Assembly and Mounting Instructions for Easy PressFIT Modules

About this document

Scope and purpose

This application note provides a guideline how to use and implement Easy modules using PressFIT connectors. The values and hints given in this document should not be handled like datasheet values.

Intended audience

This document is intended for any expert using Infineon Easy modules.

Table of Contents

About this document .................................................................................................................................................. 1
Table of Contents .................................................................................................................................................. 1
1 General Information .............................................................................................................................................. 2
1.1 General Information on power module handling ......................................................................................... 3
2 Requirements for Printed Circuit Boards ........................................................................................................... 4
3 The Press-In Process ............................................................................................................................................. 6
3.1 Press-In Tools .................................................................................................................................................... 6
3.1.1 Press-In Tools for Easy Modules with Thermal Interface Material ......................................................... 7
3.2 Press-In Forces and Speed ............................................................................................................................... 8
4 The Press-Out Process ......................................................................................................................................... 9
4.1 Press-Out Tools ............................................................................................................................................... 9
4.2 Press-Out Forces ............................................................................................................................................. 10
5 Quality of PressFIT Contacts ............................................................................................................................ 11
6 Mounting a PCB to the Module .......................................................................................................................... 13
7 Condition of the Heat Sink for Module Assembly ............................................................................................. 14
8 Applying the Thermal Grease ............................................................................................................................ 15
9 Assembling the Module on Heat sink .................................................................................................................. 16
10 System Considerations ..................................................................................................................................... 19
10.1 Module is already pressed into the printed circuit board before mounting ................................................. 19
10.2 Module is pressed into the printed circuit board after mounting ............................................................... 19
11 Clearance and Creepage distances .................................................................................................................... 20
12 Multi-Module and Automotive Application ....................................................................................................... 21
12.1 Modules press-in into the PCB ..................................................................................................................... 21
12.2 Modules and PCB mounting on the heat sink ............................................................................................. 23
Revision History ..................................................................................................................................................... 26
1 General Information

PressFIT is an alternative method for connecting control and load current contacts on IGBT modules to a PCB (printed circuit board) that complies with the requirements for greater durability, the trend towards higher temperatures, RoHS and – of course – very simple handling.

This contact technology has already been employed for years now in the automotive sector under the most difficult of conditions and with medium-sized currents. The contacts have also been used in the telecommunications sector for some time now for signal transmissions. This type of contact is therefore ideal for use in IGBT modules in which the contacts have to satisfy the requirements for load, control and sense connections.

The PressFIT contact for modules in the EconoPIM™ and EconoPACK™ series is an initial development for the technology.

The solution for modules without a baseplate is provided with the Easy PressFIT pin. It should be noted in the case of the Easy PressFIT geometry that it has been used for decades in a wide variety of applications and was able to be adapted for use in the modules.

The Easy PressFIT contact allows solderfree assembly of the EasyPIM™, EasyPACK and Easy Automotive modules in the EasyB series. In this assembly technology the module can be mounted on either side of the circuit board.

The electrical and thermal contacts with the circuit board are implemented by means of cold welding. The contacts can be used in standard FR4 printed circuit boards with the tolerances typical of manufacturers.

![Figure 1](image1.png) Modules in the EasyB series featuring PressFIT contacts

Easy PressFIT contacts have an area approximately 1.7 mm long that adapts itself to the hole in the printed circuit board during the press-in process. Plastic deformation takes place as a result. This deformation is intended to accommodate the tolerance and provides the basis for the cold welding.

The forces resulting during the PressFIT process ensure that the welded materials on the PCB and pin exhibit a continuously consistent – and unlike other contact technologies – very small electrical contact resistance (approximately 0.05 mΩ). Figure 2 shows various sections and REM images that provide a view of the materials connected together in a gas-tight manner due to the press-in force.

![Figure 2](image2.png) Easy PressFIT contact sections

Application Note 2
Note Normative References: For referenced undated standards the edition applies, which was valid at the application note release in January 2009.

1.1 General Information on power module handling

This section describes forces on module housing – DCB push-out

The power module is not designed to withstand forces on the module housing as shown in the example of Figure 3. The module pins are here located on a flat table. Forces on the module housing (Fp) are pushing the DCB out of the housing. Therefore, forces (Fp) on the module housing at handling have to be avoided. Please note that this is a different case compared to the normal press-in process, where the DCB is fully supported in the press-tool and the press-in forces act on the DCB not on the housing.

