# SCOTT SOLID-STATE STEREO AMPLIFIER LK-60B <br> FULL COLOR <br> CONSTRUCTION BOOK 



1968 H. H. SCOTT, INC.

"Hermon Hosmer Scott is a soft-spoken man, with a down-East accent to which he is entitled. . . . We have been gratefully aware of him since 1947. He is the man who took the grit out of Grieg and the scratch out of Scriabin by inventing the Dynaural Noise Suppressor. . . . Scott has received many engineering citations, some for truly basic work in electronic measurement . . . yet he is honored and heeded most by his friends on the grounds of ethics and esthetics. This . . . is reflected in the clear reliability of his products. Scott . . . is terribly irritated by imperfections of any kind. He does not see why an amplifier or a tone arm should be ugly any more than a cello is. To this we owe a revolution since it was Scott who in 1953 gave us the Model 99 amplifier which did not need to be hidden.
. . . Everyone now follows this precedent, but it was Scott who established it, and the Scott musical gear still looks best of any."

## John M. Conly, Atlantic Monthly

Hermon Hosmer Scott received B.S. and M.S. degrees from M.I.T. Inventor of the RC Oscillator, RC tuned circuits and filters, the Dynaural Noise Suppressor and other devices, he has many U.S. and foreign patents. His technical leadership was recognized by election to Fellow in the Institute of Electrical and Electronic Engineers, Acoustical Society of America, and Audio Engineering Society, and by numerous

## HERMON SCOTT, Audio Pioneer

awards, including the Potts Medal. He is the author of many technical papers and articles.

## IMPORTANT FIRSTS . . . by H. H. Scott

- First high fidelity AM/FM tuner using wide band AM design.
- First successfully to use wide-band circuitry in high fidelity FM tuners.
- First integrated high fidelity amplifier.
- First to market an FM multiplex stereo tuner and adaptor employing the FCC-approved transmission system.
- First low, flat high fidelity amplifier.
- First usable multiplex output on tuner.
- First stereo balancing circuitry.
- First dynaural interstation noise suppressor.
- First wide-range consoles without acoustic feedback.
- First silicon transistor IF tuner.
- First Professional-quality transistor kits.
- First Solid State relay-less automatic mono-stereo switching that is free from false indication from noise between stations.

The H. H. Scott plant in Maynard, Massachusetts


# The Scott LK-60B Solid State Stereo Amplifier Kit 

Your new Scottkit represents an exceptional achievement. It was developed by the same engineering team responsible for revolutionizing the hifi component industry through the introduction of new concepts in circuitry, design and styling. It is the culmination of years of research and planning. When you have completed your Scottkit, you can be sure it is the equal of superb H. H. Scott factory-wired components. The quality of your finished kit is assured because: The same conservatively rated, factory-tested parts are specified for Scottkits as for Scott factory-wired components. Kits utilize time-tested Scott circuitry, redesigned to assure perfect performance after just a few hours of instructive work at home.

The Scott full-size, full-color instruction book is designed to make kitbuilding fool-proof. You can automatically correct any errors you may make.

Before a new Scottkit is marketed, it is completely pretested.

1. Instruction book drafts are hand colored for an evaluation run by many statistically selected consumers. This consumer panel consists of doctors, businessmen, office and factory workers, housewives, engineers, students . . . many of whom have never built a kit before. Each builder notes any suggested changes in the instruction book draft, and returns the draft with the completed kit to the Scott Engineering Department.
2. Each of the completed kits is carefully tested and evaluated. Typical figures from the consumer-built units are used for determining specifications.
3. All instruction book drafts are thoroughly examined for notes by the consumer panel, and worthwhile changes are included in the finished book.

This careful evaluation and testing means your Scottkit will be easy to build and give you many years of trouble-free service. Relax . . . have fun . . . you are about to build a superb piece of high fidelity equipment.

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## Technical Specifications for the LK-60B

## Tape Output

Rated Voltage Output to Tape Recorder
Minimum Recommended Load Resistance

## Preamplifier

Inputs
Tape Head - Input Impedance
Signal for Rated Output S/N Ratio
Phono - Input Impedance (All Switch Positions)
Signal for Rated Output (Adjustable By Switch)
S/N Ratio
High Level Inputs - Input Impedance
Signal for Rated Output
S/N Ratio
Frequency Response in Flat Position
Treble Controls Measured at $10,000 \mathrm{cps}$, Boost and Cut
Bass Controls Measured at 30 cps , Boost and Cut
Scratch Filter
Rumble Filter
Loudness Compensation (maximum)
Loudness Compensation

## Amplifiers

*Music Power (IHF)
*Steady State (rms)
Total Harmonic Distortion @ rated rms power (mid-band)
Frequency Response
Power band width at rated distortion (IHF Method)
Damping Factor
Range of Line Voltage and Frequency
Power Consumption - 117 v at 60 cps (stand-by)
0.5 v

200K ohms

47K ohms
2 mv
52 db
47K ohms
3, $5,9 \mathrm{mv}$
55 db
50 K ohms
.5 v
75 db
$20-20 \mathrm{KC} \pm 1.0 \mathrm{db}$
$10 \mathrm{db} \pm 2 \mathrm{db}$
$12 \mathrm{db} \pm 2 \mathrm{db}$
$-4 \mathrm{db} /$ octave: $-3 \mathrm{db} @ 5 \mathrm{~K} \mathrm{~Hz}$
$-10 \mathrm{db} @ 50 \mathrm{~Hz} \pm 2 \mathrm{db}$
$+9 \mathrm{db} @ 50 \mathrm{~Hz}$
$+2.5 \mathrm{db} @ 10 \mathrm{~K} \mathrm{~Hz}$

50 w each channel
40 w each channel $0.6 \%$
$20-20,000 \mathrm{~Hz} \pm 1 \mathrm{db}$
$20-20,000 \mathrm{~Hz}$
20
$105-120 \mathrm{v}, 50-60 \mathrm{~Hz}$
25 w
${ }^{*}$ Specification for 8 ohm load, both channels driven, 120 vrms line.
Due to changes in technology the above specifications may change at any time without notice.

## HiFi Dictionary

ac (alternating current-no longer designated AC): an electric current which alternates between a maximum in one direction $(+)$ and a maximum in the other $(-)$, passing through zero in between. The complete reversal and return to the starting value is called one cycle. Also applied to an alternating voltage, thus: "ac voltage." The number of cycles in one second is the frequency, in cycles per second, the new international designation for which is "hertz," abbreviated "Hz" (formerly "cps"). See sine wave.
acoustics (architectural): those characteristics of a concert hall or room which modify the sound produced by a source and affect the quality of the sound reaching one's ears.
AF (audio frequency): a frequency between 20 and 20 ,000 Hz (cycles per second).
AGC (automatic gain control): a circuit that provides a relatively constant signal level output regardless of the variations in input level.
alignment: adjusting the values of the components of a tuner (such as capacitors, inductors) for optimum performance.
AM (amplitude modulation): the method of transmission in which a signal of constant frequency (the carrier) is varied in amplitude in accordance with the signal (voice or music).
ampere: the practical unit of electric current. One ampere is produced by one volt acting across a resistance of one ohm.
amplifier: a device that increases the strength of electrical signals.
amplitude: a measure of the strength of a wave.
attenuation: reduction in amplitude of a wave. Attenuating a sound reduces its intensity.
balance: to make equal in strength, or symmetrical with respect to a reference point.
bias: a dc voltage in the input circuit of tube, transistor, or diode that determines the direct current (dc) through the device.
cable: a bundle of insulated wires. Also, one or more wires within a sheath.
capacitor (condenser): a device that is capable of storing electrical charge, consisting of two conductive surfaces separated by an insulating material - the di-electric. A capacitor blocks direct current but passes alternating current. The value of a capacitor is called its capacitance; it is expressed in decimal parts of a farad. See "Frequently Used Prefixes."
class A amplifier: a vacuum tube or transistor amplifier stage in which the bias value is chosen for plate or collector current flow throughout a full cycle of the signal. The average current flow with no signal applied is equal to the current flow with signal. This type of amplifier is normally used in preamplifier stages. As a power stage, its efficiency is low.
class B amplifier: an amplifier stage consisting of two tubes or two transistors in which the bias value is chosen for approximately zero plate or collector current when no signal is applied. Current flows during approximately half of the cycle in each device. The average current greatly increases with signal. This type of amplifier is normally used in power output stages; its efficiency is high.
coaxial cable: a cable with one (or more) insulated conductors completely surrounded by a cylindrical shield (see Cable). The shield reduces pickup of hum and noise.
converter: the section of a tuner that converts the incoming RF signal to a signal of fixed lower frequency, known as the intermediate frequency (abbreviated IF). Includes the oscillator and the converter device itself.
continuous power output, rms: the maximum power output capability of an amplifier over an extended period of time without exceeding rated distortion rather than on a short burst, as in music power. The standard test frequency is 1000 Hz (cycles per second).
carrier frequency: the frequency of the original unmodulated radio wave produced by a radio station.
capture ratio: a measure of the ability of an FM tuner to suppress the weaker of two signals of identical frequency, permitting the stronger signal alone to be heard.
cross-modulation: interference of one station by another stronger station, resulting from the interaction of their signals within the tuner. The ability of the tuner's front end to handle weak and strong signals. Expressed in dB , a higher number is usually more desirable.
crossover distortion: in a Class B push-pull amplifier, one output transistor (or tube) produces the positive part of the signal, and the other transistor the negative half. Crossover distortion occurs when the transfer from one transistor to the other does not take place smoothly. This form of distortion is particularly important because of its effect at low listening levels.
current: the movement of electrons through a conductor (see ampere).
cycle: (see ac).
damping: the ability of the amplifier to maintain control over the speaker. High damping assists a speaker in cleanly reproducing transients.
$d B$ (decibel-no longer designated db): a unit of measurement for the power gain or loss in signal strength, expressed in logarithmic form. Specifically,
dB gain or loss $=\log _{10} \frac{\text { power output }}{\text { power input }}$
In terms of voltage or current, for a given impedance, dB gain or loss $=20 \log _{10} \frac{\text { voltage or current output }}{\text { voltage or current input }}$.
dc (direct current-no longer designated DC): a current that flows continuously in one direction.
de-emphasis: (see equalization).
defector: the section of a tuner that converts the modulated carrier to an audio output.
diode: device that conducts electricity in one direction only.
distortion: any unwanted change in the waveform of a signal.
efficiency: the ratio of the output power of a device to its input power, usually expressed in per cent.
equalization: modification of the frequency response of a device in a desired manner to achieve a specific result, such as reduction of background noise.
feedback: involves feeding a small part of the output of an amplifier back to the input. If the signal is fed back so as to cause a reduction in gain, it is called negative feedback. It provides a reduction in distortion.
field-effect transistor: a type of solid-state device which controls current flow by means of an electrostatic field. It has lower noise and generates less distortion than a normal "bi-polar" transistor.
filter: a circuit designed to pass certain ranges of frequency while restricting the passage of others.
flutter: rapid fluctuations in speed caused by mechanical deficiencies in turntables or tape recorders, resulting in variations in pitch.

FM (frequency modulation): the method of transmission in which a signal of constant amplitude (the carrier) is varied in frequency in accordance with the signal (voice or music).
frequencies: (see AC).
front end: the term used to describe the section of the tuner that selects the desired station, amplifies it and converts it to the IF frequency. Includes an RF amplifier and a converter.
fuse: a protective device that disconnects the circuit when the current exceeds a certain level.
gain: increase in signal strength. Usually expressed in decibels (db).
ground: a connection, intentional or accidental, between an electric circuit and the earth or a chassis serving in place of the earth.
harmonic distortion: the unwanted generation of additional signal components that are multiples of the fundamental frequency of the signal.
Hz (hertz): new international designation for cycles per second. See ac.
hum: a low-pitched, undesired sound usually caused by improper filtering of the ac power supply, or poor shielding of the same circuit. Hum is composed of the power line frequency and its harmonics.

IF (intermediate frequency): (see converter). It is easier to build a tuned (selective) amplifier for a fixed frequency than one that is adjustable over a range of frequencies. The intermediate frequency is produced in the converter. See converter.

IM (intermodulation distortion): the generation of unwanted signals by the interaction of two or more signals of different frequencies. IM products are usually not multiples of the frequencies of the input signals; that is, not harmonically related to them.
impedance: the property of a circuit that determines the amount of flow of alternating current where a given voltage is applied. It is measured in ohms.
insulator: a part that does not conduct electricity.
insulation: non-conductive material used to prevent the flow of electricity to undesired areas.
jack: an electrical receptacle into which a plug is inserted to complete an electric circuit.
lead: a wire that connects two or more points in a circuit (pronounced "leed").
limiter: an amplifier stage in an FM tuner that removes variations in the amplitude of the signal caused by atmospheric disturbances and man-made interference, which would otherwise cause noisy reception.
mixer: (see converter).
modulation: see AM and FM. The process of superimposing, music or voice on a carrier frequency.
monophonic (sometimes known as monaural reproduction): a transmission system combining all input signals in a single channel in such a manner that all reproduced sounds seem to emanate from the same location.
multiplex (mpx): a technique whereby two independent stereo signals are transmitted by a single FM station and then separated at the receiver for stereophonic reproduction.
music power or dynamic power (IHF standard): maximum power output of an amplifier that can be obtained without exceeding rated distortion measured over a time interval short enough so that power supply voltages have not changed from their no-signal values. These conditions are representative of the situation that occurs when music is being reproduced. Standard test frequency is 1000 Hz (cycles per second).
network: a combination of electrical components designed for a specific function.
nuvistor: a trade name for a sub-miniature highly dependable vacuum tube in a metal envelope.
ohm: the unit of resistance (see resistance).
oscillation: generation of an ac signal.
peak power: the maximum instantaneous power output capability of an amplifier. Twice the music or dynamic power.
phase: the time lag between two signals of identical frequency expressed in terms of parts of a complete cycle. Two ac signals are in phase when they reach their maximums simultaneously. They are out of phase when one signal reaches its maximum in one direction as the other signal reaches a maximum in the opposite direction.
potentiometer (abbreviated "pot"): a rotary control that introduces a variable amount of resistance into a circuit. Example: a volume or loudness control.
power: the time rate at which work is performed or energy expended. The power rating of an amplifier expresses the amount of energy it can provide per unit time, (to drive a loudspeaker). Power is expressed in watts. Watts $=$ amperes times volts.
power bandwidth: the lowest frequency and the highest frequency for which the harmonic distortion measured at one-half of rated continuous power output is equal to the rated harmonic distortion.
printed circuit: an insulating board to which a layer of copper has been laminated and then etched, leaving conducting areas and lines that take the place of conventional wires to interconnect components like resistors and capacitors mounted on the board.
regeneration: (see feedback). Regeneration denotes positive feedback.
resistance: the property of a conductor that determines the current flow resulting from the application of a given voltage. The unit of resistance is the ohm (ohms $=$ volts $\div$ amperes).
resistor: a device designed to control the flow of current (see resistance). Resistors are made both fixed in value and adjustable (potentiometer).
RF (radio frequency): frequencies above the audible range (above $20,000 \mathrm{~Hz}$ (cycles per second)). Specifically those frequencies used to transmit radio (or TV) signals.
rumble: low-frequency noise and vibration mechanically generated in turntables and transmitted to the phono cartridge.
semi-conductor: a material, in crystalline form, used in diodes and transistors, that permits the flow of current to be controlled in degree and direction.
sensitivity: expresses the ability of an FM tuner to receive weak signals and still be able to suppress background noise. The rating is in terms of microvolts of signal required for a given number of db of quieting (suppression of noise). The IHF usable sensitivity rating takes into account hum and distortion as well as noise, which makes it a more meaningful figure. It is specified in microvolts for 30 dB level difference between signal and the sum of noise, hum, and distortion.
sensitivity: in an audio amplifier, the sensitivity is a measure of the power output corresponding to a given input. It is usually expressed in inverse form by specifying the input voltage required to obtain rated power output.
separation: stereo is produced by the use of two separate signal channels, right and left. If the channels interact, the stereo effect is reduced. Separation is expressed in terms of the dB difference between the signal in one channel and the amount that leaks into the other channel.
signal-to-noise ratio ( $\mathbf{s} / \mathbf{n}$ ratio): the ratio of desired program signal strength to the undesired background noise, expressed in dB . The greater the $\mathrm{s} / \mathrm{n}$ ratio, the less noise will be audible during quiet passages.
sine wave: a smooth curve that varies periodically with time, going to a maximum in one direction, returning to zero, going to a maximum in the other direction and then returning to zero again. A pure tone without harmonics is a sine wave.
solid state: referring to the use of semi-conductors (diodes and transistors) as opposed to tubes.
spaghetti: cloth or plastic tubing designed to slide over uninsulated wire to prevent short circuits.
stability: the ability of a circuit to maintain its normal operating characteristics despite some change in operating conditions, such as temperature. It also refers to an audio amplifier's ability to operate without oscillating (producing an internally generated output signal) when loads of varying characteristics are connected, or the output circuit left open. Speakers have impedances that are not pure resistance and may act like capacitors over part of the frequency range and inductances at other frequencies.
stereophonic: program material (or the equipment designed for its use) providing reproduction in which the spatial location of the original source is conveyed to the listener through the use of separate right and left channels. Stereo provides the listener with a feeling of space and reality similar to that heard in the concert hall.
subsonic: frequencies below the normal range of human hearing (below 20 Hz (cycles per second)).
supersonic: frequencies above the normal range of human hearing (above $15,000-20,000 \mathrm{~Hz}$ (cycles per second)).
spurious response: the appearance of a station on the dial at points other than where it belongs. Expressed in dB , a higher number is usually more desirable.
terminal: a device providing convenient means for connection of a wire.
transformer: a device for changing voltage (and current) from one value to another without changing the electric energy. A power transformer changes line voltage to the values needed by the various circuits in an amplifier or tuner.
transient: a momentary, as opposed to a continuous, signal. Voice and music consist of a succession of transients signals that change from instant to instant.
transistor: semi-conductive device in which the flow of electrons from one connection to another is controlled by varying the current or voltage applied to a third connection. Capable of amplifying a signal voltage or current, and of generating oscillations (ac).
tube: (vacuum tube) a glass or metal enclosed device in which controlled conduction occurs by means of a flow of electrons across a vacuum from one electrode (the cathode) to the other (anode). The control electrode is called a grid. Tubes are used for amplification and oscillation.
voltage: electromotive force, the equivalent of force or pressure in a mechanical system. The electromotive force required to push one ampere of current through one ohm of resistance is one volt.

