$5.00

SHERWOOD

HP 2000

SERVICE MANUAL

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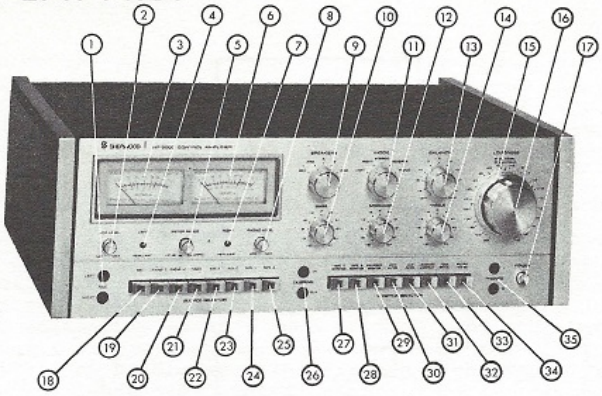
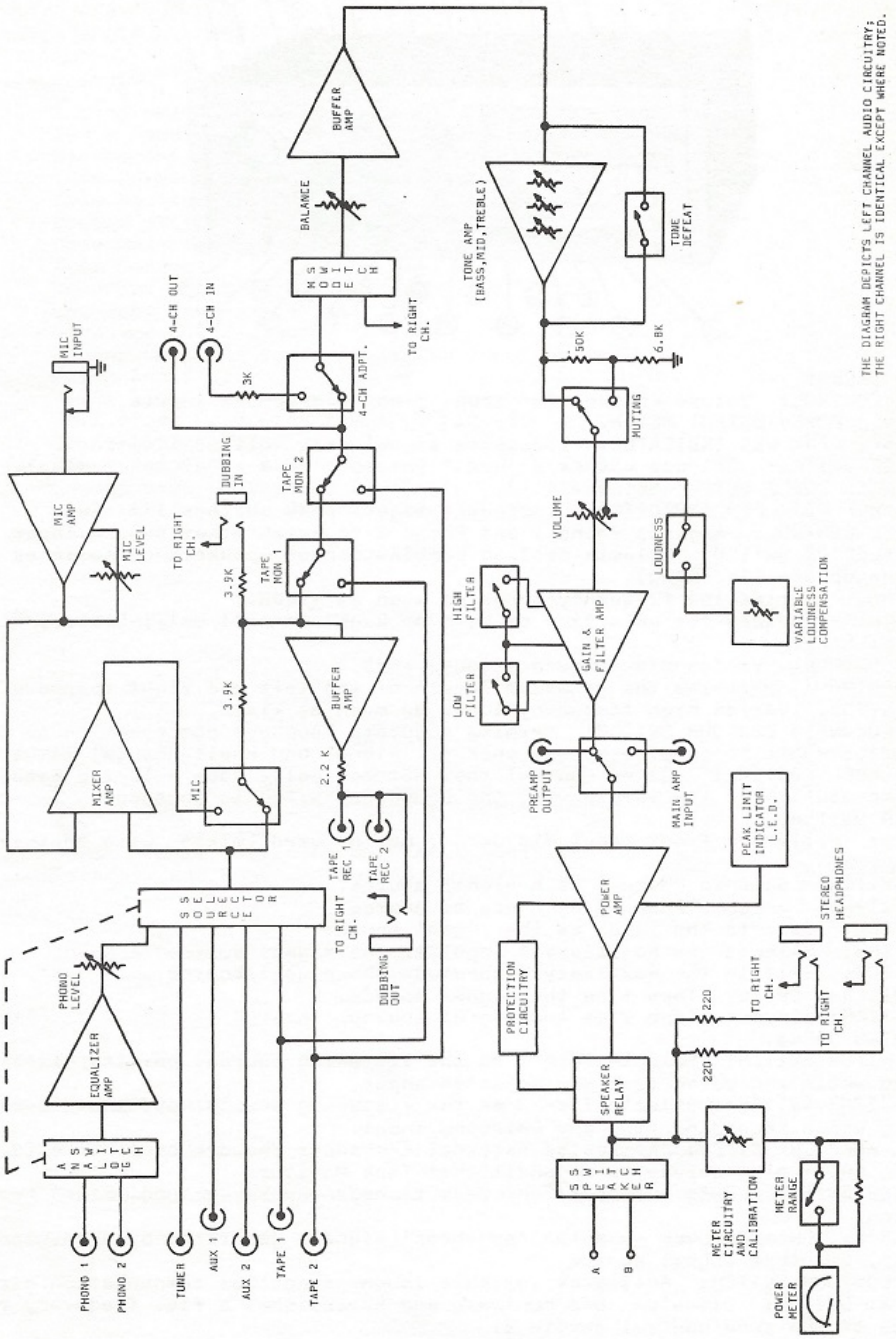
FRONT PANEL FEATURES



1. MIC INPUT JACKS.
2. MIC LEVEL CONTROL: Volume control for front panel microphone inputs.
3. LEFT CHANNEL POWER OUTPUT METER.
4. LEFT CHANNEL PEAK LED INDICATOR: Indicates signal peak voltage limiting.
5. METER RANGE SWITCH: Selects either a 'Norm' (direct) or a -10dB meter display.
6. RIGHT CHANNEL POWER OUTPUT METER.
7. RIGHT CHANNEL PEAK LED INDICATOR: Indicates signal peak voltage limiting.
8. PHONO LEVEL CONTROL: Adjusts Phono 1 and Phono 2 to match other source input levels.
9. SPEAKER SELECTOR SWITCH: Selects desired combination of speakers or switches speakers off (for headphone listening).
10. BASS CONTROL: Varies low frequency tones as much as ±14dB.
11. MODE SWITCH: Provides for selection of Left or Right Channel only, Stereo, Stereo Reverse, or Mono.
12. MIDRANGE CONTROL: Varies mid-frequency tones ±6dB.
13. BALANCE CONTROL: Balances the relative levels of the left and right speakers.
14. TREBLE CONTROL: Varies high frequency tones as much as ±14dB.
15. VARIABLE LOUDNESS CONTOUR SWITCH: Permits accurate loudness compensation by providing contour adjustments to complement any speaker, signal and environmental situation.
16. LOUDNESS LEVEL CONTROL: Volume control that automatically adds selected bass and treble compensation at low levels when the Loudness Switch is engaged.
17. MAIN POWER SWITCH.
18. MIC SWITCH: Activates front panel Mic Jacks; may be used (mixed) with another selected signal source.
19. PHONO 1 SWITCH: Selects Phono 1 as a signal source.
20. PHONO 2 SWITCH: Selects Phono 2 as a signal source.
21. TUNER SWITCH: Selects the Tuner as the signal source.
22. AUX 1 SWITCH: Selects the Auxiliary 1 input as the signal source.
23. AUX 2 SWITCH: Selects the Auxiliary 2 input as the signal source.
24. TAPE 1 SWITCH: Selects Tape 1 as the signal source.
25. TAPE 2 SWITCH: Selects Tape 2 as the signal source.
26. TAPE DUBBING JACKS.
27. TAPE 1 MONITOR SWITCH: Selects Tape 1 as the listening source; permits direct tape monitoring while recording from any selected input.
28. TAPE 2 MONITOR SWITCH: Selects Tape 2 as the listening source; permits direct tape monitoring while recording from any selected input.
29. 4-CHANNEL ADAPTER SWITCH: Activates external 4-channel decoder or other external processing unit; also serves as an additional Tape Monitor.
30. HIGH FILTER SWITCH: Cuts out 'scratch' from records and background 'hiss' from noisy FM stations.
31. LOW FILTER SWITCH: Removes unwanted 'sub-bass' signals generated by a turntable, microphone, or other signal source.
32. LOUDNESS CONTOUR SWITCH: Activates variable loudness contour compensation circuit.
33. TONE DEFEAT SWITCH: Disables tone controls and establishes a flat frequency response regardless of the tone control settings.
34. MUTING -20dB SWITCH: Offers an instantaneous volume attenuation of either 0dB or -20dB.
35. STEREO HEADPHONE JACKS.

AUDIO BLOCK DIAGRAM



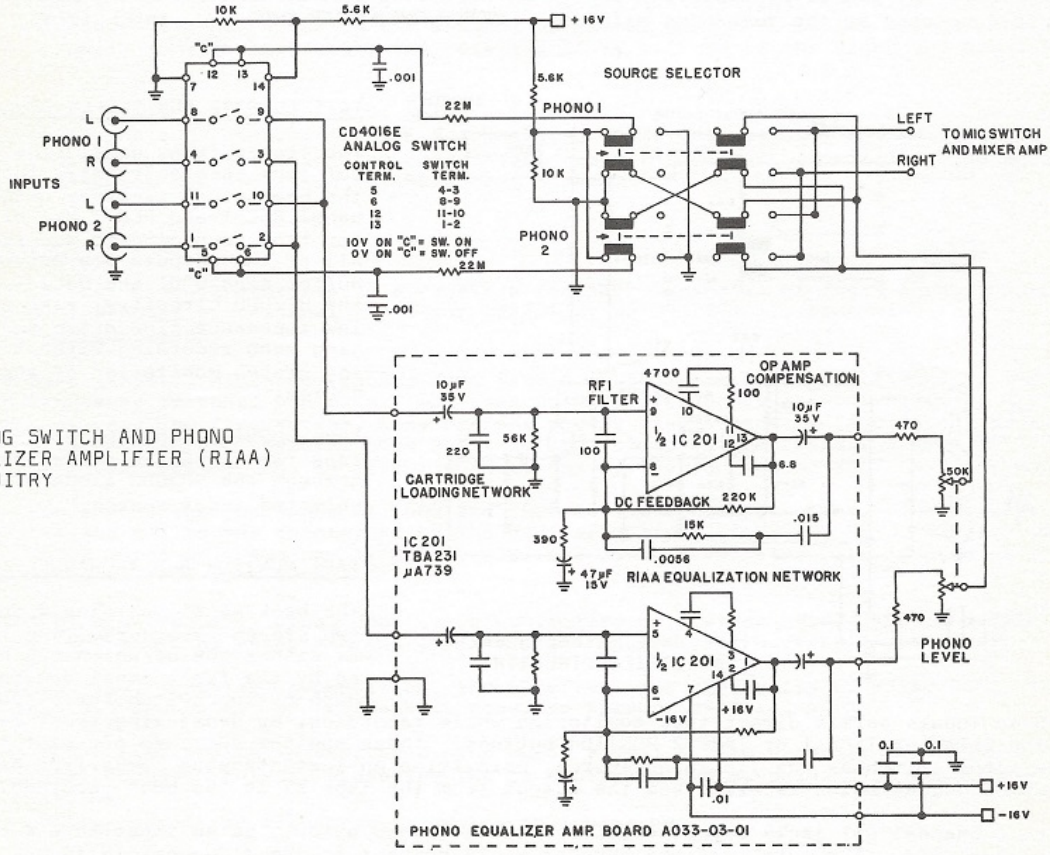
CIRCUIT DESCRIPTION

The Audio Block Diagram on the previous page, depicts the signal path through the amplifier, with careful detail given to preamp and tape recorder switching circuits. Referral to this Diagram, while reading the following circuit descriptions, will help to understand the versatile features and circuit design of the HP2000 Control Amplifier.

ANALOG SWITCHING OF PHONO 1 AND PHONO 2

Selection of the two phono inputs is accomplished using the CD4016E analog switch. This 14 pin IC, located on the "mother" board, permits switching the two inputs to the phono preamp board without running signal leads to the front panel selector switch and back to the pre-amp board input. There are four individual switches housed in the IC, each with its own control pin. When a DC voltage is applied to a control pin, the impedance between its respective switch terminals is low (approx. 600 ohms). If the control pin is grounded, this impedance is greater than 2 megohms. The desired phono input is selected by applying approximately 10 VDC to the respective control pins.

To eliminate DC shifting or "pop" problems characteristic with the CD4016E, an inverse mode of switching is used. With neither PHONO 1 or PHONO 2 selected, all four switches are "on", while the output of the phono preamp is AC shorted to ground. When PHONO 1 is selected, control pins 12 and 13 are grounded, turning the Phono 2 inputs off. When PHONO 2 is selected, control pins 5 and 6 are grounded, turning Phono 1 inputs off. The preamp output is not grounded in the Phono 1 or Phono 2 selector positions. See illustration below.



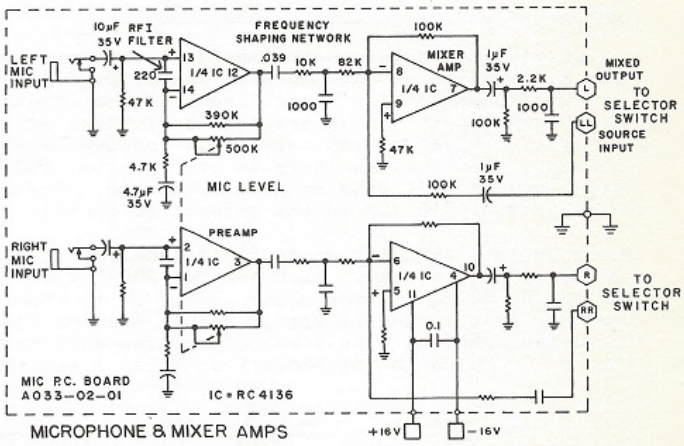
ANALOG SWITCH AND PHONO EQUALIZER AMPLIFIER (RIAA) CIRCUITRY

PHONO EQUALIZER (PREAMP) AMPLIFIER AND PHONO LEVEL CONTROL

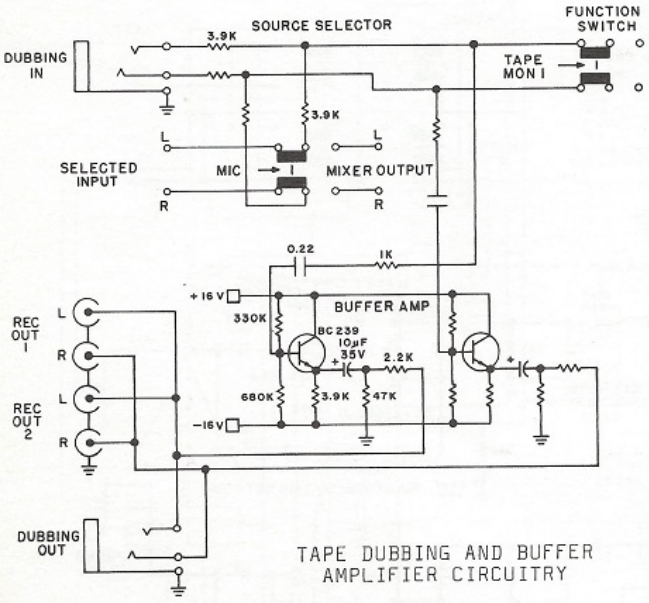
The Phono preamp and equalization is contained on PC board A033-03-01, which plugs into the "mother" board. It utilizes the low noise op amp TBA231 or uA739. The preamp output level is front panel adjustable so that it's level can be matched to the AUX input sources. The phono input sensitivity is 2.2 mV for rated amplifier output. The input signal handling capability is 160 mV. The S/N ratio is 65 dB, or 70 dB with IHF "A" weighting. The circuit is illustrated on the proceeding page.

MICROPHONE AND MIXER AMPLIFIERS

The mic preamplifier and mixer amplifier utilize the RC4136 quad op amp IC. Two of the op amps are used for the mic preamps, one for each channel. The mic preamp is a non-inverting amplifier with a variable feedback gain control. Each preamp is followed by a frequency response shaping network, feeding another op amp, which functions as a mixer amplifier. The mixer amplifier is a two input inverting summer with unity gain. When the MIC switch is in the "on" position, any other selected source is summed with the mic preamplifier output without inherent mixing gain loss. The output of the mixer amplifier is then connected to the remaining circuitry.



MICROPHONE & MIXER AMPS



TAPE DUBBING AND BUFFER AMPLIFIER CIRCUITRY

TAPE DUBBING AND BUFFER AMPLIFIER

The stereo front panel tape DUBBING OUT jack is electrically the same as the back panel recorder outputs. Back panel REC 1 and REC 2 are provided for tape recording to two recorders. All of the outputs are driven from buffer amps Q301 and Q302 to isolate the HP2000 circuitry, also providing low impedance line drive and permitting mono recording without disturbing stereo monitoring of the input source.

Tape DUBBING INput permits playing a tape for listening and/or recording through the HP2000 alone with any selected input source.

TAPE MONITOR AND 4-CHANNEL SWITCHING

The back panel contains 4 inputs for two stereo recorders, TAPE 1 and TAPE 2; either one of which can be selected by the front panel Source Selector push button switch for playback. Also, these inputs permit direct tape monitoring while recording, by depressing front panel Function Selector TAPE 1 or TAPE 2 MONITOR buttons. These monitor switches pre-empt any Source Selector switch as the listening source, permitting an instantaneous comparison between the source signal being recorded and the output from the tape as it has been recorded.

The 4 CHannel OUT jacks may be used as another Record output, as an input to a 4-channel decoder, etc. The output of the decoder would connect to the 4 CHannel IN jacks.

NOTE: The signal from this source does not appear at any of the recording outputs; therefore, this input should be used for monitoring (listening) only.

SOURCE SELECTOR/INPUT AND FUNCTION SELECTOR SWITCHES

The front panel SOURCE SELECTOR switch provides for the selection from eight stereo input sources. The push button switch buttons are designed to always return to the out position, to provide continuity of attractive appearance. Mechanically activated reflector type indicators provide visual indication of Source and Function selection. The coil spring loaded contoured moving contacts provide balanced contact pressure, assuring reliable performance with long term low contact resistance. The fixed and moving contacts are both silver plated. The enclosed housing protects the inner contact area from dust and foreign substances.

The Source Selector is an interlocking design for all buttons except the MIC button, which is a push-push type that allows the microphone input to be mixed with any other selected source.

The FUNCTION SELECTOR buttons operate independently and, therefore, any of its eight functions can be used simultaneously. For ease of maintenance, the switch plunger with sliding contacts is removable from the front without disturbing electrical connections. See page 16 for switch disassembly and assembly instructions.

MODE SWITCHING, BALANCE AND BUFFER AMPLIFIER

MODE switching is accomplished at the input to the Tone PC board. The stereo BALANCE control, mounted on the same PC board, is of the no-signal-loss type, when the control is in the centered position. Rotating the control to either side reduces the gain of the opposite channel, thus accomplishing the relative level balance of the right and the left speakers.

The Buffer amplifier following the Balance control has the function of providing low impedance drive to the tone control stage. A capacitor, C502, between base and emitter of this stage effectively prevents radio frequency interference (RFI), such as citizen band radios, from being detected and amplified in subsequent stages.

TONE CONTROLS

The tone control circuit consists of a negative feedback Baxandall configuration, incorporating dual low noise operational amplifier TBA231 or uA739 (IC501), connected in the inverting configuration.

Separate Bass (VR501), Midrange (VR502), and Treble (VR503) controls vary feedback, thereby altering frequency response and gain. The bass turnover frequency is controlled by C505 and C506. At very low frequencies, they present a very high impedance (equivalent to an open circuit). Therefore, maximum bass boost is controlled by the divider action of (VR501 + R507)/R505. The maximum cut is established by the divider action of R507/(VR501 + R505).

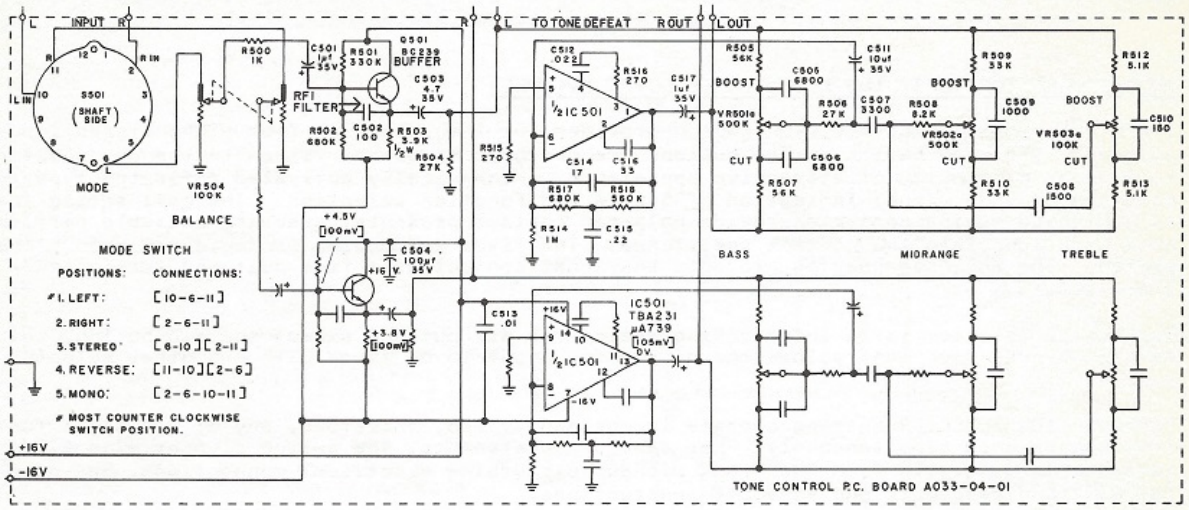
At high frequencies the impedance of C505 and C506 is low (short circuit). The maximum treble boost and cut is now determined by the divider actions of VR503, R512, R513, R506 and R505. The turnover frequency is set by C507 and C508. Capacitor C510 is used as a high frequency rolloff past 20KHz.

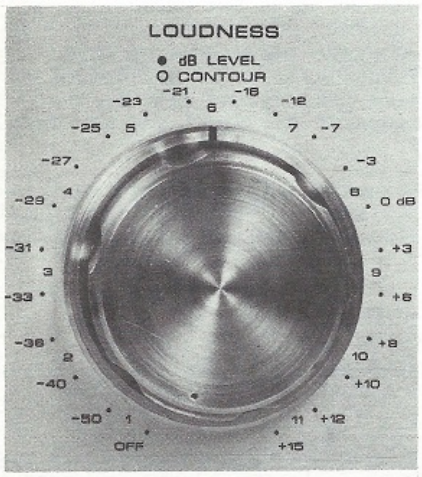
The amount of mid frequency boost and cut is controlled by divider VR502, R509 and R510. Capacitors C507 and C509 establish the low and high frequency turnovers, respectively.

Circuit stability, lead-lag compensation, and DC offset are controlled by R514, R515, R516, C512, C514, C515 and C516. DC feedback is obtained through R517 and R518.

When the TONE DEFEAT switch is depressed, the audio signal is fed directly from Q501's output to the Loudness control, bypassing the tone circuit and associated op amplifier.

See Tone control circuitry illustration on the following page.





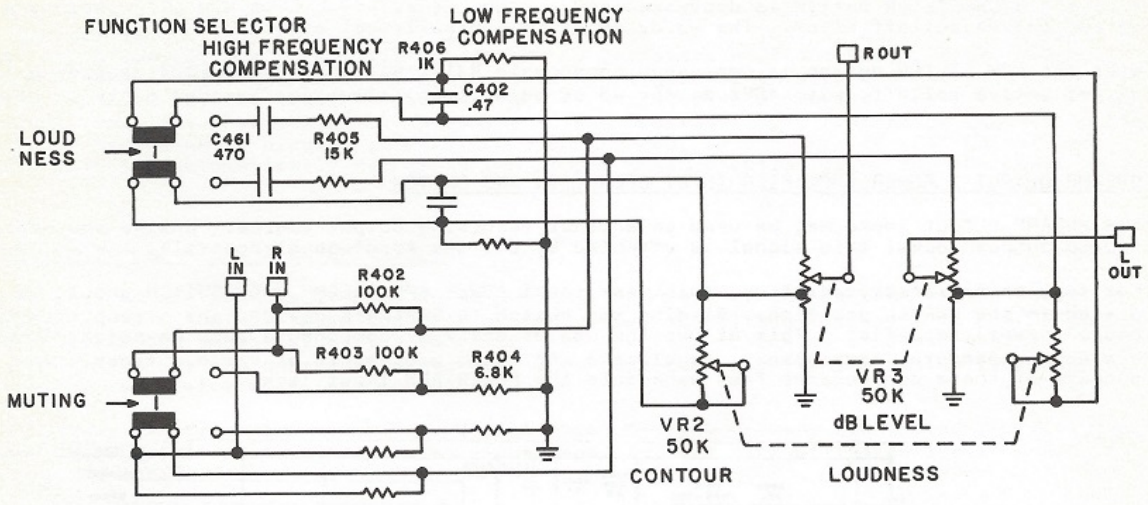
LOUDNESS dB LEVEL CONTROL

Conventional volume controls use carbon elements with a "wiper arm" rotated across them to vary the (resistance) volume. Carbon elements can not only be off as much as 3 to 5 dB in level balance between channels, but the constant wiper action can develop such problems as noise and even become intermittent with use and time. Realizing that the Loudness dB Level control is the most used function on any amplifier, the HP 2000 was designed with a precision step control, with fixed thick film resistors in 22 positions, accurately calibrated in decibels (dB) and matched within 0.5 dB between channels at ALL steps. This control should not be confused with other "step" controls that use conventional carbon element pots with a detented shaft action. This Loudness dB Level control has silver plated contacts with fixed resistor elements between the contacts. This eliminates the basic problem associated with carbon-type level controls and also provides an accurate recall of any volume, simply by setting the control to the dB level desired, as marked on the front panel.

LOUDNESS CONTOUR CONTROL

The human ear is less sensitive to extremes of treble and bass frequencies at low listening levels that at a high volume; for this reason, many people "turn up" the bass and treble controls when listening to "background" level music. Since an ideal situation would be to have the bass and treble progressively increase when the Volume (Loudness Level) control is turned down, many manufactures provide a loudness compensation circuit that adds a predetermined degree of bass and treble correspondent to the level setting. However, since speaker efficiency, room accoustics and source input levels all vary the position of the volume control, with respect to a desired listening level, a factory-set loudness contour is, at best only an average setting not accurately compensating for your specific audio needs. The Variable Loudness Contour switch offers eleven different degrees of loudness, to compensate for virtually any audio requirement. Once the loudness control is set (unless the input source levels vary considerably), it will not require readjustment.

The loudness contour circuit begins to take effect at the 0 dB calibration point. There is negligible loudness compensation above this level. However, when the Volume (Loudness dB Level) control is turned down (counter-clockwise) for lower listening levels, the bass and



LOUDNESS dB LEVEL, LOUDNESS CONTOUR AND MUTING CIRCUITRY

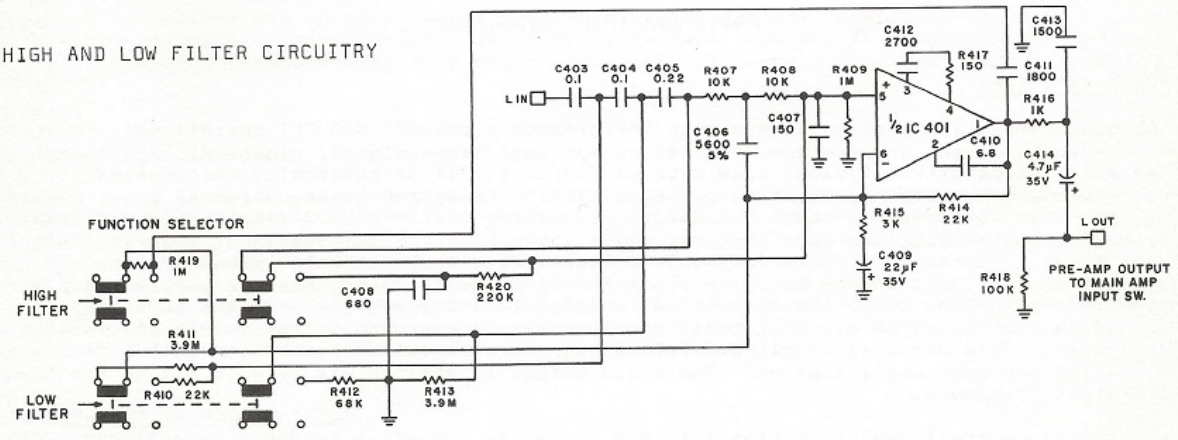
to a lesser extent, the treble frequencies are automatically boosted in accordance with the curves shown on page 21. When the loudness compensation is switched out (LOUDNESS CONTOUR off), flat frequency response is provided at all Volume (LOUDNESS dB LEVEL) control settings.

High frequencies are compensated with network C461 and R405. Low frequency compensation is obtained with C402, R406 and the variable contour switch VR2.

HIGH AND LOW FREQUENCY FILTERS

The high and low active filters are located on the function switch board. This stage uses a non-inverting, dual, low noise operational amplifier; TBA231 or uA739A (IC401). When neither filter button is depressed, circuit gain is set at 18 dB by R414 and R415. Op Amp compensation is controlled by C410, C412 and R417. 100% DC feedback is used to maintain minimum output offset voltage. Resistor R409 references the plus input to ground, establishing the input bias current. Low pass filter R416 and C413 attenuate ultrasonic noise components.

HIGH AND LOW FILTER CIRCUITRY



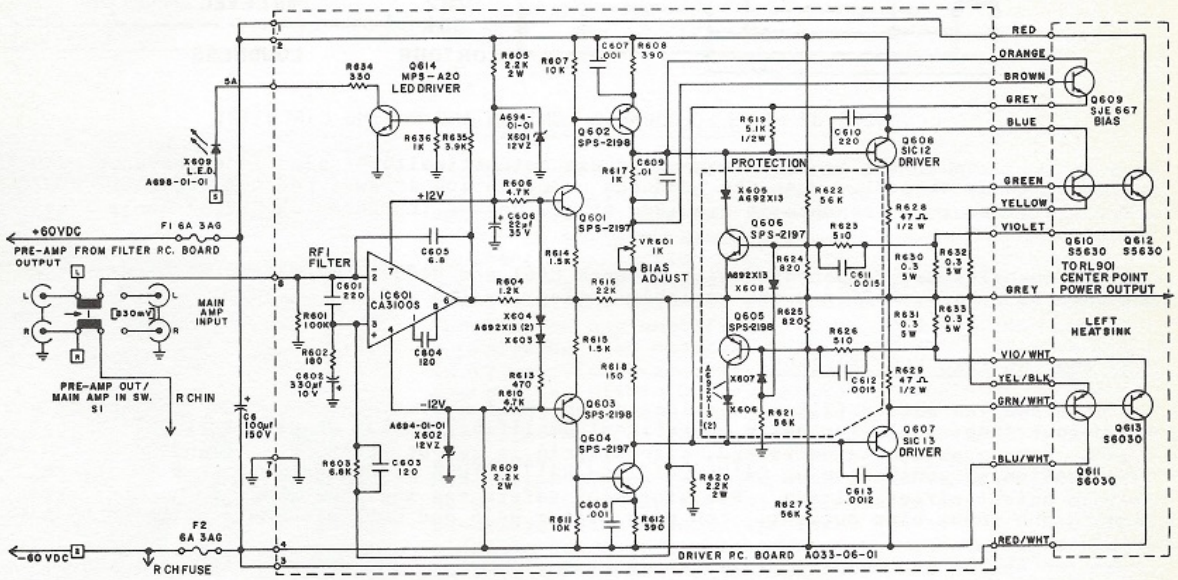
When the HIGH FILTER button is depressed R407, R408, C406, C407, C408 and C411 produce a 12 dB per octive rolloff slope. The -3 dB point is nominally set at 8KHz.

When the LOW FILTER button is depressed components R410, R412, C403 and C404 develop a 12 dB per octive rolloff, with 40Hz as the -3 dB point (see filter performance plots on page 21.

