POWER ELECTRONICS FOR E-MOBILITY

SEMIKRON DANFOSS

E-Mobility

Power Electronics for
On- and Off-Highway Vehicles

On-Highway Vehicles

Semikron Danfoss offers more than 20 years of experience and know how in automotive applications. The power module is a key differentiator for an efficient and robust EV drivetrain. As a technology leader, Semikron Danfoss aims to maximize the potential of semiconductors. With our two automotive power module platforms, eMPack and DCM, we offer highly scalable solutions for light duty to heavy duty traction inverter applications.

For the truck and bus market, Semikron Danfoss also offers complete Skai inverter systems. Our SiC and Si-based SKAI HV inverters set the benchmark for power density and offer the highest level of robustness.

Passenger Cars/Light Duty

Power Modules for Electric Drive Train
eMPack

Power Modules for Electric Drive Train
DCM

Trucks and Buses/Heavy Duty

Inverters for Electric Drive Train
SKAI HV

Power Modules for Electric Drive Train
eMPack

Power Modules for Electric Drive Train
DCM

Off-Highway Vehicles

The off-highway vehicles segment today comprises primarely the traditional material handling market where battery operated vehicles like fork-lifts have been well established for decades. Semikron Danfoss has been serving this market for more than 20 years and offers complete SKAI inverter systems for low voltages as well as for voltages of 800V_{DC}. The light electric vehicle market, a highly fragmented market with power ranges of up to around 40kW, includes two-weelers, small delivery trucks, recreational/neighbourhood vehicles and many more smaller, yet fast growing niches.

The SKAI low voltage inverter is the dedicated product for these applications.

The electrification of vehicles in the agriculture, forestry and construction sector, in contrast, is still its infancy. There is, howerver, susbstantial potential for this area to grow in the future thanks to the costs benefits of battery driven funtions. SKiM 93 power modules are the ideal choice for traction drives, while our SKAI HV inverters, which can incorporate auxiliar funtions as well, are suitable for higher integration levels. This off-highway electric vehicle segment typically relies on industrial standard products.

Material Handling

Inverters for Electric Drive Train up to 96V_{DC}
SKAI LV

Agriculture, Forestsry and Construction

Inverters for Electric Drive Train
SKAI HV

Inverters for 48V board net
SKAI LV

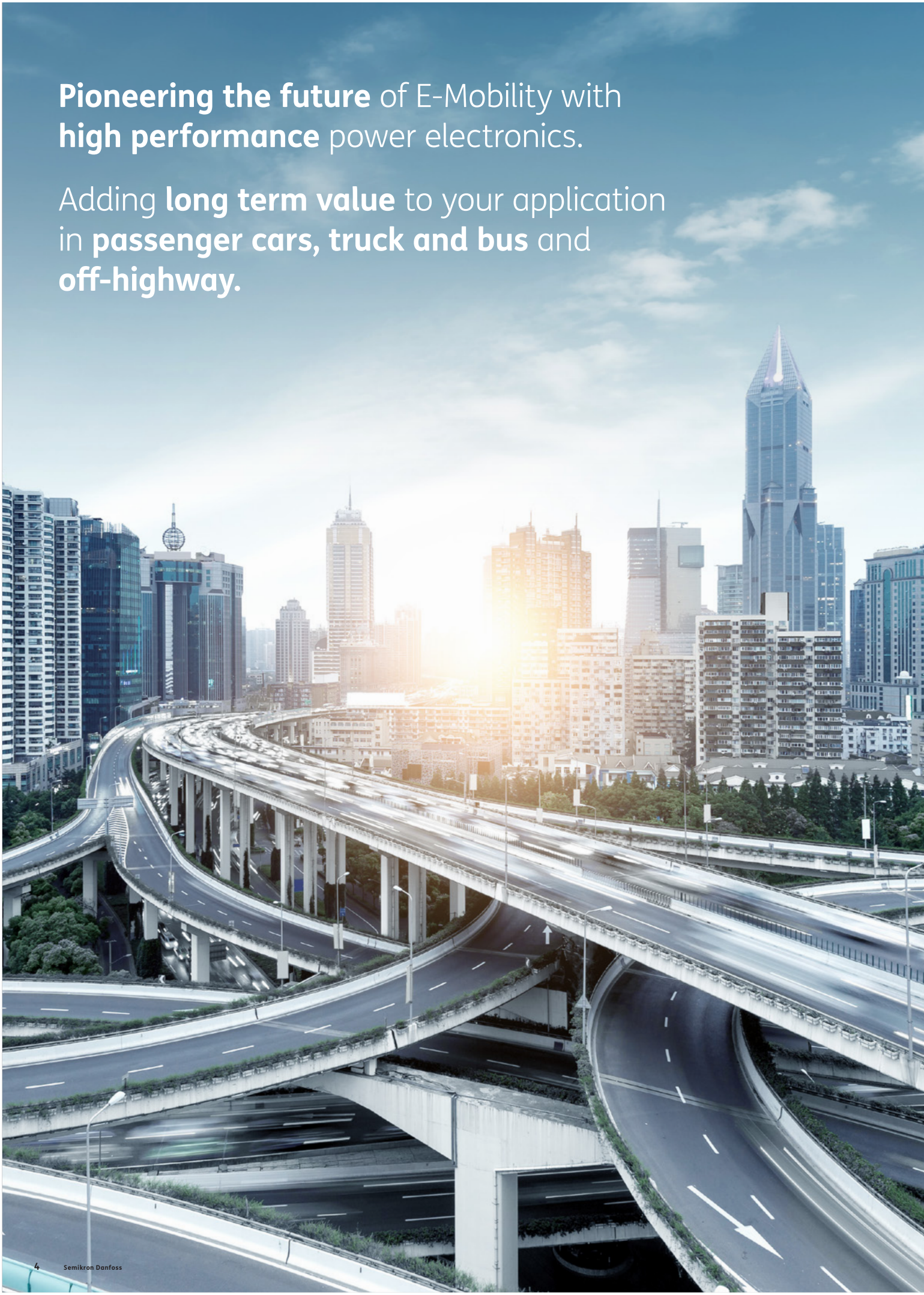
Power Modules for Electric Drive Systems
SKiM 93

