

THE hafler PREAMPLIFIER



DH-110

INSTRUCTIONS for ASSEMBLY and OPERATION

LM132

\$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.

SPECIFICATIONS

The numbers in parentheses refer to the paragraph in the IHF specifications manual which defines the test procedure.

PHONO PREAMP SECTION

Rated Output: 3 Vrms, 8 Hz-105 kHz

Maximum Output (3.5): 12 Vrms, 20 Hz-20 kHz at recording output

Total Harmonic Distortion: Less than 0.0006% @ 1 kHz, 3 Vrms

Frequency Response (3.13): +0, -0.25 dB, 20 Hz-20 kHz

RIAA Equalization Accuracy: +0, -0.1 dB, 30 Hz-15 kHz

Full Power Bandwidth: -6 dB, 4 Hz-210 kHz

Sensitivity (3.7): 12.5 millivolts

Maximum Input Signal @ 1 kHz (3.8): 300 millivolts; [3 V @ 20 kHz]

Gain: 34 dB @ 1 kHz

Input Impedance: 47,000 ohms in parallel with 30 pF; user adjustable.
Plug-in capacitors are installed to increase this
to 150 pF on Phono 1; 250 pF on Phono 2

Signal to Noise, weighted (3.12): 87 dB

Slew Rate: 12 volts per microsecond

LINE AMPLIFIER SECTION

Rated Output: 3 Vrms, 4 Hz-210 kHz

Maximum Output (3.5): 14 Vrms, 20 Hz-20 kHz

Total Harmonic Distortion (3.4): Less than 0.001%, 20 Hz-20 kHz

Frequency Response (3.13): +0, -0.1 dB, 20 Hz-20 kHz

Full Power Bandwidth: -6 dB, 2 Hz-420 kHz

Sensitivity (3.7): 50 millivolts

Maximum Input Signal @ 1 kHz (3.8): 14 Vrms; volume control @ -20 dB

Gain: 20 dB \pm 1 dB

Input Impedance: Greater than 25,000 ohms

Signal to Noise, weighted (3.12): 90 dB

Slew Rate: 12 volts per microsecond

Rise Time: 2.5 microseconds maximum, Phono in / Line out, 10 Vp-p,
1 kHz square wave; load is 10,000 ohms in parallel with 10 nF

Crosstalk (3.14): down 72 dB, any input to any output

Separation (4.2): greater than 82 dB @ 1 kHz; greater than 52 dB @ 20 kHz

Gain Tracking Error (4.4): less than 0.5 dB

Maximum Output Noise: less than 350 microvolts, wideband
less than 95 microvolts, 'A' weighted
[with 1 Kohm input termination, volume full CW]

Bass Control: 217 dB @ 20 Hz, moving inflection, variable turnover

Treble Control: \pm 17 dB @ 20 kHz, shelving @ 5 kHz, fixed turnover

Filter Response: -3 dB @ 25 Hz; -6 dB @ 15 Hz; -12 dB @ 8.2 Hz; -25 dB @ 3 Hz

Filter Cutoff (3.13.2.2.1; 3.13.2.2.2): 25 Hz; -12 dB/octave

GENERAL SPECIFICATIONS

Semiconductors: 30 transistors, 3 ICs, 12 diodes, 2 LEDs

Inputs: 2 Phono, Tuner, Compact Disc or Video, 2 Tape recorders, EPL

Outputs: 2 Tape (buffered), 2 Line, EPL, Headphone Jack

Controls: Volume, Balance, Bass, Treble, Input Selector, Phono 1/2 Selector,
Monitor Selector, Mono-Stereo, Filter, External Processor Loop,
Tone Control Engage, Power

Intermodulation Distortion: Both SMPTE and CCIF IMD at operating
levels from phono input to line output are below the
residual of currently available instrumentation

AC Supply Voltage: 100-130 and 200-260 VAC, 50/60 Hz

Power Consumption: 3.5 watts

AC Convenience Outlets: 3 switched, 5 amp continuous, 72 amp surge
1 unswitched, 5 amp continuous

Size: 17" wide x 3" high x 8½" deep
19" rack mounting accessories included

Shipping Weight: 12.5 lbs.

Net Weight: 10 lbs.

INTRODUCTION

Your preamplifier is the control center of your music system, acting as an interface between the sound sources-record players, tape recorders, FM and Video tuners-and the power amplifier which drives the loudspeakers. As the focal point of your system, it should be attractive and easy to use, versatile and yet functionally unobtrusive. It should contribute a minimum of noise or distortion while providing signal amplification, control of the signal level, and applicable modification of the frequency response.

The DH-110 achieves all these objectives with great versatility, providing for two record players with magnetic cartridges, two tape recorders, a tuner, and an additional stereo input for a compact (digital audio) disc player or video audio. It also includes inputs and outputs for an external signal processor such as a graphic equalizer, time delay device, or noise reduction unit. The performance of the DH-110 is exemplary, and its assembly from an array of discrete components of exceptional quality should ensure reliability and longevity of its capabilities.

Exceedingly low noise and distortion is a hallmark of the DH-110. Noise is essentially inaudible in the absence of a signal, and distortion of all types, both steady state and transient, is at or below the threshold of the finest measurement capabilities. These excellent characteristics are maintained far outside the customary 20 Hz to 20 kHz band, and signals well beyond that are handled without the need to restrict bandwidth.

Precise interchannel balance at all frequencies is maintained with close tolerance components, and RIAA phono equalization is engineered to very narrow limits, maintaining accurate phase relationships and correct spatial perspectives, as well as exceptional unit-to-unit consistency. The tone controls, which can provide contouring of response for individual needs when switched in, are normally isolated from the circuit for ruler-flat response.

The components in the DH-110 have been selected for their superb audio performance as well as for their reliability. They have been incorporated in the unique Hafler fully complementary symmetry push-pull circuit in a carefully designed circuit board layout which reduces crosstalk and maintains separation for a synergistic audio result that defies comparison, regardless of cost.

Those who have chosen to build the kit will find that its step by step instructions will ensure a properly working unit even for the novice builder. A substantial amount of preassembly has enabled us to check out each kit in nearly every aspect of performance, and makes the DH-110 a particularly fast, easy and enjoyable construction project, which you will likely complete in one evening.

We suggest that you read the installation and operation sections of this manual carefully, even though much may be familiar to you. There are some subtle and significant points which may be new, and their proper appreciation will enable maximum satisfaction with your DH-110. We wish you to have the very best in sound.

CONTENTS

Installation	Page 4	Additional Information16
Operation5	Functional Block Diagram16
Assembly Instructions.7	Component Values19
Building the Kit9	Schematic Diagram20
PC-14 Diagrams12	Kit Parts List22
If a Problem Arises15	Service and Warranty23
Overseas AC Line Connections15	Pictorial Diagram	Insert

INSTALLATION

The DH-110 is provided with accessory Rack Mount end caps in addition to the standard end caps installed on the unit. These accessory caps extend the width of the front panel to that of a standard 19" rack, with appropriate mounting holes. Installation instructions are detailed later in this manual under Additional Information.

POWER CONNECTIONS

As assembled, units are normally wired for 120 VAC, 50-60 Hz, as in the USA, unless they are specially identified on the carton. In the Additional Information section you will find diagrams of alternate wiring of the power transformer to conform to other line voltages.

The power regulation of the DH-110 will provide full performance with line voltages which may vary substantially from the standard. Units wired for 120 volts, for instance, will work properly with line voltages between 95 and 130 volts.

Accessory AC outlets are provided on the back panel for other equipment. One unswitched outlet is provided for a turntable or tape recorder whose mechanical system may require disengagement through its own power switch. Most units, including power amplifiers, tuners, and many tape recorders and record players, may be connected to the switched outlets for convenient remote switching from the preamp's front panel. The DH-110 power switch has been tested to provide adequate capacity for any Hafler power amplifier and typical related equipment. You should heed the maximum power rating printed on the back panel of the unit.

INPUTS-Magnetic Phono

There are two pairs of phono inputs, identified as Phono 1 and Phono 2. These are independent, and thus they may have different capacitive termination for differing cartridge requirements. As assembled, Phono 1 is provided with a compensation capacitor of 120 picofarads, and Phono 2 is provided with 220 picofarads. One of these values will accommodate most 'Moving magnet' cartridges. These have output levels intended for normal phono inputs (0.5 millivolts per centimeter or higher) and are the most popular. Some high output 'moving coil' design cartridges are not sensitive to capacitive loading, so they may be used with either input.

Though some phono cartridges are comparatively free of loading sensitivity, if the cartridge manufacturer specifies the proper load capacitance (which is the sum of the preamp's internal capacitance, and the cables you use, as well as the above described capacitor), the most accurate sound will be obtained by following that recommendation. If you have chosen the DH-110 for its sonic attributes, you will be more likely than most to be aware of these differences, and will want proper cartridge termination.

The Additional Information section of this manual details the determination of the loading capacitor for a specified cartridge load. It also describes how the resistive load of the phono inputs may be changed, if needed, from the standard 47K ohms.

Moving coil design cartridges often require an auxiliary step-up transformer or pre-amplifier (head amplifier) because of their low output signal. The DH-110 has provision for internal addition of an accessory Hafler pre-amplifier which you or your dealer can install at any time. This enables the Phono 1 input to accommodate such cartridges directly. The Additional Information describes its installation.

Adjacent to the Phono 1 input sockets are two Ground terminals on the back panel. These thumbscrews provide for connection of separate ground wires often provided on turntables, or as part of their audio cables. This 'chassis ground' may sometimes reduce the hum level of a system when it is connected to an earth ground, such as a cold water pipe, or the ground wire of 3-wire house wiring. However, the need for such connection varies with individual situations. After the system is operative, using a phono source, experiment with and without an earth ground to determine which provides the lowest hum, and use that.

INPUTS-Tuner, CD/Video

These are high level (line-50 millivolts or more) signals from FM, AM or TV tuners, or compact digital audio disc, video disc, or VCR players. These inputs are grounded at the selector switch when they are not chosen for listening. The input impedance is approximately 33K ohms.

INPUTS-Tape 1, Tape 2

These are at line level and impedance. They connect to Tape Play outputs on the tape deck. They are not grounded when unused, since they can be connected by either the main selector switch or the Tape Monitor switch. They are terminated with 1 megohm resistors to avoid a possible switching transient.

RECORDING OUTPUTS

These connect to the Line Inputs of tape decks. The two pairs of outputs are wired in parallel. Thus two tape recorders receive identical signals. These outputs are buffered with a series resistor, and have an output impedance of 1.5K ohms. To provide full specification performance, the total tape recorder load should not be lower than 10K ohms (i.e. two 20k ohm recorder inputs on each channel).

Because it is possible that a preamplifier's overall performance may be adversely affected by rectification ef-

facts that can result from unpowered electronic circuits in the tape decks when they are connected to the Recording Outputs, it is recommended that tape recorders be switched on when the preamplifier is in use. This is a commonly overlooked cause of less-than-ideal preamplifier performance.

Signals at these outputs are at line input level (phono signals are first amplified and equalized). These outputs are unaffected by external processing circuits, or by the DH-110's Mono, Filter, Tone or Volume controls. Only signals indicated by the Selector switch are available, including the other tape input, so tape copying is provided using either recorder as a source.

LINE OUTPUTS

Two pairs of outputs are provided for your power amplifier connection. The set labelled 'Via Phones' is suggested for those who regularly listen through headphones as an alternative. These are wired so that when headphones are plugged in, the signal is disconnected from the power amplifier. Two purposes are thus served. Since many headphones require fairly high volume control settings, you avoid inadvertent high signal levels to your speakers. And a power amplifier which is turned off cannot degrade the quality of signal to the headphones-

When you turn on the DH-110, power is also applied to the switched AC outlets on the back panel. One of the red LEDs on the front panel will light, indicating that the preamp is functioning. Typically, it will be the left-most LED, indicating that the Selector switch is determining the signal source. At turn-off, it is normal for the LED to fade slowly as the operating voltages decline.

