6-Band Low-Cost Graphic Equaliser

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Most EFY readers are familiar with graphic equalisers. A 10-band professional equaliser system was featured in this magazine a few years ago.

This low-cost 6-band graphic equaliser is meant for casual audio enthusiasts. With two ICs, the circuit seems quite simple but its operative quality levels are no less if not better than a professional one's. The complete system costs around Rs 100, nearly one-eighth the cost of a readymade graphic equaliser. The high operative quality of the equaliser is evident from the figures in its specifications table.

Earlier graphic equalisers used LC tuned coil/inductor circuits which were rather bulky. Such circuits were prone to noise pick-up. These circuits were originally based on transistors. Gradually transistors were replaced by ICs which worked with inductors. Then came op-amp simulated inductors which eliminated the need of any coil. It helped in constructing a more compact circuit (as in most commercial designs) around a dozen op-amps. Further improvements have facilitated the present design around just two ICs!

Using gyrators for LC simulation highly reduces cost and size of the device. As shown in the block schematic (Fig. 1), a gyrator consists of an op-amp with a rather unconventional feedback network. At resonance its impedance drops. With the control in mid position the gain is unity. When the gyrator control wiper is shifted towards the input, the output potential rises to maintain the input voltage balance and so the output is boosted. When it is moved towards the input, the output potential decreases and the output signal is attenuated.

Working

The circuit (Fig. 2) uses two quad op-amp LM324 ICs, which by far are the most common and least expensive op-amps of their type (and sell at Rs 10 a piece). Each IC has four independent op-amps, all of which are used in case of IC1. Only three op-amps are used from IC2. Each op-amp and the accompanying pair of two resistors and capacitors set the frequencies and simulate an inductor. The circuit can provide a boost of +15dB and attenuation of -15dB.

Capacitors C2 and C16 provide input and output coupling. Controls VR1 through VR6 work at 50Hz, 150Hz, 500Hz, 1500Hz, 5kHz and 15kHz. These frequencies can easily be altered by changing the accompanying capacitors. C15 provides supply decoupling. VR7 is used to adjust the final gain.

