

ABB powers rail traffic in Germany

Look inside – Efficient ABB components, solutions and systems are an ever-present part of rail infrastructure and rolling stock.

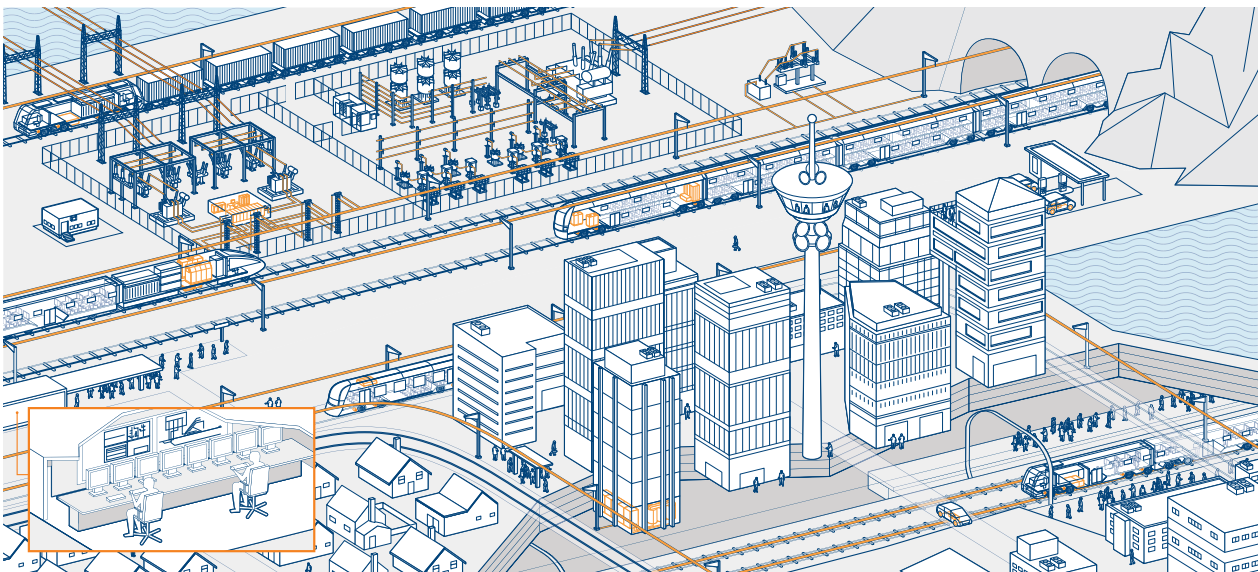
Even though it is not a train manufacturer as such, ABB has grown its rail activities considerably in recent years and today offers many innovative products and technologies to the railway industry. The following background information focuses mainly on ABB rail activities in Germany. While this is by no means a comprehensive overview, it serves to illustrate how ABB has positioned itself as a major supplier for several train manufacturers and operators in this local market.

It is an industrial powerhouse and perhaps one of the biggest producers of cars in the world. Its Autobahn is known as one of the most sophisticated road networks on the planet and its geographical location means it is easily accessible from a number of different countries. However, the increase in the number of cars and trucks on the roads of Germany, combined with the road works necessary to maintain a world-class road infrastructure have led to what is now an almost acceptable part of daily life on the autobahn – traffic jams. In addition, rapid urbanization has increased traffic congestion in and around cities and towns.

A study by ADAC, Germany's biggest traffic club, found that on average, drivers in Germany spend a grueling 65 hours per annum in traffic jams¹.

While the need for faster mobility is one reason more and more people are choosing to do their business and leisure travelling by rail, it is most certainly not the only one. The focus on reducing carbon dioxide emissions and preserving natural resources without stifling economic growth or social progress means industries have been busy developing reliable, innovative and sustainable solutions. The rail industry in particular is benefiting from these environmental concerns. In fact, rail is being rediscovered as a sustainable and energy-efficient form of transport capable of reducing congestion in cities, and this has triggered investment in infrastructure, rolling stock, control systems and service. While emerging economies are developing state-of-the-art rail and metro-rail systems, the developed world has been busy reinforcing, modernizing and expanding existing rail infrastructure.