DELAYED TURN-ON

An internal muting circuit prevents the voltage transients which may occur at turn-on or turn-off from causing annoying noises, blown fuses or damaged loudspeakers.

At turn-on, the Line Outputs (but not the Recording Outputs or EPL Send output) will be held near ground potential for a few seconds until the internal voltages have stabilized, and the unit is ready for operation. Only a faint output can be heard during this time.

At turn-off, whether by operating the preamp's power switch, or as a result of external AC failure (a 'brown-out', pulled plug, or blown house fuse), the line output will be instantaneously lowered. Following power interruption, the muting circuit will initiate a few seconds delay before allowing full signal at the line outputs.

SIGNAL SELECTION

Your choice of signal sources is usually indicated by the Selector Switch, identified by the adjacent lighted LED. This switch passes line level signals direct to the Recording Outputs and to the EPL Send output as well as to the Mono switch and subsequent line amp controls. Either or both tape recorders may record this source. Tapes may be

which is otherwise a possibility. We recommend that you turn off power amplifiers before connecting headphones, or that they be plugged in before the system is switched on, as a precaution.

The Direct outputs provide conventional signal levels independent of the headphone circuit. If headphones are plugged in, the level of the Direct output will be greatly reduced. These outputs should not be used when headphone use is anticipated.

The performance specifications will be met so long as the input impedance of the power amplifier is 10K ohms or higher, and the cable capacitance is less than 10nf. This is no problem with typical interconnecting cables up to 10 feet. If you are planning to use very long cables between preamp and power amplifier, special low capacitance cable can be obtained.

EXTERNAL PROCESSING LOOP

'Send' is an output at line level for the purpose of driving an external signal processor such as an equalizer, time delay, or noise reduction unit. Like the recording outputs, the load impedance should not be less than 10K ohms. The EPL 'Return' input impedance is 33K ohms, and should also be at line level. The EPL Return can also function as an additional high level input, switched from the front panel.

OPERATION

duplicated by selecting the playback tape recorder on the Selector switch, and recording on the second machine.

PHONO AMPLIFIER

The button in the lower left of the front panel selects either Phono 1 (in the OUT position) or Phono 2. The switch may be operated to compare two cartridges while music is playing, but if there is no cartridge connected to one input, noise or RF interference may cause a small audible transient. The phono signal is accurately RIAA equalized and amplified 34dB (at 1kHz), then passed to the Selector switch at line level.

MONITOR SWITCH

To facilitate tape recording with tape decks which provide an independent monitoring facility, the DH-110 provides this second selection function. When it is OFF, the regular Selector switch determines what signals are heard. When the Monitor switch is turned to either Tape 1 or Tape 2, the line amplifier is quietly disconnected from the signal being recorded, and is connected to the tape playback instead. This enables direct comparison of the signal source with the taped replica, without affecting the recording process. Tape decks which do not provide separate record and playback heads are not able to utilize this comparison.

Note: Do not turn the Monitor switch to Tape 1 if the Selector is also set to Tape 1. Likewise avoid simultaneous Tape 2 settings on both switches. Feedback will occur, and there is a possibility of damage.

When the Monitor switch is not in the OFF position, the LED at the Monitor switch will light, in place of the Selector LED, reminding you that tape playback has been selected.

The following controls affect all signals which are heard through speakers or headphones. They have no effect on the signals to the recording outputs.

MONO SWITCH

When this button is IN, left and right channel information is combined, and the composite signal is fed to both left and right outputs. In this mode the sound image should appear to be centrally located between the loudspeakers. Critical listeners sometimes choose the mono mode for system evaluation, for it enables you to isolate system response from the complexity of stereo effects. This switch is also useful when listening to monophonic program material. It cancels the unwanted vertical phonograph modulations which are heard as noise from monaural records.

FILTER SWITCH

This is a low frequency cutoff to remove much of the signal below 25 Hz, such as noise, turntable rumble, or loudspeaker-turntable feedback. Even in cases where the speakers may have little response at these frequencies, this filter can be useful. Very low frequencies can modulate audible midband signals, so eliminating this interference can improve overall clarity.

Note: The Filter button should be OUT when the DH-110 is turned ON to avoid a switching transient during the first minute of operation. If it is IN at turn-on, wait one minute before releasing it.

EPL SWITCH

This is the External Processor Loop. Engaging this switch enables a signal processing device to be inserted in the preamplifier signal path. Such devices include equalizers, time delays or ambience simulators, expanders, compressors, and noise reduction systems. Since the switch permits bypassing the processor loop, an unpowered device in the EPL circuit will not deteriorate the DH-110 performance, as might be the case with switched-off tape decks in the Record Outputs. The EPL switch can also function as an additional input selection.

TONE SWITCH

Until this button is depressed, all tone control circuitry is completely removed from the signal path. Activating this button may cause a slight change in the tonal balance even when both Bass and Treble controls are in their median (detent) position. Potentiometer tolerances preclude coincident mechanical and electrical centering. The tone control circuitry limits, to an extent, the total bandwidth of the DH-110.

Operation of the Tone button will be silent if it is depressed in a natural, deliberate manner. Rapid switching may generate small transient pulses.

BALANCE CONTROL

This adjusts the proportion of left and right channel signals to the Line outputs. In its detented center position the channels will be matched to ± 0.1 dB. Only the Left signal

will be heard with the control fully counterclockwise, and only the Right signal at the other extreme.

The ideal situation would find symmetry in room acoustics and in the electronics, but this realization is rare. Stereo reproduction is, at best, a splendid illusion, and the function of the Balance control is to optimize this illusion in the listening space. Sound wave reflections from walls, furniture and people can unbalance the stereo 'stage'. With judicious application of the balance control, much of the attendant distortion of stereo imaging can be overcome. With the preamplifier in the Mono mode, it will be easier to use the Balance control to centrally position the apparent sound source. This mono setting can then serve as a useful reference point, though the appropriate balance setting may vary from recording to recording in the stereo mode.

Our point is that Balance and Tone controls are intended to facilitate the most satisfying sound to the listener; it is appropriate that they be used to this end.

BASS and TREBLE CONTROLS

The Tone Switch must be IN for these controls to be effective. At full rotation, each control provides about 17 dB of boost (clockwise), or cut (counterclockwise) at the frequency extremes from the center 'flat' (detent) position.

The Bass control has a variable inflection, or 'hinge' point so that only the very low frequencies are affected by small amounts of rotation either side of center. This facilitates low frequency corrections without noticeably altering the musical balance, but speakers with diminished low frequency response will not reflect small angular movements from the detent. As the control is turned further, frequencies closer to 500 Hz are affected, so the effect is more apparent.

The Treble control has a fixed 'hinge' point at 1kHz and has a 'shelving' action above 5kHz. This affords proper correction without irritation from excessive boost at the extreme.

VOLUME CONTROL

This step action control was selected for its very accurate tracking between channels, and for its low contact distortion. Clockwise from the 12 o'clock position it increases in increments of roughly 1 dB. From 12 o'clock counterclockwise it progresses in increasing increments to full attenuation.

HEADPHONE JACK

A 3-circuit shorting jack is connected so that the tip is the left channel, in series with one set of line outputs, so that the power amplifier is automatically disconnected when the headphones are plugged in. We recommend that you turn off the power amplifier before you connect headphones, or that they be plugged in before the preamplifier is turned on, to guard against needless transients. Be sure the volume is turned down before headphones are disconnected.

ASSEMBLY INSTRUCTIONS

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.

The DH-110 preamplifier 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.

Kit building should be fun, and we are certain you will find this to be so. 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 and the proper tools. 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.

A soldering "gun" is not recommended. The unfamiliar user is more likely to damage the etched circuit boards with its higher heat potential and unbalanced weight. Also,

because he may not wait long enough for it to reach operating temperature each time it is switched on, poor solder connections are more likely. Pencil irons are much lighter and easier to use, and there is no waiting time when solder connections follow in sequence, as in kit building. Make sure you have a holder for it, though, and always unplug it when you take a break.

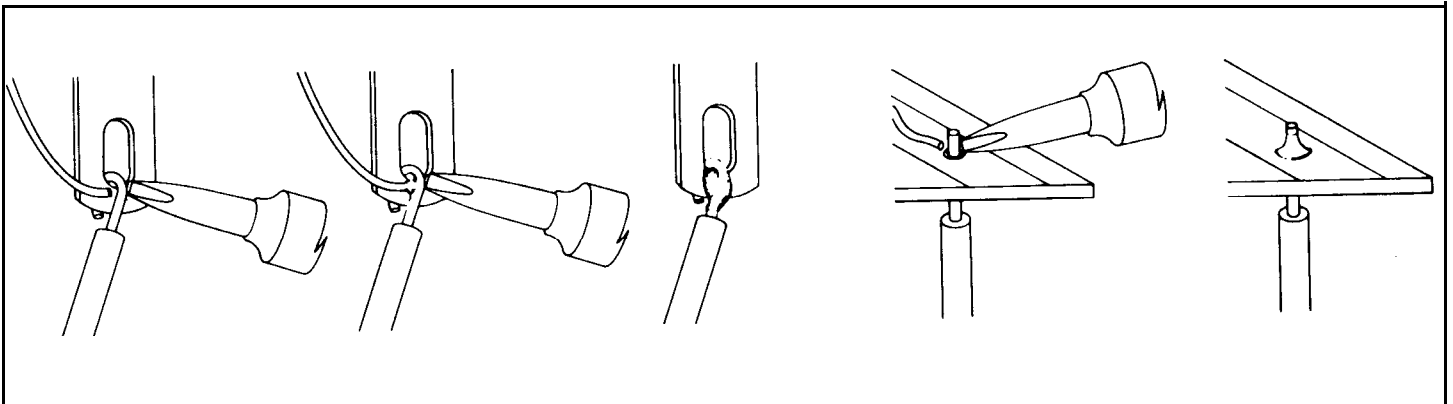
Proper Soldering

There are four steps to make 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.

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.

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 onto adjacent circuitry and cause a short circuit.

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. The hookup wire supplied with this kit does not normally need tinning, for it is pre-tinned.

Wiring the Kit

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.

To "prepare" a wire means to cut the designated length 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. The wire supplied in this kit is "bonded stranded," which provides exceptional flexibility with resistance to breakage for easier use.

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-3), 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, and for neatness.

Be sure that uninsulated wires cannot touch adjacent terminals or the chassis metalwork.

When the instructions call for twisting two or three wires together, the length of wire indicated anticipates a fairly tight, uniform twist by hand, of three full turns every two inches. If you find the wires too short, loosening the twist will gain some needed length.

Take the time to be accurate and neat, and you can be sure that your completed preamplifier 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.

BUILDING THE KIT

Partial mechanical assembly of the kit provides protection for major components during shipment. Most of the hardware thus used is included in the quantities listed in the parts list. The exception is that used to install the rear mounting bracket on the PC-14, as this is considered an integral assembly. Only the two screws securing the bracket to the side pieces need be removed, along with the hardware securing the front sub-panel. Dismount the power transformer and remove the side pieces.

A "set" of hardware includes a screw and a KEP nut with attached lockwasher. Always install the lockwasher side first. Screws are always inserted from the outside of the chassis unless otherwise specified. #4 hardware is smaller in diameter than #6. To separate #4 nuts from the #6s, use a long #4 screw to test.

We suggest you check off the parts as you unpack the kit, and separate them in an egg carton for convenience.

