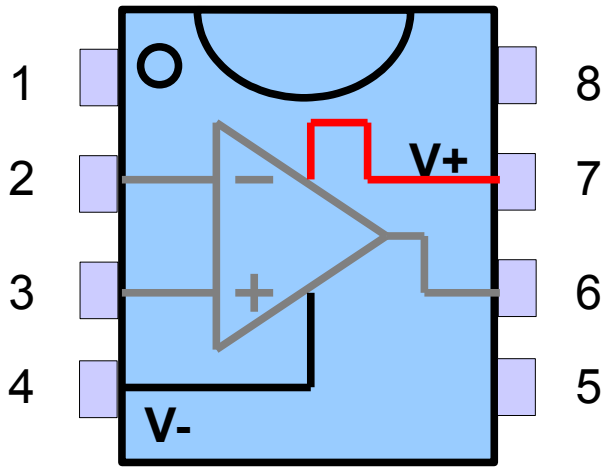
Lab 7

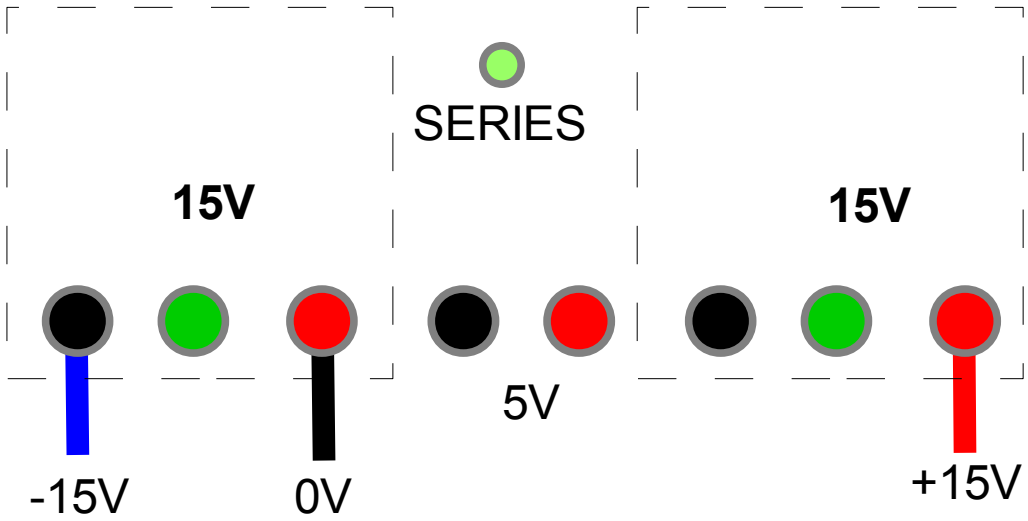
Function generator

In this lab, we will focus on building a function generator – a device that is capable of producing a sinusoidal, triangular and square wave. This kind of device is very useful test instrument. The square wave and triangular wave are produced by a two opamp circuit, while the sinusoidal wave is shaped from the triangular wave using a special shaping circuit utilizing a JFET transistor.

1. In this lab we will use 741 and TL081 opamps. The pinout for both of them is the same and is shown below. View from above.

