

A green rectangular highway sign with a white border, mounted on a metal structure. The sign features the word "SUCCESS" in large, bold, white capital letters, and "EPCOS Capacitors" in smaller, bold, white capital letters below it. The background of the slide is a 3D rendering of a winding road with yellow dashed lines, leading towards a bright horizon under a blue sky with clouds. A small black convertible car with a white driver is visible in the lower right foreground.

SUCCESS

EPCOS Capacitors

EPCOS Inc.
Capacitors Group
April, 2012

EV / HV / E-Mobility

Battery charger system & Inverter

On Board and Off Board Assembly

Trend: Wireless Charging

DC/DC Converter Filtering

DC Link

E-Mobility

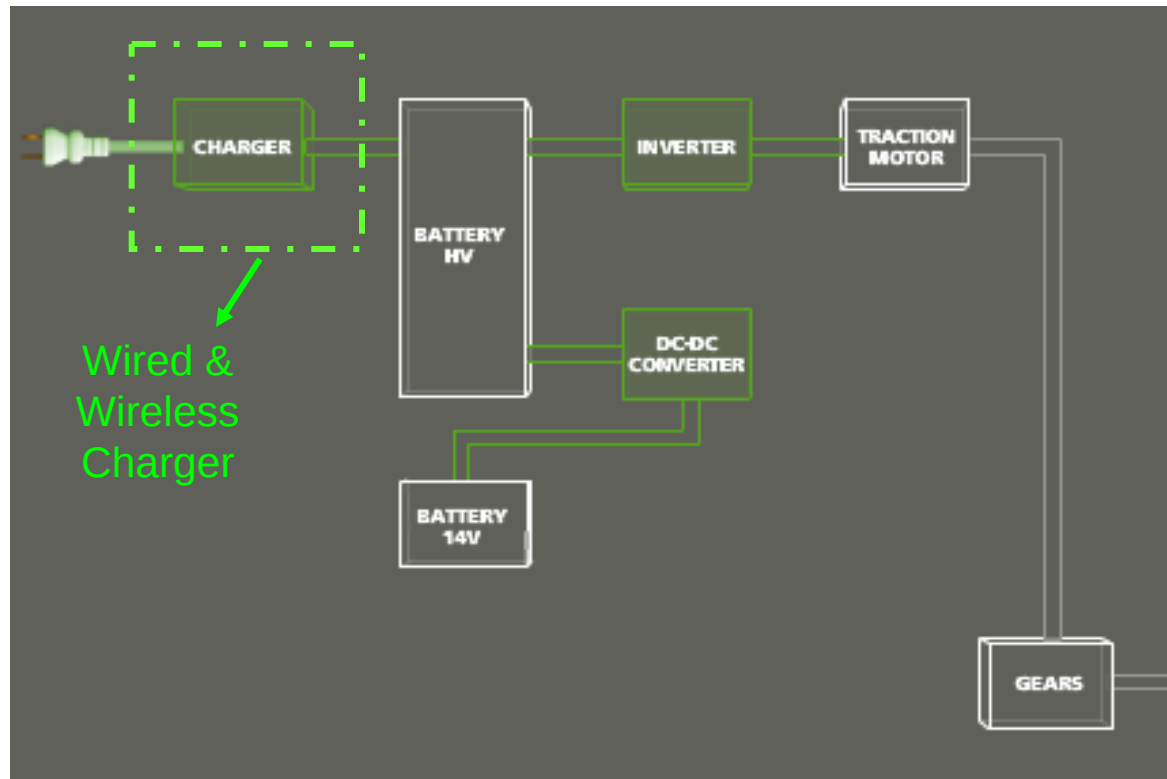
DC Link

Braking Energy Recuperation

Hybrid / Electric Vehicle



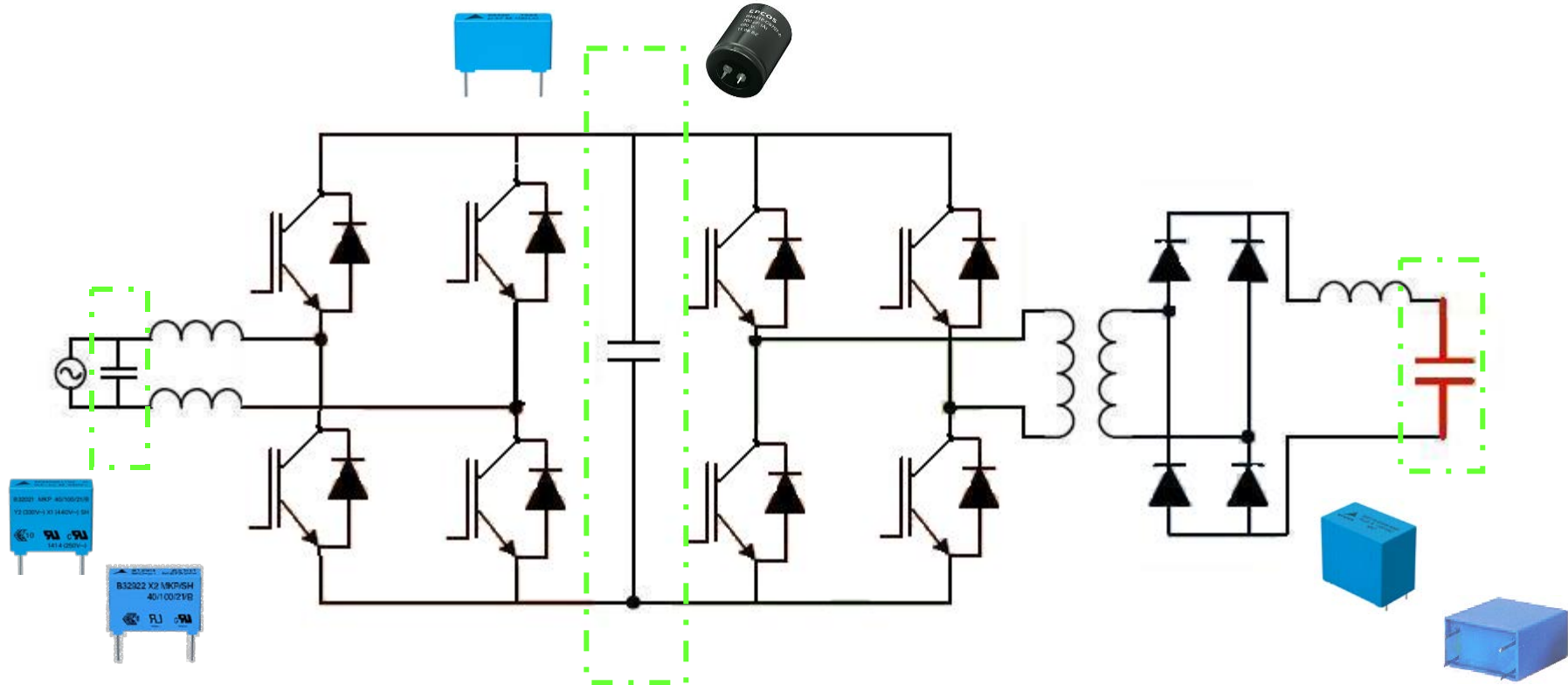
