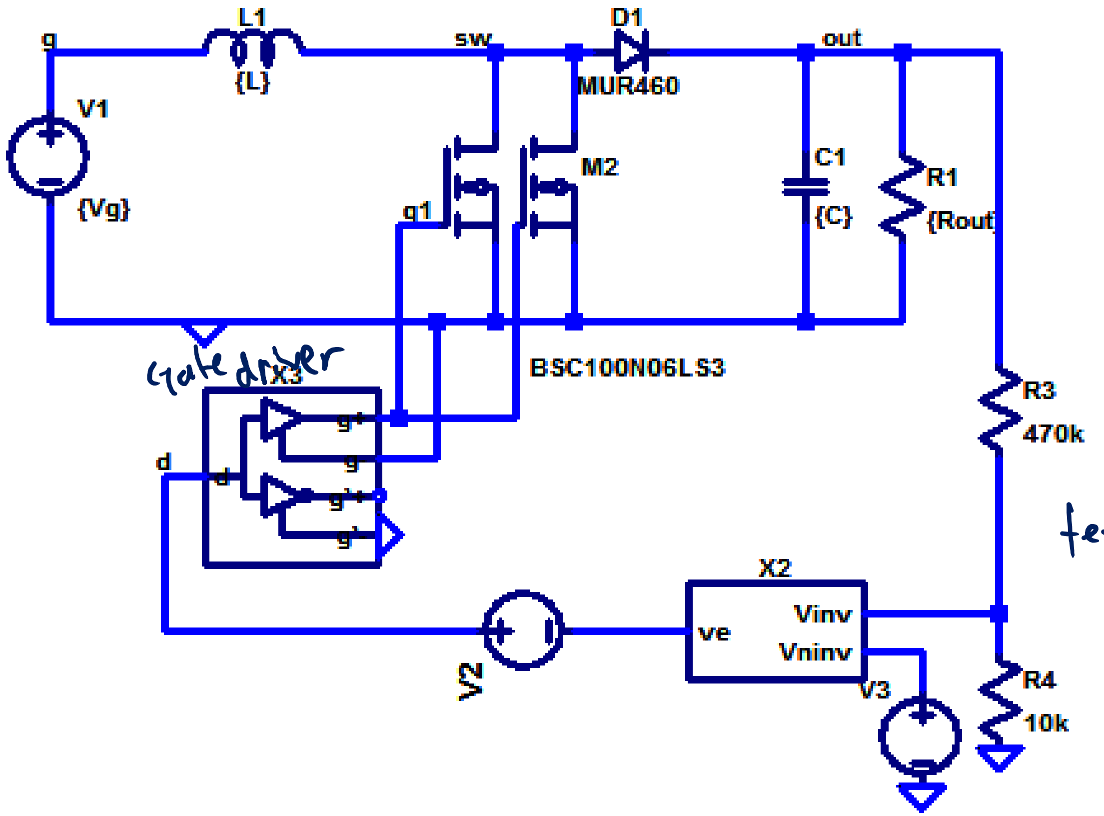
LTSpice Simulation



L	C_{out}	f_s	η (Sim)