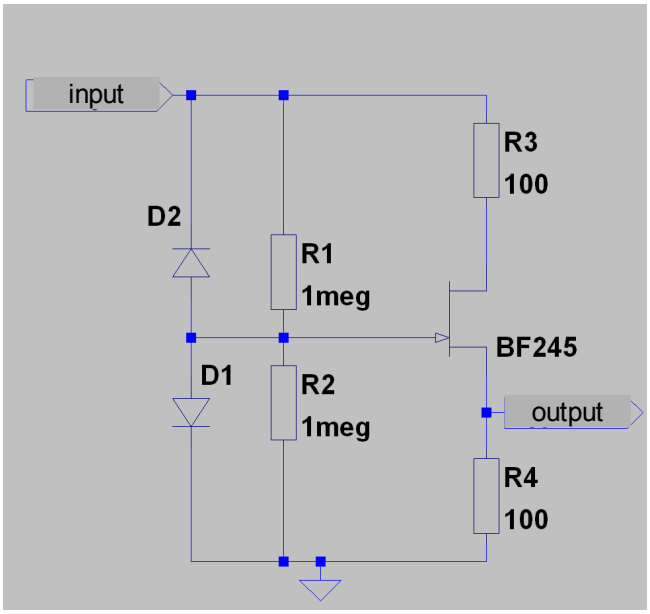


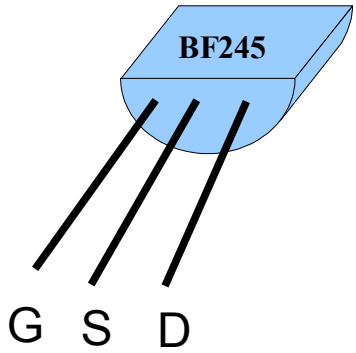
1. Symmetrical power supply ±15V used to power the amplifier during this lab can be obtained using the connections shown below (*Series* mode needs to be activated):



2. Please decode markings of all the resistors and capacitors used in today's lab. Measure the resistance and capacitance and compare it to the decoded values.

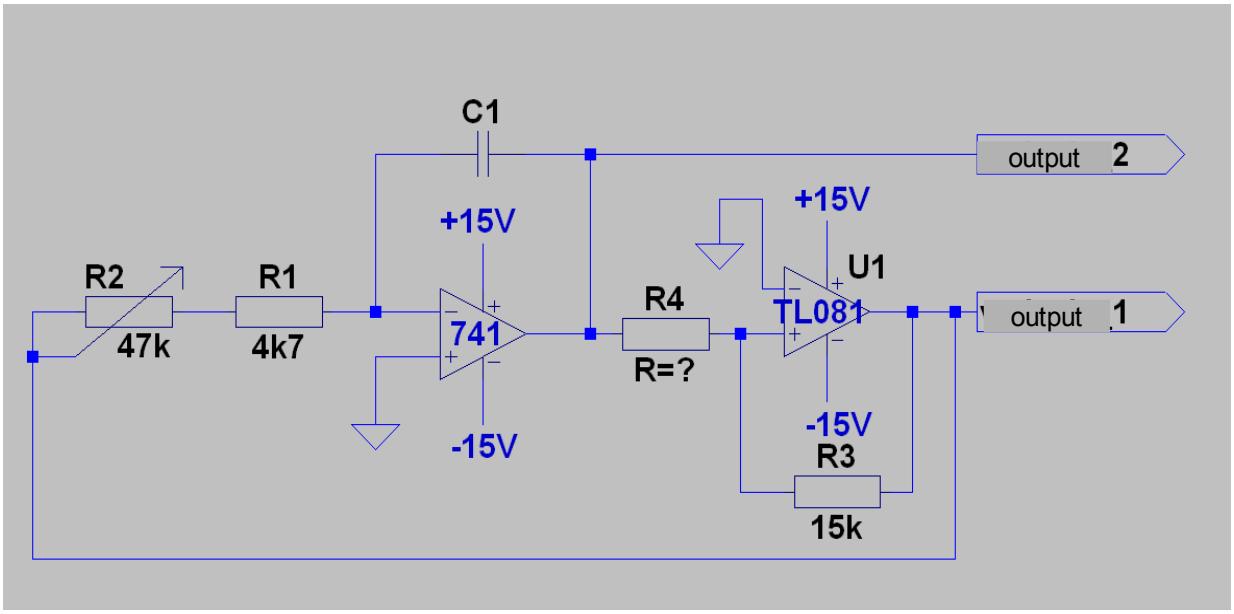
3. Please build the circuit shown below. It is a shaping circuit that will be used further on in the function generator. The pinout of the transistor is shown below. Please <u>do not disconnect</u> this circuit after measurements, since it will be used further on.





Please connect a triangular wave of the frequency of 1kHz to the input of this circuit. Please observe the shape of the output signal and adjust the input signal amplitude so that the output signal is as much similar to a sinusoid as possible. After this, please measure the peak to peak input signal voltage. This value will be needed further on.

2. Please assemble the circuit shown below. It is a triangular and square signal generator. The R2 resistor is an appropriately connected potentiometer.

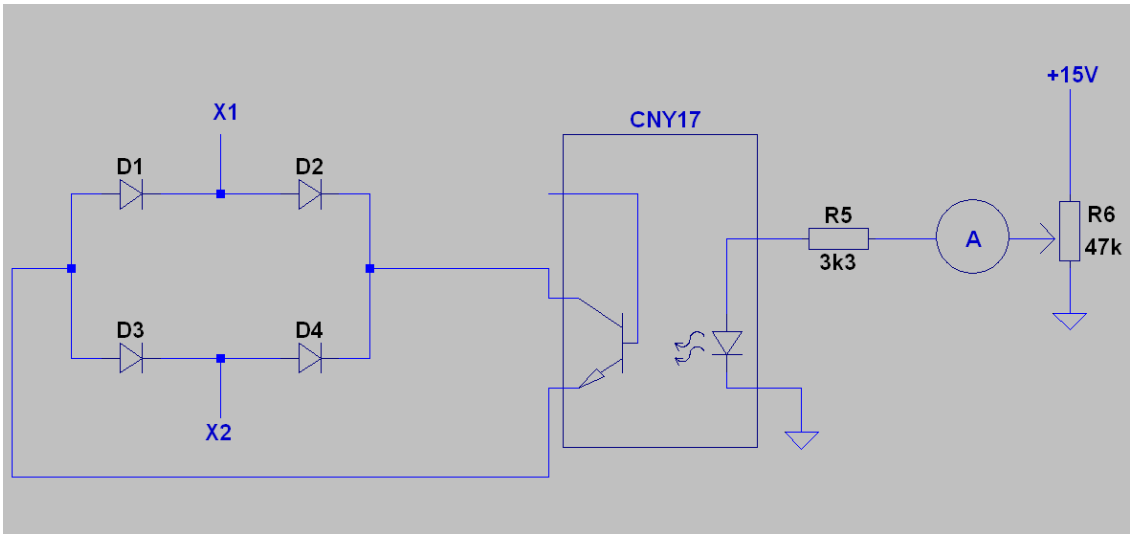


The value of R4 has to be calculated so that the hysteresis of the comparator (U1 in this role) is equal to the peak to peak signal voltage measured In the previous point. The value of C1 needs to be calculated so that the minimal output frequency is around 100Hz. Please calculate the maximal frequency value. The frequency is adjustable with the use of R2 (potentiometer).
Please remember that the rate of change of the voltage across the capacitor is directly proportional to the charging current and inversely proportional to the capacitance.
Please observe the signals on outputs 1 and 2. What is their peak to peak voltage? If the peak to peak voltage on the output 2 is different than the value measured in the previous point, the R4 needs to be readjusted.

Please measure the minimal and maximal generated frequency and compare the results to the theoretical results calculated previously.

3. Please connect the output 2 to the input of the shaping circuit. The device should now produce triangular, square and sinusoidal waves of the same frequency that can be adjusted with R2.

4. Please modify the circuit in order that its frequency can be controlled via external current or voltage. In order to do that, please replace R2 with the circuit shown below.Points X1 and X2 are connected to the points where R2 was previously connected. The circuit includes an ammeter! The R6 potentiometer acts as a regulated voltage source, in a real circuit it could be replaced by an output of digital to analog converter or a similar circuit.



The CNY17 circuit is a transoptor. The pinout needs to be found in the device documentation.

5. Please determine the relationship between the frequency of the generated signal and the current flowing through the transoptor diode. Can you think of any other method of mesasuring the current of this diode that does not require to include an ammeter in the circuit?