

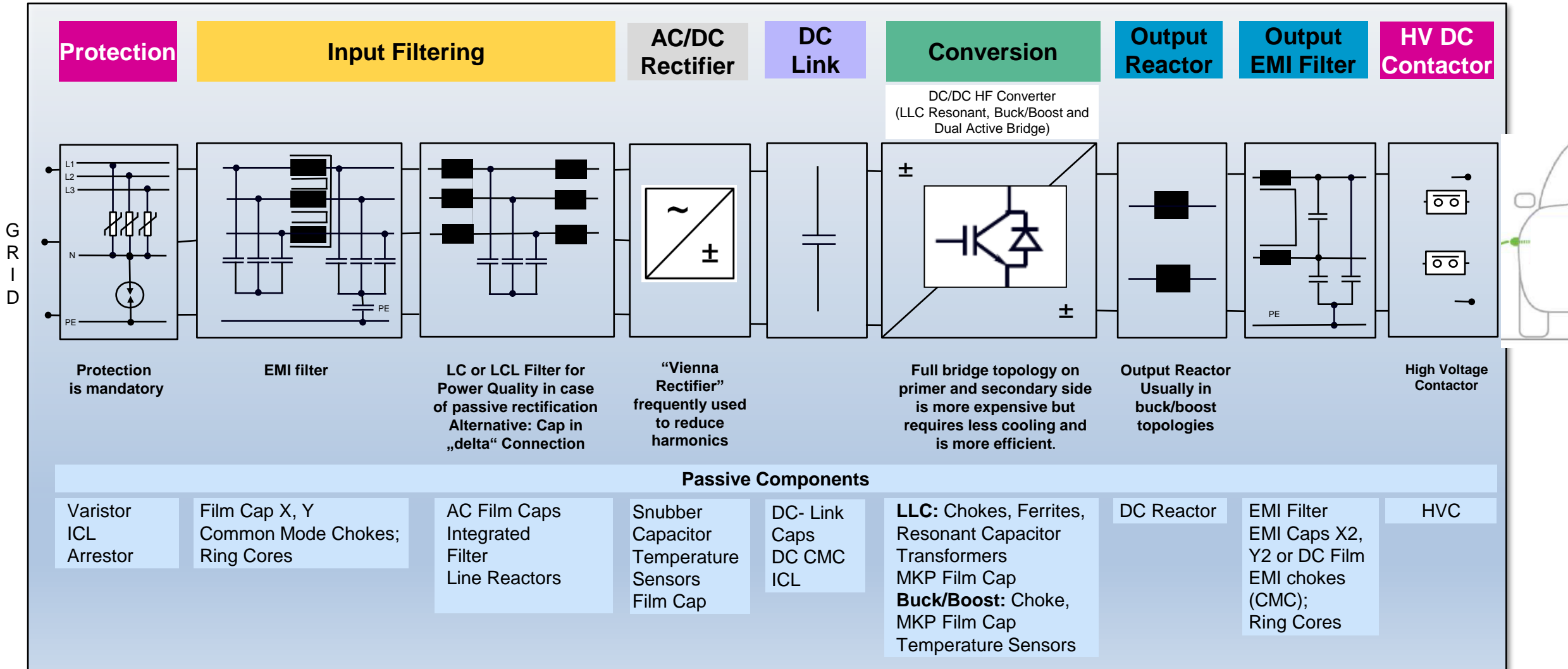
Attracting Tomorrow



Application Guide - EV Fast Charging

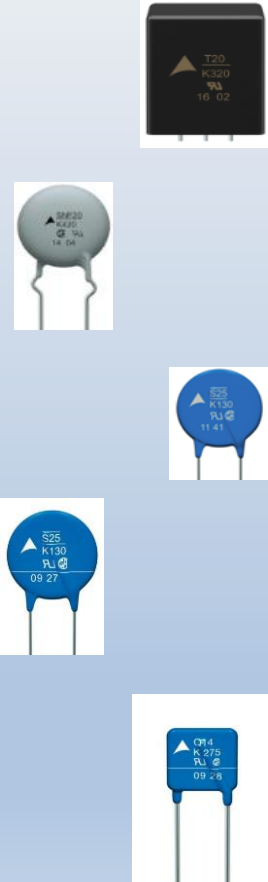
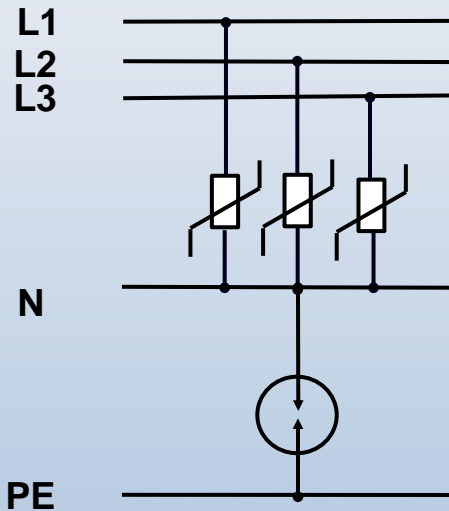
TDK Electronics AG
ISD I&HA
Munich, Germany
November 2020

