



# More Choices, Greater Security

...no supply chain issues and top performance with IGBT M7 *flow* E and MiniSKiiP® power modules

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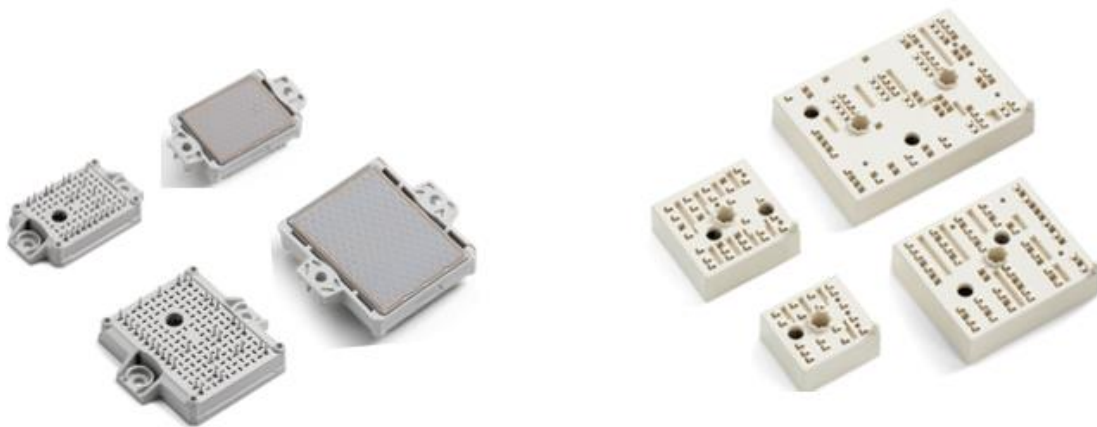
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There is trouble ahead for the electronics industry when demand spikes and supply slumps because semiconductor suppliers are slow to invest in production capacity. This would minimize customers' growth opportunities. A smart multi-sourcing strategy is the solution for this kind of problem. It is obvious that the best time to implement such a strategy is not when pending line-down situation occurs because of supply chain issue. Furthermore a proactive approach is needed to research possibilities and to establish resources for evaluation and qualification of second sources. Vincotech developed the new IGBT M7 *flow* E1/E2 and MiniSKiiP® products with two priorities in mind – to deliver the benefits of multi-sourcing while raising the performance bar for these product types.

A multi-sourcing strategy could certainly make the supply chain more reliable, but only if it factors both mechanical and electrical components into the design. Vincotech covered both aspects: The Company rolled out the new *flow* E standard industry package for low-power motor drive applications to complement its standard package portfolio besides the already existing MiniSKiiP® package. Both MiniSKiiP® and *flow* E1/E2 packages ship with the recently released IGBT M7 chip technology. The key features and benefits of the new package and the new chip technology will be discussed in detail.



**flow E and MiniSKiiP® package:**



*Figure 1: Industry standard flow E and MiniSKiiP® packages for low power motion control applications*

Vincotech developed the **flow E1/E2** package as an alternative to the easy package. It is a 12 mm-high low inductive housing with two lateral mounting screws, either press-fit pins or solder pins and no baseplate. The housing's footprint and pin-out are fully compatible with standard topologies. Customers can use the same heat sink and a printed circuit board (PCB) with identical specifications. On the other hand effort was putted while development to raise the performance bar. The housing design were optimized for an excellent mechanical contact on the heat sink. In course of this optimization the low thermal resistance phase change material was possible to be utilized for this package for the first time. The result is a superior thermal performance compared to the competition. A pressure distribution benchmark for *flow E1/E2* in comparison with a competitor easy 1b/2b module can be seen in figure 2. Both modules were screwed down onto a flat heat sink. This bench test took the easy module's mounting instructions and TIM thickness into account. The optimized *flow E* housing clearly distributes pressure much better than the competing product. This means it can take a thinner layer of phase change material to mitigate the risk of over-stressing the direct copper bonding (DCB). Its superior thermal performance –up to 15% better than the competition – translates directly into greater reliability.

