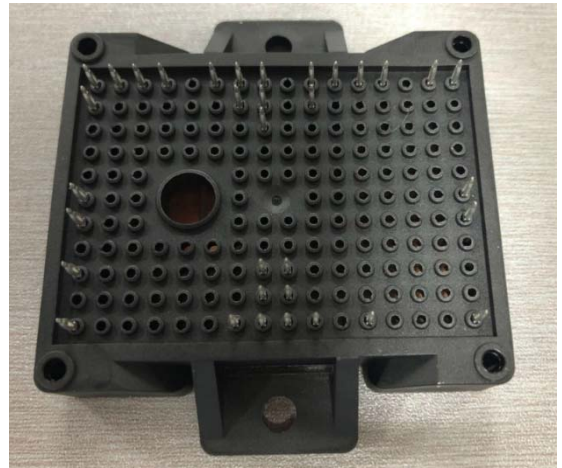


Application Note

L2 and L3 Package Power Modules with Pressfit pins





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1 General information

This application note describes the assembly of L2/L3 modules with Pressfits to the PCB and to the heat sink.

When pressing the PCB on the Pressfits, all forces which can push out the DBC from the housing must be avoided as shown in [Figure 1].

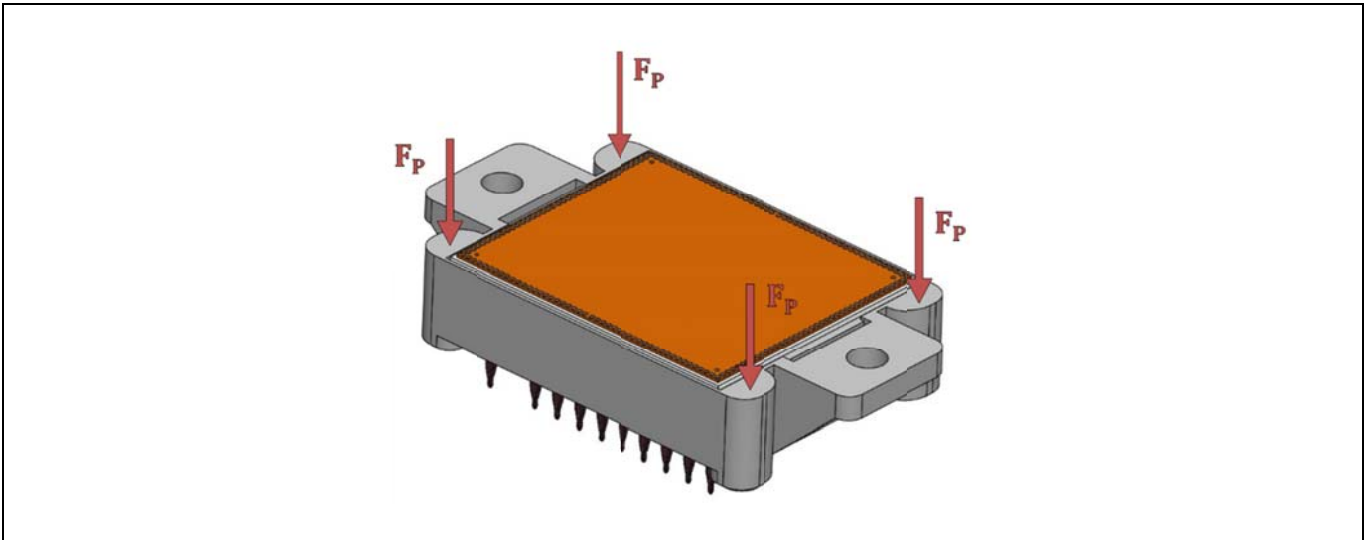


Figure 1: Avoid forces on housing backside.

2 Qualification of the pressfit contacts

A Qualification according to

- Single pin qualification: IEC 60532-5
- Module qualification: IEC 60749 and 60068

is available on request.

3 Requirements of the printed circuit board (PCB)

The Pressfit technology used in the L2 and L3 modules has been inspected and qualified by Starpower AG in China for standard FR4 printed circuit boards with tin applied chemically (IEC 60352-5 + IEC60747-15).

Requirements for the PCB material:

- Double-sided printed circuit board according to IEC 60249-2-4 or IEC 60249-2-5.
- Multilayer printed circuit board according to IEC 60249-2-11 or IEC 60249-2-12.

