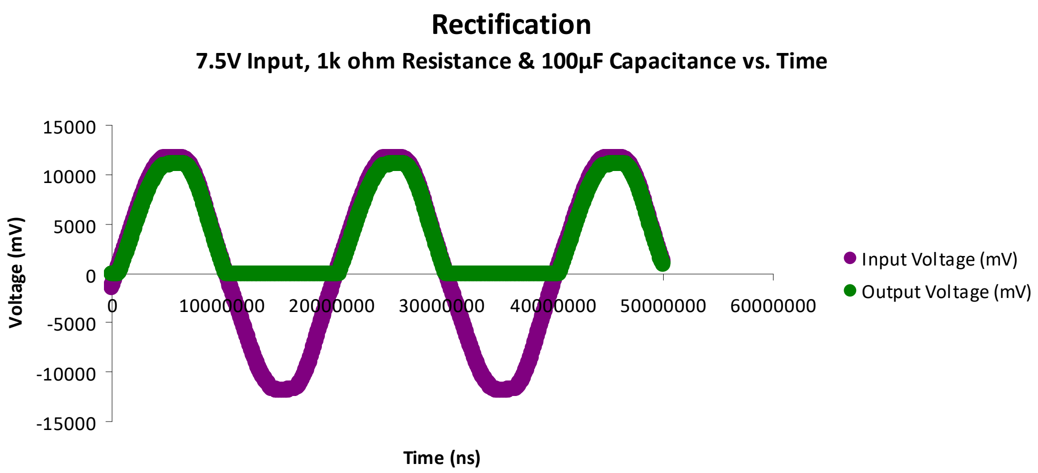
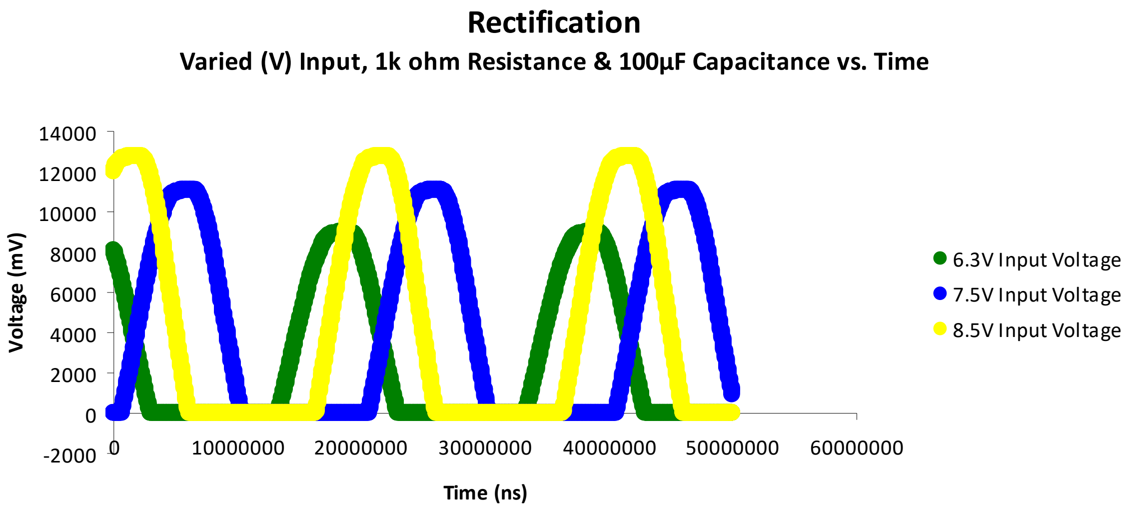
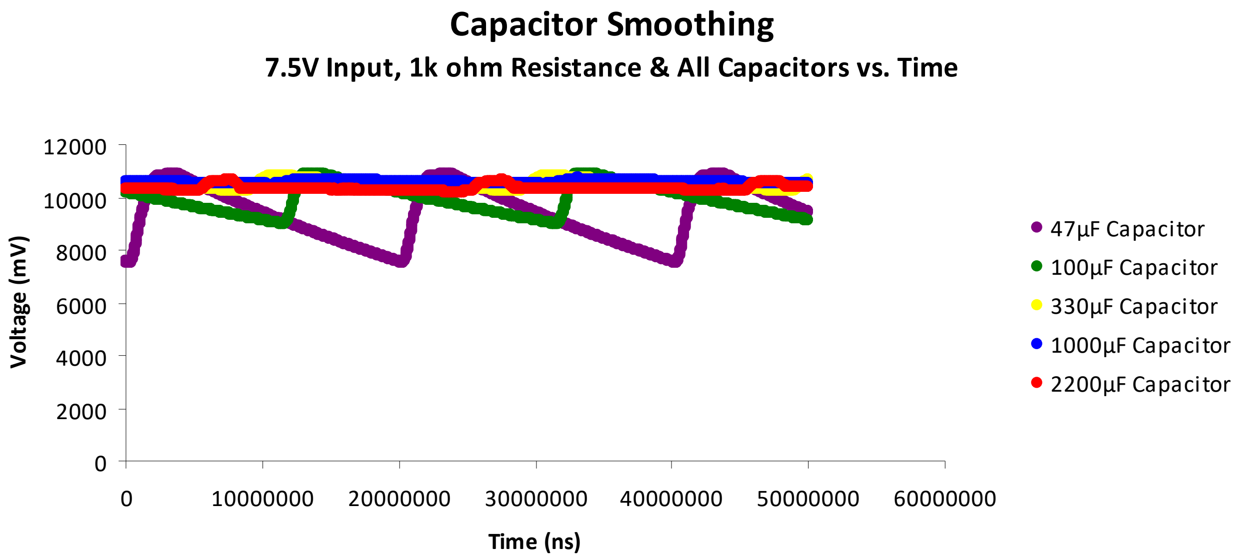
Data Analysis



