



DC Traction Power Supply and Wayside Energy Management

Power and productivity
for a better world™





Power to the line

Building upon decades of market and manufacturing experience, ABB designs and manufactures complete **DC traction power supply solutions** for rail networks, and offers a wide variety of **innovative** and **reliable** products for: mainline traction power, test track, and maintenance and storage facility substations.

Products

DC traction power supply solutions. To power trains, subways or streetcars, it is necessary to use a power converter - the traction rectifier that will convert alternating current into direct current. Whether these are diode rectifiers, controlled rectifiers or traction power supply packages, ABB provides the most reliable, flexible and cost-effective solution.

Protection technologies. While providing reliable power to the transportation infrastructure is the main goal from the TPSS, another integral role is to provide protection to further guarantee the safety of operation and maintenance personnel. ABB complements its DC traction power supply offering with protection equipment to ensure this safety.

Energy management Whether it be by diverting braking energy into wayside resistive elements, by returning this energy to the AC

grid, or by storing it and re-using it, ABB has always been at the forefront of braking energy management and has the products to suit your network's needs.

Traction power supply packages. ABB is a global leader and one of the very few independent suppliers of traction packages. This unique positioning and strong local presence in all major rail markets helps ABB to provide optimum solutions for transit authorities, contractors and OEMs.

Full service portfolio. As a long term partner, ABB has a proven track record of service packages with railway customers in which ABB commits to improve the equipment performance and reduce the operating life cycle costs.

AC to DC voltage rectification is at the heart of urban transportation infrastructure. ABB's ENVILINE rectifiers raise the bar by exceeding the transportation industry's strictest reliability and overload requirements.

ENVILINE TDR — Traction Diode Rectifier

Reliable and cost effective rectification solutions for DC power supply



To power subways, light rail vehicles and streetcars it is necessary to use a traction rectifier to convert alternating current into direct current. The ENVILINE Traction Diode Rectifier (TDR) is the most reliable and cost effective rectification solution for DC rail transportation.

Dependability and availability

Available in 600, 750, 1500VDC output voltage, ABB's TDRs are designed and tested to the world's strictest standards, including EN50328, IEC60146 and IEEE 1653.2; and are capable of sustaining overloads according to these standards. Natural cooling ensures low noise and practically maintenance free operation. TDRs are designed to withstand output short circuit conditions allowing ample time for external protection systems to trip. Rectifiers are typically designed to operate with n-1 diode redundancy; full power delivery is guaranteed despite a diode failure.

TDRs can also be provided with features typical of the traction industry, such as basic or enhanced diagnostics and communication, inter-phase transformer, transient voltage suppressors, DC disconnect switches, low impedance or ground fault relays, to name a few.

Additional equipment

Additional equipment can be added to the TDR, including but not limited to inter-phase transformer, DC disconnect switch, current and voltage measurement, protective ANSI relays, PLC for control and communication, interlocks, door limit switches.

Key benefits

- High reliability and flexibility
- Cost effective solution
- Dedicated local support



ABB's ENVILINE solutions installed at the third busiest subways in North America, Montreal's Société de transport de Montréal (STM) Metro. Since 2005, ABB has been the sole supplier of rectifiers for this network. Most recently, it has trusted ABB with the award of several traction power and energy recuperation systems for the introduction of its new AZUR trains.

ENVILINE TCR — Traction Controlled Rectifier

Maximizing the distance, balance and stability of the DC line

In cases where a TDR is not enough to maintain regulation of the DC traction line, the ENVILINE Traction Controlled Rectifier (TCR) is the right solution for maximizing the distance, balance and stability of the DC line. Additionally, the TCR can reduce losses in rolling stock and prevent interruptions caused by undervoltage.

ABB's expertise at its finest

Just as for TDRs, the TCRs are designed and tested to the world's strictest standards. Models include 600, 750, 1500VDC outputs. TCR's are controlled rectifiers where thyristors are activated by an intelligent controller to maintain the output voltage at a constant level. High speed control permits fast response time and immediate overcurrent protection. At the heart of this converter is the AC 800PEC, part of ABB's high performance controller family. This proven and rugged platform is used throughout ABB's controlled power converters applications and not only provides performance, but sustained worldwide product support.

TCRs can also be provided with features typical of the traction industry: basic or enhanced diagnostics and communication, inter-phase transformer, smoothing reactor, transient voltage suppressors, DC disconnect switches, low impedance or ground fault relays, etc.

Key benefits

- DC line voltage control
- High reliability and flexibility
- Cost effective
- Dedicated support



Control and diagnostics

The control and diagnostic system are based on the AC 800PEC, which provides the optimum solution for the high-speed control requirements of power converters.



The controller combines a very powerful CPU and a large Field-Programmable Gate Array. This allows the AC 800PEC to control demanding power electronics systems. The PP800 family touch panel is used for local control and diagnostics.

DC Switchgear

Ensuring the reliability of power distribution

Protection of traction power equipment and rolling stock relies on over-current protection devices that can interrupt large currents in the least amount of time possible. ABB's DC switchgear is based on high speed circuit breakers on trolleys, complemented by ANSI certified cubicles

Dependability and safety. ABB's DC switchgear design comprises all the necessary features to ensure personnel safety: arc voltage management; trolley mounted breaker with Open, Test and Closed positions; control, power and trolley in segregated compartments. The breaker and cell have been tested to the ANSI C37.14, C37.16 and C37.20.1 standards by an independent third party. The low voltage control section can be fitted with basic monitoring or with an industry recognized protection relay to provide enhanced control features and SCADA interfacing.



- Key benefits**
- ANSI certified
 - Proven field deployment history in extreme and diverse environments
 - Optional permanent magnet design to maintain operation despite control power loss

ENVILINE VLD — Voltage Limiting Device

The perfect negative grounding device for your floating negative network

The VLD solves rail grounding needs
Protection of passengers against safety hazards is the ultimate objective of transportation agencies. The ENVILINE VLD detects and removes hazardous voltage conditions by shorting the running rails to ground in a timely, effective and safe manner.

Installed at substations, passenger stations and crossings, or wherever else people are exposed to running rails with potentially grounded surfaces, the ENVILINE VLD provides peace of mind by helping the system comply with standard EN 50122-1 (safety, earthing and provisions against electric shock).

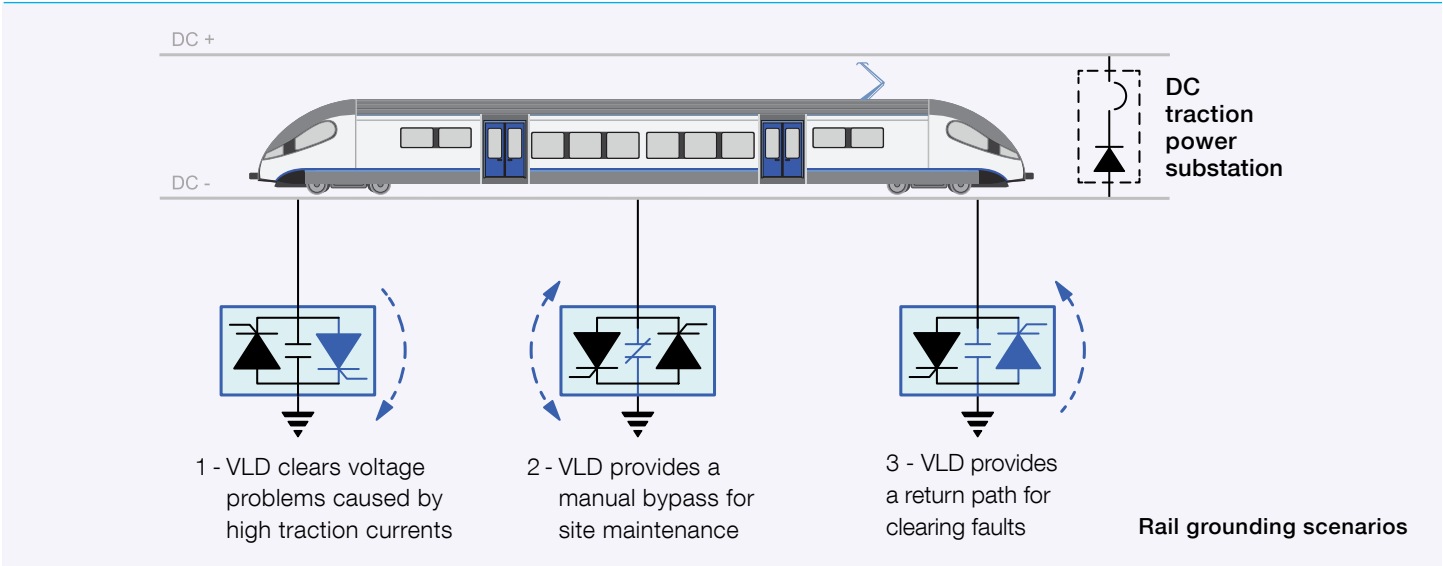
More than a voltage limiter. ABB's VLD is more than a simple voltage limiter. The VLD is a bi-directional Silicon Controlled Rectifier (SCR) in parallel with a contactor. As such, it will not only turn-on faster than other similar devices, but also, be capable of handling fault currents to enable the substation protection devices to activate.

The VLD has three time-defined voltage set points for each polarity, which allows for proper voltage coordination between normal rail-earth voltage variations and hazardous potentials as well as minimizing unnecessary stray currents. The VLD is the only voltage limiting device in the market capable of operating and eliminating hazardous potentials without control power making the VLD one the most reliable units in the market.



VLD activity trends can help determine rail to earth insulation deterioration and a sign of an increase of leakage current as well as possible corrosion current issues. ABB's controller will log numerous events that will permit the user to gather statistical information as well as monitoring of its insulation system.

- Key benefits**
- Ensures compliance with EN 50122-1 safe touch voltage limits
 - Facilitates timely and safe ground fault clearance
 - Prevents unnecessary stray currents
 - Helps understand the causes of stray currents
 - Extensive monitoring capability provides complete information about firing events
 - Flexible and easy installation
 - Helps locating rail-to-ground insulation deterioration



Transportation is energy intensive and, not surprisingly, electric rail transit operators are amongst the largest consumers of electricity in their regions. To increase sustainability and efficiency, operators need to look for ways to reduce their electrical consumption.

ENVILINE ESS — Energy Storage System

Reduce energy and peak power costs



ENVILINE ESS
ENVILINE ESS is a wayside Energy Storage System (DC connected) which recovers, stores and returns the surplus braking energy to the DC network, helping to reduce the total energy consumption of a rail transportation system up to 30 percent.

The ESS can be configured with batteries, super capacitors or in a hybrid configuration for combined benefits of high power and longer duration energy requirements. In addition to braking energy recovery, this configuration can be utilized in a smart grid environment to provide frequency regulation, peak shaving, load leveling, demand response and DC voltage support.



ABB's first ENVILINE ESS has been in operation since 2012 at Southeastern Pennsylvania Transportation Authority (SEPTA), the 5th largest overall transit system in the USA. To date, SEPTA has awarded an additional eight ABB ESS systems across their network. This innovative technology not only recovers braking energy, but also allows for participation in the Frequency Regulation market. This makes the ABB ESS a smart grid revenue generating asset as well as an environmentally friendly product by reducing the energy consumed by the trains.

- + Key benefits**
- Lowers energy costs through energy recovery
 - Reduces the demand charge and peak power
 - Lower capital cost VS a new TPSS for voltage support
 - Increases the distance between TPSS (new construction)
 - Seamlessly integrated into existing train networks
 - Has no impact on service or schedules

ENVILINE ERS — Energy Recuperation System

Reduce energy costs by returning braking energy to the AC network

ENVILINE ERS
ENVILINE ERS is a wayside Energy Recuperation System (AC connected) that saves the surplus braking energy by returning it back to the AC network, thus reducing the total energy consumption of rail transportation system up to 30 percent.

