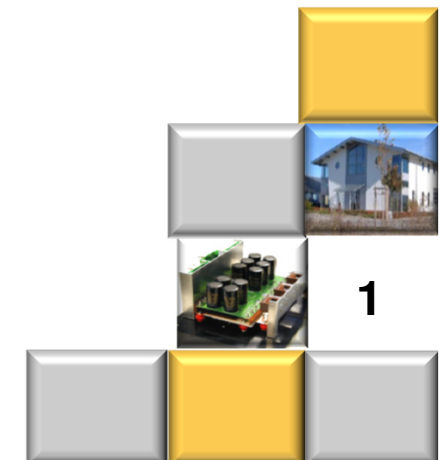
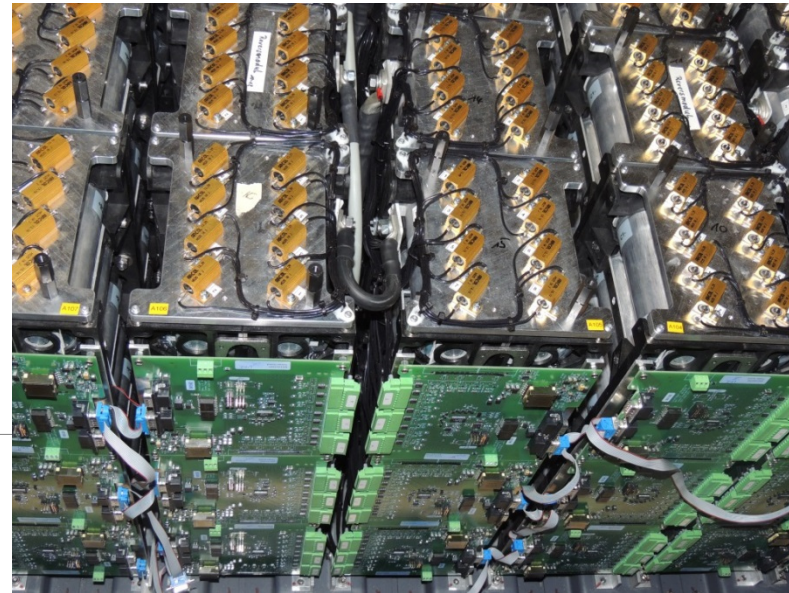
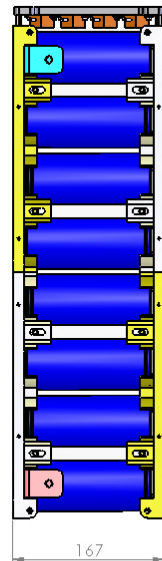
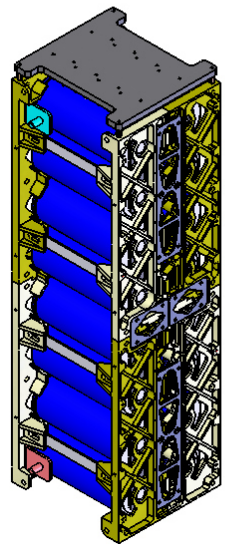
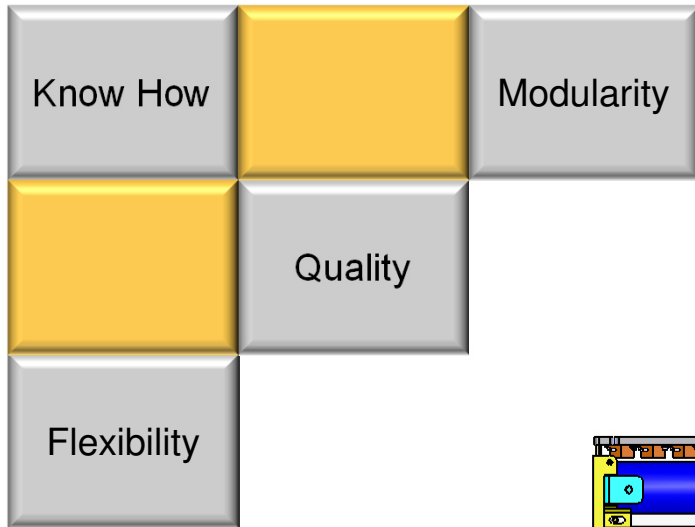


