**System overview**
The BORDLINE® auxiliary is based on modern IGBT technology and SiC semiconductor technology for battery chargers.

**BORDLINE® M40_DC_750V shall be supplied in two versions:**
- Version A (A): Insulated 3Ph Inverter only
- Version B (B): Insulated 3Ph Inverter + Battery charger module (2x BORDLINE® BC)

The system is composed by:
- 1 x Pre Charge Unit with series diode
- DC/DC high voltage converter directly supplied by the catenary (750 Vdc) to generate a galvanic isolated and regulated DC-Link
- N° 1 DC/AC inverter [DC-Link / 415 Vac 50 Hz 3Ph - 46 kVA (A) / 25 kVA (B)] to supply AC loads
- N° 2 AC/DC BORDLINE® BC Battery chargers (3Ph / 110 Vdc – 2 x 9.45 kW) (B only)

**Functionality**
A DC/DC high voltage converter is directly supplied by the catenary to generate a galvanic isolated and regulated DC-Link. A not isolated three-phase inverter, due to the installed sine-filter, generates a sine wave three phase voltage at the converter output. A V/F control is implemented to limit the inrush current when a heavy load.

Only on version B, two redundant battery charger modules (BORDLINE® BC) are available to supply DC electronic loads of the vehicle at 110 Vdc

(In case of failure of one power module the others can still operate, this gives a high availability for the train DC supply and battery charger).

**Characteristics:**
- IGBT technology
- Compact and robust design
- Integrated sine filter
- Fed by 750 Vdc catenary (400 - 900 Vdc)
- Integrated battery charger modules (BORDLINE® BC)
- Ethernet diagnostic, communication bus
- Full digital control
- Underfloor installation
- Air forced cooling

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**Technical data**

<table>
<thead>
<tr>
<th>Input Voltage</th>
<th>750Vdc (400 – 900 Vdc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltages</td>
<td>415 Vac 50Hz 3Ph</td>
</tr>
<tr>
<td></td>
<td>46 kVA (A) / 25 kVA (B)</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP55</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>-25°...+50°C</td>
</tr>
<tr>
<td>TCMS interface</td>
<td>Ethernet</td>
</tr>
<tr>
<td>Diagnostic Interface</td>
<td>Ethernet</td>
</tr>
<tr>
<td>Dimension</td>
<td>1694 x 873 x 593mm</td>
</tr>
<tr>
<td>Weight</td>
<td>405 kg (A)/436 kg (B)</td>
</tr>
</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 bus. An Ethernet interfaces is available to communicate to TCMS.

Cooling system
The converter is cooled by forced air. The internally mounted fan 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 IP55 protection and to be mounted on EMUs (underfloor). The complete equipment contains replaceable modules. All power modules are single and independent LRUs which contain all active component. Each LRU can be easily removed outwards and upwards.

Diagnostics and service
The service-friendly modular design with highly standardized components ensure high reliability, excellent spare parts availability, and optimized lifecycle costs. For maintenance a diagnostic interface (Ethernet) is available. Further data can be obtained using a standard PC and the direct connection by Ethernet Browser.

Application example
BORDLINE® M40_DC_750V are designed for retrofit project of Class 422 trains running in UK.