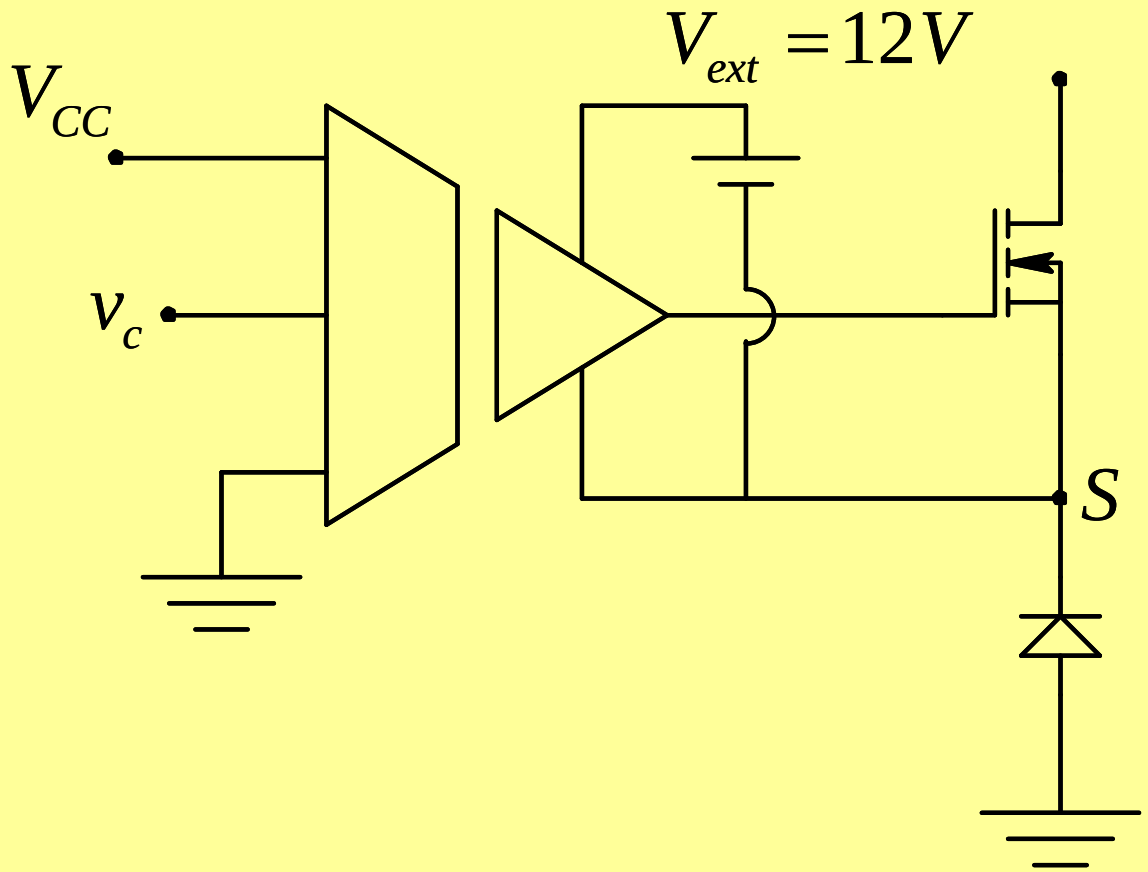
Practical Considerations in Implementing Switching Power-Poles

- Gate Driver ICs
- Design Considerations
  - Thermal Considerations
  - Magnetic Components
  - Capacitors
  - Selection of Switching Frequency
- Diode Reverse Recovery Characteristic
  - Conduction Losses
  - Increase in Switching Losses

Gate Driver Integrated Circuits (ICs) with Built-in Fault Protection



DESIGN CONSIDERATIONS

- **Switching Frequency**
- **Selection of Transistors and Diodes**
- **Magnetic components**
- **Capacitor Selection**

$$A_p = \frac{L\hat{I}I_{rms}}{k_w J_{\max} B_{\max}} \qquad A_p = \frac{k_{conv} \sum V_y I_{y,rms}}{k_w B_{\max} J_{\max} f_s}$$