PREAMP OUTPUT / POWER AMPLIFIER INPUT OPERATION AND SWITCH

The PREAMP OUTput jacks may be used as another recording output source. Unlike the regular record output jacks, this signal is affected by all the front panel controls.

For regular amplifier operation, this rear panel POWER AMP/PREAMP MODE SWITCH should be placed in the NORMAL position. Sliding the switch to SEPARATE divides the preamp from the basic (power) amplifier. This allows the use of external components such as noise reduction systems, expanders, compressors, equalizers and audio processors of various types. The outputs of these accessories feed back into the POWER AMP INput jacks.



POWER AMPLIFIER CIRCUITRY

POWER AMPLIFIER

The power amplifier section uses a high performance bipolar/P-MOS FET operational amplifier, the CA3100S, as the input stage. It has exceptional large signal, wideband, high speed characteristics with a typical slew rate of 70V/uSec. It is externally compensated for optimum high frequency performance and stability. The op amp drives a common base, complementary pair consisting of Q601 and Q603. Transistor Q601 and Q603 feed the common emitter predriver stages Q602 and Q604 respectively. These CB-CE pairs, ideal for predriver signal amplification because of their low noise and good frequency response, produce an output voltage proportional to the output current of the op amp. They therefore supply voltage and current to base drive the symmetrical emitter follower drivers Q608 and Q607, which provide a low impedance drive to their complementary power output transistors Q610/Q612 and Q611/Q614. This parallel coupling develops high current output capability with good linearity and high amplification. The audio output is applied via relay RL901 to the Speaker output terminals.

To maintain overall amplifier stability and linearity, negative feedback is utilized

throughout the amplifier. Resistor R603 and capacitor C603 condition the feedback signal for application to the non-inverting input, pin 3, of the CA3100S op amp. The overall power amplifier voltage gain, 31.5 dB, is set by resistors R602 and R603. Zener diodes X601 and X602 provide the plus and minus supply voltages for this IC and establish the reference voltages for the bases of Q601 and Q602. Resistor R616 provides local feedback for improved transient characteristic including AC and DC stability. Transistor Q609 is mounted on the heat sink to provide temperature tracking and, in conjunction with potentiometer VR601, sets and automatically maintains the proper bias operation point for the power amplifier.

POWER LIMIT 'LED' INDICATOR OPERATION

The purpose of the peak limit LEDs is to indicate when either one or both of the power amplifiers are clipping. When the peak of the output AC voltage increases to the DC power supply level, the amplifier begins to "clip" the waveform. Because of basic negative feedback action, IC601 now operates in its open loop gain condition, which instantly switches LED driver transistor Q614 into conduction.

In a current limiting mode, such as a direct short circuit or very low impedance (less than 3 ohms) at the speaker terminals, with signal applied, the LEDs will also light showing a fault has occured.

The LEDs are automatically tested for operation each time the units AC Power switch is turned on. This happens because LED driver transistor Q614 is forward biased by the momentary offset voltage of IC601. The LED flash test occurs on each Turn On, after the unit has been in the Power Off (not in use) mode for 30 seconds or more.

DUAL SLOPE LOAD LINE LIMITING CIRCUIT

The parallel complementary output transistors are load line limited, with the maximum current limited to about 9.5 Amps peak (equivalent to 180 watts at 4 ohms). Current through the emitter resistors R630 and R631 develops a voltage, which is applied to the bases of Q605 and Q606 through the voltage divider networks R623, R624, R625 and R626. The voltage across the collector to the emitter of the output transistors is also applied to the bases of Q605 and Q606 through R622 and R627. These transistors constantly monitor the negative and positive voltage current swings of the respective left and right channel parallel complementary output transistors. With the combination of these two voltages, a point is reached when, for example, if the channel's output exceeds its rated protection power level, transistors Q605 and Q606 become forward biased, shunting the output transistors base drive signal. Since both the current through and the voltage across the output transistors is sensed, these transistors are peak power or load line limited. This type of protection assures operation within their rated Safe Operating Area (S.O.A.).

The addition of diodes, X607, X608 and resistor R621 provides a second or dual slope response to voltage and current, which permits a higher current capability at lower collector/emitter voltages. This provides dual slope load line limiting for improved protection, while maintaining improved amplifier drive capability with normal speaker loading conditions.

THERMAL PROTECTION

The amplifier is also protected against excessive and potentially damaging temperatures due to abnormal load or environmental conditions. This protection is accomplished with two thermal switches (one per amplifier channel), which are fastened to the heat sinks. When the output transistor's operating temperature reaches approximately 110°C (230°F), the switch is thermally activated to cause its contacts to open and thereby disconnect the AC line voltage to the power transformer's primary; a POWER OFF condition. This open circuit condition now allows the temperature to decrease. At approximately 80°C (175°F), the contacts close and the amplifier returns to POWER ON condition.

POWER SUPPLY B+ AND B- FUSING

An amplifier malfunction, such as a collector-to-emitter short of an output transistor,

could cause very high currents to flow, which could possibly damage other components and/or the circuit board. For this reason, internal fuses are provided for each channel in both the positive and negative voltage supplies. These four (4) 6 Amp, 3AG fuses are located on the "mother" board.

LOUDSPEAKER DC VOLTAGE PROTECTION (PLUS AND MINUS)

Loudspeaker protection is also provided in the event that either a positive or negative DC voltage is developed at the amplifier speaker terminals. When an amplifier malfunction results in a positive DC voltage at the speaker terminals, this voltage is fed through a voltage divider network, R908A, R906 and R905, to the base of Q903. The resultant voltage forward biases Q903 which clamps Q901 off, and de-energizes the speaker relay. In the event that a negative voltage appears at the speaker terminals, this voltage also is fed to the voltage divider network and then directly to the base of Q901 through R907. The negative voltage biases Q901 off and de-energizes the speaker relay.

POWER SWITCH TURN ON DELAY AND INSTANT OFF CIRCUIT

The amplifier also includes a circuit which eliminates speaker pops and noises when the POWER is switched ON or OFF. Immediately after POWER is activated, a rectified negative half wave voltage is applied to the base of Q902 biasing it off. Also a positive DC voltage is applied to the base of Q901, through a timing network, determined by R902 and C901. As C901's charge voltage increases to approximately +0.7 VDC (about 1-1/2 seconds of delay), Q901's base becomes forward biased, permitting collector current to energize the speaker output relay.

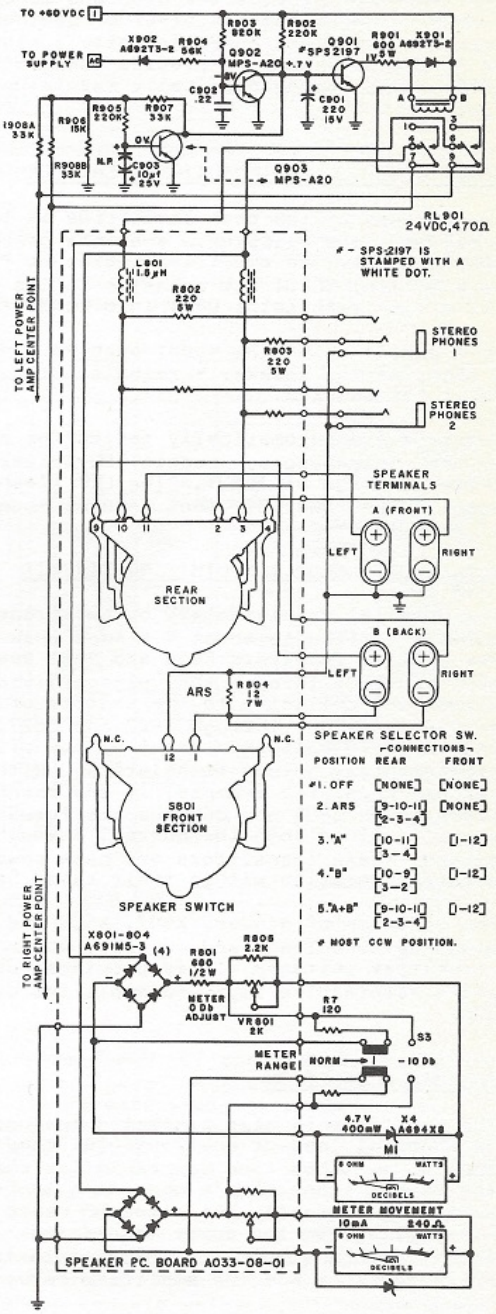
When the amplifier is turned off, the negative voltage on the base of Q902 is instantly removed while the, still present, positive DC supply voltage (positive voltage remains because of the remaining charge on electrolytic C7), is applied to the base of Q902, through R903. This positive voltage forward biases Q902 and clamps Q901 off, de-energizing the relay and disconnecting the speakers.

Transistor Q901, relay driver, must have a DC beta of 200 or greater at IC = 50 mV to assure Vce saturation and proper relay drive. This transistor is color coded with a white dot at the factory.

POWER OUTPUT METERS

The power output meters are especially designed for sensitivity and balistics. The meter scale is calibrated for readout of output power in both Watts and Decibels (dB). The illuminated meter scale will remain lighted in a POWER ON mode, except under a thermal overload condition (see previous page), when the main power to the amplifier is automatically switched off until a safe operating temperature is reached.

The METER RANGE switch provides for a selection of



LOUDSPEAKER PROTECTION, POWER SWITCH TURN ON DELAY / INSTANT OFF, "ARS" AND POWER OUTPUT METER CIRCUITRY.

either a "NORM" (direct) or -10 dB meter display. This selection permits an accurate meter reading for both low and high level power operating conditions.

The meter drive circuit consists of a discrete diode bridge, X801-804, and a calibration resistor R801 and potentiometer VR801. These components are located on the speaker selector switch board.

Zener diode, X4 [4.7V], is located on and connected across the meter terminals to provide meter protection for overdrive conditions.

AMBIENT RETRIEVAL SYSTEM (ARS)

The Ambient Retrieval System develops (hidden phase) sound information that is included in normal stereo programs, but is not reproduced during conventional stereo playback. ARS uncovers these hidden signals with a very simple resistive matrix and directs them to the left back and right back speakers of a 4-channel system. The most dramatic programs containing ambient information are those which have been recorded "live" and also where multiple microphones were used.

In the SPEAKERS ARS switch position the B (BACK) two speakers have their minus (-) returns connected to ground through a common 12 ohm, 7 watt, resistor (R804).

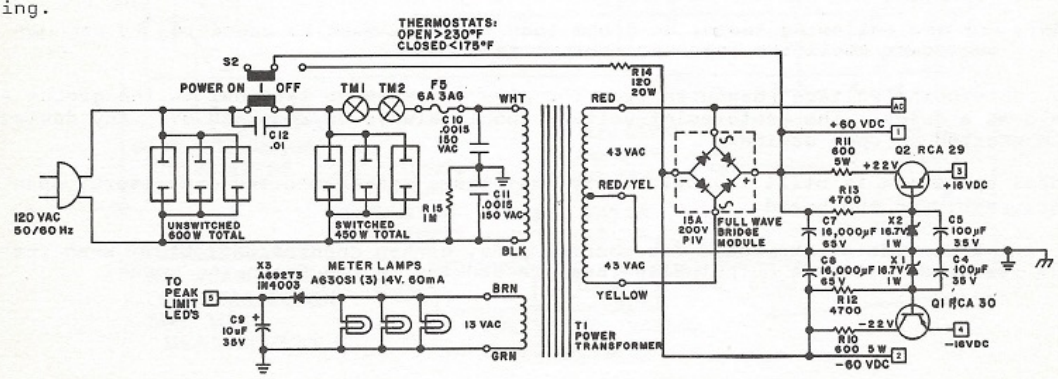
The recovered signals are, by definition, normally of a lesser value than the front channel signals (similar to listening to a live performance) and are therefore usually lower in volume. This mode is not intended to place the listener's seat in the middle of the orchestra. If more of a surround sound is desired, adding appropriate pads to the front speakers will allow volume level matching as desired.

POWER SUPPLY

Line voltage (120 volts AC, 50/60Hz) is applied to the power transformer primary winding via the power switch, thermal switches and line fuse. Capacitor C12 reduces RFI caused by the opening and closing of the power switch contacts. Capacitors C10 and C11 act as AC line bypass filters while R6 references one side of the AC line to the chassis. The 86 volt AC centertapped secondary feeds a 15 Amp full wave bridge rectifier. This rectified voltage is filtered by C7 and C8, 16,000 uF each, to obtain ±60 volts DC (±53 volts DC at maximum rated power output). Because of the large capacitance, C7 and C8 retain their charge for a long period of time under normal circuit load, after the line voltage is removed. Therefore, when this voltage is removed via the power switch, R5 is switched across these capacitors, aiding in their discharge.

The ±16 volt DC secondary supplies utilize series pass transistors with a constant voltage base source, as set by zener diodes X1 and X2. This accommodates higher load currents as well as improved filtering due to its capacity multiplicative effect.

In the case of a 220 volt or 240 volt AC, 50/60Hz, line voltage source, an export version power transformer is required. Refer to the schematic diagram for the alternate primary wiring.



SERVICING AND ADJUSTMENT PROCEDURES

NOTES:

1. For simplicity only the left channel and its related circuitry are described. The right channel is identical except for reference symbol numbers (see Schematic Diagram).

2. As a convenience for fast component location, this manual contains detailed pictorials of all printed circuit boards (shown full size). Reference to these pictorials and the parts location pictures should aid considerably in a quick, accurate fault analysis of an existing malfunction.

3. As an additional service aid, the phono preamplifier and power amplifier driver boards are of the plug-in design. To remove these and the other PC boards, see the section on Disassembly, on page 17.

USE OF A VARIAC

It is imperative that a variable voltage line source (Variac) equipped with a line wattmeter be used to identify abnormal power consumption when servicing power amplifiers and associated power supply circuitry. With the LOUDNESS control set at minimum, the power consumption should not exceed 40 watts as the AC line voltage is increased by the Variac to the rated 120 VAC. If the power consumption begins to exceed 40 watts, do NOT increase the voltage any further. Determine if the malfunction is in the power supply, preamplifier, or basic (power) amplifier circuitry.

LINE FUSE AND INITIAL CIRCUIT CHECKS

Verify that the line fuse is unopened and check idling power consumption. The main cause for abnormal power consumption, in order of decreasing occurance, are:

1. Open or shorted amplifier output, driver or predriver transistors.

2. Open or shorted power supply diodes.

3. Shorted power transformer.

AMPLIFIER FAULT ANALYSIS

If an amplifier channel is in question, check related circuit boards for burned parts and replace. Check all the transistors with an ohmmeter* for opens or shorts and replace if defective.

*WARNING: Some ohmmeters may damage sensitive solid-state devices. Whenever possible, use a high resistance range (at least RX10).

IMPORTANT: For the following tests, an 8 ohm load resistor must be connected to each of the two power amplifier (speaker) output terminals.

Use the centerpoint voltage [measured from the plus (+) speaker terminal to the ground (-) terminal] as a guide. The centerpoint voltage should always be Zero $\pm$50 mV. Any deviation suggests shorted or open devices.

If channel operation is still faulty, verify that there are no shorted capacitors, open resistors, etc., on the board.

Inspect the underside of the board for shorted pads, broken connections, etc. When the board is restored, readjust Output Bias (see proceedures on the following pages).

DISTORTION IN AMPLIFIER OUTPUT

Distortion which exceeds the amplifier ratings (see Specification section) may be due to the following:

1. Mismatched output transistors.
2. Defective (low-beta) driver transistors.
3. Incorrectly adjusted output transistor bias.

OUTPUT TRANSISTOR BIAS ADJUSTMENT

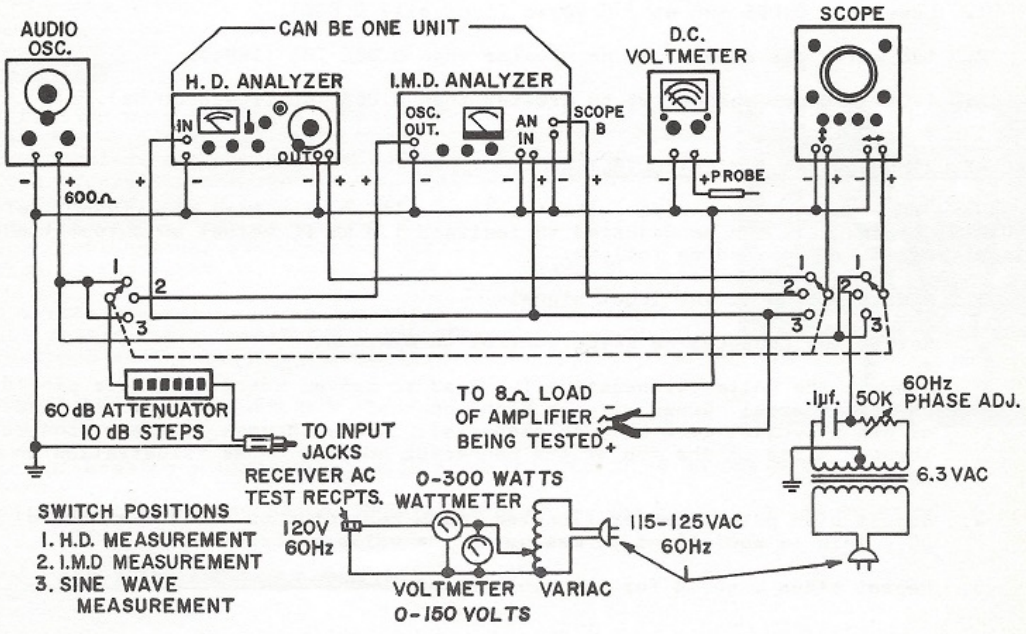
Proper output transistor operation and output bias adjustment are most important to assure cool, low-distortion operation of the amplifier. Bias adjustment is necessary if the output transistors are replaced* or if any of the transistors in the driver circuitry of the amplifier exhibits one or more of the following symptoms:

1. Overheating of the output transistors under normal operating conditions. [Normal output transistor case temperatures are 30-35°C (86-95°F), quiescent operation at 25°C (77°F) ambient].
2. Excessive low level Intermodulation Distortion (IMD) or Total Harmonic Distortion (THD) - more than 0.08% at 3.0 volts across 8 ohms.

* It is extremely important that the insulated washers used to separate the output transistors from their heat sink be unbroken and installed with silicon grease liberally applied to all surfaces in contact with each other. Make certain that the emitter and base pins of the output transistors do not touch any part of the heat sink assembly.

NOTE: For the following tests, an 8 ohm load resistor must be connected to each of the two power amplifier (speaker) output terminals.

SUGGESTED AMPLIFIER TEST BENCH SET-UP



The following are three methods for adjusting output transistor bias:

BIAS ADJUSTMENT USING A HARMONIC DISTORTION ANALYZER

1. Connect the amplifier for testing as illustrated on the proceeding page.
2. Connect an oscillator with less than 0.01% distortion at 1KHz to the amplifiers rear panel, Left POWER AMP INput, and set the POWER AMP/PREAMP MODE SWITCH on the back panel to the SEPARATE position.
3. Adjust the oscillator for an amplifier output of 3.0 volts across the 8 ohm load of the amplifier channel under test.
4. Using the Harmonic Distortion Analyzer, looking at the distortion of the amplifier properly nulled, make the adjustment as follows: Adjust bias for class "AB" operation by turning the bias potentiometer VR601 so that crossover is at the point of being eliminated. NOTE: Class "A" operation (continued CW rotation) causes the output transistors to draw excessive current and overheat. Refer to waveform illustrations below.
5. Repeat step 2, 3 and 4 for the Right channel and adjust bias with VR601B. The bias pots are located on their respective driver boards.

Improper Bias Adjustment

Proper Bias Adjustment

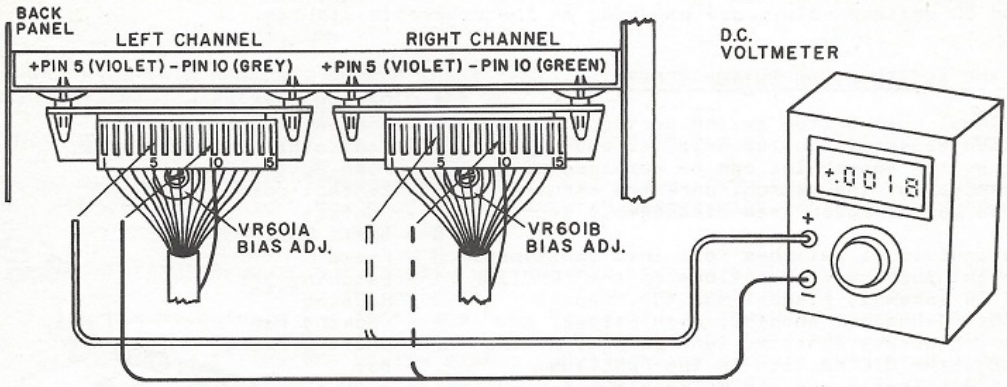
The following performance indicates a properly operating amplifier with both channels driven into 8 ohm loads:

1. Less than 0.08% THD at 3.0 volts (typically 0.03%).
2. 130 watts per channel at no greater than 0.08% THD (1KHz).
3. 120 watts per channel at no greater than 0.08% THD (20-20,000Hz).

BIAS ADJUSTMENT USING A MILLIVOLTMETER

If an accurate digital or analog voltmeter is available, the bias pots (VR601 Left and VR601B Right channel) can be adjusted to indicate 1.8 mV DC across an output transistor's emitter resistor. Proceed as follows:

1. Remove all amplifier input signals.
2. Rotate the LOUDNESS dB LEVEL control to minimum.
3. Connect the voltmeter negative (-) lead to driver board connector pin 10 (Grey wire on Left channel, Green wire on Right channel) and the positive (+) lead to connector pin 5 (Voilet wire on both channels). NOTE: Access to these pins can be made through slots on the top of the connector housing. See illustration on following page.
4. Adjust bias potentiometer (located below connector on the driver board) for 1.8 mV DC. This is equivalent to measuring the voltage across R632.
5. Repeat steps 3 and 4 for the other channel.



SETUP FOR ADJUSTING BIAS USING A MILLIVOLTMETER

BIAS ADJUSTMENT USING A LINE WATTMETER

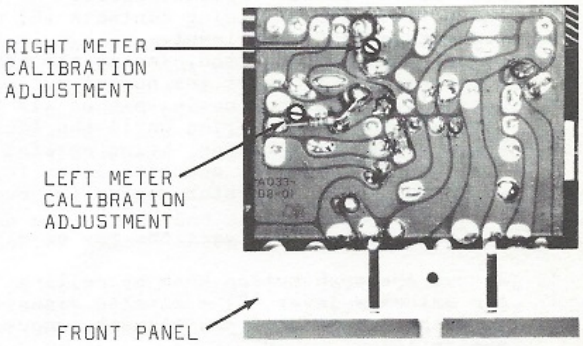
When test equipment required for the previous bias adjustments is not readily available and adjustment is absolutely necessary, the following procedure may be used which requires only an accurate line wattmeter:

1. Remove power amp input signal by switching POWER AMP/PREAMP MODE SWITCH on the rear panel to SEPARATE and turn the LOUDNESS dB LEVEL control to minimum.

2. Adjust the bias pots (VR601 on left and right driver boards) one at a time to the point at which the amplifier begins to cause a very slight increase in line wattage consumption. Typical proper operation would develop a line consumption of 30 watts.

METER CALIBRATION

Meter calibration potentiometers VR801A & B are located on the speaker selector board. These potentiometers are screwdriver adjustable and are accessible through the two 5/32" holes on this board. As viewed from the front, the Left channel pot is located to the left of the right channel adjustment. See illustration at the right.



1. To calibrate the meter, drive the amplifier so that a 1KHz signal of 9.8 VAC RMS is developed at the speaker terminals.

2. Depress the meter range switch to the -10 dB position.

3. Adjust calibration potentiometer VR801A to indicate 0 dB on the meter scale.

4. Repeat steps 1 and 3 and adjust VR801B for 0 dB on the right channel meter scale.

POWER SUPPLY SERVICING AND FAULT ANALYSIS

Power supply malfunctions are usually due to a shorted or open power rectifier bridge BR1,

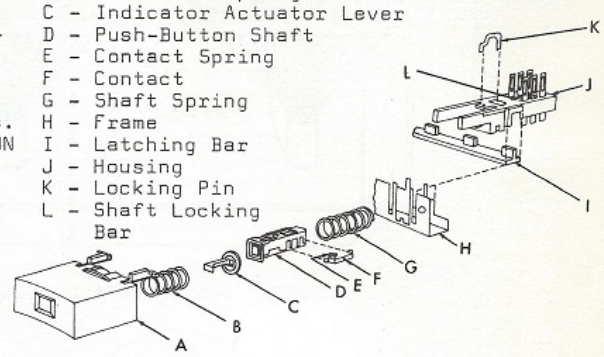
zener diodes X1 and X2, transistors Q1 and Q2, or a defective power transformer. These devices may be easily checked with an ohmmeter. The transformer's operation may be checked by measuring secondary voltages with the associated circuit legs disconnected. The normal AC and DC voltage values are provided on the schematic diagram.

SELECTOR AND FUNCTION SWITCH SERVICING

Individual push-button switch sections of the Function Selector, Source Selector and Meter Range switch assemblies can be serviced without removal of the switch, once the escutcheon has been removed (see Disassembly sect.).

These individual switches fall into two types. The eight push-button sections on the FUNCTION SELECTOR assembly [Tape 1 Monitor, Tape 2 Monitor, 4-Channel Adapter, High Filter, Low Filter, Loudness Contour, Tone Defeat, Muting -20 dB], the MIC section on the FUNCTION SELECTOR assembly and the METER RANGE switch are of the "PUSH-PUSH" type and are easily identified because of the locking pin (K)[see illustration on the right] on top of the housing (J).

A - Push-Button Knob (with Indicator)
B - Indicator Spring
C - Indicator Actuator Lever
D - Push-Button Shaft
E - Contact Spring
F - Contact
G - Shaft Spring
H - Frame
I - Latching Bar
J - Housing
K - Locking Pin
L - Shaft Locking Bar



The seven remaining push-button sections on the SOURCE SELECTOR assembly [Phono 1, Phono 2, Tuner, Aux 1, Aux 2, Tape 1, Tape 2] are of the "INTERLOCKING" type (pushing one button, releases any of the remaining buttons). These sections are easily identified since the locking pin (K) is missing. Each type is disassembled for cleaning or servicing in a slightly different manner.

PUSH-BUTTON type switches may be disassembled as follows:

1. Remove the push-button knob by pulling it away from the shaft. The indicator spring (B) and indicator activator lever (C) will also disengage.
2. Hold a finger on the push-button shaft (D) so that the shaft can not push outward. Using a long nose pliers, move the shaft spring (G) away from the switch housing until the locking pin (K) can be removed.
3. Remove the locking pin (K) and slowly release the push-button shaft. Remove the shaft assembly from the switch housing (J).
4. Locate the malfunction and repair or replace the defective part by refering to the push-putton drawing detail, above.
5. The spring loaded sliding contacts (F) may be removed for cleaning. Use contact cleaners with a light lubricant.
6. To reassemble the switch, insert the complete push-button shaft into the switch housing, holding it in to about the normal out position.
7. Carefully grasp the locking pin at its front edge with a long nose pliers and slowly compress the shaft spring until the locking pin can be inserted in the switch housing.
8. Release the shaft spring, being careful that correct reassembly has been achieved.
9. Replace the indicator actuator lever (C) onto the shaft with the stem on the left side, as shown; place indicator spring (B) over the stem on (C) and replace push-button knob.

INTERLOCKING type switch sections may be disassembled as follows:

1. Remove the push-button knob by pulling it away from the shaft. The indicator spring (B) and actuator lever (C) will also disengage.
2. Lift the rear end of the plastic tongue (L) to disengage and remove shaft (D) and spring (G).
3. The spring loaded sliding contact (F) can now be removed for cleaning. Use contact cleaners with a light lubricant.
4. To reassemble the switch, insert the complete shaft and spring assembly into the switch housing until it locks in place.
5. Replace the indicator actuator lever (C) onto the shaft with the stem on the left side, as shown; place indicator spring (B) over the stem on (C) and replace push-button knob.

DISASSEMBLY

CHASSIS DISASSEMBLY FOR SERVICING (In sequence)

1. REMOVING SIDE TRIM PANELS. Remove the 4 Phillips head screws and washers (2 each side panel) located in recessed holes in the wood panels.

2. REMOVING TOP COVER. Remove the 6 Hex head screws (3 each side). Lift up and off.

3. REMOVING THE BOTTOM PLATE. Remove the 4 Hex head screws from the bottom of the bottom plate. Remove the 3 black Hex head screws located nearest the center on the bottom edge of the rear panel. Lift the plate off.

4. REMOVING THE ESCUTCHEON (Front Panel). Remove all control knobs by pulling them away from the escutcheon. Remove the nylon spacers from the knob shafts. Note that there is a nylon spacer between the front and back knobs of the loudness control, as well as one between the back knob and the escutcheon. Remove 3 Hex head machine screws from the top flange and 1 from the bottom flange. Pull the escutcheon away from the unit. In replacing the escutcheon, be sure to include the nylon spacers and make certain that the two LED's are seated properly in the escutcheon.

5. METER REPLACEMENT. After removing the escutcheon, remove the 2 Hex head machine screws and nuts that hold the meter light shield to the front panel. Loosen the 2 meter bracket Hex head sheet metal screws located below the meter to be replaced. The meter can now be removed. Note the meter's correct wiring polarity. If the zener diode wired across the meter is functional, transfer it to the new meter, also noting the correct polarity. Be sure to retighten the meter bracket screws before replacing the light shield.

REMOVING CIRCUIT BOARDS FOR SERVICING

PHONO EQUALIZER PREAMP board uses a interlocking connector. To facilitate removal, pull up at one of the top corners of the board instead of straight up from the center. This causes the board to pivit on the opposite lower side, unlocking the connector for easy removal.

MICROPHONE PREAMP. Remove the escutcheon (steps 1 thru 4 above). Next remove the two Mic input jack and level control mounting nuts. The board can now be moved away from the front panel, exposing both sides of the board for easy signal tracing, etc. The board can be completely removed by unplugging the wire connector, located on the Source Selector switch board, in the manner described under Phono Equalizer Preamp above.

SOURCE SELECTOR SWITCH. Remove the escutcheon (steps 1 thru 4 above). By removing the 2 front panel Hex head mounting screws, one on each side of the switch bank, this board can be lowered and positioned out of the chassis for easy signal tracing and servicing. The board can be entirely removed from the unit by disconnecting the four wire-connector plug assemblies and removing the insulated dubbing jacks and phono level control mounting nuts. When remounting the dubbing jacks, be certain that the jack with the yellow connecting wires is located in the lower mounting hole.

FUNCTION SELECTOR SWITCH BOARD. This board can be lowered and removed from the unit using basically the same procedure as the Source Selector switch above.

SPEAKER SWITCH BOARD. Remove the escutcheon (steps 1 thru 4 above). Next, remove the Hex head shield mounting screw and speaker switch mounting nut. Loosen or remove the five Tone Control board mounting nuts and move the board away from the front panel. This will allow more room for removing the Speaker Switch board. Lift up the rear edge of the speaker switch board to remove the shaft from the front panel. The board and shield can now be separated and the board can be positioned to expose the component side.

