APPLICATION NOTE

Switching and Protection for Battery systems in Rolling Stock vehicles

Rail

Keep your rolling stock vehicles up and running and be an energy transition protagonist thanks to our rail standard-compliant Switching & Protection solutions.

What are battery systems?
Batteries are systems where energy generated by the catenary or generator is stored for use later on. Batteries guarantee that trains continue to run even when the main energy source fails or is disconnected.

Why you need Switching & Protection solutions for Battery Systems
Ensure that continuous power is always available in the train by protecting both batteries and systems upstream and by controlling circuit breakers remotely thanks to our complete rail standard-compliant Switching & Protection product portfolio.

Main benefits

Reliable Supplier
ABB is a market leader in supplying innovative, reliable technologies for train manufacturers and railway operators. We help to keep the world moving with new, sustainable approaches that enable customers to use energy effectively, thereby creating a low-carbon transportation industry that operates with maximum efficiency and reliability.

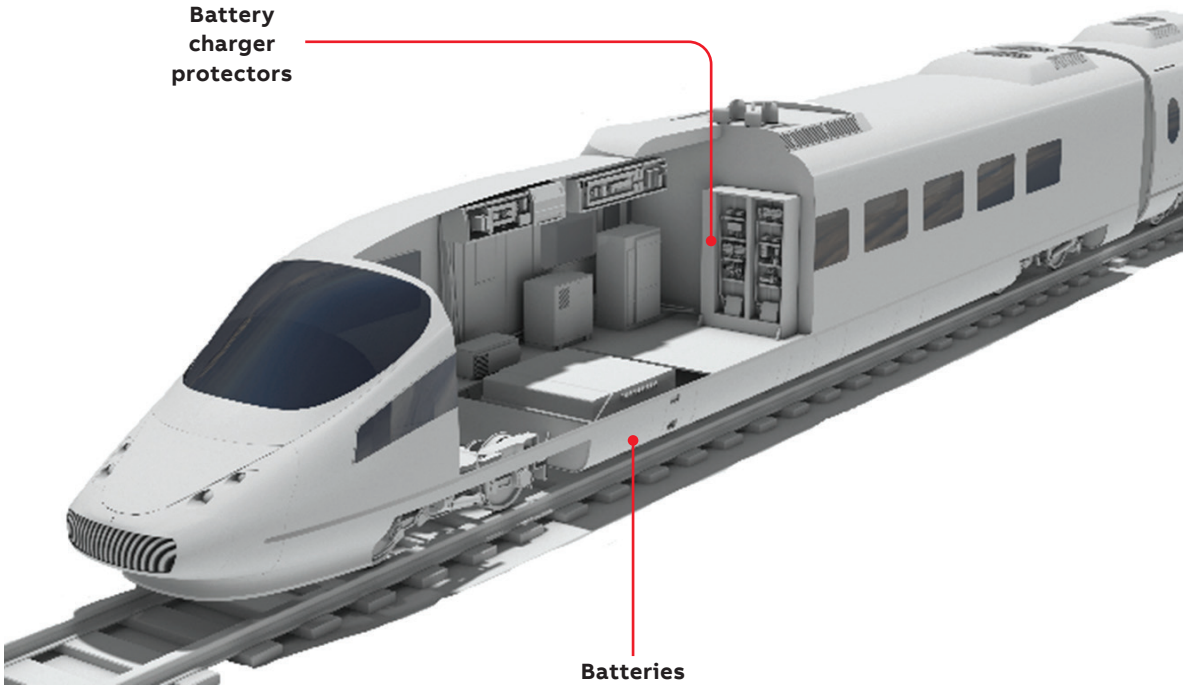
Designed for Rail
Reduce energy consumption in the control circuit system thanks to our solutions (which can run on less power) and use of AF technology to ensure less heat dissipation and reduced temperature rise.

Space Savings
Smaller in size and lower in weight, our highly reliable, top-level products will enable you to increase capacity and reduce train energy consumption.

Battery systems

Energy storage systems are becoming an integral part of rail vehicles and play a key role in sustainable mobility. They are the systems where energy generated by the catenary or generator is stored for use later on.

Use of batteries in rolling stock vehicles not only increases their availability and operational flexibility. It also helps to lower the cost of infrastructure and the total cost of ownership while maximizing energy usage.
In rolling-stock vehicles, batteries are used as exclusive power supply for auxiliary systems and as main power supply for hybrid systems.
Batteries are generally mounted under the floors of rolling stock vehicles and can leverage on different types of technology: Nickel Cadmium (NiCd), Lead Acid (LA), Nickel metal hydride (NiMH) and Lithium ion (Li-on).



Rolling Stock Vehicle typologies

Locomotives

High Speed Trains

Regional trains

Metros / Light trains (LRV)

Passenger Coaches

Electric Buses

Applicable Standards

Batteries and Power supply systems for Rolling stock:

- EN 50547 - Batteries for auxiliary power supply systems
- IEC 62973 Part 1 - Batteries for auxiliary power supply systems on rolling stock
- IEC 62864 Part 1 - Rolling stock - Power supply with onboard energy storage system
- IEC 62928 - Rolling stock - Onboard lithium-ion traction batteries
- IEEE 1476-2000 Passenger Train Auxiliary Power Systems Interfaces.

ABB products for Rolling stock:

- IEC 60571 electronic equipment used on rolling stock. This standard covers the conditions of operation, design construction and testing of electronic equipment.
- IEC 61373 Railway applications - Rolling stock equipment – Shock and vibration tests.
  - Required by IEC 60077 / EN 50155
- ABB products for rolling stock comply with category 1 (body mounted) class B.
- EN 45545-2 Railway applications - Fire protection on railway vehicles – Requirements for fire behavior of materials and components.
- The plastic materials in ABB railway products are rated HL3 R22 (the highest hazard level).
- NFPA 130 (North America) This is the standard for fixed guideway transit and passenger rail systems.
- Most plastic materials in ABB products comply with NFPA130 for ASTM E 162 and ASTM E662 standard tests. They also comply with standards FRA238.103 and BSS 7239/SMP800-C.

Switching & Protection solutions for batteries in Rolling Stock vehicles

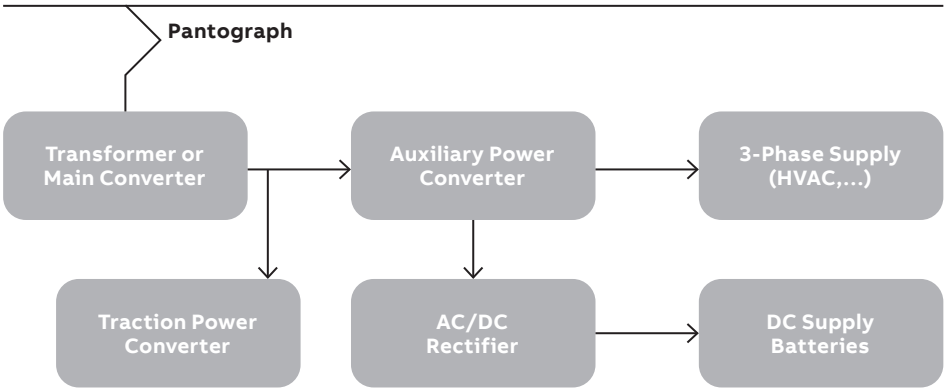
Auxiliary power supply systems

Discover our Switching & Protection solutions and keep your auxiliary power circuits running in any condition.

Onboard auxiliary power includes the heating, ventilation and air conditioning (HVAC) systems, the control system, communication, monitoring and indicators, break compressors, battery chargers, signaling and lighting systems.

These systems are critical for rolling stock operation and passenger comfort, and require power redundancy.

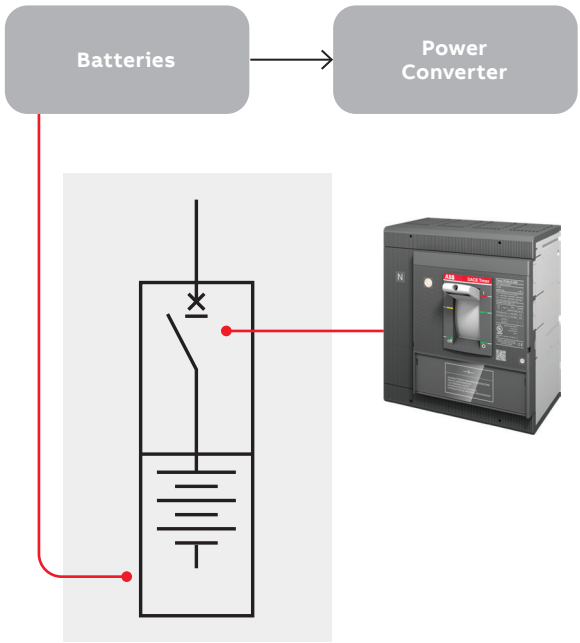
AC, DC or AC/DC Rolling stock vehicles



Batteries for auxiliary power supply systems

Batteries are responsible for keeping the auxiliary power circuits running when the main converter is disconnected or when power outages - like pantograph bounce - occur.
The typical nominal voltages of batteries are: 24 V, 32 V, 36 V, 48 V, 64 V, 72 V, 87 V, 96 V, 110 V as per IEC 60077-1, IEEE 1476 (North America) and JIS E 5004-1 (Japan).
Battery capacities are determined by the operating time requirements of the different systems. They are generally governed by the applicable standards or local regulations. When it comes to rolling stock, the protective provisions relating to electrical hazards must comply with EN 50153:2014.
As recommended, protection is provided by circuit breakers, which protect cabling and equipment from abnormal currents and short circuit events.
Galvanic isolation from all auxiliary power systems and power supplies is also typically required.
Use of breakers to protect batteries could be mandatory, depending on the different local standards or different US transit authorities (i.e. SEPTA -Southeastern Pennsylvania Transportation Authority).

ABB offering



Main input data

Auxiliary battery for trains	
Rated voltage [VDC]	600
Cell voltage [VDC]	750
Number of cells	600
Battery capacity [Ah]	12
Discharge current protection [A]	50

Main components

Battery Box
Tmax XT5 600 750VDC molded case circuit-breaker In=600 for switching and protection with shunt opening relay for remote opening

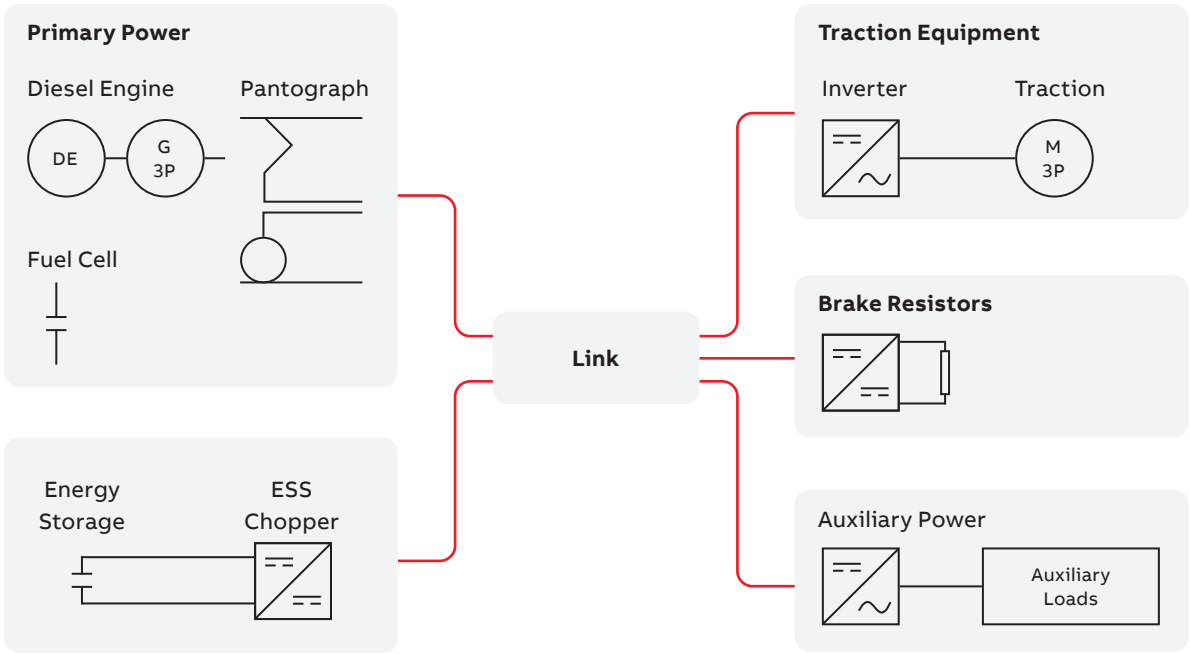
Switching & Protection solutions for batteries in rolling stock vehicles

Batteries for hybrid systems

Discover our Switching & Protection solutions for protecting the batteries in Hybrid Systems.

A hybrid system has at least 2 power sources, including an onboard energy storage system (ESS), and achieves the following results:

- Improved energy and fuel efficiency through uninterrupted running if the primary power source is lost, plus improved acceleration.
- Reduced fuel consumption and emissions (e.g. CO_2, NOx, etc.)
- Reduced environmental impact (e.g. noise, etc.).



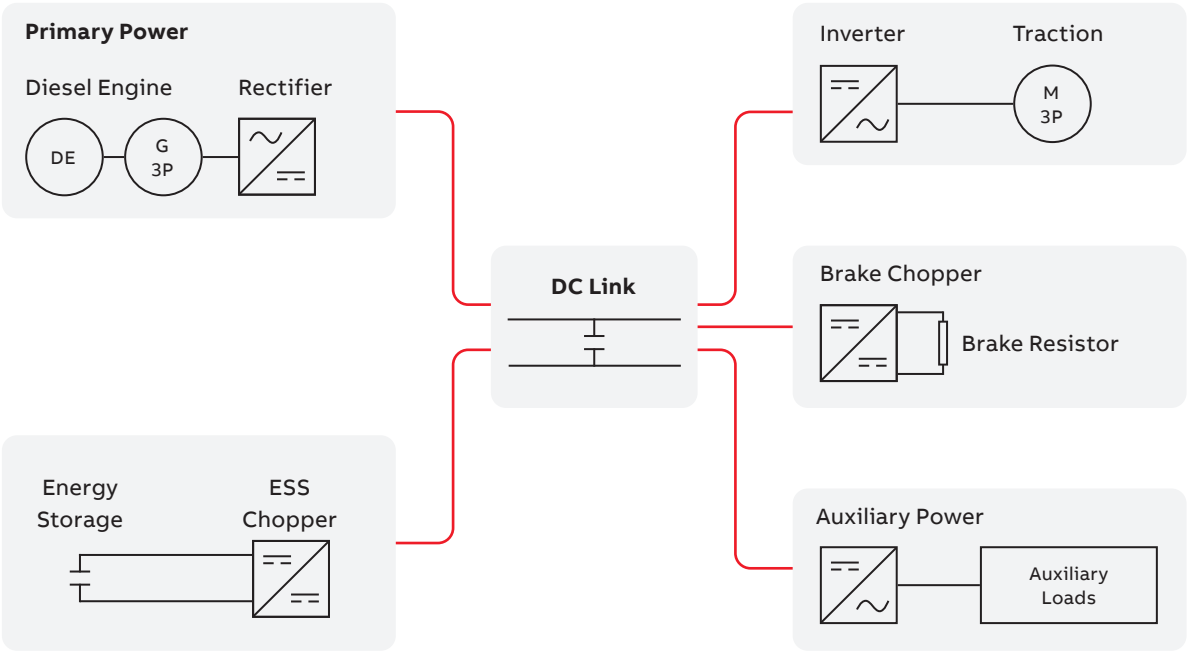
Hybrid systems - Typical configuration

Diesel - Electric

The primary power source is a diesel engine which, together with a generator, also receives power from the ESS to dissipate energy.

ESS main charging modes:
- Regenerative braking to ESS only

or during partial/no-load operation:
- Supplementary charging when railway vehicle operates
- Power source charging of ESS.



Hybrid systems Typical configuration

Fuel Cell

The fuel cell and energy storage system are the primary power source. Generally speaking, fuel cells are not able to absorb power.
The main charging modes of the energy storage system are similar to diesel:

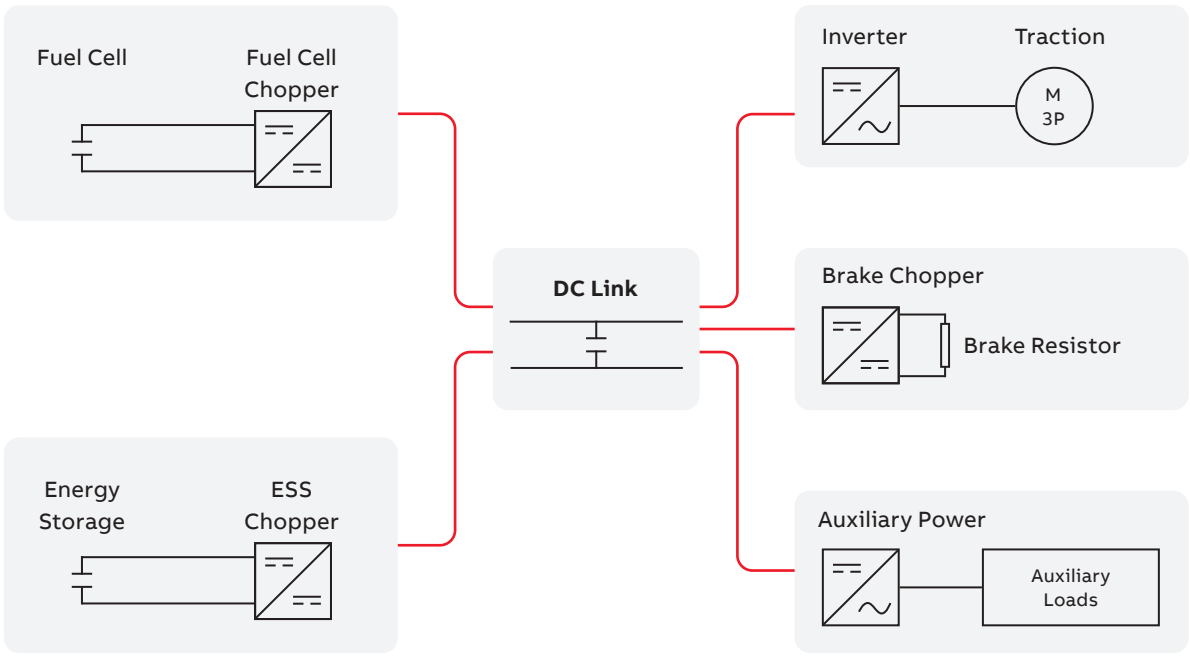
- Regenerative braking to ESS only

or during partial/no-load Operation:

- Supplementary charging when railway vehicle operates
- Power source charging of ESS.

Energy storage - typical use modes:

- Boosting
- Zero emission/ Contact line free.



Hybrid systems Typical configuration

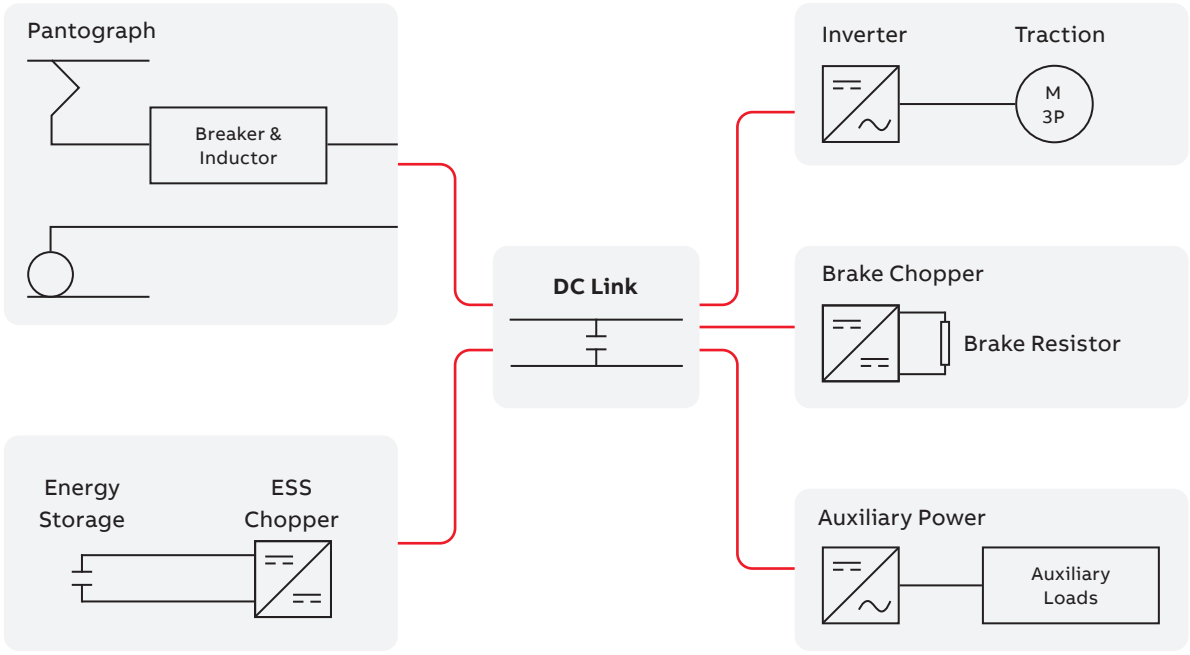
DC line powered - Parallel connection of ESS

ESS main charging modes:
- Regenerative braking to ESS and power source
- Regenerative braking to ESS only
- Supplementary charging during braking

or during other operating modes:
- Supplementary charging when railway vehicle operates
- Power source charging of ESS.

Energy storage - typical use modes:
- Boosting
- Zero emission/ Contact line free
- ESS to traction and grid

or
- ESS to grid mode
- ESS and regenerative braking to grid.



This system can be extended to AC fed trains

Hybrid systems Typical configuration

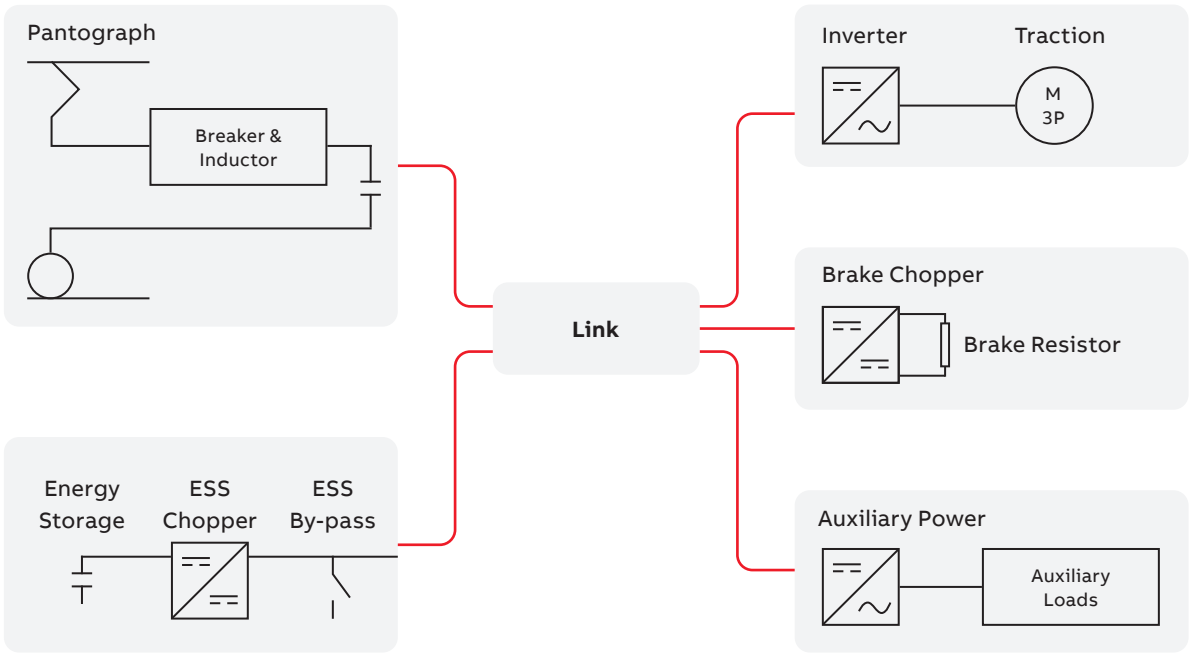
DC line powered - Series connection of ESS

The energy storage system is connected in series to the DC contact line in this configuration, so the voltage at the traction inverter input becomes the sum of the energy storage system voltage and the line voltage from the primary supply.

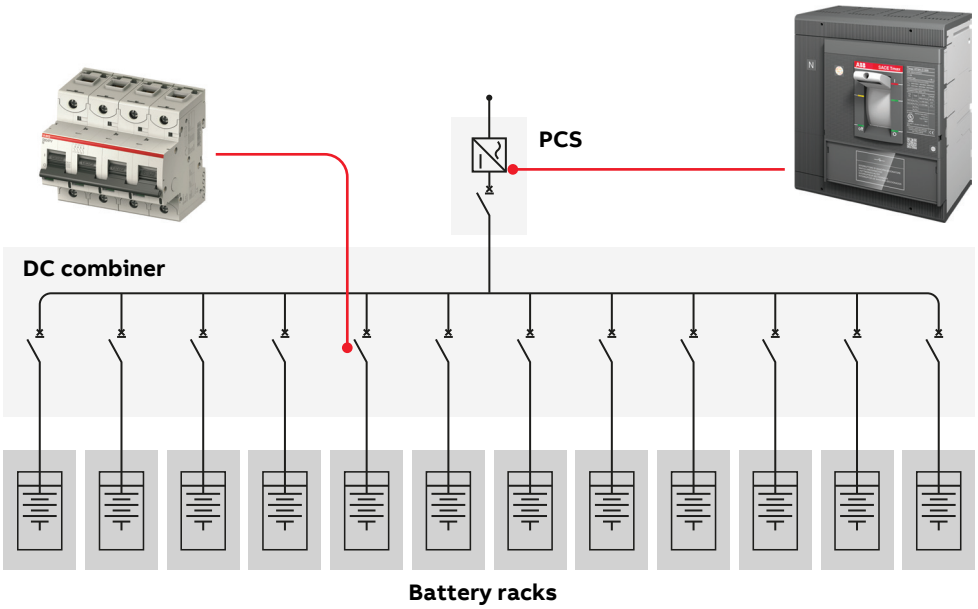
Charging modes of the energy storage system:

- Regenerative braking to ESS and power source
- Rheostatic braking with source feedback.

The only energy storage use mode is boosting.



ABB’s offering



Main input data

BESS for Hybrid Trains	
Rated energy [kW]	72
Rated voltage [V]	1.5
DC Bus Current [A]	48
Number of battery racks	520
Battery rack current [A]	500

Main components

PCS
Tmax XT6 800 750VDC molded case circuit breaker In=630 for switching and protection with shunt opening relay for remote opening
DC combiner
S804S-UCK miniature circuit breaker In=50A on each battery branch for switching and protection

Bill of materials

Auxiliary power supply systems

Device	Part Number	Quantity
XT5H 600 TMA 500-5000 4p FF InN100%In UL	1SDA102637R1	1
YO-C XT5-XT6 F/P 24...60 VAC/DC	1SDA104933R1	1
AUX-C 3Q 1SY 24V DC	1SDA054915R1	1

Hybrid systems

Device	Part Number	Quantity
XT6H 800 TMA 630-6300 4p F F InN=100%In	1SDA107595R1	1
YO-C XT5-XT6 F/P 24...60 Vac/dc	1SDA104933R1	1
AUX-C 3Q 1SY 24V DC	1SDA054915R1	1
S804S-UCK50	2CCS864001R1577	12

APPLICATION FINDER

We've made it simpler for you to set up your project!
Click here to find the reference architecture that best fits your needs and download the Bill of Materials.

Product offering

Tmax XT:

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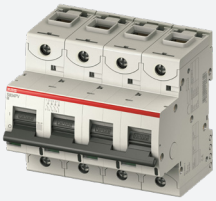
CATALOG

Modular DIN-Rail S800:



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CATALOG

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Find the reference architecture tailored to your needs and speed up your project thanks to our new Application Finder Tool!

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ABB S.p.A.
Electrification Business Area
Smart Power Division
5, Via Pescaria
I-24123 Bergamo - Italy
Phone: +39 035 395.111

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