



## DENEY RAPORU

<b>Deney Adı</b>	Non-Linear Applications of Operational Amplifiers
<b>Deneyi Yaptıran Ar. Gör.</b>	Zehra Yiğit
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<b>Grup Numarası ve Deney Tarihi</b>	C3/ April 7, 2020

Rapor Notu	Teslim Edildiği Tarih	Teslim Alındığı Tarih
	April 7, 2021	

To simulate Operational Amplifiers, use “UniversalOpamp2”.  $V_{CC} = +15V$  and  $V_{EE} = -15V$

To simulate Zener Diodes, use “1N750” 4.7V Zener Diode.

### Experiment 5.1.

Simulate the circuit shown in Figure-1.

**Outputs:** Plot the output voltage ( $V_o$ -t) and input voltage ( $V_i$ -t) for two different reference voltage ( $V_{ref}$ ).

Explain the circuit and simulation results.

**Note:** You can use two resistors, instead of potentiometer. The sum of the resistor values should be 10K.

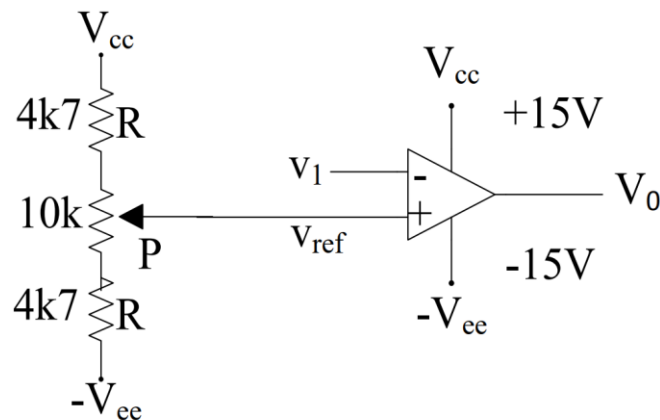
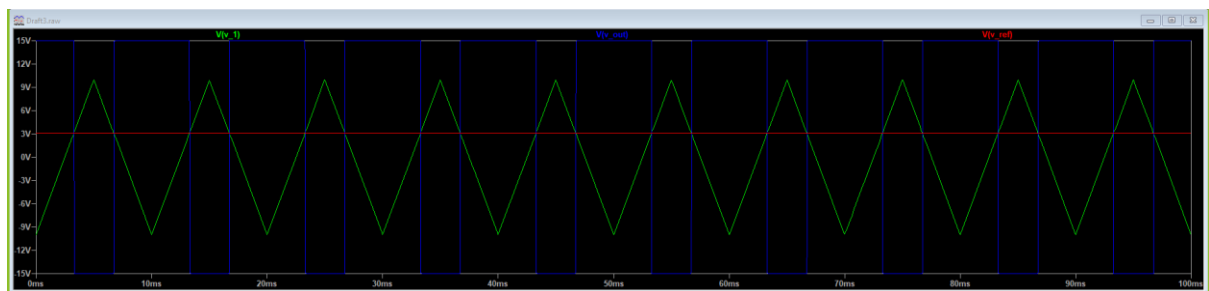
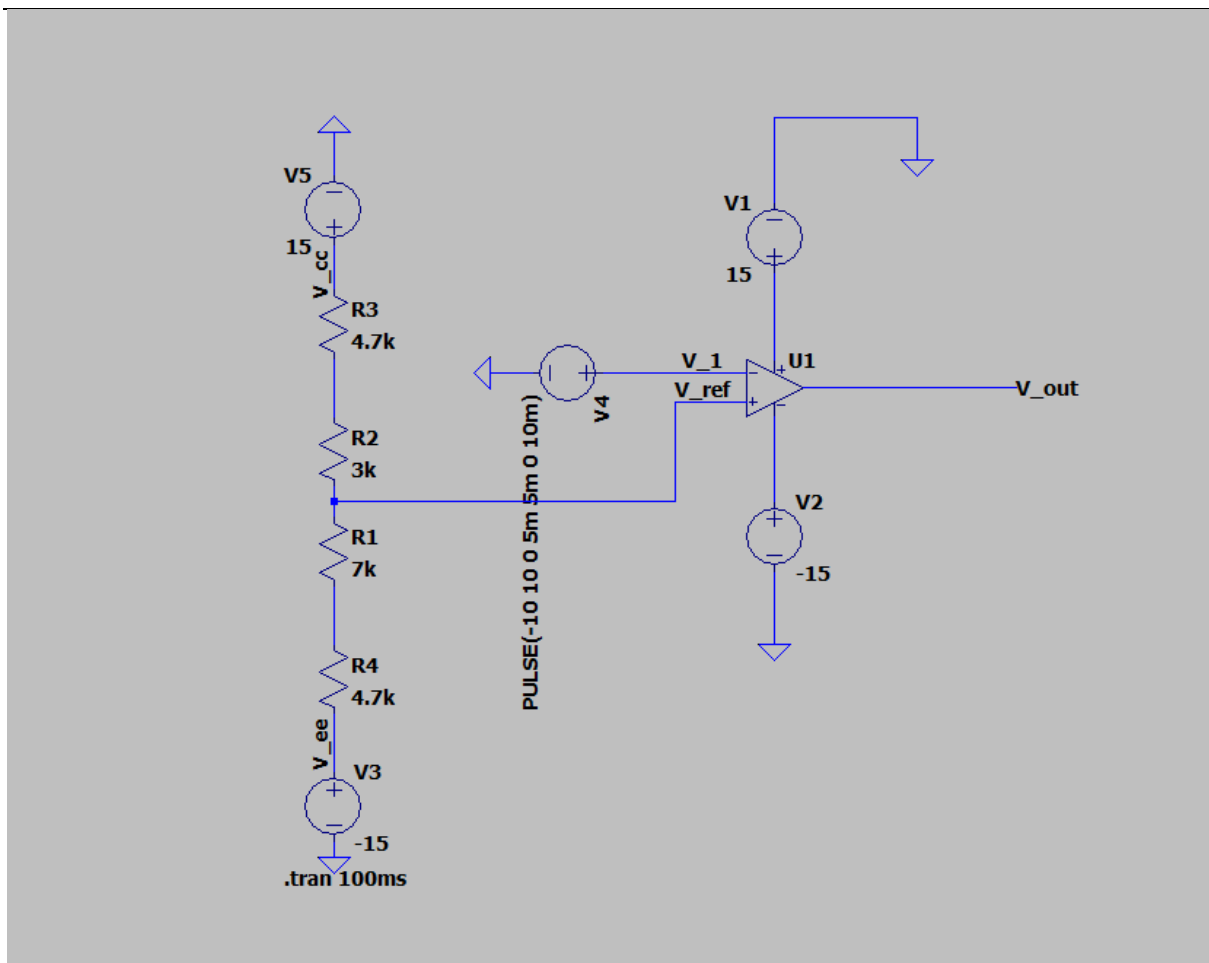


