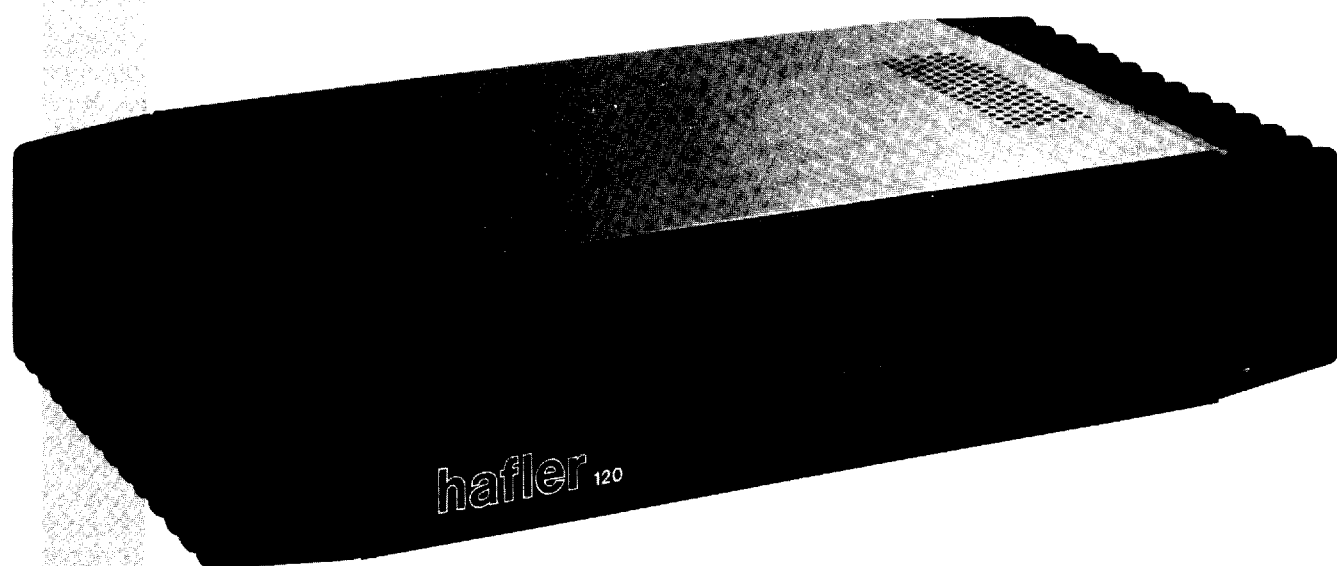


THE
hafler **DH-120**
POWER AMPLIFIER



INSTRUCTIONS
for OPERATION
and KIT ASSEMBLY

NOTE:

IF THE SPEAKER FUSES BLOW, NO SOUND
WILL BE HEARD. ALWAYS CHECK FOR
BLOWN FUSES FIRST.

LM 124
\$3.00

THE DAVID HAFLER COMPANY
5910 Crescent Boulevard, Pennsauken, New Jersey 08109

Please refer to this
serial number in all communications
regarding this equipment.

A

SPECIFICATIONS

Power Rating:

Less than 0.009% total harmonic distortion at any power level up to 60 watts continuous average power per channel into 8 ohms at any frequency between 20 Hz and 20 kHz with both channels driven.

IM Distortion (SMPTE):

Less than 0.005% from 1 watt to 60 watts, each channel, into 8 ohms.

Typical THD at 60 watts into 8 ohms:

20 Hz: 0.002%
1 kHz: 0.002%
20 kHz: 0.006%

Frequency Response into 8 ohms:

- 3 db, 4 Hz to 200 kHz at 1 watt.
+ 0 db, - 0.5 db, 10 Hz to 40 kHz at 60 watts.

Typical Channel Separation:

20 Hz: > 75 db
1 kHz: > 85 db
20 kHz: > 65 db

Signal to Noise Ratio, unweighted:

Exceeds 100 db referred to 60 watts into 8 ohms.

Input Impedance:

22,000 ohms.

Input Sensitivity:

1.1 volts rms for 60 watts into 8 ohms.

Damping Factor:

100 to 1 kHz into 8 ohms
50 to 10 kHz into 8 ohms

Rise Time:

10 kHz, 45 volts peak to peak square wave, 10% to 90%: 2 μ s.

Slew Rate:

10 kHz, 45 volts peak to peak square wave: 30V/ μ s.

Semiconductor Complement:

22 Transistors, 4 Power MOSFETs, 23 Diodes, 8 Zener Diodes, 1 Diode Bridge.

Power Consumption:

60 watts both channels into 8 ohms: 300 VA
Quiescent: 60 VA

Size:

3-1/4" high plus 1/2" feet, 15-3/4" wide, 9" deep.

Net Weight:

18 lbs.

Shipping Weight:

20 lbs.

All specifications are subject to change without notice.

INTRODUCTION

The Hafler DH-120 is a two channel medium power audio amplifier which has been engineered to the very highest performance standards. With conservative design and commensurate reliability, it follows in the Hafler tradition of exceptional value. Plus, its availability as an easily completed kit with specifications identical to those which are factory built, provides additional savings for a few hours time.

As a direct descendant of the DH-220 amplifier, the DH-120 employs the latest MOSFET technology with all silicon devices in a direct coupled configuration (except at the input). With its own unique circuit, the DH-120 utilizes the latest circuit topology and capacitor interfacing for superior sound quality in either stereo, or in the bridged mono mode. The MOSFET output devices provide exceptional reliability and resistance to abusive operating conditions, and avoid the need for special protective circuits which compromise audio performance. Their ruggedness and self-protective capability enables the DH-120 to deliver very high currents into very low impedances — even into a short circuit — affording audible benefits when driving difficult loudspeaker loads. This unique Hafler design gives you the three primary benefits: circuit simplicity, added reliability, and better sound, all at reasonable cost.

This design includes basic protective systems to provide maximum security against malfunction damage to either the amplifier or to the speaker: an AC line fuse, B+ and B- fuses and thermal breakers on each channel, and fuses to protect the loudspeakers. Only the loudspeaker fuses are accessible on the back panel, since these should be chosen with the loudspeaker's power limits in mind. When they are appropriately sized to protect the speakers, they may blow on occasion. Thus it is advisable to keep replacements on hand. However, the failure of an internal fuse should be cause for a complete inspection by a competent technician.

An exclusive adjunct in this design is the provision for connecting a second set of loudspeakers in such a way that they can reproduce the ambience information which is not accessible with a single pair of stereo loudspeakers. Many disc and video recordings, and most live broadcasts include reverberant audio information which can provide a sense of the surrounding space, yet this is not perceived with two speaker reproduction. The Hafler Ambience Recovery System will not interfere with the customary stereo sound reproduction, but it can provide added realism and pleasure to users who have a second pair of speakers available for this use.

Those who use these instructions to assemble the DH-120 kit will find that the left and right audio modules (printed circuit and heat sink assemblies) are fully assembled. This greatly simplifies the completion of the kit, so it can be done in a few hours without special skills. It also assures the audio integrity of the finished product, since all the active circuitry has been tested to meet specified performance criteria which are the same as for factory assembled amplifiers. This modular design also makes it possible to operate only one channel if the other requires service, and avoids the need to return the entire heavy amplifier when only one channel is at fault.

Accessories for special applications include a panel to facilitate standard 19" rack mounting, and an alternative power transformer to accommodate international AC line voltages.

Welcome to Hafler affordable high technology high fidelity!

INSTALLATION

Ventilation

Adequate air flow is important to the continuing reliability of any power amplifier. Cool air must be able to circulate freely through the perforations in the cover and under the chassis, and around the heat sinks. It is expected that the amplifier will always be resting on its feet, which should be on a hard enough surface that air flow underneath will not be obstructed. If the amplifier is mounted in a rack, or through a panel, the feet may be removed so long as adequate ventilation is provided through the bottom openings. It is normal for the cover and heat sinks to become warm in use.

Location

If the amplifier is to be installed close to a record player, you should first check its position for freedom from hum pickup by the phono cartridge, as any large power transformer radiates a field which may induce hum. Although the Hafler transformers are designed to minimize this field, certain cartridges are more sensitive than others, and require separation from the amplifier. Check at a comparatively high volume setting, swinging the tone arm through its arc. Usually a few inches of added space is all that is needed.

Line Connections and Switching

The DH-120 is normally wired for use on 120VAC power lines, as in the USA. If your line (mains) voltage is different, you will need the special Hafler export power transformer which accommodates many other line voltages. Be sure your amplifier is wired for your mains voltage before you plug it in.

The DH-120's power switch may be left ON, and the amplifier switched remotely by connecting its line cord to a preamplifier (or other control center) which provides a switched AC outlet. Make sure that the control device can supply a current of 5 amperes to the DH-120, in addition to the current required by other units it may also be switching. You may instead connect the amplifier directly to a wall outlet, and control it with its own front panel power switch.

NOTE: As a general rule, power amplifiers should be turned ON last in the electronics lineup, and turned OFF first, to avoid loudspeaker damage due to transients generated during the actual switching. If you are using a Hafler DH-100 or DH-110 preamplifier, you may disregard this caution because these preamplifiers have protective muting circuitry to guard against this occurrence.

Connecting Cables

INPUT. Conventional shielded cables, often supplied with preamplifiers, may connect the control center to the amplifier's input jacks. Be sure the cables are not frayed, or loosely connected to the plugs, and that the plug's outer shield connection is tight on the jack, to avoid hum. If you wish to install the DH-120 more than a few feet from the preamplifier, the permissible cable length to avoid loss of high frequencies is determined by the preamplifier's output impedance and the internal capacitance of the cable. If the output impedance is 600 ohms or less, as with Hafler preamplifiers, and the cable capacitance is less than 50 picofarads per foot, up to 50 feet is

acceptable. Ordinary stereo interconnecting cables often have higher capacitance, however, so a good quality low capacitance shielded wire should be used. When making long runs, keep the left and right cables close together, and avoid running them alongside power wiring to reduce the likelihood of hum pickup.

OUTPUT. The wires which connect the speakers to the amplifier should be of sufficient size to preserve the DH-120's high damping factor. Standard #18 gauge lamp cord ('zip cord') is satisfactory for up to 15 feet if your speakers are of 8 ohms or higher impedance. A heavier gauge (#16 or larger) wire should be used with 4 ohm speakers, or 8 ohm speakers at a greater distance. Special loudspeaker cables which have adequate thickness to accommodate long runs are usually available from audio dealers. The DH-120's red and black outputs accept standard 'banana plug' connectors, including the double ones with 3/4" spacing. These are the most convenient to use if you will be disconnecting the speakers occasionally. The terminals will also clamp a spade lug, or a bare wire through the hole in the center post. Be sure there are no frayed wire ends which could touch adjacent terminals or the chassis. 'Tin' bare wire ends with solder to secure all strands.

PHASING. This is a factor of signal integrity which is determined by 'which wire goes where'. Consistent phase relationships are important when connecting speakers, to enable full bass reproduction as well as mid-range and high frequency 'time alignment'. To be sure all the speakers in a system are wired 'in phase' to the amplifier, each 'Ground' or '-' speaker terminal should be connected to its black Ground terminal on the DH-120, and the speaker's '+' terminal to the corresponding red binding post. Speaker connecting cable identifies one wire from the other by the color of the wire, or by marking or coloring the insulation. NOTE: In the special case of monophonic operation of the DH-120, described later, different speaker connections are employed.

GROUNDING. The MAIN black output terminals of the DH-120 are connected together, and grounded to the chassis. This facilitates the use of external devices which use a common ground connection, such as some headphone junction boxes. You must be sure that the '-', ground or shield connection from such a device goes to a Main Black terminal on the DH-120. NOTE: No such connection may be made when the DH-120 is connected for bridged mono operation. Whenever you intend to use an external device employing a common ground connection, you must be certain of correct wiring polarity, because the RED amplifier terminals must NEVER be connected together.

Conventional Stereo Connections

It is best to make all connections with the DH-120 switched OFF. Each of the stereo speakers connects to one horizontal pair of red and black MAIN outputs, as identified Left (L.) or Right (R.) on the back of the DH-120. The input signals connect to the labelled input jacks. Set the MONO/STEREO switch to 'STEREO', and the AMBIANCE/NORMAL switch to 'NORMAL'. If you wish to use a second pair of speakers in parallel with the main set, driven by the exact same amplifier signal (such as for a separate room) they may be connected to the 'AUX' red and black outputs.

Connections for Ambiance Recovery

In this application, two pairs of speakers are required. The front pair, or Main speakers, are connected conventionally, as described in the preceding paragraph. The 'ambience' speakers, which are usually located behind the listener, connect to the 'AUX' left and right outputs. Be sure to observe correct phasing. The STEREO/MONO switch remains in 'STEREO'. Set the AMBIANCE/NORMAL switch to the 'AMBIANCE' position. In this mode the speakers connected to 'AUX' are provided the 'difference' information in the music (L-1/2R and R-1/2L), which is not the same as the output presented to the main speakers.

Connections for Monophonic Operation

When you wish to drive a single loudspeaker with increased power capability, the DH-120 can be operated in a 'bridged' mode which drives both channels with the same signal and combines their output to deliver more than 150 watts into 8 ohms. In this arrangement, only the Left channel input (and Left Level control) is used, and the speaker is connected only to the two Red Main output terminals. The Main Left Red terminal is '+' and the Main Right Red terminal below it is the virtual ground, or '-' connection. **No connections may be made to any black terminal**, or to the right input jack. Set the MONO/STEREO switch to 'MONO', and the AMBIANCE/NORMAL switch to 'NORMAL'. It is best to make changes with the power off, and it is a good idea to block the black terminals with tape, or otherwise mark the amplifier's Mono mode to avoid later errors.

LOUDSPEAKER SELECTION AND PLACEMENT

Normal Stereo

The DH-120 is designed to deliver more than 60 watts of audio power into an 8 ohm load. This will drive most loudspeakers to a very loud volume level without clipping. There are a few speakers which are quite inefficient, which would best be driven by an amplifier of substantially higher power. Your audio dealer can advise you of the power requirements for your speakers. Note that speaker manufacturers often specify speaker power requirements in two ways — 'nominal' power (for average volume levels); or maximum continuous power (for momentary loud passages). Our 60 watt rating applies to maximum power levels. If your speaker impedance is less than 8 ohms, the DH-120 can deliver more power into the lower impedance.

Sound reproduction accuracy is largely a measure of your success in satisfying an illusion of the original. There are few rules for speaker placement. The shape, furnishing and acoustics of the room contribute as much as speaker choice to the overall balance which you will find most satisfying. In general, the two speakers are best placed equally distant from the listener and from each other, either along or just in front of a wall. It is best to have no obstructions between the speaker and the listener. Sometimes raising the speakers is beneficial. Sound absorbing materials, such as carpeting, draperies and upholstered furniture help to reduce reflections, and thus improve the sound illusion, but excessive absorption will deaden the effect. Feel free to experiment with controls and furnishings to achieve the overall balance which you like.

Ambiance Recovery

The effectiveness of this Hafler technique for recovering hidden ambience information with only two amplifier channels relies on the similarity of all four loudspeakers and correct listener placement. The best results are achieved when all four speakers are identical. If this is not practical, at the very least the ambience (rear) speakers should be alike, and they **should not have an impedance less than 8 ohms**. To the extent that the efficiencies and frequency responses of the main and ambience speakers differ, the illusion will depart from the ideal. In this arrangement, the speakers are effectively wired in parallel, lowering the load impedance on the amplifier. As the impedance is reduced, the amplifier may rise in temperature excessively, to where deterioration in performance, or even malfunction may occur in the extreme case.

The front speakers should first be set up for optimum 'normal' stereo. The ambience speakers should be placed along the back wall, possibly overhead, or away from the back wall and pointed toward it so that the sound is reflected back into the room. The sound level of the ambience signal is normally much less than the sound from the main stereo speakers, so you should not expect to hear four equal sound sources. With all speakers of equivalent efficiency, the preferred listening position is about 2/3 of the distance back, with the sound clearly coming from the front. The listener's position determines the relative balance, both left-to-right and front-to-rear, since the preamplifier's Balance control should remain in its centered position for proper ambience recovery.

Furniture arrangements frequently dictate placing the listener at other than the optimum location for sonic balance. Rather than correct for side-to-side inequities with the Balance control, try to reposition the main speakers. If this control is not centered, the appropriate 'mix' to the rear speakers is disturbed, reducing separation and imaging. If the listener must sit close to the back wall, the ambience speakers will likely be nearer than the ideal, so it is preferable to select speakers of lower, rather than higher efficiency for the rear. It is invariably easier to move them closer if they are too subdued, but if they are too loud, the entire stereo image may be disrupted, and you may hear disquieting high frequency discolorations. If necessary, your dealer may be able to supply you with 'pads' (volume controls) to reduce speaker levels.

Rear speakers of lesser capabilities than those in front may compromise the overall quality of reproduction, for the ambience information encompasses the entire audio spectrum. Since the most apparent ambience effects often result in enhanced low frequency response, the back speakers should be good low end performers. If their high end response is not smooth, distracting noise components in the rear signals may be accentuated.

AMBIANCE RECOVERY — WHAT TO EXPECT

The effect of adding the rear speakers will vary greatly from one recording to the next. There will be a marked increase in realism with some, while others will show no change. Occasionally, special sonic effects may seem to surround you. These differences are a function of the recording techniques employed during the performance. Recordings of 'live' concerts, and those with marked stereo separation tend to make the best demonstrators for ambience recovery. Sound track recordings, video recordings, and some compact disc releases often demonstrate special engineering attention to the inclusion of ambience information.

ASSEMBLY INSTRUCTIONS

Do not expect a dramatic change when you add ambience speakers to a high quality stereo system. The additions are often subtle, but once you become accustomed to the enhancements, you will notice their removal. Suddenly the sound seems 'dry' and less 'real'. The Hafler Ambiance Recovery technique does not synthesize or add artificial reverberation to the source material. It can only reproduce what has already been recorded by the microphones. On occasion, an errant microphone placement or connection may introduce a spurious effect which is not lifelike, and you may prefer to disconnect the back speakers. There may be recordings, too, in which the rear speakers seem only to add noise. Recordings made from 'multi-track' masters, such as most 'rock' recordings, will have no true ambience information and may sound less pleasant in this mode. You can make the change to conventional stereo any time, by disconnecting the rear speakers, or by installing an external switch in one lead to each rear speaker.

OPERATION

The Pilot Lamp

The pilot lamp in the power switch will glow steadily whenever power is applied to the DH-120. If it does not light, check for a blown AC line fuse. This lamp also warns of a high temperature condition by blinking on and off, indicating that at least one of the thermal breakers has shut down the amplifier due to excessive heat sink temperature. If the DH-120 is given an opportunity to cool, operation will be restored automatically if it has not been turned off. The lamp will return to a steady glow. If a second shutdown occurs within a short time, you should check for insufficient ventilation, continuing excessive input signal, or a load impedance far below 8 ohms. If none of these conditions exist, the amplifier may have malfunctioned, and should be returned for factory service. The very generous heat sinks will accommodate the normal signal power capacity of the DH-120 with ease.