Light Battery Vehicles

Inverters for Electric Drive Train up to 96V_{DC}
SKAI LV

Pioneering the future of E-Mobility with **high performance** power electronics.

Adding **long term value** to your application in **passenger cars, truck and bus** and **off-highway.**



Product Portfolio
Power Modules

Shower Power® Technology

Bond Buffer® Technology

DCM™

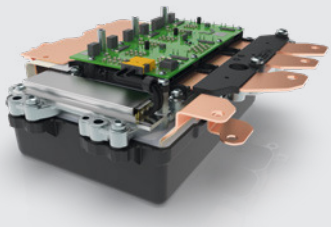
Flexible Design through Customization
Si IGBT and full SiC MOSFET technology
750V / 1200V half-bridge design for up to 900 A_{RMS}
Bond Buffer Sintering Technology for high reliability
Low thermal resistance thanks to ShowerPower®3D
Robust molded module packaging, low warpage and reliable mechanical integration
Highest power density
Multisourcing thanks to chip independency

Direct Pressed Die Technology®

eMPack®

High Performance Package for e-mobility
Optimized for SiC MOSFET technology
750V / 1200V Sixpack compatible package for up to 900A_{RMS}
Double Sided Sintering package for automotive grade reliability
Low thermal resistance thanks to Direct Pressed Die Technology
Flexible cooler arrangements
2.5nH package stray inductance including terminals
Multisourcing thanks to chip independency

Product Portfolio
Power Electronic Systems



SKAI® HV

Power Electronics for On- and Off-Highway Vehicles up to 950V_{DC}
Suitable for battery voltages up to 950V_{DC}
Sintered power semiconductors
Phase current up to 600A_{RMS}
Apparent power up to 500kVA

SKAI® LV

Inverter for Vehicles up to 120V
Power platform for utility and light electric vehicles
For compact designs
30kVA/l power density
$V_{battery}$:24V_{DC} up to 96V_{DC}
600A_{RMS} peak current during acceleration
Easy-to-use gate driver
IP66 enclosure

DCM™ and eMPack®

In passenger car applications, power electronics have to rise to considerable challenges: they must be compact and efficient, while remaining robust and reliable under the changing conditions that occur during cold start and repeated acceleration and deceleration. Semikron Danfoss offers a wide range of products that rise to the occasion in any application in the automotive sector, be it battery-powered electric vehicles, mild hybrids, plug-in hybrids or other hybrid drive vehicles.

