

## **Chapter 8**

### **SWITCH-MODE DC POWER SUPPLIES**

- 8-1 Applications of Switch-Mode DC Power Supplies
- 8-2 Need for Electrical Isolation
- 8-3 Classification of Transformer-Isolated DC-DC Converters
- 8-4 Flyback Converters
- 8-5 Forward Converters
- 8-6 Full-Bridge Converters
- 8-7 Half-Bridge and Push-Pull Converters
- 8-8 Practical Considerations
- References
- Problems

# SWITCH-MODE DC POWER SUPPLIES

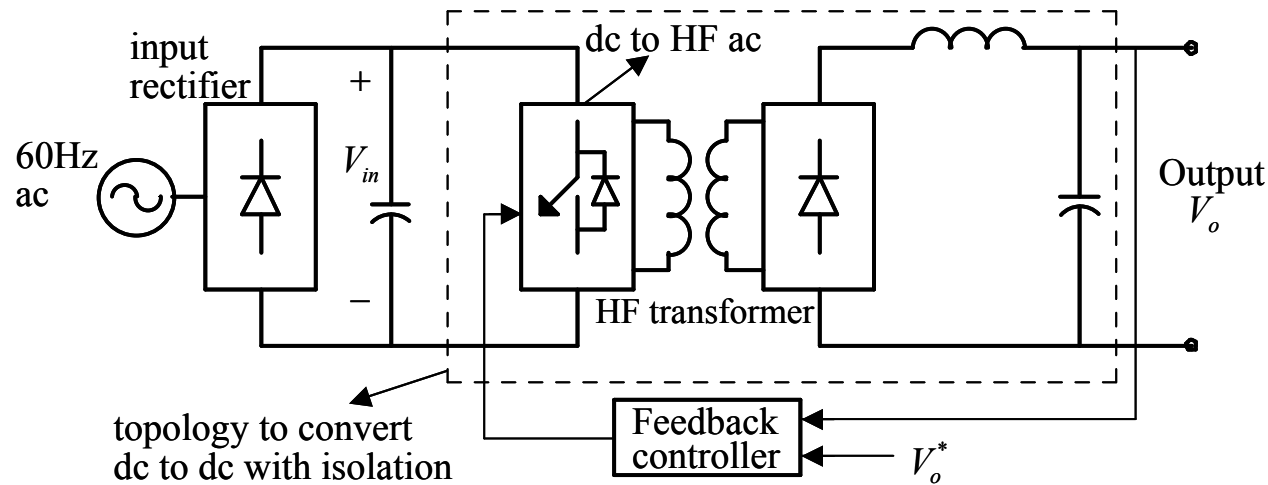


Figure 8-1 Block diagram of switch-mode dc power supplies.

- **NEED FOR ELECTRICAL ISOLATION**

# CLASSIFICATION

- Flyback converters derived from Buck-Boost dc-dc converters
- Forward converter derived from Buck dc-dc converters
- Full-Bridge and Half-Bridge converters derived from Buck dc-dc converters

# FLYBACK CONVERTERS

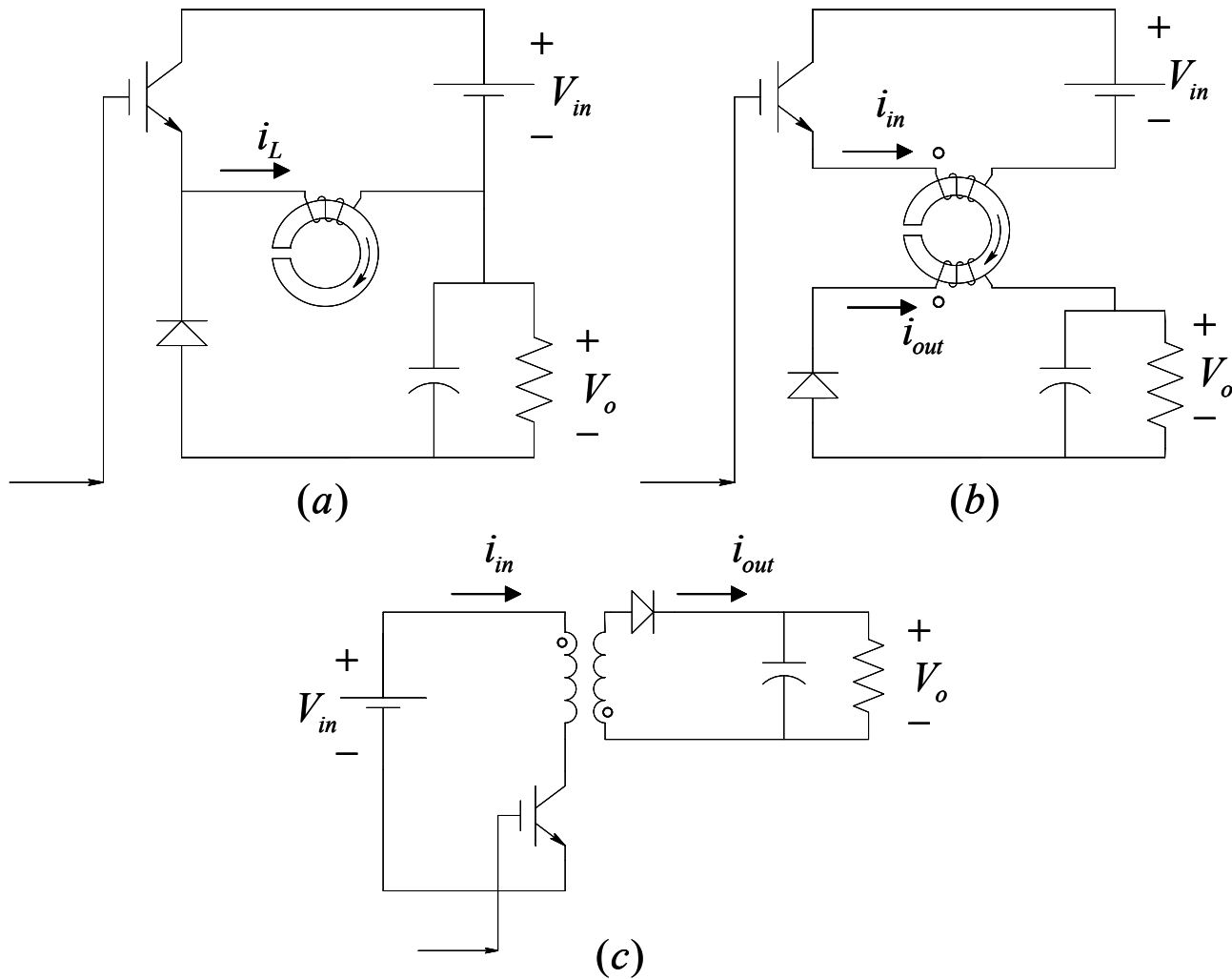


Figure 8-2 Buck-Boost and the Flyback converters.

