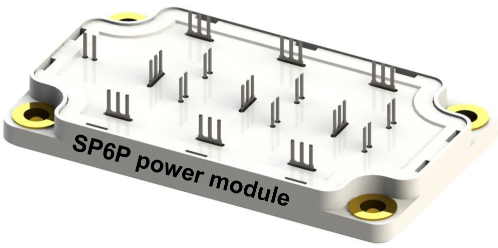
Mounting instruction for SP6P power module

Pierre-Laurent Doumergue
R&D Engineer
Microsemi Power Module Products
26 rue de Campilleau
33 520 Bruges, France



Introduction:

This application note gives the main recommendations to appropriately mount the SP6P power module onto the heat sink and the PCB (Printed Circuit Board) to the power module.

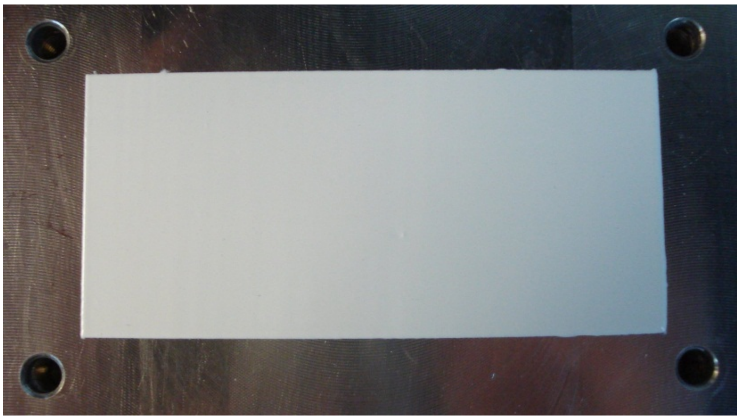
It is very important to follow the mounting instructions to limit both the thermal and mechanical stresses.

1. Power module mounting onto the heat sink.

Proper mounting of the module base plate onto the heat sink is essential to guarantee good heat transfer. The heat sink and the power module contact surface must be flat (recommended flatness <50µm for 100mm continuous, recommended roughness Rz 10) and clean (no dirt, no corrosion, no damage) in order to avoid mechanical stress when the power module is mounted, and to avoid an increase in thermal resistance.

- **Thermal grease application**

To achieve the lowest case to heat sink thermal resistance, a thin layer of thermal grease must be applied between the power module and the heat sink.
It is recommended to use screen printing technique to ensure a uniform deposition of a minimum thickness of 100µm (3.9 mils) on the heat sink (see picture 1). The thermal interface between the module and the heat sink can also be made with other type of conductive thermal interface material such as phase change compound (screen-printed or adhesive layer).



Picture 1: Grease on the heat sink before assembly.

- **Mounting the power module onto the heat sink.**

Place the power module above heat sink holes, and apply a small pressure to it. Insert the M6 screw with flat washers in each mounting hole (a #12 screw can be used instead of M6).

First lightly tighten the four mounting screws. Tighten alternatively the screws until their final torque value is reached (See the product datasheet for the maximum torque allowed).

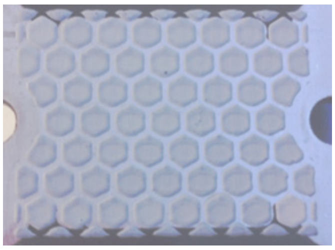
It is recommended to use a screwdriver with controlled torque for this operation. If possible, screws can be tightened again after three hours.

The quantity of thermal grease is correct when a small amount of grease appears around the power module once it is bolted down onto the heat sink with the appropriate mounting torque.
In any case, the module bottom surface must be completely wetted with thermal grease. (See pictures 2 & 3).
The thermal grease must be fluid during the application in order to reduce the mechanical stress applied on the different assembly of the power module during the screwing procedure.

A grease deposition in honeycomb (see picture 4) may be also applied on the module or on the baseplate in order to further reduce the mechanical stress applied on the power module structure during the screwing procedure.
In any case, the thermal grease, material and application must be evaluated by the user.

Picture2: Grease on the heat sink after removing the module.

Picture 3: Grease on the module after disassembling.



Picture 4: Honeycomb mask example.

2. PCB assembly on the power module

First, place the spacers on the heat sink close to the power module (see figure 5). The spacers must at least $12^{\pm 0.1}$mm.

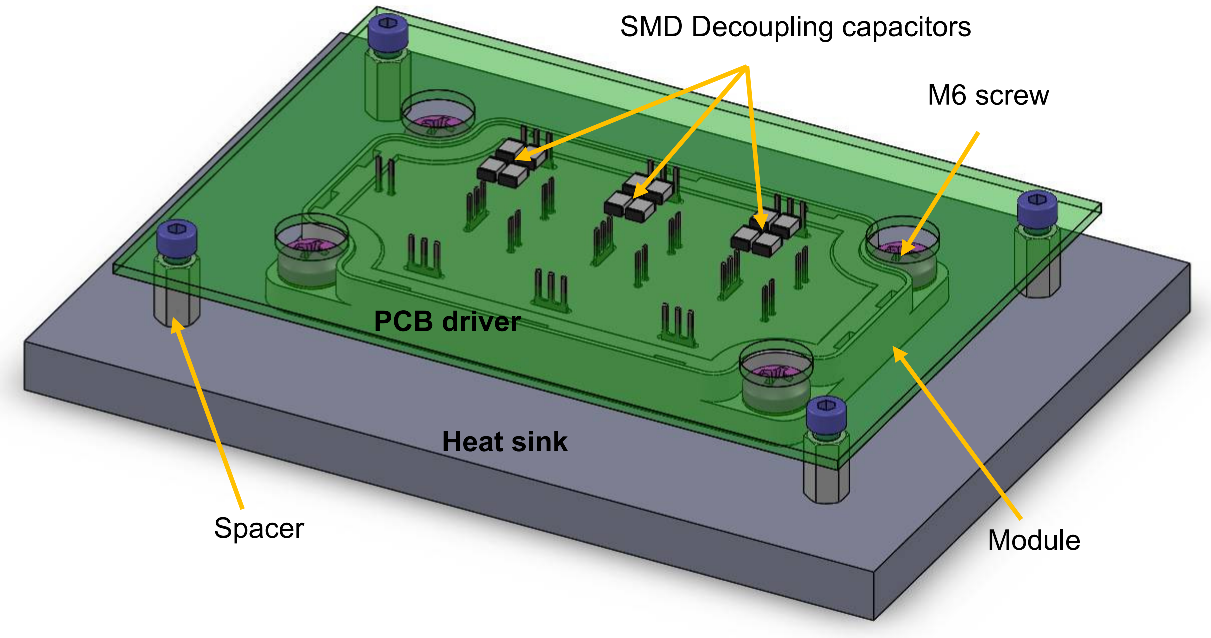
It is recommended to keep a distance of at least 5 cm between the power module and the spacers.

The PCB must be mounted onto the power module and screwed onto the spacers. A mounting torque of 0.6N.m (5 lbf·in) is recommended.

The second step consists of soldering all electrical pins of the power module to the PCB.

No-clean solder flux is required to attach the PCB onto the module since aqueous module cleaning is not allowed.

Do not reverse these two steps, because if all pins are soldered first to the PCB, screwing the PCB onto the spacers will create a deformation of the PCB, leading to some mechanical stress that can damage the tracks or break the components on the PCB.



Picture 5: General assembly view

Holes in the PCB (see picture 5) are necessary to insert or remove the mounting screws that bolt down the power module to the heat sink. These access holes must be large enough for the screw head and washers to pass through freely, allowing for normal tolerance in PCB hole location.

The PCB drilled hole diameter for the pins is recommended at $1.5^{\pm 0.1}$mm.

The PCB drilled hole diameter for inserting or removing the mounting screws depends on the screw head size used by the customer.

