Mounting Guideline for F5 Baseplate Power Module

AND90298/D

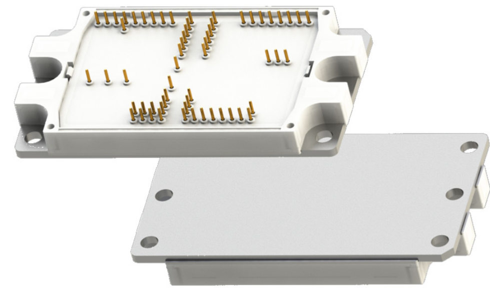


Figure 1. Package Photo

Introduction

This application note addresses the mounting instructions of the F5 Baseplate (F5BP) power module family of products. It includes specifications of press-fit, thermal interface material and various other mechanical relevant recommendations.

Features

- PCB
  - Specification of PCB
  - Design Restrictions within Mounting Area
  - PCB Fixing and Dimensions
- Press-fit Process
  - Press in Process
  - General Press-in Process
  - Press out Process
- Soldering
  - Specification for Modules with Solder Pins, Soldered to the PCB
  - Soldering to PCB
- Heatsink Specification
- Thermal Interface Material
  - Thermal Grease
- Mounting guide
  - Screw Specification
  - Methods of Screw Clamping

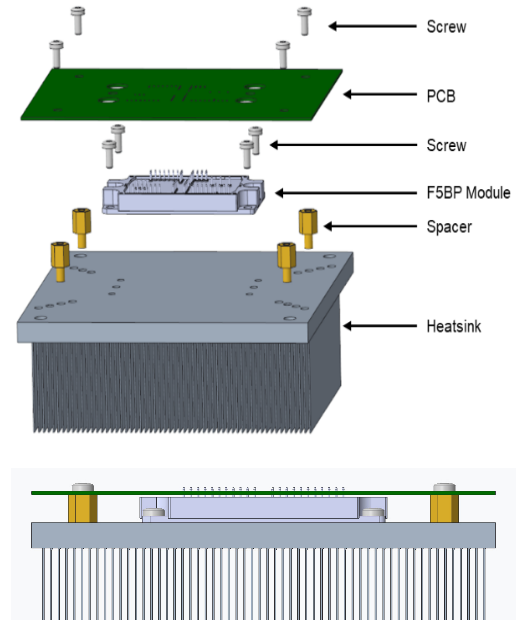


Figure 2. F5BP Assembly with Heatsink

© Semiconductor Components Industries, LLC, 2024

Specification of PCB

Minimum PCB thickness is 1.6 mm. Solder mask is recommended on both sides of the PCB. Recommended PCB hole plating options include immersion tin, immersion silver, electroless nickel immersion gold (ENIG), and organic solderable preservative (OSP). HAL plating is not recommended. For PCB specifications, please see Table 1 for press-fit pins or Table 2 for soldering pins.

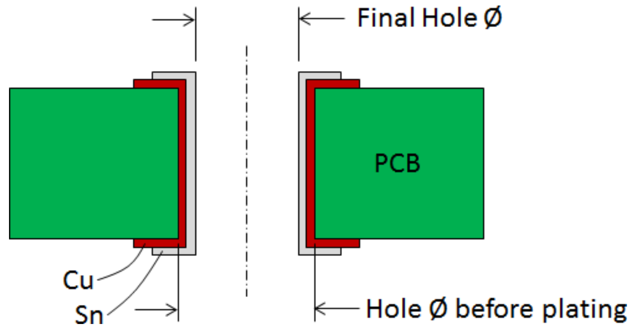


Figure 3. PCB Hole Dimensions

Table 1. PCB SPECIFICATIONS FOR F5BP MODULE WITH 1.2 MM PRESS-FIT PINS

	Min.	Typ.	Max.
Initial Drilled Hole Diameter Ø [mm]	1.12	1.15	
Cu Thickness in the Hole [μm]	25		50
Sn Thickness [μm] (Chemical Tin)			15
Final Hole Ø [mm]	1		1.09
Annular ring [μm]	200		
Thickness of Conductive Layer [μm]	35	70−105	400
Board Thickness [mm]	1.6		

Table 2. PCB SPECIFICATIONS FOR F5BP MODULE WITH 1.0 MM SOLDERING PINS

	Min.	Typ.	Max.
Cu Thickness in the Hole [μm]	25		50
Sn Thickness [μm] (Chemical Tin)			15
Final Hole Ø [mm]	1.4		
Annular ring [μm]	300		
Board Thickness [mm]	1.6		

Design Restrictions within Mounting Area

PCB bending during the press-in process causes mechanical stress to other PCB components, such as capacitors and resistors. Experiments to verify a safe minimum distance between passive components and the plated through hole were conducted with FR4 PCB. Based on experimental results, the recommended minimum space between center of the plated through hole and the edge of the component is 4 mm, as shown in Figure 4.

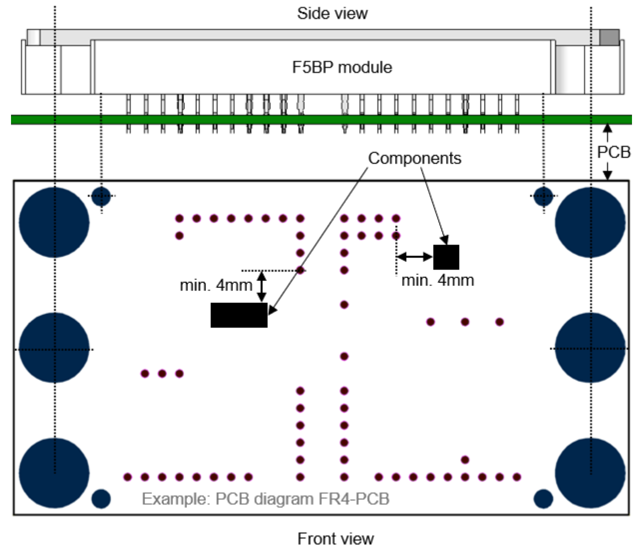


Figure 4. PCB Layout Restrictions

Share Feedback
Your Opinion Matters

PCB Fixing and Dimensions

Space post should be used to fasten the PCB to the heatsink. Space post position should be designed to be symmetrical, with weight of the PCB components considered. PCB bending or flexing should be avoided. Distance from the center of space post to the center of stand-off (dimension X) is recommended to be at least 50 mm and the maximum distance should be evaluated with consideration of system design.

The height of space post (dimension H) should match the height of the PCB after press-fit or soldering.

For press-fit modules, refer to the package drawing for the required PCB mounting height, as it varies by part number. The height of the space post should be determined by considering the PCB thickness to ensure the center of the PCB is positioned at this specified height.

For solderable modules, the recommended height of the space post is 13.1 mm.

A tolerance of +0.05/−0 mm is recommended for the space post height.

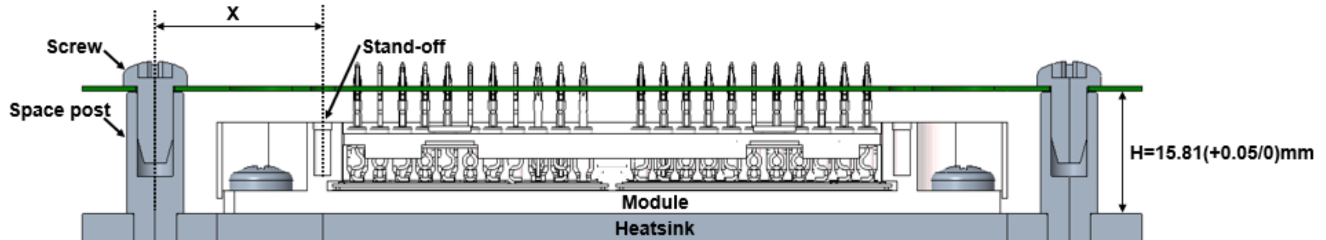


Figure 5. Module Fixed on a Heatsink

Press-in Process

The press-fit connection generates good electrical and strong mechanical interconnect between the module and the PCB. This section deals with the mounting process to achieve good press-fit connections.

