BİLKENT UNIVERSITY
ELECTRICAL & ELECTRONICS ENGINEERING DEPARTMENT

EE 311 ELECTRONICS II

Experiment 1

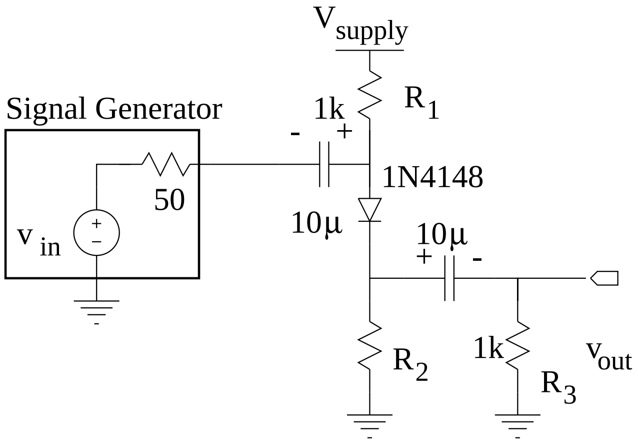
Lab Report

Biasing and Small Signal Concepts

Student Name:

ID Number:

Date:



PRELIMINARY WORK

v_{in} is a sinewave at 2kHz. At this frequency and with this circuit setting, the 10-μF decoupling capacitors may be considered as short circuit in AC small signal model.

(a1) Find the AC small-signal model for this frequency for $V_{supply} = +5V$, and $R_2 = 3.9k\Omega$, and compute the output signal amplitude for $v_{in}(t) = 100m\ \sin(2\pi 2K\ t)$V (a2) Find the AC small-signal model for this frequency for $V_{supply} = +5V$, and $R_2 = 39k\Omega$, and compute the output signal amplitude for $v_{in}(t) = 100m\ \sin(2\pi 2K\ t)$V

(a3) Find the AC small-signal model for this frequency for $V_{supply} = +5V$, and $R_2 = 390k\Omega$, and compute the output signal amplitude for $v_{in}(t) = 100m\ \sin(2\pi 2K\ t)$V

(b) Perform the following SPICE simulations to measure v_{out}, and append the print-outs to the the end of this report

(b.1) for $V_{supply} = +5V$, and $R_2 = 3.9k\Omega$,

- (b.1.1) for $v_{in}(t) = 100m\ \sin(2\pi 2K\ t)$V
- (b.1.2) for $v_{in}(t) = 200m\ \sin(2\pi 2K\ t)$V
- (b.1.3) for $v_{in}(t) = 500m\ \sin(2\pi 2K\ t)$V
- (b.1.4) for $v_{in}(t) = 1\ \sin(2\pi 2K\ t)$V

(b.2) for $V_{supply} = +5V$, and $v_{in}(t) = 100m\ \sin(2\pi 2K\ t)$V

- (b.2.1) for $R_2 = 3.9k\Omega$,
- (b.2.2) for $R_2 = 39k\Omega$,
- (b.2.3) for $R_2 = 390k\Omega$,

(b.3) for $R_2 = 3.9k\Omega$, and $v_{in}(t) = 100m\ \sin(2\pi 2K\ t)$V

- (b.3.1) for $V_{supply} = +5V$
- (b.3.2) for $V_{supply} = +3V$
- (b.3.3) for $V_{supply} = +2V$
- (b.3.4) for $V_{supply} = +1V$

(c) Explain the circuit operations and List the roles of the components.

Circuit function:

$10 - \mu F$ **capacitors:**

V_{supply}**:**

R_1**:**

R_2**:**

R_3**:**

D**:**

(d) **Design**

(d1) Calculations for redesigning the circuit to have the diode small-signal resistance equal $1k\Omega$. (For **Part 4** of the experiment)

(d2) Plan a scheme to verify the design completed in **Part (d1)**.

EXPERIMENT:

Start with the setting

$$R_2 = 3.9k\Omega$$

$$v_{in}(t) = 100\text{m } sin(2\pi 2\text{k } t)$$

$$V_{supply} = +5V$$

for parts 1, 2, and 3 in the following.

Part 1: Ramp up the amplitude of v_{in} to $1V$. Observe the output waveform and comment on it on the report. Find the maximum allowable amplitude of v_{in} to have linear operation.

Observations and comments:

Part 2: Observe the output waveform for

$$R_2 = 3.9k\Omega, \quad 39k\Omega, \quad 390k\Omega$$

cases. Comment on it on the report. Find, by experiment for each case the maximum allowable amplitude of v_{in} to have linear operation.

Observations and comments:

Part 3: Ramp down V_{supply} to $1V$ in 4 steps. Observe the output waveform and comment on it on the report. Find, by experiment for each case, the maximum allowable amplitude of v_{in} to have linear operation.

Observations and comments:

Part 4: Redesign the experimental circuit (find R_2, or V_{supply} or both, if necessary) to have the dynamic resistance of the diode equal to $1k\Omega$. Verify it by experiment.

Observations and comments: