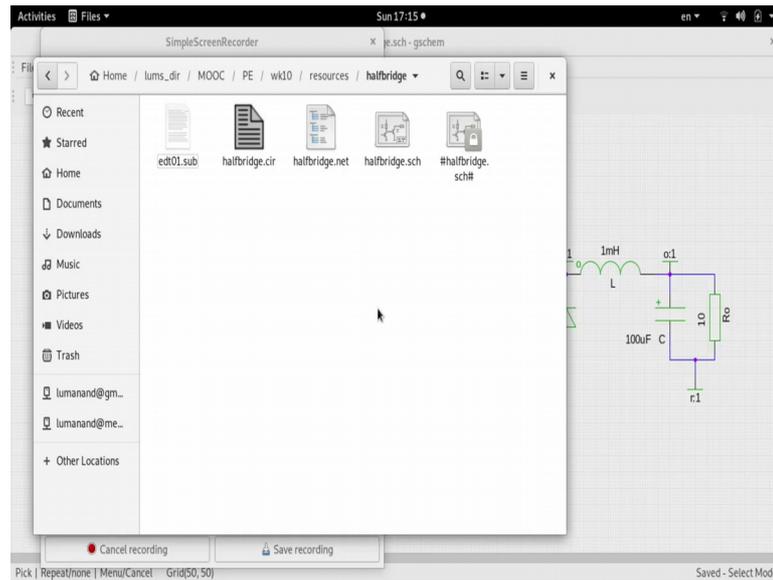


Fundamentals of Power Electronics
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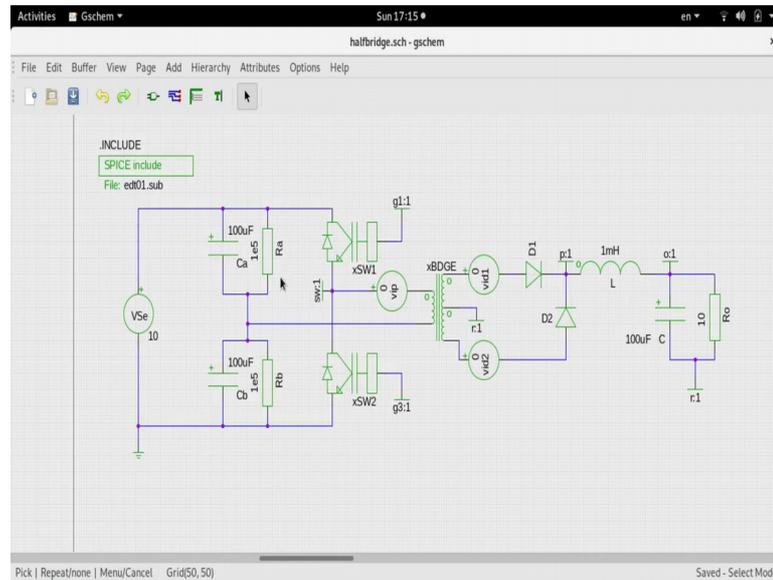
Lecture - 76
Simulation of halfbridge converter

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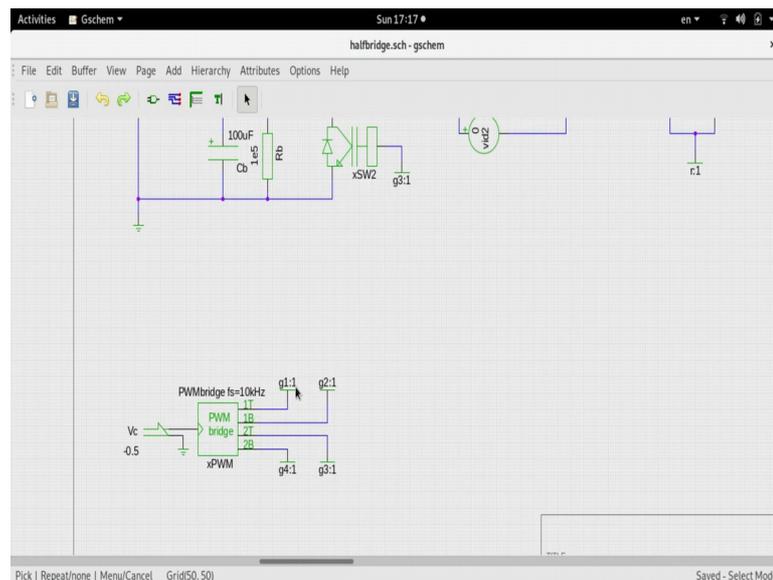
Let us do a Simulation for the halfbridge converter circuit. I have here in this folder within resources half bridge folder which is containing the sub circuit files the models, the halfbridge schematic and cir file the net list.

