



PLECS

*DEMO MODEL*

## Voltage Source Inverter with Pre-Charge

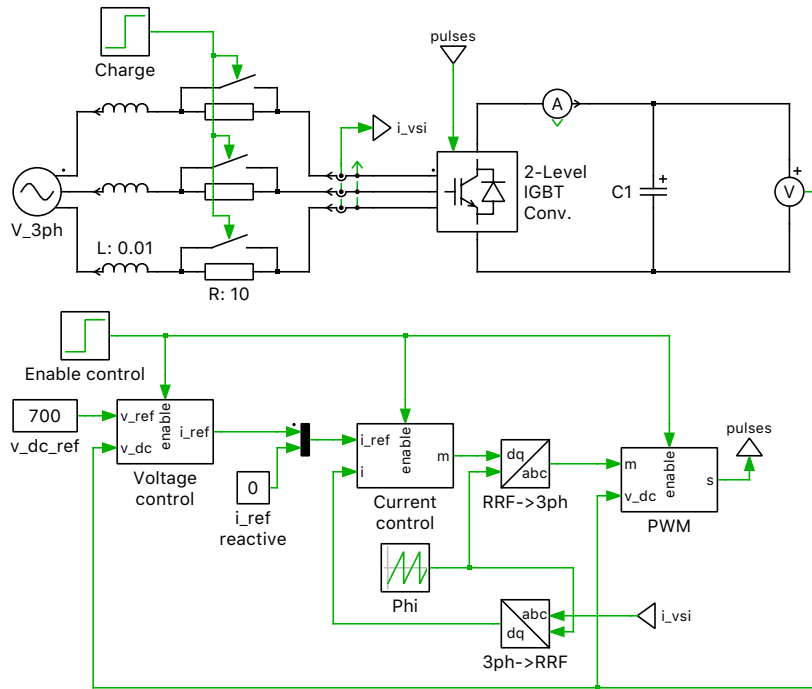
Last updated in PLECS 4.3.1

[www.plexim.com](http://www.plexim.com)

- ▶ Request a PLECS trial license
- ▶ Check the PLECS documentation

# 1 Overview

This demonstration shows a closed-loop controlled 3-phase voltage source inverter with a DC-link pre-charge.



**Figure 1: Feedback-controlled three-phase grid-connected thyristor (SCR) rectifier**

## 2 Model

### 2.1 Power circuit

A stiff three-phase voltage source with line inductance is connected to the AC-side of 2-level IGBT converter. This model extends the “Voltage Source Inverter” demo model by including pre-charging resistors connected to the three-phase source. These resistors are used to limit the inrush current during the initial charging of the DC-link capacitor.

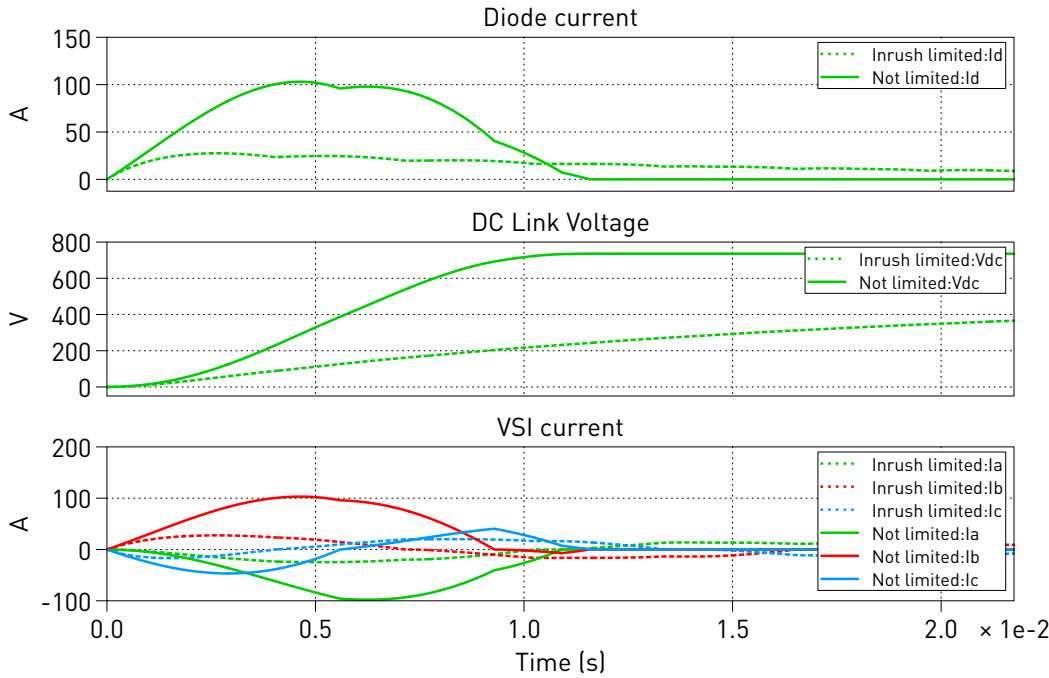
### 2.2 Control

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 setpoint. The error signal is converted to a d-axis current setpoint via a PI regulator. The circuit is controlled to achieve unity power factor by setting the d-axis current setpoint to zero. The dq-current setpoints are then fed to a current controller. The three-phase currents are measured and transformed to the dq-axis. A PI regulator with a feedforward 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 initially charges the DC-link capacitor to the rectified three-phase voltage and the charge current is limited by the pre-charge resistors. After  $t = 30 \text{ ms}$  the pre-charge resistors are switched out of the power line. This causes a rise in the input current. At  $t = 50 \text{ ms}$  the controls are enabled and the capacitor voltage is increased to the desired 700 VDC operating point.

In the PLECS scope labelled with “i\_d, v\_d, i\_vsi”, save the trace and label it “Inrush limited”. Simulate the model again, without using the “pre-charge resistors”, by setting the “Step time” of the “Charge” step function to  $t = 0 \text{ s}$ . Compare the diode current waveform to observe the effect of pre-charging on this circuit.



**Figure 2: Simulation result**

## Revision History:

PLECS 4.3.1      First release

## How to Contact Plexim:

☎	+41 44 533 51 00	Phone
	+41 44 533 51 01	Fax
✉	Plexim GmbH Technoparkstrasse 1 8005 Zurich Switzerland	Mail
@	info@plexim.com	Email
	<a href="http://www.plexim.com">http://www.plexim.com</a>	Web

## *PLECS Demo Model*

© 2002–2023 by Plexim GmbH

The software PLECS described in this document is furnished under a license agreement. The software may be used or copied only under the terms of the license agreement. No part of this manual may be photocopied or reproduced in any form without prior written consent from Plexim GmbH.

PLECS is a registered trademark of Plexim GmbH. MATLAB, Simulink and Simulink Coder are registered trademarks of The MathWorks, Inc. Other product or brand names are trademarks or registered trademarks of their respective holders.