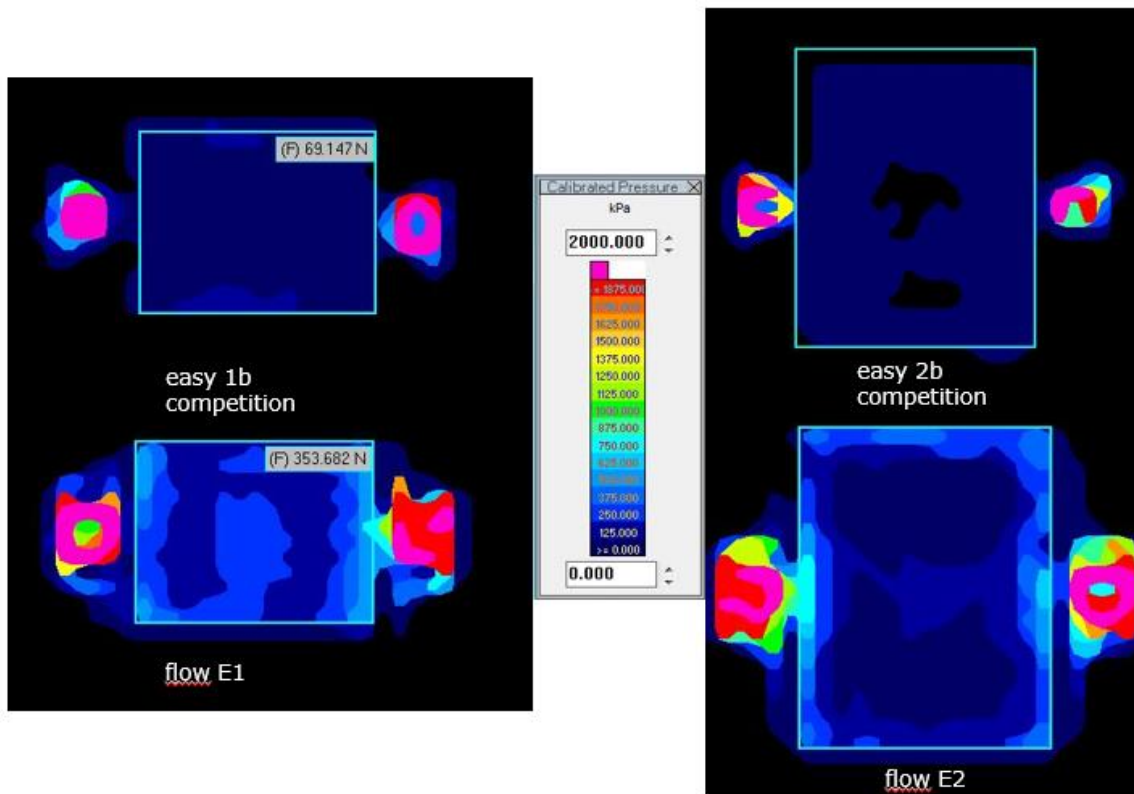


Figure 2: Pressure distribution benchmark for flow E1 and the competition (on the left) and flow E2 and competition (on the right). The flow E modules thermal contact to the heat sink is much better, resulting in lower  $R_{th(j-s)}$ .

Vincotech chose a housing material for the new *flow E1/E2* package rated for the highest CTI (Comparative Tracking Index) value of 600. CTI defines the electrical breakdown properties of an insulating material. The higher the value, the lower the minimum creepage distance and the less clearance needed between two conductive parts – which adds up to a more compact design.

**MiniSKiiP®** is the industry standard package with the solder-free SPRiNG Technology for minimum assembly time thanks to the single or two-screw connection. The PCB, the power module and the heat sink are all assembled in a single step. In 2018, Vincotech bought tools of its own for size 1, 2 and 3 housings to mitigate housing supply issues and offer a real second-source option. The company took this as an opportunity to also upgrade the housing material and step up the CTI value from 200 to 600. On top of that, the new housing material has a higher heat deflection rating, enabling modules to operate at elevated temperatures.

