« EMR and tools in an education programm»

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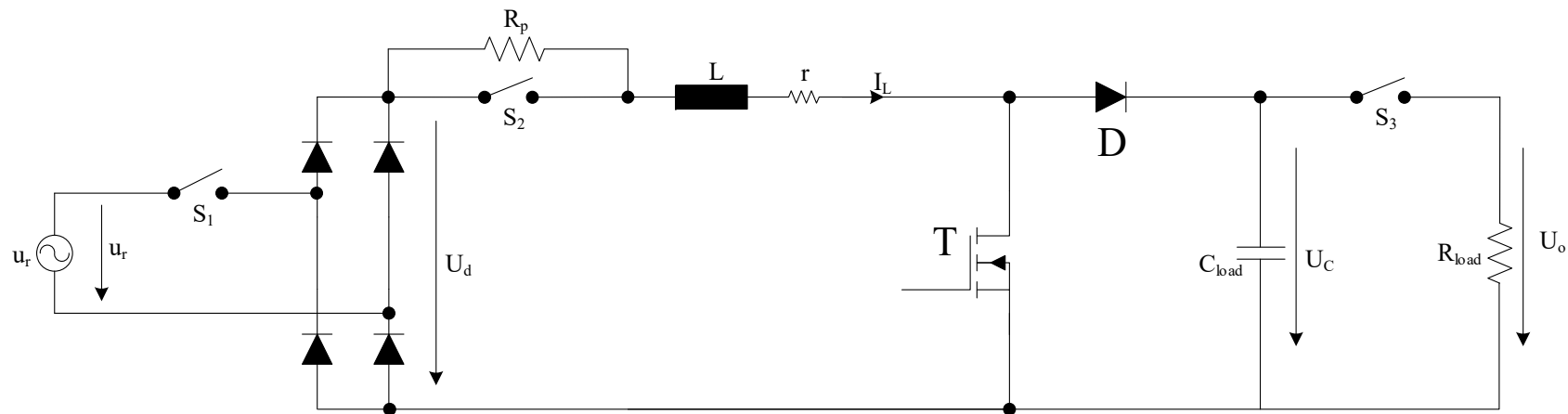
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EMR and tools in an education programm

1 **Context**

2 **Control identification of a PFC**

3 **From control identification to experimental tests**

4 **Conclusion**

« Context »

- Lab proposed for Bachelor Students

  – End last semester / 4 sessions

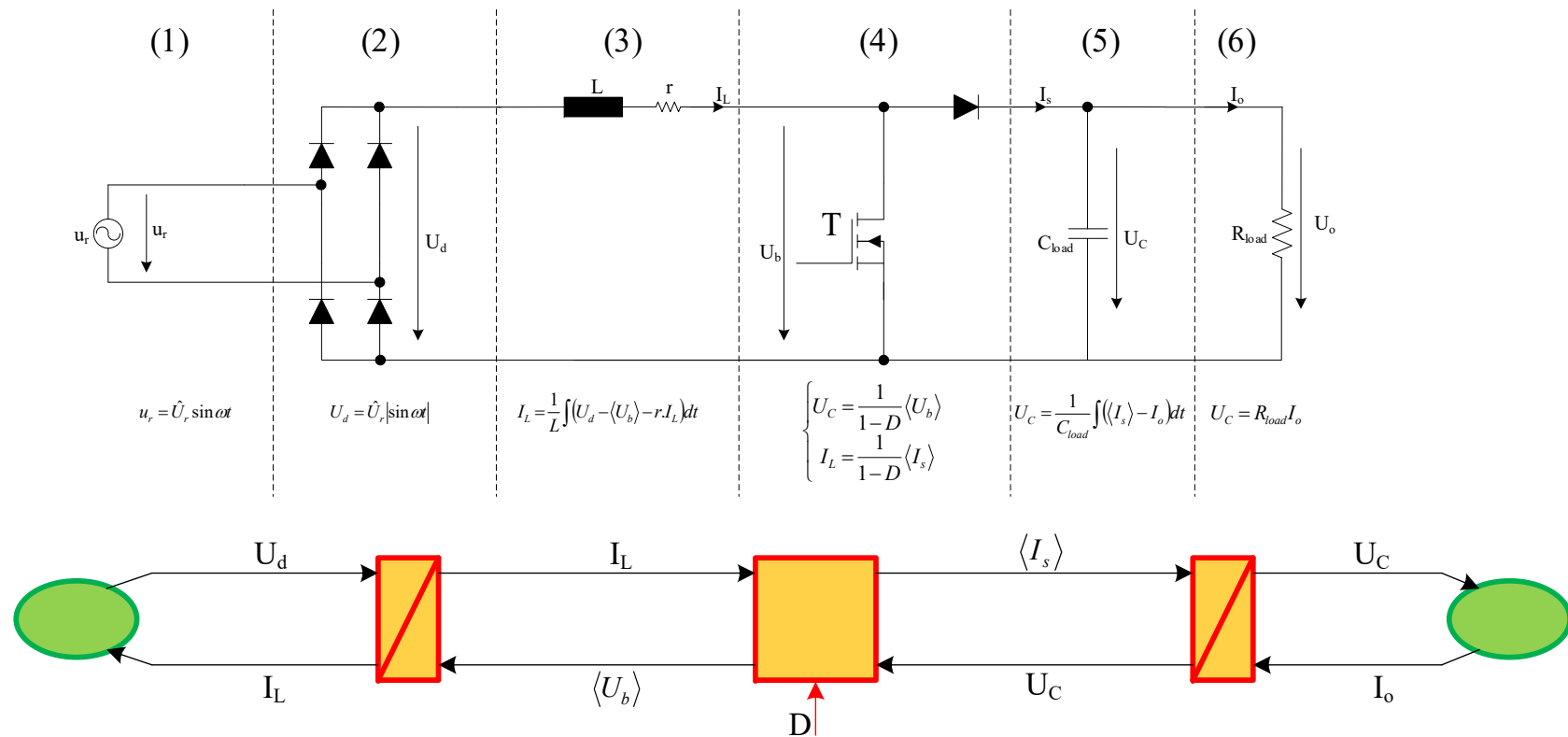 – Implementation of the control for a standard PFC rectifier

