New Features in PSIM Version 9.1

Highlights of the key new features in PSIM Version 9.1 are:

- **Real-time monitoring and debugging for TI DSP F28335**
- **Support of SCI and SPI functions for TI DSP F28335**
- **Co-simulation with ModelSim to support VHDL**
- **Temperature dependent Rdson of MOSFET**
- **Capability to display any voltages and currents from a simulation run**
- **New 4-phase and 5-phase switched reluctance machine models**
- **Improved SmartCtrl functions**

Description of key new features in Version 9.1, as compared to Version 9.0, is given below.

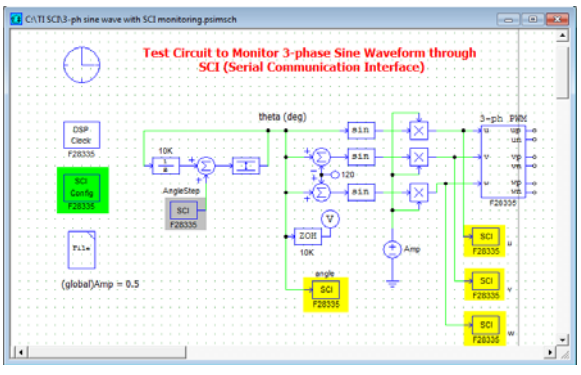
• TI F28335 Target

The new version of PSIM provides major improvements in supporting TI floating-point DSP F28335 through real-time waveform display, and support of SCI (serial communication interface) and SPI (serial peripheral interface) functions.

- Real-Time DSP Waveform Display

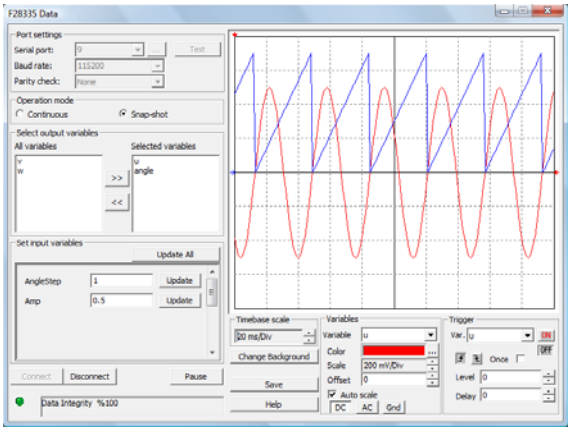
  With SCI and the new DSP Oscilloscope utility tool, PSIM offers the capability to display waveforms and change parameters inside the DSP in real time. This makes it extremely easy to test, debug, and adjust DSP code in a non-disruptive and non-intrusive way.

  The figure below shows the schematic of an example and the dialog window of the DSP Oscilloscope.



PSIM Schematic

DSP Oscilloscope



The DSP Oscilloscope shows the variables (i.e. *u*, *v*, *w*, and *angle*) that can be monitored in real time, and the parameters (i.e. *AngleStep* and *Amp*) that can be changed on-the-fly.

