

Attracting Tomorrow



CarXield™

The first EMI filter to set standards



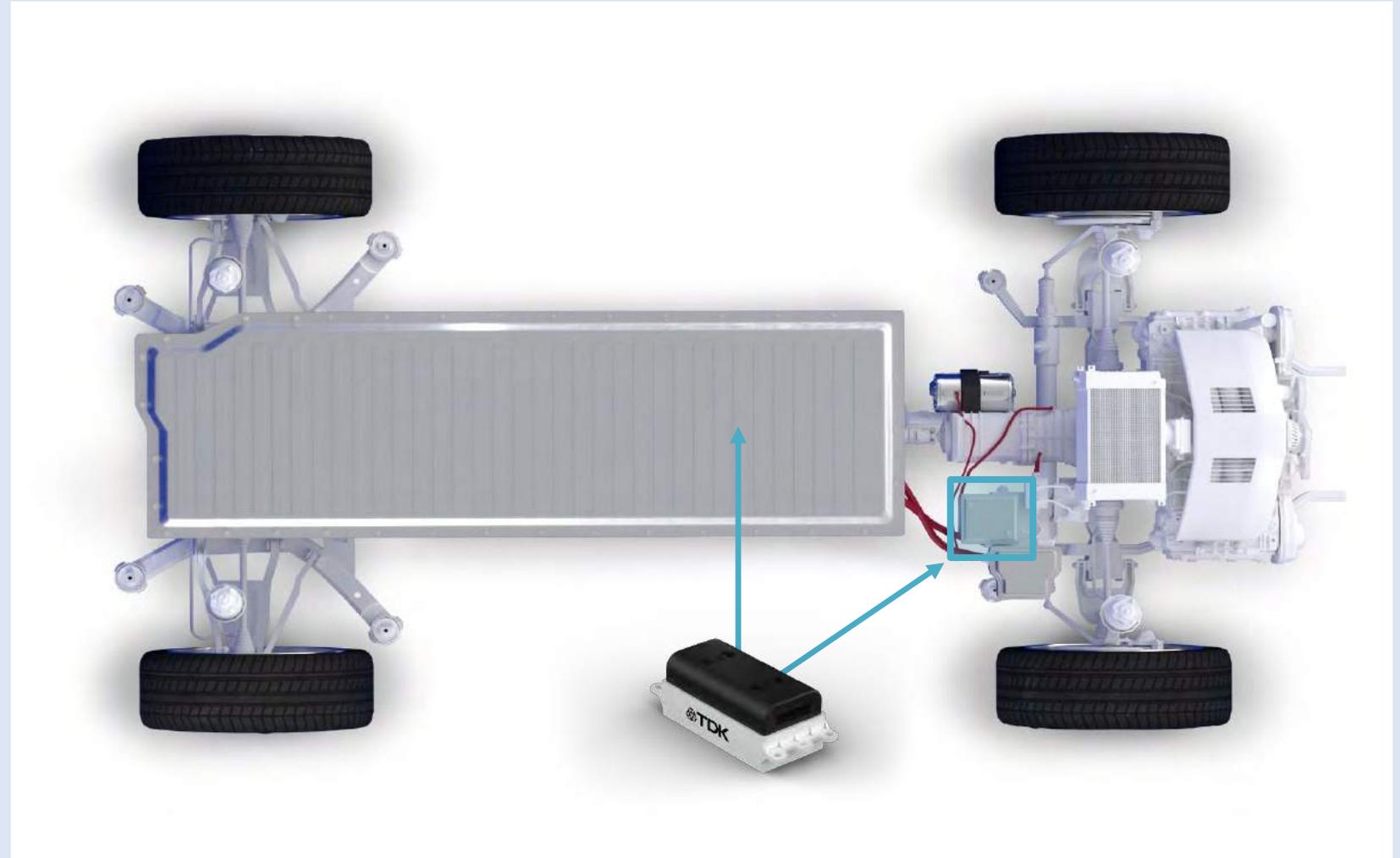
TDK Electronics AG
Magnetics Business Group
Munich, Germany
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Need for an EMI filter in xEV

High frequency switching noise from inverters is a potential source of RF emissions

Inverter noise on battery lines is also a major concern both for immunity and emissions

- Inverter is producing electromagnetic interferences
- EMI filter shall reduce the interferences between inverter and battery



Innovative standard solution: CarXield™

HV DC EMI filter for automotive drive inverters

- 900 V DC and 500 V DC with 200 to 400 A at 85 °C
- Product validation according to automotive requirements (based on MBN LV 124/AEC-Q200)
- Advantages
 - Quickly available
 - Price-competitive due to standard processes
 - Also available without copper bars

