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**Mounting Instructions for SP1F and SP3F Power Modules**

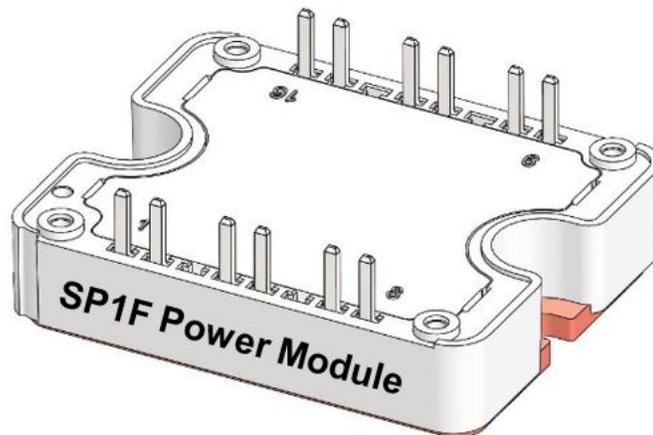
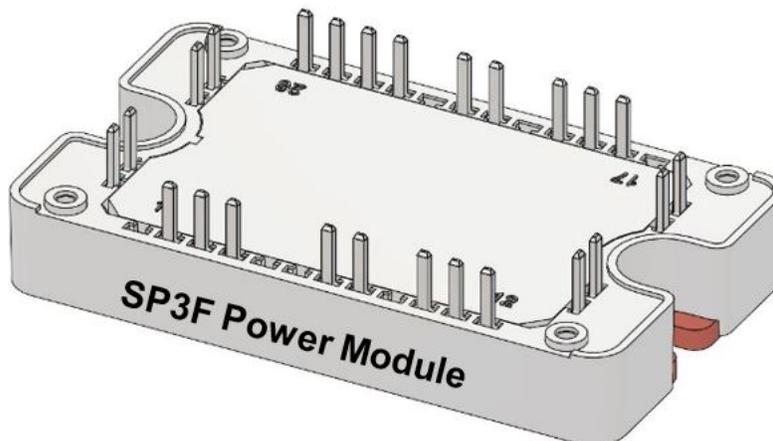
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**Introduction**

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This application note gives the main recommendations to appropriately connect the printed circuit board (PCB) to the SP1F or the SP3F power module and mount the power module onto the heat sink. Follow the mounting instructions to limit both thermal and mechanical stresses.

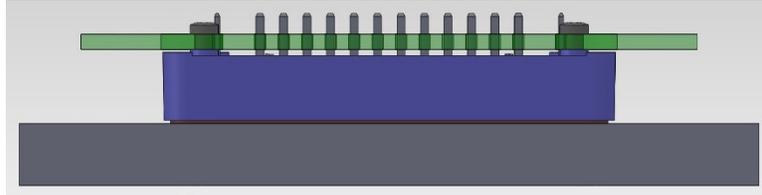
**Figure 1. SP1F Power Module****Figure 2. SP3F Power Module**

## 1. PCB Mounting Instructions

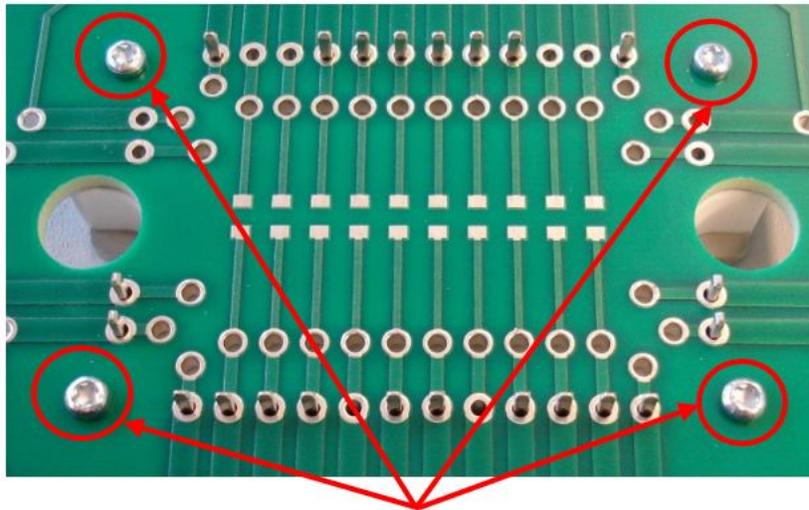
The PCB mounted on the power module can be screwed to the standoffs to reduce all mechanical stress and minimize relative movements on the pins that are soldered to the power module.

