Abdurrahim Emin

Faculty of Electrical & Electronics Engineering

Control and Automation Engineering
Department

FULL WAVE RECTIFIER (POWER SUPPLY)

2.1 Describe the function and describe each of the general power supply stages

2.2 Problem: You want to use a wall transformer that produces 10-VRMS at the secondary to generate a DC voltage. The desired voltage DC should be greater than 12 V and it should be able to supply at least 50 mA while keeping the voltage ripple to less than 5%.

Design full wave rectifier to meet these goals and explain using the obtained graphs of each stage.

2.3 Simulate a full wave rectifier power supply.

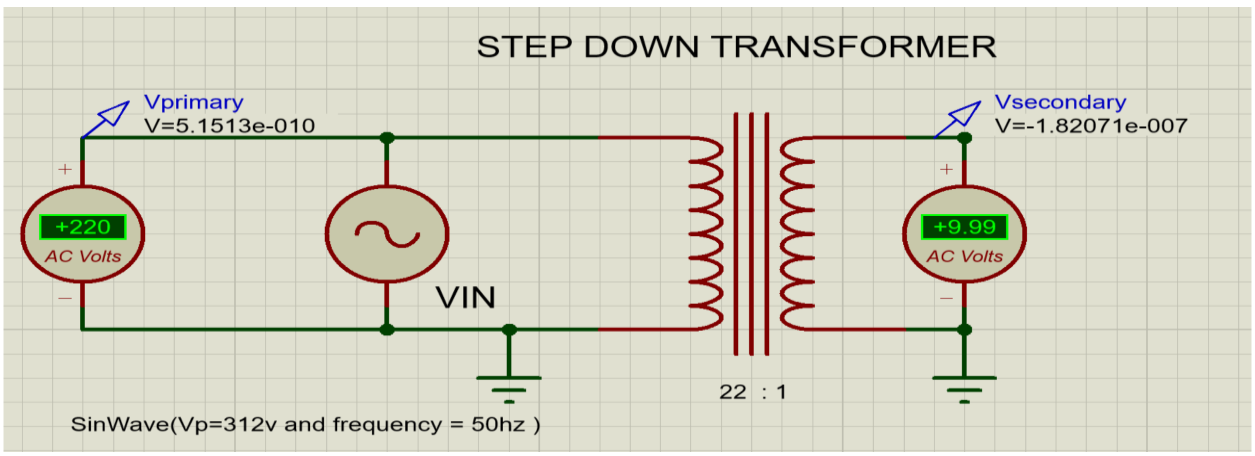
1-Transformer: is a device that can change the level of AC voltage wave or AC current wave's amplitude to another level, but the frequency remains the same.

