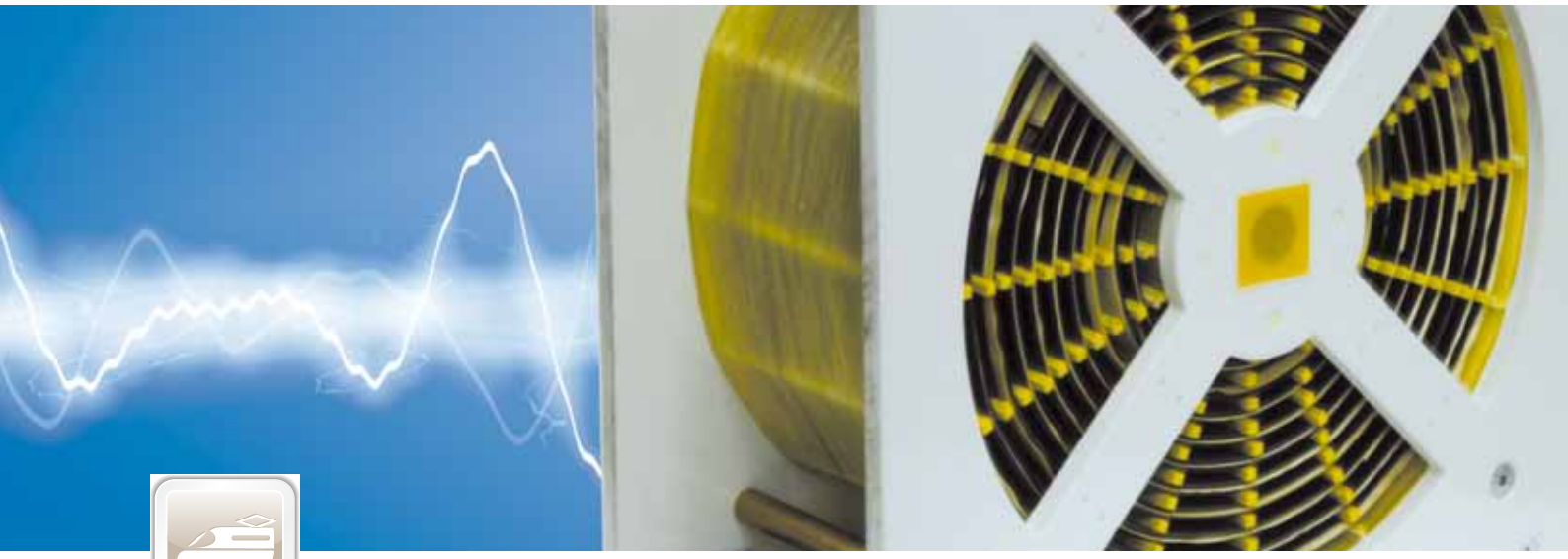
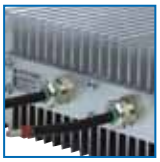
REO
INDUCTIVE COMPONENTS





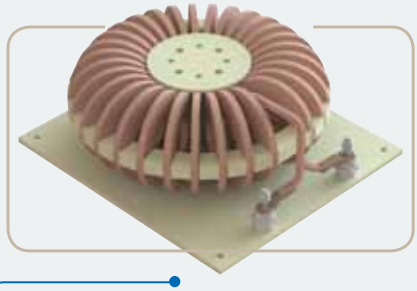
REOtrain

REO components for railway applications

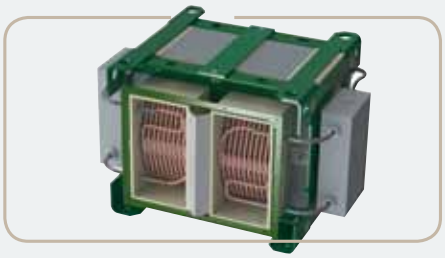
Product catalogue

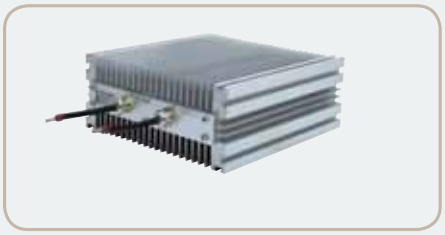
Pure|Power|Perfection

Content



Railway components





Content

Facts about railway

REO has set itself the task of contributing to making trains ever safer, today and in the future. With mains filters, inductors and transformers, we ensure that EMC problems are eliminated directly at the source.
The result is that voltage changes, short-circuits and any other problems associated with electricity cannot present a hazard to railway personnel or passengers.
Compliance with international norms, the exploitation of the latest technologies and decades of experience make REO a strong partner.

REO manufactures components for two main areas of railway technology:

A) Auxiliary converters:

- **Transformers from 16 2/3 up to 30 kHz**
- **Boost-/Buck converters**
- **EMC-Filter**
- **Sinusoidal filter**
- **Current transformers**
- **Charging resistors**
  from IP 00 - IP 65, available for watercooled systems, too.

