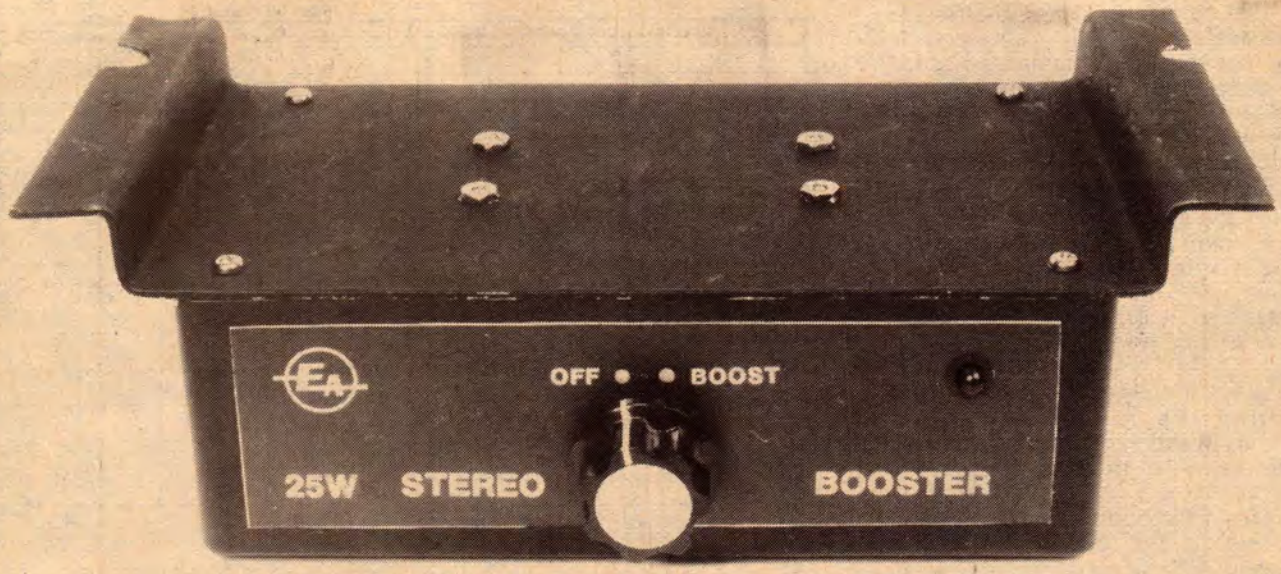


POWER BOOSTER FOR CAR STEREOS

Does your car stereo system lack the punch and bite of your home hi-fi? If so, build and fit this new booster amplifier. The design is based on a rugged single IC amplifier module, and can supply 12W per channel from a nominal 13.8V DC source. It can be used with all negative earth electrical systems.

by DAVID EDWARDS

Car stereo systems based on either FM radio or cassette signal sources have become quite popular of late, but they tend to suffer in power capability compared with the more usual domestic hi-fi. A power booster is the obvious solution to this problem, and can be quite an economical addition to the system.

The unit described in this article is intended for connection in the speaker lines between an existing stereo amplifier (such as is normally included in a stereo cassette player or stereo FM radio) and a pair of 4 ohm speakers.

Operation of the unit is controlled by the OFF/BOOST switch, and a LED is provided as a reminder that the unit is turned on. Internal preset volume controls are provided, so that the gain of the booster can be adjusted. Under normal circumstances, the volume of the boosted sound is controlled by the volume control of the signal source.

Our design is based on a new audio power IC, the TA7241P. This is a Toshiba device, and is mounted in a metal and plastic dual-in-line style package. Each IC contains two independent audio amplifiers, featuring self-centring DC output bias, overload protection, and with a high peak output current capability.

