First Course on Power Systems

Module 6: High-Voltage DC (HVDC) Transmission Systems

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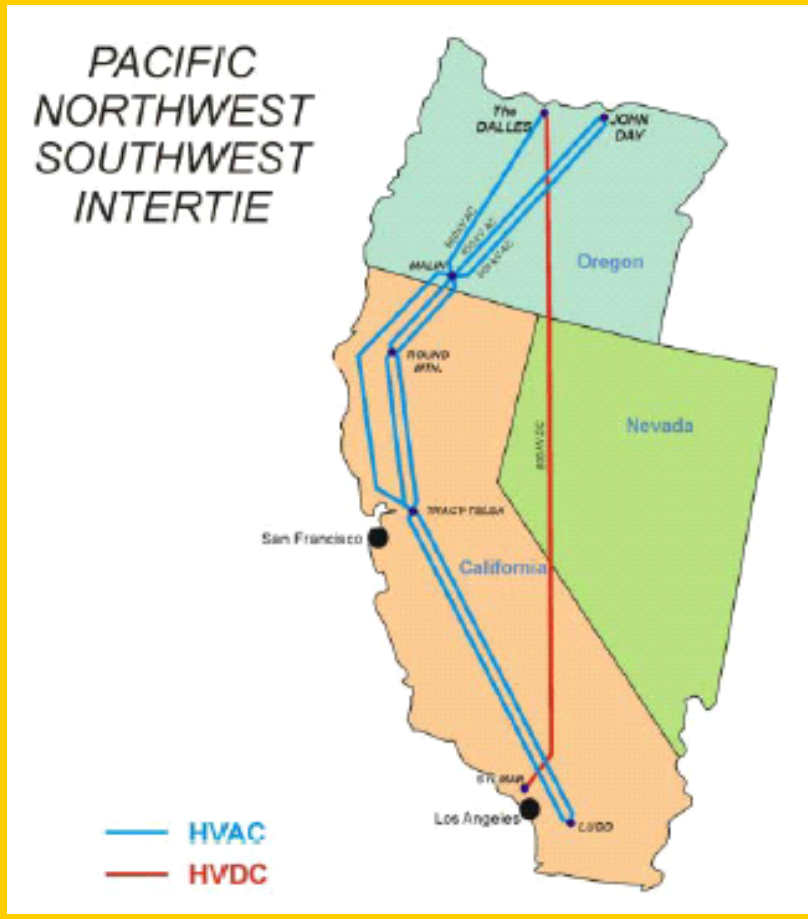
Reference Textbook:
First Course on Power Systems by Ned Mohan, www.mnpere.com

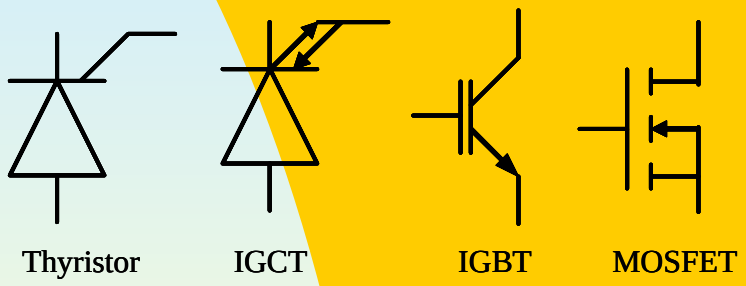
Module 6: HVDC Transmission Systems

Benefits of HVDC Systems

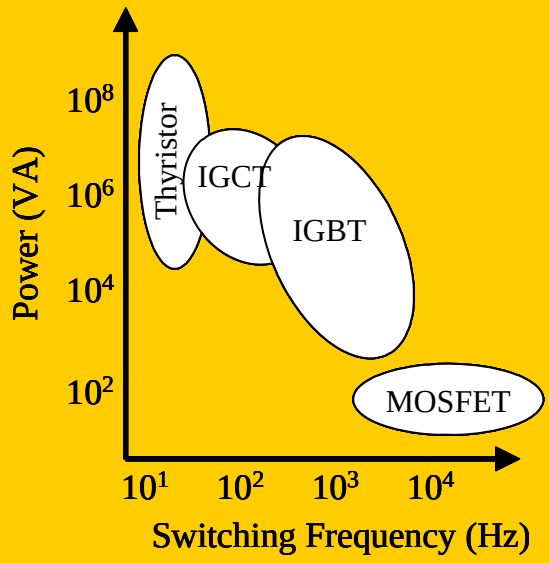
- Lower Cost at higher power and longer distances
- Lower Losses
- Stability
- Suited for Underwater Transmission