The press-fit process can be performed using one of two methods:

a) Board Pressing: The module is held while the PCB is pressed onto it.

b) Module Pressing: The PCB is held while the module is pressed into it.

The recommended method is a) Board Pressing.

This approach allows for visual inspection of the pin alignment during assembly, which prevents anomalies caused by misalignment. The appropriate method should be selected after considering the system structure and the capabilities of the assembly equipment.

Monitoring the press-in/press-out distance, speed, and force to achieve mechanical stability and high reliability of the press-fit connection is recommended best practice. The travel distance during the press-in process should be controlled to ensure the press-fit zone of the pins sits properly in the plated through hole. The speed also influences the quality of the press-fit connection.

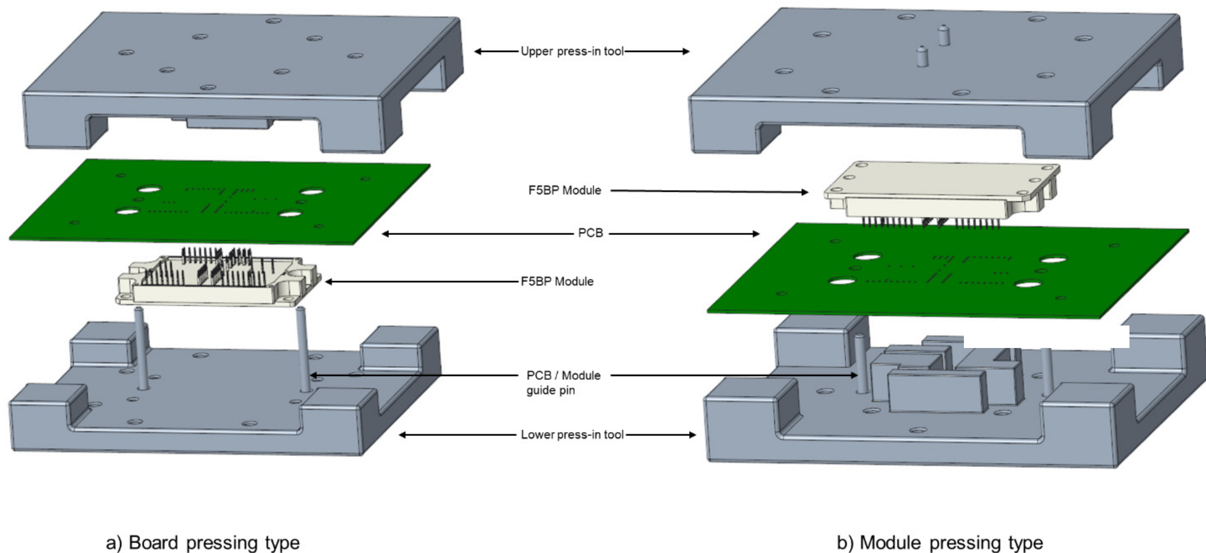


Figure 6. Press-fit Tool for F5BP Module

Share Feedback
Your Opinion Matters

General Press-in Process

Figure 7 shows the general sequence of the press in procedure. The press-in tool comprises of two parts: the upper press in tool and the lower press-in tool. Both parts of the tool need mechanical alignment to each other.

(a). In the first step of the assembly, the printed circuit board (module pressing) or module (board pressing) is placed on the guide pins of the lower press in tool.

(b). The module / PCB is placed on top of the printed circuit board / module. It is necessary to ensure the module and PCB are in proper alignment.

The press-in force is applied evenly via the upper part of the press-in tool to the upper part. The press-in tool should be designed to avoid collision with other PCB components. The module should be pressed in with a speed of 25~450 mm/min until the spacer on the upper press in tool touches the PCB while the press-in distance and force are simultaneously monitored.

