

# Scienlab Battery Test Solution

Cell Level – Up to  $\pm 25$  A, 60 or 150 Channels

SL1132A



SL1132A Scienlab Battery Test Solution – Cell Level – Up to  $\pm 25$  A – 60-Channel Configuration

## Table of Contents

Battery Test Solution   Cell Level .....	3
Configurations .....	4
Power Electronics .....	5
Temperature Chambers and Cell Fixtures .....	5
Electrochemical Impedance Spectroscopy (EIS) .....	5
RFID .....	6
Three-Terminal Measurements .....	6
SL1132A Safety Concept .....	6
Redundant Measurements .....	6
Exhaust Air Channel .....	6
Automated Door Lock .....	6
Software to Control Cell Test Systems .....	7
SL1091A Energy Storage Discover (ESD) .....	7
EP1150A PathWave Lab Operations for Battery Test .....	8
SL1132A Cell Test Systems Technical Specifications .....	9
SL1132A Cell Test Systems Operating Characteristics .....	9
System Configurations and Options .....	11
Required Configuration Elements .....	11
SL1132A 60-Channel Cell Test Solution .....	11
SL1132A 150-Channel Cell Test Solution .....	11
SL1132A 150-Channel Cell Aging Solution .....	11
Additional Function Selections .....	12
Support Service Options .....	12
PS-XPS-100 Project Management and Technical Consulting .....	12
R9001A-201 Installation Service .....	12
R9001A-202 Commissioning – Test Solution .....	13
HS0002A-100 Productivity Assistance .....	13
Battery Module and Battery Pack Testing .....	14

## Battery Test Solution | Cell Level

The SL1132A Scienlab Battery Test Solution is an innovative, compact, and efficient solution for characterizing and testing battery cells. The space-saving combination of power electronics, test chamber and sophisticatedly developed cell holders not only enables the testing of large quantities of cells in the smallest space but is also flexible in use. The defined fixtures accept a range of pouch cells, ensuring accurate measurement results.

SL1132A Basic Configurations	
SL1132A-S01 Cell Test Solution with Fixtures for 60 cells and 60-Channel SL1050A-S06 Environmental Chamber	Up to $\pm 25A$ Charge-Discharge and Measurement
SL1132A-S02 Cell Test Solution with Fixtures for 150 cells and 150-Channel SL1050A-S07 Environmental Chamber	Up to $\pm 25A$ Charge-Discharge and Measurement
SL1132A-S11 Cell Aging Solution with Fixtures for 150 cells and 150-Channel SL1050A-S07 Environmental Chamber	Cell voltage, current, temperature monitoring

Both cell testing solutions and the cell aging solution provide a central connection point on the chamber for all media (power, water, nitrogen, compressed air, and data communications) that simplifies system installation, ensures fast commissioning and easy maintenance, and minimizes both time to test and service costs. The SL1132A provides a comprehensive safety concept that prevents possible dangers in test laboratories before they occur, helping to keep your testing safe.

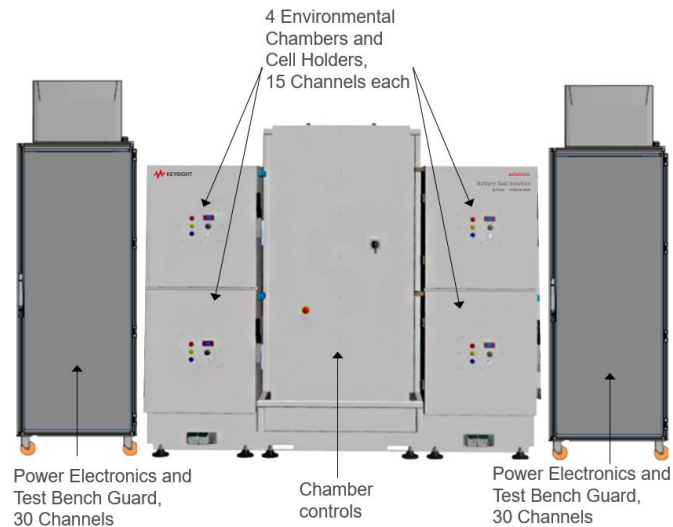


SL1132A Scienlab Battery Test Solution – Cell Level – Up to  $\pm 25 A$  – 150-Channel Configuration

