SHERWOOD TRANSISTOR AMPLIFIERS

Sherwood

STEREOPHONIC TRANSISTOR AMPLIFIER TECHNICAL DATA AND SERVICE MANUAL

IMPORTANT! READ THOROUGHLY

The enclosed information is vital to the proper servicing of Sherwood transistor amplifiers. The procedures described have been carefully and completely researched to eliminate costly errors and expedite proper servicing of the amplifier. They should be studied until complete familiarization is achieved.

Attempted servicing under conditions other than those outlined can lead to expensive and unnecessary parts replacement, not covered by the terms of our warranty agreement.

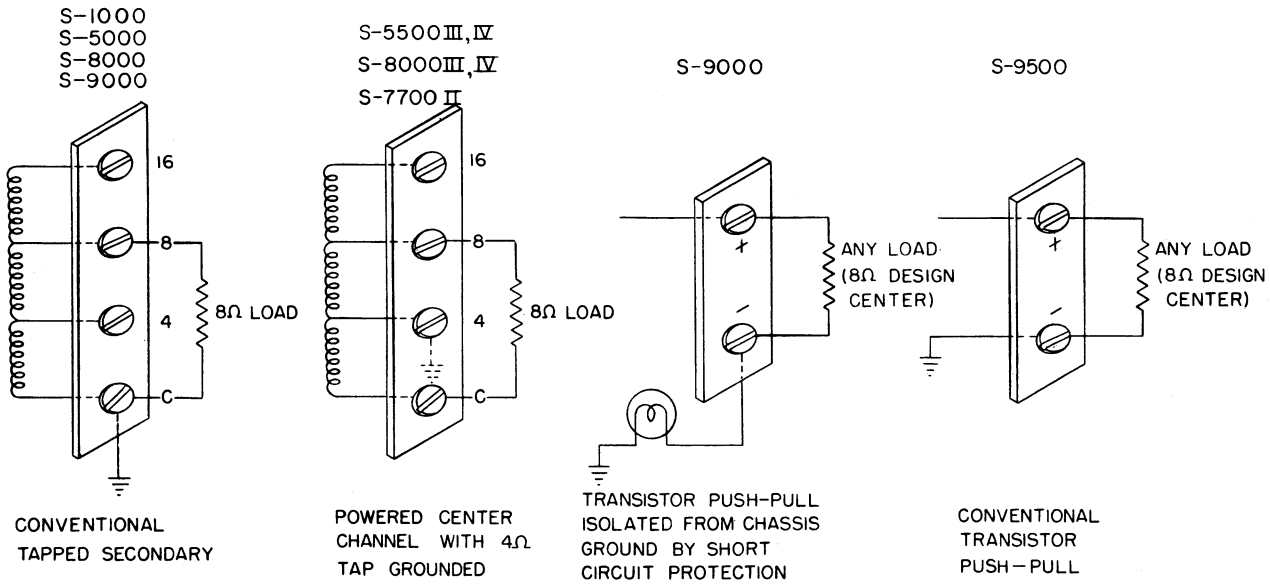
It is imperative that only SHERWOOD parts be used for replacement purposes, particularly transistors and electrolytic capacitors. Use of "look-alikes" may result in further damage to the amplifier, and possible cancellation of the warranty policy.

The specifications herein are design center figures. Deviations greater than normal manufacturing tolerances indicate a need for servicing, and these figures should serve as reference. Any questions, comments, or difficulty concerning the material covered on the succeeding pages should be directed to:

TECH. SERV. DEPT.
SHERWOOD ELECTRONIC LABS., INC.
4300 N. CALIFORNIA AVE.
CHICAGO, ILLINOIS 60618

GENERAL TEST PROCEDURES

There are four basic types of output circuitry used in Sherwood amplifiers. Each performs a definite function and each requires a slightly different test-bench set-up if approached on an individual basis.



There is, however, one test-bench set-up that will work with all Sherwood amplifiers. It requires the following equipment:

An intermodulation distortion analyzer with less than .1% residual distortion and a .3% full scale distortion range. (Audio Measurement No.168).

A harmonic distortion analyzer with less than .1% residual distortion and a .3% full scale distortion range.

(These can be combined in one instrument such as the EICO Model 902)

A DC voltmeter with 3% or better known accuracy.

A separate audio voltmeter capable of measuring .001 volts to 100 volts full scale 5-500 KC /.05db.

(Ballantine model 310A or 320)

An audio oscillator with sine and square wave output capable of providing at least 5 volts @ 600 ohms with .05% or better distortion from 5-500 kc /.05db. (Hewlett-Packard model 200CD).

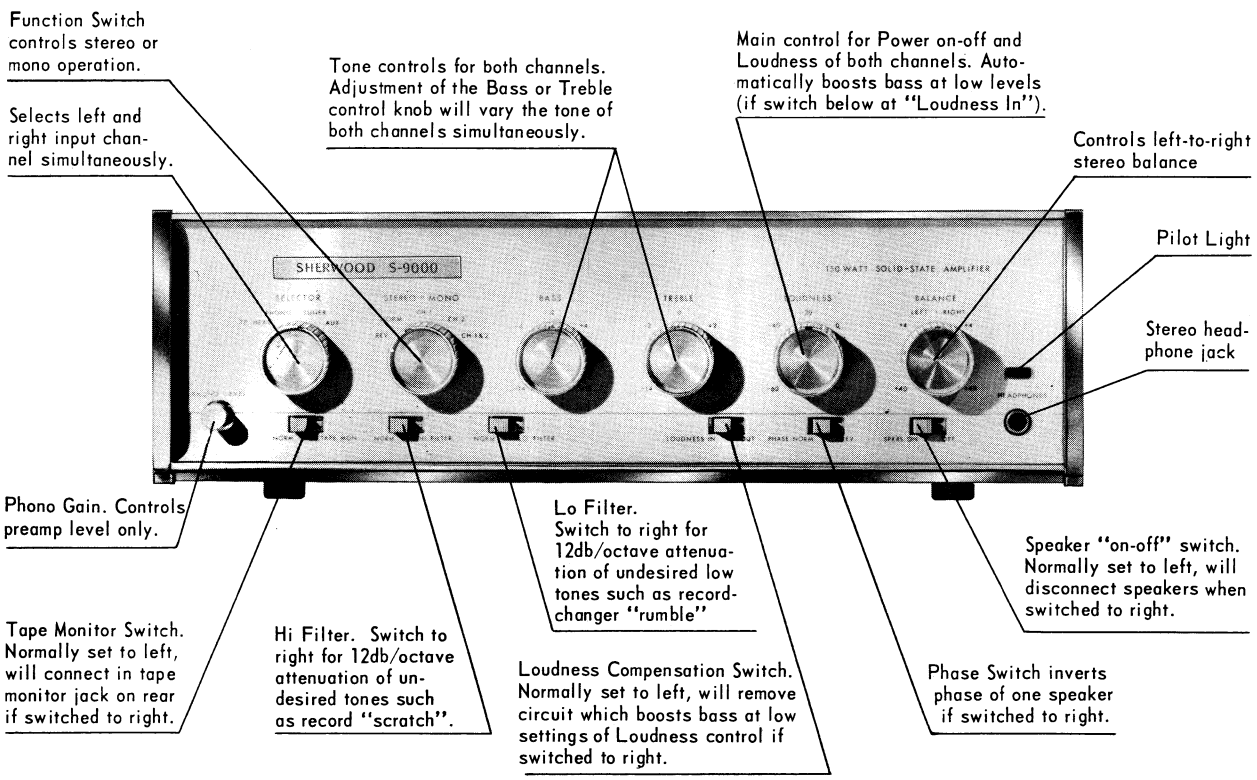
A 100 watt, 8 ohm, 1% load resistor.

It should be noted that the audio voltmeter's ground lead is separate from the test set-up ground. The test set-up ground is returned to the input plug. All output voltage readings used in power output computations must use the audio voltmeter as the only reference.

SERVICE DATA BULLETIN INDEX ——————→

S-9000 150 WATT ALL-SILICON INTEGRATED TRANSISTOR AMPLIFIER

LUDWICK



DESIGN-CENTER SPECIFICATIONS*

INPUTS:
6 high level (2 tape monitor), 2 (RIAA) Phono-preamp., 2 (NAB) tapehead preamp.

POWER OUTPUT: Stereo–Each channel 75 watts music power (50 watts continuous) at .75% IM distortion (60c:7kc/4:1).

OUTPUTS: 4 to 16-ohm left and right spkr.; stereo headphone and record output.

INVERSE FEEDBACK: 45db.

DAMPING FACTOR: 15:1 at 8 ohms.

FREQUENCY RESPONSE:
(50 w) 20 cps to 20kc ±1db.

TONE CONTROL RESPONSE:
Flat setting, 20 cps to 20kc ±1db.

