Section 29
MOS Capacitor Signal Response

29.3 Large Signal Response

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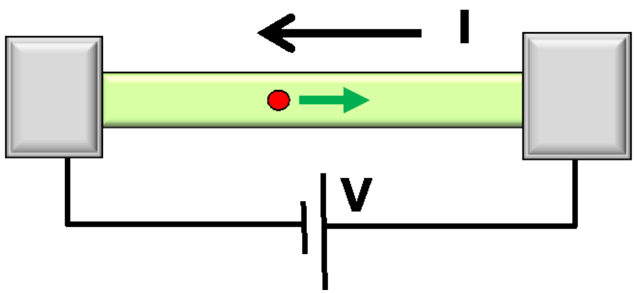
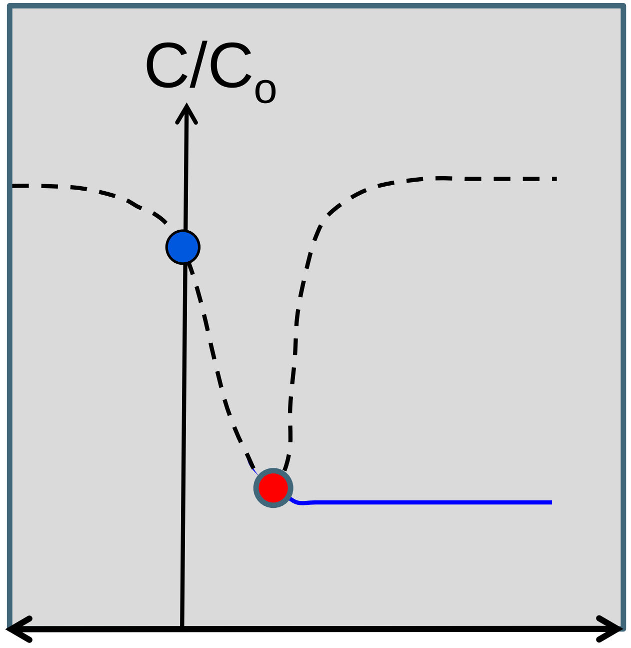
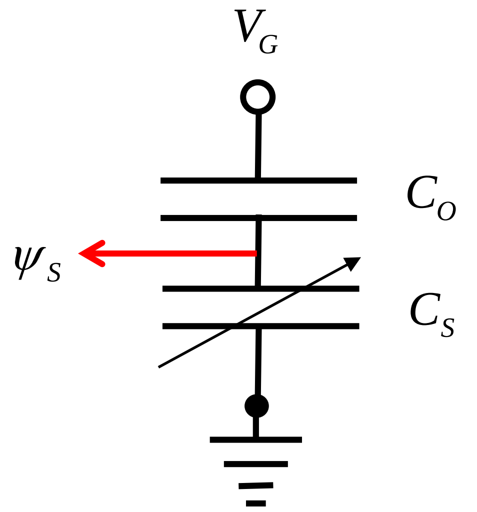