## Configurations

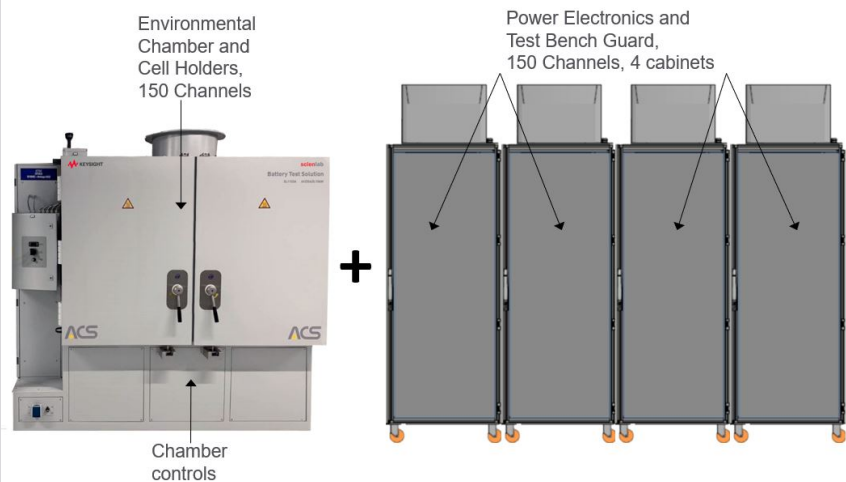
### SL1132A 60-Channel Cell Test Solution

The 60-channel cell testing solution includes an environmental chamber, cell holders, and cabling to connect the cells in the chamber to the power electronics. The Scienlab Test Bench Guard (SL1070A) is included and connected to the chamber.



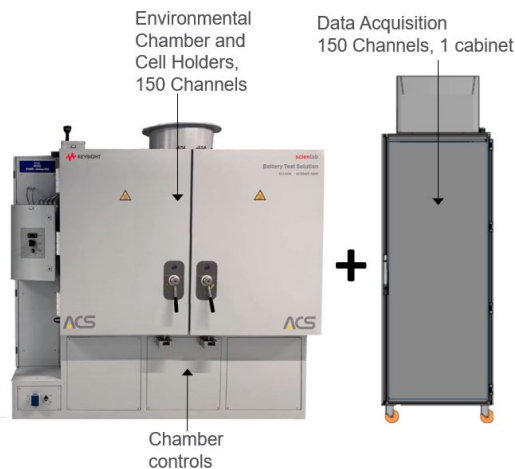
### SL1132A 150-Channel Cell Test Solution

The 150-channel cell testing solution includes an environmental chamber, cell holders, and cabling to connect the cells in the chamber to the power electronics. The Scienlab Test Bench Guard (SL1070A) is included and connected to the chamber.



### SL1132A 150-Channel Cell Aging Solution

The 150-cell aging solution includes the same chamber, cell holders, and safety system as the 150-cell test solution. 150 channels of data acquisition and associated integrated cabling to allow the system to monitor voltage, current, and temperature of the cells being aged in the environmental chamber.



## Power Electronics

All higher-power Scienlab Battery Test Systems from Keysight have high regeneration capabilities, allowing efficient, cost-effective, and environmentally-friendly operation. Thanks to the bi-directional power supply, more than 90 % of the energy is fed back into the AC grid during cell discharge. The system also offers automatic calibration to decrease ongoing service costs.

The SL1132A is protected against overheating, overcapacity, short circuit and idling. It also has reverse polarity protection and monitors all internal voltages, currents and temperatures. In the case of an emergency shutdown, contacts on the mains ensure that there is no voltage and all internal high voltage sources are automatically discharged.

The SL1132A has strong security for data acquisition and transmission. The Measurement and Control Unit (MCU) is an embedded system providing autonomous program sequence control and measurement data acquisition. This assures that a test will continue running even if communication with the system PC is lost. Communication among the elements of the test system (power electronics, chamber, cooling, system PC) is managed via Ethernet.

## Temperature Chambers and Cell Fixtures

The two available system environmental chambers (60- and 150-channels) offer homogeneous cooling/heating of the cells through optimal air flow. One of these chambers (SL1050A-S06 or SL1050A-S07) must be ordered with the SL1132A Scienlab Battery Test Solution – Cell Level.

