BATTERY PACK POWER HIL TESTBED MODEL 8610

Chroma ATE introduces the 8610 Battery Pack Power HIL Testbed, designed for comprehensive testing of electric vehicle (EV) battery systems and components. This versatile system supports testing of battery modules, battery management systems (BMS), and cooling/heating systems. Various hardware options are available for integration, such as a DC power supply, battery charge/discharge system, digital meter, Hi-Pot tester, and short-circuit and overvoltage protection devices.

Designed for development of battery modules and packs, the Chroma 8610 testbed features real-time hardware and software with an open architecture, enabling advanced testing capabilities. Besides basic test functions like importing of vehicle driving cycles, CAN signal monitoring, fault injection, insulation measurement, and EV supply equipment (EVSE) charging simulation, the testbed can also execute critical compound scenarios for real vehicles and composite operating conditions with high risk of failure (e.g. physical and communication signal errors during cyclic discharge). This feature-rich toolset greatly improves R&D efficiency by enabling in-depth tests on battery packs before entering the real car validation stage.

The 8610 testbed integrates the high-performance Chroma 170X0 series of battery charge/discharge test systems. These systems provide dynamic simulation of battery pack discharging and regeneration under various driving conditions, enhancing testing reliability at the whole-vehicle level. During testing, the Chroma 170X0 will also feed the power output from the battery pack back to the grid to increase energy efficiency and save costs.

MODEL 8610

KEY FEATURES

- Integrated real-time system and FIU hardware, to simulate fault injection and improve ISO 26262 functional safety testing
- Supports various Simulink real-time models import, to verify on-road battery dynamic charging and discharging through standard driving conditions like NEDC and WLTP
- Supports CAN, CAN FD, LIN, and RS-485 communication interfaces
- Real-time monitoring of timing sequences, incl. high power relay open/close, initial power output, CAN signal
- Extensive modular hardware, to ensure test accuracy and repeatability; expandable according to users' needs
- Supports upper-level automated test software through ASAM XIL and ASAM XIL-MA
- Independent PLC real-time monitoring, to ensure safety during testing
- Integrated DC EVSE charge interfaces, incl. CAN Bus and PLC signals, for various compatibility tests
- Integrated Hi-Pot safety analyzer, to measure and compare battery insulation and grounding status

APPLICATIONS

- Battery pack calibration and verification
- Reliability and durability testing
- Simulation of vehicle driving cycle conditions
- System integration testing

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Vehicle Development Process and Functional Safety Test Requirements

The Chroma 8610 Battery Pack Power HIL Testbed offers comprehensive testing capabilities, covering both traditional signal-level function tests and actual power behavior verification for high-power EV components. This testbed fully supports the vehicle validation requirements at the right side of the standard V-model development process. It facilitates the integration and testing of battery pack components as well as system-level functions, encompassing battery packs, battery modules, battery management systems (BMS), cooling/heating systems and other components. The testbed can implement various composite and simulated vehicle scenarios at an early stage, before real-vehicle testing begins. This enables users to identify and correct problems sooner, thereby reducing development costs and enhancing test efficiency.

In order to cover the complex behaviors of a real vehicle, many car manufacturers and their supplies have adopted ISO 26262 as the functional safety standard in product development. The ISO 26262 standard extends from the product system down to hardware and software, stipulating safety requirements across multiple domains: functional safety → technical safety → hardware safety → software safety. At any automotive safety integrity level (ASIL), HIL and fault injection tests are necessary to verify the accuracy of the vehicle's safety mechanisms and the effectiveness of its failure coverage.

The Chroma 8610 incorporates integrated fault injection units that can perform arbitrary open and short fault tests for various control and communication signals of the device under test. Moreover, the system can integrate dynamic discharge, insulation resistance change and static charging, and other vehicle behavior simulations. This allows for the comprehensive simulation and verification of the most critical compound vehicle scenarios and composite operating conditions with the highest risk of failure. By enabling more in-depth testing of battery packs without the need for a real car, the Chroma 8610 significantly enhances the ISO 26262 fault injection test process and in turn facilitates obtaining the desired ASIL certification.