![Figure 3](image)

**Figure 3** Forces on the housing at module handling should be avoided to prevent a push-out of the DCB

Some modules will have quite low DCB push-out forces (Fp) and is not an assured property of the power module. This is uncritical for real applications, because the housing is fixed later on the cooling system by the integrated clamps and thus the housing cannot move (lift) in a critical way. Furthermore, the “sealing rope” between the module frame and the DCB has only the function to seal the module, when the isolating gel is filled-in in our production process. After the filling process, the liquid gel is heated out and gets a soft but solid consistency. The sealing has no glue function in the final product.
2 Requirements for Printed Circuit Boards

The PressFIT technology used in the Easy modules has been inspected and qualified by Infineon Technologies AG for standard FR4 printed circuit boards with tin (chemically) (IEC 60352-5 + IEC60747-15). If other handling technologies are to be used in the production of printed circuit boards, they would have to be tested, inspected and qualified.

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.

| Table 1 | Requirements for a printed circuit board |
|---|---|---|
| Hole drill diameter | Min. | Typ. | Max. |
| Copper thickness in hole | > 25 μm | | < 50 μm |
| Metallization in hole | | | < 15 μm |
| End hole diameter | 0.99 mm | | 1.09 mm |
| Copper thickness of conductors | 35 μm | 70 μm | 105 μm |
| 400 μm |
| Metallization of circuit board | Tin (chemically) recommended |
| Metallization of pin | Tin (galvanic) |

In order to ensure that the PressFIT contact sits securely in the printed circuit board, the specification of the hole given in Table 1 must be adhered to.

If the specification of PressFIT holes is limited to just the finished dimension (i.e., the metallized hole), different drill sizes could be used depending on the printed circuit board manufacturer and production philosophy, and also different metallization thicknesses could be provided. This would have the consequence that other results would be obtained that would have to be rejected for quality assurance reasons. The end hole diameter is a function of the drill hole, the copper thickness and the metallization in the hole.

The recommendation still applies that the hole in the printed circuit board is to be drilled during manufacture with a drill size of 1.15 mm, and should not be milled. Experience has shown that a final hole diameter between 1.12 mm and 1.15 mm is obtained under consideration of the runout tolerances of the spindles after drilling due to shrinking of the FR4 material.

With a copper thickness of 30 μm to 50 μm in the hole and a tin layer of about 1 μm for tin applied chemically, an end hole diameter is obtained as the test dimension. Due to the thinner tin layer thickness, this diameter is always higher than the value of 1 mm stated in the standard (IEC 60352-5). The final hole diameter, under consideration of the drilling diameter, copper thickness and a chemical tin layer, is typically between 1.02 mm and 1.09 mm.
Assembly Instructions for the Easy-PressFIT Modules

Figure 4  Structure of a printed circuit board

The PressFIT technology is qualified for FR4 printed circuit board material.

After a reflow soldering process is carried out on a printed circuit board, the module can be pressed into the board without difficulty. The retention forces of the press-fitted pins are not diminished.

Depending on the applied press-tools a certain distance from the middle of the pins to other components must be observed. **A distance of 5mm is recommended, similar to Infineon Econo PressFIT power modules.**

A PressFIT module can be replaced up to two times. This means that a printed circuit board can be used in total three times. Correct handling of the components is essential.

A module that has been pressed-in and the contact then pressed-out again can no longer be pressed-in again. Instead, the module can only be attached in a new printed circuit board by soldering. The plastic deformation of the PressFIT zone does not permit a further PressFIT process.
3 The Press-In Process

This section deals with the necessary press-in forces and tools for the modules.

The PressFIT module is inserted in a printed circuit board by press-in. PressFIT can be performed using a simply toggle lever press or a machine. A press-in tool that records the necessary force and the travel distance is recommended. Consistent quality and reproducability is assured in this way. The PressFIT speed should not be lower than 25 mm/min according to IEC 60352-5. A lower PressFIT speed can lead to increased press-in forces and to deformation of the pins or a not gas-tight connection.

Note that during the press-in process the placement area of the printed circuit board and the pressing area of the pressure plate must be parallel to each other. The pressure plate should be mechanically fixed in position without any tolerance. The module is then pressed into the printed circuit board with a regular movement.

The module pins should penetrate the printed circuit board during press-in until the four standoffs on the module or optional distance keepers as described in Multi-Module and Automotive Application make contact with the board.

