

HybridPACK™ DC6i

Assembly Instructions for the HybridPACK™ DC6i

About this document

This application note describes the recommended process for mounting the HybridPACK™ DC6i power module.

Scope and purpose

In order to ensure a robust design meeting the high quality demands of the automotive industry, it is important to use the right mounting order and to use appropriate printed circuit boards (PCB) material, screw types and processes

Intended audience

Engineers and operators involved in the assembly of the HybridPACK™ DC6i power module into power electronics systems.

Table of Contents

1	General Information.....	2
2	Recommended Mounting Order	3
3	Press-Fit Assembly	4
3.1	Requirements for the PCB.....	4
3.2	General hints for the PCB Footprint	6
3.3	Press-In Tools	7
3.4	Press-In Process	8
4	PCB design hint for high thermal cycle system robustness	9
4.1	PCB design for module external mounting	9
5	Power Module Cooling System	10
5.1	Reference Cooler Design	10
5.2	Recommendation for the sealing ring.....	11
5.3	Cooling fluid	12
6	Screw types and processes	13
6.1	Baseplate Mounting Screws.....	13
6.2	Fixation/clamping of the module during the baseplate screw process.....	14
6.3	PCB mounting screws on the module housing	15
6.4	Screw Orders (Baseplate and PCB).....	16
7	Connecting to the Power Terminals	17
8	Storage and Transport	18
9	Traceability, Data Matrix and Part Markings	19
10	Pin Position and Pin Gauge	20
11	Power Module Appearance.....	21
11.1	Pin Rotation	21
12	Revision History	22

1 General Information

This application note, gives mounting instructions for HybridPACK™ DC6i module with recommendations how to screw the module, assemble the PCB and mount the module onto the heat sink.

Please also note that ground straps should be worn while working with the components and valid ESD safety instructions should be followed at all time, since IGBT modules are electronic-static sensitive components. Moreover, this application note cannot cover every type of application and condition. Hence, the application note cannot replace a detailed evaluation and examination by you or your technical divisions of the suitability for the targeted applications. The application note will, therefore, under no circumstances become part of any supplier agreed warranty, unless the supply agreement determines otherwise in writing.

2 Recommended Mounting Order

All datasheet drawings specify the power module at the state of delivery. Deformations on the product can occur when the power module is mounted to a cooling system (i.e. depending on cooler flatness and screw torque). The following mounting order can be recommended:

- 1. Align PCB to the power module (the X-Pins will support this process).**
- 2. Press-in PCB (recommended is controlled way-force press-in process).**
- 3. Prepare 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 Press-Fit Assembly

3.1 Requirements for the PCB

The press-fit technology used in the HybridPACK™ DC6i is designed based on IEC 60352-5 for standard FR4 printed circuit boards with immersion tin plating. The PCB material must be compliant with IEC 60249-2-4 or IEC 60249-2-5 for double-sided printed circuit boards and IEC 60249-2-11 or IEC 60249-2-12 for multilayer printed circuit boards.

The requirements for the PCB are in Table 1. In case the requirements are not met, there is risk of a not gas tight signal pin connection or of pin and/or PCB via damage. The recommendations for the PCB for the X-pin holes are in Table 2.

Please note that the press-fit hole specifications are only valid for assembled PCBs. In case of unassembled PCBs, e.g. for testing purposes, it is recommended to perform a standard reflow solder process before starting the power module assembly process.

Table 1: Requirements to the PCB.

No	Description	Unit	min.	typ.	max.	Remarks and known common mistakes
1	Drill tool diameter	mm	1.12	1.15		Wrong drill tool applied. Specify clearly the press-fit hole positions and required drill tool size to the PCB manufacturer.
2	Copper thickness in hole	um	25		50	In case the via metallization is lower than specification, the risk is a damaged/cracked via.
3	End hole diameter	mm	1.02		1.10	End hole diameters lower than spec may lead to increased press-in forces (typically >115 N per pin) and may damage the pins. Larger holes than spec may lead to low press-in forces (typically <40 N per pin) and can cause not gas tight connections.
4	Copper thickness of conductors	um	35	70 105	400	No results available for thinner or thicker copper layers.
5	Hole to hole pattern tolerance	um			±100	In typical PCB manufacturing hole to hole pattern is lower than ±80um.
6	Recommended PCB thickness	mm		1.6		Target value with +/-10% thickness tolerance
7	Metallization of circuit board		Immersion Tin (Sn chemically)			Immersion tin has typ 1-5um metallization in the hole. Other metallization type should be avoided can lead to strong deviation in press-in forces. E.g. HAL leadless show high variations in press-in forces and risk is a not gas tight pin connection, which can fail over application lifetime. PCB with ENIG plating can lead to increased press forces due to hard surface and this PCB type was not tested at Infineon module qualification tests.
8	Metallization of pin		Ni/Sn (galvanic)			The Sn plated pin with nickel under layer avoids potential whisker growth out of the upper galvanic tin layer.

Press-Fit Assembly

Table 2: Recommendations for the printed circuit board X-pin holes

No	Description	unit	min.	typ.	max.	Remark
1	End hole diameter X-Pin ¹	mm		5.9		The hole should be drilled with 6.0 mm drill tool and not milled in order to avoid additional unnecessary hole position tolerances.
2	End hole diameter Y- Pin ¹	mm		5.4		The hole should be drilled with 5.5 mm drill tool and not milled in order to avoid additional unnecessary hole position tolerances.
3	Hole to hole pattern tolerance	um			±100	Plated holes are preferred in order to achieve a minimum “X-pin hole” to “press-fit hole” pattern tolerance.

A structure of a PCB according to the spec in Table 1 is illustrated in Figure 1. The hole in the PCB is drilled with a drill tool size of 1.15 mm. It is normal that PCB material shrinks after drilling. Therefore, this shown hole size with 1.15mm should not be understood as a check gauge after drilling rather than an illustration for understanding the PCB stack.

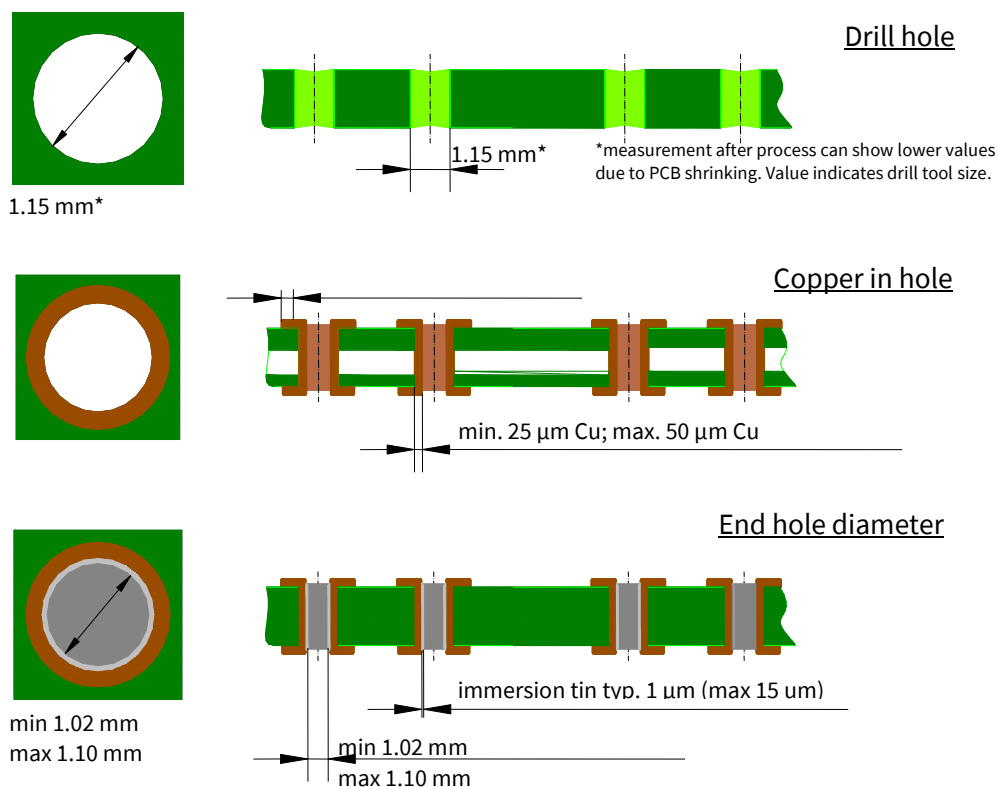


Figure 1: Structure of a PCB according to the specification in Table 1

¹ Experience has shown that PCB hole diameter should be significantly larger than the module frame element for a seamless assembly process. The given relative large hole diameters in the PCB is the best compromise between Module and PCB alignment and the necessary play during this assembly step. The specified relative large hole sizes avoid an unnecessary rotation of the PCB with respect to the signal pin coordinate system.

