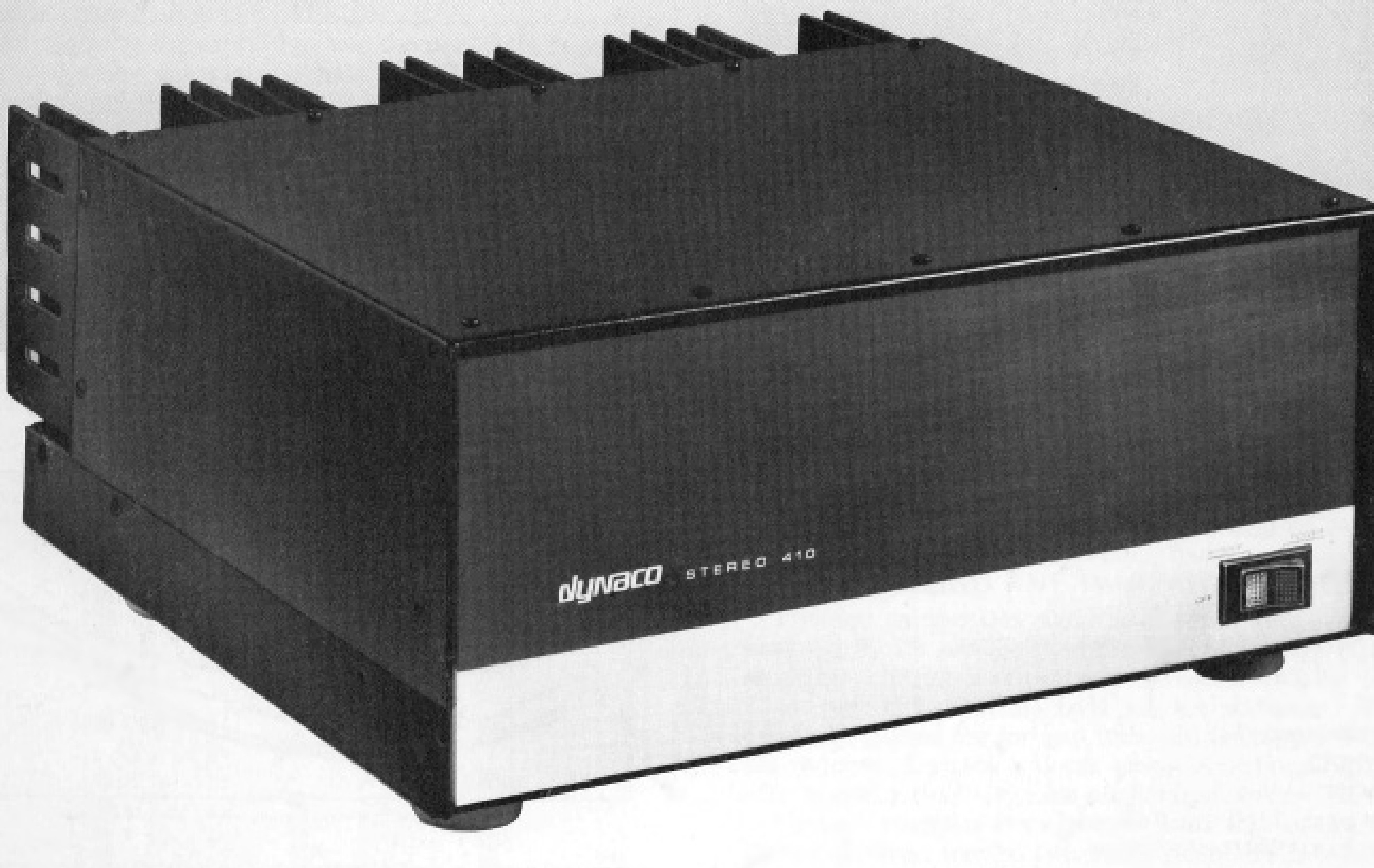
dynaco STEREO 410

SERIAL NUMBER

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

INSTRUCTIONS FOR ASSEMBLY OPERATION



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

CONTENTS

SPECIFICATIONS

Power output ratings:

Less than 0.25% total harmonic distortion at any power level up to 200 watts continuous average power per channel into 8 ohms (100 watts per channel into 16 ohms) at any frequency between 20 Hz and 20 kHz with both channels driven. Distortion reduces at lower power levels.

Available power output:

(See above for F.T.C. Power Ratings)
20 Hz to 20 kHz, both channels driven:
200 watts continuous average per channel @ 8 ohms.
300 watts continuous average per channel @ 4 ohms.*
100 watts continuous average per channel @ 16 ohms.

* 4 minute sustained full power limit.

Intermodulation distortion:

Less than 0.1% at any power level up to 200 watts rms per channel into 8 ohms with any combination of test frequencies. Distortion reduces at lower power levels.

Power at clipping, single channel, 2500 Hz, less than 1% distortion:

235 watts @ 8 ohms.
350 watts @ 4 ohms.
135 watts @ 16 ohms.

Half-power bandwidth:

100 watts per channel at less than 0.25% total harmonic distortion from 5 Hz to 35 kHz into 8 ohms.

Frequency response:

+0, —1 dB, 8 Hz-50 kHz @ 1 watt into 8 ohms.
±0.5 dB, 20 Hz-20 kHz @ 200 watts.

Hum and noise:

Greater than 95 dB below rated output, full spectrum. Greater than 100 dB below rated output, 20 Hz-20 kHz.

Input:

20,000 ohm load; 1.6 volts for 200 watts @ 8 ohms.

Slewing rate:

8 volts per microsecond.

Damping factor:

Greater than 80 to 1 kHz into 8 ohms.
Greater than 30 to 10 kHz into 8 ohms.

Channel separation:

Greater than 60 dB by IHF standards.

Connectors:

Inputs: phono jacks. Outputs: color coded 3-way binding posts with standard 3/4" spacing.

Dimensions:

16 5/8" wide; 14 1/2" deep; 7 1/4" high.

Weight:

Shipping weight 50 lbs. Net weight 44 lbs.

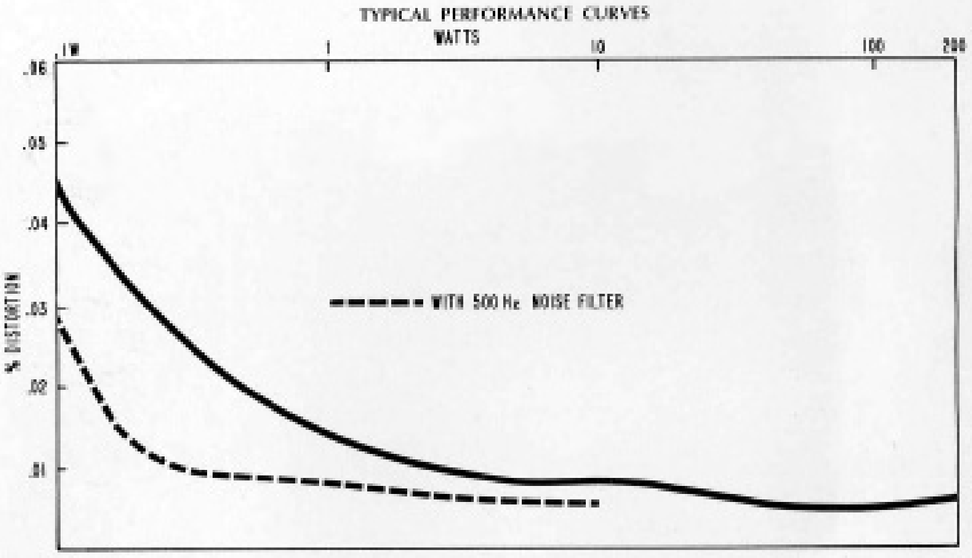
Power consumption:

120 v.a. quiescent; 11 amps maximum; 50/60 Hz, 120 vAC.

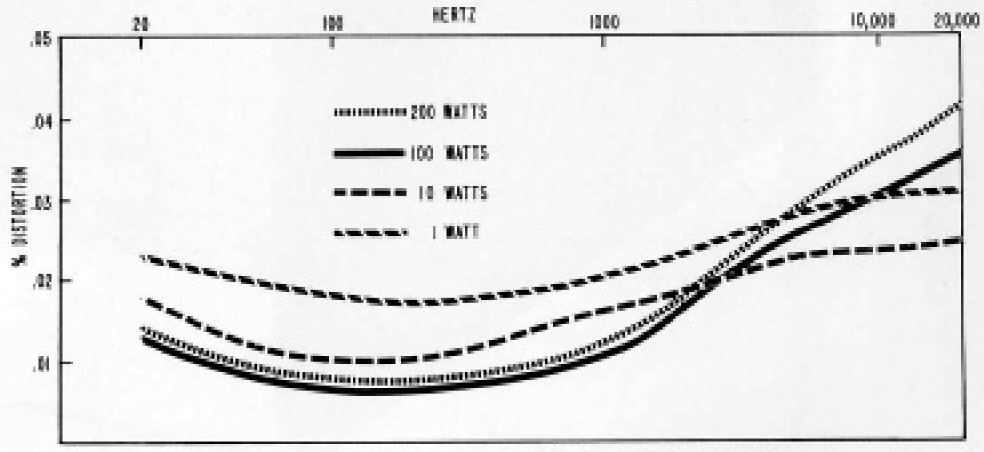
TYPICAL PERFORMANCE CURVES

To arrive at "typical" curves, four channels were evaluated on all bases. In each case, the curve shown is the next-to-the-worst of the four. Therefore, do not expect exact correlation between curves.

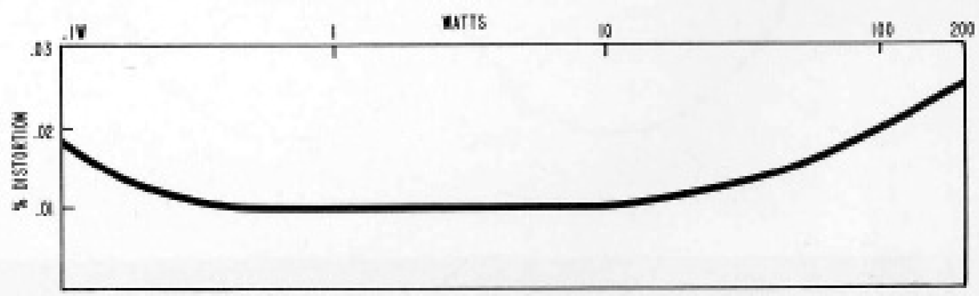
TYPICAL PERFORMANCE CURVES



Total Harmonic Distortion @ 1 kHz vs. Power Output, both channels driven, 8 ohm load



Total Harmonic Distortion vs. Frequency, both channels driven, 8 ohm load



Intermodulation Distortion vs. Power Output, both channels driven, 8 ohm load

IT IS ESSENTIAL THAT YOU READ AND UNDERSTAND THE OPERATING INSTRUCTIONS BEFORE YOU CONNECT YOUR STEREO 410. ANY AMPLIFIER WITH THE POWER OUTPUT CAPABILITY OF THE STEREO 410 IS ABLE TO DAMAGE ALMOST ANY LOUDSPEAKER IF IT IS IMPROPERLY USED.

CAUTION: For continued protection, replace power fuse with the same type and rating as indicated.
NOTE: Dynaco is not responsible for damage to the load (loudspeaker) as a result of excessive or improper input signals and resulting high power output.

INTRODUCTION

The Dynaco Stereo 410 is a basic two channel power amplifier employing all silicon semiconductors. They include 38 transistors, 2 zener diodes, 24 diodes, and 3 thermal sensors. The output circuitry is of the full complementary symmetry design. The entire amplifier, except for an input network, is direct coupled. Its measured distortion levels approach the threshold of much laboratory test equipment, not only at the commonly specified full power ratings, but more importantly at very low power outputs as well. This is the result of circuit techniques which eliminate any discernible crossover notch at low levels, and contributes to the Stereo 410's freedom from listening fatigue. Its accurate, uncolored sonics have been achieved on a wide variety of loudspeaker loads, including electrostatics and multiple drivers with complex crossovers.

The design of a superb power amplifier implies the necessity of several protection techniques for the amplifier, and for the speaker load. In addition to the AC line fuse, four separate B+ fuses are supplied. Electronic volt-amp limiting ensures safe operation of the output transistors, and an independent thermal cutout for each output stage protects from high temperature. A large radiating area for the heat fins, which are attached to an aluminum back panel, and cooled with a thermostatically operated two speed fan, form a highly efficient heat sink. Speaker fuses protect the load.

The Stereo 410 has been designed as two independent 200 watts (@ 8 ohms) amplifying channels with a common power supply having a high degree of inherent regulation. In addition, where higher power is required, an extra cost circuit board assembly will be made available to permit monophonic (bridge) operation for 8 and 16 ohm loads. An accessory kit is also planned at additional cost for two output meters and meter switching, which includes an alternative front panel. They will be available in early 1976.

INSTALLATION

The Stereo 410 should be located where the front panel power switch is convenient, since many control preamplifiers do not normally include the requisite heavy duty switching. Dynaco's PAT-5 is a notable exception, however. If the amplifier is to be mounted near a phonograph, check to make sure that the phono cartridge does not pick up hum from the very large power transformer in the amplifier. In addition to the finned heat sink, it is normal for the top to get rather warm when delivering high power output.

VENTILATION is an important consideration. Although solid state units do not generate the high heat expected from tube designs, they can be limited by excessive heat buildup. All solid state amplifiers generate very nearly the same heat at 10% as they do at 100% power output, and maximum heat is generated at about 40% of full power. Thus, ADEQUATE AIR CIRCULATION IS ESSENTIAL. The Stereo 410 puts out the heat of a 100 watt lamp under quiescent (no signal) conditions, and several hundred watts of heat at high power levels. The large, forced air heat sink has more than enough cooling capacity for any music and speech signals—even at high powers—if fresh air flow under and around the unit is not restricted.

The Stereo 410 may be installed horizontally or vertically, with its feet providing clearance for air flow under the unit to the fan opening. NEVER restrict the air intake for the fan (don't place the amplifier on a rug, for example).

If you wish to mount the amplifier without its feet, a hole the size of the fan opening MUST be cut in the mounting surface.

CONNECTIONS

INPUT

Signal inputs are connected by shielded cables to conventional phono jacks on the back panel, under the heat sink. Channel A is designated the left channel; B the right. The amplifier's nominal input load impedance is 20,000 ohms. The input sensitivity is 1.6 volts for full output. The Stereo 410 may thus be easily driven by control preamplifiers such as the Dynaco PAT-5, PAT-4 or PAS-3X. The Dynaco PAS-3X tube type preamplifier requires an easy internal modification. To change, simply locate and remove the pair of 62,000 ohm (blue-red-orange) resistors on the PC-5 printed circuit board in the preamp. Earlier PAS-2 and PAS-3 preamplifiers cannot be modified for use with the Stereo 410. Some other tube type preamplifier brands may require modification for optimum performance into a 20 K ohms load.

It is desirable to keep the left and right input cables close together throughout their run to avoid extraneous hum.

OUTPUT

Select speaker leads of sufficient size to preserve the high damping factor of your amplifier. Standard 18 gauge lamp cord ("zipcord") is suitable for distances up to 30 feet with an 8 ohm load. A larger wire size is advised for longer distances—#16 for 50 feet; #14 for 80 feet. #18 and #16 lamp cord is available from hardware and electrical supply stores, and is the easiest to use and conceal. For a 4 ohm load, these maximum distances should be cut in half, if you wish to maintain high speaker damping.

Connect the left speaker to Channel A output terminals. Be sure to maintain similar wiring "sense" for each speaker, so that they will be connected *in phase.* Normally the "–", common, or ground terminal of each speaker is connected to the black amplifier terminal. Proper phase sense is easily maintained with lamp cord because one conductor is coded with a molded ridge on the outer insulation.

Two speakers are connected in phase when maximum low frequency output is heard when they are driven from a monophonic source. Lowered output is observed when the connection to one of the speakers is reversed (out of phase, or reversed polarity). When using multiple speakers on each channel, or with 4-channel systems, it is important that all of the speakers in the same area be wired in phase.

The amplifier terminals are 3-way binding posts which will accept single or double "banana plugs," spade lugs, or simply stranded wire. If stranded lamp cord is used, the wire ends should be "tinned" with solder first to avoid fraying. To connect the wire, unscrew the terminal cap until the horizontal hole through the metal shaft is uncovered, push the wire end through the hole, and tighten the cap.

Make certain that no wire strands can touch other than the intended terminal. Double banana plugs (from radio supply houses) are the most convenient connectors, and are simply inserted into the ends of the terminals. They are particularly useful if a second set of speakers is to be connected in parallel, as they plug into one another.

The black "common" output terminals are electrically connected internally. They are also connected to the chassis, so the Stereo 410 may be used with special output connections which require common grounds. You must be *certain* that the polarity of such output connections is never reversed, however, so that the red *"hot" terminals can never be connected together* in other equipment.

AC POWER

The power cord should be plugged into a *wall outlet* providing 120 volts, 50/60 Hz on a 15 ampere (minimum) circuit. Do *not* attempt to switch the amplifier remotely by plugging it into a switched outlet on a control preamplifier unless the outlet is designated as a 12 amp (1400 watts) or higher capacity. *Most preamps are not normally designed to handle the high current switching.* The Dynaco PAT-5 is an exception.

