



SKAI systems are compact power electronic systems designed for use in hybrid and electric agricultural machinery, construction machinery and hoisting and conveying equipment, as well as in any battery-powered vehicles.

ALWAYS ONE STEP AHEAD

Semikron's innovative modules and systems are shaping the market for power electronics – and Semikron is always up to date on the latest developments such as e-mobility or renewables.

Text: Michael Brunn, Editor-in-Chief E&E

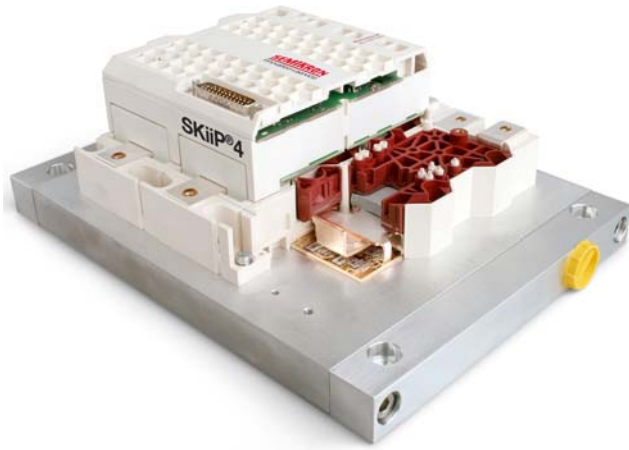
Almost 60 years have passed since the first selenium rectifiers were developed at Semikron Nuremberg. The face of the company today, however, is a far cry from the “back-yard” workshop environment of 1951. In fact, Semikron is now one of the top players on the international power electronics stage. The basis for this was a groundbreaking invention in the 1970s, when Semikron first managed to separate the thermal and electrical paths using ceramic layers. This basis was evolved over the course of subsequent years – always with a view to becoming technology leader in this market. A further point that sets Semikron apart from others in this market is its innovative new ideas and packaging concepts. Here, the main aim is to tap into new markets and offer customers important advantages. What is a must here, however, is a great deal of patience. “It takes some time for new ideas and technologies to break through on a market,” explains Thomas Grasshoff, Head of Product Management. In this somewhat conservative market, the customers often need time to get accustomed to innovative solutions. Here, the crucial edge that Semikron has is that it is an owner-run business that can pursue its own long-term strategy, irrespective of short-lived economic developments. A good example of the lengthy processes involved in the introduction of a new technology is the spring contact technology that Semikron introduced in 1996 in its MiniSKiiP module. This module makes electrical contact using springs. It does not have to be soldered and can be easily integrated into automated manufacturing. In this way, far more compact converters can be made. And yet it still took a number of years for this technology to be established on the market. Today, even our competitors are using spring contact technology.

Integration as a key competence

When asked what the often rather broadly intended term power electronics means to Semikron, Thomas Grasshoff answers: On the one hand, it is the production of our own diodes and thyristors from wafer to chip which are then integrated into bigger systems. At Semikron discrete solutions do not play a role. But it's more than that – it's also the integration of electronics, driver and cooling in total systems. “Semikron covers the entire supply chain on the power electronics market,” explains Thomas Grasshoff, from chip to module to stack. “From Chip to Systems” is Semikron's motto, too. For the chief customer requirement, i.e. to make systems smaller and cheaper, cannot be met through the end product alone, but through the interplay between the individual components in the system. Here, solutions of 500W and above play a role, while low-power applications, white goods or air conditioning systems are left to competitors.

International orientation

Shortly after its establishment, Semikron set about moving the company to the international stage. By the 1960s, Semikron was present in Italy, France Brazil and Asia. A move that was initially driven by strong competition in Germany turned out to be the right strategy. Today, the company is present in a total of 35 countries across the globe; this enables the company to offer customers individual solutions that meet their specific demands and gain early insight into the market and market trends. But these offices are more than just sales offices. In fact, on-site development engineers and application experts are available to implement custom solutions. Production sites also exist at various locations. “One product intended for the global market is manufactured at one location,”



SKiiP 4 features sintered rather than soldered IGBTs and diodes and boasts 4 times the load cycling capacity, making it far more robust than modules with soldered connections.

says Thomas Grasshoff, describing the principle. Every production location is a competence centre in itself. For example, chip, diode and thyristor production is in Germany, as is pressure contact technology, while in Slovakia traditional baseplate modules are made. Incidentally, at Semikron relocation to other locations is done for a very simple reason, namely to create space in Nuremberg for new technologies.

New growth markets

As is the case with many manufacturers of power electronics, the drives sector plays a major role for Semikron too. This market accounts for more than 50 percent of the entire power electronics market worldwide. The cost pressure on this market is particularly strong, which is why highly cost-efficient assembly and connection technologies are needed. In the past ten years, however, two other sectors have brought about huge growth on the power electronics market. In fact, as a result of the ever urgent call for energy efficiency and energy savings, the areas of renewables and e-mobility have taken on great significance. This can be seen at Semikron, too. For example, not only has the number of employees seen a huge increase over the same period from 2,000 to 3,200. In fact, this year the area of renewables is on a par with conventional powertrains sector as regards turnover figures.

Ruggedness is a must

In the area of renewable energy, Semikron is active on the wind and solar power front. As much as 20 years ago, Semikron was involved in the production of the first IGBT-controlled wind power units. This quick move onto this market has now paid off: around 50 percent of the total wind power installed globally today features

Semikron inverter technology. And the prospects continue to be good: experts are expecting to see 20-25% growth on the wind power market each year. Here, the focus is on the expansion of capacity, on the one hand, and technical improvement, on the other. Reliability is one of the most important criteria for wind power applications. A further important aspect here is space, since the inverters are normally installed in the turbine nacelle.

