

PLECS

*DEMO MODEL*

## Space Vector Control of a Boost System

Last updated in PLECS 4.7.1

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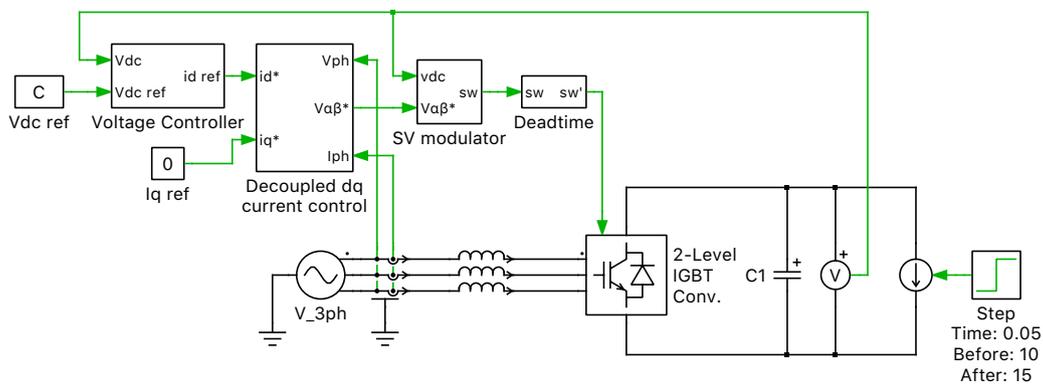
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# 1 Overview

Space vector control is a popular technique used in the control of motor drives or three-phase rectifiers since it offers reduced switching losses and better utilization of the DC bus compared to conventional PWM control. This example model demonstrates space vector control of a three-phase boost-type rectifier.

**Note** This model contains model initialization commands that are accessible from:  
**PLECS Standalone:** The menu **Simulation + Simulation Parameters... + Initializations**  
**PLECS Blockset:** Right click in the **Simulink model window + Model Properties + Callbacks + InitFcn\***

## 2 Model



**Figure 1: System model**

### 2.1 Control

The control goals for the three-phase boost rectifier are to draw sinusoidal current from the input supply,  $v_n$ , and to regulate the output voltage,  $V_{DC}$ . Current control is achieved using an inner current control loop that measures the phase current,  $i_n$ , and controls the inductor-neutral voltage,  $iv_{n1}$ , to force the phase current to track its reference value. The current reference is provided by outer control loops that implement DC voltage and power factor control.

With space vector control, the inductor-neutral voltage is controlled as a vector quantity in the  $\alpha\beta$  or  $dq$  domains. In this example, control is performed in the  $dq$  domain. The advantage of  $dq$  control is that AC quantities become DC quantities in the  $dq$  domain. Thus no tracking error exists when using a PI controller to regulate the AC input current.

The reference AC voltage vector is generated by time-averaging the available switching vectors. Several modulation strategies can be chosen in the space vector modulator: a symmetrical modulation strategy that minimizes the THD, and other Discontinuous PWM (DPWM) strategies that minimize the switching losses. A deadtime component has also been included to simulate the effect of switching delay when changing the switch state of a rectifier leg.

This model uses the Space Vector PWM block in the **Control + Modulators** component library, which is implemented by using a 3-Phase Index-Based Modulation block in series with a Symmetrical PWM block. The probed three-phase modulation index can be viewed to study space vector modulation using the equivalent three-phase zero-sequence signal injection method [1] [2].

## References

- [1] K. Zhou and D. Wang. "Relationship between space-vector modulation and three-phase carrier-based PWM: a comprehensive analysis." in *IEEE Transactions on Industrial Electronics*, vol. 49, no. 1, pp. 186-196, Feb. 2002.
- [2] A. M. Hava, R. J. Kerkman and T. A. Lipo. "Simple analytical and graphical methods for carrier-based PWM-VSI drives," in *IEEE Transactions on Power Electronics*, vol. 14, no. 1, pp. 49-61, Jan. 1999.

## Revision History:

PLECS 4.3.1	First release
PLECS 4.7.1	Update demo after the updated library Space Vector PWM block

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### *PLECS Demo Model*

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