MAINTENANCE MANUAL

RADIO
FRONT ASSEMBLY
19D902177G3 (2 Channels)
19D902177G4 (8 Channels)

TABLE OF CONTENTS

LIST OF FIGURES

DESCRIPTION

The Radio Front Assembly for the **PCS** ™ Personal Synthesized Radio consists of the following:

- Front Cap Assembly 19D902180G2 (DTMF)
- Audio/Logic Board 19D902142G3 (2 CHANNELS)

OR

- Audio/Logic Board 19D902142G4 (8 CHANNELS)
- Metal **O**ver **E**lastomer (**MOE**) Interface Connector 19A705662P1 and Holder 19B801570P2.

Front Cap Assembly

The Front Cap Assembly for the **PCS** TM Personal Radio consists of a molded plastic circuit board (Control Frame), a **L**iquid **C**rystal **D**isplay (**LCD**) assembly, a DTMF keypad, switches for the basic radio functions, and a **U**ser **D**evice **C**onnector (**UDC**) all mounted in a plastic front housing. The Front Cap Assembly is shown in the Assembly Diagram as listed in the Table of Contents.

The Control Frame acts like a three dimensional printed circuit board. The base material is a molded plastic with a two-layer printed circuit pattern on the outside perimeter of the frame. This structure interfaces several electrical components as follows:

- Control Switches
- Liquid Crystal Display (LCD)
- Microphone
- Speaker
- User Device Connector (UDC)

AUDIO/LOGIC BOARD

Audio/Logic Board 19D902142 mounts in Front Cap Assembly as shown in Figure 1. All Front Cap switch operations are connected to the Audio/Logic Board through the MOE interface connector. A microprocessor on the Audio/Logic Board interprets these commands and issues commands to the Audio/Logic circuits, the RF circuits and the LCD module on the control assembly.

The **MOE** is also the transmission path between assemblies. The Microphone and speaker audio is also transferred through the MOE path. Refer to Figure 2 for a block diagram of the microprocessor and associated circuitry. See Figure 3 for a block diagram of the audio paths.

The Audio/Logic Board consists primarily of the following:

- Microprocessor
- EEPROM
- RX Audio Processing
- TX Audio Processing
- Regulators and Special Circuits

CIRCUIT ANALYSIS

FRONT CAP ASSEMBLY

A **"Dome"** switch pad adheres to the control frame. These switches are domed metal switches which make direct contact with runs on the control frame. The switches include the PTT, Monitor, Channel Up, Volume Up and Volume Down controls. Refer to the Schematic Diagram listed in the Table of Contents for Switch operation. A rubber keypad fits over the switch assembly for operator interface and weather protection.

The DTMF Encoder is used for encoding PCS Personal Radios with standard DTMF tones. The encoder consists of two parts: printed circuit board A1, and a 12-key rubber keypad. The printed circuit board is mounted in the front cap assembly.

The encoder 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 compatibility.

DTMF ENCODER

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.

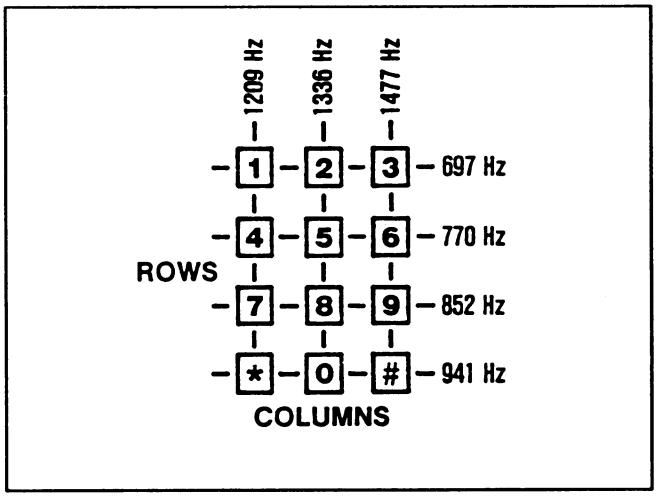


Figure 1 - Touch-Tone Keypad Frequency Format

Liquid Crystal Display (LCD)

The LCD assembly consists of LCD driver board A1, a diffuser, two zebra strips, the LCD and a lens. The assembly is retained by the lens.

The primary function of the LCD driver board is to light LCD segments as controlled by the microprocessor on the Audio/Logic Board. Another function is to provide backlighting of the LCD module. This is accomplished by using four LED devices (D1-D4). These LED's are turned on by **LCD DAT/LT** line, and powered by a voltage switching circuit consisting of chip transistors Q1 and Q2. The diffuser is located immediately above the LEDs to evenly distribute the light. The zebra strips connect the driver board to the LCD. The entire assembly is soldered to the control frame through six pins.

Microphone And Speaker

The microphone (B901) mounts directly onto the control frame (HL1 and HL2). The control assembly, when placed into the Radio Front Assembly, is located in the correct position for receiving voice when used. The speaker, mounted in the front housing, connects to the control frame (HL3 and HL4) through two wires. A protective grill cloth is mounted over the front of the speaker to screen out foreign material.

User Device Connector (UDC)

UDC connector U901 is provided for programming the radio, and for connecting external options. The speaker leads, mic high, PTT and Ground leads are all connected to the UDC.

The mic lead and one of the speaker leads are switched to the UDC only when microswitches S1 and S2 are operated. These switches are activated by plungers on compatible **PCS** Personal Radio options.

A rubber boot is mounted over the connector for weather protection.

AUDIO/LOGIC BOARD

Microprocessor (80C51)

An 8-bit microprocessor (U1) provides all of the control signals required by the radio. The microprocessor also generates Channel Guard and DTMF tones, and detects Channel Guard and Type 99 tones.

Microprocessor U1 is located on Spur Filter Board A701. This board consists of RC filters for each port of the processor. A metal can is soldered on top of the board to reduce the effect of microprocessor-generated spurious signals.

Microprocessor Port Pin Definitions

Port Pins	**I** = Input **O** = Output **I/O** = Bidirectional
P0.0 (O)	Channel Guard encode bit 0/Volume attenuator bit 0
P0.1 (O)	CG encode bit 1/Volume attenuator bit 1
P0.2 (O)	CG encode bit 2/Volume attenuator bit 2
P0.3 (O)	CG encode bit 3/Voice mute

P0.4 (I)	Low Battery indication (active low)
P0.5 (O)	Transmit CG switch (active high)
P0.6 (O)	Delayed PTT (active low)
P0.7 (O)	Mute (active low)
P1.0 (I)	Monitor (active low)
P1.1 (I)	Vol Up (active low)
P1.2 (I)	Vol Dn (active low)
P1.3 (I)	Ch Up (active low)
P1.4 (I)	CAS (active low)
P1.5 (O)	Xtal switch (active high)
P1.6 (O)	Mic mute (active low)
P1.7 (O)	Power select
P2.0 (O)	LCD enable
P2.1 (O)	LCD data
P2.2 (O)	LCD clock
P2.3 (O)	Receive mute (active high)
P2.4 (O)	Type 99 enable (active high)
P2.5 (O)	Synthesizer clock
P2.6 (O)	Synthesizer data
P2.7 (O)	Synthesizer enable
RXD (I)	Programmer data in
TXD (I/O)	Programmer data out/PTT
P3.2 (I)	Tone data in
P3.3 (I)	Lock detect (active high)
P3.4 (O)	Alert tone
P3.5 (O)	EEPROM power enable
P3.6 (O)	EEPROM clock
P3.7 (I/O)	EEPROM data

EEPROM

The 512 x 8 - bit **EEPROM** (U701), commonly referred to as the personality **PROM**, stores customer information as follows:

- Customer frequencies
- Customer tones
- Customer Options

Using this **EEPROM** provides the convenience of programming without opening the radio.

Programming of the **EEPROM** is accomplished by driving the **MIC HI** lead. This lead is connected to operational amplifier circuit U302-B. With no external signal connected to **MIC HI**, a voltage level of approximately 2.25 volts is at **MIC HI.** This causes the output of U302-B, the program data line, to be high. If the **MIC HI** is pulled low, the program Data line is pulled low. If this line remains low for 20 milliseconds or greater, the microprocessor is put in the programming mode. Once in this mode, the radio will not operate or respond to any front case button. The radio must be turned off and then back on to get the processor out of this mode. If programming is actually done, the processor will be taken out of the programming mode by the proper character from the personal computer programmer.

RX Audio Processing

Voice Path

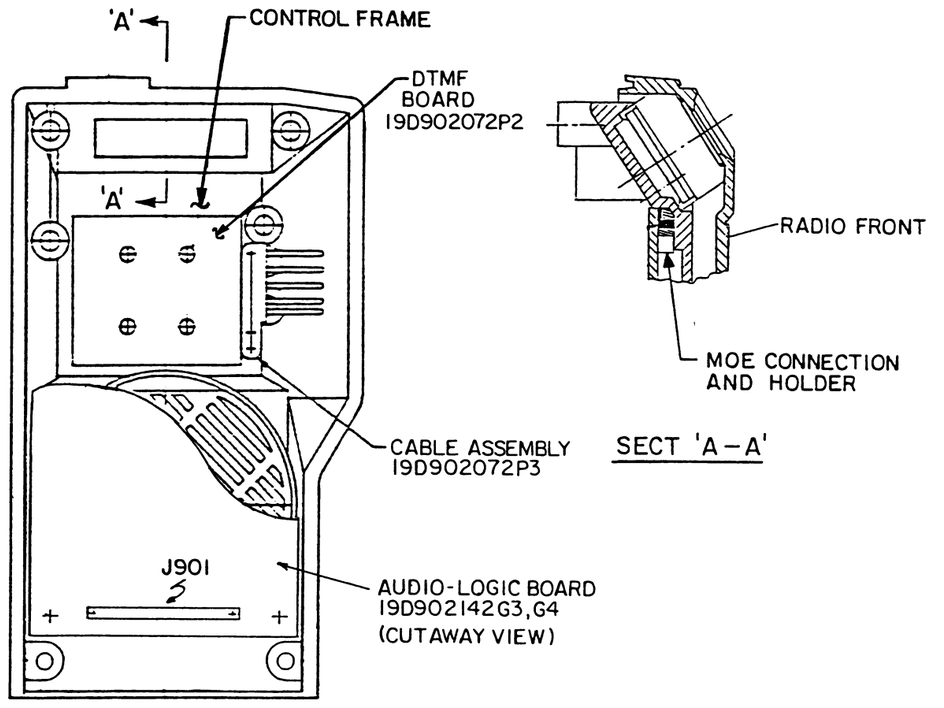
Received audio enters the Audio/Logic Board at J801, Pin 10. Frequencies below 300 Hz are attenuated by the Channel Guard reject filter consisting of U602A and associated circuitry.

The output from the CG reject filter is coupled through voice mute switch transistor Q603 to the volume attenuator circuit U602B and resistors R632 through R640. Here the 500 Hz Alert tone, generated by the microprocessor, can be added to the received audio. The volume attenuator has a range of 48 dB. The attenuator output is coupled through **RX MUTE** switching transistor Q606 to audio amplifier transistor U604. Power is supplied to the audio amplifier by transistor Q605 and controlled by the **MUTE** line from the microprocessor. Amplifier U604 drives the speaker with differential outputs, which are also connected to the accessory connector through the Control Assembly.

A 6 dB/octave de-emphasis is provided by capacitor C615 and resistor R628 in the CG reject filter. Capacitor C622 and resistor R645 provide additional roll-off at higher frequencies.

Squelch Path

The squelch circuit operates on the noise components contained in the discriminator output. The signal at J801, Pin 10 is applied to a high-pass filter consisting of U601B and associated circuitry. The output of U601B is noise in a band around 6 kHz. The gain of the high-pass filter is determined by squelch potentiometer R608.



