New Features in PSIM Version 7.0

Highlights of the key new features in PSIM Version 7.0 are:

- **Interactive simulation with waveform display and parameter change at runtime**
- **Power Modeling Block**
- **C script block**
- **Enhanced command-line simulation**
- **New Thermal Module for power device loss calculation**
- **New MagCoupler-RT Module for linking with JMAG-RT**
- **New Mechanical Power Module for mechanical system simulation**

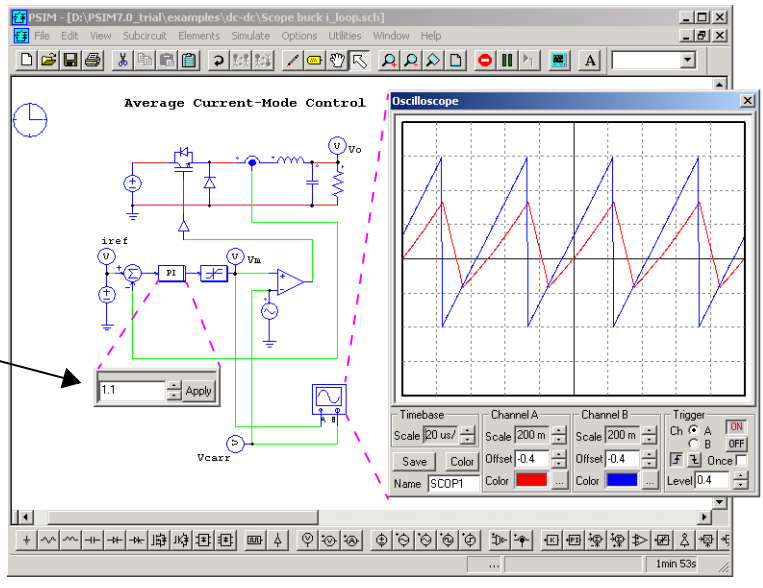
Description of the key new features in Version 7.0, as compared to Version 6.1, is given below.

• PSIM:

• Interactive Simulation

In PSIM 7.0, it is possible to interact with the simulation at runtime. For example, one can run the simulation in the free-run mode (the simulation keeps on running until stopped manually), and in the middle of the simulation, one can display node voltages and branch currents using the oscilloscopes newly added in Version 7.0. In addition, one can change parameter values at the same time and see, right away, how the circuit responds to the change.

For example, the figure below shows a circuit running in the free-run mode.



In this example, a 2-channel scope is used to monitor the inputs of the comparator. These two waveforms are updated and displayed continuously in the scope as the simulation runs. In addition, during the simulation, the gain of the PI controller is being adjusted.

The capability of running the simulation in the free-run mode while adjusting the parameters and viewing the waveforms makes the PSIM simulation environment a virtual test bench as one can tune the circuit on the spot until desired performance is achieved.

- Enhanced Command-Line Option

The command-line option in PSIM allows users to run the entire PSIM simulation with a single command. Moreover, simulation parameter values can be controlled through the command-line parameters. For example, the following command line will set the parameter R1 to 10 and L1 to 0.001, and simulate the circuit "test.sch":