Battery Electric Vehicle (BEV) Block Diagram



The battery charger performs three electronic functions.

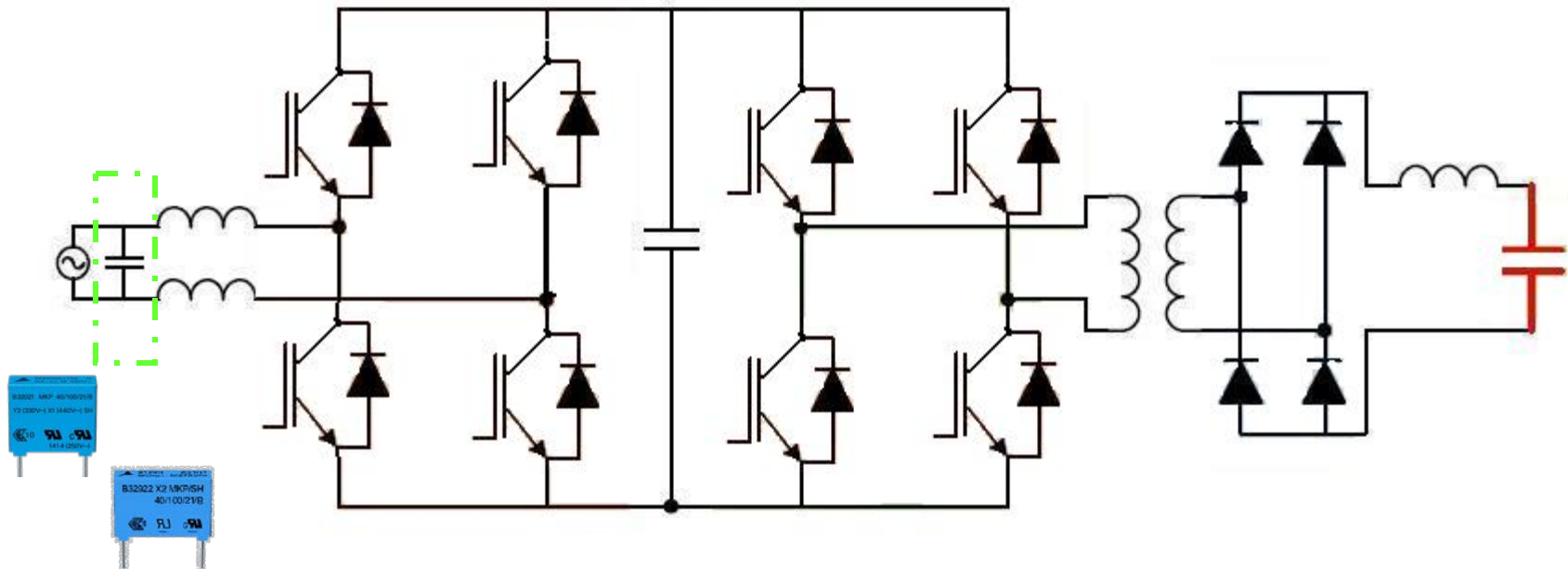
1. Enhanced phase adjustments made to the wall socket's alternating current.
2. The voltage is rectified to direct current (DC) voltage.
3. The final step is to up-convert the household voltage; enough to charge an EV with 40-mile all-electric range

Battery Charger Circuit Diagram



1. Filter Capacitor – EMI protection - X & Y caps
2. DC Link Capacitor – Alu Snap-in, MKP Cap
3. Output Capacitor – MKT and MKP caps

Battery Charger Circuit Diagram



1. Filter Capacitor - Due to the connection to the net for the external charging for the battery and the high currents we are facing inside the car, on some positions real X2 and Y2 capacitors with the standard safety approvals (ENEC and UL) are necessary.