FRONT ASSEMBLY

Figure 2 - Radio Front Assembly

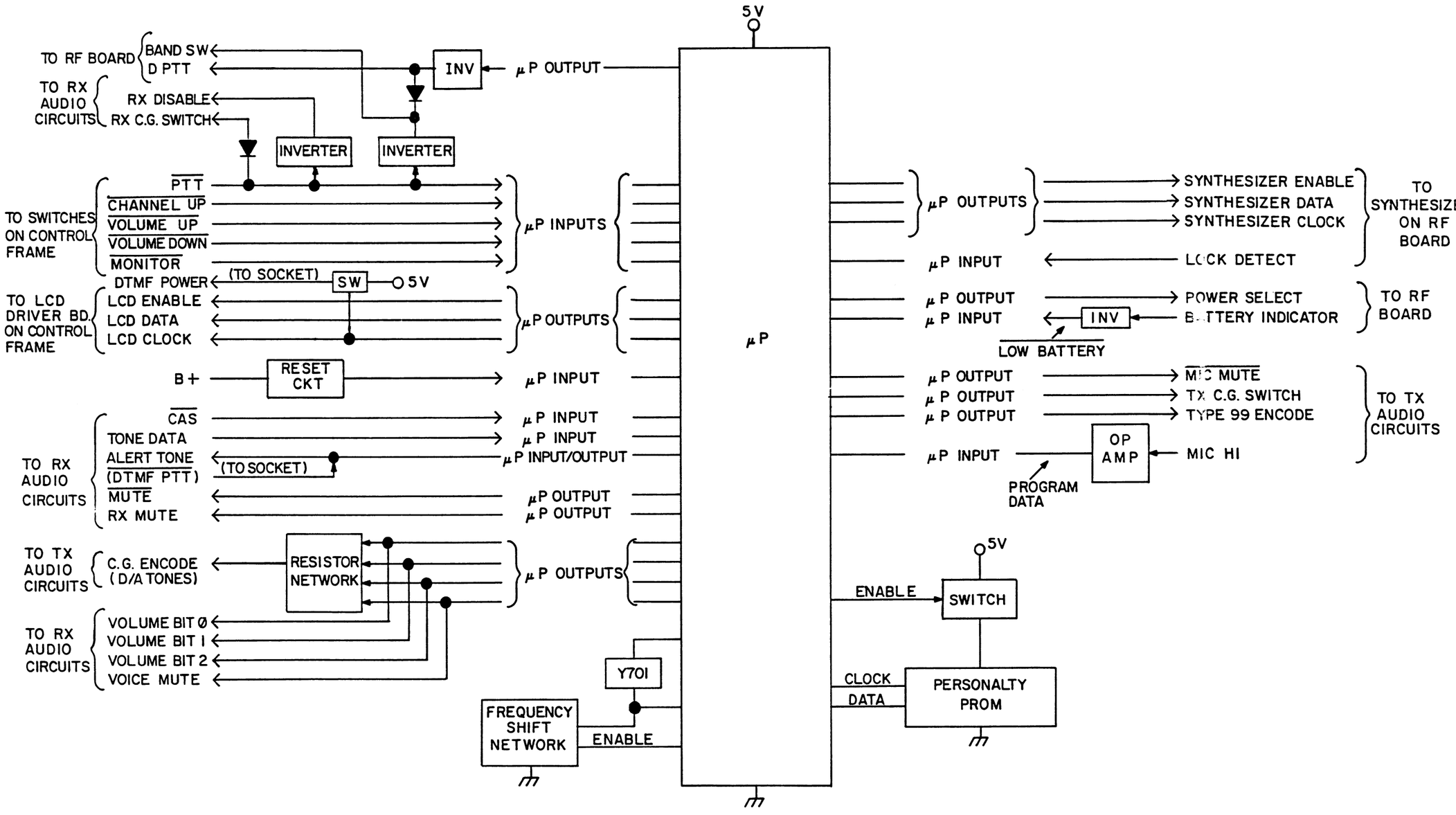


Figure 3 - Microprocessor Block Diagram

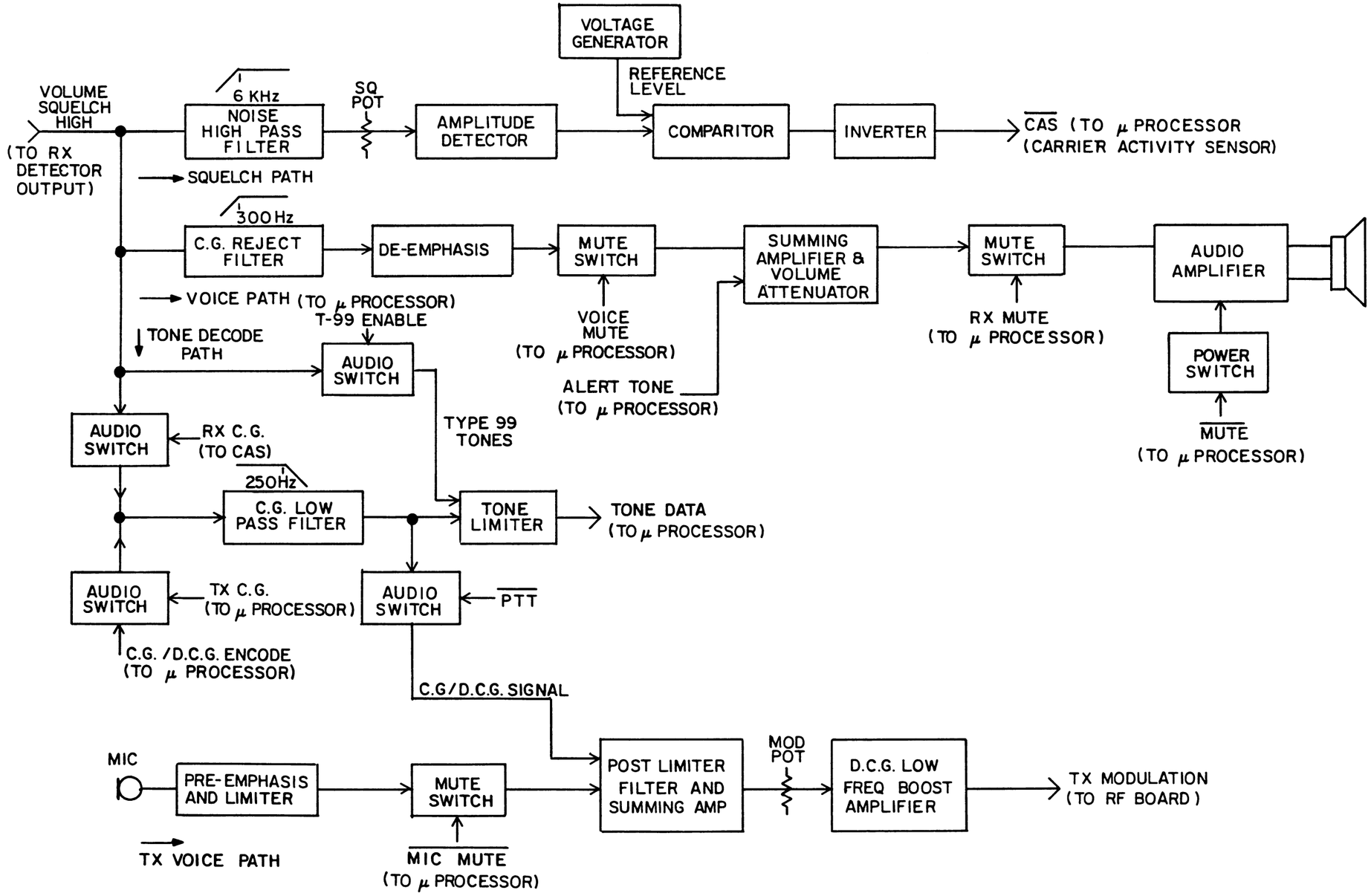


Figure 4 - Audio Paths Block Diagram

The output of U601B is rectified by U601A, resistors R610 through R612 and capacitors C607 and C608. This d.c. signal is then input to comparator U601D. If the rectified noise is more than approximately 0.20 Vd.c., the **CAS** line is high and the microprocessor mutes the audio. Resistor R613 and R615 provide about 2 dB of hysteresis. Resistors R614, R662, R663 and thermister R664 are used for temperature compensation of the threshold level.

The threshold level is temperature compensated at cold temperatures only. This is necessary because of a drop in the **VOL/SQ**. Hi noise level. Thermister R664 has a negative temperature coefficient. At 25° C and above, the thermister has little effect on the threshold voltage level at U601B, Pin 12. At temperatures below 25° C, the resistance increases exponentially, thereby causing a drop in the threshold voltage. This voltage drop approximately tracks the voltage drop at the detected noise terminal, U601B, Pin 13.

Limited Tone Data Path

Limited Tone Data is the 5 Volts (peak-peak) representation of a received tone and is fed to the microprocessor where the actual tone decoding occurs. This circuit consists of a low-pass filter for voice rejection and a voltage comparator.

The low-pass filter consists of U606A and associated circuitry. This filter is used for both Channel Guard encoding and decoding. The filter has a breakpoint at 210 Hz. Type 99 decoding is done by bypassing the low-pass filter and going directly to comparator U606B.

Tx Audio Processing

Audio from the microphone is applied to a 6 dB/octave pre-emphasis network consisting of capacitor C301 and resistor R306 and then to amplifier-limiter U301A. The output of U301A is coupled through mic mute switch U605C to the post-limiter filter consisting of U302A and associated circuitry. Transmit Channel Guard tones are added to the microphone audio at the post-limiter filter.

The transmit signal is applied to the low-frequency boost circuit U303A, U303B and associated circuitry. The transmit deviation is set by MOD potentiometer R321.

The low frequency boost circuitry provides an increasing output level as the input frequency decreases below 20 Hz. The shape of the response curve is shown in Figure 5. This shape is intended to be the mirror image of the synthesizer frequency response curve. The combined result of these two curves provide relatively flat modulation below 5 Hz. This is necessary for Digital Channel Guard modulation.

Regulator and Special Circuitry

+5 Volt Regulator

A +5 volt regulator (U802) supplies power to the microprocessor and all other circuitry requiring +5 volts. A voltage divider provides the input to U601-C to generate a 2.25 volt reference for operational amplifier biasing.

Low Voltage Reset

Voltage detector U801 along with transistor Q803 provides the microprocessor with the necessary reset signal during the power up routine and also resets the microprocessor when the battery falls below approximately 4.75 volts (Refer to Figure 6).

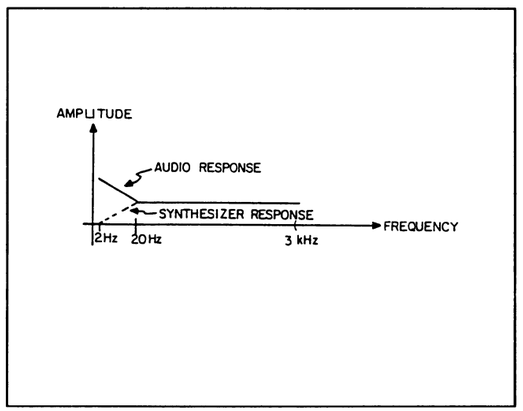


Figure 5 - Audio Response Curve

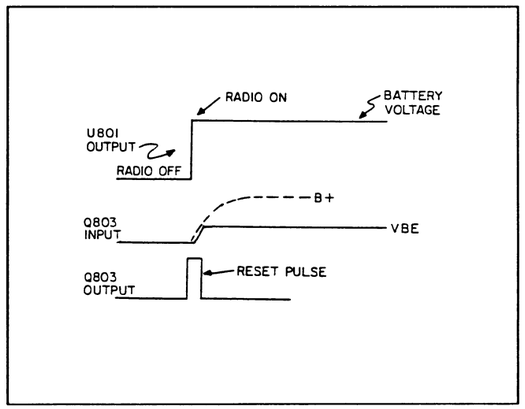


Figure 6 - Voltage Waveforms

Low Battery Indicator

When the battery voltage drops to approximately 6.3 volts, the **BATT IND** line from the RF board is sufficiently high to turn on transistor Q802. The output of Q802, the low battery line, drives a microprocessor port. This action turns on the **BAT** pixel on the LCD.

User Input

Control assembly connector J901, located on the Audio/Logic Board, provides an interface between the user and the radio. By pressing buttons on the switch panel, the user may change the volume level or channel, monitor a channel, or key the transmitter. The LCD is updated to reflect the current status of the radio. The microprocessor configures the LCD through **LCD EN** (P2.0), **LCD DAT** (P2.1) and **LCD CLK** (P2.2).

Synthesizer Programming

After a reset, when toggling between transmit and receive, and any time a new channel is selected, the microprocessor must reprogram the synthesizer through **SYN CLK** (P2.5), **SYN DAT** (P2.6) and **SYN EN** (P2.7). When locked, the **LOCK DET** line (J9801-11) is high.

Alert Tone

The microprocessor generates a 500 Hz alert tone (P3.4) used to signal the user of critical events. These events include synthesizer out of lock and activation of the volume up, volume down and channel up buttons. The alert tone can be disabled by the programmer.

Microprocessor Xtal Frequency Pull

Port P1.5 of the microprocessor is used to switch a 33 pf capacitor (C701) into the crystal oscillator circuit. The effect of adding this capacitor is to move or pull the xtal frequency approximately 250 ppm. This is done to keep harmonics of the microprocessor **ALE** line away from the receive channel frequency.

The programming from this point happens automatically when channel frequencies are initially programmed.

FRONT ASSEMBLY

ERICSSON

Ericsson GE Mobile Communications Inc.
Mountain View Road • Lynchburg, Virginia 24502

Printed in U.S.A.

