

REPAIRING SOLID-STATE PHONOS

The low supply voltages and small size of transistors have resulted in some unusual circuits and layouts

By HOMER L. DAVIDSON



THE PAST 3 YEARS HAVE BROUGHT BIG change in small phonographs, just as in other home-entertainment products. The transistor has taken over, and new circuit designs and physical layouts have been developed to take advantage of the conveniences of solid-state devices. Lower voltages, far less heat and smaller size have made phono amplifiers more compact than ever before. As always, some of the new circuits call for new servicing techniques.

impedance for a good match. In some RCA models, a choke coil is paralleled with the voice coil. Other models use output transformers, conventionally. Fig. 1 shows the circuit of a typical transistor portable. Figs. 2 and 3 show two transistor output stages.

Power supplies

Several methods are used to supply B+ voltage to the transistors. Some phono power supplies operate right off

stocked by most radio and TV shops. The special phono motor with the separate ac winding must be ordered from the manufacturer. Of course, a separate small stepdown transformer could be used if only the power-supply winding of the motor shorts or opens.

The unusual power supply of a Westinghouse manual portable is shown in Fig. 4. This phono operates from the power line or from a 9-volt battery. The phono motor runs on dc. The power transformer produces about 9 volts ac, which is rectified by a silicon diode. A transistor is used as a voltage regulator in this circuit. The regulated -9.4 volts goes to the dc phono motor and to the transistor output stage. A dropping-resistor-and-capacitor network also supplies -8.7 volts to the amplifier and driver stages.

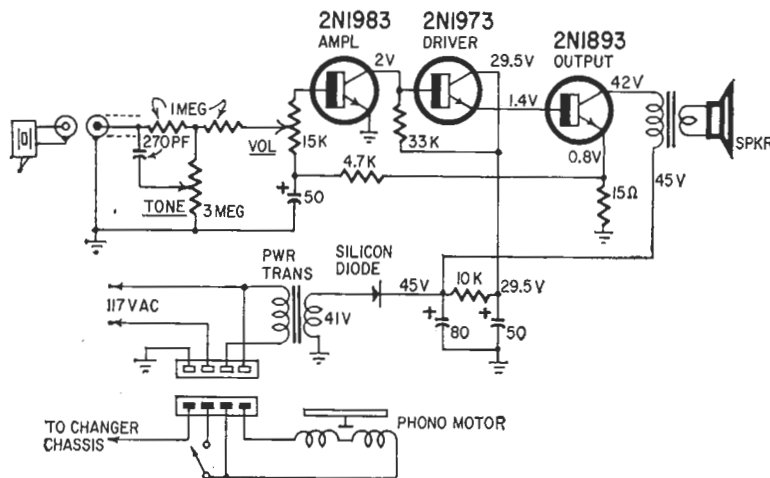


Fig. 1—One three-stage all-transistor phono amplifier is direct-coupled throughout and has fewer parts than the old traditional two-tube design. It can also be smaller.

Many manufacturers of portables use from three to ten transistors in the phono circuits. The first audio stage takes the output of the ceramic stereo cartridge. The volume control, and sometimes the bass and treble controls, are usually in that first stage. Most portables don't have a balance control. Balance of the left and right channels is most often controlled by dual volume controls.

The output stage may be single-ended or push-pull. A driver with an interstage transformer may be used, or R-C coupling. Some manufacturers, such as RCA, Westinghouse, and Silver-tone, do not use output transformers. The voice coil is made with the correct

the ac line. Others use a stepdown transformer. Several use an extra winding around the phono-motor field to develop voltage for the amplifier.

At least one manufacturer (Admiral) has a phono operating directly from the ac line. A silicon diode rectifies the ac voltage. Another photo shows the power supply of an RCA model RP-219, with the ac coming from the field of the phono motor. The ac voltage in these supplies can be from 12 to 41 volts. In the stepdown-transformer supplies, full-wave or half-wave rectification is used.

Almost always, filter capacitors in these circuits have a very high capacitance (100 to 3,000 μ F) with a low voltage rating. Capacitors like that aren't

Chassis layout

The RCA R2-219 series has an unusual physical design. All components, including the etched circuit board, power transistors and power supplies, are mounted on the turntable chassis. To get at the etched board, you must lift off the turntable. The board is mounted upside down; only the foil shows. Four mounting bolts hold the board in place and also serve as feedthrough terminals for B+ voltages.

The four bolts fasten the etched circuit board to the power transistors and power supply and are insulated from the metal chassis. To get at the amplifier, simply remove six wood-screws, lift the Masonite changer-mounting board out of the cabinet, and turn the board over. Even the tone and volume controls are mounted on the metal turntable chassis.

All voltages and resistances are measured from the top. If any components must be replaced, unscrew the four nuts holding the etched circuit. Unsolder the wire clips from the board and mark the color-coded wires on the metal chassis. At this point, the board can be raised a few inches. Unhook the emitter and base leads from the power transistors, and the board will come off.

When replacing the board, be sure

the power-transistor wires are fitted onto the correct terminals. The left channel in one RCA portable was entirely dead because one of the emitter leads had come off. Also be sure to replace the star washers on the four chassis bolts. These fastenings *must* be tight; otherwise vibration from the turntable will make the etched board intermittent.

Tie the pickup arm down to the arm rest when you turn the chassis over.

A plug-in fuse, located underneath the turntable, protects the motor and amplifier. If the trouble is no sound or no turntable rotation, replace the fuse. Be sure the turntable screws are loosened so the changer base will float. Motorboating or boomy, ringing bass notes mean that speaker vibrations are being fed back to the pickup via the changer.

Troubleshooting

Simple transistor amplifiers generally don't cause much trouble. Most troubles can be laid to the power supply or output transistors, or to the stereo cartridge. If the whole amplifier is dead, check the silicon diodes in the

voltage of the capacitor. Supply outputs may vary from 9 to 125 volts.

Let's say, for instance, that the right channel is completely dead. First, check the stereo cartridge by feeding an audio signal into the wire coming from the right-side terminal of crystal cartridge. Simply touch the wire or terminal with a screwdriver blade which is

touching your finger. If you hear a hum, that side of the cartridge is probably dead, since the amplifier is OK. If the right channel is intermittent, check the pickup arm by pressing it lightly down to the record. (Don't use one of the customer's good records for this!) Use only light pressure, then let up. An intermittent cartridge will go on and off when pressure is applied and removed.

If you get no sound with the screwdriver hum test, look for a short in the cable or at a phono plug. If there is no short, feed an audio signal into the first stage and to later stages until you find the trouble. Coupling capacitors can open and kill the signal. A shorted transistor can be spotted easily with voltage and resistance checks. Power output transistors give more trouble than low-signal ones. Intermittent sound or no volume may be caused by a defective speaker. Check the circuit board for bad connections (boards today are less troublesome than ones of a few years ago). Since there is no high voltage and no heat problem on the board, transistor amplifiers develop little trouble.

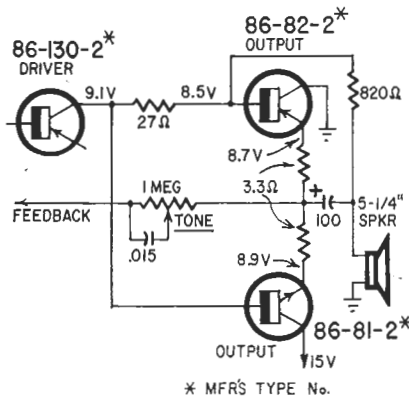
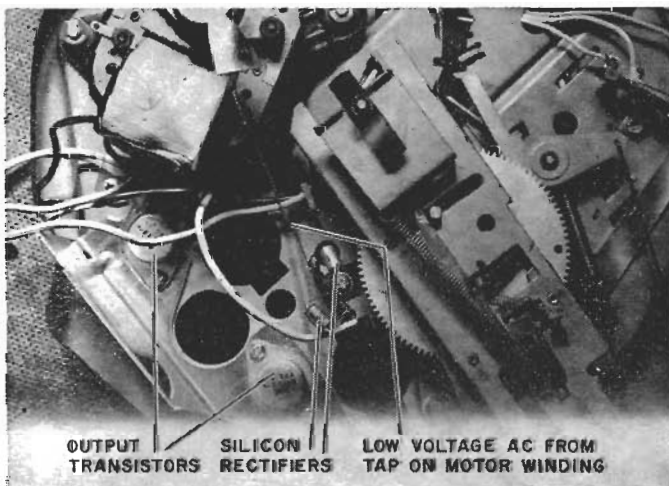
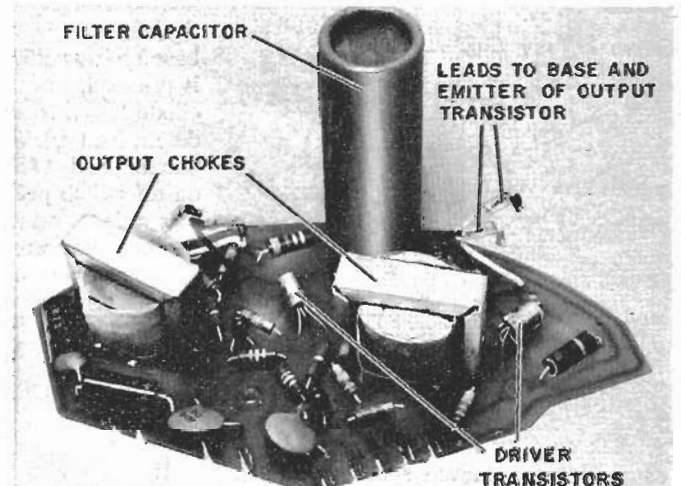


Fig. 2—This complementary-symmetry output circuit is in some Silvertone phonos.



RCA phono mounts output transistors right on changer base. Power is rectified from separate motor winding, combining functions.



Circuit board in some RCA phonos mounts on changer base. Some nearly identical chassis have output transformers, not chokes.

power supply. They sometimes short. The low-voltage transformer supply doesn't cause as much trouble as the half-wave rectifier right off the ac line. In most cases the small fuse resistor will go at the same time as the silicon diode. Replace both with units of same ratings and physical dimensions. If there is no ac voltage on the rectifier, suspect the stepdown transformer or the ac winding in the phono motor.

If the amplifier has a loud 60-Hz hum, suspect the filter capacitors. Bridge a good capacitor across each filter, but remember that some of these capacitors are 1,000- and 2,000- μ F units. You must use a substitute somewhere near those values. A 40- μ F capacitor won't help. Also, check the working

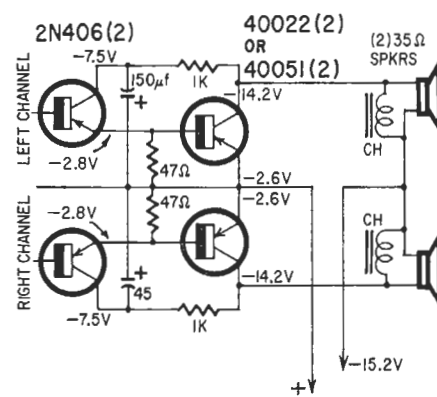
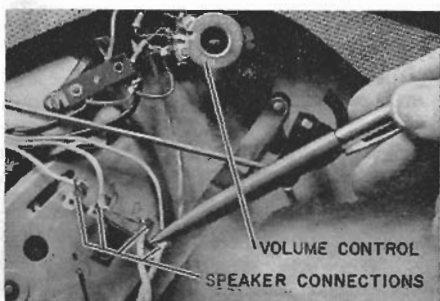


Fig. 3—Output stages of RCA phono amplifiers. Note low-resistance chokes across voice coils. Some similar RCA boards use transformers and different transistors.

Changer repair

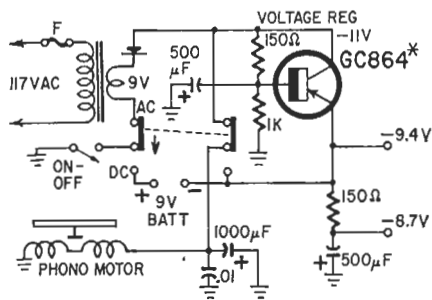
The most common complaint with a changer is slow speed, no speed, or that the arm doesn't work right. Look at the phono-motor bearings to see if they are properly oiled. If the armature is very dirty and the bearing oil is thick and gummy, clean the whole motor assembly. Take the motor apart and clean off the bearings and armature. You can tell by sound and feel when a motor is dry or sluggish. Push the idler wheel away from the motor shaft and start the motor. If the bearings make a noise, they are dry. If the motor turns slowly, or, when the motor is shut off, if the armature stops at once, clean and lightly oil the bearings.

If the turntable slows down after 30 minutes, suspect a shorted motor field. The motor-frame assembly will get very hot, if the field is shorted. Replace the motor. Another cause of slow



Even speaker connections and volume control are mounted directly on changer base in RCA phono in Fig. 3 and other photos.

speed is a hard, slick idler wheel. After several years of use, the edge of the tire becomes rounded. Put in a new idler wheel, or tighten the idler tension spring by snipping off a couple of turns.



* MFR'S TYPE No.

Fig. 4—This Westinghouse H99AC1 has a 9-volt dc phono motor, and can be used for ac-line or battery operation.

A slick or dirty turntable rim will also cause slow or uneven speeds. Clean it with alcohol and brush on a coat of liquid resin or other nonslip compound.

Check the set-down of the pickup arm on all three sizes of records. Check the cycling period and oil the record arm support; straighten it if it's bent. Last, clean off the turntable board and polish the cabinet. END

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