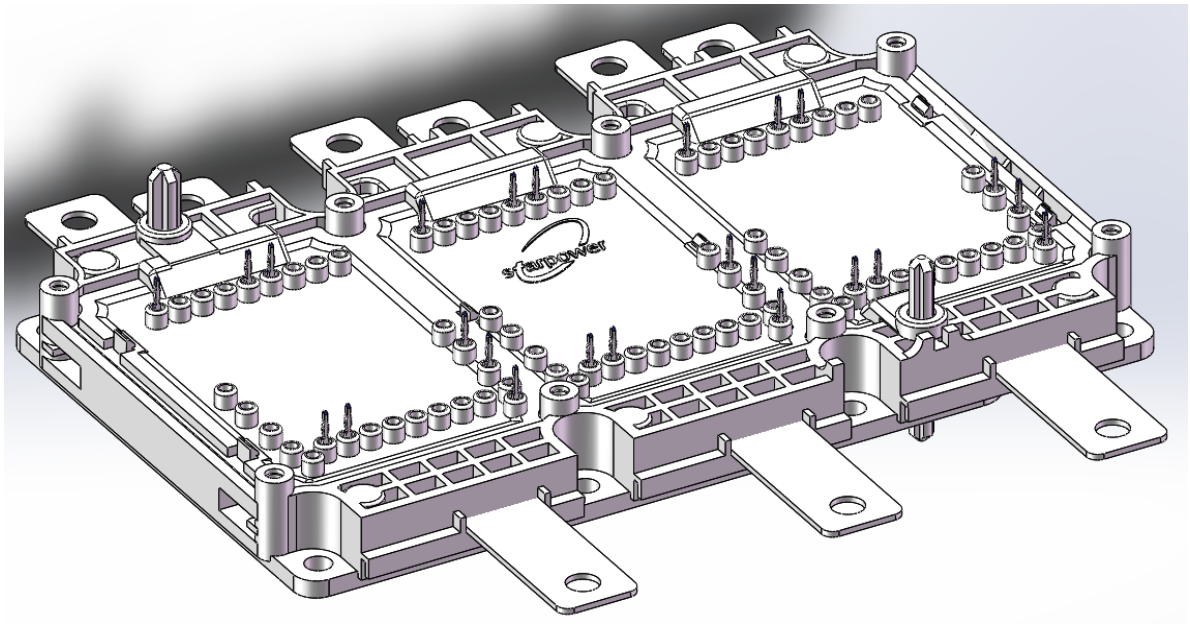
Assembly Instruction for P6-Series Module with PressFIT PIN



Content

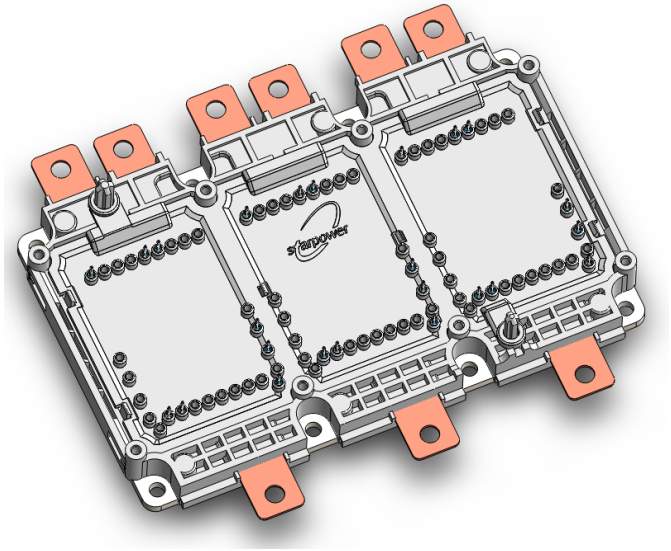
1 General information

This application note is suitable for the following P6-products with PressFIT PIN. [Figure 1] shows the appearance of a P6 module.

P6 module is suitable as a high-performance power module for the electric vehicle drive due to the following advantages:

1. Low thermal resistance, water cooling system, higher power density.
2. Optimized chip layout.
3. Terminal ultrasonic welding, high reliability.
4. High reliable process that extends module life.

a) top view



b) bottom view

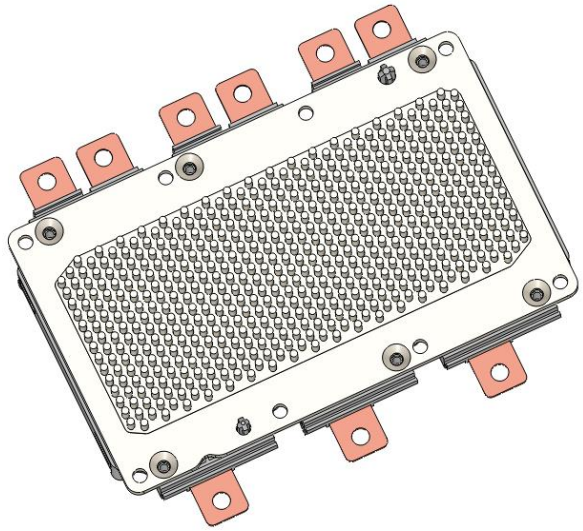


Figure 1: Typical appearance for P6 module.

2 Module related installation parts

2.1 Recommendation for the specification of the mounting screw

Table 1: Specification of the mounting screw

Screw	Specification
Power terminal screw	M5
PCB mounting screw on the module housing （self-tapping screw）	ST2.9 x 10 / M3.0 x 10
Baseplate mounting screw	M4 x 10

2.2 Requirements for the PCB

The PressFIT technology used in the P6-series modules has been inspected and qualified by Starpower AG in China for Standard FR4 PCB's with tin applied chemically (IEC 60352-5).