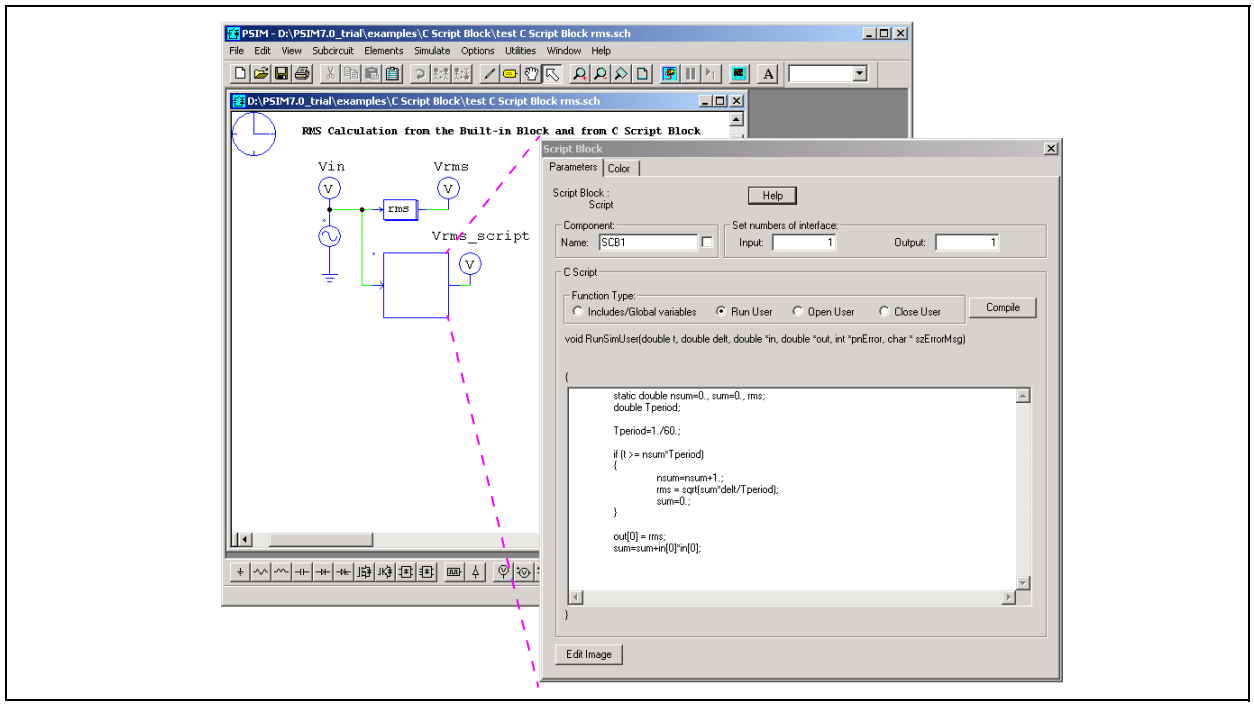
PsimCmd.exe -i "test.sch" -o "test.txt" -v "R1=10" -v "L1=0.001"

This command line can be called from a batch file, or from a custom C code. With this capability, it is, for example, possible to perform optimization of a certain objective by adjusting parameter values and running simulations repetitively until the desired optimum is reached.

- C Script Block

A C interpreter is added to PSIM 7.0. It allows users to enter the custom C code directly in the C script block without compiling. The C code will be interpreted and executed at runtime.

For example, the figure below shows the C code of a C script block for calculating the rms value.

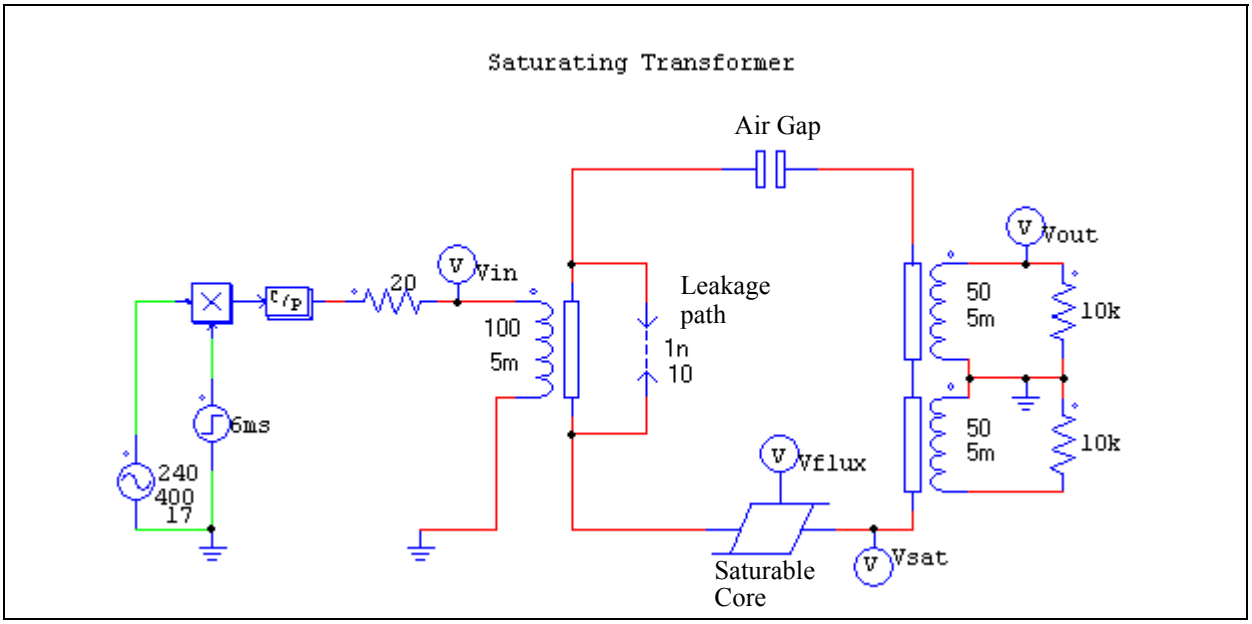


Since compiling or a C compiler is no longer required, the C script block makes it very easy to simulate embedded software devices, and to define the functions of a block using the powerful C language.

- Magnetic Modeling

  Basic building blocks, such as windings, air gaps, leakage flux paths, linear cores and nonlinear cores with saturation and hysteresis, are provided in Version 7.0 for modeling magnetic equivalent circuits. These blocks provide a powerful way of modeling any magnetic devices.

  For example, the figure below shows how the magnetic equivalent circuit of a transformer with saturation can be created using the magnetic elements.



- Power Modeling Block

  The Power Modeling Block allows users to model a power device using the C/C++ code based on equations.

  The main advantage of the Power Modeling Block is that the interface nodes of the block are power nodes. Currents can flow in and out of these nodes, and power balance is maintained. Also, equations defined inside the Power Modeling Block are solved simultaneously, not iteratively, with the rest of the equations in PSIM. This eliminates any problems due to the interface, and makes it very efficient in computation.

- Embedded Software Block

  The Embedded Software Block is a type of DLL blocks. But unlike conventional DLL blocks where an interface port is fixed and is predefined as input or output, the interface ports of the Embedded Software Block can be defined as either input or output at runtime inside the C code. Moreover, additional information, such as the time at which an event occurs, can be passed between PSIM and the block.

  The Embedded Software Block is created specifically for modeling embedded software devices (such as microprocessors or DSP).

- Library Manager

  With the Library Manager, it is possible to add custom device models, either in the form of a subcircuit or DLL, into the PSIM library, with the same interface as the standard PSIM elements. This makes it easier to share custom libraries with others.

- Customized Element Bar and Tool Bar

  PSIM 7.0 allows users to create and customize the Element Bar and Tool Bar.

- Hot Key Feature

  Function can be assigned to the keyboard (for example, the key "R" can be assigned for retrieving resistor from the library). This makes it very easy to create and edit a circuit.