I = G x V
= q x n x v x A
charge density velocity area

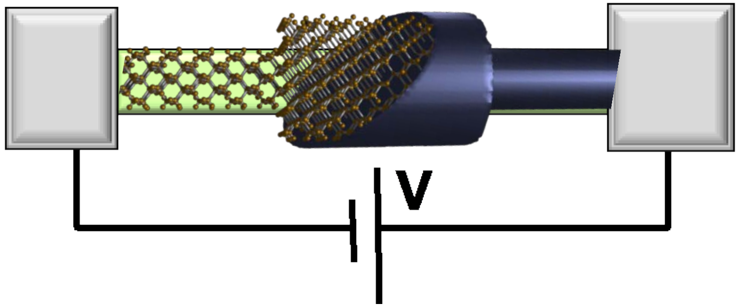
status





$$\psi_S = \frac{C_O}{C_O + C_S} V_G \equiv \frac{V_G}{m}$$

Section 27
Heterojunction Bipolar Transistor



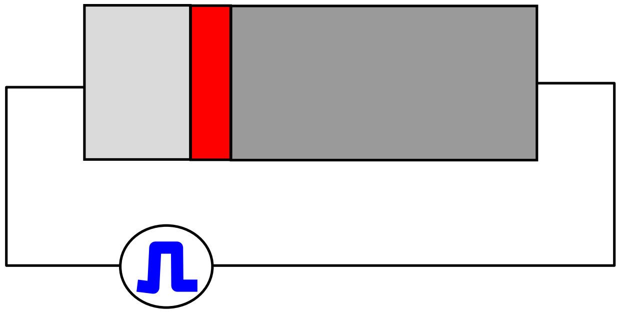
$I = G \times V$

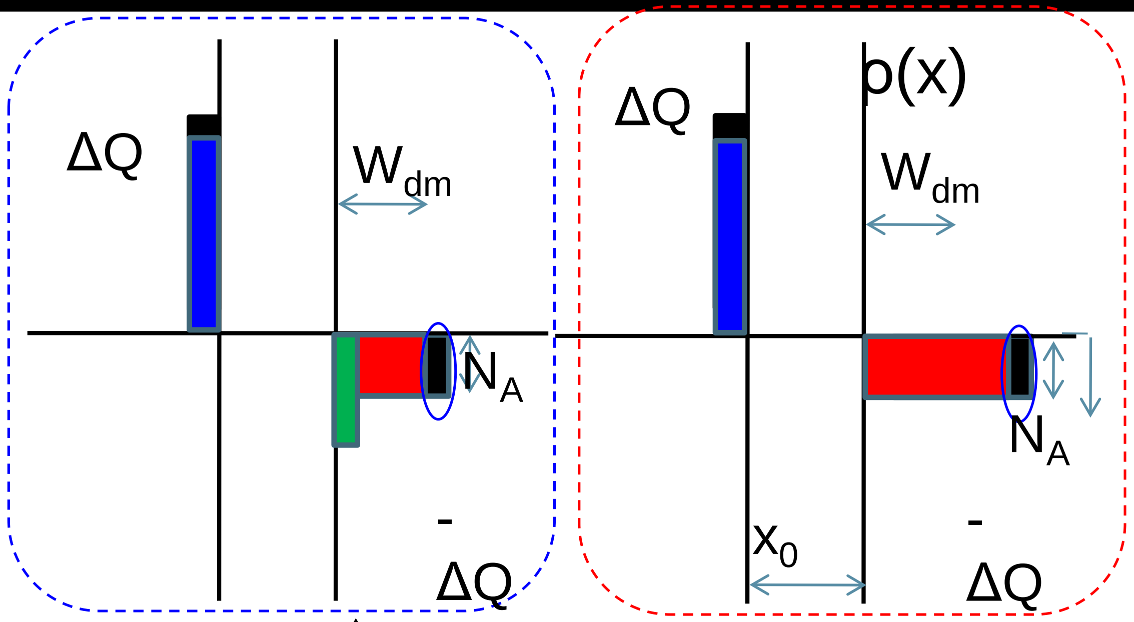
$= q \times n \times v \times A$

charge density velocity area

	Equilibrium	DC	Small signal	Large Signal	Circuits
PN Diode					
Schottky Diode					
BJT/ HBT					
MOScap MOSFET					

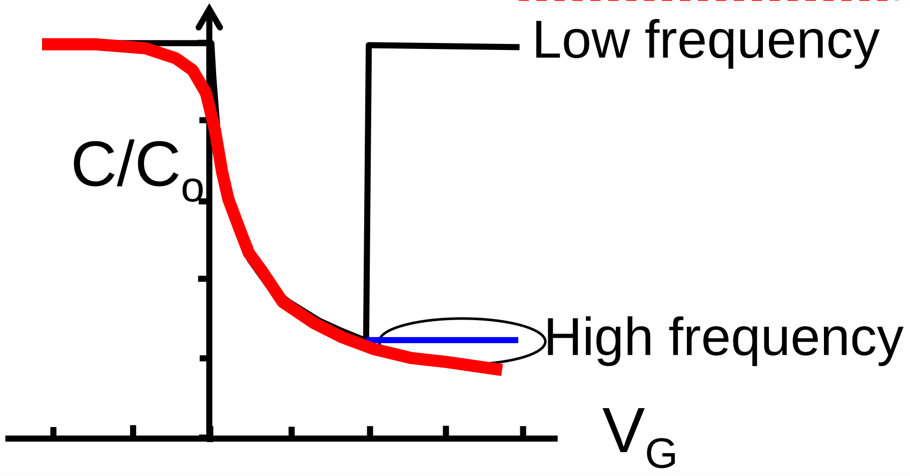
Large Signal Deep Depletion





$$C_{j,dep} = \frac{C_0 C_s}{C_0 + C_s} = \frac{C_0}{1 + \frac{\kappa_{ox}}{\kappa_s}\frac{W}{x_0}}$$

