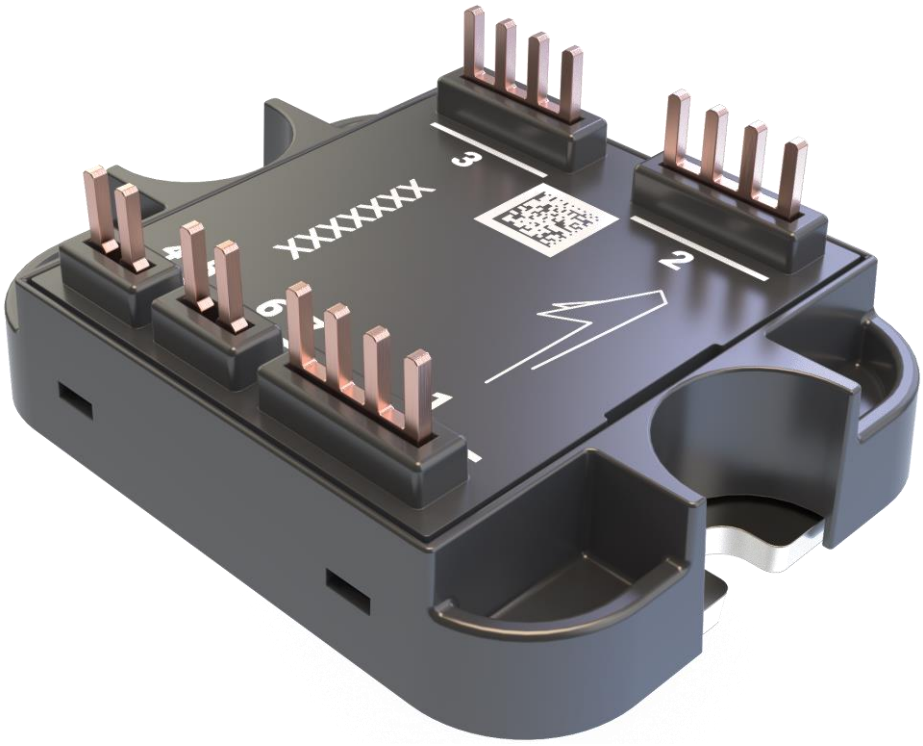
User Guide **PRD-07634**

Wolfspeed DM Module Mounting User Guide



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Achieving optimal power electronic system performance and reliability heavily relies on the assembly process in addition to the design of the system. To ensure the thermal and mechanical reliability of the system, it is crucial to adhere to the proper mounting and assembly process when affixing power modules to heatsinks and PCBs (Printed Circuit Boards). This application note provides recommendations for appropriately connecting the Wolfspeed® DM power module onto the heatsink and soldering its pins to the PCB. It is very important to follow the mounting and assembly instructions to limit the thermal and mechanical stresses to the power module and the PCB.

Contents

CAUTION

Before operating the system, please carefully review the operating limits for Wolfspeed's DM3 Half-Bridge Modules set forth in the datasheet located at www.wolfspeed.com or available upon request, and please ensure that appropriate safety procedures are followed when working with the system. There can be very high voltages present in the system when connected to an electrical source (and thereafter until applicable capacitors are fully discharged), and some components in the system can reach very high temperatures. Serious injury, including death by electrocution or serious injury by electrical shock or electrical burns, can occur if you do not operate the module within its operating limits or follow proper safety precautions.

1. Introduction

This user guide describes the recommended mounting procedure for the Wolfspeed® DM series power modules. A picture of the DM series power module is provided in Figure 1. Information in this document can be applied to any power module product with the **DM** suffix, such as the CAB003M12**DM**3.

The instructions in this document describe how to correctly mount the DM power module onto a cold plate and how to correctly solder the pins onto a PCB. The cold plate, PCB board, and power module assembly process is critical for system reliability and assembly process efficiency. It is recommended to follow these instructions in order to ensure safe and reliable operation of the DM series power module.

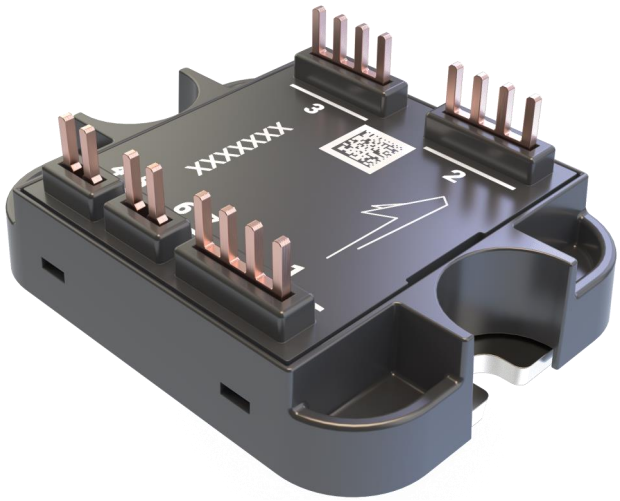

Figure 1: Wolfspeed DM power module

2. Cold Plate Module Mounting

Cold plates are necessary to remove heat from the die during operation and maximize the module's performance. Minimizing the thermal impedance between the module baseplate and the cold plate will further improve performance by allowing operation at higher power levels and reducing the die junction temperature. An important parameter to consider when selecting a proper cold plate is the roughness of its surface. Any cold plate surface will have imperfections in the surface finish that will cause void regions to develop in the contact region between the module and the cold plate. Thermally conductive material should be used to fill these void regions. To ensure the filling of these voids and to minimize the thermal impedance, it is recommended to select a cold plate with roughness less than 10 µm and flatness less than 25.4 µm per 25.4 mm, as shown in Figure 2. To ensure proper application of the thermal interface material (TIM), follow the TIM material application procedure described in the Wolfspeed's DM Module TIM application user guide, Document PRD-07636, located at www.wolfspeed.com or available upon request.

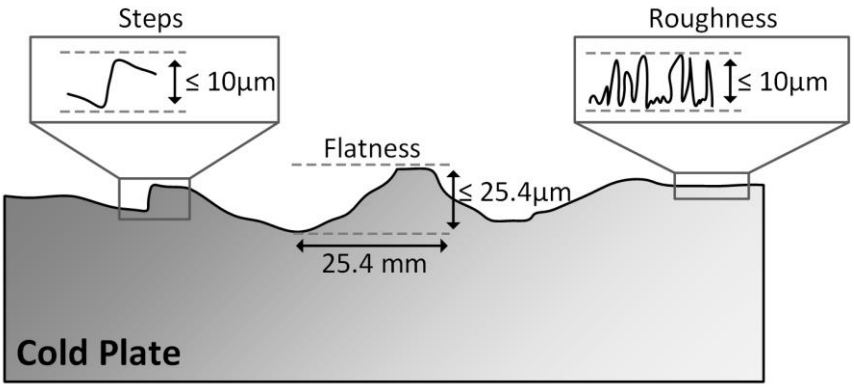

Figure 2: Required cold plate surface tolerances

The module should be attached to a cold plate using two M4 bolts with lock and flat washers at the module mounting locations (see Figure 3). When mounting the module, it is important that the module remains in full contact with the cold plate. If the module slides during mounting, it is recommended to clean off and reapply the TIM. The recommended mounting torque is between 1.1 – 2.3 Nm. To ensure proper seating of the module while mounting, the user should use one of the following methods to mount the module after centering the mounting tabs over the mounting holes of the cold plate.

Method 1: Insert both screws and tighten them simultaneously.

Method 2: First lightly tighten the two mounting screws. Then, slightly tighten the screws alternately until their final torque value is reached.

It is recommended to check the torque of each mounting screw after three hours of mounting or heat cycling the module.

Figure 3: DM3 Mounting Bolt Pattern

3. PCB Soldering and Assembly

It is recommended to adhere to the following soldering and assembly process to avoid PCB deformation that can lead to mechanical stress, which may damage the electrical traces or break components on the PCB.

First, assemble the power modules, spacers, and PCB onto the cold plate as shown in Figure 4 and screw the PCB to the spacers. A mounting torque of 0.6 Nm and a self-tapping screw are recommended to attach the PCB to the spacers. The spacers must have a height of 15.70 ± 0.10 mm. They must be close to the power module to mitigate vibrations and avoid having the power module support the weight of heavy components on the PCB while respecting electrical insulation requirements. It is recommended to keep a distance of at least 5 cm between the power module and the spacers unless heavy components like electrolytic capacitors, transformers, or inductors are located in the same area as the power module. In this case, the distance between the power module and the spacers can be lower than 5 cm to make sure the weight of these components on the board is handled by the spacers rather than the power module.

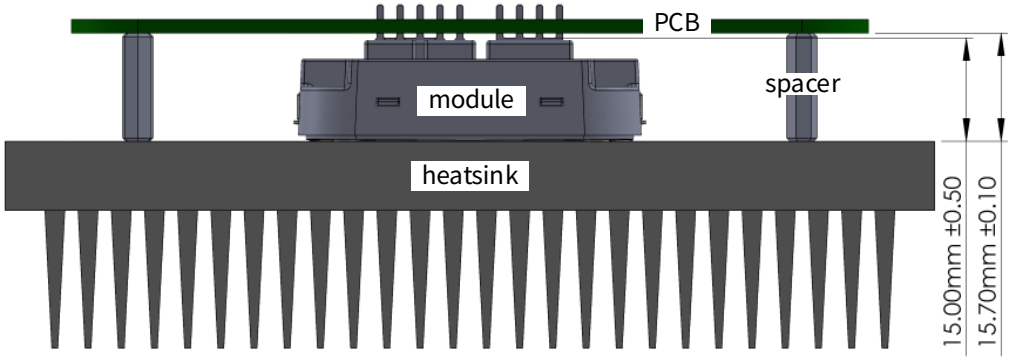

Figure 4: Power Module Assembly View

Second, solder all electrical pins of the power module to the PCB. It is recommended to use a no-clean flux for soldering the power module pins to the PCB since aqueous module cleaning is not recommended. The module is not hermetically sealed, so ionic contaminants may enter inside the module if a cleaning solution is used after soldering. A manual soldering process is recommended to solder the power module pins to the PCB, but wave soldering may also be used for efficient production. For a wave soldering process, it is recommended to start with the soldering process profile shown in Table 1.

Table 1: Recommended Wave Soldering Process Profile

Parameter	Value
Nozzle size	5 mm
Nitrogen Temperature	300 °C
Preheat temperature	125 °C
Preheat duration	3 minutes
Solder temperature	300 °C
Solder time	5 seconds
Flux type	No clean flux

Every application (cold plate, PCB, and components) is different; therefore, the wave soldering process profile must be evaluated on a case-by-case basis. If the above wave soldering process profile does not result in a

satisfactory solder result (enough solder deposited around the pins and no solder bridge occurring between pins), the process parameters can be tweaked until a satisfactory solder result is achieved. However, the power module should not be exposed to temperatures above 175 °C during this process. The power module may be exposed to temperatures between 125 °C and 175 °C for five minutes and exposed to temperatures below 125 °C indefinitely.

Holes in the PCB are also used to insert and remove the mounting screws that bolt the power module to the cold plate. These screw access holes must be large enough for the screw head and washers to pass through freely while allowing for normal tolerance in the PCB hole location.

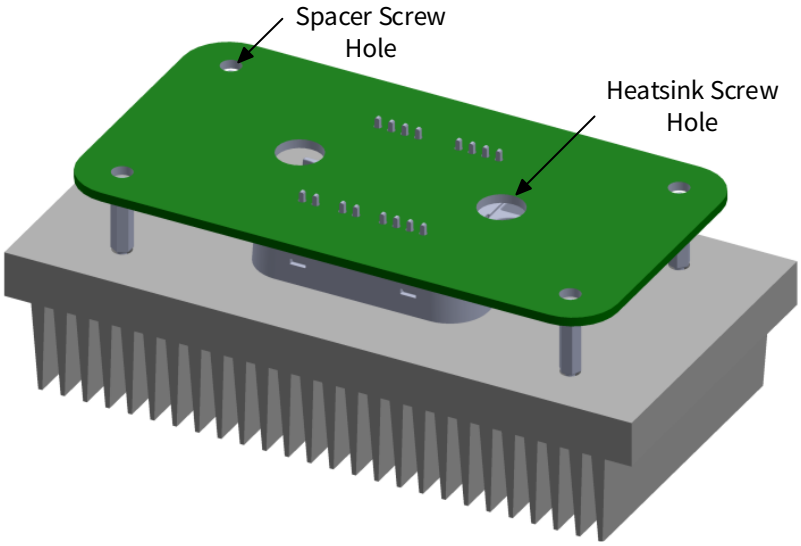

Figure 5: PCB Holes for Cold plate and Spacer Mounting

The power module footprint shown in Figure 6 below can be used for general applications, but the module footprint design should be evaluated on a case-by-case basis as the hole size for module pins and the appropriate solder pad design around the holes depends on the specific application and assembly process.

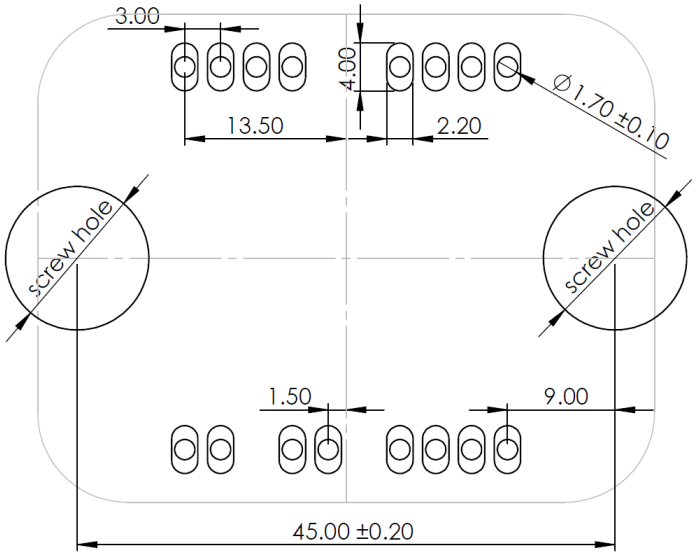

Figure 6: Recommended Module PCB Footprint (all dimensions in mm)

Revision History

Date	Revision	Changes
December 2023	1	Initial Release