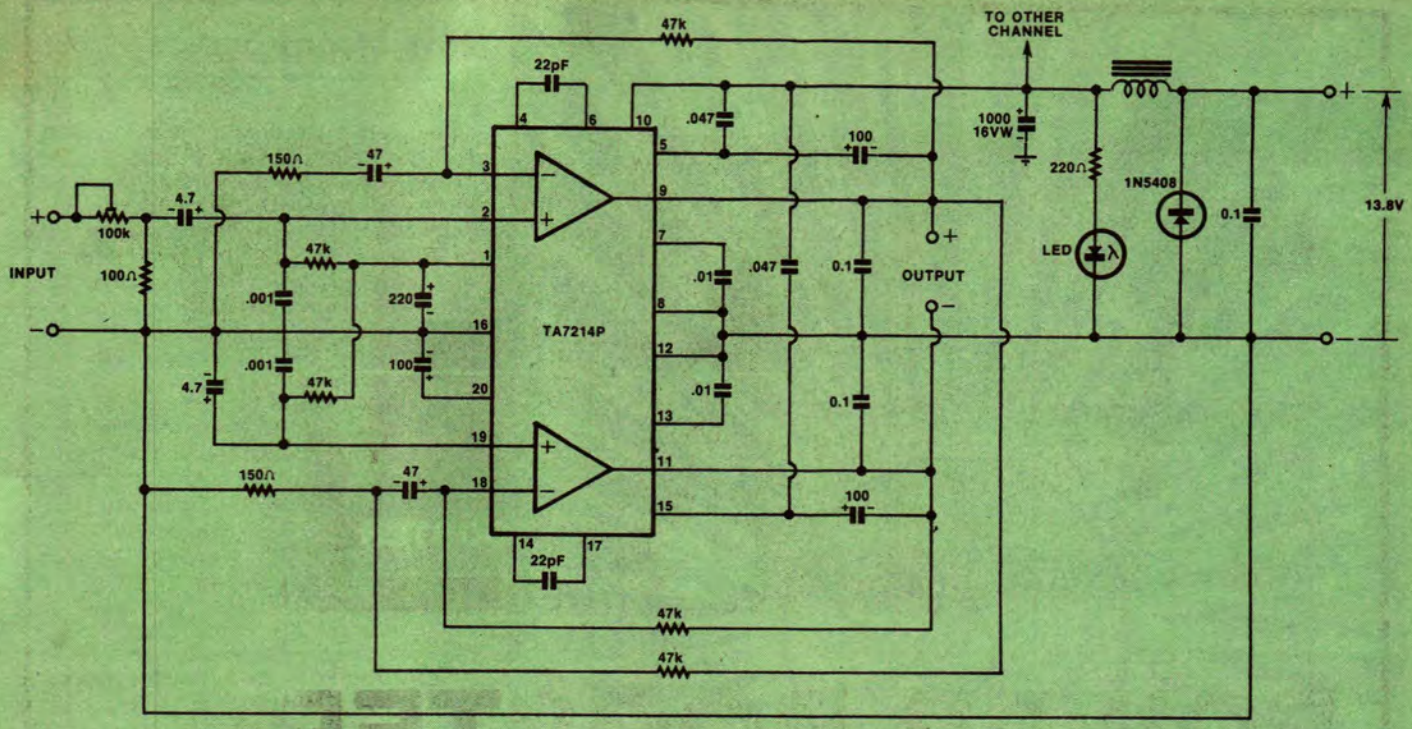
We have used two ICs, one per channel, with each one configured as a bridge amplifier. The load (in this case a loudspeaker), is connected between the two amplifier outputs, and the inputs are driven in antiphase. Since the two amplifiers are integrated onto the one chip, the DC offset between the two output is quite small, thus avoiding the need for an output coupling capacitor.

The advantage of this scheme is that the effective peak-to-peak voltage across the loudspeaker is now nominally twice the DC input voltage, and hence the nominal output power is four times that of a single class B amplifier. Of course, the actual output power is somewhat less than this, due to the inherent losses in the output stages.

In practice, with a 13.8V DC input voltage, we obtained an output power into a 4 ohm resistive load of 12W. At an output power of 10W, the distortion is typically less than 1%, while at a 1W output, distortion is typically less than 0.1%.

The distortion is primarily cross-over distortion, with a small element of 2nd harmonic distortion caused by a slight gain mismatch between the two halves of the bridge. The frequency response extends from 50Hz to 100kHz, measured at the —3dB points.

Signal-to-noise ratio (with respect to 10W into 4 ohms), is —78dB, while separation between the two stereo channels is better than —51dB. Maximum sensitivity is 26mV, and the quies-



25W STEREO BOOSTER
(ONE CHANNEL ONLY)

1/SA/-

cent current drain is only 70mA. Current drain at full power is 3 amps.

The unit is only suitable for use with cars having the negative side of the battery connected to the chassis, and requires the speakers to be fully isolated from the chassis. The negative input leads of the booster are connected to the chassis.

As you can see from the photographs the unit is mounted in a plastic Zippy box, with the aluminium lid replaced by a more substantial aluminium heatsink which also doubles as a mounting bracket. The unit is intended to mount on the underside of the dashboard.

