Scienlab Battery Test System

Pack Level – 250 kW up to 360 kW

SL1000A

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Battery Test System | Pack Level

Systems with an output power range of 250 kW up to 360 kW

The Battery Test System – Pack Level is an electric system designed to provide sink and source for high voltage battery packs for automotive and industrial applications.

This system is also available with a lower power range of up to 180 kW.
Find out more about the SL1000A Scienlab Battery Test System – Pack Level – Up to 180 kW here.

Highlights

- Synchronized control of all components in the test environment, e.g. climate chamber, conditioning of the DUT, and Battery Management System (BMS)
- Recorded measured values to use as a variable during the remainder of the test sequence
- Direct evaluation of data using practical analysis tools: post-processing is not necessary
- Maintenance-free, durable, and reliable test systems with energy recovery for cost-efficient operation
- Dynamic retracing of the sources set values and thresholds of sources (current, voltage, power)

The following voltage, current and power options are available:

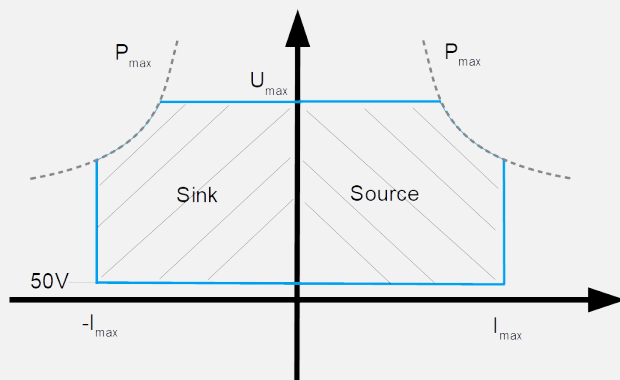|	50 to 600 V	50 to 850 V		50 to 1000 V	
Current options	600 A	300 A	600 A	300 A	600 A or 900 A
Power options	250 kW, 300 kW, 330 kW, 360 kW	250 kW	250 kW, 300 kW, 330 kW, 360 kW	250 kW, 300 kW	250 kW, 300 kW, 330 kW, 360 kW

Figure 1. Maximum power within a voltage range of 50 V – U_{max} (2-QS system).

Control unit and power amplifier

- Measurement and Control Unit (MCU) – Battery Test (BT)
- Embedded system for autonomous sequence control
- Communication-interface: Ethernet

Analog acquisition of voltage and current data

	600 V	850 V	1000 V
Voltage accuracy [1]	±0.05% of measured value, ±200 mV (offset)		±0.05% of measured value, ±300 mV (offset)

	300 A	600 A	900 A
Current accuracy [1]	±0.05% of measured value, ±60 mA (offset)	±0.05% of measured value, ±120 mA (offset)	±0.05% of measured value, ±180 mA (offset)
Ripple	±0.2% FS_{eff} = 1.2 A_{eff}	±0.2% FS_{eff} = 2.4 A_{eff}	±0.2% FS_{eff} = 3.6 A_{eff}

[1] Measurement and programming accuracy.

Data acquisition and re-calibration	
Measurement type	4-wire
Resolution	32 bits
Sample rate	Maximum 20 kS/s (internally 625 kS/s)
3x temperature input	PT100 4-wire measurement, -50 to +130 °C, ±1 K
Recommended re-calibration period	12 months
Control of external components (Test chamber, etc.; Ethernet protocol required)	

Current output characteristics

	300 A	600 A	900 A
Rise and fall time [1]	< 1.6 ms typ., max. 2 ms, -90 to +90%		
	-270 to +270 A	-540 to +540 A	-810 to +810 A
Recommended re-calibration period	12 months		

[1] No switching times within power stage or channel at transition from positive to negative current and vice versa.

Intrinsic safety

- Intrinsically safe against overheating, overcapacity, short circuit and idling
- Protection against reverse polarity by checking the polarity before output contactors are allowed to close
- No hardware protection against reverse polarity
- Monitoring of all internal voltages, currents and temperatures
- DC output contactors capable to disconnect DUT at full load current
- Mains side power contactors ensuring the absence of voltage
- Discharge of all internal high voltage sources upon emergency OFF

System cabinet

	300 A	600 A	900 A
Basic dimensions (H x W x D) [1]	2.32 m x 3.6 m x 0.8 m		2.43 m x 3.86 m x 0.8 m
Weight approx.	2400 kg	2400 kg	2900 kg

[1] Height includes rollers. Width and depth without accessories such as switches, etc.

