Tone Control

Last month our circuit feature showed the block diagram of a tone circuit. Here's the complete circuit.

ALTHOUGH fully paid-up members of the Flat Earth Society would have us believe that any form of signal processing is guaranteed to make a pig's ear of the emotional experience of listening to a group of musical morons twanging guitars and wailing, it should be remembered that most recordings are subject to considerable amounts of 'equalization', usually to satisfy the producer's requirement for a particular type of sound. No allowance is made for the introduction of random phase shifts, or that the the intricate relationship of harmonics is sent on a one-way trip to the cleaners. The object is to change the sound to make it more satisfactory, and if tone controls are used in the replay process for exactly the same purpose, surely no-one has the right to complain?

The type of tone control fitted to most hi-fi equipment is far from ideal, usually being much too dramatic in operation — for example, if it is required to lift frequencies below about 100 Hz, the effect is usually to lift, by varying amounts, everything up to at least 1 kHz, and even higher.

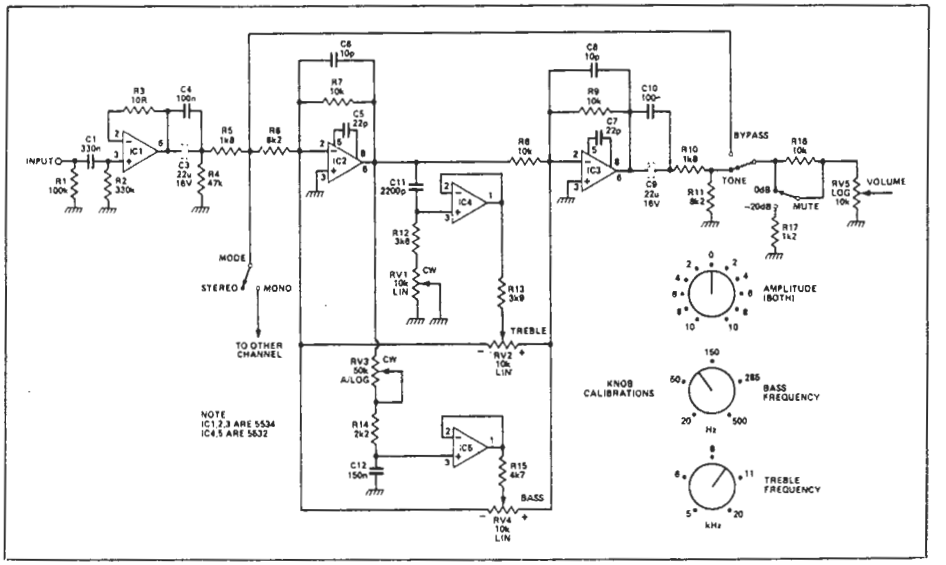

Fig. 2. Circuit diagram of the tone control module.

The circuit shown in Figures 1 and 2 is somewhat more sophisticated than usual, possessing in addition to the normal lift and cut controls, adjustment of the turnover frequencies of the two sections.

Operation of the circuit is quite straightforward. IC1 acts as an input buffer, presenting an input impedance of approximately 100k ohms to the line inputs of the preamplifier. The input of IC1 is AC coupled by C1, which together with R2 fixes the -3 DB point at about 1.5 Hz — low enough to prevent objectionable low frequency phase shift. The output of IC1 drives the pair of inverting stages formed by IC2 and IC3, the input resistor to IC2 being split to allow mono summing of the two channels. The signal path is maintained at unity gian by the equal input and feedback resistors of the two stages.