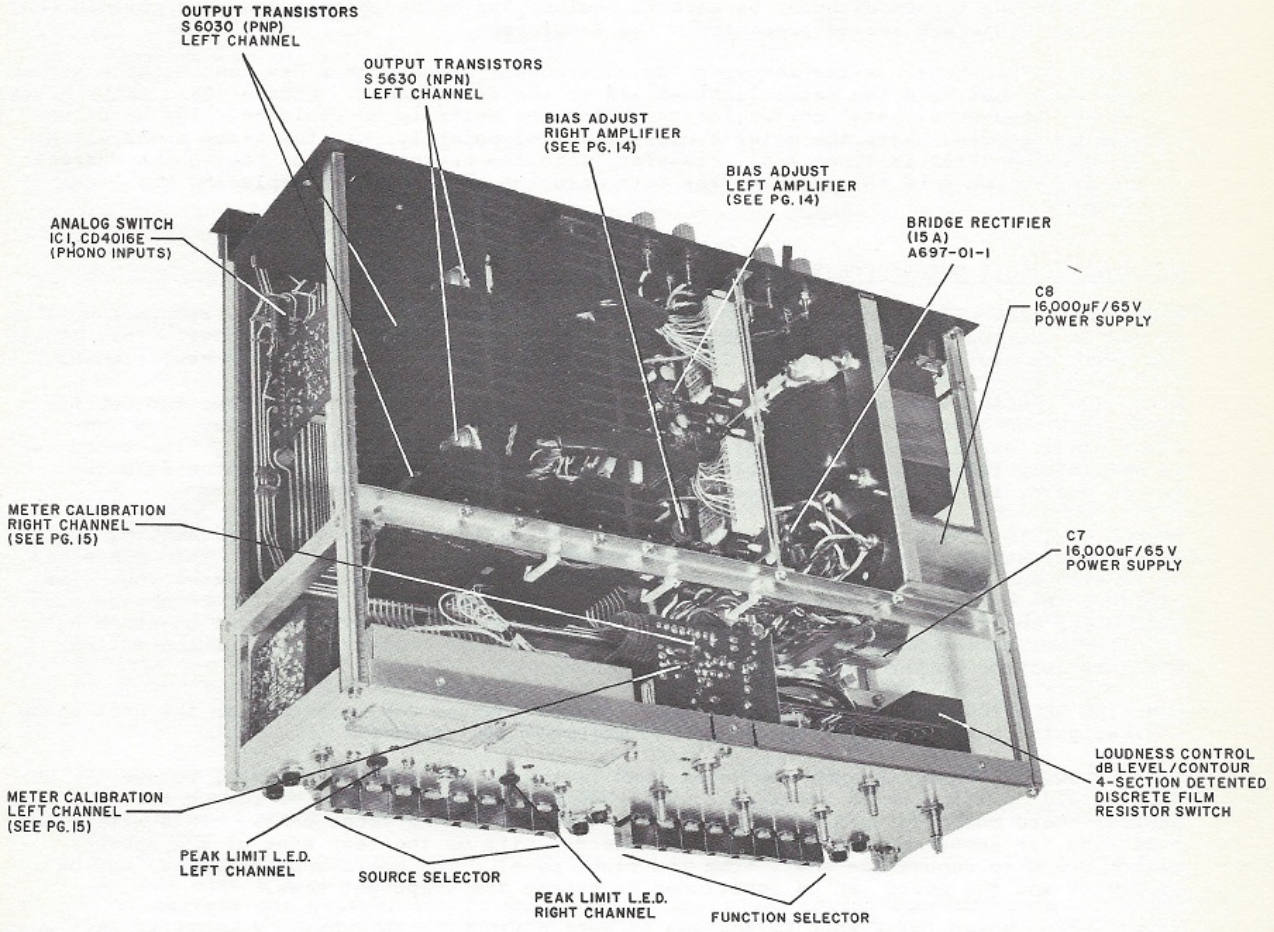
TONE CONTROL BOARD (With MODE SWITCH and BALANCE CONTROL). To greatly facilitate the removal of the Tone Control board the shield should first be removed. Next, with the 5 control mounting nuts removed, disconnect the ribbon connector plug connected to the Function Selector switch board and remove the board.

DRIVER BOARDS. Disconnect the interlocking connector from the top of the driver board to

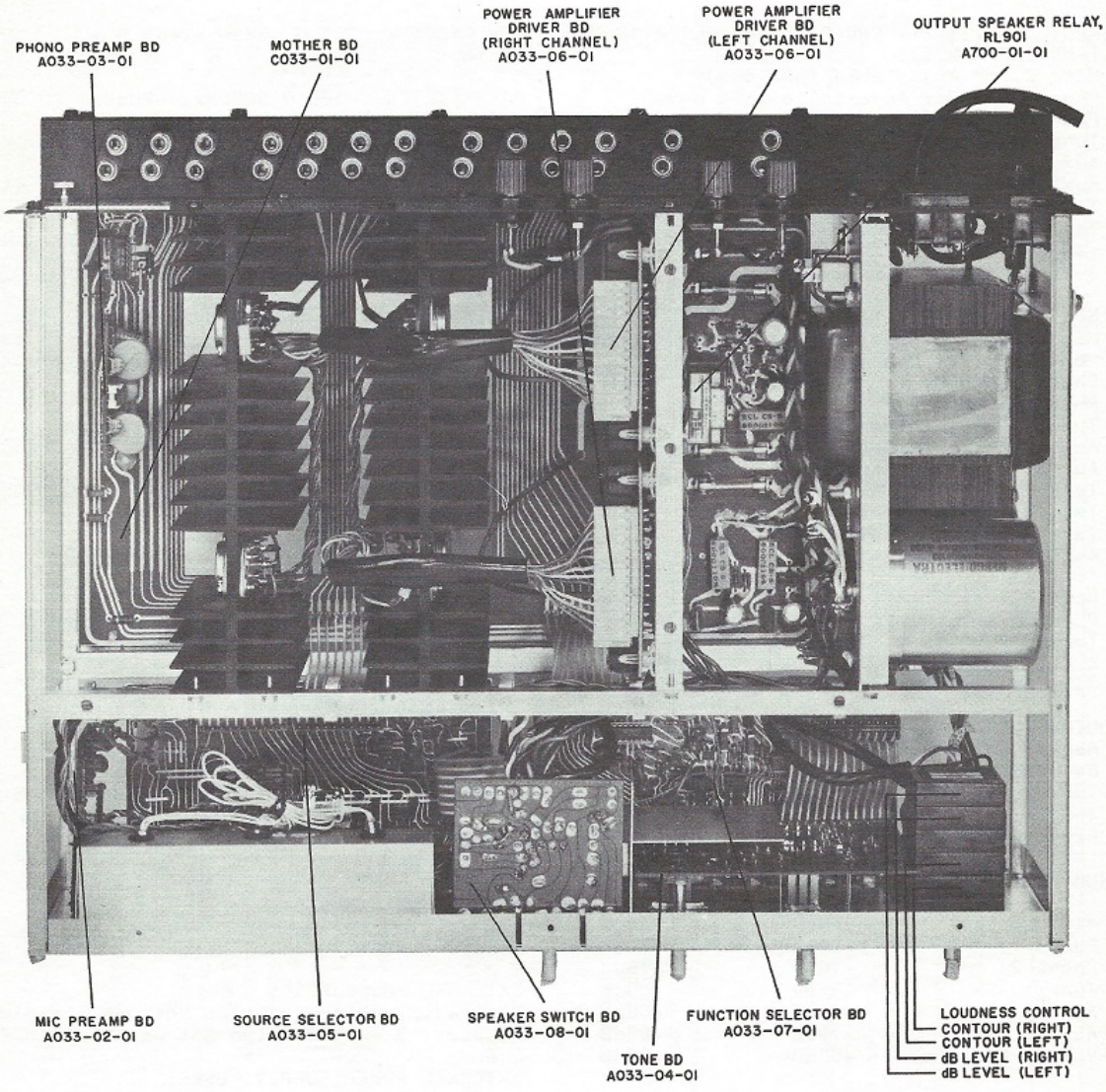
be serviced. Press the locking tab of the nylon standoff located at the top corners of the driver board. This allows the board to be removed from the mounting standoff. The board can now be pulled out of its "mother" board connector in a manner similar to that described for the Phono Equalizer Preamp board. The output transistors are easily accessable for replacement by removing one or both driver boards and/or the Phono Equalizer Preamp board.

To greatly facilitate the servicing of amplifier driver boards, interconnecting jumper cables are available from Sherwood. One of the cables provides for an extention connection between the "mother" board and the driver board input connector. Another cable connects the driver board output back to the heat sink wire connector. Each extention cable is 21 inches long. The price for the set of two cables is $5.00.

PART LOCATION PICTORIALS



VIEW 1, HP2000 AMPLIFIER CHASSIS



VIEW 2, HP2000 AMPLIFIER CHASSIS

SPECIFICATIONS*

PREAMPLIFIER

BASS CONTROL: ±14dB @ 50Hz

MIDRANGE CONTROL: ±6dB @ 1000Hz

TREBLE CONTROL: ±14dB @ 15,000Hz

INPUT SENSITIVITY FOR RATED OUTPUT @ 1000Hz (AND IMPEDANCE):
- Mic: 2.2mV Adjustable (50K ohm)
- Phono 1: 2.2mV Adjustable (50K ohm)
- Phono 2: 2.2mV Adjustable (50K ohm)
- Tuner: 110mV (50K ohm)
- Aux 1: 110mV (50K ohm)
- Aux 2: 110mV (50K ohm)
- Tape 1: 110mV (50K ohm)
- Tape 2: 110mV (50K ohm)
- Tape Dubbing: 110mV (50K ohm)
- 4-CH Adapter: 110mV (50K ohm)

INPUT CAPABILITY AT 0.08% THD, 1000Hz:
- Mic: 200mV to greater than 6V, dependent on Mic Level Control setting
- Phono 1: 160mV
- Phono 2: 160mV
- Tuner: Greater than 6V
- Aux 1: Greater than 6V
- Aux 2: Greater than 6V
- Tape 1: Greater than 6V
- Tape 2: Greater than 6V
- Tape Dubbing: Greater than 6V
- 4-CH Adapter: Greater than 6V

FREQUENCY RESPONSE:
- Phono 1 & 2: 30-20,000Hz ±0.5dB RIAA Std.
- Tuner, Aux 1 & 2, Tape 1 & 2, Tape Dubbing, & 4-CH Adapter: 20-20,000Hz ±0.5dB
- Mic: 50-15,000Hz ±1.5dB

OUTPUT LEVEL (AND IMPEDANCE):
- Record Out 1: 110mV (2K ohm)
- Record Out 2: 110mV (2K ohm)
- Tape Dubbing: 110mV (2K ohm)
- 4-CH Adapter: 110mV (4K ohm)
- Preamplifier: 830mV (1K ohm)

HUM AND NOISE:

	(Signal/Noise)	(IHF "A" Wtg.)
Mic:	-60dB	-65dB
Phono 1:	-70dB	-75dB
Phono 2:	-70dB	-75dB
Tuner:	-75dB	-80dB
Aux 1:	-75dB	-80dB
Aux 2:	-75dB	-80dB
Volume Minimum:	-85dB	-95dB

* All specifications with 120 VAC line; specifications and design subject to possible modification without notice.

PREAMPLIFIER (Continued)

TOTAL HARMONIC DISTORTION (THD):
- Less than 0.05% from 20-20,000Hz @ 830mV
- Less than 0.08% @ 7V, 1000Hz

CROSSTALK: Better than -40dB @ 1000Hz

LOW FILTER: -3dB @ 40Hz, -24dB @ 10Hz, 12dB/Octave

HIGH FILTER: -3dB @ 8000Hz, -20dB @ 20,000Hz, 12dB/Octave

LOUDNESS BOOST @ -18dB SETTING:
- Variable from 0 to +10dB @ 100Hz, (11 steps), +4dB @ 10,000Hz

POWER AMPLIFIER

POWER OUTPUT: 120 watts per channel, minimum RMS, at 8 ohms from 20-20,000Hz, with no more than 0.08% Total Harmonic Distortion

INTERMODULATION DISTORTION:
- Less than 0.08% @ 8 ohm rated output
- Less than 0.03% @ 50 watts

INPUT SENSITIVITY FOR RATED OUTPUT @ 1000Hz:
830mV (100K ohm impedance)

FREQUENCY RESPONSE: 4-130,000Hz ±1dB

HUM AND NOISE:
- Signal to Noise: -100dB
- IHF "A" Weighing: -110dB

CROSSTALK: Better than -50dB from 20-20,000 Hz; -85dB @ 1000Hz

DAMPING FACTOR: 70:1 @ 8 ohms

HEADPHONE OUTPUTS: 4 ohm or greater each jack

GENERAL

POWER REQUIREMENTS:
- Domestic: 115-125 VAC, 50/60Hz
- Export: 220-240 VAC, 50/60Hz

EXTERNAL POWER FUSE:
- Domestic: 6 Amp, 3AG (Do Not use Slo-Blo fuse)
- Export: 3 Amp, 3AG (Do Not use Slo-Blo fuse)

INTERNAL POWER SUPPLY FUSES:
- 4-6 Amp, 3AG (Do Not use Slo-Blo fuse)

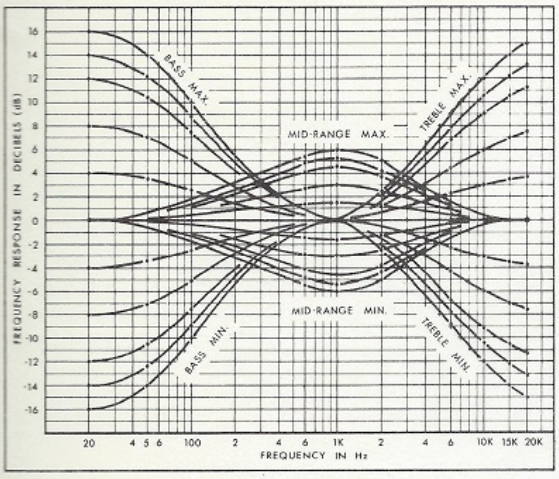
RATED POWER CONSUMPTION (DOMESTIC AND EXPORT):
- 30-420 watts

