dynaco PAT-4

STEREO PREAMPLIFIER

SERIAL NUMBER

This number must be mentioned in all communications concerning this equipment.

INSTRUCTIONS FOR ASSEMBLY OPERATION

patents pending

dynaco inc. COLES ROAD & CAMDEN AVENUE / POST OFFICE BOX 88
BLACKWOOD, N. J. 08012, U.S.A.

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SPECIFICATIONS

Frequency Response: High Level inputs: ±0.5 db from 10 Hz to 100 KHz
Low Level inputs: ±1 db from 20 Hz to 20 KHz (equalized)

Distortion at rated 2 volt output: THD less than 0.05% 20 Hz to 20 KHz
IM less than 0.05% with any combination of test frequencies

Hum and Noise: Magnetic Phono: 70 db below a 10 mv input signal
High Level: 85 db below a 0.5 volt input signal

Gain: Magnetic Phono: 54 db at 1000 Hz
High Level: 20 db

Tone Control Range: ±16 db @ 50 Hz
±12 db @ 10 KHz

Maximum Output: 10 volts into high impedance
5 volts into 600 ohms

Impedances:
Magnetic Phono: 47,000 ohms
Tape Head: 100,000 ohms
High Level: 100,000 ohms
Audio Output: 600 ohms
To Tape: from low level inputs, 600 ohms
from high level inputs, same as source
Amplifier Input: Nominal load 10,000 ohms or higher

Inputs: Low level or high level RIAA magnetic phono or ceramic phono; NAB 7½" tape head; Special (normally microphone); Tape amplifier; Tuner; Spare high level for TV, etc.; Front panel high level

Outputs: Tape output ahead of controls; 2 Audio outputs (one switched by front panel jack); Front panel output

Controls: Selector switch; Volume control; Balance control; 2 Bass controls; 2 Treble controls; High Filter switch @ 15 KHz, 10 KHz and 7 KHz; Loudness compensation switch; Tape Monitor switch; Low Filter switch; paired Stereo-Mono switches to provide A or B channels independently or combined (A+B) with 6 db blend for 3rd channel output, or stereo; illuminated power switch

Semiconductor Complement: 8 transistors; 2 diodes

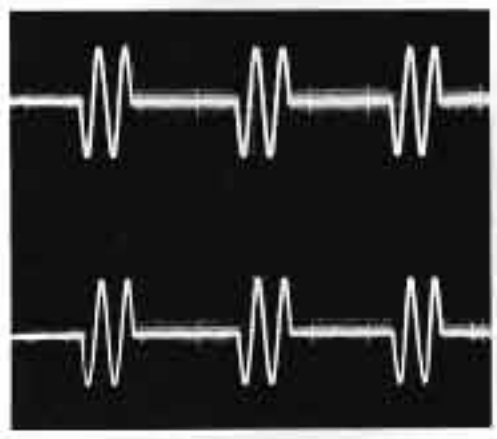
Dimensions: 13½" wide by 4¼" high by 9" deep

Shipping Weight: 10 lbs.

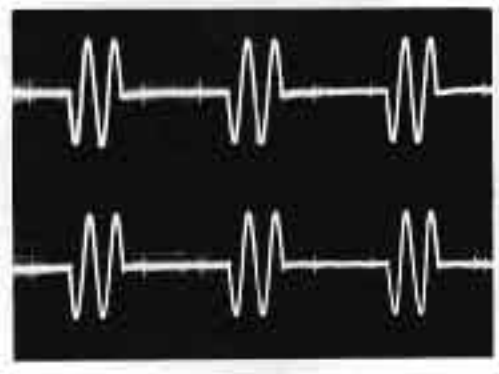
Power Consumption: 5 watts

100 Hz Square Wave

10 KHz Square Wave

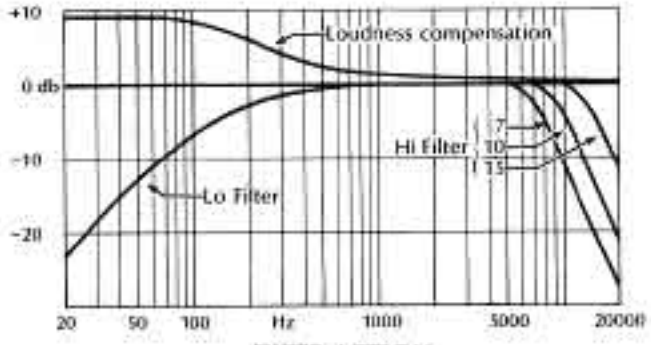


2 cycle 100 Hz Tone Burst

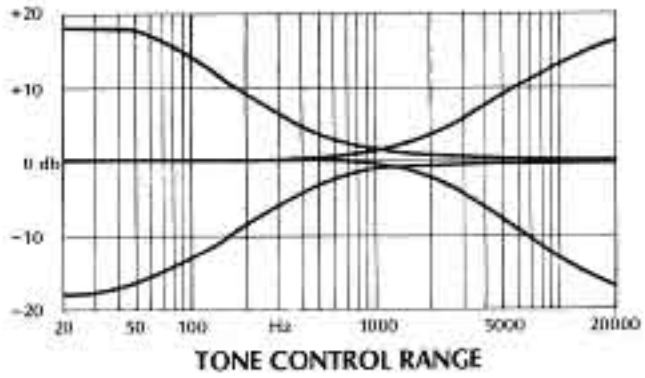


2 cycle 10 KHz Tone Burst

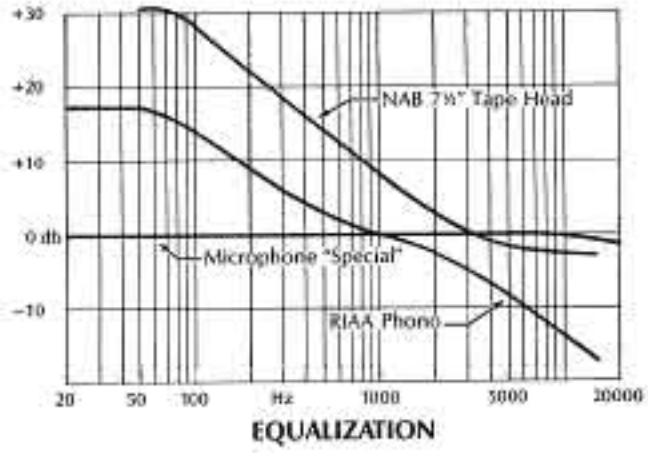
Tone bursts are indistinguishable at output of PAT-4 (top) from generator output (bottom).



FILTER ACTION



TONE CONTROL RANGE



EQUALIZATION

DYNACO PAT-4 SOLID STATE STEREO PREAMPLIFIER

INTRODUCTION

The Dynaco PAT-4 is an all silicon solid state control center and preamplifier which must be used in conjunction with a basic power amplifier, such as the Dynaco Stereo 80 or Stereo 120, and a pair of loudspeakers. In addition, the PAT-4 provides sufficient power for a pair of 600 ohm headphones. When headphones only are to be used, a power amplifier is not required.

The PAT-4 incorporates special "blend" circuitry which facilitates 4-dimensional playback with any two-channel amplifier and the requisite speaker systems. This unique Dynaco system fully utilizes the capacity of two-channel recording systems to include additional program channels of related, but discreet information by means of sum and difference matrixing. No additional electronics are needed. The connection of four speaker systems to recover this added dimensionality is described in this manual. A more detailed description is available on request.

All input signal sources, such as a phonograph, radio tuner, tape recorder, etc., are connected to the inputs of the PAT-4 and this preamplifier is the control center for all mono and stereo signals. Thoughtful planning has provided exceptional flexibility to accommodate future requirements for such sources as a second phonograph or a microphone, television sound, musical instruments requiring electronic amplification, etc. A standard phone jack input and output on the front panel enables convenient connection of a tape recorder or headphones, even when the preamplifier is installed in a cabinet.

The components in the PAT-4 are of the highest quality to protect against failure, and all parts are operated conservatively with close tolerances to assure continued proper operation. The transistors have been specially selected for minimum noise and distortion in sustained use and the etched circuit modules have been pretested in the circuit to ensure that every unit, after assembly, will meet the specifications normally associated only with laboratory prototypes.

The specifications of the PAT-4 speak for themselves. The distortion and noise, up to levels well beyond those required to drive any conventional amplifier, are comparable to the finest tube designs and below the levels which can be accurately measured with commercial grade test equipment. Specifications cannot define all the facets of superior audio performance, however. In use with varying program material, the PAT-4 achieves its design goals of sonic ease and naturalness always sought but rarely achieved in solid state designs. There is remarkable clarity and an impression of direct contact with the original without the extra brightness or stridency which, unfortunately, is sometimes attributed to high fidelity sound.

Like any precision equipment, the superior capabilities of the PAT-4 will best be realized when it is properly connected and operated. Please read the Operating Instructions below before attempting to use this preamplifier.

OPERATING INSTRUCTIONS

Connection to Power Amplifiers

On the back panel of the PAT-4 there are two pairs of audio outputs which may be connected to a power amplifier, and one pair for connection to a tape recorder. The upper row of sockets is for the Left or "A" channel, and the lower row is for the Right or "B" channel of a stereo system. A monophonic connection may be made to either channel, but the left one is most commonly used. The PAT-4 may also be used on either channel as a monophonic preamplifier without difficulty and without termination of the second channel.

Output 1 provides a low impedance (600 ohms) output at all times for normal connection to the amplifier through shielded single conductor cable of any length up to 50 feet. Two 6 foot audio cables are supplied with the unit for this purpose.

Output 2 is identical to Output 1 with the exception that it is interlocked with the front panel *Output* jack, so that Output 2 is automatically disconnected when a phone plug is inserted into the front panel jack. Thus, if headphones were connected, the loudspeakers would be silenced.

If Output 1 is used, and headphones are also connected, it will be necessary to advance the volume control farther because of the power requirements of the headphones to obtain the same level of sound from the loudspeakers.

Connection from Phonograph

There are three pairs of input sockets marked "Phono." The type and output level of the cartridge used determines which pair (only one at a time) should be used. One pair is for a ceramic cartridge, marked *Cer*, and the other two pairs provide RIAA equalization for magnetic cartridges. The *Low* input is used with all normal magnetic cartridges (maximum inputs up to 80 mv). If higher output cartridges become available, these can be used instead on the *High* input with a simple modification to each circuit board. Information and parts for this change will be supplied on request by Dynaco.

Ground Connection

Sometimes the phonograph or tape machine will have an extra wire which is to be attached to the preamplifier chassis. A grounding screw *Gnd* is provided for this purpose. Under some unusual conditions of use, where it is advisable to ground the system to a water pipe or similar earth connection, this screw can serve as the connection point.

In general, it is advisable to use the *minimum* number of separate ground leads necessary to achieve lowest hum. Some experimentation may be necessary, but extra leads often cause an increase in the hum level of a good music system.

Connection from Tape Playback

Two pairs of inputs are provided for playback from a tape. If the machine has no electronic *playback* circuitry, but the output is directly from the playback head, the *Tape Head* inputs provide NAB 7½″ equalization. Use the shortest possible shielded cables to this input because of the requirements of the playback head. This input is selected by turning the front panel selector switch to *Tape Head*. A separate ground wire should be connected from the tape deck's recommended grounding point to the *Gnd* screw on the PAT-4 to avoid hum.

When the *Tape Head* inputs are not used, the two shorting plugs supplied should be inserted in those input sockets. This will reduce noise which would otherwise be heard when switching through this position with the selector switch.

Most tape machines available today include playback preamplifiers. For these, audio cables should be connected from their "preamp output" or "line output" sockets to the *Tape Amp* inputs, and the selector switch turned to *Tape* position on the PAT-4.

Connection to Tape Recorder

If your tape machine has recording facilities, then audio cables should be connected from the *To Tape* output sockets on the PAT-4 to the "radio", "high level" or "line" inputs on the recorder. The recorder inputs should require signal levels nominally between 100 millivolts and one volt for full recording level. The microphone inputs on the recorder are not suitable, because their sensitivity is too high.

To Tape output connections are made in the PAT-4 ahead of the volume, balance, filter and tone control circuits so that these controls may be operated to adjust the amplifier signal to the speakers during the recording process without affecting the signal going to the tape recorder. This is the normal connection for recording.

To Tape outputs are ahead of the stereo-mono switches, however, so each output is independent and should not be externally connected together for monophonic recording from a stereo sound source.

If you wish to use all the controls in the preamplifier to correct the recording signal, the amplifier *Output 1* may be used. Remember that the volume control of the PAT-4 will then control not only the speaker and/or headphone level, but also the signal level going onto the tape. The filter, stereo-mono switches and tone controls may be helpful when transferring older 78 rpm discs to tape, for example. A higher signal level can be obtained from *Output 1* by advancing the volume control than from *To Tape* because of added gain in the output stages of the preamplifier, enabling the transfer of weak input signals (such as Tape Head playback) with less noise. You may wish to disconnect the power amplifier and use headphones in this case, however.

The PAT-4 does not provide the equalization and bias requirements of a complete tape recording preamplifier. It therefore cannot be used as such.

Connection from Radio Tuner and other High Level Sources

The *Tuner* and *Spare* inputs are identical and receive flat high level signals from AM/FM/Multiplex radio tuners, additional tape recorders, audio signals from a TV set, etc., via regular shielded cables.

Connection from Microphone and other Special Sources

The pair of inputs marked *Special* are normally connected for a flat high gain input such as a high impedance (50,000 ohms) microphone using single conductor shielded cable. Alternatively, by internal change described in the Technical Section of this manual, the Special input can be used as an additional phono input or other high gain equalized input.

Selector Switch

The selector switch connects your choice of program source, selecting both channels simultaneously, together with the proper equalization for phono or tape head. This switch also enables you to select a tape recorder's output, differing from the conventional switching arrangement in which the tape had been selected separately by the Monitor switch. In the PAT-4 there is a Monitor switch as well (described later), but selection of the recorder for routine playback is made in the same way as all other inputs to avoid confusion.

Volume Control

The output of both channels is controlled simultaneously by this control, with close tracking of the two stereo channels so that the program material will remain in balance over most of its range. The taper rate of this control has been chosen to provide a slow increase in volume over the first half of rotation and a more rapid volume increase above 12 o'clock. This enables most satisfactory operation with both low and high efficiency speakers.

Balance Control

The balance control is normally centered, giving equal signal strength to both channels. Rotation to the right shifts the apparent sound source to the right by reducing the left channel level, and conversely to the left. This control has a very gradual action in the first 90° of rotation either side of center, so that delicate adjustments in balance can easily be made, but its action increases rapidly to the extremes of rotation, where one channel or the other is silenced.

A balance control is required because some program sources are not accurately balanced, and it is possible that the speakers used may have different efficiencies, or some rooms may absorb more sound energy from one speaker than from the other. A certain amount of balancing adjustment is thus semi-permanent, while the rest varies with the source. If you find that your balance control gives best results in the normal listening location when it is consistently offset from center, you may wish to loosen the set screw and reposition the control knob so that it points straight up for most listening.

Tone Controls

There are individual bass and treble controls for each channel, but to make normal operation easier, the two sets of controls utilize split knobs. This enables you to make routine adjustments on both channels simultaneously, yet vary them independently when special occasions call for it. The forward knob controls the left channel, and the one nearest the panel adjusts the right channel.

The normal or "flat" position is centered, with increasing effect to the right, and a decrease to the left. Tone controls alter the original signal to suit the user; but these alterations are deviations from truly accurate reproduction. The reference point should always be the center, which gives no frequency discrimination. The tone controls also help to correct for record compensation characteristics of older discs which do not follow the present RIAA standard playback curve.

The special tone control design in the PAT-4 is a patented Dynaco design which assures that the tone controls are "out of the circuit" when they are centered. This provides the convenience of continuously variable correction without the complication of extra disabling switches.

High Frequency Filter

The *Hi Filter* rotary switch gives sharp reduction of the frequencies above the points which are marked (in KHz) on the front panel. The first step away from "flat" is barely detectable, being at the extreme of the audio range. Further steps have an increasing but still subtle effect. The 15 KHz position may be useful in filtering out supersonic disturbances when recording from some stereo radio programs. Successive steps will assist in reducing high frequency distortion in poorer program sources.

Monitor Switch

The *Monitor* switch enables direct comparison of the source signal as indicated by the selector switch, with the same signal played back from the playback amplifier of a tape recorder. This feature is applicable when recording through the PAT-4 to a tape recorder which has separate preamps and 3 or more heads designed for simultaneous playback while recording. For example, while recording from a radio tuner, the selector switch is on "Tuner," and "To Tape" is connected to the recorder input. The playback output of the recorder is connected to "Tape Amp." You will hear the tuner directly when this switch is in the normal *Input* position. When it is switched to *Tape*, you will hear the program played back from the tape a fraction of a second after you have recorded it.