The modular cell fixture system is designed to accommodate a variety of pouch cells that have both tabs on the same edge of the cell. Individual pouch cells are secured between two plates on a cell carrier, and the cell tabs are securely held against electrical contacts on the carrier. The carrier assembly is inserted into a chassis that holds 5 of the carriers. Groups of these 5-slot chassis are combined to create fixtures for all the cells held in the chamber – either four sets of three chassis comprised of 15 cells each in the 60-channel system, or 30 sets of 5-slot chassis for a total of 150 cells in the 150-channel system. These cell fixtures have been designed to precisely fit inside the rooms of both types of chambers. The defined DUT fixtures and pre-assembled wiring enable precise measurement results.

Each cell carrier can accommodate a range of pouch cell dimensions:

- Up to 80 mm width
- Up to 125 mm length (without tabs)
- Thickness from 2.8 to 5.0 mm

The cell carrier for each cell can be removed from its 5-slot chassis and replaced without affecting the rest of the cells in the carrier. You can load spare cell carriers with cells while other cells are being tested, so that you can quickly unload a chamber at the end of a test and reload the chamber to start the next test, without sacrificing test time while you unload or load individual cells from their carriers.

To test different types of cells, such as prismatic cells or pouch cells with different contact tab geometries, or for more information on the contacting system, please contact Keysight to discuss a custom cell fixturing solution to meet your needs.

## Electrochemical Impedance Spectroscopy (EIS)

You can gain deeper insights into the characteristics of your cells with the optional EIS capability. This provides integrated electrochemical impedance spectroscopy measurements per test-channel, independently programmable within a test sequence.

## RFID

RFID capability is included to allow tracking of cell location and status.

## Three-Terminal Measurements

For cell research and design verification, the SL1132A provides capability for three-terminal measurements of cells, including contact to a reference terminal. The power electronics includes this measurement capability, and the pouch cell contacting system has three terminal contacts for each cell, with the reference terminal contact located between the contacts for the positive and negative terminals.

## SL1132A Safety Concept

The primary objective of the safety concept is to protect the operating staff in case of a hazardous situation inside the test chamber. This is achieved by continually monitoring the interior of the chamber using CO and H<sub>2</sub> sensors, in order to detect outgassing and incipient thermal events at very early stages. High concentrations and accumulation of slowly leaking gaseous substances is minimized by a continuous flushing of the chamber with compressed air. As soon as hazardous levels are detected by the sensors, N<sub>2</sub> flushing will be initiated to remove volatile substances inside the chamber. This procedure reduces the content of oxygen in the test chamber to minimize the likelihood of fire.

The safety concept is also designed to avoid an explosive mixture in the chamber. The lower explosion limit (LEL) of hydrogen in air (4.1 % vol) is calculated based on the available volume of the chamber. The available volume of the chamber is calculated by the chamber inner dimensions minus the volume of cells and fixtures.

## Redundant Measurements

In the two cell test system configurations, to prevent accidents due to overcurrent, overcharging, or overtemperature, the safety concept provides a redundant measurement of current, voltage and temperature. This is verified and evaluated in a higher-level, independent safety PLC. As soon as a critical operating state is detected, the test channel affected will be switched off. The provided safety equipment is monitored by a Scienlab Test Bench Guard (SL1070A).

## Exhaust Air Channel

The test chamber is connected to the exhaust air channel of the building using a reusable one-way pressure relief flap to relieve any overpressure caused by outgassing substances. Furthermore, each chamber is equipped with an independent safety temperature limiter to avoid overheating of the DUTs.

## Automated Door Lock

An automated door lock ensures the safety of the operating staff in two respects.

1. No active parts can be reached by the operating staff during a test
2. The door cannot be opened during a test thus preventing the release of dangerous gases into the laboratory

There is an additional function whereby the operating staff may request a time-limited deactivation of the door lock via the control room (the PC supervising the test system). This enables the exchange of DUTs during a test. However, the operator of the control room must check and verify whether the chamber may be opened safely based on the currently monitored safety parameters.

## Software to Control Cell Test Systems

Keysight provides cell test system software that starts with Energy Storage Discover to control your individual cell test systems such as the SL1132A, and extends to PathWave Lab Operations for Battery Test to manage and coordinate your entire battery testing laboratory with multiple systems used to test cells, modules, and battery packs.

### SL1091A Energy Storage Discover (ESD)

Energy Storage Discover (ESD) is the intuitive test-software environment for developing, performing, and analyzing tests for an individual test system.



Energy Storage Discover controls individual test systems

- Central controlling component for all Keysight Scienlab-brand energy storage test environments.
- Comprehensive overview, user-friendly operation, easy-to-learn.
- Powerful visualization of tests and results.
- Several ESD offline versions support creating test programs.
- Available simulation environment for offline test.
- Ethernet communication with the battery test system.
- Easy integration with external control and monitoring software via optional standardized remote-interface.
- Holistic vehicle emulation from the perspective of battery cell, module and pack levels.
- Support for Windows 7 and 10. Single software license per workstation.
- Integration of external components into the test environment and process, such as environmental chambers, cooling and heating equipment, or optional Scienlab-brand Measurement and Control Modules.

## EP1150A PathWave Lab Operations for Battery Test

PathWave Lab Operations for Battery Test enables efficient planning and coordination of your entire battery test laboratory. It manages all resources, including test facilities, test systems, and your test objects or devices under test (DUTs). PathWave Lab Operations for Battery Test provides an integrated, web-based lab management platform that helps you modernize your test workflows, eliminating legacy paper-based processes, and increasing data integrity and traceability.

This powerful set of tools helps you to improve test throughput for all the cells and batteries you need to test, to fulfill the testing requirements for your projects on-schedule, and to optimize test asset utilization.

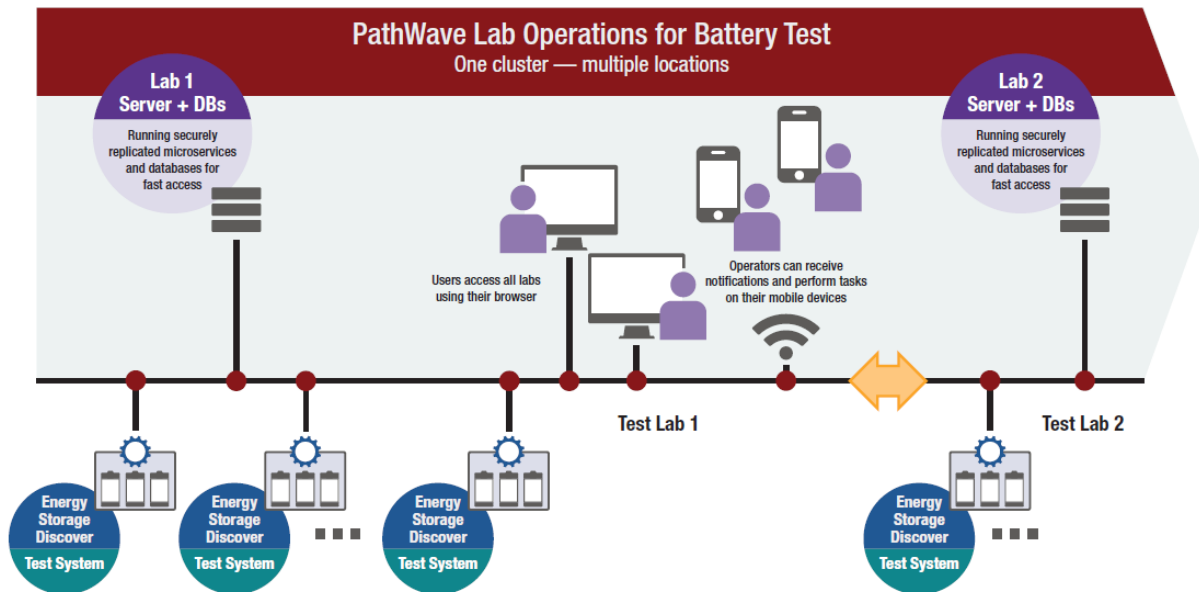


Figure 1. PathWave Lab Operations for Battery Test manages multiple test systems in a laboratory

- Easily register and track test objects in your lab.
- Quickly analyze your data and statistics.
- Organize your test lab workflow, documents, lab orders and tasks.
- Plan and optimize your test capacities and sequences.
- Share and control test plans, results, data and other documents. Collaboration and discussion among lab staff become easy and productive.
- Remotely control your lab and its devices anywhere, anytime.
- Manage and route notifications to your preferred device or email service.
- Automated, networked, and scalable for any size of testing lab – up to thousands of channels.



## SL1132A Cell Test Systems Technical Specifications

System Operation	
Test channels	60 or 150
Voltage range	6 V
Current range	±25 A
Power range	0.15 kW
Measurements	
Voltage accuracy*	<±1 mV (typical ±0.5 mV)
Current accuracy*	±0.05 % of measured value ±5 mA (offset)
Current dynamics	3 ms (10 to 90 % of max. current range) <sup>1</sup>
Resolution	32 bit
Sample Rate	1 kS/s
Temp. measuring type	1x PT1000 per channel
Temp. measurement range	-40 to +120 °C
Temp. measurement accuracy	±1 K

\* Measurement and programming accuracy

<sup>1</sup> @ Vout = 0 V. No switching times at transition from positive to negative current and vice versa.

## SL1132A Cell Test Systems Operating Characteristics

System AC Power	
Efficiency	>90 %
Reactive power compensation	cos (Φ) >0.98
Mains supplies	3 ~, Protective Earth, 400 VAC (+10%/-5%) / 50 Hz (± 0,2 Hz)
Environmental	
Operating temperature	10 to 35 °C
Storage temperature	6 to 40 °C
Humidity	30 to 75 % relative humidity

Cooling Water Connection	60-Channel Version	150-Channel Version
Inlet temperature	1½", $\vartheta_i = 14$ to 20 °C	
Return temperature	1½", $\vartheta_o$ max. 30 °C	
Connection	¾" (female thread)	1½" (female thread)
Cooling water consumption	3.6 m³/h for $\Delta T = 10$ K	3.1 m³/h for $\Delta T = 10$ K
Inlet pressure	2 to 4 bar	
Pressure difference	2 bar	
Compressed Air Connection	60-Channel Version	150-Channel Version
Connection	½" (female thread)	
Max. consumption	5.8 Nm³/h	8.7 Nm³/h
Pressure	6 to 10 bar	
Temperature	2 to 35 °C	
Moisture content	Class 6 (vaporous)	
Max. dew point	-40 °C	
GN2 Connection	60-Channel Version	150-Channel Version
Connection	¾" (female thread)	1" (female thread)
Max. consumption	58 Nm³/h	87 Nm³/h
Inlet pressure	3 to 5 bar	
Temperature	2 to 50 °C	
Temperature Chamber	60-Channel Version	150-Channel Version
Chamber type	DY200-Quatro	DY1080
Test rooms	4 <sup>3</sup>	1
Weight (approx.)	1.4 kg	1.87 kg
Test room dimensions (H x W x D)	2.45m x 3.17m x 1.4m	2.45m x 2.4m x 1.4m
Pre-fuse on site	40 A gG	50 A gG
Test room dimensions (H x W x D)	680mm x 600mm x 500mm	1200mm x 1800mm x 600mm
Max. floor loading	55 kg	250 kg
Temperature range	-40 to +120 °C	
Heating rate	4 K/min @ -33 to +80 °C <sup>1</sup>	0.9 K/min @ -33 to +80 °C <sup>2</sup>
Cooling rate	2 K/min @ +80 to -33 °C <sup>1</sup>	0.5 K/min @ +80 to -33 °C <sup>2</sup>

Heat compensation	1.5 kW @ +25 °C; 0.4 kW @ -33 °C	5.8 kW @ +25 °C; 3 kW @ -33 °C
Safety features	<ul style="list-style-type: none"> <li>• Emergency stop switch (red/yellow) for all-pole disconnection</li> <li>• Fast stop push-button (black) to stop each chamber room separately</li> <li>• Electromechanical door locking system</li> <li>• Continuous small flushing volume with compressed air</li> <li>• Gas monitoring sensors including sampling device</li> <li>• Reusable one-way pressure relief valve, flanged connection DN500 (EN 1092-1)</li> <li>• Signal light (colors red, green, blue) for each chamber room</li> <li>• Optional Nitrogen flushing in the event of an accident</li> </ul>	
Additional features	Additional feedthrough Ø 50 mm, Schuko socket and Ethernet.	

<sup>1</sup> With 36 kg of cells (50 % plastic and 50 % aluminum) within the chamber.

<sup>2</sup> With 343 kg of cells (50 % plastic and 50 % aluminum) within the chamber.

<sup>3</sup> Each test room has capacity for 15 cells.

## Documentation

Supplied documents:

- Operating instructions in English
- CE Declaration of Conformity
- Acceptance and calibration protocol

System design and realization according to applicable safety and regulatory requirements (such as EU Directives). Special customer requirements need an individual discussion and quotation.

