

SHERWOOD

MODEL S-9400
STEREO/DYNAQUAD AMPLIFIER
SERVICE MANUAL

S-9400

LOW FILTER
When depressed reduces rumble from turntable and low frequency noise. (Attenuates at 12 db/octave).

SELECTOR CONTROL
Selects your stereo listening source: PHONO 1, PHONO 2/MIC, TUNER, AUX. 1, AUX. 2.

ILLUMINATED SELECTOR INDICATOR
Describes position of selector switch.

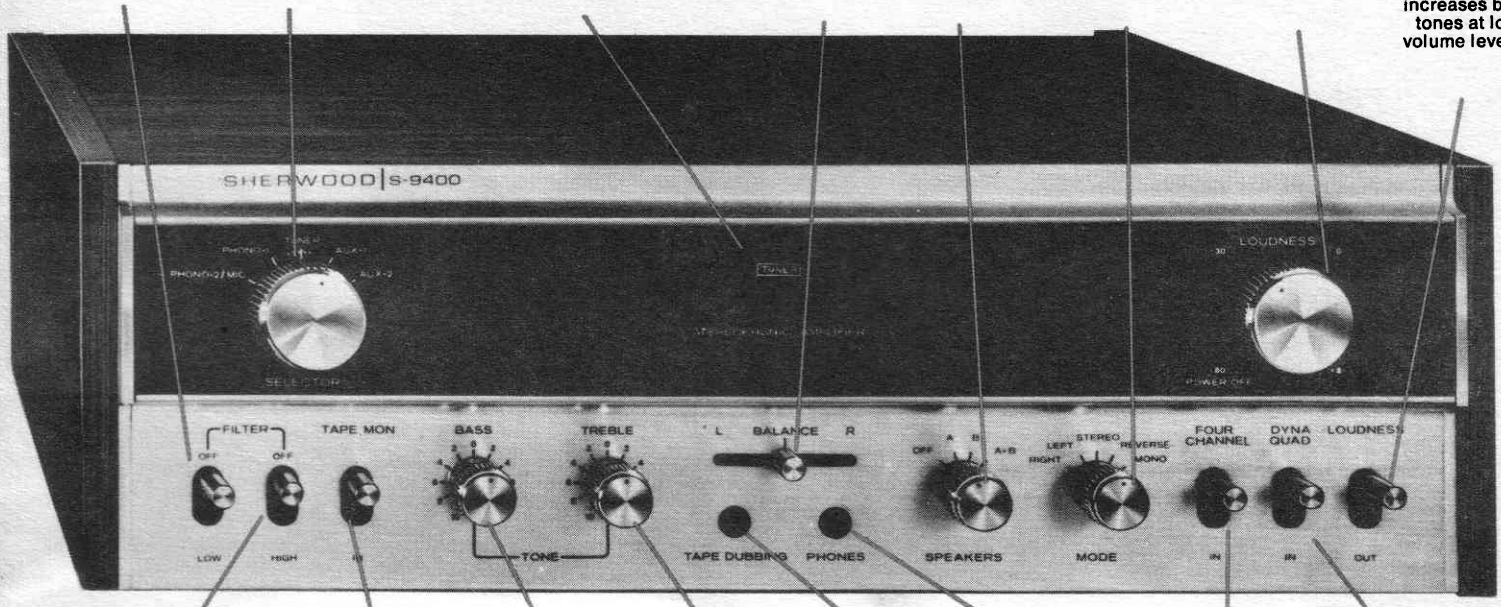
BALANCE
Balances the relative volume levels between your right and left speakers.

SPEAKERS
Selects your main stereo speakers (A), remote stereo speakers (B), both sets, or turns speakers off (for headphone listening).

MODE SWITCH
Permits listening to left channel only, right channel only, stereo, reverse or mono—through both speakers.

LOUDNESS
Master power ON/OFF and volume control for your speakers. Also automatically add bass compensation at low levels.

LOUDNESS
When depressed, defeats loudness control compensation circuit (which automatically increases bass tones at low volume levels).



HI FILTER
When depressed cuts off scratch from records, or background "hiss" from noisy FM stations. (Attenuates at 12 db/octave).

TAPE MONITOR
Permits recording to, or (depressed) playing back from tape recorder; permits monitoring during recording.

BASS
Increases bass tones up to +12 db, decreases up to -12 db.

TREBLE
Increases treble tones up to +12 db, decreases up to -12 db.

TAPE DUBBING
Permits recording to, or playing back from, a second tape recorder. Also, permits dubbing from one recorder to the other.

PHONES
For private listening with stereo headphones.

FOUR CHANNEL
Controls special rear panel inputs and outputs for a 4 channel decoder (may also be used as a second tape monitor).

DYNAQUAD
Controls built-in Dynaquad 4 channel matrixing circuit.

SPECIFICATIONS

Power Output: Music power 160 watts total (IHF)

RMS Power Output (both channels driven):

60 watts x 2 @ 4 ohms, 1 KHz
50 watts x 2 @ 8 ohms, 1 KHz
40 watts x 2 @ 8 ohms, 20-20,000 Hz

Harmonic Distortion:

0.8% 8 ohm rated output, 0.10% @ 10 watts.

