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ECE101-1L – FUNDAMENTALS OF ELECTRONIC CIRCUITS (LAB)

Activity #3: Diode Wave Shaping and Zener Diode Voltage Regulation

Part A. Multisim

1. Define Clippers in Electronics (include the 2 types)

As many electronic circuits have a specific range of voltages in which they can accept input signals, Diode Clipper Circuits are used to "clip" waveforms, which is to modify them so that the waveforms of the input signals lie within the operating voltage range of the electronic circuits. This is to prevent damage as signals greater than the specified range will cause distortions in the circuits' output and even damage to the circuits. There are two types of Clippers that are broadly defined into two types: Series and Parallel/Shunt.

A Series clipper circuit has its diode is connected in series with the output load resistance near the end of the circuit, while a Parallel/Shunt clipper circuit has the diode connected in parallel with the output load resistance.

2. Define Clampers in Electronics (include the 2 types)

Diode Clamper Circuits (Also known as DC restorers) are circuits designed to shift the waveform to a DC level without changing the actual appearance of the signal. Clampers may be broadly classified under two types: Positive and Negative.

Positive clampers shift the input waveform in a positive direction so that the waveform lies above a DC reference voltage. Negative clampers shift the waveform in a negative direction so that the waveform will lie under a DC reference voltage.

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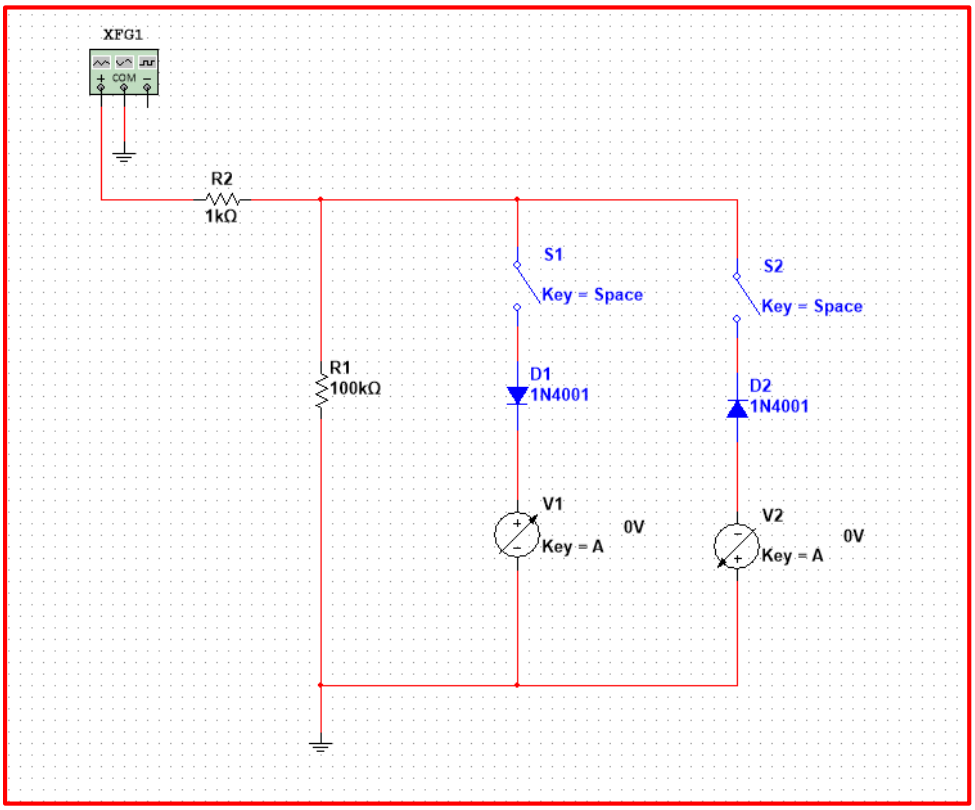
3. Open Multisim.

4. Create the schematic diagram shown below:



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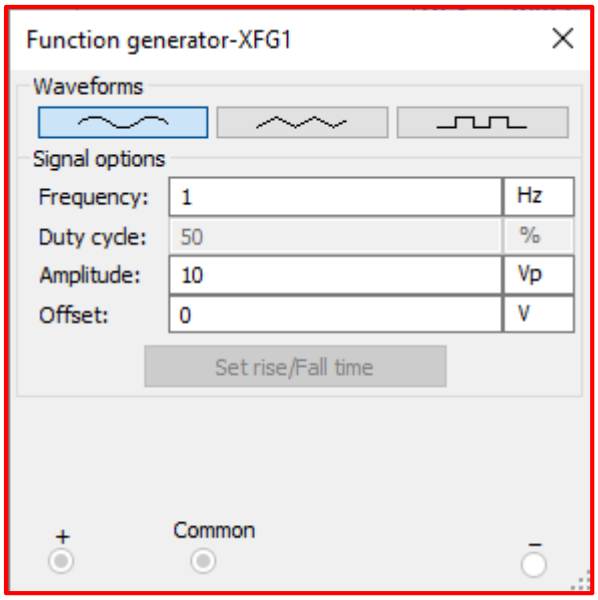
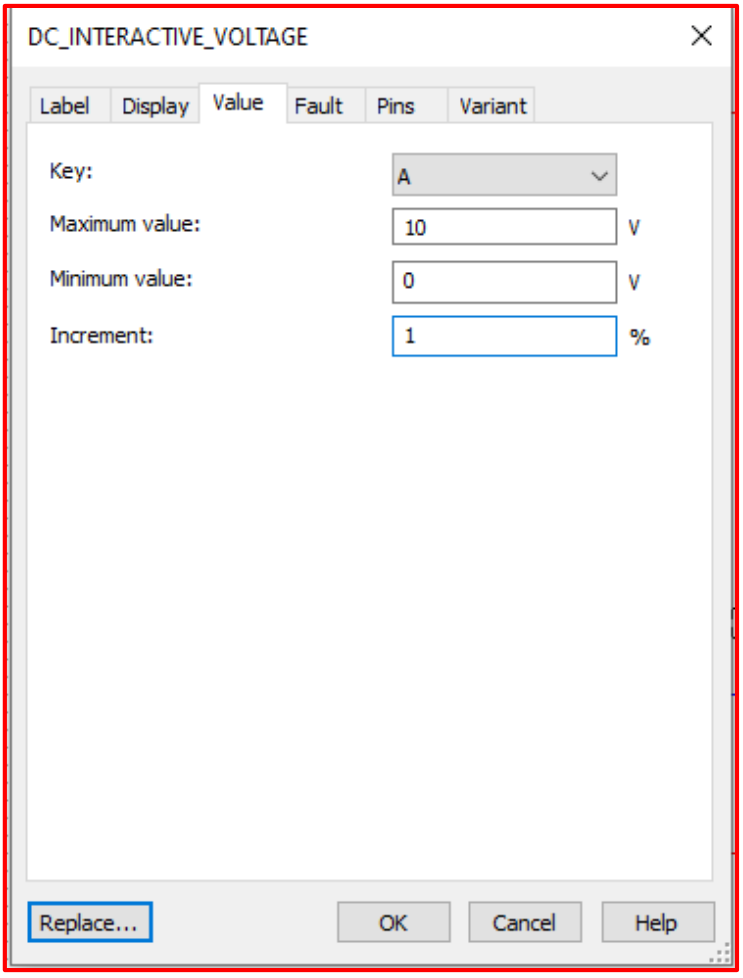
5. Adjust Function Generator and DC Interactive Voltage Settings shown below:





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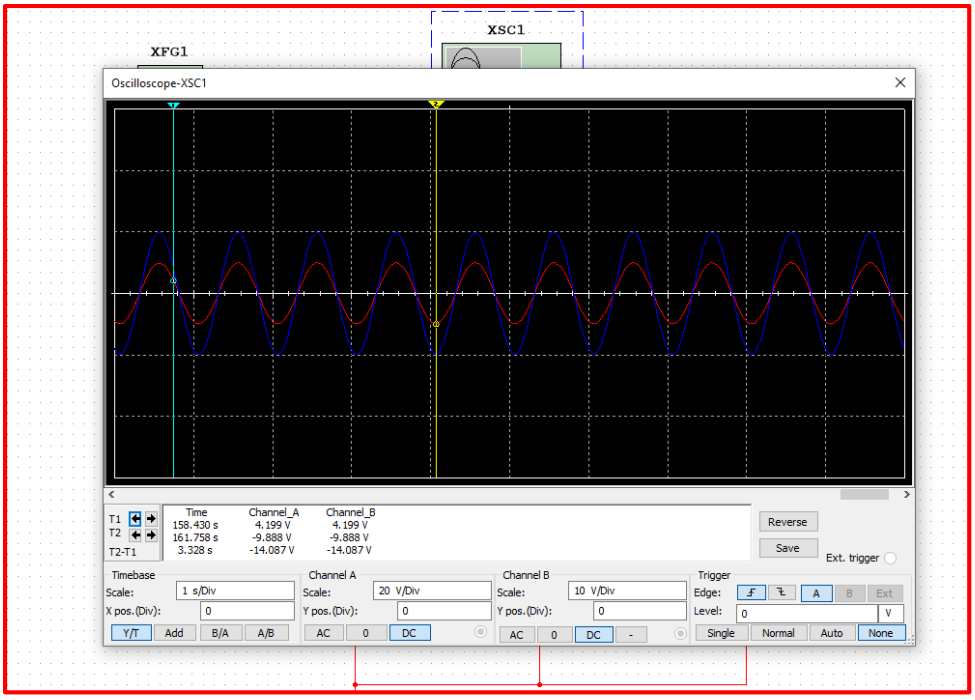
6. Place an Oscilloscope at the output and run the simulation.

a. Screenshot the output waveform shown in the oscilloscope.



b. Measure the voltage (Vpk-pk).

9888V

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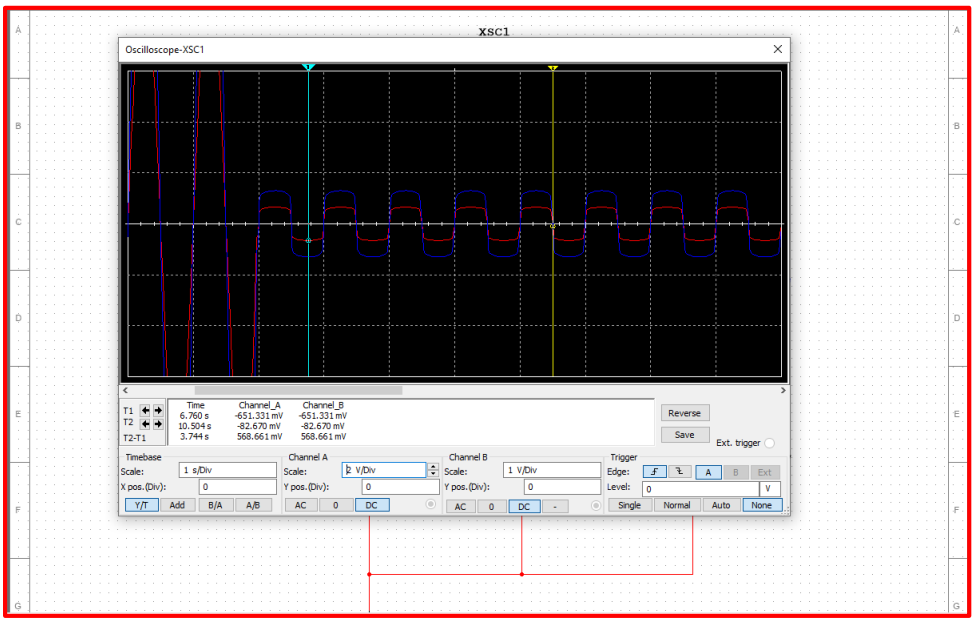
7. While the simulation is running, Turn the switch (S1 and S2) to CLOSED position and observe the Output at the oscilloscope.

a. Screenshot the output.



b. Explain what happens

Because the diodes are oriented both waves were cut off or clipped.

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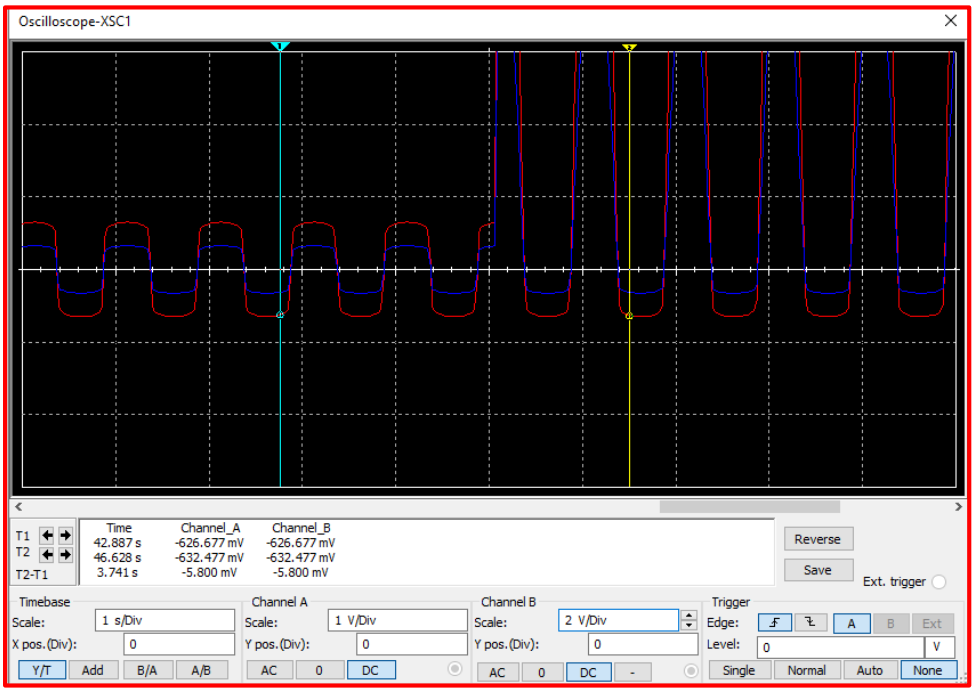
8. Switch the S1 to OPEN position and observe the waveform

a. Screenshot the output



b. What function does S1/D1 part do? (Positive Clipper or Negative Clipper)

Positive Clipper

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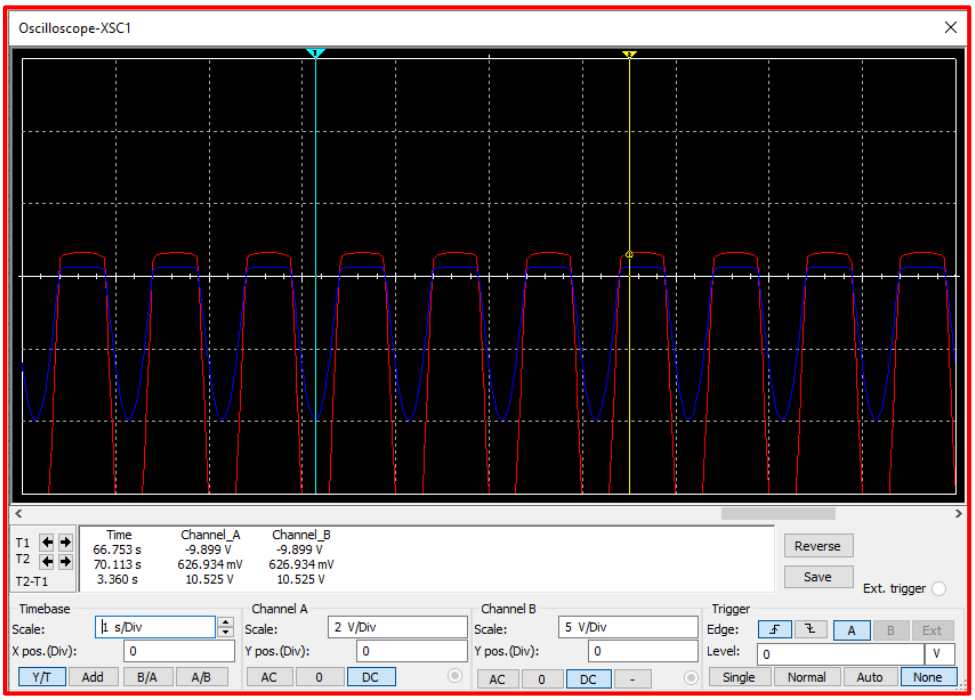
9. Switch the S1 to CLOSED and S2 to OPEN position and observe the waveform.

