

HybridPACK™ HD
Application and Mounting Consideration
AN-2026-04

Restricted

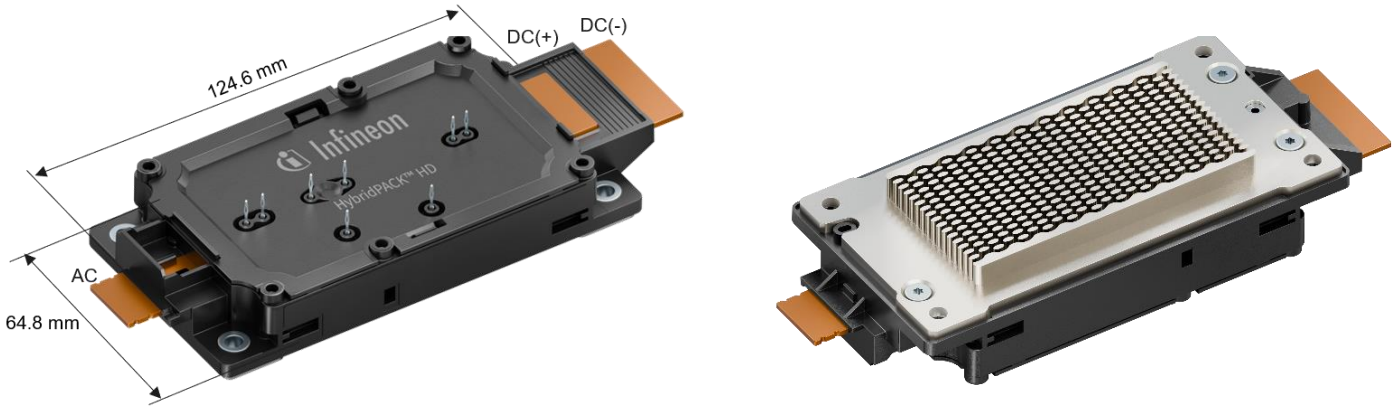
About this document

Scope and purpose

This document, in combination with the product datasheets, provides application details and assembly instructions for the HybridPACK™ HD semiconductor module family. More information on Infineon's power module datasheets is available in [1].

Beside thermal and electrical aspects of the application condition at which the components are operated is of high importance, the mechanical layout with its construction and the handling during assembly is of high importance too.

This application note should be considered for mechanical, electrical, and thermal designs using Infineon's HybridPACK™ HD products.



The notes and recommendations in this document cannot cover all applications and not all conditions. It is recommended that users perform a thorough assessment and evaluation of the suitability of this product for the purpose envisaged by their technical departments.

Note: This application note only provides guidelines and hints for the implementation of the products. The contents should NOT be regarded as warranty for any functionality, condition, or quality of the product.

Intended audience: The intended audiences for this document are design engineers, technicians, and developers of electronic systems.

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Electrostatic protective measures

Power semiconductors components are electrostatic-sensitive devices that require handling according to the electrostatic discharge (ESD) directives. Uncontrolled discharge, voltage from non-earthed operating equipment, personnel, static discharges, or similar effects can destroy the devices.
The gate emitter (IGBT)/gate source (MOSFET) control terminals are electrostatic-sensitive contacts. Users must NOT operate or measure power modules with open-circuit gate-emitter terminals.



Attention: ESD can partially or even completely damage the power modules. Users must observe all precautions to avoid electrostatic discharge during handling, movement, and packing of these components.

To avoid destruction or pre-damage to the power semiconductor components by electrostatic discharge, the devices are made using suitable ESD packaging. The module is delivered with an ESD protection at module terminals according to the ESD directives.

Note: Installing ESD workstations is required for unpacking the module, removing the ESD protection, and handling the unprotected modules.

Subsequent work steps must only be carried out at special workstations complying with the following requirements:

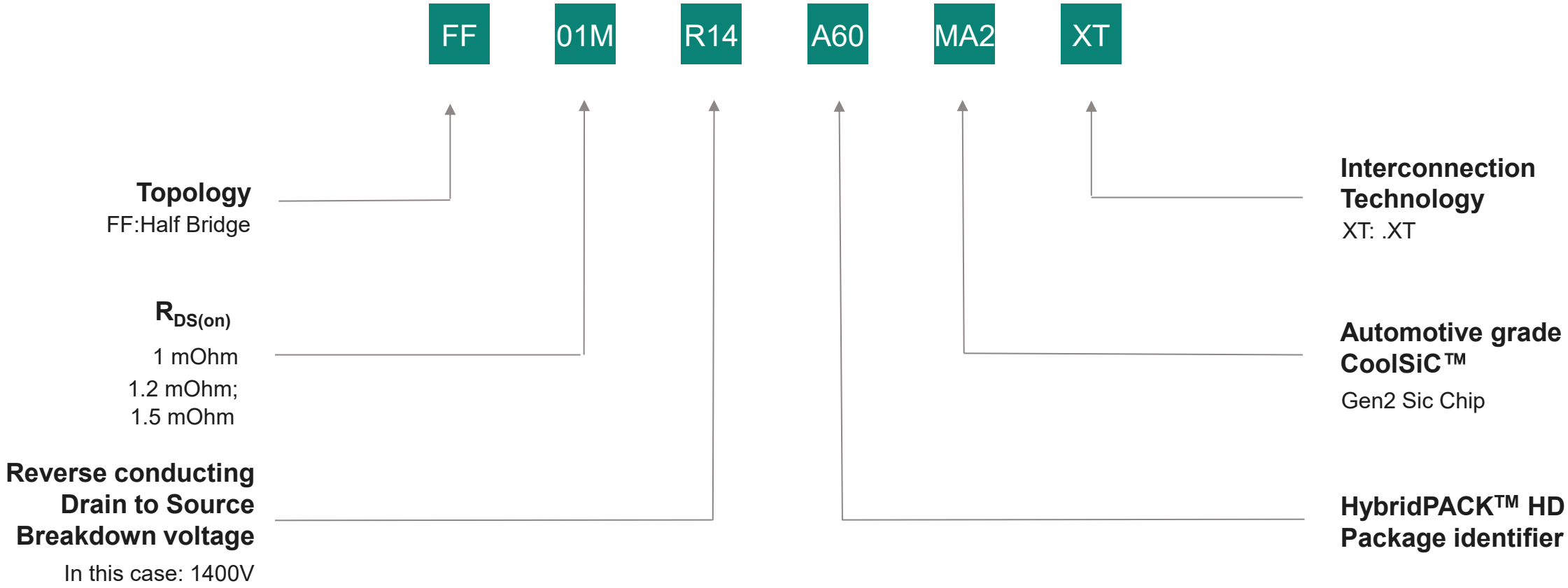
- High impedance ground connection
- Conductive workstation surface
- ESD wrist straps

Further information is available in the currently valid standards:

- IEC 61340-5-2: Protection of electronic devices from electrostatic phenomena, general requirements
- ANSI/ESD S2020
- MIL-STD 883C: Method 3015.6 for testing and classification
- DIN VDE 0843 T2: identical to IEC801-2

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HybridPACK™ HD
Product naming nomenclature of CoolSiC™ power modules



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HybridPACK™ HD - Mission Profile & Overload Consideration to achieve required lifetime

eTruck use cases

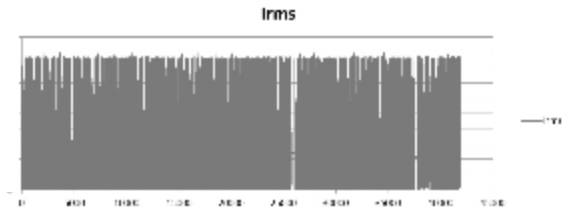
- Long haul
- Regional distribution
- City/urban Distribution



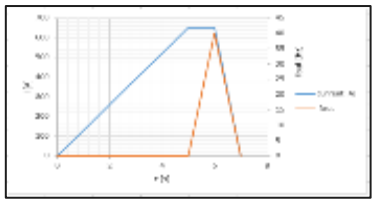
Simplified representation

* Examplary figures

Driving profile



Overload profile

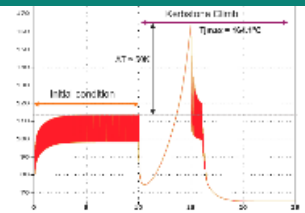


Kerbsone climbs, stall.conditions, hill hold, ...

Required Lifetime*

distance km	speed km/h	operating hours	LT consumption
1.200.000	30	40.000	40%
2.400.000	30	80.000	80%

Temperature profile



Kerbsone climbs, stall.conditions, hill hold, ...



HybridPACK™ HD

Part number	$R_{DS(on)}$	I_{nom}
FF01MR14A60MA2XT	1.0 mΩ	840A
FF01M2R14A60MA2XT	1.2 mΩ	700A
FF01M5R14A60MA2XT	1.5 mΩ	560 A

The lifetime + the overload conditions defines the required power module type with its quantity of SiC-MosFET chips.

Select the right device according to your needs!

