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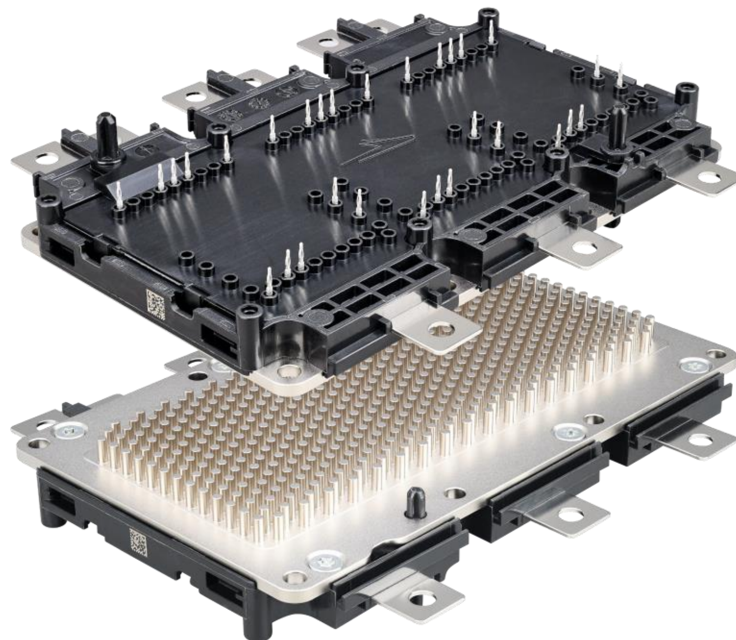
User Guide **PRD-09171**

Wolfspeed YM Module Assembly Guide



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Wolfspeed YM Module Assembly Guide

Press-fit pins enable efficient and reliable assembly of power modules in high-volume production environments. However, the efficiency and reliability of press-fit assembly depends on the quality of the PCB design and the mounting procedure used to mount the PCB to the module and cooling system. In addition to press-in assembly, press-fit pins also offer an efficient PCB soldering option, but the PCB need to be designed accordingly.

This document provides step-by-step instructions for efficient and reliable assembly of Wolfspeed YM power modules. It outlines the recommended PCB design parameters and assembly sequence to mount the gate driver PCB to the power module and cooling system. Any use of the power module beyond the specified guidelines requires additional testing and verification by the user.

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1. Introduction

The YM series power modules utilize press-fit pins as signal terminals, offering a press-in connection solution that benefits customers' process design. Dimensional drawings provided in datasheets describe the position and tolerances of the pins in an unconstrained state; however, in realized applications, stresses imparted by fasteners during mounting can deform the module and cause the position of the press-fit pins to exceed the provided tolerances. This can result in misalignment between the PCB and pins during assembly. This document provides recommendations on how to design and assemble a system using Wolfspeed's YM modules to minimize deformation and ensure consistent assembly.

2. Recommended Mounting Order

System assembly generally involves mounting the modules to multiple structures (e.g., the cold plate and bus work) sequentially. During assembly, it is recommended to first press the PCB onto the power module and then mount the combined PCB-module assembly to the cooling system. To prevent unnecessary mechanical stress on the PCB, the PCB should be securely attached to the power module after the module has been mounted to the cooling system.

The recommended mounting sequence for the press-in process is as follows:

1. Align the PCB to the power module using the PCB alignment pin for guidance (See Figure 1).
2. Press the PCB to the power module using a press tool with controlled travel distance and force.
3. Prepare the cooling system with the sealing ring (See Section 5).
4. Attach the power module with the PCB to the prepared cooling system.
5. Secure the power module to the cooler using screws.
6. Fix the PCB to the inverter housing and power module using the designated PCB fixing holes.
7. Connect external components (e.g., bus bars, DC-link capacitors, etc.).

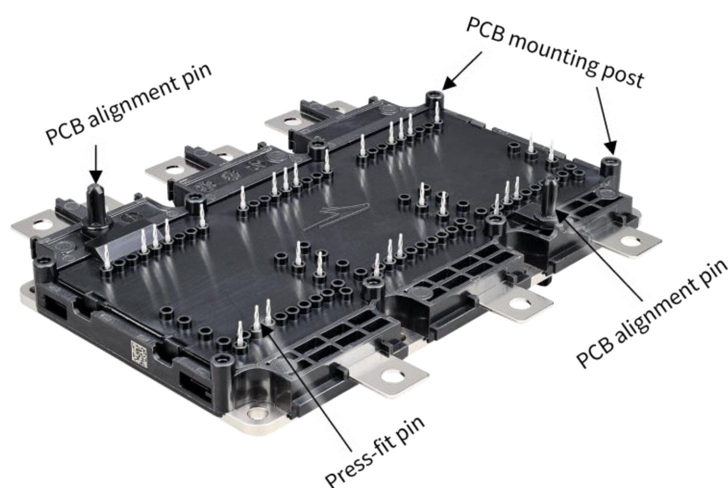

Figure 1: YM module top view showing PCB contact points

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For the press-fit pin soldering process, the recommended mounting order is:

1. Prepare the cooling system with the sealing ring.
2. Attach the power module to the cooling system.
3. Align the PCB to the power module.
4. Secure the PCB to the power module using screws.
5. Solder the press-fit pins to the PCB.

Customers may adjust the mounting sequence as long as system reliability requirements are met.

3. Press-fit Assembly

3.1 PCB Hole Requirements

The specifications for the PCB holes required for press-fit pins are shown in Figure 2 and Table 1. Please note that these requirements apply exclusively to press-in assembly and must all be satisfied simultaneously (not just the end hole diameter). The recommended PCB hole size for press-fit pins is shown in Table 2.

Table 1: Requirement of PCB hole for Press-Fit Pins

No.	Description	Unit	Min.	Typical	Max.
1	Drilled hole diameter	mm	1.125	1.15	1.175
2	Copper plating thickness	µm	25	50	75
3	Thickness of immersion Tin	µm		1 - 5	
4	End hole diameter	mm	1.00	1.05	1.09
5	Annular ring	µm	300		
6	Recommended PCB thickness	mm		1.6 mm +/-10 % tolerance	
7	Metal type on circuit board			Immersion Tin	
8	Press-fit pin plating	N/A		Ni/Sn (mitigate whisker growth)	

Table 2: Recommendation for PCB Pin Holes

No.	Description	Unit	Min.	Typical	Max.
1	End hole diameter for X pin	mm	5.82	5.90	
2	End hole diameter for Y pin	mm	4.82	4.90	
3	Hole to hole pattern tolerance	µm			±100

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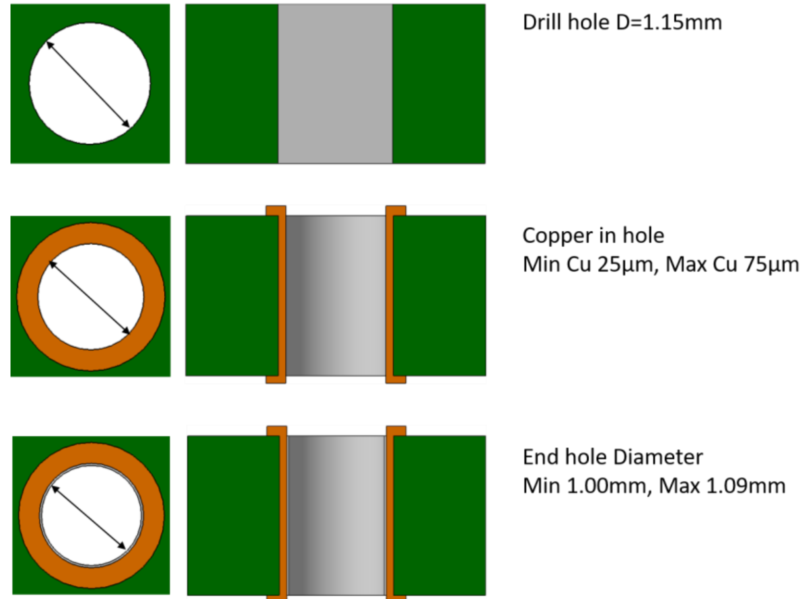

Figure 2: Press-fit pin hole definition for PCB

3.2 Press-in Process Recommendation

Before starting the press-in process, ensure the PCB hole is properly aligned with the press-fit pin. This alignment can be verified using Automatic Optical Inspection (AOI) or PCB height level measurement. The top of the press-fit pin should also be visible on the PCB surface (as shown in Figure 3). It is recommended to use equipment with both press-force control and travel-distance control, as monitoring force and travel distance is critical for assessing the quality of the press-in process.

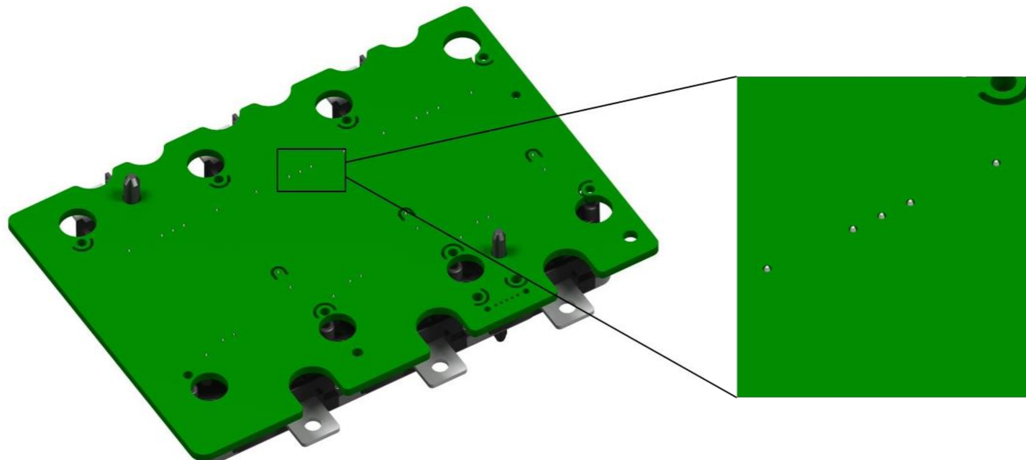

Figure 3: Alignment of PCB and module before press-in

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3.3 Press-in Process

Wolfspeed recommends the parameters shown in Table 3.

Table 3: Recommend Press-in Specification

No.	Description	Unit	Min.	Typical	Max.
1	Press-in speed	mm/min		90	
2	Travel distance	mm		2	
3	Maximum allowed force on power module	N			3500

Figure 4 shows a reference press-in force diagram. Please note that this diagram was measured using press-in tooling without a travel limit block. It's important to understand that variations in PCB hole size and process settings can result in changes to the press-in force.

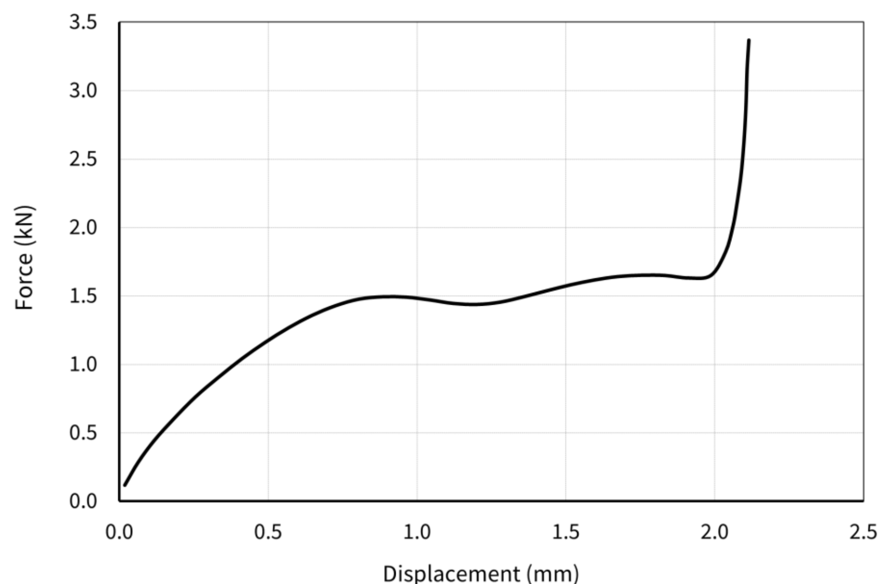

Figure 4: Press-in force diagram

4. Pin Soldering Assembly

The YM module also supports a reliable pin soldering process. The signal pins in the YM module are plated with copper, nickel, and tin, making them suitable for both press-fit and soldering assembly.

4.1 PCB Requirements for Soldering

To accommodate the specific characteristics of soldering assembly, the PCB requirements differ from those used in press-fit assembly. Table 4 below provides the recommended parameters for PCB pin soldering.

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Table 4: PCB Requirements for Soldering Press-Fit

NO.	Description	Unit	Min	Typical	Max
1	End hole diameter	mm		1.60	
2	Copper plating thickness	µm		≥ 35	
3	Hole to hole tolerance	µm			±100
5	PCB recommended thickness	mm		1.6	
6	Metal type on circuit board			Ni (thickness 3-7µm) / Au (thickness 0.05-0.12µm)	
7	Metal type on pin			Ni/Sn (to mitigate whisker growth)	

Note: Compared to press-fit assembly, soldering introduces higher mechanical stress on the PCB and pins, particularly in vibration test environments. To mitigate this, it is recommended to incorporate a grooved design in the PCB to help reduce stress.

4.2 Soldering Process Parameter

It is crucial to secure the PCB to the module using screws before starting the soldering process. This helps to minimize mechanical stress. Table 5 outlines the key parameters to adhere to during the soldering process.

Table 5: Parameter Recommendation During Soldering Process

NO.	Description	Unit	Min.	Typical	Max.
1	Peak temperature of signal pins during soldering	°C		280	320
2	Duration of signal pin peak temperature	s		4	7
3	Maximum temperature of module housing during soldering	°C			225
4	Maximum temperature of housing fixing domes during soldering	°C	100		150

4.3 Quality Assessment of Solder Joints

The following quality requirements must be met for a good solder joint:

1. The solder should cover at least 80 % of the pad area without extending beyond the pad outer edge.
2. The solder joint surface should be smooth and free from pinholes, pockmarks, or solder tumors.
3. The wetting angle between the solder edge and the weldment surface should be between 45° and 70°.
4. Solder joints must not exhibit tipping, bridging, disconnecting, warping, false solder, or missing solder.
5. Solder must be present on both the front and back pads of the PCB.

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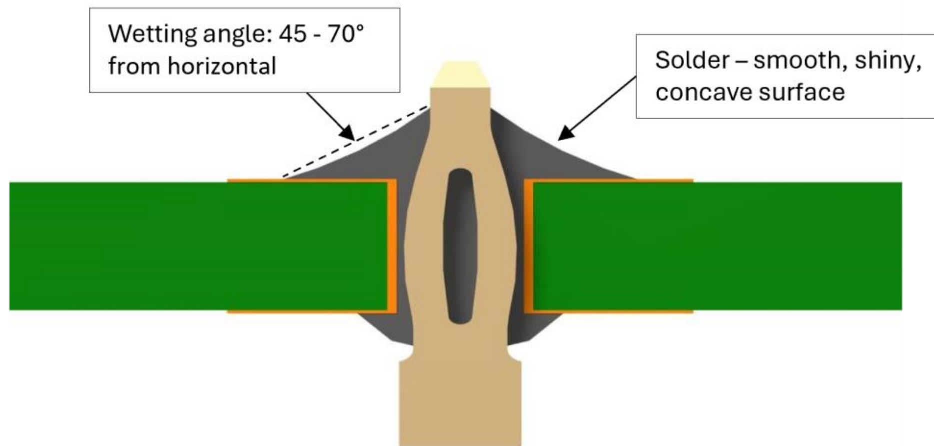

Figure 5: Cross-sectional view of solder joint

5. Module Cooling System

The cooler design affects the thermal resistance of the power module since the geometry of the cooling tub affects the pressure drop and flow rate of the cooling fluid. Figure 6 shows an example of a cooler reference design for YM module.

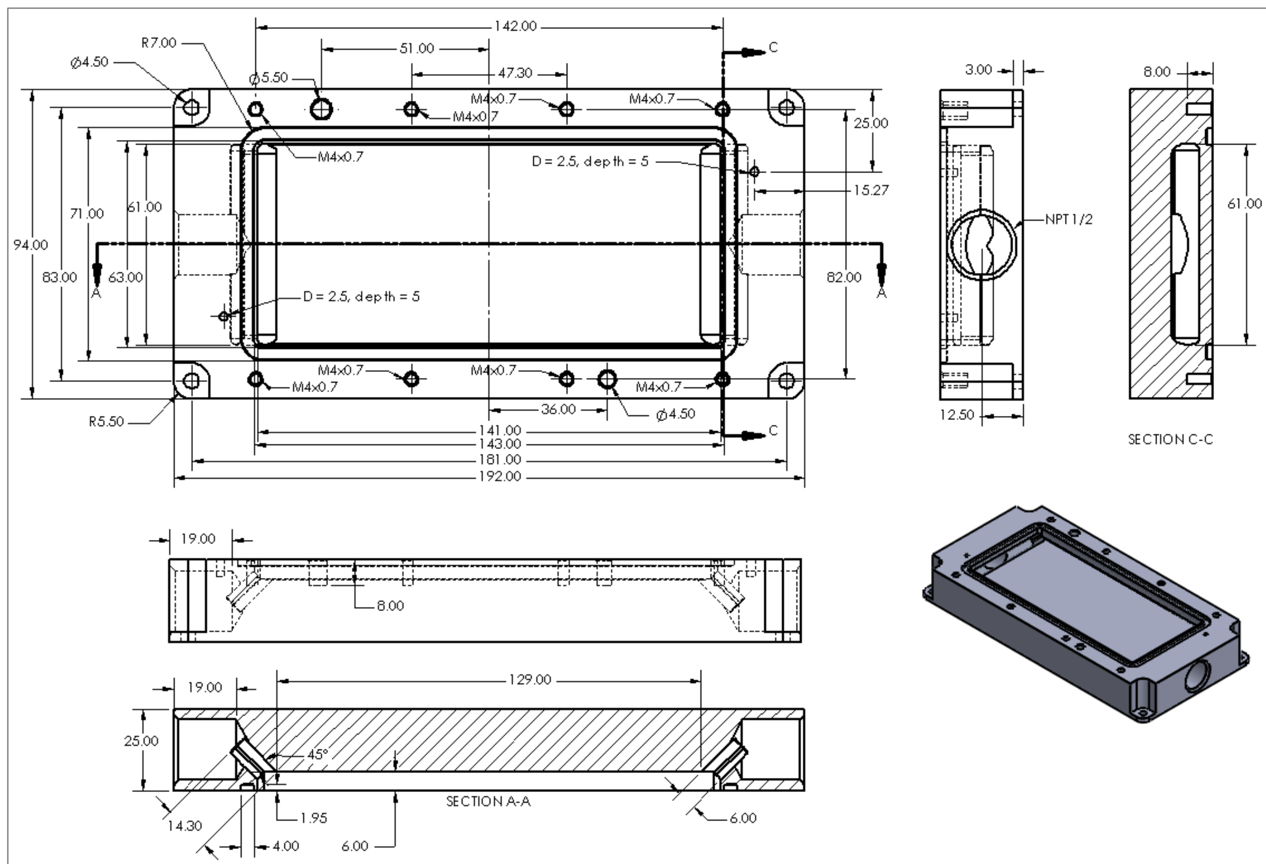

Figure 6: YM module reference cooler design

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To achieve good thermal performance, cooler roughness in sealing area ≤ 25 µm and cooler flatness in module area ≤ 50µm should be used when designing the cooler (cooling tub). In addition, a cooler material compatible to copper baseplate with nickel plating should be selected.

Figure 7 Shows a sample sealing ring (O-ring) drawing that can be used with the reference cooler in Figure 6. It is recommended to use an EPDM 70 material for the sealing ring. Please note that rigorous testing is required to verify the cooler and sealing ring assembly for the specific application.

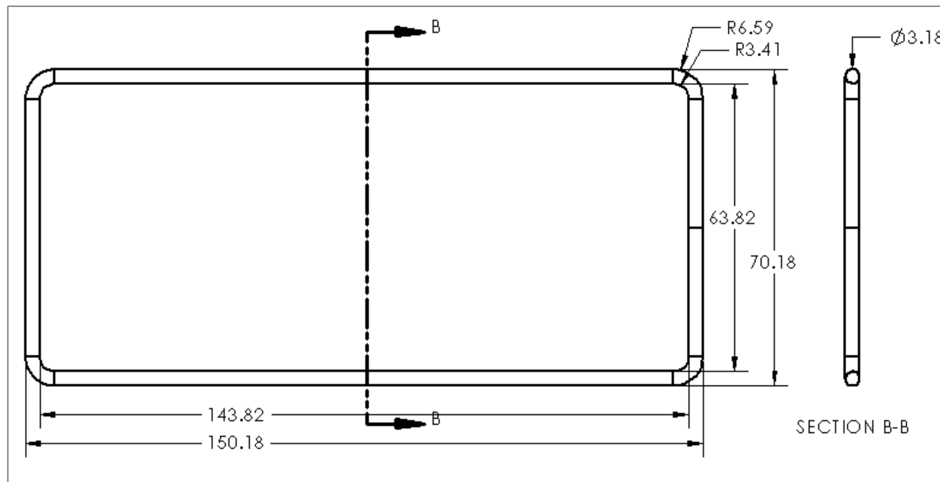

Figure 7: Sample sealing ring (O-ring) drawing

Revision History

Date	Revision	Changes
March 2025	1	Initial Release

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