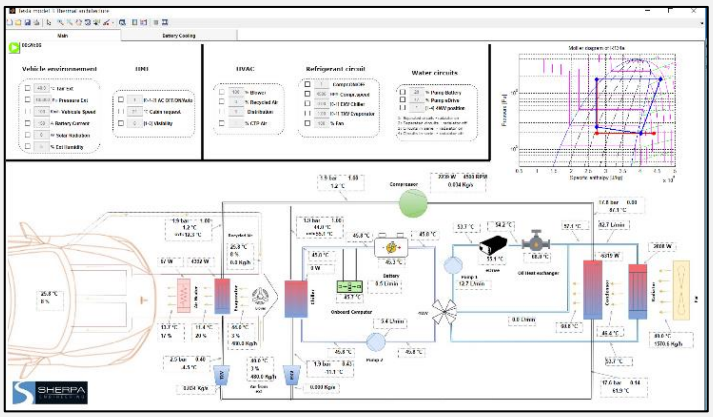
TESLA 3 THERMAL MANAGEMENT SIMULATION PLATFORM

The TESLA 3 simulation platform runs under MATLAB®/Simulink®. It integrates a Digital Twin of the Thermal System of the Tesla 3.

The platform is dynamic and represents the transient phenomena of the thermal system.
A Control Panel gives the user the possibility to run dynamic protocols in order to evaluate the functionalities and the performances of the system.

The model inside the simulator covers the thermal system of the Tesla Model 3:

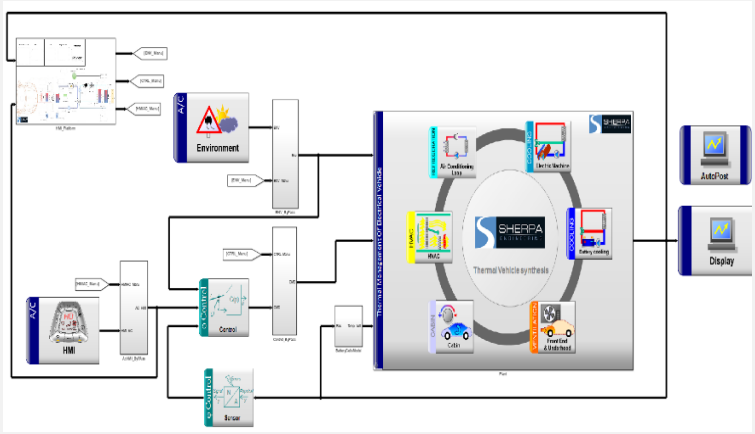
- Refrigerant loop
- Water loops
- Battery
- Air lines : HVAC and Cabin
- Other electric devices that need to be cooled or heated



TESLA 3 Thermal Management Platform
Control Panel

Precise and fast

The modelling methodology is based on the bond graph theory. It guarantees a high level of robustness in the representation of thermal phenomena, notably in diphasic fluids like the refrigerant. As we are using 0D model, the simulation is fast, typically 5 to 10 times faster than real time.



TESLA 3 Thermal Management Platform
Overall Simulink® Model

Examples of usage

- Run your own dynamic protocols to evaluate the performances of the Tesla 3 on them.
- Compare your own architecture and performances, with the Tesla 3
- Connect your own control software to the thermal system of the Tesla 3
- Test the thermal behaviour of the battery and the performance of the cooling system, in transient mode

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Calibration process

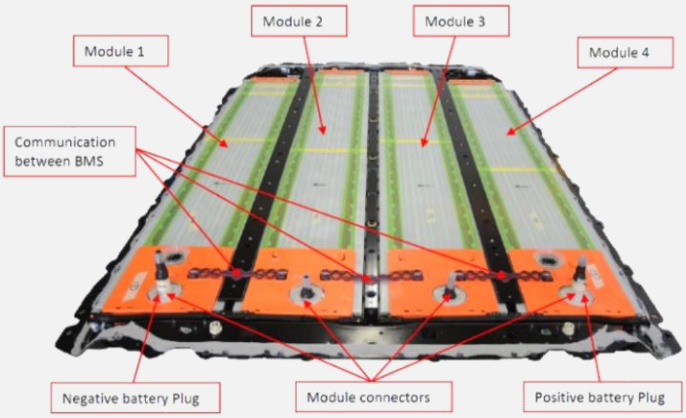
The approach is to calibrate first the components one by one, and after this phase, to make a global validation on the complete Thermal System thanks to the data acquired on the vehicle.