22uH	22uF	200k	93.9%

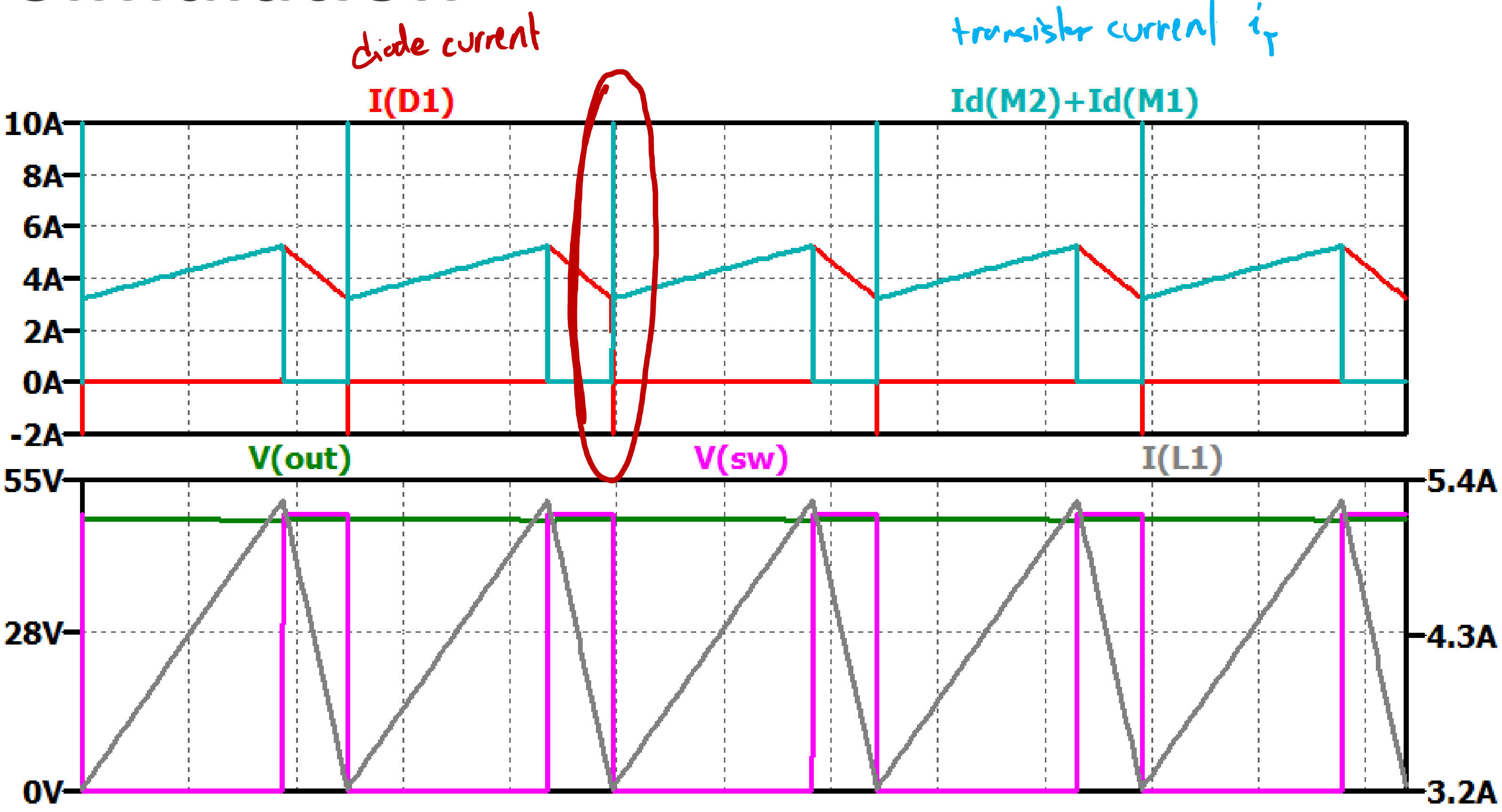
!!