a. Screenshot the output.



b. What function does S2/D2 part do? (Positive Clipper or Negative Clipper)

Negative Clipper

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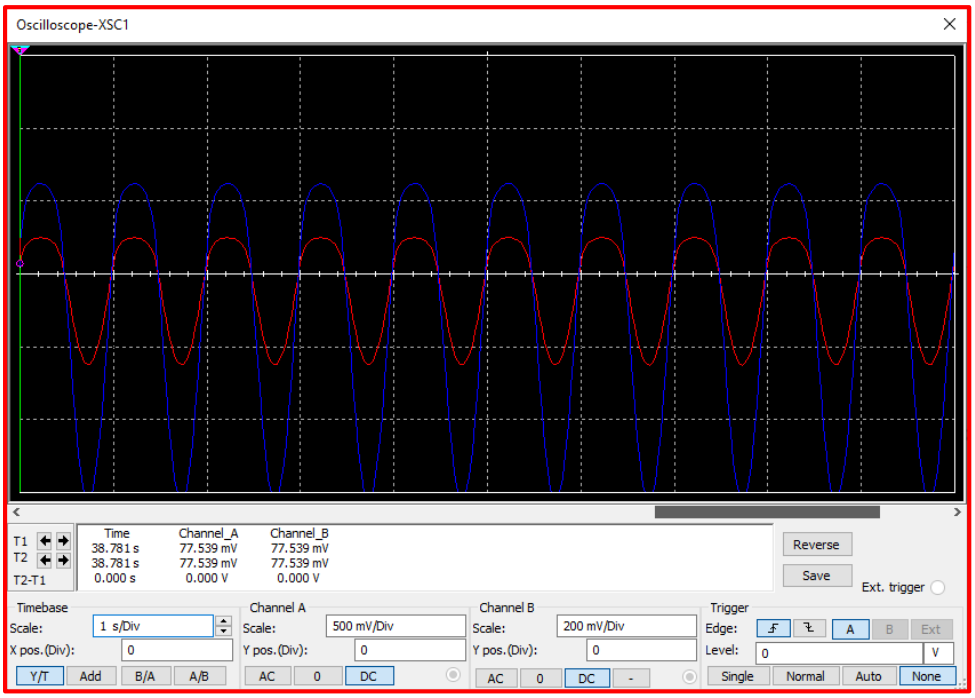
10. Create the schematic shown below (like previous circuit but change the resistor to “CAPACITOR ELECTROLYTIC” with a value of 0.1uF). Be careful of the polarity

11. Place and Oscilloscope at the output.

12. Run the simulation and switch the S3 to CLOSED position.

a. Screenshot the output.



b. Based on your answer in Question #2 and Question 12a what type of Clamper is this?

Negative Clamper

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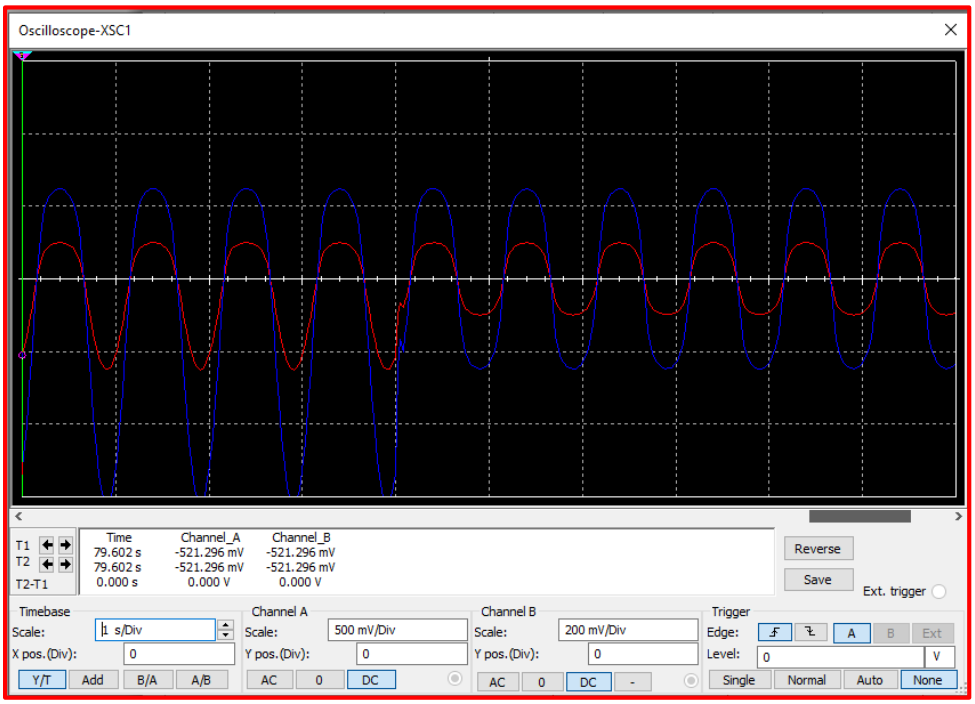
13. Switch the S4 to CLOSED position

a. Screenshot the output



b. Base on your answer in Question #2 and Question 13.a what type of Clamper is this?

Positive Clamper

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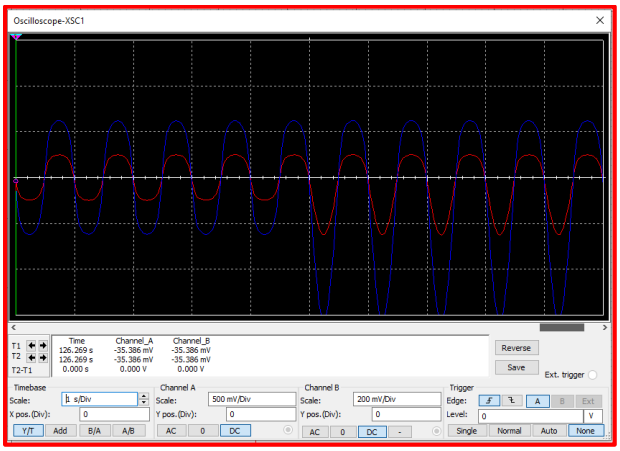
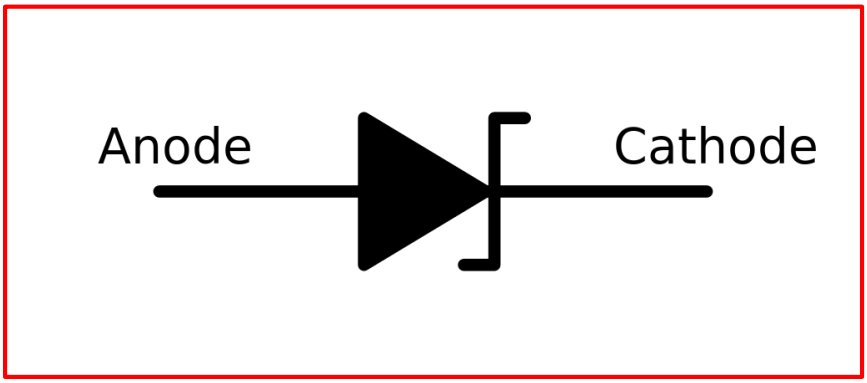
c. Switch S4 to OPEN Position



14. What is a Zener Diode?

It is a diode that operates on the 'Zener Breakdown' principle. In forward bias, it behaves similarly to a standard diode. In reverse bias, however, the diode will only conduct when the applied voltage approaches the Zener Breakdown value. It is designed to prevent other semiconductor devices from momentary voltage pulses. It performs the function of a voltage regulator.