Correct design of the plated through holes (PTH) in the PCB is essential to obtain a reliable connection between PTH and PressFIT PIN. [Table 2] lists the requirements of the PCB. The recommendations of the PCB for the guide-pin holes are in [Table 3]. The structure of the PCB according to the specification in Table 3 is shown in [Figure 2].

Table 2: Requirements for PCB.

No	Description	Unit	Min.	Typ.	Max.
1	Drill tool diameter	mm	1.07	-	1.13
2	Copper thickness in hole	um	30	-	55
3	End hole diameter	mm	0.97	-	1.07
4	Copper thickness of conductors	um	35	70 105	400
5	Hole to hole pattern tolerance	um	-	-	±100
6	Recommended PCB thickness	mm	1.46	1.6	1.74
7	Metallization of circuit board	-	Chemical Sn ≥ 1 μm (Amount of Ag: 0.5~1.5 weight %)		

Table 3: Recommendations for guide-pin holes.

No	Description	Unit	Min.	Typ.	Max.
1	End hole diameter X-Pin	mm	5.82	5.9	-
2	End hole diameter Y-Pin	mm	4.82	4.9	-
3	Hole to hole pattern tolerance	µm	-	-	±100

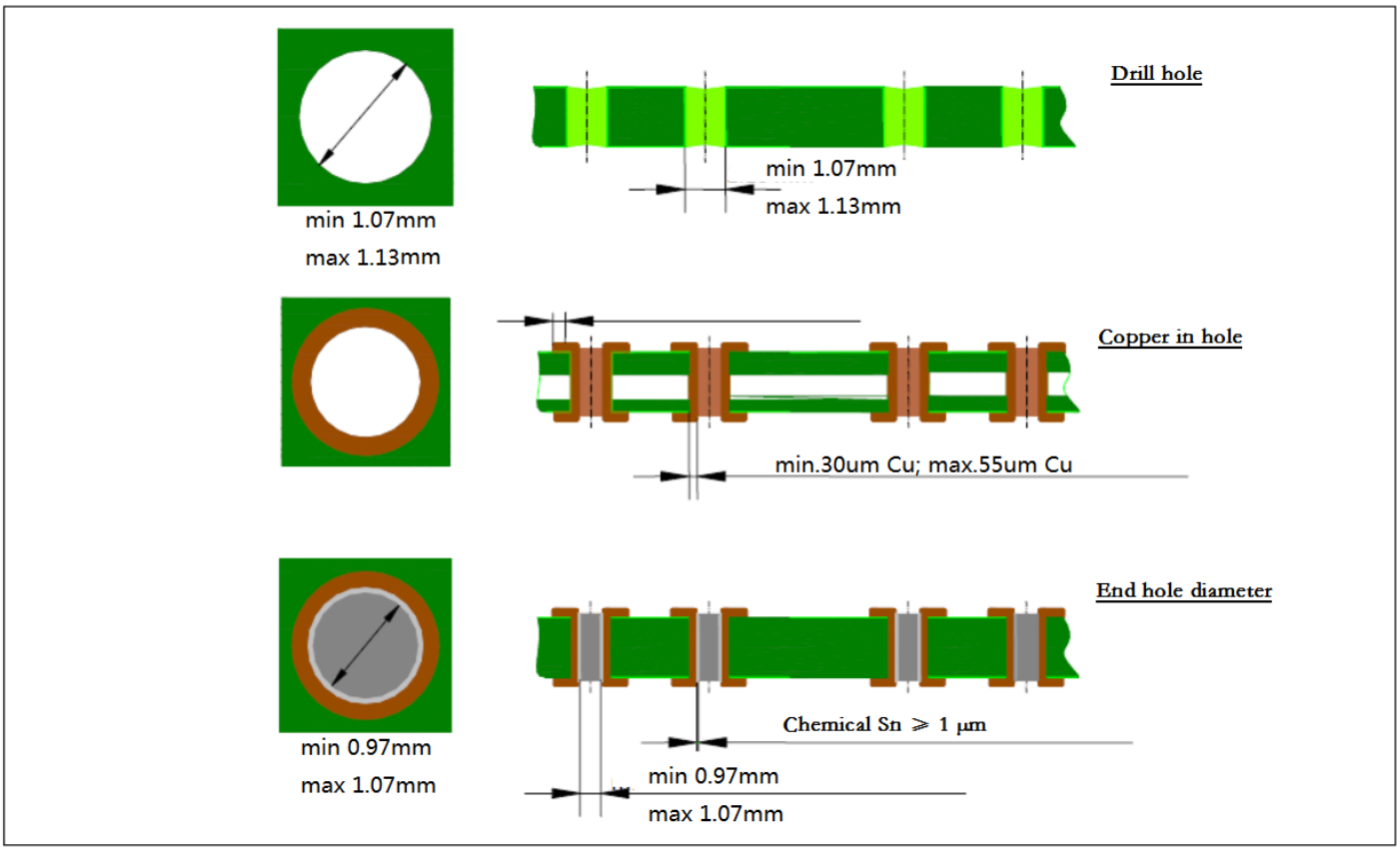


Figure 2: Structure of a PCB according to the specification in Table 3.

2.3 Press-In Tool

The press-in tool consists of two parts, including a top tool and a bottom tool, as shown in [Figure 3]. The bottom tool supports the power module. The top tool is designed with standoffs which provide a distance to the PCB surface. Please note that mechanical collisions of the PCB should be avoided during the press-in process. The technical drawing of the sample press-in tool is shown in [Figure 4] and [Figure 5].

