



Accelerate Vehicle Thermal Development with A&D's Thermal Emulator

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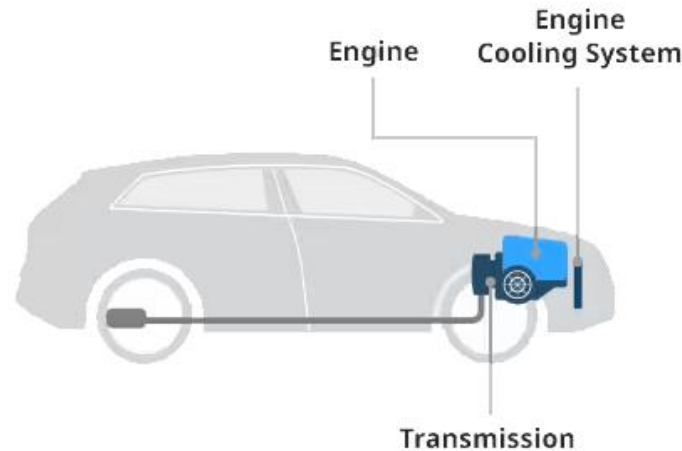
Thermal Management Systems

Traditional ICE systems mainly focused on cooling.

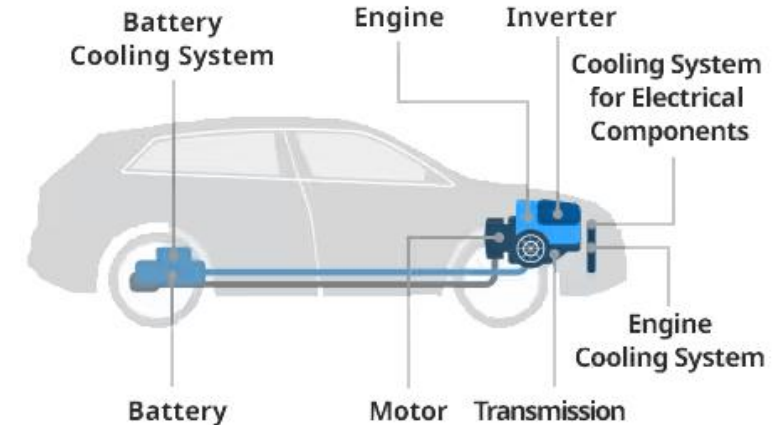
EVs require both heating and cooling for batteries, motors, and cabins.

- EV thermal management uses air cooling, liquid cooling, and heat pumps to maintain ideal operating temperatures.
- Proper thermal management prevents reduced battery capacity, high-temp aging, and thermal runaway, while improving range and charging speed.
- A&D conditioning systems leverage DSP technology for precise coolant, oil, and fuel control.

Gas-Powered Vehicle
(Internal Combustion Engine)



Electric Vehicle
(Example: Hybrid)



Thermal Emulation



1 Who

- Test Engineers
- Thermal Analysts
- Simulation Engineers
- R&D Engineers

2 What

- Simulates vehicle thermal components: battery, motor, cabin, radiator, heat exchanger
- Emulates thermal management systems
- Models both the heating & cooling behavior in a thermal management system

3 When

- During R&D & validation testing
- Supports early-stage design, prototyping, and system verification

4 Where

- Vehicle test labs for EV, ICE, and hybrid vehicles
- Thermal labs, climate chambers, powertrain test benches, battery test facilities