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So, let us go to the schematic this is a schematic of the halfbridge circuit. I have the dc link set up by these two capacitors equal capacitor 100 micro fared, 100 micro farad capacitors, I have balancing resistor there across this and this forms the dc link with the centre point being V_{dc} by 2. Now on the other side here I have two switches a bridge arm with two switches Q 1 and Q 2 or SW 1 and SW 2 now these 2 are generic switches driven by 2 gate drives g 1 and g 3.

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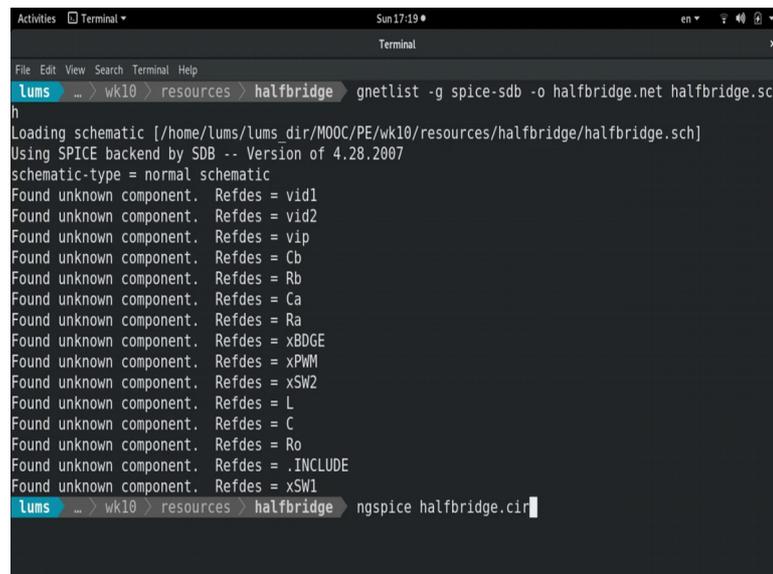


And g 1 and g 3 are coming from the PWM block which I explained while doing the push pull circuit similar same block which is generating 4 signals. And if it is for full bridge I use all the 4 otherwise you can use the top 1; 1 top or g 1 and you can use the g 3 2 top. These two 1 top and 2 top must be mutually exclusive; 1 bottom and 2 bottom must be mutually exclusive either you can use g 1 and g 3 or g 2 and g 4 for these two switches.

So, I am using g 1 and g 3 and in between you have this full bridge, you have this bridge transformer, the same type of transformer for both the full bridge and the half bridge. I am using a sensing voltage source here with 0 volts and this will sense the current through the primary. And the secondary of this bridge is centre tapped, the dot end is going through D 1 diode, the non dot end through D 2 diode they are oring up at the pole point and then you have the inductor followed by capacitance and the load, r is the reference node on the secondary side. So, anything that you want to measure on the secondary side whether it be the output voltage or the pole voltage, you measure it with respect to the reference node r.

So, now we can simulate this circuit and see how it behaves.

