MAINTENANCE MANUAL
AUDIO BOARDS
19D902188G1, G2 & G3

TABLE OF CONTENTS

DESCRIPTION

Audio Boards 19D902188G1, G2, and G3 provide analog to digital and digital to analog conversion of the receive and transmit audio. These boards also contain audio filtering, conventional analog tone processing, and the receiver squelch.

These Audio Boards contain four main paths: a receiver squelch path, a conventional tone path, a receiver audio path, and the transmitter audio path.

CIRCUIT ANALYSIS

RECEIVER SQUELCH PATH

The squelch circuit monitors the level of high frequency noise on the receiver output to determine if a carrier is quieting the receiver. A squelch adjustment sets the threshold level required to operate the squelch circuit (normally at 8 dB SINAD). When the noise falls below the threshold level, the carrier activity sensor (CAS) output switches to 5 volts. The CAS signal feeds the microprocessor on the Logic Board. The squelch path consists of a high pass filter, a noise rectifier/amplifier, and a comparator.

VOL/SQ HI (J703-7) is the unfiltered receiver audio from the RF Board. A 6 kHz high pass filter removes all voice signals from the VOL/SQ HI input. The 3-pole filter consists of the circuitry around U601-A. The filter provides a gain of 2 (6 dB) at 8-10 kHz and drops 3 dB in gain at the 6 kHz cut-off frequency.

Noise in the 6-8 kHz range is coupled to the Squelch Adjust R602, that varies the level of noise to the noise rectifier/amplifier U601-B. U601-B is biased at ground, amplifying only the positive peaks of the noise by about 9 dB.

The rectified noise is filtered by R605, C605, and C623 to provide an average DC level proportional to the noise level. This DC level is applied to the inverting (-) input of comparator U602-A. The non-inverting (+) input of U602-A is referenced to 100 millivolts DC.

When the DC noise level falls below 100 millivolts DC, the comparator output switches the CAS line to +5 VDC to tell the Logic Board microprocessor the channel is busy with a carrier. The comparator output remains at a logic high until the DC noise level exceeds 140 mVDC. This difference in voltage between the CAS turn-on and turn-off points provides sufficient hysteresis to eliminate any "bubbling" or chattering noise in the speaker. The "bubbling" would normally be caused by transitional changes in the DC noise level around the reference point. The hysteresis is provided by R610.

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The RF Board VOL/SQ HI level varies slightly over temperature which would normally cause the squelch threshold to vary. Thermistor R640 slightly varies the 100 mVDC reference voltage to stabilize the squelch threshold over a wide temperature range.

Transistor Q605 is normally turned on, placing C605 in the DC noise averaging circuit. C605 provides a conventional slow (60 ms) squelch operation to prevent chopping the audio with rapid squelch closings in weak signal areas. Q605 is turned off only if the radio is placed in a conventional mode scan by the line going low. Only C623 is in the circuit, allowing the squelch to respond quickly (5 milliseconds) while sampling the channels for activity.

CONVENTIONAL TONE PATH

The tone path processes conventional mode Channel Guard tones and data and has no function in the trunked mode. The path removes voice and noise signals from the unfiltered receiver audio (VOL/SQ HI) to provide the Logic Board microprocessor with limited tones and data. Transmitted Channel Guard tones and data, generated on the Logic Board, are low pass filtered to provide low distortion signals to the transmitter audio path.

Receiving Tones

VOL/SQ HI feeds FET switch Q601. In the receive mode, is at logical high, thus turning on Q601. Unfiltered receiver audio passes to summing amplifier U603-A. The summing amplifier provides a gain of 1 (0 dB) for the receiver audio. If the radio is put in conventional mode scan, FET switch Q604 receives 10 millisecond pulses when the microprocessor changes the scan channel frequency and detects carrier activity. Q604 momentarily turns on during the pulses to quickly charge C606 for faster tone decoding.

Receiver audio from the summing amplifier feeds the 200 Hz low pass filter U604-A, B, C and D to remove all voice signals and pass only Channel Guard tones and data. U603-B buffers the high impedance output of the filter and provides 13 dB of gain.

The output of U603-B feeds the tone limiter U602-B. The tone limiter is a comparator with a 5 VDC reference on the non-inverting (+) input provided by the output of U603-B. R615-I and C614 remove the tone signals from the reference voltage. The inverting (-) input of U602-B receives the tone signals with the 5 VDC reference voltage slightly offset (50 mVDC) by R632. The tone limiter provides a 5-volt peak-to-peak mVDC square wave to the TONE DATA line. This signal is routed to the Logic Board microprocessor where the software decodes the tone.

RECEIVER AUDIO PATH

Unfiltered receiver audio from the RF Board (VOL/SQ HI) is passed through the receiver audio path, consisting of a sidetone cancellation circuit, a digital to analog and analog to digital converter, a high pass filter, and deemphasis.

VOL/SQ HI first feeds the sidetone cancellation circuit that is required in duplex operation only. R624 (and R326 on the Group 3 Board) adjusts the amount of cancellation and does not affect the operation of a non-duplex radio. The circuit reduces the transmitted audio heard over the handset earpiece or speaker caused by transmitted audio modulation of the synthesizer VCO.

The sidetone cancellation circuit for G1 and G2 consists of an audio delay circuit U612-B, SIDETONE NULL adjustment R624, and summer/amplifier U612-A. Transmitted audio is applied to the audio time delay circuit at R317 and R319. The transmitted audio is delayed by an amount equal to the delay existing between the TX MOD output and the VOL/SQ HI audio. U612-B delays the TX MOD audio about 140 microseconds with a gain of .3 (-11 dB) for G1 and about 170 microseconds with a gain of .25 (-12 dB) for G2. This delayed audio is applied to the SIDETONE NULL adjustment R624.

The sidetone cancellation circuit for the Group 3 Board consists of an audio delay circuit U612-B,C,D, DELAY EQUALIZATION adjustment R326, SIDETONE NULL adjustment R624, and summer/amplifier U612-A. Transmitted audio is applied to the audio time delay circuit at R317 and R319. The transmitted audio is delayed by an amount determined by the DELAY EQUALIZATION adjustment R326. The delay can be adjusted from approximately 150 to 300 microseconds. The delayed audio is then applied to the SIDETONE NULL adjustment R624 which provides amplitude adjustment.

In duplex radios, VOL/SQ HI audio consists of received and transmitted audio that is summed by U612-A with the delayed TX MOD audio from the SIDETONE NULL adjustment. For the Group 1 Board, the transmitted audio present on VOL/SQ HI is 180 degrees out of phase with the delayed TX MOD audio, therefore the transmitted audio is canceled at U612-A. For Group 2 and 3 Boards, these signals are in phase and cancellation is achieved by feeding the signals to opposite polarity inputs of U612-A.

U612-A feeds a 300 Hz high pass active filter using an OP amp inside U610. Capacitors C635, C627, and C636, and resistors R625 and R626 make up the two-pole filter, providing some of the required Channel Guard tone filtering below 300 Hz. The output of the filter OP amp appears at U610-15 and internally feeds the analog to digital converter of CODEC U610. The CODEC is powered by +5 and -5 VDC with the OP amp biased to operate around ground.

CODEC U610 provides analog to digital conversion of the receiver audio. U608 divides the 8.192 MHz clock from the Logic Board to provide various clock frequencies to U610. The digitized audio data is sent serially to the logic Board to be processed by digital signal processor (DSP) U706.

Digital signal processor U706 on the Logic Board is a program masked IC that operates under the control of microprocessor U701 and provides receiver audio muting, volume control, busy tone notch filtering, receiver alert tones, and signalling tone decoding. The processed RX audio is returned as serial data back to U610 on the Audio Board

through J703-18 where the data is decoded back to an analog signal and filtered by a 3 kHz low pass filter.

The analog output of U610 (pin 2) feeds a 300 Hz high pass Channel Guard tone filter (U611-A). The filter prevents the low frequency Channel Guard tones (below 210 Hz) from passing to the speaker. The filter cuts off sharply at 300 Hz and has a deep notch at 200 Hz. The filter has a gain of 1 (0 dB) at 1 kHz. C632 provides a high frequency roll-off above 3 kHz.

The high pass filtered audio feeds U611-B providing the -6 dB/octave receiver deemphasis response. At 1 kHz, the amplifier has a gain of 4.2 (12.5 dB). C633 and R629 determine the deemphasis. R630 prevents U611-B from oscillating when driving capacitive loads for RF bypassing.

TRANSMITTER AUDIO PATH

The microphone audio feeds the MIC HI input to the Audio Board. R301 and R302 provide the supply voltage for the amplifier inside the microphone. MIC GAIN R302 allows adjusting the microphone audio gain over a 10 dB range and is normally set at maaximum gain.