Figure 1: Voltage comparator test circuit.

Table 1: Input Signal Parameters ( $V_1$ ) for Experiment 5.1.

Exp 5.1 - $V_1$	
Type	Triangle
Frequency	100Hz
Amplitude	10V ( $20V_{p-p}$ )
DC Offset	0V

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If  $V_1 < V_{ref}$ ,  $V_{out}$  will be 15V,

If  $V_1 > V_{ref}$ ,  $V_{out}$  will be -15V.

This circuit works as voltage comparator.

### Experiment 5.2.

Simulate the circuit shown in Figure-2.

**Outputs:** Plot the output voltage of the OPAMP ( $V_o - t$ ), output voltage of the circuit ( $V_o' - t$ ) and input voltage ( $V_i - t$ ).

Explain the circuit and simulation results.

**Note:**  $V_{ref}$  should be grounded. The zener voltage of the diodes is 4.7V.

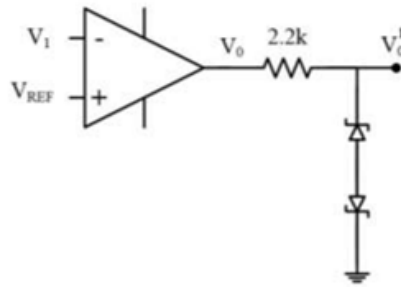
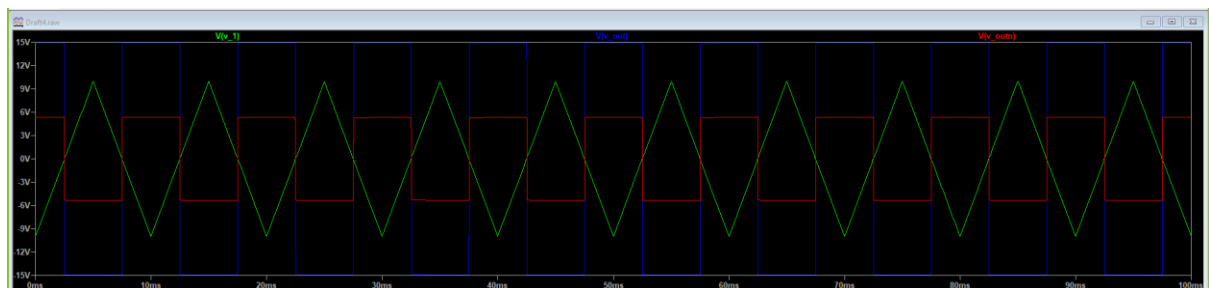
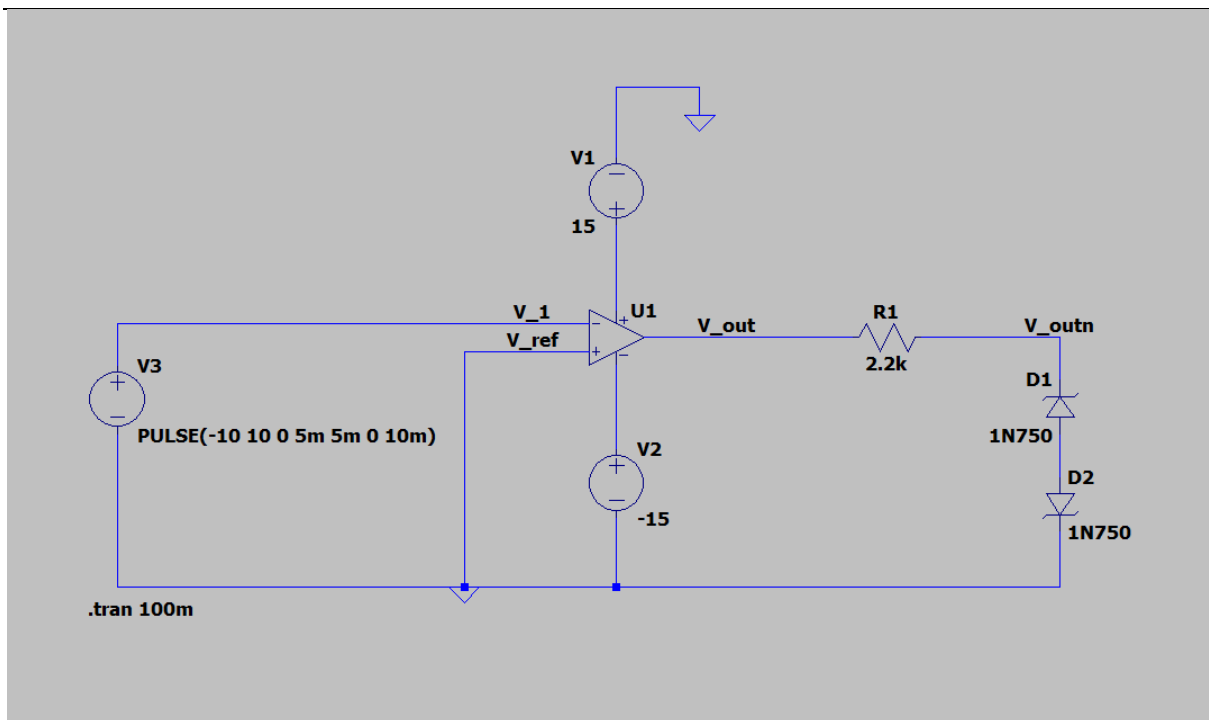


Figure 2: Voltage limiter circuit.

Table 2: Input Signal Parameters ( $V_1$ ) for Experiment 5.2.

Exp 5.2 - $V_1$	
Type	Triangle
Frequency	100Hz
Amplitude	10V ( $20V_{p-p}$ )
DC Offset	0V

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The circuit works as voltage limiter. V<sub>out</sub> is similar to part 5.1 but V<sub>outn</sub> limited by diodes and resistance. Maximum and minimum values of voltages changed for V<sub>outn</sub>.

