NLN5826A-4 NLN5877A-4	AS SHOWN		

"TOUCH-CODE" OPTION CIRCUITRY
SCHEMATIC LAYOUT DIAGRAM,
AND PARTS LIST

Front Cover Kits:
NLN5826A "Touch-Code" Private-Line
NLN5872A "Touch-Code" Carrier Squelch
NLN5877A "Touch-Code" Selective Call

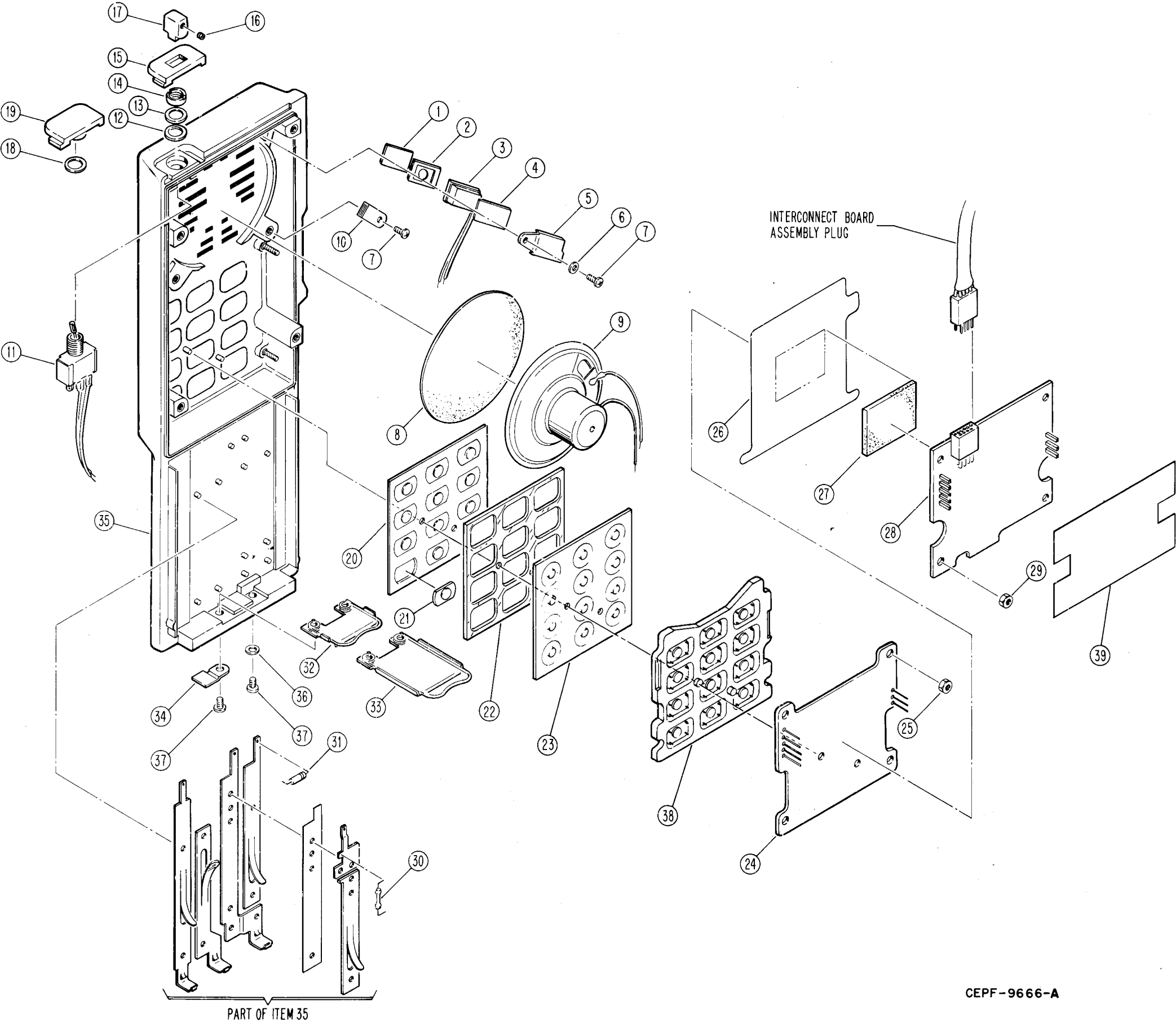
TPLF-1636-D

ITEM NO.	NOMENCLATURE	MOTOROLA PART NO.
1	CLOTH, Felt, Mic	3505450B01
2	PAD, Mic	7505577F01
3	MICROPHONE (MK1)	See Note
4	PAD	7582745J01
5	BRACKET, Mic	0705672D01
6	WASHER, Spring	0405314E01
7	SCREW, Machine; 2-56 x 1/8	0300138651
8	CLOTH, Felt Grill	3505370C01
9	SPEAKER (LS1)	See Note
10	CLAMP, Speaker	4205423H01
11	SWITCH (S1)	See Note
12	GASKET, "O" Ring (NLN5826A and NLN5877A)	3205082E01
13	WASHER, Special (NLN5826A and NLN5877A)	0405081E01
14	NUT, Mtg. (NLN5826A and NLN5877A)	0205050E03
15	ESCUTCHEON (NLN5826A and NLN5877A)	1305057E07
16	SCREW, Set (NLN5826A and NLN5877A)	0383174C04
17	KNOB, Switch (NLN5826A and NLN5877A)	3605114E01
18	GASKET, Plug (NLN5872A)	3205315E01
19	PLUG, Cover (NLN5872A)	3805115E01
20	PAD, Touch-Code*	7505902K01
21	BUTTON, Keyboard*	**
22	SPACER, Key*	**
23	PAD, Contact*	**
24	Contact Printed Circuit Board Assembly, Riveted	0105950F99
25	NUT, Hex	0205414H01
26	INSULATOR	1405755H01
27	PAD, Sponge	7505C83E01
28	CIRCUIT BOARD	0105950F28
29	NUT, Hex	0205414H02
30	FUSE (F1)	See Note
31	RECTIFIER (CR203)	See Note
32	LATCH Assembly (Slim Line)	NLN4181A
33	LATCH Assembly (Omni)	NLN4182A
34	INSULATOR, Contact (Slim Line)	1405359A01
35	COVER, with Battery Straps	0105950F26
36	WASHER, Latch	0400120581
37	SCREW, Latch	0300139982
38	PAD, (NLN5877A)	7505083E04
39	INSULATOR, (NLN5877A)	1405547G02

NOTE: See Electrical Parts List for part number and description.

* NLN5826A, NLN5827A only

** Part of Touch-Code Pad



CEPF-9666-A

END OF DOCUMENT