**Step 1:** Screw the PCB to the standoffs of the power module.

**Figure 1-1. PCB Mounted on Power Module**



**Figure 1-2. Plastite Screws on Standoffs**



### Plastite Screws on Standoff

A self-tapering plastite screw with a nominal diameter of 2.5 mm is recommended to attach the PCB. A plastite screw, shown in the following figure, is a type of screw specifically designed for use with plastic and other low-density materials. The screw length depends on the PCB thickness. With a 1.6 mm (0.063") thick PCB, use a plastite screw 6 mm (0.24") long. The maximum mounting torque is 0.6 Nm (5 lbf-in). Check the integrity of the plastic post after tightening the screws.

**Figure 1-3. Example of a Plastite Screw**

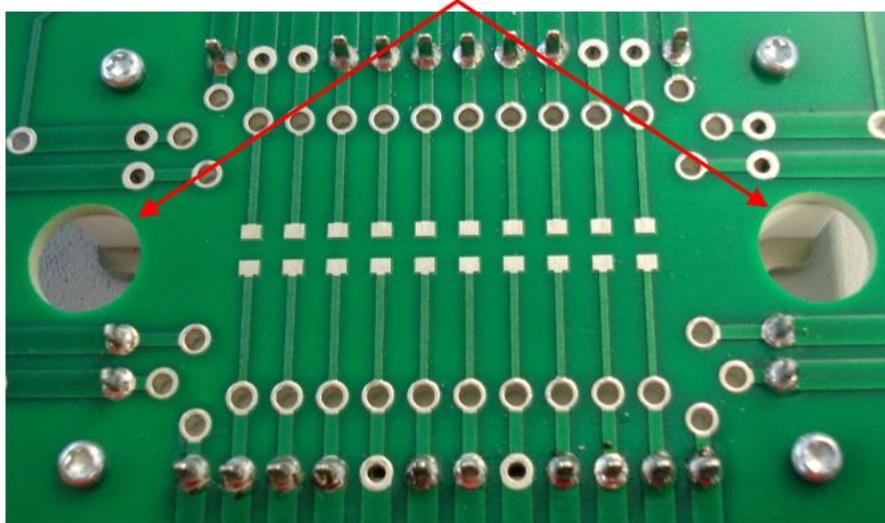


**Step 2:** Solder all electrical pins of the power module to the PCB as shown in the following figure.

A no-clean solder flux is required to attach the PCB, as the aqueous module cleaning is not allowed.

**Figure 1-4. PCB After Soldering**

### Holes in the PCB for Inserting or Removing the Mounting Screws



**Note:** Do not reverse these two steps, because if all pins are soldered first to the PCB, screwing the PCB to the standoffs creates a deformation of the PCB, leading to some mechanical stress that can damage the tracks or break the components on the PCB.

Holes in the PCB as shown in the preceding figure 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 hole diameter for the power pins is recommended at  $1.8 \pm 0.1$  mm. The PCB hole diameter for inserting or removing the mounting screws is recommended at  $10 \pm 0.1$  mm.

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.

The gap between the bottom of the PCB and the power module is 0.5 mm to 1 mm only as shown in [PCB Mounted on Power Module](#) figure. Using through-hole components on the PCB is not recommended.

SP1F or SP3F pinout can change according to the configuration. See the product datasheet for more information on the pin-out location.

## 2. Power Module Mounting Instructions

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 should be less than 50  $\mu\text{m}$  for 100 mm continuous, recommended roughness Rz 10) and clean (no dirt, corrosion, or damage) to avoid mechanical stress when power module is mounted, and to avoid an increase in thermal resistance.

**Step 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. 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) on the heat sink as shown in the following figure. The thermal interface between the module and the heat sink can also be made with other conductive thermal interface materials such as phase change compound (screen-printed or adhesive layer).