Symbols and Capabilities of Power Semiconductor Devices



(a)

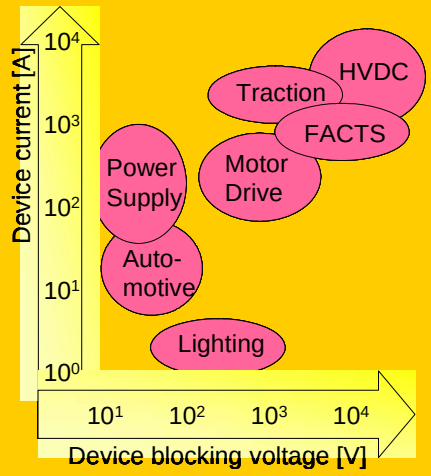


(b)

Fig. 7-1 Power semiconductor devices.

Power Semiconductor Devices and Applications

(*a*)



(*b*)

Figure 7-2 Power semiconductor devices: (a) ratings (source: Siemens), (b) various applications (source: ABB).

HVDC System

Fig. 7-3 HVDC system – one-line diagram.

HVDC Systems: Voltage-Link and Current-Link

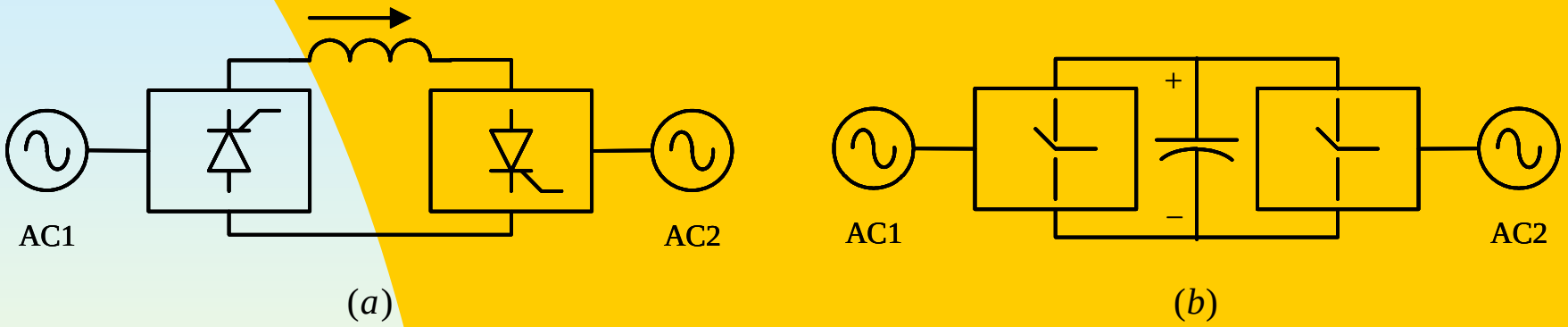


Fig. 7-4 HVDC systems: (a) Current-Link, and (b) Voltage-Link.