Intermodulation Distortion:

0.6% @ 8 ohm rated output, 0.25% @ 10 watts.

Stereo and Mono Speaker Output Impedance:

4, 8, or 16 ohms.

Stereo Headphone Output: High or low impedance.

Stereo Recording Output: 230 mv, 2K ohm.

Power Bandwidth: 5-45 KHz-1% Dist.

Frequency Response: Aux. 20-20 KHz \pm 1/2 db.

Phone: RIAA Std. \pm 1.0 db.

Damping Factor: 40:1 @ 8 ohms.

Bass Control: \pm 12 db. @ 100 Hz.

Treble Control: \pm 12 db @ 10 KHz.

Input Sensitivity (for rated output):

Phono, 1.8 mv.
Auxiliary, 200 mv.
Mic., 2.1 mv

Input Capability for 1% dist.:

Phono, 80 mv.
Auxiliary, Infinite
Mic., 60 mv

Hum and Noise (IHF): Phono -60 db.

Aux. -85 db.
Vol. Control Min. -90 db.

Crosstalk: -45 db @ 1 KHz.

Mic. Input Impedance: 50,000 Ω

GENERAL:

Power Requirements:

115-125V, 50/60 Hz. 20-200 watts fused.

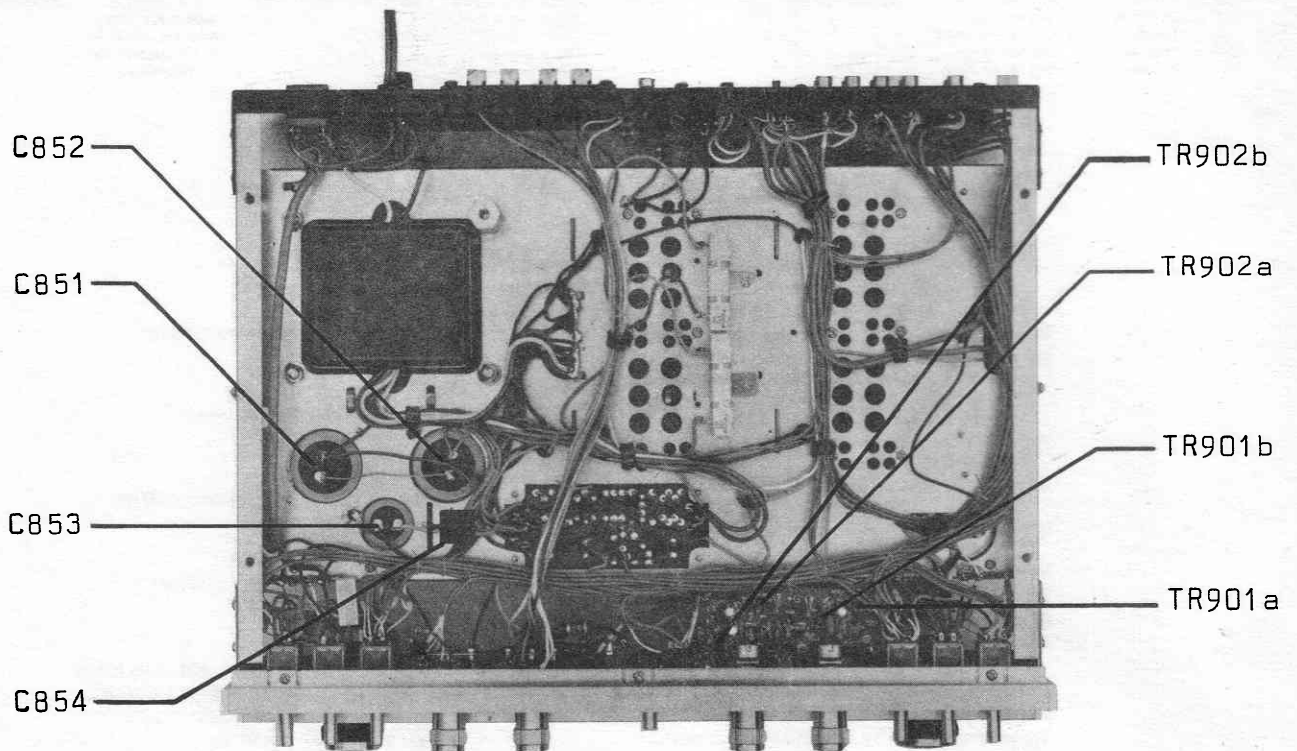
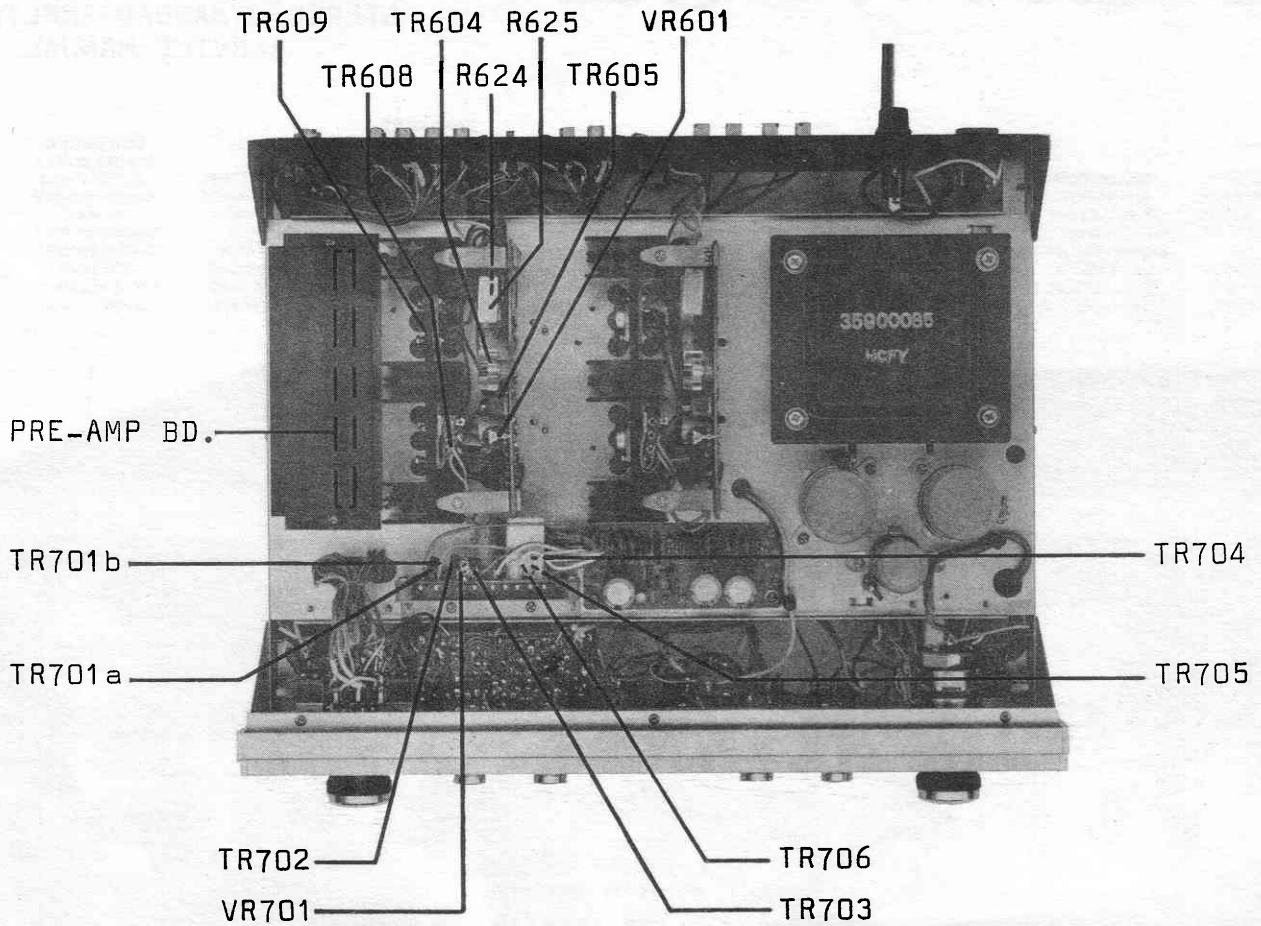
AC Outlets: Switched (2) total 180 watts.

