

# Energy Storage Test Systems for Cell Prototypes and Cells

SL1004A SL1005A

Ongoing research is dedicated to identifying new material combinations for battery cells with the goal of optimizing power and energy density, safety, durability and costs of energy storage devices. Cell samples are set up and characterized to achieve this. In addition to the galvanostatic test methods, cyclovoltammetry is frequently used as an analytical method for identifying the electrode processes. For detailed tests, the devices under test (DUTs) have an additional reference electrode. With the Scienlab test systems Keysight offers a solution for this task:

- Voltage range: -2 to +8 V, -6 to +6 V
- Output current: up to  $\pm 5$  A
- Measuring ranges:  $\pm 150$   $\mu$ A,  $\pm 5$  mA,  $\pm 150$  mA,  $\pm 5$  A, automatic range switchover
- Manual parallel connection: 2 channels to increase the current to max. 10 A
- Control modes: current, voltage, power
- Optional integrated Electrochemical Impedance Spectroscopy (EIS)



## Applications

- Characterization, selection and optimization of cell chemistry and material in research & development, production, and for quality assurance purposes
- Simultaneous characterization of up to several hundred cell specimens e.g. round cells, button cells, and laboratory cells with reference electrode
- Identification of the electrode processes: galvanostatic and potentiostatic test methods, and cyclovoltammetry, etc.
- Determination of capacity, energy, power, voltage, internal resistance, and efficiency



## Key Benefits

- Connection for one reference electrode and for one temperature sensor in each test channel
- Control based on all 3 voltages: anode/cathode, cathode/reference electrode, and anode/reference electrode
- Suitable for high-voltage materials up to 8 V
- Measuring accuracy of up to 0.03  $\mu\text{A}$
- Intuitive ESD testing and control software for reproducible, precise and reliable measurement results
- Integrated evaluation of the cyclovoltammetry in ESD

## Maximum measuring precision

Successful characterization of cell prototypes demands precise control and measuring technology. Keysight's Scienlab systems therefore offer voltage measuring accuracy of  $< 1$  mV and current measuring accuracy of up to  $0.03 \mu\text{A}$ .

## Integration of the reference electrode

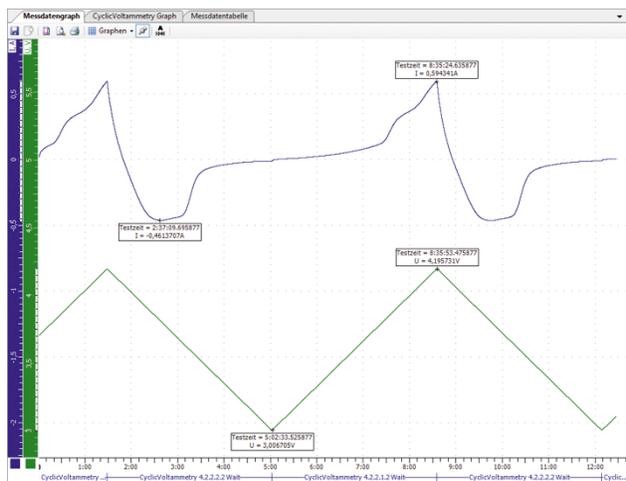
When analyzing electrode processes, it is not only important to precisely record the potential of the reference electrode compared to the anode and cathode potentials, but also to actively integrate the electrode during the measuring phase. Keysight's Scienlab systems permit selection of anode/cathode, cathode/reference electrode or anode/reference electrode as the actual voltage measurement value for every control mode as well as active control of the reference electrode potential, e.g. during cyclovoltammetry.

## Compact and flexible design

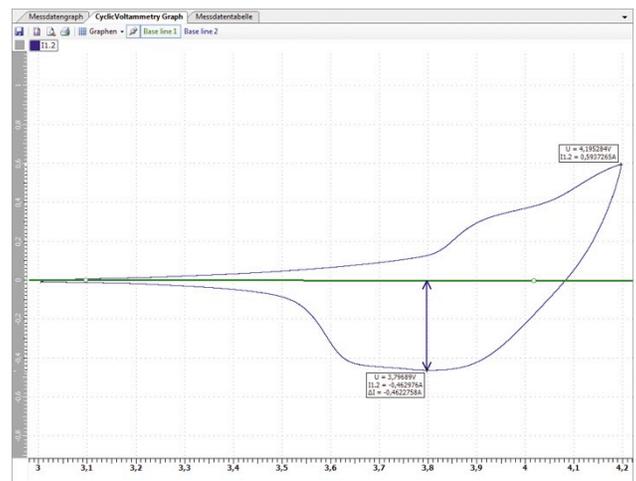
Each draw-out power stage unit has 2 test channels, which enables up to 12 channels to be integrated in a 19" rack. This makes for an extremely compact system. The modular design based on draw-out units also enables customer-specific solutions with any number of channels, for fast and cost-efficient adaptation to future test requirements. Each channel works autonomously.

## Ergonomic DUT adaptation

Testing multiple cells demands a large number of channels and therefore extensive wiring. Keysight offers compatible adapters for various cell types and convenient connection of DUTs with no disruptive cable routing. The load and measurement outputs for each channel are easily accessible on the front plate (Anderson connector) and alternatively via a bundled cable harness. The latter is fed through the base for convenient routing into a climate chamber.



Load-independent voltage and resulting current over time



Electrode current plotted against cell voltage

## Software

Keysight's Scienlab systems are supplied with the clearly structured testing and control software called Energy Storage Discover (ESD). Features popular with our customers:

- Extensive options for test creation, control, monitoring and evaluation
- Easy to learn, due to an intuitive operating concept
- Data recording with common time stamp for synchronized analysis of measurement data
- Measurement data is evaluated real-time during test
- User-friendly evaluation functions do away with the need for time-consuming post-processing
- Visualization of large volumes of measurement data using clear graphics and tables, as well as export to all common file formats
- Integrated EIS and cyclic voltammetry

## Technical data

- Output power: 40 W
- Output voltage: -2 to +8 V, -6 to +6 V
- Output current:  $\pm 5$  A continuous current
- Current output dynamic:
  - Rise time -90 to +90 %, -4.5 to 4.5 A: < 10 ms at UA = 0 V
  - Continuous transition between charging and discharging, no switchover time
- Analog measured data recording, cell voltage with reference electrode:
  - Measuring range: -2 to +8 V
  - Measuring accuracy: Full Scale 0,01 %,  $\pm 1$  mV
- Analog measured data recording, current:
  - Measuring ranges:  $\pm 150$   $\mu$ A,  $\pm 5$  mA,  $\pm 150$  mA,  $\pm 5$  A
  - Measuring accuracy: 0.01 % full scale  $\pm 0.05$  % of measured value
  - Automatic measuring range switchover
  - Sample rate: up to 1 kHz
  - Control accuracy within measuring accuracy
- Optional Electrochemical Impedance Spectroscopy
- Temperature measurement:
  - Measuring range -20 to +200 °C (type K, others on request)
  - Measuring accuracy 2 K over the full measuring range
- Communication: Ethernet interface

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

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