

POWER ELECTRONICS FOR TRACTION APPLICATIONS



Traction



Performance Range

Whenever we talk about traction applications, we see extremely high demand for reliability, lifetime and safety. Semikron Danfoss is offering this requirements to our customers since we developed the first isolated power module on the market in 1974. For 25 years, our highly reliable SKiiP IPMs are driving light rails, trams and subways all over the world.

With our new SEMITRANS 20 power module family, Semikron Danfoss brings latest sinter and bonding technology to the new high power standard package. Semikron Danfoss stands also for innovative solutions for auxiliary power supplies: our silicon and silicon carbide powered devices, especially the SEMITRANS and SEMITOP module families, allow reliable, efficient and compact systems.



AUXILIARY POWER SUPPLY

5kW - 500kW

Compact designs and high power density

High reliability in harsh environments

High power quality

High efficiency

Products

SEMITOP E1/E2

MiniSKiiP

SEMiX 3 Press-Fit

SEMITRANS

SEMITRANS 10

SEMITRANS 20

Drivers

MAIN TRACTION DRIVE

500kW - 10MW

Highest reliability and lifetime

High power cycling capability

Long lifetime and availability

Products

SEMITRANS 10

SEMITRANS 20

SEMIPACK

SKiiP 3/4 IPM

Drivers



The New **High Power Standard** in Traction Drives

The SEMITRANS 20 product family increases product lifetime and power output. SEMITRANS 20 modules deliver significant advantages for the traction market:

- A simplified inverter design leads to reduced costs for mounting materials as well as in the inverter assembly process
- More space for driver boards and less EMC disturbance from high current bus bars to the driver
- Three AC terminal connectors for low operating temperatures even at high loads
- Less de-rating at parallel operation thanks to the low inductance bus bar layout and the extremely low module inductance
- Ideal for cost-effective inverter design and scaling

On top of this, the SEMITRANS 20 TRACTION module provides Semikron Danfoss innovative technologies such as sintered chips and AlCu wire bonds. This takes reliability and power density to new levels, resulting in:

- Superior product lifetime
- Lower cost per kW and
- Higher power density

Key features

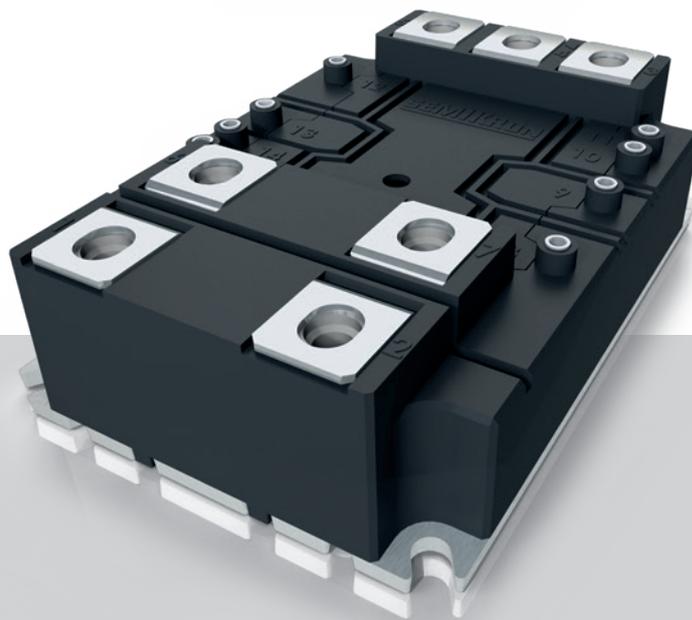
Standard package for traction and industrial applications

