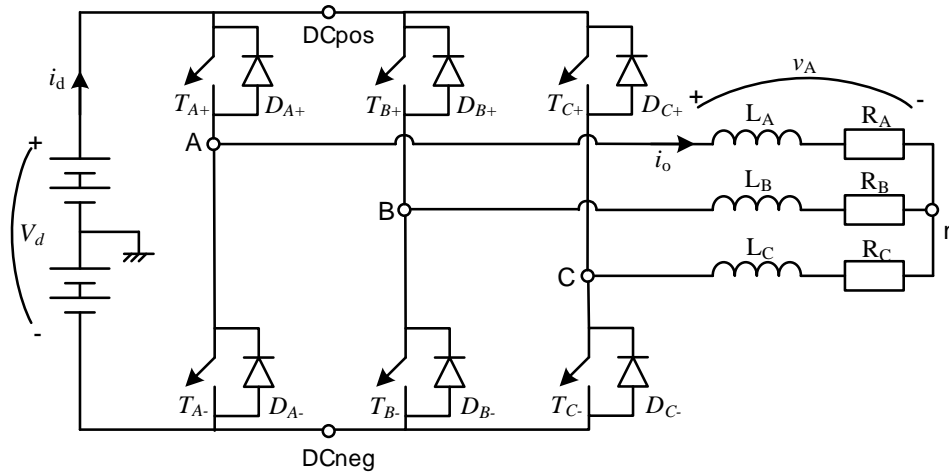# Assignment 5 – Three-Phase Inverter

The questions marked HA are home assignments to be completed before the laboratory starts.

Nominal values for square wave inverter with RL-load

Source voltage	$V_d = 300V$		Load inductance	$L_X = 10mH$
Fundamental frequency	$f_{s(1)} = 50Hz$		Load resistance	$R_X = 0.1\Omega$

Nominal values for PWM-modulated inverter with RL-load

Source voltage	$V_d = 300V$		Load inductance	$L_X = 1mH$
Fundamental frequency	$f_{s(1)} = 50Hz$		Load resistance	$R_X = 1\Omega$
Switching frequency	$f_{sw} = 1kHz$		Modulation index	$m_a = 0.8$

Source files: *assignment_5a.opj*
                      assignment_5b.opj
                      assignment_5c.opj

You can open all files in one window and move between the different simulations.

Tasks/Questions:

Square wave inverter

HA 1: For inverter operation in square wave-mode with purely resistive load, draw the phase voltage (v_A) and the phase current i_o. Do the same for a purely inductive load.

1. Open the schematic *3ph_inv_Square_RL* in *assignment_5a.opj* and run it. Do the curves agree well with the purely resistive or purely inductive sketch in the home assignment?

2. Measure and analyze the voltage between the y-point (n) and ground. Does it match with the voltage derived during the lecture?

3. Measure the DC-input current (i_d) with the specified load. Then change the load to $L_{load} = 10\mu H$ and $R_{load} = 1\Omega$ and measure the DC-input current (i_d) again. Analyze the input current in the two cases and explain the difference between the two loads and the consumed active power.

PWM-modulated inverter

HA 2: For the PWM-case with a purely inductive load, draw the phase voltage (v_A) and the phase current i_o for one switch period.

4. Open the schematic *3ph_inv_PWM_RL* in *assignment_5b.opj* and run it. Analyze the phase current i_o waveform and the harmonics content using the FFT button and explain the difference from the square wave inverter.

5. Analyze the phase voltage v_A and the voltage between the y-point (n) and ground. Do they match with the voltages derived during the lecture?

Machine load with square wave inverter

6. Open the schematic *3ph_inv_Square_Sin* in *assignment_5c.opj* and study the DC-component of the input current (i_d) and the phase current (i_o) and their FFT. Can you explain why the magnitude of the fundamental component of the phase current i_o and the DC-value of the input current i_d are both zero from the FFT plot? Is any active power transferred to the load?

7. Change the phase angle (Phi) of the back-emf compared with the phase voltage to $+3°$ and $-15°$ and analyze the input current i_d and the phase current i_o both graphically and with FFT. What happens now to the magnitude of the fundamental component of the phase current i_o and the DC-value of the input current i_d? Can you estimate, if the active power is being transferred to or from the load in this case?