

POWER ELECTRONICS FOR POWER SUPPLIES



# Power Supplies



## Performance Range

The category of power supplies covers a wide range of power converters found in laboratory, medical, and industrial settings. They share the common trait of having a well-regulated voltage or current output specified directly by the user. Beyond this commonality, the electrical characteristics can vary widely based on end application. Medical imaging systems such as computed tomography (CT) scanners require high voltages generated across a transformer using low voltage semiconductors. Welding systems work in a similar manner but with the opposite output: high currents at low voltages. In both cases, high switching frequencies and advanced resonant topologies are common.

As a pure power converter, power supplies can be paired with higher-level system controllers to simulate solar arrays or batteries. The variety of form factors, from handheld units to rackmount or cabinet-sized enclosures requires a range of power modules in high-current, robust packages. The use of high frequencies and magnetics means power supplies also stand to benefit from silicon carbide.

## GENERAL

### 10kVA - 250kVA

- Test equipment
- Solar and battery simulators
- Modular power supplies

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Scalable building blocks

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Robust construction

#### Products

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SEMITOP E

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SEMiX 3 Press-Fit

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SEMITRANS Classic

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SEMIPACK

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Drivers

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Discretes

## WELDING AND CUTTING

### 5kVA - 500kVA

- Resistance and arc welders
- Plasma torches

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High output currents

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Pulsed operation

#### Products

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SEMITOP E

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SEMiX 3 Press-Fit

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SEMITRANS Classic

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SEMITRANS 10

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SEMIPACK

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Discretes



## INDUCTION HEATING

### 10kVA - 1MVA

- Tool and component hardening
- Industrial furnaces

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Resonant conversion

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Multiple operating frequency ranges

#### Products

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SEMITOP E

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SEMITRANS Classic

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SEMITRANS 10

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SEMITRANS 20

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SEMIPACK

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SKiip 4/7 IPM

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Discretes

## MEDICAL

### 1kVA - 100kVA

- High voltage power supplies
- X-ray generators
- Imaging systems

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High reliability systems

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High frequency switching

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Compact designs

#### Products

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SEMITOP E

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SEMITRANS Classic

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SEMIPACK





**PRODUCT HIGHLIGHT**

# High Current Half-Bridges in a Standard Package

From engineering test labs to hospital imaging centers, the SEMITRANS Classic is an industry standard workhorse for power supplies .

Thanks to the integration of the latest IGBT M7, the SEMITRANS 3 now carries a maximum current rating of 800A. This gives designers more freedom in sizing building blocks common to scalable power supply architectures such as solar simulators.

If higher frequency operation is required, the SEMITRANS is also offered with High Speed IGBT 4 (12F4). Paired with Semikron Danfoss Ultrafast CAL 4U diodes, these IGBTs offer a 175°C maximum junction temperature and high current density. The 12F4 series can replace the older 125 (Ultrafast NPT) IGBT in many applications and is an excellent choice for new high-frequency designs.

For the highest speed and efficiency, silicon carbide MOSFETs with an equivalent current rating of 500A ( $R_{DS(on)} = 3.8m\Omega$ ) are also available.

With decades of experience producing 62mm packages, Semikron Danfoss continues to optimize this platform and ensure high quality production.

### Key Features

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Extended current range with Generation 7 IGBTs

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Well-proven SEMITRANS Classic package

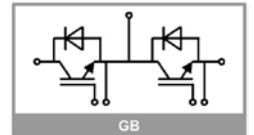
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Designed for medium and high power building blocks up to 600kVA

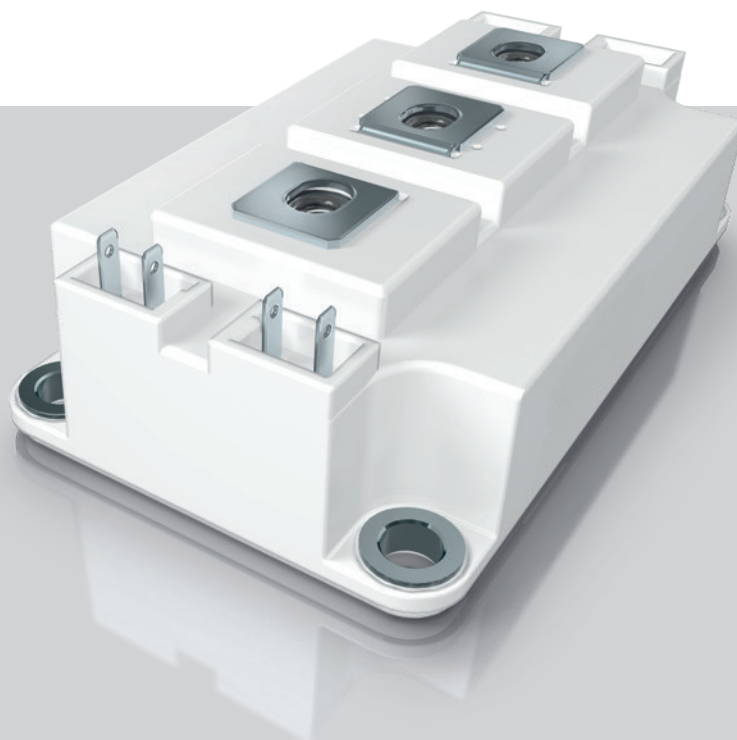
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High speed and high current chipsets available

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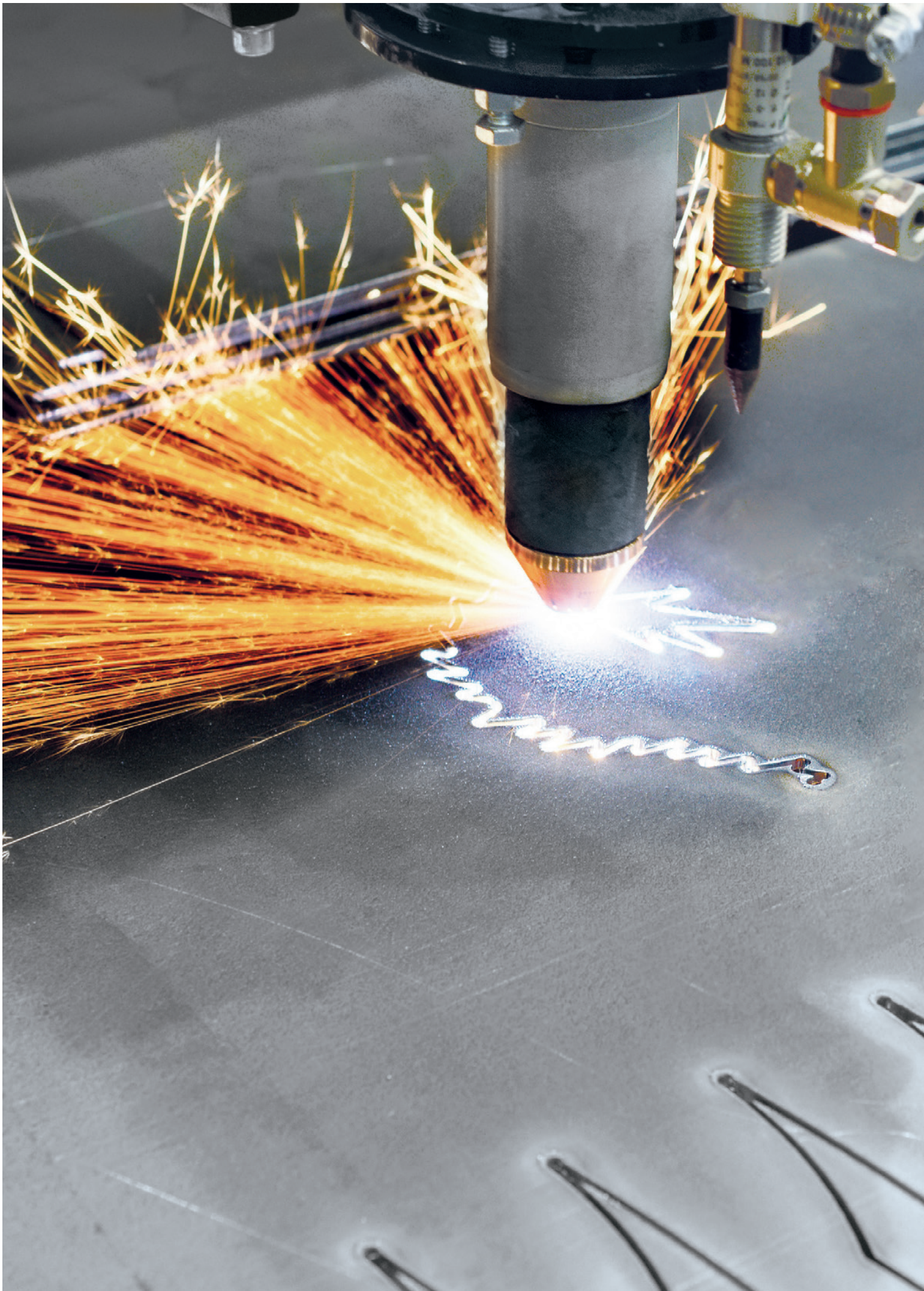


IGBT half-bridge topology



**SEMITRANS® Classic**

100kVA to 600kVA



## PRODUCT HIGHLIGHT

# The New Building Block for High Power Converters

Power converters in the megawatt range are typically constructed from converter blocks in the hundreds of kilowatts and by paralleling of power modules. At these high currents, the need for a low inductance package with balanced switching behavior is critical. The SEMITRANS 20 fulfills this requirement in a new, industry standard form factor.

The module is available with a range of high current 1200V and 1700V Si IGBTs. These make perfect building blocks for next generation, high-power, 2- and 3-level converters.

For the latest trend of 1500V<sub>DC</sub> 2-level converters, the SEMITRANS 20 now comes equipped with a 2kV SiC MOSFET. This brings simplicity and high efficiency to existing applications and opens the door for new ones.

### Key Features

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New standard package for multiple sourcing

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As low as 10nH stray inductance

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Easy DC-link connection

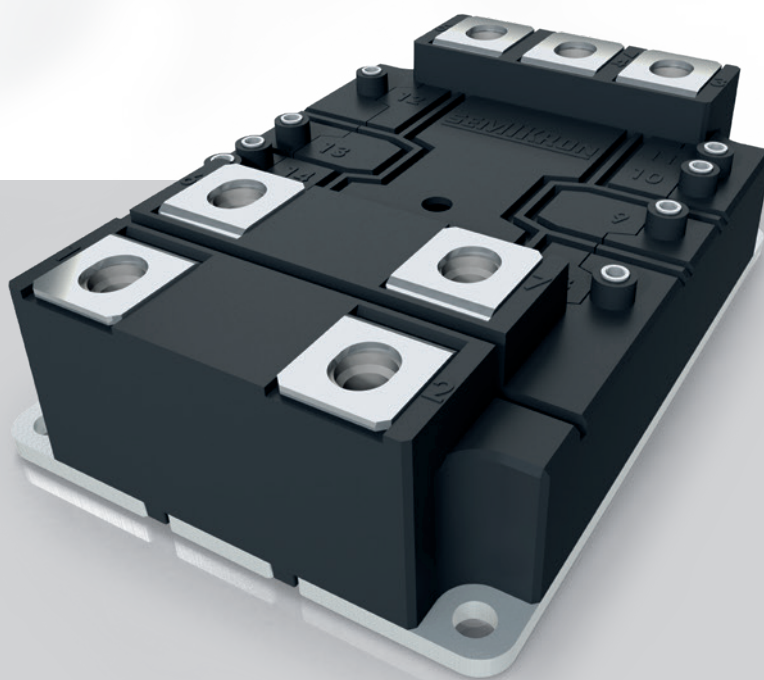
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Symmetrical structure ensures perfect current sharing in multi-module paralleling

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High reliability package from traction industry

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**SEMITRANS® 20**  
500kVA up to 2MVA





# Product Portfolio

## IGBT and Rectifier Modules



**SEMIPACK®**  
800V to 2200V

### Bipolar Modules from the Market Leader

6 housing sizes SEMIPACK 1 to 6

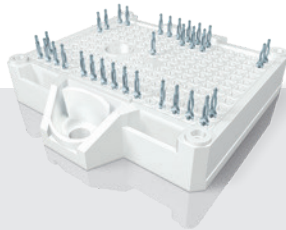
800V to 2200V: 20A to 1360A

Semikron Danfoss diode and thyristor chips

Diodes, thyristors in un-, half- and full-controlled topologies

High reliability pressure contact or cost-effective wire bonded modules

Available with line frequency or high speed diodes



**SEMITOP® E**  
5kVA to 300kVA

### 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: 30A 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



**SEMIX® 3 Press-Fit**  
100kVA to 400kVA

### 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



**SEMITRANS® Classic**  
100kVA to 600kVA

### The Proven Power Electronics Package

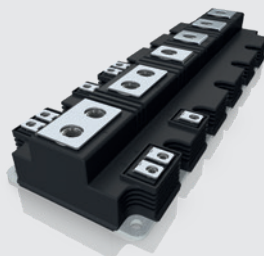
Robust industry standard package for multiple sourcing in 6 housing sizes

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



**SEMITRANS® 10**  
500kVA to 2MVA

### Robust High Power Module

Established high power module package

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

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

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



**SEMITRANS® 20**  
500kVA to 2MVA

### 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



# Intelligent Power Modules – IPMs

## The Most Powerful IPM in the Market

The SKiiP IPM product line sets a 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, also with customized heatsinks. Reliable driver technology, integrated current sensors and comprehensive protection functions complete the IPM design.

SKiiP 7 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.

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.

### Key Features

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Half-bridges and sixpacks

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

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2000V SiC: 1200A to 2400A

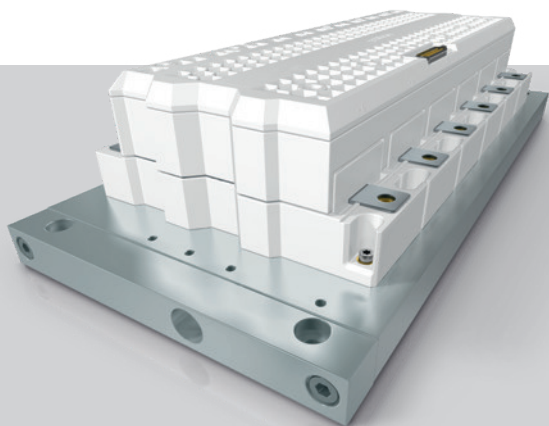
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Flexible cooling options: air, water or customized cooling options

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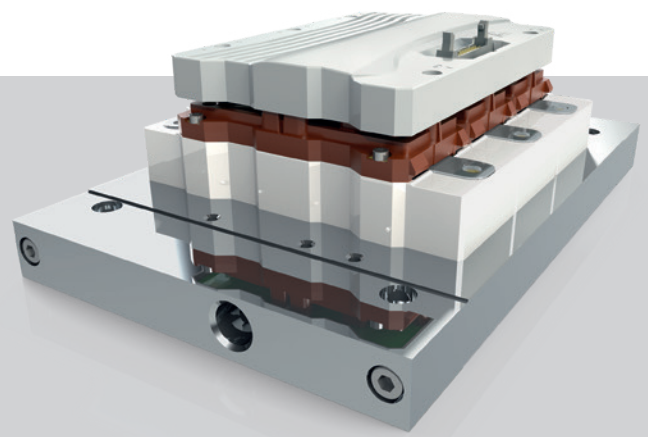
Paralleled operation for even higher output power possible

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### SKiiP®4

Up to 2MW  
available with 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

The 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 200A to 4000A.

## Water-Cooled IGBT Stacks

SEMIKUBE  
SKiiPRACK

## Air-Cooled IGBT Stacks

SEMIKUBE  
SEMIKUBE SlimLine

## Diode/Thyristor Stacks

SEMISTACK CLASSIC B6U/B6C/W3C

## Customized Stacks

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

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Shortest time to market

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Cost savings in R&D, production and qualification

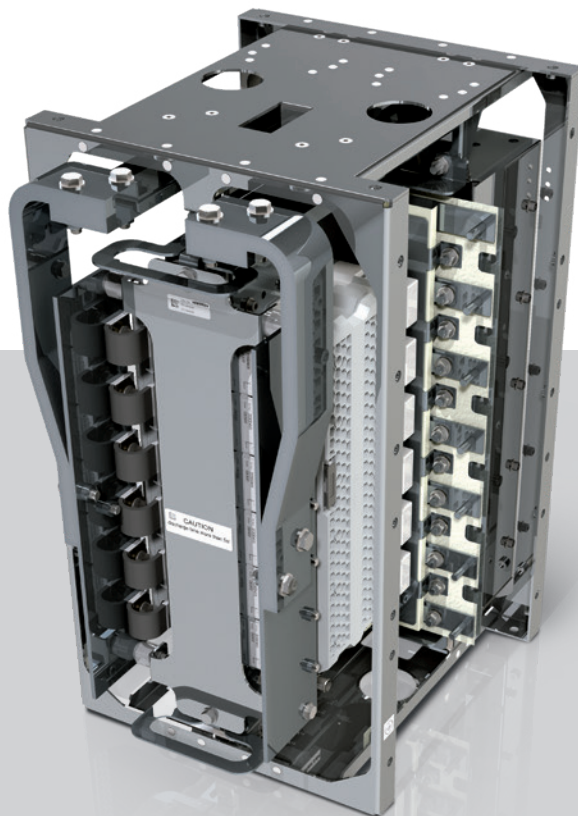
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Global Semikron Danfoss stack production footprint

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Highly experienced engineering team

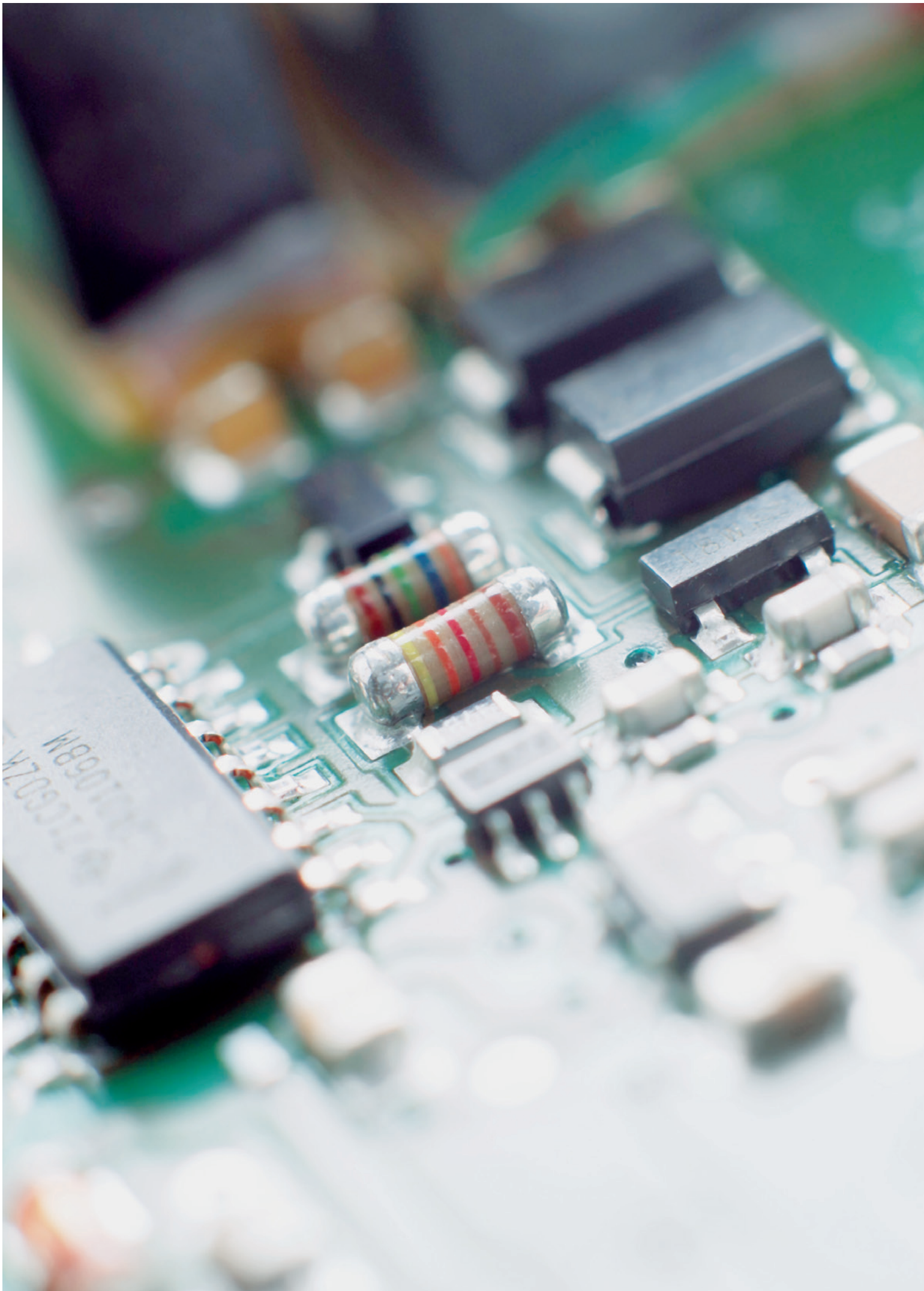
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Standard Water-cooled  
H-Bridge converter (2200A)



Customized Air cooled  
4 phases converter (200A)



# 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 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 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

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Reinforced insulation for signal and power transmission

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Two-channel driver

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Up to 1700V transients

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Up to 1500V continuous DC bus voltage

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8Apk to 35Apk per channel

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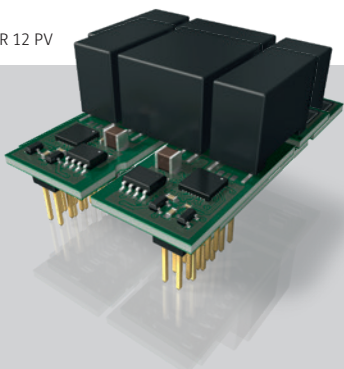
1W to 4.2W peak per channel

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Suitable for multi-level topologies and Generation 7 IGBT

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SKYPER 12 PV



### Driver Cores

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

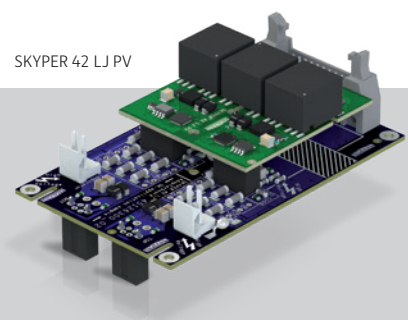
SKYPER 12 Press-fit



### 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.

Semikron Danfoss offers either thermal grease or phase change material depending on customer requirements (e.g. performance increase, reduced handling effort) and module type (with or without baseplate). The reliable assembly of baseplate-less modules is aided by a low-viscosity material such as thermal paste. Our High Performance Thermal Paste (HPTP) achieves this and, with optimized filler content, provides best in class thermal performance.

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.

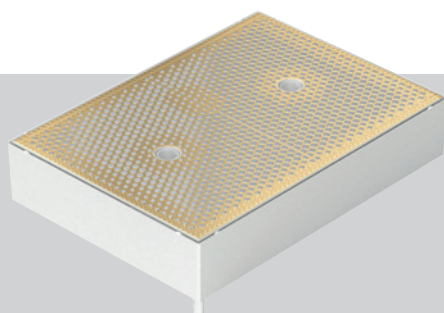
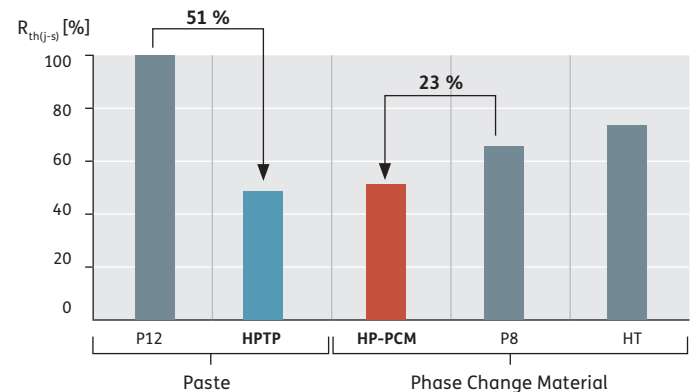
### Key Features

- Module-specific patterns for optimized TIM distribution
- 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 CO<sub>2</sub> 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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