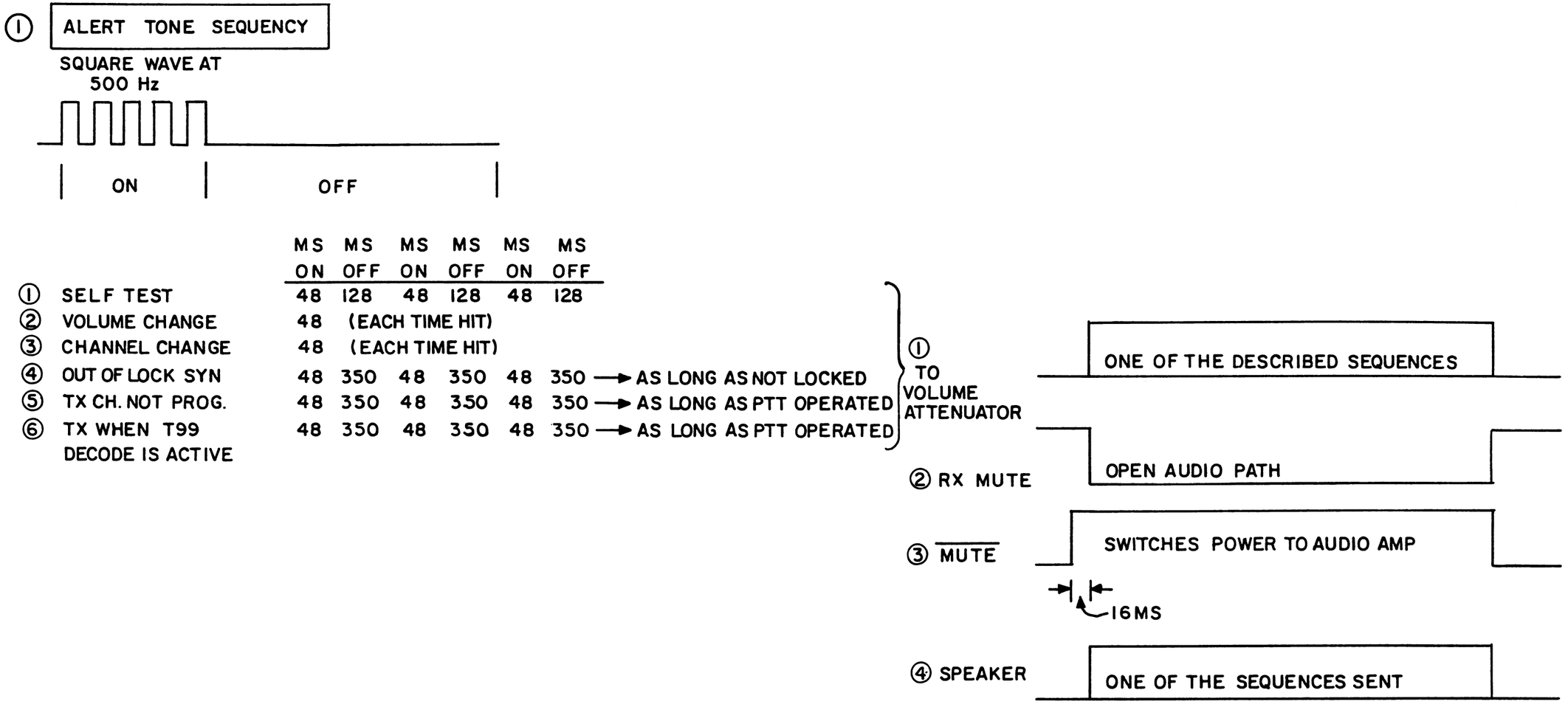


Figure 7 – Alert Tone Sequences

② RX — SQUELCH OPERATION

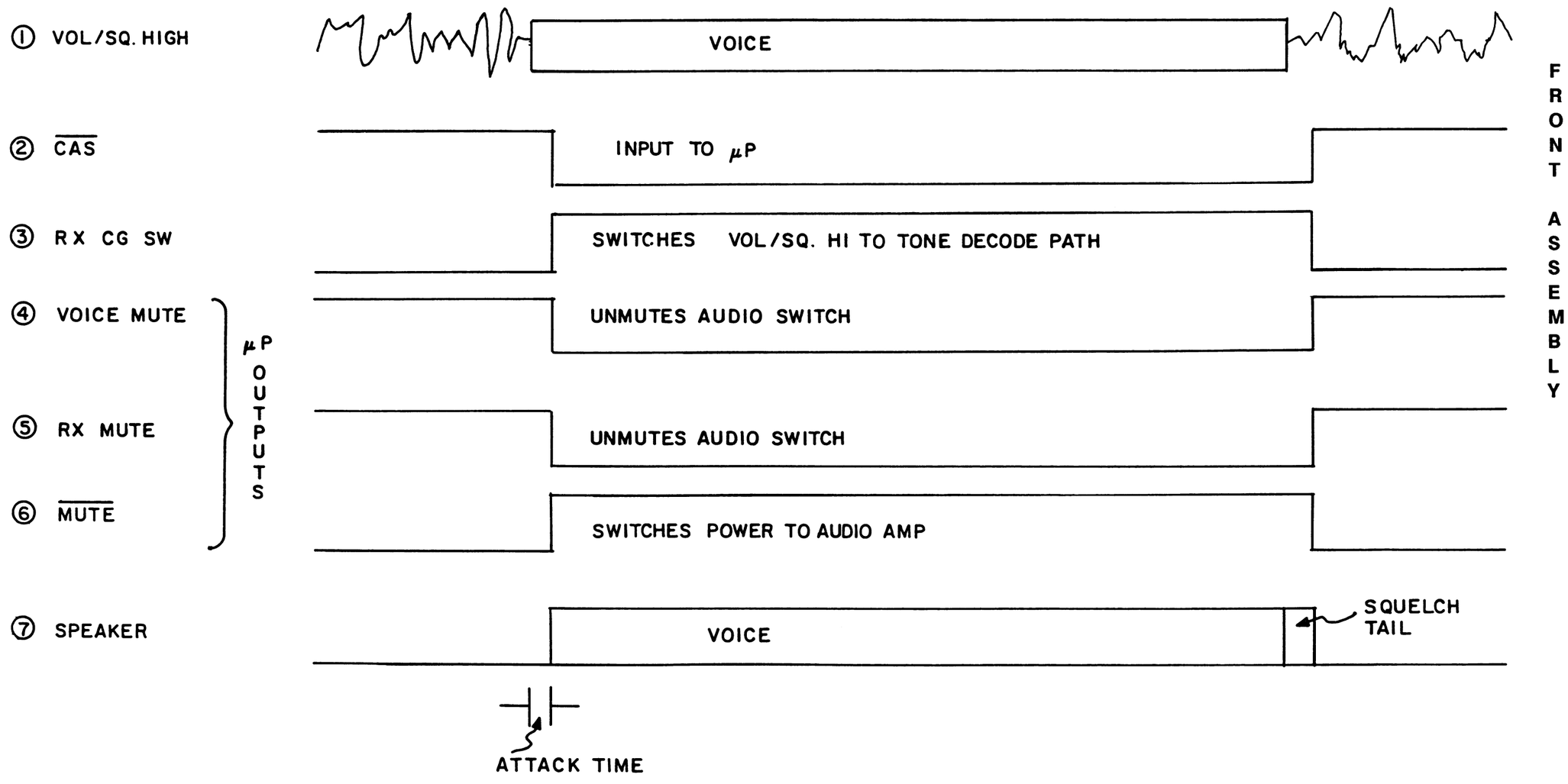


Figure 8 - RX Squelch Operation

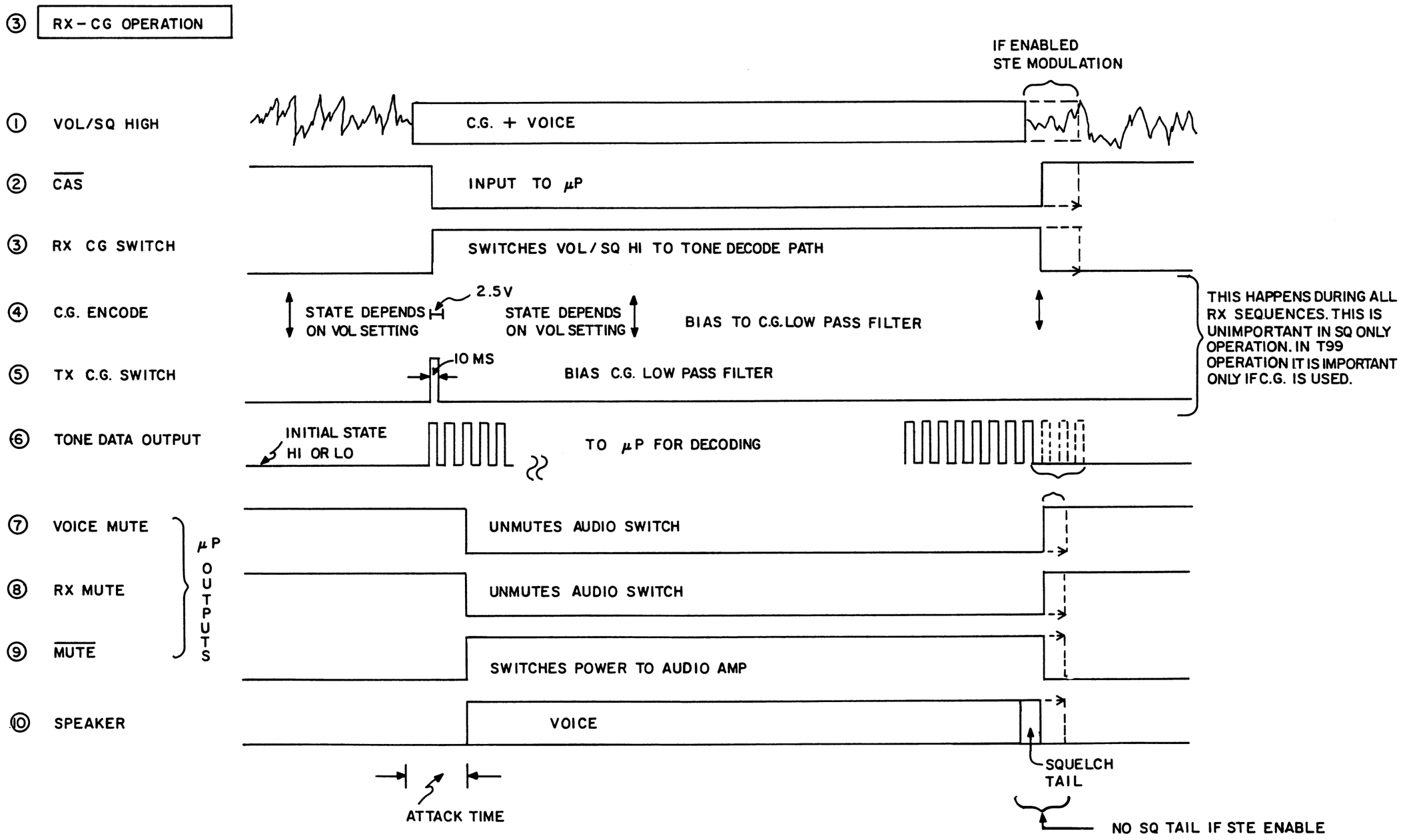


Figure 9 - RX Channel Guard Operation

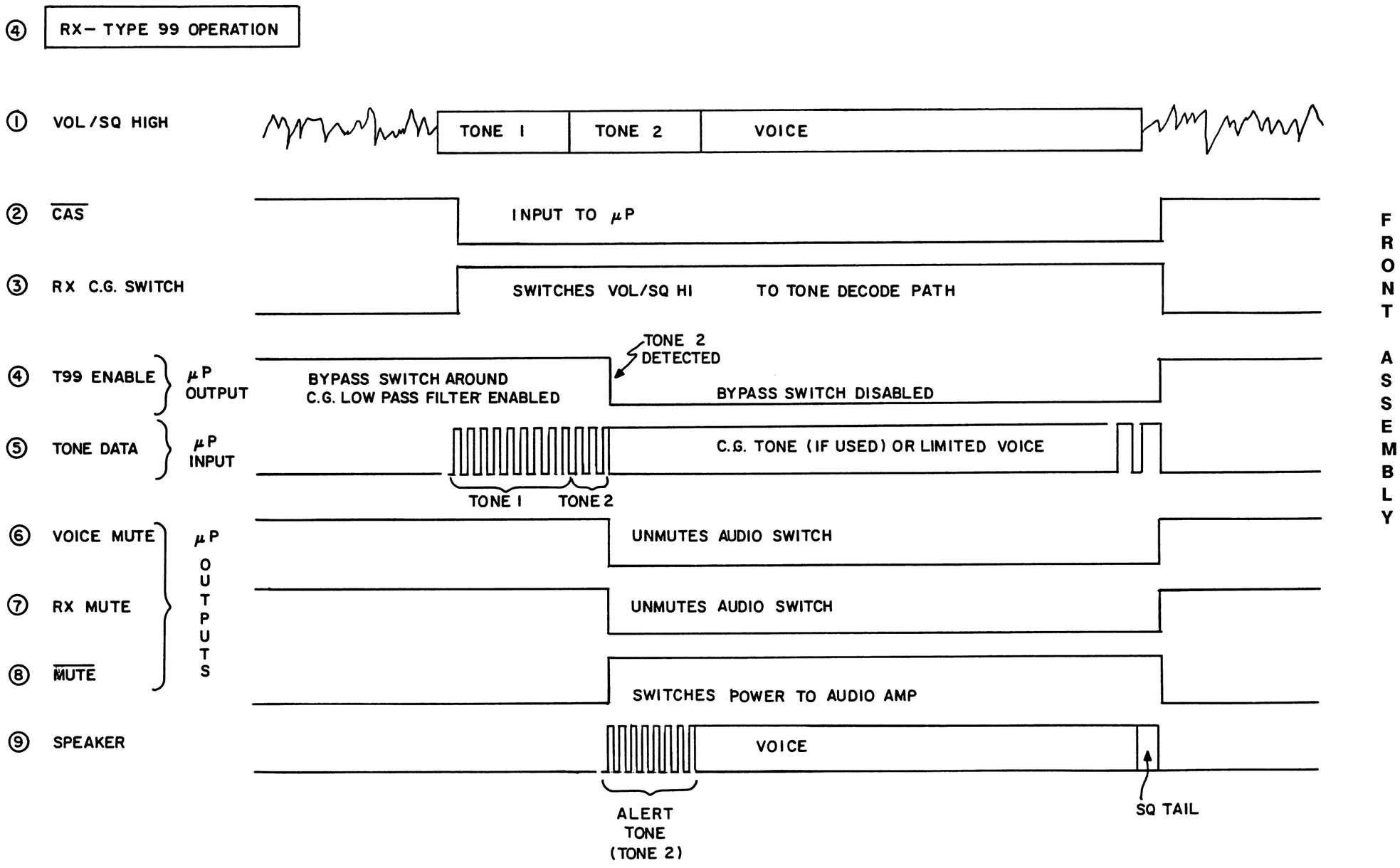


Figure 10 - RX Type 99 Operation

⑤ TX–VOICE ONLY

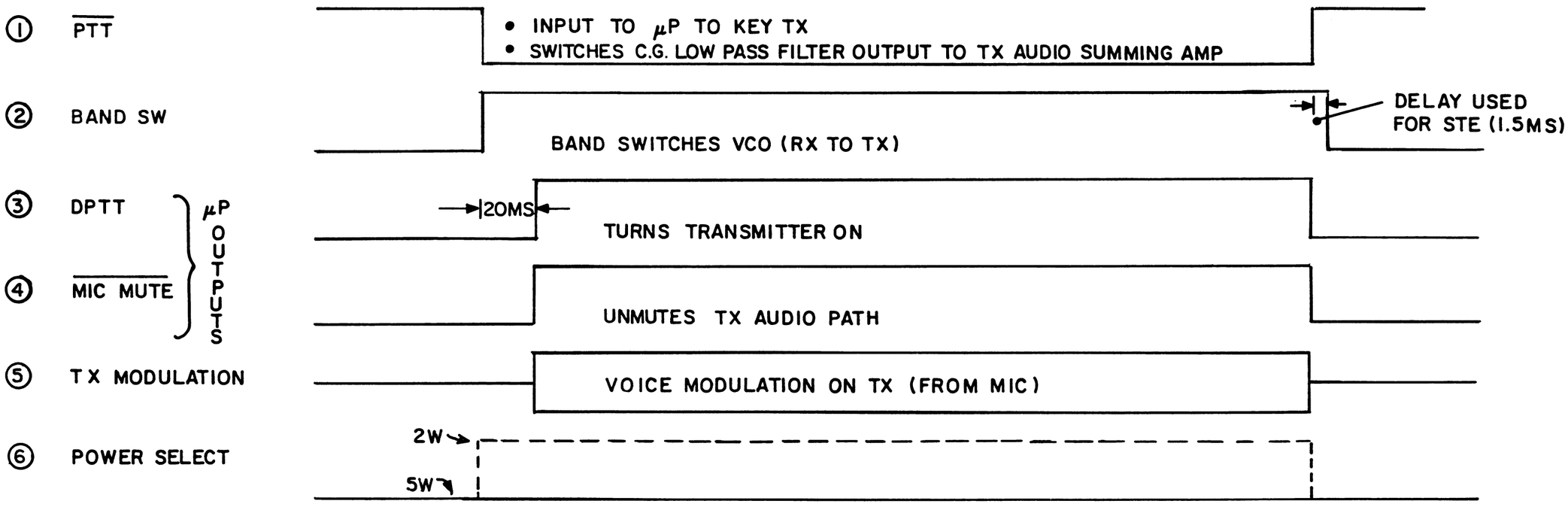


Figure 11 - TX Voice Only Operation

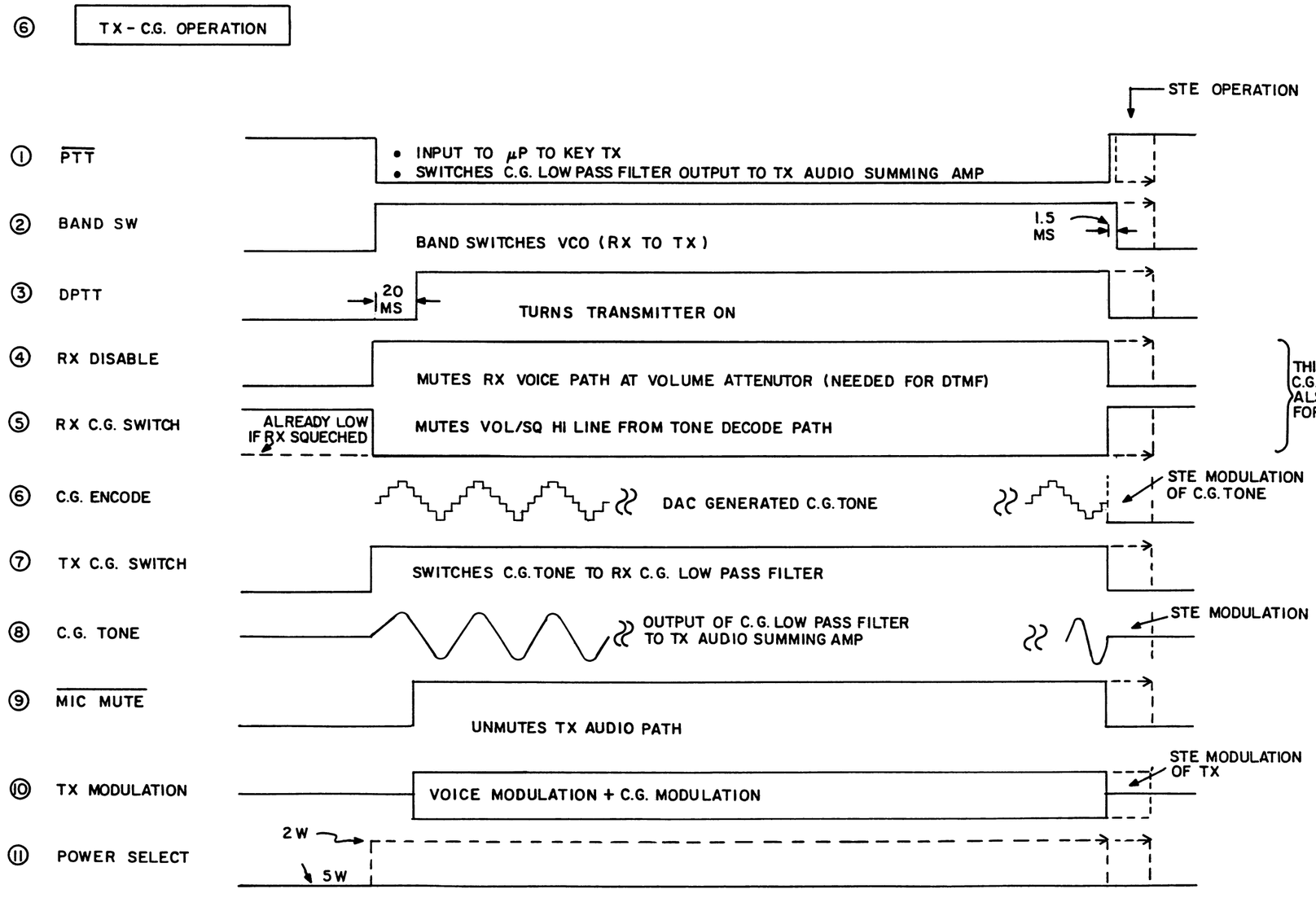


Figure 12 - TX Channel Guard Operation

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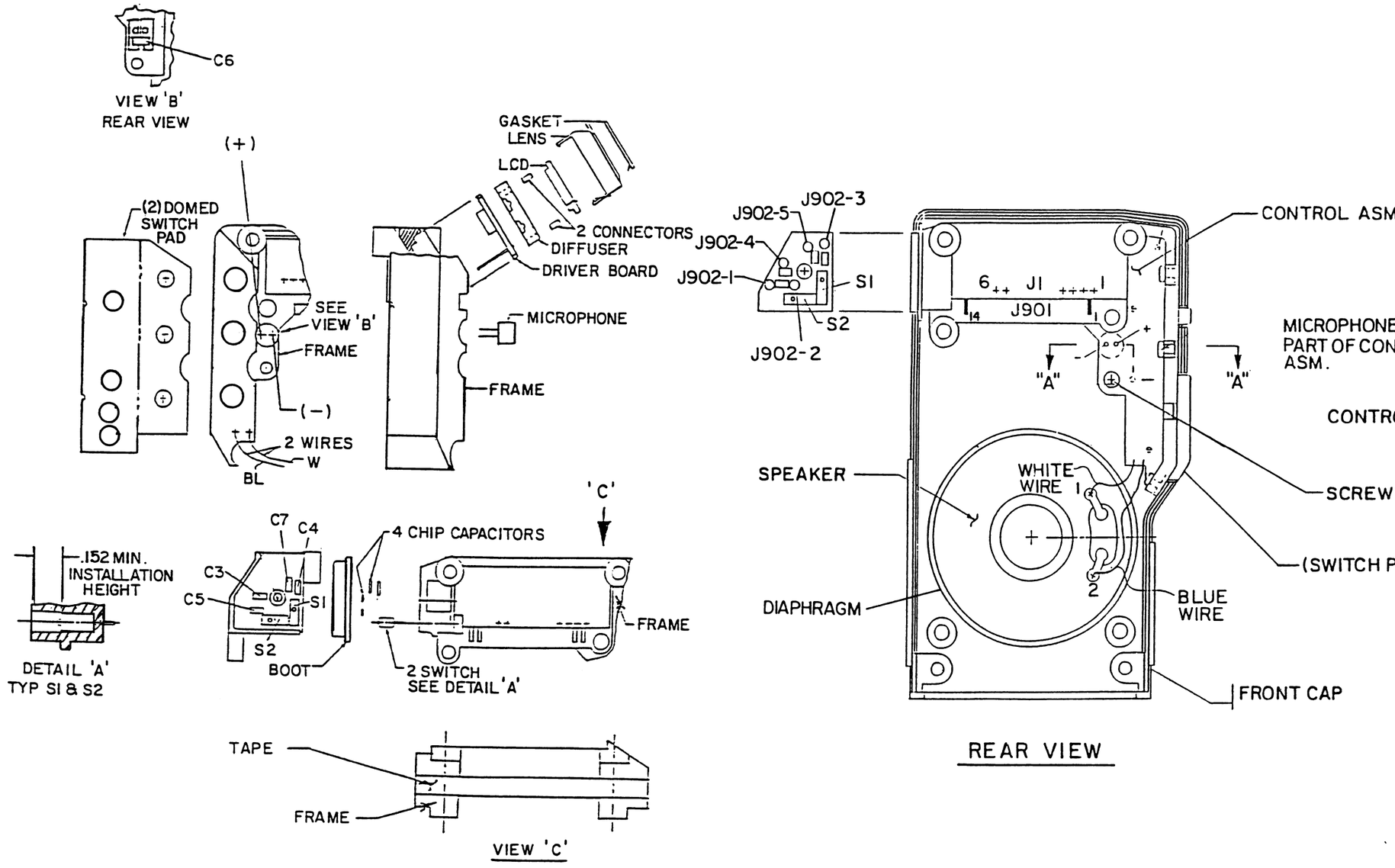
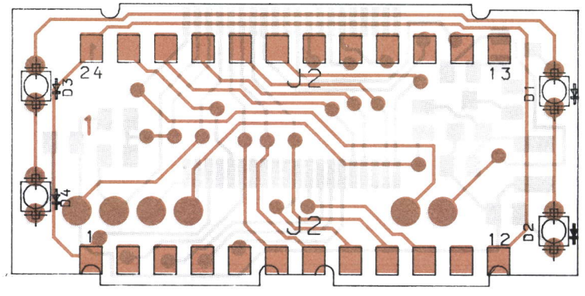
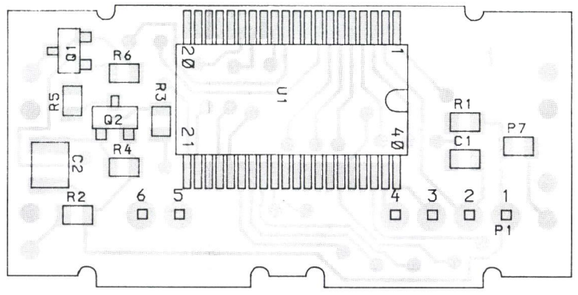

C6
VIEW 'B'
REAR VIEW
(+)
(2) DOMED SWITCH PAD
SEE VIEW 'B'
FRAME
(-)
2 WIRES
W
BL
GASKET
LENS
LCD
2 CONNECTORS
DIFFUSER
DRIVER BOARD
MICROPHONE
FRAME
J902-5
J902-3