Typical block diagram of 3 phase DC Fast Charger



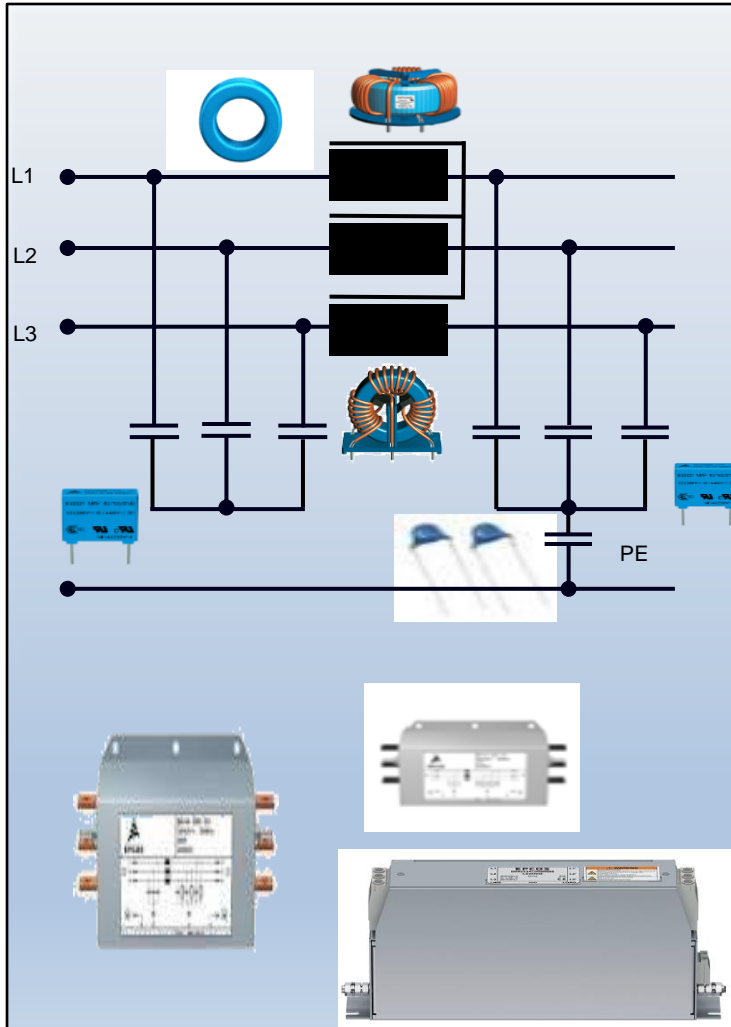
Protection

G
R
-
D



Disc Varistors	Thermo Fuse
<p>U – TYPES B72220Ux <u>Non Flamable</u></p> <p>Disk sizes: 14, 20 mm</p> <p>Voltage classes: 300 V – 625 V_{rms}</p> <p>Surge currents: S14: up to 6 kA (8/20 μs) S20: up to 12 kA (8/20 μs)</p>	<p>T – TYPES B72214T x, B72220Tx T</p> <p>Disk sizes: 14, 20mm</p> <p>Voltage classes: T14: 300 V – 420 V_{rms} T20: 300 V – 1000 V_{rms}</p> <p>Surge currents: T14: 6 kA (8/20 μs) T20: 10 kA (8/20 μs)</p>
<p>S – TYPES B72214Sx, B72220Sx <u>Leaded</u></p> <p>Disk sizes: 20 mm</p> <p>Voltage classes: 300 - 1100 V_{rms}</p> <p>Surge currents: S20: 8 kA (8/20 μs)</p>	
<p>E2 / E3(K1) TYPES <u>High Energy Leaded</u></p> <p>Disk sizes: 14... 25 mm</p> <p>Voltage classes: 300 - 510 V_{Rms}</p> <p>Surge currents: S14: 6 kA (8/20 μs) S20: 12 kA (8/20 μs) S25: 20 kA (8/20 μs)</p>	<p>Gas Discharge Tube</p>
<p>Q - TYPES <u>Square Disc Leaded</u></p> <p>Disk sizes: 14, 20 mm</p> <p>Voltage classes: 300 - 680 V_{rms}</p> <p>Surge currents: Q14: 8 kA (8/20 μs) Q20: 15 kA (8/20 μs)</p>	<p>A8x-XP EF800X M5x-XP</p>

Input Filtering



EMI Discrete Components

X2 – Capacitors series

- B3292xC/D 305 VAC / 10 nF ... 30 μ F
- B3292xH/J 305 VAC / 10 nF ... 15 μ F
- B3292xA/B4 “industrial grade” 350 VAC / 470 nF ... 20 μ F

Y2 – Capacitor series

- B3202x 300VAC / 1.0 nF ... 1.0 μ F)
- B3203#A/B4 350VAC / 4.7nF ... 1.2 μ F)

Ring and other Ferrite Cores e.g. CMC 3 – Phase Ring Core Choke

- e.g. B82746/7S* Vr up to 600VAC, Ir up to 100 A

EMI Filter integrated solutions

2 line Filter SiFi for control board

- B84111F series
- B84112G series
- B84113H series

3 line Filter for high current

- B84143A*R107 series
- B84243A* series
- B84143B*S020/S021
- B84143B*S080/S081

4 line Filter

- B84144* series

LeaYield

- B84233A1500R000
Active leakage current filter

Input Filtering

3-Phase Ring Core Choke for current compensation



Features:

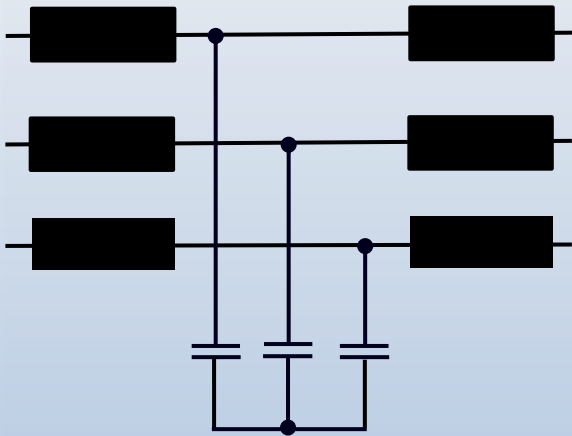
- Horizontal and Vertical Ring Core Designs
- Rated Voltage V_r up to 600 V_{AC}
- Rated Currents I_r up to 65 A
- UL Electrical Insulation System Class 155 (F)
- High resonance frequency
- High rated current and rated temperature
- Suitable for wave soldering

