



The Islamic University of Gaza

Faculty of Engineering

Department of Computer Engineering

Electronics I LAB

[LAB 05]

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Objectives

- Design a clamping circuit for the given output.
- Design a clipping circuit for the given values.

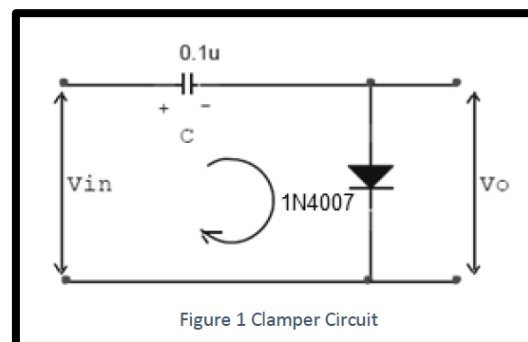
Equipment

- Diode (1N4007).
- Resistors.
- Capacitors.
- Function generator.
- Oscilloscope.

Theory

Clamper Circuits:

A clamper circuit is an electronic circuit designed to introduce a DC level shift to an AC input signal without altering its shape. Depending on the configuration, the circuit can shift the signal either upward or downward along the voltage axis. When the output waveform is shifted in the positive direction, the circuit is referred to as a *positive clamper*, whereas a shift in the negative direction produces a *negative clamper*. The figure below illustrates a clamper circuit used to achieve such DC displacement.



During the **positive half-cycle** of the input, the diode becomes forward-biased, allowing the capacitor to charge up to approximately $(V_{in} - V_D)$, where the voltage across the capacitor is established with the polarity indicated in Figure 1. When the signal enters the **negative half-cycle**, the diode is driven into reverse bias, preventing conduction. As a result, the output voltage can be expressed as:

$$V_o = V_{in} - V_C$$

For the purpose of analysis, let us consider that the capacitor has already reached its steady-state charge of $(V_{in}-V_D)$. Given that the diode drop is $V_D=0.5\text{ V}$, and assuming a peak input of 5 V , the capacitor voltage becomes $5-0.5=4.5\text{ V}$. Under this condition, when the diode conducts in the positive half-cycle, applying Kirchhoff's Voltage Law (KVL) to the circuit loop yields:

$$V_{in}-V_C-V_o=0 \Rightarrow V_o=V_{in}-V_C$$

When,

$$V_{in} = 0 \quad V_o = 0 - 4.5 = -4.5\text{V}$$

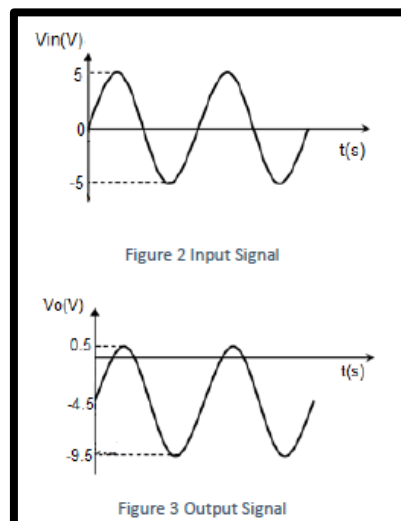
$$V_{in} = 5\text{V} \quad V_o = 5 - 4.5 = 0.5\text{V}$$

In the negative half cycle,

When,

$$V_{in} = -5\text{V} \quad V_o = -5 - 4.5 = -9.5\text{V}$$

The output shifts between 0.5V and -9.5V . Here the output has shifted down by 4.5V .



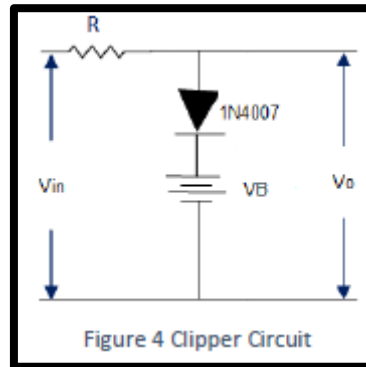
🌈 Clipper Circuits

Linear wave shaping refers to the modification of a signal's form by passing it through a network composed of linear elements. Among the most widely used wave-shaping circuits are **clippers**. These circuits function by removing or “clipping” certain portions of the input waveform without distortion to the remaining part of the signal.