5 Why

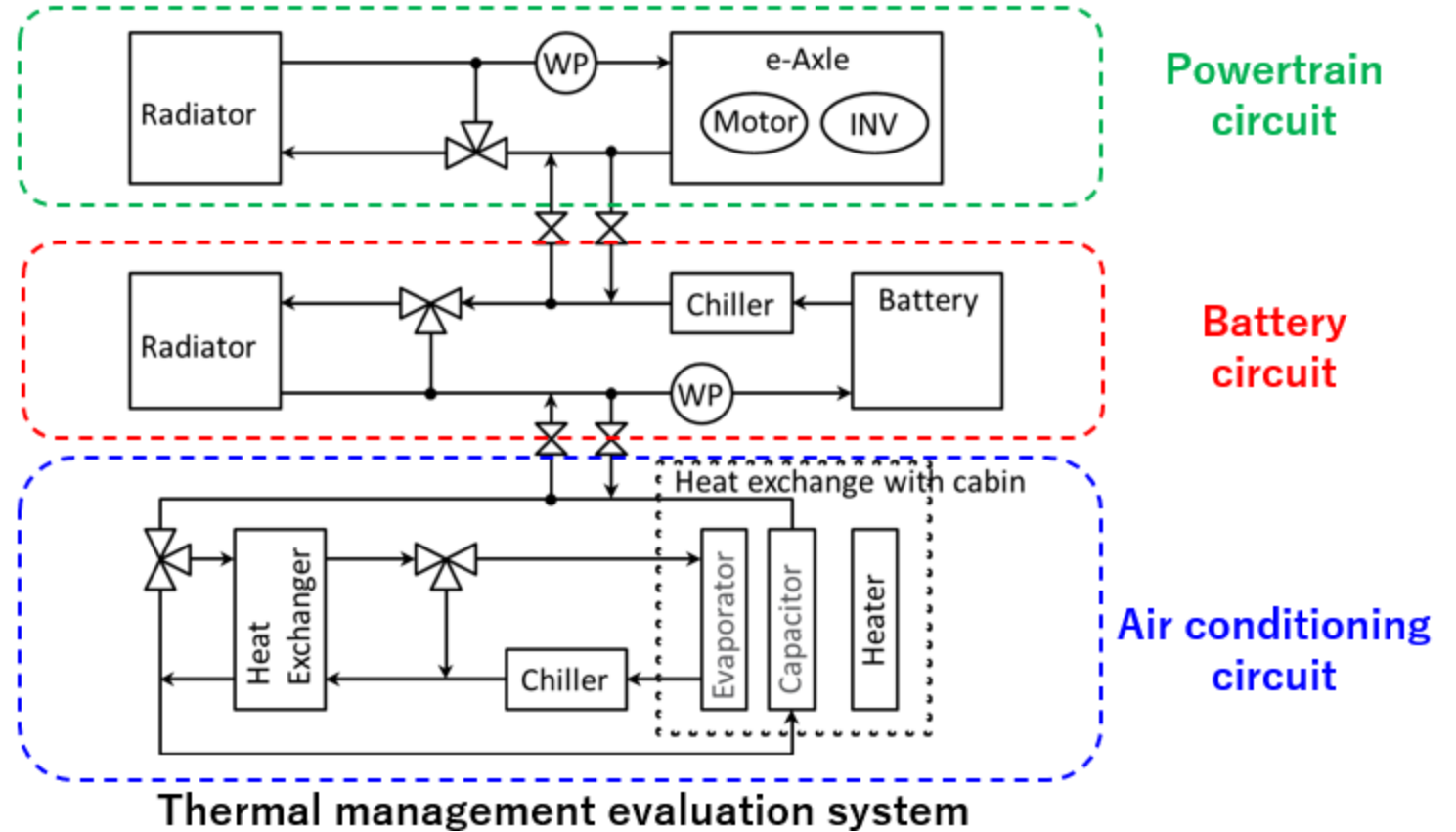
- Saves development time – flexible simulation testing doesn't require physical components
- Improves safety – test extreme thermal conditions virtually
- Optimizes thermal management systems before the vehicle is completed
- Allows controller strategies and physical components to be debugged by comparing them to a known predictive behavior.

6 How

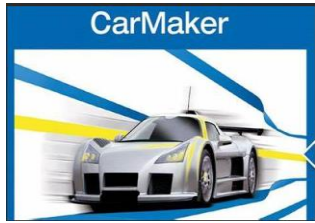
- Uses repeatable model-based development technologies
- Enables advanced simulation and real-world thermal behavior replication

A Typical EV System

- Waiting for all the systems to be available is inefficient
- Ideally, the design and testing of cooling controls should occur much earlier in the design cycle



