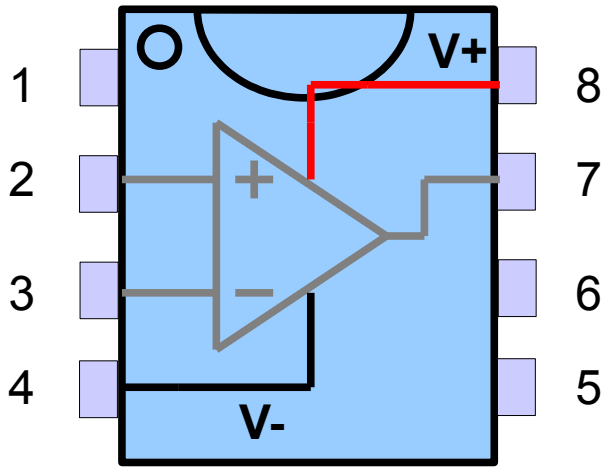
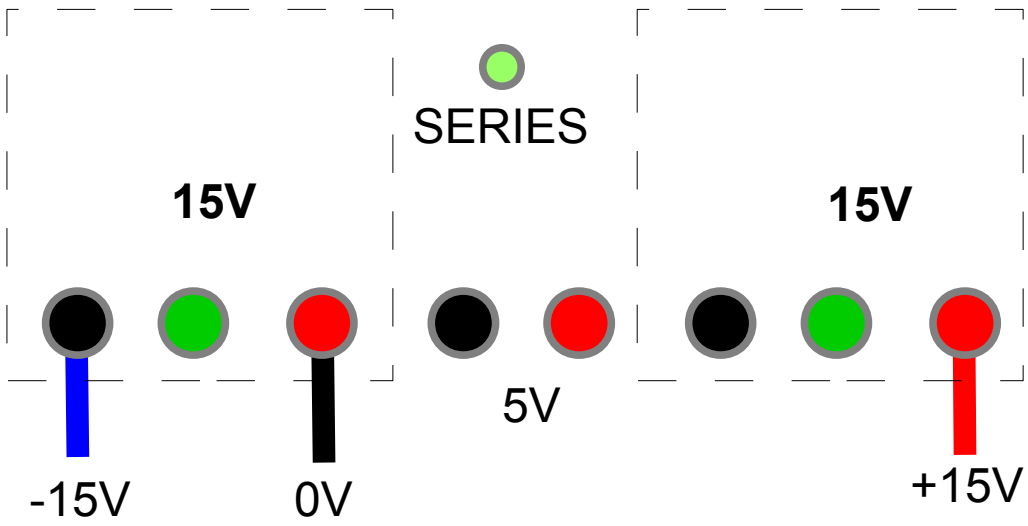
Lab 7

Comparator, twilight switch

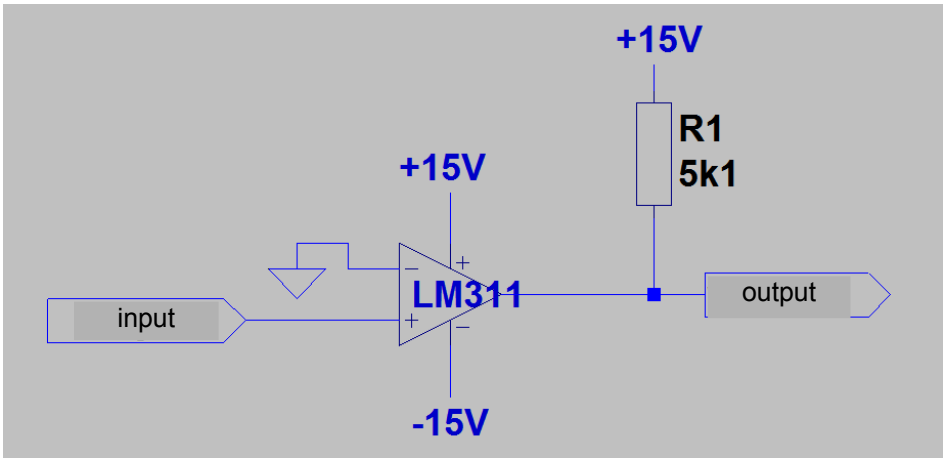
1. In this lab we will use LM311 comparator. The pinout is shown below. View from above. Please pay attention that the pins 4, 5 i 6 also need to be properly connected – the details will be given below.



