
PLECS for Solar Energy Applications

plecs

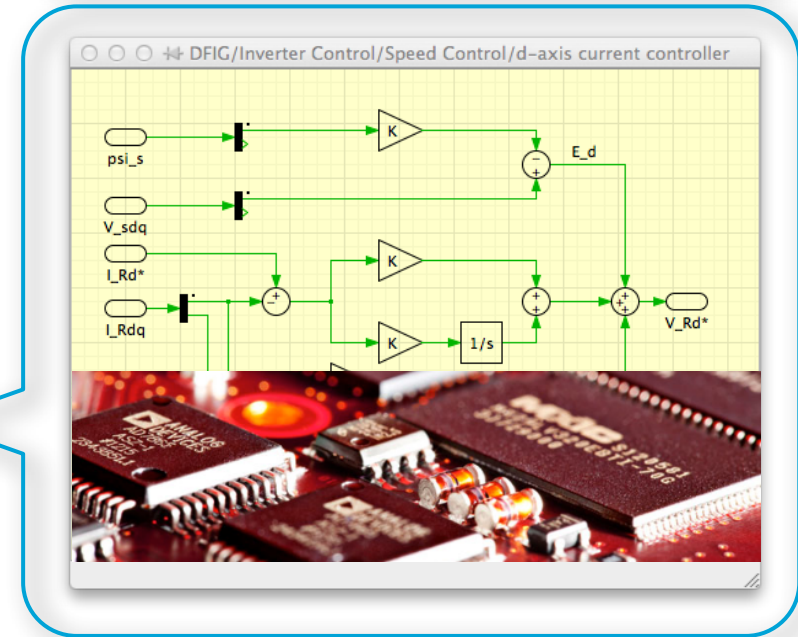
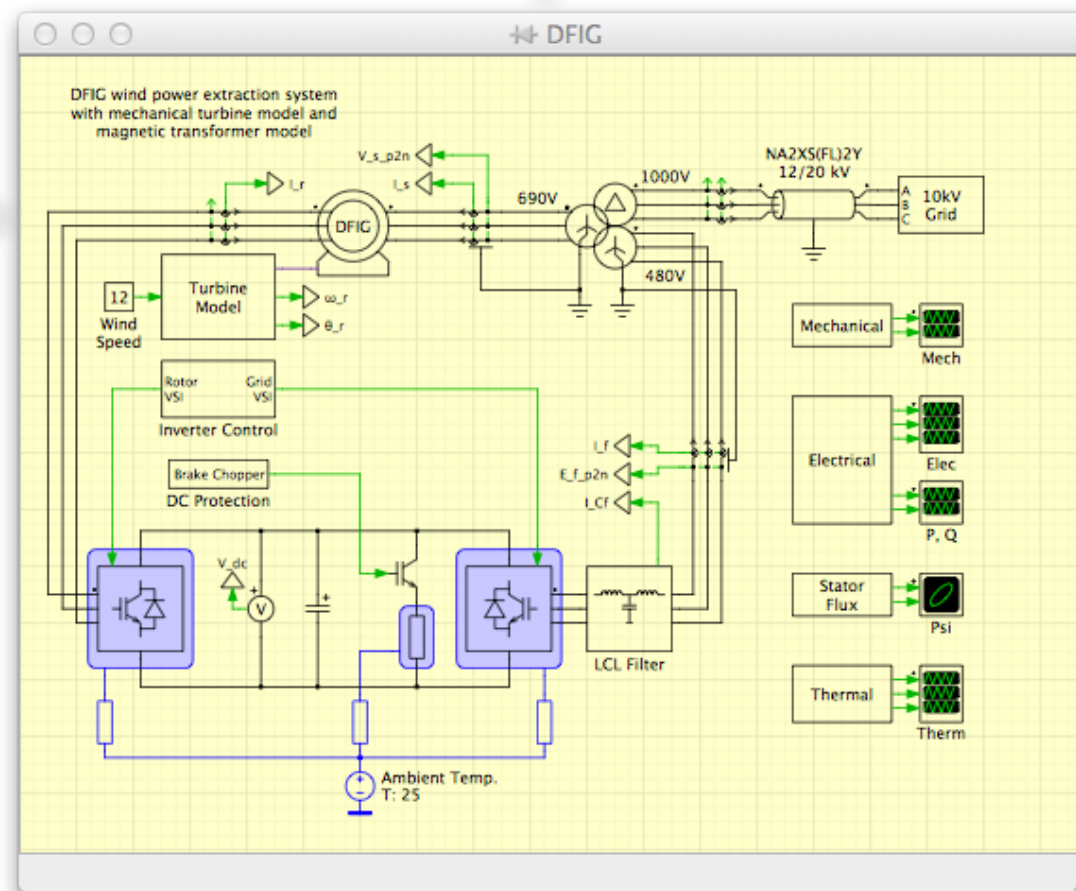
