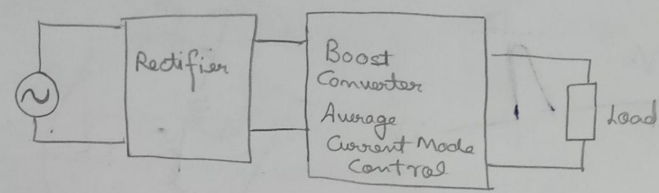
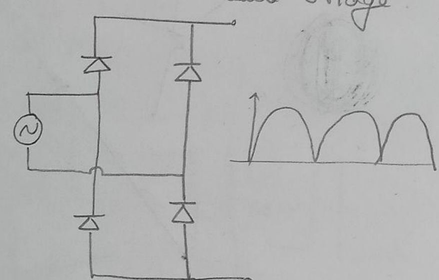
Design of Boost Active PFC

Power Factor Correction circuit

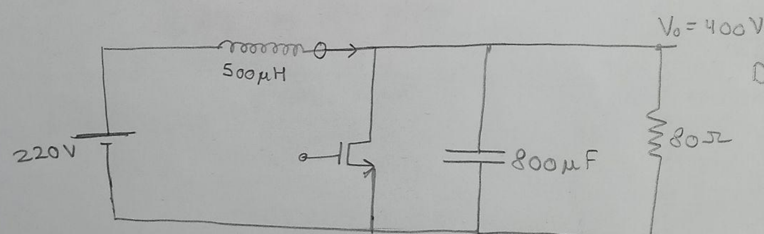
B



Rectifier → Full Diode Bridge



Boost Converter Design with Average inductor current control.



$D = 1 - \frac{V_g}{V_o}$

Lets design for 20KHZ BW of Avg. current Mode control

$$G_{vd}(s) = \frac{V_o}{D'} \frac{\left[1 - sL/D'^2R\right]}{den(s)}$$

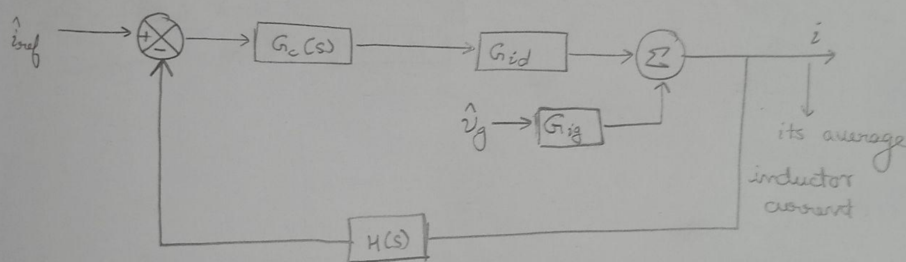
$$G_{id}(s) = \frac{2V_o\left[1 + sRC/2\right]}{D'^2 R\, den(s)}$$

$$G_{vg}(s) = \frac{1}{D'} \frac{1}{den(s)}$$

$$G_{ig}(s) = \frac{1}{D'^2 R} \frac{\left[1 + sRC\right]}{den(s)}$$

$$den(s) = 1 + \frac{sL}{D'^2 R} + s^2 \frac{LC}{D'^2} \qquad D' = 1 - D$$

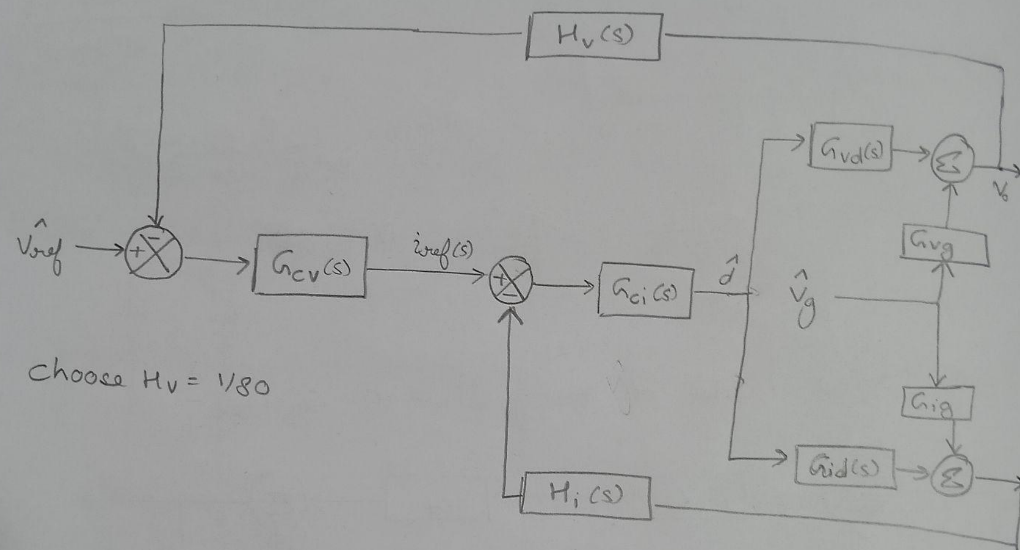
Small Signal Model of Average Inductor Control



