

MAINTENANCE MANUAL

FRONT COVER ASSEMBLY

19D904151G1

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DESCRIPTION

The Front Cap Assembly for the Dual Format MDX provides the user interface with the radio. It houses the four watt internal 8-ohm speaker and display board.

DISPLAY BOARD

The display board, 19D903957G1, contains all user interface controls including the 8 character dot matrix LED (5 by 5 dot matrix characters), a microcontroller which manages the alphanumeric displays, eight icon LED's, 12 backlight LED's, and twelve printed wire board switch contacts. It also has two connectors which provide the interface to the microphone and the audio amplifier board.

The display board communicates with the audio/logic board (straight through connection on the audio amplifier board) in the mobile radio, through a three wire serial interface, in order to update display information, report key closures, perform an audio mute to the speaker, and report hookswitch and floorswitch status.

Microcontroller

Microcontroller U1 is an 8 bit control oriented microcontroller, with internal input/output interface and 256 by 8 bit internal random access memory, operating at a crystal clock rate of 11.0592 MHz. The microcontroller controls the operation of the display board and performs the following functions.

- Samples 11 of the 12 push-button key closures
- Controls the 8 character alphanumeric display
- Controls the 8 icon LED's
- Samples the hookswitch input
- Samples the floorswitch (Option) input
- Communicates with the audio/logic board in the radio
- Dual Control Unit Operation

The microcontroller contains internal masked software operational code. It executes the internal software code with the EA pin (U1-29) at 5 volts and is reset via the power up/down reset output on the audio amplifier Board (U1-4).

The serial protocol for communication in MDX EDACS and MDX Conventional mobile radios is established with the MODE SELECT input line at a TTL high level (U1-10). The MODE SELECT line is set at a TTL high level through a jumper configuration on the audio amplifier board. Once MODE SELECT is high, the communication protocol is set at 9600 bits per second, 9 bit data field, one start bit, and one stop bit.

Support is not provided by the MDX EDACS and MDX Conventional mobile radios if MODE SELECT is configured for a TTL low on the audio amplifier board.

For MDX EDACS and MDX Conventional radios, the microcontroller communicates with the audio/logic board through DISPLAY SERIAL (U1-5), KEYPAD SERIAL (U1-7), SERIAL RQST (U1-9), which are TTL compatible lines. DISPLAY SERIAL is an input, KEYPAD SERIAL is an output, and SERIAL RQST is an output.

DISPLAY SERIAL and KEYPAD SERIAL are double-buffered by open drain buffer U2. The microcontroller receives commands on the DISPLAY SERIAL input line and transmits status information (key closures, hookswitch, and floorswitch option) on the KEYPAD SERIAL output line. SERIAL RQST is set low by the micro to indicate a status update to be sent to the audio/logic board.

The microcontroller is addressed via the proprietary protocol for the information to be sent. It then transmits the status information and subsequently raises the SERIAL RQST line. The microcontroller receives display update information from the audio/logic board at any time, irrespective of the state of the SERIAL RQST line. The microcontroller passes status information back only in the proper sequence which begins with its SERIAL RQST line going low.

The microcontroller updates the 8 character alphanumeric display as requested by the audio/logic board, through a three wire interface, LOAD (U1-11), SDCLK (U1-12), and DATA (U1-13). The microcontroller also controls the intensity of the alphanumeric display through the three wire interface.

The microcontroller updates the 8 icon LED's, CR1 through CR8, through individual output controls, PVT LED (U1-2), SCN LED (U1-3), TX LED (U1-21), BSY LED (U1-22), S LED (U1-23), P1 LED (U1-24), and P2 LED (U1-25). Note that the PVT LED output line controls CR1 and CR8 simultaneously. In addition to turning the icon LED's on and off, the microcontroller also controls the intensity by modulating the on/off rate (duty cycle) from 0% to 100%.

The microcontroller senses the key closures (POWER SW is the only one that is not read), the hookswitch input (CG DIS / HOOK SW, U1-40), the floorswitch input (OPTION), and requests to transmit the information back to the audio/logic board.

The microcontroller is also capable of operating as a second unit in a dual control unit system. This function is activated by cutting the run between HL-1 and HL-2 on the printed wire board (near and on the same printed wire board side as the microcontroller).

Optionally, a clock shift circuit, consisting of Q5 and C21, can be switched in to remove spur frequencies from the radio channels.

