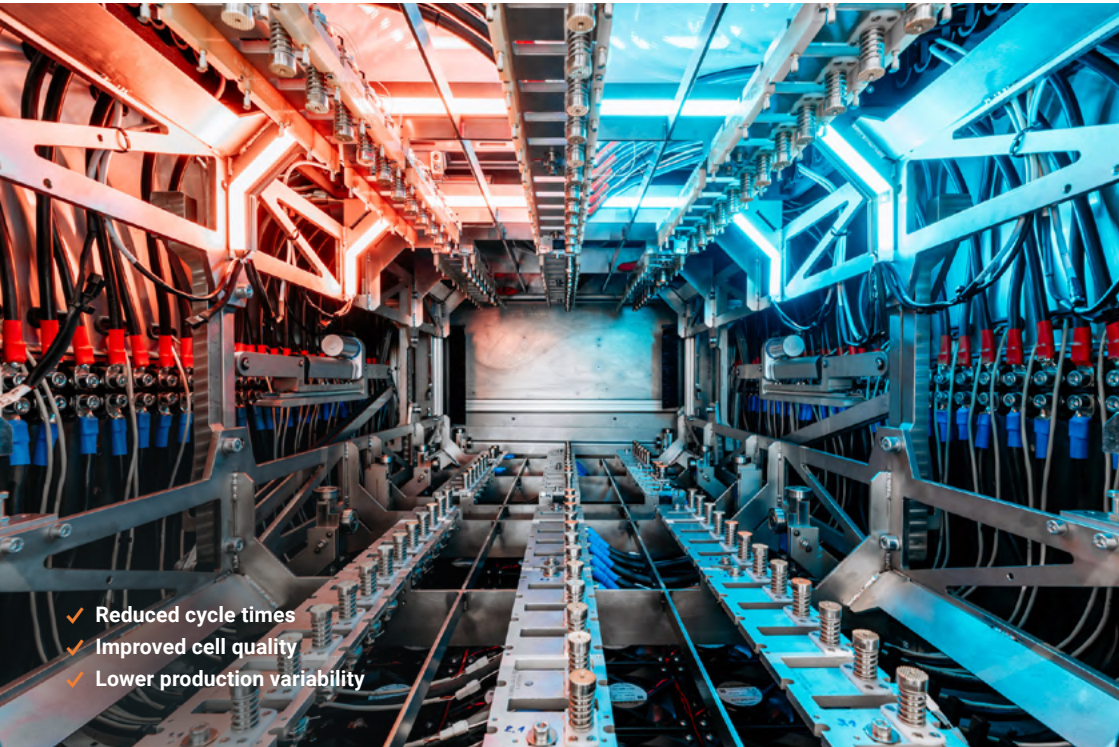




Advanced formation and battery cell testing solutions

Intelligent, measurement-driven battery formation
for GWh-scale production, pilot lines and R&D.



- ✓ Reduced cycle times
- ✓ Improved cell quality
- ✓ Lower production variability



We fundamentally innovate battery cell activation by rethinking conventional processing and enabling next level of production performance.

Kristin Lüdemann
Strategic Business Development (ext.)



FormationIQ Module formation chamber
equipped with fully automated contacting system

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Battery cell activation rethought

From fixed charging protocols to intelligent process control

Battery cell formation is one of the most critical, time-consuming and cost-intensive steps in modern battery cell production. Increasing production volumes, new cell chemistries and higher performance requirements demand **faster, more stable and more transparent formation and testing processes**.

Introducing FormationIQ

FormationIQ by Freiberg Instruments brings **advanced sensing, high-performance power electronics and intelligent control** directly to the cell level. Instead of relying on predefined CC/CV profiles alone, the formation process can be continuously monitored and dynamically adapted based on real-time cell data. This enables **shorter formation cycles, improved SEI-layer quality and reduced production variability**.



Materials

FormationIQ enables reliable formation and testing of all common battery cell formats including cylindrical, prismatic, and pouch cells.

LFP **L(M)FP** **NMC** **Na-Ions**

All Solid State **NextGen Materials**



Reduce cell formation time up to 45 %



FormationIQ powered by **Syntropic Cell Technology**® represents a **new approach to battery cell formation**. Instead of applying static charging regimes, the process is guided by **real-time data** acquired directly at the cell level.

By combining power electronics, sensing and control, **FormationIQ** enables dynamic interaction with the actual state of each individual cell. High-resolution voltage, current, temperature and impedance data create a **deeper understanding of electrochemical processes during formation** and allow targeted optimization of critical mechanisms such as SEI-layer formation.

FormationIQ is smarter

- ✓ Measurement-driven
- ✓ Adaptive control
- ✓ Integrated EIS
- ✓ Cell-level sensing
- ✓ Scalable architecture
- ✓ Production-ready



FormationIQ Board enabling application of Syntropic Cell Technology® inside our FormationIQ systems



How FormationIQ works

The continuous data loop creates a **controlled formation process** with reduced cycle times, improved cell quality and a strong foundation for further optimization in both development and large-scale manufacturing.

1

Advanced strategies

- ✓ Advanced formation protocols are applied to battery cells enabling both process acceleration plus data collection.

2

Real-time measurement

- ✓ Voltage, current, temperature and impedance data are acquired directly at cell level.

3

Cell-state evaluation

- ✓ **FormationIQ** evaluates the actual behavior and condition of each individual cell.

4

Adaptive process control

- ✓ Charging and testing protocols are dynamically adjusted beyond conventional CC/CV strategies.

5

Optimized formation

- ✓ Critical processes such as SEI-layer formation can be influenced more precisely.

6

Improved outcome

- ✓ Formation time is reduced, process stability is increased and production variability is minimized.

Extended intelligence

- ✓ Collected measurement data can be used via AI integration to optimize electrode manufacturing and cell assembly.





The smart way of battery processing

Maximum Speed and Process Stability

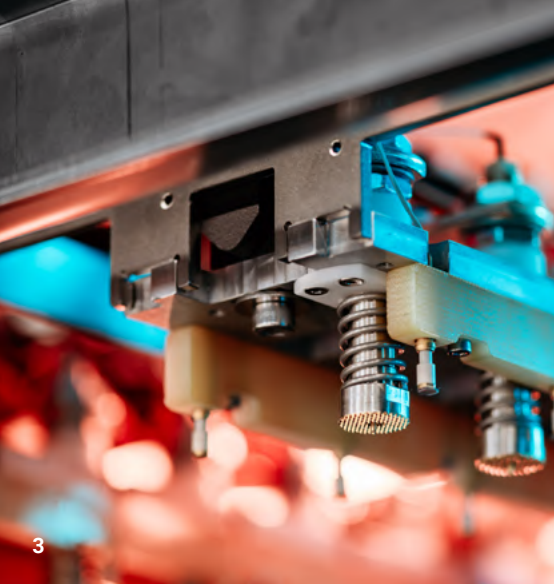
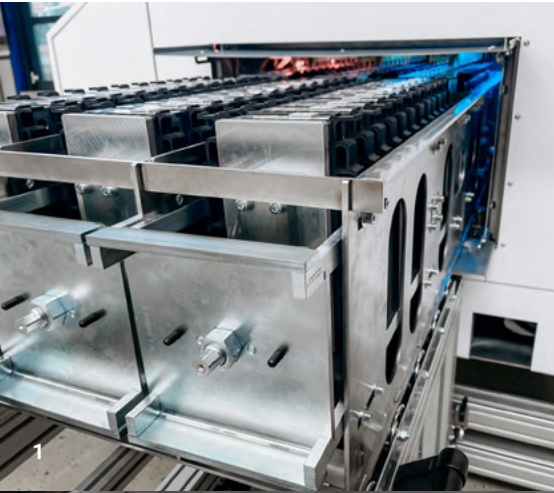
FormationIQ enables intelligent, measurement-driven battery formation and testing across research, pilot-scale validation and industrial production. By integrating precise measurement capabilities directly into the charging electronics, cell behavior becomes visible in real time – creating the foundation for controlled, reproducible and scalable battery processing.

Key Advantages of **FormationIQ**

- ✓ **Accelerated formation cycles without compromising cell quality**
Smart formation protocols beyond traditional CC and CV strategies enable a significant reduction in process time.
- ✓ **Improved SEI quality and reduced cell variability**
By actively regulating the formation process the development of the SEI layer can be optimized.
- ✓ **Controlled and monitored formation processes**
Integrated measurement technology within the formation electronics enables real-time monitoring of electrical cell properties.
- ✓ **Scalable and flexible system architecture**
From individual charging boards to fully integrated formation and testing systems, our solutions support various cell formats and production scales.



Key Advantages



- 1 Automated loading of battery cells using application-specific functional carriers
- 2 FormationIQ Module is individually designed for specific cell dimensions and terminal architectures
- 3 Specific top-contact solution for prismatic battery cells
- 4 FormationIQ Board delivers best-in-class sensing and advanced charging control at cell level



FormationIQ Board



Learn more

w × h × d
220 × 225 × 36 mm

FormationIQ Matrix



Learn more

w × h × d (32 channels)
802 × 985 × 1444 mm

The core of FormationIQ series

Integrated sensing and advanced charging control for intelligent, measurement-driven battery formation – precise and scalable.

- ✓ Extensive integrated measurement capabilities incl. EIS
- ✓ Controlled formation process with proprietary control algorithm
- ✓ Scalable modular electronics, ready for drop-in solutions

Electrical performance

75 A or 150 A per board, up to 600 A in parallel operation, Voltage range: up to 6 V

Measurement performance

Accuracy: Up to <0.03 % FSD,
Voltage accuracy: <0.05 % FSD

Dynamic performance

Fast current response (<5 ms),
Pulse mode with up to 20 kHz update rate

Testing capabilities

Electrochemical impedance spectroscopy (EIS) up to 5 kHz, Pulse testing,
Coulomb and energy counting

Pilot-scale battery formation and testing

Designed to support battery cell development and process qualification – smart, flexible and individually configurable.

- ✓ Flexible and programmable protocol designer
- ✓ Extensive integrated measurement capabilities and proprietary control algorithm
- ✓ Up to 64 channels per system for serial and parallel operation

Electrical performance

Same as FormationIQ Board

Measurement performance

Same as FormationIQ Board

Dynamic performance

Same as FormationIQ Board

Testing capabilities

Same as FormationIQ Board



FormationIQ Module



Learn more

w × h × d

1835 × 935 × 1920 mm

FormationIQ Studio



Learn more



GWh-scale battery formation

Designed to scale advanced battery cell processing into high volume manufacturing – smart, modular and fully automated.

- ✓ Seamless scale-up through unified software and control architecture
- ✓ Advanced sensing and control for continuous process monitoring and optimization
- ✓ High channel density and modular design for scalable, high-throughput production

Electrical performance

Same as FormationIQ Board

Measurement performance

Same as FormationIQ Board

Dynamic performance

Same as FormationIQ Board

Testing capabilities

Same as FormationIQ Board

Cutting-Edge Software for FormationIQ series

Easy creation and management of formation protocols by protocol designer.

- ✓ No-code protocol creation with loops, branches, limits, and versioning
- ✓ Real-time GUI for channel monitoring, alarms, and data analysis
- ✓ Secure execution with access control and CSV, PDF, PNG export



Ready for your challenge



From R&D to large scale manufacturing

Increasing demands on performance, lifetime, and production efficiency require a deeper understanding of cell behavior and more precise control of electrochemical processes. Conventional approaches often rely on predefined charge and discharge profiles with limited insight into the actual state of the cell, leading to conservative process design, longer cycle times, and high variability in production.

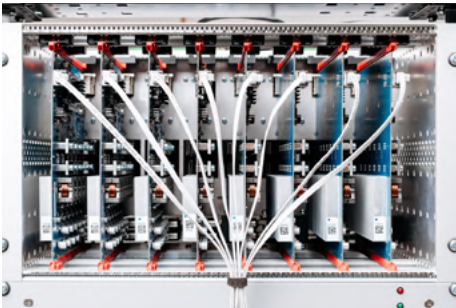
From research and development to large-scale manufacturing, **FormationIQ** supports a wide range of applications by enabling **intelligent, measurement-driven workflows**. Whether optimizing cell activation, high-performance cycling, or gaining deeper insights into cell characteristics, the platform provides the tools required to **enhance both process efficiency and product quality**.

Individual formation channels enable precise cell contacting and high-resolution sensing



Advanced Battery Cell Activation

- ✓ **FormationIQ** systems enable a new approach to battery cell activation by moving beyond conventional CC/CV-based formation strategies.



High-Performance Battery Cell Cycling

- ✓ **FormationIQ** systems combine high current capability with advanced measurement functionality, enabling demanding cycling profiles under controlled conditions.



Improved Battery Cell Characterization

- ✓ **FormationIQ** systems enable battery cell characterization by capturing extensive measurement data directly during the formation process.



Freiberg
Instruments



See FormationIQ in Action

Contact Us to Get Started



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Get in touch