

A large, industrial Siemens power transformer is shown in a close-up, low-angle shot. The transformer is a complex of metal components, including a large cylindrical tank with cooling fins, and various electrical connections and insulators. The Siemens logo is visible on a horizontal beam. The background is a bright, overcast sky.

SIEMENS

Ingenuity for life

SIEMENS

Power transformers

Machine and network transformers
from 30 to over 1,300 MVA

[siemens.com/transformers](https://www.siemens.com/transformers)

Quality and performance – for us, a tradition and a matter of principle

A basic requirement for all power transformers is to deliver power to the consumer efficiently and reliably. Every single transformer is unique, designed according to individual factors such as voltage, power rating, climate, network topography, noise level, and many other criteria. At Siemens we translate your individual requirements into the very highest quality, and our power transformers are well known for operating reliably over many years.

Our quality guarantees reliability

Our high quality standards are known and acknowledged internationally. All Siemens transformer manufacturing plants worldwide work with consistently certified quality management systems, such as DIN ISO 9001:2008, among others. Above all, our high standard of quality is based on more than a century of experience in this field, as well as continual research and development work.

You can rely on our performance – anytime and anywhere

For our customers, power transformers are a core component of their power transmission system. For us, they are a passion. For more than 100 years, we've partnered with well-known power supply and industrial companies around the world. Our global manufacturing network allows us to optimally combine the advantages of a large global group with a regional presence. Wherever you are, we are close by to assist you with our expertise acquired over many years. We're ready to partner with you from the first steps of transformer planning, design, and production to transport and commissioning. Naturally, we continue to support you and service your transformer after delivery and commissioning. With our Transformer Lifecycle Management, we can also precisely fulfill special customer wishes and play a major role in increasing the service life of transformers.

350-MVA auto transformer



40-MVA network transformer



The first choice every time

The chief applications for power transformers are as machine and network transformers. Equipped with on-load or deenergized tap changers or a combination of both, they achieve a constant output voltage. We manufacture power transformers according to their intended application and the customer's requirements in single-phase as well as three-phase versions as multi-winding transformers or autotransformers – with power ratings of up to 1,300 MVA and for voltages of up to the highest insulation class of 800 kV. They can also be designed to be fully or partially transportable. And of course we manufacture our transformers according to the specifications of IEC 60076 and other international and national standards such as ANSI/IEEE and IEC.

Technical progress is our maxim

Every one of our transformers combines decades of experience and our conviction that no matter how good and well established a product is, there is always room for further improvement. To this end, we not only develop and produce transformers according to customers' requirements, but we have a policy aimed specifically at driving innovation forward. Not so long ago, extra-quiet transformers, eco-friendly liquid dielectrics, and DC compensation solutions were still regarded as a vision for the future – but thanks to our intensive research and development work in close cooperation with our customers, they are now part of our standard delivery range.

What our customers say:

"We know our contacts at Siemens personally and they are always on hand to help us, even with complex matters. That's the way a good customer relationship should work."
Power utility, USA

"We find the Siemens service excellent."
Power supply company, United Arab Emirates

"An expert, reliable, and trustworthy business partner."
Power supply company, Austria

"Our contacts at Siemens Transformers are very knowledgeable and listen to our needs and requests. They evaluate them swiftly and try to answer our inquiries as quickly as possible."
Customer in the metal industry, Brazil

"I'm happy to recommend Siemens transformers to my business partners."
Power utility specializing in hydropower, Canada

"Their experts work highly professionally. Siemens transformers are highly regarded."
Consulting company, China



420-kV network transformer with natural ester



Power transformer in partially transportable design



Auto transformer in a gas-fired power plant

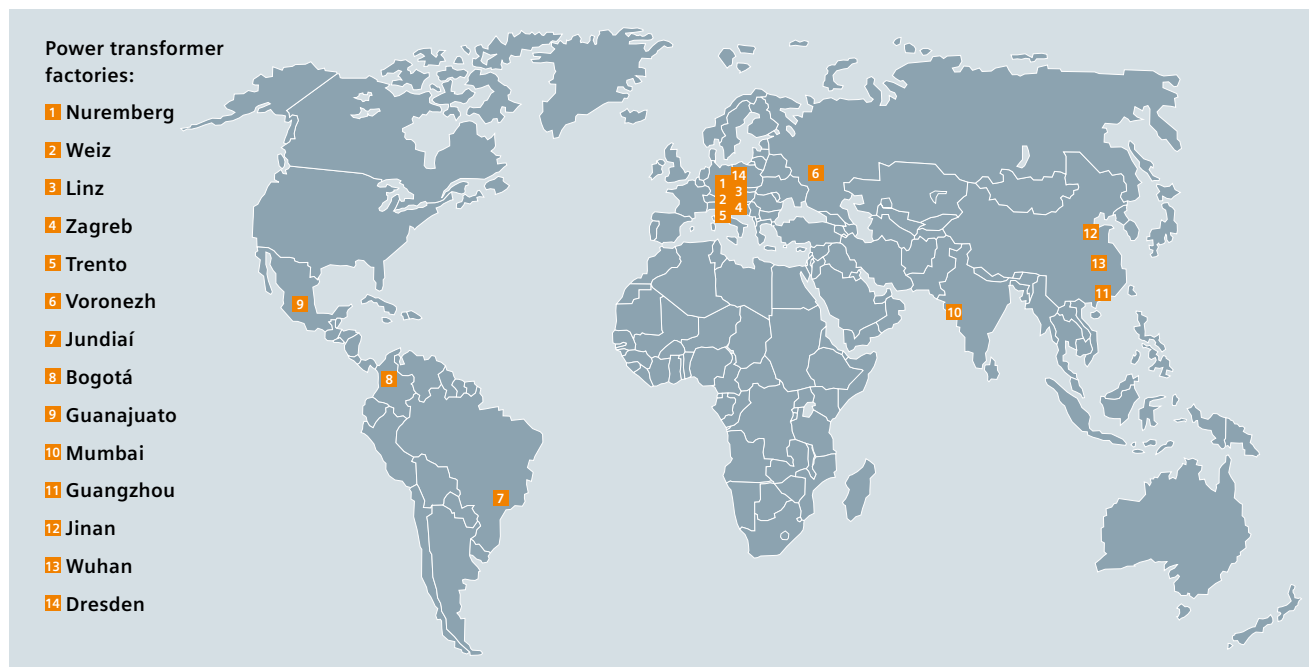
A global engineering network

We manufacture Siemens power transformers in a total of 14 transformer factories on four continents. Naturally, each one of these production plants has a different focus in terms of research and development. Our network of factories ensures that our customers worldwide profit from the special skills and solutions of all individual locations. Our production plant concept makes sure that the same extensive know-how and the same technology and quality are available to our customers around the world, regardless of location. Harmonized design, globally standardized design guidelines, and standard IT programs for all plants ensure that our customers always receive the best possible product, no matter which Siemens factory they purchase it from. A modular principle makes it possible to implement customers' specific requirements.

This brochure gives you an overview of the internationally standard steps in the manufacturing of our power transformers.

The unique organization of our global production network offers our customers clear advantages:

- Prompt preparation of bids
- Optimized, consistent end-to-end project management
- Noticeably shorter production and delivery times
- Very high delivery reliability
- Flexibility and reliability thanks to backup factories
- Fast, standardized documentation
- Just-in-time delivery



The making of a transformer

The core

The iron core forms the central element of every Siemens transformer. High-grade, cold-rolled and laser-treated metal sheets with thicknesses of 0.3 mm or less are precision-cut with computer-controlled machines, to ensure compliance with even the smallest tolerances. The individual sheets are then assembled into cores manually using the "step-lap" technique. In this way we achieve an especially good flux distribution at the joints, resulting in exceptionally low losses and minimal no-load noise. When the transformer core is ready, a hydraulic platform moves it into the vertical installation position in which the windings are assembled.

The windings

Transformer windings are subject to continuously high electrical and mechanical loads. Disk and cylindrical coils with transposed conductors of copper wire guarantee high mechanical strength here and long operational reliability.

Disk coils for high voltages consist of continuously wound coils that are divided by radial and axial channels for oil cooling. They are manufactured on vertical and horizontal winding lathes. Thanks to the continuous winding of the disk coils, the number of soldering points is reduced to a minimum. Precise control systems ensure constant contact pressure and winding tension while experienced coil winders monitor every working step.

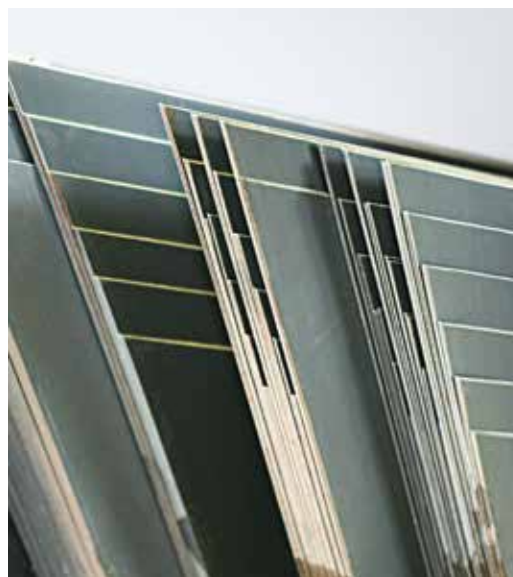
Multi-layer windings for low voltages consist of concentrically superimposed cylindrical coils separated by axial oil ducts.

After winding, the coils are pressed, dried under constant pressure, impregnated with oil, measured exactly, and geometrically adjusted if required.

Precision from the very first step: laying the core



Step-lap technique ensures ideal magnetic flux



Windings made of transposed conductors to a minimum



Voltage control

The grid and generator voltage can vary significantly from the rated value as a result of external influences. Siemens transformers therefore provide facility for adapting the voltage to the grid conditions. It can either be changed in the deenergized state by means of a deenergized tap changer or adjusted in steps under load using on-load tap changers. On-load tap changers and optionally deenergized tap changers are fitted with a motorized drive and can be controlled either locally or remotely.

The tank

High-grade, quality-assured tanks define the appearance of our transformers. This protective shell accommodates the core-and-winding assembly and the insulating oil. Together these often weigh several hundred tons. The tank should therefore not add too much extra weight, but at the same time it has to be structurally sound and leak-proof, and must withstand mechanical stresses. First-class corrosion protection is therefore a basic requirement for long tank life.

On-load tap changers reduce additional losses



On-load and deenergized tap changers ensure that the output voltage remains constant



This tank is specially built for transport on a Schnabel car



Cooling

The necessity of not exceeding the generally permissible maximum heating and of avoiding “hot spots” in the transformer require the cooling system to be dimensioned accordingly. Various methods of cooling can be used depending on the individual service conditions to guarantee reliable and problem-free operation over many years. The most noteworthy are the ONAN, ONAF, OFAF, and ODAF oil-air cooling and OFWF and ODWF oil-water cooling systems. The radiator banks and oil-air and oil-water coolers can be attached to the transformer or installed separately.

Final assembly

The core-and-coil assembly of the transformer is made up of core, windings, tap switches, and connecting cables. Particular emphasis is placed on the mechanical stability of the windings. Axial shear forces are minimized by a joint press ring for all windings on a core limb, since this fixes the geometrical position of the individual windings. The core-and-coil assembly is then dried in a vapor-phase system under vacuum at 130°C. After drying, all bolted connections on the core-and-coil assembly, which is still at a temperature of over 100°C are tested and secured, and the assembly is installed in the tank as quickly as possible. For increased life expectancy, the transformer is filled with insulating oil without delay so that the insulating parts absorb no moisture from the ambient air.

Once the attachments such as motor drive, control cabinets, bushings, and monitoring equipment are installed, the power transformer spends a certain time in the unenergized state, and is then ready for final testing and inspection.

Manual work from the first step to final assembly



The core-and-coil assembly is lowered into the tank



Cooling equipment ensures efficient heat dissipation



Final inspection and testing

Only after final inspection and testing is successfully completed do we dispatch a transformer to the customer. Each of our factories has a high-voltage test bay for this purpose in which a wide range of tests is carried out, from voltage tests – including lightning impulse voltage withstand tests – and temperature-rise tests, to special tests for insulation resistance, harmonics, or noise level. Short-circuit tests are performed in internationally recognized and approved institutes.

These comprehensive tests are a major reason why our power transformers are among the most reliable in the world, and why customers around the world trust our quality – which has been proven in every single case.

Transformer service

Even after the transformer has left the factory, customers can still rely on the support of our experts. We handle the transport and gladly carry out installation and commissioning on request.