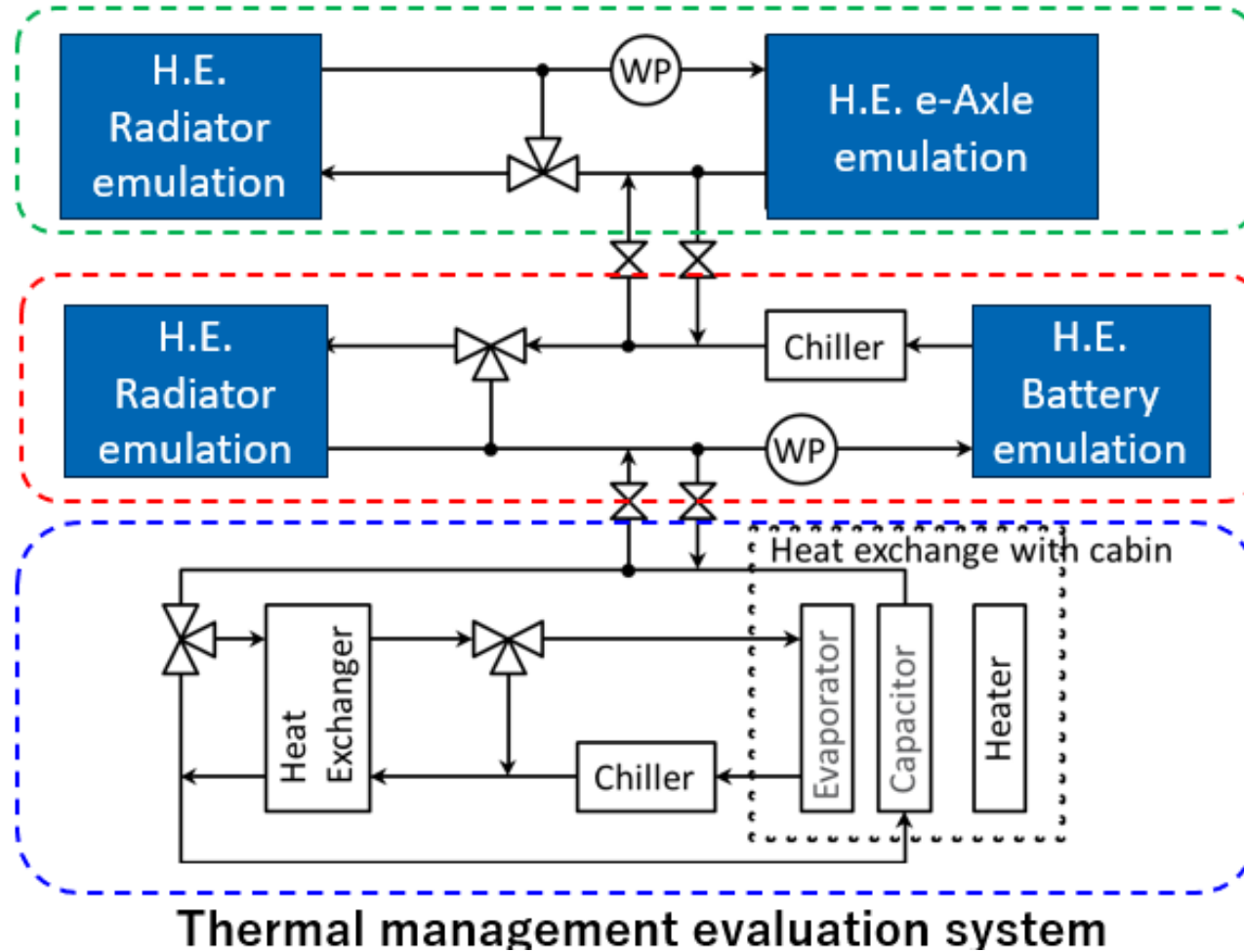
Thermal Management Evaluation System