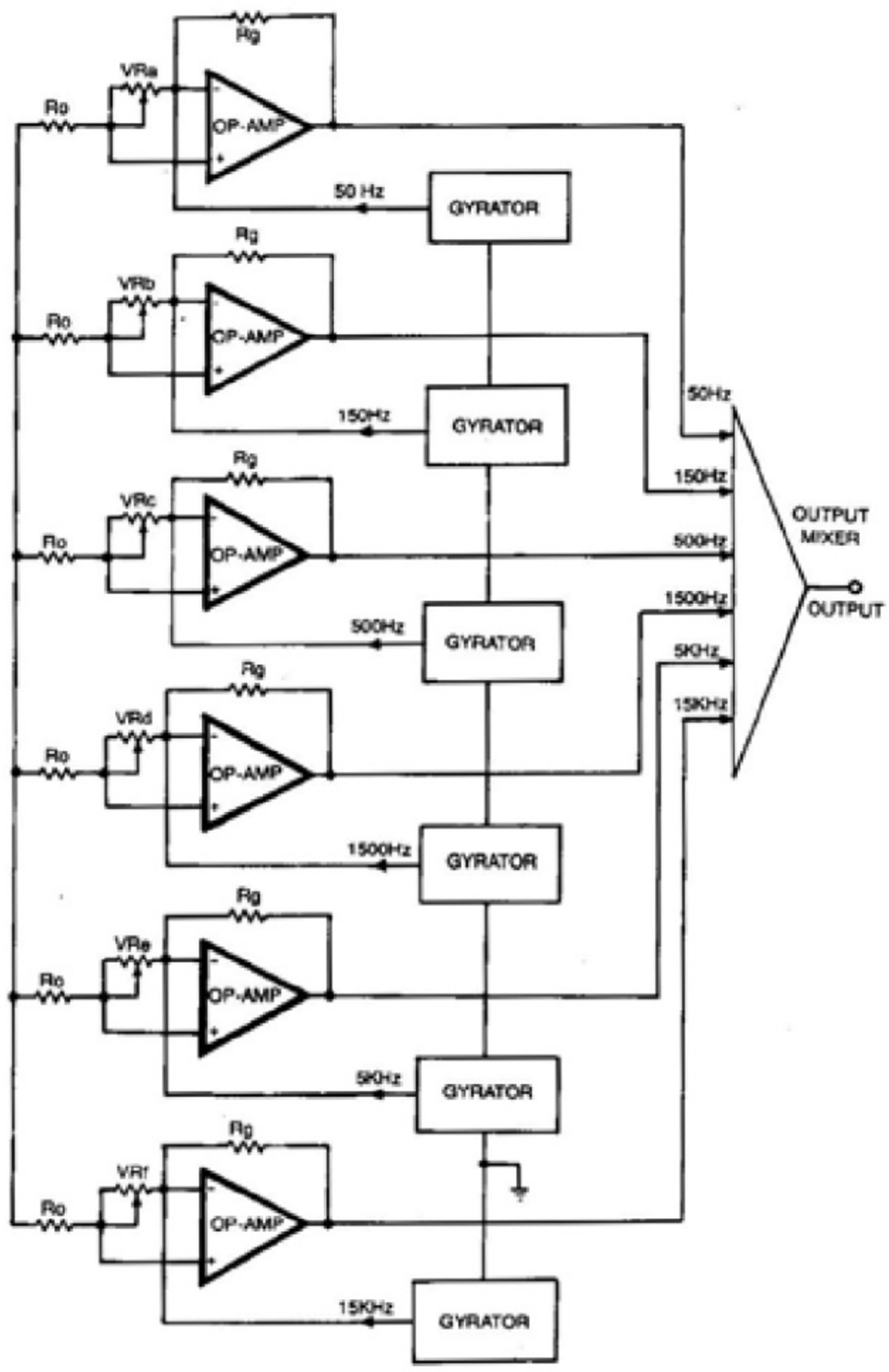

Fig. 1: Block diagram for the 6-band low-cost graphic equaliser.

