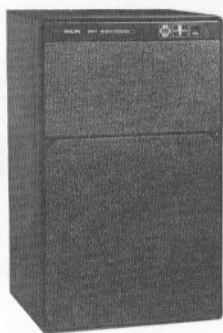


## RH567 Motional Feedback System

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Service  
Service  
Service



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# Service Manual

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**PHILIPS HIGH FIDELITY LABORATORIES, LTD.**

SERVICE DEPT.

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## TECHNICAL DATA\*

### General

Frequency Response:  
27-20,000 Hz

Volume:  
30 litres (20 litres acoustic),(1831 cu. inches acoustic).

Loudspeakers:  
AD10100/MFB, 10" Woofer  
AD0210/SQB, 2" Dome Mid-Range  
AD0140/T8, 1" Dome Tweeter

Power Supply:  
117 Volts, 60 Hz

Power Consumption, Maximum:  
150 Watts

Dimensions:  
320 x 540 x 265mm (13 x 21¼ x 10½ inches)

Treble Filter:  
Continuously variable 0-18dB/Octave, -3dB at 7 KHz.

Crossover Networks:  
Electronic Crossover at 500 Hz.  
Passive Crossover at 3500 Hz.

### Connections:

Signal: PHONO jacks (2 input, 2 output)  
AC inlet  
AC outlet (unswitched)

### Input Sensitivity:

Continuously variable 1-3 volts at 100K ohms, 3-20 volts at 1K ohm.

### Automatic On/Off Switch:

Turn-On time  $\leq$  1 second, with an input signal  $\geq$  2mV.  
Turn-Off time  $>$  2 minutes

### Amplifiers

#### Low Frequency Amplifier:

Minimum "RMS" Power: 40 Watts RMS  
Bandwidth: 35 Hz to 1000 Hz  
Maximum Total Harmonic Distortion: 0.2%  
Load Impedance: 4 ohms

#### High Frequency Amplifier:

Minimum "RMS" Power: 20 Watts RMS  
Bandwidth: 400 Hz to 20 KHz  
Maximum Total Harmonic Distortion: 0.2%  
Load Impedance: 8 ohms

\* Subject to Modification

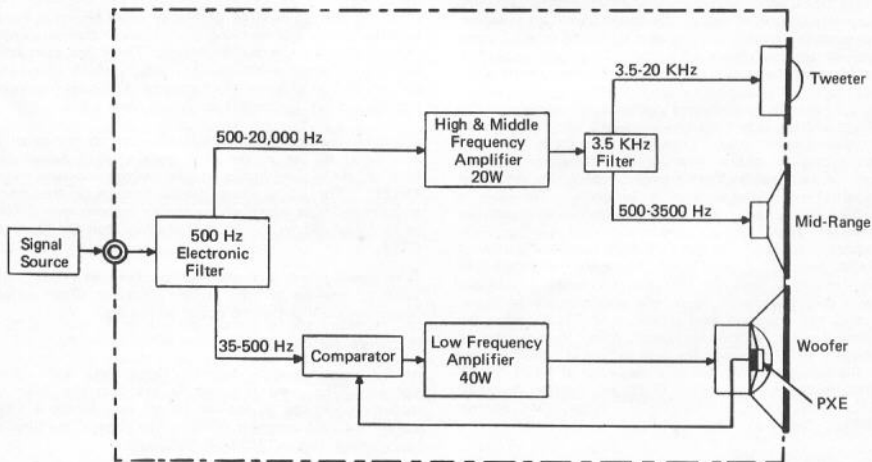


Figure 1, Block Diagram

## General Description

The RH567 is an electronic, bi-amplified, three-way loudspeaker system employing the PHILIPS Motional Feedback (MFB) principle.

The enclosure, which has a total volume of 30 liters, incorporates three driver units, an electronic regulator and control system, and two power amplifiers; one for the woofer and one for the mid-range and tweeter. The woofer (low frequency) amplifier is terminated in a 4 ohm load impedance and has a minimum continuous average sine wave (RMS) power of 40 watts. The mid-range/tweeter (high frequency) amplifier, which is of similar design to the low frequency amplifier, is terminated in an 8 ohm load impedance, and is, therefore, limited to an output power of 20 watts. An electronic crossover is used to divide the input signal between the two power amplifiers. This crossover consists of a high-pass filter feeding the high frequency amplifier, and a low-pass filter feeding the low frequency amplifier. Both filters have a cut-off point of 500 Hz, resulting in amplifier crossover at that frequency.

Since it is physically impossible for the woofer cone to produce frequencies below 25-35 Hz at a moderate sound pressure level without resulting in high non-linear distortion, the response of the low frequency amplifier is rolled-off below 40 Hz by a high-pass filter placed immediately after the low-pass filter section of the electronic crossover.

## CIRCUIT DESCRIPTION

Before examining the individual circuits in detail, it would be useful to know the construction of the acceleration transducer assembly.

As mentioned, the Motional Feedback transducer is mounted under the dust cover in the apex of the woofer cone, where it is in rigid mechanical contact with the voice coil assembly. The transducer consists of a small printed circuit board containing the ceramic piezoelectric transducer and its associated FET circuitry. The mounting of the piezoelectric chip is quite critical: It is held in place in a small hole in the PC board by two resilient rubber clamps, allowing a calculated degree of flexure due to the cone's acceleration. The leads to the chip are fastened to the PC board by two carefully weighed drops of solder . . . a most important consideration if assembly mass is to be accurately controlled.

As piezoelectric transducers (generators) are capacitive voltage sources, they must be loaded with a high impedance to obtain a linear frequency response from them. However, high impedance circuits running long distances (such as, from the motional feedback transducer back into the power amplifier) are quite susceptible to noise. Therefore, a junction FET has been used in the assembly as an impedance converter. It will be noticed that the circuit configuration is rather unusual in that the FET drain feeds the emitter of TS436 instead of the base. There are two benefits to this approach. First, the FET source provides a relatively low source impedance to reduce susceptibility to noise. Second, the common base operation of TS436 makes the driving signal a "varying resistance" rather than a "varying voltage". In other words, the base voltage of TS436 is fixed by the voltage divider network made up of R677, R680, R678, R679, and zener diode D462; and the conduction of TS436 is controlled by varying the value of its emitter "resistor", the FET.

This "dynamic resistance" drive signal makes the circuit quite insensitive to any noise signal voltage which might appear on the signal lead, as the gain from a voltage input at the emitter is very low. It will be further noticed that

The output of the high frequency power amplifier feeds a typical passive crossover network with a crossover point of 3500 Hz. The high-pass section of this crossover feeds the 1" dome-type tweeter, while the low-pass section feeds the 2" dome mid-range. The output of the low frequency power amplifier feeds the 10" MFB woofer.

The woofer consists of a standard 10" driver with an accelerometer mounted under the dust cover at the apex of the cone. It is, in fact this piezoelectric transducer (PXE) which constitutes the most important aspect of the entire system. Its function is to measure the acceleration of the woofer cone, which is exactly proportional to its acoustic output as long as the cone moves as a single, rigid "piston". This requirement forms part of the reasoning behind the 500 Hz crossover point; as above this frequency the cone will begin to move independently in small areas, resulting in less correlation between central acceleration and acoustic output.

The signal developed by the PXE is fed to a comparator circuit which derives a correction signal from any differences between the input signal and the woofer cone acceleration signal. This correction signal is combined with the input signal and fed to the low frequency amplifier, resulting in considerable reduction of distortion attributable to the loudspeaker, and keeps the acoustic output virtually identical to the input signal waveform. This is the principle of motional feedback.

the collector voltage of TS436 is Zener stabilized. This is to place the quiescent operating point on the center of the transistors curve, as the static conduction of TS436 regulates the source-to-drain bias on the FET, which must be carefully held below a maximum value to preserve the gates high input impedance.