TONE CONTROL RANGE:
15 kc, 15db. boost or cut.
40 cps. 16db. boost or cut.

LOW FILTER: 20 cps, 17db. rejection; 100 cps less than 1db. down.

PREAMP. EQUALIZER CURVES:
AES/RIAA phono and NAB tape.

All specifications with 120V AC line.

SENSITIVITY:
Radio–0.25v. Phono–1.5mv.
Tape head–.8 mv. (PH and TP inputs are adjustable with Phono Gain control).

MAX. INPUT CAPABILITY:
Phono: 35 mv. for less than .1% dist.
Radio: 2.8v. for less than .1% dist.

MAX. HUM and NOISE:
Vol. control min., 90db. (weighted) below rated output.
Radio input (controls maximum), 80db. (weighted) below rated output.
Phono input (controls flat), 70db. below rated output.

INTERCHANNEL CROSSTALK:
Better than -45db. at 1 kc.

POWER CONSUMPTION:
115-125v, 60 cps, 30 to 150 watts fused.

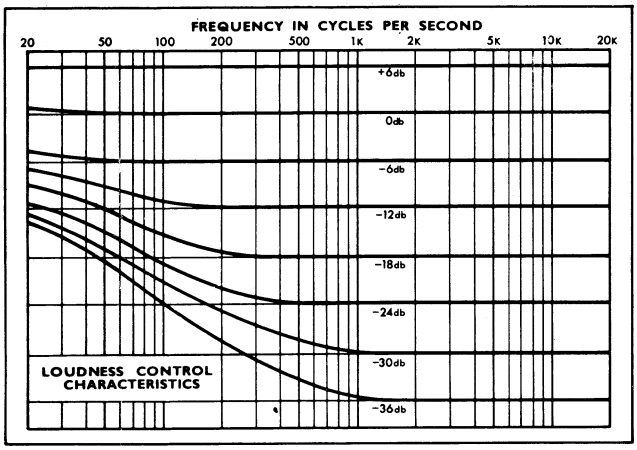
TRANSISTOR COMPLEMENT:
22 silicon transistors
4 silicon rectifiers

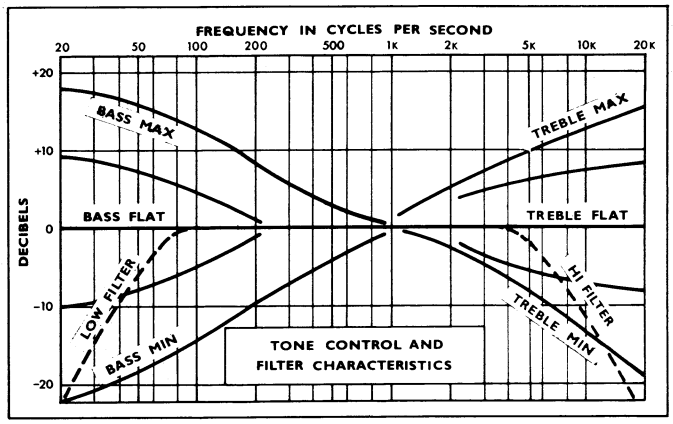
SIZE: 14 x 12½ x 4 in. high.

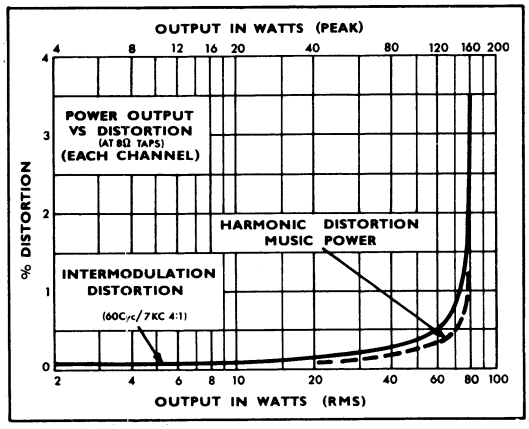
SHIPPING WEIGHT: 24 lbs.

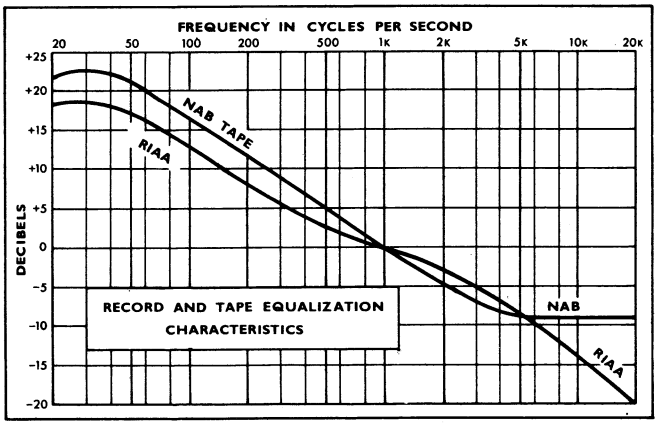
TURN PAGE FOR COMPLETE SERVICE INFORMATION

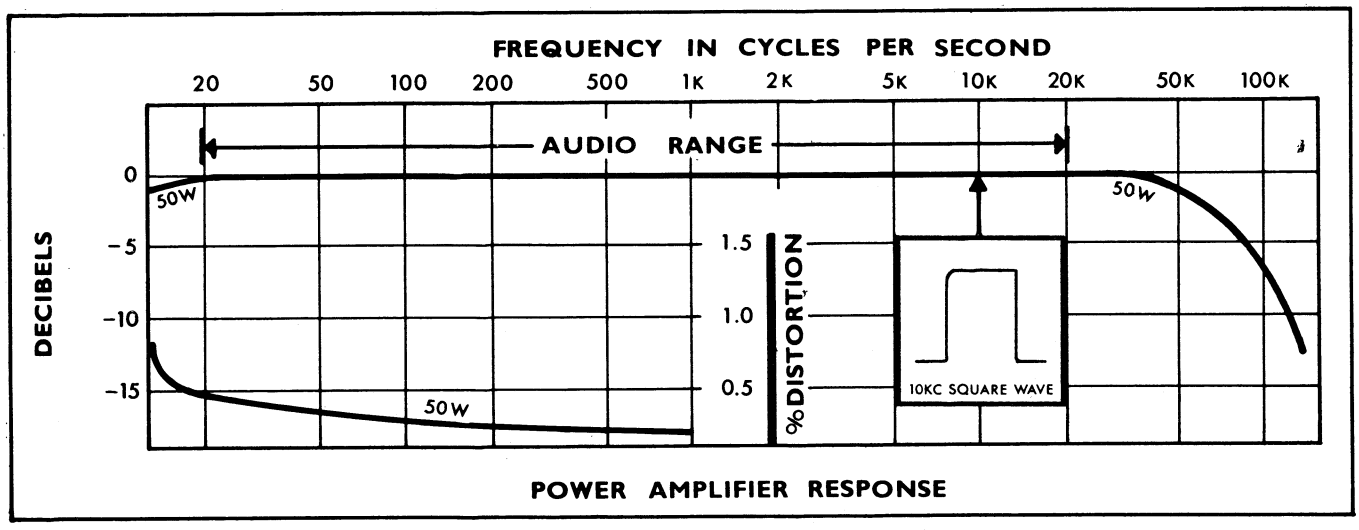
S-9000 PERFORMANCE GRAPHS











S-9000 SERVICING

WARNING

When testing the S-9000 amplifier it is important that extreme care be taken to prevent shorting the amplifier outputs if a common ground test-bench set-up is used. This precaution is necessary because the negative (-) terminal on the speaker output strip is not at chassis ground potential. (See schematic.) Bypassing this with a common ground test scheme essentially removes the short-circuit protection built into the amplifier.

All voltage measurements related to power output computation must be made between + and - (note 1). It is permissible, however, to reference the Harmonic Distortion Analyzer and Intermodulation Distortion Analyzer distortion measuring circuitry to chassis ground through the generator output of each instrument. Naturally, the "calibration" of either analyzer is independent of the actual output voltage, and distortion vs. power measurements must use the separate audio voltmeter (note 1) as the final reference of actual output power.

Only when all of the above requirements have been satisfied should one proceed with measurement of the S-9000 performance.

OUTPUT TRANSISTOR BIAS

Of all the specifications which require checking to ascertain correct performance of the S-9000, proper output transistor operation is the most important and critical. Adjustment of the output transistor bias is necessary if output transistors are replaced (note 3), or the amplifier exhibits one or more of the following symptoms:

1. Overheating of the output transistors under normal operating conditions, possibly resulting in operation of thermostats mounted on each set of output transistors; thereby turning off the entire amplifier.
2. Excessive low level Intermodulation Distortion — more than 0.1% at 2 volts across 8 ohms; (0.5 watt output).
3. If center point voltage is greater than 16 volts DC or less than 12 volts DC.