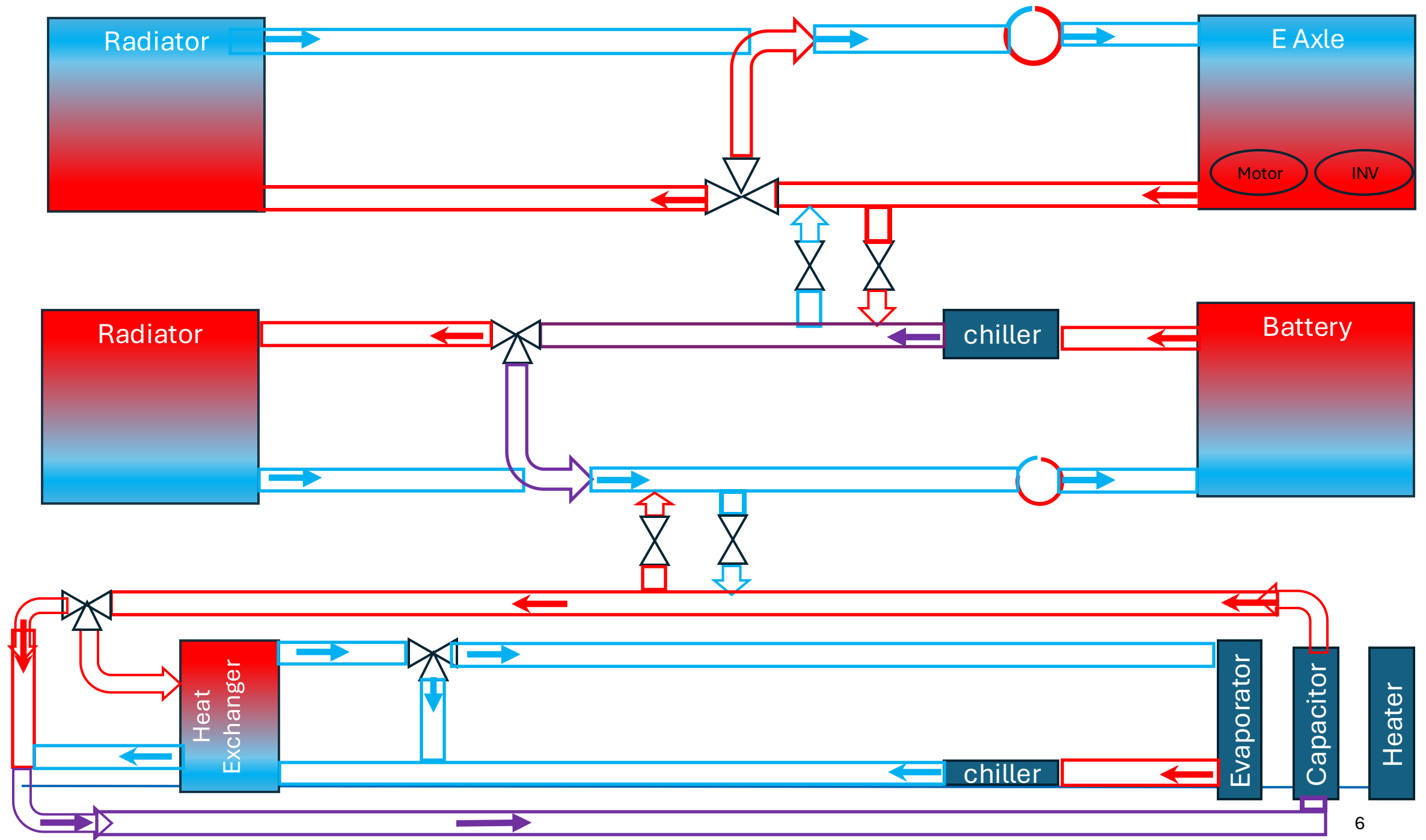


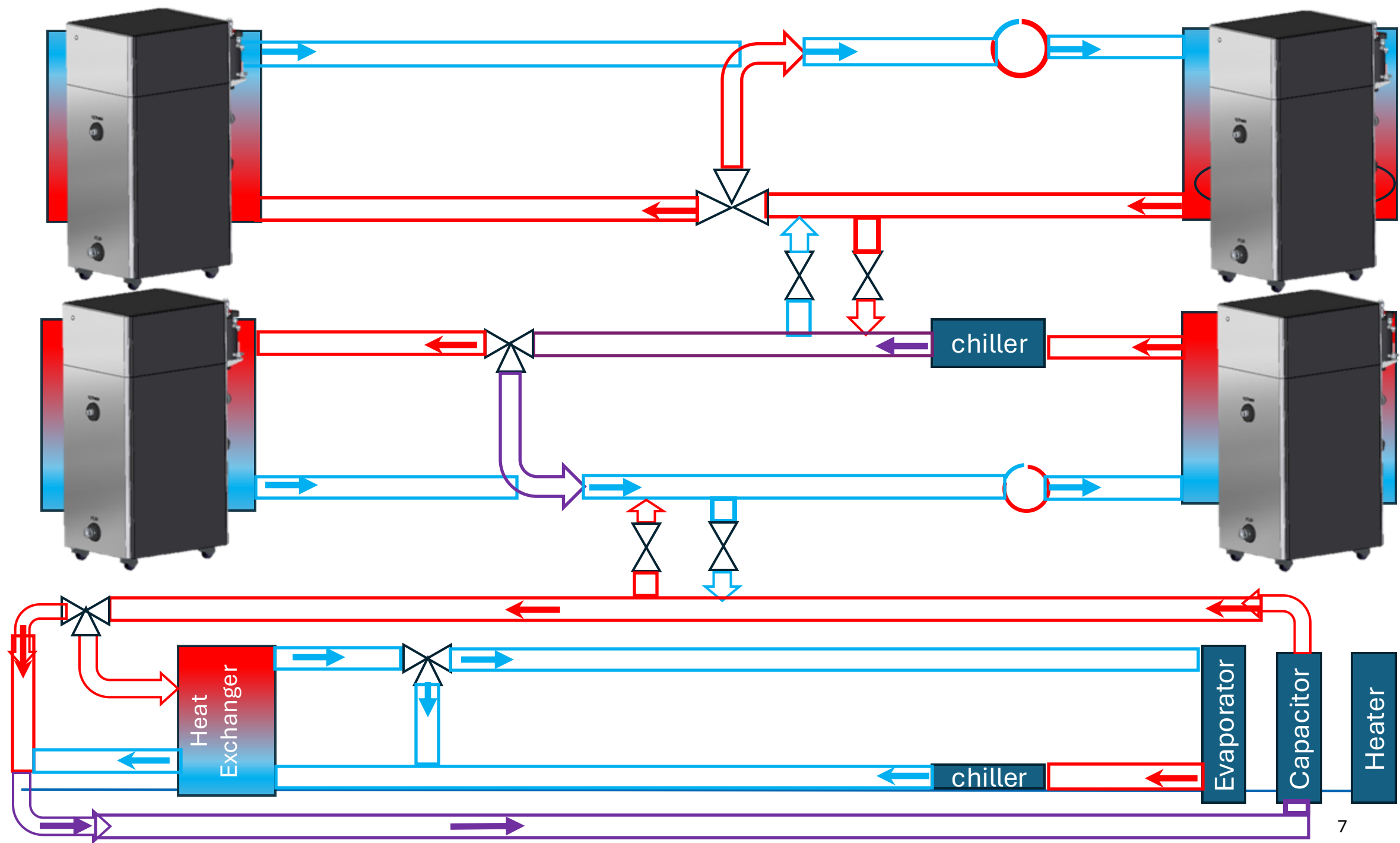
Vehicle model
(ie. CarSim)