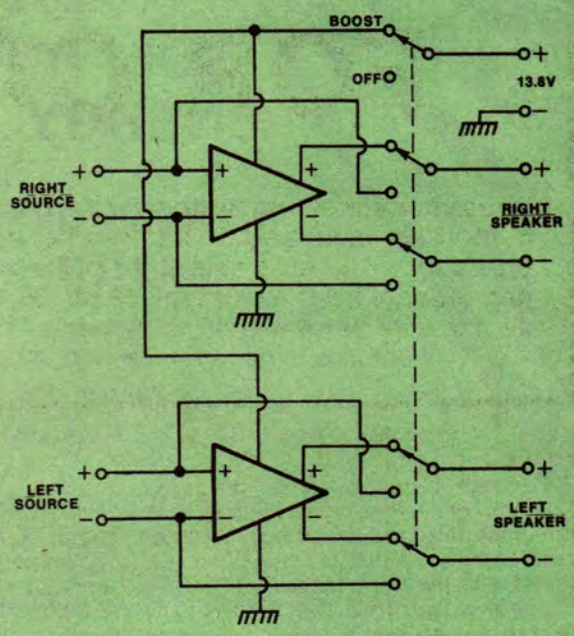
All of the circuitry is contained on a single printed circuit board, coded 78sb12 and measuring 122 x 80mm. The power ICs are mounted on the copper side of the board, so that they can be clamped directly to the heatsink. The machine screws used to do this also form the board mounts.

The interconnections to and from the unit are made with hookup wire, passing through grommetted holes in the rear of the case. An inline fuse is provided in the positive supply line. This provides protection against excessive currents, and also against supply reversals.

This latter facility depends on the reverse connected diode installed across the supply line at the PCB. If the supply polarity is reversed, the surge of current passing through this diode blows the fuse, preventing damage to both the diode and the remainder of the circuit.

The only control for the booster is a two position rotary switch. This serves as both a power switch and as a speaker switch. In the off position, the booster is unenergised, and the outputs from the signal source are connected directly through to the speakers.

The circuit diagram above is for one channel of the amplifier only, and shows only the circuitry contained on the printed board.



The schematic diagram on the right shows how the amplifiers are connected to the source stereo by the OFF/BOOST switch.

In the on or "boost" position, the booster amplifier is energised, and the outputs from the signal source are connected to its inputs. The booster outputs are now connected to the speaker leads.

All of the parts for the booster should be readily available. The TA7214P ICs and the power choke are imported by Dick Smith Electronics, and should be available through the usual sources. The heatsink is fabricated from 1.2mm (18SWG) aluminium. A dimensioned drawing is included elsewhere in this article.

The front panel of the prototype was made from self-adhesive photosensitive aluminium. A full sized reproduction of the artwork used is included with this article. In due course, commercial panels should become available from the usual sources.

Construction of the unit should be relatively easy, even for inexperienced constructors. Commence by fitting all the hardware to the case, including the LED indicator and the grommets. Check that the PCB mounting holes

align with those in the heatsink, and that the holes are free of burrs.

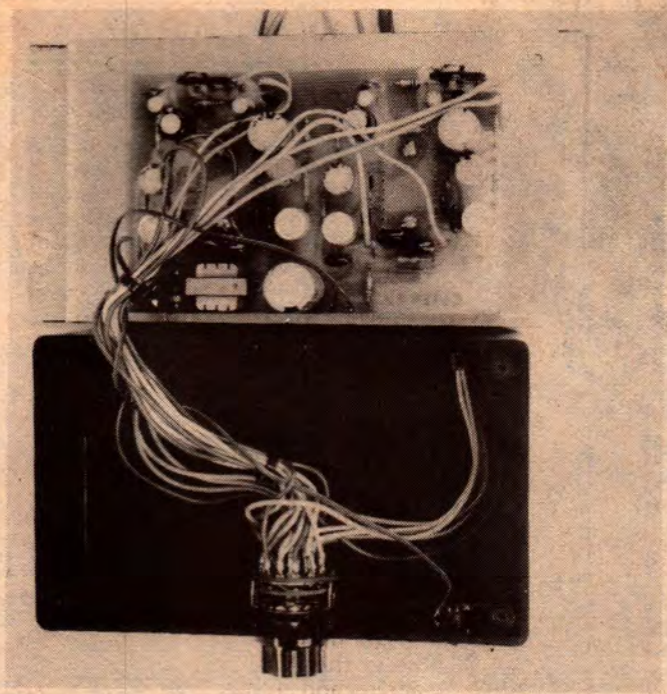
Now fit all the components to the PCB, apart from the ICs. Check carefully that all the electrolytic capacitors are orientated correctly, and that all joints are soldered correctly. Pay particular attention to the soldering of the mounting lugs of the choke, as these form part of the circuit. Set the volume presets to their mid points.