15. What is the Symbol of Zener diode?



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Activity #3: Diode Wave Shaping and Zener Diode Voltage Regulation

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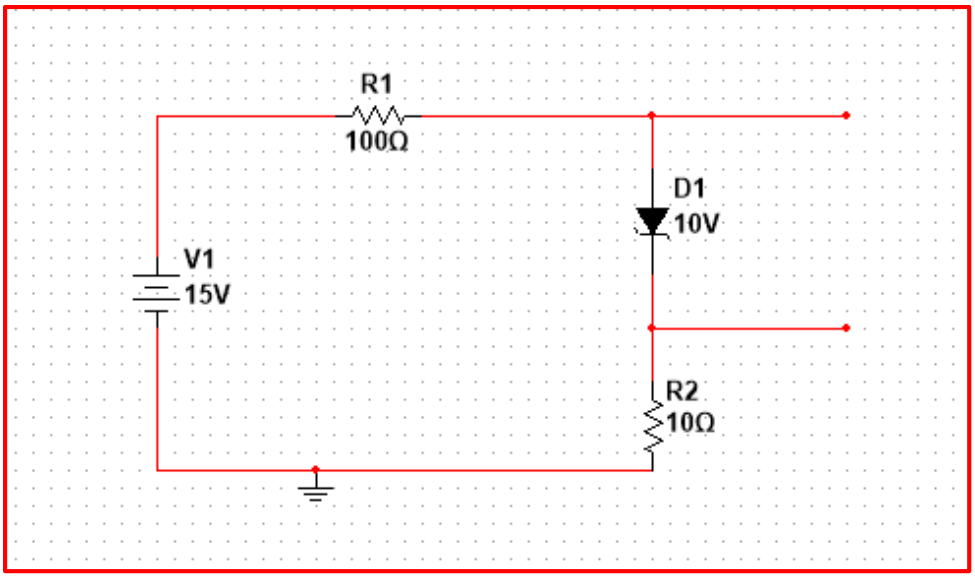
16. Create the Schematic shown below “DIODE VIRTUAL>>ZENER”. Change the settings of Zener Diode Breakdown Voltage to 10V



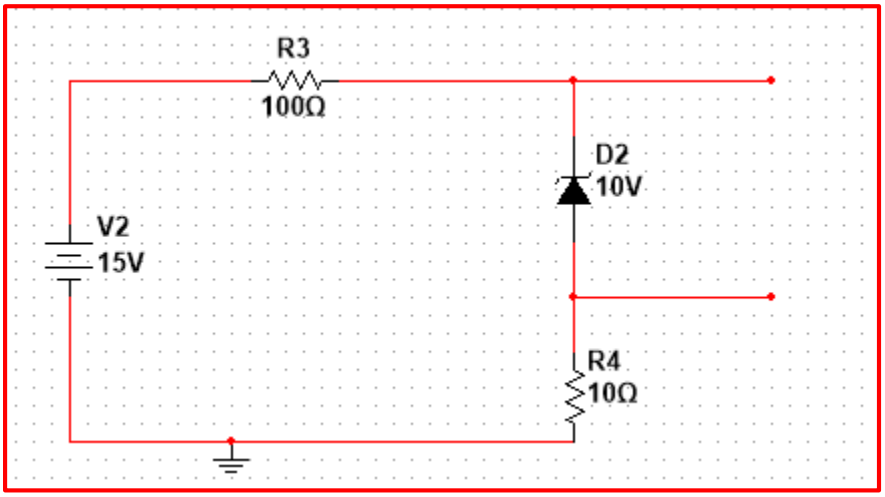
17. Measure the Voltage output using Multimeter

a. V_{out}: 665.424mv

b. Is the Zener Diode Forward Biased or Reversed Biased?

The Zener diode is forward-biased.

18. Change the Zener Diode Orientation



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20. Measure the Voltage output using Multimeter

a. V_{out}: 10.016v

b. Is the Zener Diode Forward Biased or Reversed Biased?

The zener diode is in reverse bias.

21. Adjust the V7 (DC voltage to the values shown below) and complete the table. Calculate the current (Ir7) using the formula (VR7/R7).

22. Change all values to NEGATIVE (V7) and Current (IR7). Graph the values V7 supply voltage at the horizontal axis and the Current IR7 for the Vertical Axis. Screenshot the graph you obtain. You can use Excel to plot your graph (Scatter with Lines).

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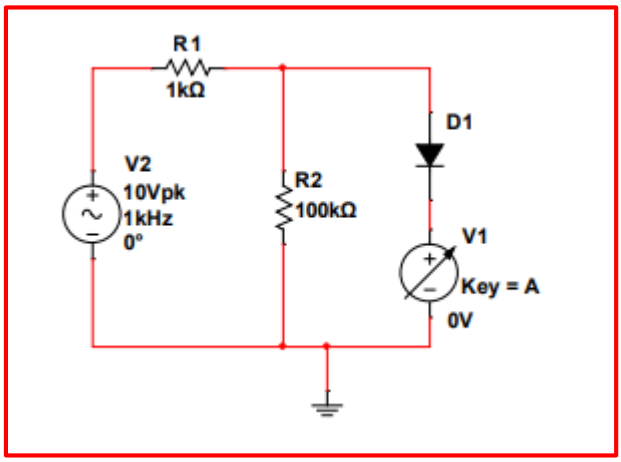
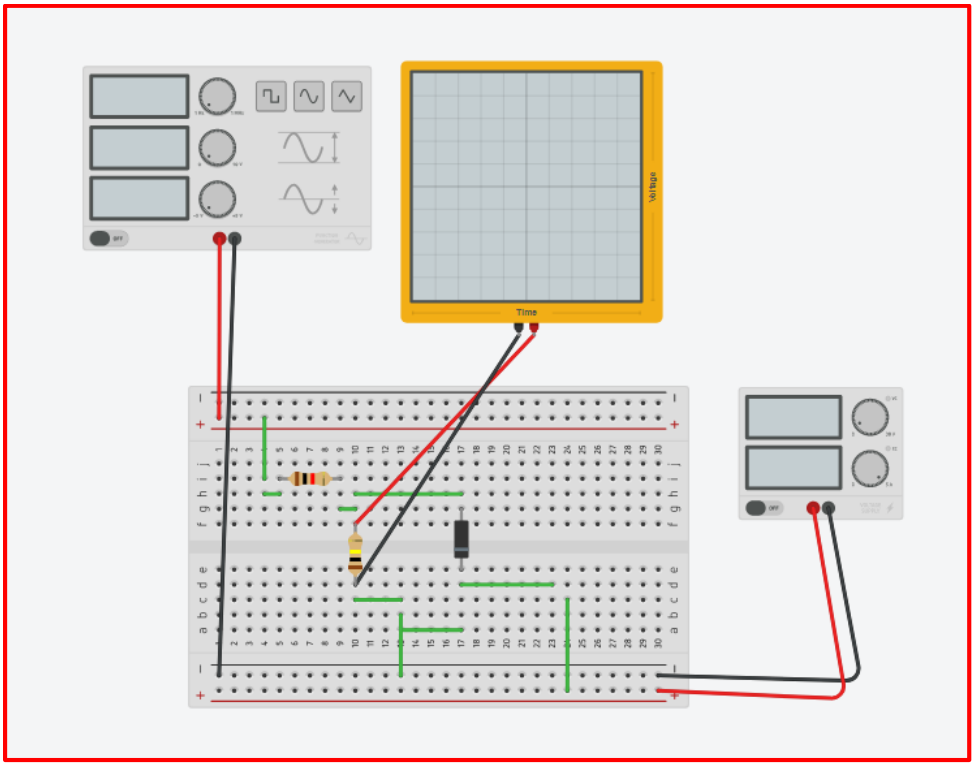
Part B. TinkerCAD