By adhering to the principles stated above, a smooth insertion process for the two components (Easy1B and Easy2B) can be achieved.

The following illustrations show the press-in process as it is implemented in the laboratory.

![Figure 5 Press-In process of an Easy module](image)

The press is aligned so that one part of the tool is directly above the other. The printed circuit board is placed on the tool and held in place by the pins on the tool. The module is placed on the tool and positioned using the pins on the tool. The module contacts are pressed onto the printed circuit board by pressing the upper tool part downwards.

Attention! It is recommendable to protect the underside of the IGBT module against damage during the press-fitting process.

3.1 Press-In Tools

The following tools that help pressing in and out the modules are recommended for the two Easy B Series modules. Figure 6 shows these press tools for the two housing types Easy 1B and Easy 2B.
Each of the tools has two parts. First there is a part that presses against the underside of the module and second, there is a part for holding the printed circuit board in place to be pressed against.

No components can be placed in the mounting areas of this special type of press-fitting tool. This will prevent damage during the press-fitting process.

When press-fitting multiple modules onto a printed circuit board, arrange the press-in tool in such a way that the modules are on the same level after the pressing. In this way, the modules can be mounted on the heat sink with a good thermal connection.

Figure 6  Press-fitting tools for Easy1B (shown left), Easy2B (shown right)

CAD drawings can be requested for both tools. The drawing can be adjusted according to different requirements (e.g. module pinning and top side assembly of other parts) and the tools produced by a manufacturer of choice.

3.1.1  Press-In Tools for Easy Modules with Thermal Interface Material

If modules with pre-applied thermal interface material (TIM) are used, the press-in stamp has to be designed with respect to the position of the TIM material on the modules base plate. Figure 7 shows the picture of a Easy2B module with TIM.

Figure 7  Easy2B with TIM
The structure of the presented TIM surfaces is only exemplary and not fixed for all products within the Easy family.

The stamp should not touch the TIM material during press-in. That is the reason why the stamp touches only the substrate areas without TIM. Figure 8 shows the geometries of the stamp for the press-in of Easy1B and Easy2B modules with TIM.

![Press-In stamp of Easy1B (left) and Easy2B (right)](image)

### 3.2 Press-In Forces and Speed

To press a module onto a printed circuit board a force of between approximately 60 N and 100 N must be applied for each pin in the module. The press-in forces vary according to the diameter of the hole and copper metallization in the PCB.

Table 2 shows the PressFIT speed and the maximum PressFIT force per pin.

<table>
<thead>
<tr>
<th>PressFIT speed</th>
<th>&gt;25 mm/min according to IEC 60352-5 qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 mm/min recommended</td>
</tr>
<tr>
<td>PressFIT forces per pin</td>
<td>Typ. 85 N</td>
</tr>
<tr>
<td></td>
<td>&lt;100 N max.</td>
</tr>
</tbody>
</table>

Table 2 PressFIT speed and forces per pin.

Attention! The maximum applied force per module during pressing should not exceed 4 kN.

The press-fitting speed should not be lower than 25 mm/min according to IEC 60352-5. Infineon recommends a press-in speed of about 100 mm/min. The typical press-in speed for automated assembly lines will be up to 450 mm/min.
4 The Press-Out Process

This section deals with the necessary press-out forces and tools for the modules.

PressFIT modules are removed with the appropriate tools as shown in Figure 9 and Figure 10. The printed circuit board is placed with the PressFIT module in the apparatus (tray). Force is applied with the extrusion plate on the PressFIT pins that protrude from the printed circuit board. The press-out tools must be aligned parallel to each other so that the individual components (such as the printed circuit board and module) are not damaged. Once the PressFIT zone has exited the PCB (printed circuit board), the module falls into the tray in the lower part of the tool and is separated from the board.

4.1 Press-Out Tools

The press-out tools consist (as already mentioned above) of two parts. The upper part of the tool presses directly downwards on the module pins. The lower part of the tool holds the module with the printed circuit board and serves as a base for the pressing operation.

The disassembly tools must be aligned parallel to each other in order to obtain an equally distributed extrusion process.

The dimensions of the press-out tool must be considered when designing the printed circuit board so that the components positioned about the module will not be damaged.
Figure 10  Press-out tools for Easy1B (left illustration) and Easy2B (right illustration) modules

Just as for the press-in tools, CAD drawings can likewise be requested for the extrusion tools. The drawing can be adjusted according to requirements and the tools produced by a manufacturer of choice.

