

Green Hydrogen



Electrolysis

Semikron Danfoss has a comprehensive power module portfolio to support DC and AC coupled electrolysis up to several megawatt. Semikron Danfoss also offers modules with dedicated drivers such as the high-power SKiiP IPMs equipped with silicon or silicon carbide chips which are ready to address 1500V_{dc} applications. Further offerings include ready-to-use power electronic assemblies to address time to market challenges. These assemblies are available as active and passive rectifiers and choppers in 2-level and 3-level configurations.

MEDIUM POWER AC SYSTEMS

200kW - 1MW

- Active rectifiers
- Choppers

High efficiency systems
Compact designs and high power density

Products

SEMiX 5
SEMiX 3 Press-Fit
SEMISTRANS Classic
SEMISTRANS 10
SEMISTRANS 20
SKiiP 4/7 IPM
Drivers
Power Electronic Stacks

HIGH POWER AC SYSTEMS

1MW - 5MW

- Controlled and uncontrolled rectifiers
- Active rectifiers
- Choppers

High efficiency systems
Compact designs and high power density

Products

SEMiX 5
SEMiX 3 Press-Fit
SEMISTRANS Classic
SEMISTRANS 10
SEMISTRANS 20
SEMIPACK
SKiiP 4/7 IPM
Drivers
Power Electronic Stacks
Discretes



Fuel Cells

For interfacing with fuel cells, Semikron Danfoss offers a wide selection of power modules for use in isolated or non-isolated DC/DC conversion stages, as well as for DC/AC inverters configured in traditional or advanced topologies. These modules are equipped with the latest generation silicon and silicon carbide to create converters with kilowatt to megawatt power levels. In addition, blocking diodes are available for preventing reverse current flow to fuel cells to meet isolation requirements.

RESIDENTIAL

< 10kW

- Isolated DC/DC converters
- High frequency rectification
- Single or 3-phase inverters
- Blocking diodes

Highest efficiency systems with the latest silicon carbide chips
SiC diodes for HF rectification

Products

SEMISTOP E

SEMIPACK

Drivers

POWER CONDITIONING SYSTEMS BACKUP POWER SYSTEMS

10kW - 500kW

- Boosters
- Inverters
- Blocking diodes

Compact designs and high power density
Common and advanced topologies

Products

SEMISTOP E

MiniSKiiP

SEMiX 5

SEMiX 3 Press-Fit

SEMISTRANS Classic

SEMISTRANS 10

Drivers





Increased Performance in 3-Level Topologies

In medium power fuel cell applications, the trend is to increase stack voltages for improved efficiency. In parallel, high power electrolysis applications also require higher voltages (up to 1500VDC) due to increased power ratings. The 3-level NPC topology addresses this trend towards higher operating voltage. However, creating an NPC phase leg with individual half-bridge modules presents problems with external inductance in the commutation loop. The SEMITRANS 10 P3L utilizes our packaging expertise to fit an entire NPC phase leg in a single power module. For even higher power converters, the SEMITRANS 10 MLI utilizes a unique split-NPC approach to build a compact, powerful phase leg. By incorporating the latest Generation 7 IGBTs, additional

area is available inside the module to increase the clamping diode rating. This enables the modules to effectively operate in both inversion and conversion modes.

