

# **dynaco**

## **PAT-4**

### **STEREO PREAMPLIFIER**

SERIAL NUMBER  
18031033

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

# **INSTRUCTIONS FOR ASSEMBLY OPERATION**



Price \$1.00

patents pending

929518

**dynaco inc.** 3060 Jefferson St., Philadelphia, Pa. 19121 U.S.A.

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## SPECIFICATIONS

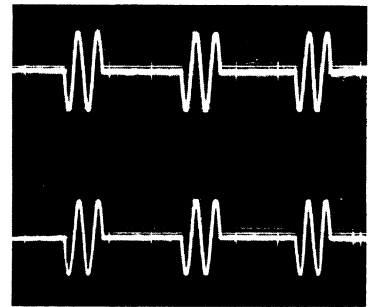
- Frequency Response:** High Level inputs:  $\pm 0.5$  db from 10 Hz to 100 KHz  
 Low Level inputs:  $\pm 1$  db from 20 Hz to 20 KHz (equalized)
- Distortion at rated 2 volt output:** THD less than 0.05% 20 Hz to 20 KHz  
 IM less than 0.05% with any combination of test frequencies
- Hum and Noise:** 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:**  $\pm 16$  db @ 50 Hz  
 $\pm 12$  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



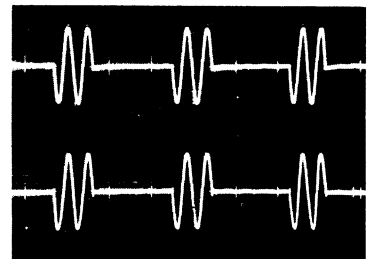
100 Hz Square Wave



10 KHz Square Wave

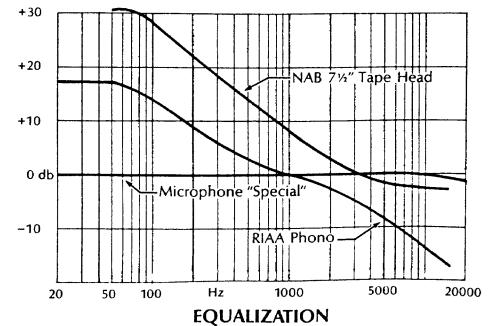
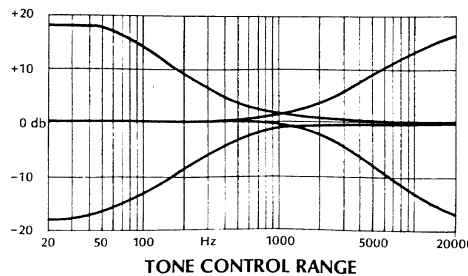
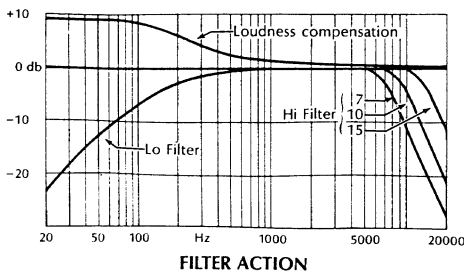


2 cycle 100 Hz Tone Burst



2 cycle 10 KHz Tone Burst

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



# 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 70 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.

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 super-sonic disturbances when recording from some stereo radio programs. Successive steps will assist in reducing high frequency distortion in poorer program sources.

### Monitor Switch

The spring-return *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 until you depress the *Monitor* switch against the spring. Then, you will hear the program just recorded as it is played back from the tape.

### 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. It can also be used when operating a center speaker in the Dynaco derived center channel system. This 3rd channel 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.

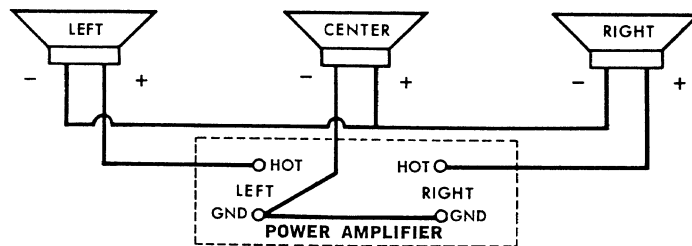
While it is possible to obtain moderate levels with even low impedance (4 to 16 ohms) headphones connected directly to the output jack of the PAT-4, the frequency response and distortion at the output will be significantly affected, and a 600 ohm matching transformer should be used to preserve high fidelity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

### DYNACO CENTER CHANNEL SYSTEM FOR 3 SPEAKER STEREO

This method of deriving the center (third) channel of a stereo system is an exclusive Dynaco development which utilizes special circuitry in the PAT-4 preamplifier to provide the proper in-phase (A+B) signal without loss of stereo separation and without the need for an additional amplifier. It is useful where the left and right speakers must be widely separated, and it also enables the use of the third channel speaker as a monophonic system in another location.

It should be recognized, however, that a two channel system will have a wider apparent sound source than any system utilizing a center speaker in a derived third channel arrangement, if the spacing between the left and right channel speakers remains the same. In order to maintain equivalent spread of sound, somewhat greater spacing between the outside speakers is required in any 3 speaker system.

The connection of the 3 speakers is diagrammed below. The use of 3 *identical* speakers is essential to achieve the most natural sound throughout their range. In any event, all speakers must have the same efficiency, and the left and right speakers should be identical. Connection of dissimilar speakers will reduce separation and adversely affect spatial orientation. The use of individual level controls in series with any of the speakers will also reduce separation. They are neither necessary nor desirable when matched speakers are used. If the speaker systems provide controls for the adjustment of relative tweeter or midrange levels, these should be set before the system is adjusted as described below. Be sure all speakers are correctly phased.



Adjusting the system is easy. Set the tone controls in their "flat" centered positions, switch off the loudness compensation and both filters, and adjust the volume control for normal listening level. Depress the top of both A and B mode switches for partially blended channels. Now use a *monophonic* source so that identical signals will be fed to both channels, and temporarily remove one of the wires to

the center speaker. Either wire gives the same result. Adjust the balance control for *minimum* sound output. If necessary, the balance control knob can be recentered so that the upright pointer indicates the position of precise balance. Then reconnect the speaker wire.

Now all program material, both stereo and mono, can be played with the mode switches in the blended position, and generally without any need to readjust the balance control. Monophonic programs will appear predominantly in the center speaker. Stereo programs will retain their separation, and when the listener changes position, the apparent distribution of sound will not shift, so that the stereo perspective will be less dependent on the listening position. If you wish to turn off the center channel speaker, normal two channel stereo is obtained by shorting across the terminals of the center speaker.

If the third channel is to be used as a remote monophonic speaker, it is advisable to first install it as a center channel of the stereo system for proper balance adjustment as indicated above. It then may be moved to another area.

### 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.

#### Monitor Switch

If frequent use of the Monitor switch makes it desirable that it operate with a normal detent action, instead of a spring-return, you can obtain the same switch as is used in the other function positions for \$1.00 postpaid by requesting Dynaco part #334002. It is possible but not simple to remove the spring in the present switch.

#### 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.

## 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

### 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  $\frac{1}{2}$  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 1/20 ampere (50 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.

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  $\frac{1}{16}$ " 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.

## 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, trouble-free operation for a long period of time when it has been properly assembled and installed. So conservative is its design that it will deliver unchanging performance with the maximum variations in AC line voltage (110 to 130) permitted in normal use.

Despite these precautions, service may sometimes be needed, and you should be sure to return the Guarantee Card promptly to validate your warranty. Dynaco maintains a complete factory test and repair facility for which no return authorization is required. Unless specifically authorized in advance by the factory, Dynaco cannot assume any responsibility for local service charges.

A factory assembled PAT-4/A is warranted to be free of defects in materials and workmanship for a period of one year from the date of purchase. During the warranty period, no charge will be made for testing or servicing any defective factory assembled preamplifier returned to Dynaco.

All parts used in a PAT-4 kit are warranted to be free of manufacturing defects for one year from the date of purchase. Defective parts will be replaced promptly at no charge upon receipt for inspection at the factory. After the warranty period has passed, Dynaco will supply any non-standard parts at net prices. Standard parts can generally be obtained from a local electronics supply store.

The guarantee does not apply to other than the original purchaser, nor to units which have been subjected to neglect, abuse, misuse or accident.

If you suspect a defect in the power transformer, *the leads must be unsoldered, not cut* for its return. The warranty on the transformer is void if the leads have been cut too short for re-use.

If the kit has been completely assembled, yet does not function properly, or if difficulty develops after some use, Dynaco will service the PAT-4 for a *maximum* charge of \$10.00. After one year, assembled units and kits are subject to the same charge, plus the cost of parts.

Once a completed PAT-4 has been serviced by Dynaco for which a regular service fee was charged, a 90 day service warranty is given.

Factory service is not available for kits which are incompletely wired, or kits wired with other than rosin core solder, or units physically or electrically modified or used contrary to the *Operating Instructions*, without prior factory authorization.

Technical assistance which may facilitate local diagnosis or service is available at no charge. Such assistance depends entirely on your description of the difficulty and any tests performed. Be as complete as possible.

