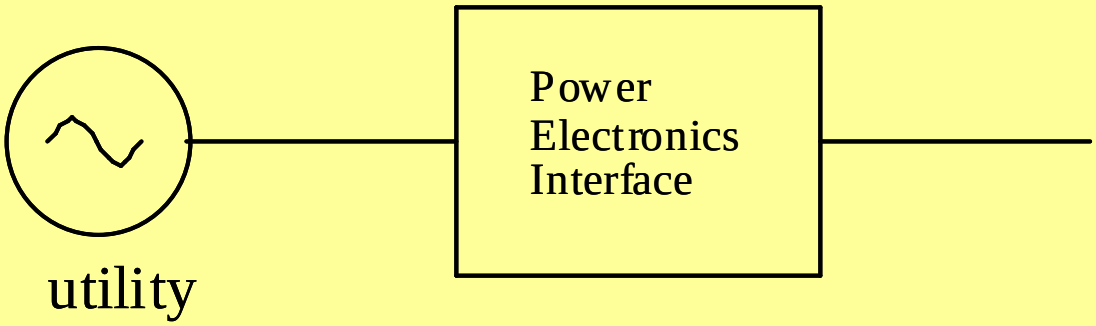
Basic Building-Block in Commonly-Used Power Electronic Converters

- Types of Structures
- Basic Building-Block in Voltage-Link Structures
  - Switching Power-Pole
    - Control by Pulse-Width-Modulation (PWM)
- Recent and Potential Advancements in Power Electronics