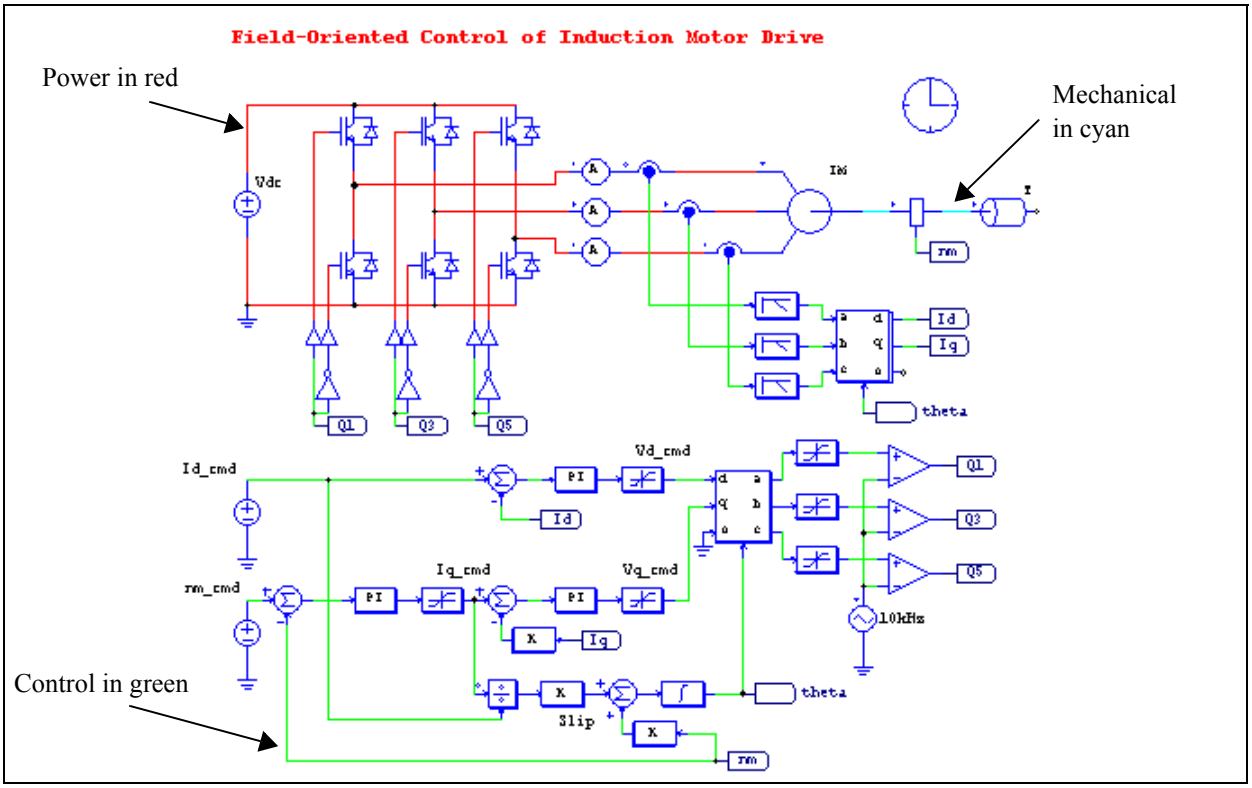
- Library Browser

  A Library Browser is provided which allows users to navigate and retrieve elements from the library easily.

- System Display by Color

  With this feature, wirings of different types of a system can be displayed in different colors.

  For example, in the following induction motor drive system, the wiring for the power circuit is in red, and wiring for the control circuit is in green, and the wiring for the mechanical system is in cyan.



- Simulation Results in Binary Format

  In PSIM 7.0, simulation results can be saved in either binary or text format. When saved in binary format, the output file is reduced by more than half in size as compared to the file in text format.