Adjustment of output transistor bias should then proceed as follows:

1. Turn set off.
2. Set bias pots R96, R196, R97, R167, to mechanical center.
3. Connect D.C. Voltmeter (50V scale) to midpoint of output stage under test. ("Hot" side of output capacitor C90, C190.)
4. Turn set on.
5. The midpoint voltage should be +14V DC ± 3V, and should remain within these limits during all of the succeeding adjustments. (Should midpoint voltage be outside these limits, adjust the attendant bias pots in the same direction for +14V.)
6. Turn main volume control to maximum. Connect I.M. analyzer output* to auxiliary input of channel under test and adjust analyzer output for 3 volts of amplifier output across 8 ohms.
7. Adjust both bias pots of the channel under test clockwise for approximately 2% I.M. distortion. This sets the output transistors into heavy class "B" operation as indicated by a sharp notch in the distortion pattern.
8. Re-adjust bias pots (while watching midpoint voltage; step 5) for minimum distortion. However, do not eliminate the class "B" notch completely. Minimum distortion and proper operation occurs with just a trace of the class "B" notch present. (It is imperative that a slight amount of class "B" notch be left. Otherwise, it is possible to push the output stage into heavy class "A" operation, causing the output transistors to overheat, thereby activating the thermostats which will turn off the amplifier.)
9. Note the midpoint voltage value at 3 volts output. Adjust analyzer output for an amplifier output of 15 volts. The midpoint voltage should not shift to more than 20 volts or less than 10 volts.
10. If the midpoint voltage shifts more than the limits in Step 9, adjust both bias pots, in the same direction of rotation, toward the shift. For example: If the midpoint voltage shifts to more than 20 volts at 15 volts amplifier output, adjust the bias pots to move the quiescent midpoint voltage upwards until the conditions in Step 9 are satisfied.
11. The following performance indicates a properly operating output stage:
    - A quiescent midpoint voltage between 11 and 17 volts D.C.
    - A slight class "B" notch in the distortion display at 3 volts output with typical .05-.075% distortion.
    - At 15 volts output, the midpoint voltage should never shift higher than 20 volts or lower than 10V, with typical distortion of .25%.
    - At least 50 watts of power output (E.S.W.P.)before clipping (16.5 volts across 8 ohms).

*60 and 7KC 4:1

VOLTAGE CHECKS

Preliminary checks of the D.C. voltages present at various points in the S-9000 can prove useful in locating defective components. They are inconclusive, however, in determining if transistors are operating properly in all aspects. They can only indicate whether the transistor is open, shorted or functioning — not how well the transistor is functioning.

IN GENERAL:

- Correct voltages indicate a functioning transistor.
- The same voltage at the collector and emitter indicates a shorted transistor.
- Full supply voltage on the collector and no voltage on the emitter indicates an open transistor.

Because of the operating characteristics and circuit location of Q8, Q108, Q9, Q109, D.C. voltage checks on these transistors may be inconclusive in determining their proper operation. Therefore, additional in-circuit checks should be used to determine proper transistor action.

(It is extremely important that the "positive" lead of the ohmeter to be used in the following test be determined with a D.C. voltmeter of known polarity.)

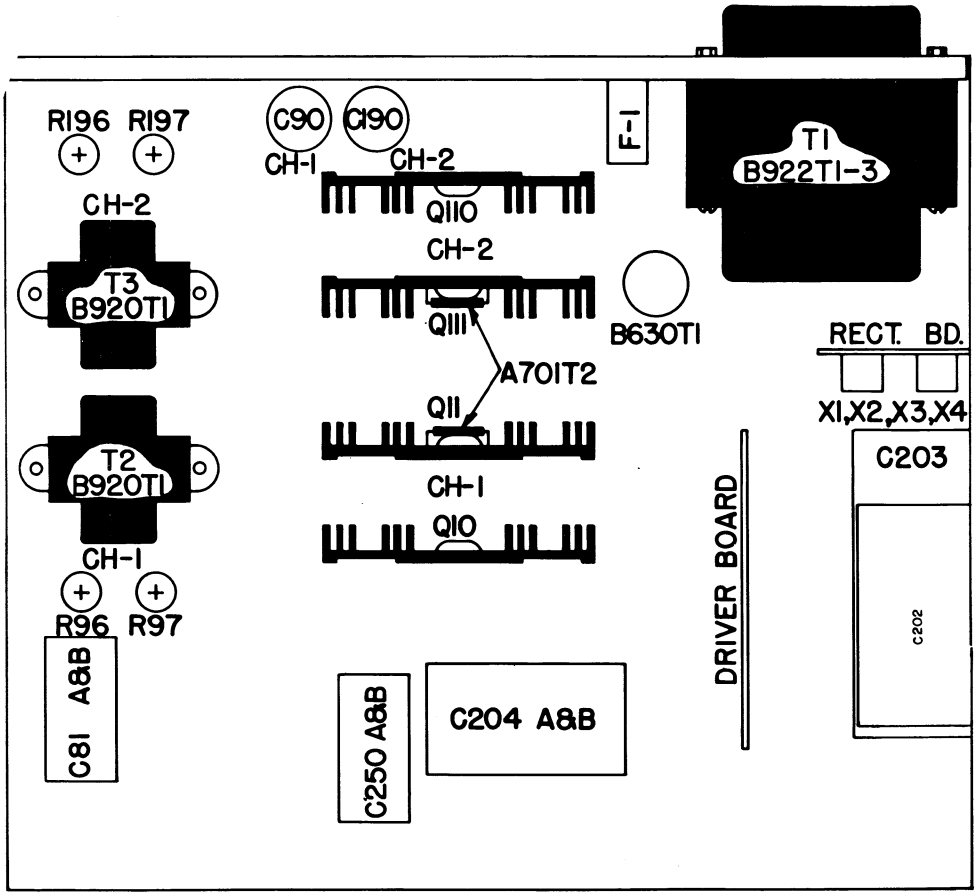
With S-9000 turned off, connect the "positive" lead of the ohmeter to the collector of Q8, Q108, (emitter of Q9, Q109) and the "negative" lead to the emitter of Q8, Q108 (collector of Q9, Q109). The ohmeter should read approximately center scale on the X100 range. (A reading of ∞ or 0 indicates a bad transistor.) Now, by shorting the base to the collector, a reading of approximately 0 ohms indicates the transistor is functioning.

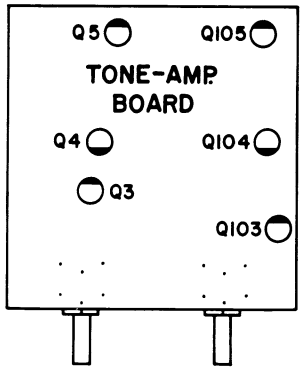
1. Since the short circuit protection circuitry of the S-9000 absorbs a small amount of the output power available between + and *chassis*, it is necessary to measure the voltage between + and - on the output terminal strip to obtain the power actually presented to the speakers. Therefore, a separate audio voltmeter, with the load resistor connected across its input, must be connected to the + and - terminals of the speaker output strip — *not* between + and chassis ground.
2. Since separating the audio voltmeter (note 1) may require a load resistor external to the test bench setup, it is necessary to use only *one* load resistor permanently connected across the audio voltmeter. The appropriate channel can then be measured by moving the leads of the audio voltmeter.
   The S-9000 will not be damaged by running one channel without a load because it is dynamically and statically stable.
3. It is extremely important that the mica insulating washers used to separate the output transistors from their heat-sinks be unbroken and installed properly, with silicon grease liberally applied to all surfaces in contact with each other. Also, make certain the emitter and base pins of the output transistors do not contact any part of the heat-sinks. (See parts list, Page 6A.)

