Objectives: *The objective of this experiment is to become familiar with the applications of diodes. In this experiment, following aims are objected, calculating, measuring, and drawing the output voltages of series and paralel clipping and clamping circuits*

Materials:

Breadboard
DMM (Digital multi-meter)
DC Power Supply
Function Generator
Oscilloscope
1N4148 diode
1N4001 diode
Capacitor(s)
Resistor(s)

Background:

The primary function of half-wave and full-wave rectification systems is to establish a DC level from a sinusoidal input signal that has zero average (DC) level.

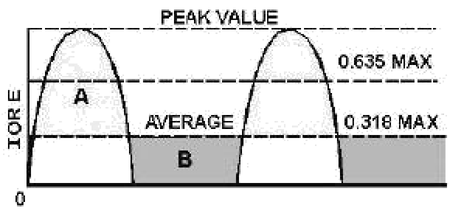
The half-wave voltage signal, normally established by a network with a single diode, has an average or equivalent DC voltage level equal to 31.8% of the peak voltage V_m. That is

$V_{dc} = 0.318 . V_{peak}$ volts (half-wave)

The full-wave rectifier signal has twice the average or DC level of the half-wave signal, or 63.6% of the peak value V_m. That is

$V_{dc} = 0.636 . V_{peak}$ volts (full-wave)

For large sinusoidal inputs ($V_m >> V_T$) the forward-biased transition voltage V_T of a diode can be ignored. However, for situations when the peak value of the sinusoidal signal is not that much greater than V_T, V_T can have a noticeable effect on V_{DC}



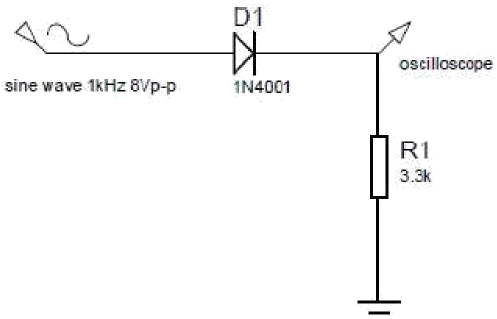
The primary function of clippers is to clip away a portion of an applied alternating signal. The process is typically performed by a resistor-diode combination. More DC supplies are used to provide addition shifts or cuts of applied voltage. The analysis of clippers with square-wave inputs is he easiest to perform since there are only two leveles of input voltage for the corresponding time interval determined. For sinusoidal and triangular inputs, various instantaneous values can be treated as DC levels and the output level has been determined, it can be sketched in total. Once the behaviour of clippers is established, the effect of the placement of elements of elements in various positon can be predicted and analysis completed.

Procedure:

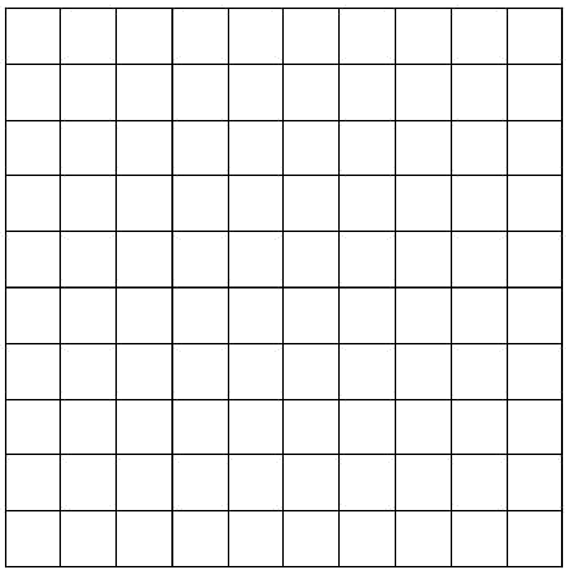
1. Determine the threshold voltage for the 1n4001, V_T, using the diode-checking capability of the DMM.

V_T =………………………………

2. Build the circuit below and record the measured value of the resistance R. Set the function generator to 1000 Hz, 8 $V_{p\text{-}p}$ sinusoidal voltage using the oscilloscope.



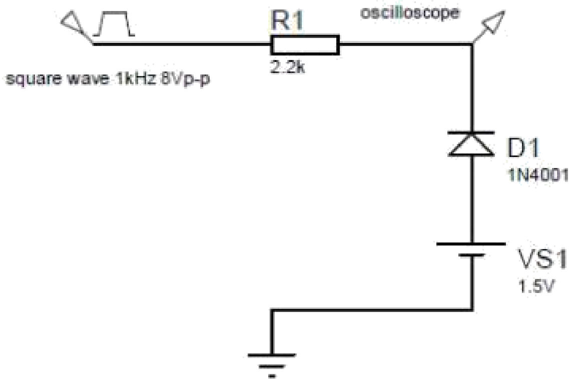
3. Plot source and output voltages one on the other



4. Measure the output DC voltage with the DC scale of the DMM. Calculate the DC voltage using your oscilloscope sketch. Compare your results.