Unswitched (1) 200 watts.

Size: 00" H, 00" W, 00" D.

Shipping Weight: 29 lbs.

DUPLICATES ON OTHER DRIVER BD.



S-9400 AMPLIFIER SERVICING AND ADJUSTMENT

NOTE: To simplify the following descriptions only the left channel and its related circuitries are described. The right channel is identical except for reference symbol numbers. (See schematic diagram) All reference numbers refer to Figure 1 unless otherwise specified.

Preliminary checks of the DC voltages present at various points in your amplifier can indicate whether a transistor is open, shorted, or otherwise malfunctioning. Fault isolation in the preamplifier, tone amplifier, and driver stages can generally be isolated by checking the DC voltages. Many times the circuit defect can be isolated by comparing gain measurements at 1KHz as indicated on the schematic or by comparing the operating channel with the defective channel.

AMPLIFIER ELECTRONIC RELAY PROTECTION AND SPEAKER SYSTEM CHECKS:

This amplifier incorporates a special electronic overload protection circuit which automatically disconnects the speakers when danger to the power amplifier exists or when danger to the speaker system exists. If there is no output to the speakers, check the speaker connections for shorted wires or shorted speakers. (Speaker line resistances should not indicate less than 4 ohm resistance on an ohmmeter.)

The Electronic Relay Protection circuit consists of an electronic switch which senses two conditions, output current and DC center point voltage, to protect both the power amplifier and the speakers. This circuit limits the current delivered to the speaker load and also protects the speaker from DC voltages in the event of an amplifier device failure. A center point DC shift is detected by differential amplifier TR702 and TR703, which disconnects the power amplifier from the speaker load by way of transistors TR704, TR705 and TR706, which deactivates a relay, disconnecting the speaker load. The power amplifier current protection is obtained by transistors TR701a and TR701b with associated components, which sense the current through the output transistor resistors R624 and R625. When the peak currents reach approximately 5 Amps, TR701a and TR701b conduct, causing multivibrator action in conjunction with TR704, TR705, and TR706 to deactivate the relay at a recurring rate, thereby protecting the amplifier from abnormal load conditions. This circuit will continually sample and disconnect the speaker line until the overload condition is removed.

While servicing the amplifier it will be valuable to operate the amplifier using a variable voltage power line (VARIAC) equipped with a line wattmeter to identify abnormal power consumption. Increase the power line voltage upward while observing the wattmeter. Power consumption should not exceed 10-20 watts (loudness control volume at minimum) as the voltage is increased

to the rated 120 VAC. If the power consumption begins to exceed 20 watts, do NOT increase the line voltage any further and determine whether the malfunction is in the power supply, tuner, or amplifier section.

If the power amplifier is suspected, verify the center point voltage at the + speaker terminal for a ZERO voltage \pm 0.2V reading. If the center point voltage reads a plus voltage, suspect a shorted top side driver transistor (TR604) or a shorted top side darlington output transistor (TR608) (schematic shows transistors as the top devices in each channel). If the center point voltage reads minus, suspect a shorted bottom side driver transistor (TR605) or a shorted bottom side darlington output transistor (TR609).

A defect can frequently be located by removing both driver transistors from their sockets. If line power consumption drops considerably, suspect faulty driver transistors. If power consumption remains high faulty output transistors should be suspected. If not the pre-driver or associated components may be defective.

If the fault still exists, then verify that capacitors are not shorted, circuit board contains no solder shorts, open resistors, poor solder connections, or broken pads.

If the center-point voltage reads zero voltage in accordance with the above check, apply audio signal to the channel or channels being tested and measure distortion. Distortion which exceeds amplifier ratings may be due to one of the following:

1. Output transistors are not beta matched.
2. Output bias requires readjustment.
3. Driver transistors are not providing adequate signal drive.

The following performance indicates a properly operating amplifier with an 8 ohm resistive load.

Distortion at 2.0V:

Less than 0.15% IM or Harmonic (1KHz), Typically 0.07%

Distortion at 10V:

Typically 0.2% IM or Harmonic (1KHz)

Typically 52 Watts Dual Channel at 0.8% (20Hz - 20KHz)

Typically 60 Watts Single Channel at 0.8%

OUTPUT TRANSISTOR BIAS:

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

1. Overheating of the output transistors under normal operating conditions.
2. Excessive low level Intermodulation or Harmonic Distortion - more than 0.15% at 2.0 volts across 8 ohms.

*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. Make certain the emitter and base pins of the output transistors do not contact any part of the heat sinks.

