Lab 5
Waveform generators

In this lab you will build different types of waveform generators.

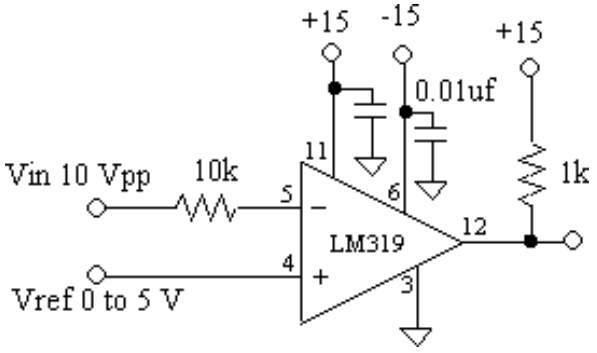
Pre-lab

1. Understand why there is a pull-up resistor on the output of the LM 319.
2. Design the circuit in step 4.
3. Compute the oscillation frequency in step 9.
4. Compute the duty cycle in step 11.
5. Redesign the circuit in step 12.

Comparator

Build a comparator circuit and investigate how the switching voltage depends on the reference voltage.

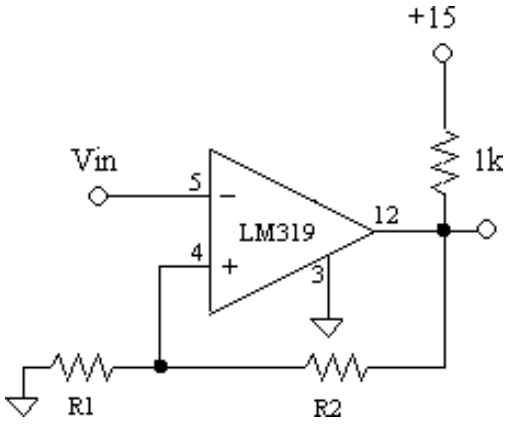
1. Connect the comparator like this



2. Attach a 10 V pp triangular wave to V_{in}.
3. Vary V_{ref} between 0 and 5 V (for example using a potentiometer) and describe how the switching voltage varies with reference voltage.

Comparator with hysteresis (Schmitt trigger)

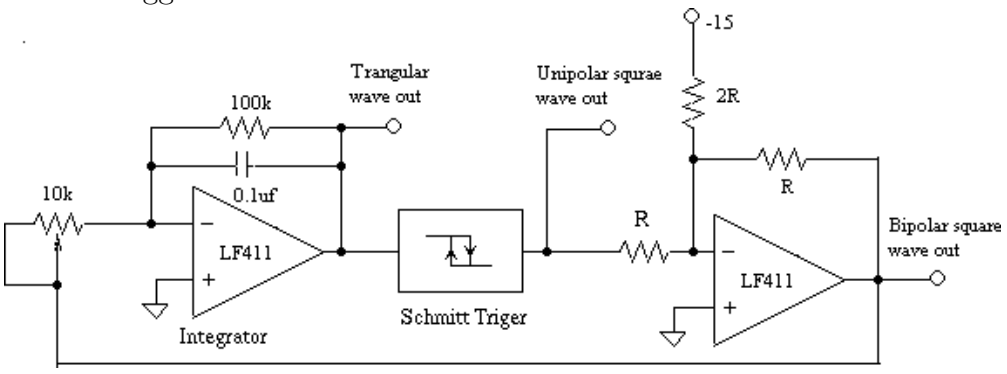
Add hysteresis to the comparator to create a Schmitt trigger by setting the reference voltage and the feedback resistances R_1 and R_2. Although V_R is connected to ground in this figure you will need to select a different voltage.



4. Choose V_R, R_1, and R_2 to produce hysteresis levels of 0 V and 1.5 V.
5. With a triangular wave measure the hysteresis levels.
6. Plot the hysteresis curve (v_{out} as a function of v_{in}).

Relaxation oscillator

Use the Schmitt trigger to create a relaxation oscillator.



7. Build the circuit.
8. Plot the waveforms at the different outputs.
9. Measure the oscillation frequency and compare it with a theoretical calculation.
10. Explain why the inverter and connected -15 V offset are needed after the Schmitt trigger.
11. Measure the duty cycle and compare with a theoretical calculation.
12. Modify the circuit to create a 50% duty cycle.