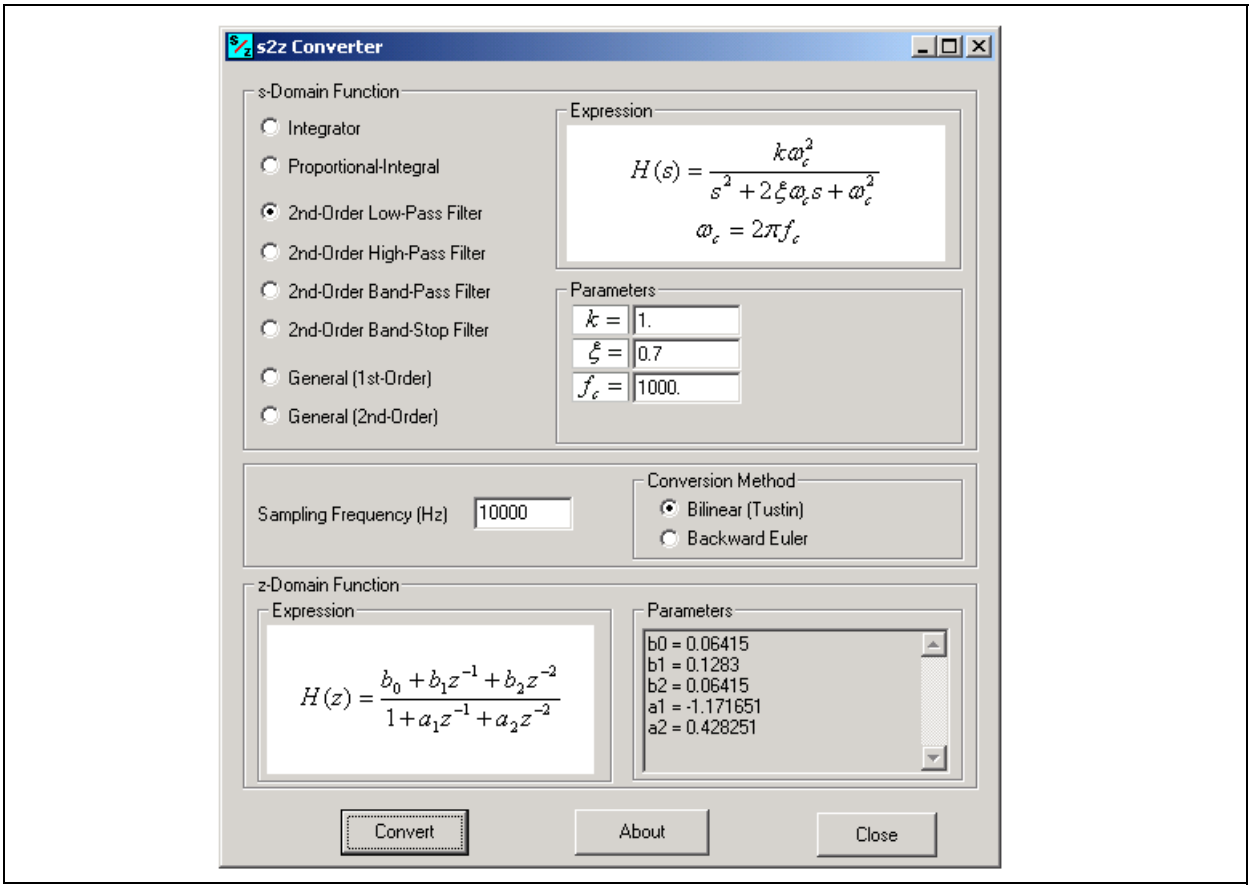
- Improvements in SIMVIEW

  The overall interface of the waveform processing program SIMVIEW has been greatly improved.

• Digital Control Module:

- Utility Tool to Discretize s-Domain Functions to z-Domain

  A handy utility tool is provided to discretize s-domain transfer functions to z-domain transfer functions. A screenshot of this tool is shown below.

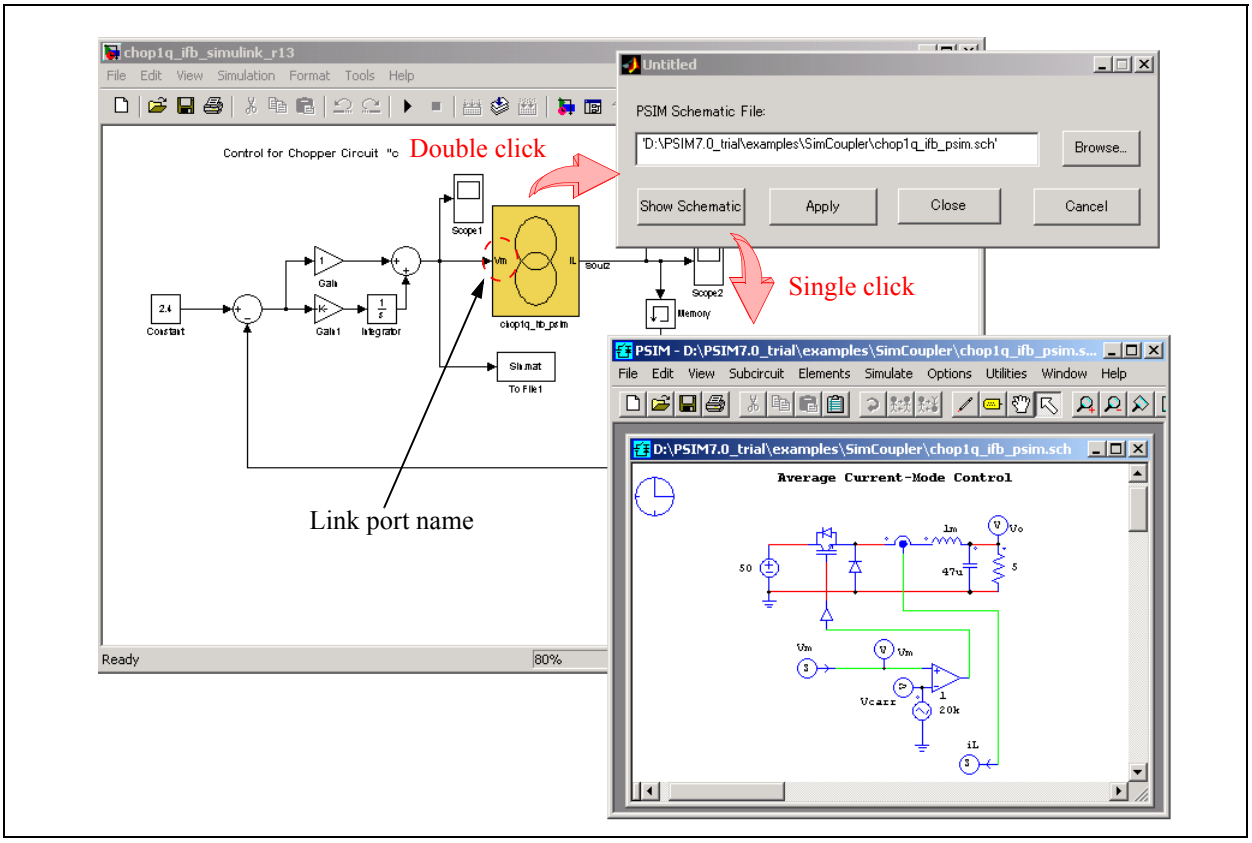


- **SimCoupler Module:**

  - Improvement on the Interface

    The interface of the SimCoupler block in Version 7.0 has been improved significantly as compared to Version 6.1. The improvements include: (a) PSIM link port names can be displayed in Simulink; and (b) users can enter and view the PSIM schematic files with just a click of a button.

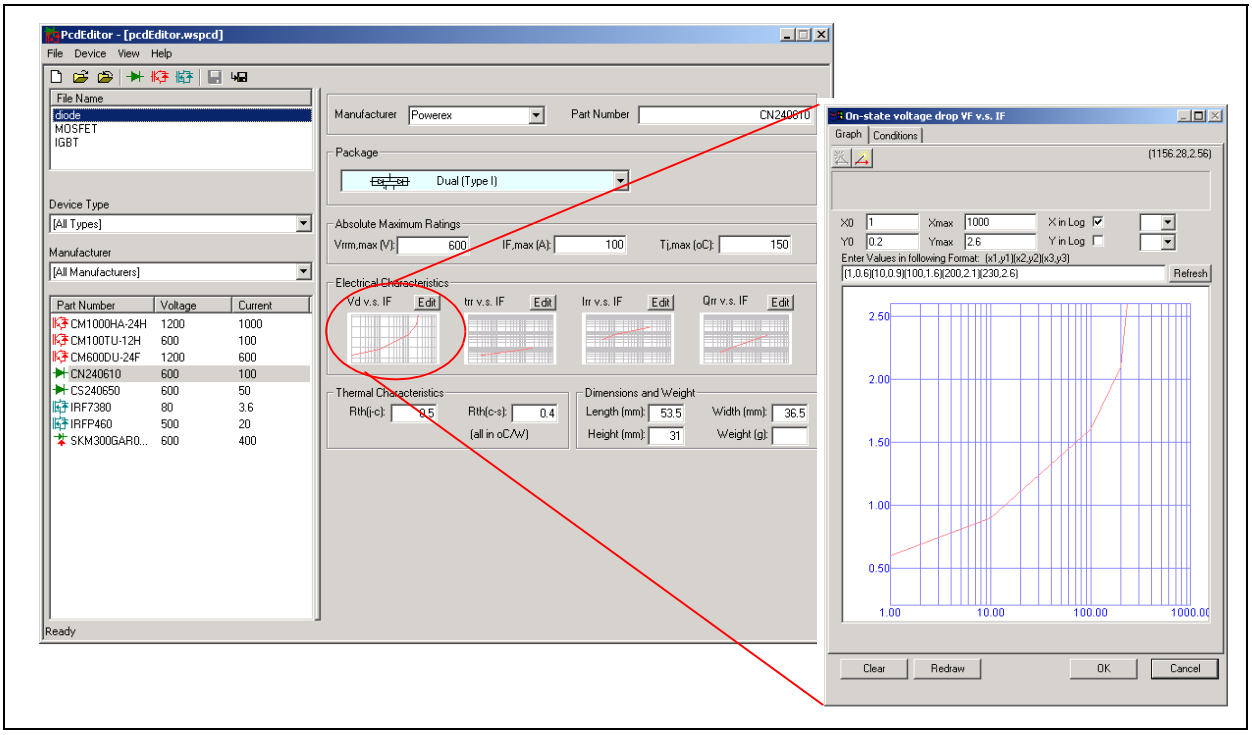
    The figure below shows a SimCoupler block in the Simulink environment. A dialog window will come up by double clicking on the block. In this dialog window, the "Browser" button allows users to browser and find the PSIM schematic file for the co-simulation. Also, by clicking on the "Show Schematic" button in the dialog window, one can view and edit the PSIM schematic file.



