Başar Demir

150180080

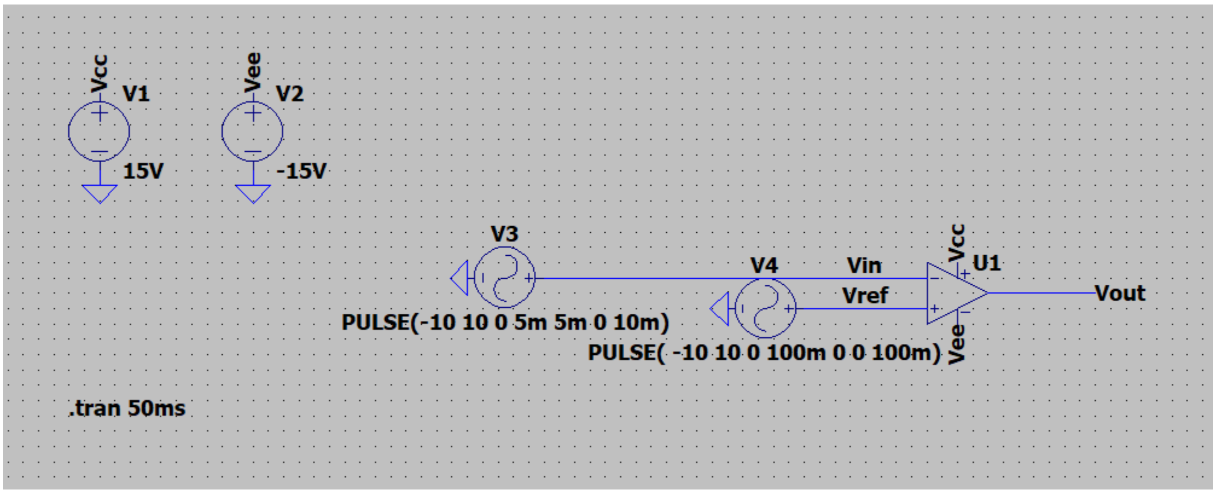
EHB-311E Experiment-5

1) Voltage Comparator

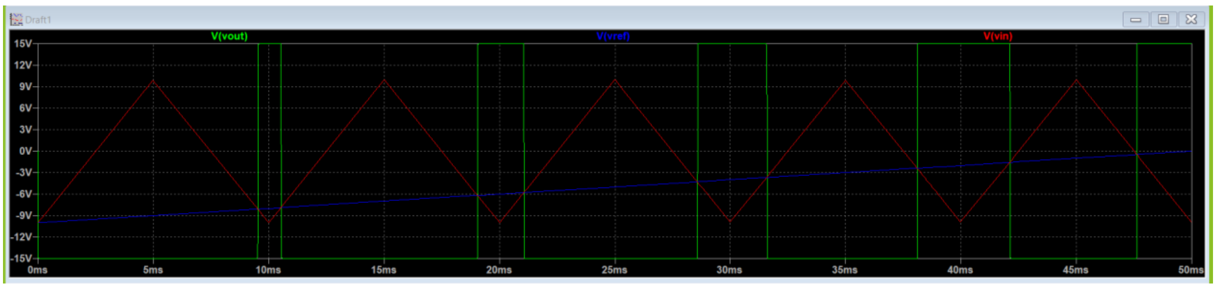
Voltage comparator based on Operational Amplifiers’ high gain property principle. Without using feed-back resistors, we can observe high output values that are occurred by small voltage differences. In this part, we have implemented comparators based on this principle. If reference voltage is bigger than input voltage, output will be Vcc. For bigger input voltage case, output will take Vee value.

For this circuit we used variable reference voltage. Because of this, we have observed not symmetrical plot table. When V reference places below (Vref<Vin) of the V input (triangular) plot, our output takes value of Vcc (such as behaviour near 10ms). When V reference places above (Vref>Vin) of the V input (triangular) plot, our output takes value of Vee (such as behaviour between ~11ms and ~19ms).