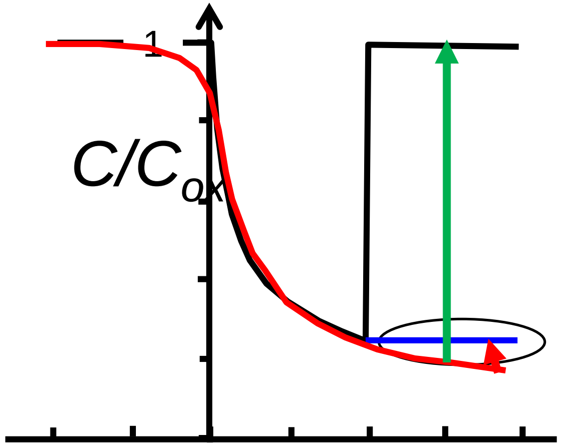
$$= \frac{C_o}{\sqrt{1 + \frac{V_G}{V_\delta}}}$$



(even beyond threshold)

For large signal, the green do not have time to response;
→ continue to deplete.
Small signal there is green because of the DC bias builds it.

Relaxation from Deep Depletion

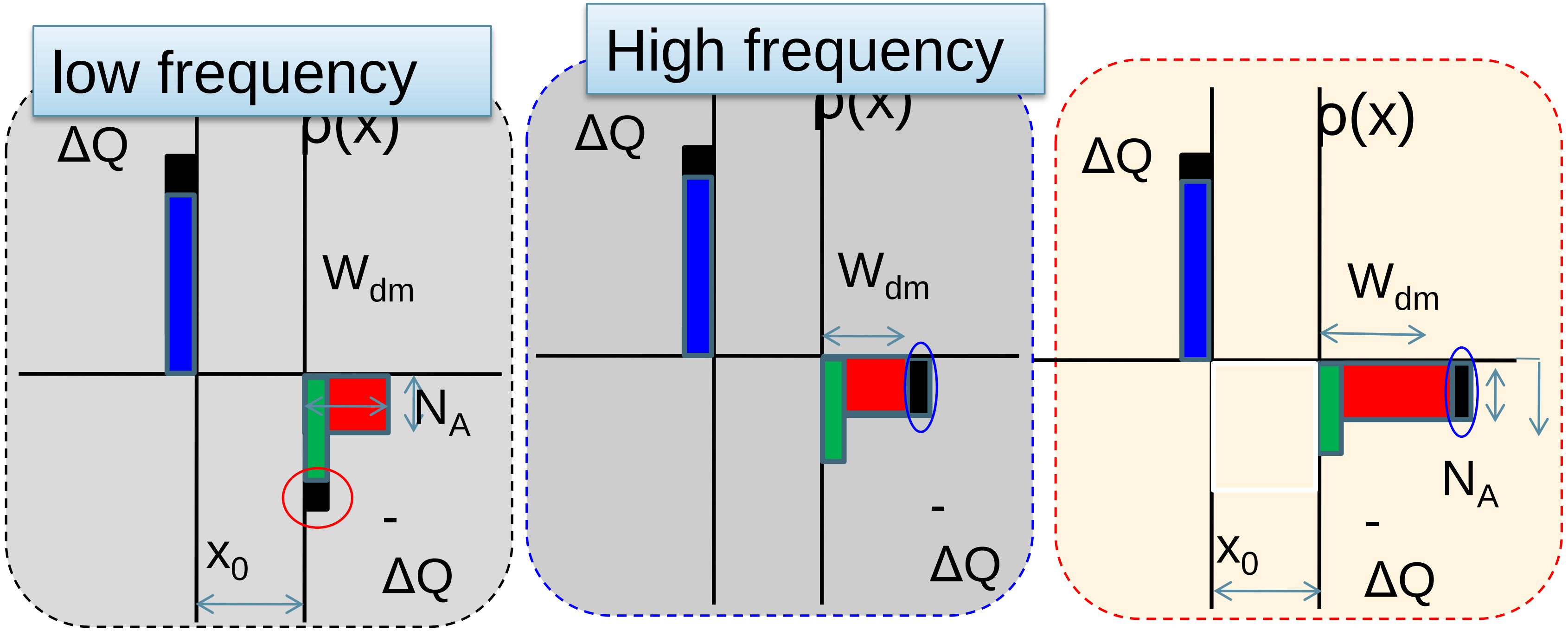


Low frequency

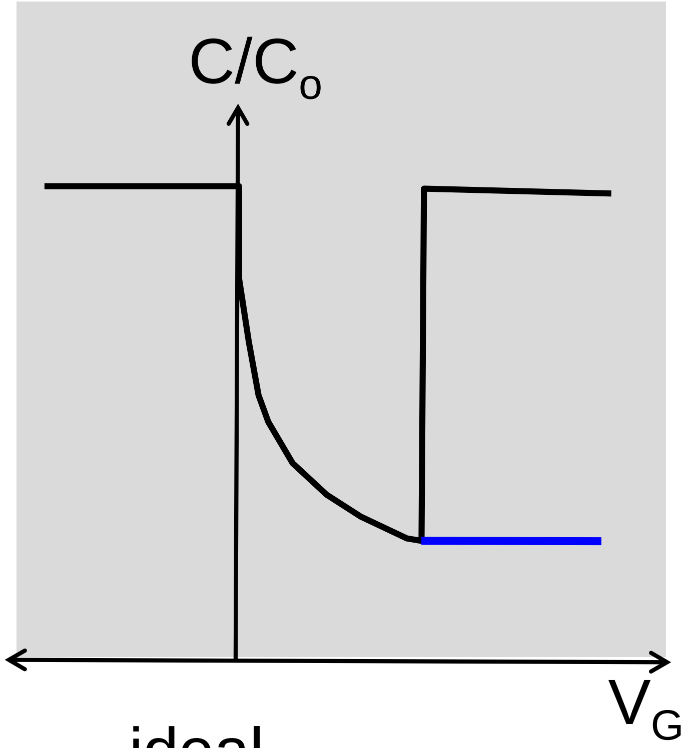
Depending on the measurement frequency, it will either merge with low-freq. or high-freq. curve.

