Flexible One-Step Mounting Technology

Aiming to cut assembly costs and avert inverter assembly flaws, several companies now offer power modules that can be mounted in a single step. Vincotech taken this notion and developed a novel Press-fit technology and made it available in a wide range of products, including modules with pre-applied phase change material and thermal grease. These power modules also enable low inductance designs. The article looks closer at how power modules, engineered for one-step assembly encompassing the PCB and heatsink, make life easier for manufacturers. **Patrick Baginski, Field Application Engineer, Vincotech, Unterhaching/Munich, Germany**

Most power modules today compel manufacturers to assemble units for their applications in several steps. Someone has to apply thermal interface material, mount the module to the heatsink, solder the module's pins to a printed circuit board (PCB), and fix the PCB to the module to relieve its pins of any mechanical stress. All this takes time and costs money. Manufacturers have been asking for something better and faster. Suppliers responded by marketing pressure, spring and press-in contacts. Vincotech's power modules enable low inductance designs and come along with pre-applied phase change material and thermal grease.

Mounting the power module, PCB and heat sink in a single step reduce effort and overhead. Figure 1 shows the basic structure of such modules:

1. The actual power module with optional pre-applied thermal grease or phase-change material
2. The PCB, which can be designed for modules with pressure contacts or with vias when using Press-fit pins
3. The pressure lid

The lid fixes the entire system, including the heat sink. There is no other way to apply pressure from the top on down to the bottom. But this setup has its drawbacks: The lid is relatively heavy because it has to bear up under considerable mechanical force bearing down from above. It also has to disperse this force across the entire area. Bracings have to be inserted in the structure to ensure mechanical stability. Some approches require the lid only during mounting; others need it to operate. Modules for higher power applications need two holes to handle the pressure and force. However, two screws defeat the purpose of one-step mounting.

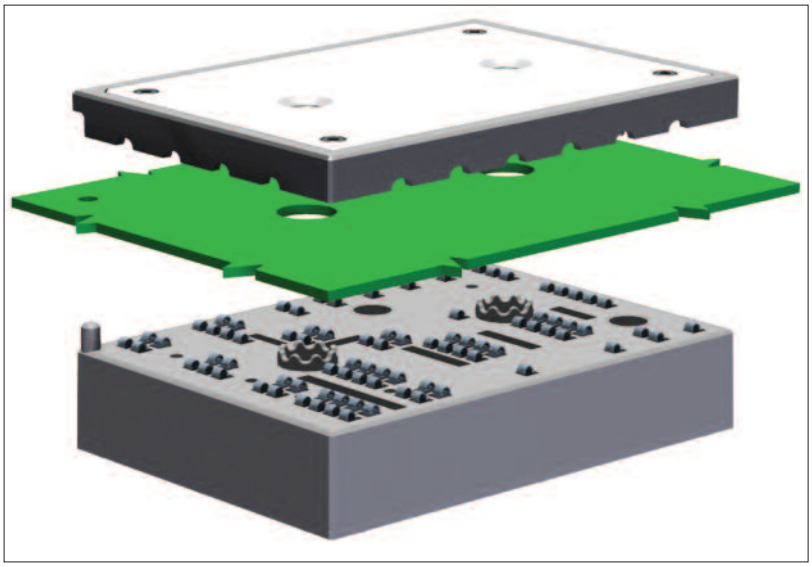


Figure 1: **State-of-the art one-step mounting technology**

Putting one or more holes in the middle of the module substrate takes up space better devoted to semiconductors. Bond wires have to be routed around the hole, which increases stray inductance within the module and throughout the application. Some legacy power modules' concave base requires more thermal interface material than a convex base, thereby increasing thermal resistance to the heat sink. A lid also limits the options when it comes to laying components out on the PCB.

The answer to one-step mounting solution

The answer to all these problems is a module without a lid and without holes in the middle of the housing. And the key is the interconnection between the module and heat sink. Vincotech's solution features two mounting holes at the module's edges. These holes are in the lateral mounting straps on the sides of the module, which means the base can be convex. The mounting straps are pressed down and fixed with the heat sink in one step. The modules' base bends, creating a flat surface, and a pre-applied thin layer of thermal interface material results in metal-to-metal contact where it is possible. For true one-step mounting, the module pins and PCB have to be interconnected at the same time.

The actual module is based on a combination of the flow technology and Press-fit contact pins. Every module has a pre-bent DBC and a step of a certain height between the mounting straps and the DBC to ensure long-term stability and very low thermal resistance to the heat sink. Thanks to flow technology, pins may be positioned freely. It also accommodates custom topologies.