Innovative technologies with sintered chips and AlCu wire bonds

Next level lifetime and power density

Lower mounting and material cost in inverter assemblies

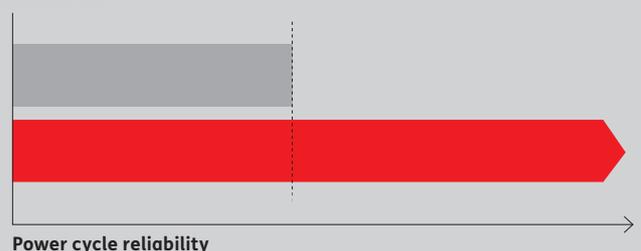
Ideal for paralleling and scaling



SEMITRANS® 20
1.7kV half-bridge module

Conventional
Traction

**SEMITRANS 20
TRACTION**



PRODUCT HIGHLIGHT

SiC and Hybrid SiC Modules for Auxiliary Power Supplies

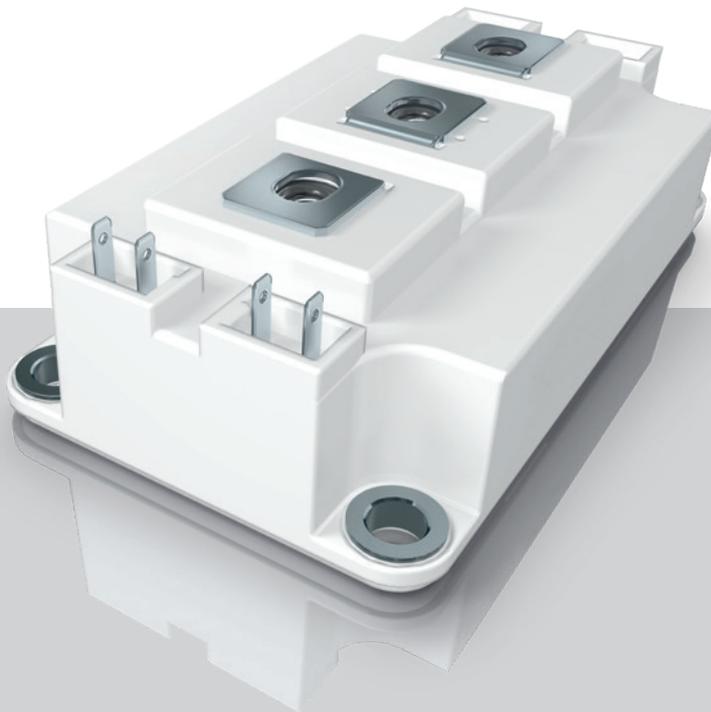
The SEMITRANS 3 product family is growing with its new Full and Hybrid SiC half-bridge modules in 1200V and 1700V. This new portfolio extension allows highly efficient auxiliary power supplies. Due to the high switching frequency of the silicon carbide devices, the size of the passive components can be reduced, and inaudible to the human ear, allowing reduced acoustic insulation.

The decreased losses reduce service and maintenance costs, thanks to passive cooling of the power electronic components.

Multiple sourcing down to chip level ensures maximum supply chain safety.

Benefits of SiC technology in auxiliary power supplies

- High switching frequencies >20kHz are not audible to human ear
- Low switching losses allow passive cooling for reduced maintenance
- Dramatically reduced filter size thanks to high switching frequencies
- Dramatically reduced transformer size of DC/DC converters
- In total smaller size and volume of complete auxiliary converter



SEMITRANS® 3

1.2kV and 1.7kV SiC and Hybrid SiC modules



MiniSKiiP®

8kW up to 300kW

Solder-free spring technology for minimum assembly time

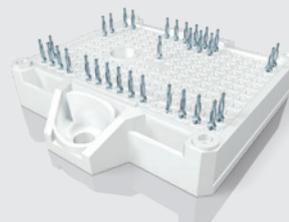
Full family of power modules up to 110kW

650V / 1200V / 1700V IGBT: 4A to 400A

1200V Hybrid SiC: 50A to 150A

Comprehensive set of topologies: CIB, sixpack, twelvepacks, H-bridge, half-bridge, 3-level, bridge rectifiers with brake chopper

Easy and flexible PCB routing without pin holes



SEMITOP® E1/E2

8kW up to 225kW

Exceeding the standard for superior performance

PCB based and press-fit connected baseplate-less industry standard power module in two housing sizes

