Development and Testing of Automotive Battery Systems @ FEV

Storage of electrical energy in hybrid and electrical vehicles is the key technology of automotive industry. The biggest challenge in such an approach is to find an energy storage system that meets all the desired requirements.

In the field of automotive traction battery systems, FEV offers the full development service, including battery management system (BMS) and testing. The development of customer specific battery solutions for certain vehicle applications is our everyday business. Starting from the scratch or using FEV standard battery modules, we offer the comprehensive package from cell selection up to vehicle integration.

The FEV LiiONPOWER modules are available with 1kWh or 2 kWh energy content, allowing customizable battery designs with scalable capacity fitting vehicle specific performance and packaging requirements.

At FEV, the development process is accompanied by computer simulations that can predict the temperature distribution and support thermal design and structural calculations. Applying thermal CFD simulation from cell, module up to pack level, the battery cooling system layout can be fitted perfectly to the requirements. The development of the battery pack is carried out according to the specifications resulting from vehicle integration, thermal requirements, and electric target values.

The FEV battery control unit (FEV LiiONMAN) combines the surveillance of all critical values with operation strategies to create a performance projection. This enables safe operation and optimized utilization of the cell’s capabilities. FEV LiiONMAN is based on a flexible master/slave concept. Via CAN-bus, slave modules integrated into the battery modules are connected to the master unit. The master unit’s algorithm structure is based on the widely used MATLAB/SIMULINK environment and can therefore be designed with a model-driven approach. The benefits are transparency, flexibility and modularity.

Testing and validation are important steps within the development process of battery systems. Hence, FEV designed its own battery test benches which allow it to carry out all necessary tests of battery modules and battery packs. In order to fulfill all safety requirements, not only the respective battery system but also the complete vehicle has to be considered. Based on a risk analysis, FEV therefore develops safety concepts that take into account functional and high voltage safety. Within the framework of a
safety agenda according to ISO/DIS 26262, all required steps from the technical specifications through to the scheduling, completion and documentation of validation activities and reviewing of suppliers of safety-relevant parts are taken.

Surveillance of a battery under test at the test bench is possible by either a client’s battery management system or a system of FEV (FEV LiIONMAN). Thus validation of existing battery management systems is possible as well as testing of a battery with no battery management system.

Numerous test specifications according to VDA, EUCAR, FreedomCAR or USABC offer standardized procedures for vehicle battery testing. Beside these procedures FEV test benches make testing with simulated or measured data profiles possible in order to test non-standardized behavior.

Some possible tests:
Certification tests according to VDA, EUCAR, FreedomCAR, etc.

Function Tests:
- Capacity
- Internal resistance
- Self discharge
- Hot / Cold
- Battery management functions
- Cooling system function

Performance tests:
- Hybrid pulse power characterization (HPPC)
- Variable power, current and voltage
- Sustained hill climb
- Cold- and hot cranking

Life cycle:
- Life cycle test
- Verification of cycle stability
- Accelerated calendar life
- Drive cycle tests

FEV offers the whole range of battery development including battery and full vehicle simulation, battery pack design, battery management systems, extensive testing in the FEV battery test bench and professional vehicle integration.

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