Standard product range:

- Large portfolio of standard triple and quad chokes available at our distribution partners
- Range: I_r 8 ... 35 A; L_r 0.35 ... 6.2 mH

Input Filtering

Power Quality (LC or LCL Filter)



Chokes & Reactors

Line Reactor for central topology
Up to 900 A / 520 VAC

LCL Filter for central topology
B84143G/Q*R/S405 16 A to 400 A for active front end (THDi < 5%) or uncontrolled rectifier (Modifications possible)

AC Reactor Choke for modular topology
Power ratings up to 10kW (per phase)
Inductance >3 mH, >1 mH @ 50 A

Flat wire ring core choke
Alloy powder core R103; 260 μH nominal inductance
60 A rated current at 70°C; 6.6 mΩ DC resistance

AC Filter Capacitor

- B32354S*
- B3237*
- B33331V*

Input Filtering

Conversion

Input Filter

Output Filter

Ferrite Cores

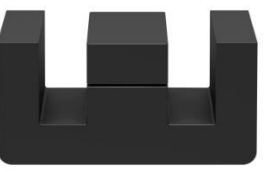
**Cores with gap
Big PM, PQ and E cores**



PM DG cores
50 - 114

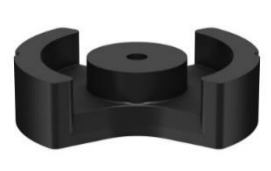


PQ DG cores
40 - 50

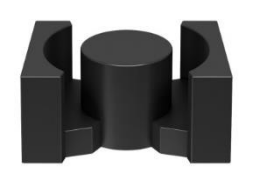


E DG cores
42 - 100

**Cores without gap
Big PM, PQ and E cores**



PM cores
50 - 114



PQ cores
40 - 50



E coes
42 - 100

**Coated and uncoated ring
cores**



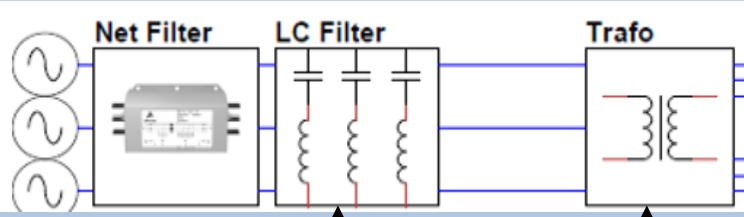
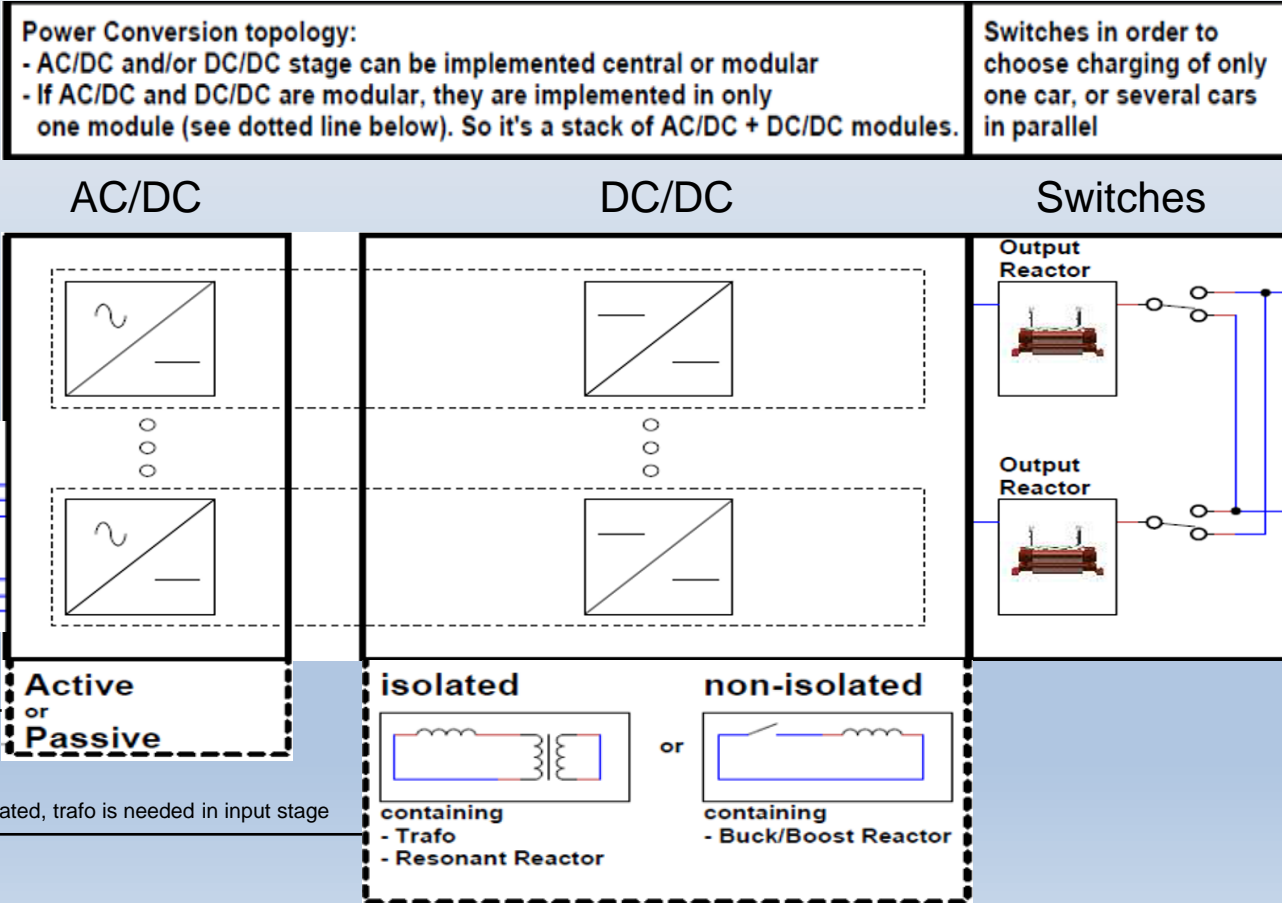
Ring cores
R 20 - R 202