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```
Activities Terminal Sun 17:19
Terminal
File Edit View Search Terminal Help
Lums ... > wk10 > resources > halfbridge gnetlist -g spice-sdb -o halfbridge.net halfbridge.sc
h
Loading schematic [/home/lums/lums_dir/MOOC/PE/wk10/resources/halfbridge/halfbridge.sch]
Using SPICE backend by SDB -- Version of 4.28.2007
schematic-type = normal schematic
Found unknown component. Refdes = vid1
Found unknown component. Refdes = vid2
Found unknown component. Refdes = vip
Found unknown component. Refdes = Cb
Found unknown component. Refdes = Rb
Found unknown component. Refdes = Ca
Found unknown component. Refdes = Ra
Found unknown component. Refdes = xBDGE
Found unknown component. Refdes = xPWM
Found unknown component. Refdes = xSW2
Found unknown component. Refdes = L
Found unknown component. Refdes = C
Found unknown component. Refdes = Ro
Found unknown component. Refdes = .INCLUDE
Found unknown component. Refdes = xSW1
Lums ... > wk10 > resources > halfbridge ngs spice halfbridge.cir
```

I have now open the terminal I am within that resources half bridge circuit; half bridge folder, and let me generate the net list first. So, the net list is generated from the schematics file so, you can generate the net list and then you simulate the circuit n g

spice half bridge dot cir. Yeah before we simulate cir let us have a look at what is within this half bridge dot cir.

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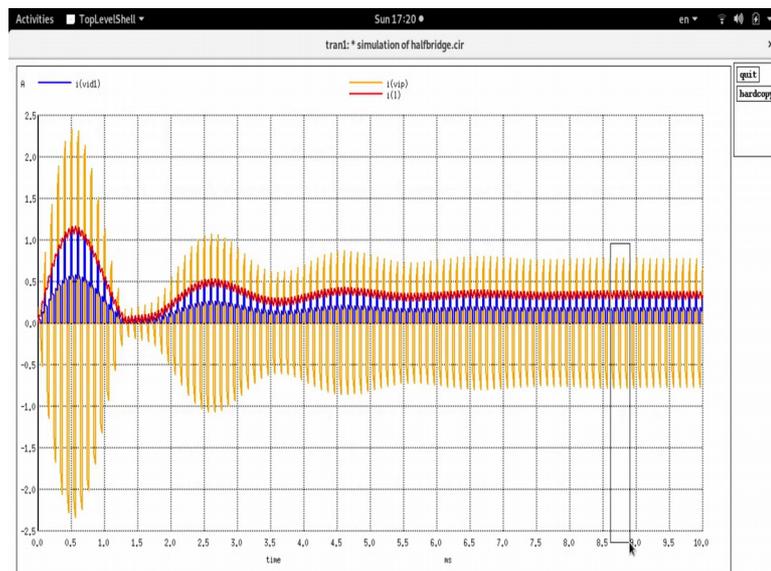


```
simulation of halfbridge.cir
.option reltol=0.01 abstol=0.001 vntol=0.001
.tran 1us 10ms uic
.include halfbridge.net

