Non-Linear Applications of Operational Amplifiers

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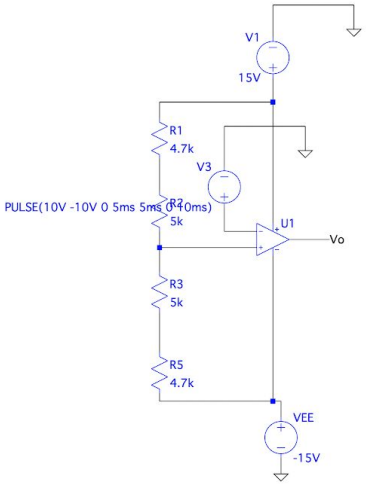
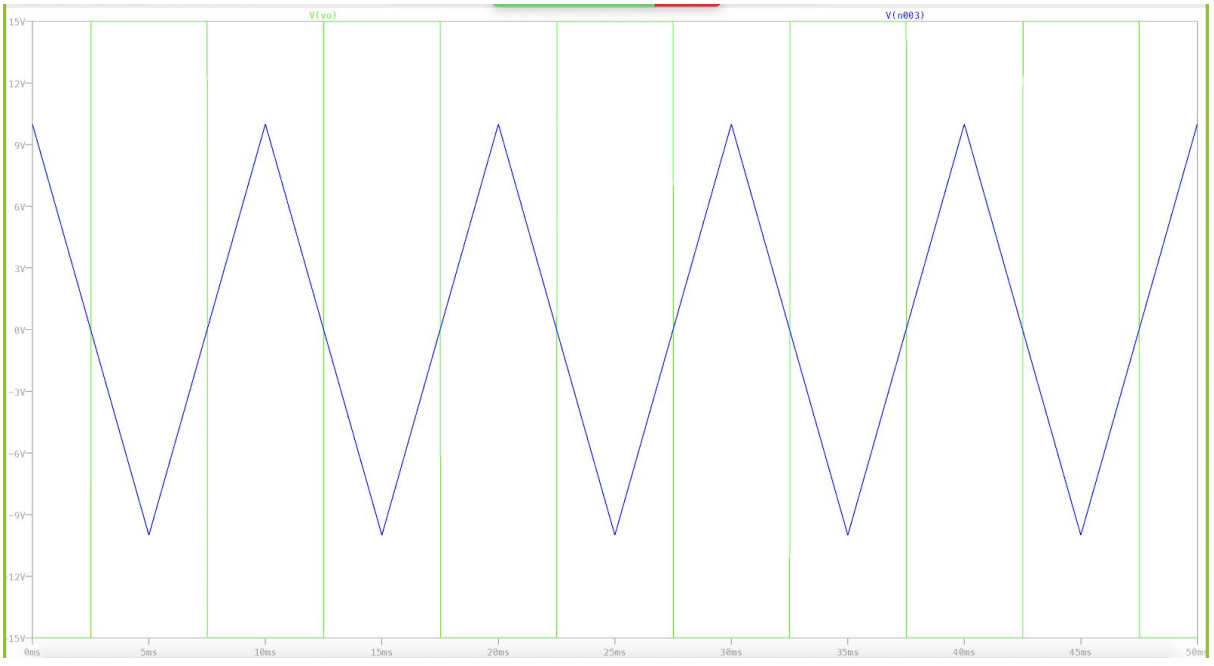
Part 1) The experiment was done on the circuit below. Also the simulation results for one of the voltage ref values can be seen below as well.

