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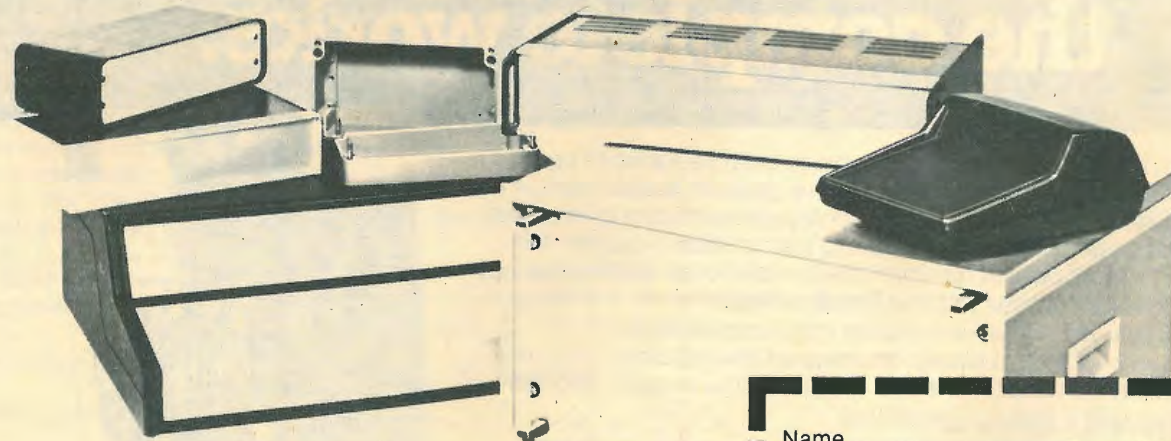
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Audio gain controls

2 - Obtaining equal gains in the two channels of a stereo pair

by Peter Baxandall, B.Sc. (Eng.), F.I.E.E., F.I.E.R.E., M.A.E.S.

Continuing his survey of gain control problems and solutions, Peter Baxandall discusses tracking volume controls in stereo amplifiers, concluding with a proposal for an unusual design of control.

Stereo gain control tracking

Connected with the problem of obtaining a satisfactory scale-shape for the volume-control law in stereo control units, is that of achieving an accurately equal gain in the two channels at all knob settings. Preferably, the channel gains, if adjusted to be equal at one volume control setting, by means of the balance control or otherwise, should remain within ± 1 dB of equality at all other settings of operational significance. This is quite likely not to be the case if cheap types of carbon-track, ganged log. pots. are used.

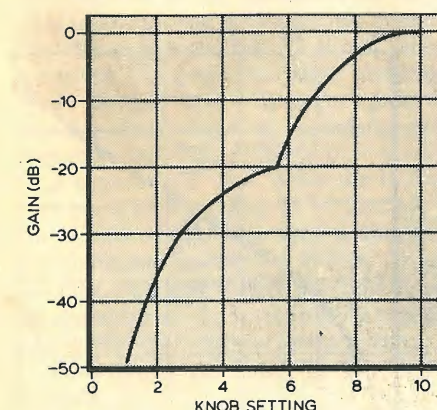


Fig. 20. Approximation to log. law obtained by changing resistivity of halves of carbon-track pot.

Figure 20 shows the measured gain-variation law on one channel of a very high quality, commercial control unit, having a simple, passive volume-control circuit, using the above type of pot. The very rough approximation to a logarithmic (linear-in-dB) law is obtained by making the two parts of the pot. element of different surface resistivities, the resistivity changing suddenly from one value to another at half-rotation of the knob. At the point of change, there is a severalfold change in slope, which is a quite undesirable feature. Though some quite cheap commercial pots. give a better approximation to a logarithmic law than that of Fig.

20, there is clearly much to be said for employing a type of gain control circuit which inherently gives a smooth and nearly logarithmic law without needing pots. with a non-linear resistance law. It ought to be easier to make ganged linear pots. with accurate matching between sections than to make ones with non-linear laws and equally good matching, though unfortunately, limited experience in measuring the departure from linearity of cheap so-called linear carbon-slider pots. has shown that undesirably large errors often occur.

One solution to the problem of obtaining a good scale shape and accurate tracking is, of course, to employ ganged, stud-type volume controls. These should give not more than 2dB per stud, at the most, and should have a click mechanism to make sure they are never left in an unsatisfactory half-way state between one stud and the next. Then, provided their internal resistors are accurate and stable, very accurate tracking will be obtained.

Careful measurements have been made of the resistance versus knob-position relationship for eight specimens of R.S. Components 10k Ω linear "slide tandem" pots, and Fig. 21 shows the results for three of these. It will be seen that:

- none of the specimens has a truly linear law;
- the departure from linearity, though

of somewhat different nature for the three specimens, is nevertheless of fairly accurately the same shape for the two halves of each specimen, and this is the case also for the other five specimens;

- there are considerable differences between the absolute total resistance values of the specimens, and, in the case of specimen number 3 particularly, between the two resistance elements in one specimen.

For normal audio control-unit applications, minor departures from the nominal volume-control law are unimportant, provided they are equal for the two channels. Differences in the absolute resistance values for the two elements in a stereo pot. may or may not cause gain mis-tracking, dependent on the nature of the associated circuit.

Consider first the circuit of Fig. 22(a), which gives a range of gain well suited to most control-unit applications. (The circuits of Figs. 12 and 14 are better suited to microphone-amplifier applications, where the higher maximum gain given is advantageous.) It is necessary in practice to insert a resistor R_1 in series with the input end of the pot. to limit the maximum value of k obtainable to, say, 0.9 or 0.95, otherwise - see Fig. 8(a) - the characteristic becomes too steep at the high-gain end. Note that k is defined as

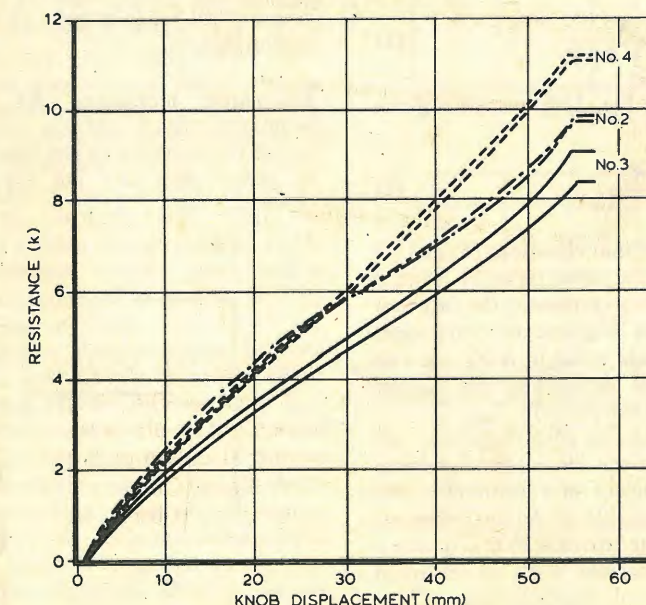


Fig. 21. Samples of characteristics of dual linear pots.