- 1 The flanges of the front sub-panel bend towards the inside of the preamp. Select the U-shaped headphone jack mounting bracket and 2 sets of #4 hardware. Install the mounting bracket on the outside of the front panel, in front of the rectangular hole in the lower right corner.
- 2 Select the headphone jack, its washer and nut. Install it through the front panel with the single lug at the bottom. The washer goes outside the bracket, secured by the nut.
- 3 Prepare a 2" black wire. Connect one end to the lower forward lug of the headphone jack. (S). Place this wire through the panel.
- 4 Prepare a 14½" green wire, but strip 3/8" of insulation from one end. Prepare a 14½" red wire. Prepare a 14½" black wire. Start with the red wire ¼" longer than the longer bare end of the green wire, and the black wire ½" shorter than the green wire. Twist these 3 wires together uniformly throughout their length. Make about 3 complete twists every two inches. On the rear of the phone jack 8 numbered positions identify the 6 lugs in a counter-clockwise rotation, with the #2 lug at the bottom (in line with the front lug), and the #6 lug at the top. Insert the longer bared end of the green wire through the #8 lug and connect it to lug #7. Solder both lugs. Connect the red wire to lug #6. (S).
- 5 Prepare another 14½" green wire with 3/8" stripped from one end. Prepare one end of a 14½" black wire. Do not strip the other end. Prepare another 14½" red wire. Start with the longer green wire end ¼" longer than the red wire, and the bare end of the black wire ½" shorter than the red wire. Twist these together as before. Insert the longer end of the green wire through lug #3 of the phone jack and connect it to lug #4. Solder both lugs. Connect the red wire to lug #2. (S).
- 6 Select the power switch and two #4 screws. Install the switch above the headphone jack so that the body of the switch is offset to the outer edge of the panel.
- 7 Select the main PC-14 circuit board assembly, with the fuse in place, and the rear bracket installed, and a rubber grommet in the bracket. Select the 6 larger nuts and washers for securing the controls to the front sub-panel. The two largest sets are used for the selector switches; the volume control is the smallest size, next to the power switch; the 3 other sets go on the 3 central control shafts. Be sure all the locating lugs on the controls engage the holes in the panel before securing the hardware. The wires from the phone jack go under the board. Push the ends of the wires through the grommet.
- 8 Select the small circuit board assembly PC-13 and two #4 screws. With the circuit board uppermost, position the assembly at the top of the large front panel opening so that the sockets on the board align with the pins from below, and plug the board downward onto the pins. Make sure each pin is properly engaged. Secure the assembly with screws through the panel.

Set the front panel aside, and select the PC-12 circuit board. The front of the board marks the component locations, and "J" designations. Most components mount on **the front**. Always install them tight against the board, and solder each lead on the **back** (circuit) side. Then cut off all excess leads.
- 9 Select the two 22,100 ohm resistors (red, red, brown, red) and install them at locations R50 and R150.
- 10 Select the two 1,100 ohm resistors (brown, brown, black, brown) and install them at R21 and R121.
- 11 Install the four 1 megohm resistors (brown, black, black, yellow) at locations R22, R23, R122 and R123.
- 12 Select the two 4-pin molded sockets. These are to be installed at locations J26 and 5126 on the front of the board, with the pins through the upper row of holes (arrow) at each location. The lower row of holes provides access from the rear of the board for plug-in capacitors. Be sure correct alignment of the socket, insert a capacitor lead from the rear into holes E, F, G and H to engage the sockets while you solder the pins, and then remove the capacitors. Be sure solder flows freely around each mounting pin for a good connection. Sometimes these pins do not accept solder easily.
- 13 The proper way to install the 24 phono input sockets is to first insert a phono plug (on the end of one of the audio connecting cables supplied in the kit) so that the center contact will not be deformed in the mounting process. Adjacent to the center hole for

each socket, the board is marked to indicate the side of the hole on which the center mounting tab should be positioned, so that it will be soldered to the widest part of the circuitry on the back side. Leave the phono plug in the socket while bending and soldering is completed. If you do not bend the center tab quite flat against the board, it is easier for solder to flow under the tab for a good connection. Solder both outer socket lugs first (they need not be bent over), and then the center tab on each socket. At J9 be careful that a solder bridge is not made between the center contact and the adjacent circuit track. Be sure holes Q and S are not filled with solder when installing sockets J 11 and J 11 1. A wooden toothpick will keep them open.

14 Select the two right angle 15-pin plugs, and install their shorter pins at locations J22 and J24 at the top of the board, so that the bent pins point toward the upper edge. Be sure these sockets are tight against the board, and make certain that every pin connection is properly soldered. Examine each connection closely to make sure there are no solder bridges between the tracks.

15 Prepare a 1" piece of green wire, and form it into a 1/2" wide "U". This wire connects on the back of the board between holes A and B. Allow this wire to sit a bit above the board, as it is a jumper which you may wish to remove at some future date, if you install a pre-preamplifier for a moving coil cartridge. After soldering be sure you cut off any excess wire on the front, so it cannot short to the input socket.

16 Prepare a 1" piece of red wire, and form it into a "U" as before. Connect it in like manner to holes C and D on the back of the board.

17 Select the two 10,000 pF capacitors and install them on the front of the board at locations C1 and C101.

18 Select the 2 long bright screws, the 2 lockwashers, and two of the spacers. Place a lockwasher over each screw first, and insert the screw from the back (circuit side) of the board into one of the mounting holes next to the rear jumpers. Add a spacer on the components side, and tighten it. Set the completed board assembly aside.

19 Select the back panel, the AC line cord, and the plastic strain relief. Separate the two conductors at the end of the cord for 2". Cut 3/4" off of one conductor. Strip both ends the usual 1/4", and tin the strands to secure them. Six inches from the longer end make a sharp V in the cord by bending it back on itself. Install the strain relief as shown in the drawing. The small end of the strain relief is nearest the stripped ends. Crimp the two halves of the strain relief together around the cord with heavy pliers to partially form it before insertion into the back panel.

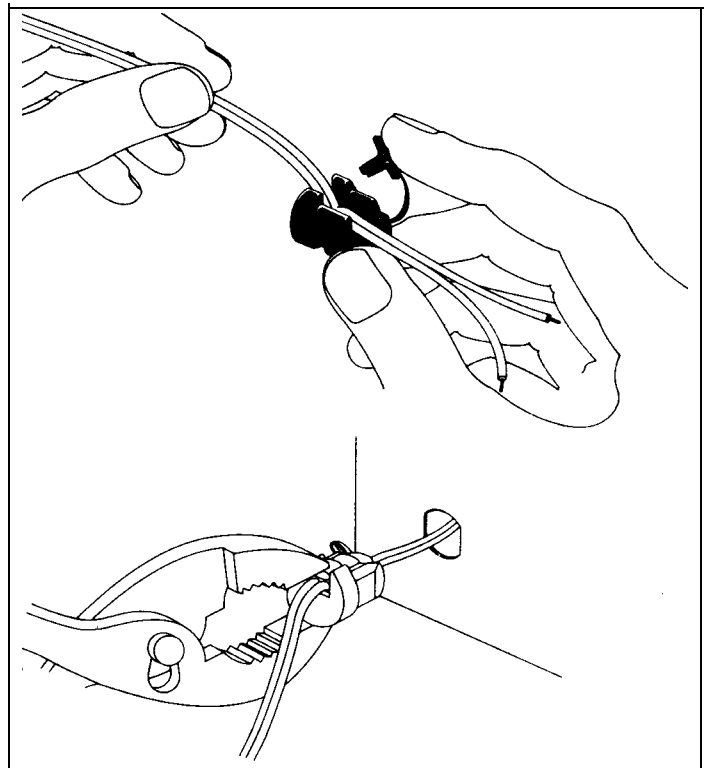
Then grip the larger portion of the strain relief with the tips of the pliers, squeeze it tightly, and insert the end of the cord and the strain relief through the panel hole from the outside. Note that the hole has a flat on one side, and the strain relief is installed so that the cord is horizontal.

This is the most difficult step in the kit. Patience, and a friend's help, if available, will make this job easier. Safety requirements dictate that this be a tight fit. Some persons might find it helpful to bolt on a side piece (with the flanges out) to add rigidity to the back panel, as well as a support to press against the back panel while you squeeze the strain relief and pull the line cord through. The fixture snaps into position when it is fully inserted. Remove the side piece if you attached it.

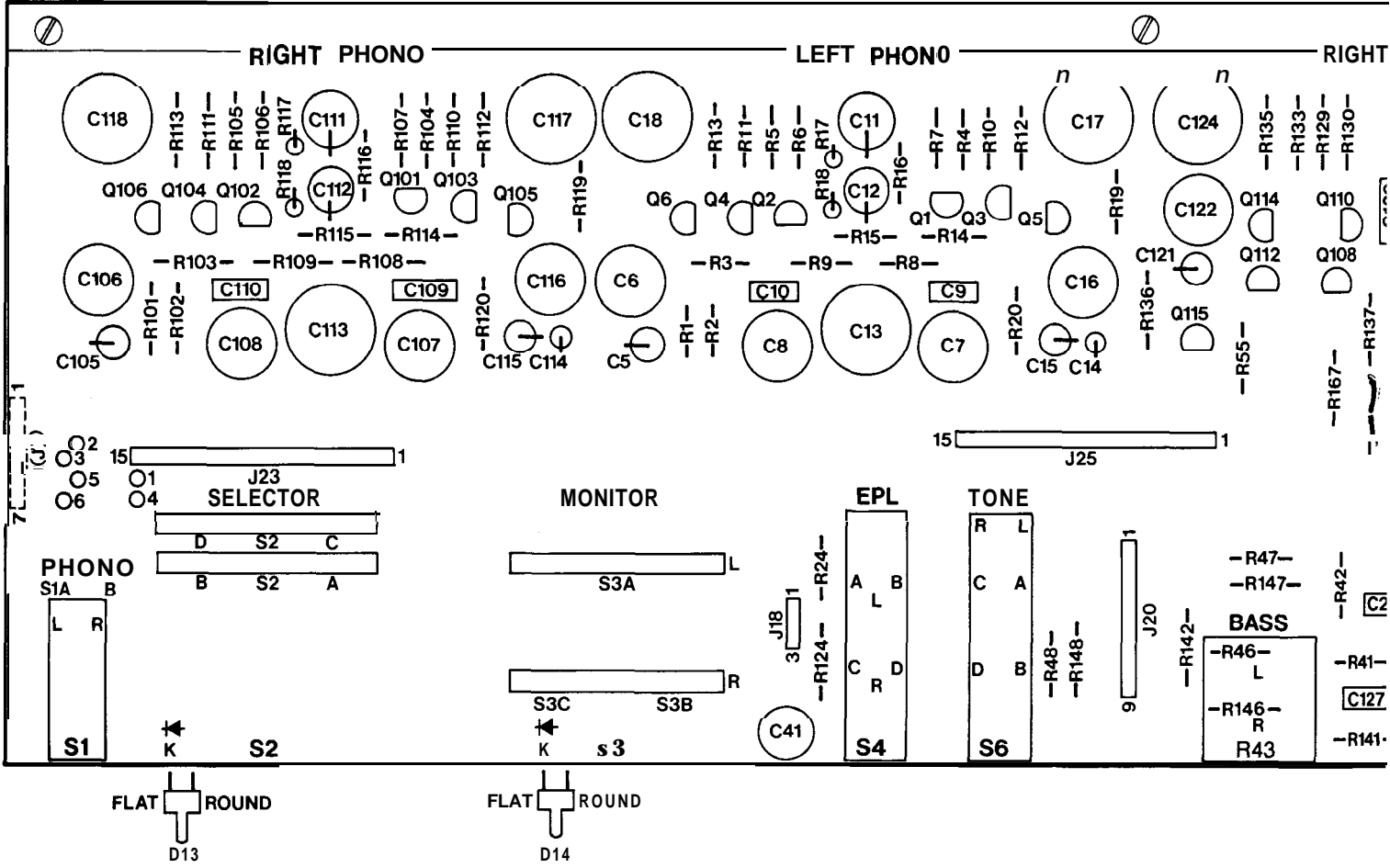
20 Select the power transformer and 2 sets of #6 hardware. Install the transformer next to the line cord so that the leads are in the lower corner below the strain relief.

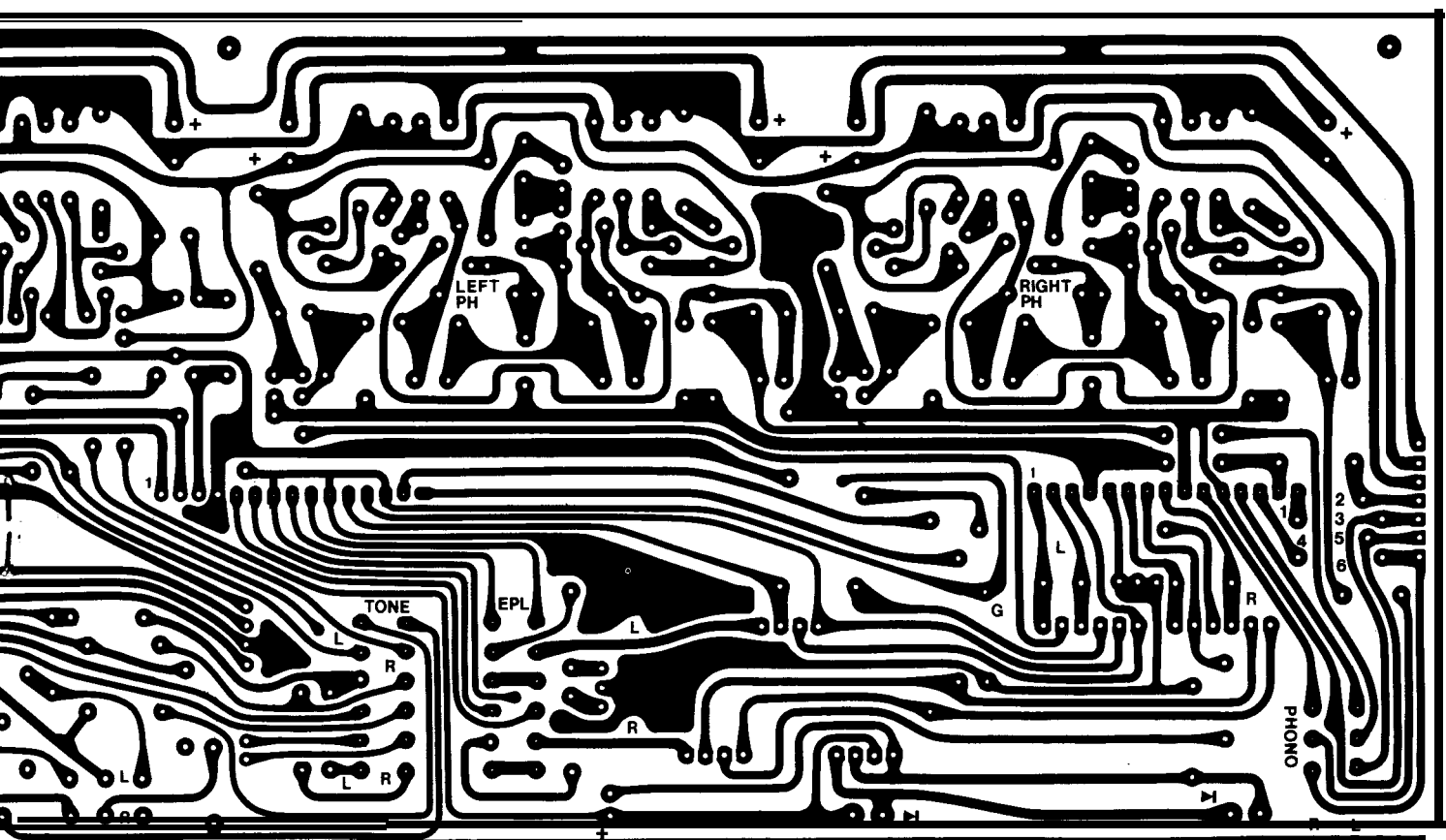
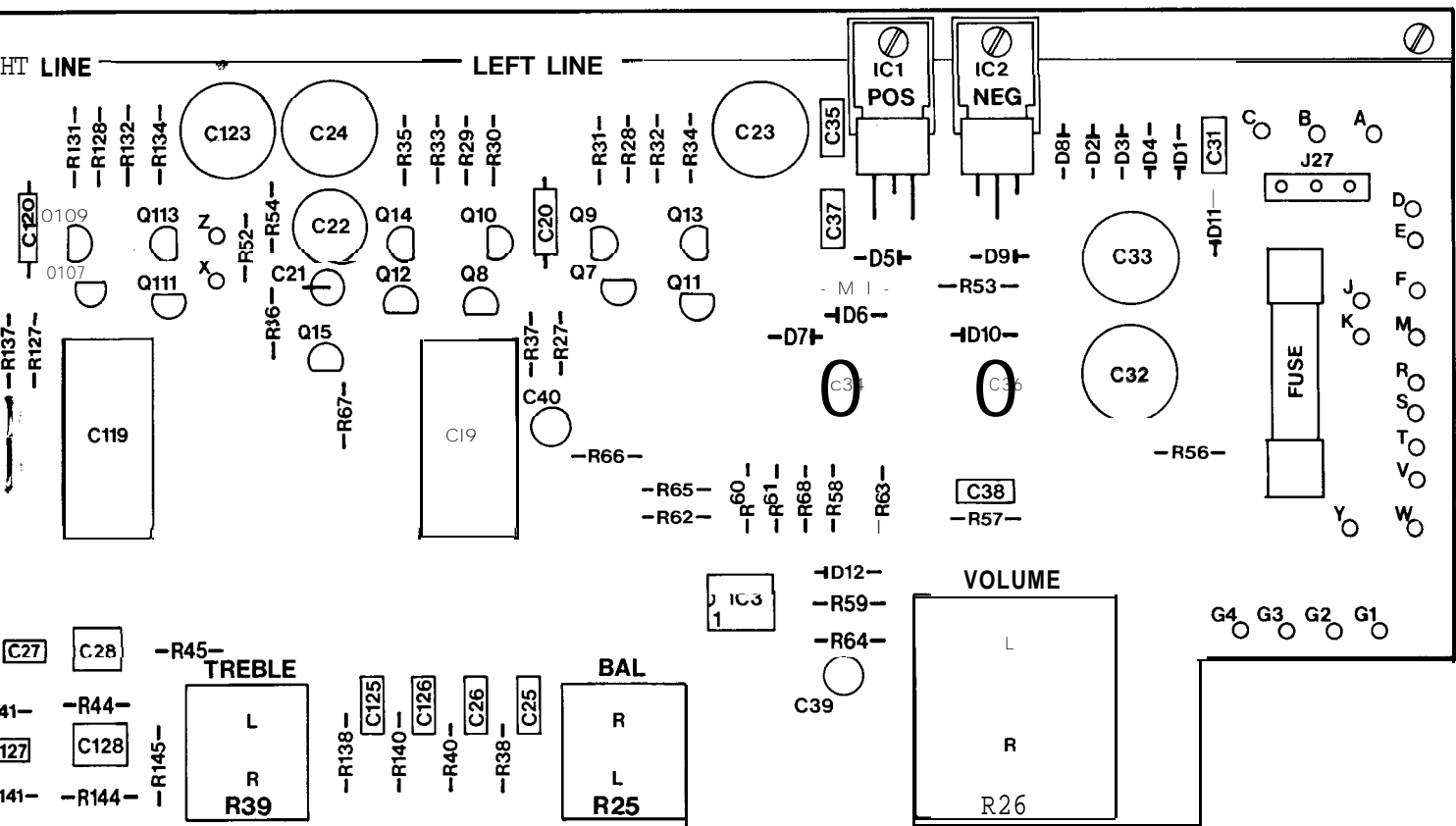
21 Select the 4 AC sockets. Snap these into the back panel holes from the outside.

22 Select the PC-12 circuit board assembly and the 2 flat cable interconnecting assemblies. Plug one end of each cable onto the pin connectors at the top of the board so the cables extend past the back of the board. The marked edge of the cable is not significant. Now check socket J1 to make sure it does not contact the stub of wire at hole A.



- 23 Select the 6 black 5/8" screws, the 6 spacers, and 6 small nuts. Insert the screws from the outside of the back panel at the locations nearer the center of the panel (not in the end holes marked "Grounds"). Install a spacer on each screw and tighten them. Place the PC-12 assembly in position so that its two screws pass through the end holes. Install the nuts on the black screws, and tighten them.
- 24 Select the 2 small nuts and the 2 knurled thumb nuts. Install a nut on each of the Ground screws, making sure the lockwasher surface is tight against the panel. It must cut through the painted surface to make a chassis ground connection. Then add the thumb nuts.
- 25 With a pair of pliers, carefully twist the 8 lugs on the AC outlets counter-clockwise 1/6 turn, or about 60°. This will enable a wire to be passed horizontally through these lugs.
- 26 Cut a 2/4" piece of the bare buss wire. Slide it through lug #2 of AC outlet B and connect it to lug #1 and to lug #3. Solder lugs 1 and 2.
- 27 Cut a 3/8" length of bare wire. Slide it through AC outlet lugs #6 and #7, and connect it to lug #5 and to lug #8. Solder lugs 5,6 and 7.
- 28 Prepare a 13" length of white wire. Connect one end to AC outlet C, lug #3. (S-2). Place this wire over the top of the transformer.
- 29 Prepare a 13" blue wire. Connect one end to outlet D lug #4. Place this and the following wire over the transformer.
- 30 Prepare a 12 1/2" length of yellow wire. Connect one end to outlet D lug #8.
- 31 Select the two side pieces, the rubber grommet, and 4 sets of #6 hardware. Install the grommet in the side piece location adjacent to the power transformer when the flanges bend towards the outside of the unit. Before bolting this piece in position, pass the line cord through the grommet from the outside, and under the transformer. From the inside thread the 3 wires which come from the AC outlets and over the top of the transformer out through the grommet. Fasten both side pieces to the back panel.
- 32 Connect the shorter line cord conductor to outlet D lug #8. (S-3). Connect the other conductor to lug #4. (S-2).
- 33 Join the front and rear halves of the preamp so that the tabs on the main board rear bracket are outside the side pieces. Select 2 sheet metal screws and fasten the bracket tabs to the side pieces.
- 34 Plug the two flat wire assemblies onto the pin connectors on PC-14.
- 35 Prepare a 1% piece of white wire. Connect one end to the rear lug of the power switch. (S). Connect the other end to eyelet Y of PC-14, nearest the fuse. (S). All eyelet connections should be soldered on the bottom of the board for secure connections.
- 36 Select the white wire from the tear grommet. Connect it to eyelet W on PC-14. (S).
- 37 Select the blue wire from the grommet. Connect it to the side lug of the power switch. (S).
- 38 Select the yellow wire. Connect it to eyelet T on PC-14. (S).
- The transformer leads may be shortened as desired for neatness, but if there is any possibility that the transformer may be connected for a different line voltage for use outside the USA, be sure to leave each lead long enough for any alternative connection. We suggest that these leads be made just long enough that they can be twisted together for neatness, and placed outside the end piece where they can be later secured with a wire tie.
- 39 Connect the Red-Yellow lead to eyelet A in the tear corner of PC-14. (S).
- 40 Connect the two Red leads to eyelets B and C along the rear edge of the board. Solder both.
- For 120 volt wiring as in the USA, the following lead connections are to be used. Refer to the alternative line voltage diagrams in the manual for other line voltages.
- 41 Connect each lead as follows and solder:
Brown/White to eyelet D
Black/White to eyelet E
Brown/Red to eyelet F
Black/Red to eyelet M
Brown to eyelet R
Black to eyelet S
- 42 Connect the short black wire from the forward lug of the phone jack to eyelet G2. (S).
- 43 There are two groups of wires connected to the phone jack under PC-14. The red and green wires which connect to lugs 2 and 3 (these are the lower lugs, adjacent to the circuit board edge) are to be connected to the upper (left channel) holes P and Q on the back panel circuit board PC-12, adjacent to the line outputs. Make certain you have the correct group. The black wire is not connected to the board. Instead, keep it twisted with the other wires until it is close to the board, then wrapped tightly around the red and green pair. Make sure no bare wire protrudes from the black insulation. Connect the red





wire to hole Q, which is between the center lugs of J11 and 512. (S). The wire should not protrude significantly beyond the front surface of the board to avoid coming in contact with a connector. To assure a good solder connection, bare wire should be visible on the circuit side of the board. Connect the green wire to hole P in like manner. (S).

