

Vincotech

DC FAST CHARGING SOLUTIONS

EMPOWERING YOUR IDEAS

CHARGING THE **FUTURE**

- / The market for electric vehicles (EVs) has entered a phase of fast growth, boosted by global challenges like CO2 reduction and energy saving. Charging infrastructure is the backbone of this transition to e-mobility and the world is going to need a lot more of it in the near future.
- / But climate-friendly mobility is not just limited to passenger cars. Heavy-duty vehicles and also industrial vehicles have to be taken in consideration.
- / Vincotech with more than 25 years' experience in power modules offers a comprehensive product portfolio to cover all conversion stages and power ranges from as little as 5 kW up to megawatt [MCS] in a DC fast charger system architecture.



Vincotech's power modules are well established in many DC charger applications from EV charger and industrial charger key manufactures who benefit from:

- / 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
- / High performance substrates for higher lifetime
- / Press-fit pins and pre-applied TIM to help reduce production cost

Key Trends and 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 - For commercial vehicles like trucks and busses for long-haul trips on the move charging availability of 45min will be needed which will require >1 MW chargers





500 V → 1000 V → 1500 V



Reliability - More challenging mission profiles

Modular Design

- For >30 kW the modular design is more dominant than the monolithic design approach, giving the benefits of high design flexibility

- Several 30 kW or 50-to-60 kW charger modules are connected in parallel to deliver the desired amount of power

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 role to achieve this goal - 3% efficiency improvement will save 2.1 billions kWh electricity per year*

DC FAST CHARGER, AC/DC Stage



There are several three-phase PFC topologies available which can be addressed with multiple three-level and 2-level topologies with pros and cons in terms of efficiency, costs and design complexity. Each of these topologies will influence:

- / The blocking voltage rating of the semiconductors, e.g. 650 V or 1200 V and as a result, the switching losses and the efficiency
- / The total system costs, e.q. PFC inductor size and costs
- / The thermal management, e.g. heat sink size
- / The design, e.q., uni- or bi-directional. For bi-directional charging the three-level SPFC and NPFC are suitable by replacing the boost diodes with switches, and the two-level sixpack per se

Two-Level Topologies





Product Line *flowDUAL SiC*

Product Line *flowPACK SiC*

Three-Level Topologies





Product Line flowNPFC SiC / flowMNPC SiC

Product Line *flowANPFC SiC*

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Product Line flowSPFC SiC
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Comprehensive 2L and 3L PFC Portfolio for the AC/DC Stage

Housing	NPFC/MNPC	ANPFC	SPFC
flow 0	-650 V/75A,100A IGBT H5, with 1200 V fast Si Diode or SiC SBD -650 V/45 mOhm SiC MOSFET -Up to 30 kW application power	-650 V/100A IGBT fast, with 1200 V fast Si Diode or SiC SBD -Up to 30 kW application power	-650 V/50A,75A,100A IGBT H5/S5, with 1200 V fast Si Diode -Up to 22 kW application power
flow 1	-650 V/100A IGBT S5, with 1200 V SiC SBD -650 V/15 mOhm SiC MOSFET -Up to 60 kW application power	-650 V/100A IGBT fast/S5 with 1200 V SIC SBD -650 V/15 mOhm SIC MOSFET* -Up to 50 kW application power	-650 V/15 mOhm SiC MOSFET* -Up to 50 kW application power
flow E2	-650 V/15 mOhm SiC MOSFET -1200 V/11 mOhm SiC MOSFET -Up to 60 kW application power		
flow E3	-3xNPFC/MNPC 650 V/15m0hm* -Up to 50 kW application power		

Housing	Half-bridge	6PACK	
flow 1		-1200 V/42 m0hm-10 m0hm SiC M0SFET -Up to 40 kW application power	
flow S3	–1200 V/3 m0hm, SiC M0SFET* –Up to 120 kW application power		
flow E1	–1200 V/32 m0hm,21 m0hm,15 m0hm,10 m0hm SiC M0SFET –Up to 40 kW application power	-1200 V/75 mOhm,32m Ohm SiC MOSFET -Up to 20 kW application power	
flow E2	–1200 V/10 m0hm,8 m0hm,5 m0hm SiC M0SFET –2300 V/8 m0hm,6 m0hm,5 m0hm SiC M0SFET –Up to 350 kW application power	–1200 V/20 m0hm,11 m0hm SiC M0SFET –Up to 35 kW application power	
flow E3	–1200 V/2 m0hm SiC MOSFET –Up to 150 kW application power		



flow 0/1

/ Baseplate-less housing / Convex shaped substrate for superior

- thermal contact / Flexible pin arrangement for optimal
- and low inductive design / Optional features like integrated DC link
- capacitors for overvoltage mitigation / Solder pin or Press-fit pins for solder less connection to PCB
- / Pre-applied PC-TIM rated for 150°C

flow S3

- superior thermal performance with

 - 1
 - / Solder pin or Press-fit pins for solder
 - / Pre-applied PC-TIM rated for 150°C
- Compact baseplate-less housing VINcoPress technology aimed for
 - improved reliability Flexible pin arrangement for optimal
 - and low inductive design Optional features like integrated DC link
 - capacitors for overvoltage mitigation
 - less connection to PCB

*in concept phase

Voltage and current Rdson are reffered to the main device of the topology Application power: Assuming a typical charging operation point: Vin 230 V, Vdc 800 V, fsw 40 kHz, Ths 80°C

flow E1/E2/E3

- / Baseplate-less standard industry housina
- / flow E1/E2 with convex shaped substrate for superior thermal contact
- / flow E3 with VINcoPress technology aimed for superior thermal performance with improved reliability
- / Optional features like integrated DC link capacitors for overvoltage mitigation
- / Solder pin or Press-fit pins for solder less connection to PCB
- / Pre-applied PC-TIM rated for 150°C

DC FAST CHARGER, DC/DC Stage



For the DC-DC power conversion stage mainly isolated topologies are employed, like the full-bridge or three-phase LLC resonant converter, and the full-bridge phase-shift DAB. The first one is a pure frequency modulated configuration and the second one operates with PWM.

