

SL1001A Scienlab Battery Test System

Module Level – Up to 68 kW per Channel



Battery Test System – Module Level

Systems up to 68 kW per channel

The Scienlab Battery Test System – Module Level is an electric system which is designed to provide sink and source for battery modules for automotive and industrial applications.

High performance for all your applications

With the interconnection of battery cells to modules further requirements are necessary on your test equipment. Higher tensions and an increase in electrical power is necessary to:

- Record several temperatures to investigate the reciprocal electrical and thermal influence of the cells.
- Check the mechanical connections and the performance of the module.
- Communicate with the Battery Management System (BMS).

Highlights

- Efficient and cost-effective operation because of recovery capabilities even for endurance tests with many channels.
- Module is useable as a cell test system with a relatively constant measurement precision for testing battery cells with up to 6 V (optional).
- Synchronize BMS values as variable or as switch-off criteria directly in the test sequence.
- Direct control of the output source via the BMS.



Figure 1. Battery test laboratory managed by PathWave Lab Operations for Battery Test.

The following voltage, current and power options per channel are available:

Voltage	20 V	60 V	80 V	90 V	200 V	300 V
Voltage accuracy ¹	±0.05% of measured value, ±4 mV (offset)	±0.05% of measured value, ±12 mV (offset)	±0.05% of measured value, ±16 mV (offset)	±0.05% of measured value, ±18 mV (offset)	±0.05% of measured value, ±40 mV (offset)	±0.05% of measured value, ±60 mV (offset)

Current options	100 A	300 A	500 A	600 A	750 A			
Current accuracy ¹	±0.05% of measured value, ±20 mA	±0.05% of measured value, ±60 mA	±0.05% of measured value, ±100 mA	±0.05% of measured value, ±120 mA	±0.05% of measured value, ±150 mA			
Ripple	0.4 A	1.2 A	2 A	2.4 A	3 A			
Rise and fall time ²	< 800 µs typ., max. 1 ms, -90 to +90%							
	-90 to +90 A	-270 to +270 A	-450 to +450 A	-540 to +540 A	-675 to +675 A			
0 to 20 V	Power options	2 kW	3 kW	6 kW	-	6 kW	12 kW	-
0 to 60 V ³ / 5 to 60 V		6 kW	18 kW	-	-	18 kW	36 kW	-
0 to 80 V ³ / 5 to 80 V		8 kW	24 kW	-	-	24 kW	48 kW	-
0 to 90 V ³ / 5 to 90 V		8 kW	24 kW	-	-	24 kW	48 kW	-
0 to 200 V ³ / 20 to 200 V		-	-	48 kW	-	-	-	48 kW
0 to 300 V ³ / 20 to 300 V		-	-	68 kW	-	-	-	68 kW
Recommended re-calibration period	12 months							

¹ Measurement and programming accuracy.

² No switching times within power stage or channel at transition from positive to negative current and vice versa.

³ Voltage range of 0 to 6 V only available with extended voltage range option [SL1001A-T03](#). Voltage range of 0 to 20 V only available with extended voltage range option [SL1001A-T02](#).

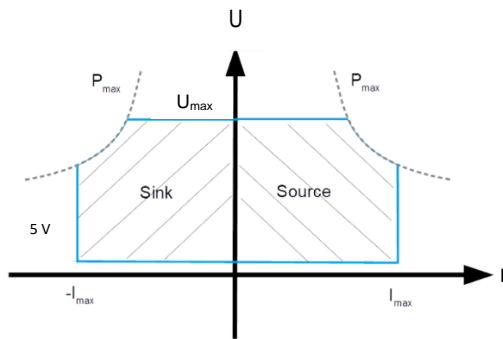


Figure 2. Maximum power of 5 V to U_{max}
(2 quadrant system)

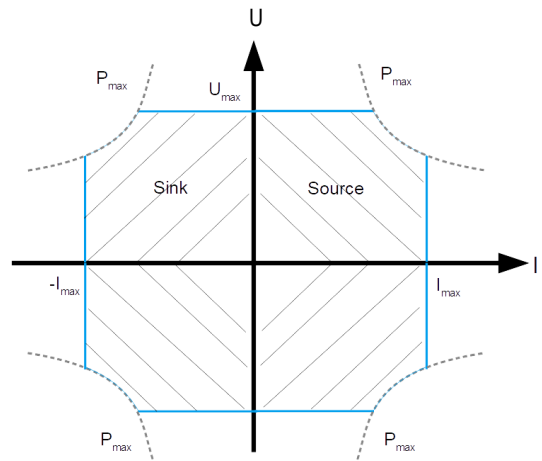


Figure 3. Maximum power of 0 V to U_{max}
(4 quadrant system)

Control unit and power amplifier

- Test Bench Control System (TBCS) – Linux real-time PC
- Embedded system for autonomous sequence control
- Measurement data acquisition
- Communication interface: Ethernet

Data acquisition

- 4-wire measurement
- Sample Rate: max. 20 kHz
- Resolution: 32 bit
- 3x temperature input: PT100 4-wire measurement, -50 to +130 °C, ± 1 K per test channel
- Control of external components:
 - e.g. temperature chamber, conditioning unit (Ethernet protocol required)
 - Additional protocol implementation possible if component not yet supported

Intrinsic safety

- Intrinsically safe against overheating, overcapacity, short circuit and idling.
- Protection against reverse polarity by checking the polarity before output contactors can be closed.
- 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.
- Discharge of all internal high voltage sources upon emergency OFF.

Manual parallel operation

- Manual parallel operation of up to six output stages possible.
- Output contacts including sense circuit have to be interconnected by the customer.
- Director/follower definition via control software Scienlab Energy Storage Discover (ESD).

Second-source mode

The second-source mode makes it possible to parameterize two channels of a battery test system, which is connected to a device under test (DUT), from a test program, to execute the test synchronously, and to save the recorded measurements in a common test report.

Each high-voltage connection can be controlled separately and synchronously with each other. Apply individual current or power profiles in four-wheel drive mode.

Note: The second-source mode is an add-on, which must first be activated. Only available for systems with 200 V and 300 V output voltage.

System cabinet

- Basic dimensions (HxD): 2.6 m x 0.8 m 1; approx. 500 kg per cabinet
- Total width of the system depends on channels and output values.

Channels		1	2	3	4	5	6	8	10	12
20 V	100 A 2 kW	1.1 m ³	1.1 m ³	-	1.1 m ³	-	1.1 m ³	1.1 m ³	-	1.1 m ³
	300 A 3 kW	1.1 m ³	1.1 m ³	-	1.1 m ³	-	1.9 m ³	-	-	-
	300 A 6 kW	1.1 m ³	1.1 m ³	-	1.9 m ³	-	1.9 m	-	-	-
	600 A 6 kW	1.1 m ³	1.1 m ³	-	1.9 m ³	-	1.9 m	-	-	-
	600 A 12 kW	1.1 m ³	1.1 m ³	-	1.9 m ³	-	2.7 m ³	-	-	-
60 V	100 A 6 kW	1.1 m ³	1.1 m ³	-	1.1 m ³	-	1.1 m	-	-	1.9 m ³
	300 A 18 kW	1.1 m ³	1.1 m ³	1.9 m ³	1.9 m	-	2.7 m	3.5 m	-	-
	600 A 18 kW	1.1 m ³	1.1 m ³	1.9 m ³	1.9 m	-	2.7 m	-	-	-
	600 A 36 kW	1.1 m ³	1.9 m ³	2.7 m	2.7 m ²	-	-	-	-	-
80 V	100 A 8 kW	1.1 m ³	1.1 m ³	-	1.1 m	-	1.1 m ²	-	-	-
	300 A 24 kW	1.1 m ³	1.1 m ^{2,3}	1.9 m ³	1.9 m ²	-	2.7 m ²	-	-	-
	600 A 24 kW	1.1 m ³	1.1 m ^{2,3}	1.9 m ³	1.9 m ²	2.7 m	2.7 m ²	-	-	-
	600 A 48 kW	1.1 m ^{2,3}	1.9 m ^{2,3}	2.7 m ²	3.5 m ²	-	-	-	-	-

		1	2	3	4	5	6	8	10	12
90 V	100 A 8 kW	1.1 m ³	1.1 m ³	-	1.1 m	-	1.1 m ²	-	-	-
	300 A 24 kW	1.1 m ³	1.1 m ^{2,3}	1.9 m ³	1.9 m ²	-	2.7 m ²	-	-	-
	600 A 24 kW	1.1 m ³	1.1 m ^{2,3}	1.9 m ³	1.9 m ²	2.7 m	2.7 m ²	-	-	-
	600 A 48 kW	1.1 m ^{2,3}	1.9 m ^{2,3}	2.7 m ²	3.5 m ²	-	-	-	-	-
200 V	500 A 48 kW	-	2.48 m	-	-	-	-	-	-	-
	750 A 48 kW	-	2.48 m	-	-	-	-	-	-	-
300 V	500 A 68 kW	-	2.56 m	-	-	-	-	-	-	-
	750 A 68 kW	-	2.56 m	-	-	-	-	-	-	-

¹ Height includes rollers. Dimensions without extra accessories like the excess of switches, etc.

² For cooling reasons, a simultaneity factor of 0.8 must not be exceeded during long-term operation.

³ Optionally without side connection box (minus 30 cm width).

- Protection type IP 54
- Control cabinet color: RAL 7035
- Ambient temperature: 5 to 40 °C
- Air humidity: 30 to 75% rel. H.
- Sound pressure level according to DIN EN 3744 <70 dB(A) measured at 1 m distance from front

Active Front End (AFE)

- Bidirectional power supply
- Reactive power compensation under load $\cos(\varphi) > 0.98$
- Efficiency >90%
- HF EMC filter
- Proven respect of limits for conducted interferences within the low voltage grid as per EN61000-6-4

Transformer

- Common potential separation of all output stages
- Output stages themselves not potential separated

Mains supply

- 3, N, PE 400 V ($\pm 10\%$), 50 Hz
- Functional Earth (FE)

Safety

- Emergency stop switch/main switch (red/yellow) for all-pole disconnection
- Fast stop push button (black)
- Door hinge mounted on the right side
- Door handles: Comfort handles with safety lock
- Parametrizable limits for the protection of the DUT
- Insulation monitoring device¹ (Bender ISOMETER® IR425-D4-1)
- Signal light with magnetic mounting
- Red: Error; yellow: Active, green: Ready

¹ While the monitoring device is switched off it must be ensured that the insulation monitoring device of the DUT is active and linked to the emergency chain. The user is responsible for the safety of the test bench.

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. Before delivery, all test systems are subjected to a performance test with a minimal duration of 30 minutes (respectively 20 minutes in case of the 300 V system).

System Options

Output configuration option class

SL1001A-50x Automatic parallel switch enabling for two channels

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

Note: Automatic parallel switch is not available for ± 100 A option. The power leads between the test system and the DUT must be designed for double the output current. Connecting two channels 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.

Additional current range option class

SL1001A-401 Additional current range – 30 A

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

Note: Only available for 300 A and 600 A output current.

Cell test option class

SL1001A-T02 Extended voltage range

- Voltage range 0 to 20 V (4QS)
- Voltage accuracy: $\pm 0.05\%$ of measured value $\pm 0.02\%$ of full-scale value

Note: This option is only available for test systems with 200 V and 300 V output voltage.

SL1001A-T03 Extended voltage range with higher accuracy

- Voltage range 0 to 6 V (4QS)
- Voltage accuracy: ± 1 mV (typ. 150 μ V)
- Voltage range selection programmable within the test sequence

Note 1: This option is not available for test systems with output voltages higher than 90 V and is always included in test systems with a voltage range of up to 20 V.

Note 2: Not available for systems with 200 V and 300 V output voltage.

Note 3: This option can be updated later via the option SL1001AU-T03.

Electrochemical impedance spectroscopy (EIS)

SL1001A-001 Electrochemical impedance spectroscopy per channel

Integrated EIS per test-channel, independently programmable within test sequence:

	100 A	300 A	600 A
Sinusoidal current	Up to 5 A		
Frequency band	100 mHz to 2 kHz	100 mHz to 5 kHz	
Absolute error $ \Phi $	2 °		
Absolute error $ Z $	$\pm 200 \mu\Omega$		
Relative error $ Z $	2%	1%	
Measurement method	Galvanostatic, 4-wire-measurement		

Note: Not available in combination with 200 or 300 V option. By default, EIS will be calibrated for the full-scale current range only. A calibration for other current ranges (e.g. in combination with additional current range 30 A, SL1001A-401) will only be done on request.

Cabinet base option class

SL1001A-701 Base stand

Battery Tester is placed on top of 15 cm high base stand and is 2.6 m high including the base stand.

SL1001A-702 Rollers

Battery Tester is placed on top of high rollers and can be moved flexible.

System cooling option class

SL1001A-K02 Air cooling with compressor

- Roof fan IP54 for compression refrigeration
- Monitoring of interior temperature

Note: Only available for selected systems with comparatively low system power. Air cooling causes additional noise and increases the heat released into the laboratory air.

SL1001A-K03 Water cooling

- Water/air heat exchanger
- Heat transfer: max. 10% of total output power¹
- Intake: ¾ “, 6 to 20 °C
- Return: ¾ “, max. 30 °C
- Max. inlet pressure: 6 bar, without pressure impact, pressure difference > 1 bar

¹ e.g. total output power = 96 kW, max. heat transfer = 9.6 kW

Test bench guard-ready tester hardware options

SL1079A-CM1 Manual parallel connection

- Support of manual parallel connection of up to two Battery Test channels by the TBG.
- Monitoring the current and voltage limit values of the respective director of the redundant measurement in parallel operation.
- Sum formation of the individual flows of the redundant measurement to the correct monitoring of the current limits in parallel operation.

SL1079A-CM2 Automated parallel connection of two channels

- Up to three automated parallel connections of two channels each.
- Detection of the automatic parallel connection of two channels of each Battery Test Bench about the state of the cross-contact.
- Automatic monitoring of the current and voltage limits of the respective director of the redundant measurement in parallel operation.
- Automatic totals of the individual flows of the redundant measurement for the correct monitoring of the current limits in parallel operation.
- Integration of standard input signals “status cross-contact channel x”.

Note: Not available for 100 A Systems. Requires “option automatic parallel connection” in the Battery test system as well as option “option integration redundant current and voltage measurement”. The power leads between the test system and the DUT must be designed for double the output current. Connecting two channels 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.

SL1079A-CM3 Redundant current/voltage measurement – up to 6 channels

- Redundant DUT current and voltage measurement
- CAN Bus with 500 kBaud
- Data rate 16 2/3 Hz per measuring signal (connection via CAN-Bus controller)
- Measurement accuracy $\pm 1\%$ from measurement range of current and voltage

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

Project Management, Consulting, and Installation Services

Service features depends highly on the facilities, expertise of the customer and overall scope of the project. For that reason, it is not possible to give exact service efforts without knowing the requirements and goals of the customer. Keysight is offering the following services to secure a successful project execution and to reduce the 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 customer's 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 support⁵		
Repair service coverage		
Repair service turnaround or onsite response time	7 business days response	3 business days response
Calibration service⁴		
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 SL1001A 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 4. 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.

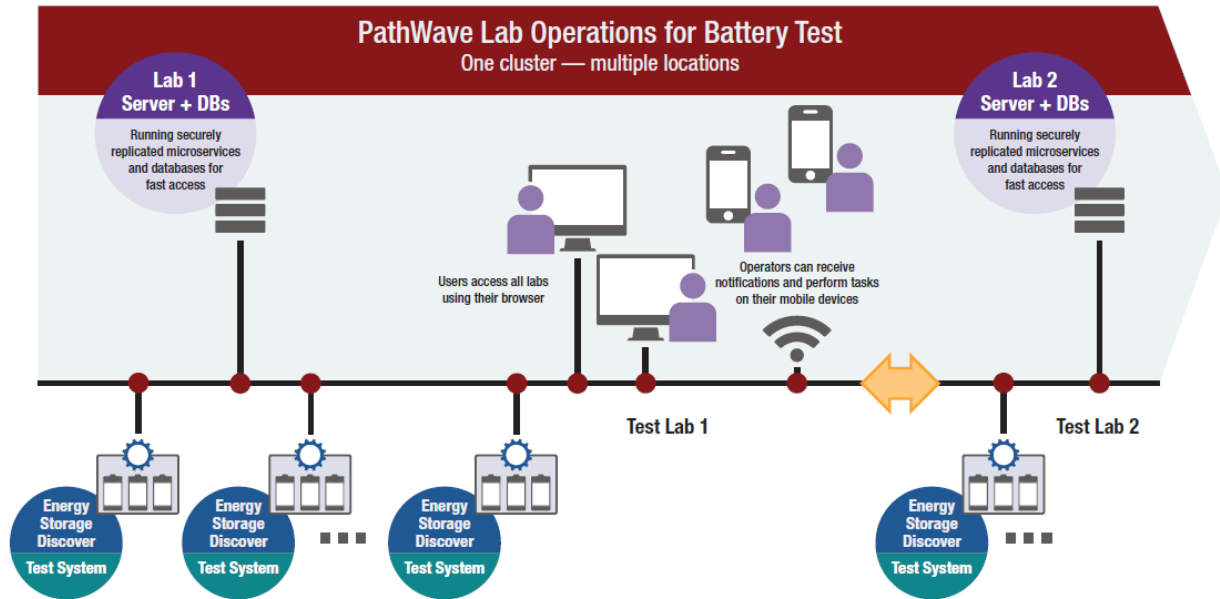


Figure 5. PathWave Lab Operations for Battery Test manages multiple test systems in a laboratory.

- 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 Series [here](#).