



We are the link  
between the real and  
the digital world.

# Vehicle Motion

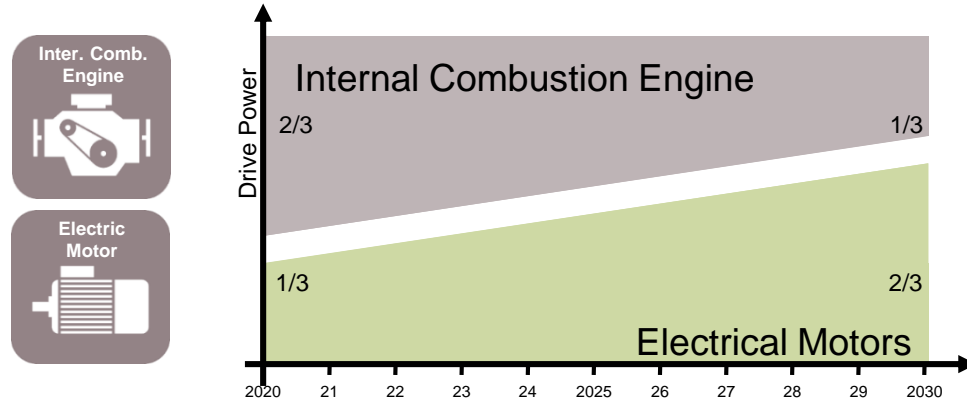
Let's make e-mobility work!

Dirk Geiger

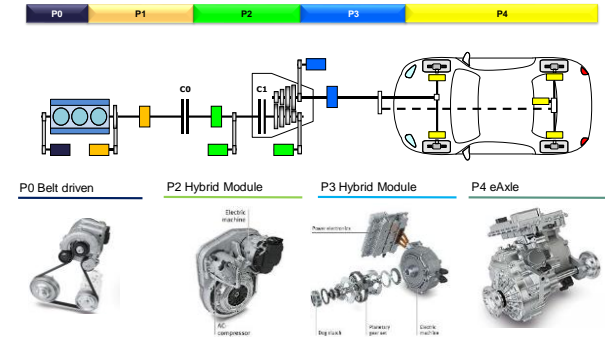


# Electrification – the way forward to Zero CO2

## Let's make E-Mobility work!



- › **Regionally different** approaches to grow xEV share. Legislations and subsidies are vital.
- › Cost delta of **ICE / xEV is getting closer**, quickly. xEV now in mainstream market segments.
- › **Charging infrastructures** are growing fast (7m WW.2019).
- › Improvements on **driving range and efficiency** are ongoing. Further declines in battery cost expected.



From 100% ICE to electrification

Impact to developing an xEV  
as well as the supply chain roles

... to 100% EV with ICE extension

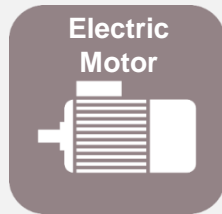
# The Traction Inverter has a multitude of jobs to accomplish

Infineon offers a **complete, reliable and dependable** solution

## Inverter

### Inverter:

- Hill hold
- Forward / Backward
- Motor / Generator



## Electric Drive Train

### Battery warm-up

- At the battery startup at cold conditions
- Make Energy transfer to the inverter and back the battery

### Torque vectoring

- Front / Rear
- Right / Left (differential)

### Battery charging

- Regenerative braking

### Discharging the DC Link

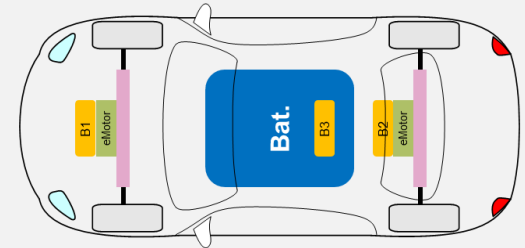
- After battery turn off

### DC-DC charging 400V-800V

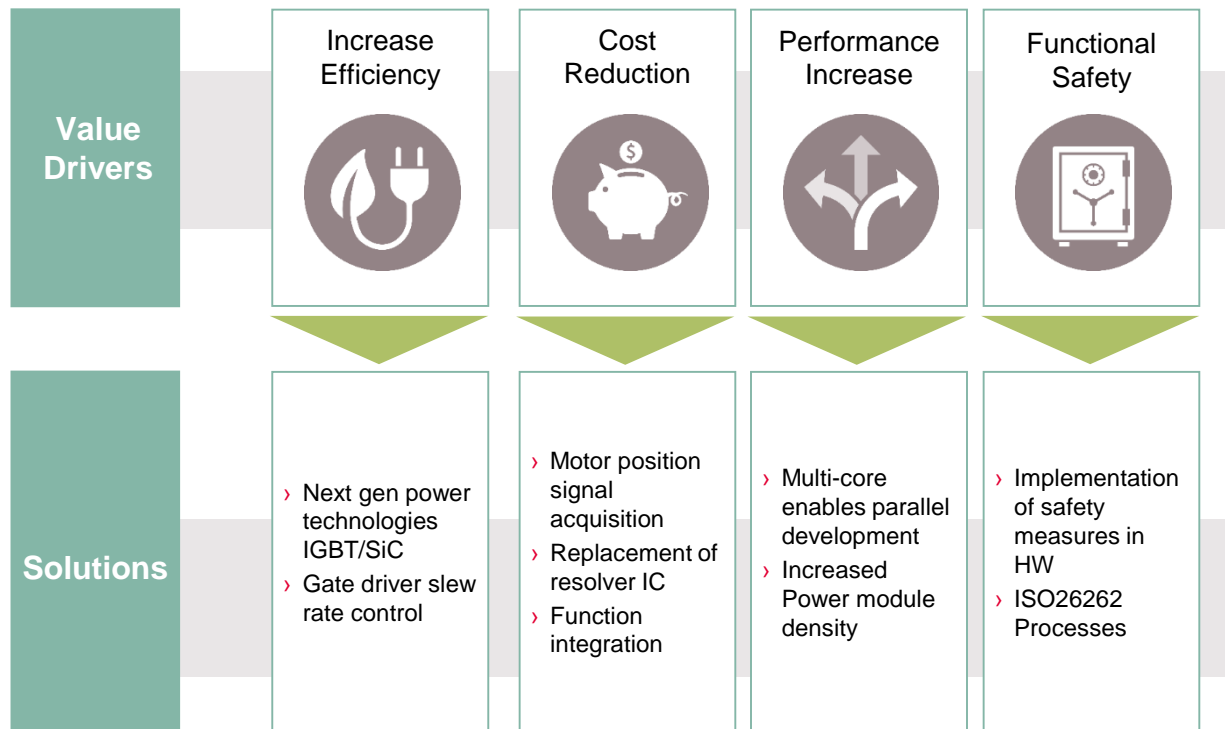
## Vehicle

### Vehicle stability system

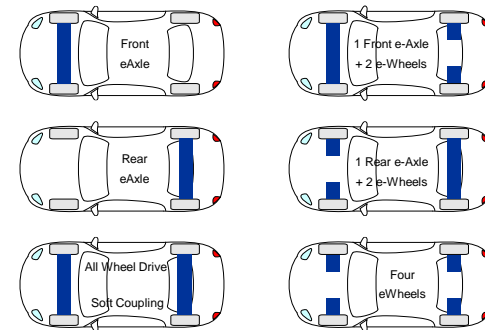
- Motion control
- Synergies:
  - Motors
  - Braking
  - Steering
  - Suspension



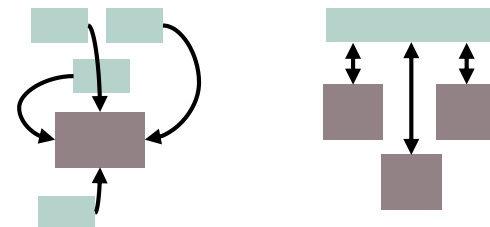
# Vehicle architectures, integration and sharing requirements are defining the **key value drivers**



## Electrification of powertrain



## Integration & Sharing



# Depending of your level of optimization ...

Motor

Control

E-Axle

Motion Platform

Electric Vehicle



Material  
Efficiency  
Weight

Electr. BOM  
Efficiency  
FuSa  
Assmeby effort

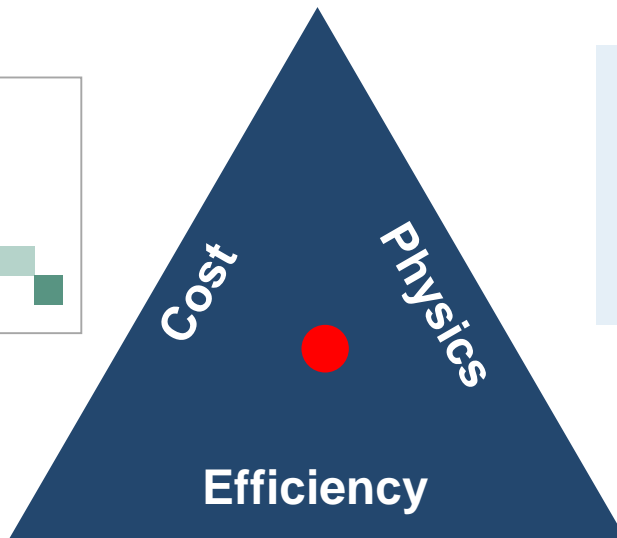
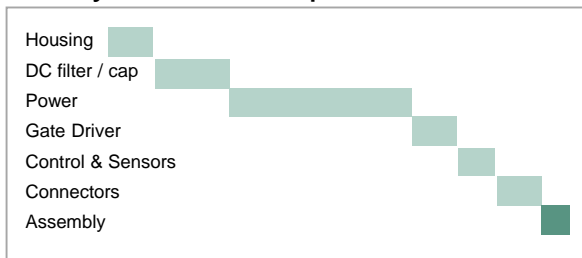
Housing  
Connectors  
Assembly effort  
System Efficiency

Integration of function  
Sharing of resources  
Wiring  
Redundent functions  
Energy Management  
Platform Efficiency

Energy Management  
Vehicle Performance  
User Experience  
Data Management

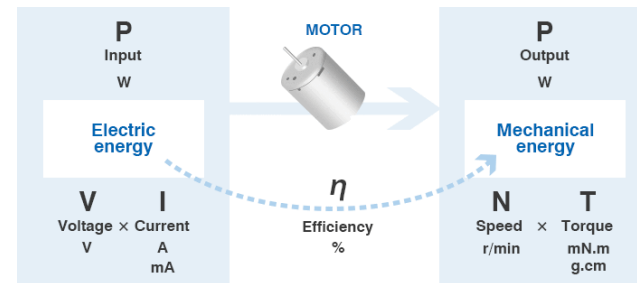
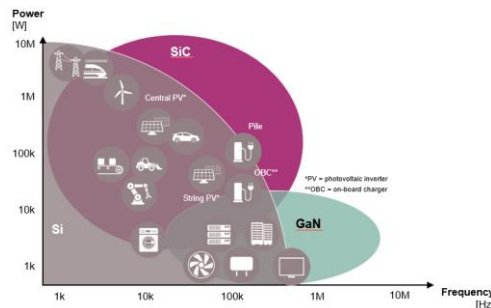
# ... Impacts the balancing of **Efficiency – Physics – Cost**

## › System Cost optimization



Depending on requirements for:

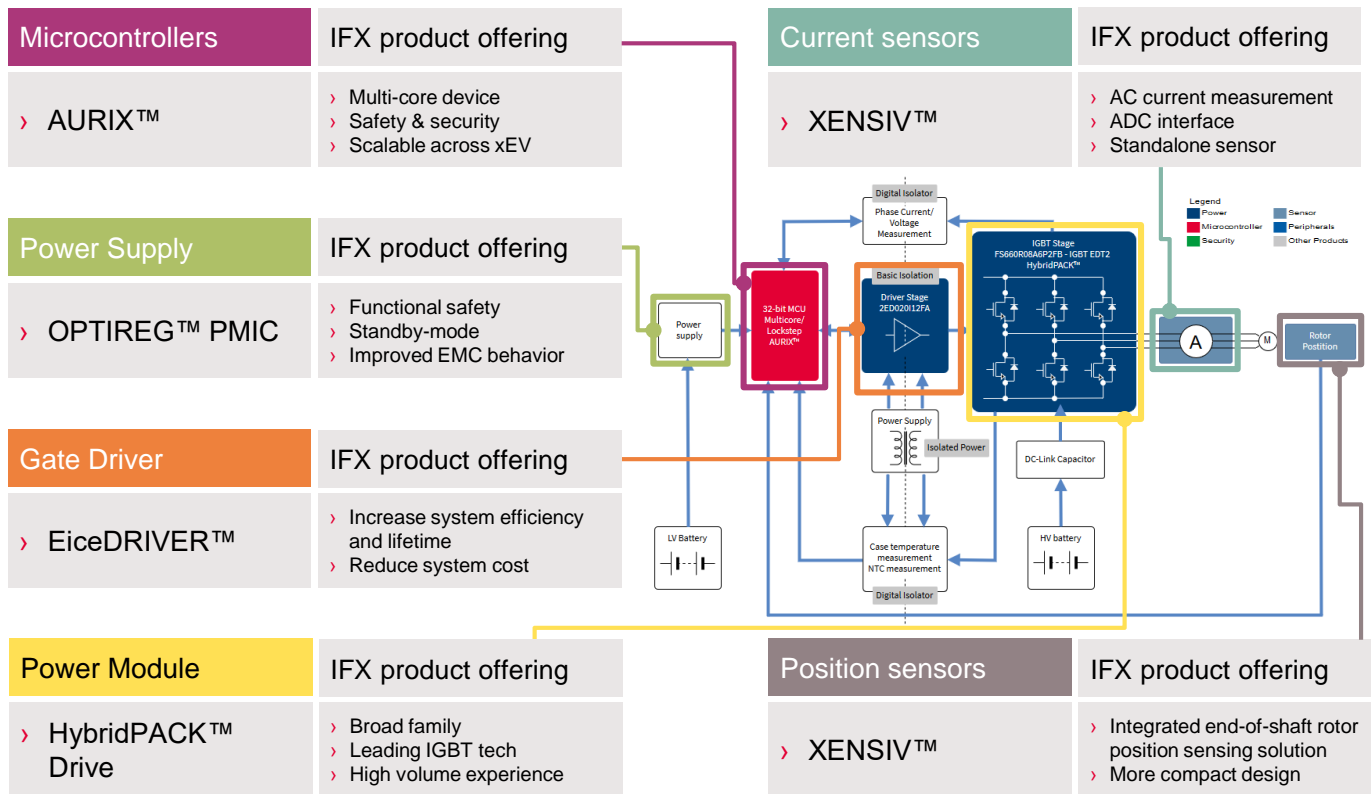
- › Cooling
- › Sharing
- › Size
- › weight



Depending on requirements for:

- › Motor technology
- › Integration
- › Size
- › Weight
- › Power

# Infineon offers **key components** for traction motor inverters, supported by deep competency and a broad eco system

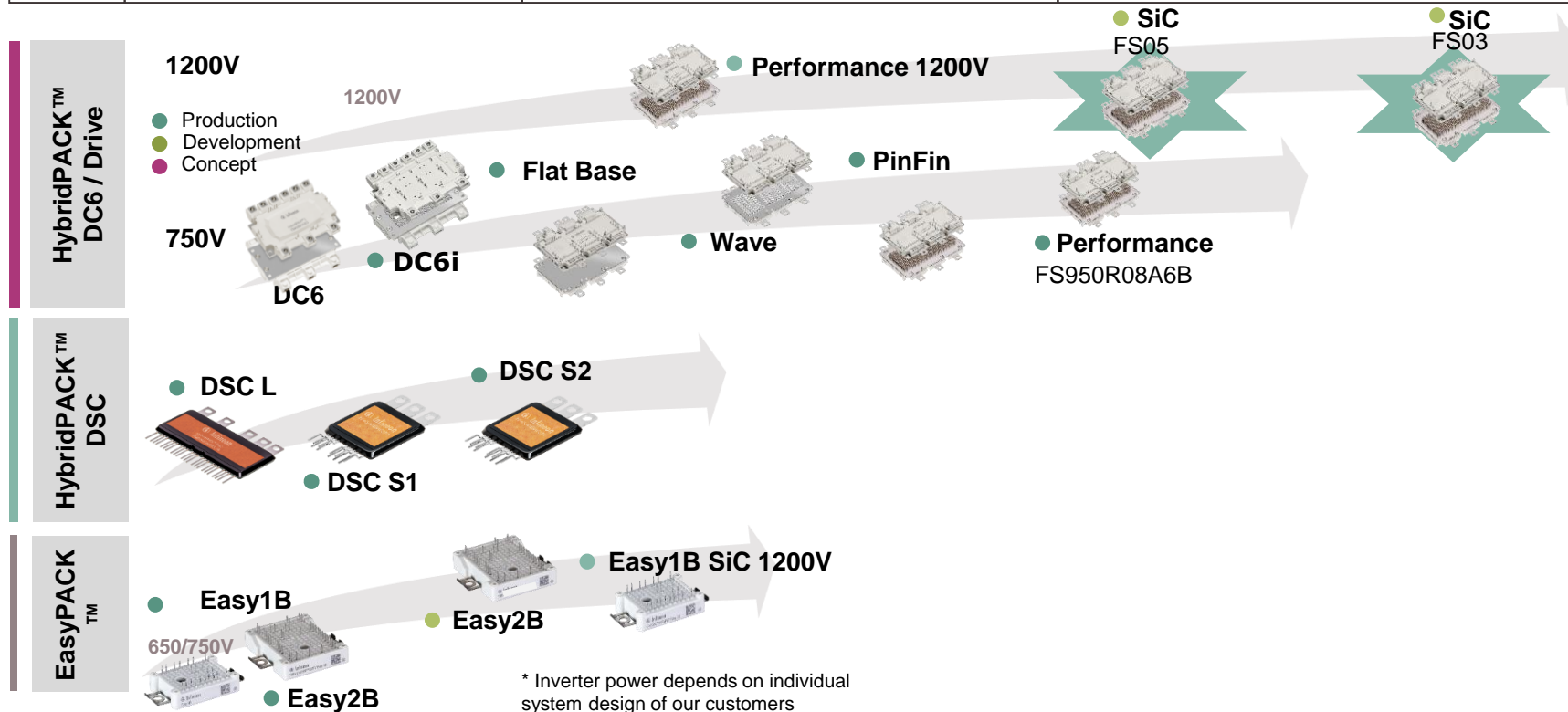


# Scalable portfolio of Si / SiC

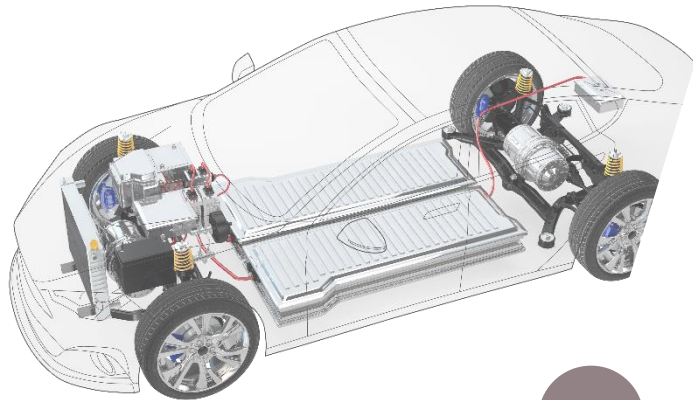
## HybridPACK™ SiC GEN1 chosen by leading OEMs, SOP B. 21



~ Power Class*	Medium		High			Ultra High
	<60 kW	80 kW	120 kW	150 kW	180 kW	>180 kW

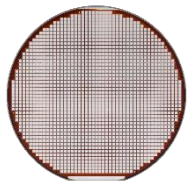
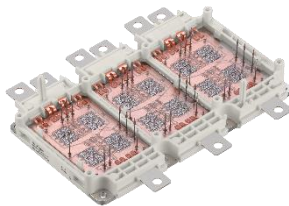


# CoolSiC™ Module, Bare Die & Discrete enable longer drive range in e-Mobility Main Inverter



Reduced battery size, less cooling effort, lower cost in passive components, longer drive range, are a few of the benefits embracing SiC based solution in electric drive train. In 800V system, SiC based main inverter can achieve appr. 7% more range vs. its Si counterpart. OEMs adopt topologies where SiC is used in the main inverter with rear wheel drive while Si-based secondary inverter in front wheel drive, achieving good balance between efficiency & cost.

+SiC



## Advantages of SiC

- › Increasing battery utilization by 5-10%
- › Higher power density for system size reductions of up to 50%
- › Lower conduction losses in light load condition and lower switching losses compared to Si IGBTs
- › IFX CoolSiC™ offers superior performance without jeopardizing quality

# The 4 main value drivers of AURIX™ TC3xx for OBC

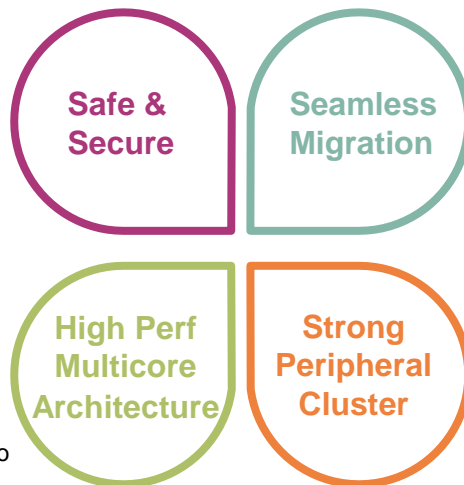
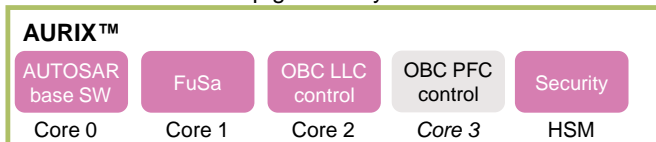
## Supports Automotive standards

- › 1st MCU with ISO 26262:2018 **certification by TÜV**
- › <4 FIT for MCU at ASIL D (D)
- › Lock-step core and HW LBIST
- › EVITA FULL security with symmetric and asymmetric encryption



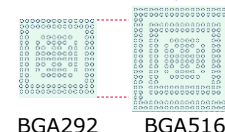
## Multicore enables OBC function integration

- › Enables **separation and parallel development** of functions
- › **Combining communication and control task** – also 12V DCDC control integration possible depending on PWM and control loop granularity



## Scalable MCU portfolio

- › **Pin and SW compatibility** between AURIX™ TC2x & TC3x
- › Pin compatible in same package, Pin Superset in high pin count packages
- › **SW compatible** across the family



## Robust, optimized ADCs and timers for OBC

- › **Safe:** SAR or FC ADC as redundant communication channel
- › **Performance:** Improved equidistant and parallel sampling
- › **GTM MCS:** potential to integrate control functions such as OBC PFC

# TLF35584 / TLF35585 (in development)

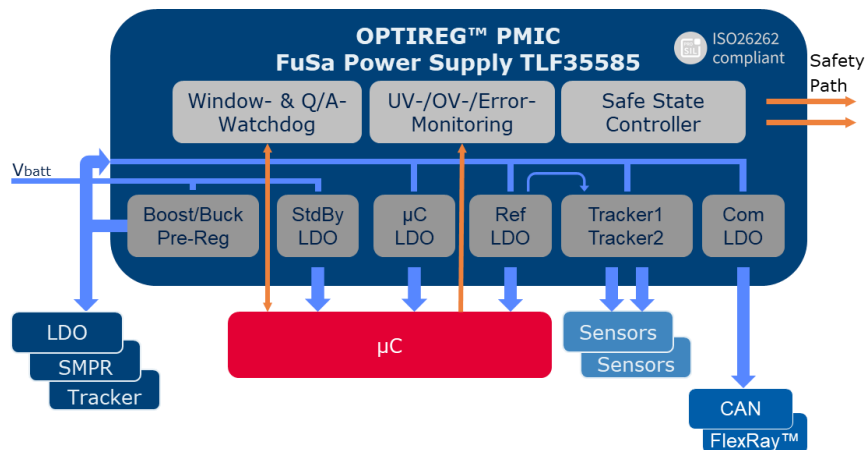
## OPTIREG™ Functional Safety PMIC



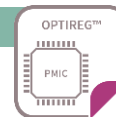
### Key Features

- › Buck/Boost-Pre-Regulator
  - IQ = 1.3A (1.5A for TLF35585); f: 300kHz-2.5MHz
- ›  $\mu$ C-Supply: 3.3V/5V @ 600mA
- › Reference-LDO: 5V @ 150mA ( $\pm 1\%$ )
- › Communication-Supply: 5V @ 200mA
- › 2x Tracker: 5V @ 150mA
- › StandBy-LDO: 3.3V/5V @ 10mA

### Block Diagram



- › EN/Wake (T15 and CAN/FlexRay)
- › SPI
- › TLF35585 enhancement vs. TLF35584
  - E.g. features: additional diagnostics information, extended timer functionality
  - Ultra low current consumption ( $<10\text{-}15\mu\text{A}$ )
- › Safety Features
  - Multiple bandgap (supply vs V-monitoring)
  - UV/OV-Monitoring, ERR-Monitoring
  - Functional-WD & Window-WD
  - Safe State Control / Secondary Safety Path
  - Protected safety area
  - Built In Self Test
  - Development acc. ISO26262



### Package



PG-VQFN-48  
(TLF35584 & TLF35585)

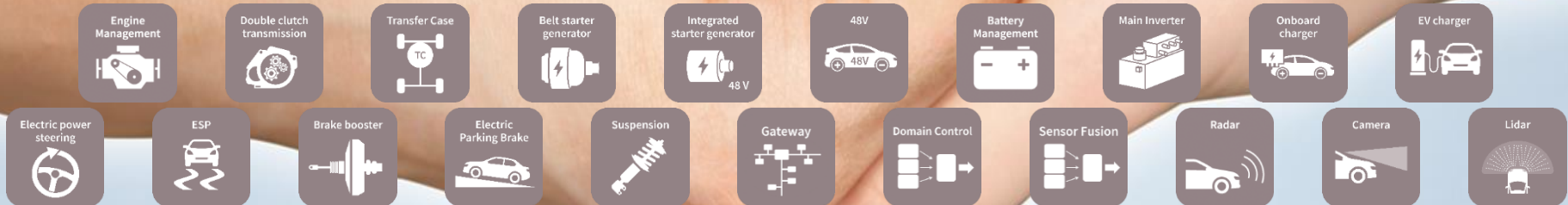
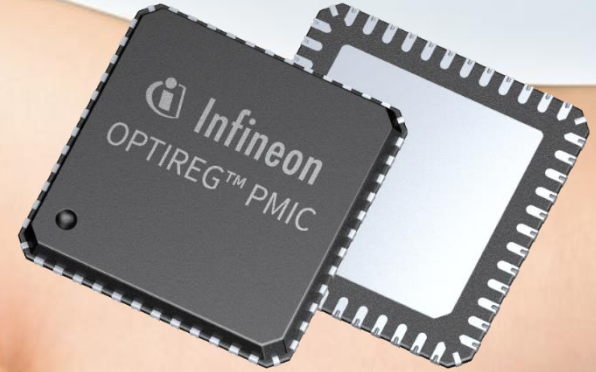
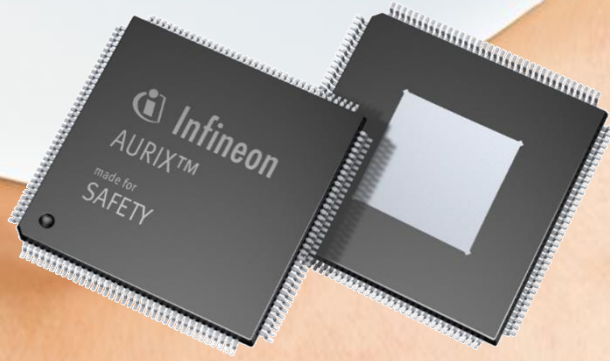


PG-TQFP-48  
(TLF35585)



PG-LQFP-64  
(TLF35584)

# AURIX™ microcontroller & OPTIREG™ PMIC teaming up for Functional Safety



# EiceDRIVER™ Enhanced: continuing the Success Story of Infineon Automotive Gate Drivers

2009

2015

2021

Meeting the key success factors as the market develops

## 1st Generation

Robust product available  
in automotive quality



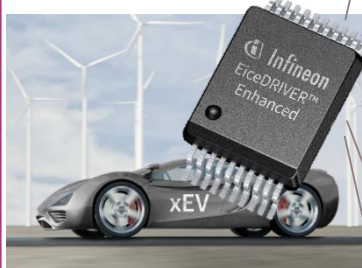
## 2nd Generation

Supporting system  
optimization & flexibility



## 3rd Generation

Maximizing system  
performance/cost ratio  
Functional Safety  
Driving IGBT & SiC



**EiceDRIVER™ Enhanced**  
launching in **Q1 2021!**

Pin-compatible product variants for  
IGBT & SiC switches

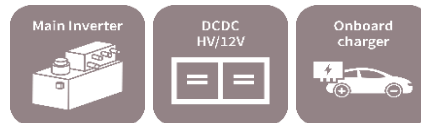
Easy to use, no programming

Integrated booster stage

Advanced safety features

Accurate Delta-Sigma ADC

Suiting various HV xEV applications:

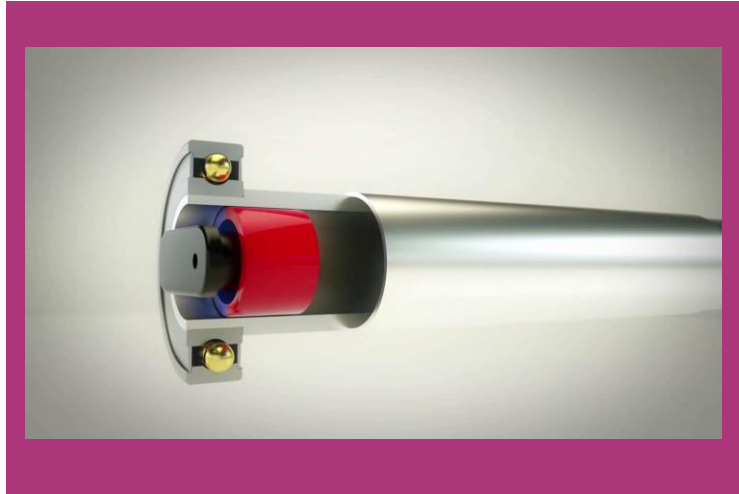


Infineon EiceDRIVER™ for automotive main inverter applications are in **volume production** since **2009**. Used in many automotive **(PH)EV** platforms **worldwide**. **Coreless transformer** galvanic isolation technology is **mature** and **certified**.

# TLE5309D Analog Angle sensor with iEoS(Integrated End of Shaft \*) –Targets Resolver replacement to reduce system cost



TLE5309D in iEoS



SYSTEM COST REDUCTION –  
No Excitation generator & carrier filter required

DIVERSE SENSING TECHNOLOGY  
(AMR & GMR )

FUNCTIONAL SAFETY –  
ASIL-D Ready

HIGH ACCURACY & HIGH SPEED

REDUCED CONSTRUCTION SPACE -with  
iEoS

TDSO Pkg. Grade 1 today ,Grade 0 in 2022 °

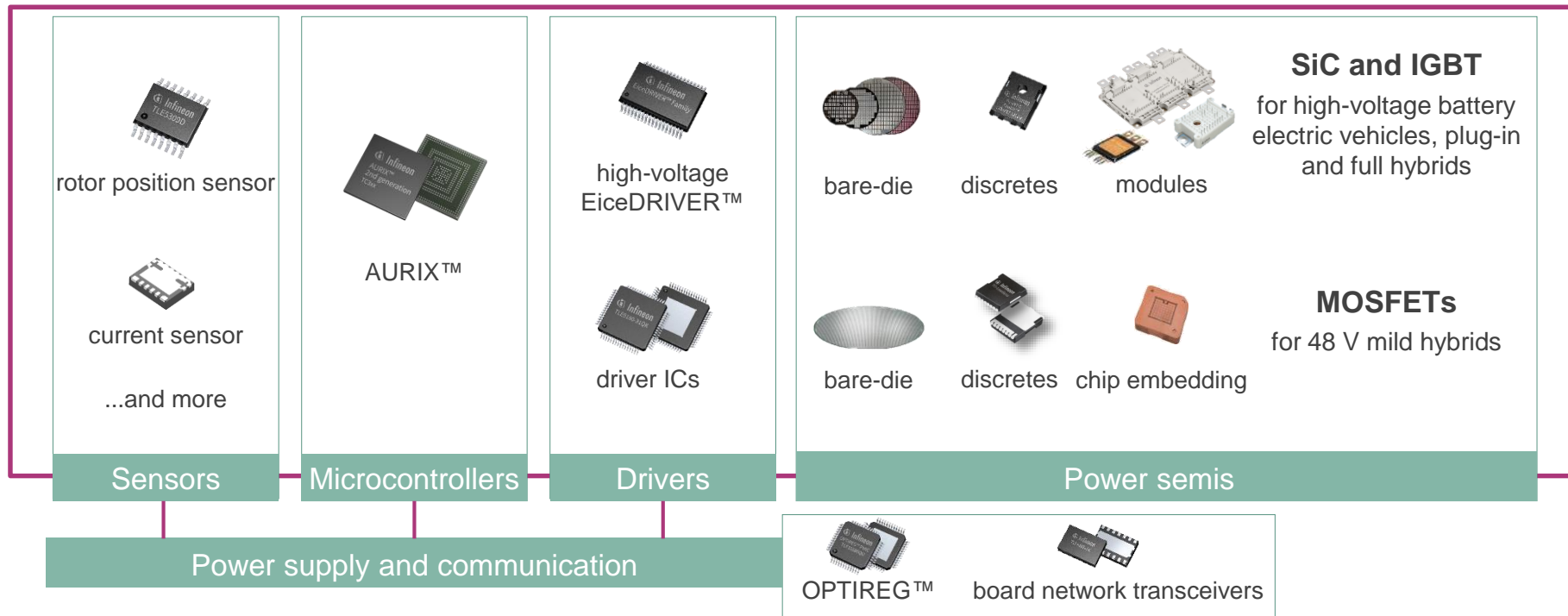
**TLE5309D together with Infineon iEoS system solution reduces system cost & provides Stray field immunity**

\* Infineon IP , Available for Licensing

Infiniteon offers full system solutions addressing all xEV segments:  
pure EV and all types of hybrid EVs



## Infiniteon offers full portfolio for the control loop of an electric car





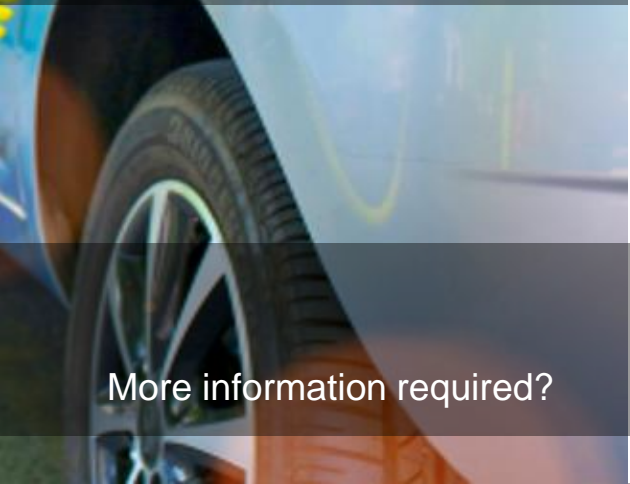
making




eMobility



work



More information required?

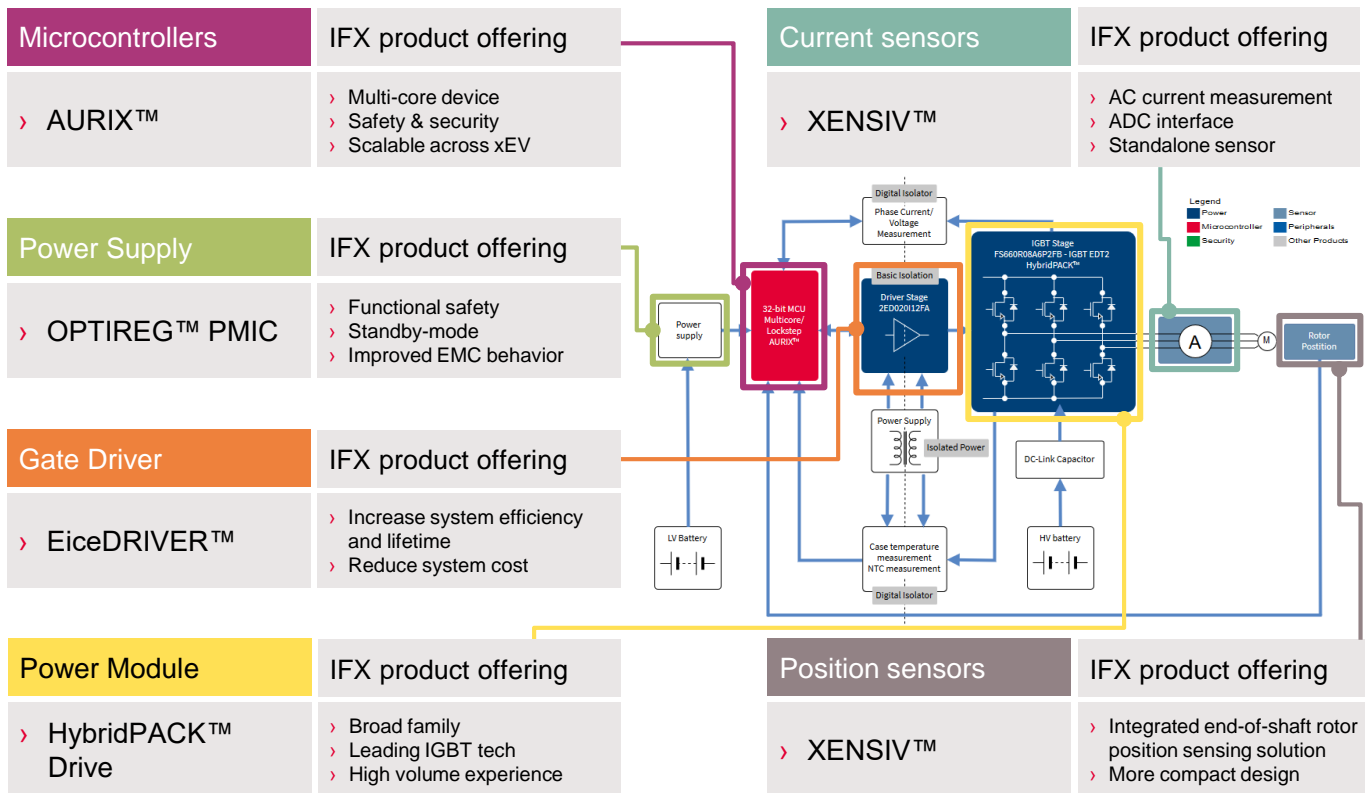


<https://www.infineon.com/emobility>



# Infiniteon offers all components for Traction Inverters

## The one-stop shop for competitive application solutions



## Learn more

### Traction Inverter

- [Overview](#)
- [Products](#)
- [Documents](#)
- [Videos](#)
- [Training](#)
- [Support](#)

### Products

- [Microcontroller](#)
- [Driver Stage](#)
- [PMIC](#)
- [CAN Transceiver](#)
- [Memory](#)
- [IGBT Modules](#)
- [Position Sensor](#)





# Support & Enablement

## Collaterals and brochures

- > Product briefs
- > Selection guides
- > Application brochures

- > [Overview](#)
- > [Hybrid and Electric Vehicles](#)
- > [Main Inverter](#)
- > [Application Brochure](#)

## Technical material

- > Application notes
- > Technical articles
- > Simulation models
- > Datasheets

- > [Simulation](#)
- > [Tools](#)

## Evaluation boards

- > Evaluation boards
- > Demoboards
- > Reference designs

- > [Evaluation Boards](#)

## Videos

- > Product information videos

- > [Videos](#)

## (H)EV main inverter - hybrid / electric vehicle

[Overview](#)

[Products](#)

[Documents](#)

[Videos](#)

[Training](#)

[Support](#)



Automotive Dependability Functional safety



E-Mobility Talks - Interview with Stephan Zizala



New HybridPACK™ product portfolio for main inverters



HybridPACK™ Drive | Power modules for main inverter applications



power modules HybridPACK™ Drive. With close to 1 Million modules shipped it is one of the most successful power modules in the open market. We will show how you can benefit from this experience and be part of the success story.

Scalability up to the highest power for electric vehicles (xEV) in main inverter



automotive components. Starting from discrete solutions such as the main inverter demo implemented by SUNGROW, HybridPACK™ drive power modules, HybridPACK™ 1 DC6 wave, HybridPACK™ drive CoolSiC™, low-loss DuoPack: IGBT in TRENCHSTOP™, and evaluation board for EiceDRIVER™ sense and EiceDRIVER™ Boost.

## Training

[3-phase AC-DC power conversion topologies](#)

[Benefits of using SiC technology on electric vehicles](#)

[CoolSiC™ MOSFET in an EV charging application](#)

[Design CoolMOS™ in a fast DC EV charger module](#)

[How AURIX™ addresses electric vehicle application needs](#)

[How to charge battery electric vehicle](#)

[IGBT Discretes for HVAC e-Compressor systems in e-Mobility](#)

[Infineon automotive dependability](#)

[Infineon's automotive power semiconductor module portfolio](#)

[Infineon CoolSiC™ Technology: Why it is a revolution to rely on](#)

[Infineon Online Power Simulation Tool \(IPOSIM\) for automotive high-power modules](#)

[On the fast lane in automotive applications: 650V CoolMOS™ CFD7A](#)

[Powertrain electrification and Infineon's solutions for inverter systems](#)

[Standards for wireless charging](#)

[Standards for wired fast charging](#)

[The basics of the software over-the-air concept using Infineon's](#)

[AURIX™ microcontroller](#)

[Why HybridPACK™ DC6i is the perfect fit for main inverter applications up to 100 kW](#)

## Discoveries

Whether it's electro mobility, the smart home or mobile payment – technologies are changing our life wherever you come into contact with the connected, digital world.

Here you can learn how far your e-car can travel on one battery charge. What the smart home of the future will look like. The advantages you can look forward to and what risks you should pay attention to. You can find answers to questions relating to mobile payment and learn what's needed to not only shop conveniently, but also securely.

The “Discoveries” present this and other technology trends that impact our life now and will do so in the future.

### Filter your level of complexity



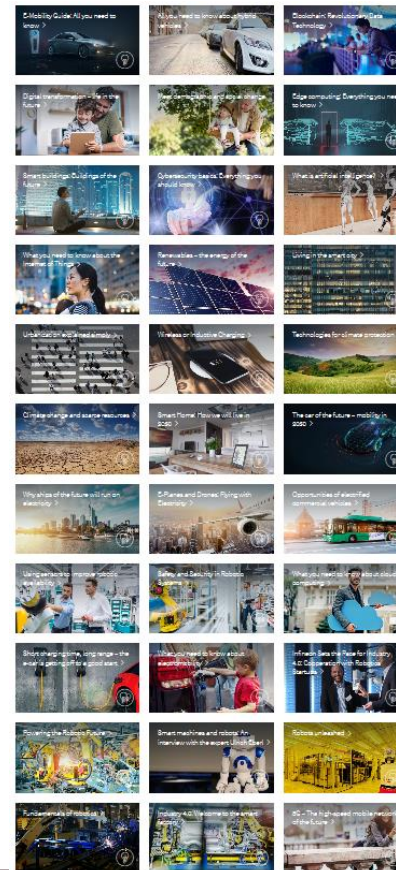
Basic



Advanced



Expert





Part of your life. Part of tomorrow.