The BORDLINE® M converters are compact rugged units with modern IGBT and Silicon Carbide semiconductors, designed for applications in rail vehicle.

System overview
The BORDLINE® M90 DC converter is based on modern IGBT and Silicon Carbide technology.

The system is composed by:
- Input LC filter to meet EMI requirements
- Multilevel DC/DC converter directly supplied by the catenary (3000 Vdc) to generate galvanic isolated and regulated DC-Link
- Two DC/3AC Fixed Frequency converters (DC-Link / 400 Vac 50 Hz 3ph+N – 50 kVA each) without galvanic isolation and with Sine Filter
- Modular battery chargers configuration based on 2 BORDLINE® BC SiC Battery charger (400 Vac 50 Hz 3ph / 24 Vdc – 2 x 6.3 kW)

Technical data

<table>
<thead>
<tr>
<th>Input Voltage</th>
<th>3000 Vdc (2000 - 4000 Vdc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltages</td>
<td>400 Vac 50 Hz 3ph+N – 50+50 kVA</td>
</tr>
<tr>
<td>Voltage</td>
<td>24 Vdc – 2x6.3 kW</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP65 + IP21</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-25°...40°C</td>
</tr>
<tr>
<td>Communication Interface</td>
<td>MVB-EMD</td>
</tr>
<tr>
<td>Dimension</td>
<td>1650 x 2100 x 430 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>920 kg</td>
</tr>
</tbody>
</table>

Functionality
A DC/DC high voltage converter is directly supplied by the catenary to generate a galvanic isolated and regulated DC-Link.

Two not isolated three-phase inverters in parallel generate sine wave three phase+N voltage at the converter output. A V/F control is implemented to limit the inrush current when a heavy load is powered (e.g. compressor).

The BORDLINE® M series converters are ready to works together in order to build a 3AC and/or DC distribution bus along the train without additional data-bus communication.

The distribution bus across coaches allows to increase the reliability of the train, and in certain circumstances it also allows to reduce the rated power of the auxiliary power converter system.

It can also be supplied by AC workshop supply in order to charge batteries and to provide energy to dc loads; it is also possible to charge empty batteries thanks to Flat Battery Start power supply.

Two battery charger modules (BORDLINE® BC) are available to supply DC electronic loads of the vehicle at 24 Vdc and for battery charging.

Characteristics
- IGBT and Silicon Carbide technology
- Compact and robust design
- Integrated sine filter
- Fed by the DC catenary voltage (3000 Vdc)
- Integrated silicon carbide battery charger module (BORDLINE® BC)
- TCMS communication bus via MVB - EMD
- Full digital control
- Roof installation
- Air forced cooling
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 (MVB – EMD).

Cooling system
The BORDLINE® M90 DC is cooled by forced air. The internally mounted fans and the air duct are integral parts of the onboard converter. A thermal monitoring device protects the converter from becoming overheated.

Mechanical design
The metal structure, based on galvanized aluminum material, has been designed for IP65 + IP21 protection and to be mounted on the vehicle (roof installation). The complete equipment contains replaceable modules. All power modules are single and independent LRU which contains all active components. Each LRU can be easily removed upwards.

Diagnostics and service
The converter will provide status and error messages on the vehicle bus system via CANOpen. With the diagnostic tool ABB BORDLINE® View, it is possible to visualize signals, parameters and states of the auxiliary converter. The tool can be installed on usual laptops and the communication with converter control unit is done via Ethernet protocol. The service-friendly modular design with highly standardized components, ensures high reliability, excellent spare parts availability, and optimized lifecycle costs. In case of a fault, its design allows for a quick removal and replacement of a complete functional unit (LRU), thus decreasing the repair time and increasing the availability and operation time. The main purpose of the service concept is to define and specify the activities and processes in order to assure the RAMS (Reliability, Availability, Maintainability, and Safety) requirements. Following this norm, the service concept allows to offer tailor-made service solutions in order to assure the predictability of low life-cycle costs while maintaining high product availability. The service package is optional available.

Application example
BORDLINE® M90 DC are designed to be mounted on Electrical Multiple Units running in Italy.