Tests used for calibration

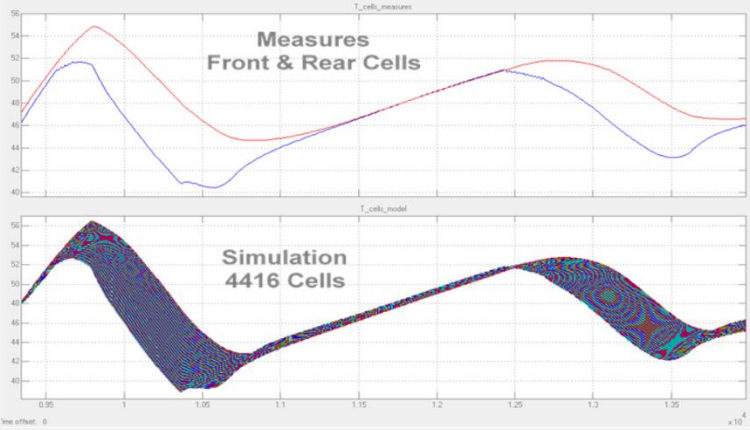
At -8°C, 23°C and 40°C in a climatic wind tunnel, following various dynamic protocols (WLTCs, stabilized vehicle speed, with/without the cabin cooling activated).

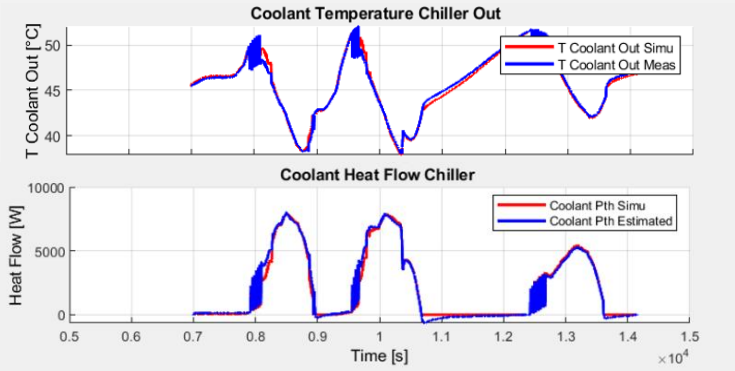
Battery cooling representation

The representation of the thermal state of each cell has been modelled using a light meshing. It enables to calculate the thermal power balance on each cell and on each mesh of the water in the coils.

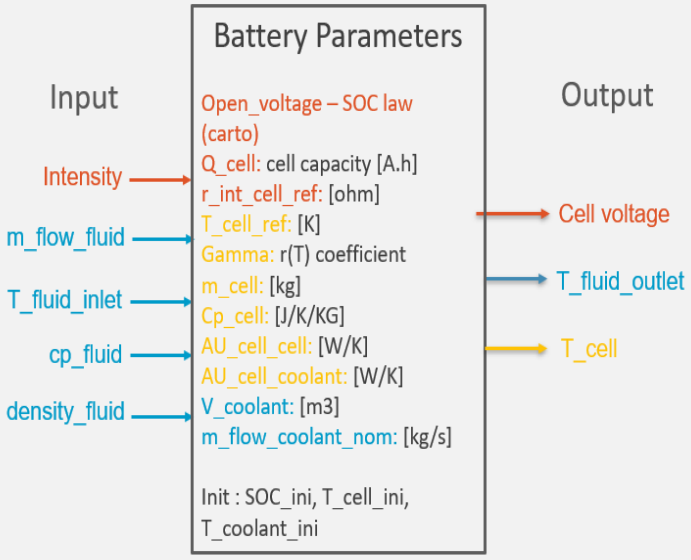


The platform is able to calculate the thermal state, in transient mode, for each of the 4416 cells of the Tesla Model 3 battery pack, as well as the gradient of water temperature inside the coils in front of each cell.





After calibration - Chiller result simulation vs measure



Battery model inputs outputs, and parameters

Sherpa Engineering has been involved in Air Conditioning and Engine Cooling activities for automotive customers for more than 20 years. The acquisition of know-how in this field through many research and industrial projects with European OEMS has enabled us to develop powerful tools, for multi-physic modelling and control system design.

Our partner ADACESS provided TESLA 3 data using test benches and real driving conditions

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