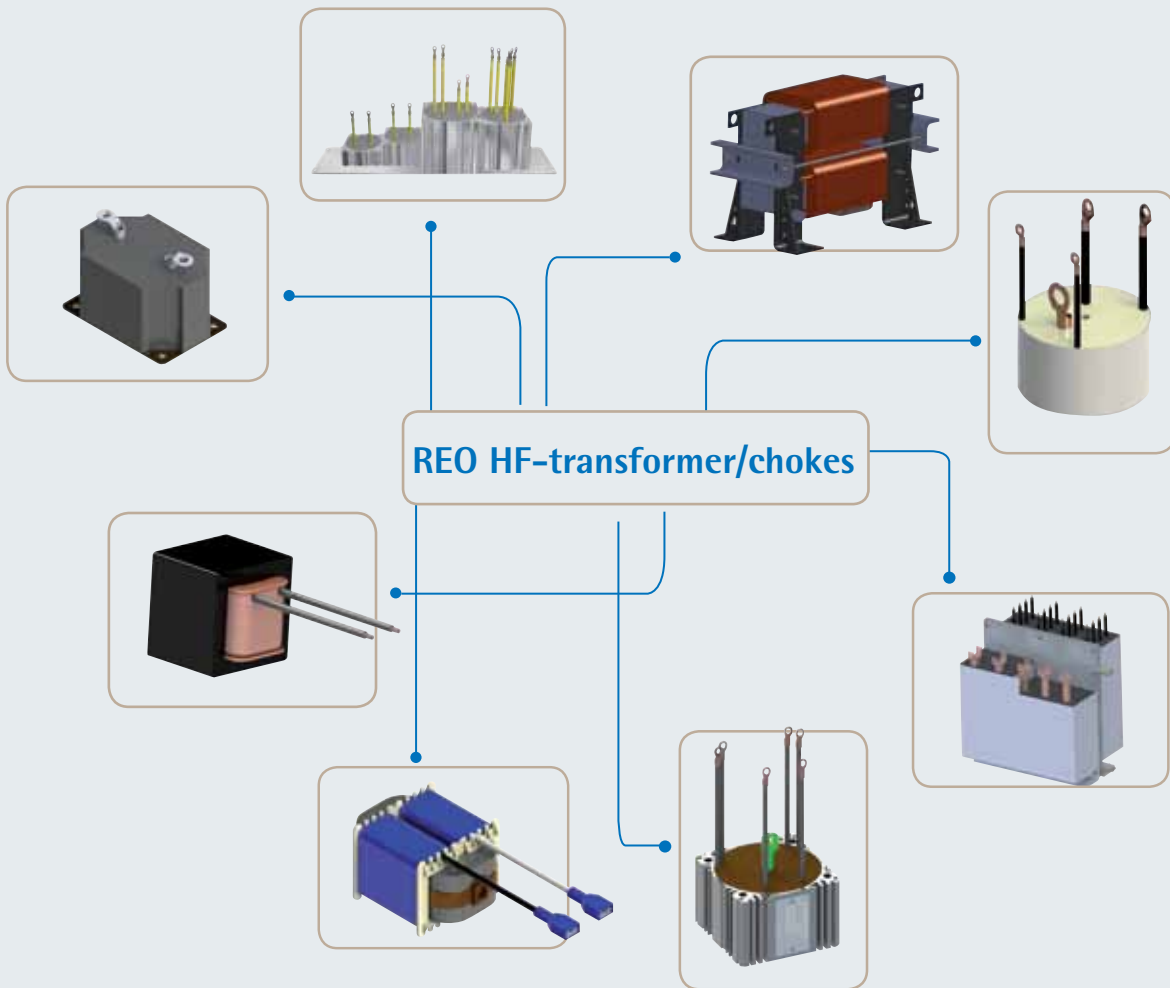


## REO HF-components Product catalogue

HF-transformers in plastic housings • Wide input voltage range HF transformers • HF-transformers in aluminium profile housing • Storage cho



REO produces high frequency components, power transformers and chokes on toroidal basis or pot core basis in UI cut with a power range from 1 kW to 90 kW in the frequency spectrum of up to 100 kHz.