Loudness Switch

The *Loudness* switch is normally left "Off," but it may be used at lower settings of the volume control to provide an increase in bass to compensate for the ear's lack of sensitivity to low frequencies at low sound levels. The high fidelity purist usually avoids any such compensation; but many listeners will find this switch, used in moderation, adds listening enjoyment at low levels. This sonic correction does not add boom or muddiness to the reproduction.

Low Filter Switch

When "On" the *Low Filter* reduces the level of signals below 100 Hz, and thus minimizes rumble and similar low frequency disturbances.

Stereo-Mono Mode Switches

The pair of switches marked *Stereo-Mono* is normally left in the stereo position, with the bottom of each switch depressed. They provide three additional choices: 1) The *left input channel "A"* is switched through both outputs by depressing the *top* of the *"A"* switch *alone;* 2) conversely, the *right input channel "B"* is available at both outputs when *"B" top* is depressed, and the *bottom* of *"A"* is depressed; 3) a partially *blended* mono signal is obtained at both outputs by depressing the tops of both switches.

When the tops of both switches are depressed this is a blended position to be used for combined channel mono signals. This gives 6 db of separation and is desirable for reducing the apparent separation between stereo speakers, or for establishing the proper spatial effect for more natural sound in stereo headphones. This is the normal position for playing mono records with a stereo cartridge. This position is also used with the Dynaco 4-dimensional sound system, and four speakers. This 4-dimensional system is described in the Technical Section of this manual. The Technical Section also describes the minor wiring change to obtain a fully blended (A+B) mono signal if desired.

Since the stereo-mono switching system enables you to play a mono program through both output channels, it is possible to have extra mono inputs by using the Spare or Special positions for different signal sources in the left and right inputs. For example, a TV input could be selected for the Spare "A" input, and a mono tape machine for the Spare "B" input. Then selection between these would be made with the stereo-mono switches.

Front Panel "Input"

The front panel *Input* jack will override the selector switch and cut out the signal from all other inputs when a phone plug is inserted. This is a normal high level input, identical to the Tuner and Spare inputs. You may wish to connect a tape recorder here, but remember that the Monitor function is not operable on this input. Another possibility is to insert the output plug from a musical instrument requiring amplification, such as an electronic guitar. If the plug from a mono source is only partially inserted (to the first detent, or notch) then only the right channel is activated by the front panel input, and you can mix a guitar, for example, on the right channel, with a record (selector switch on phono) heard on the left channel. You can adjust relative levels with the balance control. If desired, you can mix the two signals (if they are already properly balanced) by depressing the tops of both mode switches. Thus you can accompany a musical instrument with a record, tape, radio, or a microphone.

If a mono phone plug is fully inserted, it will provide signal to the left "A" channel only; then depressing the top "A" button will switch it through both output channels.

Front Panel "Output"

The front panel *Output* jack provides a normal 600 ohm output in parallel with amplifier Output 1 on the back panel. Connecting to the front panel output mutes Output 2 on the rear, enabling the use of headphones, for example, to automatically cut out the speakers.

If an amplifier is connected to Output 1, which is not muted by the front panel jack, the introduction of headphones will cut the amplifier signal approximately in half.

Headphones should be of medium impedance (nominally 600 ohms) or higher. If only low impedance (4 to 16 ohms) headphones are available, such as are normally connected to *amplifier* outputs, then a matching transformer should be used.

Because of the load imposed when headphones are connected, the high filter switch operation is altered, and in effect, only the 15 KHz position has any marked effect, albeit at a lower frequency.

AC Line Connections

There are two *black* AC outlets which are switched on and off with the PAT-4 power switch, and two *red* outlets which are always connected to the AC line. The power amplifier and radio tuner are usually connected to the switched outlets, and a phonograph and tape recorder are usually connected to unswitched outlets so that their drive mechanisms cannot be damaged if the preamp power is turned off without disengaging the machine.

Installing your PAT-4

Your PAT-4 generates very little heat; so it is unnecessary to provide ventilation, even with continuous duty operation. If it is stacked with the Dynatuner, the tuner should always be placed on top, since it does require some ventilation. The PAT-4 may be mounted in any position in a cabinet, and for panel mounting an accessory PBK bracket kit is available from Dynaco for $2 postpaid. No CODs please. A single rectangular cutout 13″ by 3-13/16″ is required in any panel up to one inch thick. Or, you can simply provide a shelf flush with the bottom of the opening. The rubber feet are not used in such mounting. In a cabinet which provides for "face up" mounting, the PAT-4 can simply be supported in the cutout by its front panel.

TECHNICAL INFORMATION

CIRCUIT DESCRIPTION

Each channel of the PAT-4 uses two pairs of *npn* transistors in similar configurations. One pair provides the low level amplification and equalization for phono cartridges, tape heads, microphones, and similar low level sources. The input transistors are selected low noise types. The low level phono input can handle signals up to 100 millivolts without overload, and the high level phono input will accept up to 800 millivolts.

The other pair of transistors comprises the tone control and filter stages, and operates at the higher signal levels of tuners, tape recorders, etc., as well as from the output of the phono preamplifier stage. Each pair has a DC feedback loop to stabilize operating conditions, as well as an AC feedback loop to provide optimum audio performance. The operating parameters of each stage have been critically adjusted to achieve the lowest possible distortion levels—below that which can be measured with commercial test equipment.

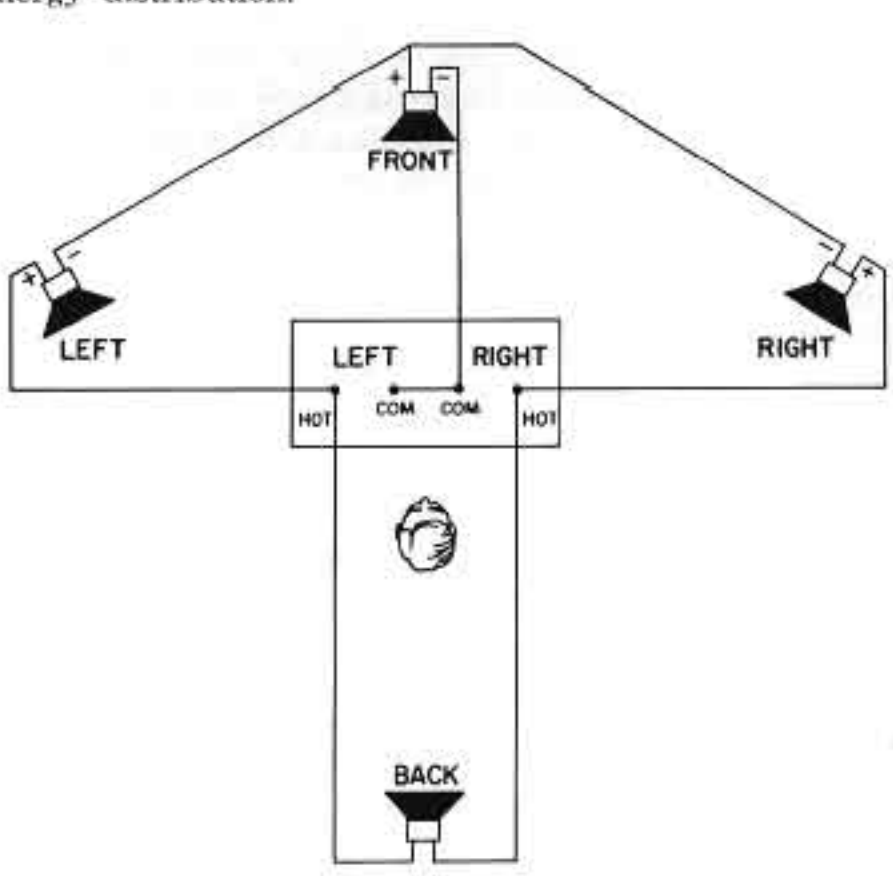
The special feedback tone control system of the PAT-4 is an exclusive Dynaco development which provides continuous independent adjustment of the frequency extremes, while providing a specific "center-flat" setting. When the controls are set to the normal mid-point of rotation, they are effectively out of the circuit and have no effect whatsoever on performance. This is accomplished through the use of special Dynaco-designed potentiometers. The treble controls have a discontinuous taper, and the bass controls utilize a dual wiper design. When the tone controls are operated away from the "flat" center point, the frequency response is varied by changes in the amount of feedback at the frequency extremes.

The output impedance of the PAT-4 is 600 ohms, enabling it to be used with long output cables, and to be relatively noncritical of load impedance. Its specifications are based on a load of 10,000 ohms or higher, encompassing virtually every tube or transistorized amplifier. If a lower impedance load is applied, there is some reduction in the maximum output level which can be obtained with low distortion. The high frequency filter, which is at the output of the preamplifier, is also altered in effect with lower load impedances, as is the bass cut curve.

While it is possible to obtain moderate levels with even low impedance (4 to 16 ohms) headphones connected directly to the output jack of the PAT-4, the frequency response and distortion at the output will be significantly affected, and a 600 ohm matching transformer should be used to preserve high fidelity results.

DYNACO 4-DIMENSIONAL SOUND SYSTEM

The PAT-4 is designed to effectively utilize 4 speakers to provide front-to-back, as well as left-to-right source localization when the speakers are connected to any 2-channel power amplifier as diagrammed below. The back speaker reproduces the difference information in the two channels, which may include an additional source, but more importantly it enables recovery of ambience, or "hall sound" hitherto masked in conventional playback of many *present* recordings. These random phase ambience effects will be most evident in recordings made "live," and where an additional distant microphone was used. The front speaker provides more precise stereo imaging with proper energy distribution.



Best results occur when all speakers have identical efficiency, impedance and sonic characteristics, as separate level controls are not feasible. The front speakers should be matched in any case. Dynaco speakers, with very uniform impedance characteristics, are ideal, and permit the A-50 to be used with the A-25 with outstanding results.

Small rooms frequently benefit most from this system. Listener position is more critical in 4-D playback. The back speaker is best when placed *above* the listener, with moderate level. A series 10 watt, 20 ohm variable resistor is a convenient means of accommodating different back speaker

efficiencies and locations. A switch to disconnect the back speaker is advisable for listening to noisy programs.

Since the speaker impedance isolates the amplifier terminals, no amplifier damage results from this connection from "hot" to "hot." No back speaker connection is made to a ground terminal. If the amplifier design cautions against connecting its ground terminals together, which is rare, then the front speaker should be eliminated, and the left and right speakers connected normally.

To balance the system for 4-D playback, disconnect the ground return from the front, switch the PAT-4 to "A" only, and play a record with the volume control at its most-used setting. Adjust the *balance* control for *minimum* output from the speakers. Then adjust the tone controls—preferably to the flat settings—for *minimum* output. The tone controls need not be flat, but will null when the two channels are identical. You can reposition the knobs on their shafts to indicate the center null position. Reconnect the center ground, and switch the preamp to the A+B (6 db blend) position (depress the tops of both switches). This is now the normal stereo playback mode when using 4 speakers. The blending is equal in amplitude and opposite in polarity to the crosstalk introduced by the center (front) speaker connection, which cancels the crosstalk and insures full separation at the speakers.

The same connection for the front speaker, which reproduces a combined mono signal, enables it to be used as a remote speaker as an alternative, or as a center-fill when the side speakers are unusually far apart.

OPTIONAL CONNECTIONS

The design of the PAT-4 makes it easy to "customize" in several ways to suit individual needs. A few of these are described here.

A+B Full Blending

If you wish the (A+B) position of the mode switches to provide complete blending with the tops of both switches depressed, rather than the normal 6 db separation, connect a short piece of wire across the 7,500 ohm (violet-green-red) resistor between lugs #2 and #5 of switch AS. You need not remove the resistor.

Special Phono Input

If, instead of a microphone input, you wish to use the Special position for a second low level phonograph input with RIAA equalization (so that you might use a separate changer and turntable, for example) change each channel for stereo as follows: Remove the wire from eyelet #8 on the circuit board. Do not disconnect the other end from rear lug #2 of the selector switch wafer, but shorten the wire and solder the free end to lug #4 of the same wafer.

Provision for Other Equalization

There is a separate group of equalization components for each low level input on each circuit board. Other values can be substituted to provide special variations if desired. R7, R8, C5 and C6 are in the Phono channel. R10, R11 and C8 affect the Tape Head input. R9 and C7, together with the wire jumper on the board at that point, control the Special input as used for microphone.

It is necessary to connect to separate input sockets, rather than simply bridging from one position to the next, when changing from one equalization position to another, because of the automatic shorting of the unselected low level inputs incorporated in the selector switch to eliminate feedthrough from unused inputs. Such shorting action can be removed only by deforming the selector switch contacts on the back of each switch wafer.

Driving a Third Channel Amplifier

A simple arrangement to power a center channel speaker without the need for an additional amplifier has been given earlier. This is an alternate approach to a three channel system.

You can obtain a combined channel signal to drive a third channel separate amplifier by connecting one pair of outputs together through isolating resistors, and taking the signal from their junction. For example, a 47,000 ohm ½ watt resistor in series with each output will maintain adequate separation between the main channels, provide a medium impedance output, and will be only about 6 db lower in signal level than the main channels. A 100,000 ohm or higher value potentiometer could be used as a center channel level control from this junction.

CONNECTIONS FOR 240 VOLT AC LINE

The power transformer supplied in the PAT-4 may be connected for a 240 volt AC line as well as for the standard 120 volt AC line, which is how the transformer is connected unless this manual is stamped "240 volt." The transformer has dual primary windings. They are connected in parallel for 120 volts, and in series for 240 volts. The notes to Steps 37, 40 and 41 on page 18 and the diagram on page 23 detail the 240 volt connections.

The 1/10 ampere (100 ma) slo-blo fuse supplied with 120 volt wiring should be replaced with a 1/16 ampere (62 ma) slo-blo fuse when the preamplifier is wired for 240 volt use.

The PAT-4 is designed for use with either 50 Hz or 60 Hz current. Variations of line voltage up to 10% from nominal value will not affect performance.

ASSEMBLY INSTRUCTIONS

GENERAL ASSEMBLY INFORMATION

Assembly of the PAT-4 is exceptionally simple when compared to other kits. The preassembled etched circuit boards have saved you much of the work, and the assembly that remains is arranged in an open, uncluttered layout that makes wiring quick and easy. The construction time will be several hours. It is better to work slowly and carefully rather than worry about the time.

When you unpack your kit, check off the components against the parts list at the back of the manual. You can identify unfamiliar parts by matching them to the pictorial diagram or photograph.

Have the proper tools at hand before starting assembly. You will need a pencil-type soldering iron of 30- to 60-watt rating with a small tip, long nosed pliers, diagonal cutting pliers, a medium-sized screwdriver, and 60/40 *rosin core* solder not larger than 1/16" diameter. You will also find a damp sponge or cloth helpful to wipe the tip of the iron clean periodically. An inexpensive wire stripping tool is helpful, but some people prefer a single-edged razor blade for removing the insulation.

If you have a soldering gun, it should be used with care, especially when working on the circuit boards. Not only can a gun provide more heat than is necessary, with some risk that an unskilled user might damage the board, but because it requires some time to heat each time the trigger is squeezed, many users tend to make poor solder connections simply because they do not wait long enough for it to reach its operating temperature each time.

You should realize that delicate components such as transistors are less likely to be damaged in the soldering process if you use a hot iron a short time, rather than a cooler iron for a longer period. You will also make a better connection with the hot iron. If you keep the iron clean by wiping the tip frequently, and occasionally add a small amount of solder to the tip, it will aid the transfer of heat to the connection. Do not allow too much solder to build up on the tip, though, or it may fall onto adjacent circuitry.

A good solder connection does not require a large amount of solder around the joint. A well-made connection looks smooth and shiny because the solder *flows into the joint* when both parts are hot enough.

There are four steps to making a good solder connection:

1. Make a good mechanical connection.
2. Heat *both* parts with the tip of the iron *at the junction.*
3. Apply solder to the *junction* until it melts and flows.
4. Allow the connection to cool undisturbed.

ALL SOLDERING MUST BE DONE WITH A GOOD GRADE OF ROSIN CORE SOLDER.

Under no circumstances should acid core solder be used. Unmarked solder, cheap solder or any of doubtful origin should be discarded, and *separate solder fluxes should never be used.* The warranty is voided on any equipment in which acid core solder or acid type fluxes have been used. Silver solder is not suitable. The recommended solder is 60/40 (60% tin, 40% lead) *ROSIN CORE.* Do not confuse this with 40/60, which is harder to use.

