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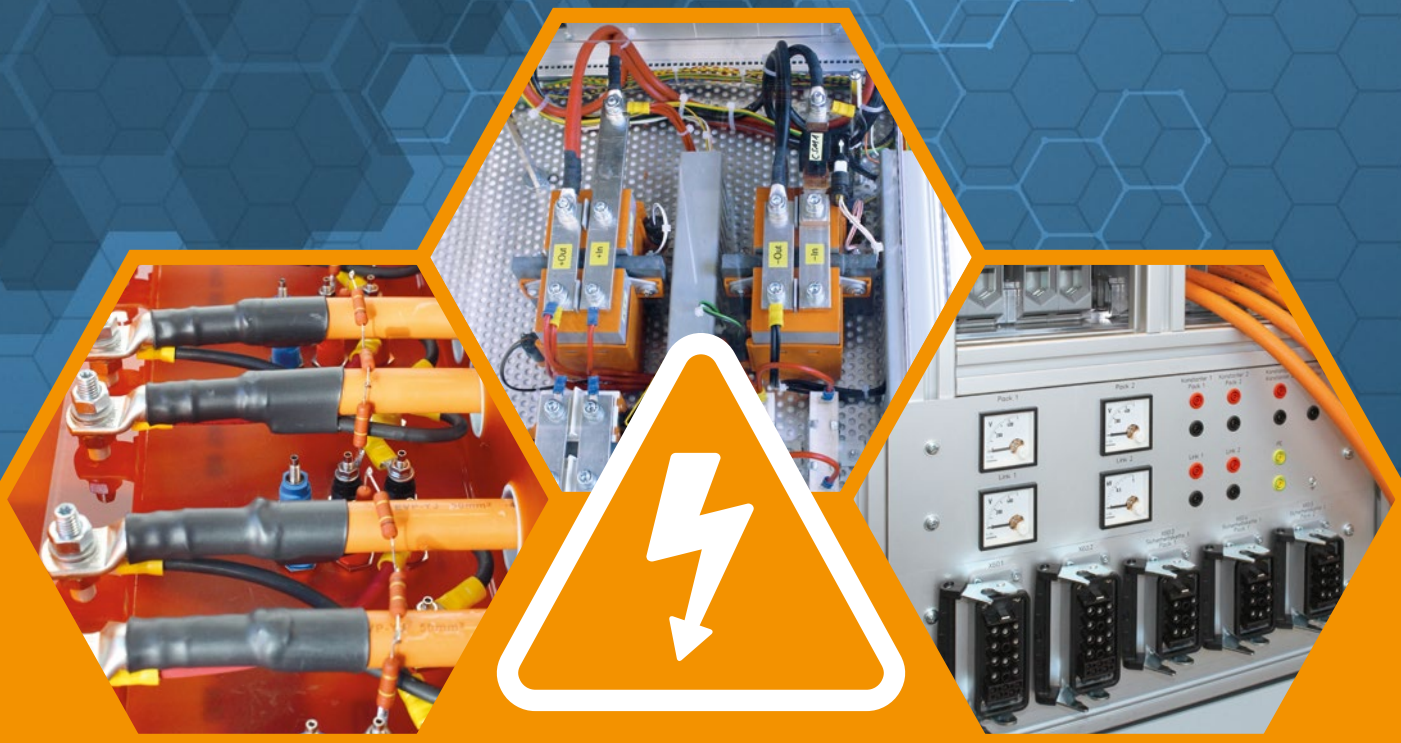
HIGH-VOLTAGE EQUIPMENT

WORKING SAFELY IN THE LAB, ON THE TEST BENCH AND ON THE VEHICLE



TESTING AND VERIFICATION SYSTEMS FOR ELECTRONIC MODULES, ECUS AND VEHICLE COMPONENTS IN THE HV RANGE

When developing vehicle components and integrating them into the vehicle, a large number of electronic testing and verification systems are required. The development and manufacture of electric and hybrid vehicles place particularly high and diverse demands on test systems and components. As is the case when handling complex control units, the safe measuring, testing, verifying and applying in the high-voltage range require transparent and reproducible test procedures. In an ideal case scenario, tests and verifications should take place automatically, sequences and test results must be able to be documented automatically for proof of performance and certification.

All this requires not only highly reliable and automatable test systems, but also simulations suitable for complex control units – for example to simulate real battery cells – and HV-compatible accessories, such as special cables, break-out boxes and adaptations.

For your HV applications, we design and develop individual adapters, supply systems as well as measurement and simulation technology – for safe handling in the laboratory, on the test bench and on the vehicle (up to 1000 V / 1000 A).