Benefits of our HF-transformers:

- Highest compatibility, low heating as well as a minimal noise development
- REO components can be manufactured according to the customer's requirements and are available in various executions, for example vacuum sealing
- The models with the aluminium profile have furthermore improved heat dissipation and can, for example, be water-cooled by means of a cold-plate (customer cold-plate with REO component or as complete set)
- All Components are tested under real conditions in the in-house laboratory
- Quality standards: DIN EN 60310, DIN EN 60076-6 as well as DIN EN 61558
- Long-term tests and 'burn in' for encapsulated transformer models

Content	S. 2-3
<b>HF-Transformers</b>	
Facts about HF-transformers	S. 4-7
HF-transformers in plastic housings	
Wide input voltage range HF transformers	S. 8
HF-transformers in aluminium profile housing, Coldplate	S. 9
<b>Storage chokes</b>	
Facts about storage chokes	S. 10
Storage chokes with toroidal core	S.11
Storage chokes with UI core	S.12
Storage chokes with UI core, railway-compatible	S.13
<b>HF-Combinations (PowerUnit)</b>	
HF-Combinations - PowerUnit	S. 14
<b>Your REO-Plus</b>	
Your Plus	S. 15

## Applications:



Renewable energies



Train technologies



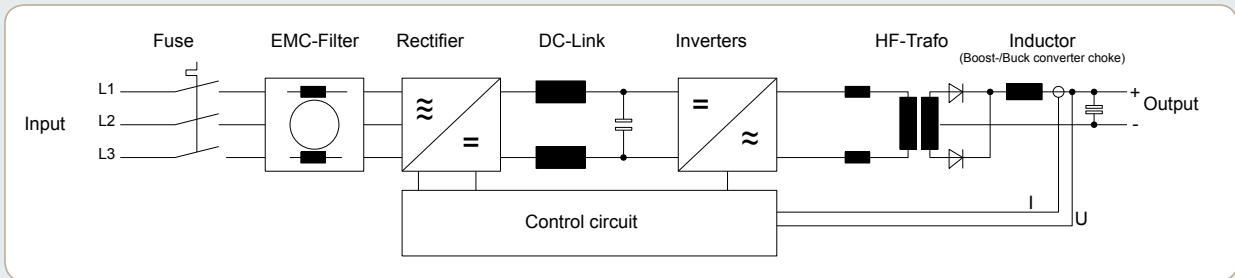
Drive converters



E-Mobility

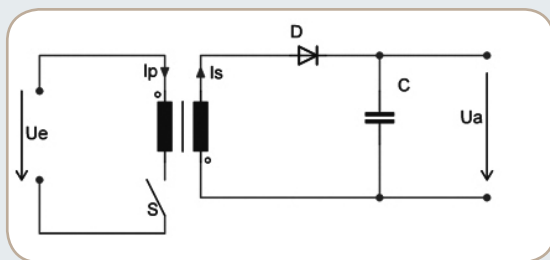
# Facts about HF-transformers

In the design of HF systems the size of the components plays an important role. Transformers operating at frequencies above 50 Hz are usually much smaller than units operating at 50 Hz at comparable power levels. In addition undesirable characteristics such as eddy current losses and leakage inductance increase proportionally to the dimensions of the device so keeping the transformer small means that these unwanted characteristics are also reduced. The use of our core materials ensures that a high efficiency design with reduced costs and increased product life is possible.

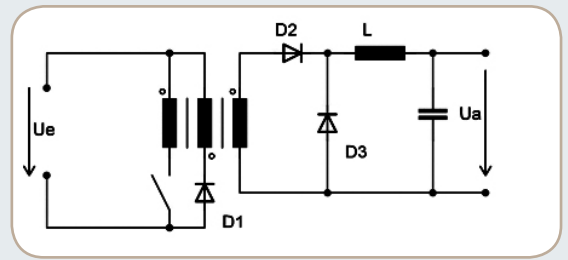


The switching frequency required by the customer plays an important role for the choice of core materials. The following core materials are used for REO transformers and chokes (depending on the frequency):

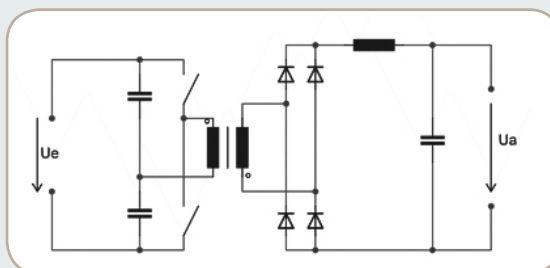
- Amorphous cores
- Nanocrystalline cores
- Ferrite cores