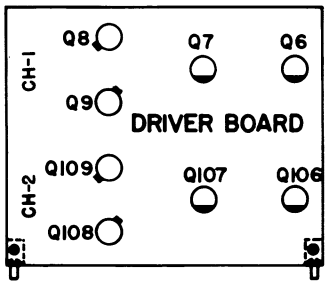
PULL OUT FOR CHASSIS LAYOUT →

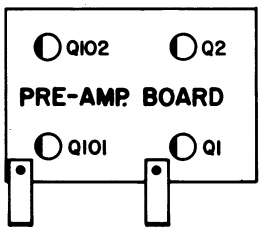
S-9000 CHASSIS LAYOUTS

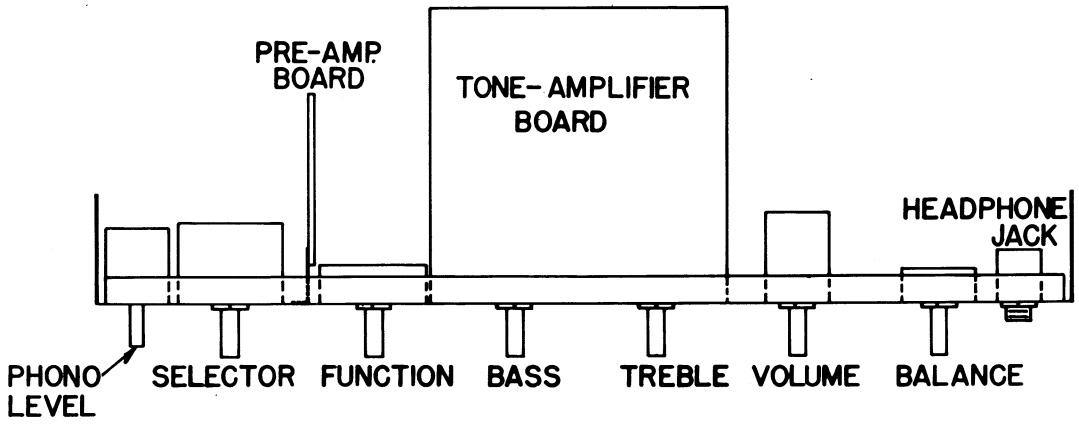
(ALL P-C BOARDS VIEWED FROM TRANSISTOR SIDE)

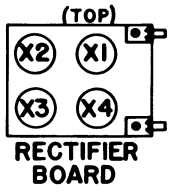


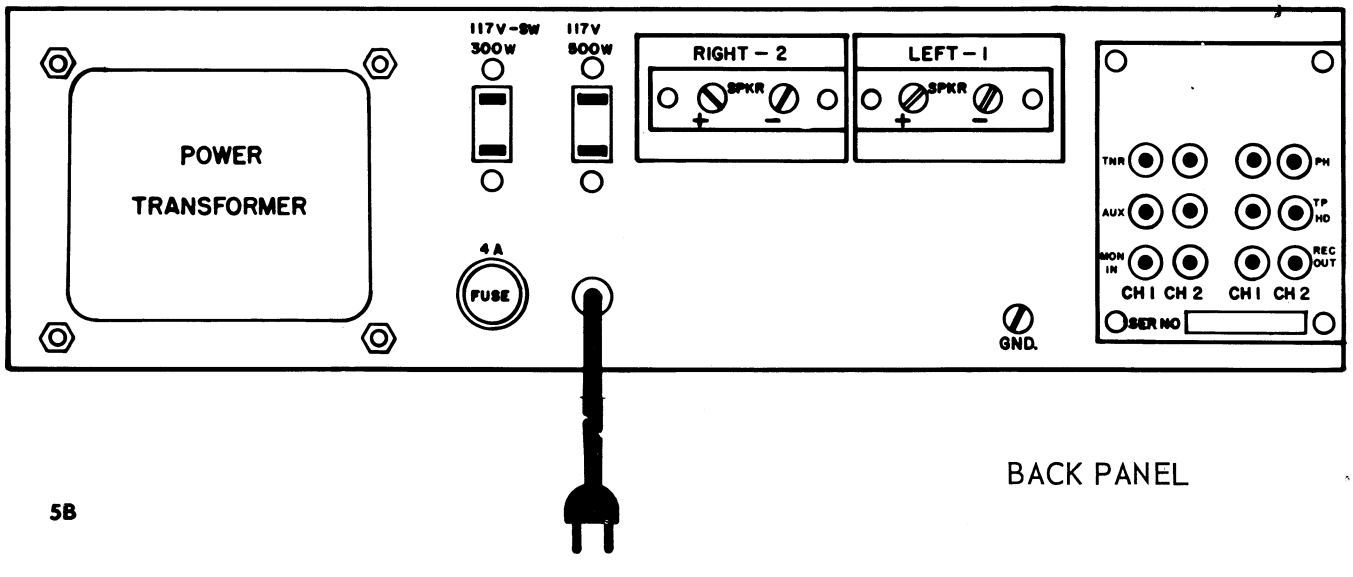












BACK PANEL

S-9000 PARTS LIST

TRANSISTOR	PART NO.	COST PER UNIT LIST
Small Signal–No Dot	2N3391 A	1.49
Small Signal–Yellow Dot	2N3392	1.30
Small Signal–Org. Dot.	2N3393	1.26
Q9, Q109 PNP Driver	SM6728	4.85
Q8, Q108 NPN Driver	7A32	5.85
Output	S355-B	16.20

You will note that all transistors used in the S-9000 are color-coded with a dot or mark of some color prominently located on the top of their case. (Some transistors have no mark, but this also is identification.) When ordering replacement transistors, it is imperative that you indicate not only its part no., but the color dot on the transistor body: red, yellow, none, etc. This is particularly important when replacing output transistors.

DESCRIPTION	PART NO.	COST PER UNIT LIST
1 μf @ 15V	B120X1	.63
5.0 μf @ 5V	B120X4	.63
5.0 μf @ 20V	B120X6	.63
10 μf @ 50V	B120X11	.68
50 μf @ 10V	B120X20	.68
30 μf @ 3V	CE8503-50P	.63
3000 μf @ 65V	A120T1	4.19
500-500 μf @ 30V	A120T2	2.93
1500-750 μf @ 35V	A120T3	2.93
3000 μf @ 20V	A120T4	3.83
3000 μf @ 35V	A120T5	5.81
Mica Insulator	A021F1-0	.25
Diode Mtg. Bd.	A035T1	.54
Pre-Amp. P-C Bd.	A031T1	3.33
Tone-Amp. P-C Bd.	A031T2	4.05
Driver P-C Bd.	A031T3	4.68
Fuse, 4 Amp.	312004	.15
Knob (Blue Dot)	A460L7-4	.50
Knob (Org. Dot)	A460L10-4	.54
Knob–Phono Gain	A460B5-2	.10
Ballast Res. Bulb	B630T1	1.66
Treble Control	A670T6-2	2.52

DESCRIPTION	PART NO.	COST PER UNIT LIST
Bass Control	A670T5-2	2.52
Loudness Control	A671T1-4	3.47
Balance Control	A670T7-2	.81
Phono Level	A670T3-3	2.30
Bias Pot.	A678T2	.63
High B+ Rect.	A692T1	.33
Low B– Rect.	A692T2	.25
Germanium Diode	A692M3-1	.27
Thermostat	A701T2-0	.27
Thermostat Ins.	A701T3-0	.10
Output Transistor Skt.	A790T1-1	.18
Headphone Jack	A795L1-0	1.04
Fuse Post	A796X2-1(A)	.81
Ballast Lamp Socket	A798T1-1	.68
Thermostat Spring Clip	A835T1	.18
Function Switch	A860K5-1	1.62
Selector Switch	A860K3-6	4.19
Slide Switch	A864T4-7(B)	.50
"Spkr. Phase" Switch*	A864T15-7(B)	.59
Driver Transformer	B920T1-2	5.27
Power Transformer	B922T1-3	16.43

*Although the speaker phase switch resembles other Sherwood slide switches, it is a special, non-shorting type switch and must be ordered by its part number.

SERVICE BULLETINS

SHERWOOD TRANSISTOR AMPLIFIERS
SERVICE MANUAL INDEX

MODEL NO. ________________ SERIAL NO. ________________ AND UP
DATE ________________ PGS. ________________

MODEL NO. ________________ SERIAL NO. ________________ AND UP
DATE ________________ PGS. ________________

MODEL NO. ________________ SERIAL NO. ________________ AND UP
DATE ________________ PGS. ________________

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DATE ________________ PGS. ________________