HVDC Projects in North America

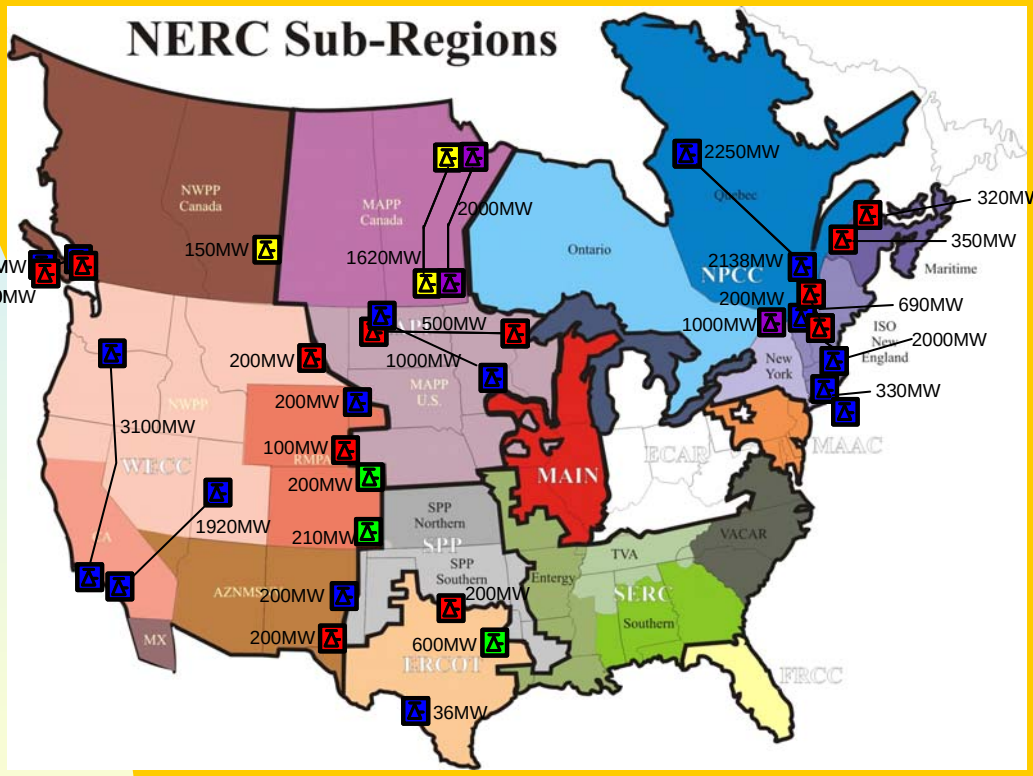


Fig. 7-5 HVDC projects, mostly current-link systems, in North America [source: ABB]

Current-Link HVDC System

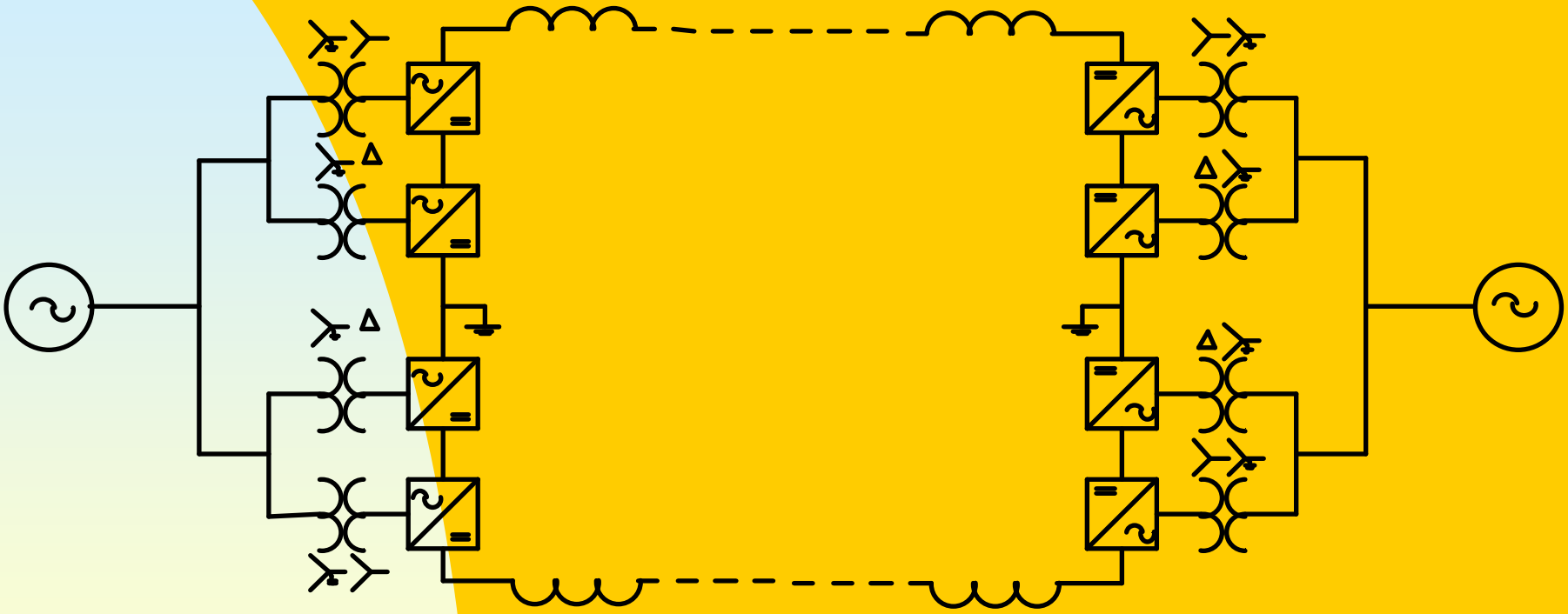
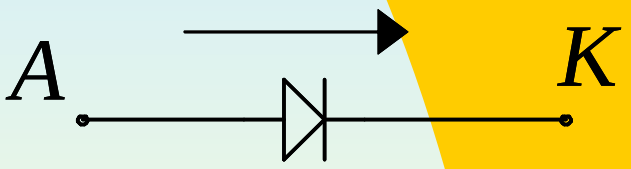
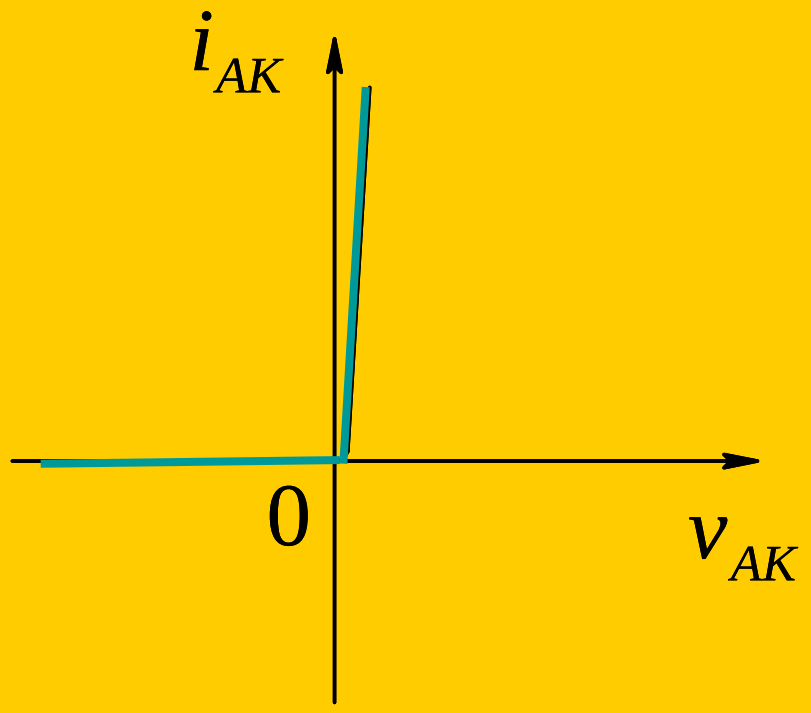