1. Create the Circuit Diagram using TinkerCAD (Function Generator, Power Supply, Resistor, Diode)



2. Place an Oscilloscope at the Output



3. Adjust the DC Supply at 1.8 V level

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Activity #3: Diode Wave Shaping and Zener Diode Voltage Regulation

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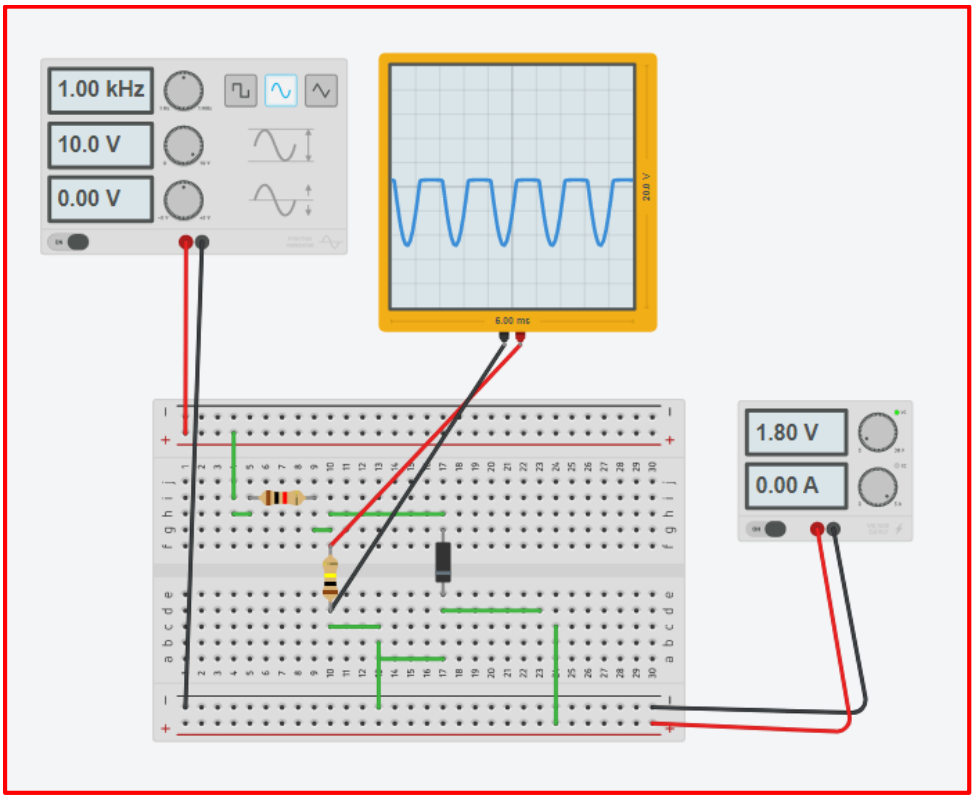
a.)



b.) Negative Clipper

4. Create the Circuit Diagram using TinkerCAD (Function Generator, Power Supply, Resistor, Diode)

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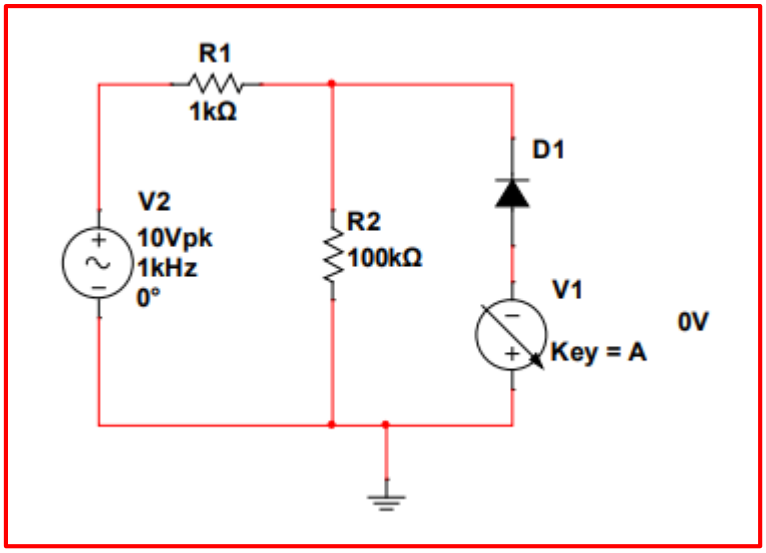
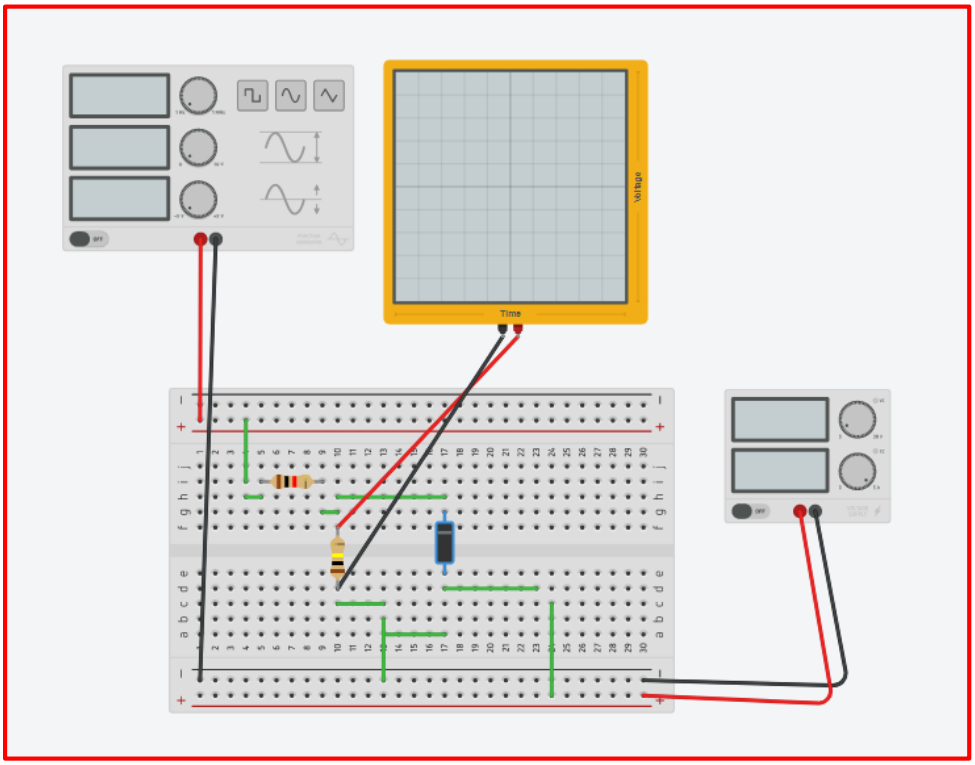


