Automotive Excellence

#1 OSAT for Automotive Packaging and Test

Amkor Technology®

The Journey Towards Autonomous Electric Vehicles

Early autos, though marvels of engineering and design, were fairly simple compared to the vehicles we rely on today.

Today's vehicles not only require advanced driver assistance (ADAS) for safety but also electrification to reduce CO_2 emission.

The complexity inherent in automotive semiconductors means that reliability is critical. To ensure the highest safety standards, automotive technology must be high-quality, reliable and proven.

As a result of continued innovation, today's automobiles are able to leverage technology that enhances safety, connectivity and fuel efficiency.

Amkor AEC-Q100 Package Qualifications

Grade 0	Grade 1	Grade 2
CABGA	FCBGA	fpfcCSP
MLF®	fcCSP	Stacked CSP
PBGA	SiP	
SOIC	WLCSP	
TQFP	WLFO	
TSSOP		

*AEC Grades may depend on package size, die size and bill of materials. All Amkor power discrete packages are qualified to AEC-Q101.

The Complete Solution For Next-Generation Automotive Systems

Automotive semiconductors encompass a wide range of products – from electrification, body electronics and access systems to connectivity, ADAS and infotainment components. Unmatched in reliability and flexibility, the packaging and technology solutions provided by Amkor address the most demanding technical challenges facing automotive packaging manufacturers today.

As the world's largest OSAT for automotive semiconductors, Amkor offers an industry-leading portfolio of packaging technologies, such as:

- Low-Cost Flip Chip
- Wafer Level Packages
- System in Package (laminate and wafer-based)
- MEMS & Sensor
- Leadframe
- Power Discrete
- BGA

Amkor designated automotive product assembly line

We Know Automotive

ZERO DEFECTS

Amkor has extensive experience with automotive process requirements shipping billions of units every year for automotive applications. Our packages meet or exceed automotive quality, reliability, burn-in and safe launch plan criteria. Amkor also has failure analysis, tri-temp test and statistical process capability in all factories. In addition to meeting automotive standards such as IATF16949, AIAG, VDA6.3, AEC-Q100, APQP, PPAP, etc., Amkor has automotive-trained personnel and designated production lines devoted to automotive products. Lastly, Amkor also offers die Unit Level Traceability (ULT) services for automotive customers.

Full Turnkey

Wafer Bump
- Solder bump and Cu pillar for flip chip and wafer level packages

Wafer Sort
- Tests for bare and bumped wafer, WLCSP, CoW, etc.