Fig. 7-6 Block diagram of a current-link HVDC system.

Diodes

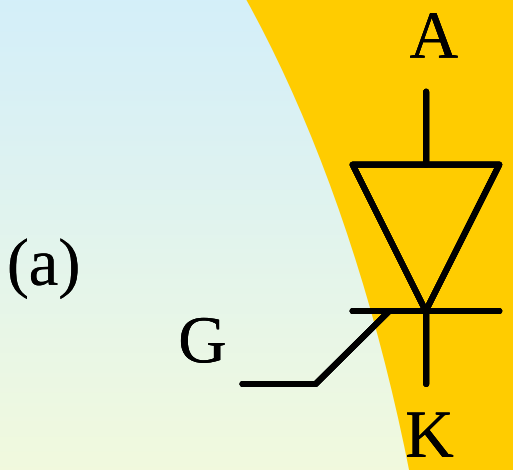


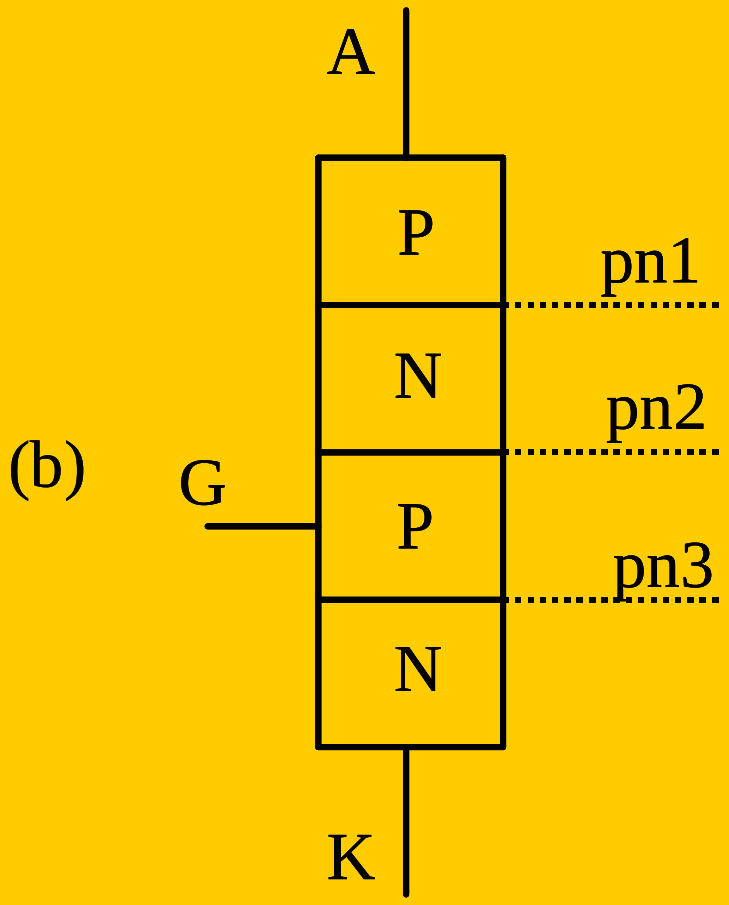
(a)