The POWER switch is the only control function on the Stereo 410. The red lamp built into the switch glows when the power is on. The amber lamp also built into the switch glows only when a thermal sensor has shut off the amplifier. This lamp is extinguished and normal operation resumes automatically when the output transistors cool below the limit threshold.

OPERATION

Almost silent turn-on and turn-off transients are a result of nearly equal charge (or drain) of the plus and minus supply voltages. However, harmless low frequency movement of the speaker may be observed as the voltages stabilize at turn-on, and decay at turn-off.

The Stereo 410 includes circuits to protect against the hazards of short circuit outputs, and abnormal load demands. Good operating practice will avoid the need to test their effectiveness, however, for there is no such thing as absolute protection from abuse.

The combination of enormously high power potential and the relative fragility of most high quality speakers makes it imperative that you take care to avoid such common faults as dropping a stylus (tone arm) onto a record; allowing the arm to skid across the record; or flicking the stylus with your finger while the volume is up on the preamplifier. These are typical errors which generate heavy low frequency pulses capable of severely overdriving the amplifier and consequently the speaker at subsonic frequencies.

LOUDSPEAKER RATINGS

Nominal speaker power ratings are a matter of concern. There is currently no U.S. standard. Manufacturers usually provide a "music power" rating, or indicate amplifier power limits. These should not be confused with continuous, or "rms" power acceptance for a sustained period which will be substantially lower. It is rare for a speaker to be able to handle as much power near the frequency extremes as in the midrange. Single woofer high fidelity speaker systems rarely have "music" ratings as high as 100 watts, or continuous duty wide band sine wave ratings as high as 40 watts.

In view of the power limitations of most high accuracy speaker systems, the connection of two or four similar speakers in the same location to a single channel is often advisable, if high signal levels are wanted. Lacking more definitive advice, a rough test is to place your hand in front of the woofer when playing a loud passage at your anticipated listening level. If you can feel *any* heat generated by the voice coil, you should consider the need for additional speakers to reproduce that level safely. When high output, high accuracy reprodution is desired, a series-parallel connection of four 8 ohm speakers (such as the Dynaco A-35) on each channel provides a resultant 8 ohm load with exceptional power handling capacity.

Speaker impedance varies with frequency—often by a factor of 4 or 5 to 1. Even the least variable speakers, like Dynaco's, have a 2:1 change. While most nominal ratings are close to the actual minimum impedance, when combinations approach the 4 ohm minimum recommended amplifier load, the safest procedure is to measure the resistance across the terminals with an ohmmeter. Speaker impedance usually varies upwards from this value. Use this figure to determine how multiple speakers (on each channel) should be connected:

IN PARALLEL:	IN SERIES:	IN SERIES-PARALLEL:
2× 8 ohms=4 ohms	2×4 ohms= 8 ohms	4×16 ohms=16 ohms
2×16 ohms=8 ohms	2×8 ohms=16 ohms	4× 8 ohms= 8 ohms
4×16 ohms=4 ohms	4×4 ohms=16 ohms	4× 4 ohms= 4 ohms

These simple examples assume identical models. It is not wise to connect dissimilar speakers in series or in series-parallel because of adverse audio effects.

LOUDSPEAKER FUSING

The outputs of the Stereo 410 are provided with speaker fuses. The 5 ampere, 3AG fuses supplied will not fail when the amplifier is operated at full power (200 watts into 8 ohms), and therefore they provide NO PROTECTION for your speakers. Please understand that a fuse in series with the output of an amplifier is supplied primarily as protection for the speaker, although it does provide a measure of protection for the amplifier circuits. Nevertheless, the size of the fuse should be determined by the type of speaker you are using.

Since the power passed by a fuse varies with load impedance, and test signals have little correlation to music signals, and fuses vary in their tolerance of music overloads, the protective rating determination for a speaker is largely empirical. Logic would suggest the smallest value fuse which does not blow frequently at what are high, but nonetheless safe levels for your speaker. There are few speakers capable of safely handling more power than will blow a 2 ampere fuse.

The speaker manufacturer who specifies a fuse rating solves your problem. Lacking this, remember that a fuse will not blow until a *sustained* signal *well above* its rating is imposed for a time. A slo-blo fuse will allow appreciably more overdrive than the same value standard fast-blow type, and is thus not generally recommended for speaker protection.

The chart at right shows the highest *sustained* power level which will *not* blow the fuses shown. Remember that speaker impedance typically rises well above its nominal value. Experience suggests that on this basis power levels of 10 watts are safe starting points for most high fidelity speakers using a single woofer.

3AG FUSE TYPE	4 OHMS	8 OHMS	16 OHMS
½ ampere	1 watt	2 watts	4 watts
¾ ampere	2.2 watts	4.5 watts	9 watts
1 ampere*	4 watts	8 watts	16 watts
1½ ampere**	9 watts	18 watts	36 watts

* Dynaco A-10, A-25 and A-35 speakers
** Dynaco A-25XL, A-40XL, and A-50 speakers

MONOPHONIC OPERATION

A single channel of the Stereo 410 may be operated at any time, provided there is no input signal to the unused channel. There is no need for any load resistor on the unused channel, for the design is completely stable.

NEVER connect the red output terminals together to attempt obtaining higher power output, because of a probability of damage to the amplifier. For high power mono requirements with multiple speakers, split the speakers between the two channels, and drive both with the same signal.

For very high power requirements, an extra cost kit is planned which combines the two channels differentially, and provides a floating (ungrounded) output between the two red output terminals for 600 watts output at 8 ohms.

Because of the nature of the volt-amp limiting protection which is a part of this amplifier, mono power output at impedances below 8 ohms drops off rapidly. Loads should be chosen which vary upwards from 8 ohms.

ASSEMBLY INSTRUCTIONS

GENERAL ASSEMBLY INFORMATION

Construction of the Stereo 410 is very simple when compared to other kits. The printed circuit boards for audio have been preassembled and tested to save you much of the work, and the assembly that remains is in an open, uncluttered layout to make wiring quick and easy. The construction time will be several hours. It is better to work slowly and carefully rather than concern yourself about the time.

When you unpack the kit, check off the components against the parts list on page 24. Separate the hardware items in an egg carton or similar container. You can identify unfamiliar parts by checking them against the Pictorial Diagram, bearing in mind that the drawing is necessarily somewhat distorted for visual separation.

Have the proper tools at hand before starting construction. The tools necessary are:

1. A pencil-type soldering iron with a 3/16″ tip or smaller of 40 to 60 watts rating, with a tip temperature of 700 to 800° F.
2. A damp sponge or cloth to wipe the tip of the iron.
3. 60/40 *rosin core* solder not larger than 1/16″ diameter.
4. A medium sized screwdriver (¼″ blade).
5. Long nosed and diagonal cutting pliers.
6. Heavy "slip joint" pliers.
7. A single edged razor blade or inexpensive wire stripping tool for removing insulation.
8. Wood toothpicks.
9. Transparent or masking tape.

We do *not* recommend using a soldering gun. Not only can a gun provide more heat than is necessary—an unskilled user might damage printed circuit boards—but also many users tend to make poor solder connections, simply because they do not wait long enough for the gun to reach its operating temperature each time. Use a conventional pencil type iron.

A good solder connection does not require a large amount of solder around the joint. A well-made conection 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.

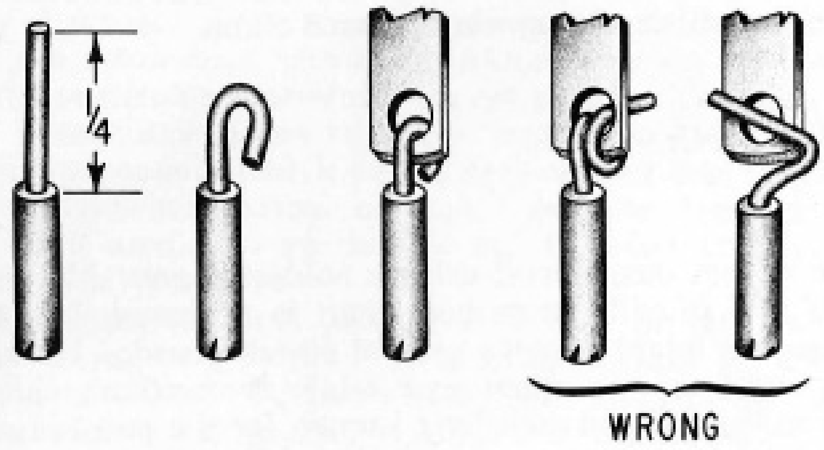
ALL SOLDERING MUST BE DONE WITH A GOOD GRADE OF ROSIN CORE SOLDER.

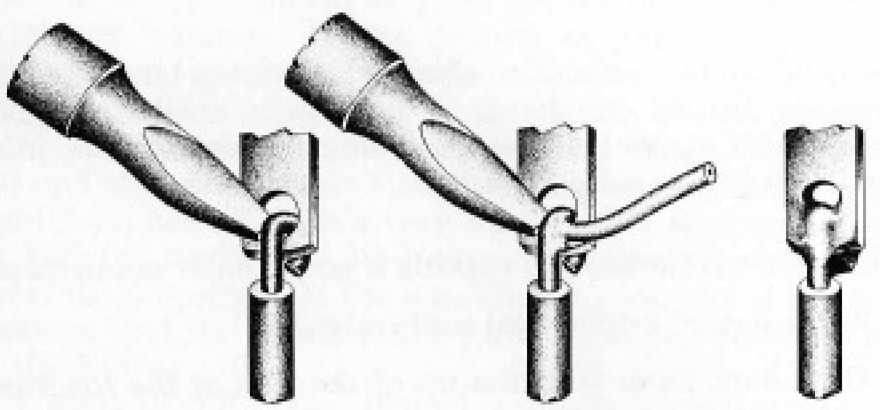
Under no circumstances should acid core solder be used. Unmarked solder, cheap solder or any of doubtful origin should be discarded, and *separate solder fluxes should never be used.* The warranty is voided on any equipment in which acid core solder or acid type fluxes have been used. Silver solder is 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.

You should realize that many of the more delicate components are less likely to be damaged in the soldering process if you use a hot iron for 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.

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.

Many of the wiring steps will call for "preparing" a wire of a certain length and color. This involves cutting the necessary length of wire and stripping ¼ inch of insulation from each end. This is most easily done with wirestrippers, but diagonal cutters can be used if you are careful not to nick the wire and weaken it.





When soldering a lead to a numbered, plated-through hole on a circuit board, push the lead through the hole first. *Do not push the wire all the way into the hole up to the insulation.* Apply the solder and the hot iron at the same time to the junction of the hole and lead. The solder should melt very quickly; it should flow easily and fully into the hole and completely around the lead. Remove the iron and allow the connection to cool. If in doubt of your connection, you may also wish to apply solder and iron to the hole and lead from the other side of the board. It is *essential* to have a smooth, shiny flow of solder from the lead to the plated circuitry on the board.

WIRING THE KIT

The position of all wire leads should follow the diagram 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.

Whenever one wire is to be soldered to a connection such as a lug terminal or hole, 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 cite the number of wires that should be connected to that point when it is to be soldered. If no soldering instruction is specifically given, do not solder; other connections will be made to that point before soldering is called for.

Check your work after each step, and make sure the entire step has been completed. 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.

The PC-28 printed circuit boards, which include most of the electronic components for the Stereo 410, have been in-circuit tested before being packed into the kit. These tests include every significant performance criterion—gain, power, distortion, frequency response, functioning of protective circuitry—as well as provide precise adjustment of necessary circuit parameters to assure that your amplifier will meet or exceed the specifications when these instructions are adhered to, and all connections have been properly completed.

Where stranded wire is used, as on the transformer leads, be very careful not to cut through the strands when stripping the end. Where stranded wire is supplied for hookup wire in the kit, the strands will be bonded together to minimize this likelihood and make handling easier.

All mounting screws are installed from the *outside* of the chassis, and a nut with lockwasher attached, called a KEP nut is used.

This kit uses a variety of hardware. Before starting assembly, separate all the hardware by using an egg carton, muffin pan, or small cups. #4, #6, #10 and ¼″ machine screws with oval (binder) heads are used in various lengths, but much of the hardware used is #6 binder head in a ½″ length. To simplify construction, nuts with lockwashers attached, called KEP nuts, are supplied. Two types of sheet metal screws are used—one kind in black with a short self-tapping thread, and the second kind in bright metal with a coarse thread and a slightly tapered, blunt end.

The center "C" (collector) lugs of the sockets for the output transistors have a notch rather than a hole for mechanical connection. Crimp the wire in a tight "U" in the notch to hold it securely for soldering. In such cases, it may be helpful to strip *slightly* more than the standard ¼″ of insulation from the wire. Note that the mechanical crimping of the wire serves *only* to hold the wire stationary while the solder is applied. The integrity of every solder connection is essential.

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

MECHANICAL ASSEMBLY

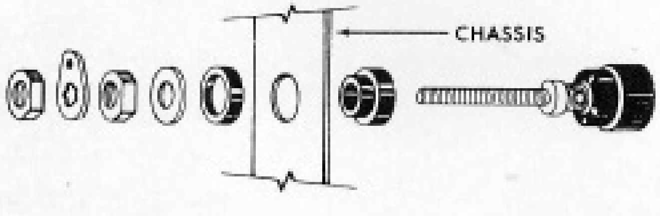
Much of the hardware used to mount the parts in this kit is #6-32 x ½". If no mention is made of the type of hardware, use this size. A set is one screw and one KEP nut.

Select the painted back panel. Note that the outside surface is printed with white lettering. Some of the parts will be mounted from the outside, and others from the inside.

1( )Select the dual input socket strip, the matching insulator strip, the two small flat washers, and two #6 screws and KEP nuts. This input strip mounts *inside* the right bottom of the back panel. Insert the screws from the outside, install the insulator first on the inside, then a flat washer on each screw, followed by the input strip, and fasten with the KEP nuts. The input strip mounts in either direction. Make sure that the metal of the socket strip does not touch any surface of the back panel, and firmly tighten the hardware.

2( )Select the two round speaker fuse holders, and install them from the outside. Their hardware is attached. The rubber washer stays outside the panel, and the flat side of the mounting hole engages a similar flat on the holder for proper positioning. Secure each holder with its lockwasher and nut.

3( )Install the two *black* binding posts in the holes next to the fuse holder at the *bottom* of the panel. Their hardware is attached. See the sketch below. The shoulder piece goes on the outside of the back panel with the smaller diameter portion protruding through the hole. The insulating plastic ring fits over it inside the back panel, followed by the washer. Before tightening the first nut, unscrew the outside knurled end and observe the hole in the metal shaft. For greater convenience in connecting leads to these posts later, rotate the assembly so that this hole is in a horizontal position. Slip a short piece of wire through the hole for easy observation as you firmly tighten the first nut. Slide on the connecting lug, and fasten with the second nut. Position each connecting lug as shown in the Pictorial Diagram, and keep the hole horizontal as you firmly tighten the second nut.



4( )In a similar manner, install the two *red* binding posts in the holes above the black posts. Keep the hole in the metal shaft horizontal, and note the correct lug placement in the Pictorial Diagram.

5( )Select the two black button plugs. Press them into place from the *outside* of the back panel adjacent to the dual input socket. No hardware is necessary. [These two holes are provided if you wish to install input level controls—not supplied with the kit. If input level controls are planned, skip this step.]

6( )Select the round thermostat with an attached screw, and a KEP nut. Insert the screw from the *inside*, position the two solder lugs parallel to the top of the back panel, and fasten securely with the nut on the *outside*. Note that this is the only nut fastened from the outside of the amplifier.

7( )Select one of the black heat fins, and six sets of #6 hardware. We recommend that you now install masking or transparent tape around the outer edges of the black heat fins to protect their finish and your work surface. The top portion of the back panel has four groupings of holes, and the central portion of the heat fin has matching holes. Place the flat of the heat fin against the *outside* of the back panel so that all the holes match. A "T" stamped in the heat fin indicates the top. Insert the screws from the *outside* in the six *smaller* holes. Fasten with a KEP nut on all six screws, and tighten only the two center screws very tightly. The other four screws should remain finger tight until later.

8( )Select the remaining three black heat fins, and 18 sets of #6 hardware. In a similar manner, tape the outer edges of the heat fins, and mount them to the back panel. Match the remaining groups of holes in the back panel with those of the heat fins, "T" at the top, and firmly tighten only the two center screws for each heat fin.

Set this assembly aside, and place the main chassis bottom plate in front of you, flanges down.

9( )Select the four rubber feet, and the four ¼" diameter bolts (the largest hardware). Insert a screw through each foot, and then mount a foot at each corner of the chassis on the *outside* (flanges down). No other hardware is required; the chassis is supplied with threaded nuts for these screws.

Turn the chassis over, flanges up, positioned so that the large hole is to the right of center and away from you. The flat edge toward you is the back—the same orientation as that shown in the Pictorial Diagram.

10( )Select the power (single clip) fuse block, and a ⅜" #4 screw and nut (the smallest hardware). Insert the screw from the outside, and install the fuse block in the smallest hole at the left center of the chassis. See that the block is perpendicular to the adjacent chassis flange in front of the two nearby chassis "dimples". Tighten the hardware.