U301-A provides the 6 dB/octave preemphasis determined by C304, R305, R306, and R307. C303 controls the cut-off point for the high frequency preemphasis above 3 kHz. The bias and gain of U301-A is also adjusted to provide prelimiting of the mic audio to protect the analog to digital converter in CODEC U302 from overload.

CODEC U302 provides analog to digital conversion of the preemphasized mic audio. U608 divides the 8.192 MHz clock from the Logic Board to provide various clock frequencies to U302. The digitized audio data is sent serially to the Logic Board to be processed by digital signal processor (DSP) U706.

Digital signal processor U706 on the Logic Board is a program masked IC that operates under the control of microprocessor U701 and provides transmit audio limiting,

busy tone injection, signalling tone injection, and part of the post limiter filtering. The processed TX audio is returned as serial data back to U302 on the Audio Board through J703-18.

U302 decodes the digitally processed TX audio data back to an analog signal and passes the signal through a 3 kHz low pass filter. The ausio output of U302 (pin 2) is then sent to U301-B to sum conventional Channel Guard tones and data into the transmit audio path from the tone path. R312 determines the modulation level of the Channel Guard relative to the mic audio level. FET switch Q301 allows additional muting when in the receive only mode and is controlled directly by the DPTT line from the microprocessor. C311 provides an additional pole of low pass filtering.

For the Group 1 Board, C310, C312, R311, R313, R314, and R315 comprise a low frequency equalizer circuit for digital data transmission. The equalizer increases the gain 6 dB/octave below 15 Hz to help compensate for the low frequency roll-off normally experienced when modulating the VCO in RF synthesizers.

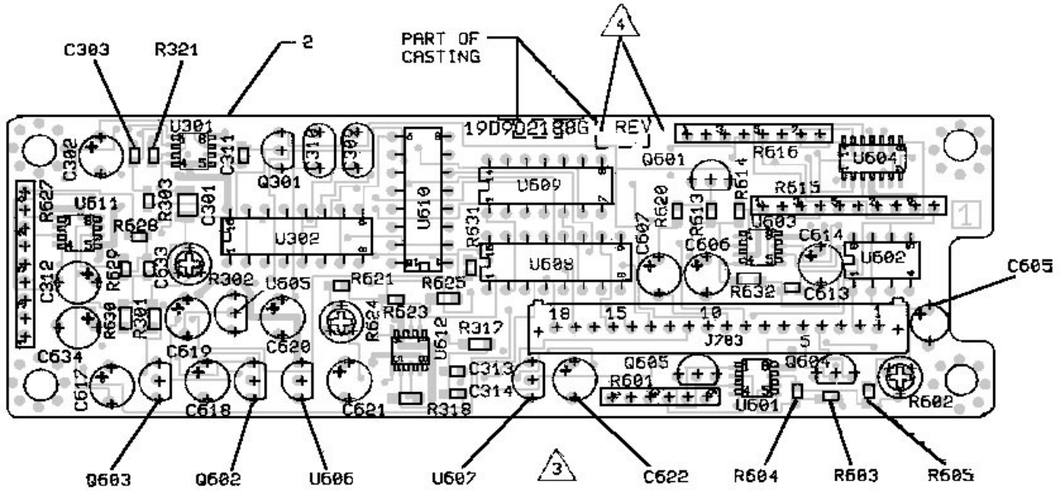
The output of U301-B is DC coupled to the TX MOD output that feeds the deviation potentiometer and the synthesizer VCO on the RF Board. The output is also fed to the time delay circuit U612-B for sidetone cancellation in the receiver audio (see Receiver Audio Path circuit description above).

SUPPLY REGULATORS

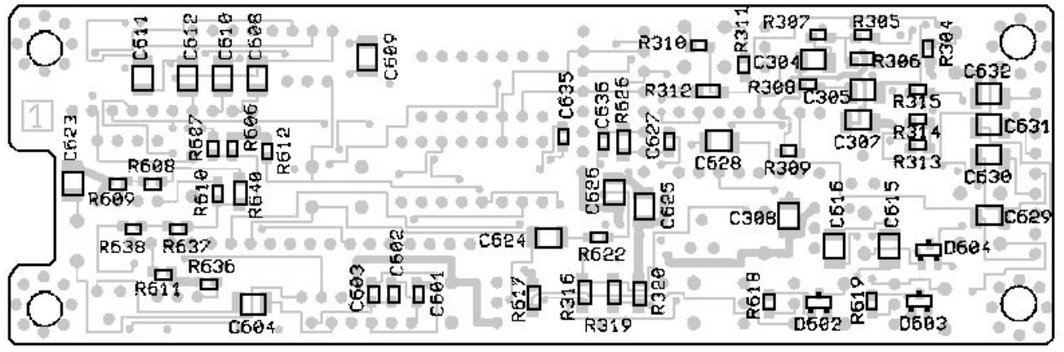
The Audio Board receives 13 volts from the SW A+ line from the Logic Board. This voltage feeds 8-volt regulator U606, OP amp U611 in the receiver audio path, and -5 volt inverter circuit Q602 and Q603. U606 supplies 8 volts to all OP amps (except U611) and to 5 volt regulator U607.

Q602 and Q603 amplify the 5-volt peak-to-peak 64 kHz signal from U608 to a 13-volt peak-to-peak signal. D604 rectifies this signal into a negative voltage and it is filtered by C619 to provide -10 VDC to the -5 volt regulator. The -5 volts is supplied to both CODEC U302 and U610.

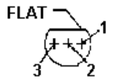
COMPONENT SIDE



SOLDER SIDE



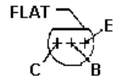
LEAD IDENTIFICATION
FOR U605 , U606 , & U607



IN-LINE
TOP VIEW

NOTE : CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

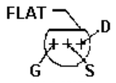
LEAD IDENTIFICATION
FOR Q602 , Q603 , & Q605



IN-LINE
TOP VIEW

NOTE : CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

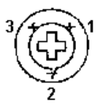
LEAD IDENTIFICATION
FOR Q301 , Q601 , & Q604



