IRS SYSTEMENTWICKLUNG GMBH

Battery Management and Junction Box Validation

Test of battery power distribution units with high voltage and high current, optionally including onboard chargers and DC/DC converters and battery cell management

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Description

One essential component in electrical vehicles – besides motor and HV battery – is the power distribution and battery management. These components are located close to the HV-battery and provide connectivity for several components like:

- Inverters for front and rear axle
- DC-charger
- AC-charger, which can be optionally included
- LV-battery via DC/DC converter
- The battery power contacts and its cells for cell monitoring

Besides the power distribution itself, additional functionality is added, like contactors, current- and voltage sensors, fuses, and isolation monitors. The latter ones are safety critical components, and in sum a lot of different tests must be performed during validation or end of line verification.

IRS provides solutions for end-of-line-, lifetime- and system-test of battery junction boxes including onboard charger, DC/DC converter and battery management.

Key Facts

- High current power tests with standard power supplies with low losses
- Grid feedback for low power consumption and losses
- Cell simulation for battery management systems

Use Cases

IRS test systems are applied in end-of-line, lifetime- and system-test of battery junction boxes.

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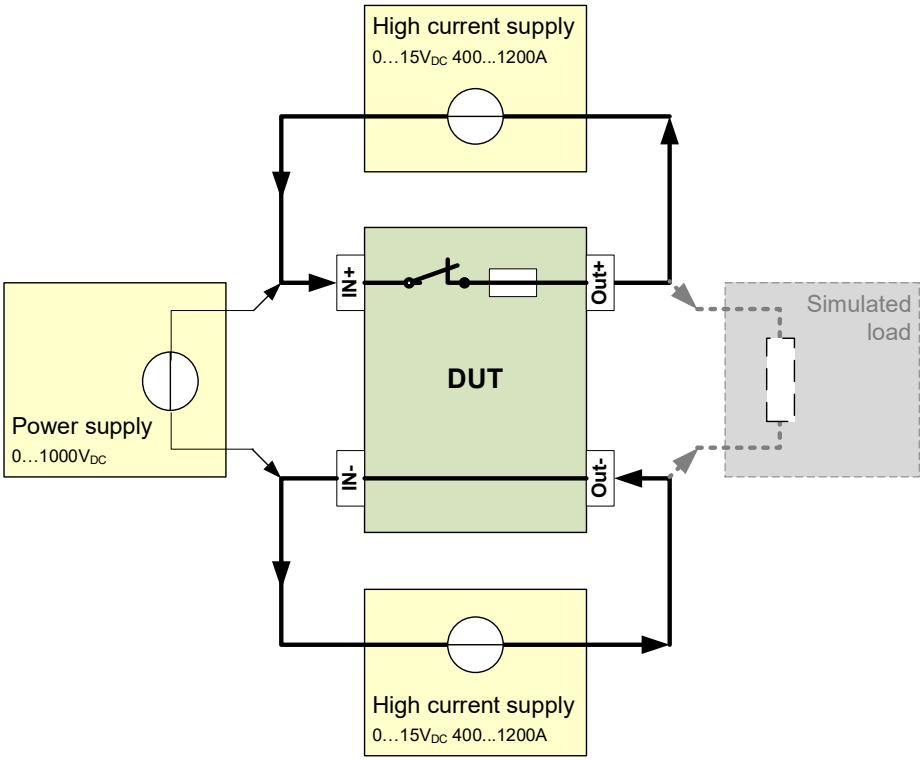
Technical Description

High Current test

Battery junction boxes provide battery power at 200…1000V_{DC} to components like inverters or DC-chargers, which may draw currents in the range of 500A or more. To simulate such a scenario without the need of an electronic load of several 100kW, standard power supplies can be used. One provides high voltage with only little current, while two low voltage supplies provide high currents.

The following figure illustrates the basic concept how to simulate high power loads with only little power losses and standard power supplies.



Please note, that not every low voltage power supply is capable of handling such high battery voltages. Choosing the right device is crucial for proper operation of such a setup. The same principle may be applied at various applications, where both high voltages and high currents are necessary. IRS has not only built such systems for battery junction boxes, but also for testing of automotive power connectors.

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When not only static currents, but dynamic current profiles are used, a synchronous power supply control is required to achieve a realistic load simulation. With IRS SensSim in combination with analog voltage-controlled power supplies, the current profiles may be generated synchronous for both positive and negative poles.

High Voltage test

In most systems, where hazardous voltages are applied, the first test to be done is the high voltage test, to determine the isolation resistance and withstand voltage. Only after this crucial test had been executed, other test steps may continue.

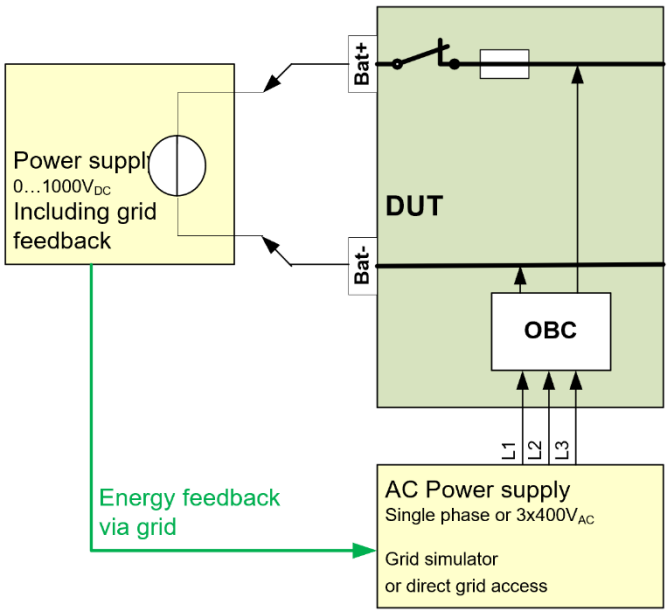
Usually, the high voltage test is separated from other tests, since in case of failure, equipment can be damaged. But IRS has already systems in the field, where high voltage tests are combined with functional tests, while safety and reliable operation can be maintained.