**IGBT M7:**

Mitsubishi Electric recently rolled out its latest generation 7 of chip technology. The company improved the IGBT M7 with ultra-thin wafer processing, which reduced  $V_{CEsat}$  and associated losses. Figure 3 (bottom) compares  $V_{CEsat}$  of the IGBT M7 and the competition to show that the IGBT M7's conduction power losses are more than 20% lower. The new Relaxed Field of Cathode (RFC) structure of the M7 diode significantly improves the Erec without the usual increase in Vf and leads to a reduction in reverse recovery losses. In addition, the softness of the M7 diode has been improved, reducing the effort needed to meet the system's EMI requirements.

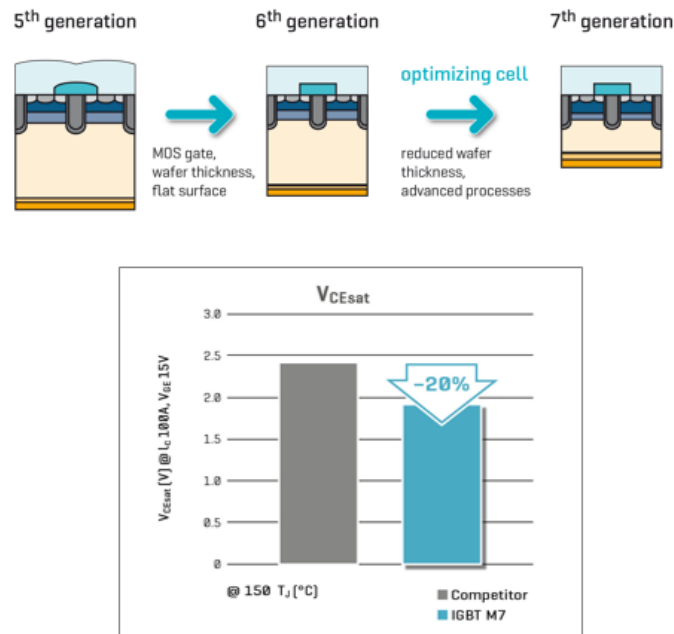


Figure 3: The above cross-sections compare the structures of chips from generation to generation; the chart below benchmarks  $V_{CEsat}$  for competing products.

Vincotech installed the latest IGBT M7 chips into *flow E* and MiniSKiiP® products, which also come with the widely used TRENCHSTOP™ IGBT4 chips. The company is now manufacturing these new IGBT M7 *flow E* and MiniSKiiP® modules as standard products to offer customers a real alternative engineered to deliver even better performance.

The reduced saturation voltage results in lower total losses at a given operation point, which yields higher output power. Figure 4 compares output power at the maximum allowed T<sub>j</sub> temperature of 150°C at switching frequencies ranging from 2 to 16 kHz. The *flowPIM E2* 1200 V/25 A module and a competitor's equivalent module were benchmarked to this end. This



bench test revealed that the new *flow*PIM E2 featuring the IGBT M7 outperforms the competition by delivering up to 15% higher output power.

Besides the achieved 20% reduced saturation losses, at the same time the chip size of the IGBT M7 has been reduced by almost 25%. Thanks to this reduction, the power level of the *flow* E and MiniSKiiP® products could be increased, either with a frame size jump or with power extension in the same package. Take, for example, the *flow* E with 1200 V products shown in figure 5. For the Converter-Inverter-Brake (CBI) topology the maximum current rating of 50 A can be realized in a *flow* E1 housing instead of a *flow* E2 housing. This means same power in 35% smaller packages for more compact inverter designs. On the other side a 30% higher power density can be achieved in the *flow* E2 package for the sixpack topology by increasing the maximum current from 75 A up to 100 A. The MiniSKiiP® product portfolio offers the same power boost with the benefit of the added IGBT M7. It brings greater power density to legacy MiniSKiiP® designs.