SUGGESTED AMPLIFIER TEST BENCH SET-UP

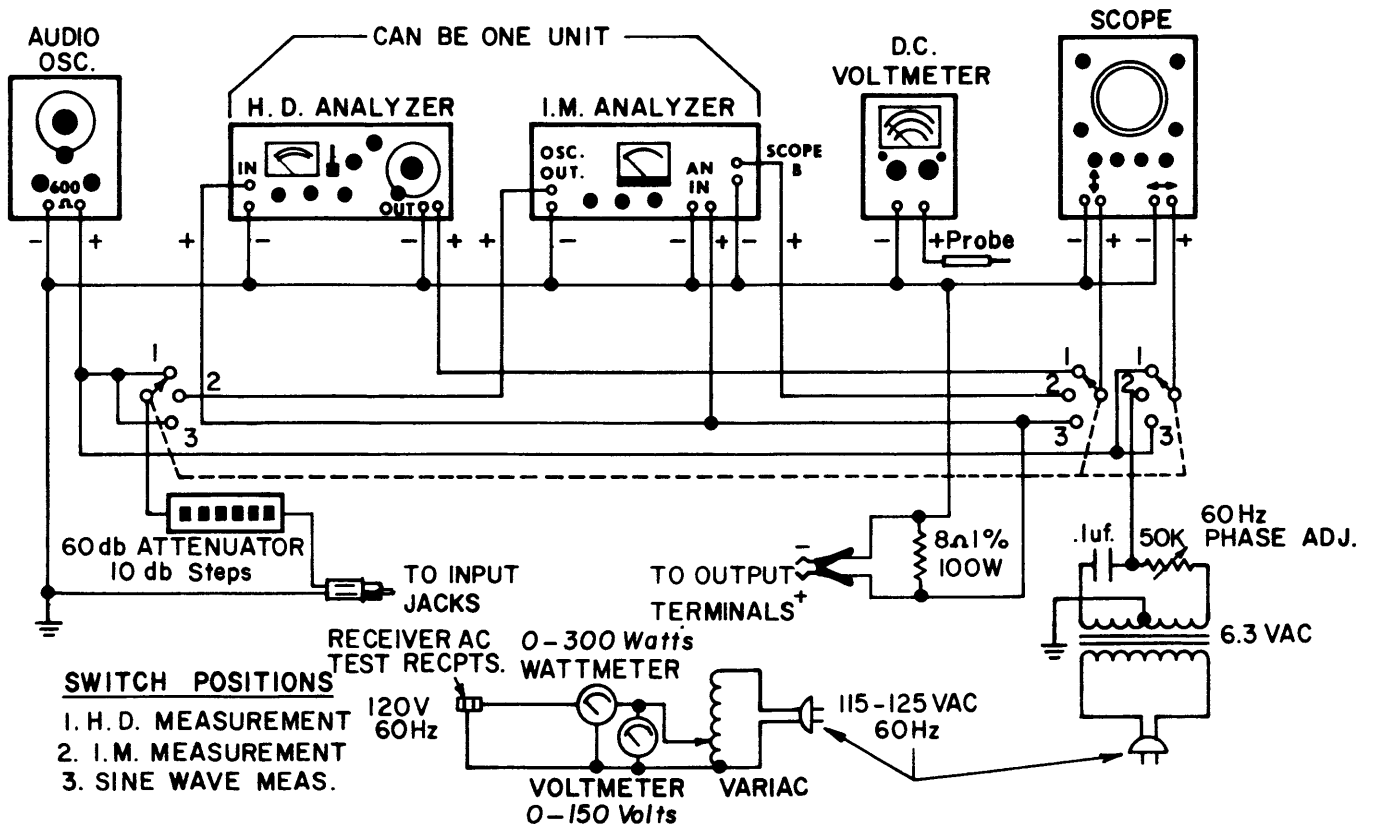


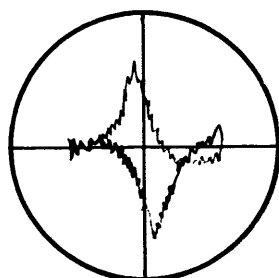
Figure 2

OUTPUT AND BIAS ADJUSTMENT USING AN INTERMODULATION DISTORTION ANALYZER

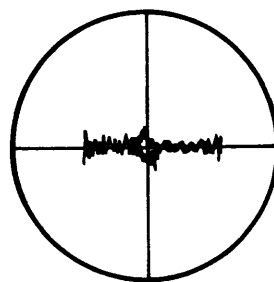
1. Connect the amplifier for testing similar to Figure 2.
2. Connect an Intermodulation Distortion Analyzer with a ratio of 4:1 using 60Hz and 7000Hz to the amplifier (AUX) input and set the selector switch to AUX.
3. Set the volume control to maximum and adjust the generator for an amplifier output of 2.0 volts across 8 ohms.
4. While observing the resultant distortion waveform, adjust the bias potentiometer (VR601) so that the crossover distortion is at a point of being eliminated. (Class "AB")

Note: Class "A" operation (continued CW rotation) causes output transistors to draw excessive current and overheat.

REFER TO DIAGRAMS BELOW



Improper Bias
Adjustment



Proper Bias
Adjustment

5. Repeat Steps 3 and 4 for opposite channel.

The following performance indicates a properly operating amplifier with an 8 ohm load.

Less than 0.15% IM Distortion at 2.0V

Typically 0.2% IM Distortion at 10V

60 Watts of power per channel at 0.8%, single channel

50 Watts of power per channel at 0.8%, Dual channel

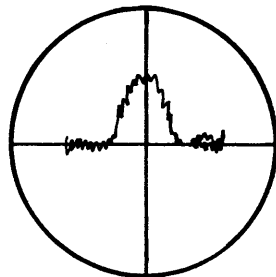
If an Intermodulation Distortion Analyzer is not available, an Oscillator and a Harmonic Distortion Analyzer may be used for adjustment of the output transistor bias as follows:

1. Connect the amplifier for testing similar to Figure 2.
2. Connect an Oscillator with less than .05% distortion at 1KHz to the amplifier (AUX) input and set the selector switch to AUX.

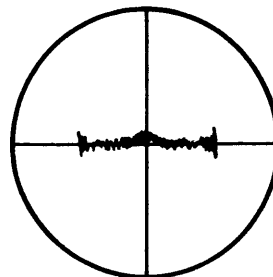
3. Set the volume control to maximum and adjust the Oscillator for an amplifier output of 2.0 volts across 8 ohms.
4. Using the Harmonic Distortion Analyzer looking at the distortion of the amplifier output, properly nulled, make the adjustment as follows: Adjust the bias for Class "AB" operation by turning the bias potentiometer (VR601) so that the crossover is at a point of being eliminated.

Note: Class "A" operation (continued CW rotation) causes the output transistors to draw excessive current and over-heat.

REFER TO DIAGRAMS BELOW



Improper Bias Adjustment



Proper Bias Adjustment

5. Repeat Steps 3 and 4 for the opposite channel.

The following performance indicates a properly operating amplifier with an 8 ohm load @ 1KHz.