MODEL NO. ________________ SERIAL NO. ________________ AND UP
DATE ________________ PGS. ________________

TURN OVER FOR COMPLETE MANUALS

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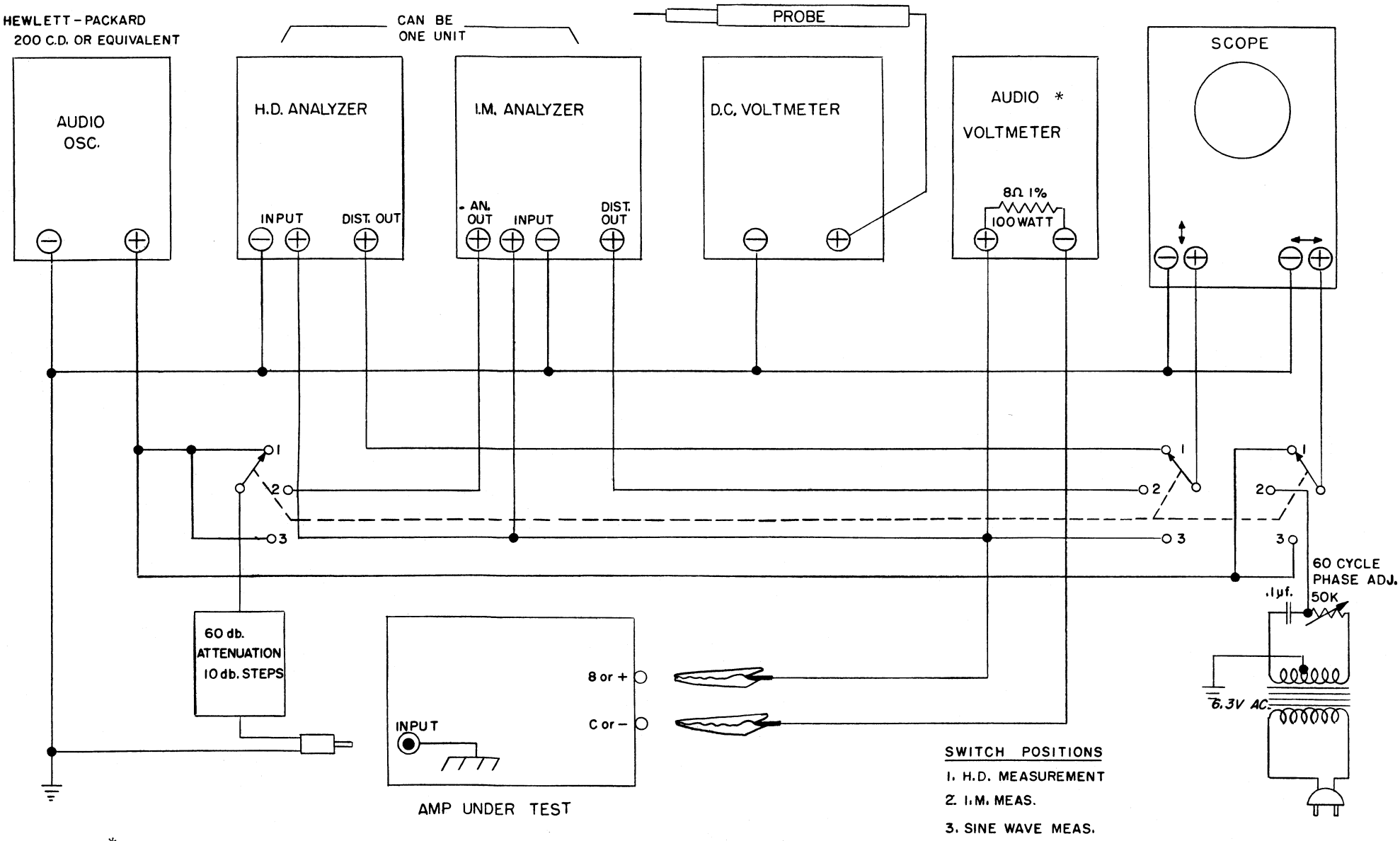
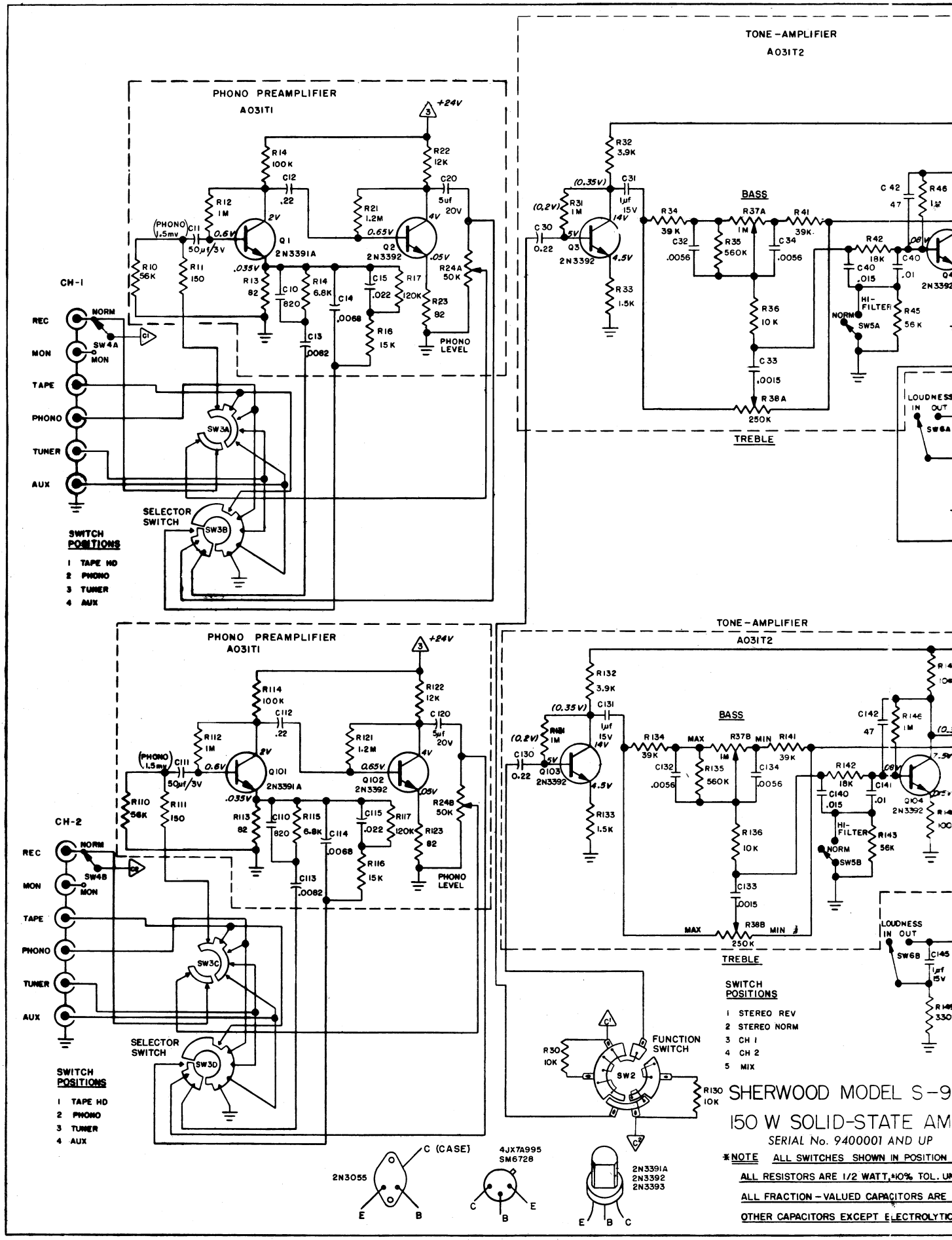
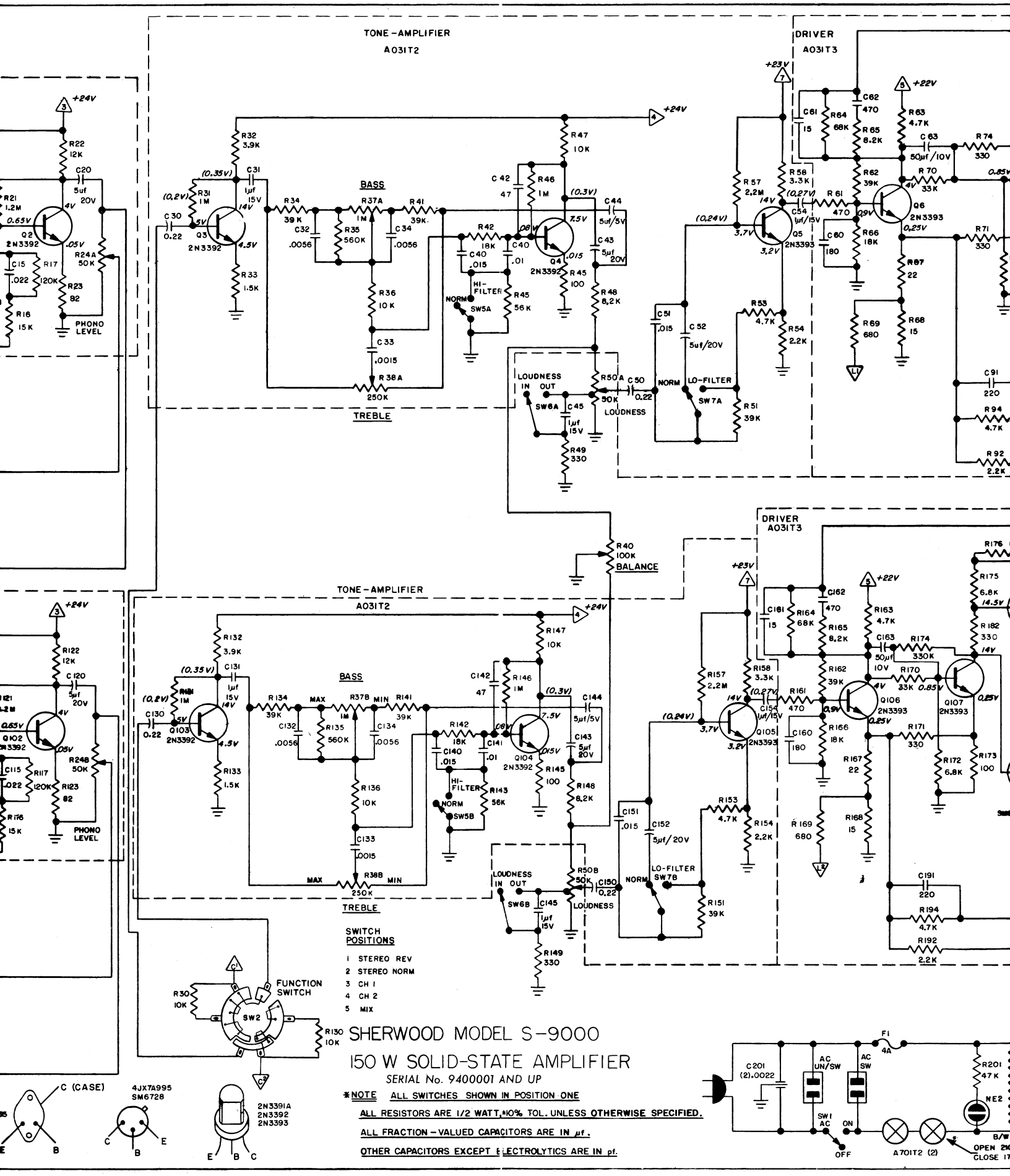
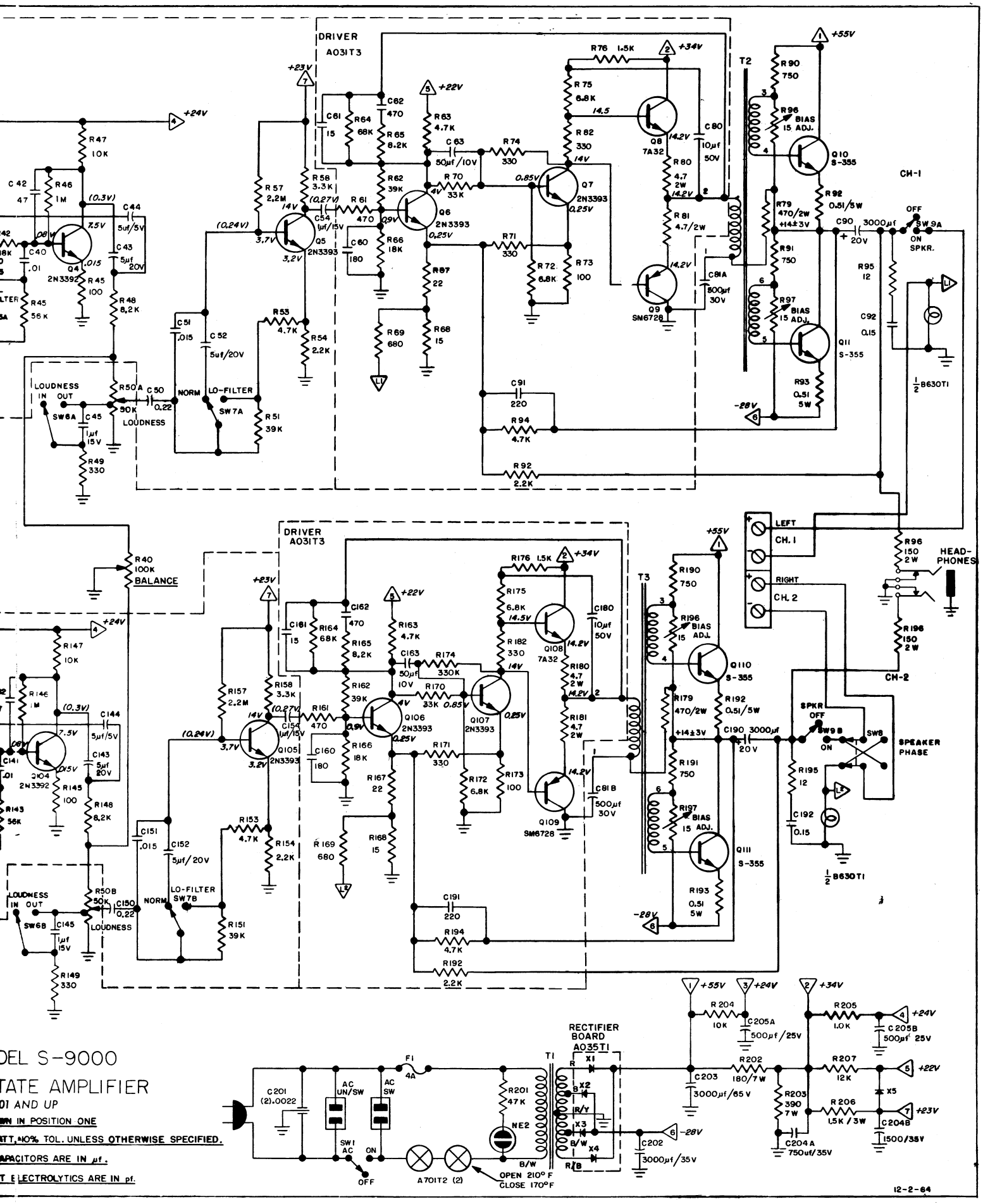
SUGGESTED TEST BENCH SET-UP