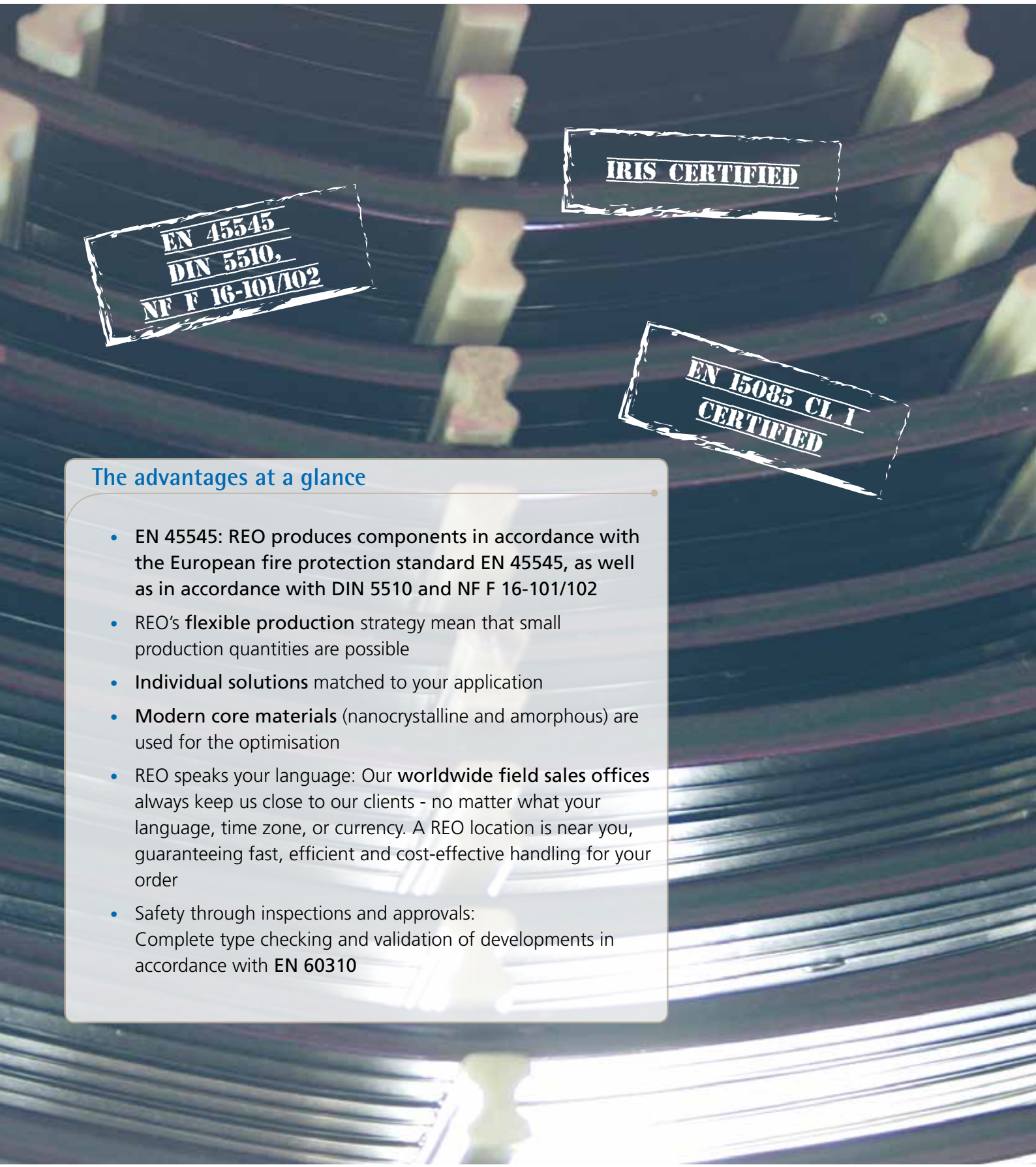
B) Main drive:

- **EMC HV chokes**
- **Leakage transformers**
- **Flow Controls**
- **Mains chokes**
- **Components for onboard power supplies**
- **Damping resistors**
- **Current transformers**
- **Filter chokes**

In its Centre of Competence in Berlin, REO today develops railway engineering components to meet the requirements of worldwide railway organizations and,
thanks to partnerships with companies in the USA, China, India and Germany, they are able to be manufactured quickly and efficiently with the highest standards of quality. In conjunction with its worldwide sales network, REO can respond quickly at any time.

With great attention to modern production methods, efficient workflow, close cooperation with universities and the constant further development and improvement of processes, every day REO provides electric railway line builders with products that contribute to the safety, functionality and global growth of rail technology.

With the IRIS certification of the subsidary in Berlin / Hennigsdorf and the ISO certification in China and the U.S., REO demonstrates quality at the highest international standards.



The advantages at a glance

- **EN 45545: REO produces components in accordance with the European fire protection standard EN 45545, as well as in accordance with DIN 5510 and NF F 16-101/102**
- REO's **flexible production** strategy mean that small production quantities are possible
- **Individual solutions** matched to your application
- **Modern core materials** (nanocrystalline and amorphous) are used for the optimisation
- REO speaks your language: Our **worldwide field sales offices** always keep us close to our clients - no matter what your language, time zone, or currency. A REO location is near you, guaranteeing fast, efficient and cost-effective handling for your order
- Safety through inspections and approvals:
  Complete type checking and validation of developments in accordance with **EN 60310**

REO air choke LD

EN 45545
DIN 5510,
NF F 16-101/102

Technical data*		
Rated current DC/AC	10 - 2000	[A]
Inductivity	0,04 - 80	[mH]
Linearity L(I)	independent	
Linearity L(f)	L(f)>75 % x L_{nom} bis 30 kHz	
Capacity	< 2	[nF]
Rated voltage AC	25	[kV]
Rated voltage DC	750 - 3600	[V]
Max. short-circuit current	50	[kA]
Test voltage	20 - 50	kV
Overvoltage category	OV1 - OV3	
Operating ambient temperature	-50 bis +65	[°C]
Cooling method	AN /AF	
Degree of pollution	PD 1- PD 4	
Protection class	IP X4	
Max. operating altitude	2000	[m]
Operating life	> 30	Years
Fault rate	< 200	fit

Air choke LD

Advantages

- Vibration and shock tested in accordance with DIN 61373 Cat. 1 Class B
- High mechanical resistance
- High linearity L(I)
- High linearity L(f)
- Very low Eddy current losses
- No hysteresis losses
- Optimal weight through forced air cooling
- Protection rating IPX4
- Installation in the exhaust duct of the converter - Integration into an existing cooling system
- Directed airflow through the use of GRP tube
- Degree of pollution PD4
- Test voltage up to 50 kV

Information on air choke LD

The air choke is designed for use in vehicles in direct current (DC) voltage systems. This includes railed vehicles such as underground and commuter trains, but also trolleybuses. The term "air choke" refers to the complete, ready-for-operation unit comprising the inductor, cooled air flow, suspension and connections.

The air choke is an inductive component which stores magnetic energy. It filters voltage peaks and prevents voltage dips so that deviations from the ideal converter input are kept as low as possible. Furthermore, it also reduces the circuit disturbances, which are created as a result of parasitic circuit components and switching operations.