Key Features

Reduced magnetics cost thanks to 3-level topology

Up to 1.5MW with liquid cooling

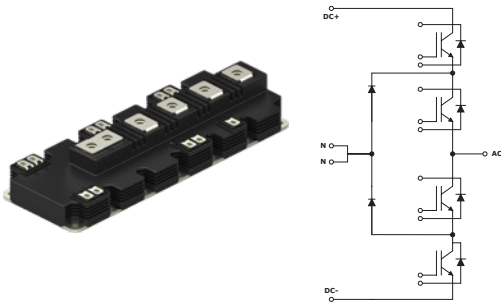
Based on latest Generation 7 IGBTs

Reduced cable diameters or cable losses with up to 1500V_{DC} operation

Reduced cooling requirements thanks to low losses

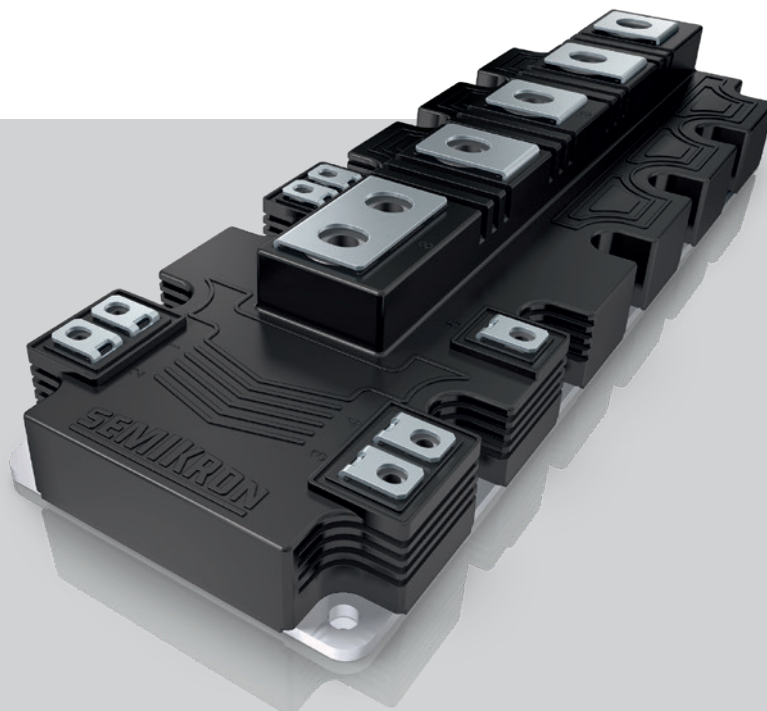
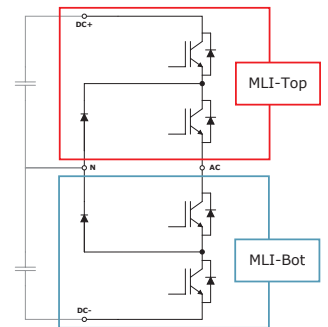
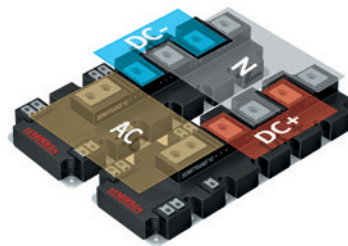
SEMITRANS® 10 P3L

Compact NPC phase-leg up to 500kW



SEMITRANS® 10 MLI

NPC phase-leg split between twomodules for up to 1.5MW



SEMITRANS® 10

500kW up to 1.5MW



ELECTROLYSIS
PROCESS

HYDROGEN H

HYDROGEN
H

H_2O

Most Flexible Rectifiers for High Power Multipulse Rectification

When first released our SEMIPACK set a new industry standard for semiconductor power modules. It was the first fully isolated power module available and at that time it marked the base for many innovations to come.

Today, almost 50 years later, SEMIPACK is still setting benchmarks. With a mean on-state current of up to 145A and a super low thermal resistance the 6th generation of SEMIPACK 1 is the most powerful 20mm module available in the market.

The complete SEMIPACK product line consists of uncontrolled, half-controlled and full-controlled rectifier modules in six module lines covering voltage classes from 1200V to 2200V, insulation voltages of 3.6kV, 4.8kV@1s and rated currents from 20A to 1360A.

With all of this, the SEMIPACK is the ideal module platform for medium to high power rectification.

Reliable Performance

Proven industry standard

Most powerful 20mm module in the market

Setting Benchmarks with 6th generation SEMIPACK 1

I_{TAV} up to 145A and I_{TSM} up to 2210A

50% lower R_{th} compared with market standard

Setting Benchmarks with 6th generation SEMIPACK 1

Six industrial standard housings

Covering 20 to 1360A in 1200/2400V

Uncontrolled, half-controlled, fully-controlled rectifier legs and switches



SEMIPACK® 5

B6U up to 1.5MW



SEMIPACK® 1
6th Generation

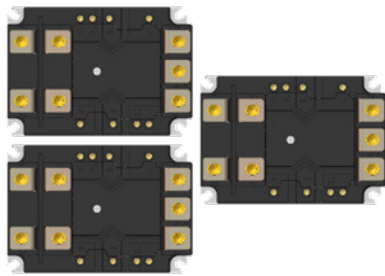
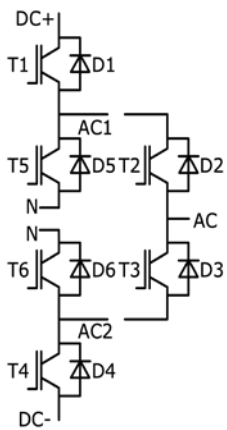
The New Standard in High Power

Meet increasing power demands for renewable, drive, and electrolyzer applications with the SEMITRANS 20. The symmetrical layout and low inductance package allow for simple paralleling up to 5MW and beyond, including 3-level topologies such as ANPC for ultra-low harmonic active rectification. The 1700V SEMITRANS 20 also includes sintering technology to increase reliability for harsh and environmental challenging applications.