We recommend the use of PCB pins for all external connections to the board, as these make the final wiring of the board much easier. The final stage of the PCB assembly is to fit the ICs. These mount on the copper side of the board, and must be orientated correctly.

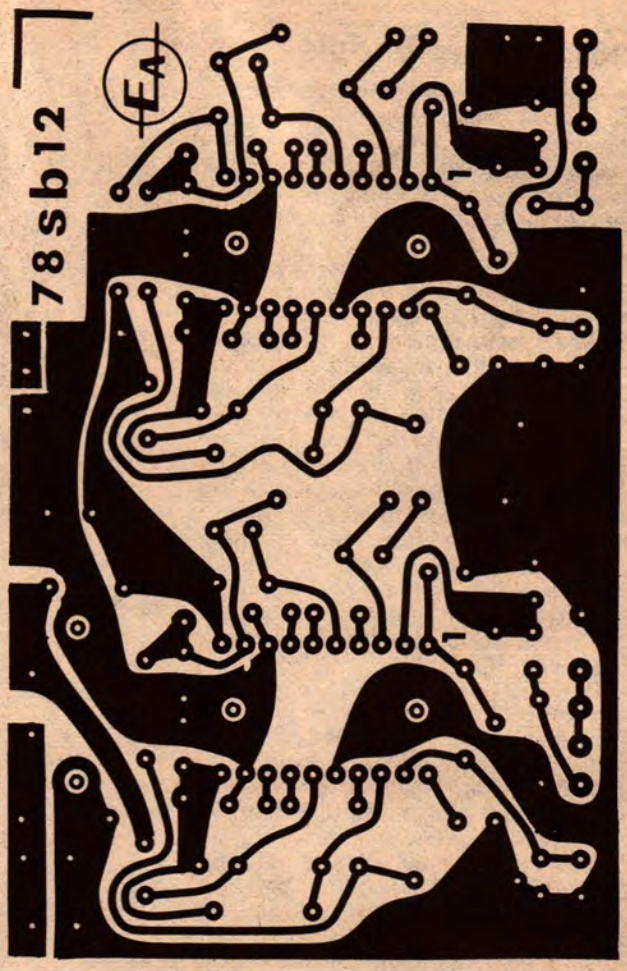
There is a small identifying mark at one end of the IC, signifying pin 1. This must be matched with the appropriate hole in the PCB. Refer to the overlay diagram, and also the PCB pattern itself, which has pin 1 marked.

PARTS LIST

2 TA7214P audio power ICs
1 3A silicon diode, 1N5408 or similar
1 power choke (see text)
1 red or green LEd and mounting clip
1 aluminium heatsink (see text)
1 Zippy box, 150 x 90 x 50mm
1 2 position 6 pole rotary switch and knob to suit
1 printed circuit board, 78sb 12, 122 x 80mm
1 front panel (see text)
2 rubber grommets
4 machine screws and nuts
1 5A fuse and inline holder
Solder, hookup wire, cable clamps, tinned copper wire
RESISTORS (all ¼W)
2 100 ohm, 4 150 ohm, 1 220 ohm, 10 47k
2 100k 5mm lead spacing trimpots
CAPACITORS
1 1000uF 16VW radial lead electrolytic
2 220uF 16VW radial lead electrolytics
6 100uF 16VW radial lead electrolytics
4 47uF 16VW radial lead electrolytics
4 4.7uF 16VW radial lead electrolytics
4 0.1uF polyester
4 0.047uF polyester
4 0.01uF polyester
4 0.001uF polyester
4 22pF ceramic
NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used provided they are physically compatible.



The photo above shows how the PCB and heatsink assembly is wired into the case. The PCB pattern is reproduced actual size at the right.



Use a minimum of solder for the joints to the PCB, and check carefully when you have soldered all 20 pins that there are no solder bridges. Any such bridges are best removed with the aid of some desoldering braid.

Now mount the PCB assembly to the heatsink, using a small amount of thermal grease to improve the heat transfer characteristics. All that remains now is to complete the internal wiring between the switch and the board.

Use the wiring diagram as a guide, and complete the wiring with multi-coloured hookup wire. We found it advantageous to code the individual wires using paper labels, as not enough colours were available to individually distinguish each wire.