Clippers are generally classified into two main types: **series clippers** and **parallel clippers**. In a series clipper, the diode is placed in series with the load, whereas in a parallel clipper, the diode is connected in parallel across the load.

Circuit Diagram and Design

Consider the configuration illustrated in *Figure 4*. For this case, the bias voltage is given as $V_B=3V$. The diode is assumed to be ideal, hence its forward voltage drop is taken as $V_D=0V$.



In the **positive** half cycle,

- (i) When $|V_{in}| > |V_D + V_B|$, D is forward biased
Applying KVL, we get

$$V_{in} = V_R + V_o$$

$$V_o = V_D + V_B$$

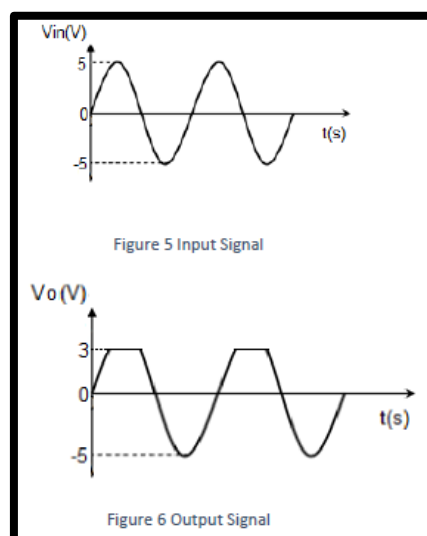
$$V_o = 0 + 3 = 3V$$

- (ii) When $|V_{in}| < |V_D + V_B|$, D is reverse biased

$$V_o = V_{in}$$

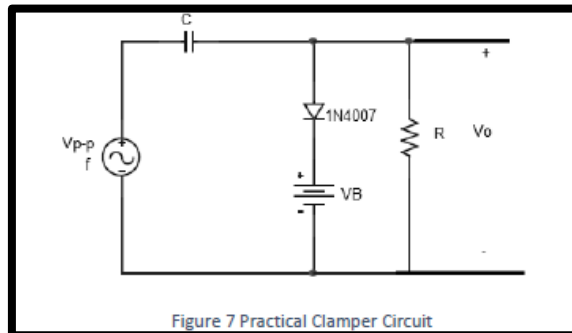
In the **negative** half cycle, D is reverse biased

$$V_o = V_{in}$$

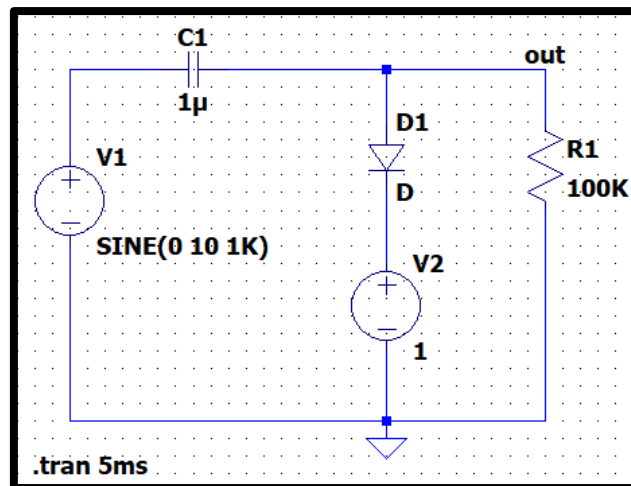


Experiment Procedure:

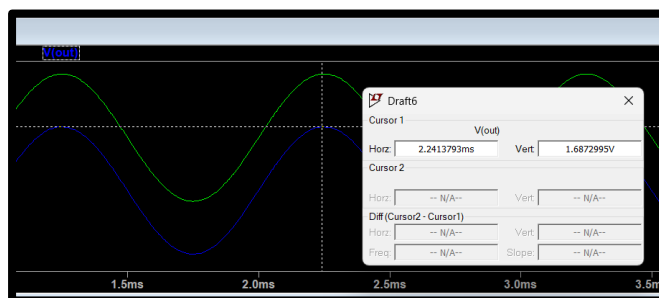
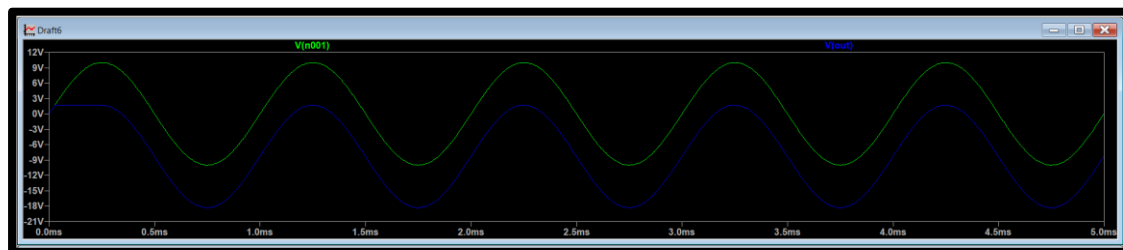
Part 1: Clamper Circuit



