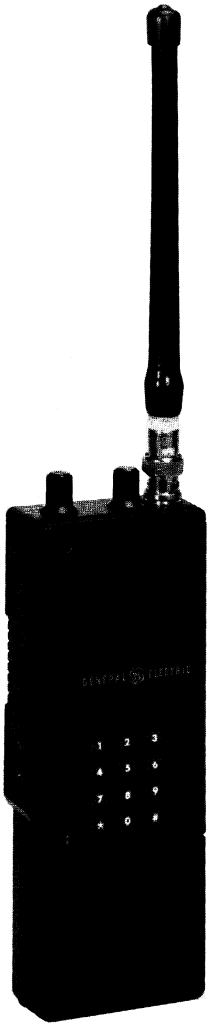
MOBILE RADIO

MAINTENANCE MANUAL

FOR
GENERAL ELECTRIC

MPI

DTMF ENCODER



GENERAL ELECTRIC

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SPECIFICATIONS

Operating Voltage	Battery Supply
Current	
Standby (no key pressed)	630 uA
Operating (key pressed)	3 mA @ 5.4 VDC 7 mA @ 7.5 VDC
Tone Levels	
Typical for 3 kHz deviation	1.8 VPP
Frequency Accuracy	±1%

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
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GENERAL ELECTRIC*
U.S.A.

DESCRIPTION

General Electric Dual Tone Multi-frequency (DTMF) Encoder is used for encoding MPI Personal radios with standard DTMF tones. The encoder consist of two parts: printed circuit board A1 and a 12-key matrix type keyboard.

The encoder is mounted on the front cover of the radio and provides the following functions:

- Generation of DTMF tone frequencies corresponding to digits dialed on the keypad.
- Continuous tone output as long as any digit is keyed on the keypad.
- Sidetone output to the radio speaker to permit monitoring the tones as they are transmitted.
- Uses standard tone format for high signaling reliability and equipment compatability.

OPERATION

To make a telephone call, use the following procedure:

1. Key the transmitter, press the star "*" key and unkey the transmitter to listen for the dial tone.
2. Key the transmitter again and dial the digits of the number. Then unkey the transmitter. Sidetone will be heard as each digit is dialed.
3. When someone answers, key the transmitter to talk and unkey the transmitter to listen.
4. When the conversation is completed, press the pound "#" key to disconnect from the telephone system.

CIRCUIT ANALYSIS

The DTMF Encoder uses standard dual-tone multi-frequency format for telephone dialing. Each digit is identified by a unique combination of two tones; one corresponding to the horizontal row, and the other to the vertical column of push-button positions shown in Figure 1. The frequencies are grouped about the geometric center of the 300 to 3000 Hz voice band used in telephone and radio systems. The two tones are generated simultaneously and remain on as long as a digit is being sent. Row tones are in a lower frequency group than column tones. The frequencies are non-harmonic to give high immunity to false identification from beat frequencies and distortion-produced overtones.

U1 is an integrated CMOS tone encoder with a 3.579 MHz crystal connected to pins 7 and 8. This acts as a reference oscillator. The oscillator runs only when a key is pressed.

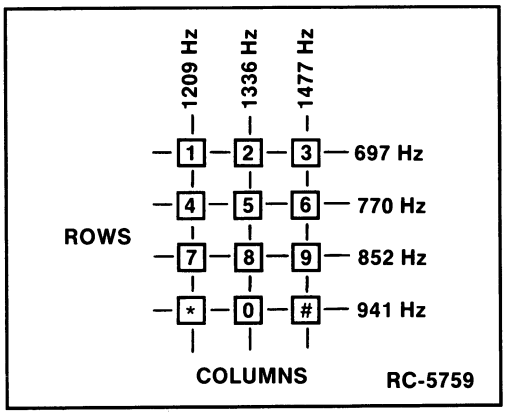


Figure 1 - Touch-Tone Keypad and Frequency Format

The row and column inputs of U1 are normally biased in opposite directions and hold their associated input sensing circuit turned OFF. When a key is depressed the inputs are tied together and the input sensing circuits sense the "1/2 level" and deliver a logic signal to the internal circuitry of U1 and cause the proper tones to be generated.

Keying the transmitter applies 5.4 volts to U1. Dialing any of the keys enables the tone output and causes Mute Output U1-10 to go high.

The tone output is applied to the modulator circuit on the audio board.

