Bipolar Transistor Amplifiers

Common Emitter Amplifier

Milestone 0

Construct a common emitter amplifier (circuit 9.1). Measure the quiescent voltages at nodes 2 and 3. If necessary, change the value of $R_2$ to bring the set point as close as possible to 6.3 V. Note what happens to the voltage at node 3 when you connect the DMM to node 2 and explain your observation. Measure and plot the small-signal voltage gain $v_3/v_1$ (in dB) from 10 Hz to 1 MHz and identify the low-frequency –3dB point. Compare the measured values with the values calculated in exercise 9.1.

Milestone 1

Series Feedback Amplifier

Construct a series feedback amplifier (circuit 9.2). Measure the quiescent voltages at nodes 2, 3 and 4. Measure and plot (on the same plot as above) the small-signal voltage gain $v_4/v_1$ from 10 Hz to 1 MHz. Compare the measured values with the values calculated in exercise 9.2.

Milestone 2
Decoupling Capacitor

Add a 0.47 µF capacitor in parallel with R4 in circuit 9.2 then re-measure and plot (on same plot as the previous measurements) the small-signal voltage gain \( v_4/v_1 \) from 10Hz to 1MHz. Briefly explain your results.

Milestone 3

Differential Amplifier

A differential amplifier has two inputs, \( V_+, V_- \), and an output

\[
V_{\text{out}} = G.(V_+ - V_-) + \frac{g}{2}(V_+ + V_-)
\]

(10.1)

where \( G \gg g \) and in the ideal case \( g = 0 \). Construct circuit 10.1 and measure \( G \) (ground one input and apply a small signal to the other) and \( g \) (apply the same signal to both inputs). Use 1 kHz in both cases. Use circuit 10.2 to mix two signals of similar amplitude (e.g. 50 mV) but different frequencies (e.g. 1 kHz and 10 kHz) and demonstrate that the differential amplifier can be used to extract \( V_B \) from \( V_C \) and \( V_D \).

Milestone 4

Analyse Circuit 10.1 and calculate the values of \( G \) and \( g \). Explain why any circuitry connected to node 8 has to have a very high input-impedance and suggest how a PNP transistor in an emitter-follower configuration might be used as a suitable buffer.

Milestone 5