Level Controls

The Level controls adjacent to each input socket determine the sensitivity of the amplifier. They are normally placed in the full clockwise position, providing maximum sensitivity and minimum noise, unless there is a need to reduce sensitivity to accommodate other equipment.

Fuses

The DH-120 is supplied with 2 ampere fuses in the loudspeaker fuse holders on the back panel. These will afford some protection for most speakers. If the instructions for your speakers recommend a specific fuse value, obtain type 3AG (or AGC) fuses of that size and install them. In certain circumstances, such as when driving only high frequency speakers, a smaller fuse value may be advisable. If you intend to test the amplifier's maximum power, 5 ampere fuses are needed. Note that speaker fuses are for the convenience of the user. They do not protect the amplifier itself. Should your amplifier fail to function, always **check the speaker fuses first**.

Inside the amplifier are other fuses which are not considered to be user-serviceable. There is an AC line fuse, and four power supply fuses. If one of these fails it is usually indicative of a fault which will require professional service.

The DH-120 amplifier is a versatile component with sophisticated circuitry which has been made remarkably easy to build by individuals with many years of experience in the design and engineering of the finest performing audio kits, and in the preparation of their manuals.

There are three basic rules for success in electronic kit building:

1. Read the instructions carefully, and follow them in order.
2. Make secure solder connections, which are bright and smooth.
3. Check your work carefully after each step.

Kit building should be fun, and we are certain you will find this to be so. Assembly will be faster and more enjoyable if you have someone help you by reading the steps aloud and selecting the required parts as you proceed. Fatigue increases the risk of error, so take a break rather than push to early completion. There are relatively few separate components in this design, to make it easy to pack everything away, if need be.

Your work area should have good lighting, the proper tools, and a place where the large pictorial diagram can be tacked to the wall within easy reach for checking. The tools should include:

1. A 40 to 60 watt pencil soldering iron with a 3/16" or smaller tip which reaches 700°F.
2. 60/40 (60% tin) ROSIN CORE solder, 1/16" diameter or smaller.
3. A damp sponge or cloth to wipe the hot tip of the iron.
4. A wire stripping tool for removing insulation. This can be a *single-edge* razor blade, but inexpensive stripping tools are safer, faster and easier.
5. A medium-blade screwdriver (about 1/4" wide).
6. Needle-nose pliers (a long, narrow tip).
7. Diagonal or side-cutting small pliers.
8. Large "gas" or "slip-joint" pliers.
9. A 1/4" "Spin-tite" nut driver may be helpful, but is not necessary.

Proper Soldering

There are four steps to making a good solder connection:

1. Make a good mechanical connection to hold the wire in position while heat and solder is applied.
2. Heat the *junction* of the wire and lug, or eyelet, with the bright, shiny tip of the iron.
3. After heating for a couple of seconds, apply solder to the junction. It should melt immediately and flow smoothly around both surfaces.
4. Allow the connection to cool undisturbed.

The general procedure is to use a hot iron for a short time to heat a connection, then add solder with the iron still in contact. Remove the solder once it flows, and then remove the iron. A cooler iron applied for a longer time is more likely to damage components, or lift the copper circuit pattern from the boards. A

break in the etched circuit can be mended by simply soldering a small piece of wire across it. Do not allow much build-up of solder on the tip of the iron, or it may fall into adjacent circuitry.

Remember that the connection is made by the solder, not by mechanically attaching the wire to the terminal. Usually the wire is looped through the lug and crimped in place, but some prefer to just place it through the hole and rely on the stiffness of the wire to hold it while soldering. Eyelet connections, of course, are handled this way.

Good solder connections are *essential* for trouble-free, noise-free operation. A good solder joint does not require much solder around the conductors. Never "butter" partially melted solder on the joint, as it is useless. A good connection looks smooth and bright because the solder flows into every crevice when the parts are hot enough. The iron must have a bright, shiny tip to transfer heat easily to the junction. That's why the damp sponge should be used frequently to wipe the tip, and occasionally you must add a small amount of solder to the tip, too. If a connection is difficult to heat, "wet" the tip with a small blob of solder to provide a bigger contact surface to the joint. Once the solder flows around the conductors, any movement must be avoided for a few seconds to allow a good bond. When cool, check the connection by wiggling the wire. If in doubt, or if the connection is not shiny, re-heat the joint. Excess solder may be removed from a connection by heating it and allowing the solder to flow onto the iron, which is then wiped on the sponge.

ALL SOLDER USED MUST BE ROSIN CORE

Never use acid core solder or any separate flux in electronic work. Silver solder is also not suitable. If in doubt about unmarked solder, always obtain a fresh supply of rosin core solder. We recommend 60/40 for easiest use. Do not confuse it with 40/60, which is harder to melt.

When soldering to an eyelet or hole on the board, insert the wire from the components side, and apply the iron to the bottom, leaving some bare wire exposed so that you can see that the eyelet is then filled with solder for a secure bond. A round wooden toothpick is suggested so that you can heat and clear an eyelet of solder if it hinders your inserting the wire. Some builders prefer to clear every eyelet first with a touch of the iron and toothpick. Others connect the lead by bringing it up to the center of the eyelet on top of the board, applying the iron from the bottom of the board, and pushing the lead in as the solder in the eyelet melts. If the wire has first been "tinned," usually no additional solder is necessary, but it is a good practice to push

the wire through, and then back it up a bit, to be sure solder fills the eyelet. On the bottom of the board, make certain a bright, shiny flow is evident from the wire onto the circuit pattern on the board.

"Tinning" refers to the process of applying a light coating of solder to the bared wire end. This keeps all the strands secured, and also makes a good connection easier. Simply touch the wire with the iron for a couple seconds, and apply solder. Allow the excess to flow away onto the iron. When properly done, the wire is uniformly bright, and no larger than before.

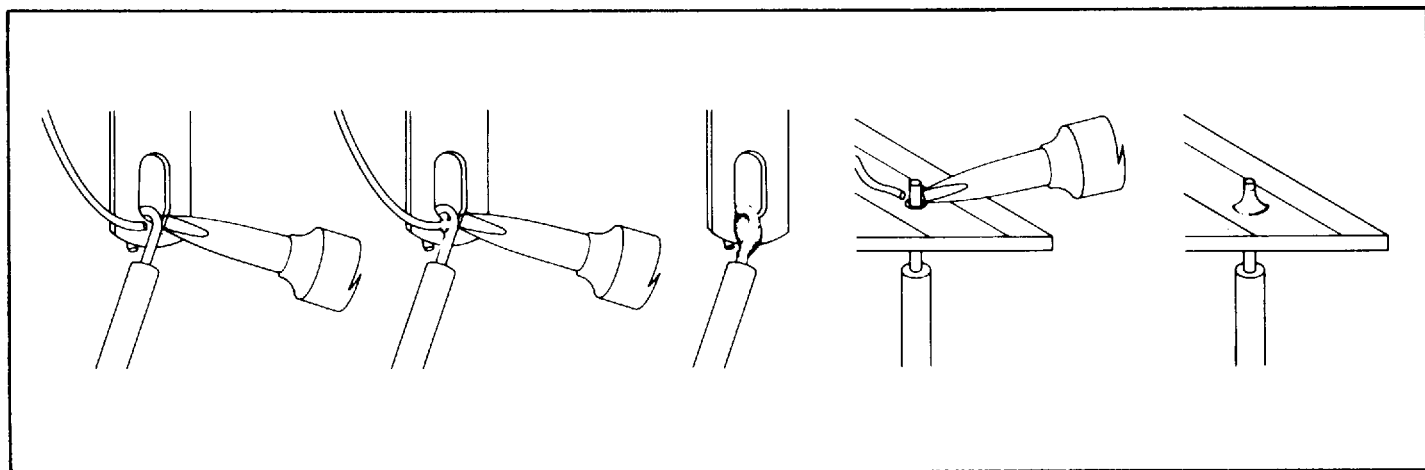
If any components are unfamiliar to you, checking the pictorial diagram should quickly identify them. Or, the quantities, and the process of elimination as you check the parts list, will help. The pictorial diagram is necessarily distorted to some extent for clarity, so that you can trace every wire in a single overall view for verification as you work. You may wish to check off on the diagram as you solder each location.

To "prepare" a wire means to cut the designated amount from the length of that color, and strip about 1/4" of insulation from each end. The wire supplied in the kit is #18 and #22, so you can set adjustable wire-strippers accordingly. The transformer leads are #18, and the line cord is #16. Be careful that you do not nick the wire when you strip it (that can happen more easily if you do not use wire strippers) for that weakens it.

Whenever a connection is to be soldered, the instructions will so state, or indicate by the symbol (S). If more than one wire is to be soldered to the same point, they will be indicated by (S-2), (S-4), etc. If soldering is not called for, other connections have yet to be made to that terminal. They would be more difficult if the connection was already soldered. Every connection in the kit will be soldered when it is complete. After soldering a connection, it is best to clip off any excess lead length to minimize the possibility of a short circuit (as on switch lugs, where terminals are very close together), and for neatness.

Handle the circuit boards carefully. They represent a major part of the kit cost. Stand-up components, such as transistors, should be checked when you install the module, to be sure all leads are separated.