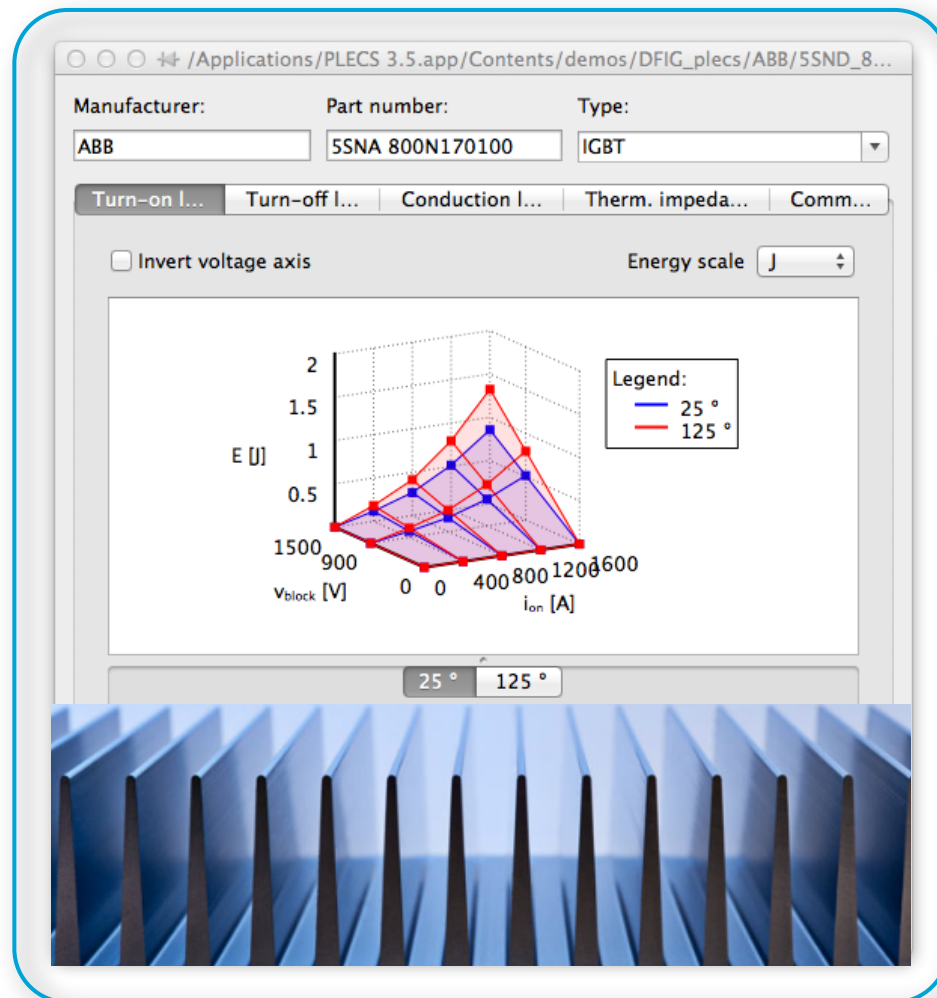
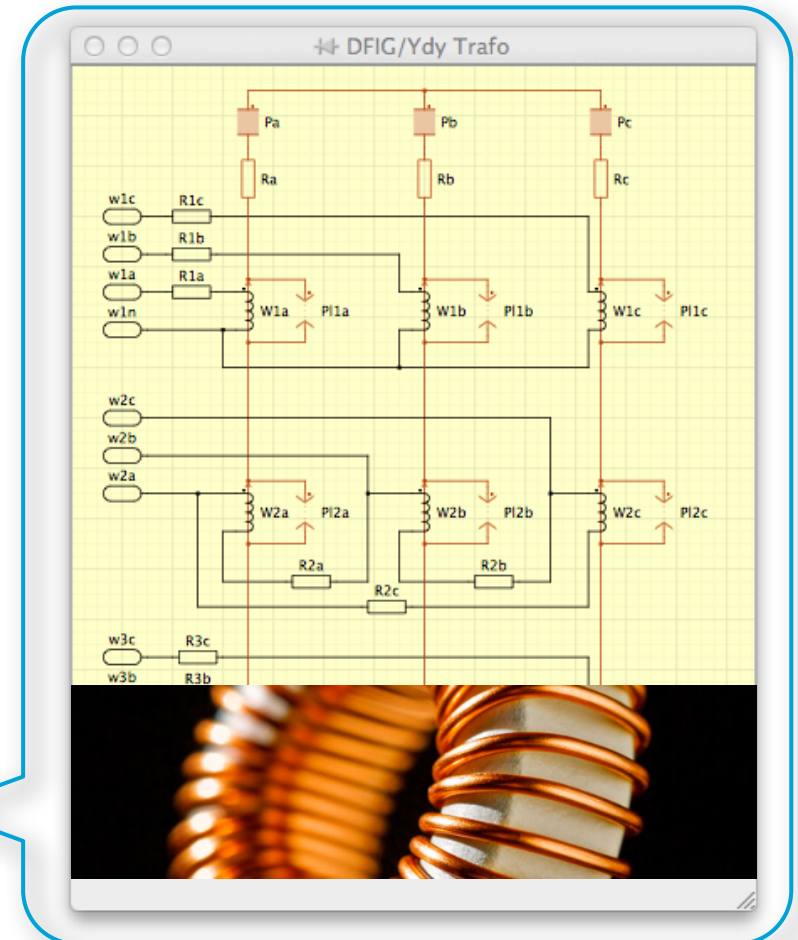
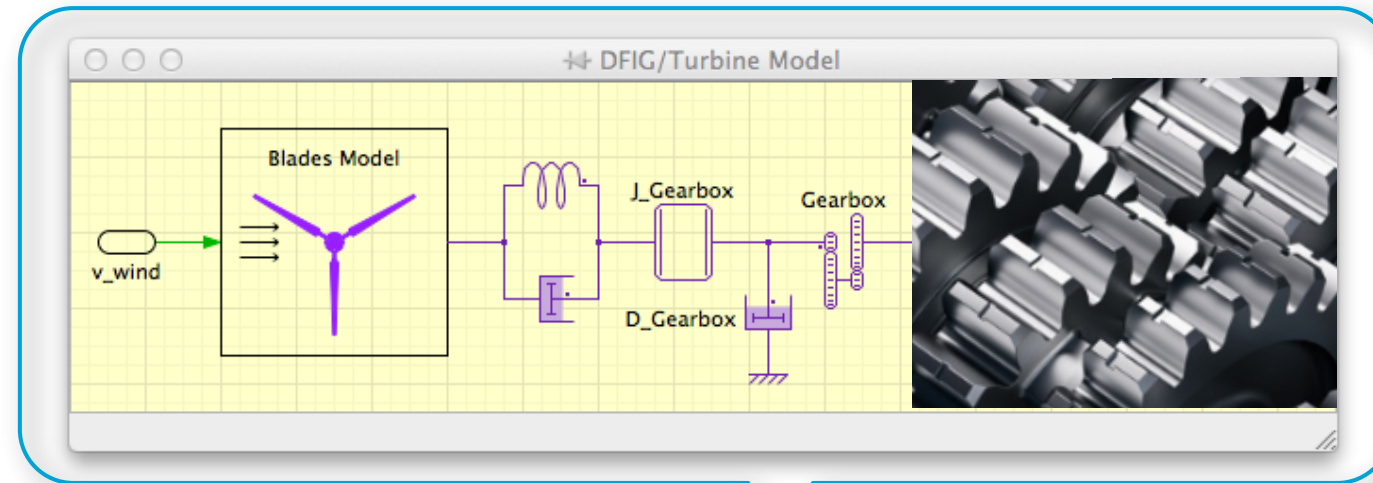