**Figure 2-1. Grease on the Heat Sink Before Assembly**

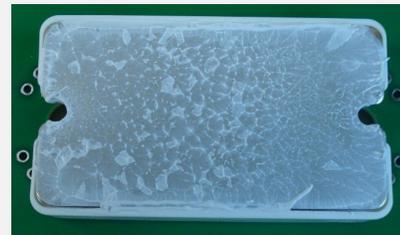


**Step 2:** Mounting the power module onto the heat sink: Place the power module above heat sink holes and apply a small pressure to it. Insert the M4 screw with lock and flat washers in each mounting hole (a #8 screw can be used instead of M4). The screw length must be at least 12 mm (0.5"). First, lightly tighten the two mounting screws. Tighten alternatively the screws until their final torque value is reached (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. The lower surface of the module must be completely wet with thermal grease as shown in the [Grease on the Module After Disassembling](#) figure. The gap between the screws, top height and the nearest terminal must be checked to maintain safe insulation spacing.

**Figure 2-2. Grease on Heat Sink After Removing the Module**

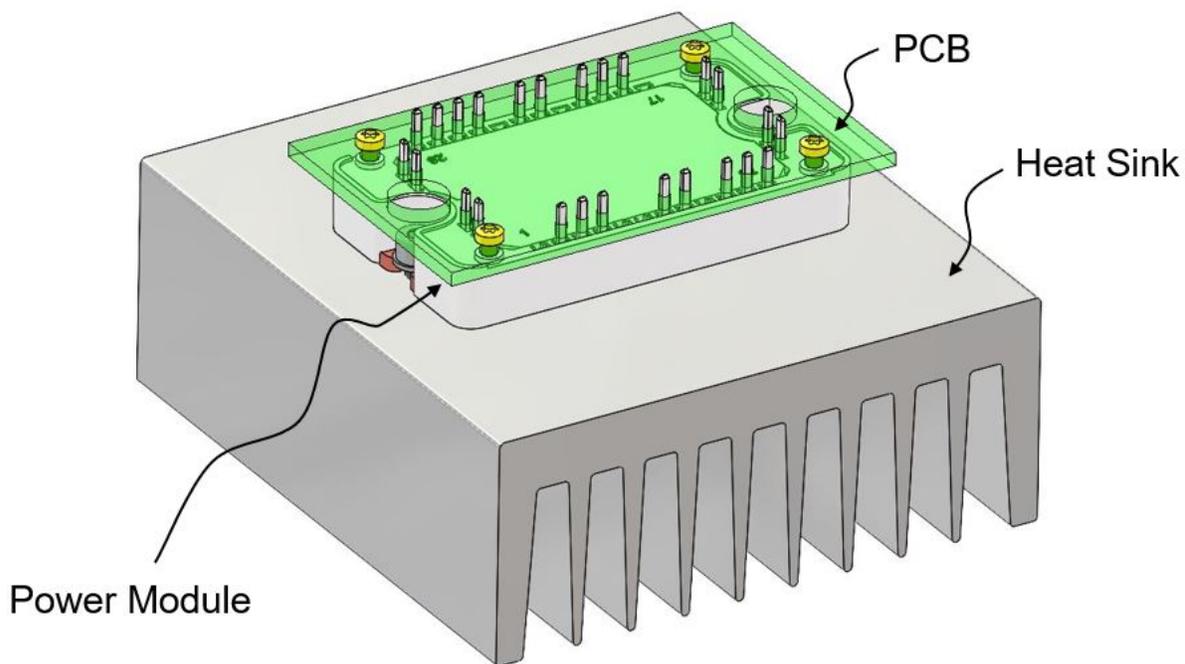


**Figure 2-3. Grease on the Module After Disassembling**



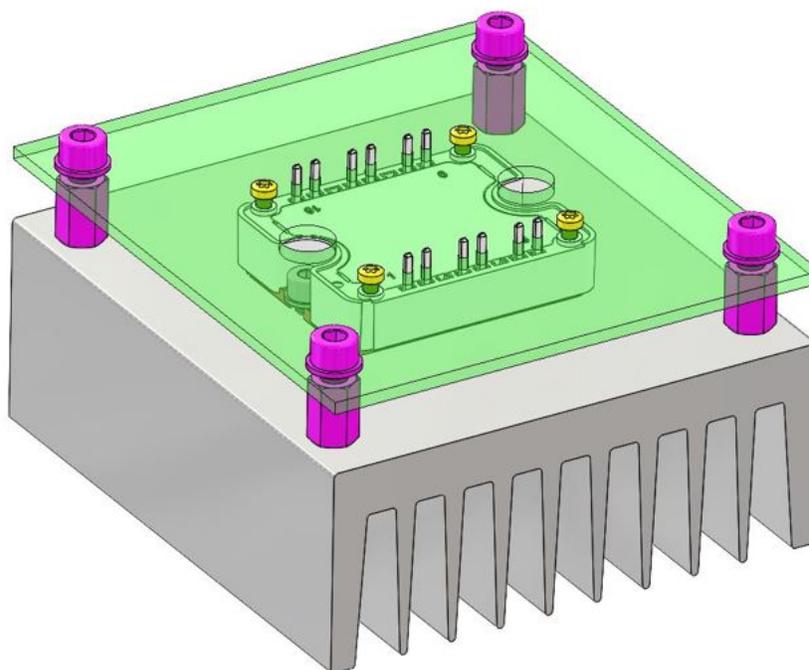
### 3. General Assembly View

Figure 3-1. General Assembly View



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 power module and the spacers as shown in the following figure. The spacers must be of the same height as the standoffs ( $12 \pm 0.1$  mm).

Figure 3-2. General Assembly View with Large PCB



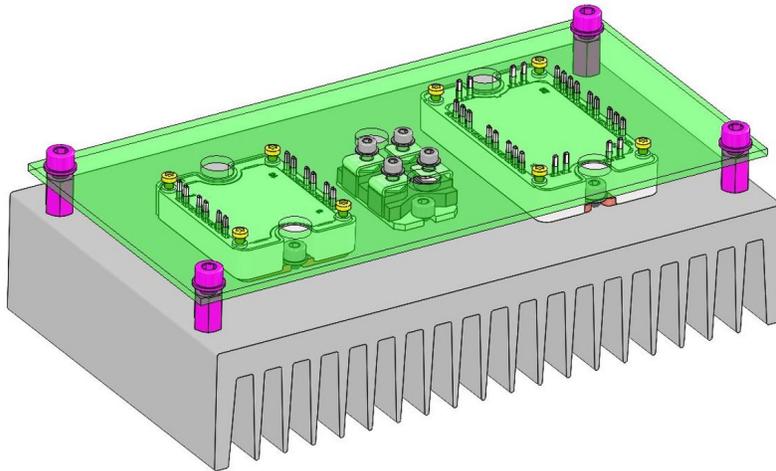
For specific applications, some SP1F or SP3F power modules are manufactured with an AlSiC (Aluminium Silicon Carbide) baseplate (M suffix in the part number). AlSiC baseplate is 0.5 mm thicker than the copper baseplate, so the spacers must be  $12.5 \pm 0.1$  mm in thickness.