  – Objective

    – Control out voltage to 400V / 1200kW

    – Match with norms IEC-61000-3-2

«Control identification of a PFC»

- Focusing on control only, components for switching on/off the system and pre-load circuit are not considered

  - Main hypothesis: average model for the power converter.

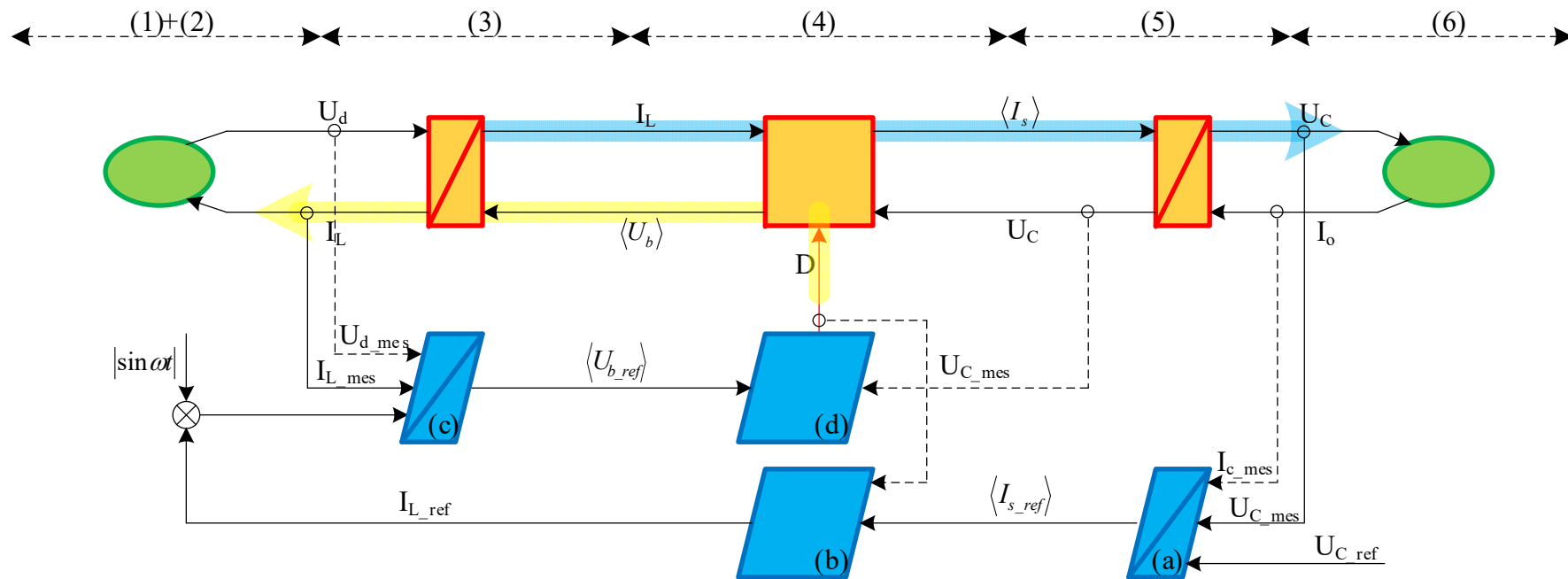 - Assumption: feeding source is a single phase grid and a diode rectifier.