To mute the speaker audio, the microcontroller generates an active logic low on AUDIO MUTE (U1-8) upon command from the audio/logic board.

8 Character Display

The display consists of a CMOS IC containing control logic and drivers for eight 5 X 5 characters. The use of the serial data interface provides the efficient interconnection between the display and the microcontroller. The CMOS IC accepts decoded serial data, which is stored in the internal random access memory. Asynchronously, the RAM is read by the character multiplexer at a strobe rate that results in a flicker free display.

Each character of the display is written by the microcontroller as a sequence of 6 eight bit bytes using the LOAD (U3-2), SDCLK (U3-1), and DATA (U3-27) serial interface lines. Bringing the LOAD line low enables the display to accept the bytes of data. The shift action occurs on the low to high transition of the serial data clock (SDCLK). After eight clock transitions of SDCLK, the LOAD line is brought high and the first byte of data has been accepted. Once loaded, the internal oscillator and character multiplexer of the display reads the data from the RAM. These characters are row strobed with column data at a rate determined by the internal clock of the device. The internal strobe rate of the display is nominally 750 Hz.

Along with the display of specific characters, there are control functions that control the brightness and blanking of the display. The brightness levels are 0%, 6.6%, 13%, 20%, 27%, 40%, 53%, and 100% of full maximum brightness.

The reset input (U3-13) is brought low at power up to clear the internal character, control, and RAM information and blanks the display.

The CLKSEL (U3-16) is tied low to enable the internal strobe rate of the display device.

ICON LED'S

Eight icon LED's are used to indicate the status of the radio as determined by the audio/logic board in the mobile radio. Two of the icon LED's (CR1 and CR8) are driven by the same signal.

The icon LED controls are derived from the microcontroller (U1) through PVT LED (U1-2), SCN LED (U1-3), TX LED (U1-21), BSY LED (U1-22), S LED (U1-23), P1 LED (U1-24), P2 LED (U1-25).

PVT LED is used to turn two LED's, CR1 and CR8 on and off. All others are used to turn their respective LED on and off.

The LED's are turned on and off by dual pass transistors, Q1 through Q4. If the line from the microcontroller is high, the respective transistor is turned off and removes power to the LED. If the line from the microcontroller is low, the respective pass transistor is turned on and this in turn supplies power to the LED.

Backlight LED'S

Backlight LED's CR11 through CR23 provide the backlighting for the buttons on the front panel. The power source is derived from 12V SW (P707-13). The 12V SW supply is generated on the audio amplifier board through a filter regulator circuit.

Optionally, the audio/logic board in the mobile radio can be programmed to turn the 12V SW supply on and off (used for surveillance applications).

Switch Contact Closures

There are twelve switch contact closures used on the display board. Eleven of the twelve push-button switches are sensed by microcontroller U1. The PWR switch is the only one not sensed by the microcontroller and is used instead to control the on/off flip flop on the system board which enables/disables power from the continuous battery power, A+, to switched power, SW A+.

The eleven switch contacts sensed by the microcontroller are :

| Switch | Micro Pin | MDX EDACS Function | MDX Conv Function |
|--------|-----------|--------------------|-------------------|
| S2 | U1-37 | VOL UP | VOL UP |
| S3 | U1-36 | VOL DN | VOL DN |
| S4 | U1-35 | GRP UP | CH UP |

| | | | |
|-----|-------|--------|-------|
| S5 | U1-34 | GRP DN | CH DN |
| S6 | U1-33 | SCN | SCN |
| S7 | U1-32 | SYS | MON |
| S8 | U1-31 | A1 | A1 |
| S9 | U1-30 | MNU | MNU |
| S10 | U1-18 | A2 | A2 |
| S11 | U1-19 | CLR | CLR |
| S12 | U1-20 | EMER | EMER |

When the microcontroller senses the switch contact closure, it initiates the sequence of events used to transfer the status information back to the audio/logic board.

Connectors

There are two connectors used on the display board, J725 (mic connector) and P707 (audio amplifier board interface connector).

Microphone connector J725 is used to pass MIC HI, MIC LO, PTT, CG DIS / HOOK SW, SW A+, and A- between the microphone and the audio amplifier board. It is also used to pass DISPLAY SERIAL, KEYPAD SERIAL, SW A+, and A- to the PC Programmer which is used to load the radio personality into the radio. Additionally, PTT / FLASH VPP is used to supply the stable 12 volts flash programming voltage to the radio and is used for flash programming the operational code in the audio/logic board's flash memory device.

