

ECE 2200L  
Introduction to Microelectronics Circuits  
Laboratory

Experiment 3  
Applications of the PN Diode

Report

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## Objective

To experiment on some examples of the applications of PN diodes as non-linear circuit elements. Specifically, rectifiers, peak detectors as DC power supplies, and clippers/limiters will be studied.

## Result

### Circuit 1

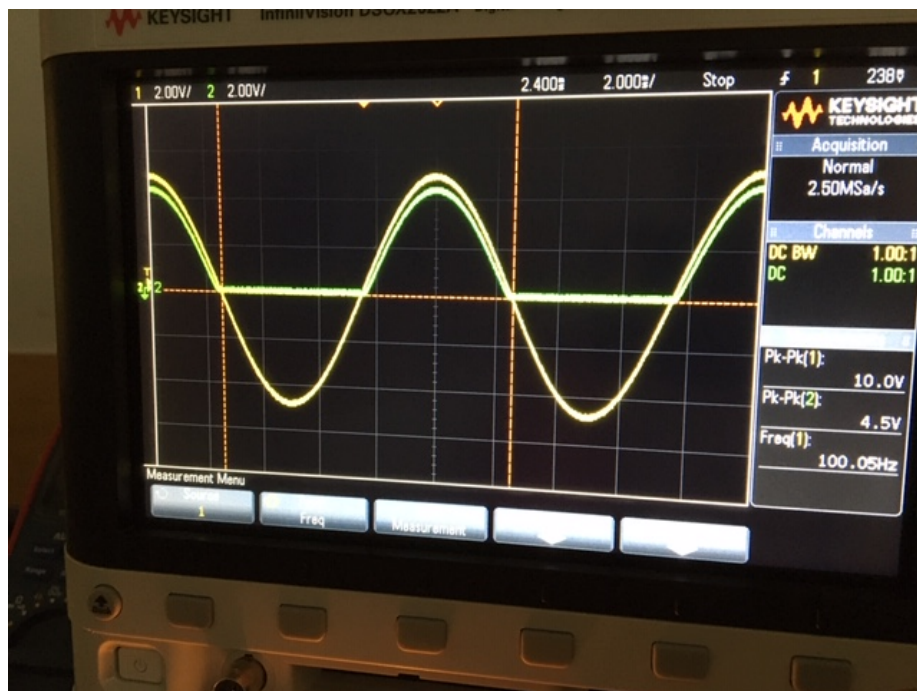


Figure 1: Oscilloscope plot demonstrating input and output voltage with  $V_{in} = 5V_{pk}$

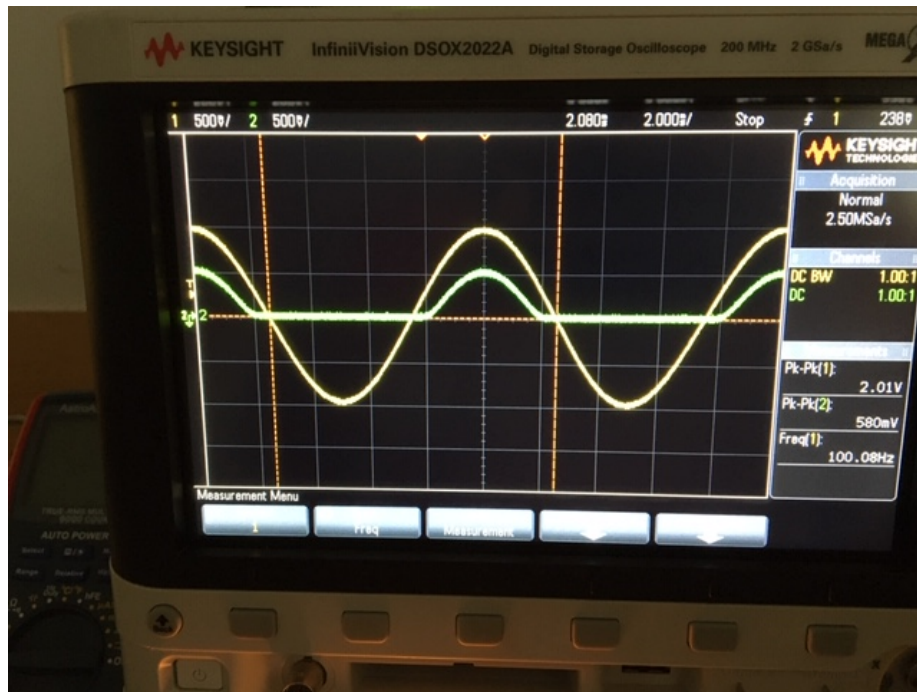


Figure 2: Oscilloscope plot demonstrating input and output voltage with  $V_{in} = 1V_{pk}$

