

problems, the new approach separates the two functions of amplifying and signal splitting completely.

To explain the problems involved with the design of a signal splitter it is usual to establish the ideal and see how this can be approached practically. As it happens there are two ideal 'half' characteristics which will give a linear cross-over when they are combined. The first, and obvious one, has a conduction path only in one direction and absolutely zero in the other. The other is more complicated and has three regions—linear region (large positive inputs), a non-linear region (transfer coefficient is proportional to signal) and a reverse region (transfer coefficient is zero).

The difficult region is the non-linear one. This will only give a linear crossover when it is combined with another conjugate characteristic. Not only this, but the relationship between the linear and non-linear portion has to be accurately defined. Normally this is achieved by altering the quiescent current in the signal splitter for minimum crossover distortion. Thus using this approach in the signal splitter means that the non-linear region has to be complementary to its partner and also that the linear and non-linear regions have to be accurately related. If additional constraints are imposed—due to device spreads and temperature changes—the situation can become very difficult unless a simple approach is used.

Returning to the first type of signal splitter, the immediate comparison which can be drawn is the simplicity of the characteristic. There are no interactions between each element and only one region has to be accurately defined. Ideally, therefore, this type of characteristic should be easy to control once a suitable device configuration is found.

Ideal element. The simple p-n diode fabricated in silicon can have a forward-to-reverse current ratio of 10^{10} ; thus it approaches the ideal almost within the boundaries of measurement. This is however only considering the forward characteristic under conditions of *current drive*. If a voltage source were used the forward transfer would revert to the familiar exponential relationship between input voltage and output current (Fig. 6a). If a signal splitter is now made of two of these diodes and a *current* of changing direction fed into the common point, then from Kirchhoff's second law the current must flow either in diode D_1 or diode D_2 depending on the direction of signal current flow. The transfer coefficient for the diode must be unity, as it is only a two-terminal device, hence this type of signal splitter is extremely linear under the conditions of current drive (Fig. 6b).

Transistor signal splitter. The use of a transistor as a signal splitter (Fig. 7) logically follows that of a p-n diode simply because the emitter-base junction has almost identical characteristics to that of a diode. Exactly where the transistor is superior to that of the diode depends on

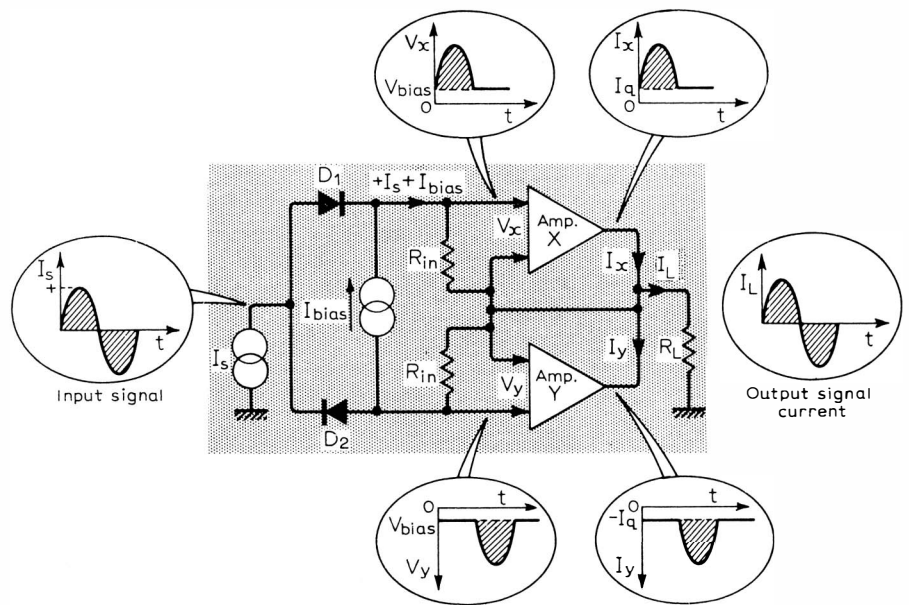


Fig. 5. New approach to class B amplifier in which sub-amplifiers are biased above non-linear region and fed with uni-directional signals produced by the diodes. This effectively transfers signal splitting from the sub-amplifiers to a separate part of the circuit.

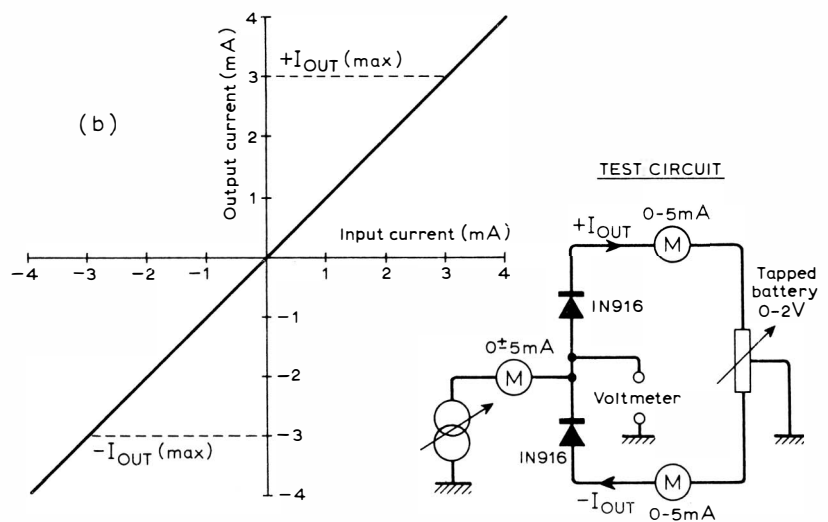
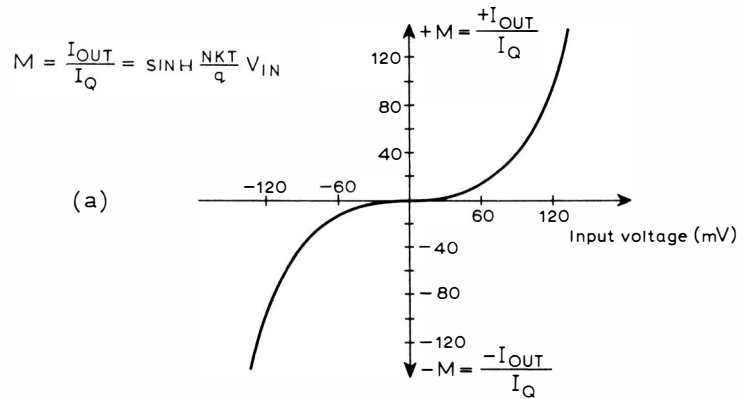


Fig. 6(a). Transfer characteristic of voltage driven diode signal splitter.

Fig. 6(b). Linear transfer characteristic of current driven diodes.

the design approach but in most cases the level-shifting property of a bipolar device is the main reason. This is very useful in a practical design but care has to be taken in the selection of the type of device. There is a problem with the use of transistors as signal splitters due to the emitter-base depletion capacitance. Under conditions of

low injection this can add an additional phase lag during the crossover period. The problem can be overcome by using silicon planar devices with very high transition frequency (f_T) or by selecting devices in which the f_T is dominated by the diffusion capacitance as f_T remains constant down to very low emitter currents.