MAINTENANCE MANUAL
FOR
FRONT CAP ASSEMBLY
19D901913G2

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DESCRIPTION

Assembly 19D901913G2 consists of a Liquid Crystal Display (LCD) Assembly, a Control Panel, a Control Board, and an internal speaker. The microprocessor on the Control Board converts the Control Panel switch closures to serial data which is applied to the main radio processor on the Logic Board. The Control Board microprocessor also converts the display serial information from the Logic Board to the data format needed by the LCD. The Control Board contains the 3 watt audio power amplifier to drive the internal speaker.

CIRCUIT ANALYSIS

LCD ASSEMBLY

The alphanumeric LCD assembly provides all of the display indicators and the POWER on/off switch. Serial commands from the Logic Board (A1) are sent to the Control

Board microprocessor (U725) on the DISPLAY SERIAL line through P701. The microprocessor converts the serial data to the data format needed to drive the LCD driver IC on the LCD Assembly.

LEDs behind the LCD provide backlighting and receive power from SWA+. The POWER switch momentarily grounds the POWER SW line which drives the A+ switching circuitry on the System Board (A5).

CONTROL PANEL

The Control Panel provides all controls to operate the radio except the POWER switch. LEDs inside the panel provide backlighting and receive power from +5 VDC. The panel connects to the Control Board microprocessor input port pins through J726. The microprocessor converts each switch closure to serial data which is sent on the KEYPAD SERIAL line through P701 to the Logic Board (A1). The microprocessor port pins are normally pulled high to +5 volts through 50K ohm resistors in the microprocessor. A switch closure on the Control Panel grounds an input port line. The diodes on these lines protect the Control Board microprocessor from static discharges.

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CONTROL BOARD

Microprocessor U725 on the Control Board uses two serial data lines to send and receive data with the main radio processor on the Logic Board (A1). Schmitt triggered hex inverters U726 buffer the lines to reduce noise and data error problems. Both serial lines normally rest at +5 volts, with the data causing the lines to go low. Diodes on the serial lines as well as all input/output port lines protect the microprocessor from static discharge.

The microprocessor uses an 11.0592 MHz clock crystal. Q726 is used to shift the clock frequency to help prevent harmonics from interfering with the radio receiver. Q726 is normally off (U725-pin 8 low) but is turned on to ground C782 and shift the clock slightly low in frequency on possible problem receive channels. (PC programming the radio normally does this shift automatically. Radio test mode does not.)

RECEIVER AUDIO

RX AUDIO from the Audio Board (A3) passes through the Logic Board (A1) and through P701-5 to feed the audio AGC circuit (U803) on the Control Board. The AGC increases the apparent loudness of the radio. At low volume levels, the AGC circuit simply adds about 9 dB of RX audio gain. At higher audio levels, when 3 watt PA U801 is at the threshold of clipping, the circuit will reduce the gain as necessary to prevent harsh clipping distortion. The AGC then functions as an unique compressor with multiple release (recovery) times providing higher average audio and far less side effects than conventional compressors. The RX audio is processed so short audio peaks cause fast release times (thus increasing the average loudness). However, long audio (e.g. long phrases) with a high average level cause slower release times to reduce the annoying rush-up of gain and noise between words.

The AGC contains a voltage controlled amplifier (D801 and U803-A), a peak detector (U803-B and D802), and timing circuitry. D801 is used as an attenuator buffered by U803-A. Normally D801 is completely off and offers no attenuation to the RX audio signal. As the control voltage from the timing circuitry increases above 5 VDC, the current through D801 begins to increase thus decreasing the signal across the diode. U803-A amplifies the low level (5 mVrms) signal while subtracting the large dc control voltage. The output of U803-A feeds AGC peak detector U803-B and 3 watt PA U801.

The AGC control voltage is produced by a peak detector (U803-B and D802) and the timing circuitry. U803-B amplifies the output of U803-A with a gain of 13 (22 dB). Since the timing circuitry normally rests at a 5 volt bias level, D802 conducts when the positive output peaks from U803-B exceed 5.5 volts. The positive peaks from D802 are filtered into a smooth DC control voltage by the timing circuitry (C814, C815, R825, R826, and R827). The increase in control voltage causes D801 to conduct and reduce the signal level. Since the clipping point of the 3 watt PA varies with the supply voltage, a sample of SWA+ is applied to U803-B through R823 to vary the threshold of the peak detector. Also, the gain of U803-B is relatively low for a peak detector. The low gain causes the AGC output to rise slightly as the RX audio level (or volume) increases allowing the perceived loudness to increase at the expense of slight clipping distortion.

The output of the audio AGC drives 3 watt audio power amplifier U801. U801 has a gain of 22 (27dB). The feedback loop consisting of R805, R806, and C803 determines the amplifier's gain. R803, C804, C806, and C810 prevent high frequency oscillations.

The 3 watt PA is muted (switched off) when the $\overline{\text{AUDIO MUTE}}$ line is low. The AUDIO MUTE line is pulled high to +5 volts by an internal 50k-ohm resistor in microprocessor U725. U725 pulls the line low to mute the audio. The line may be externally grounded at the System Board (A5) option connector to mute the receiver audio. However, the line may not be forced to +5 Vdc to unmute the audio. Grounding the line turns on Q801 which applies 1.25 Vdc to U801 pin 2. This voltage saturates U801 causing output pin 4 to switch to ground.

The 3 watt audio output is routed to the System Board (A5) on SPKR HI through J901. The internal speaker normally connects to the System Board to provide easy access to the speaker when servicing the radio. An alternate speaker connector J801 on the Control Board is used for the internal speaker in the remote mount option.

MTD AND TMX8825 (or TMX8810) OPERATION

For MTD radio operation, jumper P728 is installed on J728. This allows 9600 baud serial data stream communication with the Logic Board.

For TMX8825 and TMX8810 radio operation, the jumper is not installed. This allows 4800 baud serial data stream communication with the Logic Board.

POWER DISTRIBUTION

Switched A+ from the System Board (A5) feeds the Control Board through J901. SWA+ supplies 13 volts to 5-Volt regulator U727, 3-watt audio PA U801, and the LED backlighting in the LCD assembly.

Voltage Regulator U727 supplies +5 VDC to microprocessor U725, serial line buffers U726, and the LED backlighting in the Control Panel. A reset circuit in U727 provides a 20 millisecond logical low reset pulse at power up. The pulse is inverted by Q725 to a logical high (+5 VDC) reset pulse for the U725 rest pin.

SERVICE NOTES

1. See Figure 1 and check for the 20 ms wide reset pulse at U725 pin 9. Observe the reset pulse and the 13 volt supply simultaneously while triggering the scope on the 13 volt supply. Observe that pin 9 switches low about 20 ms after supply turns on. If not present, check regulator U727 and transistor Q725.

2. Ensure the DISPLAY SERIAL, KEYPAD SERIAL, and SERIAL RQST lines are all normally high (+5 VDC) while no switches are pushed and no LCD updates are occurring. Check for any shorts on the Logic or Control Boards before suspecting the microprocessors.

3. All output port lines from the microprocessor are pulled high to +5 volts through 50k ohm resistors inside the microprocessor. If a line is high you may ground that pin and monitor the results. However, if a line is low, the line should not be forced to +5 volts.

4. CONTROL BOARD TEST MODE:
This procedure allows testing the Control Board without the radio assembly connected. Unplug the LCD and Control Panel from J726 and J727. Apply power to J901-5,6 with U725 pin 15 grounded. Remove the ground from pin 15 after power is applied. The Control Board is now in the special board level test. Measure the signals as shown in Figure 2. Remove power from the board to exit this test.

Trigger Oscilloscope from 13.8 volts supply at power on.

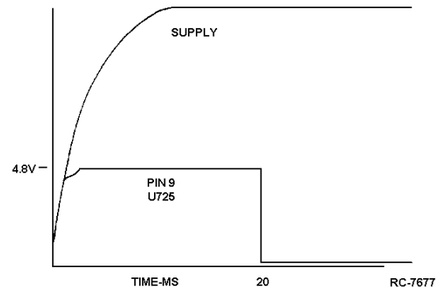
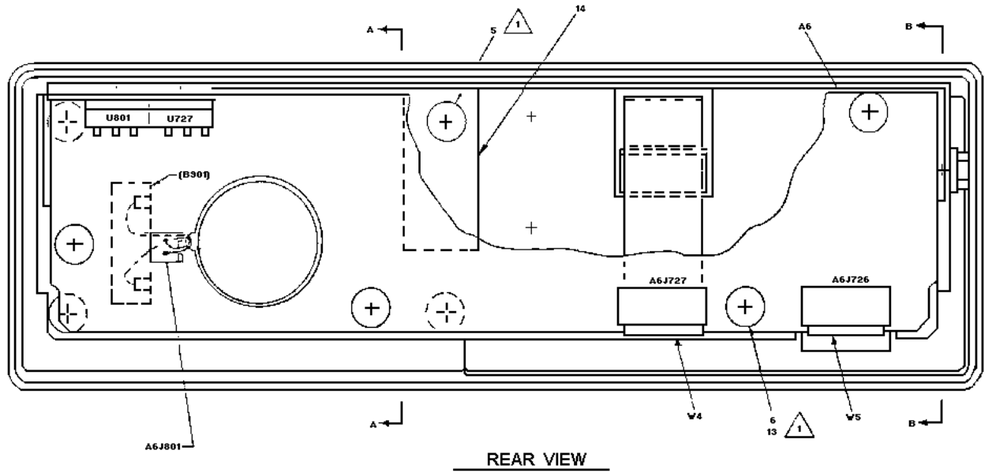