$H(s) = 1$

Now $G_c(s)$ is to be designed such that we have 60° phase Margin at 20KHz.

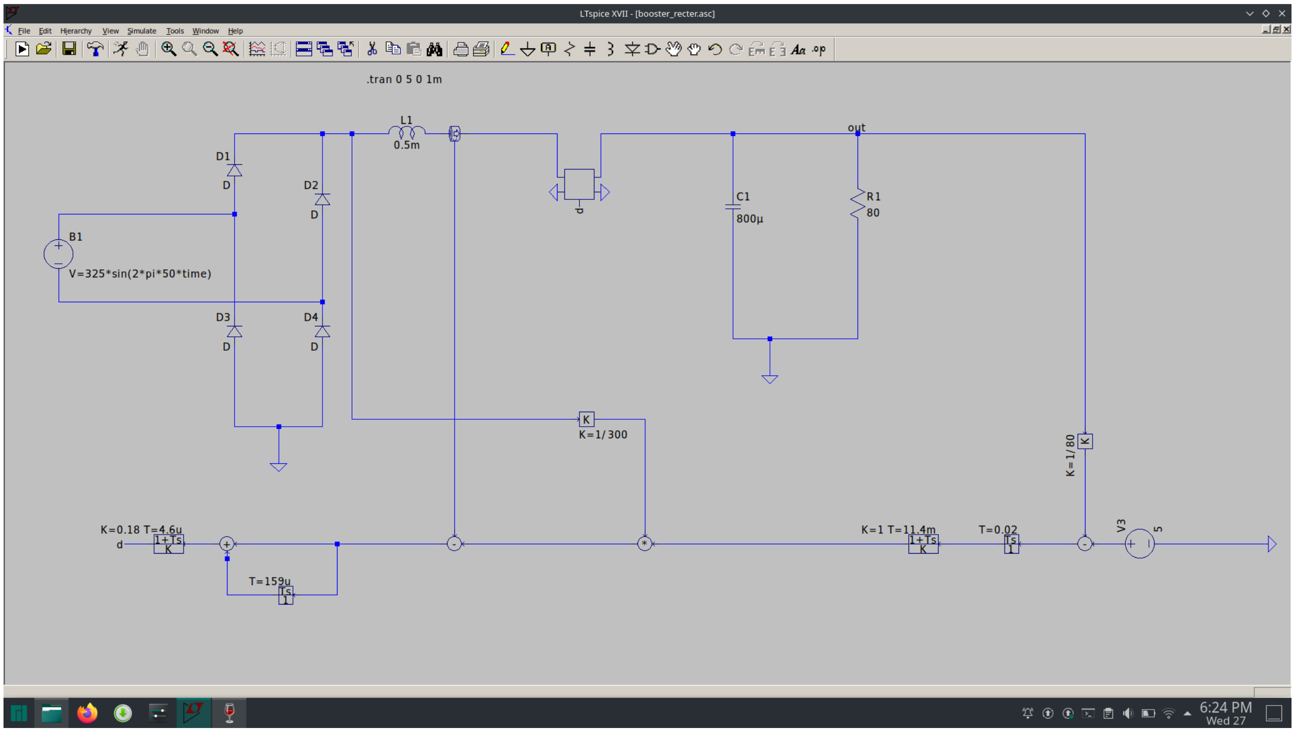
Now design the outer voltage loop control
with 2Hz BW & 60° phase Margin



Choose $H_v = 1/80$

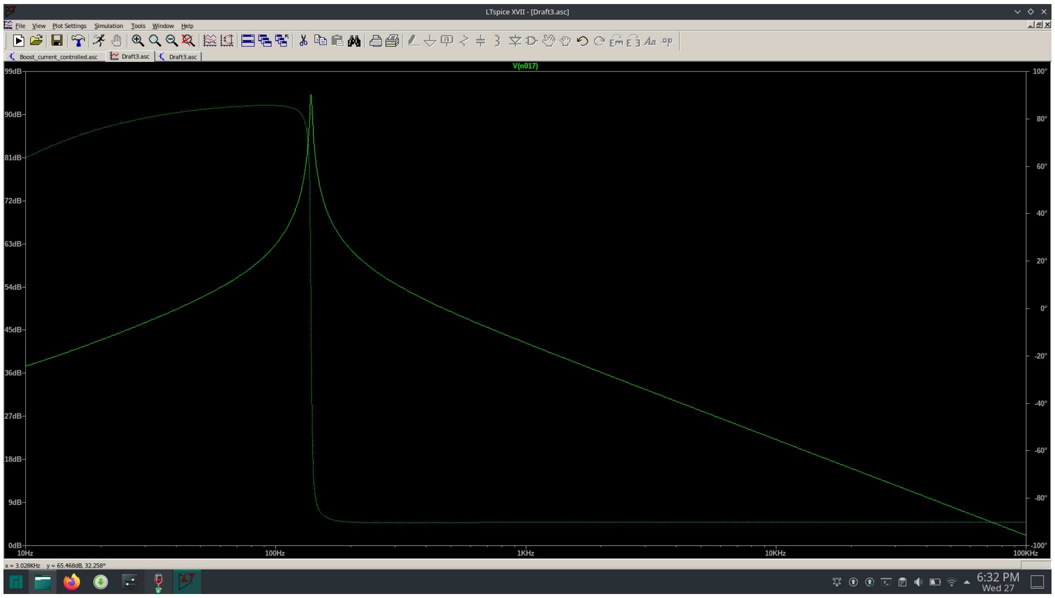
The above model is simulated in the file “small_signal_model” along with compensators

The complete circuit

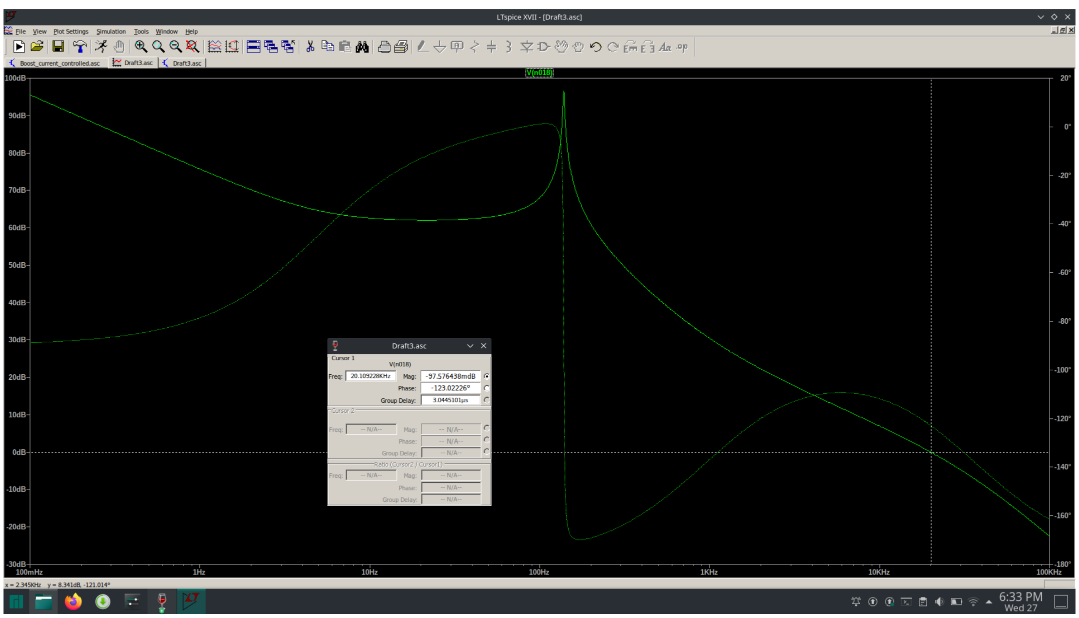


The switching circuit is modeled as a two port network with additional input d, it is an average model that ignores switching harmonics (else simulation becomes very long!), its based on average model given in “Fundamentals of Power electronics” by “Erickson”

