S. Das Gupta

Stereo Control Cum Preamplifier For 120W+120W Amplifier

As promised last month, here is a preamplifier project to go with the 120W+120W amplifier project published in May issue. This preamplifier can in fact be used equally well with almost any other audio amplifier, including the 25W+25W amplifier project published in June 1984 issue of this magazine.

The quality of sound we get from a stereo system or an audio amplifier depends very much on the quality of preamplifier and tone control systems incorporated in their amplifier stages.

The most common sources of programmes for a general listener are the tape deck, radio tuner or a record player with magnetic or crystal (ceramic) pick-up. Sometimes microphones are used with a high power system for public address applications.

Tape decks are now becoming quite popular due to availability of low-cost stereo prerecorded cassettes. These decks are designed to feed low-level audio signals to a high quality

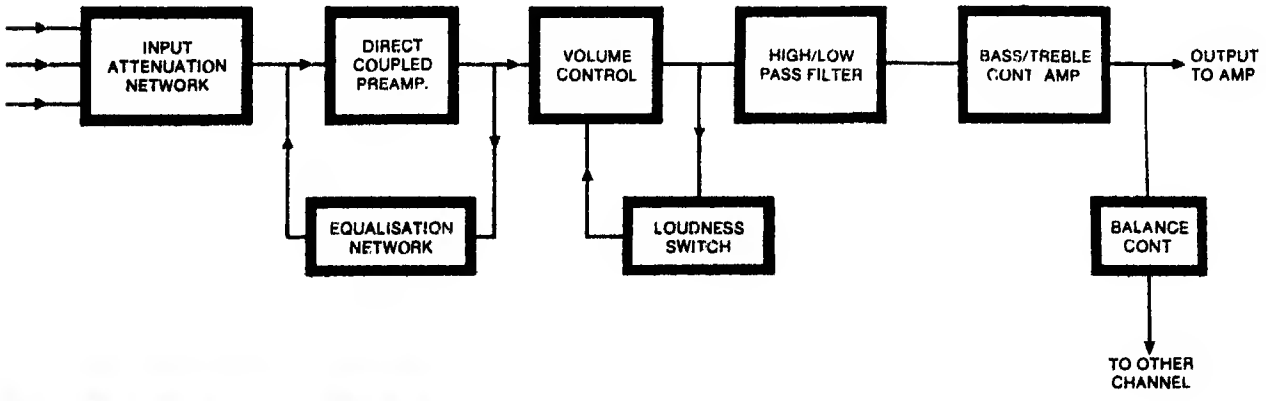


Fig. 1: Block diagram for the preamplifier.