Our dedicated automotive portfolio includes power modules and integrated converter/inverter systems that are often based on innovative semiconductor technologies such as silicon carbide (SiC), significantly improving efficiency in standard passenger vehicle applications in comparison to silicon-based technology (IGBTs).

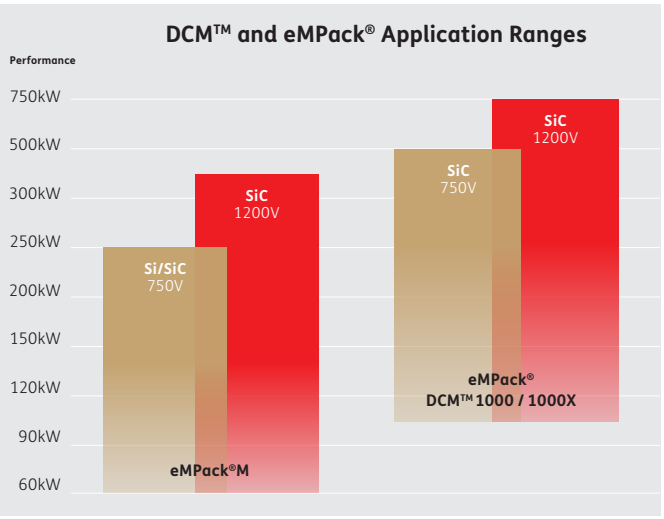
Two Leading Power Module **Platforms**

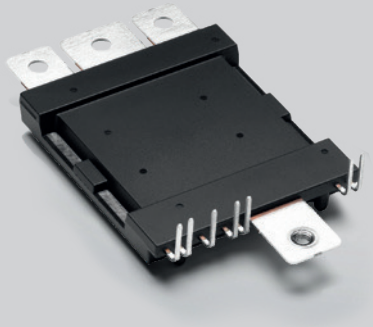
Semikron Danfoss' new power module platforms DCM and eMPack, which are both based on a highly scalable module concept, are developed for EDS inverter architectures covering a power range from 100kW up to 750kW. Both platforms cover 400V and 800V battery system applications. The combination of Silicon Carbide technology with our fully sintered and lowest stray inductance enable unmatched power densities combined with high reliability for automotive application.

As chip independent power module manufacturer, we are able to provide latest performance standards, reduced risks and increased supply security.

Product Features

High-efficiency SiC technology
Ultra-low stray inductance
Superior reliability in a fully sintered package
Dedicated configurations for all BEV power ranges
Compact package





DCM™

750V up to 1200V
500 to 800A_{RMS}

eMPack®

750V up to 1200V
~ 300 to + 1000A_{RMS}

DCM™

The DCM technology platform is designed to be scalable. In the same package, we can scale the power up or down to meet different inverter voltage classes with blocking voltages of 750V-1200V, while having different output currents from 200A to 900A.

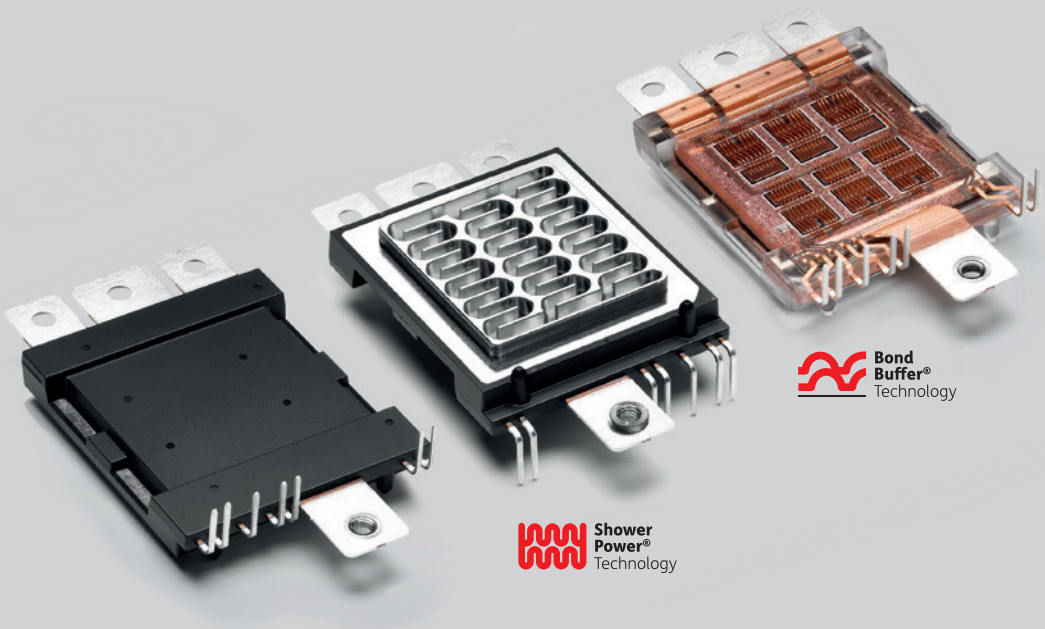
Furthermore, our power modules are based on quality components, patented packaging and cooling technologies to achieve outstanding, measurable results in terms of reliable performance and robustness – all adding up to ensure a cost-effective solution that lasts. Our certified processes assure for consistent high quality and streamlined path from development to volume manufacturing.