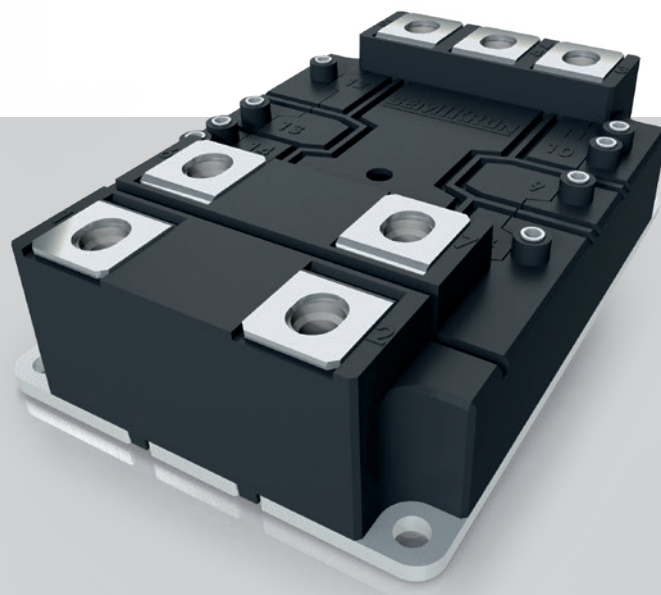
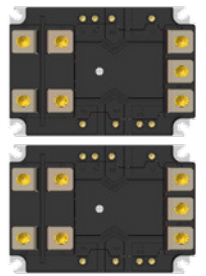
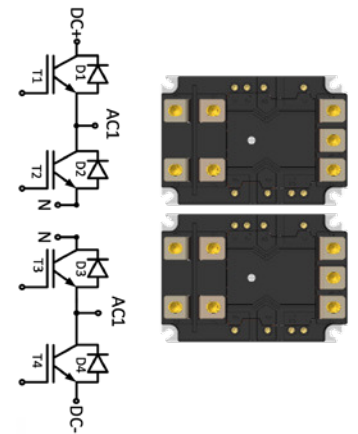
Key Features

- 1200V and 1700V half-bridge modules
- Simplified inverter design for reduced assembly and material costs
- Low inductance package for high switching frequencies with the latest technology
- Three AC terminal connectors for low operating temperatures, even at high loads
- Simple paralleling of modules thanks to symmetrical module design
- New standard package for high power applications
- Sinter technology in 1700V for harsh applications

Three SEMITRANS®20 modules form a 1.5MW ANPC phase leg



Two SEMITRANS®20 modules form a 1MW 3-level chopper



SEMITRANS® 20
500kW up to 5MW

Increase Converter Compactness in Medium Power

Today in green hydrogen applications the demand of power dense inverters has already been extended from low to medium power ranges. SEMITRANS 10 is an industry package popular among designers. SEMITRANS 10 P2 or P3L are attractive modules in 2-level, 3-level NPC or TNPC configurations from Semikron Danfoss.

Thanks to latest Generation 7 IGBTs compact and simplified design are achieved in medium power arena whether it is electrolysis or fuel cells applications.

Key Features

SEMISTRANS 10 P2

Half-bridge topology, 1200V IGBT: 900A

Latest Generation 7 IGBTs

High power density

SEMISTRANS 10 P3L

NPC and TNPC topology

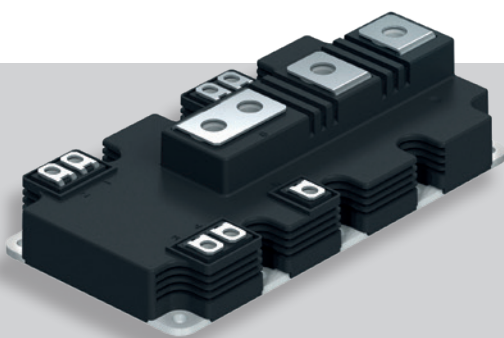
Full 3-level NPC or 3-level TNPC KH 4/15/2024

Latest Generation 7 IGBTs

Extended current rating

Highest power density

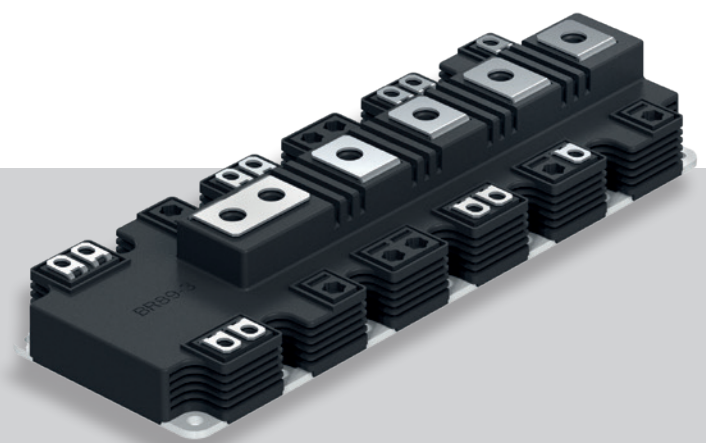
High voltage margin (1200V on all positions)



SEMISTRANS® 10 P2

Half-bridge

Up to 200kW



SEMISTRANS 10 P3L®

3-level NPC or 3-level TNPC phase leg

Up to 750kW



Best-in-Class 3-Level Modules for Fuel Cell Electric Vehicle Air Compressors

High speed compressors in the range 20kW to 60kW in Fuel Cell Electric Vehicles (FCEV) pose significant challenges. Inverters need to switch at high switching frequencies to support the compressor's high fundamental frequency and at the same time be cost-efficient. Two well-known 3-level topologies effectively address these concerns.

Semikron Danfoss offers two product lines, SEMITOP E and MiniSKiiP to design compact 3-level systems, both based upon the latest silicon chips. Other options with hybrid Si/SiC are also available to balance cost and performance.

SEMITOP E 3-level NPC topology

Highest efficiency thanks to optimised Si or Si/SiC chipsets

Improved robustness against humidity

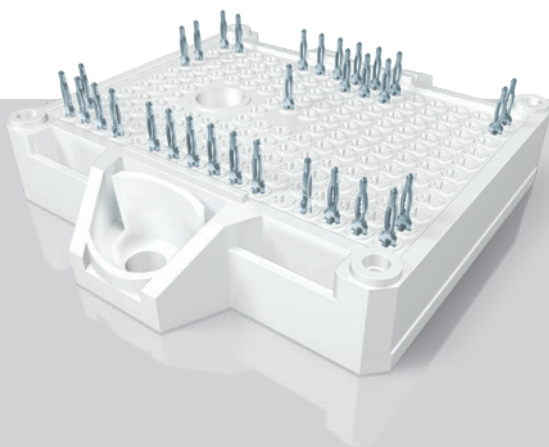
3-level NPC phase leg per module in E2 housing

MiniSKiiP 3-level TNPC topology

Power density master

3-level TNPC topology, 1200V/650V with optimized Si chipsets

MiniSKiiP 2 or MiniSKiiP 3 packages



SEMITOP® E2

3-level NPC module
up to 200A Si or hybrid SiC

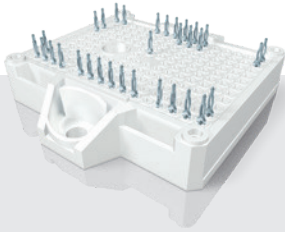


MiniSKiiP® 2/3

3-level TNPC module
up to 200A Si

Product Portfolio

IGBT and Rectifier Modules



SEMIPACK® E

5kW to 50kW

Exceeding the Standard for Superior Performance

Industry standard baseplate-less housing in two sizes

PCB-based, press-fit connections

650V / 1200V IGBT: 10A to 200A

1200V SiC: 40A to 250A

Sixpack, half-bridge, buck/boost/symmetrical boost and 3-Level NPC/TNPC topologies

Optimized mounting concept and pre-applied TIM provide lowest thermal resistance in class



MiniSKiiP®

0.4kW to 110kW

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

Easy manufacturing of single-PCB multi-axis designs

RGA IGBT and Generation 7 IGBT for true multiple sourcing



SEMIPACK®

800V to 2200V

Bipolar Modules from the Market Leader

6 housing sizes SEMIPACK 1 to 6

800V to 2200V: 20A to 1360A

Semikron Danfoss diode and thyristor chips

Diodes, thyristors in half-controlled, fully controlled and uncontrolled topologies

Different technologies for certain packages: high reliability pressure contact or cost-effective wire-bonded modules

Perfect for reverse current blocking applications

Ideal for multi-pulse passive rectification



Discretes – Diodes

Uncontrolled passive rectification

Voltage range up to 2200V

Current range up to 1500A

Metal case with epoxy or ceramic insulation

Rugged construction

Industry standard case

Capsule package for double-sided cooling

Flat design for single-sided cooling



Discretes – Thyristors

Controlled rectification

Voltage range up to 1800V

Current range from 340A up to 1200A

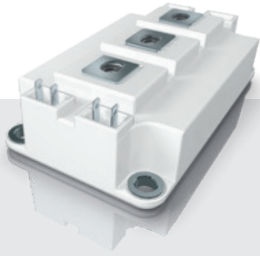
Metal case with epoxy or ceramic insulation

Rugged construction

Industry standard case

Capsule package for double-sided cooling

Flat design for single-sided cooling



SEMISTRANS® Classic

100kW to 1MW

The Proven Power Electronics Package

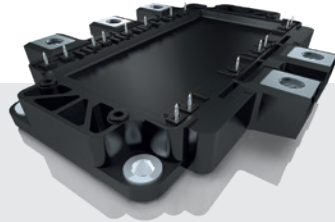
Robust industry standard package for multiple sourcing in 6 housing sizes

600V / 650V / 1200V / 1700V IGBT: 50A to 900A
1200V Hybrid and Full SiC: 125A to 500A

Half-bridge, single switch and buck/boost topologies, ready for TNPC / NPC / ANPC topology

Multiple IGBT sources including IGBT M7

Full power TNPC topology thanks to half-bridge and AC switch (common emitter) with increased free-wheeling diode rating



SEMiX® 5

50kW to 150kW

Extended Portfolio with Superior Thermal and Dynamic Performance

Industry standard baseplate module

650V / 1200V / 1700V IGBT: 150A to 400A

Sixpack, NPC and TNPC topologies

Optimized module layout for maximum heat transfer

Enhanced thermal and electrical diode performance



SEMiX® 3 Press-Fit

100kW to 1MW

Exceeding the Standard for Superior Performance

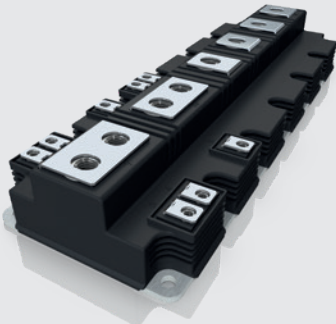
Industry standard press-fit design with 17mm high housing

650V / 1200V / 1700V IGBT: 225A to 900A
1200V Hybrid SiC: 600A

Half-bridge, split NPC and buck/boost topologies

Direct driver assembly

Available with integrated shunt resistor



SEMISTRANS® 10

500kW to 2MW

Robust High Power Module

Established high power module package

1200V / 1700V IGBT: 450A to 1800A

2300V IGBT: 1800A

Half-bridge, buck/boost, TNPC, NPC, and split NPC topologies

Full multiple source thanks to alternative 1700V chip source and IGBT M7



SEMISTRANS® 20

500kW to 2MW

The New Standard in High Power

The latest industry standard power module for high power applications

1200V / 1700V IGBT: 900A to 1400A

2000V SiC: 1700A/1mOhm

Half-bridge topology

Low stray inductance, high power density package

Increased reliability thanks to the latest packaging technology



HYDROGEN
ENERGY
STORAGE



Intelligent Power Modules – IPMs

The Most Powerful IPM in the Market

The SKiiP IPM product line set the benchmark for high performance and robust inverter designs. Both SKiiP 4 and SKiiP 7 feature high power densities combined with flexible cooling options such as air or water cooling, as well as with customized heatsinks. Reliable driver technology, integrated current sensors and comprehensive protection functions complete the IPM design.

SKiiP 7 has become increasingly popular through the industrial applications. With its sixpack or half-bridge topologies, it covers a current range of 500A to 2400A.

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

To ensure maximum reliability and service life, the power circuitry is 100% solder-free. Sinter die attach technology replaces the solder layer, the common cause of module lifetime limitations, thus improving power and thermal cycling capability.

High Performance Cooling (HPC) technology has been introduced, to provide 25% more output power capability compared to standard water cooling. A double-sided mounting HPC is also available, enabling ever higher power density.

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 measurements. The CAN interface allows setting the SKiiP 4 configuration parameter and reading application parameter.

Key Features

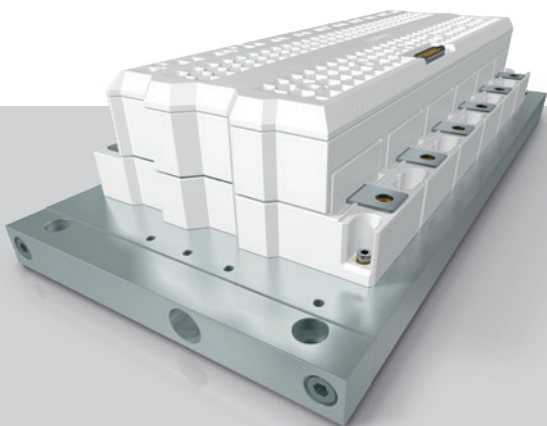
Half-bridges and sixpacks

1200V / 1700V IGBT: 500A to 3600A

2000V SiC: 1200A to 2400A

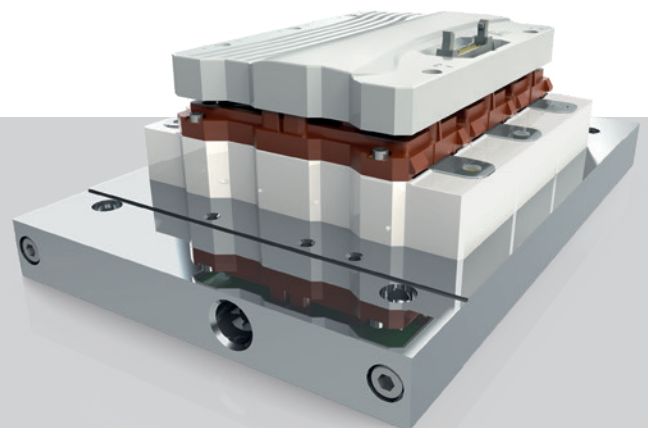
Flexible cooling options: air, water or customized cooling options

Parallel operation for even higher output power possible



SKiiP®4

Up to 2MW
available with full SiC MOSFETs



SKiiP®7

150kW up to 2.4MW



Power Electronic **Stack Platforms** for **Fully Qualified** Inverter Assemblies Tailored to Your **Specific Needs**

Standard Stacks

Our Power Electronic Stacks enable our customers to succeed in dynamic markets and meet any global challenge. We deliver rectifier, IGBT and SiC-based stacks for AC voltages from 380V to 1000V. Our standard stacks cover an output current range of 70A to 4000A and building blocks based on three level topologies that are ready to use in 1500V_{DC} environment.

Water-Cooled IGBT Stacks

SKiiPRACK
SEMISTACK RE

Air-Cooled IGBT Stacks

SEMIKUBE
SEMIKUBE SlimLine
SEMIKUBE MLI (1500V capable)

Diode/Thyristor Stacks

SEMISTACK CLASSIC B6U/B6C/W3C

Customized Stacks (>5MW)

In addition to standard stacks, Semikron Danfoss has vast experience in developing customer-specific solutions. Engineers are available in our stack centers around the globe to offer specific solutions by adapting existing platforms or designing customized converters.

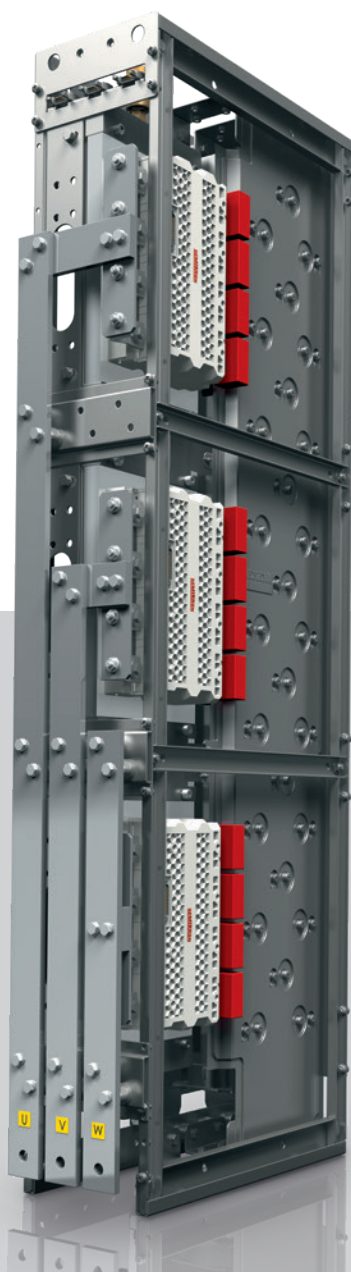
Four Key Factors to Your Success

Shortest time to market

Cost savings in R&D, production and qualification

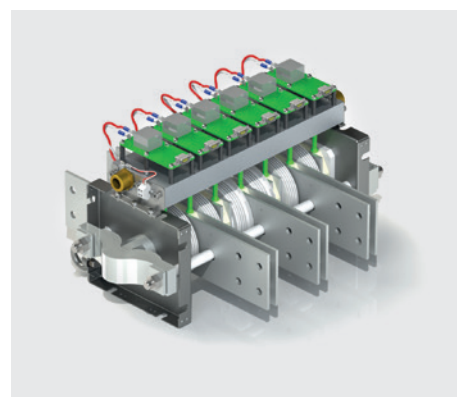
Global Semikron Danfoss stack production footprint