### Amplifier System Input

At the signal input to the Motional Feedback System are four phono jacks. These are connected in two individual pairs: left input and output, and right input and output; to allow the interconnection of two or more Motional Feedback Systems while carrying both (stereo) channel signals through the interconnection wiring. These jack pairs feed the input channel selector switch (SK-B) which allows the user to choose whether the particular Motional Feedback System is driven by the left or right channel signal.

Following the input channel selector switch the signal is attenuated to the proper level by the input Sensitivity Control, R416, and applied to an emitter follower stage, TS421. The signal then passes through a frequency selective network which allows the frequencies over 7 KHz to be rolled off by the High Frequency Roll Off Control, R417.

After passing through another emitter follower (TS422) the signal is applied to the active crossover filters which determine the input to the power amplifiers.

### High Frequency Amplifier

At the high frequency amplifier input there is an active high-pass filter. As is normally the case this filter is partially contained in the emitter to base feedback loop around the first transistor, TS441. The slope of the filter is 18db/octave, and its -3db point is 500 Hz.

The amplifier itself is of a common design. Its operation is class A/AB to eliminate crossover distortion at low signal levels. Up to about 1W of output power the amplifier

operates in a class A configuration and changes to class AB at higher input signal levels.

Each output stage is comprised of a single-chip Darlington device, assuring that the two transistors involved are completely complementary. To insure thermal stability of the Darlington pair, a negative temperature coefficient resistor (thermistor), R719, is used in the bias control circuit, and is mounted on the Darlington package heat sink along with TS442, which is also part of the quiescent bias control.

The LC networks C566-S492 and C568-S493, respectively, form high-pass and low-pass filters for the tweeter and mid-range speakers. Together they form a conventional passive crossover network. The series RC network across the mid-range is for impedance correction at high frequencies. Coil S491 is a normal high frequency neutralizing choke.

#### Low Frequency Amplifier

At the input of the low frequency channel is a low-pass filter, TS423. This circuit is similar to the 500 Hz high-pass filter incorporating TS441, and likewise has a slope of 18db/octave. Since TS423 is in the emitter follower configuration its output appears at the emitter, from which it is coupled to the base of the next stage. This stage, a high-pass filter, is made up of TS424 and associated components, and is again arranged in the emitter follower configuration. The circuit acts as a rumble filter and attenuates all frequencies below approximately 35 Hz at 12db/octave. This makes the frequency response the same as that of a speaker with a natural resonance of 35 Hz.

The signal, bandwidth limited by filters to 35-500 Hz, is applied to the adding stage, TS425, where it is combined with the feedback signal derived from the accelerometer circuit. The feedback signal arrives at the base of TS425 via C518 and R627. The "normal" input signal is applied via C516 and R634. The gain factor of this adding circuit is approximately one. The combined signal is then coupled to a differential amplifier consisting of TS428 and TS429. This stage is used to shape the electrical feedback signal, which is taken from the load side of C535 (TP1).

The low frequency amplifier operates class B. Since the frequency range does not exceed 500 Hz, practically no higher harmonics will be produced by the woofer and subsequently the possibility of crossover distortion is effectively suppressed without the need for class A/AB operation. Like the high frequency amplifier discussed earlier, each output stage is comprised of a single chip Darlington device. The thermistor, R662, is used for thermal stability and is mounted on the heat sink along with TS430 which is also part of the quiescent bias control. The output from the low frequency amplifier is coupled through C535 to the woofer.

The signal from the woofer/transducer assembly is applied to the emitter of TS436, as explained earlier in the circuit description. A prominent feature of the collector circuit of this transistor is the zener diode, D462, which is used to smooth the power supply voltage. If an electrolytic capacitor were used, the circuit would start oscillating (motorboating) at low frequencies. The signal is coupled from the collector of TS436 to the frequency correction stage consisting of TS437 and TS438. Down to approximately 80 Hz the correction stage has a flat frequency response. Below that the signal has an increasing gain slope of 6db/octave. The reason is the natural resonance of the loudspeaker, which in this case is also about 80 Hz.

In the flat part of the response the signal is amplified by a factor of only two or three, while below 80 Hz the gain increases to a factor of about 20. Two transistors, TS437 and TS438, were used to avoid distortion. The signal at the output of the frequency correction stage is coupled through C542 to R692 where the feedback level may be adjusted. From the wiper of R692 the signal is coupled through C518 and R627 to the adding stage which was discussed earlier.

#### Automatic Electronic On/Off Switch

The arrangement for switching the system On and Off has a special feature. The circuit consisting of TS447 through TS452 "senses" when a signal is applied to the speaker system and applies power to the high and low frequency amplifiers. This feature is operative only when both the Power and Automatic switches are in the "On" position. With the Automatic switch in the "Off" position the Power switch must be used to turn the system On and Off.

The input signal is applied to the gate of TS447. The output of this stage is coupled via C578 and R743 to the stage comprised of TS448 and TS449 where it is amplified and rectified. When the input signal exceeds a preset level the Schmitt trigger, TS450 and TS451, changes states and turns on the Relay Driver, TS452, which in turn energizes the relay, RE402.

A time delay circuit located immediately ahead of the Schmitt trigger will keep the relay from de-energizing during short no-signal periods; such as at the end of a record or tape. If no signal is applied to the unit within approximately 2 minutes the Schmitt trigger will change states and the relay will de-energize. With the relay de-energized only sources +6, +7 and +8 have power applied to them. The Power switch must be placed in the "Off" position to remove power from the entire unit.

#### Overload Circuit

The treble speaker (tweeter) is protected against overload conditions which might occur when the speaker must produce a maximum output for a long period of time. Experience has shown that the tweeter is more vulnerable to overloads than the woofer and the mid-range.

The signal across the tweeter is rectified by D465 and filtered by R735 and C572. Since R735 and C572 also form an RC network with a time constant of 1 second, the positive voltage at the base of TS446 develops rapidly. Being an emitter follower, the voltage on the emitter increases along with the base. The output obtained at the emitter of TS446 is coupled through the voltage divider network comprised of R737 and R761 to the base of TS440.

During an overload condition the output of TS446 causes the Schmitt trigger (TS439-TS440) to change states, thus driving TS426 into conduction. With TS426 conducting, the signal at R608 is shunted to ground through TS426 and C508, and output power is reduced to near zero.

This reduction in loudness is an indication for the listener that the Volume control should be turned slightly counterclockwise. From this moment C572 will discharge via TS446 until the emitter voltage reaches such a low value that the Schmitt trigger (TS439-TS440) changes states again shutting off TS426. The music signal then passes on without attenuation.

## Power Supply

The power supply circuits are conventional. Only the supply voltage for the preamplifiers (source +7) is electronically regulated (TS455-TS456). The circuit also ensures

that this voltage increases slowly to the correct level, as is necessary to prevent switching transients. This is a point to which great care must be paid in circuits with a bandwidth extending down to very low frequencies.

## OPERATING CONTROLS, JACKS, AND INDICATORS (Refer to Figures 2 and 3)

- Power Switch:** This is the main power switch and must be on for the unit to operate.
- Automatic Switch:** With this switch off, the unit functions normally by using the Power Switch. With the Automatic Switch and the Power Switch in the on position the unit operates on a "standby" basis. Part of the power supply is energized at all times, and the rest of the power supply energizes when a signal is applied to the unit. When the signal is removed from the unit it will return to the "standby" condition after a short delay. To turn the unit off completely the Power Switch must be in the off position. The pilot lamp (LED) is not lit in the "standby" or off condition.
- Fuse Holder (fuse 6.25ASB, 125V)**
- Fuse Holder (fuse 3A SB, 250V)**
- Fuse Holder (fuse 1.5A SB, 250V)**
- High Frequency Roll Off Control:** This control allows you to choose the slope of roll off, in dB per octave, for those frequencies above 7K Hz.
- Input Sensitivity Control:** This control allows you to match the speaker system to your amplifier or pre-amplifier. The control should be set for the output voltage of the equipment being used to drive the speaker system. If the driving equipment is rated in watts RMS

rather than volts, refer to Figure 7.