Status

- Data sheet and samples available on request
- SOP planned for 2022



F/G type

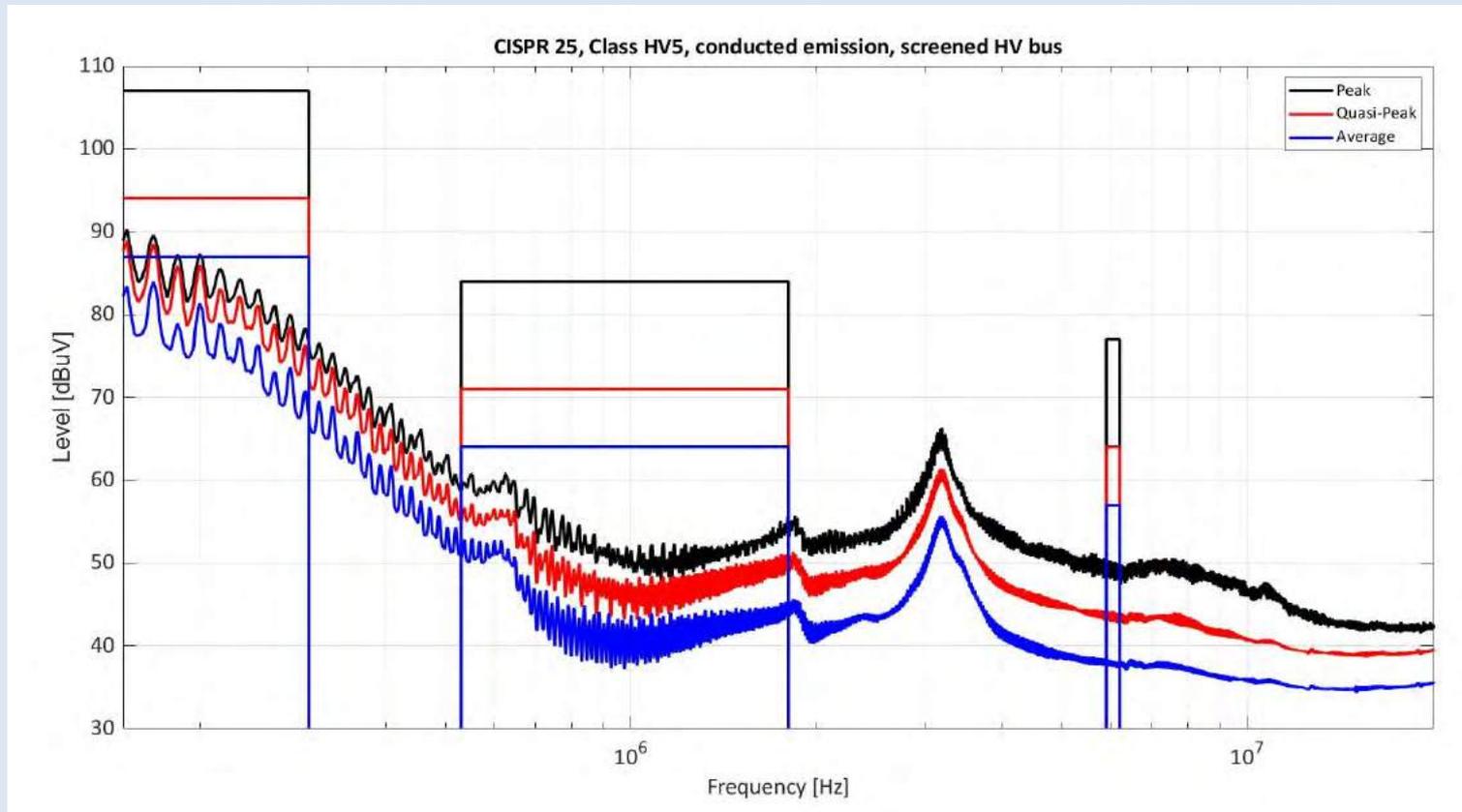


D/E/M type

Technical characteristics (1)

Performance

In compliance with CISPR 25 HV class 4 in a 50 Ω system



- Insertion loss
150 kHz 30 dB CM, 40 dB DM 500 kHz ...
- Example HV and conducted emission

Technical characteristics (2)

Energy potential & Capacitor to GND

		500 V	900 V
Energy potential*	$E_{(L-GND)}$	$\leq 0.05 \text{ J}$	$\leq 0.035 \text{ J}$
Y capacitance per line to GND	$C_{Y(L-GND)}$	$\leq 360 \text{ nF}$	$\leq 90 \text{ nF}$

Busbar packages

- Possibility to provide EMI filter without busbars



Variant without busbars
(using customer's busbar system)

or



Variant with busbars

* The potential calculation based on the r voltage as specified above.
It is for one potential (one line) to GND. The energy potential is calculated using following formula: $E = \frac{1}{2} \times C_{L-GND} \times U_R^2$ (result \leq specified value above).