5.) Place an Oscilloscope at the Output



6. Adjust the DC Supply at 1.8 V level

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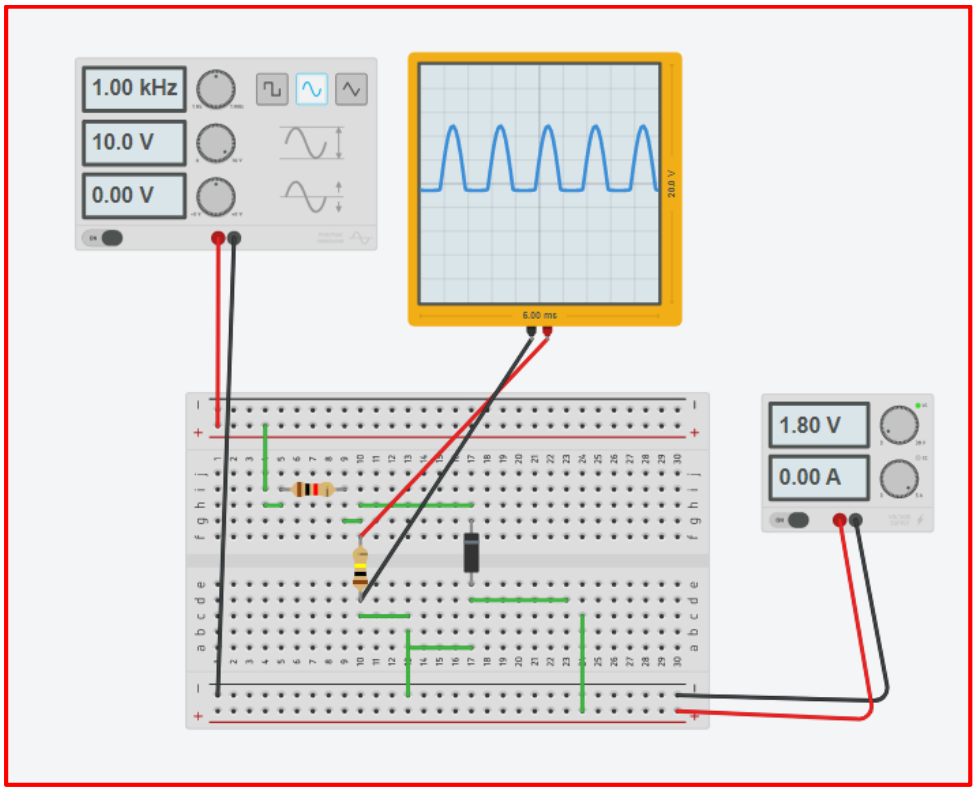
a.)



b.) Positive Clipper

7. Create the Circuit Diagram using TinkerCAD (Function Generator, Power Supply, Resistor, Diode)

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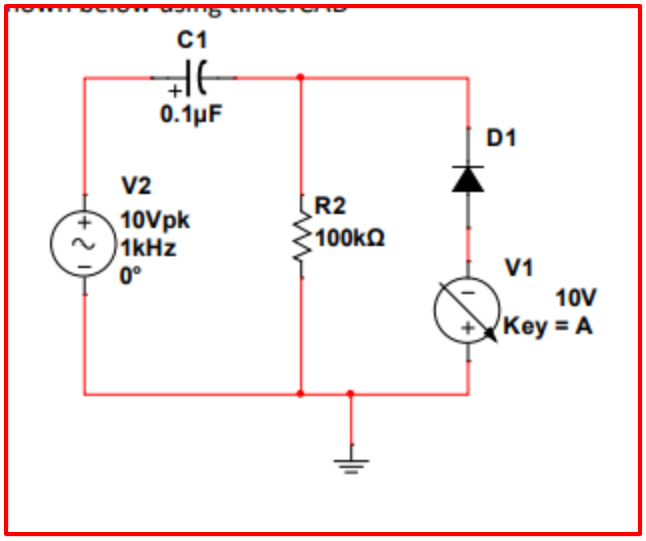

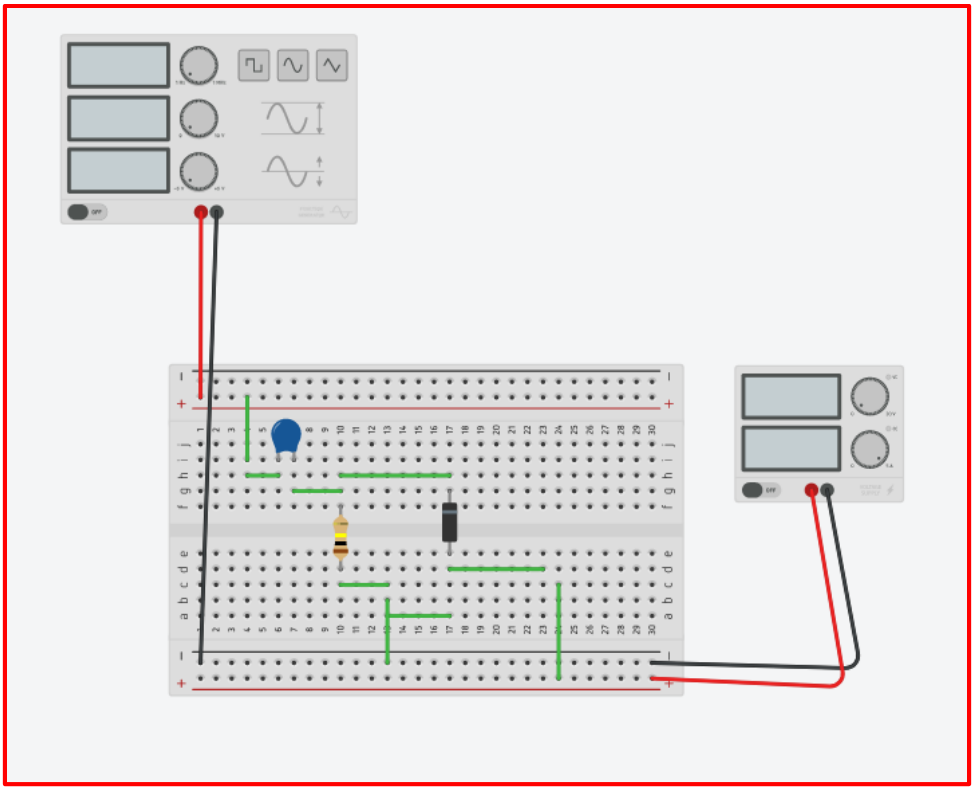

8. Place an Oscilloscope at the Output

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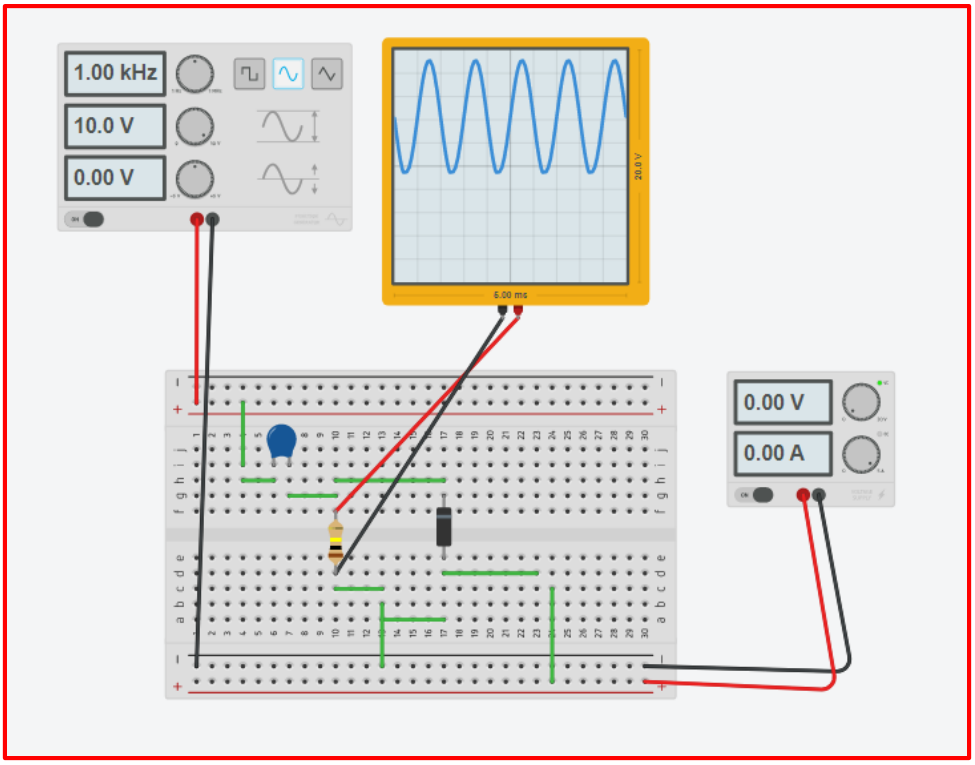

9. DC Supply at 2V

a.)