Less than 0.10% THD at 2.0V
 Typically 0.15% THD at 10V
 60 Watts of power per channel at 0.8%, single channel
 50 Watts of power per channel at 0.8%, 20Hz -20,000Hz,
 Dual channel

Bias can also be adjusted by using a VARIAC equipped with a line wattmeter:

1. Turn the loudness control to minimum.
2. Adjust the bias potentiometer (VR601), to the point at which the amplifier begins to cause a very slight increase in line wattage consumption.

PROTECTION BOARD TESTING AND ADJUSTMENT:

Without audio drive.

1. Adjust VR701 for equal voltage on the collectors of TR702 and TR703. The differential amplifier is now balanced so as to properly protect against \pm DC voltage at the speaker terminals.

2. Short the speaker terminals on both the left and right channel speaker outputs.
3. Connect an audio oscillator operating at 1KHz to both AUX inputs.
4. Now, test the protection board for proper operation by increasing the audio drive level to the power amplifier. This will cause the relay to be deactivated, disconnecting the speaker terminals from the amplifier at a recurring rate. This should occur at less than 100 watts of line input power. Do not audio drive into a short circuit, beyond this input power level.

FOUR CHANNEL OPERATION

The S-9400 incorporates a 4-channel matrixing circuit. This simple matrixing circuit allows recorded ambient signals, which are not reproduced during conventional stereo playback, to be converted to 4-channel sound without additional amplifying equipment. By connecting 2 additional speaker systems, one each to the REMOTE Left and Right terminals, they then become the left rear and right rear sound sources with the front panel toggle switch in the Dynaquad IN position.

When the toggle switch is in the "up" position the speakers connected to the REMOTE terminals can be utilized as a second set of stereo sound sources in the same area or at a remote location.

S-9400 PARTS LIST

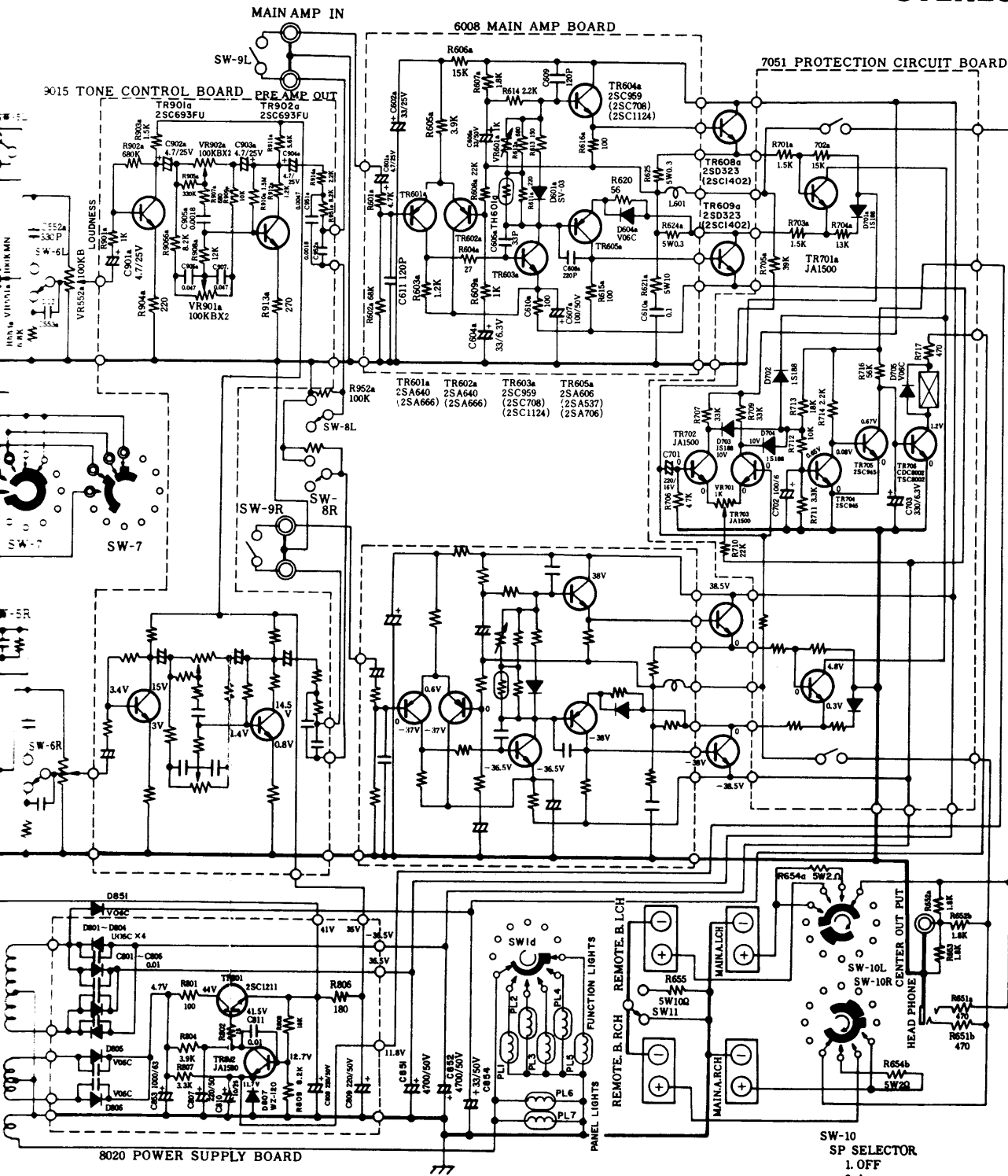
PART DESCRIPTION	SCHEMATIC REFERENCE NO.	PART NO.	LIST* PRICE
<u>TRANSISTORS</u>			
2N5087	TR501a, 501b	30200700	.90
2SA606L	TR605a, 605b	30000101	2.90
2SA640	TR601a, 601b, 602a, 602b	30000241	.78
2SC693F	TR901a, 901b, 902a, 602b	30200124	.98
2SC945P	TR704, 705	30200521	.60
2SC959L	TR603a, 603b, 604a, 604b	30200371	2.70
2SC1000	TR503a, 503b	30200710	.72
2SC1211D	TR801	30200421	1.17
2SD323K	TR608a, 608b, 609a, 609b	30300143	4.44
2SK34	TR502a, 502b	30400041	1.26
CDC8002C	TR706	30200531	1.50
SPS5456	TR701a, 701b, 702, 703, 802	30200690	.30
<u>DIODES</u>			
1S188	D701a, 701b, 702, 703, 704	30600260	.30
1S2473	D501a, 501b	30600410	.22
SV-03	D601a, 601b	30600180	1.48
U-05C	D801, 802, 803, 804	30600460	1.38
V06C	D604a, 604b, 705, 805, 806, 851	30600030	.55
WZ-120	D807	30600370	.90
<u>CAPACITORS, ELECTROLYTIC</u>			
4.7uf @ 25V	C601a, 601b, 901a, 901b, 902b, 903a, 903b, 904a, 904b	64043475	.48
4.7uf @ 25V (AXIAL)	C902a	64113475	.48
10uf @ 16V	C503a, 503b, 504a, 504b, 506a, 506b, 507a, 507b	64042106	.48
10uf @ 25V	C810	64043106	.48
10uf @ 50V	C508a, 508b	64045106	.56
33uf @ 6.3V	C604a, 604b, 702	64040336	.32
33uf @ 25V	C602a, 602b	64043336	.48
33uf @ 50V	C606a, 606b, 854	64045336	.52
47uf @ 10V	C505a, 505b	64041476	.35
100uf @ 25V	C701	64043107	.56
100uf @ 50V	C510a, 510b, 607a, 607b	64045107	1.25
220uf @ 50V	C807, 808, 809	64045227	1.45
330uf @ 10V	C703	64041337	.80
1000uf @ 63V	C853	64246108	3.00
4700uf @ 50V	C851, 852	64245478	6.30
<u>CAPACITORS, TANTALUM</u>			
.47uf @ 35V	C509a, 509b	66064474	.63
4.7uf @ 16V	C501a, 501b	66062475	.85
<u>VARIABLE RESISTORS</u>			
BIAS ADJUST (1K)	VR601a, 601b	28100018	.86

