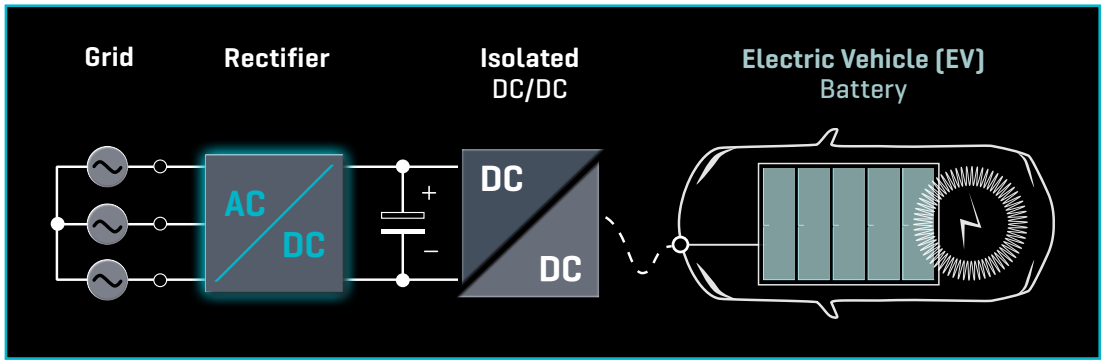
Vincotech

DC FAST CHARGING SOLUTIONS

EMPOWERING **YOUR IDEAS**

CHARGING THE **FUTURE**

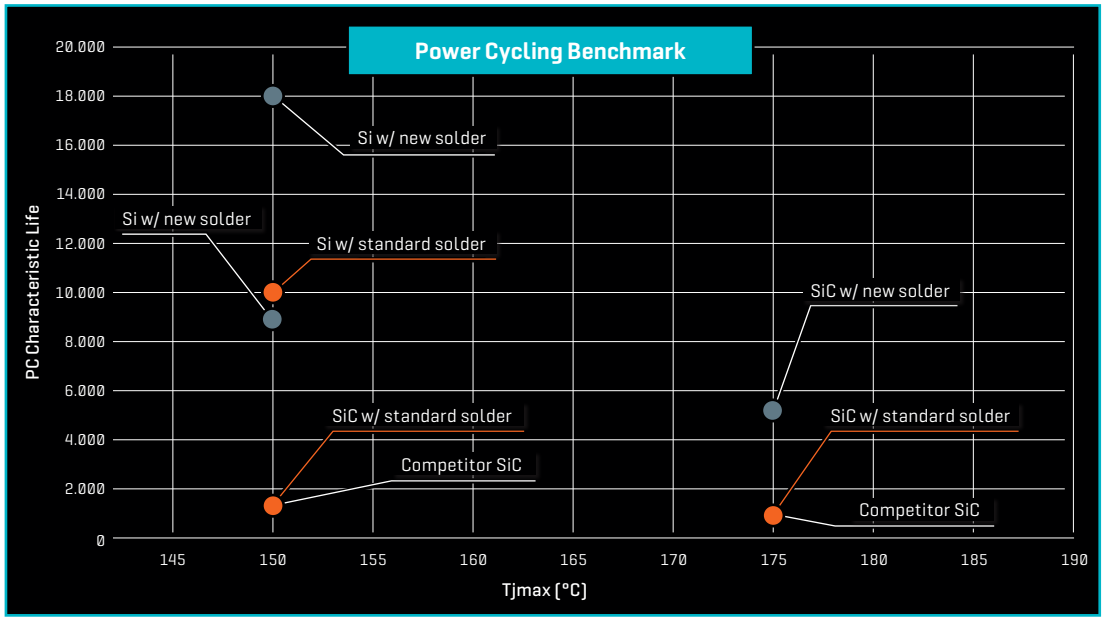
Vincotech is the partner of choice for power modules that support state-of-the-art topologies in a DC fast charger's power stages: the **AC/DC converter** and the **galvanically isolated DC/DC stage.**



State-of-the-art system architecture for DC chargers

Vincotech power modules are well established in many DC Charger applications from EV Charging key players who benefits from:

/ Higher switching frequency, lower filtering effort/costs
/ Multi-sourced SiC-components for more freedom of choice and less supply chain risk
/ Factor >3 improved power cycling capability for higher lifetime
/ Integrated DC capacitors to mitigate voltage overshoot
/ Press-fit pins and pre-applied TIM to help reduce production cost

