



TORYTRANS

CATALOGUE

ENERGY MANAGEMENT

2023



WELCOME TO OUR COMPANY

Torytrans is a leading company in the design and manufacturing of high-quality inductive products for energy management and renewable energy. With over 30 years of experience in the sector, our specialized technical team works closely with our customers to develop innovative and customized solutions that maximize efficiency, stability, and durability of power electronic converters.

We are a technological partner for our customers, offering a wide range of inductive products designed to help in the transition towards a more sustainable energy model, minimize dependence on fossil fuels, and reduce greenhouse gas emissions.

At Torytrans, we take pride in our production capacity, constant innovation, and flexibility to adapt to the needs of our customers across a variety of applications:



Wind energy



Hydraulic energy



Energy storage



EV chargers



Photovoltaic solar energy



Green hydrogen



Energy efficiency

INDUCTIVE COMPONENTS FOR POWER CONVERTERS

Inductive products are critical components in power electronic converters. We manufacture solutions that are tailored to specific needs, requirements, and regulations demanded by the topology of each converter and its application.

Some examples are:



Wind power converters for double-fed induction generator (DFIG) turbines and Full Converter systems.



Frequency converters for variable speed reversible machines in hydroelectric power generation or pumping stations.



Inverters for energy storage in batteries with DC and AC coupling for renewable energy generation plants.



Level 3 DC chargers for ultra-fast charging stations in vehicles and Level 4 for high power in commercial vehicles such as electric buses and trucks.



High power density photovoltaic solar energy inverters at 1000-1500Vdc, integrated solutions with MV transformers, compact inverters for residential, commercial and industrial applications.



AC/DC and DC/DC converters for H2 (green hydrogen) generation through water electrolysis using electricity generated by renewable energy sources.



STATCOM converters to improve energy efficiency of the grid by eliminating harmonics, compensating reactive power, and balancing unbalanced loads.



PRODUCTION CAPACITY AND CUSTOM DESIGN

With over 6000 sq.m of facilities, Torytrans has a high production capacity to meet the demand of a growing and fast-paced market. Thanks to self-sufficient materials and component supply, we can adapt to the needs of our customers, offering solutions quickly and efficiently. This gives our customers in different sectors, such as renewable energy, railways, or electromedicine, the confidence to rely on our technical and quality department to provide solutions that meet their requirements.

DESIGN, MANUFACTURING AND EVALUATION PROCESS

80% of Torytrans' production comes from customized solutions developed according to necessary requirements and service conditions of applicable UNE_EN, IEC, UL, and IEE standards. Thanks to our own analytical modeling tool with advanced algorithms, we can optimize the design of equipment as quickly and accurately as possible. This allows us to develop and produce exactly the type of product that our customer needs.

01 CONSULTING

Our extensive experience allows us to assist our customers to achieve the optimum technical-economic balance consistent with the utility and performance required. From this starting point, we define the initial data based on the requirements and in compliance with the service conditions of the applicable UNE_EN, IEC, UL, IEE standards.

03 INITIAL SIMULATION

We performed a simulation of the equipment's electrical circuit and an FEMM simulation of the transformer and reactor using finite elements. In this way, we can validate the equipment losses in real conditions of voltages, currents and frequencies of use according to the intended application.

05 ADVANCED MANUFACTURING

Once the 3D model is approved and validated by the customer, we prepare the manufacturing documentation, automatically monitoring the versions by using a PDM manager. Automated management of purchase orders, operations and manufacturing of components and assemblies streamlines and reduces lead times. Most importantly, we have a trained and experienced production team that ensures a final product according to the design.

02 CALCULATION ANALYSIS

Our own analytical modeling tool based on advanced algorithms allows us to optimize the magnetic and thermal design of transformers, reactors and equipment. The iterative calculation consistent with the current variability of the market allows to quickly evaluate and adopt the best technological solution for each possible type of winding and magnetic core.

04 3D MECHANICAL MODELING

By modeling the complete 3D mechanical geometry of the transformer, reactor or equipment, we can work together with the customer and customize to the last detail, such as dimensions, anchor points and electrical connections. All according to the integration requirements of their equipment.

06 VERIFICATION AND VALIDATION

The final product is put through the individual and type tests according to the applicable UNE_EN, IEC, UL, IEE standards. Furthermore, if the client or the project requires it, we carry out special tests, either in-house or in collaboration with certified independent laboratories. Once all the tests have been successfully completed and their suitability has been confirmed, the product is validated for its final use.



INVERTER TEST BENCH FOR TYPE TESTING

Intelligent power system for high frequency inductive modeling. It allows emulating the behavior of reactors with high frequency harmonics for their characterization, resulting in the development of optimized energy efficient reactor devices.

EXCELLENCE AND INNOVATION

TESTING & VALIDATION

In our commitment to quality and safety, all Torytrans equipment undergo rigorous testing and validation processes to ensure their operation under similar conditions to those of final use. Torytrans has a highly trained team and a wide range of state-of-the-art testing facilities and equipment to conduct tests on its equipment. These tests include insulation resistance tests, short circuit current tests, breakdown voltage tests, winding resistance tests, losses and efficiency tests, and load tests. This guarantees the highest standards of quality and safety.