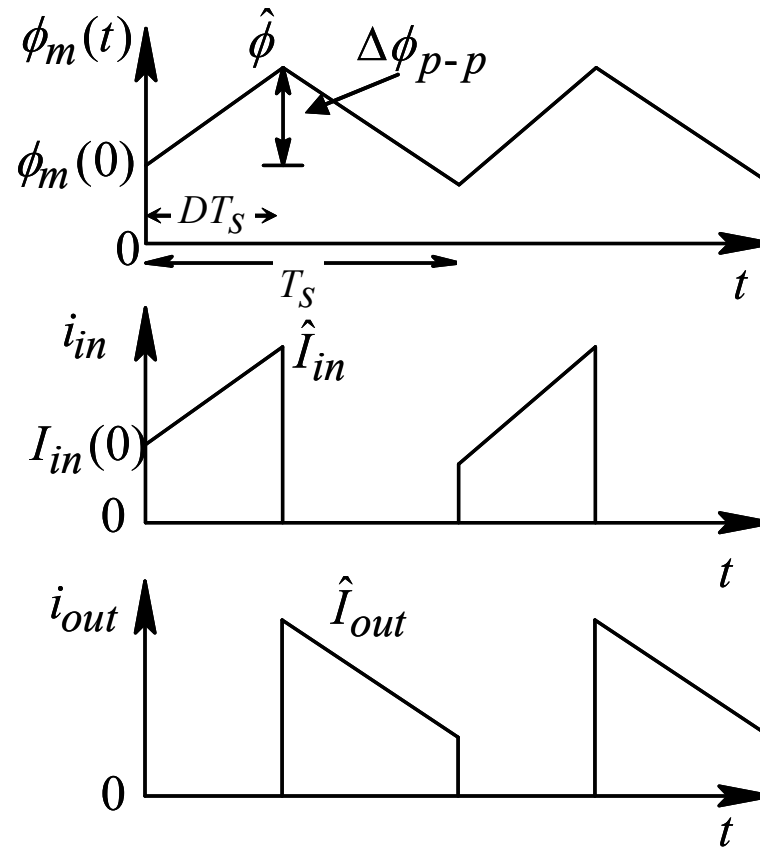
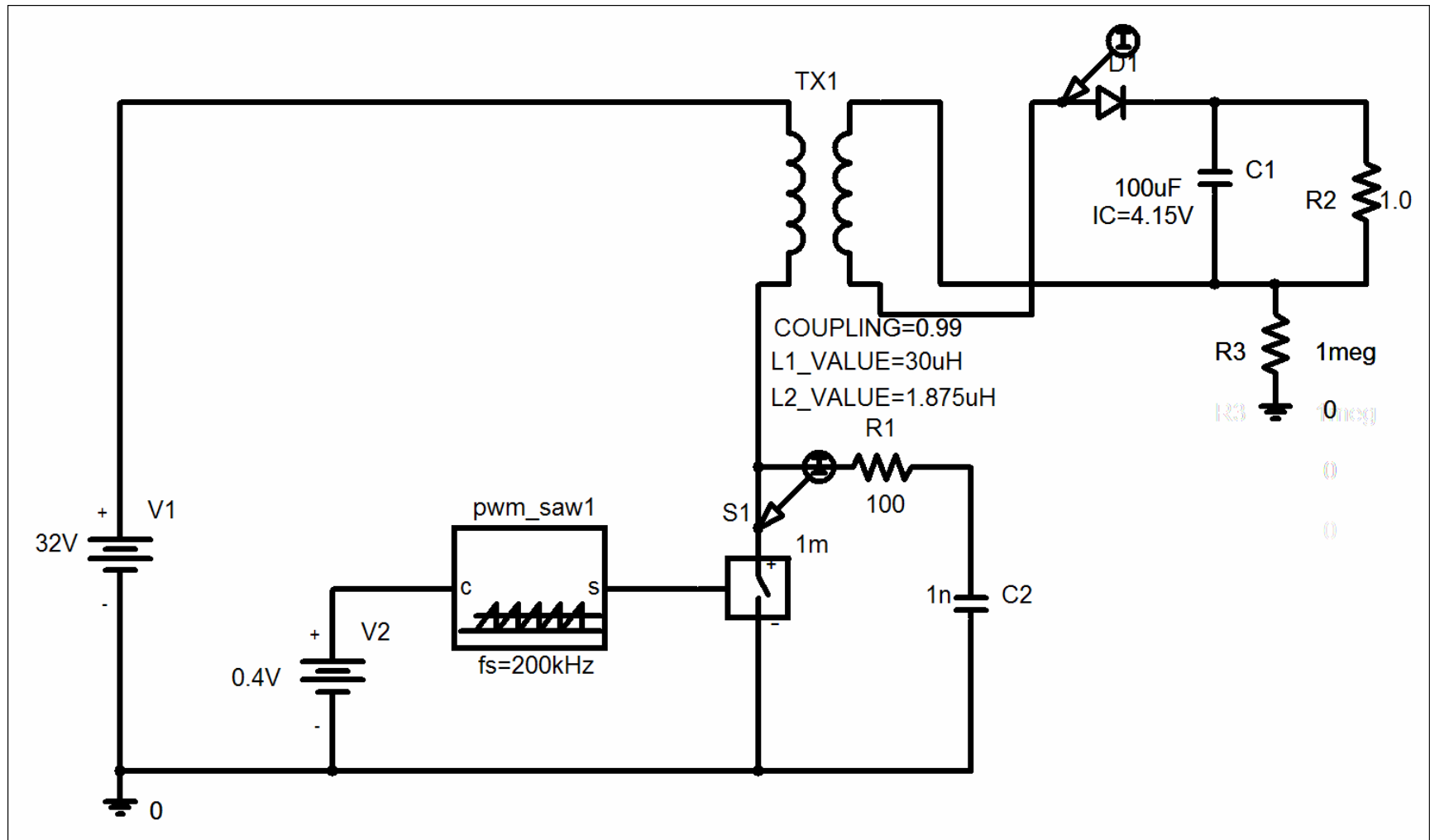