11( )Select the two dual clip fuse blocks, and the remaining four sets of ⅜" #4 hardware. Install one of the fuse blocks over the two small holes which are in the center of the chassis between the two back feet. Install the other fuse block over the two small holes at the right of the chassis in front of the right rear rubber foot. Fasten with a KEP nut on all four screws, and tighten the hardware.

12( )Select the 6-lug terminal strip, and two sets of #6 hardware. Install the strip parallel and adjacent to the power fuse block, as shown in the Pictorial Diagram, and tighten the hardware.

13( )Select the 9-lug terminal strip, and three sets of #6 hardware. Install this strip over the three holes which are left of center, parallel to the front edge, and adjacent to the left front rubber foot. Position as shown, and tighten the hardware.

14( )Select one of the large 10,000 μf capacitors, one of the large circular capacitor mounting brackets, four sets of #6 hardware, and the L-shaped grounding lug. *Do not remove the clear plastic outer insulation from either of these capacitors.* This bracket will be installed to the right and slightly back of the large hole in the chassis. Note in the Pictorial Diagram the correct position of the clamp, and also the direction of the clamping screw. One set of #6 hardware is first installed in the clamp before mounting. Insert the capacitor in the bracket, position the "+" on top to the back as shown, and temporarily tighten the clamp. Now mount the bracketed capacitor with the remaining hardware. The ground lug is mounted on the back screw before the KEP nut is installed. Now securely tighten the clamping screw on the capacitor bracket. Finally securely tighten the capacitor bracket to the chassis.

15( )Select the remaining large capacitor, the remaining bracket, and the four more sets of #6 hardware. Slide the capacitor into the bracket as before with the clamping screw, and mount the bracketed capacitor to the front of the other capacitor assembly. Position the "+" as shown, tighten the clamp first, and then secure the capacitor bracket to the chassis. Note that this assembly does not require a grounding lug.

16( )Select the four 3/8" #10 SEMS screws (with lockwashers attached), and the four ground lugs. Install the ground lugs on capacitor terminals C1 lugs #1 and #2, and on C2 lugs #3 and #4. Position the lugs as shown in the Pictorial Diagram, and secure each with a screw. See that the screws are very tight.

17( )Select the fan, the finger guard, and four sets of #6 hardware. Place the finger guard over the large hole on the *outside* so that only the four corner lugs of the guard touch the chassis. Place the fan over the large hole on the *inside*, positioned so that the words "rotation" and "air flow" are toward the back with the word "rotation" at the top away from the chassis. Insert screws from the outside first through the four corner lugs of the guard, then through the chassis and finally through the corners of the fan. Secure on the inside with the KEP nuts. Firmly tighten the hardware, but avoid excessive force, since the body of the fan is plastic. See that the fan blade turns freely.

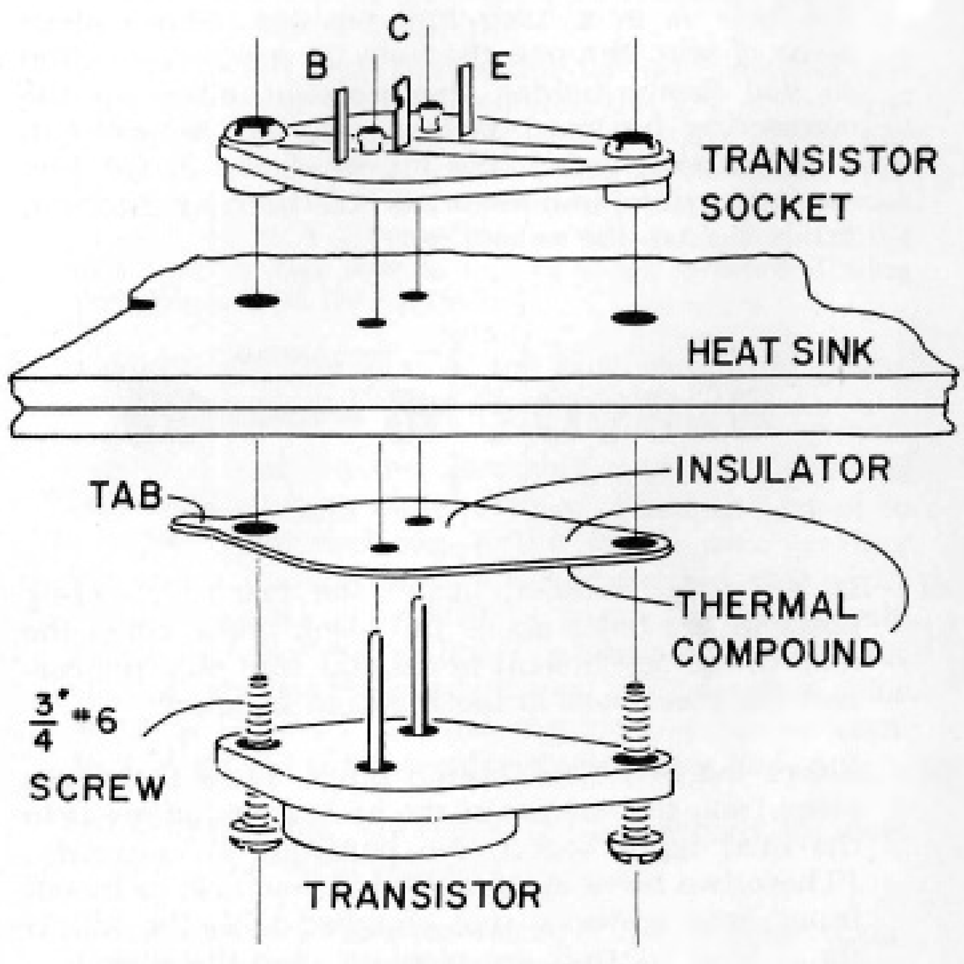
The next four steps describe the application of silicon thermal compound. A thin uniform film of thermal compound is needed to provide maximum heat transfer from the diode block to the chassis, and from an output transistor to the heat sink. Excess compound will be messy, and is a disadvantage, since the compound is intended only to fill minute voids between flat surfaces. This thermal compound can be most annoying if carelessly handled. Clean up any excess with paper tissues as you go along. It is difficult to remove from clothing, and the best removal agent, if needed, is Freon—a degreasing agent available in a pressure spray can at electronic supply houses.

One of the easiest ways to handle this compound is to apply it with the blade of a screwdriver or a toothpick. However, the screwdriver used should be other than the one employed to install the hardware.

18( )Select the one inch square diode block, the 3/4" #6 screw, a nut, and the compound. Note that the terminals of the block are identified "+", "−" and (two) "AC". The block will be mounted to the right of the 9-lug terminal strip near the front center of the chassis. The "+" terminal (which may be identified by a red dot) lies over a tiny hole in the chassis. *Make certain this diode block is correctly positioned.* Apply a thin film of thermal compound to the bottom of the block, install it over the screw through the chassis, and secure it with a nut. Recheck the location of the "+" terminal and tighten the hardware securely. Wipe off any compound which has squeezed out around the edges of the block, and also remove any compound which has contacted the lug terminals of the block.

Set the chassis aside and return now to the back panel. The eight output transistors plug into sockets on the heat fins. Note that the holes for the transistor pins in the sockets are off-center. The longer end is identified with an "E" stamped in the fiber adjacent to a lug, and the shorter end is stamped with a "B" also adjacent to a lug. The center "C" lug is unmarked.

The metal insulators (shaped like the transistors) are hard-anodized for excellent thermal conductivity with electrical isolation. Do not scratch them. Apply the thermal compound in a *very thin film* to both surfaces while holding it by the tab at the "B" end. Position the insulator correctly, and install it on the transistor. Then the combination is installed on the outside of the heat fin and plugged into a socket on the inside. The longer "E" end of each socket is positioned to the right, as viewed in the Pictorial Diagram.



The simplest procedure seems to be the following: after placing the compound coated insulator on the transistor, wipe each transistor pin clean of all compound. Then position the combination to properly match the mounting holes, and press it against the heat fin on the outside with a *slight* twisting motion to assure uniform contact. While holding it in place, snap the socket over the pins from the inside. When firmly engaged, this will hold each assembly temporarily so that the screws can be installed from the outside in one final operation to minimize smearing.

19( )Select the four transistors, Part #561356 (2N6029 or 2N6030), four metal insulating wafers, four transistor sockets, the thermal compound, and eight of the #6 *sheet metal* screws (coarse threads with slightly tapered ends). Do *not* confuse these transistors with the four 571104 transistors, which look the same, but will be mounted in the next step. First check to see that the transistor pins are straight. These four transistors will be mounted from the *outside* at the BOTTOM of the four heat fins in positions Q2A, Q2B, Q2C, and Q2D. Apply a *thin* film of compound to both sides of the insulator, position it correctly, and install it over the transistor pins. *Wipe the pins clean,* and plug each assembly through the heat fin into the transistor socket. Secure each with two sheet metal screws.

20( )Select the four transistors, Part #571104 (2N5629 or 2N5630), the remaining four insulating wafers, and *four* 3/4″ sheet metal screws. Check for straight transistor pins. Apply a thin film of compound to the insulating wafers as before, wipe the pins clean, install these from the *outside* at the TOP of the heat fins in positions Q1A, Q1B, Q1C, and Q1D. The four sheet metal screws are installed only in the two outside transistors (Q1A and Q1D) at this time.

21( )Select the two 1/2″ diameter thermal sensors, the two spring metal clips shaped somewhat like the power transistors, the compound, and the four remaining 3/4″ sheet metal screws. Apply a relatively thick film of thermal compound to the center of each of the inside top transistors (Q1B and Q1C). Slide a spring metal clip over the lugs of each sensor so that the mounting flanges project in front of the flat surface of the sensor. Fasten the entire assembly with the sheet metal screws. Rotate each sensor a little before the screws are tightened to get a good contact, and align both sensors so that their four connecting lugs are in one line.

This completes the need for the compound. Wipe off all the excess, including the threads of the transistor mounting screws, to avoid smears as you complete construction.

22( )Prepare a 9″ (23 cm) heavy white wire by removing 1/2″ of insulation from each end, rather than the standard 1/4″ of insulation. Pass one end of the wire from the inside to the outside of the back panel assembly through the center hole in the heat fin between transistors Q1B and Q2B. Crimp the wire in a tight "U" around lug #3 of the thermal sensor to hold it in place (S). Pass the other end of the wire from the inside to the outside through the center hole in the heat fin between transistors Q1C and Q2C. Crimp the wire tightly around thermal sensor lug #2 (S). On the inside, position this wire flat against the back panel.

23( )Prepare a 27″ (69 cm) white wire, but remove 1/2″ of insulation from one end, and 1″ of insulation from the other end. Pass the *shorter* prepared end through the center hole in the heat fin between transistors Q1B and Q2B. Crimp the wire around thermal sensor lug #4 (S). The other end of this wire will be connected later, but you may wish to bend it under the back panel to get it out of the way.

24( )Prepare a 24″ (61 cm) white wire, but remove 1/2″ of insulation from one end, and 1/4″ from the other. Pass the *longer* prepared end through the center hole in the heat fin between Q1C and Q2C. Crimp the wire around thermal sensor lug #1 (S). Bend the other end of the wire under the back panel for later connection.

25( )Select the four perforated black transistor covers. Their installation requires *removal* of the two sets of #6 hardware used to attach the tops of the heat fins to the back panel, and loosening the two sets of hardware used to attach the bottoms of the heat fins. Slip one end of a cover—they are made symmetrically—under the hardware at the bottom, and reinstall the hardware at the top. Tighten all sixteen screws *very* firmly.

WIRING THE CHASSIS

Set the back panel aside, and place the main chassis assembly in front of you, positioned as shown in the Pictorial Diagram.

1( )Prepare an 11″ (28 cm) white wire, but remove 1″ (2.5 cm) of insulation from one end and the usual 1/4″ (.6 cm) from the other. Feed the long-stripped end from the right through B+ fuse block lug #3 to lug #2, and then solder both connections. This fuse block is in the center back of the chassis. Connect the other end to C1 lug #1.

2( )Prepare a 12 1/2″ (32 cm) white wire in the usual manner by removing 1/4″ (.6 cm) of insulation from both ends. Connect one end to diode block lug #2 (S). Connect the other end to C1 lug #1.

3( )Select one of the .1 μf disc capacitors, and cut its leads to 3/4″ each. Do not confuse it with the .01 μf capacitors, which look similar. Connect one lead to C1 lug #1 (S-3). Connect the other lead to C1 lug #2. We suggest crimping a lead of this capacitor around each lug if the lug holes are already filled with wires.

4( )Strip the insulation from a 2 1/2″ (6.5 cm) white wire. Connect one end of the bare wire to C1 lug #2 (S-2). Connect the other lead to C2 lug #3.

5( )Select another .1 μf disc capacitor, and cut its leads to 3/4″ each. Connect one lead to C2 lug #3 (S-2). Connect the other lead to C2 lug #4.

6( )"Tin" the entire length of the bare wire connected between C1 lug #2 and C2 lug #3 with solder and your hot iron so that the wire is solid and shiny.

7( )Prepare a 12″ (30.5 cm) white wire, but remove 1″ (2.5 cm) of insulation from one end and the usual ¼″ (.6 cm) from the other. Feed the long-stripped end from the left through B− fuse block lug #6 to lug #7, and then solder both connections. This fuse block is on the right side of the chassis. Connect the other end to C2 lug #4.

8( )Prepare an 8½″ (21.5 cm) white wire in the usual manner. Connect one end to C2 lug #4 (S-3). Connect the other end to diode block lug #4 (S).

9( )Prepare a 7″ (17.7 cm) white wire, but remove ½″ of insulation from both ends. Bend a hook at both ends, and connect one end to the bare wire connected between C1 lug #2 and C2 lug #3. Connect the other end to the *bottom* of the ground lug at the base of C1. While a total of five wires will eventually be connected to this lug, you may wish to solder this wire now, although the instructions will indicate soldering at one time.

Each lug of the 6-lug and 9-lug terminal strips T-1 and T-2 has two holes, the conventional one at the tip, and the other at the base through the insulating material. For ease of connection, several of the steps following will indicate soldering to the base or to the tip of a lug. The two holes will be independently soldered.

10( )Prepare a 12″ (30.5 cm) white wire, but remove ½″ of insulation from one end, and the usual from the other. Bend a hook at the long-stripped end, and connect it next to the other wire which is already attached to the bare wire between C1 lug #2 and C2 lug #3 (S-2). Connect the other end to terminal strip T-2 lug #9 at the *tip*.

11( )Select the 600 ohm, 10 watt resistor, cut its leads to ⅝″ each, and bend them 90° to its body. Do not confuse it with the 0.18 ohm resistors, which look similar. Connect one lead to terminal strip T-1 lug #6 at the base (S). Position the resistor about ¼″ (.6 cm) in front of T-1 against the chassis, and connect the other lead to T-1 lug #1 at the base (S).

The next step describes the wiring of the fan when using the standard power transformer, part #464026, or the international transformer, part #464030, *if the international version is to be wired for 100 or 120 volts.* If the international transformer is to be wired for 200, 220 or 240 volts, refer now to the back of the Pictorial Diagram for the fan wiring instructions instead of this next step.

12( )Prepare an 8½″ (21.5 cm) blue wire, and a 10″ (25.5 cm) yellow wire. Start with the wires even, and twist them uniformly together to within ½″ (1.3 cm) of the other end of the blue wire (the yellow wire should be about 1½″ [3.8 cm] longer than the end of the blue wire at this end). This twisted pair, as well as the other twisted pairs in this kit, should be uniformly twisted 3 full turns every 2″ (5 cm). Connect the yellow wire from the even end to fan lug #2 (S). Connect the corresponding end of the blue wire to fan lug #1 (S). Connect the other end of the blue wire to T-1 lug #6 at the tip. Connect the corresponding end of the yellow wire to T-1 lug #2 at the base (S).

