

AMPLIFIER TECHNOLOGY

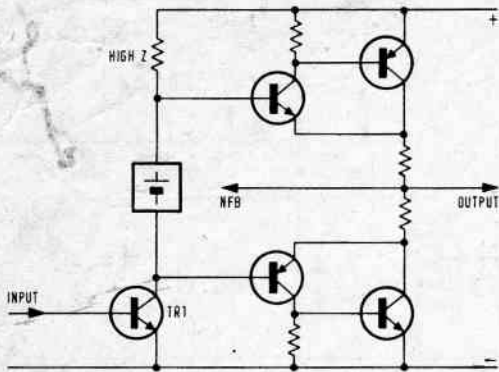


Fig.5. Alternative form of circuit shown in Fig. 4.

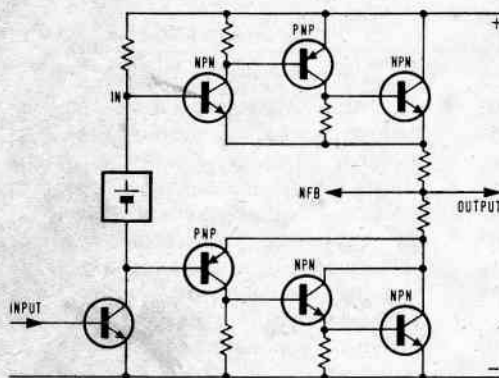
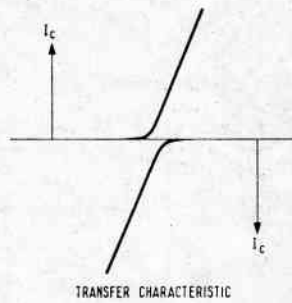


Fig.6. Quad output triple circuit.

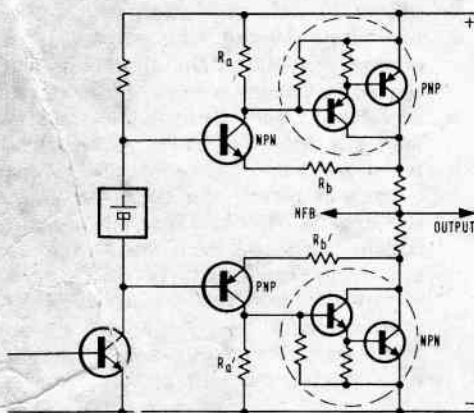
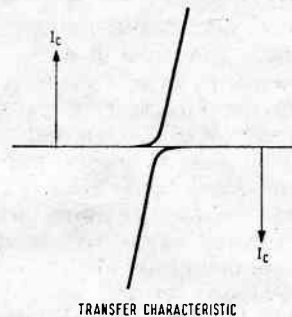
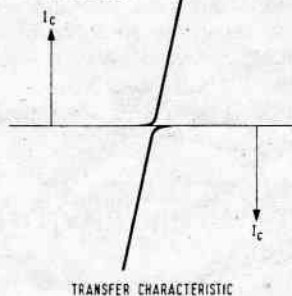


Fig.7. Darlington output stage has very good symmetry-distortion figures, as low as 0.003% can be achieved.



determined by the form of the output stage, and residually influenced by the performance of the preceding low power voltage amplifier stage.

The most obvious requirement for improvement in the open-loop linearity of the quasi-complementary transistor amplifier was the removal of the asymmetry of the output devices, which, in turn, required the production of fully complementary power transistors. When these became

available, fully symmetrical designs employing these, of the type shown in Fig. 4, were evolved by Locanthi⁴ and Bailey.⁵

The major advantage of this type of output transistor configuration is that it allows a much closer match in the transfer, at the crossover point, of the two output halves than is obtainable by other simple systems. However, it has snags. These are that the proper operation of the output stage

demands a correctly-chosen forward bias (like any other class-B push-pull system), but this depends on the temperature-dependent characteristics of the output transistor base-emitter junctions. It will be found, therefore, that if the quiescent current is set at some optimum value for minimum harmonic distortion, with the output transistors at normal idling temperature, and the amplifier is then driven hard for a minute or two, the quiescent current will alter to some less favourable value. If some temperature-sensitive device is mounted on the output heat-sink to compensate for this effect, the result will be complicated by the temperature lag between output transistor base-emitter junction and sensing device. An additional but minor disadvantage of this configuration is that the available output swing delivered to the load is lessened by the presence of two forward biased base-emitter junctions in each output stage half. Additional imperfections are that the output stages, even when employing apparently mirror-image types of device, are not truly symmetrical at high powers and at operating frequencies approaching $F/10$, as shown by the author⁶, and that even when a notionally good match has been obtained at lower powers and frequencies the crossover transfer is still discontinuous⁷ (Blomley).

Designs using an alternative output configuration of the type shown in Fig. 5, which minimises the first two of these problems, have been described by Teeling,⁸ Ruehs,⁹ the author,¹⁰ and Hardcastle and Lane,¹¹ Until the advent of monolithic complementary (pnp and npn) power Darlington output transistors at economical prices (which have tended to encourage the use of output stages of the form shown in Fig. 4 but with a substantially worse thermal stability than that obtainable using separate driver transistors) this latter form would represent the majority of the better power amplifiers having output powers of 30-75W into eight or four ohm loads designed in the USA. Numerous examples of this system can be found in the application notes of the semiconductor manufacturers.

In all of these systems, it is important that the output stage should not present a significant load upon the driver transistor ($Tr1$ in Figs. 4 and 5) which means that in general it is easier to obtain good steady state harmonic distortion characteristics if a 'triple' is used as the output 'half'. However, this leads to rather greater difficulties in obtaining the high degree of loop stability needed for satisfactory transient performance.