Mounting instruction for D3, D3-HV and D4 power modules

D3 power module

D3-HV power module

D4 power module

Introduction:

This application note gives the main recommendations to appropriately mount the D3, D3-HV and D4 power modules onto the heat sink, and connect the bus bars, wires or PCB.

It is very important to follow the mounting instructions to limit both the thermal and mechanical stresses.
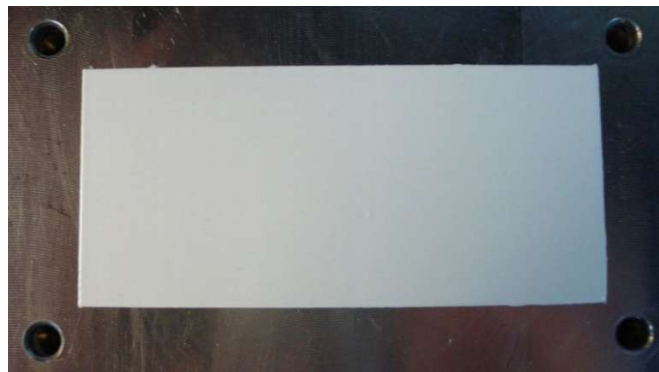
1.   Power module mounting onto the heat sink.

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, 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").

1. The four M6 screws must be torqued at 0.5Nm. Order: 1 – 2 – 3 – 4.
2. The four M6 screws must be torqued to 2Nm. Order: 1 – 2 – 3 – 4.
3. The four M6 screws must be torqued to the final torque. Order: 1 – 2 – 3 – 4.
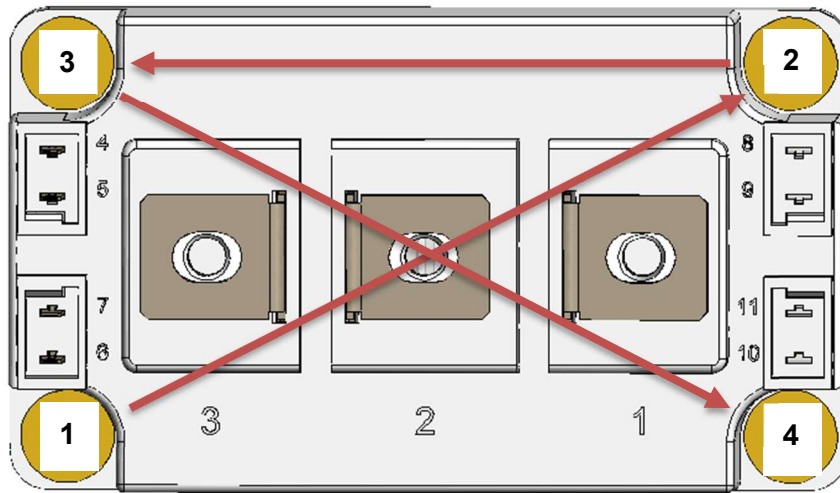
See the product datasheet for the maximum torque allowed.

It is recommended to use a screwdriver with controlled torque for this operation. If possible, screws can be tightened again in the same order (1 – 2 – 3 – 4) 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).

Picture 2: Grease on the heat sink after removing the module

Picture 3: Grease on the module after disassembling

2. Assembly with Bus bar for power connections and wires for signal connections

- **Power connections**

The bus bars must be mounted onto the power module and screwed onto the power terminals.
Put M6 screw with a M6 flat washer in each power terminal.

The screw length depends on the bus bar thickness and the washers. See the product datasheet for the maximum torque and max length into the power terminal allowed.

To reduce switching over voltages, decoupling capacitors must be placed as close as possible of the power terminals VBUS & 0/VBUS. (See figures 4 to 7).

Be careful with the heavy components like electrolytic or polypropylene capacitors. 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. (See the product datasheet for the spacer dimension).

- **D3, D3-HV Signal connections**

First, remove the ESD protection on the signal connectors if applicable. The user must observe all precautions in order to avoid electrostatic discharge during handling.

Wires should be plugged onto the signal terminals via a lug. (See product datasheet for signal connection dimensions). In order to reduce the stray inductance, the gate and the emitter wires must be as short as possible and twisted.

Additional spacers must be necessary to avoid a deformation of the PCB and to avoid some mechanical stress on the components, tracks and signal terminals. (See pictures 4 & 5).

- **D4 Signal connections**

A PCB should be screwed on the M4 signal connectors. The screw length depends on the PCB thickness and the washers.