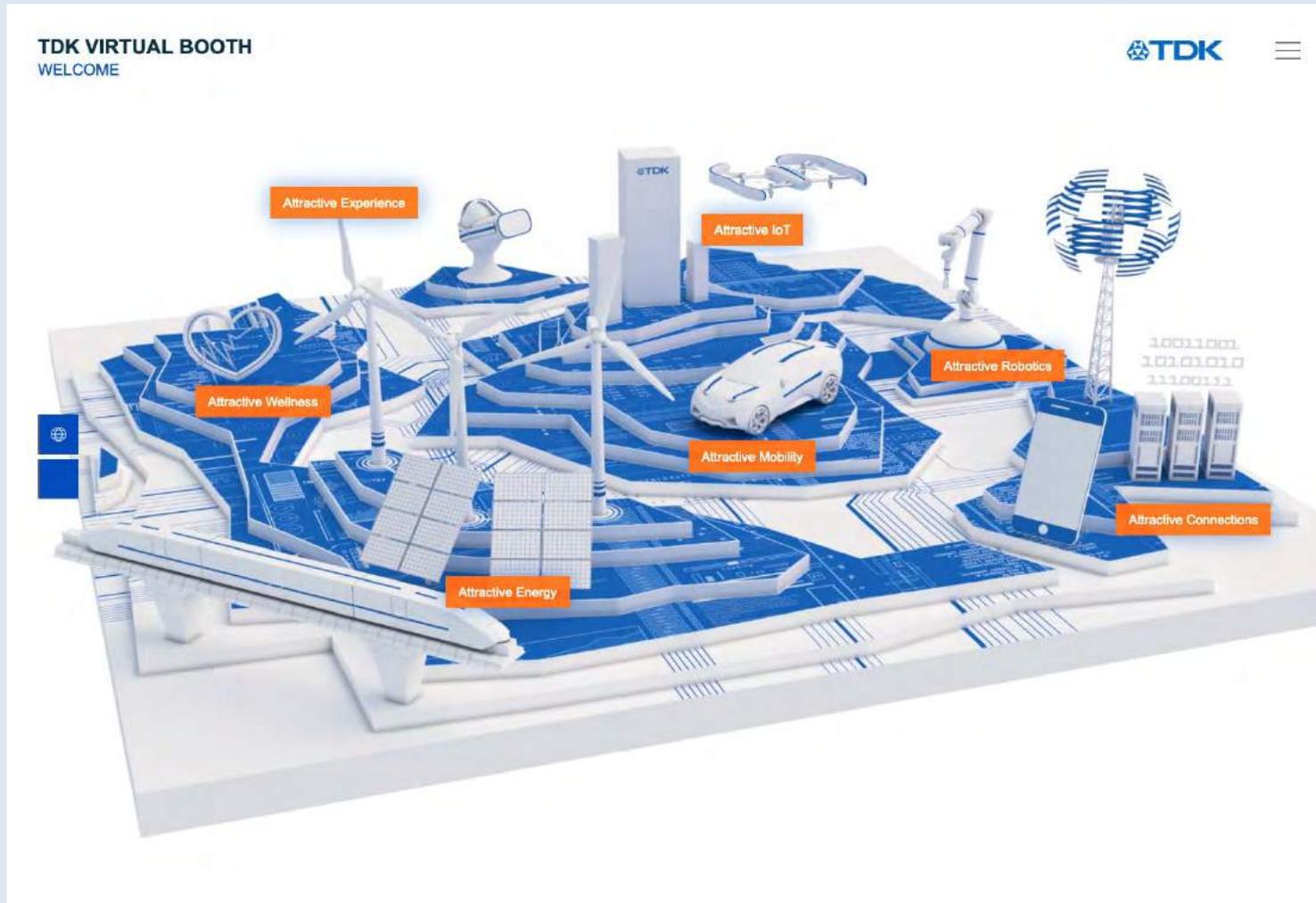
CarXield™ as standard EMI filter

Customer advantages

	<p>Cost-saving Reduced development time for the customer Product validation already done No custom-specific production line investment</p>
	<p>Reliability Basic product design already running in production Production process approved</p>
	<p>Flexibility Available with or without copper bars → Customer can use already existing own busbars</p>
	<p>Availability Samples available on request Serial production as of Q1/2022</p>



Product video and presentation in the *Digital TDK World* (1)