3.2 General hints for the PCB Footprint

PCB footprint typically depend on PCB manufacturing processes and customer specific design rules. The following table can be understood as a best practice and starting point for system design.

Table 3: Hint for PCB footprint holes. PCB bottom layer is defined on side of the power module.

No	Type	PCB Implementation Hint
1	X-Pin holes	End hole Diameter: 5.90 mm (see Table 2) Top Layer Copper Diameter: ≥ 6.40 mm Mid Layer Copper Diameter: ≥ 6.40 mm Bottom Layer Copper Diameter: ≥ 8.00 mm End hole Diameter: 5.4 mm (see Table 2) Top Layer Copper Diameter: ≥ 5.90 mm Mid Layer Copper Diameter: ≥ 5.90 mm Bottom Layer Copper Diameter: ≥ 8.00 mm
2	Signal press-fit pin holes	See Table 1
3	Components Keep out around press-fit Pins	≥ 3 mm radius from the hole centre Others: ≥ 4 mm radius from the hole centre
4	PCB fixing screw holes	End hole Diameter: 3.60 mm Top Layer Copper Diameter: ≥ 7.00 mm Mid Layer Copper Diameter: ≥ 6.50 mm Bottom Layer Copper Diameter: ≥ 6.60 mm

*: The x-pin holes can be designed both as plated or un-plated holes. Plated holes with annular rings as noted in the table are the preferred solution. All plated holes are drilled at the PCB manufacturers within the same process and leads to best hole to hole pattern tolerances as a consequence.

3.3 Press-In Tools

This chapter describes a sample press-in tool, which can be adapted to project specific details like PCB assembly locations, maximum height of other PCB parts, etc. to avoid mechanical collisions during the press-in process. The press-in tool is made of two parts (see Figure 2, Figure 3).

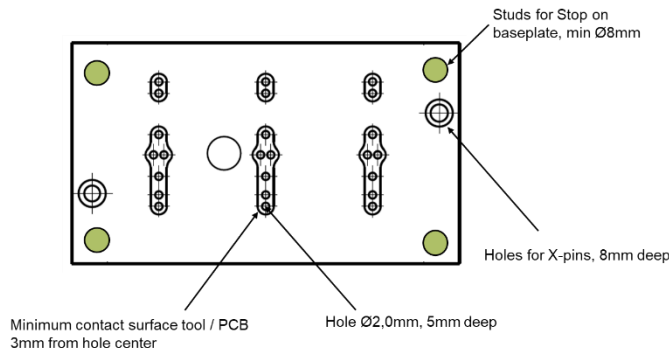


Figure 2: Recommendation upper tool

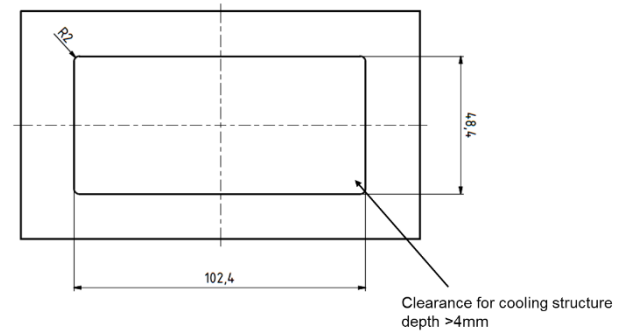


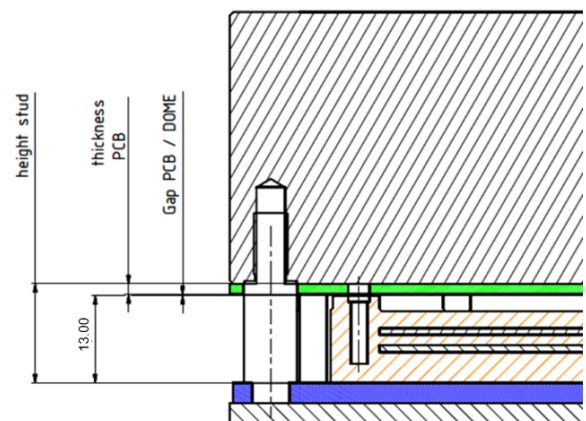
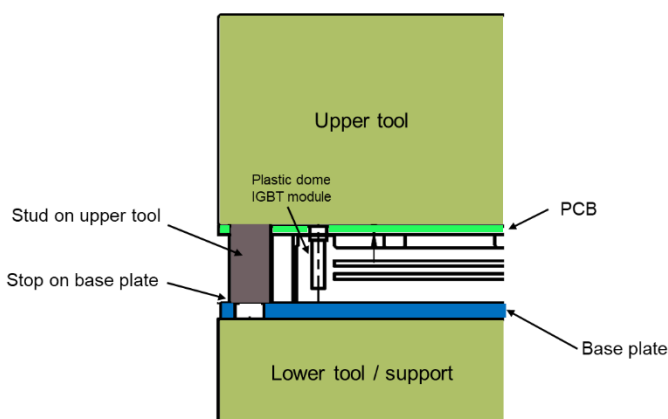
Figure 3: Recommendation lower tool

The lower tool supports the power module baseplate and has to avoid damage of the pin-fin cooling area. The material and/or plating of the bottom part of the tool has to be selected in order to avoid scratches and damage of the baseplate sealing area. The holes for the X-pins avoid, by the poka yoke concept, a wrong orientation of the power module in the press-tool.

The upper tool supports the PCB around the press-fit pins with cylindrical shapes and support the PCB during the press-in process. This part of the tool should be made of material, which can withstand the press-in forces. The top tool also has cylindrical shapes holes around the X-pins in order to avoid a press-in process with an incorrectly oriented tool or power module.

The following points must be taken into account with the press tool.

- Press-tool distance keeper (Studs) should be designed at the positions of the 4x module baseplate holes.
- Press-tool distance keeper (Studs) should have a minimum 8mm diameter.
- Maximum force press-in force specified in Table 4.
- Press-tool distance keeper height: Gap between PCB and module housing domes should typically be 150 µm after the press-in process.
- The total height of the distance keeper is 13.00 mm (typical dome height of 12.85 mm + 150 µm gap between PCB and module housing domes).



3.4 Press-In Process

The press-in process is recommended with a controlled force-distance method for serial production.