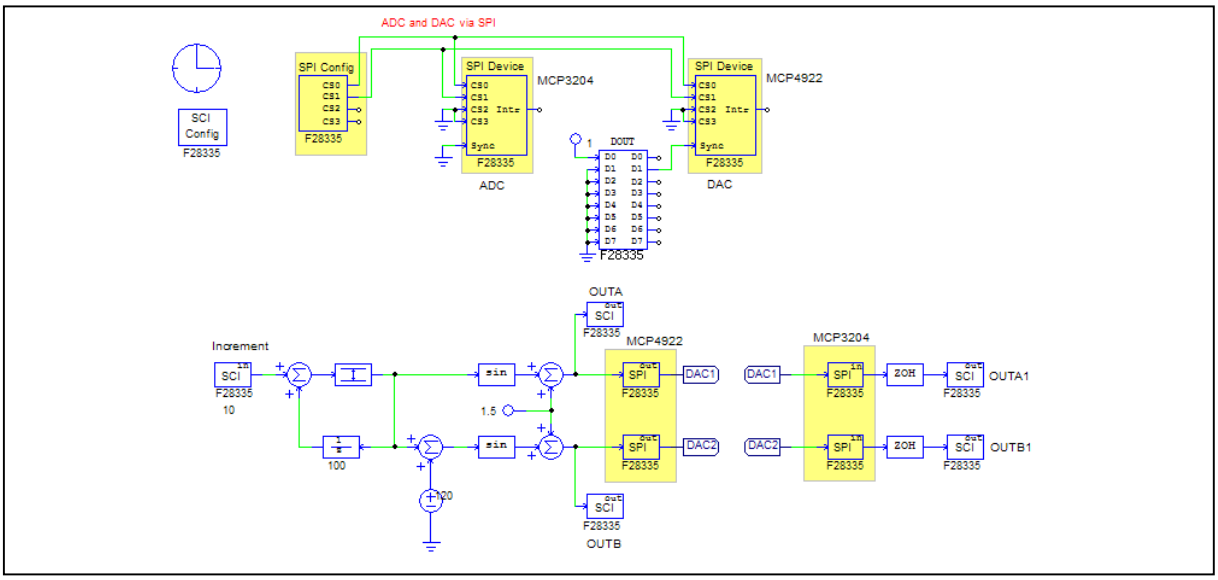
- Support of SCI

  SCI functions are supported. Blocks to configure SCI ports and define SCI inputs and outputs are provided. With the SCI function blocks, data communications between DSP and computer can be easily defined. Together with the DSP Oscilloscope, SCI provides the capability to monitor DSP waveforms in real time.

- Support of SPI

  The task of SPI implementation is non-trivial due to the complexity involved. However, with the SPI function blocks provided in PSIM, the implementation is greatly simplified as it can be done at the schematic level.

  The figure below, for example, shows two signals, generated in DSP, are sent out to an external D/A converter via SPI. These two signals are then read into DSP through an A/D converter via SPI.

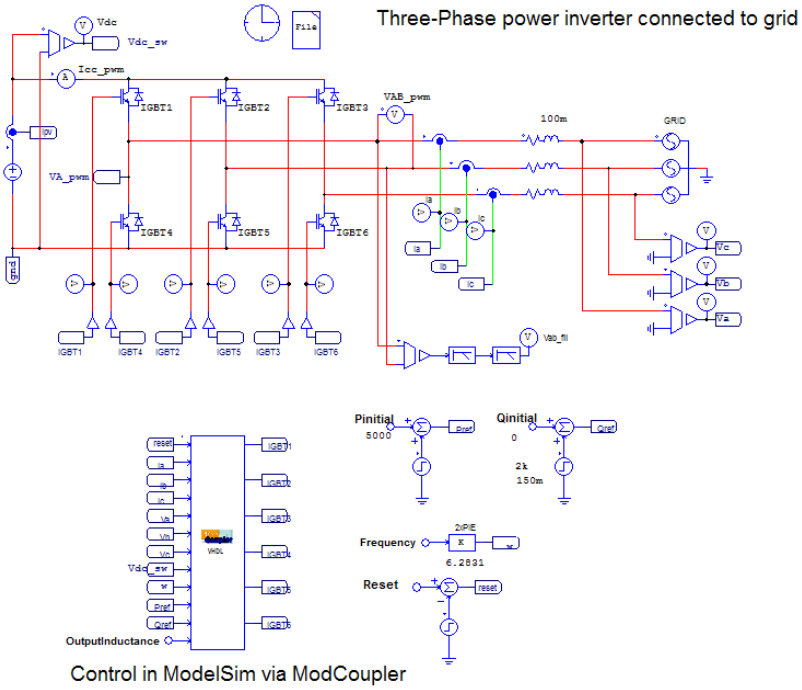


- **ModCoupler Module**

  The ModCoupler Module provides the link for co-simulation between PSIM and ModelSim for VHDL code support. With this Module, the power circuit can be implemented in PSIM, and the control circuit in VHDL code, which can then be simulated by ModelSim, for hardware implementation in FPGA.

  This Module provides a very quick way to go from conceptual validation in PSIM to hardware implementation in a FPGA hardware.

  The figure below shows a 3-phase grid-connected inverter, with the control implemented in VHDL code. The ModCoupler block provides the link to ModelSim for co-simulation.



