



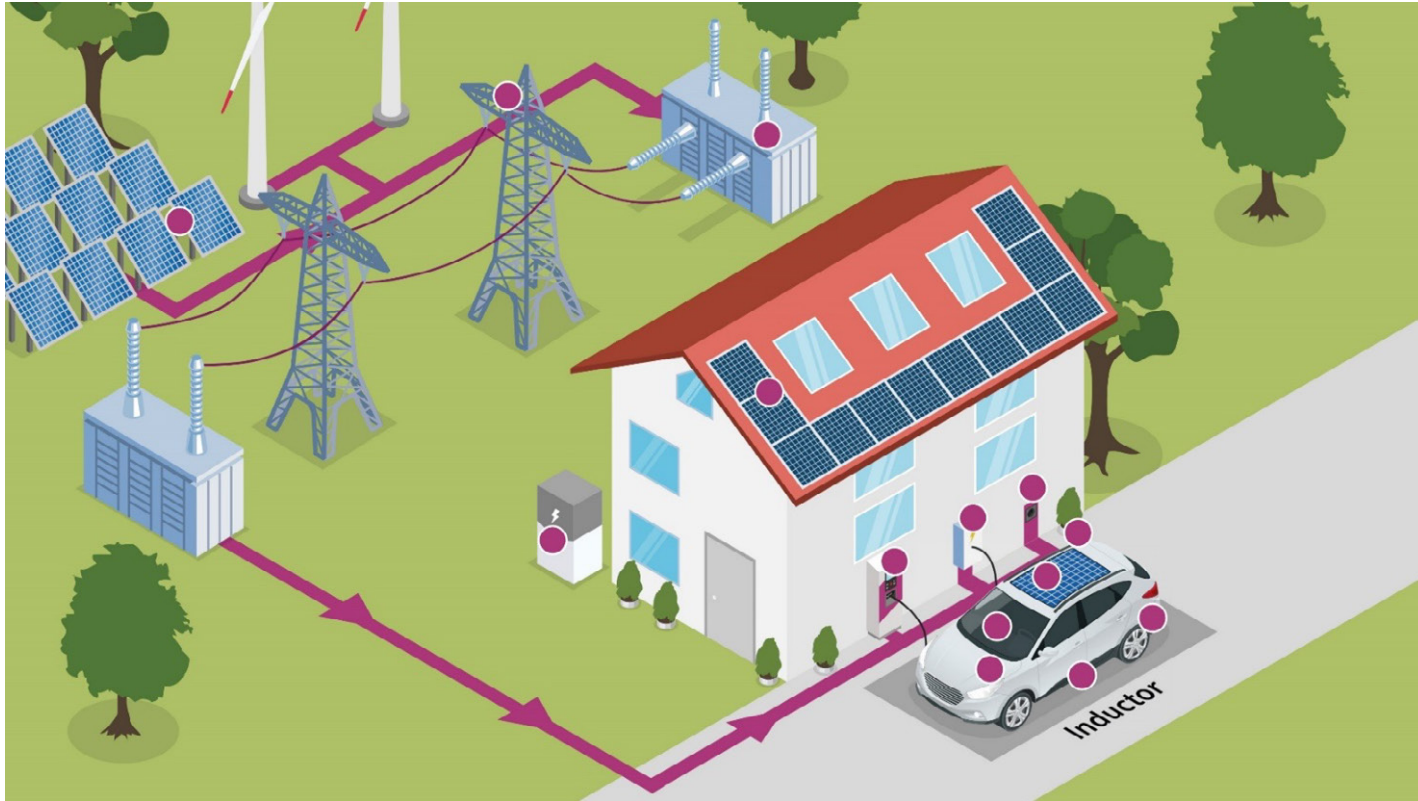
We are the link
between the real and
the digital world.

Charging with Infineon



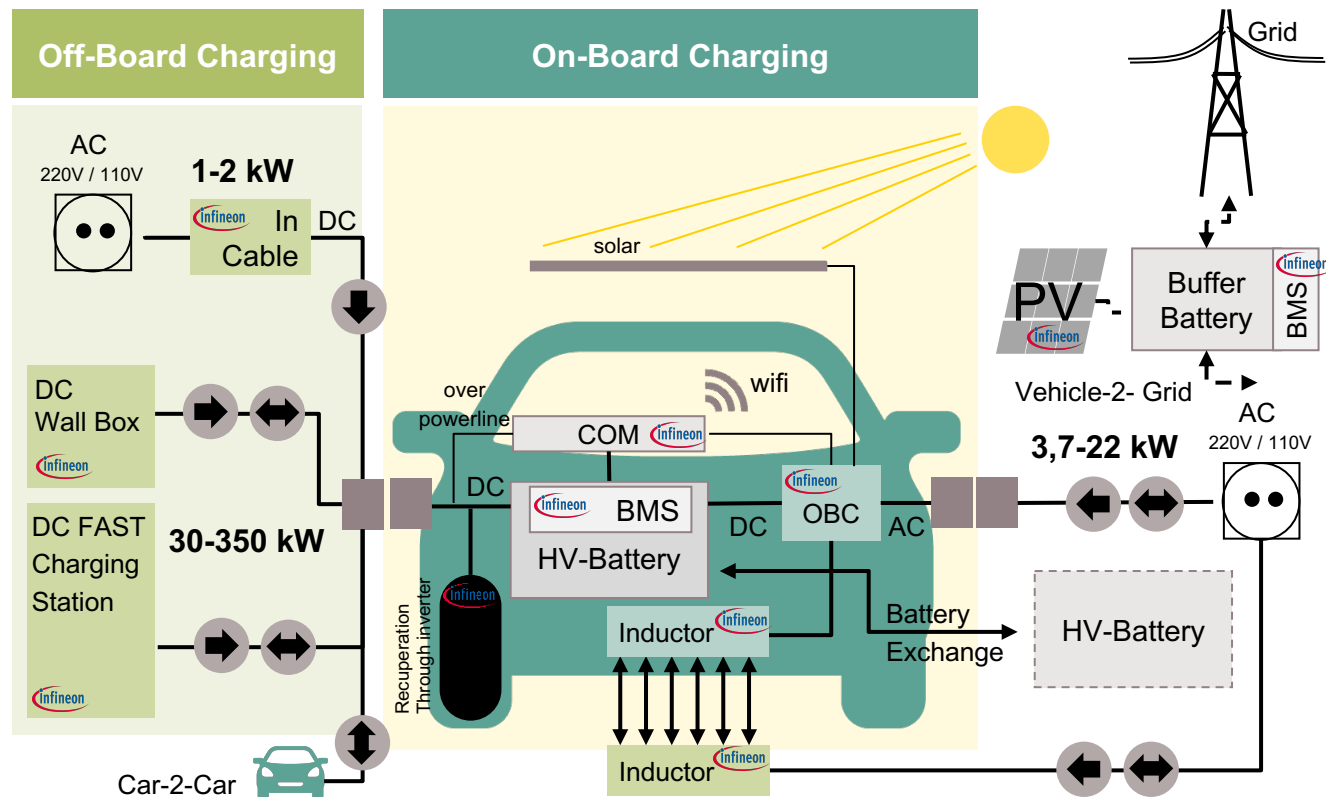
Zero CO₂ becomes real ...

Charging with Infineon



Infinion – the #1 solution provider for EV Charging

Zero CO2 – enabled by Infineon

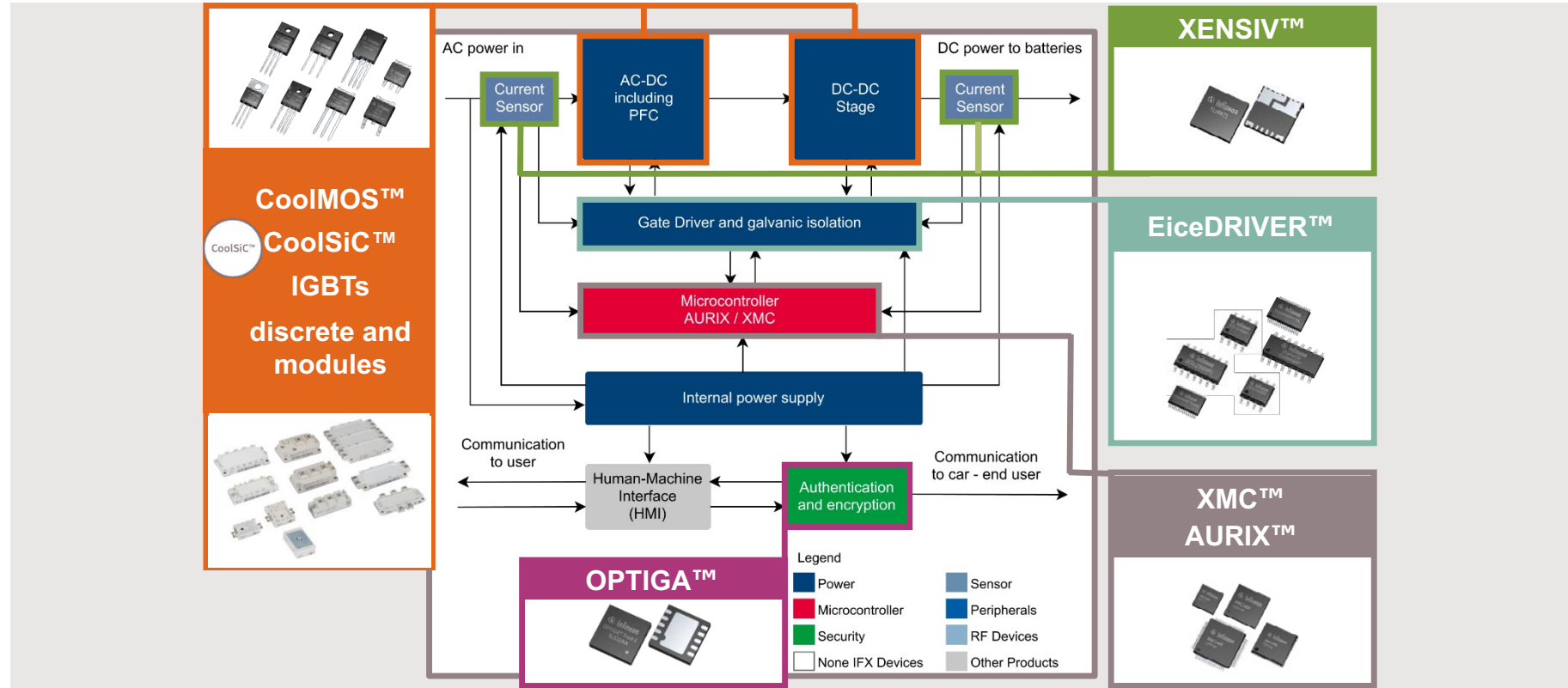


Infineon:

- › **Broadest product portfolio**, enabling your requirements
- › **Chip-sets** and system solutions for quick and efficient application designs
- › **Automotive and Industrial quality**
- › **A competent partner** with a global eco system
- › **Dependable** and trusted partner in the industry

