The BORDLINE® M400 is a bidirectional galvanically isolated DC/DC power converter for Energy Storage Systems in railway applications.

**System overview**
The BORDLINE® M400 DC converter is based on modern IGBT Technology

The system is composed by:
- Galvanically Isolated DC/DC to allow the connection between the Energy Storage System (ESS) and 3kVdc traction DC-Link (catenary)
- Interfaces with water cooling system
- A CPU-based PEC Controller able to perform all control, supervision and communication functions
- Fire detection and extinguish systems
- Earthing switch

**Functionality**
The DC/DC has two operating modes:
- in the charging mode the energy is taken from 3kV catenary or from vehicle braking. The ESS voltage is regulated accordingly with the state of charge and battery's temperature given by an external Battery Management System (BMS)
- in the discharge mode the ESS stored energy is used to supply the traction system for a catenary free operation.

BORDLINE® M400 DC can interface with other source of energy, such as catenary and/or diesel gen-set, to optimize energy and/or fuel consumptions and implement power boost as per hybrid vehicle concept.

**Characteristics**
- Bidirectional converter
- IGBT technology
- Compact and robust design
- Input/output DC-Link Filter Capacitors
- Full digital control
- Integrated Earthing switch and Fire detection and extinguish systems
- TCMS communication bus via MVB
- ESS communication via CAN SAE J1939
- Diagnostic interface via Ethernet IP
- Machine room installation (IP44)
- Liquid cooling

**Technical data**

<table>
<thead>
<tr>
<th>Technical data</th>
<th>BORDLINE® M400 DC</th>
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<tbody>
<tr>
<td>Input Voltage</td>
<td>3100 Vdc (2000 Vdc – 4200 Vdc)</td>
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<tr>
<td>DC Output Voltages</td>
<td>608 Vdc (396Vdc – 713 Vdc)</td>
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<tr>
<td>Charging power</td>
<td>400kW</td>
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<tr>
<td>Traction power</td>
<td>400kW</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP44</td>
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<tr>
<td>Operating temperature range</td>
<td>-25°...+45°C</td>
</tr>
<tr>
<td>Communication Interface</td>
<td>CAN SAE J1939 + MVB</td>
</tr>
<tr>
<td>Dimension (L x W x H)</td>
<td>1796 x 780 x 1727 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>~1200 kg</td>
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</tbody>
</table>
**Control and monitoring**
Control system of BORDLINE® M auxiliary converter is based on the AC800 PEC control platform. AC800 PEC controller is a modular high speed programmable and measurement device, which is used widely in several industrial & traction control applications. The operating conditions of the converter as well as various analogue values can be transmitted as outputs over the TCMS bus, via MVB. The BORDLINE® M400 DC is also connected to ESS via CAN SAE J1939. An Ethernet interface using BORDLINE® View tool is available for diagnostic and to download event log and failure’s event data.

**Cooling system**
The converter is cooled by liquid. The internally mounted heat exchanger allows to cool the internal ambient and passive components. Thermal protections are implemented to protect the converter from becoming overheated.

**Fire extinguish system**
The converter is equipped with an independent fire detector and extinguishing systems

**Mechanical/Electrical design**
The metal structure, based on galvanized aluminum material, has been designed for IP44 protection and to be mounted on train (machine room). The complete equipment contains replaceable modules. All power modules are single and independent LRUs which contain all active components. Each LRU can be easily removed.

**Diagnostics and service**
The service-friendly modular design with highly standardized components, ensures high reliability, excellent spare parts availability, and optimized lifecycle costs. The main purpose of the service concept is to define and specify the activities and processes to assure the RAMS (Reliability, Availability, Maintainability, and Safety) requirements. Following this norm, the service concept allows to offer tailor-made service solutions to assure the predictability of low life-cycle costs while maintaining high product availability. The service package is optional available.

**Application example**
BORDLINE® M400 DC is designed to be mounted on the machine room of any railway hybrid vehicle.