



Ultra-High Precision Coulometry (UHPC) System

NOVONIX provides the only Ultra-High Precision Coulometry (UHPC) systems available today for those seeking state-of-the-art battery testing equipment for their laboratory research, product development, and manufacturing environments. Our world-class UHPC systems are fully capable battery cyclers that allow our customers to rapidly test electrochemical processes within cells of various form factors, with industry leading precision and accuracy.

Benefits of UHPC Technology



Accurate Measurements

Allows accurate measurements of electrochemical processes within a cell. This enables non-destructive understanding of how battery chemistry is changing from cycle-to-cycle. Measure Coulombic Efficiency, up to five significant figures, to enable reliable comparisons of cells in a fraction of the time that it would take on other cyclers.



Unique Observations

Observe cycle metrics unique to ultra-high precision such as quantifying the degree of electrolyte oxidation at the positive electrode during cycling (charge endpoint slippage).



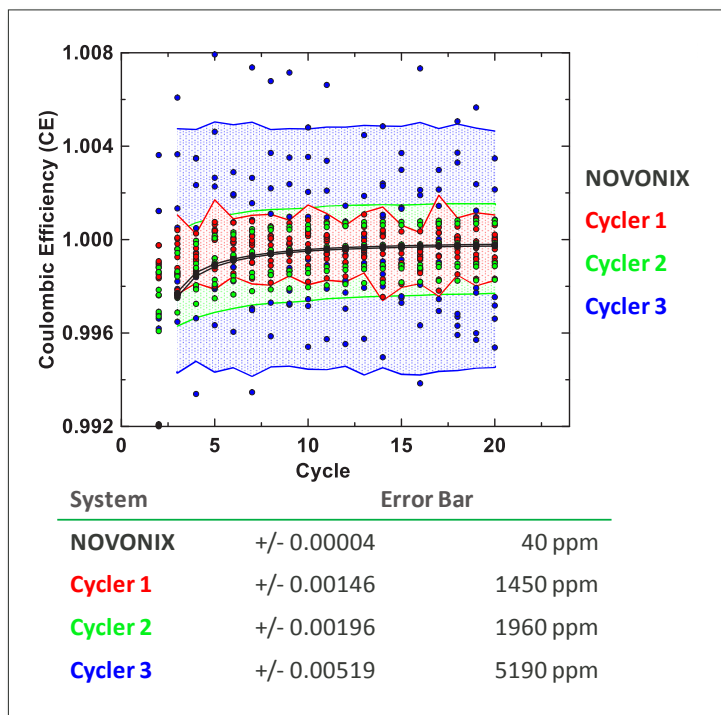
Precise Evaluation

Evaluate active material loss, lithium inventory loss, electrolyte oxidation, and more.

Benefits of NOVONIX Equipment

- Our UHPC systems offer current ranges from as low as 100 μ A, to as high as 20 A, allowing precision measurements down to nA
- NOVONIX systems can be used like any other battery cycler – for formation, DCIR, HPCC, calendar ageing, cycle ageing, rate testing – all with improved data quality
- Turnkey, modular systems – including cell holders and thermal chambers – fully racked and ready to use as delivered
- Modern, intuitive, and configurable software
- Designed and built in North America
- Supported globally

NOVONIX UHPC Coulombic Efficiency (CE) Measurement vs. Competitors



- Accurate CE values require extremely precise current and voltage sourcing and measurements
- UHPC's significantly tighter current setpoints provides higher resolution and accurate CE measurements taken on the same 8-9 cells on each system under identical conditions (40°C, 2.8 V - 4.0 V, 200 mA (~C/15))
- Scatter points are individual cycle data for all cells
- Range is shown as 2x standard deviation

Applications of UHPC Systems

NOVONIX UHPC systems deliver data in ultra-high precision that enables scientists and engineers to gain an unparalleled depth of understanding in cell performance. Our UHPC systems can be used in a variety of applications, including:

Materials Evaluation

Customers working on new materials can utilize UHPC testing to understand how changes to physical properties such as particle size distribution, surface area, surface treatment, and tortuosity impact the battery performance.

Cell Selection

When conducting cell selection between vendors or cell models, the ability to gather cell performance data at high accuracy in a short time is critical, especially when experiments have many dimensions (temperature, current, voltage windows, cells, etc.).

Battery Management Optimization

Clearly understand the electrochemical response of a cell and develop charge strategies under different environmental and use conditions.

Manufacturing Process Development

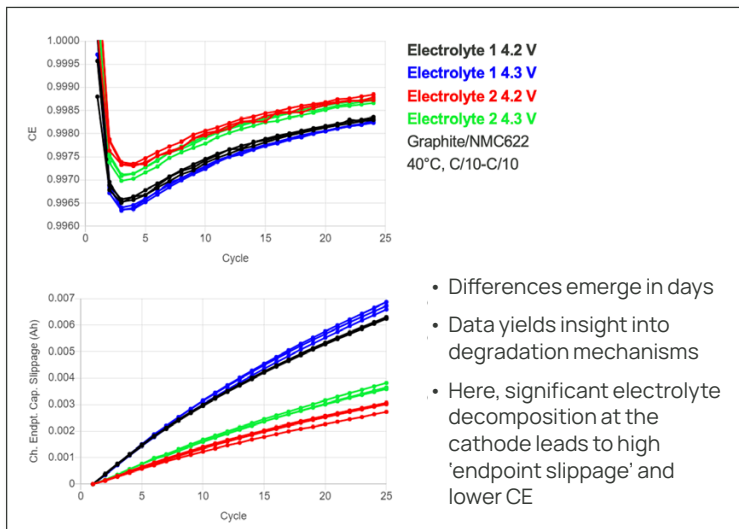
Tune process parameters on new or existing production lines – for new or existing recipes – and guarantee the repeatability of a manufacturing process to quickly gain confidence in the process.

Environmental Performance Evaluation

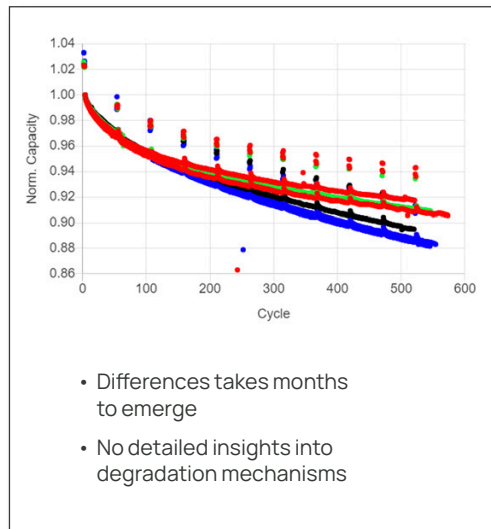
Environmental conditions matter when testing cell performance. Learn how cells perform in extreme conditions and minimize failure mechanisms through accurate analysis of metrics such as charge endpoint capacity slippage (caused by electrolyte oxidation, transition metal dissolution, self discharge, and more).

Differences with NOVONIX UHPC Equipment

3 Weeks of UHPC Testing



6 Month Cycle Life Testing



UHPC results can be used to quickly inform lifetime predictions and to understand failure modes of your cells.

Channel Module Specifications

Each channel can operate in constant current or constant voltage charge or discharge mode across the full 0 – 5 V load window. Each channel has integrated local and remote (i.e., cell-level) temperature sensing to monitor environment and cell temperature.



UHPC-2A

UHPC-10A

UHPC-20A

Part Number	CMA-HDX-99-56	CMA-HEX-99-56	CMA-HFX-99-56
Number of Channels	8	8	4
Source Current Range	200 μ A, 2 mA, 20 mA, 200 mA, 2 A	100 μ A, 1 mA, 10 mA, 100 mA, 1 A, 10 A	2 A, 20 A
Source Voltage Range	1 - 250 mV, 250 mV, 5 V	0 - 5 V	0 - 5 V
Measured Current Accuracy, FSR	<0.005%	<0.005%	<0.005%
Measured Voltage Accuracy	100 μ V (<250 mV) 200 μ V (>250 mV)	200 μ V	200 μ V
Measured Current Noise, FSR	< 0.002%	< 0.002%	< 0.002%
Measure Voltage Noise	100 μ V	100 μ V	100 μ V
Current/Voltage Temperature Coefficient, FSR over 23 $\pm$ 5°C	0.002%	0.002%	0.002%
Timing Resolution	10 ms	10 ms	10 ms
Measurement Frequency	6 Hz	6 Hz	6 Hz
Standard Rack Mountable (Size)	Yes (3U)	Yes (4U)	Yes (2U)
Depth, inches (mm)	24 (610)	27 (686)	28 (711)
Max Power Draw	320 VA	1500 VA	1500 VA

Thermal Chamber Specifications

Systems typically come with integrated Thermal Chambers to ensure the temperature stability of the cell. In UHPC experiments, this is critical for minimizing noise and ensuring data consistently collected. They can operate from -20°C to +60°C and can accommodate a range of cell sizes. NOVONIX UHPC Thermal Chambers are optimized for efficiency, keeping the cost down compared to other other products, while also working with other cyclers available on the market.



16-Position,
2A/10A

16-Position,
2A/10A WRC*

4-Position,
20A

4-Position,
20A WRC*

Set Point Temperature Range	10°C to 60°C	-20°C to 60°C	10°C to 60°C	-20°C to 60°C
Accuracy (Stability) at 20°C	±0.2°C (±0.02°C)	±1.0°C (±0.1°C)	±0.5°C (±0.05°C)	±1°C (±0.1°C)
Accuracy (Stability) at 0°C	N/A	±0.7°C (±0.06°C)	N/A	±0.8°C (±0.07°C)
Required Lab Temp Range (Stability)	18°C to 28°C (±1°C)	15°C to 20°C (±1.0°C)	18°C to 28°C (±1°C)	15°C to 20°C (±1.0°C)
Heating Method	Resistive	Resistive	Resistive	Resistive
Cooling Method	Peltier	Compressor	Peltier	Compressor
Standard Rack Mountable (Size)	Yes (10U)	Yes (10U)	Yes (11U)	Yes (11U)
External Depth, inches (mm)	17.5 (445)	37.8 (961)	21.4 (546)	37.8 (961)
Internal Dimensions, inches (mm)	14.2 x 11 x 11.25 (360 x 279 x 285)	14.2 x 11 x 11.25 (360 x 279 x 285)	14.2 x 12.5 x 15 (360 x 317 x 381)	14.2 x 12.5 x 15 (360 x 317 x 381)

* Wide Range Chamber. NOVONIX recommends WRC for applications that will demand cold temperatures. For regular applications use Peltier-style chambers with solid-state coolers, which efficiently and responsively cool within 10°C relative to ambient temperature.

UHPC Equipment

Traditionally delivered as a fully integrated system, NOVONIX UHPC equipment is modular and racked according to customer specifications.



1. 2A/10A Thermal Chamber
2. 20A Thermal Chamber
3. 2A Channel Module
4. 10A Channel Module
5. 20A Channel Module
6. Power Module
7. Controller Module

Cell Holder Specifications

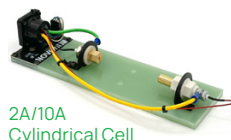
Standard format (with an integrated RTD temperature sensor) and large format cell holders are available. We manufacture cell holders configured for pouch cells, coin cells, cylindrical cells, and custom designs to accommodate specific test requirements.

Features of Standard 2A/10A Cell Holders:

- Fully isolated V+/- and I+/- leads
- Can accommodate standard cylindrical sizes (18650, 21700) and is adaptable for other cell sizes (26650, 4680)
- Maximum Current: 10A



2A/10A Coin Cell



2A/10A Cylindrical Cell



2A/10A Alligator Pouch



2A/10A Pouch Clip Cell

Features of Large Format 20A Cell Holders:

- High power large format cell connectors with custom ends such as pouch clip, ring, alligator etc.
- Maximum Current for Large Format Cell Holder: 30A



20A Pouch Clip Cell



20A Pouch Ring Cell

Electrochemical Impedance Spectroscopy (EIS)

NOVONIX has collaborated with Gamry Instruments to offer EIS integration with NOVONIX UHPC equipment.



Features of EIS

- **Seamless Hardware Integration:** Achieve effortless connectivity between the Gamry EIS Box and NOVONIX UHPC Channel Modules
- **Integrated EIS Configuration:** Set up Electrochemical Impedance Spectroscopy (EIS) procedures directly through NOVONIX UHPC Software

UHPC Software – Advanced Applications

The NOVONIX UHPC software suite (Protocol, Control, and Plot) gives users the tools to create and manage detailed test protocols with real-time monitoring of each channel's performance. It captures and stores output data as text but also offers sophisticated analysis tools for in-depth examination. The software includes advanced plotting capabilities for visualizing data trends and can export data in various formats, facilitating thorough analysis and insightful understanding of cell performance and efficiency. Additionally, it supports automated data processing and customizable reporting, enhancing the precision and usability of experimental results.

UHPC Protocol:

Used to generate the test sequence protocol files that dictate how a channel will operate for a given cell. It allows the user to configure currents, voltage limits, data collection intervals, etc.

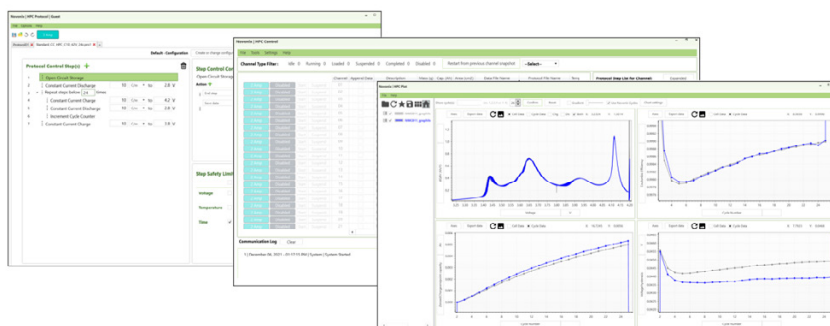
UHPC Control:

Starts and runs tests dictated by protocol files. It controls the Controller Module, its communication with connected channels and controlling charge/discharge profiles, etc.

UHPC Plot:

Allows the user to analyze data files generated by the UHPC Control software. It provides both a graphical interface for viewing of data and a data export function that allows the user to export simple text files for subsequent graphing and further analysis.

Protocol, Control, and Plot



NOVONIX provides:

- Exceptionally prompt customer support
- In-house calibration services adhering to the highest industry standards
- Third-party calibration services across North America, ensuring exceptional quality and saving valuable time locally
- Resource Center available on NOVONIX website that includes application notes, white papers, manuals, software release notes, etc.

We're providing revolutionary clean energy solutions to the battery industry. Contact us to receive a quote.

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