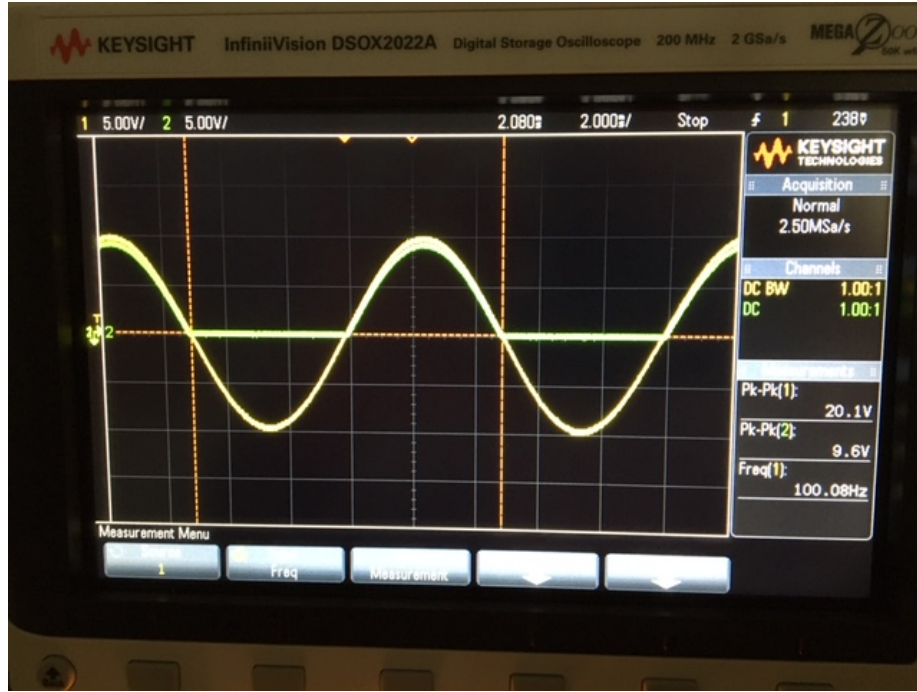


Figure 3: Oscilloscope plot demonstrating input and output voltage with  $V_{in} = 10V_{pk}$