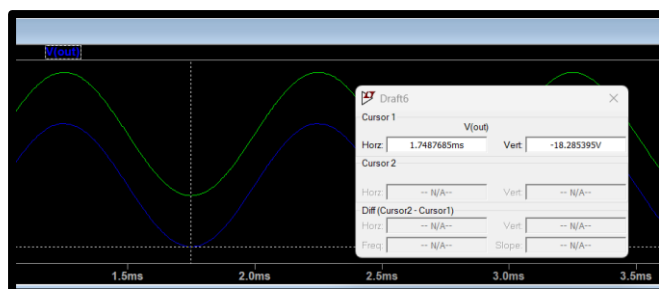
1. Connect the circuit as shown in Figure7.
2. Set function generator to a sine wave with 20Vp-p and 1 kHz.
3. Put $R=100k\Omega$, $V_B=1V$ and $C=1\mu F$.
4. Measure the input and output voltage using oscilloscope.
5. Measure the maximum and minimum values for output voltage in Table 1.
6. Simulate the circuit using LTspice program.
7. Repeat the previous step when
 - a- $V_B = 3V$
 - i. $R=1K\Omega$
 - ii. $R=1M\Omega$
 - b- $R = 100k$
 - i. $V_B = 3V$
 - ii. $V_B = 5V$
 - iii. $V_B = 7V$



When $R = 100K \text{ Ohm}$, $V_B = 1V$, $C = 1\mu F$ and frequency = $1KHz$

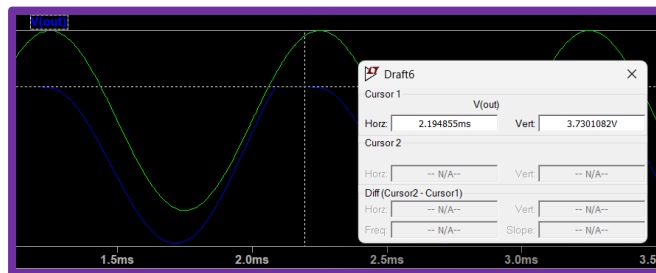
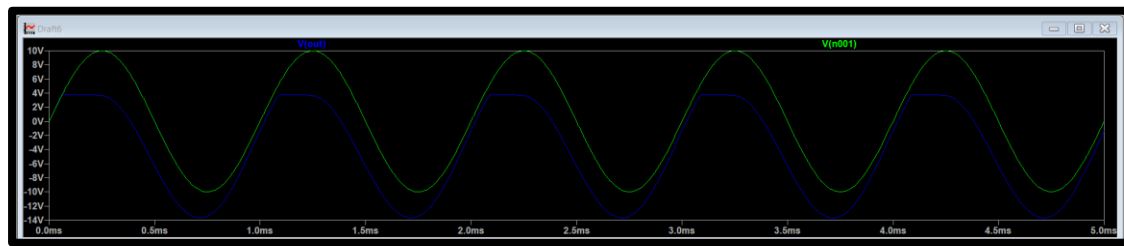