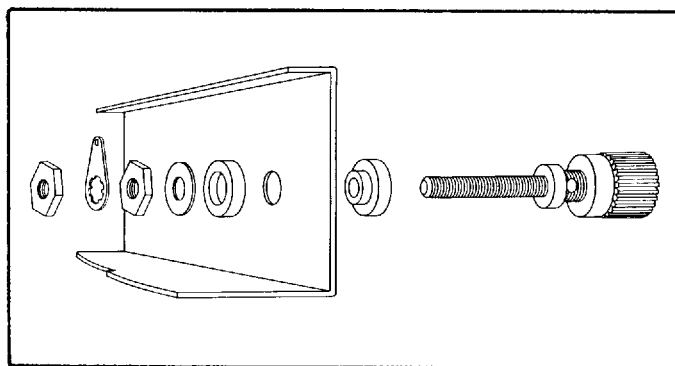
Take the time to be accurate and neat, and you can be sure that your completed amplifier will meet the performance of a factory assembled unit, and can continue to perform properly for years to come. Check your work, and make sure the entire step has been completed before placing a check mark in the space provided, and continuing on to the next step.



- 1 When you unpack your kit, you will find that the transformer, the large capacitors, and the output assemblies have been temporarily fastened to the chassis for safe shipment. Disengage these, and include this hardware with the rest when you check off the components against the parts list in the back of this manual. We recommend this check-off to be sure you have everything, and to enable you to identify any unfamiliar items by comparing them with the pictorial diagram. An egg carton is ideal for keeping hardware items separated.

A 'set' of hardware includes one screw and one KEP nut (with its attached lockwasher). Always insert a screw from the outside of the chassis. Always install the lockwasher side of the nut first. The smallest size hardware is #4, and #10 is the largest. Separate the #4 nuts from the #6 nuts, which have the same outside dimensions. A #4 screw will pass through a #6 nut.

- 2 Select the 4 rubber feet, 4 sets of #6 hardware, and the chassis. Insert each screw through a foot so that the head is recessed, and install the feet on the outside at each corner hole.
- 3 Select the two round fuse holders (with their caps) and two each 1/2" rubber washers, lockwashers and nuts. First place a rubber washer on each holder so it will be outside the chassis, and then install the holders at locations LF and RF, with the tip lug pointing toward the adjacent left chassis edge.
- 4 Select the 4 red output terminal assemblies. These are mounted in the upper and lower holes beneath each '+', at locations LR, RR, LRA and RRA. Follow the mounting sequence shown in the diagram below. Before you tighten the first nut, unscrew the cap to expose the hole drilled through the threaded shaft. Connection of loudspeaker wires will be easier if these holes are positioned vertically. A thin nail or a stiff piece of wire through both the upper and lower terminals will hold this position while the hardware is tightened. Each connecting lug should point upward before the last nut is secured. Be sure both nuts on each terminal are **tight**, as they are difficult to reach once the amplifier is completed.

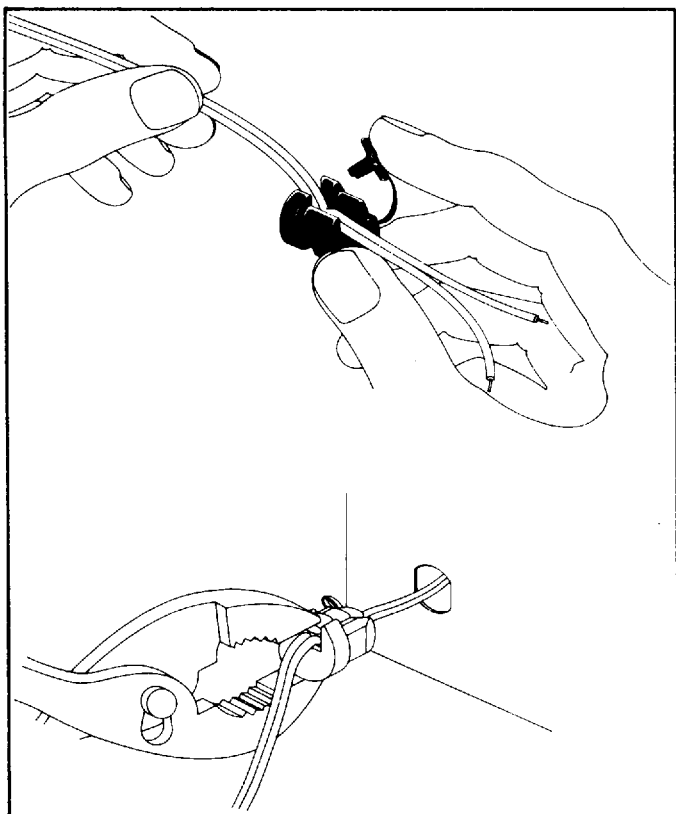


- 5 Select the 4 black output terminals and install them at LB, RB, LBA and RBA, between the red pairs. Be sure the shaft holes are vertical, the lugs point upward, and that each nut is tight. Now bend all 8 terminal lugs forward to make connections easier.
- 6 Select the two slide switches and four #4 screws. Install the switches at locations AS and MS.

- 7 Select the single ground lug (with lockwasher teeth) and one set of #4 hardware. Install it inside the chassis at the center hole GL below "Inputs" on the back panel. The lug should point downward. Bend it out for access, and twist it 90° for easier insertion of a wire from the side. Be sure this hardware is tight, for the locking teeth must cut through the chassis paint for a good ground connection.
- 8 Select the 2 input sockets and 4 sets of #4 hardware. Install the sockets at LS and RS so that the short lug of each socket is near GL.
- 9 Select the two level control potentiometers and their flat washers and nuts. Install them at LV and RV with the washer outside the chassis, making sure the locating lug engages its hole in the chassis.
- 10 Select the power switch. With the red window to the right as viewed from the front, snap it into hole PS from the outside.
- 11 Select the 5 lug terminal strip and two sets of #4 hardware. Install it at location TS, with the mounting feet pointing toward the power switch.

NOTE: Kits provided with the multiple voltage power transformer for use in locations outside the United States, having a line (mains) voltage other than 120 VAC, are also supplied with an additional 2 lug terminal strip. This strip is to be installed on the other side of the chassis, using an additional set of #4 hardware, with its mounting foot also pointing toward the power switch. See the diagrams of alternative line voltage connections later in this manual.

- 12 Select the single fuse clip and one set of #4 hardware. Install it at location FC, behind terminal strip TS.
- 13 Select the square diode block DB, with the 4 protruding wire leads, and a set of #6 hardware. Note that one lead of the block is marked with a '+'. To identify it once it is installed, leave the + lead full length, and cut off the other 3 leads 1/4" from the body. Install the diode block in the rear chassis hole closest to switch AS, with the + lead nearest the power switch PS. Bend the end of the long lead over so it is less hazardous.
- 14 Select the AC line cord and the plastic strain relief. Separate the two conductors for 4". Note that one of the conductors is ribbed on the surface of the insulation. Leave the ribbed conductor full length, and cut 3" off the plain conductor. Strip 1/4" of insulation from each lead, twist the strands tightly, and 'tin' each end with solder. Make a sharp 'V' in the cord 7-1/2" from the longest end, by bending the cord back on itself. Install the strain relief with the small end nearest the cut end of the cord. Crimp the two halves of the strain relief around the wire at the 'V', to partially form it before insertion into the back panel hole AC. Then grip the larger diameter of the relief with the tips of the pliers, squeeze it tightly together, and insert the cord and relief from the outside of the chassis. A flat side on the relief mates with the hole shape, and it snaps into position when fully inserted.



Connect the shorter lead to FC lug #1. (S). Connect the longer lead to the lower hole of TS lug #2. (S). Note that lug 2 is the second protruding lug on the terminal strip. It is not the mounting foot for the terminal strip. Soldering this lead to the lower hole now will make later connections to the top portion of the lug easier. Be sure no stray strands of either line cord conductor are left unsoldered.