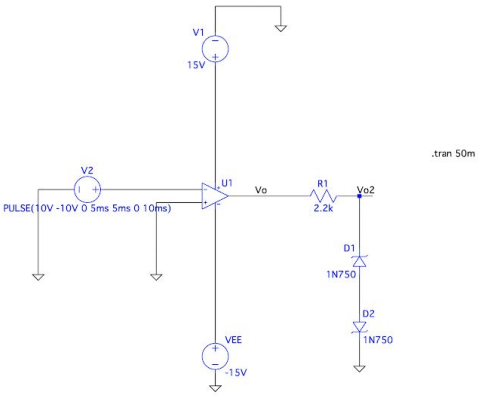


.tran 50m

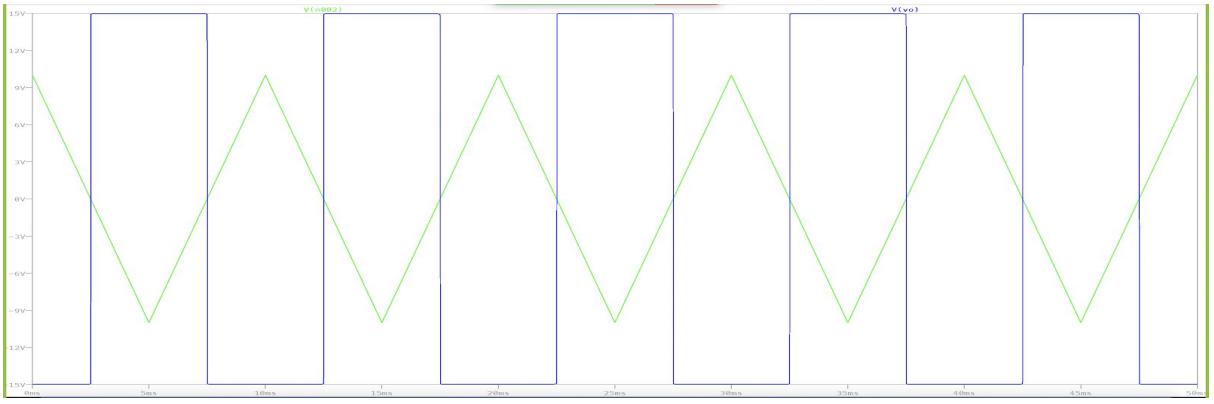


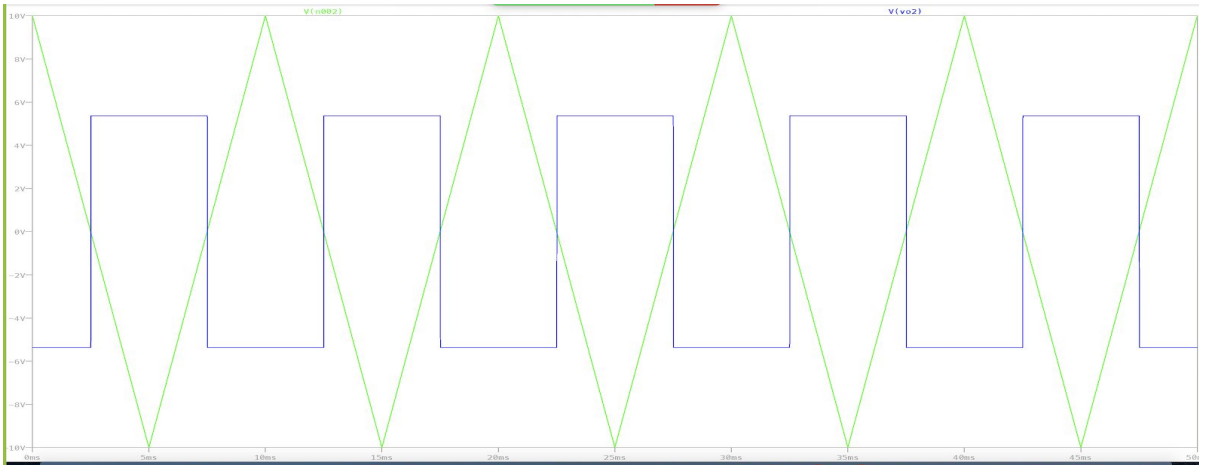
The circuit was a comparator circuit and was tested with different Vref values. Although only one of them is shown as a picture, the main idea of the comparator circuit was understood with different tests. The circuit would take the input voltage and compare it to the reference voltage. If the input voltage was less, output would be negative; positive if vice verse and 0 if they were equal.

Part 2) The experiment was done on the circuit below.



