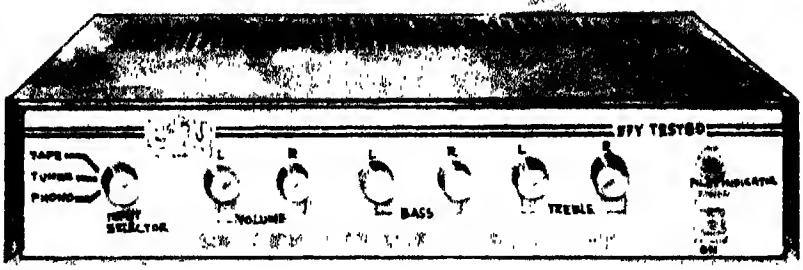
120W+120W Stereo Amplifier

C. Sanjay



A 120W stereo power amplifier is not so loud when the area which the amplifier must 'cover' is large, though its rating leads one to imagine the contrary. This amplifier is particularly suited to those who conduct music concerts. It is also suitable for use in auditoria. But if you already have something like a 70W + 70W amplifier, there isn't any meaning in making this amplifier. After all, there is hardly any difference between a 70W amplifier and a 120W amplifier as regards power; less than 3dB difference is barely audible. But then, it all depends on where you use it and how you use it.

This amplifier delivers an output of 120W RMS into a 4-ohm speaker. Those who wish to connect more than one speaker can do so by connecting two 8-ohm, 60W speakers or four 16-ohm, 30W speakers in parallel.

The circuit

Transistors T1 and T2 form a differential pair and T9 forms their constant current source. The input stage is not a purely differential stage as can be seen. Transistors T3 and T4, along with T1 and T2, form a sort of cascode-differential pair. The currents at the collectors of T3 and T4 are always constant, except when the signal is present. The cascode arrangement makes it possible to use low voltage transistors at the input. This is very necessary since high voltage transistors are often short of gain. Transistor T5 acts as an emitter-follower for the collector load of T3. This transistor operates at a collector-to-emitter voltage of 5V. T6 is the class-A driver and T8 provides the constant current source. T7 acts as the V_{BE} multiplier and also compensates for temperature changes. The output stage is made of three transistors on each side. Diodes D5 and D6 help to maintain the symmetry.

R31, C10 and C11 form the usual zobel network, to suppress spurious oscillations at the output.

The 1-ohm, 1-watt resistor (R32) and inductor L1 at the output are necessary only if any capacitive loads are likely to be used. The fuse protects the speaker from any damage due to DC appearing at the output in the event of a failure in the circuit.

SPECIFICATIONS CHART

Output power (THD=0.1 per cent)	: 120W into 4-ohms load
Input sensitivity (for 120 W)	: 820 mV to 1V
Signal-to-noise ratio (at Po=100W)	: ≥70 dB
Current consumption (DC)	: 1.5A/channel
Distortion at 200 mW output	: ≤0.1%

The protection circuit, given in Fig. 5, is not compulsory and can be done away with, if you don't need it. Even when the output goes to Vcc—the saturation voltage of T12 (or Vcc, i.e. the saturation voltage of T15), the power dissipation in the output transistor amounts to a mere 40W at the maximum. The output transistors can withstand 150W (max.). The maximum power dissipation in the transistors occurs when the output is halfway between 0V and Vcc (or -Vcc). In this case, it occurs at 20V, or at 100W. The

