ENEE2360 Project

Automatic Night Light

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Abstract:

The circuit is designed to act as Automatic Night Light, It turns on an LED when ambient light falls below a certain threshold The circuit uses the LDR to sense light levels. If the light is dim (LDR resistance increases), the op-amp output goes high, turning on the transistor and lighting up the LED. Adjusting the potentiometer sets the threshold

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Part 1: Practical Part

a) Implement practically

-adjust the 100k potentiometer to ensure that the LED turns on when it is dark

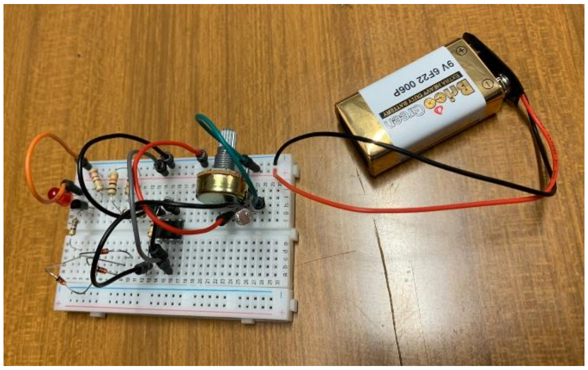

Figure 1

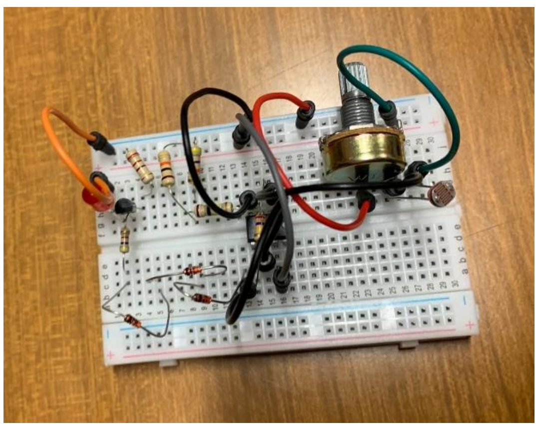

Figure 2

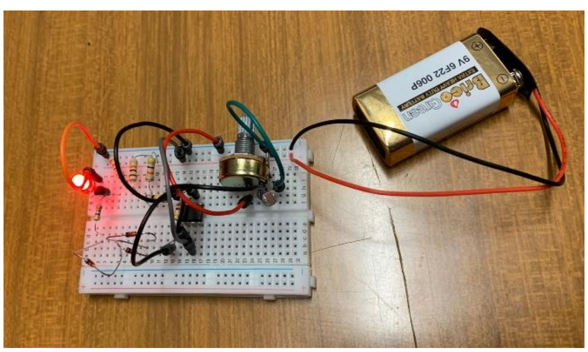

Figure 3

b) Rf=1.7k

c) The node voltages: at dark (when the LED is on).

VA=1.3v

VB=1.5v

VC=6.34v

VD=2.75v

VE =2.1v

d) The node voltages: at light (when the LED is off).

VA=1.60v

VB=4.0v

VC=0.0v

VD=0.58v

VE =9.2v

f) Explanation of the function of the circuit:

Components:

1. **Light-Dependent Resistor (LDR):**
   - **The LDR is a key component in the circuit. Its resistance changes based on the intensity of ambient light.**
   - **When exposed to bright light, the LDR's resistance decreases. Conversely, in low light conditions, its resistance increases.**
   - **The LDR is connected between the positive supply voltage (+9V) and point A.**

2. **Operational Amplifier (Op-Amp, U1):**
    - **The op-amp (labeled as uA741) is configured as a comparator.**
    - **It compares the voltage at point A (determined by the LDR) with a reference voltage set by the potentiometer (at point B).**
    - **If the voltage at point A drops below the reference voltage due to reduced ambient light, the op-amp output goes high.**
3. **Transistor (Q1):**
    - **The NPN transistor (Q1) acts as a switch.**
    - **When the op-amp output goes high, it turns on Q1.**
    - **Current flows through resistor R4 and into the LED (D6).**
4. **Diodes (D1-D5):**
    - **These diodes are likely for protection or rectification purposes.**
    - **They ensure that current flows in the correct direction and prevent damage to other components.**
5. **Resistors:**
    - **The 10kΩ resistors at points A and B set the voltage levels for comparison.**
    - **The 47kΩ resistor connected to point A influences the voltage at the non-inverting input of the op-amp.**
    - **The 100kΩ potentiometer (between points B and C) allows adjusting the threshold for light sensitivity.**