Filter Capacitor for Charging / Plug In System

Technical requirements:

Operation Temp: 105C
 Capacitance range: 1nF - 45μF
 Voltage rate: 300V_{AC}
 Standard Safety Approvals **UL / ENEC**



EPCOS solution: EMI X2 / Y2 Cap



		AEC-Q200	
Film	MKP	MKT	MKP
Capacitor	X2	X2	Y2
Boxed	B3292X	B3293X	B3202X
Cap. range (μF)	0.01 - 45μF	0.047 - 10μF	1nF - 1μF
voltage range (V _{AC})	305	305	300
		Heavy Duty	
		85/85/1000/240	

Recent test results:
 Up to **2000Hrs!!!**

DC Film Capacitors

Heavy Duty X2 Series, B3293x



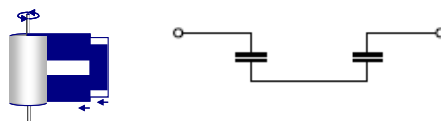
EPCOS has designed and developed a new series of MKT film capacitors for AC applications (B3293x - Heavy Duty X2 series).

This series offers high durability and very low capacitance drift even after being subjected to tests of **1000-hours at 85°C / 85%RH and 240Vac**. Their maximum capacitance change is expected to be less than 10%. The B3293# series cover a capacitance range from 0.047 μ F to 10 μ F and are designed for a nominal voltage of 305 Vac. Their maximum operating temperature is 105° C. In addition, capacitance values up to and including 2.2 μ F are safety certified as X2's capacitors.

Some features for the Heavy Duty Design:

- **Internal series connection**

Voltage per connection is divided by half so that avoiding the undesirable effects of AC voltage (i.e. partial discharges).



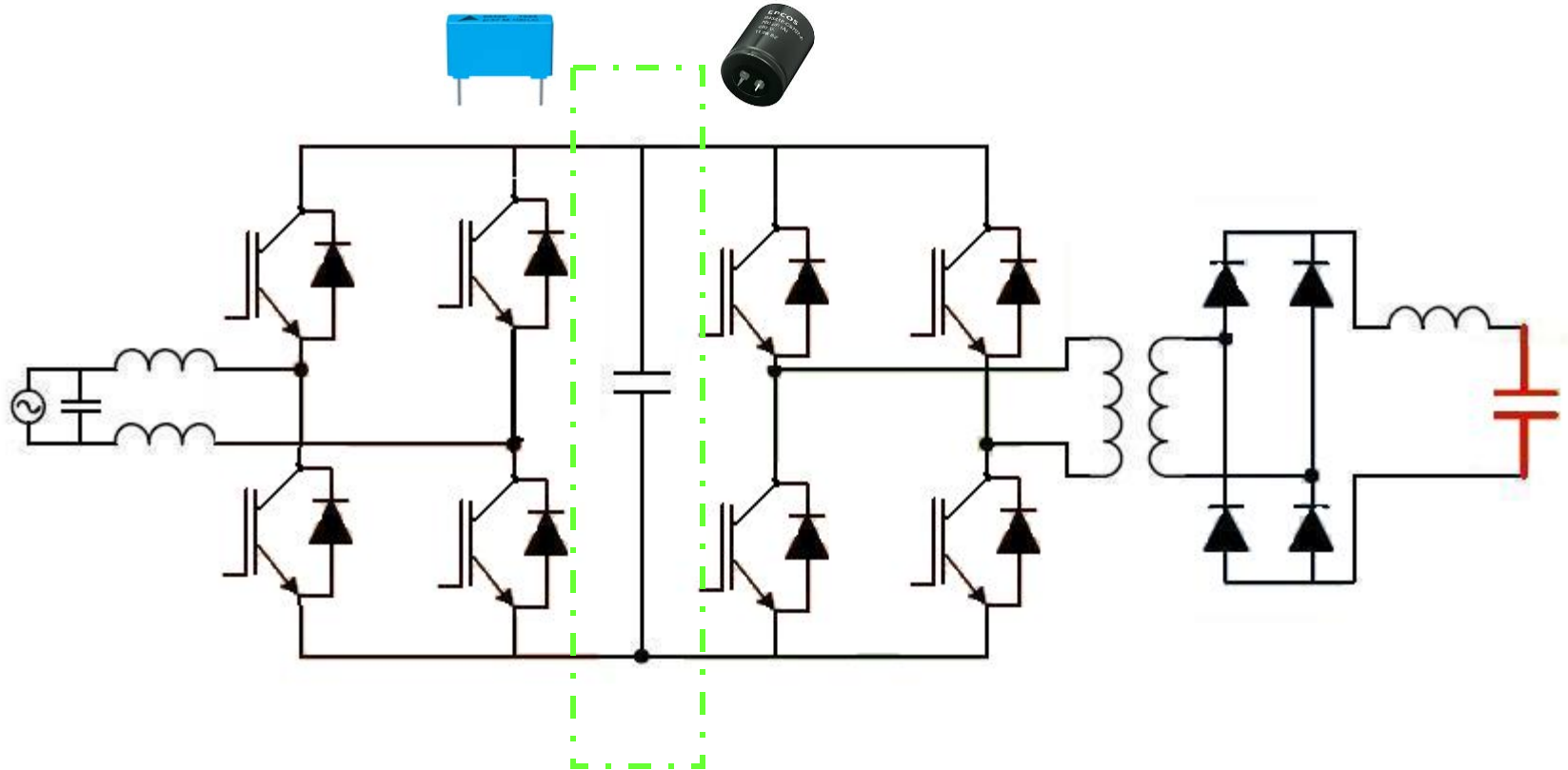
- **Polyester (PET) as dielectric material**