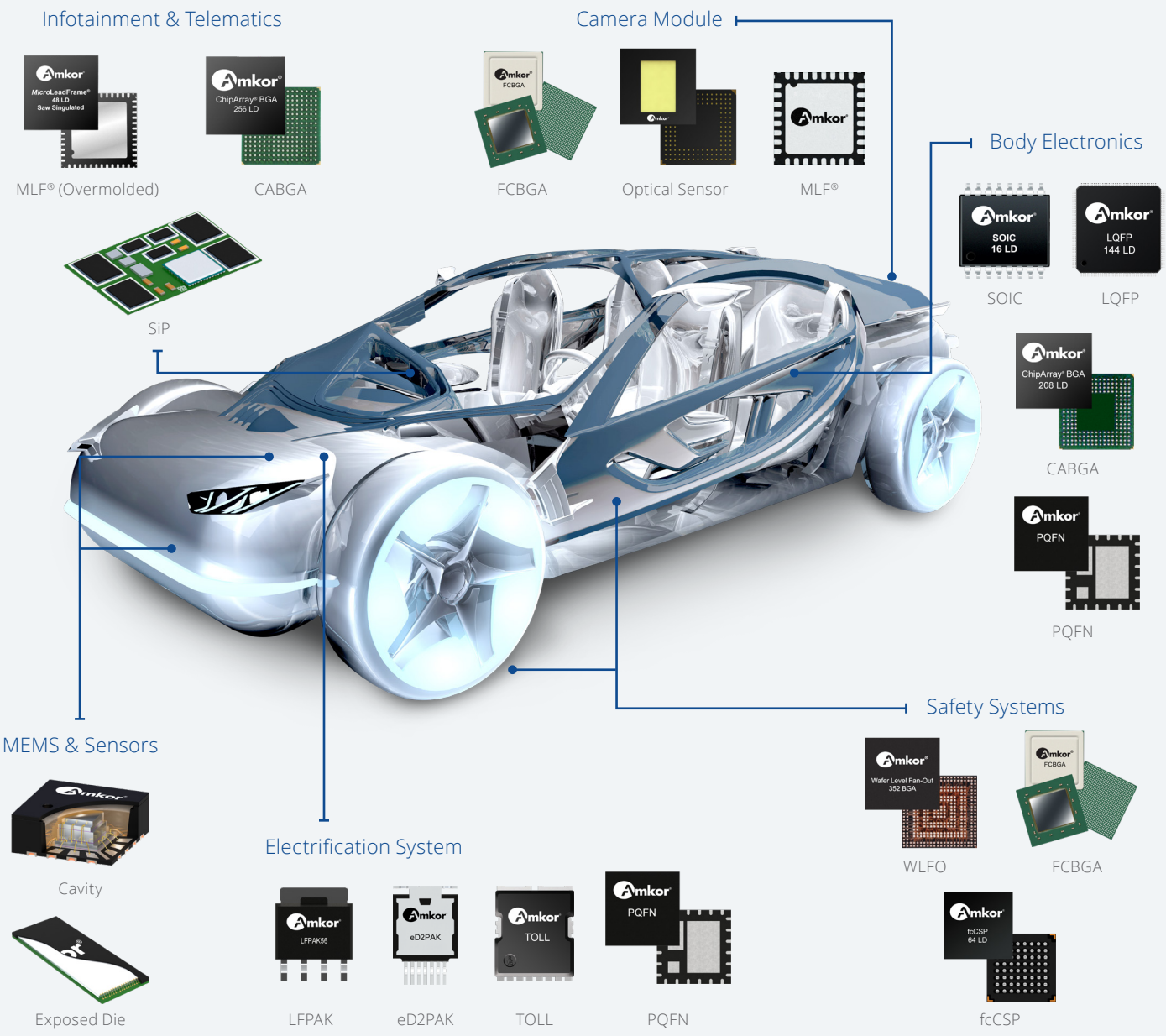
Product Assembly
- Diverse package portfolio addressing several applications