When the instructions refer to "tinning" a wire, apply the iron to the bared wire end, and after a moment, touch the solder to the wire so that the solder lightly coats the wire. This makes it easier to get a good connection when the wire is inserted into an eyelet, for example.

Whenever one wire is to be soldered to a connection such as a lug or an eyelet, the instructions will indicate this by the symbol (S). If more than one wire is to be soldered to the same point, the instructions will so state. (S-2), for example, indicates that 2 wires are to be soldered to the named lug. If no symbol is shown, do not solder; further connections will be made to that point before soldering is called for.

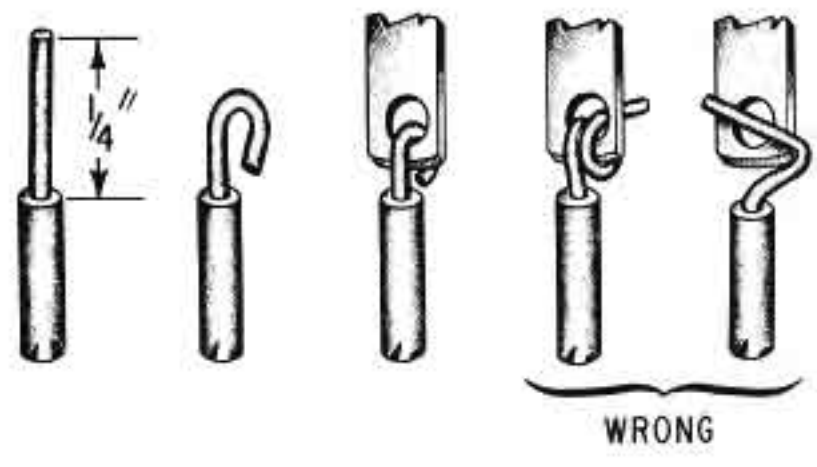
Components such as resistors and capacitors are marked individually with their values, or with a color code. The color code will be given in the instructions when needed. The first color band on a resistor is the one nearest the end.

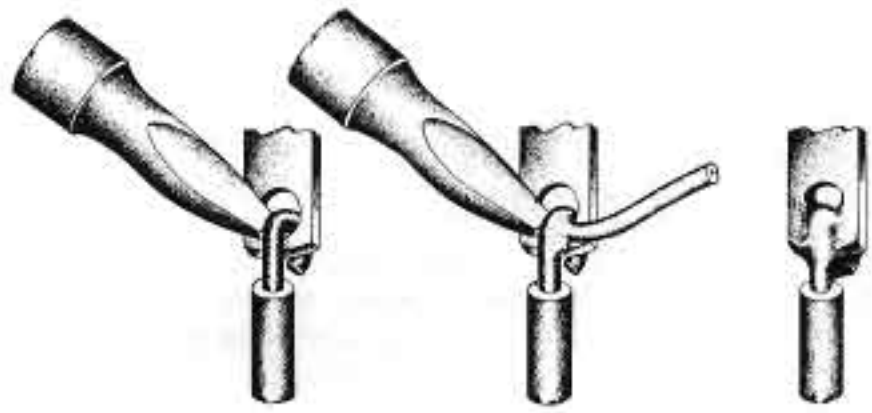
A number of steps begin, "Connect one end of a wire . . . ", with the length of wire specified. In each case, first cut a piece of the correct color wire to the specified length, and then remove about ¼" of insulation from *each* end before making the connection. This is easiest with wire strippers, but diagonal cutters can be used if you are careful not to nick the wire and weaken it. With stranded wire such as transformer leads and line cords, be particularly careful not to cut the strands when stripping the ends.

The position of all wire leads should follow the diagram and photograph closely, bearing in mind that the pictorial diagram has necessarily been distorted somewhat to show all connections clearly. See that uninsulated wires do not touch each other unless, of course, they are connected to the same point. It is especially important that uninsulated wires or component leads or terminals do not touch the chassis accidentally.

Check your work after each step. When you are satisfied that it has been correctly done, check the space provided and go on to the next step. Be sure you read carefully the explanatory paragraphs in the assembly instructions.

One of the best ways to make a good mechanical connection is to bend a small hook in the end of the wire, and then to crimp the hook onto the terminal lug. The amount of bare wire exposed need not be exactly ¼-inch, but if it is too long, the excess might touch another terminal lug or the chassis. Do not wrap the wire around the lug more than one time, as this makes the connection difficult to remove if an error is made.





When soldering a lead to an eyelet on the circuit board, the PAT-4 makes it easy to apply the iron to one side of the board while the tinned wire end is pressed into the solder-filled eyelet from the opposite side. When the eyelet is heated, the wire enters easily, but be careful that you *do not push the wire all the way into the eyelet up to the insulation.* If you do, you will not be able to see if you have made a secure connection, or if more solder is needed to provide a smooth flow from the wire, to the eyelet, and onto the circuitry on the board.

Transistor equipment, unlike much tube equipment, will not tolerate wiring errors, sloppy or incomplete soldering. TAKE THE TIME TO BE NEAT AND ACCURATE, and your preamplifier will operate properly at first, and for many years to come.

FRONT PANEL ASSEMBLY

There are two sizes of mounting hardware in this kit. #4 is the smaller, and #6 the larger. Be sure you use the correct size called for, and be especially careful that you separate the #6 lockwashers (try them for size over a #6 screw) so that one is not used in place of a #4 lockwasher.

You may wish to mark on the chassis with a pencil the letter designations of the control cutouts shown in the pictorial diagram (FS, PS, MS, VC, etc.) to facilitate assembly. In the instructions these components will be referred to in this abbreviated fashion.

There are 2 types of rocker-action switches supplied in the kit. The one with the clear rocker is the lighted power switch, and there are five conventional 2-position (DPDT) switches. All of these switches have tapped extruded mounting holes and do not require either lockwashers or nuts in assembly.

1( ) The rubber feet are installed with four each #6 screws, nuts and lockwashers. Insert the screws into the feet until the screw heads are entirely recessed within the feet. The fit is very tight, so you can place the foot over a hole in the chassis and thread the screw down. Mount the feet firmly to the bottom of the chassis in the hole nearest each corner with a lockwasher inside the chassis under each nut. Do not deform the feet with excessive tightening.

2( ) Note the correct orientation of the small wires (near the bottom of the chassis) on the clear power switch, and install it in the cutout PS near the corner of the front panel with two #4 screws.

3( ) Install one of the black rocker switches in location MS at the opposite end of the group of switch cutouts. Use two #4 screws.

4( ) Install the remaining four rocker switches in the cutouts BS, AS, RS and LS with eight #4 screws.

5( ) Place one of the 3/8" flat washers followed by one of the 3/8" lockwashers on the bushing of one of the two phone jacks. Insert the jack through the hole OJ next to the power switch and secure it with a 3/8" nut on the outside of the chassis. Note that the flattened edge (corner) of the plastic inside the chassis is nearest the *bottom* of the chassis.

6( ) Place the other 3/8" flat washer and 3/8" lockwasher on the remaining phone jack, and mount the jack through hole IJ. Keep the flattened edge on the *bottom*, and secure it with a 3/8" nut.

7( ) Cut a 14" red wire, a 13" green wire, a 12" black wire, and a 13" black wire. Twist these (4) wires together so that the *shorter* black wire projects 1/2" beyond the others. Connect the projecting black wire to PS lug #4 (S). Connect the other black wire to PS lug #3. Connect the green wire to PS lug #2. Connect the red wire to PS lug #6 (S).

8( ) Trim both leads of the .02 *disc* capacitor to 1/2". Connect one lead to PS lug #3 (S-2). Connect the other capacitor lead to PS lug #2 (S-2).

9( ) Cut two 10" black wires, a 3" black wire, and a 4" black wire. Connect one end of each to OJ lug #1 (S-4).

10( ) Connect one end of a 10" green wire to lug #5 of phone jack OJ (S). Bend the free end of this wire back on itself to enable it to be identified later.

11( ) Cut a 10" green wire and a 2 1/2" green wire. Connect one end of each to OJ lug #4 (S-2).

12( ) Connect one end of a 10" red wire to OJ lug #2 (S). Bend the free end of this wire back on itself to enable it to be identified later.

13( ) Cut a 10" red wire and a 4 1/2" red wire. Connect one end of each to OJ lug #3 (S-2).

14( ) Strip one end of a 2 1/4" green wire 3/4". Feed the long bared end *through* BS lug #4 and connect it to BS lug #1. Solder both lugs. Connect the other end to AS lug #3.

15( ) Trim *one* lead of a 10,000 ohm resistor (brown-black-orange) to 1". Connect the short lead to AS lug #3 (S-2). Place this resistor below the switch, and connect the other lead to RS lug #5, trimming the lead as needed.

16( ) Strip one end of a 2 1/4" red wire 3/4". Feed the long bared end *through* AS lug #1 and connect it to AS lug #4. Solder only AS lug #1. Connect the other end to BS lug #6 (S).

17( ) Connect one end of a 1 3/4" red wire to BS lug #5 (S). Connect the other end to AS lug #6 (S).

18( ) Connect one end of a 1 3/4" green wire to BS lug #3 (S). Connect the other end to AS lug #2.

19( ) Connect one end of a 5" red wire to IJ lug #3 (S). Position this wire above the switch group and *against the front panel*, and connect the other end to RS lug #1.

20( ) Connect one end of a 4" green wire to IJ lug #4 (S). Keep this wire above the switches and away from the front panel, and connect the other end to RS lug #4.

21( ) Trim both leads of a 10,000 ohm resistor (brown-black-orange) to 1". Connect one lead to AS lug #4 (S-2). Keep this resistor above the switch, and connect the other lead to RS lug #2.

22( ) Trim both leads of the 7,500 ohm resistor (violet-green-red) to 3/4". Connect one lead to AS lug #2 (S-2). Connect the other lead to AS lug #5. Place this resistor directly to the rear of the switch.

23( ) Trim both leads of a .01 mfd capacitor to 3/4". Connect one lead to RS lug #2 (S-2). Connect the other lead to RS lug #1 (S-2). This capacitor should be kept close to its connecting lugs, and toward switch AS, or directly out from the switch lugs.

24( ) Trim both leads of another .01 mfd capacitor to 3/4". Connect one lead to RS lug #5 (S-2). Connect the other lead to RS lug #4 (S-2). This capacitor should also be kept close to, and straight out from its connecting lugs, or towards switch LS, for if these capacitors are close together, separation will be reduced.

25( ) Connect one end of a 5¾" red wire to LS lug #2.

26( ) Connect one end of a 5" green wire to LS lug #5.

27( ) Connect one full length lead of an 18,000 ohm resistor (brown-gray-orange) to LS lug #1. Keep it near the panel, and away from the wire to RS lug #4.

28( ) Connect one lead of another 18,000 ohm resistor (brown-gray-orange) to LS lug #4.

29( ) Trim the leads of a .022 mfd capacitor to ¾". Connect one lead to LS lug #1 (S-2). Connect the other lead to LS lug #2 (S-2).

30( ) Trim the leads of the other .022 mfd capacitor to ¾". Connect one lead to LS lug #4 (S-2). Connect the other lead to LS lug #5 (S-2).

31( ) Connect one end of an 11" green wire to MS lug #6 (S).

32( ) Connect one end of a 12" green wire to MS lug #4 (S).

33( ) Connect one end of a 9" red wire to MS lug #3 (S).

34( ) Connect one end of a 10½" red wire to MS lug #1 (S).

35( ) Trim both leads of a 1 mfd electrolytic capacitor to 1". Connect the positive (+) lead to MS lug #5 (S). Place the capacitor above the jack IJ, and connect the other lead to IJ lug #5 (S). Be certain that the bare leads do not touch any other lugs.

36( ) Trim both leads of another 1 mfd capacitor to ¾". Connect the positive (+) lead to MS lug #2 (S). Keep the capacitor away from MS lugs 4, 5 and 6, and connect the other lead to IJ lug #2 (S).

37( ) Install the volume control #177254 (250 K ohms, with 8 lugs) in position VC, and fasten with a ⅜" nut. Note the tab on the control which engages the hole in the panel, assuring correct positioning.

Be sure that you double-check to be sure that you are installing each control in its correct location, and that the lugs are positioned as shown in the pictorial diagram. Occasionally a control may have the locating tab bent flush, and you may wish to raise it with a screwdriver to properly engage the hole.

Each of the four control potentiometers have their lugs numbered as follows: when viewed from the rear (inside the chassis) the numbers increase clockwise from 1 to 3 on the front section (right channel, red wiring) and from 4 to 6 on the rear (left or green) section. The extra lugs for taps on the volume control are #7 (front) and #8 (rear).

38( ) Connect the free end of the red wire from LS lug #2 to VC lug #7 (S).

39( ) Strip one end of a 3" black wire ¾". Feed the bared end *through* VC lug #4 and connect it to VC lug #1. Connect the other end to IJ lug #1 (S).

40( ) Connect one end of a 2" black wire to VC lug #1.

41( ) Connect the free lead of the 18,000 ohm resistor from LS lug #1 to VC lug #1 (S-3). Position this resistor's leads along the front panel, but they must not touch the panel.

42( ) Connect one end of a 1¼" red wire to VC lug #2 (S).

43( ) Connect one end of a 6½" red wire to VC lug #3 (S). Place this wire against the panel, under BAL and BC, and connect the other end to AS lug #5 (S-2).

All of the red wires and the 18,000 ohm resistor to VC-1 should be kept as close to the panel as possible to preserve full channel separation.

44( ) Connect one end of a 1½" black wire to VC lug #4.

45( ) Connect the free end of the 18,000 ohm resistor from LS lug #4 to VC lug #4 (S-4). Remember, the through wire counts as 2 wires.

46( ) Connect one end of a 1½" green wire to VC lug #5 (S).

47( ) Connect one end of a 7" green wire to VC lug #6 (S). Connect the other end to BS lug #2 (S).

48( ) Connect the free end of the green wire from LS lug #5 to VC lug #8 (S).

All of the green wires and the 18,000 ohm resistor to VC-4 should be kept away from the red wire group. Place them above and to the rear of the switches.

49( ) Install the balance control #167224 (220 K ohms) in position BAL. Temporarily, before you install the nut, rotate the control counterclockwise so that it is easier to reach the #3 lug. Connect the short red wire from VC lug #2 to BAL lug #3 (S). Now position the control correctly, engaging the locating tab in the hole, and fasten with a ⅜" nut.

50( ) Cut a 3" black wire and a 3½" red wire. Twist them together so that one pair of ends are even. Connect the *long* red end to BAL lug #2 (S). Connect the corresponding black wire end to BAL lug #1.

51( ) Connect the free end of the black wire from VC lug #1 to BAL lug #1 (S-2).

52( ) Connect the free end of the black wire from VC lug #4 to BAL lug #6.

53( ) Cut a 4½" black wire and a 4½" green wire. Twist them together so that the ends are even. Connect one end of the black wire to BAL lug #6 (S-2). Connect the corresponding end of the green wire to BAL lug #5 (S).

54( ) Connect the free end of the green wire from VC lug #5 to BAL lug #4 (S).

55( ) Install the bass control #161503 (50 K ohms) in position BC and fasten with a ⅜" nut.

56( ) Install the treble control #161403 (40 K ohms) in position TC and fasten with a ⅜" nut.

57( ) Connect one end of a 3½" red wire to TC lug #1 (S).

58( ) Connect one end of a 3¼" red wire to TC lug #2 (S).

59( ) Connect one end of a 3" red wire to TC lug #3 (S).

60( ) Connect one end of a 3½" red wire to BC lug #1 (S).

61( ) Connect one end of a 3″ red wire to BC lug #2 (S).

62( ) Connect one end of a 2½″ red wire to BC lug #3 (S).

63( ) Cut three green wires each 4¼″ long. Connect one end of each wire to TC lugs #4, #5, and #6 respectively. Solder each of the three lugs.

64( ) Cut three green wires each 4″ long. Connect one end of each wire to BC lugs #4, #5 and #6 respectively. Solder each of the 3 lugs.

FILTER SWITCH SUB-ASSEMBLY

The filter switch FS is the smaller of the two rotary switches supplied. Hold it with the shaft *towards you* and the locating tab at 9 o'clock. There is a red dot on the frame on top. The lugs for each wafer are numbered clockwise from the red dot. The two wafers of the switch are identical but are not placed on the frame in the same orientation.