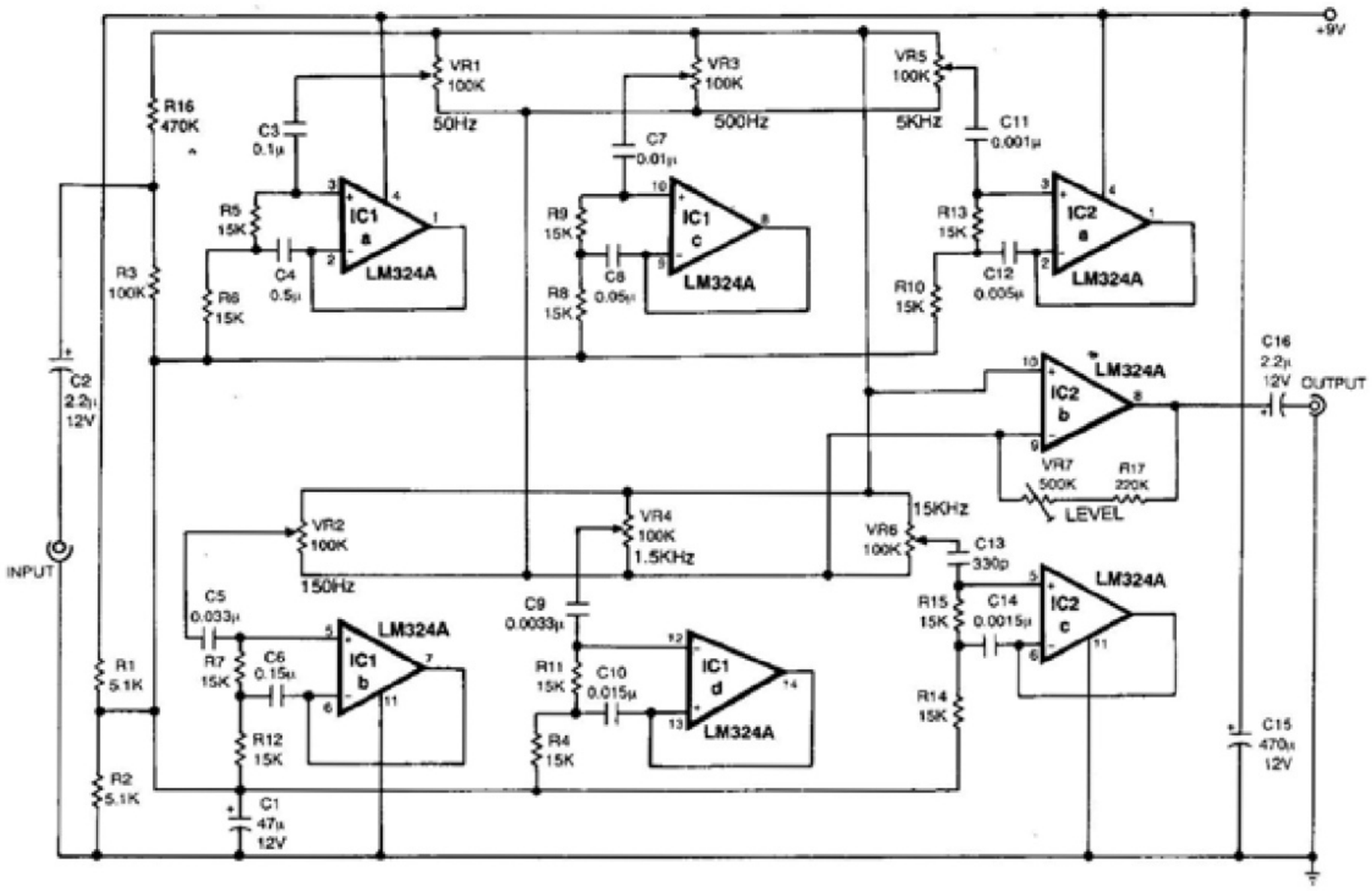

Fig. 2: Circuit diagram for the 6-band low-cost graphic equaliser.

PARTS LIST

Semiconductors:
IC1, IC2 — LM324A, quad op-amp

Resistors (all 1/4W, ±5% carbon, unless stated otherwise):
R1, R2 — 5.1-kilohm
R3 — 100-kilohm
R4-R15 — 15-kilohm
R16 — 470-kilohm
R17 — 220-kilohm
VR1-VR6 — 100-kilohm linear pot.
VR7 — 500-kilohm preset

Capacitors:
C1 — 47µF, 12V electrolytic
C2, C16 — 2.2µF, 12V electrolytic
C3 — 0.1µF ceramic
C4 — 0.5µF ceramic
C5 — 0.033µF ceramic
C6 — 0.15µF ceramic
C7 — 0.01µF ceramic
C8 — 0.05µF ceramic
C9 — 0.0033µF ceramic
C10 — 0.015µF ceramic
C11 — 0.001µF ceramic
C12 — 0.005µF ceramic
C13 — 330pF ceramic
C14 — 0.0015µF ceramic
C15 — 470µF, 12V electrolytic

In the prototype, VR7 was adjusted at mid position, where it gave excellent results. All the measurements were made at this position. A suitable power supply (substitute for batteries) for the circuit can also be used, which can be accommodated on the main PCB itself.

Construction

The complete circuit can be assembled on the PCB shown in Fig. 3. Begin by soldering the resistors followed by capacitors. IC sockets are not required, provided adequate care is taken while soldering to prevent the temperature from exceeding 300°C. Once the ICs are soldered, the potentiometers and other input and output sockets may be soldered. While ribbon cable is used for the former, shielded wire is a must for the latter.

Clean the PCB with protective spray or petrol. Varnish its copper side. To give a neat finish, use solder pins on the PCB. Keep all wires as short as possible. Note that the PCB is designed so as to keep all wiring on one side in proper order.

If the potentiometers are of sliding or plastic type then no chassis is needed.

Specifications Table For 6-Band Low-Cost Graphic Equaliser

Operative voltage	: 9 volts DC or 230V AC @50 Hz	
Nominal input	: 200 mV	
Output (Peak to Peak)	= 4 volts	
Control ranges	: 50 Hz, 150Hz, 500 Hz, 1500 Hz, 5 KHz, 15 KHz	
Frequency response (typical)		
At	30 Hz	: +2 dB
	40 Hz	: + 4 dB
	100 Hz	: + 11 dB
	150 Hz	: + 16 dB
	300 Hz	: + 6 dB
	1 kHz	: + 2 dB
	2 kHz	: 0 dB
	4 kHz	: -12 dB
	5 kHz	: -15 dB
	10 kHz	: -5 dB
	15 kHz	: -4 dB

Note: These readings were taken in author's prototype using a Meco DMM with 1-megohm impedance and on a Hewlett Packard digital storage oscilloscope.