*It goes without saying, that for us the customer specification forms the bedrock for our development process

REO air choke TD

EN 45545
DIN 5510,
NF F 16-101/102

Technical data*		
Rated current DC/AC	10 - 1000	[A]
Inductivity L_{nenn}	0,01 - 1,2	[mH]
Linearity L(I)	independent	
Linearity L(f)	L(f) > 90 % x L_{nenn} up to 30 kHz	
Capacity	< 2	[nF]
Rated voltage AC	25	[kV]
Rated voltage DC	750 - 3600	[kV]
Max. short-circuit current	10	[kA]
Test voltage	50	kV
Overvoltage category	OV1 - OV3	
Operating ambient temperature	-50 bis +65	[°C]
Cooling method	AN / AF	
Degree of pollution	PD1 - PD 4	
Protection class	IP 00 - IP X4	
Max. operating altitude	2000	[m]
Operating life	> 30	Years
Fault rate	< 200	fit

Air choke TD

Advantages

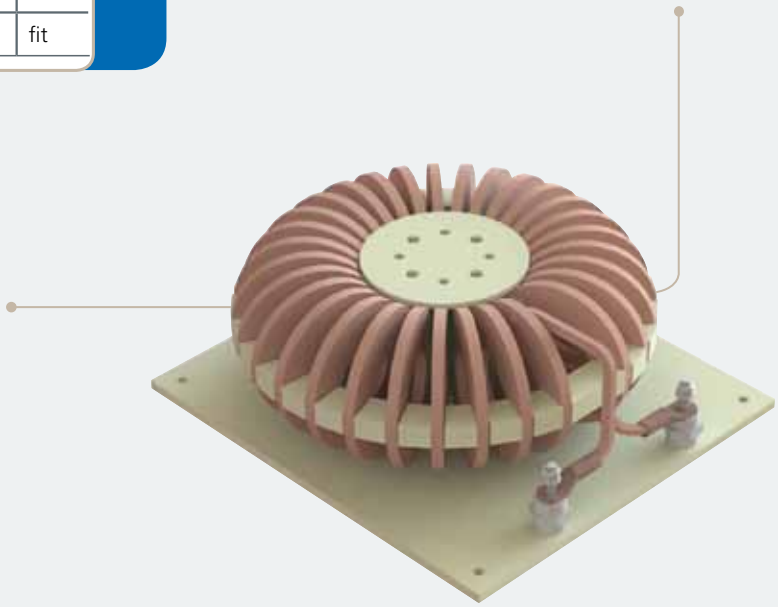
- Vibration and shock tested in accordance with DIN 61373 Cat. 1 Class B
- High mechanical resistance
- Very useful for naturally air cooling AN
- Very low magnetic leakage and therefore well suited for low good EMC limits
- High linearity L(I)
- High linearity L(f)
- Very low Eddy current losses
- No hysteresis losses
- Optimal weight through forced air cooling
- Protection rating IPX4
- Installation in the exhaust duct of the converter - Integration into an existing cooling system
- Degree of pollution PD4

Information on air choke TD

The air choke is designed for use with vehicles in direct current (DC) voltage systems. This includes railed vehicles such as underground and commuter trains, but also trolleybuses. The term "air choke" refers to the complete, ready-for-operation unit comprising of inductor, cooled air flow, suspension and connections.

This component has a very low magnetic leakage and is very good suitable for low EMC limits.

The air choke is an inductive component which stores magnetic energy. It filters voltage peaks and prevents voltage dips so that deviations from the ideal converter input are kept as low as possible. Furthermore, it also reduces the circuit disturbances, which are created as a result of parasitic circuit components and switching operations.



***It goes without saying, that for us the customer specification forms the bedrock for our development process**

REO iron choke ED

EN 45545
DIN 5510,
NF F 16-101/102

Technical data*		
Rated current I_{nom} DC/AC	30 - 2500	[A]
Inductivity L_{nom}	0,1 - 280	[mH]
Linearity L(I)	L(I) >90% x L_{nom} up to 1,5 x I_{nom}	
Linearity L(f)	L(f) > 90% x L_{nom} up to 30 kHz	
Withstanding voltage	Up to 24 kV	[kV]
Parasitic capacitance	< 50	[nF]
Rated voltage	Up to 25 kV AC; up to 3600 kV DC	
Max. short-circuit current	10	[kA]
Test voltage	20	kV
Overvoltage category	OV1 - OV3	
Ambient temperature	-50 up to +65	[°C]
Cooling method	AN / AF	
Degree of pollution	PD1 - PD 4	
Protection class	IP X4 - IP 21	
Max. operating altitude	2000	[m]
Operating life	> 30	Years
Fault rate	< 200	fit

Iron choke ED

Advantages

- Suitable for use in rail vehicles
- High mechanical resistance
- Very high diversification of geometry possible
- Good short-circuit response of the winding
- High inductivity in a small installation space
- Low magnetic leakage
- Optimal weight through forced air cooling
- Protection rating IPX4
- Installation in the exhaust duct of the converter- Integration into an existing cooling system
- Degree of pollution PD4
- Vibration and shock tested in accordance with DIN 61373 Cat. 1 Class B

Information on iron choke ED

The iron choke is designed for use with vehicles in an AC or DC network. This includes railed vehicles such as underground and commuter trains or passenger trains in AC network systems.
The term "iron choke" refers to the complete, ready-for-operation unit comprising of core package, winding, cooled air flow, suspension and connections.

The iron choke is an inductive component which stores magnetic energy. It filters voltage peaks and prevents voltage dips so that deviations from the ideal converter input are kept as low as possible. Furthermore, it also reduces the circuit disturbances, which are created as a result of parasitic circuit components and switching operations. A REO ED Choke provides particularly high inductivity and low magnetic leakage.

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REO iron choke LFD

EN 45545
DIN 5510,
NF F 16-101/102

Technical data*

Rated current I_{nom} DC/AC	60 - 1500	[A]
Inductivity L_{nom}	1 - 32	[mH]
Linearity L(I)	L(I) >90% x L_{nom} bis 1,5 x I_{nom}	
Linearity L(f)	L(f) > 90% x L_{nom} bis 30 kHz	
Parasitic capacitance	< 50	[nF]
Rated voltage	200 - 4000	[kV]
Saturation inductance L_{nom}	50%	[%]
Max. short-circuit current	10	[kA]
Test voltage	6 - 12	kV
Overvoltage category	OV1 - OV3	
Operating ambient temperature	-50 up to +65	[°C]
Cooling method	AN / AF	
Degree of pollution	PD1- PD 4	
Protection class	IP X4 – IP 21	
Max. operating altitude	2000	[m]
Operating life	> 30	Years
Fault rate	< 200	fit

Iron choke LFD

Advantages

- Suitable for use in rail vehicles
- High mechanical resistance
- High inductivity in a small installation space
- Very high saturation inductance
- Very low magnetic leakage
- Optimal weight through forced air cooling
- Protection rating IPX4
- Installation in the exhaust duct of the converter - Integration into an existing cooling system
- Degree of pollution PD4
- Good for AN Vibration and shock tested in accordance with DIN 61373 Cat. 1 Class B

Information on iron choke LFD

The iron choke is designed for use with vehicles in an AC or DC network. This includes railed vehicles such as underground and commuter trains or passenger trains in AC network systems.