4.2  Press-Out Forces

To press a module out of a printed circuit board a force of approximately >40 N has to be applied for each pin in the module. The extruding forces depend mainly on the diameter of the hole in the printed circuit board.
5 Quality of PressFIT Contacts

PressFIT is an alternative solution for connecting control and load current contacts on IGBT modules with a printed circuit board.

The requirements for greater durability, the trend towards higher temperatures and absence of lead and – of course – very simple handling are continuously growing.

The PressFIT technology makes it possible for the first time to improve reliability up to a factor of 100 compared to manually soldered contacts and other contact types. The results of the reliability analyses in the Siemens norm SN 29500-5 demonstrate the factor.

The assembly process is simple and consequently saves time and money. The process is reliable and system reparable is ensured.

An extract from the Siemens Norm SN 29500-5 / Edition 2004-06 Part 5 shown in Table 3 illustrates the failure rates of different contact technologies.

<table>
<thead>
<tr>
<th>Process</th>
<th>Conductor diameter in mm²</th>
<th>Failure rate λref in FIT¹)</th>
<th>Notes: Standards/guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solder manual</td>
<td></td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>automatic</td>
<td>automatic</td>
<td>0.03</td>
<td>IPC 6102), class 2</td>
</tr>
<tr>
<td>Wire bonding for hybrid circuits Al</td>
<td>0.05 to 0.5</td>
<td>0.1</td>
<td>28 μm / wedge bond</td>
</tr>
<tr>
<td>Au</td>
<td></td>
<td>0.1</td>
<td>25 μm / ball bond</td>
</tr>
<tr>
<td>Winding</td>
<td></td>
<td>0.002</td>
<td>DIN EN 60352 – 1 /</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>IEC 60352 – 1 CORR1</td>
</tr>
<tr>
<td>Crimping manual</td>
<td>0.05 to 300</td>
<td>0.25</td>
<td>DIN EN 60352 – 2 /</td>
</tr>
<tr>
<td>automatic</td>
<td></td>
<td></td>
<td>IEC 60352 – 2 A 1+2</td>
</tr>
<tr>
<td>Clips</td>
<td>0.1 to 0.5</td>
<td>0.02</td>
<td>DIN 41611 – 4</td>
</tr>
<tr>
<td>PressFIT</td>
<td>0.3 to 2</td>
<td>0.005</td>
<td>IEC 60352 – 5</td>
</tr>
<tr>
<td>Insulation piercing connectors</td>
<td>0.05 to 1</td>
<td>0.25</td>
<td>IEC 60352 – 3 / IEC 60352 –</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Screws</td>
<td>0.5 to 16</td>
<td>0.5</td>
<td>DIN EN 60999 – 1</td>
</tr>
<tr>
<td>Terminals (spring force)</td>
<td>0.5 to 16</td>
<td>0.5</td>
<td>DIN EN 60999 – 1</td>
</tr>
</tbody>
</table>

1) 1 FIT = 1 x 10⁻⁹ 1/h; (one failure per 109 component hours)
2) Acceptance conditions for printed circuit boards

The PressFIT contact has been qualified in accordance with the usual standards for IGBT modules at Infineon.

Figure 11 shows a small extract of the various tests. The extract shows that the conditions in the individual tests are to be regarded as considerably stricter than stated in the standards. For example, the significantly higher temperatures or the loads that are up to 5 times greater during a corrosive gas test (H₂S concentration
Assembly Instructions for the Easy-PressFIT Modules

according to the norm: 10 ppm / H2S concentration in the test: 50 ppm). The green fields show the differences to the less critical requirements according to the norm.

<table>
<thead>
<tr>
<th>Test</th>
<th>Boundaries</th>
<th>Requirement</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min-screw of contact</td>
<td>min. hole</td>
<td>No damage</td>
<td>6 contacts to min hole</td>
</tr>
<tr>
<td>Press-in and push out forces</td>
<td>min. hole max. hole</td>
<td>No minimum and maximum push-out force shall be specified by the manufacturer</td>
<td>7 contacts min hole</td>
</tr>
<tr>
<td>Climatic sequence</td>
<td>(contact resistance after different serial tests)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IST</td>
<td>-40°C to +120°C, exposure time 30min, 10 cycles</td>
<td>No relevant change of resistance</td>
<td>100 contacts min hole</td>
</tr>
<tr>
<td>Vibration</td>
<td>10h dry heat 120°C, 5 cycles, damp heat (13°C, 65°C, 95% RH, and 85°C, 95% RH), &gt;2h, cold 45°C</td>
<td>Standard: 85°C</td>
<td></td>
</tr>
<tr>
<td>Dry heat</td>
<td>120°C, 1000h</td>
<td>No relevant change of resistance</td>
<td>100 contacts min hole</td>
</tr>
<tr>
<td>Aging mixed gas</td>
<td>4-components mixed gas, 240h 70°C: 0.2 ppm; 80°C: 0.2 ppm</td>
<td>No relevant change of resistance</td>
<td>100 contacts min hole</td>
</tr>
</tbody>
</table>

