1 Quasi-Resonant Buck Converter

By adding a resonant tank (L_r , C_r) within the switches V_1 and V_2, a conventional Buck Converter is modified to a quasi-resonant Buck Converter.

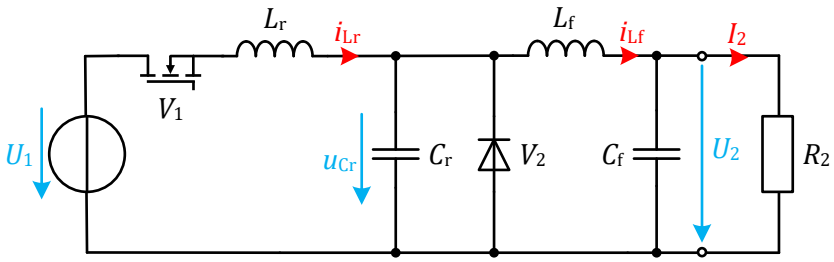

Figure 1: Buck Converter with resonant tank

The following values are known:

- Output current: $I_2 = 10$ A
- Input voltage: $U_1 = 10$ V
- Resonant choke: $L_r = 320$ nH
- Resonant capacitor: $C_f = 500$ nF
- Switching period: $T_S = 0.5$ µs

On the condition $L_r << L_f$ and $C_r << C_f$ the network L_f , C_f and R_2 can be replaced by a constant current source during the time of one switching period. The input voltage source and semi-conductors are considered as ideal.

1. The state, where free-wheeling diode V_2 conducts the filter current $i_{Lf} = I_2$, is the initial point in order to investigate the course of events in one switching period. After the transistor V_1 is switched on, the circuit passes through three different states before the initial point is reached. Again the transistor is switched off immediately after zero current occurs. Sketch the equivalent circuits for all four possible switching states.

2. Compute the wave-shape of the capacitor u_{Cr} voltage and the transistor current i_{Lr} in all intervals of a switching period T_S and the duration of the intervals.

3. Sketch the qualitative wave-shape of the capacitor voltage u_{Cr} and the transistor current i_{Lr} for one switching period T_S.

4. Determine the DC voltage ratio U_2/U_1.