Başkent University
Department of Electrical and Electronics Engineering
EEM 214 Electronics I Laboratory
Experiment 5

Diode Clipping & Clamping Circuits

Aim:

The purpose of this experiment is to investigate the application of the diode applications in clipping and clamping circuits.

Theory:

In addition to the use of diodes as rectifiers and voltage regulators, there are a number of other interesting applications. For example, diodes are frequently used in applications such as wave-shaping circuits, detectors, protection circuits, and switching circuits. In this experiment, two widely used applications of diode circuits are investigated, namely diode *limiter (clippe*r) circuits and diode *clamping (DC Restore*r) circuits.

Diode clipping circuits are used to prevent a waveform from exceeding some particular limit, either negative or positive. This is achieved by realizing that when a diode is conducting, the voltage drop across the diode is constant and is nearly equal to 0.7 volts.

Diode clamping circuits are used to shift the dc level of a waveform. When a signal is passed through a capacitor, the dc component is blocked. A clamping circuit can restore the DC level. For this reason, these circuits are sometimes called dc restores.

Preliminary Work:

1) Review section 3.19 from the text book.

Clipper Circuits

2) **a.** Consider the clipper circuit in Fig.1, draw the input and output voltage waveforms in same plot(explain briefly how you obtain), assume diode model is constant voltage drop, v_i(t)=10sin(200πt), R=1kΩ and R_L=47kΩ.
Construct and simulate the circuit using PSPICE and get the waveform of the input and output voltage in same plot. Vary the dc voltage and explain briefly the effects on output voltage. Check your drawing with the simulation. Does the minimum values of the input and output voltage same? Why? Explain briefly.

b. For the clipper circuit in Fig.1; reverse the diode and replace the positive supply with negatively supply and repeat the 2-a.

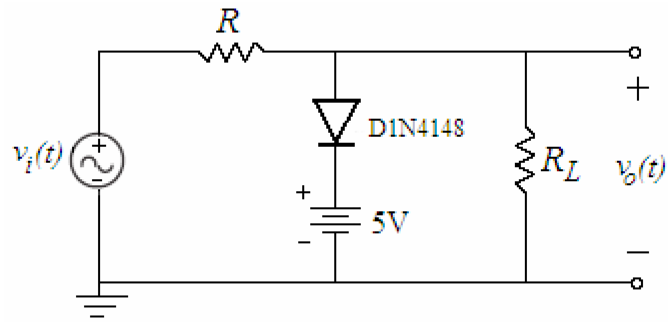

figure_1

3) **a.** Consider the clipper circuit with zener diode in Fig.2, draw the waveforms of input voltage, output voltage and voltage across the each zener in same plot(explain briefly how you obtain), assume diode model is constant voltage drop, $v_i(t)$=10sin(200πt), R=1kΩ and R_L=47kΩ.
Construct and simulate the circuit using PSPICE and get the waveform of the input voltage, output voltage and voltage across the each zener diode. Check your drawing with the simulation.

b. Reverse the zener diodes(both zener) in Fig.2 and simulate in PSPICE and get the waveform of the output voltage and voltage across each zener diode. Does the output voltage changes? Why?(Explain briefly)

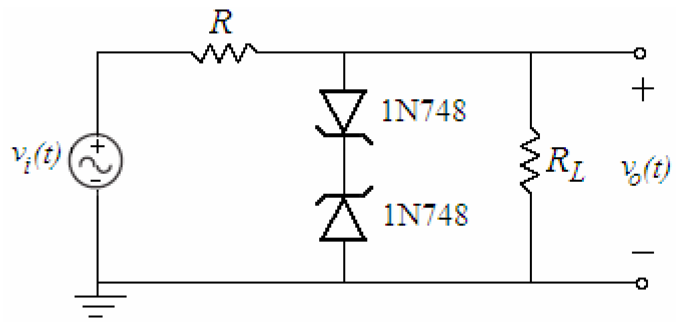

figure_2

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4) **Design**(explain briefly) the circuit, using the constant voltage drop model of diode, resistors and batteries, which have the input voltage and clipped output voltage in Fig.3. Construct and simulate the circuit using PSPICE and get the waveform of the input and output voltage. Compare the simulation result with the given output voltage. Check whether your design is correct or not.

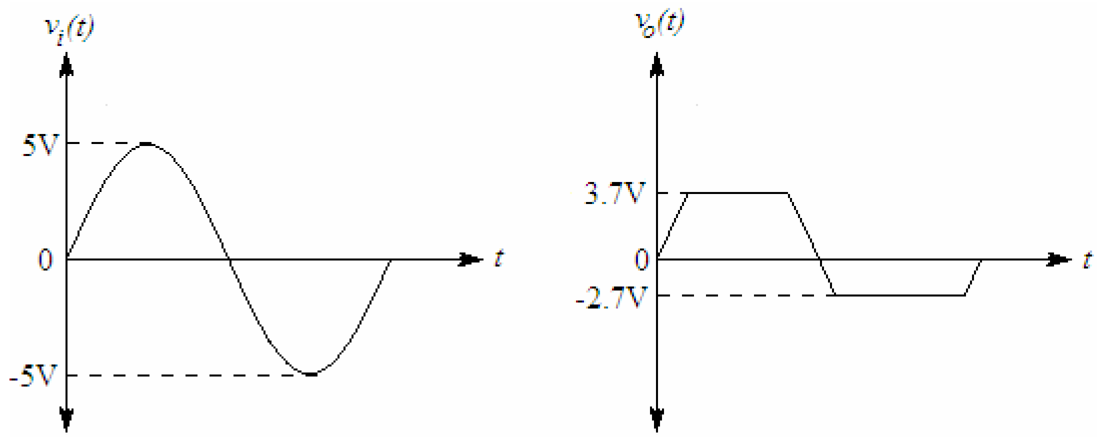


figure_3

Clamper Circuits

5) **a.** Consider the clamper circuit in Fig.4a, draw the input and output voltage waveforms (explain briefly how you obtain), assume diode model is constant voltage drop, v_i(t)=10sin(200πt) and C=1µF. What is DC value of the output voltage?

Construct and simulate the circuit using PSPICE and get the waveform of the input and output voltage waveform in same plot also obtain DC(average) value of the output voltage using PSPICE **add trace button**. Check your drawing with the simulation.

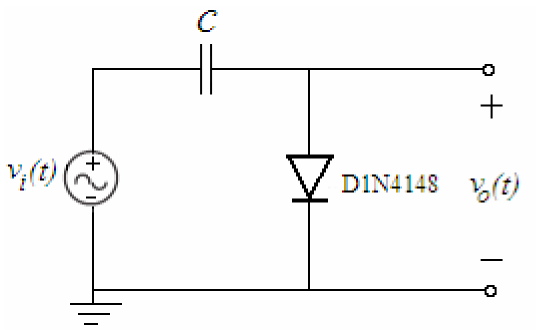


figure_4a

b. Consider the clamper circuit in Fig.4b, draw the input and output voltage waveforms (explain briefly how you obtain), assume diode model is constant voltage drop, v_i(t)=10sin(200πt) and C=47µF.

Construct and simulate the circuit using PSPICE and get the waveform of the input and output voltage waveform. Vary the dc voltage and explain briefly the effects on output voltage. Check your drawing with the simulation.

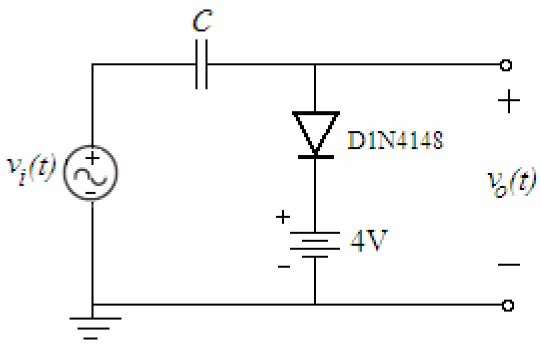


figure_4b

c. For the clamper circuit in Fig.4b; reverse the diode and repeat the 5b.

6) Consider the clamper circuit with zener diode in Fig.5, draw the input and output voltage waveforms (explain briefly how you obtain), assume diode model is constant voltage drop, v_s(t)=2sin(200πt) and R_L=1kΩ. Construct and simulate the circuit using PSPICE and get the waveform of the input($v_i(t)$) and output voltage waveform. Check your drawing with the simulation.

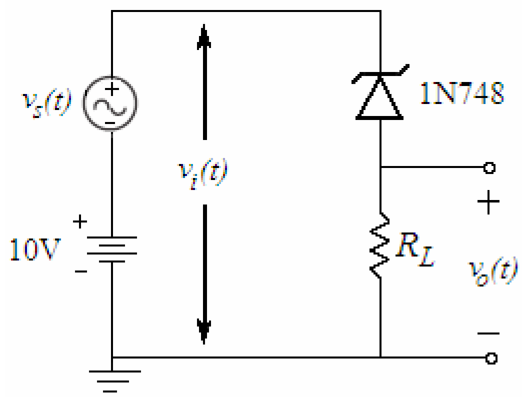


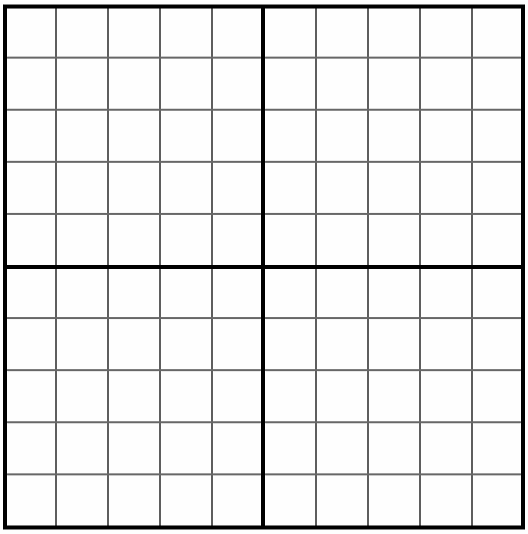
figure_5

7) Read the experimental work.

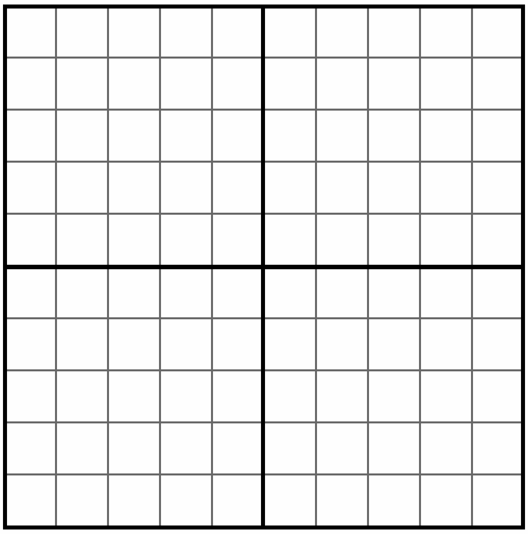
Experimental Work:

1. **a.** Setup the circuit of Fig.1. Set the input voltage signal to a sinusoid with 100 Hz frequency and 20V peak-to-peak amplitude with R=1kΩ and R_L=47kΩ. Obtain and plot the input and output voltage waveforms. (in DC coupling mode)

v_{in}

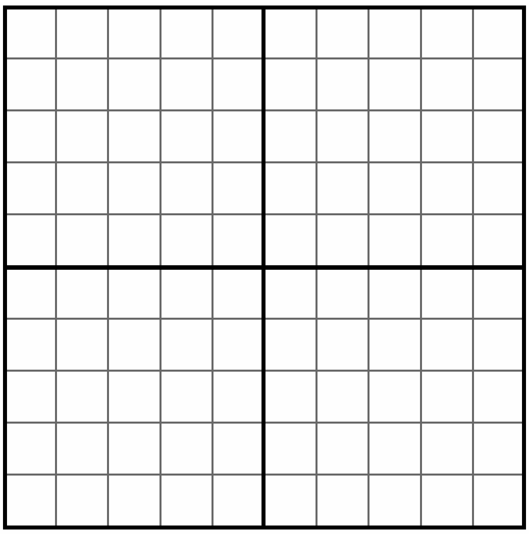


v_{out}



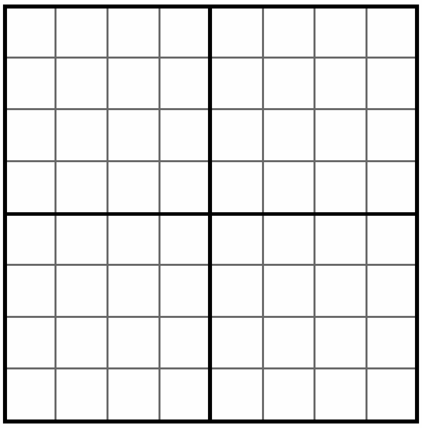
b. Reverse the diode and replace the positive DC supply with negative DC supply and repeat the 1a. Does the output voltage waveform change? Why?(Explain Briefly)

v_{out}

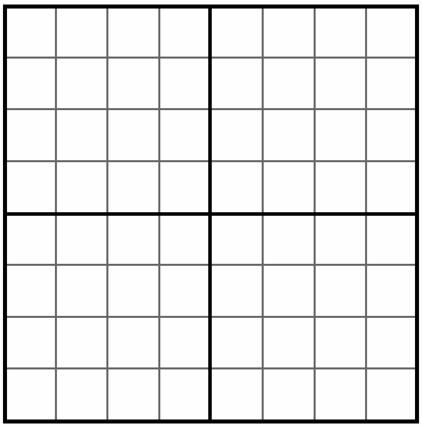


2. **a.** Setup the circuit of Fig.2. Set the input voltage signal to a sinusoid with 100 Hz frequency and 20V peak-to-peak amplitude with R=1kΩ and R_L=47kΩ. Obtain and plot the input voltage waveform, output voltage waveform and voltage waveforms across the zener diodes.

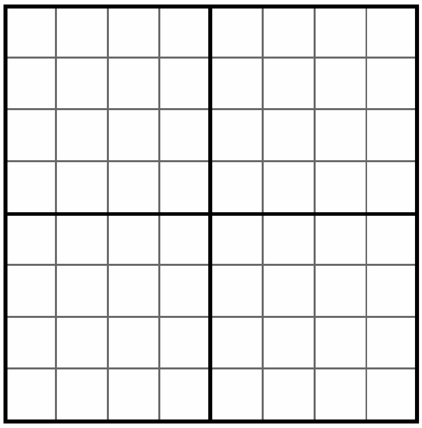
v_{in}



v_{out}

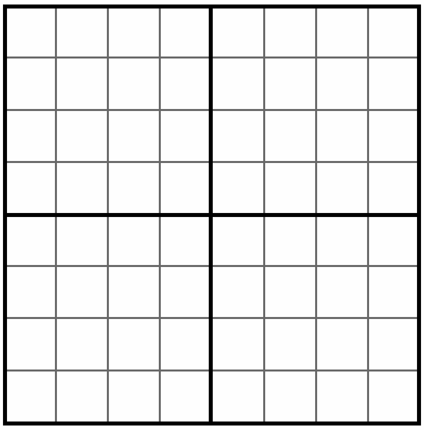


v_{zener}

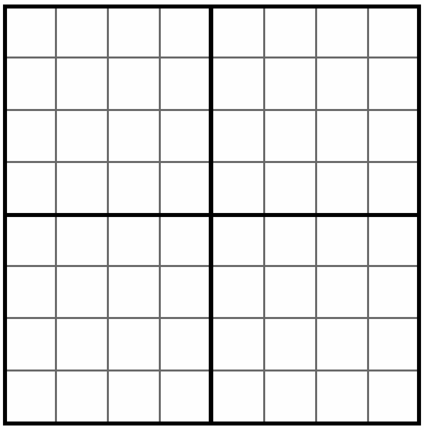


b. Reverse the upper zener and repeat the 2a. Does the output voltage and voltages across the zener diodes change? Why?(Explain Briefly)

v_{out}

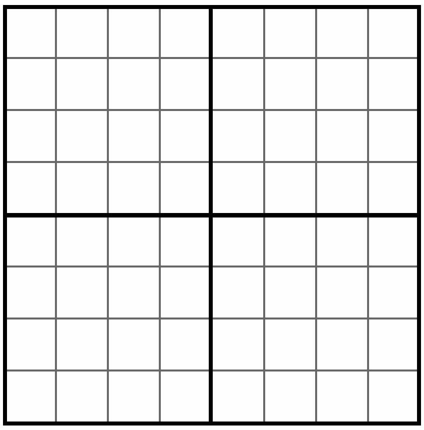


v_{zener}

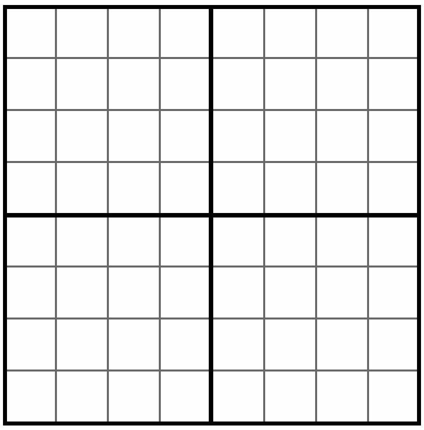


3. Setup the circuit that you designed in preliminary work part_4. Set the input voltage signal to a sinusoid with 100 Hz frequency and 10V peak-to-peak amplitude. Obtain and plot the input and output voltage waveforms.

v_{in}

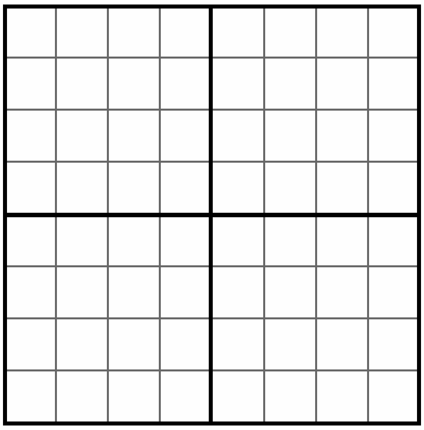


v_{out}

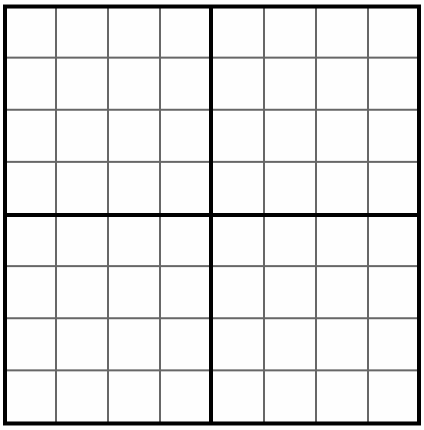


4. a. Setup the circuit of Fig.4a. Set the input voltage signal to a sinusoid with 100 Hz frequency and 20V peak-to-peak amplitude with C=1μF. Obtain and plot the input and output voltage waveforms.

v_{in}

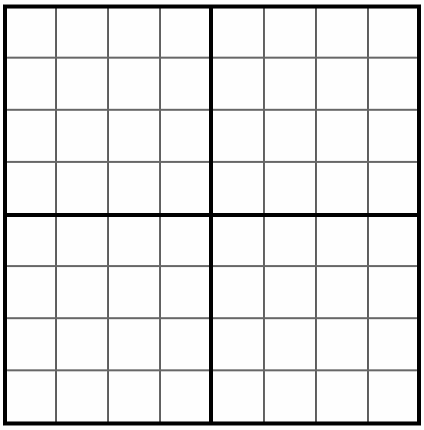


v_{out}

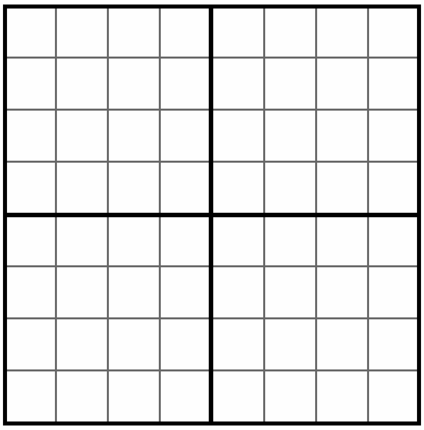


b. Setup the circuit of Fig.4b. Set the input voltage signal to a sinusoid with 100 Hz frequency and 20V peak-to-peak amplitude with C=47μF. Obtain and plot the input and output voltage waveforms.

v_{in}

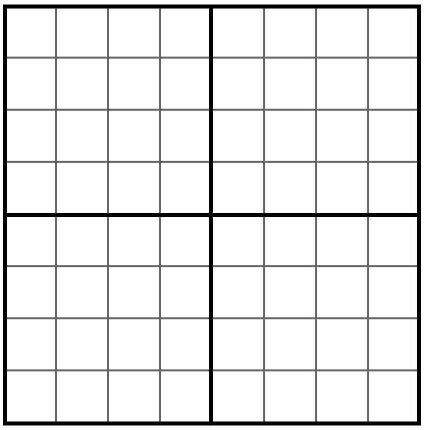


v_{out}



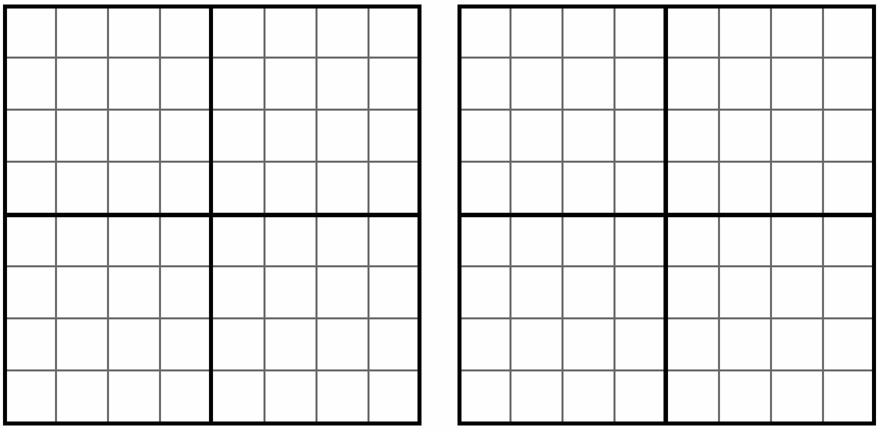
c. Reverse the diode and replace the positive DC supply with negative DC supply and repeat the 4b. Does the output voltage waveform change? Why? (Explain Briefly)

v_{out}



5. Setup the circuit of Fig.5. Set the input voltage signal to a sinusoid with 100 Hz frequency and 4V peak-to-peak amplitude and 10V DC offset with R=1kΩ. Obtain and plot the input and output voltage waveform. Indicate the DC levels and the peak values of the ac components. What happens when peak value of input voltage increases? (Hint: Consider when $V_{peak}>V_{DC}-V_Z$)

v_{in} v_{out}



6. Setup the circuit of Fig.6. Set the input voltage signal to a sinusoid with 100 Hz frequency and 20V peak-to-peak amplitude with R=1kΩ and C=1μF.
   a. Obtain and plot the input and output voltage waveform. Vary the DC voltage separately (one at a time) and explain briefly the effects on output voltage.
   b. Obtain and plot transfer characteristics v_{out} vs v_{in} on the oscilloscope.(X-Y mode)

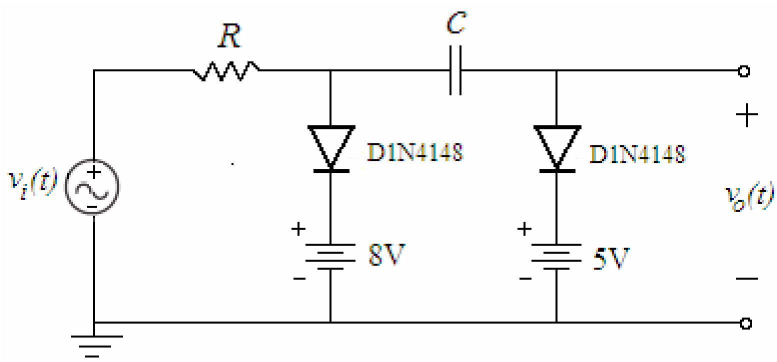
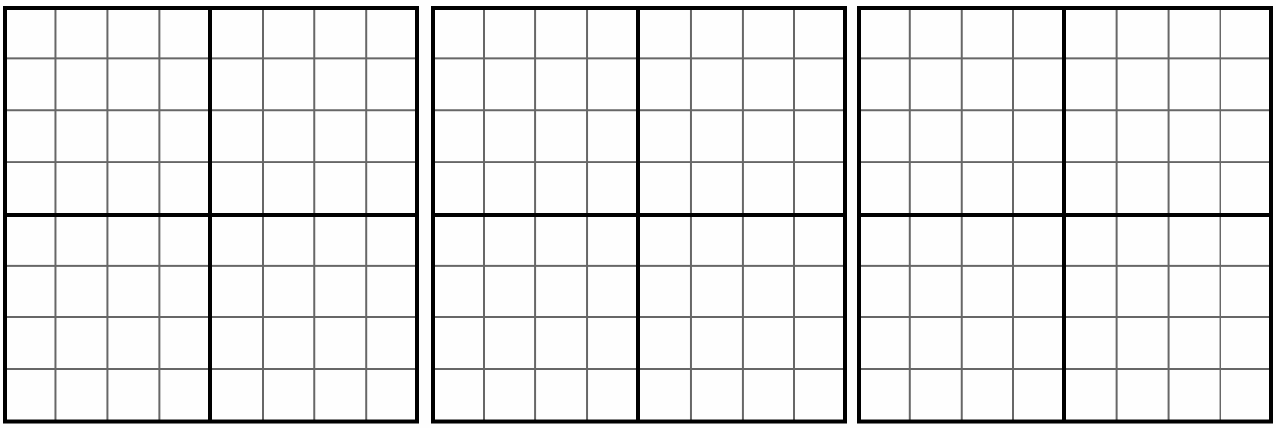


figure_6

v_{in} v_{out} v_{in} vs v_{out}



Lab Instruments:	Components:			
Breadboard	2	1N4148	1	47μF
Oscilloscope	2	1N748	1	1μF
Signal Generator	1	1kΩ		
DC Power Supply	1	47kΩ		