Summarizing the Role of Power Electronics and Applications

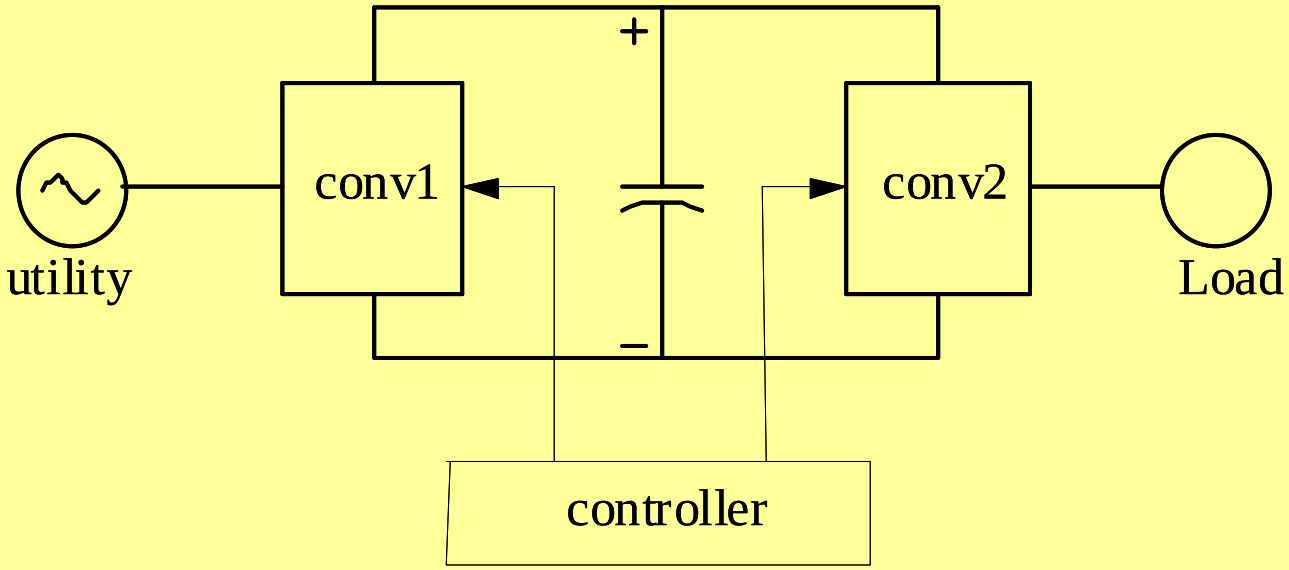


Output to Load
- Adjustable DC
- Sinusoidal AC
- High-frequency AC

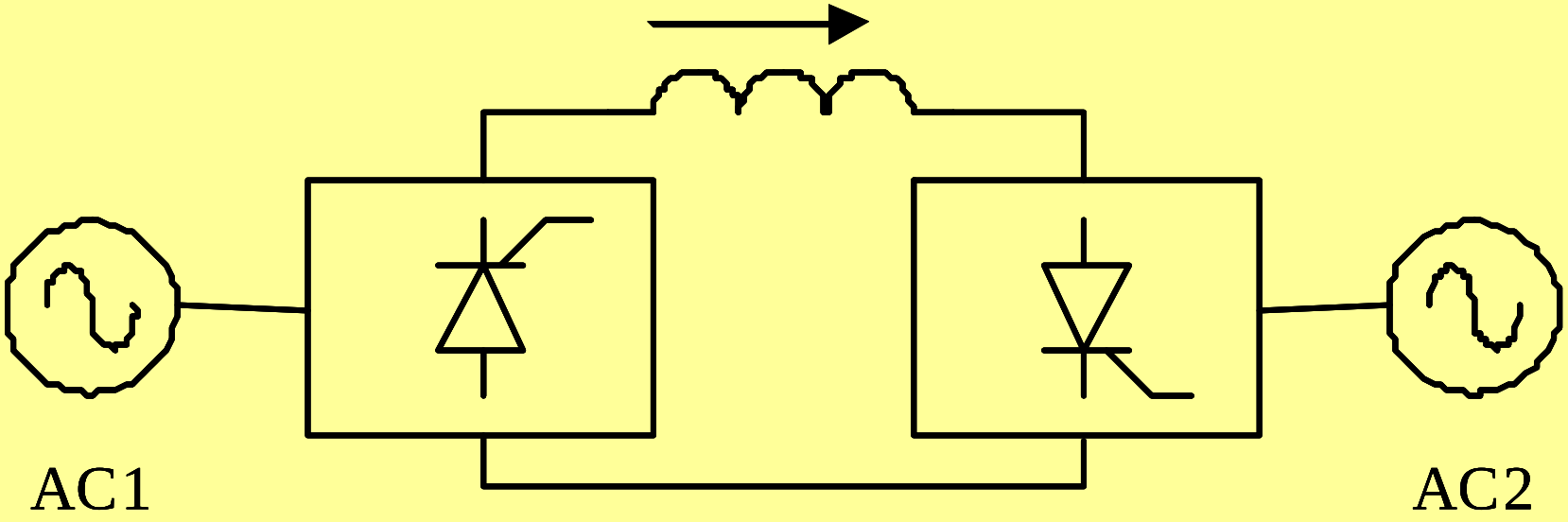
Classifying Structures in Power Electronics

- Voltage-Link Systems
- Current-Link Systems
- Matrix Converters (Direct-Link Systems)