Once the unit is completed, all that remains is to fit and wire it to the car. Start by determining the mounting location, which should be under the dashboard in some convenient place. Try to mount the unit away from either the driver's or the passenger's knees.

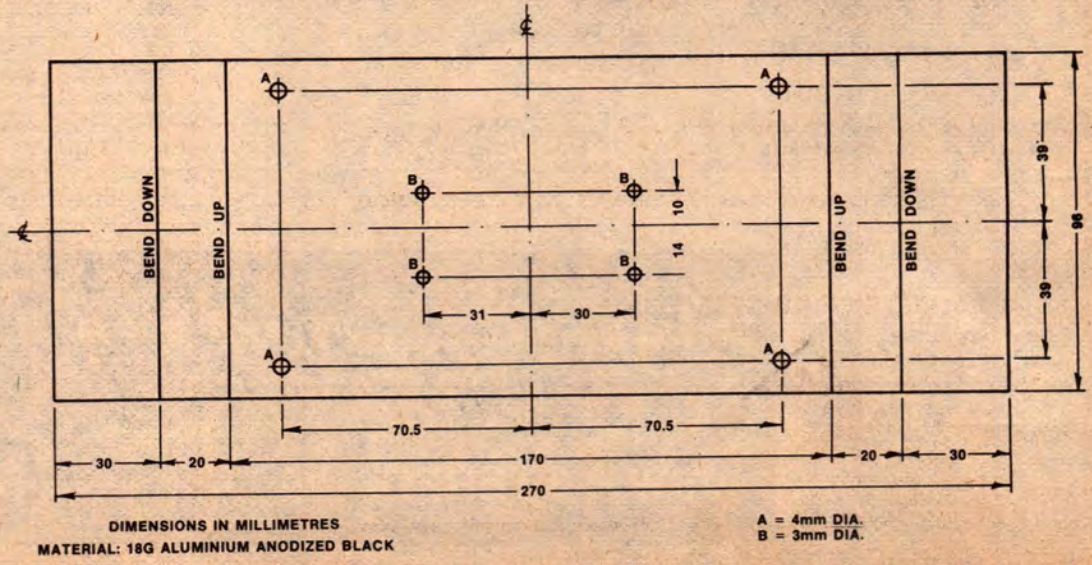
There may be existing screws in the dashboard which can be utilized, or it may be necessary to use additional self-tapping screws. In either case, mark and drill the heatsink first.

Now locate and identify the power wires to the signal source unit. One of these wires will be connected to the car chassis, and this wire must be connected to the negative supply line of the booster. The positive supply line of the booster must connect to the positive supply line of the source unit.

These connections can be made with either the new Scotchlok connectors, or by soldering. In the latter case, the joints must be well insulated. (Scotchlok connectors involve no stripping, soldering and insulating, and are available from auto electricians and also from DSE — cat. no. H-6720).

Now locate the wiring to the left speaker. There should be two wires. Cut these, and join the speaker ends to

Use this drawing of the heatsink as a guide if you are constructing your own heatsink. The outside of the heatsink can be painted black to improve it's thermal efficiency.



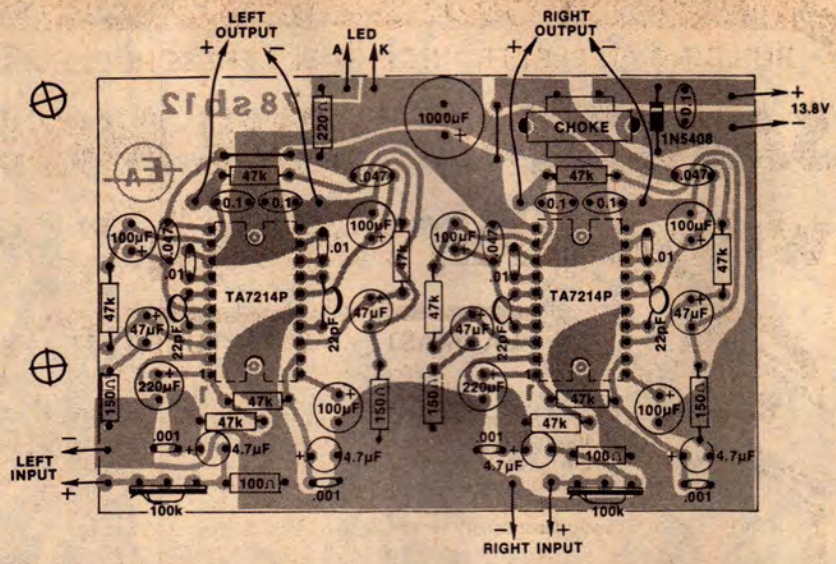
the left booster output. Check before you do, however, that both wires are insulated from the vehicle chassis. If they are not, you will have to rewire the speaker so that they are.