Switching principle flyback



Switching principle forward converter



Switching principle half-bridge push-pull converter

### The benefits at a glance:

- Size reduction prolongs service life and enables cost savings
- Modular design
- Water cooling with Coldplate available
- Wide range of core materials and windings
- Insulation between primary and secondary windings for test voltages up to 6 kV
- Insulation for partial discharge  $\leq 10$  pC  
DIN EN 61287: 1–10 mm (Insulation distance between primary and secondary winding)
- Protection class up to IP 65 with litz wires and encapsulation
- Insulation class B, F and H
- Ambient temperature:  $-40$  to  $+85^{\circ}\text{C}$
- Wide range of construction designs and options
- Customized solutions
- REOplus: REO speaks your language - with global sales offices and production REO is always close to its customers and can react quickly, efficiently and cost effectively



Depending on the calculation and application REO offers the following winding types:

- Stranded wire winding
- Wire winding
- Cu-strip

REO power transformers are available in plastic housings for industrial use (HF transformers for less demanding applications), mounted onto a plate with pins or in aluminium profile case. Full encapsulation and a wide range of winding types are further advantages of our transformers.

### Why HF wires?

- High efficiency
- Suppression of the skin- and proximity-effect
- Minimal eddy current losses
- Prevention of „Hot spots“
- High dielectric strength



### Suppression of the skin effect by HF wires

Alternating currents in all conductors naturally flow more easily near their surface. This skin depth is proportional to the frequency and power flowing. The magnetic field created by the flow of current, generates a current that opposes the main flow. This means that current only flows in the outer regions of the conductor effectively reducing its cross sectional area. This is known as the 'skin effect'.

In HF wires the copper cross section is divided onto many small individual conductors. This ensures that the diameter of each conductor is less than the skin depth, so that the entire cross section for the current flow is available.

## Optional liquid cooling for HF transformers and chokes

REO's aluminium profile housing provides the possibility to mount the component onto a cooling plate (Coldplate) allowing further component optimization thanks to better heat dissipation.

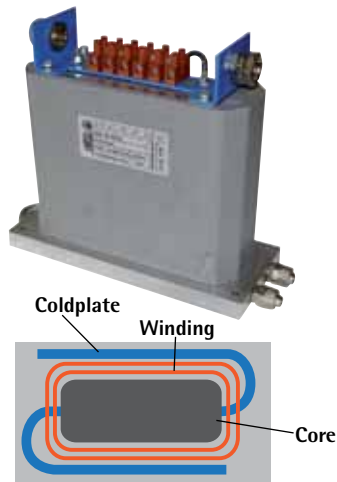
The cooling is carried out via cooling plates, which separate the cooling system physically from the electric circuit meaning that the electrically active components have no contact with the cooling medium.



### Coldplate-Version

HF-transformers and chokes in aluminum profiles, mounted on a Coldplate can dissipate the heat more efficiently and can be integrated into existing systems.

- **Example of a customized solution: Combination of filter chokes, boost converter and transformers, suitable for railway engineering and mounted on a Coldplate**



Schematic diagram

### Coldplate-Choke CNW MC

- Targeted and optimized cooling
- Suitable for industrial water and standard cooling liquids
- Easy connection for liquid cooling
- Working pressure up to 4 bar (10bar test)
- Protection up to IP64
- Various connections: wires, terminals, terminal box
- Low audible noise
- Lower surface temperature

## Competence and service down to the smallest detail

The most significant advantage of REO is the ability to design components for specific applications based on standard series.

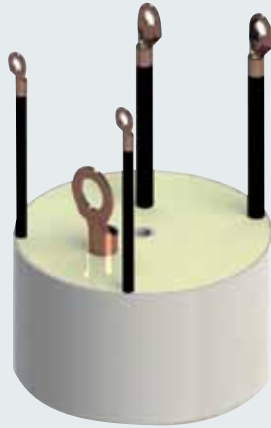
For us, service is not just a word: Specialized technicians and engineers develop customer specific product solutions. Product development, calculation and construction are made in close coordination with the customer at all stages of development.