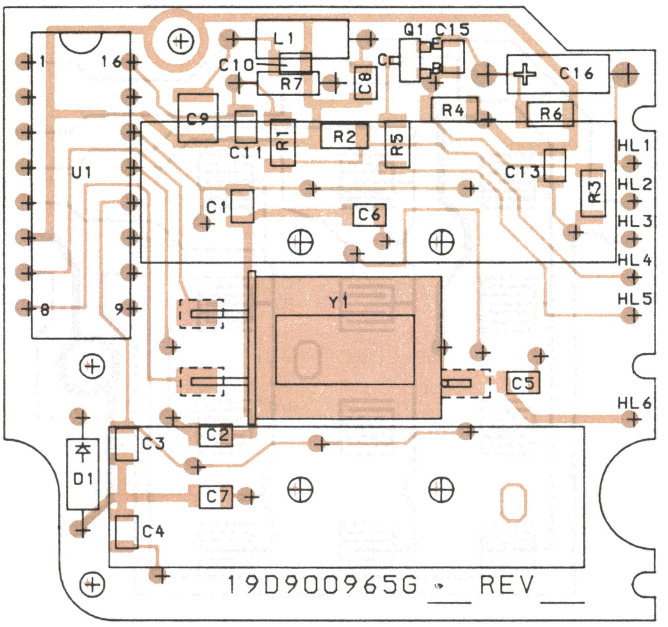
When U1-10 goes high, Q1 turns on and applies side tone directly to the speaker. The high MUTE OUTPUT is also applied to transistor Q5 on the audio board, turning it on. Turning Q5 on shunts any audio from the microphone to ground.

When the key is released, both TONE OUT (U1-16) and MUTE OUT (U1-10) are disabled.

QUICK CHECKS

Before beginning the following procedure, refer to the MPI Trouble-shooting Chart in the appropriate Maintenance Manual.

SYMPTOMS	CHECK
No sidetones but have TX Tones	Q1
No sidetones and no TX Tones	U1 & Q1
Does not encode at all	Keypad
Microphone does not mute when sending tones	U1



(19D900966, Rev. 3)
(19A702962, Sh. 1, Rev. 0)
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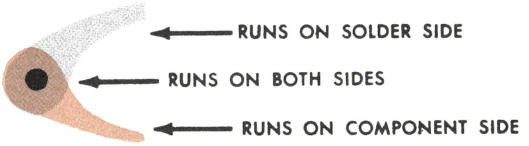
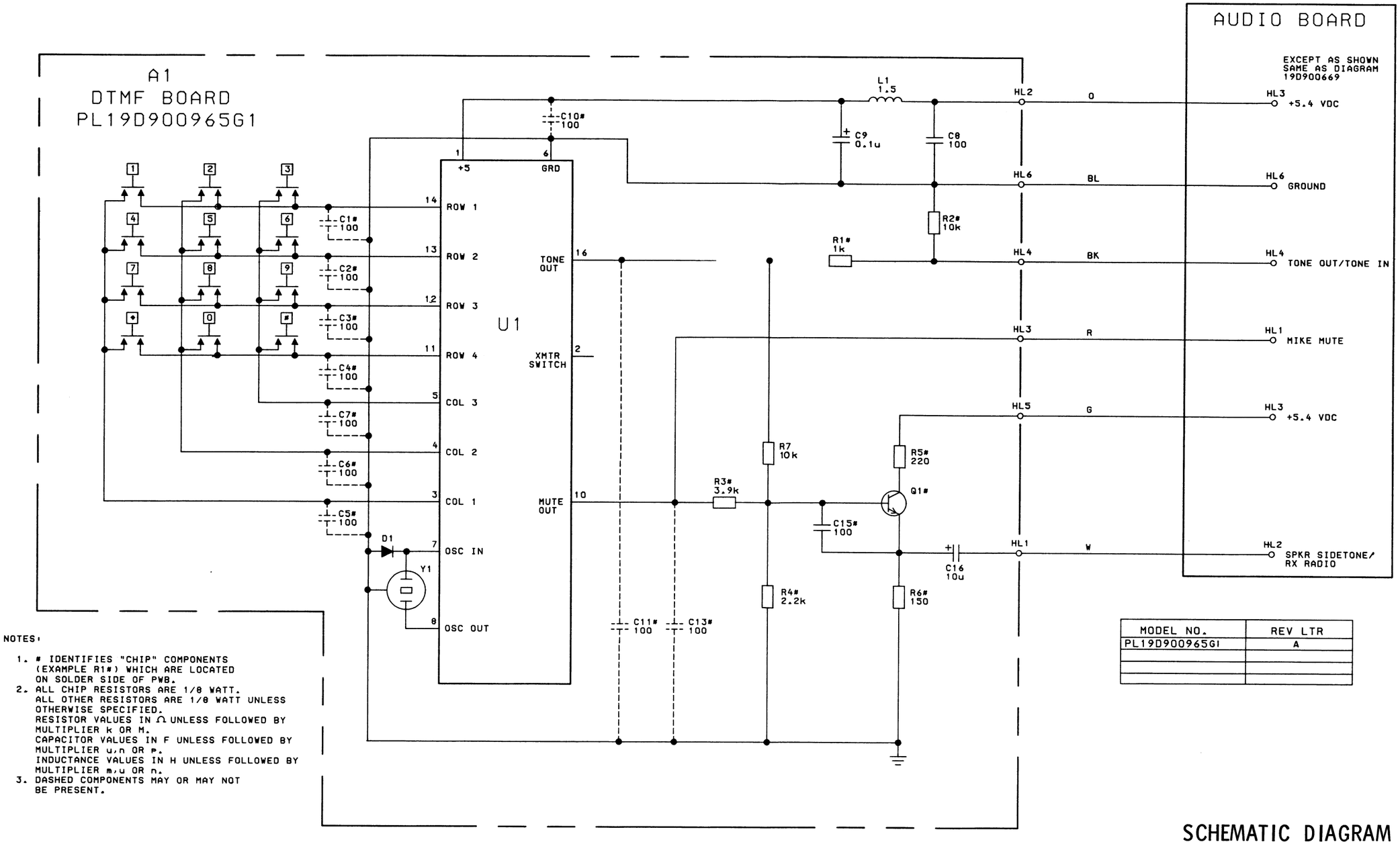


OUTLINE DIAGRAM

DTMF BOARD
19D900965G1



NOTES:

1. # IDENTIFIES "CHIP" COMPONENTS (EXAMPLE R1#) WHICH ARE LOCATED ON SOLDER SIDE OF PWB.
2. ALL CHIP RESISTORS ARE 1/8 WATT. ALL OTHER RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED. RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER k OR M. CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER u,n OR p. INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m,u OR n.
3. DASHED COMPONENTS MAY OR MAY NOT BE PRESENT.

MODEL NO.	REV LTR
PL19D900965G1	A

SCHEMATIC DIAGRAM

DTMF BOARD

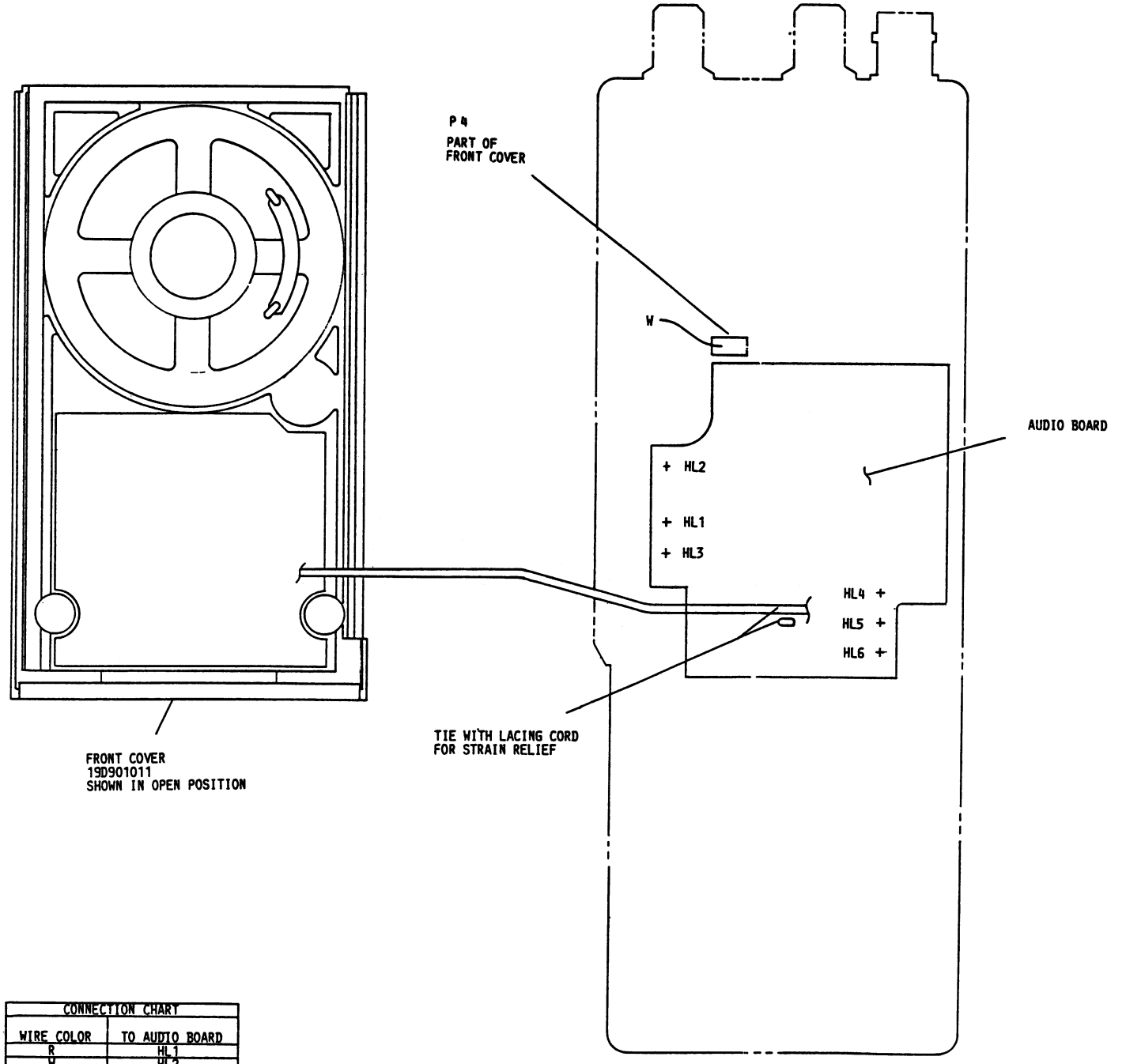
PARTS LIST

DTMF ENCODER
19D901011G1 STANDARD GE
19D901011G3 STD GE W/O METAL
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
A1		COMPONENT BOARD 19D900965G1 REV A
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C8	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C9	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C15	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C16	19B800650P16	Tantalum: 10 uF ±20%, 10 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - - -
D1	19A700025P10	Silicon, zener: 400 mA max; sim to BZX55-C10.
		- - - - - - - - - - - COILS - - - - - - - - - - -
L1	19A700024P15	Coil, RF: 1.5 uH ±10%.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A700076P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R2	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R3	19B800607P392	Metal film: 3.9K ohms ±5%, 200 VDCW, 1/8 w.
R4	19B800607P222	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 w.