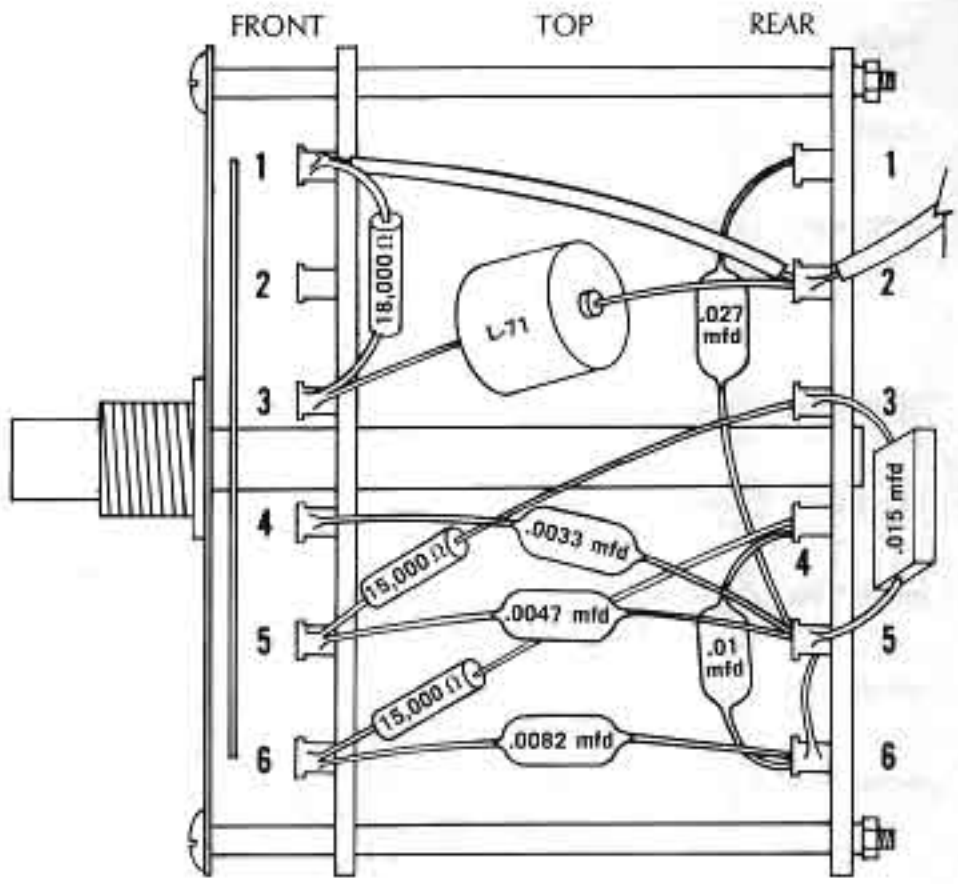
You will connect the components for the right half of the switch first. To make it easier to reach each lug for soldering when the time comes, and because space is at a premium, try to keep each component close to its mounting lugs, and in most cases within the frame of the switch. Keep the lead from each component to its lug as short and direct as possible, but you may not wish to trim off the excess length until after you have soldered that particular lug. Because more than one wire must be connected to most lugs, and the holes in them are small, it will probably be easier if you do not hook each wire around the lug and crimp it in place, but rather allow the excess lead to project through the lug, bending it to one side to hold each component in position. This makes it more important than ever that each lead to a lug be properly soldered. In a good assembly job only the solder is relied on for the connection—the mechanical crimping of the lead serves no purpose but to hold the lead in position for soldering.

Because of the limited space, neatness is important, and some thought should be given to placing each component so that its leads run directly to the proper lugs. In *most* cases a better job will result if the leads are fed through from near the center of the switch, allowing the excess lead to project outside the frame. This will avoid the problem of bare leads touching adjacent lugs or the leads to them, or the switch frame. Because the leads to each component will be cut very short, it is important that you take the time to double-check at each step to be sure that you are using the correct part, and that the lug numbers are correct.

Be careful not to use an excessive amount of solder on a switch lug, for if solder flows down onto the spring contacts the operation of the switch will be impaired. If the rosin flux from the solder is not boiled off in the soldering process, it too can prevent proper switch operation. Now before you start, check again to make sure the red dot is at the top. Handle the switch with reasonable care. The wafers are *not* unbreakable.

1( ) Place a .027 mfd capacitor inside (in front of) the rear switch wafer. Feed one lead through *rear* lug #5, and connect the other lead to *rear* lug #1 (S).

2( ) Bend the two leads of a .015 mfd capacitor into a "U" and place this capacitor outside (behind) the rear wafer. Connect one lead to rear lug #3. Feed the other lead *through* rear lug #5 and then connect it to rear lug #6.



RIGHT HALF

3( ) Connect one lead of a choke L71 to *rear* lug #2. Connect the other lead to *front* lug #3. Do not flex the choke leads close to its body, or you may break the fine wire coil conections where they are soldered to the leads.

4( ) Connect one end of a 4″ red wire to *rear* lug #2. You may wish to crimp the end of this wire over, to hold it in place while the next step is being completed.

5( ) Connect one end of a 2″ red wire to *rear* lug #2 (S-3). Connect the other end to *front* lug #1.

6( ) Bend the two leads of an 18,000 ohm resistor (brown-gray-orange) into a "U", and keeping this resistor inside (behind) the front wafer, connect one lead to *front* lug #1 (S-2). Connect the other lead to front lug #3. Do not confuse *gray* with *green*.

7( ) Bend the two leads of a .01 mfd capacitor into a "U". Place it inside the rear wafer, and connect one lead to *rear* lug #4. Connect the other lead to rear lug #6.

8( ) Connect one lead of a 15,000 ohm resistor (brown-green-orange) to *front* lug #5. Connect the other lead to *rear* lug #3 (S-2). Press this resistor back into the switch about ¼″ to make room for other components on top of it.

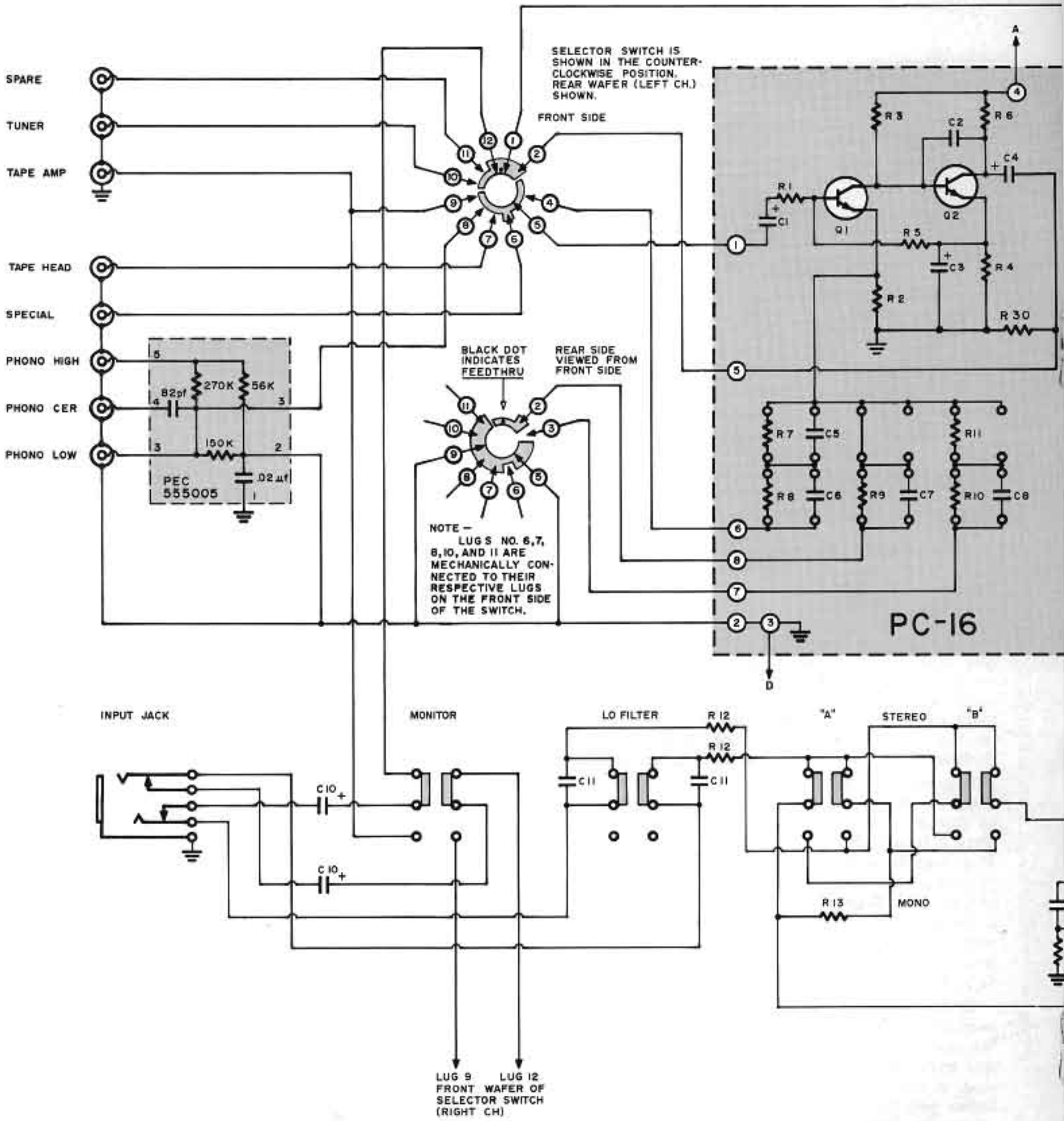
9( ) Connect one lead of another 15,000 ohm resistor (brown-green-orange) to *front* lug #6. Connect the other lead to *rear* lug #4 (S-2). Press this resistor back into the switch ¼″.

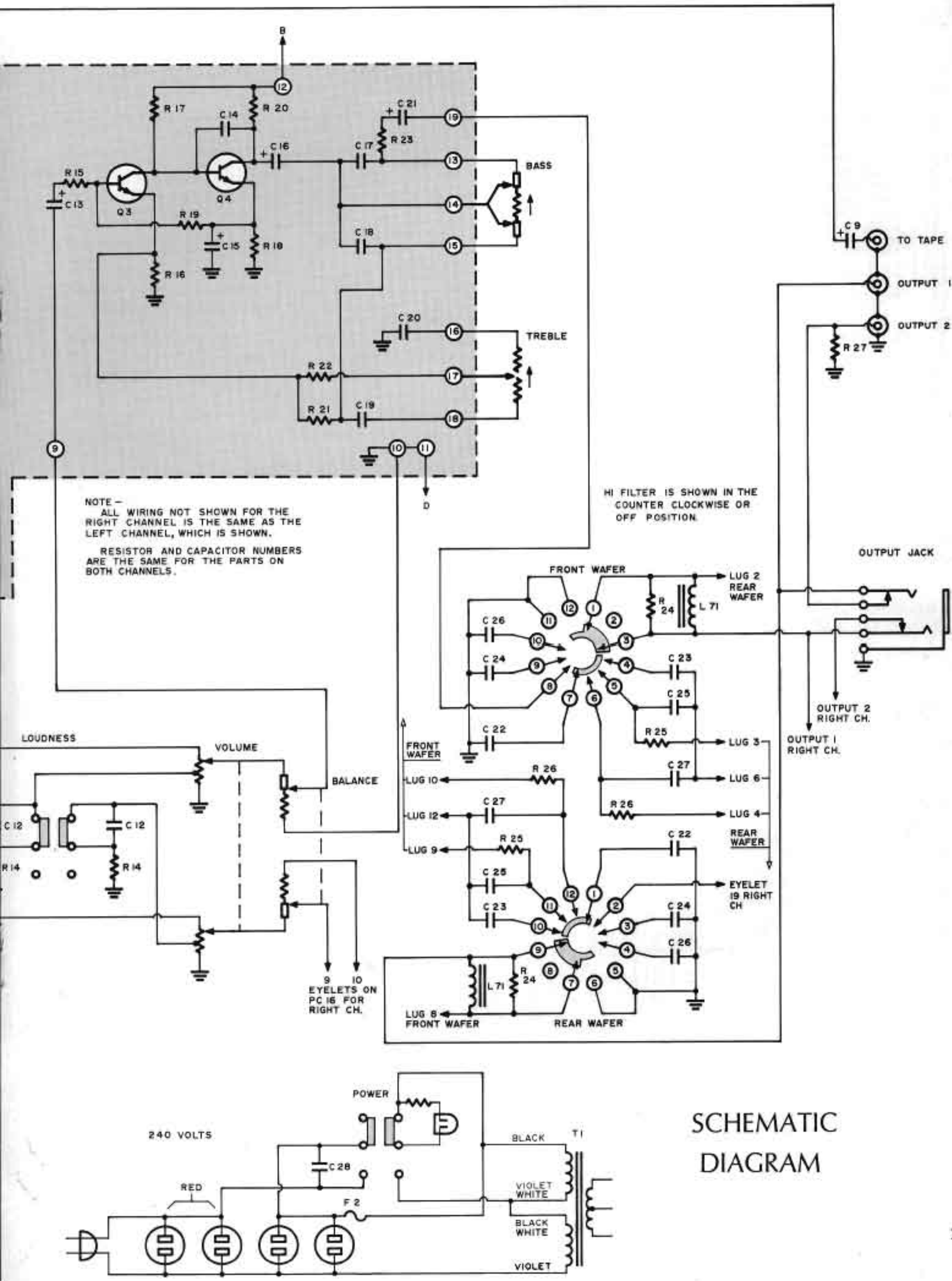
10( ) Connect one lead of a .0033 mfd capacitor to *front* lug #4(S). Connect the other lead to *rear* lug #5.

11( ) Connect one lead of a .0047 mfd capacitor to *front* lug #5 (S-2). Connect the other lead to *rear* lug #5 (S-5). (One *through* wire).

12( ) Connect one lead of a .0082 mfd capacitor to *front* lug #6 (S-2). Connect the other lead to *rear* lug #6.

NOW TURN TO PAGE 15


SPARE
TUNER
TAPE AMP
TAPE HEAD
SPECIAL
PHONO HIGH
PHONO CER
PHONO LOW
PEC 555005
82pf
270K
56K
150K
.02 µf
SELECTOR SWITCH IS SHOWN IN THE COUNTER-CLOCKWISE POSITION. REAR WAFER (LEFT CH.) SHOWN.
FRONT SIDE
BLACK DOT INDICATES FEEDTHRU
REAR SIDE VIEWED FROM FRONT SIDE
NOTE — LUGS NO. 6,7, 8,10, AND 11 ARE MECHANICALLY CONNECTED TO THEIR RESPECTIVE LUGS ON THE FRONT SIDE OF THE SWITCH.
PC-16
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R30
C1
C2
C3
C4
C5
C6
C7
C8
Q1
Q2
INPUT JACK
MONITOR
LO FILTER
R12
C10
C11
"A"
STEREO
"B"
R13
MONO
LUG 9 LUG 12 FRONT WAFER OF SELECTOR SWITCH (RIGHT CH)
POWER
120 VOLTS
C28
RED
F1
BLACK
T1
VIOLET WHITE
BLACK WHITE
VIOLET
D1
D2
R28
R29
C29



SCHEMATIC DIAGRAM

COMPONENT VALUES

All resistors are ½ watt, 5% unless otherwise indicated.