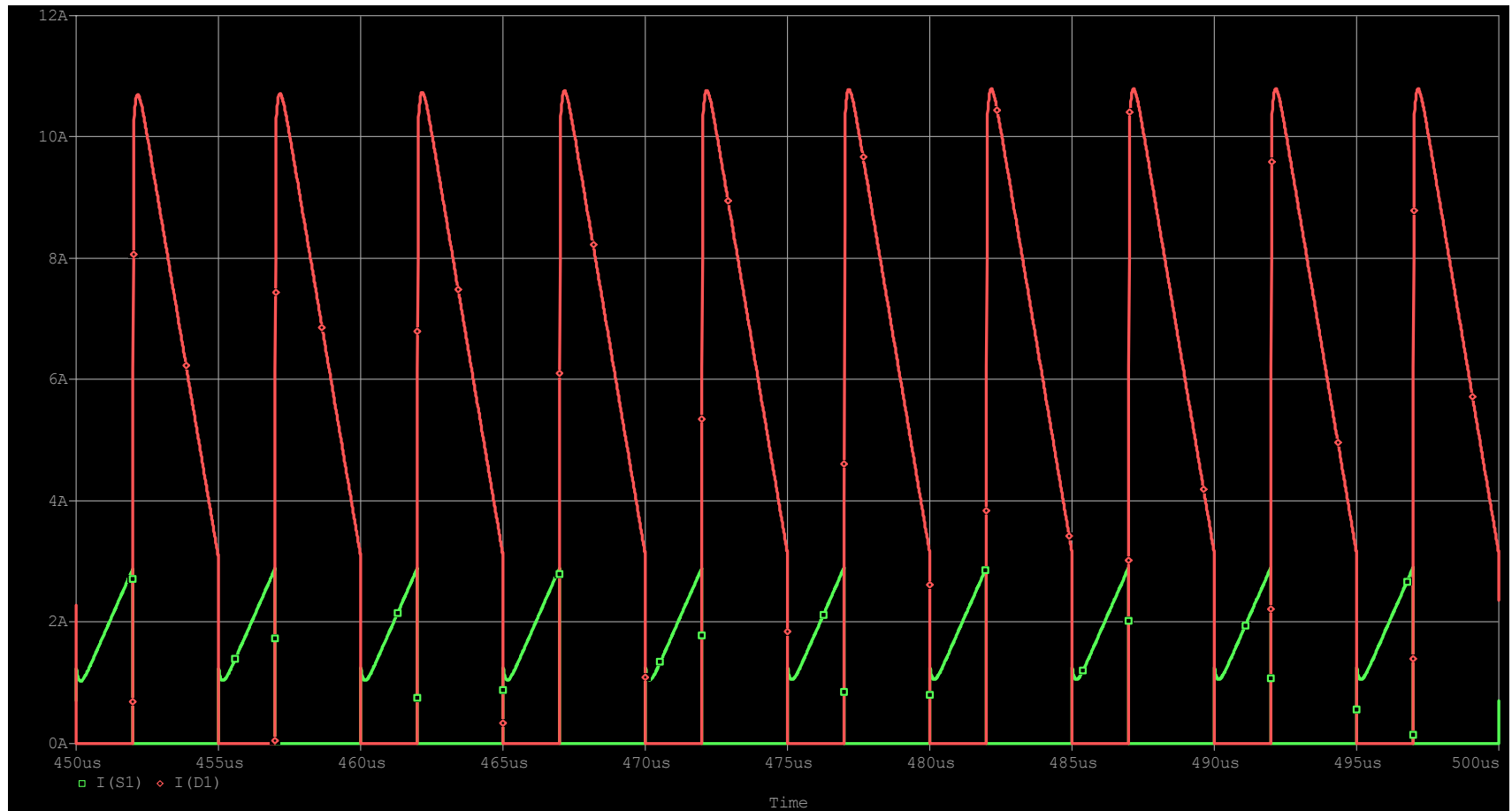
Figure 8-3 Flyback converter waveforms.

$$\Delta\phi_{p-p} = \frac{V_{in}}{N_1} DT_s = \frac{V_o}{N_2} (1-D) T_s \quad \Rightarrow \quad \frac{V_o}{V_{in}} = \left( \frac{N_2}{N_1} \right) \frac{D}{1-D}$$

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## Simulation Results



# FORWARD CONVERTERS

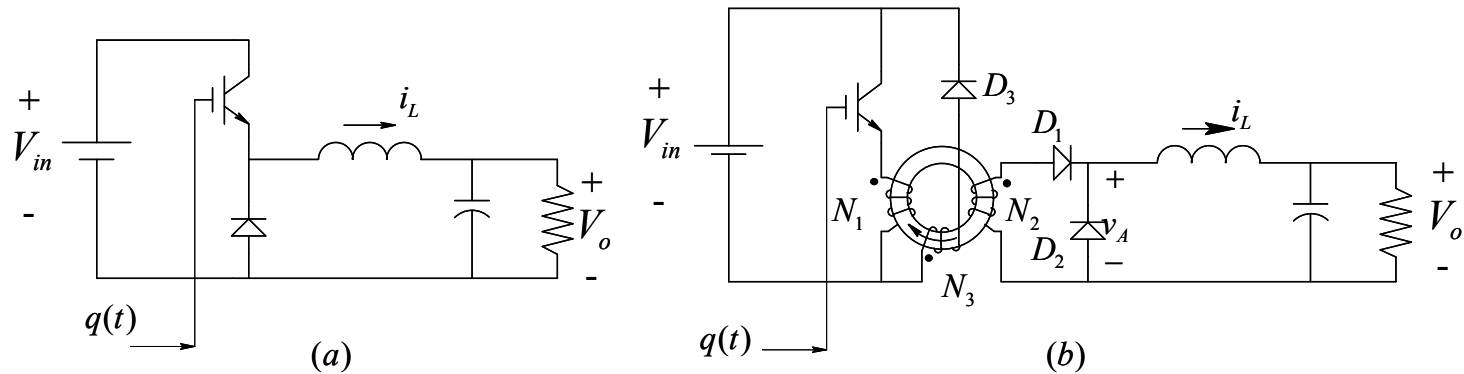


Figure 8-4 Buck and Forward converters.