- **The 4.7kΩ resistors (between points C and D) are likely part of biasing or current limiting.**

6. **LED (D6):**
    - **When Q1 is turned on, current flows through R4 and activates the LED (D6).**
    - **The LED lights up when ambient light falls below the threshold set by the potentiometer.**

Part2 (Simulation):

a) **Simulate the circuit of Fig.(1) for LDR = 10K and determine VA, VB, VC, VD, and VE**

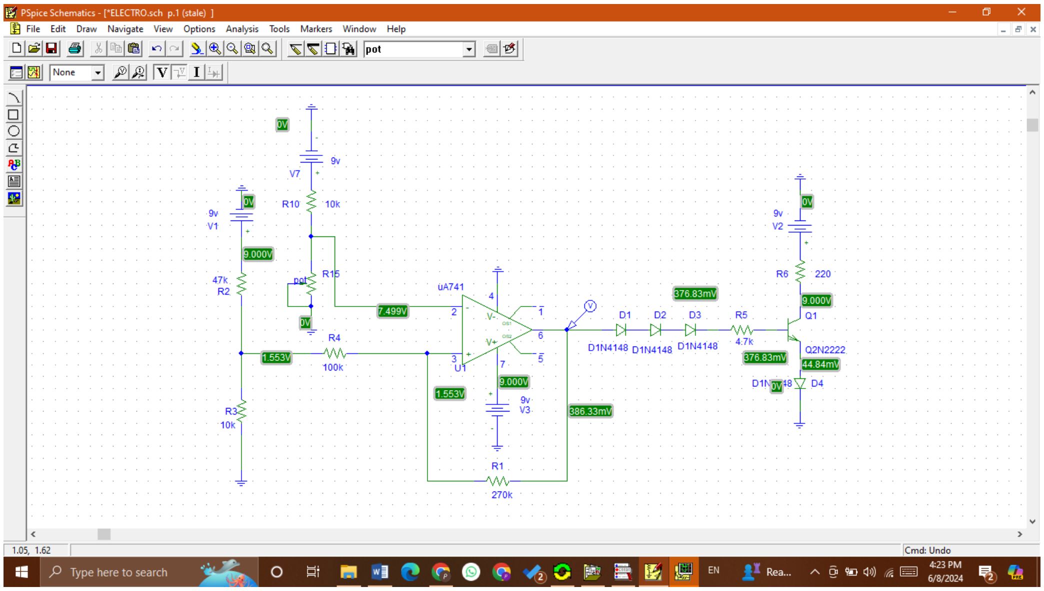

Figure 4

for different LDR =

1. **100KΩ**

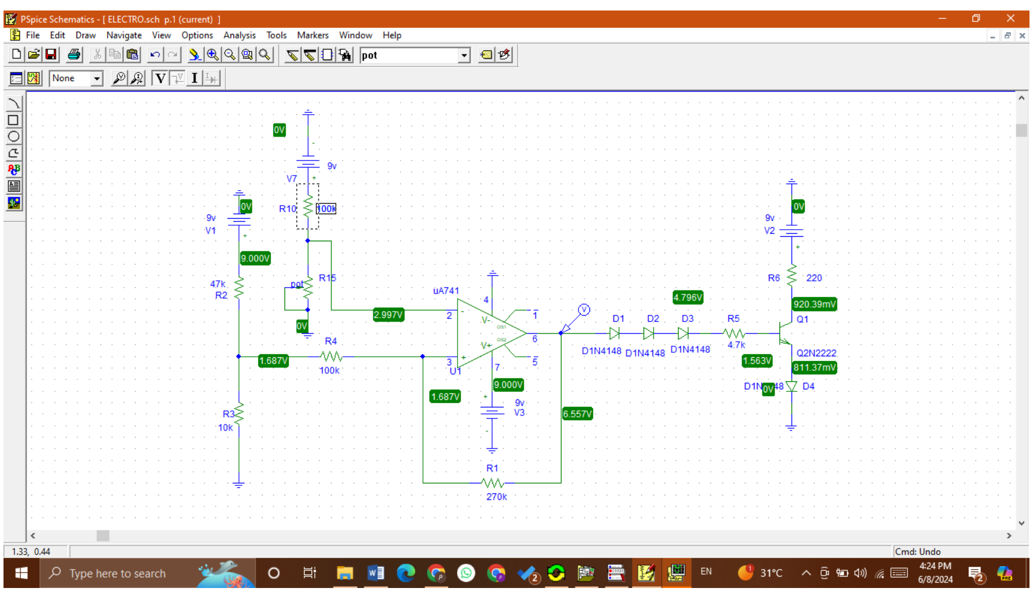

Figure 5

2. 400ΩK

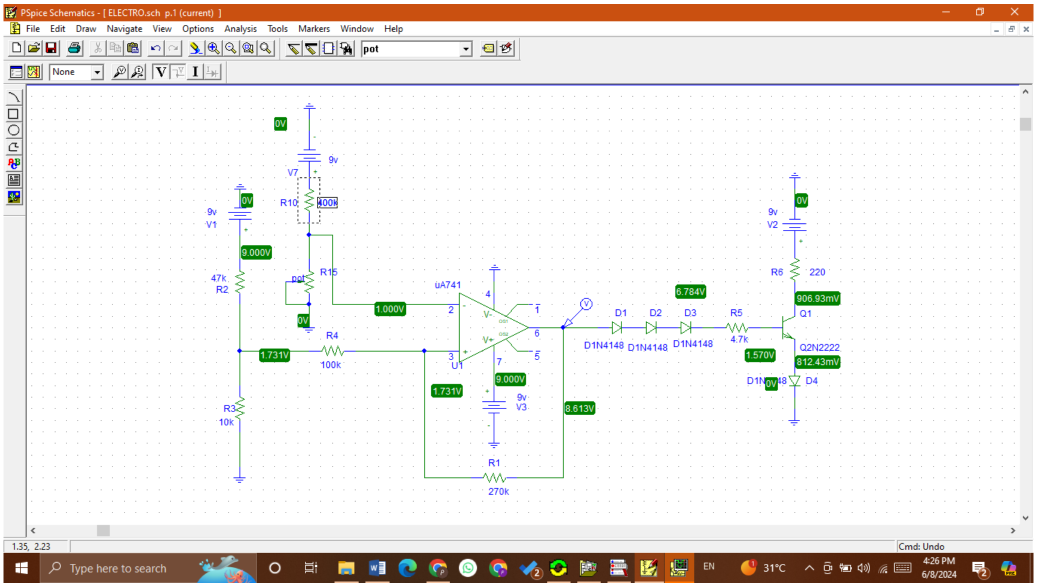

Figure 6

3. 600ΩK

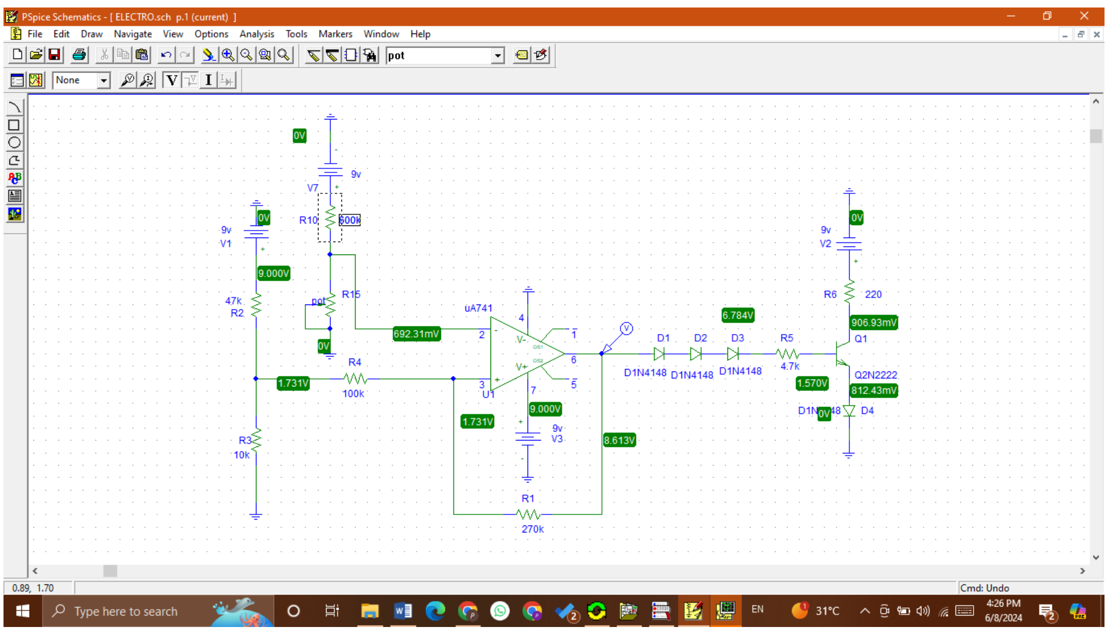

Figure 7

b) Replacing the LDR, the 100k pot, and the 9V with a VPWL Voltage source, Simulate the circuit.

