

FET Cascade With Bipolar Transistor

Where it is desired to couple a very high-impedance source to a low-impedance load, a unipolar-bipolar cascade transistor stage is a good circuit. Such a circuit is shown in Fig. 20a. The similarity between this circuit and the source follower of Fig. 18a should be noted. To a first approximation, the improvement in performance (8) can be determined by multiplying the g_m of FET Q_1 by the h_{fe} of the npn bipolar transistor Q_2 . If the output admittance of the combination of Q_1 and Q_2 , g_d' , is assumed to be small compared to $g_m h_{fe}'$ and $1/R_S$, the voltage amplification of Fig. 20b can be written

$$A_v = \frac{e_o}{e_{in}} = \frac{g_m h_{fe}' R_S}{1 + g_m h_{fe}' R_S} \quad (99)$$

In equation (99) and in the equivalent circuit of Fig. 20b,

$$h_{fe}' = h_{fe} \frac{R_D}{R_D + h_{ie}} \quad (100)$$

where h_{fe} = current gain of Q_2

and h_{ie} = input impedance of Q_2 .

Equation (99) is similar to Equation (96) except that g_d has been neglected and the factor h_{fe}' has been introduced to account for the additional current gain of the bipolar transistor. The cascade circuit is useful for video amplifiers or RF amplifiers up to about 100 MHz. Noise figures of less than 2DB are realized at 100-200 MHz. (8).