

Dropping the HV Battery for more Safety



HV Acceleration Measurement

In the development of battery-powered electric vehicles, tests on high-voltage components must be performed in accordance with applicable standards and norms. To verify an electric vehicle for various national markets, accelerations inside and outside the traction battery must be measured during drop tests. If the HV battery does not pass the test according to the requirements – for example, because it is too severely damaged by the impact – further optimization is required. Green Testing Lab, a service provider in the field of battery testing, performs combined, synchronous measurements in special test environments using measurement technology from CSM.

Safety tests for worldwide sales

The use of high-voltage components in electric vehicles not only brings new technical challenges, but also requires components to meet new safety standards. These are primarily intended to prevent danger to people and possible damage to property – in every situation over the entire life cycle of

the vehicle. This also includes different national drop tests for the high-voltage battery of electric cars. These drop tests must be successfully passed before the vehicles can be sold in the respective countries.

Joint expertise in testing

The company Green Testing Lab specializes in a range of standard-relevant tests on high-voltage batteries. Founded in 2020, various tests are performed in special test chambers at the site in Greinbach (Austria). Here, the impact of extreme conditions on the safety of high-voltage batteries is analyzed. The battery drop tests performed by Green Testing Lab include the standards SAE J2464, SAE J2929, UL 2580, USABC, Freedom CAR, QC/T 743 and the South Korean standard KMVSS. Green Testing Lab uses measurement technology from CSM to test among other things vehicles for sale in South Korea: The “Korea Motor Vehicle Safety Standard” (KMVSS) requires a battery pack with a state of charge of 80% to hit a concrete floor from a height of 4.90 meters.

The forces acting on the battery during the test can be used to determine how the component will behave in the event of an accident, for example. This is intended to prevent high-voltage batteries from burning or exploding in certain situations, for instance in the event of a collision. "The decision to use measurement technology from CSM was not a difficult one. The robust measurement modules are well-known in the industry and represent a certain standard for us. With a measurement setup from CSM, we achieve reliable results for various tests, while at the same time receiving excellent support", explains Max Hofer, Managing Director at Green Testing Lab GmbH.

Setup for special requirements

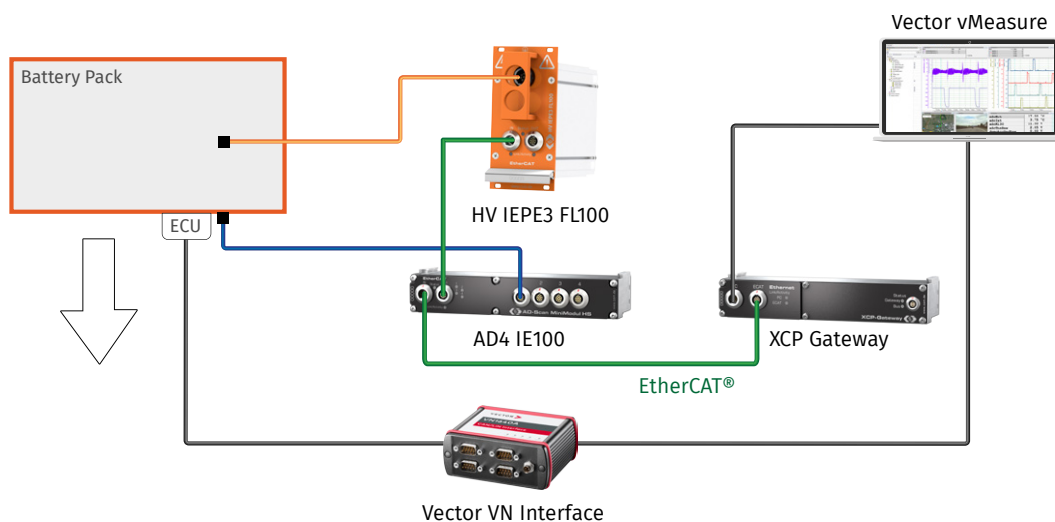
For the drop test to be successful, acceleration must be measured at various points inside and outside the HV battery. This means that different measurement technology must be combined: Inside the pack, the data is acquired in a high-voltage-safe manner and synchronized with measurement data from other acceleration sensors attached to the outside of the pack housing. The measurement technology itself must also not interfere with or be compromised by the test setup. With a drop

height of almost five meters, robust measurement technology and sensor cables must be used that are suitable for the expected loads. To ensure that the dynamics of the forces occurring when the pack hits the ground can be recorded in detail, the events during the fall are to be filmed from different angles. By additionally acquiring the communication of the battery control unit, it is possible to check whether the safety mechanisms of the battery are functioning as planned.

Merging signals and acquiring the measured values

All measurement modules are placed at half the drop height to minimize interferences due to the optimal length of the sensor cables. For acceleration measurement within the pack, an HV-safe HV IEPE sensor cable is inserted into the high-voltage battery pack via cable glands and three commercially available uniaxial accelerometers are connected to it. The data from these accelerometers is acquired with the **HV IEPE3 FL100** high-voltage measurement module at a data rate of up to 100 kHz per measurement channel. The data from

other accelerometers attached to the outside of the battery pack housing is measured with the **AD4 ECAT IE100**. This module also allows a measurement data rate of up to 100 kHz per channel. An **XCP-Gateway** ensures the synchronization of the connected measurement modules using the distributed clocks method integrated in the Ethernet standard. It also acts as the interface to the data acquisition software by converting the signals to XCP-on-Ethernet.