Correct design of the plated through holes (PTH) in the PCB is essential to obtain a reliable connection between PTH and Pressfit pin. [Table 1] lists the specification of the holes that must be met.

Table 1: Specification of the hole in the PCB.

	Min.	Typ.	Max.
Hole drill diameter	1.13 mm	1.15 mm	-
Copper thickness in hole	25 μm	-	50 μm
Tin metallization in hole	-	-	15 μm
End hole diameter	1.0 mm	-	1.1 mm
End hole nominal diameter	-	1.0 mm	-
Recommended PCB thickness	1.0mm	1.6mm	

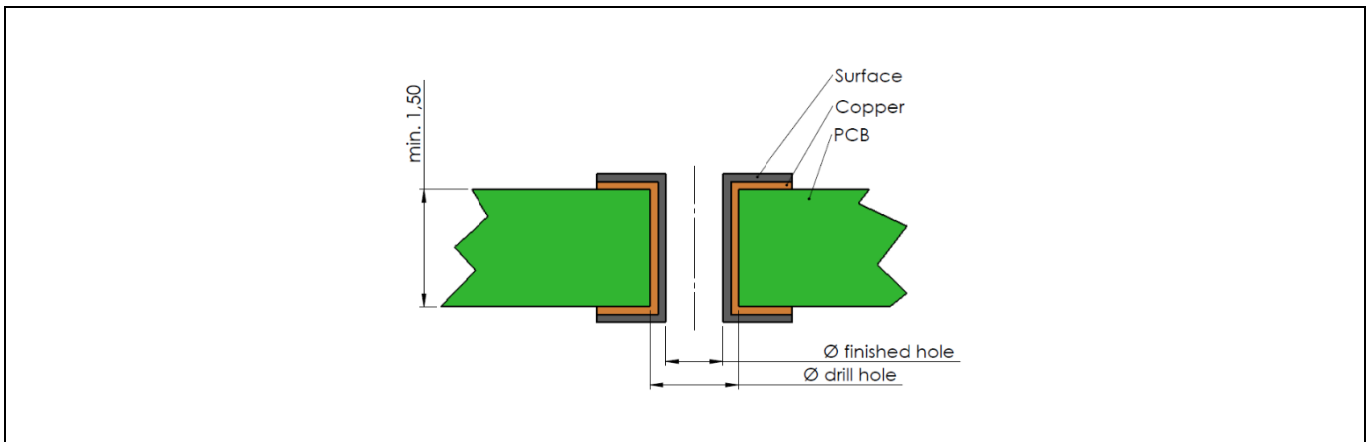


Figure 2: Structure of the PCB.

If a reflow solder process (PCB with Pressfits) is necessary, it should be done before mounting the module on the heatsink.

If handled correctly, a PCB can be used up to 3 times.

After a module has been pressed-in and -out, it can only be attached to a new PCB by soldering due to the mechanical deformation of the Pressfits.

Any components on the PCB should have a distance of approx. 5 mm to the middle of the pins. The pressing tool must also be considered when designing the PCB.

4 The press-in process

4.1 Press-in tools

This section introduces the necessary press-in force and tools for the press-in process. The Pressfit module can be pressed into a PCB by using a toggle joint press [Figure 3-a] or an automated press machine [Figure 3-b].

The automated press machine is recommended, which records the force and distance during the pressing process. This tool should ensure a parallel pressing of the module into the PCB with a steady movement, until the PCB is in contact with the four standoffs of the housing or optional distance keepers. [Figure 4] show the press-in process as it is implemented in the laboratory.