## Resistor Color Code

The color bands around the body of most resistors indicate the value of the resistance. The two bands close to end of the resistor body give the first two digits of the value, the third band represents the multiplier, and the fourth band (sometimes omitted) gives the tolerance.

The size of the resistor gives an indication of the power rating (watts). A resistor rated at $1 / 2$ watt has a diameter of $1 / 8^{\prime \prime}$, a one-watt resistor is $1 / 4^{\prime \prime}$ in diameter, and a two watt resistor is $5 / 16^{\prime \prime}$. Precision resistors do not necessarily conform to this rating system.

COLOR CODE


FREQUENTLY USED PREFIXES IN ELECTRONICS

| Symbol | Prefix | Multiplying Factor |
| :--- | :--- | :--- |
| $\mu \mu$ or $\mathrm{mm}^{*}$ | micro-micro | $10^{-12}$ |
| p | pico | $10^{-12}$ |
| $\mu$ or $\mathrm{m}^{*}$ | micro | $1 / 1,000,000\left(10^{-6}\right)$ |
| m | milli | $1 / 1000\left(10^{-3}\right)$ |
| K | kilo | $1000\left(10^{3}\right)$ |
| M | mega | $1,000,000\left(10^{6}\right)$ |

*For capacitors only. Example: 1 mfd $=1$ microfarad.

## Section 1 - Getting Started

First, unpack the kit from the KIT-PAK ${ }^{\circledR}$ container. You should take care not to mislay any small items or packages. If you wish, you can work right inside the KIT-PAK®. It will help protect your work table. When you want to stop working for a few hours, just close the cover and put the whole kit away out of sight. You will find the KIT-PAK ${ }^{\circledR}$ cover an ideal rest for the instruction book.

### 1.1 Tools Required

A small screwdriver is provided with the kit. In addition, you will need a pair of long nose pliers, a regular size screwdriver ( $3 / 16^{\prime \prime}$ wide blade), a pair of wire cutters, and a soldering iron. The soldering iron should have a rating between 35 and 55 watts and must have a small tip. It is extremely dangerous to use any iron of greater wattage as too much heat can damage the printed circuit boards. You will find a $1 / 4^{\prime \prime}$ hexagonal nut driver very useful for installing sheet metal screws.

### 1.2 Basic Electrical Assembly Procedure

Each switch, terminal strip, printed circuit board, etc., has a code number (S1, T1, PC1). Every pin or terminal on these parts and sub-assemblies is also numbered (Pin 1, Pin 2, etc.). For example, the instructions may call for a wire or component to be connected to S5-3. This means that you are to connect a wire to Pin 3 of S5. Another example: P1-2 means Pin 2 of P1.

There is a specific pictorial diagram which shows the actual connections in full color for each group of step-by-step instructions. Using the color pictorials and occasionally referring to the top and bottom view photographs (Section 1.8), will enable you to easily construct a kit equal to a factory-wired unit.

The parts and wires to be used are packed in transparent envelopes. For each wiring group of instructions, open the specified envelope and spread the contents out on your work table. The envelope number which appears in the wiring instructions will also appear on a card inside the transparent envelope. As the step-by-step instructions are followed, you will gradually use all the parts and wires in the transparent envelopes. Parts for more than one series of steps will sometimes be included in a single transparent envelope.

As each step is completed, place a check beside the step number so that you will not lose your place if you are interrupted.

The many wires used in the kit are of the proper length and have been stripped back. If, for example, a $10^{\prime \prime}$ black wire is called for, select the black wires from the transparent envelope and with the ruler located on the inside cover of the kit box, select the correct $10^{\prime \prime}$ wire. This is important, for if you use the wrong wire you may find that later on in the course of construction a wire will be too short.

### 1.3 Soldering And Wiring Instructions

All the solder ordinarily needed to assemble the kit is supplied. If for any reason additional solder is needed, make sure that you use 60/40 ROSIN CORE SOLDER. Under no circumstances should you use Acid Core Solder. All guarantees are voided if Acid Core Solder is used.

## Soldering Instructions:

a. Before using the soldering iron, the tip must be tinned as follows: First heat up the iron. When the tip is hot, wipe it gently with a cloth till bright and shiny and apply a generous amount of solder. Remove any excess solder with the cloth. Repeat the process for all sides of the tip.
b. Make sure that all wires and terminals to be soldered are completely clean. Do not use fluxes or paste of any sort.
c. The wires should be mechanically secure before soldering. Make a single turn around the contact and then pinch the wire tightly with the long nose pliers. If the wire is too large to be bent, position the wire so that a good solder connection can still be made by holding the wire against the terminal when soldering.
d. Wires on resistors, capacitors, and similar components are generally longer than required to make the indicated connections; cut off this excess wire while adding the part to the chassis. The wires should be long enough to reach their destination, allowing a little left over (approximately $1 / 4^{\prime \prime}$ ) to make a good mechanical joint.
e. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated.
f. Hold the end of the solder against the junction


FIGURE A HOW TO SOLDER
of the tip of the iron and the terminal. This solder will immediately melt and quickly transfer more heat to the terminal, allowing the solder to flow around the joint. At this instant the joint must be hot enough to melt the solder by itself without the aid of the iron. Use only enough solder to flow smoothly over the joint.
g. As soon as the joint is covered with solder, remove the solder and then a second later, the iron. Do not allow the wire to move until the joint has hardened (about 5 seconds). A good solder joint is bright and shiny. After the solder hardens, check the joint for rigidity. If it is not firm and tight, reheat the joint and permit the solder already present to flow again. Usually a little more solder will have to be added.
h. When soldering diodes, it is advisable to use no more heat than necessary. Excessive heat can damage these components. Use a paper clip or an alligator clip as a heat absorber (sink) to protect the diodes.
i. The printed circuit boards may be supplied with either turret terminals (pins), bifurcated terminaleyelets (a hollow slotted pin), or eyelets (metal-rimmed holes).

The procedure for soldering to the turret terminals is the same as given above in "c."

There are two methods for soldering to the bifurcated terminal-eyelets; the method used is dependent upon the side of the printed circuit board to which the wire is to be attached. If the wire is to be attached to the side of the board on which the components are located, the soldering is accomplished in the same manner as outlined above in this section. Mechanically attaching the wire to the bifurcated terminal-eyelet may be done by either wrapping the wire around the pin (as given above) or by dropping the wire in the slot and pinching the sides of the pin together. If the
wire is to be attached to the etched side of the board (opposite side from the parts), then the wire is soldered into the hole of the bifurcated terminal-eyelet by the same method illustrated in the following paragraph for eyelets (tack soldering).
"Tack soldering" is somewhat different from the normal soldering procedure. It essentially consists of soldering a wire without mechanically attaching it first. The wire is held in place while soldering and the solder itself is used as both a mechanical and electrical connection. The procedure for "tack soldering" to eyelets is as follows:

1. The bare end of the wire going to the eyelet must be tinned by heating the end of the wire with the soldering iron and coating the wire with solder.
2. The soldering iron itself is tinned by placing a small amount of solder on the tip. It is not necessary for a big "glob" of solder to be left on the soldering iron. However, the iron should not be wiped completely clean.
3. Place the wire on the hole and apply the point of the soldering iron to the edge of the eyelet until the solder flows freely; push the wire in, then immediately remove the iron and hold the wire until the solder has hardened.

j. In some cases additional wires have to be attached to some terminals that have been previously soldered. To do this, connect the wire to the terminal with a good mechanical joint, then heat the connection so that the solder already on that terminal will melt and hold the new wire. If you doubt the security of the connection, add a little more solder. Additional connections to eyelets ąnd bifurcated terminal-eyelets are made in the same manner.
k. Keep the soldering iron clean and bright by an occasional gentle wipe with a cloth. The iron does not have to be cooled for this purpose.

If you have never done any soldering before, it would be an excellent idea to practice on scraps of wires before beginning. Some of the most common errors to avoid are insufficient solder to flow to the very bottom of large joints and not positioning the wires far enough away from each other to prevent shorts.

Be sure to place the wires or components in the same position as shown in the pictorial. Be as neat as possible: this will greatly cut down on mistakes, shorts and other difficulties. Neatness will also make it easier to check your wiring.

## Wiring Instructions:

The symbol (S) after any connection, means that this connection and all other wires on the same pin should be soldered. A number will appear after the (S). This number indicates exactly how many leads or wires are supposed to be connected to the terminal or pin in question. For example: "Connect an orange wire to T6-2 (S3)." The soldering number (S3) will always be in bold parenthesis so it can be found quickly. It indicates that there should be 3 wires or leads (including the orange one in this case) connected to Pin 2 of T6 and that all three of them are to be soldered. This provides an additional check for wiring errors.

Do not solder any connection that is not marked with an (S). Other connections are still to be made to this point before it can be soldered. Frequently, one end of a wire or component will be soldered while the other end will not (for the moment). The (S) will only appear after the description of the end that is to be soldered. After completing the soldering, cross out the (S) symbol with your pencil indicating that it has been done. This is in addition to checking off each step. In this way you can glance over the assembly instructions and spot any (S) that has not been crossed out, indicating that you may have overlooked a joint to be soldered.

The instructions for assembling the kit have been arranged in a logical order to insure perfect results. Follow them exactly, checking off each step as completed.

### 1.4 Types of Wire

Regular hook-up wire: these are the standard insulated wires that you will be using most of the time. They will be found in transparent envelopes for the different portions of the assembly procedure. Buss wire is a term used to describe short pieces of uninsulated wire. A length of buss wire will be found in one of the transparent envelopes for the first steps.

Spaghetti: a hollow plastic insulating tubing. This tubing is slipped over bare wires to provide insulation.

Stranded wire: Wire composed of many small strands. When using stranded wire be careful to prevent a single strand from separating and accidentally shorting with an adjacent pin or terminal. To insure that this will not happen, carefully twist the strands starting from the insulation and work towards the end. When the strands are twisted tightly as shown in the illustration, check once again to be sure that no strands have separated.

Cable (ESS:) Hollow tubing with a black or white outer insulation and a spiral metal shield inside.

figure C TYPES OF WIRE

## VERY IMPORTANT



FIGURE D HOW TO SPLICE

### 1.5 What To Do If You Make A Mistake

No matter how careful you are, it is still possible that you may break something accidentally or cut a wire too short. If you work when tired or try to do too much too fast, the possibility of mishap increases greatly. Fortunately, it is easy to correct most errors.
a. Cutting a wire too short: If you cut the wire from one of the components too short, you can easily correct it by taking a small piece of buss wire and splicing it on as shown.
b. If a wire supplied is damaged: cut off a replacement from one of the four-foot pieces provided.
c. Breaking a terminal strip: the terminal strips are quite sturdy and will withstand a great deal of handling. If you are unlucky enough to break a terminal, make all connections to the small hole below the pin. Be careful to avoid having any of the bare wires touch the chassis. If the phenolic material cracks but does not break off, you can continue, as the wires themselves will keep the broken piece in place.
d. In the unlikely circumstance that the entire terminal strip breaks off, write to the Parts Department at the factory for a replacement. Drill out the rivet holding the broken strip, using a number 28 drill. Mount the replacement with a binder head 6/32 x $1 / 4$ machine screw, lockwasher and nut.

### 1.6 The Double Check System

After finishing each sub-assembly, you will be referred to a DOUBLE CHECK SHEET to check over your work. This DOUBLE CHECK SHEET is most important in assuring error-free construction.

In our extensive evaluation tests we have had kits built by people with a wide variety of experience. Most of the kits worked perfectly upon completion. Of these people, virtually all of the successful builders took the time to follow this Double Check System, and most of them reported catching small errors. In those units that did not work, we discovered the malfunction could, in most cases, be traced directly to skipping the double check, carelessness, and working when overtired. Simple miswiring errors or short circuits prevented proper operation of the kit. Stop for a moment, RELAX, and be sure to check over your work.

An easy method of doing this has been provided. Ask a friend or another member of the family to help you. Have them look over charts AF-1, AR-1, etc. On these diagrams, a series of numbers have been placed next to each pin or terminal. These numbers indicate the number of wires and leads (including those from resistors or capacitors) that have been soldered to that pin. While you count off the number of wires on each pin and terminal, your assistant can check your count against the chart. When you count the wires going to Pin 1 of P1, your helper will observe that this agrees with his chart and place a small check mark on it. This will be continued until the entire kit is checked over.

WHILE YOU ARE COUNTING THE WIRES, YOU CAN ALSO BE CHECKING FOR SHORT CIRCUITS AND PROPER SOLDERING. It would be very handy if you had a tool with a small, sharp point (like an ice pick) to probe the connections and make certain they are soldered properly. A pencil with a sharp point can also be used. Even the most meticulous worker can make a mistake or have a poorly soldered joint. LOOK SHARP! Move every cable and wire a little to insure that it is not causing a short circuit with some other wire or pin.

If a mistake is caught and it involves a component which is now too short to reach the correct pin, refer to Figure D on splicing a piece of buss wire. This will work quite well and eliminate the need for purchasing a replacement. Make sure that you correctly measure the length of the pre-cut pre-stripped wires. This is important, for if you use the wrong wire, you may find that later on in the construction a wire will be too short.

Section 1.7 - Photographs of Wired Kit


Section 1.7 - Photographs of Wired Kit


## Section 2 - LK-60B Parts List

This parts list is broken down to cover each plastic envelope. The plastic envelopes are arranged in their order of use. Each plastic envelope contains the parts for a given Assembly Group of construction.

Check off each part just before each Assembly Group is used. Do not open any plastic envelope until you reach the appropriate step. This will eliminate the possibility of losing some of the small parts.

If you should accidentally damage or misplace any parts, write to the LABORATORY KIT SERVICE

DEPARTMENT at the factory immediately. Extra four feet lengths of blue insulated wire and black insulated wire have been supplied with the first step. They can be used to replace any missing wires or ones accidentally damaged. Simply cut off the length required (a convenient ruler is printed on the inside cover (and strip off $1 / 4^{\prime \prime}$ of insulation at each end, being careful not to knick the wire. If you have to replace a twisted pair, first evenly twist the correct length of blue and black wires together and then cut them.

| Env. \#1 | Rear Chassis Group 1 |  |
| :---: | :--- | :--- |
| 1 | XF-3AG | Fuse Post (Power) |
| 2 | XF-HJM | Fuse Post (Output) |
| 2 | RC21-33K | 33,000 ohm $1 / 2 \mathrm{w}$ resistor (orange- |
|  |  | orange-orange) |
| 2 | RW5-12 | 12 ohm 5w resistor wire wound |
| 2 | RW5-470 | 470 ohm 5w resistor wire wound |
| 2 | CMM-.22/250 | .22mfd capacitor, mylar |
| 1 | 15" IT-18 | Spaghetti (insulation) |
| 14 | Wires |  |
| 2 | Spare wires, blue \& black |  |
| 2 | Buss wires, \#22 (small) \& \#18 (large) |  |

Env. \#2 Front Chassis Mechanical Assembly

RCVD-100KT-3B
J3-ST
RCV-50KST-3B
RCVCC-100KT
H-N- $3 / 8 \times 1 / 2 B$
A-CL-22

1-TO-P
H-B- $3 / 8 \times 1 / 4$
H-LW-3/8L

Env. \#3 Front Chassis Group 1
$4 \quad$ CMM-68nf/250v (068/250v)
CC-. 0027 (2700)

Loudness Control (P1)
Phone Jack (J1)
Balance Control (P2)
Bass \& Treble Controls (P3 \& P4)
Brass Hex Nut
Meter Clip
Machine Screw
Kep Nut
1" Black Tubing
Brass Bushing
Lockwasher

68nfd Capacitor, Mylar
.0027 mfd capacitor, Ceramic


H-MS-632 MACHINE SCREW
$12,000 \mathrm{ohm} 1 / 2 \mathrm{w}$ resistor (brown-red-

330 pfd ceramic capacitor

H-NK-632
KEP NUT

Env. \#4

ESS-3/16v
I-NS-8

Spiral Shielded Cable (ESS)
Nylon Sleeves
.0047mfd capacitor, high voltage, Ceramic
orange)
2 RC21-12K
12 Wires
2 CC-330
Front Chassis Group 2

RC31-220
RC21-10K

RC21-6.8K
CC-180
Wires

Black tube

## Front Chassis Group 3

6800 ohm $1 / 2 \mathrm{w}$ resistor (blue-grey-red) 180pfd capacitor, Ceramic

## Heat Sink \#1

Env. \#8
2

2

Env. \#9

2
2

2

4
4
4 Wires
$1 \quad \mathrm{HN}-3 / 8 \times 1 / 2 \mathrm{~B}$
Env. \#10
RC21-12K
CC-. 0012 (1200)
Wires
Heat Sink \#2


S9 Input Switch (SRW 64-2) Groups $1 \& 2$
12,000 ohm $1 / 2 \mathrm{w}$ resistor (brown-redorange)
.0012mfd capacitor, Ceramic

Preamp Chassis Group 1


## Plastic grommets

390 ohm $1 / 2 \mathrm{w}$ resistor (orange-whitebrown)
1000 ohm $1 / 2$ w resistor (brown-blackred)
.005 mfd capacitor, Ceramic
$2,200,000 \mathrm{ohm} 1 / 2 \mathrm{w}$ resistor (red-redgreen)

Brass hex nut

## Preamp Chassis Group 2

| 8 | Wires |
| :--- | :--- |
| 4 | H-MS-632 x $1 / 4 B$ |

Env. \#11


METER LIGHT SHIELD


Meter light shield

| 37 | H-SMS-6 $\times 1 / 4 \mathrm{HW}$ |
| ---: | :--- |
| 1 | H-SMS-6 $\times 1 / 4 \mathrm{HWB}$ |
| 3 | A-CL-38 |
| 3 | H-MS-63 $\times 1 / 2$ B |
| 1 | H-N- $3 \times 1 / 2$ B |
| 1 | A-SB-375-3 |
| 3 | A-SB-437-4 |
| 3 | A-SB-625-8 |

Sheet metal screws (4 extra)
Bronze sheet metal screw
CEC can bracket
Machine screw
Brass Hex Nut
Plastic grommet (small)
Plastic grommet (medium)
Plastic grommet (large)


PLASTIC GROMMET

Env. \#12

## Main Chassis Groups $1 \& 2 \& 2 B$

| 1 | DZ-27 |
| :--- | :--- |
| 2 | RC41-1.5K |

$1 \quad \mathrm{RC} 21-150$
1 CETM-250/50
1 CETM-1000/30
1 RC21-8.2K
3 Wires

Zener diode (D1), 27v
1500 ohm 2 w resistor (brown-greenred)
150 ohm $1 / 2 \mathrm{w}$ resistor (brown-greenbrown)
250mfd capacitor, Tubular