IN-LINE
TOP VIEW

NOTE : CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

LEAD IDENTIFICATION
FOR R302, R602, R624



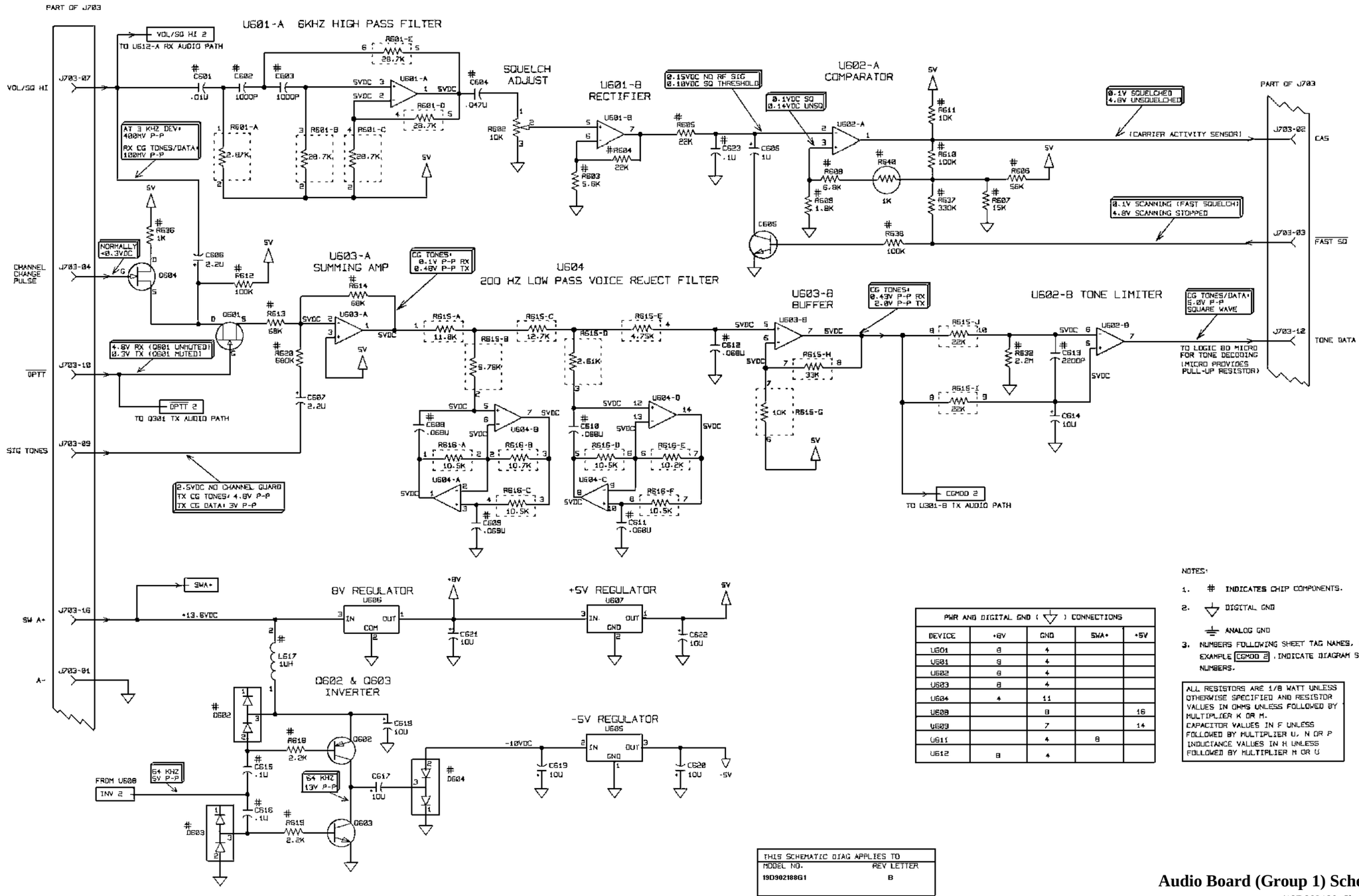
TOP VIEW

LEAD IDENTIFICATION
FOR D602-D604

VIEW FROM SOLDER SIDE

Audio Board (Group 1)
(19D902188P1)

(19D902189, Layer 1, Rev. 1)
(19D902189, Layer 4, Rev. 1)



PWR AND DIGITAL GND (⏚) CONNECTIONS				
DEVICE	+8V	GND	SWA+	+5V
U601	8	4		
U581	9	4		
U602	8	4		
U603	8	4		
U604	4	11		
U608		8		16
U609		7		14
U611		4	8	
U612	8	4		

NOTES:

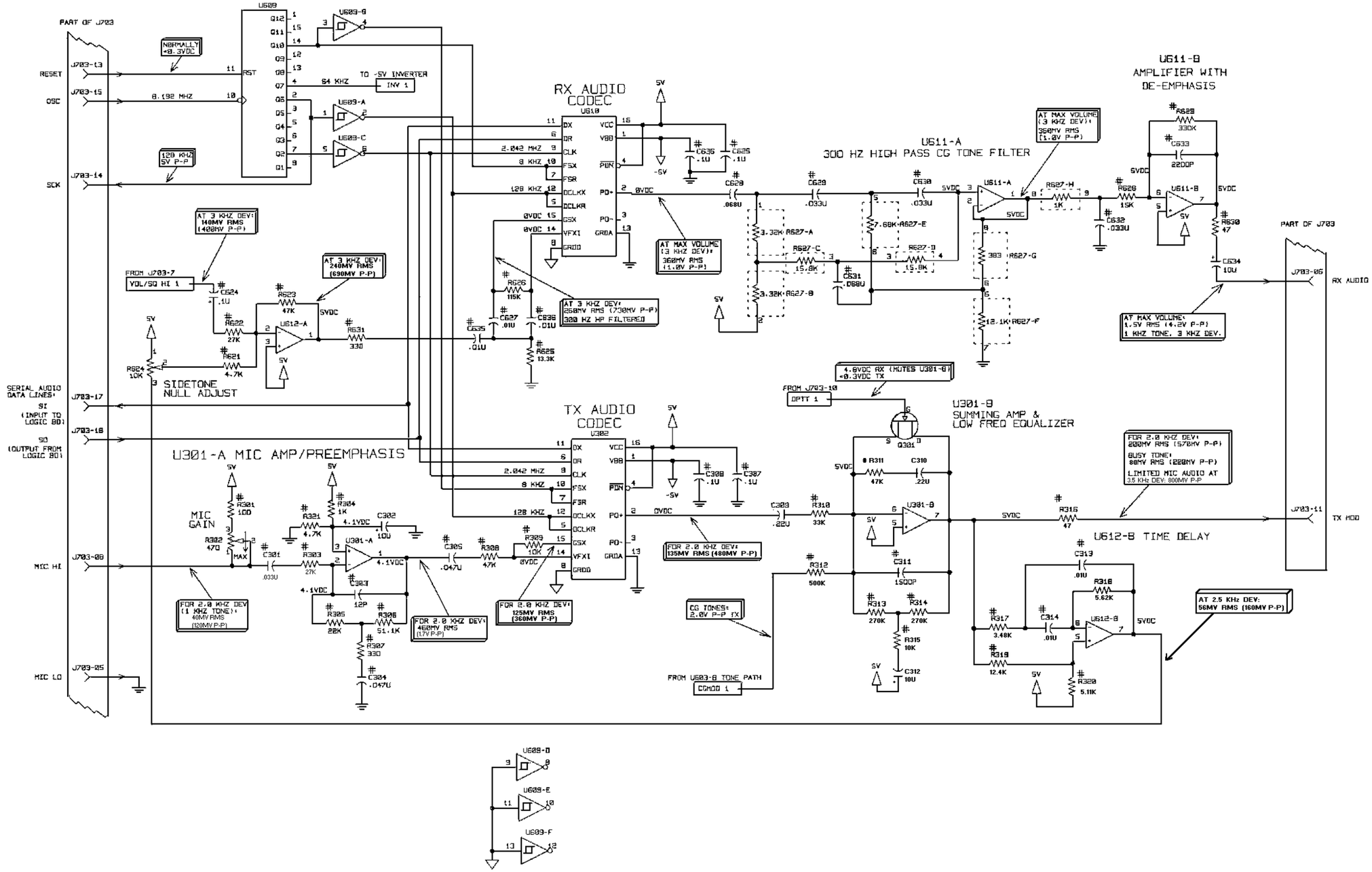
1. # INDICATES CHIP COMPONENTS.
2. ⏚ DIGITAL GND
   ⏚ ANALOG GND
3. NUMBERS FOLLOWING SHEET TAG NAMES, FOR EXAMPLE CGMOD 2, INDICATE DIAGRAM SHEET NUMBERS.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS 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

THIS SCHEMATIC DIAG APPLIES TO	
MODEL NO.	REV LETTER
19D902188G1	B

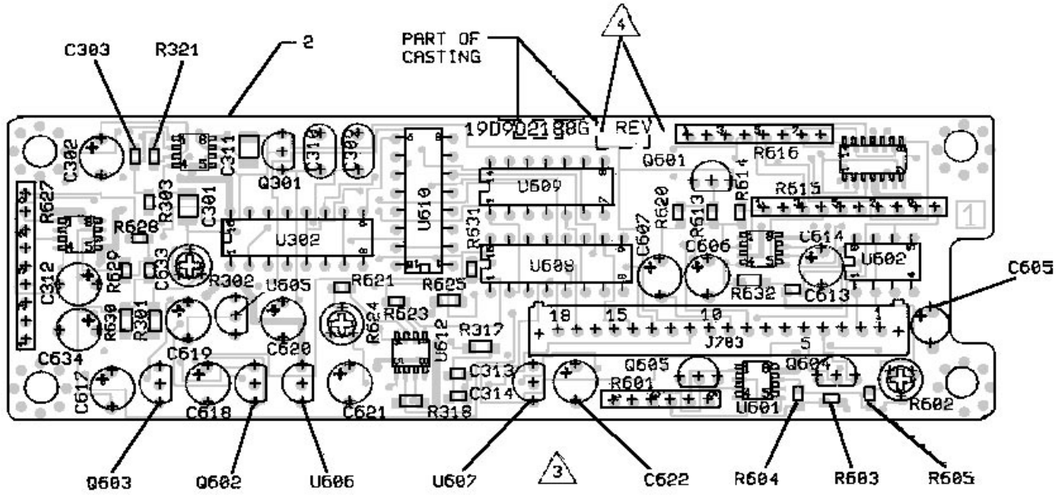
Audio Board (Group 1) Schematic

(19D902190, Sh. 1, Rev. 2)

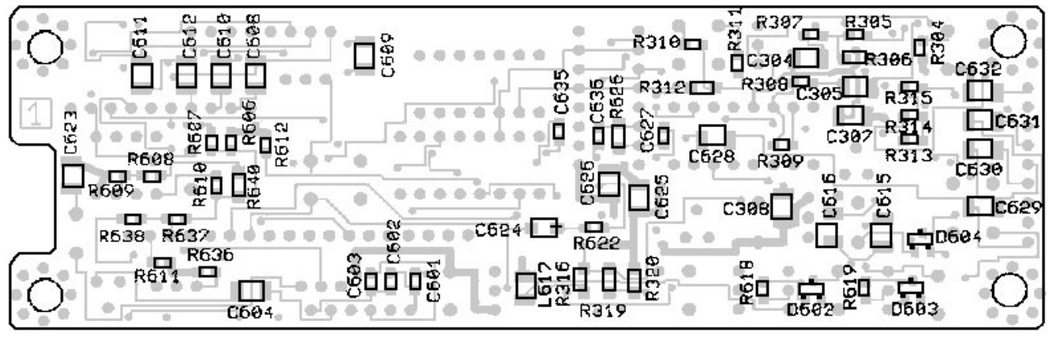


19D902190, Sh. 2, Rev. 1)