R 1	4,700 ohms	113472	
R 2	120 ohms	133121	
R 3	33,000 ohms	113333	
R 4	330 ohms	113331	
R 5	100,000 ohms	113104	
R 6	3,300 ohms	113332	
R 7	56,000 ohms	113563	
R 8	4,700 ohms	113472	
R 9	4,700 ohms	113472	
R 10	330,000 ohms	113334	
R 11	3,000 ohms	113302	
R 12	10,000 ohms	113103	
R 13	7,500 ohms	113752	
R 14	18,000 ohms	113183	
R 15	4,700 ohms	113472	
R 16	390 ohms	113391	
R 17	68,000 ohms	113683	
R 18	33 ohms	113330	
R 19	120,000 ohms	113124	
R 20	620 ohms, one watt	116621	
R 21	4,700 ohms	113472	
R 22	68 ohms, 10%	112680	
R 23	560 ohms	113561	
R 24	18,000 ohms	113183	
R 25	15,000 ohms	113153	
R 26	15,000 ohms	113153	
R 27	10,000 ohms	113103	
R 28	220 ohms, 3 watt, 10%	120221	
R 29	3,300 ohms	113332	
R 30	47,000 ohms	113473	

C 1	5 mfd, 15 v.	283505	
C 2	100 pf	245101	
C 3	100 mfd, 6 v.	281107	
C 4	50 mfd, 25 v.	283516	
C 5	.056 mfd	265563	
C 6	.015 mfd	265153	
C 7	.001 mfd	244102	
C 8	.015 mfd	265153	
C 9	1 mfd, 15 v.	283105	
C 10	1 mfd, 15 v.	283105	
C 11	.01 mfd	265103	
C 12	.022 mfd	265223	
C 13	5 mfd, 15 v.	283505	
C 14	100 pf	245101	
C 15	320 mfd, 6 v.	281327	
C 16	50 mfd, 25 v.	283516	
C 17	.047 mfd	265473	
C 18	.068 mfd	265683	
C 19	.015 mfd	265153	
C 20	.22 mfd	266224	
C 21	50 mfd, 25 v.	283516	
C 22	.027 mfd	266273	
C 23	.0033 mfd	265332	
C 24	.015 mfd	265153	
C 25	.0047 mfd	266472	
C 26	.01 mfd	265103	
C 27	.0082 mfd	266822	
C 28	.02 mfd, 500 v.	227203	
C 29	700 mfd @ 75 v. ▲		
	700 mfd @ 60 v. ■		
	800 mfd @ 20 v. ◓	294228	

D 1	Silicon diode, 200 ma, 200 prv	544012	
D 2	Silicon diode, 200 ma, 200 prv	544012	
F 1	1/10 amp, slo-blo	342101	
F 2	1/16 amp, slo-blo (alternate)	342062	
L 71	53mh choke	422530	
T 1	Transformer 10415	464018	

TRANSISTORS

Q 1	BC109B	240-500 Beta @ 5 v, 2 ma	572109
Q 2	BC109B	240-500 Beta @ 5 v, 2 ma	572109
Q 3	BC109B	240-500 Beta @ 5 v, 2 ma	572109
Q 4	40436/2N3053	200-500 Beta @ 10 v, 150 ma	572436

VOLTAGE TEST POINTS

Measured with VTVM from chassis reference, with 120 volt line. Tolerance: ±20%. All voltages DC unless otherwise specified.

CAPACITOR C-29

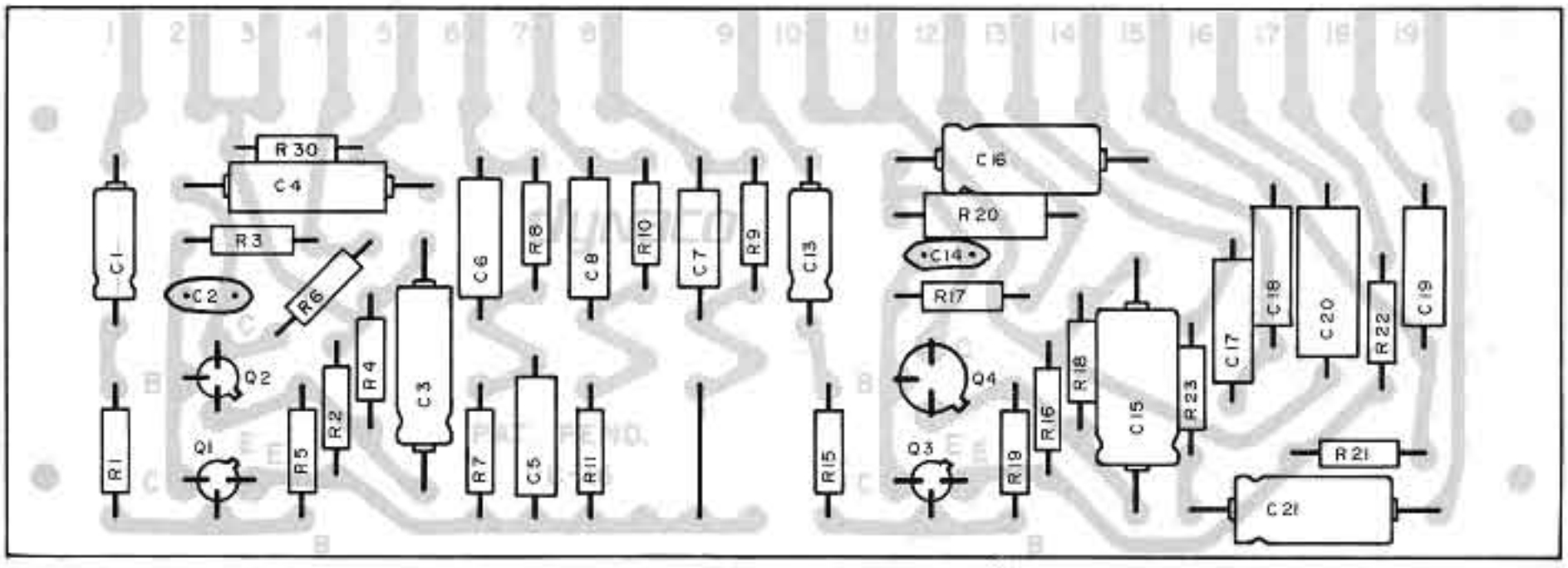
▲	52
■	38
◓	17.5

5 LUG TERMINAL STRIP

#1	0 *
#2	52
#3	0
#4	44 AC
#5	44 AC

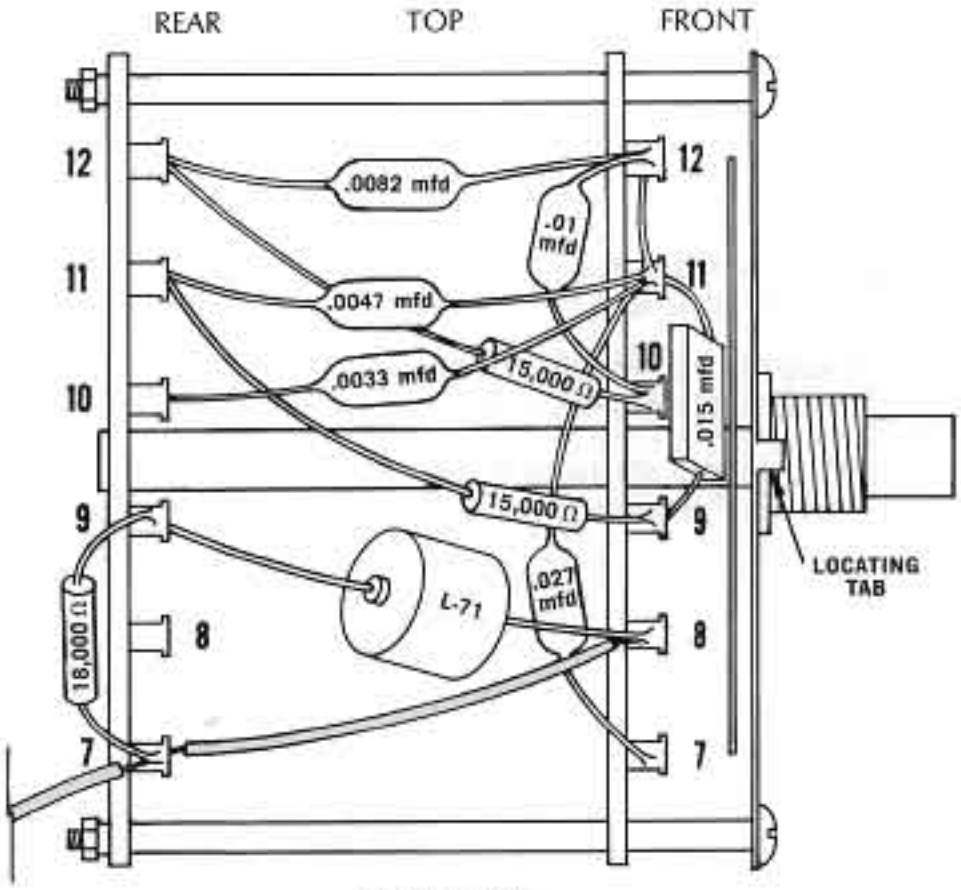
* *In 240 volt version, 120 volts AC to either side of the line.*

	Q 1	Q 2	Q 3	Q 4
E	.06	.8	.18	1.0
B	.65	1.4	.75	1.6
C	1.4	9.6	1.6	18



CIRCUIT BOARD

Now the wiring of the left half of the switch will be completed. Though there is a great deal of similarity between the two halves, they are not identical.



LEFT HALF

13( ) Place the other .027 mfd capacitor inside (behind) the front wafer and connect one lead to *front* lug #11. Connect the other lead to *front* lug #7 (S).

14( ) Bend the two leads of the other .015 mfd capacitor into a "U" and place this capacitor outside (in front of) the front wafer. Feed one lead *through* front lug #11 and connect it to front lug #12. Connect the other lead to front lug #9. This capacitor should be close to the wafer, under the lugs, if possible, to avoid interference with the switch rotation.

15( ) Connect one lead of the other choke L71 to *rear* lug #9. Connect the other lead to *front* lug #8.

16( ) Connect one end of a 2" green wire to *front* lug #8 (S-2). Connect the other end to *rear* lug #7.

17( ) Bend the two leads of the other 18,000 ohm resistor (brown-gray-orange) into a "U". Connect one lead to *rear* lug #7, and the other lead to *rear* lug #9.

18( ) Connect one end of a 4" green wire to rear lug #7 (S-3).

19( ) Bend the two leads of the other .01 capacitor into a "U". Place it on the inside of the front wafer, and connect one lead to *front* lug #10, and the other lead to front lug #12.

20( ) Connect one lead of a 15,000 ohm resistor (brown-green-orange) to *front* lug #9 (S-2). Connect the other lead to *rear* lug #11. Push this resistor back into the switch ¼" to make room for other components.

21( ) Connect one lead of the remaining 15,000 ohm resistor (brown-green-orange) to *front* lug #10 (S-2). Connect the other lead to *rear* lug #12. Push this resistor back into the switch ¼".

22( ) Connect one lead of the remaining .0033 mfd capacitor to *rear* lug #10 (S). Connect the other lead to *front* lug #11.

23( ) Connect one lead of the remaining .0047 mfd capacitor to *front* lug #11 (S-5). Connect the other lead to *rear* lug #11 (S-2).

24( ) Connect one lead of the remaining .0082 mfd capacitor to *rear* lug #12 (S-2). Connect the other lead to *front* lug #12.

You have completed the filter switch subassembly, and if it is correct, you will find that front lug #2 and rear lug #8 have no connections to them. Front lugs #3 and #12 are not yet soldered; nor are rear lugs #6 and #9. Have you clipped off all excess leads to soldered lugs?

25( ) Install the filter switch assembly *very loosely* in position FS with a ⅜" nut. Rotate the switch so that lug #10 is on top.

26( ) Connect the short green wire from OJ lug #4 to FS *rear* lug #9 (S-3).

27( ) Rotate the filter switch so that lug #3 is uppermost. Connect the shortest black wire (3") from OJ lug #1 to FS *rear* lug #6 (S-4).

28( ) Position the shorter red wire from OJ lug #3 vertically, and over the top of the filter switch. Connect it to FS *front* lug #3 (S-3).

29( ) Rotate the filter switch so that the red dot is uppermost, engage the locating tab in its hole, and tighten the ⅜" nut to secure the switch.

30( ) Connect the shorter of the three remaining black wires from OJ lug #1 to FS *front* lug #12 (S-4).

This completes the front panel assembly, with the exception of mounting the selector switch. It may not appear so, but you are about half way to completion.

BACK PANEL ASSEMBLY

1( ) The two 5-socket input strips are to be mounted on the *inside* of the back panel with the short ground lug to the *left* (viewed from inside). Use #4 hardware, inserting the screws from the outside, and secure with a lockwasher under each nut, *except for* the upper left screw of each strip adjacent to the short ground lug, which uses a locking *ground lug* in place of the lockwasher. Before tightening the bolts, make sure that none of the metal socket mounts can touch the chassis—especially the Phono Low sockets.

2( ) Mount the four 3-socket input strips on the inside using #4 hardware. *Note* that the short ground lug on each of these strips is on the *right*.

3( ) Mount the two black AC outlets in the lower two rectangular holes (marked "switched") using #4 screws, lockwashers and nuts.

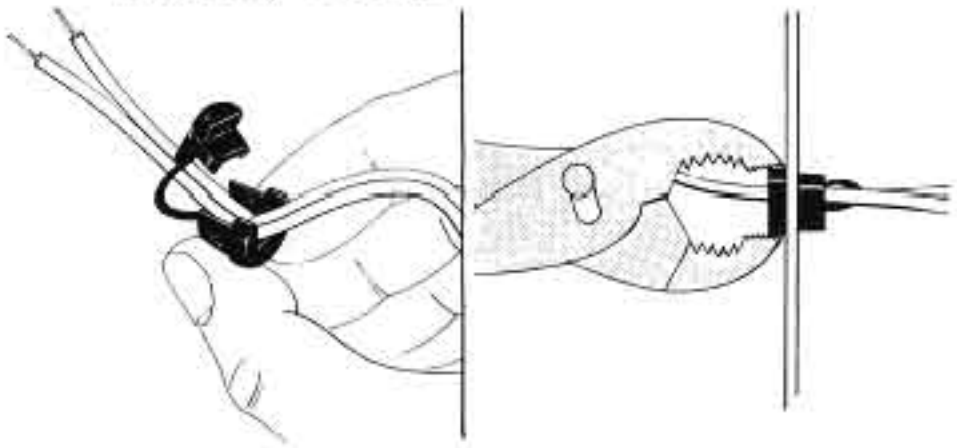
4( ) Mount the two red AC outlets in the remaining rectangular holes with #4 hardware.

5( ) Install the fuse holder in the corner hole. The rubber washer goes on the outside of the chassis, and the lockwasher and nut on the inside.

6( ) Mount the 5-terminal strip with a #4 screw, lockwasher and nut. It is installed vertically between the input sockets and the AC outlets with the mounting bracket facing as shown in the pictorial diagram.

7( ) Mount the 2-terminal strip with a #4 screw, lockwasher and nut between the upper and lower socket strips. Note position of the mounting bracket.

8( ) Separate the two conductors of the line cord for about 2". Cut off ¾" from one of the conductors, and strip ¼" of insulation from each (unless the line cord was supplied with stripped ends). Mark the line cord 3" from the longer end with a pencil or pen. Bend the cord sharply back on itself at the marking so that a "V" is formed. Install the strain relief at the "V" as shown in the detail drawing. The small end of the strain relief is nearest the end of the wire. With heavy pliers, crimp the two halves of the strain relief together around the wire to partially form the wire before insertion in the chassis. Now grasp only the larger diameter portion of the strain relief with the tips of the pliers, squeeze it fully closed, and insert the combination from the outside of the chassis into the cutout next to the fuse holder. The device can only be installed in the cutout one way, and will snap into its locked position when fully inserted.



9( ) There are two PEC (packaged electronic circuit) modules, #555005. One of these is to be connected to each of the 5-socket input strips. Connect lead #1 of the first PEC to the bolted-on ground lug at the corner of the upper strip of sockets (S). Trim the leads as needed to give a neat job. Keep them short, and there will be less possibility of their shorting to adjacent wiring or hardware. Connect lead #2 to the *short* ground lug on the strip which is attached to socket #1. Connect lead #3 to socket #1 (long lug). Connect lead #4 to socket #2 (long lug) (S). Connect lead #5 to socket #3 (long lug) (S).

10( ) Connect the other PEC #555005 to the lower socket strip in the same manner. Connect lead #1 to the bolted-on ground lug (S). Connect lead #2 to the *short* lug of socket #12. Connect lead #3 to socket #12 (long lug). Connect lead #4 to socket #13 (S). Connect lead #5 to socket #14 (S).

11( ) Cut 10 black wires each 2" long. Strip each end as usual.

These wires will be used to connect certain groups of the *short* ground lugs which are adjacent to each numbered socket. For convenience they will be referred to by the number of the adjacent long lug of the socket, and where they are located between lugs, they will be identified by a dash, as [#2-3], and then connections are made to both.

12( ) Connect one end of the first wire to *short* lug #1, and the other end to the pair #2-3.

13( ) Connect one end of the second wire to pair #2-3 (S-2). Connect the other end to pair #4-5 (S).

14( ) Connect one end of the third wire to *short* lug #12, and the other end to the pair #13-14.

15( ) Connect one end of the fourth wire to pair #13-14 (S-2). Connect the other end to pair #15-16 (S).

16( ) Connect one end of the fifth wire to pair #6-7 (S). Connect the other end to short lug #8.

17( ) Connect one end of the sixth wire to short lug #8 (S-2). Connect the other end to pair #9-10.

18( ) Connect one end of the seventh wire to pair #9-10, and the other end to short lug #11.

19( ) Connect one end of the eighth wire to pair #17-18 (S). Connect the other end to short lug #19.

20( ) Connect one end of the ninth wire to short lug #19 (S-2). Connect the other end to pair #20-21.