- 15 Prepare two 3-1/2" lengths of white wire, but strip 1" of insulation from one end of each. Pass the longer bared end of one wire through lug #RR, and connect it to RF lug #4. Solder both lugs. Connect the other end of this wire to lug #RRA. (S).
Pass the longer bared end of the other wire through lug #LR and connect it to LF lug #2. Solder both lugs. Connect the remaining end to lug #LRA.
- 16 Prepare a 3" red wire. Connect one end to lug #LRA. (S-2). Place this wire under switch AS and connect it to MS lug #3.
- 17 Select the small 22K (red-red-orange) resistor. Keep its leads as short as possible when you connect one lead to MS lug #2, and the other lead to MS lug #3. Solder both lugs. Lug #3 has two wires to solder.
- 18 Prepare a 4" blue wire, but strip 3/8" of insulation from one end, and 1" of insulation from the other end. Pass the shorter bare end through AS lug #3 and connect it to AS lug #6. Solder both lugs. This is a very tight fit, and it may be necessary to unwind one strand and cut it off to enable insertion. Pass the other end through lug #RBA from the bottom, and connect it to lug #LBA. Solder only RBA.
- 19 Select the large 7.5 ohm resistor, and strip a 3/4" piece of white wire insulation. Slide the insulation over one resistor lead and pass that lead through AS lug #2, and connect it to AS lug #5. Solder both lugs. Place the resistor above terminal LRA, against the back panel, and connect the other lead to lug #LBA. (S-2).
- 20 Prepare a 5-1/2" red wire. Connect one end to MS lug #5. (S). Place this wire along the bottom edge of the chassis, and connect the other end to RV lug #2.
- 21 Prepare a 2-1/2" red wire and a 3-1/2" black wire, but strip 1" of insulation from one end of the black wire. Starting with the shorter black end even with a red end, twist these wires together for the length of the red wire. Pass the longer black end through RS lug #4 from the right, through GL, and connect it to LS lug #2. Solder only RS lug #4.
Connect the red wire to RS lug #5. (S). Connect the other end of the black wire to RV lug #1. Connect the red wire to RV lug #3. (S).
- 22 Prepare a 2" red wire, and a 2-1/2" black wire. Starting with one pair of ends even, twist these wires together. Connect the projecting black wire end to LS lug #2. (S-2). Connect the red wire to LS lug #1. (S). Connect the other end of the black wire to LV lug #1. Connect the red wire to LV lug #3. (S).
- 23 Prepare a 6" blue wire, and connect it to lug #RB. (S).
- 24 Prepare a 6" blue wire, and connect it to lug #LB. (S).
- 25 Prepare a 5" blue wire, and connect it to the bare wire between AS lugs 2 and 5. (S). Make sure the lugs remain securely soldered.
- 26 Prepare a 6" blue wire, and connect it to GL lug #3. (S-2). (One through wire). Place these 4 blue wires down against the chassis.
- 27 Prepare a 9" red wire and a 9" black wire. Twist these wires together throughout their length, and connect the black wire to LV lug #1. (S-2). Connect the red wire to LV lug #2. (S). Place this pair off to the left of the chassis.
- 28 Prepare an 8" red wire and an 8" black wire. Twist these together and connect the black wire to RV lug #1. (S-2). Connect the red wire to RV lug #2. (S-2). Place these wires off to the right of the chassis.
- 29 Prepare a 9" red wire and a 9" black wire. Twist these wires together, and connect the red wire to MS lug #1. (S). Connect the black wire to MS lug #4. (S). Place this pair off to the right of the chassis.
- 30 Prepare two 20" white wires, and twist them together throughout their length. 6" in from one end of the pair, cut one of the wires, and unwind it about 1-1/2" in each direction from the cut. Strip 1/4" of insulation from each of these cut ends. Place the longer portion of the wire along the lower front edge of the chassis, with the break at the terminal strip TS. Connect the cut end from the left to TS lug #2. Connect the other cut end to the lower hole of TS lug #5. (S). Place the pair under the power switch, with the ends projecting from the front corners of the chassis.

- 31 Select the 1 megohm (brown-black-green) resistor, and trim its leads to 1/2". Connect one lead to TS lug #2. (S-3). One of these wires has already been soldered to the lower lug hole. Connect the other lead to TS lug #3.
- 32 Select the diode and trim its leads to 1/2". Note that one end of the diode is marked with a stripe (or an arrow head). Connect the marked end to TS lug #4. Connect the other lead to TS lug #3. (S-2).
- 33 Prepare a 2-1/2" blue wire. Select a quick disconnect spade terminal, and solder it to one end. Connect it to PS lug #3 on the right, near the edge of the chassis. Connect the other end to TS lug #4.

The proper way to attach one of these terminals to a wire is to first cut the bared wire end to the right length (no longer than 1/4") so that the insulation will be securely gripped by the longer, outer tabs, while the wire does not protrude into the spade clamp area. Tin the bare wire end. Bend the shorter, middle set of tabs tightly around the bare wire, and then bend the longer tabs around the insulation. Then flow solder into the joint around the bare wire, keeping the solder away from the spade section.

- 34 Select the 0.39 mfd (.39K) capacitor and trim its leads to 1/2". Connect one lead to TS lug #4. (S-3). Connect the other lead to TS lug #5.
- 35 Prepare a 2-3/4" white wire. Select another quick disconnect spade terminal, and solder it to one end. Connect it to PS lug #2. Connect the other end to FC lug #2. (S).
- 36 Prepare a 6-1/2" white wire, and wrap one end around the base of the long lead which is the + lug #4 of the diode block DB. (S). Cut off the excess diode lead.
- 37 Prepare a 6-1/2" green wire, and connect it to DB lug #1. (S).
- 38 Select the power transformer, and 4 each of the largest (#10) screws, nuts and flat washers. Place the washers inside the chassis below the transformer, and install the transformer with the black leads nearest the power switch, and the red leads toward the diode block. Make sure the white pair is along the front edge, and not trapped.

Transformer leads may be trimmed for a neat appearance when they are connected, but be sure you do not cut them too short for re-use (particularly if yours is the multiple voltage version, and a later change is possible). Leads which have been cut too short may void the transformer warranty, if it is thought to be defective.

Be sure all strands of each transformer lead are tinned and soldered together before connection to a lug, so there is no possibility of a stray strand touching anything but the lug.

NOTE: If the transformer is the multiple voltage version for overseas use, the additional leads will be connected as shown later in this manual for the desired line (mains) voltage.

- 39 Connect the black/white transformer lead to TS lug #5. (S-3). One of these wires was previously soldered to the lower hole of this lug.
- 40 Select the remaining quick disconnect spade terminal, and solder it to the black transformer lead. Connect it to PS lug #1.
- 41 Twist together the two red transformer leads (do not confuse the red/yellow lead). Wrap one red lead around DB terminal #2, and wrap the other red lead around DB terminal #3.
- 42 Select the .01 mfd (103M) disc capacitor, and trim its leads to 3/4". Strip two 1/2" pieces of insulation from the black wire, and slide one piece over each of the capacitor leads. Connect one lead to DB terminal #2. (S-2). Connect the other lead to DB terminal #3. (S-2). Make sure both wires are securely soldered to each terminal, and that no bare wire can touch the mounting hardware.
- 43 Select the .005 mfd (502M) disc capacitor, and trim its leads to 1/2". Wrap one lead around the shaft of the spade terminal which is connected to PS lug #1. Wrap the other lead around the spade terminal on PS lug #2. Solder both leads. Make sure there is plenty of clearance between these connections, and that all 3 terminals are fully engaged.

Put the chassis assembly aside temporarily, and select the right output module. The right channel module is identified by the thermal breaker's position in the upper right corner when you face the row of holes along the bottom of the circuit board. The thermal breaker has two connecting lugs, and is mounted on the metal board support, adjacent to the large capacitor on the board.

When connecting a wire to one of the holes on the circuit board, you must be sure that the wire is soldered to both the front and back sides of the board. The best way is to insert the bared end of the wire half way, apply solder, then push the wire all the way in, up to the insulation, and then back it out half way, so that bare wire is visible on both sides of the board. Do all of this while the iron touches the connection so the solder flows easily. You should then see a smooth flow of solder from the wire to the circuit pad on both sides of the board.

- 44 Prepare a 6" white wire. Connect one end to hole #5 on the board. (S).
- 45 Prepare a 12" white wire, and connect it to hole #6. (S).
- 46 Prepare a 12" green wire, and connect it to hole #8. (S).
- 47 Prepare an 11" blue wire, and connect it to hole #10. (S). Set the right module aside, and select the left module.
- 48 Prepare a 10" white wire, and connect it to hole #5. (S).
- 49 Prepare a 5" white wire, and connect it to hole #6. (S).
- 50 Prepare a 5-1/2" green wire, and connect it to hole #8. (S).

- 51 Prepare a 7" blue wire, and connect it to hole #10. (S). Set the left module aside, and again select the right module.
- 52 Select one of the plastic wire ties. Place the 4 wires off to the bottom left of the right channel module, as you face the row of holes along the bottom. Wrap the wire tie around all 4 wires in front of hole #3.
- A wire tie can only be installed once, and locks after the tail is pushed through the head from the flat side of the head. Cut off the excess tail.
- 53 Select 4 of the black sheet metal screws, and fasten the right module to the chassis. Make sure that no wires are trapped. Note that the middle hole is used at the back of the module, and the lower hole in front.
- 54 Place the longer white wire from the module hole #6 along the rear of the chassis, under the other wires, and connect it to RF lug #3. (S).
- 55 Select the red and black twisted pair from switch MS in the middle of the back panel. Connect the black wire to hole #A on the circuit board, near the lower inside corner of the large capacitor. (S). Be careful the iron does not touch any components on the board. Connect the red wire to hole #B, which is about one inch to the left, or rear, of hole A on the board (S).
- 56 Select the red and black twisted pair from level control RV. Connect the red wire to hole #1 at the top of the board. (S). Connect the black wire to hole #2. (S).
- 57 Select the white twisted pair at the front of the module, and connect one of the wires to each of the lugs on the thermal breaker. Solder both.
- 58 Select the left module, and one of the plastic wire ties. Wrap the tie around the longer white wire, and the green and blue wires, about 1" in front of hole #8.
- 59 Select 4 black sheet metal screws, and install the module, making sure no wires are trapped.
- 60 Connect the shorter white wire from the left module hole #6 to LF lug #1. (S).
- 61 Select the red and black pair from control LV, and connect the red wire to left module hole #1. (S). Connect the black wire to hole #2. (S).
- 62 Select the white twisted pair at the front of the module, and connect one wire to each of the thermal breaker lugs. Solder both.
- 63 Select the two large capacitors with their bracket assemblies, and 4 sets of #6 hardware. Check the location of each clamp, and the direction of insertion of the clamping screw, to see that it agrees with the pictorial diagram, and fasten these to the chassis, making sure no wires are trapped. Place the unattached wires in their approximate locations around the capacitors.
- Loosen each clamping screw, and position the positive terminal of each capacitor (marked +) as shown in the pictorial diagram. Make sure the capacitor is tight against the chassis when resealing the clamp.
- 64 Select the 4 solder lugs, and the 4 short #10 screws (with attached lockwashers). Install the solder lugs on the capacitors, pointing as in the diagram.
- 65 Strip a 1-1/2" piece of white wire bare. Connect CL lug #2 to CR lug #3. Solder both lugs very securely.
- 66 Select the red/yellow transformer lead, and connect it to the exact center of the bare wire between the two capacitors. (S). Lowest noise and distortion will be achieved when the proper grounding sequence is followed on connections to this bare wire. It is important that all connections be kept as close to the center as possible.
- 67 Select the blue wire from GL 3, and connect it next to the red/yellow wire, on the right side. (S).
- 68 Select the blue wire from lower ground terminal RB, and connect it next to the previous blue wire — on the right side. (S).
- 69 Select the blue wire from the right output module, and connect it next to the previous wire, on the right. (S).
- 70 Select the blue wire from the output terminal LB, and connect it next to the red/yellow wire, on the left. (S).
- 71 Select the blue wire from the left module, and connect it to the left of the previous wire. (S).
- 72 Select the blue wire from switch AS, and connect it to the left of the previous wire. (S). There are now 7 wires soldered close to the center of the bare connecting wire, with origins in the following sequence, reading left to right, facing the front of the chassis: AS, left module, LB, transformer (center), GL, RB, right module.
- 73 Select the green wire from the left module, and connect it to CL lug #1.
- 74 Select the green wire from DB lug 1, and connect it to CL lug #1.
- 75 Select the green wire from the right module, and connect it to CL lug #1. (S-3).
- 76 Select the white wire from DB lug **4** and connect it to CR lug #4.
- 77 Select the white wire from the left output module, and connect it to CR lug #4.
- 78 Select the white wire from the right module, and connect it to CR lug #4. (S-3).
- 79 Select the 5 amp slo-blo fuse (it has distinctive internal construction), and install it in the single chassis fuse clip, near the right module. Check to make sure the 4 fuses in the two modules are in place.
- 80 Select the two 2 amp fuses, and install them in the speaker fuse holders on the back panel. These fuses will provide some protection for most speakers. See the operation section of this manual for more detailed information on appropriate fuse size for speaker (load) protection. The remaining 4 amp fuses are alternates for the back panel fuse holders for high power test purposes.