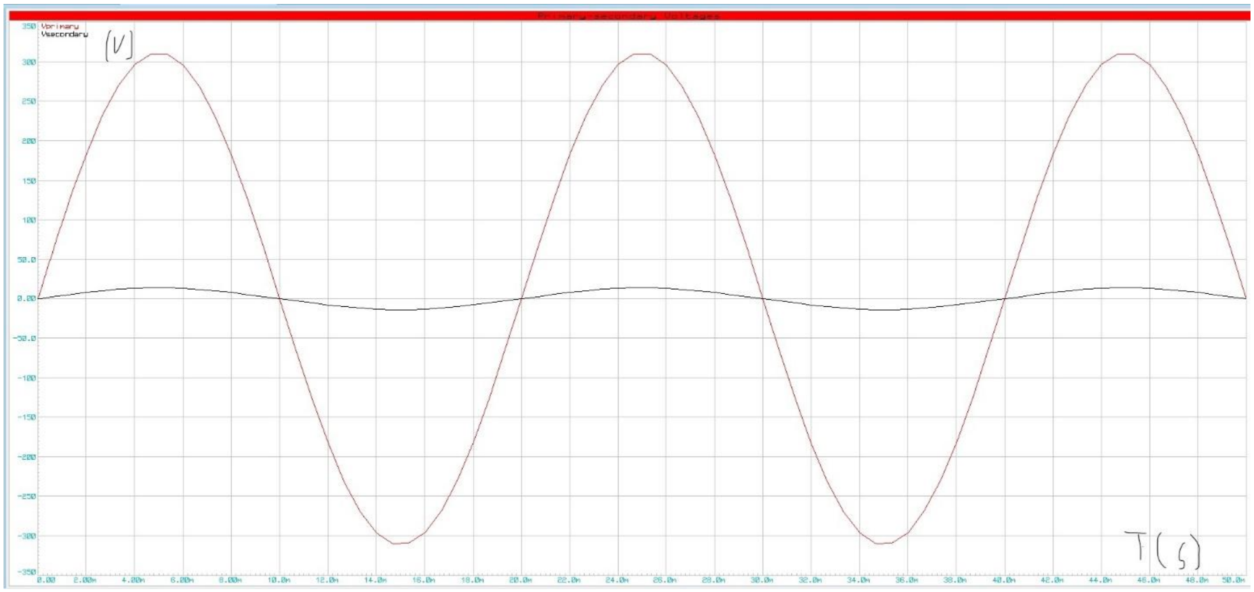
There are two types of transformers step up and step down, in our circuit we are going to provide low enough voltage to the diodes, so that we need to use the step down because we want to reduce the primary input Vrms = 220v (Vm=311.1v) AC voltage amplitude to secondary output Vrms = 10v (Vm = 14.14 v) AC voltage amplitude. To set up any transformer there are some useful formulas that we can use them $V_p/V_s = N_p/N_s$

In our circuit, the primary part is in terms of RMS Vp = 220 v and Vs=10 v so if we divide them we get

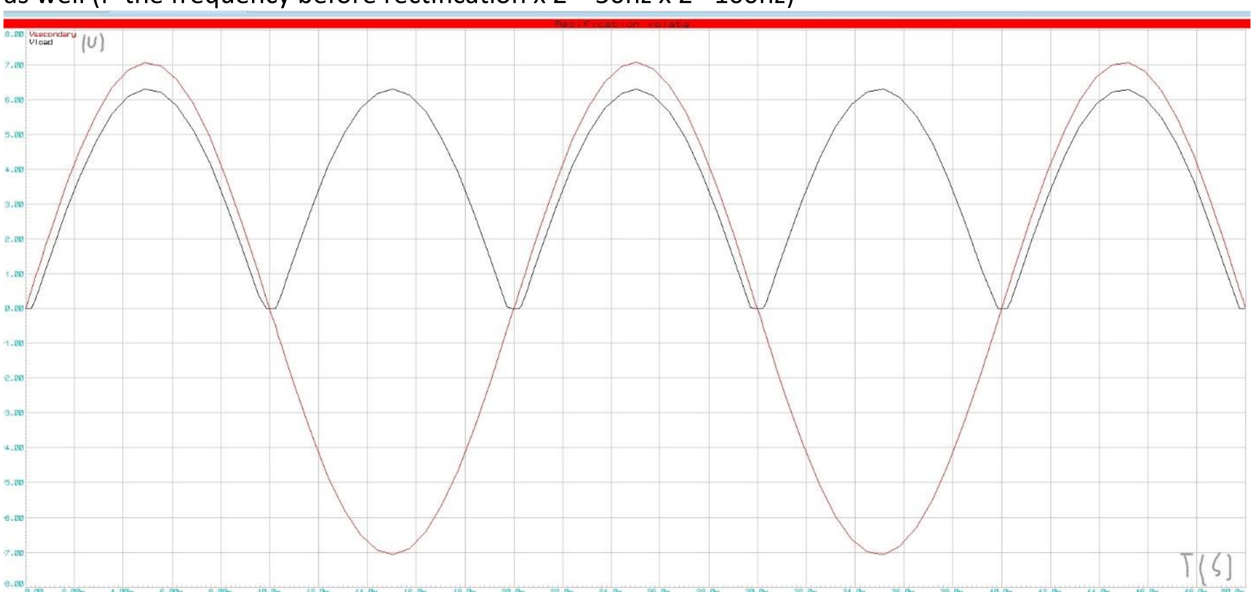
$N_p/N_s=22/1$.

In the graph, we can see the values of the primary and secondary RMS and Peak voltages as well as the numbers of turns in terms of time





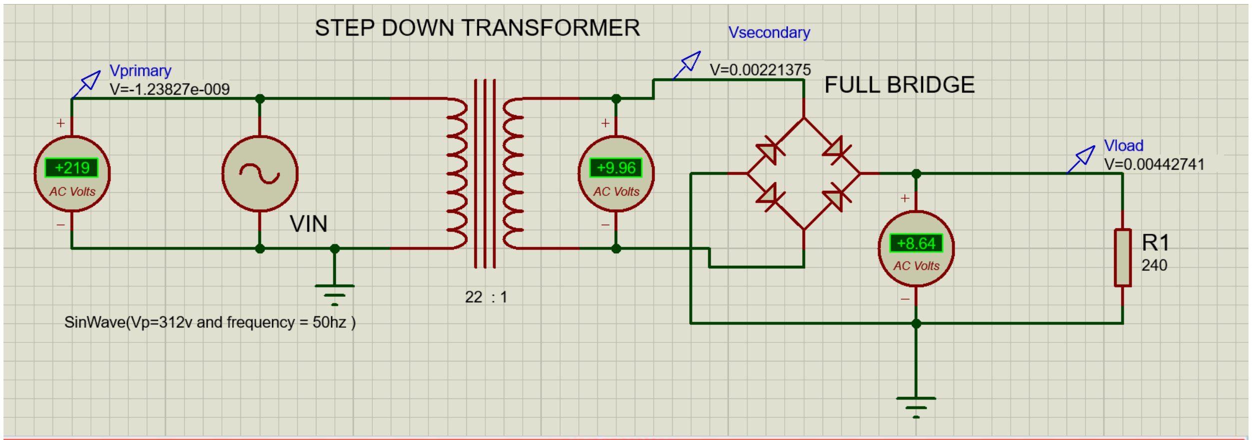
2-Full wave Diode Bridge rectifier: is a combination of four diodes, each two diodes used for either positive half cycle or negative half cycle of the voltage wave, in the negative two diodes we flip the negative half cycle to the positive as shown below, In this operation we are doubling the frequency as well (f=the frequency before rectification x 2 = 50hz x 2= 100hz)