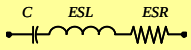
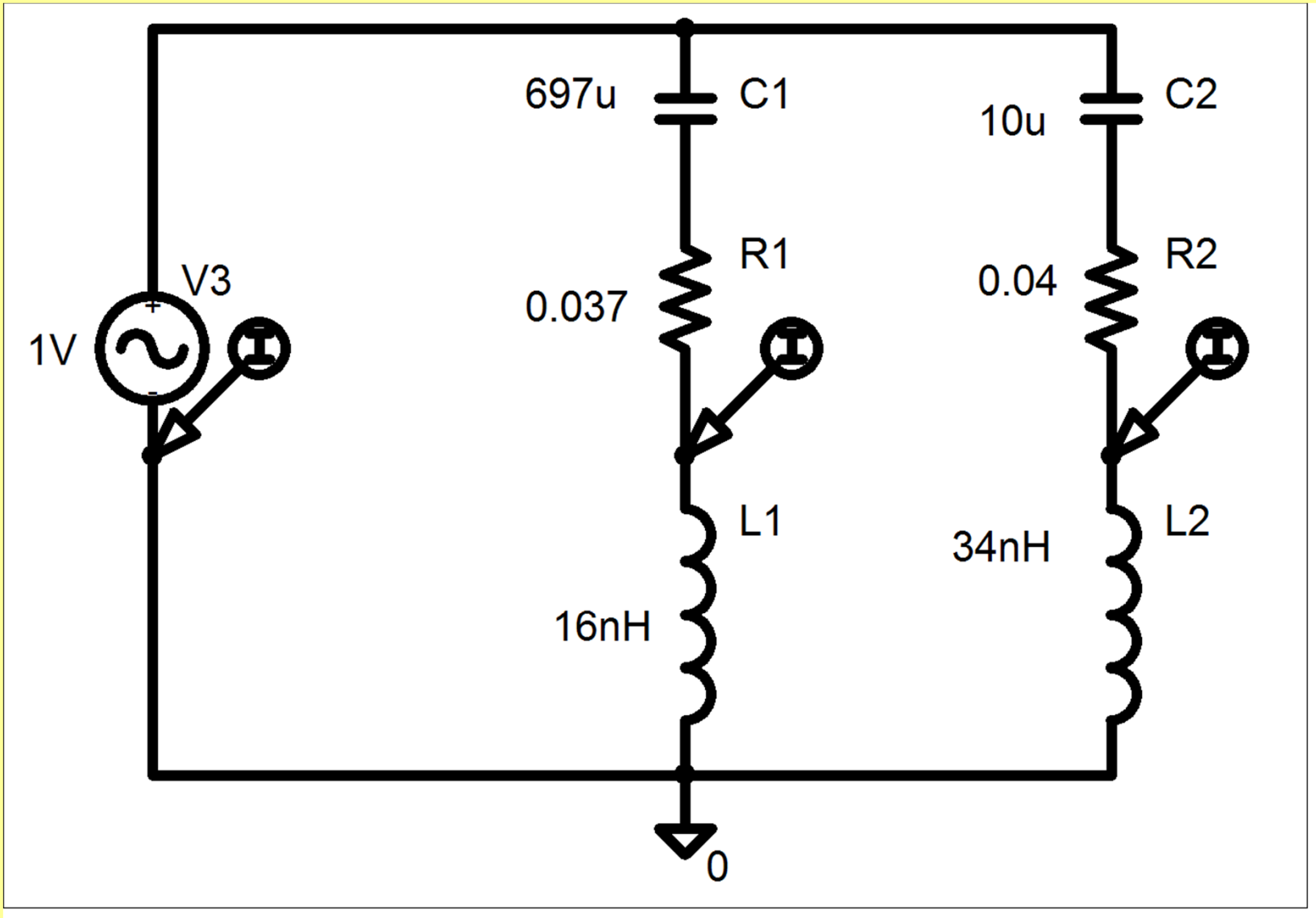