This trend can certainly be seen in the order books of many companies. From an ABB point of view, rail revenues experienced a compound annual growth rate of about 50 percent between 2004 and the end of 2007, a year in which ABB secured more than \$700 million in orders.



¹ The study also found that around 14 billion liters of fuel are used up every year by people stuck in traffic jams in Germany

Between 2007 and 2009, the orders received by ABB grew by almost 80 percent! In its annual report 2009, ABB stated that orders from the rail industry increased by more than 40 percent to \$1.3 billion in just one year [1], and the estimated order target for 2010 is approximately \$1.4 billion. While this reflects the company's strong product offering in this market, it also shows a growing interest in sustainable transport solutions.

Germany alone has invested vast sums of money in its rail industry over the past number of years, making it one of the most modern, punctual, clean, affordable and efficiently networked systems in the world. Deutsche Bahn (DB), the main provider of railway service in Germany, has employed both domestic and imported technologies to create such a rail service. For its part, ABB has been playing a major role as an independent supplier, both directly and indirectly, to Germany's railway industry for many years².

Drawing on its expertise in the power and automation sectors, the company is contributing reliable and cost-efficient solutions for both infrastructure and rolling stock. To be more specific, ABB substations contain all the necessary transformers, switchgear protection and station automation systems that ensure the supply of stable power for train traction systems, while on the rolling-stock side its broad portfolio of equipment and services, including traction transformers, converters, motors and many other components are used by railway integrators all over the world.

The importance of stable power supply

The number of passengers carried by railways in Germany has been steadily increasing over the past decade. In 2008, DB alone carried almost two billion passengers and 380 million tons of goods [2]. While this is good news for rail operators and the environment, it brings with it serious engineering challenges that need to be overcome. As both passenger and freight traffic continue to increase on existing tracks, combined with new high-speed rail projects, the electric supply grids are forced to deal with more loads that have the potential to cause instability in the network. In fact, much of the electric energy used by railways is drawn from the national grid. While this helps to lower rail's carbon footprint, there are, however, significant differences between railway electrification and national grids, such as the single phase used mostly by AC-electrified railways compared to the three-phase power transmitted and distributed by domestic grids, and the frequency

used for electrification often differs from these grids. Even when the same frequency is used, there may be problems with synchronization. To overcome these problems, large frequency converters based entirely on power electronics are used to transfer electricity between national and railway grids.

ABB can draw on a long history of static converter technology. The first railway power supply converters with powerful turn-off semiconductors in the form of gate turn-off thyristors (GTOs) went into operation in Switzerland in 1994. Since then a new semiconductor element, the integrated gate-commutated thyristor (IGCT), was developed that features a much more advanced switching capability, lower losses, and a low-inductance gate unit as an integrated "component." The compact design led to the development of standardized converter modules and permitted converters of various power classes to be built. Today, more than twenty converter units in the 15 to 20 MW range are in operation and several of them have been ordered by DB Energie GmbH.

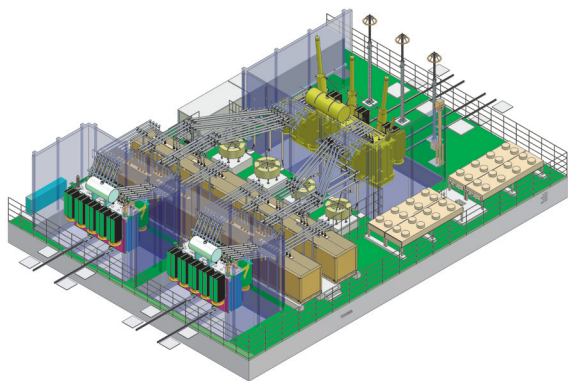
Examples of ABB converter stations in operation in Germany

Location	Total/unit AC apparent power 16.7 Hz (MVA)	Total/unit AC apparent power 50 Hz (MVA)	Total/unit true power (MW)	Three-phase system 50 Hz	Railway voltage 16.7 Hz	Number of units
Düsseldorf	18.9 / 18.9	17.7 / 17.7	15 / 15	3AC 20 kV	2AC 110 kV	1
Karlsfeld	132 / 66	112 / 56	100 / 50	3AC 110 kV	2AC 110 kV	2
Limburg	151.2 / 18.9	141.6 / 17.7	120 / 15	3AC 20 kV	2AC 110 kV	8
Wolkramshausen	37.8 / 18.9	35.6 / 17.8	30 / 15	3AC 110 kV	2AC 15 kV	2
Doberlug-Kirchhain	37.8 / 18.9	35.6 / 17.8	30 / 15	3AC 110 kV	2AC 15 kV	2
Genin	37.8 / 18.9	35.6 / 17.8	30 / 15	3AC 110 kV	2AC 15 kV	2
Neckarwestheim	186 / 93	172 / 86	150 / 75	3AC 400 kV	2AC 110 kV	2

The world's largest rail converter station is currently under construction in Datteln, North Rhine Westfalia and will provide a power rating of 413 MW. Ordered by the German power supplier E.ON in 2007, it will replace existing rotary converters that have reached the end of their economic and technical lifespans. The converter station will receive power at 50 Hz from the new nearby Datteln power station and feed power at 16.7 Hz into the 110 kV DB network. The Datteln node is one of the most important supply points of DB's grid. A very high availability is therefore required of the converter station. ABB is responsible for the entire engineering of this project, ie, the design of the converter system, specification of all the components and development of control and protection more, flexible requirements. A converter reach efforts successful demanding software. Since it is a turnkey project, installation and commissioning is also part of the project scope. The scope of supply for ABB includes four independent converter stations each with a rated power of 103 MW, obtained from four standard 30 MW converters. The built-in overload capability allows the customer to still receive the nominal power of 413 MW even if one of the four converter stations is not in service.

² Even though ABB only started to develop its railway business in 2005, it has long been associated with the rail industry. In 1996, ABB Transportation Systems became part of AdTranz (a jointventure with Daimler-Benz that was later sold to Bombardier). ABB, however, retained the production of components such as traction transformers, converters and motors.

An illustration of a 103 MW converter unit



Apart from the technical challenges presented by this major project, logistics and good planning are essential to enable the equipment to be delivered on time. The long contract duration (completion is scheduled for 2011) is accompanied by a rigid timetable. This project may also pioneer further applications: four converter blocks with 103 MW each set a new standard in terms of power for static frequency converters.

Another indication of DB's confidence in ABB's rail technology is a multi-million euro order, again from DB Energie GmbH, to provide a substation in Neckarwestheim. With a rating of 140 MW, this substation will be the biggest DB substation. The static frequency converters will come from ABB in Turgi, Switzerland, the transformers from ABB's facility in Bad Honnef and the control system from ABB in Mannheim.

In Germany, over 19,000 km of the railway network is electrified and DB's 110 kV traction network has a total length of 7,745 km. The importance of high-voltage equipment in ensuring an uninterrupted supply, high network availability, and the protection of personnel and equipment can never be emphasized enough.

Switchgear and circuit breakers plays an important role in substations by ensuring safe and flexible operation. Ideally, utilities or operators look for switchgear that is reliable during its lifetime, flexible in configuration, easy to operate and requires minimum maintenance. ABB switchgear have proved a popular choice for DB and many can be found in railway substations around Germany.

One such example is ABB's plug and switch system (PASS) family of devices. To begin with, specially designed breakers are used for railways where they have to extinguish longer burning arcs in 16.7 Hz networks. DB Energie GmbH was looking for a solution with a small footprint, which was reliable and cost effective, and which would guarantee high

safety and availability. In addition, they wanted to minimize the downtime needed for the installation and commissioning phase by as much as possible.

One such breaker is ABB's PASS pure dead-tank circuit breaker with an SF₆-filled self-blast interrupting chamber. With this arrangement the SF₆ gas filling insulates the high-voltage live parts of the contact assembly from the housing, and bushings connect the interrupter chamber with the high-voltage terminals. Following successful prototype tests in January 2006, DB ordered around 140 of these devices from ABB, making the company the main supplier of circuit breakers to DB. The one hundredth 110 kV PASS circuit breaker for 16.7 Hz went into operation for DB at the Datteln converter station in December 2009. DB's very positive experiences have led rail operators in Switzerland to consider implementing this technology.

