

ENGINEERING TRANSFORMATION FOR Li-ION BATTERY

Bosch Software and Digital Solutions' Battery Solutions are the leading provider of complete engineering solutions for developing lithium-ion battery packs. With the global battery energy storage market projected to grow at a CAGR of 16.3% from 2022 to 2029*, it is crucial to have a reliable partner who can offer comprehensive solutions for your energy storage needs.

To ensure our partners receive the best and most comprehensive battery solutions, we have identified what every modern company in the Li-Ion battery domain needs to flourish: **Building Resilient Enterprises, Reimagining Business, and Scaling Sustainability.** By ensuring our partners find success on all three of these fronts, we help companies reach their highest potential.

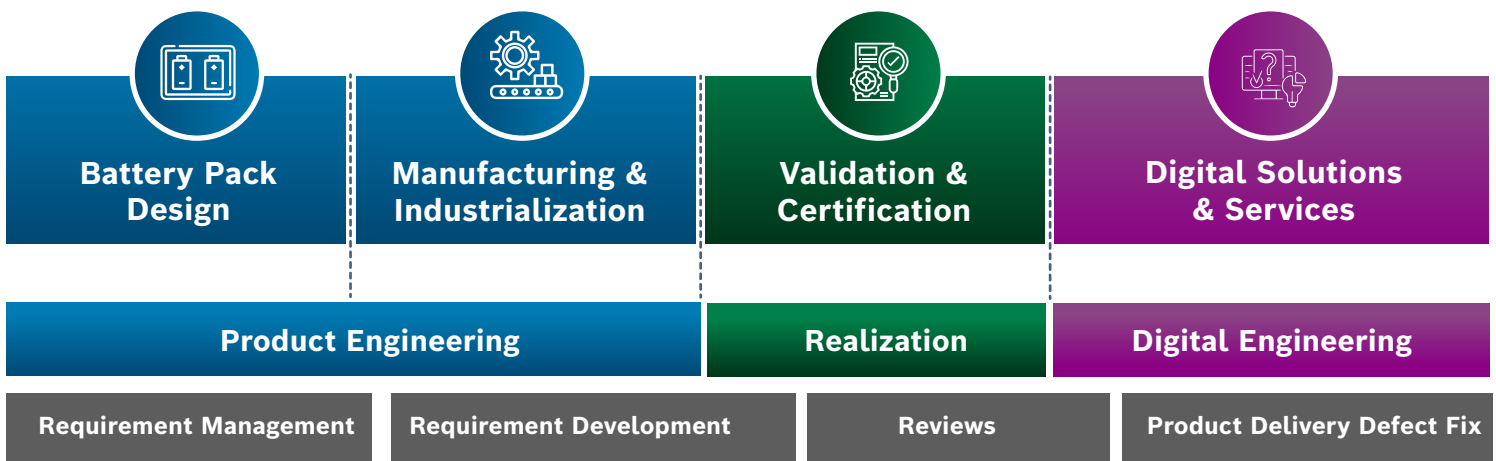
We help partners achieve resilience by taking designs for reliability into consideration when developing Li-Ion battery solutions. From building CoEs for functional safety and cybersecurity within the organization to creating in-house labs in areas of high voltage for long-duration testing of Li-Ion battery solutions, we ensure our partners become resilient enterprises.

We understand that remodeling your businesses is also a critical step for long-term success. Our EBM/SDS team is dedicated to deliver tailored solutions that meet the specific requirements of different Li-Ion applications. We mainly focus on low and high voltage battery applications, including digital and cloud solutions that encompass remote

monitoring and asset management. Through successful digitization, our partners can leverage the latest cloud solutions to monitor their batteries remotely and perform asset management, enabling predictive maintenance and massively reducing manual checks. Furthermore, we implement embedded solution battery algorithm to achieve incredible accuracy of over 95%.