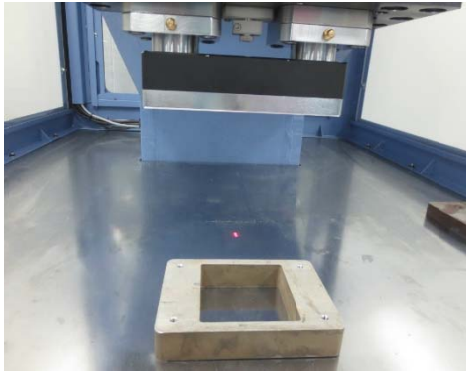


a) toggle joint press

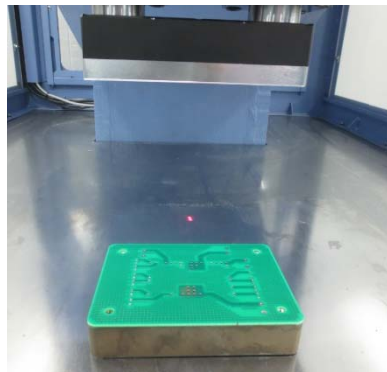


b) automatic press machine

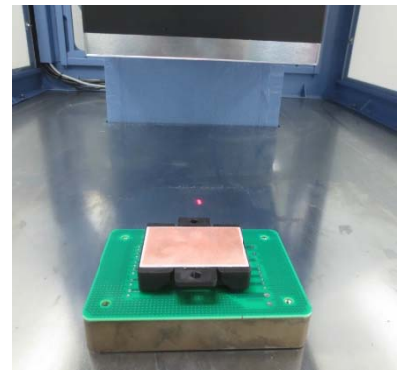
Figure 3: Press-in tools.



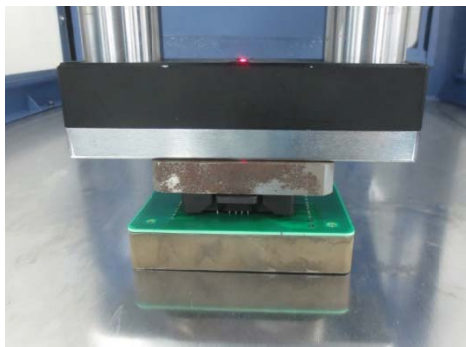
a) The counter stamp has to be mounted on a flat and stable surface.



b) The PCB has to be positioned.



c) The module is placed on the PCB.



d) The module is pressed into the PCB with the stated force.
e) After the assembly the Push-pull force tester monitors the total force.



Figure 4: Press-in process by an automated Pressfit machine.

4.2 Press-in forces and speed

The speed and the force with which the module is pressed into the PCB is important for the quality of the connection. A lower speed can lead to increased press-in forces, deformation of the pins or a non gas-tight connection.

The press-in force depends on the diameter of the hole and the copper metallization of the PCB, but should always be within the tolerated force range. [Table 2] shows the Pressfit speed and the force per pin.

Table 2: Press-in forces and speed.

Description	Unit	Min.	Recommended	Max.
Press-in speed	mm/s	0.4	2 - 4	5
Max allowed press force per pin	N	40	-	100

5 The press-out process

A press-out tool consisting of two parts, one holds the module with the PCB and one presses directly downwards on the module pins.

When designing this tool, it is important to ensure a parallel movement, so that the force is distributed evenly on all pins, and they are not damaged. Furthermore, the components on the PCB should be taken into account.

To press a module out of a PCB, a force of approximately > 40 N has to be applied to each pin in the module. This force can vary depending on the diameter and the metallization of the hole.

6 Fixing a PCB on Heat Sink

The PCB has to be fixed on the heat sink by the support pillar to minimize the mechanical stress on the Pressfit pins, as shown in [Figure 5]. The number and position of the support pillar are designed according to the system. The height from the surface of the heat sink to the underside of the PCB is determined by the press-in process and the press-in tools. In order to reduce the PCB deformation, the recommended height of the support pillar is between 12.35 mm and 12.45 mm.