Bushings and bolts rather than screws hold the module down, as illustrated in

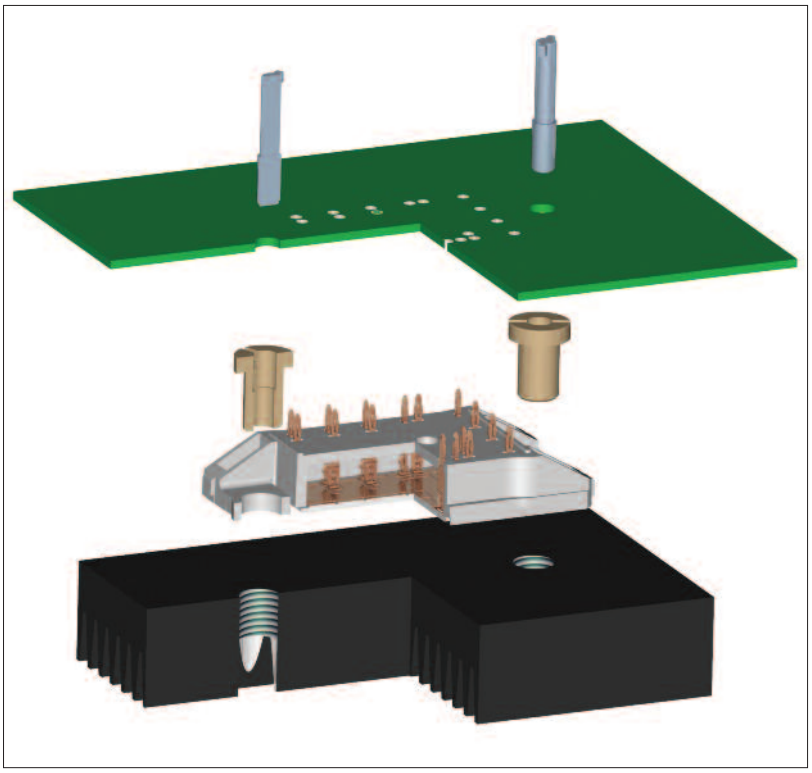


Figure 2: **Flexible one-step mounting**

Figure 2. The bushing needs a blind or through-hole in the heat sink. These bushings are inserted into mounting straps after the thermal interface material has been applied. This facilitates pasting with silk screens or stencils.

The bushings help align the module to the heat sink. Then the PCB is put in place. Next the bolts go through the PCB into the bushings. These bolts serve several purposes. A specially contoured shoulder ensures that the module is pushed through the mounting straps towards the heatsink for the first millimeter of travel. The module bends to create a plane, and the remaining force is applied through the mounting straps. The bolts slide into the bushings and push them apart, attaching the module to the heatsink. This also presses the PCB onto the module, achieving a mechanical and electrical contact between the module's Press-fit pins and the PCB. Two small retention nibs on the bolts hold the PCB permanently in place.

This one-step mounting technology retains all the advantages of conventional modules with Press-fit pins. The module can be assembled as a last step after all other SMD and through-hole components are placed on the PCB. It is just as reliable as conventional modules in terms of FIT rates. Discrete components can be sited in the space above the module on the PCB, both on the top and back sides. Without a mounting lid, there is one less part that costs money and one less part number to worry about.

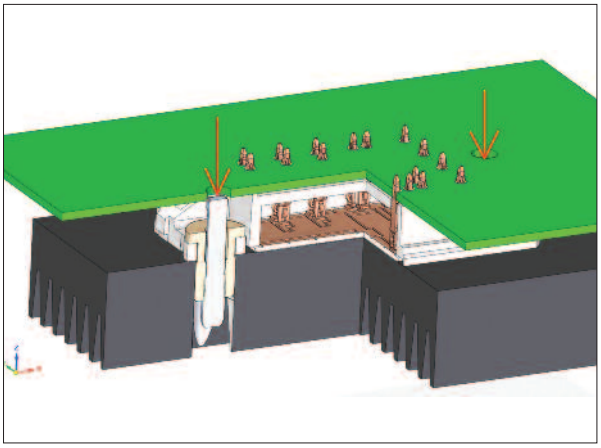
All this can be done by simply putting a larger hole in the mounting straps to hold the bushings. That is the only change from a conventional module. The diameter of the hole in the mounting straps may be increased for modules of various sizes, particularly those without a base plate. Such low-power, high-volume modules are very cost-sensitive.

One-step mounting also solves a problem that has been widely accepted as a necessary evil - the creepage and clearance distances on the PCB required for metal parts or screws and track widths. These one-step mounting bolts are plastic, putting an end to concerns about the distance from the screw to the PCB tracks. The bolt hole in the PCB can be much smaller than a screw hole, affording engineers far greater flexibility in PCB design.

Disassembly is done in three steps. First the retention nibs have to be cut with a wire cutter. The next step is to push the bolts through the bushings with a press-out tool so they release the module from the heat sink. Then the PCB is pressed out with another tool.

Conclusion

Vincotech's one-step mounting solution works with the entire flow family, and brings all the advantages of free pin positioning, convex DBCs and pre-applied thermal interface material to bear. None of the PCB real estate is sacrificed for the sake of a lid, and the PCB may even be reused. Creepage and clearance distances and track widths on the PCB can also be reduced. Vincotech's approach of one-step mounting is the ticket to greater flexibility and low-inductance design possibilities built on proven technologies. And the novel Press-fit technology is available in many modules, even with pre-applied phase change material.



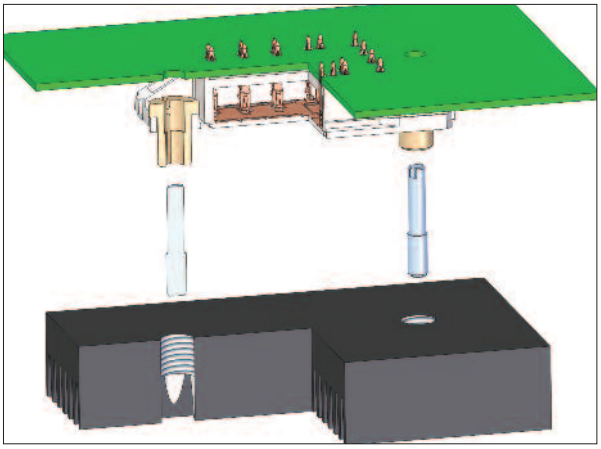


Figure 3: **Pushing bolts through the bushings**