- 44 At the rear of the phone jack, connect the black wire from the first group (lugs 2 and 3) to PC14 eyelet G3. (S).
- 45 Select the other group of three wires, and connect the black wire to PC-12 hole T. (S). Connect the red wire to hole S between J11 and J112. (S). Connect the green wire to hole R. (S). Make sure the wires do not protrude significantly beyond the outside surface of the board.
- 46 Connect the black wire of the second group to PC14 eyelet G1. (S).
- 47 Select the 2 red LEDs. To install these with correct polarity, observe the tiny 'flat' on the LED flange which marks the cathode lead. This must be towards the rear end of the PC-14 board, or Phono switch S 1, when the LED is attached to the front, near the edge. When the nipple of the LED is pointed toward you, with the flat on the left, bend the leads (together, with long-nosed pliers) upward at a right angle, so the bend will be 7/10" from the back surface of the LED (about 3/4"). Solder the LEDs to the front holes on the under side of PC-14 with the bent portion of the leads emerging on the top side. Each LED protrudes through the front sub-panel hole. Solder both leads on each LED.
- 48 Cut two 1/2" lengths of the black plastic shrink tubing. Slide a piece of tubing over each LED from the front, so only the nipple of the LED protrudes. Shrink the tubing around the LED body by holding a lighted match near the tubing. This will prevent back light from reflecting on the sub-panel.
- 49 Select the two flat knobs, 2 set screws, and the smaller L-shaped Allen wrench. Place a screw on the end of the wrench and thread it into each knob. Install these knobs on the switch shafts above the LEDs. The set screw should engage the flat on each shaft.
- 50 In like fashion install the remaining set screws in the 4 round knobs, and fix them to the flatted shafts on the other controls.
- 51 Taking care not to use excessive force, install the 6 black pushbuttons on the switches.
- 52 Select a pair of end caps-either the standard ones, or those for rack mounting-and the black front panel extrusion. Place the front panel in position, taking care to insert the LEDs into their holes, and check for sufficient clearance around each knob. It is possible to shift the phone jack bracket slightly, or the mounting of an individual control (by resoldering) if necessary for correct alignment. Slip each end

cap into the slots of the front panel. Select the 4 cap screws and nuts, and secure the end caps with the large Allen wrench.

- 53 Install the appropriate loading capacitors at the pairs of holes identified E, F, G and H below the phono input sockets on the back panel board. The correct choice is discussed in the Additional Information section of this manual. In lieu of more specific information, we suggest the 120 pF values at E and G for Phono 1, and the 220 pF values at F and H for Phono 2. Bend one lead around the capacitor so it is parallel with the lead at the opposite end. The leads should extend more than 1/8" from the body, but must not be longer than 3/8", or they might touch the metal back panel. Plug each into adjacent pairs of holes.

Now check to make sure that there are no strands of power transformer leads, or the line cord, that are unsoldered. **Where the line cord passes under the transformer, make sure it is clear of the screw hole in the back panel flange.** Check that a 1/10 ampere (100mA) fuse is installed in the PC-14 clips, and that the Red/Yellow transformer lead connects to the corner eyelet A.

- 54 A wire tie can secure the transformer leads to the side piece through the slot behind the PC-14 bracket. These ties can be used only once, and lock securely when the tail is pushed through the head end from the flat side. Cut off the excess after pulling it tight.
- 55 The two groups of output leads from the phone jack should be positioned at least 1" in from the side piece, and straight to the rear of the PC-14 board; then kept close to the bracket. A wire tie is suggested at the rear corner. You may wish to use the 3rd tie on the wiring to the AC sockets, or on the output leads near the back panel.
- 56 With 6 of the sheet metal screws, install the bottom plate. The 2 large holes should be near the phono inputs at the rear.
- 57 Place the 4 rubber feet in the corners of the bottom plate. They are self adhesive when you remove the paper backing.
- 58 Slide one piece of the U-shaped long plastic grommet onto the top flange of the front sub-panel. The other piece goes on the top flange of the back panel.
- 59 Check to make sure that the flat ribbon cable assemblies are up close to the top of the unit, away from the circuit board, and slide the cover on from the rear. Secure it with the 4 sheet metal screws.
- 60 Affix the self adhesive serial number label to the center rear of the bottom.

You may wish to secure the smaller Allen wrench for the knobs to the bottom of the unit with tape.

IF A PROBLEM ARISES

If neither LED lights when you first turn on the power switch, turn the unit off immediately. Check the fuse. Check the polarity of the LEDs. Check the power transformer wiring for proper connections for your line voltage. Look for a short caused by a stray strand of wire, or for a solder splash on the circuit board. A print of the circuit pattern in this manual enables you to check out a doubtful connection which might include a solder bridge.

If there is no audio output, is the monitor switch OFF? Is the EPL switch OUT? Is the wiring of the phone jack correct? Are the plugs seated properly on the flat ribbon cables-not offset by one pin? Is the Phono pushbutton switch in the correct position? Check the PC-12 for a solder splash between the circuit paths. A sharp knife can correct that.

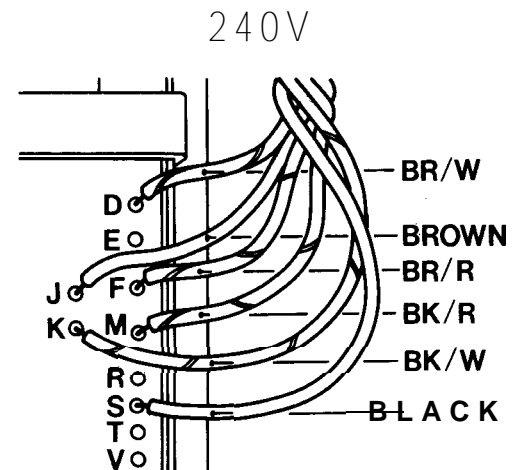
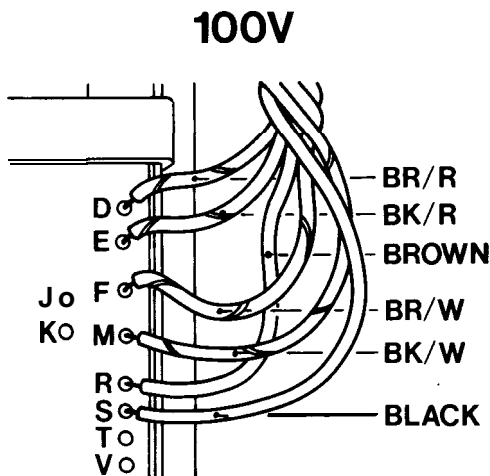
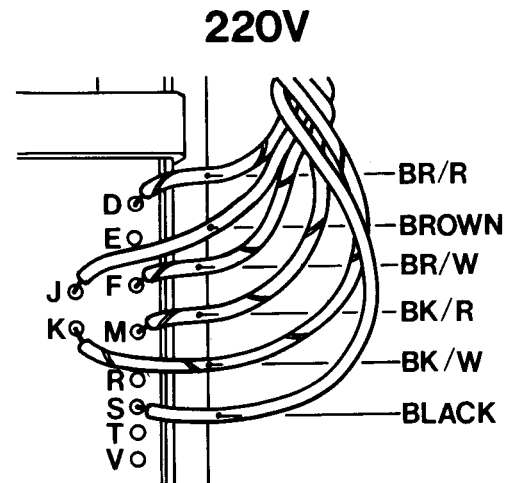
If there is noticeable hum; turn off the unit and reverse the line cord. Make sure the preamp is not too close to the power amplifier (or that the turntable is not too close, either). Check for a defective connecting cable, or turntable ground wire. Inside the preamp, the screws for the thumb nut ground connections must be tight, both to the PC-12 board, where the lockwasher under the screw head contacts the circuit ground, and to the back panel, where the lockwasher must break through the paint to the metal. Also, the PC-14 rear bracket mounting screw near the power transformer must be tight for a good ground contact.

A spare 1/10 ampere slo-blo fuse is supplied with the kit. A larger value fuse will not provide protection in the event of a fault. If the replacement fuse blows, the unit should be returned to the factory for competent service.

AC LINE CONNECTIONS FOR OVERSEAS USE

The power transformer supplied with the DH-110 has dual tapped primary windings. By arranging these two windings in various series-parallel combinations, line voltages of 100,120,200,220 and 240 volt 50/60 Hz lines can be accommodated.

The diagrams below show the connections for alternatives to the 120 volt connections shown on the pictorial diagram. When connected for 200-240 volt lines, the line fuse should be changed to 1/16 ampere (60 mA) slo-blo.



ADDITIONAL INFORMATION

RACK MOUNT END CAP INSTALLATION

Every DH-110 is supplied with front panel accessory end caps which adapt it to a standard 19" rack panel, and with a 5/32" Allen wrench which fits the mounting screws.

Remove all power and signal connections from the DH-110. On a protected surface such as a towel, remove the two cover screws on each side of the bottom, and slide the cover back. Remove the screws in each corner of the front panel. Exchange the end caps—they slide outward. If you are careful, you will not dislodge the LEDs from the panel. Replace the cap screws and nuts only finger tight at first. Check the alignment of the panel around the knobs before tightening fully. Then replace and secure the cover.

PHONO CARTRIDGE CAPACITOR LOADING

The cartridge manufacturer usually specifies in their instructions the optimum 'load' or termination for the cartridge. The needed capacitance is expressed in picofarads (pF). The DH-110 is supplied with pairs of two values of capacitors plugged into the sockets behind the rear circuit board at the Phono inputs (one for each channel). One of these values is likely to accommodate the majority of available cartridges with most high quality connecting cables within the accepted tolerance of $\pm 50\text{pF}$. If no information is available, we suggest first trying the 120pF which is installed in the Phono 1 input.

The total capacitive load is the sum of three numbers:

Turntable cable capacitance (from its manufacturer)
+ Preamp input capacitance (DH-110 = 30 pF)
+ Compensation capacitor (value you desire)
= The specified load (from the cartridge manufacturer)

You need to know the cable capacitance, from either the turntable maker, or the cable supplier, if they are separate. Unfortunately, this is not always readily available, and it can vary widely, but lower capacitance cables invariably are more expensive. If you must guess, use 60pF per foot. If your turntable accepts plug-in cables, you can usually overlook its internal wiring capacitance, as it will likely be within the 50pF tolerance. Short cables are desirable because total cable capacitance can itself be higher than the total specified load. The lowest you can go in compensation is to leave that capacitor out. It is why a good preamp design has a low input capacitance.

As an example: Recommended cartridge load= 320 pF

The turntable has a three foot cable, and they say it is 60pF/foot. Subtract $3 \times 60 = -180$

So far we still need 140 pF
Subtract the DH-110 input capacitance = **-30**

Compensation capacitor required =110 pF

This is close enough to the 120pF supplied that Phono 1 can be used without change.

If you require new capacitors, we suggest that you purchase, if possible, either polypropylene or polystyrene types. These premium grades have been selected for all critical circuits in the DH-110 because of their superior audio performance. Their leads should be formed like those presently installed, and they must extend at least 1/4", but not more than 3/8" beyond the capacitor body to avoid a short circuit to the back panel.

Some fastidious users prefer to solder the compensation capacitors in place once a final value has been determined, to preclude any less-than-perfect socket contact as time passes.

PHONO CARTRIDGE RESISTIVE LOADING

As supplied, the phono load resistance of the DH-110 is 46.55K ohms, which is accurate loading for most cartridges. This value may be changed if need be, by replacing R1 and R101 on the main circuit board. See the board diagram in the center of the manual.