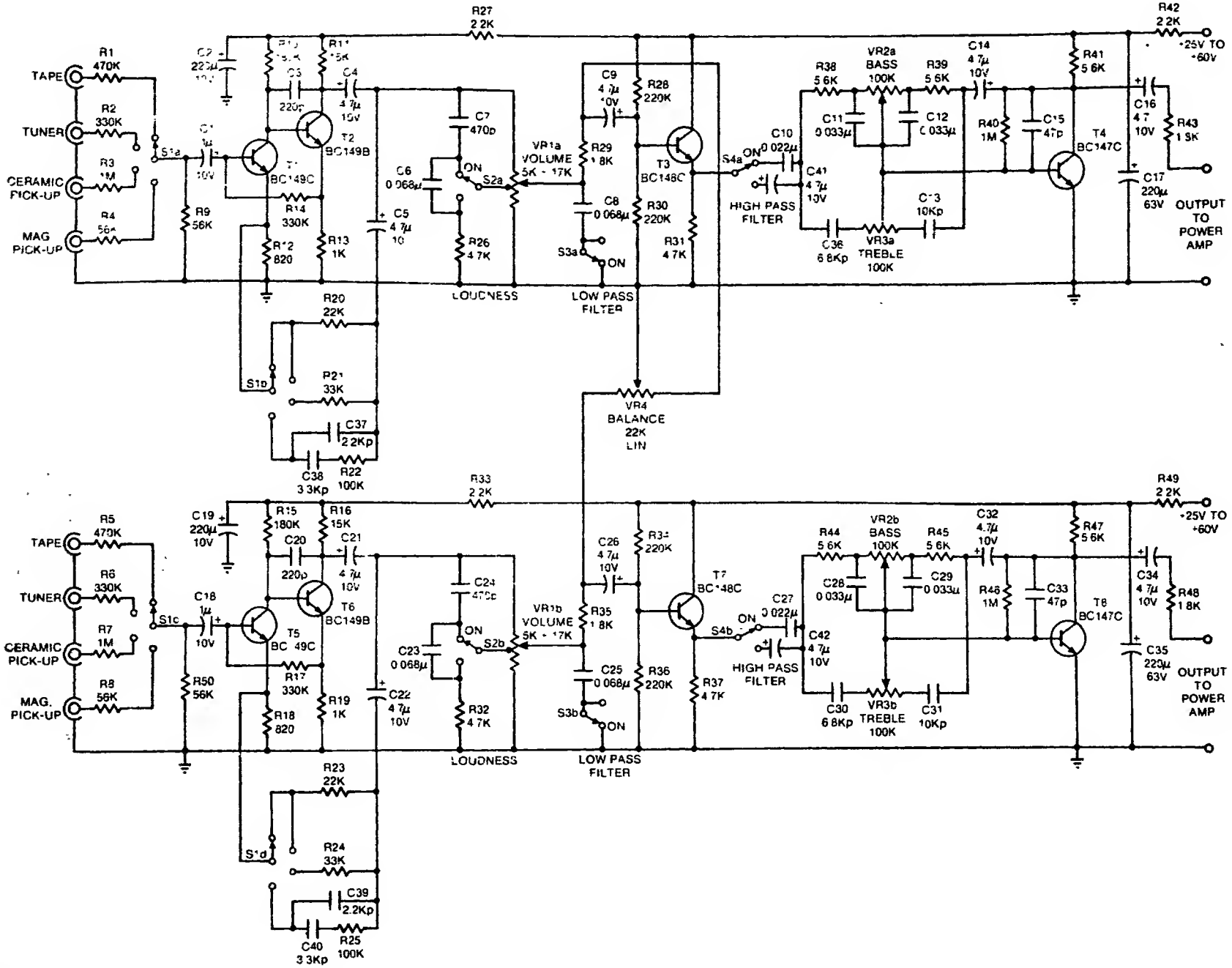


Fig. 2: Circuit diagram for the preamplifier, both channels are shown.

PARTS LIST

Semiconductors:

T1, T5	— BC149C low-noise npn transistor
T2, T6	— BC149B low-noise npn transistor
T3, T7	— BC148C npn AF transistor
T4, T8	— BC147C high-gain npn transistor

Resistors [all 1/4-watt, 5% carbon]:

R1, R5	— 470-kilohm
R2, R6, R14, R17	— 330-kilohm
R3, R7, R40, R46	— 1-megohm
R4, R8, R9, R50	— 56-kilohm
R10, R15	— 180-kilohm
R11, R16	— 15-kilohm
R12, R18	— 820-ohm
R13, R19	— 1-kilohm
R20, R23	— 22 kilohm
R21, R24	— 33-kilohm
R22, R25	— 100-kilohm
R26, R31, R32, R37	— 4.7-kilohm
R27, R33, R42, R49	— 2.2-kilohm
R28, R30, R34, R36	— 220-kilohm
R38, R39, R41, R44, R45, R47	— 5.6-kilohm
R29, R35, R43, R48	— 1.8-kilohm
VR1	— 5k+17k log dual potentiometer
VR2, VR3	— 100k lin. dual potentiometer
VR4	— 22k lin. potentiometer

Capacitors:

C1, C18	— 1μF, 10V electrolytic
C2, C19	— 220μF, 10V electrolytic
C3, C20	— 220pF styroflex
C4, C5, C9, C11, C16, C21, C22, C26, C32, C34, C41, C42	— 4.7μF, 10V electrolytic
C7, C24	— 470pF ceramic disc
C6, C8, C23, C25	— 0.068μF polyester
C10, C27	— 0.022μF polyester
C11, C12, C28, C29	— 0.033μF polyester
C13, C31	— 10kpF polyester
C15, C33	— 47pF ceramic disc
C17, C35	— 220μF, 63V electrolytic
C30, C36	— 6.8kpF styroflex
C37, C39	— 2.2kpF ceramic disc
C38, C40	— 3.3kpF ceramic disc

Miscellaneous:

S1	— 4-pole, 4-way switch
S2, S3, S4	— DPDT switch
	— RCA sockets, PCB, shielded wire, enclosure, knobs, lugs and fittings etc.

preamplifier or control amplifier to boost and process the basic signal for further amplification. Tape deck and radio tuner outputs vary from 200 mV to 500 mV p-p (peak-to-peak).

Disc players available in India have either crystal pick-ups or magnetic pick-ups. Crystal pick-up record players can be connected directly to a preamplifier without 'equalising'. But they require a very high impedance (about 1-megohm) preamplifiers. Otherwise there is considerable loss of low frequency components (bass).

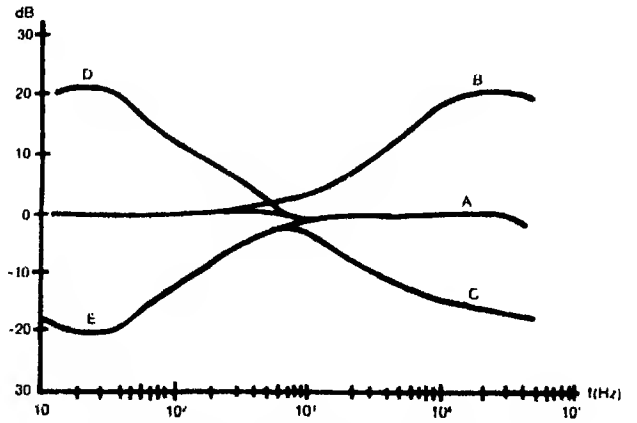
Crystal pick-ups generally produce 1V p-p output signal. But the preamplifier in this case is required to accept a signal level of about 300 mV with an input impedance of 1-megohm. Besides, an extra precaution has to be taken to prevent damage of input transistor if and when the pick-up cartridge slips while playing a record which generates a voltage of the order of 100V p-p.

Magnetic pick-ups are however more suitable for a true high fidelity than a crystal pick-up, give a much lower output signal (approx. 3 mV), require a high gain and well equalised preamplifier for a proper amplification of the low signal voltage. This leads to some complications in the designing of the preamplifier, and precautions have to be taken to prevent feedback and instability in frequency response.

The circuit

A suitable multipurpose preamplifier cum control amplifier is therefore offered here. It is designed specifically for operation with the 120-watt power amplifier circuit published in May 1986 issue of EFY as well as with the 25-watt power amplifier project published in July 1984 issue. It is nonetheless suitable for use with almost any power amplifier as it is capable of delivering 500 mV to 1V p-p at 1-kilohm output impedance.

The circuit has provision for almost all types of input sources, viz, tape deck, radio tuner, crystal pick-up and



CURVE A - BASS AND TREBLE CONTROL IN MID POSITION
CURVE B - MAXIMUM TREBLE, BASS FLAT
CURVE C - MINIMUM TREBLE, BASS FLAT
CURVE D - MAXIMUM BASS, TREBLE FLAT
CURVE E - MINIMUM BASS, TREBLE FLAT

Fig. 3: Frequency response characteristics of the tone control circuit.