650V and 1200V: 10A to 100A

IGBT 4 and IGBT T7

CIB and sixpack topologies

Optimised mounting concept and pre-applied High Performance Thermal Paste provide lowest thermal resistance in class

Increased power density thanks to Generation 7 IGBT T7

Hybrid and full SiC modules up to 1200V/250A

Product Portfolio

IGBT and Rectifier Modules



SEMIPACK®

800V up to 2200V

Bipolar modules from the market leader

Industrial standard thyristor/diode modules

Market experience for over 40 years

Broad power and topology range

800V up to 2200V

15A up to 1360A

Un-, half- and full-controlled rectifiers

SiC Schottky Diode modules up to 300A



SEMIX®3 Press-Fit

55kW up to 350kW

Exceeding the standard for superior performance

Industry standard press-fit design with 17mm high housing

650V/1200V/1700V IGBT: 225A to 700A

1200V Hybrid SiC: 600A

Direct driver assembly

Solder-free contacts for highest durability

Increased power density thanks to Generation 7 IGBT M7

Available with integrated shunt resistor



SEMITRANS®

5kW up to 200kW

The proven power electronics package

Robust industry standard package for multiple sourcing in 6 housing sizes

600V/650V/1200V/1700V IGBT: 25A to 900A

1700V SiC: up to 260A

Half-bridge, single switch and brake chopper topology

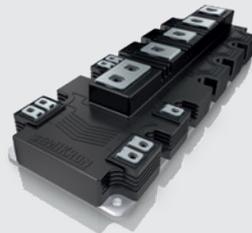
Multiple IGBT sources including Generation 7 IGBT M7

Increased power range in 62mm thanks to portfolio extension in 1200V and 1700V

half-bridges:

1200V/600A

1700V/500A



SEMITRANS® 10

200kW up to 1MW

Robust high power module

Established high power module package

1200V IGBT: 1400A

1700V IGBT: 1000A and 1400A

Half-bridge and split NPC topologies

Latest Generation 7 IGBTs for

for 3-level NPC modules



SEMITRANS® 20

200kW up to 1MW

The new standard in high power

The latest standard power module for high power traction inverters

1200V: 1400A

1700V: 1000A and 1200A

Half-bridge and brake chopper topology

Low stray inductance, high power density package

Increased reliability thanks to the latest packaging technology



Intelligent Power Modules – IPMs

For Maximum Reliability

The SKiiP IPM product line sets a benchmark for high performance and robust inverter designs. Both SKiiP 3 and SKiiP 4 feature high power densities combined with flexible cooling options such as air- or water cooling, also with customized heat sinks. Reliable driver technology, integrated current sensors and comprehensive protection functions complete the IPM design.

SKiiP 3 has propagated widely through the industrial drive segment. With its sixpack or half-bridge topologies, it covers a current range from 500A up to 2400A.

Key features

1200V and 1700V

Half-bridge and sixpack

500A to 3600A

Flexible cooling options: air, water or customized cooling options, high performance cooling, single and double side mounting water coolers

Paralleled operation for even higher output power possible

Special version for 1500V_{DC} available

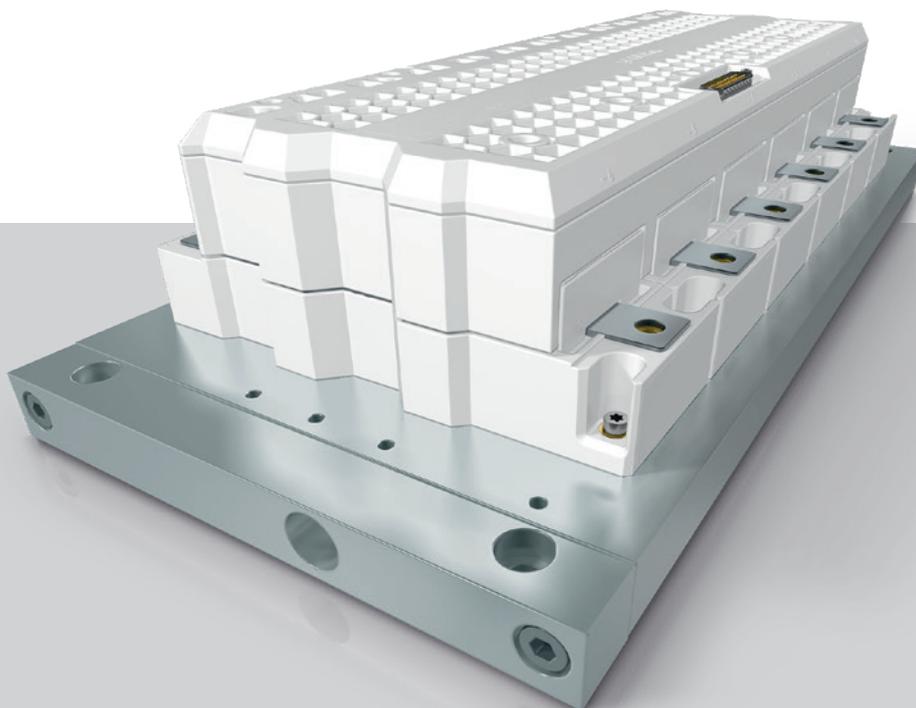
Not valid for 1500V_{DC} traction

The SKiiP 4, available in half-bridge topology, has been optimized for highest power cycling requirements and covers the higher power range up to 3600A.

To ensure highest reliability and service life, the power circuitry is 100% solder-free. Sinter technology as die attach replaces the solder layer, which usually causes the limitation in lifetime. Hence, sintering improves power and thermal cycling capability.

The integrated gate driver in the SKiiP 4 has set new standards in terms of reliability and enhanced functionality through its CAN interface. The digital driver guarantees safe isolation between the primary and secondary side for both switching signals and parameter measurement. The CAN interface allows setting the SKiiP 4 configuration parameter and reading application parameter.

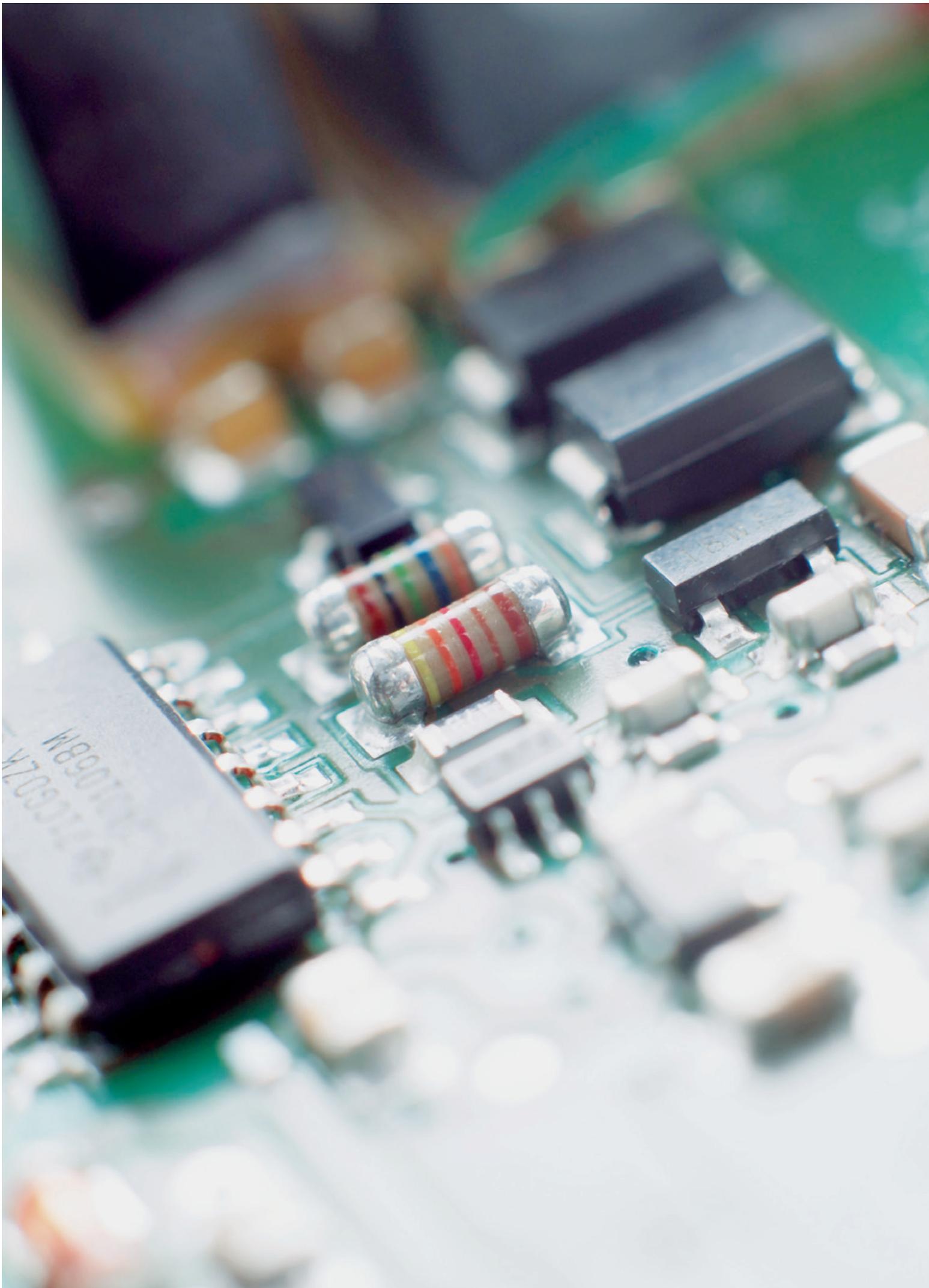
High performance cooling (HPC) technology has been introduced providing approximately 25% more output capability compared to standard water cooling. A double side mounting HPC water cooler is also available and enables an even higher power density.