Another version of ABB's PASS is its M0-16.7 flexible and reliable 110 kV switchgear bay which combines all the functions of a complete air insulated switchgear (AIS) bay (ie, circuit breaker, disconnecter, instrument transformer and earthing switch) in a single ready-to-install module that requires 60 percent less space than the conventional AIS alternative. It is easy to transport to and from the site and can be easily replaced in case of failure. In addition to taking just a few hours to install, the use of SF₆ gas and the reduction in the number of components and moving parts make it extremely low maintenance.

ABB's 110 kV PASS M0-16.7 switchgear for railways



Between September 2007 and April 2008, this module successfully underwent extensive testing under realistic operating conditions at the transformer substation in Fronhausen, near Giessen. This project marked the first delivery of a complete hybrid module for DB's 110 kV 16.7 Hz network. Not only that, but it formed the basis of the licensing of such a module by the Federal Railway Authority (EBA), whose "seal of approval" officially opened the way for further PASS M0 installations. For DB, this confirmed ABB's PASS M0 switchgear as a suitable alternative to conventional switchgear construction [3]. In the meantime a substation using five of these hybrid modules was erected in Bengel and is now in operation. A further 22 PASS M0 modules have been ordered by DB for installations in Rudersdorf (8 modules) and Bremen (14 modules). The original hybrid module tested in Fronhausen is currently installed for temporary use in the substation in Bingen am Rhein.

Another type of ABB switchgear proving popular in Germany's rail industry is the UniGear R for railway power supplies. Based on ABB's UniGear ZS2, this metal-clad, air-insulated switchgear can withstand internal arcs of up to 40 kA, which helps provide a safe working environment for railway employees by preventing dangerous electrical discharges. The enclosure and internal partitions of the panels are made of 2 mm thick high quality aluminum-zinc coated steel sheets. The three high-voltage compartments (busbar, circuit breaker and cable connection) are equipped with top-mounted and secured pressure relief flaps. These open in the event of overpressure due to an internal arc fault. The front of the panel is closed off by a pressure resistant door, which opens to an angle of almost 165 degrees. The circuit-breaker compartments are equipped with inspection windows made of security glass. Neighboring panels are partitioned from one another by the sidewalls of each panel and, as a result of the design, the air cushion remains between these walls when the panels are jointed together. Operational safety and performance are secured via integral interlocks. The UniGear R switchgear is based on the latest technology request by DB Energie GmbH, the NSA 3³. In addition it is also approved by the EBA.

The 15 kV single-phase UniGear R switchgear was first installed in Germany in DB's Dresden-Niedersedlitz substation in 2006/2007. This project enabled a detailed test of the switchgear in a first-class facility under realistic operating conditions. The success of this installation led to further orders for DB substations in Bengel (Rhineland-Palatinate) and Amstetten (Baden-Württemberg). In December 2009, ABB received more switchgear orders from DB Energie GmbH for substations in Garssen and Löhne (both in

³ NSA 3 is defined by DB and stands for Norm Schaltanlage version 3. NSA 3 means the switchgear is arc proof.

Lower Saxony). It is expected that the Garssen substation will receive a delivery of 10 panels later this summer while seven panels are scheduled for Löhne in 2011. As recent as June 2010, new orders have been received for UniGear R switchgear for medium-voltage switchgear stations⁴ in Radebeul and Neukieritzsch (both in Saxony).

Another important component in DB's rail substation is the current transformer (15 MVA or 10 MVA), which transforms the 110 kV network voltage to the required 15 kV. ABB has delivered these sought-after reliable and energy-efficient solutions to DB and many infrastructure system suppliers for many years. Furthermore ABB is a leading supplier of transformers that are implemented in frequency and auxiliary converter stations, hydroelectric power stations and train pre-heating systems.

Providing reliable and effective protection against over voltages on contact wires and locomotives is extremely important in helping trains to run smoothly and constantly. That is why a range of ABB surge arrestors are widely used in both DC and AC railway applications in Germany to increase the availability of the power supply and therefore of railway operation. All ABB surge arrestors for railway applications incorporate the latest metal-oxide technology, and with housings made of silicone rubber (exclusively developed by ABB), these devices are not just easy to handle but they are also shock and pollution resistant. ABB's railway surge arrestors carry the International Railway Industry Standard⁵ (IRIS) certification, which is acknowledged by all major system integrators and equipment.