Symmetrical power supply ±15V used to power the comparator during this lab can be obtained using the connections shown below (*Series* mode needs to be activated):

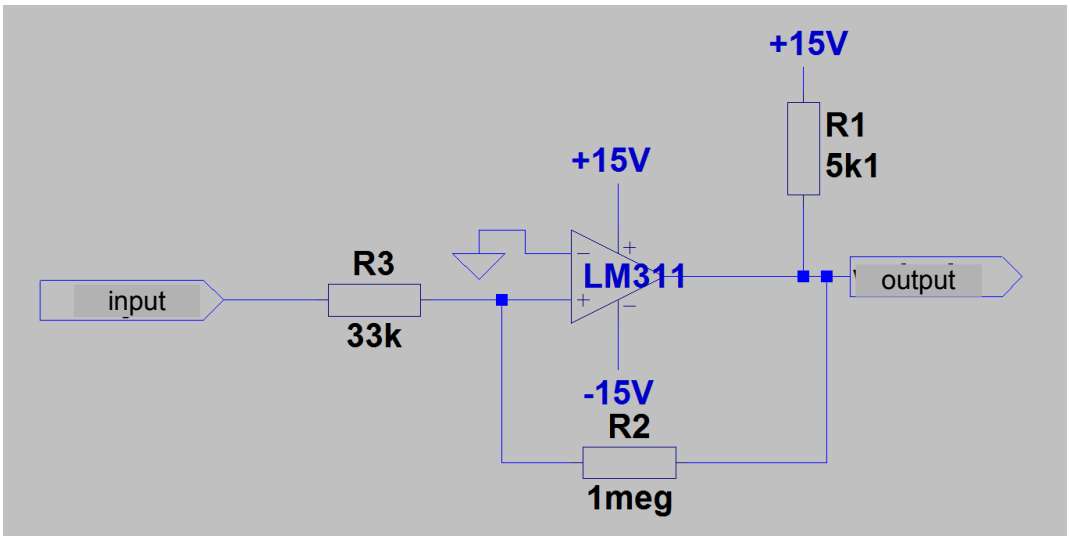


2. Please build a zero crossing detector shown below. **Pin this circuit, the pins 1 and 4 need to be connected to the negative power supply rail. The pins 5 and 6 need to be connected together and not connected to any other part of the circuit.** For more details please see the LM311 datasheet.
Between pins 4 and 8 always connect a 100 nF capacitor AS CLOSE TO THE PINS AS POSSIBLE (you may also check the behaviour of the circuit without the capacitor).
The input signal should be a triangular signal of the amplitude of **1 V** and the frequency of **500 Hz**.



Please observe the output signal, pay attention to the edges of the output signal. What may be the cause of the distortions?

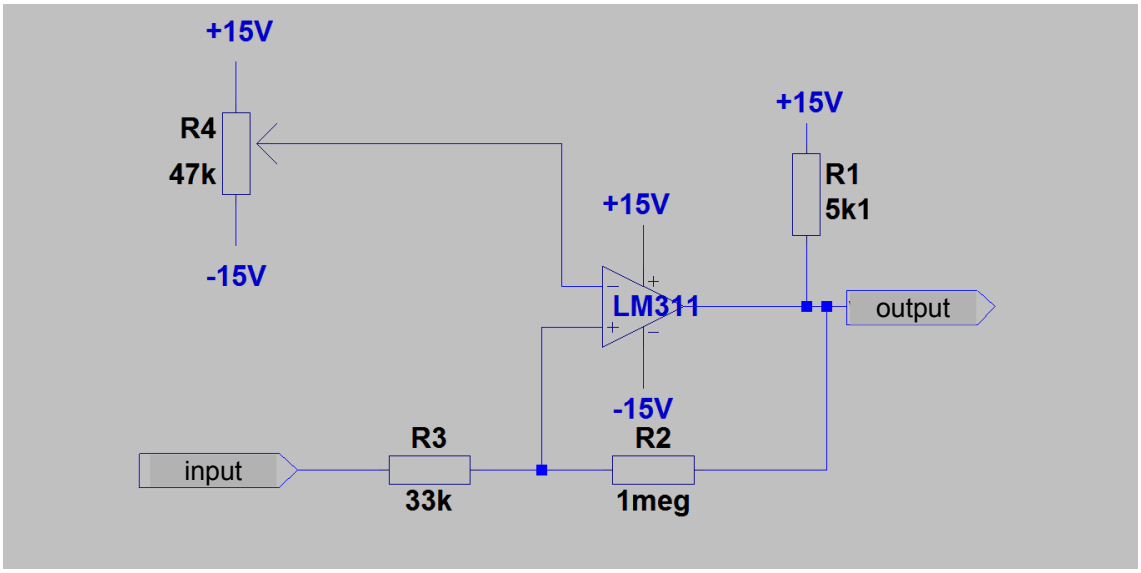
3. In order to elliminate the distortions, please modify the circuit by adding a positive feedback, as shown below.



Please compare the output signal to the one obtained in the previous point. Please measure the output maximum an minimum values and calculate the theoretical hysteresis loop width.

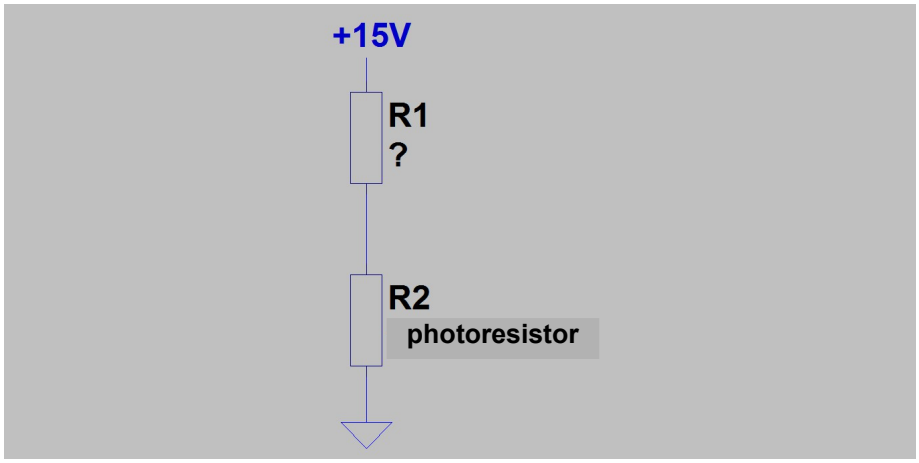
4. Please measure the maximal input signal frequency for which the output remains an undistorted square wave. Please measure the rise and fall time of the output signal. If you encounter some oscillations, please consider only the part of the edge that is free of oscillations. Please set the oscilloscope so that the slope is clearly visible and measurable.
Please repeat the same measurements for different R1 values: 2.2kΩ and 10kΩ.

5. Please check the behaviour of the following circuit as a detector with an adjustable threshold. Please increase the amplitude of the input signal to 5V and the frequency to 1kHz. **How does the duty cycle change** when you adjust the potentiometer setting? **Why is it so? Please draw input and output signal WITH COMMENTS explaining this behaviour.**

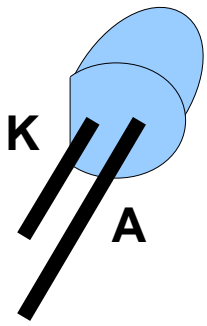


6. In practice it is sometimes inconvenient to use symmetrical power supply – it is easier to use a single supply voltage. Further on we will thus use only the single-supply circuit using +15V supply.

7. Please chceck the resistance of the photoresistor kept in the dark and in the light. Please select the R1 value so that in a light shade the voltage developed across this resistor is approximately half of the supply voltage.