electrical engineering software

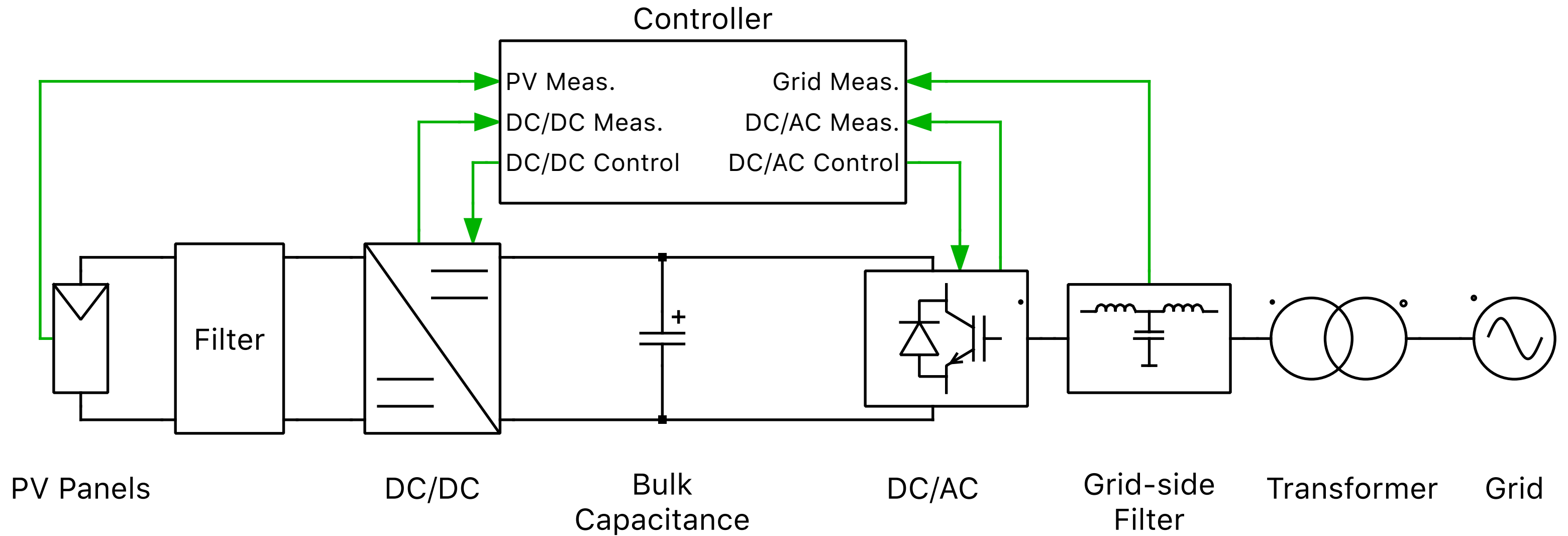
Outline

- ▶ Introduction to PLECS
- ▶ Conventional Standalone PV System Overview
- ▶ Photovoltaic Panel Modeling
- ▶ Single Phase Inverter with Partial Shading
 - ▶ Maximum power-point tracking
 - ▶ DC/DC controls
 - ▶ DC/AC controls
- ▶ SVPWM Control of a Grid-Connected Three-Level NPC Inverter
 - ▶ Hardware-in-the-Loop
 - ▶ Embedded Code Generation

PLECS - Multi Domain System Level Simulation



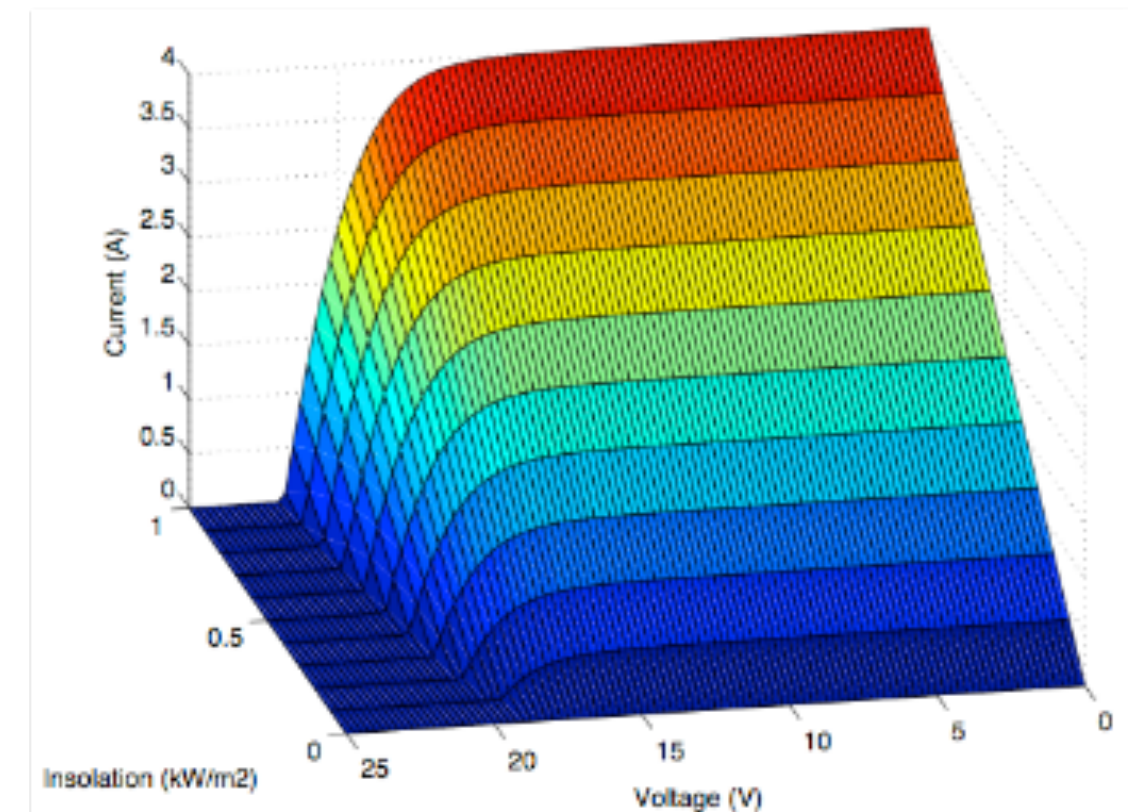
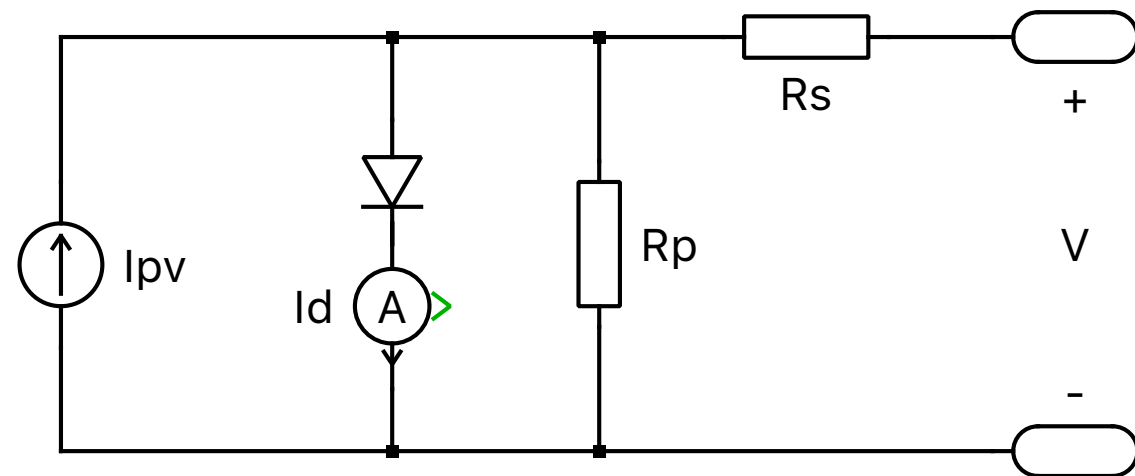
Conventional Standalone Photovoltaic Conversion System