1000 mfd capacitor, Tubular
8200 ohm $1 / 2 \mathrm{w}$ resistor (grey-red-red)

Env. \#13
Main Chassis Groups 3 \& 4

20
1
13
H-MS-632 x 1 14 B
CC-. 005
Wires
Machine screw
.005 mfd capacitor, Ceramic


Env. \#14 Main Chassis Groups 5 \& 6

| 2 | CC-.0047/1.4KV |
| :--- | :--- |
| 1 | RC21-820K |
| 2 | RC21-39K |
| 4 | RW5-.82 |
| 2 | RC21-1.8K |
| 2 | RP-150K-2\% |
| 10 | Wires |

.0047 mfd capacitor, high voltage, $\mathrm{Ce}-$ ramic
. $820,000 \mathrm{ohm} 1 / 2 \mathrm{w}$ resistor (grey-redyellow)
39,000 ohm $1 / 2 \mathrm{w}$ resistor (orange-white-orange)
.82 ohm 5 w resistor wire wound
1800 ohm $1 / 2 \mathrm{w}$ resistor (brown-greyred)
150,000 ohm $1 / 2 \mathrm{w}$ resistor (brown-green-yellow) precision


WIRE WOUND RESISTOR

Env. \#15

Final Mechanical Assembly
H-SMS-6 x $1 / 2 \mathrm{HW}$
H-SMS-6 x $1 / 4 \mathrm{HW}$
H-SMS-6 x $3 / 8$ BBS
H-MS-632 x $1 / 4 \mathrm{~B}$
$\mathrm{H}-\mathrm{N}-3 / 8 \times 1 / 2 \mathrm{~B}$
F-SB-1 1/4
F-AGX-2
Labels
H-T-SL + H-T-SLB
Plastic feet
Sheet metal screw (long)
Sheet metal screw
Black sheet metal screws
Machine screws (spare)
Hex Nut
$11 / 4 \mathrm{amp}$ Slo-Blo fuse (1 spare)
2 amp instrument fuse (2 spares)
Spade Lugs for speaker wires


SHEET METAL SCREW

| 1 | N-LK-60-1 |
| :--- | :--- |
| 2 | KN-P-6CTT |
| 3 | KN-P-6LTT |
| 2 | KN-P-8CT |
| 1 | KN-P-10PTT |

Panel
Knob (Bass, Treble) small
Knob (Balance, Selector Input)
Knob (Bass, Treble) large
Knob (Loudness)

Parts Packed in "KIT-PAK" ${ }^{\text {® }}$

| 1 | M-SS-6 |
| :--- | :--- |
| 2 | A-HS-3 |
| 2 | *Z-PC-D4 |
| 2 | *Z-PC-P4 |
| 2 | Z-PC-T1 |
| 1 | SRW-52-1 |
| 1 | SRW-64-2 |
| 1 | SRW-27-3 |
| 2 | ${ }^{*}$ CEC-2000/65 |
| 1 | ${ }^{*}$ CEC-1000/75 |
| 1 | A-MC-9 |
| 1 | A-MC-10 |
| 1 | LK-60-M3 |
| 1 | A-MC-12 |
| 1 | A-BC-20 |
| 1 | A-BC-21 |
| 1 | A-BC-22 |
| 1 | E-LT-AV-R |
| 1 | E-LT-SD |
| 1 | V-L15w |

Meter (M1)
Heat sink assemblies
Driver PC Board (PC4 \& PC3)
Preamp PC Board (PC1 \& PC2)
Tone Control PC Board (PC5 \& PC6)
Meter Test Switch
Preamp Switch (S9) Input
Selector Switch
Electrolytic Capacitor
Electrolytic Capacitor
Main chassis
Front chassis
Rear chassis
Preamp chassis
Preamp cover
Bottom cover
Top cover
50 gms of solder \& its holder
Screw driver
Light bulb, 15w, 120v (not included in units with $110 / 220 \mathrm{v}$ transformers)

CEC CAN ELECTROLYTIC CAPACITOR


* This Electrolytic Capacitor may be replaced by CEC-2000/75

| *Assembly Number | Blank PC Board |
| :---: | ---: |
| Z-PC-D4 | PC-D3 |
| Z-PC-T1 | PC-T1 |
| Z-PC-P4 | PC-P4 |

If it is necessary to order a replacement PC Board be sure to specify the Assembly Number. The PC Board Number is the PC Board minus components.

## Section 3 - Kit Construction



FIGURE 1

Having read "Getting Started," you are now ready to start building your kit. Proceed slowly, read carefully and enjoy yourself.

### 3.1 Rear Chassis

## Mechanical Assembly Env. \#1

Assemble the XF-3AG FUSE HOLDER (Power Fuse) to the rear chassis as shown in Figure 1 using the rubber washer, lockwasher, and hex nut as shown.

Install the two XF-HJM FUSE HOLDERS (output fuses) to the rear chassis using the rubber washers and hex nuts supplied with each fuse holder.

## Rear Chassis Electrical Assembly Group 1

During this assembly group, you will be wiring
the rear chassis of your LK-60. Make sure that all leads and wires are exactly as shown on the Group 1 diagram.

In numerous places throughout this booklet, reference will be made to "heavy" colored wire. This wire is identical to regular hookup wire (see Page 9), but it is thicker and of heavier weight. Use the "heavy" wire only where specified.

Note: When connecting "buss" wire in this sstep, it is much easier to hold the complete bundle of "buss" wire in one hand and feed the free end of the wire through the appropriate pins. The free end of the wire is then crimped around the last pin, and the wire is pulled tight and the other end of the wire can be clipped off and wrapped around the first pin. This is much easier than trying to work with a very small piece of wire.

In the main part of the construction manual some steps appear with heavy brackets. Example: Rear Chassis Assembly Group 1, Step 23. When these steps are reached during construction, you will be referred to Section 3.7 for the necessary wiring steps for $110 / 220 \mathrm{v}$ conversion units. For domestic 117v units the steps in brackets must be completed.

## Connect:

1. A $1 \frac{1}{4}$ " light buss wire from S10-3 through S10-5 (S2) * to S10-4.
2. A $11 / 4^{\prime \prime}$ light buss wire from S11-12 through S11-8 (S2) * to S11-7.
3. A 33 K resistor [orange-orange-orange] from S10-4 (S2) to S10-6.
4. A 33 K resistor [orange-orange-orange] from S11-7 (S2) to S11-9.
5. A large 12 ohm wire wound resistor from S10-1 (this wire may be wrapped around the pin) to S10-3.
6. A large 12 ohm wire wound resistor from S11-10 (this wire may be wrapped around the pin) to S11-12.
7. A $121 / 4^{\prime \prime}$ heavy black wire to T5-3 (S1) .
8. A $123 / 4$ " heavy black wire to T5-4 (S1) .
9. A large 470 ohm wire wound resistor from T4-1 to S10-1.
10. A large 470 ohm wire wound resistor from T6-1 to S-11-10.
11. A .22/250 mylar capacitor to T6-1, the other end to S11-10 (S3).
12. A .22/250 mylar capacitor to T4-1, the other end to S10-1 (S3).
13. An $181 / 4^{\prime \prime}$ black wire to T4-1 (S3).
14. A $161 / 2^{\prime \prime}$ orange wire to S10-3 (S3).
15. A $163 / 4$ " green wire to S10-6 (S2).
16. An $183 / 4$ " green/white wire to S11-9 (S2). (A green/white wire $=\mathrm{a}$ white wire with a green stripe.)
17. A $93 / 4^{\prime \prime}$ orange/white wire to S11-12 (S3).
18. A $131 / 4^{\prime \prime}$ black/white wire to T6-1 (S3).
19. A $11 / 4^{\prime \prime}$ light buss wire with $1 / 2^{\prime \prime}$ spaghetti (see Page 9) from S12-6 (S1) to S12-1. (Wrap lead around notch of Pin 1. Do not put through hole).
20. An $113 / 4^{\prime \prime}$ heavy green wire to F2-3 (S1).
21. An 183/4" heavy blue wire to F1-1 (S1).
22. A $2^{\prime \prime}$ heavy red wire from F3-6 to S12-3 (S1).

On all units with $110 / 220 \mathrm{v}$ power transformers, the construction steps in brackets should be omitted - refer to construction steps in Section 3.7 for correct wiring. For domestic 117v units this step should be completed.

24. A $5^{\prime \prime}$ heavy white wire to S12-2 (S1).
25. A $4^{\prime \prime}$ heavy grey wire to S12-5 (S1).

Pick up rear chassis and shake any loose clippings from the unit.

Check your work with double check sheet AR-1, which indicates the number of connections to each pin and whether or not it is soldered. Circled numbers mean that there will be future connections to that pin.

You have now completed most of the electrical assembly on the rear chassis of your LK-60. The rear chassis is used as a mechanical support for the protective fuses (output stage and power supply) and as a mechanical support for the output connections for the speakers.
*When a wire passes through a pin, it counts as two solder connections.


FRONT - GROUP 1


During the next three groups you will be working on the front chassis of your LK-60. Make sure that all wires coming from resistors and capacitors are cut as short as possible and that the mechani cal joints on the switch terminals are as small as possible to avoid shorting between one pin and another.
The potentiometers P1, P3, and P4 have one deck nearest the aluminum chassis. This deck which is nearest the aluminum chassis is shown with the long pins on the diagrams, and this should be remembered when making connections to P1, P3, and P4.
The switch S 7 has several pins that are double, such as pins 6 and 7 . When making connections to these pins, make sure that the wire is attached and soldered to both pins.


Front Chassis Assembly Group 1 Env. \#3
Connect:

1. A $41 / 2^{\prime \prime}$ yellow wire from P1-1 (S1) to S3-2.
2. A $51 / 2^{\prime \prime}$ yellow/white wire from P1-5 (S1) to S3-5.
3. A $31 / 2^{\prime \prime}$ black wire from P1-2 to P2-1.
4. An $11^{\prime \prime}$ yellow wire from P1-4 to S7-6 (S1).
5. A 9 " yellow/white wire from P1-8 to S7-7 (S1).
6. A $71 / 2^{\prime \prime}$ twisted green and black wire. Green from P1-3 (S1) to S5-2, black from Pl-2 to T3-1.
7. An $8^{\prime \prime}$ twisted green and black/white wire. Green from P1-7 (S1) to S5-5, black/white from P1-6 to T3-2.
8. A $31 / 22^{\prime \prime}$ red wire from S4-3 to P3-3 (S1).
9. A $31 / 4^{\prime \prime}$ red/white wire from S4-6 to P3-7 (S1).
10. A $53 / 4$ " yellow wire from P3-4 to T2-4.
11. A $33 / 4$ " yellow/white wire from P3-8 to T2-3.
12. A $31 / 4$ " black wire from $57-5$ to T2-B (ground lug) (S1).
13. A $68 \mathrm{nf} / 250 \mathrm{v}$ Mylar capacitor from $\mathrm{S} 3-2$ (S2) to S3-3.
14. A $68 \mathrm{nf} / 250 \mathrm{v}$ Mylar capacitor from S3-5 (S2) to S3-6.
15. A 2700 ceramic capacitor from S4-3 (S2) to T2-2.
16. A 2700 ceramic capacitor from S4-6 (S2) to T2-1.
17. A $68 \mathrm{nf} / 250 \mathrm{v}$ Mylar capacitor to P4-4, and the other end to P4-1.
18. A $68 \mathrm{nf} / 250 \mathrm{v}$ Mylar capacitor to P4-4 (S2), and the other end to P4-3.
19. A 12 K resistor [brown-red-orange] from T2-2 to P4-2 (S1).
20. A 12 K resistor [brown-red-orange] from $\mathrm{T} 2-1$ to P4-6 (S1).
21. A 330 ceramic capacitor from S7-5 to S7-1.
22. A 330 ceramic capacitor from S7-5 (S3) to S7-2.

## Front Assembly Group 2 Env. \#4

## Connect:

1. A $143 / 4^{\prime \prime}$ heavy twisted red and white wire. Red to S1-2, white to S1-1.
2. Unwrap $1^{\prime \prime}$ of spiral shield at one end only of the ESS cable. Add the nylon bushings as shown in Figure 4. Slip the unwrapped shield end of the ESS cable over the red and white twisted wires.

Connect the shield wire to T1-A (ground lug) (S1). Bend the red wire to hold the bushing in place at the other end.
3. A . $0047 / 1.4 \mathrm{KV}$ high voltage ceramic capacitor from S1-1 (S2) to S1-2 (S2).
4. One end of a large 220 ohm 1 watt resistor [red-red-brown] to J1-1 (S1). This wire may be wrapped around the pin and crimped. Use $11 / 4^{\prime \prime}$ spaghetti on the other end and connect to S2-2.
5. One end of a large 220 ohm 1 watt resistor [red-red-brown] to J1-3 (S1). This wire may be wrapped around the pin and crimped. Use $3 / 4$ " spaghetti on the other end and connect to S2-5.
6. A 10 K resistor [brown-black-orange] from P3-2 to P4-1 (S2).
7. A 4700 ceramic capacitor to P3-2. Use $1^{\prime \prime}$ spaghetti on the other end and connect to S4-2 (S1) .
8. A 4700 ceramic capacitor from P3-6 to S4-5 (S1).
9. A $68 \mathrm{nf} / 250 \mathrm{v}$ Mylar capacitor to $\mathrm{P} 4-8$, the other end to P4-5.
10. A 10 K resistor [brown-black-orange] from P3-6 to P4-5 (S2).
11. A 10 K resistor [brown-black-orange] from $\mathrm{T} 2-4$ to P4-3 (S2).
12. A 10 K resistor [brown-black-orange] from T2-3 to P4-7.
13. A $68 \mathrm{nf} / 250$ v Mylar capacitor to P4-8 (S2), the other end to P4-7 (S2).
14. A . 0082 ceramic capacitor from $\mathrm{S} 5-1$ to $\mathrm{S} 5-2$ (S2).
15. A . 0082 ceramic capacitor from $\mathrm{S} 5-4$ to $\mathrm{S} 5-5$ ( S 2 ).
16. A 10 K resistor [brown-black-orange] from S7-2 (S2) to S6-5 (S1).
17. A 10 K resistor [brown-black-orange] to S7-1 (S2) . Use $1^{\prime \prime}$ spaghetti on the other end and connect to S6-2 (S1).
18. A $10^{\prime \prime}$ orange wire to P3-2 (S3).
19. A $91 / 2^{\prime \prime}$ orange/white wire to P3-6 (S3).

## Front Assembly Group 3 Env. \#5

## Connect:

1. A 6.8 K resistor [blue-grey-red] to P1-2 (S3). Use $1^{\prime \prime}$ spaghetti on the other end and connect to S3-3 (S2).
2. A 180 ceramic capacitor from P1-4 (S2) to S3-1 (S1).
3. A 6.8 K resistor [blue-grey-red] to P1-6 (S2). Use $l^{\prime \prime}$ spaghetti on the other end and connect to S3-6 (S2).
4. A 180 ceramic capacitor from P1-8 (S2) to S3-4 (S1).
5. A $19^{\prime \prime}$ heavy twisted yellow and orange wire. Yellow to S2-1 (S1), orange to S2-4 (S1).
6. A $16^{\prime \prime}$ heavy twisted blue and green wire. Blue to S2-2 (S2), green to S2-5 (S2).
7. A $193 / 4$ " heavy twisted grey and red wire. Grey to S2-6 (S1), red to S2-3 (S1).
8. A $2^{\prime \prime}$ black wire from P2-3 (S1) to P2-1 (S2).
9. A $4^{\prime \prime}$ yellow wire from P2-4 (S1) to P3-4 (S2).
10. A $31 / 2^{\prime \prime}$ yellow/white wire from P2-2 (S1) to P3-8 (S2).
11. A $71 / 2^{\prime \prime}$ blue/white wire to $\mathrm{T} 2-1$ (S3).
12. An $83 / 4^{\prime \prime}$ blue wire to T2-2 (S3).
13. A $9^{\prime \prime}$ twisted green and black wire. Green to $\mathrm{S} 5-1$ (S2), black to T3-1.
14. A $6^{\prime \prime}$ twisted green and black/white wire. Green to S5-4 (S2), black/white to T3-2.
15. A $231 / 4^{\prime \prime}$ twisted green and black wire. Green to S6-3 ( S 1 ), black to T3-1.
16. A $24^{\prime \prime}$ twisted green and black/white wire. Green to S6-6 (S1), black/white to T3-2.
17. A $53 / 4^{\prime \prime}$ yellow/white wire to T2-3 (S3).
18. A $7^{\prime \prime}$ yellow wire to $\mathrm{T} 2-4$ (S3).

Pick up front chassis and shake clippings loose.
Check your work with double check sheet AF-1.
You have now completed the front chassis which is the heart of the control center and is closely associated with the two tone control boards (Z-PC-T1). The function of the control center and the tone control boards is to permit the user to vary the sound to suit his taste. It permits him to increase and decrease the treble, bass, and volume as well as reduce record scratch and subsonic rumble. The input selector switch (S-9), which is more closely associated with the preamplifier, is controlled from the front panel and permits the user to select a wide range of program sources while insuring proper equalization for tapes or records.


AF - 1


HEAT SINK GROUP-1

HEAT SINK
\#1.


HEAT SINK ${ }^{\#} 1$.
LEFT CHANNEL

right channel

HEAT SINK
\#2.


AHS-1

HEAT SINK\#2.
RIGHT CHANNEL
LEFT CHANNEL


### 3.3 Heat Sinks Group 1

Heat Sink No. 1 Env. \#6

Connect (All wires below are stranded.):

1. A heavy $163 / 4$ " blue wire to Q10-3 (S1).
2. A heavy $16^{\prime \prime}$ red wire to Q10-2.
3. A $143 / 4$ " red wire to Q10-2 (S2) .
4. An $181 / 4^{\prime \prime}$ green wire to Q10-1 (S1).
5. A $17^{\prime \prime}$ blue wire to T11-2 (S2).
6. A $171 / 4^{\prime \prime}$ violet wire to T11-1 (S2).
7. Slip the $101 / 2^{\prime \prime}$ black plastic tubing over all the wires which you have previously connected to the heat sink. Make sure that the plastic tubing is pushed up as snugly as possible to the heat sink.
S. A $133 / 4^{\prime \prime}$ heavy blue/white wire to Q110-6 (S1) .
8. A heavy $15^{\prime \prime}$ red/white wire to Q110-5.
9. A $16^{\prime \prime}$ red/white wire to Q110-5 (S2).
10. A $141 / 4^{\prime \prime}$ green/white wire to Q110-4 (S1).
11. A $14^{\prime \prime}$ blue/white wire to T12-2 (S2).
12. An $181 / 2^{\prime \prime}$ violet/white wire to T12-1 (S2).
13. Slip on the 9 " clear plastic tubing over the wires. Make sure that it is snug against the heat sink.