iTest.DC:
Controls the
temperature and
thermal operating
circuits



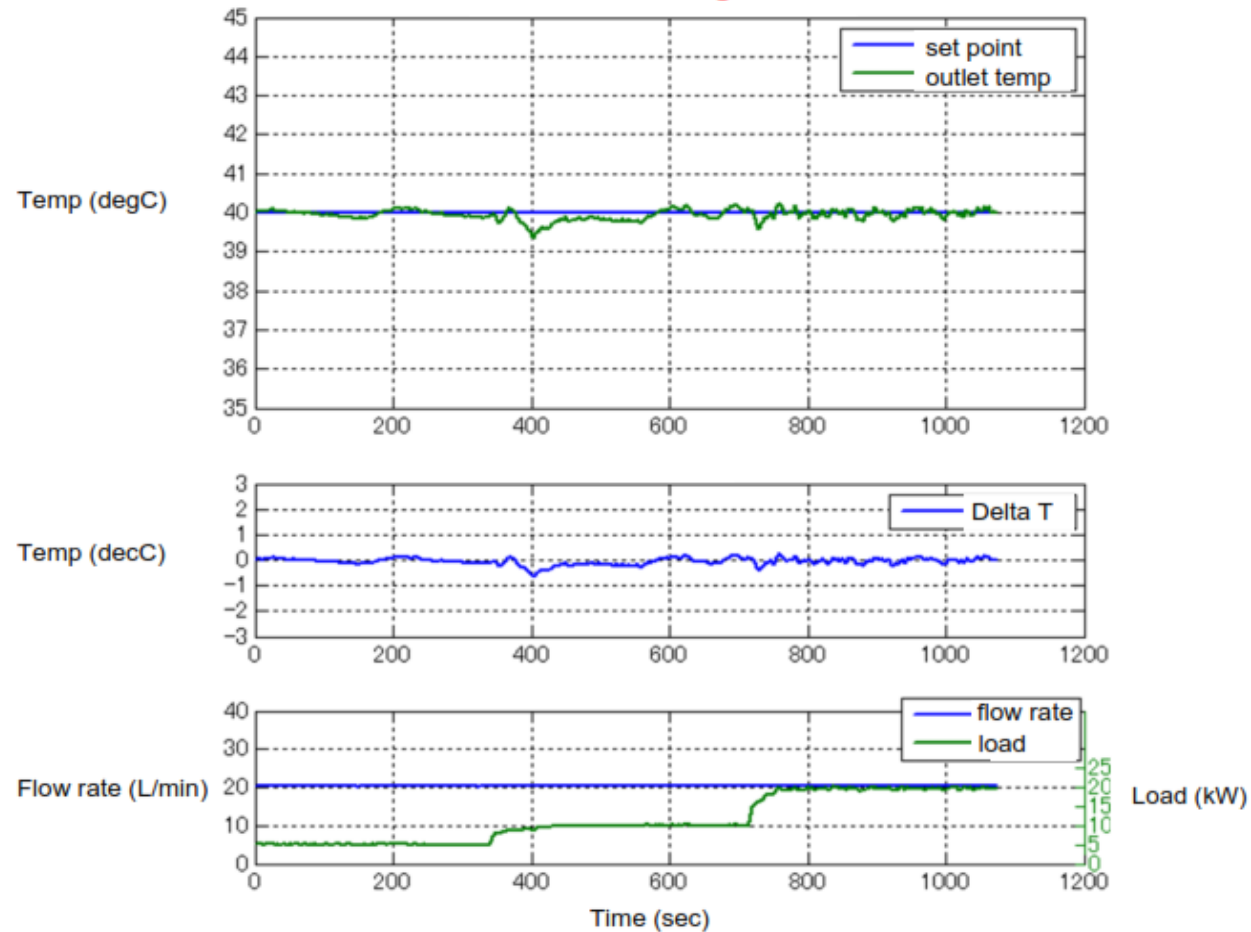




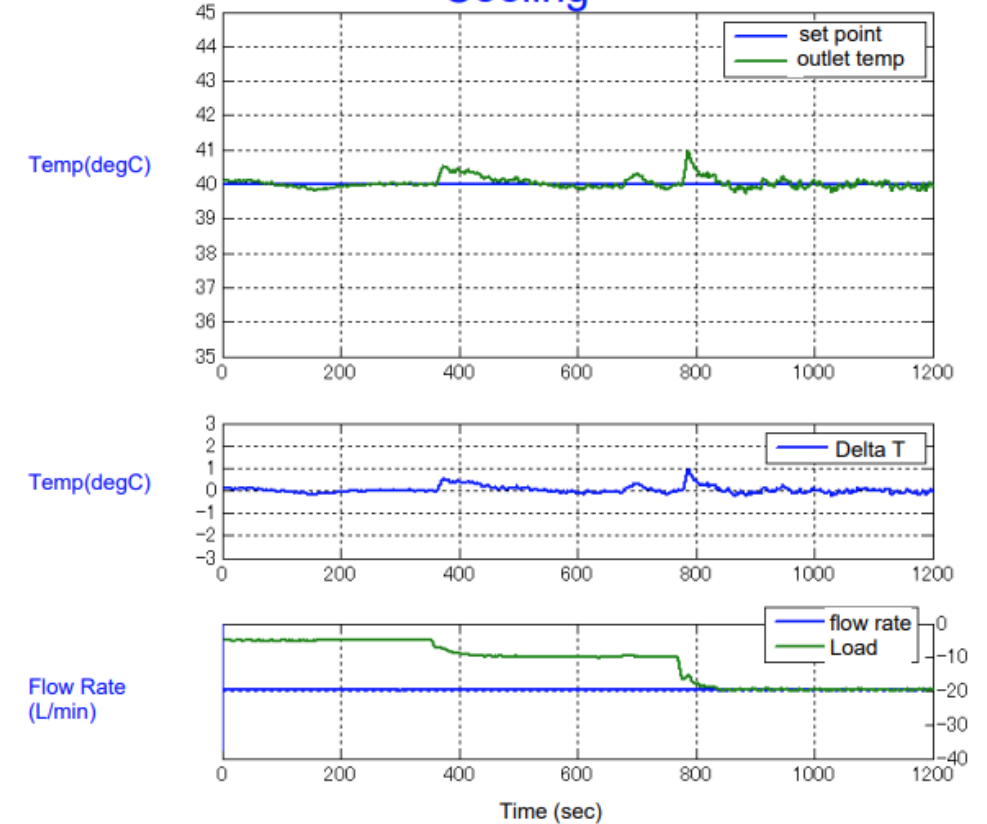
Reaction Against Step Loading (live data)