21( ) Connect one end of the tenth wire to pair #20-21, and the other end to short lug #22.

22( ) Connect one lead of a 10,000 ohm resistor (brown-black-orange) to pair #9-10 (S-3). Connect the other lead to the *long* lug of socket #11.

23( ) Connect one lead of the other 10,000 ohm resistor (brown-black-orange) to pair #20-21 (S-3). Connect the other lead to the *long* lug of socket #22.

From now on, all socket number designations will refer only to the *long* lug, unless a specific reference is made to the adjacent short lug.

24( ) Connect the positive (+) lead of a 1 mfd capacitor to terminal #1 of the 2-lug terminal strip. Connect the other lead to input socket #9 (S).

25( ) Connect the positive (+) lead of the remaining 1 mfd capacitor to terminal #2 of the 2-lug terminal strip. Connect the other lead to input socket #20 (S).

26( ) Connect the positive (+, striped, or colored) lead of a rectifier diode #544012 to lug #2 of the 5-lug vertical terminal strip. Connect the other lead to lug #4 of the terminal strip.

27( ) Connect the positive lead of the other rectifier diode #544012 to lug #2 of the 5-lug terminal strip. Connect the other lead to lug #5 of the terminal strip.

28( ) Strip a 3" piece of wire bare. Bend it into a shallow "V" and feed one end *through* lug #1 of AC outlet B, while you feed the other end *through* lug #1 of AC outlet C. Connect the first end to lug #1 of AC outlet A, and the second end to lug #1 of AC outlet D. Solder the #1 lug of outlet C and the #1 lug of outlet D.

29( ) Strip a 1" piece of wire bare, and connect one end to lug #2 of outlet A and the other end to lug #2 of outlet B.

30( ) Strip another 1" piece of wire bare, and connect one end to lug #2 of outlet C, and the other end to lug #2 of outlet D (S).

31( ) Connect the longer end of the AC line cord to lug #1 of outlet A (S-2).

32( ) Connect the shorter end of the AC line cord to lug #2 of outlet A (S-2). Make sure all strands of the line cord are soldered in this, and in the preceding step.

MAIN CHASSIS ASSEMBLY

Handle the etched circuit boards with reasonable care, for they account for a large portion of the cost of the PAT-4. For protection in transit, small fiberboard protectors have been placed over the transistors to prevent their leads from being crushed. Remove these with care, as they are a tight fit over the one finned radiator on each board. The radiators are friction-fitted on the transistors, and if they come off they are difficult to replace without flexing the transistor leads, and such *flexing must be avoided*. A special heat-conducting silicon grease is used between the transistor and the radiator.

Check to make sure each transistor is standing up from the board, and that its leads do not touch one another. Because each circuit board has been in-circuit checked prior to shipment, and these instructions do not require any connections to the boards except to the numbered eyelets along the top edge, there should be no need for you to solder to any of these components. However, if the occasion arises, remember that excessive heat will damage any transistor, though these are rugged silicon types. When soldering to a transistor lead, it is most important that the iron and the junction be hot enough when you apply the solder so that the solder will flow rapidly into the junction, and then you can remove the iron quickly and allow it to cool.

1( ) The circuit boards are mounted on the U-shaped brackets so that the bracket is on the component side (not the copper circuit side) and both boards face the same way, with the row of eyelets at the top (the open part of the "U" bracket). Use 8 sets of #4 screws, nuts and lockwashers.

2( ) Mount the bracket and board assembly in the chassis so that the components face the rear, and the eyelet numbers are read from the front. Use two sets of #6 screws, nuts and lockwashers. Insert all screws from outside (under) the chassis.

3( ) Note the position of the screw head in the clamp of the capacitor mounting bracket in the pictorial diagram, and install a #6 screw and nut (no lockwasher) in the clamp loosely. Mount the bracket in the chassis as indicated with two sets of #6 screws, nuts and lockwashers, but do not tighten these bolts.

4( ) Install the 3 section electrolytic capacitor in the bracket with the terminals oriented as in the diagram. Make sure it is snug against the chassis, and tighten the clamp. Now tighten the two bracket mounting bolts.

5( ) Mount the power transformer with two sets of #6 screws, nuts and lockwashers making sure the leads face the direction indicated in the diagram.

You will be soldering wires to the eyelets on the etched circuit boards next. These eyelets have solder in them to make the job easier, but it will probably be necessary to use additional solder to assure a good connection from the wire to the eyelet, and to the copper circuitry on the board. The job will be easier if the tip of the iron is kept clean, and a small drop of solder on the tip will aid heat transfer. The wire will be easier to connect if it is first "tinned" (see soldering instructions).

The steps will *not* specify which side of the board is used; you should follow the diagram. "Front" and "rear" in these steps refer to the appropriate circuit board. The red wires connect to the front circuit board, which is the right channel.

When soldering to the eyelets on the board, touch the soldering iron to the opposite side of the eyelet as you insert the wire. Be sure the wire penetrates the eyelet as you move the iron aside. *Do not push the bared end of the wire all the way into the eyelet until the insulation touches the board.* If you do, you cannot be certain that you have a good solder connection from the wire to the eyelet, and to the circuitry on the board.

Be particularly careful not to drop or flick solder onto the back (circuit side) of the boards, as it might cause a short circuit between two conductors, causing damage or inoperation when the preamplifier is turned on.

It may be easier to "tin" all of the leads now from the front panel which will connect to the circuit boards, rather than each one when it is called for, and you can also go back and add any necessary solder to connections which do not show a smooth flow of solder from the wire to the circuitry on the board, after you have completed a group of connections.

The following eight steps refer to connections made to the *front* PC-16 circuit board:

6( ) Insert the free end of the red wire from FS rear lug #2 into eyelet #19 (S).

7( ) Insert the red wire from TC lug #1 into eyelet #18 (S). This, and the wires in the following 5 steps should be positioned around the side of the rear section of the control, as in the pictorial diagram.

8( ) Insert the red wire from TC lug #2 into eyelet #17 (S).

9( ) Insert the red wire from TC lug #3 into eyelet #16 (S).

10( ) Insert the red wire from BC lug #1 into eyelet #15 (S).

11( ) Insert the red wire from BC lug #2 into eyelet #14 (S).

12( ) Insert the red wire from BC lug #3 into eyelet #13 (S).

13( ) Insert the black wire of the red and black twisted pair from control BAL into eyelet #10 (S). Insert the red wire of this pair into eyelet #9 (S).

Remember that as new wires are added, it is best to "tin" them before connecting them to an eyelet.

14( ) Connect one end of a 5¾" black wire to the ground lug (part of the outside can) of the electrolytic capacitor which is nearest the filter switch FS. Insert the other end of this wire into eyelet #11 of the *front* PC-16 (S).

15( ) Connect one end of an 8½" black wire to the same ground lug on the electrolytic capacitor (S-2). Insert the other end into eyelet #3 of the *front* PC-16 (S).

16( ) Connect one end of a 5¾" black wire to the ground lug of the electrolytic capacitor which is nearest the power transformer. Insert the other end into eyelet #11 of the *rear* PC-16 (S).

17( ) Connect one end of an 8½" black wire to the same ground lug on the capacitor (S-2). Insert the other end into eyelet #3 of the *rear* PC-16 (S).

18( ) Connect the red-and-yellow transformer lead to the ground lug of the electrolytic capacitor which is nearest the right outside edge of the chassis (S). This lead may be trimmed as desired.

19( ) Connect one end of an 8¼" red wire to lug A (marked with a half-circle) of the electrolytic capacitor. Insert the other end into eyelet #4 of the *front* PC-16 (S).

20( ) Connect one end of a 5½" red wire to capacitor lug B (marked with a square). Insert the other end into eyelet #12 of the *front* PC-16 (S).

21( ) Connect one end of a 5¼" red wire to capacitor lug B (square). Insert the other end into eyelet #12 of the *rear* PC-16 (S).

22( ) Connect one end of an 8¼" red wire to capacitor lug A (half-circle). Insert the other end into eyelet #4 of the *rear* PC-16 (S).

The following eight steps refer to connections made to the *rear* PC-16 circuit board:

23( ) Insert the green wire from FS rear lug #7 into eyelet #19 (S).

24( ) Insert the green wire from TC lug #4 into eyelet #18 (S).

25( ) Insert the green wire from TC lug #5 into eyelet #17 (S).

26( ) Insert the green wire from TC lug #6 into eyelet #16 (S).

27( ) Insert the green wire from BC lug #4 into eyelet #15 (S).

28( ) Insert the green wire from BC lug #5 into eyelet #14 (S).

29( ) Insert the green wire from BC lug #6 into eyelet #13 (S).

30( ) Insert the black wire of the green and black twisted pair from control BAL into eyelet #10 (S). Insert the green wire of this pair into eyelet #9 (S).

31( ) Bend both leads of the 3300 ohm resistor (orange-orange-red) to form a "U". Connect one lead to lug A (half-circle) of the capacitor (S-3). Connect the other lead to lug B (square) of the capacitor.

32( ) Bend both leads of the 220 ohm 3 watt resistor to form a narrow "U". Connect one lead to lug B (square) of the capacitor (S-4). Connect the other lead to lug C of the capacitor (marked with a triangle).

33( ) Connect one end of a 6" red wire to capacitor lug C (triangle) (S-2).

Place the rear panel assembly near its proper location at the rear of the chassis. Make the following connections before finally attaching it to the chassis.

34( ) Twist together the two red wires from the power transformer. Trim them to a convenient length and connect one of them to lug #5 of the 5-lug terminal strip on the back panel (S-2). Be careful that you do not damage the rectifier diode by using excessive heat. Connect the other red wire to lug #4 of the terminal strip (S-2). Be careful of the heat.

35( ) Connect the *shorter* of the two black wires from the power switch PS to lug #1 (side) of the fuse holder.

36( ) Connect the green wire from the power switch to lug #2 (tip) of the fuse holder.

37( ) Connect the red wire from the power switch to lug #1 of AC outlet B.

NOTE: If this unit is to be used with a 240 volt AC line, connect the red wire *instead* to lug #1 of the 5-lug terminal strip.

38( ) Connect the remaining (longer) black wire from the power switch to lug #2 of outlet B (S-2).

39( ) Connect one end of a 5" black wire to lug #2 of the fuse holder (S-2). Connect the other end to lug #2 of outlet C (S-2).

40( ) Twist together the black wire and the black & white wire from the power transformer. Trim to a convenient length, and connect both of them to lug #1 of the fuse holder (S-3).

NOTE: If this unit is to be used with a 240 volt AC line, connect only the black wire to lug #1 of the fuse holder (S-2). Connect the black & white wire to lug #1 of the 5-lug terminal strip.

41( ) Twist together the violet and the violet & white wires from the power transformer. Trim to a convenient length, and connect both of them to lug #1 of outlet B (S-5).

NOTE: If this unit is to be used with a 240 volt AC line, connect only the violet wire to lug #1 of outlet B (S-3). Connect the violet & white wire to lug #1 of the 5-lug terminal strip (S-3).

42( ) Twist together the two red wires and one of the black wires from output jack OJ. You have bent back the end of the red wire from OJ lug #2 to identify it. Connect this wire with the bent end to socket (long lug) #22 (S-2).

43( ) Connect the other red wire to socket #21 (S).

44( ) Connect the black wire to the short ground lug of socket #22 (S-2).

45( ) Twist together the two green wires and the other black wire from jack OJ. You have bent back the end of the green wire from lug #5 to identify it. Connect this wire with the bent end to socket #11 (S-2).

46( ) Connect the other green wire to socket #10 (S).

47( ) Connect the black wire to the short ground lug of socket #11 (S-2).

48( ) Connect the free end of the red wire from lug C (triangle) of the electrolytic capacitor to lug #2 of the 5-lug terminal strip (S-3). Be careful not to damage the diodes with excessive heat. This wire should be placed so that it does not contact the 220 ohm resistor, which will get hot.

49( ) Install the selector switch in the front panel, locating the tab in its hole, and securing it with a ⅜" nut.

The lug numbers of the selector switch increase clockwise from the top of the switch, when viewed from the front. Note that on both wafers, lugs #2, #5 and #9 have special insulated mountings on the back of the wafer. These lugs are *not connected* to the correspondingly numbered lug on the front of the wafer and it is essential that you do not allow connections to short between them in the assembly process. In other cases where a double lug appears, both lugs are to be considered as one, and *soldered together*. The instructions will explicitly refer to the *front* or *rear lug* of each wafer when these lugs are insulated.

The following steps refer to the *front* wafer of the selector switch, and to the *front* PC-16 board.

50( ) Connect one end of a 1½" black wire to *rear* lug #5. Connect the other end to *rear* lug #9.

51( ) Connect one end of a 2½" black wire to *rear* lug #5 (S-2). Insert the other end into PC-16 eyelet #2 (S).

52( ) Connect one end of an 8" black wire to *rear* lug #9 (S-2).

53( ) Connect the free end of the red wire from MS lug #1 to lug #12 (S).

54( ) Connect the free end of the red wire from MS lug #3 to *front* lug #9. Keep this wire, and the wire to lug #12 in the preceding step along the bottom of the front PC-16.

55( ) Connect one end of a 2" red wire to *front* lug #5 (S). Insert the other end into eyelet #1 (S).

56( ) Connect one end of a 3¼" red wire to *front* lug #2 (S). Insert the other end into eyelet #5 (S).

57( ) Connect one end of another 3¼" red wire to lug #4 (S). Insert the other end into eyelet #6 (S).

58( ) Connect one end of a 3¾" red wire to lug #3 (S). Insert the other end into eyelet #7 (S).

59( ) Connect one end of a 4" red wire to *rear* lug #2 (S). Insert the other end into eyelet #8 (S).

60( ) Connect one end of a 10" red wire to lug #2 of the 2-lug terminal strip on the back panel (S-2). Connect the other end to switch lug #1 (S).

61( ) Connect one end of another 10" red wire to lug #6 (S). Bend the other end of this wire back for later identification.

62( ) Connect one end of another 10" red wire to lug #7 (S).

63( ) Connect one end of an 8" red wire to lug #8 (S).

64( ) Position the 3 red wires from lugs #6, #7 and #8 together with the black wire from lug #9 straight off the side of the switch, being careful not to put stress on the switch wafer. Twist these 4 wires together. Bend the group so that it drops down to the chassis, and back along the chassis edge towards the 5-socket input strip.

65( ) Connect the black wire from this group to the *short ground lug* of socket #12 (S-3). Make sure none of the bare leads at this lug touch the hardware, as this ground is *not* the same as chassis ground.

66( ) Connect the shortest red wire to socket #12 (long lug) (S-2).

67( ) Connect the red wire with the bent end to socket #15 (S).

68( ) Connect the remaining red wire to socket #16 (S).

69( ) Connect one end of an 8½" red wire to *front* lug #9 (S-2). Connect the other end to socket #17 (S).

70( ) Connect one end of another 8½" red wire to lug #10 (S). Connect the other end to socket #18 (S).

71( ) Connect one end of a 9" red wire to lug #11 (S). Connect the other end to socket #19 (S).

This completes the work on the front wafer and front PC-16. The following steps will refer to the *rear* wafer and the *rear* PC-16 board.

72( ) Connect one end of a 1½" black wire to *rear* lug #5. Connect the other end to *rear* lug #9.

73( ) Connect one end of a 2½" black wire to *rear* lug #5 (S-2). Insert the other end into eyelet #2 of PC-16 (S).

74( ) Connect one end of a 4¼" black wire to *rear* lug #9 (S-2).

75( ) Connect the free end of the green wire from MS lug #4 to lug #12 (S).

76( ) Connect the free end of the green wire from MS lug #6 to *front* lug #9. Position this wire, and the wire to lug #12 in the preceding step, along the front of the chassis to keep them clear of the red wires from the switch MS to the front wafer of the switch.

77( ) Connect one end of a 2" green wire to *front* lug #5 (S). Insert the other end into eyelet #1 (S).

78( ) Connect one end of a 3" green wire to *front* lug #2 (S). Insert the other end into eyelet #5 (S).

79( ) Connect one end of a 3¼" green wire to lug #4 (S). Insert the other end into eyelet #6 (S).

80( ) Connect one end of a 3¾" green wire to lug #3 (S). Insert the other end into eyelet #7 (S).

81( ) Connect one end of a 4" green wire to *rear* lug #2 (S). Insert the other end into eyelet #8 (S).

Now fasten the back panel in place with 4 sheet metal screws.

82( ) Connect one end of a 6" green wire to lug #6 (S). Bend the other end of this wire over to identify it later.

83( ) Connect one end of another 6" green wire to lug #7 (S).