Additional spacers must be necessary to avoid a deformation of the PCB and to avoid some mechanical stress on the components, tracks and signal connectors. (See the product datasheet for the spacer dimension, maximum torque and max length into the signal terminal allowed). (See pictures 6 & 7).
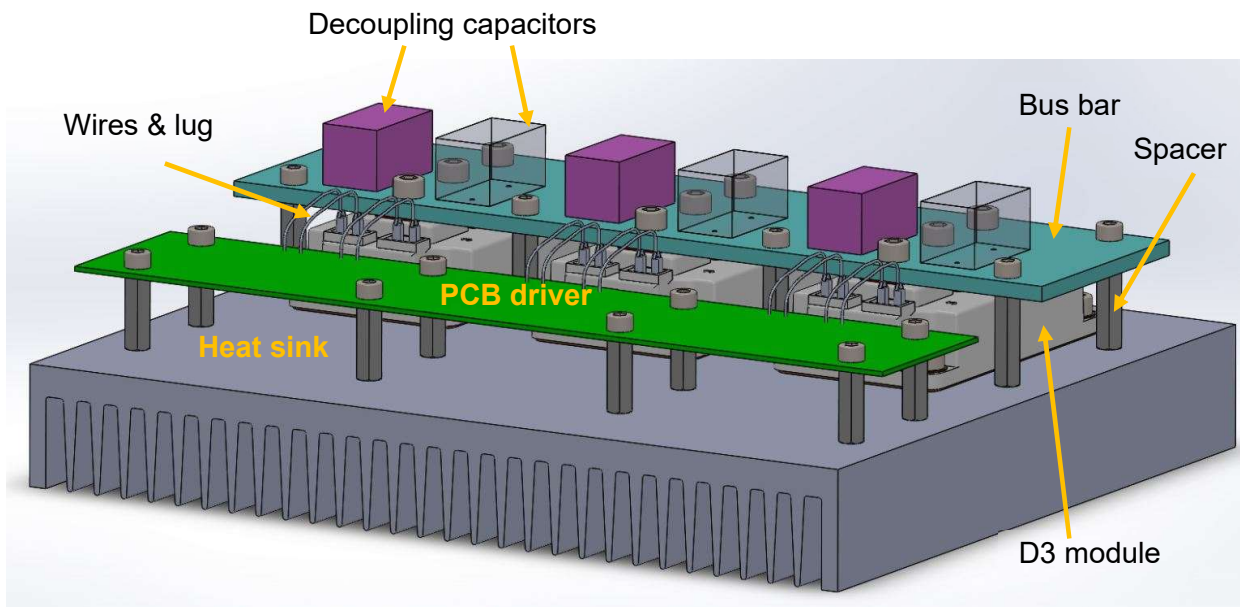
Figure 4: D3, D3-HV General assembly view in a 3 phase bridge configuration
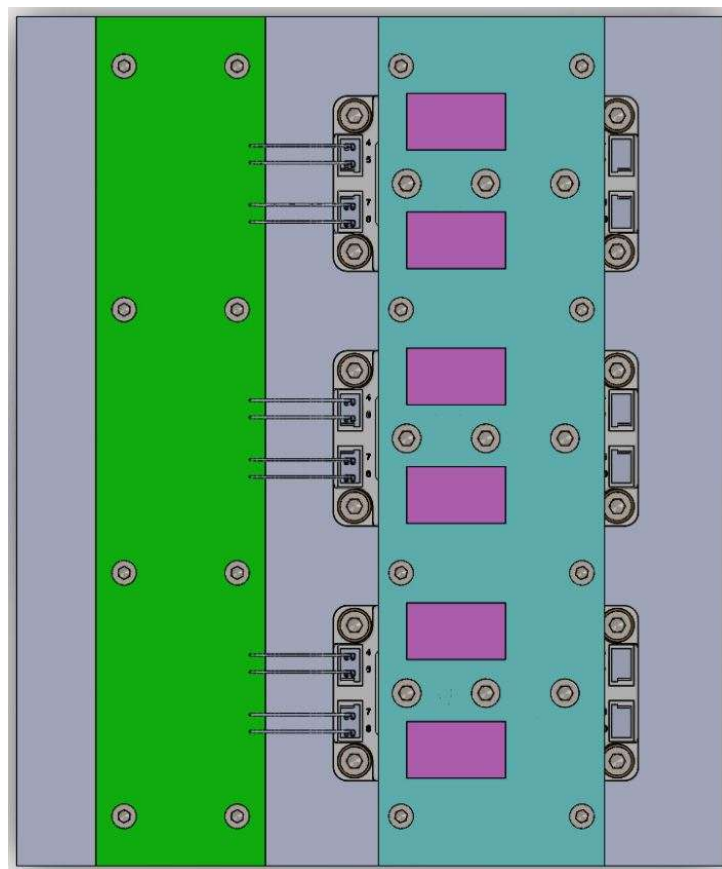

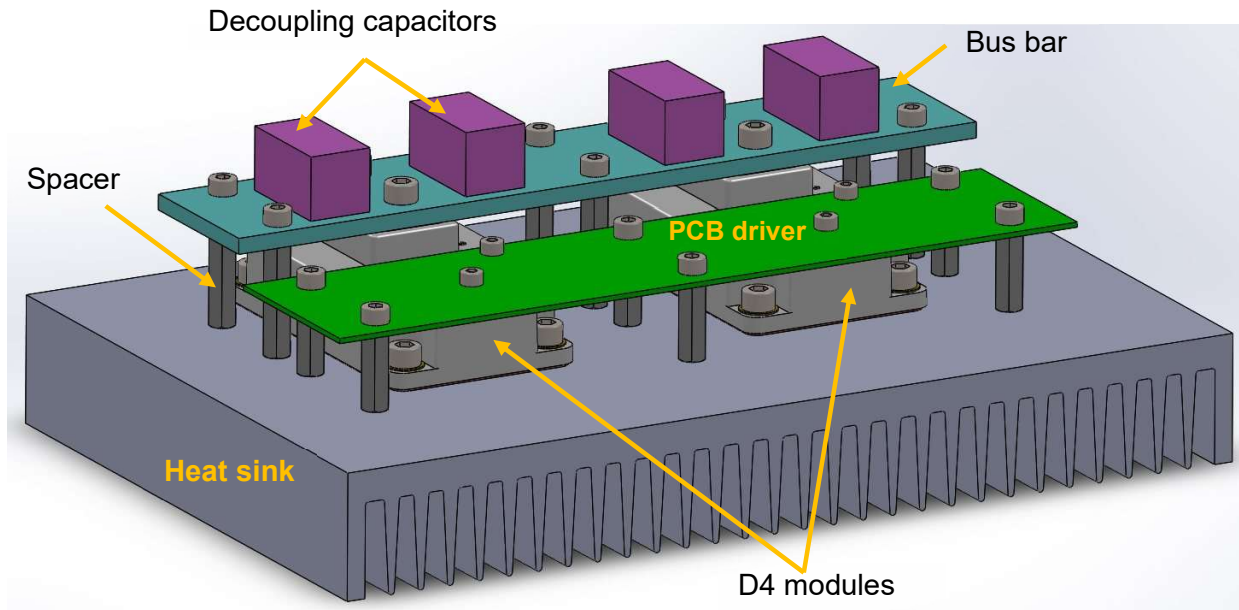Figure 5: D3, D3-HV General assembly view in a 3 phase bridge configuration

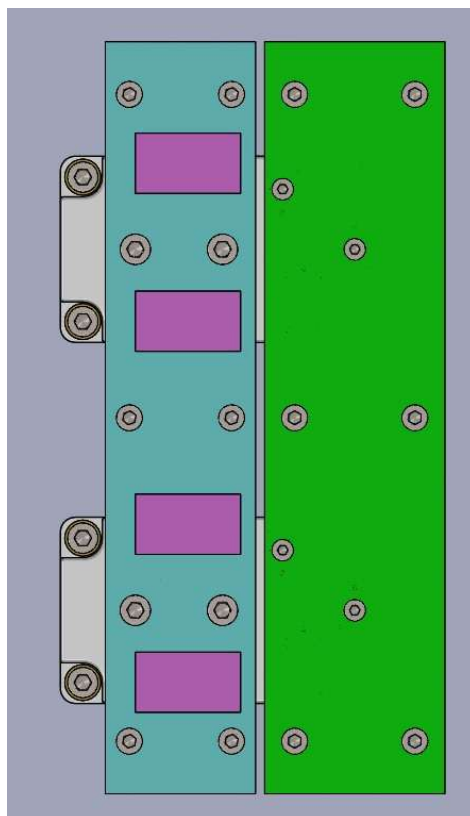Figure 6: D4 General assembly view in a phase leg configuration

Figure 7: D4 General assembly view in a phase leg configuration

Each application, bus bar and PCB are different; the spacers placement must be evaluated on a case-by-case basis. In any case, the power module must not handle the components weight.

3. Connection pull and push forces for D3 & D3-HV.

Power module must be mounted in such way that the resulting pull forces are limited for the power and the signals terminals. See Pictures 8 & 9 for D3 & D3-HV power modules.
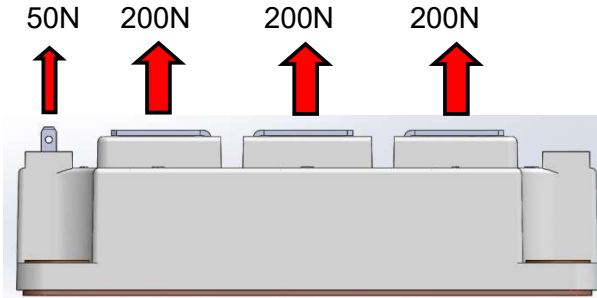
| 50N | 200N | 200N | 200N |

fig 8: D3, D3-HV pull force

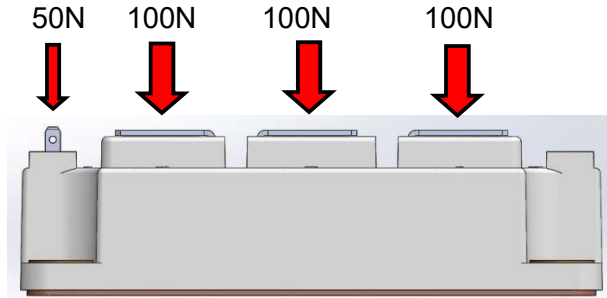| 50N | 100N | 100N | 100N |

fig 9: D3, D3-HV push force

Conclusion:

This application note gives the main recommendations regarding the mounting the D3, D3-HV and the D4 power modules. 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.

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