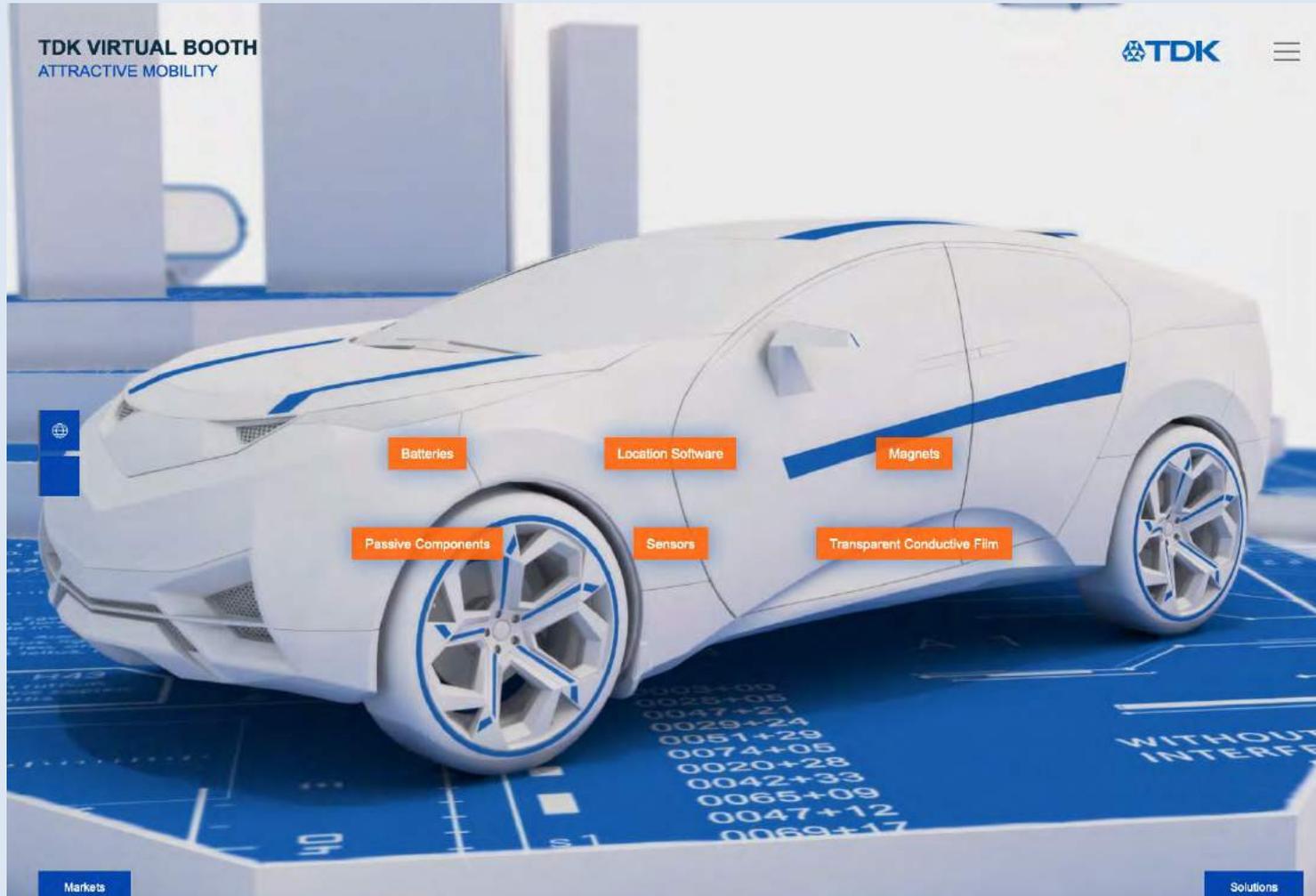
Explore our Digital World
and find a short introduction video
and a detailed PowerPoint presentation
at the following link

www.tdk.com/world

and then go to:

Attractive Mobility

Product video and presentation in the *Digital TDK World* (2)



and then go to:

Passive Components

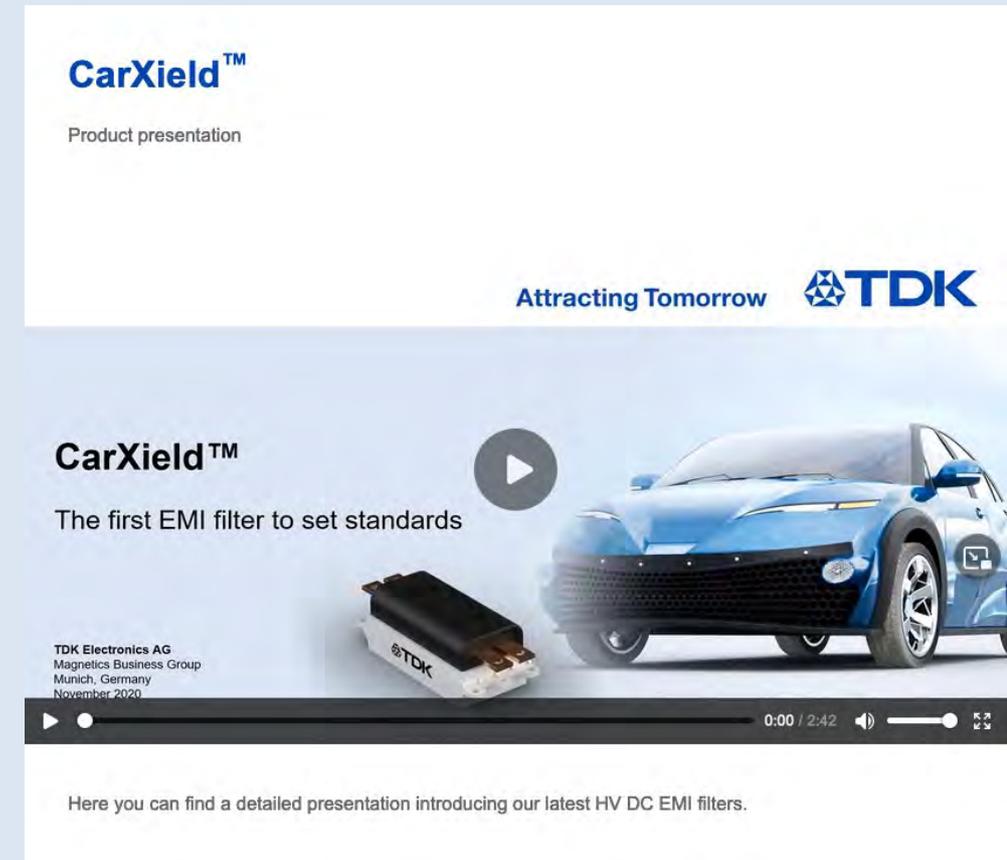
- EMC Components
- The first EMI filter to set standards

Product video and presentation in the *Digital TDK World* (3)

- 1 On the first page you will find a short introduction video



- 2 On the second page you will get detailed information from our PowerPoint presentation

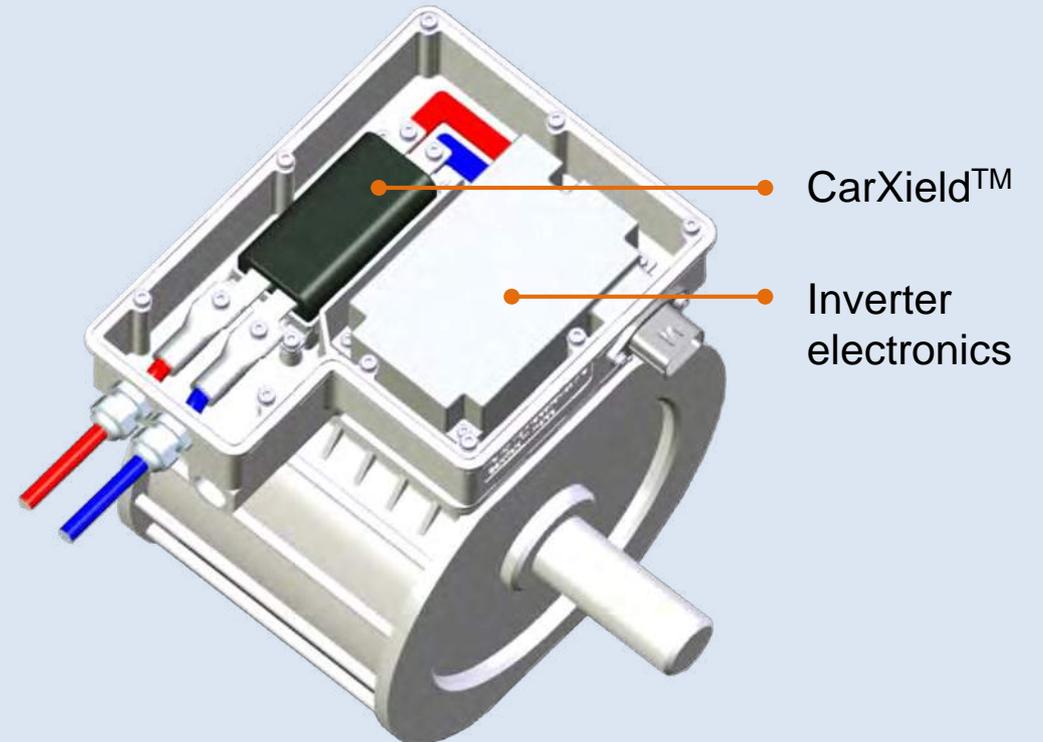
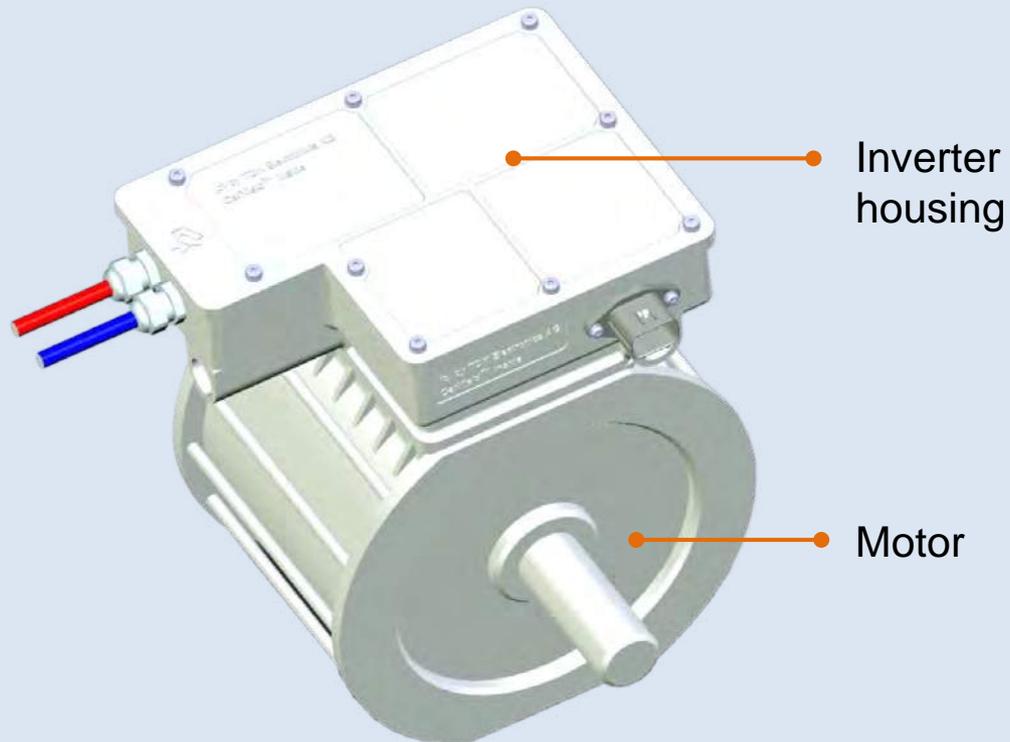