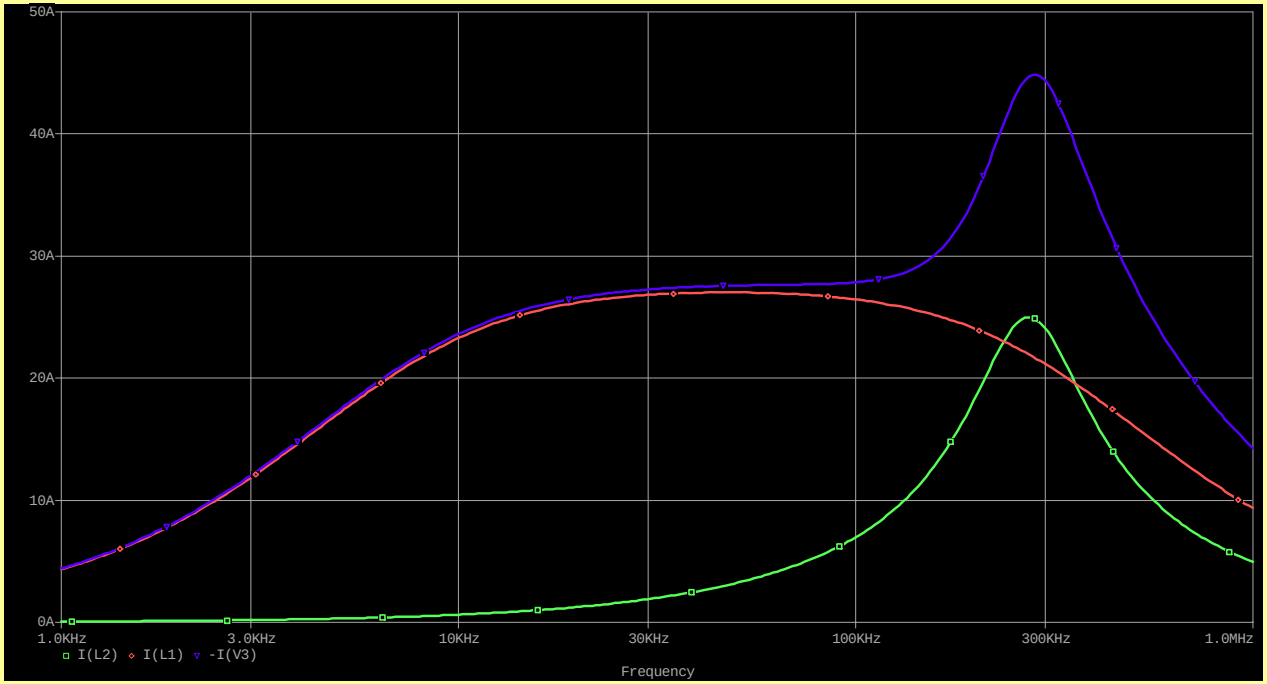