J902-4
J902-1
S1
S2
J902-2
CONTROL ASM
(FRONT CAP)
6 J1 1
14 J901 1
"A"
"A"
MICROPHONE PART OF CONTROL ASM.
SWITCH PAD
CONTROL ASM
SECTION "A-A"
SPEAKER
WHITE WIRE
1
SCREW
(SWITCH PAD)
2
BLUE WIRE
DIAPHRAGM
FRONT CAP
REAR VIEW
'C'
C7
C4
4 CHIP CAPACITORS
C3
C5
S1
S2
BOOT
FRAME
2 SWITCH SEE DETAIL 'A'
.152 MIN. INSTALLATION HEIGHT
DETAIL 'A'
TYP S1 & S2
TAPE
FRAME
VIEW 'C'

COMPONENT SIDE



(19C851720, Rev. 0)
(19C851721, Component Side, Rev. 1)
(19C851721, Solder Side, Rev. 1)

SOLDER SIDE



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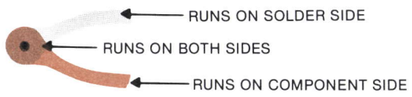
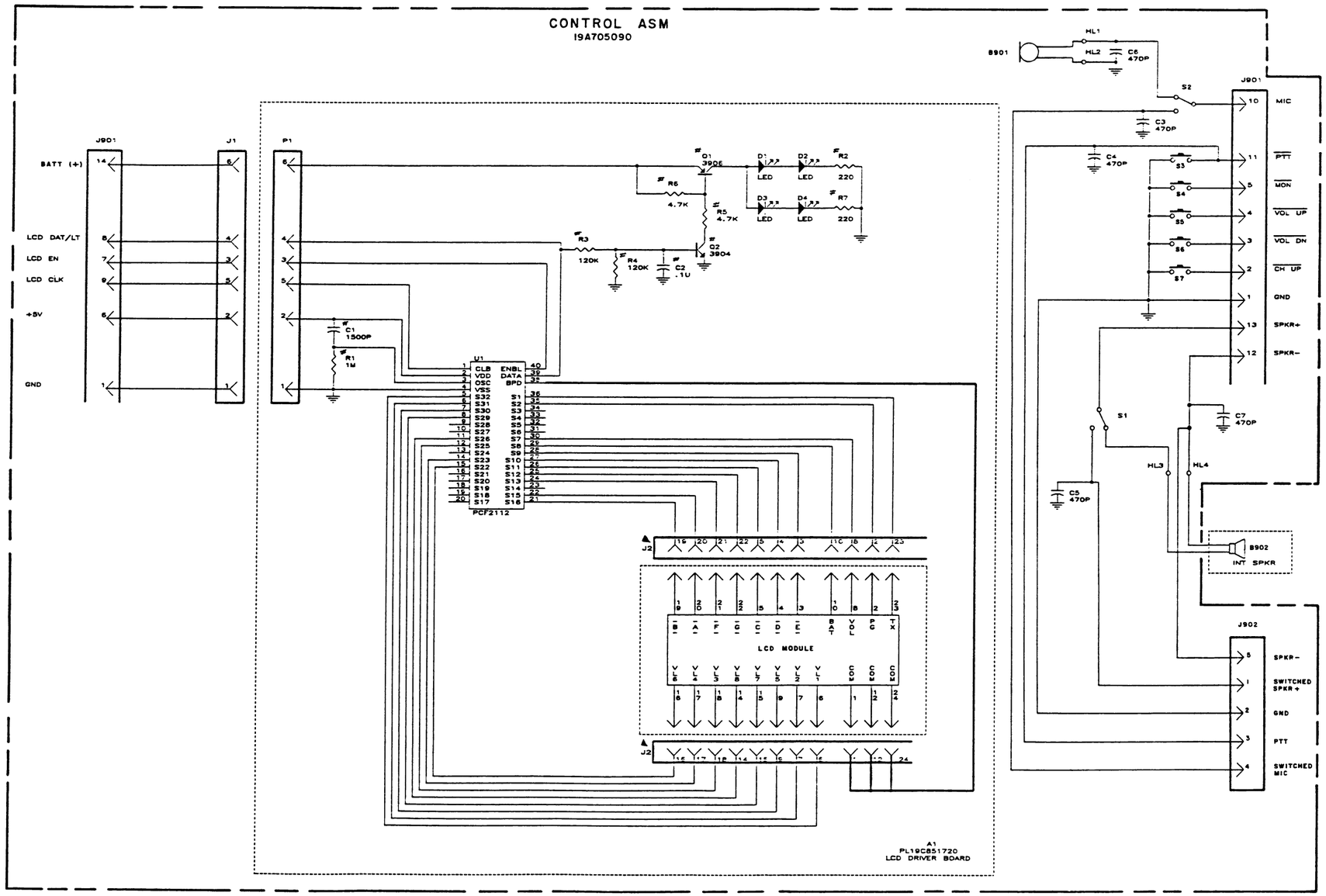
(19C851721, Solder Side, Rev. 1)



LCD BOARD
19C851720G2



MODEL NO.	REV. LETTER
19D902180P1	
19A705090P1	A

FRONT ASSEMBLY

NOTES:
1. ALL RESISTORS ARE .1 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 OR U.