Rolling stock

One of the most instantly recognizable and popular train fleets in Germany is the high-speed IntercityExpress (ICE). Introduced in 1991, it is capable of reaching speeds of up to 300 km/h. While many travelers like to experience the comfort that is characteristic of these trains, those of a more technical orientation will marvel at some of the technologies that make these, and commuter and regional trains, fast, smooth, efficient, reliable and quiet.

In fact manufacturers of regional, commuter and high-speed trains are continuously refining their designs to meet rising demands in terms of speed,

⁴ SP stands for Schaltposten (switching position). DB makes a difference between SP and Unterwerk (UW) or substation. An UW contains the high-voltage part (110 kV) and the traction transformers while the SP contains just the medium-voltage switchgear (15 kV).

⁵ IRIS is an internationally recognized standard for the evaluation of railway industry management systems. It was developed by UNIFE, the Independent Association of European Railway Industries, and is supported by system integrators, equipment manufacturers and operators such as Bombardier Transportation, Siemens Mobility, Alstom Transport and Ansaldo Breda.

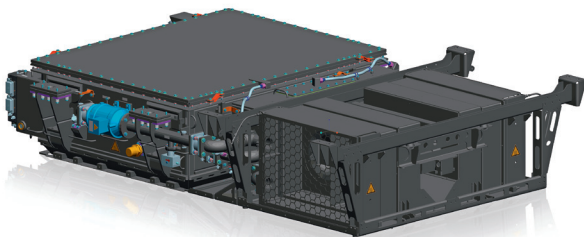
efficiency, comfort, compatibility (with different safety and signaling systems in other countries) and reliability, and are placing similarly high demands on their suppliers. The combination of traction chain components, such as traction transformers, traction converters, motors and control equipment are the main determinants of a train's operation performance and services.

In the global market, ABB is one of the very few independent suppliers of traction packages⁶. Over the last 10 years, it has designed several thousands traction transformers and is now the world leader in this field with a 50 percent market share. The company has long-term agreements with rolling stock manufacturers including Alstom, Ansaldo Breda, Bombardier, CAF, Siemens, Skoda and Stadler. Various types of traction transformers have been designed and delivered to practically all railway integrators around the globe for use on regional, commuter and high-speed trains.

In Germany, ABB traction transformers can be found on many of the regional, commuter, and ICE trains such as the Siemens Velaro high-speed train, which is a development of the DB's ICE-3 train. The ICE-3 and Velaro are not pulled by dedicated locomotives or power units, but instead use a distributed-traction concept. This means that all the traction equipment is distributed along the subfloor space of the vehicles, which in turn permits better use of adhesion due to the lower power required per axle.

In December 2008, DB placed an order with Siemens Mobility for 15 Velaro trains that are intended for international service in France, Germany, Belgium and Switzerland. This means the trains must be equipped to operate under four different power supplies and be compatible with the different safety and signaling systems of the respective countries. In June 2009, Siemens Mobility entrusted the supply of the traction transformers to ABB. Two traction transformers will be fitted to every eight-car train.

ABB's traction transformers are used for Siemens' Velaro high-speed platforms.



⁶ ABB's traction package is composed of a main vacuum circuit breaker, a traction transformer, traction generator, traction converter, auxiliary converter, battery charger, and converter control and traction motors. As the designer, manufacturer and supplier of complete traction packages, ABB is ideally positioned to provide and install the most optimum and cost-effective solution.

The traction transformer and its cooling system jointly. The traction transformer and its cooling system jointly form a plug-and play assembly, which is useful for installation and maintenance. The unit does not require de-gassing or oil refilling and so can operate for prolonged periods with minimal intervention. The first transformer was delivered in December 2009.

ABB has also designed and delivered under-carriage traction transformers for the many regional and commuter Bombardier transportation trains that are in service for DB, including:

- TALENT mono system 15 kV
- TALENT bi-system 15 and 25 kV
- TALENT 2
- Electro talent (E-talent)
- TRAXX AC
- ET430 and ET423

Bombardier's all-round modular TALENT 2 trains are setting a new standard in regional and commuter rail transportation. Significantly different from its namesake, the original TALENT train, TALENT 2 is modular based (meaning it can be easily adapted to both commuter and regional service without much effort) and capable of speeds of up to 160 km/h [4]. In February 2007, DB signed a frame contract with Bombardier for 321 TALENT 2 trains, who in turn entrusted the supply of the traction transformers to ABB.

To satisfy customer requirements, ie, under carriage mounted and two different traction transformers (a 4-traction and a 2-traction winding instead of the unique 6-traction winding) for better weight distribution, the company had to design a completely new traction transformer for this project. Because the TALENT 2 platform is an ECO⁷ train, ABB designed a solution that offers an energy efficiency ratio of 93.5 percent instead of an average of 90 percent for the 15kV train.

⁷ An ECO train combines ecoactive technologies to maximize energy, efficiency, economy and ecology. For more information please see Bombardier Transportation Railway Gazette, Issue 09 2008 pp 6-7.

Bombardier TALENT 2 EMUs use ABB's under-carriage traction transformers. (Source Bombardier picture press).



TRAXX locomotives are effectively powerhouses on wheels: with more than 7,500 horsepower and speeds of up to 160 km/h for passenger services, the 85 ton locomotive can easily haul a 1,600 ton train on 1.2 percent gradient slopes. These locomotives are manufactured in Kassel and can run with four different power supplies. In addition, they are designed to be compatible with Europe's future ETCS/ERTMS train control and safety systems, and to date, they have been officially approved for operation in Germany, Austria, Switzerland, France, Luxembourg, Sweden, Denmark, Poland, Belgium, Italy and Netherlands. [5].

Since 1998, ABB has been supplying all the transformers for this type of locomotive, many of which are in operation in Germany. The company's collaboration with this family of locomotives began with the design of traction transformers for the TRAXX AC bi-system locomotive. ABB then went on to design traction transformers for the multi-system TRAXX MS locomotive, which is capable of running on four different networks.

The ET 423 train series, which is in operation in Munich, Stuttgart, and the Rhine Main and Rhine-Rhur areas (S-bahn) are equipped with ABB traction transformers. These transformers will also feature on the 83 units (two transformers per unit) of the ET 430 train series ordered by DB Regio in 2009 for the Stuttgart S-bahn network. The EMUs, which will be manufactured by Bombardier Transportation and Alstom Transport, are up to 40 percent more energy efficient than the currently used ET 420 series, and the heat released by the transformers and power converters will be used to warm the vehicles, which in turn will generate significant cost and energy savings. To date, ABB has delivered more than 1,000 transformers for the Bombardier manufactured ET train series alone.

Commuter trains that will be operated by the transport service in Karlsruhe (VbK) and

manufactured by Bombardier Transportation will also be fitted with ABB traction transformers. This is the first time ABB has designed a mono-system under-carriage traction transformer for a tram-train application. As well as complying with German regulations regarding vibrations, noise emission, and fire and smoke emission and toxicity, the most challenging part was to design an under-carriage transformer to fit within the limited space available under the car frame. Given that the design also integrates the cooling system, the additional requirements for a very compact and lightweight product have been successfully achieved.

Another commuter train powered by ABB transformers is the Alstom-built Coradia Continental (XCC), which is one of the most popular train platforms used by operators, such as BeNEX (operated by Agilis), Veolia (operated by Nordwestbahn) and DB. Due to a frame agreement with DB, these trains run everywhere in Germany. The design is a development of the Coradia Nordic family (X60 – X61) of regional articulated trainsets. Following the success of the Nordic version, Alstom decided to adapt the X60 design where ABB traction transformers are in operation and chose ABB again for its XCC regional train design. Drawing on its past experience, ABB developed a new traction transformer design from the old one originally made for trains that operate in Sweden. The transformers are roof mounted but several new features have been added, such as auxiliary windings, and a high performing silent block system and filter windings to reduce the harmonics introduced by the converter. One of the biggest demands from the customer was that noise emitted by the train in the station should be limited as much as possible. Transformers with auxiliary windings isolate the stationary traction converters, which in turn contribute to reducing noise emissions.

Alstom's Coradia are used on Germany's S-Bahn network and are powered using ABB traction transformers.



Many of the transformers used on German trains were manufactured at ABB's transformer factory in Halle, Germany. In 2009, production was transferred to ABB's production facility in Geneva.