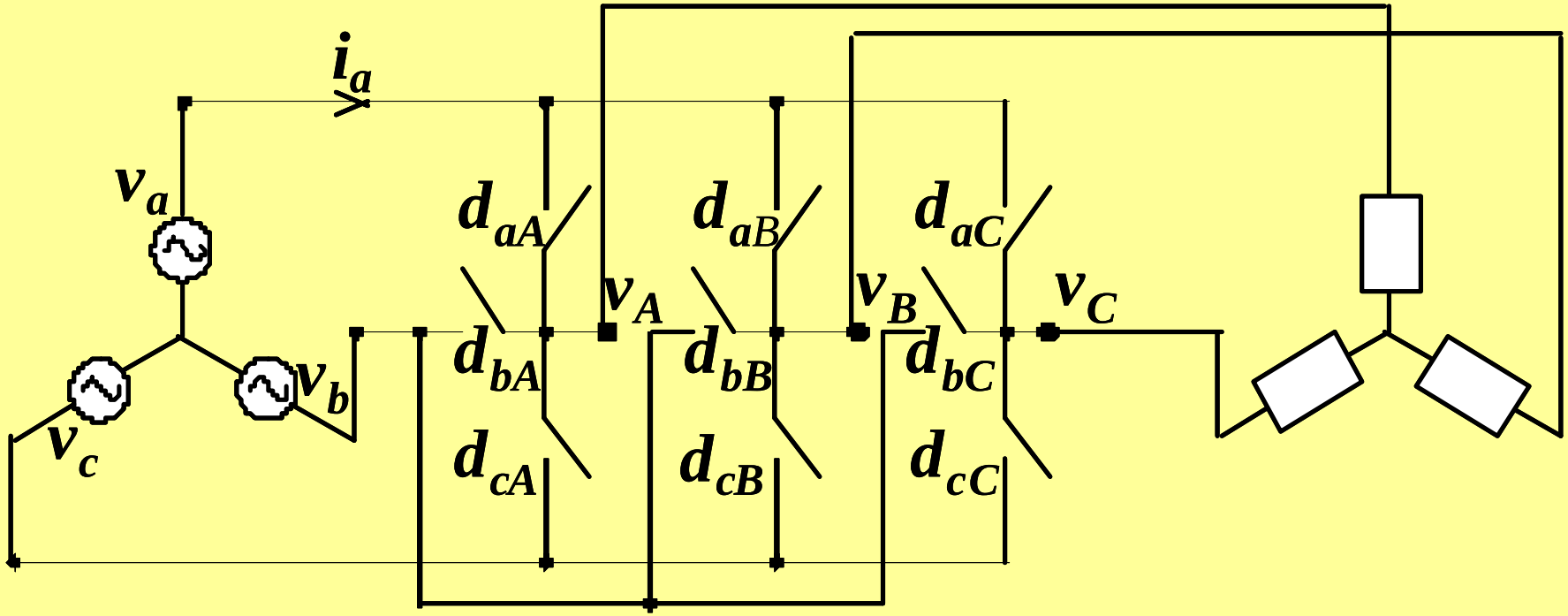
Voltage-Link System



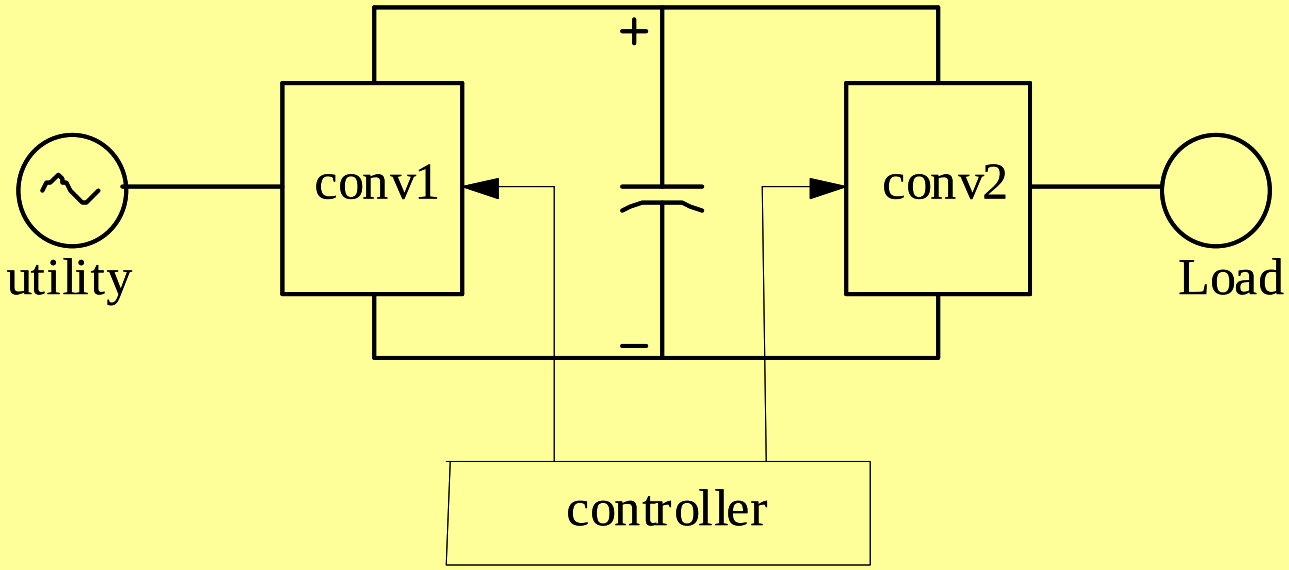
Current-Link System



Matrix Converter
(Direct-Link System)