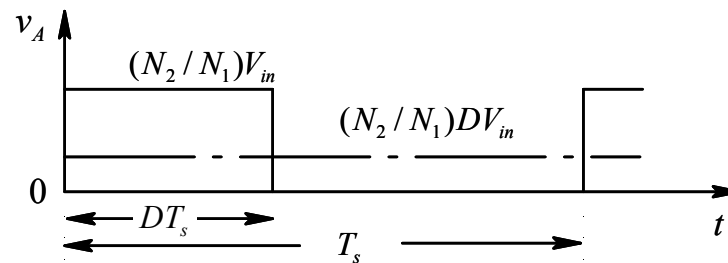


Figure 8-5 Forward converter operation.

$$V_o = \left( \frac{N_2}{N_1} \right) D V_{in}$$



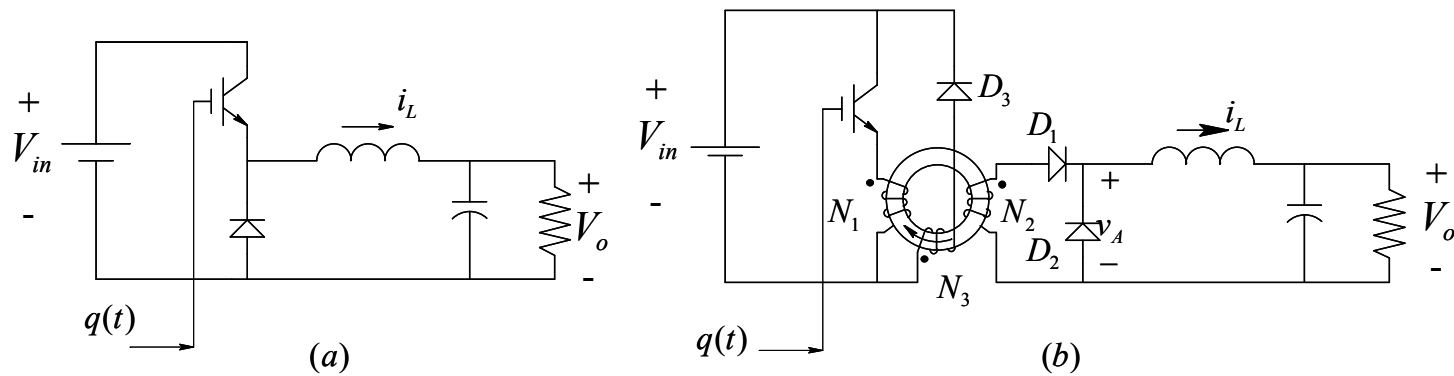


Figure 8-4 Buck and Forward converters.