If ABB's innovative traction transformers have proved their worth among train manufacturers, the same can also be said for the group's traction converters. In the past ten years, ABB has brought new and highly successful traction converters to the railway market that excel in energy efficiency, reliability, compactness and service-friendliness.

In modern rail vehicles driven by electric motors, all movement is controlled and powered by traction converters built on insulated gate bipolar transistor (IGBT) semiconductors. The traction converter is the "intelligent link" between, on the one side, the energy supply through the catenary, transformer or Diesel-generator, and the traction motors on the other side. ABB's traction converters are built on the AC 800PEC control platform, probably the most powerful modular controller for high-speed performance on the market. The AC 800PEC software is implemented on three performance levels, and this provides an excellent range of control and communication functionality in cycle times that extend from the sub-microsecond to the millisecond level. In addition, the application software in the AC 800PEC is built in a way that speeds up train commissioning significantly. The controller is complemented by a variety of input/output modules as well as engineering and service tools.

In most rolling stock projects, the vehicle design imposes challenging constraints on the physical dimensions of traction converters, transformers and motors. Through very compact and lightweight constructions, the ABB equipment gives more freedom for the vehicle design. This compactness and high power-density is achieved using internal liquid cooling, smart power module design and a housing made of aluminum or stainless steel.

In principle, ABB traction converters and transformers can be mounted in the machine room, under the floor or on the roof of the trains or tramways. The roof mounted highly integrated BORDLINE® compact converters for light rail vehicles (BORDLINE CC400) are examples of complete power-electronics sub-systems that consist of two motor inverters, two auxiliary converter outputs, a battery charger, a braking chopper and all control electronics. They are characterized by straight-forward interfaces to the vehicle, lower weight and smaller dimensions. In Germany, these types of roof-mounted converters have already been sold for Stadler Rail AG trams (types Tango and Variotram) to public transport operators in Bochum, Mainz, Munich, Nuremberg and Potsdam.

Highly integrated BORDLINE Compact Converters are mounted on the roof of tramways and narrow-gauge regional trains.

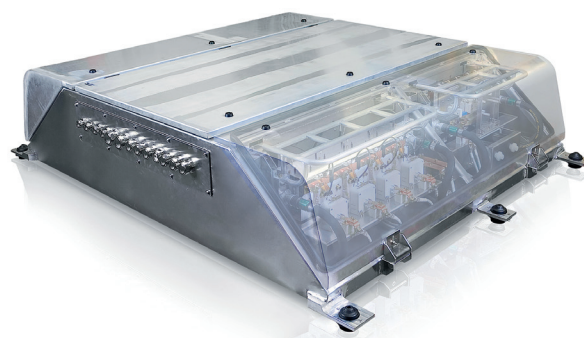


ABB auxiliary converters also run in many fleets in Germany, including DB electric multiple units (EMUs) and in light rail vehicles in cities like Braunschweig, Darmstadt, Duisburg, Essen, Gera, Heidelberg, Mannheim and Stuttgart.

The fast light innovative regional train (FLIRT) is an electric multiple unit produced by Stadler Rail AG. FLIRT units are currently operated in Germany by DB, Arriva, SBB, Cantus, Abellio Rail, WestfalenBahn and Eurobahn/Keolis, and all run with ABB Compact Converters and traction transformers.

ABB has also supplied traction converters for the retrofit project of DB's ICE-1. For the power cars, DB launched a tender in 2007 with the goal of replacing older thyristor-equipped traction converters with modern IGBT converters. ABB won the prototype order in September 2008, and within only 13 months had developed and produced new traction converters for two 4.8 MW ICE-1 power cars.

This converter is based on ABB's three-level topology for power modules, resulting in much lower harmonics on both motor and supply sides. In addition, this minimizes energy losses and reduces stress on the motors, which in turn enhances their life expectation. Compared to the thyristor converters being replaced, energy consumption was cut by 15 percent. This not only improves the energy balance and makes the train greener, but it also substantially reduces operating costs (by more than 100,000 Euros per year and train).

The old thyristor power modules weighed 300 kg and were almost 1.5 m in length. ABB's three-level IGBT modules weigh less than 35 kg and have dimensions of about 80 x 40 x 20 cm, meaning they can be exchanged by one person without any lifting tools. High modularity, increased reliability and sophisticated software for service and diagnosis also contribute to the reduction of maintenance requirements of the ICE1 fleet. Test runs successfully began in November 2009.