Figure 1 - Reset Waveform

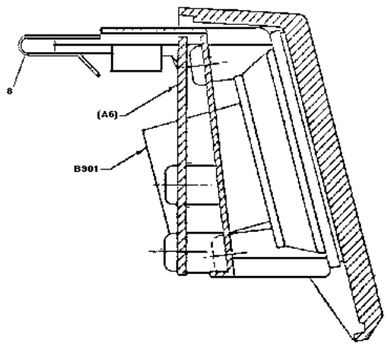
PIN	MEASUREMENT 5-VOLT PEAK-TO-PEAK SIGNALS
J726-2	157 Hz
J726-3	313 Hz
J726-4	20000 Hz
J726-6	10000 Hz
J726-7	625 Hz
J726-8	5000 Hz
J726-9	1250 Hz
J726-10	2500 Hz
J727-1	10000 Hz
J727-3	2500 Hz
J727-4	5000 Hz
J727-5	1250 Hz
J727-10	20000 Hz
J901-10	313 Hz
J901-12	5000 Hz
J901-14	625 Hz
P701-1	10000 Hz
P701-7	2500 Hz

Figure 2 - Control Board Test Mode

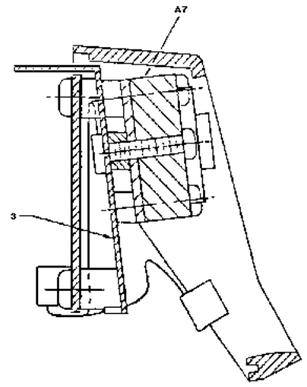
FRONT CAP



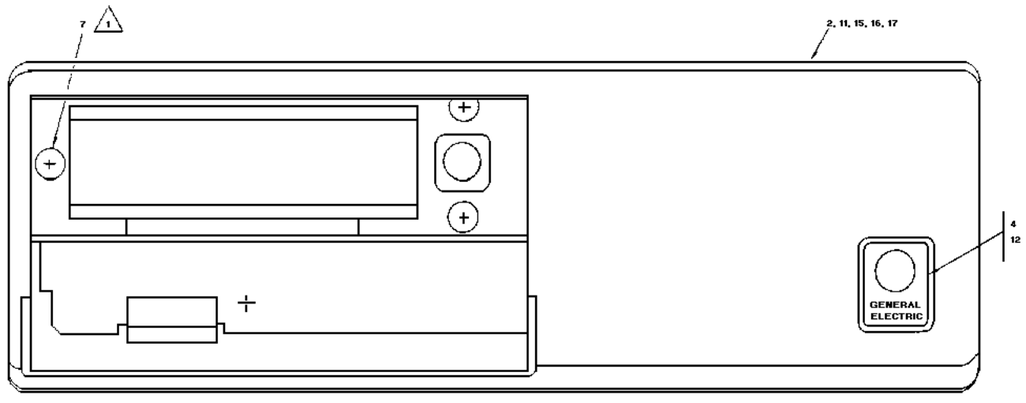
REAR VIEW



SECTION A-A

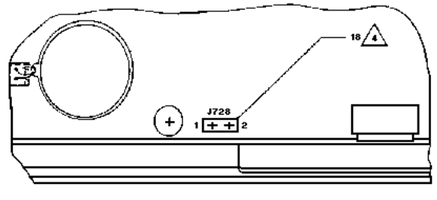


SECTION B-B



FRONT VIEW

(19D901913, Rev. 6)



REAR VIEW

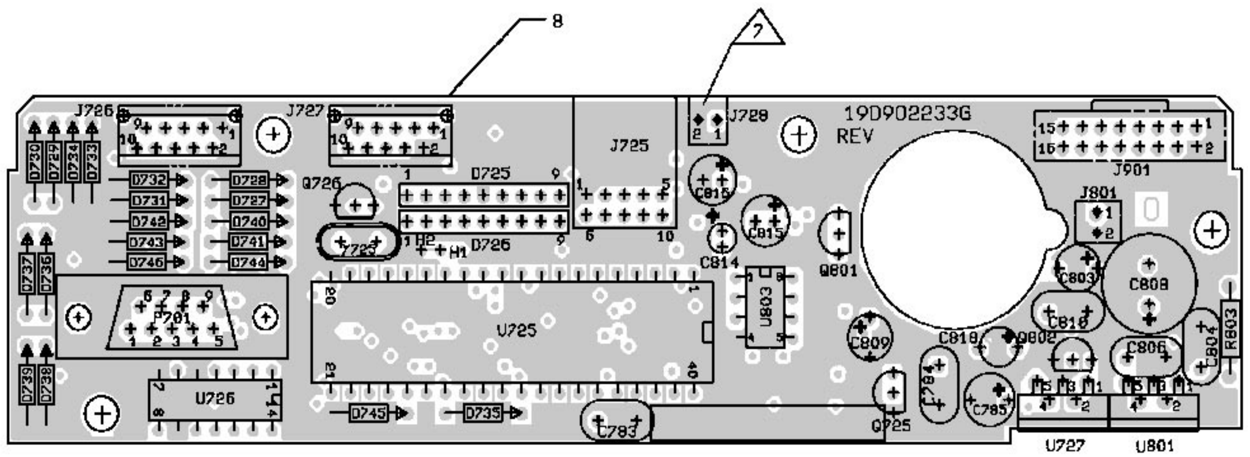
(19) SAME AS PT 1 EXCEPT AS SHOWN.