(1) (2) (3) (4) (5) (6)

$$u_r = \hat{U}_r \sin\omega t$$

$$U_d = \hat{U}_r |\sin\omega t|$$

$$I_L = \frac{1}{L}\int(U_d - \langle U_b\rangle - r.I_L)dt$$

$$\begin{cases} U_C = \frac{1}{1-D}\langle U_b\rangle \\ I_L = \frac{1}{1-D}\langle I_s\rangle \end{cases}$$

$$U_C = \frac{1}{C_{load}}\int(\langle I_s\rangle - I_o)dt$$

$$U_C = R_{load}I_o$$

U_d I_L $\langle I_s\rangle$ U_C

I_L $\langle U_b\rangle$ U_C I_o

D

- Objective : control of out voltage
- Constraint : Current must be a rectified sinewave in the main coil

« From control identification to experimental tests »
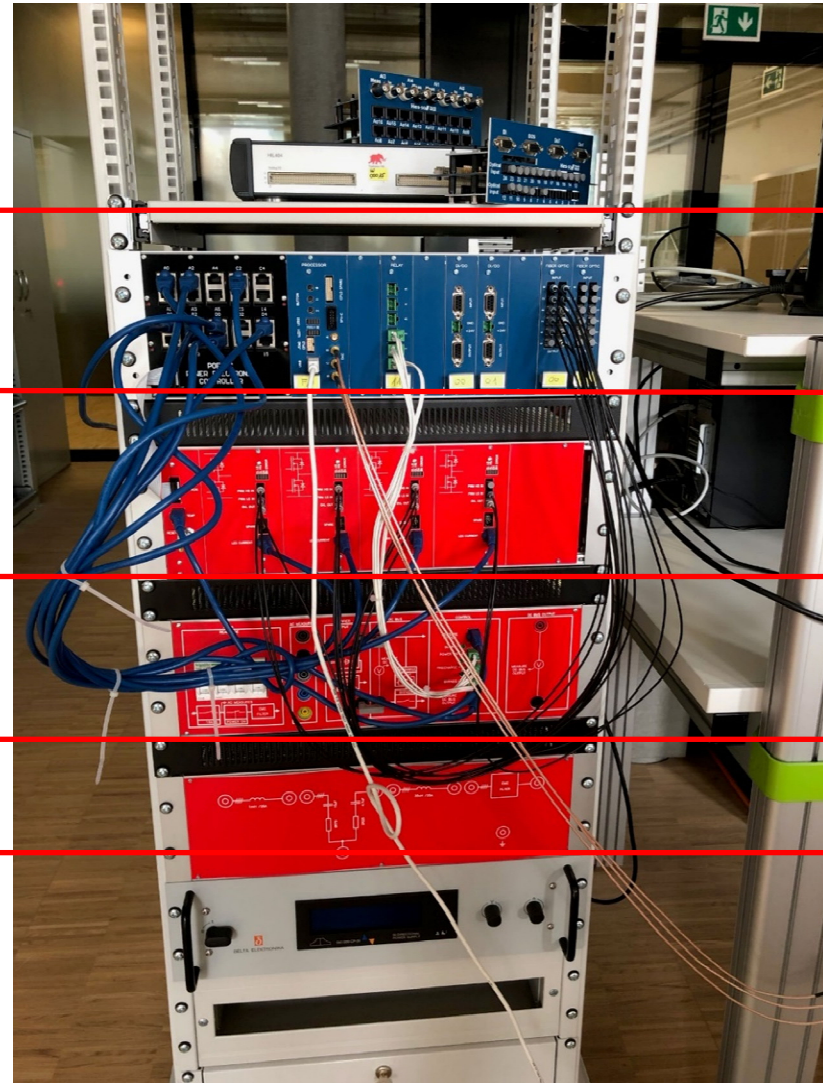
- POETIC: Power Electronics Control

Real-time simulator: interfaces board compatible
With Digital control platform and system sensors

Digital control platform. ADCs, muC, Digital
Input and Output

Power Board: 4 legs, current sensors,
over-current protections
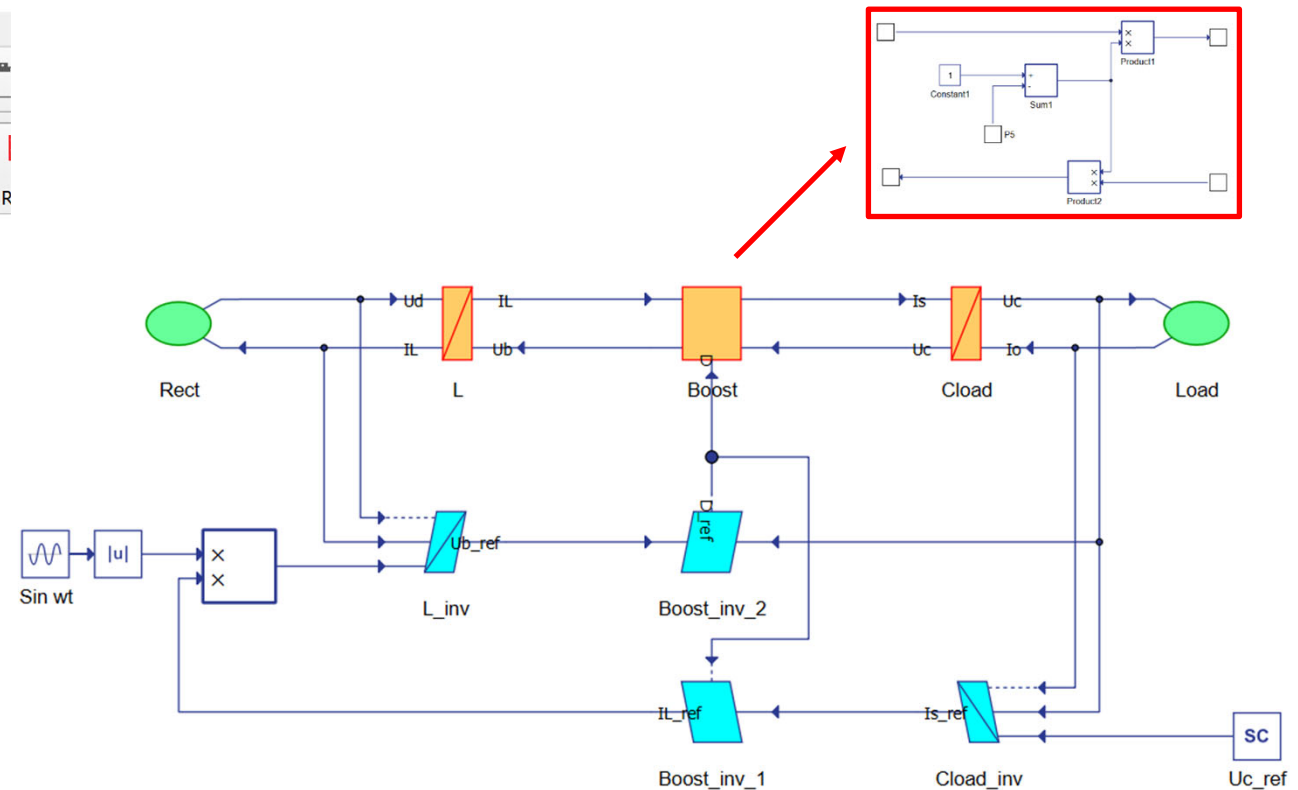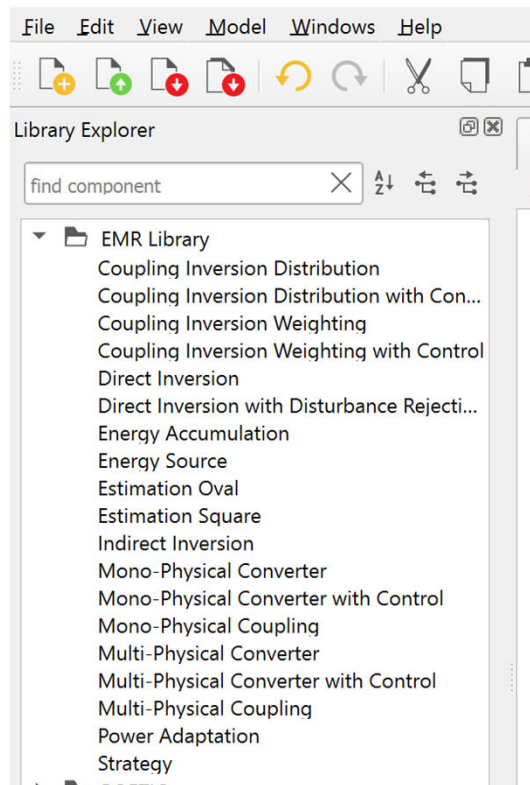
Input Board: rectifiers, pre-charge unit,
Voltage sensors