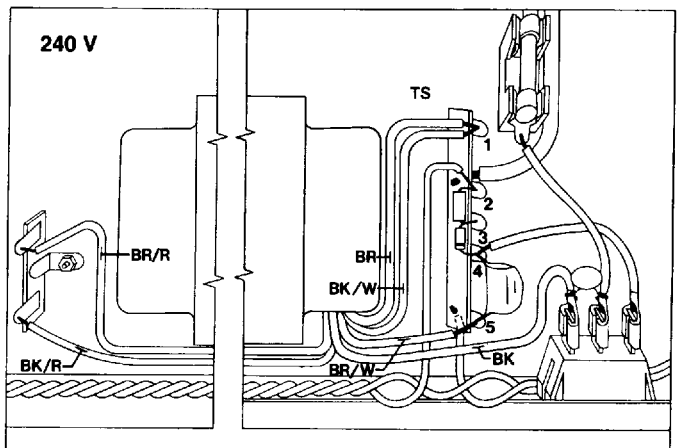
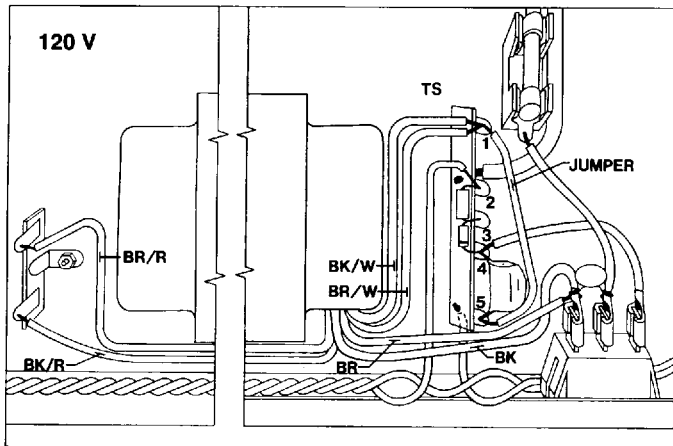
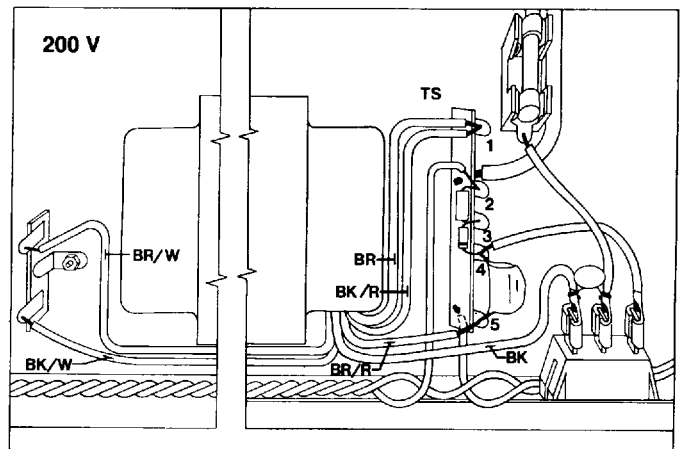
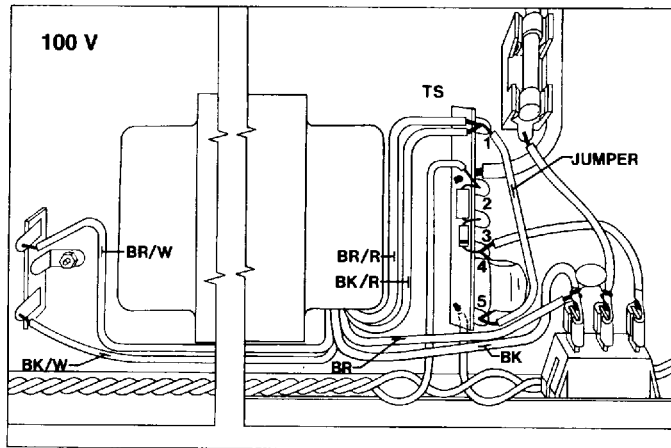
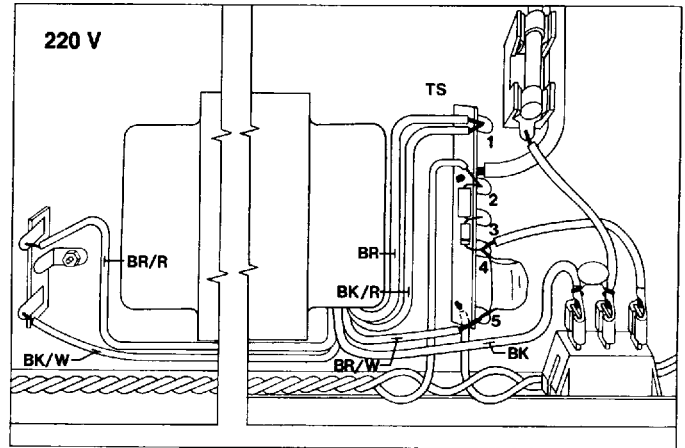
- 81 For maximum performance, you should make sure that the twisted input pairs are kept at least an inch above the chassis, away from the output and power supply wiring. Those wires should generally be down against the chassis. Also keep the input pairs an inch away from the circuit board. Fasten a plastic wire tie around the two twisted pairs near the rear edge of the right output module to help maintain their position. You may use the remaining wire ties to secure groups of wires at the base of the large capacitors, to provide a neat appearance.
- 82 Check all your soldered connections. Every wire connection should be soldered. Especially make sure there are no loose strands at places where the line cord

and transformer leads are connected. Are the three connectors fully in place on the power switch? Make sure no bare wire touches the wrong points on the two slide switches, or the input level controls. Is there any possibility that bare wire can touch the mounting hardware for the diode block? Now turn the amplifier upside down, and shake out any pieces of wire, insulation, etc.

- 83 To make the cover easier to install, loosen the screws securing one module. Install the cover with the remaining 8 sheet metal screws. Remove the backing from the serial number label, and affix it to the bottom of the chassis (unless this was installed at the factory).

AC LINE CONNECTIONS FOR OVERSEAS USE

The power transformer supplied in DH-120 amplifiers sold in the USA is intended for 120 volt, 60 Hz operation only. For use with other voltages, an export version of the kit is supplied with a multi-voltage transformer and the requisite additional 2-lug terminal strip, hardware, the higher voltage disc capacitor for the power switch, and a 2.5 ampere slo-blo type fuse. The terminal strip is mounted to the left of the power transformer. The schematic diagram details the series or parallel transformer winding combinations which are represented pictorially here. Note that extra wire jumpers are added in some cases. The 2.5 amp fuse should replace the 5 amp line fuse when wired for 200 to 240 volt operation.



IF PROBLEMS ARISE

Each circuit module, which comprises all of the 'active' amplifier circuitry, has been tested for power and distortion, to standards identical to factory built amplifiers, prior to being packed in the kit. Thus, with careful assembly, the likelihood of a circuit fault is near zero. If you are certain the problem lies in the power amplifier, check the pilot lamp. If it is blinking, excessive temperature has shut down the amplifier. After a few minutes to cool, it will turn on automatically. If it soon shuts down again, and the amplifier has sufficient ventilation, the malfunction is either internal, requiring service, or is the result of an excessive (and likely inaudible) input signal. In the latter case, investigate the signal source.

If the pilot lamp is not lighted, the main fuse in the single fuse clip inside the chassis is probably open. If a replacement 5 ampere Slo-Blo fuse (do not use a larger value) also blows, the amplifier has a power supply problem. For 200 volt and higher AC lines, the fuse should not exceed 2.5 amps.

If there is a problem in only one channel, that module may be isolated by removing the power supply fuses on its circuit board. The other channel may be used as a mono amplifier. We do not encourage local service of this amplifier because some components may not be available locally, and substitutions are not recommended. You may return a defective module for

factory service, rather than the entire amplifier. This reduces the weight, speeds service, and minimizes the risk of damage in transit. To remove the module (leave the circuit board attached to the heat sink), tag each wire with the hole number as you unsolder it from the board, and *insulate* each bare wire end. The wires to the thermal breaker must be temporarily *soldered together*, and insulated, if you wish to use the amplifier monophonically.

Adjustments for Bias and Balance

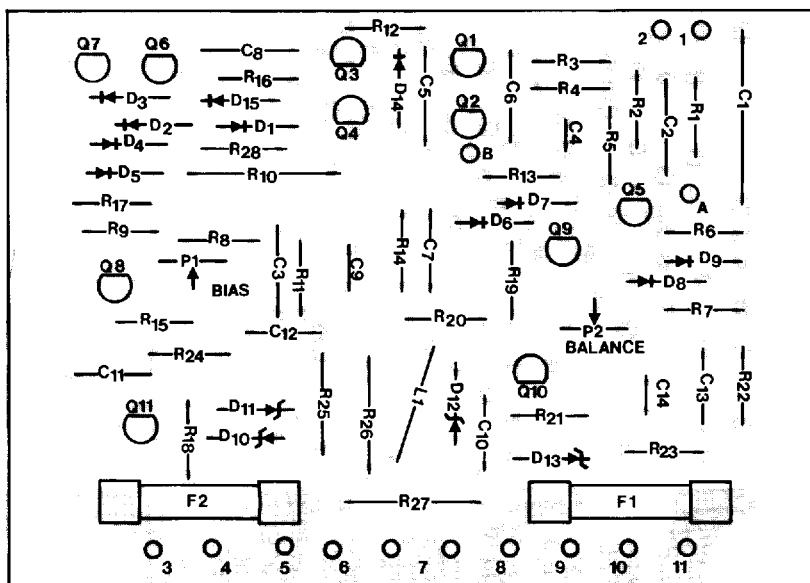
These two potentiometers on each circuit board have been set at the factory, and should not normally require adjustment for the life of the amplifier. The Balance control, which is P2, is to the right when facing the board with the row of connecting eyelets along the bottom. It should not be adjusted without a distortion analyzer, and even then, only with factory advice, since other factors affect distortion as well.

If the output or driver transistors are replaced, the Bias control, P1, may warrant adjustment to achieve the desired 150 mA current. Remove the fuse on the left of the board, below the potentiometer, and connect an ammeter across the fuse clip. Avoid intermittent connections, and do not short the leads together. With the AC line adjusted for its nominal value (120 Volts in the USA), set P1 for 150 mA. Turn the amplifier off, and when the current drops to zero, remove the ammeter and replace the fuse.

VOLTAGE CHART

Measured with 120 volt line, no signal, with respect to the ground buss between the two power supply capacitors. B + and B - are 54 volts.

	E	B	C
Q1	-0.67	-0.07	52.7
Q2	-0.65	-0.05	52.7
Q3	53.5	53.0	52.7
Q4	53.3	52.7	52.7
Q5	-52.3	-51.5	-14.6
Q6	53.4	52.9	51.7
Q7	51.7	51.2	1.35
Q8	-1.18	-0.57	1.35
Q9	-52.3	-51.7	-1.18
Q10	-0.6	-1.18	-53.5
Q11	0.8	1.35	54.0
	S	G	D
Q201	0	0.8	54
Q202	0	-0.6	-54



PC-25 COMPONENTS

SERVICE POLICY AND LIMITED WARRANTY

The DH-120 Power Amplifier has been carefully engineered to provide many years of use without requiring any maintenance or servicing.

Factory assembled units are subjected to many physical and electrical tests before shipment. The amplifier module assemblies of kit units are similarly tested to meet performance specifications prior to packing. In spite of this, shipping damage does occur, a kit may not be assembled properly, or human error interferes, so service may be needed. The David Hafler Company provides complete service facilities at the factory to make any necessary repairs. Because many of the components in this refined design are not readily available through local sources, and the performance of the unit is likely to be compromised with "similar type" substitutions, we strongly recommend factory service, or obtaining the requisite parts from the factory.

It is the owner's responsibility to return or ship the unit freight prepaid to the factory service department and to provide insurance in transit. Units shipped freight collect will not be accepted. For units to be repaired under warranty, a copy of the dated bill of sale must accompany the unit.

Shipment should be via UNITED PARCEL SERVICE. Parcel Post is not a safe way to ship electronic equipment. The factory will not be responsible for damage caused by parcel post shipment and repairs will be made at the owner's expense. When shipping your DH-120 be sure to insure it for the full value of an assembled amplifier.

Use the complete original carton and all packing material to ship your amplifier. The kit packaging is designed to accommodate the completed unit. Enclose with the unit the following information:

1. Complete shipping address (Post Office box numbers are often not acceptable, except for correspondence).
2. The serial number.
3. Copy of dated bill of sale if repairs are to be made under warranty.
4. Description of the malfunction. If intermittent, be sure to indicate.
5. You may also wish to attach your address directly to the unit, or to the line cord.

All service work is guaranteed for 90 days.

Warranties apply to the original purchaser only. The warranty is void if the amplifier has been modified without factory authorization; or if parts have been substituted which, in the factory's judgment, are not suitable; or if the amplifier has been either physically or electrically abused, or used for some purpose for which it was neither designed nor intended. The warranty on the transformer is void if the leads have been cut too short for re-use.

Technical assistance to help you locate the source of a problem may be obtained by calling or writing the Technical Services Department. Phone (609) 662-6084 between 8 A.M. and 4:30 P.M., eastern time. It is helpful to know the serial

number of the unit, and the results of any tests you have performed. However, we do not recommend that you attempt your own servicing unless you are knowledgeable in this regard.

SERVICING AN AMPLIFIER MODULE

If you are certain that the problem is confined to one of the amplifier modules (comprising the circuit board, heat sink, and output transistors), you may remove and return only the module for service. Be sure that the components on the circuit board are well protected — as by a surrounding sleeve of corrugated cardboard which rests against the heat sink, and projects beyond the components. Properly packed and insured for \$125, this assembly can be sent by parcel post, as well as UPS, if necessary. A service fee of \$20 must be sent with every module, since the fault may have been caused by a wiring error elsewhere. For this reason, too, and because we have no control over its proper reinstallation, the service warranty on a separate module is limited to assurance of its proper functioning when it leaves the service facility. All modules are tested before being returned to you. If you believe the fault is the factory's warranty responsibility, include the serial number and the *bill of sale*. If in our judgement the fault is entirely a manufacturing defect, a portion of the service fee will be refunded. Only a complete amplifier can be fully checked and given a service warranty.

WARRANTY FOR KIT-BUILT UNITS

The parts in a DH-120 kit are warranted for a full year from the purchase date. If a defective component is found on a circuit board or in a kit, simply return the *individual* part to the factory prepaid together with the serial number and the date of purchase, and it will be replaced at no charge.

If you cannot locate what is wrong with your DH-120, return it to the factory along with a copy of the dated bill of sale, and a check for \$35. If the sole cause of the problem is a defective part, the unit will be repaired and returned to you transportation prepaid, and your \$35 *less a charge for repackaging and shipping* will be returned to you. If the problem is found to be an error in your assembly of the amplifier, the amplifier will be put in working order, tested to be sure it is meeting specifications, and returned to you (freight prepaid within the continental U.S.). Excess shipping charges for expedited service, or overseas delivery are your responsibility. At the sole discretion of the factory service department, if the time required for diagnosis, repair and testing, and the nature of the malfunction warrants it, a portion of the submitted repair fee may be rebated.