3.7% pts less efficiency

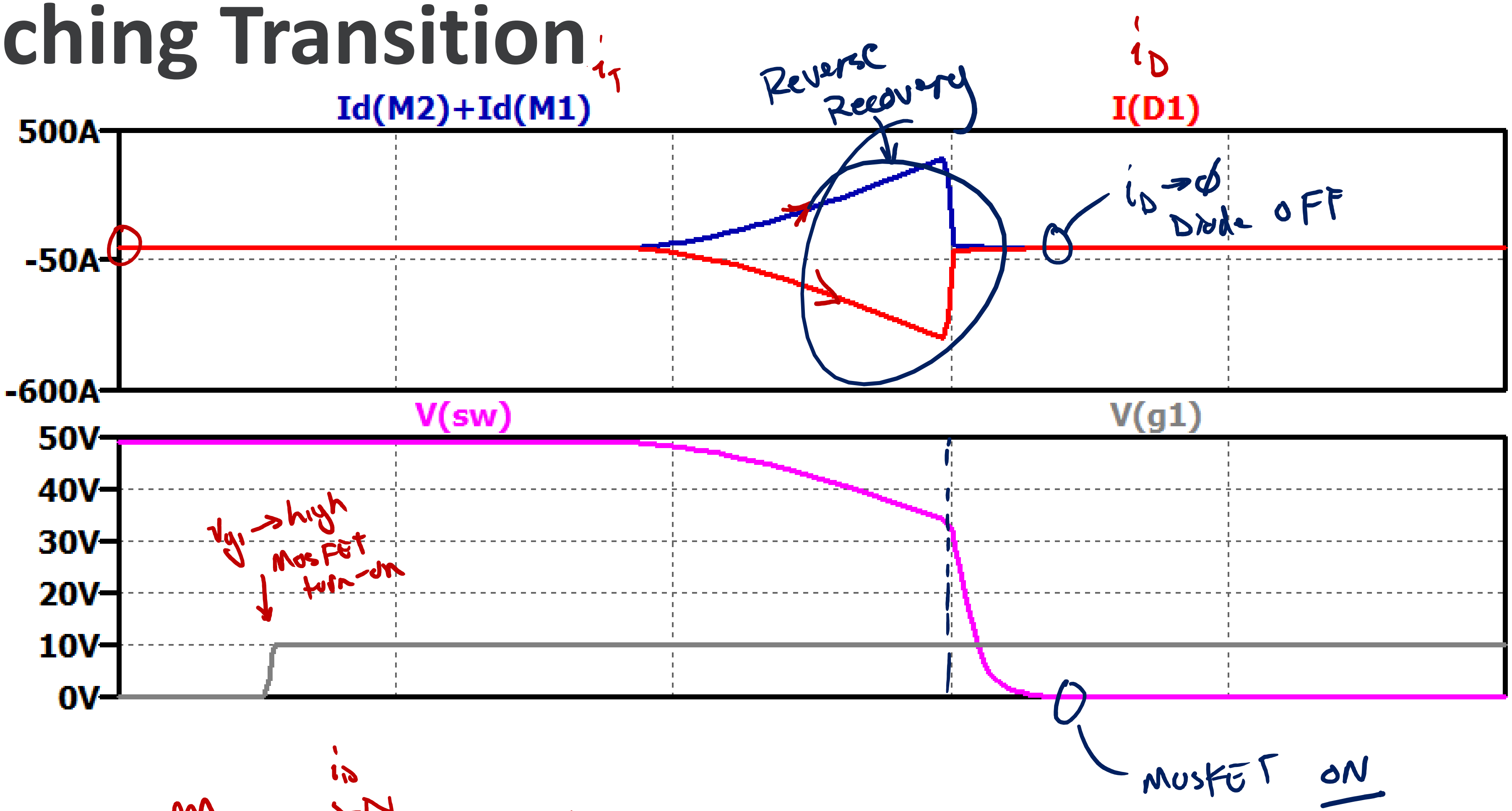
6.1% of power lost

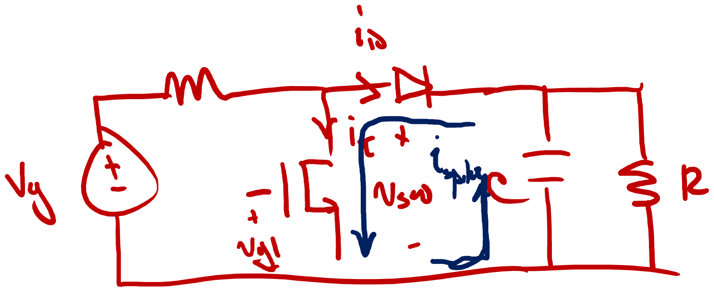
> 2x losses we predicted

LTSpice Simulation



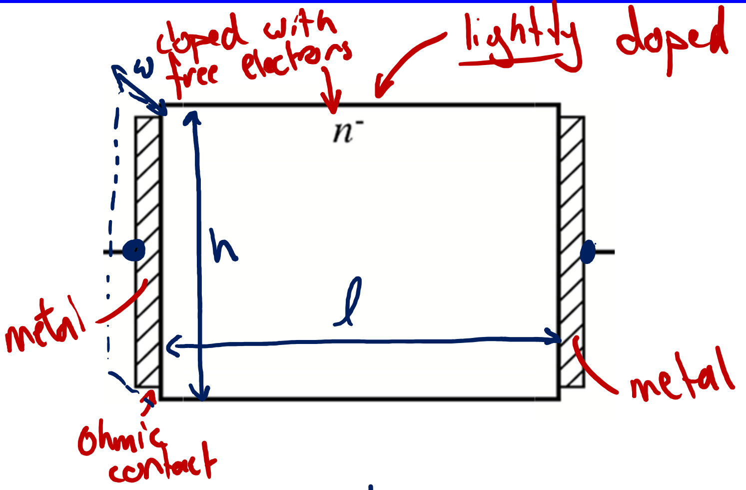
Switching Transition





Power Semiconductors

https://potenntial.eecs.utk.edu/About.php?topic=PowerSemiconductors