SKiiP®4

500kW up to 3MW

The most powerful IPM in the market



Product Portfolio IGBT Driver

Above the Standard

The unique product portfolio enables access to all established industries with a one-stop solution that combines state-of-the-art power modules and driver electronics.

Our IGBT drivers are available as two-channel driver cores suitable for any standard semiconductor power module or as Plug-and-Play solutions, which perfectly fit the SEMiX 3 Press-Fit, SEMITRANS 10 and compatible modules.

Cost Efficient

Achieve outstanding system compactness and create space- and cost-effective inverter designs with our drivers, utilizing highly integrated ASIC technology. Isolated DC-link voltage and temperature sensor signals at the driver's interface along with over-voltage and over-temperature lockout also help to reduce system costs significantly.

Time Efficient

More than 25 years of experience in developing innovative IGBT driver electronics enables Semikron Danfoss to have a short-term solution for almost every challenge related to driver electronics. Our Plug-and-Play drivers connect directly to most common standard IGBT modules. The IGBT driver cores fit with the adapter boards or application sample PCBs. For the latter, Semikron Danfoss shares the entire manufacturing data to decrease development time, speeding up the time-to-market.

Reliable

Our SKYPER and SKHI are well-known, highly robust and reliable IGBT driver solutions under demanding environmental conditions. Over many years of field operation experience the proprietary IGBT driver technology has been relentlessly developed further. This technology sets new standards for the essential features of safe gate control, reliable gate protection and reinforced insulation.

Key factors

Reinforced insulation for signal and power transmission

Two-channel driver

Up to 1700V transients

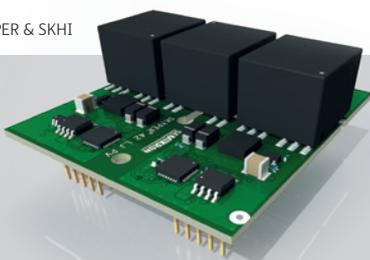
Up to 1500V continuous DC bus voltage

8Apk to 35Apk per channel

1W to 4.2W peak per channel

Suitable for multi-level topologies and Generation 7 IGBT

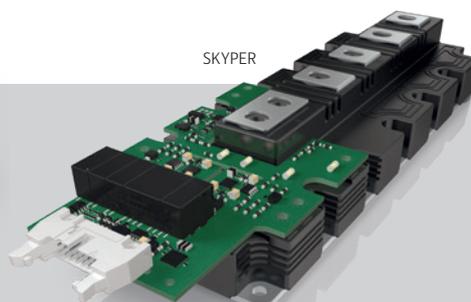
SKYPER & SKHI



Driver Cores

Two-channel driver cores for PCB integration with Semikron Danfoss ASIC technology and integrated safety functions

