

ENGINEERING
TOMORROW

Danfoss

ShowerPower®

Cost **efficient** cooling. Tailor-made
for **maximum** heat transfer

Up to
50%

less silicon require
compared to standard
cooling solutions.

siliconpower.danfoss.com

Three key benefits

- Eliminate the thermal interface material (TIM) that is normally used between the power modules and heat sink/cold plate.
- Secure homogenous cooling to eliminate temperature gradients across large power modules
- Reduce costs and increase component reliability

ShowerPower® is a unique concept for direct liquid cooling of power modules. The patented technology offers superior thermal performance at a very low cost.

ShowerPower® makes it possible to cool standard, flat baseplate power modules using low cost plastic parts. This is the result of a high heat transfer coefficient, the ability to secure homogenous cooling, all with a low differential pressure drop.

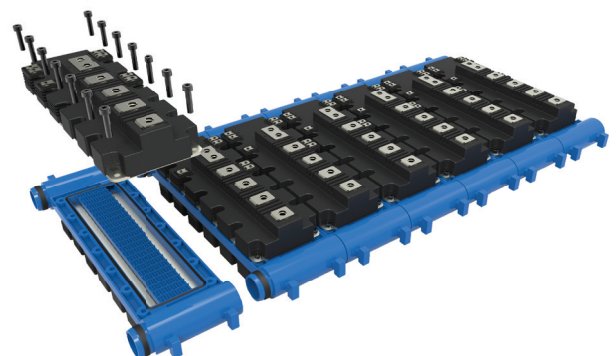
Tailor cooling for optimal results

Homogenous cooling is essential in many applications. Especially in power modules that comprise several power semiconductors that are switched in parallel and therefore need the same operating temperatures. Homogenous cooling is particularly beneficial in wind turbine generators where huge assemblies of large power modules are running in parallel.

By tailoring the way the coolant moves along the module surface intelligently, it is also possible to achieve better cooling at for example hotspots without jeopardising the overall cooling efficiency.

LONG LIFETIME

In accelerated lifetime tests ShowerPower® has been able to provide constant cooling performance and secure water tightness for the requested lifetime of the system. Long term investigations at highly elevated temperatures (105°C) result in proven solutions for the 20 years of reliable service required by the wind industry.





ShowerPower® COMBINES THE BEST OF TWO WORLDS
high heat transfer related to turbulence and low pressure drop associated with laminar flow.

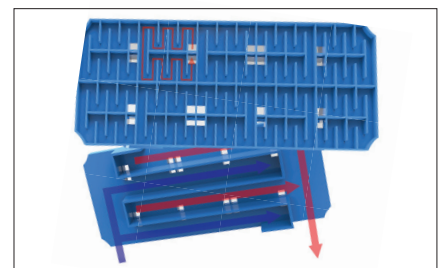
Boost reliability

By eliminating the thermal interface material (TIM) it is possible to reduce complexity in design and increase the reliability of the application. This is especially important in applications that need long lifetimes, where pump-out and dry-out effects of the thermal interface material are known to be problematic.

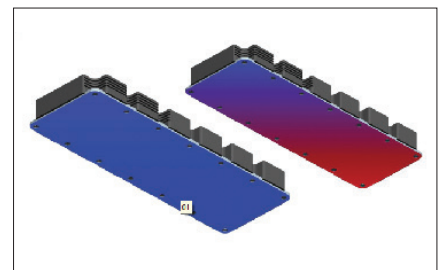
By integrating ShowerPower® in wind turbines the cost of energy can be reduced, making the wind turbine a more profitable investment.

Easily scalable

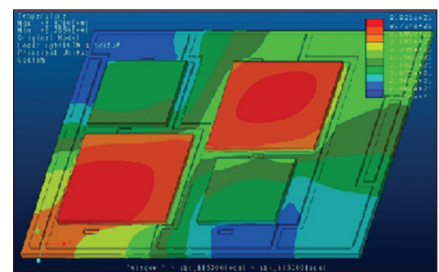
ShowerPower® offers the opportunity to design easily scalable power stage solutions. Combined with transfer molded power module technology, ShowerPower® enables 3D solutions that offer the highest possible power density and great potential in a wide array of applications.



The ShowerPower® principle.



Direct liquid cooling versus cold plate.



Localised cooling, only underneath the chips.

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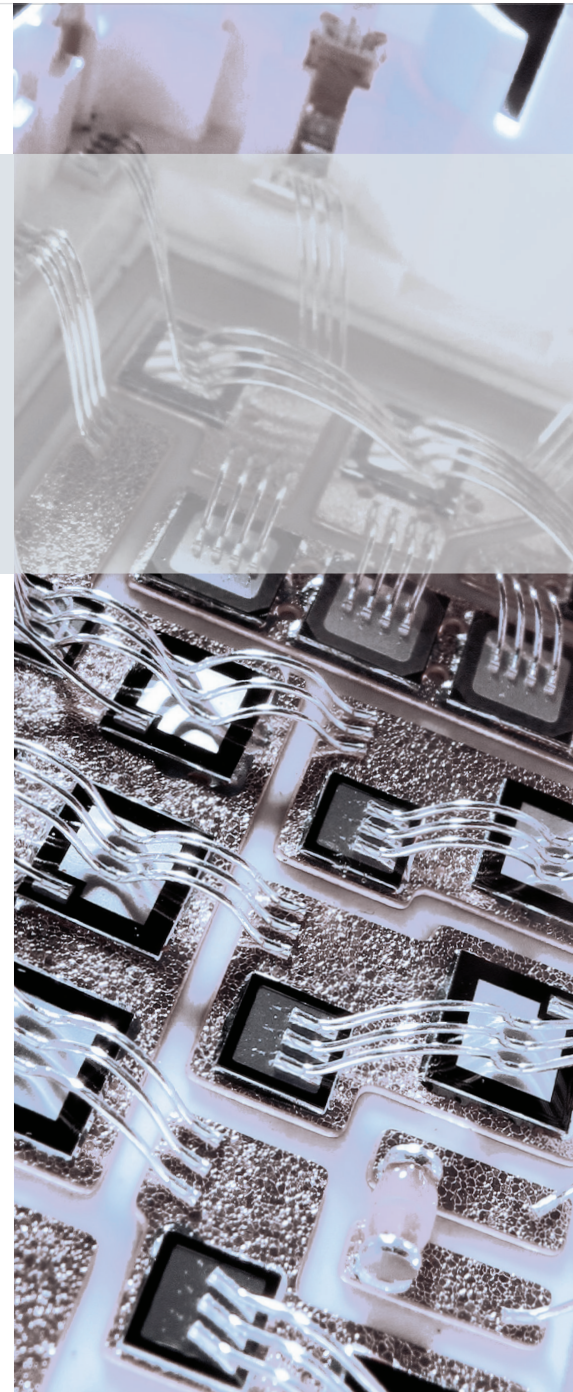
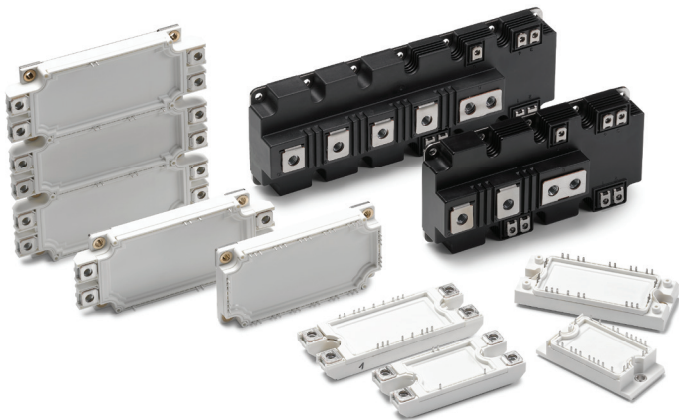
Based in Flensburg, Germany, Danfoss Silicon Power is a leading developer of customer specific IGBT and MOSFET modules and power stacks for power intensive applications.

Our power modules and power stacks are a preferred choice in demanding automotive and wind power applications and a wide variety of industrial applications.

Our 35,000 m² research, development and production facility is certified according ISO 9001, ISO/TS 16949, ISO 14001, ISO 50001 and OHSAS 18001. This enables us to quickly transfer

development projects to high volume production that can be integrated seamlessly into our customers' supply chain with full focus on quality.

Danfoss Silicon Power is a subsidiary of the Danfoss Group, the largest industrial company in Denmark. Danfoss employs more than 24,000 people in 100 countries within development, production, sales and support.



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