

ModCoupler Tutorial

Single-phase inverter

The ModCoupler¹ provides interface for co-simulation between PSIM® and the software ModelSim®.

This tutorial is intended to guide you, step by step, to perform a co-simulation PSIM® – ModelSim® example based on the closed loop operation of a single phase inverter.

1.1 ModCoupler block configuration.

Before configuring the ModCoupler block, the PSIM® schematic will be created.

In this example PSIM® is in charge of the inverter power simulation while ModelSim® is doing the control part. The final schematic is included in the working directory (ModCoupler Tutorial 3) and its name is SinglePhase_Inverter.psimsch but, in this example, the complete communication process between PSIM® and ModelSim® is explained. So, we will start with a single-phase inverter (Fig. 1).

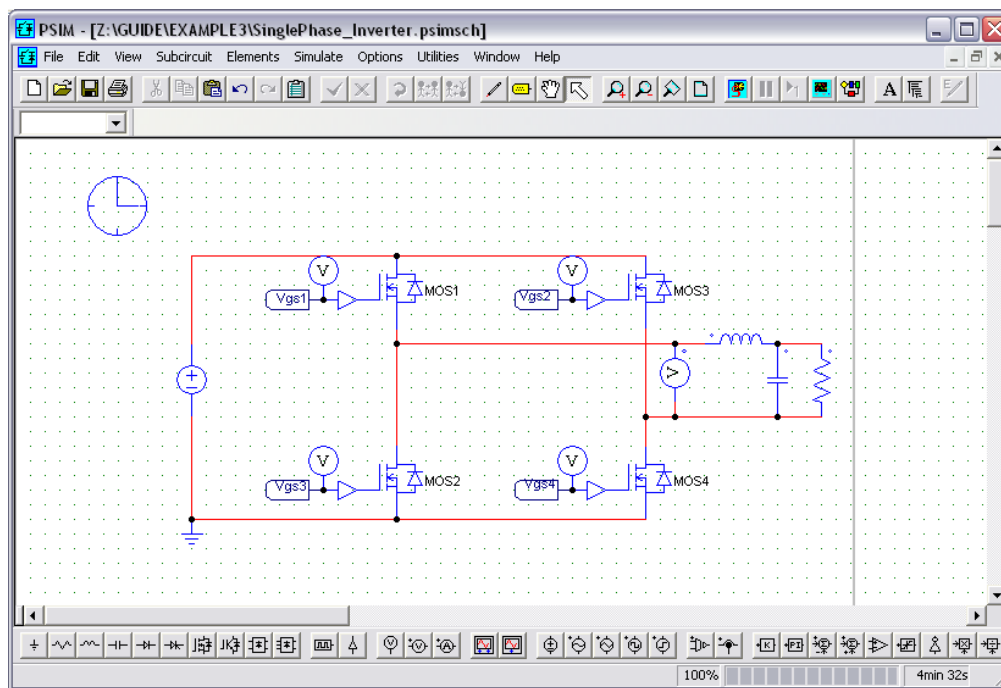


Fig. 1: Single-phase inverter.

To make this design functional it's only necessary to give PSIM® the MOSFET's pulses (Vgs1-Vgs4 in the figure). These pulses will be calculated by means of the ModelSim® simulator. For this purpose a ModCoupler Block is inserted and the SPWM_unipolarVariable_patron.vhd file (located in the *vhdI* folder of this example) is selected as VHDL file (Fig. 2). The IN/OUT Nodes lists will be created.

¹ ModCoupler is copyright in 2011 by Carlos III University of Madrid, GSEP Power Electronics Systems Group and Microelectronic Design and Applications Group, Spain.