R5	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R6	19B800607P151	Metal film: 150 ohms ±5%, 200 VDCW, 1/8 w.
R7	3R151P103J	Composition: 10K ohms ±5%, 1/8 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A134958P1	Linear/Digital CMOS TONE ENCODER.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y1	19A702511G1	Quartz: Frequency 3.579545 MHz.
		FRONT COVER 19D900647G6 STD GE 19D900647G7 STD GE W/O METAL
		- - - - - - LOUDSPEAKERS & MICROPHONES - - - - -
B1	19A134460P1	Permanent magnet: 2 inches, 8 ohms ±10%, imp 500 mW, 450 ±100 Hz resonant freq; sim to Pioneer A50AP13-01F.
B2	19J706041P1	Microphone cartridge: 200-850 ohms output imp., 1.5 to 10 VDC; sim to Primo EM-60.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 and C2	19A700232P64	Ceramic: 100 pF ±10%, 100 VDCW, temp coef -5600 PPM.
C3	19B800650P13	Tantalum: 1 uF -20+40%, 10 VDCW.
P4		Connector, Includes:
	19A702405P4	Shell.
	19A702405P28	Contact, electrical. (Quantity 3).

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A703346P1	Pad. (Located in front cover).
	19A702471P6	Crystal pad. (Used with U1).
	19A702396P1	Nameplate. (GENERAL ELECTRIC).
	19C851082P1	Switch, touch pad.
	19A116125P1002	Machine screw, phillips head: No. 0-80 x 1/8. (Secures A1).
	4033714P14	Solderless terminal. (Used to tie W1 back).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



CONNECTION CHART	
WIRE COLOR	TO AUDIO BOARD
R	HL1
W	HL2
O	HL3
BK	HL4
G	HL5
BL	HL6

DTMF

(19D901090, Sh. 3, Rev. 1)

MECHANICAL LAYOUT

DTMF BOARD