(1)

NOTES:

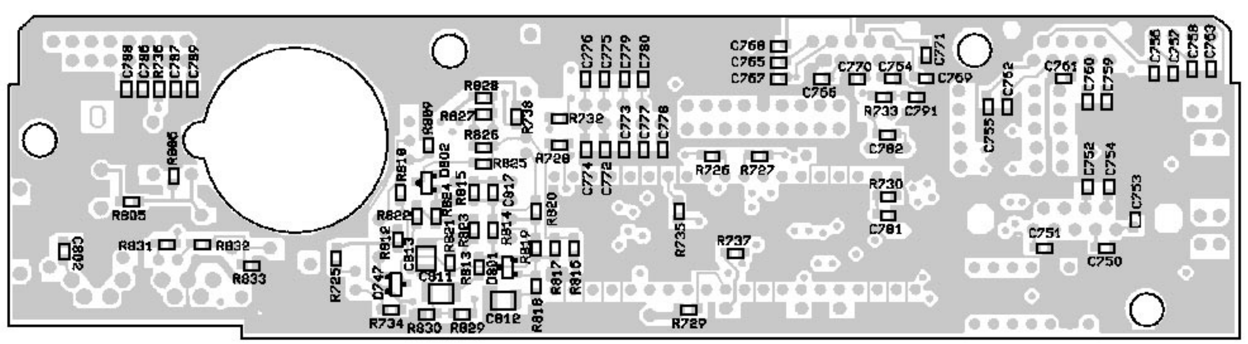
1. TORQUE SCREWS, ITEM 5, TO 10 INCH-POUNDS: SCREWS, ITEM 6 AND 13 TO 15 INCH-POUNDS: SCREWS, ITEM 7, TO 1 INCH-POUNDS.
2. FOLD W5 CCABLE APPROXIMATELY AS SHOWN AND LET ONE END HANG: THIS END WILL CONNECT TO CONTROL PANEL AT THE NEXT ASM LEVEL.
3. CONNECT SPEAKER CABLE TO A6J801. THIS CABLE WILL CONNECT TO A5J304 AT THE NEXT ASM LEVEL WHEN USED IN A FRONT MOUNT RADIO.
4. INSTALL SHORTING PLUG (ITEM 18) FOR GROUPS 3,4 & 5.

COMPONENT SIDE

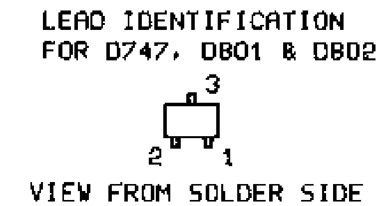


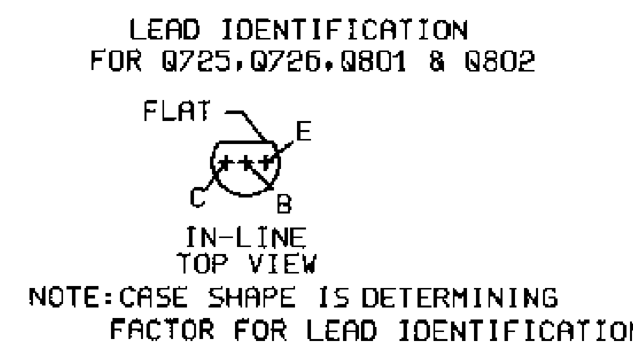
△3 (19D902233, Sh. 2, Rev. 0)
(19D902863, Layer 1, Rev. 0)

SOLDER SIDE



(19D902233, Sh. 2, Rev. 1)
(19D902229, Layer 4, Rev. 0)





6. THE FOLLOWING DEVICES ARE ELECTROSTATTIC SENSITIVE DEVICES REQUIRING SPECIAL CARE: U725

△7 SHORTING PLUG P728:

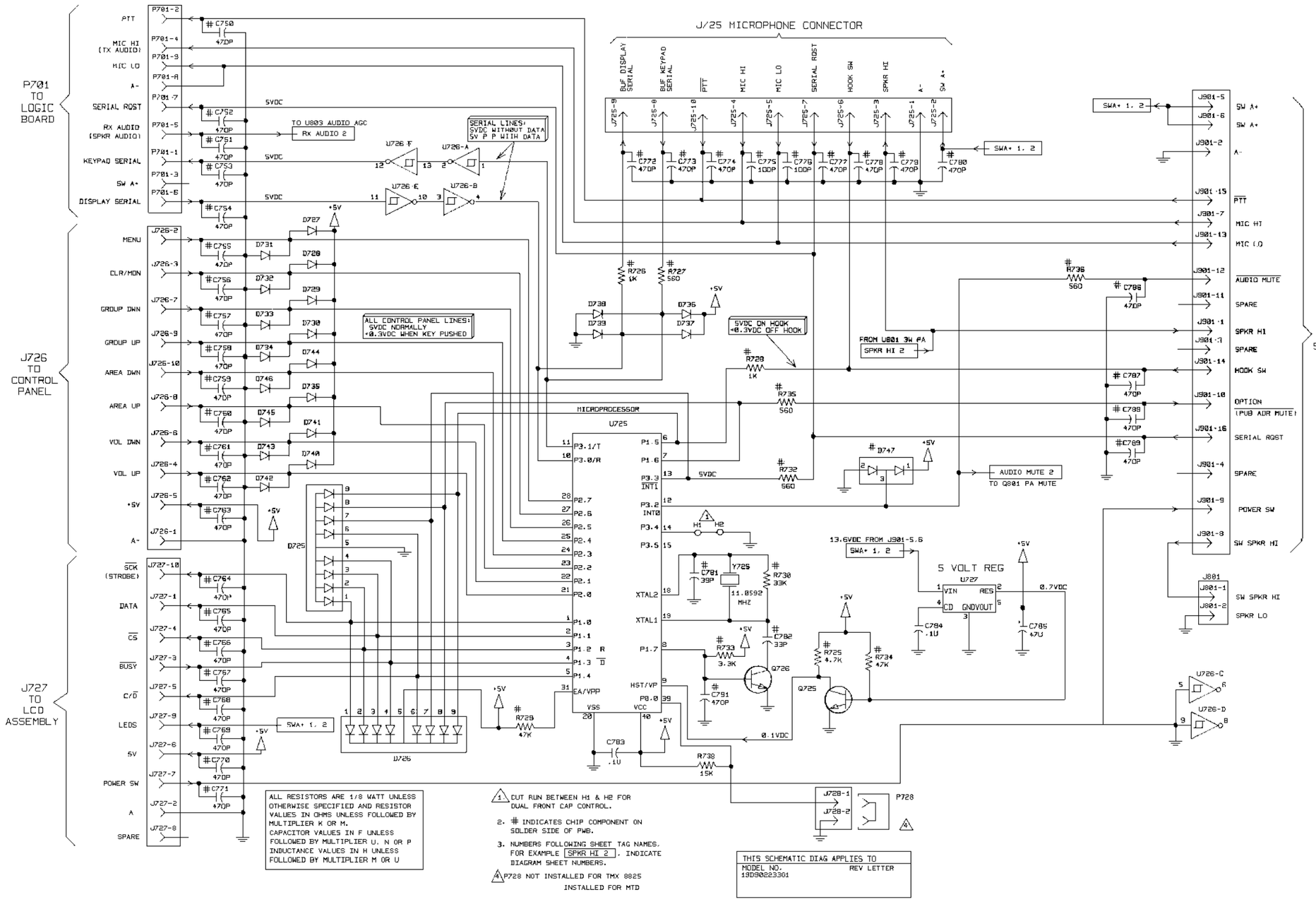
INSTALLED – 9600 BAUD SERIAL OPERATION

NOT INSTALLLED – 4800 BAUD SERIAL OPERATION

F R O N T C A P

CONTROL BOARD

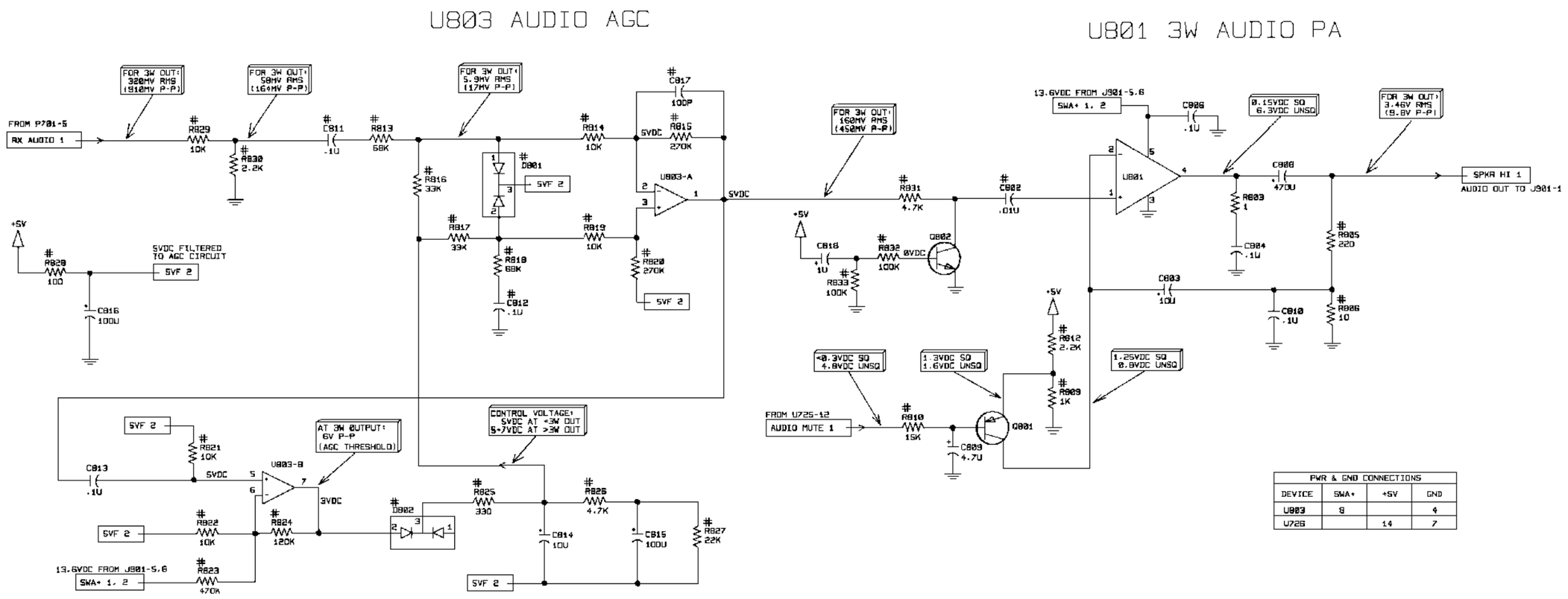
19D902233G2



CONTROL BOARD

19D902233G2

(19D902864, Sh. 1, Rev. 0)



PWR & GND CONNECTIONS			
DEVICE	SWA+	+5V	GND
U803	8		4
U726		14	7

CONTROL BOARD

19D902233G2

(19D902864, Sh. 2, Rev. 0)

FRONT CAP ASSEMBLY
19D901913G2
ISSUE 2

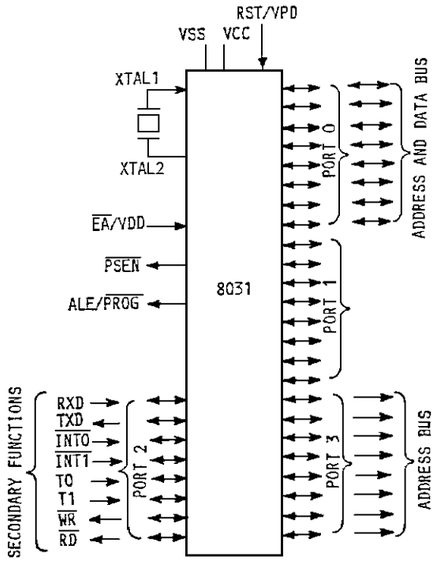
SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - -ASSEMBLIES- - - - - - - - - -
A6		Control Board 19D902233G2
		- - - - - - - - - - CAPACITORS- - - - - - - - - -
C750 thru C774	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0æ30 PPM.
C775 and C776	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0æ30 PPM.
C777 thru C780	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0æ30 PPM.
C781	19A702061P41	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0æ30 PPM.
C782	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0æ30 PPM.
C783 and C784	T644ACP410K	Polyester: 0.1 uF ±10%, 50 VDCW.
C785	19A701534P9	Tantalum: 47 uF ±20%, 6.3 VDCW.
C786 thru C789	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0æ30 PPM.
C791	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0æ30 PPM.
C802	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C803	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C804	T644ACP410K	Polyester: 0.1 uF ±10%, 50 VDCW.
C806	T644ACP410K	Polyester: 0.1 uF ±10%, 50 VDCW.
C808	19A701225P11	Electrolytic: 470 uF ±10% to +7æ5%, 16 VDCW.
C809	19A701534P6	Tantalum: 4.7 uF ±20%, 35 VDCW.
C810	T644ACP410K	Polyester: 0.1 uF ±1 0%, 50 VDCW.
C811 thru C813	19A702052P26	Ceramic: 0.1uF ±10%, 50 VDCW
C814	19A704879P5	Electrolytic: 10 uF ±20%, 16 VDCW.
C815 and C816	19A704879P1	Electrolytic: 100 uF, 6.3 VDCW.
C817	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0æ30 PPM.
C818	19A701534P4	Tantalum: 1 uF ±20%, 35 VDCW.
		- - - - - - - - - - DIODES- - - - - - - - - -
D725	19A705313P2	Integrated Circuit: common anode, sim to DAP 801.
D726	19A705313P1	Integrated Circuit: common cathode, sim to DAN 801.
D727 thru D746	19A700028P1	Silicon: 75 mA, 75 PIV; sim to 1N4148.
D747	19A700053P2	Silicon: 2 Diodes in Series; sim to BAV99.
D801 and D802	19A134587P2	Silicon: 2 diodes, Common Cathode; sim to BAV 70.
		- - - - - - - - - - JACKS- - - - - - - - - -
J72	19A702333P52	Printed wire, sim to Dupont 78207-110.
J726 and J727	19A705236P1	Connector, 10 contacts: sim to MICS-10-.8.
J728	19A703248P11	Post: Gold Plated, 10 mm length.
J801	19A703248P11	Post: Gold Plated, 10 mm length.
J901	19A703248P17	Post: Gold Plated, 14 mm length.

