PHOENIX
TECHNICAL MARKETING

Electrification Automotive Catalog

nexperia

Electrification

Less than 50 years ago there were virtually no electronics in the car. Today electronic systems are driving a revolution in how we interact with our car but also enabling its electrification. Whether it is plug-in hybrid electric vehicles (PHEV) or full battery electric vehicles (BEV), the need to charge the battery, manage power requirements and drive traction motors are the same. And while 48 V plays a key role, most systems are moving to either 400 or 800 V batteries requiring greater innovation in high-power wide bandgap semiconductors.

Electrification Applications

- **48 V Battery Management System (BMS)**
- 48 V batteries tend to be created using Li-ion multi-cell battery packs suing 8-16 cells. From a safety perspective, but ...
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- **High-voltage traction inverter**
- With both battery electric vehicles (BEV) or plug-in hybrid electric vehicles (PHEV), transferring the stored energy from...
- Read more
- **Inverter for aux. and e-compressor**
- An internal combustion engine provides more than just traction power to the wheels, it also powers auxiliary loads such a...
- Read more
- **On-Board Charger (OBC)**
- Whether a car is a battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV), one critical component is th...
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- **In-Vehicle Network (CAN FD / LIN / FlexRay / Ethernet) protection**
- The car is an extremely interconnected system, with over 100 ECUs all attempting to communicate with other systems in the...
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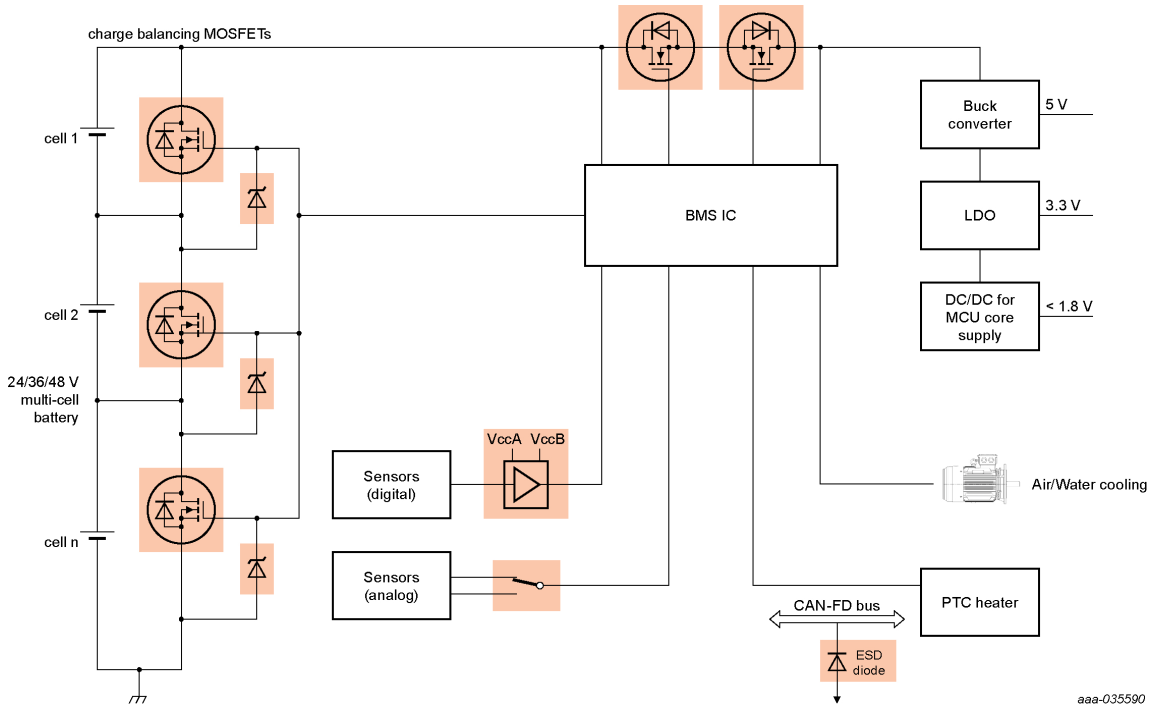
48 V Battery Management System (BMS)

48 V batteries tend to be created using Li-ion multi-cell battery packs suing 8-16 cells. From a safety perspective, but also to ensure the best efficiency and longest battery life these battery packs need to be carefully monitored and controlled. This requires accurate voltage, temperature and current as well as battery state of charge (SoC) and state of health (SoH) monitoring. In addition for most efficient battery use, good cell balancing and battery optimization is a must.



Products - Cell balancing

- Charge balancing MOSFETs: 40 V, RDSon < 5 mOhm
- Battery protection MOSFETs: 40-100 V; < 5 mOhm
- ESD: TVS diodes 400-600 W
- Zener diodes: SOT23 / SOD32(F) / SOD123(F)

Products - e-fuse / regulation

- efuse MOSFET: 30-60 V, P-channel
- Linear pre-regulation: Bipolar transistor, NPN, 100 V, 3 A

Products - HMI / MMI

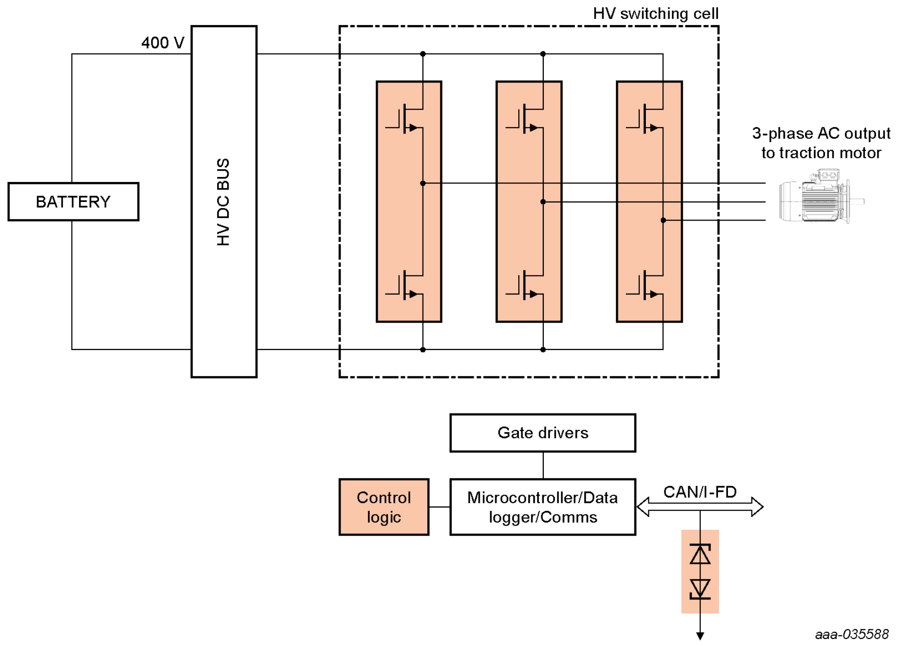
- ESD: CAN / CAN-FD bus protection
- Autosense translators: NXB / NXS families
- Control logic: LVC family
- Analog switch: LV/LVC family

Products - related

- DC/DC conversion for MCU core supply

High-voltage traction inverter

With both battery electric vehicles (BEV) or plug-in hybrid electric vehicles (PHEV), transferring the stored energy from the high-voltage (400 / 800 V) battery to the electric motors used to drive the wheels is the job of the high-voltage traction inverter. Traction inverters currently come in all shapes and sizes, ranging from 50 kW up to more than 500 kW with currents of several hundred amps. So safe and efficient DC to AC conversion is critical. In addition a small efficient traction inverter using GaN FETs can help eliminate the high-frequency whine associated with many battery powered vehicles.



Products

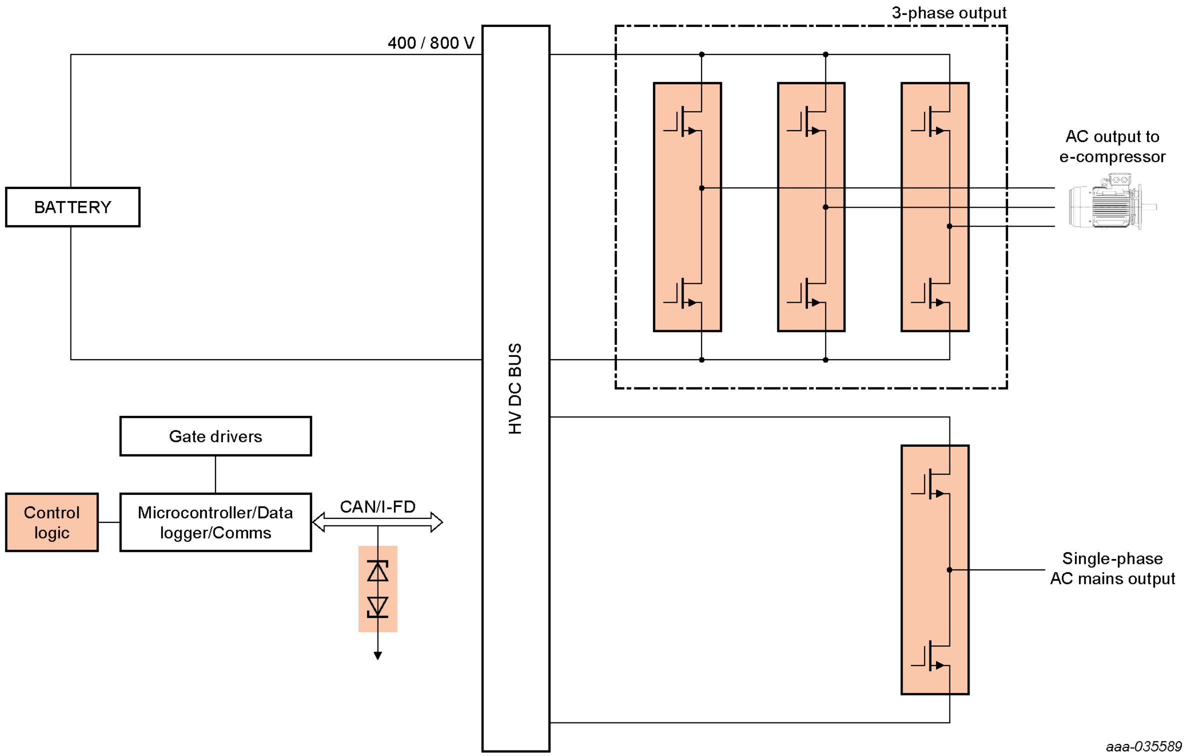
- GaN FETs: 650 V, CCPAK1212
- ESD: CAN-FD
- Control logic: LVC / HC family

Design considerations

- Dual electric motor architecture is more economical than one electric motor and a mechanical differential
- In premium BEVs trend is to have separate inverters – one for each axle or one for each electric motor
- To maximise range, inverters need to be extremely efficient yet at the same time be as small as possible, often with multiple dies per switch (4 – 8) and multiple switches per inverter cell
- Using GaN FETs eliminates the need for a separate body diode in the inverter switches.

Inverter for aux. and e-compressor

An internal combustion engine provides more than just traction power to the wheels, it also powers auxiliary loads such as compressors and pumps for brakes, suspension, heating and coolants. In battery or hybrid vehicles these auxiliaries need to powered independently. Applications including cabin cooling & heating, battery thermal management (fast charging and driving) and drive-train cooling require three-phase inverters typically rated from 2 kW to 10 kW. A single-phase inverter can also be used to provide an auxillary AC mains output to power various external devices.



Products

- [GaN FETs: 650 V, CCPAK1212]
- [ESD: CAN-FD]
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Design considerations

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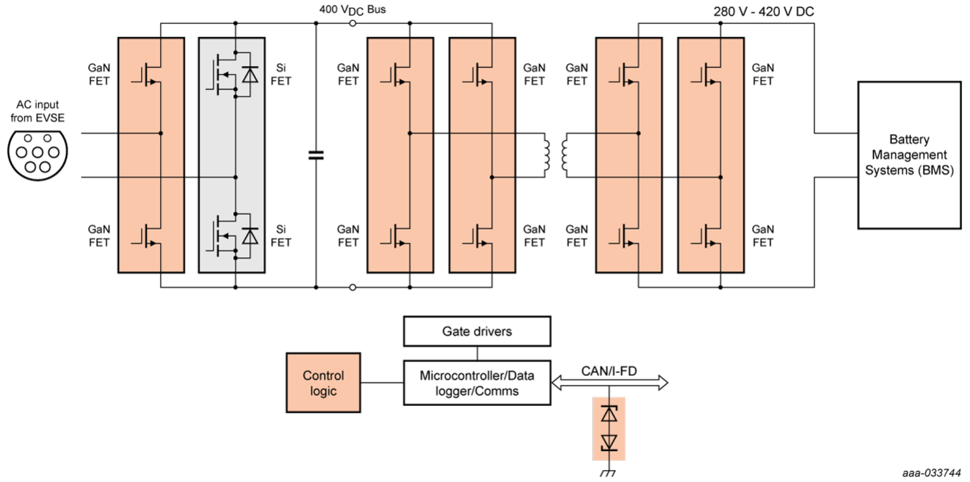
- Using GaN FETs eliminates the need for a separate body diode in the inverter switches.
- AC outlet - usually fixed frequency and voltage amplitude, passive filter required for high signal fidelity and low distortion (low THD)

On-Board Charger (OBC)

Whether a car is a battery electric vehicle (BEV) or plug-in hybrid electric vehicle (PHEV), one critical component is the on-board charger (OBC). This enables the charging of the high-voltage DC battery packs from various electric vehicle service equipment (EVSE) or charging stations. Those range from single-phase Level 1 residential chargers (~3 kW) to multi-phase Level 2 commercial capable of providing up to 22 kW, supporting both 400 and 800 V batteries. Of course Level 3 fast chargers provide a DC voltage direct to the battery, bypassing the OBC. However, a small highly efficient form factor is required to give manufactures the flexibility to place the OBC in different locations in various models.



Products

- [GaN FETs: 650 V, CCPAK1212]
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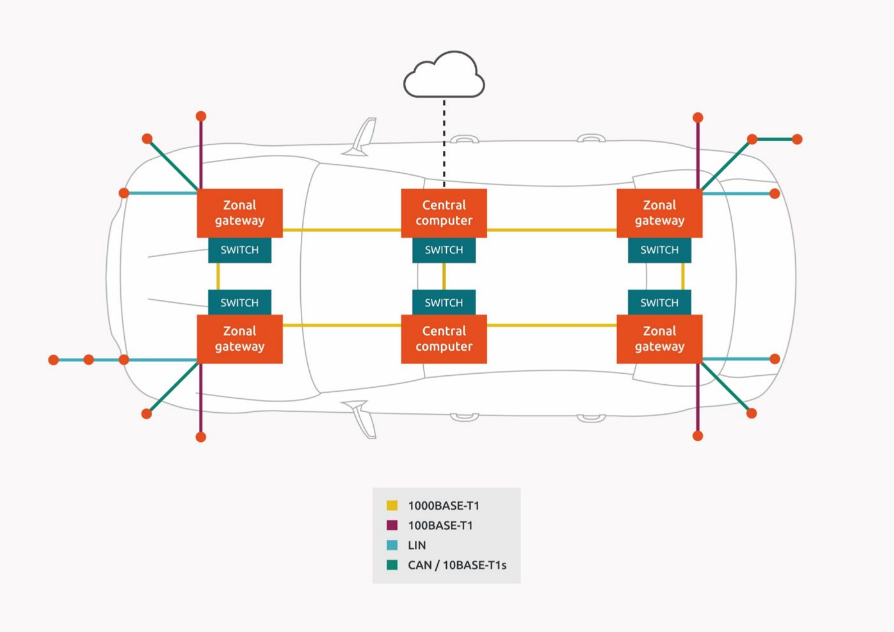
Design considerations

- Designers have multiple options for OBC conversion topologies, including single-phase / multi-phase and uni- / bidirectional
- Current batteries are typically 400 V, using 650 V FETs in a bidirectional OBC topology where GaN brings the highest efficiencies (for unidirectional topologies SiC diodes can be used on the secondary side
- For 800 V batteries, need to go multi-level GaN or high-voltage SiC
- However OBC topologies are heavily fragmented which may lead to combined 650 / 1200 V device solutions
- PFC output defines blocking voltage of power semiconductors at DC-DC-Input and battery voltage defines blocking voltage at DC-DC-Output (650 or 1200 V)
- Trend towards higher OBC charging power and 800 V batteries for higher class BEV solutions, will require more 1200 V solutions

In-Vehicle Network (CAN FD / LIN / FlexRay / Ethernet) protection

The car is an extremely interconnected system, with over 100 ECUs all attempting to communicate with other systems in the car. To manage increased complexity and higher data rates as new versions of existing protocols find their way into vehicle networks (CAN FD, Ethernet), the classic flat wiring harness architecture is changing to a domain and zonal architecture with Automotive Ethernet as the backbone. Offering increased system robustness, our IVN bus line protection solutions are well suited to automotive bus protection without impeding signal integrity in this electrically noisy environment.



Products

- LIN / CAN(FD) / FlexRay
- Automotive ESD Ethernet

Design considerations

- High ESD robustness up to 30 kV and high surge currents up to 3.5 A (8/20µs)
- Excellent ESD clamping behavior
- Operate at a low capacitance avoiding any unwanted circuit disturbances
- Asymmetrical internal diode configuration, ensures optimized electromagnetic immunity