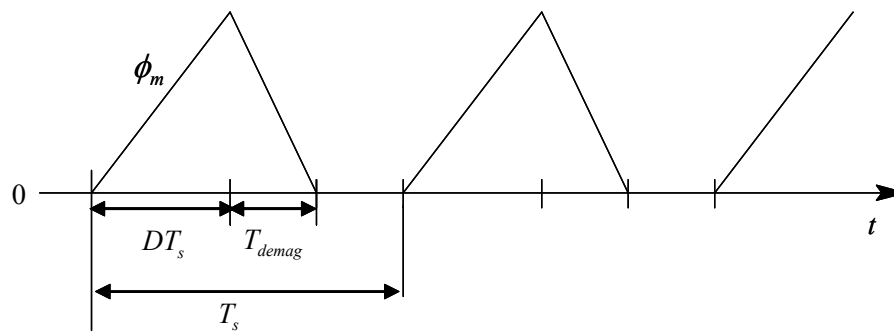
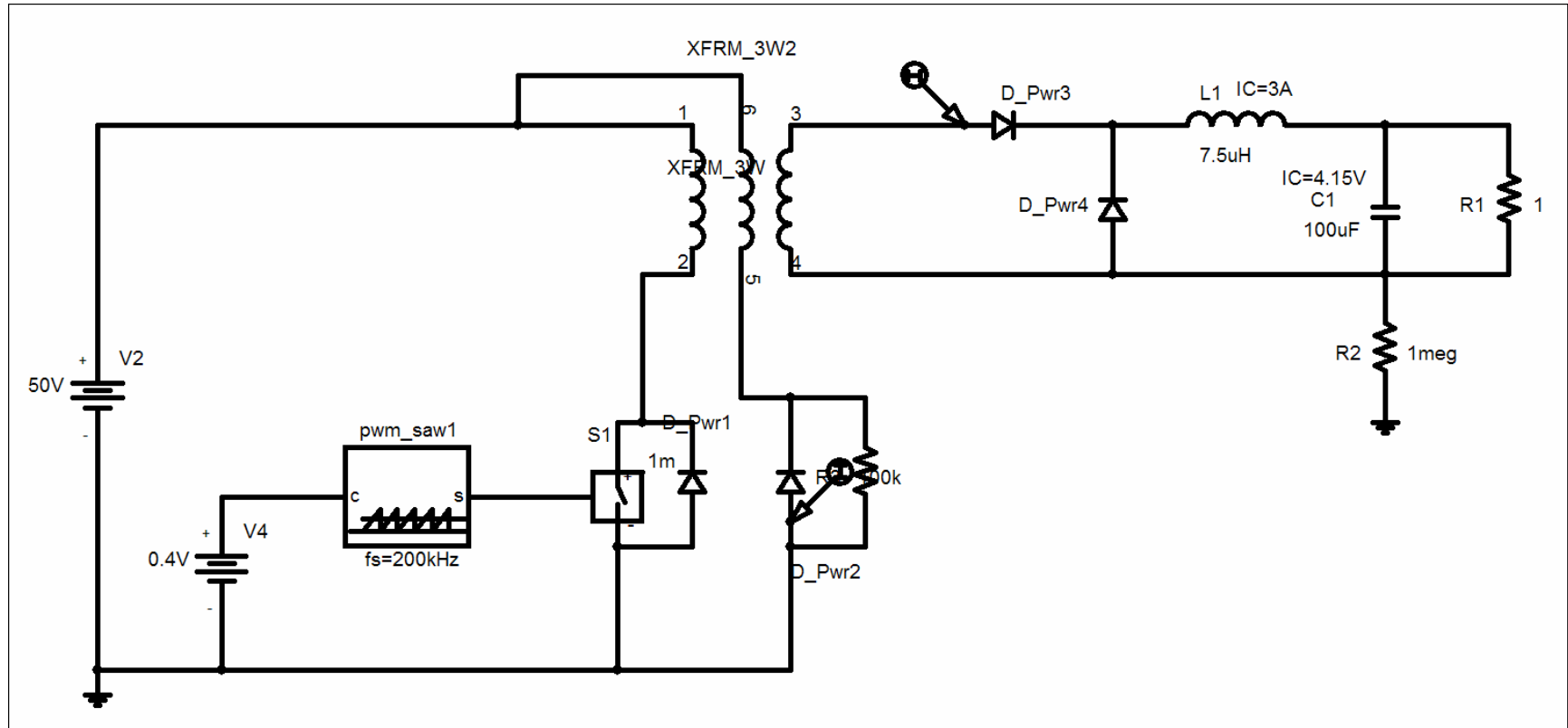
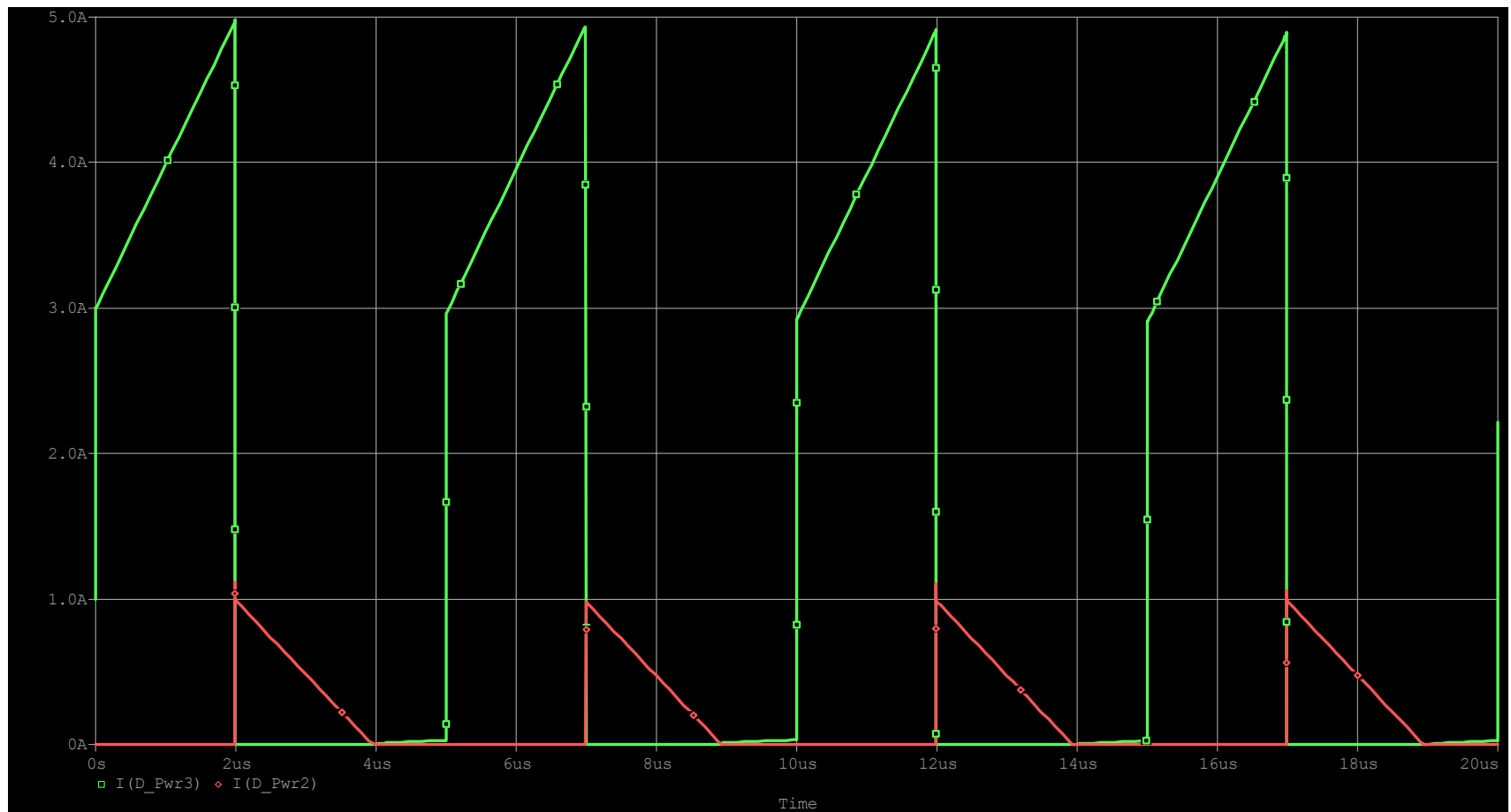


Fig. 8-6 Forward converter core flux.

# PSpice Modeling: C:\FirstCourse\_PE\_Book03\forward.sch



# Simulation Results



## Two-Switch Forward Converters

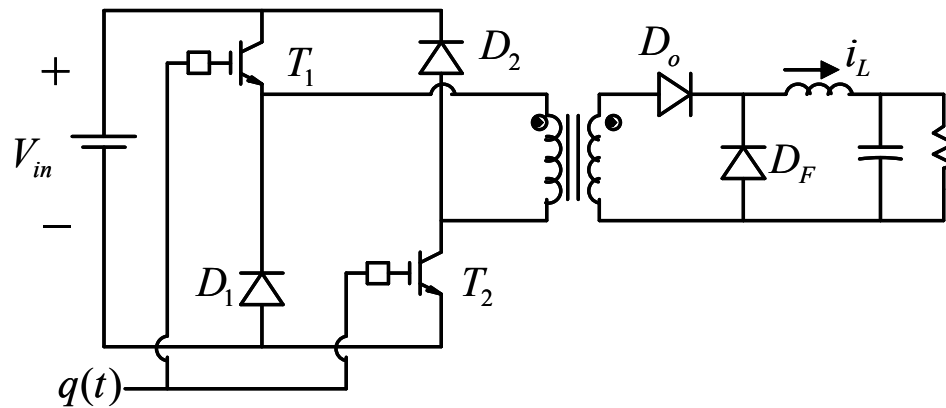


Figure 8-7 Two-switch Forward converter.