- Signal Input Jack, Left Channel:** Receives the left channel output signal from the driving equipment.
- Signal Input Jack, Right Channel:** Receives the right channel output signal from the driving equipment.
- Signal Output Jack, Left Channel:** Relays the left input signal for feed-thru hook-up to other MFB.
- Signal Output Jack, Right Channel:** Relays the right input signal for feed-thru hook-up to other MFB.
- Input Channel Selector Switch:** Determines which channel input will be amplified by that particular speaker assembly.

**IMPORTANT:** Take special care that the connections for Left and Right on the control unit are not interchanged.

- AC-Inlet (117 Volts, 60 Hz).**
- AC-Outlet (117 Volts, 60 Hz, 550 Watts) Unswitched.**
- Pilot Lamp (LED), on front panel:** This lamp, when lit, indicates that the speaker unit is completely operative. When the unit is in the "standby" condition or completely off the indicator is not lit.

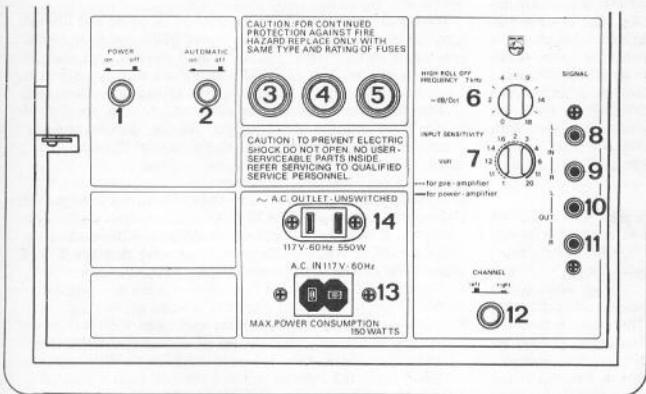


Figure 2, Rear Panel

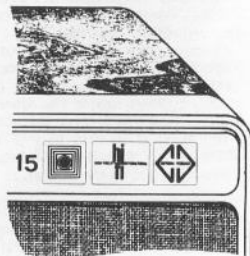


Figure 3, Front Panel

## DISASSEMBLY INSTRUCTIONS

**NOTE:** To insure proper reassembly, replace each screw in the same location from which it was removed.

### Chassis Access (Refer to Figure 5)

1. Remove the five screws securing the rear panel to the speaker enclosure. These screws are designated by an "O" on the rear panel and an "A" in Figure 5.
2. The rear panel is hinged, allowing it to swing away from the back of the speaker enclosure. Pull out on the right side of the rear panel to gain access to the chassis.
3. To completely remove the rear panel from the speaker enclosure, disconnect Plug (4) from Socket (2) and lift the rear panel up and out of the hinge brackets.
4. To reassemble, reverse the preceding steps, making certain Plug (4) is inserted properly into Socket (2). This is accomplished by placing the referenced end of the plug adjacent to the referenced end of the socket.

### LED Access (Refer to Figure 5)

1. Remove the three screws securing the Name Panel (19) to the front of the speaker assembly. Then pull outward on the Name Panel to gain access to the LED.
2. To reassemble, reverse the preceding steps, making certain the LED is properly positioned into the Name Panel (19).

### Speaker Access (Refer to Figures 4 & 5)

1. Insert a table knife or similar dull-edged tool between the Grille (20 or 21) and the speaker enclosure frame.
2. Draw the Grille (20 or 21) forward while prying outward with the tool. The Grille is held to the speaker enclosure by friction snaps.
3. To reassemble, place the Grille (20 or 21) into position while aligning the snaps. Then press firmly at the corners.

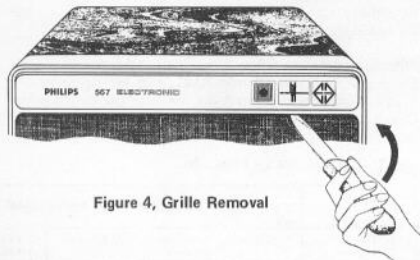
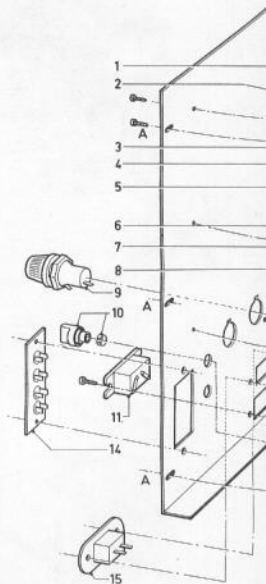


Figure 4, Grille Removal

### Main PC Board Access (Refer to Figure 5)

1. Swing the rear panel away from the back of the speaker enclosure (see Chassis Access).



2. Remove the six screws securing the Main PC Board / Heat Sink to the rear panel.
3. The Main P.C. Board/Heat Sink is hinged to the inside of the rear panel, allowing it to swing away for easy access to either side of the P.C. Board.
4. To remove the Main P.C. Board/Heat Sink from the rear panel, lift it up and out of the hinge brackets.
5. To reassemble the Main P.C. Board/Heat Sink, reverse the preceding steps.



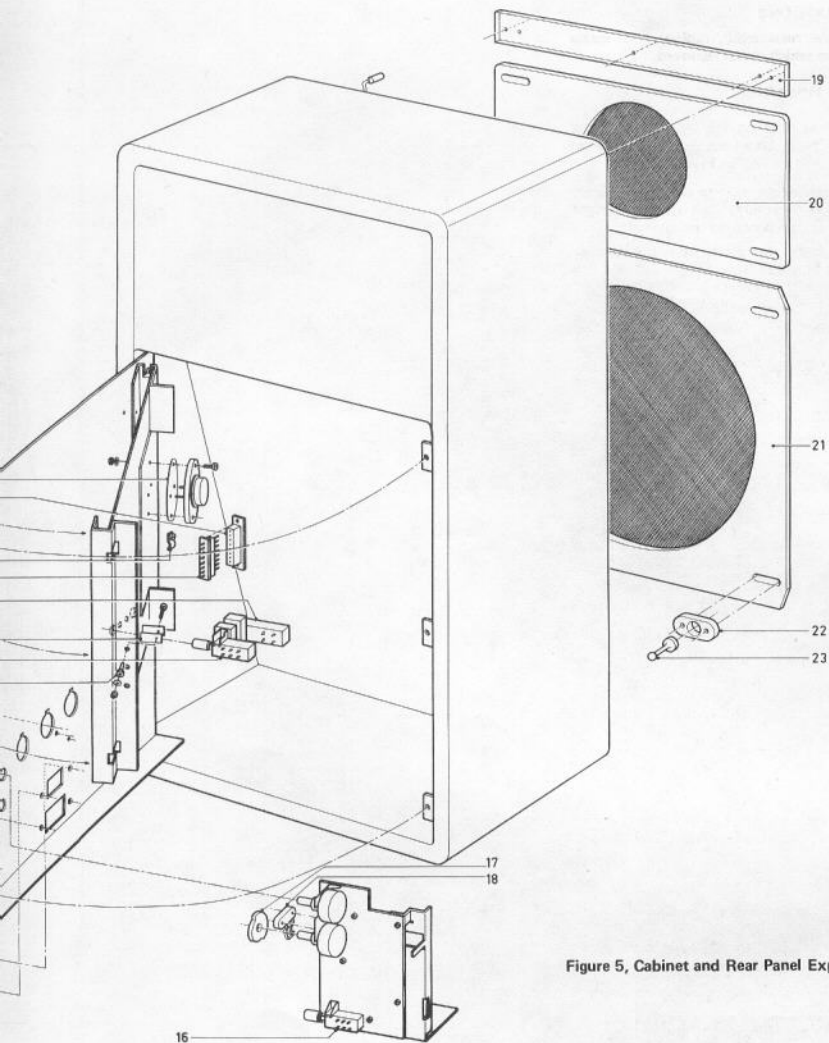


Figure 5, Cabinet and Rear Panel Exploded View

CABINET REPLACEMENT PARTS LIST (Refer to Figure 5)