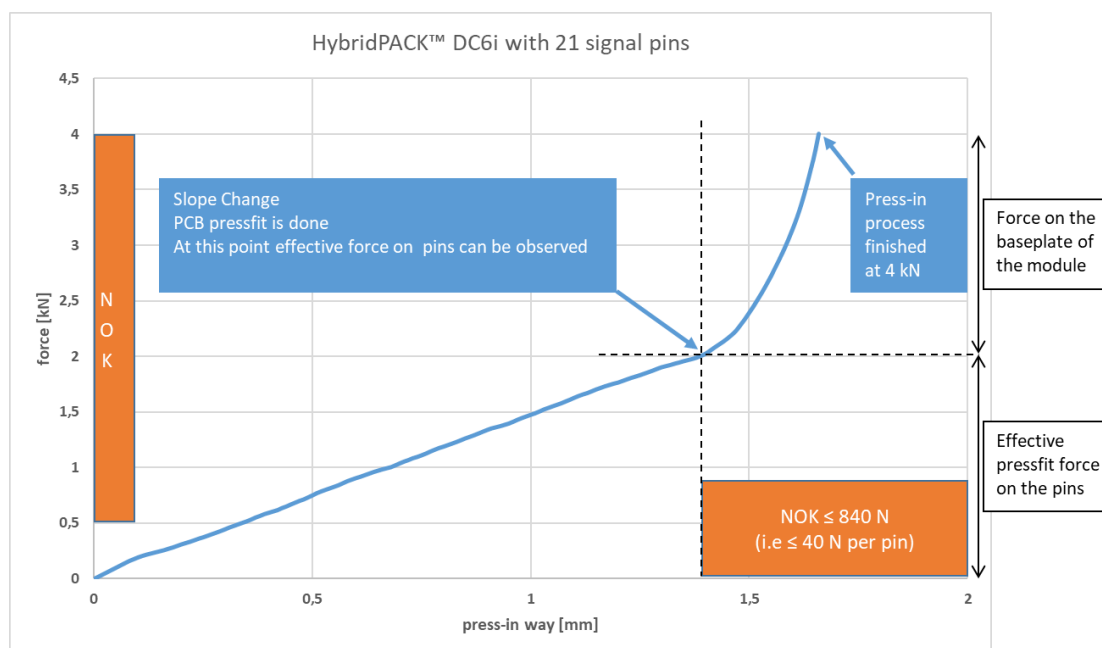


Figure 4: Typical way-force press-in diagram from a HybridPACK™ DC6i module with 21 signal pins

The Figure 4 show an example of a HybridPACK™ DC6i press-in process. The press-in process starts when the force increases. At this point the z-axis is set to 0 mm in this diagram. In case an initial high peak is detected it may indicate a failure in the process like PCB hole plugged with solder, not properly inserted PCB before the process starts, machine collision with other external parts, etc.

The force curve will increase smoothly while pressing down the PCB (see diagram).

Lower press-in speeds as noted in Table 4 are not allowed as the press-in forces can increase and damage the pin. Higher press-in speeds are uncritical for the module.

Considering the 1st derivative of the force-distance diagram (see diagram) a significant slope change can be detected at the end of the process. At this point the PCB is fully pressed on the module housing and the effective part of the press-in process is done.

At this point the force should be minimum 40N per pin (i.e. 840N for HybridPACK™ DC6i with 21 pins).

Please note it is important that the press-in equipment is designed for the expected high forces. During the press-in process the bottom and top press tool must be parallel to each other and should be mechanically fixed without tilt.

Table 4: Overview press-in process

No	Description	unit	min.	typ.	max.	Remarks
1	Press-in speed	mm/s	0.4	2 - 4	8	During the press-in process it is not allowed to come under the minimum speed (no multistep press-in process). The maximum press-in speed is typically limited due to non ideal press machine.
2	Max allowed press force	kN			4	

4 PCB design hint for high thermal cycle system robustness

Especially in applications where high module ambient temperatures and/or high thermal cycle stress is expected it is recommended to take care in system design for minimized pin pull forces. Following parameters can be optimized in the system design:

- PCB mounting positions (e.g. see section 4.1)

4.1 PCB design for module external mounting

Section 3.3 described the press-tool and the distance (gap) between the PCB and the dome .

After the press-in a gap between PCB bottom side and the power module housing domes remain (see indicated area (2) in the Figure 5). Inverter system designer can implement a PCB fixing point outside of the power module (see indicated area (3) in the Figure 5). The fixing point should be designed so that a gap of 150 µm is achieved after pressing process (height of the fixing point approx. 16 mm). The power module after fixing the PCB by screws to the fixing point. It has to be clearly mentioned that no screws (i.e. the Ejoy screws) are allowed at the module domes in case of module external fixation method. A small gap between module and PCB is intended and has to remain after the final assembly.

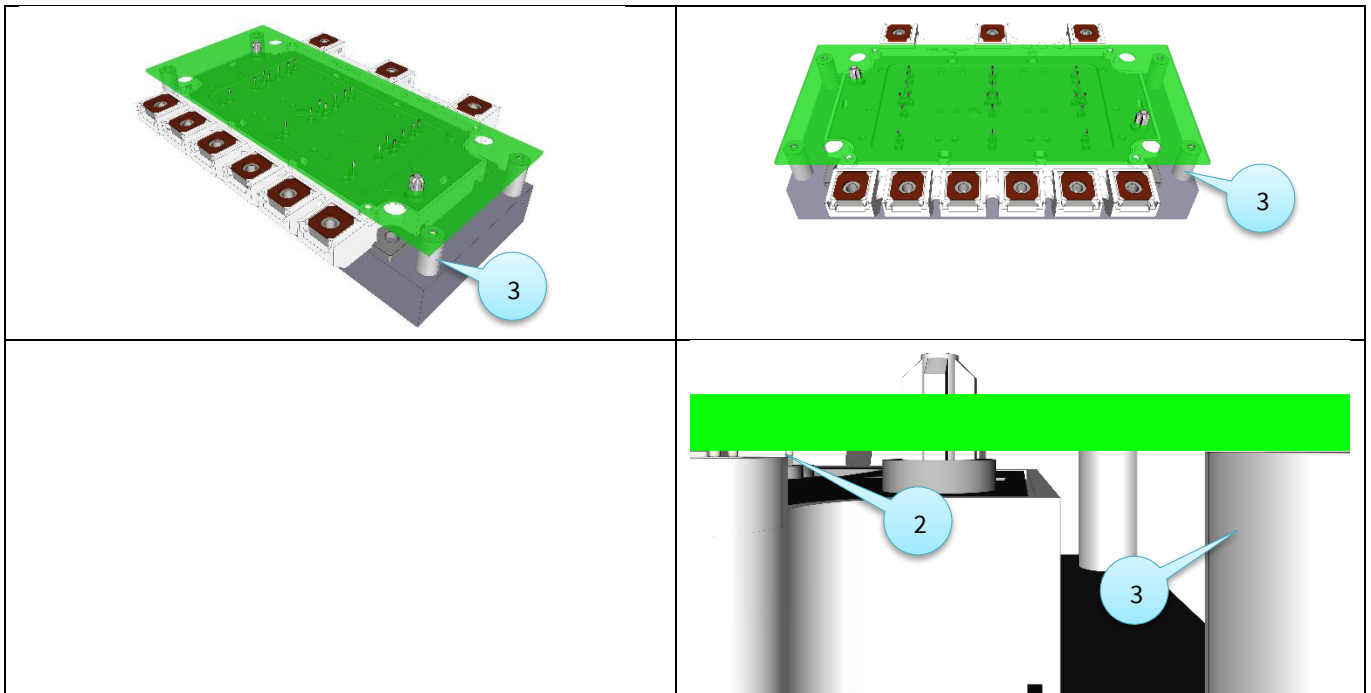


Figure 5: Example of module with external mounted PCB. Distance keeper from the Press-tool ensure a distance of PCB to module dome (2). PCB can be fixed externally of the module (3).

5 Power Module Cooling System

The cooler design has a great impact on the overall cooling performance, which means the combination of thermal resistance/impedance, pressure drop, and cooling flow rate. Thus, for all of these thermal related product specifications a reference cooling system is needed, where the given specification values are valid.