### Experiment 5.3. and Experiment 5.4.

Simulate the circuit shown in Figure-3.

**Outputs:** Plot the output voltage ( $V_o - t$ ) and input voltage ( $V_i - t$ ) graphs.

Find the hysteresis parameters  $V_{o1}$ ,  $V_{o2}$ ,  $V_{i1}$  and  $V_{i2}$  as shown in Figure 4.

Explain the circuit and simulation results.

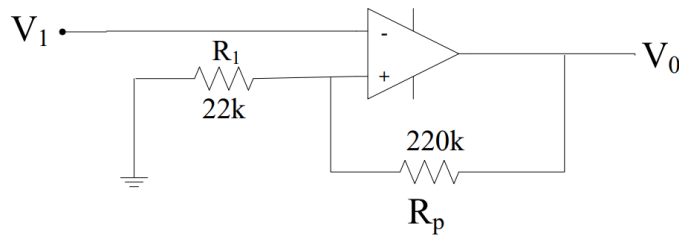


Figure 3: Schmitt trigger circuit.

Table 3: Input Signal Parameters ( $V_1$ ) for Experiment 5.3 and Experiment 5.4.

Exp 5.3-5.4. - $V_1$	
Type	Triangle
Frequency	100Hz
Amplitude	10V (20V <sub>p-p</sub> )
DC Offset	0V

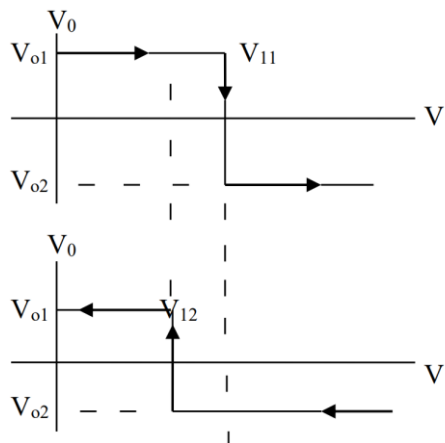
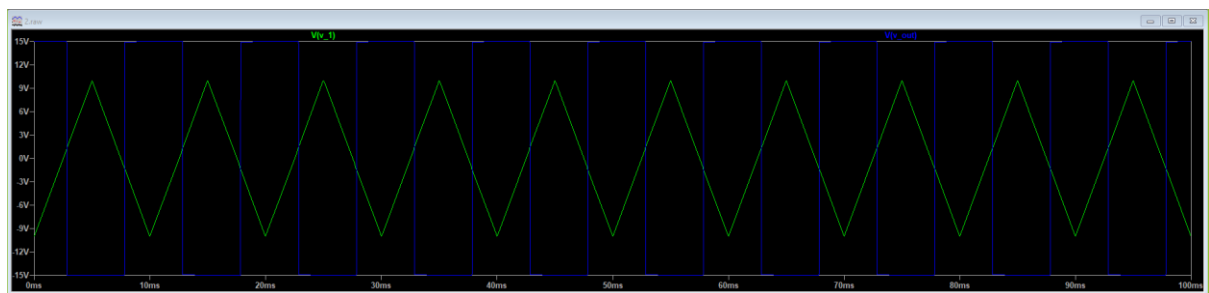
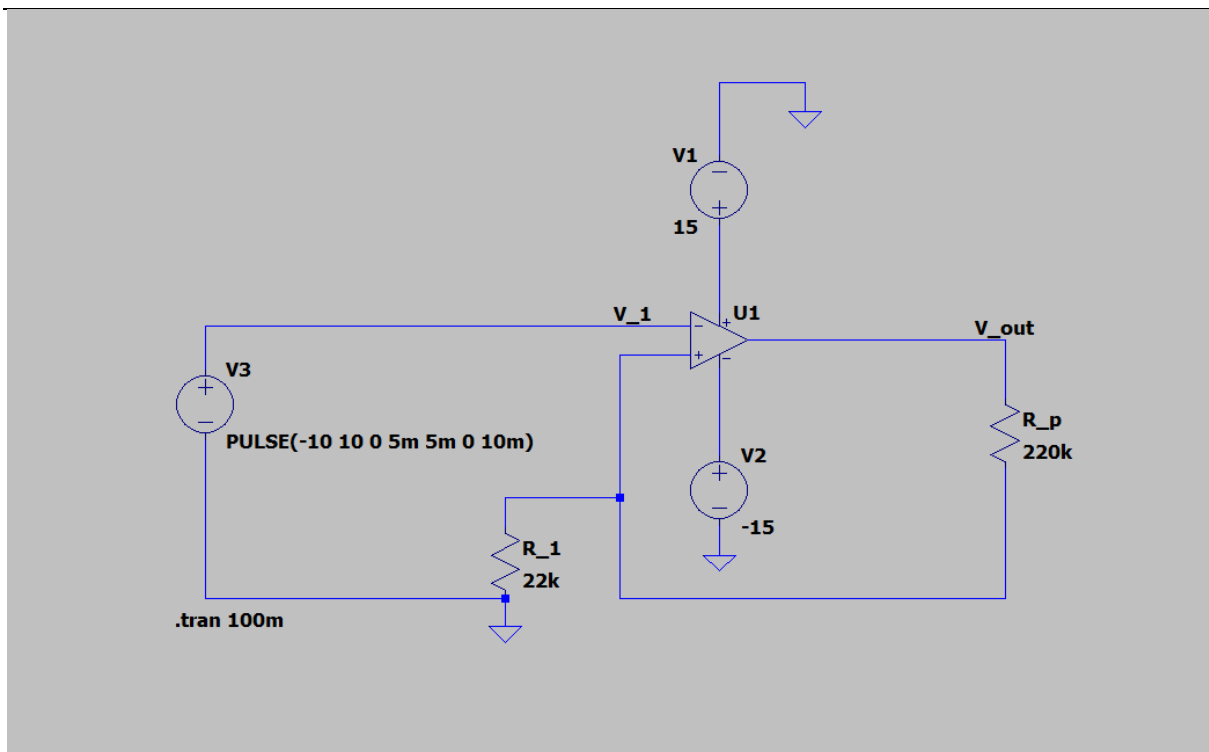