REF.	DESCRIPTION	PART NO.
1	Mica Insulator f/TS432a & TS432b (2 used)	5H46690433
2	8 Pin Socket	4H26750221
3	Bracket f/TS442 & TS430 (2 used)	4H25540127
4	8 Pin Plug	4H26450081
5	AC Switch (SK-A-1)	4H27610564
6	Mica Insulator f/TS444a & TS444b (2 used)	4H25540112
7	Automatic Switch (SK-D-111)	4H27610616
8	Insulator Bushing f/TS432a, TS432b, TS444a & TS444b (6 used)	4H53251043
9	Fuse Holder (3 used)	4H25640048

REF.	DESCRIPTION	PART NO.
10	Knob, w/Compression Spring (2 used)	4H41330623
11	AC Inlet (Interlock)	4H26520052
14	Jack Assembly (Input/Output)	4H26740222
15	AC Outlet	4H26730255
16	Channel Selector Switch (SK-B-11)	4H27610616
17	Disc Cam f/SK-E-1V	4H53260643
18	Input Impedance Switch (SK-E-1V)	4H27890303
19	Name Panel	4H45910476
20	Grille (Small)	4H44530042
21	Grille (Large)	4H44530043
22	Locking Pin Holder (8 used)	4H46690844
23	Locking Pin (8 used)	4H41720039



MISC	T5442	T5427 430	T5437	T5425	T5436	T5424	T5429 5152	T5428	T5425 430 450	T5445 5165
MISC	T5449 D	D106	S491	T5443	T5441	T5431	S402	RE 402	DW61 177	T5430 5130 5120
MISC	S493			T5455 456 5482			S402	RE 402	DW61 177	VL450 459 408
C	512 514 542 541	507 543 514 540	539 515 544 516 515 522	555 563 550 564 534	516		532 528 525	530	509	509 522
C	558	510 511 552 561	513 560 564 563							
C		507 508 560 562 561					528		536 500 580 527	
H	692 631	693 691 627 690 682	685 629 635 630 634 628 648 633 626 680				678 679	630 738 733		
H	621 622 633 721	704	701 707 634 632 710 689 700 724 625 703 721 708				649 650 667 668 643	647 651 650 658 665 657 673 612 662		
H	719 722 728 718 720 727	713 724	713 714 726	723 678 675 676			671 669 682 684 686 685 653 689 670 663 664 737			
H	730	630		784 783 763 677 764 767			637 638	760 762 761		725

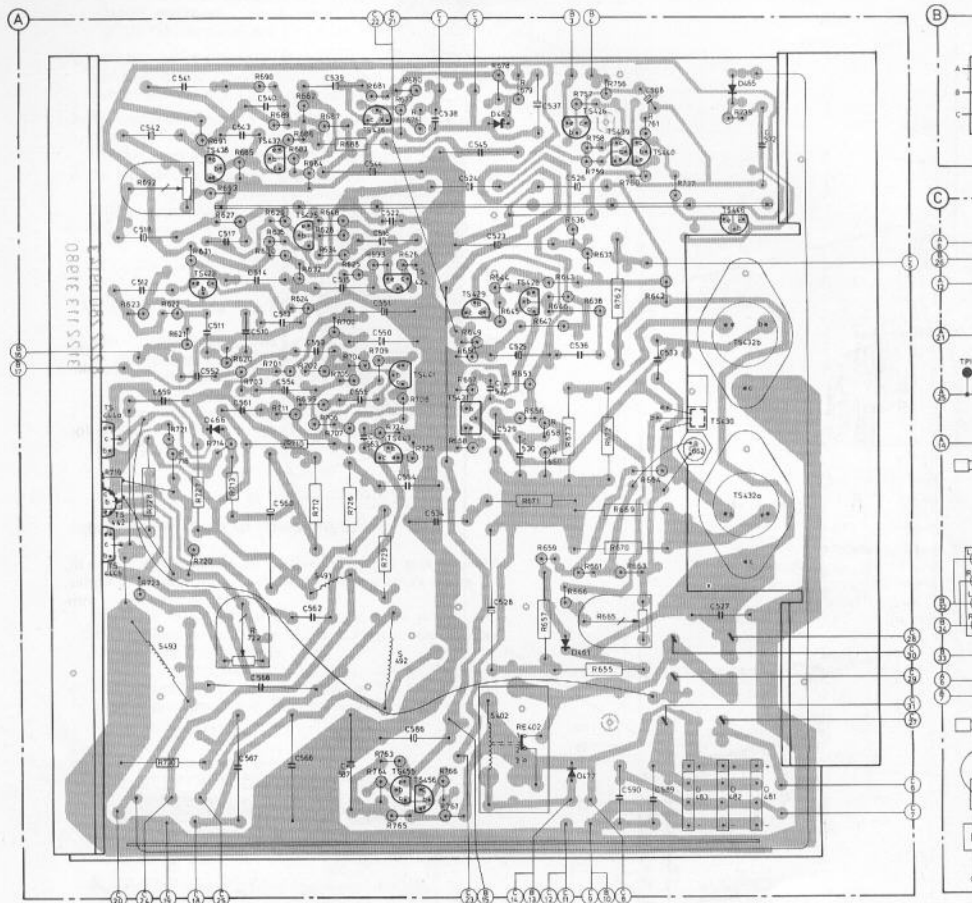


Figure 6, Wiring Diagram

Output of Driving Amplifier  
(Rated in Watts, RMS)

Input Sensitivity Control Setting	4 Ohm Load	8 Ohm Load
	3 V	< 5 W
4 V	5 - 10 W	2.5 - 5 W
6 V	10 - 30 W	5 - 15 W
11 V	30 - 100 W	15 - 50 W
20 V	> 100 W	> 50 W

Figure 7, Input Sensitivity Chart

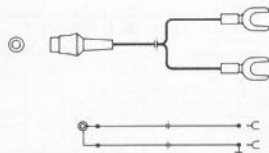


Figure 8, Adapter Cable Drawing

S400	TS422	D472	TS424	TS426	TS428	TS432	TS434	TS436	TS438	TS440	TS442	TS444	TS446	TS448	TS450	TS452	TS454	TS456	TS458	TS460	TS462	TS464	TS466	TS468	TS470	TS472	TS474	TS476	TS478	TS480	TS482	TS484	TS486	TS488	TS490	TS492	TS494	TS496	TS498	TS500	TS502	TS504	TS506	TS508	TS510	TS512	TS514	TS516	TS518	TS520	TS522	TS524	TS526	TS528	TS530	TS532	TS534	TS536	TS538	TS540	TS542	TS544	TS546	TS548	TS550	TS552	TS554	TS556	TS558	TS560	TS562	TS564	TS566	TS568	TS570	TS572	TS574	TS576	TS578	TS580	TS582	TS584	TS586	TS588	TS590	TS592	TS594	TS596	TS598	TS600	TS602	TS604	TS606	TS608	TS610	TS612	TS614	TS616	TS618	TS620	TS622	TS624	TS626	TS628	TS630	TS632	TS634	TS636	TS638	TS640	TS642	TS644	TS646	TS648	TS650	TS652	TS654	TS656	TS658	TS660	TS662	TS664	TS666	TS668	TS670	TS672	TS674	TS676	TS678	TS680	TS682	TS684	TS686	TS688	TS690	TS692	TS694	TS696	TS698	TS700	TS702	TS704	TS706	TS708	TS710	TS712	TS714	TS716	TS718	TS720	TS722	TS724	TS726	TS728	TS730	TS732	TS734	TS736	TS738	TS740	TS742	TS744	TS746	TS748	TS750	TS752	TS754	TS756	TS758	TS760	TS762	TS764	TS766	TS768	TS770	TS772	TS774	TS776	TS778	TS780	TS782	TS784	TS786	TS788	TS790	TS792	TS794	TS796	TS798	TS800	TS802	TS804	TS806	TS808	TS810	TS812	TS814	TS816	TS818	TS820	TS822	TS824	TS826	TS828	TS830	TS832	TS834	TS836	TS838	TS840	TS842	TS844	TS846	TS848	TS850	TS852	TS854	TS856	TS858	TS860	TS862	TS864	TS866	TS868	TS870	TS872	TS874	TS876	TS878	TS880	TS882	TS884	TS886	TS888	TS890	TS892	TS894	TS896	TS898	TS900	TS902	TS904	TS906	TS908	TS910	TS912	TS914	TS916	TS918	TS920	TS922	TS924	TS926	TS928	TS930	TS932	TS934	TS936	TS938	TS940	TS942	TS944	TS946	TS948	TS950	TS952	TS954	TS956	TS958	TS960	TS962	TS964	TS966	TS968	TS970	TS972	TS974	TS976	TS978	TS980	TS982	TS984	TS986	TS988	TS990	TS992	TS994	TS996	TS998	TS1000
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## ADJUSTMENTS