Ring cores
R 20 - R 140

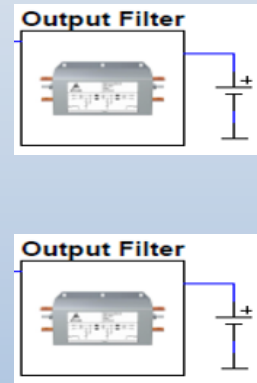
Input Filtering

PEMC Products in dependency of the charger topology



If passive, LC needed

If non-isolated, trafo is needed in input stage



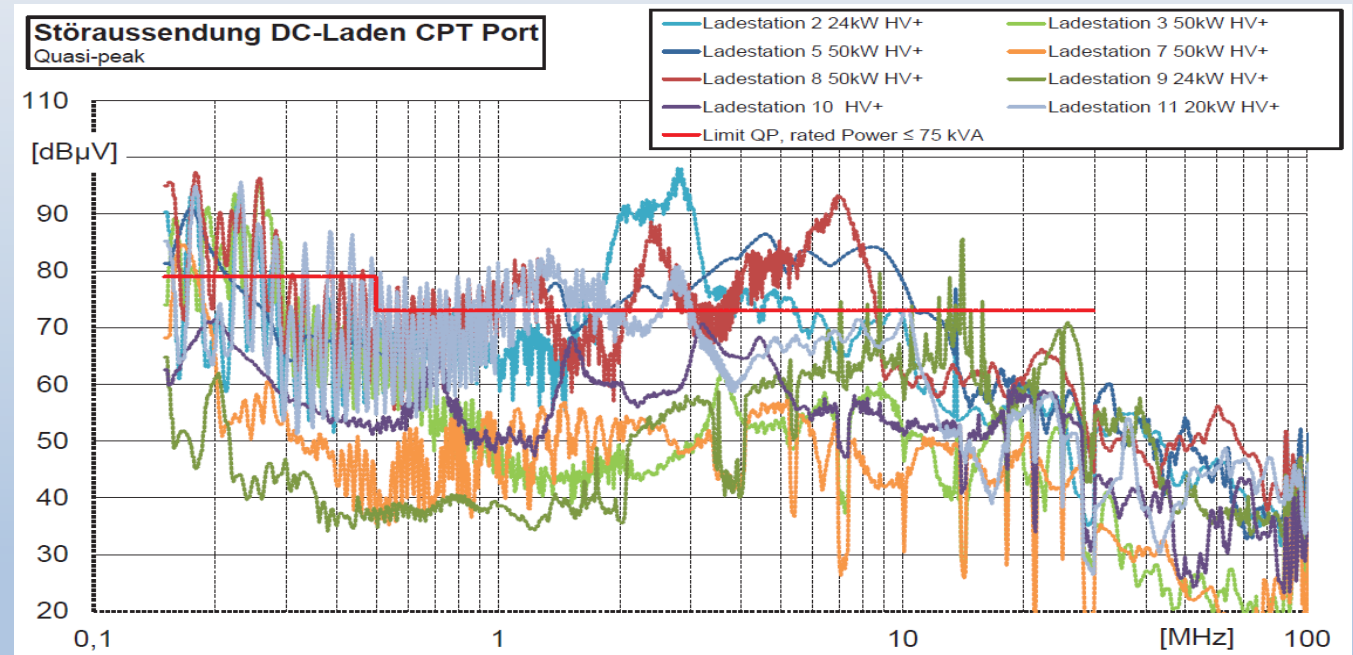
Input Filtering

EMC Standard for Charging Stations

IEC 61851/21/2 Norm is about to become a harmonized standard. It is defining limits for the DC side of charging stations for the first time. Furthermore the total capacitance to ground is limited to 1 μ F

Consequences:

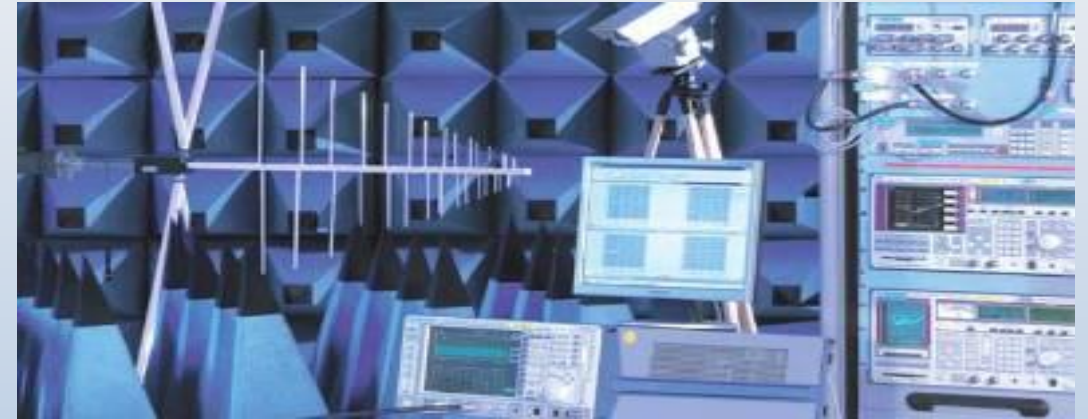
- Possible need to redesign charging stations to achieve the new DC limits.
- Demand for support by an EMC laboratory for detailed measurement and elaboration of EMC solution.



Input Filtering

EMC Laboratory in Regensburg, Germany

- High Experience Level in measurement of DC Fast Charging stations
- Accredited test laboratory for industrial and household appliances, automotive
- Full customer EMC support:
From pre-compliance investigations to declaration of conformity
- Semi-anechoic chamber for radiated emission testing, 2 shielded cabins for conducted emissions
- Measurement service on customers premises for bulky or otherwise special EUTs



Accreditation - ISO IEC 17025 (EMC tests)



Certification - ISO 9001, ISO/TS 16949

DC Link

DC Link ALU or FILM Cap



Power Film Capacitors

B2562*, 40 - 4 000 μ F / 700 - 3000 VDC,
High current capability, UL certified,
customized types also available,
Diameter: 75, 85, 116 and 136mm

B2563*, 40 μ F - 600 μ F / 500-1500 VDC
Low LSI (<20 nH)
Ultra Low LSI upon request

B2568* & B3269*

Aluminum Capacitor (max. values)

Snap In: 105°C / 8000 h, 600 V

Screw terminal: 105°C / 15000 h, 600 V

4/5 PIN: 105°C / 10000 h, 500 V

MKP Film Capacitors

B3277x High Density
1.50 – 480 μ F / 450 VDC – 1300 VDC

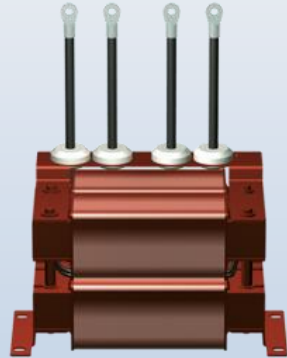
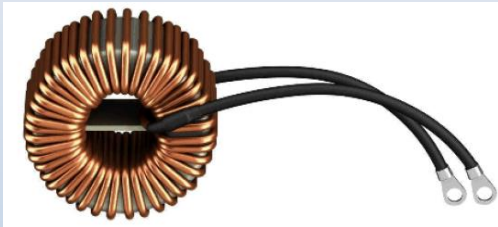
B3267x High Power
0.47 – 270 μ F / 450 VDC – 1050 VDC

B3277xH Humidity
1.50 – 120 μ F / 450 VDC – 1300 VDC
(THB 60°C/95% RH V_{rated} 1000 h)

B3277xP High Temp.
1 – 50 μ F / 630 – 840 VDC, up to 125°C

DC Link

DC Reactors and Inrush Current Limiter



DC Reactors Customized solutions

For power ratings up to 10 kW (per phase)
Inductance >3 mH

>1 mH @ 50 A

For power ratings > 10 kW
(per phase)

