

# Thermal management development

Applus+ IDIADA offers full support in the development of thermal management systems, from the concept phase to final validation, including design, engineering, and simulation.



We are a multidisciplinary team composed by around 50 engineers and technicians with more than 20 years' experience. We have manpower capabilities for thermal management activities in IDIADA headquarters near Barcelona, China, and India.

Our background is covering different specializations like design (CAD) and virtual development (1D and CFD), logic and strategies (Simulink), electronics (sensors, wiring and communications) and testing (on component, system module and vehicle level)

One of our strengths is the capability to combine virtual and testing tools along the development process, starting to work on activities like energy management from the very early development stages.

We cover the following thermal management aspects:

- **Concept definition:** We support concept definition through the benchmarking and target setting process and Design Verification Plan (DVP) definition.
- **Virtual development:** The virtual analysis offers a wide range of key results for proper decision making.
- **Controls and logics:** We provide support in the development of climate and thermal controls, as well as a virtual validation through Model-in-the-Loop (MiL).
- **Testing activities:** We provide a complete vehicle instrumentation and first-class testing facilities, including a proving ground and climate chambers.

## Virtual analysis

The co-simulation platform developed by IDIADA (1D, CFD and Simulink integration), allows the virtual development of a wide range of functionalities.

**Climate and cooling control logic:** Through the climate and cooling control we are capable to regulate the thermal loop and climatic conditions of the cabin, achieving an optimal level of energy efficiency, while maintaining passenger thermal comfort.

**Energy management:** Management of the operation conditions of all the Cooling and HVAC components (coolant pumps, AC compressor, radiant panels, active seats, active glazing, etc.).

**System lay-out and components definition:** To achieve the system performances and energy consumption targets.

## Thermal controls

Thermal controls' definition for Cooling (EPWT and HV Battery) and HVAC loops and cabin comfort:

- **Sensors and actuators:** Inputs/outputs definition, sensors, and actuators specifications.
- **Harness and communications:** LIN / CAN, analog to digital conversion.
- **HMI:** Definition of human-machine interface.
- **Climate Control SW:** Requirement definition and application development. Validation test at system level and vehicle level.

## Testing activities

Testing activities are covering from component characterization to full vehicle validation.

### System and Components

- Components and system characterization operating alone.
- Used tools: Component and Hardware-in-the-Loop (HiL) test benches.

### Calibration tests

- At both system and complete vehicle levels for thermal loop, HVAC controls and energy management.
- Used tools: (INCA, CANoe, CANape...).

**Performances tests**

- In Climatic Wind Tunnel (CWT) and field tests for winter and summer conditions.
- Used tools: Climatic facilities, thermal comfort mannequin, Digital Particle Image Velocity (cabin airflow characterization, ventilation test bench, etc.).