Audio amplifier board interface connector P707 is used to pass the necessary signals between the microphone and display board back to the audio amplifier and audio/logic boards.

POWER DISTRIBUTION

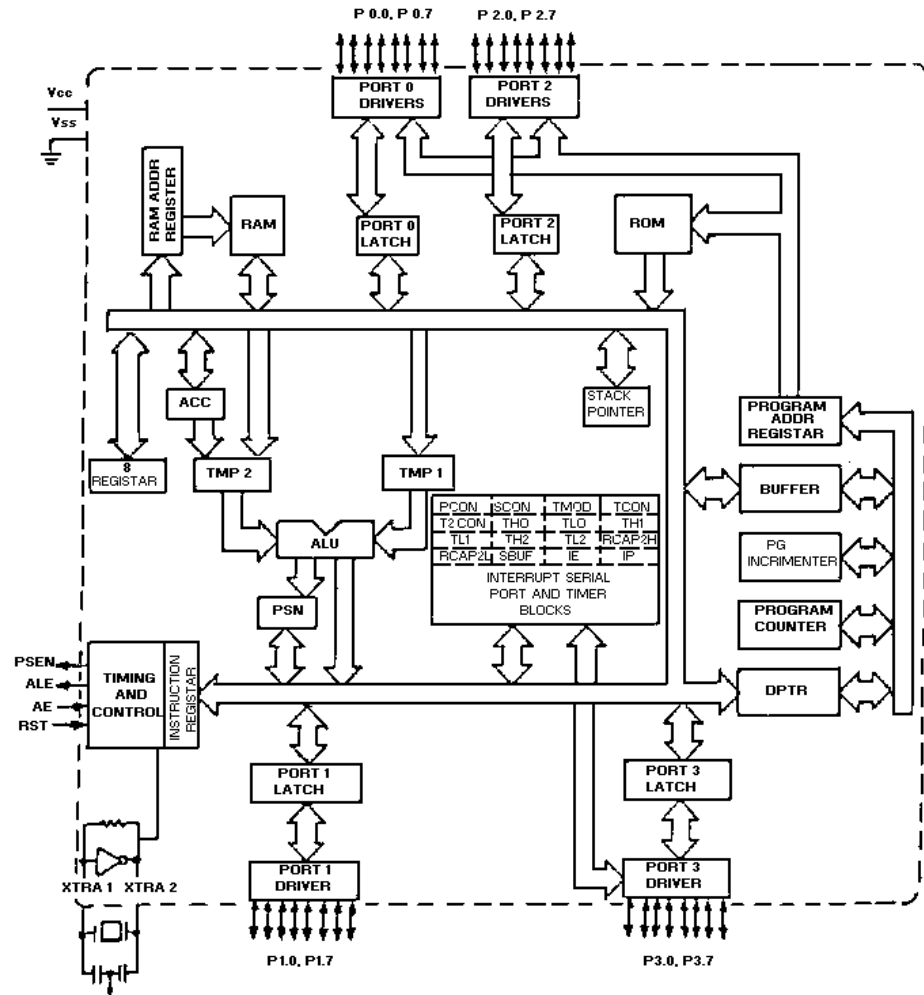
The display board receives +5V power from the regulator on the audio amplifier board. The +5V supply powers microcontroller U1, 8 character display U3, open drain buffer U2, and pass transistors Q1 through Q4.

The display board receives 12V SW power from the audio amplifier board. The 12V SW power is used to provide the power to backlight LED's CR11 through CR24. Optionally, the audio/logic board can turn off the 12V SW power on the audio amplifier board for surveillance applications.

The display board passes A+ SW power from the audio amplifier board to microphone connector J725, where it is used to power an optional DTMF microphone or supply power to the PC/Flash Programmer Interface module.