The term “iron choke” refers to the complete, ready-for-operation unit comprising of core package, winding, cooled air flow, suspension and connections.

The iron choke is an inductive component which stores magnetic energy. It filters voltage peaks and prevents voltage dips so that deviations from the ideal converter input are kept as low as possible. Furthermore, it also reduces the circuit disturbances, which are created as a result of parasitic circuit components and switching operations. It can also be used as a chopper inductor or an inductive link of a filter combination.
A REO LFD choke provides particularly high saturation inductance and very low magnetic leakage.

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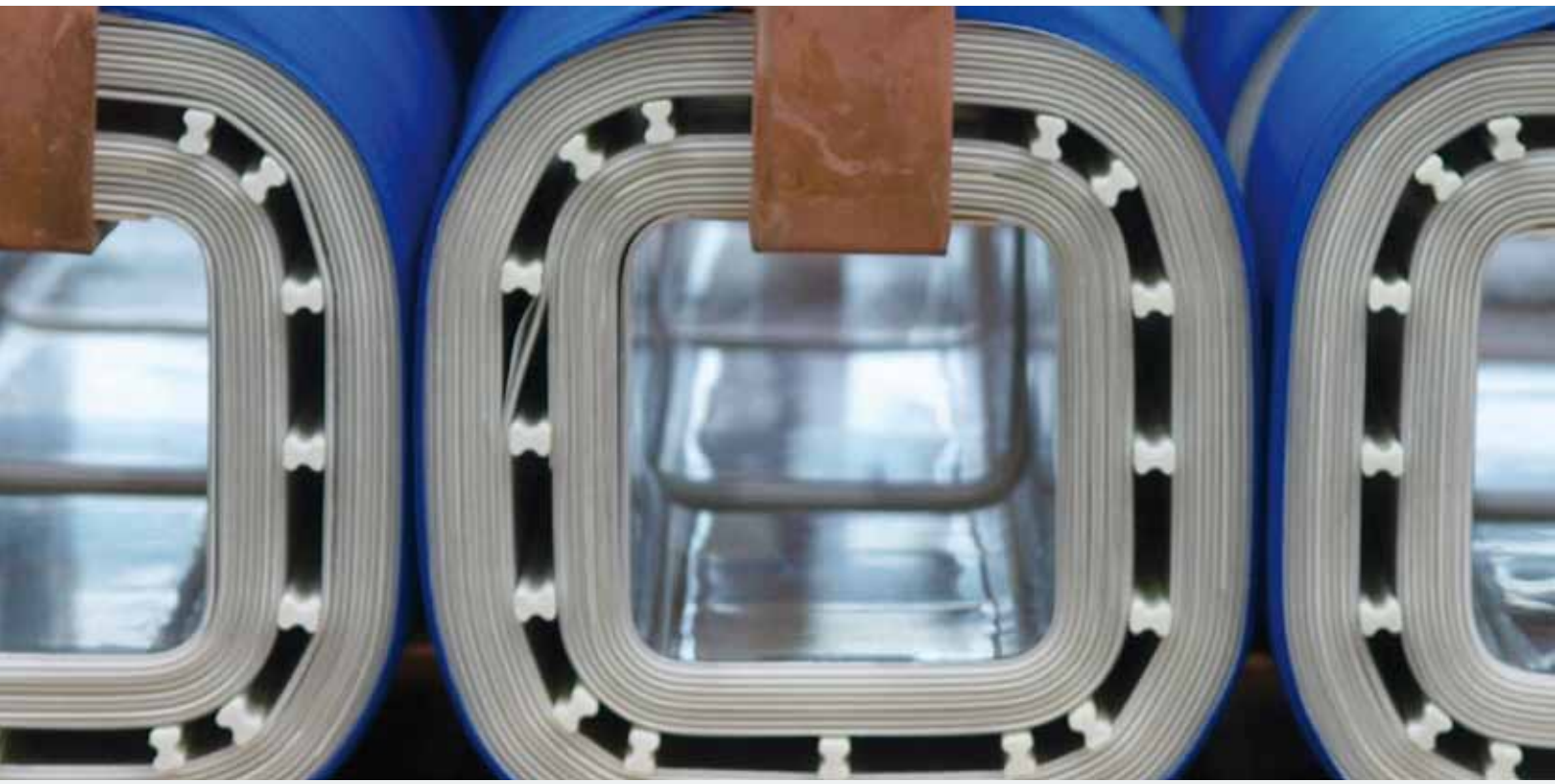
Comparison NTT chokes



Comparison between NTT chokes*

	LD	TD	ED	LFD
Max. current	2000 A	1000 A	2500 A	1500 A
Inductivity L_{nom}	50 mH	0,5 mH	280 mH	280 mH
Linearity L(I)	very good	very good	ok	good
Linearity L(f)	very good	very good	ok	good
Magnetic stray field	high	very low	low	very low
Short circuit strength	very good	good	good	ok
Mechanical strength	very good	good	good	ok

NTT chokes

*It goes without saying, that for us the customer specification forms the bedrock for our development process

REO transformers NTT ET/DT

EN 45545
DIN 5510,
NF F 16-101/102

Technical data*		
Rated power P_{nom}	2.5 - 1000	[kVA]
Primary voltage U_{prim}	50 - 2000	[V]
Frequency	50/60	[Hz]
uk	2 - 32	%
Test voltage	1 - 12	kV
Operating ambient temperature	-50 bis +65	[°C]
Cooling method	AN / AF	
Degree of pollution	PD1- PD 4	
Protection class	IP X4 – IP 55	
Max. operating altitude	2000	[m]
Operating life	> 30	Years
Fault rate	< 200	fit

