The Compact Converter BORDLINE® CC400 converts 600 V\textsubscript{DC} or 750 V\textsubscript{DC} line voltage into propulsion power to control and drive the traction motors and auxiliary power to supply the onboard loads. It is complemented by a modular energy storage system, including batteries, cooling, and battery management system.

**Characteristics**
- All power electronics (traction and auxiliary power) in one roof-mounted housing
- Light weight
- Easy maintenance
- Standard ABB modules
- Energy storage system (ESS) as compact additional roof-mounted unit
- ESS purposes: operation in catenary-free sections (distance depending on traction battery capacity); supply for auxiliary loads during short overhead line voltage interruptions; braking energy saving in case of non-receptive overhead line; peak load saving

**System overview**
The BORDLINE® CC400 converters are compact, modular, rugged units based on modern IGBT technology and designed for light rail vehicle applications.

This BORDLINE® CC400 Compact Converter contains:
- 1 propulsion converter
- 1 main switch
- 1 line filter
- 1 braking chopper
- 1 DC/DC converter with filter for ESS
- Integrated auxiliary converter (60 or 60 Hz)
- Integrated auxiliary converter (variable frequency)
- Integrated battery charger
- AC 800PEC control module

The BORDLINE® CC400 can be directly coupled (power, auxiliary power, CAN bus) to an ESS unit which consists of a traction battery unit, a cooling unit, and a battery management system.

**Propulsion converter / ESS converter**
The propulsion converter controls two motors and the braking chopper. During braking operation the energy can be stored in the ESS, recuperated to the grid or dissipated in the braking resistor.

**Auxiliary converter**
The auxiliary converter provides a three-phase sinusoidal AC voltage output and a DC voltage output for charging the vehicle battery. Both outputs are galvanically insulated from the DC line voltage.
Technical data
ABB traction converters are built on the AC 800PEC control platform, probably the most powerful modular controller for high-speed performance on the market. A wide range of other industrial applications uses this control platform. The AC 800PEC software provides an excellent range of control and communication functionality, in cycle times that extend from the sub-microsecond to the millisecond level. Compared to most other commercially available traction control systems, the modular application software in the AC 800PEC optimizes significantly the train commissioning.

Converter cooling system
The Compact Converter is efficiently cooled using liquid coolant. This allows a very compact construction. The temperature of the coolant is lowered using an external heat exchanger.

Energy storage system battery unit
The ESS battery unit is based on lithium cells with lithium titanate oxide (LTO) anode with inherently safe cell chemistry. The battery management system (BMS) monitors battery temperature, insulation, and cell voltages; it controls battery functions, currents, and the cooling system for the traction battery; and it provides safety and protection functions.

Battery cooling system
The ESS batteries are water-cooled for optimized power rating. The battery temperature is controlled by the BMS to be at around 25 °C to get a long lifetime, therefore a compact temperature management system is mounted next to the battery unit.

Mechanical design
Both BORDLINE® CC400 and energy storage system are housed in IP65 aluminum cabinets, resulting in very low overall weight. The equipment is designed for mounting on the vehicle roof. Due to its modular design, it offers easy maintenance access.

Reference example
Vossloh’s light rail vehicles of the type Tramlink V4 for the São Paulo Metropolitan Urban Transport Company (EMTU) are equipped with BORDLINE® CC400 with energy storage system.

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