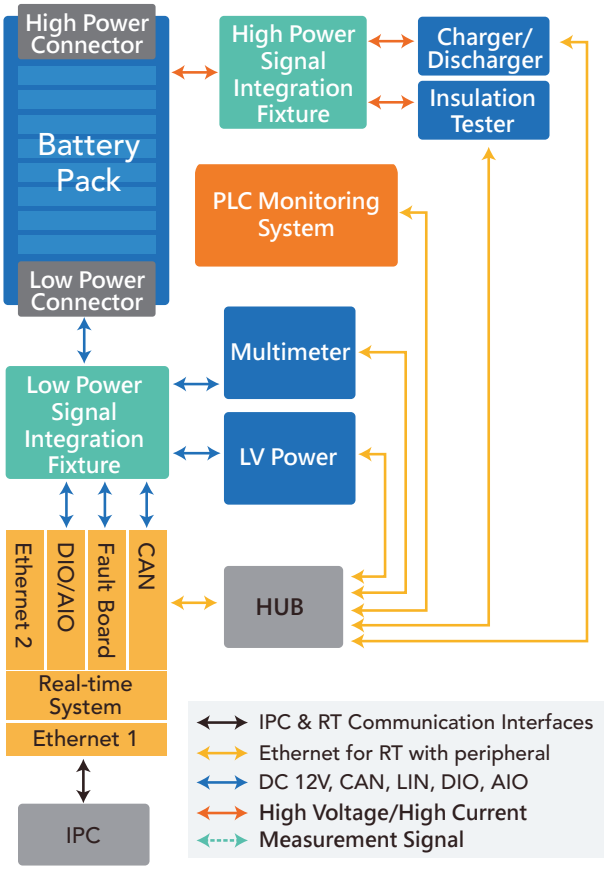
Fault Injection Interface

Real-time Control, Data Collection, Communication, and Protection

The Chroma 8610 is equipped with comprehensive warning functions and protection mechanisms, including overcurrent, overvoltage, undervoltage, and short-circuit safeguards, as well as temperature monitoring. The open software architecture enables easy integration with real-time systems, power equipment, measurement modules, along with designated simulation models for highly dynamic, vehicle-level testing of battery packs.

The testbed supports the common CAN, CAN FD, LIN, and RS-485 communication interfaces and accepts .dbc files for quick parametric configuration. The system offers great flexibility for manual testing, allowing users to edit and manipulate UI functions to continuously optimize test items and procedures. For automated testing, the Chroma 8610 is compatible with upper-level test software that follows ASAM XIL standards. Upon completion of each test sequence, the system records monitoring parameters for subsequent analysis.

The test interface of the Chroma 8610 allows users to set data collection times and displays parameter values in real time (vehicle speed, voltage, current, input power, output power, efficiency, temperature, operating mode, and more). Users can acquire this test data to generate comprehensive reports, complete with graphical features for all parameters, either during or after testing. An independent PLC system monitors the operational status of the system and power equipment in real time. If any error occurs, the charging and discharging power can be cut off immediately for instant protection of the product and equipment.



Highly Flexible and Intuitive User Interface

Central to the test system is the user interface (UI), which directly impacts both the convenience and efficiency of R&D testing. Recognizing the diverse needs of its users, the Chroma 8610 offers customizable functions and integrates various equipment to create a flexible control and test program development environment. Users are able to write and modify test sequences as well as edit the UI to suit their specific requirements. The main functions are centered around two key areas:

Display for equipment and DUT parameters:

Includes battery charge/discharge status, voltage, current, SOC, protection alarm, insulation level, etc. Update the values in real time digitally and graphically.