Transformers NTT ET/DT

Advantages

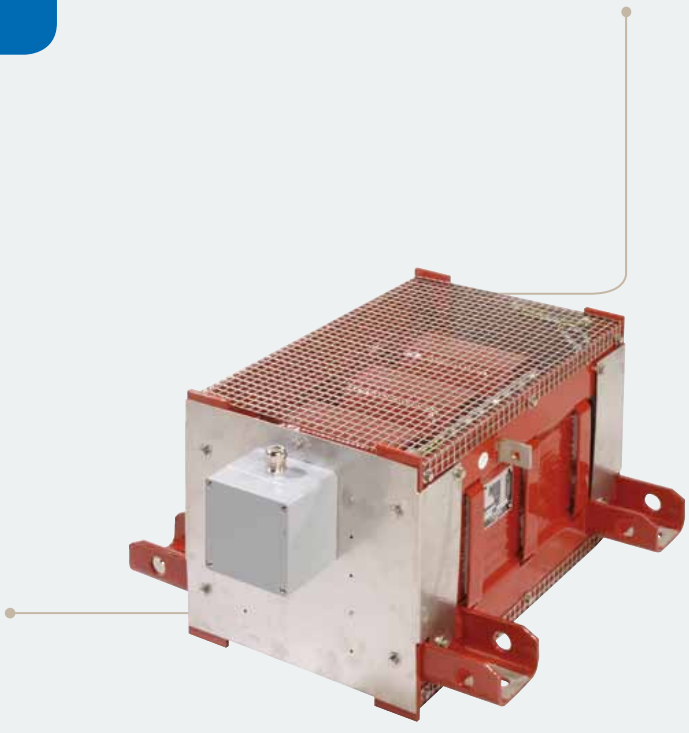
- High degree of efficiency
- Low no-load losses
- Reduced field scattering
- Low noise level
- Weight-optimized
- High mechanical resistance
- Protection rating IPX4
- Installation in the exhaust duct of the converter - Integration into an existing cooling system
- Degree of pollution PD4
- Also available as a scattering field transformer with an integrated scattered core
- Vibration and shock tested in accordance with DIN 61373 Cat. 1 Class B

Information on transformers

The transformer connects single-phase or multiphase alternating voltage networks of the same frequency but often with differing voltages. The primary and secondary windings are magnetically coupled, so there is always galvanic isolation of the windings.

The transformers ET and DT are designed for use in vehicles in an AC or DC network (in inverter mode). This includes railed vehicles such as underground and commuter trains or passenger trains in AC network systems. To do this, the transformers are either used for the galvanic isolation of the AC networks and for voltage adjustments of auxiliary plant inverter output voltage.

The term "transformer" refers to the complete, ready-for-operation unit comprising of core package, winding, cooled air flow, suspension and connections.



***It goes without saying, that for us the customer specification forms the bedrock for our development process**

REO load and attenuating resistors

Certified for railway

EN 45545
DIN 5510,
NF F 16-101/102

Advantages

- High mechanical protection
- Low-noise
- Air and water cooled resistors
- High operational reliability and operating life
- Protection classes from IP 00 to IP 65
- Wires are spaced apart through a special winding technology, meaning there is higher dielectric strength
- The resistor can absorb higher pulse loads and store them temporarily
- Resistors are resistant to moisture and pollution
- Low vulnerability for vibrations and oscillations
- Many years of experience with profile filters in the rail sector
- Vibration and shock tested in accordance with DIN 61373 Cat. 1 Class B
- Environmental assessment (damp heat) according to EN60068-2-78
- Salt mist according to EN60068-2-78

REO resistors

Technical data*		
Continuous output	Up to 25.000	[W]
Rated voltage	Up to 4.200	[V]
Protection class	IP 00 - IP 65	

REOhm NTT-resistors

For the REOhm NTT series, only railway-capable, high-quality materials are used. The connection cables and all other components are especially designed for use in railway applications and only materials which have railway approval are used.
Profile version resistors are fully encapsulated, this allows very high protection classes up to IP 65.
Due to the special construction, external environmental influences have very little impact on the resistors.

Example: REOhm series
NTT R 153

Example: REOhm attenuating resistor R 159

Example: REOhm series
NTT R D 158

*It goes without saying, that for us the customer specification forms the bedrock for our development process

UL94V0

Technical data*			
Primary nominal current	I_{PN}	0 up to 3.000	[A]
Maximum primary nominal current	I_{maxPN}	0 up to 1.000	[A]
Secondary current	I_{aN}	0 up to 1.000	[mA]
Ambient temperature	T_A	-25 - +85	[°C]
Insulation test voltage	V_P	3	[kVac]

REO current transformers

Advantages

- Current transformers for precise current measurements
- Measurements in the frequency range 16 2/3 to -50kHz
- Use of nanocrystalline and high-quality cores
- High-quality wires in temperature class F (155°C), H (180°C)
- High-quality UL listed insulating materials (e.g. UL94-V0)
- Safe electrically isolated primary and secondary circuits
- High reliability
- Non-critical in the event of overload currents
- Robust housing designs (for horizontal/vertical mounting)
- Shock and vibration tests in accordance with DIN EN 61373 Category 1 Class B
- Variable connections: clamps, plugs, flat-cable plugs or cables
- Wide range of housings with various push-through openings

REO current transformers

A broad spectrum of current and voltage transformers from REO provide solutions for a number of applications - for simple current monitoring or working within frequency converters, main and subsidiary current monitoring, and for the efficient reduction of energy consumption.

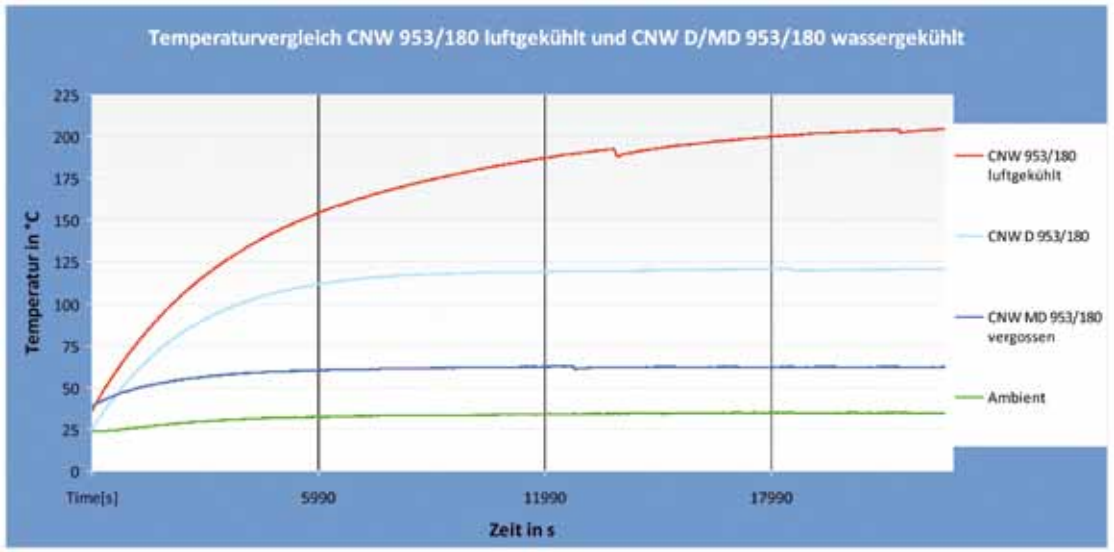
A variety of technologies, such as open loop and closed loop technology, and the measurement of currents ranging up to 3000 A, ensure that the application can be optimized by using a sensor from REO.

