Push-Pull Converters

The push-pull converter can be designed for high power..

![Push-pull converter diagram](image)

Fig. 2.3.1: Push-pull converter, here: full-bridge typ

The push-pull converter drives the high frequency transformer with an AC-voltage, where the negative as well as the positive half swing transfers energy. The primary voltage $V_1$ can be $+V_{in}, -V_{in}$ or zero depending on which pair of transistors ($T_1, T_4$ or $T_2, T_3$) are turned on or off. At the secondary side the AC-voltage is rectified and smoothed by $L$ and $C_{out}$.

For continuous mode follows (see also Chapter 1.1 "buck converter"): 
\[ V_{out} = V_{in} \cdot \frac{N_2}{N_1} \cdot \frac{t_1}{T} \]

The duty cycle \( \frac{t_1}{T} \) may theoretically increase to 100%. This is not possible in practice because the serial connected transistors \( T_1, T_2 \) or \( T_3, T_4 \) have to be switched with a time difference to avoid a short-circuit of the input supply. The turns ratio of the transformer has to be:

\[ \frac{N_2}{N_1} \geq \frac{V_{out}}{V_{in}} \]

- The transistors of the push-pull converter can be switched with the maximum duty cycle of 0.5. This leads to the maximum duty cycle of \( \frac{t_1}{T} = 1 \) after rectification.

The calculation of \( L \) and \( C_{out} \) follows those of the buck converter (chapter 1.1).

### 2.3.1 Half-Bridge Push-Pull Converter:

![Half-bridge push-pull converter with full-wave rectifier](image)

A variant of the push-pull converter is the **half-bridge push-pull converter**. The capacitors \( C_1 \) and \( C_2 \) divide the input voltage \( V_{in} \) into two. Therefore the magnitude of the primary voltage is \( \pm V_{in}/2 \). In comparison to the full-bridge push-pull converter follows for the half-bridge typ the turns ratio of the transformer to:

\[ \frac{N_2}{N_1} \geq 2 \frac{V_{out}}{V_{in}} \]

**NOTE:**

In Fig. 2.3.3 a two diode full-wave rectifier is used instead of a full-wave bridge rectifier. The choice of rectifier type is dependent on the output voltage and current. The difference between these two rectifier types is, that the current has to pass through two diodes in the bridge type and only one diode in the full-wave type. Consequently the full-wave type is used for high current to reduce the rectifier losses and the bridge type is used for high voltage purpose to save one secondary winding of the transformer.