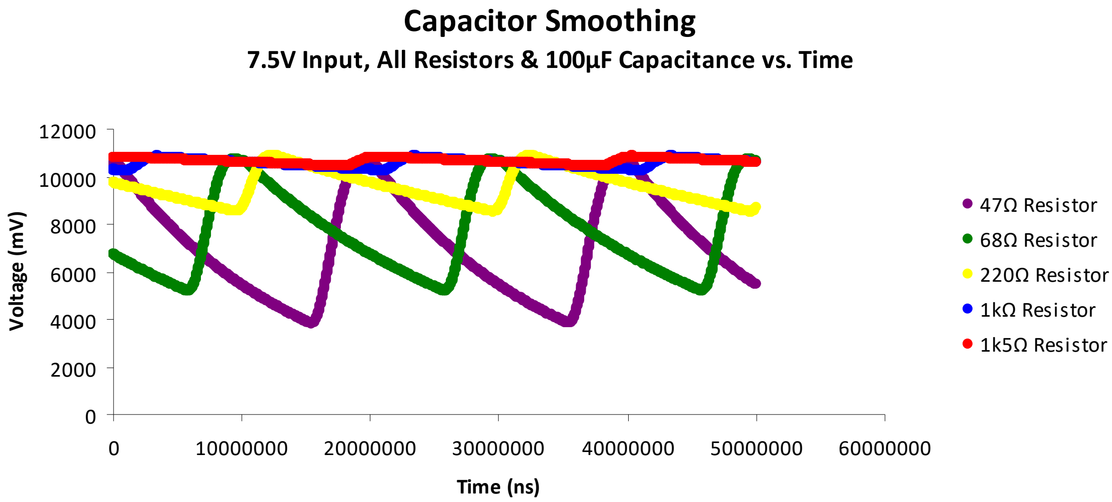
The graph above shows the rectification of voltage with a voltage input of 7.5 V AC voltage into a half-wave rectifier circuit with 1k ohm resistance and 100μF capacitance. The input and output voltages are in phase with one another however half the wave of each period of the output voltage is at 0V due to the rectification; diode prevents any current from flowing during every second phase. The input voltage above has a peak voltage of 11.8 with a peak to peak of 21.2 V. After the half-wave rectification, the graph displays a slightly lower peak voltage of 11.1 V; this is due to the half-wave rectifier containing a silicon diode which has a voltage drop of approximately 0.7 V. The resulting output voltage is a DC voltage; thus the half-wave rectifier has converted the AC input voltage to a DC output voltage. For half of the DC signal, the output voltage value is 0. Although hard to see, the thickness of the input voltage is slightly greater at the lower values of voltage.



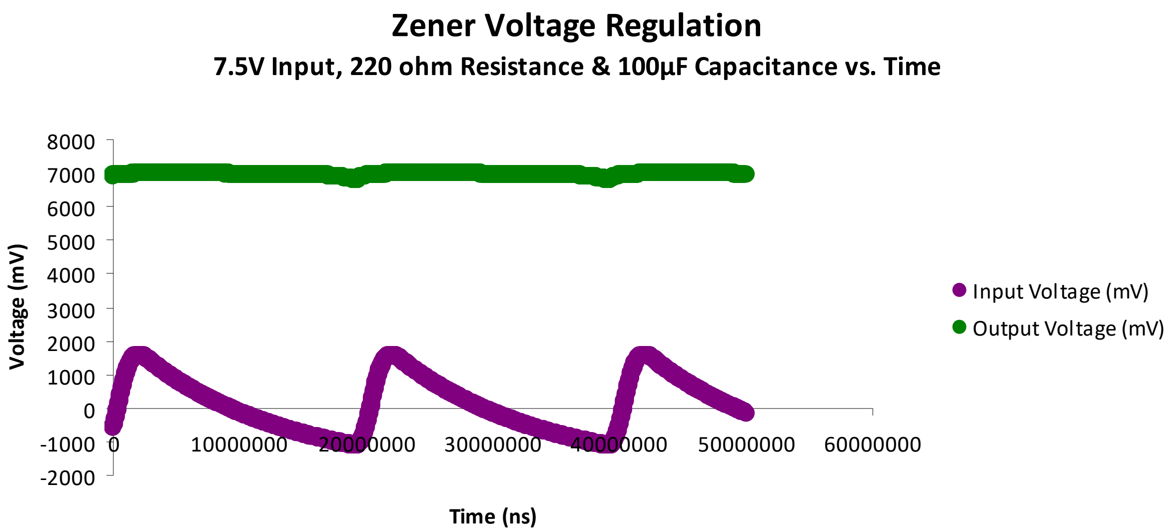
The graph above shows the comparison of the output voltages of a half-wave rectifier when the input voltages were varied. The input voltage is once again AC voltage but has been omitted from this graph. As you can see, the physical interpretation of the graph would be that the higher the input voltage, the higher the output voltage. The phases of the input and output of each individual value is in sync just like the previous graph on rectification. However, although difficult to see, the thickness of each series is different such that the higher the peak voltage, the thinner the wave is. Thus, at the point where each series is about to rise to the peak from 0 V, the lower peak voltage (6.3 V) would rise quicker. This could be mean that an appliance could be supplied voltage for longer if it demanded a voltage value within the range where the 6.3 V output of the rectifier is higher. We can derive from this graph that the input voltage into a half-wave rectifier affects only the peak voltage of the output; increase of input voltage = increase of output voltage.



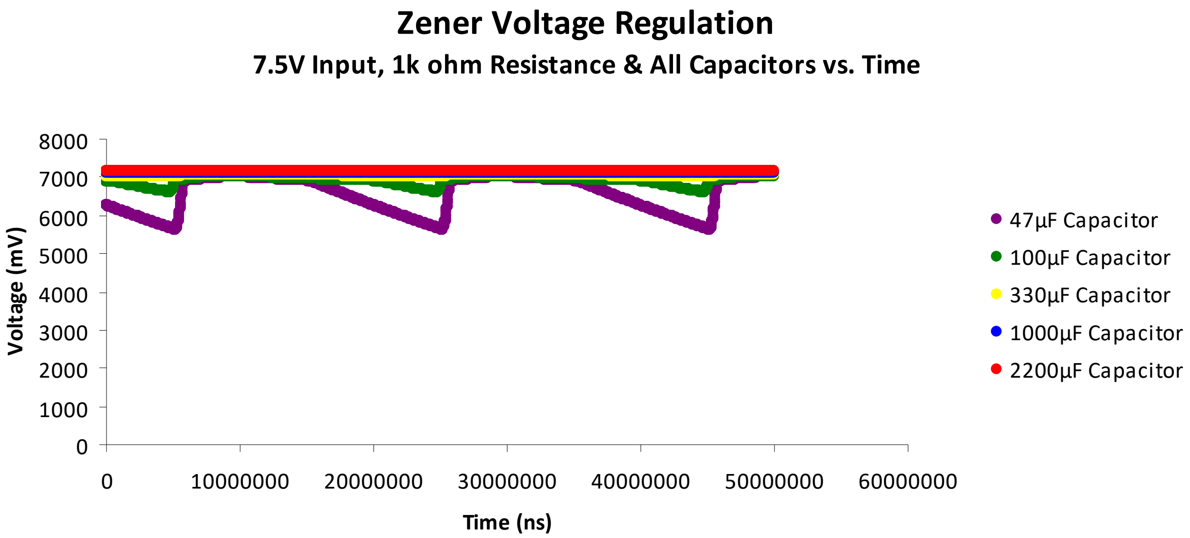
This graph is the comparison of the different output voltages supplied by using varying capacitors in the capacitor smoothing circuit. As the capacitor is placed inside a rectifier circuit, the output voltage is DC voltage. Firstly, it is obvious that the higher the capacitance placed in the circuit for smoothing, the more consistent the output voltage is. This can be interpreted where there is less ripple voltage as the capacitance increases. Secondly, the phases of the charging and discharging of the capacitors are consistent for each series and each wave for that matter. This is due to the face that the input voltage is constant at 7.5 V. Thus, we can derive from this graph the fact that the higher the capacitance, the smoother the output DC voltage is. The reason why the capacitance allows for a smoother output voltage is because it has a higher time constant which means that it will take longer to discharge, maintaining a higher voltage value for longer, or until the next charge.



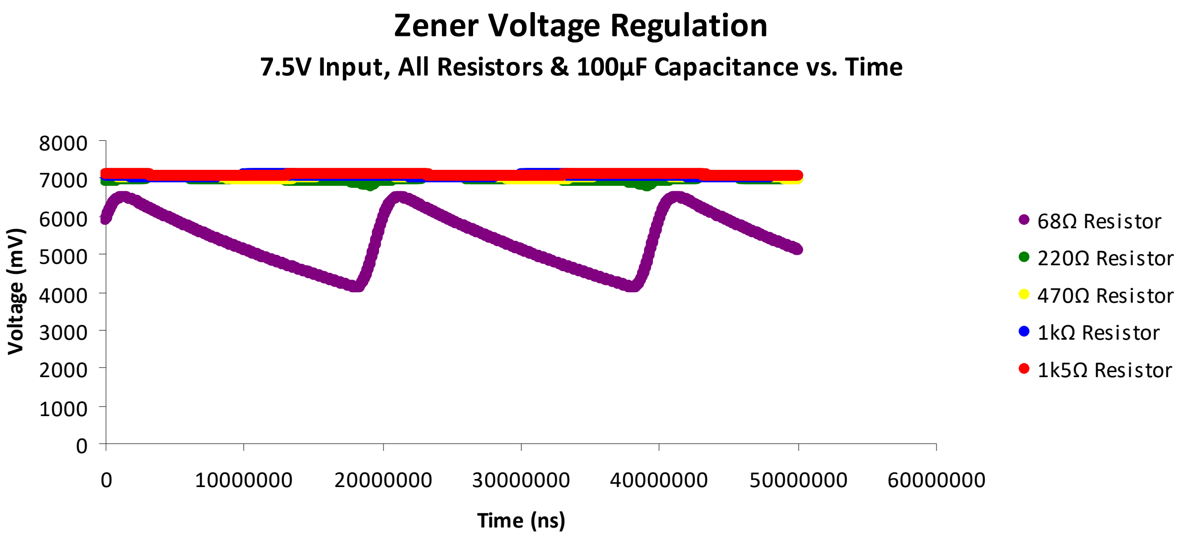
This graph is the comparison of the different output voltages supplied by using varying load resistors in the capacitor smoothing circuit. The output voltage of the circuit is DC due to the fact that the capacitor was placed inside a rectifier. Firstly, we can see that the higher the load resistance of the circuit, the more consistent output voltage is achieved. This means that there is less ripple voltage as can be seen from the charging and discharging of the capacitors being less and less prominent as we move up the value of resistance. Secondly, the phases of the charging and discharging of the capacitors are consistent for each series and each wave for that matter. This is due to the face that the input voltage is constant at 7.5 V. Thus, we can derive from this graph the fact that the higher the load resistance of the circuit, the smoother the output DC voltage is. This is because the resistance affects the time constant such that it will have a higher time constant allowing for the maintaining of a higher voltage until the next charge as it takes longer to discharge.



This graph is the representation of the Zener diode regulating the voltage. There is a 7.5 V input voltage into a circuit with the load being 220 ohm resistance. As you can see, the output voltage is DC due to the fact that there is the use of a half-wave rectifier. The output voltage is very consistent, even more so than the capacitor smoothing. The Zener voltage however, is always lower than the input voltage. The voltage, thus current, supplied to the Zener diode is sufficient for it to break down and thus the output DC voltage is regulated.



This graph shows the comparison of the output voltages of Zener voltage regulation whilst varying the capacitance. Firstly, we see that the higher the capacitance, the more regulated the output DC voltage is. The output voltage once again, is DC due to the use of a half-wave rectifier. Secondly, the phases are the same for each graph as the input voltage remains at a constant 7.5 V. Thus, it can be concluded that the higher the capacitance of the circuit, the more regulated the output voltage is. This is due to the fact that the higher the time constant, the more time it takes to discharge and so for the dropping of the input voltage after rectification, the higher capacitance will discharge for longer meaning it will maintain a higher voltage value for longer, or until the charging has come again.