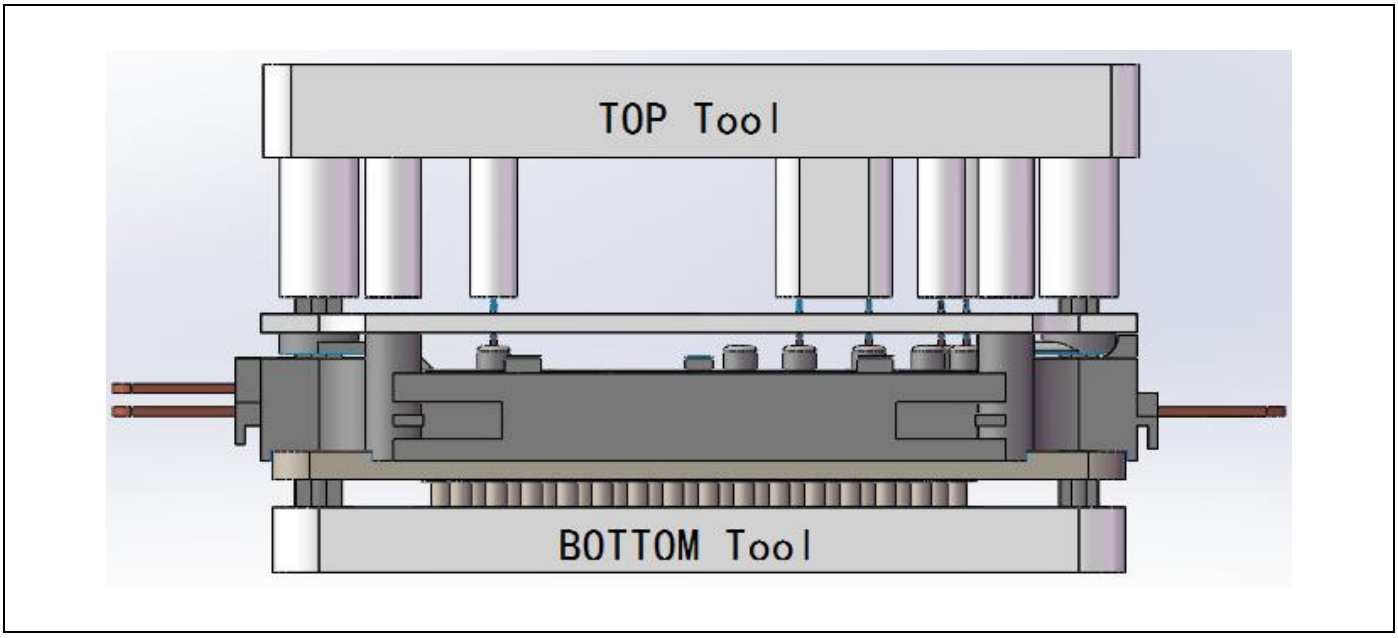


Figure 3: Schematic of press-in tool.

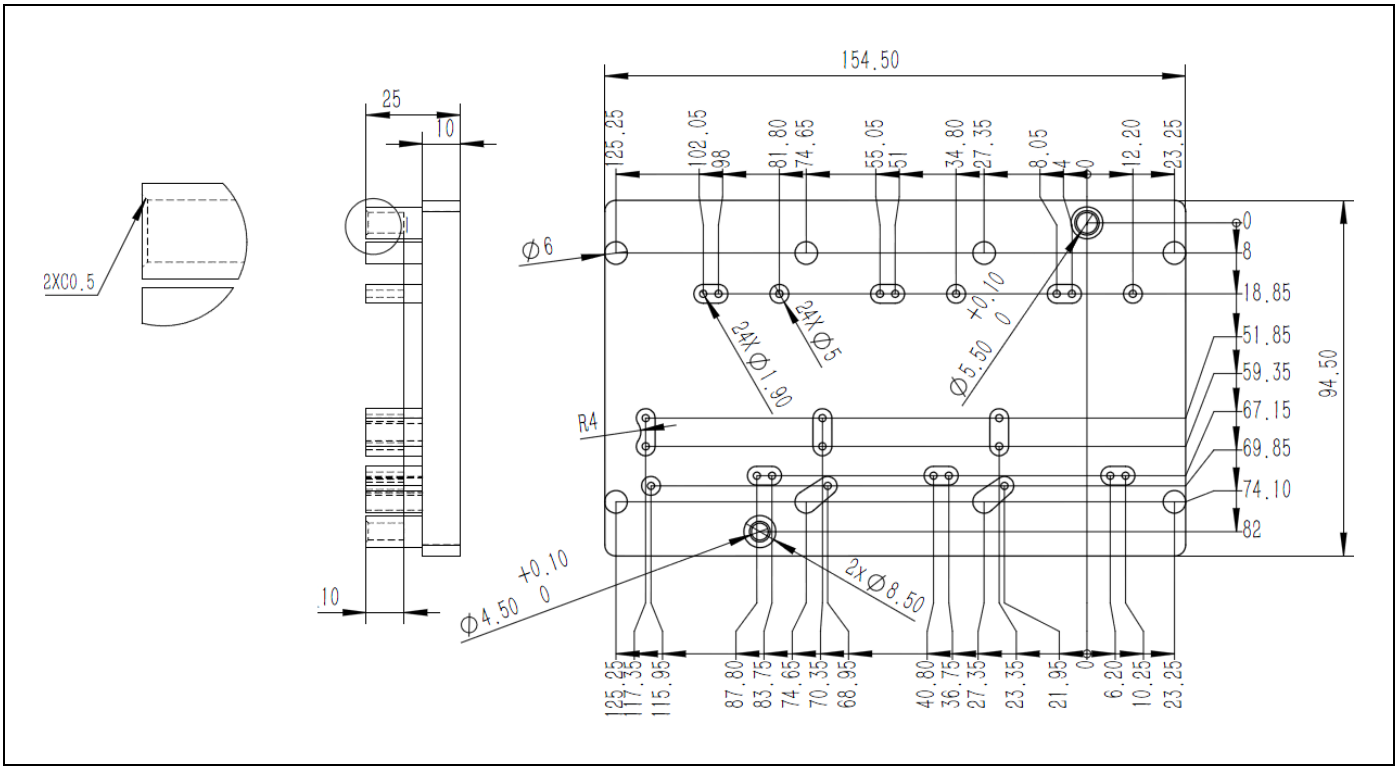


Figure 4: Technical drawing of the top press-in tool; Material: 1.4301 (V2A).

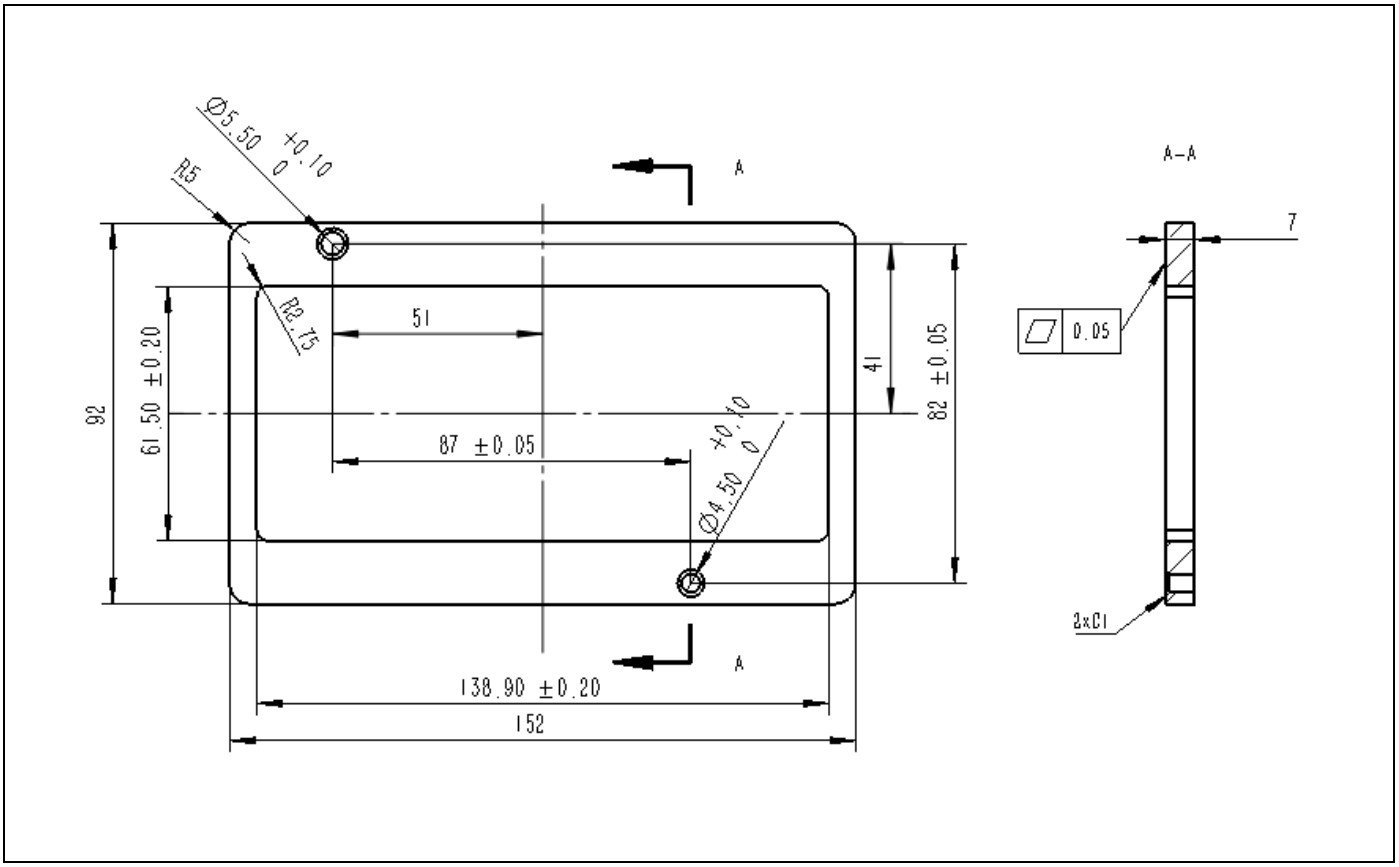


Figure 5: Techanical drawing of the bottom press-in tool; Material: ABS plastic.

2.4 The cooler design and the module sealing area

[Figure 6] shows the technical drawing of the recommended cooler. AlMgSi0.5 should be used as the cooler material, which is compatible with a copper base plate with nickel plating and can withstand the mechanical stress depending on the application. The sealing area is on the baseplate with a flat region of 6.5 mm surrounding the entire pin fin area, as shown in [Figure 7].

