SL1007A Scienlab Battery Test System

Cell Level – Up to ±600 A

KEYSIGHT

Scienlab Battery Test System – Cell Level

Test up to 64 cells, 6 V, ±25 to ±1600 A

Accelerate lab throughput with fast, accurate testing of up to 64 cells using the SL1007A battery cell test system (25 to 1600 A). Our purpose-built Energy Storage Discover software helps you automate common compliance, load, and endurance tests. The system hardware provides excellent accuracy, ensuring precise capacity, efficiency, internal resistance, and cell lifespan measurements. The high-resolution dynamic output produces a realistic power profile, for example, emulating EV driving to characterize cell behavior and performance. In addition, calibrated electrochemical impedance spectroscopy (EIS) measurements and reference-electrode connections enable you to gain deeper insights into the potential benefits of your latest cell chemistry and design innovations. Of further benefit to your lab, this solution keeps operating costs under control with an efficiency of up to 90% by returning power to the grid.

The following output voltage, current and power options are available:

Voltage range	**0 to 6 V**							
Current range	±25 A	±50 A	±75 A	±100 A	±200 A	±300 A	±400 A	±600 A
Power per channel	0.15 kW	0.3 kW	0.45 kW	0.6 kW	1.2 kW	1.8 kW	2.4 kW	3.6 kW

SL1007A Power electronics

The SL1007A cell test system has high regeneration capabilities, allowing highly efficient, cost-effective, and environmentally friendly operation. Thanks to the bi-directional power supply, up to 90% of the discharge energy is fed back to the mains.

The SL1007A includes safety features within the power electronics preventing overheating, overcharging, short-circuiting and open-circuiting. 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.

Figure 1. SL1007A Cell Test System, from left to right: Single rack-cabinet configuration, front door closed and double rack-cabinet configuration, front doors opened. Example configuration for large channel count or very high-current system.

The SL1007A is a Complete Cell Test System

The SL1007A provides electrical charge, discharge, and measurement capability for the cells you are testing. You can select current capacities ranging from ±25 A to ±600 A and the number of test system channels from 4 to 64 channels.

In a cell test application, the SL1007A will typically be combined with additional system resources, including test system software, contacting, and fixturing for your cells, cables, environmental chambers, and redundant safety systems. The user or Keysight can provide the supporting equipment. Keysight can combine and integrate all the components to create a test solution. Contact Keysight to discuss complete customized test solutions incorporating one or more of these additional components that will meet your specific test needs for the number and types of cells you require.

Electrochemical impedance spectroscopy

You can gain deeper insights into the characteristics of your cells with the optional electrochemical impedance spectroscopy (EIS) capability. SL1007A provides integrated electrochemical impedance spectroscopy measurements per test channel, independently programmable within a test sequence. Multi-sinusoid excitation delivers faster results. Find out more below.

Parallel channels to increase current

You can increase the total current/power for a cell being tested by manually connecting channels in parallel, outside of the system cabinets. Up to 16 channels with identical current can be connected in parallel for up to a maximum total current of 1600 A. For example:

- Up to 16 channels rated at ±100 A channels can be connected in parallel to provide up to ±1600 A.
- Up to five ±300 A channels can be connected in parallel to provide up to ±1500 A.
- Up to four ±400 A can be connected in parallel to provide up to ±1600 A.

The Energy Storage Discover software allows you to define groups of channels that have been connected in parallel, so they may be treated as a single channel for programming purposes.

Note: For SL1007A configurations with two cabinets of power electronics (see the configuration table on page 6), channels from the power electronics in one cabinet cannot be connected in parallel with the channels from the power electronics in the second cabinet.

Reference electrode connection

You can connect up to three electrodes per channel to allow voltage measurements between positive, negative and a reference electrode. This allows performing cyclic voltammetry measurements. The measured values allow a separate analysis of the cathode's or anode's behavior, which helps to understand the performance of the overall cell in more detail.