Temperature is controlled during loading of test specimen

Heating

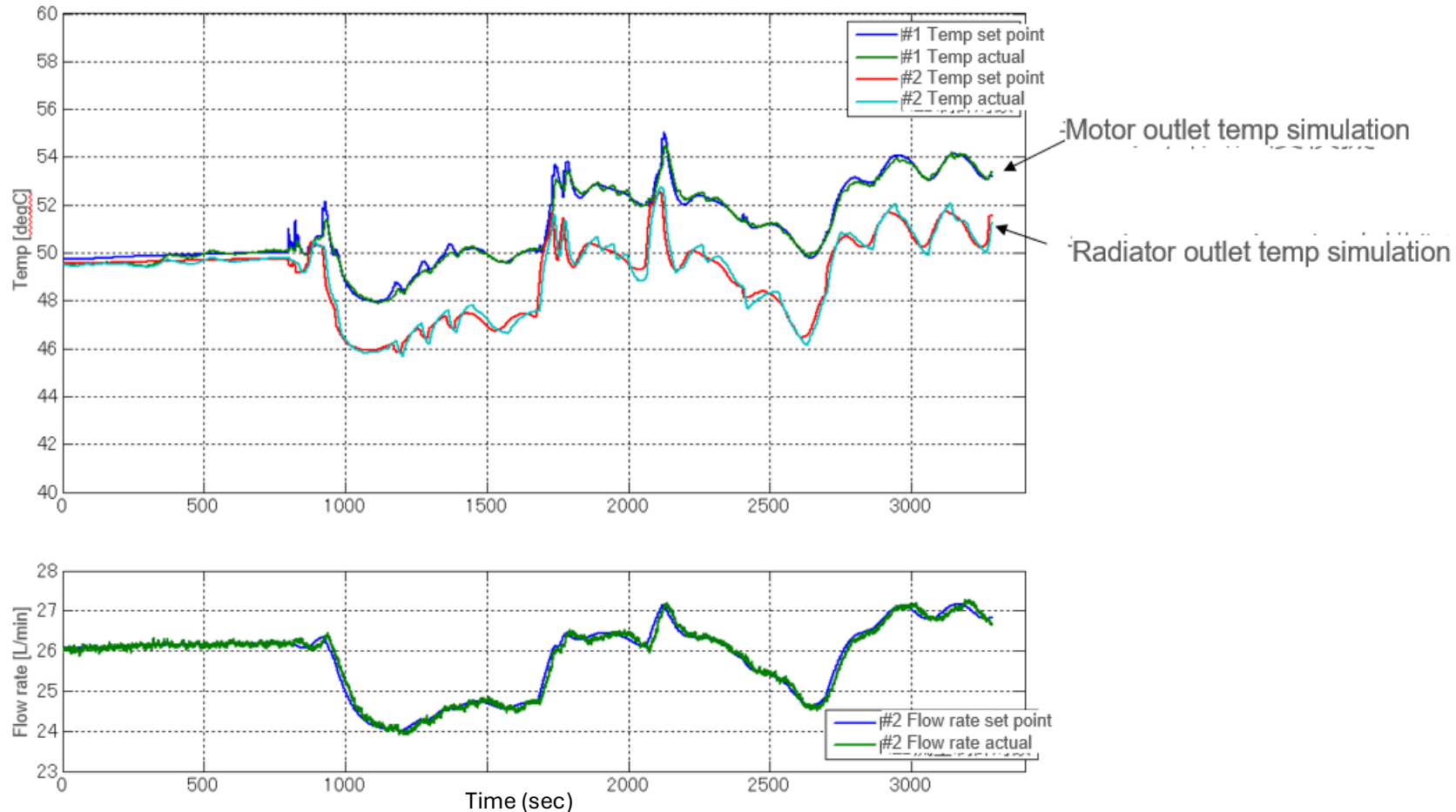


Cooling



Transient Response (live data)