## Heat Sink No. 2 Env. \#7

Connect (All wires below are stranded.):

1. A $14^{\prime \prime}$ heavy black/white wire to Q111-9 (S1).

2 A heavy $141 / 2^{\prime \prime}$ orange/white wire to Q111-8 (S1).
3. A $141 / 2^{\prime \prime}$ yellow/white wire to Q111-7 (S1).
4. A $19^{\prime \prime}$ orange/white wire to T13-2 (S2).
5. A $14^{\prime \prime}$ blue/white wire to T13-1 (S2) .
6. Slip the $83 / 4^{\prime \prime}$ clear plastic tubing over the wires and push it up as close as possible to the heat sink.
7. A 153/4" heavy black wire to Q11-12 (S1).
8. An $181 / 4^{\prime \prime}$ heavy orange wire to Q11-11 (S1).
9. A $173 / 4^{\prime \prime}$ yellow wire to Q11-10 (S1).
10. A $163 / 4$ " orange wire to T14-2 (S2).
11. A $17^{\prime \prime}$ blue wire to T14-1 (S2).
12. Slip the $10^{\prime \prime}$ black plastic tubing over the wires and push up as close as possible to the heat sink.

This completes the assembly of both the heat sinks. Carefully set these aside, as they will later be mounted to the main chassis. Check your work with double check sheet AHS-1.

The heat sinks provide the mechanical support for the output transistors of the power amplifier but more importantly, they act as extremely efficient heat dissipators to ensure cool operation of the output transistors, assuring stable operation and long life.

### 3.4 Input Switch (S9)

Before starting to wire the switch, it is suggested that you carefully look over the electrical assembly diagrams. Familiarize yourself with all of the switch positions and their numbering system.

Each wire will be bent to the positions shown on the diagrams. The reason for pre-bending the wires is to avoid breaking them when placing the switch in the pre-amplifier chassis. Many of the wires from the switch are connected to the terminal boards at the rear, or go through the grommet holes on the right and left hand side.

Important: Notice the LOCATING LUG shown in the Group 1 diagram of the Input switch (S9). This lug must be oriented so that it matches the diagram for Group 1 since this is the only method for matching the correct wires to the correct pins.

For ease of assembly on the switch, look at Figure 5. This arrangement will hold the switch firmly so that your two hands are free to wire and solder.


CLOSE FLAP ON SHAFT TO HOLD SWITCH SE. CURELY IN PLACE.


FIGURE 5

## Input Switch Assembly Group 1 Env. \#8

Connect the following components and wires to the first deck of the input switch (S9). Be extremely careful to route the wires exactly as shown in the diagram.

## Connect:

1. A 12 K resistor [brown-red-orange] from Deck 1-21 (S1) to Deck 1-16.
2. A .0012 ceramic capacitor with $7 / 8$ " spaghetti from Deck 1-16 to Deck 1-22 (S1).
3. "A $101 / 4$ " twisted green and black wire. Green to Deck 1-23 (S1).
4. "A 9" twisted blue and black wire. Blue to Deck 1-24 (S1).
5. An $11^{\prime \prime}$ twisted red and black wire. Red to Deck 1-13 (S1), and black to Deck 1-17.
6. A $10^{\prime \prime}$ twisted yellow and black wire. Yellow to Deck 1-14 (S1), black to Deck 1-17.
7. A 5 " twisted green and black wire. Green to Deck 1-15 (S1), black to Deck 1-17 (S3).
8. A 7 " violet wire to Deck 1-16 (S3).
9. *A $91 / 2$ " twisted orange and black wire. Orange to Deck 1-18 (S1).
10. A 7" orange wire to Deck 1-19 (S1).
11. A 14 " yellow wire to Deck 1-20.
12. "A 17 " twisted yellow and black wire. Yellow to Deck 1-20 (S2).

## Input Switch Assembly Group 2 Env. \#8

Connect:

1. A 12 K resistor [brown-red-orange] from Deck 2-4 to Deck 2-9 (S1).
2. A .0012 ceramic capacitor using $3 / 4$ " spaghetti from Deck 2-4 to Deck 2-10 (S1).

* The black wire is never connected at this end. To avoid this wire touching any other wire, cut it back $1 / 4$ " and bend it away from the switch.

3. "An $81 / 2$ " twisted green and black/white wire. Green to Deck 2-11 (S1).
4. "A 9" twisted blue and black/white wire. Blue to Deck 2-12 (S1).
5. A $12^{\prime \prime}$ twisted red and black/white wire. Red to Deck 2-1 (S1), black/white to Deck 2-5.
6. An $11 \frac{1}{2}$ " twisted yellow and black/white wire. Yellow to Deck 2-2 (S1), black/white to Deck 2-5.
7. A $10^{\prime \prime}$ green and black/white twisted wire. Green to Deck 2-3 (S1), black/white to Deck 2-5 (S3).
8. A $61 / 2^{\prime \prime}$ violet/white wire to Deck 2-4 (S3).
9. "A twisted $91 / 2$ " orange and black/white wire. Orange to Deck 2-6 (S1).
10. An $83 / 4^{\prime \prime}$ orange/white wire to Deck 2-7 (S1).
11. A $12^{\prime \prime}$ yellow/white wire to Deck 2-8.
12. "A 17 " twisted yellow and black/white wire. Yellow to Deck 2-8 (S2).

Check your work with double check sheets A-SW-1 and A-SW-2.

This completes the wiring of the Input Switch (S9). This switch allows the selection of various program material ranging from extremely low level magnetic phono cartridges and tape heads to the high level outputs of tuners and tape recorders. As previously mentioned, this switch changes the circuitry of the preamplifier to various equalization curves when using phono or tape head inputs.

Carefully set this switch aside until a portion of the next step has been completed; then the switch will be mounted in the preamplifier chassis.
${ }^{* *}$ The black/white wire is never connected at this end. To avoid this wire touching any other wire, cut the wire back $1 / 4^{\prime \prime}$ and bend it away from the switch.

INPUT SWITCH-S9

DECK 1


INPUT SWITCH-S9
DECK 2




### 3.5 Preamplifier

## Mechanical Assembly Env. \#9

Install the two plastic grommets (A-SB-375-3) as shown in Figure 6.

## Preamplifier Assembly Group 1

You will now be wiring the preamplifier subassembly. Make sure that the following connections are mechanically tight before soldering.

Note: Before connecting the two resistors to pins 5,7 , and 8 of S 8 (Steps 1 and 2), it is recommended that you pre-cut and pre-bend their wires to the following approximate dimensions (see Figure 7 in preamp Group 1 drawing); then simply hang them in place for soldering.

## Connect:

1. A 390 ohm resistor [orange-white-brown] from S8-5 (S1) to S8-8.
2. A 1 K resistor [brown-black-red] from S8-7 (S1) to S8-8.
3. Using $1 / 2^{\prime \prime}$ spaghetti on each end, a 390 ohm resistor [orange-white-brown] from S8-1 (S1) to S8-4.
4. A 1 K resistor [brown-black-red] from S8-3 (S1) to S8-4.
5. A .005 ceramic capacitor from G2 to J2-3.
6. A .005 ceramic capacitor from G2 to J3-11.
7. A .005 ceramic capacitor from G1 to J3-9.
8. A .005 ceramic capacitor from G1 to J2-1.
9. A $1 / 2$ " buss wire with spaghetti from J3-13 to J3-15.
10. A $1 / 2^{\prime \prime}$ buss wire with spaghetti from J2-5 to J2-7.
11. A $2^{\prime \prime}$ black wire from J3-15 to G2.
12. A $2^{\prime \prime}$ black wire from J2-7 to G2.
13. A 2.2 M resistor [red-red-green] from G 2 to J2-8.
14. A 2.2 M resistor [red-red-green] from G2 (S6) to J3-16.
15. A 2.2 M resistor [red-red-green] from G1 to J2-6.
16. A 2.2 M resistor [red-red-green] from G1 (S4) to J3-14.
17. A $22^{\prime \prime}$ black wire to J2-7. Insert the other end of the wire through grommet "B."
18. A $231 / 2^{\prime \prime}$ black/white wire to $\mathrm{J} 3-15$. Insert the other end of the wire through grommet "C."
19. Refer to the photographs for proper wire dress. Before placing the input switch (S9) in the preamp chassis, insert the yellow and twisted yellow and black wires from Deck 1-20 through grommet " $B$ " and the yellow/white and twisted yellow and black/white wires from Deck 2-8 through grommet "C." Then position the switch using the locating lug. Be sure the switch bushing is bottomed in its slot before tightening the hex nut. Thread on and tighten the brass hex nut, as shown in Figure 6.
20. A twisted blue and black wire from S9, Deck 1. Blue to J2-8 (S2), black to J2-7 (S4).
21. The twisted green and black wire from S9, Deck 1-23. Green to J2-6 (S2), black to J2-5.
22. The twisted yellow and black wire from S9, Deck 1. Yellow to J2-4 (S1), black to J2-3 (S2).
23. The twisted red and black wire from S9, Deck 1. Red to J2-2 (S1), black to J2-1 (S2).
24. The twisted blue and black/white wire from S9, Deck 2. Blue to J3-16 (S2), black/white to J3-15 (S4).
25. The twisted green and black/white wire from S9, Deck 2-11. Green to J3-14 (S2), black/white to J3-13.
26. The twisted yellow and black/white wire from S9, Deck 2. Yellow to J3-12 (S1), black/white to J3-11 (S2).
27. The twisted red and black/white wire from S9, Deck 2. Red to J3-10 (S1), black/white to J3-9 (S2).

## Preamplifier Assembly Group 2 Env. \#10

## Connect:

1. A $51 / 2^{\prime \prime}$ twisted blue and black/white wire. Blue to S8-8 (S3), black/white to S8-6 (S1).
2. A $71 / 4^{\prime \prime}$ twisted black and blue wire. Blue to $\mathrm{S} 8-4$ (S3), black to S8-2 (S1).
3. A $53 / 4$ " black wire to J2-5 (S3).

Handle the PC boards by the edges so as not to leave impurities on the etching.
4. Mount the two preamplifier printed circuit boards identified by the two mounting feet [PC-1 and PC-2] as shown in Figure 6 using two machine screws for each printed circuit board. Both preamplifier circuit boards are identical; it makes no difference which one is designated PC-1 when mounting them.
5. The orange wire from S9, Deck 1 to PC1-6 (S1) .
6. The violet wire from S9, Deck 1 to PC1-7 (S1) .
7. The twisted blue and black wire from S8. Blue to PC1-5 (S1), black to PC1-3.
8. The black wire from J2-5 to PC1-8.
9. The twisted green and black wire from S9, Deck 1. Green to PC1-4 (S1), black to PC1-3.
10. The twisted orange and black wire from S9, Deck 1. Orange to PC1-9 (S1), black to PC1-8 (S2).
11. Insert one end of a $153 / 4$ " twisted blue and black wire through grommet hole "B." At the other end, blue to PC1-2 (S1), black to PC1-3 (S3).
12. Insert one end of a $121 / 4^{\prime \prime}$ red wire through grommet "B." The other end to PC1-1 (S1).

## Preamplifier Assembly Group 3 Env. \#10

During this third step, you will be wiring the second printed circuit board (PC2).

Connect:

1. The orange/white wire from S9, Deck 2 to PC2-15 (S1).
2. The violet/white wire from S9, Deck 2 to PC2-16 (S1).
3. A $73 / 4$ " black/white wire from $\mathrm{J} 3-13$ (S3) to PC2-17.
4. The twisted blue and black/white wire from S8. Blue to PC2-14 (S1), black/white to PC2-12.
5: The twisted green and black/white wire from S9, Deck 2. Green to PC2-13 (S1), black/white to PC2-12.
5. Insert one end of a $151 / 2^{\prime \prime}$ twisted blue and black/ white wire through grommet "C." At the other end, blue to PC2-11 (S1), black/white to PC2-12 (S3).
6. The twisted orange and black/white wire from S9, Deck 2. Black/white to PC2-17 (S2), orange to PC2-18 (S1) .
7. Insert one end of a $101 / 2^{\prime \prime}$ red/white wire through grommet "C." The other end to PC2-10 (S1).

Pick up the preamp chassis and shake clippings loose.

Check your work with double check sheet APC-1.
Congratulations! You have now completed what is perhaps the most difficult portion of the LK-60. This entire sub-assembly will later be mounted to the main chassis as an integral part of the amplifier.

The preamplifier takes the exceptionally small output from conventional magnetic phono pickups and tape heads ( 3 to 16 thousandths of a volt in most cases) and amplifies the signals up to a level where they can be properly accepted by the control center. As a matter of convenience, the preamplifier also accepts inputs from FM tuners and complete tape recorders which are sufficiently strong so that they do not need this preliminary preamplification. This permits the use of one switch to control all input functions.

Use one of the extra H-SMS-6 x $1 / 4$-HW sheet metal screws supplied in Envelope \#11 to tap (prestart) the holes in the chassis before attaching the mechanical sub-assemblies to the main chassis., This suggested procedure will make it easier to assemble, and will reduce the possibility of stripping a screw and/or the chassis.

PREAMP-GROUP 2



### 3.6 Main Chassis

## Meter Light Socket Mechanical Assembly Env. \#11

Install the meter light socket (XPL-U6) as shown in Figure 8 using 1 H-NK-632 kep nut and $1 \mathrm{H}-\mathrm{MS}$ $632 \times 1 / 4-\mathrm{B}$ machine screw. Hold the socket against the chassis and thread the screw through the socket and attach the nut.

Do not install the light bulb or shield at this time.

## Preamp to Main Chassis Mechanical Assembly

 Env. \#11Mount the completed preamplifier chassis to the main chassis as shown in Figure 9 using 5 H -SMS-6 x $1 / 4$-HW sheet metal screws.

## Preamp Cover Mechanical Assembly Env. \#11

Mount the preamplifier cover to the preamp chassis as shown in Figure 10 using 9 H-SMS-6 x $1 / 4^{-}$ HW sheet metal screws.

Use the bronze colored screw in the position shown.

## Plastic Grommet Installations Env. \#11

Grommets should be pushed through from top of chassis.

Refer to DOUBLE CHECK CHART AM-1.
Insert an A-SB-375-3 grommet in hole "A."
Insert an A-SB-437-4 plastic grommet in holes "D," "E," and "F."

Insert an A-SB-625-8 plastic grommet in holes "G," "H," and "I."

## CEC Can Mechanical Mounting Env. \#11

Install the 3 CEC can brackets as shown in Figure 11 using 2 H -SMS-6 x $1 / 4$-HW sheet metal screws for each bracket. Use 1 H -MS-632 x 1/2-B machine screw and 1 H-NK-632 kep nut, but do not tighten at this time.

Tip the main chassis on its side and install C1 (CEC-2000/65). Be sure to install the CEC can exactly as shown so that the markings on the bottom of the can correspond to Figure 12. Tighten the machine screw on the mounting bracket to hold the can in place.

Install C2 (CEC 1000/75) and C3 (CEC 2000/65) as shown in Figure 12. Make sure the symbols on the bottoms of the cans correspond exactly with the diagram.

Place the main chassis so that you can see the top of the preamp cover. Slightly loosen the machine screw on the mounting bracket of C1. Pull up on C1 (WITHOUT TWISTING) until the top of the can is no higher than the top of the preamp cover. Tighten the machine screw on the mounting bracket to lock the can in position.

Note: A ruler held flat against the top of the pre-amp cover will give you the exact height of the can.

Repeat the previous step for C 3 again being sure that the can is not twisted when pulled up.

Adjust C2 (WITHOUT TWISTING) so that it is $1 / 2$ inch below the top of Cl and C3. Tighten the machine screw so that the can is locked in position.

## Meter/Test Switch Mounting Env. \#11

Install the meter test switch (S13) as shown in Figure 11 using one $\mathrm{H}-\mathrm{N}-3 / 8 \times 1 / 2-\mathrm{B}$ hex nut.

## Front Chassis to Main Chassis Mechanical Assembly Env. \#11

Mount the front chassis to the main chassis as shown in Figure 14 using 6 H -SMS- $6 \times 1 / 4$-HW sheet metal screws. Make sure that no wires are pinched between the front and main chassis.

Insert the orange and orange/white wires from the front chassis through grommet "D."

## Rear Chassis to Main Chassis Mechanical Assembly Env. \#11

Mount the rear chassis to the main chassis as shown in Figure 15 using 7 H -SMS-6 x $1 / 4$-HW sheet metal screws. Refer to electrical assembly Group \#2 of MAIN CHASSIS for proper positioning of wires.

(SRW-52-1) S13 Locating Lug

0
00
00
00
-
(3) HEX NUT
FIGURE 11

FIGURE 12



## Main Chassis Assembly Group 1 Env. \#12

During this next step, you will be wiring the main chassis using some of the wires coming from the preassembled preamplifier section. The connections to S6 and T3 are shown in the small separate diagram with the chassis right side up for ease of construction.

Be especially careful to mount the two large capacitors and the small diode in the direction shown in the diagram. These components are polarized and if placed in backwards can cause damage to other parts of the amplifier.

Connect:

1. The red wire from grommet " B " to $\mathrm{T} 7-2$.
2. The red/white wire from grommet "C" to T7-2.
3. The twisted blue and black/white wire from grommet "C." Blue to T7-1, black/white to T8-2.
4. The twisted blue and black wire from grommet "B." Blue to T7-1, black to T8-2.

Note: Place the wires in Steps 5 and 6 under the two 10 K resistors which have previously been installed on the front assembly.
5. The black/white wire from grommet "C" to T3-2. (Put this wire under the switch [S9] shaft and with the wires from grommet "B.")
6. The twisted yellow and black/white wire from grommet "C." Yellow to S6-4 (S1), black/white to T3-2 (S5).
7. The black wire from grommet " $B$ " to $\mathrm{T} 3-1$.
8. The twisted yellow and black wire from grommet "B." Yellow to S6-1 (S1), black to T3-1 (S5).
9. The yellow wire from grommet "B" to J4-3 (S1) .
10. The yellow/white wire from grommet " $C$ " to J4-5 (S1).
11. The twisted green and black wire from S 6 and T3 to J4. Green to J4-1 (S1), black to J4-2 (S1).
12. The twisted green and black/white wire from S6 and T3 to J4. Green to J4-7 (S1), black/white to J4-8 (S1).
Note: Refer to Fig. 16 for heat sink illustration.
13. The pointed or banded end of the DZ27 diode to T8-1 and the other end to T8-2.
14. A large 1.5 K 2 watt resistor [brown-green-red] from T8-3 to T8-4.
15. A large 1.5 K 2 watt resistor [brown-green-red] from T8-3 to T8-1.
16. A 150 ohm resistor [brown-green-brown] from T7-2 to T8-1 (S3).
17. The red or positive end of a $250 \mathrm{mfd} / 50 \mathrm{v}$ tubular capacitor to T7-2, the other end to T8-2.
18. The red or positive end of a $1000 \mathrm{uf} / 30 \mathrm{v}$ tubular capacitor to T7-1, the other end to T8-2 (S5).
19. An 8.2 K resistor [grey-red-red] from T7-2 to T7-1 (S4).