Due to its higher dielectric constant than polypropylene (PP), it allows a higher density of capacitance per volume, reaching smaller sizes. Better resistance to higher temperatures (i.e. 125° C)

- **Electrode metallization**

No use of Zn material, for high resistance to humidity.

Battery Charger Circuit Diagram



2. DC Link Capacitors - The main objective is energy storage. A high energy and high capacitance by voltage product that can withstand high temperatures and offer long life.

DC Link Capacitor – Film Capacitors

Technical requirements:

Operation Temperature: 105°C

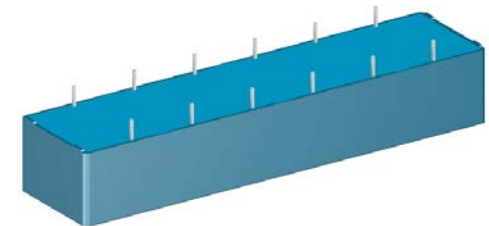
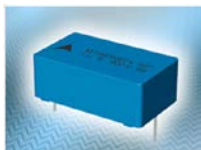
Capacitance range: Up to 480µF

Voltage range: Up to 1300V_{DC}

High Reliability

EPCOS solution:

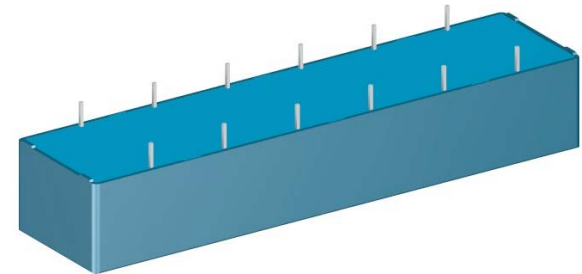
Capacitor	MKP
	DC Link
	1.5 - 480µF
Cap. range(µF)	(std)
voltage range (V _{DC})	450-1300



DC Link Capacitors

High Density DC Link B3277x series

NEW!!!



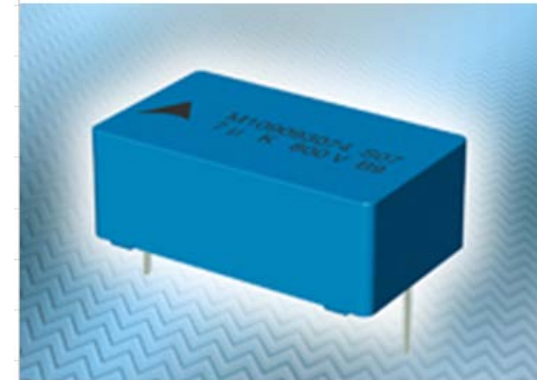
Lead Spaces (mm): 37.5 – 52.5				
Climatic Category: 40/100/56				
U _N / U _{OP}	450V	700V	900V	1100V
10 µF				
12 µF				
15 µF				
20 µF				
25 µF				
30 µF				
35 µF				
40 µF				
50 µF				
60 µF				
70 µF				
100 µF				
110 µF				

C (µF)	450 Vdc	575 Vdc	800 Vdc	900 Vdc	1100 Vdc	1300 Vdc
14						
25						
40						
60						
75						
80						
90						
100						
110						
120						
130						
140						
170						
180						
210						
250						
270						
320						
360						
480						

Low-Profile Capacitors, B32*6T series

NEW!!!

- ♦ Low-profile with heights of only **15 or 19 mm**
- ♦ Good self-healing properties
- ♦ High reliability
- ♦ Long useful life
- ♦ Very high mechanical resistance to vibrations and shocks



Product Series: B3722						
Dielectric: MKP						
Lead Spaces: 37.5 - 52.5mm						
Climatic Category: 40/85/56						
C V	450	575	800	900	1100	1300
9						
13						
14						
17						
20						
17						
22						
25						
30						
40						
55						

DC Link Capacitor – ALU Capacitor

Technical requirements:

Operation temperature:	105C
Service Life	15 years / 120,000 km
Ripple capability:	8Arms, 60C, 10kHz
Capacitance range:	1,500 μ F - 2,000 μ F
Voltage:	450Vdc

