

Quasi-complementary Output Stage Modification

A single diode used to overcome distortion at low listening levels

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The quasi-complementary output stage (Fig. 1) has differing input impedances for its upper and lower halves. This is because there are two emitter-base junctions in series in the upper half, but only one in the lower half. In the configuration of Fig. 2 it can be seen that the lower has an input impedance consisting of one emitter-base junction and one forward-biased diode in series, which in practice should approximate to two emitter-base diodes in series. Thus it should be possible to construct a low distortion transformer-less output stage using one pair of low-current complimentary transistors and one pair of identical output transistors.

An amplifier with an output stage similar to that in Fig. 1 was constructed, and the distortion levels measured down to 2mW output at quiescent currents of 7mA, 20mA and 80mA. The distortion was measured using a wave analyser (Marconi TF2330) and a low distortion generator (Marconi TR2100/1M1).

The results of the measurements are given in Fig. 3. From these it can be seen that at the normal quiescent current for class B operation (20mA) the total harmonic distortion rises to approximately 1% at 15mW output from 0.1% at full output. This distortion is clearly well above the accepted limit for high-quality reproduction and it can be seen to reduce as the quiescent current is increased towards class A conditions.

An amplifier was constructed with Fig. 2 as a basis, the complete circuit of which is given in Fig. 4. This second amplifier, which had the same amount of negative feedback as the previous amplifier, gave the results indicated in Fig. 5 at 20mA quiescent current.

The amplifier was operated from a simple unstabilized power supply (Fig. 6), and the d.c. level at the output was set below half of the supply voltage so that the output voltage at full output would not be clipped due to the ripple limited positive rail.

It can be seen from Fig. 5 that the distortion level does not rise, down to a measured output of 100 μ V, thus showing that the extra diode has equalized the input impedances giving a fourth and cheap alternative output stage for true high-quality reproduction.

The amplifier has successfully driven a Quad electrostatic loudspeaker without any instability and tests were carried out with the latter and with the simulated circuit (Fig. 7) which is the salient part as regards high frequency instability.

Above 15W output the supply rails clip the output voltage giving rise to a large increase in the harmonic distortion levels, but up to this point the distortion level is extremely low.

List of Figures

Fig. 1. Typical quasi-complimentary output stage.

Fig. 2. Modified quasi-complimentary output stage.

Fig.3. Distortion characteristics of conventional amplifier with 7mA, 20mA, and 80mA quiescent current.

Fig. 4. Complete circuit diagram of modified power amplifier.

Fig. 5. Distortion characteristics of the amplifier at 20mA quiescent current.

Fig. 6. Simple power supply used with amplifier.

Fig. 7. Test circuit equivalent to Quad electrostatic speaker.