* Example of Easy-PressFIT

Figure 11 Extract from qualification test

Further details on the individual tests can be found in various publications, such as "Reliability of PressFIT connections" at www.infineon.com.
6 Mounting a PCB to the Module

To fix a PCB onto the module additional screws can be used if desired. These screws will be tightened into the stand offs of the module.

An electronically controlled or at least slowly turning electric screwdriver \( n \leq 300 \text{ rpm} \) is the preferred mounting tool.

Due to the lack of accuracy we do not recommend the use of pneumatic screwdrivers or manual screwdrivers.

![Figure 12 Detailed view of the assembly insert](image)

The effective length of the thread in the stand-off should have a minimum of 4 mm and a maximum length of 8 mm.

The initial 1.5 mm of the mounting stand-off serves as guidance only and cannot take any force. The thread in the plastics will form itself by screwing.

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

The following screws are tested to fix the PCB to the module:

- Ejot PT WN 1451 K25*10 A2K Mmax=0,45 Nm ±10%
- Ejot DELTA PT WN 5451 K25*8 Mmax=0,4 Nm ±10%
- Metric screws: M2.5*x – for example, M2.5*8 or M2.5*10 depending on the thickness of the printed circuit board used

To avoid damage or splitting of the stand-off, straight insertion of the screw into the stand-off has to be observed during assembly.
7 Condition of the Heat Sink for Module Assembly

The power loss occurring in the module has to be dissipated via heatsink in order not to exceed the maximum permissible temperature $T_{\text{vijop}}$ specified in the datasheets during operation.

The condition of the heatsink surface in the area where the module is mounted is of great importance, as this interface between heatsink and module is of decisive influence on the heat transfer of the entire system.

The contact surfaces, the surface below the module and the surface of the heatsink, have to be free of degradation and contamination to prevent excess mechanical stress to the module as well as an increase in thermal resistance.

Heat sink requirements:

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

Note 1.: The flatness of the heat sink should not exceed the values listed above. This area includes the entire module mounting area as well as that of the clamps.

Note 2.: If the layer of thermal grease is applied too thick, e.g. as a consequence of cavities, the thermal resistance $R_{\text{th}}$ between module and heat sink will increase.
8 Applying the Thermal Grease

Due to the individual surface shape (e.g. roughness and flatness) of the heatsink and the module these do not touch across the entire area so that a certain localized separation between the two components cannot be avoided.

To dissipate the losses occurring in the module and to achieve a good flow of heat into the heatsink, all localized cavities have to be filled with a thermal compound. When using a heat conductive paste, a homogenous application needs to be assured.

A well applied layer will fill all cavities and at the same time does not prevent the metallic contact between module base and heatsink surface. A compound should be selected which shows permanently elastic features in order to assure a continuously favorable heat transfer resistance.

Before the module is mounted onto the heat sink an even layer of thermal grease, 80 μm thick, should be applied to the module base or to the heat sink according to the module size and used thermal grease. This grease can be applied using either a spatula, a roller or by a silk screen printing. The quantity of thermal grease is sufficient if a small amount of grease is visible around the module after assembling it to the heat sink.

Recommended is the application of thermal grease by means of a screen print process. Apart from an optimized and module specific distribution of the heat conductive paste, a homogenous and reproducible layer thickness is achievable with this procedure. If a screen print process is used the layer thickness could be reduced to values under the above mentioned numbers. The size of the module and the viscosity of the thermal grease are important factors in this case.

Further notes regarding the application of screen print templates for the application of thermal grease can be found in the application note AN2006-02 Application of silk screen.
9  Assembling the Module on Heat sink

The module is mounted onto the heat sink using M4 screws. It is also possible to use an additional flat washer. The heat sink has to be provided with threaded holes as shown in Figure 13.