Inrush current Limiter PTC

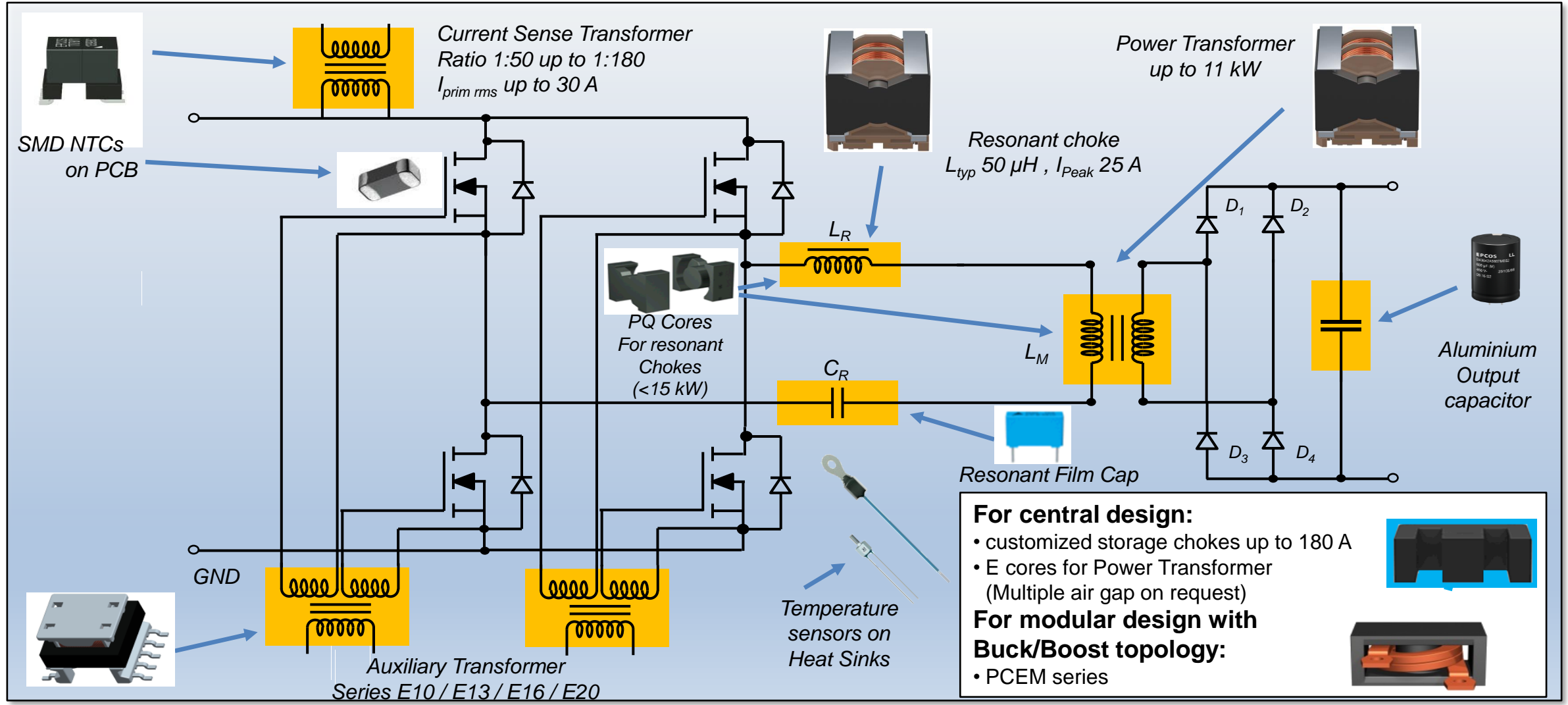
B5921*J*

- Max. DC Link voltage: 800V DC
- Max. Rated Voltage: 560V AC
- Rated Resistance: 100 ohm
- Max. Thermal Capacity: 2.3 J/K

B597**C* / B59451C* / B59412C*

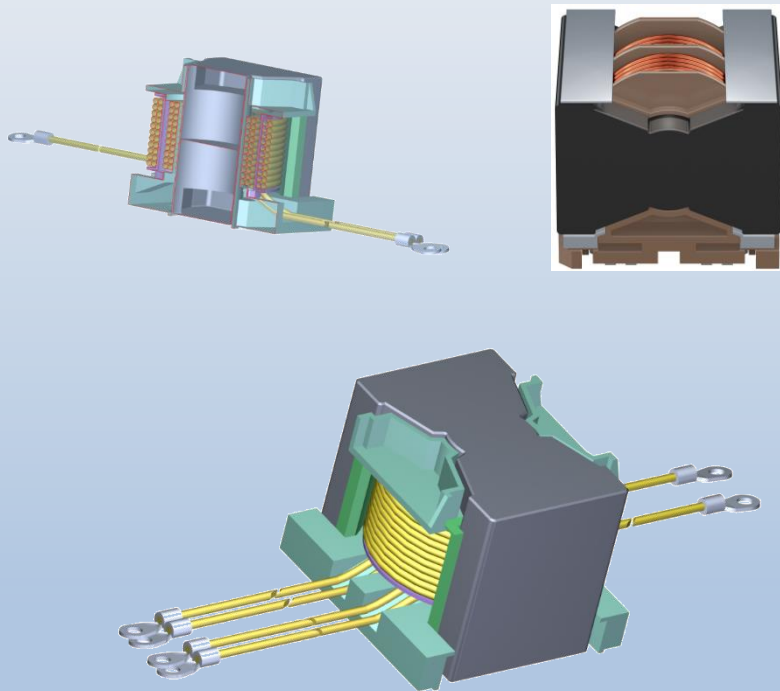
- Max. DC Link voltage: 800V DC
- Max. Rated Voltage: 560V AC
- Rated Resistance: 1100 ohm
- Max. Thermal Capacity: 2.1 J/K

DC/DC Converter with LLC Resonant Topology



DC/DC Converter with LLC Resonant Topology

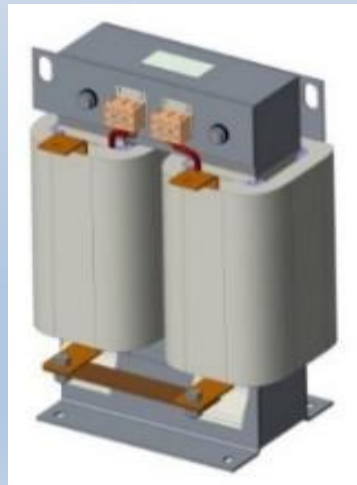
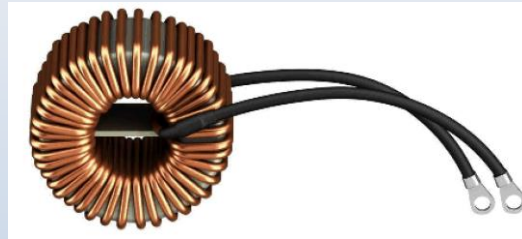
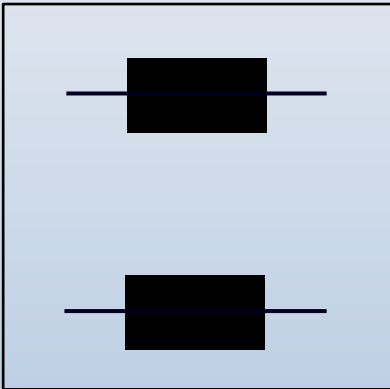
PQ platform