84( ) Connect one end of a 4" green wire to lug #8 (S).

85( ) Position the 3 green wires from lugs #6, #7 and #8 together with the black wire from lug #9 straight off the side of the switch. Carefully twist them together, and bend the group to the rear toward the upper input sockets.

86( ) Connect one end of a 5" green wire to lug #1 (S). Connect the other end to lug #1 of the 2-lug terminal strip on the back panel (S-2).

87( ) Connect one end of another 5" green wire to lug #11 (S). Connect the other end to input socket #8 (S).

88( ) Connect one end of another 5" green wire to lug #10 (S). Connect the other end to socket #7 (S).

89( ) Connect one end of a 6" green wire to *front* lug #9 (S-2). Connect the other end to socket #6 (S).

90( ) Of the group of 4 twisted wires, connect the black wire to the *short ground lug* of socket #1 (S-3). Make sure these bare leads do not touch the adjacent hardware.

91( ) Connect the short green wire to socket #1 (long lug) (S-2).

92( ) Connect the green wire with the bent end to socket #4 (S).

93( ) Connect the last green wire to socket #5 (S).

This completes the wiring of your PAT-4. Check to see that there are no unattached wires and no unsoldered connections. Clip off any excessive stubs of wires to make a neat job. Check to make sure that the wires to each eyelet on the circuit boards show a smooth flow of solder to the eyelet and to the circuitry.

Now turn the chassis over and shake out any bits of wire or solder. Check the 220 ohm resistor on the electrolytic capacitor, to be sure it is clear of the red wire which connects to the lug beneath it. See that the red wire and the green wire from lugs #1 of the selector switch to the 2-lug terminal strip are kept clear of adjacent wiring.

Take a moment to see that the general placement of wires is similar to the photograph of the inside of the chassis. The pictorial diagram has necessarily been distorted so that you can trace individual wires, with the result that it does not provide an accurate indication of how your wiring should look upon completion. Be sure that the specified twisted groups of wires have been followed, and properly positioned.

Check the separate rear lugs #2, #5 and #9 on the selector switch (both wafers) to see that the wiring has not strained them so that the contacts are twisted off center. The phono input will not function, for example, if the #5 rear lug is not properly positioned.

Make sure that red and green wires do not parallel each other closely for any distance, for such a condition will reduce the separation between right and left channel signals. A separation of one half inch is usually sufficient. In particular, keep the red wires from the front panel switches to the volume control and input jack close to the panel, and the green wires behind the switches. Also, separate the red and green wires which connect the monitor switch to the selector switch. The red wires between the back panel and the selector switch should be kept close to the chassis, and the green wires high.

94( ) Insert a sheet metal screw into the hole in the back panel marked "GND". This is the point to which separate ground wires from the record player, tape player, etc. may be connected.

95( ) Insert the fuse into the fuse holder.

96( ) Two phono plugs are included in the kit, which are to be used as "shorting plugs" in the left and right inputs marked "Tape Head" if a tape playback deck is not connected to these inputs. To make each into a shorting plug, strip two 1½" pieces of wire bare, and crimp over one end of each to form a *very tight* "U". Slide the crimped end down into the center conductor of each plug from the large end. The crimped end prevents the wire from sliding out the other end. Solder the other end of the wire to the "handle". Now solder the wire inside the center conductor by flowing solder into it, while the iron heats the side.

97( ) Install the front plate, securing it with a ⅜" nut on shafts SS, BAL and FS. Be sure the jacks IJ and OJ protrude very slightly, to avoid scarring the panel when plugs are inserted. The fit of the front plate over the jacks and switches is tight. If the plate does not seat properly, you can loosen the mounting hardware and shift the jacks or switches slightly.

98( ) Set screws are included in the bag with each knob. Install these first. The large knobs are positioned on shafts SS and VC so that the set screw engages the flat on the shaft. The small single knobs go on BAL and FS. Position BAL so that rotation is symmetrical from center. The set screw of FS engages the flat on the shaft. Then install the double knobs on BC and TC so that rotation is symmetrical from center.

99( ) Slide the cover on after checking to make sure the holes in the side line up with the chassis. Secure it with the 4 sheet metal screws.

ADDITIONAL STEREO CONTROL FUNCTIONS

Those who are experimentally inclined may wish to add phase reversal and/or channel reversal switches to their music system, though standardization of program material makes them unnecessary. Instructions for incorporating double-pole-double-throw switches in the speaker connections to the power amplifier for either of these functions is available on request from Dynaco.

IN CASE OF DIFFICULTY

Although your PAT-4 has been designed to be as free from trouble as possible, there is always the chance that a defective component or improper assembly will cause difficulty. However, because the circuit is essentially simple, and the layout accessible, it should not be difficult to locate and correct the source of trouble.

Because 90% of the difficulties which are encountered in kit-built units can be attributed to incorrect wiring or to poor solder connections, it is strongly recommended that you ask someone else to check your wiring against the pictorial diagram, as frequently one person will overlook the same error repeatedly. Unless a wiring error has been made which would cause the breakdown of one or more parts, it is highly unlikely that inoperation upon completion will be caused by a faulty component on either of the circuit boards, since these have been in-circuit tested prior to shipment.

There are certain general precautions to be observed in servicing any transistorized equipment:

1. Never make circuit changes (connections or disconnections) of any kind when the preamplifier is turned on.
2. Be particularly careful not to short any transistor leads to each other or to the chassis when the power is on.
3. When using test equipment, you must avoid transient voltage peaks and excessive test voltages.
4. Exercise caution when soldering and unsoldering transistor and diode leads to avoid excessive heat.

The average kit-builder should confine his servicing to the basic suggestions given here, after first checking to make sure the fuse is intact. Audio transistors, unlike tubes, cannot be easily checked locally for any other than gross defects, and even this should be left to the qualified technician.

First, construction problems should be eliminated by close inspection and rechecking. Trace the wiring, and examine solder connections closely. Look for small flecks of solder, especially on the back (etched circuit side) of the boards, which may be causing improper connections. Sometimes a connection which appears solid between an eyelet and the wire will not have a smooth flow of solder from the wire to the eyelet and also from the eyelet to the board. The positions of the wires should be essentially as shown in the photograph, since the pictorial diagram must necessarily be distorted for clarity.

Second, a systematic procedure should be followed to trace the source of the trouble, once you understand the basic circuit configuration of the PAT-4.

Power Supply

The power supply section includes the line cord, power switch, power transformer, the rectifier diodes on the 5-lug terminal strip, and the large electrolytic capacitor (C-29). If the voltages at the lugs of this capacitor, measured with a VTVM, are reasonably close to those indicated on the voltage chart, then the power supply must be operating satisfactorily. However, if they measure more than 25% low, detach the wires which connect each PC-16 board to the capacitor at eyelets #4 and #12 to see if the voltages go to normal or above. If they do, some fault in connection with one or the other circuit board is imposing an excessive load on the supply, and the fault is not in the supply. Try connecting only one or the other board to the capacitor to localize the trouble area.

Preamplifier—Tone Controls

All four pairs of transistors are used in essentially similar configurations. On each circuit board, the first pair is the low level preamplifier for the Phono, Tape Head and Special inputs. The second pair is the tone control and output section. High level inputs, such as for Tuner, Tape Amp, and Spare connect directly to this section. Most of the other controls and switches are located after the low level circuitry with the exception of the Hi Filter which is placed at the output of the tone control section. The two pairs of transistors which comprise each channel are interconnected by the selector switch. A problem can thus be localized to one or the other channel, and then to the preamp or tone control sections.

For example, if there should be insufficient output on the left channel with the phonograph playing, see if this channel is operating properly with a tuner input. If it is, then the trouble is in the low level section of the left channel.

Again, if there is no output on the right channel from any input, then the low level section can be tested by exercising some ingenuity. If you realize that the "To Tape" output signal is available *before* the volume and tone controls, you can connect the right channel tape output directly to the power amplifier, or into the identical input on the left channel as the program source you are switched to on the right channel. If you then have suitable signal level, you have determined that the trouble lies in the right channel tone control and output section.

An additional aid is to compare voltages measured with a VTVM with the chart in this manual. A higher than normal voltage at the collector of one of the transistors, for example, is possibly indicative that it is open and requires replacement.

If the problem is one of little or no signal, then simple signal tracing, following the signal path carefully and injecting some hum by touching each connection in turn, is advisable. If there is a point after which hum occurs, and before which there is silence, you have localized the trouble.

Check especially the double (front and rear) lugs #2, #5 and #9 on each wafer of the selector switch (and particularly #5 if you get no phono signal) to make sure they have not been twisted in their insulated mountings on the rear of each wafer.

As another example, if you have signal on both channels with the hi-filter in the flat position, but the left channel signal drops sharply when you switch to one of the high frequency cut positions, remember that this switch is at the output of the preamp, so everything prior to it must be working properly. Examining the circuit shows that the choke coil L-71 is in series with the output signal, but is shunted out when the switch is in the flat position. Therefore, a break in its coil would prevent signal from passing until the switch is "off," when the shunt permits the signal to pass. Replacing L-71 would correct the trouble.

Hum and Noise

The PAT-4 is inherently hum-free, and if any hum is detected the inputs should be unplugged to see if the hum disappears. If there is no hum with the cables removed, at the same volume setting which produced hum when cables were attached, the problem must be corrected in the associated equipment. Frequently hum which is injected via the phonograph cables can be eliminated by connecting a ground wire between the record player chassis and the preamp. Some phono cartridges are more hum

susceptible than others, and may not be suitable in certain installations where they are close to power transformers, AC power lines, etc.

Hum traced to the PAT-4 may indicate power supply problems. If it is common to both channels, it is almost certainly in the supply, which should be checked carefully, including bridging additional capacity across the large electrolytic filter capacitor to determine if any of the three sections are ineffective. Hum tests should be made with the cover in place, however, for external hum fields will affect the results.

When there are no cables connected to the low level inputs, it is normal to have a high hiss level at higher volume settings on Phono, Tape Head and Special. With the usual sources connected, the hiss should be inaudible at the settings used in normal listening, though at much higher settings, some hiss may be evident.

Objectionable hiss at normal listening levels may be caused by a faulty input transistor Q1, unless it occurs on both channels. If there is hiss on all low level inputs of one channel, you can interchange transistor Q1 between channels to determine if one is defective. The transistors in the tone control stages will not be a source of objectionable hiss.

Checking Transistors

An ohmmeter is all that is required to locate a transistor which has failed. Transistors must be removed from the circuit board for test. All transistors can be considered (for this test procedure) to be two diodes connected in series with common elements tied together. The junction point represents the base of the transistor. Observed from the bottom, the collector, base and emitter are arranged counterclockwise, with the collector attached directly to the case.

With one ohmmeter probe connected to the base, the other probe should be touched to the collector and emitter in turn. Readings from the base to the collector, and from the base to the emitter should be similar. With one orientation of the probes, there should be a high resistance reading (almost an open circuit). When the polarity of the probes is reversed, there should be a relatively low reading. Then the ohmmeter should be connected from collector to emitter, and a high resistance (almost open circuit) should be read, regardless of the orientation of the probes. If all of these qualifications are met, the transistor does not exhibit any gross defects. Determination of more subtle defects than "opens" or "shorts" requires specialized transistor testers and/or curve tracers.

In similar fashion, diodes can be checked by verifying that they have a high resistance in one direction, and low resistance in the other.

When replacing transistors, the larger ones with the finned radiators should have the radiators transferred to the replacement. The silicon grease between transistor and radiator should be transferred to the new transistor. Be careful to insert the leads into the proper eyelets. Do not use excessive heat on the leads—let the heat go to the eyelet instead.

When making replacements, standard types can be used provided they are screened beyond the manufacturer's routine specifications. This is necessary because transistors of a given type vary far more widely than do tubes. The requirements for each transistor are given in the parts list with the schematic diagram. No screening will be necessary for transistors obtained from Dynaco if the application (Q-number) or the Dynaco part number is specified.

While the parts list does not show all of the possible transistor options, Q1, Q2 and Q3 are selected for low noise, low leakage and high Beta. Q4 is a high Beta selection from the 2N3053 type. While almost any low power *npn* transistor can be temporarily substituted for Q1, Q2 or Q3, optimum performance will not be assured unless all specifications are met.

FACTORY SERVICE AND WARRANTY

The PAT-4 has been designed to provide reliable operation for a long time when it has been properly assembled and used. Nonetheless, through damage in transit, faulty kit assembly, or human error, service may sometimes be required.

To provide fast, reliable service, Dynaco has authorized service facilities in the U.S. and Canada, in addition to its factory service facility. These stations are authorized to make repairs in or out of warranty under the terms below. A current list of these facilities is available on request.

It is the owner's responsibility to take or send the unit freight prepaid to the service station. In the event you incorrectly diagnose which unit is faulty, you will be responsible for a check-out charge on any unit tested.

Shipment should be made via United Parcel Service or Bus Package Express (or CN or CP Express in Canada) if possible. REA Express is an alternative. DO NOT USE PARCEL POST. IT IS NOT A SAFE METHOD OF SHIPPING ELECTRONIC EQUIPMENT. The service facilities cannot handle Parcel Post claims, so repairs thus incurred will be made at the owner's expense at net prices.

Pack the unit properly in the original carton with all the protective inserts. Or, double-pack it with adequate cushioning between the cartons. Insure it for $160. Include the following information: 1) Your name and complete shipping address (Post Office box numbers are not adequate); 2) the serial number from the cover of this manual, *together with a copy of the dated bill of sale*; 3) the symptoms, in brief, but complete. Specifically note any intermittent problem.

Warranties apply to the original purchaser only. They do not apply to units which have been physically or electrically abused, or used contrary to the Operating Instructions, or to units which have been modified without prior factory authorization. If you suspect a defect in the power transformer, cutting the leads too short for re-use may void its warranty.

Dynaco maintains a Technical Services Department to help you locate the source of, and possibly correct a problem yourself. You may write or telephone. When writing, include the serial number, and describe any tests you have performed.

The components of a PAT-4 kit are warranted against manufacturing defects for one full year from the purchase date. If a defective component is found in a completed circuit board, or kit, simply return that individual part to the *factory* prepaid, and it will be replaced at no charge. Local service stations are not obligated to supply separate parts.

If you cannot locate the source of the difficulty, ship the entire PAT-4 to the nearest service station. Parts in warranty will be replaced at no charge, although a nominal service fee (currently $10.00) will be charged for the labor to diagnose, correct, and test the unit to ensure that it meets factory specifications.

Shipping charges to and from the service facility are the owner's responsibility. Units will normally be returned on a COD basis via UPS. A 90 day warranty is provided on the service work performed, including shipment both ways, labor and parts.

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

After the warranty period Dynaco establishes maximum labor fees which may be charged by its service facilities (plus the cost of parts, and shipping fees) without prior approval by the owner. This current PAT-4 fee is $10.00. Dynaco reserves the right to limit the service facility or the established fees to two years from the date of purchase.

Dynaco cannot assume responsibility for service at other than Dynaco authorized service facilities. Dynaco assumes no liability or responsibility for damages or injuries sustained in the assembly or operation of this equipment.

PARTS LIST

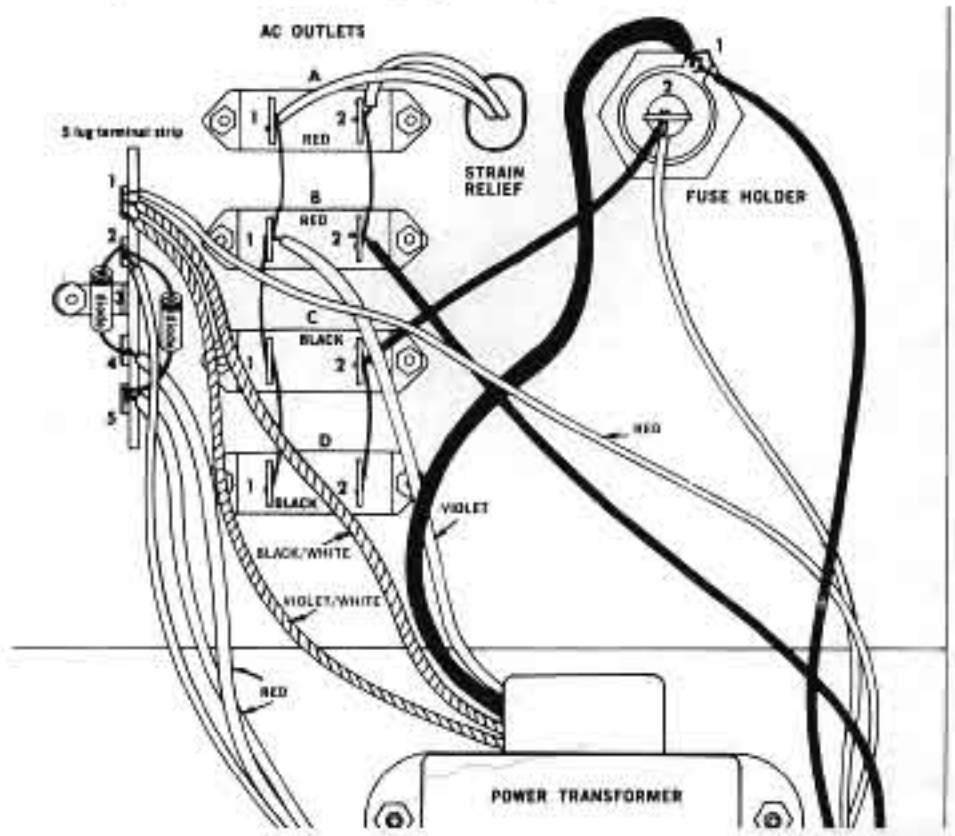
Parts of similar type which do not change performance will sometimes be included as a matter of expediency. This will account for slight variations in value and appearance.

		PART #
1	Chassis	711024
1	Back panel	711025
1	Cover	711022
1	Front plate, gold	769018
2	Circuit board assembly, PC-16	556016
1	Selector switch	334602
1	Filter switch	334603
1	Power transformer 10415	464018
1	Line Cord	322092
2	Shielded audio cable	321072
1	Wire, hookup, black	
1	Wire, hookup, green	
1	Wire, hookup, red	
1	Capacitor, electrolytic, C-29	294228
1	Bracket, 1⅜" diameter	717001
2	Bracket, "U" shape	717010
2	Knob, large with set screw	764186
2	Knob, small solid with set screw	764185
2	Knob, small dual with 2 set screws front	764234
	rear	764235
2	Socket strip, 5 inputs	355005
4	Socket strip, 3 inputs	355003
1	Terminal strip, 5 lugs	375002
1	Terminal strip, 2 lugs	372002
1	250 K dual volume control	177254
1	220 K dual balance control	167224
1	40 K dual treble control	161403
1	50 K dual bass control	161503
1	Switch, power, lighted rocker	334001
5	Switch, rocker, DPDT	334005
2	Circuit module, PEC, 5 leads	555005
2	Jacks, phone	355014
1	Fuse holder with hardware	341001
2	AC outlet, black	351001
2	AC outlet, red	351002

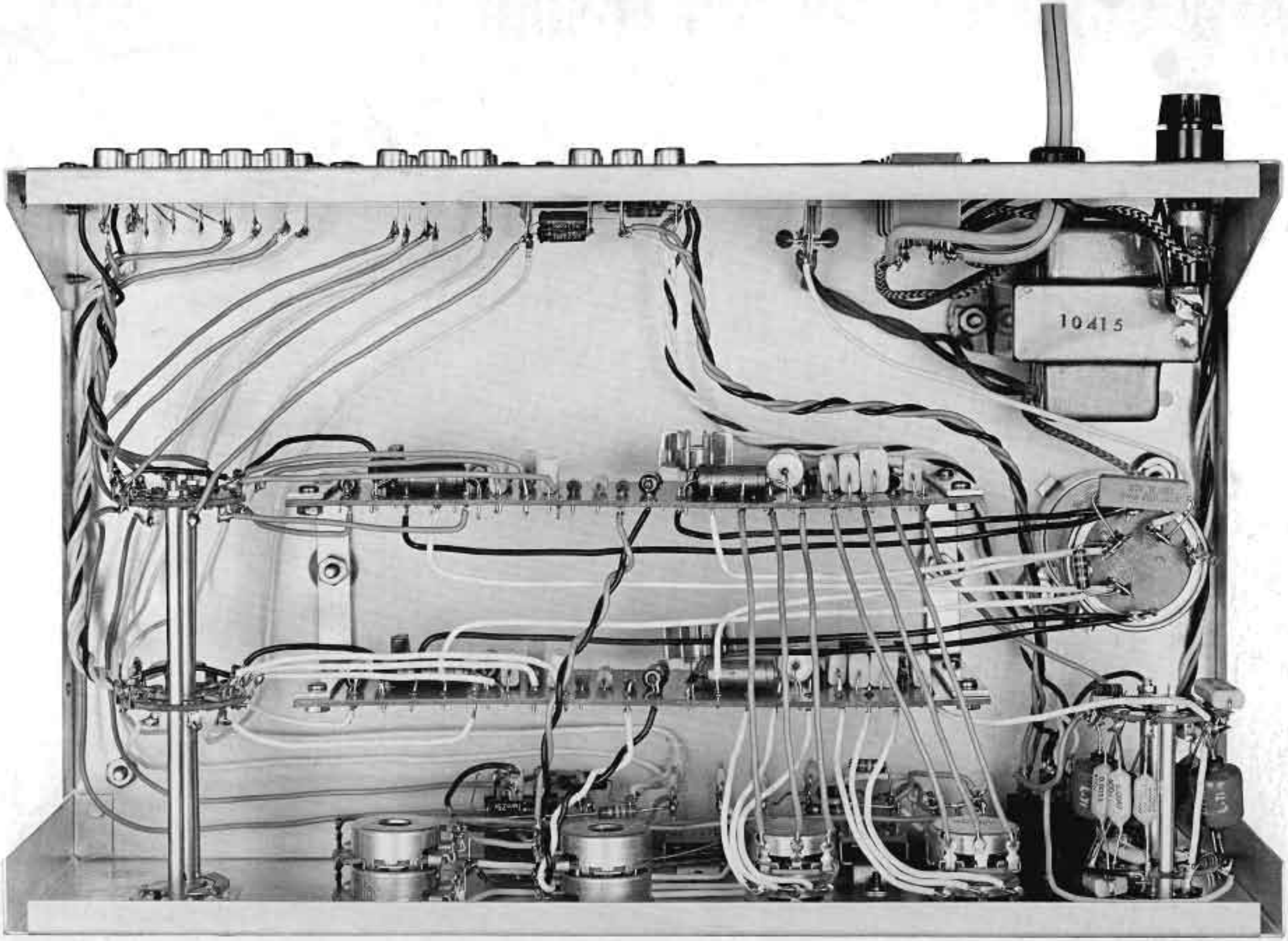
	ENVELOPE #1	997118
4	Foot, rubber	859001
1	Fuse, 1/10 amp, slo-blo	342101
40	Lockwasher, #4	617205
10	Lockwasher, #6	617305
2	Lockwasher, ⅜"	617165
2	Lug, ground	639308
42	Nut, hexagonal, #4-40	614245
11	Nut, hexagonal, #6-32	614355
11	Nut, hexagonal, ⅜"	614065
2	Plug, phono	361044
54	Screw, machine, #4-40 x ¼"	611245
11	Screw, machine, #6-32 x ½"	611385
9	Screw, sheet metal, #6 brass	612339
1	Strain relief, plastic	895001
2	Washer, flat ⅜"	616165

	ENVELOPE #2	997218
2	Rectifier diode, 200 ma, 200 prv	544012
	Capacitors	
2	.01 mfd mylar	265103
1	.02 mfd disc	227203
2	.022 mfd mylar	265223
4	1.0 mfd tubular electrolytic	283105
	Resistors	
1	3,300 ohm (orange-orange-red)	113332
4	10,000 ohm (brown-black-orange)	113103
2	18,000 ohm (brown-gray-orange)	113183
1	7,500 ohm (violet-green-red)	113752
1	220 ohm, 3 watt	120221

	ENVELOPE #3	997318
2	Choke coil, L-71	422530
	Capacitors	
2	.0033 mfd mylar	265332
2	.0047 mfd mylar	266472
2	.0082 mfd mylar	266822
2	.01 mfd mylar	265103
2	.015 mfd mylar	265153
2	.027 mfd mylar	266273
	Resistors	
4	15,000 ohm (brown-green-orange)	113153
2	18,000 ohm (brown-gray-orange)	113183



WIRING FOR 240 VOLT AC LINE


10415

SPARE
TUNER
TAPE AMP
TAPE HEAD
SPECIAL
PHONO HIGH
PHONO CER
PHONO LOW

PEC 555005
82pf
270K
56K
150K
.02 mf

SELECTOR SWITCH IS SHOWN IN THE COUNTER-CLOCKWISE POSITION. REAR WAFER (LEFT CH.) SHOWN.

FRONT SIDE

BLACK DOT INDICATES FEEDTHRU

REAR SIDE VIEWED FROM FRONT SIDE

NOTE – LUGS NO. 6,7, 8,10, AND 11 ARE MECHANICALLY CONNECTED TO THEIR RESPECTIVE LUGS ON THE FRONT SIDE OF THE SWITCH.

PC-16

R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11
C1 C2 C3 C4 C5 C6 C7 C8
Q1 Q2

R13 R14 R15 R16 R17 R18 R19 R20 R21 R22
C12 C13 C14 C15 C16 C17 C18 C19 C20 C21
Q3 Q4
R23

BASS
TREBLE

NOTE – ALL WIRING NOT SHOWN FOR THE RIGHT CHANNEL IS THE SAME AS THE LEFT CHANNEL, WHICH IS SHOWN.

RESISTOR AND CAPACITOR NUMBERS ARE THE SAME FOR THE PARTS ON BOTH CHANNELS.

HI FILTER IS SHOWN IN THE COUNTER CLOCKWISE OR OFF POSITION.

C9
TO TAPE
OUTPUT 1
OUTPUT 2
R27

OUTPUT JACK

INPUT JACK
MONITOR
LO FILTER
R12
C11
"A"
STEREO
"B"
C10
R13
MONO
LOUDNESS
VOLUME
BALANCE
C12
R14

LUG 9 LUG 12 FRONT WAFER OF SELECTOR SWITCH (RIGHT CH)

9 10 EYELETS ON PC 16 FOR RIGHT CH.

FRONT WAFER
LUG 2 REAR WAFER
R24
L71
C22 C23 C24 C25 C26 C27
R25 R26
LUG 3
LUG 6
LUG 4
REAR WAFER
EYELET 19 RIGHT CH
LUG 10
LUG 12
LUG 9
LUG 8 FRONT WAFER
REAR WAFER

OUTPUT 2 RIGHT CH.
OUTPUT 1 RIGHT CH.

120 VOLTS
POWER
RED
C28
F1
BLACK
VIOLET WHITE
BLACK WHITE
VIOLET
T1
D1
D2
R28
R29
C29

240 VOLTS
F2

SCHEMATIC DIAGRAM

COMPONENT VALUES

All resistors are ½ watt, 5% unless otherwise indicated.

R 1	4,700 ohms	113472	
R 2	120 ohms	133121	
R 3	33,000 ohms	113333	
R 4	330 ohms	113331	
R 5	100,000 ohms	113104	
R 6	3,300 ohms	113332	
R 7	56,000 ohms	113563	
R 8	4,700 ohms	113472	
R 9	4,700 ohms	113472	
R 10	330,000 ohms	113334	
R 11	3,000 ohms	113302	
R 12	10,000 ohms	113103	
R 13	7,500 ohms	113752	
R 14	18,000 ohms	113183	
R 15	4,700 ohms	113472	
R 16	390 ohms	113391	
R 17	68,000 ohms	113683	
R 18	33 ohms	113330	
R 19	120,000 ohms	113124	
R 20	620 ohms, one watt	116621	
R 21	4,700 ohms	113472	
R 22	68 ohms, 10%	112680	
R 23	560 ohms	113561	
R 24	18,000 ohms	113183	
R 25	15,000 ohms	113153	
R 26	15,000 ohms	113153	
R 27	10,000 ohms	113103	
R 28	220 ohms, 3 watt, 10%	120221	
R 29	3,300 ohms	113332	

C 1	5 mfd, 15 v.	283505	
C 2	100 pf	245101	
C 3	100 mfd, 6 v.	281107	
C 4	50 mfd, 25 v.	283516	
C 5	.056 mfd	265563	
C 6	.015 mfd	265153	
C 7	.001 mfd	244102	
C 8	.015 mfd	265153	
C 9	1 mfd, 15 v.	283105	
C 10	1 mfd, 15 v.	283105	
C 11	.01 mfd	265103	
C 12	.022 mfd	265223	
C 13	5 mfd, 15 v.	283505	
C 14	100 pf	245101	
C 15	250 mfd, 6 v.	281251	
C 16	50 mfd, 25 v.	283516	
C 17	.047 mfd	265473	
C 18	.068 mfd	265683	
C 19	.015 mfd	265153	
C 20	.22 mfd	266224	
C 21	50 mfd, 25 v.	283516	
C 22	.027 mfd	266273	
C 23	.0033 mfd	265332	
C 24	.015 mfd	265153	
C 25	.0047 mfd	266472	
C 26	.01 mfd	265103	
C 27	.0082 mfd	266822	
C 28	.02 mfd, 200 v.	227203	
C 29	700 mfd @ 60 v. ▲		
	700 mfd @ 60 v. ■		
	800 mfd @ 20 v. ▬	294228	

D 1	Silicon diode, 200 ma, 200 prv	544012	
D 2	Silicon diode, 200 ma, 200 prv	544012	
F 1	1/10 amp, slo-blo	341101	
F 2	1/20 amp, slo-blo (alternate)	341051	
L 71	53mh choke	422530	
T 1	Transformer 10415	464018	

TRANSISTORS

Q 1	A2289/A116 or BC109B	200-400 Beta @ 1.5 v, .5 ma selected for low noise	572289
Q 2	A2387/A104 or BC109B	200-400 Beta @ 1.5 v, .5 ma	572104
Q 3	A2289/A116 or BC109B	200-400 Beta @ 1.5 v, .5 ma	572289
Q 4	40436/2N3053	200-500 Beta @ 10 v, 150 ma	572436

VOLTAGE TEST POINTS

Measured with VTVM from chassis reference, with 120 volt line. Tolerance: ±20%. All voltages DC unless otherwise specified.

CAPACITOR C-29

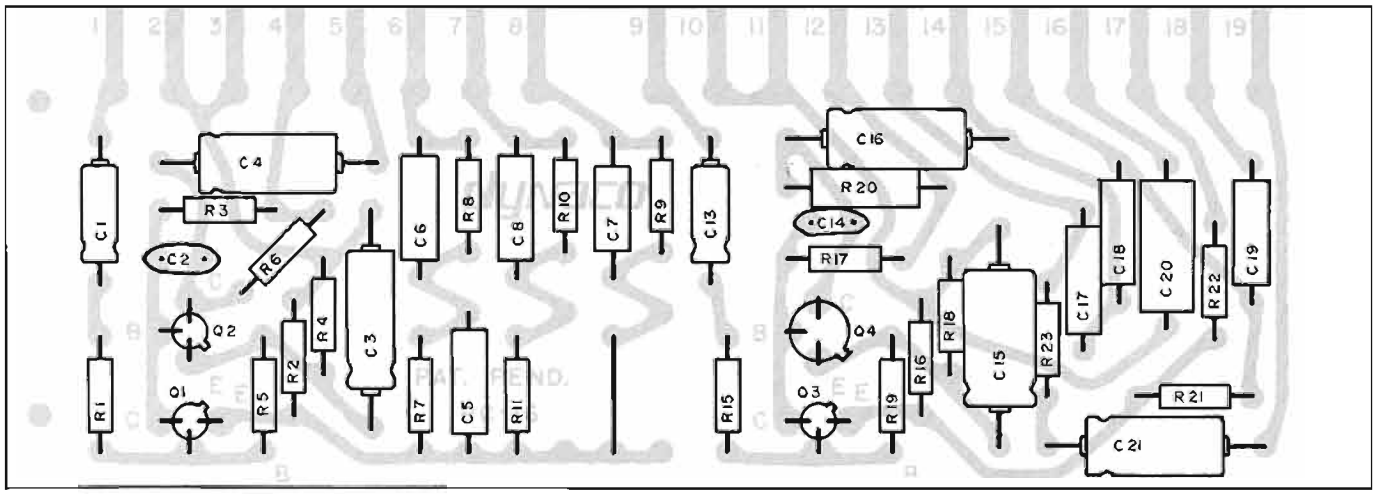
▲	52
■	38
▬	17.5

5 LUG TERMINAL STRIP

#1	0 *
#2	52
#3	0
#4	44 AC
#5	44 AC

** In 240 volt version, 120 volts AC to either side of the line.*

	Q 1	Q 2	Q 3	Q 4
E	.06	.8	.18	1.0
B	.65	1.4	.75	1.6
C	1.4	9.6	1.6	18



CIRCUIT BOARD