



PLECS

*DEMO MODEL*

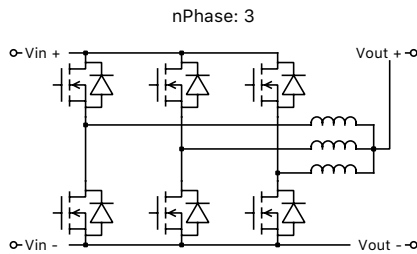
## Multiphase Synchronous Buck Converter

Last updated in PLECS 4.6.1

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**Figure 2: Switching cell**

## 2.2 Controls

The switch modulation is generated by comparing the modulation index, provided via feedback control, with the output of a Triangular Wave Generator block. The output voltage is measured and compared with a 5 VDC set point. Nested voltage and current PI control loops are used to determine the duty cycle of the FETs. For the current feedback, a voltage measurement is made across a current sensing resistor rather than an ideal ammeter block to account for its associated impedance. The control signal is scaled by a factor of this resistance to effectively convert the voltage measurement into amperes. The gain parameters of the controller are adjusted automatically depending on the switching frequency, output capacitance and resistance. The duty cycle range is limited between 1 % and 99 %, and logic is included to prevent windup of the integrator. The two switches in each phase are then modulated in a complementary manner. In practice, it is important not to gate both switches on at the same time to avoid shoot-through. This is prevented by introducing a dead time to delay the turn-on of the opposing switches. Also, the individual phase currents are averaged over one period and subtracted from the current set point in an effort to reduce the inductor current offset and achieve balancing across the phase inductors.

## 3 Simulation

Run the simulation with the model as provided to view the output signals and individual inductor currents. The simulation includes the start-up of the converter as well as a load step demonstrating the controller response. Try comparing a few simulations with an increasing number of phases - you should be able to observe reduced individual phase current averages and ripple magnitudes, resulting in reduced strain on the individual switches.

## Revision History:

PLECS 4.3.1	First release
PLECS 4.5.5	Updated the PWM modulator
PLECS 4.6.1	Fixed the issue with dead-time

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## *PLECS Demo Model*

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