VHDL code

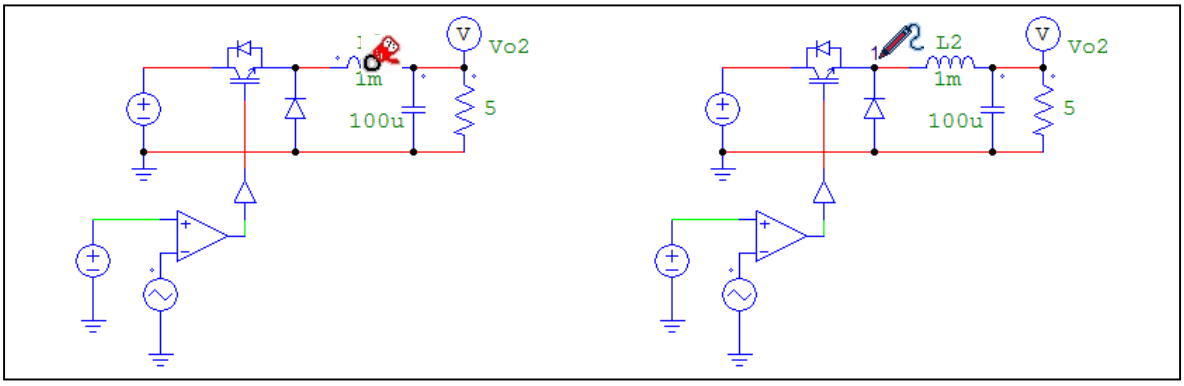
```
library IEEE;

use ieee.std_logic_1164.all;
use ieee.std_logic_arith.all;
use ieee.std_logic_unsigned.all;


entity Top_Inversor is

port(clk, reset: in  std_logic;
     Ia, Ib, Ic: in  real;
     Va, Vb, Vc: in  real;
     Vdc_sw    : in  real;
     w         : in  real;
     P_ref, Q_ref: in  real;
     L         : in  real;
    I_GBT1     : out std_logic;
    I_GBT2     : out std_logic;
    I_GBT3     : out std_logic;
    I_GBT4     : out std_logic;
    I_GBT5     : out std_logic;
    I_GBT6     : out std_logic);

end Top_Inversor;
... ... ... ...
```

- **PSIM**

  - Displaying All Voltages and Currents

    In previous PSIM versions, circuit voltages/currents will only be saved to the output file for display if users specifically request them (by using voltage/current probes or setting display flags). In this release, an option is provided to save all voltages and currents of a circuit automatically. After the simulation is complete, one can view any voltages or currents by clicking on a node or on top of an element.

    The image on the left, for example, shows that the cursor changes to the image of a current probe when placed on top of the inductor L2. On the right, when the cursor is close to Node 1, the cursor will be changed to the image of a voltage probe. In both cases, a left click will have the waveform being displayed in Simview.



  - Temperature-dependent Rdson of MOSFET

    The on-resistance Rdson of MOSET devices can be defined so that it is a function of the junction temperature.

- Relay Models

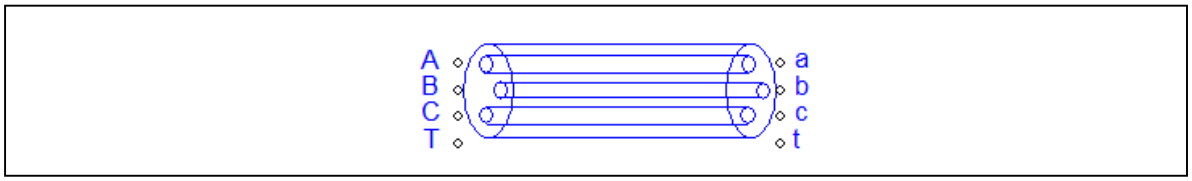
  New models are provided to simulate the behavior of relays. Two models are provided for the relay with one with 1 normally open switch and 1 normally closed switch: one with two separate switches and the other with switch changeover. The images of the relays are shown below:

- 3-phase Transformer with Saturation

  A model for 3-phase transformer with saturation is added. It can take into account not only saturation, but also residual flux as well.