Optimized products and chip-sets for EV DC charging

The trusted supplier to the industry



Infineon's power solution positioning for EV charger

350 kW
modular
solutions

up to
150 kW
grey zone

≤60 kW
discrete
solutions



Discrete solutions

Modular solution is recommended

4/5 x 30 kW

Stacked 20 / 30 kW
discrete solutions

20 kW
20 kW
20 kW

30 kW
30 kW



IGBT
TRENCHSTOP™ 5



IGBT
TRENCHSTOP™ 5

Module solutions

Stacked modular
solutions

6 x 60 kW

100 kW

100 kW

100 kW

Stacked 50 kW
modular solutions

50 kW
50 kW
50 kW

EconoDUAL™

EconoPACK™4

Easy CoolSiC™

EconoPACK™4

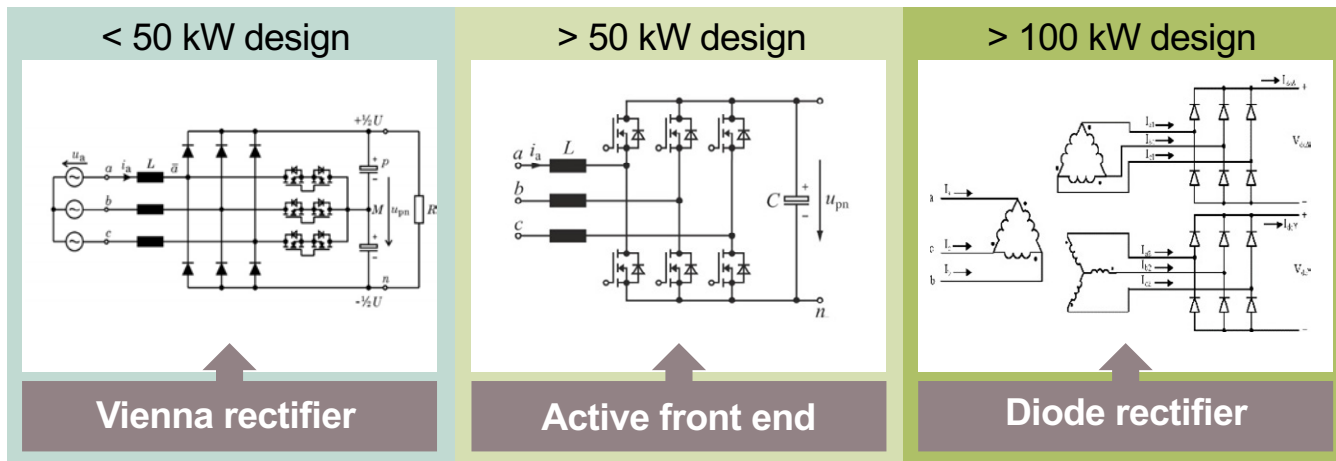
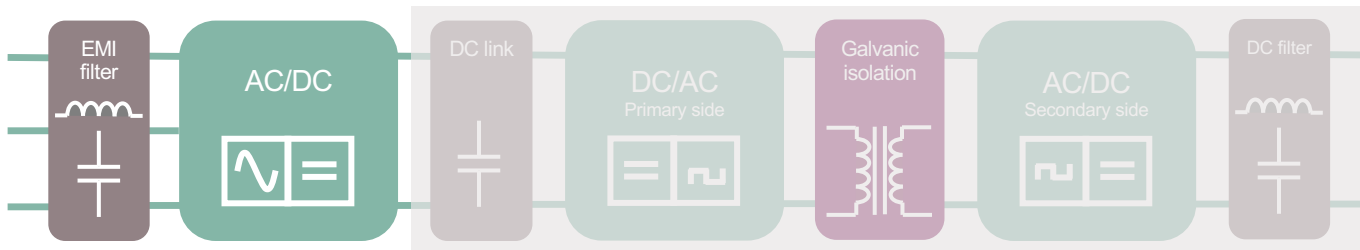
Discrete solution is recommended

Discrete solution is recommended

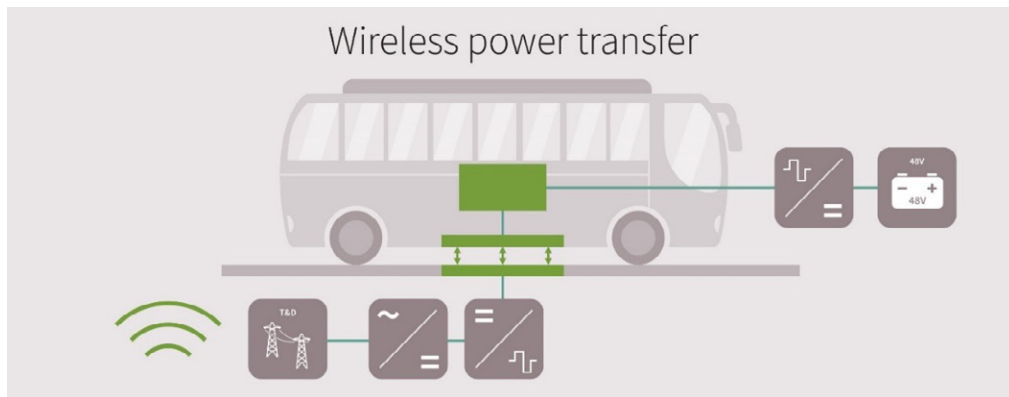
* DC charger subunit
or DC charger

Commonly used topologies for AC/DC conversion

Rectifiers exist in different forms and types



Wireless Power Transfer



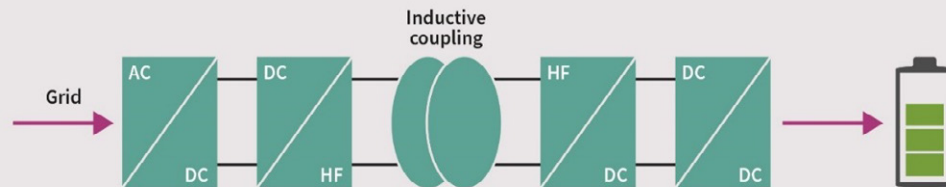
Characteristics

- › Power Class: 3.7 kW, 7.7 kW, 11 kW
- › Static WPT: Charge while the vehicle is not in motion
- › Dynamic WPT: Charge while the vehicle is moving along the WPT enabled roadway
- › DC/DC conversion inside the vehicle to adapt the input voltage to the converter

Topologies and Solutions

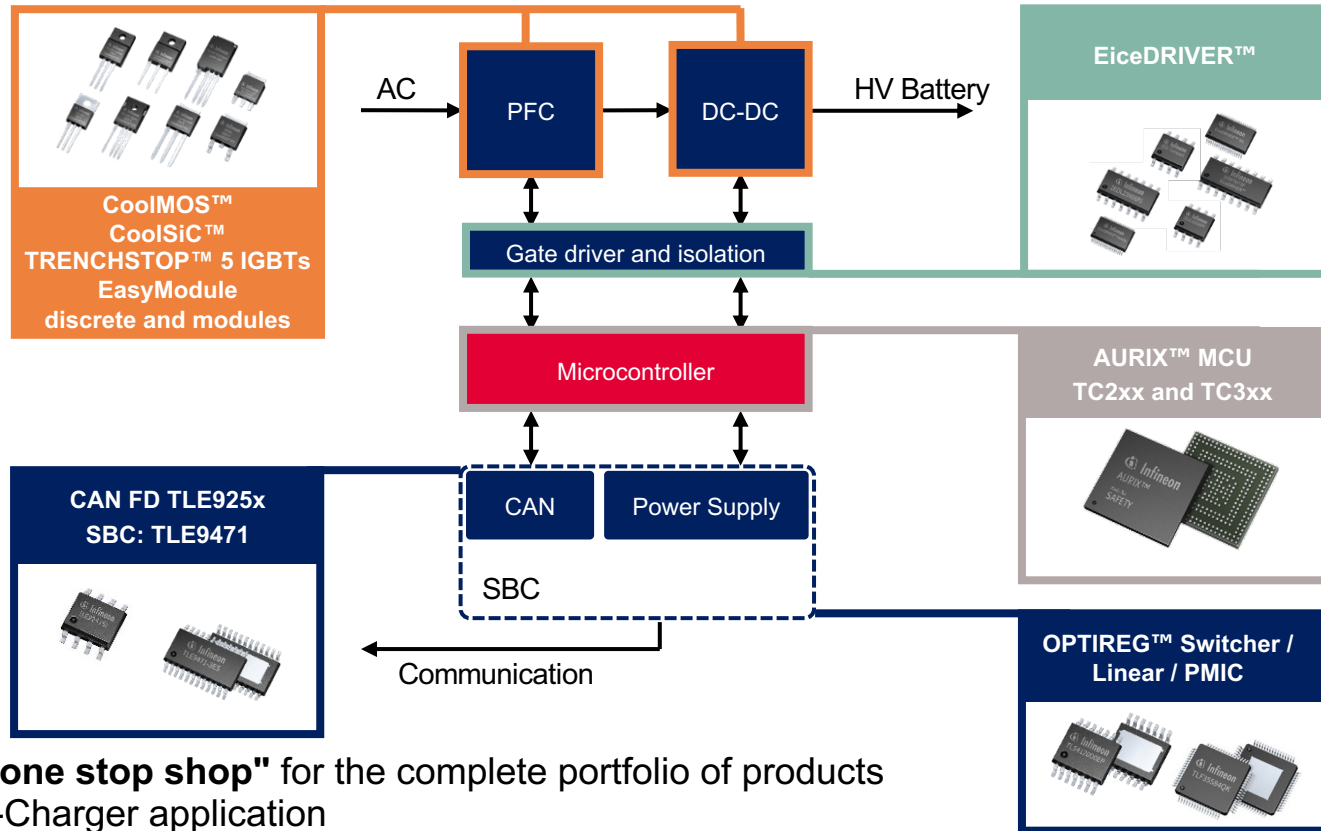
- › Resonant topologies are often preferred since these reduce switching losses
- › DC-DC-Stage is installed in the car to align output voltage and battery requirements
- › Wireless Power Transfer Units are usually built using discrete solutions CoolSiC™ MOSFET, CoolSiC™ diodes, and CoolMOS™