Possible integration of the CarXield™ filter

Example: Inverter mounted on E-motor

Advantages of CarXield

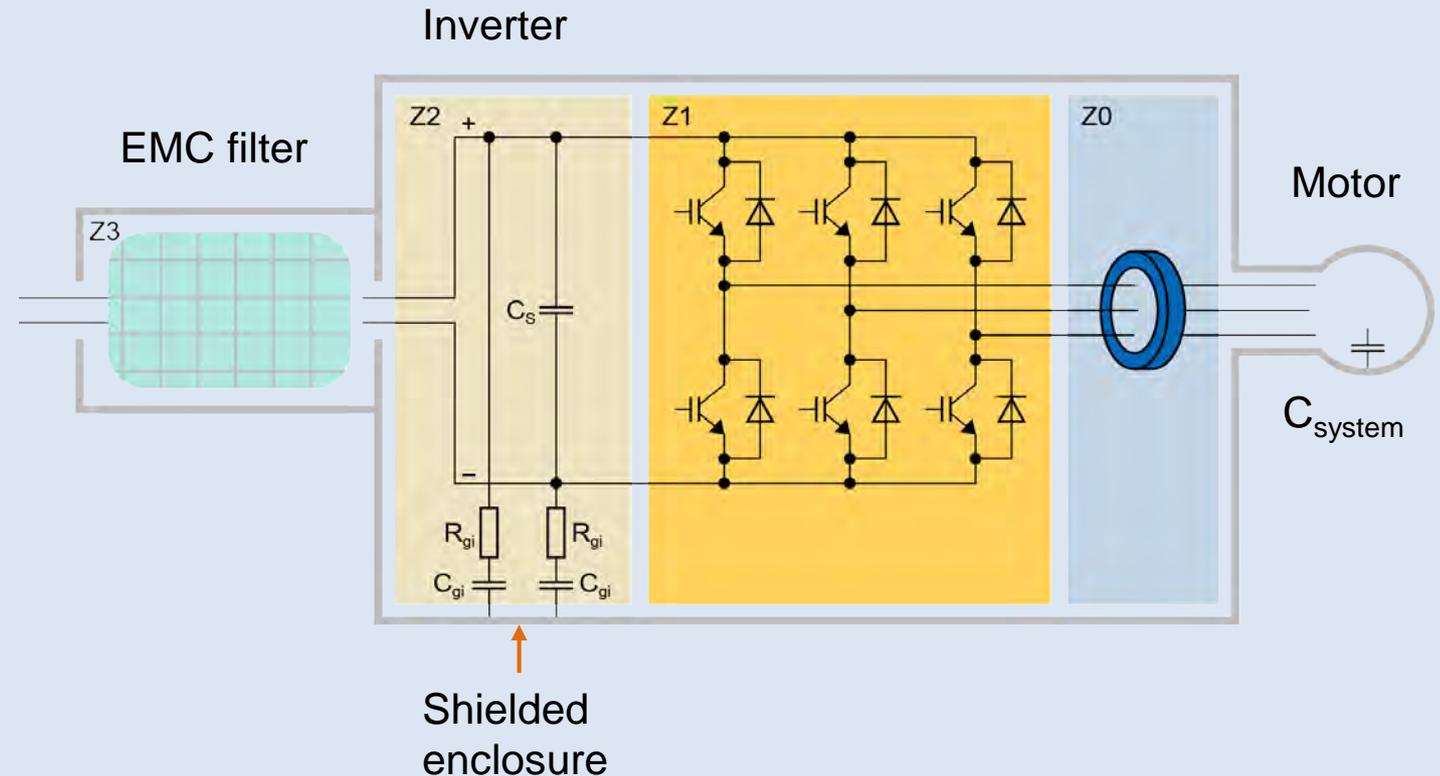
- Customer connection via cables with easy feedthrough connectors or plug
- Possibility to use customer busbar system



