GE VERNOVA

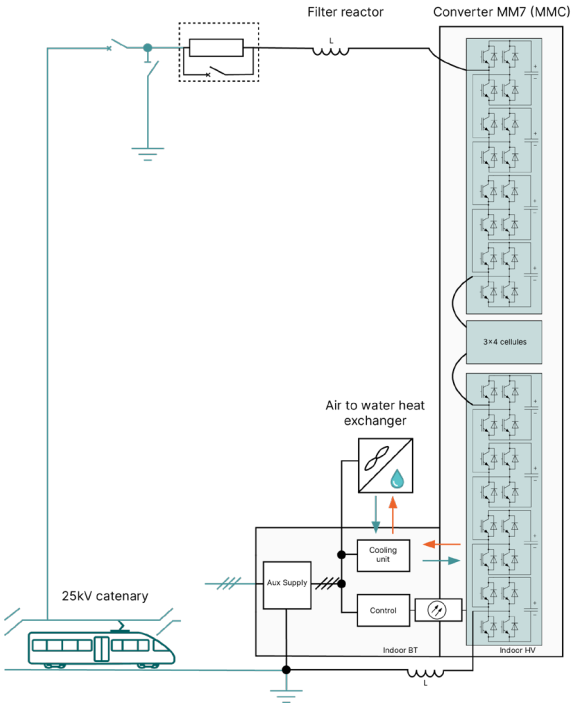
HIGH VOLTAGE BOOSTER FOR RAIL ELECTRIFICATION

Power Conversion & Storage solution to enhance power while stabilizing catenary grid.

As global demand for transportation continues to rise, electric railways are recognized as the optimal solution due to their superior energy efficiency, reduced emissions, and lower operating costs. However, the electrification of railways encounters a significant challenge: existing catenary power supplies struggle to maintain voltage levels compatible with rolling stock, thereby limiting traffic capacity. GE Vernova's High Voltage Booster (HVB) solution addresses this issue by stabilizing the catenary grid, ensuring reliable operations but also helps to increase electrified line capacity in response to traffic ramp-up.

High Voltage Boosters stabilize and maintain catenary voltage at functioning levels for the rolling stock, with little impact on the already installed substations and without requiring a new grid connections.

The HVB system actively monitors the catenary voltage levels and injects reactive power to enhance them, proving essential for long-distance connections where the installation of additional intermediate substations poses challenges. This technology is particularly beneficial in scenarios such as tunnel catenaries, where boosters positioned at each end help sustain voltage levels and facilitate increased traffic capacity.



Typical detailed HVB implementation

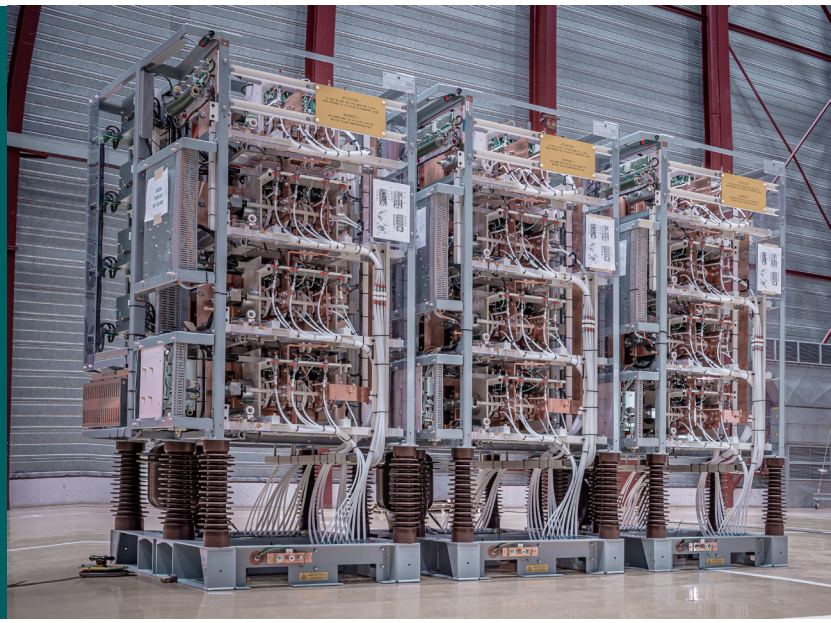
BENEFITS

Efficient, reliable and safe rail traction booster

Regulates AC voltage on catenary to increase power transfer

Permits to increase distances between grid connections

Stabilize catenary supply feeding modern rolling stock



TECHNOLOGY

The HVB is directly connected with the catenary system and comprises either a single-phase SVC or an MMC-based STATCOM.

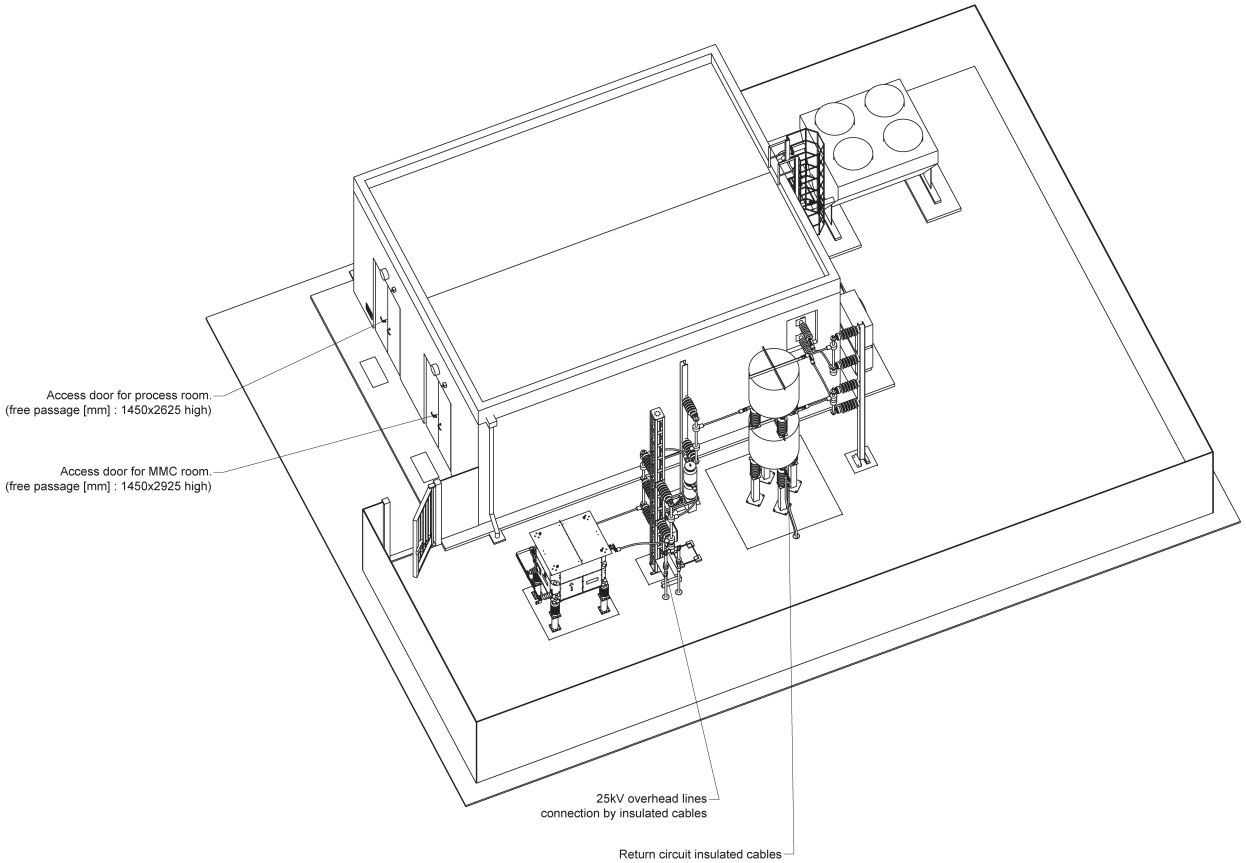
It injects reactive power to counteract voltage drops along the line, thereby enhancing power transfer capabilities without necessitating the installation of additional substations.

The converter is assembled by linking five towers in series, with each tower consisting of up to four full-bridge submodules. Each transport unit undergoes factory testing to ensure functionality. These towers are equipped with control and protection components, sensors for current and voltage, isolated power supplies, and are pre-mounted on insulators. Each submodule is composed of four Insulated Gate Bipolar Transistors (IGBTs) and a capacitor array.

An MMC-based voltage booster, utilizing full-bridge modules, is capable of injecting reactive power to support and stabilize the catenary voltage. The scalability feature of an MMC allows for a transformerless connection to the catenary system.

MMC levels	20
Nominal voltage – Rail network voltage 1 phase Uc	Operating 18 kV– 27.5 kV No load 17.5 kV et 29 kV
Insulation	52/95/250 kV
Reactive nominal power Sn (permanent load) capacitive	19 kV → 11.4 MVAr 27,5 kV → 24 MVAr <18 kV → 0 MVAr
Frequency – rail voltage network 1 phase	50 Hz
Cooling MMC	Air & glycol/water mixture
Typical land plot dimensions	19,500×14,000 mm

Example layout



About GE Vernova's Power Conversion & Storage business

GE Vernova's Power Conversion & Storage business combines advanced energy conversion and storage systems to meet the electrification needs of utilities and industries. With a focus on power stability, energy storage, and industrial electrification solutions, Power Conversion & Storage empowers customers by addressing their most complex electrification challenges and accelerating their transition to a sustainable, decarbonized future.

For more information, please visit
gevernova.com/power-conversion

Glossary

HVB	High Voltage Booster
IGBT	Insulated Gate Bipolar Transistors
MMC	Modular Multilevel Converter
STATCOM	STATic synchronous COMpensator
SVC	Static Var Compensator

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