



NICUSOR STAN, TRACTION, & MOTION BUSINESS

Regional Approach - Sofia

ABB portfolio - BORDLINE® ESS

15th September 2022



Rail Propulsion

Personal Introduction



Nicusor Stan

Local Sales Manager
Balkans Area - Rail Propulsion

ABB Asea Brown Boveri S.r.l

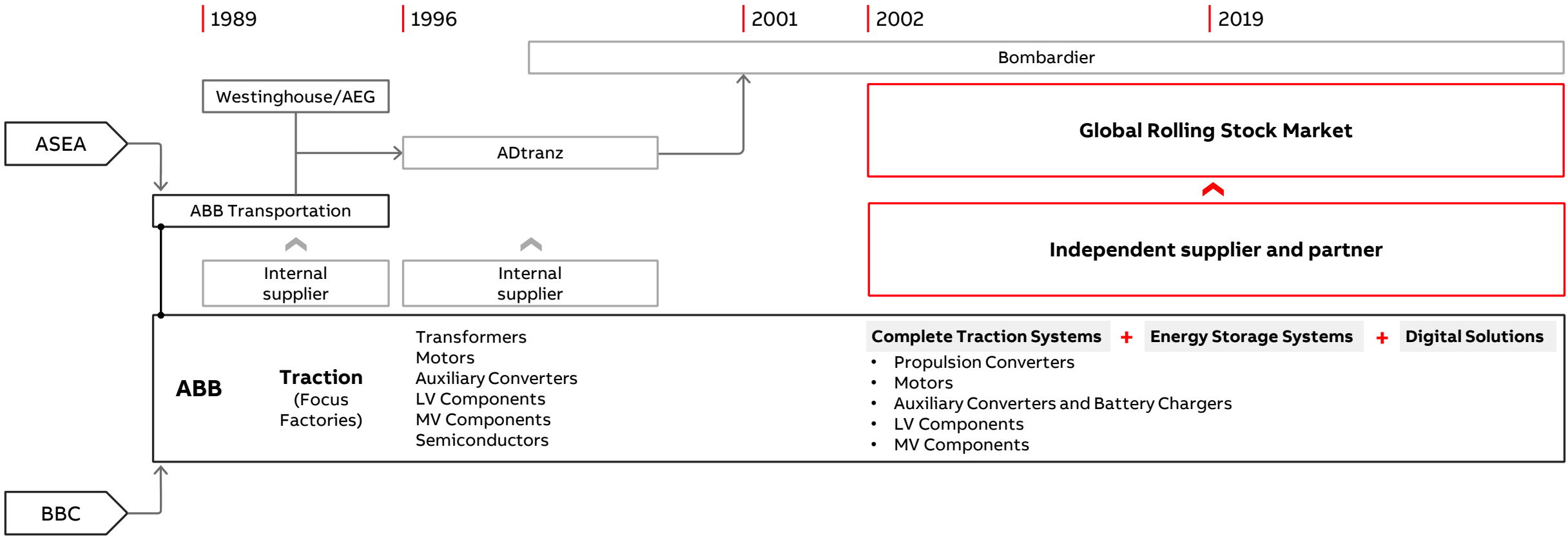
Motion, Traction Business
Green Court
4D, Gara Herestrau Str. Building C, 8th Floor
020334 Bucharest, Romania