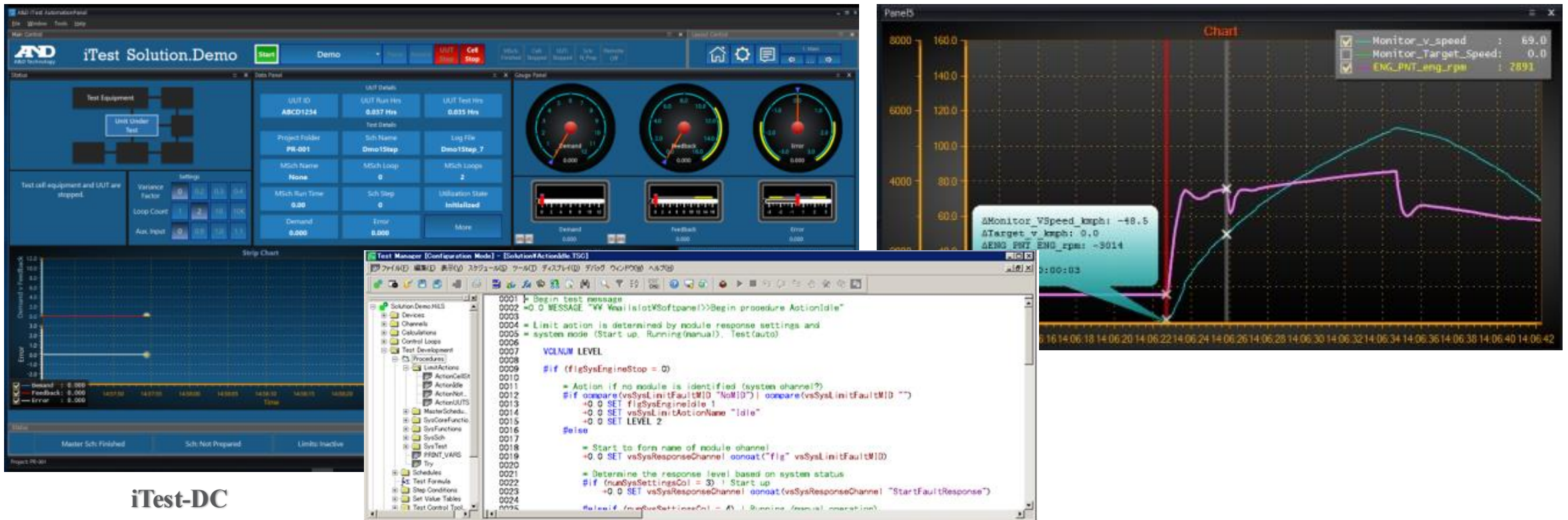
Temperature is controlled during flow rate changes in the test system



iTest.DC Front End GUI

iTEST and Automation Panel front end

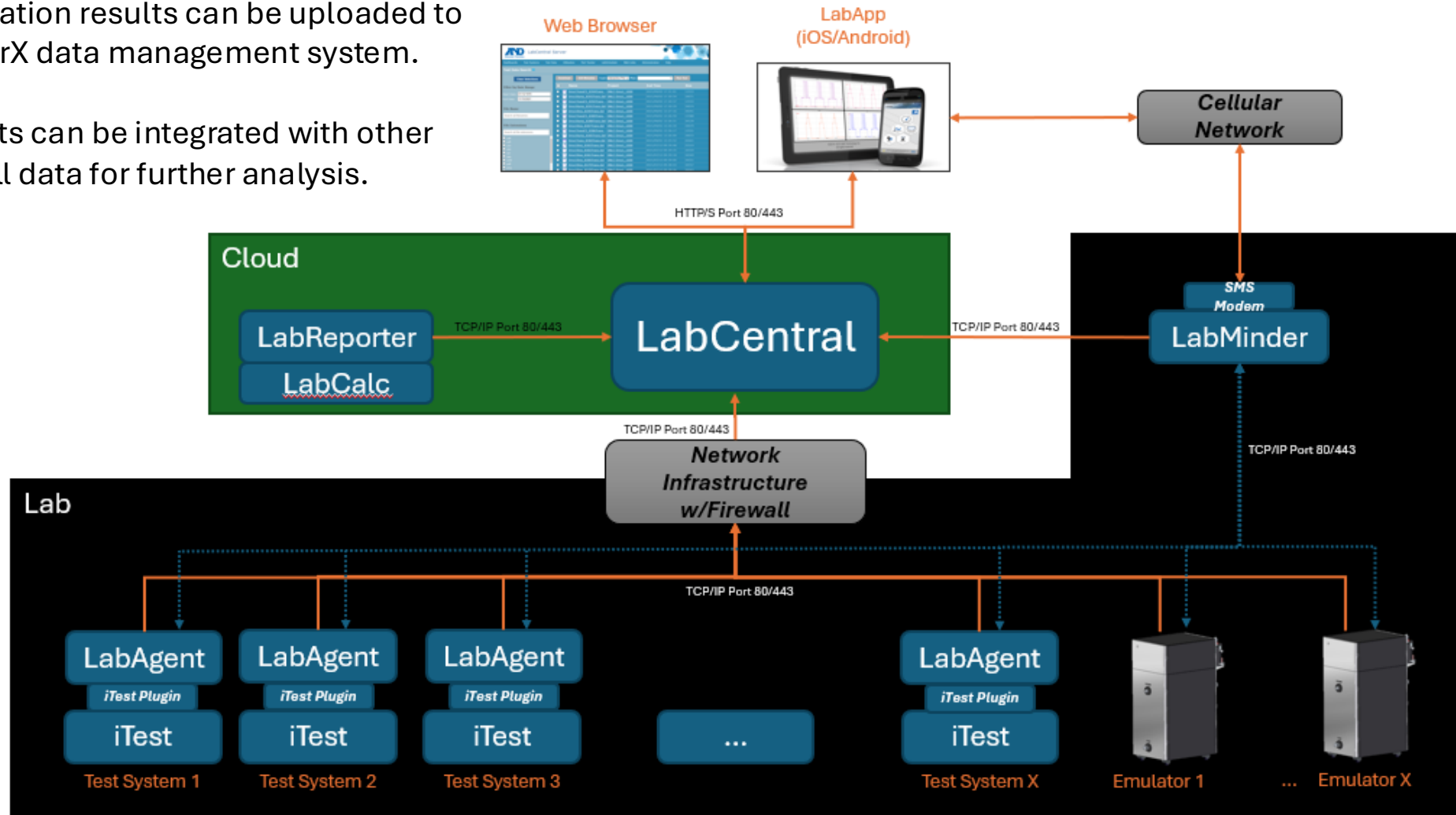
- Provides all the functionality of iTEST test automation (i.e. Creating test schedules, generating reports, Access to all the iTEST device drivers etc.)
- View signals and tune parameters in the Model running on the thermal emulator in RealTime



iTest-DC

LabWorX Data Integration

- Simulation results can be uploaded to LabWorX data management system.
- Results can be integrated with other test cell data for further analysis.