To the best of ABB's knowledge, this project is the first retrofit project of propulsion converters in the high-speed train sector worldwide. It is unique in terms of complexity and the engineering challenges faced as only the converter is changed; all mechanical, electrical and control interfaces remain fixed. The success of this project has resulted in a follow-up order for new traction converters for a further 18 ICE-1 power cars.

Expansion is the way forward

ABB is aware that the installed base of many customers may have been built up and developed over a period of 40 years or more, and will reflect the different technological paradigms of that period. Railways across the world expect to handle increasing traffic in an increasingly competitive environment, and for many operators overhauls on both the infrastructure and rolling stock sides can often present an economically attractive alternative to replacement.

Traditionally of course, most, if not all, railway companies used to perform their maintenance and engineering inhouse. Recent years, however, have seen a shift in this approach, with railways increasingly entrusting such work to external contractors. While ABB's work on the infrastructure side is well documented, its reputation as a provider of services for rolling stock is not as well known. This is gradually changing and something which ABB continues to develop on a daily basis.

The company has developed a service portfolio to help customers face this challenge. It can provide service for rolling stock regardless of type or age – even extending this service to the equipment of other manufacturers. Work performed can range from routine diagnosis and maintenance to retrofitting, re-engineering and heavy overhauls, enabling trains to operate more efficiently and economically.

The demand for auxiliary power on trains has increased considerably in recent years. In addition to heating, ventilation and air-conditioning (HVAC) systems, staff and passengers expect facilities such as passenger information, entertainment systems and power sockets for laptops. While largely standard on new vehicles, these offerings need to be provided on older vehicles if they are to remain attractive to passengers. Very often this means a complete redesign is often required to cope with the present demands.

As well as being a renowned manufacturer of traction transformers and motors, ABB provides a full range of services, stretching from spare parts to overhauls and repairs, and covering both current and older types of traction motor. In terms of traction converters, the last 15-20 years have seen much advancement in the

area of control electronics, semiconductors and software, making the refurbishment of many old arrangements uneconomical. DB has already started to replace the old converters on some of its high-speed trains with effective and efficient alternatives and it is hoped that other operators will follow suit in the coming years.

Other technologies and products developed by ABB for the rail industry have yet to find their way into the German market although they are used by other rail providers around the globe. Some of these include:

- Flexible AC transmission systems (FACTS)

ABB FACTS devices, such as the conventional static VAR compensator (SVC) as well as the more recently developed SVC Light® (STATCOM) are used to enhance power quality in rail feeder systems. Recently, an SVC was commissioned for the London Underground in the 11 kV feeding grid to operate together with several others in operation since mid 2000. All in all, six SVCs as well as a number of stand-alone Harmonic filters, all supplied by ABB, are operated in critical points of the London Underground 22 kV and 11 kV grids.

- Traction motors

ABB's new series of modular induction traction motors is the result of several years of product design and development. They feature a new electrical design, optimized for high energy efficiency and a competitive performance/weight ratio, are poised to meet increasing demands for energy efficient electric traction motors in the rail industry.

Considering the growing number of passengers and the ever-increasing amount of freight on Germany's railways, it is clear that rail network modernization and expansion is unavoidable. Another reason the rail industry will continue to grow in the future is that railroads are a safe and environmentally friendly means of transport, and they maintain a significantly better ecological balance than cars, trucks and planes.

As a liberalized market, Germany has roughly 150 rail operators including DB, and many of these will form quite a chunk of the future rolling stock market. According to Rolf Amann, ABB's Key Account Manager for DB, the future for ABB as a contributor to Germany's rail industry looks bright. He says, "From ABB's point of view, I see many very good opportunities for us to continue growing in this sector because we possess a comprehensive and competitive portfolio that provides reliable, innovative and energy-efficient solutions, and we have accumulated extensive experience and know-how on all kinds of projects directly and indirectly

related to the rail industry. As an independent supplier with a business relationship that goes back many years with DB as well as with big rail system suppliers and system integrators, we are about to increase our market penetration by doing business with many local transport companies in Germany.”

Background information

ABB and the railway industry

For more information

References

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