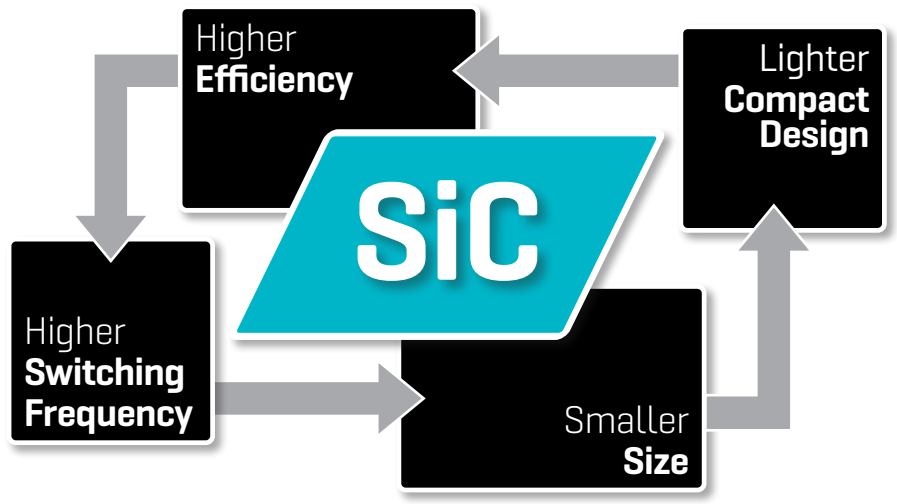


Key trends/drivers in DC charger engineering:

High power charging stations
– Charging will shift towards public and workplace options, as more people without access to home charging start to buy EVs. There will be a growing need for DC fast chargers with nominal power beyond 22 kW in the next years.
– Megawatt Charging Systems (MCS) >1MW for electrical heavy-duty vehicles

Battery voltage 400V ➔ 800V
– Wide DC output voltage range (200V ➔ 920V)

Bi-directional charging
– V2L, V2G or V2H



Modular Design
– For >30 kW The modular design is more dominant than the monolithic design approach, giving the benefits of high design flexibility and scalability

Reliability
– More challenging mission profiles

Power module Solution
– for >30 kW The power module solution is more preferred than the discrete solution, thus benefiting from optimal thermal management, simplified mechanical assembly, and low parasitic inductance

Efficiency: from today 95% to 98%
– WBG components are playing a key roll to achieve this goal
– 3% efficiency improvement will save 2,1 billions kWh electricity per year*

* 30million electric vehicles by 2025 / 15000 km annual driven kilometers / average power consumtion 15kWh