Photovoltaic Panel Modeling

- ▶ Production is a function of insolation, voltage, and temperature.
- ▶ Equation and lookup-table based approaches common

$$I = I_{pv}(G) + I_0 \left(\exp \left(\frac{V + R_s I}{V_t a} \right) - 1 \right) - \frac{V + R_s I}{R_p}$$



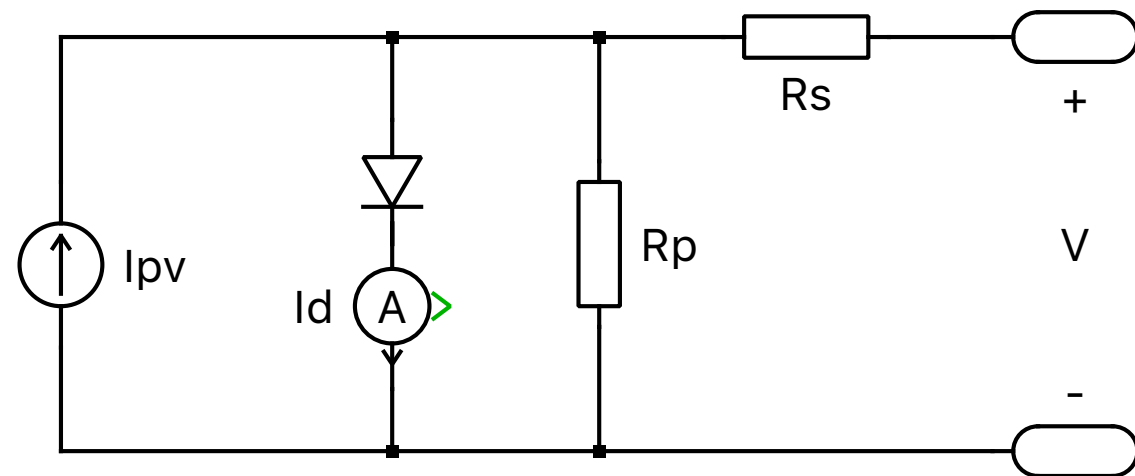
M. G. Villalva, J. R. Gazoli and E. R. Filho, "Comprehensive Approach to Modeling and Simulation of Photovoltaic Arrays," in *IEEE Transactions on Power Electronics*, vol. 24, no. 5, pp. 1198-1208, May 2009, doi: 10.1109/TPEL.2009.2013862.

D. J. Schnberger, "Modeling of a photovoltaic string using PLECS", 2009, [online]

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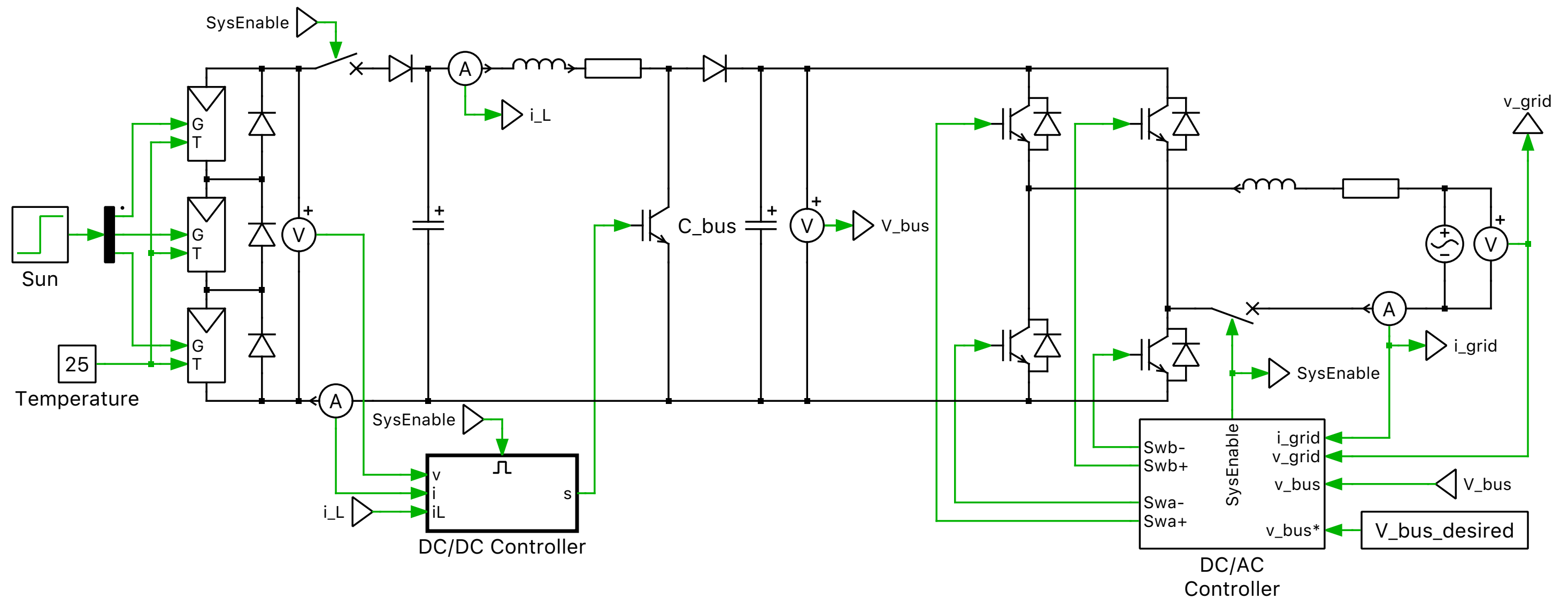
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R_s	0.221 Ω
R_p	415 Ω
I_{pv}	8.214 A
I_0	9.8e-8 A
$V_t = N_s k T / q$	1.3867 V
a	1.3