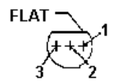
COMPONENT SIDE



SOLDER SIDE



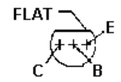
LEAD IDENTIFICATION FOR U605 , U606 , & U607



IN-LINE
TOP VIEW

NOTE : CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

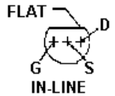
LEAD IDENTIFICATION FOR Q602 , Q603 , & Q605



IN-LINE
TOP VIEW

NOTE : CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

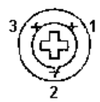
LEAD IDENTIFICATION FOR Q301 , Q601 , & Q604



IN-LINE
TOP VIEW

NOTE : CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

LEAD IDENTIFICATION FOR R302, R602, R624



TOP VIEW

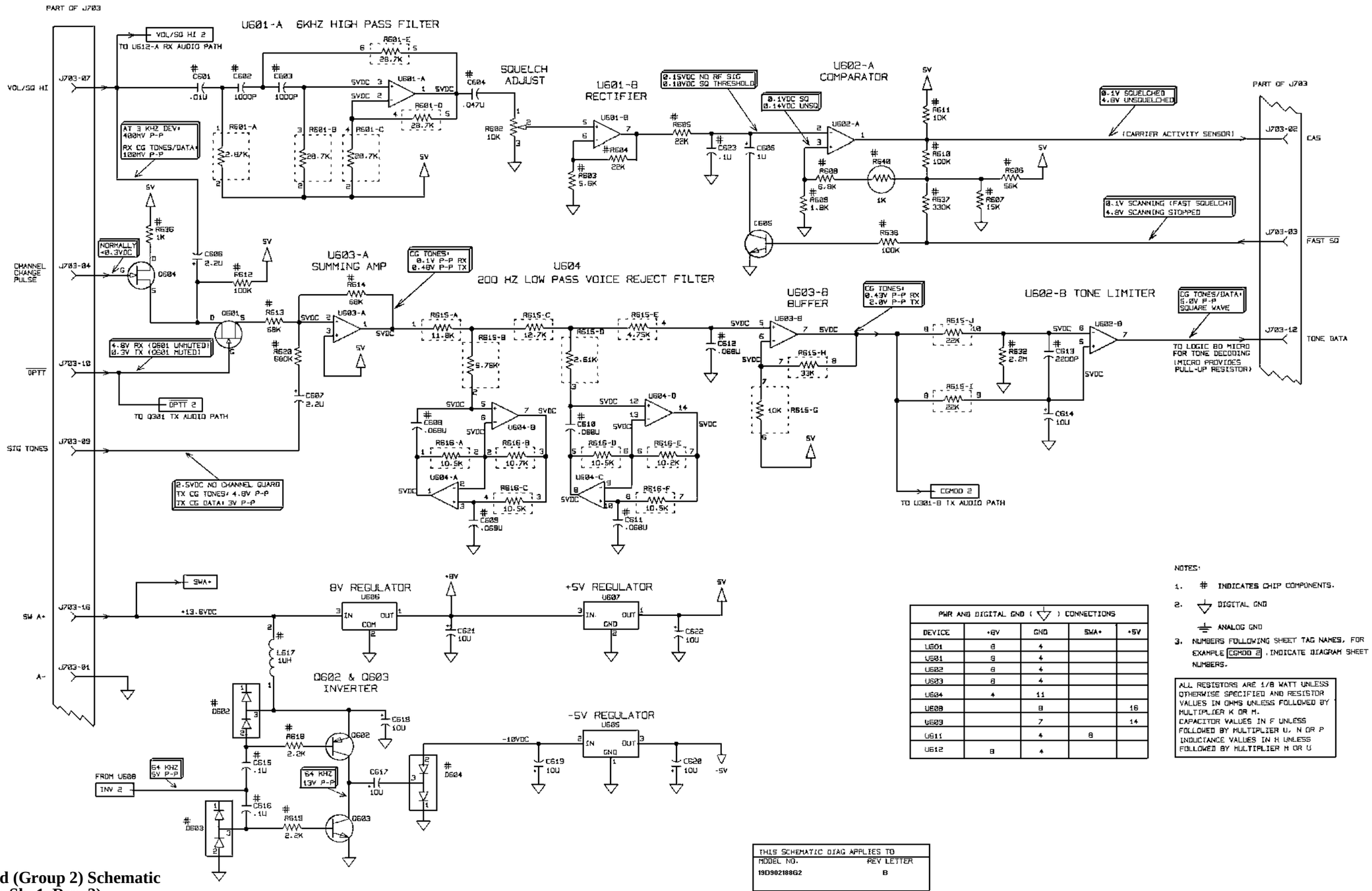
LEAD IDENTIFICATION FOR D602-D604

VIEW FROM SOLDER SIDE

Audio Board (Group 2) (19D902188P7)

(19D903633, Layer 1, Rev. 1)

(19D903633, Layer 4, Rev. 1)



Audio Board (Group 2) Schematic (19D903634, Sh. 1, Rev. 2)

PWR AND DIGITAL GND (▽) CONNECTIONS				
DEVICE	+8V	GND	SW A+	+5V
U601	8	4		
U602	8	4		
U603	8	4		
U604	4	11		
U608		8		16
U609		7		14
U611		4	8	
U612	8	4		

NOTES:

1. # INDICATES CHIP COMPONENTS.
2. ▽ DIGITAL GND
   ⏚ ANALOG GND
3. NUMBERS FOLLOWING SHEET TAG NAMES, FOR EXAMPLE CGMOD 2, INDICATE DIAGRAM SHEET NUMBERS.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS 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