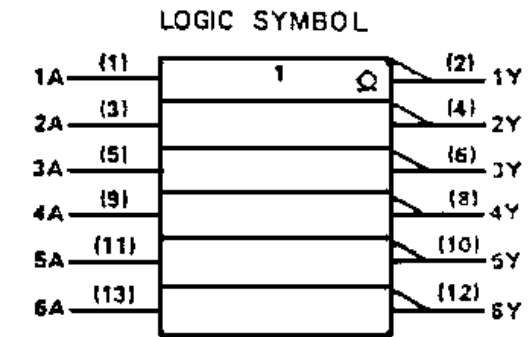
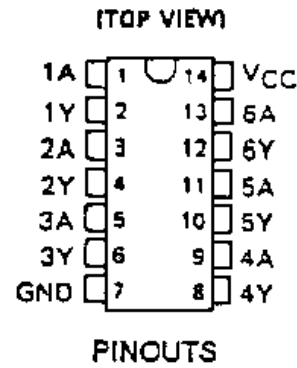
U1, MICROCOMPUTER
19A705557P10

FUNCTION DIAGRAM



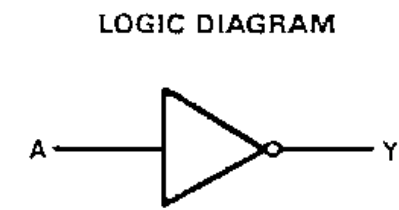
U2, HEX INVERTER
19A703484P322

HEX OPEN - DRAIN INVERTER
19A703483P322
(74HC05)



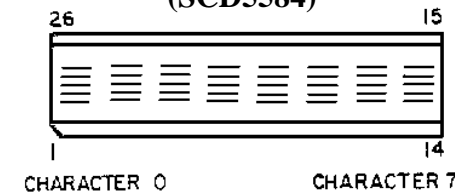
FUNCTION TABLE

| Input | Output |
|-------|--------|
| A | Y |
| H | L |
| L | H |



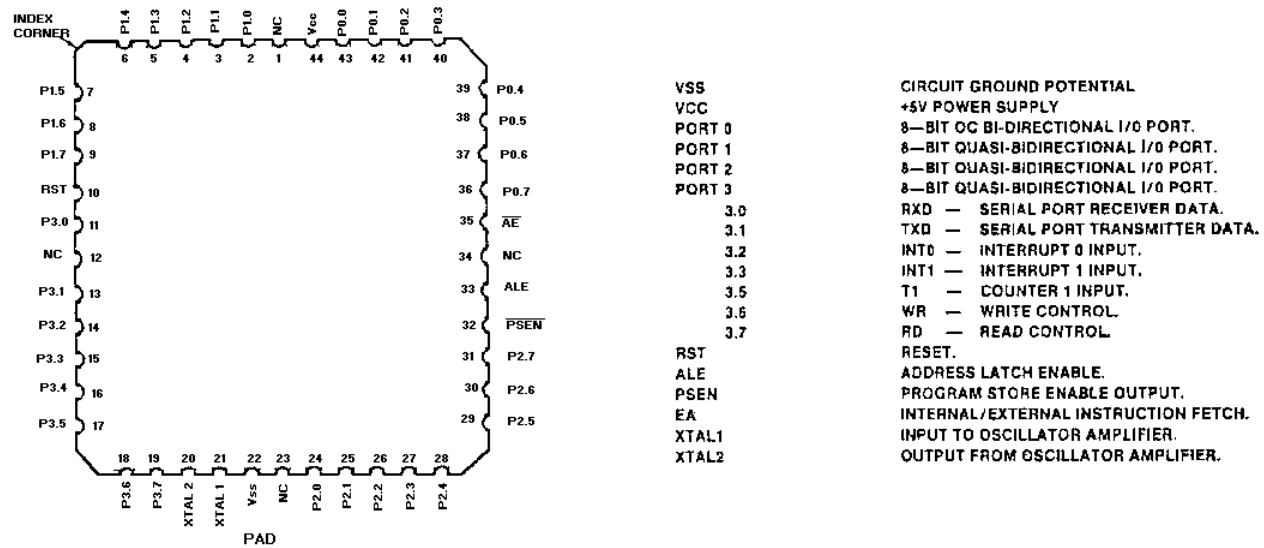
U3, DIGITAL DISPLAY
344A4184P1

LED 5X5 CHARACTERS DISPLAY
344A4184P1
(SCD5584)



PIN ASSIGNMENTS

| PIN | FUNCTION | PIN | FUNCTION |
|-----|----------|-----|----------|
| 1 | SDCLK | 28 | GND |
| 2 | LOAD | 27 | DATA |
| 3 | NC | 26 | NC |
| 4 | NC | 25 | NC |
| 5 | NC | 24 | NC |
| 6 | Vcc | 23 | Vcc |
| 7 | Vcc | 22 | Vcc |
| 8 | Vcc | 21 | Vcc |
| 9 | Vcc | 20 | Vcc |
| 10 | NC | 19 | Vcc |
| 11 | NC | 18 | NC |
| 12 | NC | 17 | NC |
| 13 | RST | 16 | CLKSEL |
| 14 | GND | 15 | CLK I/O |