**All devices are available as standard design - but also as customer-specific solutions.**

# HF transformers in plastic housing



## Frequency from 7-100 kHz



Example of a design

### Benefits

- Smaller size due to high frequencies
- Less losses due to nanocrystalline, amorphous and ferrite cores
- Reduced use of materials
- Higher insulation class and less noises due to sealing technology
- Wide input voltage range possible, if  $U_{pmax} \geq 2x U_{pmin}$  is required.

### Connections

- Stranded wires with cable gland
- Copper connection bracket
- Brass stud bolt

Technical data	
Power range	0,5 - 10 kW
$U_{pmin}$ [V]:	150-500 V
$U_{pmax}$ [V]:	50-800 V
$U_{sec}$ [V]:	8,75-1650 V
T:	0,1-80
$I_{sec}$ [A]:	0,05-2x42A

Series HPTV

# Wide input voltage range HF-transformers

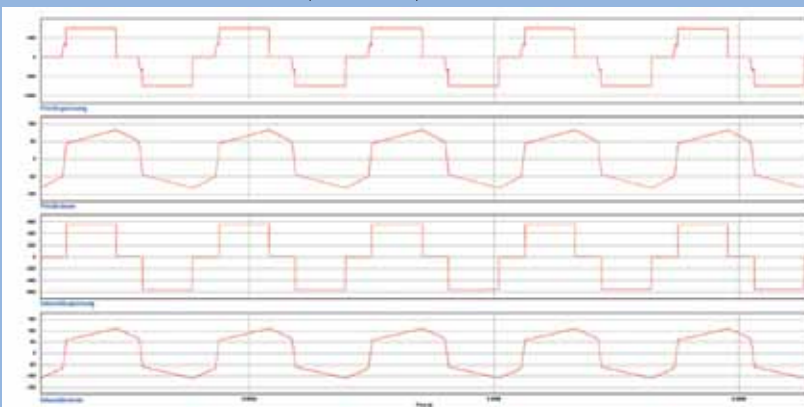
REO HF-transformers are used for wide voltage ranges ( $U_{min}$  50 V -  $U_{max}$  150 V/500 - 800 V) - this means no additional circuit complexity for the user.

The use of special toroidal cores allows a higher power/performance ration.



## Wide input voltage range for HF transformers

Wide input voltage range:  $U_{pmax} \geq 2x U_{pmin}$



Upper curve: primary voltage  
 Second curve: Primary current  
 Third curve: Secondary voltage  
 Lower curve: Secondary current

# HF transformers in aluminium profile housing

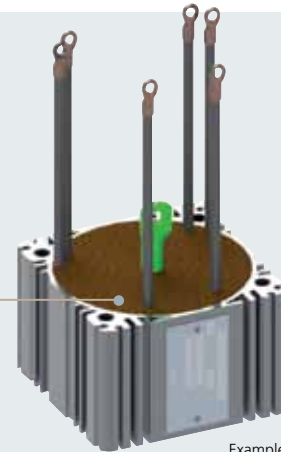


Frequency from 1-30 kHz

## Benefits

- Smaller size due to high frequencies
- Loss optimisation due to nanocrystalline, amorphous and ferrite cores
- Reduced use of material
- Higher insulation class and less noises due to sealing technology
- Simple mounting on Coldplate supplied by the customer /optionally available as Coldplate version
- Wide input voltage range possible, if  $U_{pmax} \geq 2x U_{pmin}$  is required.

Power range	1-90 kW	Series HPTB
$U_{pmin}$ [V]:	190-685 V	
$U_{pmax}$ [V]:	300-1800 V	
$U_{sec}$ [V]:	32-900 V	
T:	0,5-20	
$I_{sec}$ [A]:	1,7-2x500 A	



Example of a design

- Stranded wires with cable gland
- Copper connection bracket
- Brass stud bolt



## Coldplate-Version

### HF-Coldplate

REO's aluminium profile housing provides the possibility to mount the component onto a cooling plate (Coldplate) allowing further component optimisation thanks to better heat dissipation.

The cooling is carried out via cooling plates, which separate the cooling system physically from the electric circuit meaning that the electrically active components have no contact with the cooling medium.

## Benefits

- Reduction of product weight
- Separation of the cooling circuit from the electrical circuit
- Multiple combinations possible

## REO storage chokes

In addition to HF transformers REO also produces storage chokes (booster converter chokes/ step-down converter chokes), typically used in circuit configurations which transform a defined input voltage into a higher output voltage (boost converter chokes) or lower output voltage (buck converter chokes).

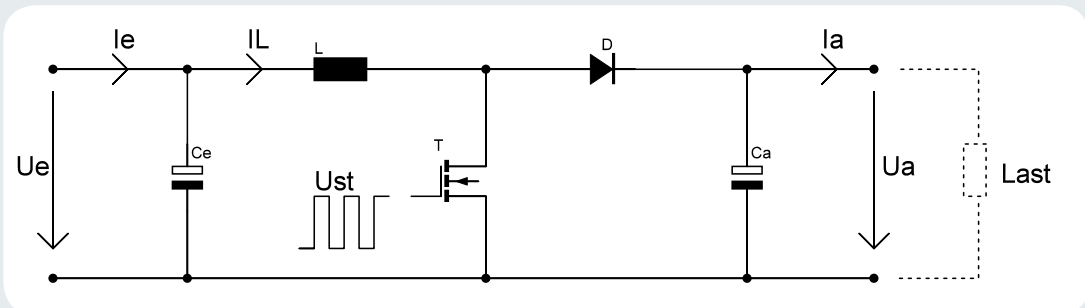
The boost converter / step-down converter choke are inductive passive components used for the attenuation of undesired frequencies or for energy saving and energy storage. This term describes the complete, ready-to-use unit consisting of choke, cooling air flow, mountings and connections.

The chokes can be manufactured with different cores and can therefore be tailored to the individual application. As well as traditional iron based core material REO can also utilise amorphous alloy. This must be specially processed to allow its effective use as either a toroidal cores, cut core or specific solutions.

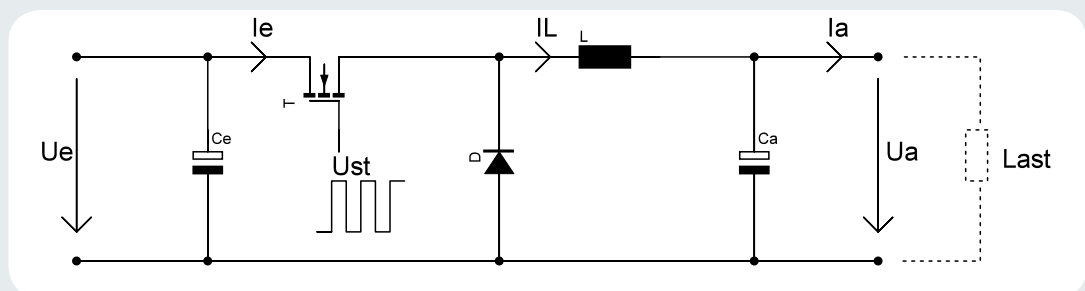
### Typical area of application:

- Direct current side of power inverters in photovoltaic plants
- Current control of stepping motors and speed control of direct current motors
- Switch-mode power supplies for direct current supply

### Switching principle boost converter choke:



### Switching principle buck converter choke:



# Storage chokes with toroidal core



Frequency up to 150 kHz

## Benefits

- High storage capacity
- High clock frequency
- Operating temperature maximum 125°C
- Low losses
- Minimal magnetic stray field
- Various models available
- According to UL 94 V-0

Technical data		Series CHI 21(X)
Power range INom [A]:	up to 150 A	
IRipple [ASS] (ripple current):	up to 50 A	
fT [kHz]:	up to 150 kHz	
UNom [V]:	up to 900 V	
Inductivity [mH]:	according to customer	



Example of a design

## Connections

- Stranded wires with cable gland
- Copper connection bracket
- Brass stud bolt

## Designs

The following designs are available:

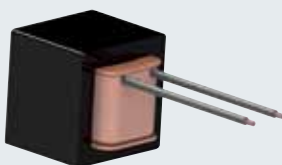
- Design A = open design, low-profile (example: CHI 215 A)**
  - Design B = open design, upright**
  - Design C = housing, low-profile**
  - Design D = housing, upright**
  - Design E = housing, sealed with stranded wire**
  - Design F = socket, low-profile**
  - Design G = socket, upright**
  - Design H = aluminium housing, sealed with stranded wire**
  - Design J = aluminium profile**
- Further designs available - contact us!

## Core materials

The following core materials are available for storage chokes, these are used for the complete range of the series:

- 1 = standard; iron powder (example: CHI 211 = series (21) + x (1) for the core material)**
- 2 = Kool M $\mu$**
- 3 = MPP**
- 4 = HF**
- 5 = Ferrite (with LS) (e.g. CHI 215)**
- 6 = amorphous, nanocrystalline**
- 7 = SiFe**
- 8 = other**

Examples of different designs:

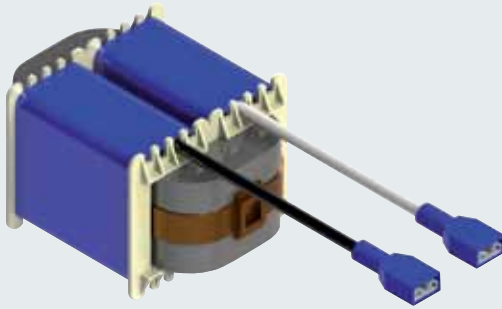


CHI 215





Frequency up to 150 kHz



Example of a design

## Connections

- Stranded wires with cable gland
- Copper connection bracket
- Brass stud bolt

## Benefits

- Low eddy current loss and hysteresis loss
- Suitable for high temperatures (up to 155°C)
- High saturation induction of 1.56 T
- Smaller requirement of space with same performance

## Technical data

Power range I <sub>Nom</sub> [A]:	up to 400 A
I <sub>Ripple</sub> [ASS] (ripple current):	up to 175 A
f <sub>T</sub> [kHz]:	up to 150 kHz
U <sub>Nom</sub> [V]:	up to 1000 V
Inductivity [mH]:	according to customer

Series CHI 21(X)

## Designs

The following designs are available:

**Design A = open design, low-profile (example: CHI 215 A)**

**Design B = open design, upright**

**Design E = housing, sealed with stranded wire**

**Design H = aluminium housing, sealed with stranded wire**

**Design J = aluminium profile**

**Design P = filter housing, encasted**

**Further designs available - contact us!**

## Core materials

The following core materials are available for storage chokes, these are used for the complete range of the series:

**1 = standard; iron powder**

**(example: CHI 211 = series (21) + x (1) for the core material)**

**2 = Kool M $\mu$**

**3 = MPP**

**4 = HF**

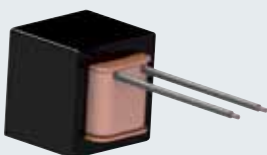
**5 = Ferrite (with LS) (e.g. CHI 215)**

**6 = amorphous, nanocrystalline**

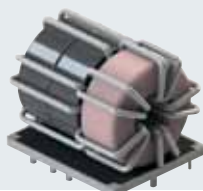
**7 = SiFe**

**8 = other**

Examples of different designs:



CHI 215





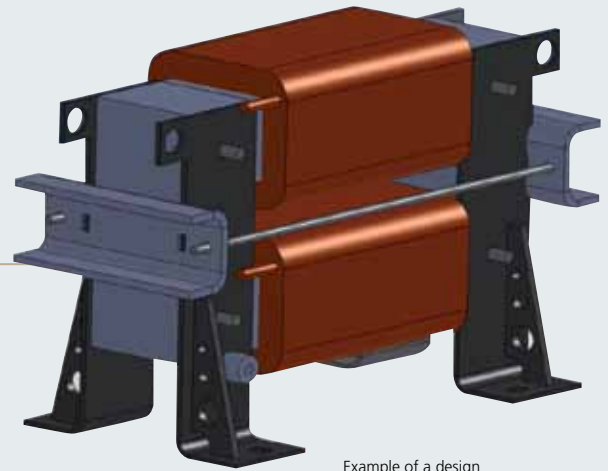
## Frequency according to customer

### Benefits

- Resistant to shock and vibration
- High level of electrical strength
- Contamination level of up to PD 4
- Fire protection standard DIN EN 5510-1 and -2
- Low weight with high electric load due to forced air cooling
- Robust, predominantly in the railway sector

### Connections

- Connection with stranded wires
- Clamp connection
- Cu-bars
- Radox railway cable