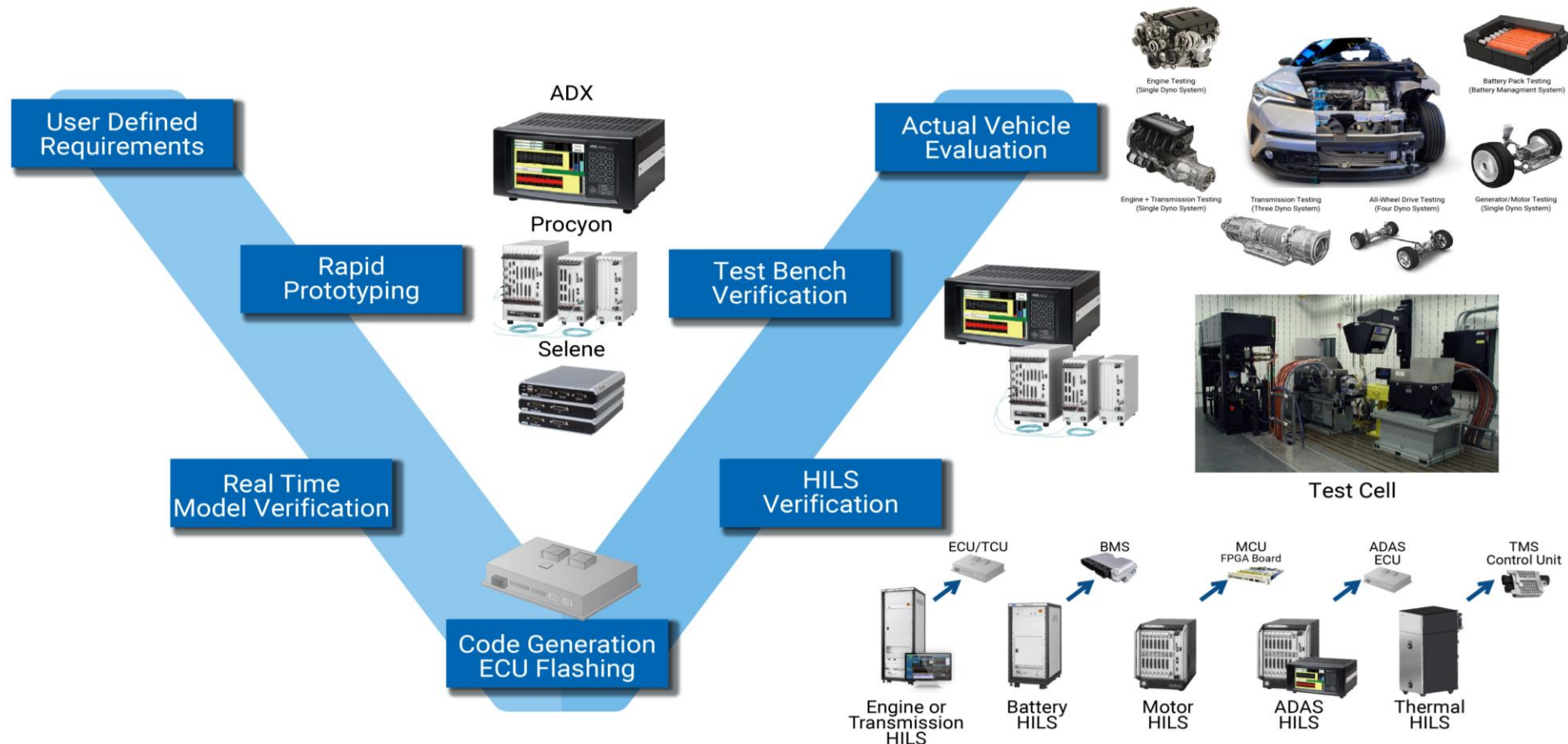
Specifications



AC Power	220V 3p 50/60hz @ 250A
Heat exchange capacity	Max 50kW
Heating/cooling speed	4C/sec or faster
Size	1000mm(W) x 870mm (D) x 1700mm (H) [39" x 34" x 67"]
Weight	550Kg (when filled with liquid)
Temp. range (operating)	-40C to 120C
Temp. range (control)	-30C to 80C
Temp Control accuracy	+/- .5C
Flow rate (operating)	0 to 40L/min
Flow rate (control)	2 to 30L/min
Flow control accuracy	+/- .5L/min

Vehicle Development V Curve

Besides A&D's Thermal Emulator, which leverages the same Hardware-in-the-Loop (HILS) architecture A&D has refined and applied successfully for over 20 years, A&D offers a variety of other HILS solutions to simulate vehicle components such as engines, motors, batteries, and ADAS scenarios.



Thank You

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