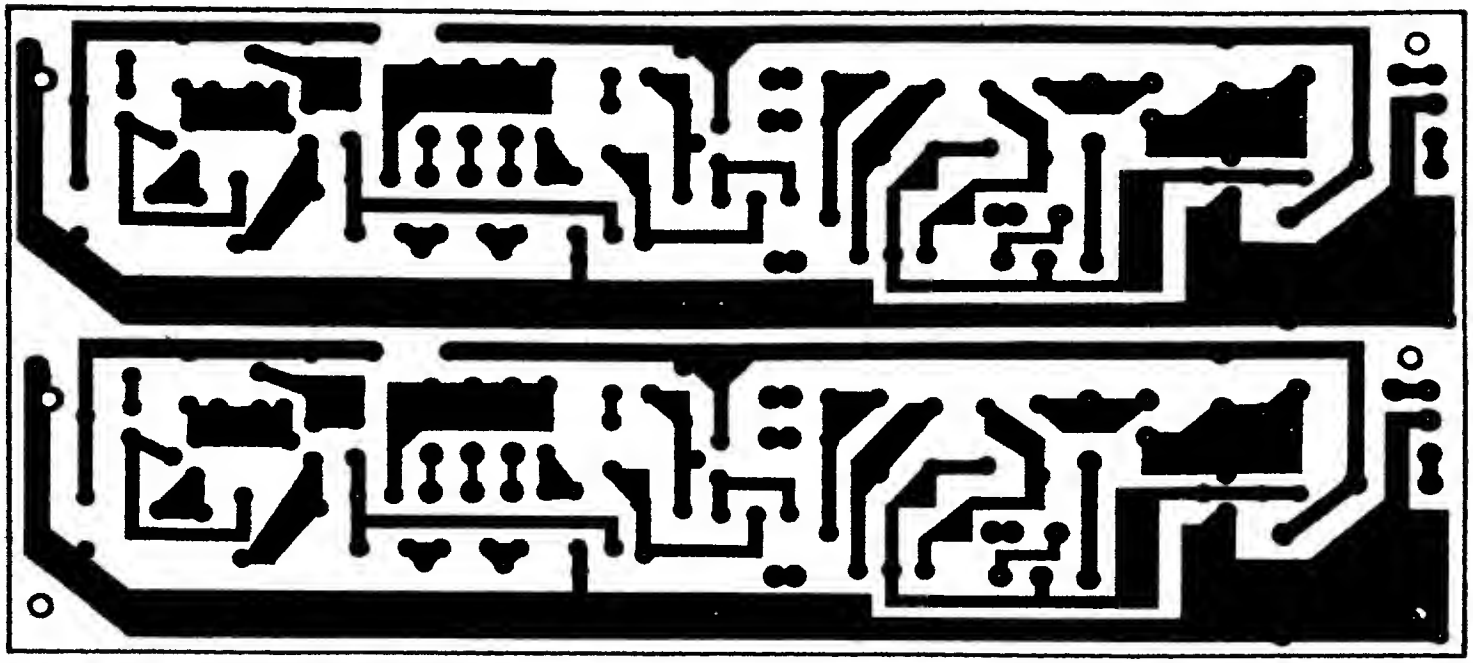


Fig. 4: Actual-size PCB pattern for both the channels of the preamplifier circuit.