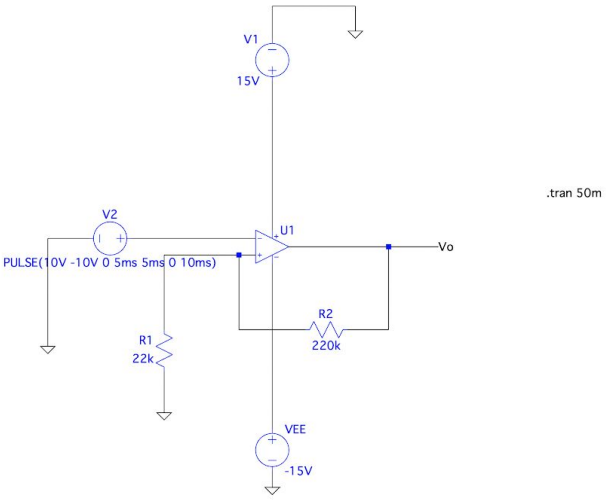
The simulation for output voltages Vo and Vo' can be seen below in two photos. In both of these photos; Vi is denoted by the green lines while Vo and Vo' are denoted by blue lines.

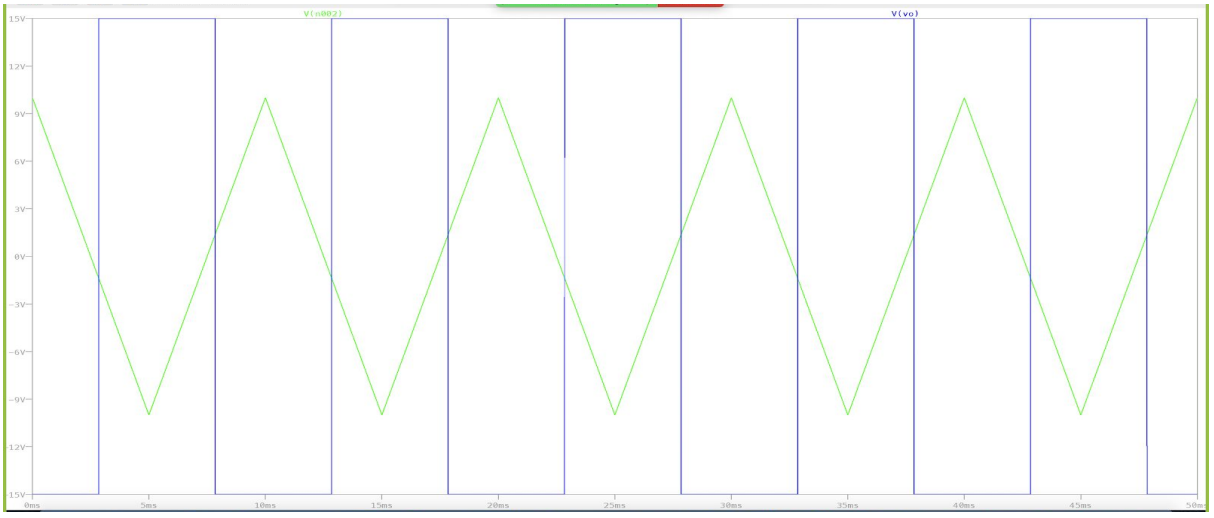




This circuit is a voltage limiter circuit, the zener diodes work as the limiter voltages. When the output voltage has to go through these zener diodes, it's voltage drops to get through the forward bias voltages of the zener diodes which are about 4.7. Passing through the diodes, the input voltage drops to about 5.4 voltages and gets its voltage limited like the circuit name would suggest.

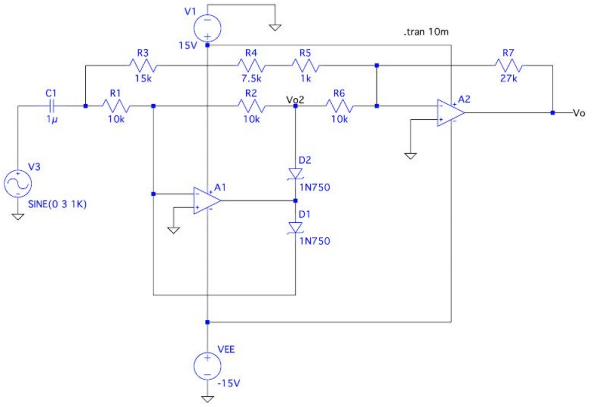
Part 3-4) The experiment was done on the circuit below. Also Simulation for Vo and Vi can be seen below as well. These simulation results are for part 3 of the experiment.