PORTFOLIO

- HV measuring adapters
- HV break-out boxes
- HV insulation fault simulations
- HV capacity decades
- Passive HV cell simulations
- Complex HiL test adapter for HV components
- HV changeover switches with liquid-cooled components
- HV supply systems with energy recovery
- HiL test systems for HV components

AREAS OF APPLICATION

- Component development for electric and hybrid vehicles
- Testing and validation (HiL testing, FMUs)
- Component and vehicle testing
- Product release
- Quality assurance

BENEFITS

- Greatest possible occupational safety in all use cases
- Greatest reliability and long-term usability thanks to outstanding quality
- High-grade, robust versions designed to suit the particular area of use (dirt, climate, …)
- Permanent labeling and identification
- At least compliance with and mostly overfulfillment of relevant standards

HV MEASURING ADAPTERS AND HV BREAK-OUT BOXES

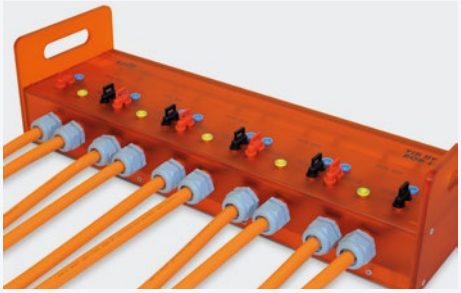
HV measuring adapters and HV break-out boxes are used to safely and reliably perform measurements on high-voltage systems which are normally closed.

Alongside interfaces for tapping individual I/O signals, HV measuring adapters also provide possible access to the HV power supply. In the case of HV break-out boxes, I/O signals and supply lines can be specifically manipulated by using suitable jumpers. Equipped with the original vehicle plug connections, this means that signals at the control unit plug can be measured without any contact or can be specifically influenced by interruption, short-circuit or connection of a bleeder and transfer resistor.

Typical areas of application are:

- Engineering and development departments
- Test benches
- Service areas

at OEMs, system and module suppliers (Tier1), in test companies as well as in repair shops.



HV INSULATION FAULT SIMULATIONS FOR TESTING SAFETY-RELEVANT FUNCTIONS

HV insulation fault simulations are used to test and validate safety-relevant system functions, either during the engineering process or also after repairs carried out by after-sales service or the repair shop, or directly on the vehicle. This enables the testing and verification of correct system responses in a (safety-critical) fault case. The occurrence of insulation faults in the HV wiring harness has to be detected immediately and reliably during vehicle operation and, once detected, the complete HV on-board electrical system must be switched off immediately. Faults such as short circuits, leakage currents or even line interruptions in the HV connection area must be permanently monitored by battery management systems (Battery Management Controller, BMC) – typically by cyclically measuring the insulation resistance of HV+ and HV- against KL-31 (chassis). With our HV error simulations, error states in the area of HV connections and lines can be specifically generated – either manually or automatically, depending on the application.

Typical areas of application are:

- HiL and function testers (automated error simulations)
- Labs, test benches and engineering workshops (manually operated error simulations)

at OEMs, system and module suppliers (Tier1), in test companies as well as in repair shops.

HIGH-VOLTAGE CAPACITY DECADES

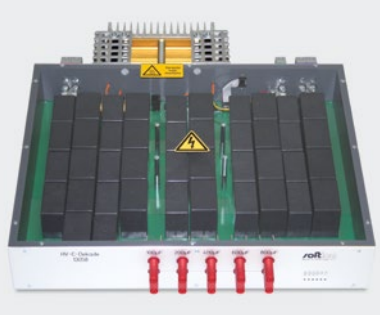
During the development of electric and hybrid vehicles, high-voltage capacity decades (HV-C decades) are used to replace the DC link capacity in the vehicle – and thus simulate one of the most important energy storage devices of the power electronic vehicle system.

With the HV-C decades realized by Softing to date, capacity values can be set in steps of 100uF up to a total capacity of 21mF. In this context, Softing offers both automated solutions and manually operated devices for laboratory operation.

Typical areas of application are:

- HiL and function testers (automated HV-C decades)
- Labs, test benches and engineering workshops (manually operated HV-C decades)

at OEMs, system and module suppliers (Tier1) as well as in test companies.



PASSIVE CELL SIMULATION – ECU TESTS WITHOUT REAL CELLS

During acceleration, the batteries of electric vehicles must provide particularly high performance. In order to keep the necessary currents and line cross-sections small, up to 200 individual cells are connected in series. During operation, the permissible voltage range of all battery cells must always be adhered to in every operating state to exclude danger, which can range from damage to fire and even explosion.