# SuperCap Storage Systems



# Double Layer Capacitors (DLC's SuperCap)

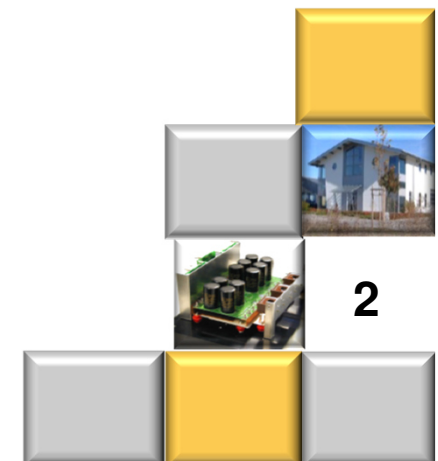
## What are SuperCaps?

Super Caps are Capacitor Elements with very high Capacitance, Low ESR and high Life Time and Life Cycles. DLC's are very suitable for all type of storage and buffer applications with high energy and very high power requirements.

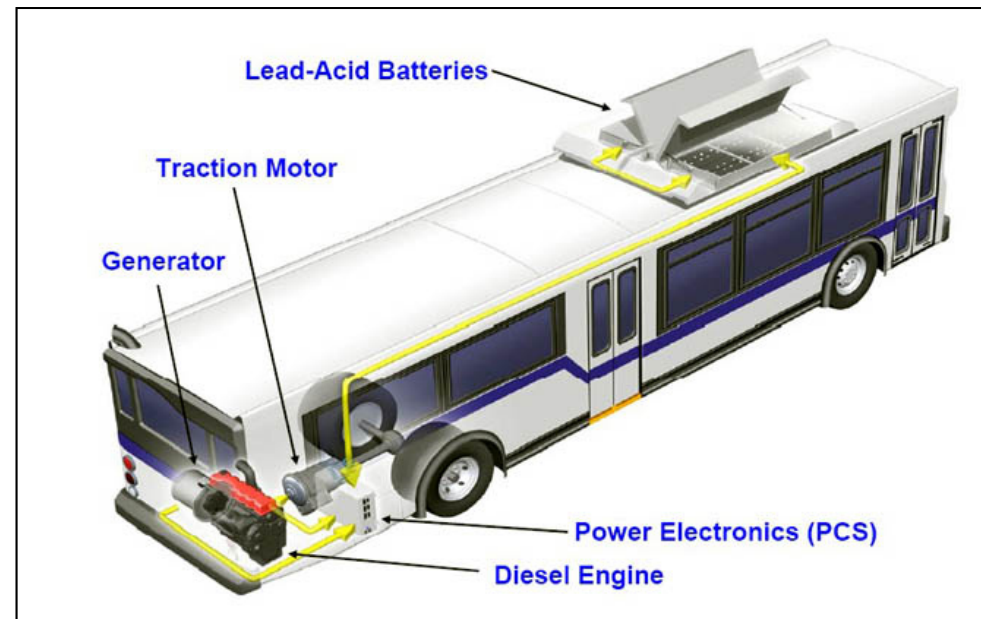


## SuperCap Highlights

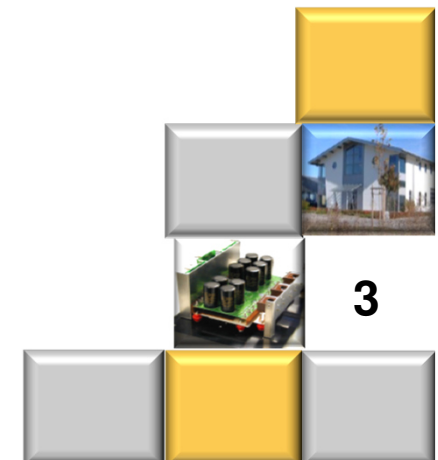
- Very High Power Density (fast charging capability)
- High Life Cycles (< 1.500.000)
- Good temperature performance at low temperature
- High efficiency

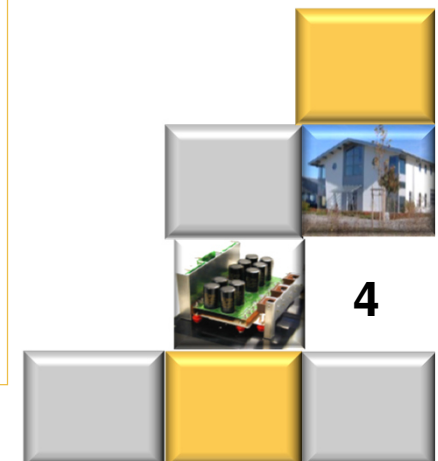
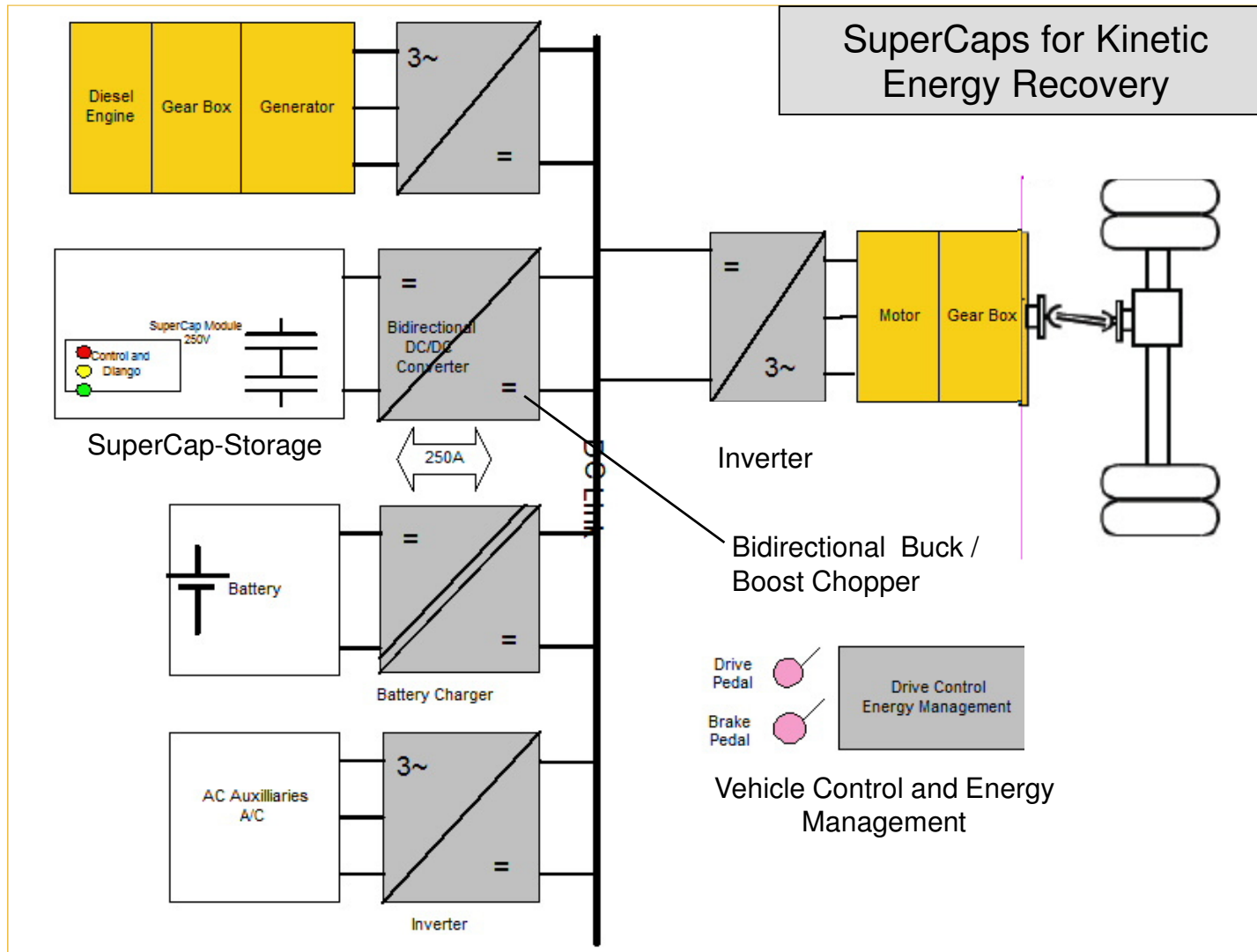


- Design & integration of SuperCaps Systems for mobile and stationary applications
- Intelligent Energy Management with SuperCaps
- Intelligent, self-protective SuperCap modules in variable stack arrangements
- Rugged mechanical design and cooling for mobile, military or aircraft applications
- Active balancing and overvoltage protection
- Bidirectional DC Buck-Boost Choppers and charging devices
- Diagnostic and Maintenance equipments



SuperCap-Anwendung: Antriebsunterstützung für Busse





# Super Cap Applications

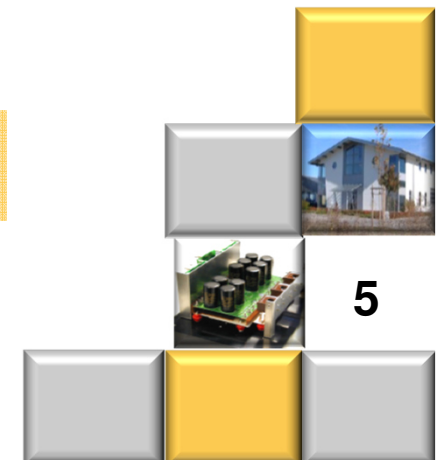
## Peak Power Booster for Launch Coasters Highlights

- Smoothing of very high power peaks
- Nominal energy capacity between 1 up to 2kWh
- Output power up to 1,8 MW
- Mean connection (Grid) power 50 to 150 kW
- Intelligent preactive balancing and optimized intelligent charging for optimized life cycles
- Thermal management and protection
- Continious Charge and Health Monitoring (SoH, SoC)
- Launch cycles up to 30 sec
- Active Front End (AFE) charger with optional Power Factor Correction (PFC) and power feedback capability
- Intelligent interface to the Drive Control
- High efficiency
- Low audible noise
- Long Life Time and Life Cycles (>1.5 Mio)

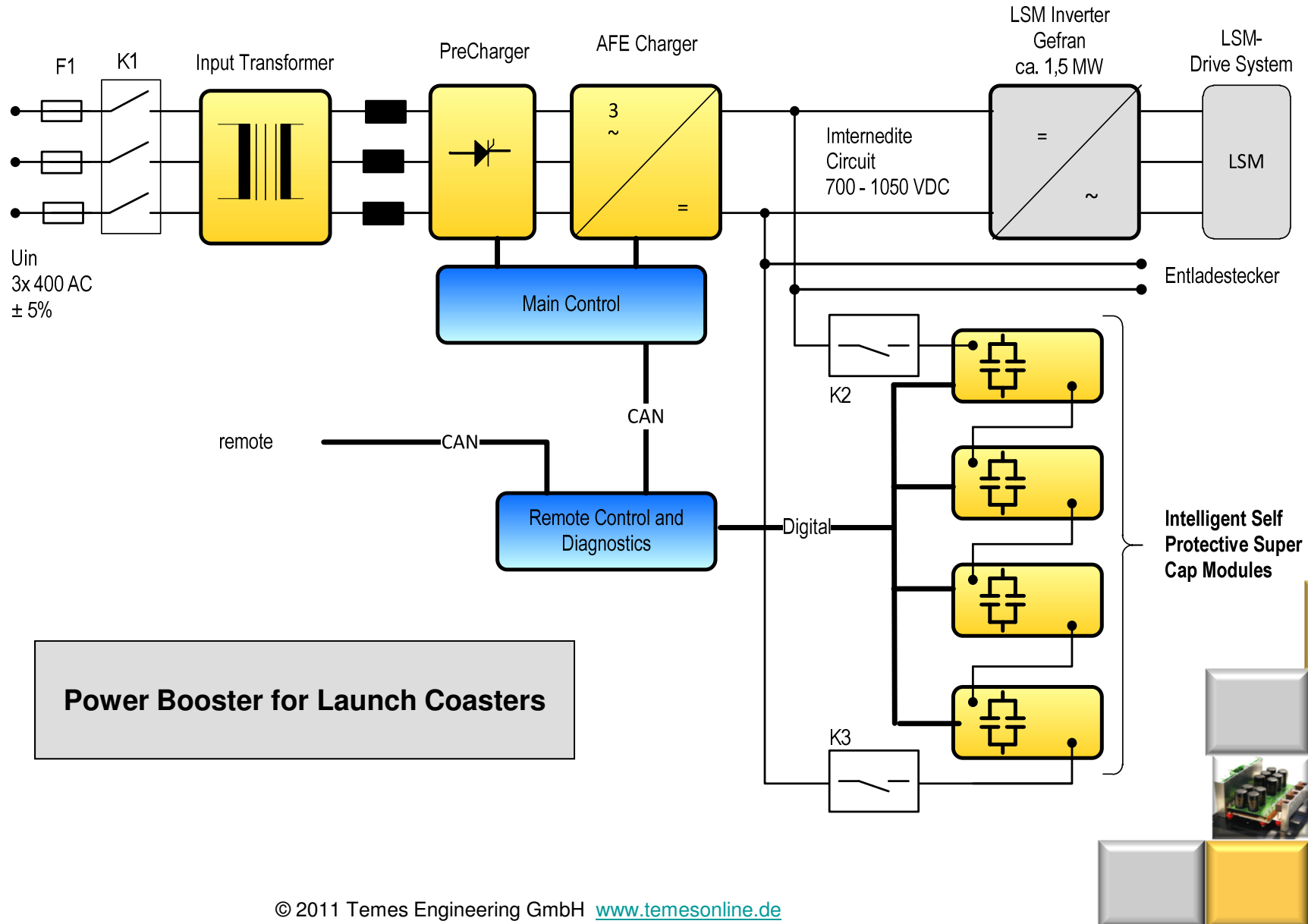


Electrical Priniple next  
Slide

- Options:
  - Recuperative Braking (Kinetic Energy Recovery)
  - Maintenance Discharge into AC grid
  - Power Factor Correction

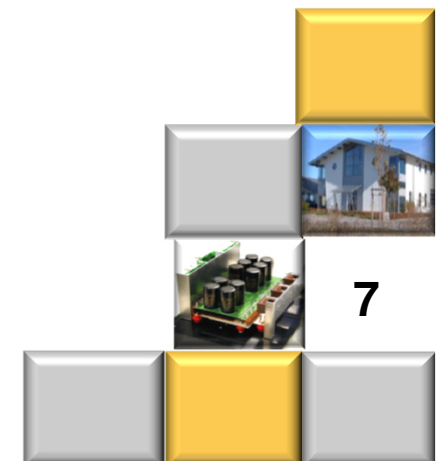
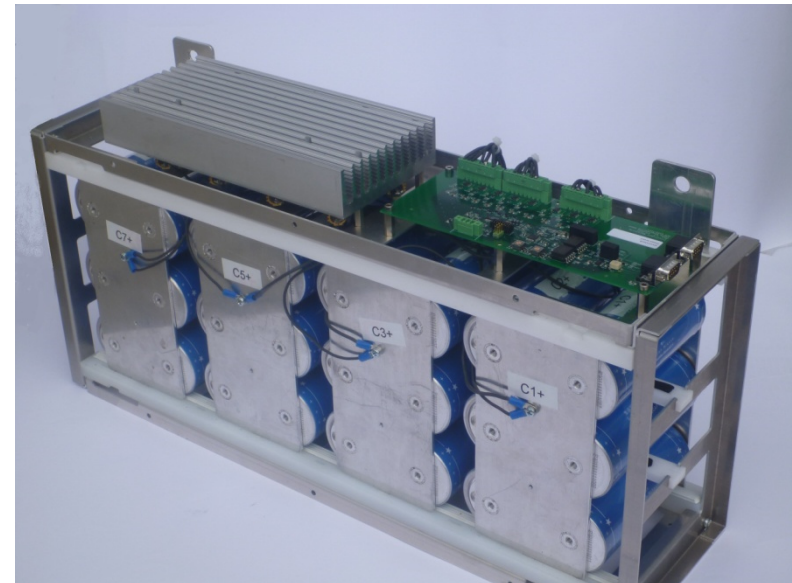


# Peak Power Booster Principle



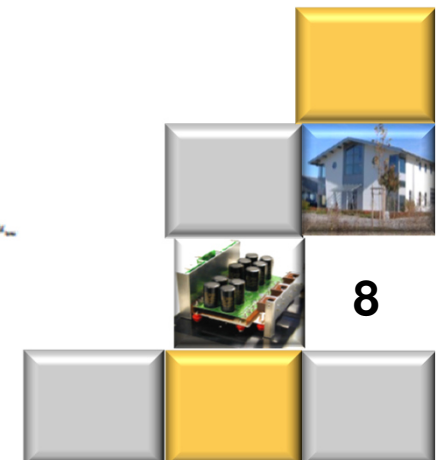
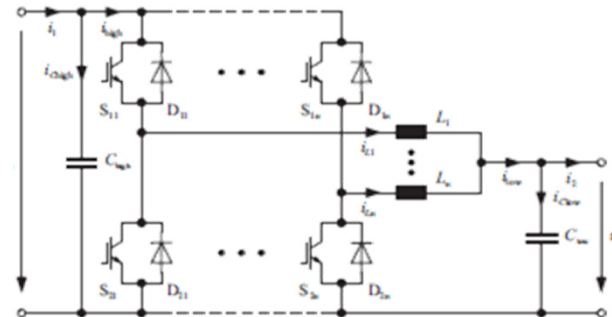
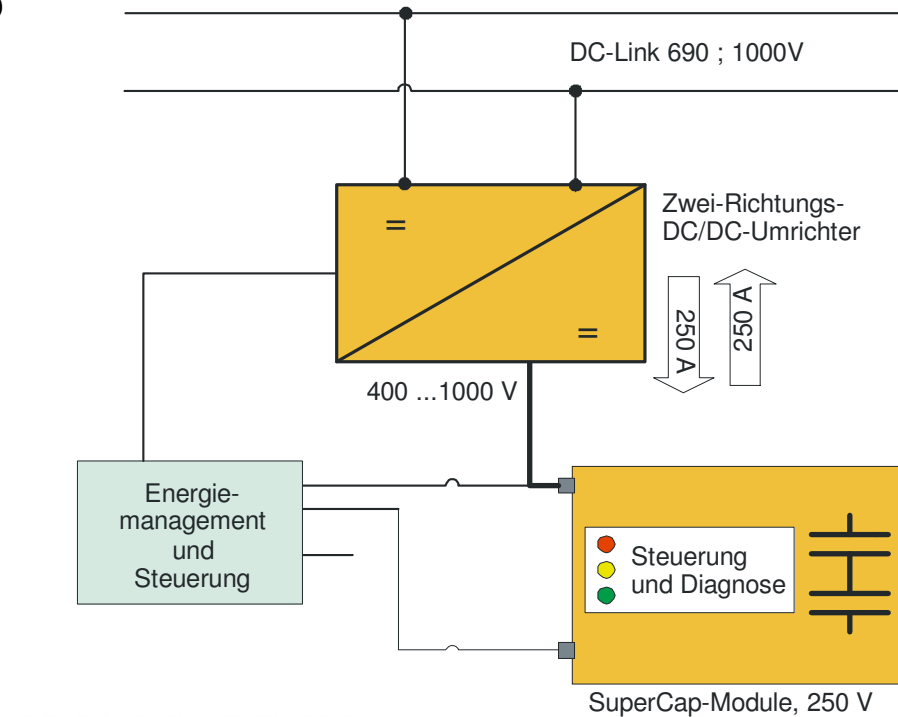
# Power Booster Technical Highlights

- 100 or 150 kW AFE (Active Front End) Charger System with Power Factor Correction and Energy feedback option
- Charger support during launch
- Maintenance discharge capability
- Remote control
- Intelligent self protective SuperCap modules with dynamic pre-active balancing and overvoltage protection down to individual CAP levels
- Optimized charging procedure due to intelligent interface
- Data- and Event logging
- SoH and SoC monitoring
- Remote Interface (GUI) and control
- Optimized cooling and thermal protection



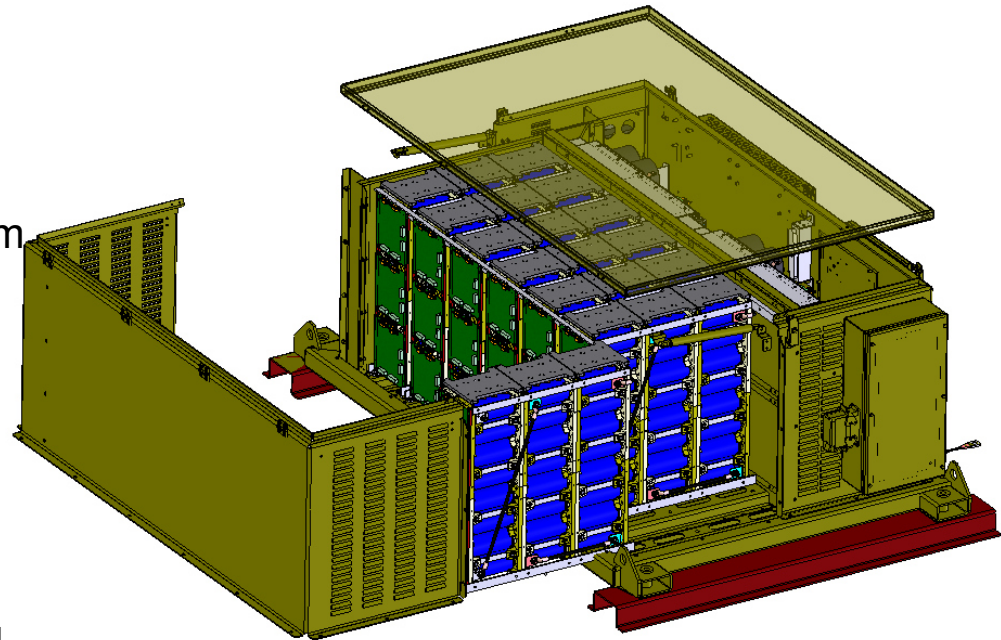
# Bidirectional DC/DC Converter

- Designed to Link SuperCap Modules to a constant DC Link
- Can be operated in a charging and load mode
- Uses modular interleaved technology
- Extended diagnostic features for SuperCap protection and Life Cycle optimization
- Energy Management Device
- Designed for stationary or mobile applications
- Application for example in Hybrid Busses
  - to store braking energy for re-use in the next acceleration phase
- Wide SuperCap Voltage range
- Various DC Voltages up to 1100V up to 250A short term in both directions
- Galvanic Isolation using an Electronic Transformer optional





- Saves up to 1 KWh recuperated energy
- 750 V DC (500 ... 1.000 V) System  
Operating in Portland, USA
- 1.500 V DC ( 1.000 V ... 2.000 V) System  
operating in Seattle, USA
- Extremely wide temperature Range  
from  $-40^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$
- Data and Event Logging
- Remote Interface and Control
- Charging / Discharging Power 150 KW
- Accumulates saved energy / commercial  
savings by long-term data logger
- Latest generation of self protective Super  
Cap technology with dynamic pre-active  
balancing down to individual CAP level
- Galvanic Isolation using an Electronic  
Transformer



# Combination of Battery and Super Caps: Super Battery

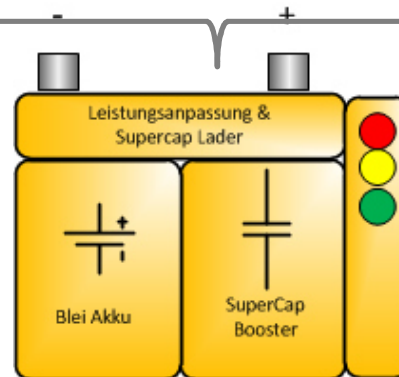
## ..Marathon runner meets sprinter

- Lead Acid Battery
- High Energy Density
- Low Price
- Durable and Reliable

- SuperCaps
- High Peak Currents
- High Power Density
- High Cycles (> 1 Million)
- Full performance also at lower temperatures down to -45 °C

Character:  
**Marathon Runner**

Charakter:  
**Sprinter**



**Combination of both Character as an  
ideal High Power High Energy  
Storage Element**

