

IPMs – a solution for compact motor drive applications?

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Power electronics for application embedded motor drives need to be compact and to have good thermal characteristics. Different IPM concepts are competing with different sets of features to be the best solution.

Higher integration and more complex subsystems are some of the current mega trends in power electronics. Very popular are Intelligent Power Modules (IPM) for motor drive applications. They are a combination of power semiconductors like IGBTs, MOSFETs and diodes with peripheral components like driver circuits. If a whole subsystem has a good match to an application, an IPM can bring a lot of unique benefits.

Transfer Molded IPMs

Very often IPMs are produced in transfer molding process. The power semiconductors and other components are mounted on a lead frame. For isolation and protection everything is molded with plastic. The advantage of this technology is the simple production process. Disadvantages are the scale down limitation of the lead frame and the limited heat conductivity of the isolation material. The mechanical design also has some strong limitations. Typical applications are consumer products like white goods or low cost standard motor drives.



Fig. 1: flowIPM

Thick Film Technology

Another possibility for high integrated power electronics is the thick film technology. Different layers of conduction and isolating materials are printed on a ceramic sheet. The layers can build tracks, pads, or resistors. Advantages of this technology are the good thermal conductivity and the possibility to create layouts similar to a PCB. The design of the housings and pins has no limitation. Thick film is a very mature technology. It is already in use for several years, especially in critical application, e.g. at the automotive industry.

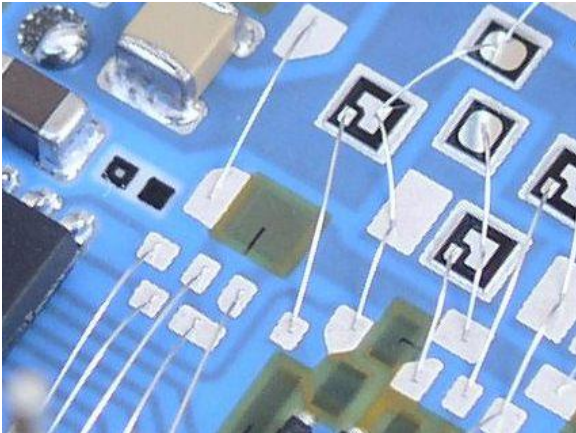


Fig. 2: IPMs in Thick Film Technology

One thick film based IPM is the *flowIPM* from Vincotech. It has power semiconductors for the rectifier and a 3 phase inverter, a complete driver circuit with bootstrap circuit and shunt resistors for current sensing all together in one package. Optional a PFC power stage is also integrated (MOSFET with driver, diode, and capacitor). Nearly all components which are working on grid voltage are integrated to the module.

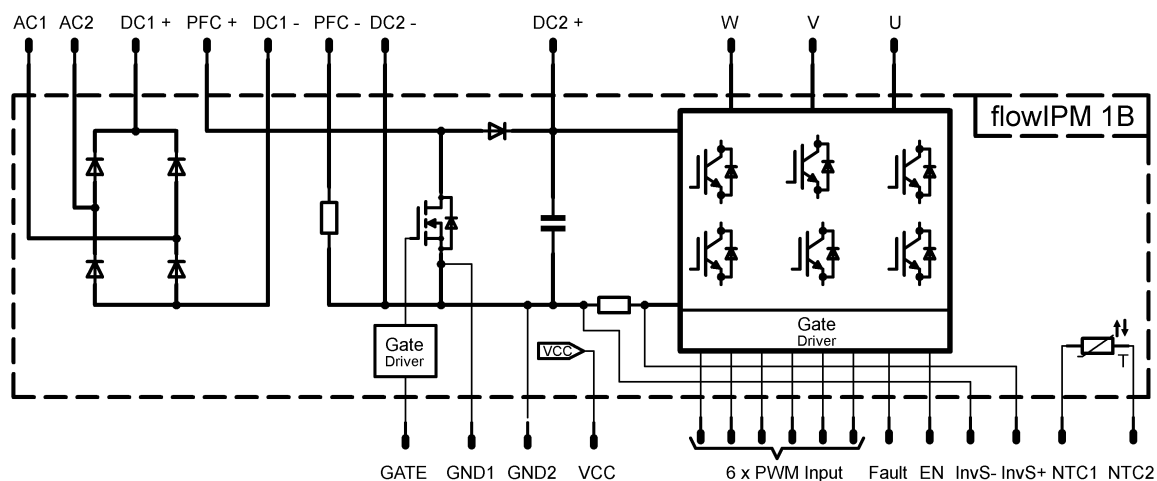


Fig. 3: Schematics for *flowIPM 1B*

The most featured applications for the *flowIPM* are embedded motor drives. These are systems where the motor and its driving electronics are integrated, e.g. fans, pumps, compressors, air conditioning, or professional power tools. All of these systems offering only very limited space. The compact and often hermetical design is a big issue for the heat dissipation of all electronic components. Such an environment is the perfect place for the *flowIPM* to show his strength:

High Integration: The *flowIPM* contains all power semiconductors and most of the peripherals for a motor drive. Only the big passive components have to be mounted separately. The connection pins are separated in two lines, one with the power connections and one with the control signals. The order of the power connections prevents any input/output crossings. The in- and outputs of the driver circuit are on logic level and can directly connected to a microcontroller or similar.

Cooling Concept: The ceramic sheet has a very low thermal resistance. All components are placed on the ceramic; the ceramic is directly connected to the heat sink. All components are directly and optimal cooled. For the power semiconductors this is very important to have good performance and high efficiency. But also components like driver circuits and shunt resistors take a benefit from a good cooling. Especially when used in a hermetic environment without air circulation.

High Efficiency: All power components are state of the art and have very low power losses. This leads to very good energy efficiency and low heat dissipation. The integrated PFC circuit is optionally equipped with a SiC diode. This enables PFC switching frequencies > 200 kHz. With higher switching frequencies, smaller passive components can be used.

EMC Capabilities: The close component connections and the integrated capacitor for the DC link are preventing HF loops. The limitation of parasitic inductivities reduces voltage overshoots during switching operations.

Hermetic Assembly: The module is filled with silicone gel. It acts as electrical isolator, fixing, and protects all components against humidity and harmful gases.

Mounting System: The *flowIPM* is optionally available with Press-fit pins. The module is pressed into the PCB, without any soldering. This is a big advantage for the production process. (See Fig.: 3)

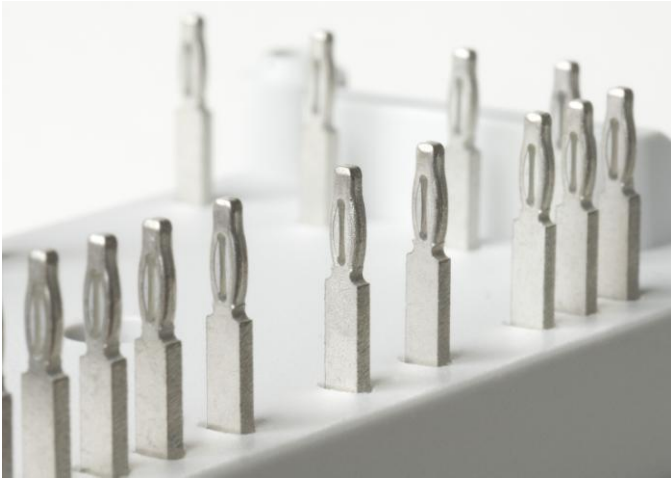


Fig. 4: Press-fit pins for solder less mounting

The creepage and clearance distances of the module fulfill the relevant industrial standards. There are no special requirements to the shape of the heat sink. Optionally a pre-applied phase change material creates a very good and reliable thermal interconnection between *flowIPM* and heat sink.

Best Solution for Compact Motor Drives

Application integrated motor drives have very unique requirements. The need to be very compact, are often used in harsh environments and can have ten thousands of operating hours. The *flowIPM* is dedicated to embedded motor drive applications and takes all typical requirements under consideration.