Figure 2-10 Capacitor ESR and ESL.

PSpice Modeling:

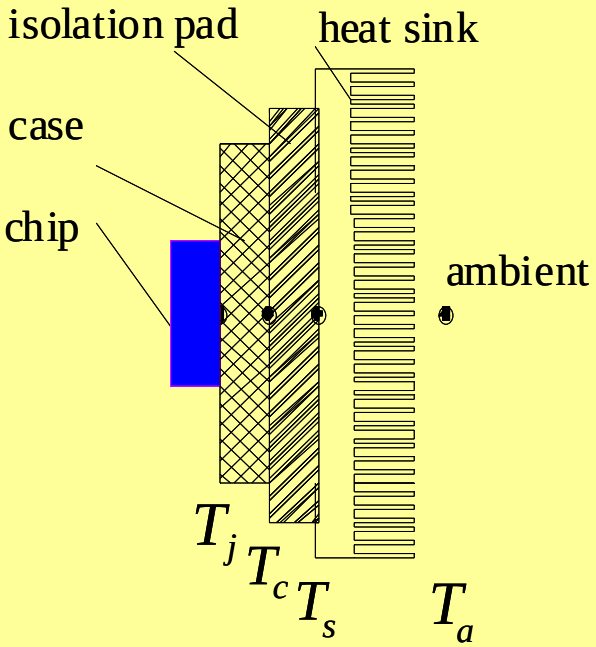


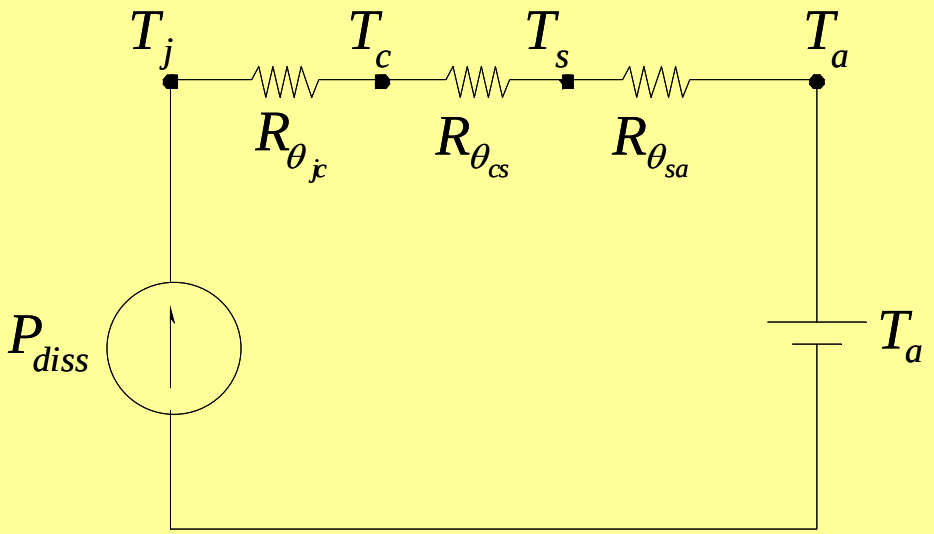
Simulation Results: Individual and Total Admittances