SL1007A Technical Data

Voltage/current control and measurement	
Voltage accuracy[1]	<±1 mV (typ. 0.5 mV)
Current accuracy[1]	±0.05% (measured value) ±0.01% (Full Scale offset)
Measurement type	4-wire
Current dynamics	3 ms (10 to 90% of max. current range)[2]

1. Measurement and programming accuracy; Number of Power-Line-Cycles (NPLC) = 100.

2. No switching times at transition from positive to negative current and vice versa.

Data acquisition	
Data acquisition rate	1 kHz

Operating characteristics

Temperature measurement	≤100 A	200 A	≥300 A
Temperature channels per DC channel	1x	2x	3x
Measurement type	Pt1000 (4-wire measurement)		
Measurement accuracy	±1 K		
Ambient conditions			
Storage temperature	-25 to +55 °C		
Operating temperature	5 to 40 °C		
Relative air humidity	30 to 80%		
Sound pressure level according to DIN EN 3744	<70 dB(A) at a distance of 1 m from the front		

System AC Power	
Efficiency	Up to 90%
Reactive power compensation under load	cos(φ) >0.98
Mains supply	3 ~, Protective Earth, N, 400 VAC (±10%), 50/60 Hz (±2%)
System cooling	
Cooling type	Water/air heat exchanger
Heat exchange	Max. 10% of total output power
Inlet temperature	10 to 20 °C
Return temperature	Max. 30 °C
Inlet pressure	Max. 6 bar
Pressure difference	Min. 1 bar
Connection	¾ “

Documentation

Supplied documents:

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

Contact Keysight to discuss custom or special requirements.

Channel options and dimensions

System cabinet

- The System is placed on rollers and can be moved flexible.
- Dimensions (H x D): 2.6 m x 0.8 m
- The system width varies depending on current range, and the number of channels selected:

System width

Current range	±25 A	±50 A	±75 A	±100 A	±200 A	±300 A	±400 A	±600 A
4 channels	-	-	-	-	0.8 m	0.8 m	0.8 m	1.6 m
6 channels	-	-	-	-	0.8 m	0.8 m	0.8 m [1]	1.6 m
8 channels	-	0.8 m	0.8 m	0.8 m	0.8 m	1.6 m	1.6 m	-
12 channels	-	-	-	-	0.8 m [1]	1.6 m	1.6 m [1]	-
16 channels	0.8 m	0.8 m	0.8 m	0.8 m	1.6 m	-	-	-
20 channels	-	-	0.8 m	0.8 m	-	-	-	-
24 channels	0.8 m	0.8 m	0.8 m	0.8 m*	1.6 m [1]	-	-	-
32 channels	0.8 m	0.8 m	1.6 m	1.6 m	-	-	-	-
36 channels	-	-	1.6 m	1.6 m	-	-	-	-
40 channels	1.6 m	1.6 m	1.6 m	1.6 m	-	-	-	-
48 channels	1.6 m	1.6 m	1.6 m	1.6 m [1]	-	-	-	-
56 channels	1.6 m	1.6 m	-	-	-	-	-	-
64 channels	1.6 m	1.6 m	-	-	-	-	-	-

1. Max. simultaneity factor 0.8. For these configurations, up to 80% of the maximum rated power is available if all channels are used for charge-discharge at the same time, due to system cooling reasons. Because the maximum rated power of the channel is based on a channel output voltage of 6 V, lower channel output voltages consume less than full rated power. The channel output voltage required to deliver the desired voltage at the cell will depend on the IR voltage drop in your wiring connecting the system to the cell.

System Options

SL1007A-001 Electrochemical impedance spectroscopy

Integrated electrochemical impedance spectroscopy (EIS) per test-channel, independently programmable within a test sequence. Superposition of AC output current with a DC offset possible.

Specifications

Measuring method	Galvanostatic and potentiostatic
Measurement range	Up to 1 Ω
Measurement resolution	1 µΩ
Excitation amplitude	Smaller than 10 A and 1 V
Frequency range	1 mHz to 10 kHz
Multi-sinusoid operation	Yes, for frequencies ≤1 Hz

Note: A parallel connection of several channels doesn't affect the EIS specifications.

Supplemental characteristics

Electronics repeatability	Magnitude error term	±20 µΩ
	Phase error term[1]	±2 degrees
Typical cabling and fixture	Relative magnitude error term Kr	1%
	Magnitude error term Ka	20 µΩ
	Resistive error term Kd	50 nΩ/Hz
	Inductive error term Kq	20 nH

1 The minimal phase error is given by the electronics phase error.

Error calculation:
error_re = ±(Ka + Kr·|Zdut| + f·Kd)
error_im = ±(Ka + Kr·|Zdut| + 2·π·f·Kq)

Numerical example

For the measured impedance at	f	=	1000	Hz
Zdut = Zdut_re + j·Zdut_im with	Zdut_re	=	0.01	Ω
and	Zdut_im	=	-0.005	Ω
then	|Zdut|	=	0.0112	Ω
and the phase angle is	ϕ(Zdut)	=	-26.6	deg

Applying the above formulas results in			
error_re = ±(20e-6 + 1/100·0.0112 + 1e3·50e-9)	= ±	182	µΩ
error_im = ±(20e-6 + 1/100·0.0112 + 2·π·1e3·20e-9)	= ±	257	µΩ

These describe a rectangle centered at Zdut_re + j·Zdut_im.
The four corners of the rectangle are

Z_1 = Zdut + error_re + j·error_im

Z_2 = Zdut + error_re - j·error_im

Z_3 = Zdut - error_re - j·error_im

Z_4 = Zdut - error_re + j·error_im

If one wants, one can compute the magnitude and the phase angle of each of the corners and use these to compute the worst-case amplitude and phase error, by computing the difference to |Zdut| and ϕ(Zdut).

For the numerical example the			
maximal amplitude error is	±	278.7	µΩ
and the maximal phase error is		1.60	deg

As the phase error term is smaller than the phase error term of the electronics, the final value of the phase error is defined by the error of the electronics. Hence the final phase error term is ±2.00 deg.

SL1070A Test bench guard-ready enable kit

To use the Keysight Scienlab Test Bench Guard (TBG) redundant safety system with the SL1007A, you must separately order the Keysight SL1070A in a configuration that matches your configuration of the SL1007A Cell Test System. You may order either or both of the following optional items to enable the SL1070A Test Bench Guard to operate with your SL1007A Cell Test System.

SL1079A-CM1 Manual parallel connection

- Support by the Test Bench Guard (TBG) for manual parallel connections of test channels.
- Supports monitoring of the current and voltage limit values of the respective director of the redundant measurements in parallel operation.

SL1079A-CM2 Redundant current/voltage measurement

- Data rate 20 Hz per measuring signal (connection via Ethernet)
- Measurement accuracy ±1% full scale of current and voltage

Note: Use of the SL1079A–CM2 Redundant current/voltage measurement requires the SL1070A-105 option to be chosen when ordering the SL1070A.

Software to Control Cell Test Systems

Keysight provides cell test system software that starts with Scienlab Energy Storage Discover to control your individual cell test systems such as the SL1007A 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 Scienlab Energy Storage Discover

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

Figure 2. Scienlab 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.
- ESD supports creating test programs even offline.
- 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 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 & Control Modules.

Find out more about Scienlab Energy Storage Discover here.

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 and 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 tool 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.

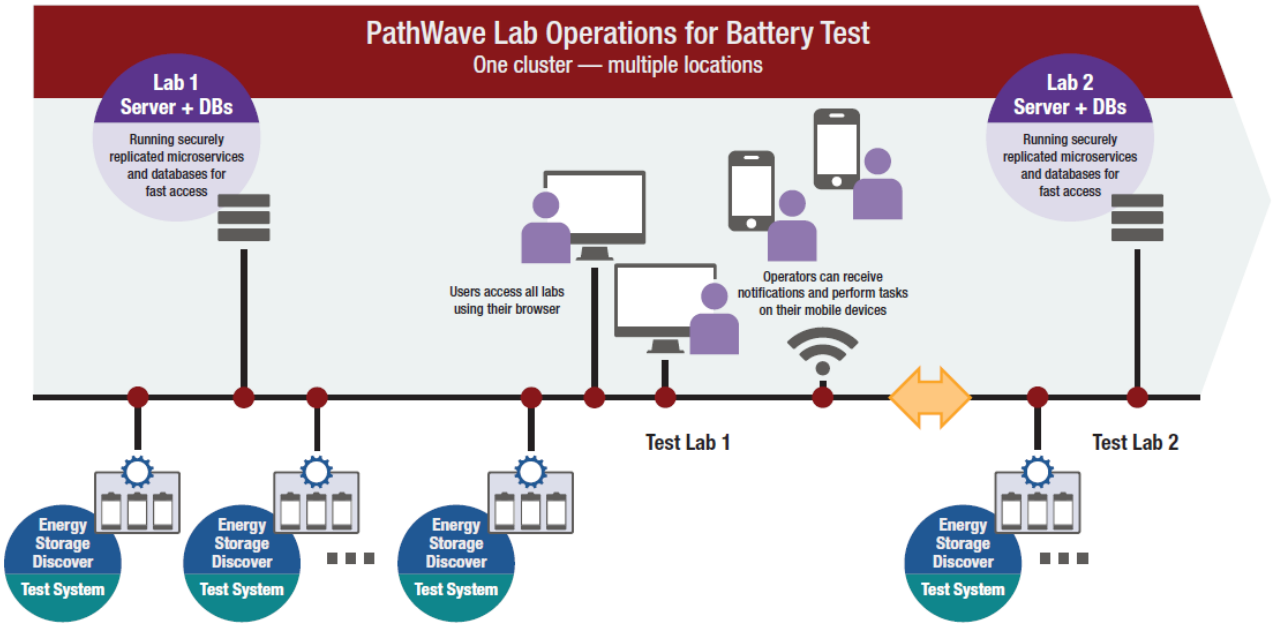

Figure 3. PathWave Lab Operations for Battery Test manages multiple test systems in a laboratory.

- 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.
- Improve collaboration by sharing test plans, results, data, and other documents.
- 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.

Find out more about PathWave Lab Operations for Battery Test here.

Project Management, Consulting and Installation Services

Service features depend on the facilities, customer expertise, and overall scope of the project. For that reason, it is not possible to give exact service efforts without knowing the customer's requirements and goals. Keysight offers the following services to secure a successful project execution and reduce ramp-up time for our customers.

PS-XPM-100-SL Project management services

Keysight recommends project management services for each test bench project. By ordering the project management services, an experienced project manager is dedicated to your project and acts as a direct communication interface from Keysight to the customer's project management team. The project manager takes over the responsibility:

- To develop and manage the project plan.
- To track project progress and milestones.
- Communication project status regularly and ensure any unscheduled project events or project deviations are communicated and promptly discussed with the customer project team.
- To provide complete and accurate project documentation to the customer.

PS-XINS-100-SL Project installation services

These services provide installation expertise to manage, deliver and coordinate local facilities installation for the test bench. Specific installation efforts depend on the customer's individual facility, the locally available power and cooling, and the test bench being delivered.

PS-XENG-100-SL Project engineering services

Project engineering services provide specialized engineering services during project development and implementation. The customers project team will have access to engineering expertise to aid in various tasks specific to their project including but not limited to – safety matrix and test bench guard, facilities and lab layout, special power requirements, etc.

PS-XCOM-100-SL Project commissioning services

Project commissioning services for the test solution provide an experienced test bench engineer to validate and complete the test bench setup in readiness for the customer's initial usage. It includes validating specific hardware and software configurations per the project requirements and any specific consulting agreed to beforehand, given the test bench's customer-specific usage.

KeysightCare for Solutions

KeysightCare for Solutions service goes beyond basic warranty, providing a priority-one connection between our resources and your teams. Every support tier includes access to the Keysight Support Portal and Knowledge Center where you can find answers, manage service requests, and interact with Keysight experts familiar with the instruments and software you are using and the challenges you face. And all the packages offer onsite options for large systems which cannot be moved.

- Warranty Plus – Reduce risk and avoid project delays with technical support coverage.
- Assured – Increase supportability to match your application needs with a committed turnaround time.
- Enhanced – Keep your project schedules on track and receive priority support and even faster turnaround times for repairs and calibration to optimize your solution.

Service deliverables

	KeysightCare for Solutions Warranty Plus	KeysightCare for Solutions Assured	KeysightCare for Solutions Enhanced
	Onsite Upgrade R-55T-005- X[1]	Onsite Upgrade R-55U-005-X[1]	Onsite Upgrade R-55V-006-X[1]
Solution Technical Support (SW[2] & HW)			
Keysight Support Portal & Knowledge Center, 24x7	•	•	•
Remote technical support response time[3]	2 business days	4 business hours	2 business hours
Onsite Technical Support[4]		•	•
Solution Hardware Support			
Repair service coverage	Onsite	Onsite	Onsite
Onsite response time	No commitment	12 business days response time[6]	5 business days response time[6]
Solution calibration[7]			Up to Keysight calibration + uncertainty + guard banding - Onsite
Calibration turnaround time			Scheduled
Application of service notes	Safety and recalls	Recommended - during service	Recommended - proactive
Preventative maintenance[5]			•
Proactive firmware release notifications		•	•

1 When ordering, update with the relevant (Solution Product Number (SPN) based on the length of service required (e.g. -1, -2, -3, or -5 for 1 year, 2 years, 3 years or 5 years).

2 KeysightCare Software Agreement required for software support.

3 Remote Technical Support Response time is measured from the time you contact the KTAS team to have an initial meaningful response from the case owner.

4 Onsite technical support is provided or at the discretion of Keysight.

5 3rd party products are excluded for assured and enhanced packages.

6 Response time is measured from the date the service request is received to the date Keysight arrives at your site.

7 Recommended re-calibration period is 12 months.

Find out more about KeysightCare Service and Support here.