Circuit:



Output:



2) Voltage Limiter

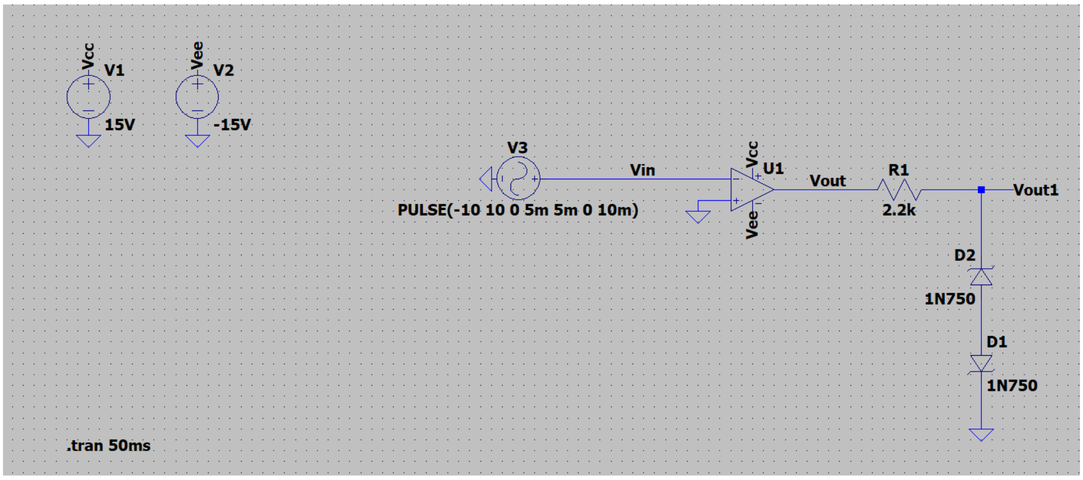
Voltage limiter circuit is constructed on voltage comparator principles. In this circuit, we gave 0V as a reference voltage. Therefore, we have observed Vcc when input is smaller than 0; we have observed Vee when input is bigger than 0 in Vout.

For Vout1 part, Zener diodes performs their roles. When Vout has negative value, D1 works at forward bias mode, D2 works at breakdown mode and When Vout has positive value, D1 works at breakdown mode, D2 works at forward bias mode.

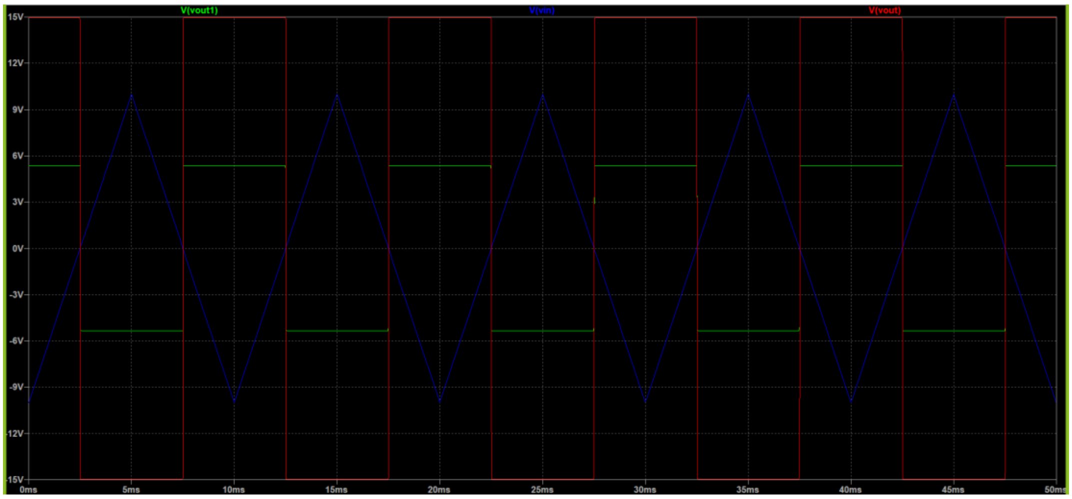
Zener diodes in forward biased mode supplies voltages as Vzener+Vd. We know our Zener voltage, it is 4.7V and Vd value is generally around 0.7V. As a result, our Vout1 value should take values between 5.4V and -5.4V. Our simulation gave similar result with 0.04 absolute error.

In conclusion, we have obtained output values between limited voltages.