Finally, to ensure our partners achieve their sustainability goals, we design and develop Li-Ion products to meet UL and ISO standards. Some of the key standards that our products meet are **UL 1973, IEC 62619, UL 60730.**

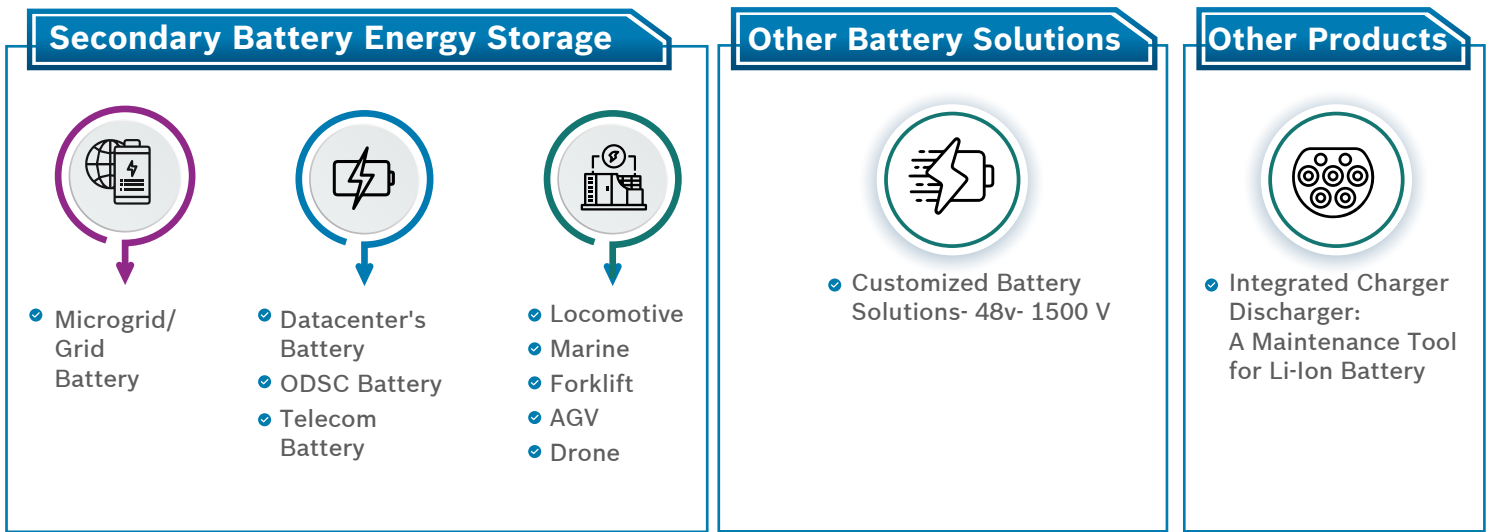
OUR OFFERINGS



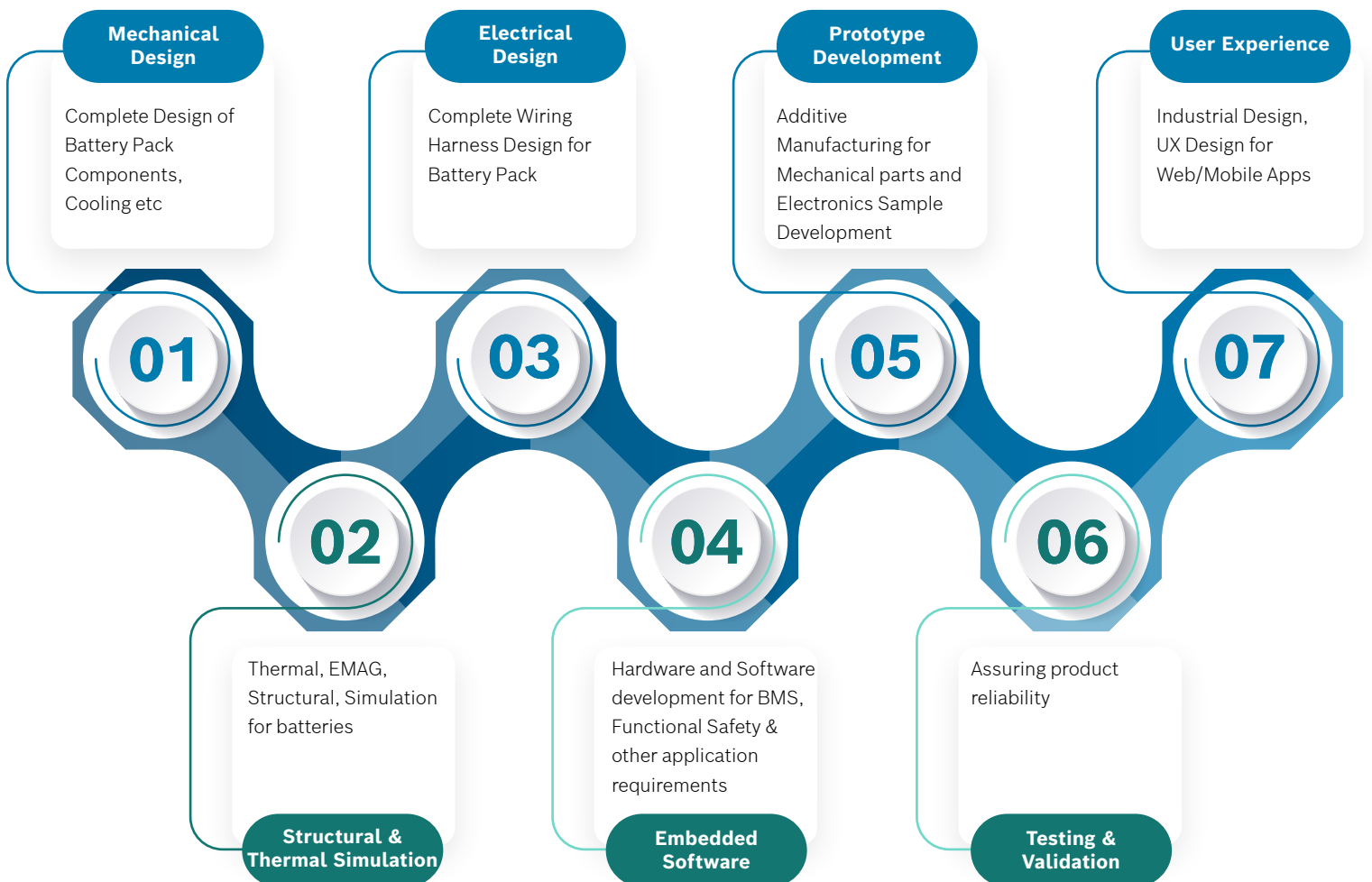
Furthermore, we offer a digital platform that provides remote monitoring, artificial intelligence of things (AIoT), web portals, mobile apps, cloud solutions, digital twins, and battery optimization. We utilize a wide range of cloud-based applications and data analytics to achieve key features such as lifetime monitoring, anomaly detection, and aging prediction.

*(according to "Fortune Business Insights")

PRODUCT APPLICATIONS

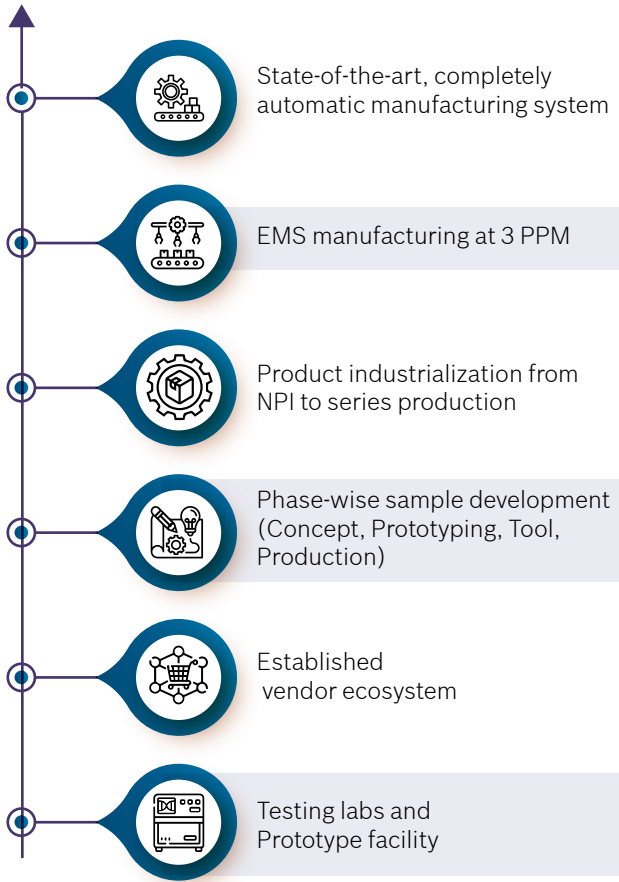


BATTERY PACK DESIGN



Complete Solution for Li-Ion Battery Technology

MANUFACTURING AND INDUSTRIALIZATION



Line Automation: Digital Manufacturing

Automation & Digital Advisory

Industrial Automation

Digital Manufacturing & Logistics

Safety and Sustainability

Services

- Lean Consulting
- Automation & Digital Roadmap
- Enterprise Architecture
- Sustainability Audit & Roadmap
- Change Management
- WEF lighthouse Recognition Facilitation

- Factory Automation
 - Line, Assembly / Process, Machine tool Automation
 - Automation Services(PLC Programming)
- Packaging Automation
- Industrial Engineering

- IT-OT integration
- MES
- PLM & ERP
- MFG & Logistics apps and analytics
- Advanced Tech use cases

- Utilities Design/Redesign
- Energy analytics
- Perimeter Safety and Access Protection
- Workplace safety

- Maintenance services
- Spares and accessories
- Upgrades

TESTING AND VALIDATION

Test Types

- Charge and Discharge test
- SOC, SOH Verification
- Overcharge, Over discharge
- Imbalanced charging
- Temperature Tests
- Fault Test (SC, OC)
- Isolation tests
- Cooling function
- Capacity test
- Drive cycle tests
- MIL, SIL, HIL testing

Non-Functional Tests

- Stress and drop test
- Corrosion
- Thermal Characterization
- Endurance(temperature and humidity)
- Vibration, Performance and Abuse
- EMI/MC Tests
- Storage time Test

Standard / Compliance



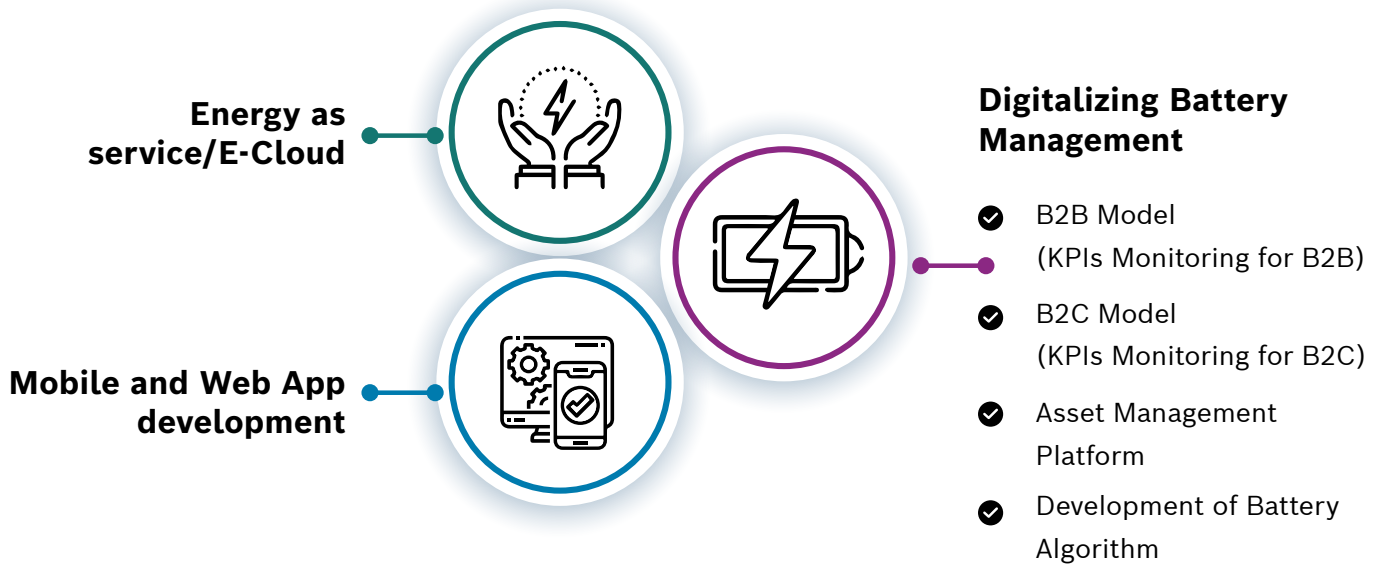
- ISO 12404
- AIS 038/039
- IEC 61000
- AIS004
- ISO11452
- IEC 62660
- IEC 60068
- UL2580/2271
- UN 38.3