$V_{max} = 1.6872995V$

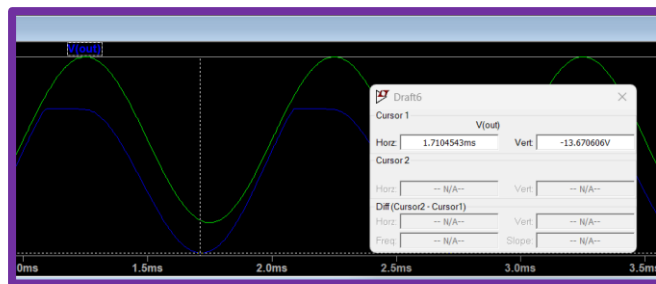


$V_{min} = -18.285395V$

When $V_B = 3V$ and $R = 1K\ \Omega$

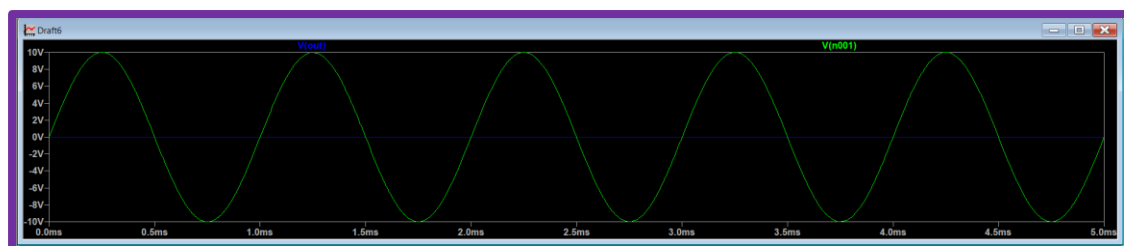


$V_{max} = 3.7301082V$



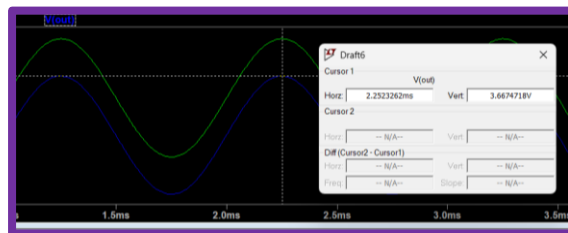
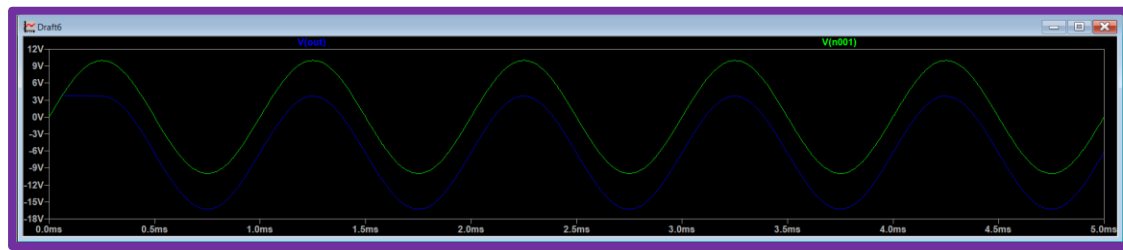
$V_{min} = -13.670606V$

When $V_B = 3V$ and $R = 1M\ \Omega$



$V_{max} = V_{min} = 0V$

When $R = 100\text{K Ohm}$ and $V_B = 3\text{V}$

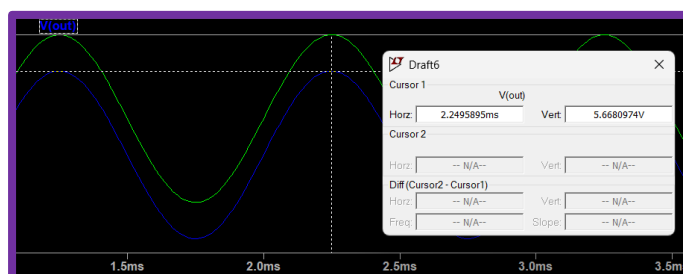
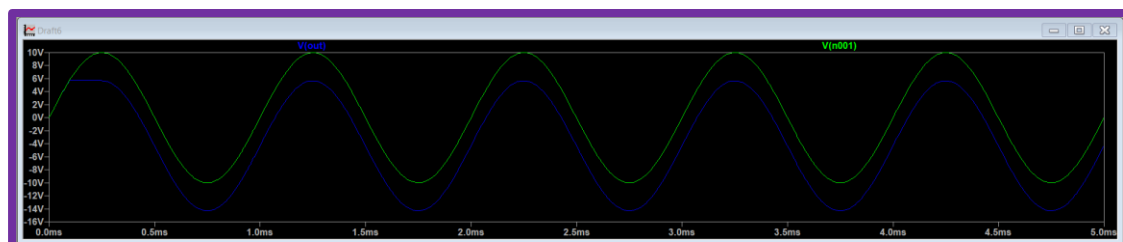