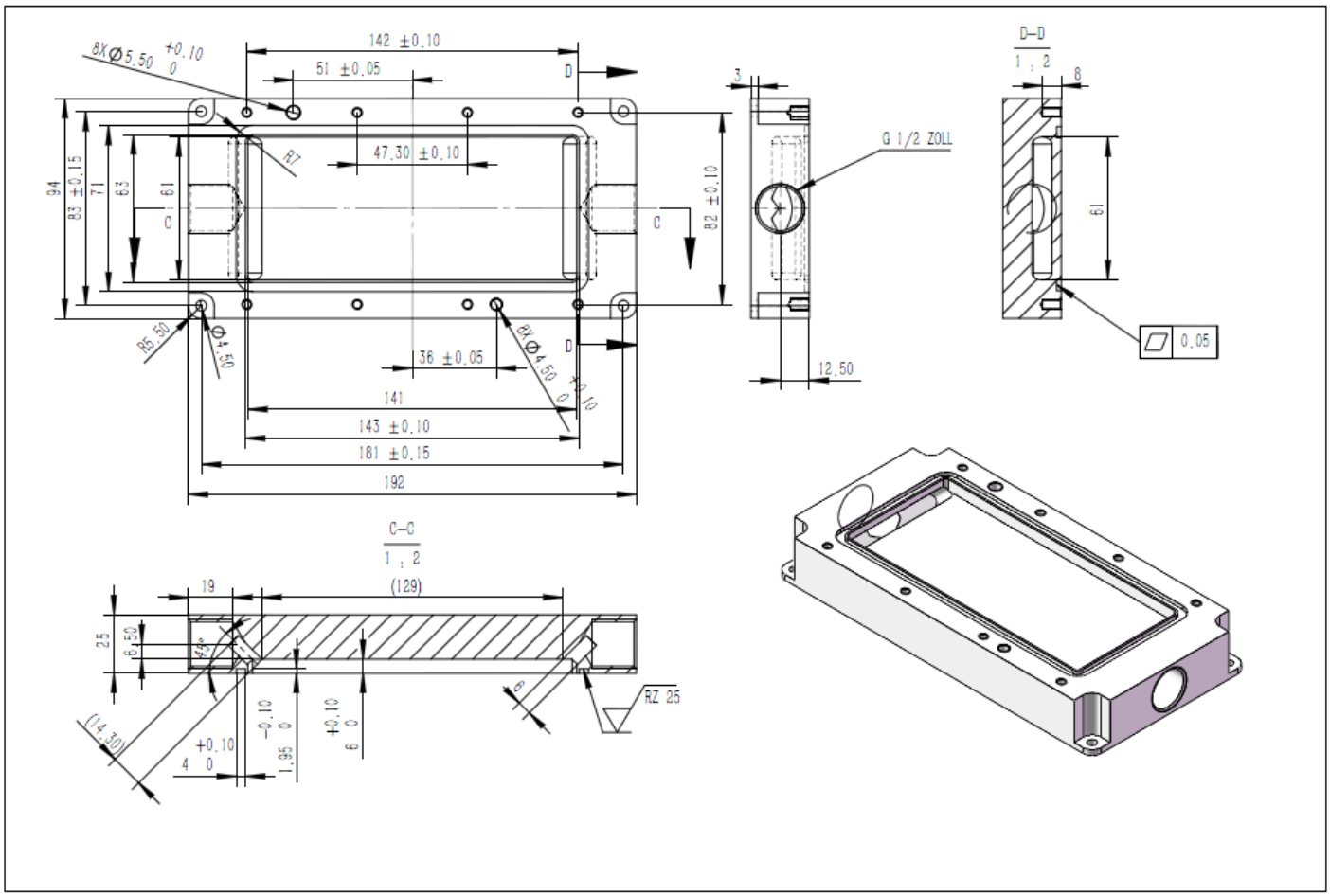


Figure 6: Technical drawing of the cooler; Material: AlMgSi0.5.

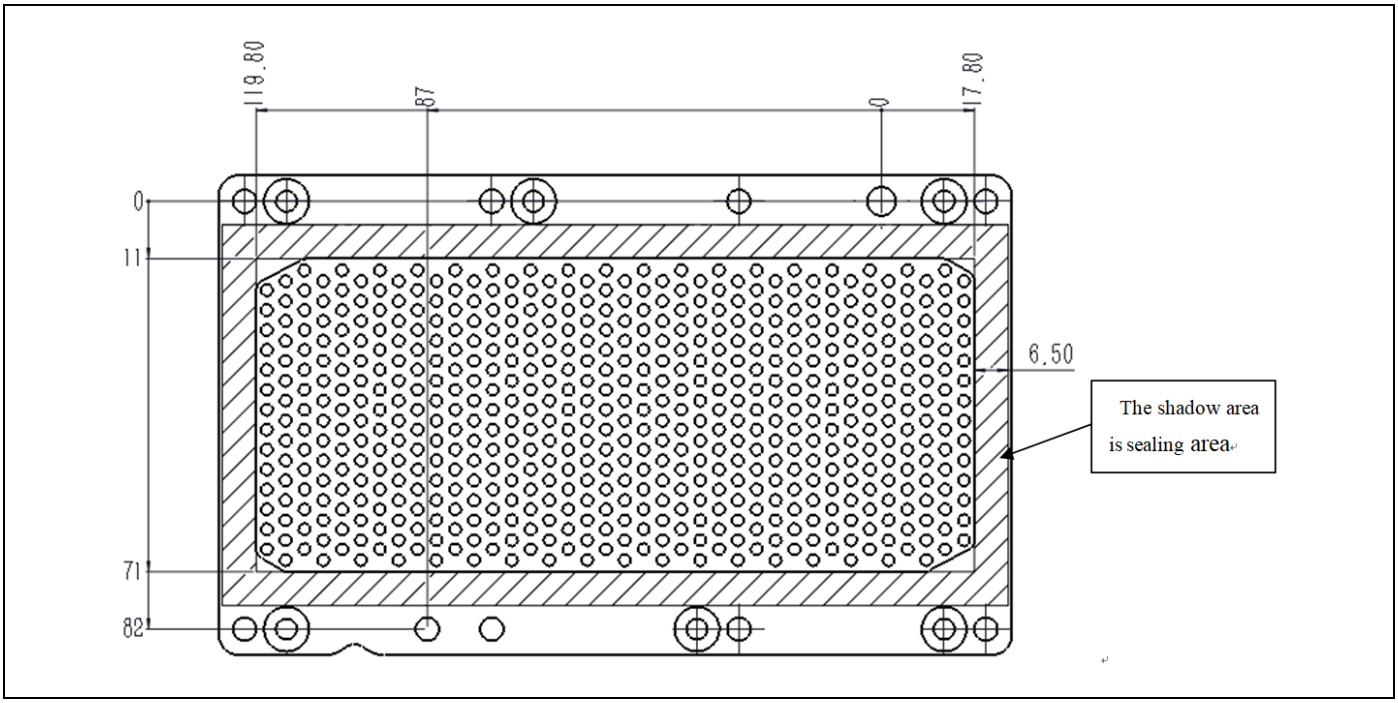


Figure 7: Sealing area with a flat region of 6.5 mm surrounding the pin fin.

3 Module installation and requirements

The following mounting order can be recommended:

1. Align PCB to the power module (the guide-Pins will support this process).
2. Press-in PCB to the power module.
3. Prepare the cooling system with the sealing ring.
4. Attach power module with PCB to the prepared cooling system.
5. Fix module baseplate on the cooler by screws.
6. Fix the PCB on the power module by screws.
7. Connect the module power tabs to busbar, capacitor, etc.

3.1 Align PCB to the power module

X-pin and Y-pin are the guide pins on the module with different diameter, as shown in [Figure 8]. Therefore, PCB can be assembled to the power module only in a correct orientation.

Before the press-in process, the X-pin and Y-pin guide the PCB to the correct position to ensure that all signal pins are correctly inserted into the corresponding holes on the PCB, as shown in [Figure 9].

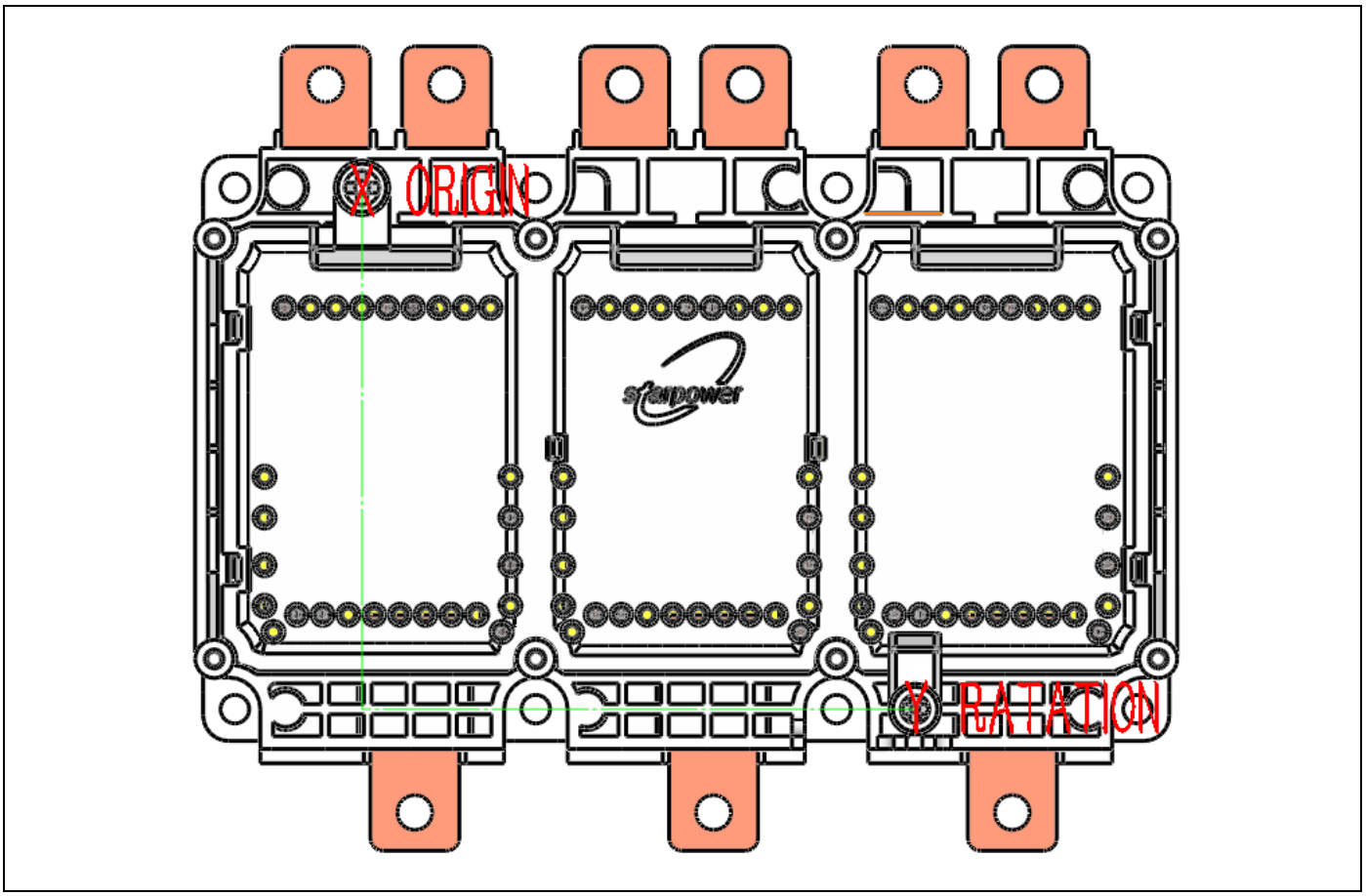


Figure 8: Position of X-pin and Y-pin.