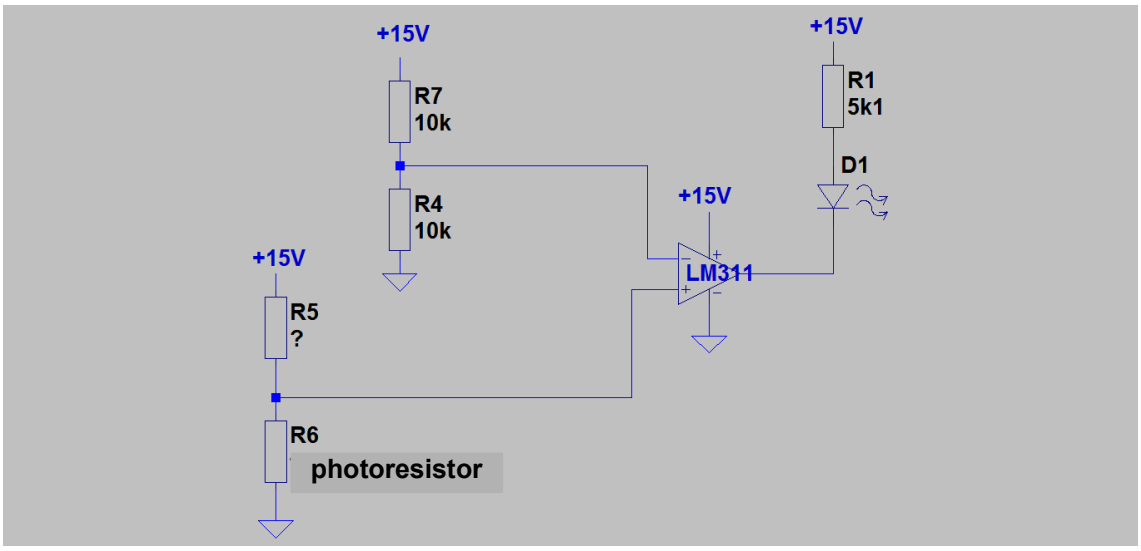


8. Please build a twilight switch according to the schematics shown below. Please remember about grounding pins 1 and 4 and to connect the pins 5 and 6. The LED pinout is shown below.

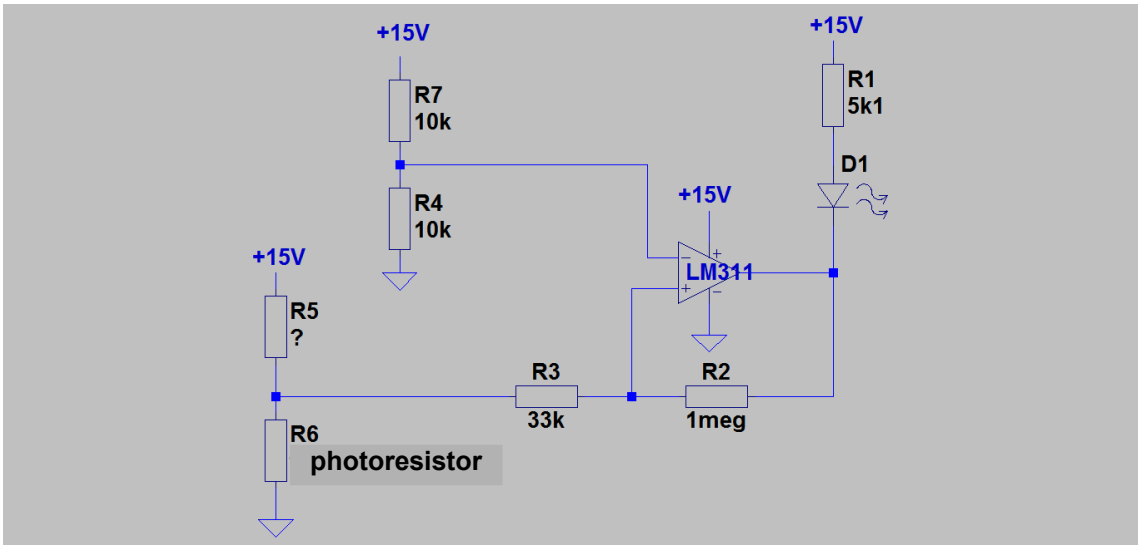


Please observe the behaviour of the diode, especially during switching. Is the switching fast and reliable? Does it change its brightness when slowly covering the photoresistor? Please observe the

voltage on the cathode of the LED.



9. Please add the positive feedback components, as shown below. If the switching is not reliable, please replace the correct resistor with a resistor with different value.



10. It would be much more practical to design a switch that turns the light on when it is dark. Please propose a modification to the circuit that performs this kind of function. Please build the proposed circuit abd test its behaviour.