5. How did you observe the effect of threshold voltage, explain.

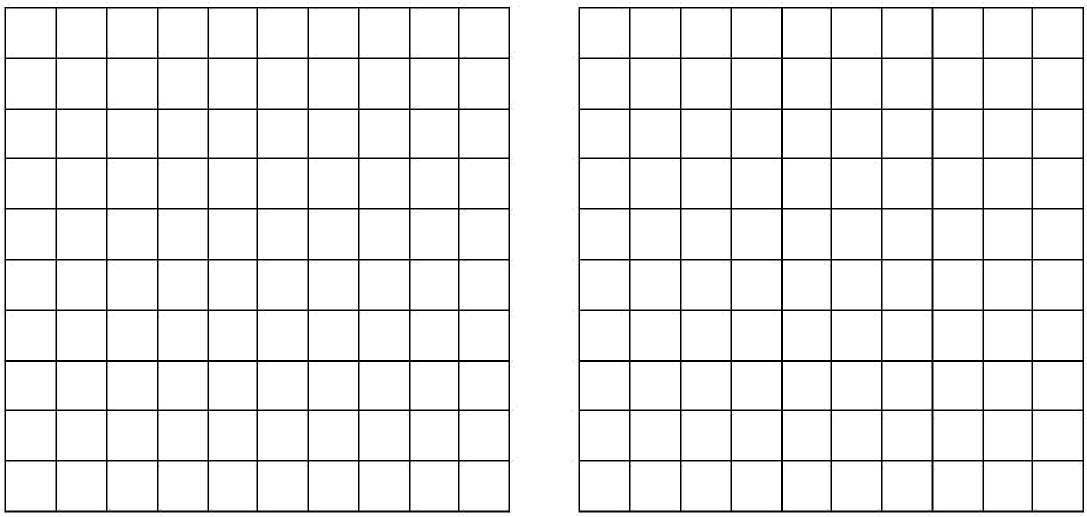
6. Record the measured value of resistance value of R and build the circuit below. Note that the input voltage is an 8 Vp-p square-wave at frequency of 1000 Hz.



7. Using the measured values of V_T, E, and R, calculate the output voltage V_{OUT}. Show all steps of your calculations. Note that the output voltage will have different values for each input values of +4 V and -4 V)

V_{OUT} =………………………………

8. Plot waveform of the output voltage; expected on left, measured on right sides.

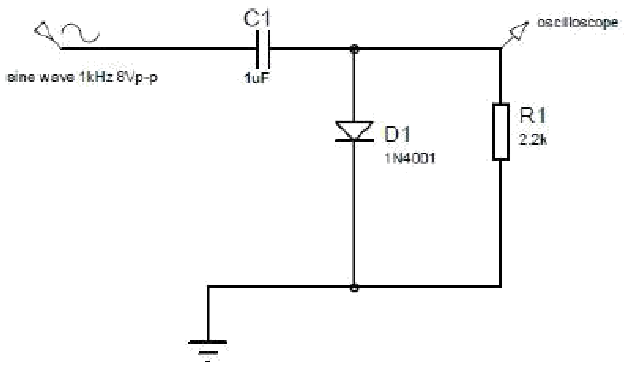


9. Reverse the DC source E and calculate the output voltage V_{OUT}. Show all steps of your calculations. Note that the output voltage will have different values for each input values of +4 V and -4 V).

V_{OUT} =………………………………

10. Plot waveform of the output voltage; expected on left, measured on right sides.

11. Construct the network given below and adjust the input signal to 8 Vp-p sinusoidal wave at frequency of 1000 Hz.



12. Plot waveform of the output voltage; expected on left, measured on right sides.

Experiment-3

13. Deteremine the time constant τ =RC for the same circuit for measured values of R and C.

R (measured) = ………………………………
C (measured) = ………………………………
τ (calculated) = ………………………………

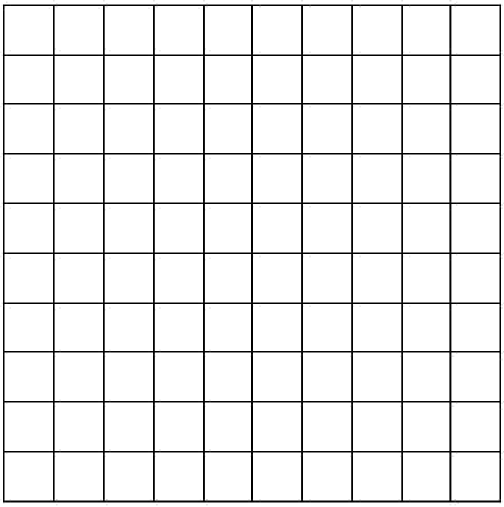
Calculate the period of the input signal and determine half of the period as "off" state for the diode.

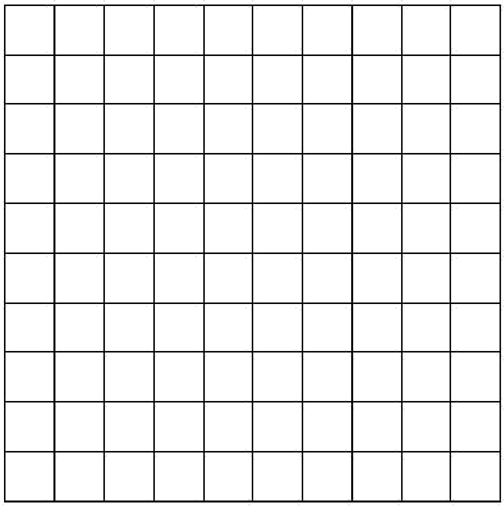
T (calculated) = ………………………………
T/2 (calculated) = …………………………

The charge / discharge period of an RC circuit is approximately 5τ. And for a good clamping action it is important that 5τ must be larger than T/2 of applied signal. Compare calculated values of 5τ and T/2.

14. Change R to 1 kΩ. Calculate the new 5τ value. How would you expect the new value of R to affect the output waveform V_O?

15. Plot waveform of the output voltage; expected on left, measured on right sides.





16. Compare expected and measured waveforms of both (12) and (15). Explain on your report.

17. What is the effect of decreasing the value of R ? Explain on your report.