.control
set color0 = white ; set background as white
set color1 = black ; set foreground as black
run
plot i(L) i(viD1) i(vip)
.endc
```

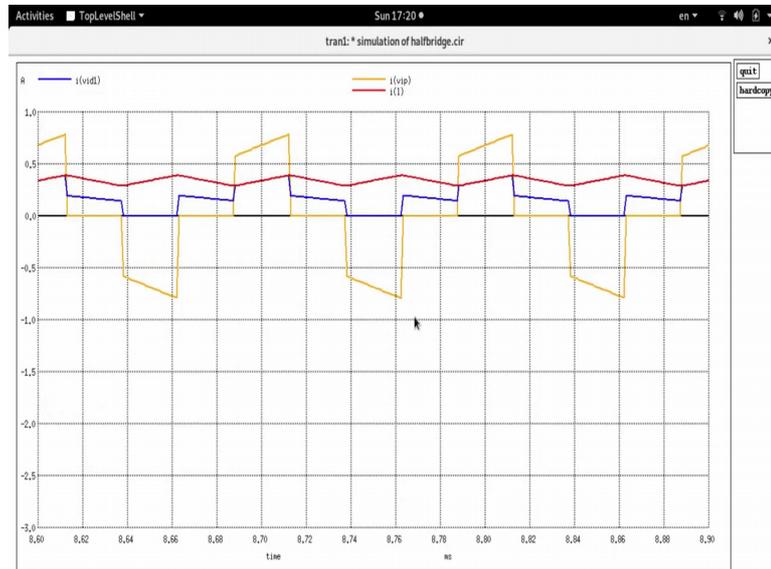
See half bridge dot cir contains this one you have the simulation commands dot option, dot tran which is the analysis command, include half bridge dot net. And then in the control set of commands in the Ngspice environment setting the background to white, foreground to black, running the plot simulation and plotting iL inductor current their diode d 1 current and the primary current these three proper currents we will see.

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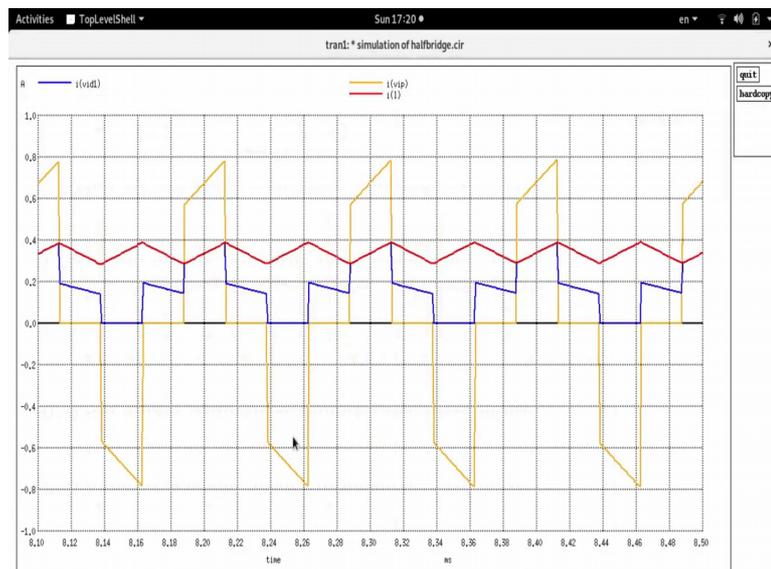
So, let us go back and do the simulation now. In the terminal I will do the simulation. Simulation is performed and then you see all this waveforms coming up let me go to the steady state and you will get an idea of what we are seeing yes.

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So, here you see the red waveform is the inductor current and the blue waveform is the diode d 1 current just like in the push pull case, and the orange waveform is the primary current. Probably we can zoom in a bit and see you will get a much better view if you just few cycles yes. Now this gives you a much clearer picture.

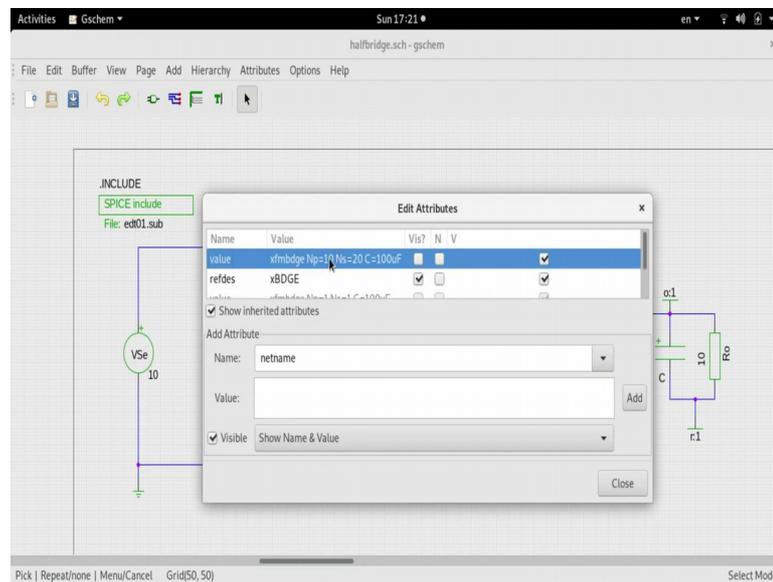
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So, you see the primary current 1 2 3 4, 1 2 3 4 it is an a c current flowing through the primary that is the a c current flowing through the primary. So, you see that when the switch S 1; SW 1 is on, you have the current flow in this fashion to into the dot and when the switch S 2 is on you have the current flow into the non dot end coming out of the dot and into the ground.

So, you have current flow on both directions and it is basically a reflected inductor current onto the primary.

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Here to in the bridge transformer I have said primary turns as 10, secondary turns as 20 you can explore with other turns ratios and the sub circuit for this bridge transformer you will find it in edt01dot sub.

various waveforms of the half bridge circuit. You can try to see the pole voltage and the output voltage too, maybe I can show that to you briefly before closing.

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```
Activities Terminal Sun17:23
Terminal
File Edit View Search Terminal Help
v.xbdge.xgyp.vp1#branch 0
b.xbdge.xgyp.bgp1#branch 0
v.xbdge.xgyp.vsl#branch 0
l#branch 0
vse#branch 0
vc#branch 0
vip#branch 0
vid2#branch 0
vid1#branch 0
a.xpwm.ainv#branch_1_0 0
a.xpwm.alim4#branch_1_0 0
a.xpwm.alim3#branch_1_0 0
a.xpwm.alim2#branch_1_0 0
a.xpwm.alim1#branch_1_0 0
a.xpwm.acompare2#branch_1_0 0
a.xpwm.acompare1#branch_1_0 0
a.xpwm.atr1#branch_1_0 0

Reference value : 5.90200e-03

No. of Data Rows : 10570
ngspice 171 -> Warning: Missing charsets in String to FontSet conversion
ngspice 171 -> plot v(p,r) v(o,r)
```