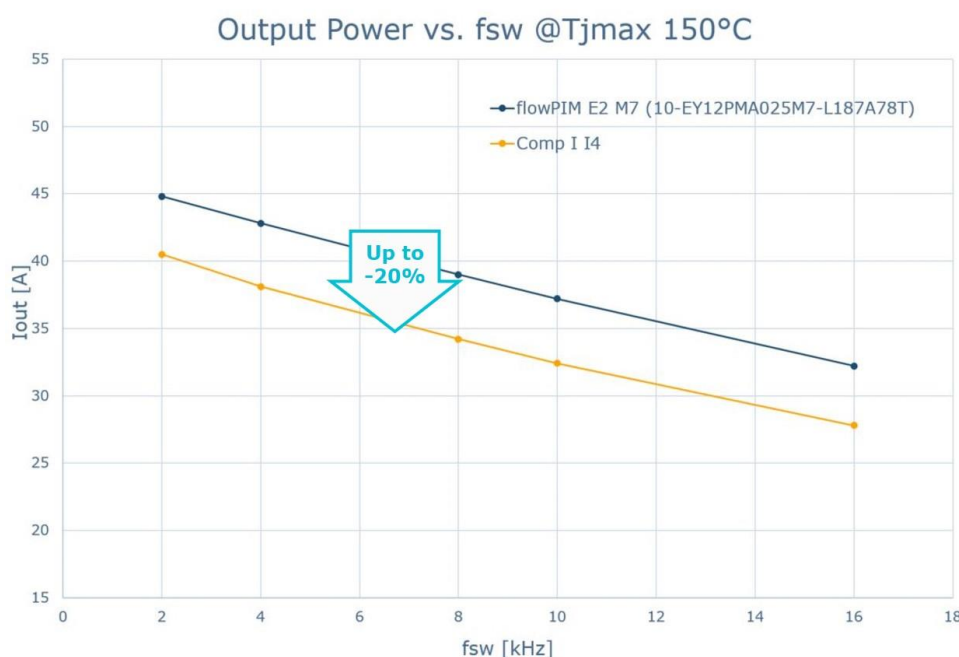


Figure 4: Output power losses vs.  $f_{sw}$  benchmarked at maximum allowed  $T_j$  temperature of 150°C ( $f_{out}=50\text{Hz}$ ,  $T_{sink}=80^\circ\text{C}$ ,  $V_{out}=340\text{ V}$ )

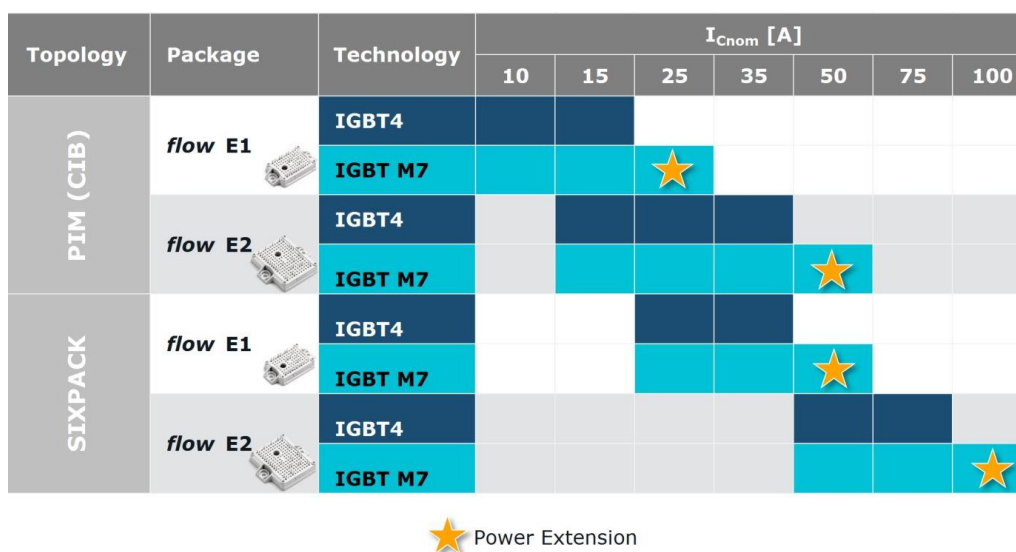


Figure 5: The flow E IGBT M7 1200 V product portfolio

**Summary:**

“More choices, greater security” – that is Vincotech’s answer to customers’ demand for a more reliable supply chain. The new *flow* E IGBT M7 and the upgraded MiniSKiiP® IGBT M7 product lines afford the customer freedom of choice with real multi-sourcing options at every mechanical and electrical level. And the company has sweetened the deal with superior thermal performance and maximum output power to increase reliability and enable more compact and scalable inverter designs.