Fundamentals of Power Electronics.
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Lecture - 57
Simulating with lossless core reset

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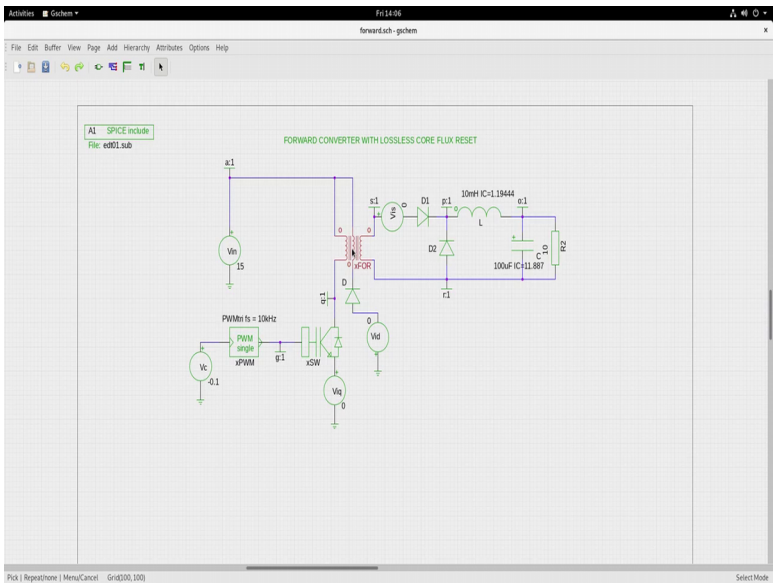

Let me now show you the simulation or the forward converter with lossless core flux reset. This is the entire circuit diagram of the forward converter with lossless core reset. Observe this transformer part so, in the transformer part you have 3 windings; one is the primary, other the secondary and in between you have the demagnetizing winding. So, this demagnetizing winding is the one which will perform the core reset. I have this demagnetizing diode flowing into the source.

I have here current sensors in the form of 0 voltage sources I am sensing the i q current by using V i q 0 voltage source V i d 0 voltage source for the demagnetizing current and V i s another 0 voltage source or measuring the i D 1 current. Another change you will notice is in the values of L 10 millinery have also provide initial condition of 1.1944.

Now, this value I took from the simulation after it has reached steady state so that the simulation can be quicker and you can see the outputs in less number of cycles. I have also given a voltage initial condition for the capacitors these 2 are the states of the system and therefore, you need to provide the initial conditions for these 2 states and I

given a voltage initial condition value here. Again taken from the steady state value of the previous simulation that I did without initial conditions. Now, in giving this initial condition the simulation can be very very quick and you can directly look at the steady state and see the simulation for just a few cycles 5 or 6 cycles.

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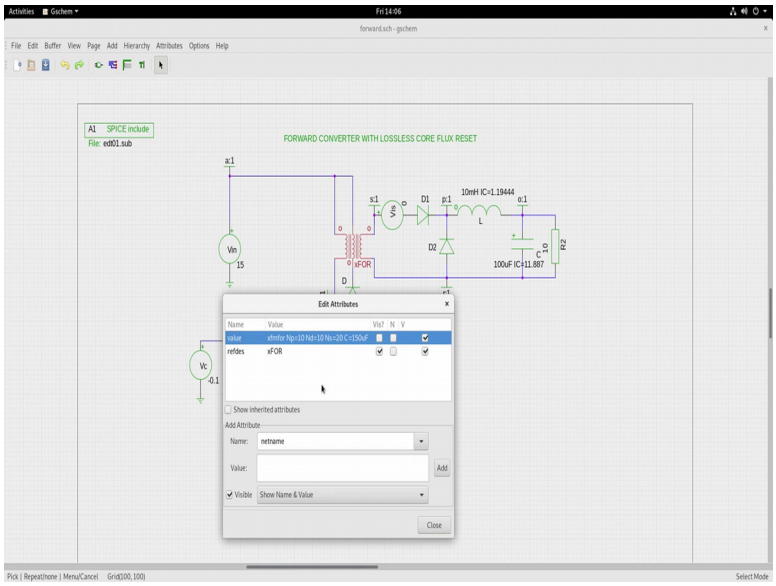

This transformer here forward converter transformer when you double click you will see that it is a sub circuit x N p the primary turns is 10 N d that the demagnetize number of; demagnetizing winding number of turns is 10 N s 20 and the permiance I have put as 150, I have put it in electrical parameters of microfarad, but it is micro, 10 to the power of minus 6 in terms of the magnetic parameters. So, we can now simulate it in Ngspice before we simulate it in Ngspice let us have a look at the dot cir file.

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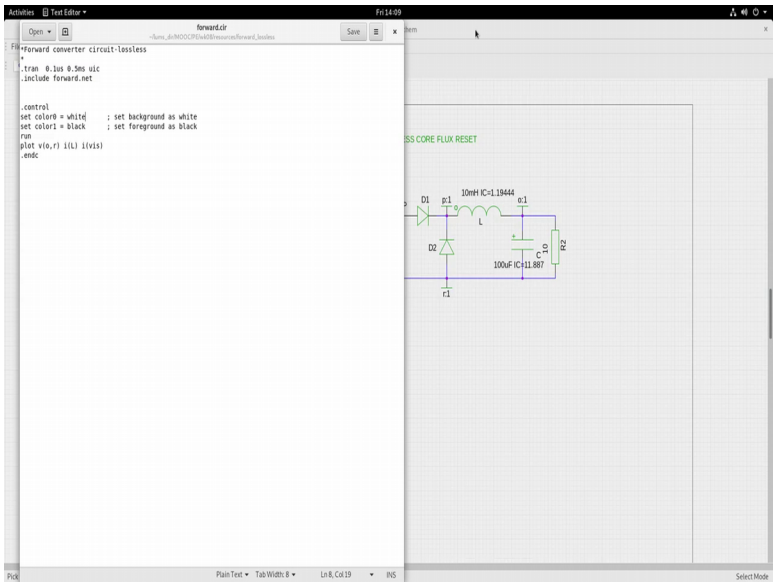

So, double click on the forward dot cir file and you will see that you have the trans statement for the transient analysis, the include statement including the net file which will get generated from after having run the schematic to net generation command. Then in the control statements I have here set background color to white, foreground color to black, run the simulation and plot. Now, in plot I am using output voltage v naught with respect; with reference to or if we just put v naught it will be with respect to ground, and ground is on the primary side and you need to see actually the v naught with respect to its secondary ground which is the reference here in this case is r.

So, therefore, you need to see v naught with respect to r, i L the inductor current and i v is is nothing but the diode D 1 current. So, you can put in many other variables; other variables to see the various other wave forms, but I just put these two so that you get started and then you include an explorer on your own.

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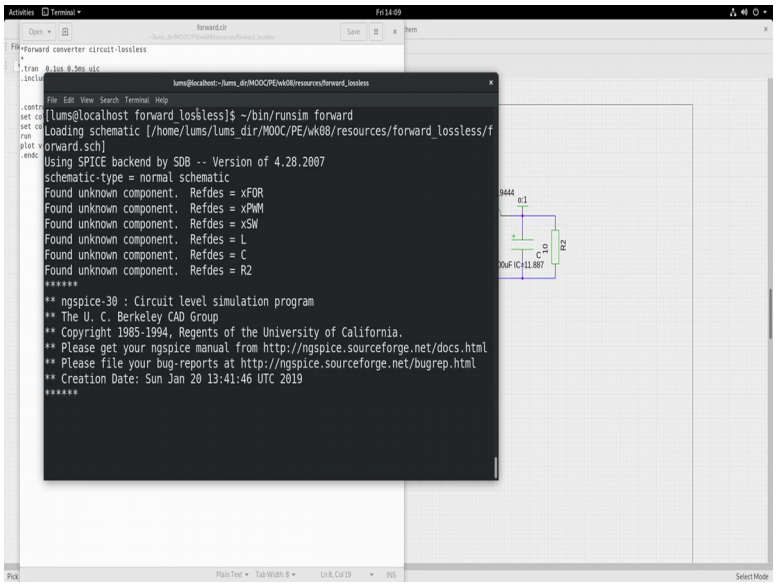

Now, let us open a terminal window command window and run the simulation. So, I have here the command window opened in front of me, I will run the simulation like before I will use a runsim and forward. So, this will run the simulation in the forward lossless and generate the output.

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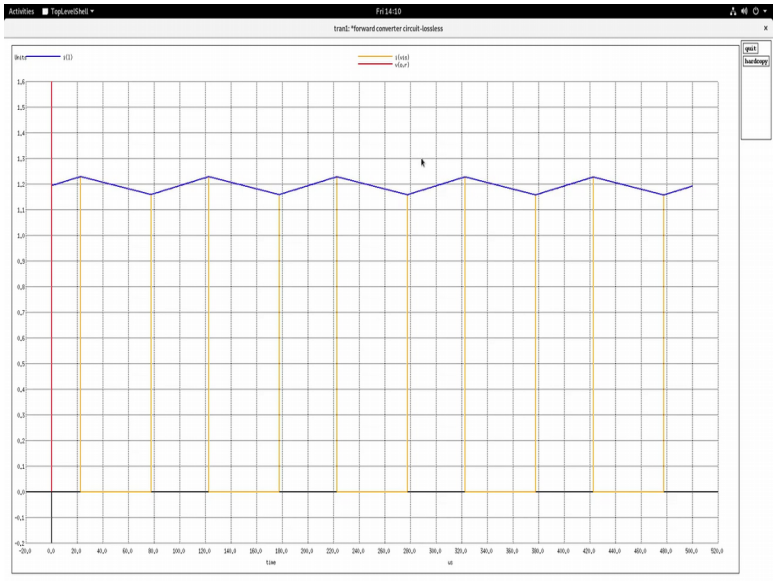

As you can see I have given it for very small number of cycles, you will see this as the output voltage v o, r ok. So, that's close to around 12 volts and calculate it with their input and then find out if by the input-output voltage relationship you get approximately

this value. Then you have this blue and this other one the diode current and the inductor correct. So, let me probably expand it so, that you get I will expand it here and see. So, this is your inductor current; so, this is inductor current and the diode current here ok. And this portion diode current is 0 and inductor current is falling. You can separately see these waveforms also just to confirm whether your theory is proper.

Anyway I will allow you to explore the circuit and you can try to change values and change the initial conditions and also the change the value redesign for different frequencies of the PWM and try to get more insight into the workings of these forward converter with lossless core reset.