Resonant switching in Wireless Power Transfer (WPT) / inductive charging



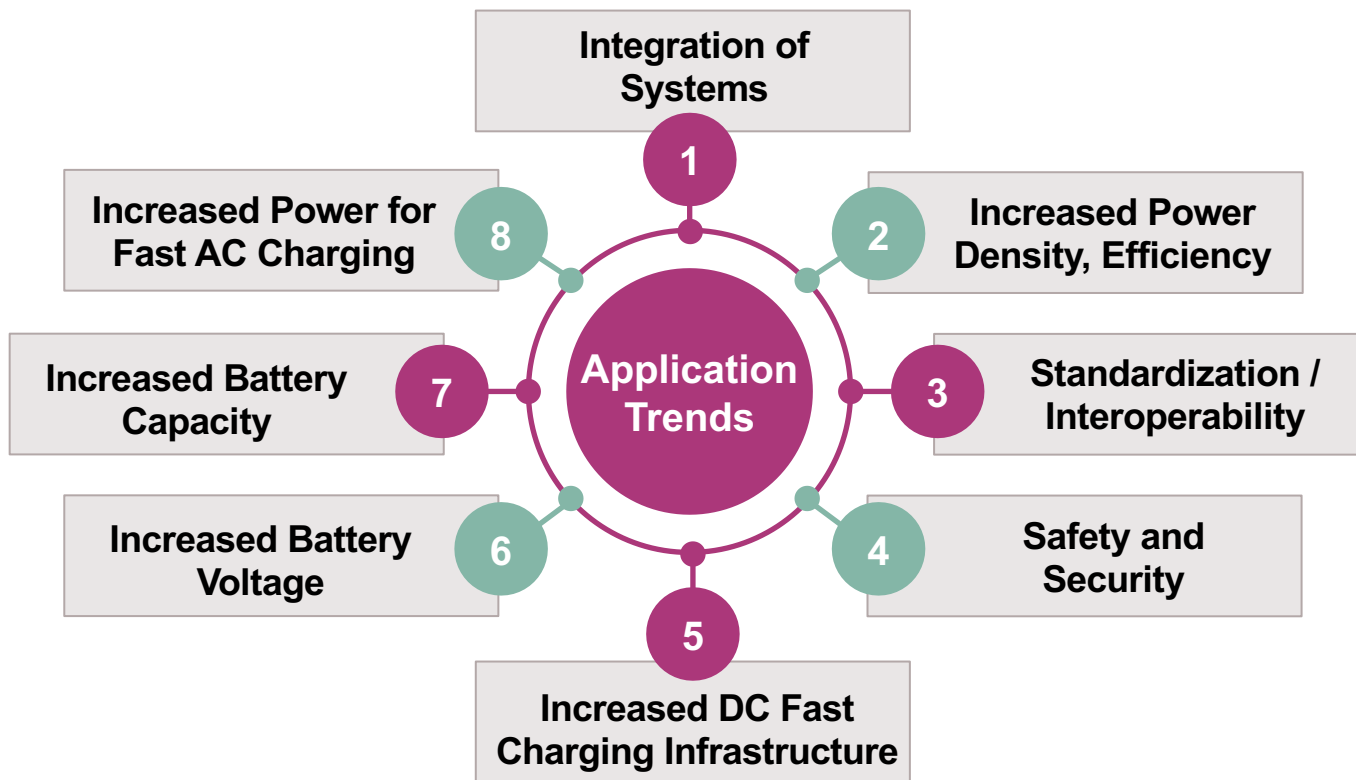
Optimized products and chip-sets for OBC

Outstanding efficiency and performance with Infineon chip sets

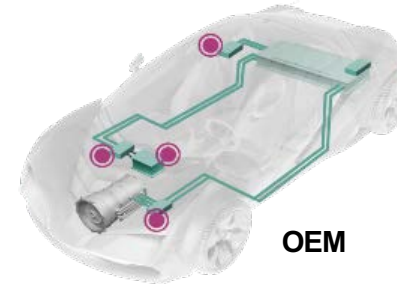
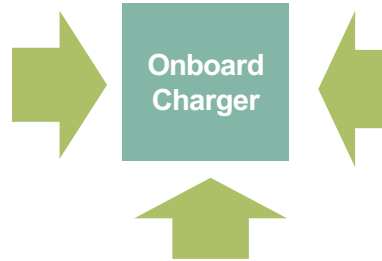


The leading **"one stop shop"** for the complete portfolio of products for On-Board-Charger application

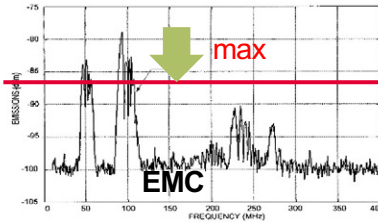
OBC Application trends



Various Generic Requirements are defined by Regulations (Grid) and OEM's (Car side)



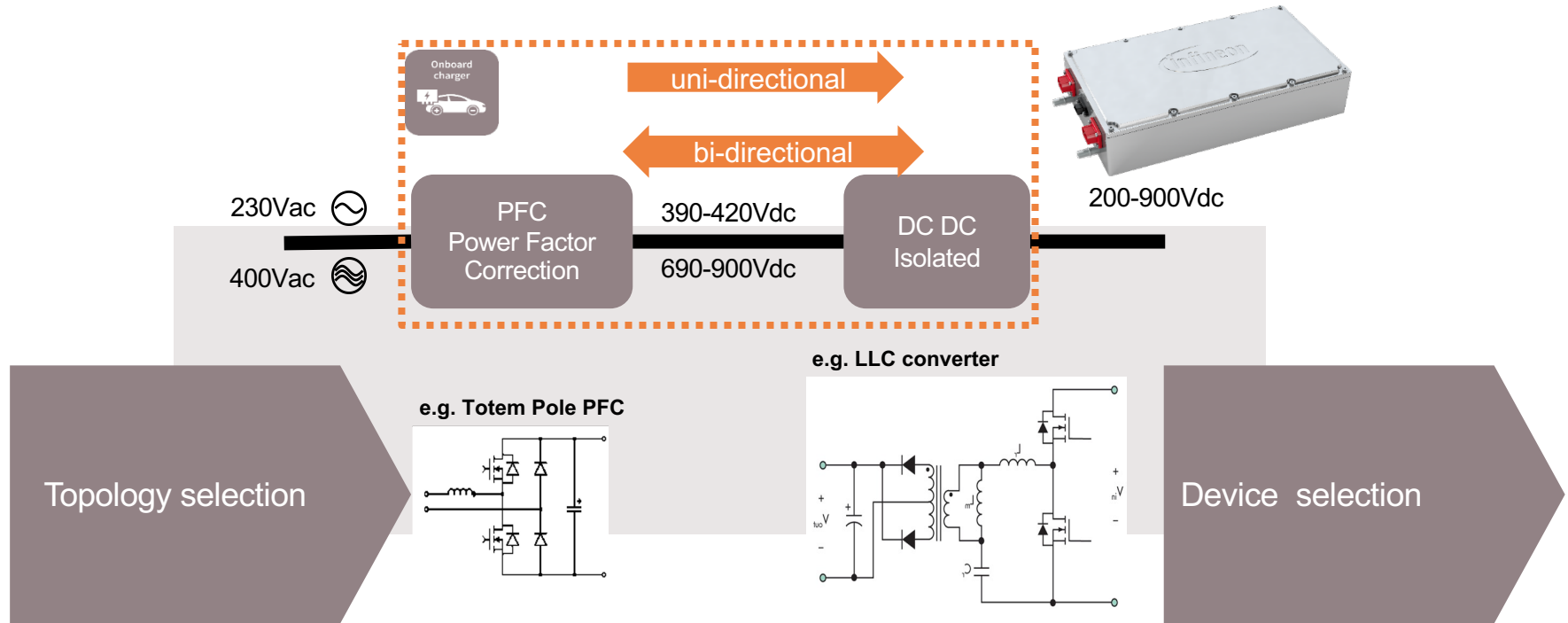
- › Different Power Levels, depending on installation
 - Different Grid Voltages
 - Single vs. three phase
- › Respect power factor typ. >0.9
- › Different communication interfaces
- › Isolation



- › Lowest cost for required functionality
- › High Power Density especially for PHEV
- › Battery Voltage Level
- › Efficiency
 - as requested
 - according to regulation (if applicable)



The OBC market is diverse in functionality, power levels, topologies...

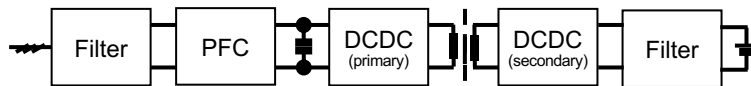


Broad Power Switch Portfolio required

There are various Power Classes from 6.6kW – 22kW

Power Classes OBC (as of today)		
Power level	Description	Adoption
3.6kW	Single Phase systems, 110V/230V, world-wide	Mainly Plug-In hybrids and small BEVs
6.6kW/7.2kW	Single Phase 110V/230V → Asia, NAFTA Dual Phase 230V → EU (only 4kW per phase allowed due to grid symmetry)	Main stream today
11kW/18kW	Single Phase (Split Phase) 110V/230V → NAFTA (up to 18kW max) Three Phase, 230V → EU, China	Main Stream mid Range
22kW	Three Phase, 230V → EU, China	High End segment + Future adoption

Unique benefits of complete portfolio for On-Board Charger Application



CoolMOS™, CoolSiC™, TRENCHSTOP™ 5

Higher power density for reducing system size by up to 50% or increasing power by 100 % on the same footprint

High power density

Reduced cooling effort

CoolMOS™, CoolSiC™, TRENCHSTOP™ 5

Reduced switching and conduction losses to support high frequency operation

CoolMOS™, CoolSiC™, TRENCHSTOP™ 5

Covering the most of topologies from one hand
→ full flexibility on the customer side

High Flexibility

Scalability

Discrete and module

Scalability across various platforms for upgrading system power charger levels on demand

EiceDRIVER™ and AURIX™ microcontroller

Tailored gate driver solutions and high performance AURIX™ microcontroller family