Filter Board

- Using a real-time simulator…. as a simulator

  - With a dedicated library of elements (from PANDA EU project)

  - Elements are empty, one must define all models to be implemented!

- Using a real-time simulator…. as a simulator

  - With a dedicated library of elements (from PANDA EU project)

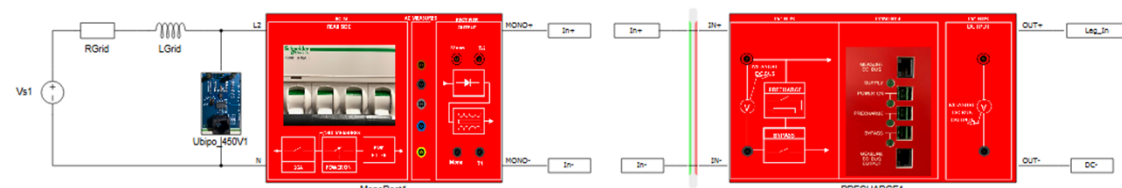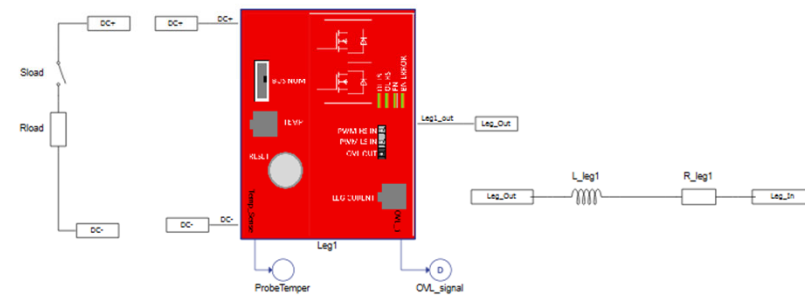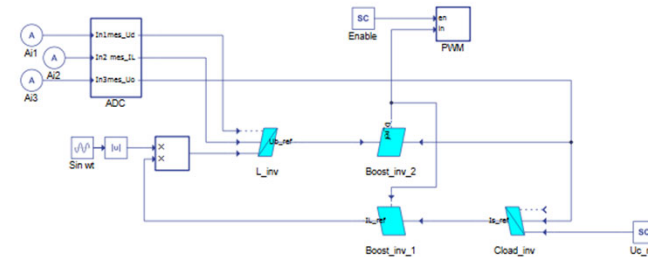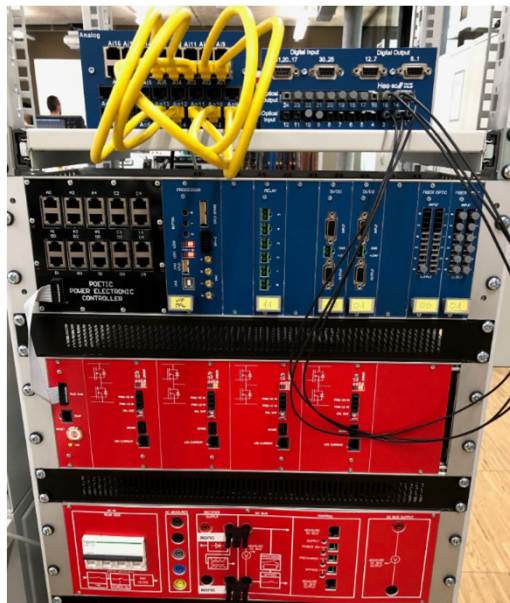 - With a library of models, developed according the POETIC modules
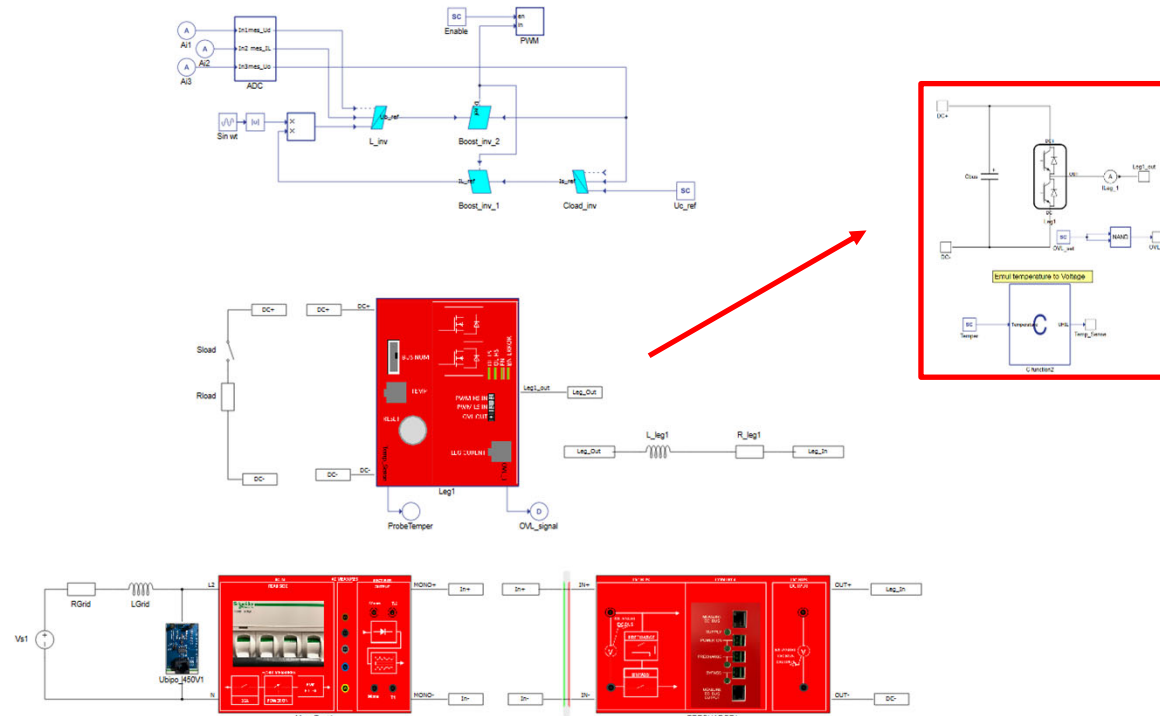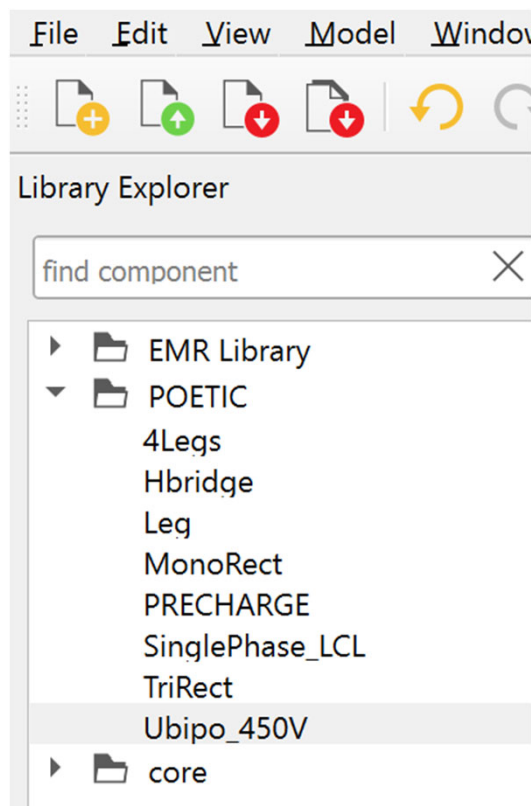
