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Title

EXERCISE 4: THREE-PHASE INVERTER MODELING

Course Name

EE-465 Industrial Electronics I

1 INTRODUCTION

A three-phase 2L inverter (see Fig. 1) is connected to the 3ph grid ($V_{RMS,l-l}$ =400 V, 50 Hz) through a RL filter. By appropriately setting the phase and magnitude of the voltage synthesized by the inverter, the power exchange with the AC grid can be modified or set.

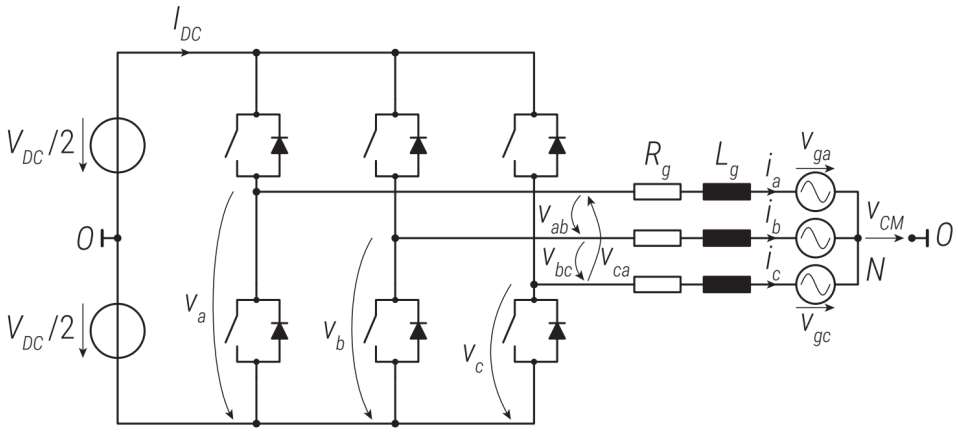

Fig. 1 PV system output stage. The input stage has been replaced by an equivalent voltage source.

2 TASKS DESCRIPTION

1. Create a switched model of the three-phase 2L inverter as seen in the lecture and as illustrated in fig. 1.
   - A few useful elements are already there in the PLECS template file.
   - Use the signals provided from the PWM block to drive the inverter switches.

   In the report, show your implementation by taking a capture of your circuit.

2. The Reference signals are modified a few times during the simulation, this is handled by the blocks in the blue frames. Initially, the converter voltage should have the same magnitude as the grid voltage, but with a phase shift of $\pi/4$. At t = 0.25s, the phase shift is set to 0 (converter and grid voltages should be almost identical). At t = 0.5s, the modulation index (m) is increased to 1. Finally, at t = 0.75s the modulation index is increased to 1.5.
   In the report, show a capture of the "Converter Voltages & References" scope. Explain what you see and describe what is happening after t = 0.75s.
   Show a capture of the "Switched model Voltages and Currents" scope. Explain the behavior of the grid currents for the different converter voltages applied during the sequence.

3. Model the system in $\alpha\beta$ reference frame (c.f. lectures). Use the Clarke transformation to obtain the inverter and grid voltages in $\alpha\beta$ reference frame. In the report, show your implementation (PLECS block diagram) and a scope capture of converter voltages, grid voltages and grid currents in $\alpha\beta$ reference frame.

4. Model the system in *dq* reference frame (c.f. lectures). Use the Park transformation to obtain the inverter and grid voltage components in *dq* reference frame. In the report, show your implementation (PLECS block diagram) and a scope capture of converter voltages, grid voltages and grid currents in *dq* reference frame.

5. Transform the currents obtained with both models into the *abc* reference frame (using inverse Clarke/Park transformations), and compare them with the switched model. In the report, show a capture of the "Model Comparison" scope. If you see any difference between the models, discuss them.