A wide variety of commercially available cabinets can be adapted for this purpose. The choice of sliding or rotary controls is left to the reader. The input and output sockets are mounted on the back panel. The PCB may be mounted using 6mm spacers. A suitable cabinet for the stereo version of the circuit is available @ Rs 75 a piece from Gala

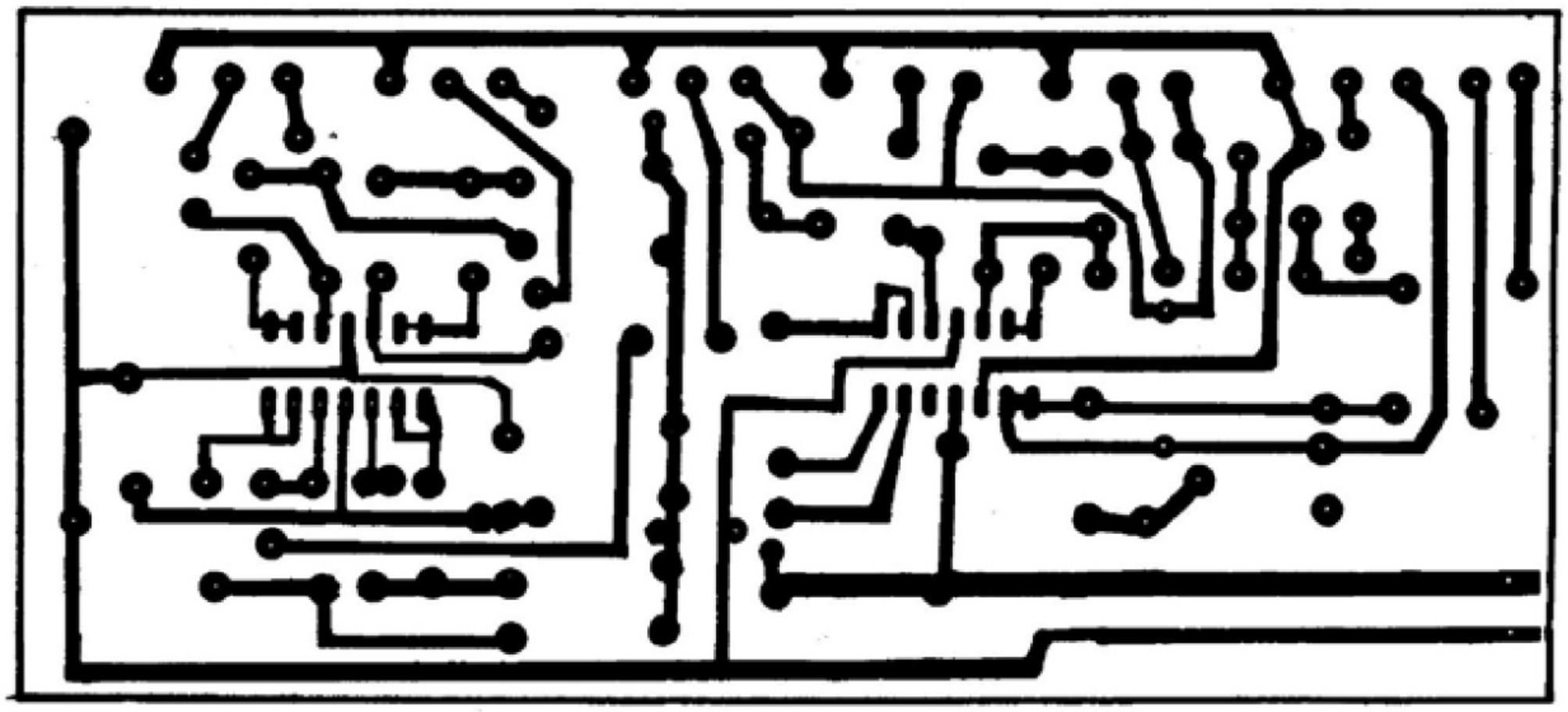

Fig. 3: PCB layout for the 6-band low-cost graphic equaliser.