Product Features

Highest flexibility in design, customized interfaces
Scalable across voltage classes
Advanced bonding technologies for highest power cycling robustness
High power density
Robust molded module packaging
Direct liquid cooling with ShowerPower 3D

DCM™

100kW up to 750kW



eMPack®

The transition of complete car platforms to full electric battery vehicle architectures is progressing rapidly. These architectures will demand scalable power electronics solutions for Electric Drive Systems (EDS) that are capable of realizing a wide performance range in an economic way, resulting in competitive advantage to vehicle manufacturers.

Semikron Danfoss' new power module platform eMPack, which is based on a common module concept, is being developed for EDS inverter architectures covering a power range from 100kW up to 750kW. eMPack covers 400V and 800V battery system applications. The combination of Silicon Carbide technology with our fully sintered, low stray inductance Direct Pressed Die Technology enables unmatched power densities combined with high reliability for automotive application.

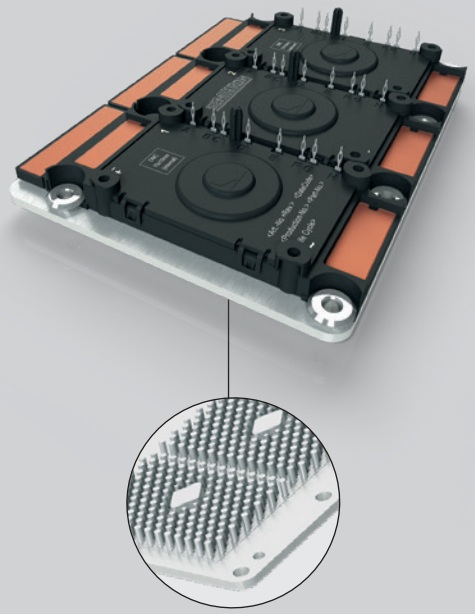
Product Features

- High-efficiency Si and SiC technology
- Ultra-low stray inductance
- Superior reliability in a fully sintered package
- Dedicated configurations for all BEV power ranges
- Compact package

eMPack®

100kW up to 750kW

Direct Pressed Die Technology®



PINFIN cooler option

Customer-specific cooler options, e.g. closed aluminium cooler

SKAI® LV

More and more utility vehicles such as forklift trucks now run on electric power. In fact, what was once state of the art for indoor vehicles, is now increasingly finding its way into outdoor vehicles, as powertrain electrification continues to advance and enter new vehicular applications. Today, power electronic systems are as commonplace in motorbikes, quads and other light electric vehicles as they are in agricultural and construction vehicles.

The SKAI LV converter/inverter system is a platform solution that is designed for use in combination with existing or optimized controller systems, enabling the quick development of optimized, cost-efficient custom solutions for utility and light electric vehicles. The compact design of the SKAI LV makes it the right fit for use in industrial forklift trucks as well as in other industrial or road vehicles.