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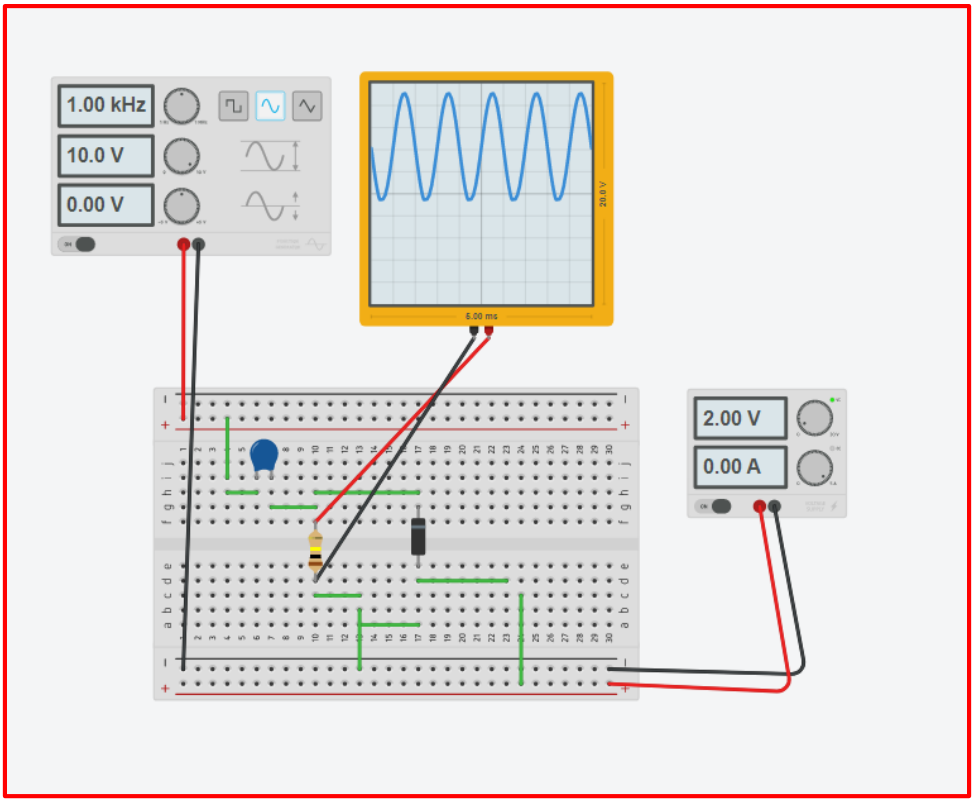

b.) Positive Clamper

10. Create the Circuit Diagram using TinkerCAD (Function Generator, Power Supply, Resistor, Diode)

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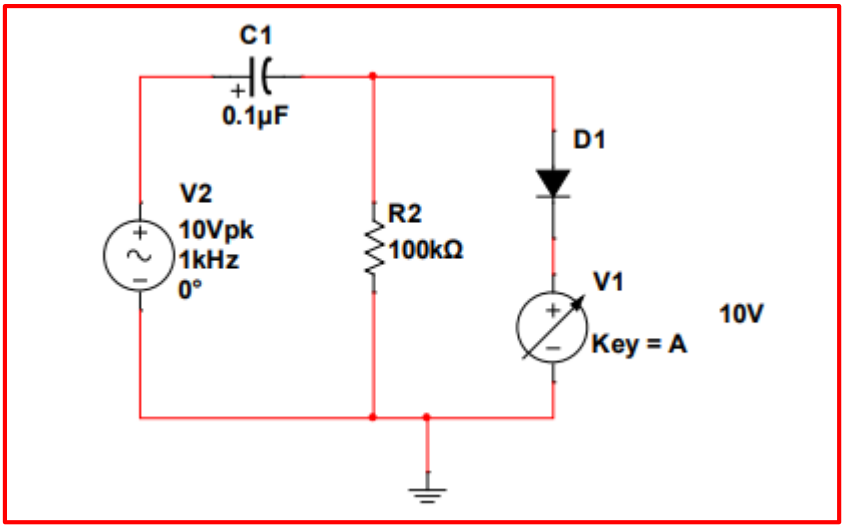

