Bipolar Transistor Amplifiers

Common Emitter Amplifier

Milestone 0

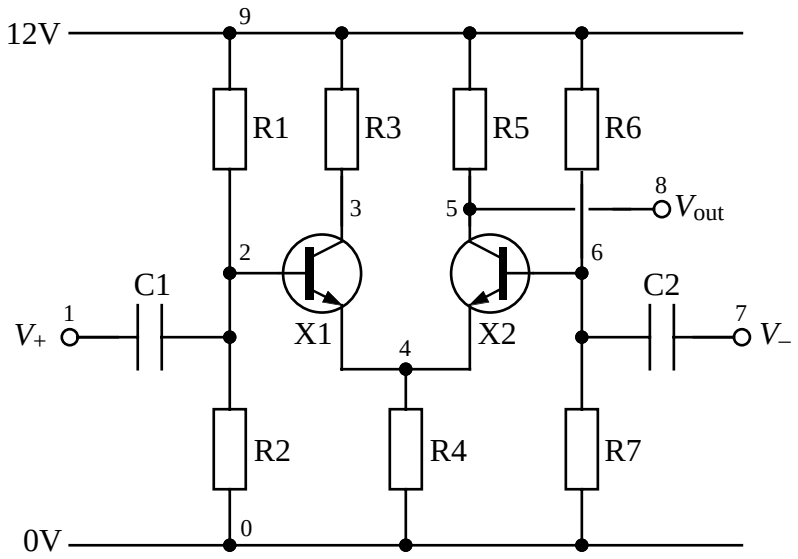
Construct a common emitter amplifier (circuit 9.1). Measure the quiescent voltages at nodes 2 and 3. If necessary, change the value of R_2 to bring the set point as close as possible to 6.3 V. Note what happens to the voltage at node 3 when you connect the DMM to node 2 and explain your observation. 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



C1,2	0µ1
R1,6	33K
R2,7	10K
R3,5	5K6
R4	1K0
X1,2	BC107

Circuit 10.1 Differential Amplifier

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 10 Hz to 1 MHz. Briefly explain your results.

Milestone 3

Differential Amplifier

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

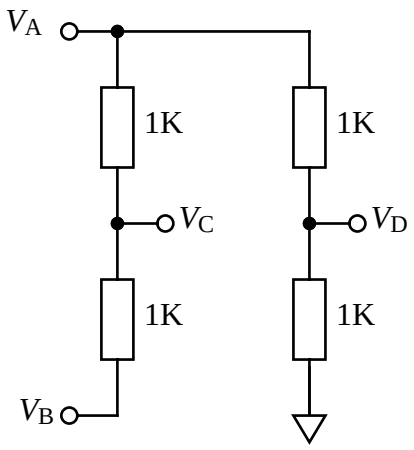
$$V_{\text{out}} \approx G.(V_+ - V_-) + \frac{g}{2}(V_+ + V_-) \qquad (10.1)$$

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



Circuit 10.2 Signal Mixer