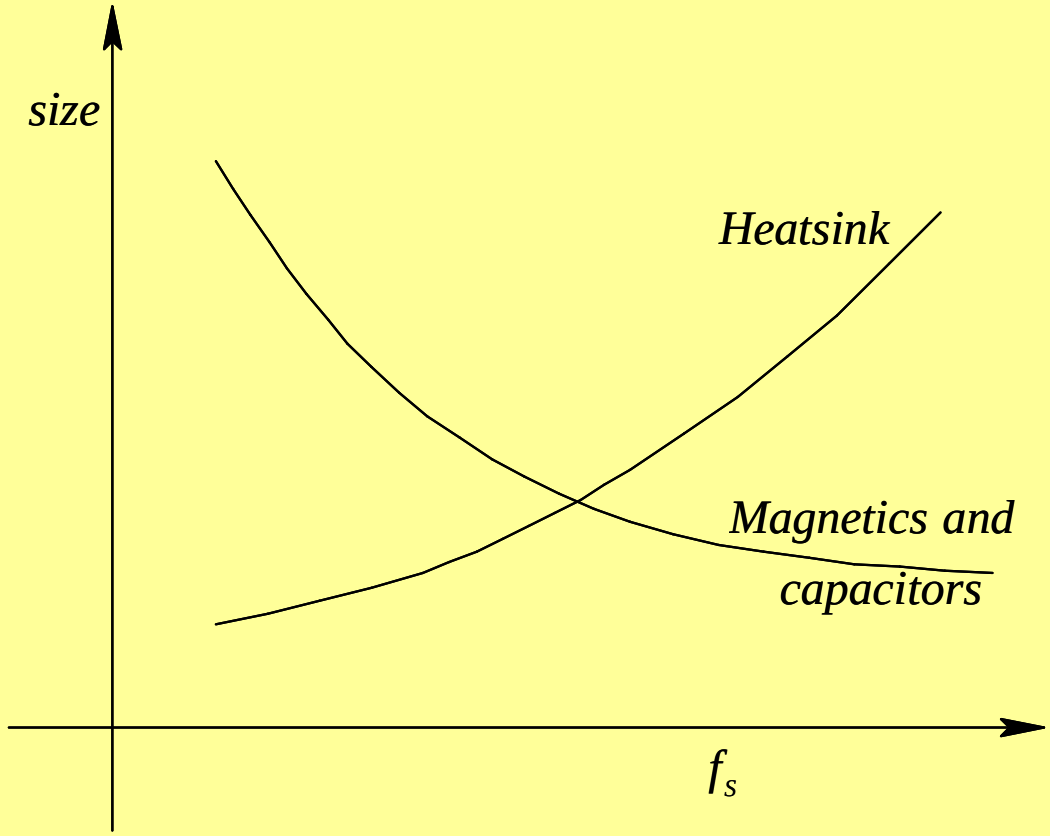
Thermal Design

$$T_j = T_a + (R_{\theta jc} + R_{\theta cs} + R_{\theta sa})P_{diss}$$





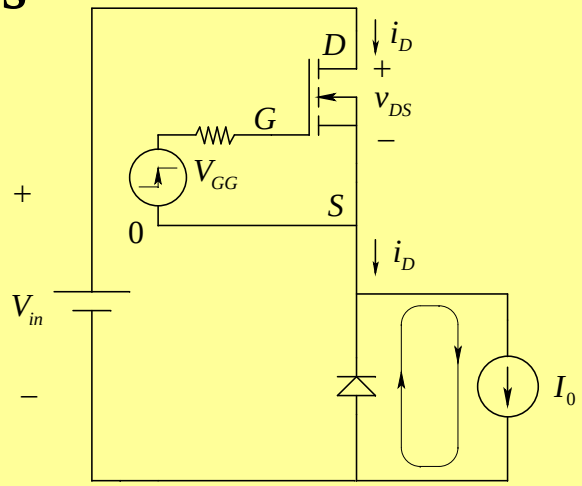
Design Tradeoffs



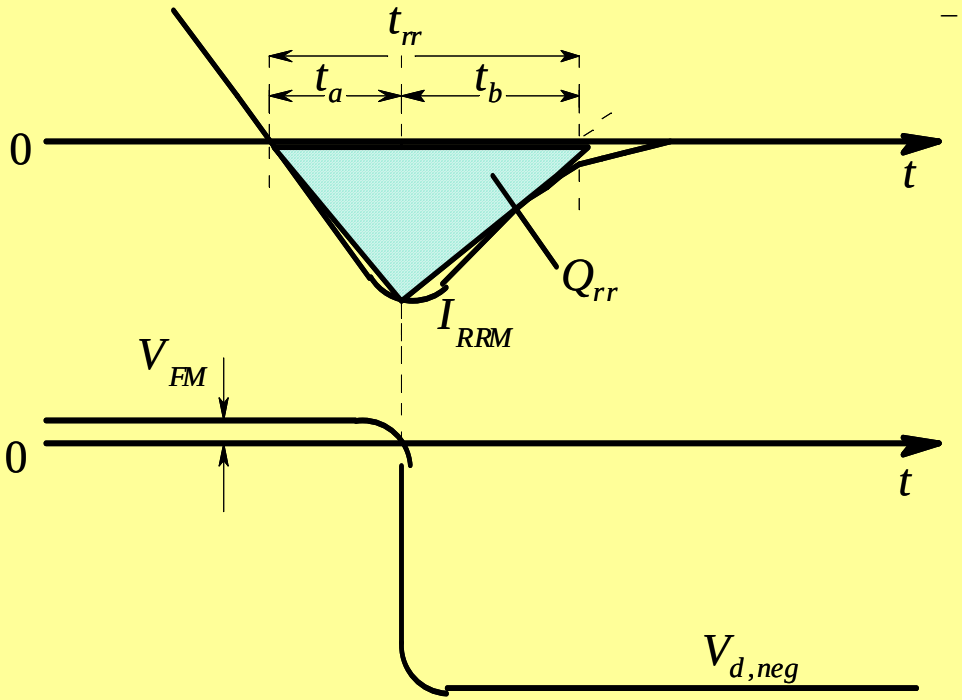
Size of magnetic components and heat sink as a function of switching frequency