The output of IC2 feeds two single-pole filters which are buffered by IC4 and

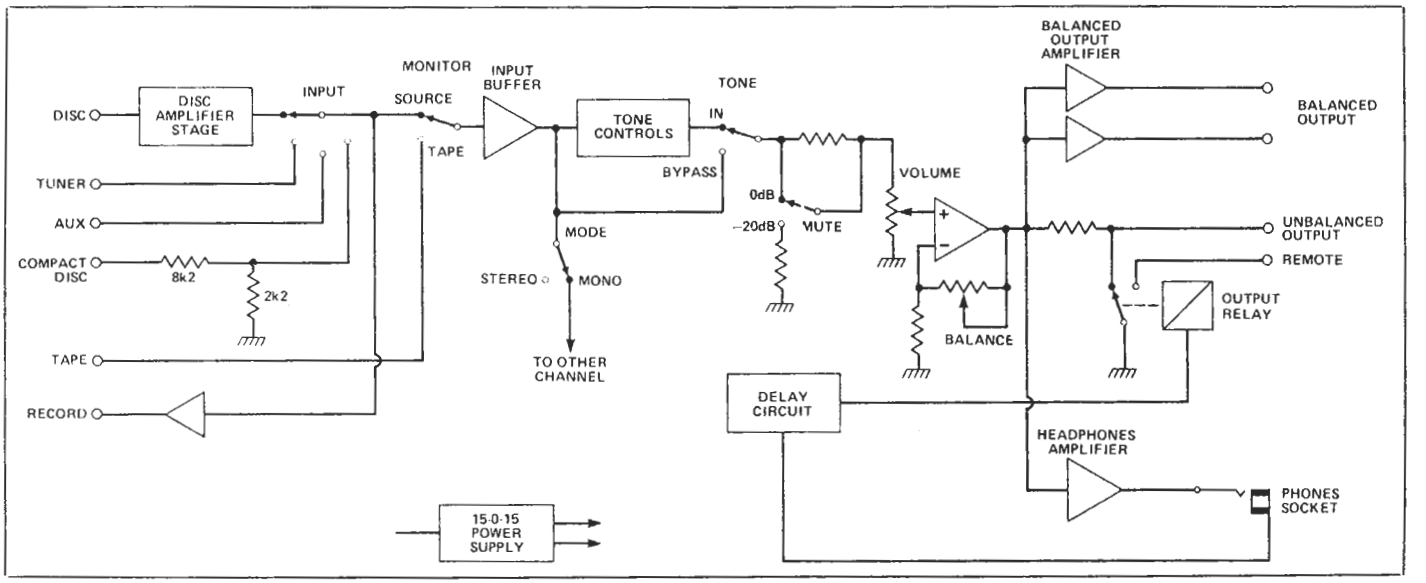

Fig. 1. Block diagram of the extended preamp.

IC5. The filter formed by C11, R12 and RV1 has a high pass characteristic with its -3 DB point adjustable by VR1 from 5.3 kHz to 20 kHz. Operation of the treble control, RV2, decides the destination of the high frequencies that emerge from the output of IC4 — in the "Cut" position, they are applied as negative feedback to IC2, and in the "lift' position, they bypass R8 giving additional gain to IC3. The amount of lift and cut is controlled by R13, the value specified giving a ±10 dB variation.

The bass control works in the same way except that a low pass filter comprising C12, R14 and RV3 selects the low frequency range which is variable between 20 Hz and 480 Hz.

This type of tone control is characterized by shelving response curves with no interaction between the bass and treble sections. The curves are shown in Fig. 3 which illustrates the range of the variable frequency controls.

As the tone control section is non-inverting from input to output, it can readily be bypassed as shown. To ensure that there is no change in level when the bypass switch is operated, the 2.9 dB attenuator formed by R5, R6 and the volume control is duplicated by the addition of R10 and R11 at the output of IC3.

The mute switch has been added, as much for convenience as anything. When changing records or when the phone rings, it is very useful to be able to reduce the overall gain without disturbing the volume control setting.

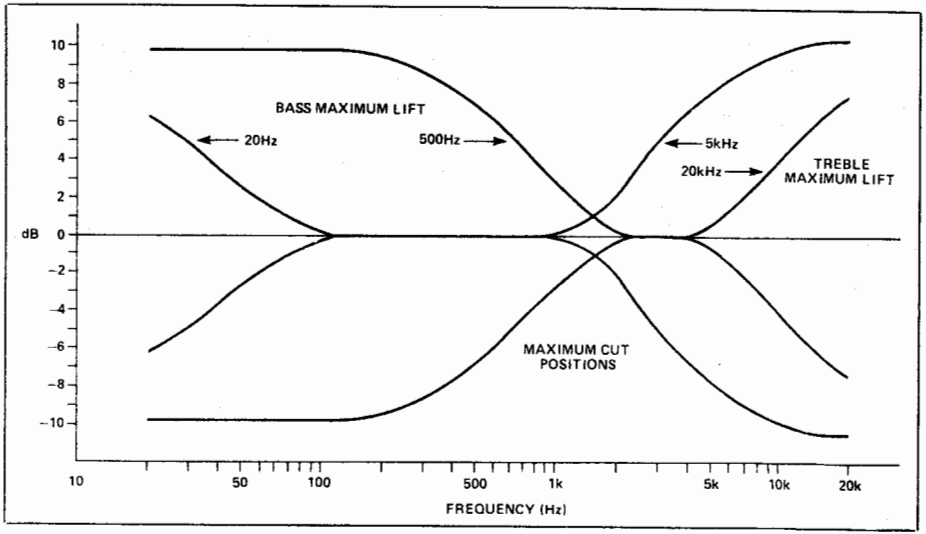

Fig. 3. Response curves for the tone control module.