***It goes without saying, that for us the customer specification forms the bedrock for our development process**

Watercooled chokes - a speciality of REO

The chokes are available in protective types IP 00 to IP 65. REO can realize various types of water cooling for these components. This means the targeted discharge of losses via the cooling circuit - the losses are not discharged into the environment. By using water cooling, the temperatures in the components can be greatly reduced - this means less stress on the insulation materials and a longer lifetime.

Advantages of water-cooled chokes



- Max. temperature CNW 953/180 air-cooled: 205°C
- Max. temperature CNW D 953/180 water-cooled: 120°C
- Max. temperature CNW MD 953/180 water-cooled and poured: 68°C

The advantages of the water cooling method can be clearly seen based on the measurements. All 3 variants were tested with the same load; when doing so, the open water-cooled reactor had a temperature advantage of 52 K.
In the CNW MD version, the temperature in the reactor could even be lowered by 137 K. This advantage was achieved due to special encapsulation techniques and a special REO construction. In addition, the behavior at different inlet temperatures was researched to test the behavior at different operating conditions.

Series CNW MC - for smaller components

- Reactor cast on a metal plate, with integrated cooling channels. This component enables targeted and optimized cooling for smaller power levels and is characterized by its simple integration into existing cooling systems
- Available in 4 versions (IP 00, IP 20, IP 20+EMV and IP 64)
- Current 3-70A

Certified for railway

Technical data*	
Current	6 - 70 A
Protection	IP 00...IP 64
Inductance	0,1 - 10 mH

CNW MC

Series CNW MD - for medium to larger power levels

- Choke in an open design, for which the cooling profile is integrated into the winding. With this technology, the heat can be directly tied to its source and can be removed easily.
- Completely encapsulated chokes, for which „water pockets“,are connected to a water cooling system. These are constructed within the windings and encapsulating compounds. This technology unites the advantages of encapsulation technology to achieve a high protective class and the effective heat dissipation at its source.

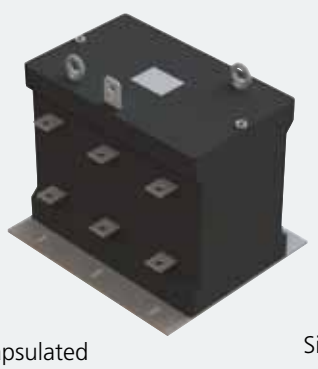
Technical data*	
Design	Open design
Current	100 - 1200 A
Protection	IP 00...IP 40
Inductance	5 - 147 mH

CNW MD

Open design

Technical data*	
Design	Encapsulated version with water-pockets
Current	100 - 3000 A
Protection	IP 00...IP 65
Inductance	5 - 200 mH

CNW MD



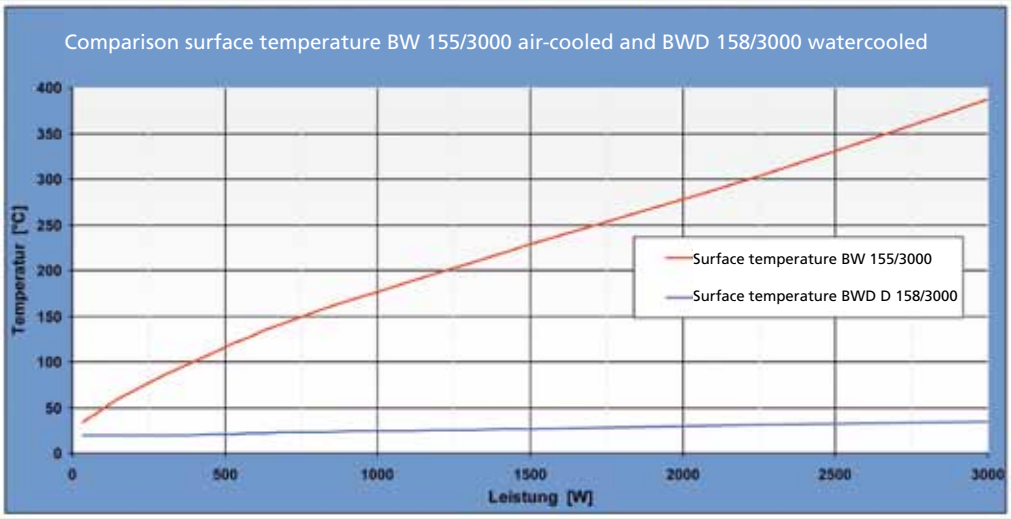
Fully encapsulated

Single casting of the coils

Water cooled resistors - ideal for railway technology

Certified for railway

EN 45545
DIN 5510,
NF F 16-101/102



Are available with power levels from 1 to 100 kW. Cooling channels introduced into the heat sink enable efficient cooling and the spatial separation of the electrical conductors- and coolant - enabling safe application. In addition to the general advantages of the REOHM braking resistors, such as modular construction to attain higher power levels or the compact design, the braking resistors have an optimal structure and power consumption, enabling them to also withstand vibration and shock tests. REOHM braking resistors are an optimized combination of proven and innovative techniques, so that nothing stands in the way of its use with high power classes under conditions of limited space especially when using water cooling.