Control parameters for test project setup:

Includes battery charge/discharge start and stop, charge/discharge voltage/current/power settings, insulation measurement start, fault injection signal selection, test condition selection, etc. Control the values digitally and through dragging and switching.

Battery Charge & Discharge interface

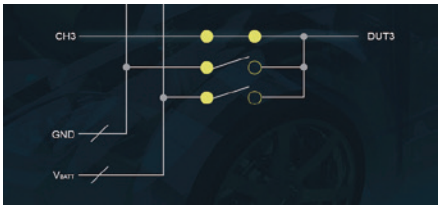
Dynamic Charging/Discharging & Compound Vehicle Scenarios

The Chroma 8610 can be connected to a Chroma 170X0 series battery charge/discharge test system. This powerful combination can simulate the e-propulsion system's dynamic loading and regenerating on the battery pack and supports the import of Altair Activate vehicle models and various real-time mathematical models with Simulink model-based design. Integration of predefined or standard driving cycles like NEDC and WLTP serves to verify the dynamic discharge and regeneration functionality of car batteries directly.

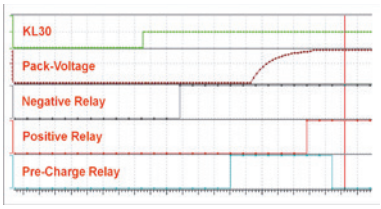
Unlike other battery test systems that rely on preloaded on-road charge/discharge records for replay, the Chroma 8610 can perform dynamic battery pack tests in real-time, offering a more authentic and flexible testing environment. Test functions include charging/discharging, signal measurement and control, fault injection, insulation measurement, and simulated EVSE charging. Users have the flexibility to arrange and combine these test functions to create a wide array of compound vehicle scenarios, enabling thorough and realistic testing of battery packs.

The example below illustrates charging and discharging after loading the real on-road profile, as well as simulation of charging changes right after a fault injection.