* Because of the differences in output stages between Sherwood models it is necessary to measure power output as applied to the speaker. Therefore, a separate AC voltmeter must be used as the final reference for output voltage in power output computations. All other measuring devices may use the amplifier chassis for their ground reference. (Naturally I.M. and H.D. analyzer "calibration" is independent of the actual output voltage. The actual value must be determined with the separate audio voltmeter.) As all Sherwood amplifiers are unconditionally stable, they cannot be damaged by operating with no load on one or both channels.


PHONO PREAMPLIFIER
A031TI
TONE-AMPLIFIER
A031T2
CH-1
CH-2
REC
MON
TAPE
PHONO
TUNER
AUX
NORM
MON
SW4A
SW4B
SW3A
SW3C
SELECTOR SWITCH
SW3B
SW3D
SWITCH POSITIONS
1 TAPE HD
2 PHONO
3 TUNER
4 AUX
+24V
PHONO 1.5mv
PHONO LEVEL
BASS
TREBLE
HI-FILTER
NORM
SW5A
SW5B
LOUDNESS
IN OUT
SW6A
SW6B
FUNCTION SWITCH
SW2
SWITCH POSITIONS
1 STEREO REV
2 STEREO NORM
3 CH 1
4 CH 2
5 MIX
Q1 2N3391A
Q2 2N3392
Q3 2N3392
Q101 2N3391A
Q102 2N3392
Q103 2N3392
Q104 2N3392
2N3055
4JX7A995
SM6728
2N3391A
2N3392
2N3393
SHERWOOD MODEL S-9
150 W SOLID-STATE AM
SERIAL No. 9400001 AND UP
*NOTE ALL SWITCHES SHOWN IN POSITION
ALL RESISTORS ARE 1/2 WATT, ±10% TOL. UN
ALL FRACTION-VALUED CAPACITORS ARE
OTHER CAPACITORS EXCEPT ELECTROLYTIC


TONE-AMPLIFIER
A031T2
DRIVER
A031T3
+24V
+23V
+22V
BASS
TREBLE
LOUDNESS
BALANCE
LO-FILTER
HI-FILTER
NORM
SW5A
SW6A
SW7A
SW5B
SW6B
SW7B
PHONO LEVEL
FUNCTION SWITCH
SW2
SWITCH POSITIONS
1 STEREO REV
2 STEREO NORM
3 CH 1
4 CH 2
5 MIX
SHERWOOD MODEL S-9000
150 W SOLID-STATE AMPLIFIER
SERIAL No. 9400001 AND UP
*NOTE ALL SWITCHES SHOWN IN POSITION ONE
ALL RESISTORS ARE 1/2 WATT, ±10% TOL. UNLESS OTHERWISE SPECIFIED.
ALL FRACTION-VALUED CAPACITORS ARE IN µf.
OTHER CAPACITORS EXCEPT ELECTROLYTICS ARE IN pf.
C (CASE)
4JX7A995
SM6728
2N3391A
2N3392
2N3393
AC UN/SW
AC SW
SW1 AC
ON
OFF
A701T2 (2)
OPEN 2
CLOSE 1