PART DESCRIPTION	SCHEMATIC REFERENCE NO.	PART NO.	LIST* PRICE
<u>VARIABLE RESISTORS (CONT.)</u>			
DIFF-AMP BALANCE (1K)	VR701	28100048	.60
BALANCE CONTROL (DUAL 100K)	VR551a,551b	28200011	2.24
LOUDNESS CONTROL W/SWITCH (DUAL 100K)	VR552a,552b	28000053	4.40
TONE CONTROLS (DUAL 100K)	VR901a,901b,902a,902b	28000040	2.80
<u>GENERAL SECTION</u>			
SWITCH, MIC/PHONO 2	SW2	27300003	1.44
SWITCH, PRE-AMP OUT/MAIN-AMP IN	SW9	27300005	1.26
SWITCH, LEVER TYPE	SW3,4,5,6,8,11	27600012	1.86
SWITCH, MODE	SW7	27100040	2.34
SWITCH, SPEAKER	SW10	27100044	2.34
SWITCH, SELECTOR	SW1	27100061	4.04
LAMP (8V-0.1 AMP)	PL1,2,3,4,5	37008016	.63
LAMP (8V-0.25 AMP)	PL6,7	37008019	.66
THERMISTOR D-22A	TH601a,601b	30700010	.72
FUSE 3A	F1	38300030	.30
<u>MECHANICAL SECTION</u>			
MICROPHONE JACK		33020700	.96
HEADPHONE AND TAPE DUBBING JACK		33030400	1.20
INPUT BD. (1 JACK)		33010100	.60
INPUT BD. (4 JACK)		33040500	1.68
INPUT BD. (8 JACK)		33080300	2.50
INPUT BD. (10 JACK)		33100300	2.68
DIN JACK (5 PIN)		34034001	.90
SPEAKER TERMINAL BD. (8 POST)		53080200	3.10
FUSE HOLDER		34032001	1.25
A.C. OUTLET		34042001	.60
FUNCTION GLASS (CALL-OUTS)		20054001	3.66
TRANSFORMER, POWER		35900085	28.96
TRANSISTOR SOCKET, POWER		34011002	.54
THERMISTOR HOLDER		63162001	.24
KNOB, LARGE W/MARK		29068001	1.20
KNOB, SMALL W/MARK		29066001	.96
KNOB, SLIDE CONTROL		29107002	.86
KNOB, FLIP LEVER		29106002	.66
ESCUTCHEON		10091001	19.76
WOOD CABINET		85034002	22.80
FEET, PLASTIC		74074001	.24
POLYETHYLENE BAG		81100013	.48
STYREFOAM ENDCAPS		89048001	6.26
CARTON, SHIPPING		86083001	

