**Fundamentals of Power Electronics**
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# Lecture – 30
# Simulation – power factor improvement

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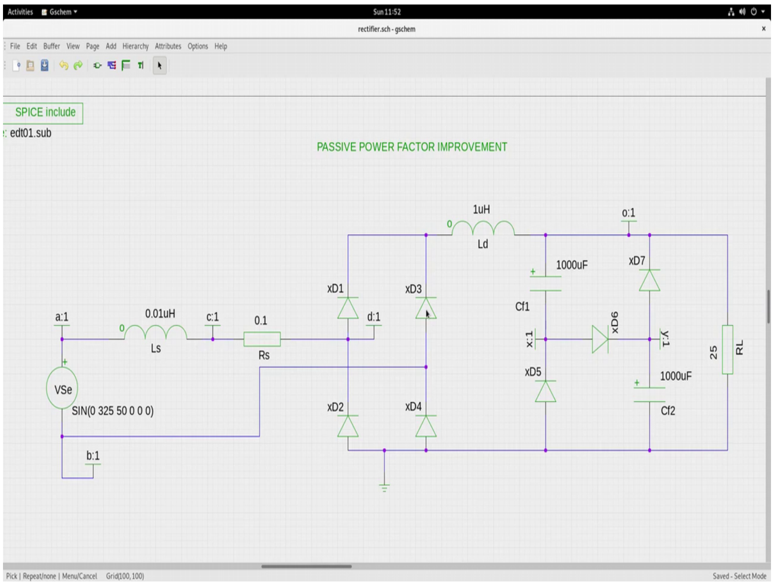


Let us now have a look at the Simulation of the Passive Power Factor Improvement Circuit. Observe that all parts of the rectifier filter circuit is same, except for this part that we discuss the power factor improvement part. You have the capacitor 1 and capacitor 2, you have this central diode and then you have to reverse diodes like this. So, when the capacitors charging you will see the path go in this fashion, and when the capacitor discharges it will discharge through this diode and resistor and this diode capacitor will capacitor Cf 1 will discharge through the load resistor.

Now, I have a node here x 1 I have another node here y and this is the output node. Let us look at the current through this inductor which will give you the current before the power factor improvement portion and let us verify if the way from that we have understood is correct and whether we can gain more insight into the power factor improvement portion. So, now to simulate we need to go to the terminal, but before we do that I want to make some changes in the rectifier dot cir file to see what we would like to measure and let me change that open it and show it to you.

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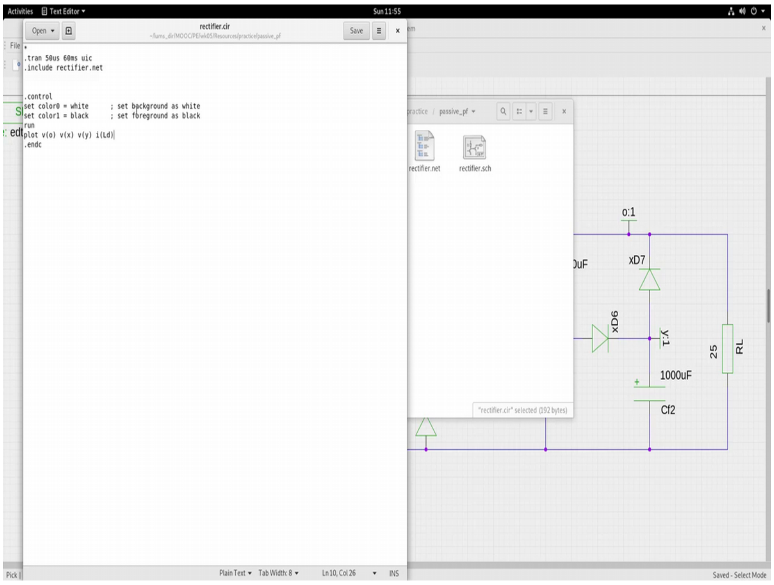


So, rectifier dot cir let us open that and see how it looks. These two statements are familiar to you the Tran function the Tran directive. And here you have the control statements to operate within the ngspice environment. I am setting the background as white, foreground as black, run the simulation and then plot. So, what am I plotting? I am plotting v naught, that is this node potential this node potential then v x, v y and the current through L; v x, v y and the current through Ld. So, this is what we will do. So, let us close open the terminal and see how the simulation goes through.

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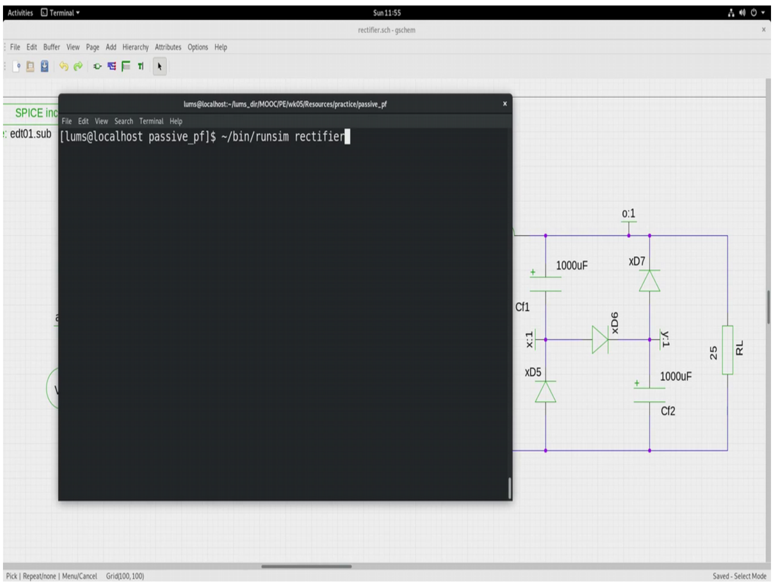

I now have the terminal open. Let us run the simulation runsim.

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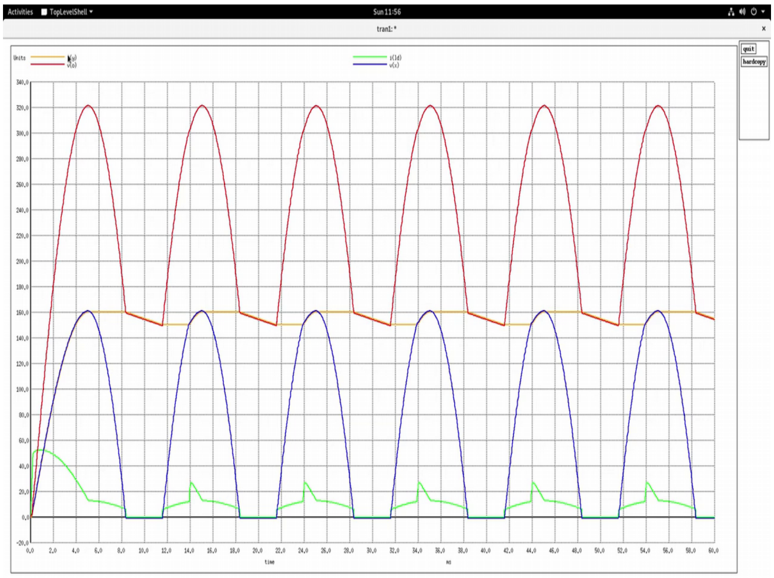

So, it will generate the net list, after this net list is generated port it into ngspice environment and we have the plots. So, if you look at the plots, observe this red waveform is v naught, so as we said that v naught has around 50 percent ripple. Now, the blue waveform is the v x waveform, again the v x waveform similar to the one that we had discussed going up to v x is the voltage waveform across the diode.

Now, look at this v y here, the voltage across the capacitor. See that after it has followed the input and then come to the 50 percent mark v m by 2, it then holds there till the input voltage comes below the v m by 2 point when the rectifier diodes stop operating and the capacitor is discharging into the load. Each of the capacitor discharging into the load, till again the input comes up and then crosses over here the rectifier diode comes into operation and then you have the output following the input.

Now, during this portion you will see that there is current drawn; the current drawn is having 2 parts. This part is actually, this part the smooth part is actually the current direct being given directly to the load and this part is now this is where the capacitor gets recharged. So, this capacitor recharge point gets recharged at this, at this point and then you see that small spike coming in. We did not discuss this point while calculating while discussing the waveform in theory.

Just that it would confuse the issue, but you can explore much more while you are having the simulation in front of you and you can explore the various branch currents on a node potentials at great detail. So, I will enclose this circuit also as a resource for you, so that you can work on it and try to understand and get as much in site as you can about this circuit.

The basic take away is that we have introduced a current wave shape with a larger conduction angle and thereby reducing significantly the peak current and thereby improving the power factor. But all these at the expense of an output voltage ripple which is very high. This is generally not a problem because the output of this is generally given to DC DC converters or DC AC inverters and they have a very good closed loop control mechanisms which will handle fluctuations in the DC link as provided by this power factor improvement circuit. So, this fluctuation this very high ripple is generally not a problem, but that is disadvantage of this particular circuit.