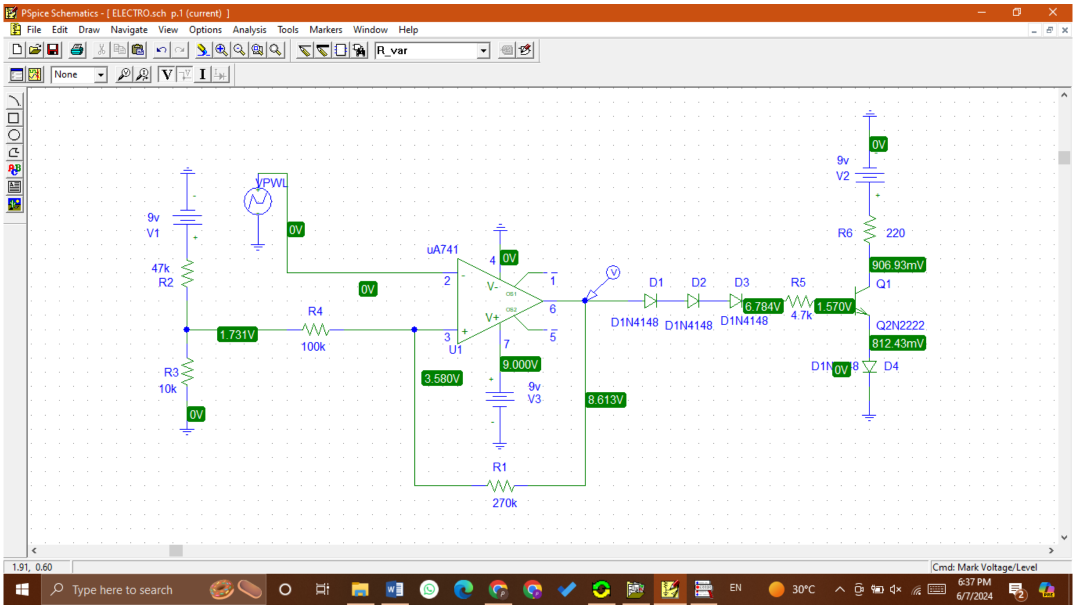

Figure 8

plot VC(t), and VE(t)

Vc(t):

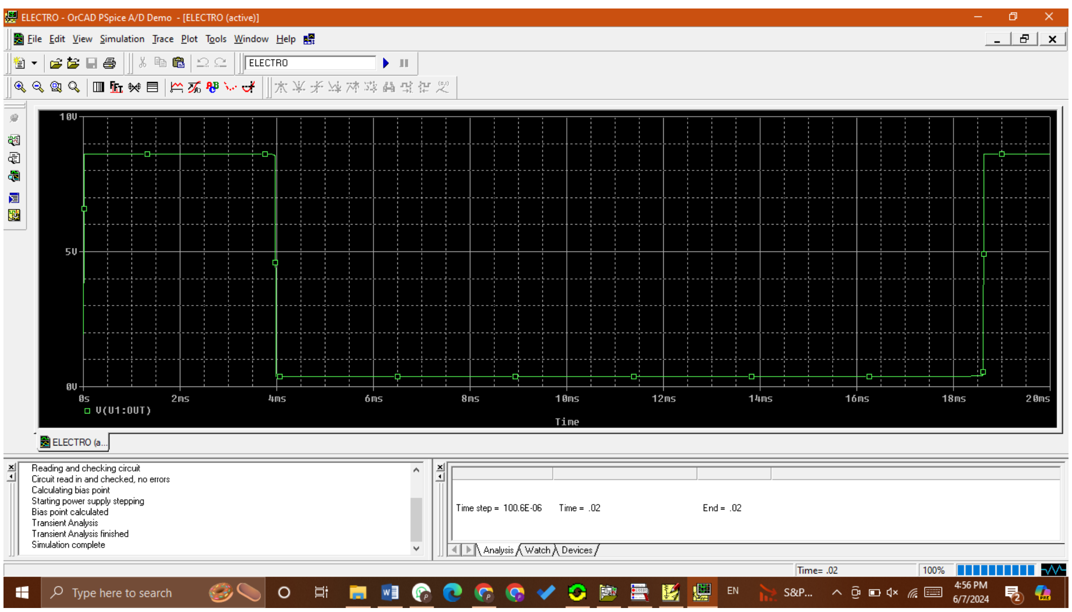

Figure 9

VE(t):