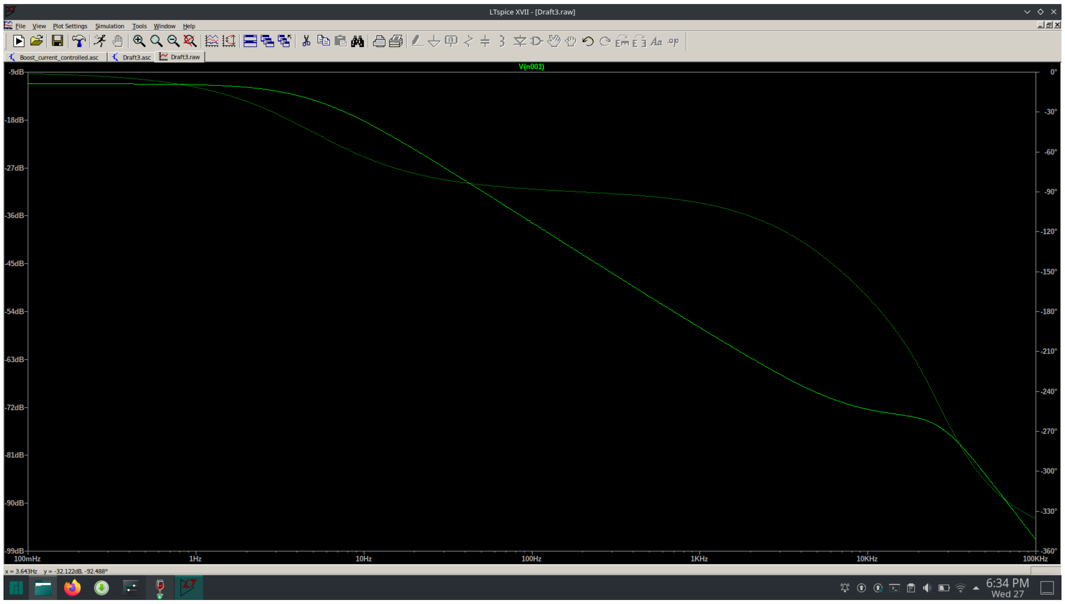
The input voltage is scaled and multiplied by current reference to generate the appropriate reference to keep PF=1 (chapter 21 3rd edition of “Fundamentals of Power electronics” by “Erickson”)