Circuit:



Output:

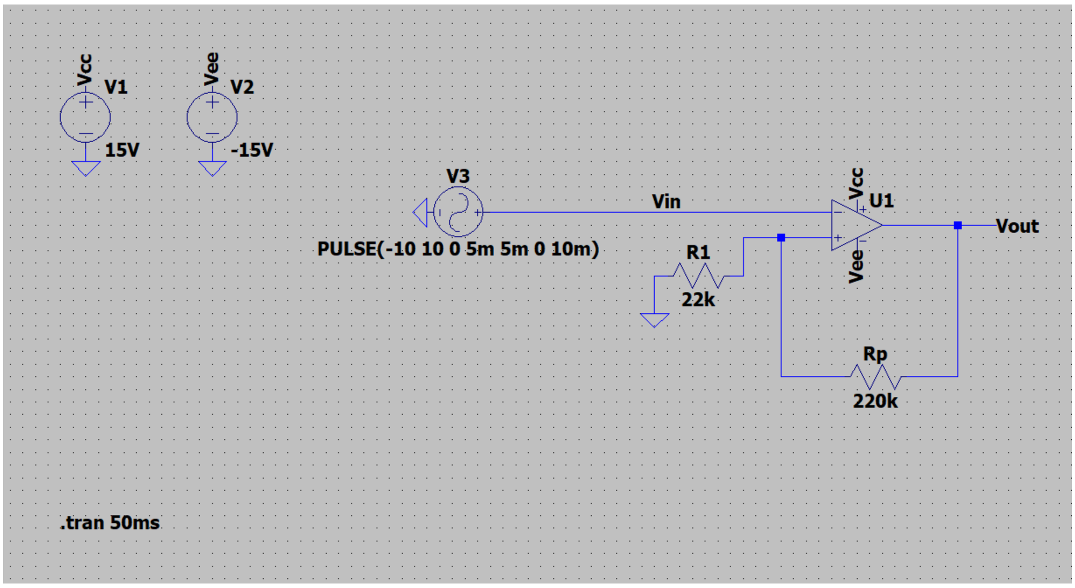


3) Schmitt Trigger

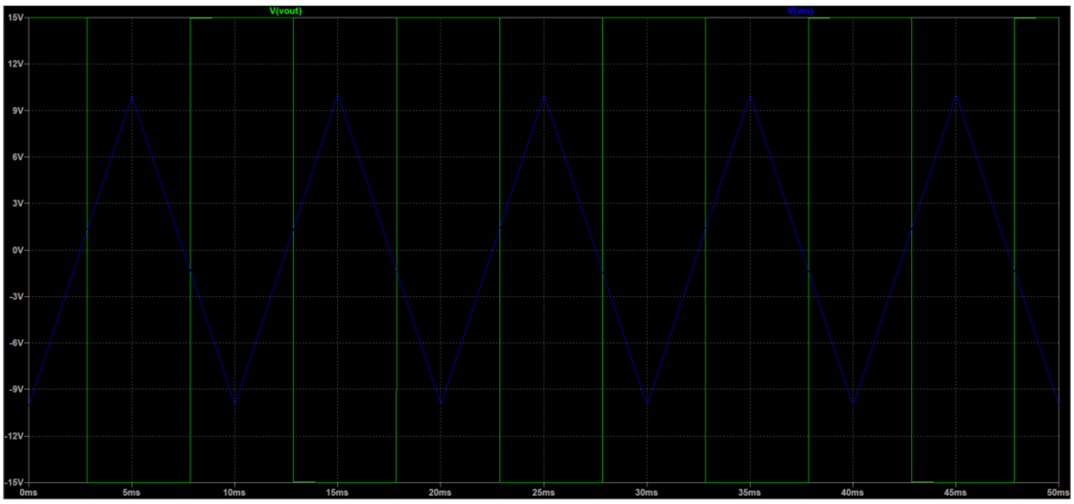
Schmitt Trigger circuit is similar to comparator circuit that has positive feedback. In this circuit, we have some values called upper and lower trigger points. That determines, boundary of high and voltage output. We can observe them from hysteresis plot. These are related to Rp and R1 values, because they provide a voltage division and it directly effects reference and output.

In output plot, we can observe the behaviour of the Schmitt trigger. When it goes above a value (I will calculate in hysteresis part), Vout becomes Vcc value. When it goes below some other value (I will calculate in hysteresis part), Vout becomes Vee value. It uses in noisy mediums to decrease effects of the noise.

Circuit:



Output:



Calculation of Hysteresis:

Theoretically, there is two values called upper trigger point (V11) and lower trigger point (V12). These are calculated as:

$$V_{11} = \frac{R_1}{R_1 + R_p} V_{cc} = \frac{22k}{22k + 220k} 15 = 1.3626V$$

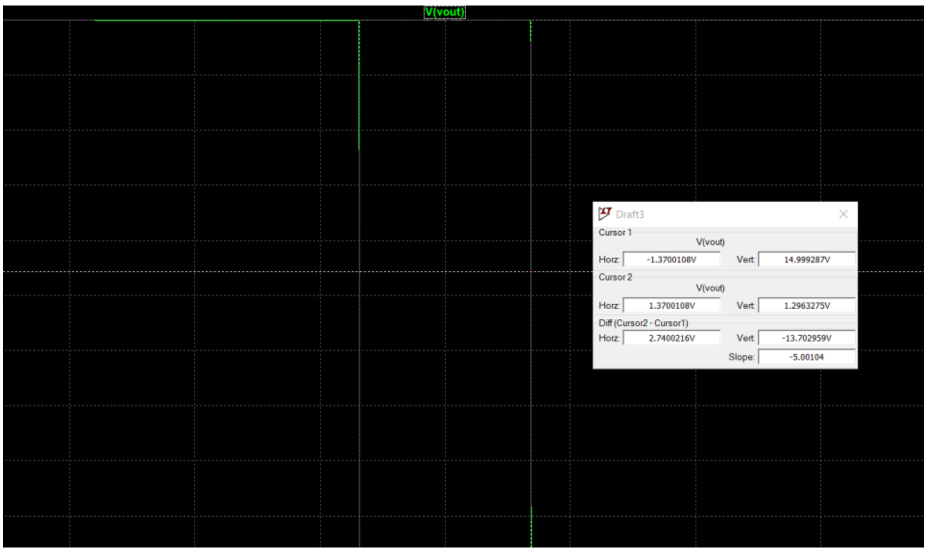
$$V_{12} = \frac{R_1}{R_1 + R_p} V_{ee} = \frac{22k}{22k + 220k}(-15) = -1.3626V$$

The Vo1 and Vo2 values for our experiment are directly out Vcc and Vee values.

As seen in the Hysteresis plot, we have two values that determines output voltages. In the second figure, we can observe simulation results for the trigger points that are close to out theoretical findings.

Hysteresis Plot:

V11 and V12 values with cursor:

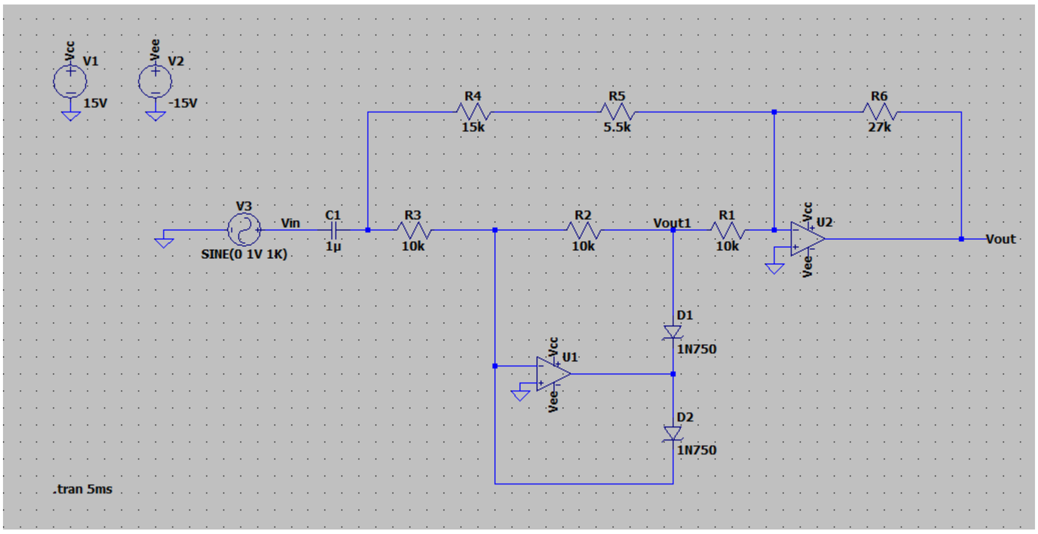


4) Full-Wave Rectifier Circuit

Full wave rectifier circuits that are implemented with OpAmp, consist of summation circuit and half wave rectifier circuits. In this experiment, we have to obtain symmetric output voltage. There are two crucial points that are determining input voltage amplitude and finding R5 value. I set input voltage as 1V (not too big) to prevent saturation condition of the OpAmp. For R5 value, theoretically R4+R5 should take R1 multiplied by 2 (20K) to obtain symmetrical output voltage. But for this experiment, I found this best-symmetrical value by trying different values of R5 and I determined to set it as 5.5K.

In output plot, we can easily observe the behaviour of the half-wave rectifier part (Vout1) that gives negative half-rectified output and Vout value that gives full-rectified absolute output voltage with the help of summation unit.

Circuit:



Output: