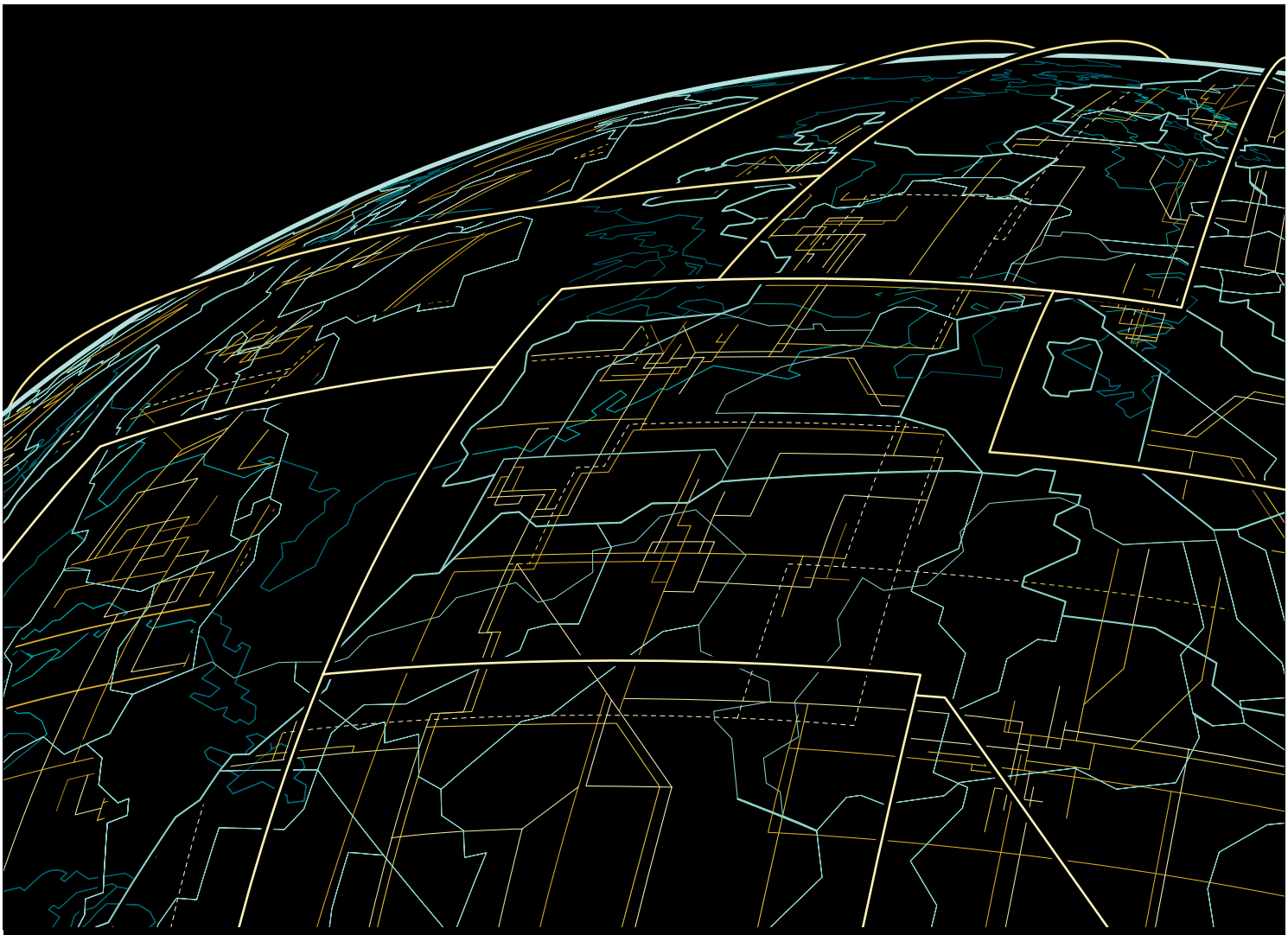


Power transformers

Power transformers
Built for reliability and efficiency

Power and productivity
for a better world™

Power transformers
A safe partner

Safe operation
Safe delivery
Safe investment

A safe choice in transforming electric energy
Reliability throughout the transformer life cycle

A power transformer is a technology investment that needs to be secured for decades. The reliability and efficiency of the transformer has a major impact on the total cost of transmission over a long period of time. Ultimately, it affects the quality of life for the people who depend on a continuous power supply – which makes ABB's high-quality power transformers a safe investment, ensuring our clients benefit from profitable and long-term relations with their customers.

Safe operation

Grid stability depends greatly on the availability of power transformers, and every operational standstill is costly due to repair costs and loss of revenues. That is why in every part of the supply chain – from design to delivery – ABB never compromises on quality.

ABB's platform for designing and manufacturing a complete portfolio of power transformers is unique to the industry. It allows us to maintain control of the quality of all relevant parts – including key components such as bushings, tap changers, insulation materials and active parts. We also ensure that the same rigorous demands apply to our first-class certified suppliers.

Before delivery, every ABB power transformer is tested according to international standards. Through continuously improved design and manufacturing procedures, we have succeeded in reducing test failures by 50 percent between 2000–2010. As a result, our short circuit reliability is now more than twice as high as the market average.

Safe delivery

Customers can rely on ABB's consistent, high quality products. This is the result of our TrafoStar™ platform, a common design and manufacturing platform that is today implemented in all 13 of our power transformer plants worldwide. ABB has delivered more than 14,500 power transformers (over 17,000,000 MVA) based on TrafoStar, including over twenty 800 kV UHVDC units and over five hundred 735–765 kV AC units to all major global markets.

All of our plants use identical routines so that we operate as one large virtual factory and in turn provide consistent, location-independent quality of delivery. In fact, we are able to operate multiple parallel manufacturing processes in different countries, or even continents, in order to ensure timely delivery according to strict deadlines.

Our success is the result of continuous feedback of information throughout our organization. Since every power transformer delivery is unique, we re-use all experience by feeding information back into our vast and growing library of best practices. This helps guarantee the successful transfer of skills across national borders as well as between generations of our people.

Safe investment

The purchase price of a power transformer represents only a fraction of the total cost of ownership of the asset. Operating costs such as losses, excessive repairs and low availability combine to dramatically change the picture.

Even a short power transformer outage may cost millions of dollars in lost revenues. The risk of failure is therefore, an inevitable cost to be considered when evaluating the total cost of ownership.

Modernizing their power transformer fleet is a sound investment for power companies. ABB's power transformers have close to 100 percent efficiency, which ensures a short payback time on the investment. With a global average of 10 percent losses in today's T&D systems, the lifetime cost for losses alone may exceed the purchase price of a new ABB transformer by a factor of two – based on estimates of future energy prices.

Proven transformer technology and long-term, global field experience

Power transformers are key components in power networks. Their availability and longevity have a major impact on grid reliability and profitability. ABB does not compromise on quality. We therefore ensure that every one of our 14,500 delivered units has undergone rigorous full-acceptance testing. This has made us the undisputed world leader in the power transformer industry.

50 percent fewer test faults in 10 years

Fewer test failures generally means fewer field failures. An in-depth understanding of the root cause of each failure is necessary to ensure high reliability in power transformers. Unfortunately, in today's fiercely competitive global market, many suppliers refrain from carrying out the necessary tests or from adequately presenting their results.

At ABB, correct and transparent failure reporting is an affair of the heart. We invest vast resources into rigorous full-acceptance testing. Continuously improved design and manufacturing methods have helped us to reduce test failures by 50 percent between 2000–2010. We track and analyze all reported field failure incidents to ensure consistently high transformer availability.

Twice as high short circuit reliability as the market average

ABB conducts all the necessary electrical and thermal tests according to international test standards. Short circuit tests are particularly expensive to carry out, but they are vital to the reliability of the transformer. That is why we conduct more short circuit tests than any other supplier. The results are clearly demonstrated by KEMA statistics, proving our short circuit reliability to be more than twice as high as the market average.

