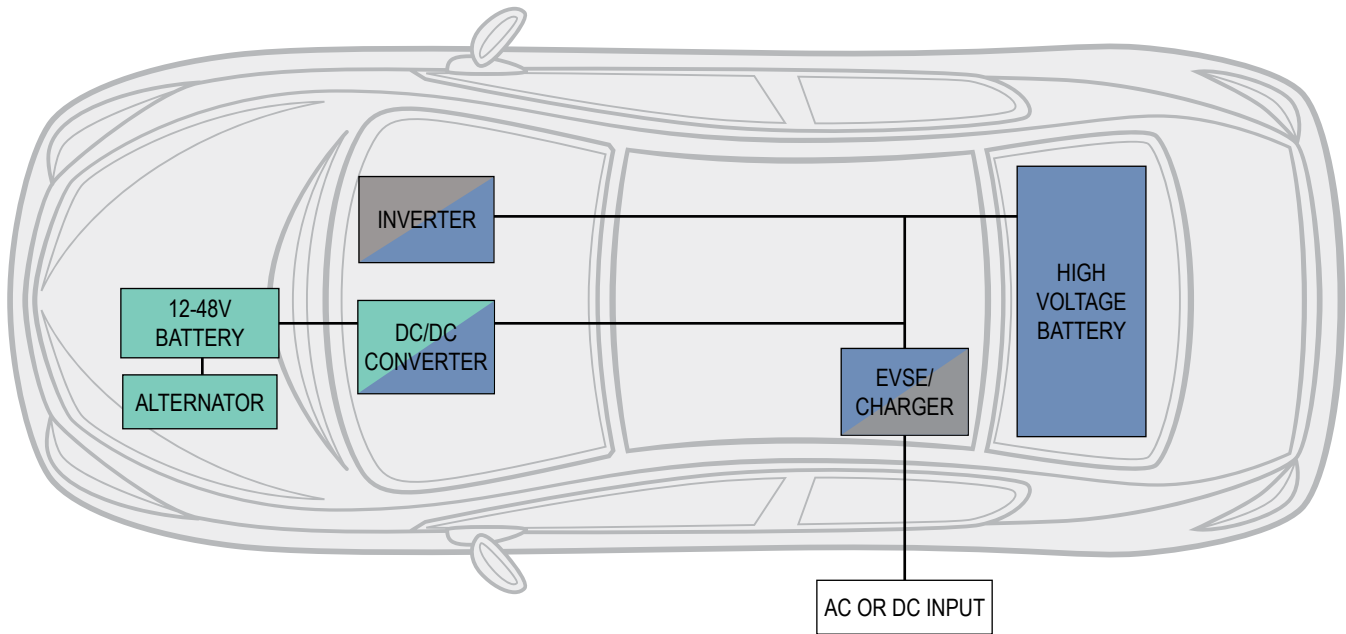


Electric Vehicle Testing

NH Research, Inc. (NHR) manufactures test equipment for evaluating the operation, the performance, the safety, and the endurance of electrical power components utilized in Electric Vehicles (EVs).

The EV industry is constantly improving technologies in order to meet CO₂ emissions reductions goals requirements as well as meeting customer performance expectations for a good driving experience and a reasonable recharge time. These factors are driving EV manufacturers development for efficient power converters, inverters, faster charging, and improved battery performance. The simplified EV diagram below (Fig. 1) illustrates a few of the key EV components that utilize NHR test equipment including: batteries, chargers, alternators, DC/DC converters, and inverters. For example, NHR's battery emulation mode dramatically simplifies testing of chargers, DC/DC converters, Inverters, and Vehicle to Grid (V2G) features. Additionally, the same test equipment is able to be used to evaluate EV battery performance using drive-cycle simulation and by emulating real-world transients.



NHR solutions for: ■ Low-voltage DC ■ High-voltage DC ■ High-voltage AC & DC

Figure 1: Simplified diagram of a typical EV electrical system.

NHR's test equipment and software tools simplify testing. Our products provide engineering and manufacturing with the right tools needed to validate designs and confirm manufacturing processes by using real-world simulations. Testing performed using real-world simulations reduces cost, reduces risk, improves test coverage, and improves overall design confidence. Refer to the following page for some example solutions for Electric Vehicle sub-assembly testing.

NH Research, Inc. Solutions for Electric Vehicle Testing

DC - DC TESTING

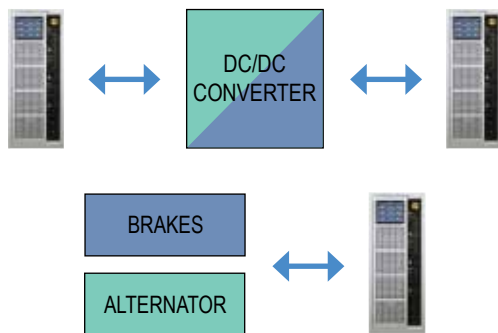


Figure 2: Converter & generator testing

9200 & 9300 Battery Emulation Test System

- Bi-directional DC power (battery emulation)
- Regenerative DC load mode (discharge)
- Product endurance & certification testing
- Transient & accessory load inrush simulation
- Modular system sizing from 40VDC to 1.2kVDC

4700 & 4760 DC Load

- Linear air-cooled DC loads for 120VDC & 600VDC
- Transient & accessory load inrush simulation

DC - AC TESTING

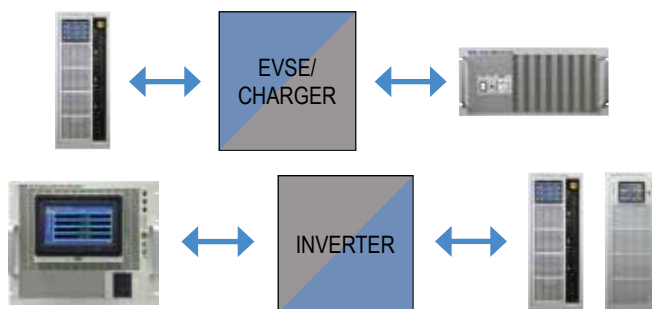


Figure 3: AC/DC & DC/AC testing

9200 & 9300 Battery Emulation Test System

- Easily & safely simulate batteries & battery failures
- Source mode (charge) emulates level 3 DC chargers

9200 & 9300 Battery Emulation Test System

- Programmable level 1 & 2 AC power simulation
- Bi-directional AC power (V2G)

9200 & 9300 Battery Emulation Test System

- EVSE/Inverter testing & calibration

DC BATTERY TESTING

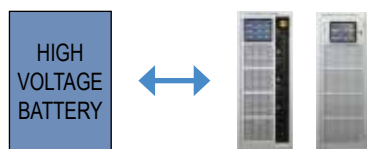


Figure 4: High-voltage battery testing

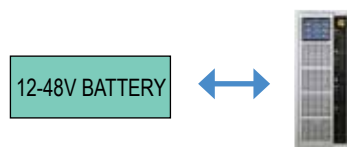


Figure 5: Low-voltage battery & alternator testing

9200 & 9300 Battery Test System for High Voltage

- Drive cycle simulation & battery performance tests
- BMS calibration & verification
- Battery safety certification testing
- Modular system sizing from 240VDC to 1.2kVDC

9200 Battery Test System for Low Voltage

- Cranking amp, endurance & cycle life testing
- Modular system sizing from 40VDC to 240VDC

4700 & 4760 DC Load

- Cranking amp & battery discharge testing