

Mounting Instructions for SP6 Power Modules

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Introduction:

This application note gives the main recommendations to appropriately connect the SP6 power module onto the heat sink, and the PCB (Printed Circuit Board), the bus bars or wires 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 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 $<50\mu\text{m}$ 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.

1.1 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. If the grease is applied onto the module base plate, a minimum thickness of $100\mu\text{m}$ (3.9 mils) of grease should be applied with a roller or a spatula.

If the grease is applied onto the heat sink, it is recommended to use screen printing technique to ensure a uniform deposition of a minimum thickness of $100\mu\text{m}$ (3.9 mils). In any case, the

module bottom surface must be wetted completely with thermal grease.

1.2 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 lock and flat washers in each mounting hole (a #12 screw can be used instead of M6). The screw length must be at least 16 mm (0.6").

First lightly tighten the four mounting screws. Tighten alternatively the screws until their final torque value is reached (between 3 and 5 N.m, or 2.21 and 3.69 lbf.ft).

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 (see figure 1, screws are tightened with a mounting torque of 4 N.m, or 2.95 lbf.ft). Figure 2 shows the thermal grease on the SP6 module base plate when removed from the heat sink. Screws are tightened with a mounting torque of 4 N.m.



fig 1: Proper application of thermal grease to the power module.

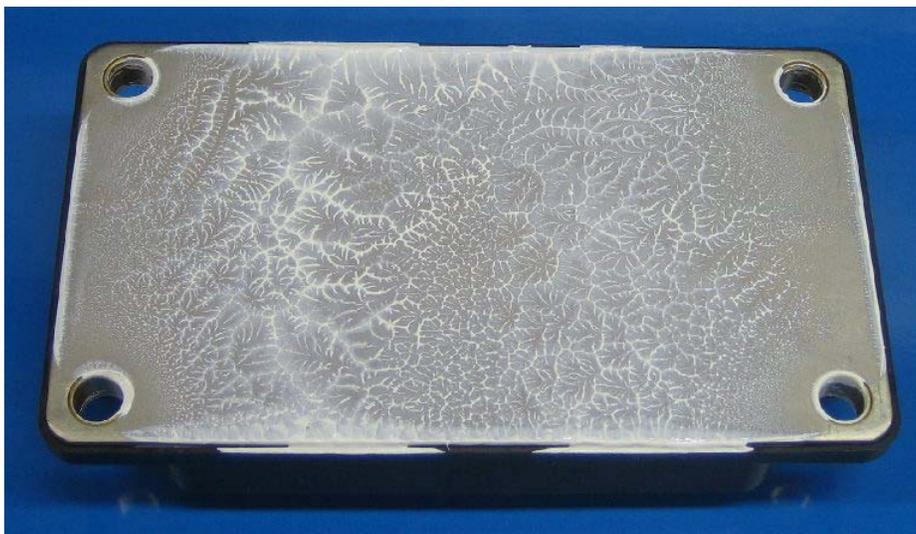


fig 2: SP6 base plate with properly applied thermal grease after removal from heat sink.

2. Electrical connections.

2.1 Assembly with a PCB for power and signal connections.

First, the PCB must be mounted onto the power module and screwed onto the power terminals. Put M5 screw with a M5 flat washer in each power terminals.

The screw length depends on the PCB thickness and the washers. Be careful, the maximum length into the power terminal is 7.8mm (0.307") see figure 6. The mounting torque must be between 2 & 3.5 N.m (1.47 & 2.58 lbf·ft).

The second step consists of soldering all signal terminals of the power module to the PCB. Manual soldering process is recommended to solder the signal terminals 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 signal terminals are soldered first to the PCB, screwing the PCB onto power terminals will create a deformation of the PCB, leading to some mechanical stress that can damage the tracks or break the components on the PCB.

If a large PCB is used, additional spacers between the PCB and the heat sink are necessary. It is recommended to keep a distance of at least 5 cm between the connection to the power module and the spacers (see fig 3). The spacers must have the same height as the power connectors ($17^{\pm 0.5}$ mm).

Note: To reduce switching over voltages, decoupling capacitors must be placed as close as possible of the M5 power terminals VBUS & 0/VBUS. (See figure 6).

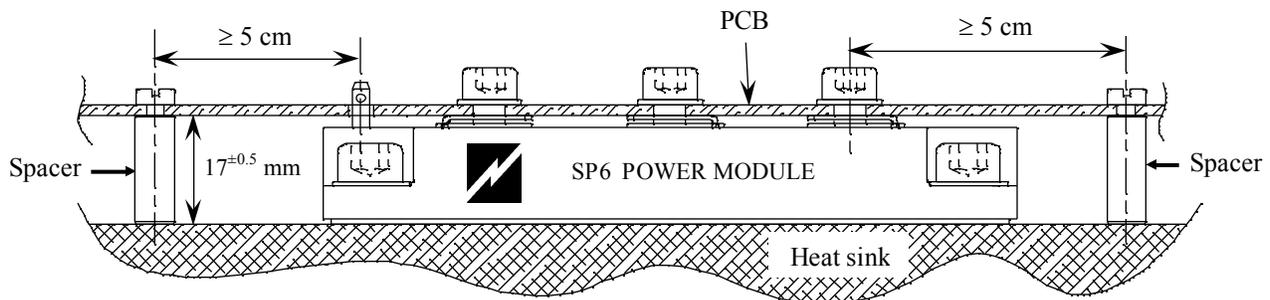


fig 3: PCB for power and signal terminals with spacers for a large PCB.

2.2 Assembly with Bus bars for power connections and a PCB for signal connections.

The bus bars must be mounted onto the power module and screwed onto the power terminals. Put M5 screw with a M5 flat washer in each power terminals.

The screw length depends on the bus bar thickness and the washers. Be careful, the maximum length into the power terminal is 7.8mm (0.307") see figure 6. The mounting torque must be between 2 & 3.5 N.m (1.47 & 2.58 lbf-ft).

The PCB must be soldered to all signal terminals of the power module. Manual soldering process is recommended to solder the signal terminals to the PCB. No-clean solder flux is required to attach the PCB onto the module since aqueous module cleaning is not allowed.

It is recommended to use spacers on the PCB to avoid a deformation of it and to avoid some mechanical stress on the components, tracks and signal terminals. The spacers must have the same height as the power connectors ($17^{\pm 0.5}$ mm).

If long bus bars are used, additional spacers between the bus bars and the heat sink are necessary. It is recommended to keep a distance of at least 5 cm between the connection to the power module and the spacers (see fig 4).

Note: To reduce switching over voltages, decoupling capacitors must be placed as close as possible of the M5 power terminals VBUS & 0/VBUS. (See figure 6).

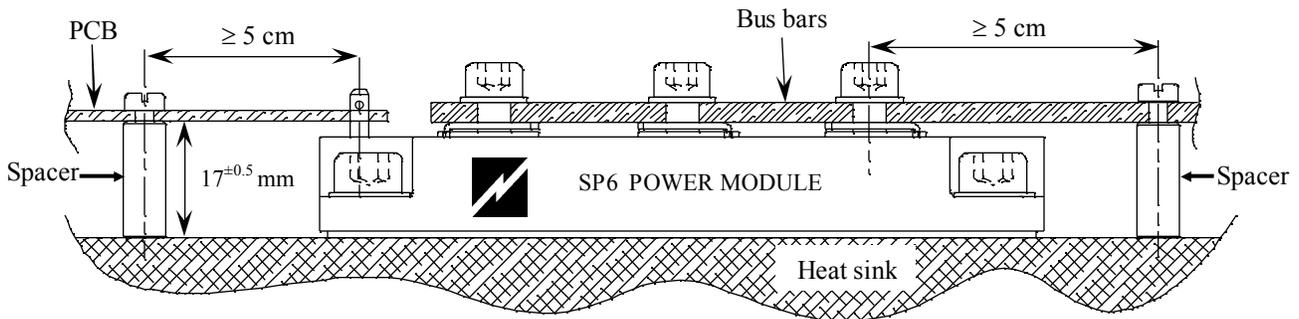


fig 4: PCB for the signal terminals and bus bars for the power terminals with spacers.

2.3 Assembly with Bus bars for power connections and wires for signal connections.

The bus bars must be mounted onto the power module and screwed onto the power terminals. Put M5 screw with a M5 flat washer in each power terminal.

The screw length depends on the bus bar thickness and the washers. Be careful, the maximum length into the power terminal is 7.8mm (0.307") see figure 6. The mounting torque must be between 2 & 3.5 N.m (1.47 & 2.58 lbf-ft).

If long bus bars are used, additional spacers between the bus bars and the heat sink are necessary. It is recommended to keep a distance of at least 5 cm between the connection to the power module and the spacers (see fig 5).

Wires should be plugged onto the signal terminals via a lug or soldered to it. If wires are directly soldered, manual soldering process is recommended to solder the signal terminals to the PCB.

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

Note: To reduce switching over voltages, decoupling capacitors must be placed as close as possible of the M5 power terminals VBUS & 0/VBUS. (See figure 6).

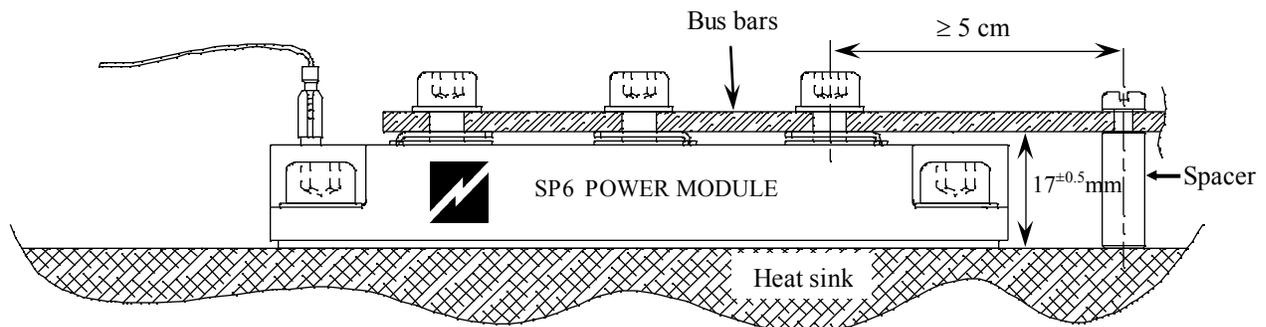


fig 5: Wires for the signal terminals and bus bars for the power terminals with spacers.

3. Holes diameters in the PCB and power terminal view.

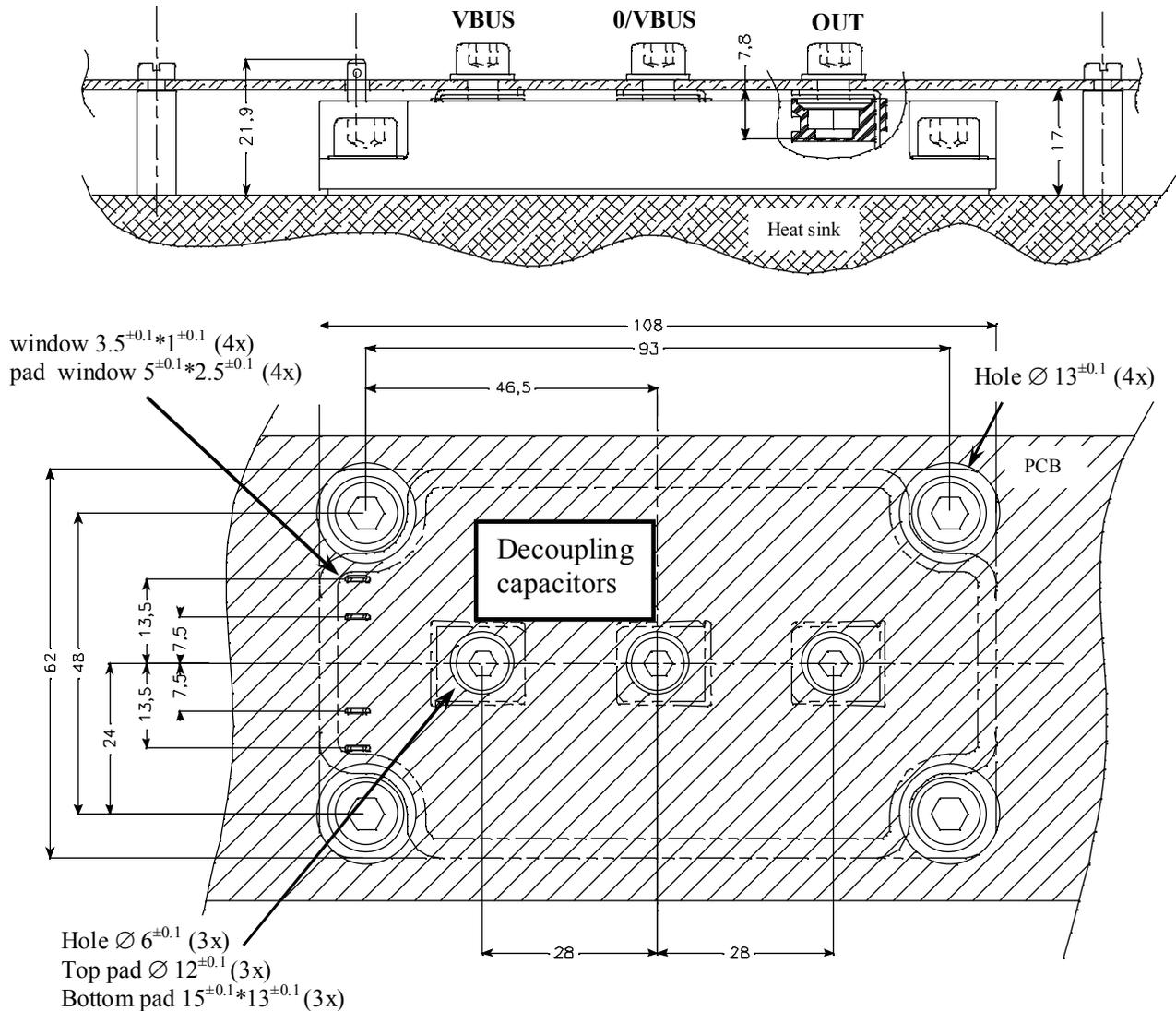


Fig 6: pad and hole diameters (in millimeters).

Example of PCB specification:

Material Epoxy FR4
Type double side
Metallized holes
Plating: tinning or gold
Conductor layers thickness in accordance with the current capability.

SP6 pinout can change according to the configuration (full bridge, asymmetrical bridge...). Each module datasheet has specific hole location information.

Note: Holes in the PCB are necessary to insert and tighten the mounting screws that attach the power module to the heat sink.

These access holes must be large enough for the screw head and washer to pass through freely, allowing for normal tolerance in PCB hole location.

4. Connection pull forces.

SP6 Power modules must be mounted in such way that the resulting pull forces are limited to 200N (44.96lbf) for the power terminals and are limited to 50N (11.24lbf) for the signals terminals. This acceptable maximum value of pull force may vary depending on the mounting and operating conditions.

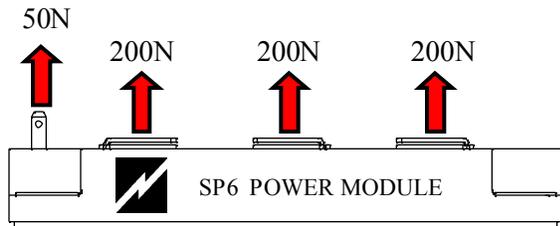


fig 7: pull force

5. Connection push forces.

SP6 Power modules must be mounted in such way that the resulting push forces are limited to 150N (33.72lbf) for the power terminals and are limited to 50N (11.24lbf) for the signals terminals. This acceptable maximum value of push force may vary depending on the mounting and operating conditions.

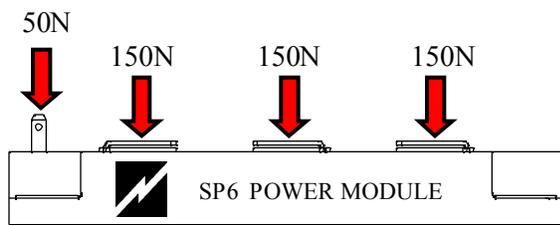


fig 8: push force

Conclusion:

This application note gives the main recommendations regarding the mounting of SP6 modules. Applying these instructions will help decreasing the mechanical stress both on PCB, bus bars or wires 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 and achieve the highest possible MTBF (Mean Time Between Failure).