

New Approach to Class B Amplifier Design

by Peter Blomley*

The class B amplifier has established itself as the most versatile and lowest cost amplifier known. This is mainly due to the excellent work in the field of semiconductor circuit design by H. C. Lin¹, R. C. Bowes², R. Tobey and J. Dinsdale³, A. R. Bailey⁴ and P. J. Baxandall⁵. In this article it is hoped to complement the work of these designers by putting forward a new approach† which may solve some of the problems inherent in present designs.

Conventional approach

A definition of a class B amplifier could be 'one in which the operating point of each output device is set at the lower extreme of its transfer characteristic. Hence in a push-pull design, for any symmetrical input signal, each output device conducts only one half of the output waveform'. This method of operation gives the amplifier zero (or nearly zero) quiescent power consumption, high efficiency and excellent peak current drive capability. It is unfortunate that the sacrifice paid for these virtues is the problem of ensuring a linear transfer of signal drive from one output device to the other.

So that the class B system can be analysed it is useful to approach the output circuit as two separate amplifiers (labelled X and Y in Fig. 1 for convenience), the outputs of which combine to give the complete signal. This is shown in diagrammatic form in Fig. 1, where it is assumed that the blocks representing the amplifiers form the equivalent of a complementary output stage.

The transfer characteristic for one of these 'sub-amplifiers' is shown in Fig. 2, where above the bias point A the characteristic is extremely linear and below it becomes a combination of linear and exponential relationships. The designer's task is to define this last region so accurately that when it is combined with that of the other sub-amplifier, the overall gain will remain constant (i.e. as the gain of one sub-amplifier decreases, the other increases equally to compensate).

The workings of a class B output circuit can be clarified by the use of g_m diagrams, these being a plot of gain—or in this case

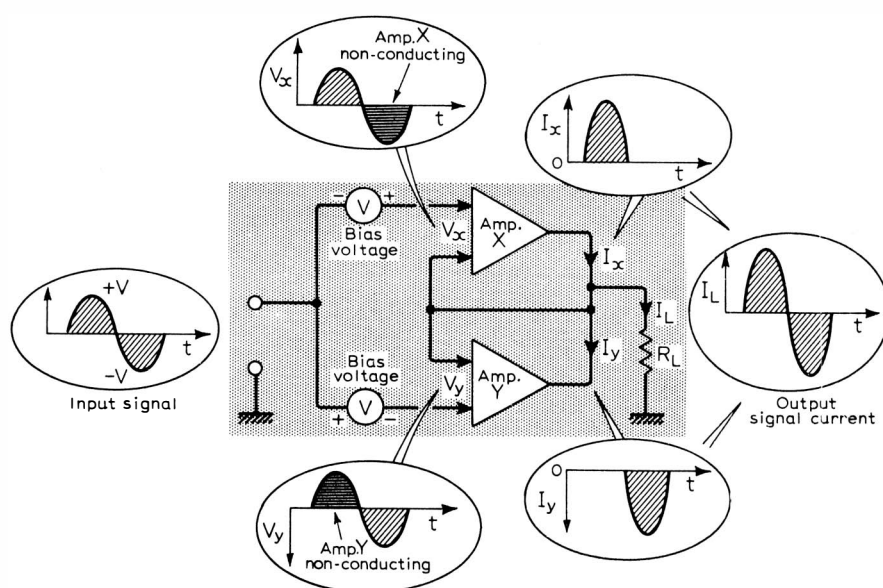


Fig. 1. Block diagram of conventional class B amplifier with the two halves of a complementary output stage represented by sub-amplifiers X and Y.

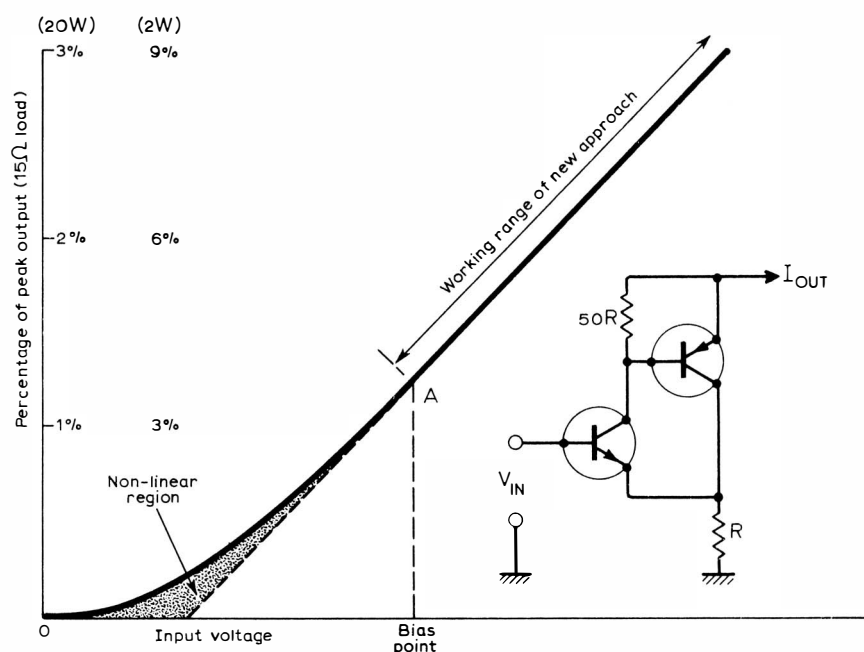


Fig. 2. Transfer characteristic of sub-amplifier X which is linear above bias point A and non-linear below. In conventional class B, non-linear regions of X and Y sub-amplifiers have to be accurately matched to give overall linearity.

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†The subject of patent application 53916/69.