$V_{\text{max}} = 3.6674718\text{V}$

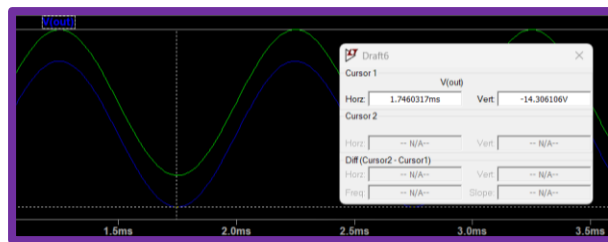


$V_{\text{min}} = -16.291581\text{V}$

When $R = 100\text{K Ohm}$ and $V_B = 5\text{V}$

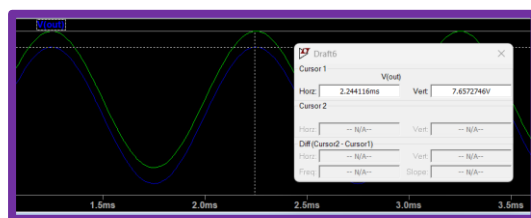
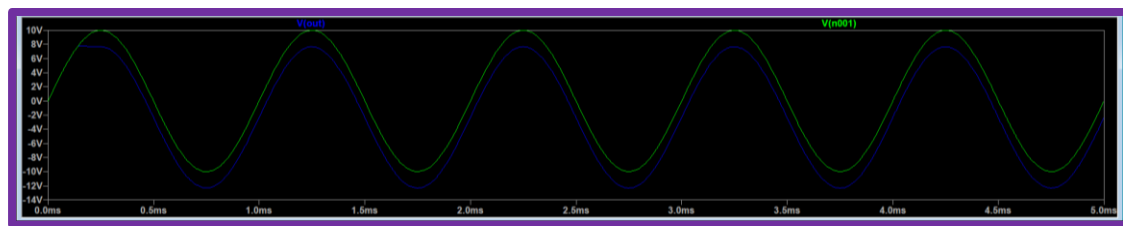


