Transforming know-how into top technology

Siemens cast-resin transformers

siemens.com/geafol
Siemens cast-resin, distribution transformers deliver unsurpassed safety, long service life and operational reliability. Designed and built to efficiently handle harsh conditions, cast-resin technology is an ideal option when compared to liquid-filled transformers.

Siemens cast-resin transformers comply with UL 1562, ANSI / IEEE C57.12.01, Department of Energy (DOE) efficiency requirements as well as CSA C22.2 standards. However, they can also be customized to meet special regulations or customer requirements. We offer tailor-made solutions that meet the requirements when it comes to operating mode, low noise, high efficiency, special terminal connections, type of cooling, as well as transport and installation.

Siemens cast-resin transformers are available with aluminum (GEAFOL®) or copper windings (CARECO®).

Safety proven: more than 150,000 times since 1966
Siemens cast-resin transformers are used wherever absolute safety is required. They are found in high-rise buildings, data centers, hospitals, road and underground railway shafts, offshore installations, mines, wind turbines, nuclear power plants, and many other similar safety-critical environments.

150,000 Siemens cast-resin transformers have proven themselves in power distribution all around the globe. Siemens is the inventor of cast-resin technology and proudly celebrated its 50-year anniversary in 2016.

Siemens cast-resin transformers cover power ratings ranging from 500 kVA to 50 MVA with operating voltages up to 46 kV in accordance to ANSI / IEEE or CSA standards.

The insulation system of Siemens cast-resin transformers is certified by UL with a thermal index of up to 180 °C.

We offer our transformers with enclosures of many different types, such as:
• NEMA 1 for indoor installation
• NEMA 3R for outdoor installation
• Customized enclosures for harsh ambient conditions.

Siemens cast-resin transformers offer environmentally sustainable technology and versatility, ensuring efficient energy distribution at load centers.
The progressive technology: Siemens cast-resin transformers

No gas inclusions: the epoxy-resin casting process
The high-voltage windings are potted with epoxy resin under vacuum at a high temperature. This procedure prevents undesirable gas inclusions. The quality of the potting, combined with the electrical advantages of the foil winding, play decisive roles in providing transformers that are practically free of partial discharges up to twice the rated voltage. The width of the aluminum or copper low-voltage winding is equal to the length of the coil. This considerably reduces axial short-circuit forces in the transformer. The conductor strip and the insulation material are bonded together by heating and form a compact unit with high strength to withstand radial and axial forces reliably, including short circuits.

Operating with vacuum circuit breakers
Transformers are the key operating elements at hubs in the distribution system. Switches must control distribution transformers switching reliably and safely without overvoltage protection. An important transformer parameter is the magnetization current (one of the “small inductive currents”). Interrupting these currents naturally creates marked transients causing high switching overvoltages that could pose a threat to connected distribution transformers.

Extensive trials using a combination of Siemens cast-resin transformers and vacuum switches have proven that our windings can handle switching overvoltages at load and no-load conditions. There is no need for expensive RC-snubber circuits when operating Siemens cast-resin transformers with vacuum circuit breakers.

Electrically safe: foil winding technology
The coils of the high-voltage windings are made of aluminum or copper foil. Foil windings combine a simple winding technique with a high degree of electrical safety. The insulation is subject to less electrical stress compared to other types of windings. In a conventional round-wire winding, the interturn voltages can add up to twice the interlayer voltage, while a foil winding never exceeds the plain voltage per turn because each layer consists of only one winding turn. The result: high-power frequency and impulse voltage - withstand capability.

Voltage stress comparison

Round-wire winding – The interturn voltages can add up to twice the interlayer voltage
Siemens foil winding – The interturn voltage is equal to the interim voltage
The reliable technology: Siemens cast-resin transformers

Siemens cast-resin technology has excellent electrical, mechanical and thermal characteristics that are compatible with the environment.

**Low maintenance, eco-friendly, rugged: insulation**

Siemens cast-resin transformers are insulated with a special epoxy-resin/quartz powder mixture. This is an environmentally friendly material that makes the windings practically maintenance-free, moisture-resistant, tropicalized, flame-retardant and self-extinguishing. This eliminates the need for additional flame-retardant chemicals, such as aluminum oxide trihydrate, that can negatively affect mechanical properties and hasten aging. Even when the insulation is exposed to arcing, there is no risk of toxic gases.

**Why we recommend aluminum?**

By increasing the cross-section of aluminum windings, their electrical properties are in no way inferior to their copper counterparts. Aluminum windings are the most reliable, proven and economical solutions.

**Universal: the application areas**

The highest safety requirements must be met whenever transformers are operated in the direct vicinity of humans or critical areas, which is why they must be marked with proven environmental, climate and fire-resistance ratings. Our cast-resin transformers are suitable for universal use and exceed the requirements of the highest classes presently defined by IEC 60076-11, which is proven by comprehensive testing. In addition, Siemens cast-resin transformers can be designed to fulfill the environmental class E3 defined by IEC 60076-16 as well as the climate categories C3 and C4 for lower ambient temperatures.

**Suitable for your application**

Siemens cast-resin transformers are the ideal solution wherever high-load densities necessitate provision of power sources close to the load. They give designers the necessary freedom, since they facilitate the economic implementation of network concepts, are environmentally friendly and safe.

Requirements stipulated in regulations, such as those for fire protection or water conservation, can be easily satisfied using Siemens cast-resin transformers. The design employed is not only flame-retardant and self-extinguishing, humidity and tropic-proof, but is also low noise. Because a wide range of possibilities are available, we can meet your planning needs.
The flexible technology: Siemens cast-resin transformers

50% performance reserves – with radial-flow fans
Radial-flow fans with temperature-dependent control can be installed to provide capacity reserves and to cover peak load periods. As a result, the transformer output can be raised by up to 50%.

Uncomplicated: planning with maximum freedom
Siemens cast-resin transformers remove the planning limitations imposed by conventional transformer technology. Since these transformers can be installed without difficulty at load centers, optimum supply system concepts are possible. No special safety features are required and there is no need for oil-containment pits. Since Siemens cast-resin transformers often need less space than liquid-filled and gas-insulated transformers, a higher output can be accommodated in the same area. The modular design of the transformer is another economical feature. Windings, for instance, can be mounted and replaced individually at the site.

To simplify installation, the transformers are optionally available with connections on the high-voltage (HV) or low-voltage (LV) side, top or bottom (note: LV connections are usually located on top, if fans are installed). Plug connections are also available.

Economical: low maintenance
Siemens cast-resin transformers are practically maintenance-free. When the advantages of Siemens cast-resin transformers are taken into consideration as early as at the planning stage, the overall costs of a power supply system can often be considerably reduced.

CO₂ balance
State-of-the-art Siemens cast-resin transformers reduce the CO₂ balance because of their high efficiency and low losses. Thanks to environmentally friendly product design and reduce materials and final weight, CO₂ is also reduced during the manufacturing process.

Disposal
Siemens cast-resin transformers are long-lasting with an economic lifetime of 30 or more years. Yet the time will come when the product will need to be replaced. Siemens cast-resin transformers have a high recycling rate. On average, approximately 4% of the material is disposed thermally, 2% of the material can be disposed of in the landfill, and a full 94% of the material can reenter the raw material cycle and be reused.
Construction and features

A new design for your success – the reliable, space-saving GEAFOL Neo

1. Three-limb core made of grain-oriented, low-loss electric sheet steel insulated on both sides
2. Low-voltage winding made of aluminum or copper strip; turns are permanently bonded with insulating sheet (Prepreg)
3. High-voltage winding made of individual aluminum or copper coils using foil technology and vacuum casting
4. Lifting eyes integrated into the upper core frame for simple transport
5. Delta connection tubes with HV terminals
6. Clamping frame and truck
   Convertible rollers for longitudinal and transverse travel
7. Insulation made of an epoxy-resin/quartz powder mixture makes the transformer extensively maintenance-free, moisture-proof and suitable for the tropics, fire-resistant, and self-extinguishing
8. High-voltage tappings ± 2 x 2.5% (on the HV terminal side) to adapt to the particular network conditions; reconnectable in de-energized condition

Temperature monitoring with PTC thermistor detectors in all low-voltage windings (alternatively: PT100 sensors or thermocouples)

Painting of steel parts
   High-build coating, RAL 7016, on request: special two-component coating for particularly aggressive environments

Structure made of individual components
   For example, windings can be individually assembled and replaced on site

Climatic Class C2

Environmental class E2/E3

Fire classification F1
The matching technology: Siemens cast-resin transformers

Cooling requirements for special applications
Siemens cast-resin transformers achieve efficiencies of more than 99%. Nevertheless, heat loss will occur and must be eliminated with suitable cooling. Depending on the place of installation, this sometimes requires enhanced technical and structural precautionary measures. The inflow and outflow of these air volumes can lead to a significant additional structural cost for air ducts, as well as additional measures for noise reduction if forced ventilation using fans is required. Furthermore, enclosures with a higher protection class may be desirable in harsh ambient conditions (including heavily dust-polluted or corrosive cooling air) in order to avoid construction costs for a transformer cell.

The solution: Siemens cast-resin transformers in air-force directed, water-forced cooling (ADWF) enclosures
We offer an optimized alternative for demanding ambient conditions – Siemens cast-resin transformers in ADWF cooling enclosures. These differ from the classic design with natural (AA) or forced-air cooling (AA/FA) with respect to the method of cooling.

Converter transformers for your drive application
These special transformers are particularly suitable for heavy-duty drives for steel mills, oil rigs, off-shore installations, conveyance facilities, wind turbine installations as well as DC-powered light rail systems, such as underground trains.

Siemens static converter cast-resin transformer windings are designed to cope with the thermal and electrical stresses generated during operation as well as for frequent start-up loading. They are primarily made with Dy5 or Dd0Dy5 vector-group for two-tier design. Required phase shifts are also possible with our technology by installing shift-tip windings. With this configuration, harmonics within the grid can be reduced.

Load-tap changers for voltage changes during operation
In order to supply highly modern and sensitive plants with a stable voltage, Siemens cast-resin transformers can be equipped with oil-free, load-tap changers. During operation our load-tap changers are capable of automatically regulating the voltage for a variation of up to 900V / step of the primary voltage with up to nine steps. This ensures a reliable power supply for sensitive areas, such as data centers, hospitals, and industrial companies or wherever grid voltages or load conditions are not stable. The load-tap changer’s drive is mounted in a control cabinet attached to the transformer frame.
The technical data presented in this document is based on an actual case or on as-designed parameters, and therefore should not be relied upon for any specific application and does not constitute a performance guarantee for any projects. Actual results are dependent on variable conditions. Accordingly, Siemens does not make representations, warranties, or assurances as to the accuracy, currency or completeness of the content contained herein. If requested, we will provide specific technical data or specifications with respect to any customer’s particular applications. Our company is constantly involved in engineering and development. For that reason, we reserve the right to modify, at any time, the technology and product specifications contained herein.