The input resistance is determined by the parallel combination of R1 (101) and R2 (201), each of which is 93.1K ohms (white, orange, brown, red). A different value of R1 (101) will change the desired load to the value RT in accordance with the formula:

$$R1 = \frac{-93.1}{1 - 93.1/RT}$$

To simplify, the following standard 1% values of R1 will provide desired loads RT as shown (all in Kohms):

R1 Value Kohms	Desired Load Kohms
11.3	10
17.8	15
24.9	20
34.8	25
44.2	30
56.2	35

Metal film type resistors are recommended for lowest noise.

MINIMIZING NOISE IN THE SYSTEM

Your choice of separate components is the right way to secure the best performance from a music system, but the wide-band characteristics and complexity of the best systems may also not conceal the introduction of ground loops and noise pickup-especially RFI (radio frequency interference). With exceedingly high quality equipment we may become conscious of distractions that would be ignored on a lesser level. Careful interwiring practice will greatly reduce the likelihood of such problems.

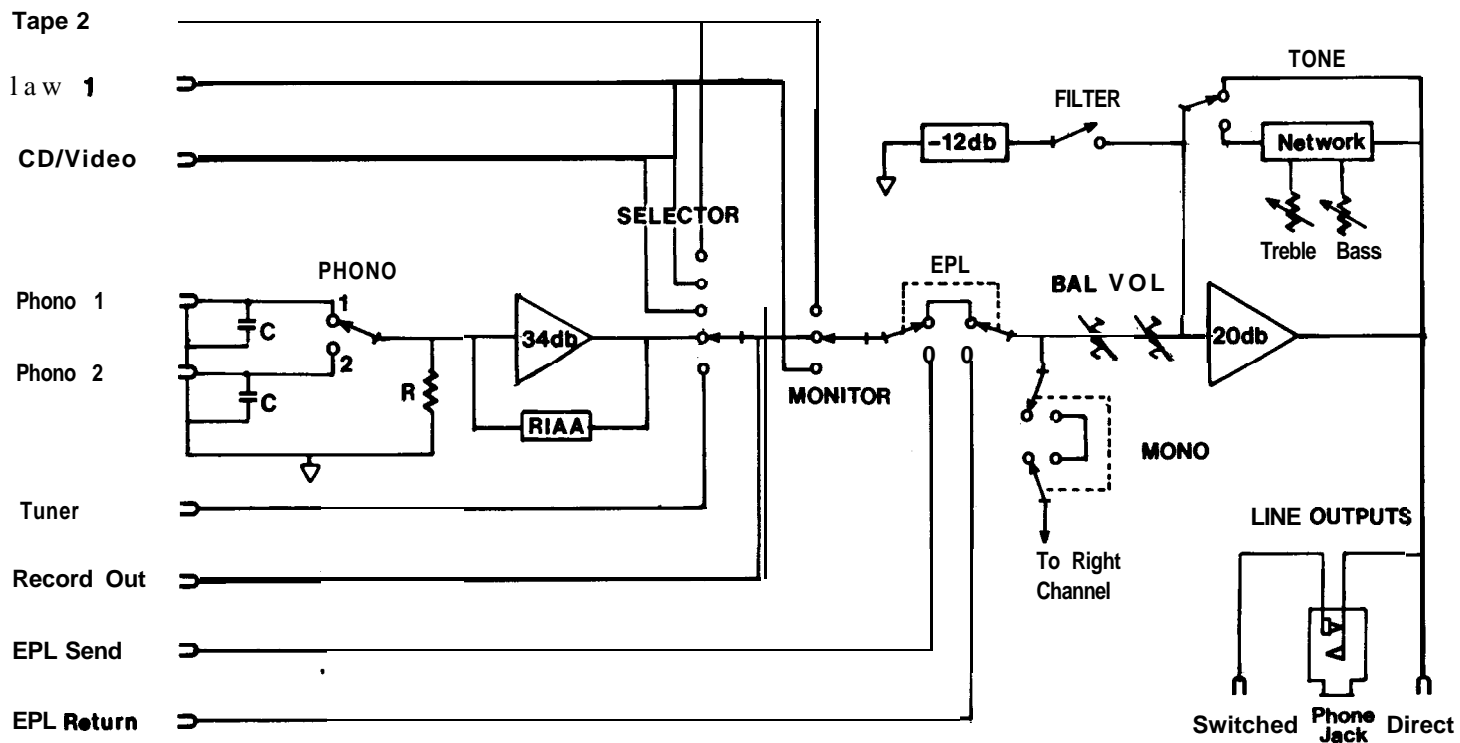
The DH-110 is a very quiet performer. There can be occasions where even the finest equipment exhibits hum or noise due to irregularities in its interconnection. The simple expedient of reversing line cord plugs will often reduce hum. Listen to the hum level after each change, reversing only one cord at a time.

CAUTION: Do not indiscriminately disconnect and reconnect a power amplifier when other components are turned ON. Use the DH-110 muting circuit for protection against loud noises. With the power amp connected to a switched convenience outlet on the DH-110, turn the preamp OFF, reverse the amplifier line cord, and then turn the preamp ON.

Use connecting cables of high quality, and treat them with care. Unplug cables by grasping the connector-not the cord-to maintain good connections. We have no evidence that special connector platings are required, but the surfaces should be free from grease, fingerprints, or any contaminate that may prevent a firm and complete connection. Some audiophiles are convinced that a good contact cleaner is an important adjunct to a high quality music system.

It does not usually reduce noise to connect each component to an 'earth' ground. This may even aggravate a ground loop problem, for good 'earth' grounds are hard to find, and unsatisfactory grounds are likely carriers of RFI.

The previous suggestions may also help reduce RFI. In difficult cases, RFI filters can be purchased for insertion between the line cord plug and the wall outlet, or a device called a ferrite bead may be installed in the phono stage by a competent technician. If you use a pre-preamplifier and find that it is RFI sensitive, increasing the cartridge compensation capacitor may help (moving coil cartridges do not require a specific value), or try connecting a 0.01 mfd capacitor across the phono input jack that feeds the pre-amplifier. Even for experienced engineers, RFI presents problems which often demand that they simply 'try and try again'.



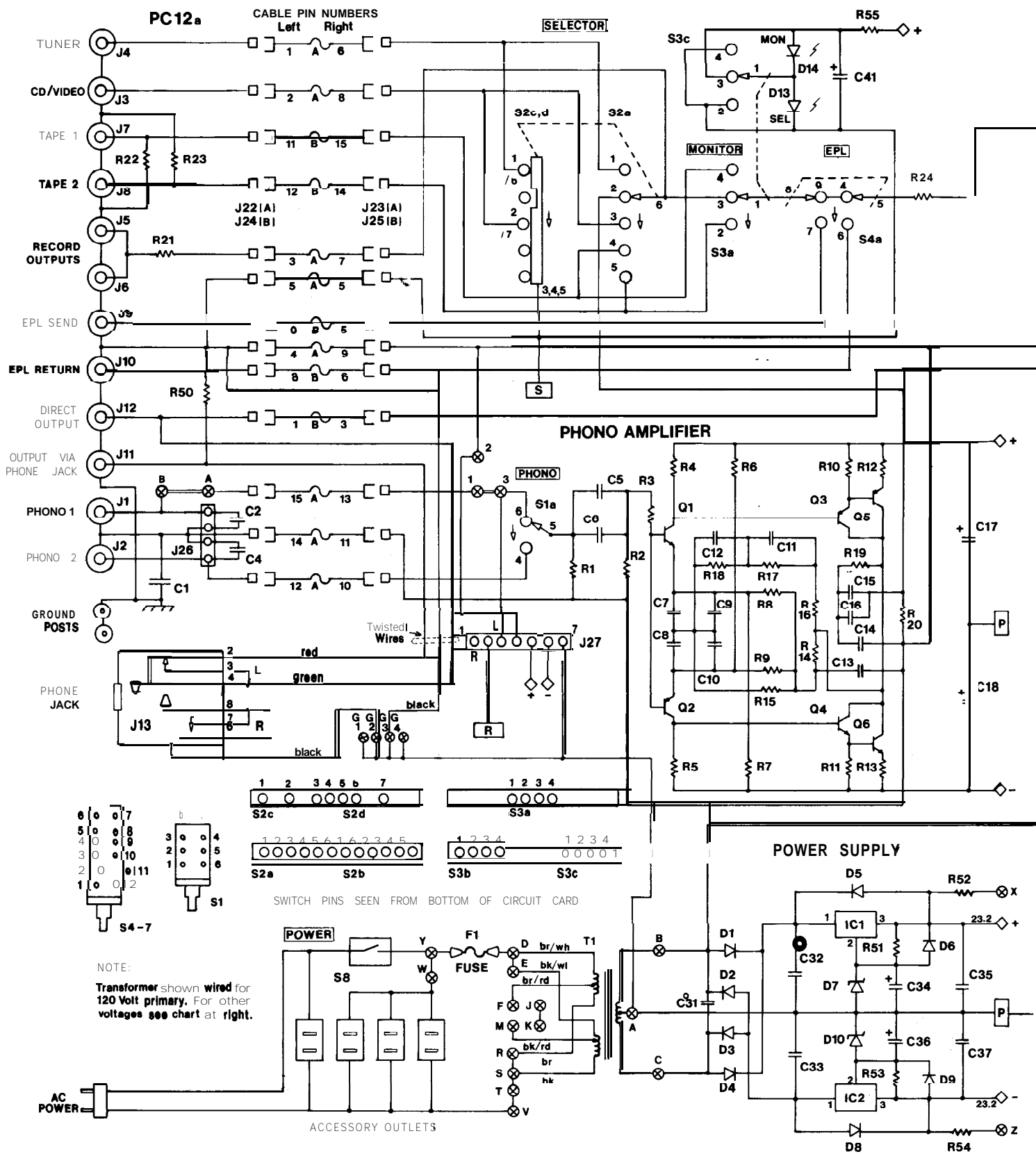
FUNCTIONAL BLOCK DIAGRAM

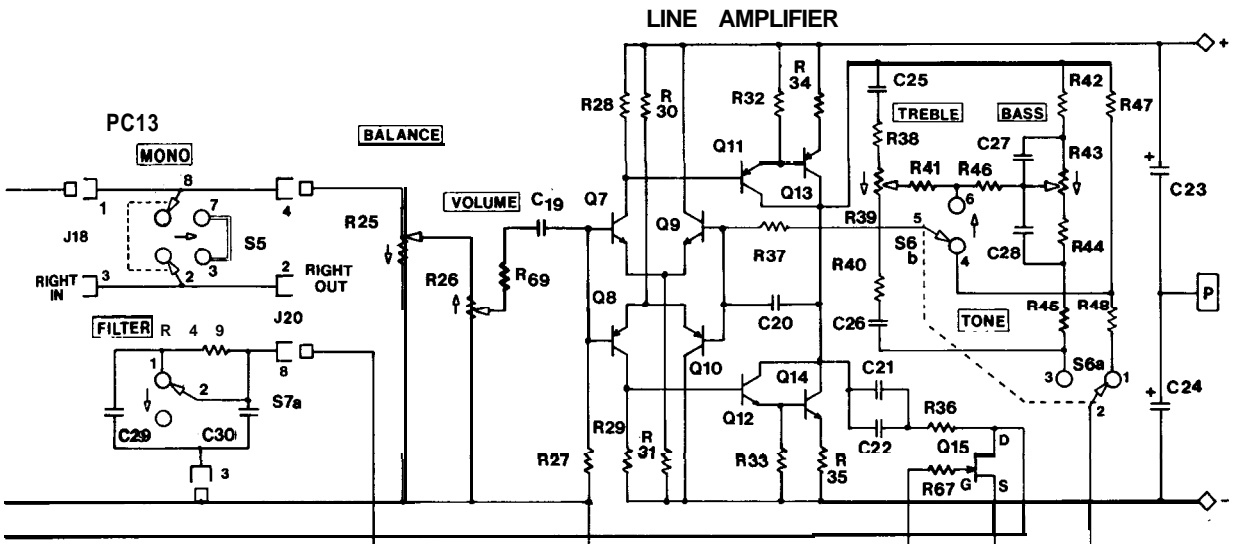
All resistors are 1/4 watt 1% Metal Film unless otherwise noted.