$V_{\text{max}} = 5.6680974\text{V}$



$V_{min} = -14.306106V$

When $R = 100K \text{ Ohm}$ and $V_B = 7V$



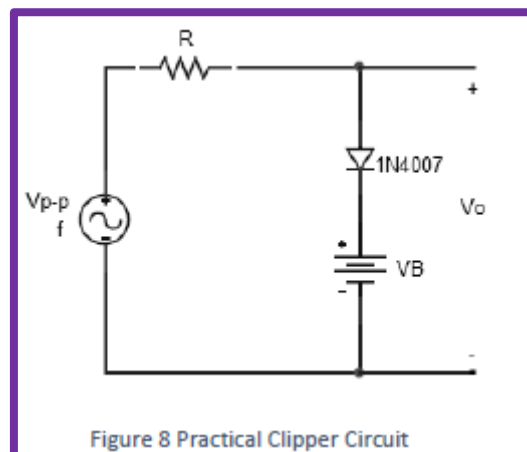
$V_{max} = 7.6572746V$



$V_{min} = -12.313708V$

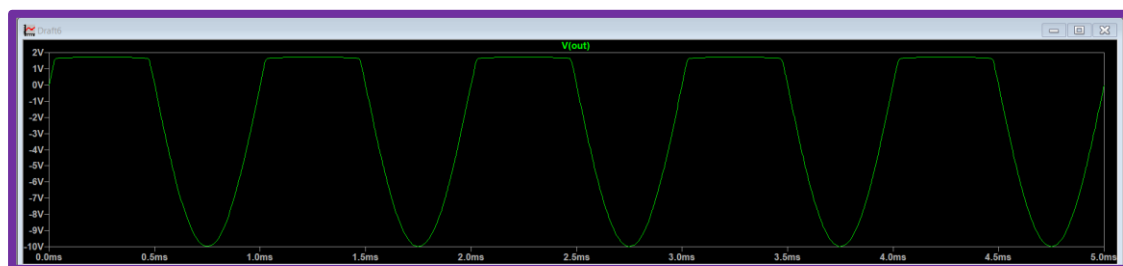
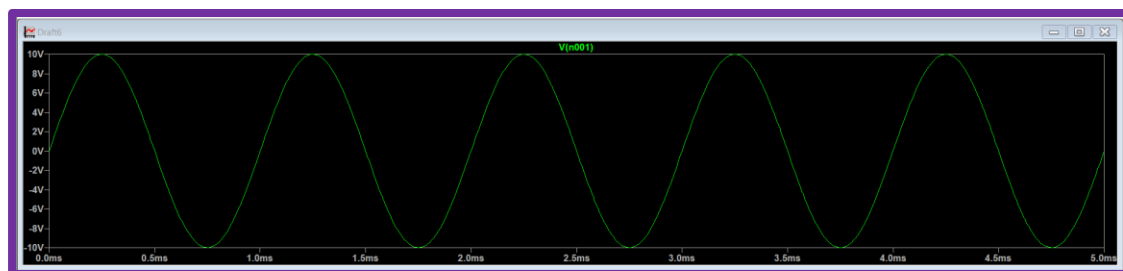
VB(V)	Max Value of Vo(V)	Min Value of Vo(V)
1	1.6872995	-18.285395
3	3.6674718	-16.291581
5	5.6680974	-14.306106
7	7.6572746	-12.313708

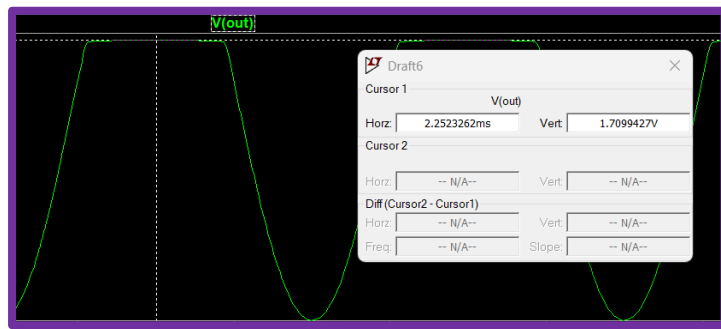
Part02: Clipper Circuit



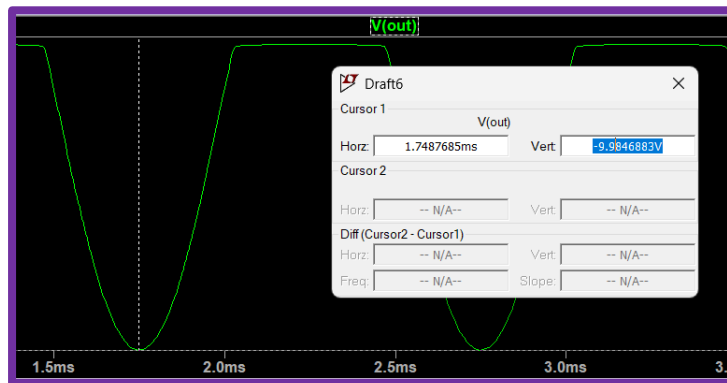
1. Connect the circuit as shown in Figure 8.
2. Set function generator to a sine wave with 20Vp-p, 1 kHz.
3. Put $R=1k\Omega$, $V_B=1V$
4. Measure the input and output voltage using oscilloscope.
5. Measure the maximum and minimum values for output voltage in Table 2.
6. Simulate the same circuit using LTspice program.
7. Repeat the previous step when
 - i. $V_B = 3V$
 - ii. $V_B = 5V$
 - iii. $V_B = 7V$