The SP1F and SP3F plastic frame height is the same height as a SOT-227. On the same PCB, if a SOT-227 and one or several SP1F/SP3F power modules with copper baseplate are used, and if the distance between the two power modules does not exceed 5 cm, it is not necessary to install the spacer as shown in the following figure.

If a SP1F/SP3F power modules with AlSiC baseplate is used with a SOT-227 or other SP1F/SP3F modules with copper baseplate, the heatsink height must be reduced by 0.5 mm under the SP1F/SP3F modules with an AlSiC baseplate to maintain all the module standoffs at the same height.

Care must be taken with heavy components like electrolytic or polypropylene capacitors, transformers, or inductors. If these components are located in the same area, it is recommended to add spacers even if the distance between two modules does not exceed 5 cm such that, the weight of these components on the board is not handled by the power module but by the spacers. In any case, each application, heat sink, and PCB are different; the spacers placement must be evaluated on a case-by-case basis.

**Figure 3-3. General Assembly View with Several Modules with Copper Baseplate**



### Conclusion

This application note gives the main recommendations regarding the mounting of SP1F or SP3F modules. Applying these instructions helps decrease the mechanical stress on PCB and power module, while ensuring 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 steps are essential to guarantee the best system reliability.

#### **4. Revision History**

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

<b>Revision</b>	<b>Date</b>	<b>Description</b>
A	05/2020	This is the initial release of this document.

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