Safe drive and control

Power Supply

OPTIREG™ Linear, Switcher and PMIC, SBC's

High quality discrete and high integrated power supply solutions

CAN FD Transceivers

High quality robust CAN FD transceivers including galvanic isolated technology

Communication

Sensors

XENSIV™

Innovative, space optimized current sense solutions

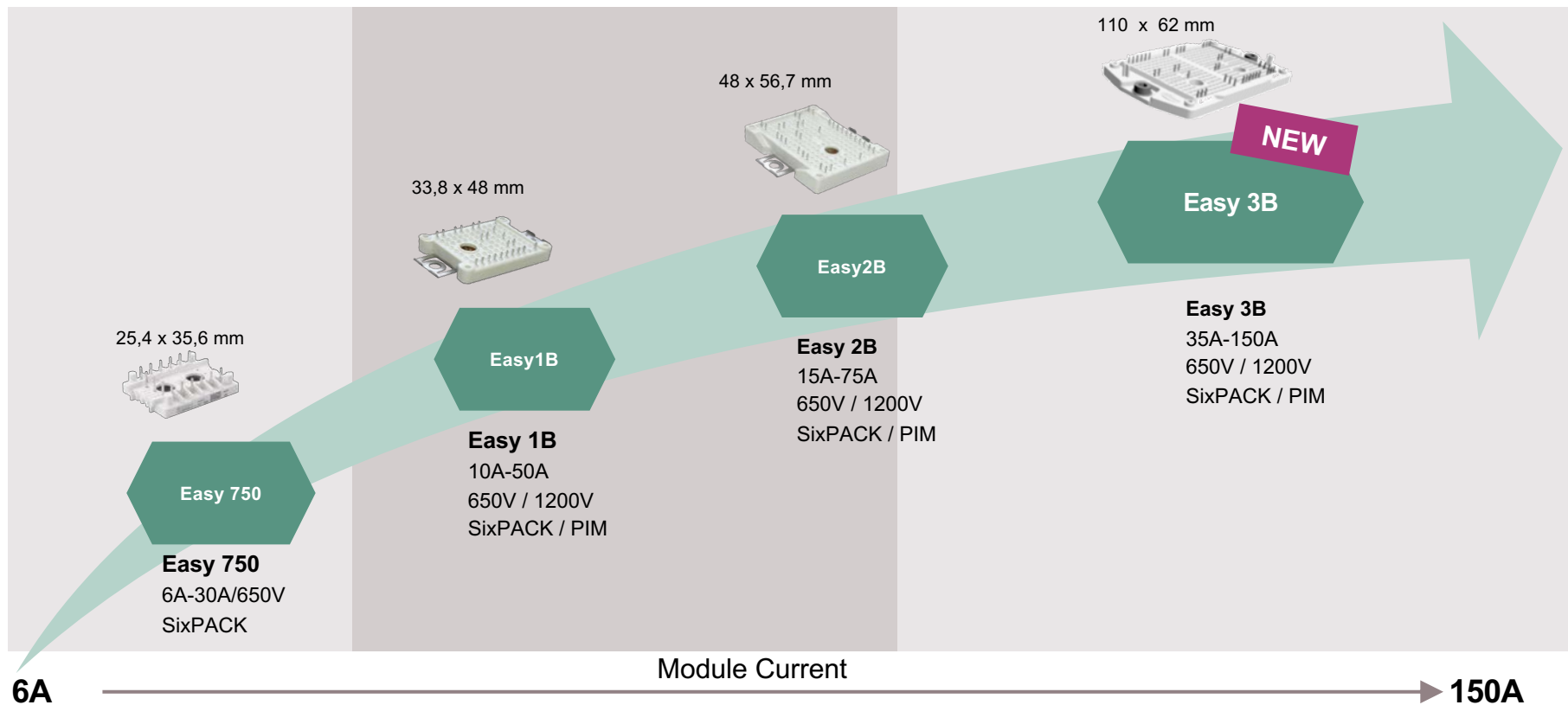


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Easy Overview for Charging

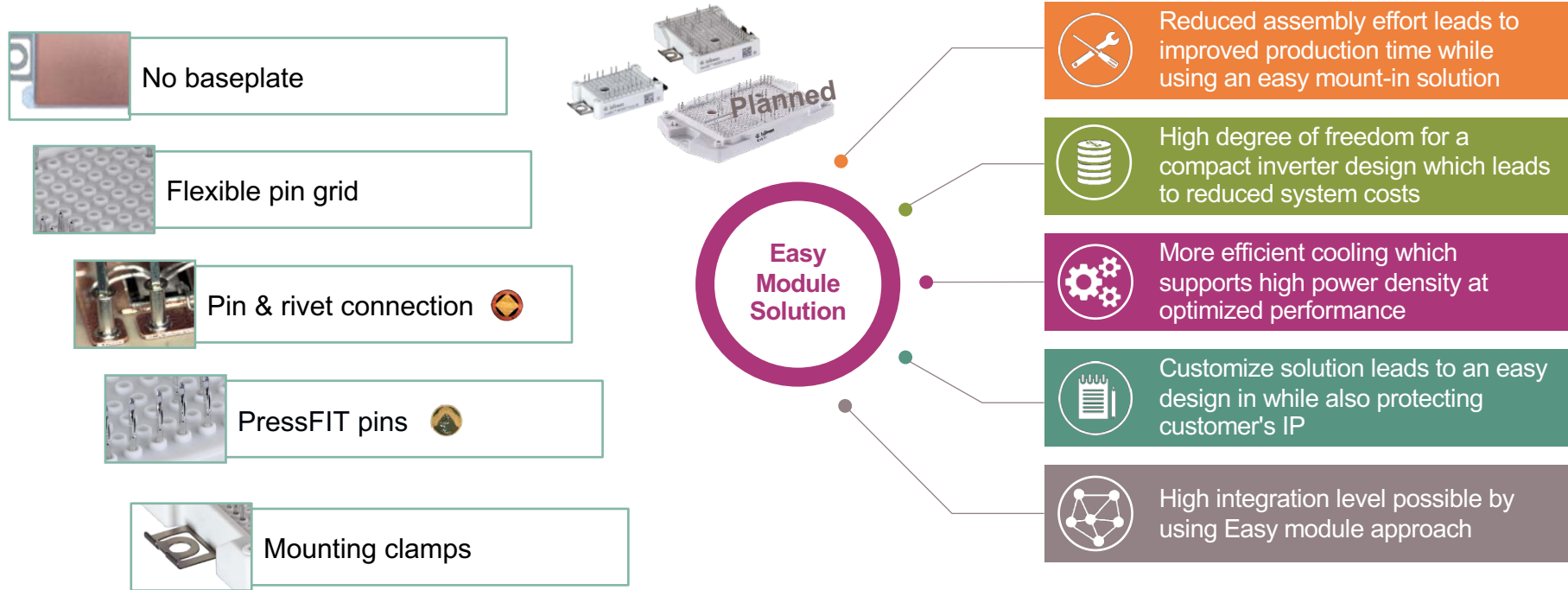


LMP Product Lineup: Easy Modules



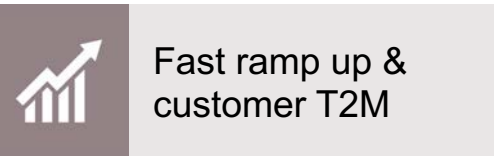
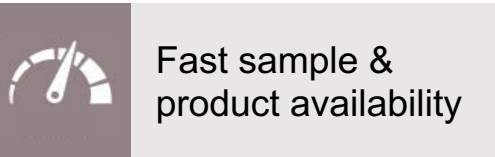
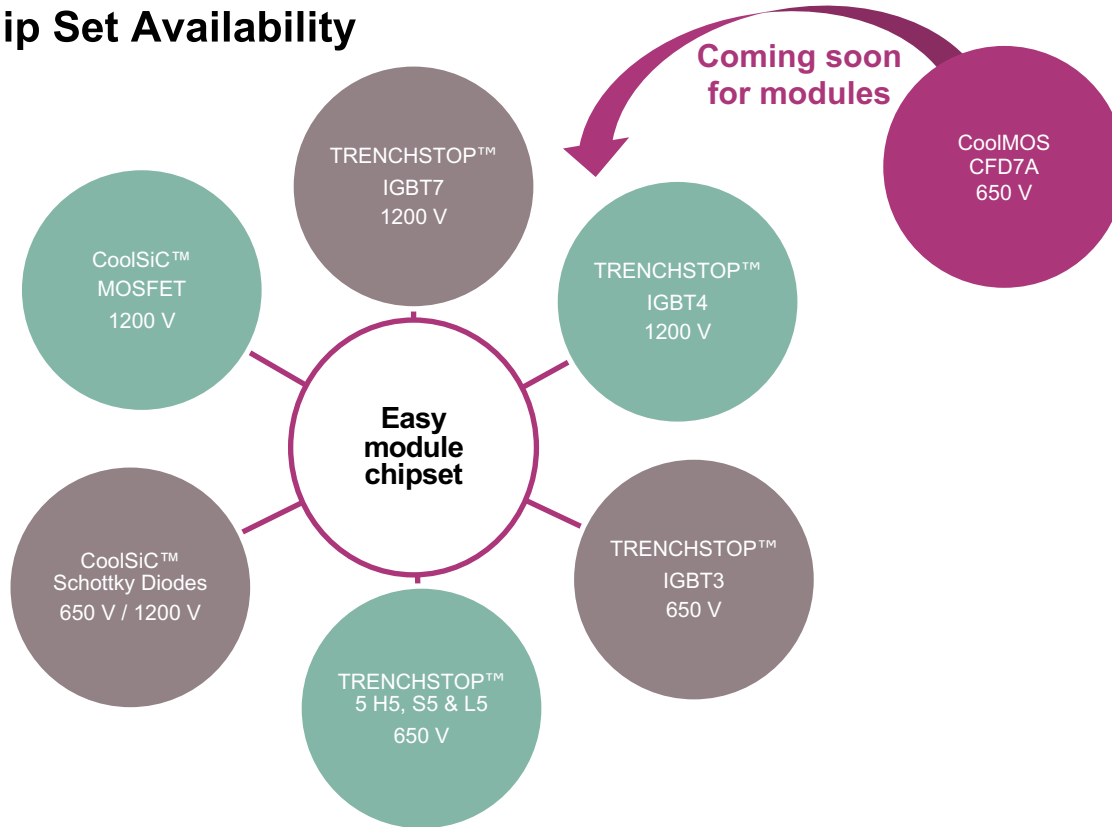
Easy is the best choice for customers who are looking for a flexible & scalable power module family with the best performance

Key features & benefits of Easy modules

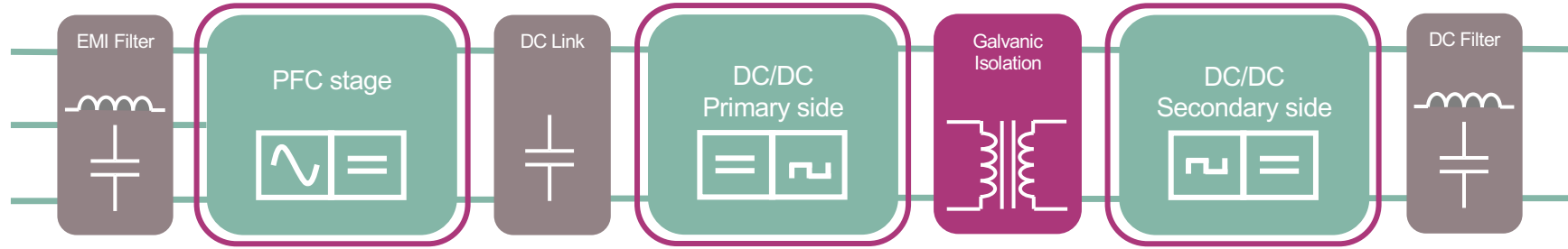


Our customization approach in combination with our variety of chipsets for Easy modules enables customers' differentiation

Chip Set Availability



Easy modules are flexible and scalable and are a perfect solution for future AC/DC & DC/DC on board charger designs

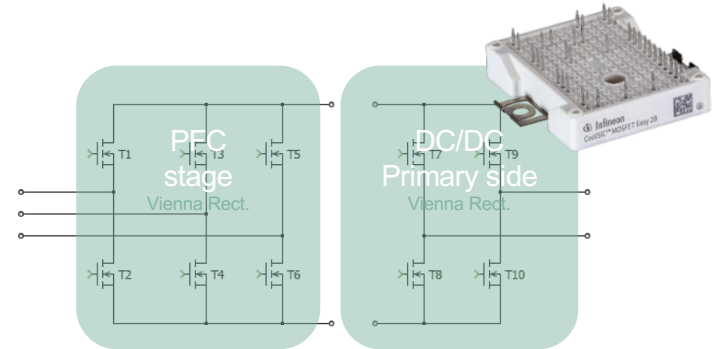


Power rating	RDson [mΩ]	1200 V half-bridge	1200 V H-Bridges	1200V SixPACK
3kW - 22kW	45	FF45MR12W1M1_B11	F4-45MR12W1M1(P)_B76	FS45MR12W1M1(P)_B11
	23	FF23MR12W1M1(P)_B11	F4-23MR12W1M1(P)_B11 F4-23MR12W1M1(P)_B76	
Up to 50kW	15		F4-15MR12W1M1(P)_B76	
	11	FF11MR12W1M1(P)_B11 FF11MR12W1M1_B70	F4-11MR12W1M1(P)_B76	
75kW - 150kW	8	FF8MR12W2M1(P)_B11		
	6	FF6MR12W2M1(P)_B11 FF6MR12W2M1_B70		

Orderable, registerable and available now

In development

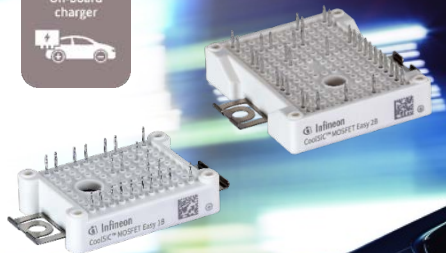
B11 = PressFIT Pin
 B70 = AlN ceramic
 B76 = Improved pinouts
 F = SiC Diode
 P = TIM



Combined Easy 2B module with CoolSiC™ MOSFET 1200V 45mOhm for 11kW OBC

 Easy module possible

Key take-aways of Easy module portfolio & roadmap on OBC, DCDC & eCompressor application



We are extending our product portfolio to grant new designs and to support our customers with our best in class module solutions and experience

We will further investigate new product solutions to meet customer requirements and to ensure fast and efficient on board charging

