Lithium-Ion NMC Battery Module
7 kWh | 60 kg | 20-175 V | 40-280 Ah

Marine
Electric propulsion
Hybrid propulsion
Peak shaving

Solar
Off-grid
Back-up systems
Self-consumption

Industrial
Electrical drives
UPS systems
Mobile energy

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Lithium-Ion LFP Battery Module

General
The Lithium-Ion NMC (LiNiMnCo) battery module is designed for use in marine and industrial energy storage solutions. Due to its high-energy density and high charge and discharge capability it is suitable for full-electric and hybrid propulsion as well as peak shaving applications. The modules can be placed in series up to 1000 VDC and in parallel up to several hundred kilowatt-hours.

- High energy density of 8.6 kg/kWh
- Scalable to large systems
- Adjustable cell configurations
- High charge and discharge capability
- Liquid cooling/heating
- IP65

Battery Management System
Each battery module comes with an integrated battery management system (BMS). This is an intelligent electronic module (slave BMS) that measures all cell voltages, temperatures and controls the balancing. Each slave BMS has an intelligent balancing system that allows balancing on battery cell and module level. The battery modules communicate by a galvanic isolated CAN-Bus with the MG Master HV (master BMS). The status of the battery modules are collected and monitored. If the measured values from a battery module exceeds the limit, the MG Master HV will automatically takes action to protect the connected battery modules.

MG Master HV
The MG Master HV is the safety and control unit of the BMS system. It protects the connected battery modules against over-charging, over-discharging, over-temperature, under-temperature and controls the balancing of the battery cells. The MG Master HV can handle up to 1000 VDC and 600 A.

- Integrated safety contactors
- HV distribution
- Voltage and current measurement
- SOC & SOH estimation
- Insulation measurement
- Two isolated CAN-Bus interfaces
- I/O for connecting to external systems
Example project

Full-electric speed boat
In this project an full-electric speed boat was developed. One of the requirements of the boat was the weight. It needed to be as light as possible, but still have enough energy.

The requirements are as follows:

**PROJECT REQUIREMENTS:**
- System voltage range: 300 - 400 V
- Battery bank capacity: 40 - 50 kWh
- Motor power: 40 - 50 kW
- Charge power: 16 kW
- BMS: integrated master/slave with CAN-Bus interface.
- Weight: as light as possible

**Solution**
Due to the adjustable cell configurations inside the battery modules, it was possible to achieve an almost perfect fit to satisfy the requirements. Only six modules were needed. The battery system also needed to communicate with the chargers and motor controller through a CAN-Bus interface. Because of the flexibility of the MG Master HV the software was adjusted to get a seamless integration with the other components in the system.

**Battery module specifications**
- Cell configuration: 16 in series and 6 in parallel
- Voltage range: 48 - 66 V
- Capacity: 120 Ah
- Energy: 7 kWh
- Maximum continous current: 600 A liquid cooled
- Maximum peak current (<10 s): 1200 A
- Weight: 59 kg

**Battery bank specifications**
- Number of modules: 6 in series
- Voltage range: 288 - 396 V
- Capacity: 120 Ah
- Energy: 42 kWh
- Maximum continous current: 600 A liquid cooled
- Maximum peak current (<10 s): 1200 A
- Weight: 355 kg
## Technical specifications

<table>
<thead>
<tr>
<th>Lithium Ion Battery Module</th>
<th>MG16S6P120</th>
<th>MG14S7P140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Lithium Ion NMC (Li[NiCoMn]O₃)</td>
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</tr>
<tr>
<td>Cell configuration</td>
<td>1656P</td>
<td>1457P</td>
</tr>
<tr>
<td>Nominal voltage</td>
<td>58,4 V</td>
<td>51,1 V</td>
</tr>
<tr>
<td>Nominal capacity</td>
<td>120 Ah</td>
<td>140 Ah</td>
</tr>
<tr>
<td>Nominal energy</td>
<td>7,0 kWh</td>
<td>7,15 kWh</td>
</tr>
<tr>
<td>Weight</td>
<td>60 Kg</td>
<td>62 Kg</td>
</tr>
<tr>
<td>Dimensions (lxwxh)</td>
<td>650x318x268 mm</td>
<td>650x318x268 mm</td>
</tr>
</tbody>
</table>

### Discharge
- Discharge cut-off voltage: 48,0 V (MG16S6P120), 42,0 V (MG14S7P140)
- Maximum continuous discharge current (3C): 360 A (MG16S6P120), 420 A (MG14S7P140)
- Maximum peak discharge current (10s. 6C): 720 A (MG16S6P120), 840 A (MG14S7P140)

### Charge
- Charge voltage: 66,4 V (MG16S6P120), 58,1 V (MG14S7P140)
- Recommended charge current (1C or less): 120 A (MG16S6P120), 140 A (MG14S7P140)

### Cycle Life at 25°C (1C charge/discharge), (cycle life until 70% of original capacity)
- DOD 80%: 4000 cycles (MG16S6P120), 4000 cycles (MG14S7P140)
- DOD 50%: 6000 cycles (MG16S6P120), 6000 cycles (MG14S7P140)

### Temperature
- Storage temp.: -30 to +55 °C (MG16S6P120), -30 to +55 °C (MG14S7P140)
- Recommended charge temp.: 0 to +40 °C (MG16S6P120), 0 to +40 °C (MG14S7P140)
- Discharge temp.: -30 to +50 °C (MG16S6P120), -30 to +50 °C (MG14S7P140)

### Mechanical
- Power connections: Amphenol PowerLok 300/500 Series (MG16S6P120), Amphenol PowerLok 300/500 Series (MG14S7P140)
- IP-Protection class: IP 65 (MG16S6P120), IP 65 (MG14S7P140)
- Cooling: Air or liquid cooling/heating depending on application (MG16S6P120), Air or liquid cooling/heating depending on application (MG14S7P140)

### BMS
- Batteries are always used in combination with a MG BMS Master Box. Integrated Slave BMS. Passive balancing. (MG16S6P120), Integrated Slave BMS. Passive balancing. (MG14S7P140)
- Communication: CAN-Bus (M12, CANopen) (MG16S6P120), CAN-Bus (M12, CANopen) (MG14S7P140)
- Safety features: Interlock circuit in HV and CAN-Bus connectors. (MG16S6P120), Interlock circuit in HV and CAN-Bus connectors. (MG14S7P140)
Hybrid propulsion solution

Example schematic: 800 V | 93 kWh

Used technologies:

- ION-SAFE Technology Smart guarding system
- ION-MONITOR Technology Battery monitoring system
- ION-BALANCE Technology Intelligent balancing
- ION-COOL Technology Thermal management system
Dimensions

All dimensions are in mm.