Region Certification

- NAM (UL 1973)
- EMEA (IEC 62619)
- JP



LI-ION BATTERY- DIGITAL SOLUTIONS



Fleet Management

- Fleet segregation software designed for:
- Asset monitoring
 - Alerts trends
 - Forecasting



Component Life Analysis

- Battery life management based on history and expected future use
- Minimizing downtime and unplanned outages



Dispatch Optimization

- Battery charging and discharging based on equipment status
- Maximized customer outcomes



AI Analytics

- Collect and analyse data
- Simulations to provide insights, power optimization and predict possible failures

SUCCESS STORIES

Successful Establishment of EAC to Empower a Leading Battery Company



Challenge:

One of the leading European battery company needed an Innovation and Engineering Acceleration Center (EAC) for the design and development of their Li-Ion energy storage solutions and wanted to accelerate the development and launch of their products.



Solution:

Bosch SDS provided a dedicated EAC, enabling quick development and launch of Li-Ion batteries for our partner. Leveraging digital solutions and remote monitoring improved battery lifetime, while also ensuring compliance with UL-60730 safety norms for ESS battery containers and implementing SIL-compliant Railway BMS solutions for TGV trains.

Benefits:

- ✓ ESS Battery container made in compliance with UL-Safety norms like UL-60730.
- ✓ Railway BMS solutions implemented for TGV trains with SIL compliance.



High Voltage Battery Pack for Industrial UPS Application



Challenge:

As a newcomer in the Li-Ion battery domain, a multinational company with expertise in energy management was searching for a technology collaborator to develop UPS battery packs.



Solution:

As a technology collaborator, Bosch SDS brought expertise in hardware, software, mechanical, thermal management, validation and certification. SDS designed, developed and certified UPS battery pack of 180V, 5kW specification for industrial applications.

Benefits:

- ✓ A number of compliances were met: UL 1973, IEC 62619, UL 60730-1, and IEC 60730-1.
- ✓ State-of-the-art thermal management and mechanical engineering.



Simplifying Maintenance With an Integrated Charger Discharger



Challenge:

A multinational company with services in design, development and the manufacturing of batteries, needed a maintenance tool to equalize a battery module capacity and voltage before it could be used as a replacement for a faulty module in a ESS Rack



Solution:










Bosch SDS developed an integrated charge-discharge equipment meeting UL 1564, IEC 61010-1, UL 60721, and IEC 61000-4-x compliances, enabling our client to equalize and prepare battery modules to the desired voltage level for use as replacements in high in high voltage ESS application.

Benefits:

- ✓ A number of compliances were met: UL 1564, IEC 61010-1, UL 60721, and IEC 61000-4-x.
- ✓ Charge and discharge a battery to the desired voltage.



WHY BOSCH SDS FOR LI-ION BATTERY SOLUTIONS?

-  Our Complete solutions encompass the design, prototyping, validation, and certification phases to provide customers with a personalized experience.
-  By embracing digitization, we help our partners remodel their businesses by leveraging a plethora of innovative cloud-based applications and data analytics solutions that enable remote monitoring, asset management, and anomaly detection.
-  Our products are designed with a key focus on reliability, ensuring our partners can create highly resilient enterprises.
-  Take advantage of our CoEs for functional safety, cybersecurity, and product safety within the organization.
-  Ensure organizational responsibilities are met by achieving key compliance goals through meeting critical standards such as UL 1973, IEC 62619, UL 60730, AIS 156, and AIS 038 certifications.
-  Leverage our sophisticated embedded system Battery Algorithms to achieve accuracy of over 95%.
-  70+ skilled resources with multi-domain competency with 10+ years of experience in Li-Ion Battery.
-  Utilize our in-house labs in areas of high voltage for long duration testing of products.
-  60+ proven expertise of Battery Pack Development and BMS ranging 3kWh to 10 MWh and 12V to 1500V.

Get Started Now!

Bosch Software and Digital Solutions

India | USA | Europe | UK | Japan | Middle East | China



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