Note: If the module is first pressed in to the PCB or if a later disassembling of the module is desired, the PCB must contain suitable through holes. The hole size depends on the screwdriver size or the screw's head diameter or washer.

The module should be positioned onto the heat sink in such a way that the holes of the screw clamps are exactly above the threaded holes of the heatsink. The mounting surface must be clean and free of contamination.

The module can be fastened by screwing in and tightening both screws at the same time (Figure 14a) or by holding down the module during the mounting process with a force of approximately 10 N so that the module cannot rise up (Figure 14b).
Alternatively one screw can be applied initially. It is important that the module does not rise up. To prevent this, the first screw has to be loosely tightened to avoid a press force to the clamp (Figure 15a). Afterwards the second screw has to be fully tightened (Figure 15b). Finally the first and still loose screw has to be fully tightened (Figure 15c).

Figure 14  Module fastening options

Figure 15  Steps for alternative fastening of the module
### Table 4  Technical data of the mounting screw

<table>
<thead>
<tr>
<th>Description</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting screw</td>
<td>M4</td>
</tr>
<tr>
<td>Recommended mounting torque</td>
<td>Ma = 2,0 – 2,3 Nm</td>
</tr>
<tr>
<td>Recommended thread engagement for screws with</td>
<td></td>
</tr>
<tr>
<td>property class 4.8 to 6.8 for different materials</td>
<td></td>
</tr>
<tr>
<td>Aluminium cast alloy</td>
<td>2,2 x d = 8,8 mm ¹¹</td>
</tr>
<tr>
<td>Aluminium alloy hardened</td>
<td>1,2 x d = 4,8 mm ¹¹</td>
</tr>
<tr>
<td>Aluminium alloy not hardened</td>
<td>1,6 x d = 6,4 mm ¹¹</td>
</tr>
<tr>
<td>Washer acc. to DIN 125</td>
<td>D = 9 mm</td>
</tr>
</tbody>
</table>

¹¹ As per technical literature
10 System Considerations

If the module is correctly mounted to the heat sink and to the printed circuit board, the screw clamps will apply the necessary pressure. This pressure together with the correct amount of thermal grease will ensure a low thermal resistance and an optimal thermal flow between the module and the heat sink. Since the PCB is connected to the module by pressed-in pins only, suitable measures have to be taken to ensure that vibrations are kept at a minimum. Any possible movement between the terminals and the module case has to be avoided. Each single pin may only be subjected to a maximum press and pull force of 6 N vertical to the heat sink. The overall pulling force to the module of 20 N must not be exceeded. The compressive force could be 10 times higher than the possible pulling force. A low compressive load to the module is preferred. Therefore, the circuit board should additionally be fixed to the heat sink at a position close to the module. Two options are possible:

![Figure 16 Fixing the printed circuit board](image)

10.1 Module is already pressed into the printed circuit board before mounting

To minimise the forces that are applied to the pins of a module, it is recommended to keep a distance of at least $x = 5$ cm from the module’s outer edges (Figure 16).

10.2 Module is pressed into the printed circuit board after mounting

In this case no mechanical stress will occur. Therefore it is allowed to place the distance keeper as close as possible $x \leq 5$ cm to the module.
11 Clearance and Creepage distances

When defining the layout of the PCB, application specific standards, mainly regarding clearance and creepage distances, have to be considered. This is particularly important for the area of the screw clamp which is located under the printed circuit board. In order to meet the respective requirements regarding clearance and creepage distances, current carrying devices or through-holes in this area should be avoided or additional isolation measures like lacquering must be taken.

![Figure 17](image.png)

Figure 17 Air path between clip and PCB

The minimum clearance distance between the screw and the PCB depends on the screw itself. The distance will be 6.8 mm with a hexagon socket head screw according to DIN 912, a washer according to DIN 125 and the clamp which can be seen in Figure 17.

The clearance and creepage distances specified in the datasheet are minimum values irrespective of other devices that would be mounted close to the module.

In any case, the application specific clearance and creepage distances have to be checked and compared to relevant standards and guaranteed by suitable constructive means, if required.
12 Multi-Module and Automotive Application

An increasing number of applications require the mounting of several power modules on the PCB. Furthermore, new power module applications, like automotive hybrid electrical vehicles and full electric vehicles (H)EV, have high requirements on vibration and mechanical shock robustness. In such applications the height tolerance of the modules has to be considered in the mounting concept in order to avoid a mechanical deformation of the PCB or unwanted forces on the modules and PressFIT pins.

Please note that the following instruction shall be regarded as additional information to the general mounting instructions before. The chapter focuses on mounting concept of the module, taken into account the height tolerance. General recommendations like PCB requirements, press speed, heat sink requirements, etc. are unaffected by the following instructions.

12.1 Modules press-in into the PCB

Figure 18 shows the press-in process of the power modules into the PCB. This process is quite similar to chapter 3.

Figure 18a shows the bottom side of the press-tool with guiding domes, which are useful for a pre-alignment. In Figure 18b the PCB is placed into the press-tool, whereby the correct placement is obtained by the guiding domes of the press-tool.

Figure 18c shows the press-tool with the PCB ready for module assembly.

In Figure 18d the module is placed on the guiding elements. The module is released and the module pins will insert now into the PCB.

In Figure 18e shows the state where the module pins are inserted into the PCB. The module is now placed even to the press-tool and the pin touches the PCB at the beginning of the active press-zone, which starts at about 2.5 mm from the pin top. If the module is uneven to the press-tool or pins are not inserted (module about 2.5 mm higher than the normal case shown here), than the assembly should be corrected before damaging pins in the later press-in process.

In Figure 18f the top press-tool with the distance keeper is shown.

Figure 18g shows the controlled way-force press-in process. The press-process stops by the increasing force between the PCB and this distance keeper. It is correct, if the press-in process is stopped before the PCB is on the module housing. Thus, the distance of the module backside to the PCB is independent of the module height.

Please note: It is possible to press the module tighter to the PCB than the maximum 12.45 mm. This will increase the overlapping zone in the active press zone (contact area: pin to PCB). Please do not forget to lower the fixing elements of the cooling system (Figure 19b) accordingly, if the modules are pressed tighter to the PCB! The value (H) of Figure 19b must not be higher than the module to PCB height of Figure 19a! A force of the PCB on the module in direction to the cooling system is uncritical and is desired as it improves the thermal contact.
Assembly Instructions for the Easy-PressFIT Modules

a) Guiding dome

b) PCB assembly

c)

d) The pins are inserted into the PCB.

e)
12.2 Modules and PCB mounting on the heat sink

After the power module(s) is pressed into the PCB (see Figure 19a), the PCB with the module(s) has to be mounted to the cooling system. Please see chapter 7 and 8 for more information on heat sink, thermal grease requirements and how the grease should be applied to the system. The Figure 19b-d shows the mounting process by an example of three power modules pressed into the PCB. However, the illustrated concept can also be applied with a different number of modules or single module application. Figure 19b shows the process where the PCB with the pre-assembled modules is placed on the cooling system and the modules are fixed with screws via the spring clamp of the Easy module. Please refer to chapter 9 for detailed information on assembly of the modules on the heat sink. It is important to fix the modules before the PCB is fixed to the cooler!

Figure 19c shows fixing of the PCB to the heatsink. As the height tolerance of the module is quasi compensated in the press process, the fixing points for the PCB can be close to the power modules. This is an advantage compared to the concept in section 10.1 where >=5 cm distances has to be maintained between module and distance keepers.

The position of the distance keepers should be designed symmetrically around the power module(s).

Figure 19d shows the final system assembly.
Assembly Instructions for the Easy-PressFIT Modules

Figure 19  Mounting example of the PCB and module to the cooling system (drawing not true to scale)

The Figure 20 shows a zoom of the final system assembly. Depending on the height of the module a small air gap remains between module and PCB.

As the value (H) of Figure 19b must not be higher than the module to PCB height of Figure 19a, it is ensured that no pull forces are applied to the power modules, which would be critical in consideration of the thermal contact between module and heat sink.
Please note that using this press-concept with a remaining air gap does not allow to screw down the PCB to the stand-offs (guiding holes) as shown in chapter 6.
## Revision History

### Major changes since the last revision

<table>
<thead>
<tr>
<th>Page or Reference</th>
<th>Description of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 - 6</td>
<td>Correction of min. end hole for PCB</td>
</tr>
<tr>
<td>8 – 9</td>
<td>Insertion of Press-In for modules with TIM/ Addition of recommended press-in speed</td>
</tr>
<tr>
<td></td>
<td>and typical force.</td>
</tr>
</tbody>
</table>