**IMPORTANT:** The amplifier circuitry should be allowed to warm-up for 1-1½ minutes to stabilize prior to final adjustments.

### Low Frequency Amp Quiescent Current Adjustment

To adjust the complementary symmetry push-pull output stage of the low frequency amplifier:

1. Switch the speaker system On and remove the audio input signal.
2. Connect a DVM across R670 and adjust R665 for 37.5 mV.

**NOTE:** This adjustment must be performed when the low frequency amplifier output transistors are replaced. Misadjustment may cause crossover distortion or possible premature failure of the output transistors.

### High Frequency Amp Quiescent Current Adjustment

To adjust the complementary symmetry push-pull output stage of the high frequency amplifier:

1. Switch the speaker system On and remove the audio input signal.
2. Connect a DVM across R727 and adjust R722 for 35mV.

**NOTE:** This adjustment must be performed when the high frequency amplifier output transistors are replaced. Misadjustment may cause crossover distortion or possible premature failure of the output transistors.

### Motional Feedback Adjustment

To adjust the amount of feedback produced by the frequency correction circuit:

1. Switch the speaker system On and place the Input Sensitivity Control, located on the rear panel, to the 1V position. Connect an AC VTVM to TP1.
2. With a low impedance (less than 100 ohms) Audio Generator apply a 10 mV RMS, 125 Hz signal to the Audio Input Jack located on the rear panel. Place the Channel Selector Switch in the proper position to amplify the signal.
3. Adjust R692 for 82 mV.

**NOTE:** This adjustment must be made after replacing a bass speaker (woofer).

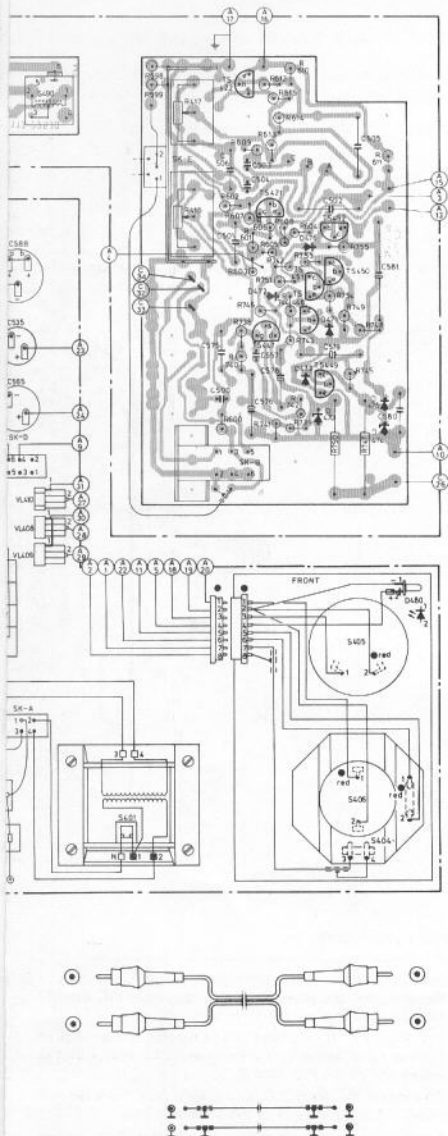


Figure 9, Stereo Cable Drawing

MISC				TS421	TS426	S490/TS439	TS440	TS422		TS423	TS441	TS441+											
MISC		TS447	DL71-473	TS448	TS449	DL74-476	TS450	TS451	DL76,477		DL86	TS441+											
C		800	501			508	502	504	506	503	505	510	511	512	552	553	554	555	563				
C	575	576	577	578	579	580	581																
R		598	599	600		601	602	603	608		417	613	609	612	614	615	620	621	622	623	624	625	
R						756				757	758	760	759	761						631	632	6	
R		738	739	740	741	742	743	744	745	747	748	749	742	754	753	751	755			702	706	899	71

1 nf = .001 uf  
 10 nf = .01 uf  
 100 nf = .1 uf

	Carbon resistor E24 series	0.125 W	5%		Refractory carbon resistor
	Carbon resistor E12 series	0.25 W	5% 10%		Flat-foil polyester capacitor
	Carbon resistor E93 series	0.5 W	5% 10%		Miniature electrolytic capacitor
	Carbon resistor E33 series	1 W	5% 10%		

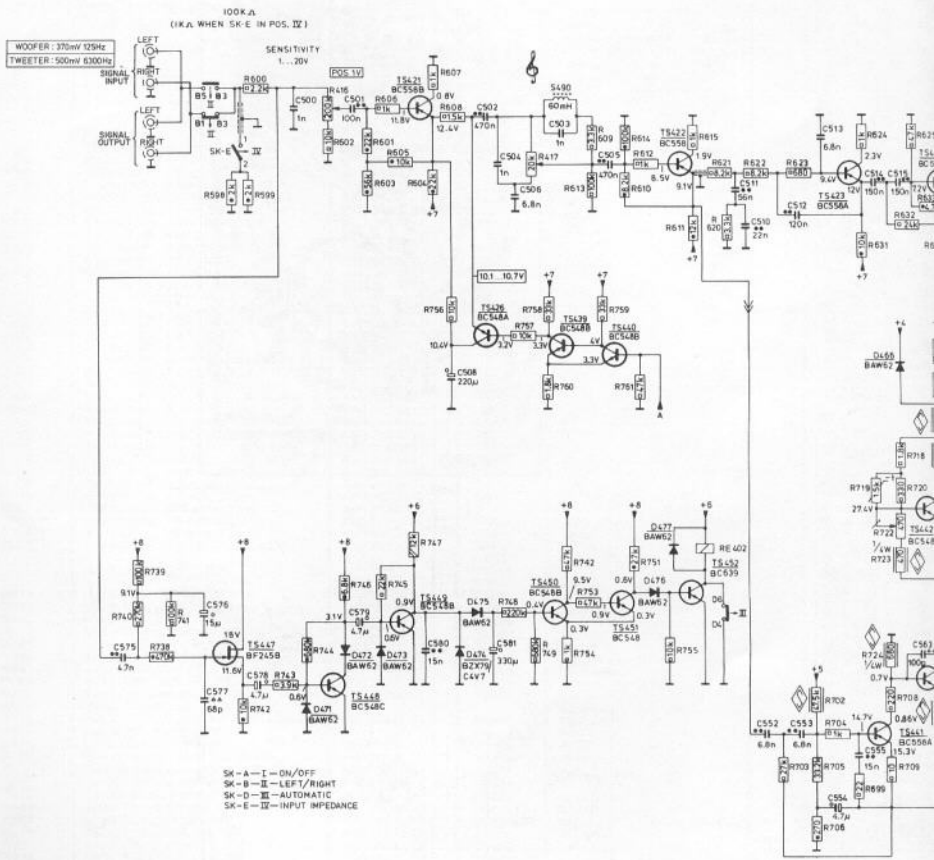


Figure 10, S

TS424				TS425				TS428				TS429+L31				TS432+B				S404		D465 TS436				TS460 D463				TS437 L38				MISC	
T5441				T5444				S491				S492,L43				S405 L06 TS455 456				D470 D181		D482,480 D483 VL400-470				S407 VL411				MISC					
S15 S15				S16 S18 S17				S14 S22				S30 S32 S25 S26 S33S30				S28 S31 S33		S38 S39 S37 S40 S43 S40-S42				C													
S18 S83				S82 S81				S80 S84 S86 S85 S87				S88 S50 S21 S51 S28 S56 S27		S72,S89 S80				S75-81		S82-888				S89-893		R									
S24 S25 S26				S31 S27-229 S35 S18 S47 S48 S36				S30 S87				S85 S86		S89 S70 S72 S81				S70 S71		S79				S77		R									
S31 S32 S33 S30				S70 S71 S74				S38 S42 S44 S45 S46 S51 S49				S70 S71		S70 S71				S72		S72				S77		R									
T08				S89 T18-725 T09 T07				T11 T20 T27 T28 T26 T29				T30 T69-766		T67		S37 S50 S47				T62		T37				R									

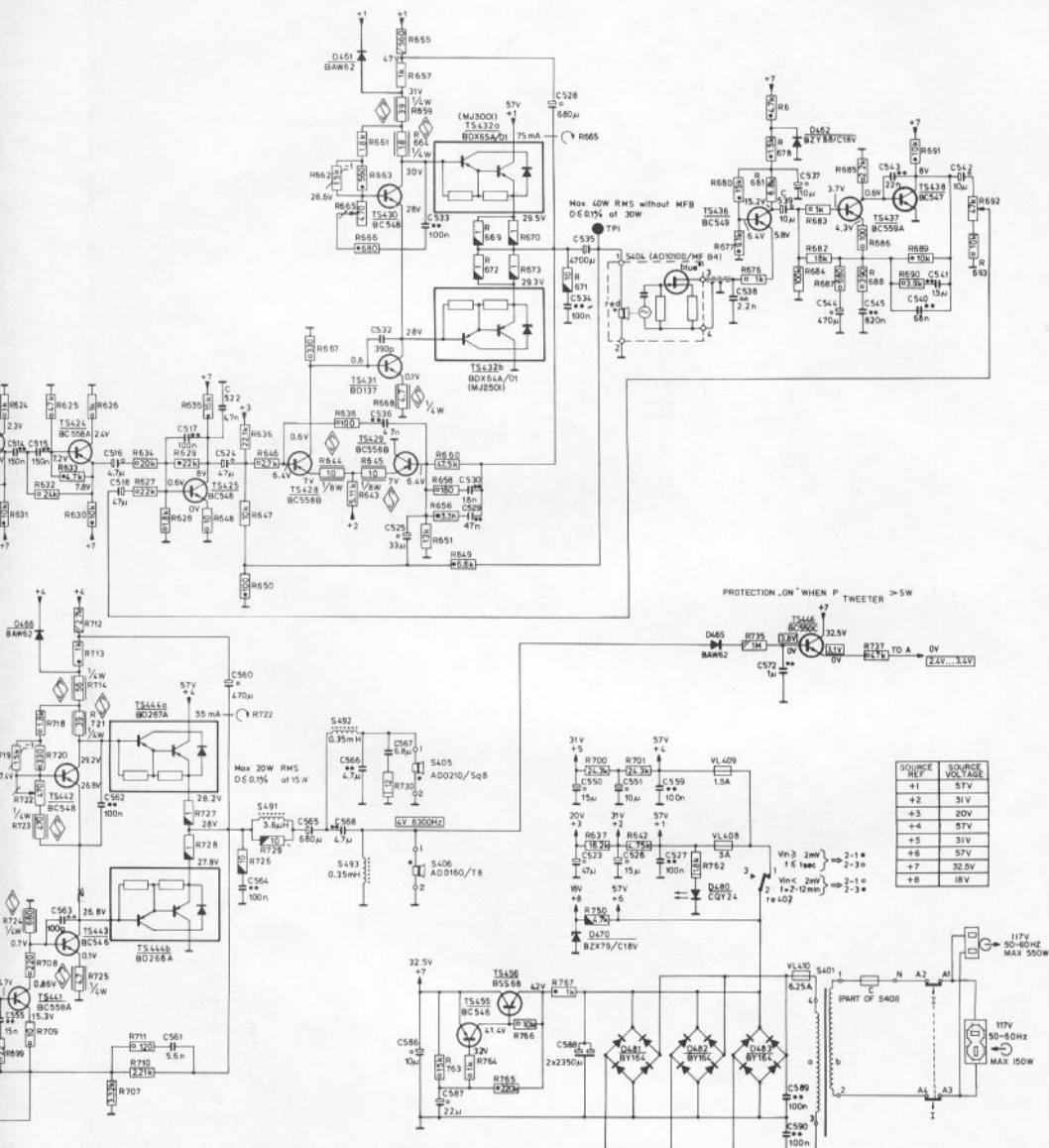


Figure 10, Schematic Diagram

MISC	D465, TS446	TS440,439,426	TS428	D462 TS429	TS424, TS436	TS425	TS437
MISC	TS430,30,430				TS431	TS441,443	
MISC	D481,482,483 VL408... 410	D477,461	RE402,5402			TS456,455,5492	
C	572	508	526 537	523 545 524 538		522,551,516,544	515,539
C		533		530	525,529,532	534	550,563,555
C		527	589 590	536	528	586,564	587,562,566,568,567
R			756...759,636	579,678,677		580,626,633,648,628,634,630,635	629,682...689,690
R		735	662,642,762,673,680	665,651,643...647	668,667,650,649	708,724,709	700,706,599,710,632,624
R			737,662,750,669	659,661,648,637	671,636	725	729,687,726,705,712,707
R			761,664	638,637,672,670,658,659		767,766,676,765,763,764	825,702,706