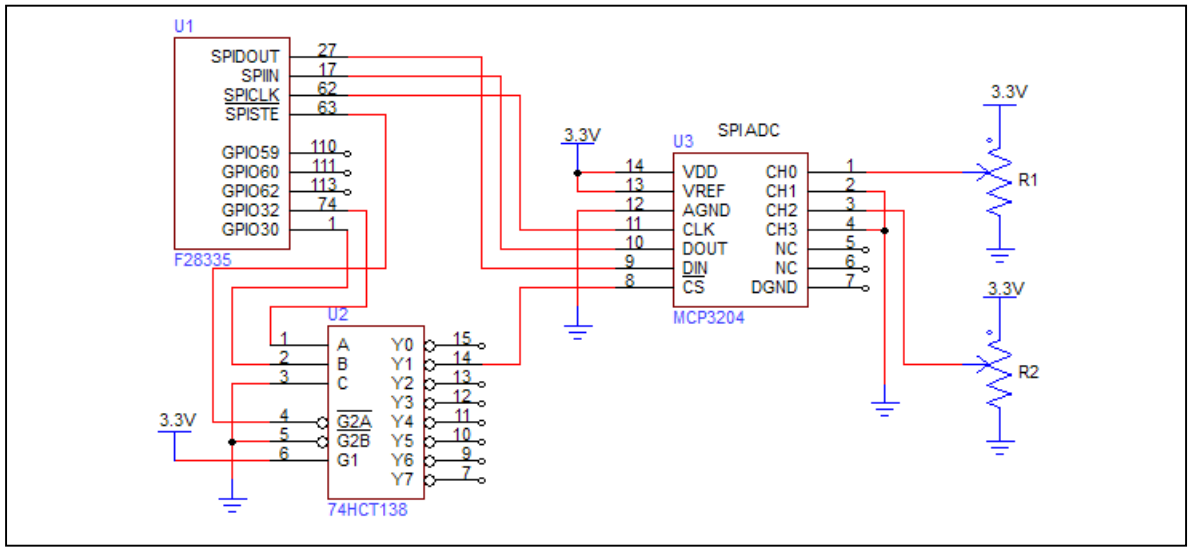
- 3-phase AC Cable

  A model is provided for 3-phase ac cables. It takes into account inductive coupling and capacitances between phases. The image of the ac cable is shown below.



- New image Editor for Subcircuit and New Elements

  A new image editor is provided to create images for subcircuits or new elements. The image editor allows one to create consistent and high-quality images quickly and conveniently. For example, in the schematic below, the three devices F28335, MCP3204, and 74HCT138, are elements created by the new image editor.



- Improved Data Viewer in Simview

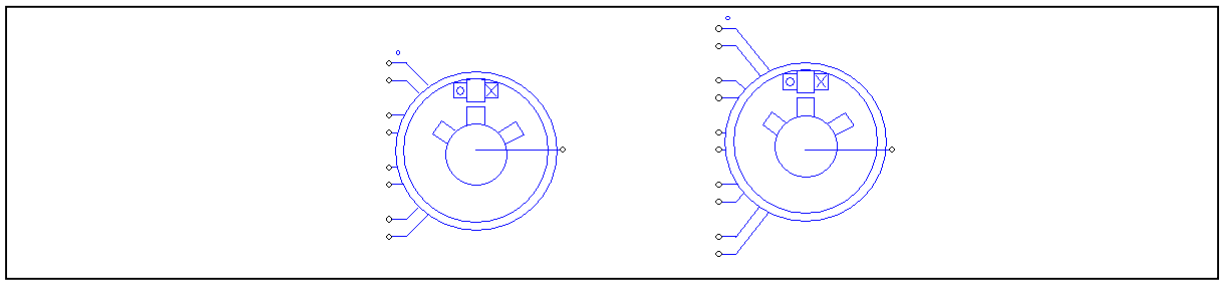
  Data points of a waveform in Simview can be displayed for inspection. The data viewer is improved to be more user friendly, and it allows easier selection and copy & paste.

- C Block Limit

  Previously, the length of the code in a C block is limited to 32,000 characters. This limit is removed in this release.

- **Motor Drive Module**

Models for 4-phase and 5-phase switched reluctance machines, with both linear and nonlinear characteristics, are provided, as shown below.



- **Thermal Module:**

For MOSFET, the temperature dependency of the on-resistance Rdson can now be defined and taken into account in the loss calculation.

- **SmartCtrl**

A number of enhancement is incorporated in SmartCtrl, as shown below.

- Transient Time-Domain Response

  Previously, transient time-domain response is provided for single-loop structure only. In this release, the transient response is provided to all structures, including double-loop and in the case where the transfer function of the plant is imported from ac sweep data.

- Improved Design for Power Factor Correction Circuit

  The way the controllers are designed is improved for better results.

- Improved Modeling for PWM Generator

  The way the PWM generator is modeled is improved. The improved version provides duty cycle limit and behaviors more closely with manufacturer PWM IC's.