Passive cell simulations are used to avoid being permanently dependent on real batteries or very complex and expensive active cell simulations during the development of Cell Supervision Electronics (CSE). These simulate the complete cell stack in a balanced state of charge, the individual cell controllers detect suitably charged cells and thus a fully functional battery system. Passive cell simulations thus make it possible to test and protect all functions of CSE control units which are not directly battery relevant without having to implement real cells or active cell simulations.

Typical areas of application are:

- Software development for electric and hybrid vehicles
- OBD tests
- Labs, test benches and engineering workshops

at OEMs, system and module suppliers (Tier1) as well as in test companies.

COMPLEX TEST ADAPTERS FOR THE SAFE TESTING OF HV COMPONENTS ON THE HIL TESTER

If high-voltage components or subsystems of electric and hybrid vehicles are to be tested, the highest safety standards must be ensured for the persons testing and the operating personnel. For this purpose, HV components must be constructed so that they are safe to touch and all queries to be measured or influenced must be fed to the test system galvanically isolated from the high voltage.

For this purpose, Softing realizes test adapters for HV control units, in other words for Battery Management Controllers (BMC) as well as for Cell Supervision Electronics (CSE).

Typical areas of application are:

- HiL and function testers
- OBD tests
- Labs, test benches and engineering workshops

at OEMs, system and module suppliers (Tier1) as well as in test companies.

CHARGE CHANGEOVER SWITCHES WITH LIQUID-COOLED COMPONENTS FOR HIGH POWER CHARGING (HPC)

High Power Charging (HPC) enables fast charging with charging performances of up to 400 kW. This makes it possible to quickly charge electric vehicles with power for distances of up to 600 kilometers – in the time it takes for a coffee! But fast power charging is not totally unproblematic. Charging voltages of up to 1000 V and charging currents of up to 400 A continuous current generate a lot of power loss and thus heat.

In order to reduce the thermal load on the affected components, the energy transfer systems must be cooled efficiently. Furthermore, it is sensible to equip HPC fast charging stations with interfaces for the Combined Charging System. This is how it can be ensured that the charging stations remain compatible with older electric vehicles (downward compatibility).

Typical areas of application are:

- Test benches
- Labs
- Engineering workshops
- Environmental simulations (e.g. wind tunnel)

at OEMs and system suppliers.

Softing has planned and developed technically sophisticated high-voltage charge changeover switches for DC fast charging systems. Charging cables and charging plugs are cooled with a special liquid. There are two versions of the cooling unit integrated in the charge changeover switch: as an air cooling system or with a connection to an existing house cooling system. It is also possible to switch between the charging plug variants CCS1 (COMBO 1) and CCS2 (COMBO 2).

HV SUPPLY SYSTEMS WITH ENERGY RECOVERY

Testing battery management systems (Battery Management Controllers, BMC) and high-voltage components requires the reliable supply of sufficient electrical power to these systems. Currents and voltages must be applied to the device under test in compliance with the highest safety measures, and measured and controlled precisely during operation. In order not to uselessly convert many kilowatts of electrical power into heat loss, the energy from loaded systems must be fed back into the supply network.

Typical areas of application are:

- HiL and function testers
- Labs and test benches
- Engineering workshops

at OEMs, system and module suppliers (Tier1) as well as in test companies.

Softing plans and develops customized individual high-voltage supply systems with integrated energy recovery up to 1000 VDC and 1000 ADC.

HIL TEST SYSTEMS FOR HV COMPONENTS

Softing develops and designs individual high-voltage test setups for the development of electric and hybrid vehicles in the laboratory and on the test bench. We realize HiL test systems for testing and protecting

- Cell Supervision Electronics, CSE
- Battery management systems (Battery Management Controllers, BMC)
- On-board chargers for converting mains alternating current (AC) to direct current (DC) while “filling up”.

When using HiL test systems in the high-voltage range, permanent monitoring of insulation safety is essential in order to be able to guarantee the highest safety standards. All HV components are constructed so that they are safe to touch and all queries to be measured or influenced are fed to the test system galvanically isolated from the high voltage.

In our HV HiL test systems, different HV components are used for the ECU test depending on the specific requirements:

- HV test adapters
- HV cell simulations
- HV insulation fault simulations
- High-voltage capacity decades
- Controllable NTC/PTC temperature sensor simulation decades for simulating temperature progressions of a battery

Alongside the outstanding quality of the systems, an essential feature of our test systems is their high flexibility. Thanks to the modular plug-in technology in the test setups, the test modules can be changed quickly and thus different ECU variants can be tested on just one test setup with minimal conversion effort.

Typical areas of application are:

- Component tests
- Function tests

at OEMs, system and module suppliers (Tier1) as well as in test companies.

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