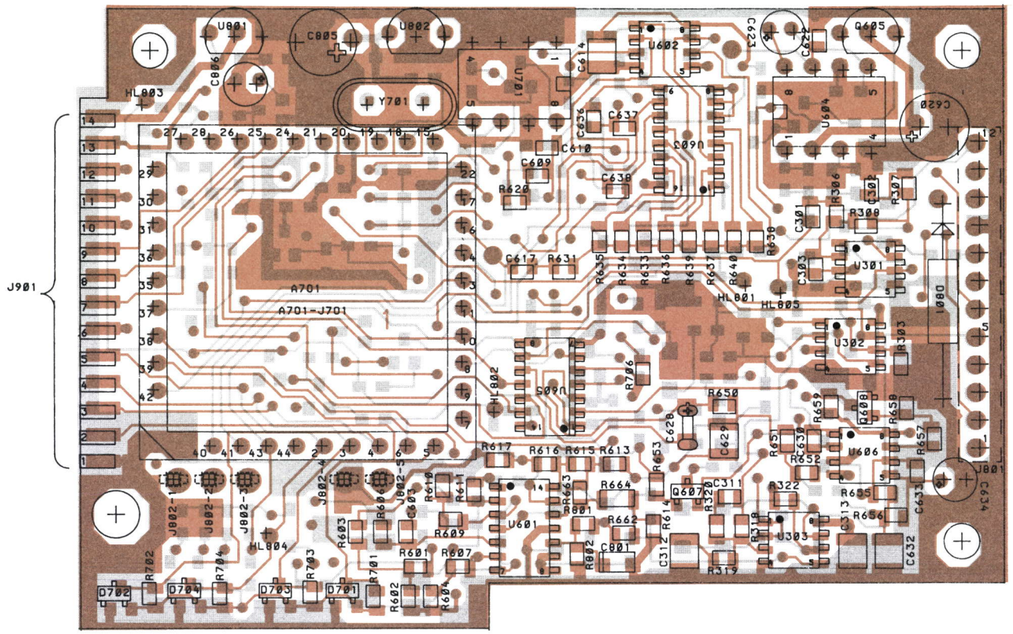
2. # INDICATES CHIP COMPONENTS.

3. ▲ PART OF PWB.

(19D902216, Sh. 1, Rev. 3)

FRONT CAP ASSEMBLY & LCD BOARD 19D902180G2

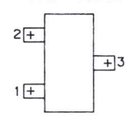
COMPONENT SIDE



(19D902142, Sh. 2, Rev. 2)
(19D902585, First Layer, Rev. 1)
(19D902585, Fourth Layer, Rev. 1)

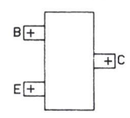
LEAD IDENTIFICATION FOR
D601 & D701-D707
(SOT) DIODES

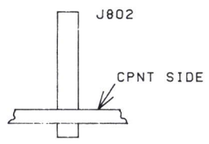
(TOP VIEW)



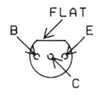
LEAD IDENTIFICATION FOR
Q601-Q608,Q701,Q702,Q704-Q706
Q801-Q803
(SOT) TRANSISTORS

(TOP VIEW)





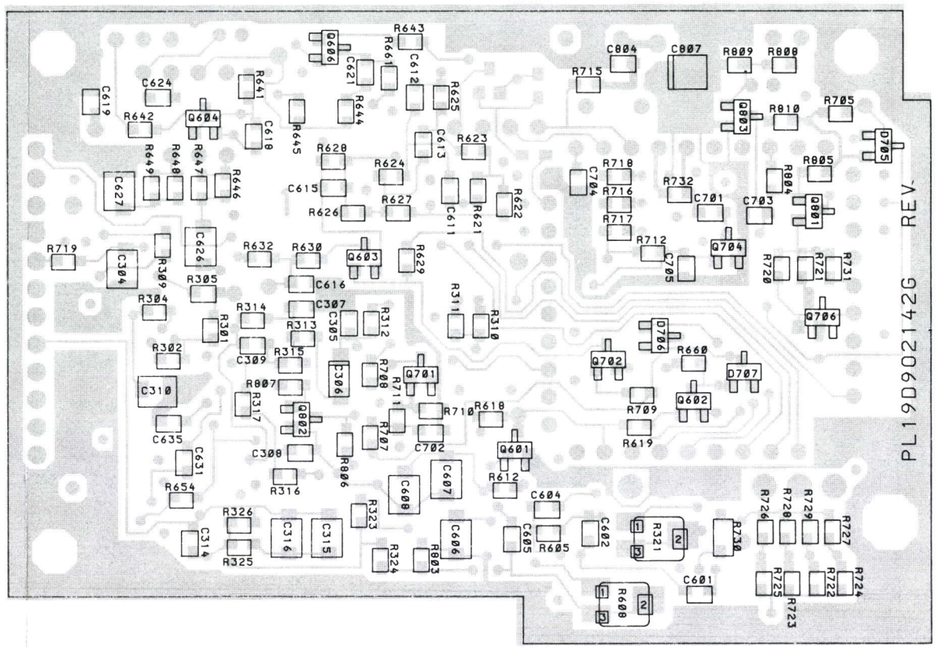
LEAD IDENTIFICATION
FOR Q605



IN-LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

SOLDER SIDE



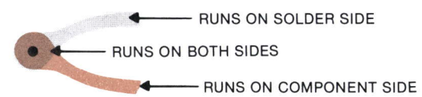
(19D902142, Sh. 2, Rev. 2)
(19D902585, Fourth Layer, Rev. 1)

CAUTION

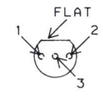
OBSERVE PRECAUTIONS FOR HANDLING

ELECTROSTATIC SENSITIVE DEVICES

THE FOLLOWING ITEMS ARE MOS DEVICES REQUIRING SPECIAL CARE : U301-U303,U601-U606, U701 & A1.



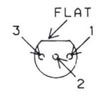
LEAD IDENTIFICATION
FOR U802



IN-LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

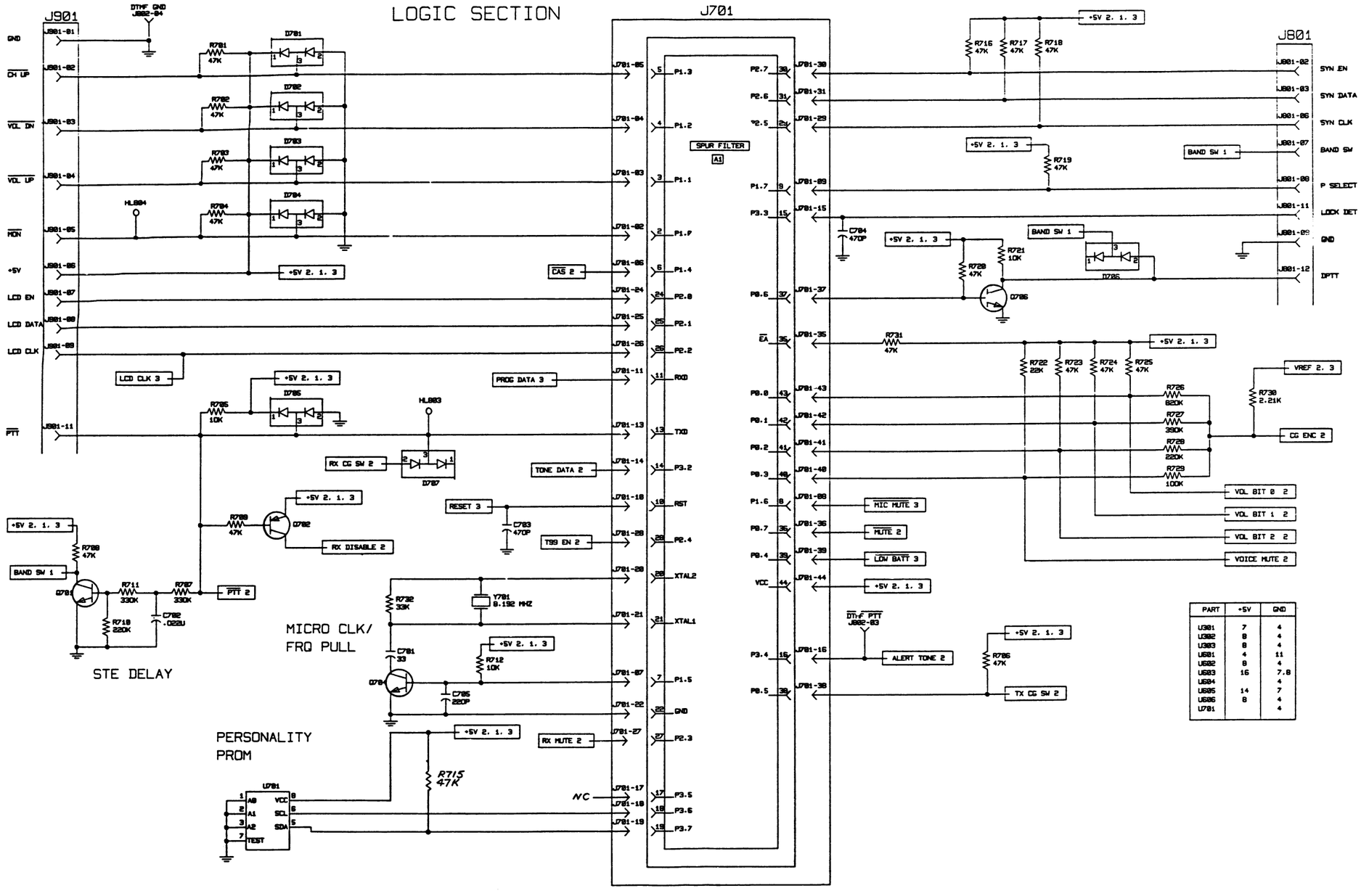
LEAD IDENTIFICATION
FOR U801



IN-LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

AUDIO/LOGIC BOARD
19D902142G3 AND G4

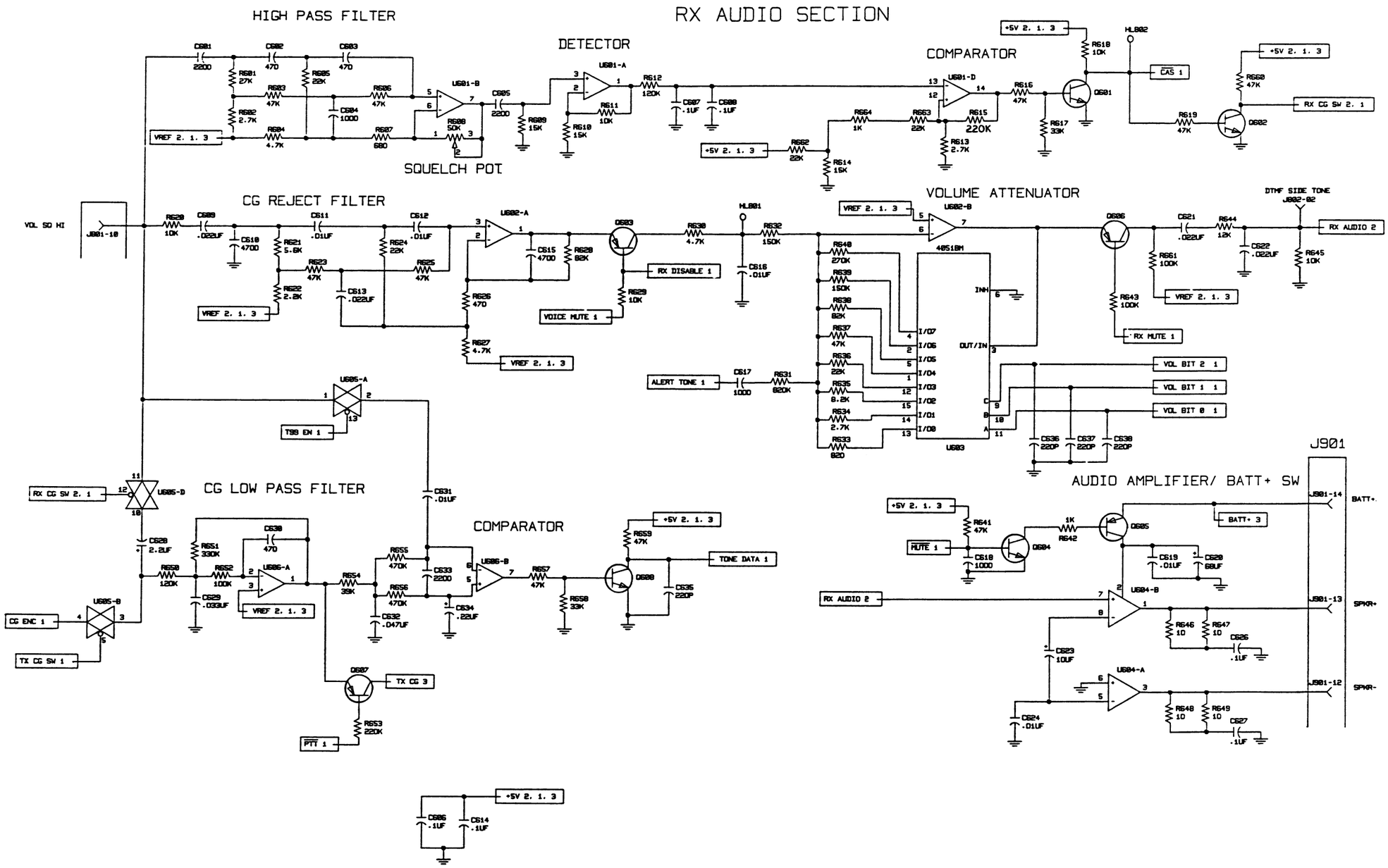


PART	+5V	GND
U381	7	4
U382	8	4
U383	8	4
U681	4	11
U682	8	4
U683	16	7,8
U684		4
U685	14	7
U686	8	4
U781		4

(19D902586, Sh. 1, Rev. 1)