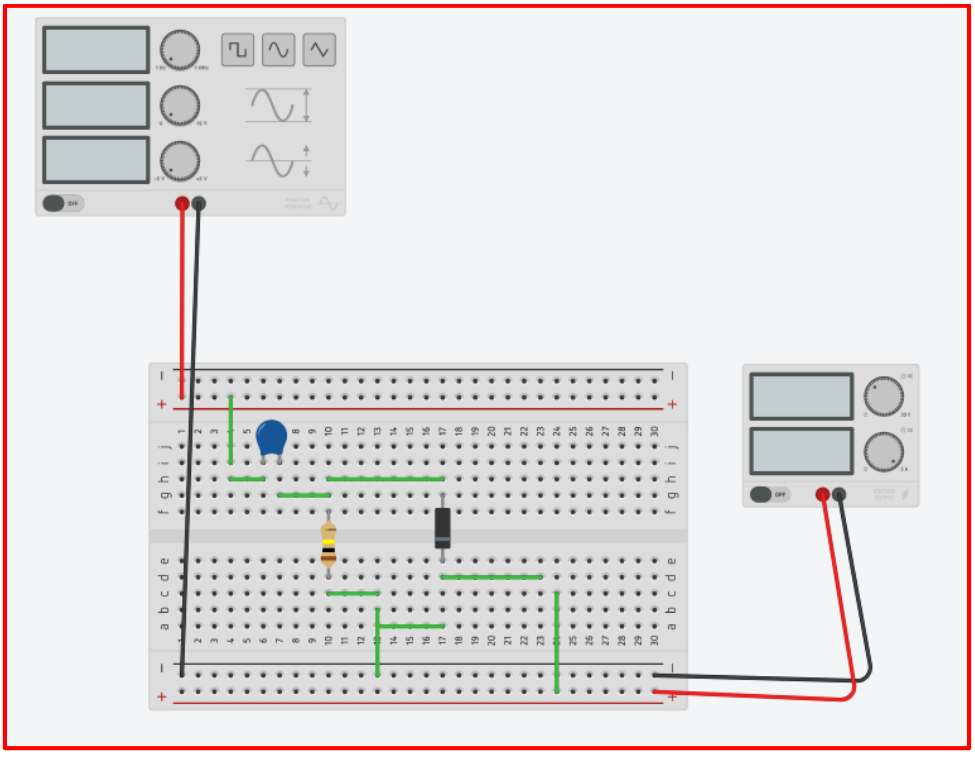

11. Place an Oscilloscope at the Output

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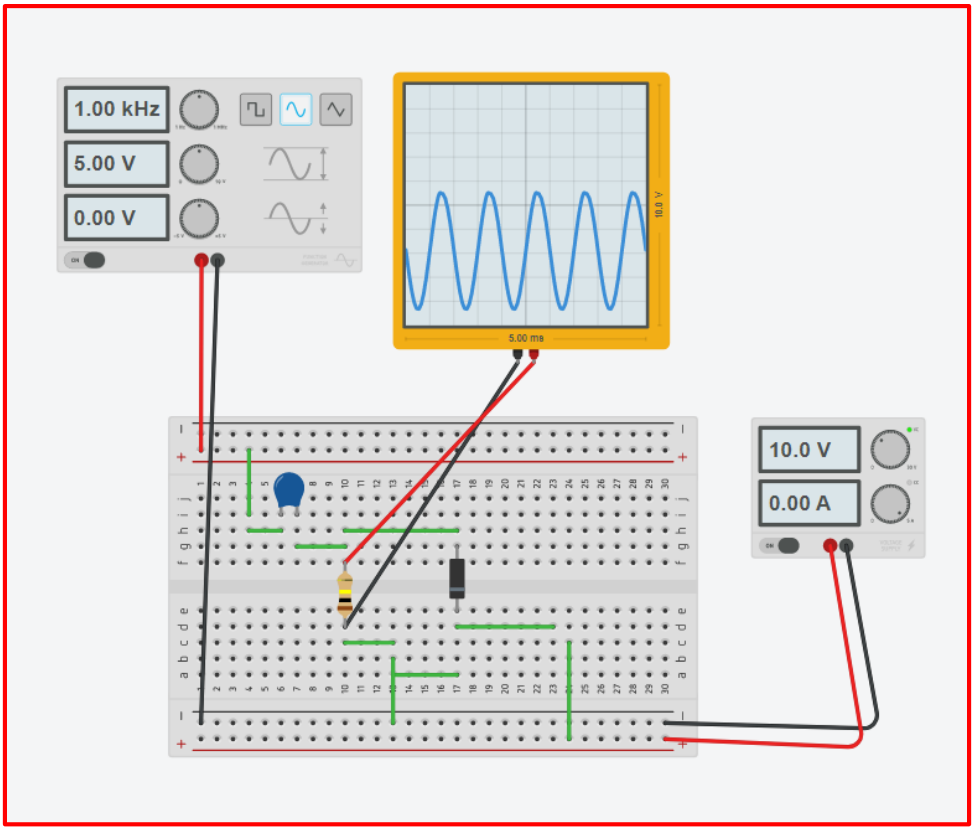

12. DC Supply at 2V

a.)

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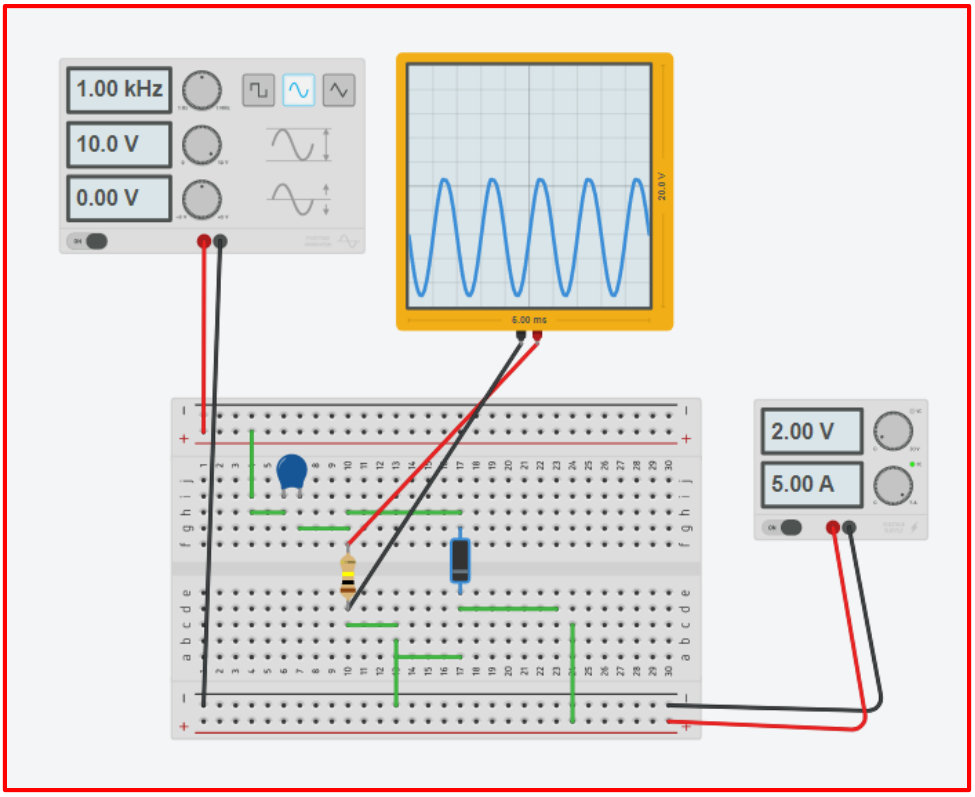
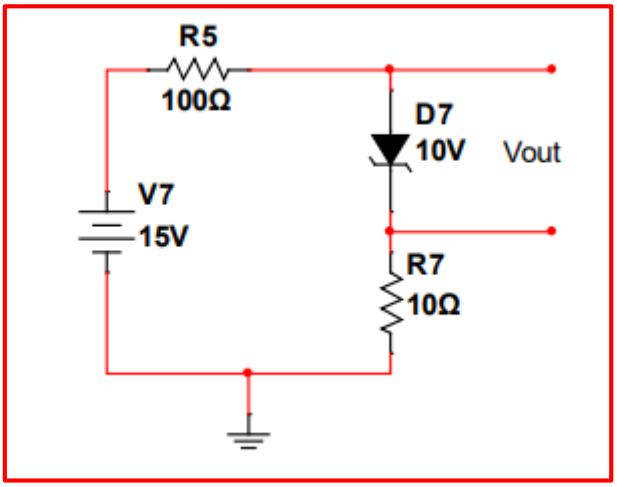


b.) Negative clamper

13. Create the Circuit Using TinkerCAD



14. Screenshot your Circuit

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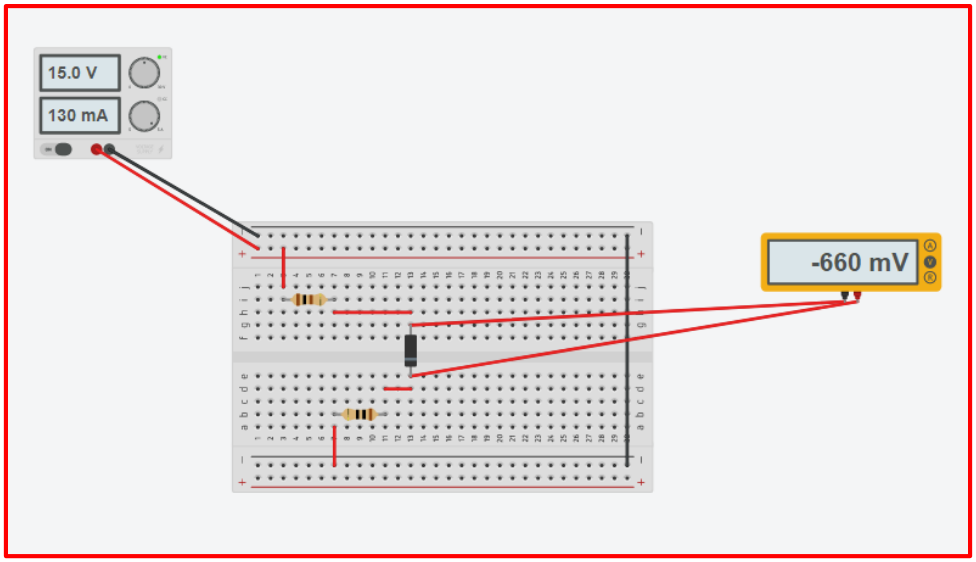

15. Measure the Output Voltage