when conducting current through semiconductor

$$R = \rho \frac{l}{wh}$$

↑ resistivity

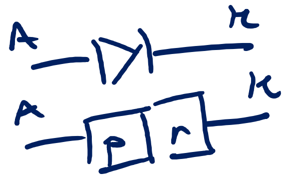
$$\rho = \frac{1}{\mu_n n q + \mu_p p q}$$

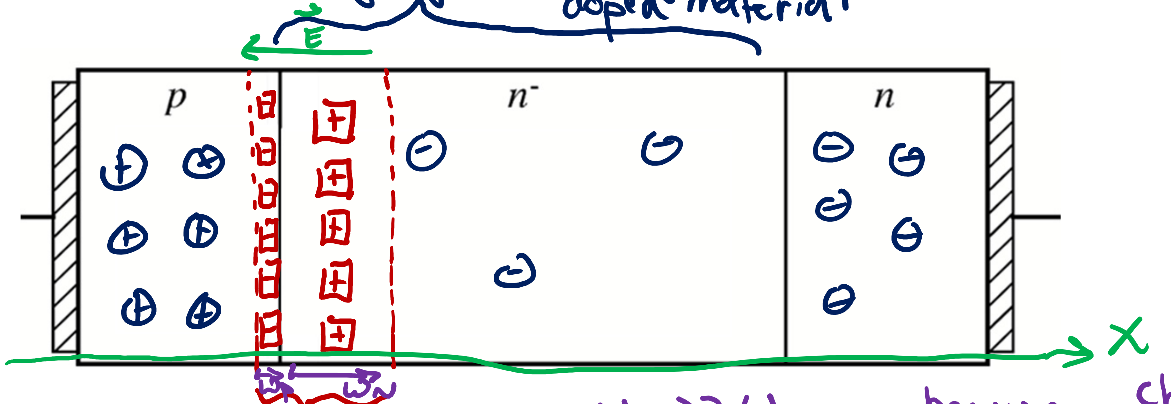
electron mobility (μ_n); electron free carrier density (n); unit charge (q)