R1	93,100ohms	RM045
R2	93,100ohms	RM045
R3	1,100 ohms	RM025
R4	22,100 ohms	RM035
R5	22,100 ohms	RM035
R6	147,000 ohms	RM043
R7	147,000 ohms	RM043
R8	22,100 ohms	RM035
R9	22,100 ohms	RM035
R10	47,500 ohms	RM036
R11	47,500 ohms	RM036
R12	100 ohms, 1/2 w, 5% carbon film	RD121
R13	100 ohms, 1/2 w, 5% carbon film	RD121
R14	11,000 ohms	RM024
R15	301 ohms	RM014
R16	100 ohms	RM012
R17	147,800 ohms	RM043
R18	11,000 ohms	RM024
R19	499 ohms	RM018
R20	1 megohm	RM044
R21	1,100 ohms	RM025
R22	1 megohm	RM044
R23	1 megohm	RM044
R24	1,100 ohms	RM025
R25	100,000 ohms linear taper potentiometer (Balance)	RPO21
R26	50,000 ohms log taper potentiometer (Volume)	RPO29
R27	147,000 ohms	RM043
R28	17,400 ohms	RM027
R29	17,400 ohms	RM027
R30	82,500 ohms	RM046
R31	82,500 ohms	RM046
R32	47,500 ohms	RM036
R33	47,500 ohms	RM036
R34	100 ohms, 1/2 w, 5% carbon film	RD121
R35	100 ohms, 1/2 w, 5% carbon film	RD121
R36	316 ohms	RM015
R37	100 ohms	RM012
R38	11,000 ohms	RM024
R39	100,000 ohms inverse log taper potentiometer (Treble)	RP022
R40	4990hms	RM018
R41	1,100 ohms	RM025
R42	11,000 ohms	RM024
R43	100,000 ohms inverse log taper potentiometer (bass)	RP022
R44	316 ohms	RM015
R45	1,100 Ohms	RM025
R46	11,000ohms	RM024
R47	11,000 ohms	RM024
R48	1,100ohms	RM025
R49	1 megohm	RM044
R50	22,100 ohms	RM035
R51	270 ohms, 1/4 w, 5% carbon film	RC029
R52	1,800 ohms, 1/4 w, 5% carbon film	RC023
R53	270 ohms, 1/4 w, 5% carbon film	RC029
R54	1,800 ohms, 1/4 w, 5% carbon film	RC023
R55	4,708 ohms, 1/2 w, 5% carbon film	RC042
R56	470,000 ohms, 1/4 w, 5% carbon film	RC044
R57	470,000 ohms, 1/4 w, 5% carbon film	RC044
R58	39,000 ohms, 1/4 w, 5% carbon film	RC038
R59	10,000 ohms, 1/4 w, 5% carbon film	RC016
R60	2.2 megohms, 1/4 w, 5% carbon film	RC028
R61	680,000 ohms, 1/4 w, 5% carbon film	RC046
R62	270ohms, 1/4 w, 5% carbon film	RC029
R63	100,000 ohms, 1/4 w, 5% carbon film	RC017
R64	47,008 ohms, 1/4 w, 5% carbon film	RC043
R65	10,000 ohms, 1/4 w, 5% carbon film	RC016
R66	1,800 ohms; 1/4 w; 5% carbon film	RC023
R67	1,000 Ohms, 1/4 w, 5% carbon film	RC015
R68	1,000 ohms, 1/4 w, 5% carbon film	RC015
R69	4,640 ohms, 1/4 w, 5% metal film	RM034
S1	Phono Input Selector, DPDT	SPI 12
S2	Source Selector	SRI 12
s3	Monitor Selector	SR111
s4	EPL switch, 4PDT	SPI 13
S5	Mono switch, 4PDT (assembly)	SAI 16
s6	Tone switch, 4PDT	SPI11
S7	Filter switch, 4PDT (assembly)	SAI 16
S8	Power switch	SLI12

Rii channel corresponding values have designations above 100.

C1	10 nF, polypropylene, 50v	CP111
C2	120 pF, polypropylene, 50v	CP112
C4	220 pF, polypropylene, 50v	CP116
C5	10nF polypropylene, 50v	CP11
C6	22 mfd, NP ekctmlytic, 50v	CNI16
C7	220 mfd, NP ekctmlytic, 10v	CNI12
C8	220 mfd, NP ekctrolytic, 10v	CNI12
C9	15 nF, polycarbonate, 50v	CC123
C10	15 nF, polycarbonate, 50v	CC123
C11	25 nF 1%, polypropylene, 50v	CZ1 14
C12	6.8 nF, 1%, polypropylene, 50v	CZ115
C13	1000 mfd, NP ekctrolytic, 6v	CNI11
C14	1.5 nF, polypropylene, 50v	CP114
C15	10 nF, polypropylene, 50v	CP11 1
C16	22 mfd, NP ekctrolytic, 50v	CNI 16
C17	470 mfd, low ESR electrolytic, 25v	CL111
C18	470 mfd, low ESR electrolytic, 25v	CL111
C19	470 nF, polypropylene, 50v	CP118
C20	68 pF, polypropylene, 50v	CP144
c21	10 nF, polypropylene, 50v	CP111
c22	22 mfd, NP electrolytic, 50v	CNI116
C23	470 mfd, low ESR electrolytic, 25v	CL111
C24	470 mfd, low ESR electrolytic, 25v	CL111
C25	1.5 nF, polypropylene, 50v	CP114
C26	15 nF, polycarbonate, 50v	CC123
C27	47 nF, polycarbonate, 50v	CC114
C28	470 nF, polycarbonate, 50v	CC115
C29	4.7 mfd, NP ekctrolytic, 25v	CNI18
C30	47 mfd, NP ekctrolytic, 16v	CNI19
C31	100 nF, polycarbonate, 50v	CC125
C32	1000 mfd, electrolytic, 50v	CL124
c33	1000 mfd, electrolytic, 50v	CL124
C34	22 mfd, ekctmlytic, 50v	CL117
c35	100 nF, polycarbonate, 50v	CC125
CM	22 mfd, ekctrolytic, 50 v	CL117
c37	100 nF, polycarbonate, 50v	CC125
C38	47nF, polycarbonate, 50v	CC114
c39	4.7 mfd, NP ekctmlytic, 25v	CNI18
C40	4.7 mfd, NP ekctrolytic, 25v	CNI18
C41	22 mfd, electrolytic, 50v	CL117
D1	IN4003	QD115
D2	IN4003	QD115
D3	IN4003	QD115
D4	IN4003	QD1 15
D5	IN4003	QD115
D6	IN4003	QD115
D7	IN5251F 22v Zener, 1%	QD113
D8	IN4003	QD1 15
D9	IN4003	QD115
D10	IN5251F 22v Zener, 1%	QD113
D11	IN4003	QD115
D12	IN5240B 10v Zener, 5%	QD111
D13	LED	QD119
D14	LED	QD1 19
IC1	LM317T Positive Regulator	QB113
IC2	LM337T Negative Regulator	QB114
IC3	LM393 Dual Comparator	QB116
Q1	414C Transistor	QNI17
Q2	416C Transistor	QP117
Q3	416C Transistor	QP117
Q4	550B Transistor	QNI18
Q5	556B Transistor	QP124
Q6	546B Transistor	QNI26
Q7	550C Transistor seketed	QNI19
Q8	560C Transistor seketed	QP119
Q9	550C Transistor seketed	QNI19
Q10	560C Transistor seketed	QP119
Q11	560B Transistor	QPI18
Q12	550B Transistor	QNI18
Q13	560B Transistor	QPI18
Q14	550B Transistor	QNI18
Q15	J112 FET	QNI131
T1	Transformer, Power	TAI18
FI	Fuse, 1/10A Slo-Blo, AGC	SF022



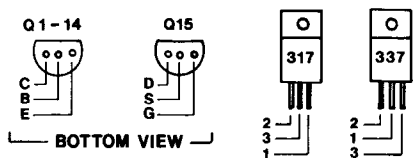
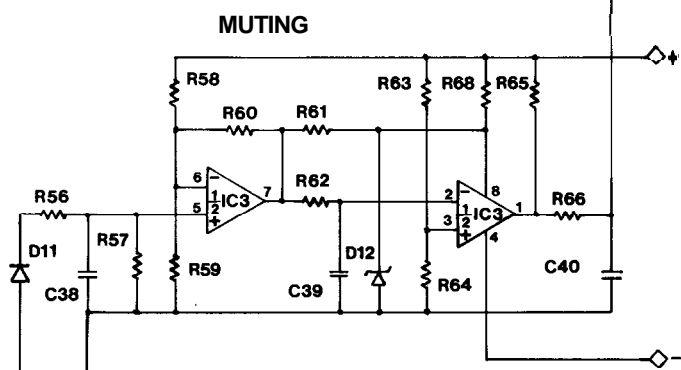


- CABLE PIN ASSIGNMENTS**
- J22 TO J23; A PIN**
- 1 AUX L
 - 2 TUNER L
 - 3 RECORD L
 - 4 LINE GND L
 - 5 SHIELD GND
 - 6 AUX R
 - 7 RECORD R
 - 8 TUNER R
 - 9 LINE GND R
 - 10 PHONO 2 R
 - 11 PHONO GND R
 - 12 PHONO 2 L
 - 13 PHOND 1 R
 - 14 PHONO GND L
 - 15 PHONO 1 L
- J24 TO J25; B PIN**
- 1 GUT LINE L
 - 2 SHIELD
 - 3 WT LINE R
 - 4 SHIELD
 - 5 EPL SEND R
 - 6 EPL RETURN R
 - 7 SHIELD
 - 8 EPL RETURN L
 - 9 EPL SEND L
 - 10 SHIELD
 - 11 TAPE 1 L
 - 12 TAPE 2 L
 - 13 SHIELD
 - 14 TAPE 2 R
 - 15 TAPE 1 R

SYMBOLS

	POWER SUPPLY GROUND
	SHIELD GROUND
	LEFT & RIGHT CHANNEL SIGNAL GROUND
	POWER SUPPLY RAILS
	CIRCUIT CARD LAND
	CHASSIS GROUND
	MALE CONNECTOR PIN
	FEMALE CONNECTOR SLEEVE
	SWITCH CLOCKWISE, DEPRESSED

TO RIGHT MUTE



POWER TRANSFORMER WIRING

PRIMARY VOLTS	100	120	220	240
BR/WH	F	D	F	D
BR/RD	D	F	D	F
BR	R	R	J	J
BK/WH	M	E	K	K
BK/RD	E	M	M	M
BK	S	S	S	S
FUSE	1/10A		1/16A	

DH 110 PREAMPLIFIER SCHEMATIC DIAGRAM 8-85

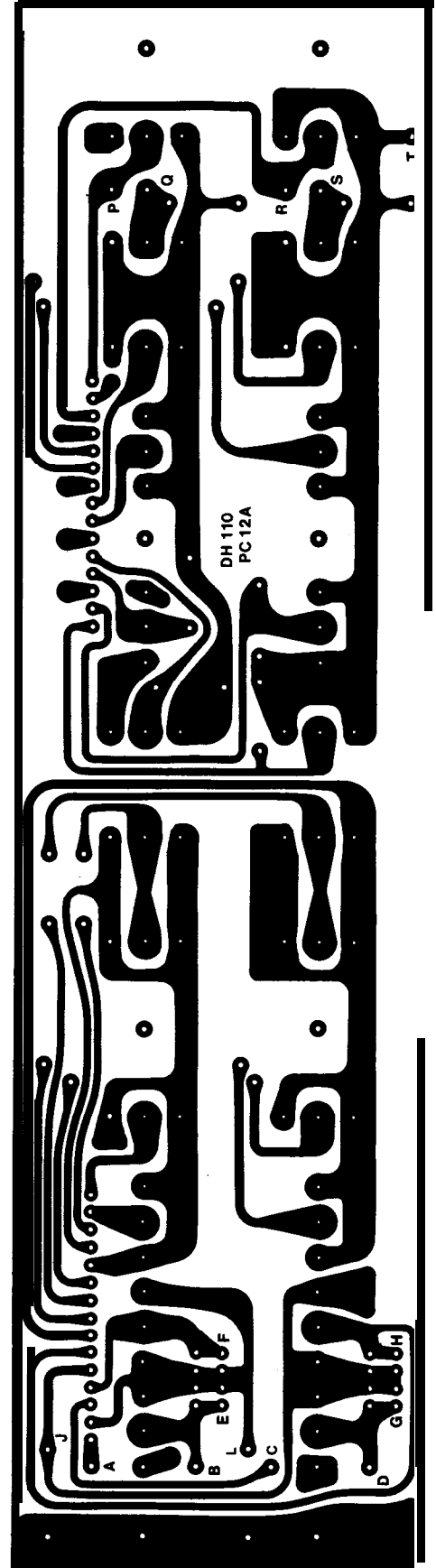
LEFT CHANNEL SHOWN TO Q15, S7, C30 AND R50.
LARGE CIRCUIT CARD IS PC14c

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Minor variations may sometimes be encountered in value or appearance. These will not affect performance. Some items may have been used to package the kit for shipment.