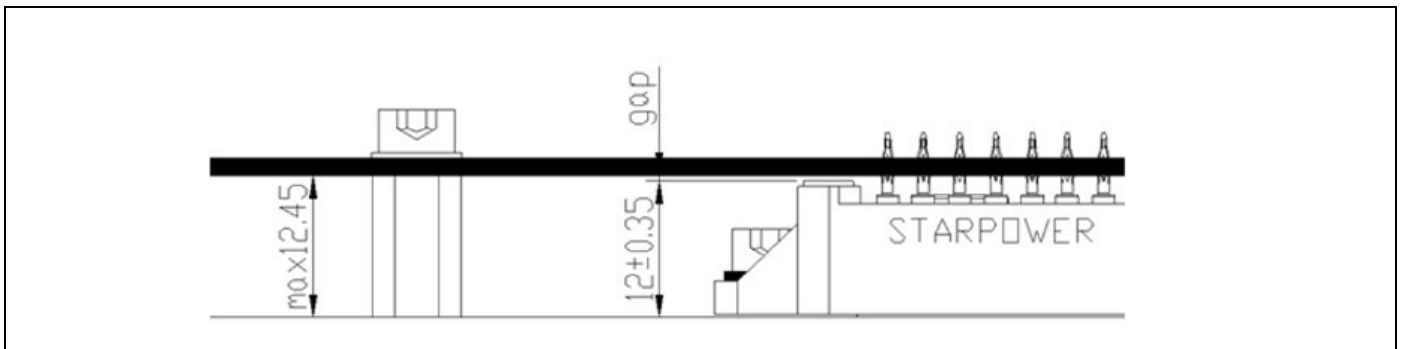


Figure 5: Fixing a PCB on the heat sink.

7 Fixing a PCB on the module

Any possible shift between the pins and the housing must be avoided. If the PCB is connected with the module only through the Pressfits, vibrations will occur and cause excessive mechanical stress on the module. Therefore, an additional fixation of the PCB on the housing or on the heat sink is recommended.

The PCB can be fixed additionally with screws into the stand-offs of the module housing, as shown in

[Figure 6-a]. The effective length of the thread in the stand-off should be a minimum of 4 mm and a maximum length of 10.5 mm.

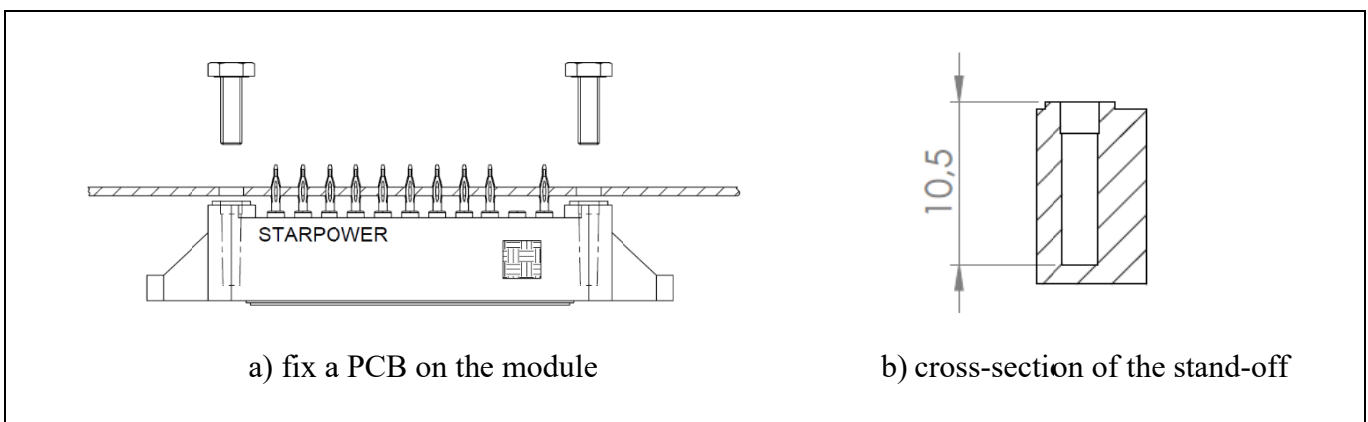


Figure 6: Additional screws to fix the PCB on the module.

For the choice of the screw length, the given PCB thickness has to be taken into account.

The recommended screws are listed as follows:

- Ejot PT WN 1451 K25 x 10 A2K; $M_{max} = 0.45 \text{ Nm} \pm 10\%$
- Ejot DELTA PT WN 5451 K25 x 8; $M_{max} = 0.4 \text{ Nm} \pm 10\%$
- Metrical screws M2.5 (e.g. M2.5 x 8 or M2.5 x 10 depending on PCB thickness)

8 Requirements for the heat sink

The contact surface between the base plate and the heat sink must be kept clean, free of any contamination to avoid excessive mechanical stress and increased thermal resistance to the module. The heat sink must have sufficient rigidity to meet assembly and shipping requirements without introducing additional stress or strain on the base plate.

The surface of the heat sink should meet the following requirements:

- Roughness: $\leq 10 \mu\text{m}$.
- Flatness based on a length of 100 mm: $\leq 50 \mu\text{m}$.