DEL S-9000

TATE AMPLIFIER

01 AND UP

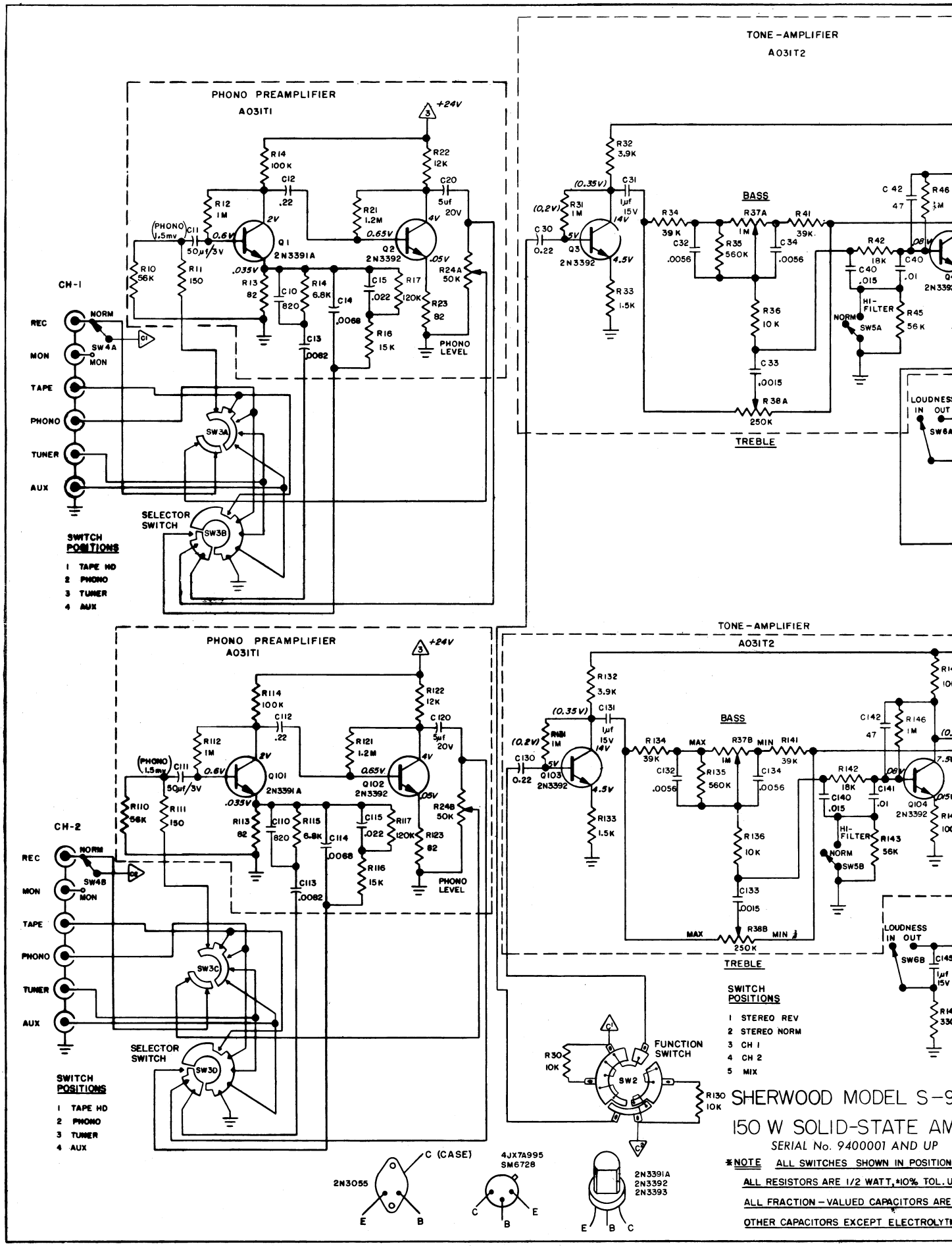
SW IN POSITION ONE

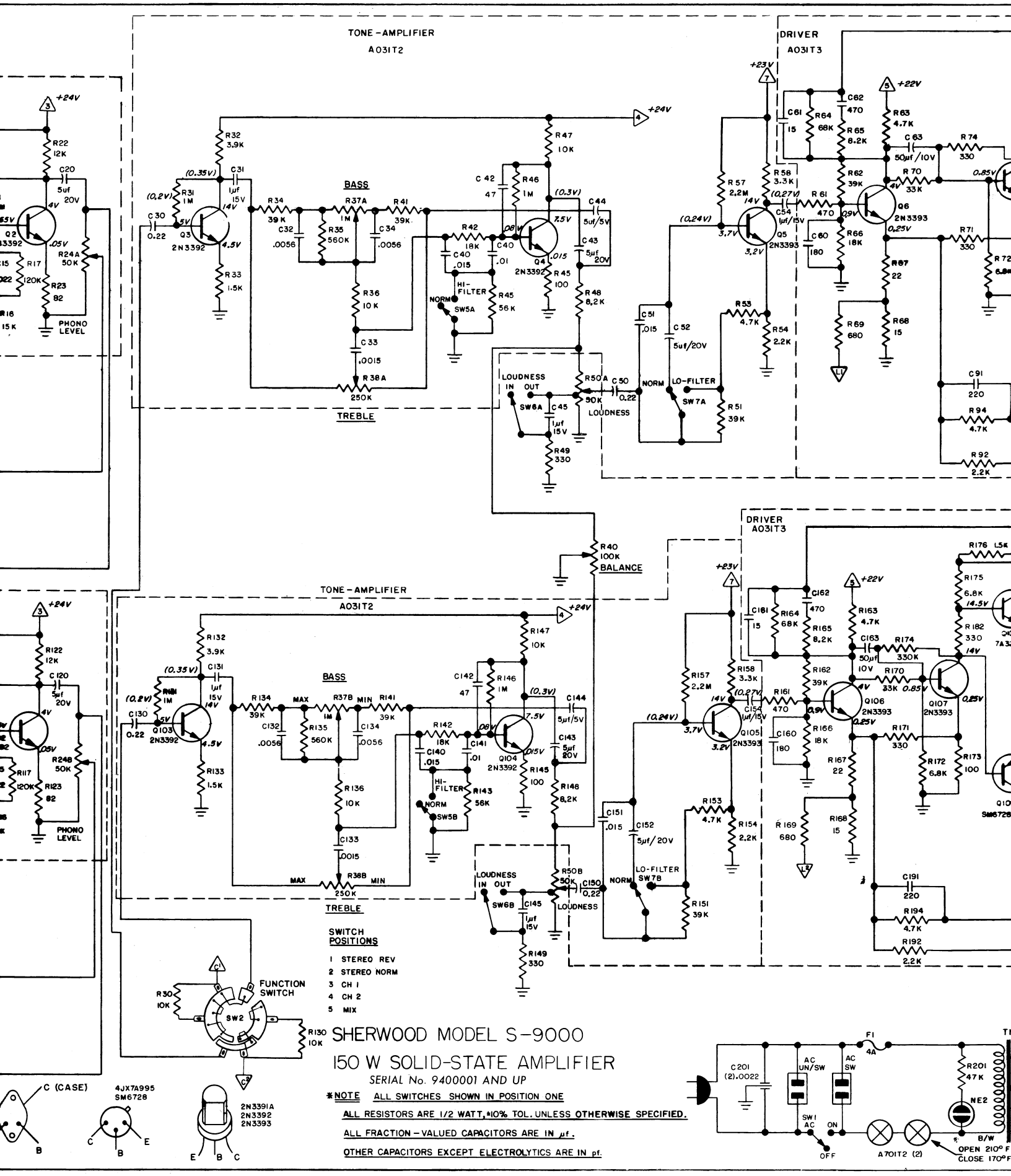
LT, ±10% TOL. UNLESS OTHERWISE SPECIFIED.