*NOTE: PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

CIRCUIT DIAGRAM

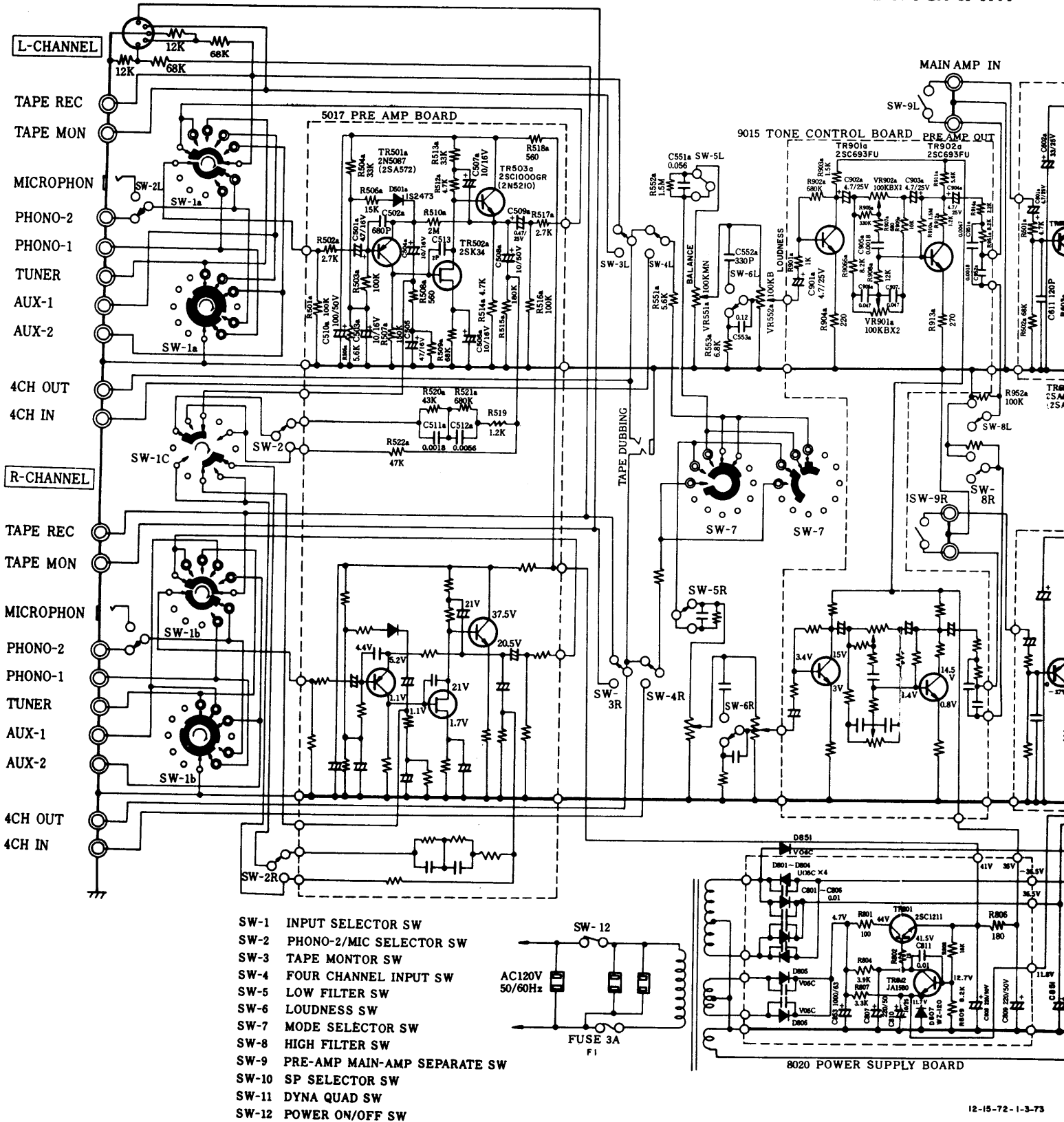
SHERWOOD S-9400 STEREO AMPLIFIER



12-15-72 - 1-3-73

- SW-10
SP SELECTOR
1. OFF
2. A
3. B
4. A+B

CIRCUIT DIAGRAM



NOTES

LITHO 1-73 IN U.S.A. 124

SHERWOOD ELECTRONIC LABORATORIES; INC.
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