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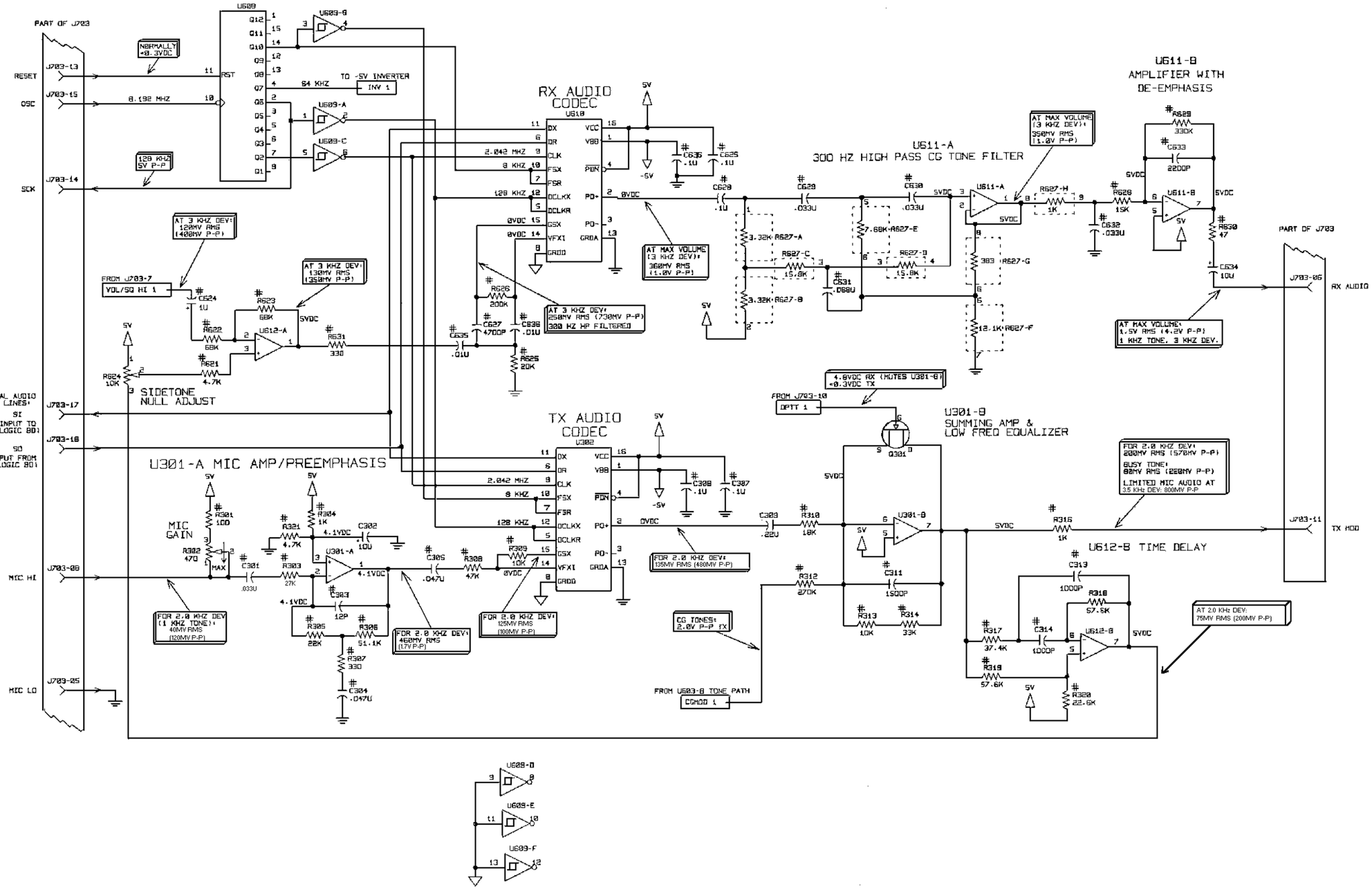
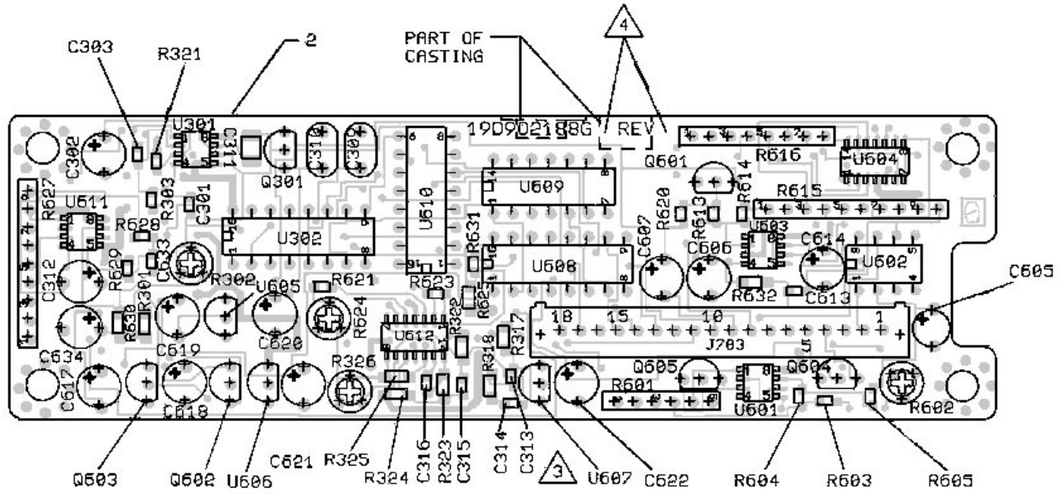
19D902188G2	B



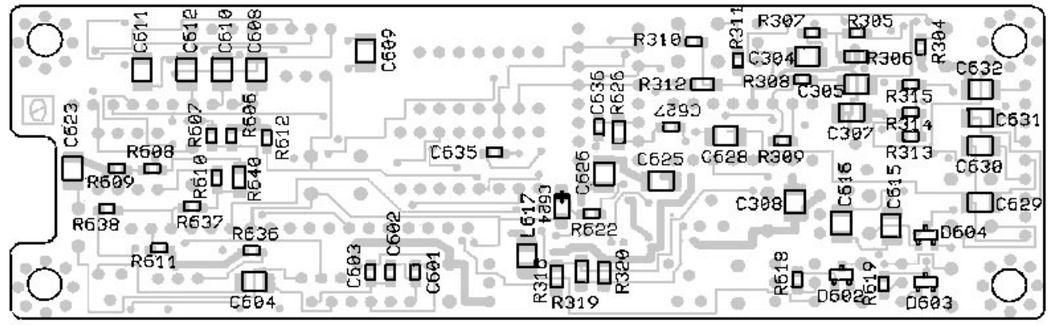
Audio Board (Group 2) Schematic

(19D903634, Sh. 2, Rev. 2)

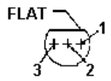
COMPONENT SIDE



SOLDER SIDE



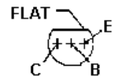
LEAD IDENTIFICATION
FOR U605 , U606 , & U607



IN-LINE
TOP VIEW

NOTE : CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

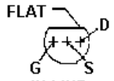
LEAD IDENTIFICATION
FOR Q602 , Q603 , & Q605



IN-LINE
TOP VIEW

NOTE : CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

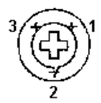
LEAD IDENTIFICATION
FOR Q301 , Q601 , & Q604



IN-LINE
TOP VIEW

NOTE : CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION

LEAD IDENTIFICATION
FOR R302, R602, R624



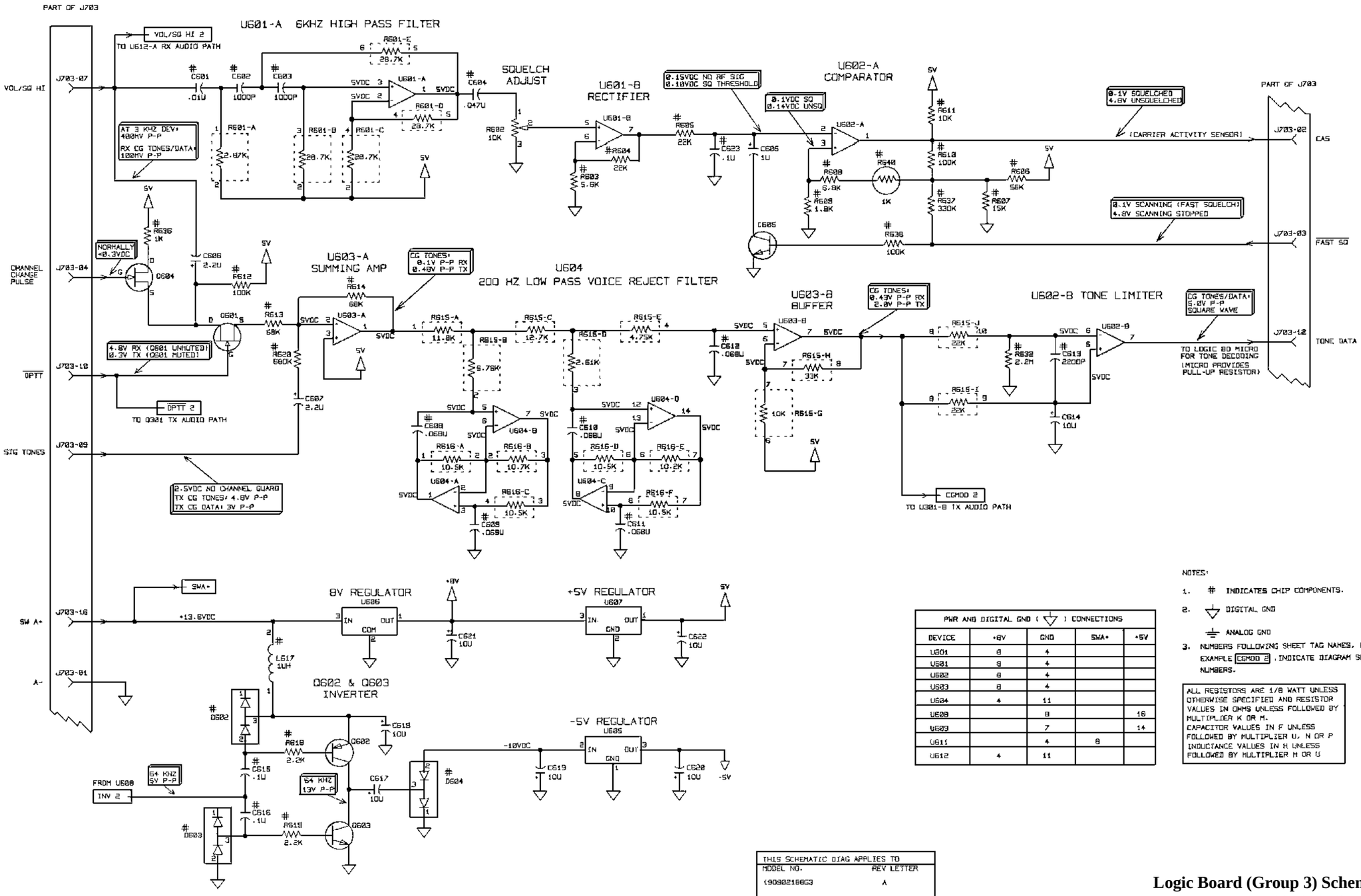
TOP VIEW

LEAD IDENTIFICATION
FOR D602-D604

VIEW FROM SOLDER SIDE

Audio Board (Group 3)
(19D902188P14)

