Fundamentals of Power Electronics
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Lecture - 59
Simulating the flyback converter

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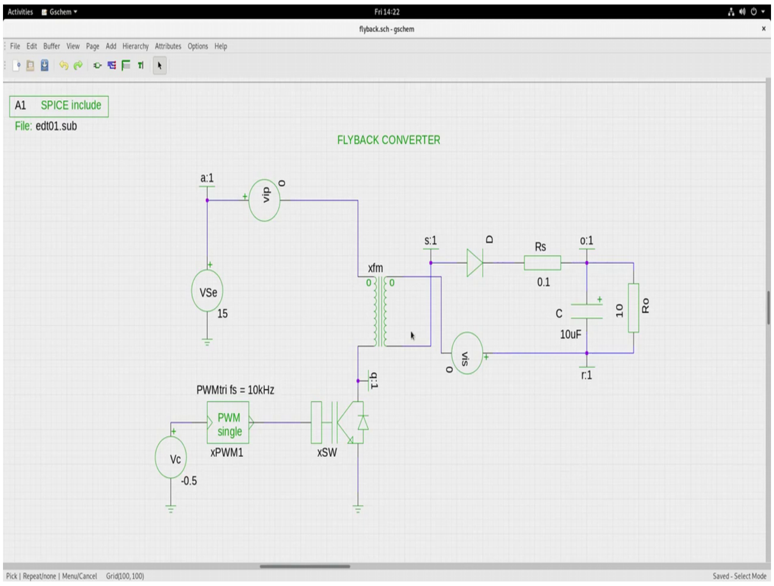

Let us see now the Simulation of a flyback converter. So, this is the circuit of a flyback converter. You have the switch here; you have a flyback transformer. The reason I am saying this is the flyback transformer is that it is actually inductor with an extra winding, which gives isolation to the secondary part. You have the diode, the capacitor I have put, a small resistance here R s 0.1 ohm, this is basically because the simulation engine can run into numerical instability if you do not put this resistance. You will be connecting a capacitance directly across a voltage source and that can give issues while simulating.

So, good practice to decouple that by putting 0.1 ohm resistance, and you have the load resistance here. And, I have the reference node r, output node o. And, you have the transformer this is the switch Q and the PWM block. I have set the control signal to minus 0.5. Remember that the triangle is going from minus 1 to plus 1, minus 0.5 would mean around 25 percent duty cycle.

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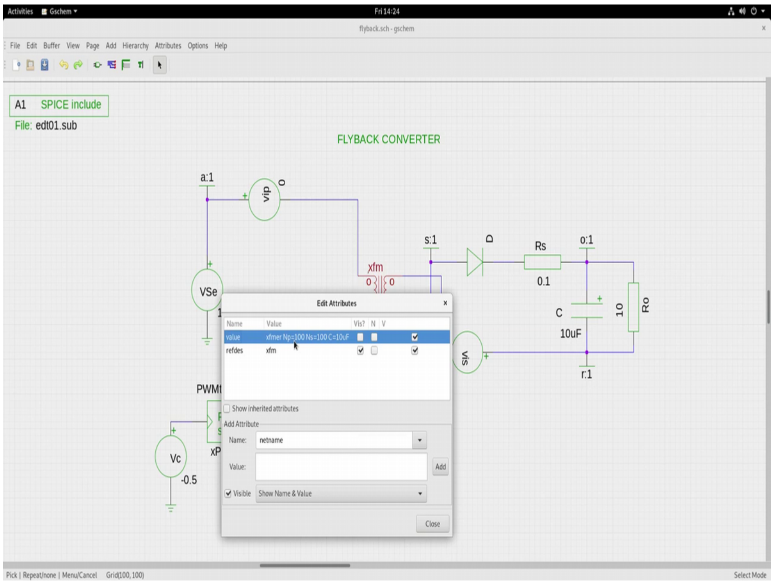

So, if it is 25 percent duty cycle, N here is you see N D is 100; N s is 100. Therefore, N is 1 is to 1. So, because it is 1 is to 1, you have V naught is equal to V i to d by 1 minus D, 0.25 by 0.75, which is one-third of this which is 5 volts one-third of 15 – 5 volt. So, it should settle somewhere around 5, 5 volts, but it can be lesser than 5, because you have various other drops you have the diode drops, and you have the drop across this resistance R s. So, now, let us simulate it in ngspice before simulating it have a look at the dot cir file.