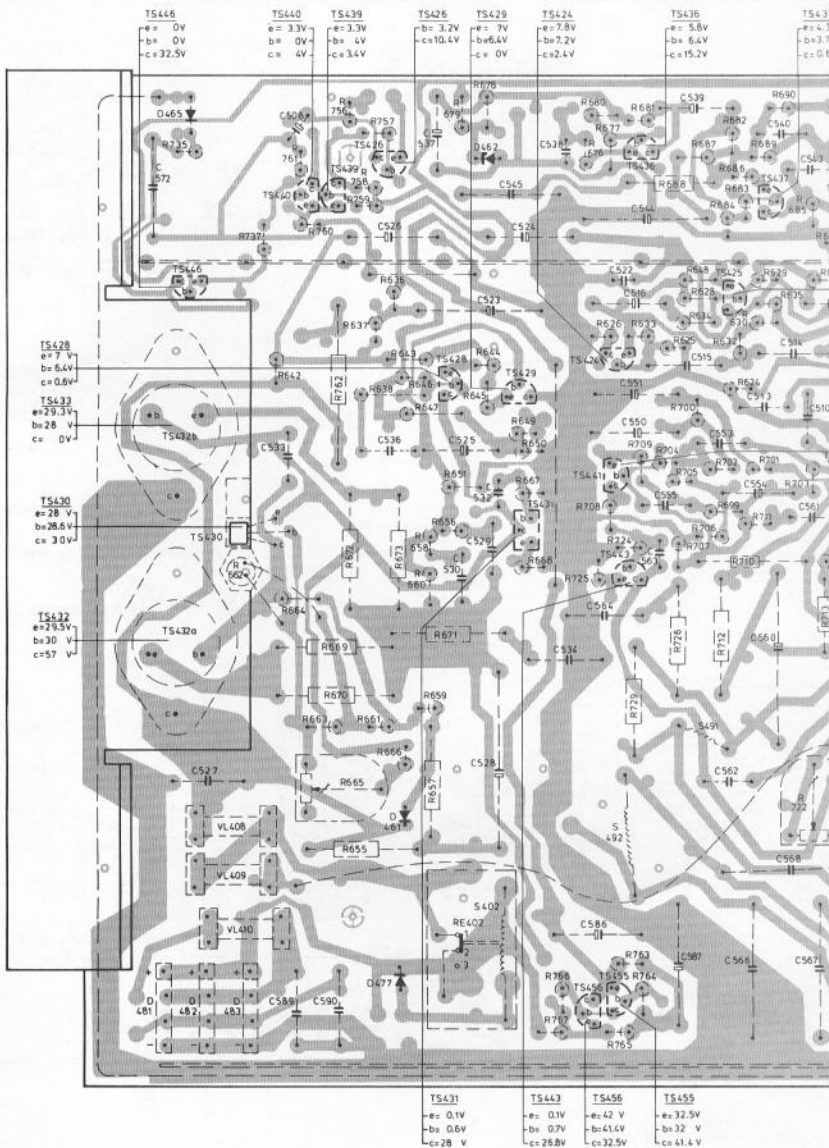
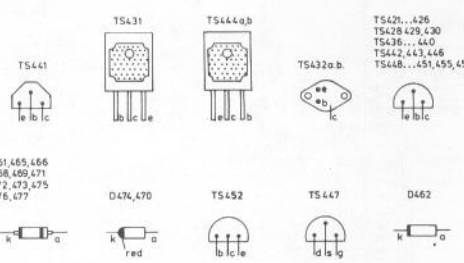
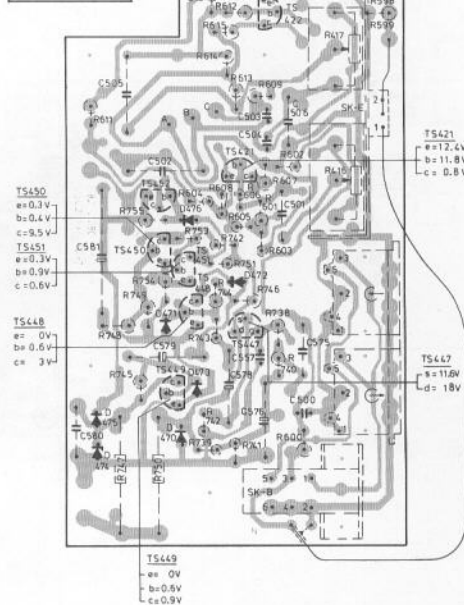
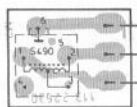
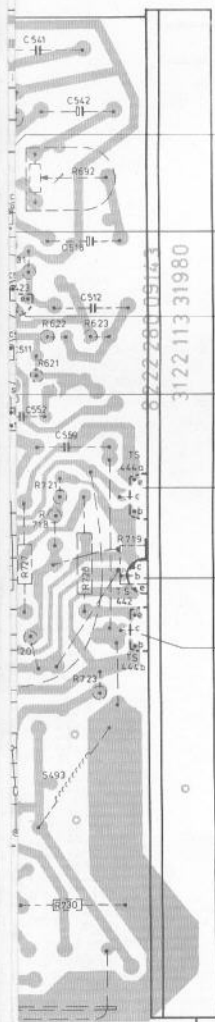


Figure 11, Printed Circuit Board

38-423		5490	TS450, 452	D476	TS451, 448	D472	TS422		MISC
56	TS422, 444, 40, b		D475, 474	TS449	D476, 741, 473	TS447	TS421	SK-E	MISC
	5493						SK-B		MISC
541	542, 518, 512		581	505	502	504, 503, 501, 506			C
51	559		580		579	557	576	500, 575	C
						578			C
31, 693, 627, 631, 692			811		604, 610, 614, 613, 615, 612, 609, 607, 602, 608	417	598, 599		R
L	721, 623, 622, 621				755, 753, 744, 742, 608, 606, 605, 751, 746, 601, 603	416			R
27, 720, 718, 728, 723			748, 747, 745, 750	739	743, 744, 741	740, 800			R
0	730	719		754, 749		746, 738			R



th Test Points and Basing Diagrams

## OUTPUT TRANSISTOR REPLACEMENT

Since transformerless complementary symmetry push-pull output circuitry is utilized in the motional feedback system, extreme care should be exercised when servicing or replacing the output transistors. It is imperative that the transistor be isolated from the metal bracket by means of a mica insulator coated on both sides with Dow-Corning DC4 silicon grease, or equivalent. Before removal of an output transistor, the type (PNP or NPN) should be noted to insure the identical replacement is reinserted into the same holes of the P.C. Board.

The output transistors in both the low and high frequency amplifiers should be replaced with matched pairs, as indicated in the Electrical Replacement Parts List. After replacing the low frequency amplifier output transistors the Low Frequency Amp Quiescent Current Adjustment must be performed. Likewise, if the high frequency amplifier output transistors are replaced the High Frequency Amp Quiescent Current Adjustment must be performed. Misadjustment of the output transistors may cause cross over distortion and possible premature failure of the output transistors.