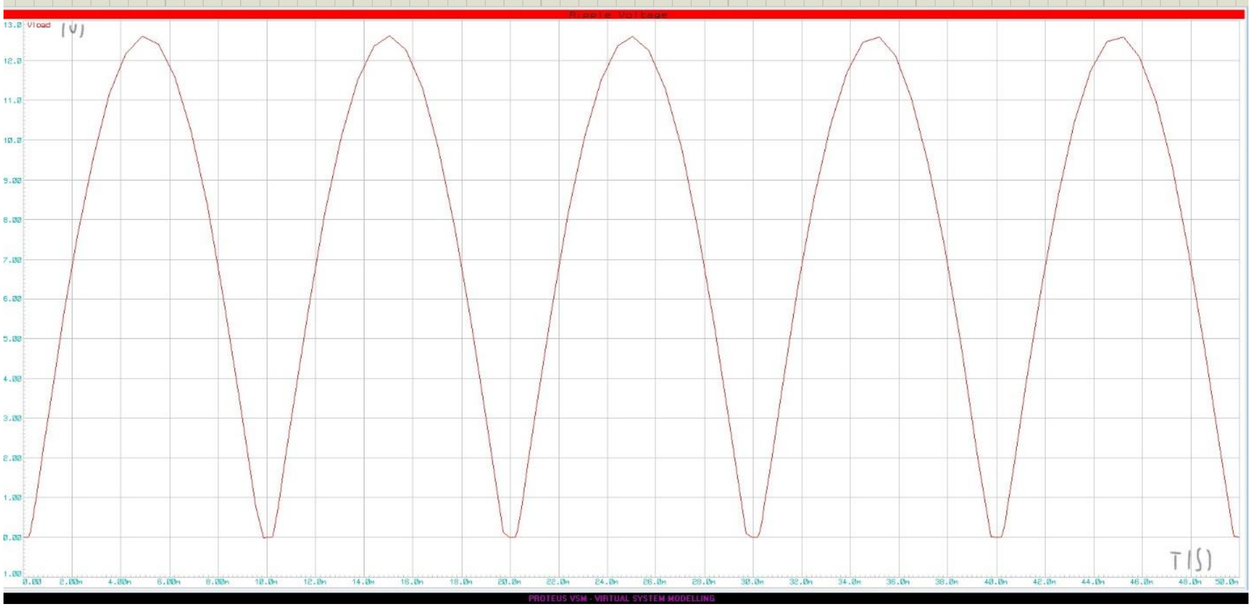


3-Capacitor in parallel with the load: when we put a capacitor in parallel with the load (in our circuit RL= Vdc / Idc = 12v/50mA = 240 ohm), the capacitor charges when the wave goes from zero to peak and discharges when the wave goes from peak to zero, in this case, we have smoother waveform which close to dc waveform, the smoothness of the waveform depends on the load and the capacity of the capacitor, in order to decrease the ripple voltage we need to place much larger capacitor

<u>Without a capacitor the ripple voltage is</u>

V_average = 2 * Vm / pi = 2*12.21/ pi =7.77v (Vm: voltage from zero to peak)
%ripple =Vm / V_average x 100% =12.21/ 7.77v x100= **157.14%**

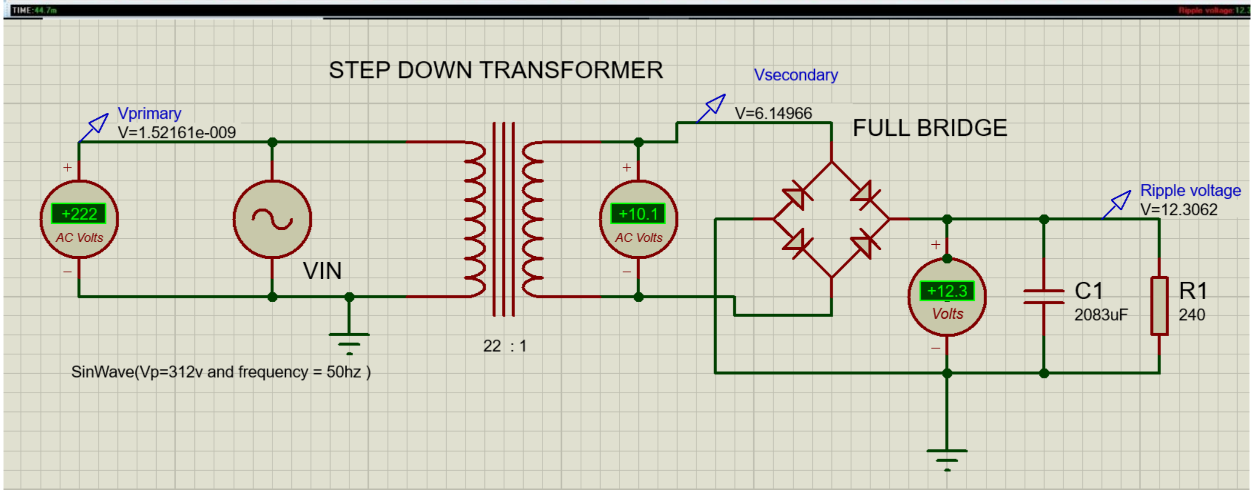




<u>With capacitor</u>

deltaV0/Vm= ripple ratio =1%

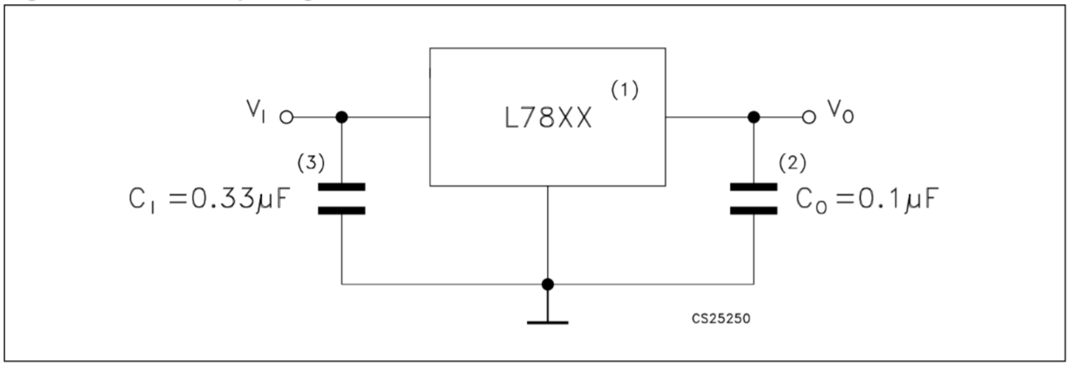
C=1/((deltaV0/Vm)*2*f*R) = 1/((0.01)*2*100hz*240ohm)=2083uF

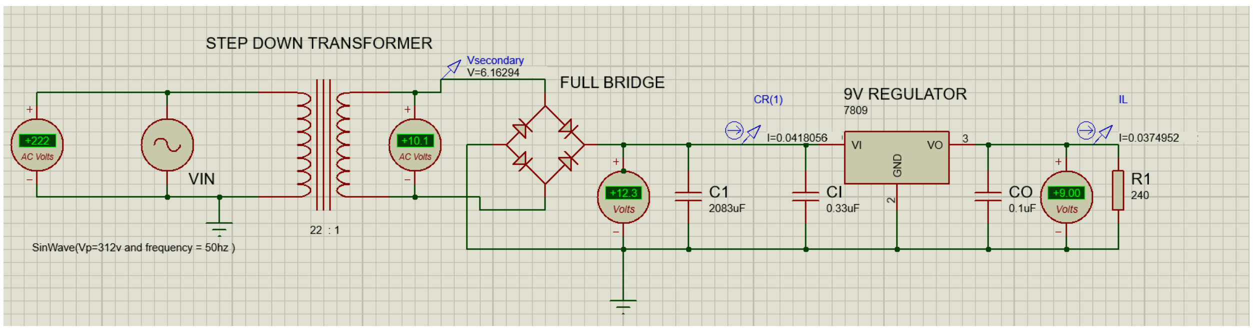


3-Voltage Regulation: we use linear regulator when we need stable output voltage from unstable input voltage, Normally the input voltage should be bigger than the output voltage to make sure that the regulator will provide stable output voltage, in order to use a 7809 which provides 9v stable output voltage, we need to use two capacitors CI and CO, basically CI used in the input part which can help the regulator getting more stable input voltage(reducing the change of the input voltage), as the manufacturer recommended to use 0.33uF for CI, CO used to make small increases in the output voltage and it is recommended in the datasheet to use 0.1uF.