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - PLUGS- - - - - - - - - -
P701	19B209727P31	Connector, shielded: 9 contacts; sim to 74951-1.
		- - - - - - - - - - TRANSISTORS- - - - - - - - - -
Q725 and Q726	19A700023P2	Silicon, NPN: sim to 2N3904.
Q801	19A700022P2	Silicon, PNP: sim to 2N3906.
Q802	19A700023P2	Silicon, NPN: sim to 2N3904.
		- - - - - - - - - - RESISTORS- - - - - - - - - -
R725	19B801251P472	Metal film: 4.7K ohms ±5%, 1/10ω.
R726	19B801251P102	Metal film: 1K ohms ±5%, 1/10ω.
R727	19B801251P561	Metal film: 560 ohms ±5%, 1/10ω.
R728	19B801251P102	Metal film: 1k ohms ±5%, 1/10ω.
R729	19B801251P473	Metal film: 47K ohms ±5%, 1/10ω.
R730	19B801251P333	Metal film: 33K ohms ±5%, 1/10ω.
R732	19B801251P561	Metal film: 560 ohms ±5%, 1/10ω.
R733	19B801251P332	Metal film: 3.3K ohms ±5%, 1/10ω.
R734	19B801251P473	Metal film: 47k ohms ±5%, 1/10ω.
R735 and R736	19B801251P561	Metal film: 560 ohms ±5%, 1/10ω.
R737 and R738	19B801251P153	Metal film: 15k ohms ±5%, 1/10ω.
R803	H212CRP910C	Deposited carbon: 1 ohm ±5%, 114 ω.
R805	19B801251P221	Metal film: 220 ohms ±5%, 1/10ω.
R806	19B801251P100	Metal film: 10 ohms ±5%, 1/10ω.
R809	19B801251P102	Metal film: 1K ohms ±5%, 1/10ω.
R810	19B801251P153	Metal film: 15k ohms ±5%, 1/10ω.
R812	19B801251P222	Metal film: 2.2K ohms ±5%, 1/10ω.
R813	19B801251P683	Metal film: 68K ohms ±5%, 1/10ω.
R814	19B801251P103	Metal film: 10k ohms ±5%, 1/10ω
R815	19B801251P274	Metal film: 270K ohms ±5%, 1/10ω.
R816 and R817	19B801251P333	Metal film: 33k ohms ±5%, 1/10ω.
R818	19B801251P683	Metal film: 68K ohms ±5%, 1/10ω.
R819	19B801251P103	Metal film: 10k ohms ±5%, 1/10ω.
R820	19B801251P274	Metal film: 270k ohms ±5%, 1/10ω.
R821 and R822	19B801251P103	Metal film: 10k ohms ±5%, 1/10ω.
R823	19B801251P474	Metal film: 470K ohms ±5%, 1/10ω.
R824	19B801251P124	Metal film: 120K ohms ±5%, 1/10ω.
R825	19B801251P331	Metal film: 330 ohms ±5%, 1/10ω.
R826	19B801251P472	Metal film: 4.7k ohms ±5%, 1/10ω.
R827	19B801251P223	Metal film: 22K ohms ±5%, 1/10ω.
R828	19B801251P101	Metal film: 100 ohms ±5%, 1/10ω.
R829	19B801251P103	Metal film: 10k ohms ±5%, 1/10ω.
R830	19B801251P222	Metal film: 2.2K ohms ±5%, 1/10ω.
R831	19B801251P472	Metal film: 4.7K ohms ±5%, 1/10ω.
R832 and R833	19B801251P104	Metal film: 100k ohms ±5%, 1/10ω.
		- - - - - - - - - - INTEGRATED CIRCUITS- - - - - - - - - -
U725	19A704345P11	Microcomputer CHMOS 8-bit; sim to TP80C51BH
U726	19A700037P313	Digital: Hex Schmitt-Trigger Inverter; sim to 74LS14.
U727	19A704970P1	Linear: 5 Volt Regulator with Reset output; sim to SGS L387.
U801	19A701830P1	Linear: Audio Power Amplifier; sim to TDA2003.
U803	19A701789P2	Linear: Dual Op Amp; sim to LM358.

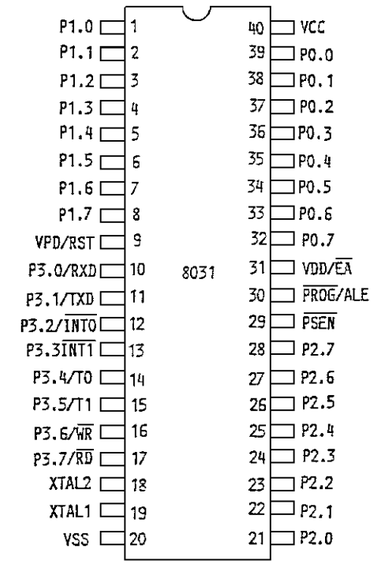
SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y725		Quartz: 11.0592 MHz. 19A702511G26
		- - - - - - - - - - MISCELLANEOUS- - - - - - - - - -
9	19D902233G8	CONTROL BOARD
A7	19B801459P2	LCD ASSEMBLY
		- - - - - - - - - - MODULE - - - - - - - - - -
B901	19A705165P1	Loudspeaker, permanent magnet.
		- - - - - - - - - - CABLES - - - - - - - - - -
W4 and W5	19A705234P1	Cable assembly.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
3	19D901889G1	Can, Shield.
5	19A705381P1	3008 Screw, thread forming.
7	19A702364P316	Machine Screw: Pan Head, Steel.
8	19A705244P2	Clip, spring tension.
11	19D901890P2	Front Cap.
13	19A702381P506	Screw, thread forming: TORX, No. M3.5-.6 x 6.
14	19A121175P5	Plate Insulator.

U725
MICROCOMPUTER (CHMOS 8-BIT)
19A704345P11

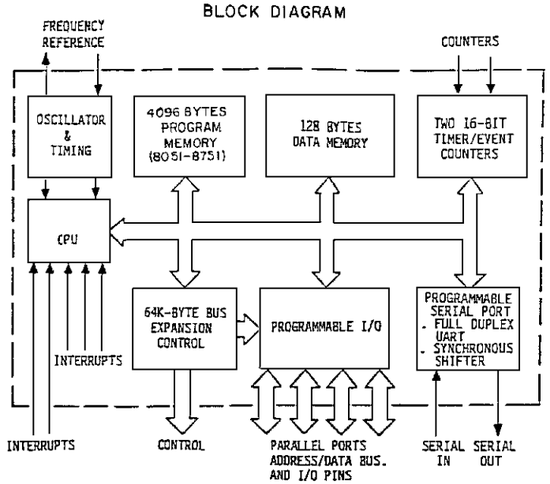
LOGICAL SYMBOL



PIN CONFIGURATION

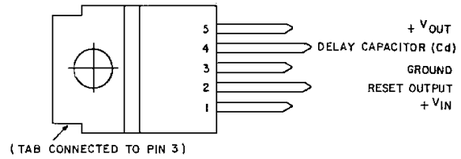


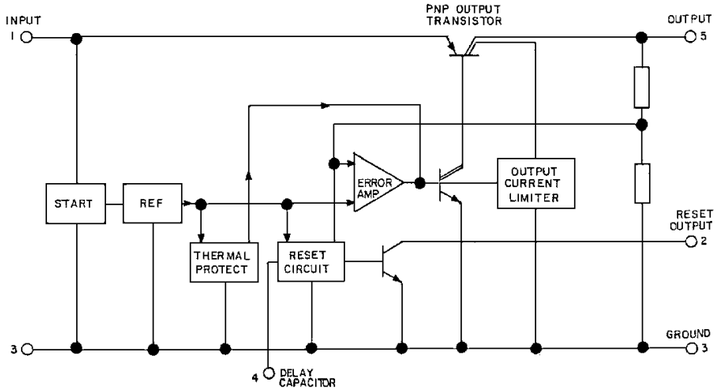
BLOCK DIAGRAM



U727

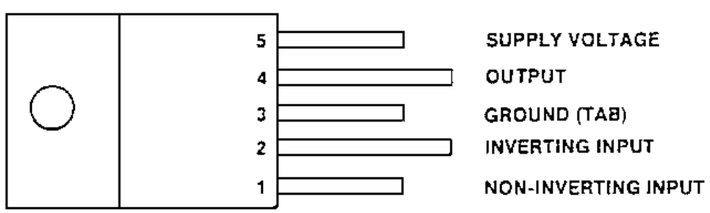
VOLTAGE REGULATOR
19A704970P1





U801

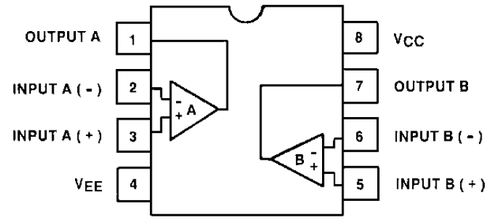
AUDIO AMPLIFIER
19A701830P1



PIN INDENTIFICATION

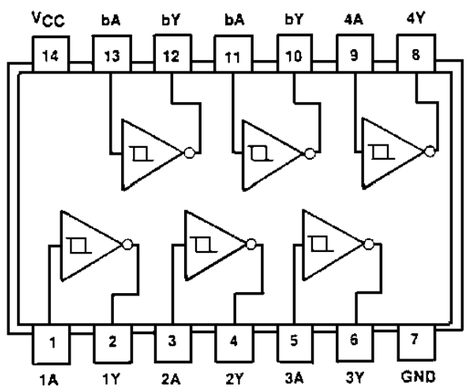
U803

OPERATIONAL AMPLIFIER
19A701789P2



U726

HEX SCHEMITT TRIGGER INVERTER
19A700037P313



FRONT CAP