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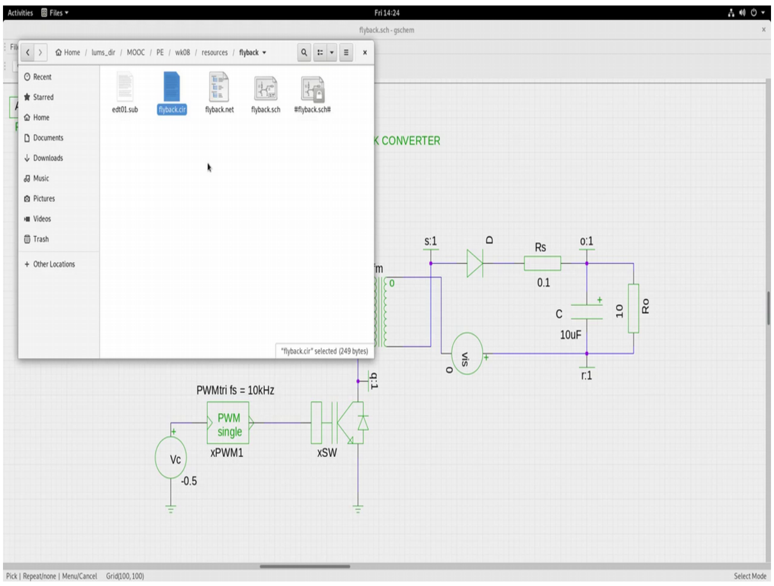

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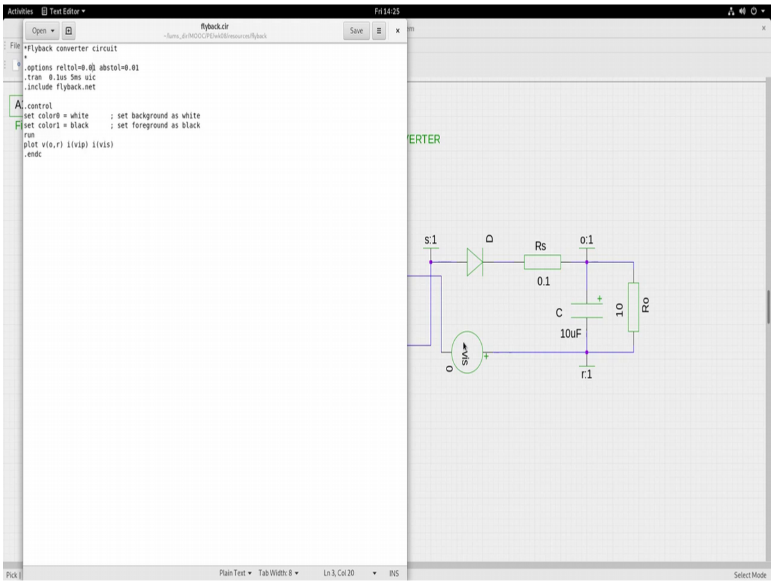

So, let us open the dot cir file. What does it contain? So, it has a dot option statement, I have put reltol 0.01, and abstol tolerance for voltage and tolerance for current 0.01. You sometimes when you end up in numerical instability issues, you need to limit the tolerance of voltage and current, I have done that one. Dot transit transition as a statement and you are including the flyback netlist, which is generated from the schematic.

And, within the control statements again setting the background white, foreground black, running the plot, running the simulation and plotting. What do I plot v o, r, there is output with respect to r; v i, p which is the input current flowing through the switch, flowing through the switch. And, i v i s which is the secondary current have seen here. Now, we open a terminal and simulate the circuit.