FRONT ASSEMBLY

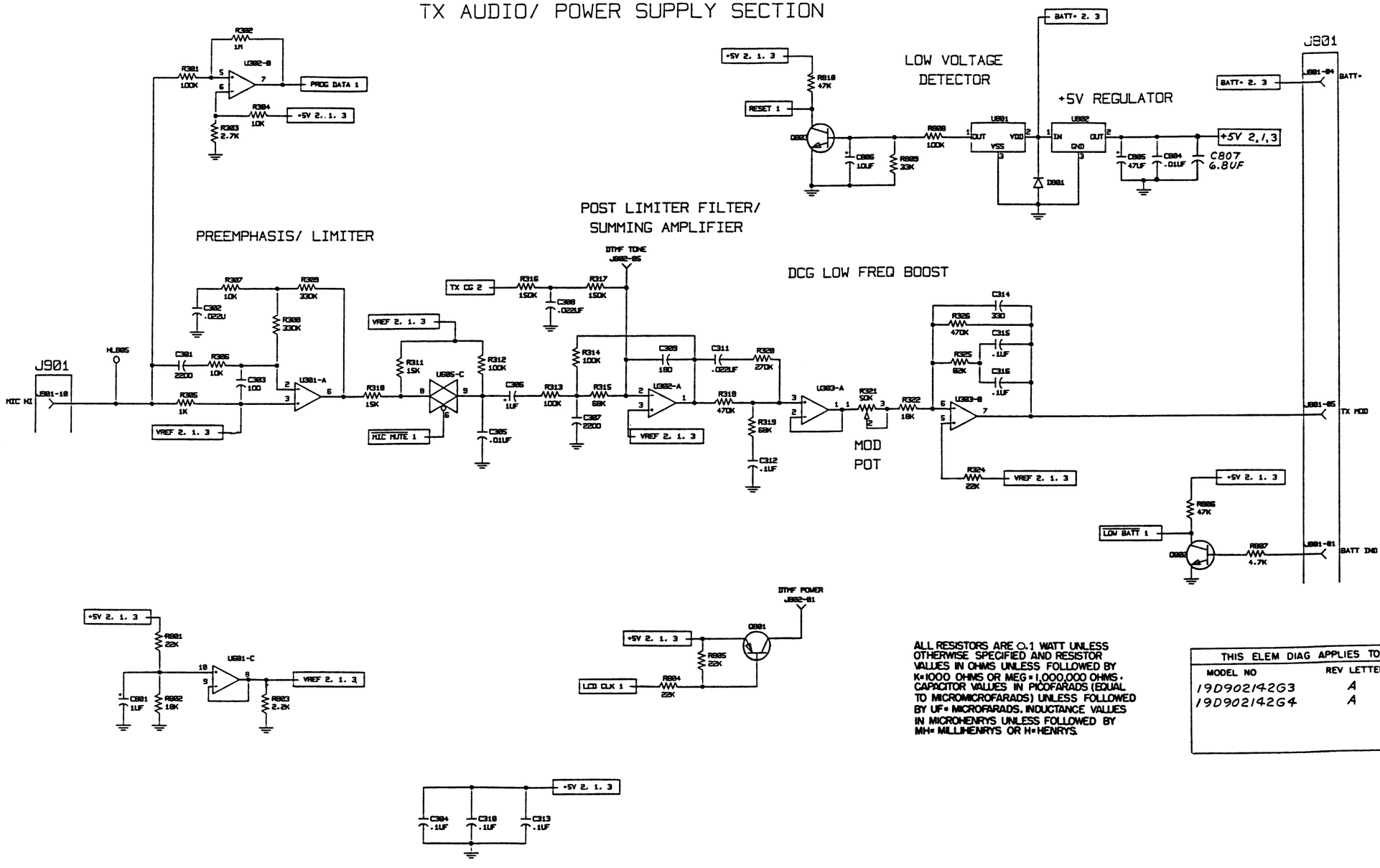
AUDIO/LOGIC BOARD
19D902142G3 AND G4



AUDIO/LOGIC BOARD
19D902142G3 AND G4

(19D902586, Sh. 2, Rev. 1)

TX AUDIO/ POWER SUPPLY SECTION



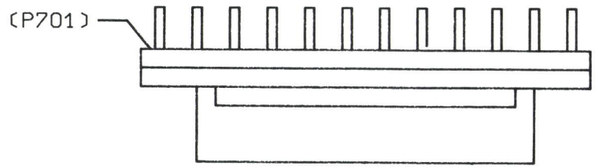
ALL RESISTORS ARE 0.1 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
19D902142G3	A
19D902142G4	A

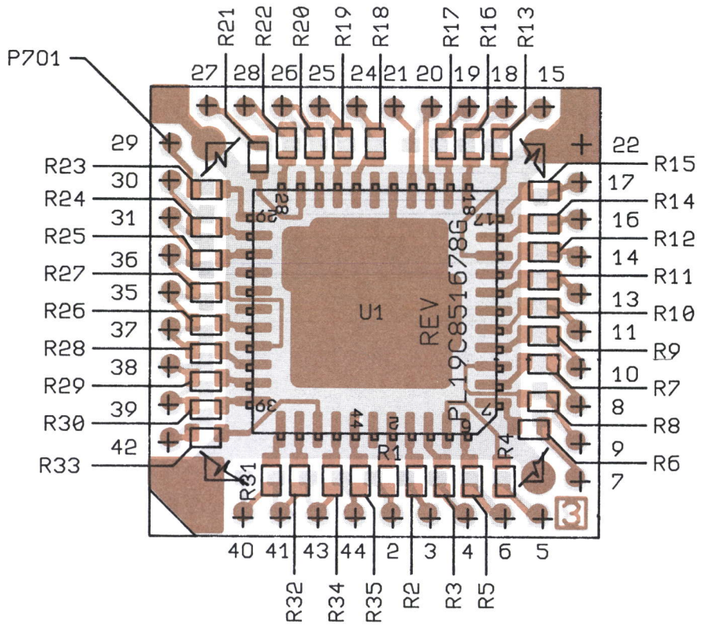
(19D902586, Sh. 3, Rev. 1)

FRONT ASSEMBLY

AUDIO/LOGIC BOARD 19D902142G3 AND G4

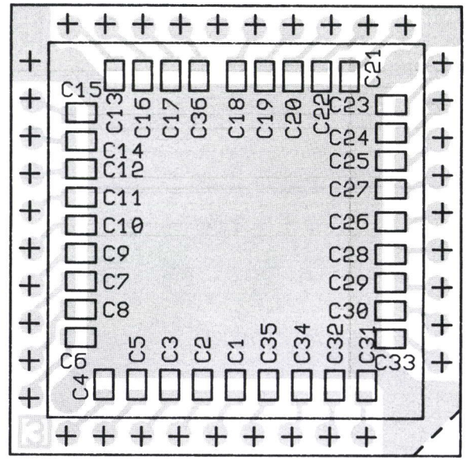


COMPONENT SIDE

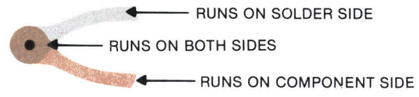


(19C951678, Rev. 1)
(19C851679, Component Side, Rev. 3)
(19C851679, Solder Side, Rev. 3)

SOLDER SIDE

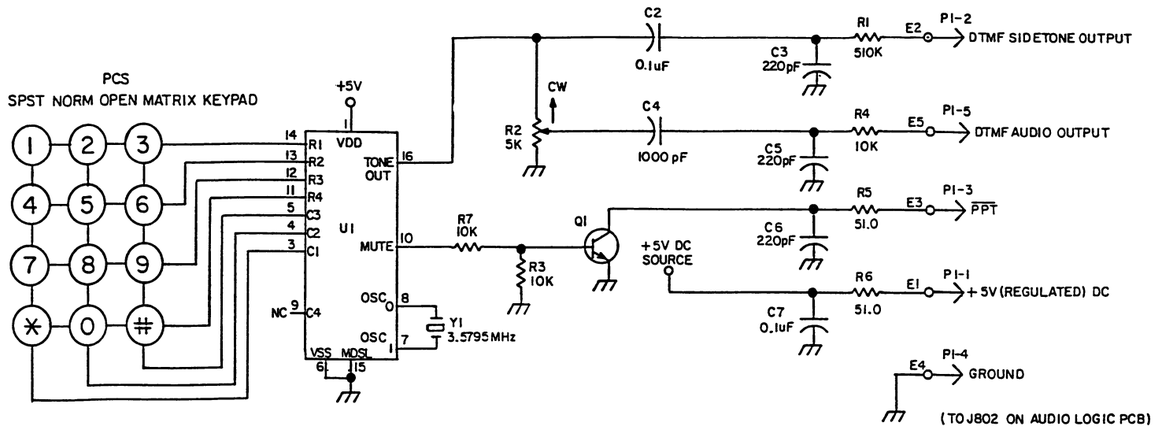


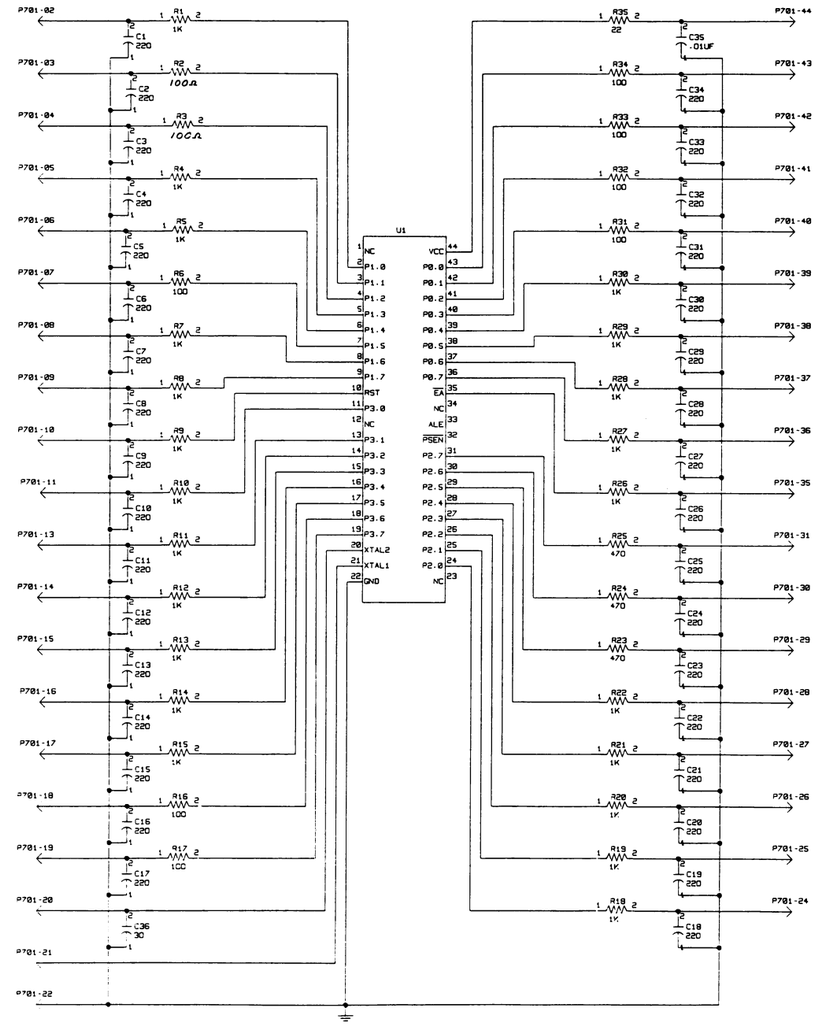
(19C851678, Rev. 1)
(19C851679, Solder Side, Rev. 3)



SPUR FILTER BOARD
19D851678G1 AND G2

DTMF BOARD
19D902072P2





(19D902215, Rev. 3)

MODEL NO.	REV. LTR
19C851678G1	B
19C851678G2	B
19C851678G3	

SPUR FILTER BOARD
19D851678G1 AND G2
DTMF BOARD
19D902072P2

FRONT ASSEMBLY

PARTS LIST

RADIO FRONT ASSEMBLY
19D902177G3 (2 Channels & DTMF)
19D902177G4 (8 Channels & DTMF)
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
A2		AUDIO/LOGIC BOARD 19D902142G3 (2 Channel) 19D902142G4 (8 Channel)
A701		MICROPROCESSOR BOARD 19C851678G1 (2 channel) 19C851678G2 (8 Channel)
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1 thru C34	19A702061P69	Ceramic: 220 pf ±5%, 50 VDCW, temp coef 0 ±30 PPM/C.
C35	19A702052P14	Ceramic: 0.01 µf, ±10%, 50 VDCW.
C36	19A702061P35	Ceramic: 30 pf, ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P701	19B801573P1	Connector.
		- - - - - - - - - - - RESISTORS - - - - - - - - -
R1	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R2 and R3	19B801251P101	Metal film: 100 ohms ±5%, 1/10 w.
R4 and R5	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R6	19B801251P101	Metal film: 100 ohms ±5%, 1/10 w.
R7 thru R15	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R16 and R17	19B801251P101	Metal film: 100 ohms ±5%, 1/10 w.
R18 thru R22	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R23 thru R25	19B801251P471	Metal film: 470 ohms ±5%, 1/10 w.
R26 thru R30	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R31 thru R34	19B801251P101	Metal film: 100 ohms ±5%, 1/10 w.
R35	19B801251P220	Metal film: 22 ohms ±5%, 1/10 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A704345P4	Microcomputer: CHMOS, a bit; sim to N80C51BH. (Used in G1).
U1	19A704345P5	Microcomputer: CHMOS, a bit; sim to N80C51BH. (Used in G2).
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C301	19A702052P7	Ceramic: 2200 pf ±10%, 50 VDCW.
C302	19A702052P30	Ceramic: 0.022 µf ±10%, 50 VDCW.
C303	19A702061P61	Ceramic: 100 pf ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C304	19A702052P26	Ceramic: 0.1 µf ±10%, 50 VDCW.
C305	19A702052P14	Ceramic: 0.01 µf, ±10%, 50 VDCW.
C306	19A705205P2	Tantalum: 1 µf, 16 WVDC; sim to Sprague 293D.
C307	19A702052P107	Ceramic: 2200 pf ±5%, 50 VDCW.
C308	19A702052P30	Ceramic: 0.022 µf ±10%, 50 VDCW.
C309	19A702061P67	Ceramic: 180 pf ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C310	19A702052P26	Ceramic: 0.1 µf ±10%, 50 VDCW.
C311	19A702052P130	Ceramic: 0.022 µf, ±5%, 50 VDCW.
C312 and C313	19A702052P26	Ceramic: 0.1 µf ±10%, 50 VDCW.
C314	19A702061P73	Ceramic: 330 pf ±5%, 50 VDCW, temp coef 0 ±30 PPM/C.
C315 and C316	19A702052P26	Ceramic: 0.1 µf, ±10%, 50 VDCW.
C601	19A702052P107	Ceramic: 2200 pf ±5%, 50 VDCW.
C602	19A702061P77	Ceramic: 470 pf ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C603	19A702061P77	Ceramic: 470 pf ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C604	19A702052P105	Ceramic: 1000 pf ±5%. 50 VDCW.
C605	19A702052P7	Ceramic: 2200 pf ±10%, 50 VDCW.
C606 thru C608	19A702052P26	Ceramic: 0.1 µf ±10%, 50 VDCW.
C609	19A702052P130	Ceramic: 0.022 µf ±5%, 50 VDCW.
C610	19A702052P10	Ceramic: 4700 pf ± 10%, 50 VDCW.
C611 and C612	19A702052P114	Ceramic: 0.01 µf ±5% VDCW.
C613	19A702052P130	Ceramic: 0.022 µf ±5%, 50 VDCW.
C614	19A702052P26	Ceramic: 0.1 µf ±10%, 50 VDCW.
C615	19A702052P10	Ceramic: 4700 pf ±10%, 50 VDCW.
C616	19A702052P14	Ceramic: 0.01 µf, ±10%, 50 VDCW.
C617	19A702052P5	Ceramic: 1000 pf, ±10%, 50 VDCW.
C618	19A702052P5	Ceramic: 1000 pf, ±10%, 50 VDCW.
C619	19A702052P14	Ceramic: 0.01 µf ±10%, 50 VDCW.
C620	19A704879P14	Electrolytic: 68 µf, ±20%, 10 VDCW.
C621 and C622	19A702052P30	Ceramic: 0.022 µf ±10%, 50 VDCW.
C623	19A704879P5	Electrolytic: 10 µf ±20%, 16 VDCW.
C624	19A702052P14	Ceramic: 0.01 µf ±10%, 50 VDCW.
C626 and C627	19A702052P26	Ceramic: 0.1 µf ±10%, 50 VDCW.
C628	19A701779P13	Tantalum: 2.2 µf ±20%, 10 VDCW.
C629	19A702052P20	Ceramic: 0.033 µf ±10%, 50 VDCW.
C630	19A702052P3	Ceramic: 470 pf ±10%, 50 VDCW.
C631	19A702052P14	Ceramic: 0.01 µf ±10%, 50 VDCW.
C632	19A702052P22	Ceramic: 0.047 µf ±10%, 50 VDCW.
C633	19A702052P7	Ceramic: 2200 pf ±10%, 50 VDCW.
C634	19A704879P12	Electrolytic: 0.22 µf ± 20%, 50 VDCW.
C635 thru C638	19A702061P69	Ceramic: 220 pf ±5%, 50 VDCW, temp coef 0 ±30 PPM/C.
C701	19A702061P37	Ceramic: 33 pf ±5%, 50 VDCW, temp coef 0 ±30 PPM/C.
C702	19A702052P30	Ceramic: 0.022 µf ±10%, 50 VDCW.
C703	19A702061P77	Ceramic: 470 pf ±5%, 50 VDCW, temp coef 0± 30 PPM.
C704	19A702061P77	Ceramic: 470 pf ±5%, 50 VDCW, temp coef 0±30 PPM.
C705	19A702061P69	Ceramic: 220 pf ±5%, 50 VDCW, temp coef 0 ±30 PPM/C.
C801	19A705205P2	Tantalum: 1 µf, 16 WVDC; sim to Sprague 293D.
C804	19A702052P14	Ceramic: 0.01 µf ±10%, 50 VDCW.
C805	19A701534P9	Tantalum: 47 µf ±20%, 6.3 VDCW.
C806	19A704879P5	Electrolytic: 10 µf ±20%, 16 VDCW.
C807	19A705205P14	Tantalum: 6.8 µf ±20%, 6 VDCW.
		- - - - - - - - - - DIODES - - - - - - - - -
D701 thru D707	19A700053P2	Silicon, fast recovery (2 diodes in series).
D801	19A116585P1	Silicon, fast recovery, 600 mA, 50 PIV.
		- - - - - - - - - - JACKS - - - - - - - - -
J701		Part of PWB 19D902141P1.
J801	19A705482P1	Connector, printed wire.
J802	19B209648P1	Contact, electrical.
J901		Part of PWB 19D902141P1.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q601 and Q602	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q603	19A700059P2	Silicon, PNP.
Q604	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q605	19A700026P2	Silicon, PNP.
Q606	19A700059P2	Silicon, PNP.
Q607	19A700059P2	Silicon, PNP.
Q608	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q701	19A134739P2	Silicon, NPN.
Q702	19A700059P2	Silicon, PNP.
Q704	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q706	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q801	19A700059P2	Silicon, PNP.
Q802 and Q803	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R301	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R302	19B801251P105	Metal film: 1M ohms ±5%, 1/10 w.
R303	10B801251P272	Metal film: 2.7K ohms ±5%, 1/10 w.
R304	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R305	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R306 and R307	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R308 and R309	19B801251P334	Metal film: 330K ohms ±5%, 1/10 w.
R310 and R311	19B801251P153	Metal film: 15K ohms ±5%, 1/10 w.
R312 thru R314	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R315	19B801251P683	Metal film: 68K ohms ±5%, 1/10 w.
R316 and R317	19B801251P154	Metal film: 150K ohms ±5%, 1/10 w.
R318	19B801251P474	Metal film: 470K ohms ±5%, 1/10 w.
R319	19B801251P683	Metal film: 68K ohms ±5%, 1/10 w.
R320	19B801251P274	Metal film: 270K ohms ±5%, 1/10 w.
R321	19A705496P6	Resistor, variable.
R322	19B801251P183	Metal film: 18K ohms ±5%, 1/10 w.
R324	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.
R325	19B801251P823	Metal film: 82K ohms ±5%, 1/10 w.
R326	19B801251P474	Metal film: 470K ohms ±5%, 1/10 w.
R601	19B801251P273	Metal film: 27K ohms ±5%, 1/10 w.
R602	19B801251P272	Metal film: 2.7K ohms ±5%, 1/10 w.
R603	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R604	19B801251P472	Metal film: 4.7K ohms ±5%, 1/10 w.
R605	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.
R606	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R607	19B801251P681	Metal film: 680 ohms ±5%, 1/10 w.
R608	19A705496P6	Resistor, variable.
R609 and R610	19B801251P153	Metal film: 15K ohms ±5%, 1/10 w.
R611	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R612	19B801251P124	Metal film: 120K ohms ±5%, 1/10 w.
R613	19B801251P272	Metal film: 2.7K ohms ±5%, 1/10 w.
R614	19B801251P153	Metal film: 15K ohms ±5%, 1/10 w.
R615	19B801251P224	Metal film: 220K ohms ±5%, 1/10 w.
R616	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R617	19B801251P333	Metal film: 33K ohms ±5%, 1/10 w.
R618	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R619	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R620	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R621	19B801251P562	Metal film: 5.6K ohms ±5%, 1/10 w.
R622	19B801251P222	Metal film: 2.2K ohms ±5%, 1/10 w.
R623	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R624	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.
R625	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R626	19B801251P471	Metal film: 470 ohms ±5%, 1/10 w.
R627	19B801251P472	Metal film: 4.7K ohms ±5%, 1/10 w.
R628	19B801251P823	Metal film: 82K ohms ±5%, 1/10 w.
R629	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R630	19B801251P472	Metal film: 4.7K ohms ±5%, 1/10 w.
R631	19B801251P824	Metal film: 820K ohms ±5%, 1/10 w.
R632	19B801251P154	Metal film: 150K ohms ±5%, 1/10 w.
R633	19B801251P821	Metal film: 820 ohms ±5%, 1/10 w.
R634	19B801251P272	Metal film: 2.7K ohms ±5%, 1/10 w.
R635	19B801251P822	Metal film: 8.2K ohms ±5%, 1/10 w.
R636	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.
R637	19B801251P473	Metal film: 47K ohms ±5% 1/10 w.
R638	19B801251P823	Metal film: 82K ohms ±5% 1/10 w.
R639	19B801251P154	Metal film: 150K ohms ±5%, 1/10 w.
R640	19B801251P274	Metal film: 270K ohms ±5%, 1/10 w.
R641	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R642	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R643	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R644	19B801251P123	Metal film: 12K ohms ±5%, 1/10 w.
R645	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R646 thru R649	19B801251P100	Metal film: 10 ohms ±5%, 1/10 w.
R650	19B801251P124	Metal film: 120K ohms ±5%, 1/10 w.
R651	19B801251P334	Metal film: 330K ohms ±5%, 1/10 w.
R652	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R653	19B801251P224	Metal film: 220K ohms ±5%, 1/10 w.
R654	19B801251P393	Metal film: 39K ohms ±5%, 1/10 w.
R655 and R656	19B801251P474	Metal film: 470K ohms ±5%, 1/10 w.
R657	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R658	19B801251P333	Metal film: 33K ohms ±5%, 1/10 w.
R659 and R660	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R661	19B801251P104	Metal film: 100K ohms ±5% 1/10 w.
R662 and R663	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
R664	19A705813P1	Thermistor: sim to ALO3006-624-73-G100.
R701 thru R704	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R705	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R706	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R707	19B801251P334	Metal film: 330K ohms ±5%, 1/10 w.
R708 and R709	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R710	19B801251P224	Metal film: 220K ohms ±5%, 1/10 w.
R711	19B801251P334	Metal film: 330K ohms ±5%, 1/10 w.
R712	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R715 thru R720	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R721	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R722	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.
R723 thru R725	10B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R726	19B801251P824	Metal film: 820K ohms ±5%, 1/10 w.
R727	19B801251P394	Metal film: 390K ohms ±5%, 1/10 w.
R728	19B801251P224	Metal film: 220K ohms ±5%, 1/10 w.
R729	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R730	19A702931P234	Metal film: 2210 ohms ±1%, 200 VDCW, 1/8 w.
R731	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R732	19B801251P333	Metal film: 33K ohms ±5%, 1/10 w.
R801	19B801251P223	Metal film: 18K ohms ±5%, 1/10 w.
R802	19B801251P183	Metal film: 18K ohms ±5%, 1/10 w.
R803	19B801251P222	Metal film: 2.2K ohms ±5%, 1/10 w.
R804 and R805	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.
R806	19B801251P473	Metal film: 4 7K ohms ±5%, 1/10 w.
R807	19B801251P472	Metal film: 4.7K ohms ±5%, 1/10 w.
R808	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R809	19B801251P333	Metal film: 33K ohms ±5%, 1/10 w.
R810	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U301	19A705450P3	Operational Amplifier, sim to MC34071.
U302 and U303	19A702293P2	Linear: Dual Op Amp; sim to LM358D.
U601	19A702293P1	Linear: Quad Op Amp; sim to LM324D.
U602	19A702293P2	Linear: Dual Op Amp; sim to LM358D.
U603	19A702705P3	Digital: 8 CHANNEL ANALOG MPX; SIM TO 4051BM.
U604	19A705452P1	Linear: Audio Amplifier; sim to TDA 2822M.
U605	19A702705P1	Digital, CMOS: QUAD ANALOG SWITCH/MULTIPLEXER; sim to 4066BM.
U606	19A702293P2	Linear: Dual Op Amp; sim to LM358D.
U701	19A704724P3	EEPROM: CMOS, 512 x 8 serial; sim to XICOR X24C04.
U801	19A705454P1	Voltage Detector, sim to Seiko S8054ALO.
U802	19A702536P1	Linear positive voltage regulator; sim to LM2931AZ-5.
		- - - - - - - - - CRYSTALS - - - - - - - - - -
Y701	19A702511G30	Crystal unit.

SYMBOL	GE PART NO.	DESCRIPTION
		FRONT CAP ASSEMBLY 19D902180G2
	19D902072 G5	Front Cover, includes:
	19D902072 P42	Keypad DTMF
	19D902072P2	DTMF Board.
	19A705861P1	Diaphragm.
	19C851636P1	Switchpad.
	19A702364P304	Screw.
	19A116318P4	Foil, Magnetic Shield.
	19A705664P1	Gasket.
	19D902072P7	DTMF Front Cover. w/SCAN
	19D902072P13	DTMF Cable.
000001	19D902180G2	W/O DTMF 2
		CONTROL ASSEMBLY 19A705090P1
		CONTROL FRAME
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C3 thru C7	19A702052P3	Ceramic: 470 pf ±10%, 50 VDCW.
		- - - - - - - - - - - - JACKS - - - - - - - - - -
J1 and J3		Part of 19A705733P1 Control Frame.
J901		Part of 19A705733P1 Control Frame.
		- - - - - - - - - - MICROPHONES - - - - - - - - -
M1	19A701301P3	Microphone.
		- - - - - - - - - - - - SWITCHES - - - - - - - - -
S1	19A705712P1	Switch, subminiature.
S2	19A705712P2	Switch, subminiature.
S3 thru S7		Part of 19A705733P1 Control Frame.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A705733P1	Control Frame, circuitized.
	19B801571P3	Switch, domed.
	19C851722P1	Boot, Auxiliary jack.
		LCD ASSEMBLY
	19C851719P1	Lens.
	19B801569P1	Diffuser.
	19A703685P3	Connector.
	19A705664P1	Gasket.
	19A702787P3	Tape.
	19C851660P1	LCD.
		LCD DRIVER BOARD 19C851720G1
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A702052P6	Ceramic: 1500 pf ±10%, 50 VDCW.
C2	19A702052P26	Ceramic: 0.1 µf ±10%, 50 VDCW.
		- - - - - - - - - - - DIODES - - - - - - - - - -
D1 thru D4	19A705713P1	LED, subminiature.
		- - - - - - - - - - - - JACKS - - - - - - - - - -
J2		Part of 19A705733P1 Control Frame.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - - PLUGS - - - - - - - - - -
P1-A	19B801235P3	Terminal Strip.
P1-B	19B801235P13	Terminal Strip.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A700059P2	Silicon, PNP.
Q2	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
		- - - - - - - - - - - - RESISTORS - - - - - - - - -
R1	19B801251P105	Metal film: 1M ohms ±5%, 1/10 w.
R2	19B801251P221	Metal film: 220 ohms ±5%, 1/10 w.
R3 and R4	19B801251P124	Metal film: 120K ohms ±5%, 1/10 w.
R5 and R6	19B801251P472	Metal film: 4.7K ohms ±5%, 1/10 w.
R7	19B801251P221	Metal film: 220 ohms ±5%, 1/10 w.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	19A705714P1	Chip, LCD Driver.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19C851721P1	LCD printed wire board.
	19A702364P310	Machine screw, TORX Drive: No. M3-0.5 x 10.
	19B801570P2	Connector holder.
	19A705662P1	Connector.