Highly experienced engineering team



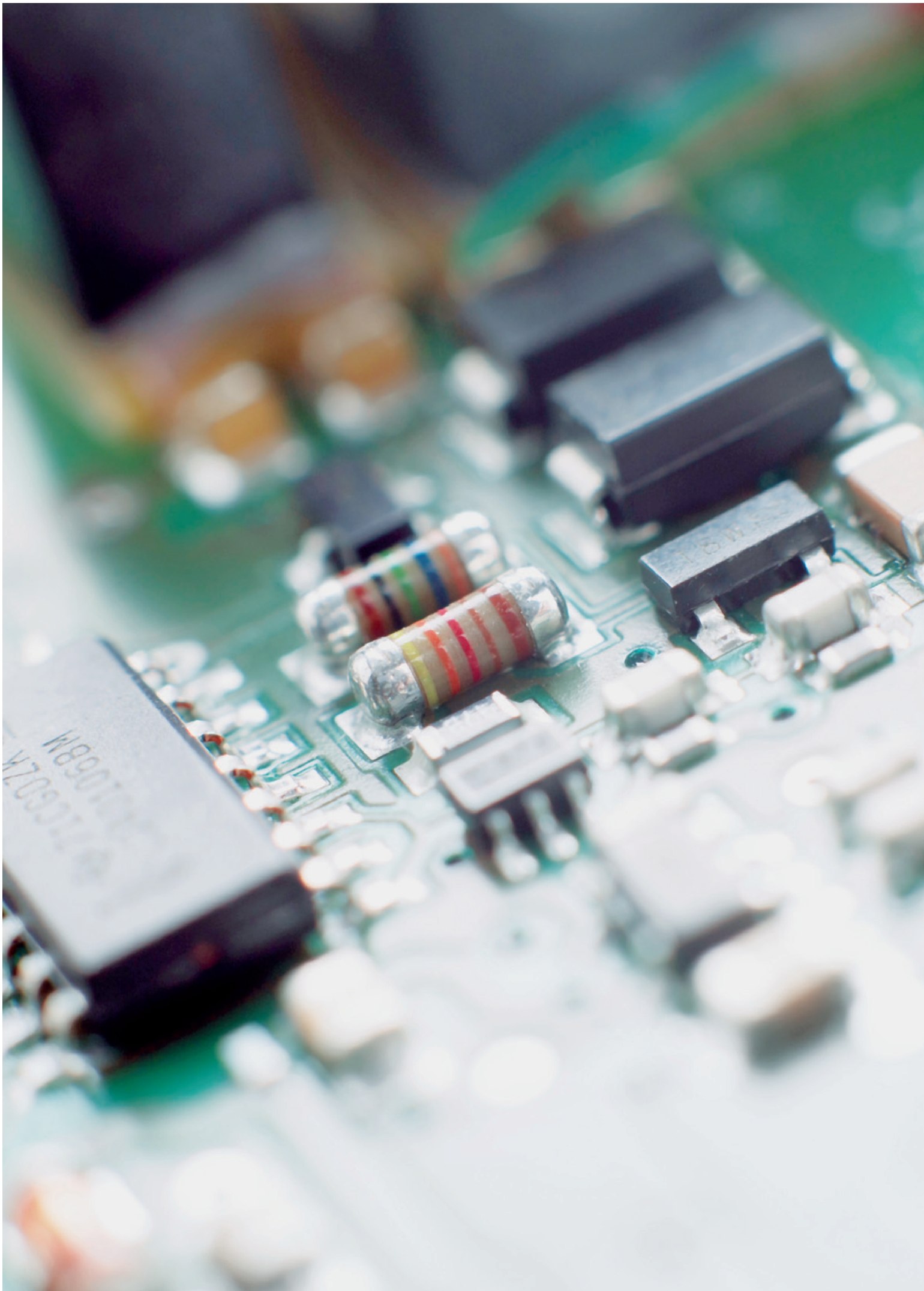
Standard Stack

Up to 5MW AFE/Chopper



Customized Stacks

3000A controlled rectifier



Product Portfolio

IGBT Driver

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 other 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

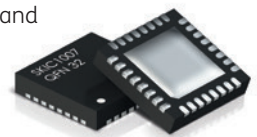
More than 25 years of experience in developing innovative IGBT driver electronics enables Semikron Danfoss to have a short-term solution for almost every challenge related to driver electronics. The Plug-and-Play drivers connect directly to most common standard IGBT modules. The IGBT driver cores fit with our 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 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.

