

# Scienlab Battery Test System

Module Level

SL1001A SL1006A



## Table of Contents

Battery Test System   Module Level.....	3
Systems up to 68 kW per channel.....	3
System Options .....	7
Output Configuration Option Class.....	7
SL1001A-50x Automatic parallel switch enabling for two channels.....	7
Additional Current Range Option Class.....	7
SL1001A-401 Additional current range 30 A.....	7
Cell Test Option Class .....	7
SL1001A-T01 Extended voltage range with higher accuracy .....	7
SL1001A-T02 Extended voltage range .....	7
Electrochemical Impedance Spectroscopy (EIS) .....	8
SL1001A-001 Electrochemical impedance spectroscopy per channel.....	8
Cabinet Base Option Class .....	8
System Cooling Option Class.....	8
Test Bench Guard-ready Tester Hardware Options.....	9
SL1079A-CM1 Manual parallel connection.....	9
SL1079A-CM2 Automated parallel connection of two channels .....	9
SL1079A-CM3 Redundant current / voltage measurement – up to 6 channels .....	9
Services.....	10
PS-XPS-100 Project management and technical consulting .....	10
R9001A-201 Installation service .....	10
R9001A-202 Commissioning service .....	10
HS0002A Productivity support service.....	11

## Battery Test System | Module Level

### Systems up to 68 kW per channel

The 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.

### 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 Battery Management System (BMS) values as variable or as switch-off criteria directly in the test sequence.
- Direct control of the output source via the BMS.

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

Current Options		100 A	300 A		500 A	600 A		750 A
Current accuracy*		±0.05 % of measured value ±20 mA	±0.05 % of measured value ±60 mA		±0.05 % of measured value ±60 mA	±0.05 % of measured value ±120 mA		±0.05 % of measured value ±60 mA
Voltage accuracy*		±0.05 % of measured value, ±0.02 % of full scale						
Ripple		0,4 A	1,2 A		2 A	2,4 A		3 A
Rise and fall time**		< 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 – 20 V	Power options	2 kW	3 kW	6kW	-	6 kW	12 kW	-
0 – 60 V***/ 5 – 60 V		6 kW	18 kW		-	18 kW	36 kW	-
0 – 80 V***/ 5 – 80 V		8 kW	24 kW		-	24 kW	48 kW	-
0 – 90 V***/ 5 – 90 V		8 kW	24 kW		-	24 kW	48 kW	-
0 – 200 V***/ 20 – 200 V		-	-	48 kW		-	48 kW	
0 – 300 V***/ 20 – 300 V		-	-	68 kW		-	68 kW	

\* Measurement and programming accuracy

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

\*\*\* Voltage range of 0 to 20 V only available with extended voltage range options [SL1001A-T01](#) or [SL1001A-T02](#).

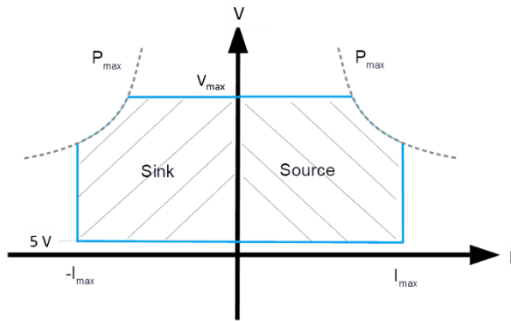


Figure 1:  
Maximum power of  $5\text{ V} - V_{max}$  (2 quadrant system)

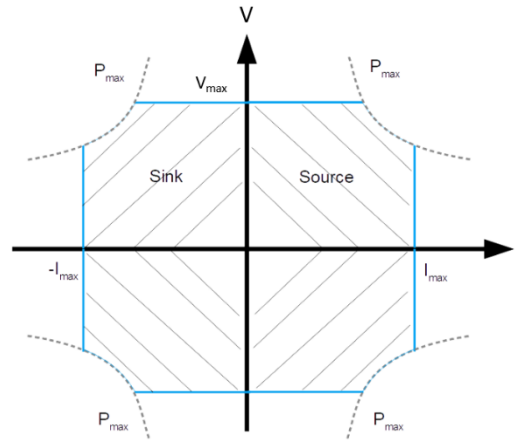


Figure 2:  
Maximum power of  $0\text{ V} - V_{max}$  (4 quadrant system)

### 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 kS/s
- 3x temperature input: PT100 4-wire measurement, -50 to +130 °C,  $\pm 1\text{ K}$  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 Energy Storage Discover (ESD)

## System cabinet

- Basic dimensions (HxD): 2.6 m x 0.8 m\*; approx. 500 kg per cabinet
- Total width of the system depends on the amount of test channels and cabinets. The width of each cabinet is 0.8 m. In some cases, an additional side mounted cabinet increases the width by 30 cm.

Channels		1	2	3	4	5	6	8	10	12
<b>20 V</b>	100 A 2 kW	0.8 m	0.8 m	-	0.8 m	-	0.8 m	0.8 m	-	0.8 m
	300 A 3 kW	0.8 m	0.8 m	-	0.8 m	-	1.6 m	-	-	-
	300 A 6 kW	0.8 m	0.8 m	-	1.6 m	-	1.6 m	-	-	-
	600 A 6 kW	0.8 m	0.8 m	-	1.6 m	-	1.6 m	-	-	-
	600 A 12 kW	0.8 m	0.8 m	-	1.6 m	-	2.4 m	-	-	-
<b>60 V</b>	100 A 6 kW	0.8 m	0.8 m	-	0.8 m	-	0.8 m	0.8 m	-	1.6 m
	300 A 18 kW	0.8 m	1.1 m	1.6 m	1.9 m	-	2.7 m	3.5 m	-	-
	600 A 18 kW	0.8 m	1.1 m	1.6 m	1.9 m	-	2.7 m	-	-	-
	600 A 36 kW	0.8 m	1.6 m	2.4 m	2.4 m**	-	-	-	-	-
<b>80 V</b>	100 A 8 kW	0.8 m	0.8 m	-	0.8 m	-	0.8 m**	-	-	-
	300 A 24 kW	0.8 m	0.8 m**	1.6 m	1.6 m**	-	2.4 m**	-	-	-
	600 A 24 kW	0.8 m	1.1 m**	1.6 m	1.9 m**	2.4 m	2.7 m**	-	-	-
	600 A 48 kW	0.8 m**	1.6 m**	2.4 m**	3.2 m**	-	-	-	-	-
<b>90 V</b>	100 A 8 kW	0.8 m	0.8 m	-	0.8 m	-	0.8 m**	-	-	-
	300 A 24 kW	0.8 m	0.8 m**	1.8 m	1.6 m**	-	2.4 m**	-	-	-
	600 A 24 kW	0.8 m	1.1 m**	1.8 m	1.9 m**	2.4 m	2.7 m**	-	-	-
	600 A 48 kW	0.8 m**	1.6 m**	2.4 m**	3.2 m**	-	-	-	-	-
<b>200 V</b>	500 A 48 kW	-	2.6 m	-	-	-	-	-	-	-
	750 A 48 kW	-	2.6 m	-	-	-	-	-	-	-
<b>300 V</b>	500 A 68 kW	-	2.6 m	-	-	-	-	-	-	-
	750 A 68 kW	-	2.6 m	-	-	-	-	-	-	-

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

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

- Protection type IP 54
- Control cabinet color: RAL 7035
- Ambient temperature: 10 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 (+10 %/-5 %), 50 Hz ( $\pm 0,2$  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 device (Bender ISOMETER® IR425-D4-1)

**Note:** 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.

- Signal light with magnetic mounting
- Red: Error; yellow: Active, green: Ready

### 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  $\pm 100$  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  $\pm 30$  A, accuracy  $\pm 0.05$  %,  $\pm 6$  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-T01 Extended voltage range with higher accuracy

- Measuring range 0 to 6 V (4QS)
- Voltage accuracy:  $\pm 1$  mV (typ. 150  $\mu$ V)
- Voltage range selection programmable within the test sequence

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

#### 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

## Electrochemical Impedance Spectroscopy (EIS)

### SL1001A-001 Electrochemical impedance spectroscopy per channel

Integrated electrochemical impedance spectroscopy 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 V 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 power\*
- Intake:  $\frac{3}{4}$  ", 6 to 20 °C



- Return: ¾ “, max. 30 °C
- Max. inlet pressure: 6 bar, without pressure impact, pressure difference >1 bar

\*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 3 automated parallel connections of 2 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 ±1 % from measurement range of current and voltage

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

## 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-XPS-100 Project Management and Technical Consulting

Project Management and Technical Consulting is highly recommended for each test bench project. By ordering the project management service, an experienced project manager is dedicated to your project and acts as direct communication interface from Keysight to the customers project management team.

The project manager takes over the responsibility:

- To observe internal project progress and secure that project schedule/project milestones are kept.
- That any unscheduled occasions with relevance for the project are immediately communicated and discussed with the customer.
- To provide complete and accurate project documentation to the customer.

### R9001A-201 Installation Service

The scope of the offered Installation Service strongly depends on the individual facility of the customer. Please share all relevant information and requirements with regards to test bench components that require installation such as connection to the local grid and to the local water supply with your local field engineer that scope of service personnel and material costs for installation can be calculated.

**Note:** Installation can also be executed by the customer.

### R9001A-202 Commissioning Service

The Commissioning Service is offered to guide the customer during first usage of the test bench after installation. Commissioning is highly recommended for each test bench project. It includes:

- Local presence of experienced test bench engineer during first usage of the test bench
- Consulting of customer personnel with regards to intended usage of the test bench (e.g. initial test with customer specimen)
- Review of executed hardware installation of Keysight products
- Review and consulting to software settings of operation software if ordered
- Travel expenses

**Note:** Commissioning is offered on a daily base. Keysight recommends considering at least two days for each test bench project.

## HS0002A-100 Productivity Support Service

The Productivity Support Service is offered to support, consult and train the customers operation personnel on the one hand to reduce the ramp-up time for initial usage of a new test bench, on the other hand with regards to any unexpected system behavior during the test bench life cycle. Productivity Support Service is executed via remote (phone/internet) or on site (on request). It includes:

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

**Note:** Keysight recommends considering at least two days of Productivity Support Service for each test bench project.

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