(19D904784, Layer 1, Rev. 0)
(19D904784, Layer 4, Rev. 0)



PWR AND DIGITAL GND (▽) CONNECTIONS

DEVICE	+8V	GND	SWA+	+5V
U601	8	4		
U601	9	4		
U602	8	4		
U603	8	4		
U604	4	11		
U608		8		16
U609		7		14
U611		4	8	
U612	4	11		

NOTES:

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   ⏚ ANALOG GND
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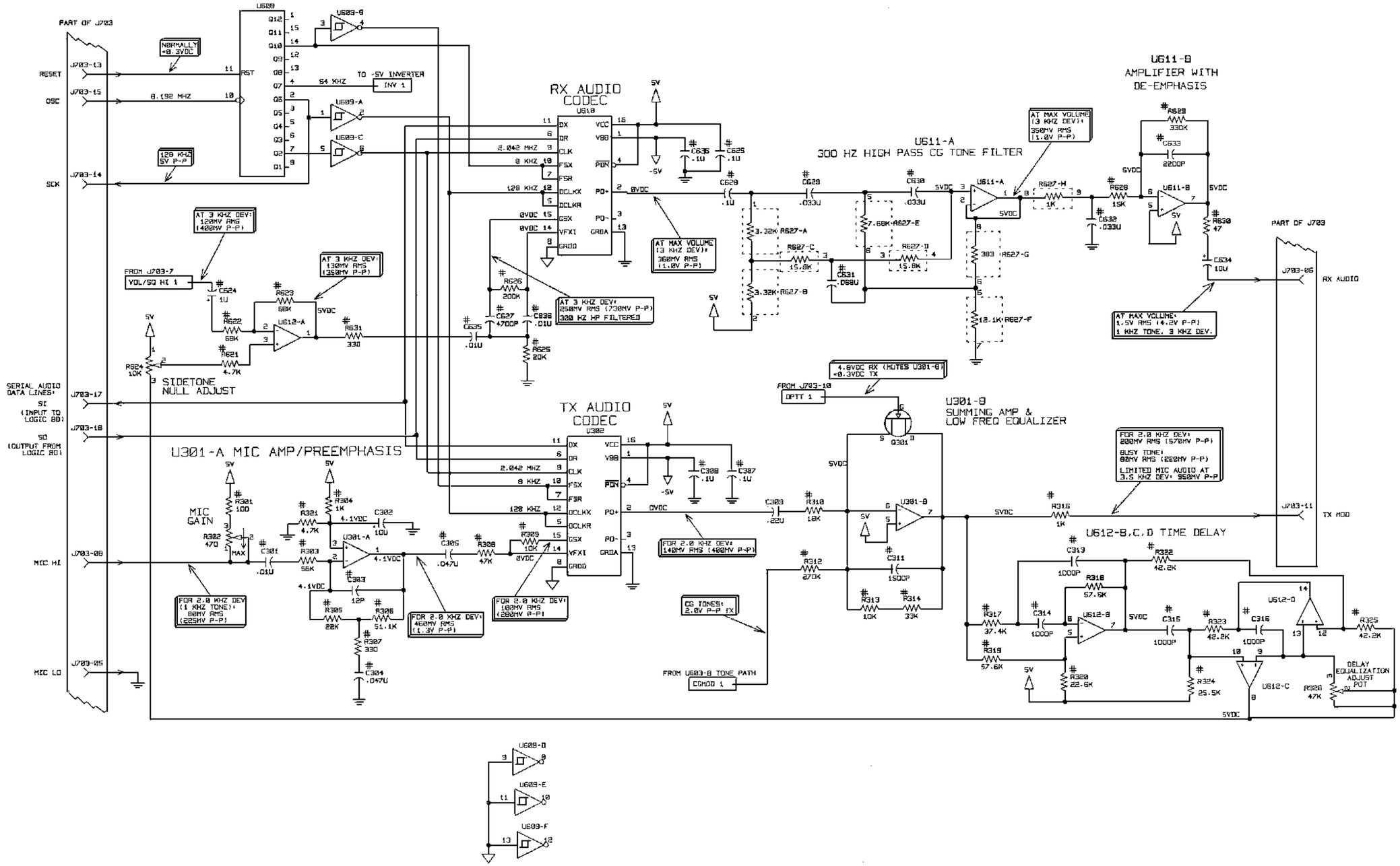
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER U, N OR P
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER M OR U

THIS SCHEMATIC DIAG APPLIES TO	
MODEL NO.	REV LETTER
(9D902186G3	A

Logic Board (Group 3) Schematic

(19D904785, Sh. 1, Rev. 0)



Logic Board (Group 3) Schematic

(19D904785, Sh. 2, Rev. 0)

AUDIO BOARD 19D902188G1 - G3

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C301	19A702052P114	Ceramic: 0.01 µF ±5%, 50 VDCW. (Used in G3).
C301	19A702052P120	Ceramic: 0.033 µF ±5%, 50 VDCW. (Used in G1 and G2).
C302	19A701534P7	Tantalum: 10 µF ±20%, 16 VDCW.
C303	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 30 PPM.
C304 and C305	19A702052P122	Ceramic: 0.047 µF ±5%, 50 VDCW.
C307 and C308	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW
C309	162B3688P422K	Ceramic: 0.22 µF ±10%, 50 VDCW; sim to Erie 8131-M050-W5R-224K.
C310	162B3688P422K	Ceramic: 0.22 µF ±10%, 50 VDCW; sim to Erie 8131-M050-W5R-224K. (Used in G1).
C311	19A702052P6	Ceramic: 1500 pF ±10%, 50 VDCW. (Used in G1).
C311	19A702061P89	Ceramic: 1500 pF ±5%, 50 VDCW, temp coef 0 30 PPM. (Used in G2 and G3).
C312	19A701534P7	Tantalum: 10 µF ±20%, 16 VDCW. (Used in G1).
C313	19A702052P114	Ceramic: 0.01 µF ±5%, 50 VDCW. (Used in G1 and G2).
C313	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 30 PPM/C. (Used in G3).
C314	19A702052P114	Ceramic: 0.01 µF ±5%, 50 VDCW. (Used in G1 and G2).
C314 thru C316	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 30 PPM/C. (Used in G3).
C601	19A702052P114	Ceramic: 0.01 µF ±5%, 50 VDCW.
C602 and C603	19A702052P105	Ceramic: 1000 pF ±5%, 50 VDCW.
C604	19A702052P122	Ceramic: 0.047 µF ±5%, 50 VDCW.
C605	19A701534P4	Tantalum: 1 µF ±20%, 35 VDCW.
C606 and C607	19A701534P5	Tantalum: 2.2 µF, ±20%, 35 VDCW.
C608 thru C612	19A702052P124	Ceramic: 0.068 µF ±5%, 50 VDCW.
C613	19A702052P7	Ceramic: 2200 pF ±10%, 50 VDCW.
C614	19A701534P7	Tantalum: 10 µF ±20%, 16 VDCW.
C615 and C616	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW
C617 thru C622	19A701534P7	Tantalum: 10 µF ±20%, 16 VDCW.
C623	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW
C624	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW (Used in G1).
C624	19A705205P2	Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D. (Used in G2 and G3).
C625 and C626	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW
C627	19A702052P114	Ceramic: 0.01 µF ±5%, 50 VDCW. (Used in G1).
C627	19A702052P110	Ceramic: 4700 pF ±5%, 50 VDCW. (Used in G2 and G3).
C628	19A702052P124	Ceramic: 0.068 µF ±5%, 50 VDCW. (Used in G1).
C628 and C630	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW (Used in G2 and G3).
C629	19A702052P120	Ceramic: 0.033 µF ±5%, 50 VDCW.
C631	19A702052P124	Ceramic: 0.068 µF ±5%, 50 VDCW.
C632	19A702052P120	Ceramic: 0.033 µF ±5%, 50 VDCW.
C633	19A702052P7	Ceramic: 2200 pF ±10%, 50 VDCW.
C634	19A701534P7	Tantalum: 10 µF ±20%, 16 VDCW.
C635 and C636	19A702052P114	Ceramic: 0.01 µF ±5%, 50 VDCW.