PLEASE NOTE: During the mounting process, damage to the nickel plating or mechanical deformation of the cooling structure as well as contamination, scratches or other damage in the sealing region (see Figure 7) must be strictly avoided.

5.1 Reference Cooler Design

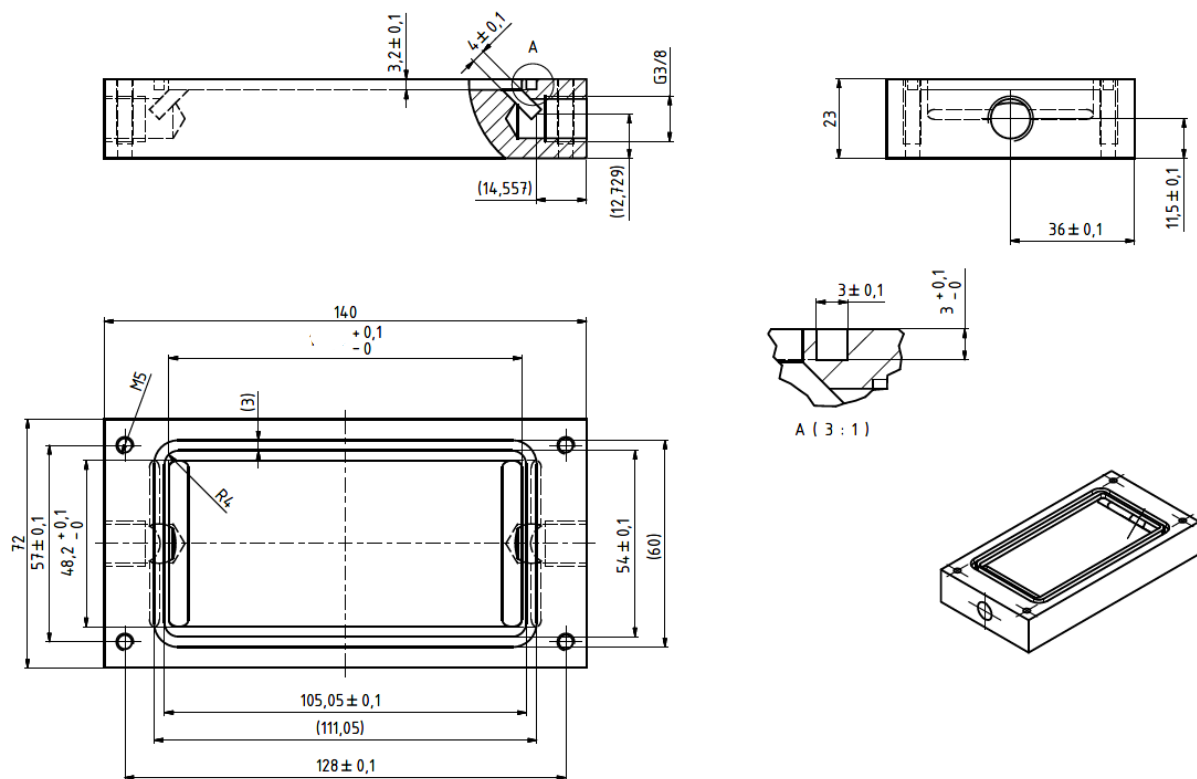


Figure 6: Reference cooler design for HybridPACK™ DC6i.

5.2 Recommendation for the sealing ring

The power module baseplate is designed with a flat region of 7 mm surrounding the entire wave area (see Figure 7).

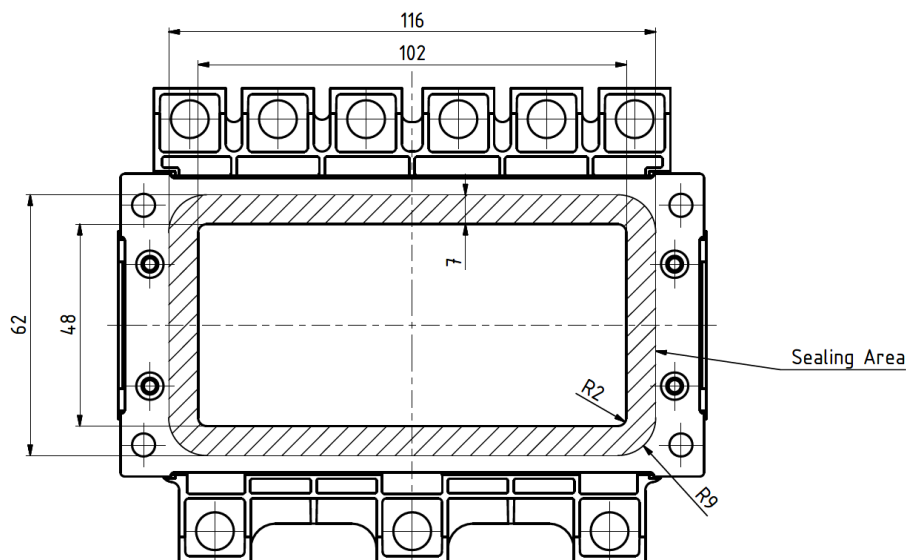


Figure 7: The sealing region with 7 mm surrounding the wave area.

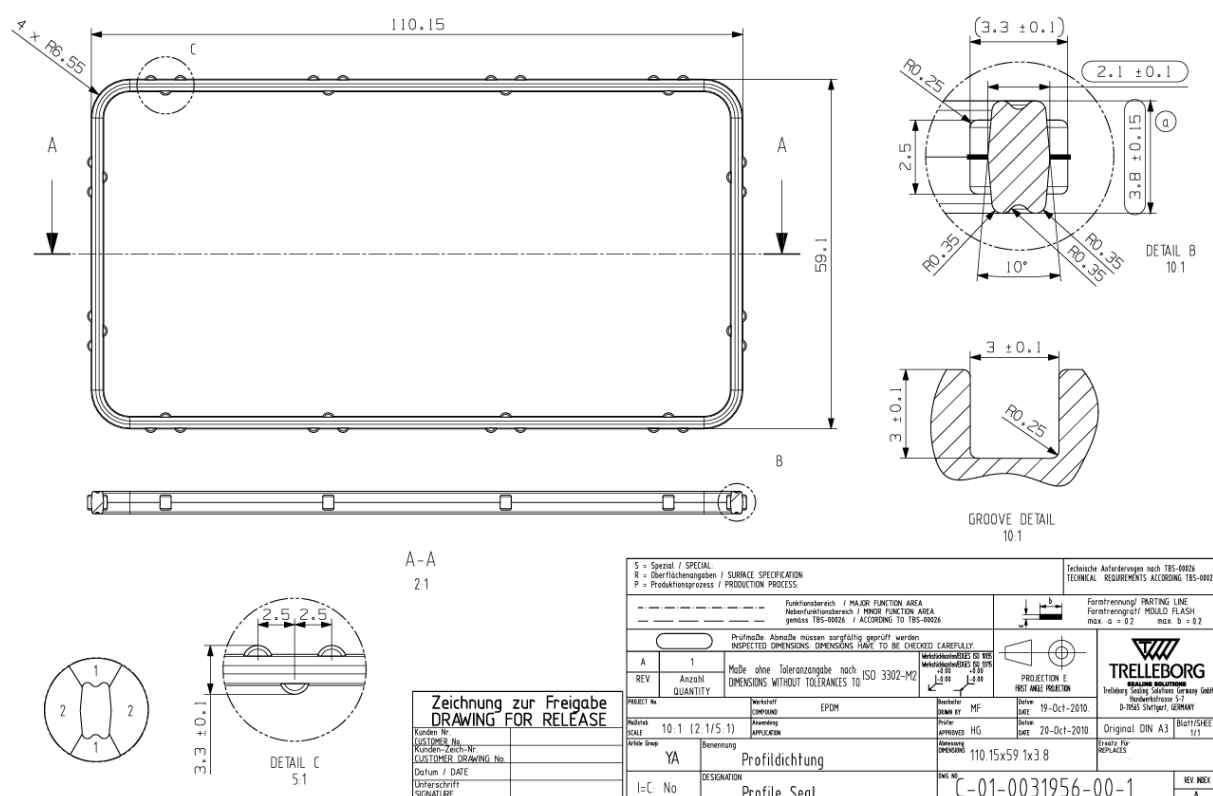


Figure 8: Drawing of sealing ring

It is recommended to use a HybridPACK™ DC6i module with a sealing ring from Trelleborg.