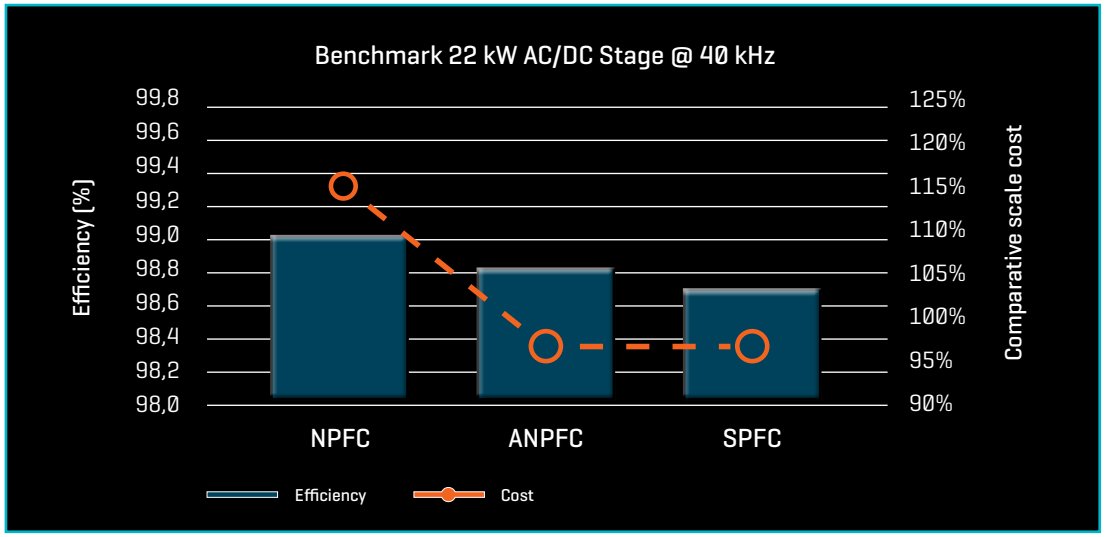
DC **FAST CHARGER**

AC/DC Product Portfolio

/ The **front-end three-phase PFC** might be implemented in multiple topologies. It can be distinguished between **two-level** and **three-level** which have an impact on the design and the blocking voltage rating of the semiconductors.

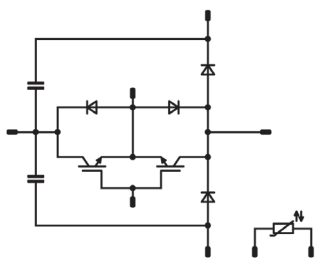
/ Three-level topologies are great for engineers seeking high efficiency at low costs.

/ These topologies are designed for unidirectional charging. Three-level SPFC and NPFC can be adapted for **bidirectional** charging by replacing boost diodes with switches.

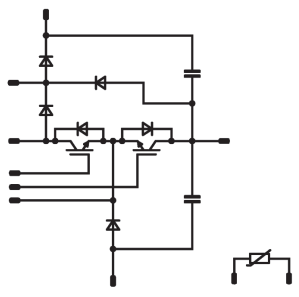


The most common three-level PFC topologies in chargers:

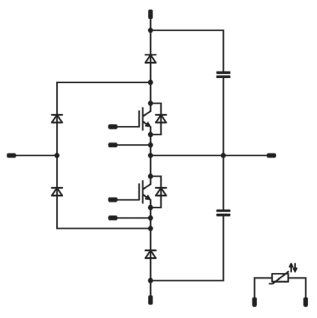
NPFC (Neutral Boost PFC)



ANPFC (Advanced Neutral Boost PFC)



SPFC (Symmetric Boost PFC)



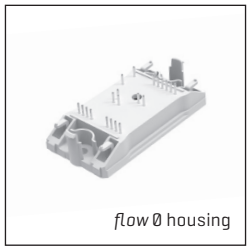
Comprehensive 2L and 3L PFC portfolio for the AC/DC stage

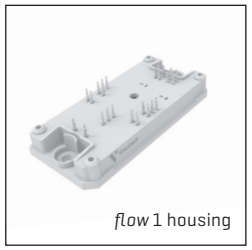
/ SiC MOSFET and fast IGBT chip technology for high-speed switching and greater efficiency
/ Kelvin emitter for better switching performance
/ Integrated DC capacitor to reduce voltage overshoot
/ High-power, low-inductive package
/ Temperature sensor

		ANPFC (T-Type)		NPFC (T-Type)			SPFC (I-Type)
		*flow*ANPFC	*flow*3xANPFC	*flow*NPFC	*flow*3xNPFC	*flow*MNPC	*flow*SPFC
3L-PFC	*flow* 0	25 kW		15 kW (35 kW)*		(30 kW)*	25 kW
	flow 1	35 kW (60 kW)*	15 kW	60 kW (NEW)	20 kW		(60 kW)*
	flow 2		30 kW				
	flow E2					75 kW (NEW)	
	flow S3				(50 kW)*		
	flow E3					(50 kW)*	

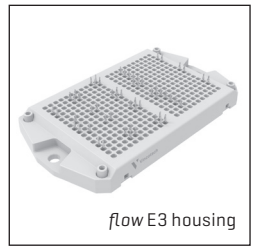
		Sixpack	Half-Bridge	CSPFC
		*flow*PACK SiC	*flow*DUAL SiC	*flow*CSPFC
2L-PFC w/SiC MOSFET	*flow* 1	22 kW		
	flow E1	10 kW	40 kW	
	flow E2		100 kW	30 kW
	flow E3		150 kW (NEW)	