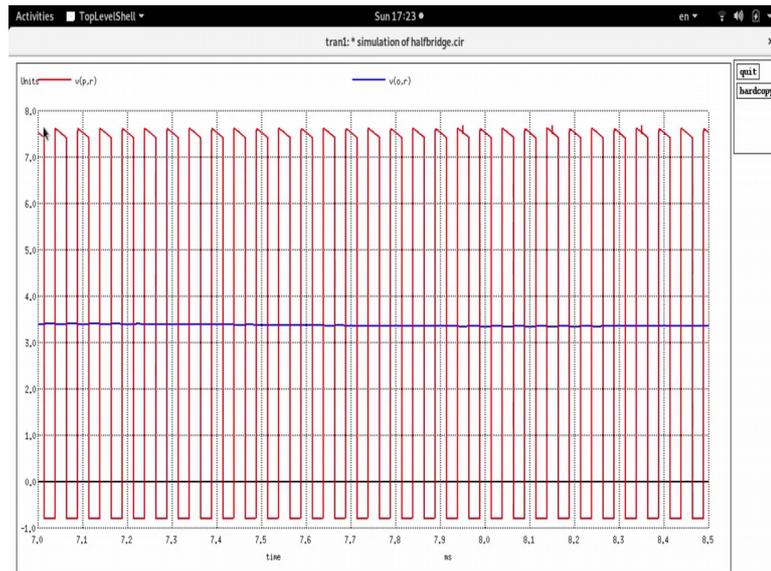
Plot v pole voltage with respect to the reference node r, plot output with refers reference with respect to the reference node r see the outputs.

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And when you expanded it you will be able to see; you will be able to see both the pole voltage and output voltage

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Here is a pole voltage and the blue one is the output voltage here.