EMC design hints for our customers in the data sheets (1)

EMC zone concept (ex. inverter application)

- **Z3 Shielded EMC filter zone**
- **Z2 The zone Z2** (e.g. DC link capacitor) must incorporate at least a minimum capacitor value of $C_{gi} = 68 \text{ nF}$. In combination with a damping resistor R_{gi} , the losses of the resistor shall be considered.
- **Z1 The inverter bridge**
PWM frequency shall not exceed 10 kHz.
- **Z0 Motor connector/busbars**
A common mode choke is recommended to reduce the asymmetrical current (CM current).

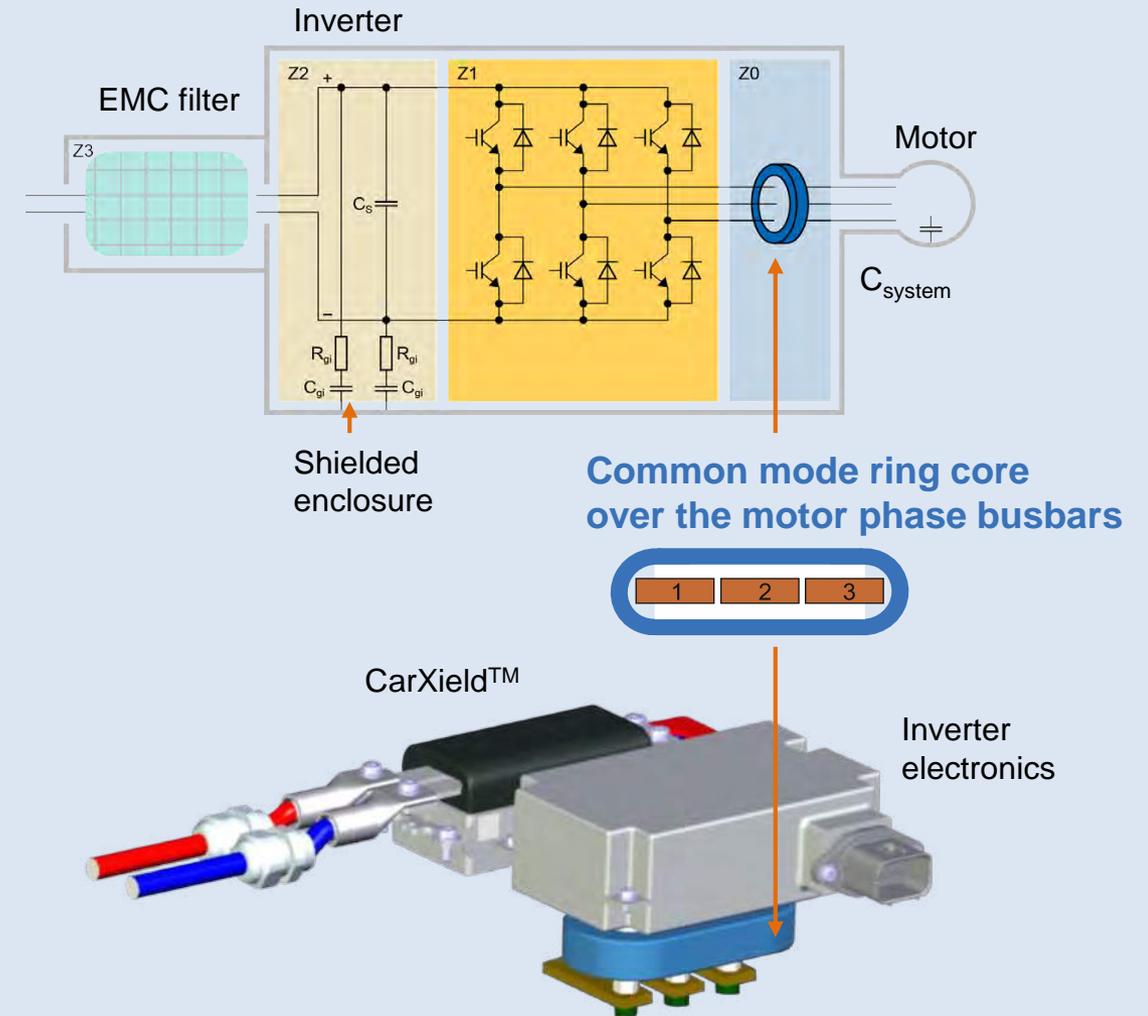


EMC design hints for our customers in the data sheet (2)

EMC zone concept (ex. inverter application)