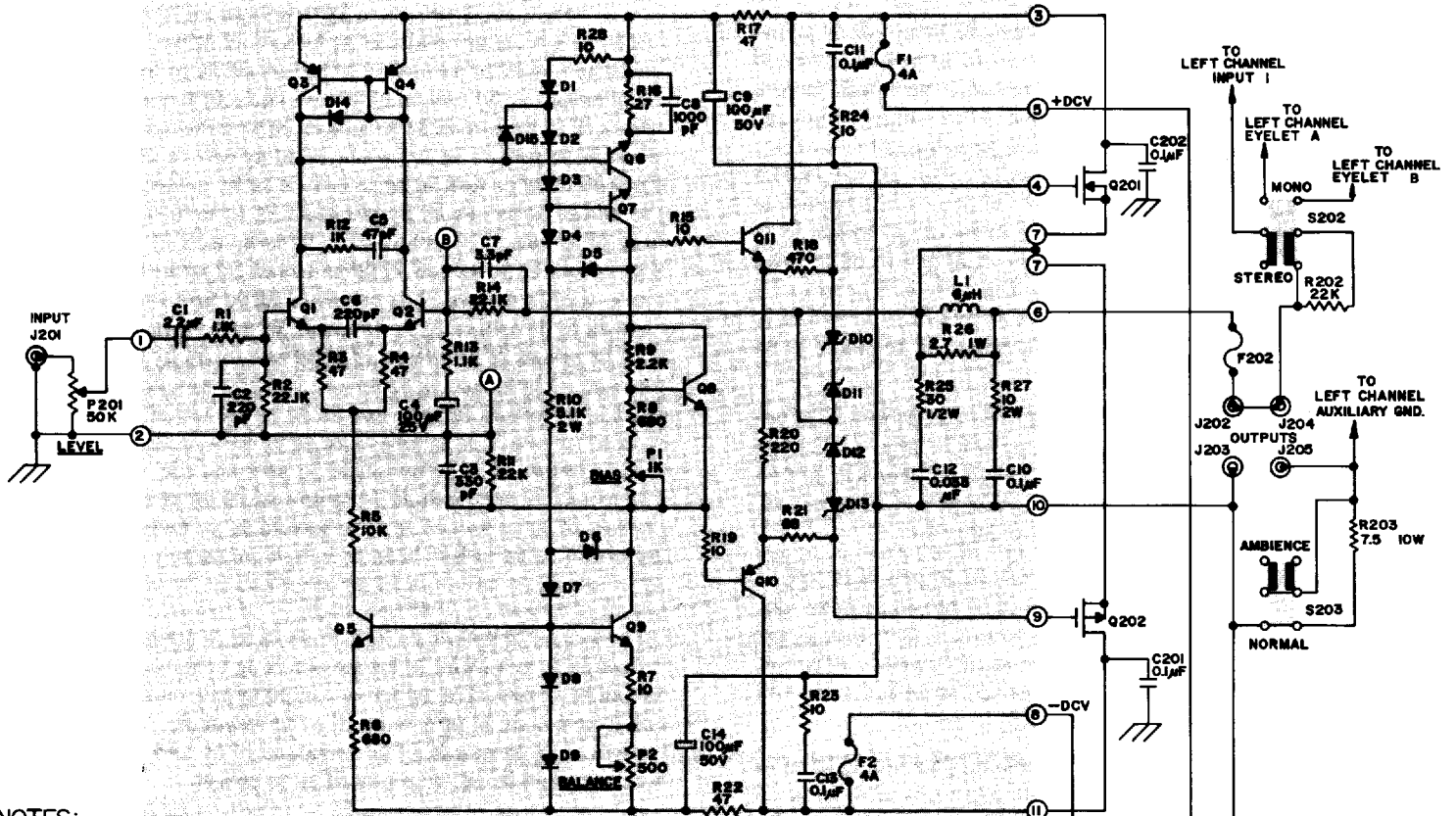
This warranty is void if the kit has not been completely assembled or if other than rosin core solder has been used. Units assembled with acid core solder or paste flux will be returned unserviced.

WARRANTY FOR FACTORY ASSEMBLED UNITS

The DH-120 is warranted for 3 full years from the purchase date including parts and labor and normal shipping costs from the factory to the owner within the continental U.S. The owner is responsible for returning the unit to the factory and must submit a copy of the dated bill of sale.

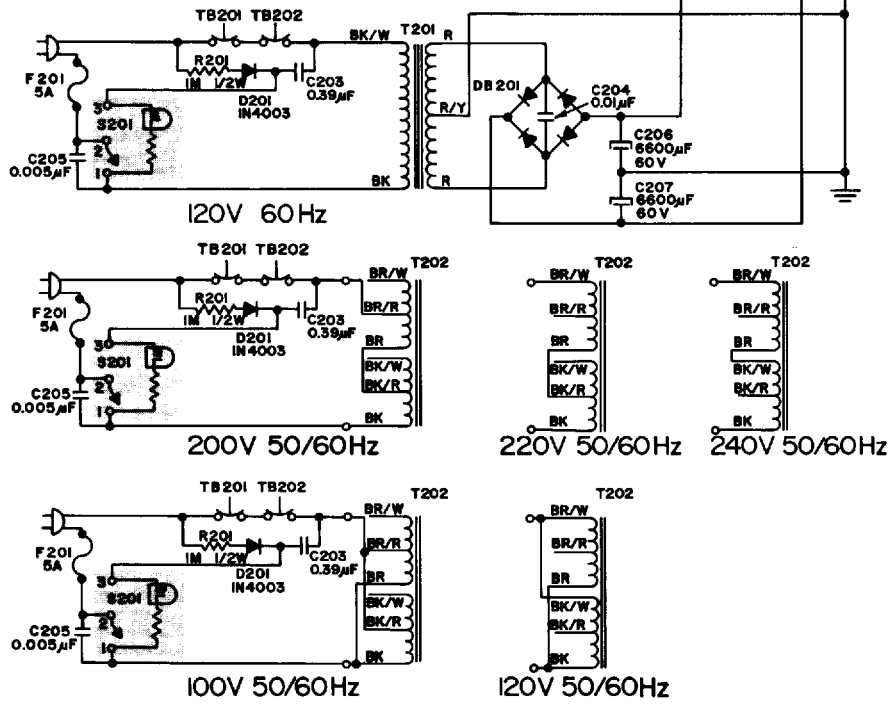
This warranty gives you specific legal rights. You may also have other rights which vary from state to state.

PC-25_B RIGHT CHANNEL



NOTES:

- ① D1-D9, D14 AND D15 ARE 1N4148.
- ② D10-D13 ARE 1N5240B.
- ③ Q1, Q2, Q5, Q8 AND Q11 ARE 2N5550.
- ④ Q3, Q4, Q6, Q7 AND Q10 ARE 2N5401.
- ⑤ Q8 IS 2N2222.
- Q201 IS 2SK134.
- Q202 IS 2SJ49.



**SCHEMATIC
DIAGRAM**

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COMPONENT VALUES

All resistors are 1/4 watt carbon film unless specified otherwise.

	Part No.		Part No.
R1	1,100 ohms, 1/4W, metal film	RM025	D1 1N4148 QD116
R2	22,100 ohms, 1/4W, metal film	RM035	D2 1N4148 QD116
R3	47 ohms	RC039	D3 1N4148 QD116
R4	47 ohms	RC039	D4 1N4148 QD116
R5	10,000 ohms	RC016	D5 1N4148 QD116
R6	680 ohms	RC059	D6 1N4148 QD116
R7	10 ohms	RC013	D7 1N4148 QD116
R8	680 ohms	RC059	D8 1N4148 QD116
R9	2,200 ohms	RC025	D9 1N4148 QD116
R10	5,100 ohms, 2W, metal film	RZ022	D10 1N5240B QD111
R11	22,000 ohms	RC026	D11 1N5240B QD111
R12	1,000 ohms	RC015	D12 1N5240B QD111
R13	1,100 ohms, 1/4W, metal film	RM025	D13 1N5240B QD111
R14	22,100 ohms, 1/4W, metal film	RM035	D14 1N4148 QD116
R15	10 ohms	RC013	D15 1N4148 QD116
R16	27 ohms	RC072	D201 1N4003 QD115
R17	47 ohms, 1/4W, carbon comp.	RZ011	DB1 Diode Bridge 8A QD131
R18	470 ohms	RC041	
R19	10 ohms	RC013	F1 4A, 3AG SF028
R20	220 ohms	RC063	F2 4A, 3AG SF028
R21	68 ohms	RC073	F201 5A, Slo-Blo AGC SF018
R22	47 ohms, 1/4W, carbon comp.	RZ011	F202 2A, 3AG (size optional) SF011
R23	10 ohms	RC013	F203 2.5A, Slo-Blo AGC (alternate) SF016
R24	10 ohms	RC013	
R25	30 ohms, 1/2W	RD129	L1 6 microhenry inductor TA134
R26	2.7 ohms, 1W	RZ024	
R27	10 ohms, 2W, metal film	RZ023	P1 1000 ohms Trimpot RP011
R28	10 ohms	RC013	P2 500 ohms Trimpot RP026
R201	1 megohm, 1/2W	RD113	P201 50,000 ohms Level control RP036
R202	22,000 ohms	RC026	
R203	7.5 ohms, 10W	RW014	TB201 Thermal breaker SF024
			TB202 Thermal breaker SF024
C1	2.2 mfd, 100V, film	CC127	
C2	220 pF, 630V, film	CP116	Q1 2N5550 QN128
C3	330 pF, 630V, film	CP134	Q2 2N5550 QN128
C4	100 mfd, 25V, electrolytic	CL128	Q3 2N5401 QP122
C5	47 pF, 250V, film	CP117	Q4 2N5401 QP122
C6	220 pF, 630V, film	CP116	Q5 2N5550 QN128
C7	3.3 pF, 500V, mica	CM126	Q6 2N5401 QP122
C8	1 nF, 250V, film	CP136	Q7 2N5401 QP122
C9	100 mfd, 50V, electrolytic	CL135	Q8 2N2222 QN124
C10	100 nF, 100V, film	CE115	Q9 2N5550 QN128
C11	100 nF, 100V, film	CE115	Q10 2N5401 QP122
C12	33 nF, 250V, film	CP138	Q11 2N5550 QN128
C13	100 nF, 100V, film	CE115	Q201 2SK134 QN112
C14	100 mfd, 50V, electrolytic	CL135	Q202 2SJ49 QP112
C201	100 nF, 100V, film	CE115	
C202	100 nF, 100V, film	CE115	S201 Power switch SL111
C203	390 nF, 100V, film	CE117	S202 DPDT slide switch SZ119
C204	10 nF, 1000V, disc	CZ112	S203 DPDT slide switch SZ119
C205	5 nF, 1000V, disc	CZ113	
C206	6600 mfd, 60V, electrolytic	CL151	T201 Power transformer TA135
C207	6600 mfd, 60V, electrolytic	CL151	T202 Power transformer (alternate) TA136