Complete power transformer portfolio

ABB offers a complete range of power transformers and related components and parts. We have delivered more than 14,500 power transformers (over 17,000,000 MVA), including over twenty 800 kV UHVDC and over five hundred 735–765 kV AC units, to all major global markets. Our entire range is the result of our own research, development and manufacturing, which makes us unique in the industry. This has given us extensive experience in every relevant part of power transformer technology. Customers worldwide can securely rely on the quality and reliability of our products.

Our product range includes:

- Generator step-up and intertie power transformers
- HVDC and HVDC Light transformers
- Phase shifting transformers
- Shunt reactors and variable shunt reactors (VSR)
- Industrial transformers
- FACTS transformers
- Railway trackfeeder transformers
- Collector transformers for wind and solar plants
- Mobile transformers
- Polytransformers and multi-voltage generator step-up transformers
- Environmentally safe and silent transformers

Most of ABB's power transformers are available with core- or shell-type technology. Contact ABB or refer to ABB product notes for detailed descriptions of our range.

Consistent quality of vital components

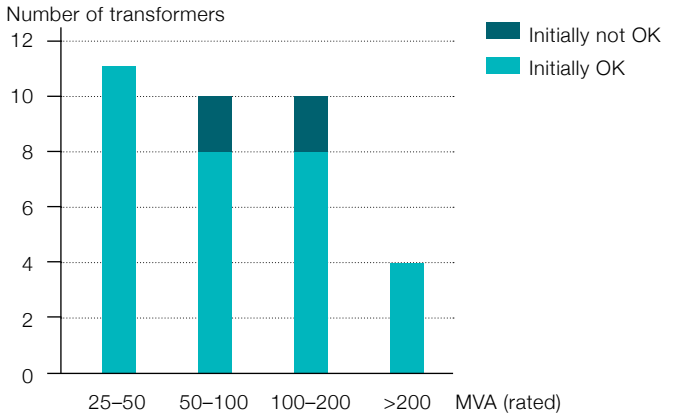
A power transformer must withstand tremendous loads during a lifetime of up to 40 years. This requires quality down to the smallest detail and carefully selected components. Global reliability surveys indicate that reliability is heavily dependent on excellent quality bushings, tap changers and the active part. Thanks to in-house production, ABB is able to consistently control and guarantee the quality of these key components. For those materials that ABB does not produce, it maintains supply agreements with first-class certified suppliers to ensure the continuous supply of high-quality materials – even during periods of raw material shortage.

Undisputed global leader

ABB is the world's largest power transformer manufacturer with 1,000+ units delivered annually from 13 factories worldwide. ABB has more than 4,500 employees and works with customers and suppliers in more than 100 countries. We have the capacity to rapidly deliver customized power transformers, regardless of specification or international standard. Our global service support network delivers truly professional, local, 24/7 support to almost every corner of the earth.

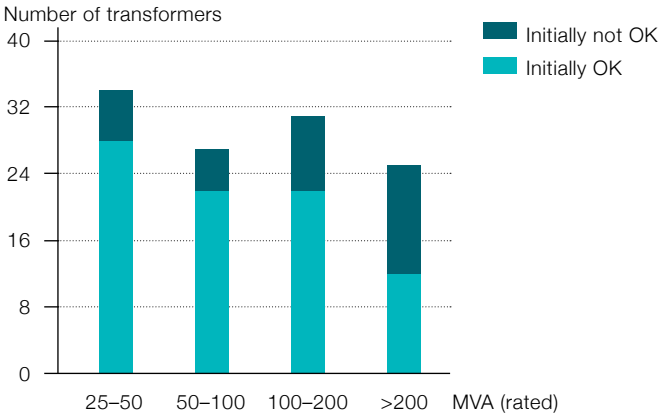
A KEMA* report and ABB statistics indicate that ABB's short circuit reliability is more than twice as high as the market average.