Easy is a perfect fit for customized solutions, particular in combination with our current chip set for on board charger, DCDC, Booster and many more applications



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

CoolMOS / CoolSiC / IGBT



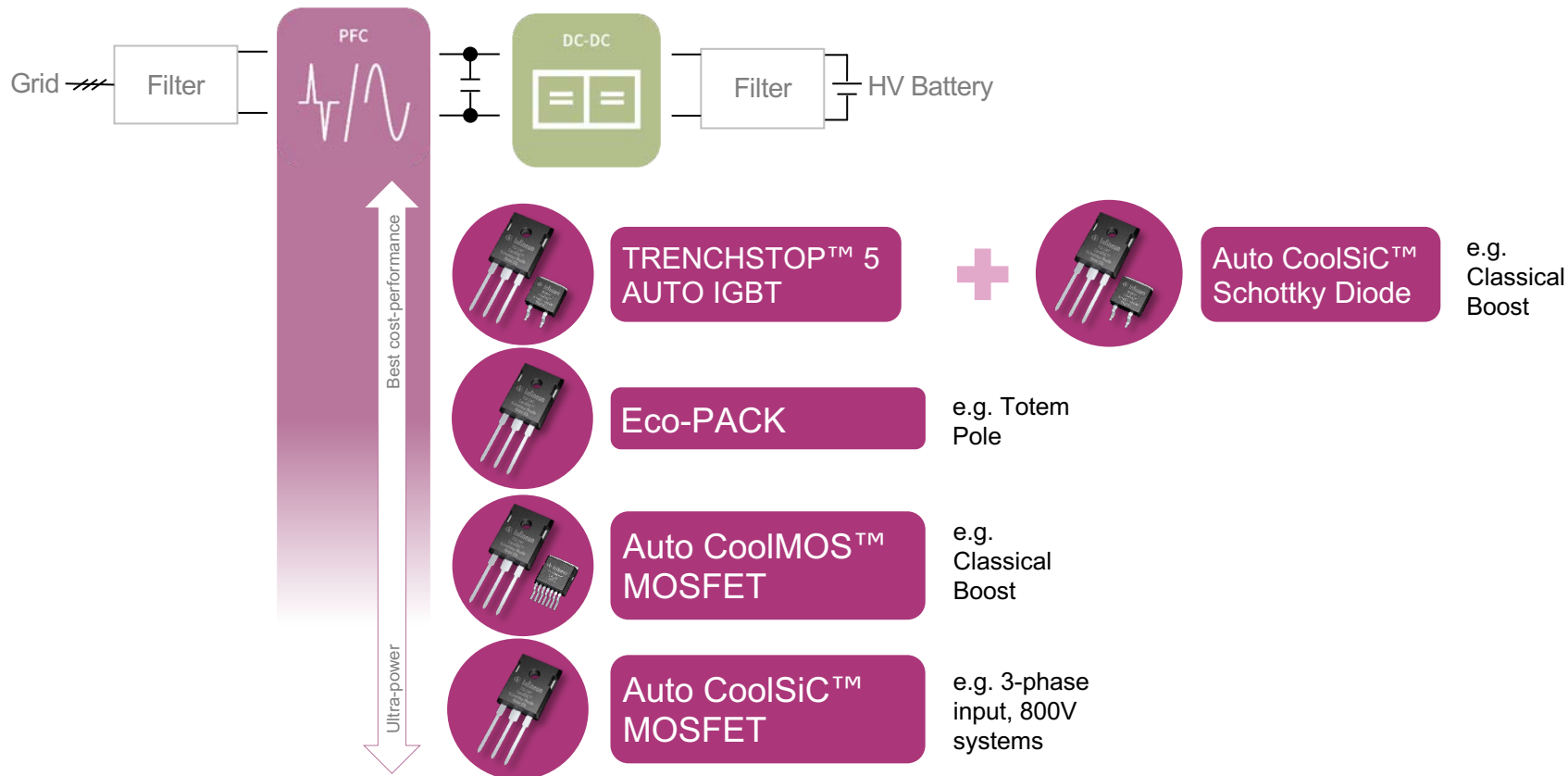
Infinion offers the complete automotive-grade portfolio of discrete SiC components



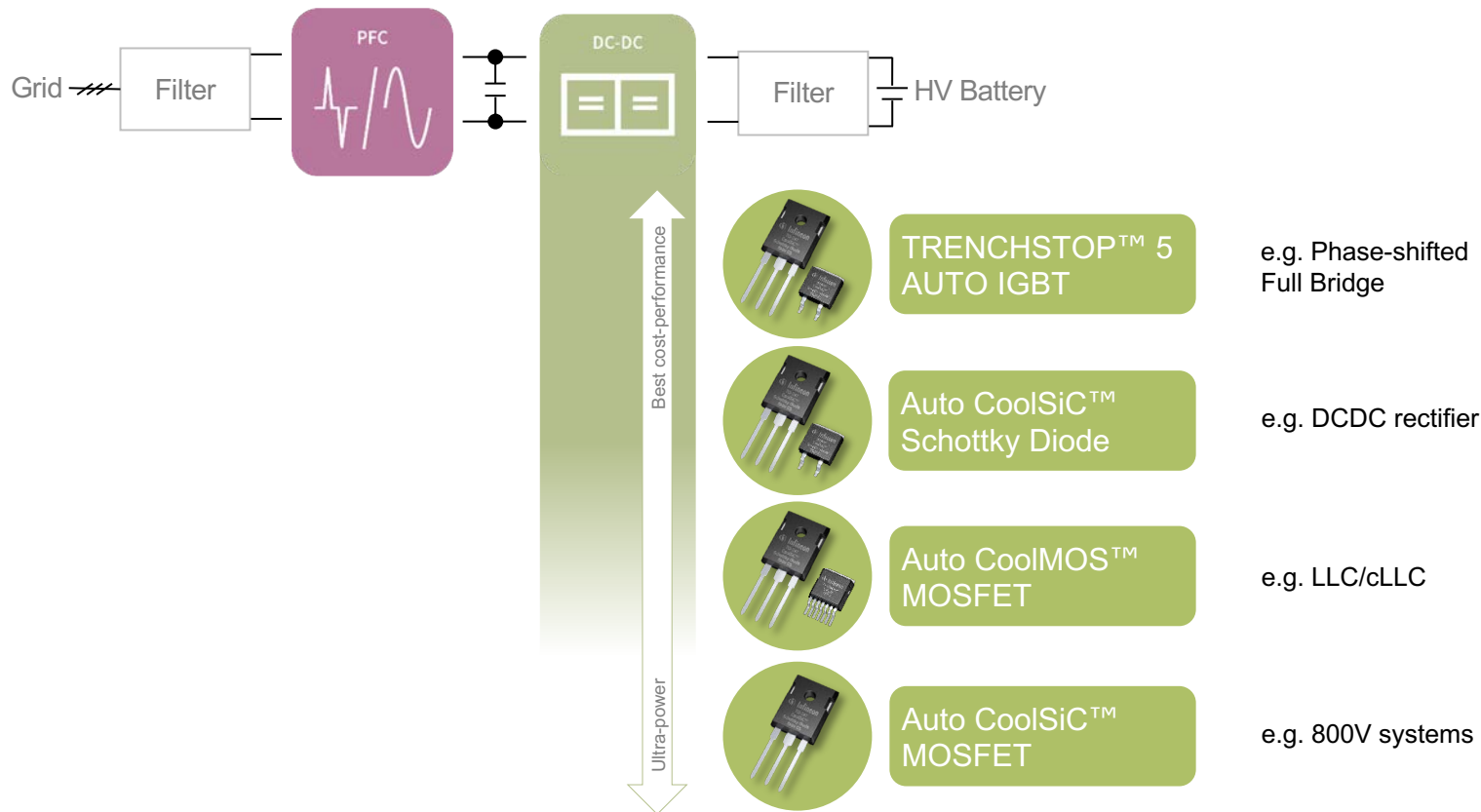
Automotive CoolSiC™ Schottky Diode	Automotive CoolSiC™ MOSFETs 650V and 1200V	Eco-PACK: Hybrid of IGBT + CoolSiC™ Diode
  	  	  

- › More than 30 leading OEMs and tier-1s are evaluating Infineon's SiC solutions for automotive
- › Over 20 years of field experience used for ramping up this new technology to the Automotive world
- › Infineon's internal quality test procedures exceed common industry norm; test results proof that Infineon's SiC products reach that quality level
- › Industry's broadest portfolio allows customer to "pick what they need" rather than to "take what we have"

Usage of the Discrete line-up for the On-Board Charger Application



Usage of the Discrete line-up for the On-Board Charger Application

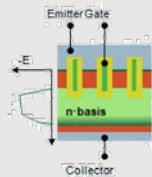


Automotive TRENCHSTOP™ 5 IGBT

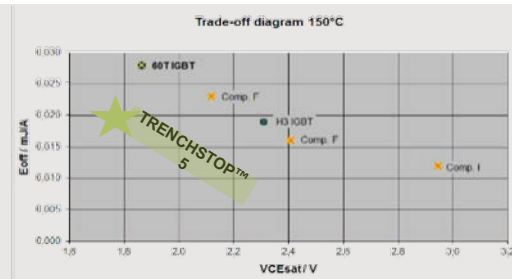


Technology

- › TRENCHSTOP™ 5 technology with **low V_{CEsat}**
- › **650V** blocking voltage
- › Very fast switching (up to **150kHz**)
- › Automotive qualified



Competitiveness

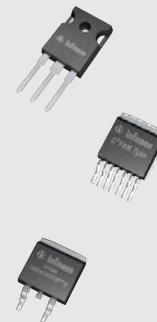


Key Features

- › Max junction temperature **175 °C**
- › **Highest efficiency**
 - very low conduction losses
 - very low switching losses
- › Very low junction and case temperature
- › High power density design
- › High device reliability
- › **Applications:**
 - PFC
 - DCDC

Portfolio

- › TO247-3L and SMD (D2Pak)
- › TRENCHSTOP™ 5: **H5** and **F5**
- › Single IGBT or
- › Copack with Silicon RAPID1 diode or
- › Copack with CoolSiC™ Diode
- › Current Classes between 15A – 50A

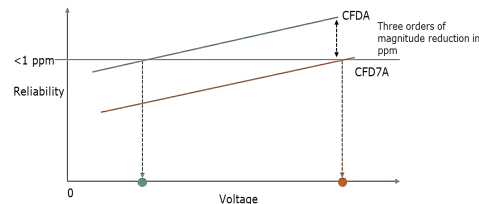


Automotive CoolMOS™ 650V CFD7A



1 Technology robustness

Higher application voltages possible
(at same proven reliability level)



*Schematic representation, real-life benefits depend on individual customer use profile



400V → 475V

2 SMD packages

D2PAK 7-pin with increased creepage distance and Kelvin source

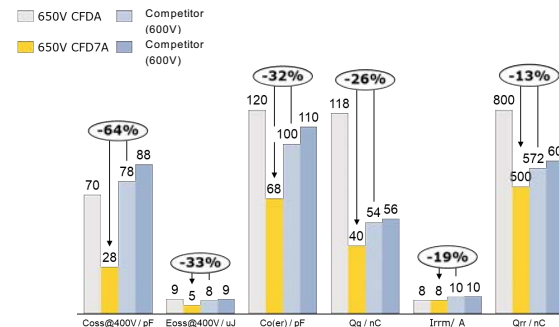


First products already
available (IPB65R115CFD7A
and IPBE65R115CFD7A)

3 One part for soft and hard switching (economies of scale)

Considerable improvement in key
parameters (higher efficiency)

Comparison of 110mS class IFX vs. next best discrete alternative on market



Automotive CoolSiC™ Schottky Diode Gen 5



Key Features

- › 650V class
- › Excellent Figure of Merit ($Q_c \times V_F$)
- › No reverse recovery charge
- › High operating temperature ($T_j \text{ max} = 175^\circ\text{C}$)
- › Robust against surge currents
- › Automotive Qualified

Benefits

- › Highest reliability against environmental conditions
- › Best match with CoolMOS™ and IGBT TRENCHSTOP™
- › Mature technology: several years field experience in industrial applications



Released:

- › 10 A
- › 12 A
- › 16 A
- › 20 A
- › 30 A
- › 40 A



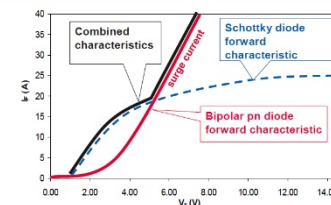
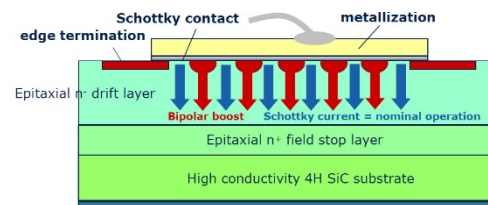
Released:

- › 8 A
- › 10 A
- › 12 A

Coming in 2020:

- › 16 A

Diode Gen 5 concept



Automotive CoolSiC™ Discrete MOSFET Generation 1



Key Features

- › 1200V / 45mΩ Trench MOSFET.
- › Low device capacitances.
- › Temperature independent switching losses.
- › Intrinsic diode with low reverse recovery charge.
- › Short-circuit robustness

Advantages

- › Superior gate oxide reliability
- › Best in class switching and conduction losses
- › IGBT compatible driving voltage (VGS=-5V / +15V or +18V)
- › Threshold voltage prevents parasitic turn-on ($V_{th} = 4V$)



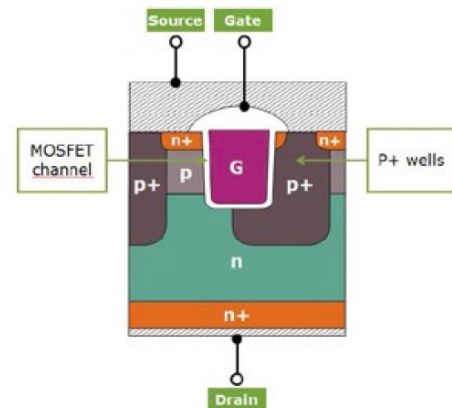
Released:

- › 45 mΩ

Coming in 2020:

- › 35 mΩ
- › 60 mΩ
- › 80 mΩ

MOSFET Gen 1 concept



Automotive CoolSiC™ EasyPACK™ 1B

FF08MR12W1MA1_B11A – In Production



Key Features & Benefits

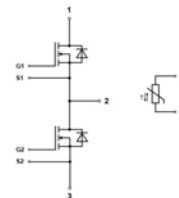
- › 1200V CoolSiC™ Trench MOSFET Gen1
 - FF08 version: 150A (DC rating)
- › Low stray inductance 5nH
- › Intrinsic diode with low reverse recovery
- › PressFIT pins for easier assembly process
- › IGBT compatible driving voltage ($V_{GS} = -5V / +15V$)
- › Superior gate oxide and cosmic ray reliability
- › High gate threshold voltage prevents parasitic turn-on ($V_{th} = 4.4 V$)
- › Qualified according AQG 324

Three variants:

$R_{DS(ON),typ} = 22 m\Omega$ FF22MR12W1MA1_B11A (on request)

$R_{DS(ON),typ} = 11 m\Omega$ FF11MR12W1MA1_B11A (on request)

$R_{DS(ON),typ} = 7.33 m\Omega$ **FF08MR12W1MA1_B11A**



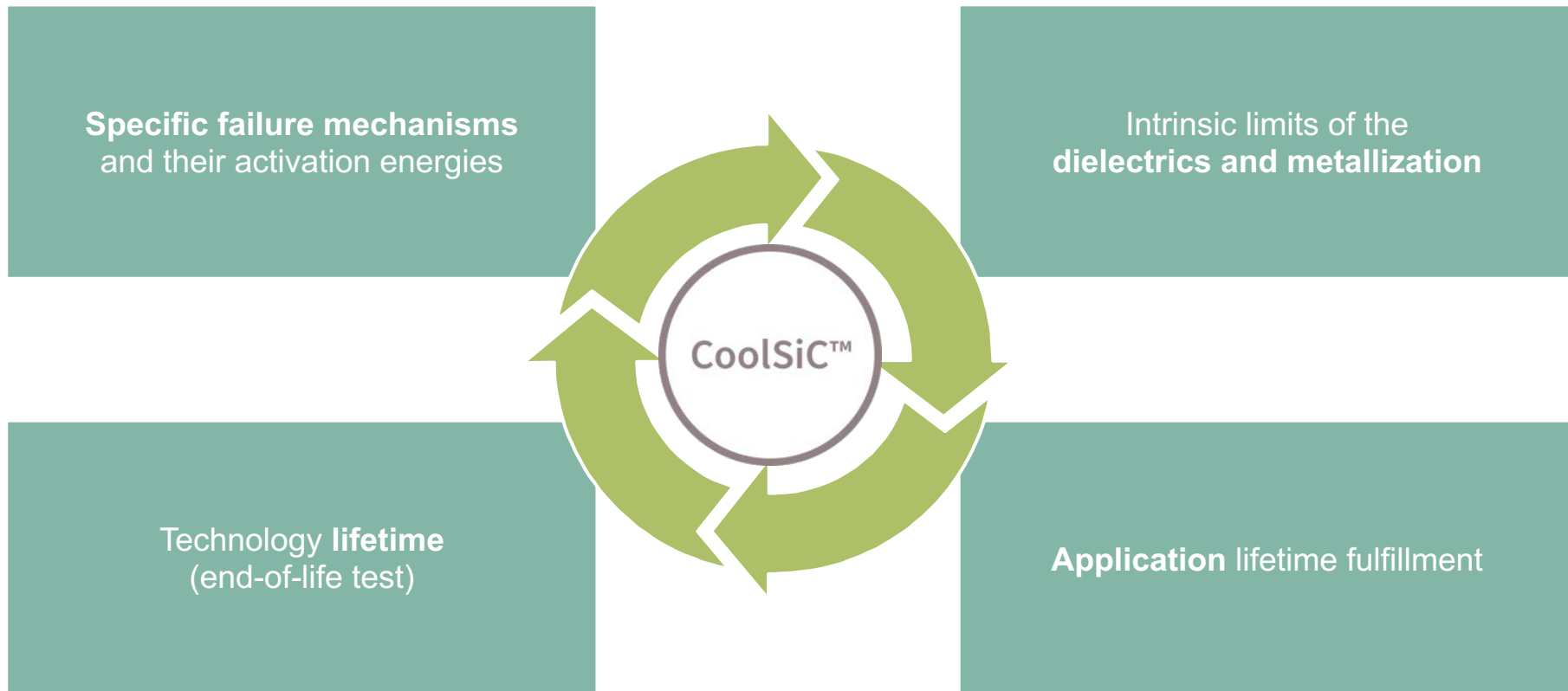
Applications

- › DC/DC converter
- › Auxiliary inverters
- › E-compressor (e.g. FCEV)

Schedule (FF08):

- › SOP July 2020
- › Engineering samples available

CoolSiC™ The best in class technology reliability



CoolSiC™ High Performance Portfolio for OBC

Schottky Diode

MOSFET

	D ² PAK TO263	TO247	TO247	D ² PAK TO263
650V	8A	10A		
	12A			
		10A		
		12A		
		16A		
		20A		
		30A		
		40A		
			35mOhm	
			45mOhm	
			60mOhm	
			80mOhm	
				10mOhm
				20mOhm
				40mOhm
				80mOhm
				120mOhm
				180mOhm
				1200V

XXX

= in development

SJ MOS 1st choice for 600 V-800 V automotive applications



Experience

- › 10 years of experience in xEV market
- › CoolMOS™ technology experience for more than 20 years



Quality

- › 0.009 dpm on average
- › Only 1 fail in >100M parts shipped in the last 5 years
- › Qualification beyond AECQ101



Performance

- › Best performance in 600 V-800 V automotive applications
- › CoolMOS™ CFDA provides for best-in-class reliability for repetitive hard commutation due to fast body diode, low ringing and low voltage overshoot
- › CoolMOS™ CPA is an excellent choice for PFC and other hard switching topologies



Capacity

- › Expected market growth supported by coherent production strategy in terms of capacity

CoolMOS™ Automotive: Wide scalable Product Portfolio

CoolMOS™ automotive product families

650V CFD7A
0.022-0.230 Ω

600V CPA
0.045-0.299 Ω

650V CFDA
0.048-0.660 Ω

800V C3A
0.290 and 2.7 k Ω

Power supply topology and market segment

On-board charger

PFC

LLC

DC-DC converter
active clamp

HV-LV DC-DC converter

Phase-shift full-bridge ZVS/LLC

Auxiliaries,
Pre-charge, Discharge

TRENCHSTOP™ 5 Technology Enables Best-in-Class Fast-Switching IGBT Discretes for On-Board Charger



TRENCHSTOP™ 5



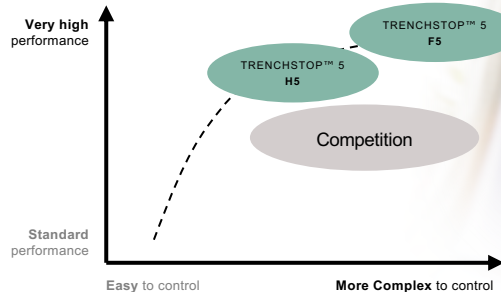
TO247

D²PAK
TO263

NEW



Competitiveness



Features

Best-in-Class performance
of conduction & switching

300mm wafers soon

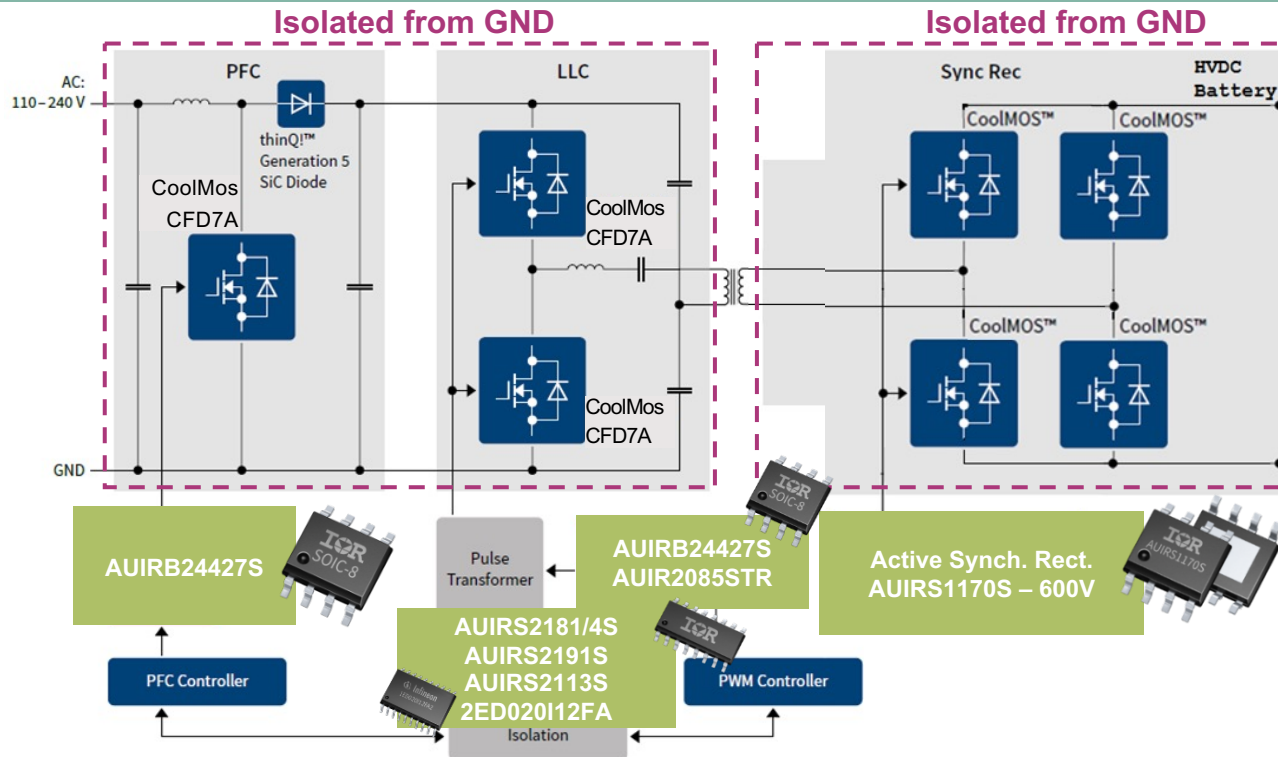
Benefits

Cost-effective solution
for **PFC stages** in OBCs

Supports **fast ramping**
market of OBC

Infinion Complete Gate Driver Portfolio to address all functional blocks

AC/DC charger simplified block schematic



The Right Drivers for Every OBC Implementation



Product Benefits

- › High Efficiency
- › Safe Operation
- › System Cost Savings
- › Lower System Size & Weight

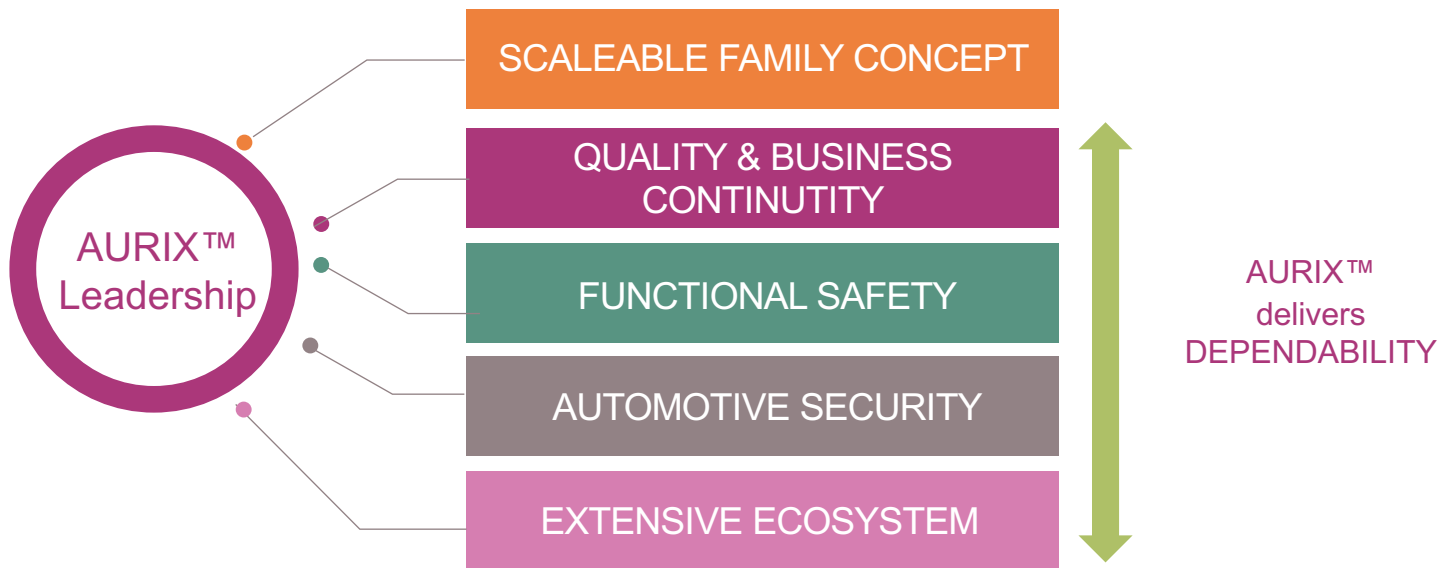


We are the link
between the real and
the digital world.

AURIX™

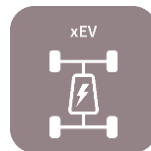
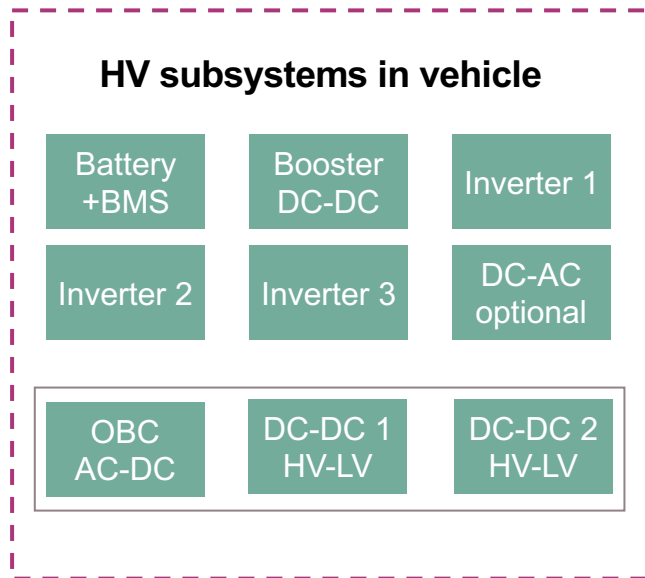


AURIX™ TC3xx offers a "One-Stop-Shop" for xEV applications



No other MCU family can offer this **combination** of functionality across multiple compatible products and this level of **dependability**

AURIX™ TC3xx addresses key integration trends in OBC



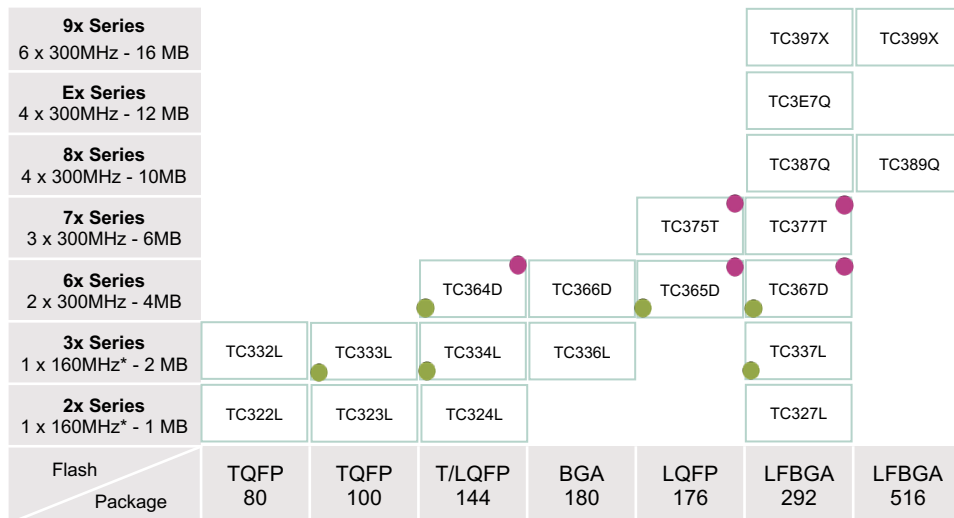
AURIX™

Growing to >30% market share in xEV*

- › **Integration** of on-board charger and HV-LV DC-DC functionalities into one module allows costs saving
- › **AURIX™ family scalability** allows performance upgrades and the **multicore capability** means that several different applications can run concurrently
- › **AURIX™ family scalability** means that customers can use an xEV platform approach to cover all applications saving SW costs and optimizing reuse

*Infineon Internal sources

AURIX™ TC3xx offering for On-board Charging



● On-Board Charger
 HV-LV DC DC Converter

● LV-LV DC DC Converter

AURIX™ delivers for OBC and prepares the ground for further integration such as OBC and HV LV DC-DC converter

Key AURIX™ TC3xx feature by application	OBC	Integration Trends
High Multicore. Perf.		<input checked="" type="checkbox"/>
Ext. Comms: CAN-FD (up to x20) Gb Ethernet (up to x2)		
Fast ADC, ADC/ compare	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
High RAM content	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Same timer across family	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Low power modes	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Automotive Safety	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Security	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
SOTA support	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Scalability	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
HOT Package		

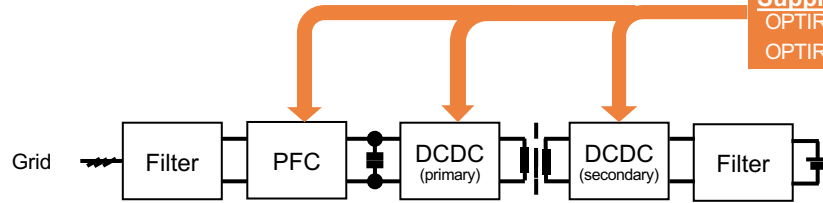
Power Supply and Transceiver Products enable supply and fast communication in On-Board Charger

Supply & Communication

OPTIREG™ Linear CAN FD Transceiver

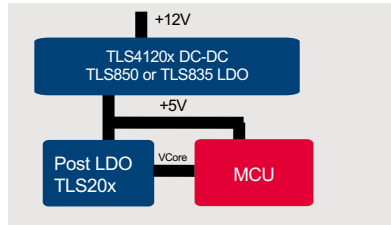
OPTIREG™ Switcher System Basis Chips (SBC)

Auxiliary Supply

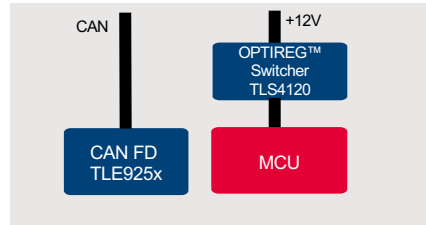


Discrete Solutions

OPTIREG™ Linear OPTIREG™ Switcher



CAN Transceiver



Low Power Applications

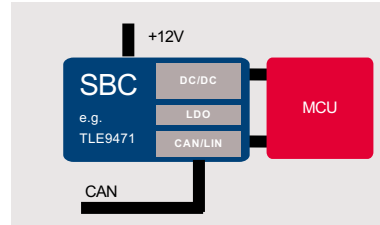
Cost Effective

Flexible and scalable solution

Highest Quality

High integrated chip sets

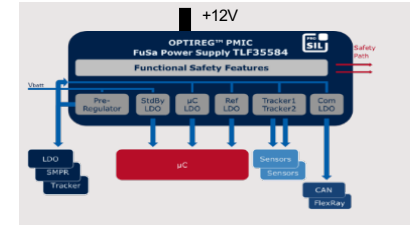
System Basis Chip



High Integration

Diagnostic and communication

OPTIREG™ PMIC



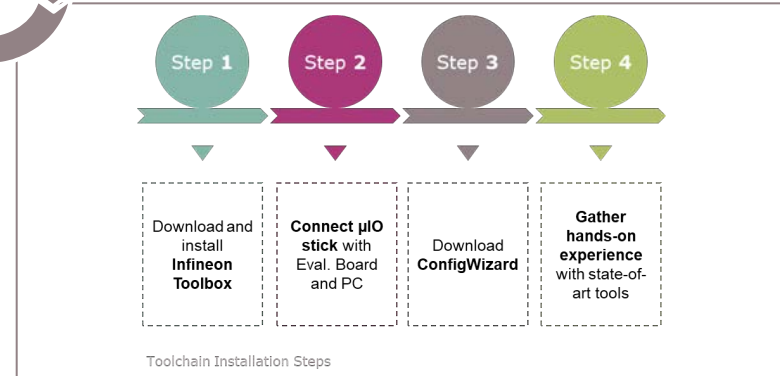
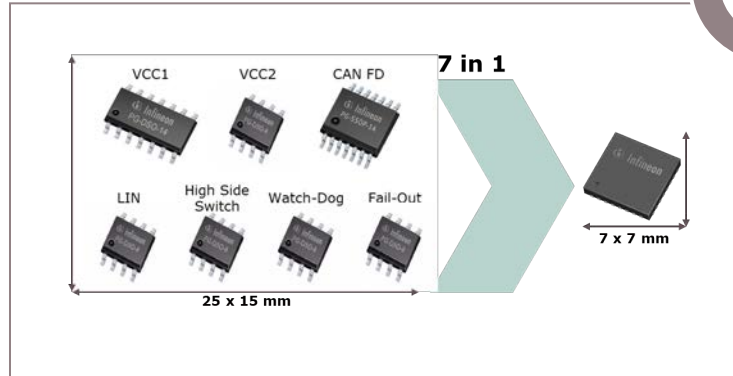
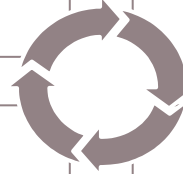
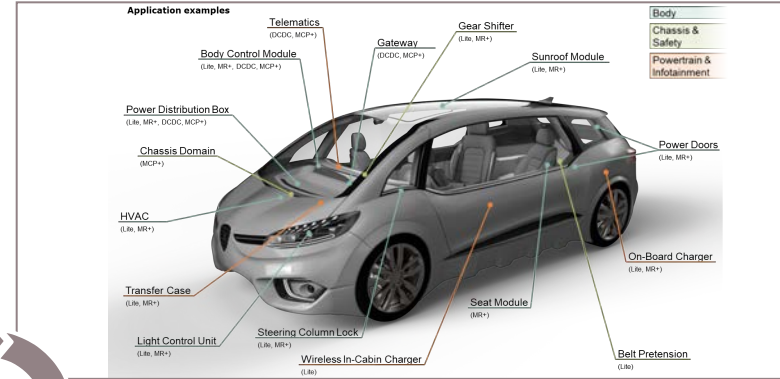
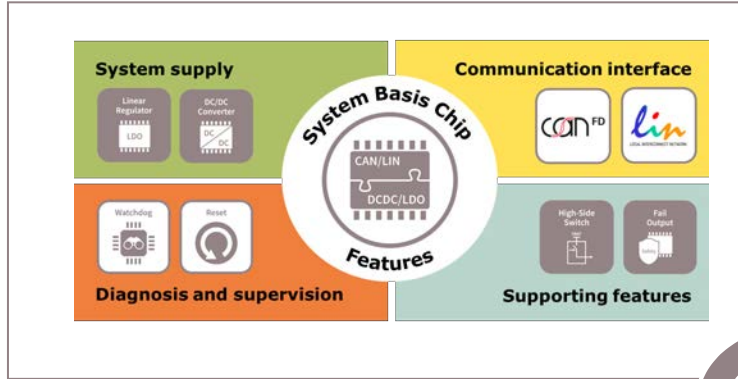
ISO26262 Compliant up-to ASIL-D

High Diagnostic and safety

The complete Power Supply and Communication portfolio enables flexibility and safety implementation

System Basis Chip (SBC)

What? Where? Why? How?





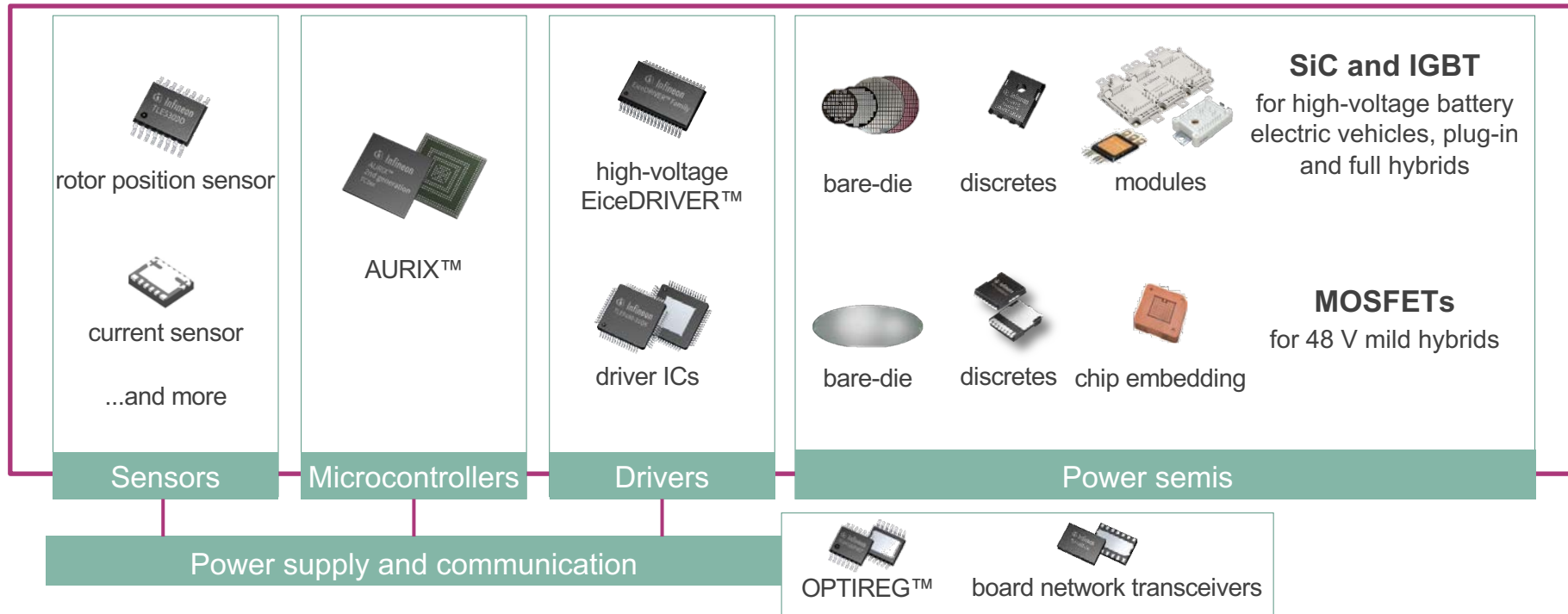
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the digital world.

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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



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Support material



Collaterals and Brochures

- › Product briefs
- › Selection guides
- › Application brochures
- › Presentations
- › Press releases

- › [CoolMOS™ P7](#)
- › [CoolMOS™ CFD7](#)
- › [CoolSiC™](#)
- › [TRENCHSTOP™ 5](#)
- › [EiceDRIVER™](#)

Technical Material

- › Application notes
- › Technical articles
- › Simulation models
- › Datasheets, MCDS Files
- › PCB Design Data

- › [XENSIV™ Current Sensors](#)
- › [AURIX™ - Microcontroller](#)
- › [System Basis Chip's \(SBC\)](#)
- › [OPTIREG™ Power Supply Solutions](#)
- › [CAN FD Transceivers](#)

Evaluation Boards

- › Evaluation boards
- › Demoboards
- › Reference designs

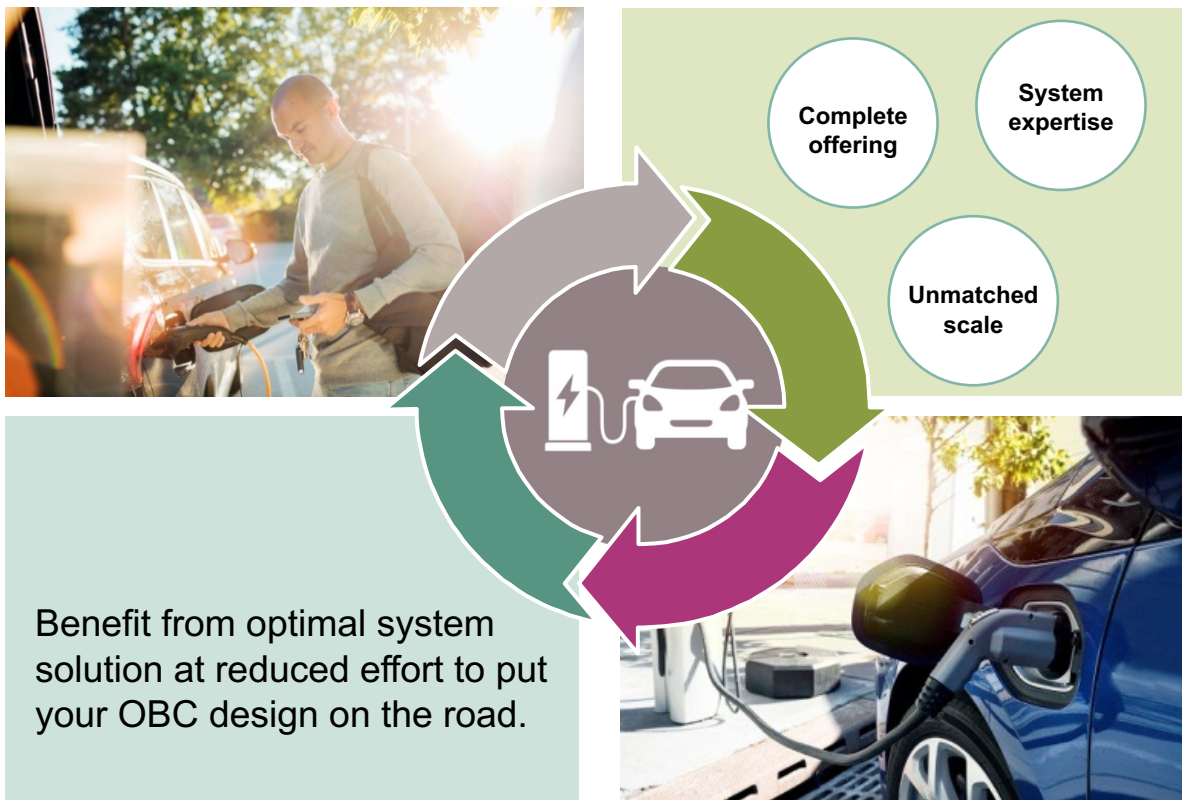
- › www.infineon.com/evaluationboards

Further Info

- › Technical videos
- › Product videos

- › [Fast DC Electric Vehicles charging](#)
- › [Charging solutions for the future of e-mobility](#)
- › [EV-Charger: Powering the future](#)

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