The company Trelleborg designed a sealing ring with the article number: **C-01-0031956-00-1**.

PLEASE NOTE: Infineon does not recommend the usage of a silicon gasket or other sealing methods. The usage of sealing methods different then sealing ring can cause damage on HybridPACK™ DC6i module

5.3 Cooling fluid

A general recommendation for a specific cooling fluid cannot be provided, as the power module is only one single part in the entire cooling system. Following items have to be considered at the system supplier to find appropriate coolant fluid:

- Coolant fluid with its corrosion protection has to be compatible with the aluminium of the cooler material and the nickel overplated Cu module baseplate.
- Also other parts in the coolant system has to be compatible to the fluid type (e.g. Zn screws and chrome parts are typically not allowed in the cooling system).
- The fluid mixture has to provide enough anti-freeze for the application conditions. Freezing events of the fluid has to be strictly avoided. Freezing fluid will lead to plastic deformation of the power module baseplate and may lead to fluid leakage and/or isolation failure consequently.

For power module tests at Infineon where cooling is required (e.g. thermal characterization, power cycling tests) typically BASF Glysantin™ G30™ with an organic-acid-technologie (OAT) silicate-free corrosion protection is applied. A known effect in combination with HybridPACK DC6i “Wave” FS650R08A4P2 is a chemical reaction of the corrosion protection of the Glysantin™ G30™ with the aluminum coolant structure (see Figure 9). This is a known effect of this coolant type and had in the tests no influence on thermal performance or pressure drop.

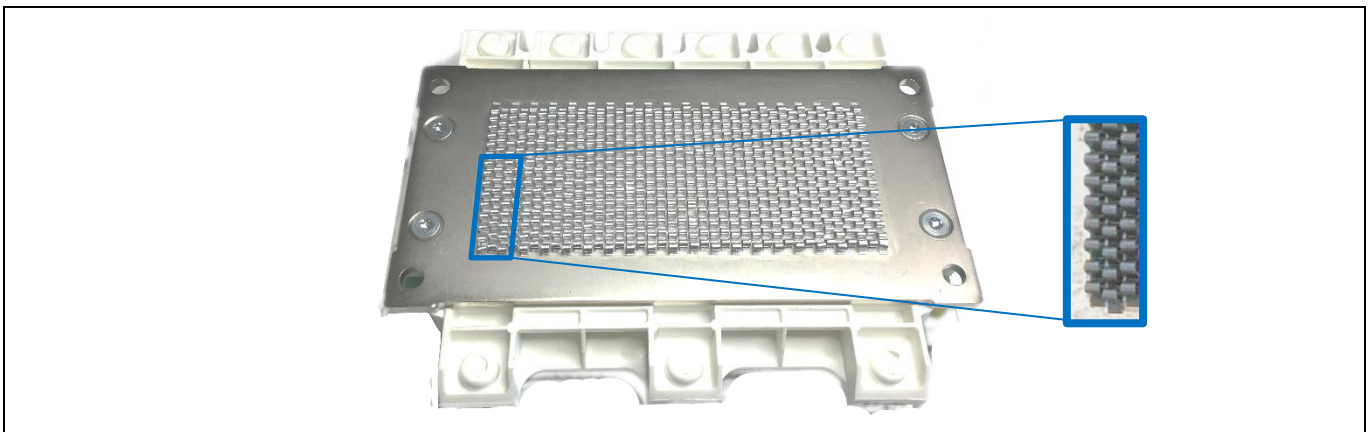


Figure 9 Example of HybridPACK DC6i FS650R08A4P2 after long time tests with G30™ fluid. The aluminum cooling structure may appear black after the test. The reaction of the organic corrosion protection is a known effect and has no negative influence on the thermal performance or aging of the module.

6 Screw types and processes

6.1 Baseplate Mounting Screws

The clamping force of the module resulting from the assembly process to the heat sink depends on the torque applied and the condition of the heat sink material. The following torque values specified in the datasheet result from steel screws in aluminium heat sinks with a dry M5 thread.

Recommended screw order can be seen in chapter 6.4.

Table 5: Recommended baseplate fixing screw M5x10 DIN EN ISO 7380-1-TX

No	Description	min.	typ.	max.	Remarks
1	Mounting torque	3 Nm		6 Nm	
2	Effective length of screw in cooler		7mm		

6.2 Fixation/clamping of the module during the baseplate screw process

It is required to fix properly the power module to the cooler during the screwing process in order to avoid tilting of the module with a possible damage (i.e. plastic deformation of the baseplate).

Following methods are preferred for module fixation. Screw orders are listed in section 6.4:

- 1. Multi-Step Screw Mounting:** Place screw number 1 & 2 and fix with lowest torque (this avoids only module tilting and will not to provide a high clamping force). Fix screw 3 to 4 with low torque (e.g. 0.4-0.6 Nm). Fix screws with final torque as specified.
- 2. Module Clamping:** After the power module (with PCB) is placed onto the cooling system the module should be clamped in z axis of the module with a total force of **$F_c = 600\text{ N}$ (300 N per AC/DC side)**. The clamping can be performed in the area where the power tabs are located (see Figure 10). It is important that the PCB or the pins are not further pushed down during the clamping.

Please note that the described fixing method with multi step screw mounting is not suitable for self-tapping screws. For self-tapping screws it is mandatory to use proper clamping which enables a single step screw mounting.