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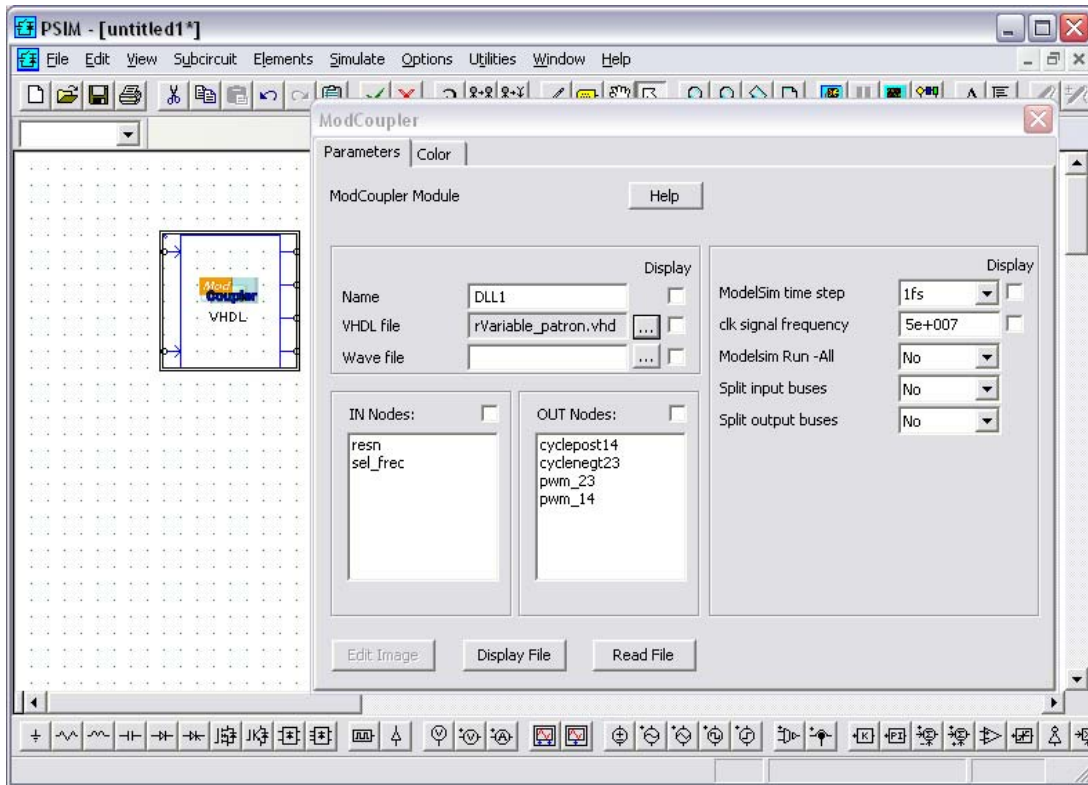


Fig. 2 ModCoupler Block dialogue window.

The outputs will be obviously connected to the MOSFET's gates in order to commutate them. The first input is the reset of the VHDL design, connecting a voltage step source is enough to allow the reset process. The second input controls which switching pattern is going to be used changing its value from 0 to 3. In order to do this value change, a triangular-wave voltage source is used (Fig. 3).

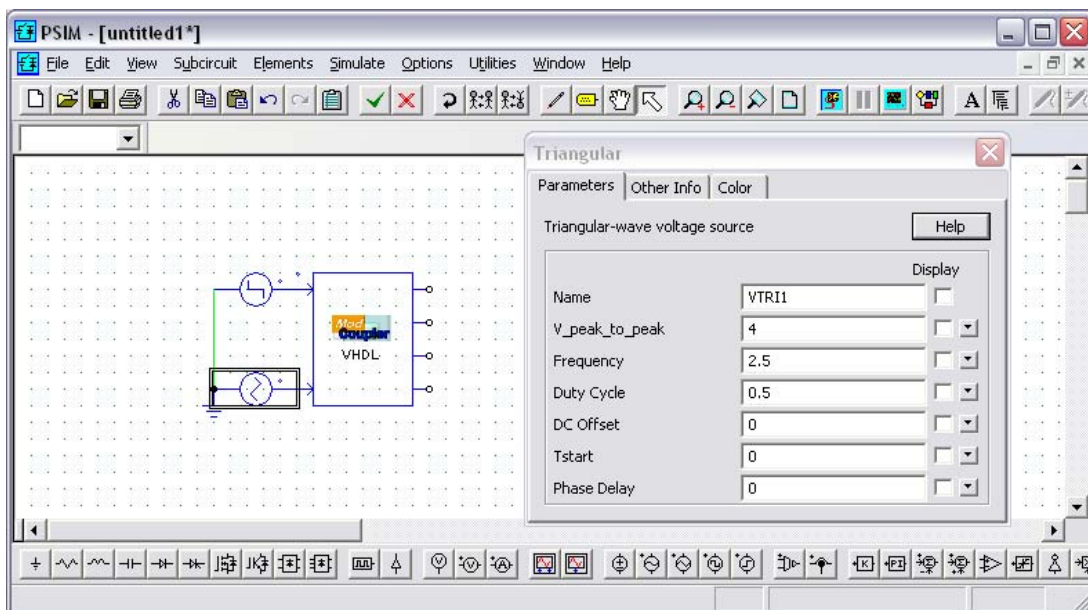


Fig. 3: Configuration of the triangular-wave voltage source.

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Despite PSIM® uses real numbers, it is not necessary to use any other elements to convert the control signal since these values will be truncated to integers and the bits will be send separately. So the final control schematic can be seen in Fig. 4.