* in concept

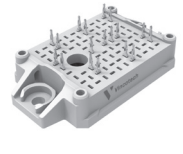

flow 0 housing

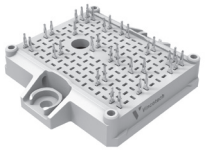

flow 1 housing


flow 2 housing


flow E3 housing


flow S3 housing


flow E1 housing

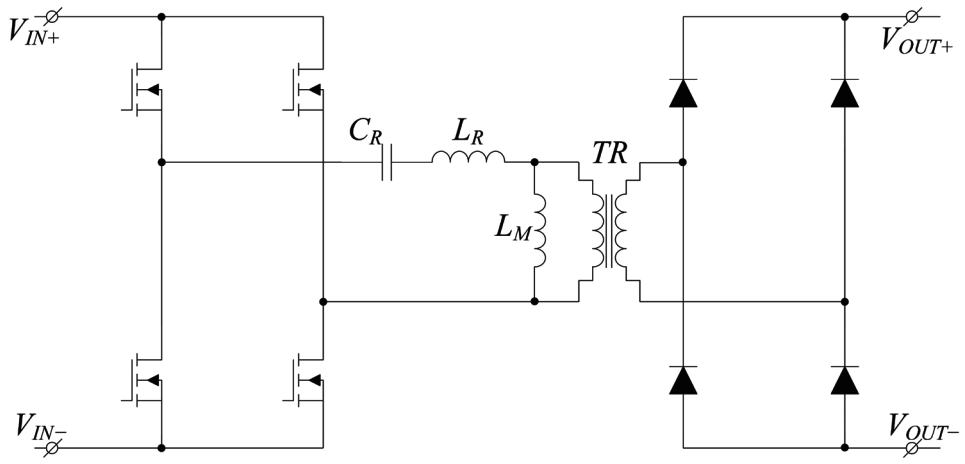

flow E2 housing

DC **FAST CHARGER**

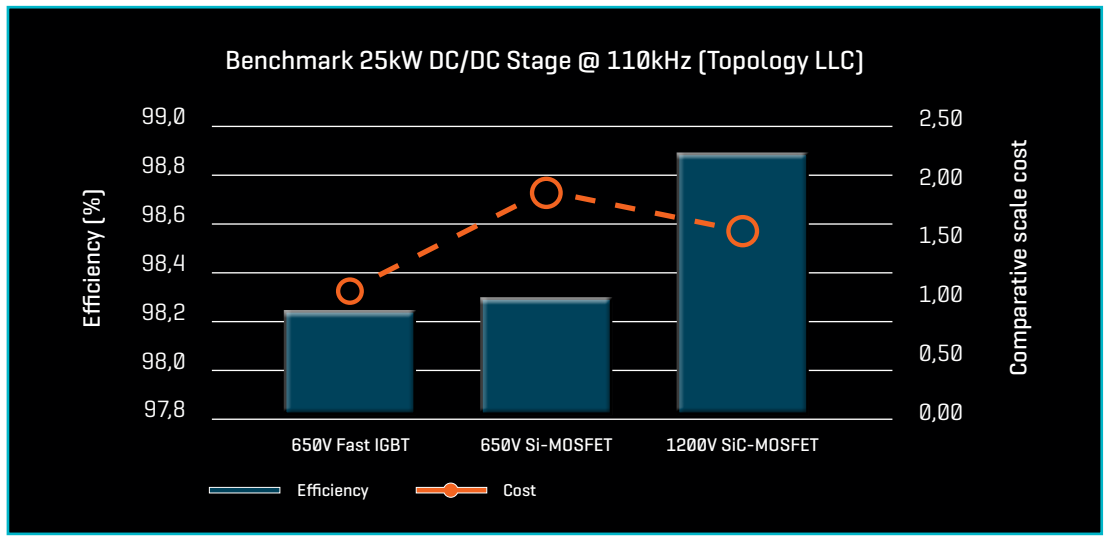
DC/DC Product Portfolio

The most frequently used topology in the isolated DC/DC conversion stage is the **full-bridge resonant LLC converter.** In this stage, **SiC MOSFET chip technology** is essential to meeting switching frequency (>100 kHz) and peak efficiency (>98.5%) requirements.

A 1200-V SiC MOSFET streamlines the topology by transitioning from a two cascaded interleaved LLC with 650V Si components to a single full-bridge LLC.



Full-bridge LLC converter with a full-bridge rectifier



If the application requires very high efficiency, the full-bridge (2-level) with 1200 V SiC-MOSFET would be the configuration of choice. The price decrease of this chip technology over the last years favours this option also from cost point of view

Vincotech *fast*PACK products

- Integrated DC capacitor to reduce voltage overshoot
- Kelvin emitter for better switching performance
- SiC MOSFET and fast IGBT chip technology for high-speed switching and greater efficiency
- Open or common emitter configuration
- High-power, low-inductive package

Wide H-bridge SiC MOSFET portfolio for the DC/DC primary stage

H-Bridge w/SiC MOSFET	*fast*PACK SiC		
	650 V	950 V	1200 V
flow 0		15 kW	10 kW
flow 1			(50 kW) *
flow E1			25 kW (NEW)
flow E2			50 kW

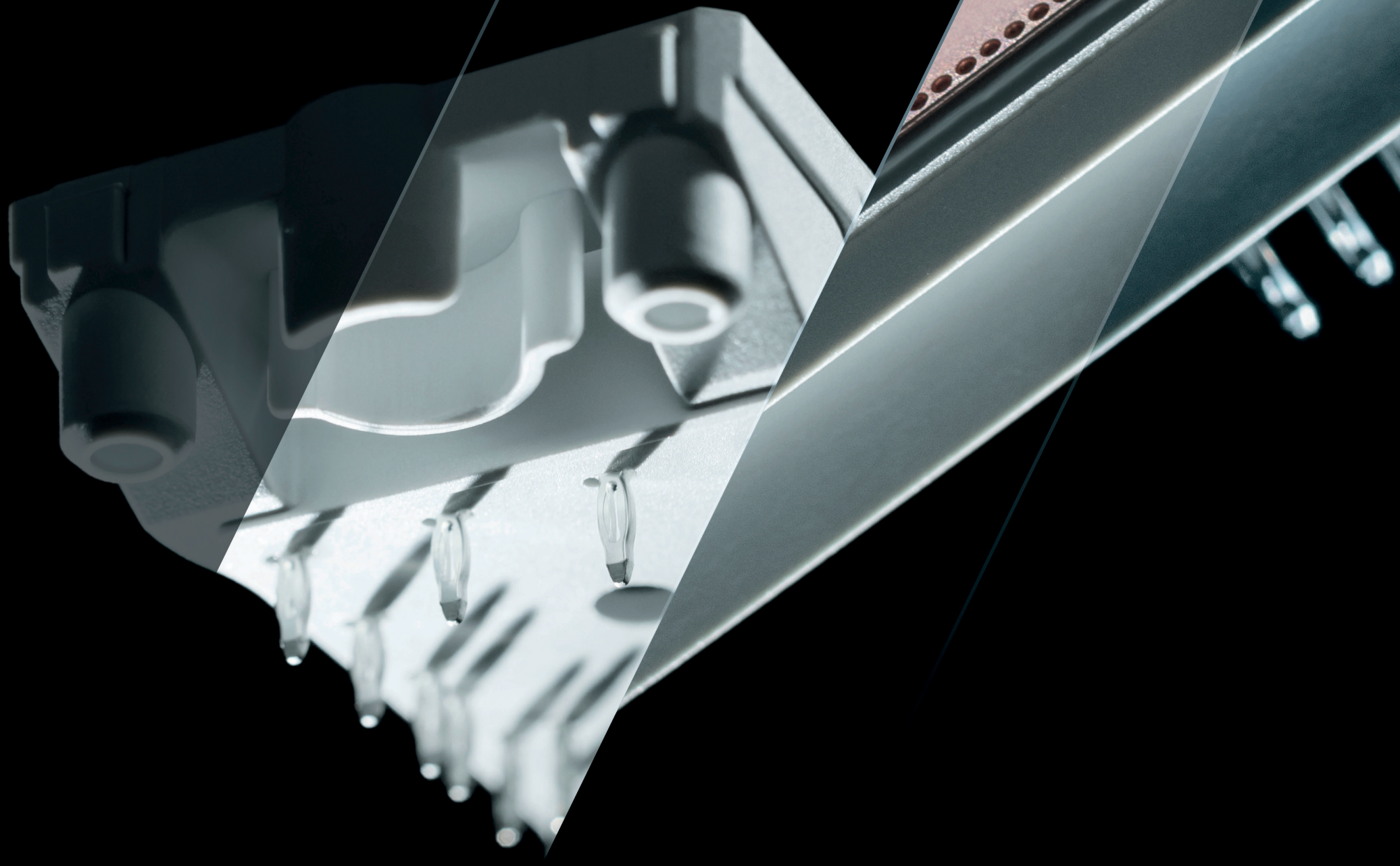
H-Bridge w/IGBT fast	*fast*PACK		
	650 V	950 V	1200 V
flow 0	22 kW (NEW)		22 kW (NEW)
flow 1	30 kW		22 kW (NEW)

Ultrafast rectifier-bridge portfolio for the DC/DC secondary stage

Rectifier-Bridge w/SiC Diode	*fast*PACK SiC		
	650 V	1200 V	1700 V
flow 0	15 kW		
flow 1	30 kW	50 kW (NEW)	
flow E1		25 kW	15 kW
flow E2		(50 kW) *	
flow S3		50 kW (NEW)	

Rectifier-Bridge w/ fast Diode	*fast*PACK		
	650 V		1200 V
			30 kW
	50 kW		

* in concept

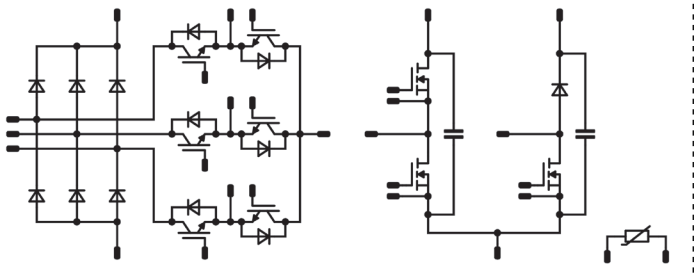


New *flow*CSPFC S3 SiC

- **New Current Synthesizing PFC (CSPFC) topology** for highest efficiency at lowest total system costs through
  - Reduced number of SiC devices
  - Reduced number and size of the PFC inductors
- **Latest SiC-MOSFET chip technology** for high speed switching and high efficiency up to 100 kHz and >99% respectively
- Bi-directional ready
- Thin Al_2O_3 substrate eases the system's thermal design
- Temperature sensor

B0-SP12CFA016ME-PD98G68T

flow S3 housing



New *flow*NPFC 1 SiC

- **Optimised layout/pinout** for SiC MOSFET use
  - Lower stray inductance
  - Optimal commutation loops
- **SiC MOSFET Gen3 chip technology** for high speed switching and highest efficiency

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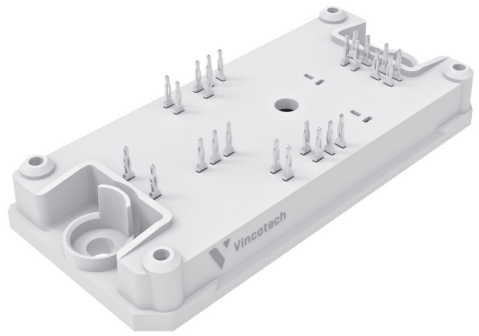
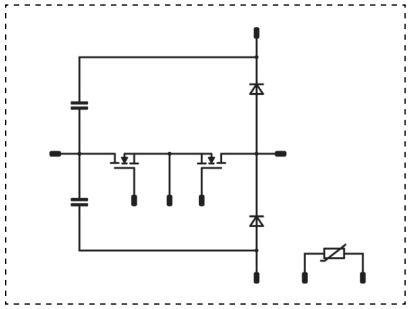
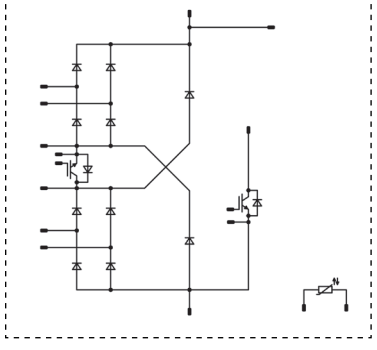




*fast*PACK S3 SiC

- Ready for 400 V and 800 V battery systems
- Latest generation SiC SBD for high switching and high efficiency
- Optional w/ or w/o discharge switch

B0-SP12ORA080RO-LM90J48T



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