New Features in PSIM Version 9.0

Highlights of the key new features in PSIM Version 9.0 are:

- **Renewable Energy Package, with solar cell models, wind turbine model, and MPPT examples**
- **Support to Texas Instruments DSP F28335**
- **Temperature effect in Thermal Module calculation**
- **New calculation functions in Simview**
- **64-bit version**
- **New and improved MagCoupler and MagCoupler-RT blocks**
- **Control loop design software SmartCtrl, and integration with PSIM**

Description of key new features in Version 9.0, as compared to Version 8.0, is given below.

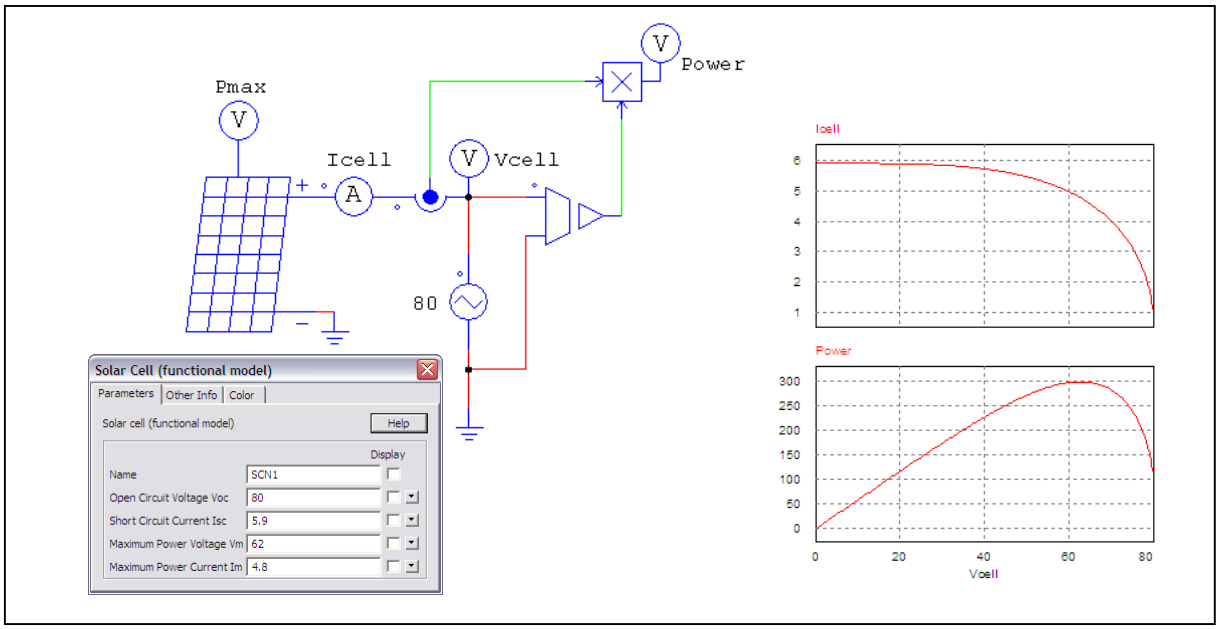
• Renewable Energy Package

The new Renewable Energy Package includes solar cell models and wind turbine model renewable energy applications.

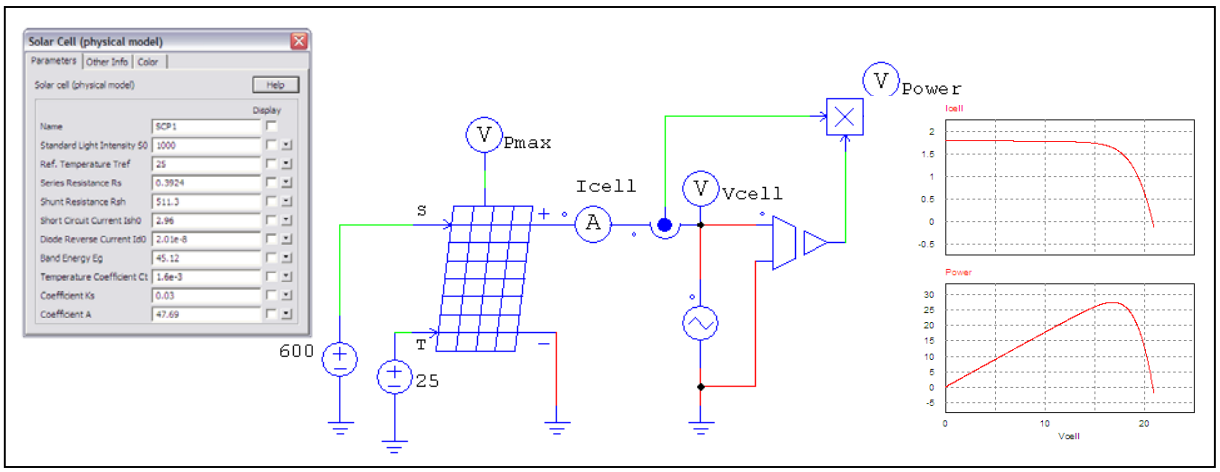
- Solar Cell Models

  Two types of solar cells models are provided. One is the functional model that requires the minimum parameter inputs, and the other is the physical model that can take into account the light intensity and ambient temperature variations.

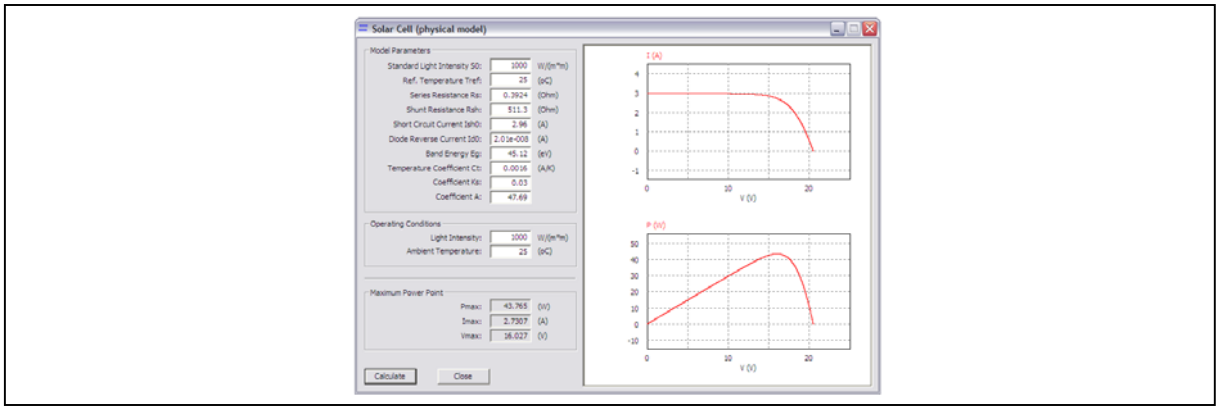
  The figure below shows the parameters of a solar cell functional model and its I-V curve.



The figure below shows the parameters of a solar cell physical model and its I-V curve.



To make it easy to use the physical model, a utility tool is provided that plots the I-V curve based on a set of parameters, as shown below.

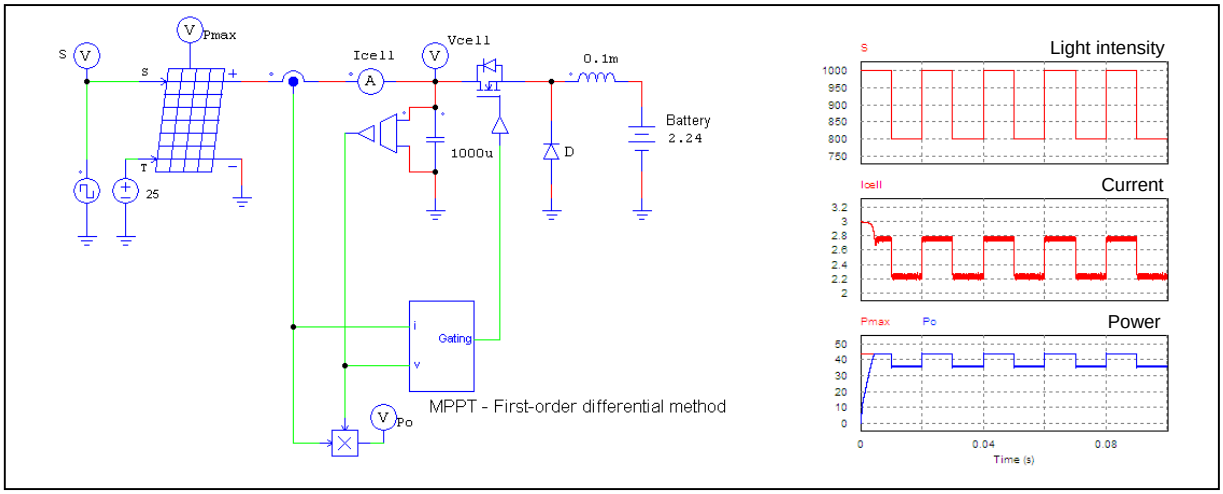


With this tool, it is easy to adjust the model parameters to match the characteristics of a specific solar cell.

- <u>Maximum Power Point Tracking (MPPT)</u>

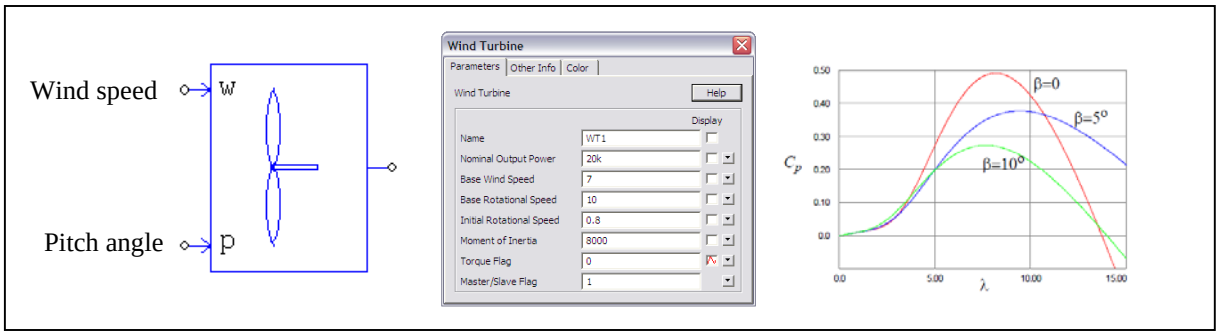
  Three MPPT methods are provided: first-order differential, incremental conductance, and perturb and observe. Examples are provided for each method.

  The figure below shows a MPPT control example using the first-order differential method.



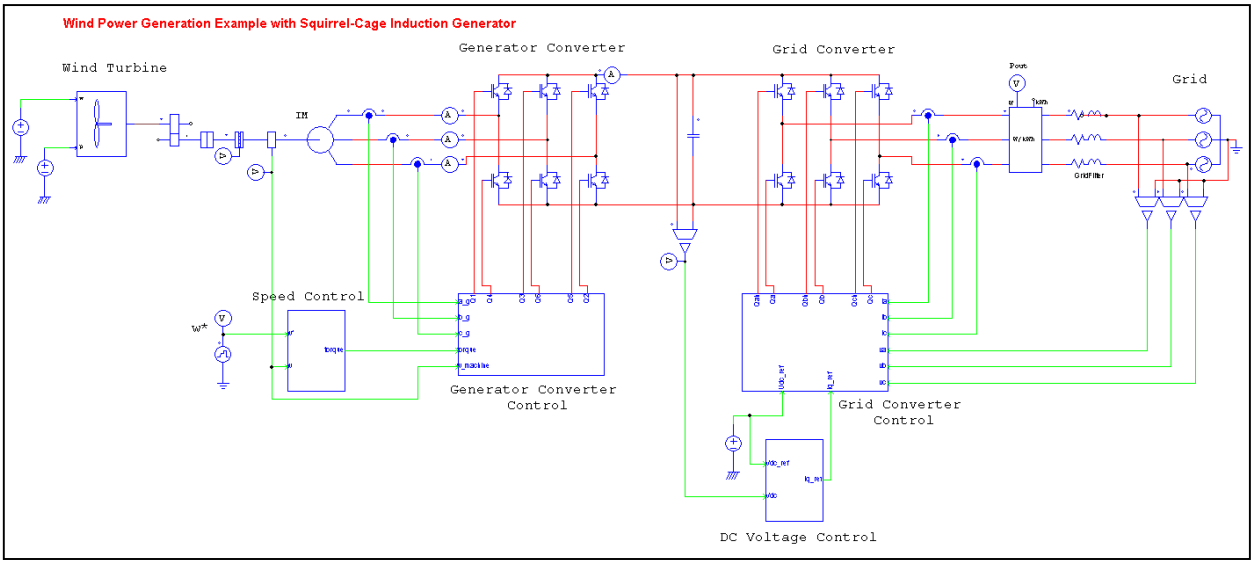
- Wind Turbine Model

  The figure below shows the wind turbine model, the model parameters, and the curve of the power coefficient versus the tip speed ratio of the wind turbine. With this model, a wind power generation system can be implemented and simulated.



- Wind Power Generation Example Using Squirrel-Cage Induction Generator

  A complete sample wind power generation example based on a squirrel-cage induction generator is provided. The system consists of a wind turbine, induction generator, generator converter with current and speed control, and grid converter with current and dc bus voltage control. The overall diagram is shown below.

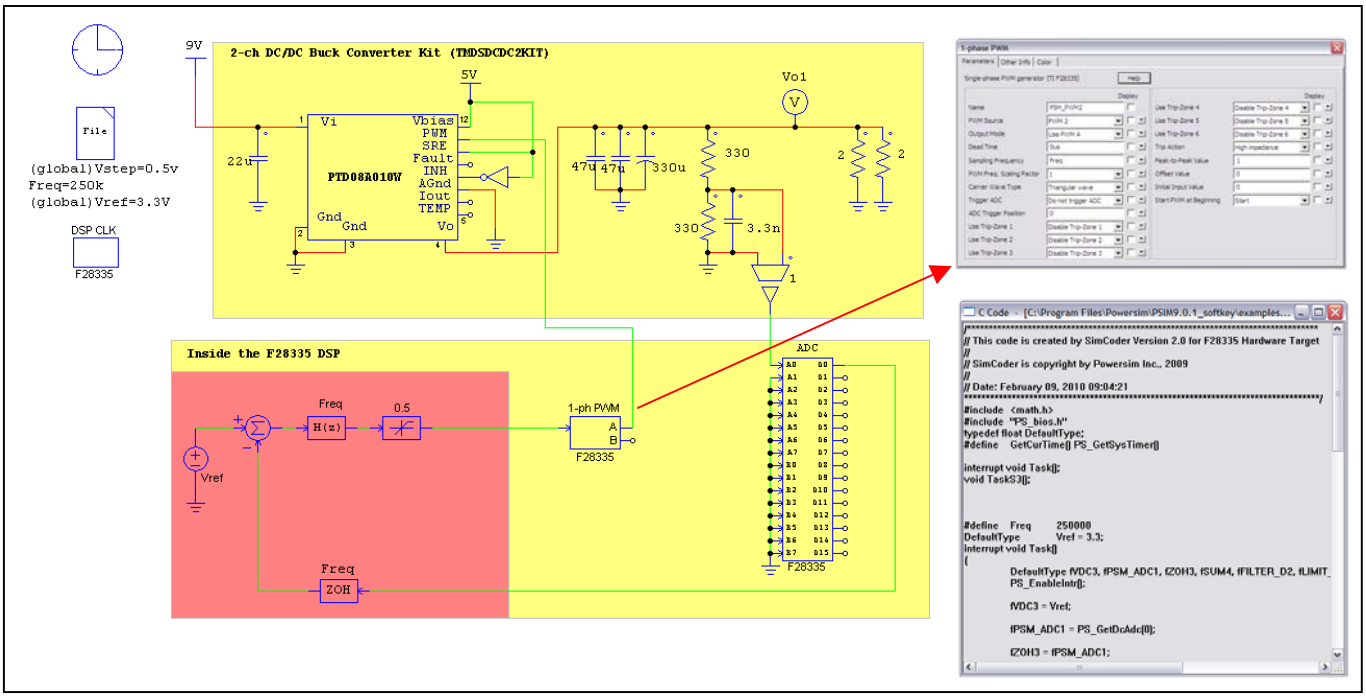


- **Support for Texas Instruments DSP F28335**

  PSIM 9.0 offers a new TI F28335 Hardware Target for SimCoder. With this target, users can set up a circuit in PSIM, perform the simulation, and automatically generate the C code for Texas Instruments' F28335 floating-point DSP. This greatly simplifies and speeds up the development process of digital control using DSP.

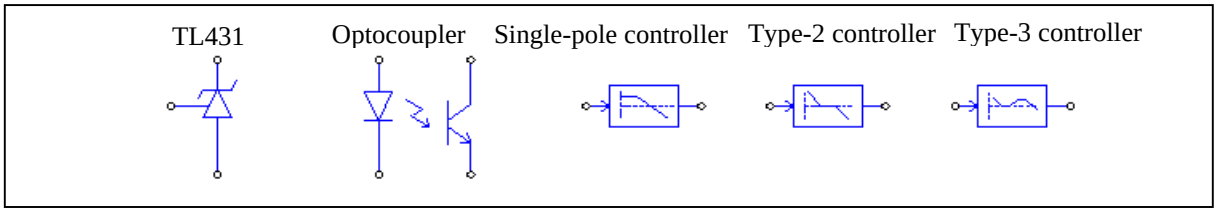
  This target will support any DSP boards that use the F28335 DSP.

  The figure below shows the power and control circuits of the TI DC/DC Development Kit in PSIM, with the code generated automatically for the DSP.



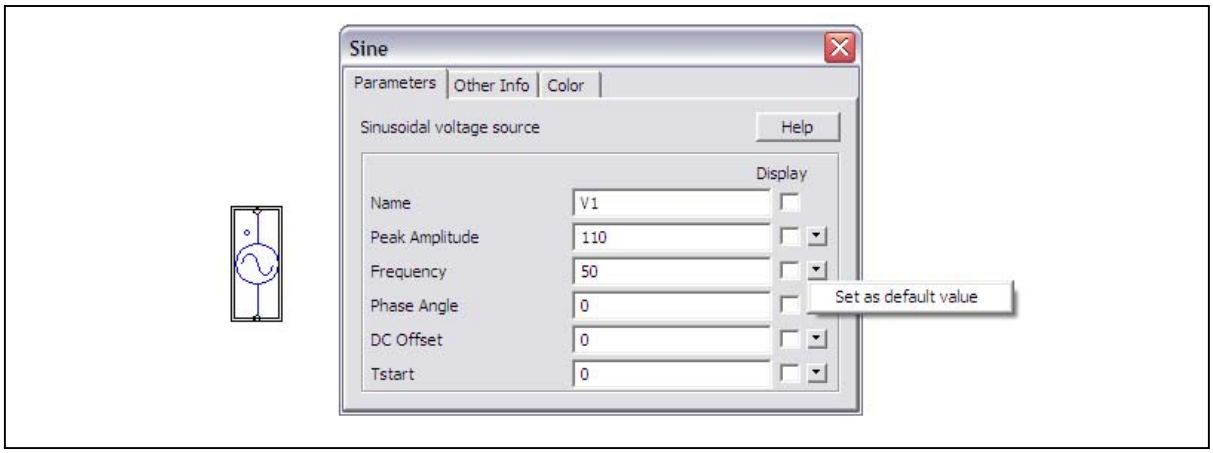
- **PSIM**
  - New Elements

    A number of new elements are added to PSIM 9.0, including: TL431, optocoupler, minimum/maximum function block, single-pole and Type-2/Type-3 controllers.



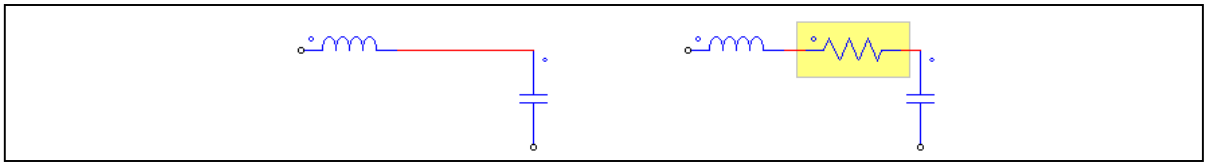
  - Saving Default Parameter Values

    In the previous versions, default parameter values can not be changed. In PSIM 9.0, default parameter values can be set to any values. The figure below shows the process of setting the default value of the sine voltage source frequency to 50 Hz.



- Inserting An Element to a Circuit

  When an element is inserted to a circuit, the wire segment that overlaps the element will be deleted automatically. The figure below shows the circuit before and after the resistor (highlighted in yellow) is inserted.



- Automatically Deleting Output Files on Exit

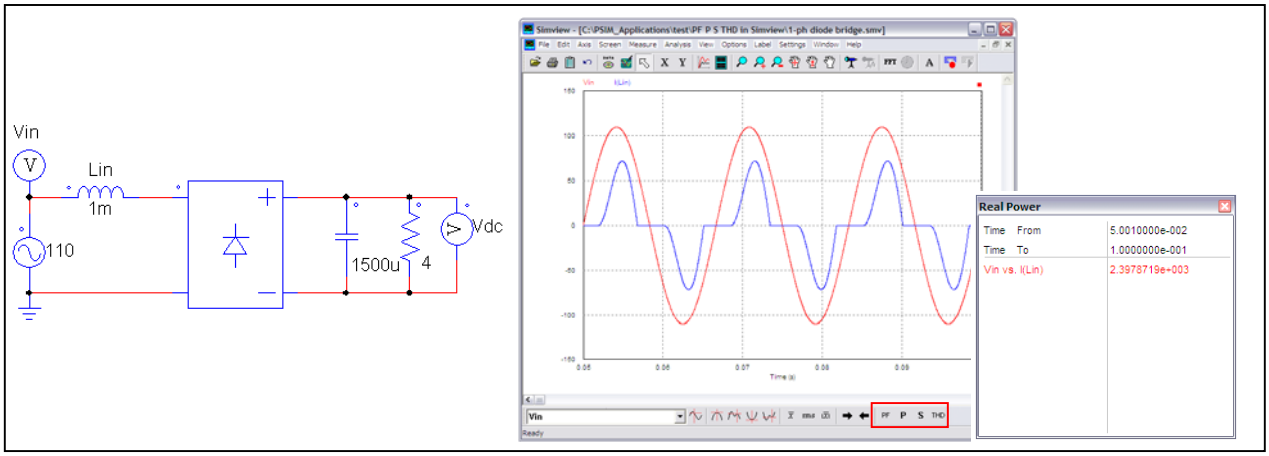
  Sometimes simulation output files do not need to be saved. An option is provided to automatically delete the output files when PSIM exits.

- 64-bit Version

  PSIM 9.0 comes in both 32-bit and 64-bit. The 64-bit version allows PSIM to work with other software in a co-simulation environment, and to take the full advantages of a 64-bit computer.

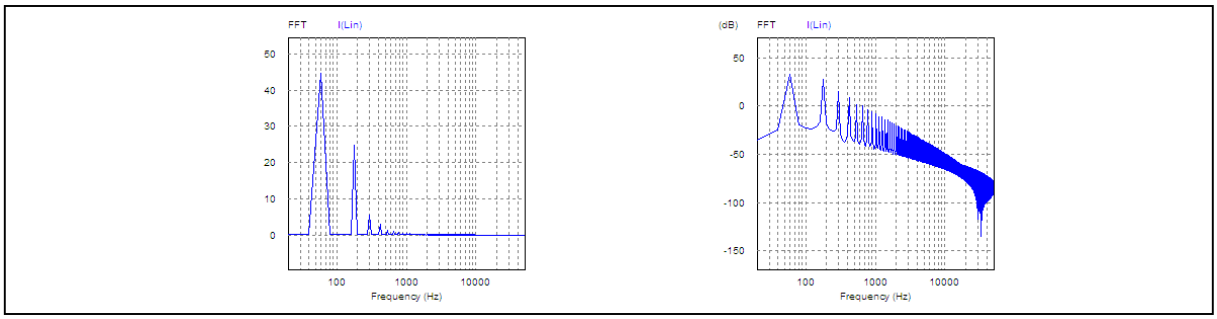
- Calculating Power Factor, Real Power, Apparent Power, and THD in Simview

  In Simview, new functions to calculate power factor, real power, apparent power, and THD (total harmonic distortion) are provided. For example, the figure below shows the input voltage and current of a diode bridge circuit. By clicking on the corresponding icons on the calculation toolbar at the bottom (enclosed in the red box in the figure), one can calculate the power factor, real and apparent power, and the THD with the click of a button.



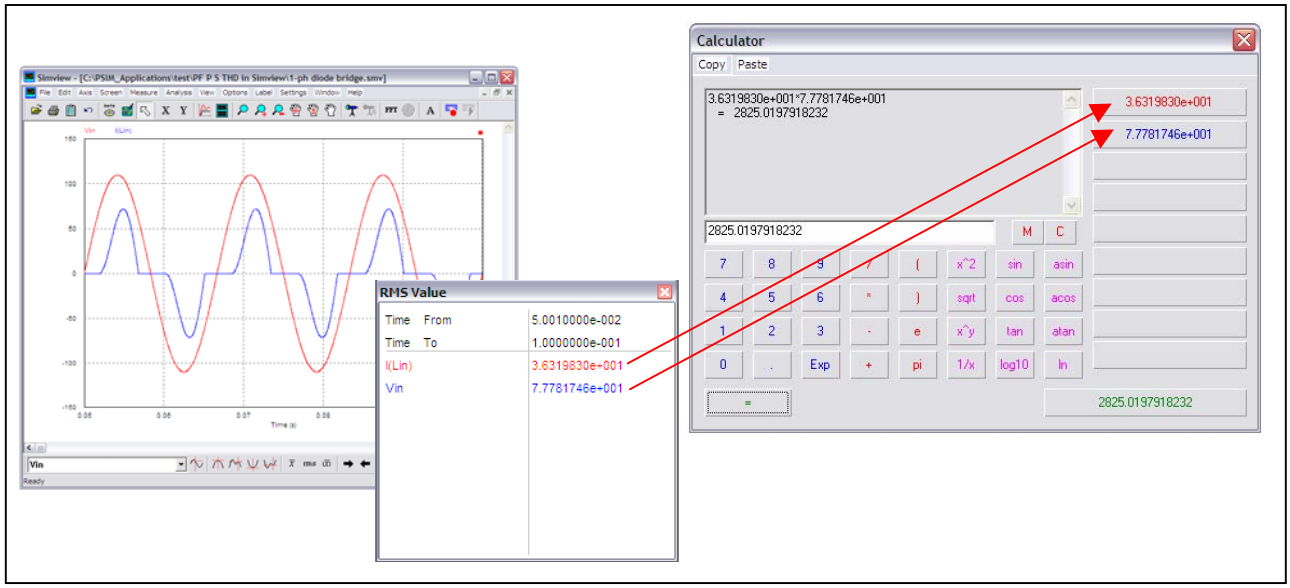
- Y-Axis Display in dB

  The Y-axis can be displayed in dB. The example below shows a harmonic spectrum in both real value and dB.



- Integrated Calculator

  An integrated calculator is created for Simview. A key new feature of the calculator is that values from Simview's measurement window can be directly transferred to the calculator memory for calculation. For example, the figure below shows that the rms values of a voltage and current are first calculated in Simview. By double clicking on the numbers in the measurement window, one can transfer them to the calculator and use them for calculation without the need to copy them or write them down on a piece of paper.



- FFT Results in both Amplitude and Phase Angle

  When FFT analysis is performed, previously only harmonic amplitudes are provided. In PSIM 9.0, the harmonic phase angles are also provided. With both the amplitude/angle information, one can reconstruct the harmonics in the time domain based on the FFT results.

- Saving Display Settings Temporarily

  A function is provided to save the display setting temporarily for later use. This function is especially useful when comparing results, or generating consistent display for presentation.

- Managing Favorite Settings

  One can save a specific display setting as a favorite, and apply the favorite to other display later. Multiple favorites can be saved and managed.

- Handling Large Files

  Previously, the largest file that Simview can load is limited by the amount of RAM memory on a computer (roughly 1 GB). In PSIM 9.0, there is no limit on the file size. When a very large file (several GB, for example) is loaded, Simview will oversample the data file, and users have the option to load the data of a specific segment in full.

- **Motor Drive Module:**

  - New Parameter Interface for Brushless DC Machine

    A new interface is provided for the brushless dc machine model. In the new interface, all the parameters can be read directly from manufacturers' datasheet.

- **Digital Control Module:**
  - Improved Unit Delay Block

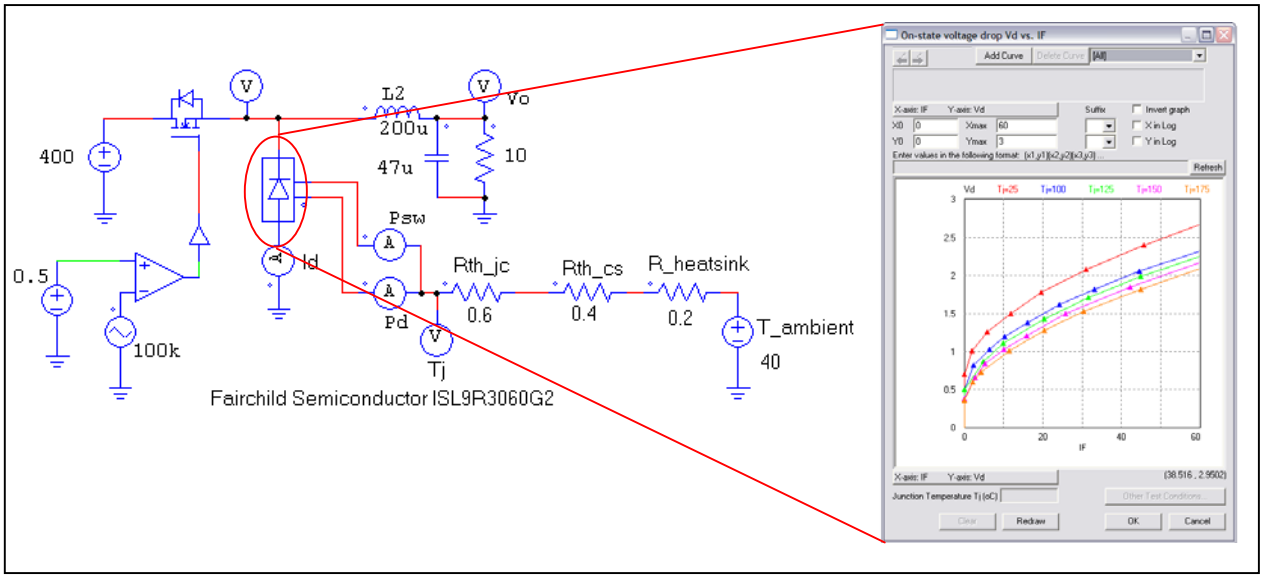
    The initial output value is added to the unit delay block so that the output can have a nonzero value.
  - New Single-Output Circular Buffer Block

    A new single-output circular buffer block is added. It simulates the behavior of a first-in-first-output device.
  - New Quantization Block

    A new quantization block is added. As compared to the existing quantization block, this block simulates the behavior of an A/D converter with a quantization error of +/-0.5 LSB (least significant bit).

- **Thermal Module:**
  - Temperature Dependency

    In PSIM 9.0, multiple curves with different temperatures can be entered for Thermal Module devices. For example, the figure below shows the forward characteristics of a diode under different junction temperatures. PSIM will then use the calculated junction temperature from the simulation, and use the junction temperature information in loss calculation.



    The capability to takes into account the temperature dependency makes it possible to predict the device thermal behavior more accurately.

- **MagCoupler Module:**

  The MagCoupler-DL block is improved to handle other devices, such as inductors, linear solenoid, and synchronous reluctance machine.

- **MagCoupler-RT Module:**

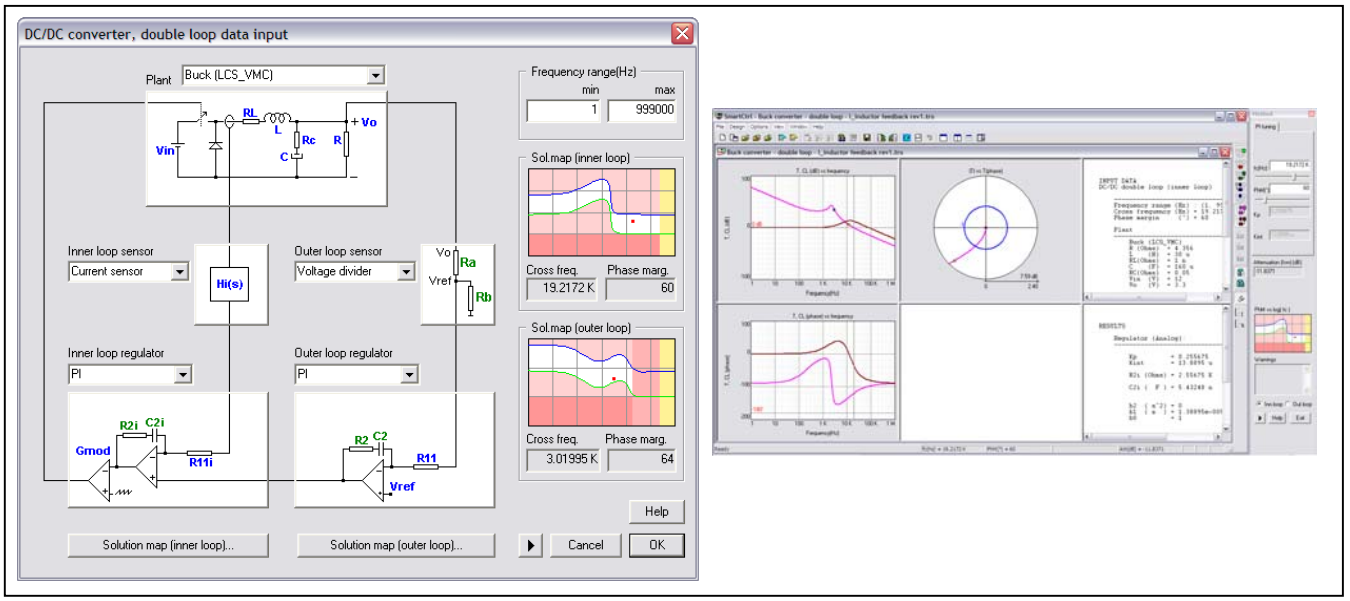
  New MagCoupler-RT blocks are added: 2-phase step machine, linear solenoid, and linear synchronous machine.

- **SmartCtrl Software for Control Loop Design**

SmartCtrl is a self-contained general-purpose control loop design software specifically for power electronics applications. It features easy-to-use interface, simple workflow, and straightforward visual display of control loop stability and performance. Using SmartCtrl, one can design controllers of various power converters (e.g. dc/dc converters, PFC converters, inverters, etc.) easily and with confidence.

- SmartCtrl

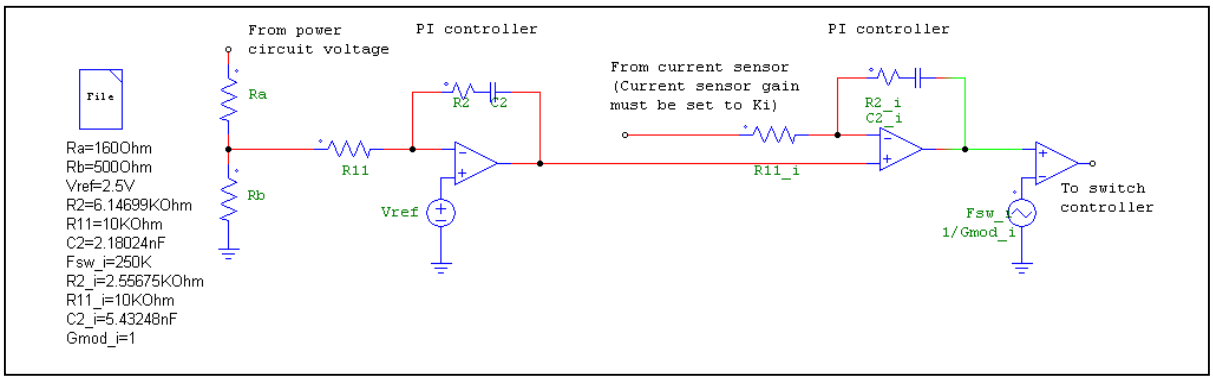
SmartCtrl can design controllers for both single-loop and double-loop structures. The figure below shows a buck converter with the inner current loop and the outer voltage loop.



SmartCtrl introduces a unique tool called *Solution Map* to help users design the controllers. Control loops can be fine tuned easily, and control loop performance in terms of the Bode plot, the Nyquist plot, and time-domain response, can be inspected and evaluated easily.

- Integration with PSIM

SmartCtrl is well integrated with PSIM. After control loops are designed in SmartCtrl, the controller schematic and parameters can be exported to PSIM directly, as shown below.



Also, the ac sweep result from PSIM can be exported to SmartCtrl for control loop design.

The combination of SmartCtrl and PSIM provides a powerful and efficient platform for power converter design and analysis.