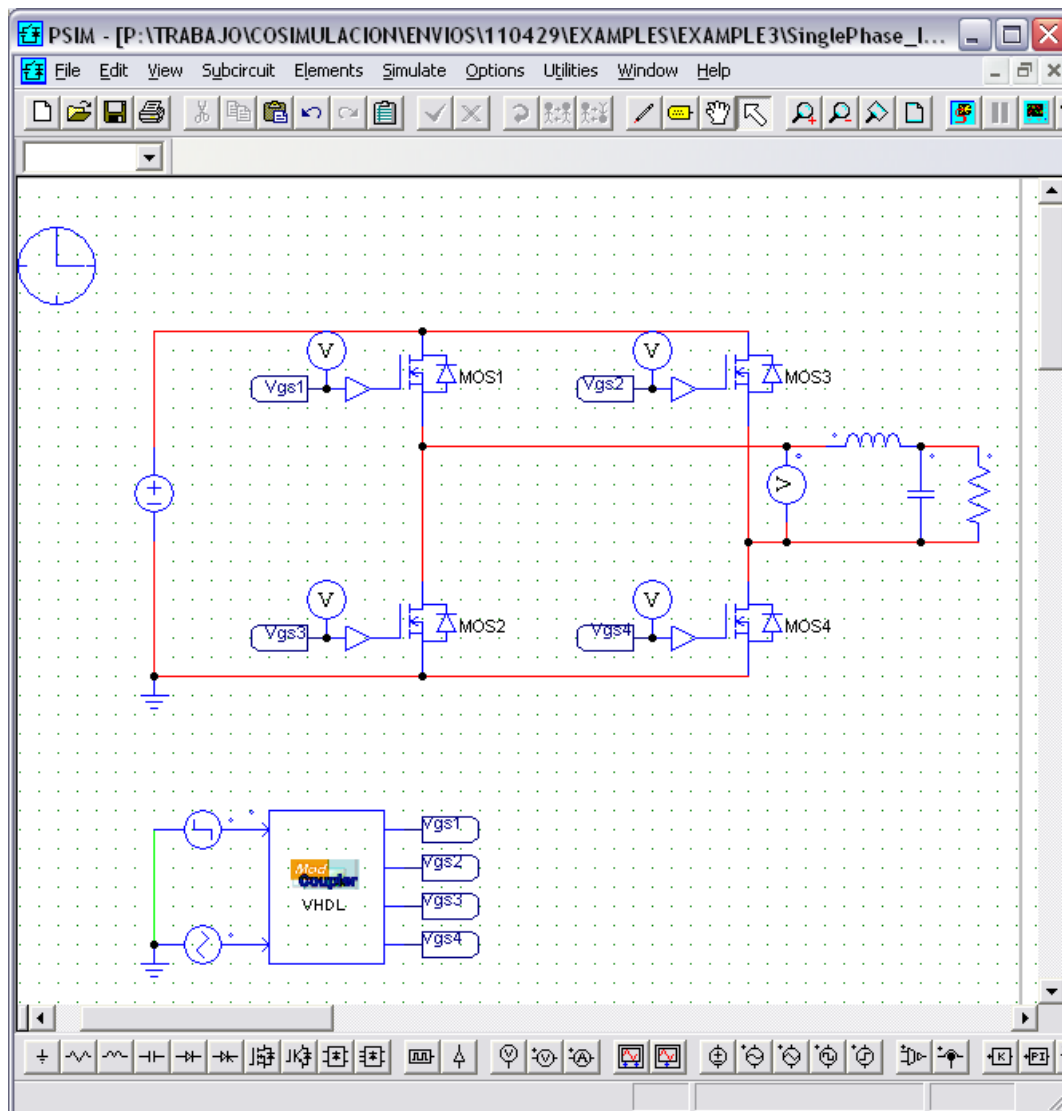


Fig. 4: Final schematic.

Next, the ModCoupler Block parameters will be set with the following values:

- *Wave file:* Point to the wave.do file placed on the example folder.
- *ModelSim time step:* 10ns
- *Clk signal frequency:* 5E7
- *ModelSim Run All:* Yes
- *Split input buses:* No
- *Split output buses:* No

1.2 Compilation of VHDL files

The compiled version of the model is included in the work folder included in the example main directory, anyway, a batch file is given to re-compile the design if it is needed.

This batch file is located in the subfolder “vhdl” and it is called compile.bat. Double click to execute them. In this batch file, the ModelSim® applications *vcom* and *vlib* are used, so the path to both of them must be in the environment variable PATH.

This .bat file also moves the “work” subfolder to the main folder of the example (ModCoupler Tutorial 3). If other compilation method have been used (e.g. using de command prompt or the ModelSim® IDE), the created “work” folder must be moved manually to the work directory (“ModCoupler Tutorial 3” in this example).

1.3 Simulation

The last step is run the simulation. Start it by pressing the PSIM® “Run simulation engine” button. At this point, ModCoupler creates a VHDL file called ModCouplerTemporaryFile.vhd in the vhdl directory and compiles it. After a few seconds, a ModelSim® window will appear with the compiled model. As the RunAll parameter was set to “Yes”, the ModelSim® simulation will start immediately.

NOTE: ModCoupler uses the ModelSim® applications *vcom* and *vsim*, so the path to both of them must be in the environment variable PATH