Two-Stage Step-up Converter with Different Voltage Transformation Ratios depending on the Duty Cycle

Felix A. Himmelstoss, Helmut L. Votzi
University of Applied Sciences Technikum Wien

218-22

Introduction

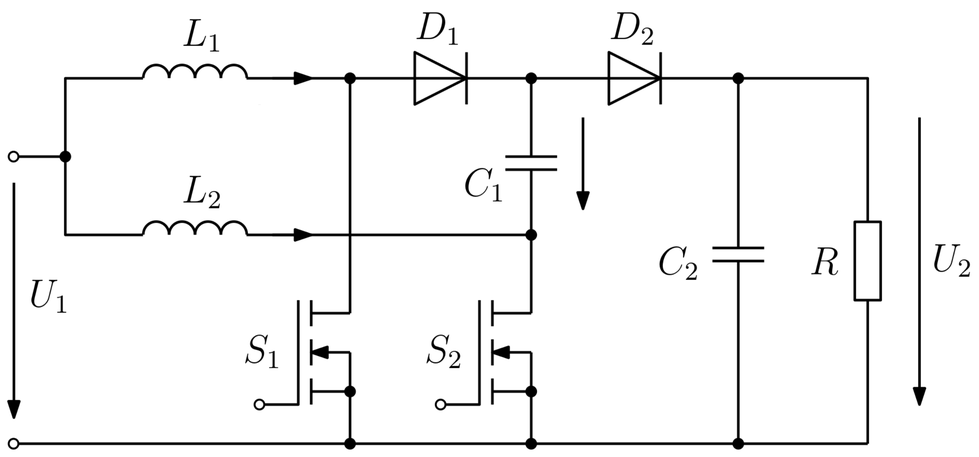
- two-stage converter
- high output voltage ratio
- reduced current stress of the inductors
- partly reduced voltage stress
- transformation ratio
  - d < 0.5 ⇨ quadratic step-up
  - d > 0.5 ⇨ double Boost converter