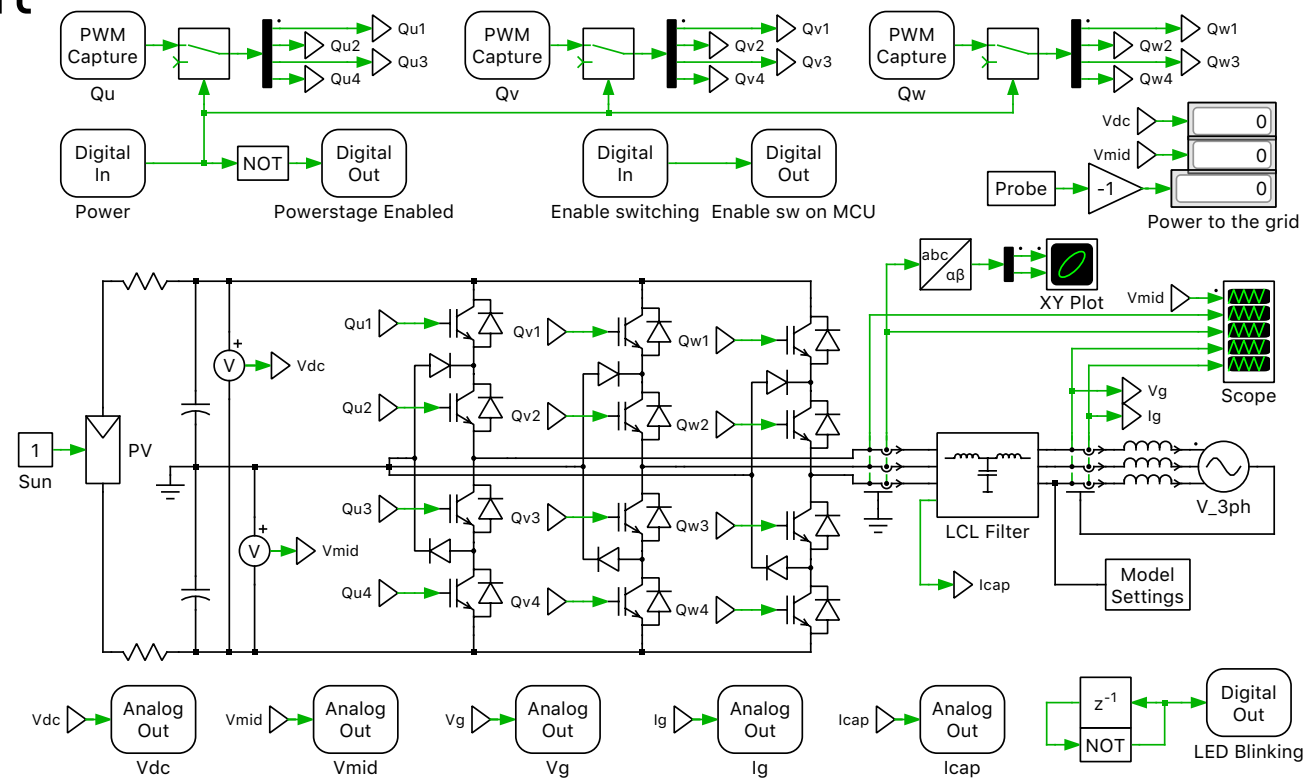
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Single-Phase PV Inverter with Partial Shading