9 Applying the thermal grease

The thermal conductive paste with permanently elastic properties and a favorable heat transfer resistance is selected to fill the gap between two contact surfaces. Screen print process is recommended to apply the thermal conductive paste for a homogenous and reproducible layer thickness. Before the module is mounted on the heat sink, it is recommended to apply the thermal conductive paste with a thickness of 80-100 μm to the heat sink. The thickness of the thermal paste depends on the compound and the application method.

10 Mounting the module on the heat sink

L2/L3 module is mounted on the heat sink with M4 screws. A flat washer with a diameter of 9 mm is recommended (according to ISO 7090). The position of the threaded holes on the heat sink is shown in [Figure 7].

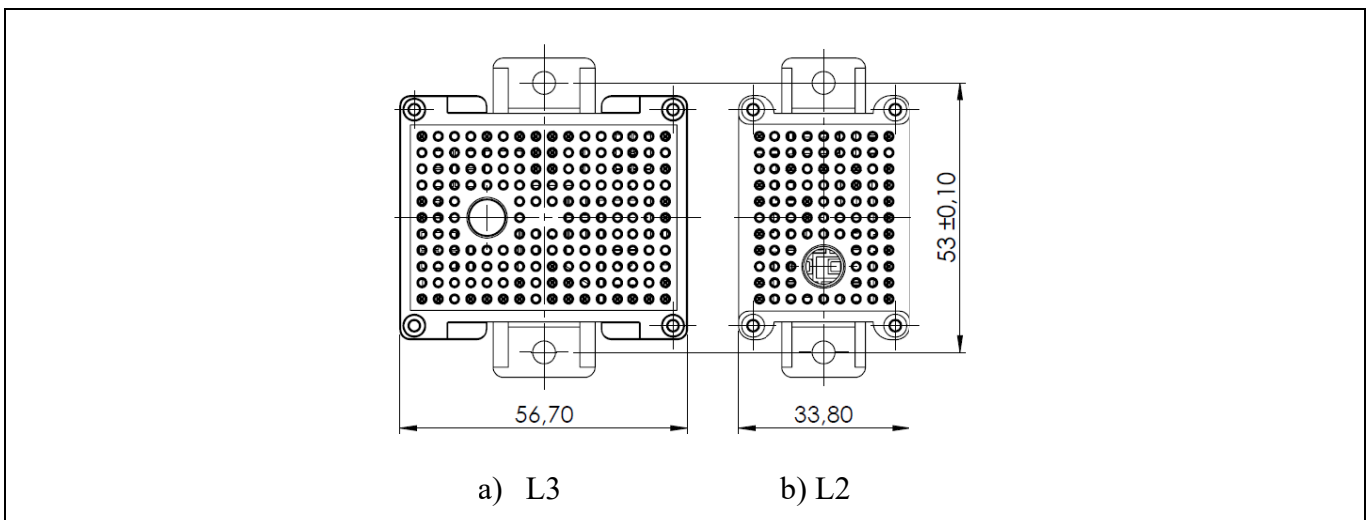


Figure 7: Threaded hole position for L2 and L3.

After applying of the thermal paste, the module should be mounted on the heat sink. The holes of the module should be positioned on the heat sink above the threaded holes. The screws should be tightened simultaneously, or the module should be pressed down with a force of about 10 N.

Another option is to tight one screw loosely and then tighten the second one fully. Finally, tighten the first screw completely.

Table 3: Technical data of the mounting screw.

Description	Specification
Mounting screw	M4 x 10 mm (The effective thread length into the heat sink is not less than 4 mm)
Washer	M4
Pre-tightening torque	0.2 - 0.3 Nm
Tightening torque	1.6 - 1.7 Nm
Screw velocity (pre-tightening)	Max. 120 rpm
Screw velocity (tightening)	Max. 15 rpm
Effective thread length into the heat sink	Min. 5 mm

10.1 Mounting the module on the heat sink after PCB pressing

If the module is mounted on the heat sink after the PCB has been pressed on it, through-holes in the PCB are required. The screws for tightening the module onto the heat sink will pass through these additional PCB holes.