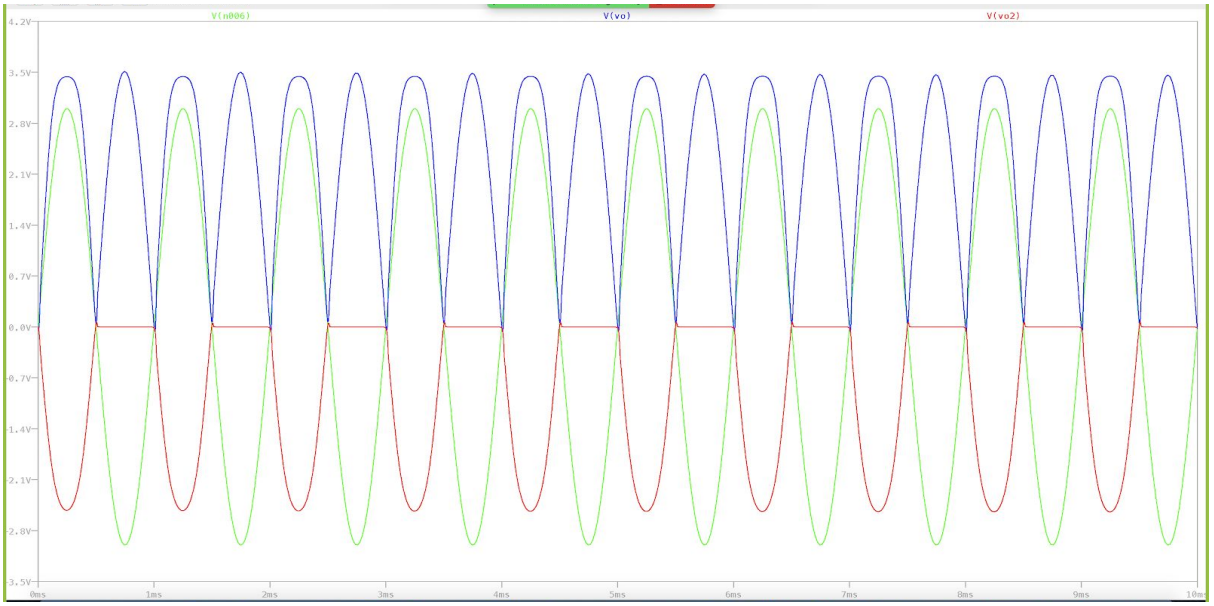




Part 4 (Circuit explanation and parameter values): This circuit output is very similar to what we have done in part 1 of the experiment but it's different. The difference is that this is a Schmitt trigger circuit and the output is not only dependent on the input but also the output. Because of this, the switch that happens when going from positive to negative or negative to positive input voltage is not the same. This makes us find V11 and V12.
For the parameters:
V11 = -1.5
V12 = 1.2
Vo1 = -15
Vo2 = +15

Part 5) The experiment was done on the circuit below. Also Simulation for Vo, Vo' and Vi can be seen below as well. Vo is denoted by red lines, Vo' by blue lines and Vi by green lines.





For negative input voltages, output of the first opamp tries to go to positive which turns the diodes off. This way the output is held at ground potential since the action of the first opamp forces the input voltages of the second opamp to the same level. For positive input voltages, the output of the first op amp goes to negative; turning D2 on and D1 off. In this configuration, output of the first op amp acts as an inverting amplifier with gain R2/R1. This gain is generally 1 so with this, the output of the first op amp is the inverted version of the input.

The results of the outputs on the first opamp are then fed to the second one. The first stage has a gain of 2 which is the gain of a half wave rectifier. Because of this; for the negative half cycle of the input, the input wave is summed with the reference potential (ground). The output gain is positive in the negative half of the input cycle. For the positive half cycle, the inverted half wave rectifier is summed with the input gain of the half wave rectifier which is 2. This then again gives us a positive half wave at the output of the second op amp. Adding the two negative and positive cycle inputs together, we get a full wave rectifier.