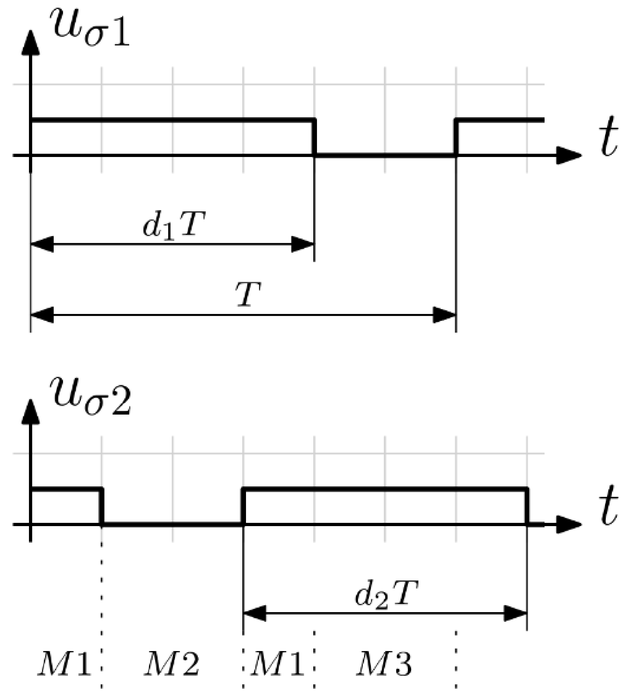
d > 0.5

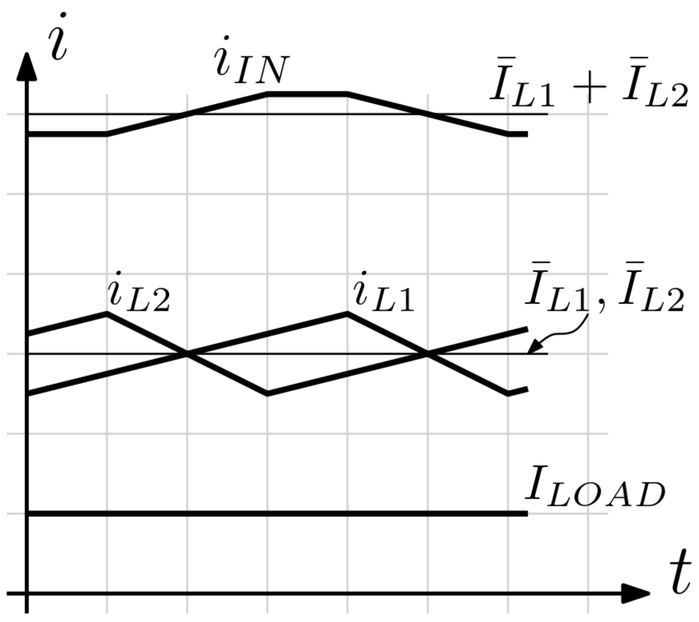
$$M = \frac{U_2}{U_1} = \frac{2}{1-d}$$

d < 0.5

$$M = \frac{U_2}{U_1} = \frac{1}{(1-d)^2}$$





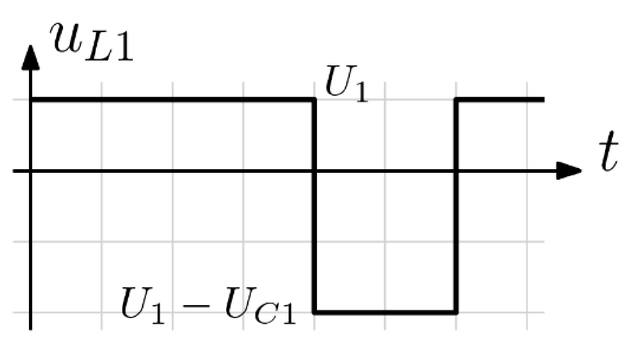


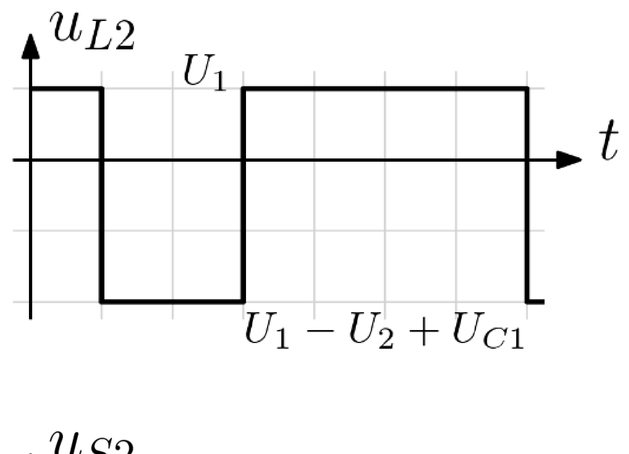
$$L = U_1 \frac{U_2 - 2U_1}{U_2 \cdot \Delta I_L \cdot f}$$

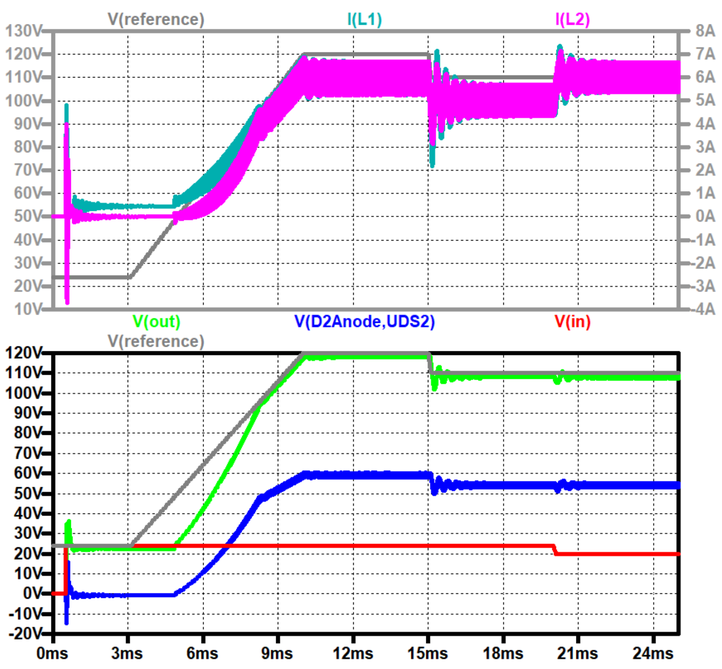
$$C_2 = \frac{(U_2 - 2U_1) I_{Load}}{U_2 \cdot \Delta U_{C2} \cdot f}$$

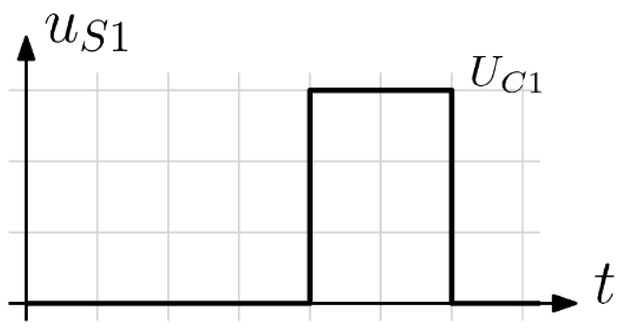
$$C_1 = \frac{I_{Load}}{\Delta U_{C1} \cdot f}$$

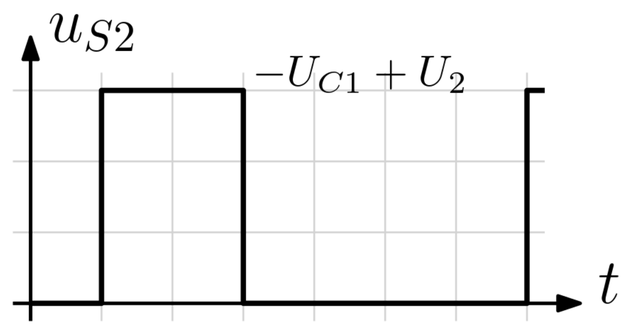
$$d = \frac{U_2^* - 2U_1}{U_2^*}$$











Conclusion

- two special voltage transformation ratios – high step up rates
- stress of the semiconductor devices is reduced
- converter is especially useful for solar, fuel cell, battery, and micro grid applications