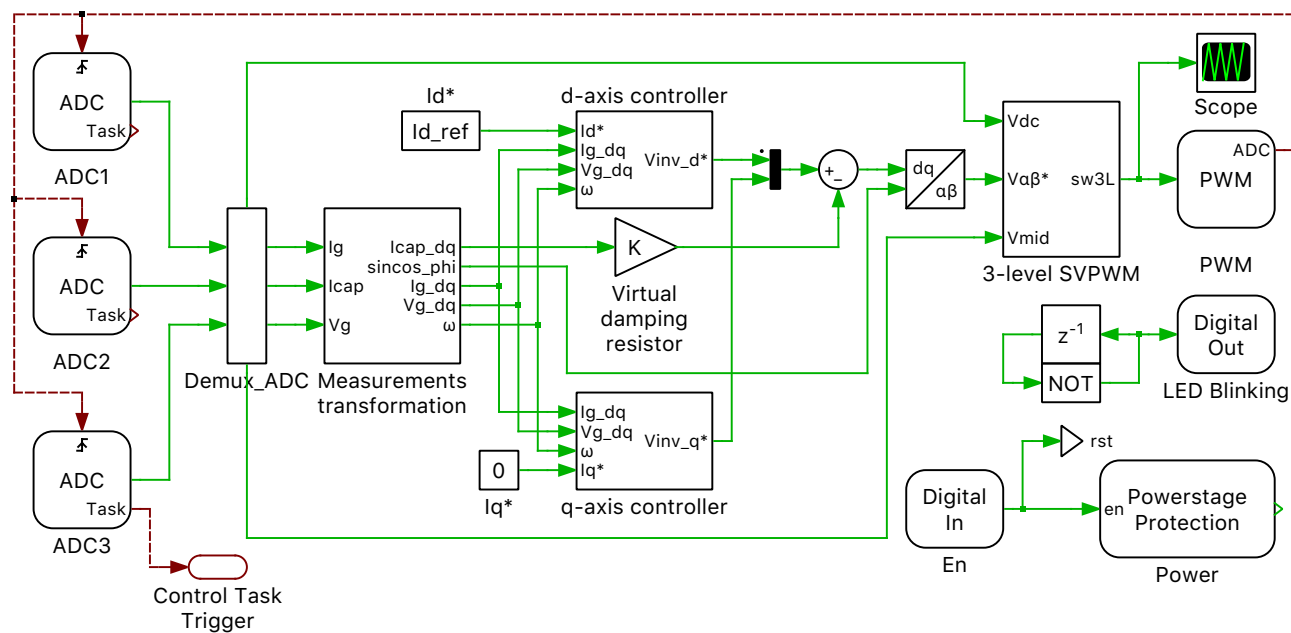


Hardware-in-the-Loop and Embedded Code Generation Demo

Plant



Controller



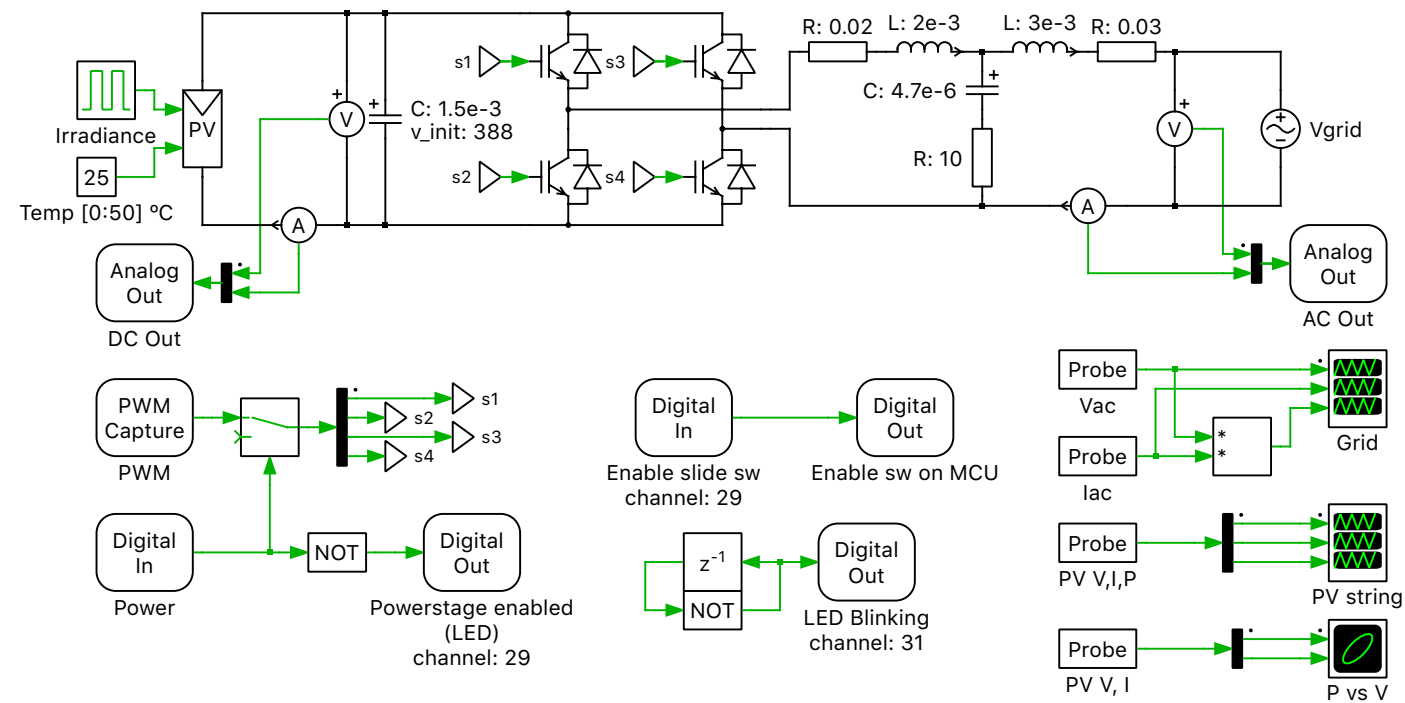
PLECS RT Box



TI 28379D
LaunchPad

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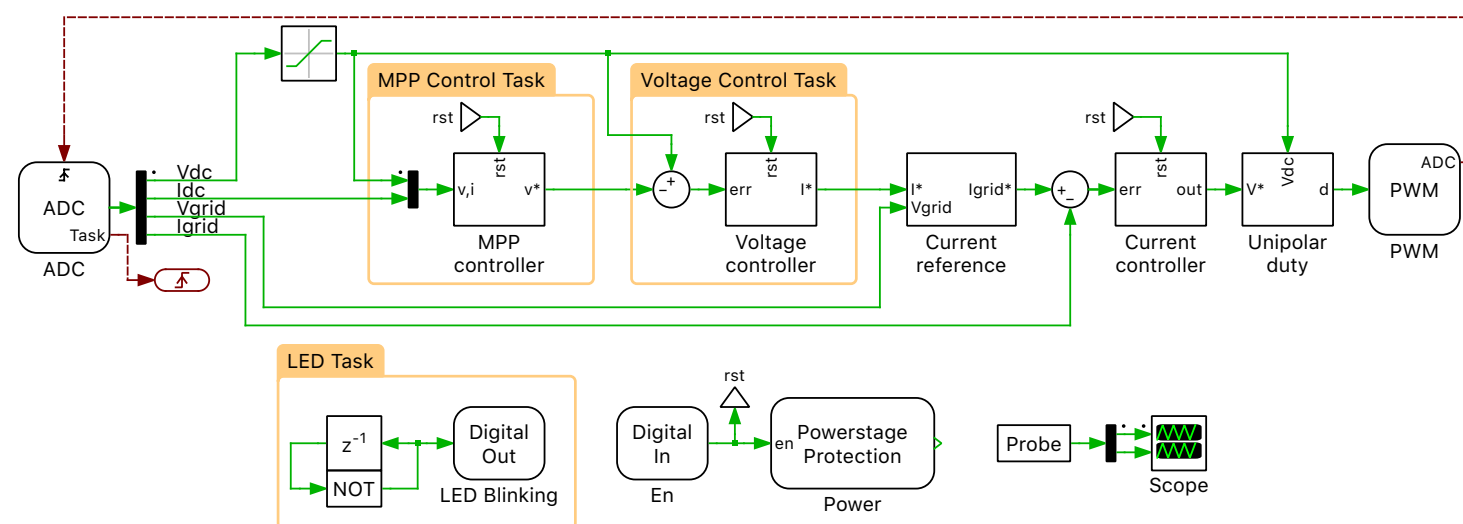