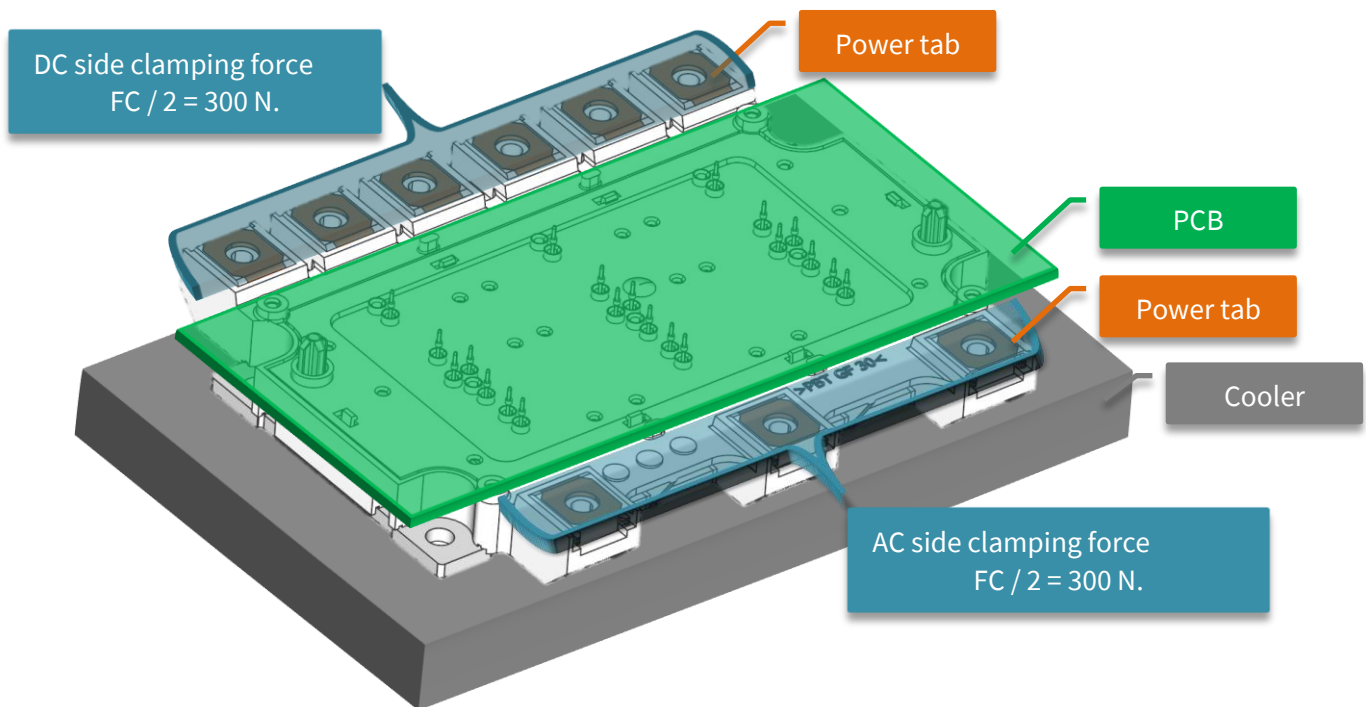


Figure 10: Indicated area where module can be normally clamped/hold down to the cooling system during the baseplate screw process.

6.3 PCB mounting screws on the module housing

Please take note that fixing the PCB to the module with screws is recommended after the module is attached to the cooling system. The module dome was designed for the following screw type:

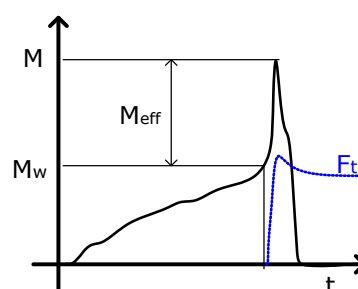
- **EJOT Delta PT WN5451 30 x 10 (for 1.6 mm PCB thickness)**

The thread in the plastics will form itself by driving in the EJOT screws. It is important to have an appropriate minimum turn-in speed, which causes a self-heating of the screw in order to have a proper thread forming in the plastic housing without splitting and cracking. An electronically speed controlled screwdriver is the preferred aid for this purpose. Furthermore, a straight insertion of the screw into the stand-off must be observed during assembly.

a)



b)



c)

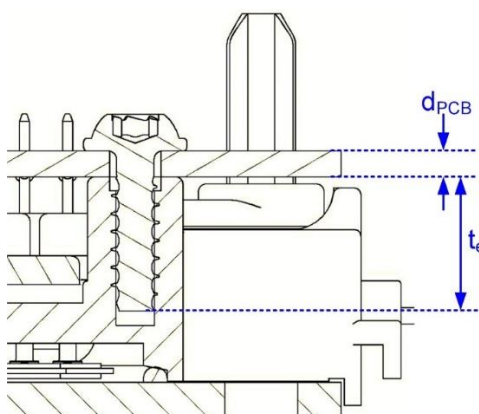


Figure 11: Picture of EJOT Delta PT typical appearance (a), basic mounting torque diagram (b), cross-section drawing of PCB screw in module dome (c).

Table 6 PCB fixing screws EJOT Delta PT WN5151 30x10:

No	Description	Unit	min.	typ.	max.	Remarks
1	Mounting torque M_{eff} M_{eff} + M_w (for 1.6 mm PCB)	Nm	0.45	0.50 1.0	0.55	M _w ≈ 0.45..0.5 Nm torque is required for the self-tapping of a 10 mm screw length and 1.6 mm PCB thickness. This torque is not effective for the mounting force F _t and may change for different screw length and PCB thickness.
2	Recommended mounting speed	rpm	400		600	Lower than 200 rpm is not recommended.
3	Screw length in the module dome (t _e)	mm	6		9	Typical screw length 10 mm for 1.6 mm thick PCBs.

6.4 Screw Orders (Baseplate and PCB)

The screw order as shown in Figure 12 is very important in order to avoid damage on the part. Please see section 6.1 and 6.3 for specification of screw type and torque as well as required processes like module fixation/clamping during the baseplate screw process.

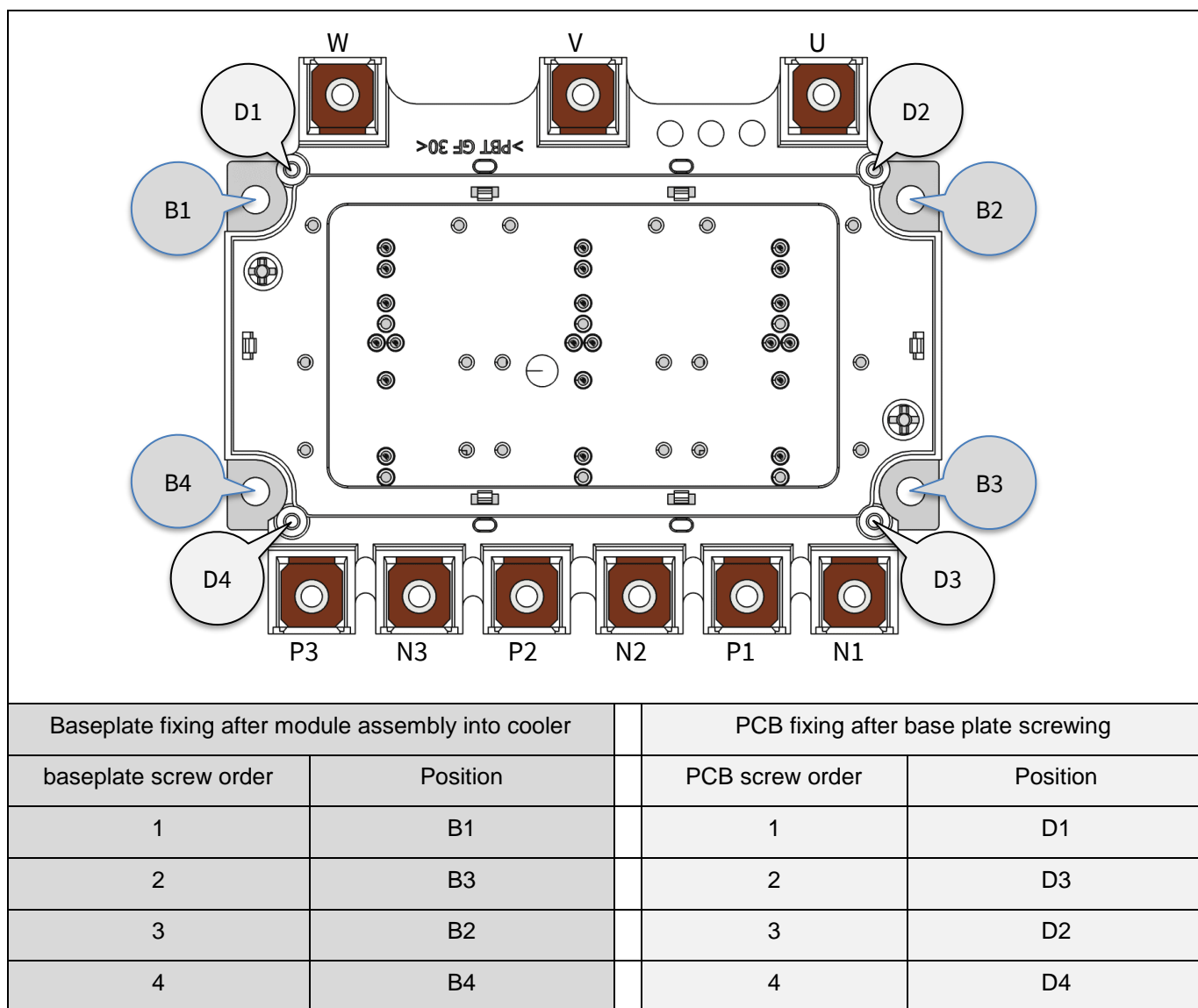


Figure 12: Screw order for baseplate and PCB screws.