1	Cover, black	MS138
1	Bottom plate	MS137
1	Front Panel extrusion, black	MEI 14
1	Front subpanel	MS132
1	Back panel, black	MS136
2	Side piece	MS135
1	Power transformer	TAI18
1	PC-12A circuit board	KB037
1	PC-13 circuit board assembly	KF319
1	PC-14C circuit board assembly	KF346
2	Cable assembly, interconnect	WA011
1	AC tine cord	WA016
2	Grommet, U-shape plastic 12"	HR127
	Wire, red, 22 gauge	
	Wire, green, 22 gauge	
	Wire, black, 22 gauge	
	Wire, white, 18 gauge	
	Wire yellow, 18 gauge	
	Wire blue, 18 gauge	
	Wire, bare, 18 gauge	
	Bag #1	
2	Capacitor, 10,000 pF (0.01 uf)	CP111
2	Capacitor, 120 pF	CP112
2	Capacitor, 220 pF	CP116
2	Lockwasher, X4, external tooth	HW121
1	Nut, volume control, M8 x .75	HK114
2	Plug, 15 pin, right angle	XM019
2	Resistor, 1.1K ohms (brown, brown, black, brown)	RM025
2	Resistor, 22.1K ohms (ted, red, brown, red)	RM035
4	Resistor, 1 megohm (brown, black, black, yellow)	RM044
6	Set screw, #8 x 3/16"	HP122
2	Socket, 4 pin bottom entry	XM012
1	Washer, volume control, M8 flat	HW111
2	LED, red	QD119
1	Shrink tubing, 1"	HR135
	Bag #2	
10	Nut, 4-40 KEP	HK111
6	Nut, 6-32 KEP	HK112
4	Nut, 10-32 KEP	HK113
3	Nut, control shaft, M7 x .75	HK115
2	Nut, 3/8"	HK119
2	Lockwasher, 38"	HW118
6	Screw, 4-40 x 5/16"	HA113
6	Screw, 4-40 x 5/8", black	HP112
2	screw, 4-40 x 7/8"	HA1 14
6	Screw, 6-32 x 1/2", black	HP1 13
4	Screw, cap head, 10-32 x 1", black	HP1 14
12	Screw, sheet metal, #6, black	HP116
8	Spacer, threaded, 38" long	HZ112
2	Thumb nut, 4-40	HK122
3	Washer, control shaft, M7 flat	HW113
	Bag #3	
4	AC outlet	XA015
1	Bracket, phone jack	MS133
4	Foot, square plastic	HR134
1	Grommet, rubber	HR128
1	Nut, phone jack, M12 x I	HK117
1	Phonejack	XZ015
6	Pushbutton, black	HD121
24	Socket, phono input	XP01 1
1	Strain relief, black	HR144
1	Switch, power	SL112
3	Ties, wire, nybn	HR138
1	Washer, phone jack, M12.2 flat	HW1 19
	Bag #4	
2	End Caps, regular	MC111
2	Knobs, flat	HD118
4	Knobs, round	HD117
	Bag #5	
1	Audio cable pair	WA017
2	End Caps, rack mount	MC112
1	Fuse, 1/10 ampere Slo-Bo	SF022
1	Wrench, Allen, 5/32" cap screw	HZ138
1	Wrench, Allen, +8 set screw	HZ139

NON-COMPONENT (BACK) SIDE



SERVICE POLICY AND LIMITED WARRANTY

Your DH-110 Preamplifier has been carefully engineered to provide many years of use without maintenance or service. Factory assembled units undergo many physical and electrical tests before shipment. The circuit board in kits is similarly tested to meet all primary specifications before it is packed. Nevertheless, shipping damage can occur, or human error may intervene to make service necessary.

Because many of the components in this refined design are not readily available, and because substitution of apparently similar parts can easily compromise its performance, we strongly recommend that you make use of our complete factory service facilities, or order exact replacement parts from the factory.

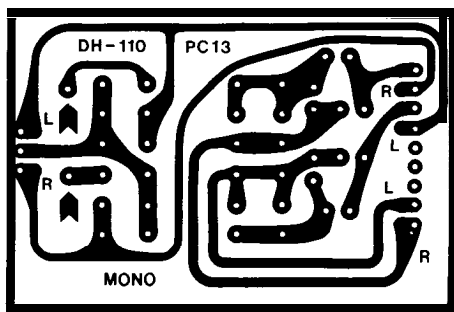
It is the owner's responsibility to return the unit, freight prepaid, to the factory service facility. *Units shipped freight collect will not be accepted.* Shipment should be made via United Parcel Service whenever possible. We will not be responsible for damage caused by parcel post shipment; repairs in this case will be made solely at the owner's expense. Be sure you insure for the full value of an assembled unit.

Use the original carton and packing materials, and enclose all of the following:

1. Complete shipping address (Post Office Box numbers are not acceptable for UPS return)
2. Serial number (if not on the unit).
3. Copy of dated bill of sale (for service under warranty)
4. Description of malfunction. If it is intermittent, please indicate this.
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 only to the original purchaser, and are void if the Preamplifier has been modified without factory authorization, or if parts have been substituted which, in the factory's opinion, are not suitable, or if the Preamplifier has been physically or electrically abused or used for some purpose for which it was not designed or intended.



Technical assistance to help you locate the source of a problem may be obtained by calling the Hafler Company Technical Service Department at 609-662-6084 between 8 am and 4:30 pm, eastern time. It will be helpful to know the serial number, 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. If you return a properly functioning Preamplifier for service or a checkout, a charge will be made for the checkout time required, as well as for packing and shipping.

WARRANTY FOR FACTORY ASSEMBLED UNITS

The assembled DH-110 is warranted for three years from the purchase date, including parts, labor and normal return shipping costs from the factory to the owner within the continental United States. The owner is responsible for shipment to the factory and must submit a copy of the dated bill of sale.

WARRANTY FOR KIT-BUILT UNITS

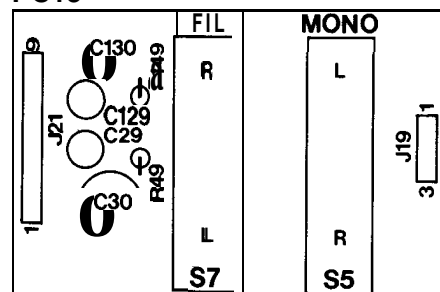
The parts in a DH-110 kit are warranted for a full year from the purchase date. If a defective component is found on a circuit board or in the kit, simply return the individual part to the factory prepaid, together with the serial number and the date of purchase. It will be replaced at no charge.

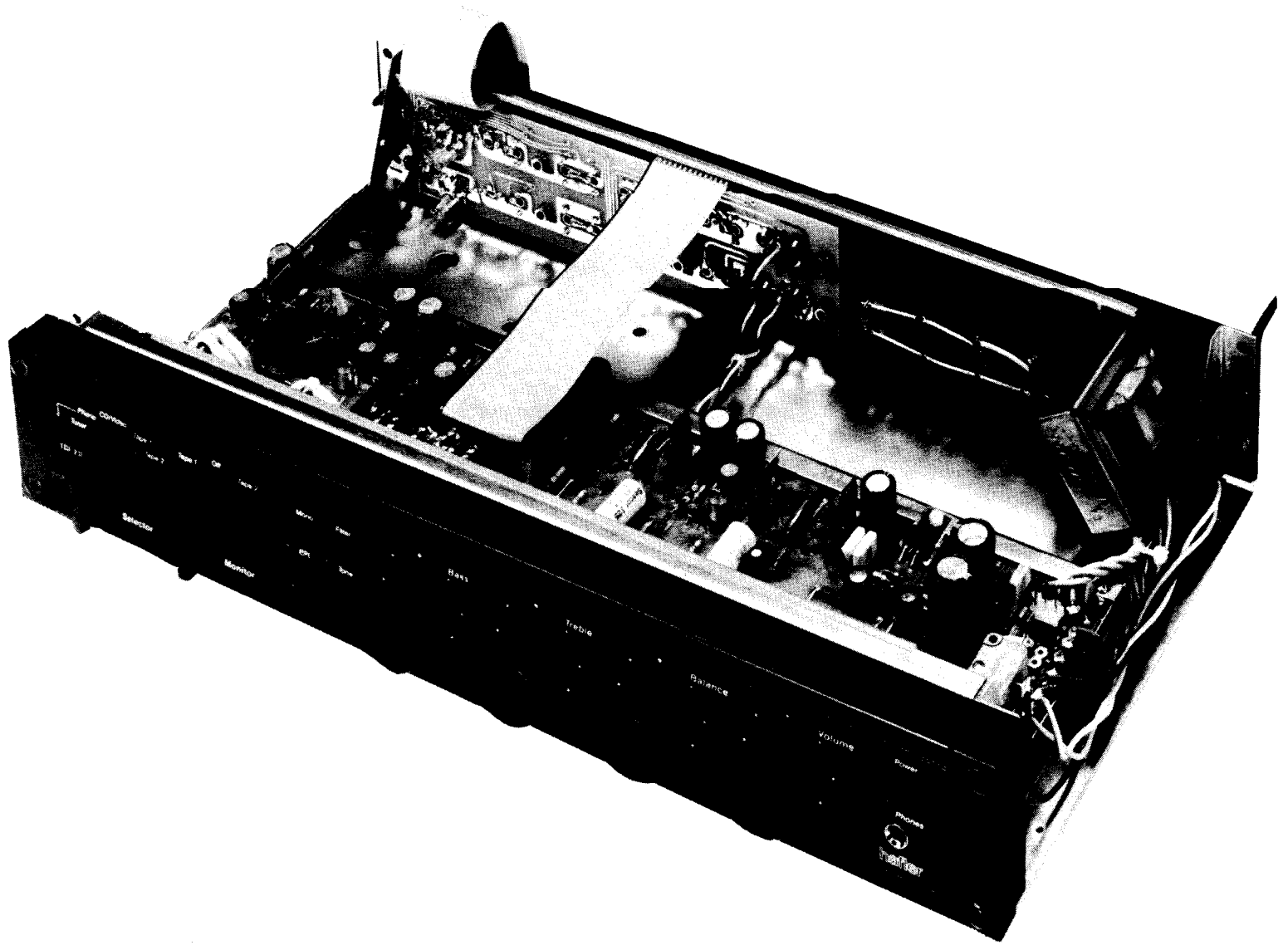
If you cannot locate the cause of a problem in your DH-110, return it to the factory along with a copy of the dated bill of sale, and a check for \$30. If the difficulty is solely a defective part, the unit will be returned to you prepaid, and your \$30 less shipping and packing charges will be returned to you. If the problem is found to be an error in your assembly of the kit, the unit will be put in proper working order and returned to you prepaid.

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 or silver solder, or paste flux, will be returned unserviced.

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

PC13





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