Example of a design

### Technical data

Power range $I_{Nom}$ [A]:	76-420 A
$I_{Ripple}$ [ASS]:	36-295
$f_T$ [kHz]:	0,3-4 kHz
$U_{Nom}$ [V]:	1000-2800 V
Inductivity [mH]:	0,5-3 mH

### Designs

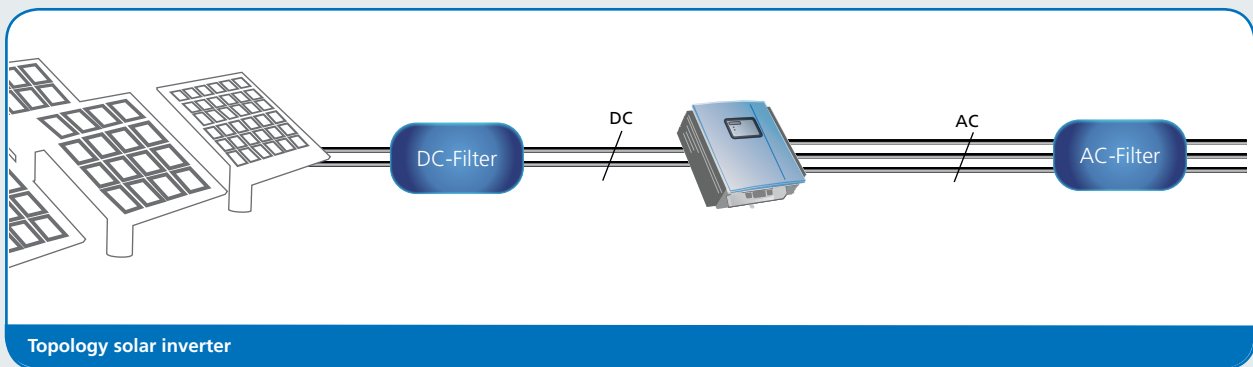
The following designs are available:

- Horizontal, upright
- Vertical, upright
- Horizontal, low-profile



## REO PowerUnit

Based on the HF-transformer and storage choke program REO has developed the REO PowerUnit for easier interference suppression of power inverters in the sector or renewable energies. The REO PowerUnit consists of various components which are delivered as a complete system. For example, the REO PowerUnit can contain an HF-transformer, an HF-storage choke, a power-compensating choke and a mains filter as components. Of course be delivered individually, if required.



Designed for the range of 50 Hz with clock frequencies of 10 to 100 kHz the use of the REO PowerUnit provides excellent protection of sensitive semiconductor components against transient disturbances from the circuit or the wind generator or solar generator. This increases the overall system reliability.

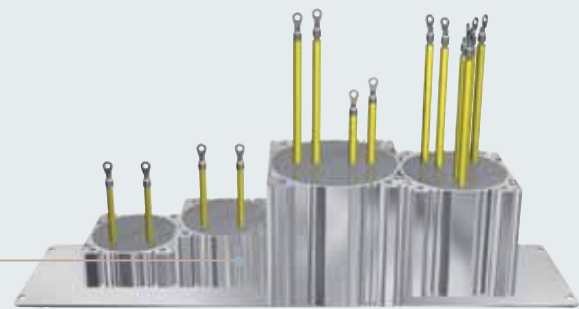
### Frequency according to customer specifications

#### Benefits

- Water cooling, forced cooling with fans or natural convection is possible for all REO products.
- Easy integration into components supplied by the customer
- Modular construction of components allows power assemblies to be easily manufactured.

#### Connections

- Connection with stranded wires
- Clamp connection
- Terminals
- Others on request



Technical data (Example)	
Power range [VA]:	1000-5000 VA
fT [kHz]:	up to 150 kHz
Voltage [V]:	up to 500 V

- REO Unity
- REO at your side
- REO Service



### Worldwide Sales Network

With a worldwide sales network and comprehensive product portfolio, REO can react rapidly to your wishes anywhere in the world - no matter what language you speak. Besides our wide selection of standard products, we can of course offer you tailor-made solutions, developed specially to meet your wishes. Our production facilities in China, India and the USA are equipped in exactly the same way as those in Germany, and designed to provide the same product at the same quality. Using the same software and with development and design in Germany we ensure that REO products are always up to the latest state of the art.

Wherever you are, even after the 1000th production run, a REO product always has the same quality.



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