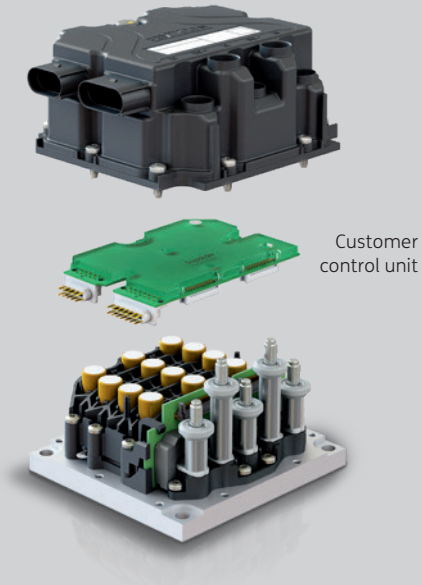
Ultra Compact MOSFET Inverter Platform

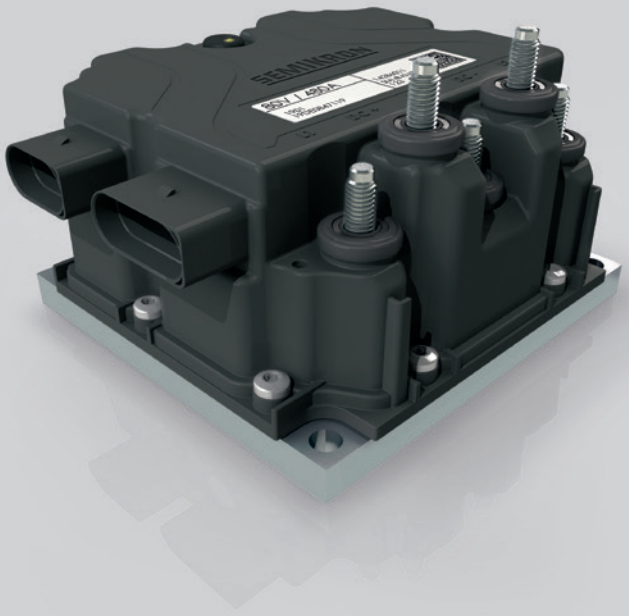
The SKAI LV is a platform for low-voltage inverter systems for on- and off-road applications. This platform constitutes the 3rd generation of low-voltage inverter systems and the 7th generation of MOSFET inverter technology developed by Semikron Danfoss, with more than 2 million MOSFET inverters in the field.

To create an optimized application-specific motor control system, simply integrate a customized control board. The SKAI LV platform is based on the same power-technology found in high-voltage, high-reliability applications today, providing access to high-power, maximum reliability technologies across a wide range of low-voltage on and off-road applications.

Product Features

- Voltage, current and temperature sensors
- Gate driver with protection
- Low inductance, low loss power section
- DC link capacitors
- Air and plate cooling
- Easy-to-use gate driver interface
- Platform for customised designs





SKAI® LV

MOSFET Inverter System up to 55kVA

SKAI® HV

Hybrid electric or all-electric buses are already in widespread use in our cities today and are an effective way of reducing pollutant emissions or avoiding them altogether. This move towards cleaner mobility is also being seen in trucks, with more and more manufacturers introducing hybrid electric or all-electric trucks to their fleets.

In heavy-duty off-road utility vehicles such as construction site vehicles and agricultural machinery, the power electronics are exposed to particularly harsh ambient conditions. They have to be ultra-compact and lightweight, while exhibiting good vibration, impact, and shock resistance in order for them to work reliably on uneven terrain. They have to be able to work at both very low and very high ambient and coolant temperatures and boast excellent thermal and power cycling capabilities at the same time.

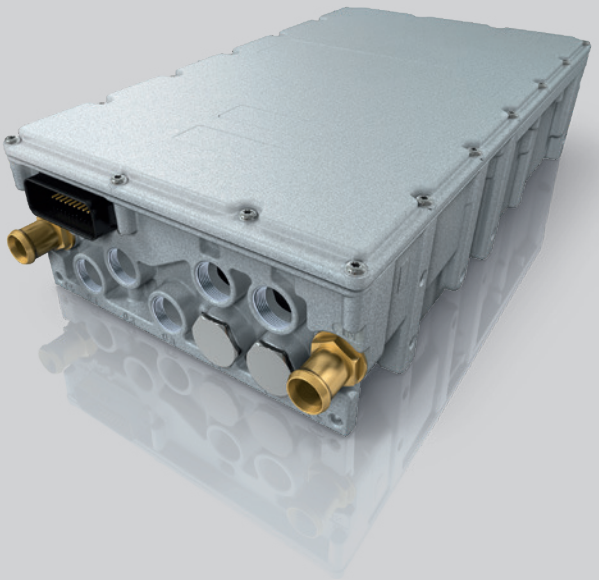
Compact Power Electronic System

SKAI HV comprises a versatile 3-phase power electronic platform designed for use in electrified vehicles. It covers key requirements such as high power density and exceptional ruggedness.

