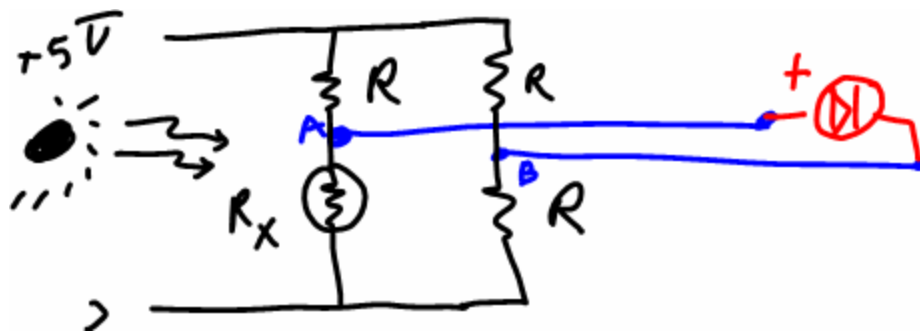


Mobile Studio (MS)-03 - CdS Cell Application With Comparator

1. Load Effect Problem

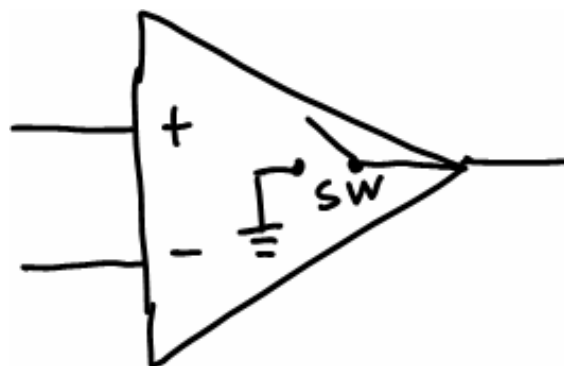
From the basic bridge circuit, we could get the voltage between A and B, and we could observe the voltage variation as we cover/uncover the CdS photo cell, changing the illumination amount on the cell. Then, since LED can be turned on with just a few volt with tens of milli-amps, we connected an LED hoping that it turns on when the voltage between A and B is high enough. But that did not happen. The measurement of the voltage V_{AB} with the LED connected was lower than that without LED connection. So we saw the real loading effect. The resistance of the LED is added into A and B, and the voltage between A and B was lowered.



As we learned in the class, the loading effect disappears when the load's resistance is infinity or very large, and loading effect (which means the voltage drop) is severe when the load resistance very low. Now the question is: how do we connect a load which has some resistance (not infinity) without loading effect? Since we cannot change the load, we look for a device which can provide very high resistance while keeping the input and output intact.

2. Comparator

A comparator is an electronic chip of transistors which can serve perfectly for our purpose of connecting a load without experiencing load effect. A comparator is an active device which requires power source to perform as defined by its input-output rule. A comparator is indicated by a symbol of triangle with two inputs and an output.



The two inputs are disconnected (or connected with infinity resistance – this is the point of goodness in using comparator, “infinity resistance can be connected to A and B of our circuit for CdS cell.), and the output is connected (or not yet connected) to the ground via a switch (SW).

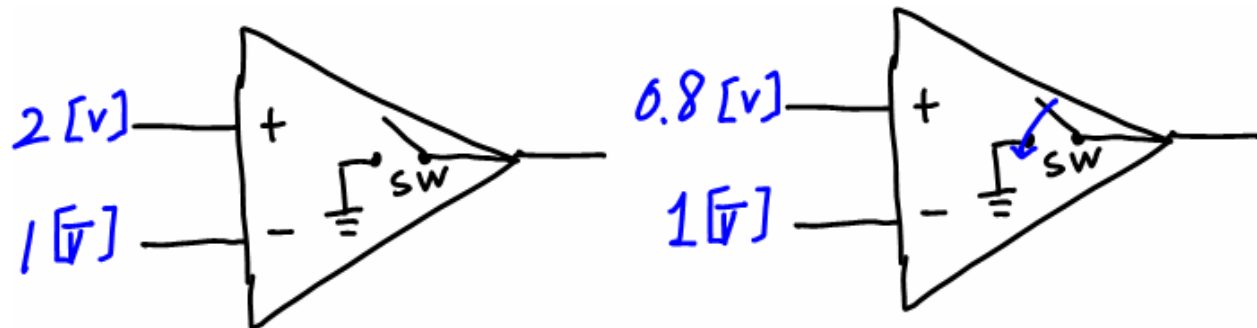
As the name implies the comparator compare two input voltages appear at (+) input and (-) input terminals, and either close the SW or open it.

3. The Rule of Comparator

This is the simple rule.