## Main Chassis Assembly Group 2 Env. \#12

Route the following wires through grommet "I" on the main chassis and connect:

On all units with $110 / 220 \mathrm{v}$ power transformers, the construction steps in brackets should be omitted - refer to construction steps in Section 3.7 for correct wiring. For domestic 117v units the following bracketed steps should be completed.

1. The heavy red wire from F3-6 to X1-2. See step 2, Section 3.7.
2. The heavy white wire from S12-2 to X2-3 (S1).
3. The heavy grey wire from S12-5 to X2-4.
4. The heavy twisted green and blue wire from S2 (front chassis). Blue to F1-2 (S1) and green to F2-4 (S1).
5. One end of the line cord to F3-6 (S3), the other end to S12-1 (S2).

Note: Twist the two black transformer wires together.
6. The longest of the two black leads from the power transformer to F3-5 (S1). Delete this step on $110 / 220 \mathrm{v}$ units.

Note: Place the six wires coming from T4, S10, S 11 , and T 6 through grommet " H " on the main chassis. These will be connected during the next step.

Route the blue wire from F1-1 and green wire from F2-3 through grommet "I." These wires will be connected during the next step.



## Main Chassis Assembly Group 2B Env. \#12

Insert green and green/white wires from grommet "H" through grommet "F."

Connect:
7. The orange/white wire from grommet " H " to C3-6.
8. The heavy green wire from grommet "I" to C3-6 (S2).
9. The orange wire from grommet " H " to $\mathrm{C} 1-1$.
10. The heavy blue wire from grommet " I " to $\mathrm{C} 1-1$ (S2).
11. The heavy black wire from T5-4 to C2-4.

Note: There will be a total of 7 wires attached to C2-4 when the main chassis is completed. Be extremely careful when wrapping the wires to leave enough room for all the wires.
12. The heavy black wire from T5-3 to C2-4.
13. The heavy twisted red and grey wire from S2 (front chassis). Red to T5-1 (S1), grey to T5-6 (S1).
14. The heavy twisted yellow and orange wire from S2 (front chassis). Yellow to T5-2 (S1), orange to T5-5 (S1).

On all units with $110 / 220 \mathrm{v}$ power transformers, the construction steps in brackets should be omitted - refer to construction steps in Section 3.7 for correct wiring. For domestic 117v units the following bracketed steps should be completed.
15. The heavy red wire in the black cable from S1 (front chasis) to X2-4.
(S2), the heavy white wire in the black cable from S1 (front chassis) to X1-1. See Step 3, Section 3.7.
16. The second black wire from the transformer to X1-1. See step 4, Section 3.7.
17. A $1^{\prime \prime}$ heavy buss wire from R2-3 (S1) to R1-1.
18. A $7^{\prime \prime}$ heavy red wire from R1-1 (S2) to C2-3.
19. The red/yellow wire from the power transformer to C2-4.

Note: Twist the two red transformer wires together.

Note: If the power rectifiers, R1 and R2, are supplied with a wire instead of an "eye," then cut back rectifier wire to be $5 / 8^{\prime \prime}$ long as measured from the end of the body of the rectifier. This will leave about $5 / 16^{\prime \prime}$ of wire to which connections can be made; proceed as below.
20. One of the twisted red wires from the power transformer to R1-2 (S1).
21. The other twisted red wire from the power transformer to R2-4 (S1).
22. The black/white wire from grommet " H " to $\mathrm{T} 9-3$.
23. The black wire from grommet "H" to T9-2.
24. A $73 / 4$ " heavy black wire from T9-3 to C2-4.
25. A $73 / 4$ " heavy black wire from T9-2 to C2-4.

For $110 / 220 \mathrm{v}$ conversion, see steps $5,6,7$, and 8 , Section 3.7.

## Main Chassis Assembly Group 3 Env. \#13

Connect:

1. A $61 / 4^{\prime \prime}$ red wire to $\mathrm{T} 7-2$. Insert the other end through grommet "D."
2. An $8^{\prime \prime}$ red wire to T7-2 (S7). Insert the other end through grommet "D."
3. A $121 / 4^{\prime \prime}$ blue wire to C1-2. Insert the other end through grommet "F."
4. A $7^{\prime \prime}$ blue/white wire to C3-5. Insert the other end through grommet "F."
5. A $13^{\prime \prime}$ black wire to T9-2. Insert the other end through grommet "F."
6. A $91 / 4$ " black/white wire to T9-3. Insert the other end through grommet "F."
7. An $8^{\prime \prime}$ heavy orange wire from T9-4 to C3-5.
8. A $51 / 2^{\prime \prime}$ heavy yellow wire from T9-1 to C1-2.
9. A 5 " red wire from $\mathrm{T} 8-3$ to $\mathrm{C} 2-3$.

Note: Handle the PC boards by the edges so as not to leave impurities on the etching.
10. Turn the chassis right side up and mount PC6 and PC5 (Z-PC-T1) as shown in Figure 17 using 4 H-MS-632 x $1 / 4$-B machine screws for each board. Do not overtighten the screws as this can crack the board.
Mount PC4 and PC3 (Z-PC-D4) as in the previous step.
11. The orange wire from grommet "D" to PC6-12 (S1).
12. The orange/white wire from grommet "D" to PC5-5 ( S 1 ).
13. The short red wire from grommet " $D$ " to PC6-14 (S1).
14. The second red wire from grommet "D" to PC5-7 (S1).
15. An 11" black wire from PC4-12 to PC6-9.
16. The black wire from grommet " F " to $\mathrm{PC} 4-12$ (S2).
17. The blue wire from grommet " F " to $\mathrm{PC} 4-15$ (S1).
18. The green wire from grommet " $F$ " to PC4-10 (S1).
19. The green/white wire from grommet " $F$ " to PC3-1 (S1).
20. The black/white wire from grommet " $F$ " to $\mathrm{PC} 3-3$.
21. The blue/white wire from grommet " $F$ " to PC3-6 (S1).
22. A $121 / 2^{\prime \prime}$ black/white wire from PC3-3 (S2) to PC5-2.



## Heat Sinks to Main Chassis Mechanical Assembly Env. \#13

Mount Heat Sink \#1 and Heat Sink \#2 to the main chassis as shown in Figure 18 using $2 \mathrm{H}-\mathrm{MS}-$ $632 \times 1 / 4-\mathrm{B}$ machine screws for each heat sink.

Insert the clear and black cables from Heat Sink \#1 through grommet "G" and the clear and black cables from Heat Sink \#2 through grommet "H."

## Main Chassis Assembly Group 4 Env. \#13

Note: Before starting this assembly group, position the two black cables coming from grommet " H " and grommet " G " side by side on the chassis. Take the small orange and the yellow wire from the black cable from grommet " H " and the violet, red, and green wires from the black cable from grommet "G" and push them through grommet "E." Do not position the clear cables at this time. These will be wired later in this assembly group.

Connect:

1. The heavy orange wire from black cable " H " to T9-1.
2. The blue wire from black cable " H " to $\mathrm{T} 9-5$.
3. The heavy black wire from black cable "H" to T10-7.
4. The heavy blue wire from black cable "G" to T10-6.
5. The small blue wire from black cable " G " to T9-5 (S2).
6. The heavy red wire from black cable "G" to C2-3.

Note: Now dress the two clear cables side by side on top of the two black cables. Take the small orange/white and the yellow/white wire from the clear cable coming from " H " and push through grommet "E." Take the violet/white, red/white, and green/ white from the clear cable coming from grommet " G " and push through grommet "F."
7. The heavy black/white wire from clear cable " H " to T10-8.
8. The heavy orange/white wire from clear cable "H" to T9-4.
9. The blue/white wire from clear cable " H " to T10-10.
10. The heavy red/white wire from clear cable "G" to C2-3.
11. The heavy blue/white wire from clear cable "G" to T10-9.
12. The blue/white wire from clear cable " $G$ " to T10-10 (S2).
13. A .005 ceramic capacitor from $\mathrm{C} 2-3$ to $\mathrm{C} 2-4$.

Note: Turn the chassis right side up so that the four PC boards are facing you. The rest of this assembly group will be connecting the wires coming from grommet " F " and grommet " E " to the PC boards.
14. The orange/white wire from grommet " E " to PC3-9 (S1).
15. The violet/white wire from grommet " $F$ " to PC38 (S1).
16. The red/white wire from grommet " F " to $\mathrm{PC} 3-7$ (S1).
17. An $83 / 4^{\prime \prime}$ green/white wire from PC3-2 (S1) to PC5-6 (S1).
18. A $71 / 2^{\prime \prime}$ green wire from PC4-11 (S1) to PC6-13 (S1).
19. The orange wire from grommet "E" to PC4-18 (S1).
20. The violet wire from grommet "E" to PC4-17 (S1).
21. The red wire from grommet "E" to PC4-16 (S1).
22. The yellow/white wire from grommet "E" to PC3-4 (S1).
23. The green/white wire from grommet " $F$ " to PC3-5 (S1).
24. The yellow wire from grommet "E" to PC4-13 (S1).
25. The green wire from grommet "E" to PC4-14 (S1).

## Power Amplifier Section

You have now mounted and completed most of the wiring for the power amplifier section of the LK-60. This section consists of the two driver printed circuit boards (Z-PC-D4) and the two heat sinks with their output transistors.

The driver printed circuit boards give preliminary power amplification and prepare the signals to drive the output transistors. The output transistors deliver the high amount of power required to physically move the speaker cone. The purpose of the high fidelity power amplifiers is to take very weak signals, increase their strength tremendously and convert them into watts of power necessary to operate the speakers. The amplifier must do this without adding or subtracting or altering the contents of the original signal in any way. Such alteration of the original program material is referred to as "distortion."

## Main Chassis Assembly Group 5 Env. \#14

On all units with $110 / 220$ v power transformers, the construction steps in brackets should be omitted - refer to construction steps in Section 3.7 for correct wiring. For domestic 117v units the following bracketed steps should be completed.

Connect:

1. A .0047 high voltage ceramic capacitor from X1-1 (S3) to X1-2. See step 9, Section 3.7.
2. An 820 K resistor [grey-red-yellow] from G3 to X1-2. See step 10, Section 3.7.
3. A .0047 high voltage ceramic capacitor from G3 (S2) to X1-2 (S4). See step 11, Section 3.7.
4. The wire from the meter light socket to T8-4 (S2).
5. An $81 / 2^{\prime \prime}$ red wire to $\mathrm{T} 8-3$ (S4). Insert the other end through grommet "A."
6. An $11 \frac{1}{2} 2^{\prime \prime}$ white wire to T10-7. Insert the other end through grommet "A."
7. A $101 / 4^{\prime \prime}$ black/white wire to T10-8. Insert the other end through grommet "A."
8. An $113 / 4$ " blue/white wire to C3-5. Insert the other end through grommet "A."
9. A $121 / 4^{\prime \prime}$ black wire to C2-4 (S7). Insert the other end through grommet "A."
10. A $13^{\prime \prime}$ blue wire to C1-2. Insert the other end through grommet "A."
11. A 39 K resistor [orange-white-orange] from C2-3 to Cl-2 (S4).
12. A 39 K resistor [orange-white-orange] from C2-3 (S7) to C3-5 (S4).
13. A 82 ohm wire wound resistor from T9-1 (S3) to $\mathrm{T} 10-6$ (S2).
14. A . 82 ohm wire wound resistor from T9-2
(S4) to $\mathrm{T} 10-7$ (S3).
15. A 82 ohm wire wound resistor from T9-3 (S4) to $\mathrm{T} 10-8$ (S3).
16. A .82 ohm wire wound resistor from T9-4 (S3) to $\mathrm{T} 10-9$ (S2).

Main Chassis Assembly Group 6 Env. \#14
Turn chassis right side up.

## Connect:

1. The blue wire from grommet "A" to S13-1 (S1).
2. The white wire from grommet " $A$ " to S13-3.
3. The black wire from grommet "A" to S13-6.
4. The black/white wire from grommet "A" to S13-7.
5. The blue/white wire from grommet " A " to $\mathrm{S} 13-8$ (S1).
6. The red wire from grommet "A" to S13-12.
7. A $61 / 2^{\prime \prime}$ red wire to $\mathrm{S} 13-11$ (S1).

Note: The other end of this wire should be placed through the meter cutout on the front chassis and will be connected at a later time when the meter is installed.
8. A $3^{\prime \prime}$ black wire from S13-4 (S1).

Note: This wire should be placed through the meter cutout near the front panel and will be connected later when the meter is installed.
9. A $3^{\prime \prime}$ green wire from S13-10 (S1) to PC6-8.
10. A $43 / 4^{\prime \prime}$ green/white wire from S13-2 (S1) to PC5-1.
11. A 1.8 K resistor [brown-grey-red] from $\mathrm{S} 13-9$ to S13-7 (S2).
12. A 1.8 K resistor [brown-grey-red] from S13-3 (S2) to S13-9 (S2).
13. A large precision 150 K resistor from S13-5 to S13-6 (S2).
14. A large precision 150 K resistor from S13-12 (S2) to S13-5 (S2).
15. The blue wire from T2-2 to PC6-11 (S1).
16. The yellow wire from T2-4 to PC6-10 (S1).
17. The twisted green and black wire from $\mathrm{S} 5-1$ and T3-1 Green to PC6-8 (S2), black to PC6-9 (S2).
18. The blue/white wire from T2-1 to PC5-4 (S1).
19. The yellow/white wire from T2-3 to PC5-3 (S1).
20. The twisted green and black/white wire from S5-4 and T3-2. Green to PC5-1 (S2), black/white to PC5-2 (S2).
Pick up unit and shake any loose clippings out.



RED SLASHES INDICATE HAZARDOUS
AREAS WHEN POWER IS ON.

### 3.7 110/220 Volt Conversion

 UnitsThis page contains the instructions necessary to wire the LK-60 that is suppled with a 1110/220v Power Transformer. (These units are available only outside the continental United States.)

In the main part of the construction manual some steps appear with heavy brackets
steps appear with heavy brackets
Example: Rear Chassis Assembly Group 1, Step 23. When these steps are reached during construction, you will be referred to this page for the necessary wiring steps for $110 / 220 \mathrm{v}$ conversion.

The correct wiring diagrams for these steps appear on this page along with the Double Check Chart AR-2.

## Connect:

1. Take the roll of extra blue wire and cut off a $61 / 2^{\prime \prime}$ length. Strip the ends of the insulation back $1 / 8^{\prime \prime}$. Connect one end to F3-5 (S1) and push the other end through grommet " ${ }^{1}$."
2. The blue wire from grommet "I" to S14-4
3. The white wire in the black cable from S1 [fron chassis] to S14-1.
4. The black wire from the Power Transformer to S14-1
5. A $3 / 4$ " buss wire from S14-6 (S1) to S14-3 (S1)
6. The green/black wire from the Power Trans The green/black
7. The yellow/black wire from the Power Transformer to S14-5 (S1).
8. The red/black wire from the Power Transformer to S14-2 (S1).
9. A . 0047 high voltage capacitor from X2-4 to G3,
10. An 820 K resistor [gray-red-yellow] from X2-4 (S4) to G3 (S2)
11. A 0047 high voltage ceramic capacitor from S14-1 (S3) to S14-4 (S3)

## AR-2




APC-2



FIGURE 20


FIGURE 21

## Fuse Installation

Install 2 F-AGX-2 (2 Amp Instrument) fuses into the fuse holders as shown in Figure 1. Note: The F-AGX-2 Fuse is short in length and has a very thin wire inside. Push the fuse into the cap and then twist the fuseholder cap clockwise to lock it in position. Repeat the above procedure for 1 FSB- $11 / 4$ (Slo-Blo power fuse) using the conical cap.

## Knob Assembly

Turn the "Bass," "Treble," "Balance" and "Loudness" control shafts completely counter-clockwise

Position a large knob on the shaft of the "Bass" control so that the indicator on the knob is in the most counter-clockwise position. Tighten the set screw. Assemble a small knob in the same manner.

Repeat the above step for the "Treble" control.
Assemble a medium-size knob to the "Balance" control in the same manner as above.

Assemble the "Loudness" control knob in the same manner. (Since no marking is on the knob, position the set screw so that it is in the upper right hand side. Refer to set screw position on "Balance" control.)

The "Stereo Selector" and "Input Selector" switches each have one flat side. Assemble a mediumsize knob to each so that the set screw is against the flat side, and tighten the set screw.

## Bottom Cover Assembly

Install the bottom cover and four feet as shown in Figure 21. The bottom cover is attached with 6 H-SMS-6 x $1 / 4$-HM sheet metal screws. The feet are attached with 4 H -SMS- $6 \times 1 / 2$-HW sheet metal screws.

## Labels

Install the labels on the top cover as shown in Figure 22. Install the "Meter Function Switch" label on the bottom cover as shown in Figure 23. For layout of printed circuit boards see page 64 of this manual.


FIGURE 22 POSITIONS OF LABELS FOR LK-60

## Section 4 - Adjusting The Balance and Bias Controls Without Instruments

The advanced design of your LK-60 transistor amplifier would ordinarily require complex laboratory equipment to insure the full performance of this remarkable instrument. For those who have good test equipment available, you must make your first checks and adjustments using the procedure here, and then you may turn to Section 7, "Technical Service Instructions," for your final testing. However, for those without test equipment, Scott engineers have perfected a simple method that uses the meter on the front of the amplifier and guarantees equally superb results if you have carefully followed the wiring instructions. Follow the step-by-step instructions below:

### 4.1 Component Layout

As you know, your LK-60 consists of two complete amplifiers, one for the left channel speaker and a duplicate amplifier (with common controls) for the right channel speaker. All of the printed circuit boards and input and output plugs for the left channel are on the left as viewed from the front of the chassis. All of the audio signal wires for the left channel are solid colors. Correspondingly, all of the printed circuit boards and input and output plugs for the right channel are on the right as viewed from the front of the chassis. All of the audio signal wires for the right channel are striped colors. Reference to the labels on the covers of your LK-60 will be of further assistance in locating components. For the instructions below, you will need to refer to the DRIVER Printed Circuit Board layout as shown on page 64.