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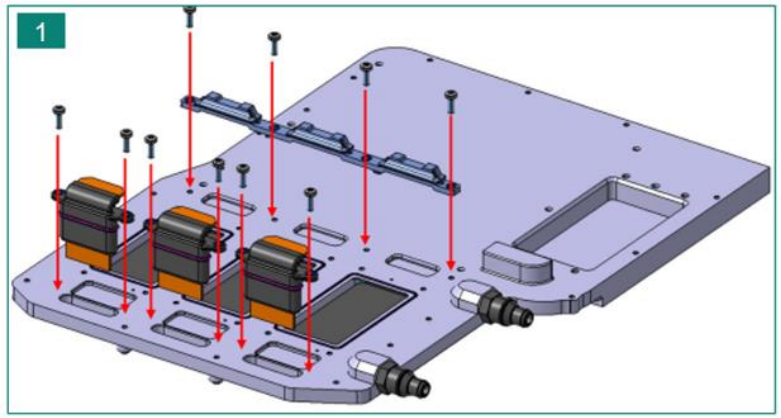
HybridPACK™ HD
Overview of a possible inverter assembly sequence

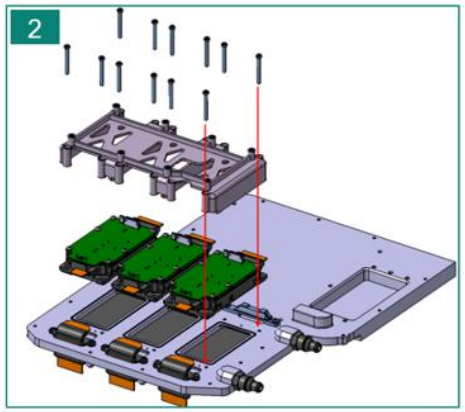
HybridPACK™ HD
Exemplary Overview of a system mounting sequence

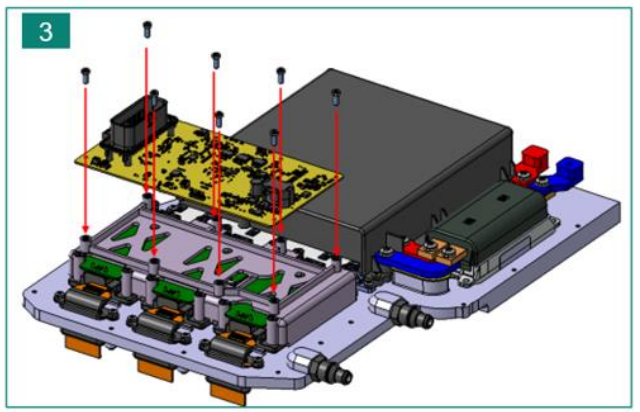
An exemplary and highly simplified illustration of a possible inverter assembly sequence.

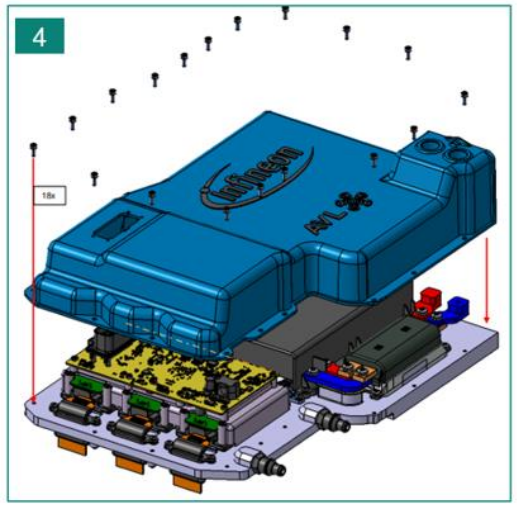
1. Preparation sub assemblies
   - pre-manufactuered heatsink
   - cooling fluid inlet.- outlet connector
   - AC busbar
   - AC busbar bracket for laser welding support and/or fixing
   - Optional: Module positioning pins
2. Mounting HybridPACK(TM) HD power module with module adapter board
3. Mounting futher components
   - controll board and connecting to module adapter board
   - input EMI filter and connector
4. Inverter housing assembly
5. Inverter connectors
6. End of line inverter testing and product inspection

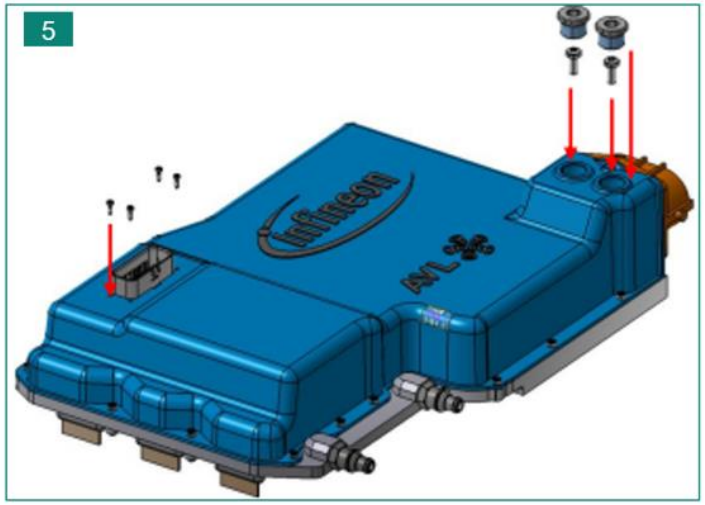
***Note:** The user is responsible for qualifying the development of assembly processes and workflows, based on the specifications of the manufacturing concept, and for implementing them for serial production.*

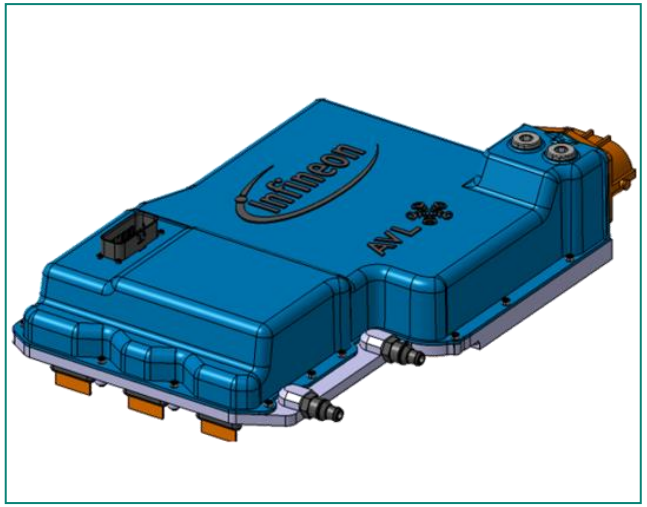












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HybridPACK™ HD
Module Mounting and Assembly Features

HybridPACK™ HD - Mounting Features

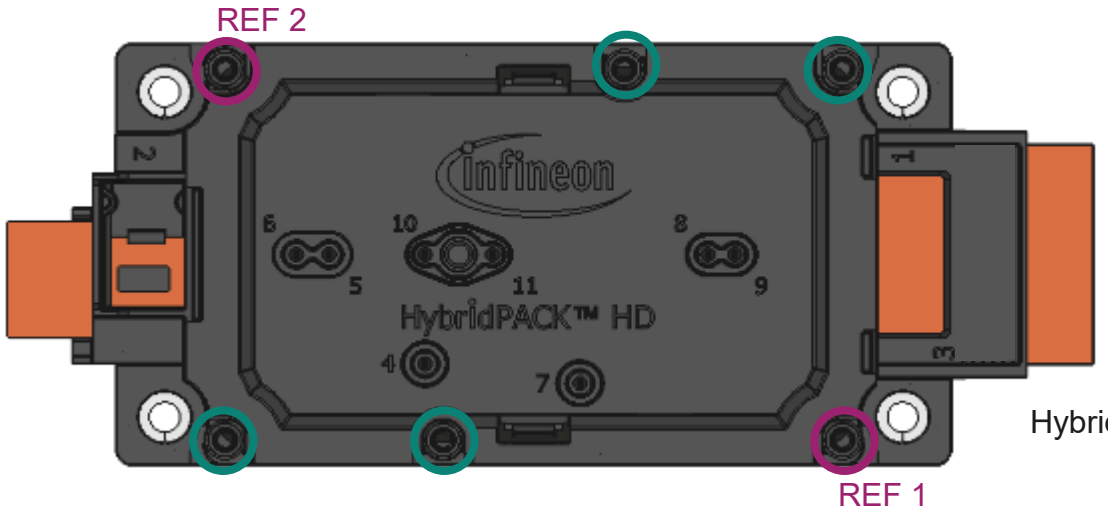
Power Circuit Board (PCB)
Gate Drive Unit (GDU)

Fixing stand-off for PCB/GDU

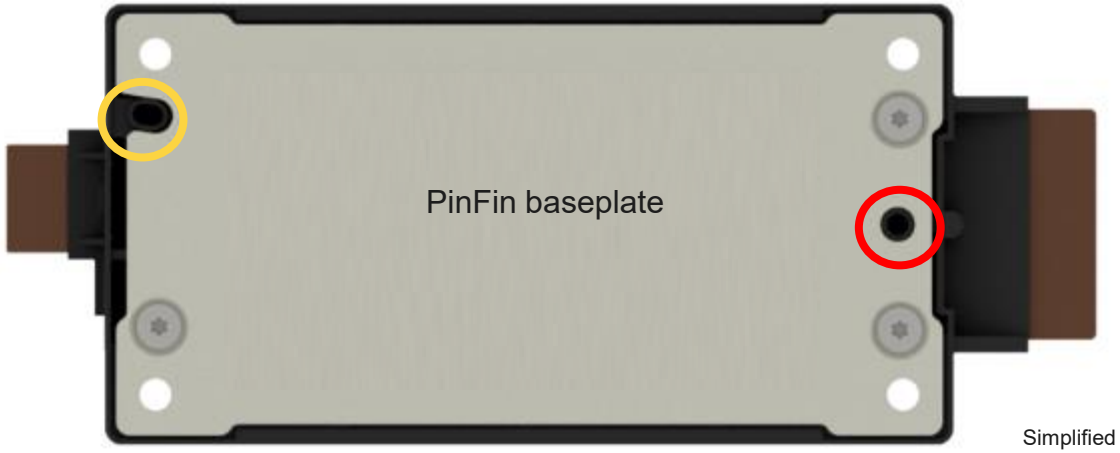
Fixing stand-off for PCB/GDU
+ Reference for PressFIT