The appropriate application of the EMC filter product requests a basic EMC understanding, an appropriate earth and shielding concept and the application of an EMC zone concept Z3 ... Z0.

- Z3 **Shielded EMC filter zone**
- Z2 **The zone Z2** (e.g. DC link capacitor) must incorporate at least a minimum capacitor value of $C_{gi} = 68 \text{ nF}$. In combination with a damping resistor R_{gi} , the losses of the resistor shall be considered.
- Z1 **The inverter bridge**
PWM frequency shall not exceed 10 kHz.
- Z0 **Motor connector/busbars**
A common mode choke is recommended to reduce the asymmetrical current (CM current).



Further filter types

K type



500 V DC/200 to 400 A

M type



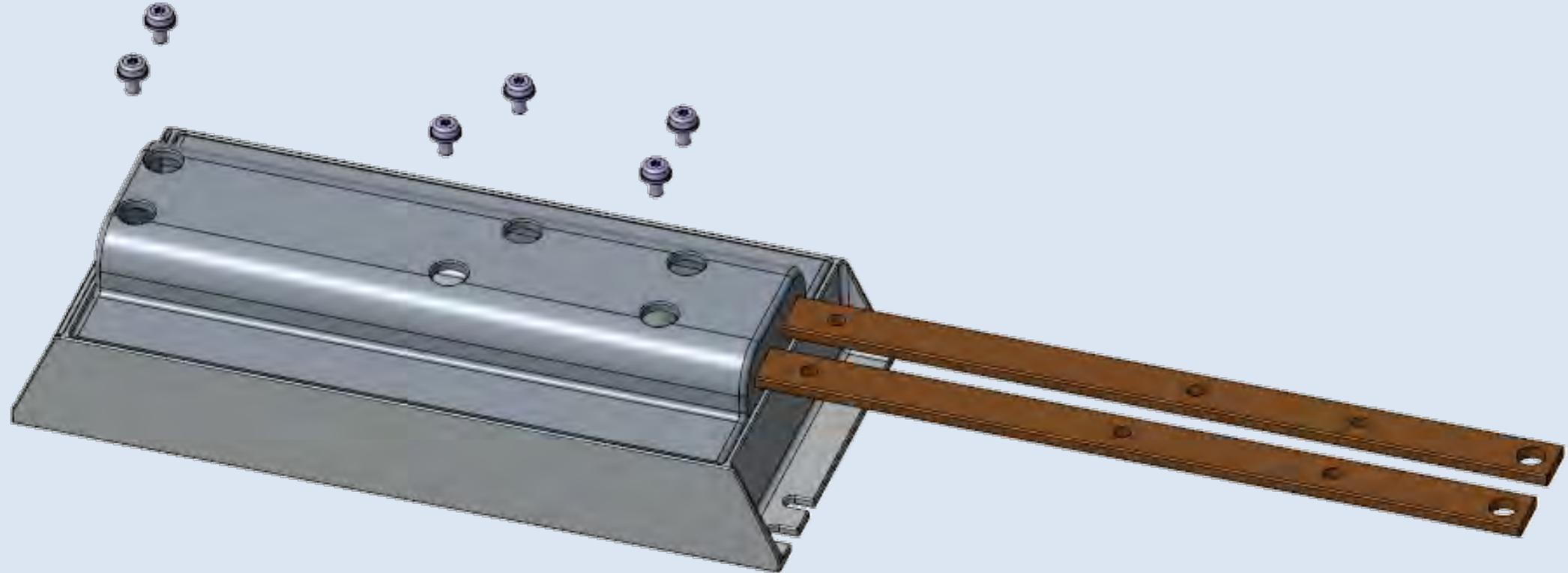
900 V DC/200 to 400 A

L/H type



900 V DC/250 A

Busbar installation





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