### 4.2 Initial Test

Set the LK-60 on its side with the transformer side down and the panel facing you.
a. Setting your unit up for the Initial Test.

Turn the BIAS ADJUST controls (R11) on each DRIVER PC Board fully counter-clockwise for minimum current in the power amplifier. Turn the BALANCE ADJUST controls (R6) on each DRIVER PC board fully clockwise for the highest voltage on the plus side of the output coupling capacitors. Under the unit is the METER FUNCTION SWITCH. With a screwdriver, turn it to its normal position, POWER MONITOR. On the rear of the chassis is the INITIAL TEST slide switch. Move the slide switch up to the INITIAL TEST position. Set the LOUDNESS (vol-
ume) control on the front of the amplifier to the minimum position, which is fully counter-clockwise. Make sure that the POWER slide switch is OFF. Take the ordinary 15 watt electric light bulb and screw it into any handy table lamp. Plug the lamp into a wall receptacle and turn it on to make a mental note of the brilliance of the bulb. (If you have an extra 15 watt bulb, you might also plug it into a wall receptacle and leave it on for a reference.) [For those of you who have $110 / 220$ volt conversion units, switch the LINE VOLTAGE SWITCH to the correct power line voltage (if you don't know the voltage, contact your local electric power plant) and use a 15 watt electric light bulb of the correct power line voltage.]

## b. Making the Initial Test.

Read these entire instructions first before starting. It is best if you have this section partially memorized. Note the position of the needle on the POWER MONITOR panel meter, this is zero current and it should agree with Figure 24, "Meter Indications for Bias and Balance Adjustments."


FIGURE 23 METER FUNCTION SWITCH LABEL


FIGURE 24 METER SCALE

In a few cases when the air is very dry (relative humidity low), static electricity may make the meter needle become charged and move off zero current as you are unpacking and handling the meter. This is normal. You may simply discharge the meter by wetting your finger and wiping it across the front or rear face of the meter in the direction you wish the needle to move.

Leaving the switch of the lamp on, connect the AC plug of the 15 watt lamp into the UNSWITCHED RED ACCESSORY OUTLET on the back of the LK60. Connect the amplifier power cord to any convenient AC wall outlet (never use DC or you will destroy the amplifier). While watching the 15 watt lamp, turn the LK-60 POWER slide switch to ON. At first, the light bulb will get somewhat bright and then quickly dim to an illumination well below your mental reference point. The panel meter should read zero current. If these conditions do not exist, then stop here, turn the amplifier off, remove the power cord and carefully check the wiring associated with the OUTPUT transistors, the DRIVER PC boards, the METER FUNCTION SWITCH and the power supply. If all is well with the previous test, then procede with the following checks. Turn the METER FUNCTION SWITCH to BAL. RIGHT CH; the meter should read somewhere between 3 and 6. Turn the METER FUNCTION SWITCH to BIAS RIGHT CH; the meter should read zero current. Turn the METER FUNCTION SWITCH to BAL. LEFT CH; the meter should read somewhere between 3 and 6 , and it may not be the same reading as it was for the right channel. Turn the METER FUNCTION SWITCH to BIAS LEFT CH ; the meter should read zero current. Return the METER FUNCTION SWITCH to its normal position, POWER MONITOR.

If the above checks are satisfactory, chances are that you have made no serious errors, and you can go ahead with the next adjustments. However, if the bulb stays bright and does not dim and the meter indications are not correct, then something is wrong. Turn the amplifier off. Further operation and especially normal OPERATE (the INITIAL TEST switch down) without the 15 watt lamp will probably lead to instantaneous burnout of the expensive silicon OUTPUT and DRIVER transistors. Disconnect the power cord and check the wiring related to the OUTPUT transistors, DRIVER boards, and METER FUNCTION SWITCH. Referring to Section 4.4, "TroubleShooting the Power Amplifier" will show you the specific wiring to check.

### 4.3 Balance and Bias Adjustment

Assuming all is well so far, turn the amplifier OFF, disconnect the 15 watt lamp and move the INITIAL TEST slide switch to the OPERATE position. Make sure that the LOUDNESS (volume) control is still at minimum and observe the zero current position of the meter. READ THE ENTIRE FOLLOWING INSTRUCTIONS FIRST BEFORE STARTING. It is best if you have this Balance and Bias Adjustment section partially memorized, for then you can follow the procedure through without hesitation. UNDUE HESITATION WITH INCORRECT METER READINGS CAN LEAD TO BURNING OUT THE DRIVER TRANSISTORS.

## a. Preliminary Checks.

With the METER FUNCTION SWITCH in the POWER MONITOR position, turn the amplifier on. The meter may jump up and then immediately go back to zero current and stay there, if not, then immediately turn the unit off and look for mis-wires between the DRIVER boards and OUTPUT transistors. If all is well, procede. Immediately turn the METER FUNCtion SWITCH all the way to BIAS RIGHT CH. and then to BIAS LEFT CH. In both cases, the meter should read zero current and not climb up-scale towards 10 . If the meter does not stay at zero current, then quickly turn the amplifier off and check the wiring. Recheck the BIAS RIGHT CH. to make sure the meter still reads zero current a few seconds later. Switch the METER FUNCTION SWITCH to the two BAL. positions. The meter will be somewhere between 1 and 8 for each position. If all of the meter indications are correct, then all of your worries about catastrophic mis-wires are over. However, if they are not correct, refer to Section 4.4, "Trouble-Shooting the Power Amplifier," for specific directions in locating mis-wires.
b. Balance and Bias Adjustments-Left Channel.

Turn the METER FUNCTION SWITCH to BAL. LEFT CH. Turn the BALANCE ADJUST control (R6) for the left channel (located on the left channel DRIVER PC board) until the meter indicates zero current. Turn the METER FUNCTION SWITCH to BIAS LEFT CH. Turn the BIAS ADJUST control (R11) until the meter indicator reads $11 / 2$. Refer to Figure 24 "Meter Indications for Bias and Balance Adjustments." Return the METER FUNCTION SWITCH to BAL. LEFT CH. to make sure the meter is still on zero current. If not, readjust.
c. Balance and Bias Adjustments-Right Channel.

Repeat the procedure given directly above in 4.3b, "Balance and Bias Adjustments - Left Channel" on the Right Channel.
d. Turn the METER FUNCTION SWITCH back to the normal position, POWER MONITOR.

In this position there will be a meter indication of approximately " 1 " with the LOUDNESS control at its present minimum position. Leave the amplifier on for about 1 hour so that the DRIVER PC board transistors will completely warm up. During this time the meter indication may increase from " 1 " up to as high as " 2 ."

Repeat the "Balance and Bias Adjustments" for both channels. Sections 4.3a and 4.3b above. Return the METER FUNCTION SWITCH to the normal position, POWER MONITOR. Again the meter indication will be approximately " 1 " with the LOUDNESS control at its present minimum position. The needle, of course, will move when you are normally operating your LK-60.

Note: Normal changes in power line voltage throughout the day, and from day-to-day, along with warming up of the transistors, may cause the meter
readings to vary slightly up and down approximately $11 / 2$ scale divisions. This is normal.

The amplifier is now ready to use. CONGRATULATIONS! You have just completed the finest transistor amplifier kit available. To make sure that you obtain the maximum enjoyment from your handiwork, turn to the next section on OPERATING INSTRUCTIONS. The above adjustments only check out the DRIVER and OUTPUT sections (POWER AMPLIFIER) of your LK-60. As you set your amplifier up for operation, you will also be checking out the PREAMPLIFIER, CONTROL CENTER and TONE CONTROL sections of the LK-60. Thus, if these sections do not work properly, then recheck them for mis-wires. Referral to Section 7, "Operational Trou-ble-Shooting Without Instruments" for instruction on isolating any difficulties to specific areas in your LK-60.

## Top Cover Assembly

Assemble the top cover to the main chassis as shown in Figure 25, using 10 H -SMS-6 x $3 / 8$-BBS sheet metal screws. Make sure no wires are pinched between the top cover and the main chassis.


FIGURE 25

### 4.4 Trouble-Shooting The Power Amplifier

The following sections refer directly to specific paragraphs in the test procedure. If you have had any difficulty in any of the initial test, and/or "Balance and Bias Adjustment" procedures, refer back to the paragraph you were originally having difficulty with and locate that paragraph below.

## Component Layout

|  | Left Channel | Right Channel |
| :--- | :--- | :--- |
| Output transistors | Q10 \& Q11 | Q110 \& Q111 |
| Driver PC boards | PC-4 | PC-3 |
| Tone Control PC boards | PC-6 | PC-5 |

## Trouble-Shooting for 4.2b "Initial Test"

If the light bulb remains bright or the meter indications are incorrect, TURN THE UNIT OFF AND REMOVE THE PLUG FROM THE WALL RECEPTACLE. Check the following interconnecting wires by referring to the following assembly steps to check out wires and connections.

## Trouble-Shooting for Driver Boards and Output Transistors, Heat Sink Group 1, Main Chassis Group 3 and 4.

Right Channel
PC3-8 to HS1 (Heat Sink \#1) - T12-1
PC3-9 to HS2 (Heat Sink \#2) - T13-2
PC3-4 to HS2-7
PC3-5 to HS1-4
PC3-6 to C3-5
Left Channel
PC4-17 to HS1-T11-1
PC4-18 to HS2-T14-2
PC4-13 to HS2-10
PC4-14 to HS1-1
PC4-15 to Cl-2
Power Supply
Main Chassis, Group 2B
C2-3 to R1-1 and R2-3
R1-2 and R2-4 to 2 Red transformer wires
C2-4 to Yellow/Red transformer wire
C2-4 to T5-3 and T5-4
Main Chassis, Group 3
C1-2 to T9-1
C3-5 to T9-4
T9-2 to PC4-12
PC4-12 to PC6-9
T9-3 to PC3-3
PC3-3 to PC5-2
Main Chassis Group 4-Heat Sink Group 1
T9-5 to HS1-T11-2
T9-5 to HS2-T14-1
T10-6 to HS1-3
T10-10 to HS1-T12-2
T10-10 to HS2-T13-1
T9-4 to HS2-8
T9-1 to HS2-11

Violet/White wire
Orange/White wire
Yellow/White wire
Green/White wire
Blue/White wire
Violet wire
Orange wire
Yellow wire
Green wire
Blue wire

Red wire (large)

2 Black wires (large)
Yellow wire (large)
Orange wire (large)
Black wire
Black wire
Black/White wire
Black/White wire
Blue wire
Blue wire
Blue wire (large)
Blue/White wire
Blue/White wire
Orange/white wire (large)
Orange wire (large)

T10-9 to HS1-6
T10-8 to HS2-9
T10-7 to HS2-12

## Main Chassis, Group 5

Check placement of the 4 RW5-. 82 ohm resistors. Make sure they are connected only from Pins 1 through 4 of T9 and Pins 6 through 9 of T10. None of the resistors should be connected to T9-5 or T10-10. None of the resistor leads should short to the chassis.

## Driver PC Boards

Check the polarity of the large tubular capacitors on the Driver Boards using the Driver Board Label as a guide. The plus sign on the label should correspond with the red end and/or the plus mark on the capacitor.

Blue/White wire (large)
Black/White wire (large)
Black wire (large)

## Meter Function Switch

Check the meter function switch wiring by referring to MAIN CHASSIS, GROUPS 5 and 6.

Trouble-Shooting for 4.3a, b, c "Balance and Bias Adjustments"

If the Bias and Balance checks cannot be accomplished, refer to Trouble Shooting for 4.2 "Initial Test."

## Section 5 - Installation And Operating Instructions

## Installation

Your Scott amplifier can be placed on a table or bookshelf, in existing furniture like an end table, buffet, or room divider, or in a specially designed equipment cabinet. A handsome hand rubbed wood accessory case is available from your dealer in finishes to blend with your decor. Wherever the amplifier is placed, some provision should be made for ventilation: at least $4^{\prime \prime}$ of space above and behind the unit where air may circulate freely. If it is installed in a cabinet, the cabinet should have an open back. Do not put magazines, books, papers, etc., directly on top of the amplifier or its accessory case, as this will restrict the ventilation required for the amplifier to perform properly. To help disperse heat rapidly, Scott employs aluminum in the construction of the chassis and in the oversized heat sinks (radiators). The heat sinks cannot function properly if the ventilation is obstructed as outlined above. See Customers Mounting Template, Section 9, for shelf cut-out and custom mounting procedure.

Under no circumstances should the amplifier ever feel hot to the touch. If the solid state amplifier is allowed to overheat the internal temperature of the transistors will increase so rapidly that they will burn out before any preventive measures can be taken. This is known as thermal runaway.

If the amplifier is to be installed in the same cabinet with a solid state FM tuner, always place the amplifier above the tuner or beside it. Never mount
it below the tuner, as the heat from the power transformer in the amplifier may cause drift in the tuner. If installed with a vacuum tube tuner, however, place the amplifier below the tuner.

For vertical mounting the face panel is not designed to support the weight of the unit. Therefore, a vertical "shelf" must be installed so that the unit may be mounted in the same manner as that used for horizontal custom mounting. Ventilation is now an acute problem because air becomes trapped within the unit. For these reasons, the back and the bottom of the cabinet must be left open and/or a ventilating fan installed in the cabinet. See mounting template for custom mounting hardware description.

## VERTICAL MOUNTING



## Connecting the Amplifier

Note: Do not connect or disconnect anything to the LK-60 without first making sure the amplifier is turned off. This will prevent possible blowing of protantivo fucos


SERIAL NUMBER
In case of difficulty, always refer to model
and serial number in your correspondence.

SPEAKER IMPEDANCE switch If your main and remote speakers are all 8
or 16 ohms impedance, set slide switches to or 16 ohms impedance, set slide switches to
the 8.16 position. If any speaker in either the $8-16$ position. It any speaker in either
channel is 4 ohms, move slide switch for that channel to the 4 ohm position. If you plan to connect several speakers in parallel, be
sure to read special instructions on speaker sure to read special instructions on speaker connections.
Always replace with the correct type and value. Avoid speaker
fuses from blowing oo

NITIAL TEST switch
When using the amplifier leave in the OPERATE position. Do not move switch when

AC LINE CORD
Connect to any 105 to 120 volt AC wall out Cot. Do no connect to DC. Either 60 cycles
lor 50 cycles is satisfactory. For $110 / 202$ volt
or or 50 cycles is satisfactory. [For $110 / 220$ volt Conversion Models, make sure that the line
voltage switch is in the correct position.]

Accessory Outlets
AC POWER at the black receptacle goes on and off as the amplifier is turned ON and OFF. T should be plugged in here

AC POWER at the red $A C$ receptacle is on as long as the amplifier itself is connected to as long as the amplifier itself is connected to an
AC outlet. Connect the line cord of a turnAC outlef. Connect the line cord of a turn-
table, changer, or tape recorder here, and
make sure you turn it on or off independently.


TAPE RECORDER jacks For full details, see the section entitled TAP
grounding
For lowest hum, many record players and tape decks have to be grounded to the amplitape decks have to be grounded to the ampli-
fier chassis. Connect ground wires to the copper-colored screw on the top rear of the amplifier.

TAPE HEAD
Used with tape decks without preamplifiers
for playback only. See "Tape Recording."
record player
The LK-60 is designed to work with any good quality magnetic cartridge. If you desire to
use a ceramic cartridge, be sure to use special adaptors that permit you to connect such a cartridge to the MAG. PHONO inputs.

TUNER
If the tuner has a level control, adiust it so that the over-all loudness does not vary when EXTRA This set of inputs can be used for any high level source like an AM tuner, TV sound, o

## PHONO SENSITIVITY Switch

Set to A for cartridges with output above $8 \mathrm{mv}$. . B for those between 5 and 8 mv ., and
Cor those below 5 mv . If this information
is not available, turn LOUDNESS control o
front to 12 o'clock position and set sensitivity switch for average room volume (as loud as you would ordinarily want).
evel source like an
a second tape player.


LEFT SPEAKER

Connecting And Using Your LK-60 Amplifier

Above and on the next page are two photographs one showing how to connect the LK-60 to the rest of your music system, the other indicating the functions of
the various controls. Careful study of these two charts plus the additional material will allow any member of your family to operate the amplifier properly

## power monitor meter

The indicator needle shows the combined re ative power output from both channels of the
amplifier. The meter circuitry is so designed that when using 8 chm itry is so designe reading of ten on sound speaks indicater ate your amplifier is is just delivering maximum your amplifier is just delivering maximum
power output. The meter is also useful as a check on the operation of your remote speakers. If the speakers are disconnected, there

## TAPE switch

IN position is for listening to tape played on a tape deck with playback electronics. Always return to OUT position when you finish with the tape. Can also be used to monitor recordings with certain types of recorders.

## rumble filter

Reduces low frequency sounds below 50
cycles. Helps improve tone quality in the presence of turntable rumble or other low
frequency noises.

## SCRATCH FILTER

Reduces high frequency sounds above 5000 cycles. Improves sound of old, noisy records hiss.

## OUDNESS control

Rotate clockwise to increase volume.

## COMPENSATOR switch

In the "L" position a circuit automatically boosts the extreme high and low notes whe the LOUDNESS is set for low volume levels. It has no effect on the sound at loud levels. mproves the tonal balance by compensating
or the relative insensitivity of the ear to very high and very low notes at low volume levels. In the " $V$ " (volume) position this circuit is inoperative and the frequency response of the amplifier is flat.

NPUT switch
PHONO - for playing phonograph records.
TAPE HEAD - for listening to tape played on See Tape Recording section)

TUNER - FM or AM broadcasts including FM tereo

EXTRA - any device like TV sound connected - EXTRA inputs on back.


SELECTOR switch
STEREO - for mal position of this control.)
REV. STEREO - Stereo with right chan sounds coming from left speaker, and left channel from right speake
MONO - for playing mono records with steree cartridge, Reduces recod rumble and noises.

L INPUT - left channel signal is fed to both left and right speakers.
R INPUT - right channel signal to both speak
BAL. L-both left and right channel signa
fed to left speaker only.
BAL. R-both left and right channel signals
fed to right speaker only.

## ONE CONTROLS

BASS modifies the strength of the low notes and TREBLE the high notes. The flat or normal position is straight up. Adjust to suit your
taste and to compensate for varying program aste and to compensate for varying program
material. The larger knob controls the left thannel, while the smaller front knob is for he right channel. These are clutched controls; to turn iust one, hold the knob you do not wish to turn while rotating the other.