With **vMeasure** from Vector Informatik, the measured values can be analyzed and evaluated in accordance with the specifications of the South Korean standard. In addition, a **Vector interface** is used to record the data from the battery control unit via CAN to check what effects the forces from the drop have on the communication between the battery and the vehicle. This data is acquired and evaluated synchronously with the physical measured values.

»The integration of CSM's measurement technology with other products, especially with Vector's software, works perfectly. As a result, the measurement and evaluation of measurement data merge smoothly.«

Max Hofer, Managing Director Green Testing Lab GmbH

In addition, several high-speed and infrared cameras are positioned around the measurement setup to visualize any damage or temperature changes to the battery.

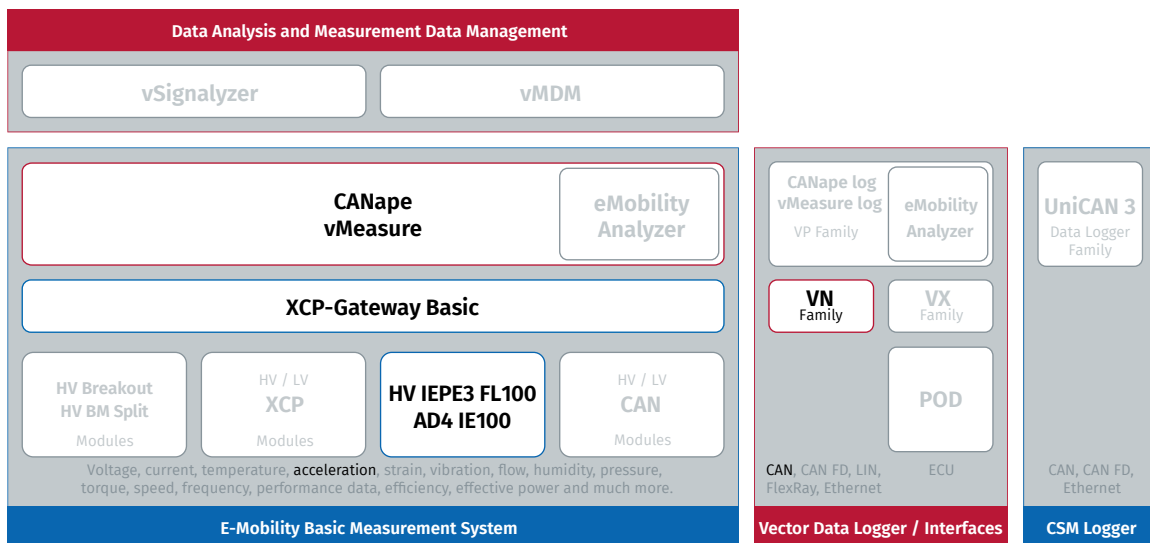


Fig. 1: The Battery drop test in the systematics of the Vector E-Mobility Measurement System

Harmonized overall system

With the solution consisting of CSM measurement modules and Vector software and hardware, the battery test can be performed precisely in accordance with KMVSS specifications, as the high-voltage-safe measurement technology also allows the conditions within the battery pack to be measured.

»We would choose measurement technology from CSM time and time again: This is not only due to the quality of the hardware, but above all to the great support from the CSM team. Any questions or problems are dealt with quickly and in a solution-oriented manner – a decisive criterion for us.«

Max Hofer, Managing Director Green Testing Lab GmbH

The combination of measurements inside and outside the high-voltage environment and the acquisition of ECU data in a single measurement system offers particular advantages for the synchronization and rapid acquisition of data from the accelerometers. This facilitates the evaluation of the collected data, especially due to the synchronization better than 1µs and the temporal resolution of up to 100 kHz. In addition, the CSM safety concept allows the simple use of known standard sensors in the HV environment and thus ensures an easy-to-implement measurement setup.



Featured Products

HV IEPE3 FL100

CSM's HV IEPE3 FL100 measurement module was specially designed for measurements with IEPE sensors, e.g. triaxial acceleration sensors, in a high-voltage environment. It offers three analog inputs with a modified sensor supply for the connection of IEPE sensors. Sensor cables such as the K960, designed for this module, enable the safe operation of standard sensors in HV environments.



AD4 ECAT MM-Series – Typ IE 100

CSM's AD4 ECAT IE100 measurement module is ideally suited for the most accurate analysis of high-frequency signals with measurement data rates of up to 100 kHz per channel. It offers a high-precision and unipolar sensor excitation from 5 to 24V DC for a variety of sensors.



XCP-Gateway Series

CSM's XCP-Gateway Series protocol converters were specially developed for CSM EtherCAT® measurement modules and for measurement tasks with multiple measurement channels and high measurement data rates. The XCP-Gateway is available in "Basic" and "pro" versions. The "pro" version has two CAN interfaces via which CAN-based CSM measurement modules can be connected and integrated into the XCP-on-Ethernet measurement data protocol. In the "pro" version, temperature data from the HV Breakout Modules can also be transferred directly via EtherCAT®.



Complete solutions from a single source:

CSM provides you with comprehensive complete packages consisting of measurement modules, sensors, connecting cables and software - customized to your individual needs.

Further information on our products are available on our website at www.csm.de or via e-mail sales@csm.de.



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