The gap between the bottom of the PCB and the power module is low. Microsemi does not recommend using through hole components above the module. To reduce the switching over voltages, SMD decoupling capacitors above the module as close as possible of the power terminals VBUS & 0/VBUS can be used.

Be careful with the heavy components like electrolytic or polypropylene capacitors, transformers or inductors placed around the power module. If these components are located in the same area, it is recommended to add spacers such that the weight of these components on the board is not handled by the power module but by the spacers.

Additional spacers must be also added to avoid vibration and shock issues.

In order to reduce the PCB and the heat sink dimensions, it is possible to add specific spacers on each SP6P power module mounting hole. (See red spacer on picture 6).

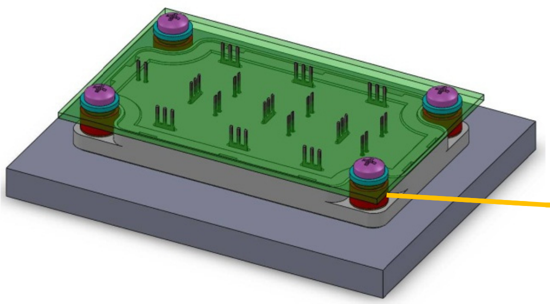
In this case, the goal is to insert a M5 screw (instead of M6 screw) through the specific spacer and tighten the module to the heat sink through these spacers and the PCB. #10 screws can be used instead of M5.

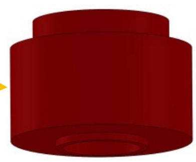
According to the different tolerance of the module, the spacer height must be at $6.2^{\pm 0.1}$mm.

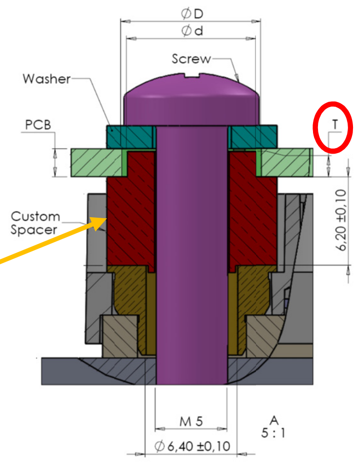
The dimension noted “T” of the specific spacers (circled in red), must be determined by the user as a function of the PCB thickness and tolerance such that appropriate mounting torque is applied to the module without any mechanical stress on the PCB. In any case, a washer is recommended in order to reduce the stress on the PCB and spacers.

To have a good thermal transfer between the power module baseplate and the heat sink, the same mounting torque must be applied on the M5 screws compared to the procedure with the M6 screws (see picture 5).

The same procedure must be used to tighten the four M5 screws compared to the M6 screws.







Picture 6: specific spacers on SP6P mounting hole

spacer

Assembly zoom

For efficient production, a wave soldering process can be used to solder the terminals to the PCB. Each application, heat sink and PCB can be different; wave soldering must be evaluated on a case-by-case basis. In any case, a well-balanced layer of solder should surround each pin.

SP6P pinout can change according to the configuration. See the product datasheet to see the pin out location.

Each application, thermal grease, PCB, spacers placement and the specific spacers are different and must be evaluated on a case-by-case basis.

3. Connection push - pull forces.

When the PCB is mounted onto the power module and the terminals soldered to it, some mechanical forces may be applied to the terminals. Such push or pull forces must not exceed 10N (2.25lbf) maximum per individual connector. This acceptable maximum value of push-pull force may vary depending on the mounting and operating conditions.

Conclusion:

This application note gives the main recommendations regarding the mounting of the SP6P power module. Applying these instructions will help decreasing the mechanical stress both on bus bar, PCB and power module and therefore will ensure long term operation of the system. Mounting instructions to the heat sink must also be followed to achieve the lowest thermal resistance from the power chips down to the cooler. All these operations are essential to guarantee the best system reliability.

Microsemi Corporate Headquarters
One Enterprise, Aliso Viejo CA 92656 USA
Within the USA: +1(949) 380-6100
Sales: +1 (949) 380-6136
Fax: +1 (949) 215-4996

1902/11.15