Figure 4: Hysteresis characteristic.

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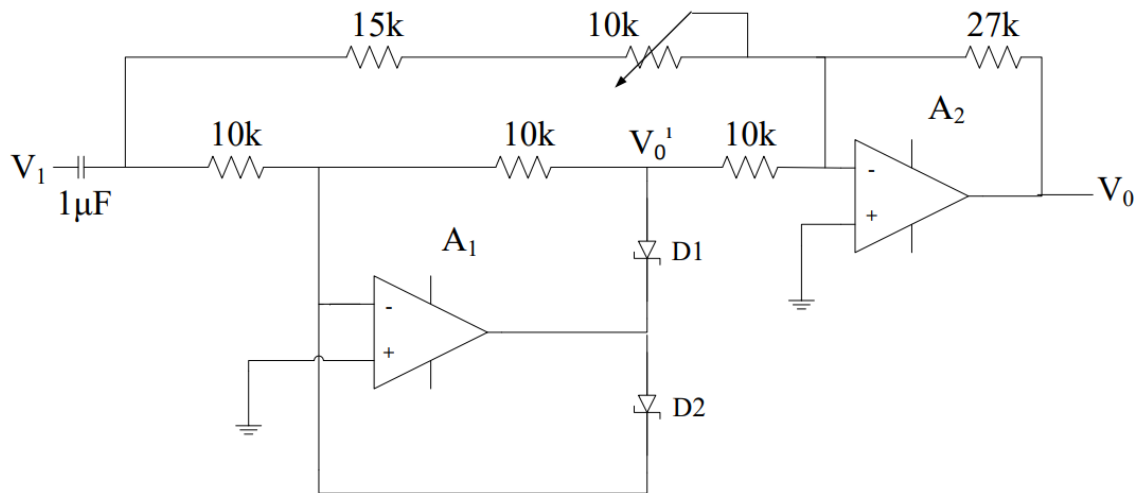


Here, sign of the value of  $V_{out}$  changes to  $V_1 = 1.3879544V$  according to graph.

If  $V_1 < 1.3879544V$ ,  $V_{out}$  will be 15V.

If  $V_1 > 1.3879544V$ ,  $V_{out}$  will be -15V.

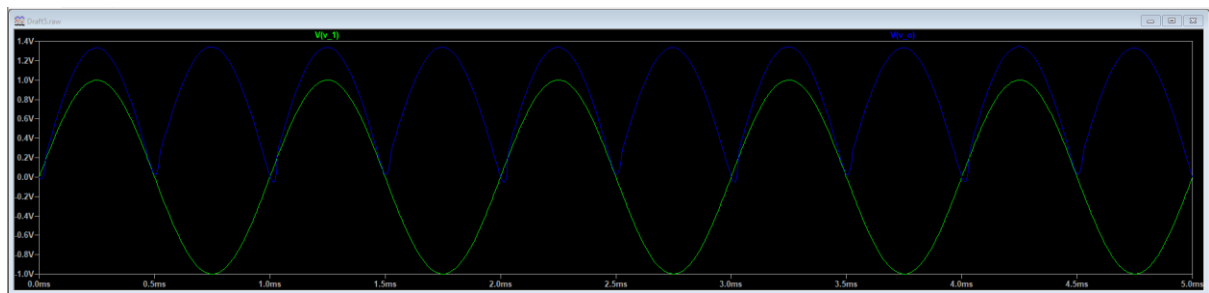
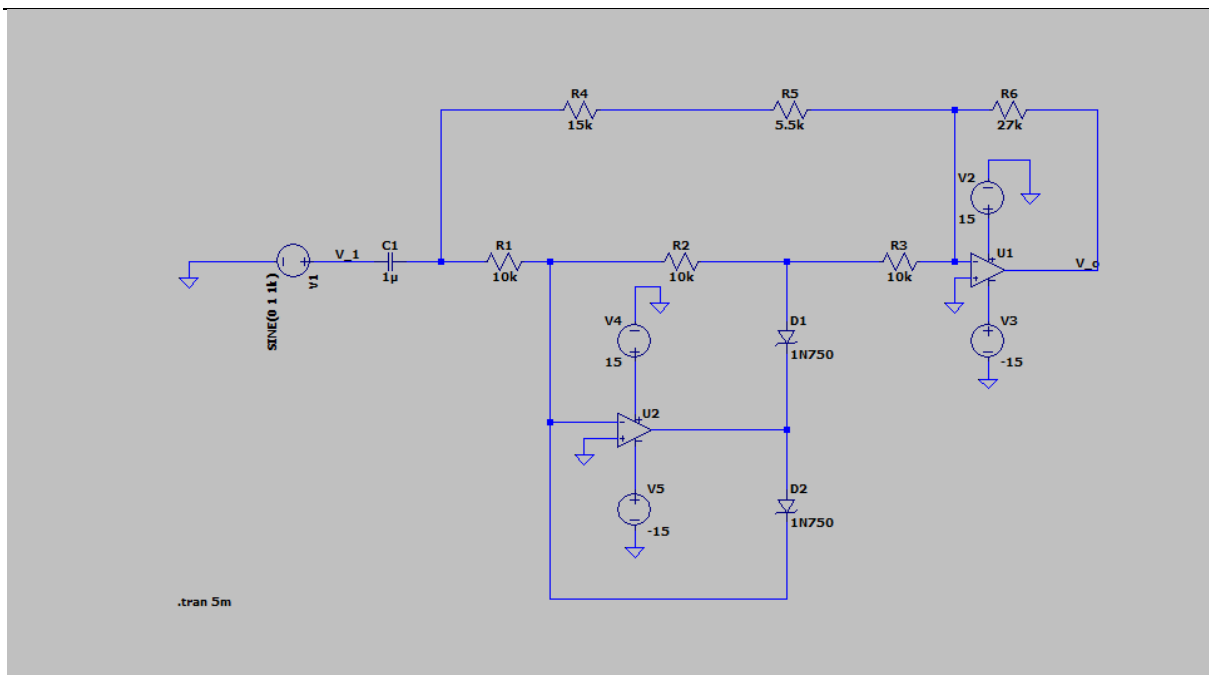
**Note:** The zener voltage of the diodes is 4.7V.



Exp 5.5. - $V_1$	
Type	Sine
Frequency	1kHz
Amplitude	Appropriate Level
DC Offset	0V



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We only able to change the value of R5, to get symmetrical graph, we obtain the value of R5 is 5.5k ohm.

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