POWER ELECTRONICS FOR MOTOR DRIVES

SEMIKRON DANFOSS

Motor Drives

Performance Range

Since the first appearance of motor drives, Semikron Danfoss has been committed to supplying solutions for every power range. Starting with the first insulated power module, the SEMIPACK rectifier module series more than 40 years ago, the MiniSKiiP in particular has revolutionised the motor drive design for low and medium power systems.

Today Semikron Danfoss offers the complete industrial standard power module portfolio that serves a power range of 0.2kW to several megawatts.

The portfolio is completed with high power IPMs, power electronic stacks and a comprehensive product line of driver electronics that help to reduce development effort and time-to-market. The latest Generation 7 IGBTs of two different suppliers, optimized for motor drive applications, boost performance and power density.

SERVO DRIVES

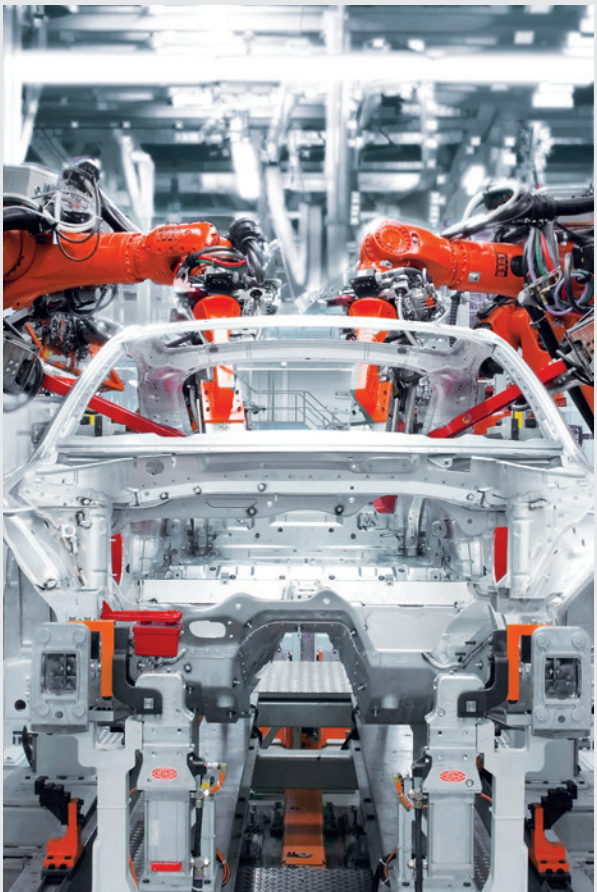
0.2kW - 75kW

- Robotics
- Material handling
- Machine tools

Compact designs and high power density
High peak overload capabilities
Multiple axis in one drive or modular drives with common DC bus
Decentralized high IP grade drives

Products

SEMITOP E1/E2
MiniSKiiP
SEMiX 6 Press-Fit
SEMIPACK
Drivers



LOW/MID POWER DRIVES

0.2kW - 300kW

- Pumps and fans
- Process automation
- Cranes and lifts
- Marine drives

Compact designs and high power density
Platform designs, covering wide power range with the same mounting concept

Products

SEMITOP E1/E2
MiniSKiiP
SEMiX 3 Press-Fit
SEMiX 6 Press-Fit
SEMITRANS
SEMiSTART
SKiiP 3/4 IPM
SEMIPACK
Drivers
Power Electronics Stacks

MID/HIGH POWER DRIVES

300kW - 10MW

- Oil, gas and mining industry
- Chemical industry

Compact designs and high power density
High reliability in harsh environments

Products

SEMiX 3 Press-Fit
SEMITRANS 10
SEMITRANS 20
SKiiP 3/4 IPM
SEMiSTART
SEMIPACK
Drivers
Power Electronics Stacks


GENERATION
IGBT

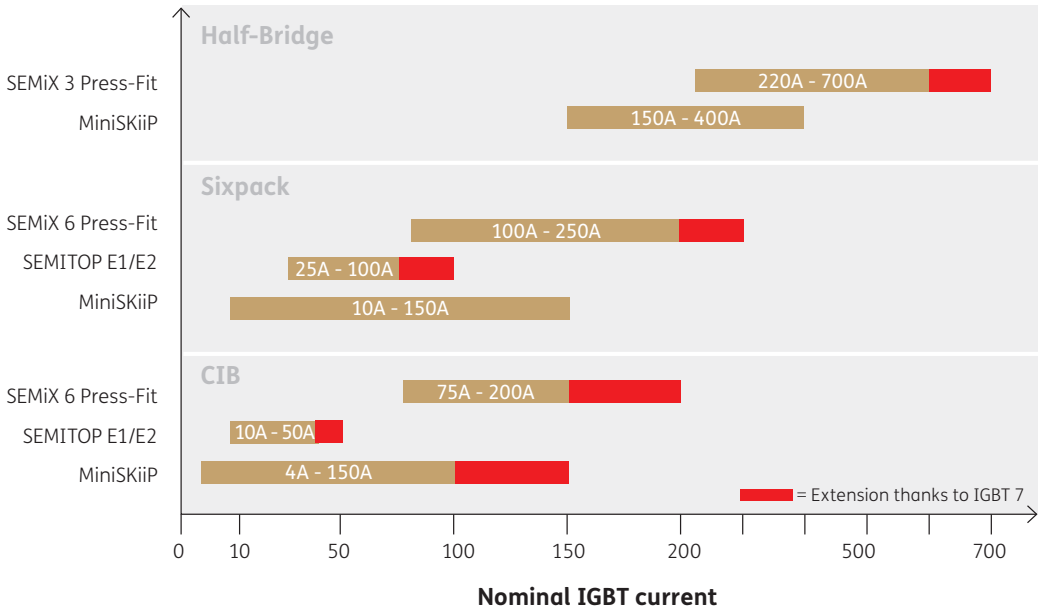
The Latest **IGBT Generation** from Two Suppliers for **Highest Supply Chain Safety**

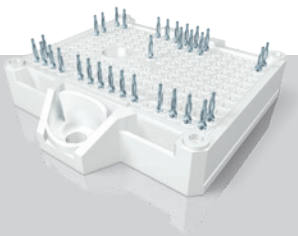
The Generation 7 IGBT chips T7 and M7 enable higher power density and higher performance. Thanks to a new IGBT cell design technology the chip size could be reduced by approximately 25% compared to the previous generation.

The features translate into up to 20% higher output power in given power package sizes and motor drive applications. Thanks to the higher allowed operation temperature an overload of e.g. 110% can be covered without the need of additional design reserves.

Additionally the Generation 7 IGBTs share the following features:

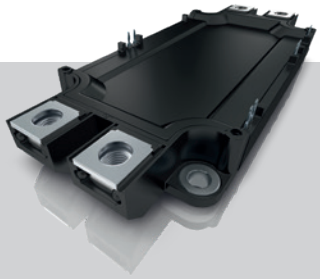
- 20% lower on-state voltage $V_{ce,sat}$
- Operation junction temperature of 175°C during overload
- High humidity robustness
- About 25% smaller chip size
- Up to 20% higher output power or 20% lower losses
- Up to 35% smaller housing





SEMITOP® E1/E2
0.4kW up to 30kW

SEMiX® 6 Press-Fit
15kW up to 75kW



SEMiX® 3 Press-Fit
55kW up to 350kW

MiniSKiiP®
0.4kW up to 110kW

PRODUCT HIGHLIGHT

IGBT and **Rectifier Module** Family for Complete Motor Drive Solutions

SEMiX 3 Press-Fit features IGBT and rectifier modules in the same housing design for a complete medium/high power drive solution. As an industry standard power module available with the latest generation IGBT chips from different suppliers, it gives a full supply chain safety.

It's your choice: SEMiX 3 Press-Fit is available with optional ...

... integrated current measurement shunts.
The integration of the current measurement into the power module replaces expensive and bulky current sensors (i.e. Hall sensors) .
This reduces size and cost of the motor drive system

... Plug-and-Play driver SKYPER 12 Press-Fit.
Simply pressed onto the power module's press-fit pins, the driver reduces time-to-market thanks to a ready-to-go solution

... pre-applied phase change material (PCM).
The choice between different materials optimises either the thermal performance or the allowed heatsink temperature.

Industry standard package with optional

- Integrated current shunts
- Plug-and-Play gate driver
- Pre-applied phase change material

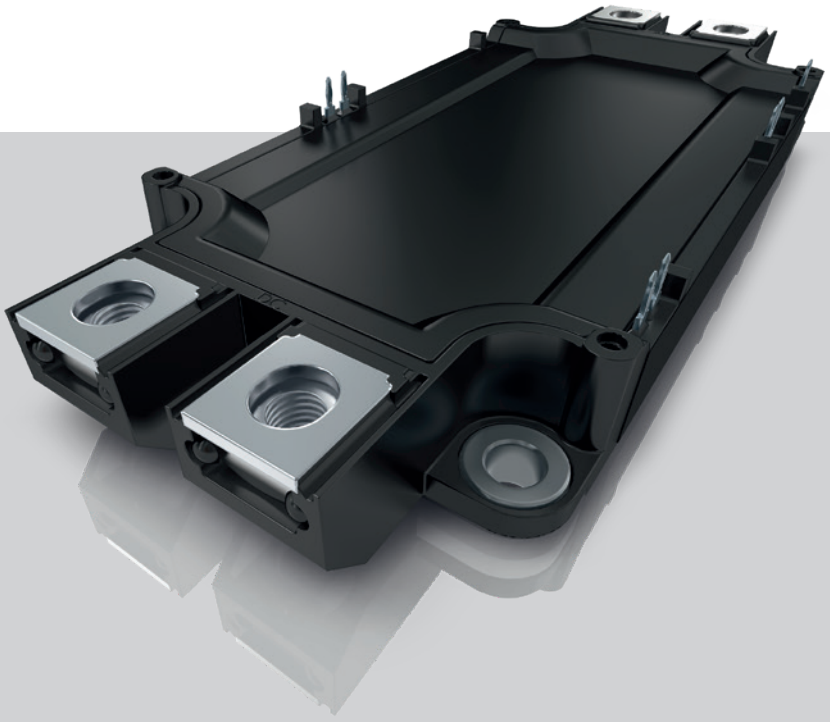
Available for a complete 17mm high solution

- Rectifier, brake chopper and half-bridge
- 650V / 1200V / 1700V: 225A to 700A
- 55kW up to 350kW
- Full second source thanks to several IGBT suppliers
- Hybrid Silicon Carbide version offers highest efficiency and power density

The latest Generation M7 IGBT

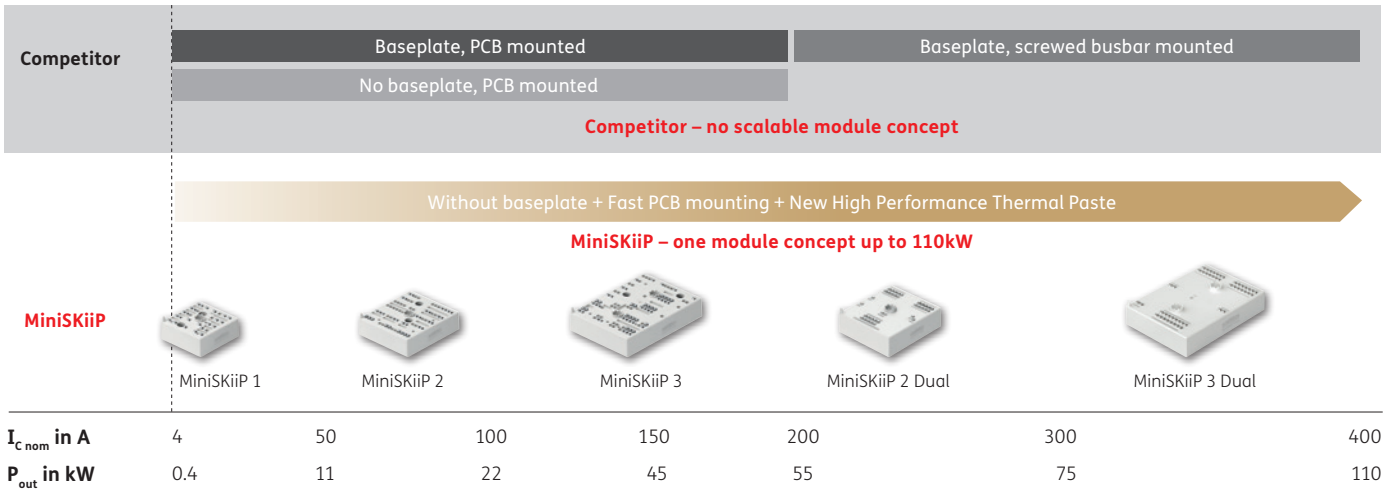
- 25% higher output power thanks to the new Generation 7 IGBT M7

GENERATION IGBT 7



SEMiX® 3 Press-Fit
55kW up to 350kW

The **Power Density Master**: New Levels Utilizing the Latest **Generation 7 IGBT** Chips



One continuous mounting concept from 0.4 to 110kW

- PCB based assembly concept with only 1 or 2 mounting screws
- High productivity mounting thanks to automatable production lines
- No additional tools required:
  No soldering, no press-in process required
- High vibration resistance
- Benchmark thermal resistance with High Performance Thermal Paste (HPTP).

One continuous module concept for all voltages and topologies

- 600/650V, 1200V, 1700V
- Available as CIB, sixpack, rectifier, brake chopper, twelvepack
- Hybrid Silicon Carbide version offers highest efficiency and power density

First Semikron Danfoss module to provide Generation 7 IGBT

- Generation 7 IGBT T7 increases output power by up to 20%

GENERATION IGBT 7

MiniSKiiP®
0.4kW up to 110kW

GENERATION IGBT7

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
- Complete motor drive topologies available: Half-Bridge, Rectifier and Brake Chopper Direct driver assembly
- Available with integrated shunt resistor

GENERATION IGBT7

MiniSKiiP ® | 0.4kW up 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

Product Portfolio
Power Modules

SEMIPACK® | 800V to 2200V

Bipolar modules from the market leader

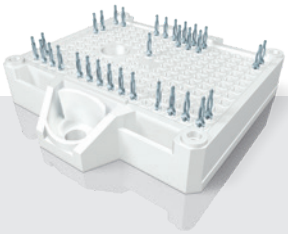
6 housing sizes SEMIPACK 1 to 6

800V to 2200V: 20A to 1360A
Semikron Danfoss diode and thyristor chips

Diode and thyristor in un-, half- and full-controlled topologies

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

Enhanced isolation voltage of 4.8kV/1s available on request



SEMITOP® E1/E2 | 0.4kW up to 30kW

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

SEMiX® 6 Press-Fit | 15kW up to 75kW

The complete press-fit standard

PCB based and press-fit based industry standard baseplate power module.

650V and 1200V: 75A to 250A
IGBT 4 and IGBT M7
1600V and 2200V rectifier diodes: 200A and 300A

Bridge rectifier (B6U),
CIB and sixpack topologies

Latest press-fit pin technology for optimal assembly and connection reliability

IGBT 4 and Generation 7 IGBT M7 ensure high supply chain safety.

SEMITRANS® | 25kW up to 500kW

The proven power electronics package

Robust industry standard package for multiple sourcing in 6 housing sizes

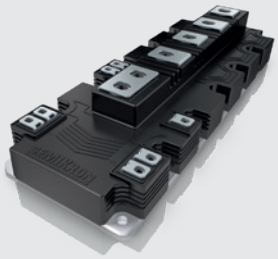
600V / 650V / 1200V / 1700V
IGBT: 50A to 900A

1200V Hybrid and Full SiC: 125 to 500A

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 | 300kW 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

Full second source thanks to alternative 1700V chip source and Generation 7 IGBT M7

SEMITRANS® 20 | 300kW up to 1MW

The new standard in high power

The latest industry standard power module for high power applications

1200V: 1400A
1700V: 1000A and 1200A

Half-bridge 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 and water cooling, also with customized heatsinks. 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

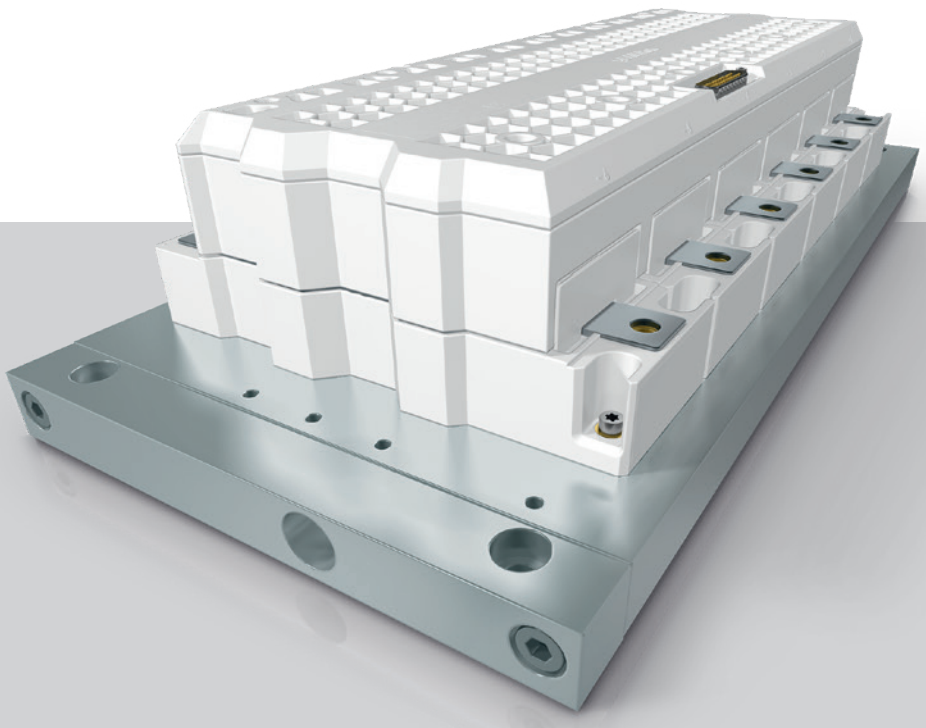
1200V and 1700V
Half-bridge and sixpack
500A to 3600A
Flexible cooling options: air, water or customized cooling options, high performance cooling, single and double side mounting water coolers
Paralleled operation for even higher output power possible

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
100kW up to 3MW
The most powerful IPM in the market

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 690V. Our standard stacks cover an output current range from 70A to 4000A.

Water-Cooled IGBT Stacks
SKiiPRACK

Air-Cooled IGBT Stacks
SEMIKUBE
SEMIKUBE SlimLine

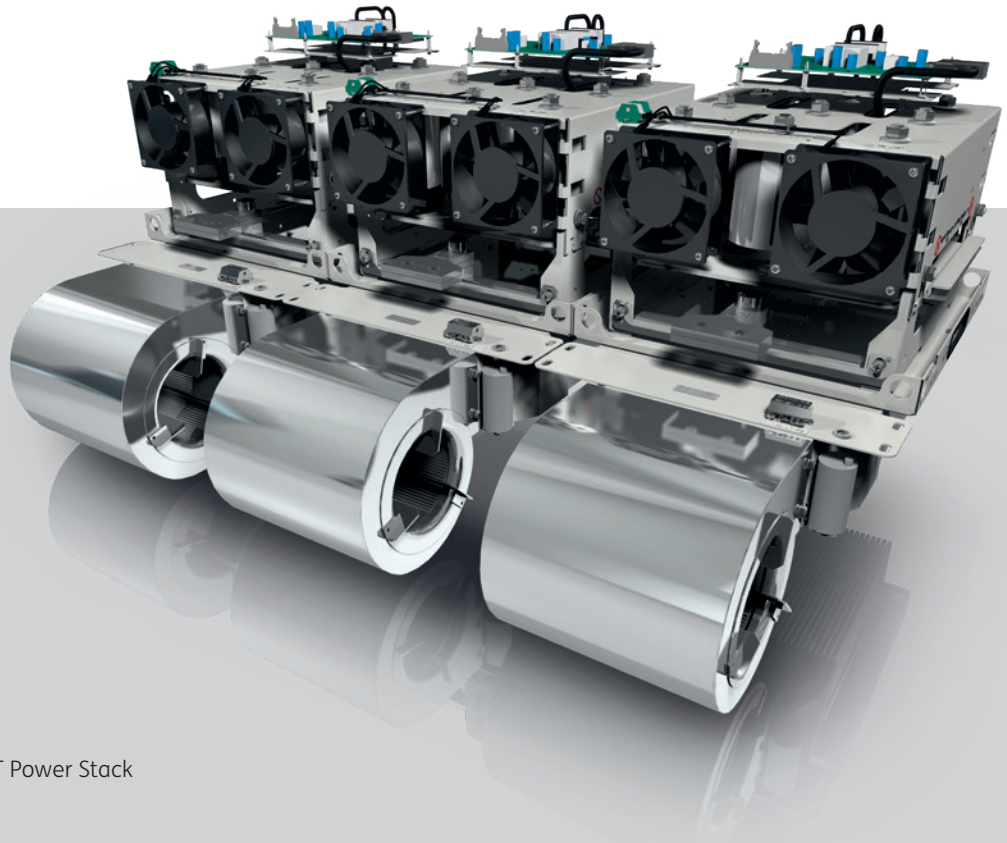
Diode/Thyristor Stacks
SEMISTACK CLASSIC B6U/B6C/W3C

Customised Stacks

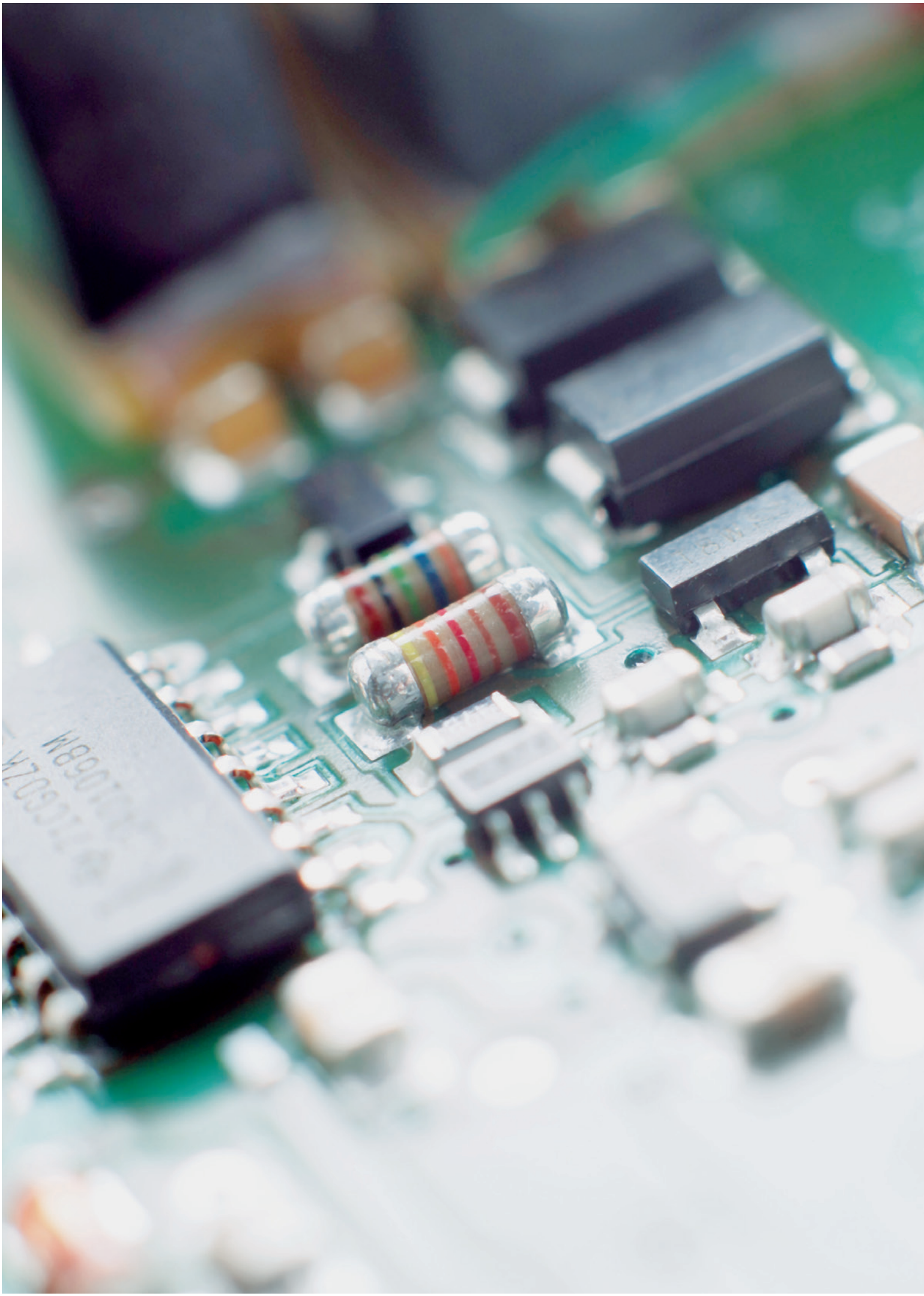
In addition to standard stacks, Semikron Danfoss has vast experience in developing customer-specific solutions. Engineers are available in our stack centres around the globe to offer specific solutions by adapting existing platforms or designing customized converters.

Four key factors for your success

- Shortest time to market
- Cost savings in R&D, production and qualification
- Global Semikron Danfoss stack production footprint
- Highly experienced engineering team



SEMIKUBE®
Air-cooled IGBT Power Stack



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.

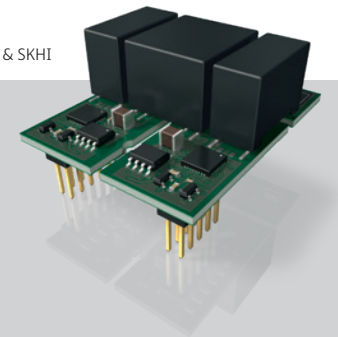
Time Efficient
More than 25 years of experience in developing innovative IGBT driver electronics enables Semikron Danfoss to have a short-term solution for almost every challenge related to driver electronics. Our Plug-and-Play drivers connect directly to most common standard IGBT modules. The IGBT driver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

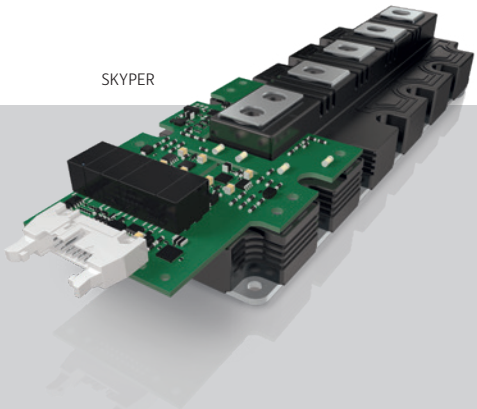
Reinforced insulation for signal and power transmission
Two-channel driver
Up to 1700V transients
Up to 1500V continuous DC bus voltage
8Apk to 35Apk per channel
1W to 4.2W peak per channel
Suitable for multi-level topologies and Generation 7 IGBT

SKYPER & SKHI



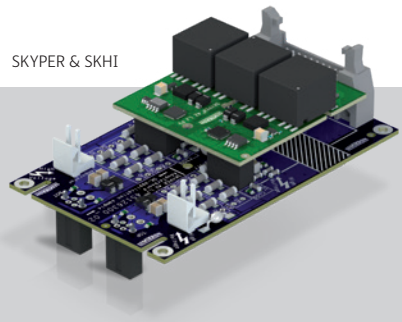
Driver Cores
Two-channel driver cores for PCB integration with Semikron Danfoss ASIC technology and integrated safety functions

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.

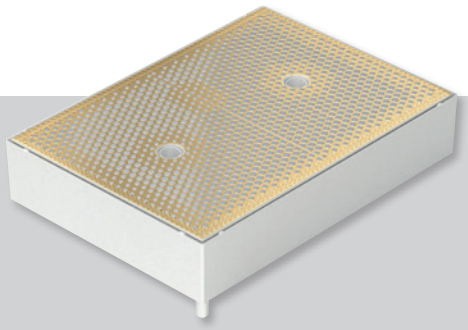
Semikron Danfoss offers either thermal grease or phase change materials depending on customer requirements (e.g. performance increase, reduced handling effort) and module type (with or without baseplate). Phase change materials have a solid consistency at room temperature, fully exploiting the advantages 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

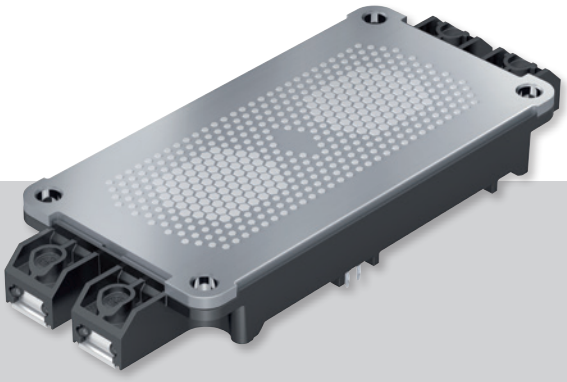
- Increased productivity thanks to reduced handling costs and improved logistics
- Low thermal resistance with optimised TIM layer thickness
- Improved lifetime and reliability
- Improved assembly robustness
- Modules can be shipped directly to the assembly line without any additional treatment processes
- 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

www.semikron-danfoss/thermal-interface-materials

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 sustainable 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.

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