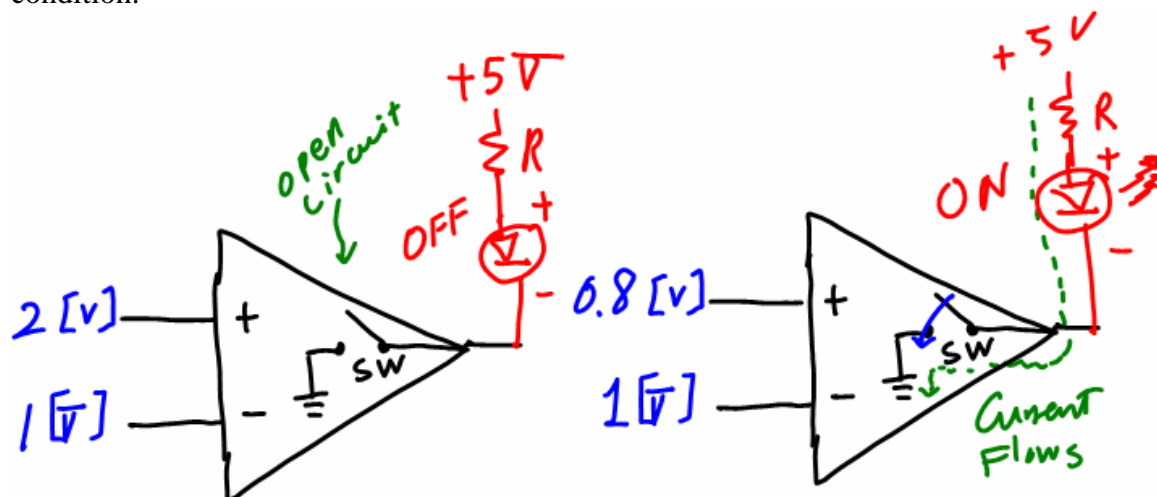
- (1) If the voltage at (+) is higher than that of (-), SW is opened, and the Output is disconnected from GND.
- (2) If the voltage at (+) is lower than that of (-), SW is closed, and the Output is GNDed.

For example, if we use (-) terminal as a reference input, like 1[V], then, when (+) terminal voltage is bigger than 1[V], the SW is open; when (+) terminal voltage is lower than 1[V], the SW is closed (See illustration below)



4. Connection of LED to Comparator

Now how do we connect our load to the comparator (which in turn will be connected to the bridge circuit of CdS cell)? The point is that the output of the Comparator is connected to GND or floated from it. If we connect an LED and a series resistance to +5V source, then (1) if the SW is closed, the current flows from +5V source through the series resistor, LED, to GND, thus lighting the LED; and (2) if the SW is open, the circuit is open so that there is no current flowing through the LED, darkening it. See the illustration below for LED connection and its ON/OFF condition.



5. Overall Connection

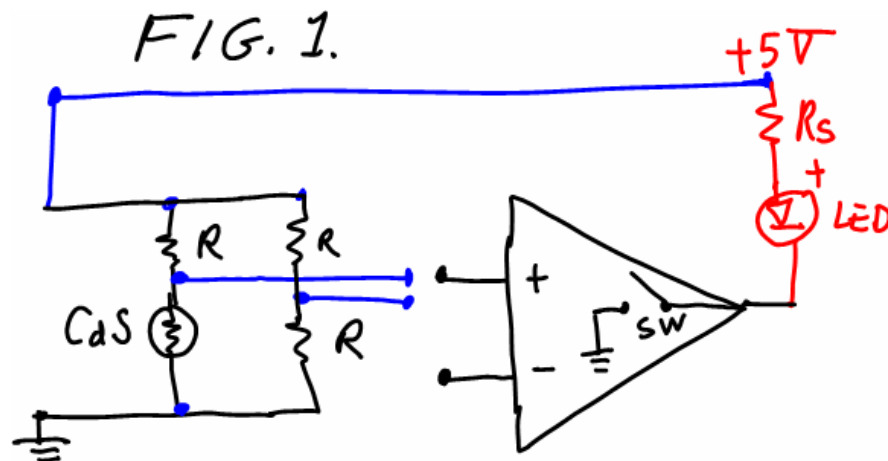
Let's connect the no-loading effect load (LED via Comparator) to the CdS cell bridge circuit. (See Figure 1 for details in the Pre-Lab section)

Mobile Studio (MS) 03 – CdS Application with Comparator

MS-03 Pre-Lab

NAME: _____

1. In the overall connection diagram below for CdS and LED connection, explain
 - (a) why do we need R_s in series with LED, and
 - (b) Connect bridge circuit terminals to the comparator (draw your connection below)
 - (b) if $R=10K$, and the resistance of CdS (R_x) varies between $3K$ and $70K$, in what condition does the LED turn on or off?



2. Comparator is realized in an IC (Integrated Circuit) package and, usually, more than one comparator are enclosed in a chip. One of the most popular comparator chip is LM339. Do web search with “LM339 Data sheet”, and explain:
 - (a) How many comparators are LM339 chip and
 - (b) Draw Pin connection diagram.

3. Draw overall connection diagram for the CdS cell bridge circuit, LM339, and LED, Voltage source.

Mobile Studio (MS) 03 – CdS Application with Comparator

REPORT

Name: _____ ID#: _____ Group#: _____

1. Analysis on the LED turn on condition and illumination on CdS for Single LED circuit.

2. Analysis on the turning on/off condition of the LEDs and illumination on CdS for 4-LED circuit.