Now locate the wire leading back to the source unit which is connected to the vehicle chassis. Connect this wire to the left negative input of the booster, and connect the remaining wire to the left positive input of the booster. Insulate all connections thoroughly.

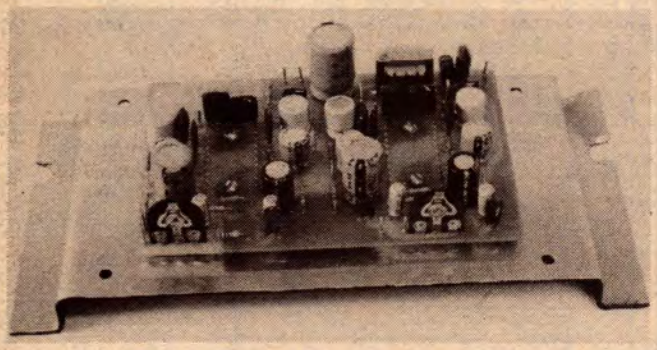
The right speaker connections are treated in an identical manner to the left speaker connections. Once all the wiring has been completed, go over it and double check for mistakes. Then, leaving the booster switch in the off position, switch on the program source, and check that it operates correctly. At any sign of trouble, switch off and trace and rectify the fault.

With the program source volume control set at minimum, switch on the booster. There will probably be a thump from the speakers, and then silence. Now advance the volume control, and check that sound is coming from both speakers.

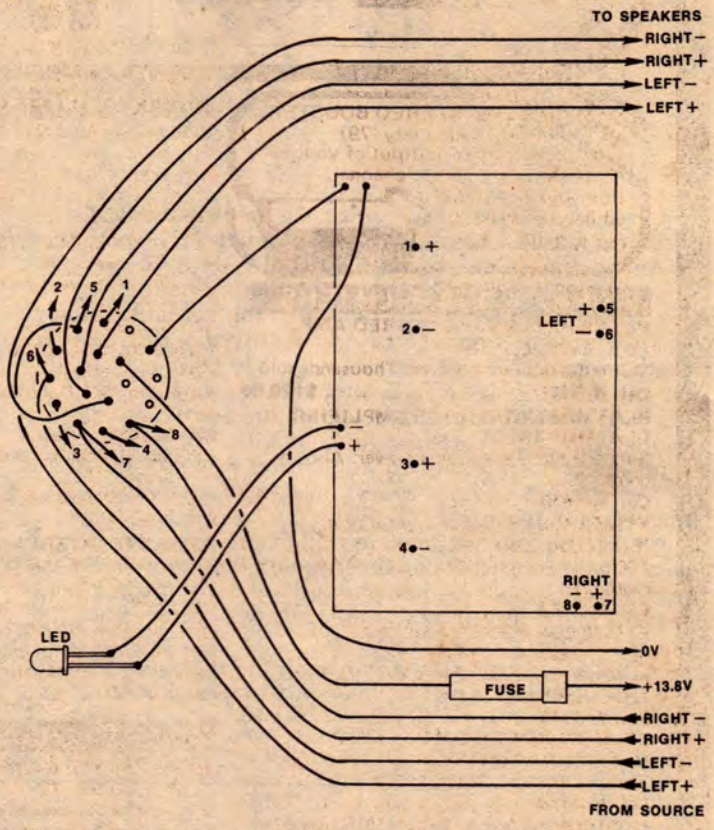
Switch the booster off, and note the change in sound intensity. With the booster on, the sound should be significantly louder. If it is not, adjust the two presets to suit. Do not adjust for too great an increase in intensity, as this will only make the operation of the source volume control rather fierce. It will not increase the available power level.



Use the overlay diagram above as a guide when assembling the components onto the PCB. Note that the power ICs are mounted on the copper side of the board.



The photograph above shows how the PCB assembly is mounted on the heatsink. Use thermal grease to improve the heat transfer rate.



Shown above is the wiring diagram. Connections to the stereo source and the speaker wiring are made with connectors as described in the text.

The front panel artwork is reproduced at the right. It is actual size, and may be used directly if desired.