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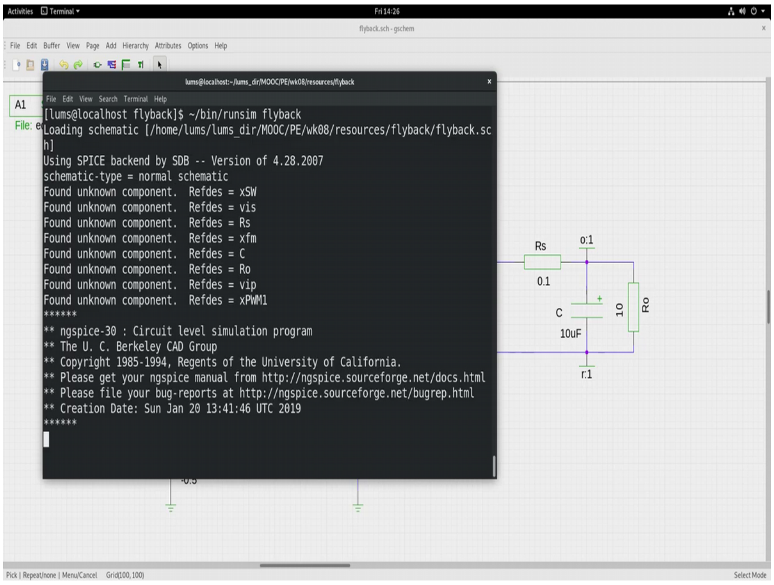

So, I have the terminal open here, let me simulate it. I am in the folder flyback, it is available in the resources section. And, you can you are welcome to use it, let me run the simulation using runsim flyback.

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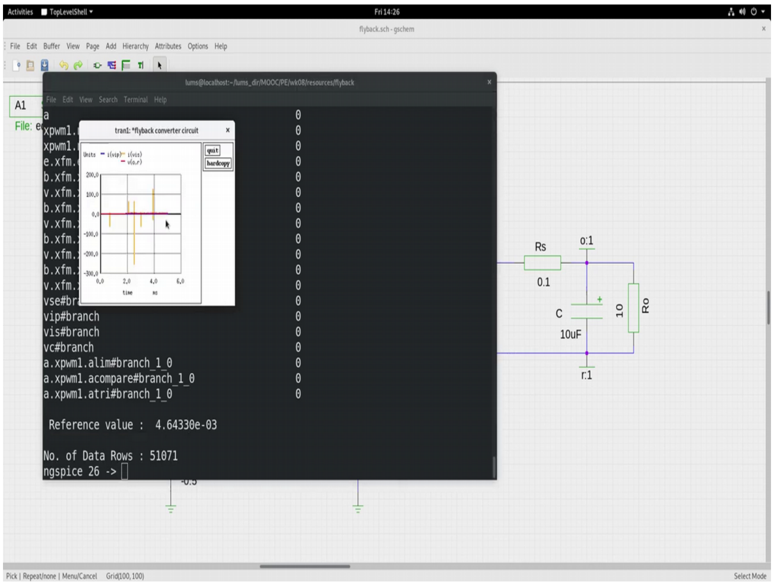

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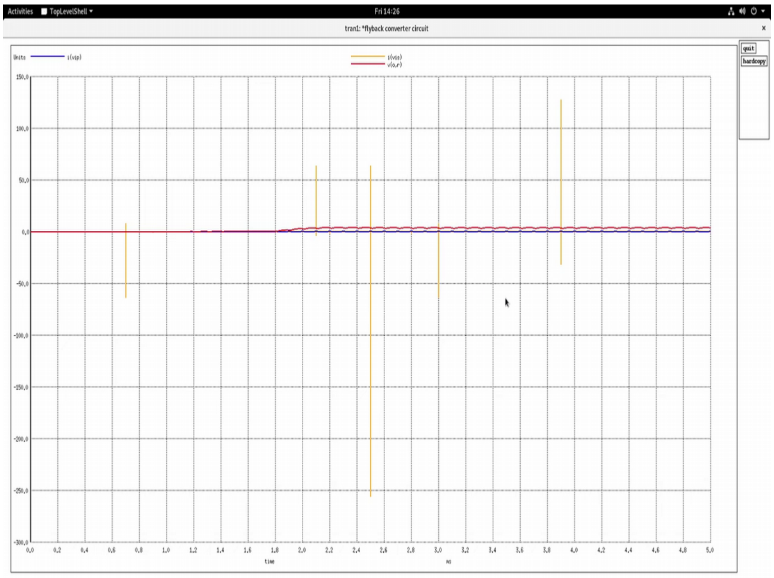