# FULL-BRIDGE CONVERTERS

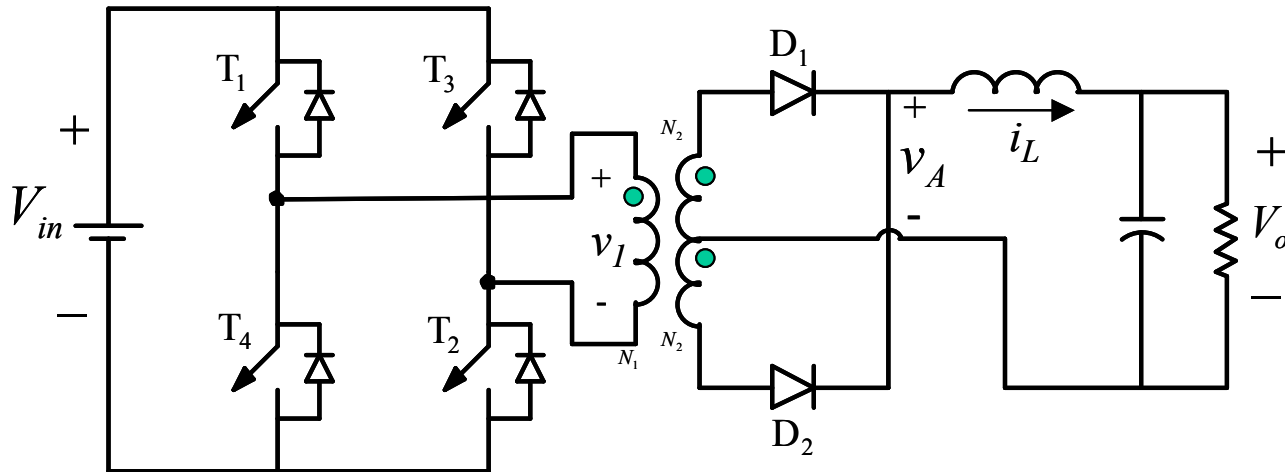


Figure 8-8 Full-Bridge converter.

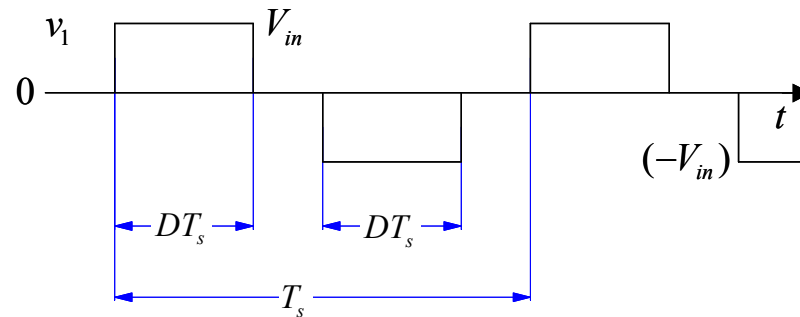


Figure 8-9 Full-Bridge converter waveforms.

- Pulse-Width Modulated (PWM), and
- Phase-Shift Modulated (PSM)

# PWM Control

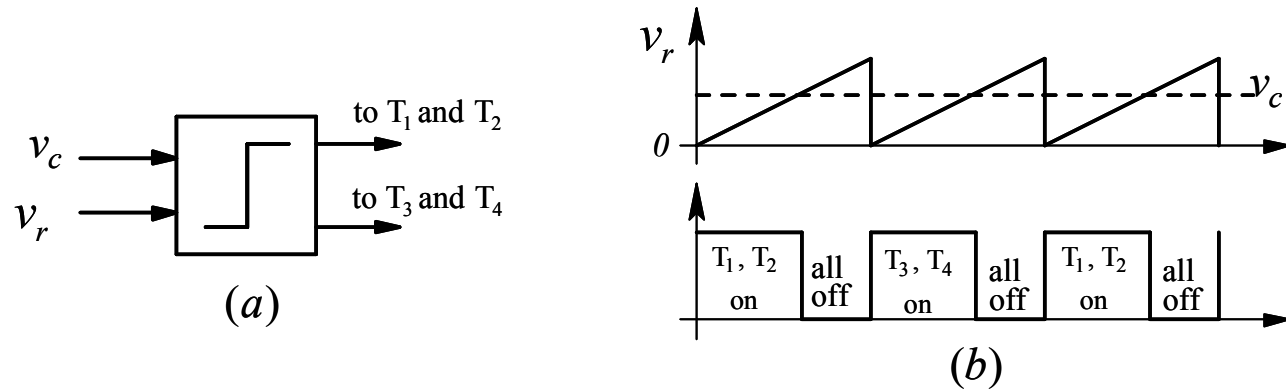


Figure 8-10 PWM-IC and control signals for transistors.

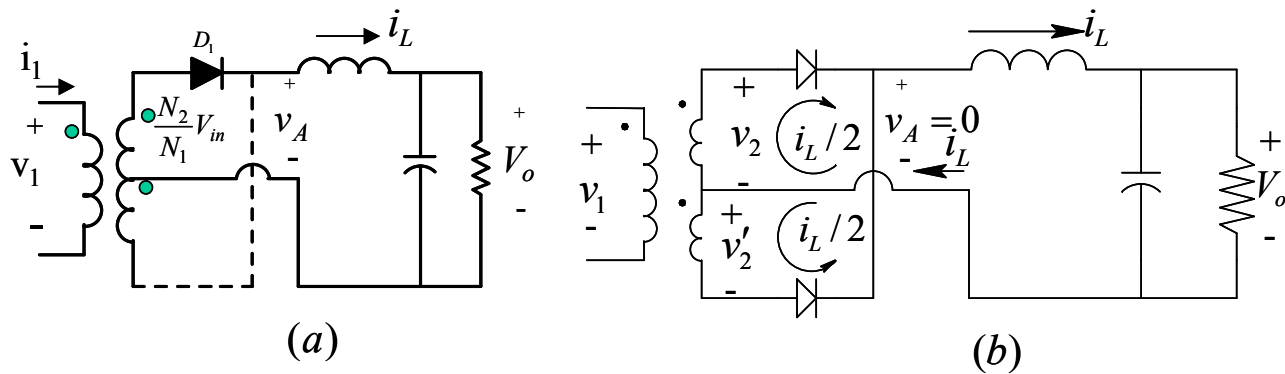


Figure 8-11 Full-Bridge: sub-circuits.