- Protection type IP 54
- Control cabinet color: RAL 7035
- Ambient temperature: 10 to 40 °C
- Air humidity: 30 to 75% relative humidity
- Sound pressure level according to DIN EN 3744 < 70 dB(A) measured at 1 m distance from front
- 2x 230 V-service-outlets accessible from the outside, door installation

Documentation

- Operating instructions in English
- CE Certificate of Conformity

System design and realization according to applicable safety and regulatory requirements (such as EU Directives). Special customer standards are not taken into account by default and require explicit agreement and quotation.

Active front end (AFE)

- Bidirectional power supply
- Reactive power compensation under load cos(phi) > 0.98
- Efficiency > 90%
- HV EMC filter
- 2 kHz filter
- Proven respect of limits for power-related disturbances within the low voltage grid as per EN61000-6-4

Resonance converter

All-pole potential separation of the power stages to the supply network.

Mains supplies

- 3, PE 400 V (+10%/-5%), 50 Hz (±0.2 Hz)
- Functional Earth (FE)
- Wire feedthrough via EMC screw joint on the roof

	250 kW	300 kW	330 kW	360 kW
Pre-fuse on site	2x 224 A gG	2x 315 A gG	2x 315 A gG	2x 315 A gG

Cooling of power electronics

- Water/water heat exchanger including internal water cycle to prevent condensation
- Limiting water amount within cabinet
- Supervision of water temperature and internal controller
- Metal-coated coolant hoses

Cooling of cabinet interior

- Water/air heat exchanger
- Supervision of the inner room temperature and the heat exchanger
- No waste air emitted into laboratory environment
- Roof mounting

Cooling water

	250 kW	300 kW	330 kW	360 kW
Heat transfer	25 kW	30 kW	33 kW	36 kW
Flow rate	0.39 l/s resp. 1.43 m³/h	0.47 l/s resp. 1.7 m³/h	0.52 l/s resp. 1.89 m³/h	0.57 l/s resp. 2.0 m³/h
	$\vartheta I = 15 \ ^\circ C, \vartheta o = 30 \ ^\circ C, \Delta\vartheta = 15 \ K$			
	Intake: 1", $\vartheta I = 6$ to 20 °C; Return: 1", max. $\vartheta R = 30 \ ^\circ C$			
Inlet pressure	Max. 6 bar, without pressure impact, pressure difference > 1.5 to 3.0 bar			

Safety

- Emergency stop switch/main switch (red/yellow) for all-pole disconnection
- Dual-channel fast stop (black push button)
- External fast stop input for Test Bench Guard integration
- Key switch for output contactor interlock
- Door hinge mounted on the right side
- Door handles: Comfort handles with safety lock
- Parametrizable limits for the protection of the DUT
- Insulation monitoring device (Bender ISOMETER® iso685-D-B)
- Evaluation of the insulation resistance via interface
- Insulation monitoring device can be switched off

Note: While the monitoring device is off user must ensure that the DUT's insulation monitoring device is active and linked to the emergency chain. The user is responsible for the safety of the test bench.

- Signal light with magnetic mounting
- Red: Error; Yellow: Active, Green: Ready
- Display elements: moving coil meter to display the output terminal voltage Measuring point: on DUT side of output contactors
- Display area: 0 to 1000 V respectively 0 to 1250 V for 1000 V Systems, installation point: door

Interface to supervisory system (terminal block)

- Release AC input contactor
- Release DC output contactor
- Status signal: output contactor open/closed
- Alarm: violation of the limit values
- Alarm: internal error
- Output: fast stop
- Release system
- Input: fast stop

System Options

Output configuration option class

Note: The selection of any option in this section adds approximately 50 kg to the system weight.

SL1000A-501 Automatic parallel switch enable for two systems – 300 A

- Parallel operation of two amplifiers automatically controllable within the test sequence
- Parallel operation of system 1 + 2 with DUT 1 or DUT 2

Note: The power leads between the test system and the DUT must be designed for 600 A output. Connecting two systems in parallel has no effect on the voltage accuracy. The offset of the current accuracy is multiplied by two. The error of the measured value [%] is not affected.

SL1000A-502 Automatic parallel switch enable for two systems – 600 A

- Parallel operation of two amplifiers automatically controllable within the test sequence
- Parallel operation of system 1 + 2 with DUT 1 or DUT 2

Note: The power leads between the test system and the DUT must be designed for 1200 A output. Connecting two systems in parallel has no effect on the voltage accuracy. The offset of the current accuracy is multiplied by two. The error of the measured value [%] is not affected.

SL1000A-506 Automatic Parallel switch enable for two systems – 900 A

- Parallel operation of two amplifiers automatically controllable within the test sequence
- Parallel operation of system 1 + 2 with DUT 1 or DUT 2

Note: The power leads between the test system and the DUT must be designed for 1800 A output. Connecting two systems in parallel has no effect on the voltage accuracy. The offset of the current accuracy is multiplied by two. The error of the measured value [%] is not affected.

SL1000A-503 Second DC output – 300 A

SL1000A-504 Second DC output – 600 A

SL1000A-507 Second DC output – 900 A

- Switch to another power outlet including sense-wires
- Switching programmable within test sequence
- Redundant trip limits for containment in test running are dynamically adjustable in ESD
- Additional display element for DC output voltage

Additional current range option class

Note: The selection of any option in this section adds approximately 50 kg to the system weight.

SL1000A-401 Additional current range – 30 A

- Measuring range ±30 A, accuracy ±0.05%, ±6 mA (offset)
- Current range selection programmable within the test sequence
- Tester must be disabled to switch the measurement range

Note: Combination of 30 A and 100 A (SL1000A-401 and SL1000A-402) is not possible.

SL1000A-402 Additional current range – 100 A

- Measuring range ±100 A, accuracy ±0.05%, ±20 mA (offset)
- Current range selection programmable within the test sequence
- Tester must be disabled to switch the measurement range

Note: Combination of 30 A and 100 A (SL1000A-401 and SL1000A-402) is not possible.

SL1000A-403 Additional current range, second output – 30 A

- Measuring range ±30 A, accuracy ±0.05%, ±6 mA (offset)
- Current range selection programmable within the test sequence
- Tester must be disabled to switch the measurement range

Note: Combination of 30 A and 100 A (SL1000A-403 and SL1000A-404) is not possible.

SL1000A-404 Additional current range, second output – 100 A

- Measuring range ±100 A, accuracy ±0.05%, ±20 mA (offset)
- Current range selection programmable within the test sequence
- Tester must be disabled to switch the measurement range

Note: Combination of 30 A and 100 A (SL1000A-403 and SL1000A-404) is not possible.

DC Emulator option including communication interface

SL1000A-D00 DC Emulator including ethernet

Enhancement of the Battery Test System to be used as a DC Emulator (DCE)

- Key switch to select operation mode
- System boots in either Battery Test mode or DC Emulator mode

Control unit

- Measurement and Control Unit (MCU) – DCE
- Real time-computer to control the electrical output variables
- Communication-interface: Ethernet
- Including RLC-battery-simulation model

Documentation

- Ethernet interface description in English

Output characteristics

	600 V	850 V	1000 V
Voltage accuracy	±0.05% of measured value, ±200 mV (offset)		±0.05% of measured value, ±300 mV (offset)
Voltage ripple	300 mV$_{eff}$ typ., 500 mV$_{eff}$, max. at measuring range of 500 kHz		

	300 A	600 A	900 A
Current accuracy	±0.05% of measured value, ±60 mA (offset)	±0.05% of measured value, ±120 mA (offset)	±0.05% of measured value, ±180 mA (offset)
Output capacity	1600 µF	3200 µF	3200 µF

Voltage output dynamics

- Rise time (10% → 90%): typ. 5 ms, max. 10 ms
- Load stability: < 80 V (typically < 40 V) @ 400 V

300 A	600 A	900 A
0 → 250 A < 1 ms, 400 µF load	0 → 500 A < 1 ms, 400 µF load	0 → 750 A < 1 ms, 400 µF load

Explanation of load stability:

- @ 400 V   → output voltage of 400 V
- 0 → 250 A, < 1 ms   → current rise from 0 to 250 A in less than 1 ms
- 400 µF   → load capacity of typical device under test
- typically 40 V   → average overvoltage of 40 V
- < 80 V   → maximal 80 V overvoltage

Safety

- Shut-down mode for fast stop: U = 0 V or I = 0 A selectable
- Fast stop delay adjustable between 0 to 30s

Note: The system weight increases by 50 to 75 kg.

SL1000A-D01 Additional EtherCat interface

An EtherCat interface is added to control the system in DC Emulator mode, including interface specification.

SL1000A-D03 Emulator control

Inhouse-Software to control the Battery Tester while in DC Emulator mode. Find out more about the Emulator Control software here.

Note: Mandatory if DC Emulator option is chosen.

Electrochemical impedance spectroscopy (EIS)

SL1000A-001 Electrochemical impedance spectroscopy

Integrated electrochemical impedance spectroscopy per test-channel, independent programmable within test sequence.

- Sinusoidal current up to 10 A
- Absolute Error |Phi| = 2 degrees
- Measurement method: galvanostatic, 4-wire-measurement
- Relative Error |Z| = 1%
- Absolute Error |Z| = 500 µOhm

	600 V	850 V	1000 V
Frequency band	100 mHz to 2 kHz		100 mHz to 1 kHz

Cabinet base option class

SL1000A-701 Base stand

Battery Tester is placed on top of 15 cm high base stand (reduces cabinet height to 238 cm).

SL1000A-702 Rollers

Battery Tester is placed on top of heavy-duty rollers and can be moved flexible.

Test bench guard-ready tester hardware options

SL1079A-BP1 – Redundant current/voltage measurement

Redundant DUT current and voltage measurement

- Interface to the test bench guard
- CAN-Interface

Note: Only in combination with the test bench guard option redundant current/voltage measurement.

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.

Education Service

Education Service provides insight into the solution setup and quickly prepares your team to use the solution. Keysight experts help you optimize your usage of Keysight solutions whether through integration or optimization of performance. Receive training at your site to gain the confidence to make accurate, efficient, fast, and repeatable measurements, every time.

PS-S40-01 Startup assistance

Instrument fundamentals and operations starter training

- Switching a system on, order of instruments
- Getting a system in ready mode (software & hardware)
- Resetting system & safety matrix after emergency off
- Connect cables to DUT
- Setting up a system in software and start a test
- System care

PS-S40-02 Advanced training

Technology and measurement science standard training

- User interface
- Programming examples and exercises
- Details on system warnings/errors and how to react to them

PS-XPS-100 Premium consulting

Custom training to focus on your application

- Customized content based on customer needs

KeysightCare Solutions

The KeysightCare Solutions provide comprehensive coverage for all support needs, including all hardware support and technical support.

Two levels of post-delivery solution support are available:

- KeysightCare Premium Solution Support – Prioritized support designed to minimize down time with committed technical support response times and hardware support turnaround times.
- KeysightCare Basic Solution Support – complete solution coverage for installations where uptime is less critical. Includes technical support and hardware support with non-committed response times.

Both Premium and Basic Solution support include on-site options. This is necessary for large installations and an option for smaller solutions (such as some portable solutions).

Service deliverables

	KeysightCare Solution Basic	KeysightCare Solution Premium
	Onsite R-55L-001-X[7]	Onsite R-55M-001-X[7]
Technical support (Application and solution specific for both hardware and software[1])		
Self-service web portal & knowledge center, 24/7	✓	✓
Technical support response times	2 business days	4 business hours[3]
Weekend support available on request[2]	X	✓
On-site technical support response time[2]	7 business days[2]	3 business days[2]
Software configuration support[1]	✓ remote	✓ remote or onsite[4]
Solution hardware support[5]		
Repair service coverage	✓	✓
Repair service turnaround or onsite response time	7 business days response	3 business days response
Calibration service[4]	✓	✓
Calibration type	Keysight Calibration	Keysight Calibration + Measurement Uncertainty + Guard Banding
Calibration turnaround or onsite response time	mutually scheduled	priority scheduled
Preventive maintenance[8]	X	✓
Preventive maintenance frequency	X	twice a year
Application of service notes[6]	✓ mandatory notes only	✓ mandatory and recommended notes
Customer care review twice a year on request	X	✓

1 KeysightCare Software Agreement required for software support including software updates and notifications. Onsite support at the discretion of Keysight.
2 Onsite technical support is provided or at the discretion of Keysight. Weekend support is only available for existing tickets by prior arrangement.
3 Technical support response times may vary for specific solutions.
4 Annual calibration service and calibration after repair if applicable is included for instruments that require calibration.
5 Offering may be different by country. Certain solution configurations are not applicable for return to Keysight. Please contact regional representatives.
6 We perform application of service notes during scheduled service events.
7 Service Product Number (SPN). When ordering, update with the relevant 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).
8 3rd party products are excluded for basic and premium packages.

Find out more about KeysightCare Service and Support here.

Extend the Capabilities of your Scienlab Battery Test System

Software to control battery test systems

Keysight provides battery test system software that starts with Scienlab Energy Storage Discover to control your individual battery test systems such as the SL1000A, 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.

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.
- 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.

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 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.
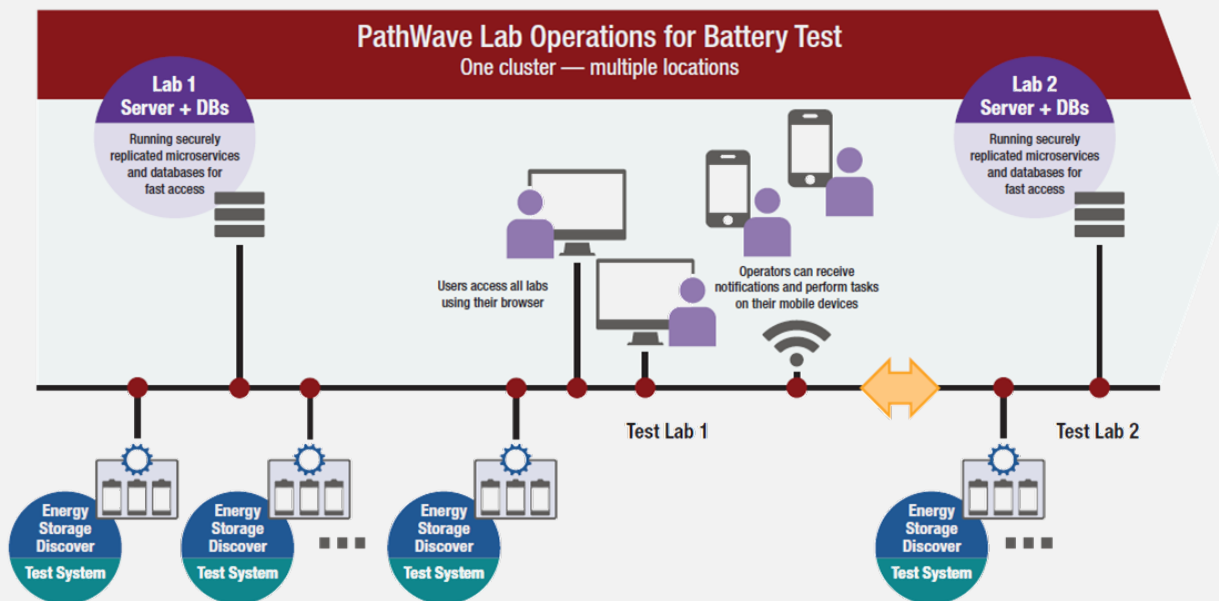

Figure 2. PathWave Lab Operations for Battery Test manages multiple test systems in a laboratory.

- 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.

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

Meet the SL106XX Series Scienlab Measurement & Control Module

The Scienlab SL106XX Series covers a wide range of test, measurement, and control tasks. If required, you can combine your measurement task and scope.

They are ideal for carrying out challenging measurement tasks, even under difficult environmental conditions, for example, a climate chamber. The modules offer top quality, robustness, and easy and intuitive operation.

- Precise, reproducible, and time-synchronous measurement data recording
- Fully electrically isolated measurement channels up to 1000 V insulated between each channel
- Connection via open Ethernet interface; automatic detection of Scienlab Energy Storage Discover (ESD) software
- Easy to use in challenging test environment (-40 to +80 °C, IP20)
- Individual combination of different measurement module types

Find out more about the Scienlab Measurement & Control Modules here.

Learn more at: 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

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