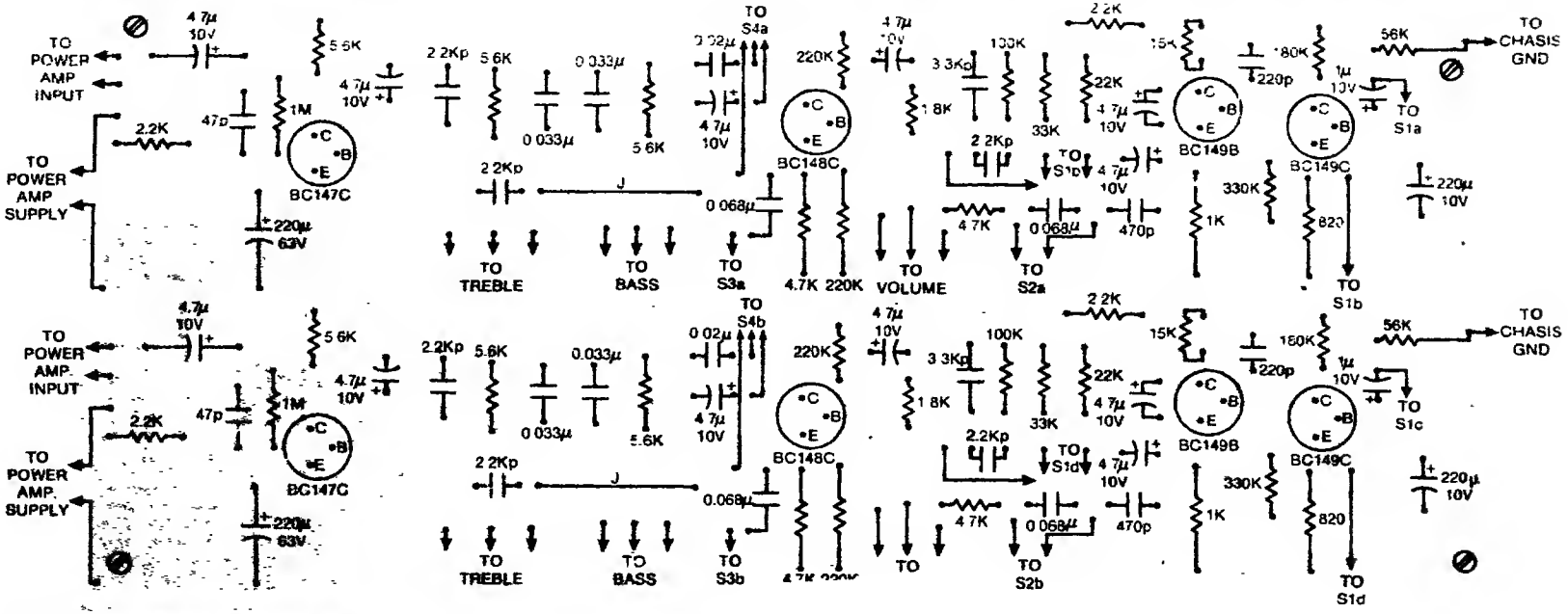


Fig. 5: Components layout for the PCB.

magnetic pick-up. The magnetic pick-up equalising characteristics of the preamplifier are in accordance with the RIAA (Recording Industry Association of America) standard. In addition, the circuit provides 'tape out' signal of about 300 mV for tape recording. It also provides for loudness control and 'hi-pass' and 'lo-pass' filters.

The preamplifier is designed such that it employs a very high AC and DC feedback which leads to a very low distortion level of less than 0.2 per cent with the prescribed values of components.

Table I shows the frequency response, input sensitivity and input impedance of the preamplifier with different input sources. The rated figures were measured with a 15MHz oscilloscope by feeding sinewave signals.

TABLE I

Input Source	Input Impedance (approx.)	Input Sensitivity (approx.)	Frequency Response
Tape deck	470-kilohm	300 mV	20Hz-30kHz
Radio tuner	470-kilohm	200 mV	20Hz-25kHz
Magnetic pick-up	47-kilohm	5 mV	20Hz-20kHz
Crystal pick-up	1-megohm	500 mV	20Hz-30kHz

Working principle

The block diagram of the preamplifier is shown in Fig. 1 and its circuit diagram is shown in Fig. 2. Eight low-noise npn transistors have been used for broadband amplification and a low distortion figure.

The first two transistors are direct coupled to ensure a good frequency response. The first and second stages use BC149C and BC149B silicon transistors for high gain with a low signal-to-noise ratio. Base bias to transistor T1 (and T5) is obtained through a 330k resistor connected between T1's base and emitter of the next transistor T2 (T5's base and T6's emitter in case of T5). This system of giving base-bias ensures bias stabilisation and is called DC feedback.

AC feedback is provided in the form of an equalising network. It depends totally on the type of input source and determines the gain of the preamplifier. In case of a magnetic pick-up, the feedback circuit comprising R22 (100k), C38 (3.3 kpF) and C37 (2.2kpF) provides the equalisation in accordance with the RIAA characteristics required for magnetic pick-up. It should be remembered that all other inputs are frequency independent and have a flat response.

Emitter-follower stage comprising transistor T3 (and T7) is employed to obtain a high input impedance and low output impedance to make the operation of the tone control circuit totally independent of the volume control settings. The tone control circuit itself, which is the heart of the sound shaping circuit, is the well-known Baxandall type circuit. It is used here to avoid all the common defects of high distortion under signal boost conditions.

Bass and treble potentiometers are connected in the feedback loop between the base and collector of output transistor T4 (and T8). The main advantage of this feedback system is that a low output impedance is maintained while both the controls can be varied independently. The rates of boost and cut of the bass and treble controls are ±25 dB at 20 Hz and ±20 dB at 20 kHz respectively (see curve 'b', 'c', 'd' and 'e' in Fig. 3.). When both the controls are in their mid positions, then the frequency response curves are flat (see curve 'a' in Fig. 3) and the feedback is practically independent of frequency.

Construction

A suitable printed circuit board layout is given in Fig. 4 for stereo application. The component layout (Fig. 5) shows the placement of all the components for a stereo system as well as the external connections that have to be made for volume, bass and treble controls, and for filter switches.

All the controls, filter switches and the selector switch are mounted on the front panel of the enclosure. Input and speaker sockets are normally fitted on the rear panel.

Remember that the printed circuit board should be mounted close to the controls and switches in order to keep the interconnections as short as possible for avoiding hum and distortion. Three-core shielded wire should be used for all internal wirings. □