$V_{in_{pk}}$ (V)	$V_{out_{pk}}$ (V)
1	0.58
5	4.5
10	9.6

Table 1: Peak value of output voltage as input voltage changes

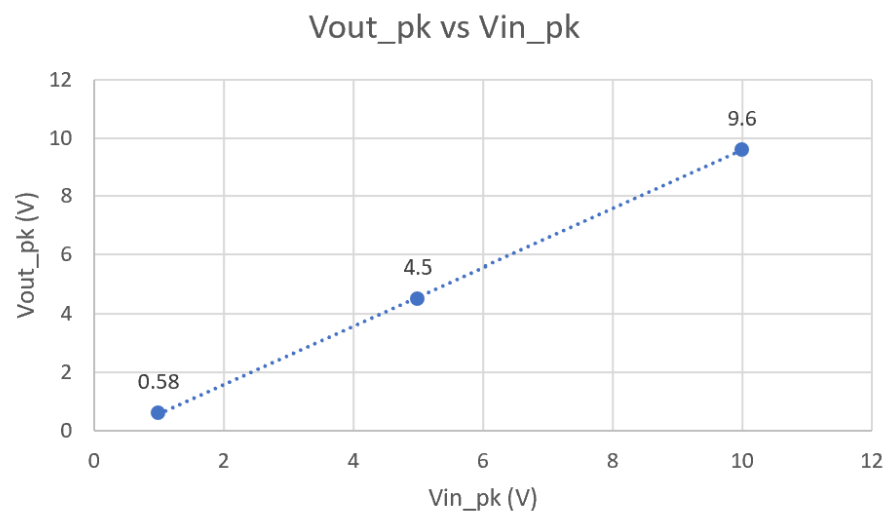


Figure 4:  $V_{out_{pk}}$  vs.  $V_{in_{pk}}$  plot

## Circuit 2

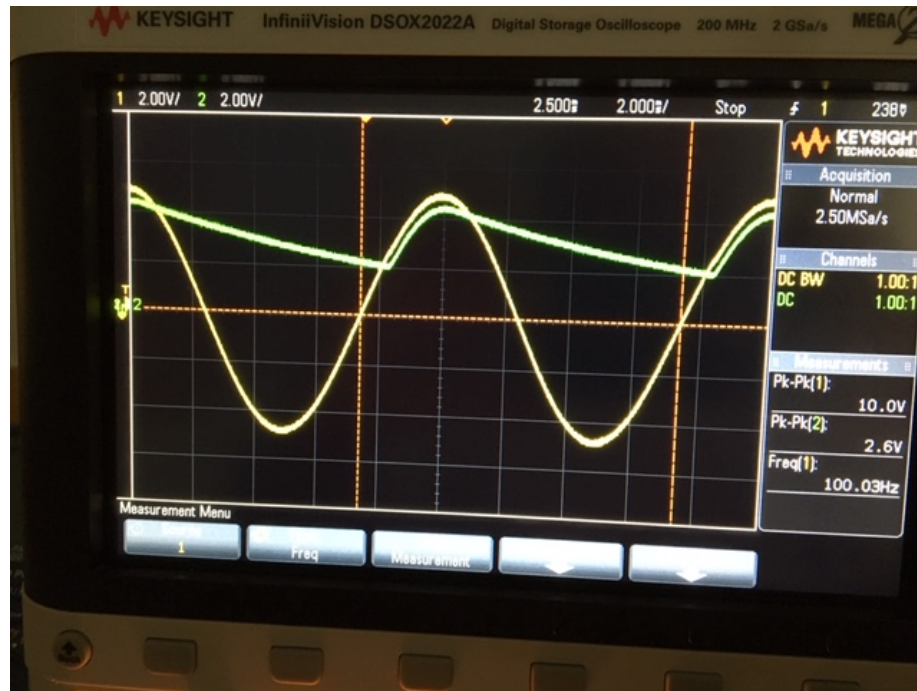


Figure 5: Oscilloscope plot demonstrating input and output voltage with 1  $\mu\text{F}$  capacitor and 10  $\text{k}\Omega$  resistor

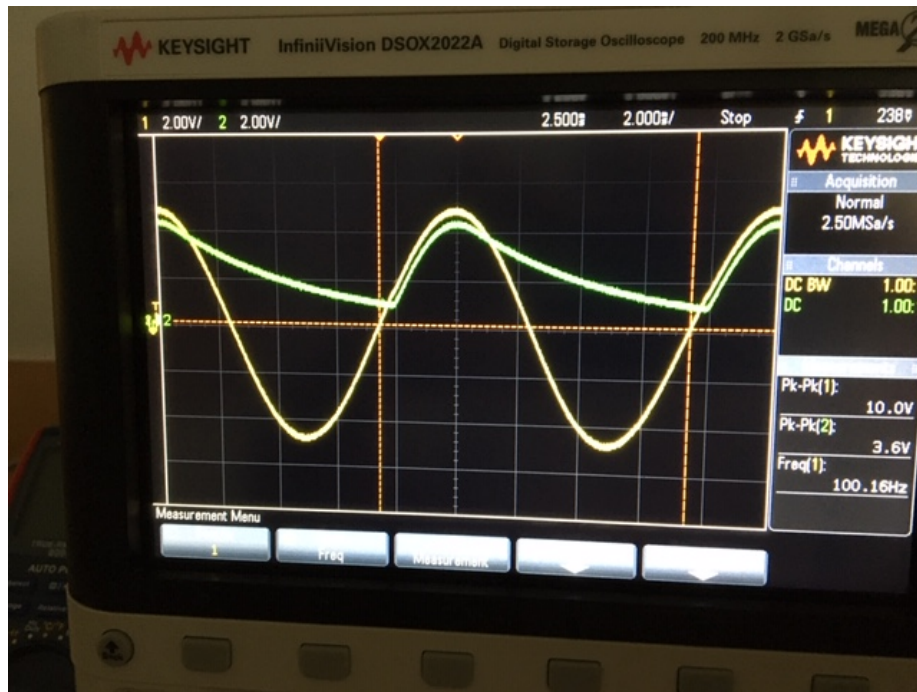


Figure 6: Oscilloscope plot demonstrating input and output voltage with  $1\ \mu\text{F}$  capacitor and  $4.7\ \text{k}\Omega$  resistor