7 Connecting to the Power Terminals

For the connection of the power terminals DIN M5 screws are required which comply at least with class 6.8, in combination with a suitable washer and spring washer or complete combination screws.

When selecting the bolt length the layer thickness of the connected parts has to be subtracted from the total length of the screws. The effective length of engagement into the module thread may not exceed the maximum specified depth of 10mm.

The connected parts have to be mounted to the power terminals in such a way that the specified static forces are not exceeded during assembly or later in operation, as shown in Figure 13.

PLEASE NOTE: The values of the specified forces refer only to static forces. No oscillation (vibration) forces are allowed here.

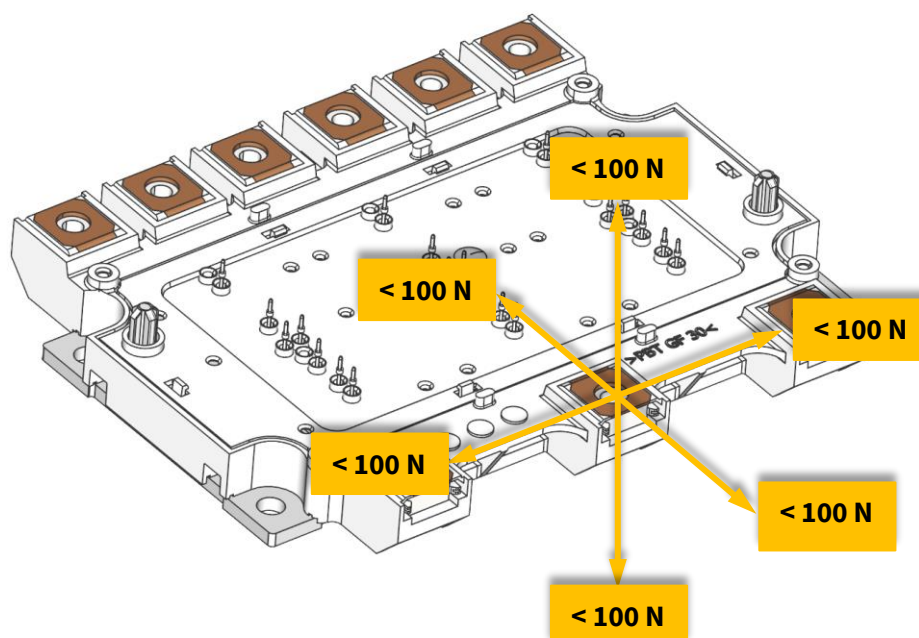


Figure 13: Maximum permissible static pull and push forces at the power terminal

Recommended screw for connecting the power terminals (see Table 7)

Table 7: Power tab recommended screw M5x10 DIN EN ISO 7380-2-TX

No	Description	min.	typ.	max.
1	Mounting torque	3 Nm		6 Nm

8 Storage and Transport

During transport and storage of the modules, extreme forces through shock or vibration have to be avoided as well as extreme environmental influences.

Storage of the modules at the limits of the temperature specified in the datasheet is possible, but not recommended.

The recommended storage conditions according to IEC60721-3-1, class 1K2 should be assured for the recommended storage time of max. 2 years.

Max. air temperature: $T_{\text{maxair}}=+40^{\circ}\text{C}$

Min. air temperature: $T_{\text{minair}}=+5^{\circ}\text{C}$

Max. relative humidity: 85%

Min. relative humidity: 5%

Condensation: not permissible

Precipitation: not permissible

Icing: not permissible

Pre-drying of the power module prior to the press-in process (as is recommended for molded discrete components, such as microcontrollers, TO-cases etc.) is not required for the HybridPACK™ DC6i power modules.

9 Traceability, Data Matrix and Part Markings

Traceability of materials, equipment and processes is a must for key automotive components. Therefore, the HybridPACK™ DC6i is produced at Infineon in a seamless traceability environment. Nevertheless, traceability must not be aborted after the modules are shipped to the customer and assembled into the inverters. In order to reap the full benefit of a traceability chain, the unique module number (module ID) should be linked to the inverter ID at customer side.

Figure 14 shows the module labels and where to find the DMX-code necessary for tracing the module-ID.

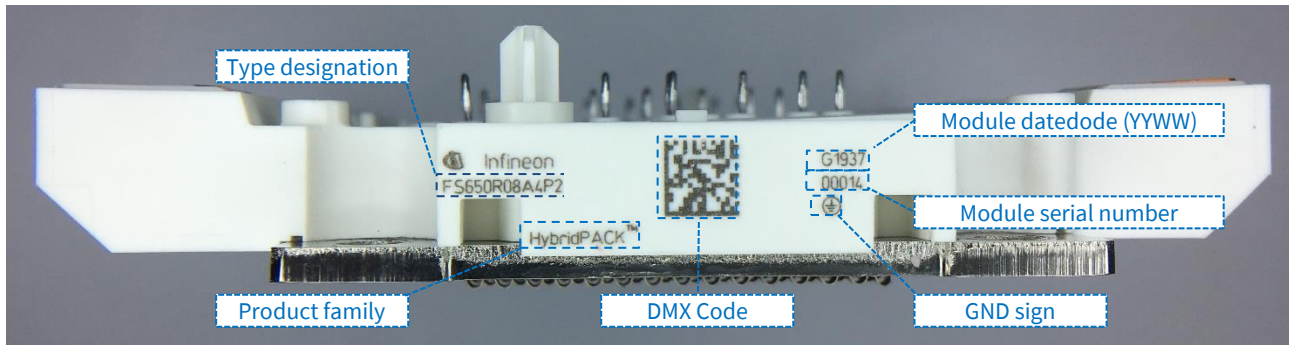


Figure 14: Picture of module labels (typical appearance). For a seamless traceability the DMX code which is the module ID (or alternative the type designation + date code + serial number) should be recorded and linked to the inverter ID.

The DMX code is readable with all professional data matrix code scanners compatible to the IEC24720 and IEC16022 standard.

Engineers in the lab can also use free DMX code reader apps on their smartphones.

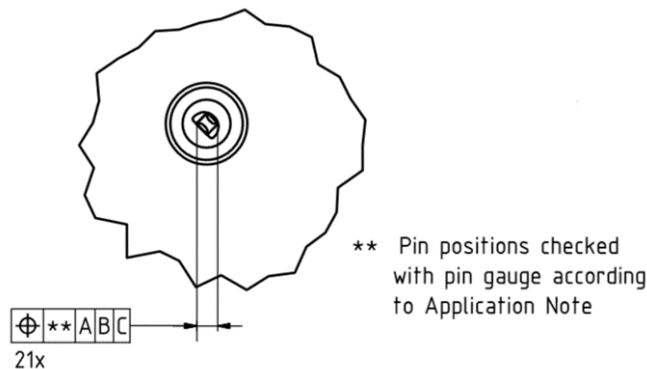
Android: QR Extreme, QR Droid, and many others supporting data matrix codes.

iOS: i-nigma QR, and many others supporting data matrix codes

10 Pin Position and Pin Gauge

For power modules which have in product specification a note as shown in Figure 15A, a pin gauge test is implemented in the production line at Infineon. The specification of this pin gauge is shown in Figure 15B for pinning as implemented in FS650R08A4P2. At power module production the parts are tested if pin gauge can be applied to the module. A low force in module z-direction on the gauge are allowed (typical up to 10..20N, which is uncritical for the module and its pins). When the pin gauge can be smoothly attached to the module the test is rated as PASS and can be seen as a test if customer can later smoothly assembly their PCBs on the power module. The basic description of the test and pin gauge specification is placed only for information how these modules are tested at Infineon production. It is not needed at customer side to test power modules at incoming inspection again.