(c). The traveling distance of the press requires adjustment to avoid damage to the module from the pressure applied. When the spacer contacts the PCB surface, press-in force rises sharply, and the press-in process can be terminated by reaching the limit of the press-in force.

The recommended press-in speed ranges from 25 mm/min to 450 mm/min.

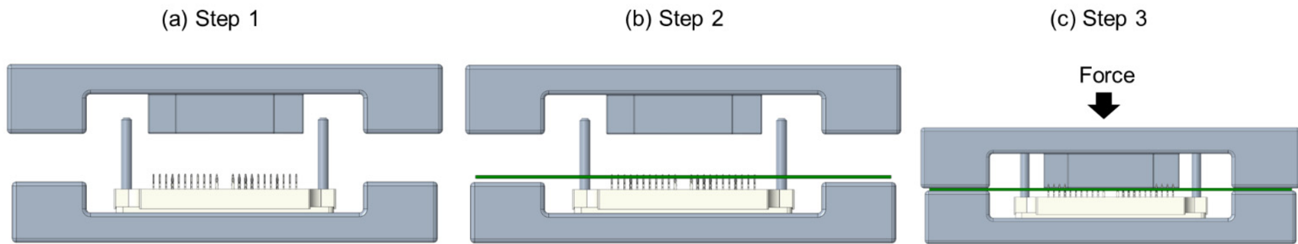


Figure 7. Press-in Process of Board Pressing

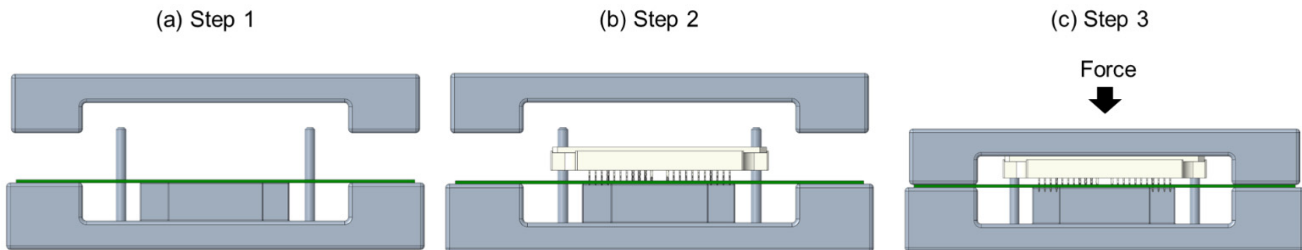


Figure 8. Press-in Process of Module Pressing

The press-fit pins must be pressed into the holes of the PCB to the correct depth. The center of the press-fit zone has to be at least 0.5 mm below the top surface and at least 0.5 mm above the bottom surface of the PCB (Figure 9).

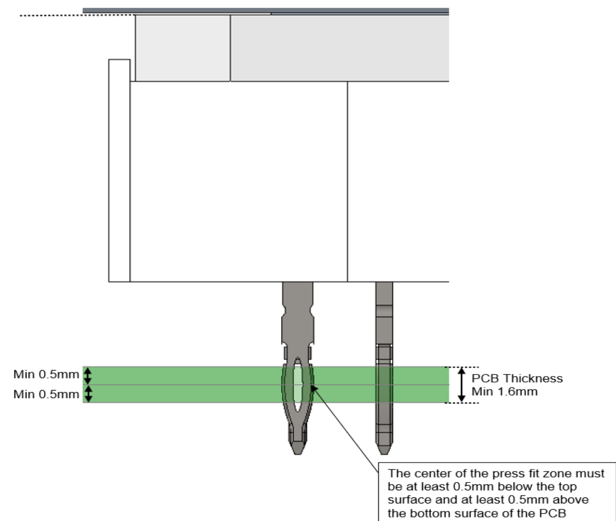


Figure 9. PCB Thickness Specification

Share Feedback
Your Opinion Matters

Force measured in a module is a sum of all pins being pressed at once (Figure 10). The total press-in force is the result of the number of pins in a module, multiplied with the force required for a single pin. A sharp increase in the force gradient can be observed at the point where the assembly is complete (approximately 3.3 mm in the example). This signifies the end of the effective press-in phase of the process. The force applied on each pin can be calculated by dividing the total measured force at this point by the number of pins. Press-in forces lower than 26N/pin (i.e. 1560N for F5BP with 60 pins) means that press-fit pin may have a less secure connection inside the plated through hole. The primary reason for the low press-fit force is that the diameter of plated through hole is too large for the press-fit pins. Press-in forces higher than 80N/pin (i.e. 4800N for F5BP with 60 pins) can cause mechanical damage to the press-fit terminal, the PTH, or to the tracks on the PCB.

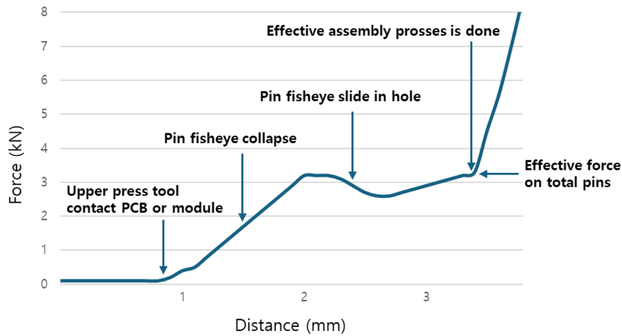


Figure 10. Total Press-in Force Graph

Press-out Process

In some situations, it is necessary to remove power modules from the PCB. It is possible to disconnect the contact between module pins and PTH. The press-out process can be performed with similar equipment used in the press-in process. The top-plate should be designed to touch only the pin area and not the component area. The lower jig should firmly support the PCB and top plate pushing down the pin area. The push down distance must be calculated accurately.

Careful handling in the press-out process is essential to avoid mechanical damage to both the module and the PCB. Reuse is not recommended for both the module and the PCB.

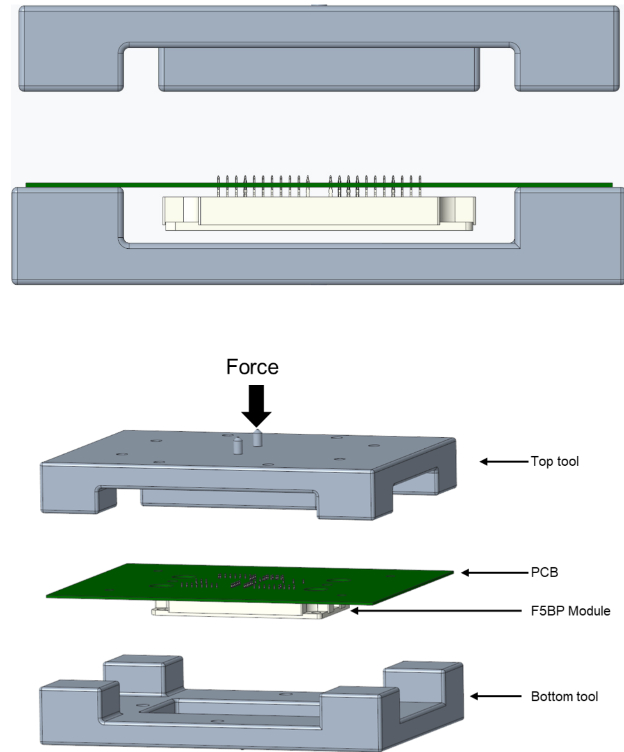


Figure 11. Press-out Tool for F5BP Module

Share Feedback
Your Opinion Matters

Soldering to PCB

PCB holes with fully plated through-holes will enable 100% wetting and fillets between pin and both sides of PCB.

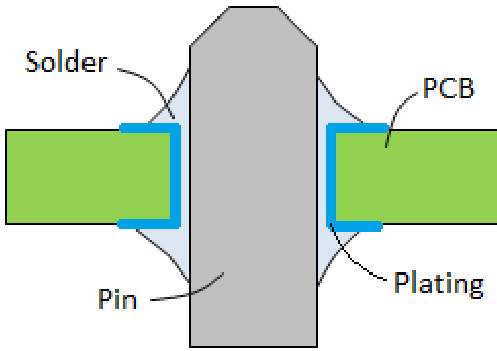


Figure 12. Solder Wetting of PCB Through Hole

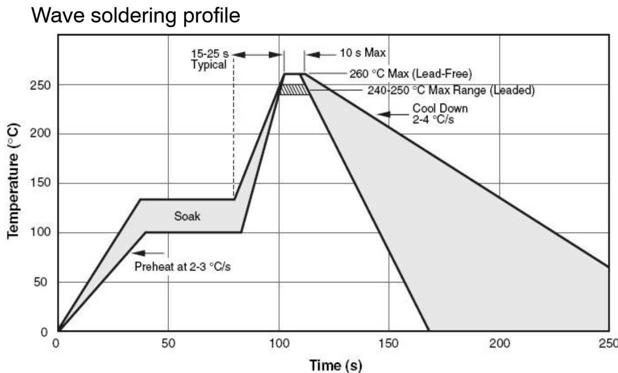


Figure 13. Wave Solder Profile

Heatsink Specification

The following surface qualities are required for the heatsink to achieve good thermal conductivity, according to DIN 4768-1. Roughness (Rz) should be 10 μm or less and flatness, based on a length of 100 mm, should be 50 μm or less. The heatsink should have no contamination, unevenness, and burrs on the surface contacting the module.

The interface surface of the heatsink must be free of particles and contamination (Surface tension min. 32 mN/m, verification with ink test). Avoid handling the heatsink surface with bare hands or contacting any foreign materials. If it is necessary to remove contamination from heatsink, cleaning can be accomplished using dry cloth soaked with solvent, such as isopropyl or ethylene alcohol.

A: Flatness of heat sink ≤ 50 um
based on length of 100 mm

B: Roughness (Rz) of heat sink (=Average distance between the highest peak and lowest valley in sampling length.)
≤ 10 um

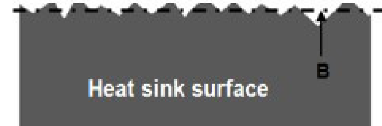


Figure 14. Heatsink Surface Specification

Thermal Interface Material

Thermal interface material can be applied to the heatsink or the module substrate using a rubber roller or spatula or by screen printing. Alternatively, apply thermal paste by screen printing, for example using a honeycomb pattern. The recommended thermal paste thickness is 120 μm.

Thickness of TIM layer exceeding this recommendation will unnecessarily increase thermal resistance. When applying thermal grease, the material must be applied uniformly to the entire surface that is in contact with the module baseplate surface. If the module is re-mounted, surfaces should be cleaned, and TIM re-applied.

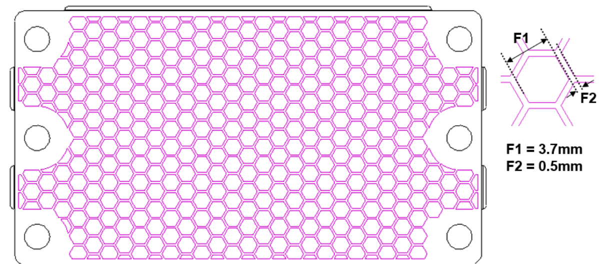


Figure 15. TIM Pattern Example on F5BP Module

Share Feedback
Your Opinion Matters

Screw Specification

- Metric screw: M5 TORX
  - Glue (ex. Loctite) added screw is recommended.
  - Not less than 8.8 property class is recommended.
- Mounting torque range:
  - Pre mounting torque: 0.5 Nm ± 15%.
  - Final Mounting torque: 4.5 Nm ± 15%.
  - The torque range should be adjusted regarding the operation environment and production condition.
- Mounting sequence: 1 - 2 - 3 - 4.
- Screw size: M5 according to ISO 7045 (Pan head screw)
- Screw thread length in the heatsink ≥ 8 mm.
- Screw head height ≤ 5mm
  - Please check clearance to fulfill the system requirement
- A torque wrench shall be used to tighten the mounting screws at the specified torque. Excessive torque may result in damage or degradation of the device. The inaccuracy of torque wrench tightening method can range up to ±10%. This must be considered to prevent overtightening the fastening. Glue added screw is recommended to prevent the loosening of the screws.

Methods of Screw Clamping

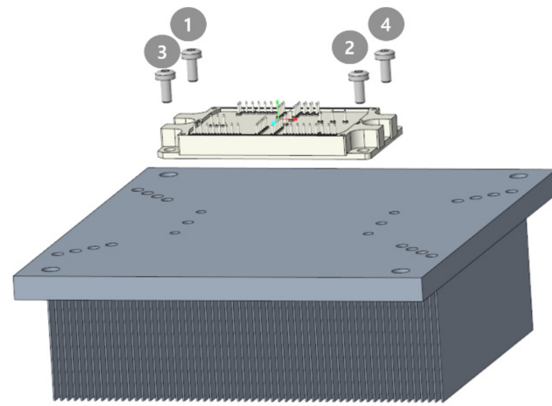
Below is the recommended screw clamping method.

This method can be applied for both module & PCB mounting. PCB mounting is performed after the module is fixed to the heatsink.

Step 1. Fasten all screws with pre-mounting torque according to the right sequence to prevent tilting or elevating the module.

Step 2. Fasten all screws again with final torque to properly fasten to the heatsink.

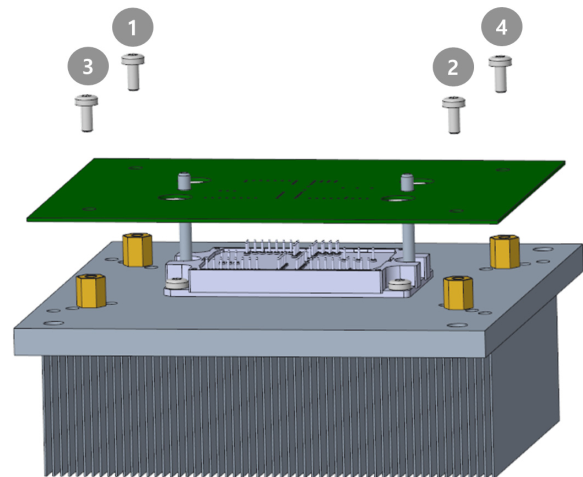
Electric screwdrivers can tighten the screws with the specified torque. Screw holes on heatsink need to be countersunk.



Step 1.
Sequence: 1-2-3-4
Mounting torque: 0.5 Nm ± 15%

Step 2.
Sequence: 1-2-3-4
Mounting torque: 4.5 Nm ± 15%

Figure 16. Method of Screw Clamping (Module)



Step 1.
Sequence: 1-2-3-4
Mounting torque: 0.5 Nm ± 15%

Step 2.
Sequence: 1-2-3-4
Mounting torque: 4.5 Nm ± 15%

Figure 17. Method of Screw Clamping (PCB)

Share Feedback
Your Opinion Matters

REVISION HISTORY

Revision	Description of Changes	Date
0	Initial document version release	9/4/2024
1	- Added PCB Requirements Table for Soldering Module - Updated space post height information - Added Press-fit process method (Board pressing, Module pressing) - Changed maximum speed of press-fit process - Realized press-in force graph based on actual behavior - Updated TIM thickness requirement - Updated screw-related requirement (Property, Torque, etc..) - Deleted misleading information	8/14/2025

onsemi, onsemi, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as−is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales