

PLECS

*DEMO MODEL*

## Voltage Source Inverter

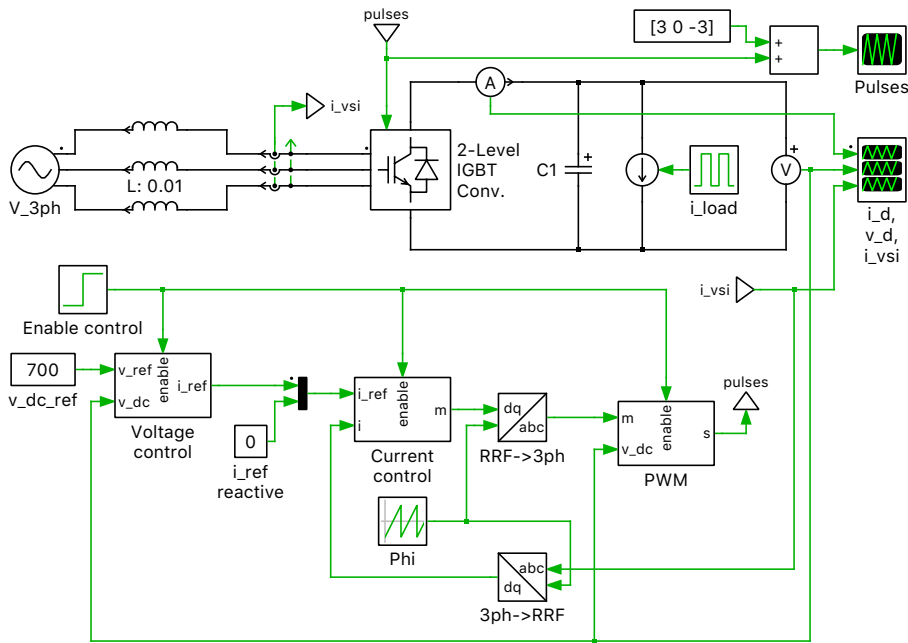
Last updated in PLECS 4.3.1

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# 1 Overview

This demonstration shows a closed-loop controlled 3-phase voltage source inverter operating as an active rectifier.



**Figure 1: Voltage source inverter operating as active rectifier in closed-loop control**

## 2 Model

### 2.1 Electrical model

A stiff three-phase voltage source with line inductance is connected to the AC-side of a 2-level IGBT converter. The DC-side of the inverter is connected to a load, modeled as an ideal current source, via a DC-link capacitor. The load is initially disconnected and is then connected periodically, drawing 20 A of current for a 40 ms interval during each cycle. The demo model “Voltage Source Inverter with Pre-Charge” includes DC-link pre-charging resistors connected to the three-phase source to limit the in-rush current at startup.

### 2.2 Control

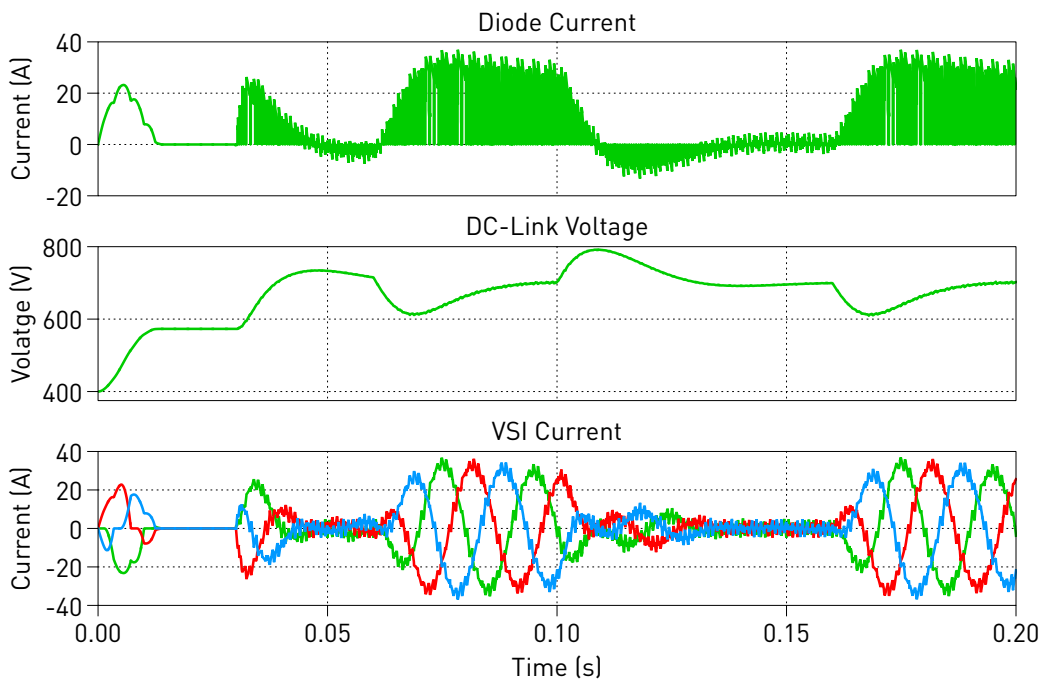
The inverter is controlled with an outer voltage control loop and an inner current control loop. The DC-link voltage is measured and compared against a voltage set point. The error signal is converted to a d-axis current set point via a PI regulator. The circuit is controlled to achieve unity power factor by setting the d-axis current set point to zero. The dq-current set points are then fed to a current controller.

The three-phase currents are measured and transformed to the dq-axis. A PI regulator with a feed-forward term is used to convert the current error signal into a corresponding modulation signal. The modulation signal is scaled with the DC-link voltage and fed into a PWM modulator to generate the gating signals for the IGBT converter.

### 3 Simulation

Initially all the controls are disabled and the 2-level IGBT converter acts as a passive rectifier. The rectified three-phase voltage charges the DC-link capacitor to the rectified three-phase voltage. When the controls are enabled, after 30 ms, the DC-link capacitor is actively controlled to the 700 VDC set point. At 60 ms the load is stepped into the circuit and starts drawing 20 A. This causes a sag in the DC-link voltage as the capacitor is discharged by the load.

As the capacitor voltage sags, the voltage error increases and the voltage controller adjusts the current set point to draw additional power from the source to increase the DC-link voltage back to the desired level. At 100 ms the load is removed and the DC-link voltage overshoots the 700 VDC voltage set point. This voltage sag and overshoot is repeated throughout the simulation as the load periodically draws power. The waveforms of rectified current, DC-link voltage, and three-phase currents are depicted in Fig. 2.



**Figure 2: Simulation result of voltage source inverter operating as an active rectifier**

## Revision History:

PLECS 4.3.1      First release

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### *PLECS Demo Model*

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