Vincotech

IPM cost benchmarks

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1 Abstract

Higher integration and more complex subsystems are some of the current trends in power electronics. Vincotech's intelligent power modules show the highest level of integration among power modules currently available on the market, enabling significant system-level cost reductions and offering the best solution for space-constrained and cost-driven mechanical environments. This paper describes the embedded drive assembly process and analyzes the costs for three alternative solutions.

2 Intelligent power modules for Industrial motion control

Discrete drives are standard solutions designed to control a wide range of motion applications. Nevertheless, higher integration and more complex subsystems are some of the current trends in the industrial market and increasingly, companies are providing embedded drive systems with different levels of customization.

Embedded drive systems integrate all the control and power electronics together with the electric motor. Thanks to their compact and hermetic design, these help to reduce the space occupancy in the systems. Since they are dedicated to specific applications, design engineers can further optimize the embedded drive systems to reduce the size and cost of the final product and increase the reliability and performance.

Highly integrated intelligent power modules represent a very cost-effective solution for this type of mechanical environment, as they dramatically reduce the number of external components and help minimize the system assembly time.

3 Assembly

During system assembly, one side of the power module is mounted on the printed circuit board (PCB) to connect it to the rest of the application circuitry, while the other side of the power module is typically connected to a heat sink to dissipate the heat generated by the electrical components in the power module itself. (*Fig. 1*).

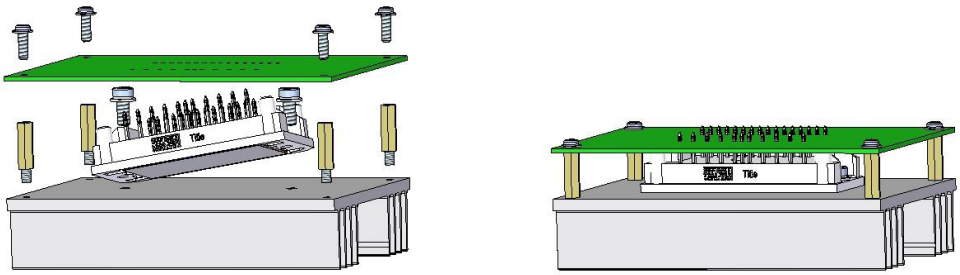

Fig. 1 – Module with PCB and heat sink

The electrical connections between the module and PCB can be made by soldering or by using Vincotech's Press-fit technology.

The distance between the top surface of the heat sink and the bottom surface of the PCB is typically defined by the height of the power module. PCB spacers can be used to ensure the correct distance. To ensure stability and robustness, the number and the position of the fixing points depends on many factors; for example, the design of the circuit, the location of different bulky components i.e. capacitors or inductors, and the operating environment of the system. Screws, springs and isolation pads may also be used during the mounting process.

Furthermore, the assembly process may require the drilling of holes in the heat sink and the application of thermal paste to the module-to-heat sink interface to improve the thermal dissipation.

4 Cost Benchmark

Table 1 shows the cost comparison between Vincotech's intelligent power module, a competing intelligent power module and a discrete solution:

	*flow*IPM	Competition IPM	Discrete
Cost of Assembly (Assembly Material + Labor)	10,1%	30,6%	71,8%
Module	89,9%	49,6%	0,0%
Discrete Electrical Components	0,0%	29,2%	57,1%
Total	**100,0%**	**109,4%**	**129,0%**

Table 1 – Cost comparison

Using Vincotech's intelligent power module as a reference, the normalized costs clearly show that the high level of integration of Vincotech's intelligent power module results in a significant

system level cost saving and represents the best solution for space-constrained and cost-driven mechanical environments. (*Fig. 2*).

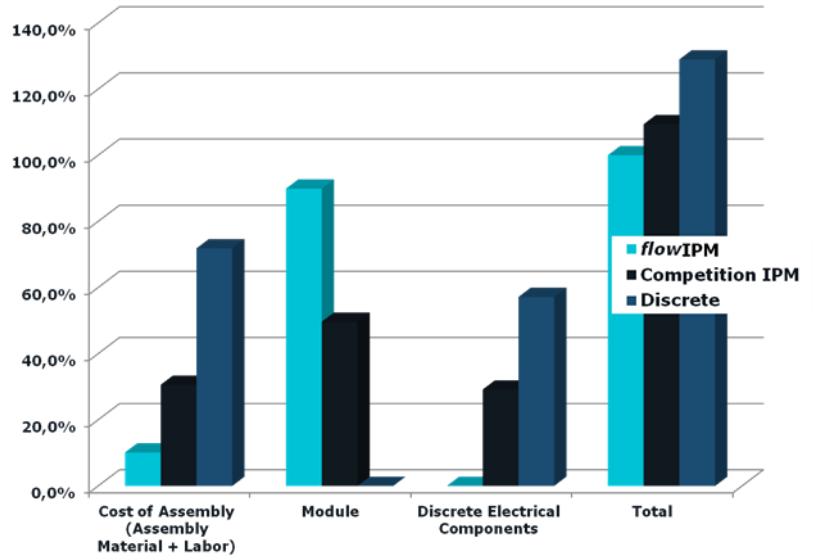

Fig. 2: Cost analysis – flowIPM vs. discrete and competing IPM

The assembly costs can be dramatically reduced by integrating all the motor drive's functional blocks. Due to size constraints and application flexibility, the input filter, DC capacitor and microcontroller are typically not integrated.

Using integrated intelligent power modules simplifies and streamlines the motor drive assembly with fewer external components and smart isolation techniques. In addition, diode rectifiers, brake chopper or power factor correction circuits and sixpack output stages can also be integrated.

Thick-film technology enables higher levels of integration, allowing the integration of gate drives, PFC controllers and passive components (see Fig. 3).

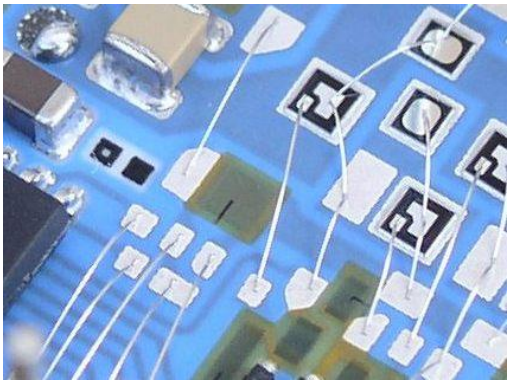

Fig. 3 – Thick film technology

Different layers of conduction and isolating materials are printed on a ceramic sheet. The layers can build tracks, pads, and resistors which can be laser-trimmed to achieve high levels of precision.

Additional cost savings can be achieved by using Vincotech's Press-fit technology (Fig. 4). This further reduces PCB assembly time and effort by eliminating the need for soldering, cuts process time and costs, and boosts production output.

Fig. 4 - Press-fit pins for solder less mounting

5 Conclusion

Vincotech's intelligent power modules provide the functional integration and power density that engineers need to design cost effective embedded drive systems. The high level of integration achieved by Vincotech's IPMs enables system engineers to develop more compact designs and take advantage of a proven combination of power components and gate drive circuits. As these are the most critical elements in the control and power electronics, this mitigates the risk associated with circuit design, speeds up development, and dramatically reduces both costs and time to market.