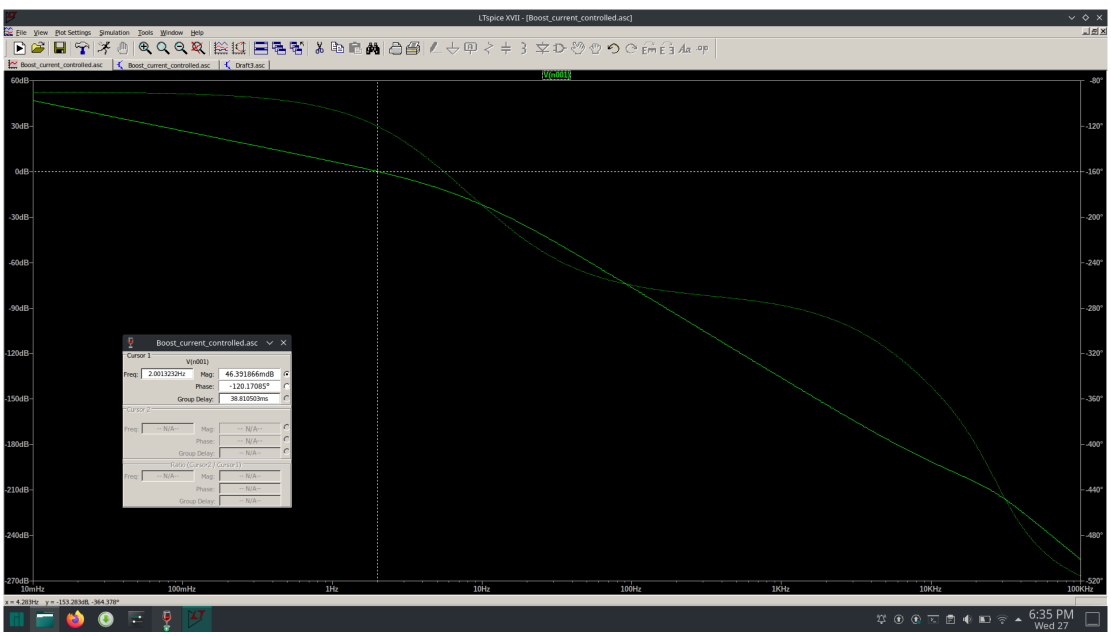
Open loop average control control



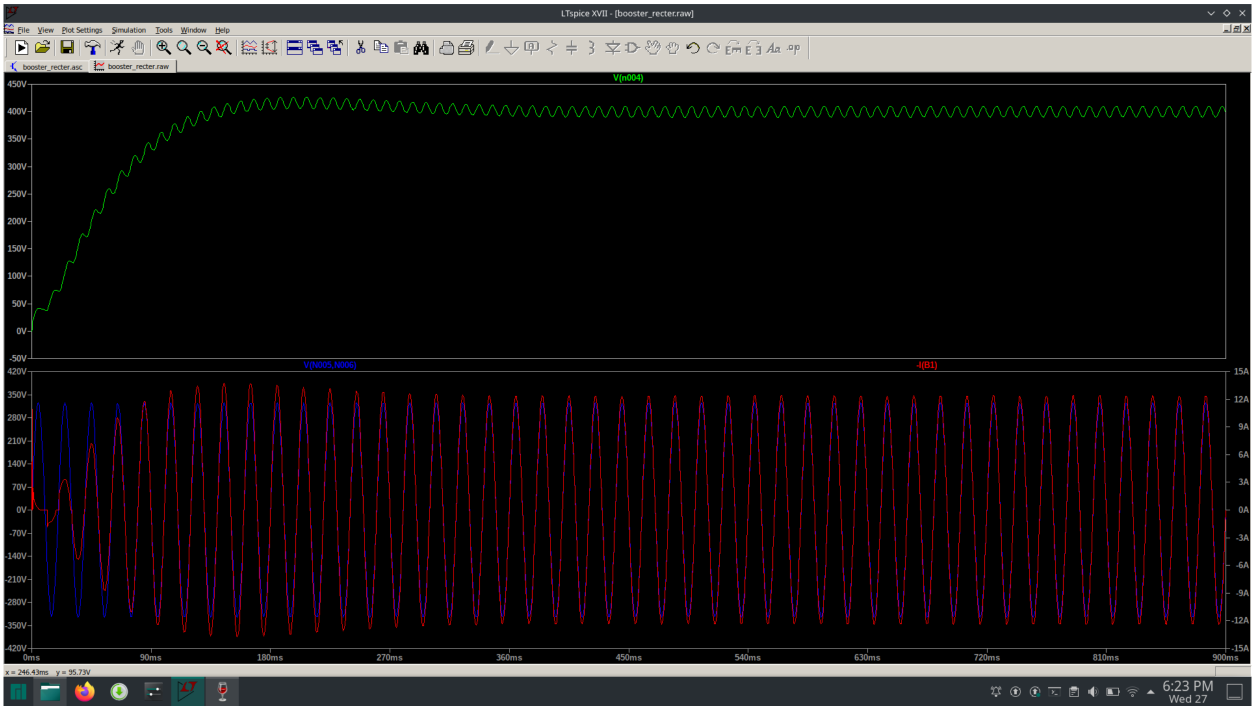
Compensated open current loop control



Open Loop Voltage control loop



Compensated voltage loop



The output voltage is more or less constant at 400V and the input PF in 1