In the next generation of SKiiP modules,



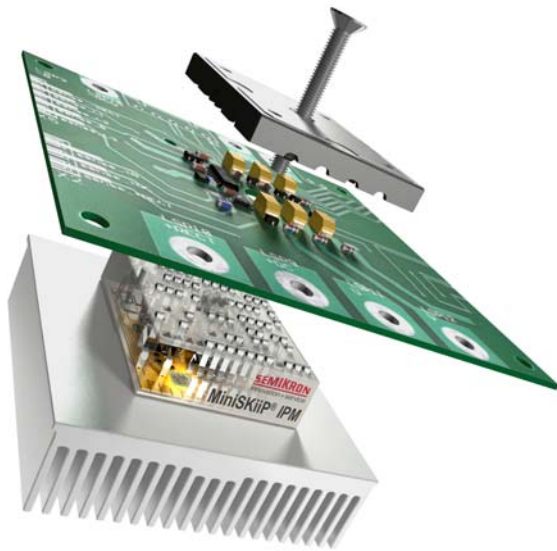
**Thomas Grasshoff,
Head of Product
Management
SEMIKRON**

of SKiiP modules, Semikron came up with an advanced solution.

The module comprising driver and power circuitries and heat sink offers up to 30 percent more power density than its predecessor, thus saving space and costs. In addition, the switching losses are 20 percent lower, meaning more energy can be

converted. "As the IGBTs and diodes are no longer soldered but sintered instead, SKiiP 4 has four times the load cycling capacity," explains product manager Andreas Winterholler. "This is why SKiiP 4 modules are far more robust than soldered modules, which is why the failure rate is lower".

In offshore wind parks, failure is particularly disastrous, which is why Semikron offers an additional burn-in-test in which the inverters are tested to their specification limits for 60 and 120 minutes. SKiiP 4 modules include a further novelty - a digital driver. As a result, fewer components are needed and the interface is less sensitive to interference. The use of a diagnosis



MiniSKIIP module - first integrated IGBT power inverter module in solder-free spring contact technology

interface enables differentiated error analysis. These modules also feature an intelliOff function for optimum turn-off based on three adjustable resistances.

Systems for wind and solar power

The significance of a systems and integration approach is particularly important for wind power applications. The manufacturers of WPU do not come from the electronics sector and therefore need finished systems that meet their demands. This is where Semikron comes in, offering suitable stacks featuring power electronics, driver and heat sink in one system. The same applies to solar power systems manufacturers whose key competence is not electronics either. Here, Semikron makes a distinction between low-power solutions up to 5 kW for use in private applications and centralised inverters for large solar parks with outputs of up to 500 kW - a figure which is on the rise. At the moment, 3-level and multi-level inverters are in particularly high demand for solar applications. These inverters, originally used in UPS systems, provide a better approximation of the desired sinusoidal wave. A further merit of multi-level inverters is that they offer three voltage states, while in other modules ON and OFF are the only possible voltage states. In solar applications, where efficiency is crucial, the energy has to be fed into the grid with minimum losses. 3-level inverters enable higher voltages and correspondingly lower currents. In comparison

to 2-switch topologies, this brings about a 1.5 - 2% increase in efficiency.



**Andreas Winterholler,
Product Manager
SEMIKRON
International**

In general, renewable energies pose entirely new problems for electricity companies and consequently for power electronic systems, too. Besides the previous top-down infrastructure from the power plant to the consumer, we now have a situation where power is being fed into different

grids from various power generation systems. In addition to dynamic consumption, we are now suddenly faced with dynamic grid feed, too. These fluctuations have to be offset by grid operators - a huge challenge for power electronic systems.

E-mobility

A further new challenge is e-mobility. But here, too, Semikron boasts a wealth of experience: in the 1990s power electronics were used for the first ever hybrid vehicles; for almost 20 years Semikron has been one of the main suppliers of technology for forklift equipment. The takeover of Compact Dynamics opens up possibilities for the electronics industry at large on one of the most viable future markets. This takeover has brought about innovative technologies used in race cars which are to be implemented in conventional vehicles in the future. In the

mobility industry, too, Semikron's core competence lies in the integration of power and drive electronics. "We believe that these two areas will become even more closely entwined in the future," explains Thomas Grasshoff. "It has to be small and lightweight and mustn't cost much either." According to Mr Grasshoff, costs are instrumental to the breakthrough of hybrid and electric vehicles.

Technology pioneer

"The reduction of losses, size and cooling measures – these are the three areas where power electronics come into play," says Thomas Grasshoff, explaining the role of power electronic systems. Here, a number of factors are important, not least new assembly and connection technologies. For example, for some time now Semikron has been using sintered rather than conventional soldered connections – an

impressive example of how existing technologies can be used to create innovative new solutions – and has really shaken up the market. According to experts, the next logical step here is to eliminate bond connections entirely to enable higher temperatures. "Step by step one weak point after another is being eliminated and new, improved solutions are taking their place," says Andreas Winterholler, explaining the Semikron approach. Semikron is continuing to work on setting the pace in power electronics. Even competitors duly recognise the innovative strength of the Nuremberg-based company. The real thanks, however, goes to the customers, who put their trust in Semikron power electronic systems time and again.

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