Transformers	Resonance Chokes
<p>Output Power: 3.6 kW to 7.4 kW</p>	<ul style="list-style-type: none"> ZVS - full bridge: L_{typ} 3 - 5 μH, I_{Peak} 25 A LLC - topology: L_{typ} 50 μH, I_{Peak} 25 A
<p>Common Features:</p>	
<ul style="list-style-type: none"> PQ design PTH – Pin through hole and cable shoe Operating Temperature: -40°C to +150°C Frequency typ. 100 kHz Creepage and clearance distances according IEC 60664 and IEC 61558 (U_{op} 500V; PU2; CTI3) AEC-Q200 qualified 	

Output Reactor

For smoothing of the inverter output current



DC Reactor Coils

For modular topology:

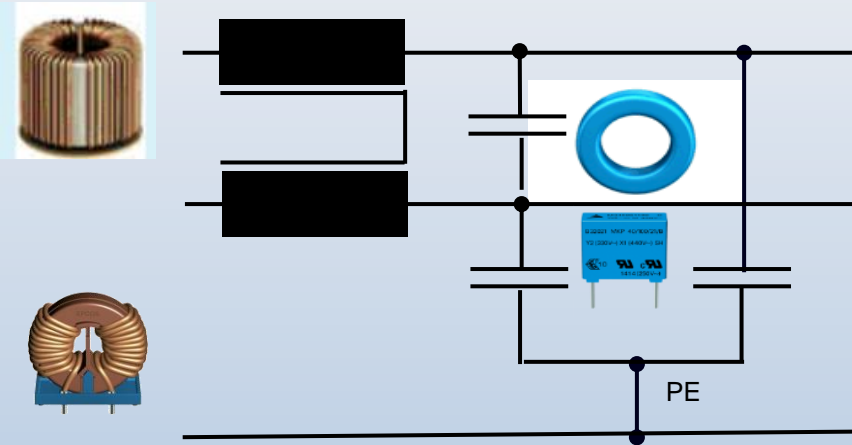
- Power ratings up to 10 kW
- Inductance > 3 mH
- Inductance > 1 mH @ 50 A
- Single and double chokes
- UL Electrical Insulation System (Class F) applicable
- Optimized to withstand high peak voltage across winding
- Individually optimized power loss and EMC behavior

For central topology:

- Customized DC reactor up to 2000 A

Output EMI Filter

Discrete and integrated Solutions



EMI Filter solution

Discrete DC filter solutions:

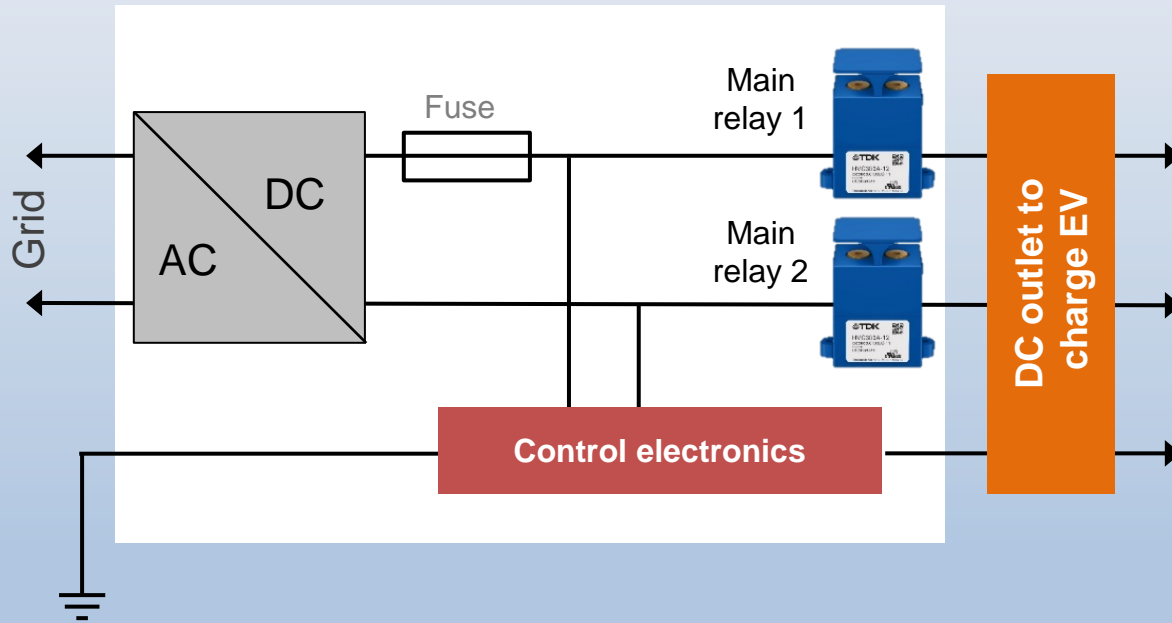
- EMI X and Y capacitors
X2: B3292xH/J series and B3292xA/B4 350 VAC)
Y2: B3202x series 0,001 ... 1 μ F, 300 VAC
B3203x series 0,0047 ... 1.2 μ F, 350 VAC
alternatively DC Film capacitors can be used
- DC EMI Filter Chokes
CMC with ferrites cores: B82726/7S*
Vertical ring core designs R36, R42, R50
 V_r 1000 VDC, I_r up to 50 A
UL Electrical Insulation System Class 155 (F)
- Ring Cores

Integrated DC filter solutions:

- B84142A/C/J*S081
- Up to 1600 A and 1500 VDC
- Low leakage current types available