In this stage, SiC MOSFET chip technology is essential to meet 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 650 V Si components to a single full-bridge LLC.





Product Line 6Pack flowPACK SiC New Product Line Ultrafast Rectifier flowCON SiC

fastPACK SiC and New flowCON SiC Product Line for the DC/DC Stage

Housing	H-Bridge	2ph Ultrafast Rectifier	3ph Ultrafast Rectifier
flow 0	-1200 V/75m0hm,32m0hm SiC MOSFET Gen3 and Gen4 -950 V/35m0hm,16m0hm SiC MOSFET Gen3 -650 V-750 V/45m0hm,20m0hm SiC* MOSFET Gen3 and Gen4	-650 V/20 A SiC SBD	
flow 1	–1200 V/11m0hm SiC MOSFET Gen3* –650 V-750 V/11m0hm SiC* MOSFET Gen3 and Gen4	-1200 V/60 A,100 A,120 A Si fast diode and 60 A,80 A,100 A SiC SBD -650 V/160 A Si fast diode and 60 A,80 A,100 A SiC SBD	- 650 V/70 A Si fast diode
flow E1	-1200 V/32m0hm,16m0hm SiC MOSFET Gen3 -650 V/21m0hm,16m0hm SiC MOSFET Gen3	-1200 V/10 A,30 A SiC SBD	
flow E2	-1200 V/16m0hm,11m0hm SiC MOSFET Gen3 -750 V/20m0hm SiC MOSFET Gen4	-1200 V/80 A SiC SBD*	- 1200 V/40 A SiC SBD
flow S3		-1200 V/80 A SiC SBD	

/ Convex shaped substrate for superior

/ Flexible pin arrangement for optimal

/ Optional features like integrated DC link

capacitors for overvoltage mitigation

flow 0/1

/ Baseplate-less housing

and low inductive design

/ Solder pin or Press-fit pins for

solderless connection to PCB

/ Pre-applied PC-TIM rated for 150°C

thermal contact

flow S3

- / Compact baseplate-less housing
 / VINcoPress technology aimed for superior thermal performance with
- improved reliability / Flexible pin arrangement for optimal
- and low inductive design / Optional features like integrated DC link
- capacitors for overvoltage mitigation / Solder pin or Press-fit pins for
- solderless connection to PCB / Pre-applied PC-TIM rated for 150°C



flow E1/E2

- / Baseplate-less standard industry housing
- / Convex shaped substrate for superior thermal contact
- / Optional features like integrated DC link capacitors for overvoltage mitigation
- / Solder pin or Press-fit pins for solder less connection to PCB
 / Pre-applied PC-TIM rated for 150°C
- Pre-applied PC-IIM rated for 150°C





New Optimized Pin-out Features

- / Shorter DC+ to GND and DC- to GND distance
- / Lower stray inductance
- / Optimal commutation loops
- / Symmetrical and short commutation loops with balanced operation in pos and neg half period
- / Symmetrical gate commutation loops
- / Easy to add separated gate resistance

10-FY07LBA100S5-PG08J58T

- / For uni-directional charger
- / Cost-efficient hybrid solution with 650 V Trenchstop[™] 5 IGTB and 1200 V SiC boost diode



10-PY07LBA015ME-PG08J68T

/ For uni-directional charger / High efficient SiC solution with 650 V SiC MOSFET and 1200 V SiC boost diode

/ Optimized for 1500 Vdc applications addressing maximum power density and greater scalability

flowDUAL E2 /E3BP SiC for Application Power up to 300 kW

/ Reduced system complexity by enabling 2-level operation with 1500 V DC link voltage

P/N: 10-EY232PB008ME01-PN97F08T

Product line: flowDUAL E2 SiC Technology: Gen4 SiC MOS Voltage: 2300 V Rdson: 8m0hm Substrate: ALN

P/N: 30-EP232PB004ME01-PR09F07T

Product line: flowDUAL E3BP SiC Technology: Gen4 SiC MOS Voltage: 2300 V Rdson; 4m0hm Substrate: Al203

Features

- / Latest SiC MOSFET technology with high blocking voltage and low on-resistance
- / High speed switching with low capacitance
- / Advanced solder technology
- / High thermal conductive ceramic ALN substrate
- / CTI >600 housing material
- / Available with pre-applied 150°C rated phase-change material



10-PY12NMD016ME-PG08F18T

/ For bi-directional charger / High efficient solution with 650 V/1200 V SiC MOSFET

flowMNPC E2 SiC Product Line





10-EY12NMA016ME-LS28F16T 10-EY12NMA011ME30-LS28F18T

/ For bi-directional charger / High efficient SiC solution with 650 V SiC MOSFET and full 1200 V SiC MOSFET







Additional information:

Link to highlight page: https://highlights.vincotech.com/EVchargers/

Link to product page: https://www.vincotech.com/products/by-application/charging-stations.html

Link to video: https://www.vincotech.com/news/videos/free-the-power-of-your-ev-charger.html





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