- Using a real-time simulator…. as a simulator
  - Link between control and simulated system are external
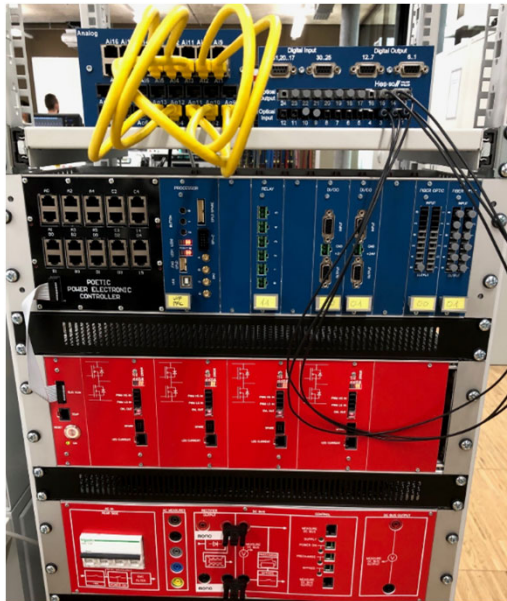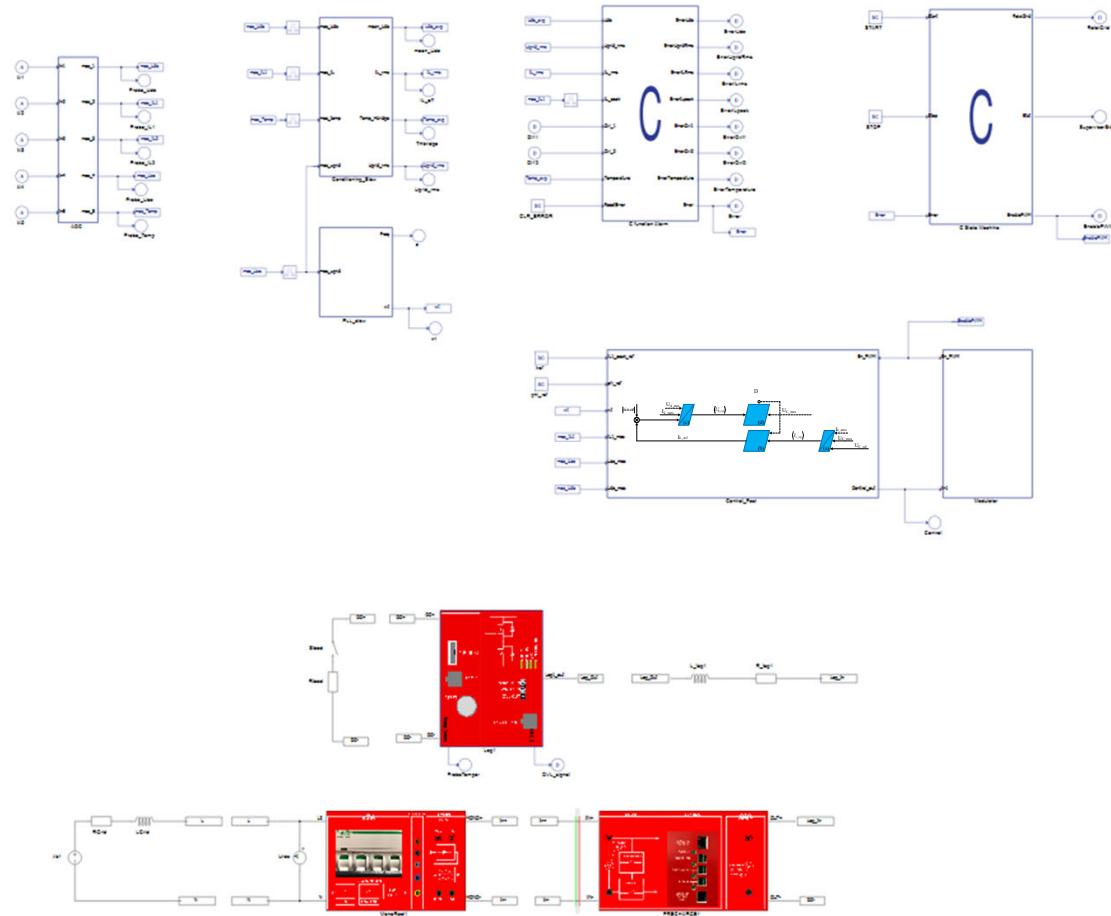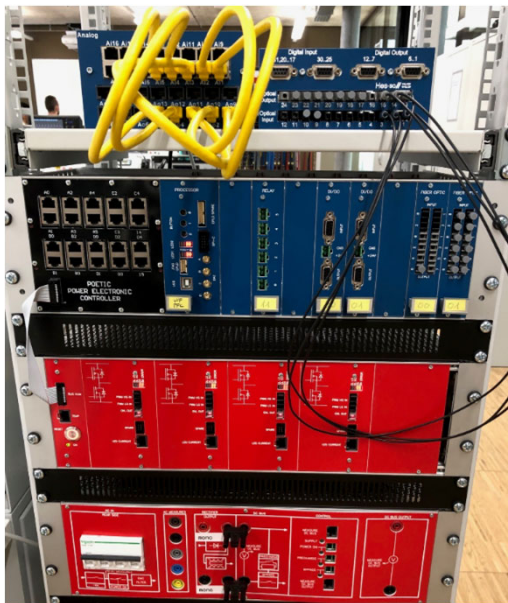   - To prepare the deployment on the real system