EPCOS solution



Type

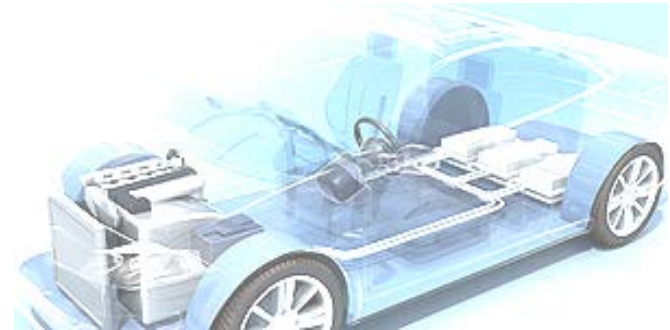
Series
Operation Temp
Cap. range (μ F)
voltage (V_{DC})

Qualified according

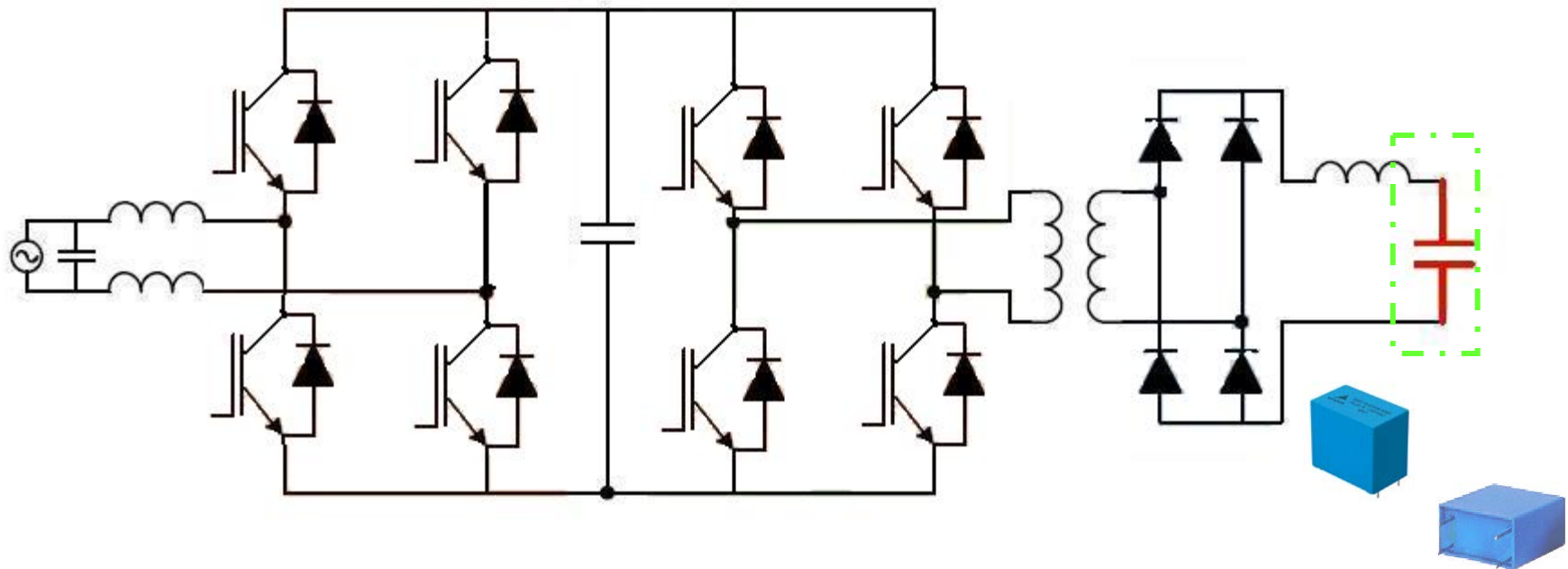
Snap-in

B43540 / B43508
up to 105C
100 - 470 μ F
450V

AEC Q200 (*)
(*) in qualification - Jun. 2012
Samples available



Battery Charger Circuit Diagram



3. Output Capacitor - Capability to withstand over-voltages, and transients coming from the mains.
Capability to withstand high current pulses together with a high frequency harmonics

International approvals such as UL/IEC are not always required for this position.

Output Filter Capacitor

Technical requirements:

Operation Temperature: 105C

Capacitance Range: 0.47 - 220 μ F

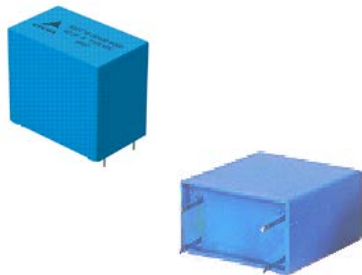
Voltage rate: 63-450V_{DC}

Ripple Capability: 20A, 70C, 10KHz

Useful life: 100KHrs/70degC



EPCOS solution: Film Capacitors



	MKT	MKP	MKP
Film Capacitor	B32524A	AC Filter	DC Link
Boxed	B32526A	B3279x	B3277x
Cap. range (μ F)	4.7-220 μ F	0.82-75 μ F	1.5 - 480 μ F
Voltage range	63-250V _{DC}	250-400V _{AC}	450-1300 V _{DC}

Trend: Wireless Charging



**Wireless power transfer technology is not a new technology;
however, recent developments have allowed it
to become more practical, and recent interest in the consumer market has
brought it to the center of attention**