So, when you execute that simulation goes through. And you will see that there are some noise spike spikes coming in here again due to numerical instability. What you see this is the waveform. You can zoom that. Let me zoom just that portion of the waveform. Let me zoom it a bit more, so that you can see it clearly.

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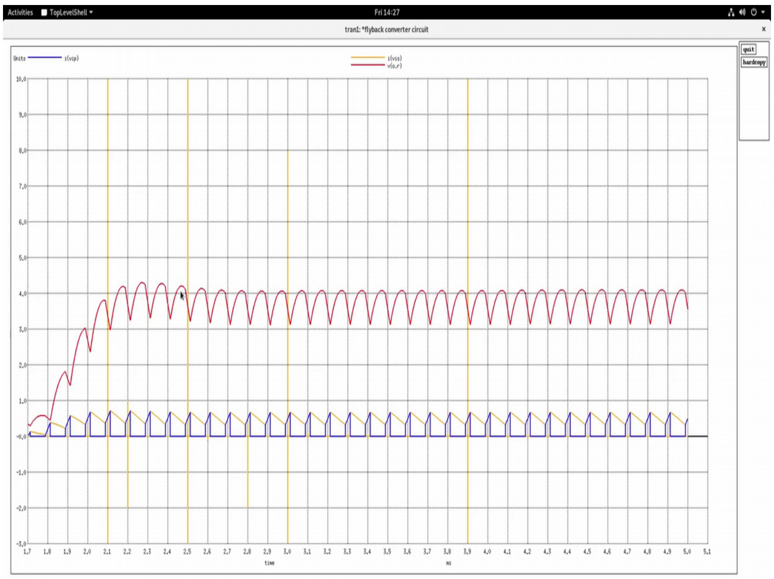

So, you see this red waveform is v o, r output with reference to with respect to r and here the blue and these way from the primary in the secondary currents. I could zoom the primary secondary current a bit more, and have a look at that.

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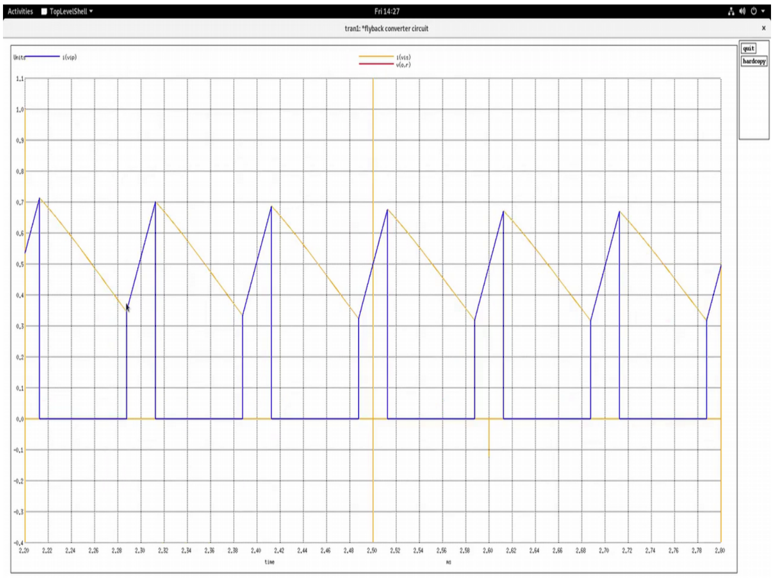

So, blue one that is the primary current ok, and this falling one is the secondary current. So, these are the currents that are flowing through the q switch i q and i d. And, I will leave it to you to explore the rest and experiment with it.