GUI



Fault Injection

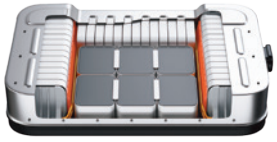


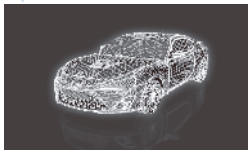
Timing Control & Measurment

Integrated Testbed 8610

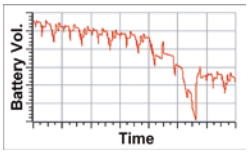
Battery Cycler 17040E

Alarm

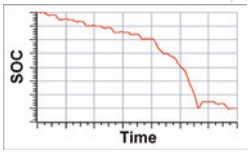




EV model



SOC v.s. Time



Voltage v.s. Time

Key-on

Start Timing Detection

Diverse Test Items

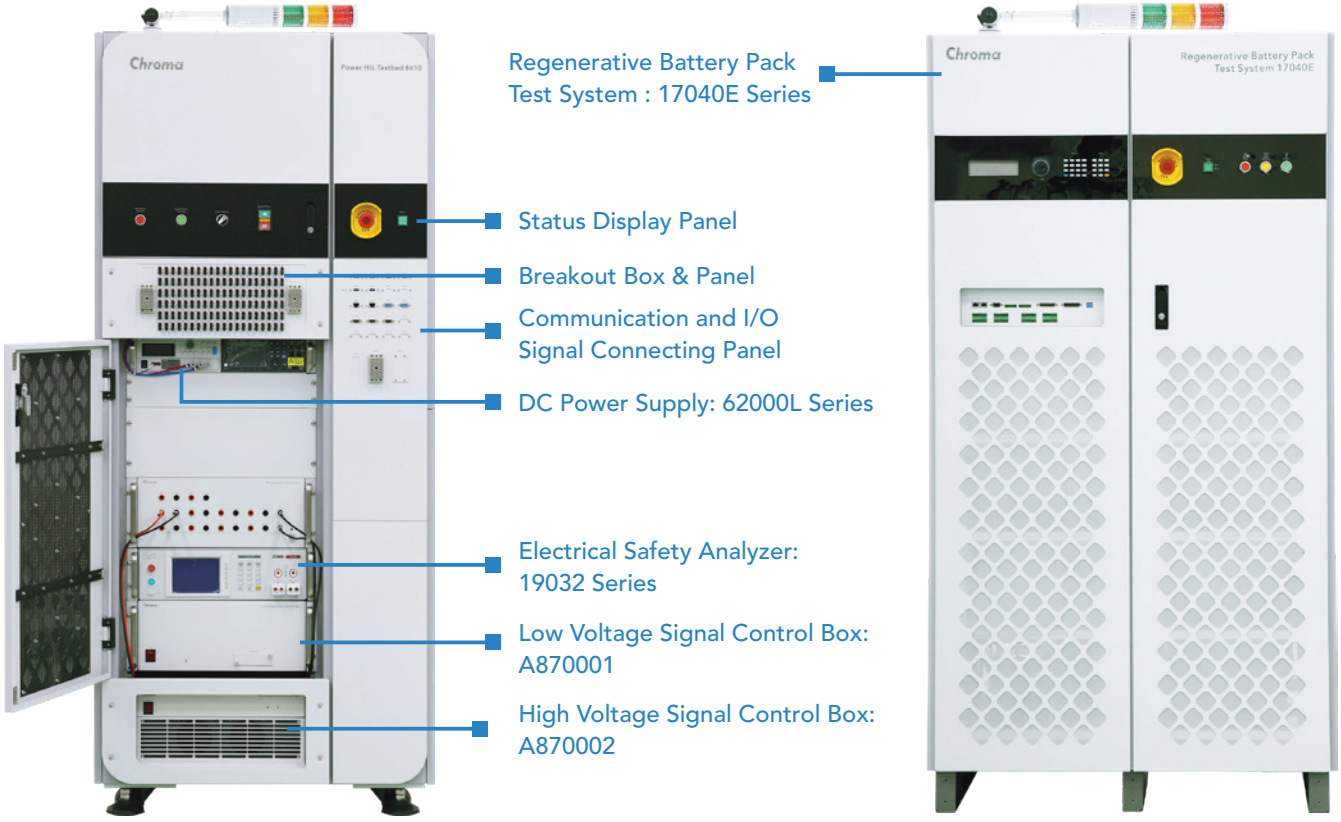
Single Test Functions

(1) CC and CV charge/discharge tests
(2) Vehicle driving cycle discharge
(3) Arbitrary charge/discharge pattern reproduction
(4) Voltage measurement and voltage difference detection
(5) Current measurement and current difference detection
(6) High Power ON/OFF control logic and timing (relay self-test mechanism confirmation)
(7) High voltage interlocking mechanism
(8) Battery protection function timing check
(9) Insulation resistance measurement
(10) GB/T, CHAdeMO, CCS DC charging and interoperability tests
(11) Dynamic leakage current
(12) AC/DC withstand voltage tests

Compound Test Functions

(1) Checking insulation & withstand voltage status after fault injection while discharging with vehicle driving cycle importing
(2) Checking insulation & withstand voltage status after fault injection while arbitrary charge/discharge pattern reproduction
(3) Impact of fault injection on SOC calculation and protection functions
(4) Checking insulation & withstand voltage status after fault injection while AC and DC charging process
(5) Charging energy and strategy verification with different SOC, cell & total voltage and fault signals
(6) Fully charged calibration mechanism test
(7) Combine the programmable environmental chamber and the energy consumption model of the object under test to conduct automated durability dynamic testing

High Performance Equipment



Ordering Information

Battery Pack Power HIL Testbed: 8610
Regenerative Battery Pack Test System: 17040E
DC Power Supply: 62000L Series
Electrical Safety Analyzer: 19032 Series

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