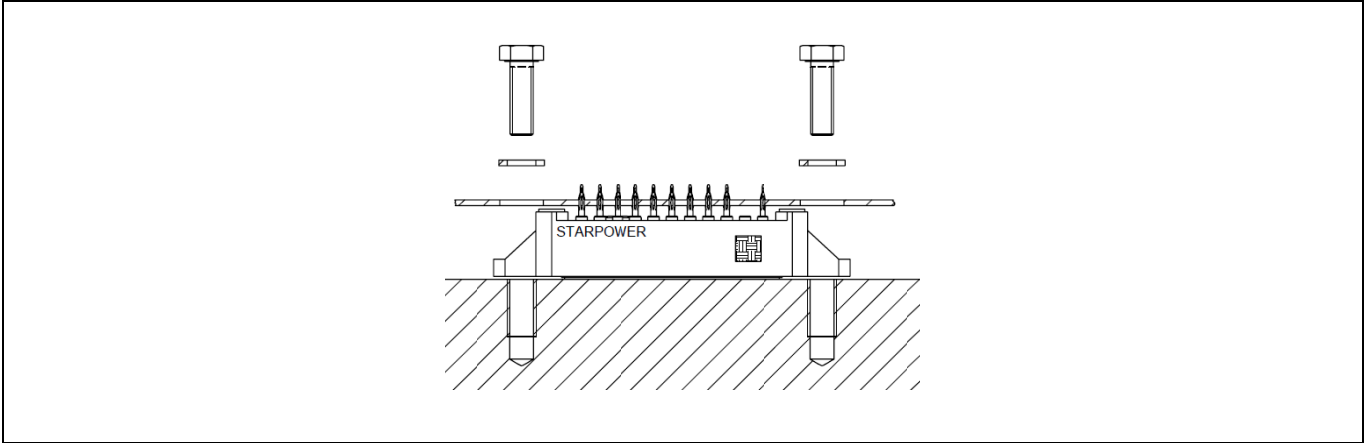


Figure 8: Mounting of module after assembling the PCB (through holes needed)

10.2 Mounting the module on the heat sink before PCB pressing

When mounting the PCB after assembling the module on the heat sink, the heatsink dimensions should be considered when designing press-in tools.

11 Fixing a PCB on the heat sink with additional distance keepers

In order to fix a PCB to the heat sink at a position close to the module, the distance keepers can be used. This can be done in two ways:

- The modules and the PCB are connected first, when the modules are screwed to the heatsink: to minimize the forces that are applied to the pins, it is recommended to keep a distance of $x > 5$ cm from the module outer edges.
- The modules are first screwed on the heatsink, then the PCB is pressed on it: in this case, no mechanical stress will occur. Distance keeper can be placed to the module as close as possible.

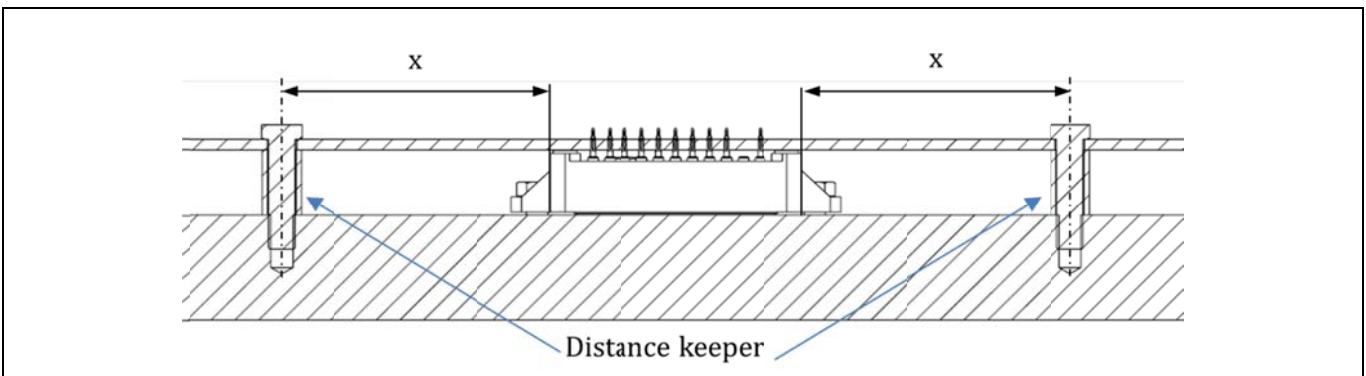


Figure 9: Fixing of the PCB with additional distance keepers.