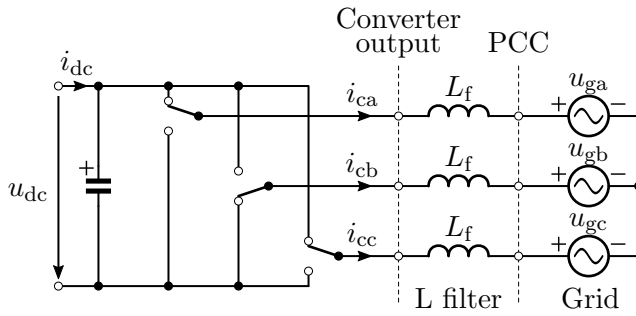


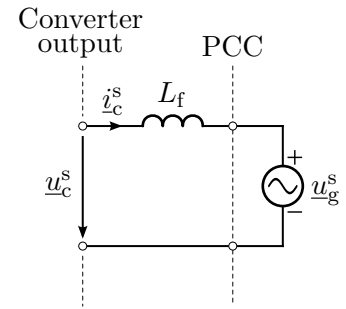
**Problem 1: Grid support, current and voltage limits**

The figure shows a grid-connected converter equipped with an L filter ( $L_f = 2$  mH). A solar generator feeds the constant power of 80 kW to the DC bus. The maximum AC-side current of the converter is  $i_{\max} = \sqrt{2} \cdot 200$  A (peak). The grid frequency is 50 Hz and the nominal grid voltage is  $u_N = \sqrt{2/3} \cdot 400$  V (peak, phase-to-neutral). Assume the converter to be lossless and to operate in the steady state.

- The displacement power factor at the PCC is kept at unity. Calculate the power  $p_g$  fed to the grid, the current magnitude  $|\underline{i}_c|$ , and the converter voltage magnitude  $|\underline{u}_c|$ .
- The grid voltage decreases to  $|\underline{u}_g| = 0.8u_N$  due to a symmetrical grid fault. Calculate  $|\underline{i}_c|$  and  $|\underline{u}_c|$ . What would happen if the grid voltage decreased to  $|\underline{u}_g| = 0.5u_N$ ?
- For supporting the grid at  $|\underline{u}_g| = 0.8u_N$ , the converter feeds the maximum reactive power  $q_g$  to the PCC, taking the current limit  $i_{\max}$  into account. Calculate  $q_g$  and  $|\underline{u}_c|$ . What is the minimum value for the DC-bus voltage  $u_{dc}$  in this operating condition?



Grid-connected converter



Space-vector equivalent circuit

**Problem 2: Refence calculation under unbalanced voltage conditions**

The grid voltage is unbalanced due to an unbalanced fault. The PLL of the grid converter is able to decompose the measured grid voltage into the positive-sequence and negative-sequence components. Furthermore, the current controller is capable of feeding the desired positive- and negative-sequence current components as well as any desired harmonics. Calculate the grid current references in the following cases:

- (a) Both the active power and reactive power are kept constant.
- (b) The grid currents are controlled to be sinusoidal and balanced.
- (c) The active power is kept constant and the grid currents are controlled to be sinusoidal.

The inputs to the current reference calculation are the active and reactive power references.