Voltage-Link Systems

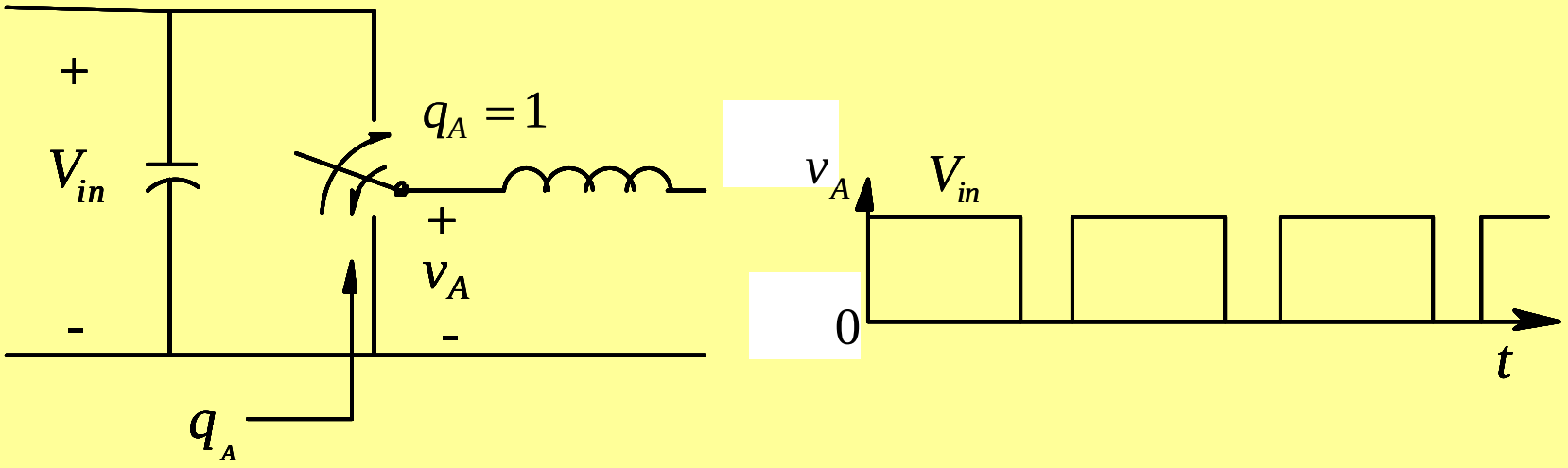


Characteristics:

- Unipolar voltage-handling transistors are needed
- Decoupling of two converters
- Immunity from momentary input power interruptions