AC OUTLETS:
- 3-Switched, 450 watts total
- 3-Unswitched, 600 watts total

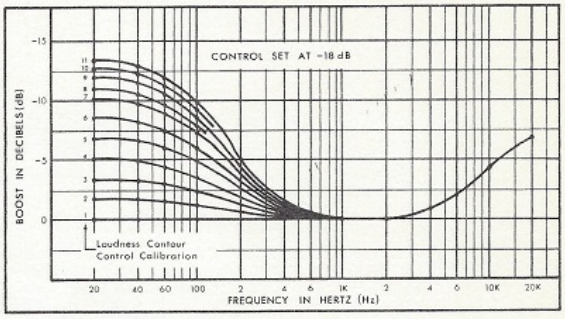
PERFORMANCE CURVES

PREAMPLIFIER

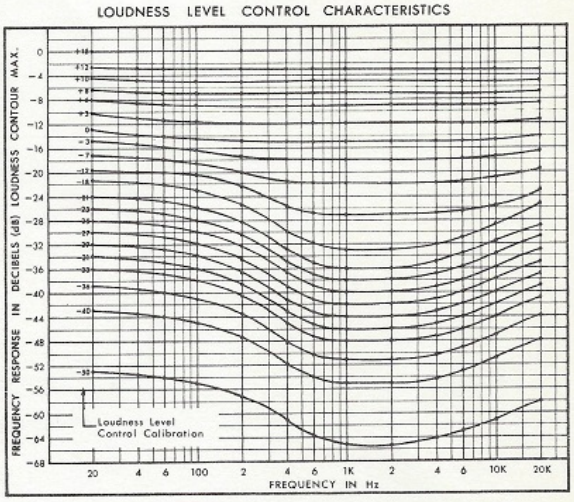
TONE CONTROL CHARACTERISTICS



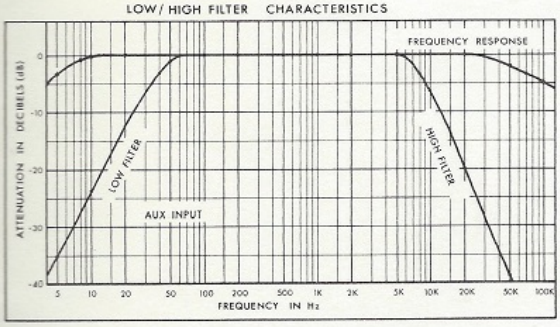
VARIABLE LOUDNESS BOOST CHARACTERISTICS



LOUDNESS LEVEL CONTROL CHARACTERISTICS

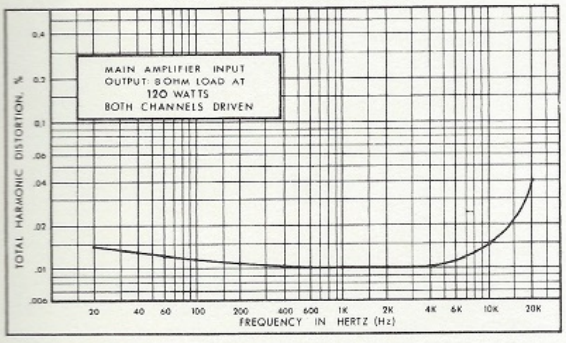


LOW/HIGH FILTER CHARACTERISTICS

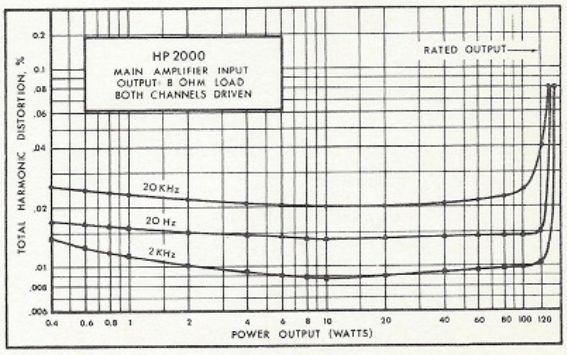


POWER AMPLIFIER

DISTORTION VS FREQUENCY, HP2000



POWER OUTPUT VS DISTORTION



SHERWOOD MODEL HP2000 REPLACEMENT PARTS LIST

ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE

TRANSISTORS	REFERENCE NO.	PART NO.	LIST PRICE
BC239	Q301a,b; 501a,b		$ .63
MPS-A20	Q614a,b; 902, 903		.36
RCA29	Q2		1.53
RCA30	Q1		1.75
S1C12	Q608a,b		2.83
S1C13	Q607a,b		2.83
S5630 [Output, NPN]	Q610a,b; 612a,b		7.38
S6030 [Output, PNP]	Q611a,b; 613a,b		8.01
SJE667	Q609a,b		1.26
SPS2197	Q601a,b; 604a,b 606a,b; 901		.95
SPS2198	Q602a,b; 603a,b 605a,b		1.04

INTEGRATED CIRCUITS			
CA3100S	IC601a,b		5.40
CD4016	IC1		1.57
TBA231/uA739	IC401a,b; 501a,b		3.42
RC4136	IC101		4.55

DIODES: SIGNAL, POWER, ZENER & LED			
Signal, Germanium	X801a,b; 802a,b; 803a,b; 804a,b	A691M5	.36
Signal, Silicon	X603a,b; 604a,b; 605a,b; 606a,b; 607a,b; 608a,b	B692X13	.54
Power (1.5A 200 PIV)	X3, 901, 902	A692T3	.68
Zener (12VZ 5% 0.5W)	X601a,b; 602a,b	A694-01-01	.42
Zener (16VZ 5% 1W)	X1, 2	A694X6	.54
Zener (4.7VZ 5% 0.4W)	X4a,b	A694X8	.51
Bridge (15A 200 PIV)	BR1	A697-01-01	6.75
L.E.D. (20mA 2V)	X609a,b	A698-01-01	.72

ELECTROLYTIC CAPACITORS (PC unless otherwise specified)			
10mf 25VAC [Non-Polar]	C903	CNRM4100NVS	.27
50mf 15VDC	C205a,b	B120X36	.41
100mf 35VDC	C4, 5, 504	B120X46	.54
100mf 150VDC	C6a,b	CERM9101XXS	1.71
220mf 15VDC	C901	B120X38	.28
330mf 10VDC	C602a,b	B120X47	.45
16,000mf 65VDC [Can]	C7, 8	A120-01-01B	15.34

ELECTRICAL COMPONENTS	REFERENCE NO.	PART NO.	LIST PRICE
Control, Dual 50K Ohm	VR1 [Phono Level]	A670-06-01D	$2.87
Control, Quad 50K Ohm	VR2, 3 [Loudness/ Contour]	B670-05-01B	15.25
Control, Dual 500K Ohm	VR101 [Mic Level]	A670-06-02D	2.87
Control, Dual 500K Ohm	VR501a,b; 502a,b [Bass, Midrange]	A670-04-02C	3.19
Control, Dual 100K Ohm	VR504 [Balance]	A670-09-01B	3.10
Fuse, 6 Amp, 3AG	F1, 2, 3, 4, 5	312006	.23
Lamp, 14 VDC, 60mA		A630S1	.70
Meter, "VU", 120 Watt	M1a,b	C550-01-02	10.98
Relay, Speaker, 10 Amp	RL901	A700-01-01	11.25
Switch, Slide, DPDT	S1 [PreAmp/Main]	A864-01-01	1.01
Switch, 1 Push-Button	S2 [AC On/Off]	A866-02-01	3.33
Switch, 1 Push-Button	S3 [Meter Range]	A866-03-01A	1.21
Switch, 8 Push-Button	S301 [Selector]	C866-01-01A	28.44
Switch, 8 Push-Button	S401 [Function]	C866-01-02A	27.99
Switch, Rotary, 5 Pos.	S501 [Mode]	A860-01-01B	4.88
Switch, Rotary, 5 Pos.	S801 [Speaker]	B860-02-01C	6.70
Transformer, Power	T1 [120 VAC]	C922-01-02B	47.13
Transformer, Power	T1 [120/240 VAC]	C922-01-02X	*
Trimmer Resistor, 1K	VR601a,b [Bias]	A675T13	.54
Trimmer Resistor, 2K	VR801a,b[Mtr Cal]	A675X5	.49

MECHANICAL COMPONENTS		
Escutcheon, Meter Window Frame	B250-01-01C	2.47
Escutcheon Assembly [Less Meter Window]	F250-05-01	24.61
Extrusion, Side Trim [Either side piece]	B250-04-01C	8.42
Knob, Aluminum, 50mm Dia. [Loudness]	B468-01-01B	6.81
Knob, Aluminum, 59mm Dia. [Contour]	B468-02-01A	5.68
Knob, Aluminum, 20.8mm Dia. [Tone]	B468-03-01A	2.40
Knob, Aluminum, 27mm Dia. [Spkr, Mode, Balance]	B468-03-02A	2.85
Knob, Aluminum, 11mm Dia. [Phono, Mic, Meter]	A468-04-01	.87
Plexiglass Meter Window	A642-01-01	.87
Receptacle, Phono, PC Mounting	A794-01-01	.32
Jack, Mono Phone, Insulated Bushing	A795-01-02	1.17
Jack, Stereo Phone, Insulated Bushing	A795-02-01	1.05
Fuse Post Assembly, Complete	A796X2-1A	1.35
Terminal Post, Red and Black (Speakers)	A901-01-01	2.70
Shipping Carton and Poly End Caps	N130-01-01	8.00

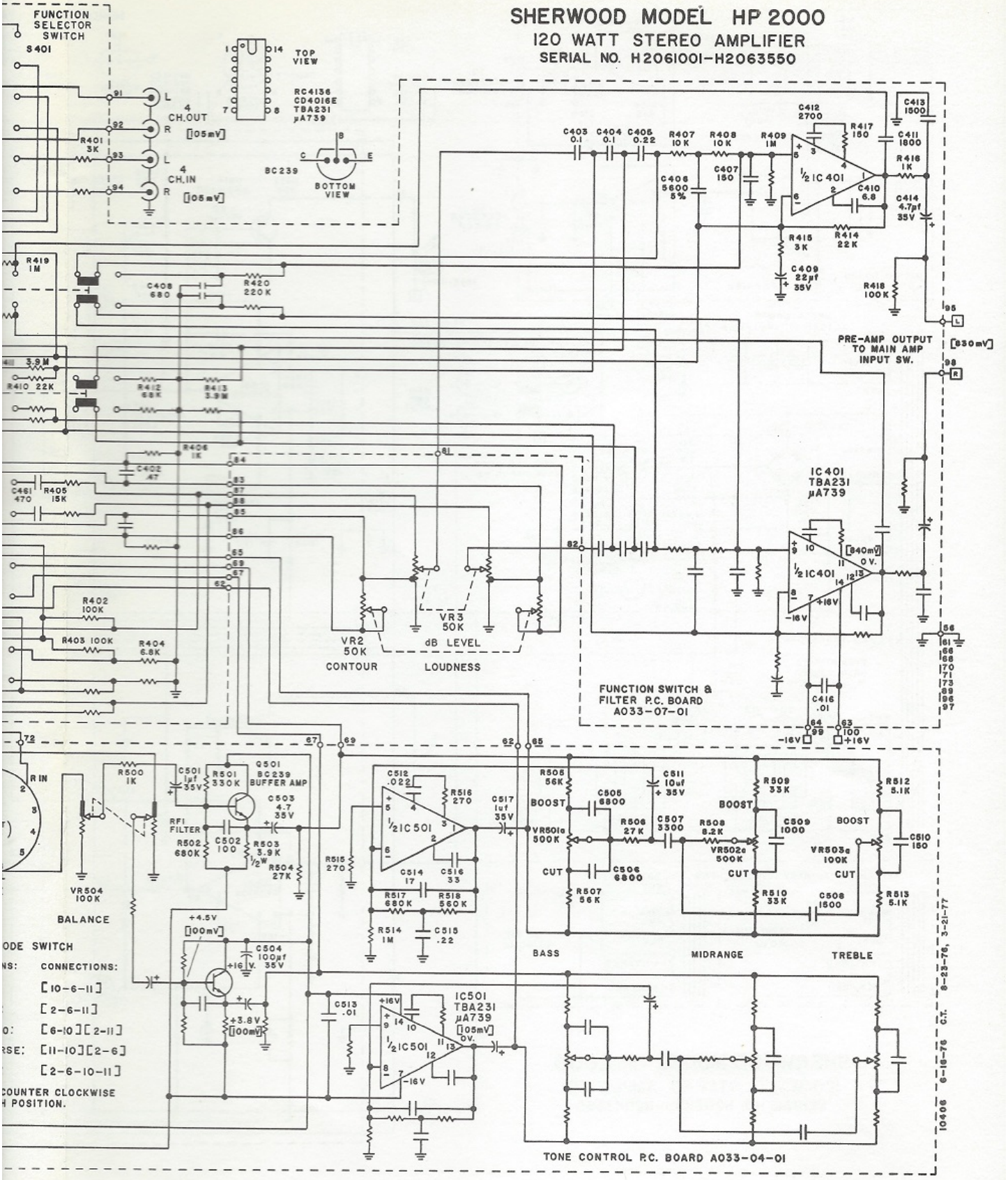
* Write for quotation on purchase or exchange of domestic transformer for export transformer [120/240V, 50/60Hz]

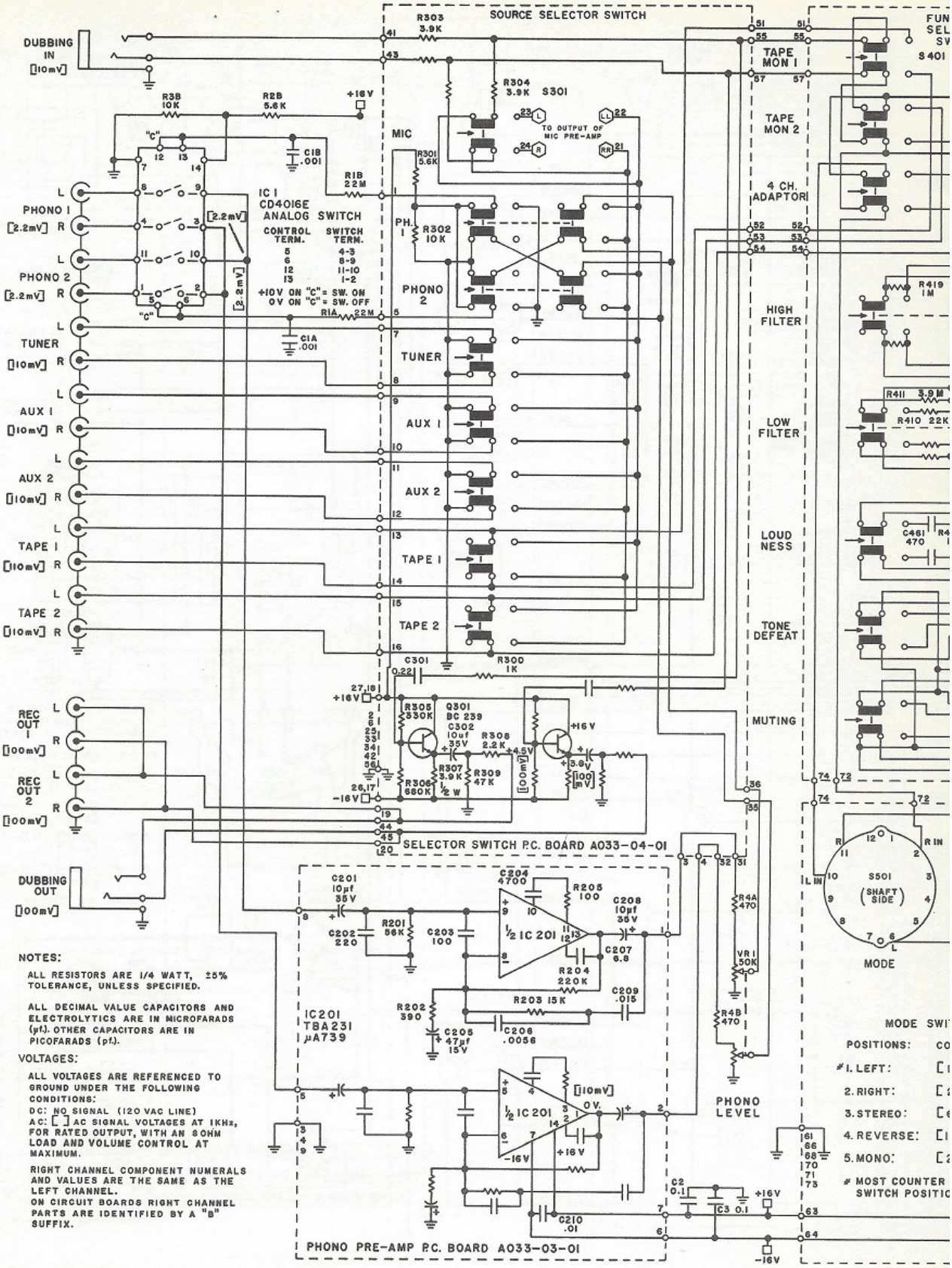
SHERWOOD ELECTRONIC LABORATORIES, INC., 4300 N. CALIFORNIA AVE., CHICAGO, IL 60618 (312)478-7300 Litho in USA 3-77

SHERWOOD MODEL HP 2000

120 WATT STEREO AMPLIFIER

SERIAL NO. H2061001-H2063550





NOTES:

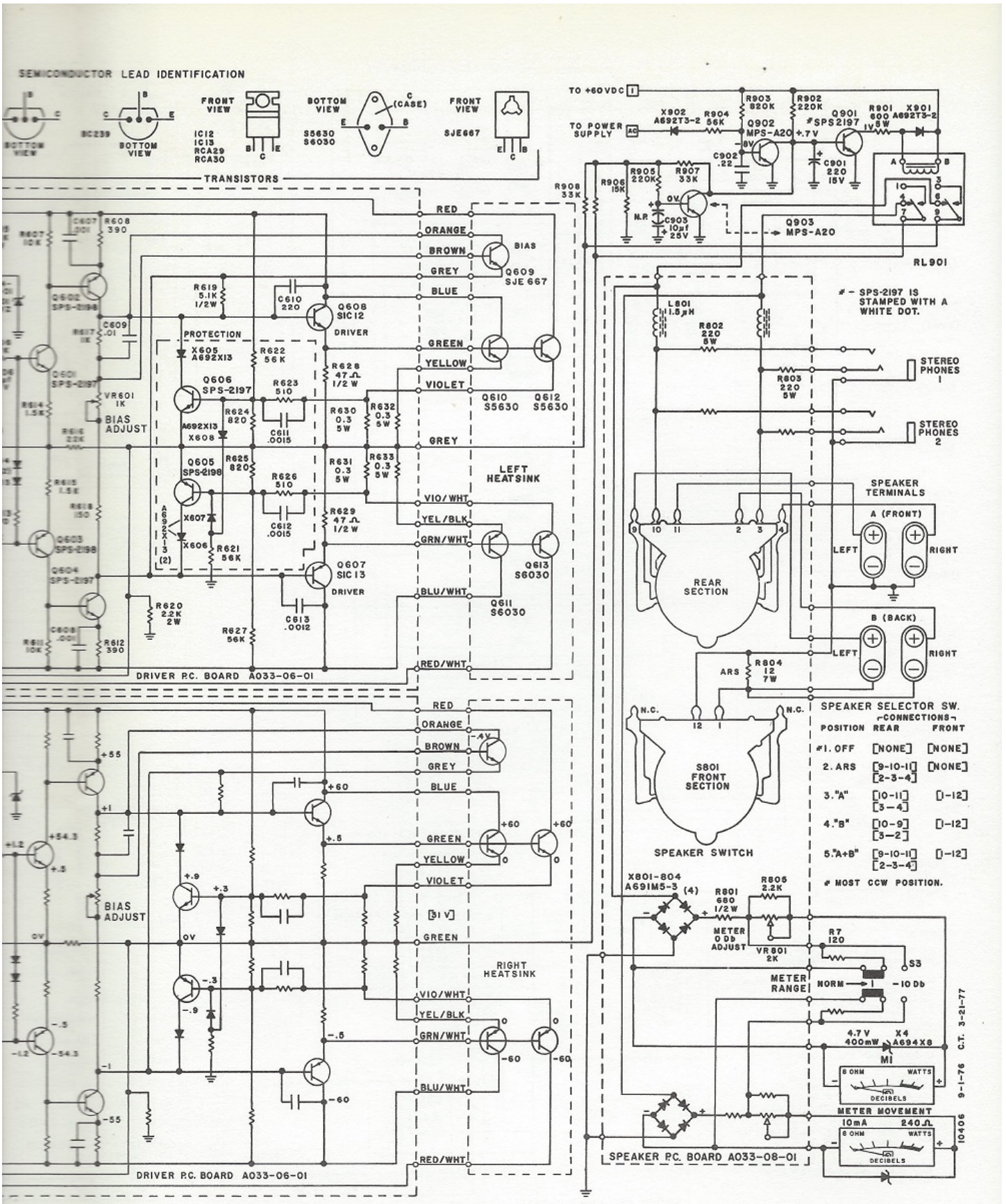
ALL RESISTORS ARE 1/4 WATT, ±5% TOLERANCE, UNLESS SPECIFIED.

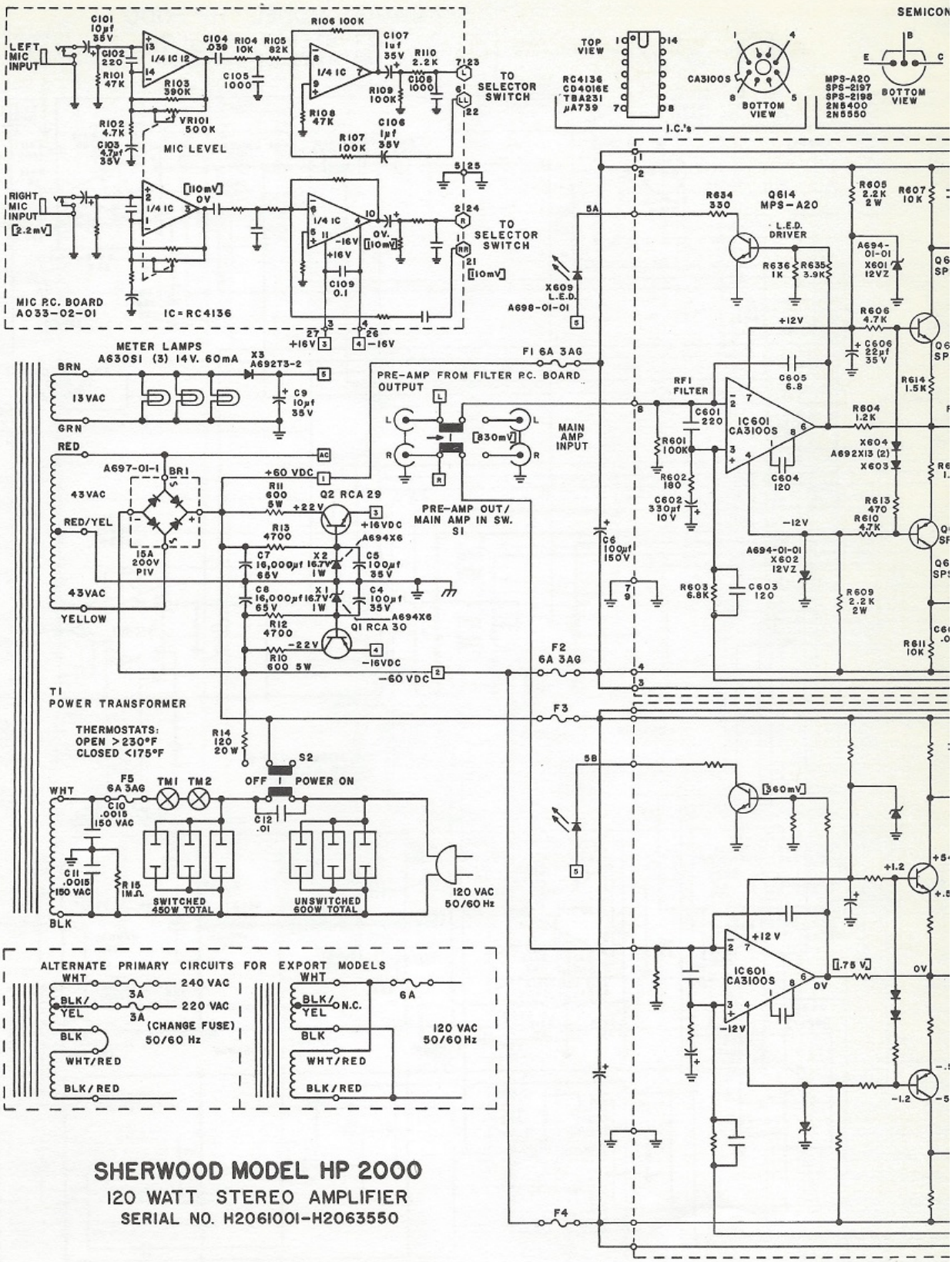
ALL DECIMAL VALUE CAPACITORS AND ELECTROLYTICS ARE IN MICROFARADS (µf). OTHER CAPACITORS ARE IN PICOFARADS (pf).

VOLTAGES:

ALL VOLTAGES ARE REFERENCED TO GROUND UNDER THE FOLLOWING CONDITIONS:
DC: NO SIGNAL (120 VAC LINE)
AC: [ ] AC SIGNAL VOLTAGES AT 1KHz, FOR RATED OUTPUT, WITH AN 8OHM LOAD AND VOLUME CONTROL AT MAXIMUM.

RIGHT CHANNEL COMPONENT NUMERALS AND VALUES ARE THE SAME AS THE LEFT CHANNEL.
ON CIRCUIT BOARDS RIGHT CHANNEL PARTS ARE IDENTIFIED BY A "B" SUFFIX.

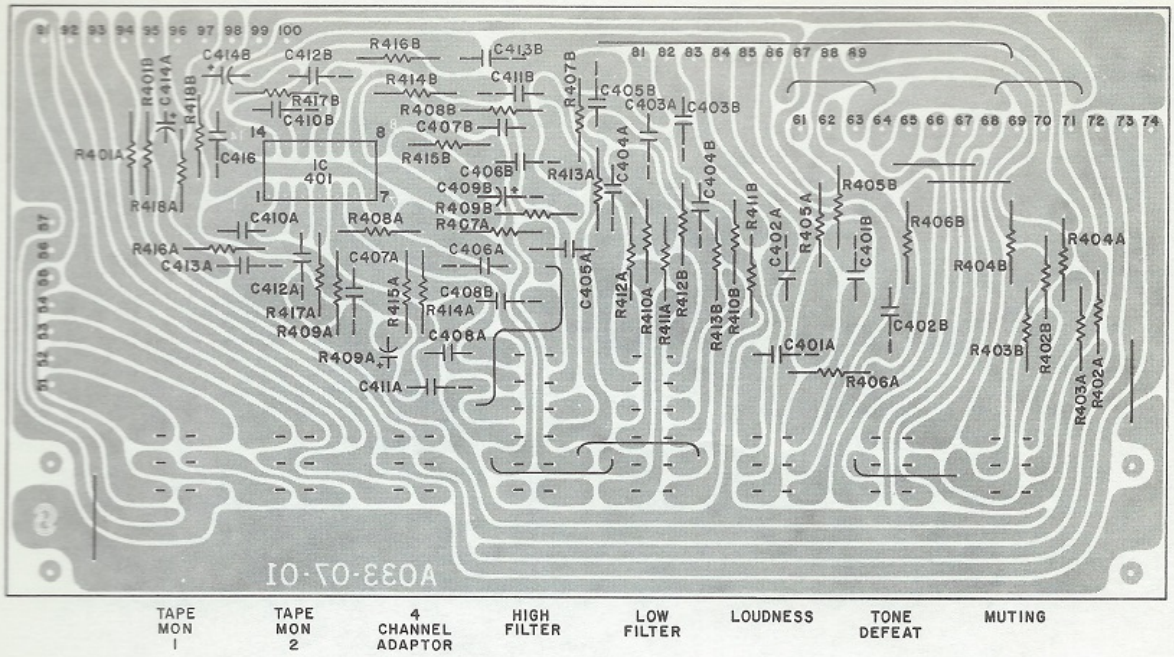

SEMICONDUCTOR LEAD IDENTIFICATION
BOTTOM VIEW
BC239
BOTTOM VIEW
FRONT VIEW
IC12
IC13
RCA29
RCA30
BOTTOM VIEW
S5630
S6030
FRONT VIEW
SJE667
TRANSISTORS
TO +60VDC
TO POWER SUPPLY
X902 A692T3-2
R904 56K
R903 820K
R902 220K
Q902 MPS-A20
Q901 #SPS2197
R901 600 8W
X901 A692T3-2
C902 .22
C901 220 15V
R906 15K
R905 220K
R907 33K
R908 33K
C903 10µf 25V
Q903 MPS-A20
RL901
- SPS-2197 IS STAMPED WITH A WHITE DOT.
L801 1.5µH
R802 220 5W
R803 220 5W
STEREO PHONES 1
STEREO PHONES 2
SPEAKER TERMINALS
A (FRONT)
B (BACK)
LEFT
RIGHT
REAR SECTION
ARS
R804 12 7W
SPEAKER SELECTOR SW.
CONNECTIONS
POSITION REAR FRONT
#1. OFF [NONE] [NONE]
2. ARS [9-10-11] [2-3-4] [NONE]
3. "A" [10-11] [3-4] [-12]
4. "B" [10-9] [3-2] [-12]
5. "A+B" [9-10-11] [2-3-4] [-12]
MOST CCW POSITION.
S801 FRONT SECTION
SPEAKER SWITCH
N.C.
X801-804 A691M5-3 (4)
R801 680 1/2W
METER 0 Db ADJUST
VR801 2K
R805 2.2K
R7 120
S3
METER RANGE
NORM
-10 Db
4.7V 400mW
X4 A694X8
MI
METER MOVEMENT
10mA 240Ω
8 OHM WATTS
DECIBELS
SPEAKER P.C. BOARD A033-08-01
C.T. 3-21-77
9-1-76
10406
RED
ORANGE
BROWN
GREY
BLUE
GREEN
YELLOW
VIOLET
GREY
VIO/WHT
YEL/BLK
GRN/WHT
BLU/WHT
RED/WHT
BIAS
Q609 SJE 667
Q608 SIC12 DRIVER
Q610 S5630
Q612 S5630
Q613 S6030
Q611 S6030
LEFT HEATSINK
RIGHT HEATSINK
PROTECTION
BIAS ADJUST
Q607 SIC 13 DRIVER
DRIVER P.C. BOARD A033-06-01
DRIVER P.C. BOARD A033-06-01