High frequency

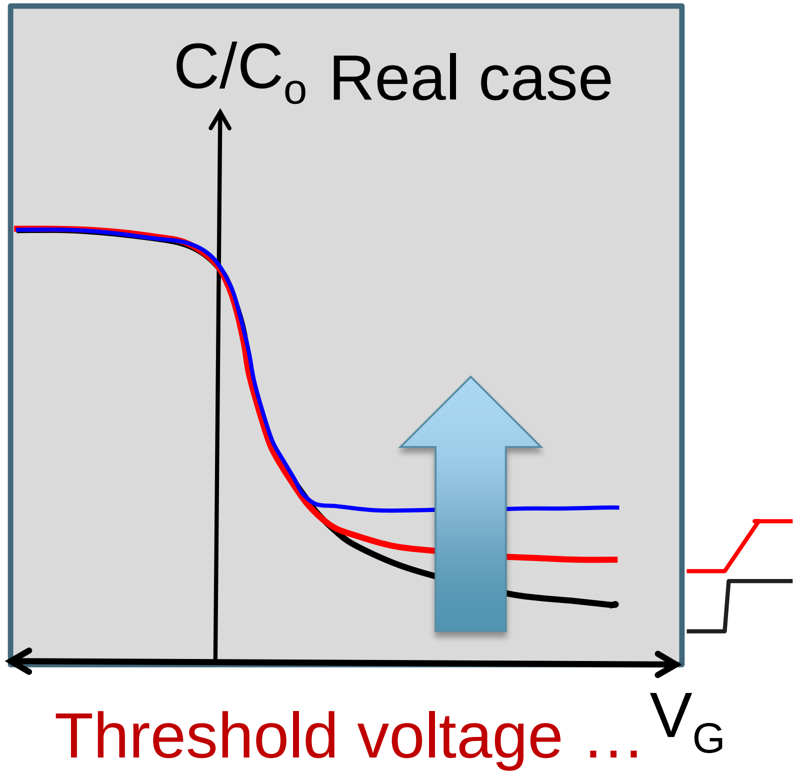
Deep depletion



Ideal vs. Real C-V Characteristics



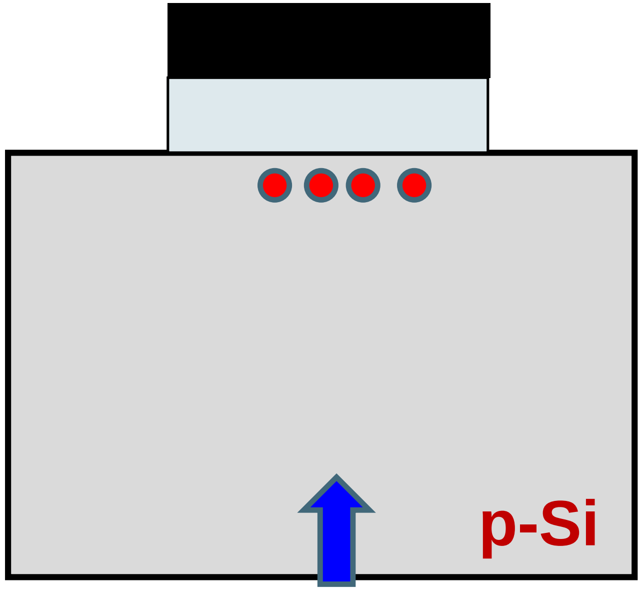
Flat band voltage …



Threshold voltage …

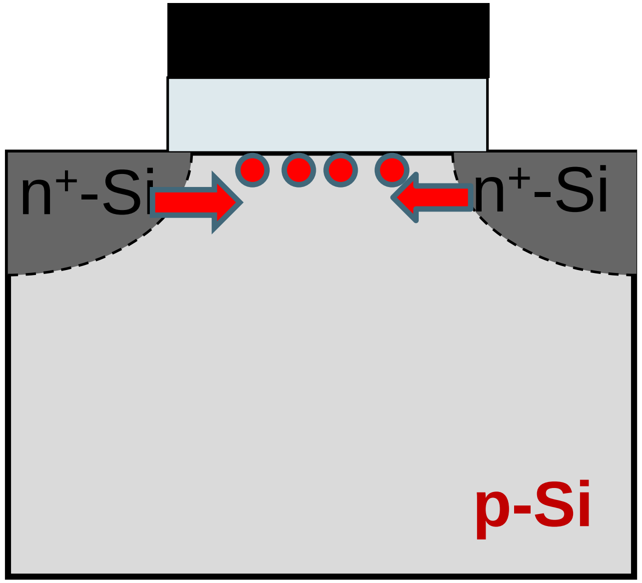
If the signal rise slower,
it will be closer to ideal case

Low or High frequency?



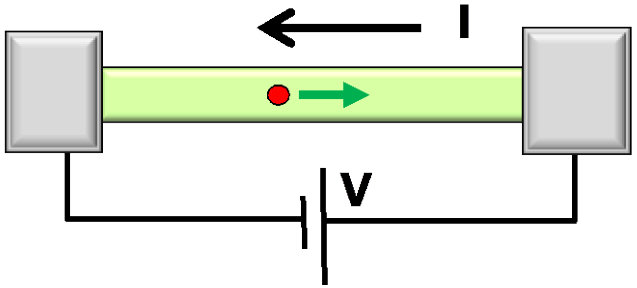
typically observe hi-frequency CV

$$G = \frac{n_i}{2\tau}$$



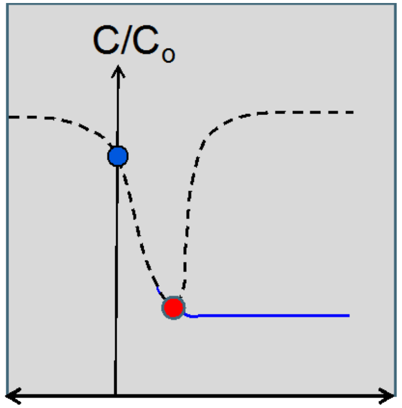
typically observe low-frequency CV
No deep-depletion as well

What happens if I shine light on a MOS capacitor?



$$I = G \times V$$
$$= q \times n \times v \times A$$

charge density velocity area



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1) Since current flow through the oxide is small, we are primarily interested in the junction capacitance of the MOS-capacitor.
2) High frequency of MOS-C is very different than low-frequency C-V.
3) In MOSFET, we only see low frequency response.
4) Deep depletion is an important consideration for MOS-capacitor that does not happen in MOSFETs.