Figure 9: Align PCB to the power module.

3.2 Press-In Process

[Figure 10] shows the force-path diagram for the press-in process. The press-in process starts when the force increases. During the press-in process the bottom and top press tool must be parallel to each other without tilt. The parameters for press-in process are given in [Table 4].

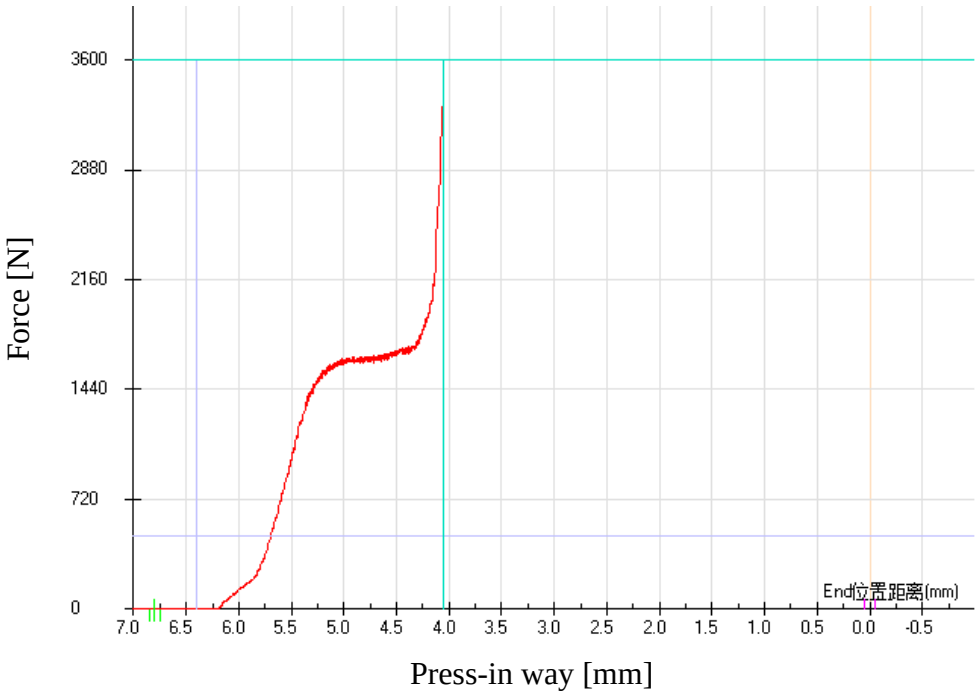


Figure 10: Force-path diagram for press-in process.

Table 4: Parameter for press-in process.

No	Description	Unit	Min.	Typ.	Max.
1	Press-in speed	mm/s	0.4	2 ~ 4	5
2	Max allowed press force on module	kN	-	-	3.6

3.3 Fixing baseplate on the cooling system

The power module baseplate is mounted on the cooling system using M4 screws. It is recommended to mount the module on the cooler in the following sequence: 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8, as shown in the [Figure 11]. The screws are pre-tightened with a torque of 0.5 Nm. Then tightened the screws firmly to the cooler with a standard torque in the range of 1.8 Nm to 2.2 Nm.