**Wireless charging, also known as inductive charging, removes the need to
run a cable from the device
to the charging point and instead sends energy between two flat plates –
one in the device and
one on (or in) the ground below it – which charges the battery.**

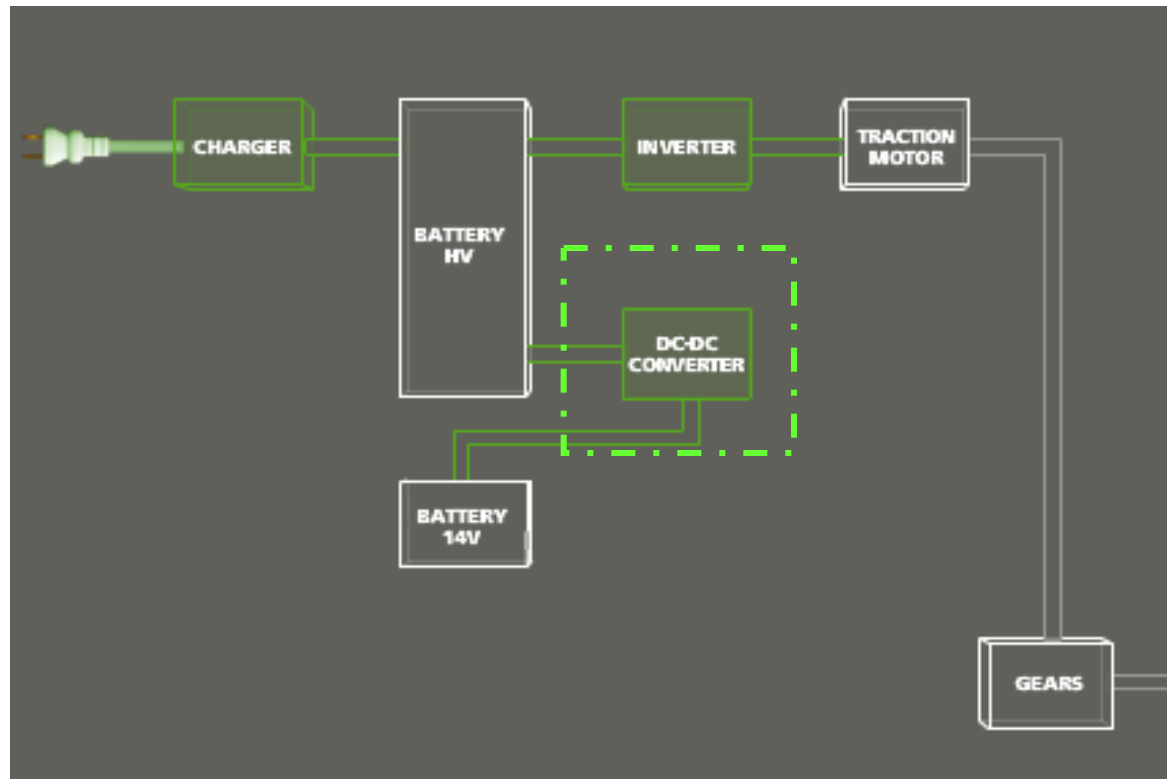
Trend: Wireless Charging



- 1/ POWER SUPPLY 2/ TRANSMITTER PAD
3/ WIRELESS ELECTRICITY & DATA TRANSFER
4/ RECEIVER PAD 5/ SYSTEM CONTROLLER 6/ BATTERY

ntom EE (aka 102EX) uses wireless charging technology. A pad connected to a the ground so all the driver need do is drive over it and park in roughly the right position - magnets ensure proper alignment.

Battery Electric Vehicle (BEV) Block Diagram



The DC/DC converter is responsible for converting High DC Voltage from batteries to Low DC Voltage on general applications

DC/DC converter – Filtering

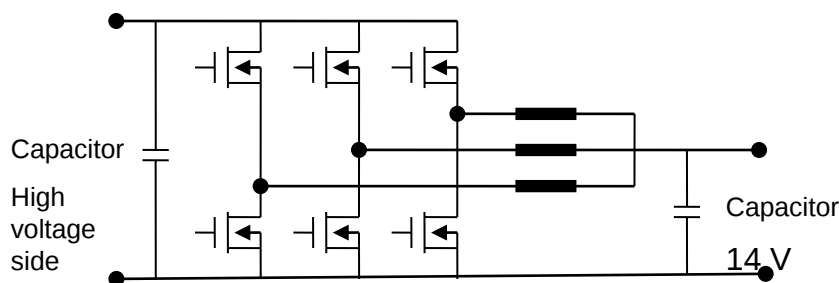
Since in most of the hybrid drives there is no starter and no alternator, the DC/DC converter has to be bi-directional.



The voltage level in the hybrid circuit is at the level of 200 – 400 Vdc.