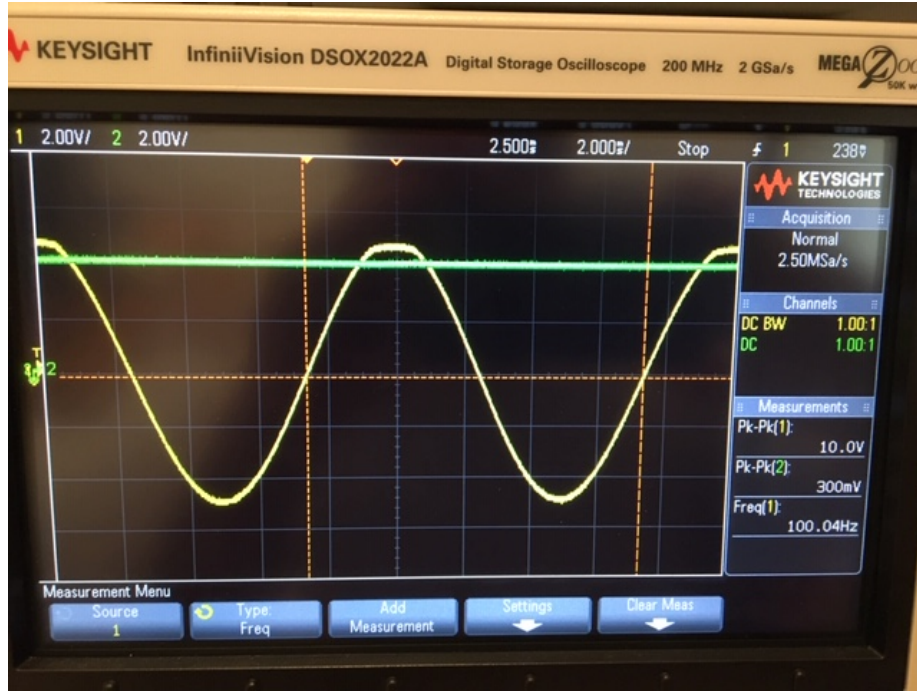


Figure 7: Oscilloscope plot demonstrating input and output voltage with 100  $\mu\text{F}$  capacitor and 10  $\text{k}\Omega$  resistor

$f$ (Hz)	$\frac{1}{f}$ (s)	$V_{r_{pp}}$ (V)
50	0.02	3.7
100	0.01	2.7
200	0.005	1.7
400	0.0025	1
600	0.001667	0.8
800	0.00125	0.56
1000	0.001	0.44