- Using a real-time simulator…. as a simulator
  - First tests: control does not necessarily solve inrush current issues when powering the system ON…

- Using a real-time simulator…. as a simulator
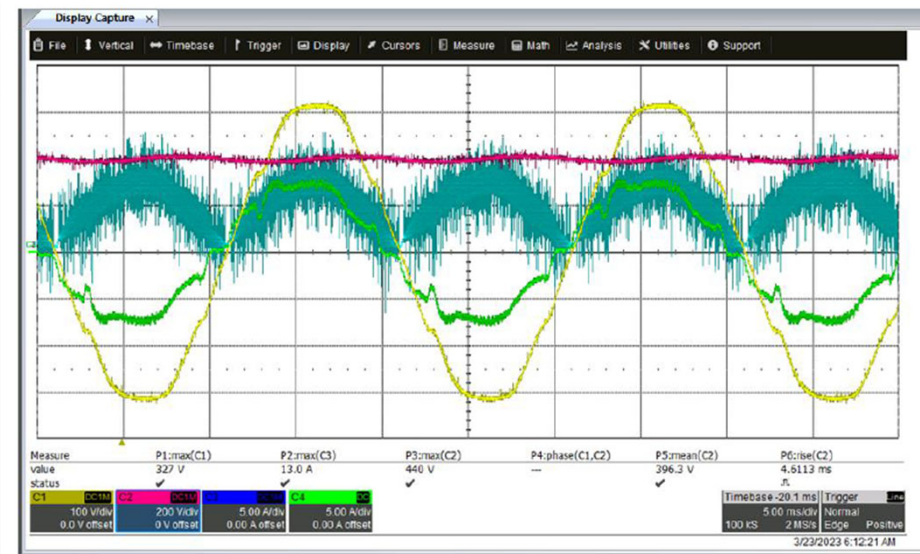 - Implementation of: state machine, signal pre-processing, alarms, etc…

- Using a real-time simulator…. as a controller

Simulation of control and system
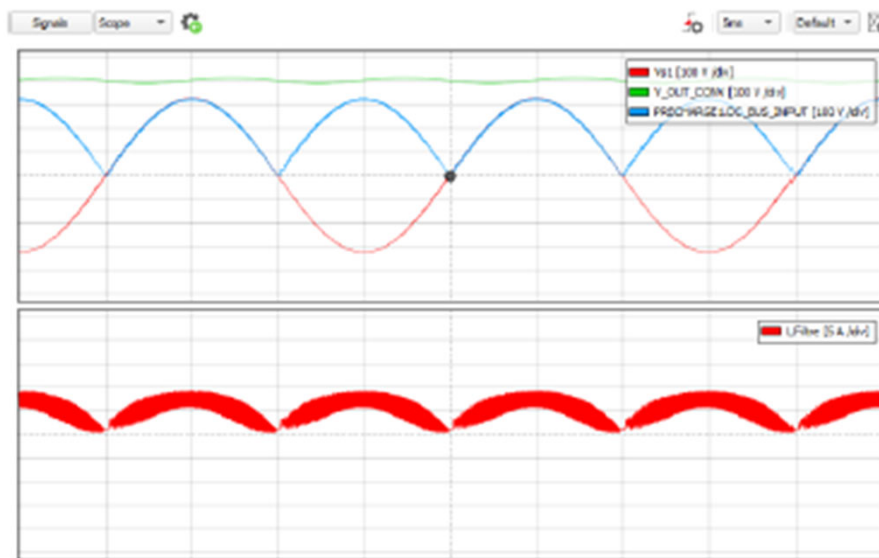
Simulation of control, real system

« Conclusion »

- The use of EMR is done to introduce how the control of a system should be implemented

- A fast-prototyping environment has been introduced
  - Based on a real time simulator
  - With dedicated libraries
  - In a step-by-step approach

- All configuration are possible:
  - Control can be translated to be implemented in a digital control platform.
  - Tests can be performed using a HIL as power converter emulator.