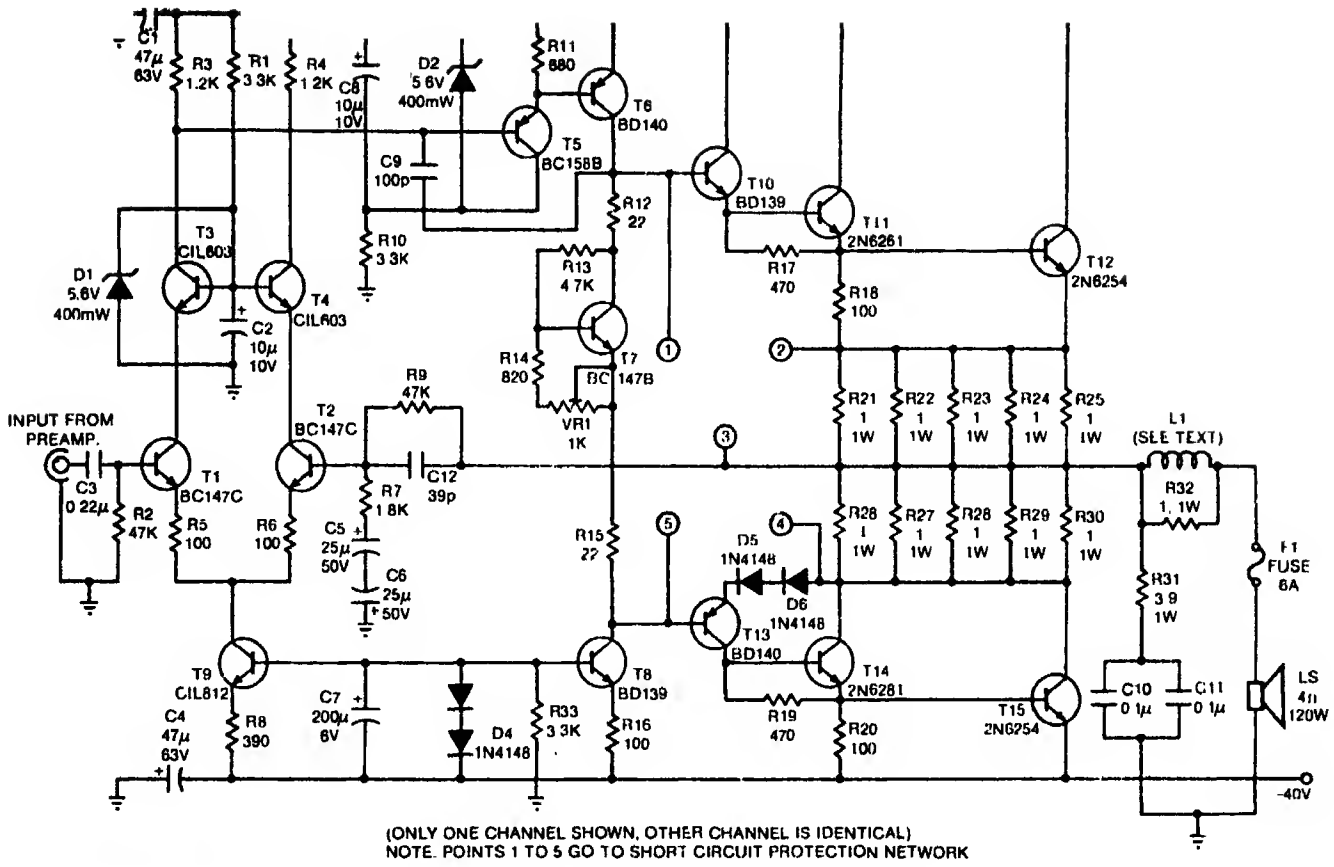


Fig. 1: Circuit diagram for 120W + 120W stereo amplifier.

PARTS LIST

Semiconductors:

T1, T2	BC147C npn AF transistor
T3, T4	CIL603 npn AF transistor
T5	BC158B pnp AF transistor
T6, T13	BD140 pnp low-power transistor
T7, T16	BC147B npn AF transistor
T8, T10	BD139 npn low-power transistor
T9	CIL612 npn transistor
T11, T14	2N6261 npn driver transistor
T12, T15	2N6254 npn power transistor
T17	BC157 pnp transistor
D1, D2	5.6V, 400mW zener diode
D3-D6	1N4148 silicon switching diode
D7-D10	2SM15, 15-amp rectifier diode

Resistors (all ¼ watt, ±5% carbon, unless stated otherwise):

R1, R10, R33	3.3-kilohm, ½ watt carbon
R2, R9	47-kilohm
R3, R4	1.2-kilohm
R5, R6, R16, R18, R20	100-ohm
R7	1.8-kilohm
R11	680-ohm
R8	390-ohm
R12, R15	22-ohm
R13	4.7-kilohm
R14	820-ohm
R17, R19	470-ohm
R21-R30, R32	1-ohm, 1W carbon
R31	3.9-ohm, 1W carbon
R34, R37	2-kilohm
R35, R36	1-kilohm

Capacitors:

C1, C4	47µF, 63V electrolytic
C2, C8	10µF, 10V electrolytic
C3	0.22µF, 100V ceramic
C5, C6	25µF, 50V electrolytic
C7	200µF, 6V electrolytic
C9	100pF styroflex
C10, C11	0.1µF, 100V ceramic disc
C12	39pF styroflex
C13, C14	0.01µF, ceramic disc
C15, C16	10000µF, 100V electrolytic

Miscellaneous:

LS	Loudspeaker (see text)
L1	See text
X1	33V-0-33V, 10-amp secondary transformer
S1	SPDT switch
F1	6-amp fuse with holder
F2	1-amp fuse with holder
	PCB, heatsink, coaxial cable, capacitor clamps, hardware, BNC plug/socket, enclosure, mains lead etc.

dissipation in the output transistor is then 100W. The transistor can,of course, withstand this.

The use of an output coupling capacitor is eliminated by using a symmetrical power supply. To connect this amplifier to a crossover network, be sure that the capacitors in it are non-polarised.

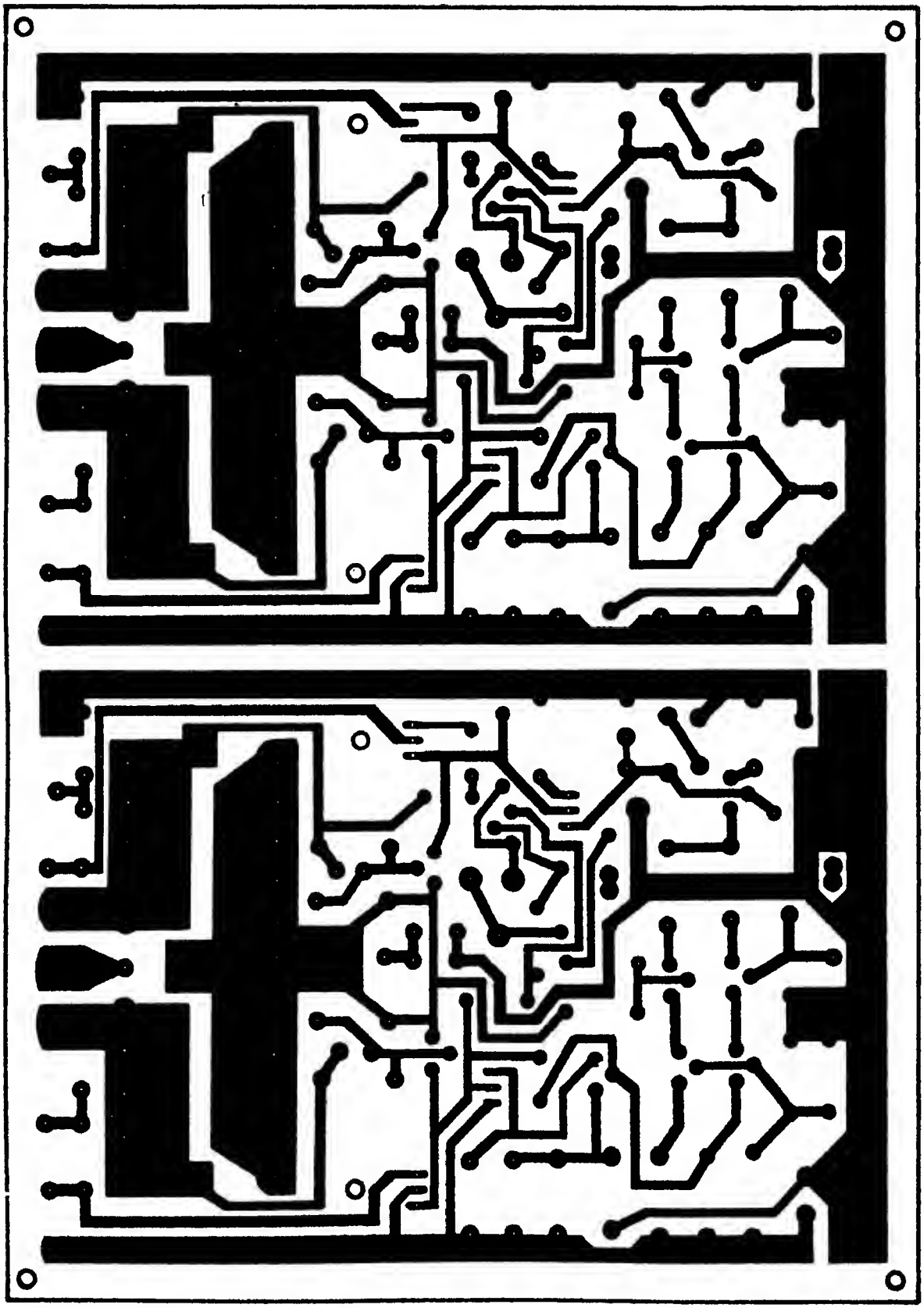


Fig. 2: PCB layout for 120W + 120W stereo amplifier.

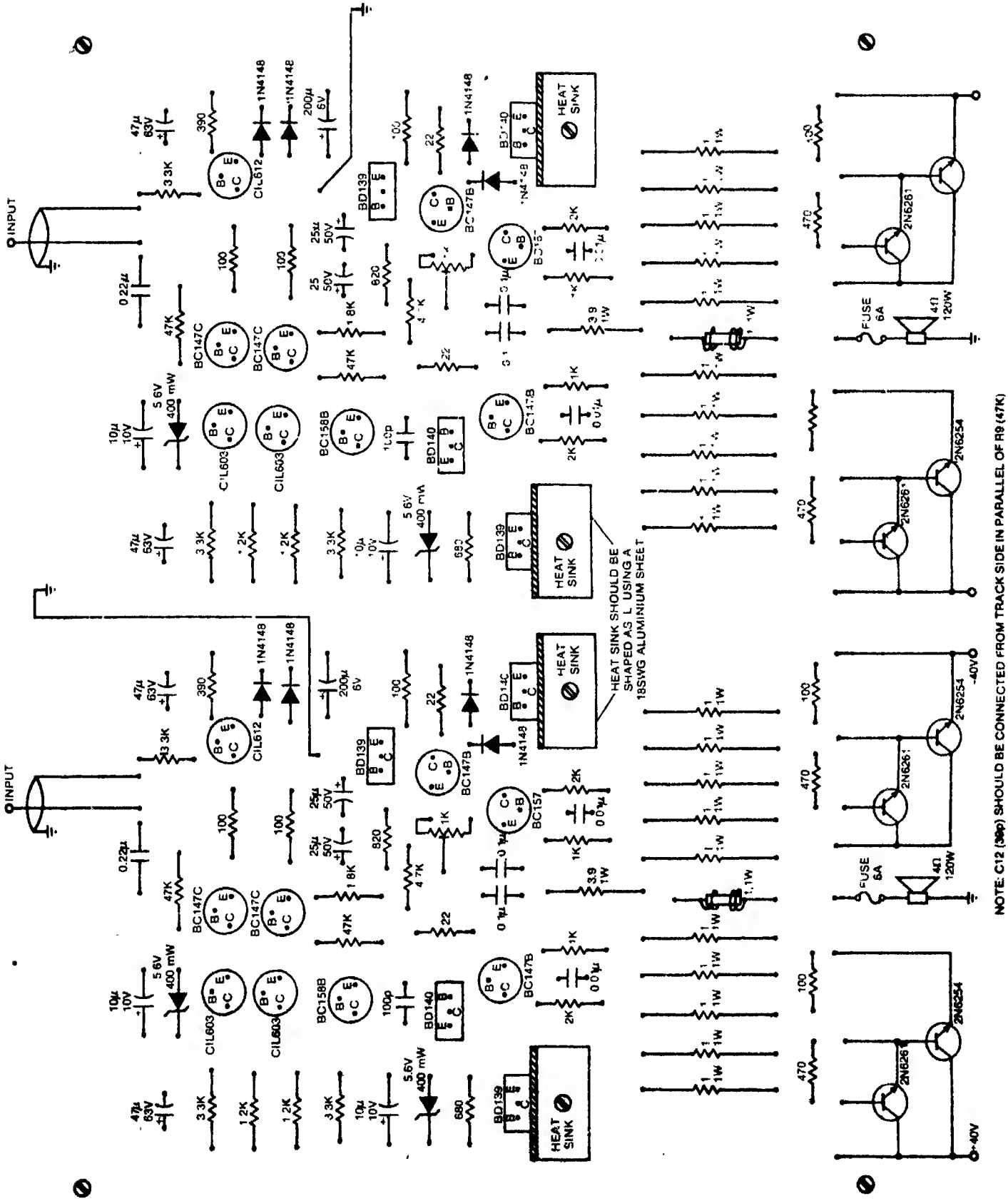


Fig. 3: Components layout for 120W + 120W stereo amplifier.