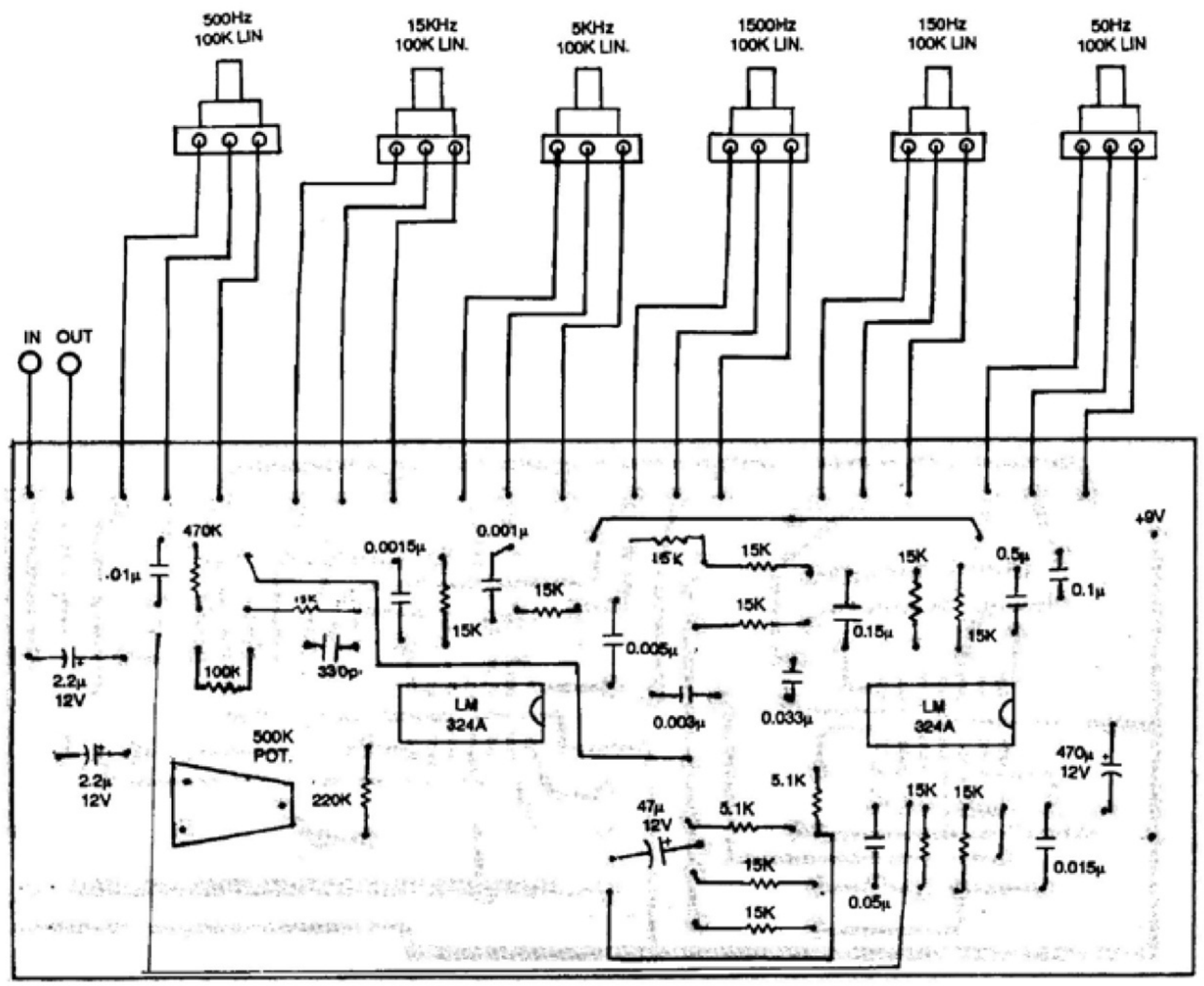

Fig. 4: Component layout for the PCB shown in Fig. 3.

Electronics, Bombay.

The equaliser has to be connected between a preamplifier having an output between 220mV and 3.8 volts and an amplifier. The system has a remarkably excellent signal-to-noise ratio. □