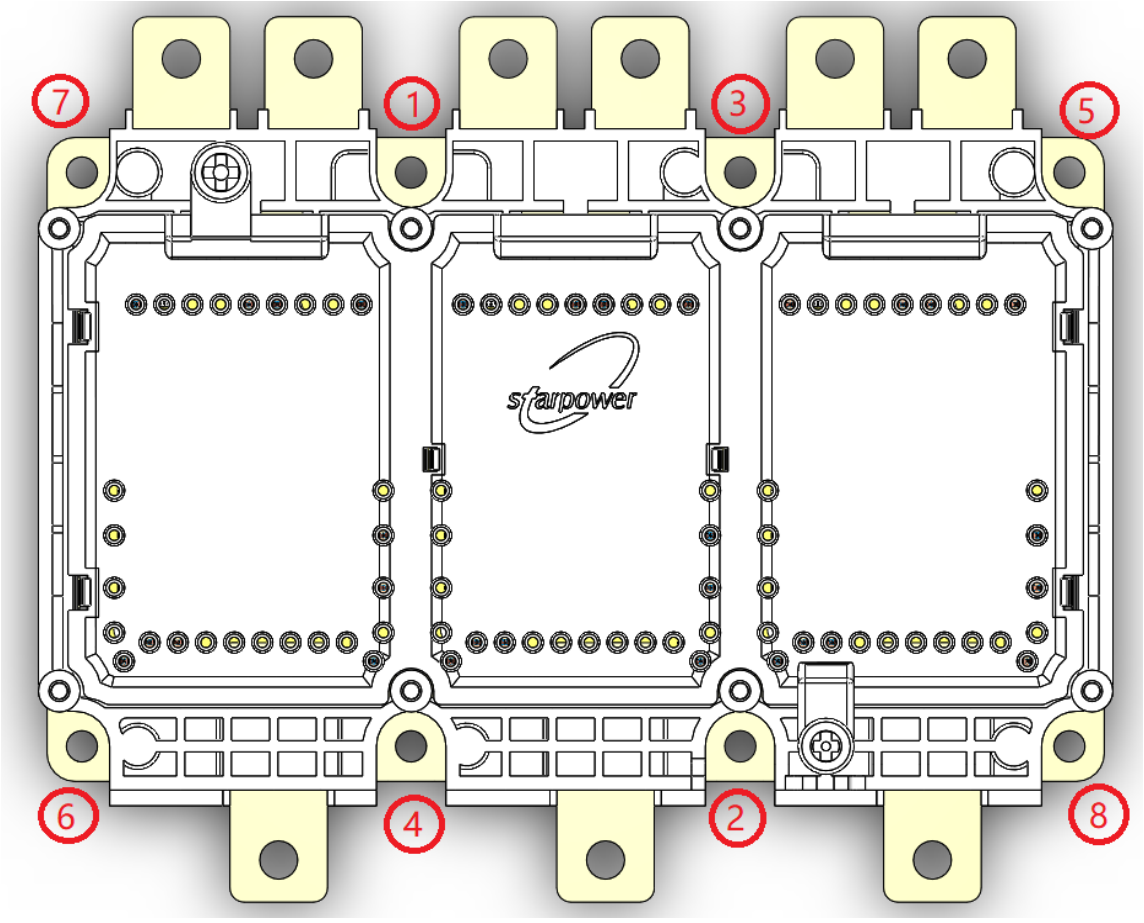


Figure 11: Screw order for baseplate.

3.4 Fixing PCB on the power module

It is recommended to mount the PCB on the module in the following sequence: 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8, as shown in the [Figure 12].

The PCB is fixed on the power module with self-tapping screws (ST2.9X10 or M3.0X10). Self-tapping screws should be inserted perpendicular to the module. The self-tapping screws are tightened with the recommended torque and speed, corresponding to 0.6 Nm to 1.0 Nm and 400 rmp to 600 rpm.

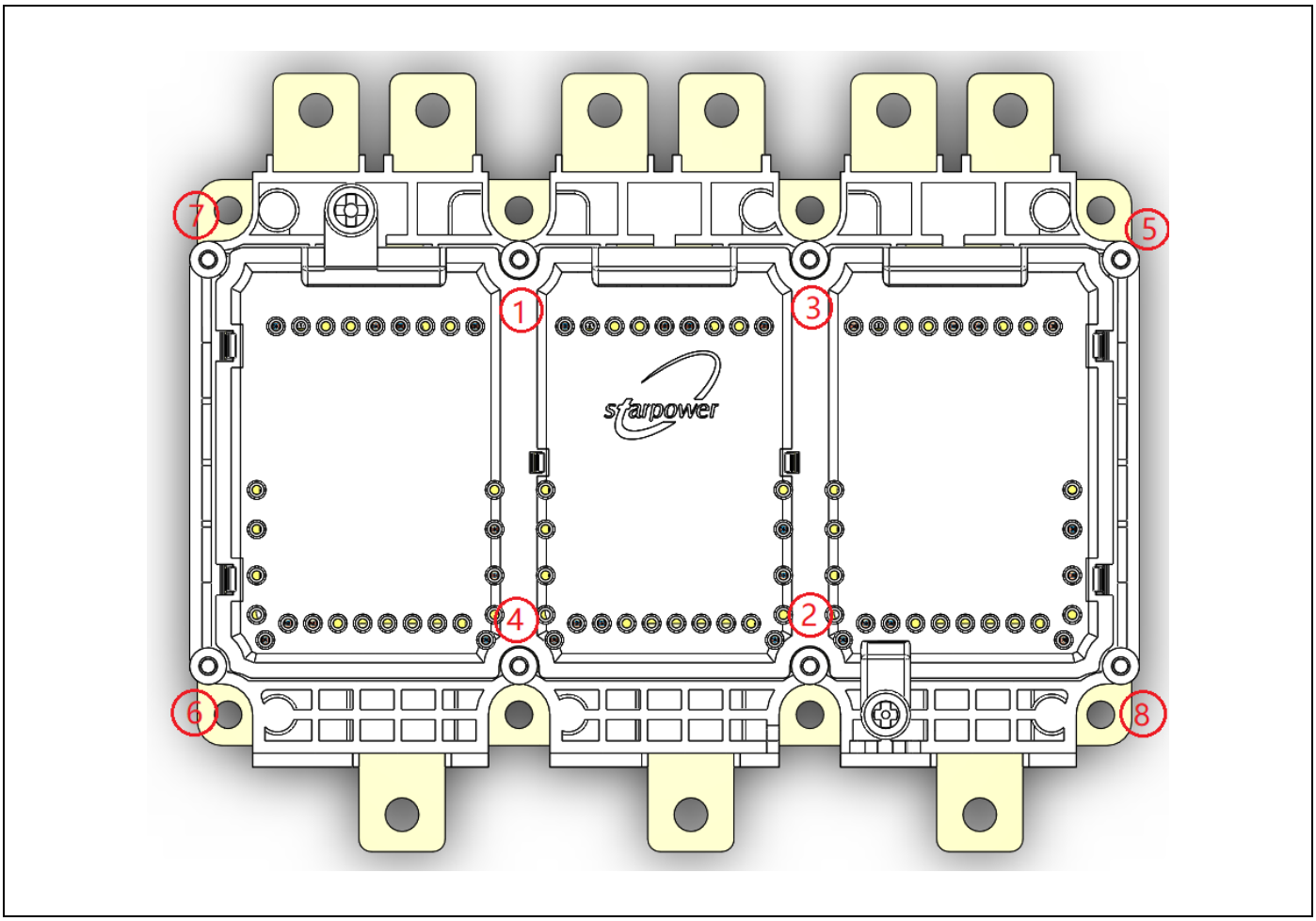


Figure 12: Screw order for PCB.

3.5 Connect the module power tabs to busbar, capacitor, etc.

Module power tabs is connected to busbar, capacitor, etc using M5 screw with a torque in the range of 3.6 Nm to 4.4 Nm.