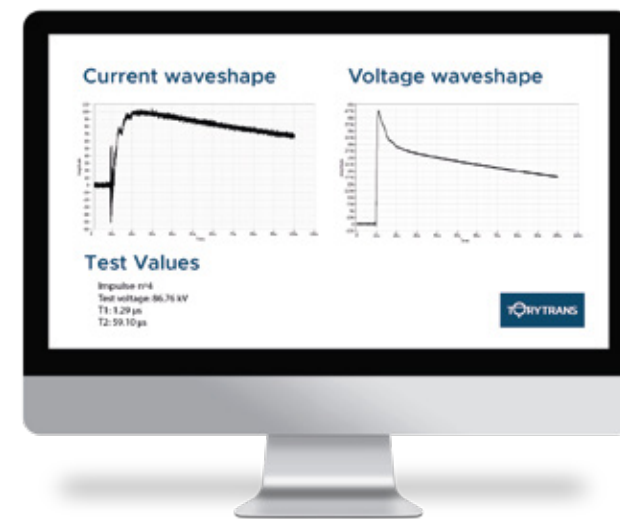


AUTOMATED TEST STATION FOR INDIVIDUAL TESTING

Automated testing protocols reduce errors and ensure the quality of the final product. It generates the necessary certificates to meet the customer's requirements.

SPECIAL TEST IN ACCREDITED LABORATORIES

- ✓ Lightning test
- ✓ Short circuit test
- ✓ Vibrations
- ✓ Fire suitability tests F1.
- ✓ Adverse weather conditions E3 C3



TECHNICAL CHARACTERISTICS APPLICABLE TO REACTORS FOR POWER CONVERTERS

ELECTRICAL CHARACTERISTICS

- ✓ **Rated voltage** LV 400 ÷ 1100 V / MV: 3.6 ÷ 17.5 kV
- ✓ **Rated current** 100 ÷ 5000 Arms
- ✓ **Inductance** 1 ÷ 900µH / 1 ÷ 900mH
- ✓ **Inductance tolerance** ±5% / ±10% depending on application
- ✓ **Inductance linearity** 1.5 ÷ 5 x I_n without saturation
- ✓ **Nominal frequency** DC / AC 25 ÷ 400Hz
- ✓ **Switching frequency** 2 ÷ 10kHz Magnetic steel / >10 ÷ 50kHz Ferrite core
- ✓ **Current harmonics** FFT specified according to switching topology
- ✓ **dV/dt slope** Up to 10 kV/µs
- ✓ **Phase-to-ground voltage stress** LV 2500 Vpph-gnd / MV: 25000 Vpph-gnd
- ✓ **Insulation voltage** LV 1.1kV / MV: 17.5 kV
- ✓ **Applied voltage test** LV: 4 kV 1' 50Hz / MV: 38kV 1' 50Hz
- ✓ **BIL test** Up to 95kV 1,2/50µs
- ✓ **Short circuit current** Up to 200 kA 1'
- ✓ **Number of columns** 1, 2, 3 and 4 / Optional armored for common mode
- ✓ **Number of phases** 1, 2, 3 and 4 for neutral
- ✓ **Insulation** Dry type
- ✓ **Service** Indoor
- ✓ **Safety class** Class I
- ✓ **Contact protection degree** IP00

(*)Other applicable technical characteristics can be considered under customer's specifications.

SERVICE CONDITIONS

- ✓ **Ambient temperature** 50°C / up to 80°C depending on application
- ✓ **Installation altitude** ≤1000m / up to 4500mm
- ✓ **Air relative humidity** ≤95%
- ✓ **Climatic class** C2 - Minimum operating, transport and storage temperature -25°C
- ✓ **Environmental class** E1 - Occasional condensation and limited pollution
- ✓ **Fire class** F0 - No fire risk considerations
- ✓ **Seismic requirements** Vertical acceleration ≤0.2g
- ✓ **Vibration level** According to requested specification
- ✓ **Water or liquid protection** Not protected
- ✓ **Special conditions** Not protected against contamination by substances of biological, chemical, particle, excessive dirt or dust origin.

APPLICABLE REGULATIONS

- ✓ UNE-EN IEC 61558-2-20
- ✓ UNE-EN IEC 60076-6
- ✓ UL 5085-1, UL 5085-2
- ✓ CAN/CSA C22.2 No. 66.1-06
- ✓ CAN/CSA C22.2 No. 66.2-06
- ✓ UL1446
- ✓ RoHS / REACH



CONSTRUCTION TECHNOLOGIES OF REACTORS FOR POWER CONVERTERS

✓ ALUMINUM OR COPPER WINDINGS ACCORDING TO APPLICATION, CURRENT, AND FREQUENCY

- Grade 2 enamel round wire with thermal class of 200°C
- Grade 2 enamel rectangular strip or double-crossed taped with thermal class of 220°C
- Annealed foil with smooth edge.
- Multiple enameled wire Litz conductor wired in a string

✓ MAGNETIC CORES ACCORDING TO APPLICATION, INDUCTION, AND FREQUENCY

- GO and high-permeability GO magnetic sheets
- NOGO and high-permeability NOGO magnetic sheets
- Ferrite, amorphous, and nanocrystalline materials

✓ INSULATION CLASS F155°C OR H180°C ACCORDING TO REQUIRED THERMAL CLASS

✓ CONNECTIONS BY PRESSURE TERMINALS, SCREWS, OR BUSBARS ACCORDING TO CURRENT RATING

✓ VACUUM AND PRESSURE IMPREGNATION (VPI) IN EPOXY RESIN-BASED VARNISH AND SUBSEQUENT OVEN DRYING

✓ ANTICORROSIVE TREATMENTS UP TO C4M GRADE ACCORDING TO ISO12944

✓ TEMPERATURE SENSORS: PT100, NC THERMAL CONTACTS FOR ALARM AND TRIP, NTC, ...

✓ OPTIONALLY: SILENT BLOCKS, LIFTING EYES, INTEGRATION OF MULTIPLE REACTORS.

✓ LIFETIME ≥ 20 YEARS AND MTBF 10^6 HOURS

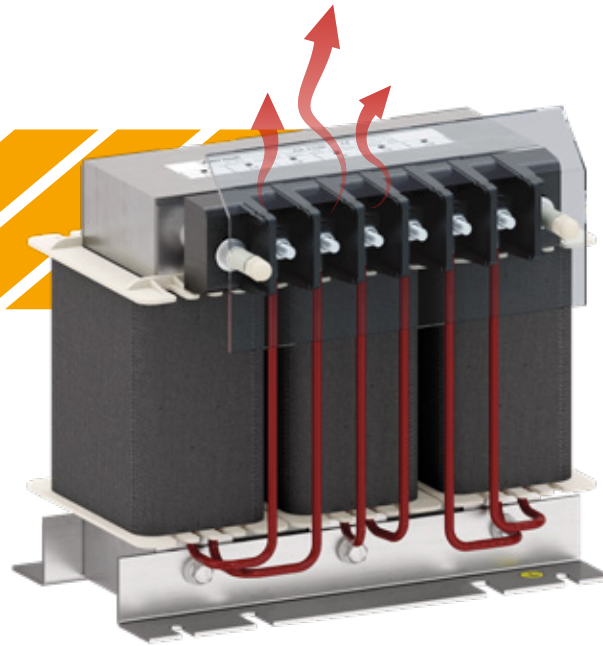




COOLING SYSTEMS

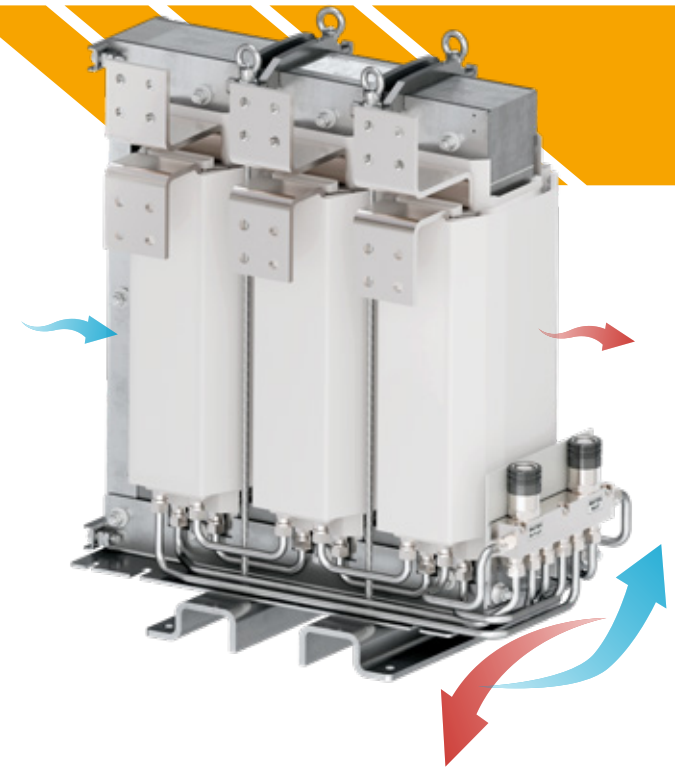
AN: NATURAL AIR

Losses are dissipated by natural air convection.
For low power density



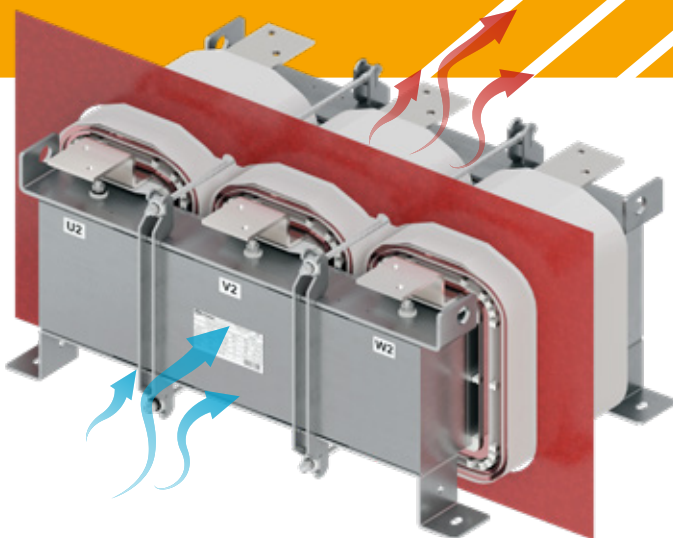
WF: FORCED WATER

Losses dissipate:
 ≈75% to the forced water recirculation loop.
 ≈25% to natural or forced air convection.
 For medium and high power density
 50% glycol - 50% water



AF: FORCED AIR

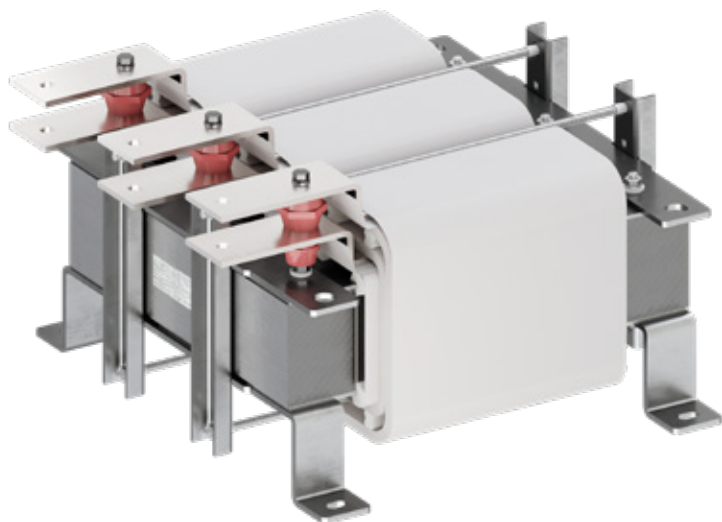
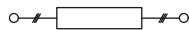
Losses are dissipated by forced air convection.
For low and medium power density



REACTOR TYPOLOGY BY FUNCTIONALITY IN A POWER CONVERTER

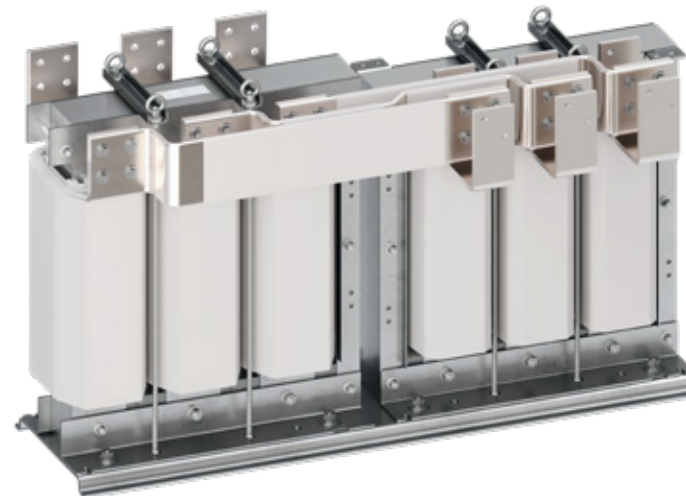
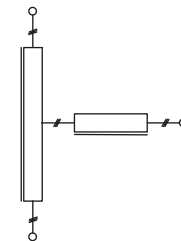
THREE-PHASE dV/dt FILTER REACTOR

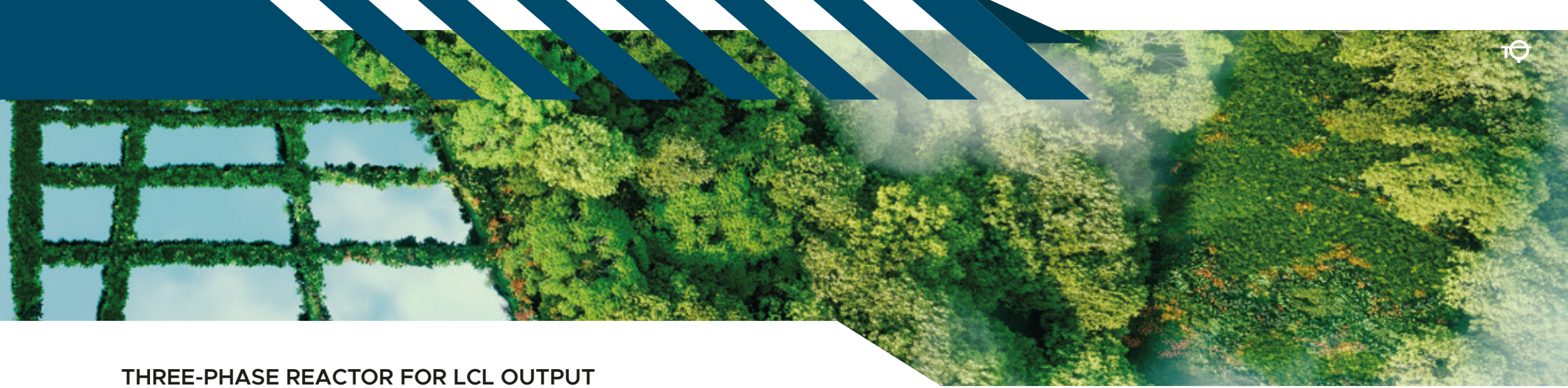
The reactor attenuates the rapid voltage variation of the power converter's PWM. It protects generators/motors and electronic components against transient overvoltages caused by switching pulses.



THREE-PHASE DISTRIBUTION REACTOR FOR DOUBLE CONVERTER WITH INTEGRATED dV/dt FILTER

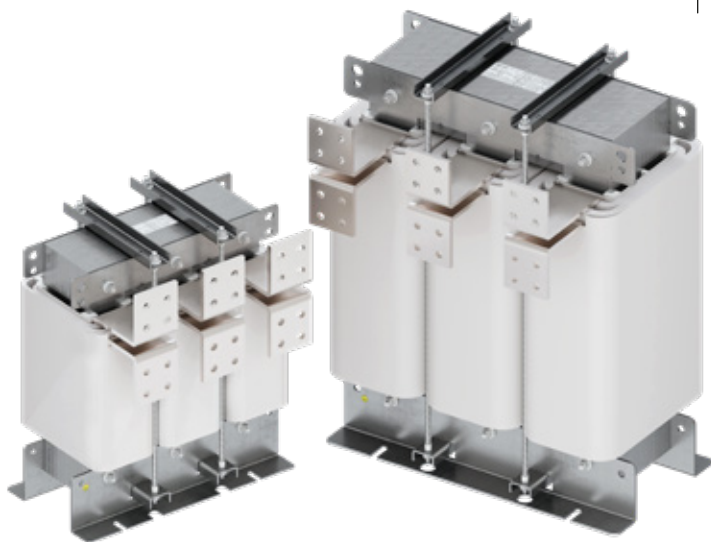
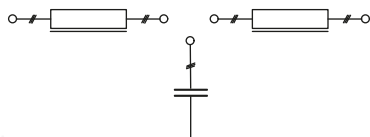
The distribution reactor couples two converters forming a back-to-back topology, allowing bidirectional energy control in the converters. In addition, it is connected to the output of a common dV/dt filter reactor for both converters.





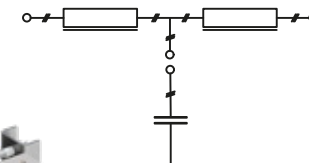
THREE-PHASE REACTOR FOR LCL OUTPUT SINUSOIDAL FILTER - PRIMARY AND SECONDARY REACTORS

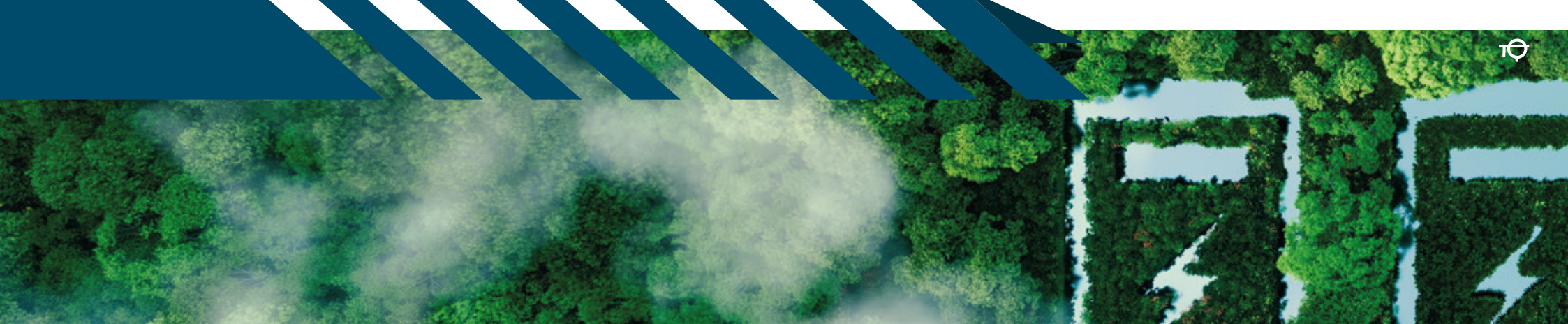
Independent primary and secondary reactors for the converter's LCL output filter. They attenuate PWM switching harmonics by restoring the sinusoidal wave and also eliminate problems associated with high dV/dt .



THREE-PHASE REACTOR FOR SINE FILTER INTEGRATED 2 IN 1 THE L_PRIMARY AND L_SECONDARY

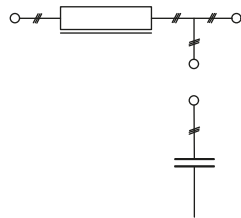
Primary and secondary reactors integrated in a single device for LCL filter converter output. They attenuate the PWM switching harmonics restoring the sine wave and at the same time eliminate the problems associated with high dV/dt .





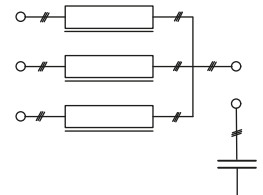
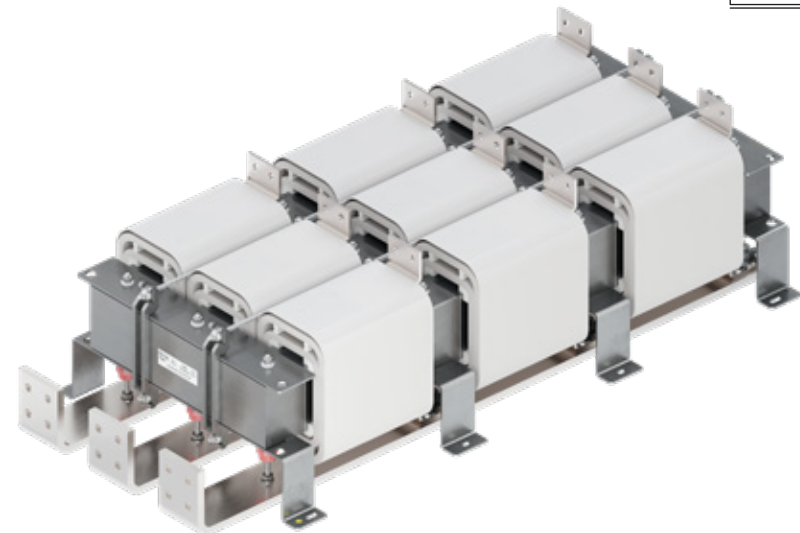
THREE-PHASE REACTOR FOR HIGH POWER DENSITY SINE FILTER WF COOLING

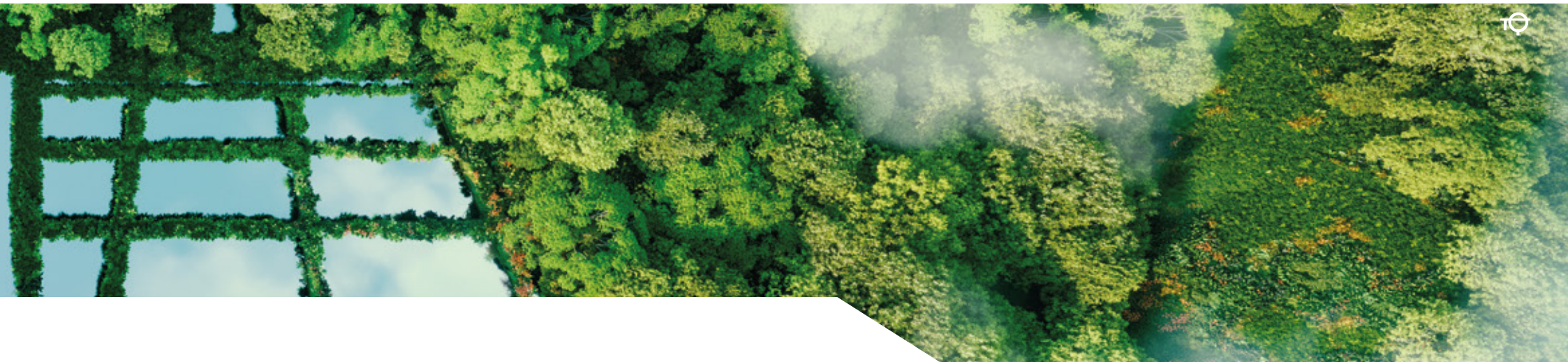
Primary reactor for LC filter output converter with liquid cooling WF. Allows to reduce the size of integration in the converter. They attenuate the PWM switching harmonics restoring the sine wave and at the same time eliminate the problems associated with high dV/dt .



THREE-PHASE REACTOR FOR SINE FILTER INTEGRATED FOR 3 MODULES IN PARALLEL

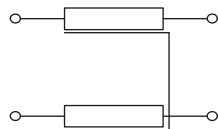
Integration in a single unit of 3 primary reactor for paralleling 3 converters. For converter output LC filter. Attenuates PWM switching harmonics restoring the sine wave and at the same time eliminates the problems associated with high dV/dt .





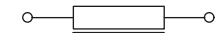
DC REACTOR COMMON MODE AND DIFFERENTIAL MODE FILTER

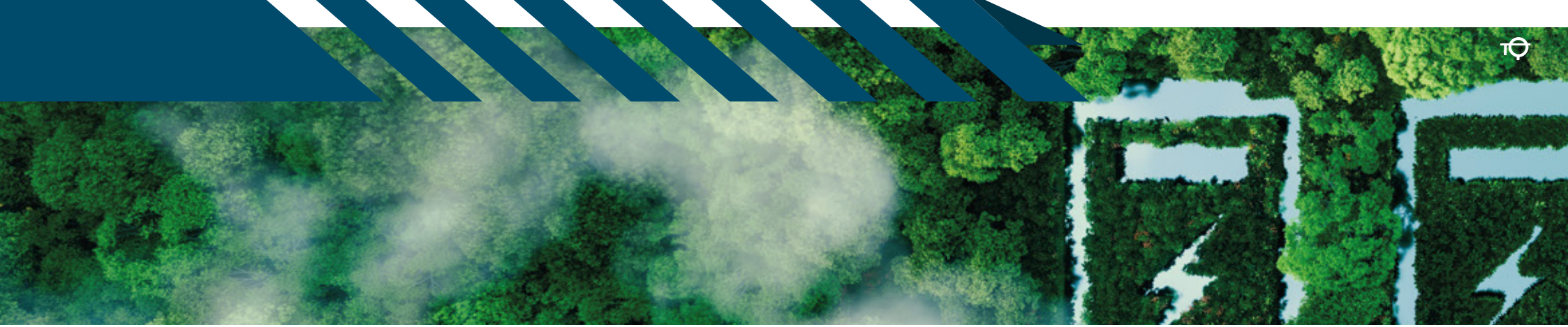
The reactor is used simultaneously as differential mode reactor (DM) and also as common mode reactor (CM). It attenuates the switching ripple in DC/DC converters.



DC FILTER REACTOR

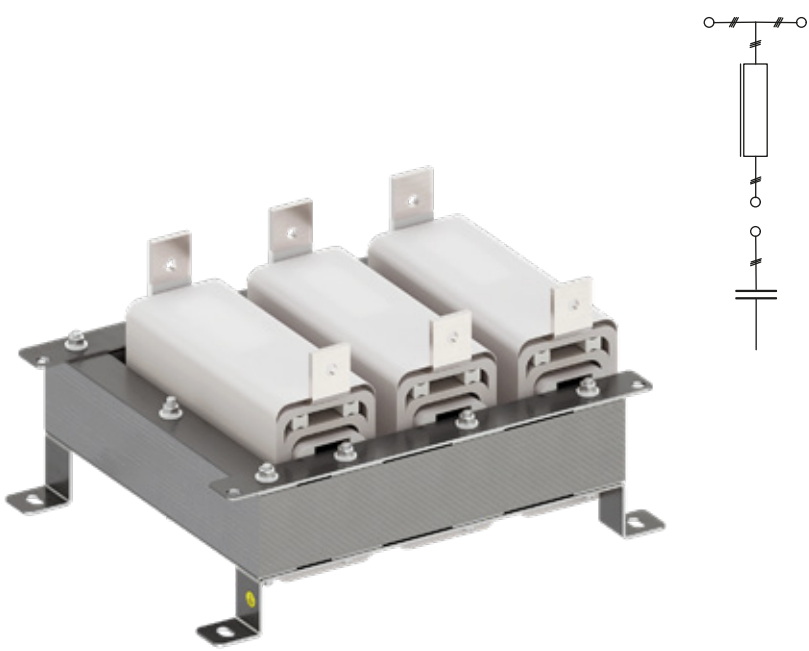
Filter reactor for AC/DC converters. They attenuate DC ripple and improve the power factor on the AC side.





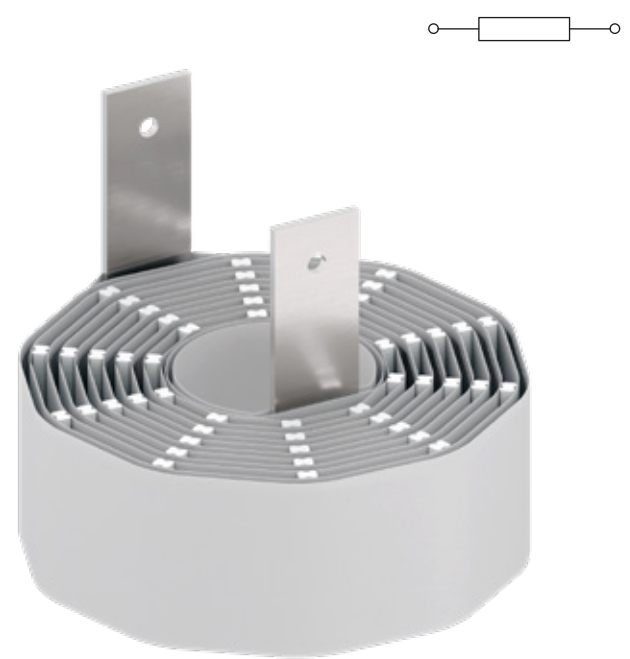
THREE-PHASE NOTCH FILTER REACTOR

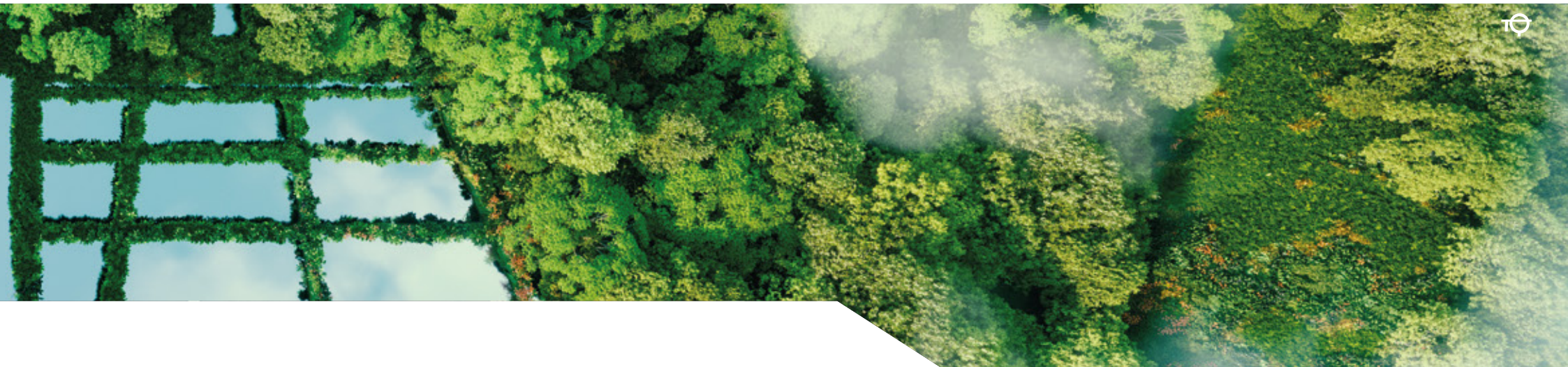
Notch filter reactor tuned in the unwanted kHz band, attenuates or eliminates the residual harmonics of the main filtering obtaining a sine wave in accordance with the most demanding IEEE harmonic standards.



AIR CORE REACTOR

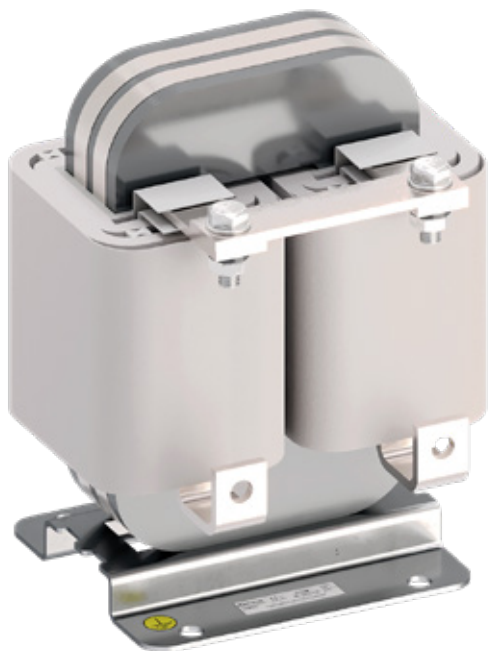
Reactor or filter reactor in alternating current without magnetic saturation. It admits high short-circuit current minimizing the radial electrodynamic stresses and maintaining its nominal inductance value L(mH).





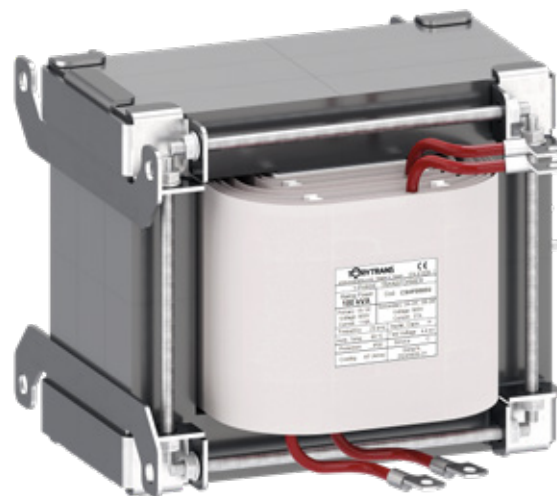
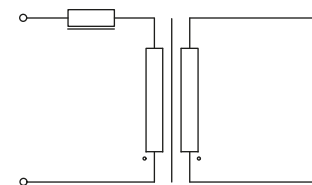
HIGH FREQUENCY REACTOR FOR DC CONVERTERS

Reactor of HF filter for DC Flyback and Buck-Boost converters.
Attenuates switching ripple and reduces dV/dt .



ISOLATION TRANSFORMERS WITH LEAKAGE REACTOR

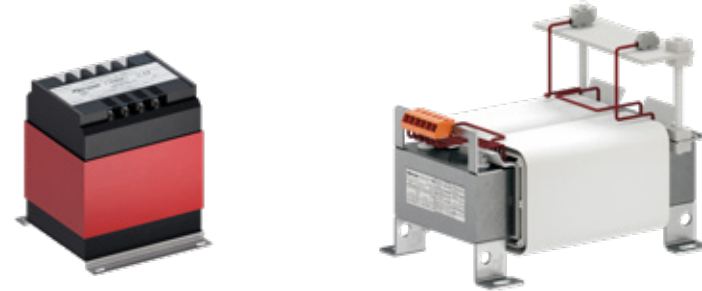
Introduce an electrical isolation barrier between the input and output bridges. Enable power transmission through their leakage reactor (leakage).



SINGLE-PHASE CONTROL TRANSFORMERS IN POWER CONVERTERS

CSE series (IP20) and CNS series (IP00)

They provide an isolated safety voltage and to supply the inverter's control systems.



AUXILIARY SERVICES TRANSFORMERS IN POWER CONVERTERS

TTS Series (IP00) - TTC Series (IP23) - TTP Series (IP54)

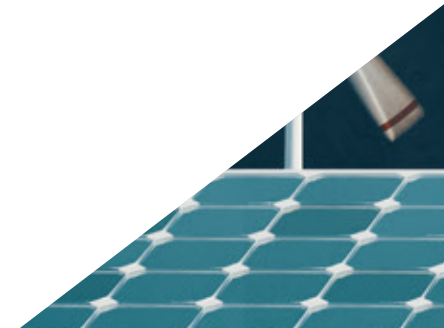
They are used to supply electrical power to auxiliary equipment of the converter or power plant such as lighting, ventilation and cooling pumps.



POWER TRANSFORMERS FOR RECIRCULATION IN BACK-TO-BACK CONVERTERS

TTHS series (IP00) - TTHC series (IP23)

Allow to transfer electrical power from one AC system to another AC system through a DC link through a DC link



INNOVATION FOR AN EFFICIENT FUTURE





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