



Fast Charging Battery Pack



Electric motorcycle battery pack

Clean Sheet Battery Development

MAHLE Powertrain has designed and developed a high performance, fast charging battery pack for small vehicle applications, based on its in-house M3x architecture.

The original concept was based on a UK Gov funded research project to convert a hybrid-powered 3-wheeler motorcycle, designed for 'fast responder' usage, to fully electric with ultra-fast recharging capability.

This application also involved some difficult challenges in designing the battery pack to fit in a small and awkwardly shaped package space. Considerations were also given to minimising weight and achieving a low centre of gravity, as well as integrating an innovative aerodynamic V-duct around the pack.



3-wheeler motorcycle application

A comprehensive programme of modelling and simulation was conducted to fully understand the cooling requirements for the pack and to ensure that peak performance is available, both during fast charging scenarios and when the vehicle is in use. The novel cooling features of the M3x architecture also ensure that even temperature profiles are maintained across the complete pack.

The specific requirements for this application required a detailed investigation into a wide range of cell chemistries in order to identify the candidate cell with the optimum characteristics, both in terms of achievable charge rate and thermal stability.



M3x technology for fast charging
Flexible battery architecture

Battery Cell Selection

The selected battery cells are 21700 cylindrical format featuring advanced LCO / NMA chemistry which allows very high charge rates combined with excellent resistance to ageing. There are 720 individual cells within the pack, arranged in a 90S8P configuration and the total capacity is 11.9 kWh. This cutting edge technology allows a 3C charge rate which equates to a 10% - 80% charging time of less than 15 minutes.

To simplify the vehicle integration, a bespoke DC-DC converter is included within the pack assembly to allow direct connections to the traction motor, charger and the vehicle's 12V electrical system. Despite this, the pack has a very compact, space-efficient design allowing the bike's under-seat storage to be retained and also allowing the revolutionary aerodynamic V-duct to be packaged.

Battery Pack Specifications

Normal Voltage (V):	324
Max Capacity (kWh):	11.9
Nominal Capacity (kWh):	8.3
Continuous Power (kW):	37
Peak Power (kW):	40
Max Charging Rate	3C
Volume (litres)	61.3

Vehicle Specifications

Speed (kph)	161
Acceleration 0-100kph (s)	8.6
Range (km)	180
Fast Charge Time (min)	<15
Uptime (%)	90



Battery Development Centre (BDC)

Summary

MAHLE Powertrain has developed a state-of-the-art, fast charging battery pack utilising the advanced thermal management features of its in-house, M3x architecture, to deliver a 3C charge rate, high space efficiency and realistic production feasibility in a highly optimised package for a revolutionary motorcycle application.



Series of supercell assemblies

This project demonstrates the full scope of our comprehensive battery development process from the initial concept design to vehicle installation, testing and validation.