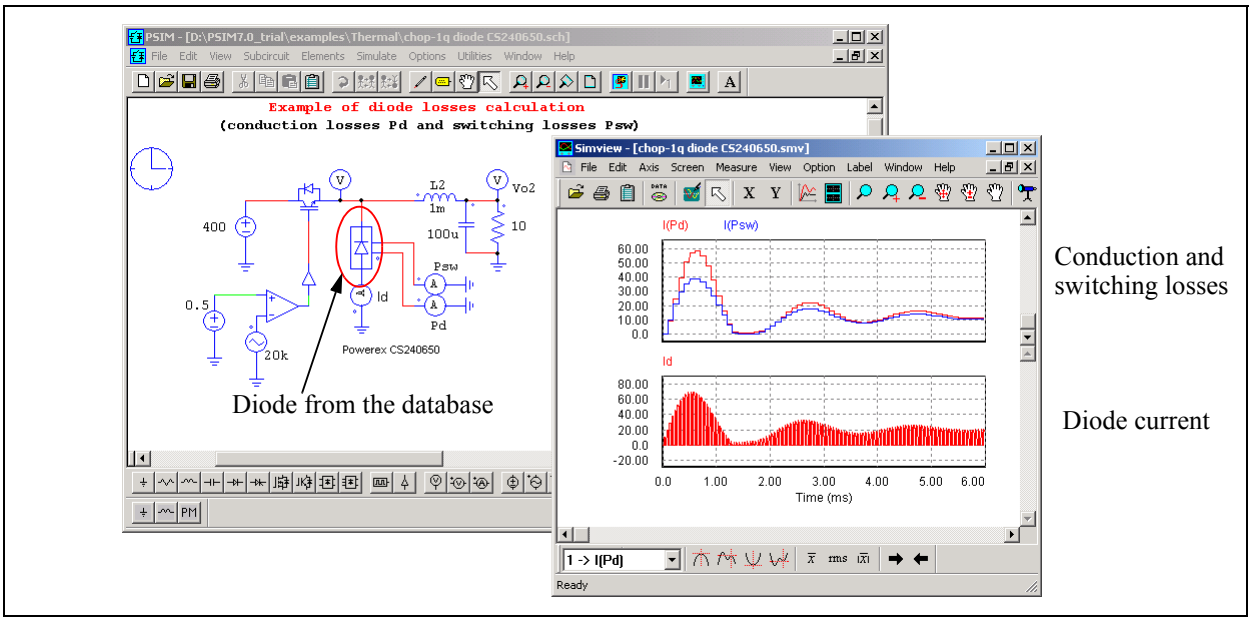
- **Thermal Module:**

The Thermal Module provides a quick way of estimating semiconductor device losses. Facilities of adding the device information to the database are provided. Device conduction losses and switching losses can then be calculated in the simulation based on the device characteristics.

The figure below shows the device database editor. Device information from the datasheet can be easily entered into the database or captured graphically directly from the datasheet image. The enlarged view below, for example, shows the forward conduction characteristics of the diode.



The figure below shows how a diode from the database is used in the PSIM environment. The simulation waveforms show the diode current, as well as the conduction and switching losses.



- **MagCoupler-RT Module:**

  The MagCoupler-RT Module provides the link between PSIM and JMAG-RT data files. JMAG-RT data files are obtained by running the electromagnetic field analysis software JMAG separately.

  The main advantage of JMAG-RT is that, since the JMAG-RT data are obtained from the JMAG simulation, the accuracy of a JMAG-RT model is comparable to that of a dynamic JMAG model. However, since JMAG is no longer involved in the simulation, the simulation is significantly faster with the JMAG-RT model.

- **Mechanical Power Module:**

  The Mechanical Power Module contains all the elements needed for modeling and simulating the dynamics of one-dimensional rotary and linear motion mechanical power conversion systems. This Module contains over 45 elements, including inertia, springs, dampers, gears, planetary gears, belts, bearing, clutches, and various sources and sensors, for rotary/linear motions and interface between these two types of mechanical systems.

  With this Module, users will be able to build complicated mechanical systems, such as automotive drive drain, mechanical loads of electric drives and automatic manufacturing systems. Together with the PSIM core elements and optional Modules, users can perform multi-domain dynamic modeling and simulation of real-world power generation/transmission/utilization systems. Furthermore, the Module is fast and easy to use, and helps to increase engineering productivity in designing and analyzing complicated system dynamics.