Optional for dowel pin / reference pins.
Reference 1 for the module alignment on cooling surface

Optional for dowel pin / reference pins.
Reference 2 for the module alignment on cooling surface



HybridPACK(TM) HD power module



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HybridPACK™ HD - Mounting Features

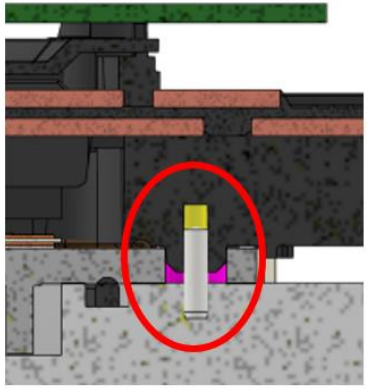
Optional for dowel pin / reference pins. Reference 1 for the module alignment on cooling surface

Optional for dowel pin / reference pins. Reference 2 for the module alignment on cooling surface



Optional dowel pin for reference and guiding





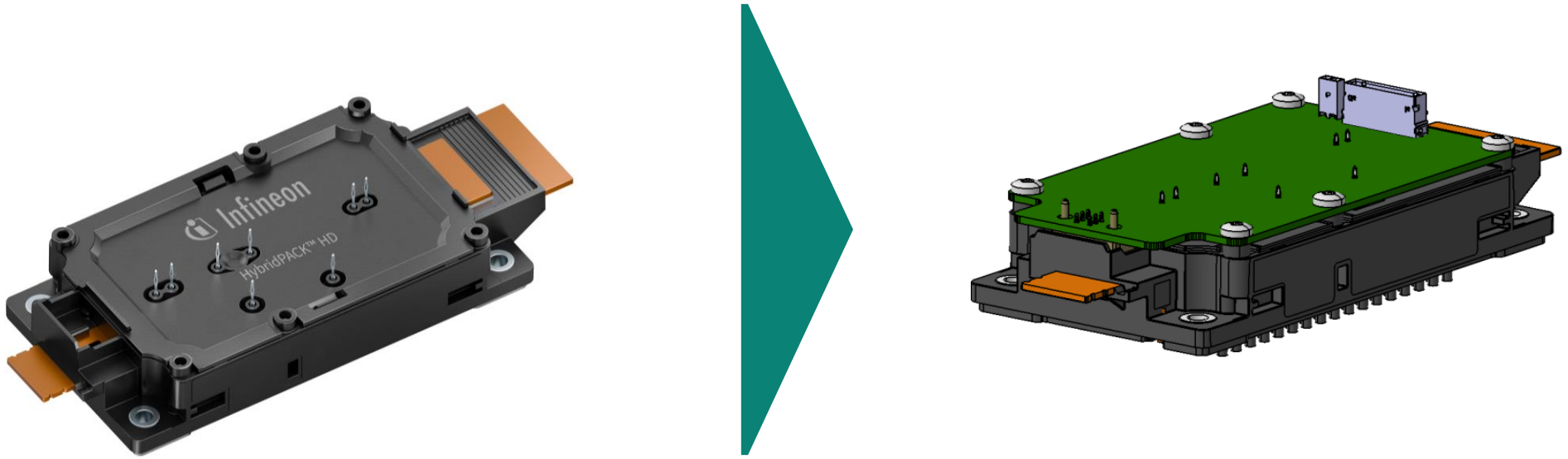
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HybridPACK™ HD
PressFIT Assembly Consideration

HybridPACK™ HD – Pre-Assembling Power Module



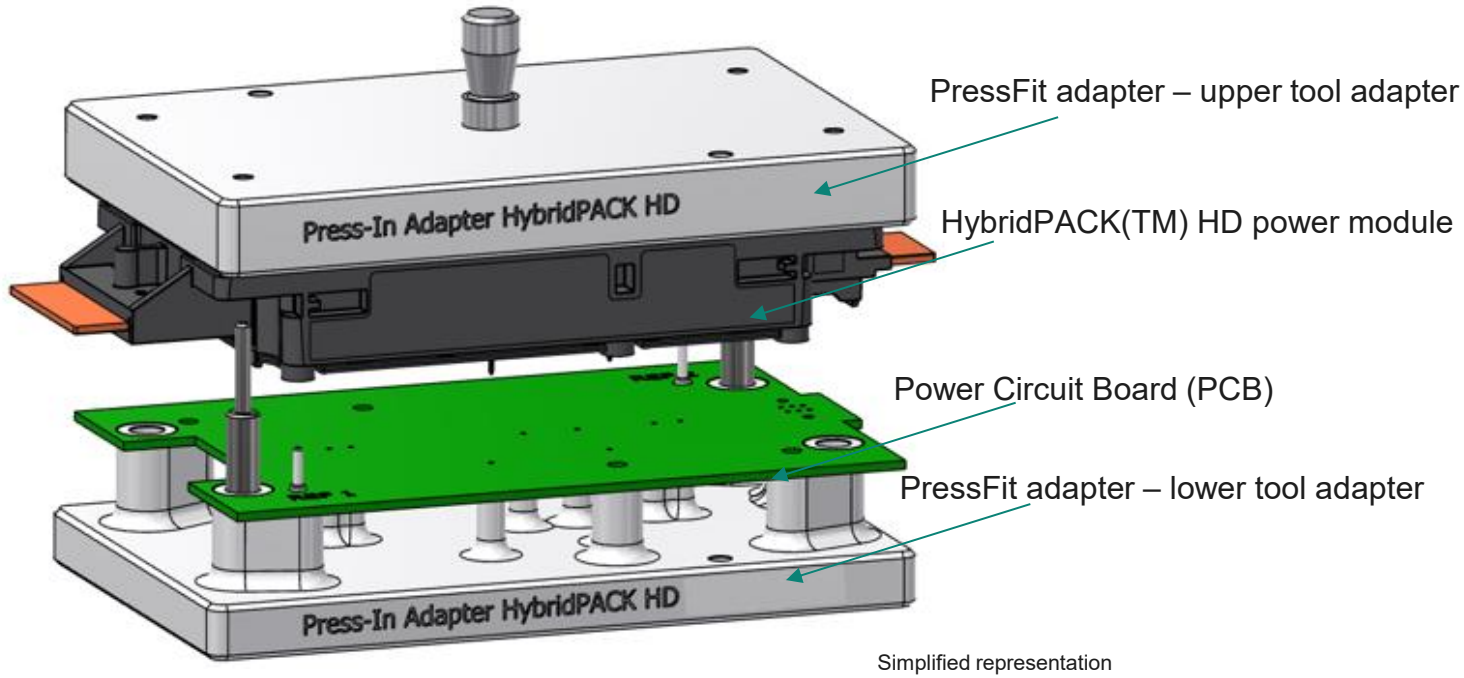
Simplified representation

- Infineon offers tools and services to support the design-in process for Infineon power semiconductor modules. The adapters and tools depicted in this document are intended solely to provide basic, qualitative results and to visually document assembly guidelines.
- Adapters and tools—such as those exemplifying the requirements for integrating a series production PressFIT process for Infineon power semiconductor modules—must be developed by the user, under their own responsibility, in accordance with their specific requirements.

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HybridPACK™ HD – Pre-Assembling Power Module



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HybridPACK™ HD – PCB requirements for the PressFIT technology

The PressFIT technology used in the Easy modules has been inspected and qualified by Infineon Technologies AG for standard FR4 PCBs according to the IEC 60352-5 and IEC 60747-15 with “chemical tin” and a hot-air-leveling (HAL) surface. Infineon recommends the use of chemical tin metallization. The qualification tests were done on standard FR4 material, which is complaint with the requirements of IEC 61249-2-7.

If other handling technologies are to be used in the production of PCBs, they have to be checked, tested and qualified.

Table 1 Requirements for a PCB

	Minimum	Typical	Maximum
Hole drill diameter	1.12 mm	1.15 mm	
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 conductive layers	35 µm	70 µm 105 µm	400 µm
Metallization of circuit board	Tin (chemical) recommended		
Metallization of pin	Tin (galvanic)		

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

If the specification of PressFIT holes is limited to only the finished dimension (i.e., the metallized hole), different drill sizes could be used depending on the PCB manufacturer and production philosophy, and also different metallization thicknesses could be provided. This would lead to results 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. If the end hole diameter is too small, the press-in force can be too high. The FR4 material can also have an influence on the press-in force.

The recommendation still applies that the hole in the PCB is to be drilled during manufacturing with a drill size of 1.15 mm, and should not be milled. Experience has shown that a drill 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, considering the drilling diameter, copper thickness and a chemical tin layer, is typically between 1.02 mm and 1.09 mm.

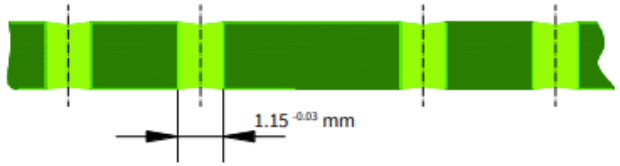
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HybridPACK™ HD – PCB requirements for the PressFIT technology

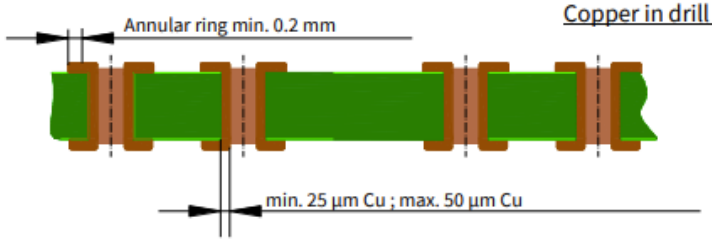


Drill hole



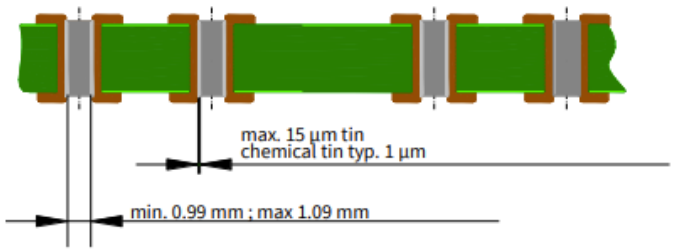


Copper in drill hole





Final hole diameter



The PressFIT technology has been qualified for FR4 PCB material.

After a reflow soldering process is carried out on a PCB, 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 5 mm is recommended.

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

A module that has been pressed in, and the contact pressed out again, can no longer be pressed back in again. Instead, the module can only be attached to a new PCB via soldering. The plastic deformation of the PressFIT area does not permit a further PressFIT process.

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HybridPACK™ HD – PressFIT Process Introduction

The PressFIT modules are inserted into a printed circuit board by using the press-in technology. PressFIT can be performed by using a toggle lever press or a machine. A press-in tool that records the applied force and the travel distance is strongly recommended to monitor the press-in process. Consistent quality and reproducibility are assured in this way.

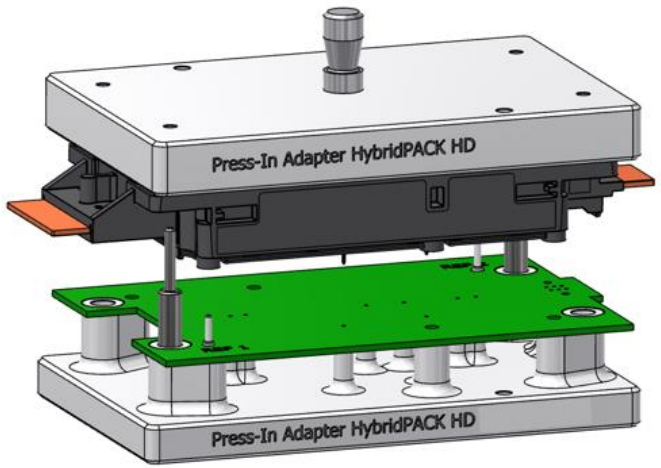
The press-in force is related to the retention force and the quality of the press-fit connection (electrical resistance and reliability). The PressFIT speed for standard tests is between 25-50 mm/min according to IEC 60352-5. A PressFIT speed of under 25 mm/min can lead to increased press-in forces and a deformation of the pins, or to a connection that is not gas-tight. Infineon recommends a press-in speed of about 100 mm/min. The typical press-in speed for automated assembly lines is up to 450 mm/min.

Note that during the press-in process, the position of the PCB 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 PCB in a regular motion. The module pins should penetrate the PCB during press-in until the four stand-off holes of the module, or optional distance spacers, as described in Multi-modules on a PCB (chapter 11.3), contact the board.
To limit the force at the end of the press-in process, distance spacers such as dowel pins can be implemented at the bottom tool of the press-in tool.
If the principles listed above are adhered to, a smooth insertion process for the two components can be
achieved

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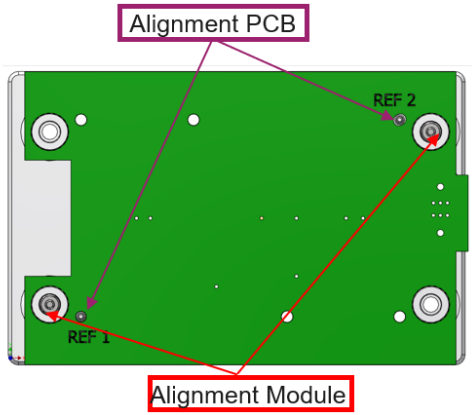
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HybridPACK™ HD – Simplified representation of a recommended PressFIT sequence