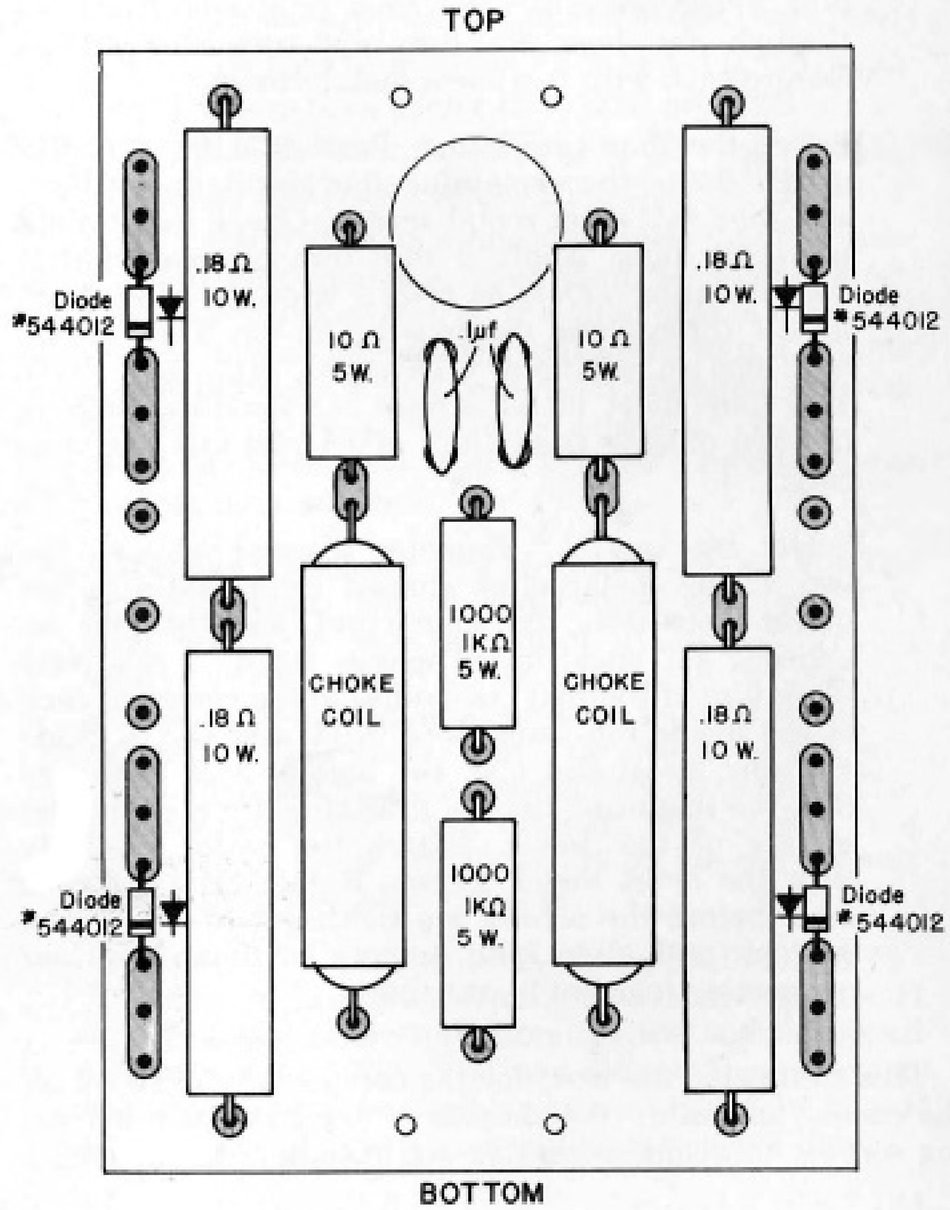
WIRING PC-40

You will next install all the parts on circuit board PC-40. Markings, lines and hole numbers on the *front* of the board indicate the placement of each part and where the leads of the parts or wires are inserted. *All parts and wires are installed from this marked side.* The parts are mounted just as they are on the preassembled PC-28 circuit boards.

Each part is identified by a part number or written value. Bend the leads of the resistors and diodes as required to fit the space between the marked holes. Then push the leads through the holes and spread them slightly to hold the part in place for soldering. The capacitors are pushed into the holes and held in place for soldering. Make certain that the solder flows all around the lead or connection smoothly onto the foil, without bridges or links of solder to other parts of the circuitry. Cut off excess leads on the *back* of the board.

Solder each lead carefully to the *back* side of the board. THERE IS NO SUBSTITUTE FOR GOOD SOLDERING TECHNIQUE.

Place the PC-40 board in front of you, positioned with the marked *front* side facing up, as shown in the accompanying sketch.



1( )Install the two 1000 ohm (1K Ω), 5 watt resistors in positions R4-L and R4-R. *Do not place them against the board, but allow the leads to support them ⅛″ (.3 cm) above the board.* Solder all 4 leads on the back of the board, and cut excess leads.

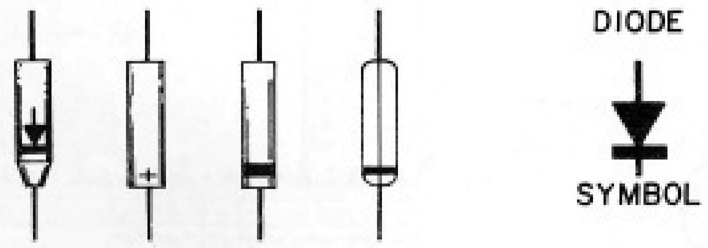
2( )Install the two 10 ohm, 5 watt resistors in positions R6-L and R6-R. In a similar manner, allow the leads to support them ⅛″ (.3 cm) above the board. Solder all 4 leads on the back, and cut excess leads.

3( )Install the four .18 ohm, 10 watt resistors in positions R1-L, R2-L, R1-R and R2-R. Allow the leads to support them 1/8" (.3 cm) above the board. Solder all 8 leads on the back, and cut excess leads.

4( )Install the two choke coils (which may be covered with black plastic) in positions L1R5-L and L1R5-R. Place these parts, as well as the other parts to be mounted on this board, against the board. Solder all 4 leads on the back, and cut excess leads.

5( )Install the remaining two .1 μf disc capacitors in positions C1-L and C1-R. Solder all 4 leads on the back, and cut excess leads.

The next step describes the installation of the diodes to the board. All diodes supplied have their cathode end marked with a stripe, an arrow head, or a colored tip. It is this *marked* end that will be referred to in the next step. The sketch below shows the diodes more than double size.



6( )Install the four diodes, part #544012 in the *unmarked* holes which are adjacent to each diode symbol (this symbol is shown in the sketch above). The marked end of each diode points toward the *bottom* of the board. Solder all 8 leads on the back, and cut excess leads.

This completes the installation of the parts to the PC-40 board. Now is the time to check all your connections. No solder blobs or excess wire should connect other than the intended terminal. Cut off any excess wire on the back side of the board with your side cutters. Make certain that the connections to the common circuitry are secure. Observe that all of the *numbered* holes on the left and right sides are as yet unconnected.

WIRING THE HEAT SINK

Position the back panel assembly so that it lies on its heat fins, the top toward you, as shown in the Pictorial Diagram.

1( )Select the PC-40 board assembly, the four 3/4" #4 screws, the four 3/8" spacers, and the four remaining #4 nuts. Insert the screws from the outside of the back panel, mount the spacers over the screws on the inside, and install the PC-40 on the spacers (components side away from the heat sink). Secure on the components side of PC-40 with the nuts. The round thermostat should be centered in the large hole at the top of PC-40.

In succeeding steps connections will be made to the numbered, plated-through holes on PC-40. A good connection is more certain if the wire is inserted in the hole so that bare wire is visible on *both* sides of the board. Let the soldering iron contact the junction of wire and board hole on the exposed *front* side as you feed solder to the junction. Solder should flow smoothly *around the hole* to completely surround the wire. Keep the wire steady while the connection cools, and then wiggle it to make sure the connection is secure. If in doubt, reheat the connection and add more solder.

Do *not* add solder to the holes before a wire is inserted. If you do, it will be difficult to find the hole to clear it. However, should you solder a wire in error to a wrong hole, first remove the wire by using the iron, and while the solder is still hot, push a toothpick through the hole to clear it.

Once a connection has been completed, make certain that the bare wire end NEVER touches the heat sink.

2( )Prepare a 4 1/2" (11.5 cm) white wire by removing 1/4" of insulation from both ends. Connect one end to PC-40 hole #6 (S). Position this wire along the adjacent edge of PC-40 against the back panel, and connect the other end to right speaker fuse holder lug #3 (S).

3( )Prepare a 6" (15.3 cm) black wire. Connect one end to PC-40 hole #5 (S). Position this wire next to the white wire from the previous step, and connect the other end to right black binding post lug #3.

4( )Strip the insulation from *two* 1 1/4" (3.2 cm) black wires. Connect one end of one bare wire to right red binding post lug #4 (S). Connect the other end of the same wire to right fuse holder lug #4 (S). Similarly connect one end of the other bare wire to left red binding post lug #1 (S). Connect the remaining end to left fuse holder lug #1 (S).

5( )Prepare a 4" (11 cm) white wire. Connect one end to PC-40 hole #17 (S). Position this wire along the adjacent edge of PC-40 against the back panel, and connect the other end to left speaker fuse holder lug #2 (S).

6( )Prepare a 6" (15.3 cm) black wire. Connect one end to PC-40 hole #16 (S). Position this wire next to the white wire from the previous step, and connect the other end to left black binding post lug #2.

7( )Prepare an 8" (20.5 cm) white wire. Connect one end to Q1A lug E (S). Connect the other end to Q1B lug C. Notice that each lug C has a notch in it rather than a hole. Hook the lead in the notch until soldering is called for.

8( )Prepare a 2 1/2" (6.5 cm) white wire. Connect one end to PC-40 hole #1 (S). Connect the other end to Q1B lug E (S).

9( )Prepare an 8 3/4" (22.3 cm) yellow wire. Connect one end to PC-40 hole #3 (S). Bend a hook around the other end, and connect it to the notch in Q1A lug C.

10( )Prepare a 14" (35.5 cm) white wire. Bend a hook around one end and connect it to the notch in Q1A lug C (S-2). The other end will be connected later.

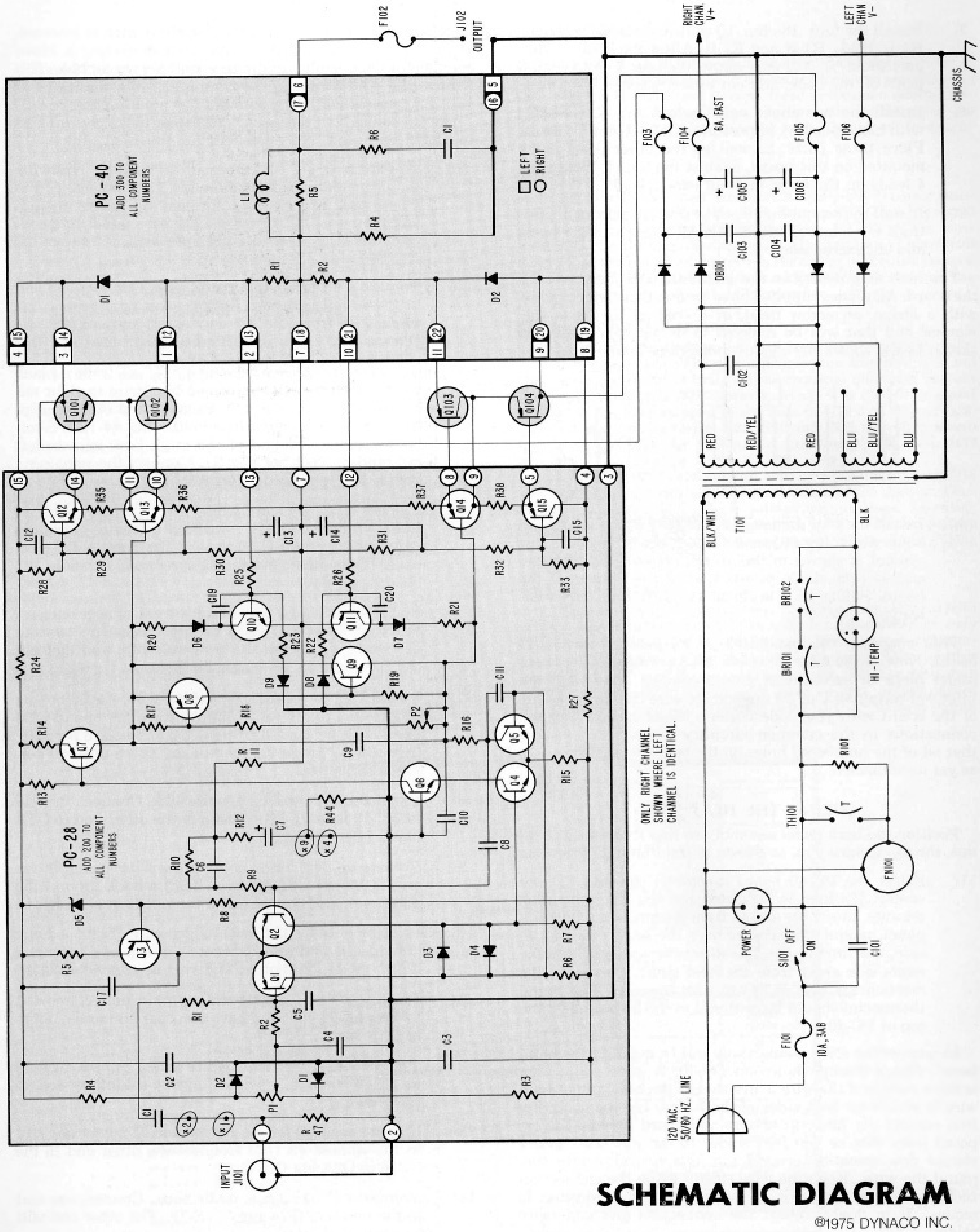
11( )Prepare a 6 3/4" (17 cm) white wire. Connect one end to Q2A lug E (S). Connect the other end to the notch in Q2B lug C.

12( )Prepare a 2 1/2" (6.3 cm) white wire. Connect one end to PC-40 hole #11 (S). Connect the other end to Q2B lug E (S).

13( )Prepare an 8" (20.3 cm) blue wire. Connect one end to PC-40 hole #9 (S). Connect the other end to the notch in Q2A lug C.

14( )Prepare a 6" (15.3 cm) white wire. Connect one end to the notch in Q2A lug C (S-2). The other end will be connected later.

Now turn to page 15.



SCHEMATIC DIAGRAM

COMPONENT VALUES

All resistors are ¼ w., 5% unless otherwise indicated.

		PART #
R101	600 ohms, 10 watts	120601
R201	1,000 ohms	119102
R202	22,000 ohms	119223
R203	33,000 ohms	119333
R204	33,000 ohms	119333
R205	4,700 ohms	119472
R206	2,200 ohms	119222
R207	2,200 ohms	119222
R208	100,000 ohms	119104
R209	100 ohms	119101
R210	22,000 ohms	119223
R211	6,200 ohms 5% ½ watt film	133622
R212	220 ohms	119221
R213	130 ohms	119131
R214	150 ohms	119151
R215	100 ohms	119101
R216	22 ohms	119220
R217	1,000 ohms	119102
R218	2,200 ohms	119222
R219	1,000 ohms	119102
R220	20 ohms	119200
R221	20 ohms	119200
R222	2,400 ohms	119242
R223	2,400 ohms	119242
R224	10 ohms AB	119100
R225	100 ohms	119101
R226	100 ohms	119101
R227	10 ohms AB	119100
R228	1,000 ohms 5% 2 watt	110102
R229	750 ohms 5% 2 watt	110751
R230	300 ohms 5% 1 watt	116301
R231	300 ohms 5% 1 watt	116301
R232	750 ohms 5% 2 watt	110751
R233	1,000 ohms 5% 2 watt	110102
R235	47 ohms 5% ½ watt AB	103470
R236	47 ohms 5% ½ watt AB	103470
R237	47 ohms 5% ½ watt AB	103470
R238	47 ohms 5% ½ watt AB	103470
R244	200,000 ohms	119204
R247	330,000 ohms	119334
R301	0.18 ohms 3% 10 watt	120180
R302	0.18 ohms 3% 10 watt	120180
R304	1,000 ohms 10% 5 watt	120107

		PART #
R305	1.8 ohms 10% 10 watt (part of L301 assembly)	453001
R306	10 ohms 10% 5 watt	120103
BR101	thermal sensor 85°C 15A	342001
BR102	thermal sensor 85°C 15A	342001
C101	.01 µf 500v 20% disc	244104
C102	.01 µf 500v 20% disc	244104
C103	.1 µf 100v 20% disc	224104
C104	.1 µf 100v 20% disc	224104
C105	10,000 µf 80v	284109
C106	10,000 µf 80v	284109
C201	4.7 µf 15v tantalum	282505
C202	.1 µf 100v 20% disc	224104
C203	.1 µf 100v 20% disc	224104
C204	50 µf 10v non-polarized	282506
C205	180 µµf 100v 10%	224181
C206	.47 µf 100v 5%	260474
C207	320 µf 6v	281327
C208	47 µµf 100v 10% disc	224470
C209	.1 µf 100v 20% disc	224104
C210	.001 µf 100v 10% disc	240102
C211	82 µµf 100v 10% disc	224820
C212	.001 µf 100v 10% disc	240102
C213	200 µf 15v	283207
C214	200 µf 15v	283207
C215	.001 µf 100v 10% disc	240102
C217	.001 µf 100v 10% disc	240102
C219	.022 µf 100v 10%	264223
C220	.022 µf 100v 10%	264223
C301	.1 µf 100v 20% disc	224104
D201	silicon diode 1N4148	543148
D202	silicon diode 1N4148	543148
D203	silicon diode 1N4148	543148
D204	silicon diode 1N4148	543148
D205	zener diode 14v .4w 5%	540014
D206	silicon diode 1N4148	543148

		PART #
D207	silicon diode 1N4148	543148
D208	silicon diode 1N4148	543148
D209	silicon diode 1N4148	543148
D301	silicon diode 1A 200prv	544012
D302	silicon diode 1A 200prv	544012
DB101	silicon diode bridge 25A	544504
F101	fuse 10A 3AB	342016
F102	fuse 5A 3AG	342025
F103	fuse 6A 8AG	342006
F104	fuse 6A 8AG	342006
F105	fuse 6A 8AG	342006
F106	fuse 6A 8AG	342006
FA101	fan 115v 65 cfm	943001
L301	choke assembly (wound on R305)	453001
P201	1,000 ohms trimpot	190103
P202	1,000 ohms trimpot	190103
Q101	transistor 2N5630	571104
Q102	transistor 2N5630	571104
Q103	transistor 2N6030	561356
Q104	transistor 2N6030	561356
Q201	transistor 2N4889	562889
Q202	transistor 2N4889	562889
Q203	transistor 2N4889	562889
Q204	transistor 2N3440	572440
Q205	transistor 2N3440	572440
Q206	transistor 2N3440	572440
Q207	transistor 2N5415	562415
Q208	transistor BC308B	567070
Q209	transistor SE6020A	577021
Q210	transistor SE6020A	577021
Q211	transistor BC308B	567070
Q212	transistor TIP41C	577041
Q213	transistor TIP41C	577041
Q214	transistor TIP42C	567042
Q215	transistor TIP42C	567042
S101	switch SPST lighted rocker 15A	334022
T101	power transformer	464026
T102	power transformer international model	464030
TH101	thermostat 55°C 15A	342007

CIRCUIT DESCRIPTION

The accompanying block diagram will aid an understanding of the specific circuit concepts expressed in the Stereo 410. Those not interested in the technology may ignore this section.