This graph shows the comparison of the output values of the Zener voltage regulation when the load resistance is varied. The output voltage is obviously DC as there is a half-wave rectifier incorporated in this circuit. Firstly, we can see that the higher the resistance of the load, the more regulated the output DC voltage is. Secondly, the phases are the same and in sync with all the others as the input voltage into the rectifier is constant and since rectification does not change when the input doesn't change, the phases will remain the same for all values of load resistance. Thirdly, we see that one of the series does not have the regulation that all the others have; the 68ohm load resistance. This is due to the resistor being of too low a value to supply the Zener diode with sufficient current to break down thus the ripple voltage from capacitor soothing is still eminent. Thus, we can conclude not only that the higher the load resistance, the more regulated the output voltage is, but also the fact that each Zener diode has a breakdown value and if not reached, it will have no effect on the output voltage.

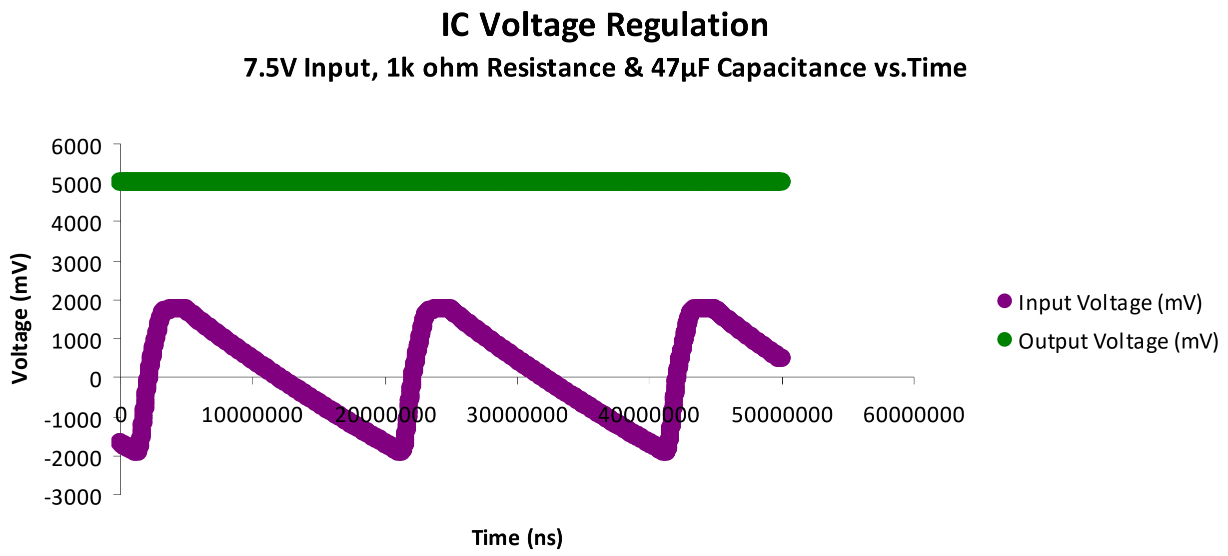
TABULATED DATA

7.5 V Input Voltage

Resistance (Ω)	Capacitance (μF)	Practical Average Output VDC (V)
1k	47	6.540
	100	6.907
	330	7.048
	1000	7.124
	2200	7.157

7.5 V Input Voltage

Resistance (Ω)	Capacitance (μF)	Practical Average Output VDC (V)
68	100	5.372
220		6.961
470		7.020
1000		7.056
1500		7.086



This graph shows the integrated circuit (IC) regulation from the LM7805 IC voltage regulator. As you can see, the output voltage from this circuit is well-regulated and that it is DC due to the rectification. The output DC voltage is at a constant 5 V as the LM7805 represents positive voltage output of +5 V. This means that the breakdown voltage of this particular Zener diode is at +5 V.

Part 3b

7.5 V Input Voltage

Resistance (Ω)	Capacitance (μF)	Practical Average Output VDC (V)
1k	47	5.014
	100	5.012
	330	5.013
	1000	5.012
	2200	5.014

7.5 V Input Voltage

Resistance (Ω)	Capacitance (μF)	Practical Average Output VDC (V)
68	100	5.012
220		4.989
470		5.021
1000		5.012
1500		5.023