- **Abstract:**

The main target of this assignment is to design a regulated power supply that is fed from a three- phase full wave Rectifier, with ratings of (12V and 15A).

- **Introduction:**

A three phase full wave rectifier can also be called a six wave half wave rectifier, it consists of six diodes, and each of them conducts only for ⅙ of the period, with a period of pi/3. The variation in its output lies between the maximum alternation voltage and 86.6% of this, with the average value being 0.955 times the maximum value.

A linear regulator is a system used to maintain a steady voltage. The resistance of the regulator varies in accordance with the load resulting in a constant output voltage. The regulating device is made to act like a variable resistor, continuously adjusting a voltage divider network to maintain a constant output voltage and continually dissipating the difference between the input and regulated voltages as waste heat.

Regulation process passes through multiple stages to achieve the desired output. This process starts with a linear step-down transformer. The second stage is; Rectification Process, represented by a full-wave bridge rectifier of Power Diodes. The third stage is; Filtration, it is done by adding a shunt capacitor, the value of the capacitor is calculated and simulated later on. The last stage is; Voltage Regulation; the regulator receives the input from the filter and supplies a constant voltage of 12V regardless of the variations on the load. It was designed using pure discrete values of an ideal OPAMP and two resistors and a voltage reference of either a constant voltage source or a zener diode.

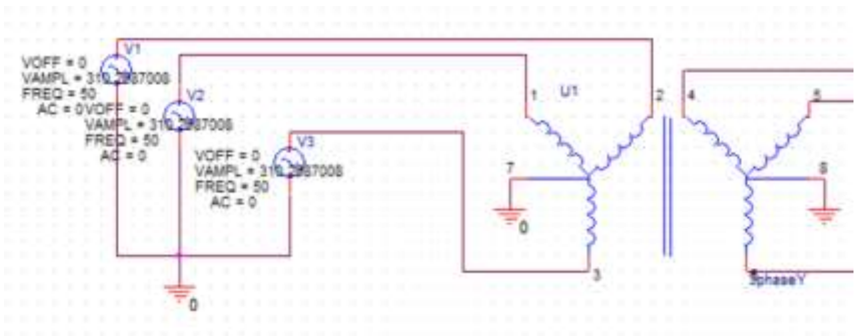
- <u>**Design and Simulation:**</u>

Stage1: Step-down Transformer:

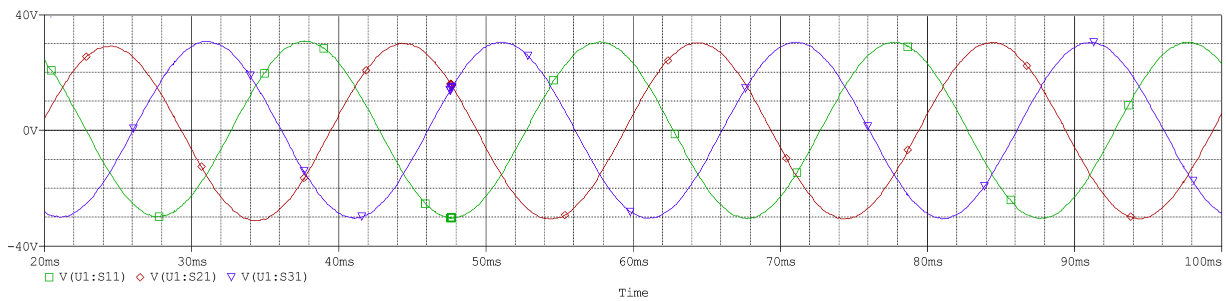
Since the desired output voltage is 12V, we need a secondary voltage above this value. We can achieve a secondary line to line voltage of 50V by choosing a ratio of 10:1. Using the relation of coupling inductance, we determine the needed ratio by applying a coupling of 1 and setting L1 = 1200mH and L2 = 1.2mH.