Table 2: Peak-to-peak value of output voltage as frequency changes



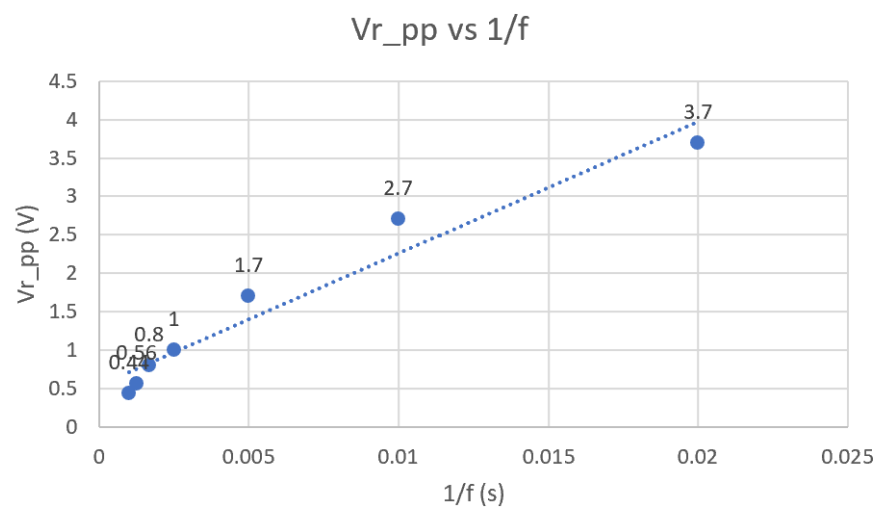


Figure 8:  $V_{out\_pp}$  vs.  $\frac{1}{f}$  plot

### Circuit 3

According to [1N4001 datasheet from ON Semiconductor](#), the average forward voltage drop of 1N4001 is 0.8 V. Therefore, as  $V_{in}$  increases pass 5.8 V,  $V_{out}$  will be limited by the middle branch of the circuit to 5.8 V. As  $V_{in}$  decreases pass  $-5.8$  V,  $V_{out}$  will be limited by the right branch of the circuit to  $-5.8$  V.

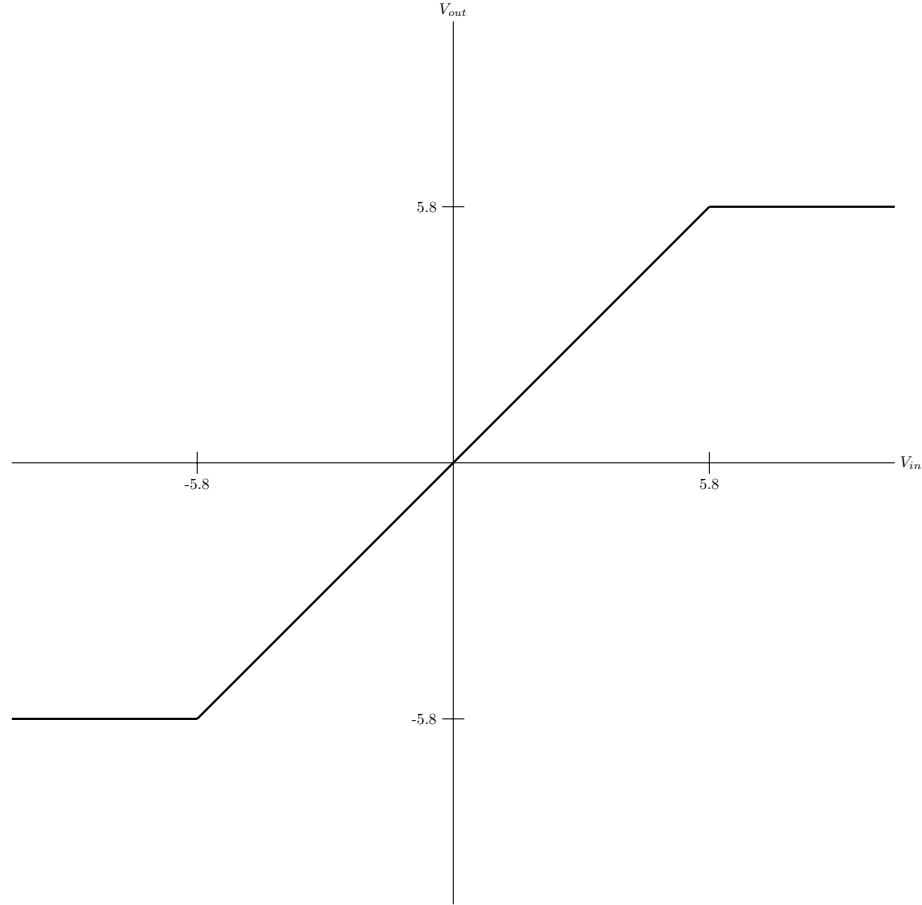


Figure 9:  $V_{out}$  vs  $V_{in}$  plot in theory with 1N4001 forward voltage drop as 0.8 V

