CIRCUIT ACTION AND PROGRAMME SIGNALS

High fidelity enthusiasts claim to have heard differences in the performance of wide-range amplifiers. In recent issues Mr Peter Baxandall and Mr James Moir have tried to show that the claims are ill-founded; but mathematical physics suggests that this may not always bo so.

If a potential difference $V = E\,e^{j\omega t}$ be applied across a capacitance C, then the current flowing at time $t = C\,dV/dt$

$$\text{is } VC\left\{\frac{1}{E}\frac{dE}{dt}+j(\omega+t\frac{d\omega}{dt})\right\}$$

and so the capacitance's complex impedance

$$Z = \frac{1}{\left\{C\;\frac{1}{E}\frac{dE}{dt}+j(\omega+t\frac{d\omega}{dt})\right\}}$$

Hence, if the amplitude is small but rising rapidly, or if the frequency has a high rate of variation, then Z may differ considerably from $1/j\omega C$ – a formula often used in the design of RC circuits for amplifiers and measuring instruments.

The complex impedance of an inductance contains somewhat similar terms with further complications arising from the non-linear relationship between current and associated magnetic flux.

I tried to take account of all this recently when designing variable high-pass and low-pass filters with a slope of some 40 dB per octave and a plateau variation within + 0.5 dB; but the mathematics became impossible; and although I achieved my objectives, I came to realise how little is known about the *actual* behaviour of electric circuits.

Variations from steady-state values depend upon programme material in ways that defy exact analysis. It has not yet been proved mathematically or otherwise that their effect upon the performance of wide-range amplifiers must always be inaudible. Until it has, the possibilities remain that the high fidelity enthusiasts are right in their claims, that distorted sound from gramophone records and loudspeakers has characteristics that reveal this effect to a sensitive ear, and that specifications which appear to be unnecessary tend to cause its decline.

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