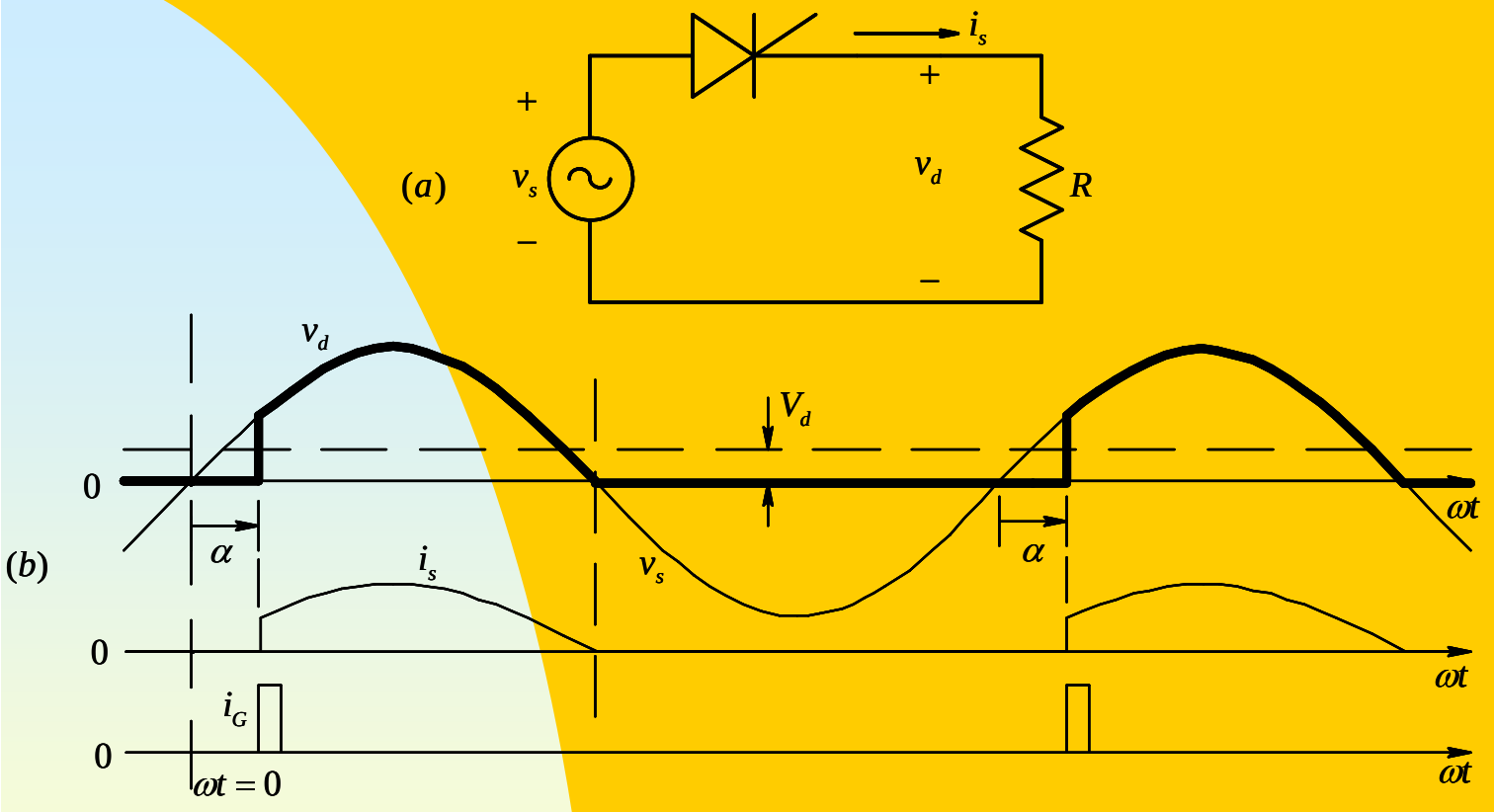
(b)

Thyristors





A Primitive Resistive Circuit



$$V_d = \frac{1}{2\pi}\int_{\alpha}^{\pi} \hat{V}_s \sin\omega t \cdot d(\omega t) = \frac{\hat{V}_s}{2\pi}(1+\cos\alpha)$$

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