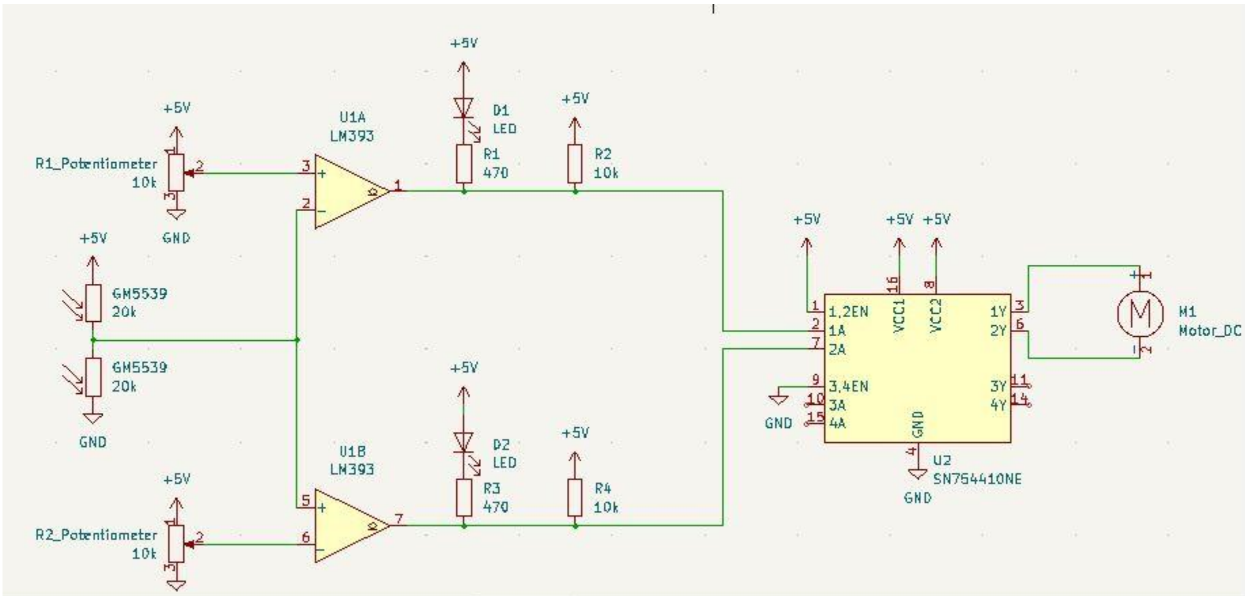
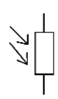
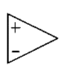
Lab 8: Solar Tracker Lab



Purpose:

The purpose of this lab is to create a solar tracker that automatically rotates the solar panel towards a light source. If more light is shown on the left side of the solar tracker, the solar tracker should rotate counterclockwise towards the light. Likewise, if more light is shown on the right side of the solar tracker, the solar tracker should rotate clockwise towards the light.

In this lab, you will be experimenting with the solar tracker to understand 4 concepts:

- Photoresistors 
- Comparators 
- Pullup resistors
- H-Bridges

Solar Tracker Sockets:

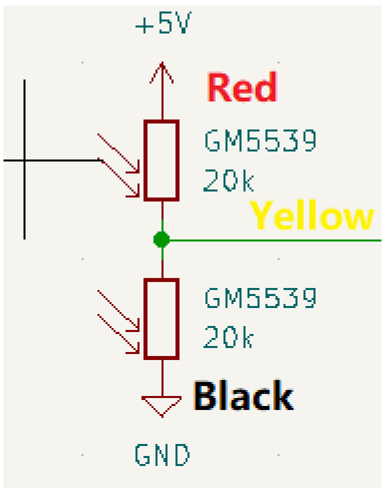
The solar tracker has 6 banana sockets: Red, Black, Yellow, Orange, White, Blue.

Here are their functions:

Red: The red banana socket is meant to connect power to the upper photoresistor in the schematic.
Black: The black banana socket is meant to connect a ground to the lower photoresistor in the schematic.
Yellow: The yellow banana socket connects the upper photoresistor and lower photoresistor to a common.

Orange: The orange banana socket is a path to the power generated by the solar tracker.
Blue: The blue banana socket connects to the upper pathway on the motor.
White: The white banana socket connects to the lower pathway on the motor.