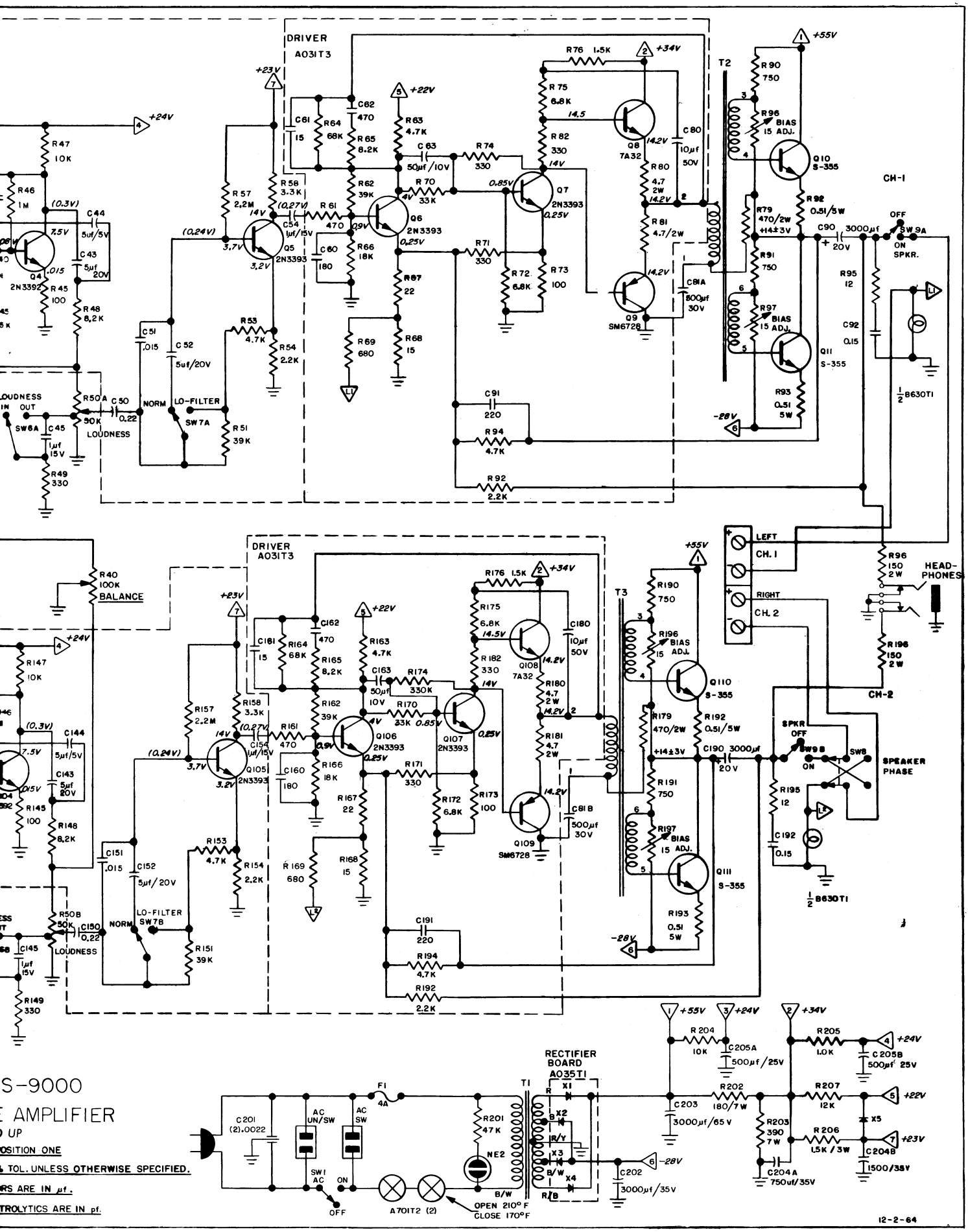
APACITORS ARE IN µf.

T ELECTROLYTICS ARE IN pf.

12-2-64


PHONO PREAMPLIFIER
A031TI
TONE-AMPLIFIER
A031T2
CH-1
CH-2
REC
MON
TAPE
PHONO
TUNER
AUX
NORM
MON
SW4A
SW4B
SELECTOR SWITCH
SW3A
SW3B
SW3C
SW3D
SWITCH POSITIONS
1 TAPE HD
2 PHONO
3 TUNER
4 AUX
+24V
PHONO LEVEL
BASS
TREBLE
LOUDNESS
IN
OUT
SW6A
SW6B
HI-FILTER
SW5A
SW5B
FUNCTION SWITCH
SW2
SWITCH POSITIONS
1 STEREO REV
2 STEREO NORM
3 CH 1
4 CH 2
5 MIX
2N3055
C (CASE)
E
B
4JX7A995
SM6728
2N3391A
2N3392
2N3393
SHERWOOD MODEL S-9
150 W SOLID-STATE AM
SERIAL No. 9400001 AND UP
*NOTE ALL SWITCHES SHOWN IN POSITION
ALL RESISTORS ARE 1/2 WATT, ±10% TOL. U
ALL FRACTION-VALUED CAPACITORS ARE
OTHER CAPACITORS EXCEPT ELECTROLYTI


TONE-AMPLIFIER
A031T2
DRIVER
A031T3
BASS
TREBLE
LOUDNESS
BALANCE
LO-FILTER
HI-FILTER
NORM
PHONO LEVEL
FUNCTION SWITCH
SWITCH POSITIONS
1 STEREO REV
2 STEREO NORM
3 CH 1
4 CH 2
5 MIX
SHERWOOD MODEL S-9000
150 W SOLID-STATE AMPLIFIER
SERIAL No. 9400001 AND UP
*NOTE ALL SWITCHES SHOWN IN POSITION ONE
ALL RESISTORS ARE 1/2 WATT, ±10% TOL. UNLESS OTHERWISE SPECIFIED.
ALL FRACTION-VALUED CAPACITORS ARE IN µf.
OTHER CAPACITORS EXCEPT ELECTROLYTICS ARE IN pf.
4JX7A995
SM6728
2N3391A
2N3392
2N3393
AC SW
OFF
ON
OPEN 210° F
CLOSE 170° F


DRIVER
A031T3
+24V
+23V
+22V
+34V
+55V
R47 10K
R46 1M
Q4 2N3392
R45 100
R48 6.2K
C44 5µf/5V
C43 5µf 20V
C61 15
R64 68K
C62 470
R65 8.2K
R63 4.7K
C63 50µf/10V
R74 330
R76 1.5K
R75 6.8K
R82 330
Q8 7A32
C80 10µf 50V
R80 4.7 2W
R81 4.7/2W
C81A 500µf 30V
Q9 SM6728
R72 6.8K
R73 100
R71 330
R70 33K
Q7 2N3393
R57 2.2M
R58 3.3K
C54 1µf/15V
R61 470
Q6 2N3393
Q5 2N3393
C60 180
R66 18K
R67 22
R68 15
R69 680
C51 .015
C52 5µf/20V
R53 4.7K
R54 2.2K
R50A 50K LOUDNESS
C50 0.22
SW6A
C45 1µf 15V
R49 330
NORM
LO-FILTER
SW7A
R51 39K
C91 220
R94 4.7K
R92 2.2K
T2
R90 750
R96 BIAS 15 ADJ.
Q10 S-355
R92 0.51/5W
R79 470/2W
R91 750
R97 BIAS 15 ADJ.
Q11 S-355
R93 0.51 5W
-28V
C90 3000µf 20V
SW9A OFF ON SPKR.
R95 12
C92 0.15
1/2 B630TI
CH-1
R40 100K BALANCE
R147 10K
R146 1M
Q104 2N3392
R145 100
R148 8.2K
C144 5µf/5V
C143 5µf 20V
R150B 50K LOUDNESS
C150 0.22
C145 1µf 15V
R149 330
C151 .015
C152 5µf/20V
R153 4.7K
R154 2.2K
LO-FILTER
SW7B
R151 39K
C162 470
R164 68K
R165 8.2K
R163 4.7K
C163 50µf 10V
R174 330K
R176 1.5K
R175 6.8K
R182 330
Q108 7A32
C180 10µf 50V
R180 4.7 2W
R181 4.7 2W
Q109 SM6728
C181B 500µf 30V
R158 3.3K
R162 39K
R161 470
C154 1µf/15V
Q106 2N3393
Q107 2N3393
Q105 2N3393
C160 180
R166 18K
R167 22
R168 15
R169 680
R170 33K
R171 330
R172 6.8K
R173 100
C191 220
R194 4.7K
R192 2.2K
T3
R190 750
R196 BIAS 15 ADJ.
Q110 S-355
R179 470/2W
R192 0.51/5W
R191 750
R197 BIAS 15 ADJ.
Q111 S-355
R193 0.51 5W
C190 3000µf 20V
+14±3V
LEFT CH. 1
RIGHT CH. 2
R96 150 2W
HEAD-PHONES
R196 150 2W
CH-2
SPKR OFF
SW9B
SW8 SPEAKER PHASE
ON
R195 12
C192 0.15
1/2 B630TI
RECTIFIER BOARD A035T1
F1 4A
T1
C201 (2).0022
AC UN/SW
AC SW
SW1 AC
ON
OFF
R201 47K
NE2
A701T2 (2)
OPEN 210°F
CLOSE 170°F
B/W
R/B
X1
X2
X3
X4
X5
C202 3000µf/35V
C203 3000µf/65V
R202 180/7W
R204 10K
C205A 500µf/25V
R205 1.0K
C205B 500µf 25V
R207 12K
R203 390 7W
R206 1.5K/3W
C204A 750uf/35V
C204B 1500/35V
S-9000
E AMPLIFIER
O UP
OSITION ONE
& TOL. UNLESS OTHERWISE SPECIFIED.
ORS ARE IN µf.
TROLYTICS ARE IN pf.
12-2-64