Series REOHM BW D158 /160

- Braking and load resistance for the drive technology, industrial applications.
- Power: 5 – 100 kW
- Cooling channels series BW D 158: Aluminum (AlMgSi 0.5) Di = 10.5mm
- Cooling channels series BW D 160: Copper or stainless steel Di = 10 mm

Technical data	
Power	1 - 100 kw
Protection	IP 20...IP 65
Resistance value	0,2 - 850 Ohm

BW D 158

Technical data	
Power	5 - 100 kw
Protection	IP 20...IP 65
Resistance value	0,2 - 850 Ohm

BW D 160

Advantages

- Vibration and shock tested in accordance with DIN 61373 Cat. 1 Class B
- Environmental assessment (damp heat) according to EN60068-2-78
- Salt mist according to EN60068-2-78

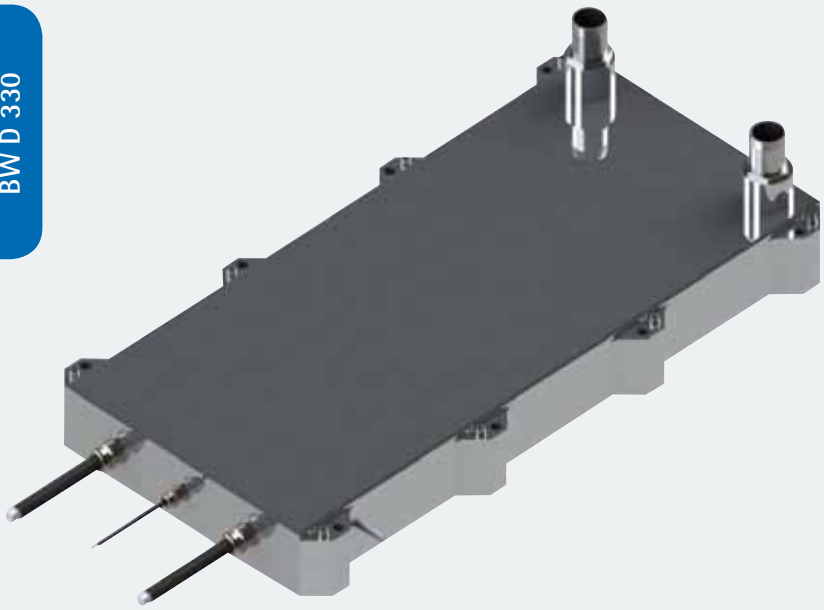
Series REOHM BW D330

- This series BWD 330 is available as loading or damping resistor or braking resistor for railway technology with capacities up to 100 kW.
  Liquid cooling enables space savings up to 88 %. As a special bonus, the resistor can be connected easily via non-drip quick connectors.

Certified for railway

Technical data	
Power	up to 60 kW
Protection	IP 20 up to IP 66
Resistance value	1 up to 100 Ohm

BW D 330



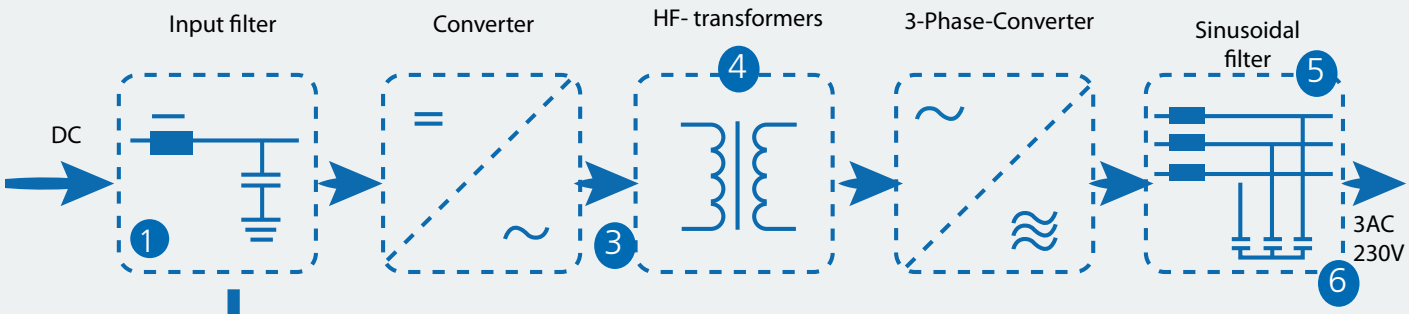
Advantages

- Watercooling
- 88% space savings
- higher power by combinations possible
- Vibration and shock tested in accordance with DIN 61373 Cat. 1 Class B
- Environmental assessment (damp heat) according to EN60068-2-78
- Salt mist according to EN60068-2-78
- dripless quick-connections

Components for auxiliary converters

Electric railways have an extraordinary energy demand, e.g. for heating, air conditioning, lighting or cooking in the bistro car. All of these peripheral applications normally require a supply that is different from the available electricity source. In addition to providing optimum power to these facilities there is also an important requirement to ensure electromagnetic compatibility for the protection of passengers.
These auxiliary converters must meet the tough requirements of railway technology: shock and vibration resistance, high protection levels and a long life are just a few examples of these demands.

REO develops and manufactures components for this purpose, often available as standard products but also providing fast turnaround of special designs - for every application the right solution!



EN 45545
DIN 5510,
NF F 16-101/102
UL 94V0

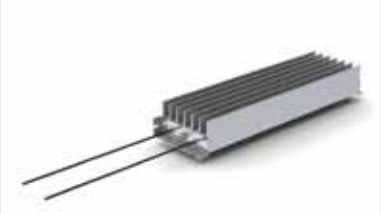
Input

Water-cooled
ColdPlate version

1 REO mains choke 750V-3600 V*
– in cast design for ingress protection up to IP65; Used for reducing commutation losses and harmonics; very robust and good heat transfer

or

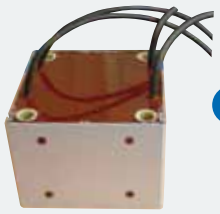
REO EMC filter*
– with high attenuation (up to 100 dB from simple to broad spectra) in a practical profile housing for variable installation and with low heating guaranteed



2 REO charging resistors (up to 3kW)*
– high power density, wide variety of connection options and possible combinations of several resistors in one profile (type of protection up to IP67)

DC-link

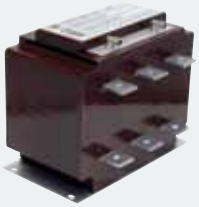
3 REO Boost/Buck converter
The choke is used in applications where DC voltages are converted into another (higher or lower) DC voltage in a vehicle power supply and is operated at a voltage of 500 V .. 1100.
Chokes are manufactured with copper windings and amorphous core.



or

4 REO HF-Transformer**
The HF transformer is used for example at a voltage supply as an isolating transformer. A safe separation and low partial discharge voltages are characteristic.