Onboard-charger test

Some battery junction boxes have integrated the functionality of a wired onboard charger (OBC). This component draws AC power from the grid. The OBC converts this energy to a DC current to charge battery.

In lifetime testers, the power is usually drawn directly from the grid. A power supply with grid feedback simulates the battery and feeds back the energy directly to the grid input of the OBC. With careful design of the device supplies, most of the energy circulates, resulting in low power losses in the test system.

For detailed parameter verification in system-testers, a grid simulator is applied to simulate all different grid variations including single-phase operation.



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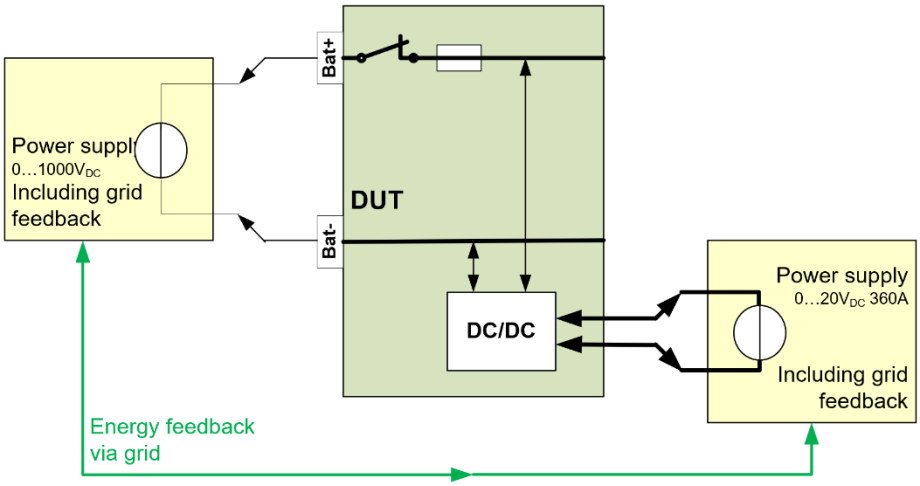
DC/DC test

Some battery junction boxes include a DC/DC converter to shift energy between HV and LV battery. The energy is flowing from HV to LV battery in buck mode since there is no electric generator available in the electrical vehicle to charge LV battery. Energy is transferred from LV to HV-battery in boost mode. The following figure shows the typical setup:

To cover both directions, bidirectional power supplies with grid feedback are applied both on LV and HV side, resulting in flexibility, low power consumption and low losses of the system.



Safety

Of course, testing battery power distribution boxes with voltages of up to 1000V requires measures for safety. Thus, IRS systems include hosing, isolation monitoring and safety controllers to make sure, that operators and visitors and not harmed at any time.

Battery junction boxes for electrical vehicles may include isolation monitors. Since only one isolation monitor may be active at the same instant, flexible isolation monitors are used in the test system, which can be deactivated at certain test steps.

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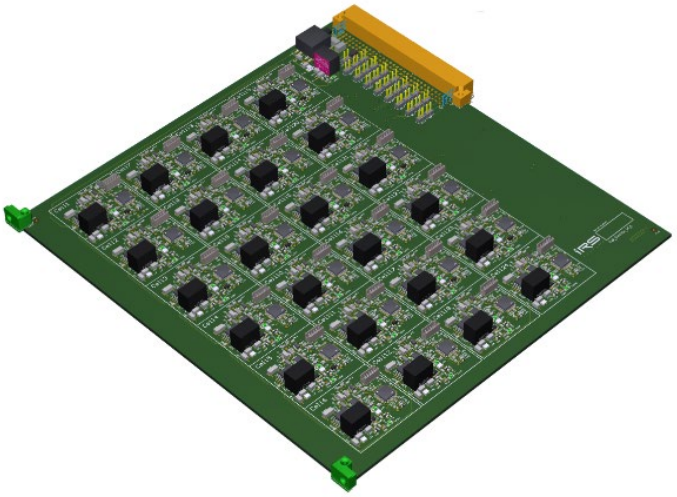
Cell simulator for battery management

Finally, battery junction boxes may include the battery management. The battery management determines and influences the status of every single cell of the battery. Battery management monitors the voltage of all cells and can equalize their state by balancing mechanisms. To test the battery management, a cell simulation is necessary.



IRS provides a modular cell simulation for 24 cells on a single board. The cells on the simulator can be combined in series and several simulator boards are cascadable for higher voltages.

Technical Data

	Min	Typ	Max	Unit
HV-DC voltage range	0		1000	V
DC current ranges (Typical values)		500	1000	A_{RMS}
Cell Simulation Voltage	0,5	4	4,8	V
Cell current	-150		150	mA
Charger power		11	22	kW
DCDC power		4	15	kW

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