When $F = 1\text{KHz}$, $R = 1K\ \Omega$, $V_B = 1$



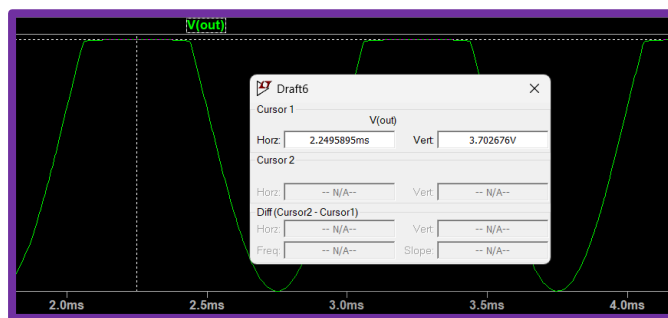


$$V_{\max} = 1.7099427V$$

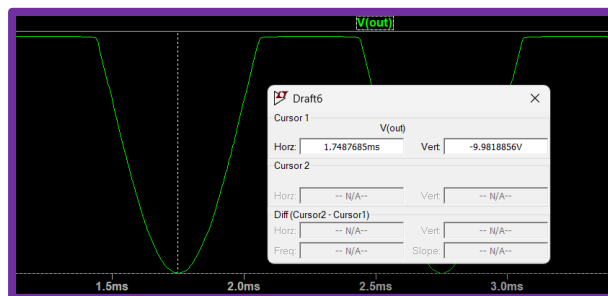


$$V_{\min} = -9.9846883V$$

When $V_B = 3V$

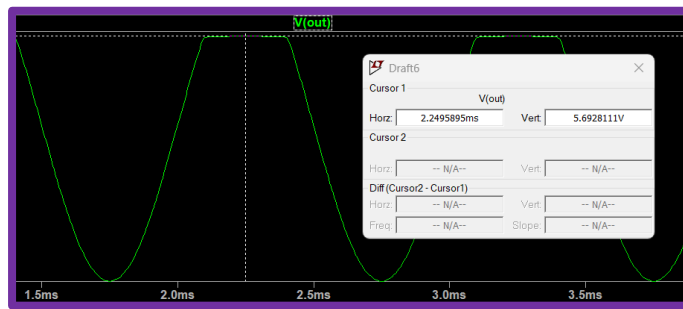


$$V_{\max} = 3.702676V$$

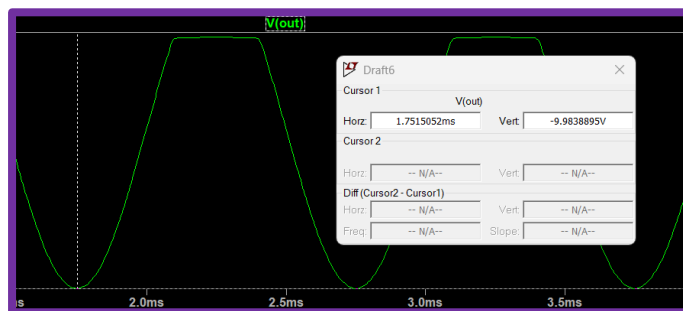


$$V_{\min} = -9.9818856V$$

When $V_B = 5V$

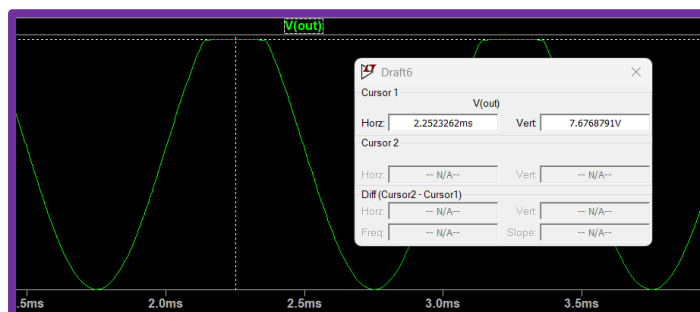


$V_{max} = 5.6928111V$

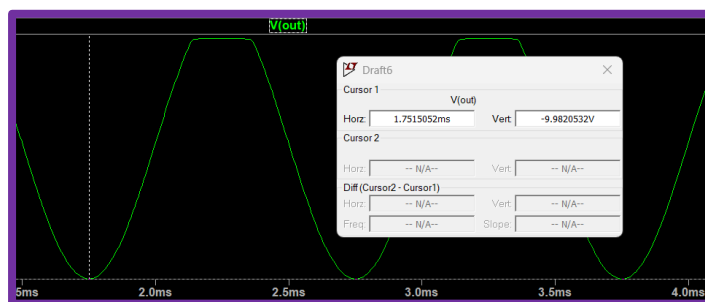


$V_{min} = -9.9838895V$

When $V_B = 7V$



$V_{max} = 7.6768791V$



$V_{min} = -9.9820532V$

VB(V)	Max Value of Vo(V)	Min Value of Vo(V)
1	1.7099427	-9.9846883
3	3.702676	-9.9818856
5	5.6928111	-9.9838895
7	7.6768791	-9.9820532