A)



B)

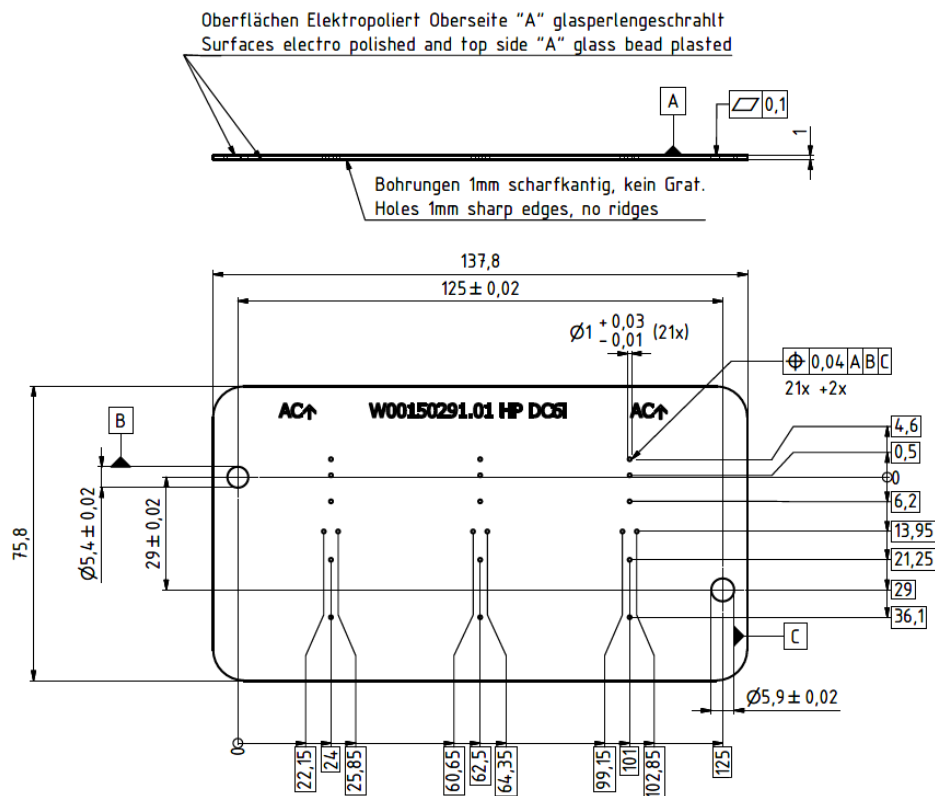


Figure 15: Extract of datasheet regarding pin positions on example of FS650R08A4P2 (A). Specification of Infineon pin gauge for power module production test (B).

11 Power Module Appearance

This chapter explains frequent questions about the typical power module appearance.

11.1 Pin Rotation

The position tolerance is an important value and ensures that a PCB designed according to the recommendations fits to the power module. The positions of the pins are clearly specified in the product datasheet.

The pin rotation is not fixed as the interface (PCB via) is totally symmetric. A pin rotation is clearly visible due to the asymmetric pin geometry (i.e. three contact pressfit pin). An example is shown in Figure 16, where the rotation is indicated. Typically about 45° pin rotations can be seen. Nevertheless, different angles may occur in the final product and it is no reason for an objection and has no influence on the final contact quality.

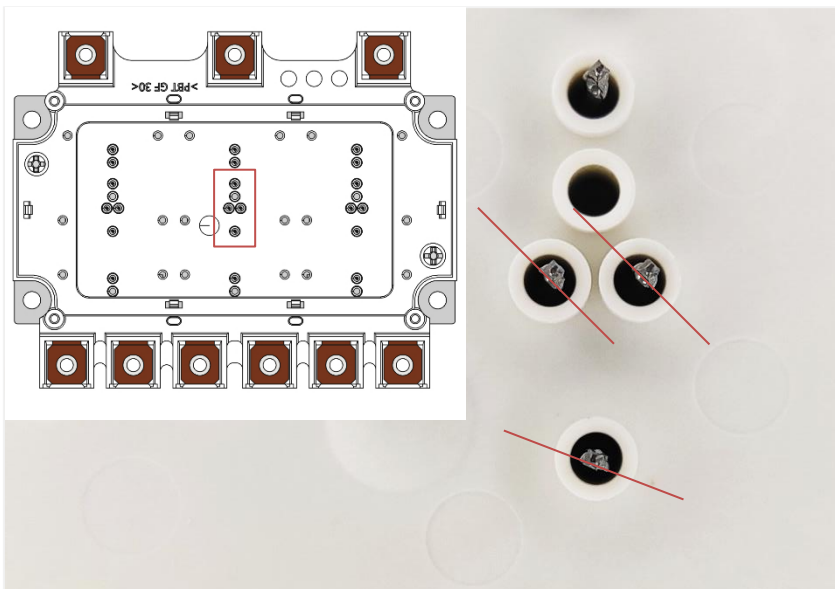


Figure 16: Pins are not symmetrical (three contact pressfit pins) and thus a rotation angle is visible. Different angles may occur in final product but are uncritical for the contact quality and is no reason for an objection.

12 Revision History

Revision History			
Date	Version	Changed By	Change Description
2019-09	0.9	P. Jones, N. Gorte	Initial DRAFT Version.
2020-04	0.95	P. Jones, N. Gorte	Revised: <ul style="list-style-type: none">• Traceability, Data Matrix and Part Markings• Pin Position and Pin Gauge• Cooling fluid
2020-09	1.0	N. Gorte	Added new chapter for: <ul style="list-style-type: none">• PCB design for module external mounting• Fixation/clamping of the module during the baseplate screw process• Pin Rotation

Trademarks of Infineon Technologies AG

AURIX™, C166™, CanPAK™, CIPOS™, CoolGaN™, CoolMOS™, CoolSET™, CORECONTROL™, CROSSAVE™, DAVE™, DI-POL™, DrBlade™, EasyPIM™, EconoBRIDGE™, EconoDUAL™, EconoPACK™, EconoPIM™, EiceDRIVER™, eupec™, FCOS™, HITFET™, HybridPACK™, Infineon™, ISOFACE™, IsoPACK™, i-Wafer™, MIPAQ™, ModSTACK™, my-d™, NovalithIC™, OmniTune™, OPTIGA™, OptiMOS™, ORIGA™, POWERCODE™, PRIMARION™, PrimePACK™, PrimeSTACK™, PROFET™, PRO-SiL™, RASIC™, REAL3™, ReverSave™, SatRIC™, SIEGET™, SIPMOS™, SmartLEWIS™, SOLID FLASH™, SPOC™, TEMPFET™, thinQ!™, TRENCHSTOP™, TriCore™.

Trademarks updated August 2015

Other Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition <2020-09-24>

Published by

Infineon Technologies AG

81726 Munich, Germany

© 2020 Infineon Technologies AG.

All Rights Reserved.

Do you have a question about this document?

Email: erratum@infineon.com

Document reference

AN-DC6i-ASSEMBLY

IMPORTANT NOTICE

The information contained in this application note is given as a hint for the implementation of the product only and shall in no event be regarded as a description or warranty of a certain functionality, condition or quality of the product. Before implementation of the product, the recipient of this application note must verify any function and other technical information given herein in the real application. Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind (including without limitation warranties of non-infringement of intellectual property rights of any third party) with respect to any and all information given in this application note.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the type in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof could reasonably be expected to result in personal injury.