Final Test
- A/C and D/C data sheet tests under cold, room and hot conditions

Burn-in
- Voltage and temperature stresses to reduce infant mortality

System Level Test
- Improves performance and functional yield in end application

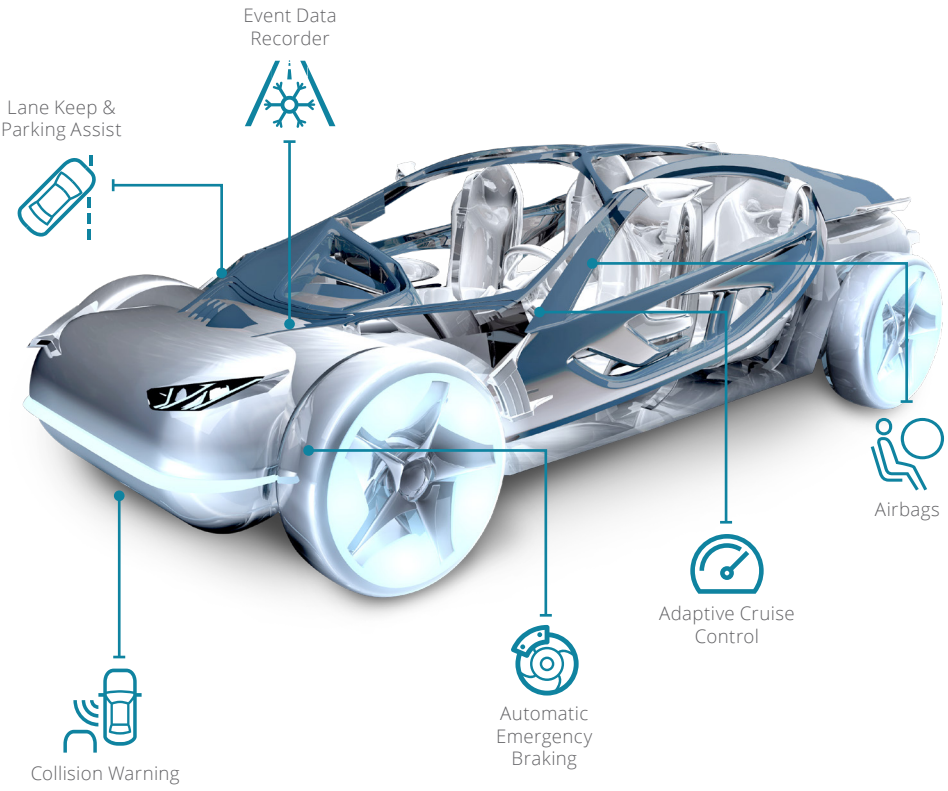
Automotive Packages

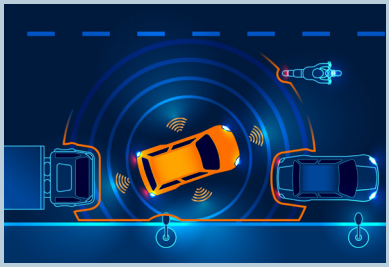


Industry-Leading Technologies

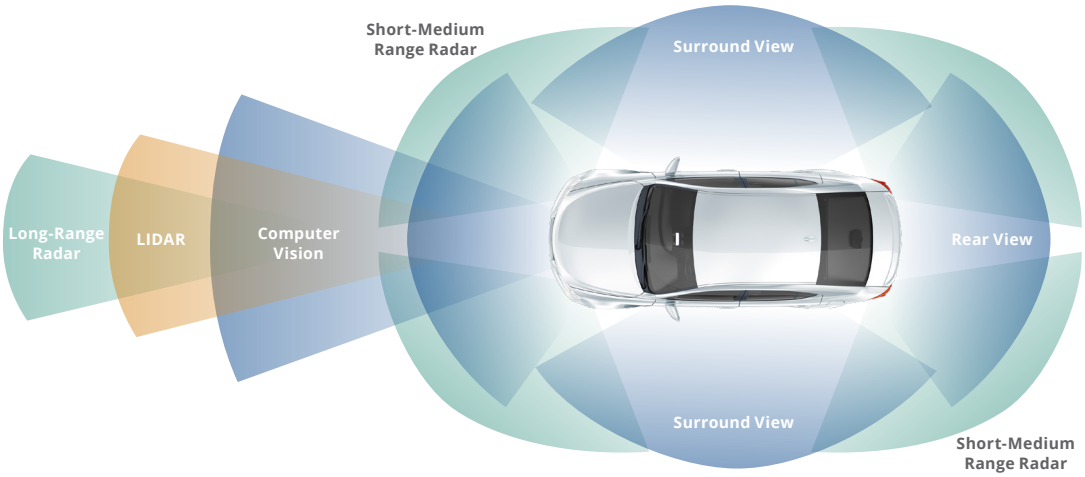
ADAS & Safety

Advanced Driver Assistance Systems (ADAS) automate several aspects of the driving process, such as parking assistance, lane positioning and collision avoidance. ADAS systems use inputs from multiple sensors including cameras, radar, LIDAR and ultrasonic sensors to improve the safety of the vehicle. Cameras provide surround, rear and machine vision that is essential for higher ADAS levels. LIDAR helps in object ranging and detection. Newer radar sensors that are designed for 77 GHz offer a smaller form factor and act as an antecedent technology that works in all adverse environmental conditions. The fusion of these inputs is processed in a central compute element to enable not only ADAS, but also autonomous driving. These vehicle sensor and compute systems are enabled by advanced semiconductor packaging technologies.





- Optical sensors in cavity and molded cavity BGA/LGA form factor enabling CMOS image sensing for cameras and computer vision
- fcCSP and Wafer Level Fan-Out (WLFO) enables mmWave radar integrating MMIC and signal processing blocks
- ADAS processors such as vision, radar and LIDAR use advanced flip chip Chip Scale Packaging (fcCSP) and Flip Chip BGA (FCBGA)
- Emerging LIDAR functional blocks like emitter and detector are enabled in cavity and molded cavity BGA/LGA

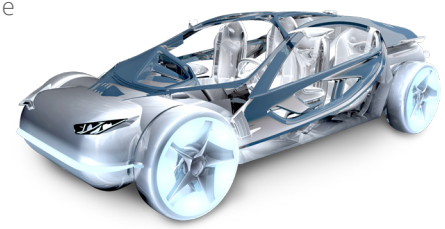


Microcontrollers, power management ICs and protection devices that enable mission critical ADAS applications are used in leadframe, wirebond BGA (WBBGA) and power discrete packages.

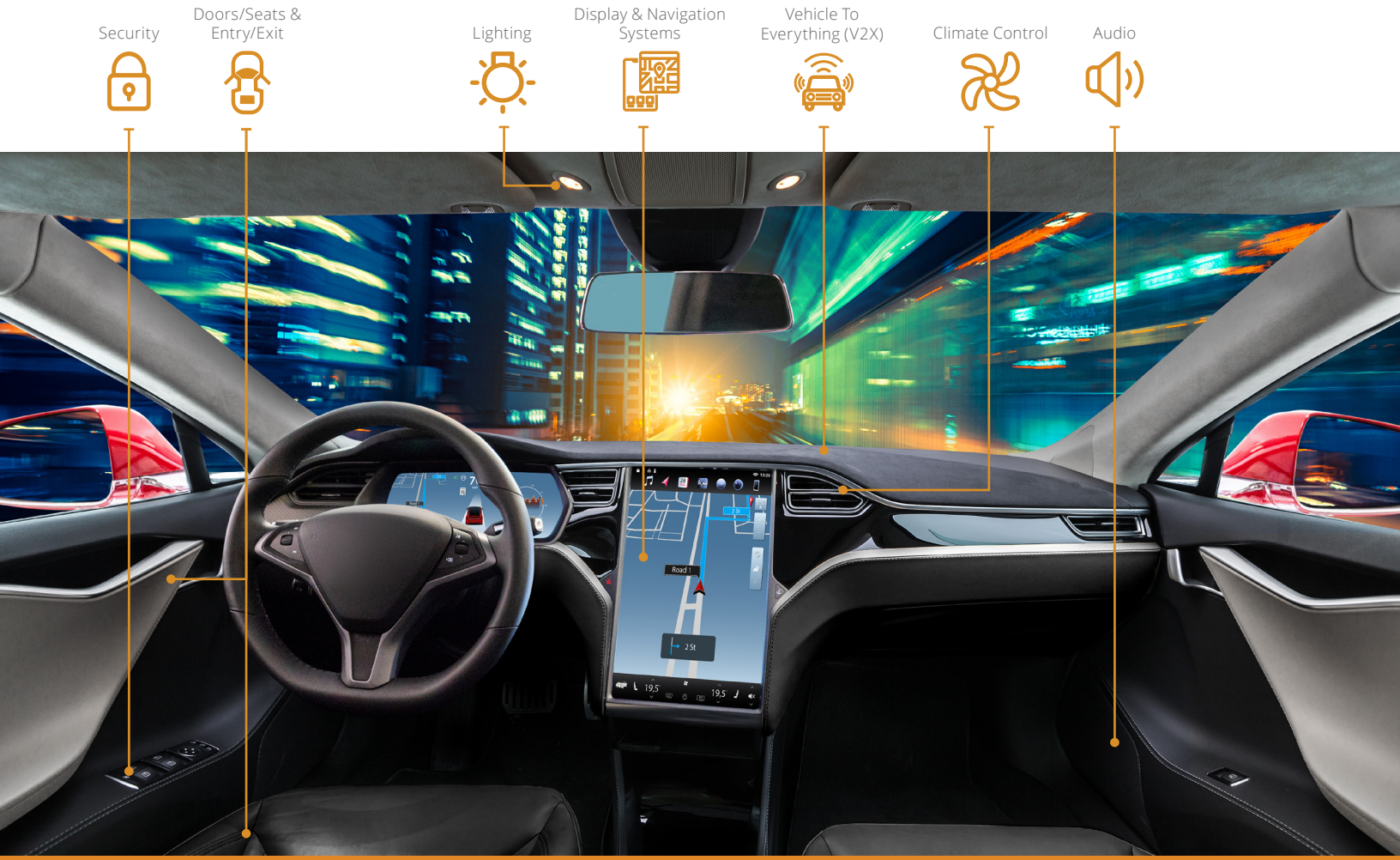
- LIDAR
- Radar
- Vision

Infotainment, Telematics & Body Electronics

Vehicles utilize a variety of hardware and software products that enhance the driver and passenger experience. Consumers expect in-cabin experiences to be an extension of their personal electronics. Innovation in infotainment has been centered around vehicle occupant entertainment and access to information from a variety of sources. Telematics connect the car to the cloud and help keep drivers and passengers safe, as well as optimize traffic flow. Vehicle gateways play a vital role in protecting the vehicle from cyberattacks and in enabling new IoT services like car sharing, over-the-air software updates and predictive maintenance.



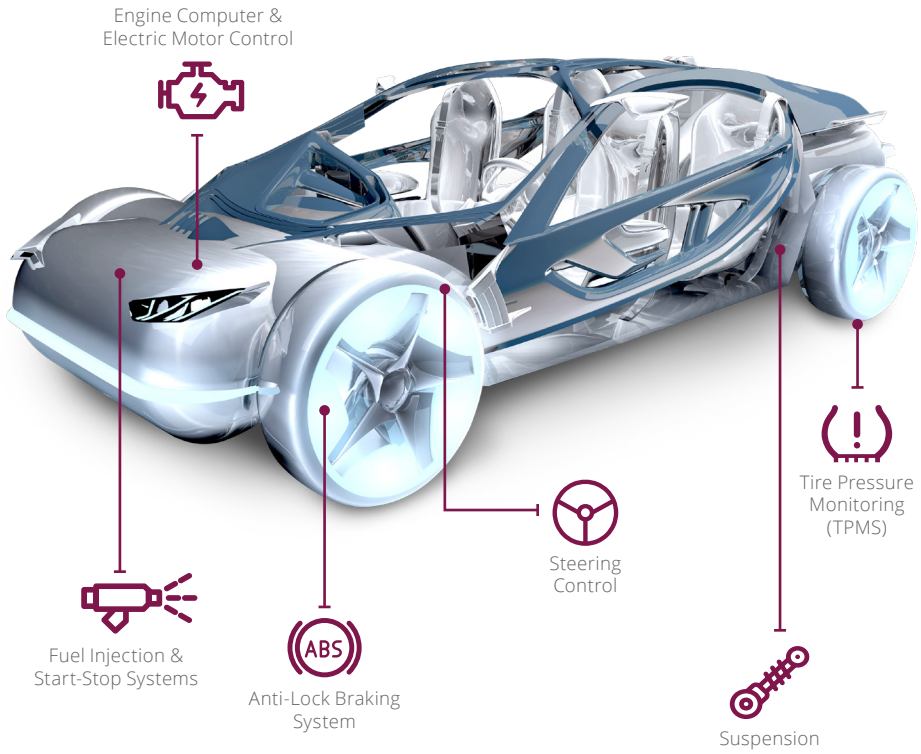
Body and convenience systems are evolving to increase safety and comfort for occupants. Electronic control unit (ECU) modules are specialized to monitor and control vehicle body functions. By adding and connecting these ECUs, in-vehicle networking is set to evolve from distributed to zonal to central architectures. Consequently, Ethernet is used to reduce wiring harnesses and increase required data bandwidths. To meet the demands of evolving automotive applications, Amkor is developing packaging solutions that offer seamless integration of chips with increased functionality.



- In-vehicle infotainment systems are enabled by SiP with processor, memory, power management and passives integrated on a laminate substrate
- RF connectivity modules enable telematics and in-cabin connectivity (Wi-Fi, Bluetooth) by integrating ASIC, antenna and passives in SiP form factor
- Body control modules manage functions such as power management and diagnostics; discretes and ICs in power and leadframe packages control seat positioning, climate control, headlamps and door locks
- Ethernet switches and physical (PHY) layers enable reliable and high-speed (>100 Mbps) network connections that are required to enable ADAS domain and central computing. Leadframe and wirebond BGA packages are predominantly used for traditional CAN, CAN FD, LIN and emerging Ethernet solutions

Chassis Electronics & Powertrain

The chassis is the structural framework of a vehicle to which the body and related components are mounted. Chassis electronics are compact and robust to ensure passive and active safety of drivers, passengers and cargo. Active safety applications such as electric power steering (EPS) and anti-lock braking system (ABS) rely on several sensors and switches to improve performance. Passive safety includes airbag sensors, tire pressure monitoring system (TPMS) and seat belt tensioners. Powertrain refers to primary components, such as the engine, transmission and drive shafts, tasked with generating and delivering power where needed where needed for successful vehicle operation. Powertrain semiconductors are used in managing and reducing fuel consumption and emissions. Partial electrification schemes such as micro hybrid (start/stop) and mild hybrid (48V) are part of powertrain innovation to reduce tailpipe emissions.

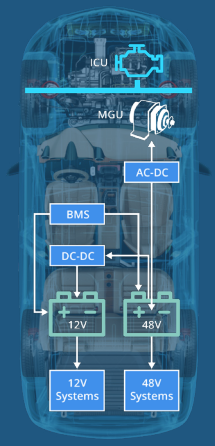


- Active safety use cases such as EPS are enabled with position, angle sensors, controllers and power discretes using leadframe and wirebond packages
- Passive safety applications such as airbag and TPMS sensors are enabled by SiP MEMS packages that integrate sensors, ASIC die and passive components
- To improve the efficiency of internal combustion engines, engine management systems use components such as angular sensors, pressure sensors, wheel speed detectors, microcontrollers and power discretes in leadframe and power packages
- 48V mild hybrid systems improve fuel efficiency by capturing regenerative brake energy and with an integrated starter generator. Power discrete packages enable both silicon and GaN power devices to improve powertrain performance

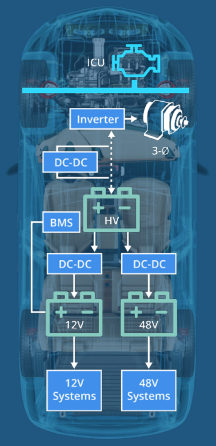
xEV

xEV solutions are power components that aid in power conversion from DC battery to electric drive motors, on-board charging of batteries and voltage conversion from high voltage to traditional 12V/24V systems. Traction inverter is the critical subsystem that propels the vehicle by transforming the direct current from battery to the alternating current that drives the electric motor. The on-board charger (OBC) system in a vehicle recharges the high voltage battery in battery powered electric and plug-in hybrid vehicles. Complementing the OBC is the battery management system (BMS) that keeps track of state of health (SOH) and state of charge (SOC) to ensure batteries perform as expected. The high to low voltage DC-DC converter enables bidirectional energy flow between these two electrical subnets.

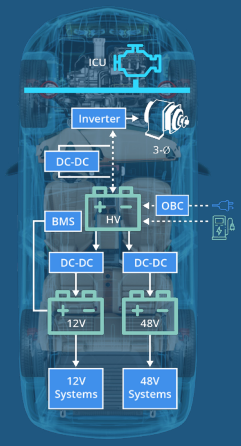
MHEV
(Mild Hybrid Electric Vehicle)



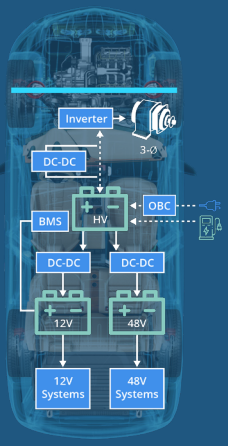
HEV
(Hybrid Electric Vehicle)



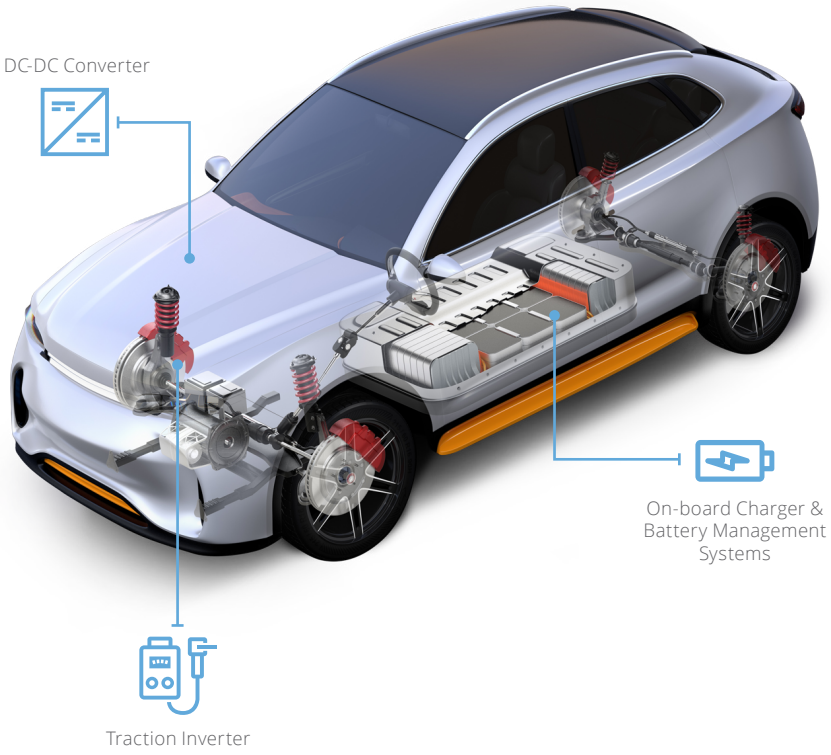
PHEV
(Plug-in Hybrid Electric Vehicle)



BEV
(Battery Electric Vehicle)



- Traction inverters are enabled by power modules that offer high-power/temperature operation. These modules can be transfer molded or frame based supporting either single side or dual side cooling options
- On-board charger and DC-DC converters systems require modularity. Flexibility in design and scalability in wattage are addressed with power discrete packages using various interconnect technologies
- Battery management systems require ICs that not only monitor but also balance the current required to charge battery packs. Transceiver ICs are required to transmit state of charge data to a host controller. These components use leadframe form factors



Amkor Automotive by the Numbers

Ø Defect
Quality Focus

40 Different
Package Families

#1 OSAT
for Automotive

~$1B Net Sales

11
Automotive
Production Locations

40+
Years Engaged
in Automotive

VISIT AMKOR TECHNOLOGY ONLINE FOR LOCATIONS AND TO VIEW CURRENT PRODUCT INFORMATION

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Questions? Contact us: **sales@amkor.com**

Amkor Technology®