Mobile: +40 732.279.384

E-mail: nicusor.stan@ro.abb.com

Web: <http://www.abb.com/railway>

ABB in the rail industry



Technology leadership through R&D



+1.3B\$

Invested Annually



100+

University Collaborations



~8000

R&D Engineers and Scientists



7 Research labs & 45+ R&D centers

Devising globally applicable solutions

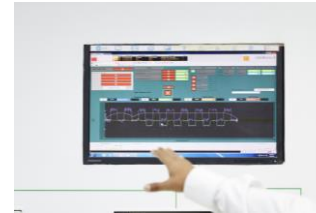


15 Start-ups

Breakthrough technology partners



Materials & Manufacturing



Sensors



Software



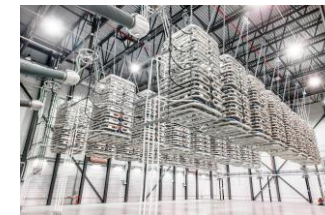
Switching



Control



Electro-magnetics



Power Electronics

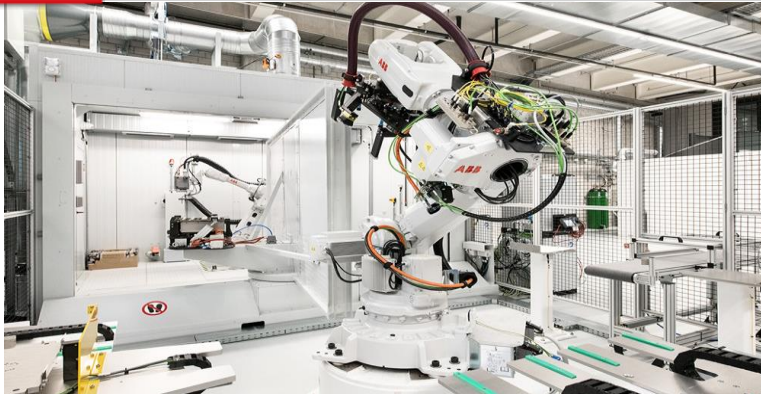


Mechanics

ABB Traction, Global Footprint. Traction factories



Switzerland/ Turgi & Baden



Germany/ Minden



Poland/Lodz



Italy/ Genova



USA/ Richmond



India/ Bangalore

ABB Romania

București

Head Office



Company Address

București
Green Court
4D, Gara Herastrau Str, Building C,
8th Floor
020334 Bucharest, Romania
Email: abb.office@ro.abb.com
Telefon: +40 372 158 200
Fax: +40 371 602 287

Local Motion include:

- 65 employees (incl. temps)
- Product Mgmt., Engineering, Sales and Service.





ABB Traction Products

Portfolio of ABB Traction for OEM's and End Users. New and Retrofit projects

ABB Key products and complete propulsion packages

ABB Ability®

Traction Transformer



Traction converter



Traction motor



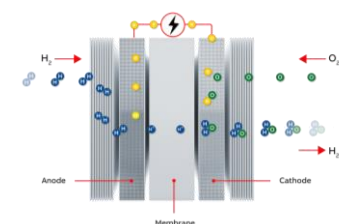
Auxiliary converter



Battery Energy Storage System



Fuel cells



*Non-ABB Product, but can be a part of the system

Single components or complete traction packages



Very-high-speed and high-speed



Locomotive, dual, electric, diesel-electric



Multiple unit trains



Metro



Light Rail Vehicles



E-bus propulsion

ABB solutions for all rolling stock applications

New vehicles and retrofit

Very high-speed and high-speed



Metro



Multiple unit trains



Light Rail Vehicles, People mover



Locomotive, dual, electric, diesel-electric



E-Bus



Compact and reliable traction converters

For all types of rail vehicles and electric buses

BORDLINE® CC series

Modular technology platform for fast project delivery,
economies of scale, maintainability, and optimum life-cycle cost
Very compact, reliable, and energy-efficient



CC200

for electric buses



CC400

for Light Rail Vehicles, metros,
people movers



CC750

for mass transit EMUs, DMUs,
mountain trains, metros



CC1500

for locomotives, high-speed trains and
high-power EMUs



ABB Traction

Product Line Auxiliaries

Product Line Auxiliaries

Auxiliary converters and battery chargers

Genova Site



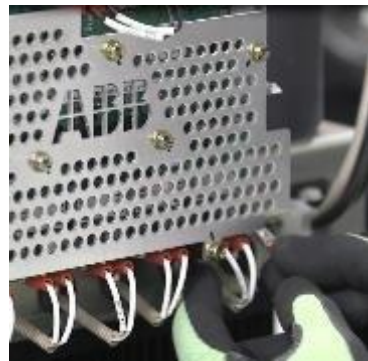
Green Building Genova:

- Around 400 employees
- 4 divisions represented



Engineering:

- Power Electronics
- Control Electronics
- Mechanical Design
- Technical Office



Production Areas:

- Assembling of power modules
- Assembling of complete system









Testing & Prototyping Areas:

- 4 Engineering testing areas
- 12 high voltage testing areas
- Service Areas

Modular auxiliary converters and battery chargers

BORDLINE® M Series

The BORDLINE® M series is a **flexible platform** of static converter for a wide application range on each vehicle type.

-  Compact and lightweight solution. Robust design for different application: roof, underframe, indoor
-  Different cooling solution: Forced Air, Natural convection, Integrated Fan, Liquid Cooling with and without integrated pump
-  Modular design based on the re-use of the power electronic building blocks (PEBB)
-  Output power range from 1 to 1'200 kW, individually controlled. AC & DC and multi-system input voltages
-  Large variety of cabinets and protection levels. Galvanic separation; optional integrated battery charger
-  Reliable and low noise



Battery Charger – BC
For all railway applications



M50 DC
For metro cars



M90 DC
For light rail vehicles



M170 DC
For metro

Platform converter for urban mass transit vehicles

Three power sizes according to vehicle requirements

BORDLINE® M55_DC_600/750_R



- Ambient temperature: $-25^{\circ}\text{C} \div 45^{\circ}\text{C}$
- Dimensions (LxWxH): 1600mm x 600mm x 500mm
- Weight: < 255 kg
- Cooling type: forced air
- Installation: roof

BORDLINE® M90_DC_750_U



- Ambient temperature: $-25^{\circ}\text{C} \div 45^{\circ}\text{C}$
- Dimensions (LxWxH): 1800mm x 800mm x 560mm
- Weight: < 350 kg
- Cooling type: forced air
- Installation: underframe

BORDLINE® M170_DC_750/1500_U



- Ambient temperature: $-25^{\circ}\text{C} \div 45^{\circ}\text{C}$
- Dimensions (LxWxH): 2300mm x 940mm x 600mm
- Weight: < 655 kg
- Cooling type: forced air
- Installation: underframe

Based on BORDLINE® BC SiC battery charger

SiC

BORDLINE® BC main installed base

World map updated Nov. 2021

Italy

Box: 311 pcs

M: 108 pcs

UK

Box: 81 pcs

M: 44 pcs

France

Stand alone: 74 pcs

Canada

M: 848 pcs

USA

Rack: 228 pcs

Box: 262 pcs

CC: 61 pcs

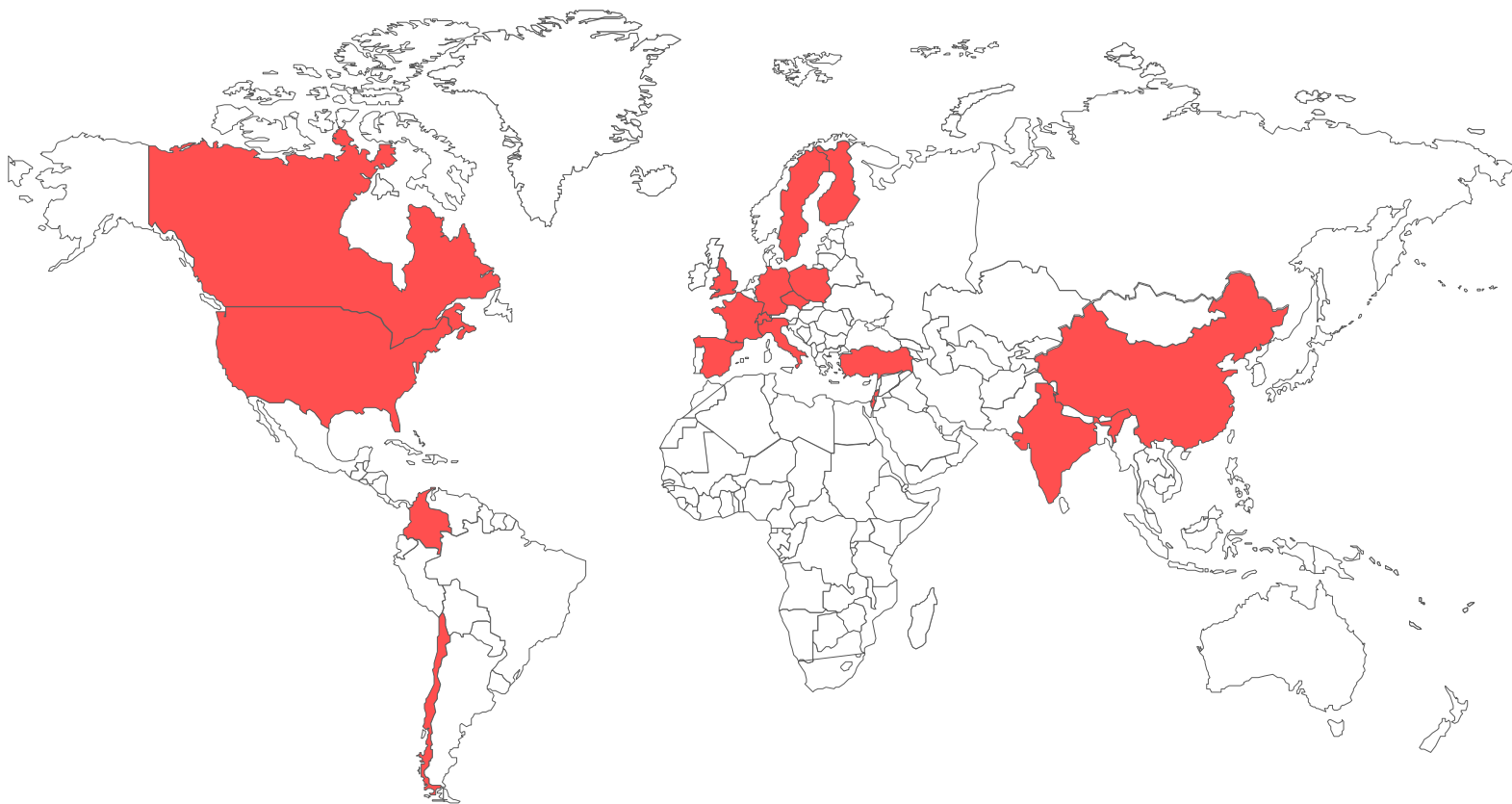
Spain:

Rack: 96 pcs

M: 84 pcs

Poland

CC: 146 pcs



Switzerland

Stand alone: 18 pcs

CC: 64 pcs

Finland

CC: 120 pcs

Sweden

CC: 44 pcs

Hungary

Box: 20 pcs

Israel

CC: 360 pcs

Germany

CC: 10 pcs

Turkey

Stand alone: 38 pcs

CC: 108 pcs

M: 68 pcs

India

Box: 871 pcs

M: 301 pcs

China

CC: 453 pcs

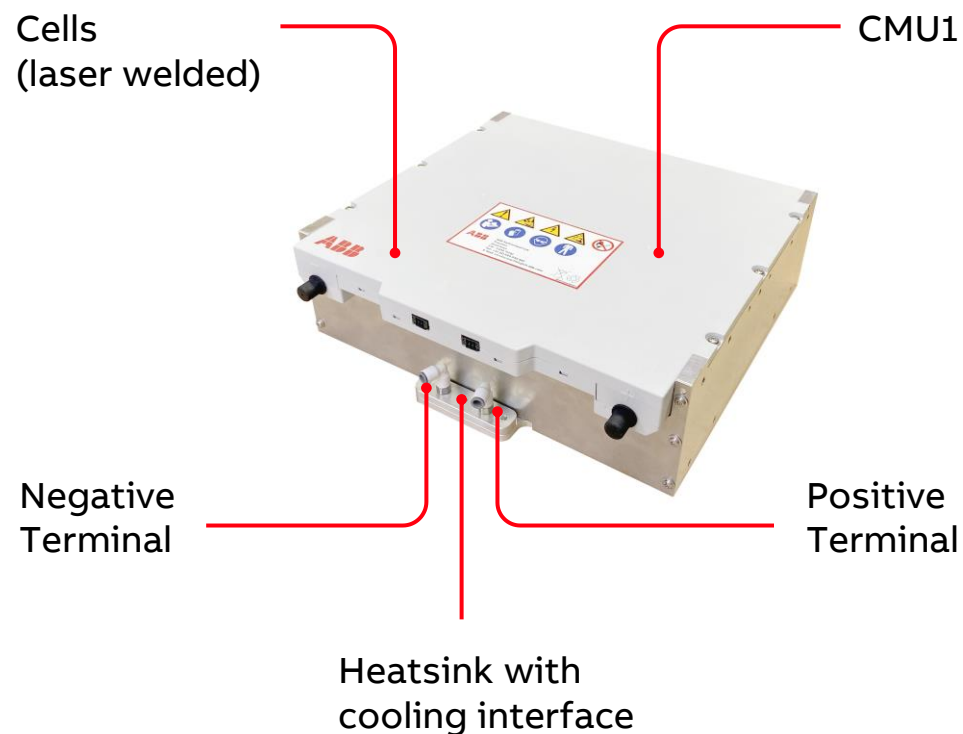
Tot. Battery Chargers: around 5172

Our Offering: BORDLINE® Battery Module, 2.54 kWh and 55.2 Vdc

Technical Data

Technical Data

Cell technology	LTO
Configuration	24s2p
Nominal Capacity	2.54 kWh
Nominal Voltage	55.2 Vdc
Peak C-Rate (CH & DCH)	8C for 30s
RMS C-Rate (CH & DCH)	3...4C RMS
Cooling	Liquid cooled
Weight	33 kg
Dimensions (LxWxH)	417 x 466 x 128 in mm



General overview Lithium-ion batteries

Lithium-ion variants

	Unom	Wh/kg	Continuous Charge C-Rate	Onset of Thermal Runaway	Cycle Life (0.5°C, 100% DoD, 25°C)
LCO	3.6	150...240	0.5C	~150 C	300...700
LMO	3.7	100...150	0.5C	~250C	300...1000
NCA	3.6	130...240	1 to 1.5C	~150C	300...1000
NMC	3.7	120...220	1 to 1.5C	~210C	1000...4000
LFP	3.2	100...150	1 to 1.5C	~270C	1000...5000
LTO	2.3	85...130	3 to 5C	Not Susceptible	>20000

Benefits of LTO technology



Safety

Low risk of fire or explosion



Long life

> 20.000 cycles



Low-temperature operation

Excellent low temperature performance



Power density

> 511 W/kg



Rapid charging

Charges to about 80% of the capacity in 12 minutes



Wide effective SOC range

Available State of Charge (SOC) range of 0-100%

LTO batteries are best suited for heavy duty vehicles in rough conditions, demanding huge charging cycles

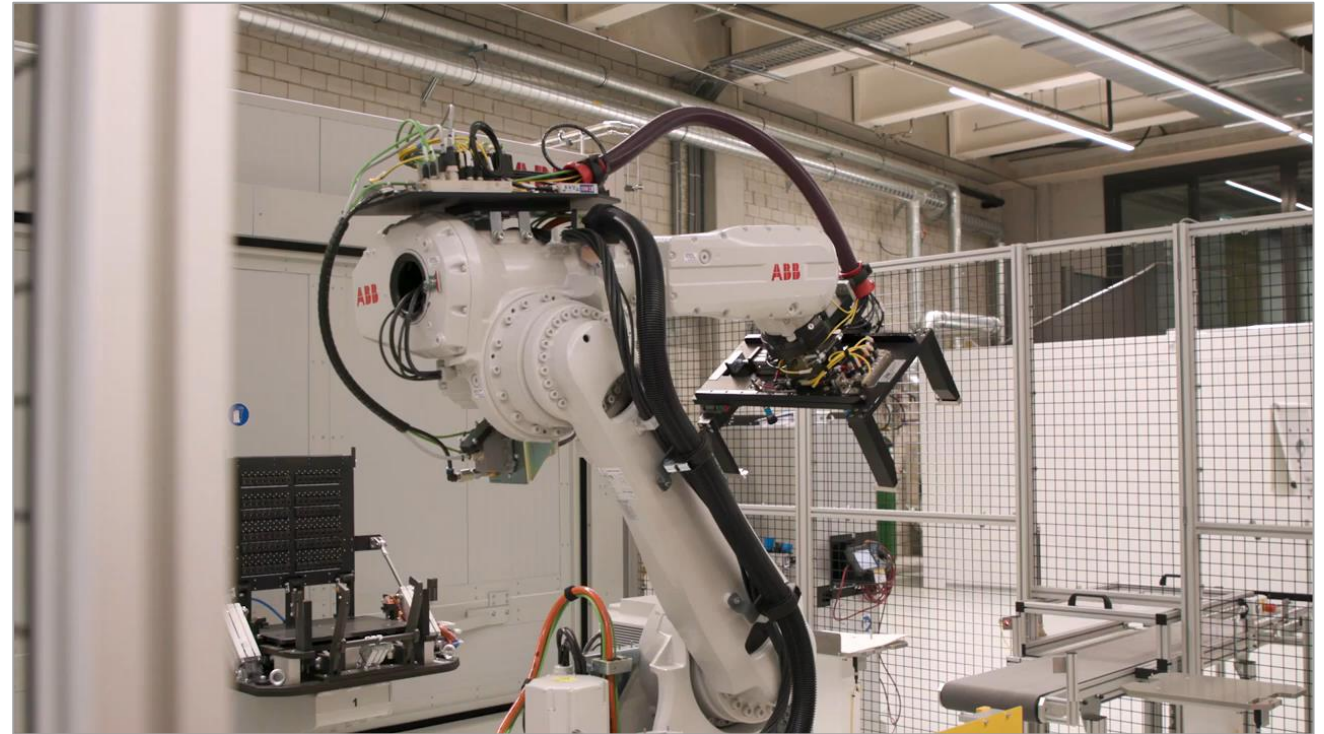
Bordline® Energy Storage Systems

High Quality Production

Assembly by robot and laser-welded cells

- Very high process stability
- Safe for production personnel
- Excellent quality of connection – low impedance and no corrosion

From cell selection to final product – enabling highest performance, lifetime, and safety.



Projects with BORDLINE Energy Storage System

Bordline® ESS

Past and ongoing projects

Order summary

- 68 MWh
 - ~300 Railway Vehicles &
 - 70+ City buses

NL, 51x DMUs



2018

NL, 18x DMUs



2018

NO, 14x DMUs



2019

IT, 29x DMUs



2019

GB, 24x BMUs



2020

GB, 36x LRVs



2020

DE, 55x BMUs



2020

GB, 1x Demonstrator



2020

RO, 3x EMU



2014 to 2017

DE, 23x Maintenance Vehicles



2020

BORDLINE® ESS and more

Installed Base

Zurich



articulated

St. Gallen



articulated

Fribourg



articulated

Lausanne



(double) articulated

Lucerne



(double) articulated

Bern



(double) articulated

Biel



articulated

Lyon



articulated

Salzburg



articulated

CH/A/FR Trolleybus
70+ vehicles



Battery powered trams for Romania

New air-cooled converter platform for light rail vehicles

City:

Timisoara, Iasi (RO)

Operator:

- Societatea de Transport Public Timisoara - STPT;
- Compania de Transport Public Iasi - CTP

Vehicle type:

100% low floor tramway

Scope of supply:

Traction package for

56 (40+16) trams:

- BORDLINE CC400 Traction converter
- TCMS with source code handover
- **Surge Arrester, HSCB, Braking Resistor**

Key data:

750Vdc/880 kW

Deliveries:

2021-2022

Customer need

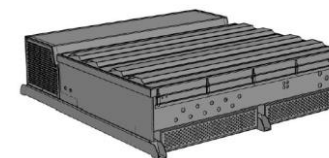
- Compact and light-weight design
- Energy Storage Connection
- Train Control and Monitoring System

ABB solution

- Compact, air-cooled and roof mounted converter CC400
- Highly integrated, powerful and modular design
- Integrated Energy Storage Connection for catenary-free operation
- Train Control and Monitoring System with source code handover

Customer benefits

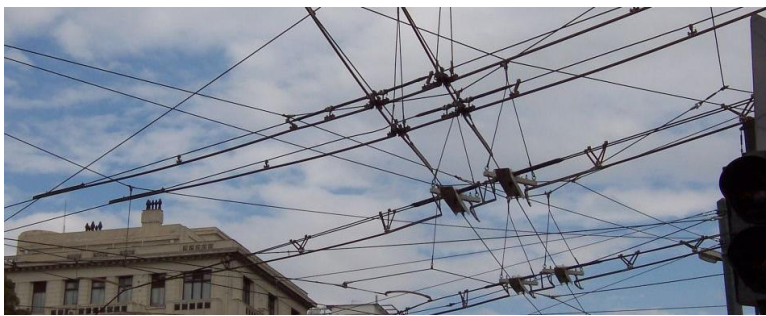
- High reliability
- Service-friendly
- In-house know-how for tram TCMS
- Energy Storage Connection
- Modern and predictive diagnostics for easy maintenance



Dynamic Charging

Use cases

Existing grid – Line Crossings



Line crossings of trolley lines (tram lines) are costly in investment and maintenance.

With the option to drive without catenary these intersections can be eliminated.

Reduction of maintenance costs of existing lines

Existing Grid- line extension



Utilizing of existing infrastructure and extension of lines without investment in new catenary.

Driving 50% under catenary enables 50% cat free driving

Extension of lines with existing infrastructure

New BRT line- partially catenary



Cost for 1km Catenary (2 directions incl. substation) 500`000 EUR

Operation with 50% catenary
→ 250`000 EUR/km (2 directions)

Competitive solution for BRT lines

Drivetrains for trolley buses

Catenary-free operation

Countries:

Switzerland, Austria

Cities:

Zurich, Bern, Biel, Lucerne,
Lausanne, Salzburg

Category:

ebus

Scope of supply:

BORDLINE® CC200
Traction Motors
BORDLINE ESS

Key data:

2x 160kW peak power

Deliveries:

Since 2017

Customer need

- State-of-the-art propulsion enabling catenary-free operation

ABB solution

- Drivetrain consisting of BORDLINE® CC200 including traction and auxiliary converter, two permanent magnet motors and energy storage system (ESS)

Customer benefits

- Reduction of maintenance cost of existing lines, line crossings which are expensive in maintenance can be driven catenary-free due to ESS
- Existing catenary is used as charging infrastructure, ESS to extend lines in catenary free operation
- In general, the trolleybus gets more flexibility in daily operation



OppCharge: e buses with standardized charging interface

Interoperability on the rolling stock, infrastructure and operator side

Cities:

Bern L17 (5 x 18m bus)
drivetrain and infrastructure

Category:

e-Bus

ABB scope of delivery:

OppCharge infrastructure
Drivetrain components

Key data:

450 kW DC output power

Deliveries:

2018-19

Customer need

- Minimal amount of charging infrastructure
- Energy efficiency and emission reduction

ABB solution

- Charging stations for depot and terminal station
- Drivetrain including integrated traction power converters (motor inverters, auxiliary battery charger, auxiliary drives) and traction motors

Customer benefits

- Standardized charging system interfaces
- Standardized drivetrain platform
- Remote access to charging infrastructure



Q&A



ABB