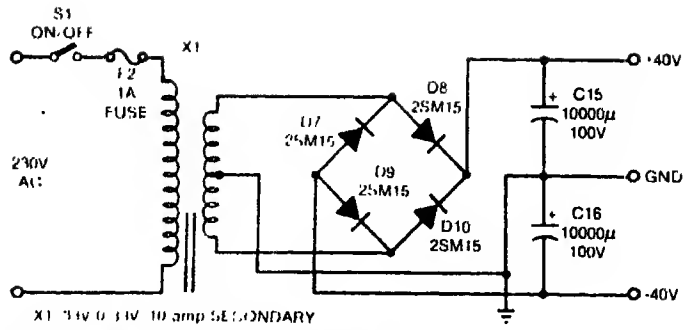


Fig. 4: Suggested power supply for the circuit.

Details of the Power Supply Components

Components	Mono	Stereo
Fuse (F2)	1A	2A
Capacitors C15 and C16	5000µF	10000µF
Diodes D7 to D10 Current(PIV > 200V)	6A	12A
Transformer		
Secondary Current	5A	10A
Core Size	Tongue Width 6.25 cm Stack height: 5 cm	Tongue Width 7.5 cm Stack height 7.5 cm
No. of turns in Primary SWG	460T 23 SWG	256T 20 SWG
No. of turns in Secondary/SWG	66T+66T 17 SWG	37T+37T 15 SWG

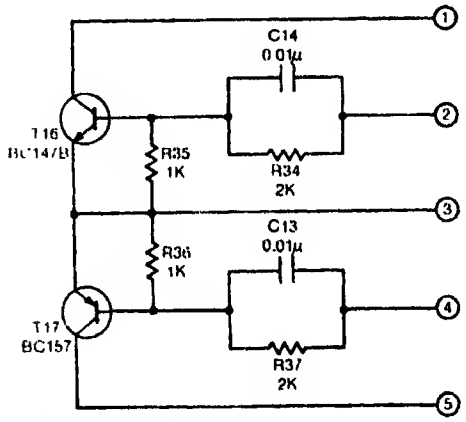


Fig. 5: Short circuit protection network.

Construction

The wiring should pose no problem if the PCB whose pattern is shown in Fig. 2 is used. When soldering components, solder all the resistors, except R21-R30, first. Then solder the capacitors and finally the transistors and the resistors R21-R30. There is no specific reason for this sequence. It is just that low-profile components should be mounted first. It will be easier to solder them in this sequence.

If soldering all the resistors R21 to R30 side by side poses any problem, first solder three resistors on each side and then solder the other two on top of them, on each side. Transistors T11 and T12 can be mounted on the same heatsink. The same goes for T14 and T15. The heatsinks must be of 1.2°C/W type. Use of silicon grease is advisable. The heatsinks for T6 and T8 are made by bending 1.2mm thick, 3cm × 2cm pieces of aluminium in 'L' shape. The longer arm of the 'L' should be screwed to the transistor and the shorter to the PCB. Only then should the transistors be soldered.

The fuse that is connected in series with the speaker can be fixed at the back panel of the amplifier. These fuses must be of quick blow type. All wiring must be made with 18SWG tinned wire or flexible wires that can carry currents up to 6A. Use separate power supply wires for each channel and separate speaker return leads.

Adjustments

After checking the wiring, turn VR1 clockwise fully or set to maximum resistance. Now connect a voltmeter, capable of reading millivolts, across the resistors R21-R25. Switch on the amplifier and adjust VR1 so that the meter shows 6 to 10 mV.

This is the only adjustment required. Connect a tape recorder or a tuner through a suitable preamplifier and tone control amplifier to enjoy the music.

Note: A suitable preamplifier designed and developed at EFY lab to go with this power amplifier will be published in the next issue to enable a complete hi-fi stereo amplifier system.

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