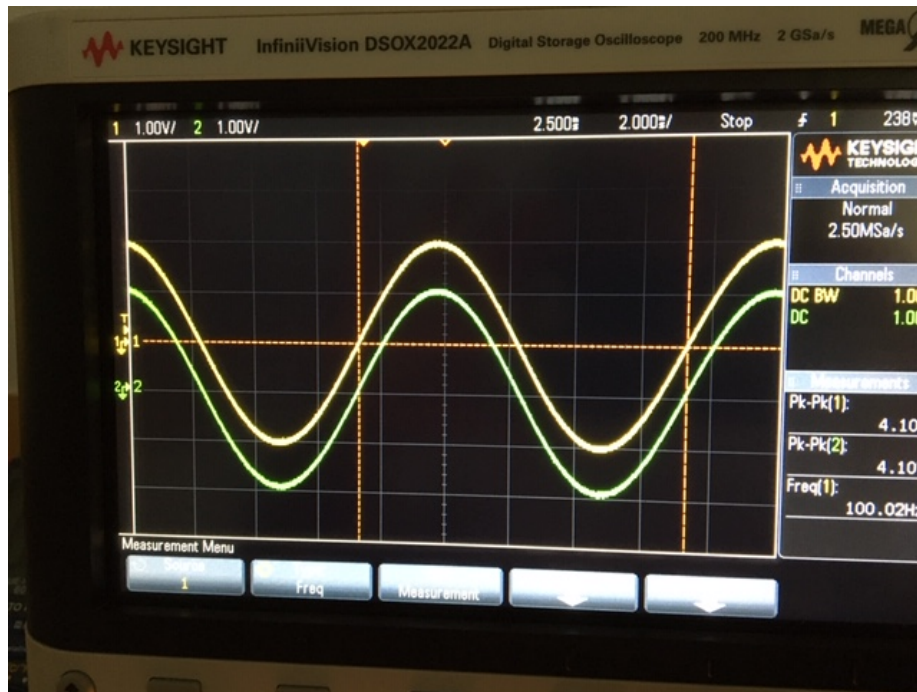


Figure 10: Oscilloscope plot demonstrating input and output voltage with  $V_{in} = 2V_{pk}$

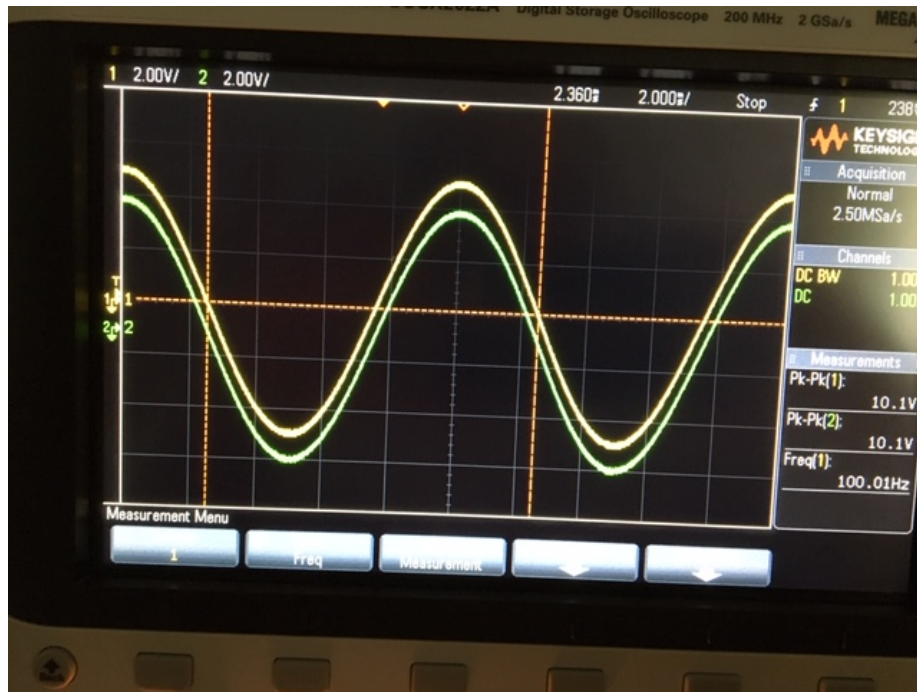


Figure 11: Oscilloscope plot demonstrating input and output voltage with  $V_{in} = 5V_{pk}$