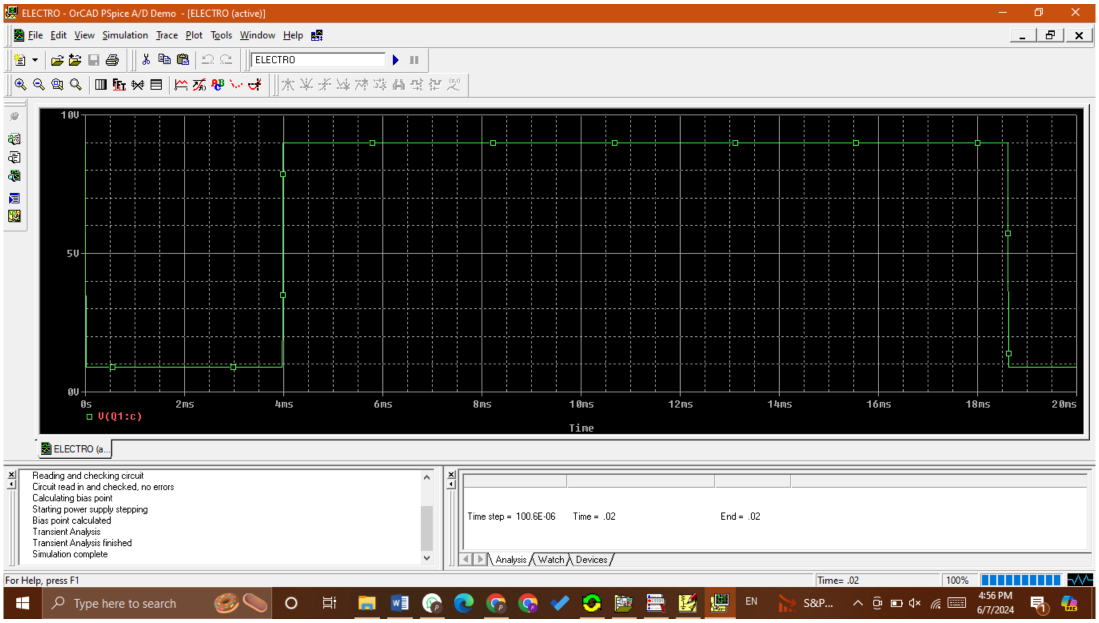

Figure 10

c) The estimation of upper threshold and the lower threshold voltages from VC (t).