Contactor

High-voltage Contactor - Application



HVC2.5 series

- For DC Fast Charging Stations
- Up to 500 ADC and 1200 VDC
- Contactless auxiliary contact
- Single coil or dual coil
- Bipolar design available

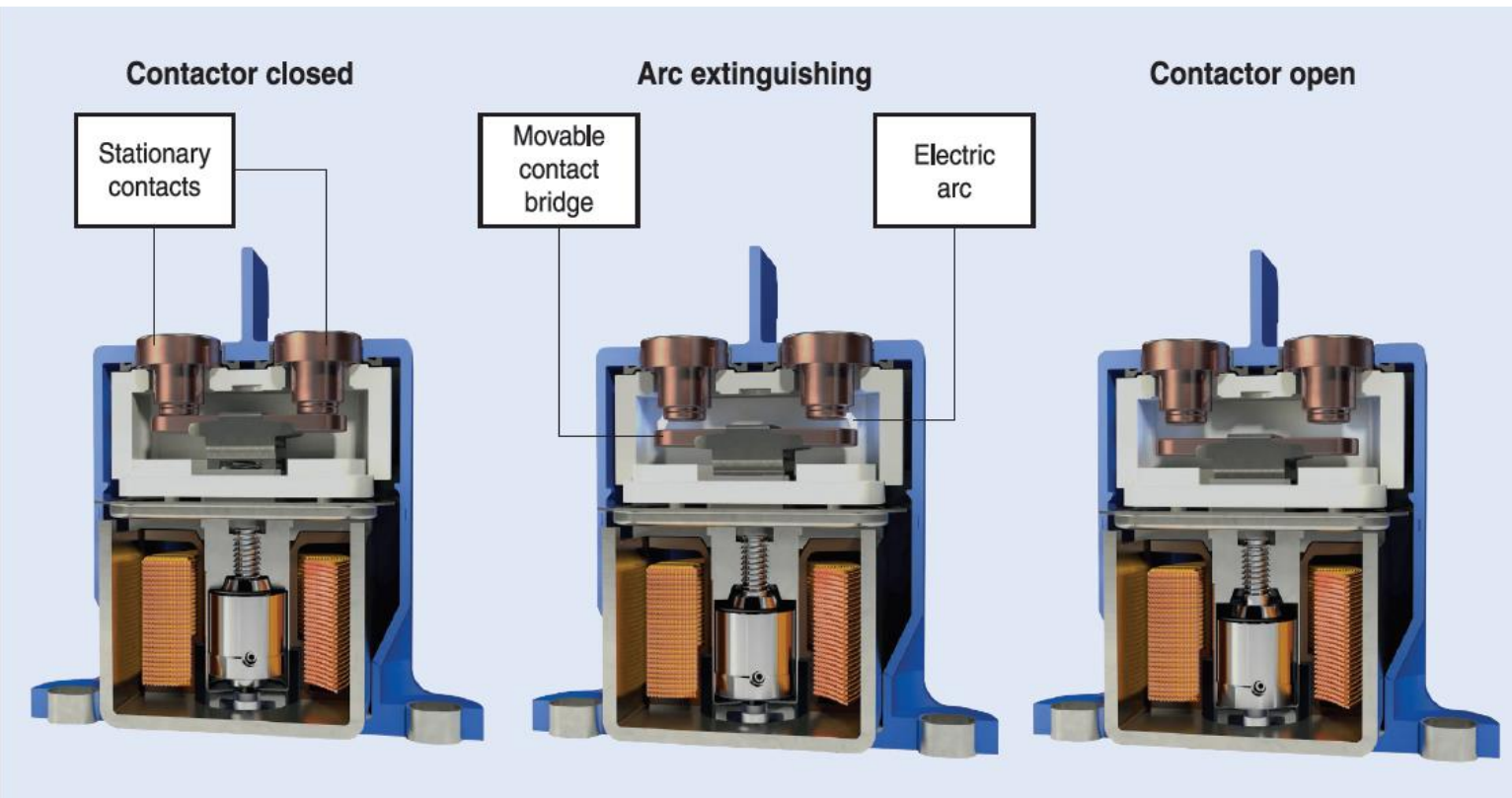
HVC4.3 series

- For DC Chargers up to 50 kW
- Up to 250 ADC and 750 VDC
- Up to 150 ADC and 1000 VDC
- Bipolar design
- 30 % smaller,
30 % lighter than HVC2.5

Contactor

High-voltage Contactor - Principle

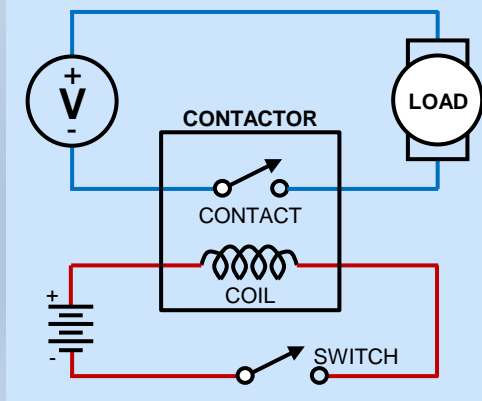
Operating Principle



Technology

- Ceramic arc chamber
- Magnets on the side of ceramic chamber
- Hydrogen gas-mixture to cool and extinguish electric arc

Example Circuit



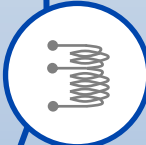
Contactor

Product Features HVC2.5

UL 60947-4-1, CE, AECQ-200

 Up to 1200 V and 500 A

 Bipolar design

 Dual coil or single coil

 Auxiliary contacts

 Temperature sensor

 Voltage sensor





www.tdk-electronics.tdk.com