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - DIODES - - - - - - - - - -
D602 thru D604	19A700053P2	Silicon: 2 Diodes in Series; sim to BAV99.
		- - - - - - - - - - JACKS - - - - - - - - - -
J703	19A704874P1	Connector: sim to: Elco 00-9021-18-12-00-339.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L617	19A705470P25	Coil, fixed: 1 H ±20%, sim to Toko 380LB-IR0M. (Used in G2 and G3).
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q301	19A134137P7	N-type, field effect.
Q601	19A134137P7	N-type, field effect.
Q602	19A700022P2	Silicon, PNP: sim to 2N3906.
Q603	19A700023P2	Silicon, NPN: sim to 2N3904.
Q604	19A134137P7	N-type, field effect.
Q605	19A700023P2	Silicon, NPN: sim to 2N3904.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R301	19B800607P101	Metal film: 100 ohms ±5%, 1/8 w.
R302	19B800779P2	##RES VAR ,470
R303	19B801251P563	Metal film: 56K ohms ±5%, 1/10 w. (Used in G3).
R303	19B801251P273	Metal film: 27K ohms ±5%, 1/10 w. (Used in G1 and G2).
R304	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R305	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.
R306	19A702931P369	Metal film: 51.1K ohms ±1%, 200 VDCW, 1/8 w.
R307	19B801251P331	Metal film: 330 ohms ±5%, 1/10 w.
R308	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R309	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R310	19B801251P333	Metal film: 33K ohms ±5%, 1/10 w. (Used in G1).
R310	19B801251P183	Metal film: 18K ohms ±5%, 1/10 w. (Used in G2 and G3).
R311	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w. (Used in G1).
R312	19B800607P564	Metal film: 560K ohms ±5%, 1/8 w. (Used in G1).
R312	19B800607P274	Metal film: 270K ohms ±5%, 1/8 w. (Used in G2 and G3).
R313	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w. (Used in G2 and G3).
R313 and R314	19B801251P274	Metal film: 270K ohms ±5%, 1/10 w. (Used in G1).
R314	19B801251P333	Metal film: 33K ohms ±5%, 1/10 w. (Used in G2 and G3).
R315	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w. (Used in G1).
R316	19B800607P470	Metal film: 47 ohms ±5%, 1/8 w. (Used in G1).
R316	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w. (Used in G2 and G3).
R317	19A702931P253	Metal film: 3480 ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R317	19A702931P262	Metal film: 4320 ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).
R317	19A702931P356	Metal film: 37.4K ohms ±1%, 200 VDCW, 1/8 w. (Used in G3).
R318	19A702931P273	Metal film: 5620 ohms ±1%, 200 VDCW, 1/8w. (Used in G1 and G2).
R318	19A702931P374	Metal film: 57.6K ohms ±1%, 200 VDCW, 1/8 w. (Used in G3).
R319	19A702931P310	Metal film: 12.4K ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R319	19A702931P293	Metal film: 9090 ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).
R319	19A702931P374	Metal film: 57.6K ohms ±1%, 200 VDCW, 1/8 w. (Used in G3).
R320	19A702931P269	Metal film: 5110 ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R320	19A702931P247	Metal film: 3010 ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).

SYMBOL	PART NO.	DESCRIPTION
R320	19A702931P335	Metal film: 22.6K ohms ±1%, 200 VDCW, 1/8 w. (Used in G3).
R321	19B801251P472	Metal film: 4.7K ohms ±5%, 1/10 w.
R322 and R323	19A702931P361	Metal film: 42.2K ohms ±1%, 200 VDCW, 1/8 w. (Used in G3).
R324	19A702931P340	Metal film: 25.5K ohms ±1%, 200 VDCW, 1/8 w. (Used in G3).
R325	19A702931P361	Metal film: 42.2K ohms ±1%, 200 VDCW, 1/8 w. (Used in G3).
R326	19B800779P14	Variable, 47K ohms, 25%, 100 VDCW, 3 watt. (Used in G3).
R601	19A704885P7	Resistor Network, Custom: 6 pins, .125 W.
R602	19B800779P10	Variable: 10K ohms 25%, 100 VDCW, .3 watt.
R603	19B801251P562	Metal film: 5.6K ohms ±5%, 1/10 w.
R604 and R605	19B801251P223	Metal film: 22K ohms ±5%, 1/10 w.
R606	19B801251P563	Metal film: 56K ohms ±5%, 1/10 w.
R607	19B801251P153	Metal film: 15K ohms ±5%, 1/10 w.
R608	19B801251P682	Metal film: 6.8K ohms ±5%, 1/10 w.
R609	19B801251P182	Metal film: 1.8K ohms ±5%, 1/10 w.
R610	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R611	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R612	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R613 and R614	19B801251P683	Metal film: 68K ohms ±5%, 1/10 w.
R615	19A704885P9	Resistor Network, Custom: 10 pins, .125 W.
R616	19A704885P10	Resistor Network, Custom: 8 pins, .125 W.
R617	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w. (Used in G1).
R618 and R619	19B801251P222	Metal film: 2.2K ohms ±5%, 1/10 w.
R620	19B801251P684	Metal film: 680K ohms ±5%, 1/10 w.
R621	19B801251P472	Metal film: 4.7K ohms ±5%, 1/10 w.
R622	19B801251P273	Metal film: 27K ohms ±5%, 1/10 w. (Used in G1).
R622	19B801251P683	Metal film: 68K ohms ±5%, 1/10 w. (Used in G2 and G3).
R623	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w. (Used in G1).
R623	19B801251P683	Metal film: 68K ohms ±5%, 1/10 w. (Used in G2 and G3).
R624	19B800779P10	Variable: 10K ohms 25%, 100 VDCW, .3 watt.
R625	19A702931P313	Metal film: 13.3K ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R625	19A702931P322	Metal film: 16.5K ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).
R625	19A702931P330	Metal film: 20K ohms ±1%, 200 VDCW, 1/8 w. (Used in G3).
R626	19A702931P407	Metal film: 115K ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R626	19A702931P422	Metal film: 165K ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).
R626	19A702931P430	Metal film: 200K ohms ±1%, 200 VDCW, 1/8 w. (Used in G3).
R627	19A704885P8	Resistor Network, Custom: 9 pins, .125 W.
R628	19B801251P153	Metal film: 15K ohms ±5%, 1/10 w.
R629	19B801251P334	Metal film: 330K ohms ±5%, 1/10 w.
R630	19B800607P470	Metal film: 47 ohms ±5%, 1/8 w.
R631	19B801251P331	Metal film: 330 ohms ±5%, 1/10 w.
R632	19B800607P225	Metal film: 2.2M ohms ±5%, 1/8 w.
R636	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R637	19B801251P334	Metal film: 330K ohms ±5%, 1/10 w.
R638	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R640	19A705813P1	Thermistor: sim to AL03006-624-73-G100.

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U301	19A116297P7	Linear: Dual Op Amp; sim to MC4558CD.
U302	19A703924P1	Encoder-Decoder; sim to Intel 2916.
U601	19A702293P3	Linear: Dual Op Amp; sim to LM358D.
U602	19A134764P2	Linear: Dual Voltage Comparator; sim to LM393N.
U603	19A116297P7	Linear: Dual Op Amp; sim to MC4558CD.
U604	19A702293P1	Linear: Quad Op Amp; sim to LM324D.
U605	19A704971P5	Linear: -5 Volt Regulator; sim to MC79L05ACP.
U606	19A704073P2	Linear: 8 Volt Regulator; sim to MC78L08CP.
U607	19A704971P1	Linear: +5 Volt Regulator; sim to MC78L05ACP.
U608	19A703987P1	Digital Logic. (HIGH SPEED CMOS COUNTERS).
U609	19A700037P313	Digital: Hex Schmitt-Trigger Inverter; sim to 74LS14.
U610	19A703924P1	Encoder-Decoder; sim to Intel 2916.
U611	19A116297P7	Linear: Dual Op Amp; sim to MC4558CD.
U612	19A116297P7	Linear: Dual Op Amp; sim to MC4558CD. (Used in G1 and G2).
U612	19A704883P2	Digital: Quad Op Amp; sim to MC3303D. (Used in G3).

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 BOARD 19D902188G1**

Correct low squelch hysteresis. Changed R604 from 10K ohms to 22K ohms,Metal Film, ±5%, 1/10w (19B801251P223).

REV. A - **AUDIO BOARD 19D902188G2**

Incorporated in initial shipments.

REV. B - **AUDIO BOARD 19D902188G1**

Correct receive audio frequency response. Changed R626 from 90.9K ohms to 115K ohms, Metal Film, ±1%, 200 VDCW, 1/8w (19A702931P407).