We also offer our customers many different services to ensure reliable, fault-free operation throughout the entire lifecycle of our transformers. Our professionals from the Transformer Academy provide training courses on every aspect of our transformers, while our Transformer Lifecycle Management takes care of all problems and questions that arise during operation, from oil analysis and fault diagnosis, online monitoring, maintenance, and repair to fast and reliable procurement of spares, as well as repairs and retrofits.

For testing, the transformer is completely set up and connected



Transformer in the extra-high voltage test hall



Siemens TLM – service for the entire operating life



Always keeping an eye on overall costs

Transformers are high-value capital goods that have to pay back their cost over decades. That's why it is advisable not to make the acquisition costs the sole determining factor when purchasing a transformer, but also to always include the operating costs in the equation. Downtimes, fires, and explosions, but also failure to take perfectly plannable details into account, can quickly make an ostensibly low-cost transformer an expensive investment. So these factors must always be calculated as part of acquisition and operating costs before making a purchase decision.

Daily savings with efficient transformers

The question of efficiency has top priority in the calculation and design of our transformers. Ultimately, low losses mean real savings for our customers, and they also help protect the environment. That's why efficiencies of over 99 percent are standard for our transformers today. At the same time, more efficient transformers are quieter, which also benefits people and the environment. And if they need to be extra quiet in a particular case, you can rely on our engineers' unique noise-minimizing solutions. Our "whisper transformers" do not operate with purely passive attenuation, but actively remedy the root cause of the characteristic transformer hum.

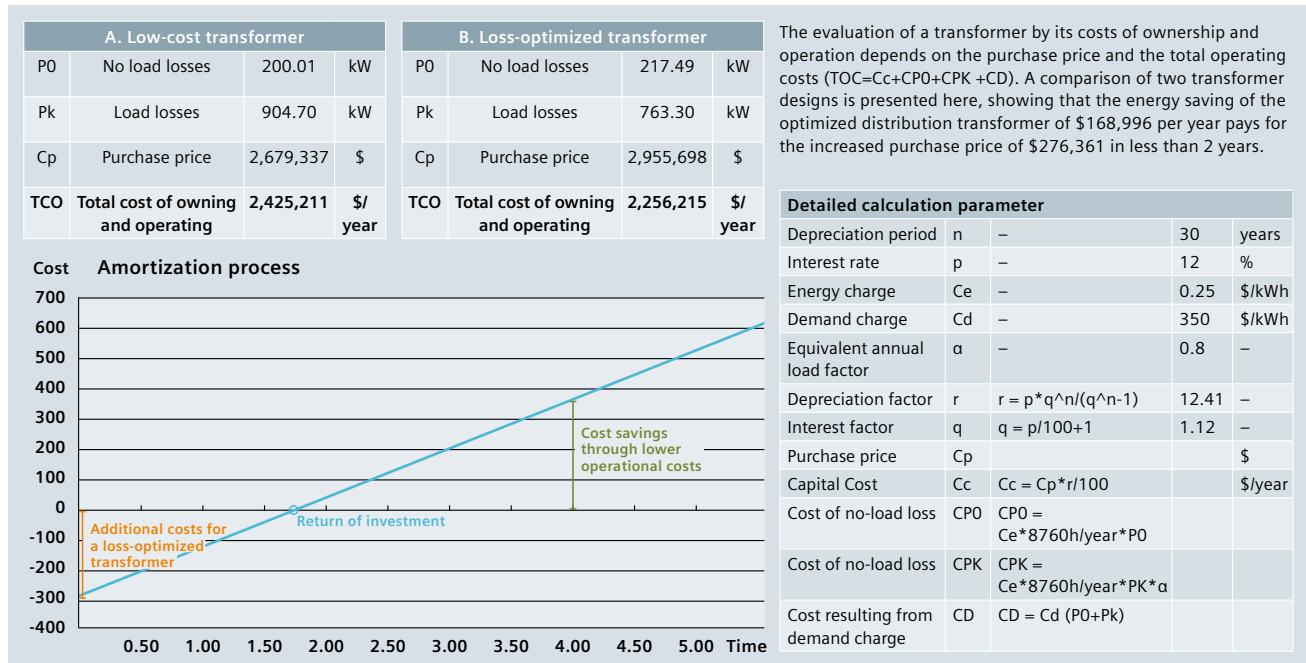
Environmentally friendly solutions

Thanks to our innovations and research in all aspects of alternative liquid dielectrics, we can offer transformers for deployment in locations with particularly high safety requirements, such as nature reserves, groundwater protection areas, or at sea. We have many years of experience with mineral oil alternatives in power transformers, as well as with silicone oils and also with liquid dielectrics made from synthetic and natural esters.

Minimized risk of failure

An important major requirement in transformer construction is keeping the risk of failure as low as possible. Unscheduled disconnection of a transformer from the grid causes high costs. That's why we ensure maximum reliability of all our products in everyday operation. There are good reasons why Siemens transformers are known for maximum short-circuit strength, overload capability, high-temperature operation, reliable start-up after a power outage, and low maintenance costs.

Sample calculation for total investment cost



References

Plant:
Guanajuato, Mexico
Operating location:
USA

For this dual low-voltage series transformer (20/26.66/33.33-MVA/138x69/26.18 kV) for an American transformer substation, the factory in Guanajuato, Mexico, combined expertise from various projects to deliver the best solution for the customer.



Plant:
Weiz, Austria
Operating location:
South Africa

Relations with the South African power supplier over many years led to the plant in Weiz, Austria, building large transformers for their transformer substations. The 800-MVA/400/275/22-kV unit shown has a total weight of 390 metric tons.



Plant:
Guangzhou, China
Operating location:
Australia

This single-phase 120-MVA transformer (132/66/11 kV) for a mining substation in Australia was delivered by the Guangzhou plant in China.



Plant:
Wuhan, China
Operating location:
China

The transformer factory in Wuhan developed the first transportable transformer substation with 66/110 kV and integrated 20-MVA transformer, to meet the requirement for a very safe and reliable transformer in compact design.



Plant:
Linz, Austria
Operating location:
Australia

Siemens developed and built a transformer for direct current compensation that is particularly quiet and energy-efficient in operation, designed for use in a reactive power compensation system. The energy saving is up to ten percent, with noise reduction of up to 15 decibels.



Plant:
Zagreb, Croatia
Operating location:
Philippines

This 318-MVA transformer was built in Zagreb, Croatia, for a combined cycle power plant in the Philippines. The extremely short delivery time of 5.5 months was achieved in part thanks to transport with a cargo plane.



Plant:
Jinan, China

Operating location:
Singapore

This 490-MVA transformer with $230\pm 15\%/22$ kV does its duty at a CHP plant in Singapore. It was manufactured at the transformer factory in Jinan, China, and is equipped with a special type of cooling (ONAN/ONAF/ONDF).



Plant:
Mumbai, India

Operating location:
India

This single-phase 240-MVA/22-kV transformer was built for an Indian thermal power plant. The unit was short-circuit tested at the KEMA in Holland, making it the largest Siemens transformer to pass this special test.



Plant:
Trento, Italy

Operating location:
Italy

Two of these 140-MVA transformers were built in Trento, Italy, for a local power generator. They fit perfectly in the existing fireproof housing of a thermoelectric power plant.



Plant:
Voronezh, Russia

Operating location:
Russia

The extreme temperatures in Siberia place special demands on transformers. This 125-MVA autotransformer easily fulfills these requirements, and losses are below the value stipulated in the Russian GOST standard.



Plant:
Nuremberg, Germany

Operating location:
Germany

This 420-kV power transformer for a substation was built at the transformer plant in Nuremberg. The customer needed an alternative, eco-friendly liquid dielectric for use in a water protection area. In response, Siemens developed the first transformer for the 420-kV extra-high voltage level using natural ester, which does not need a water hazard classification.



Plant:
Dresden, Germany

Operating location:
UK

For the London Array wind farm, the Siemens transformer plant in Dresden delivered four network transformers of 180 MVA each. As is usual in the case of transformers for offshore platforms, particular importance was attached to corrosion protection and compact design.



Plant:
Jundiaí, Brazil

Operating location:
Brazil

The factory in Brazil produced a 150-MVA reactor for use in a system for flexible three-phase transmission (FACTS). The 230-kV transformer weighs 125 metric tons.



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Energy Management Division
Freyeslebenstrasse 1
91058 Erlangen, Germany

Siemens AG
Transformers
Katzwanger Strasse 150
90461 Nuremberg, Germany

For more information, please contact
our Customer Support Center.
Phone: +49 180/524 70 00
Fax: +49 180/524 24 71
(Charges depending on provider)
E-mail: support.energy@siemens.com

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