TrafoStar rated 25 MVA or higher, short circuit tested 1996–2011



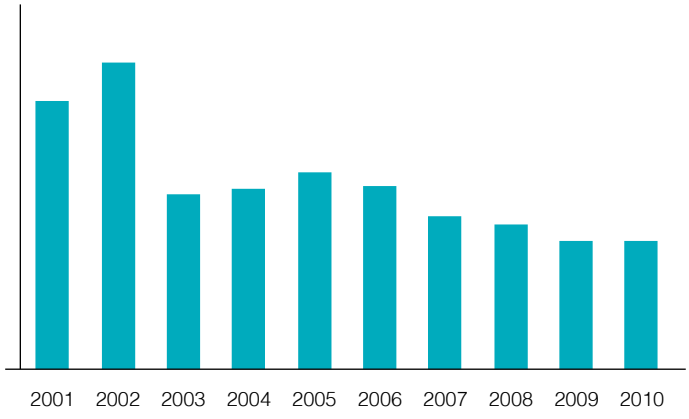
31 out of 35 tested units ≥ 25 MVA were passed between 1996 and 2011, corresponding to 11% test failures.

Transformers rated 25 MVA or higher, tested by KEMA 1996–2009



Total test failures 28%.

Test failures



The total number of test failures on ABB's 60+ MVA units was reduced by 50% between 2001 and 2010.

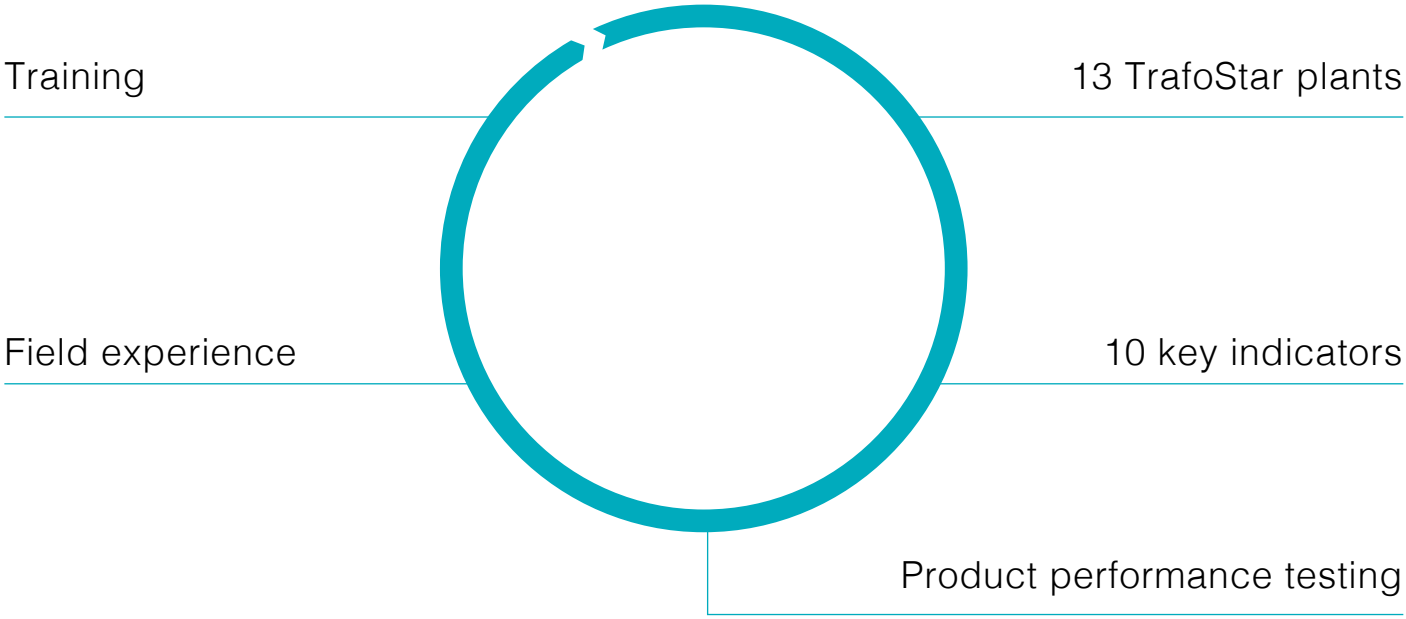
* R.P.P. Smeets, L.H. te Paske. Fourteen Years of Test Experience with Short-Circuit Withstand Capability of Large Power Transformers Travek VIIth Int. Sci. and Techn. Conf. on Large Power Transf. and Diagn. Syst., Moscow, 2010

Safe operation
– First class quality
– Highest availability
– Complete technology
– First class suppliers
– 13 factories

VALUE
ABB quality and reliability is verified by testing to be the highest in the market.

On-time delivery of high quality power transformers
TrafoStar Platform

TrafoStar is a global process including more than 60,000 measurements per year in the group.



The global feedback process in ABB's engineer-to-order process.

Delivering a power transformer takes time and planning. There is a chain of events on which the project success depends. ABB's strong delivery performance builds on its common TrafoStar platform, which provides rigorous control throughout the design, manufacturing, testing, transport and delivery stages. Our reliable manufacturing and delivery processes mean efficiency in your business.

Global design standards speed up development

Consistently designing high-quality power transformers requires knowledge and experience on a worldwide basis. With our global design system including common design rules, processes and IT systems, we have built up a global knowledge base. This allows us to design every power transformer according to the same high standards regardless of location. The transfer of knowledge between countries, continents and generations is secured by a learning organization that continuously feeds back experience to a growing library of best practices. Knowledge transfer is further strengthened through our global Knowledge Communication Center in Germany.

One virtual factory – 13 manufacturing locations

For decades, ABB has refined a common, industry-unique manufacturing platform that is now implemented in all of our 13 manufacturing facilities around the globe. Common manufacturing methods, quality standards and test standards allow us to manufacture 1,000+ units annually with the same high quality in all of our plants worldwide. Our harmonized manufacturing processes also enable us to operate several plants in parallel to meet the strictest contractual delivery deadlines.

More than 60,000 process measurements every year

Every year, we conduct more than 60,000 process parameter measurements to collect data to improve our global feedback process. All design and production improvements are implemented in a structured release process of IT program, design instructions and manufacturing standards to further increase customer value. These improvements translate into increased value for ABB's customers.






Delivering a power transformer takes time and planning. ABB's global common TrafoStar platform provides rigorous control throughout the design, manufacturing, testing, transport and delivery stages.

Our improvement processes measured yearly include:

- On-time delivery
- Test and field failures
- Inventory
- Cost of poor quality
- Total throughput time
- Manufacturing throughput time
- Productivity
- Operational health and safety
- Supplier quality

Secure transportation

Moving an object the size and weight of a power transformer requires planning, know-how and a global network of contacts. At the time of transportation, up to 90 percent of the cost of the transformer has already been expended. Hence there is a significant risk for several parties involved, and the demands for secure and reliable transportation are stringent. ABB has extensive experience in delivering power transformers by rail, road, ship and even air. Transport security is ensured through robust transformer design and reliable logistics partners, selected by a global internal logistics organization.

On-site installation and startup support

No customer delivery is completed until the transformer has been successfully energized. ABB installation engineers are therefore always on site to supervise installation and startup. On arrival, they will prepare the transformer by carefully reassembling all parts dismantled for transit, refill it with oil and conduct all necessary on-site tests to ensure long and trouble-free service. As far as possible, the engineers assigned will have local language skills.

Safe delivery
– Common platform
– Global design standards
– 60,000+ measurements
– Installation support
– Secure transport

VALUE
The global TrafoStar platform ensures the highest quality from design to installation.

Efficient operation and reliable local support

The purchase price is not the only consideration when estimating the total cost of ownership for a power transformer. Risk of failure, efficiency factors, support and environmental concerns are other important factors. Adding them all up, ABB's value proposition will appear highly favorable.

Lower risk of failure with proven technology

Transformers are key components in any electric power system. Operational outages can have many negative consequences such as lost revenues, repair costs, dissatisfied customers etc. For example, an outage of a three-phase generator step-up transformer of 500 MVA may cost 3 million euros* per day in lost revenues. Securing transformer availability should therefore be considered an inevitable expense to ensure long-term continuous operation.

The costs can be estimated by summing up a large number of operational risk factors. What if the transformer has a weak short circuit design? Will it withstand the startup load after a blackout? Due to their proven robust design and reliability, ABB power transformers dramatically reduce these and other operational risks.

These are some of the factors that affect the total cost of ownership, aside from the purchase price:

- Capitalized losses
- Short circuit strength
- On-time delivery
- Test failure records
- Transport security
- Low maintenance cost
- Environmentally safe design

Efficiency increase through modernization – a safe investment

Total loss in today's Transmission and Distribution systems is about 10 percent on average. Lifetime capitalized losses alone amount to approximately twice the cost of a modern ABB power transformer, based on estimates of future energy prices. The figures speak for themselves: investing in energy efficiency pays off. In fact, new high-performance power transformer technology is one of the safest investments imaginable – particularly as demand for power supply and energy prices are likely to continue to increase.

Pushing 100 percent efficiency

Efficiency factors of up to 99.85 percent are achievable today. These levels are mainly determined by the loss capitalization factors applied by the customer and ABB's design skills. Correct loss capitalization factors, together with high-quality core steel grades, core designs, winding conductors and magnetic shielding methods, combine to make ABB's power transformers among the most efficient in the market.

*Calculation based on a load of 400 MW, 170 operating hours per week and a power price of 0.05 euro/kWh.

Life cycle cost

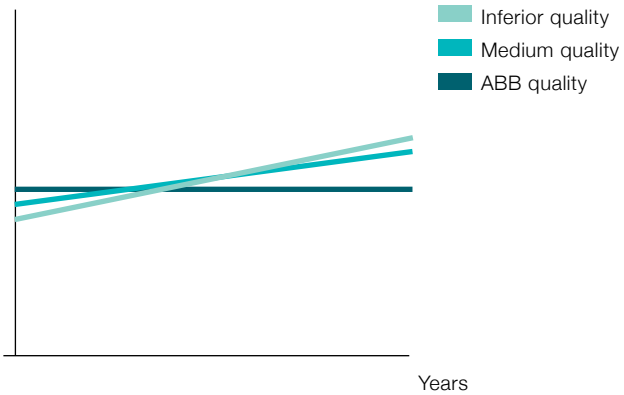
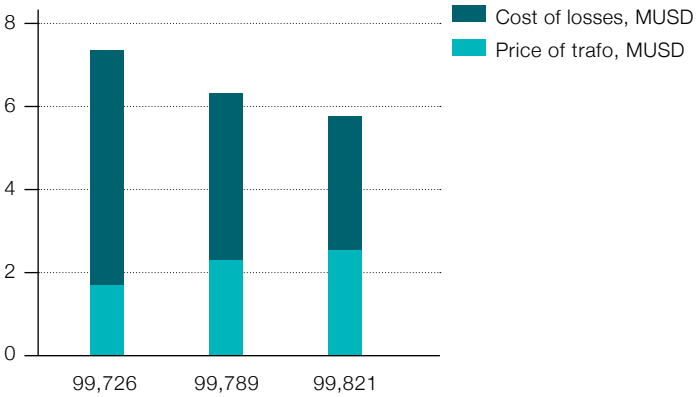


ABB life cycle cost is lower when also considering costs for repairs and loss of revenues due to potential breakdowns.

Total ownership cost, MUSD



Relation between total ownership costs, price and cost of losses (15,000 EUR/kW) as a function of efficiency.

ABB Power Transformers
– Manufacturing facilities

Reduced environmental impact

ABB seeks to minimize its environmental footprint by applying environmental management systems that encourage manufacturing sites, suppliers and subcontractors to adopt strict environmental standards. These standards form the benchmark by which we hold our manufacturing facilities accountable. For example, we have reduced overall volatile organic compounds (VOC) emissions from our manufacturing processes by introducing low-VOC painting processes. Additionally, ABB has developed environmentally friendly products such as ultra-low sound transformers and BIOTEMP®-filled transformers.

Low noise and risk of personal injury

ABB ranks among the world leaders in noise reduction. For example, the total noise level of an ABB three-phase 93 MVA unit can be up to 20 dB lower than a similar standard power transformer. ABB power transformers also minimize the risk of explosion due to their safe design, mainly through the use of leading-edge bushings and well-insulated HV and LV leads. Leakage-free gaskets further improve the safety of our transformers.

Close to customers with local support

ABB is the world's leading provider of professional transformer services. With more than 1,000 service experts located in 25 service centers worldwide, we can offer local support in most major global markets. Backed by 100 years of transformer know-how and ABB corporate research centers, we are able to provide highly professional support to ensure maximum power transformer availability and system efficiency. We offer original design and OEM spare parts for more than 30 brands.

Efficiency through 24/7 support

ABB provides customers with a 24/7 support service, an offering which few others can rival in terms of standards. Our global support organization works across borders to solve even advanced customer problems in a short time. Our common design and manufacturing platform grants every support team access to the same support facilities, backed by a truly global organization. Our advanced logistics processes make it possible to transport standardized components within 24 hours, even across continents.

Ensuring local needs with global knowledge

	Born healthy	Live healthy	New lease of life
Needs	Safety Environmentally conscious Asset at performance level On-time delivery Smooth handover	Trouble-free operation Maximize asset utilization Low Life Cycle Cost (LCC) Optimize investment planning	Reduce outage Extend asset life Get more out of aged assets Optimize capital expenditure
ABB Solutions	Asset at performance level Smooth handover Transportation/hauling	Maximize asset utilization Low Life Cycle Cost (LCC) Optimize investment planning Control and monitoring Condition/risk/life assessment Transformer management training	Reduce outage Extend asset life Optimize capital expenditure Spare parts Preventive maintenance Refurbishment/enhancement Upgrades Remanufacturing/ TrafoSite Repair End of life management

Safe investment
– Low risk
– High efficiency
– Low environmental impact
– Personal safety
– 24/7 local support

VALUE
A modern ABB trafo is a safe investment due to its high efficiency.

ABB – your long-term trusted partner

ABB has a long history of proven capability and reliability. With our global resources in the T&D business, we can ensure continuous improvement and development. Our worldwide presence, size and financial strength make us a partner that can be relied upon time and again.

Quality through experience and cooperation

Every grid is unique and so too is every power transformer. Transformers are specified by customers who know their grids and who rely on the manufacturer to come up with a solution that perfectly suits their needs. This is why we invite our customers to provide their input into the design, manufacturing and installation processes.

Global methodology passed down between generations

After the BBC-ASEA merger in 1988, ABB's power transformer technology was developed through a process in which experience and best practices from a wide range of previously independent transformer manufacturers were selectively combined into an improved, common technology known as TrafoStar.

This concept epitomizes ABB's culture of continuous improvement. Everyone involved in the supply chain works according to the same set of rules. All plants manufacture in accordance with the rules, and follow this up with testing and corrective procedures. This way, our worldwide global industrial system is passed down to the next generation of employees – thus securing our continued knowledge and expertise which places us as world leaders in power transformers.

Pushing the research frontline forward

ABB's power transformer operations are backed by the ABB Group's extensive research and development (R&D), which is financed by three percent of the Group's annual turnover – equivalent to a yearly investment of more than $1 billion. The interaction between our growing practical experience and the support of our corporate R&D is unique in the market, and further demonstrates our commitment to guaranteeing superior product quality and continuous improvement.

We have access to the research results of 6,000 scientists and engineers in R&D. Cooperation with 70 universities adds to the combined knowledge base, in basic as well as applied research. In addition, our manufacturing facilities around the world have their own resources for development and local implementation of global R&D results.

Demand will always be there – and so will ABB

Demand for a secure power supply continues to increase. New economies are booming, and along with it, demand for vast amounts of electrical energy. Meanwhile, there is growing demand for improved energy efficiency and reduced environmental impact. ABB continues to invest in the world's future by developing solutions for the energy challenges of tomorrow.

Power transformers
A safe partner

VALUE
Reducing life cycle costs and energy consumption – generation after generation.


ABB

Contact us

ABB Ltd.
Affolternstrasse, 44
P.O. Box 8131
8050 Zurich, Switzerland

www.abb.com/transformers

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