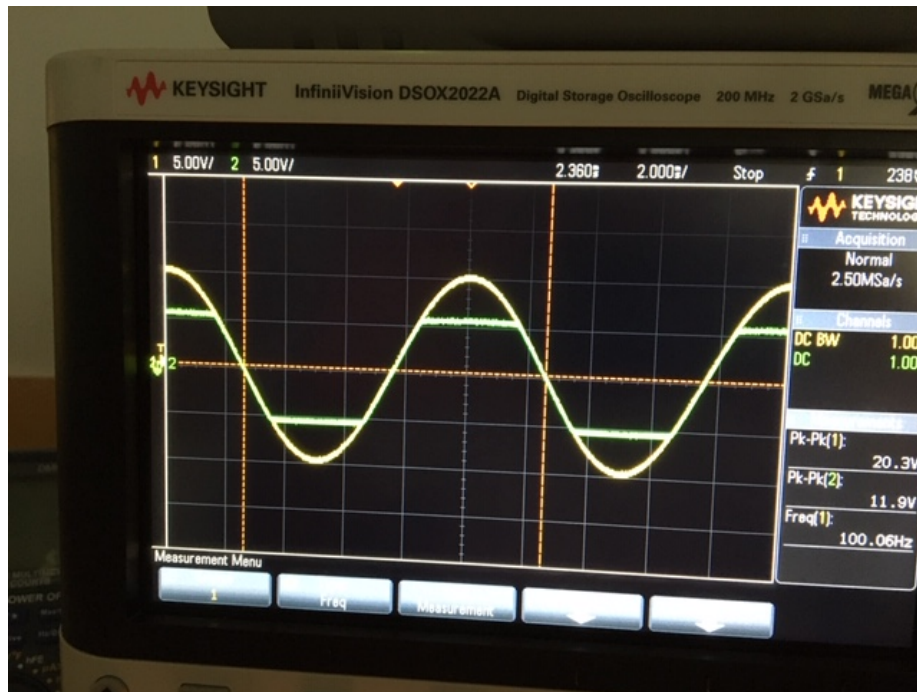


Figure 12: Oscilloscope plot demonstrating input and output voltage with  $V_{in} = 10V_{pk}$

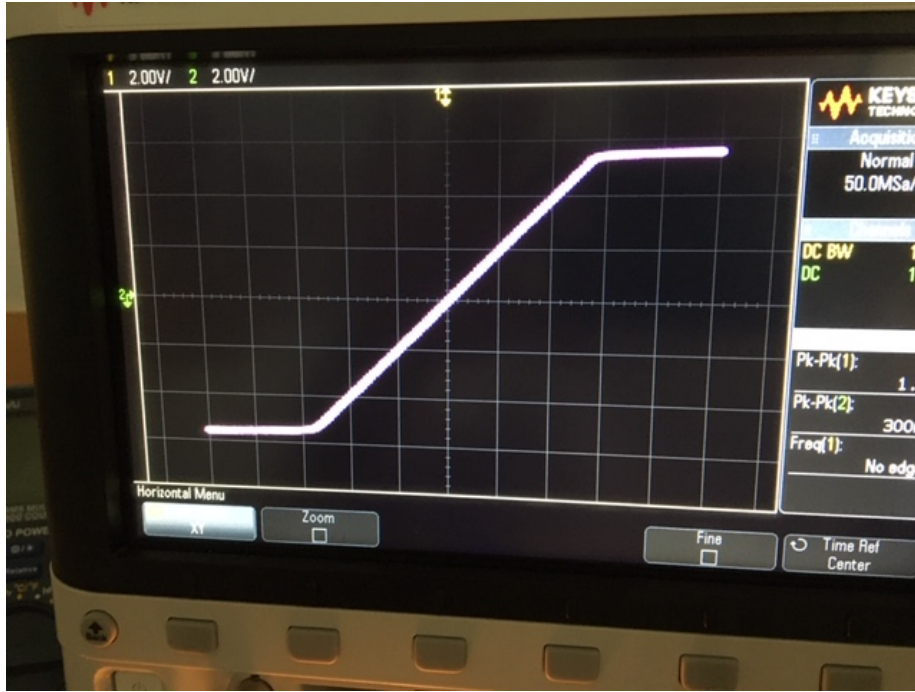


Figure 13: Oscilloscope plot of  $V_{out}$  vs  $V_{in}$

$V_{in_{pk}}$ (V)	$V_{out_{pk}}$ (V)
1	0.58
5	4.5
10	9.6

Table 3: Peak value of output voltage as input voltage changes

As can be seen from the Oscilloscope plot similar to the theoretical plot, the circuit behaved as expected.

## Conclusion

Various application of diode, specifically half-wave rectifier, peak detector and clipper circuit. As can be seen from the result, the diode have an effect of a small decrease in peak load voltage in a half-wave rectifier circuit; the configuration of larger resistance and capacitance have an effect of decreasing the magnitude of ripple on the output voltage; and the clipper circuit characteristics is observed.