

Mounting Instructions for SP1 Power Modules

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Introduction:

This application note gives the main recommendations to appropriately connect the SP1 power module onto the heatsink, 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 heatsink.

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 $60\mu\text{m}$ (2.4 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 $60\mu\text{m}$ (2.4 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 M4 screw with lock and flat washers in each mounting hole (a #8 screw can be used instead of M4). The screw length must be at least 12 mm (0.5").

First lightly tighten the two mounting screws. Tighten alternatively the screws until their final torque value is reached (4.7 N.m max, or 3.5 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 SP1 module base plate when removed from the heat sink. Screws are tightened with a mounting torque of 4 N.m.

Note: For insulation purposes, the maximum height of screw head plus washer must not exceed 7mm to maintain a safe spacing between the screw head and the nearest terminal of SP1 power module.

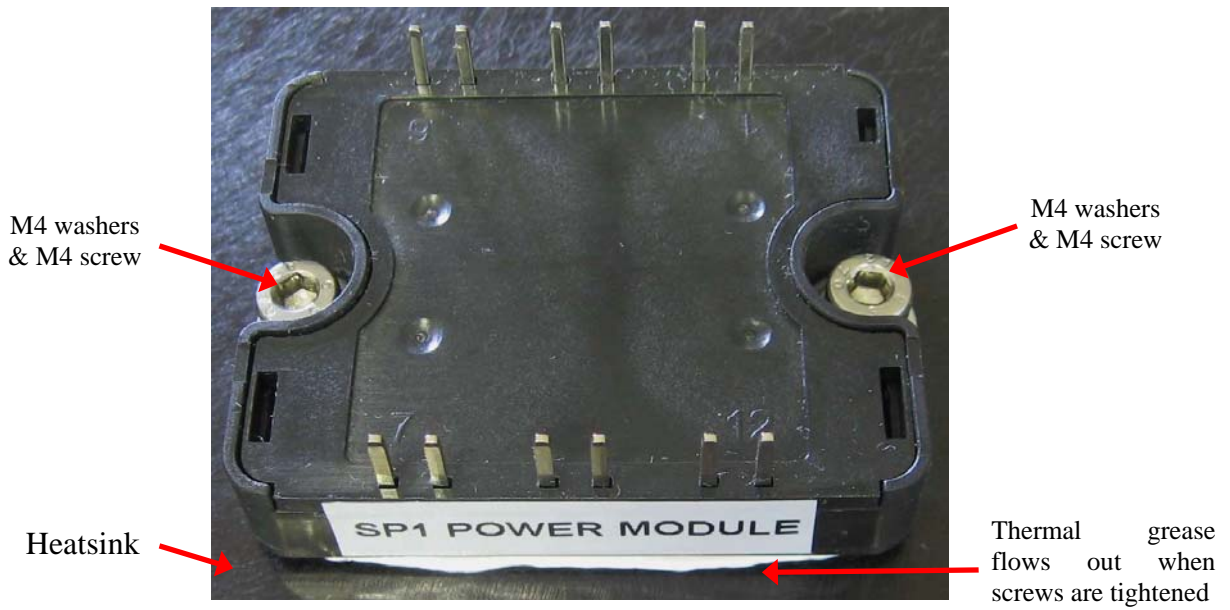


Fig 1: Proper application of thermal grease to the power module.



Fig 2: SP1 base plate with properly applied thermal grease after removal from heat sink.

2. Mounting the PCB onto the power module.

First, place spacers on the heat sink close to the power module (see figure 3). The spacers must have $12^{\pm 0.2}$ mm height. 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 signal terminals of the power module to the PCB.

Manual soldering process is recommended to solder the 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 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 traces or break the components on the PCB.

If a long and large PCB is used, other additional spacers between the PCB and the heat sink are necessary. It is recommended to keep a distance of at least 5 cm between each spacer.

Note 1: The SP1 plastic frame height is the same height as an Isotop[®] (SOT-227). On the same PCB, if an Isotop[®] and an SP1 power module are used and if the distance between the two power modules does not exceed 5 cm, it is not necessary to install the spacer.

Note 2: To reduce switching over-voltages, decoupling capacitors must be placed as close as possible of the V_{BUS} and $0/V_{BUS}$ terminals (See figure 4).

Note 3: 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.

Note 4: For specific applications some SP1 power modules are manufactured with an AlSiC (Aluminium Silicon Carbide) baseplate (M suffix in the part number). AlSiC baseplate is 0.5 mm higher than the copper baseplate, so the spacers must be $12.5^{\pm 0.2}$ mm height.

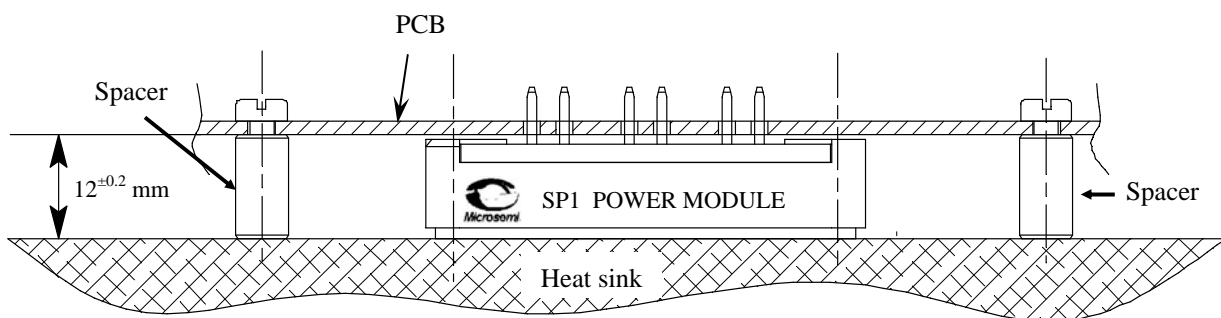


Fig 3: PCB onto the power module.

3. Holes diameters in the PCB.

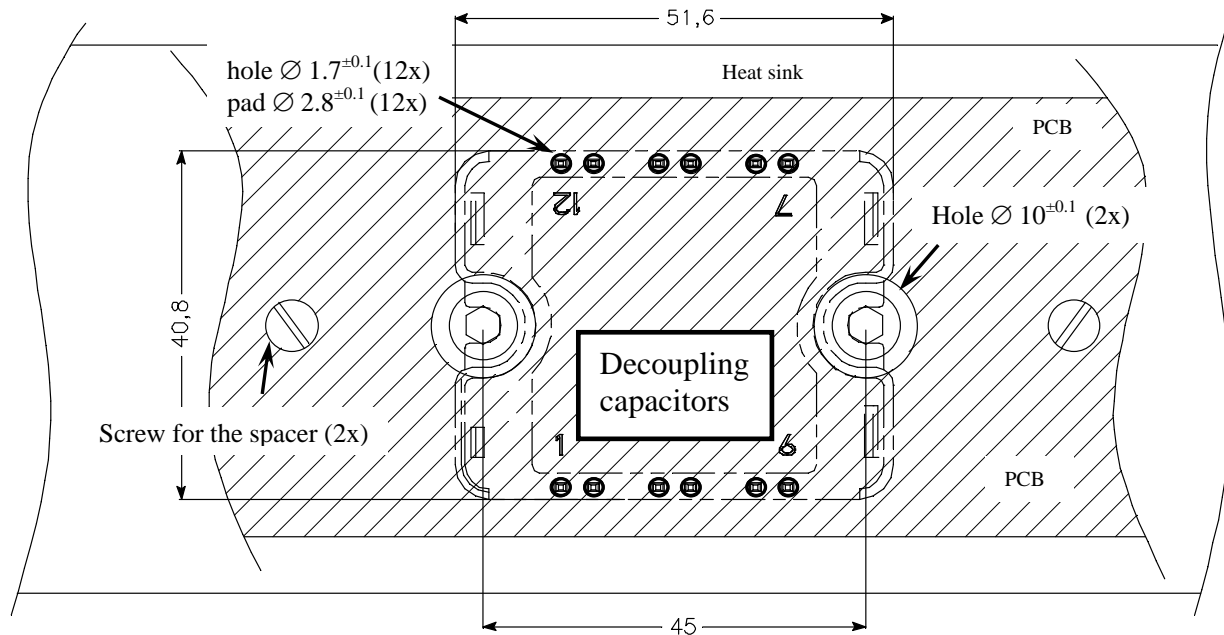


Fig 4: Pad and hole diameters (in millimeters) for a phase leg configuration.

Example of PCB specification:

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

Pin out location can change according to the configuration (full bridge, boost chopper, fast diode full bridge...). Refer to the datasheet to see how the pins connect to the PCB.

Note: Holes in the PCB are necessary to insert and tighten 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.

4. Connection push - pull forces.

The SP1 Power module must be mounted in such way that the resulting pull or push forces are

limited to 30N (6.75lbf) for the terminals. This acceptable maximum value of pull or push forces may vary depending on the mounting and operating conditions.

Conclusion:

This application note gives the main recommendations regarding the mounting of SP1 modules. Applying these instructions will help decreasing the mechanical stress both on 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 and achieve the highest possible MTBF (Mean Time Between Failure).

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