DC/DC converter for hybrid / electric vehicle

- Used for the conversion of the battery voltage of 14V to a higher voltage level (42V or even more) and vice versa. (Typical application: Power steering)
- The film capacitor is used as an input and output filter



DC/DC converter - Filtering

Requirements:

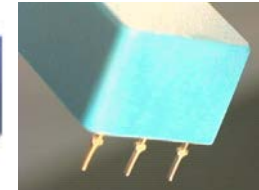
- Very high reliability
- Vibration resistance
- Excellent current handling capability
- Low ESR

Solutions from Epcos

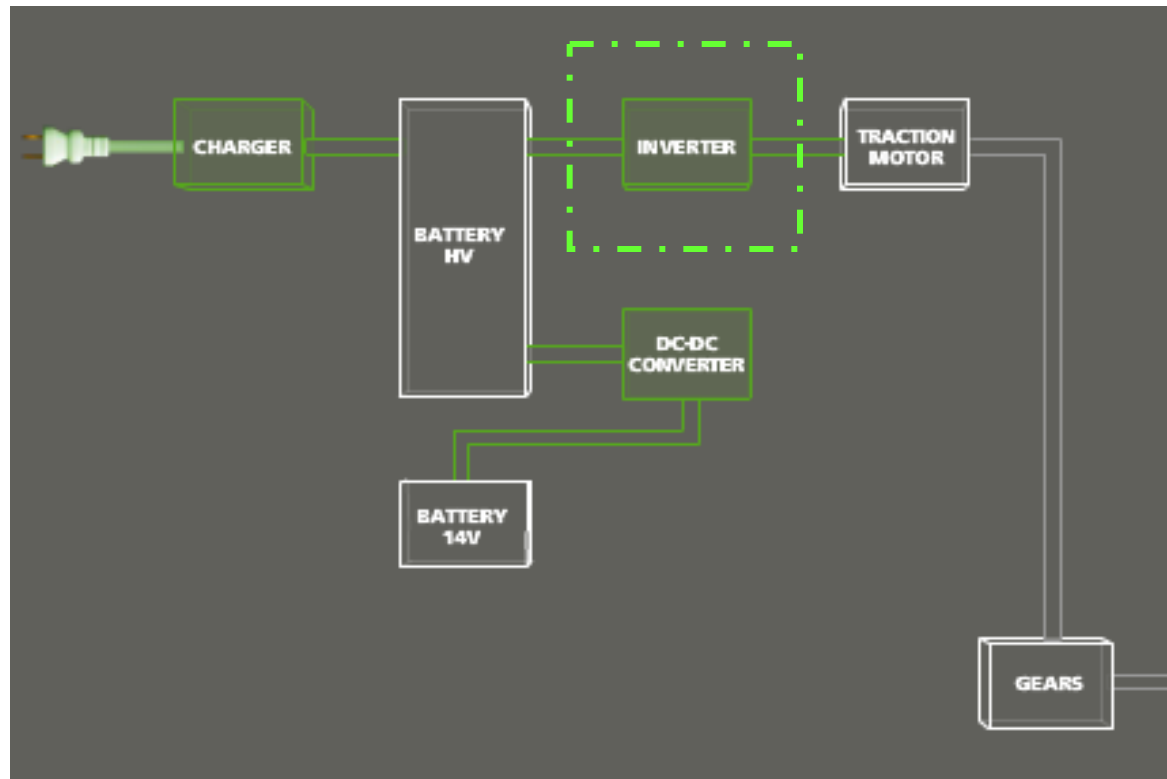
MKT B3252x and MKP B3277x

- different lead configurations for vibration resistance:
 - normal 2-pin
 - 4-pin or multi-pin
 - flat terminals
- low ESR at high frequencies
- high current handling capability

Series	B3252x				B3277x
Type	MKT				MKP
V_R (Vdc)	63	100	250	400	450
C_R (μF)					
5					
10					
22					
33					
50					
68					
100					
110					
150					
200					
220					



Battery Electric Vehicle (BEV) Block Diagram

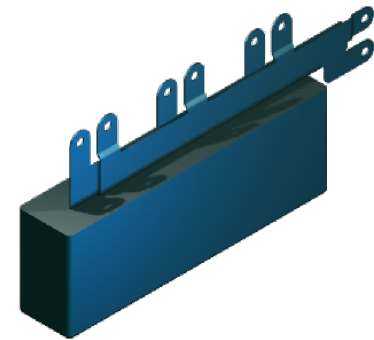
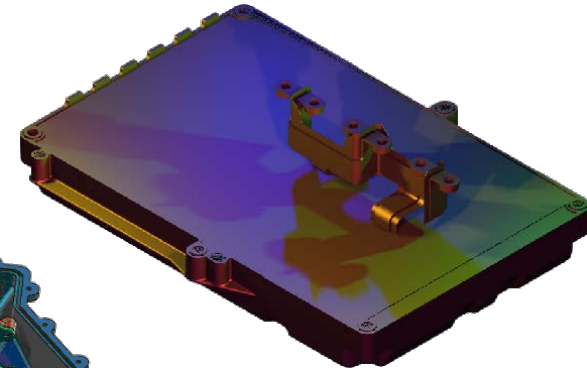
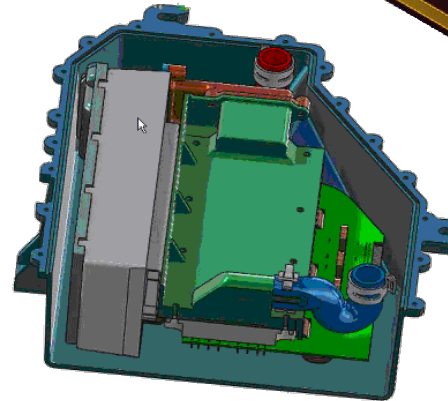
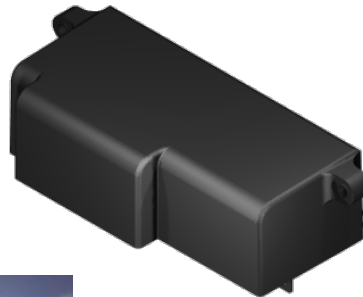


The DC Link is responsible for supplying energy or smoothing voltage ripple during the conversion of DC High voltage for the motors.