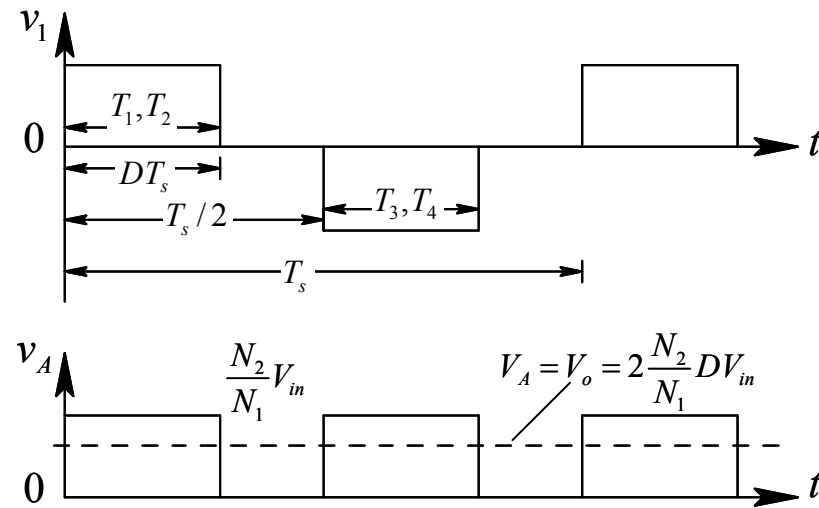
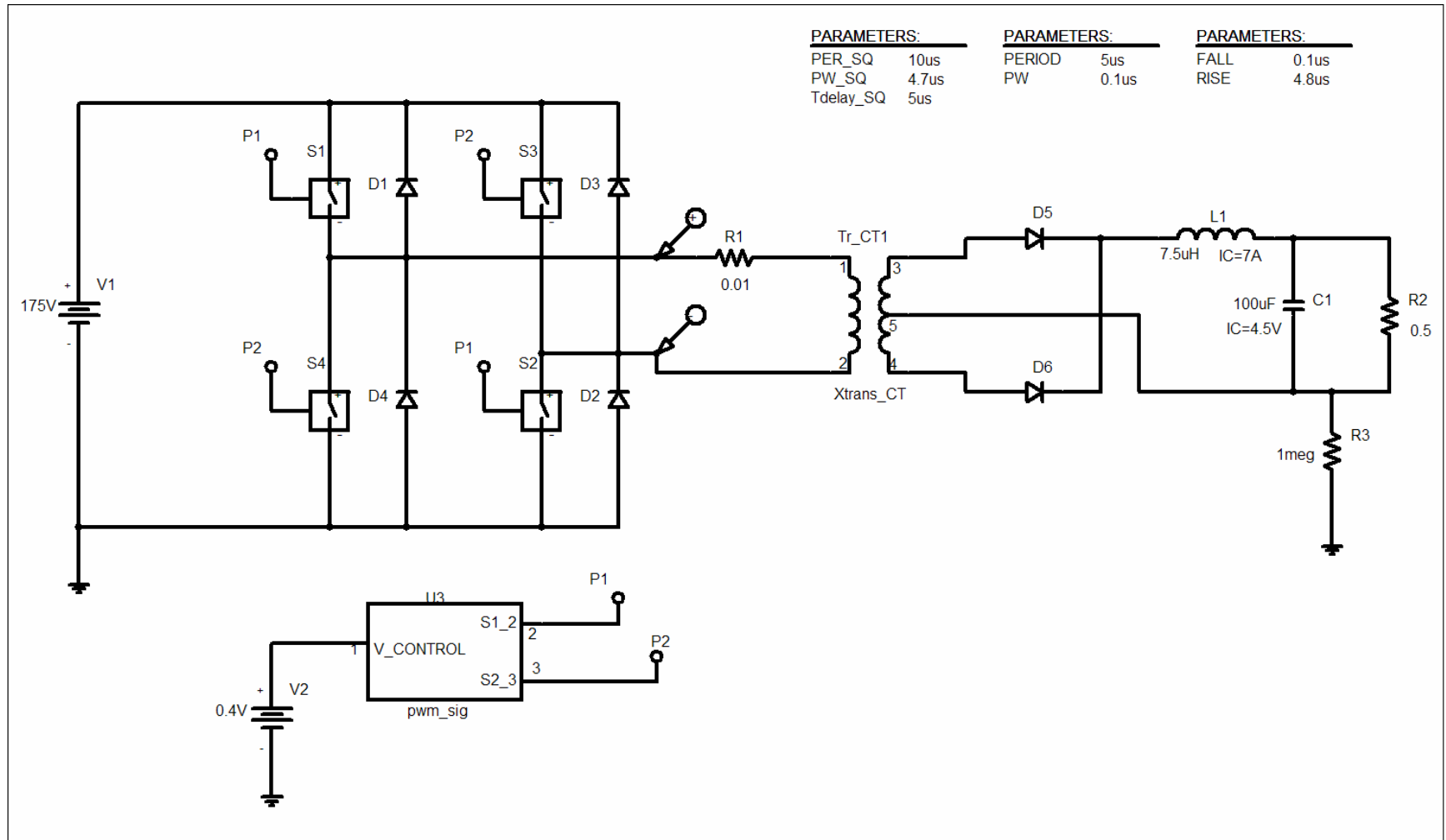


Figure 8-12 Full-Bridge converter waveforms.