For low R → dope very heavily to have many free carriers

Power Diodes

p-i-n
↳ intrinsic
long region of very lightly doped material





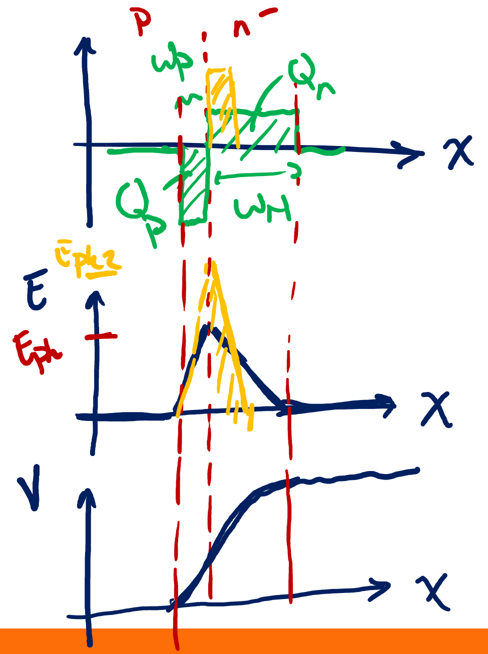
$W_n >> W_p$ because charges are equal but doping density is much lower in n^-

Poisson's Equation

$$\nabla^2 \varphi = \frac{-\rho_f}{\varepsilon}$$

∇^2 → Laplacian; φ → electric potential; ε → permittivity; ρ_f → charge density

In 1-D

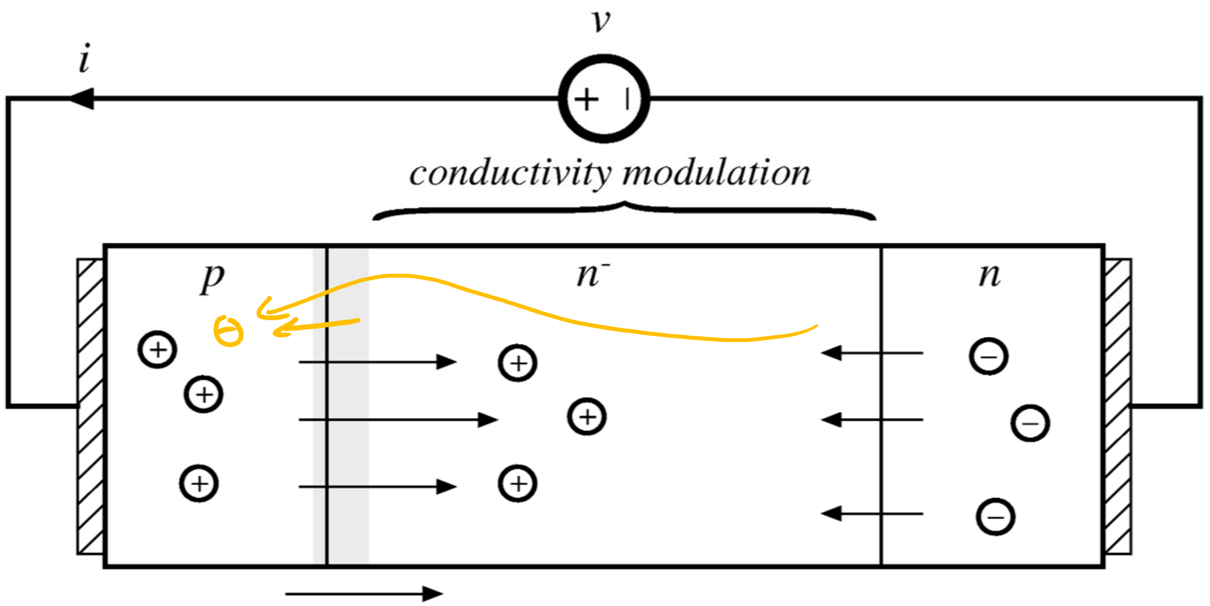


if $n^- \rightarrow n$

E_{crit} → critical electric field

what a material can support before breakdown

Forward Biased Diode



Minority carrier device:

+ conductivity modulation: minority free carriers increase with current (& temperature) so resistance drops at higher currents

- Built in junction barrier
- Minority carriers need to be removed before device can shut off