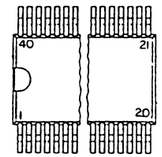
PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for the descriptions of parts affected by these revisions.

REV. A - AUDIO/LOGIC BOARD 19D902142G3, G4
Incorporated into initial shipment.

FRONT ASSEMBLY

19D902072 G5
19D902072 P42
1-800-446-5005



TOP VIEW

PINNING

SUPPLY

2 V_{DD} POSITIVE SUPPLY
4 V_{SS} NEGATIVE SUPPLY

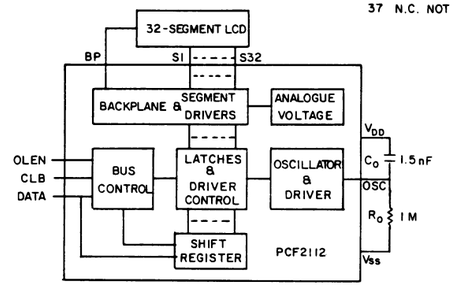
INPUTS

3 OSC OSCILLATOR INPUT
39 DATA DATA LINE
40 DLEN DATA LINE ENABLE
1 CLB CLOCK BURST

} CBUS

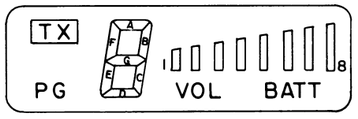
OUTPUTS

38 BP BACK PLANE DRIVER (COMMON OF LCD)
5 TO 36 LCD DRIVER OUTPUTS (S32 TO S1)
37 N.C. NOT CONNECTED



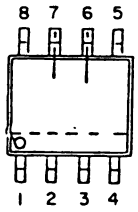
BLOCK DIAGRAM

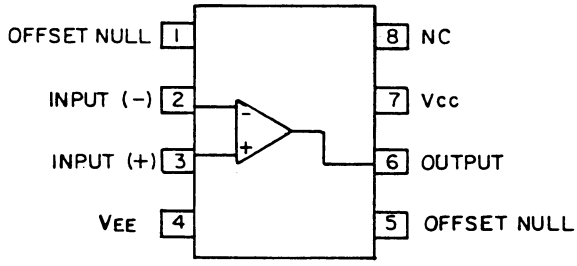
LCD DRIVER U1
19A705714P1



PIN	OUT	PIN	OUT
1	COM	13	—
2	PG	14	BAR 8
3	1E	15	BAR 7
4	1D	16	BAR 6
5	1C	17	BAR 4
6	BAR 1	18	BAR 3
7	BAR 2	19	1B
8	VOL	20	1A
9	BAR 5	21	1F
10	BAT	22	1G
11	—	23	TX
12	COM	24	COM

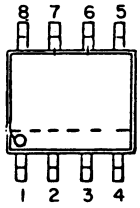
LCD
19C851660P1

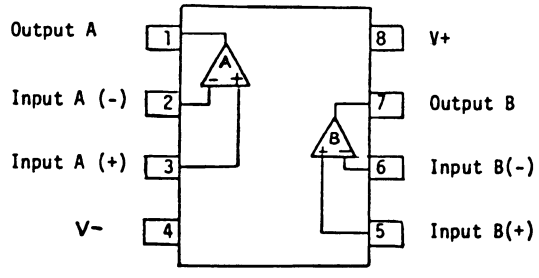




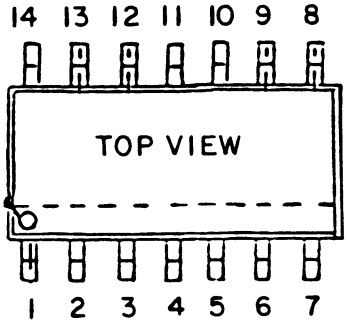
FRONT ASSEMBLY

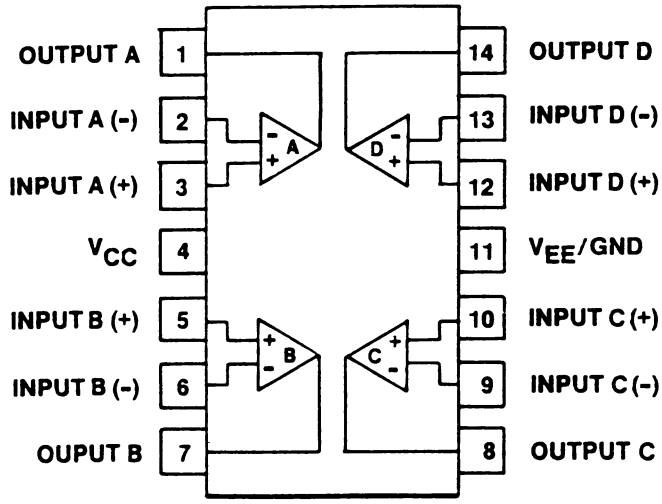
OPERATIONAL AMPLIFIER U301
19A705450P3





OPERATIONAL AMPLIFIER U302/U703/U602
19A702293P2

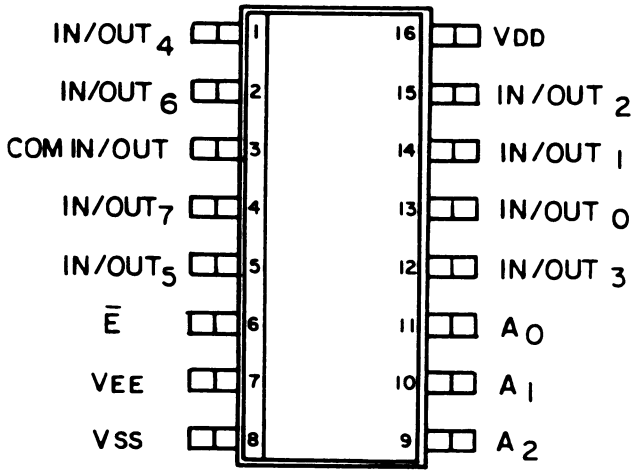




PIN 1 MAY BE IDENTIFIED BY INDENT OR CHAMFER

OPERATIONAL AMPLIFIER U601
19A702293P1

PIN CONFIGURATION

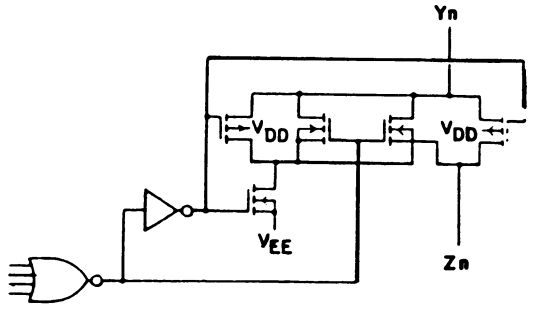


FUNCTION TABLE

INPUTS				CHANNEL ON
E	A_2	A_1	A_0	
L	L	L	L	Y_0-Z
L	L	L	H	Y_1-Z
L	L	H	L	Y_2-Z
L	L	H	H	Y_3-Z
L	H	L	L	Y_4-Z
L	H	L	H	Y_5-Z
L	H	H	L	Y_6-Z
L	H	H	H	Y_7-Z
H	X	X	X	NONE

H=HIGH STATE (THE MORE POSITIVE VOLTAGE)
L= LOW STATE (THE LESS POSITIVE VOLTAGE)
X=STATE IS IMMATERIAL

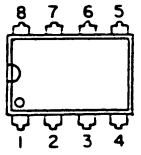
LOGIC DIAGRAM

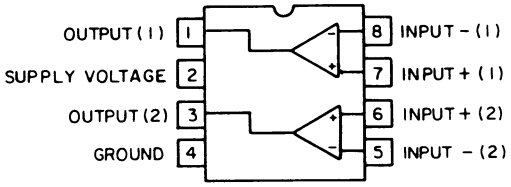


(ONLY 1/8 OF DEVICE SHOWN)

FRONT ASSEMBLY

BILATERAL SWITCH U603
19A702705P3

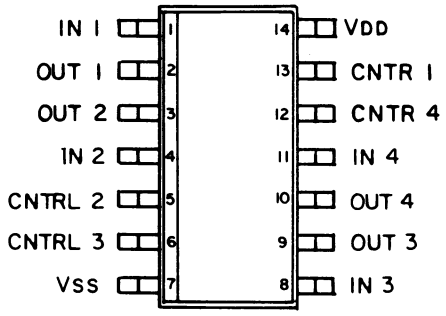




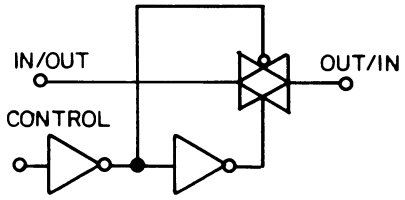
(TOP VIEW)

AUDIO AMPLIFIER U604
19A705452P1

PIN CONFIGURATION



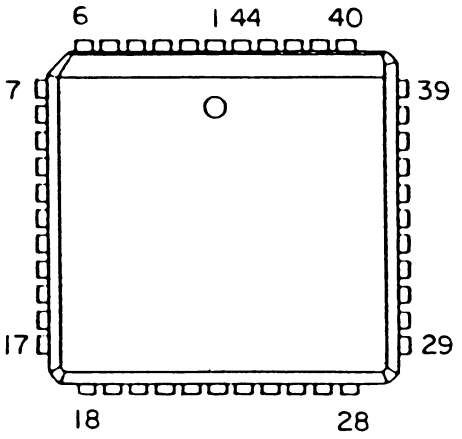
LOGIC DIAGRAM



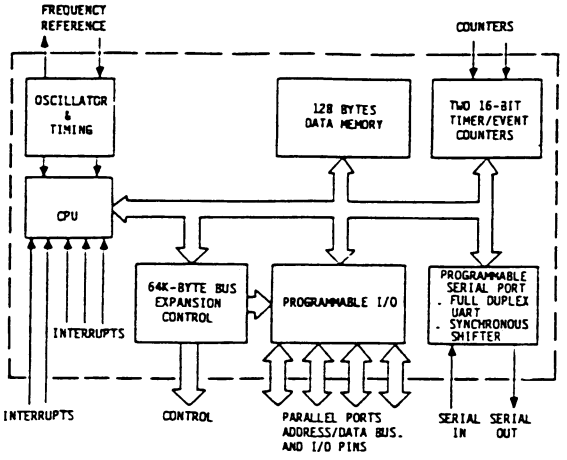
(1/4 OF DEVICE SHOWN)

CONTROL	SWITCH
0	OFF
1	ON

BILATERAL SWITCH U605
19A702705P1

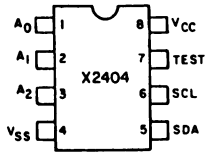


BLOCK DIAGRAM



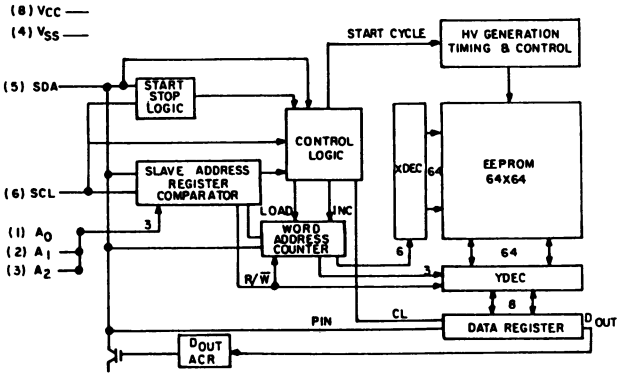
MICROPROCESSOR U1
19A704345P2 & P3

PIN CONFIGURATION

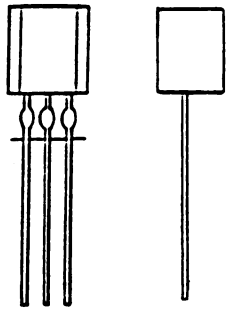


1 A_0 → TO V_{SS}
2 AND 3 A AND A ADDRESS INPUTS
4 V_{SS}
5 SDA SERIAL DATA — I^2C
6 SCL SERIAL CLOCK — BUS
7 TEST INPUT — TO V_{SS}
8 V_{CC}

FUNCTION DIAGRAM



EEPROM U701
19A704724P1

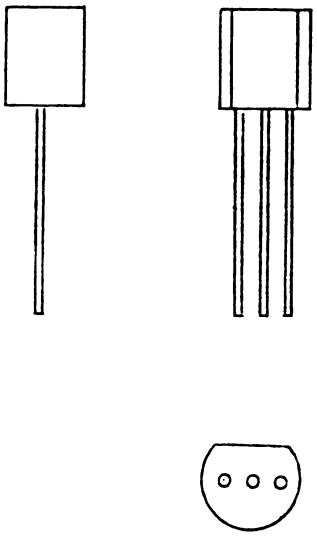


BOTTOM VIEW

TO 92 PACKAGE
PIN 1 - OUT
PIN 2 - V_{DD}
PIN 3 - V_{SS}

VOLTAGE, DETECTOR U801
19A705454P1

FRONT ASSEMBLY



BOTTOM VIEW

PIN 1 INPUT
PIN 2 OUTPUT
PIN 3 GROUND

VOLTAGE REGULATOR U802
19A702536P1