In brief, the amplifier stages are fully DC coupled, with a complementary driver, and a series connected output stage. The input is a differential pair fed from a constant current source. The full wave bridge power supply includes 10,000 mfd on both plus and minus outputs, providing filtering and dynamic load stability. Fuses on both the plus and minus supplies, volt/amp dissipation limiting, and thermal sensing cutouts protect the amplifier.

Driver and Output Stages

Consider the PC-28 circuit board and output stage as five basic sections:

1) Differential amplifier #1—Q1, Q2, Q3.
2) Differential amplifier #2—Q4, Q5, Q6, Q7.
3) Bias Adjuster—Q8, Q9.
4) a) Master power amplifier—Q13, Q102 (+ signals).
   —Q14, Q103 (− signals).
   b) Slave power amplifier —Q12, Q101 (+ signals).
   —Q15, Q104 (− signals).
5) Protection circuitry—Q10, Q11, D8, D9, R301, R302, D301, D302.

Differential Amplifier #1

Q1 and Q2 are driven from a constant-current source, Q3. D5 and R5 set the current level through Q3. Q1 and Q2 drive similar loads, ensuring approximately equal signals of opposing phase at the collectors of Q1 and Q2. D1 and D2 limit excessive out of phase signals.

The feedback network consists of R9, R10, R11, R12, C6 and C7. Since the negative feedback to the base of Q2 approximates the signal feeding the base of Q1 when the signal is DC, unity DC gain is ensured. As a result the DC level at the output varies with the DC input to Q1, determined by P1. D1 and D2 maintain a constant voltage across P1, while C2 and C3 are diode noise filters, and C4 is a ripple filter.

Differential Amplifier #2

The differential pair Q4 and Q5 is driven by the signals on R6 and R7. Their quiescent DC voltages and R15 determine this amplifier's quiescent current. Q6 supplies a constant voltage to the collector of Q4, and transmits the signal current from Q4 to Q7B. Thus Q7B sees a signal of the same phase and amplitude as Q5B. Q5 and Q7 may each be considered as common-emitter amplifiers whose load resistance is the dynamic resistance of the other. C8, C10 and C11 provide high frequency feedback/compensation.

Bias Adjuster

An adjustable electronic zener with negligible dynamic resistance is formed by Q8, Q9, R17, R18, R19 and P2. Thus the signal sees the bases of Q14 and Q13 tied together. P2 adjusts the zener voltage to bias the amplifier into class AB operation. This circuit determines the quiescent current in the driver and output stages. Q8 is mounted to thermally track the driver transistors, providing temperature compensation for the amplifier.

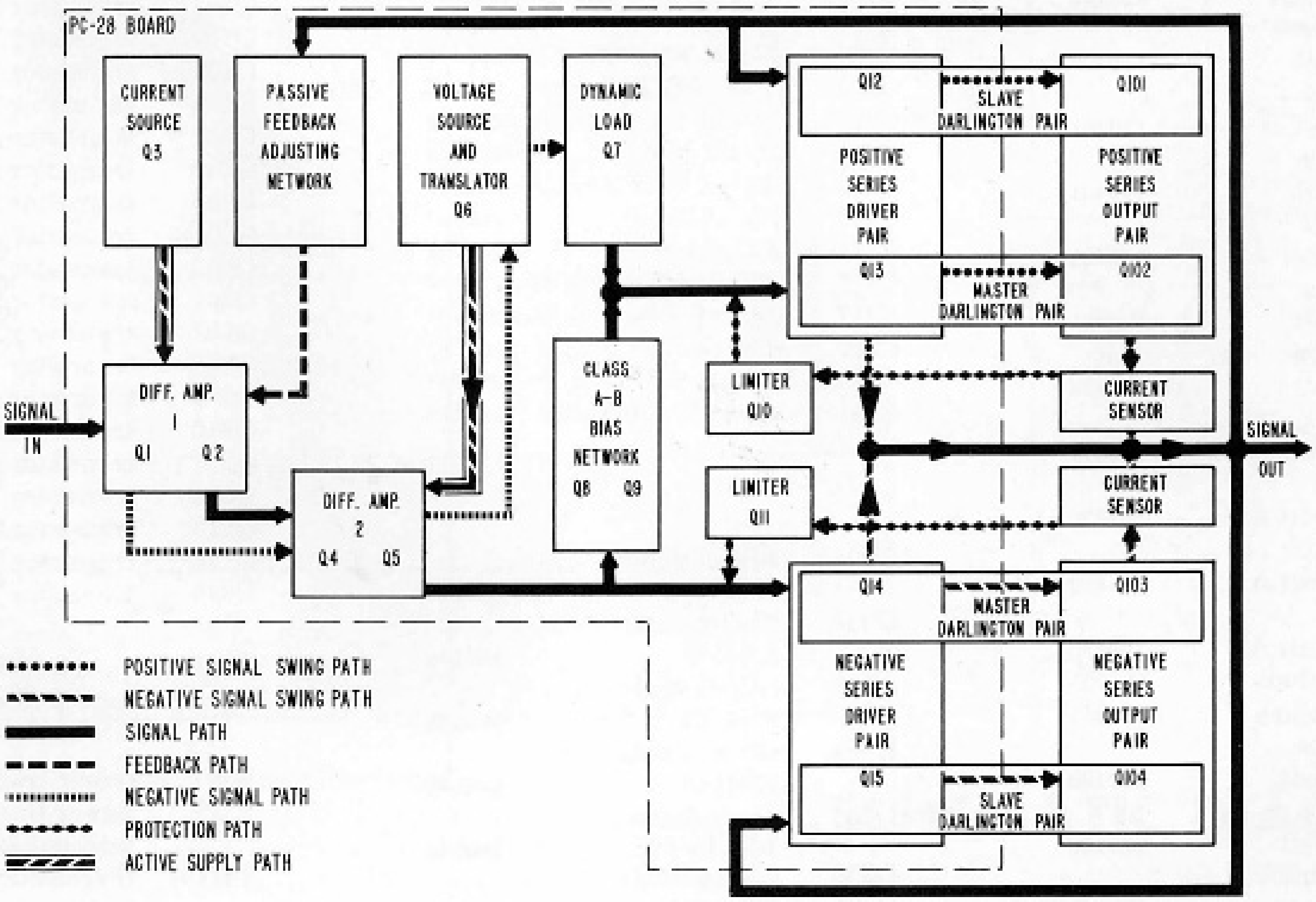
Master / Slave Power Amplifier

Only positive signal operation will be covered since the negative portion is similar. The master Darlington amplifier, Q13 and Q102, drives the output line. At the required quiescent current for Q13, R36 maintains Q102 nearly cut off. The centerline signal (eyelet #7) is bootstrapped to the base of Q12 by C13 and R29. The bias network for Q12 is R28, R29 and R30, providing a zero quiescent reference for the output line along with R31, R32 and R33.

As a result of the bootstrapping, the slave Darlington pair, Q12 and Q101, has a signal input identical to that of the master. Thus we have a high current, high voltage output stage, operating effectively as one Darlington amplifier with twice the voltage capability. R304 provides a reference emitter impedance during no-load conditions.

Protection Circuitry

A volt-amp limiter circuit provides identical protection for both positive and negative sides of the amplifier. Again referring only to positive signal operation, when the current through R301 exceeds a preset limit, the resulting voltage turns on Q10, limiting the drive to Q13 until the current is reduced. Voltage protection is obtained from R23, R25 and D9. Any reverse voltage caused by an inductive load will be limited to 0.7 volts across both output devices by D301.



Continued from page 11.

Set the back panel aside. You will now prepare one of the preassembled circuit boards. Be particularly careful handling the circuit boards, for they represent a substantial portion of the cost of the Stereo 410. Many of the components stand upright on the board, and careless handling can unduly flex and possibly break their leads. There are also two adjustable potentiometers on each board whose values (positions) have been precisely set under operational test conditions for optimum performance. *Be very careful* that none of these is disturbed when handling a board.

15( )Select one of the PC-28 circuit boards. On the Pictorial Diagram you will find a template for the eyelet numbers. Cut out the template and affix it with transparent tape to the *foil side* of PC-28 so that it lies between the row of holes at one end and the aluminum heat transfer assembly.

Connections will now be made to eyelets on this circuit board. Insert the wire in the eyelet so that bare wire is visible on both sides of the board. Do *not* add solder to the eyelets before the wires are inserted. Let the iron contact the junction of the wire and the board circuitry as you feed solder to the junction. The solder should flow smoothly around the eyelet to completely surround it. Steady the wire as the connection cools, and then wiggle it to make sure the connection is secure.

16( )The following connections will all be made to the *foil side* of the board. Prepare the wires in the usual manner at both ends. The other ends will be connected later:

a( )A 2¾″ (7 cm) yellow wire to eyelet #15 (S);
b( )A 7″ (18 cm) blue wire to eyelet #14 (S);
c( )A 2¼″ (6 cm) black wire to eyelet #13 (S);
d( )A 4″ (10 cm) blue wire to eyelet #12 (S);
e( )A 2¼″ (6 cm) yellow wire to eyelet #11 (S);
f( )A 2½″ (6.3 cm) black wire to eyelet #10 (S);
g( )A 2¾″ (7 cm) yellow wire to eyelet #9 (S);
h( )A 2¾″ (7 cm) blue wire to eyelet #8 (S);
i( )A 2¼″ (6 cm) black wire to eyelet #7 (S);
j( )No wire to eyelet #6;
k( )A 7¼″ (18.5 cm) yellow wire to eyelet #5 (S);
l( )A 2¼″ (6 cm) blue wire to eyelet #4 (S).

Wires will be connected later to eyelets #1, #2 and #3.

17( )Position the prepared PC-28 assembly over the PC-40 board assembly, foil side toward you so that eyelet #1 on PC-28 is adjacent to hole #11 on PC-40, and so that eyelet #15 on PC-28 is adjacent to hole #1 on PC-40. You may wish to protect the components on both boards by temporarily placing a piece of cardboard or heavy paper between them. You will now connect the free end of each wire from PC-28 to components on the back panel:

a( )Tuck the long blue wire from eyelet #12 under the other wires connected to the PC-28 board, and connect the free end to PC-40 hole #10 (S);
b( )The blue wire from eyelet #4 to PC-40 hole #8 (S);
c( )The black wire from eyelet #7 to PC-40 hole #7 (S);
d( )The black wire from eyelet #13 to PC-40 hole #2 (S);
e( )The yellow wire from eyelet #15 to PC-40 hole #4 (S).

This will have completed the soldering to all holes on the right side of PC-40 (holes #1 to #11). You may now wish to reposition the PC-28 board very carefully, supported by its wires, 90° to the back panel next to the right edge of PC-40 for the final connections:

f( )The long yellow wire from eyelet #5 to Q2A lug B (S);
g( )The long blue wire from eyelet #14 to Q1A lug B (S);
h( )The blue wire from eyelet #8 to Q2B lug B (S);
i( )The yellow wire from eyelet #9 to Q2B lug C (S-2);
j( )The black wire from eyelet #10 to Q1B lug B (S);
k( )The yellow wire from eyelet #11 to Q1B lug C (S-2).

You should now check all your connections. See that no solder blobs or excess wire connects other than the intended terminal. Cut off any excess wire on the other side of a connection with your side cutters. All the lugs to the four transistor sockets on the right side should be securely soldered; all holes #1 through #11 on the right side of PC-40 should be soldered.

18( )Select two each of the 1½″ long screws, 1″ tubular spacers, and #6 KEP nuts. Remove but do not discard the paper template from PC-28. Gently but firmly turn the board on its wires until the board is approximately in its final position parallel to the inside of the back panel. Insert the screws in the back panel from the outside, through the aluminum heat transfer assembly, then through the spacers, and finally through the board. Secure on the components side of the board with the nuts.

19( )Prepare a 9″ (23 cm) black wire, and an 8¾″ (22.3 cm) blue wire. Start with the black wire ¼″ (.6 cm) longer than the blue wire, and twist them uniformly together to within ½″ (1.3 cm) of the other ends (both wires should be even at this end). Connect the blue wire from the even end to PC-28 eyelet #1 (S). Connect the corresponding end of the black wire to PC-28 eyelet #2 (S). You may connect these wires, and the wire in the next step to either side of the board. Connect the other end of the black wire to input socket lug #3 (S). Connect the corresponding end of the yellow wire to input socket lug #4 (S). As much as possible, position this twisted pair along the bottom edge of the PC-28 circuit board.

20( )Prepare an 11″ (28 cm) black wire, but remove ½″ (1.3 cm) of insulation from one end, and the usual ¼″ from the other. Connect the shorter stripped end to PC-28 eyelet #3 (S). The other end will be connected later.

This completes the soldering of the wires from these PC-28 eyelets to the back panel. Notice that only eyelet #6 is without connection.

We suggest that you take a 10 or more minute break now, before working on the left side of the back panel.

21( )Prepare a 22½″ (57 cm) blue wire, and a 24″ (61 cm) yellow wire. Start with the wires even, and twist them uniformly together to within ¾″ (2 cm) of the other end of the yellow wire (the yellow wire should be 1½″ [3.7 cm] longer than the end of the blue wire at this end). Connect the blue wire from the even end to thermostat lug #1 (S). If these lugs do not contain holes, lay the wire flat against the lug and hold it in position as you solder. Connect the corresponding end of the yellow wire to thermostat lug #2 (S).

Avoid shorting out these wire ends from nearby resistor leads on PC-40. Feed this pair around the top of PC-40, and to the bottom of the back panel between the left side of PC-40 and transistor sockets Q1C and Q2C, flat against the panel. The other ends of this pair will be connected later.

The following steps describe connections of wires to the transistor sockets Q1C, Q2C, Q1D and Q2D. As before, the wires should lie against the back panel around the inside edges, and avoid positioning wires in the left central portion of the back panel.

22( ) Prepare a 6″ (15.3 cm) white wire. Connect one end to Q1D lug E (S). Bend a hook around the other end and connect it to Q1C lug C.

23( ) Prepare a 2″ (5 cm) white wire. Connect one end to PC-40 hole #12 (S). Connect the other end to Q1C lug E (S).

24( ) Prepare a 6″ (15.3 cm) white wire. Connect one end to Q2D lug E (S). Bend a hook around the other end and connect it to Q2C lug C.

25( ) Prepare a 7″ (17.7 cm) blue wire. Connect one end to PC-40 hole #20 (S). Bend a hook around the other end and connect it to Q2D lug C.

26( ) Prepare a 17″ (43 cm) white wire. Bend a hook around one end and connect it to Q2D lug C (S-2). The other end will be connected later.

27( ) Prepare a 2″ (5 cm) white wire. Connect one end to PC-40 hole #22 (S). Connect the other end to Q2C lug E (S).

28( ) Prepare a 7¼″ (18.5 cm) yellow wire. Connect one end to PC-40 hole #14 (S). Bend a hook around the other end and connect it to Q1D lug C.

29( ) Prepare a 12″ (30.5 cm) white wire. Connect one end to Q1D lug C (S-2). The other end will be connected later.

Set the back panel aside, and select the other PC-28 board. Affix the template for the eyelets as before to the foil side, so that it lies between the row of eyelets and the attached heat transfer assembly. Use care handling the board.

30( ) Add a small amount of solder to each eyelet on the board so that connections will be easier. Prepare the wires in the usual manner at both ends, and solder to the foil side of the board. The other ends of the wires will be connected later:

a( ) A 3½″ (9 cm) yellow wire to eyelet #15 (S);
b( ) A 9½″ (24.5 cm) blue wire to eyelet #14 (S);
c( ) A 4″ (10 cm) black wire to eyelet #13 (S);
d( ) A 2¼″ (6 cm) blue wire to eyelet #12 (S);
e( ) A 3″ (7.6 cm) yellow wire to eyelet #11 (S);
f( ) A 3″ (7.6 cm) black wire to eyelet #10 (S);
g( ) A 2¾″ (7 cm) yellow wire to eyelet #9 (S);
h( ) A 3″ (7.6 cm) blue wire to eyelet #8 (S);
i( ) A 2¾″ (7 cm) black wire to eyelet #7 (S);
j( ) No wire to eyelet #6;
k( ) A 9½″ (24.5 cm) yellow wire to eyelet #5 (S);
l( ) A 3½″ (9 cm) blue wire to eyelet #4 (S).

Wires will be connected later to eyelets #1, #2 and #3.

31( ) Position the prepared PC-28 assembly over the PC-40 board assembly, foil side toward you so that eyelet #1 on PC-28 is adjacent to hole #12 on PC-40, and so that eyelet #15 on PC-28 is adjacent to hole #22 on PC-40. Protect the components on both boards by temporarily placing a piece of cardboard or heavy paper between them. You will now connect the free end of each wire from this PC-28 to components on the back panel:

a( ) The yellow wire from eyelet #15 to PC-40 hole #15 (S);
b( ) The black wire from eyelet #13 to PC-40 hole #13 (S);
c( ) The blue wire from eyelet #4 to PC-40 hole #19 (S);
d( ) The blue wire from eyelet #12 to PC-40 hole #21 (S);
e( ) The black wire from eyelet #7 to PC-40 hole #18 (S).

Soldering from the PC-28 board to all the holes on PC-40 is complete. You may now wish to move the PC-28 board very carefully on its wires 90° to the back panel next to the left edge of PC-40 for the final connections:

f( ) The long yellow wire from eyelet #5 to Q2D lug B (S);
g( ) The long blue wire from eyelet #14 to Q1D lug B (S);
h( ) The yellow wire from eyelet #9 to Q2C lug C (S-2);
i( ) The blue wire from eyelet #8 to Q2C lug B (S);
j( ) The yellow wire from eyelet #11 to Q1C lug C (S-2);
k( ) The black wire from eyelet #10 to Q1C lug B (S).

You should check all your connections. See that no solder blobs or excess wire connects other than the intended terminal. Cut off any excess wire on the other side of a connection with your side cutters. All the lugs to the four transistor sockets on the left side should be securely soldered; all holes #12 through #22 on PC-40 should be soldered.

The work you have done should look very much like the photograph on the next page.

32( ) Select the remaining two 1½″ long screws, the last two 1″ tubular spacers, and two #6 KEP nuts. Discard the paper template from PC-28. Gently but firmly turn the board on its wires until the board is approximately in its final position parallel to the inside of the back panel. Insert the screws in the back panel from the outside, through the aluminum heat transfer assembly, then through the spacers, and finally through the board. Secure on the components side of the board with the nuts.

33( ) Prepare a 15½″ (37 cm) black wire, but remove ½″ (1.3 cm) of insulation from one end, and the usual ¼″ from the other end. Connect the short-stripped end to eyelet #3 (S). You may connect this wire, and the wires in the next step, to either side of the board. The other end of this wire will be connected later.

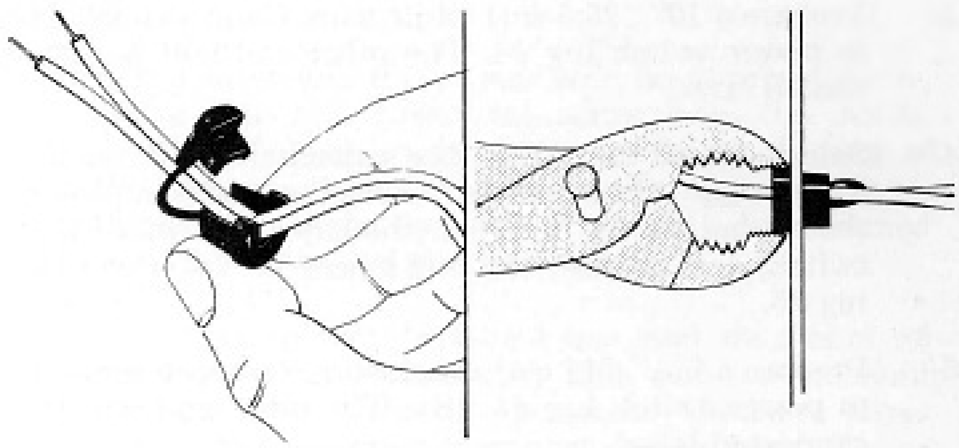
34( ) Prepare a 17″ (44.5 cm) black wire, and a 16¾″ (44 cm) yellow wire. Start with the black wire ¼″ (.6 cm) longer than the yellow wire, and twist them uniformly together to within ½″ (1.3 cm) of the other ends (both wires should be even at this end). Connect the black wire from the even end to eyelet #2 (S). Connect the corresponding end of the yellow wire to eyelet #1 (S). Position this pair along the edge of the PC-28 board adjacent to the eyelets, and tuck the pair under wires connected to the left and the right binding posts and speaker fuse holders. Connect the other end of the black wire to input socket lug #2 (S). Connect the corresponding end of the yellow wire to input socket lug #1 (S).

This completes the soldering of wires from the eyelets on PC-28. Only eyelet #6 is without connection.

35( )Prepare an 8½" (21.5 cm) black wire, but remove ½" (1.3 cm) of insulation from one end, and the usual ¼" from the other. Connect the short-stripped end to the *black* binding post lug #3 (S-2). The other end will be connected later.

36( )In a similar manner, prepare a 12½" (31.7 cm) black wire. Connect the short-stripped end to the *black* binding post lug #2 (S-2). The other end will be connected later.

37( )Select the line cord and the strain relief. Separate the two conductors of the line cord for about 2" (5 cm). Strip ⅜" of insulation from each conductor, unless this has already been done. Mark the line cord 10½" (27 cm) from the stripped 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 as shown in the sketch at right. The small end of the strain relief faces the stripped end of the wire. With heavy pliers, crimp the two halves of the strain relief together around the wire to partially shape the wire before insertion. Now grasp 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 back panel in the large hole at the left bottom. Note that the hole has slightly flat vertical sides, and therefore the strain relief installs easily in the cutout with the cord horizontal. The strain relief snaps into its locked position when fully inserted.



This completes the assembly of the back panel. Turn the assembly over and shake it vigorously to remove any bits of solder or pieces of wire or insulation. Set this assembly aside.

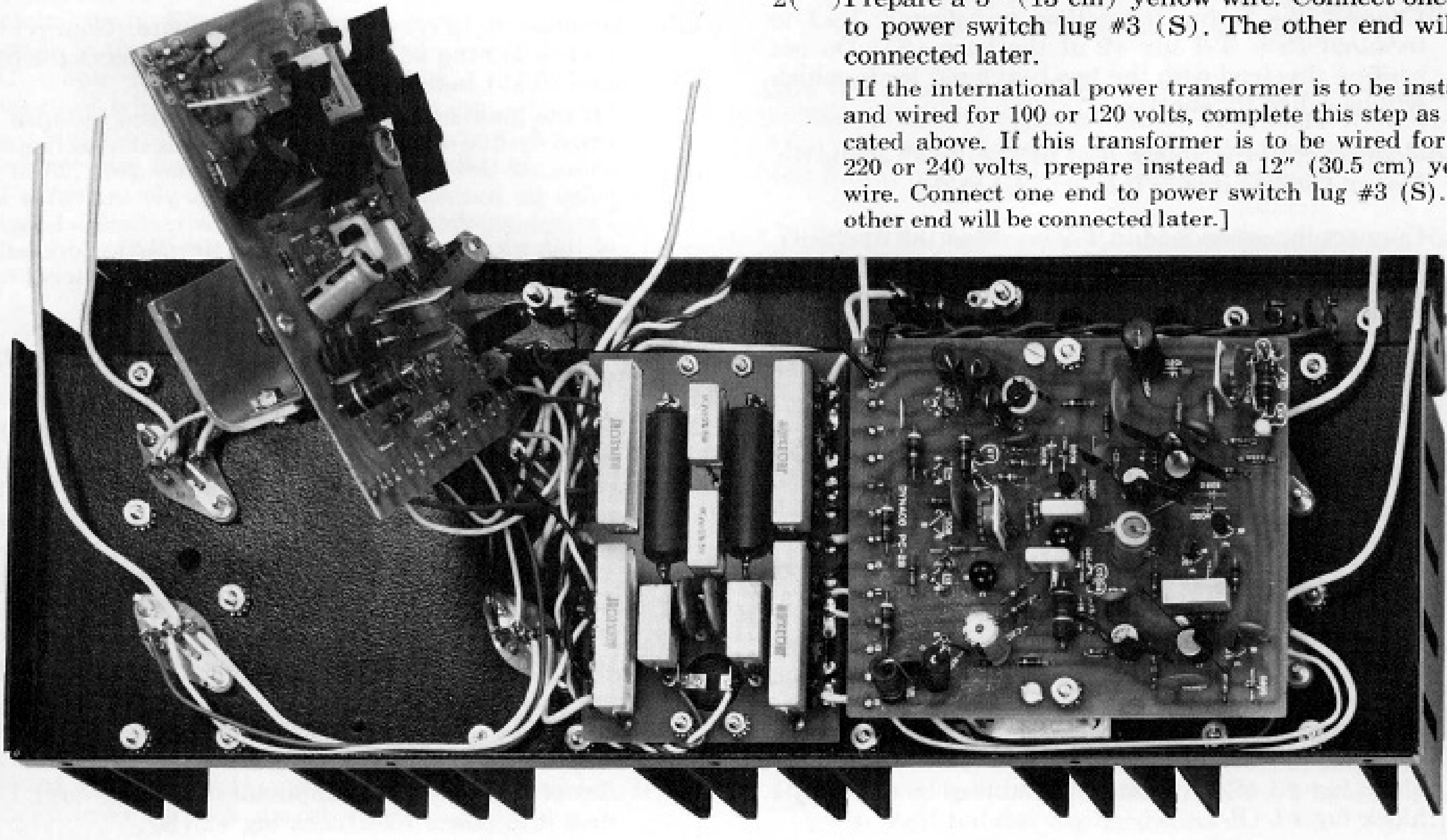
FINAL ASSEMBLY

1( )Select the front panel with the decorative trim decal attached, and the power switch. [If meters are being installed, select instead the front panel supplied with the MC-5 meter kit.] Peel back the protective plastic from the decal in the area of the rectangular hole near the bottom left. Install the power switch in the hole; observe that the dark *red* jewel is positioned toward the nearby side (the dark amber jewel is positioned away from the side). Press it into place from the *outside.* No hardware is used. Spread the four plastic mounting tabs of the switch against the inside of the front panel with the blade of your screwdriver to secure the switch. Then tape the loose edge of the decal's protective plastic over the front of the switch to protect its finish.

Position the front panel assembly with its switch on the left and the lugs toward you, as shown in the Pictorial Diagram.

2( )Prepare a 5" (13 cm) yellow wire. Connect one end to power switch lug #3 (S). The other end will be connected later.

[If the international power transformer is to be installed and wired for 100 or 120 volts, complete this step as indicated above. If this transformer is to be wired for 200, 220 or 240 volts, prepare instead a 12" (30.5 cm) yellow wire. Connect one end to power switch lug #3 (S). The other end will be connected later.]



3( )Prepare a 10" (25.5 cm) white wire. Connect one end to power switch lug #4. The other end will be connected later.

4( )Select one of the .01 μf disc capacitors, and cut its leads to 3/8" (1 cm) each. Connect one lead to power switch lug #4 (S-2). Tuck the capacitor under the switch, and connect the other lead to power switch lug #5.

5( )Prepare a 5½" (14 cm) black wire. Connect one end to power switch lug #1 (S). The other end will be connected later.

[If the international power transformer is to be installed and wired for 100 or 120 volts, complete this step as indicated above. If this transformer is to be wired for 200, 220 or 240 volts, prepare instead a 12½" (32 cm) black wire. Connect one end to power switch lug #1 (S). The other end will be connected later.]

6( )Prepare a 13" (33 cm) blue wire. Connect one end to power switch lug #5. The other end will be connected later. [If meters are being installed, refer now to the MC-5 instructions before continuing with the next step.]

Set this assembly aside for a moment, and place the chassis assembly in front of you.

7( )Select the power transformer, the four ½" #10 screws, the four large flat washers, and the four #10 KEP nuts. Mount the transformer on the left front of the chassis with both sets of transformer leads facing front. Place a larger washer on top of each transformer foot before the nut is installed. Slide the transformer over toward the fan as far as it will go, and firmly tighten the hardware.

When connecting the leads from the power transformer, you may shorten them appropriately to fit.

8( )Connect the heavy red-yellow transformer lead to terminal strip T-2 lug #9 at the base (S). Do not confuse this lead with the two heavy red leads, which will be called for shortly.

9( )Connect the blue-yellow lead to T-2 lug #9 at the tip. Do not confuse it with the two blue leads.

10( )Connect the green lead to T-2 lug #9 at the tip (S-3).

11( )Connect either one of the blue leads to T-2 lug #8 at the base (S).

12( )Connect the other blue lead to T-2 lug #7 at the base (S).

13( )Twist the two heavy red leads together. Connect either one of them to diode block lug #3. Connect the other red lead to diode block lug #1. You may wish to solder these two connections now, even though another lead will be connected to each in the next step.

14( )Select the remaining .01 μf disc capacitor, and cut its leads to ¾" (2 cm) each. Strip a 1" (2.5 cm) piece of insulation from the black wire, and cut the insulation in two equal pieces. Slip a piece of insulation on each lead of the capacitor. Connect one lead to diode block lug #3 (S-2). Connect the other lead to diode block lug #1 (S-2).

The next two steps, 15 and 16, describe the wiring for the primary of the standard power transformer, part #464026. If instead the international power transformer, part #464030, is installed, the wiring will differ because of the additional leads (even if it is to be wired for 120 volts). Instructions for wiring it will be found on the back of the Pictorial Diagram, and they should be followed in place of the next two steps.

15( )Connect the heavy black lead to terminal strip T-2 lug #3 at the base (S). Do not confuse this wire with the heavy black-white lead.

16( )Connect the heavy black-white lead to terminal strip T-2 lug #1 at the base (S).

Place the front panel assembly adjacent to the front of the chassis assembly flat against your work surface, positioned as shown in the Pictorial Diagram. You will now connect the power switch wires.

17( )Connect the free end of the white wire from power switch lug #4 to power fuse block lug #1 (S).

18( )Connect the free end of the yellow wire from power switch lug #3 to terminal strip T-2 lug #3 at the tip.

[If the international transformer has been installed and wired for 100 or 120 volts, complete this step as indicated above. If this transformer is wired for 200, 220 or 240 volts, instead connect the free end of this yellow wire to lug #3 of the additional 6-lug terminal strip at the tip (S-2).]

19( )Connect the free end of the black wire from power switch lug #1 to T-2 lug #1 at the tip.

[If the international transformer has been installed and wired for 100 or 120 volts, complete this step as indicated above. If this transformer is wired for 200, 220 or 240 volts, instead connect the free end of this black wire to lug #5 of the additional 6-lug terminal strip at the tip (S-2).]

20( )Prepare a 13½" (34 cm) white wire. Connect one end to T-2 lug #1 at the tip (S-2). Connect the other end to T-1 lug #2 at the tip.

[If the international transformer has been installed and wired for 100 or 120 volts, complete this step as indicated above. If this transformer is wired for 200, 220 or 240 volts, do not solder the white wire yet on either end. Prepare another 9" (23 cm) white wire. Connect one end of this wire to T-2 lug #1 at the tip (S-2). Connect the other end of this wire to lug #4 of the additional 6-lug terminal strip at the tip (S-2).]

21( )Connect the free end of the blue wire from power switch lug #5 to T-1 lug #1 at the tip.

22( )Select the back panel assembly, and two ¼" black self-tapping sheet metal screws. Place the panel in position at the back edge of the chassis, after bending the several single leads and the twisted pair away from the panel at the bottom. Insert the screws only in the rear most corner hole at each end of the chassis. The screws cut their own thread and therefore some force is required. Do not tighten the screws completely so the panel can be tilted out for working.

23( )Select one of the conductors of the line cord. Connect it to T-1 lug #2 at the tip (S-2).

24( )Select the remaining conductor of the line cord. Connect it to power fuse block lug #2 (S).

25( )Select the blue and yellow twisted pair. Connect the free end of the yellow wire to T-1 lug #6 at the tip (S-2). Connect the free end of the blue wire to T-1 lug #1 at the tip (S-2).

26( )Select the hum shield, and the last two #6 screws and KEP nuts. Position the line cord and the blue and yellow twisted pair as far to the left of the chassis as possible, and mount the shield as shown in the Pictorial Diagram. See that the line cord and the twisted pair are not pinched between the shield and the chassis, and secure it to the chassis with the hardware.

27( )Select the long white wire from thermal sensor lug #4. This is the wire with 1″ of insulation removed from the free end. Feed the wire along the left inside edge of the chassis, and connect the free end through power switch lug #2 (S), to power switch lug #5 (S-3).

28( )Select the long white wire from thermal sensor lug #1. Do not confuse it with the white wires connected to the output transistors. Feed this wire along the left edge of the chassis, and connect the free end to T-2 lug #3 at the tip (S-2).

[If the international transformer has been installed and wired for 100 or 120 volts, complete this step as indicated above. If this transformer is wired for 200, 220 or 240 volts, instead connect the free end of this long white wire to T-2 lug #6 at the tip. Prepare another 5½″ (14 cm) white wire. Connect one end to T-2 lug #6 at the tip (S-2). Connect the other end to lug #2 of the additional 6-lug terminal strip at the tip (S-2).]