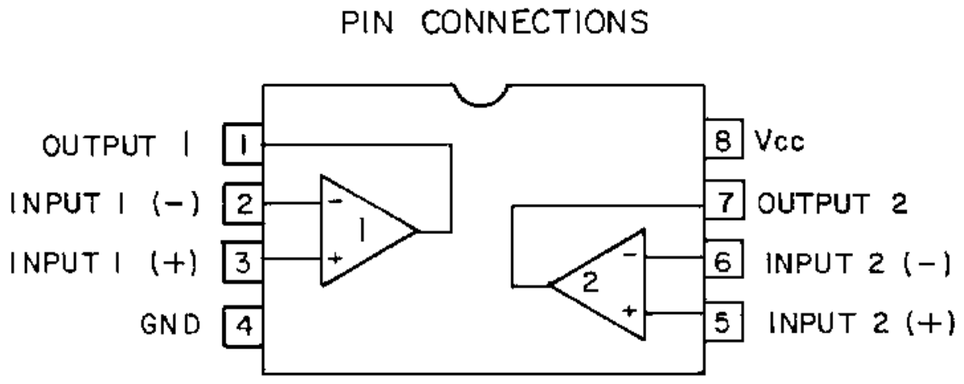
REV. B - **AUDIO BOARD 19D902188G2**

Higher quality chip capacitor. Changed C311 to Ceramic, ±5%, 1500 pF (19A702061P89). PWB also changed.

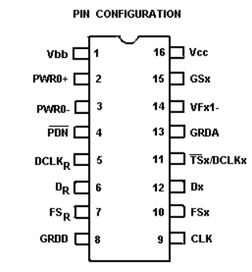
REV. A - **AUDIO BOARD 19D902188G3**

Improve receive audio frequency response. Changed R625 from 16.5K ohms to Metal Film, 20K ohms, ±1%, 200 VDCW, 1/8w (19A702931P330) and R626 from 165K ohms to Metal Film, 200K ohms, ±1%, 200 VDCW, 1/8w (19A702931P430).

OPERATIONAL AMPLIFIERS U301, U603, U611, U612(G1 & G2) (MC4558CD)

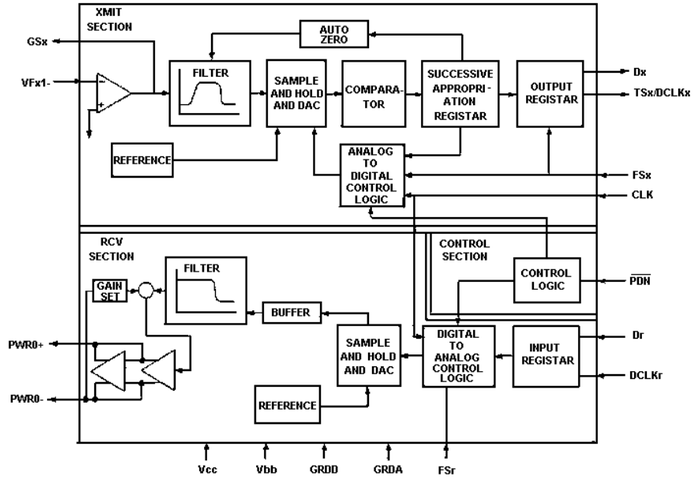


ENCODER/DECODER U302, U610 (INTEL 2916)



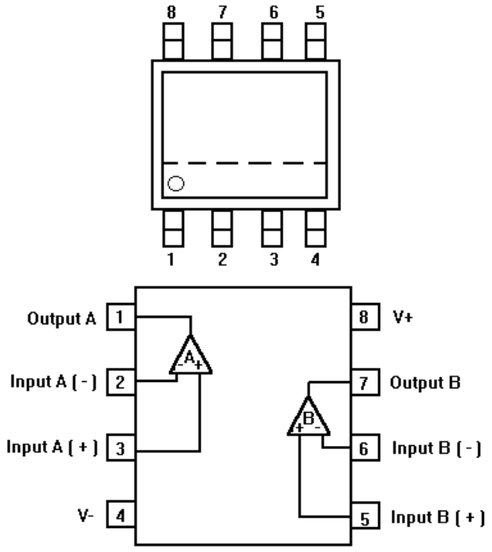
PIN NAMES

Vbb	POWER (-5V)
PWR0+, PWR0-	POWER AMPLIFIER OUTPUTS
$\overline{PDN}$	POWER DOWN SELECT
$DCLK_R$	RECEIVE VARIABLE DATA CLOCK
D_R	RECEIVE PCM INPUT
FS_R	RECEIVE FRAME
GRDD	DIGITAL GROUND
Vcc	POWER (+5V)
$\overline{TSx}$	TIMESLOT STROBE/BUFFER ENABLE
DCLKx	TRANSMIT VARIABLE DATA CLOCK

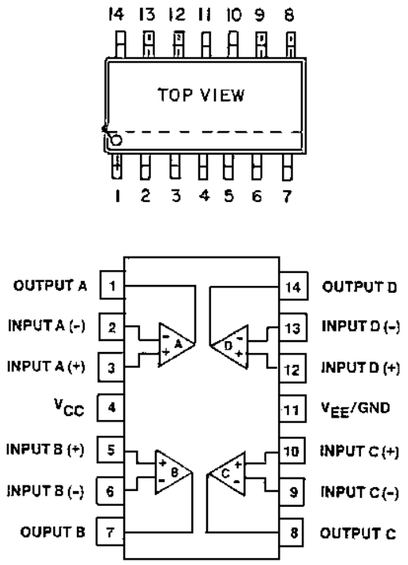


GSx	TRANSMIT GAIN CONTROL	Dx	TRANSMIT PCM OUTPUT
VFx1-	ANALOG INPUT	FSx	TRANSMIT FRAME
GRDA	ANALOG GROUND	CLK	MASTER CLOCK

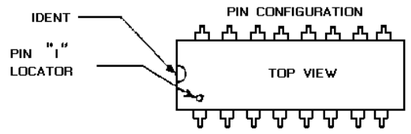
OPERATIONAL AMPLIFIER U601 (LM358D)



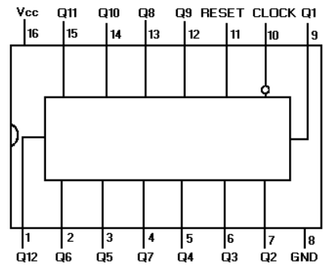
OPERATIONAL AMPLIFIER U604 (LM324D)



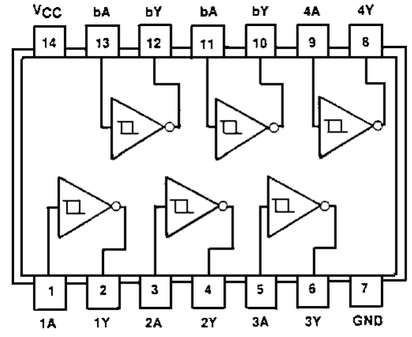
HIGH SPEED COUNTER U608



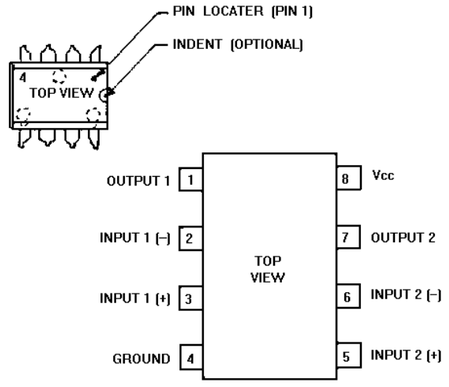
4040 12 STAGE BINARY COUNTER



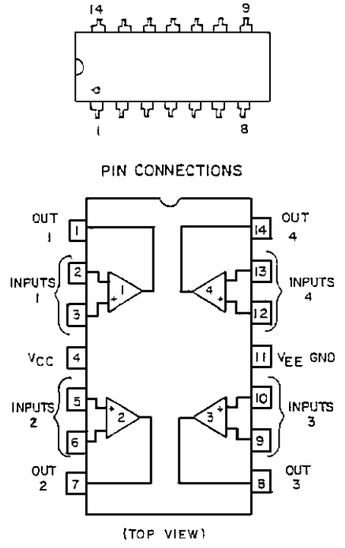
HEX SCHMITT TRIGGER INVERTER U609 (74LS14)



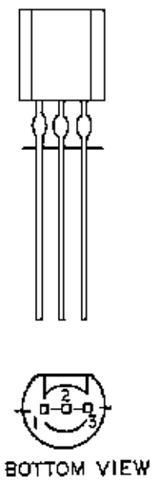
DUAL VOLTAGE COMPARATOR U602



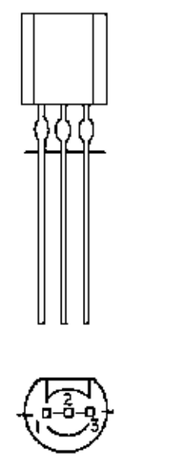
QUAD OP AMP U612(G3)



VOLTAGE REGULATOR (-5V)



VOLTAGE REGULATOR (8V)



VOLTAGE REGULATOR (-5V) U605