Part1(Photoresistor):

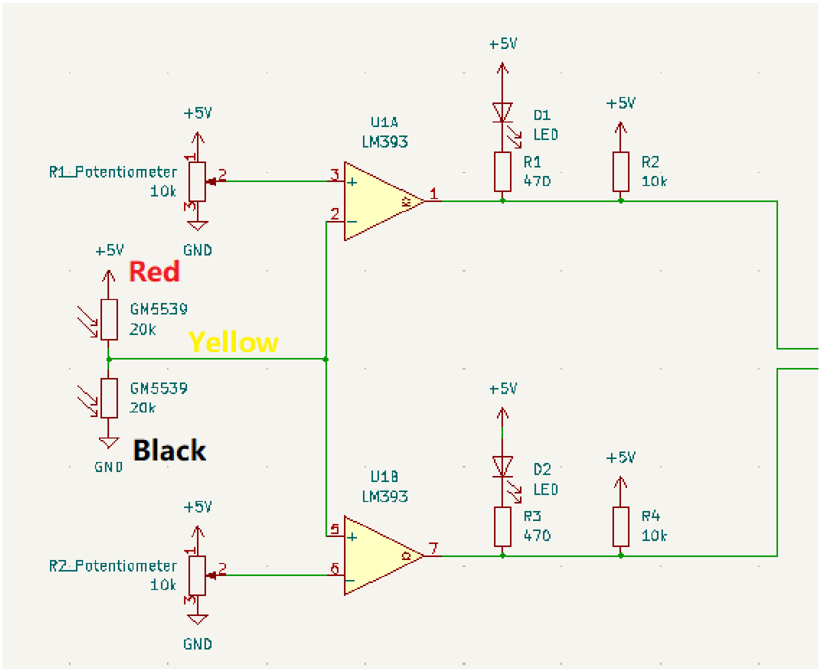


1. First, when talking about the photoresistors, a common perspective is needed. We will be viewing the solar tracker from the front where the front is where the banana jacks are facing towards you. Thus, there are a left and a right photoresistor on the solar tracker.
2. Second, it goes to note that the photoresistors of the circuit form a voltage divider where shining the light on the left(upper) photoresistor will decrease the resistance from the voltage source to the common and shining the light on the right(lower) photoresistor will decrease the resistance from the common to the ground.
3. Next, hookup a 5V voltage source to the red socket and the ground to the black socket.
    - Record the voltage from the yellow socket to ground with no light shining on the photoresistors. 2.5 V
    - Then, shine light on the left photoresistor and record the voltage from the yellow socket to ground. 0.8 V
    - Then, shine light on the right photoresistor and record the voltage from the yellow socket to ground. 3.9V
    - Do these voltages make sense? Why? Think back to part 1, question 2(hint: look at the voltage divider formula).
    - Based on what was learned, what condition should cause the solar tracker to go counterclockwise? Clockwise?

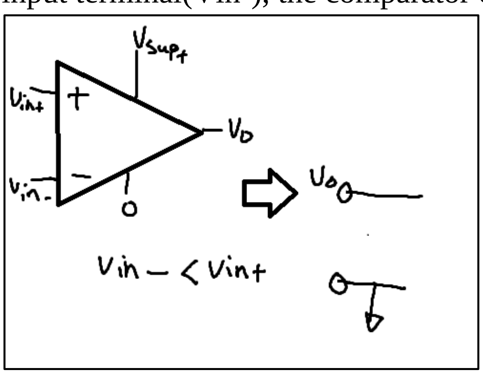
Part2(Comparators):

Yes, the light is inversely proportional to resistance so there is less of a voltage drop so the LED goes off.

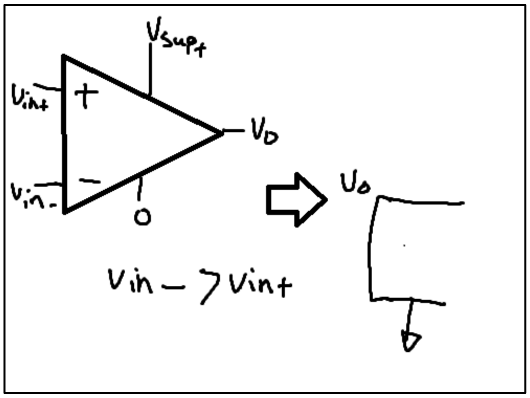
Shine light on left makes it go clockwise. Shining light on right makes it go counter.



4. Look back at the solar tracker schematic and hook up the comparators **EXCEPT** for the SN754410NE H-Bridge. Set both the potentiometers to output 2.5V. Here are some specifics on the comparators **FOR THIS CIRCUIT(not all comparators work this way, read the datasheet for any comparator you get).**
   - When the positive input terminal(Vin+) has a higher voltage than the negative input terminal(Vin-), the comparator output is seen as a high impedance:



   - When Vin- has a higher voltage than the Vin+, the comparator output is seen as a short to the negative voltage supply.

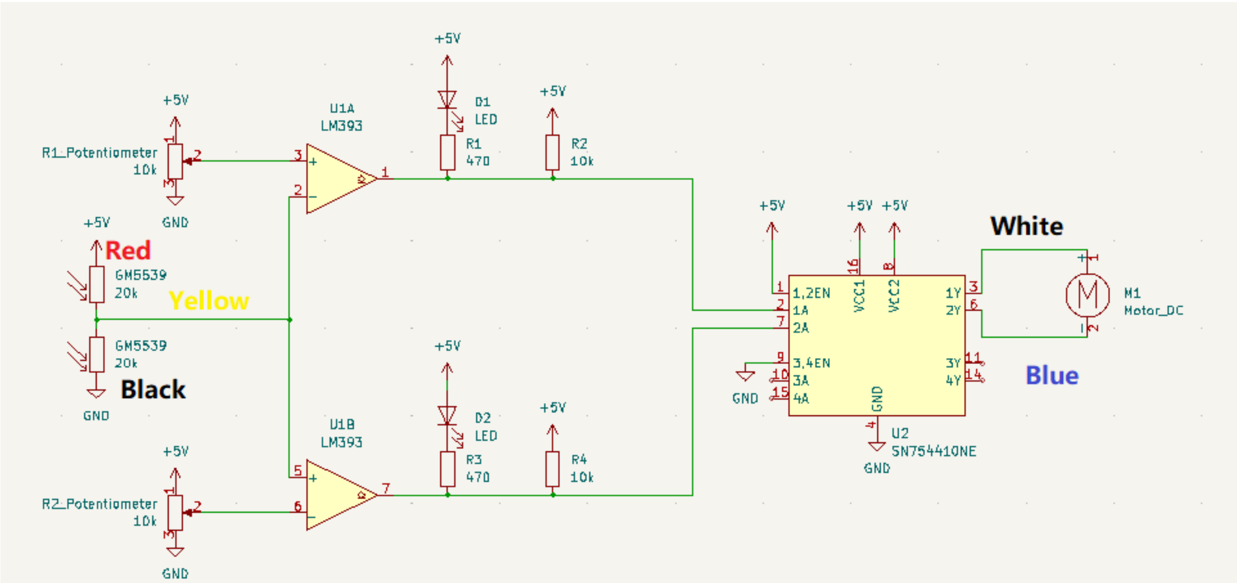


	LEFT	RIGHT
	COMP A = 5 V LED OFF	COMP A = 0.28 V LED ON
	COMP B = 0.25 LED ON	COMP B = 5.01V LED OFF

5. Now, based on this logic, the comparator naturally has no voltage on the output of the comparator when Vin+ > Vin-. To make it such that this condition does have an output voltage, there needs be pullup resistor which is your R2 for the upper comparator and R4 for the lower comparator.
6. Shine the light again on the left resistor and measure and record both comparator output voltages to ground. Do the same measurements after shining light on the right resistor. Compare the voltages on the outputs to the effects on their respective LEDS. What are the purpose of the LEDs?
7. Knowing the output voltages from the comparators and what was found on number 3, what is the purpose of the upper comparator? The lower comparator?
8. Next, remove resistors R1 and R2 from output 1 of the upper comparator. Measure and record the voltage on output 1 with reference to ground after shining light on the left photoresistor. Record the same while shining light on the right photoresistor. What happens and why? This effect showcases what the pullup resistor does.

Part3(H-Bridge):

Left	Right
COMP A = 0 V	COMP A = 0 V



With a light source on left photoresistor, solar tracker moves to the left. Same idea with a source on right.

9. Now, hookup the rest of the circuit. Experiment and document what occurs when you shine the left and right photoresistors. Again, the solar tracker should rotate to follow the light source.
10. A final issue should be occurring in our current setup with the solar tracker. Notice when the solar tracker is idling, the voltage source is still outputting current only that it is not enough overcome the torque needed to rotate the motor. Based on the voltage and current outputted by the voltage source, how much power is being wasted? Note, this is not only a waste of power, but it will also destroy the motor overtime.

Vs = 5 V
Is = 0.1 A

P = 0.5 W

11. To solve this, there needs to be a deadzone voltage that the yellow socket can safely output without activating either of the comparators, or a deadzone that activates both comparators. There are two ways to solve this, and you only need to figure out one of the ways:
    - Create a condition where both comparators are on.
    - Create a condition where both comparators are off.

    To do either of these conditions, the voltages outputted the potentiometers should be adjusted. Pick and note down which method you decide to use, and record what voltages you observed on the R1_potentionmeter and R2_potentionmeter to get this effect.

Both comparators are off

Upper Potentiometer = 5 V
Lower Potentiometer = 2.5 V