The ERS can be configured to provide rectification boost (bidirectional operation of ERS) and reactive power mitigation when not recovering the energy.

- + Key benefits**
- Lowers energy costs through energy recuperation
 - Lowest upfront and maintenance costs
 - Small footprint, easy installation, low maintenance
 - Elimination of on-board resistors
 - Moving the heat out of the tunnel
 - Compatible with new and existing systems



ENVILINE ARU — Automatic Receptivity Unit

The most reliable and low cost solution for braking energy receptivity in DC rail systems

ENVILINE ARU
ENVILINE ARU is a wayside Automatic Receptivity Unit that ensures track receptivity during regenerative braking by dissipating all surplus energy that cannot be absorbed by other onboard loads/nearby trains, nor recovered by the ENVILINE ERS or ESS.

By deploying the wayside ARU instead of onboard resistors, the rail operator reduces the train's weight and energy consumption, and also eliminates accumulation of heat caused by braking in tunnels and underground stations.

- + Key benefits**
- Highest reliability
 - Low operational and maintenance costs
 - Elimination of on-board resistors
 - Moving the heat out of the tunnel
 - No EMC or audible noise
 - Protects on- and off-board equipment against overvoltage
 - Compatible with new and existing train systems
 - Easy deployment





Infrastructure solutions

ABB's DC traction power supply solutions provide reliable power to the line, keeping urban rail transit networks on track.

Energy-efficient and reliable infrastructure solutions ABB specializes in the delivery of DC traction power supply systems for subways, light rail vehicles and streetcar applications. Building upon decades of market and manufacturing experience, ABB is able to design and manufacture complete power supply systems for rail networks, offering a wide variety of innovative and reliable products for rail infrastructure.

Traction Power Packages value added services In addition to product supply, ABB's experienced traction power engineering

group offers a variety of services that adds value to the customer experience.

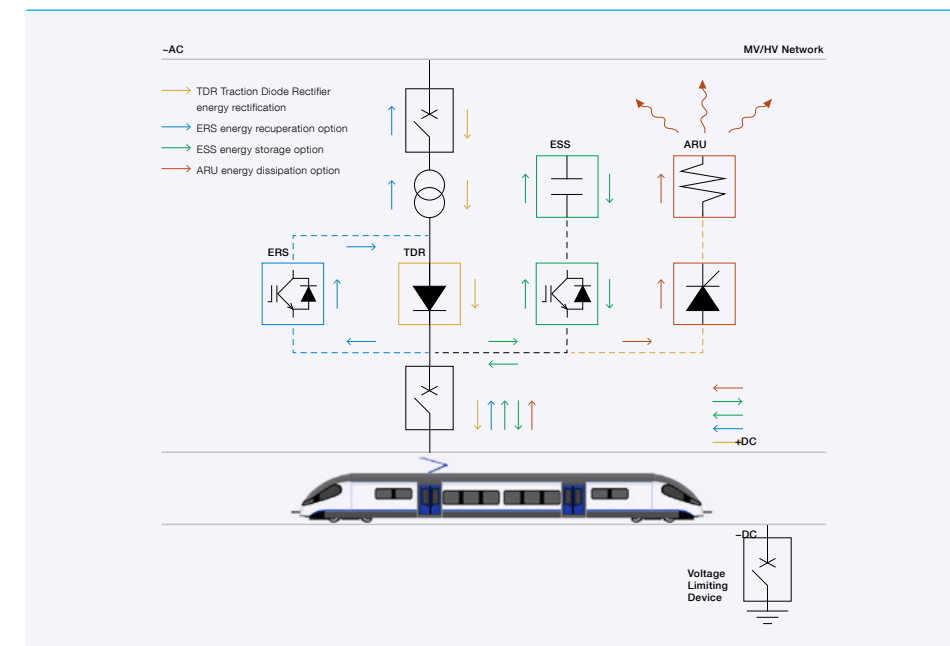
For new DC powered rail transit lines or line extensions, many projects in North America are now being constructed via the Design-Build project delivery method. This method requires close collaboration in design between the equipment vendor, design-builder, owner and/or owner's consultant. ABB has solid experience in supporting the design-builder and owner with recommendations and alternate solutions related to traction power equipment to

optimize ratings, footprint, performance, capital investment and lifecycle costs.

For retrofit projects involving the replacement of ageing equipment with new gear, physical footprint is crucial given existing access and cable entry/exit connections. ABB's engineers have experience in working with partners to find the optimal fit-form-function power conversation, controls and switchgear solutions to equipment retrofit and replacement challenges.

ABB offers the following value added services:

- Support during design phase of DC Traction Power Substations based on customer requirements and applicable industry standards
- Electrical/mechanical block diagrams, single line and layout drawings, wiring diagrams
- Project-specific documentation, such as CDRL, RAMS
- Support customers in their system safety assurance programs
- Routine factory and design testing
- Project management reporting
- Operations and maintenance manuals
- Quality Assurance documentation
- Arc flash and coordination studies
- Field acceptance testing, commissioning, start-up and reporting
- Training, spare parts



DC Traction power supply solution (TPSS)

ABB is a world leading supplier of innovative and reliable technologies designed for the rail transit industry.

Traction power supply systems

Investment in the world's urban rail transit networks is growing under the influence of traffic growth, the development of mass transit systems, rail utility restructuring, and the increased involvement of the private sector.

ABB not only supplies a complete line of products and services for traction power substations but also provides complete solutions, including the design of the system and its components, the integration testing and, for outdoor deployment, the pre-assembly of containerized solutions.

ABB's products include:

- Medium voltage AC switchgear (Unigear, Safegear, ZX2)
- Traction transformers (oil-filled, VPI/VPE, cast coil)
- Traction power rectifiers (ENVILINE TDR and TCR)
- DC switchgear equipment
- Wayside Assured Receptivity Unit (ENVILINE ARU)
- Negative Grounding device (ENVILINE VLD)
- Energy Recovery Systems (ENVILINE ESS and ERS)
- Custom DC traction products (disconnect switch cubicles, stinger panels, shop power supplies)
- Complete containerized traction power systems (ENVISTATION)

This offering is supported by experienced ABB personnel that are well versed with the high standards for quality and reliability required by the Rail industry. ABB's experienced

engineering and project management teams follow internal practices of Risk Management by utilizing all tools necessary to detect, manage and minimize project risks, and to maintain delivery schedules. ABB's experienced field service teams are available to provide local support for commissioning and to ensure that traction power equipment supplied is operating according to specifications.

DC traction power supply systems

ABB is also an experienced partner for DC traction substations for all types of applications including urban transport systems, suburban and mainline railways, covering the standard traction voltages of 750 and 1500VDC. The ABB portfolio covers complete substation packages including DC switchgear, transformers, rectifiers, substation automation, control and protection systems.

DC wayside energy storage and recuperation systems

ABB's DC traction substations with energy storage capabilities allow energy to be recovered from braking trains that would otherwise be dissipated as heat through braking resistors. Storing this energy on the wayside is one way to prevent this energy waste. Another way, also offered by ABB, is through an energy recuperation system, which feeds the recovered energy back into the grid. ABB's modular energy recuperation and wayside storage systems are available for standardized traction voltages of 750VDC and 1500VDC and can be used in existing and new urban transport systems as well as suburban and mainline railways.

System studies

ABB offers a broad range of system studies and dynamic traction power supply simulations based on powerful software tools. The offering also includes energy consumption analysis and prognosis or a design and rating verification for electrical installations.

Electrical Houses (E-House)

Electrical House (E-House) is a custom-engineered, walk-in modular, metal enclosure specifically built to protect critical electrical equipment in the power distribution network. It contains medium voltage (MV) and low voltage (LV) switchgear as well as auxiliary equipment. It can be skid or wheel mounted and is ready to operate in the field with minimum installation, commissioning and start up time.

Proximity to major suppliers during design and construction makes the changes and integration easier. The E-House is tested before shipping including all its components, which minimizes risks in the field. Its mobility makes it easy and cost effective to install and relocate. E-House can be installed close to the main loads which reduces the power and control cable size and length, as well as energy cost.

+ Key benefits

- Cost-efficient, grid-compliant solutions
- Compact, modular design
- High degree of integration
- A project team acting as a single source of responsibility to minimize risk and reduce project complexity



AC switchgear (AIS)



AC switchgear (GIS)



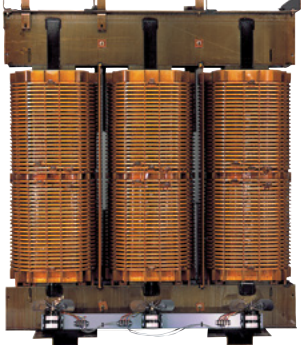
Liquid (oil) filled transformer



DC switchgear



E-house enclosure



Dry-type transformer



Battery charger



Voltage limiting device



SCADA



Your service experts

ABB's experienced and dedicated after-sales support team is ready to provide service throughout North America.

As your service partner, ABB ensures the overall support of the full ENVILINE product range. ABB's complete after-sales service portfolio is designed to increase your assets' reliability and efficiency.

Furthermore, ABB works closely with its research and development team in order to deliver the most advanced services for the ENVILINE product line and to ensure a proactive approach to the life cycle management of your ABB systems.

Field support - troubleshooting Customer issues are treated as top priority and are investigated and fixed as quickly as possible. ABB's field support offers a full range of services to address any technical issues your facility may face. In addition to advanced on-site troubleshooting, ABB field service technicians are responsible for conducting detailed failure investigations, data collection and the replacement of components and spare parts.

Customer support line ABB offers professional product support for all types of products and systems. With the support line there is one general entry point for all technical issues. Managed by highly experienced former field service experts the support line helps you to reduce the downtime of systems through fast and precise technical support. Each problem resolution is individually tracked with professional case tracking tools. During office hours a response to each support request is guaranteed.



24/7/365 emergency support In case of emergency issues outside ABB office hours, there is a service hotline (+1 800 HELP 365) which operates 24/7, 365 days a year. During regular office hours this hotline is served by ABB's support team. Outside regular office hours, ABB representatives will answer phone calls to assess the best support for you, thereby ensuring a fast response.

Preventative maintenance

Performance review ABB's performance review program was designed to optimize the reliability of your ENVILINE assets. The Performance Review program tests all critical protection devices and system settings in various operating conditions to ensure the correct and safe operation of your system. ABB will identify possible improvements to increase the overall performance of your system such as software upgrades or modernization of equipment to outline the optimal operation strategy.

The Performance Review program is available for all phases of your asset's lifetime, and will help you minimize unexpected downtime, and therefore increasing your revenues.

Professional project documentation ABB field service engineers prepare professional project documentation, which allows ABB to give you the best possible support in the long-term.

Training

Operation and maintenance training Training sessions are given by experienced ABB-certified trainers and can take place in ABB's training facility in Montreal or on-site. These sessions are specifically focused on preparing operator and maintenance staff. The focus of the trainings is to teach the operation, maintenance and troubleshooting of your ENVILINE products and systems.

Contact us

ABB Inc.

10300 Henri-Bourassa West
St-Laurent, Québec, Canada
H4S 1N6

Phone: +1 514 332 5350

Fax: +1 514 332 0609

Email: pes@ca.abb.com

URL: www.abb.com/enviline

**ABB reserves the right to make technical
changes or modify the contents of this
document without prior notice.**

© Copyright 2016 ABB. All rights reserved.