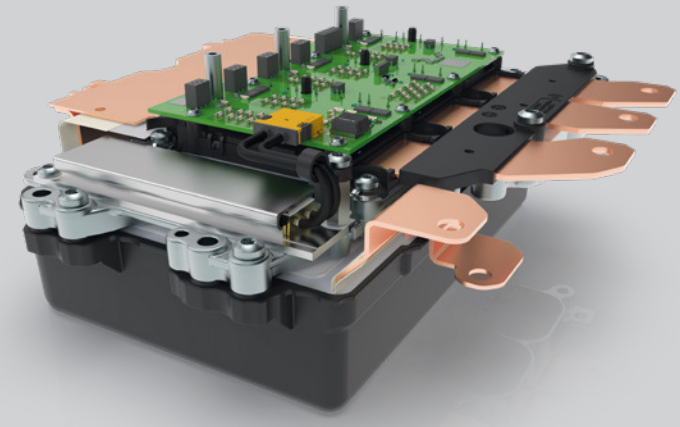
The products are designed to operate with supply voltages of up to $950V_{DC}$ and with output power ratings of up to 500kVA. The IGBT based SKAI 2 HV+ operates with single side sintered, AlCu bonded and 100% solder free 1200V power semiconductors whereas the SKAI 3 HV Power Core utilizes double side sintered silicon carbide based MOSFETs. All SKAI HV products feature polypropylene film DC-link capacitors. The integrated coldplate enables efficient liquid cooling. The SKAI 2 HV+ is designed for chassis assembly in commercial vehicles, whereas the SKAI 3 HV Power Core can be directly integrated into an e-axle.

Product Features SKAI 2 HV+
Single Side Sintered IGBT power semiconductors
DC-link capacitor
Liquid cooled coldplate
Gate driver with protection functions
DC Voltage, current and temperature sensing
Micro Controller
EMI filters
IP67 enclosure

Product Features SKAI 3 HV Power Core
Double Side Sintered Silicon Carbide based MOSFETS
DC-link capacitor with active discharge function
Liquid cooled coldplate



SKAI® 2 HV+
Up to 300kVA



SKAI® 3 HV Power Core
Up to 500kVA


SEMIKRON
DANFOSS

Helping Your Business Use Our Products

Application Expertise is our Strength

Being able to access service, technical support and experts that our customers can always rely on is instrumental to our customers' success.

Today, increased product diversity in power semiconductors calls for customer support far beyond the information contained in data sheets. Only comparison under application-specific conditions – such as voltage, switching frequency or cooling conditions – can demonstrate the differences in performance of available devices. That's why we continue to invest in our professional application engineering support, including lab space and reference designs.

Customize your Power Solution

Besides standard configurations, Semikron Danfoss also offers customer specific topologies in various housings, addressing the market need for innovation and differentiation.

It allows us to provide an unmatched flexibility in power module designs. Our highly skilled and specialized engineers at Semikron Danfoss work closely with you to design power modules for your specific drivetrain design, allowing you to scale your power solution according to your specifications.

In recent years, we have built a network comprising 24 sites across the globe to provide fast, comprehensive application support. Our application engineering teams work with our customers both locally and globally. throughout the entire project life cycle. We strive to understand and help our customers overcome both big and small challenges throughout their projects. For example, we conduct topology studies to fully understand the advantages in the end user application and carry out benchmark investigations when needed. It is this application-centred approach that sets us apart from others.

How can Semikron Danfoss help you with Inverter Design?
Application and performance calculations
DC link design and capacitor selection
Isolation coordination
Lifetime calculations
Measurement support
Application samples and reference designs

THE ULTIMATE PARTNER IN POWER ELECTRONICS

Semikron Danfoss is a global technology leader in power electronics. Our product offerings include semiconductor devices, power modules, stacks and systems. In a world that is going electric, Semikron Danfoss technologies are more relevant than ever. With our innovative solutions for automotive, industrial and renewable applications we help the world utilize energy more efficiently and sustainably and thus to significantly reduce overall CO_2 emissions – facing one of the biggest challenges today. We take care of our employees and create value for our customers by investing significantly in innovation, technology, capacity, and service to deliver best-in-industry performance and for a sustainable future.

05/2025

SEMIKRON DANFOSS

Semikron Danfoss GmbH
Husumer Strasse 251
24941 Flensburg, Germany

Semikron Danfoss International GmbH
Sigmundstrasse 200
90431 Nuremberg, Germany

www.semikron-danfoss.com