FRONT CAP ASSEMBLY - MDX
19D904151G1

| SYMBOL | PART NUMBER | DESCRIPTION |
|-------------------------|---------------|--|
| A3 | | DISPLAY BOARD 19D903957G1 |
| ----- CAPACITORS ----- | | |
| C1 thru C8 | 19A149897P47 | Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. |
| C10 thru C15 | 19A149897P47C | Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. |
| C21 | 19A149897P21 | Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. |
| C22 | 19A149897P27 | Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. |
| C23 | 19A149897P15 | Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. |
| C30 thru C41 | 19A149897P47 | Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. |
| C51 | 19A705205P111 | 47 µF ± 10%, 10WVDC; sim to Sprague |
| C52 | 19A149897P47C | Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM. |
| C53 and C54 | 19A702052P134 | Ceramic: 0.1 µF ± 5%, 25 VDCW. |
| ----- DIODES ----- | | |
| CR1 | 19A705713P6 | LED: SUBMINATURE. |
| CR2 | 19A705713P9 | LED: SUBMINATURE. |
| CR3 | 19A705713P7 | LED: SUBMINATURE. |
| CR4 thru CR8 | 19A705713P6 | LED: SUBMINATURE. |
| CR11 thru CR22 | 19A705713P5 | LED: SUBMINATURE. |
| CR23 and CR24 | 344A4533P1 | LED: Chip, surface mount, green; sim to CL-140G. |
| ----- DIODES ----- | | |
| D1 thru D4 | 19A149615P | 1Silicon: Diode Bridge; sim to BGX50A. |
| ----- JACKS ----- | | |
| J725 | 344A4485P1 | Connector, Special; sim to CONXALL E4408. |
| | 344A4485P2 | Gasket, used with 344A4485P1. |
| ----- PLUGS ----- | | |
| P707 | 19B801689P3 | Socket, integrated circuit: 20 pin, surface mount, gold contacts. |
| ----- TRANSISTORS ----- | | |
| Q1 thru Q4 | 19A705943P1 | Silicon, Dual PNP: sim to R OHM FMAI. |
| Q5 | 19A700076P2 | Silicon, NPN: sim to MMBT3904, low profile. |