SHERWOOD MODEL HP 2000

120 WATT STEREO AMPLIFIER

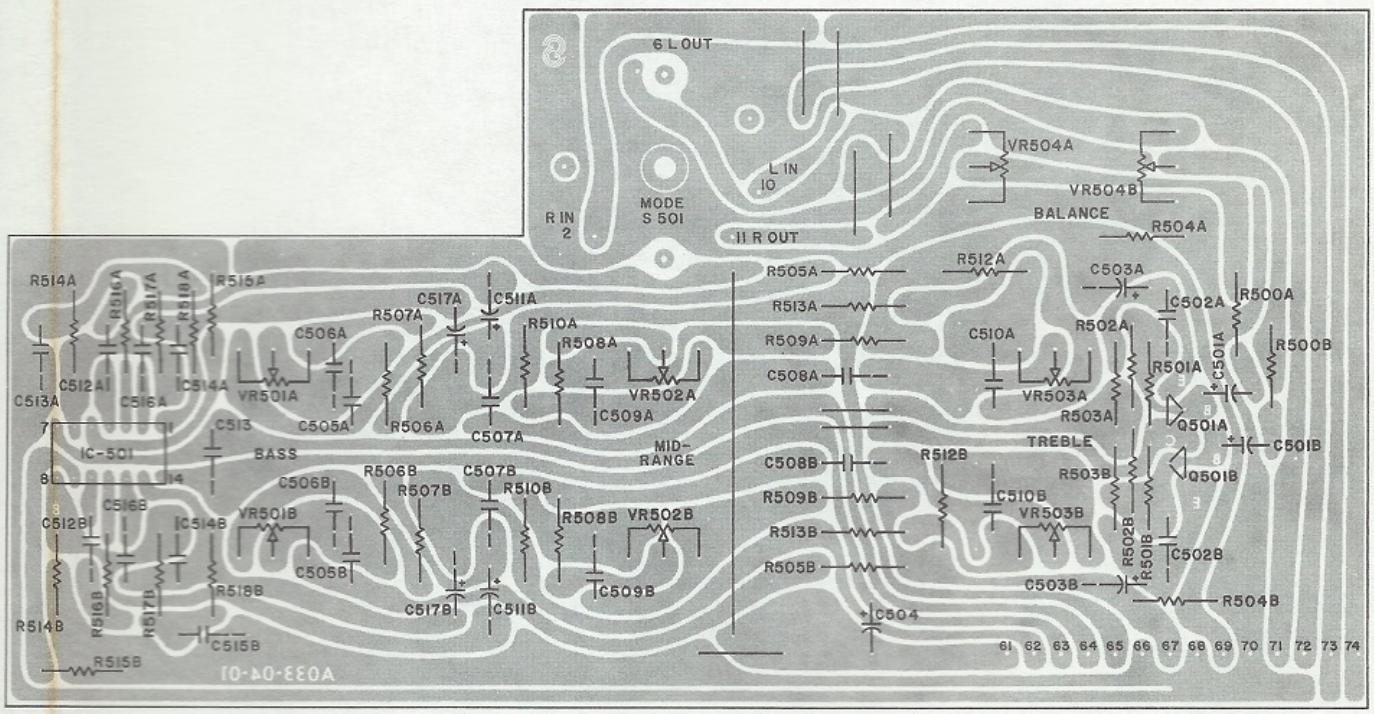
SERIAL NO. H2061001-H2063550



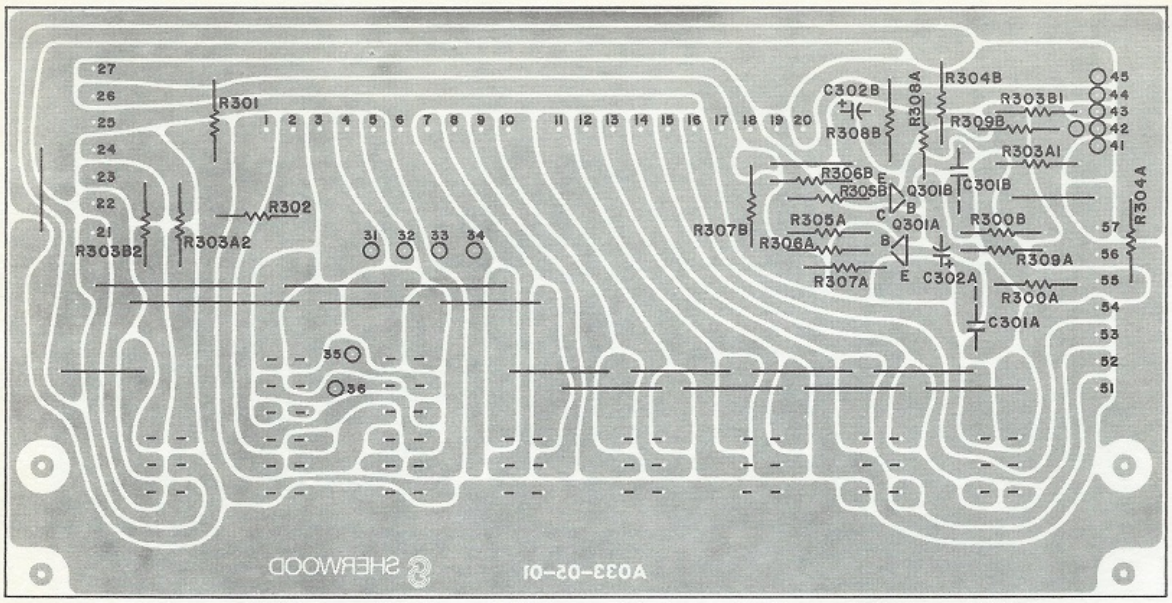
FUNCTION SWITCH and FILTER BOARD A033-07-01

HP2000 PRINTED CIRCUIT BOARD ASSEMBLIES Sheet 2 of 2 sheets

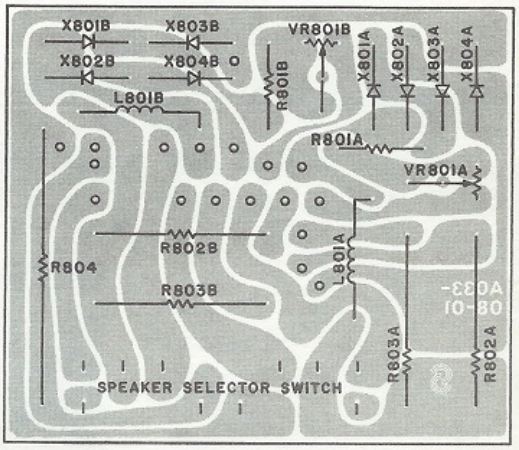
CIRCUIT BOARDS ARE SHOWN FROM THE COMPONENT SIDE; FOR A VIEW FROM THE COPPER SIDE, TURN THIS SHEET OVER AND HOLD UP TO A LIGHT.



TONE CONTROL, BALANCE and MODE SWITCH BOARD A033-04-01

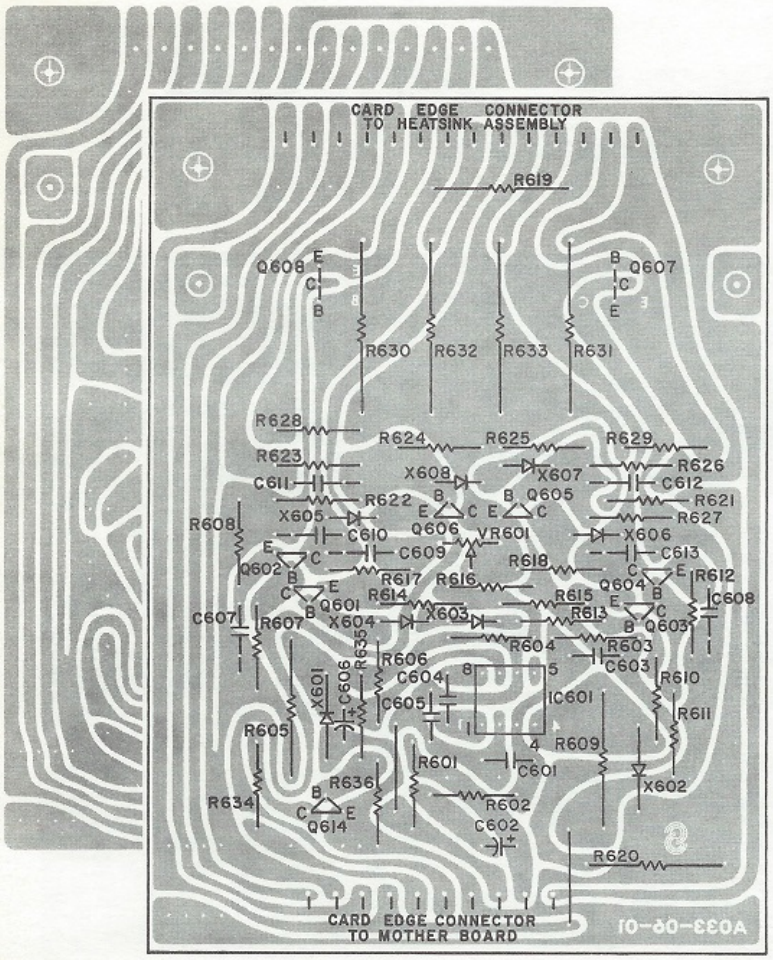


SELECTOR SWITCH and DUBBING BUFFER AMP BOARD A033-05-01



SPEAKER SELECTOR BOARD

A033-08-01

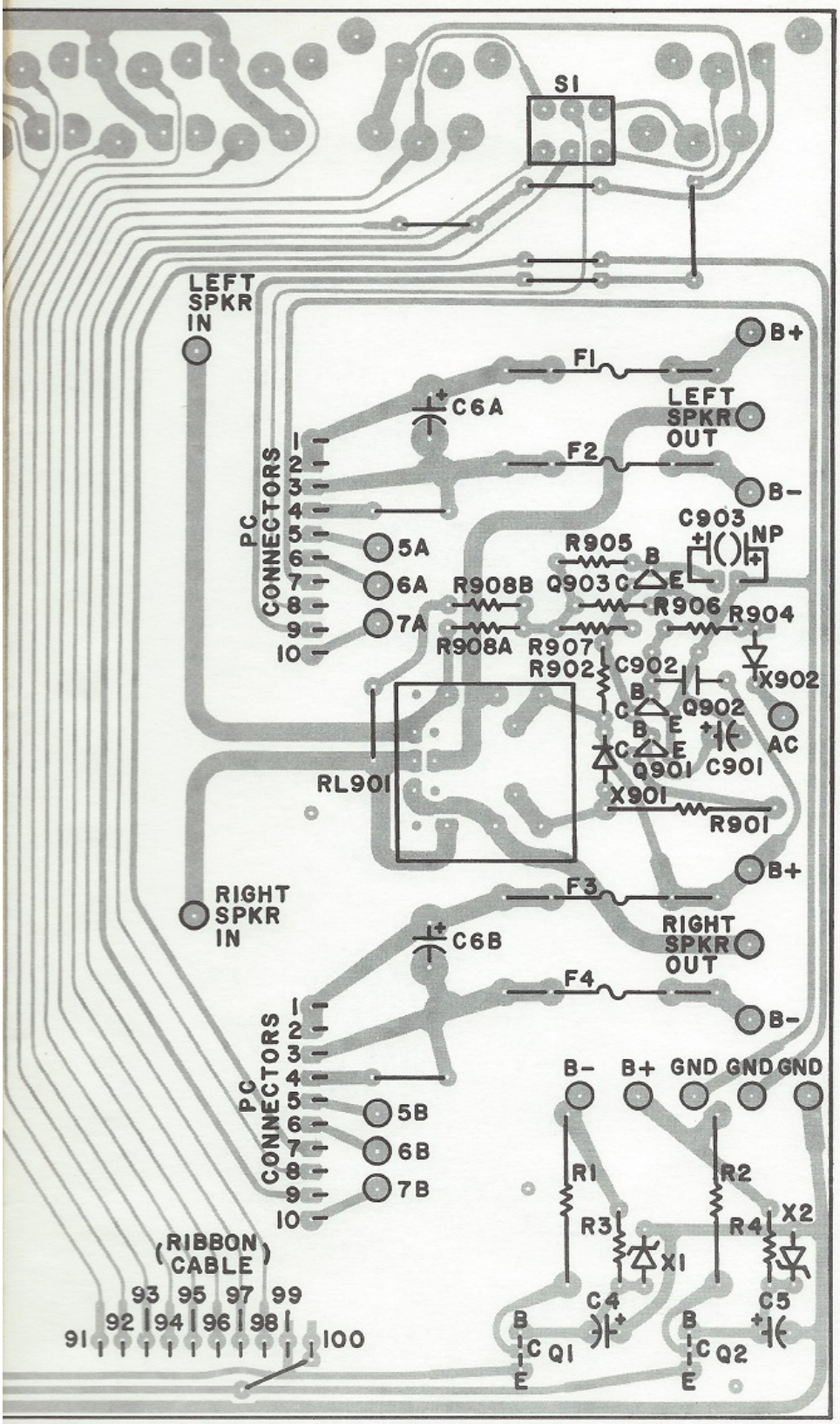


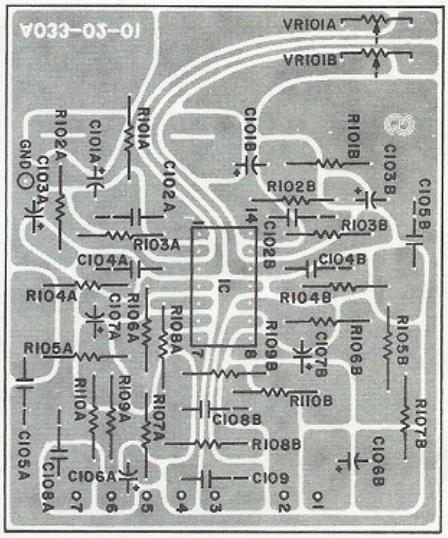
DRIVER BOARDS [Two per unit] A033-06-01

HE COPPER SIDE, TURN THIS SHEET OVER AND HOLD UP TO A LIGHT.

HP2000 PRINTED CIRCUIT BOARD ASSEMBLIES

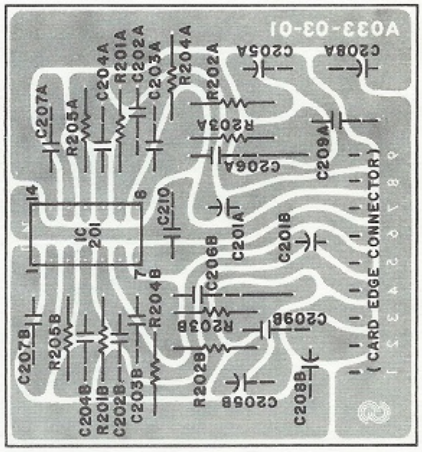
Sheet 1 of 2 sheets





MIC PREAMP BOARD

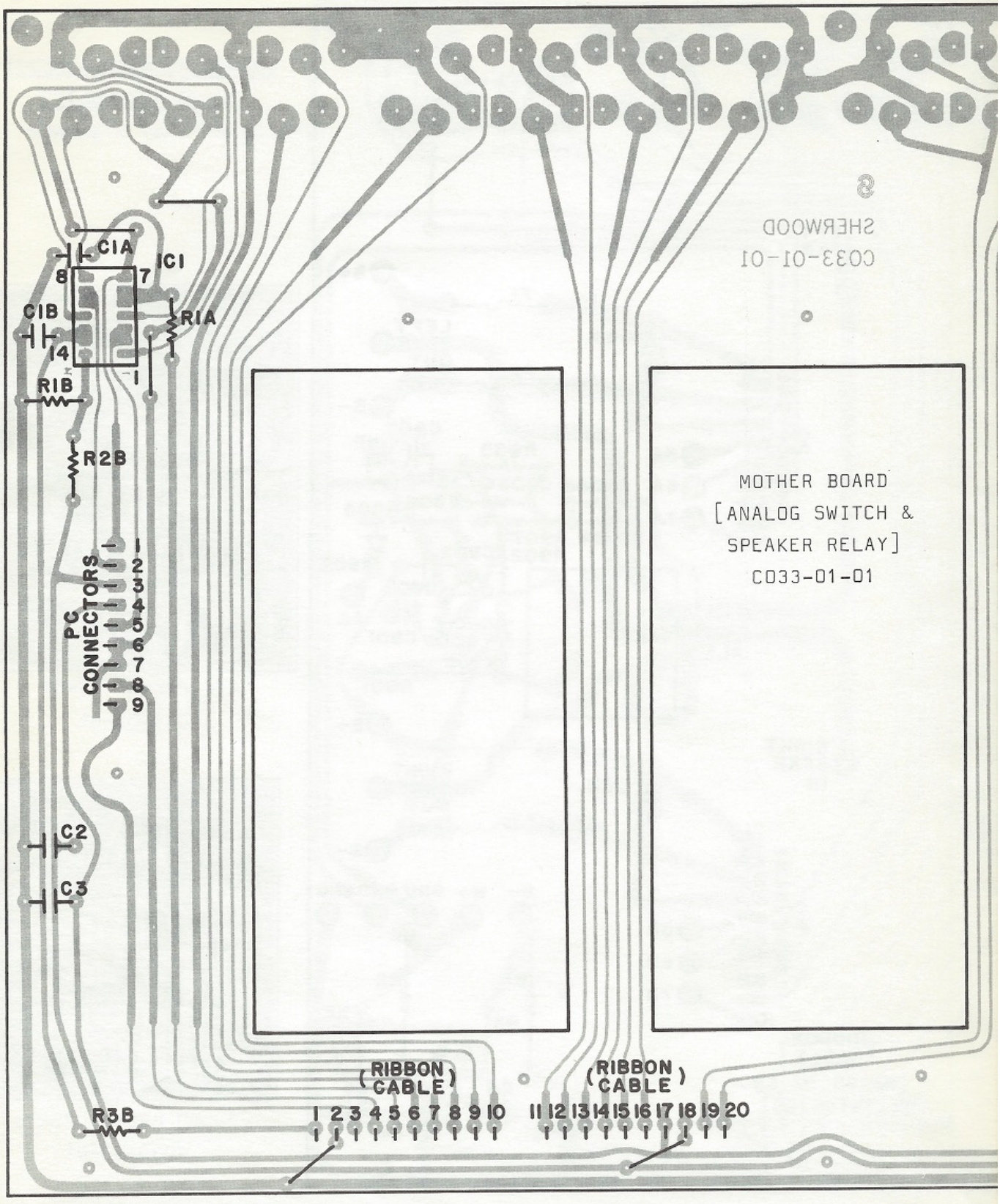
A033-02-01



PHONO PREAMP BOARD

A033-03-01

CIRCUIT BOARDS ARE SHOWN FROM THE COMPONENT SIDE; FOR A VIEW FROM T



SHERWOOD ELECTRONIC LABORATORIES, INC. 4300 North Californ