## BALANCE control

To make one speaker louder than the othe Clockwise rotation reduces volume of lef speaker, counter-clockwise reduces volume of
right speaker. This allows adjustment for un equal volume caused by room acoustics o aulty program material. (See Speaker Bal ancing)

## POWER switch

Sliding switch to ON will turn on the amplifier and supply power to the black $A C$ receptacle on the back.

SPEAKERS swith
MAIN - to turn on the principal set of speak ers only.
only. Also use this onsition remote speak listen in private with the headphones, with the MAIN speakers off

## PHONES jack

Plug low impedance stereo headphones here. The jack will accept the standard three-conductor phone plugs found on most popular stereo headphones. For private headphone SPEAKERS switch.

## Notes On Connections

## Connecting Loudspeakers

Note: When connecting speakers, turn amplifier OFF.

Ordinary lamp cord is suitable for connecting loudspeakers. The wire gauge should be \#18 or less (smaller number-thicker wire) for lengths between the amplifier and speaker of 50 feet or less. For wire lengths greater than 50 feet use \#14 or \#16 wire to prevent excessive loss of power and reduction of damping factor. Since phasing is important in stereo speaker systems (see below), use a color coded wire, one with a marker yarn, raised bead or some other means of distinguishing one wire of the pair from the other. SPT "zip cord" usually has one wire of the pair identified by a thin outside rib on the insulation.

Eight spade lugs ( 4 silver colored and 4 copper colored) have been supplied with the kit for ease of installation and to prevent speaker shorts. Two silver and two copper colored spade lugs should be soldered to each speaker cable. The end of each wire in the pair should have the same colored spade lug attached to them.

Most speakers have one or all of the terminals coded or numbered. Make sure that the speakers are properly phased when connecting them by attaching corresponding terminals on the speakers to corresponding terminals on the amplifier. Example: " 0 " on the amplifier to " 0 " on the speaker and " H " on the amplifier to "High" on the speaker. The other speaker is hooked up in the identical manner with the second pair of wires.

If you have only one speaker, connect it to the left channel speaker terminals and set the front panel SELECTOR switch to BAL. L. No load need be used on the channel as all SCOTT amplifiers are stable, even without a load. If you plan to connect more than one set of speakers to either set of the terminals (MAIN or REMOTE), be certain that they are not connected so that the combined impedance is less than 4 ohms. Examples: two 4 ohm speakers connected in parallel will result in an impedance of 2 ohms. An 8 ohm speaker connected in parallel with a 4 ohm speaker results in a combined impedance of 2.7 ohms. Two 8 ohm speakers connected in parallel are equivalent to 4 ohms. If there is any doubt about speaker impedance, slide the SPEAKER IMPEDANCE switches to the 4 ohm positions.

## Phasing The Loudspeakers

The two loudspeakers of a stereo system must be properly "phased" or in step. The cones must move back and forth at the same time. If the right cone is moving forward when the left cone is moving backward, there will be a noticeable reduction in the bass response as well as a poor stereophonic effect. These speakers are "out of phase."

If you are unable to purchase coded wire (as above), you will have to phase the speakers. When phasing the loudspeakers, be careful not to touch the speaker wires together, causing a short circuit across the amplifier's speaker output. In order to minimize the chances of a speaker short circuit while phasing the loudspeakers, the following precautionary steps are suggested: Reverse the speaker wires at the amplifier rather than at the speaker. If you have someone to help, have them turn the LOUDNESS control down momentarily while you are reversing the wires.

Tune to a monophonic broadcast with a male voice speaking or play a monophonic record with a male singing voice. Turn the volume to full room level. Stand in front of the two stereo speakers and midway between them. Have someone quickly reverse the wires to one speaker. With the correct connection, the voice will sound full and appear to be coming from a source directly between the two speakers. In the wrong position, the voice will lose some of its bass response and will be hard to locate as to its source.

## Notes On Operating The Amplifier <br> Tape Recording

There are two basic types of tape playing devices that can be used with the LK-60. One is a tape deck without electronics. Such a device cannot record but it can play back prerecorded tape. It is similar to a phonograph record with a magnetic cartridge and, as such, it must be connected to the preamplifier section for additional gain and equalization. Connect this device to the TAPE HEAD input on the back of the amplifier, and turn the INPUT switch to TAPE HEAD.

A second type of tape playing device includes electronics. It is variously referred to as a tape recorder or a tape deck with electronics. This device is not only capable of making recordings, but also it has additional gain and equalization built in. It can be considered similar to a tuner or other high level device. Connect the output of your recorder to the TAPE INputs on the back of the LK-60. Whenever you want to listen to a tape recording, slide the TAっE switch to the IN position. Be sure you slide the switch back to the OUT position when you finish. This switch bypasses the INPUT selector. Thus, while it is in the IN position, you will be unable to listen to any other source.

If you wish to record any program material passing through the amplifier, connect the cables from the LK-60 TAPE OUTputs to the high level (not microphone) inputs on your tape recorder. These outputs are unaffected by the setting of any front panel controls with the exception of the INPUT selector.

If your particular tape deck or recorder is equipped for tape monitoring (this requires separate record and playback heads) then the TAPE switch on the front of the amplifier can be used for this purpose. Slide the switch to the OUT position and you will be listening to the source. In the IN position, you will hear the recording as it is being made. By sliding the switch back and forth, you can compare your recording with the source material instantaneously.

## Balancing The System

Whether the system is being used stereophonically or monophonically, it is important that the sound from the two speaker systems be of equal volume. They may differ because of room acoustics, differences in speaker efficiencies, differences in output between the two channels of a stereo cartridge, speaker placement, listener position and discrepancies between the two chanels in the original program material.

SCOTT'S patented stereo balancing system makes it easy to detect and correct any differences in loudness between channels.

Set the volume at full room level. Turn the SELECTOR to BAL. L. Listen to the overall loudness of the sound coming from the left speaker. Quickly turn to BAL. R. The volume from the right speaker should be at the same level.

If the volume is the same at both positions, the system is in balance. If it is not, proceed as follows:

Shift the SELECTOR between BAL. L and BAL. $R$ rapidly, and vary the setting of the BALANCE control until the sounds from the two speakers are equally loud. Unless there are discrepancies introduced by out-of-balance records or stereo broadcasts, the control should not have to be varied frequently.

## Section 6 - Basic Amplifier Theory

## How Does The LK-60 Complete Control Amplifier Work?

Your LK-60 offers on one compact chassis four pieces of precision equipment. There is a preamplifier/control center with its power amplifier for the left channel, and an identical preamplifier/control center with its power amplifier for the right channel. See block diagram.

### 6.1 Preamplifier/Control Center

## a. Preamplifier Stage

The preamplifier takes the exceptionally small output from magnetic phono cartridges and tape heads, which is $3 / 1000$ to $16 / 1000$ of a volt in most cases and amplifies it to a voltage large enough for the control center to accept. The inputs used for this preamplification of very weak signals are the MAG PHONO and TAPE HEAD inputs. The outputs of FM tuners, FM/AM tuners and complete tape re-
corders have sufficiently high voltage to bypass the preamplifier and go directly to the control center.

The preamplifier must increase the signal strength without adding or subtracting or altering the contents of the original signal in any way. Alteration of the original program material is known as distortion. The amplifier stages in the LK-60 have been carefully designed to keep distortion low. To further reduce distortion down to virtually unmeasurable amounts, negative feedback is employed in every stage of the LK-60. Negative feedback involves returning part of the output signal to the input in opposition to the input signal. This reduces the effective gain, but more importantly, virtually eliminates distortion.

If any noise or hum was permitted to get in at this critical stage, it would be amplified along with the program material and could be heard as background noise. To avoid this, the preamplifier has
BASIC BLOCK DIAGRAM OF LK-60

been placed at the rear of the chassis and as close as possible to the input connections. This avoids the use of any long wires with the possibility of hum pickup. The location of wires and components inside the preamplifier chassis also affects the noise and hum level. Careful wire placement (lead dress) while building this section is of great importance.

Equalization is also accomplished in the preamplifier. When manufacturing a record, the bass frequencies are reduced in strength and the high frequencies are increased in strength. The equalization in the LK-60 preamplifier reverses this process by increasing the strength of bass frequencies and reducing the strength of high frequencies, resulting in a flat frequency response. This process of recording and playback equalization is indispensable in obtaining clear sound (minimum distortion), long playing time and reduction of record surface noise. A similar process is used when making tapes. When playing back prerecorded tapes from a tape deck without playback amplifiers, the LK-60 TAPE HEAD input automatically provides the correct equalization and preamplification. In complete tape recorders, this process is built in.

## b. The Control Center

The function of the control center is to permit the user to alter the sound to suit his taste and to select a wide variety of program sources. In altering the sound the user may increase or decrease the treble, bass and volume as well as reduce record rumble (low frequency noise) and scratch.

The preamplified and equalized signal goes to the tone control circuit board on the LK-60. The signals from tuners and complete tape recorders, being much stronger, bypass the preamplifier stage and go directly to this circuit board. Here, the signal is further amplified and modified (if desired) by the tone controls and filters. H. H. Scott uses feedback-type tone controls; the best means of obtaining low distortion. This type of tone control only changes the high and low frequencies and does not affect the loudness. When the control is in the " 0 " position on the front panel, there is no tone control boost or attenuation.

It is a phenomenon of the human hearing mechanism that when the volume is low, the ear is less sensitive to extreme low and high notes. Thus, whenever the system is operated at a low level the sound will not seem to be as wide range as it is at higher levels. To compensate for this deficiency in the human ear, the LK-60 incorporates a special circuit which automatically boosts the extreme lows and highs whenever the volume is reduced. This circuit is controlled
by the COMPENSATOR switch in the control center. In the "L" position the Loudness compensation is IN while listening at low levels. This compensation automatically decreases as the sound level is increased. When the switch is in the "V" position the compensation network is inactive and the amplifier's frequency response is "flat."

### 6.2 Power Amplifier

The purpose of the power amplifier is to take signals from the control center, increase their strength tremendously and convert them into the power (watts) necessary to drive the cone of a speaker. The power amplifier must do this without adding to or subtracting from or altering the contents of the original signal in any way.

## a. Driver Circuit Board

The driver circuit board provides a stage of voltage and power again and then produces two separate signals of the correct relationship (push-pull) to drive the two power output transistors of each channel. It is extremely important that these two signals be of exactly equal strength, otherwise harmonic distortion will result.

The four transistors on the driver printed circuit board serve several functions. The first transistor (Q1) amplifies the signal voltage. The other three transistors (Q2, Q3, Q4) provide power gain and change the one signal into the two separate signals of the correct relationship to be fed to the two power output transistors. (The driver transistors Q3 and Q4 operate as Class B, push-pull power amplifiers.) The BALANCE (R6) and BIAS controls on the driver board provide the means to properly set the operating conditions of the power output transistors for both low and high volume conditions. The three sheet metal clamps on Q1, Q3 and Q4 are heat sinks (radiators) for these transistors.

## b. Power Output Stage

Two high power silicon transistors, which are mounted on the heat sinks, comprise the output stage. The output stages are designed for high efficiency and very low distortion (series connected push-pull Class B). The power used by the output stages is directly proportional to the volume of the music. This means that at low listening levels the output stages consume very little power which is one reason for the very low heat produced by the transistor power amplifiers.

During high listening levels, the output stages consume tremendously more power which would normally cause a large temperature rise. This excess heat which is produced by the output transistors is absorbed and dissipated by the massive heat sinks used in the LK-60. These finned heat sinks are aluminum and are extremely efficient heat dissipators as long as the air circulation is not inadvertently blocked off.

The excellent transient response of the LK-60 is due in part to the circuit design, which does not require driver or output transformers. Since there is no output transformer to match the impedance of the output stage to a speaker, a special speaker impedance circuit has been devised. When using a 4 ohm speaker instead of an 8 ohm speaker, the output voltage of the power amplifier must be reduced to obtain the same power output. The SPEAKER IMPEDANCE selector switch reduces the amplifier output voltage and retains the high damping factor for 4 ohm speakers by increasing the negative feedback when in the 4 ohm position. If you are using very low efficiency loudspeakers (much less than $5 \%$ ), then you may use the 8-16 ohm SPEAKER IMPEDANCE switch position to allow the LOUDNESS control to be set in the proper range for the COMPENSATOR to be effective. The amplifier can be operated in this manner with no fear of damaging the transistors.

Each power output stage is also protected against short-circuited speaker terminals by a fast-acting in-strument-type fuse. If, for any reason, the speaker
cables are accidentally shorted together with the LOUDNESS turned up, these fuses will immediately blow, protecting the expensive silicon output transistors from damage.

To prevent direct current from being present across the loudspeakers, which might possibly cause speaker burn-out, large output coupling capacitors ( 2000 mfd ) are employed. Direct current across the loudspeakers would limit their linear movement in one direction, thereby causing distortion of the program material.

### 6.3 Power Supply

A rugged power supply is needed to supply the necessary voltages and currents for the operation of all the stages of the amplifier. The power supply converts the a c voltage from a wall receptacle to the correct dc voltages for the various stages of the amplifier. The heart of the power supply consists of the over-sized power transformer, the large rectifiers bolted on the main chassis and several large filter capacitors. The extremely efficient filtering of the power supply capacitors produces an almost perfectly pure dc voltage for the preamplifier control center, which is extremely important in maintaining low hum. A zener diode is used in the power supply as a voltage regulator device to maintain the dc supply voltage for the preamp/control center at a pre-determined level of 25 volts. This further insures that these stages will operate correctly.

## Section 7 - Operational Trouble-Shooting Without Instruments

### 7.1 Use The Input Selector To Determine What Component Is At Fault

Determine what inputs sound bad by playing all your available sources (Tuner, Phono, Tape, etc.) and switch the Input Selector to each source.
a. If you find the sound is bad on only one source, let us say tuner, then the problem lies with either the tuner or with the interconnecting cables between it and the Input Selector switch. The rest of the stages in the amplifier and the other sources can be assumed to be operating correctly.

Note: There are two basic sets of inputs with your LK-60. First the "high level" inputs, which consist of TUNER, EXTRA and TAPE IN jacks; and the "low level" inputs such as PHONO and TAPE HEAD. If the high level inputs seem to be operating correctly, then the tone control, driver, power output, and power supply sections of the LK-60 are operating correctly.
b. If using the above procedure with the INPUT Selector switch you find that only the PHONO or TAPE HEAD gives bad sound and all other sources are good, the difficulty is either in the preamplifier and/or the INPUT Selector switch, or in the low level sources themselves.
c. If distortion is evident in low level inputs, check the following:

1. Check turntable for leveling, as an improperly leveled turntable will cause the stylus to contact the side of the record groove unevenly and will give distortion.
2. Check the stylus for proper tracking weight using a good stylus pressure adjustment and following the manufacturer's recommendations.
3. Check for worn stylus or dust and dirt imbedded near the stylus assembly.
4. Check the interconnecting cables and grounds for intermittent shorts or opens.
5. Check tape recorder for clean recording and playback heads.
d. If the sound is bad or non-existent on all sources, Tuner, Phono, Tape, etc., then the problem could lie in:
6. The amplifier. (Tone Control, Driver, Power Output or Power Supply Stages.)
7. The speakers.
8. The interconnecting wire between amplifier and speakers.

### 7.2 Using The Stereo Selector Switch For Trouble-Shooting

High level inputs - If the difficulty appears only on one channel of your stereo system, the Stereo SELECTOR switch can be used to pinpoint the area of difficulty. Refer to Section 8.4 i showing the operation of the Stereo SELECTOR switch. With the Stereo SELECTOR switch in the Stereo position, note which channel (left or right) sounds bad. Now turn the switch to the Reverse Stereo position. If the difficulty
shows up on the other channel, the difficulty is in the signal source (Tuner, Tape, etc.).

Low level inputs - To determine if the source or the amplifier is defective, interchange the input cables to the amplifier. If the difficulty shows up in the opposite channel, the signal source is bad. If the difficulty shows up in the same channel, the preamplifier is bad.

### 7.3 High Hum In Speakers With No Input - In All Positions Of The Input Selector Switch

Determine which channel has hum by listening to each speaker. Turn the unit off and remove Q2 from the tone control PC board in the defective channel. With the volume control at minimum, turn the unit on.
a. If the hum disappears, the trouble is located in the wiring connecting the tone control PC board to the rest of the circuit.
b. If the hum continues, check for mis-wires at Pins 10 or 14 (PC-6) or Pins 3 or 7 (PC-5).

### 7.4 One Or Both Channels Low Or No Output

Turn the level control maximum counter-clockwise. For left channel, touch Pin 8, PC-6, and turn the level up one-half of its total rotation. If hum is heard, then the difficulty is in the circuit before the tone control board.

Repeat the same test for Pin 1 of PC-5 if the difficulty is in the right channel.

Section 8 - Technical Service Instructions


### 8.2 PC Board Component Layout With Resistance Measurements

Q 1 - Q-2N3391A (QA-12)
Q 2 - Q-2N2926 or Q-2N3708 (QA-13) Q 3- 2N2613 or 2N508A


PREAMP
PC106-1L

Z-PC-P4 Parts List

|  | Z-PC-P4 Parts List |
| :--- | :--- |
| C1 |  |
| C2, C3 | CETM-2/25 |
| C4 | CETM-10/25 |
| C5 | CC-180 |
| C6 | CETM-250/3 |
| C7 | CETM-5/15 |
| C8 | CETM-50/25 |
|  | CC-.0056 |
| R1, R5, R9 | RC21-68K |
| R8, R2 | RC21-33K |
| R3 | RC21-470 |
| R10, R4 | RC21-5K |
| R6 | RC21-12K |
| R7 | RC21-27K |
| R11 | RC21-1K |
| R12 | RC21-1M |
| R13 | RC21-820 |
| R14 | RC21-56K |
| R15 | RC21-220 |
| R16 | RC21-1.5K |

Q. 1 - Q-2N2924 or Q-2N3710(QA-14) Q.2- $\mathbf{Q}-2 \mathrm{~N} 2925$ or $\mathrm{Q}-2 \mathrm{~N} 3711$ (QA-15)


TONE CONTROL
N-PC105-1L

Z-PC-T1 Parts List

a1- OA-10 GREEN Dの
a2- aA-9 GREEN'OR BLUE DOT


Z-PC-D4 Parts List

|  | Z-PC-D4 Parts List |
| :--- | :--- |
| C1 |  |
| C2 | CETM-50/25 |
| C3 | CET-25/25 |
| C5, C4 | CC-47 NPO |
| C6 | CETM-250/3 |
| C7 | CET-50/75 |
| C8 | CC-120 |
| C9 | CC-470 |
| R1 | CC-22NPO |
| R7, R2 | RC21-2.7K |
| R3 | RC21-15K |
| R4, R16, R12 | RC21-18K |
| R5 | RC21-3.3K |
| R6 | RC21-39K |
| R13, R8 | RCV-10K-PC |
| R9 | RC21-270 |
| R10, R15 | RC21-220 |
| R11 | RC21-47 |
| R14 | RCV-1K-PC |
| R17 |  |
| R19, R18 | RC21-1.5K |
| D1 | RC21-1K |
| RC21-390 |  |



Resistance Measurements

1. All measurements made with Triplett Model 630 VOM on RX1000 scale
2. Negative side of VOM battery to ground.
3. Pilot light bulb removed for resistance mea surements only.