### ELECTRICAL REPLACEMENT PARTS LIST

REF.	DESCRIPTION	PART NO.	REF.	DESCRIPTION	PART NO.
<b>COILS &amp; TRANSFORMERS</b>					
S401	Power Transformer	4H14550059	R714	Safety, 56 ohm, 5%, 1/2W	4H1130029
S490	Coil, 60 mH	4H15610346	R719	N.T.C. (Thermistor), 1.5K, 10%, 1/2W	4H11630009
S491	Coil, 3.6 uH	4H15750718	R721	Safety, 39 ohm, 5%, 1/2W	4H11130005
S492	Coil, .35 mH	4H15750809	R723	Safety, 470 ohm, 5%, 1/2W	4H11130013
S493	Coil, .35 mH	4H15750809	R724	Safety, 680 ohm, 5%, 1/2W	4H11130038
<b>CAPACITORS</b>					
C506	Electrolytic, 220 mfd., 16V	4H12420473	R725	Safety, 4.7 ohm, 5%, 1/2W	4H11130262
C516	Electrolytic, 4.7 mfd., 63V	4H12420494	R727	Carbon Film, 1 ohm, 5%, 1W	4H11203027
C518	Electrolytic, 47 mfd., 4V	4H12420592	R728	Carbon Film, 1 ohm, 5%, 1W	4H11203027
C523	Electrolytic, 47 mfd., 40V	4H12420487	R730	Wire Wound, 12 ohm, 10%, 4W	4H11221056
C524	Electrolytic, 47 mfd., 10V	4H12420461	R732	Metal Film, 1 meg., 5%, 1/2W	4H11042187
C525	Electrolytic, 33 mfd., 16V	4H12420484	R762	Wire Wound, 1.8K, 5%, 4W	4H11221114
C526	Electrolytic, 15 mfd., 40V	4H12420534	<b>CONTROLS &amp; SWITCHES</b>		
C528	Electrolytic, 680 mfd., 40V	4H12474071	R416	Input Sensitivity, 200K	4H10120473
C535	Electrolytic, 4700 mfd., 63V	4H12420475	R417	High Frequency Roll Off, 20K	4H10130017
C537	Electrolytic, 10 mfd., 25V	4H12420475	R665	Current Adjust (Low Freq. Amp)	4H10110063
C539	Electrolytic, 10 mfd., 25V	4H12420475	R692	Motional Feedback Adjust, 47K	4H10110027
C541	Polyester Film, 10 mfd., 10%, 100V	4H12420452	R722	Current Adjust (High Freq. Amp)	4H10110063
C542	Electrolytic, 10 mfd., 25V	4H12420475	SK-A-1	AC Power Switch	4H27610564
C544	Electrolytic, 470 mfd., 6.3V	4H12420457	SK-B-11	Channel Selector Switch	4H27610616
C550	Electrolytic, 15 mfd., 40V	4H12420484	SK-D-11	Automatic Switch	4H27610616
C551	Electrolytic, 10 mfd., 63V	4H12420496	SK-E-1V	Input Impedance Switch	4H27890303
C554	Electrolytic, 4.7 mfd., 63V	4H12420494	<b>SEMICONDUCTORS</b>		
C557	Ceramic, 68 pf., 2%, 100V (N750)	4H12231076	D461	Silicon Diode, BAW62	5H13030613
C560	Electrolytic, 470 mfd., 25V	4H12420527	D462	Zener Diode, BZY88C18V	5H13030304
C561	Polyester Film, 5.6 mfd., 10%, 630V	4H12231081	D465	Silicon Diode, BAW62	5H13030613
C563	Ceramic, 100 pf., 10%, 100V (N750)	5H12647017	D466	Zener Diode, BAW62	5H13030613
C565	Electrolytic, 680 mfd., 63V	4H12140461	D470	Zener Diode, BZX79C18V	5H13030613
C566	Polyester Film, 4.7 mfd., 10%, 100V	4H12140463	D471	Silicon Diode, BAW62	5H13030613
C567	Polyester Film, 6.8 mfd., 10%, 100V	4H12140461	D472	Silicon Diode, BAW62	5H13030613
C568	Polyester Film, 4.7 mfd., 10%, 100V	4H12140447	D473	Zener Diode, BZX79C14V7	5H13034174
C572	Polyester Film, 1 mfd., 10%, 100V	4H12420467	D475	Silicon Diode, BAW62	5H13030613
C576	Electrolytic, 15 mfd., 16V	4H12420467	D476	Silicon Diode, BAW62	5H13030613
C578	Electrolytic, 4.7 mfd., 63V	4H12420494	D477	Silicon Diode, BAW62	5H13030613
C579	Electrolytic, 4.7 mfd., 63V	4H12420465	D480	Light Emitting Diode (LED), COY24	4H13030922
C581	Electrolytic, 330 mfd., 10V	4H12420496	D481	Silicon Bridge Rectifier, BY164	5H13030414
C586	Electrolytic, 10 mfd., 63V	4H12420496	D482	Silicon Bridge Rectifier, BY164	5H13030414
C587	Electrolytic, 22 mfd., 63V	4H12420499	D483	Silicon Bridge Rectifier, BY164	5H13030414
C588	Electrolytic, 2 x 2350 mfd., 63V	4H12470198	D821	PNP Silicon, BC558B	5H13044197
<b>RESISTORS</b>					
R636	Metal Film, 22.1K, 1%, 1/2W	4H11651114	TS421	PNP Silicon, BC558A	4H13040941
R637	Metal Film, 18.2K, 1%, 1/2W	4H11654382	TS422	PNP Silicon, BC558B	4H13040962
R642	Metal Film, 4.75K, 1%, 1/2W	4H11651115	TS423	PNP Silicon, BC558A	4H13040962
R643	Metal Film, 5.11K, 1%, 1/2W	4H11651115	TS424	PNP Silicon, BC558A	4H13040938
R644	Safety, 10 ohm, 5%, 1/2W	4H11130405	TS425	PNP Silicon, BC548	4H13040948
R645	Safety, 10 ohm, 5%, 1/2W	4H11130405	TS426	PNP Silicon, BC548	5H13044197
R647	Metal Film, 10K, 1%, 1/2W	4H11654327	TS428	PNP Silicon, BC558B	4H13040938
R651	Metal Film, 13K, 1%, 1/2W	4H11651158	TS429	PNP Silicon, BC558B	4H13040938
R659	Safety, 39 ohm, 5%, 1/2W	4H11300005	TS430	NPN Silicon, BC548	5H13040664
R660	Metal Film, 47.5K, 1%, 1/2W	4H11651117	TS431	NPN Silicon, BC137	
R662	N.T.C. (Thermistor), 5K, 10%, 1/2W	4H11303177	TS432a/b	Darlington Matched Pair, BD X65A/01-BDX64A/01 (MJ3001 - MJ2501)	4H13041115
R664	Safety, 18 ohm, 5%, 1/2W	4H11650087	TS436	NPN Silicon, BC509	4H13040964
R668	Safety, 4.7 ohm, 5%, 1/2W	4H11303262	TS437	PNP Silicon, BC559A	4H13041052
R669	Carbon Film, 1 ohm, 5%, 1W	4H11203027	TS438	PNP Silicon, BC547	5H13044257
R670	Carbon Film, 1 ohm, 5%, 1W	4H11203027	TS439	PNP Silicon, BC548B	4H13040937
R672	Carbon Film, 1 ohm, 5%, 1W	4H11203027	TS440	PNP Silicon, BC548B	4H13040937
R673	Carbon Film, 1 ohm, 5%, 1W	4H11203027	TS441	PNP Silicon, BC558A	4H13040962
R681	Metal Film, 6.8K, 2%, 1/2W	5H11654908	TS442	PNP Silicon, BC548	4H13040938
R682	Metal Film, 18K, 2%, 1/2W	5H11654382	TS443	PNP Silicon, BC548	4H13040938
R684	Metal Film, 24.3K, 2%, 1/2W	4H11651123	TS444a/b	Darlington Matched Pair, BD267A-BD266A	4H13041001
R700	Metal Film, 100K, 2%, 1/2W	4H11651123	TS446	NPN Silicon, BC550	4H13041045
R701	Metal Film, 24.3K, 1%, 1/2W	4H11651118	TS447	Silicon, N-Channel FET, BF245B	4H13041096
R702	Metal Film, 47.5K, 1%, 1/2W	4H11651117	TS448	PNP Silicon, BC548B	4H13041034
R705	Metal Film, 33.2K, 1%, 1/2W	5H11654915	TS449	PNP Silicon, BC548B	5H13044196
R707	Metal Film, 3.32K, 1%, 1/2W	5H11650638	TS450	PNP Silicon, BC548B	4H13041023
R710	Metal Film, 2.21K, 1%, 1/2W	5H11654409	TS451	NPN Silicon, BC548	4H13040937



## ELECTRICAL REPLACEMENT PARTS LIST (Con't)

REF.	DESCRIPTION	PART NO.
TS452	NPN Silicon,BC639	4H13041053
TS455	NPN Silicon,BC546	4H13041001
TS456	PNP Silicon,BS568	5H13044247
	MISCELLANEOUS	
RE402	Relay	4H28060437
S404	Speaker (Woofer) AD10100/MFB4	4H24060077
S405	Speaker (Mid-Range) AD0210/SO8	4H24050095
S406	Speaker (Tweeter) AD0160/T8	4H24070004
VL408	Fuse,3 Amp,Slow Blow	4H25330047
VL409	Fuse, 1.5 Amp, Slow Blow	4H25330046
VL410	Fuse, 6.25 Amp, Slow Blow	5H25354015

REF.	DESCRIPTION	PART NO.
	Mica Insulator f/TS432a & TS432b (2 used)	5H46690433
	Mica Insulator f/TS444a & TS444b (2 used)	4H25540112
	Insulator Bushing f/TS432a, TS432b, TS444a, & TS444b (6 used)	4H53251043
	8 Pin Socket	4H26750221
	8 Pin Plug	4H26450081
	Fuse Holder (3 used)	4H25640048
	AC Inlet (Interlock)	4H26520052
	Jack Assembly (Input/Output)	4H26740222
	AC Outlet	4H26730255
	Disc Cam f/SK-E-1V	4H53260643
	Acoustic Gasket f/S404	4H53280644




DESCRIPTION	ILLUSTRATION	PART NO.
Stereo Cable		4H32120344
Adapter Cable		4H32120331
AC Power Cable		4H32110092

Figure 12, Cable Chart