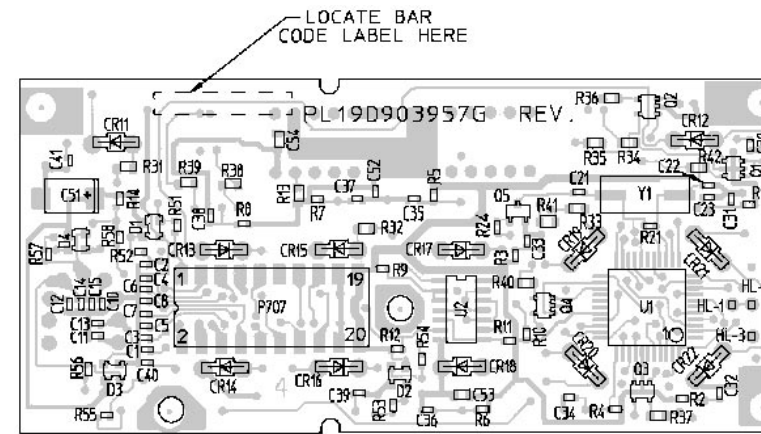
| SYMBOL | PART NUMBER | DESCRIPTION |
|---------------------------------|---------------|---|
| ----- RESISTORS ----- | | |
| R1 thru R12 | 19A149818P104 | Metal film: 100K ohms ±5%, 1/16 w. |
| R13 | 19B801251P471 | Metal film: 470 ohms ±5%, 1/10 w. |
| R14 | 19A149818P104 | Metal film: 100K ohms ±5%, 1/16 w. |
| R21 | 19A149818P333 | Metal film: 33K ohms ±5%, 1/16 w. |
| R24 | 19A149818P333 | Metal film: 33K ohms ±5%, 1/16 w. |
| R31 thru R33 | 19B801251P331 | Metal film: 330 ohms ±5%, 1/10 w. |
| R34 thru R40 | 19B801251P181 | Metal film: 330 ohms ±5%, 1/10 w. |
| R41 | 19B801251P391 | Metal film: 390 ohms ±5%, 1/10 w. |
| R42 | 19B801251P181 | Metal film: 330 ohms ±5%, 1/10 w. |
| R51 thru R58 | 19A149818P101 | Metal film: 100 ohms ±5%, 1/16 w. |
| ----- INTEGRATED CIRCUITS ----- | | |
| U1 | 19A705557P10 | Microcomputer: CMOS, 8-bit, control oriented CPU, includes 8 kbytes masked programmed ROM; sim to 80C52. |
| U2 | 19A703483P322 | Digital: Hex inverter; sim to 74HC05. |
| U3 | 344A4184P1 | Display: 8 characters, green LED 5 X 5 dot matrix; sim to Siemens SCD5584. |
| ----- CRYSTALS ----- | | |
| Y1 | 19A702511G64 | Crystal unit, quartz: 11.0592 MHz. |
| ----- LOUDSPEAKERS ----- | | |
| LS1 | 19A705165P2 | Speaker: 8 ohm, 4 watts, includes weather resistant cone and dust cover and rubberized gasket. |
| | 19D904038P1 | Speaker gasket. |
| ----- MISCELLANEOUS ----- | | |
| | 19D904030P1 | Front cap. |
| | 19D904031P1 | Keypad. |
| | 19D904035P1 | Front cap bracket. |
| 7 | 19B802434P1 | IC display assembly (includes light pipes). |
| | 19B802434P2 | Display lens: Panelgraphics gray 10 (used with P1). |
| 9 | 19D904032P12 | Keycap: Emergency/Hazard. |
| 10 | 19D904032P11 | Keycap: Power (PWR). |
| 11 | 19D904032P21 | Keycap: Volume up, Volume down. |
| 12 | 19D904032P22 | Keycap: Group/Channel up/down(+ -). |
| 13 | 344A4432P406 | Threadforming screw. |
| 14 | 344A4432P410 | Threadforming screw. |

PRODUCTION CHANGES

Rev A. - Display Board 19D903957G1
Incorporated in initial shipment.

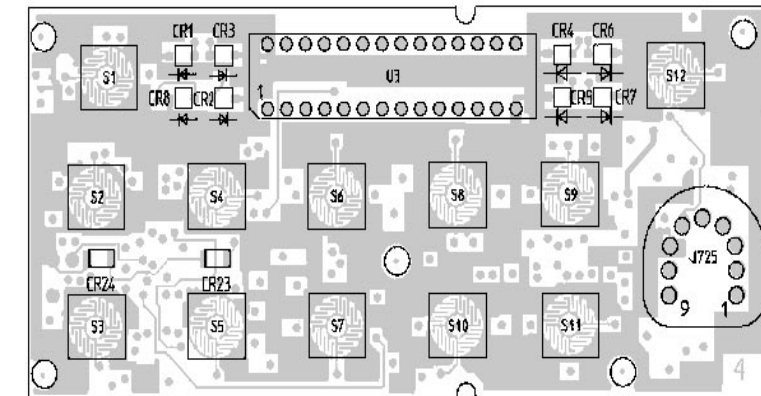
* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

COMPONENT SIDE

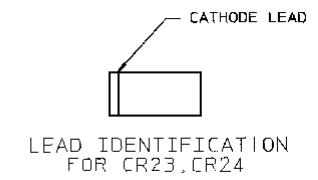
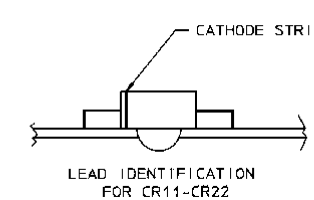
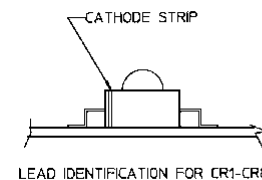
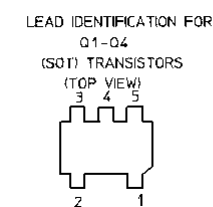
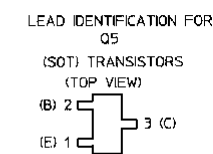
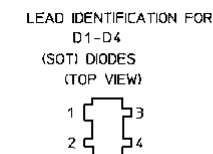


(19D903957, Rev. 1)
(19D903958, Layer 1, Rev. 4)