Output



5 REO Sinusoidal filter (690 V / 1200 A)*
– for giving sinusoidal form to current and voltage. For example, used in air conditioning systems against noise (protection up to IP65)

or

REO dv/dt-filter (690 V / to 150 A)*
–for limiting the voltage rise at the output from the converter with high inductance, low total losses and minimal leakage field (type of protection up to IP65)

or

6 REO Current transformers (0 - 1000 A)**
– in suitable design for AC/DC measurements up to 150 kHz in railway applications, distinguished by short response times and excellent linearity.

Combinations

As an alternative to directly water-cooled chokes REO provides a cold plate version, too, which has the advantage that different components can be mounted on a plate. Besides you can see an example of a customized solution with chokes and HF-components.

Coldplate version

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

*higher performances on request

Find more information about HF transformers and current transformers in the new catalogues

Headquarters - Germany

REO ELEKTRONIK AG
Brühler Straße 100 · D-42657 Solingen
Tel.: +49 (0)212 8804 0 · Fax: +49 (0)212 8804 188

REO INDUCTIVE COMPONENTS AG
Brühler Straße 100 · D-42657 Solingen
Tel.: +49 (0)212 8804 0 · Fax: +49 (0)212 8804 188

E-Mail: info@reo.de
Internet: www.reo.de

Divisions - Germany

REO INDUCTIVE COMPONENTS AG

REO Train Technologies Division

TrainTechnologies Division
Centre of Competence Berlin
Erasmusstraße 14 · D-10553 Berlin
Tel.: +49 (0)30 3670236 0 · Fax: +49 (0)30 3670236 10
E-Mail: zentrale.berlin@reo.de · Internet: www.reo.de

Fertigung/Production
TrainTechnologies Division
Eduard-Maurer-Straße 13 · D-16761 Hennigsdorf

REO IBK Drives Division

IBK Drives Division
Holzhausener Straße 52 · D-16866 Kyritz
Tel.: +49 (0)33971 485 0 · Fax: +49 (0)33971 485 90
E-Mail: ibk@reo.de · Internet: www.reo.de

REO Setzermann Medical Division

Setzermann Medical Division
Schuldholzinger Weg 7 · D-84347 Pfarrkirchen
Tel.: +49 (0)8561 9886 0 · Fax: +49 (0)8561 9886 40
E-Mail: setzermann@reo.de · Internet: www.reo.de

REO Test and PowerQuality Division

Test and PowerQuality Division
Brühler Straße 100 · D-42657 Solingen
Tel.: +49 (0)212 8804 0 · Fax: +49 (0)212 8804 188
E-Mail: main@reo.de · Internet: www.reo.de

**Give us a call –
our production plant in
Berlin is always ready to you
if you have any questions or
suggestions.**

Tel.: +49 (0)30 3670236 0

China

REO Shanghai Inductive Components Co., Ltd
No. 536 ShangFeng Road · Pudong, 201201 Shanghai · China
Tel.: +86 (0)21 5858 0686 · Fax: +86 (0)21 5858 0289
E-Mail: info@reo.cn · Internet: www.reo.cn

France

REO VARIAC S.A.R.L.
ZAC Du Clos aux Pois 1 · 6/8 rue de la Closerie-LISSES· F-91048 Evry Cédex
Tel.: +33 (0)1 6911 1898 · Fax: +33 (0)1 6911 0918
E-Mail: reovariac@reo.fr · Internet: www.reo.fr

Great Britain

REO (UK) Ltd.
Units 2-4 Callow Hill Road · Craven Arms · Shropshire SY7 8NT · UK
Tel.: +44 (0)1588 673 411 · Fax: +44 (0)1588 672 718
E-Mail: main@reo.co.uk · Internet: www.reo.co.uk

India

REO GPD INDUCTIVE COMPONENTS PVT. LTD
2/202 Luna Road · Village Luna · Taluka Padra
Vadodara - 391440 · India
Tel.: +91 (2662) 221723, +91 (265) 2396148 · Fax: +91 (265) 2396971
E-Mail: info@reogpd.com · Internet: www.reo-ag.in

Italy

REO ITALIA S.r.l.
Via Treponti, 29 · I-25086 Rezzato (BS)
Tel.: +39 030 279 3883 · Fax: +39 030 279 0600
E-Mail: info@reoitalia.it · Internet: www.reoitalia.it

Poland

REO CROMA Sp.zo.o
ul. Pozaryskiego 28, bud 20 · PL-04-703 Warszawa
Tel.: +48 (0)22 812 3066 · Fax: +48 (0)22 815 6906
E-Mail: croma@croma.com.pl · Internet: www.croma.com.pl

Russia

REO RUSSIA Ltd.
17/2, Dorozhnaya st., · Voronezh 394062 · RUSSIA
Tel.: +7 (0)4732 202 453 · Fax: +7 (0)4732 707 011
E-Mail: info@reo-russia.ru · Internet: www.reo-russia.ru

Spain

REO ESPAÑA 2002 S.A.
C/Manuel Ventura i Campeny 21B · local 9 · E-08339 Vilassar de Dalt (Barcelona)
Tel.: +34 937 509 994 · Fax: +34 937 509 995
E-Mail: info@reospain.com · Internet: www.reospain.com

Switzerland

REO ELEKTRONIK AG
Im Halbiacker 5a · CH-8352 Elsau
Tel.: +41 (0)52 363 2820 · Fax: +41 (0)52 363 1241
E-Mail: info@reo.ch · Internet: www.reo.ch

Turkey

REOTURKEY ELEKTRONİK San. ve Tic. Ltd. Şti.
Halil Rıfatpasa Mah. · Darülceze CD Perpa Tic Merkezi
B Blok Kat 8 No:1095 · TR-34384 Sisli – Istanbul
Tel.: +90 (0)212 2215 118 · Fax: +90 (0)212 2215 119
E-Mail: info@reo-turkey.com · Internet: www.reo-turkey.com

USA

REO-USA, Inc.
8450 E. 47th St · USA-Indianapolis, IN 46226
Tel.: +1 (317) 899 1395 · Fax: +1 (317) 899 1396
E-Mail: info@reo-usa.com · Internet: www.reo-usa.com

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