PLECS RT Box

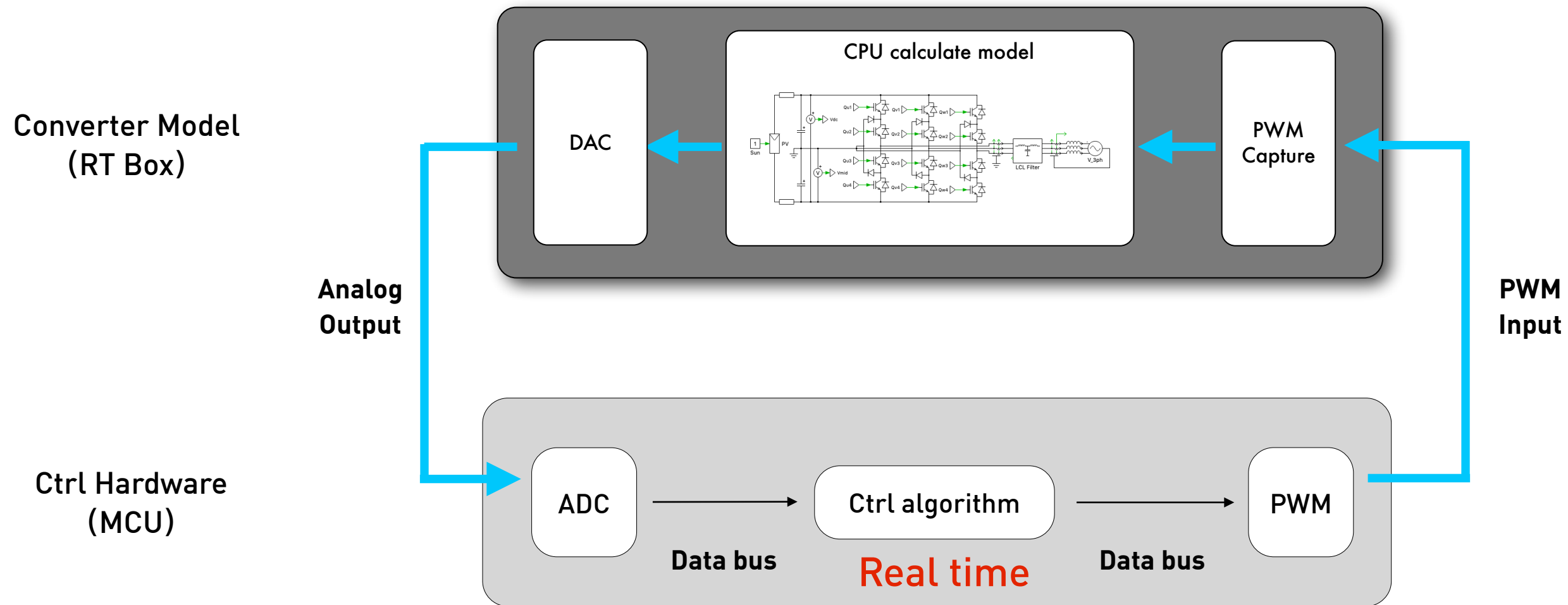


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Controller



Hardware In the Loop (HIL) - Detailed Structure



electrical engineering software

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