DC Link Capacitors for Automotive Applications

Customer Demands

- Compact Size
- Higher Temperature Ratings (105 ambient)
- Higher Currents
- Customized terminals
- Lower ESL



Specifications

- Capacitance: 300 to 1000 μF
- Voltage Rating: 450 to 600 V DC
- Ripple Current: 112 to 240 A

DC/DC Converter - DC Link Capacitor – ALU Capacitor

Function: the inverter controls the energy flow between electric motor and the hybrid battery while the DC/DC converter couples the hybrid battery to the overall power supply system.

Requirements:

- Voltage bank – 160V
- High reliability up to
- High current capability – 10A / cap
- Vibration resistance up to 40g
- Excellent current handling capability
- Low ESR



EPCOS solution

Type

Axial / Soldering Star

Series

B43693 / B43793

Operation Temp

up to 105C

Cap. range (μF)

100 - 470μF

voltage (V)

160 - 200V

Qualified according

AEC Q200

High vibration
strength up to
40g

E-Mobility – New Application

- Hybrid DC-Link with MOSFET Technology – 110V operating voltage at high ripple current



E-Bike (BEV)



E-Scooter(BEV)



E-Stapler (BEV)



Mild-HEV



- Axial-lead capacitor in Soldering star mechanical configuration
- e.g. 21 x 49 mm, 400 μ F, 160 V with max. 9 Arms at 125°C

E-Mobility – New Application

- Energy recuperation via braking system, high ripple current and vibration resistance >40 g

The cooperative regenerative braking system ensures that as much braking energy as possible is recuperated and stored as electrical energy.

To do this, the generator is used to slow the vehicle down. As soon as the braking requirements exceed the braking capacity of the generator, the classic wheel brakes are applied.



- Axial-lead capacitor
- e.g. 20 x 29 mm, 500 μF , 63 V with max. 9.5 Arms at 125°C

Comfort Electronics - EMC Protection



Power seat



Wiper



Smart Parking



Mirror control



All these motors are causing radiofrequency emissions!!!

Comfort Electronics - EMC Protection

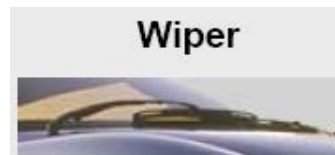
To ensure successful operation of all electronic modules in the car, these interferences must be caught directly at each motor

Requirements:

- thermal stability up to 125°C
even up to 150°C for special applications like the waterpump
- high pulse handling capability according ISO 7631
- high reliability
- flexible mounting possibilities

Typical applications:

- Power windows
- Windscreen wipers
- Power seats
- Sun / Moon roof



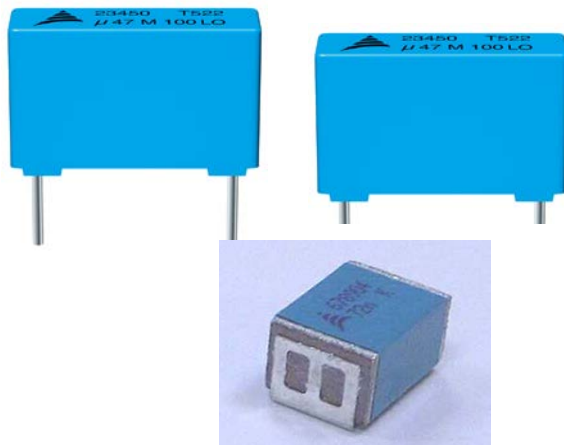
Comfort Electronics - EMC Protection

MKT boxed B3252x series

➤ Customized mechanical configuration available

- Bent leads
- Longer leads
- Lead-frames

➤ AEC Q200 qualified



Leadspace	5.0 mm		7.5 mm		10.0 mm		15.0 mm	
Type	B32529		B32520		B32521		B32522	
V_R (Vdc)	63	100	63	100	63	100	63	100
V_{rms} (Vac)	40	63	40	63	40	63	40	63
C_R (μF)								
0.1								
0.22								
0.33								
0.47								
0,68								
1.0								
1.5								
2.2								
3.3								
4.7								
6.8								
10.0								

Why TDK-EPC Capacitors?

- ✓ Long-standing experience in developing reliable Capacitors for Automotive applications.
- ✓ High end product technologies with long life & high ripple capability
- ✓ ALU Cap with vibration strength up to 40g
- ✓ Wide voltage range from 25V up to 1kV
- ✓ Specialist for customized solutions
- ✓ Local resource able to provide strong technical support to customers' engineers