Compact Design

Our SKIC ASIC technology enables very compact system design with minimal peripheral components. With highly integrated signal processing and multi-channel failure management, our ASICs offer robust gate control



Key Factors

Reinforced insulation for signal and power transmission

Two-channel driver

Up to 1700V transients

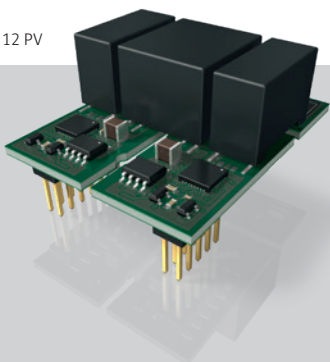
Up to 1500V continuous DC bus voltage

8Apk to 35Apk per channel

1W to 4.2W peak per channel

Suitable for multi-level topologies and Generation 7 IGBT

SKYPER 12 PV



Driver Cores

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

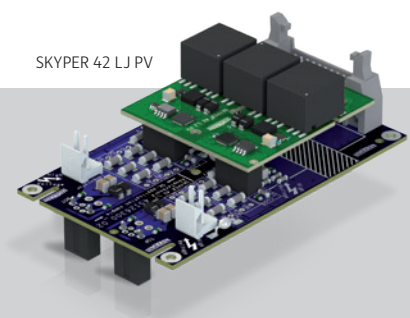
SKYPER 12 Press-fit



Plug-and-Play Driver

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

SKYPER 42 LJ PV



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 (TIM). We now have over two decades of experience and more than 30 million pre-printed modules in the field.

We design print patterns for each module type for the best TIM distribution and thickness when the module is mounted to a heatsink. These patterns are printed on the modules in a clean environment on an automated silkscreen and stencil printing line. Statistical process control (SPC) is used to guarantee consistency. Special packaging is implemented to ensure that the TIM arrives at your production line in pristine condition.

In order to achieve the best thermal performance in all applications, Semikron Danfoss power modules can be supplied with our High Performance Thermal Paste (HPTP).

Alternatively, for ease-of-handling during assembly, most power modules are also available with pre-applied phase change material (PCM). Phase change materials have a solid consistency at room temperature. With the application of heat during first operation, the PCM flows to fill gaps and provide a thermal interface. With HP-PCM, the new Semikron Danfoss-exclusive High Performance Phase Change Material, we combine the benefits of a phase change material with the performance of the best available paste.

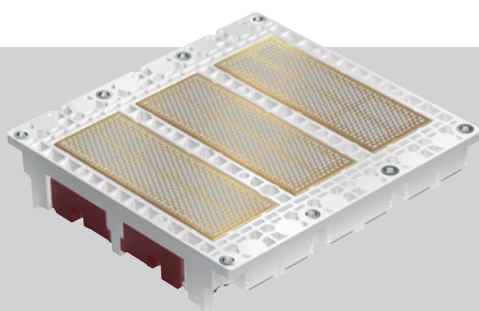
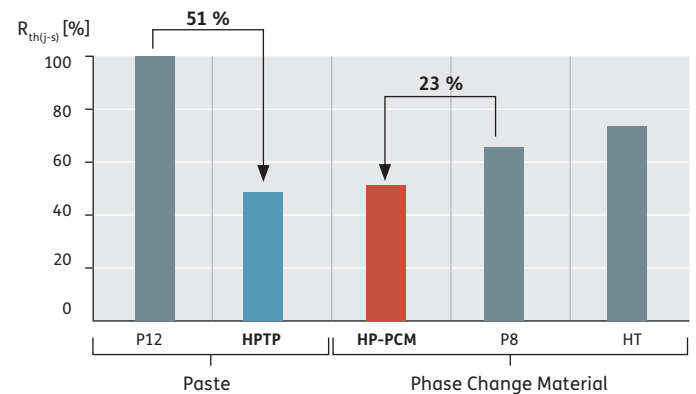
Key Features

- Best possible thermal performance
- Simplified logistics and reduced production costs
- Improved assembly robustness
- Increased lifetime and reliability

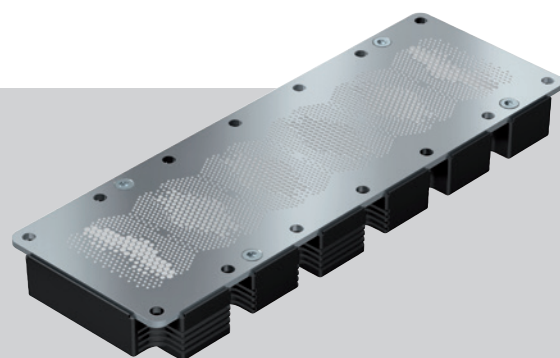
Portfolio

HPTP: High Performance Thermal Paste

HP-PCM: High Performance Phase Change Material



Baseplate-less module with pre-applied thermal paste



Baseplate module with pre-applied phase change material

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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Semikron Danfoss GmbH

Husumer Strasse 251
24941 Flensburg, Germany

Semikron Danfoss International GmbH

Sigmundstrasse 200
90431 Nuremberg, Germany

www.semikron-danfoss.com

Note: All information is based on our present knowledge and is to be used for information purposes only. The specifications of our products may not be considered as an assurance of component characteristics.