$N1 / N2 = \sqrt{(L1 / L2)}$

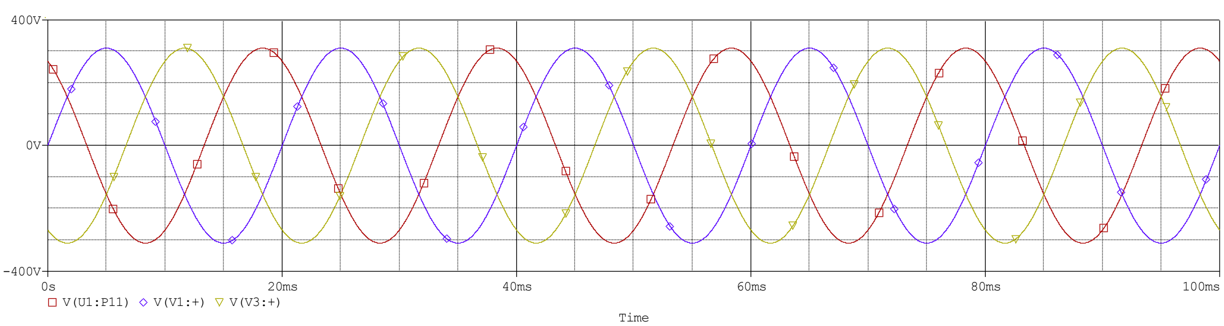
$10 / 1 = (\sqrt{(1200mH / 1.2mH)})$



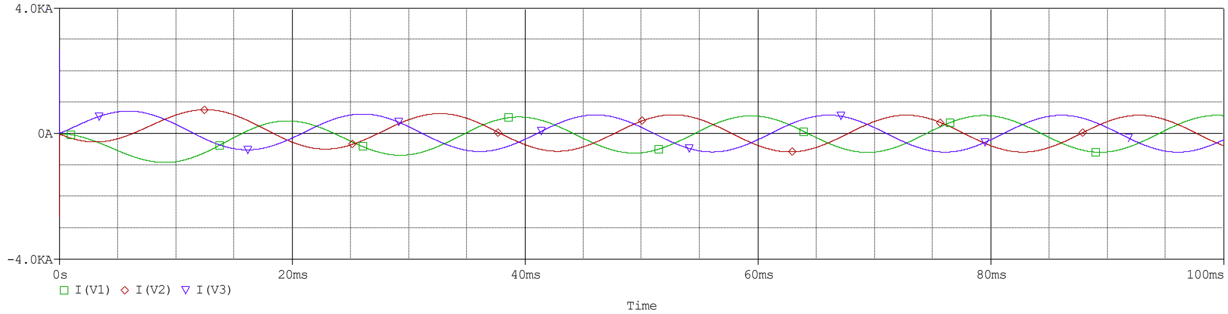
Primary Voltages:



Secondary Voltages:

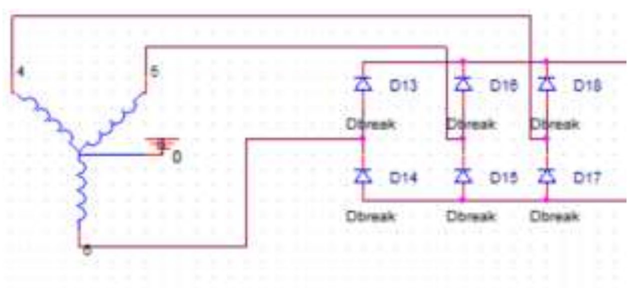


Primary Currents:

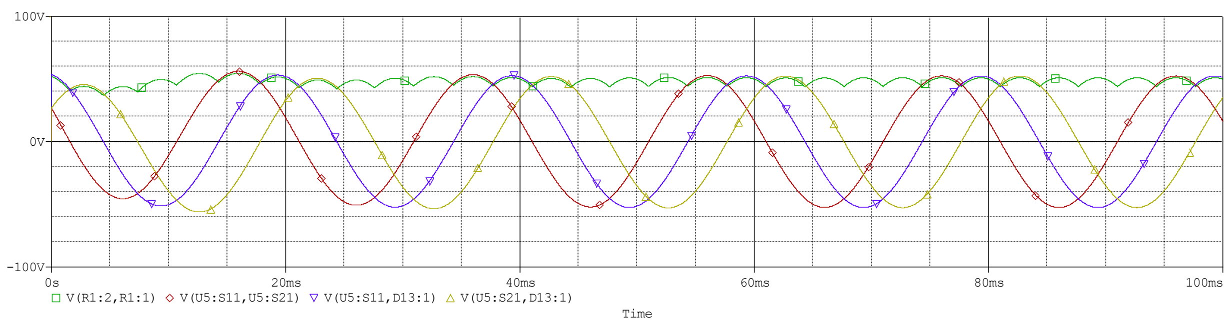


Stage2: Rectification (Pulsating DC):