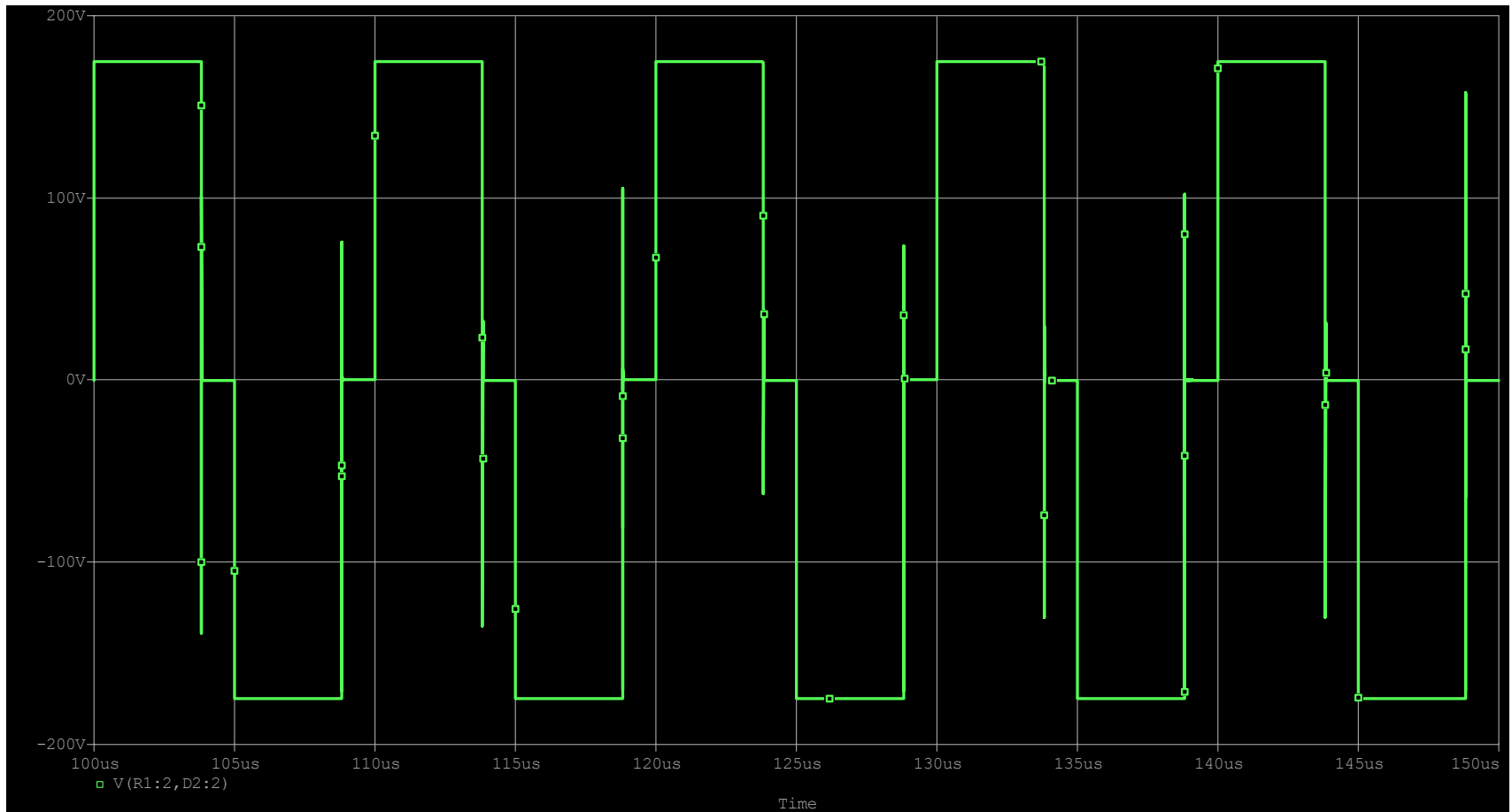
$$\frac{V_o}{V_{in}} = 2 \left( \frac{N_2}{N_1} \right) D$$

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## Simulation Results



# Half-Bridge and Push-Pull Converters

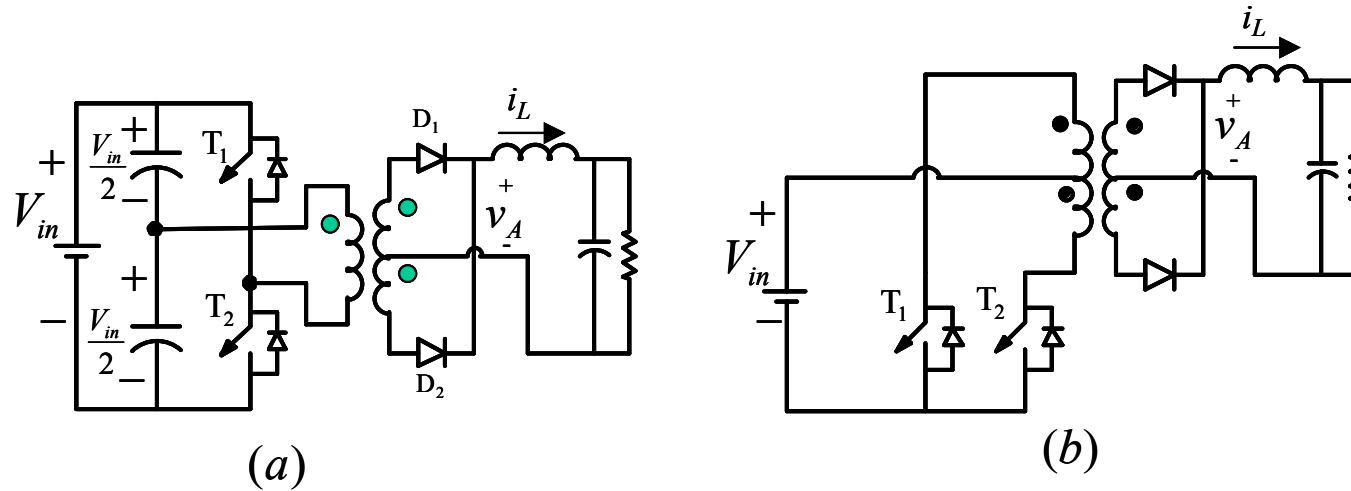


Figure 8-13 Half-Bridge and Push-Pull converters.