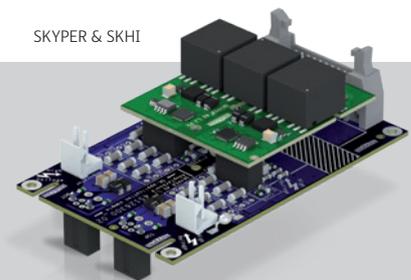
SKYPER



Plug-and-Play Driver

Two-channel drivers for direct module mounting with electrical or optical interface

SKYPER & SKHI



Adapter Board and Application Samples

Adapter boards for driver core mounting to Semikron Danfoss IGBT and SiC modules



Thermal Interface Materials

Stay Cool – Heat Dissipation is Our Job

Semikron Danfoss was the first power module manufacturer on the market to offer power modules with pre-applied thermal interface material. With more than two decades of field experience and more than 17 million pre-printed modules in the field, benchmarks are being set. The modules with pre-applied TIM are printed in a clean environment on an automated and SPC controlled silkscreen and stencil printing line.

For each requirement, we offer the right choice of material. In addition to the standard silicone thermal grease, phase change materials and high performance thermal paste with improved thermal performance are also available.

Semikron Danfoss offers either thermal grease or phase change materials depending on customer requirements (e.g. performance increase, reduced handling effort) and module type (with or without baseplate). Phase change materials have a solid consistency at room temperature, fully exploiting the advantages a non-smearing TIM layer offers, with no drawbacks. Baseplate-less modules, on the other hand, usually require a lower-viscosity material to help improve robustness during assembly. Here, thermal grease is the preferred solution.

Key features

Increased productivity thanks to reduced handling costs and improved logistics

Low thermal resistance with optimised TIM layer thickness

Improved lifetime and reliability

Improved assembly robustness

Modules can be shipped directly to the assembly line without any additional treatment processes

Lower overall costs

Portfolio

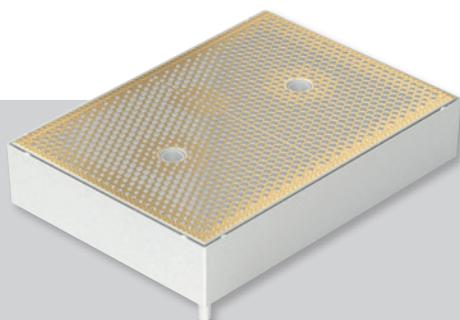
P8: Phase Change Material for highest performance

HT: Phase Change Material for highest sink temperature

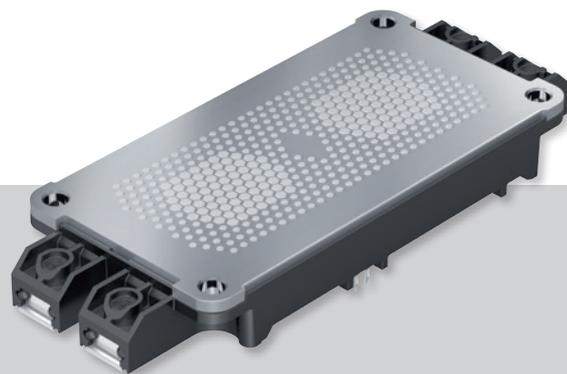
HPTP: High Performance Thermal Paste

P12: Standard Thermal Paste

HP-PCM: High Performance Phase Change Material



**Baseplate-less
Power Modules**



**Baseplate
Power Modules**

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 CO₂ 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.



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