Input Selector - "Phon"
Phono Sensitivity - "C"

|  | Tone Control Ckt. Board |
| :--- | :---: |
| Loudness | Min. |
| Input Selector | "Extr"" |
| Stereo | "Stereo" |
| Balance | "0" |
| Tone Controls | "0" Flat |
| Rumble Filter | "Out" |
| Scratch | "Out" |
| Tape Monitor | "Out" |
|  |  |
|  | Driver Ckt. Board |
| R6 Balance | Max CW |
| R11 Bias | Max CCW |
| Speaker Impedance | $8-16$ ohms |



### 8.4 Test And Service Pro-

 cedures With Instruments

Note: Remove 28v Meter Light bulb for resistance measurements.

## a. Resistance Measurements

Measure resistance to chassis in the following locations:

Collector Q10 and Q110 - Approximately 3000 ohms.
Collector Q11 and Q111 - Approximately 1500 ohms.
Across Speaker Taps - Approximately 500 ohms.
Replace 28v Meter Light bulb.
Note: Refer to initial light bulb test in section \#4.2 This check should be done if there is any question regarding correct wiring in the power output section of the LK-60.

## b. Balance Adjustment

With no signal input and 8 ohm loads connected across the speaker outputs, measure voltage on case of output transistors Q10-Q110 (68-72 volts). Set voltage at collector of lower output transistors Q11 Left Channel, and Q111 Right Channel, for one-half supply voltage, approximately 35 volts, using Balance Adjust R6 (A3 Left Channel Driver PC Board) and R6 (A103 Right Channel Driver PC Board). Variations of $\pm 1 / 2$ volt due to line voltage fluctuations are normal.
Note: The adjustment without instruments is just as accurate.

## c. Bias Adjustment

Using Triplett VOM, measure across R15 and R115 the .82 ohm emitter resistors of Q11-Q111, with VOM set to 12 ma . scale. Set .8 ma . by adjusting A3-R11 (Left Channel) and A103-R11 (Right Channel) Bias pots, on PC boards. Recheck Step No. 2 of Test Procedure (Balance Adjustment).

If a DC millivolt meter is available, a more accurate adjustment can be made by reading 17 millivolts $\pm 4 \mathrm{mv}$ across R15 and R115. Note: If the above instrument is not available, the adjustment without instruments has been found to be quite accurate.

Note: Before inserting or removing any inputs, turn Loudness Control to minimum (full CCW).

## d. Sensitivity Check

Connect audio oscillator ( 400 cps ) through attenuator into EXTRA input jack. Set output from attenuator to " 0 " db on .3 volt scale (. 25 v ) 400 cps. Turn Level Control to maximum. Output at speaker terminals should be -1 db on the 10 volt scale $\pm 1 \mathrm{db}(7$ volts). Turn Level Control to minimum. Connect the audio oscillator to the tuner input. Switch input switch to TUNER and turn Level Control to maximum. Voltage gain should be the same as in EXTRA. At this point recheck Bias Step "C" of Test Procedure.

## e. Distortion Check

Using a 400 cps distortion analyzer, distortion must be no greater than $.6 \%$ at 16 volts ( 32 watts) output.

## f. Loudness Control Check

Check Loudness Control tracking between left and right channels in 10 db steps to -40 db , maximum deviation 2 db .

Turn Loudness Control to 10 o'clock position. (The correct 10 o'clock point is where the output voltage does not change for a few degrees movement of the Loudness Control.)

## Loudness Volume Switch to

 LOUDNESS$1 \mathrm{kc}=0 \mathrm{db}$
$10 \mathrm{kc}=+3 \mathrm{db} \pm 2 \mathrm{db}$
$50 \mathrm{cps}=+8 \mathrm{db} \pm 2 \mathrm{db}$

## Loudness Volume Switch to

 VOLUMEFlat Response
Flat Response
Flat Response
Loudness Control to minimum. Output should be -75 db from 16 volt ( 32 watt) level.

## g. Tone Control Check

Adjust Loudness Control to maximum. Use attenuator to obtain 0 db on 3 volt scale for BASS and TREBLE boost measurements.

## Bass 50 cps

Boost $12 \mathrm{db} \pm 2 \mathrm{db}$
Cut $14 \mathrm{db} \pm 2 \mathrm{db}$

Treble 10 kc
Boost $10 \mathrm{db} \pm 2 \mathrm{db}$
Cut $10 \mathrm{db} \pm 2 \mathrm{db}$

## h. Frequency Response Check

Set Tone Controls flat (mechanically centered).
Attentuate oscillator to obtain " 0 " db on 3 volt scale at speaker terminals. Maximum variation $\pm 1$ db from 30 cps to 20 kc .3 db downpoints should be between $10-17$ cps low end, and $32-38$ kc high end.

## j. Cross Talk Check

Feed oscillator at 1 kc into one of the tuner inputs. Set the Stereo Selector Switch to MONO position and record the opposite channel output. Set Stereo Selector Switch to STEREO. Measure -50 db at 1 kc . Repeat for the opposite channels.


## i. Stereo Selector Switch Check

## For Right Channel Input

Left Channel
Output
Signal
No Signal
Signal
No Signal
Signal
No Signal
Signal

Right Channel Output
No Signal
Signal
Signal
Signal
No Signal
No Signal
Signal

Stereo Switch Position
Bal. Left
Bal. Right
Monaural
Stereo
Rev. Stereo
Left Input
Right Input

For Left Channel Input

Left Channel
Output
Signal
No Signal
Signal
Signal
No Signal
Signal
No Signal

Right Channel Output
No Signal
Signal
Signal
No Signal
Signal
Signal
No Signal

## k. Rumble Scratch Filter

Set attenuator for 0 db on 3 volt scale ( 2.5 volts). Loudness Control maximum.

## Rumble Filter In <br> $50 \mathrm{cps}-10 \mathrm{db} \pm 2 \mathrm{db}$

## 1. Balance Control Check

With the oscillator in the left channel input, note the left channel output. Turn Balance Control to Balance Left. Note no loss of signal. Turn Balance Control to Balance Right. Note complete loss of signal.

Repeat for opposite effect when feeding and monitoring right channel.

## m. Speaker Switch Check

Speaker switch to REMOTE. Note complete loss of signal. Switch output leads to REMOTE and note return of output.

## n. Regulation Check

With oscillator at 1 kc , set attenuator to 0 db on 3 volt scale ( 2.5 volts) and remove 8 ohm load. Note .5 db or less rise in output.
o. Speaker Impedance Switch

Switch from 16-8 ohm position to 4 ohm position. Note $-3 \mathrm{db} \pm 1 \mathrm{db}$ loss in output.

## p. Phone Jack Output Check

With 0 db reference on 3 volt scale, remove 8 ohm load from VTVM. Connect output from phone jack to VTVM. Output should be the same as across speaker terminals. Reconnect 8 ohm load.

## q. Tape Monitor Switch Check

BEFORE REMOVING OR INSERTING INPUTS, TURN LEVEL CONTROL TO MINIMUM. Tape Monitor Switch to IN position. Note complete loss of signal. Remove oscillator from tuner input jack. Plug into TAPE IN jack. Note signal is restored. Switch Tape Monitor to the OUT position. Again
note signal loss. Remove oscillator from the TAPE IN jack and insert in TAPE OUT jack; again, note signal is restored.

## r. Preamp Gain Check

BEFORE REMOVING OR INSERTING INPUTS, TURN LEVEL CONTROL TO MINIMUM. Turn controls back to their original settings as described in the beginning of Section 8.4. Set oscillator to 1 kc and connect to the EXTRA input. Set Loudness Control to maximum and adjust attenuator to obtain 0 db ( 2.5 volts) on 3 volt scale at speaker terminals. Turn Input Selector Switch to phono. Adjust attenuator for -47 db and plug into phono input. Output should be 0 db on 3 volt scale $\pm 1 \mathrm{db}$.

Check Phono Input Sensitivity Switch:

| Position <br> "B" | $-3 \mathrm{db} \pm 1 \mathrm{db}$ |
| :--- | :--- |
| "A" | $-8 \mathrm{db} \pm 1 \mathrm{db}$ |

Return Input Sensitivity Switch to "C" position. Switch Input Selector Switch to Tape Head position. Remove input from Phono and place in Tape Head input. Output should be the same $+1-0 \mathrm{db}$ as Phono.
s. Phono and Tape Head Frequency Response Check

| Audio Oscillator | Tape | Phono |
| :---: | :---: | :---: |
| 1 kc (reference) | 0 db | 0 db |
| 10 kc | $-10 \mathrm{db} \pm 2 \mathrm{db}$ | $-14 \mathrm{db} \pm 2 \mathrm{db}$ |
| 100 cps | $+19 \mathrm{db} \pm 2 \mathrm{db}+13 \mathrm{db} \pm 2 \mathrm{db}$ |  |

t. Hum and Noise Check (maximum readings)

|  | Level Control | Level Control |
| :--- | :---: | :---: |
| Selector Switch | 4 mv | 3 mv |
| EXTRA | 4 mv | 3 mv |
| TUNER | 30 mv | 3 mv |
| PHONO (shorted inputs) | 45 mv | 3 mv |
| TAPE HEAD (shorted inputs) | 45 |  |

[^0]w. General Service Notes and Transistor Precautions
Service, other than replacement of pilot lights, is usually not required. If the amplifier is not operating properly, all external connections should be checked to make sure that the difficulty is in the amplifier. For example, it is advisable to substitute a tuner for a tape recorder or a phono cartridge for a tape head (similar devices) to check out the amplifier performance. Then, the transistors should be checked by replacing them with new ones, one by one. Transistor defects frequently do not show up in a transistor tester. Only operation in the amplifier will insure the proper operation of transistors. Transistors may be checked for shorts as outlined below.

## Transistor Electrical and Mechanical Precautions

1. All cracked printed circuit boards should be replaced.
2. Only 60 watt or smaller soldering irons are to be used because larger ones emit too much heat and will cause the circuit boards to de-laminate or possibly crack. Use as little heat as possible to obtain good solder connections.
3. PC boards should be handled only by the edges. Do not put fingers across the boards.
4. Be exceptionally careful to install the correct transistor in the correct socket; and correctly install the transistor into the socket.
5. Mica insulators and silicon grease shall be used when installing power transistors. Make a good solid contact with insulator, but be careful not to puncture it because it is just a little thicker than a human hair. Be very observant of metal filings, chips and solder because they are attracted to the silicon grease. The mica insulator and its holes must be centered over the power transistor and transistor socket before installation.

## Transistor Test Precautions

1. The cases of some of the transistors we are using are "hot" (have voltage on them) so be very careful not to short them.
2. Be sure the right transistor is in the right socket.
3. All clip leads, scope probes, and meter leads should be insulated so that only the tip of the lead will be bare. This is to prevent accidental shorting.
4. Never check any voltage by sparking against chassis.
5. When checking transistors for shorts, use only X1,000 scale on meter because X1 and X10 may provide too much current for the transistor to take. Only power transistors can be tested on X100,000 or

X 1 range. There is 350 ma on the XI range and 30 v on the X100,000 range (Triplett 630 VOM).
6. Check all transistors in unit for heat dissipation. If it is uncomfortable to the touch, then it is no good. Shut power off immediately.
7. Do not short the output or the fuses will blow.
8. All test gear will be grounded to the unit and also will be isolated from each other (load box, etc.).
9. Always turn all power off when changing transistors and wait 30 sec . for capacitors to discharge.

## Some Transistor Characteristics

1. A tube can withstand prolonged overload whereas a transistor cannot.

2. NPN pos. voltage on collector with respect to the emitter. PNP neg. voltage on collector with respect to the emitter for proper operation.
3. Arrow on the emitter indicates the direction of current flow.


## Transistor Installation Precautions

The transistor sockets are of a type which will allow the use of several different styles of pin breakout. It is, therefore, most important that both the transistor and the socket breakout be known so that no installation problems arise.

To aid in properly orienting the transistors in their sockets, the chassis and/or applicable layout diagrams will have the letter "C" beside the COLLECTOR pin contact.

The XQ-4 socket is designed to accept TO-5 lead spaced transistors using the three outside pin connections. The pin connection inboard of the emitter pin connection is externally connected to the base pin connection so that transistors having an "inline" pin breakout may be substituted. When installing non "inline" type transistors, be sure that the inboard


As viewed from power transistor side

## Scott Kit Warranty

All H. H. Scott professional quality audio kits are guaranteed for two (2) years from the date of sale to the customer. This guarantee covers repair or replacement of any part found by the manufacturer or his agent to be defective; providing the part is delivered to an authorized Scott dealer or authorized Scott Warranty Service Station or to the company itself as instructed below within two (2) years from the date of purchase from an authorized dealer.

The above guarantee does not apply to vacuum tubes, piezo-electric, solid state, or semiconductor devices, or plug-in units, or any items which are covered by the guarantee of the original manufacturer. The normal guarantee of this type of item is 90 days and will be handled by our warranty service stations. To validate the guarantee, the enclosed guarantee card must be returned to H. H. Scott, Inc., within ten (10) days from date of purchase from an authorized Scott dealer.

This guarantee covers only parts which have not been subject to misuse or accident or damage by use, in violation of instructions furnished by us, and which have not been repaired or altered outside of our factory or its authorized service agency. Any unit which has not been constructed according to the instruction manual will not be covered by this guarantee, nor will any unit which has the serial number removed or defaced. The use of acid core solder will negate the warranty.

Should your Scott kit require servicing at any time, please do one of the following, whichever is convenient for you:

1. Return the unit to the dealer from whom it was purchased. On units returned to your authorized Scott dealer, any repair work or inspection of the kit will be handled at the dealer's regular rates. Defective parts will, of course, be replaced at no charge.
2. Take the unit to one of Scott's authorized service stations. These service stations are specialists in our equipment.
3. Write the Customer Service Department, H. H. Scott, Inc., 111 Powdermill Road, Maynard, Massachusetts, describing the difficulty in detail. Be sure to include the Model Number and Serial Number of your Scott unit and list all associated equipment. If it is determined that the unit should be returned to the factory, you will be sent the proper forms including a Return Authorization Label. Pack the equipment well to prevent shipping damage. Ship Railway Express Agency or U.P.S. prepaid. Do not ship via Parcel Post. Insure the unit for full value.
4. On units submitted either to the Authorized Warranty Service Station, or to the Factory, the following warranty procedure will apply:
a. You will be charged an inspection fee of $\$ 2.50$ when the unit is submitted to either the Authorized Warranty Service Station or to the Factory.
b. If it is found, however, that it is necessary to go into the unit and touch up any solder joints, correct mis-wires, etc., then an additional $\$ 7.50$ charge will be made.

Note: This warranty is only valid where instructions have been carefully followed. When there are serious deviations from our instructions requiring major reconstruction, the warranty is voided and the work will be done at normal Wararnty Service Station and/or Factory rates (the above charges plus $\$ 5$ per hour).

In an instance where faulty components supplied in the kit are the sole reasons for the unit's malfunction and no work other than replacement of the faulty components is necessary, only the $\$ 2.50$ inspection fee will be charged.

This guarantee supersedes all previous warranties of H. H. Scott, Inc., and is lieu of all other warranties expressed or implied. We reserve the right to change or improve our products without incurring any obligation to modify products previously manufactured.


## Scott LT-112B Solid State FM MPX Tuner Kit

A superb companion piece to your recently completed LK-60B Solid State Stereo Amplifier Kit is the LT-112B Solid State FM MPX Tuner Kit.

This outstanding Kit comes supplied with four prewired, pretested subassemblies, assuring you of

It is one of the finest tuners Scott makes. And that means it is one of the finest tuners anywhere.

The limiters must be quite unusual judging by the extremely effective performance they provide.
-AUDIO, July 1964
As a fringe-area tuner, the 312 did magnificently. Not only is it as sensitive as any tuner I've come across, but its limiting curve is such that full limiting seems to take place with signals just a hair above the minimum strength needed for marginal quieting.

An undeniably "hot" tuner that will pull in distant FM stations with ease.

In places where stations were crowded closely on the dial, the Scott's excellent selectivity kept them neatly apart with hardly a trace of audible interference.

To sum up, the Scott 312 has remarkable sensitivity, good stereo separation, and excellent overall audio quality. It can be recommended particularly to fringe-area dwellers who don't want to spend a year's income or thereabouts on other tuners of comparable capability.-John Milder

-RADIO-ELECTRONICS, March 1965

outstanding performance from the minute you turn the tuner on.

Here are some of the comments by leading testing laboratories on the factory-wired 312 from which the LT-112 was developed:

The 312 has excellent tuning feel; and last, but not least, the sound quality of the 312 is, to our ears, the best Scott has ever produced. Altogether, a product to be proud of.

The front face of the Scott 312 shows the distinctive new styling which was introduced just last year in Scott tuners. This includes a large and easy-to-read slide rule dial; a tuning meter just to the left of it; a large knob to the right for tuning; and two small knobs for function and mode selection. The function selector permits choice of Off, Normal, SubChannel Filter, and Stereo Noise Filter positions. The other knob permits selection of mono or automatic stereo operation. A stereo indicator light is located just below the center of the slide rule dial, and just to the right of the indicator light is a jack which permits tape recording from the front panel. To this latter we say HEAR! HEAR!-finally. We've often wondered why somebody hasn't made life easier for the tape recordist.
-AUDIO, July 1964
In addition to the previously mentioned controls, a 3-position meter switch allows the meter to be used either for alignment, signal strength, or as a highly sensitive zero center tuning meter.

H. H. SCOTT, INC., 111 POWDERMILL ROAD, MAYNARD, MASSACHUSETTS 01754


[^0]:    u. Repeat Tests "d" Through "t" for Opposite Channel
    v. Using Test Bulb, Check AC Outlets. Black Is Switched.