Diode Reverse Recovery and Power Losses

Diode Forward Loss: $P_{diode,F} = (1-d)\cdot V_{FM} I_o$

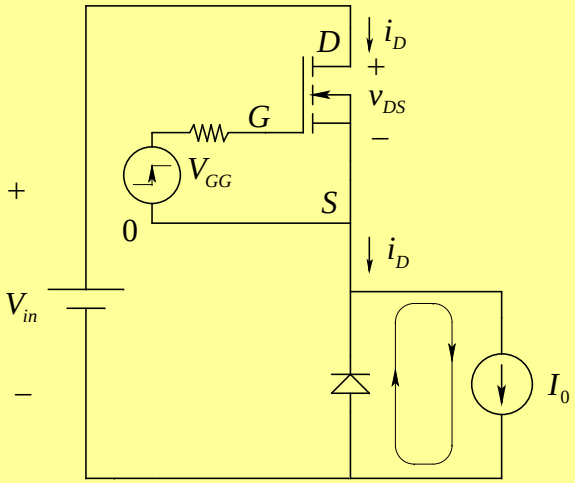


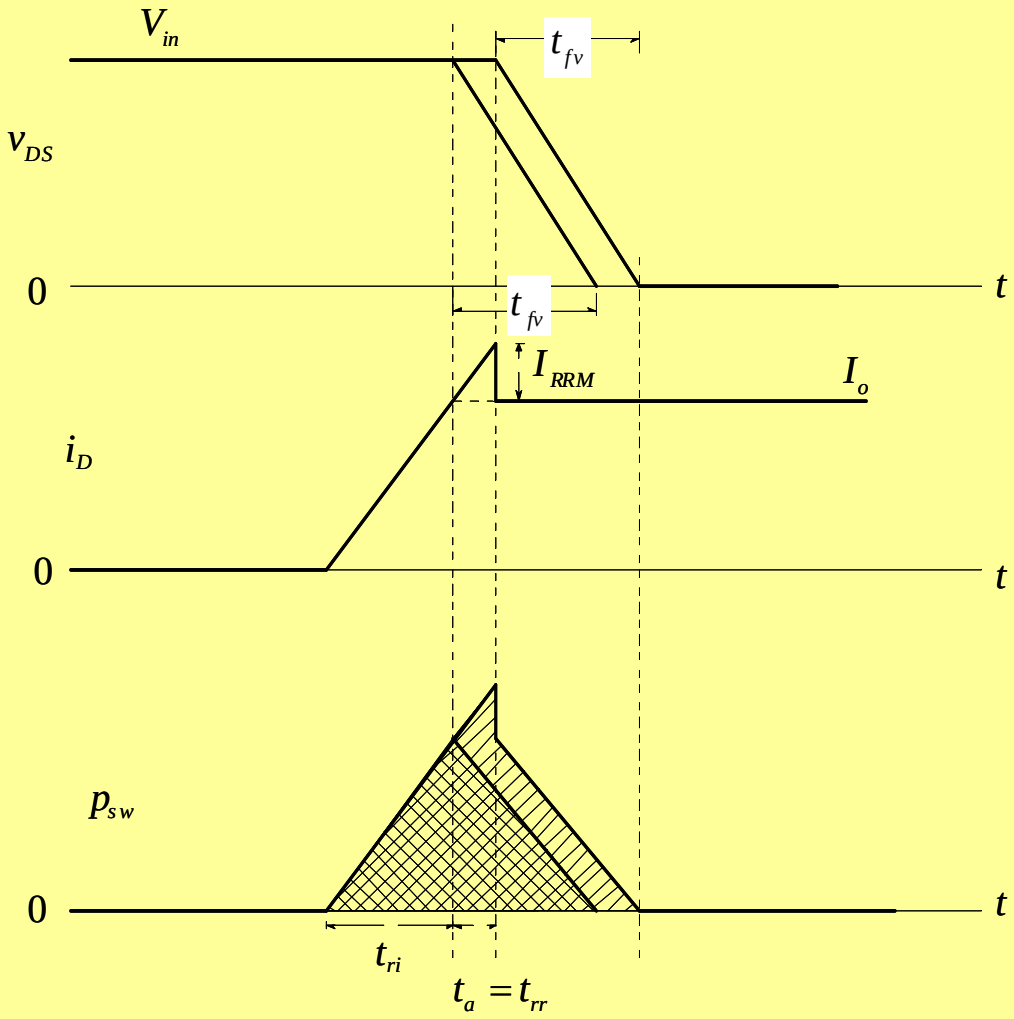
Diode Reverse Recovery Characteristic:



Diode Switching Losses: $P_{diode,sw} = (\frac{1}{2} I_{RRM} t_b)\cdot V_{d,neg} \cdot f_s$

Effect of Diode Reverse Recovery Current:





Summary

- Practical Implementation Considerations
  - Gate Driver ICs
  - Design Considerations
    - Thermal Considerations
    - Magnetic Components
    - Capacitors
    - Selection of Switching Frequency
  - Diode Reverse Recovery Characteristics
    - Conduction Losses
    - Increase in Switching Losses