$V_{LT} = 1.24v$

$V_{UT} = 3.58v$

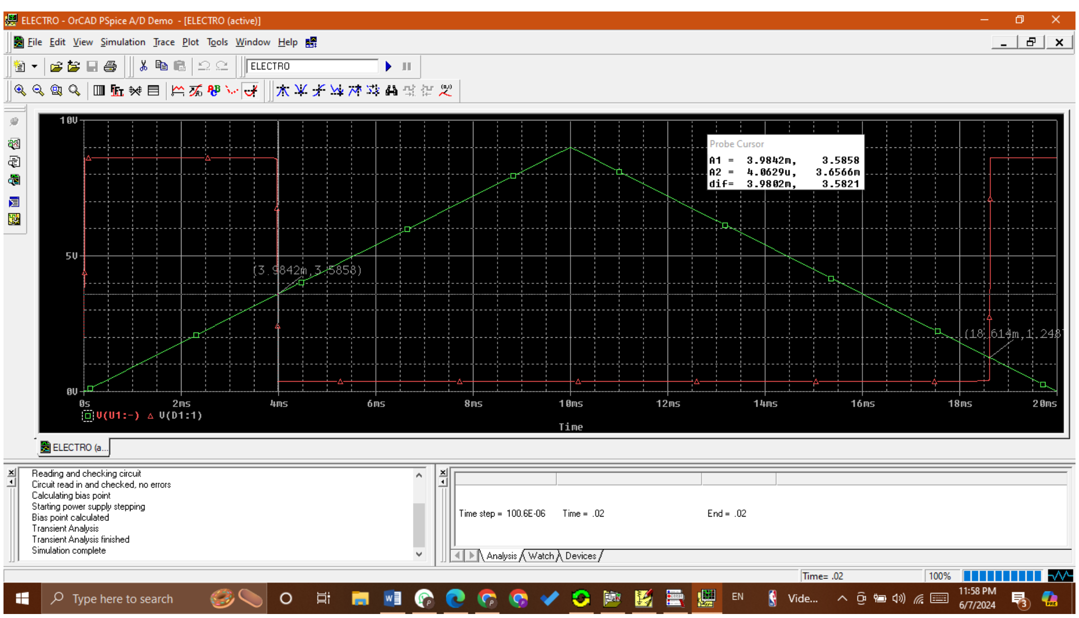

Figure 11

d) by hand Calculation for the upper threshold and the lower threshold voltages:

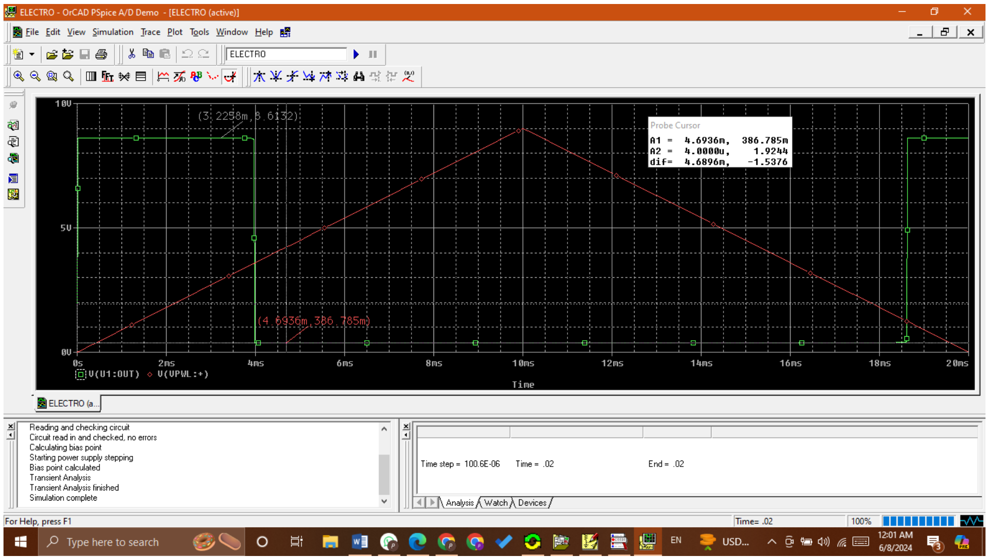

Figure 12

$$V_{sat+} = 8.6v \; from \; the \; graph$$

$$V_{sat-} = 0.386v \; from \; the \; graph$$

R1= 270K

R2=100K+(47K//10K)=108K

Vref = (10k/(47k+10k))*9v=1.6v

$$V_{UT} = \left(\frac{R_1}{R_2 + R_1}\right) \cdot V_{ref} + \left(\frac{R_2}{R_2 + R_1}\right) \cdot V_{sat+}$$

$$= \left(\frac{270k}{108k + 270k}\right) \cdot 1.6 + \left(\frac{108k}{108k + 270k}\right) \cdot 8.6 = 3.6v$$

$$V_{LT} = \left(\frac{R_1}{R_2 + R_1}\right) \cdot V_{ref} + \left(\frac{R_2}{R_2 + R_1}\right) \cdot V_{sat-}$$

$$= \left(\frac{270k}{108k + 270k}\right) \cdot 1.6 + \left(\frac{108k}{108k + 270k}\right) \cdot 0.386 = 1.23v$$

e) Comparison of simulation results to hand calculation

In simulation result v upper threshold = 3.58v, in hand calculation =3.6v

In simulation result v lower threshold = 1.24v, in hand calculation =1.23v

All results are closed which means that the design values are right and design is accepted

Conclusion:

In conclusion, I learned how to design the circuits using PSpice and the breadboard, and how to simulate my results using PSpice to make sure that the designs will assure and accept results. And I see the effect of using vpwl power supply to the dc signal, Finally, the results were accepted and the simulated values were close to required values and the practical values.