29( )Select two black sheet metal screws. Place the front panel assembly in its final upright position inside the front edge of the chassis, after observing that the several wires in this vicinity are not pinched between the bottom lip of the front panel and the chassis. Insert the screws in the corner hole on each side of the chassis, and tighten them securely. The other sheet metal screws will be installed later to avoid turning the amplifier upside down more than once.

30( )Select the white wire from Q2*A* lug C, and connect the free end to B− fuse block lug #8 (S).

31( )Select the white wire from Q2*D* lug C, and connect the free end to B− fuse block lug #5 (S).

32( )Select the white wire from Q1*A* lug C, and connect the free end to B+ fuse block lug #4 (S).

33( )Select the white wire from Q1*D* lug C, and connect the free end to B+ fuse block lug #1 (S).

34( )Select the black wire from right binding post lug #3, the black wire from left binding post lug #2, the black wire from right PC-28 eyelet #3, and the black wire from left PC-28 eyelet #3. Wrap the free ends of these four wires around the ground lug at the base of C1. Solder these four wires, plus the white wire already connected, to the ground lug very carefully and securely. This is the main ground connection for the entire amplifier.

This completes the wiring of your Stereo 410.

35( )Install the seven fuses in their respective fuse blocks and holders. The ceramic body fuse goes in the power fuse block; the four short fuses fit the B+ fuse blocks; the two long fuses fit the speaker fuse holders.

36( )Select twelve black sheet metal screws. Turn the entire amplifier upside down, and shake it vigorously to remove any bits of wire, insulation and solder. The amplifier now weighs more than 40 pounds (18 kilos)! Install five of the sheet metal screws across the bottom front of the chassis, another five across the bottom back of the chassis, and the remaining two on each side at the bottom back of the chassis. Also tighten the two previously installed black screws on each side at the back of the chassis.

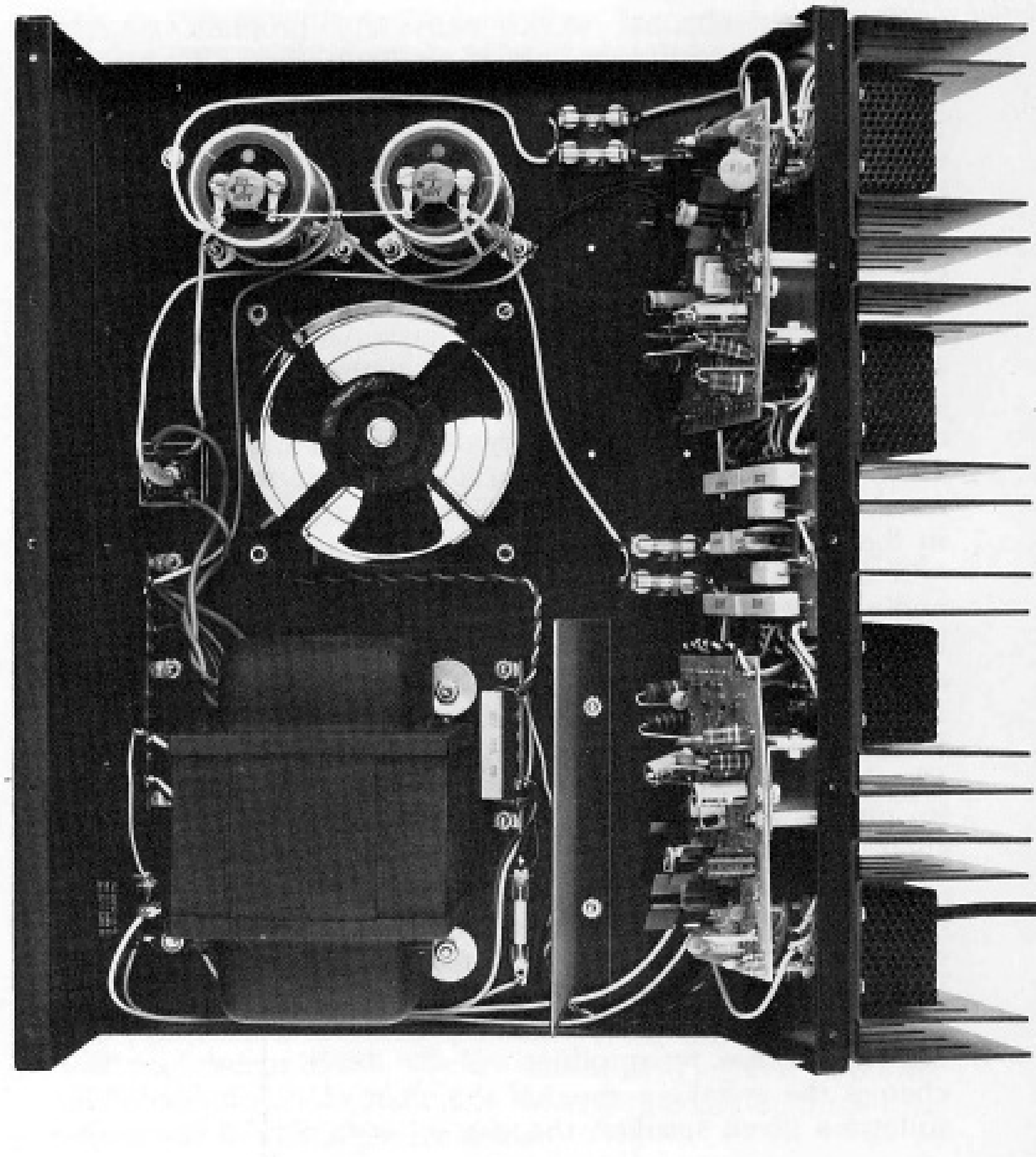
Turn the amplifier right side up. The general placement of wires should conform closely to the photograph below.

Before installing the cover, you may now wish to test the amplifier. See that the power switch is turned off, plug the line cord into a wall outlet, and turn the power switch on. It is safe to operate the Stereo 410 without connection to the inputs or outputs. If the red lamp in the power switch glows, the fan runs, and the fuses hold, there are no gross faults. Unplug the amplifier and finish your work. If one or more of the fuses fail, check your wiring and refer to the IN CASE OF DIFFICULTY section of this manual.

37( )Remove the protective tape from the edges of the heat fins; remove the plastic from the front panel decal.

38( )Slide on the cover so that its bottom flanges fit inside the chassis, and the bent-in flanges lie in front of the front panel to form a frame or bezel. Secure the cover with the last twenty-two black sheet metal screws.

39( )Remove the backing from the CAUTION label, and install it vertically on the heat fin adjacent to the back panel. Similarly remove the backing from the serial number sticker, and install it on the same heat fin.



THE MC-5 ACCESSORY METER OPTION KIT

The optional meter kit is most easily installed at step 6 of the Final Assembly instructions, before continuing to step 7.

The action of the meters supplied is "fast" enough to respond to substantial musical peaks, but no meter can accurately indicate the magnitude of transient waveforms which occur in music. They are effective in determining electrical balance of stereo programming, but the very nature of stereo implies discrête information on each channel, so exact level matching rarely occurs. With sine wave test signals and an *accurate* 8 ohm load, the meter is a measure of output power. A square wave test signal puts out approximately 11% more voltage than the equivalent sine wave meter indication.

To protect the meters from "pegging" (overdrive), it is recommended that the 0 dB position of the meter range rotary switch be used where the anticipated power levels are not known, and when starting any test. Switching to successively higher sensitivity ranges until the loudest passages indicate near "0" will yield the most information.

The accompanying chart lists 8 ohm load power outputs in watts for each meter range. For a 4 ohm load, the wattage should be doubled. For a 16 ohm load, the wattage should be halved. When the amplifier is wired for mono use, only the Channel B meter will read, and the power indicated remains the same as the chart below.

	METER RANGE			
SCALE	0 dB	−6 dB	−12 dB	−18 dB
+ 3	400	100	25	6.25
0	200	50	12.5	3.12
− 3	100	25	6.25	1.56
−10	20	5	1.25	.312

IN CASE OF DIFFICULTY

If there is an initial fault with your component system, or one develops in use, separate units enable relatively easy diagnosis of the source of the problem. Before blaming the electronics, check the connections on all components, particularly carefully on the preamplifier. See that the connections agree with the instructions supplied for each component. Check on the preamplifier that the monitor switch is in its normal or "input" position. If the Dynaco PAT-5 is used, also see that the E.P.L. switch is in its normally "out" position.

If neither channel works with any program source (phono, tuner and tape), it is unlikely that all sources would be faulty. To test whether the problem lies in the preamplifier, temporarily connect the audio cables from the tuner or tape deck to the inputs of the Stereo 410. Use the volume control or level set on the tuner or deck to adjust volume. If the system operates without the preamplifier, even after double checking its connections, the preamplifier is at fault. If the system is still defective, check the *speaker* fuses on the back panel of the Stereo 410 and the speaker connections at both ends. Also, if the amplifier's heat sinks are very warm, allow the unit to cool off and try again, for the thermal sensors may have shut down the amplifier. If the amplifier is cool, and if the connections and the speaker fuses are all right, the fault lies in the Stereo 410.

A fault in only one channel suggests interchanging the audio cables channel for channel to determine the problem. If the fault occurs with only one sound source, such as phonograph, the problem cannot lie in the Stereo 410. Interchange the phono cables at the preamplifier. If the fault reverses channels, the problem is in the source. Check the phono cables, the connection of the cartridge in its mounting shell, and the connecting pins between the shell and the tone arm.

If the faut lies in one channel with any sound source, check the cables between the preamplifier and the Stereo 410, as well as the speaker wires and the speaker fuses. If these are not defective, connect the tuner or tape deck directly to the Stereo 410. If the problem goes away, the fault is in the preamplifier. If the fault remains, interchange the speakers channel for channel. If the problem follows a given speaker, the speaker is faulty. If the problem remains in the same channel regardless of the location of the speakers, one channel of the Stereo 410 is faulty.

Because 90% of the difficulties encountered with kit-built units can be attributed to incorrect wiring or poor solder connections, it is strongly recommended that you ask someone else to check your wiring against the Pictorial Diagram, for one person will frequently make the same error repeatedly.

There are certain general precautions to be observed when servicing any semiconductor equipment:

1. Never make circuit changes of any kind when the amplifier 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 semiconductor leads to avoid excessive heat.

If circuit difficulties are encountered with the Stereo 410, the average kit builder will not likely be able to locate the source of the problem. DO NOT ATTEMPT TO SERVICE THIS AMPLIFIER UNLESS YOU HAVE THE KNOW-HOW AND SUITABLE TEST EQUIPMENT.

CHECKING SEMICONDUCTORS

An ohmmeter can sometimes serve as a gross check for transistor or diode failure. The device must be removed from the circuit. Diodes should have a high resistance in one direction (probe polarity) and a low resistance in the other.

Transistor types vary widely in resistance, but a (near) short circuit indicates probable failure. Readings from base to collector should be similar to those from base to emitter. Both will have a higher reading with one probe polarity than with the reverse orientation. NOTE: Some types of solid state meters do not provide enough probe voltage to forward bias a silicon junction. Hence, a high resistance reading may be obtained in both directions.

Such gross checks can only ascertain clearly faulty semiconductors. More sophisticated test equipment, or direct substitution is necessary to qualitatively evaluate their performance.

TESTS

The availability of a VTVM, TVM, or VOM with at least 20,000 ohms per volt sensitivity will enable you to make some checks to minimize the likelihood of trouble. Since each PC-28 circuit board has been checked in actual operation prior to packing into the kit, a component fault there is not likely. However, a splash of solder, poor or wrong connections, or broken or shorting components leads can result in failure.

The following resistance reading should be made with the amplifier unplugged, and with all four B+ fuses and the two speaker fuses removed from the circuit:

1. From the *rear* of the B+ and B– fuse clips to ground: 3000 ohms.

Large variations are possible because of differences in types of meters, and variations in output transistors.

If a reading is low, remove the wire on the left or right PC-28 which corresponds to the trouble source. (B+ is eyelet #15; B– is eyelet #4.) Check from these eyelets to ground, and the associated pair of output transistors to determine which is causing the low reading. If a board is at fault, check for solder splashes, bad connections, or defective components. If the output stage is at fault, check for shorts between the transistor case or its pins and the heat sink, or for a defective transistor.

If the reading is very high, examine the circuit for open connections or an open transistor on the board or output stage.

NO SOUND OUTPUT

A blown fuse is the most likely cause of interrupted sound in one (or both) channels. First check the speaker fuses, then the power fuse, and finally the B+ fuses. A failed speaker fuse usually indicates that you have driven the system at a high enough level to "pop" the fuse. Replacement should restore sound. However, the failure of either the power fuse or the B+ fuses usually indicates more than routine difficulty. When one of these fail, take B+ and B– resistance readings, as outlined above, to find the source of the trouble.

PERFORMANCE TESTING

The intention to test an amplifier of this power potential assumes a requisite level of technical competence and familiarity with the proper equipment. High power tests, and any distortion tests, require larger output fuses than those normally used. A minimum 5 ampere rating is needed for 8 ohm loads; 9 amps for 4 ohms; and 3 amps for 16 ohms. For mono full power tests at 8 ohms, a 9 ampere fuse is needed in each channel.

Prolonged high power tests signals at low impedance at some frequencies may eventually trigger the thermal cutout even though the heat sink is fan cooled and does not appear unduly hot. The thermal sensors are mounted on the transistor cases for quick response, and under some conditions the case cannot transfer the heat to the sink fast enough, especially if the amplifier is already hot when the test begins. The thermal sensors shut the amplifier off when they reach 85°C.

The power supply with its low loss transformer has a high degree of inherent regulation, but since up to 11 amps is drawn, the voltage drop off the line may be appreciable, especially if a variac is used. Thus the AC line must be corrected to 120 volts (measured on an rms reading meter) during high power testing.

BIAS ADJUSTMENT

The output bias current has been set at the factory, and should remain in proper adjustment for the life of the amplifier. However, should you wish to check the output bias, the following procedure should be followed:

1. Remove the input connections, and also the load from the output connections.
2. Remove the B– fuses (you should not remove the B+ fuses). The B– fuses are both located in the dual clip at the right back of the chassis, as shown in the Pictorial Diagram.
3. Connect the "+" lead of an ammeter to the rear fuse clip for the channel to be adjusted, and the ground lead to the corresponding front fuse clip. Avoid shorting out the leads or allowing them to make intermittent connections.
4. Turn the unit on, but wait for 10 *minutes* until operating temperatures have stabilized. Then adjust the B+ current (trimpot P202) for approximately 150 milliamps. Turn the unit off, remove the ammeter, reinstall the B– fuses, and then turn the unit on again.
5. With a volt meter connected to the output terminals of the channel being adjusted, set the center line voltage (trimpot P201) for 0 volts (±20 millivolts).

Repeat the procedure for the second channel. NOTE: The actual current through the output transistors is approximately 60-75 milliamps.

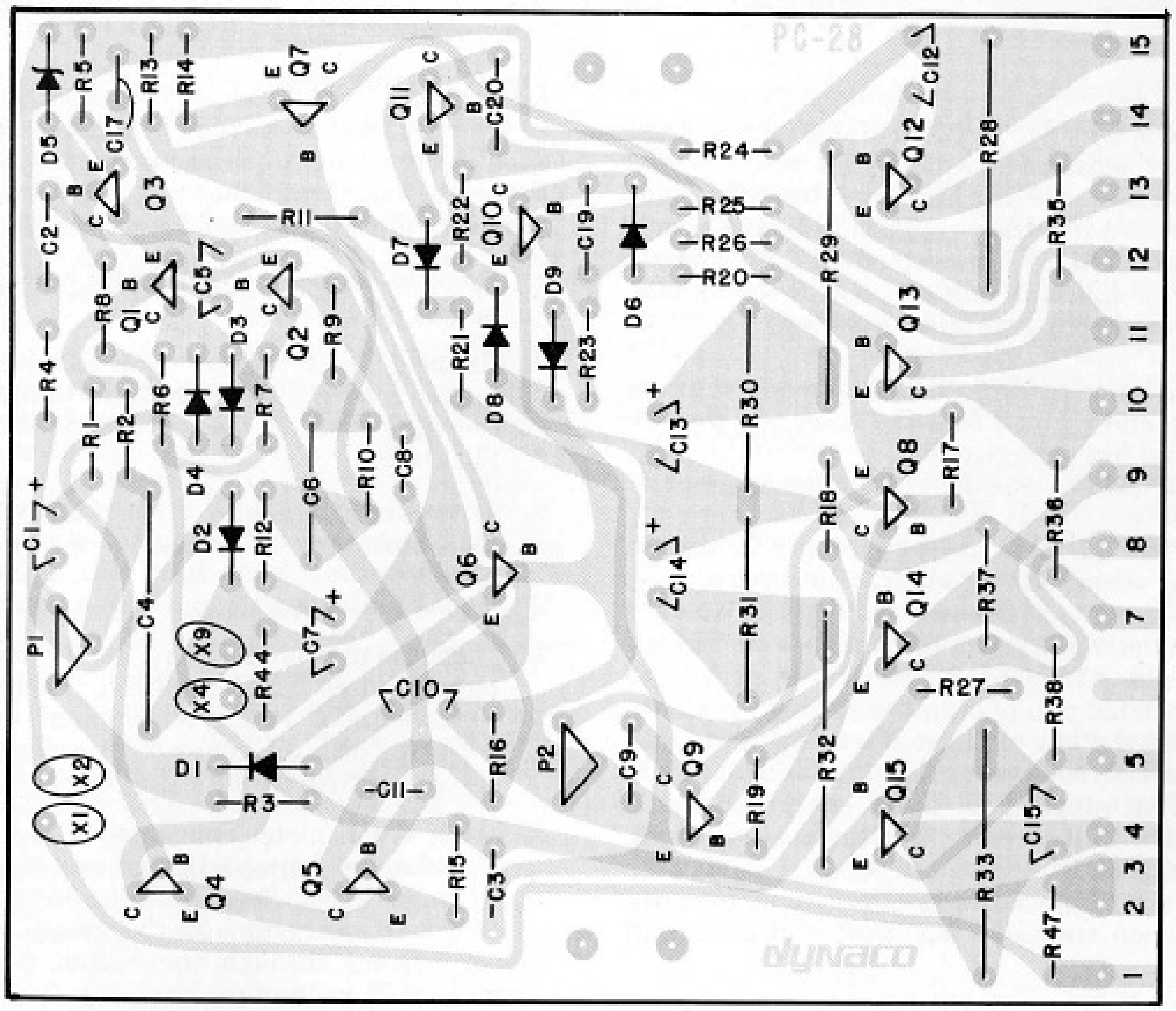
VOLTAGES

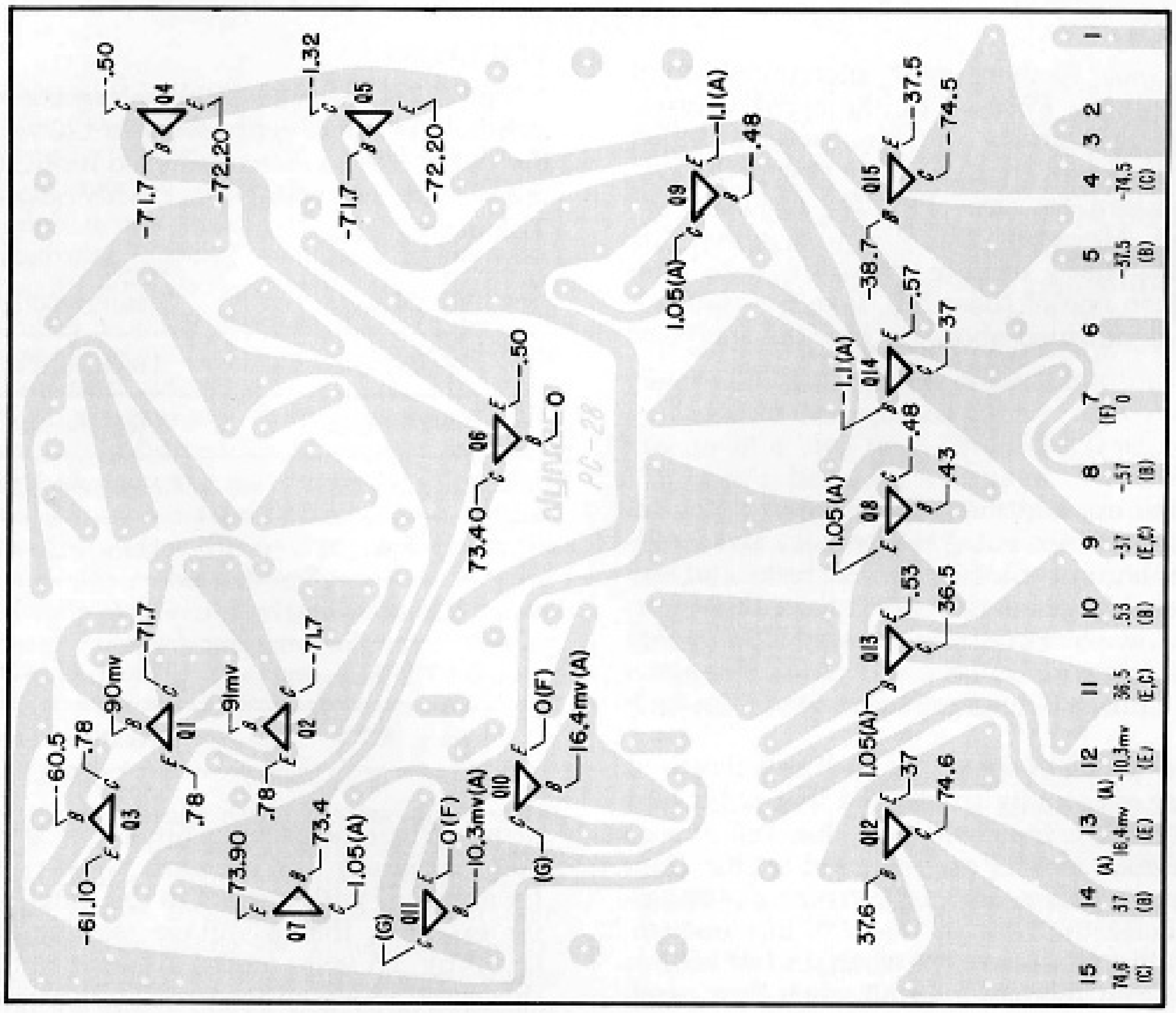
The chart below lists the voltages and location of the test points. The values are based on a 120 volts, 60 Hz line, amplifier connected in stereo, shorted input, no load connected to the output. All voltages are with respect to circuit ground. Tolerance: 20%

VOLTAGE	PC-40 CIRCUIT LOCATION
+74 v. DC	Hole #3, #4, #14, #15
–74 v. DC	Hole 8#, #9, #19, #20
+16 mv. DC	Hole #1, #2, #12, #13
–16 mv. DC	Hole #10, #11, #21, #22
0 (center line)	Hole #6, #7, #17, #18
GROUND	Hole #5, #16
55 v. AC	Rectifier Diode Block Lug #1, #3

NOTE: When measuring voltages, it is important to take volt meter accuracy into account. Most volt meters are specified for accuracy with respect to the range selected. This means, for example, that a voltage reading on ±5% meter could be off by ±5 volts on the 100 volt range. In the Stereo 410 this could imply an incorrect indication when measuring the DC supply, which has been specified ±10 volts (with a 120 volt line). Even if the voltages were exactly 74 volts, a ±5% meter reading could indicate a voltage from 60 to 88 and still be within the specifications of both the meter tolerance and the voltage tolerance. It is therefore necessary to always consider the tolerances of *both* the voltage being measured and of the measuring instrument.

ADD 200 TO ALL COMPONENT NUMBERS





VOLTAGE TEST POINTS

All voltages measured with a VTVM or TVM, 120 vAC, chassis ground reference. 10% tolerance permissible.

Notes:

A Will vary with P2.

F Will vary with P1.

G Do not measure. Reading valid only when amplifier is limiting.

SERVICE POLICY AND LIMITED WARRANTY

The Stereo 410 has been carefully engineered to provide many years of musical enjoyment without difficulty. Each factory-assembled Stereo 410 has been subjected to a full complement of performance tests prior to shipment. Each PC-28 circuit board in the kit has been tested and adjusted in operation as a fully functioning unit to verify its performance capability. Nevertheless, through damage in transit, faulty kit assembly, or human error, service may sometimes be required.

To provide rapid and reliable service, Dynaco has authorized competent, well-equipped service facilities in several localities in the United States and Canada, in addition to its service facility at the factory. These stations are authorized to make repairs in and out of warranty under the terms listed below. Service is always available at the factory, but you will often find a more convenient facility locally. A current list of these facilities is enclosed. Write to Dynaco for the name of the service station nearest you.

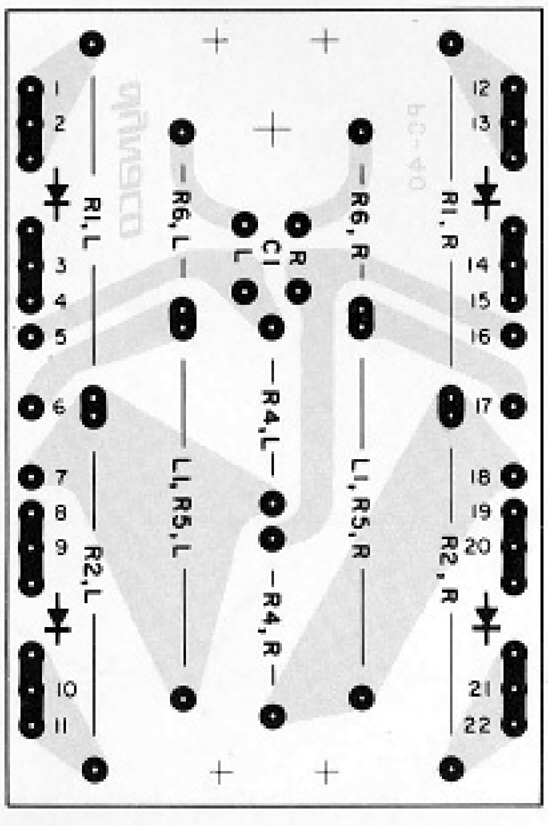
It is the owner's responsibility to *take or send the unit freight prepaid to the service facility. A dated bill of sale must be submitted.* In the event that you incorrectly diagnose which unit is faulty, please understand that you will be responsible for a check-out charge on any properly performing kit or factory-assembled unit submitted for testing.

Shipment should be made via United Parcel Service (Express in Canada), whenever possible. DO NOT USE PARCEL POST FOR IT IS NOT A SAFE METHOD OF SHIPPING ELECTRONIC EQUIPMENT. Should damage occur because of parcel post shipment, repairs will be made at the owner's expense, as neither the factory nor the service stations has the facilities to process parcel post claims. Insure the carton for the full value of a *factory wired* Stereo 410.

When shipping the amplifier, use the original carton with all the styrofoam inserts. Include with the returned unit the following information:

1. Your name and complete shipping address (Post Office box numbers are not suitable);
2. The serial number (from the cover of this manual), *together with a copy of your dated bill of sale;*
3. The symptoms, complete, but preferably brief. If the problem is intermittent, this *must* be noted.

Once service work has been performed, an additional 90 day warranty on the service work is provided.



Warranties apply to the original purchaser only; they are not transferable. They do not apply to units which have been physically or electrically abused, or to units which have been modified without prior written factory authorization. The use of non-Dynaco replacement parts may in some instances void the warranty. 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.

Dynaco maintains a Technical Services Department to help you locate the source of, and possibly correct a problem yourself. When writing, mention the serial number of the Stereo 410 and any tests you have performed.

WARRANTY FOR KIT-BUILT UNITS

The components in a Stereo 410 kit are warranted for a full year from the purchase date. If a defective component is found in a completed circuit board module, 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 Stereo 410 to the nearest authorized service station or to the factory for service. A dated bill of sale must be submitted. In-warranty parts will be replaced at no charge, although a service fee 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 be returned on a COD basis via UPS wherever possible.

If you are *certain* that the problem in the Stereo 410 is confined only to a particular PC-28 circuit board, you may, at your option, unsolder (do not cut wires) and return the board *to the factory only* for service. Since responsibility for proper diagnosis, packaging and reinstallation is yours alone, we recommend that you contact Dynaco prior to such action, to be certain it is the best alternative.

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

WARRANTY FOR FACTORY ASSEMBLED UNITS

The Stereo 410A is warranted for a full year from the purchase date, including parts and labor, and shipment costs *from* the service facility to the owner (within the U.S. or Canada). The owner is responsible for shipment *to* the service facility, and must submit a copy of the dated bill of sale.

SERVICE BEYOND THE WARRANTY PERIOD

Dynaco establishes maximum labor fees which may be charged by its service facilities (plus the cost of parts, and shipping charges) without prior approval by the owner. A current list of authorized service stations, and the current established fee for any unit will be supplied by Dynaco on request. Dynaco cannot assume responsibility for service at other than *Dynaco authorized service stations.*

Dynaco reserves the right to limit the service facility or the established fees to two years from the date of purchase. Dynaco assumes no liability or responsibility for injury or damages sustained in the assembly or operation of this equipment, or for damage to other equipment connected to it. Dynaco reserves the right to make design changes without the obligation to revise prior versions. Prices and specifications subject to change without notice.

COMPONENT VALUES

All resistors are 1/4 w., 5% unless otherwise indicated.

		PART*
R101	600 ohms, 10 watts	120601
R201	1,000 ohms	119102
R202	22,000 ohms	119223
R203	33,000 ohms	119333
R204	33,000 ohms	119333
R205	4,700 ohms	119472
R206	2,200 ohms	119222
R207	2,200 ohms	119222
R208	100,000 ohms	119104
R209	100 ohms	119101
R210	22,000 ohms	119223
R211	6,200 ohms	
	5% 1/2 watt film	133622
R212	220 ohms	119221
R213	130 ohms	119131
R214	150 ohms	119151
R215	100 ohms	119101
R216	22 ohms	119220
R217	1,000 ohms	119102
R218	2,200 ohms	119222
R219	1,000 ohms	119102
R220	20 ohms	119200
R221	20 ohms	119200
R222	2,400 ohms	119242
R223	2,400 ohms	119242
R224	10 ohms AB	119100
R225	100 ohms	119101
R226	100 ohms	119101
R227	10 ohms AB	119100
R228	1,000 ohms	
	5% 2 watt	110102
R229	750 ohms	
	5% 2 watt	110751
R230	300 ohms	
	5% 1 watt	116301
R231	300 ohms	
	5% 1 watt	116301
R232	750 ohms	
	5% 2 watt	110751
R233	1,000 ohms	
	5% 2 watt	110102
R235	47 ohms	
	5% 1/2 watt AB	103470
R236	47 ohms	
	5% 1/2watt AB	103470
R237	47 ohms	
	5% 1/2 watt AB	103470
R238	47 ohms	
	5% 1/2 watt AB	103470
R244	200,000 ohms	119204
R247	330,000 ohms	119334
R301	0.18 ohms	
	3% 10 watt	120180
R302	0.18 ohms	
	3% 10 watt	120180
R304	1,000 ohms	
	10% 5 watt	120107

		PART #
R305	1.8 ohms	
	10% 10 watt (part	
	of L301 assembly)	453001
R306	10 ohms	
	10% 5 watt	120103
BR101	thermal sensor	
	85°C 15A	342001
BR102	thermal sensor	
	85°C 15A	342001
C101	.01uf 500v 20%disc	244104
C102	.01 uf 500v 20% disc	244104
C103	.1 uf 100v 20% disc	224104
C104	.1 uf 100v 20% disc	224104
C105	10,000 uf 80v	284109
C106	10,000 uf 80v	284109
C201	4.7 uf 15v tantalum	282505
C202	.1 uf 100v 20% disc	224104
C203	.1 uf 100v 20% disc	224104
C204	50 uf 10v	
	non-polarized	282506
C205	180 .uuf 100v 10%	224181
C206	.47 uf 100v 5%	260474
C207	320 uf 6v	281327
C208	47 uuf 100v 10% disc	224470
C209	.1 uf 100v 20% disc	224104
C210	.001 uf 100v 10% disc	240102
C211	82 uuf 100v 10% disc	224820
C212	.001 uf 100v 10% disc	240102
C213	200 uf 15v	283207
C214	200 uf 15v	283207
C215	.001 uf 100v 10% disc	240102
C217	.001 uf 100v 10% disc	240102
C219	.022 uf 100v 10%	264223
C220	.022 uf 100v 10%	264223
C301	.1 uf 100v 20% disc	224104
D201	silicon diode	
	1N4148	543148
D202	silicon diode	
	1N4148	543148
D203	silicon diode	
	1N4148	543148
D204	silicon diode	
	1N4148	543148
D205	zener diode	
	14v .4w 5%	540014
D206	silicon diode	
	1N4148	543148

		PART
D207	silicon diode	
	1N4148	543148
D208	silicon diode	
	1N4148	543148
D209	silicon diode	
	1N4148	543148
D301	silicon diode	
	1A 200prv	544012
D302	silicon diode	
	1A 200prv	544012
DB101	silicon diode bridge	
	25A	544504
F101	fuse 10A 3AB	342016
F102	fuse 5A 3AG	342025
F103	fuse 6A 8AG	342006
F104	fuse 6A 8AG	342006
F105	fuse 6A 8AG	342006
F106	fuse 6A 8AG	342006
FN101	fan 115v 65 cfm	943001
L301	choke assembly	
	(wound on R305)	453001
P201	1,000 ohms trimpot	190103
P202	1,000 ohms trimpot	190103
Q101	transistor 2N5630	571104
Q102	transistor 2N5630	571104
Q103	transistor 2N6030	561356
Q104	transistor 2N6030	561356
Q201	transistor 2N4889	562889
Q202	transistor 2N4889	562889
Q203	transistor 2N4889	562889
Q204	transistor 2N3440	572440
Q205	transistor 2N3440	572440
Q206	transistor 2N3440	572440
Q207	transistor 2N5415	562415
Q208	transistor BC308B	567070
Q209	transistor SE6020A	577021
Q210	transistor SE6020A	577021
Q211	transistor BC308B	567070
Q212	transistor TIP41C	577041
Q213	transistor TIP41C	577041
Q214	transistor TIP42C	567042
Q215	transistor TIP42C	567042
S101	switch SPST lighted	
	rocker 15A	334022
T101	power transformer	464026
T102	power transformer	
	international model	464030
TH101	thermostat 55°C	
	15A	342007

SCHEMATIC DIAGRAM