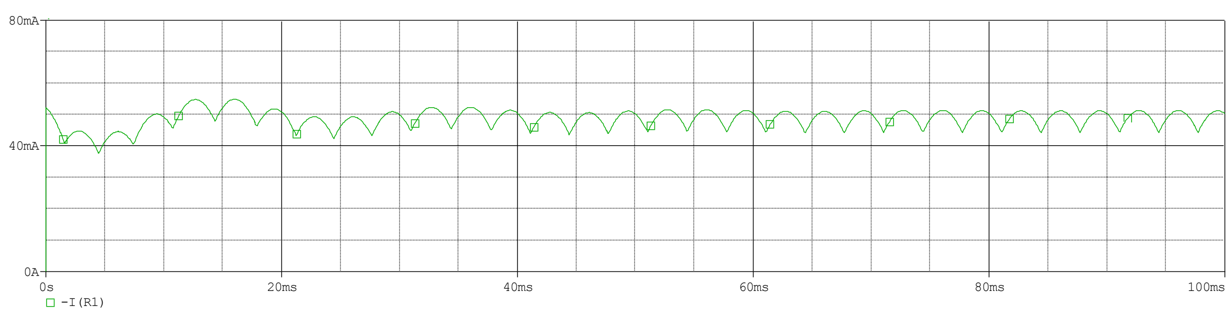
Note that the peak voltage of the three phase Full-Wave Bridge is less than 20V since we face a voltage drop of approximately 1.6v due to power diodes.



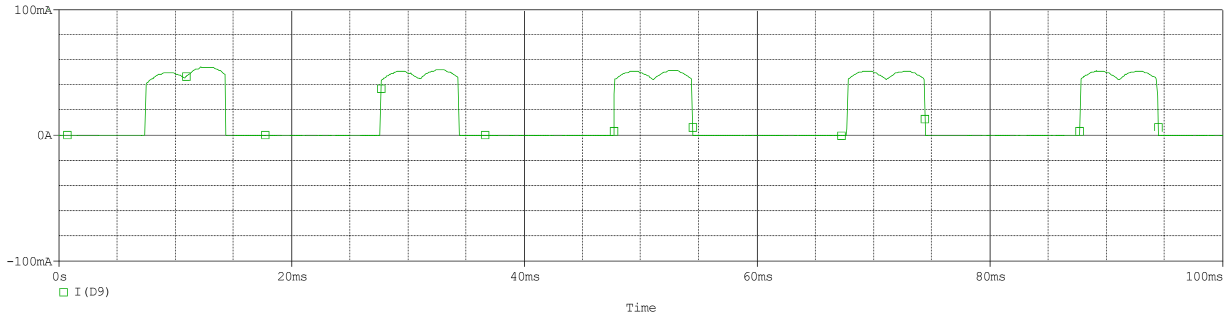
Three Phase Full Wave Rectifier Output Voltage:



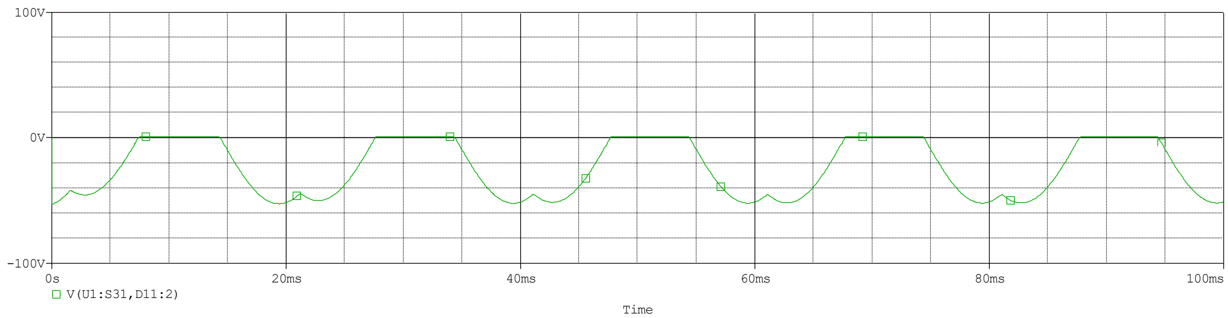
Three Phase Full Wave Rectifier Output Current:



Diode Current:



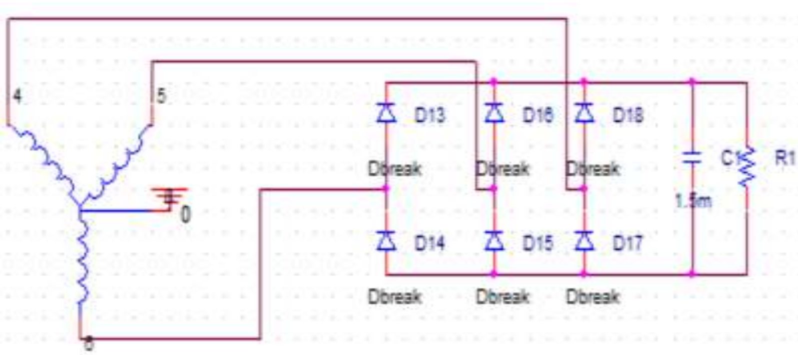
Diode Voltage:



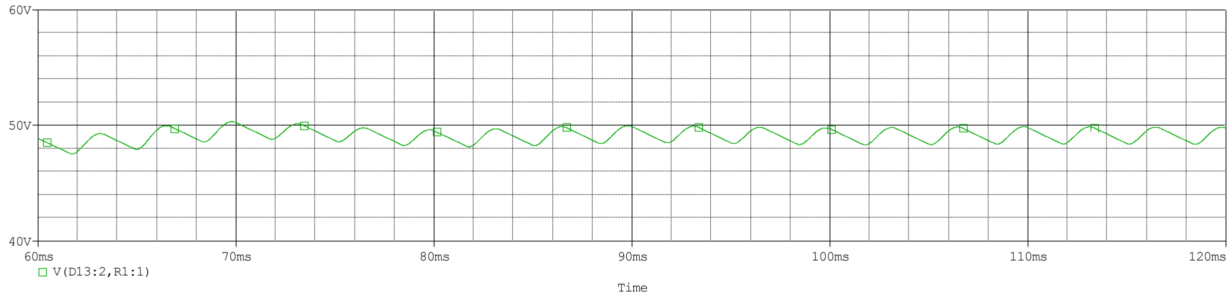
Stage3: Filtration (Shunt Capacitance):

The source is 380 $V_{RMS} \rightarrow 380*\sqrt{2} = 537.4V$ Now the secondary line to lie voltage =50V. Assume the voltage drop on the regulator is 2V>> $V_{MIN} = V_{out} + V_{Regulator} = 12+2=14V$

While $V_{max}= V_{secondary}-V_{dropondiodes}$ >> V_{max}=48.4V
$\Delta V = V_{max} - V_{min}$
$\Delta V = I /(fr\ C)= 15 / (6*50*C)$
>> C= 1500uF



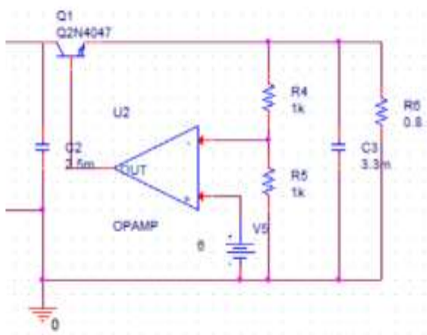
Filtration Output Voltage:



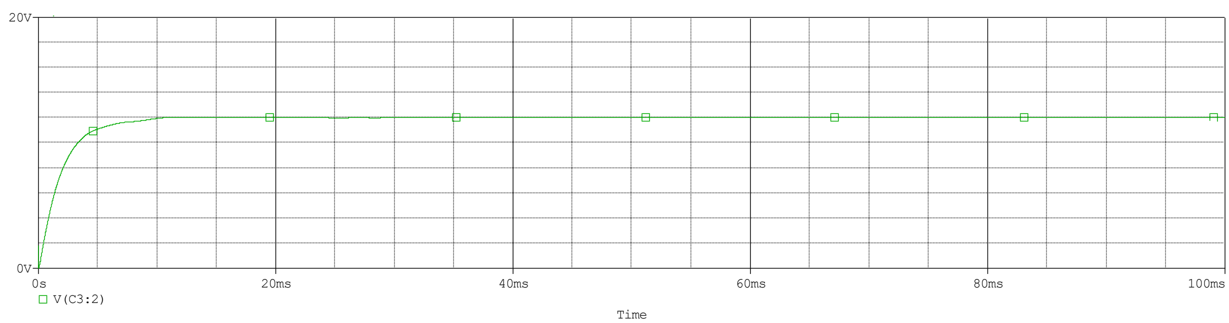
Stage4: Voltage Regulator:

$V_O = (1+R2/R1)*V_{REF}$

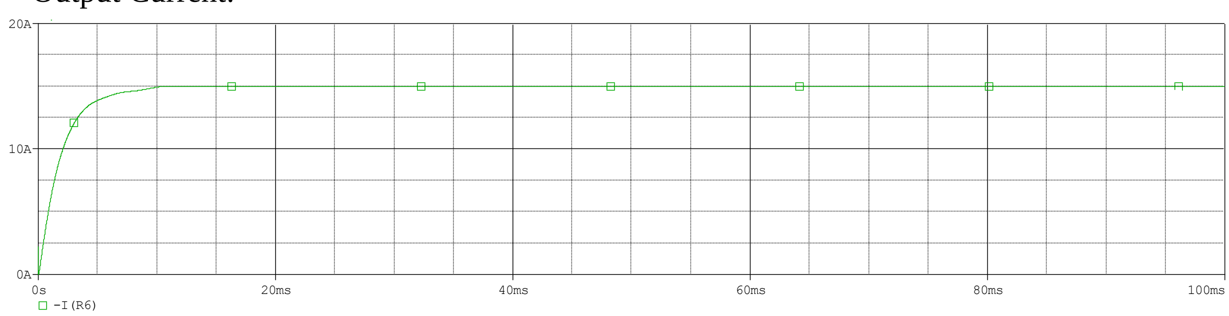
Take V_{REF} = 6V, and R1=R2=1k.



Output Voltage:



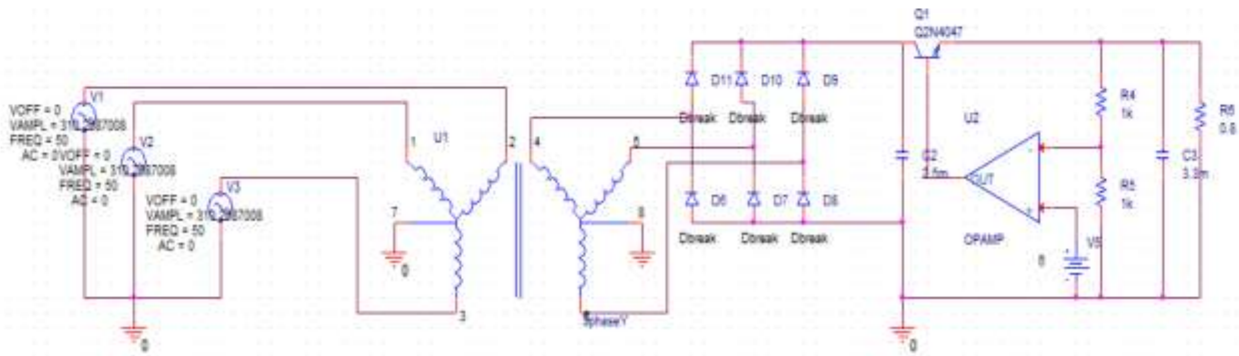
Output Current:



Attenuation in Ripple:

To calculate attenuation in ripple, the ripple on the input and output of the regulator will be calculated:-

$Ripple_{INREGULATOR}$ = 2V (measured from C_1 graph).
$Ripple_{OUTREGULATOR}$ = 0V (measured from output graph).
$\Delta R = Ripple_{INREGULATOR} - Ripple_{OUTREGULATOR} = 2V$



- <u>**Conclusion:**</u>

During this assignment, I got to know the characteristics of a power supply regulator. The DC power supply circuit consists of multi-stages. A DC Voltage supply have been used instead of a zener to achieve a better linearization of output voltage. Regarding attenuation, the regulator has greatly helped to remove harmonic variations at the input, since such harmonics may damage some application.