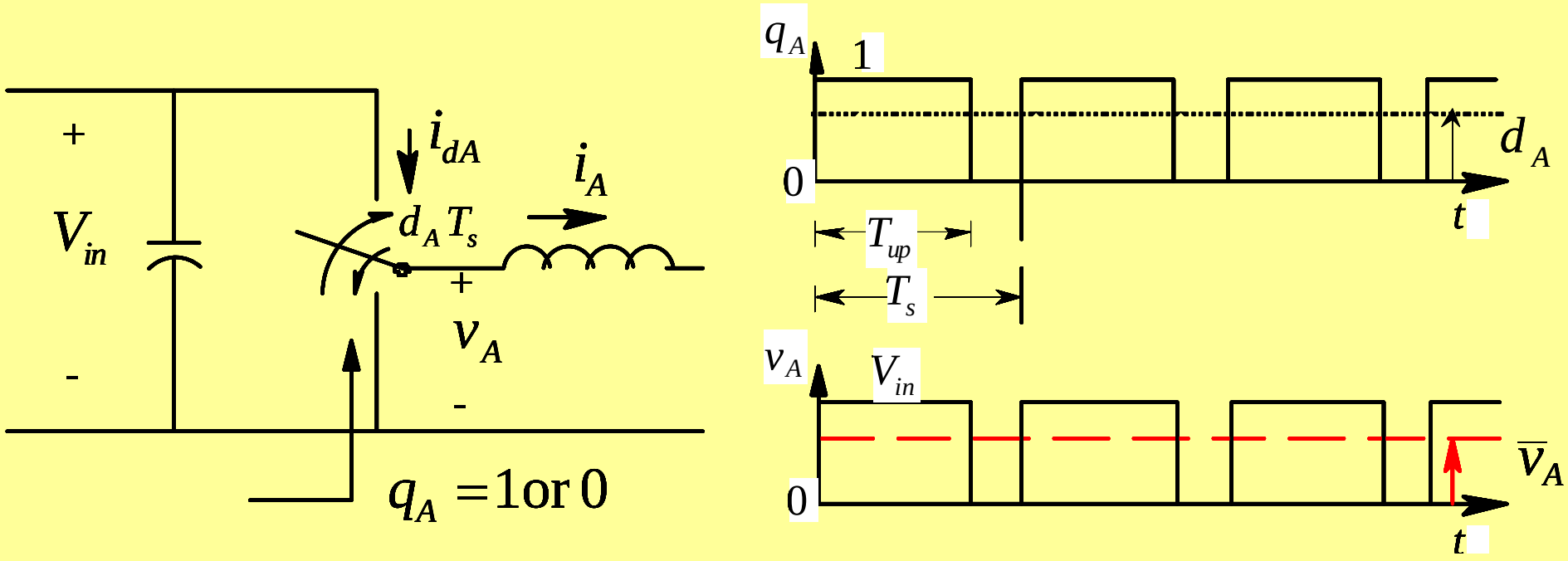
Voltage-Link Systems

- Switching Power-Pole as the basic building-block

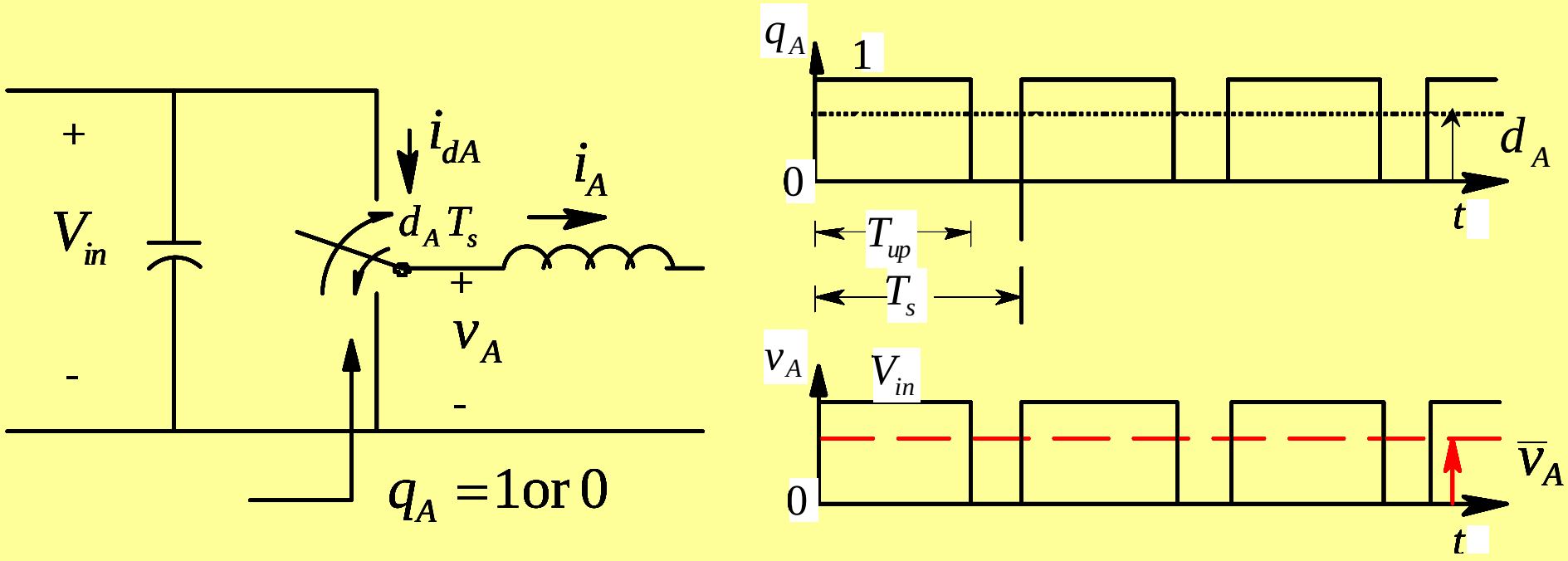


- Voltage Port
- Current Port
- Bi-Positional Switch

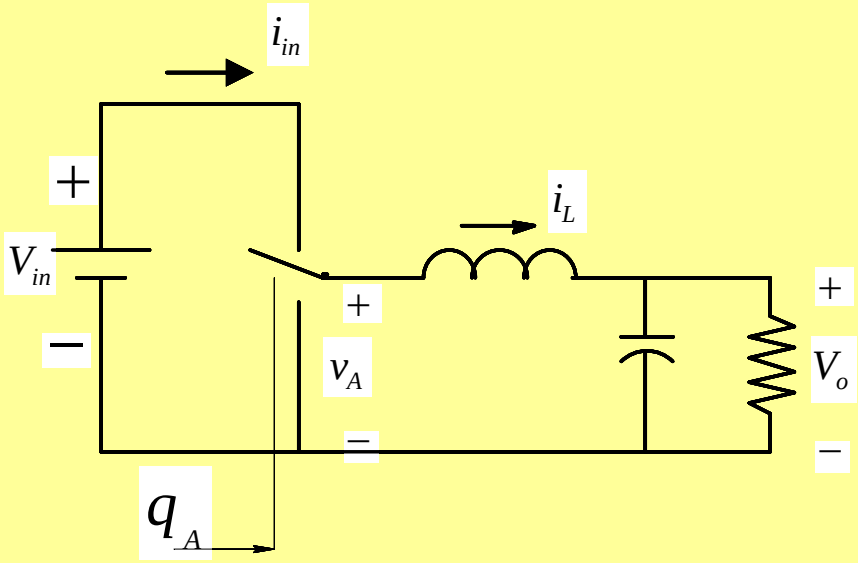
Control by Pulse-Width Modulation (PWM)



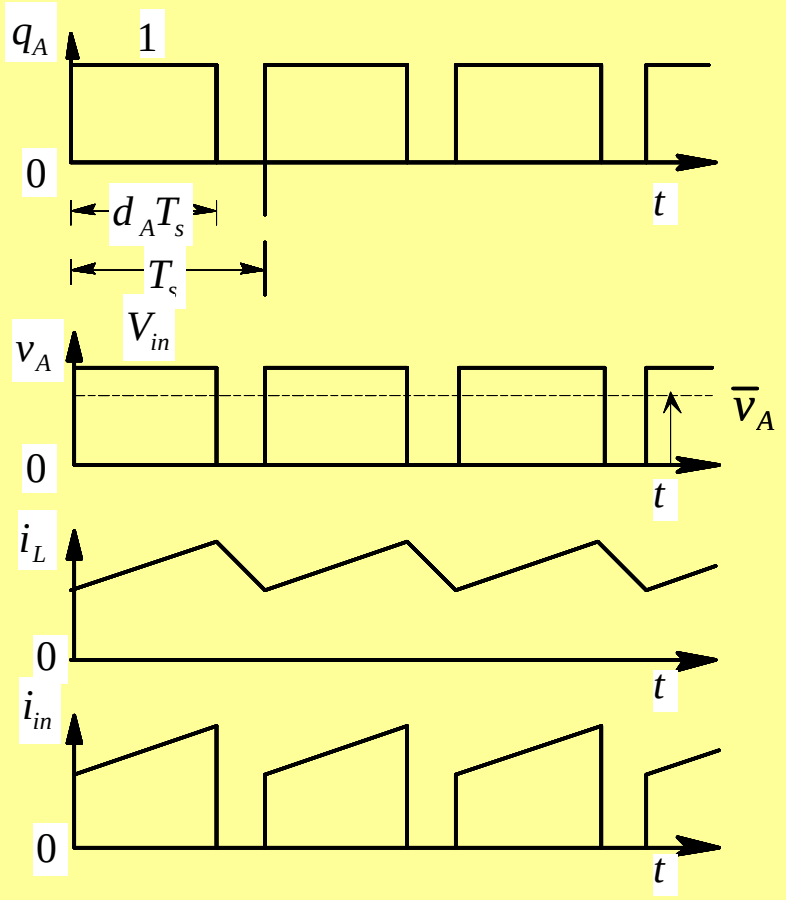
Control by Pulse-Width Modulation (PWM)



Switching Power-Pole in a Buck DC-DC Converter: An Example



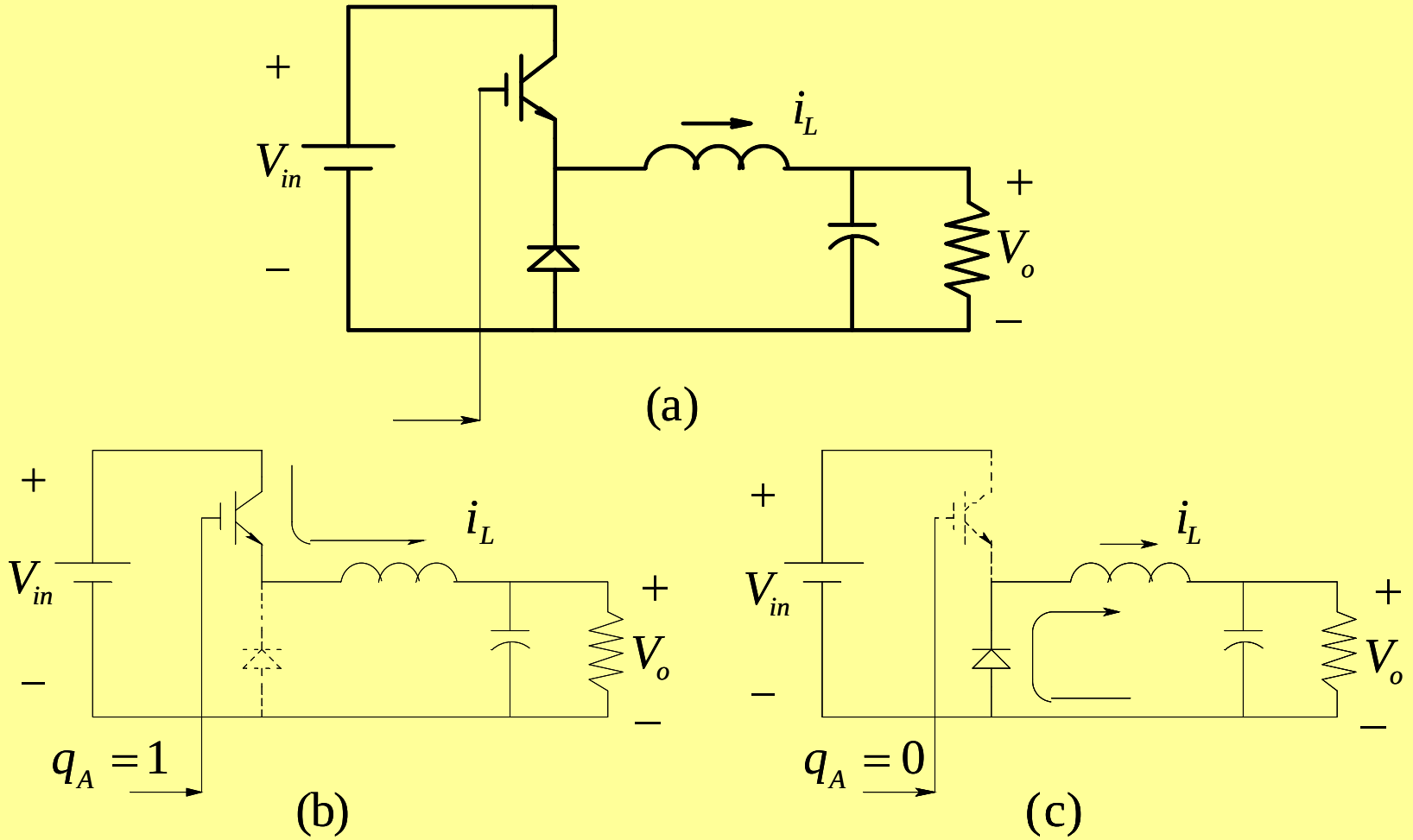
(a)



(b)

$$V_o = \overline{v}_A = d_A V_{in} \qquad 0 \le V_o \le V_{in}$$

Transistor and diode forming a switching power-pole in a Buck converter



RECENT AND POTENTIAL ADVANCEMENTS in Power Electronics

- Devices that can handle voltages in kVs and currents in kAs
- ASICs
- DSPs
- Micro-controllers
- FPGA
- Integrated and intelligent power modules
- Packaging
- SiC-based solid-state devices
- High energy density capacitors

Summary

- Basic Building-Block of Power Electronic Converters
  - Types of Structures
  - Basic Building-Block in Voltage-Link Structures
    - Switching Power-Pole
      - Control by Pulse-Width-Modulation (PWM)
- Recent and Potential Advancements in Power Electronics