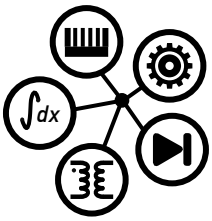

PLECS

DEMO MODEL

Three-Phase 6-Pulse Thyristor Converter

Last updated in PLECS 4.5.1

1 Overview

This example demonstrates a feedback-controlled three-phase grid-connected thyristor (SCR) rectifier. The control scheme first ramps up the output DC current from 0 to $10\,\mathrm{A}$ and then steps it up to $25\,\mathrm{A}$.

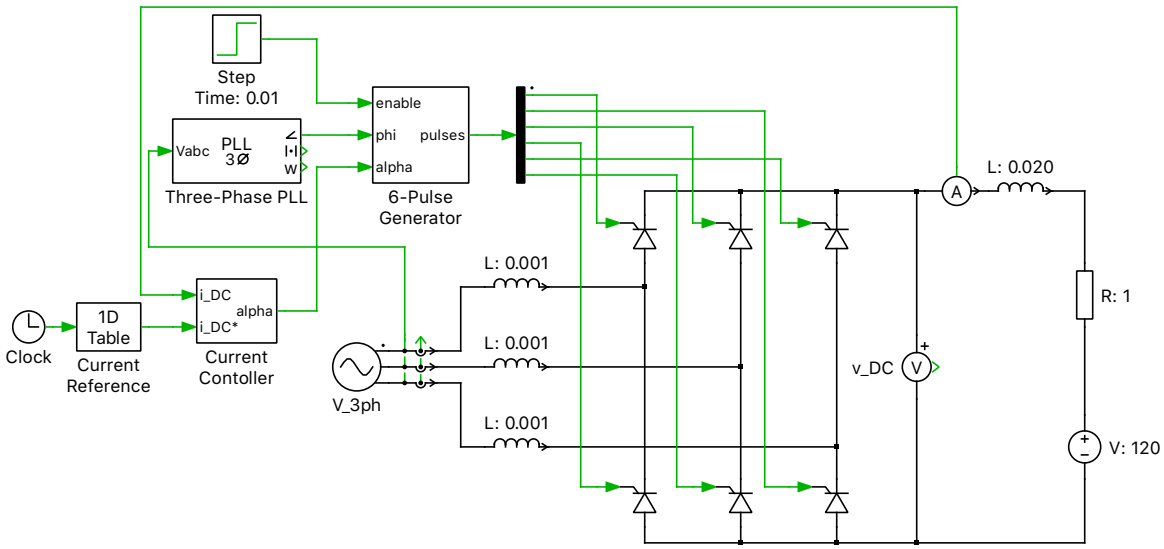

Figure 1: Feedback-controlled three-phase grid-connected thyristor (SCR) rectifier

2 Model

2.1 Power circuit

This three-phase, 6-thyristor AC-DC converter rectifies a three-phase grid source on the AC-side to supply a desired current on the DC-side. A detailed description on the behavior of thyristors can be found in the demo model “Single-Phase 2-Pulse Thyristor Converter” in the PLECS demo models library.

A full-wave rectifier utilizes both the positive and negative pulses of the sinusoidal input waveform to produce a DC output. In reality the output will still contain a certain amount of ripple, but filtering can achieve a specific target of reduced high frequency distortion.

The output voltage of a three-phase rectifier can be estimated with this equation:

$$V_{\mathrm{out}} = \frac{3 \cdot \sqrt{3} \cdot V_{\mathrm{peak}}}{\pi \cdot \cos(\alpha)}$$

Where V_{peak} is the amplitude of the AC input phase (to neutral) voltage and α is the firing angle for the thyristors.
The thyristor firing angle is synchronized with the input voltage to achieve a maximum power factor. A demonstration of a single-phase full-wave diode rectifier with power factor correction is given in the demo model “Single-Phase Diode Rectifier with PFC” in the PLECS demo models library.

2.2 Control

A 6-Pulse Generator component is used to control the firing of the thyristors. A Phase-Locked Loop (PLL) detects the phase angle of the three-phase supply voltage. The low-frequency DC-side current is measured and fed into a current controller. This current is compared with a reference DC current and the error is fed into a PI controller, which generates a firing-angle setpoint. The 6-Pulse generator produces the the switching signals for the 6 thyristors based on the firing angle setpoint from the current controller and the phase angle information from the PLL.

3 Simulation

The DC-side reference current is initially set to zero. At $t = 10\,\mathrm{ms}$, the reference current is ramped up to $10\,\mathrm{A}$, and subsequently stepped to $25\,\mathrm{A}$ at $t = 60\,\mathrm{ms}$. Run the simulation and observe the DC current waveform in the scope. Notice the low-frequency AC-component of the current.

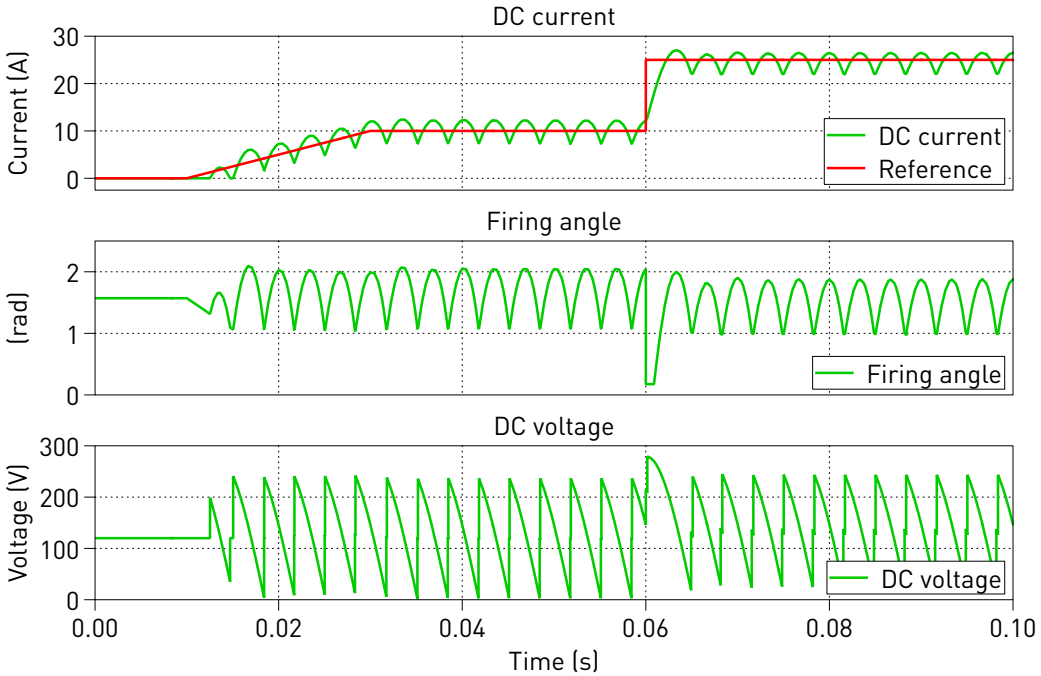

Figure 2: Simulation result

Revision History:

PLECS 4.3.1	First release
PLECS 4.5.1	Updating PLL component with new library block

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
	http://www.plexim.com	Web

PLECS Demo Model