## System Configurations and Options

Required Configuration Elements (Contact Keysight to create a complete custom configuration)

### SL1132A 60-Channel Cell Test Solution

- SL1132A-S01 Battery Test System, ±25 A, 60 Channels, RFID without Chamber
- SL1132A-A01 Cell holder for pouch cells
- SL1050A-S06 Custom chamber definition S06 - requires custom Statement of Work

### SL1132A 150-Channel Cell Test Solution

- SL1132A-S02 Battery Test System, ±25 A, 150 Channels, RFID without Chamber
- SL1132A-A01 Cell holder for pouch cells
- SL1050A-S07 Custom chamber definition S07 - requires custom Statement of Work

### SL1132A 150-Channel Cell Aging Solution

- SL1132A-S11 Battery Aging System, 150 Channels, without Chamber
- SL1132A-A01 Cell holder for pouch cells
- SL1050A-S07 Custom chamber definition S07 - requires custom Statement of Work

## Additional Function Selections

SL1132A-001 Electrochemical Impedance Spectroscopy (EIS)	
Description	Integrated electrochemical impedance spectroscopy per test-channel, independently programmable within a test sequence
Measurement method	Potentiostatic and galvanostatic
Absolute error  Phi	±2 degrees
Absolute error  Z	±50 µOhm
Relative error  Z	1 %
Frequency band	1 mHz to 10 kHz

## Support Service Options

The service features of the SL1132A Scienlab Battery Test Solutions can be tailored to the requirements of your facilities, expertise, and the overall scope of your test project. Keysight will work with you to define your service options based on your requirements and goals. Keysight offers the following services to secure a successful project execution and to reduce your ramp-up time.

### PS-XPS-100 Project Management and Technical Consulting

With this Project Management Service, an experienced Keysight project manager is dedicated to your project and acts as direct communication interface between Keysight and your project management team.

The project manager assumes these responsibilities:

- Observes internal project progress, helping ensure the project schedule and project milestones are maintained.
- Notifies you of any unexpected project-related events or occurrences.
- Provides complete and accurate project documentation for your project.

### R9001A-201 Installation Service

The scope of this Installation Service strongly depends on your individual facilities. After sharing all relevant information and requirements regarding test bench components that require installation such as connection to the local grid and the local water supply with your Keysight field engineer, the scope of service personnel and material costs for installation can be calculated.

## R9001A-202 Commissioning – Test Solution

The Commissioning Service is offered to provide guidance to your team during the initial usage of the test bench following installation. Commissioning is highly recommended for each test bench project. The Commissioning Service includes:

- Local presence of experienced test bench engineer(s) during initial usage of the test bench.
- Consulting with your personnel regarding the intended usage of the test bench (e.g. initial test with your test specimen).
- Review of executed hardware installation of Keysight products.
- Review and consulting related to software settings of operational software if ordered.
- Travel expenses of Keysight personnel related to the performing of the commissioning service.

Commissioning is offered on a per-day basis. Keysight recommends at least two days for each test bench project.

## HS0002A-100 Productivity Assistance

Productivity Assistance is offered to support, consult, and train your operational personnel to reduce the ramp-up time for initial usage of a new test bench and for any unexpected system behavior during the test bench life cycle. Productivity Assistance is executed either remotely (phone/ Internet) or on site (on request). It includes:

- Direct access to an experienced system specialist via phone/internet.
- Support for failure analysis and troubleshooting.
- Software and programming support and consulting.

Keysight recommends at least two days of Productivity Assistance for each test bench project.

## Battery Module and Battery Pack Testing

As your testing needs move beyond testing of single cells, Keysight provides test solutions for battery modules and battery packs. You can select test systems that address the range from small coin cells to large EV packs. Keysight offers integrated systems that include power electronics, fixturing and contacting, independent and redundant safety systems, environmental chambers, battery cooling and heating, and interfaces to your BMS, ECU, and other control systems. Or you can select Keysight system components and combine them with other components (e.g. chambers, cooling) you have chosen, and have Keysight provide a fully integrated, customized test solution. And all your test systems at all levels (cell, module, pack) are controlled with the same Energy Storage Discover software to provide a consistent user interface and data management.

Keysight offers systems and solutions with capabilities up to 1000 V and 1200 A for development, characterization, product validation, and durability testing. Contact Keysight to explore how we can create a solution for your battery testing needs.



SL1000A Scienlab Battery Test System – Pack Level

Learn more at: [www.keysight.com](http://www.keysight.com)

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at: [www.keysight.com/find/contactus](http://www.keysight.com/find/contactus)

