



Hydrogen

Power Electronics for Electrolysis





PERFORMANCE RANGE

The electrolysis process for Hydrogen production requires electric power, whether the method of generation is through fossil fuels from grid or through renewable sources from wind turbines and photovoltaics.

Power electronic converters play a crucial role in supplying a controlled high-current DC power flow for the electrolyser. SEMIKRON has a comprehensive power module portfolio to support AC and DC coupled systems with choppers up to the megawatt range. SEMIKRON also offers modules with dedicated drivers such as the high-power SKiiP IPMs. SEMIKRON extends its offerings to ready-to-use power electronic assemblies for passive and active rectification **up to 1500V_{dc}** and chopper assemblies for DC conversion.

MEDIUM-POWER DC SYSTEMS

200kW - 1MW

- Active rectification
- Choppers

High efficiency systems

Compact designs and high power density

Products

SEMITRANS Classic

SEMiX 3 Press-Fit

SEMiX 5

SEMITRANS 10

SEMITRANS 20

SKiiP 3/4 IPM

Drivers

Water and air cooled power electronic stacks

HIGH-POWER DC SYSTEMS

1MW - 5MW

- Controlled and uncontrolled rectification
- Active rectification
- Choppers

High efficiency systems

Compact designs and high power density

Products

SEMiX 3 Press-Fit

SEMiX 5

SEMITRANS Classic

SEMITRANS 10

SEMITRANS 20

SKiiP 3/4 IPM

SEMIPACK

Discs/Capsules

Water and air cooled power electronic stacks

Drivers



Product Highlight

The New Standard in High Power

Meet increasing power demands for renewable, drive and electrolyser 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.

1200V and 1700V half-bridge modules

Simplified inverter design for reduced assembly and material costs

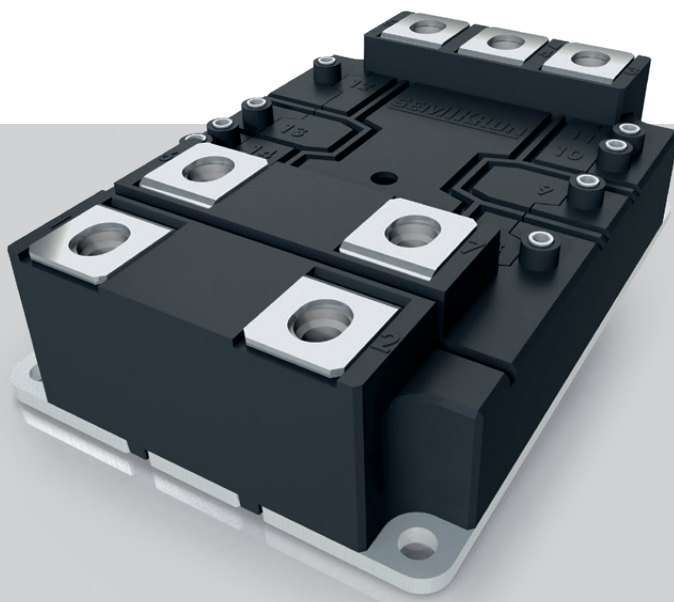
Low inductance package for high switching frequencies with the latest technology

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



SEMITRANS® 20

500kW up to 5MW

Product Highlight

Reach Higher Power in the Existing Footprint

The SEMITRANS 10 package is the undisputed king in the high power converter world. For 2-level (1200V/1700V half-bridges) or 3-level (1200V split NPC) topologies, the SEMITRANS 10 meets the demands of electrolysis processes.

In the 1700V class, the SEMITRANS 10 is available with the IGBT R8 and the reputable SEMIKRON CAL 4 diode. This allows for a full multiple sourcing strategy down to the chip level. As an alternative solution, SEMIKRON is introducing a fully compatible module using the 1700V IGBT E4 and IGBT P4 with 1000A and 1400A, respectively. Both modules will be drop-in replacements for existing designs, minimizing the adaption and tuning effort required, while still enabling multiple sourcing strategies.

With the SEMITRANS 10+, SEMIKRON introduces the natural extension to the next level of power density. Equipped with the latest generation 7 IGBTs, it achieves a new nominal current rating of 1800A in half-bridge configurations. The additional AC terminal extends the output current range and supports the powerful chipset to its full potential. As with the standard SEMITRANS 10, the SEMITRANS 10+ is also a key component to a full multiple sourcing approach.

Key features

Multiple sourcing down to chip level: IGBT R8 and IGBT M7

Fully compatible with the industry standard: IGBT E4 and IGBT P4

Half-bridge in 1200V/1700V

Split NPC topology in 1200V with IGBT M7

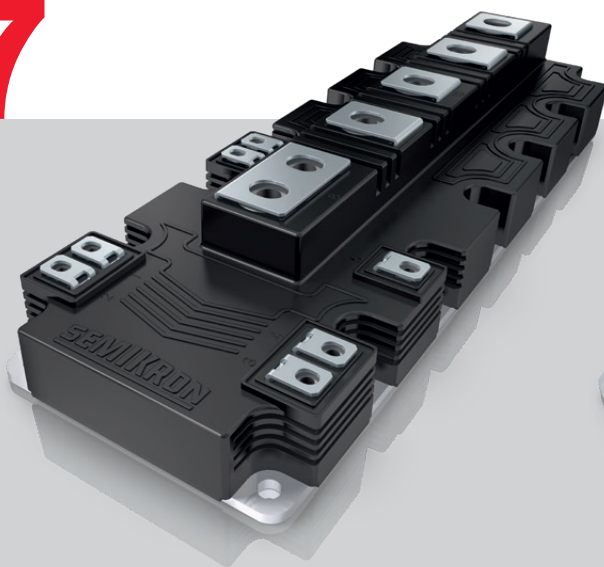
SEMITRANS 10+ with additional AC terminal for highest power density

Benefits

Supply chain safety down to chip level

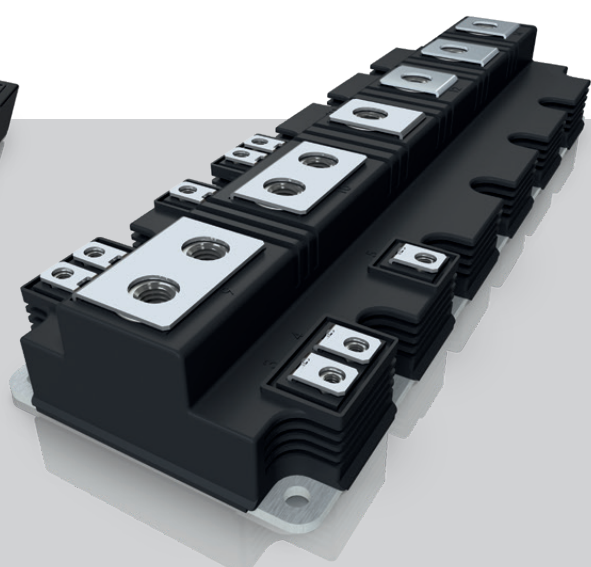
Highest power density in renowned packages

High level of flexibility



SEMITRANS® 10

500kW up to 2MW



SEMITRANS® 10+

Up to 2.5MW



Discs and Capsules 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

Discs and Capsules Thyristors

Controlled rectification

Voltage range up to 1800V

Current range from 340A up to 1200A

Metal case with epoxy or ceramic insulation

Rugged construction

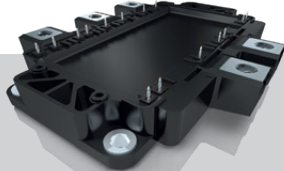
Industry standard case

Capsule package for double-sided cooling

Flat design for single-sided cooling

Product Portfolio

IGBT and Rectifier Modules



SEMIPACK®

800V up to 2200V

Bipolar modules from the market leader

6 housing sizes SEMIPACK 1 to 6

800V to 2200V: 20A to 1360A

SEMIKRON 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 charging and bypass topologies

SEMiX® 5

50kVA up to 250kVA

Extended standard for superior thermal and dynamic performance

Industry standard baseplate module

650V/1200V/1700V IGBT: 100A to 400A

Sixpack, symmetrical boost, NPC and TNPC topologies

Optimised module layout for maximum heat transfer and enhanced thermal and electrical diode performance

Most complete 3-level and booster portfolio, up to 500kVA in parallel connection

SEMiX® 3 Press-Fit

100kVA up to 300kVA

Exceeding the standard for superior performance

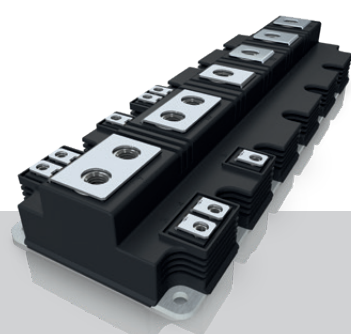
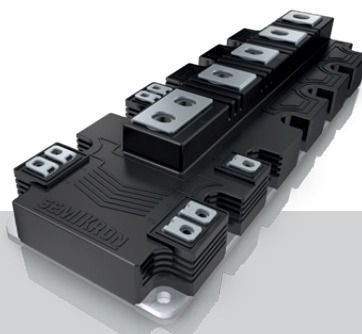
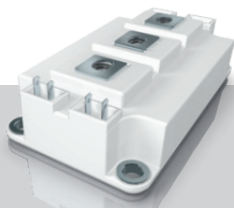
Industry standard press-fit design with 17mm high housing

650V / 1200V / 1700V IGBT: 225A to 700A
1200V Hybrid SiC: 600A

Half-bridge, split NPC and buck/boost topologies

Direct driver assembly

Available with integrated shunt resistor



SEMITRANS® Classic

100kVA up to 600kVA

The proven power electronics package

Robust industry standard package for multiple sourcing in six 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 topologies

Multiple IGBT sources including Generation 7 IGBT M7

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

SEMITRANS® 10

300kVA up to 2MVA

Robust high power module

Established high power module package

1200V IGBT: 1400A

1700V IGBT: 1000A and 1400A

Half-bridge, split NPC and buck/boost topologies

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

SEMITRANS® 10+

300kVA up to 2.5MVA

Higher Power –Same footprint

Naturally extended standard power module to next level of power density

1200V IGBT: 1400A

1700V IGBT: 1000A and 1400A

1200V: 1800A

1700V: 1800A

Half-bridge topology

Double AC Terminal for up to 200A_{RMS} current

High level of flexibility and multiple sourcing approach



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 3 and SKiiP 4 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 3 has become increasingly popular through the industrial drive segment. 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

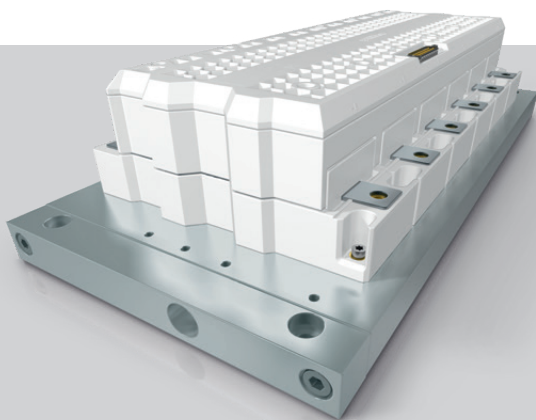
1200V and 1700V

Half-bridges and sixpacks

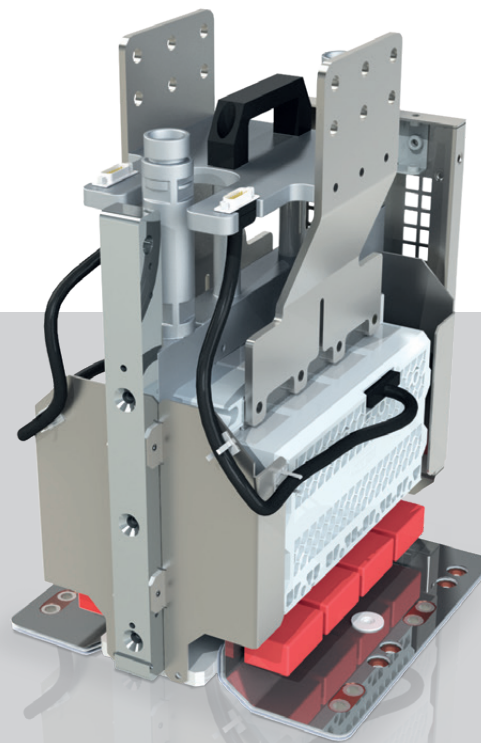
1800A to 3600A

Flexible cooling options: air, water or customised cooling options

Parallel operation for even higher output power possible



SKiiP®4
Up to 2MW



SKiiP®4
with double-sided high
performance cooler



Power Electronic Stack Platforms

Fully Qualified Power Electronic Assemblies Tailored to Your Specific Needs

Standard Stacks

SEMIKRON's 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

Customised Stacks (>5MW)

In addition to standard stacks, SEMIKRON 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 customised converters.

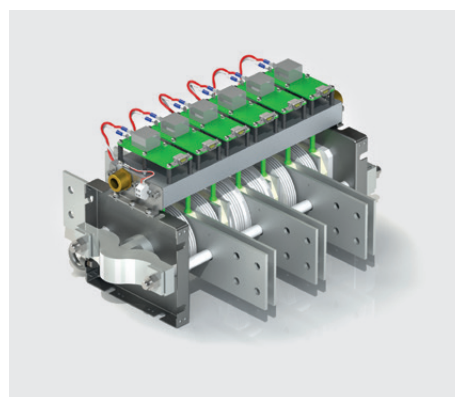
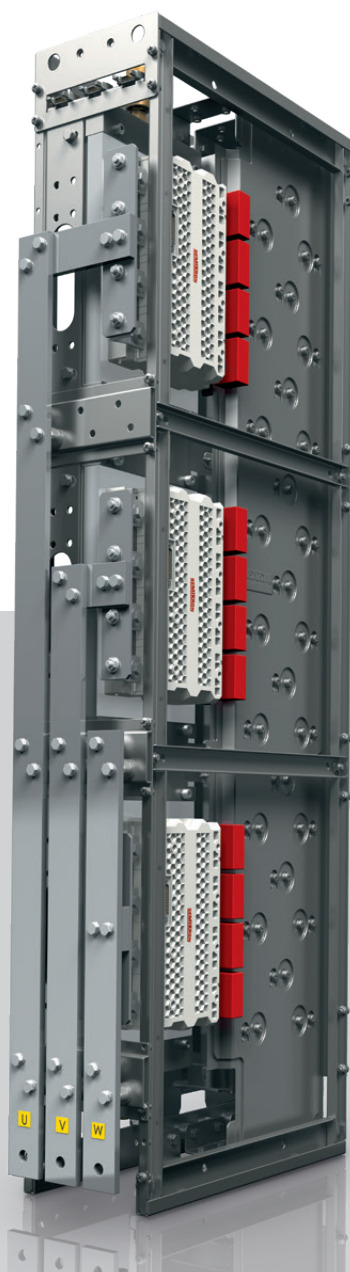
Four key factors for your succes

Shortest time to market

Cost savings in R&D, production and qualification

Global SEMIKRON stack production footprint

Highly experienced engineering team

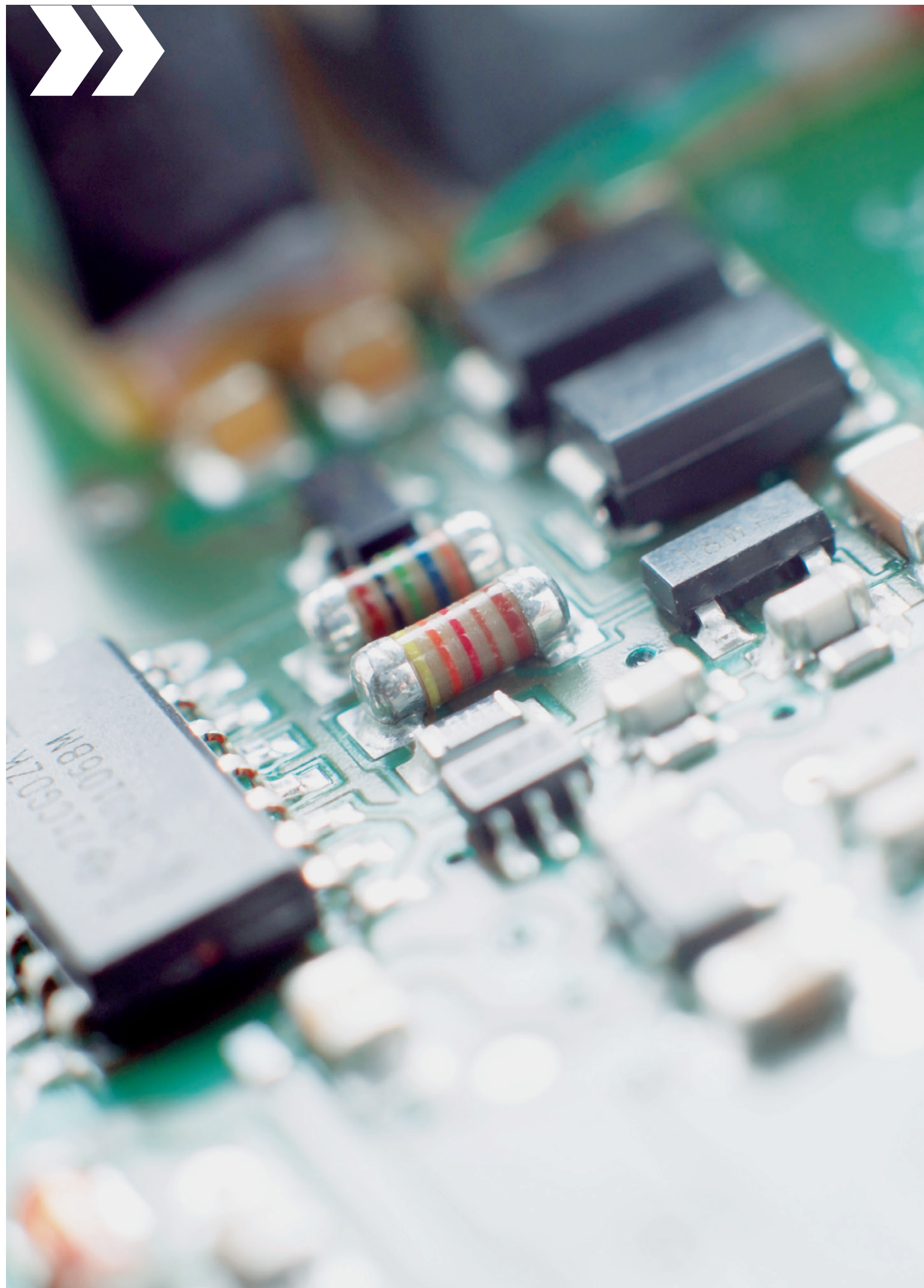


Customised Stacks

3000A controlled rectifier

Standard Stack

Up to 5MW AFE/Chopper



Product Portfolio IGBT Driver

Above the Standard

SEMIKRON's 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.

SEMIKRON's 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 SEMIKRON's 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 to have a short-term solution for almost every challenge related to driver electronics. SEMIKRON's Plug-and-Play drivers connect directly to most common standard IGBT modules. The IGBT driver cores fit with SEMIKRON's adapter boards or application sample PCBs. For the latter, SEMIKRON shares the entire manufacturing data to decrease development time, speeding up the time-to-market.

Reliable

SEMIKRON's 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

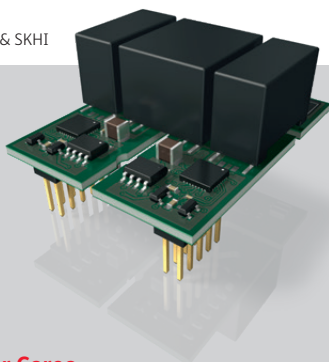
Up to 1500V continuous DC bus voltage

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 ASIC technology and integrated safety functions

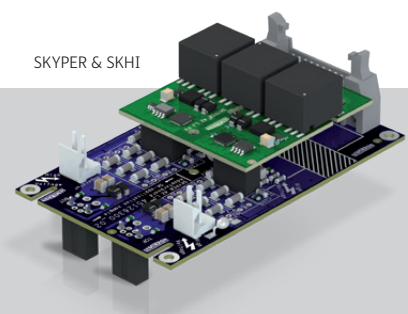
SKYPER



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 IGBT and SiC modules



Thermal Interface Materials

Stay Cool – Heat Dissipation is Our Job

SEMIKRON 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 20 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, SEMIKRON offers 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 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

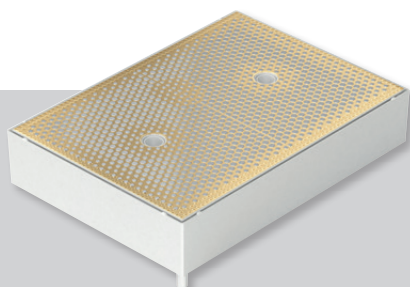
P8: Phase Change Material for highest performance

HT: Phase Change Material for highest sink temperature

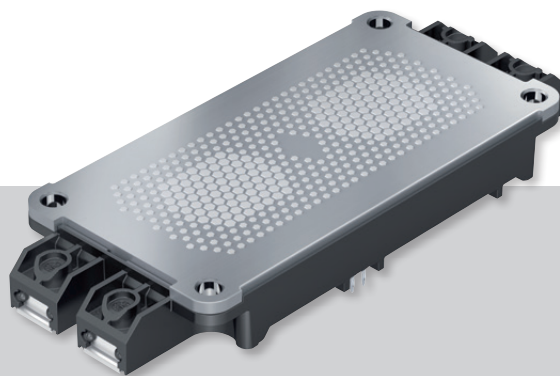
HPTP: High Performance Thermal Paste

P12: Standard Thermal Paste

HP-PCM: High Performance Phase Change Material



**Baseplate-less
Power Modules**



**Baseplate
Power Modules**



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SEMIKRON INTERNATIONAL GmbH

Sigmundstrasse 200
90431 Nuremberg, Germany
Tel: +49 911 6559 6663
sales@semikron.com

www.semikron.com
shop.semikron.com