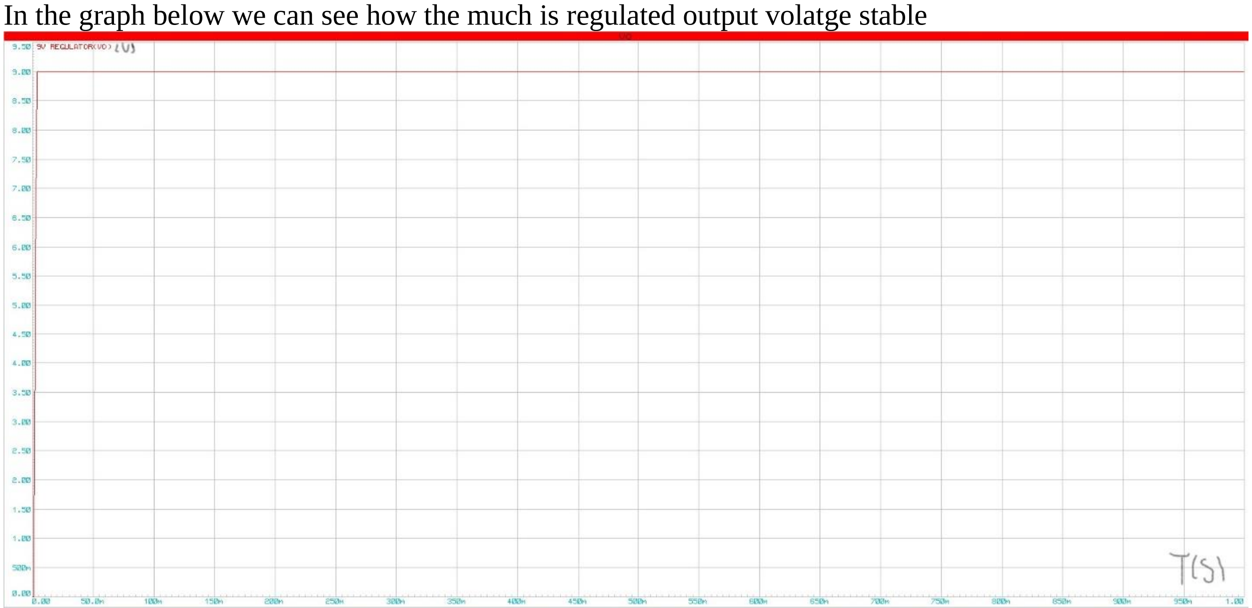
The datasheet recommended capacitors values shown below.

Figure 16. Fixed output regulator



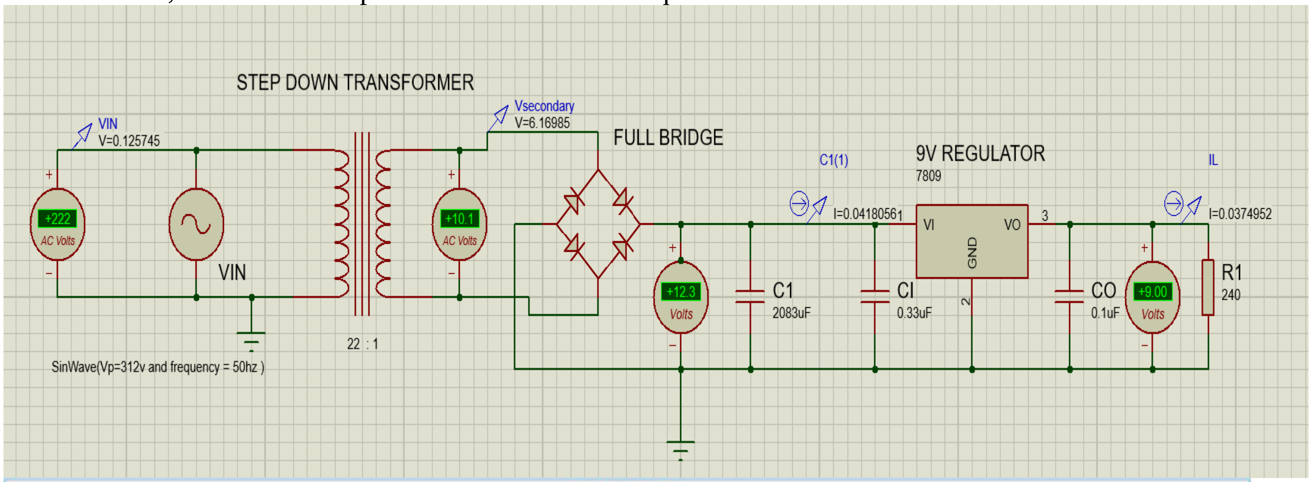


In the graph below we can see how the much is regulated output volatge stable



The output:

The purpose of this circuit to get 9v stable DC output voltage from VIN=220-50hz AC input voltage by using transformer to step down the VIN to V secondary = 10-50hz we feed this voltage to the full-wave bridge, then adjustıng a value for the C1 so that we get only 1% ripple voltage, finally we used regulator to get 9v stable DC output voltage from 12.3 DC input voltage, and then using 240 ohm resistor to get current IL=37,49mA as an output current to meet the requirement of the homework



The Real Life Circuit