Distortion in Class AB Power Amplifiers*

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The transition from class A to class B in power amplifiers have been investigated with regard to distortion. It is shown that this transition triggers off one of two different nonlinearity mechanisms dependent upon the realization of the output stage. The theoretically derived equations are shown together with measured parameters of a typical design. The results reveal large amounts of distortion, reaching a maximum at medium power levels.

0 INTRODUCTION

Most modern power amplifier designs use the complementary emitter–follower output stage. One of its many features is the ease with which the quiescent current may be chosen, so that the stage can easily be operated in class A, class AB, or class B. Due to the poor switching performance of class B, and the high quiescent losses of class A, the class AB solution is the most common. The quiescent current chosen by the designer ranges from some tens to a few hundred milliamperes. There are two modes of operation for these emitter–followers, the voltage-controlled and the current-controlled modes. The current-controlled designs are used when one wants an integrating open-loop transfer function. The compensation is then placed around the current source driving the output stage. This topology seems to lose ground in modern power amplifier designs, where it is replaced by its opposite, the voltage-controlled output stage. This design performs better with respect to linearity, at high frequencies, and is easier to control. The voltage-controlled design behaves quite well when operated in either class A or class B, but it has problems in the transition region, as indicated in this communication. It should be pointed out that the nonlinear function of current gain with emitter current, and especially the rapidly falling slope of this characteristic at higher current levels, will probably dominate the distortion performance at very high output level. Due to the fact that the current-controlled design is very dependent upon this function, it will also be most affected by this anomaly.

1 THE VOLTAGE-CONTROLLED DESIGN

The basic schematic of a suitable output stage is shown in Fig. 1, and the idealized transfer characteristic is shown in Fig. 2. The shift in gain is caused by the transition from class A to class B. This is again caused by the change in output impedance, due to the fact that

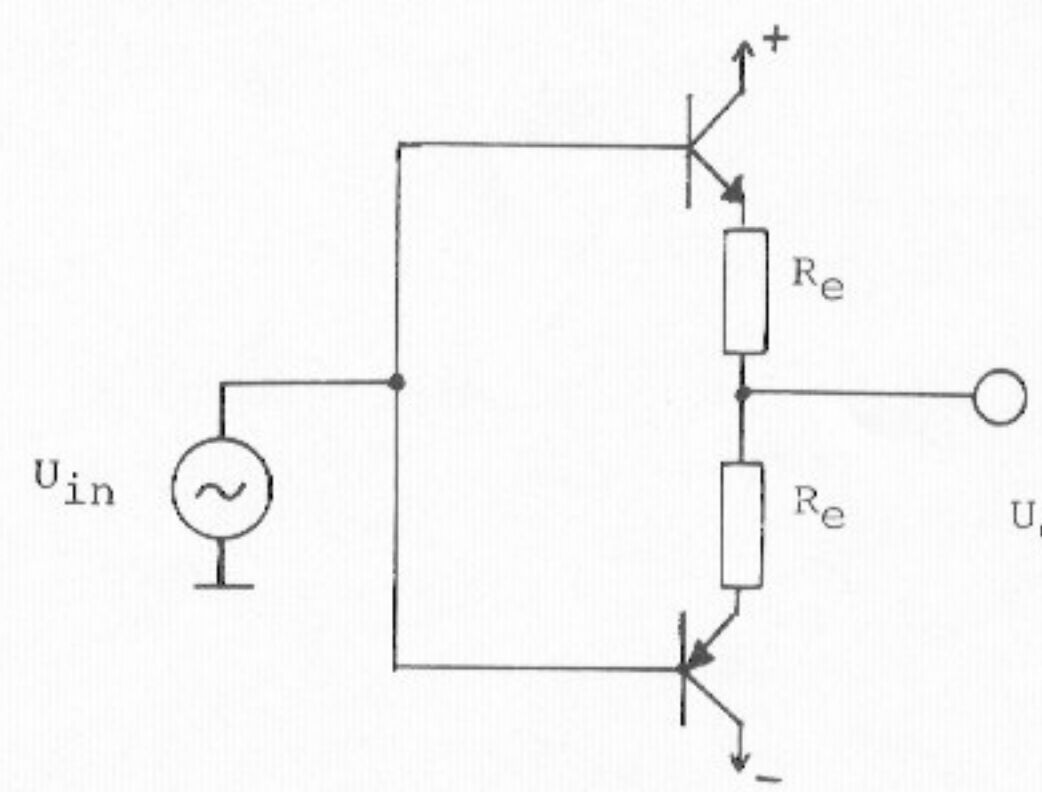

Fig. 1. Ac equivalent schematic of output stage.

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