SOLDER SIDE



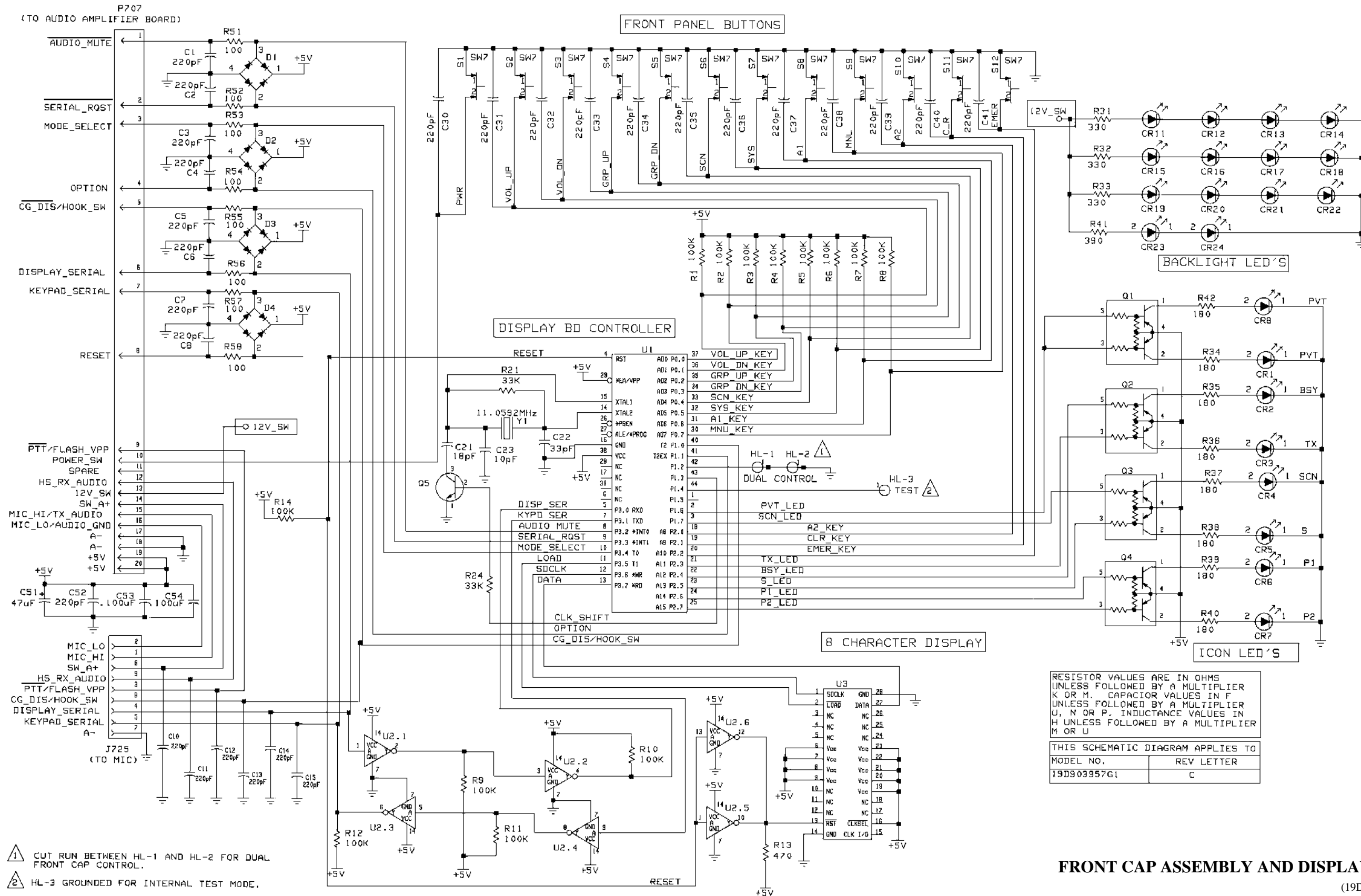
(19D903957, Rev. 1)
(19D903958, Layer 4, Rev. 4)



CAUTION

OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES

FRONT CAP ASSEMBLY AND DISPLAY BOARD
19D904151G1/19D903957



1 CUT RUN BETWEEN HL-1 AND HL-2 FOR DUAL FRONT CAP CONTROL.

2 HL-3 GROUNDED FOR INTERNAL TEST MODE.

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