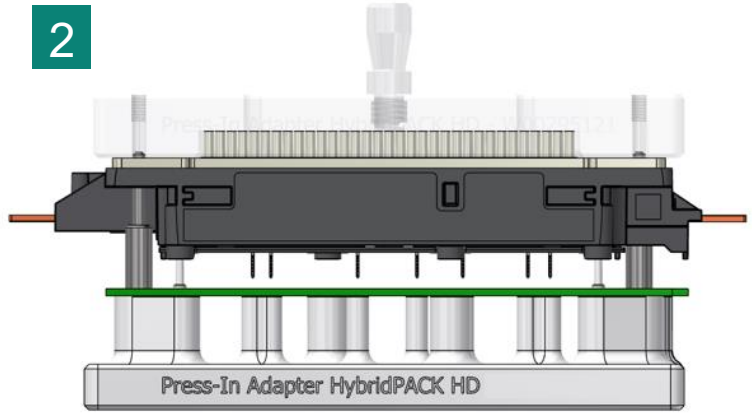
Insert PCB into the press-in adapter and alignment via centering pins REF 1 and REF 2

1



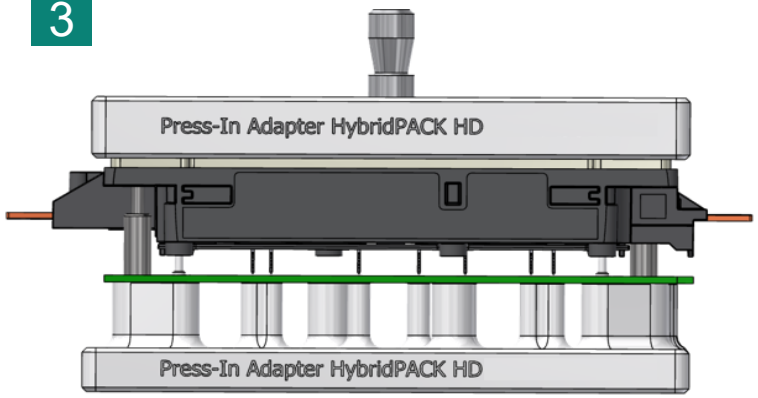
Pre-centering the modue and the press-in adapter

2



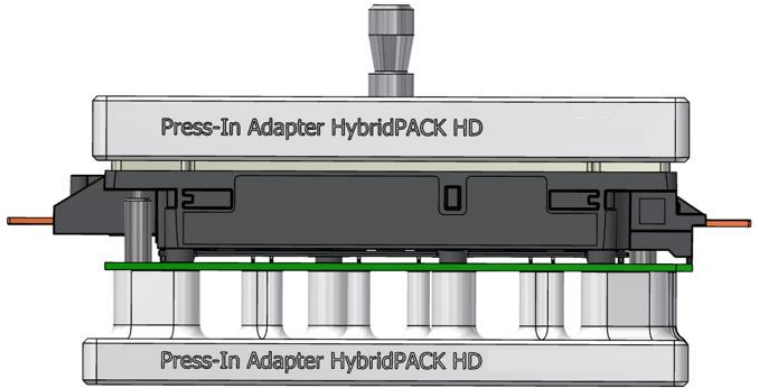
Centering the module via PCB screw domes (before Press Fit pins are in contact)

3



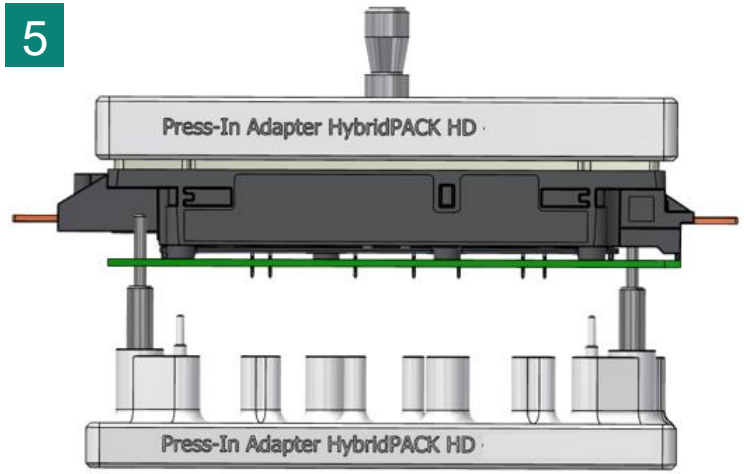
Press down with force controlled press

4



Open the tool and eject the module with the PCB

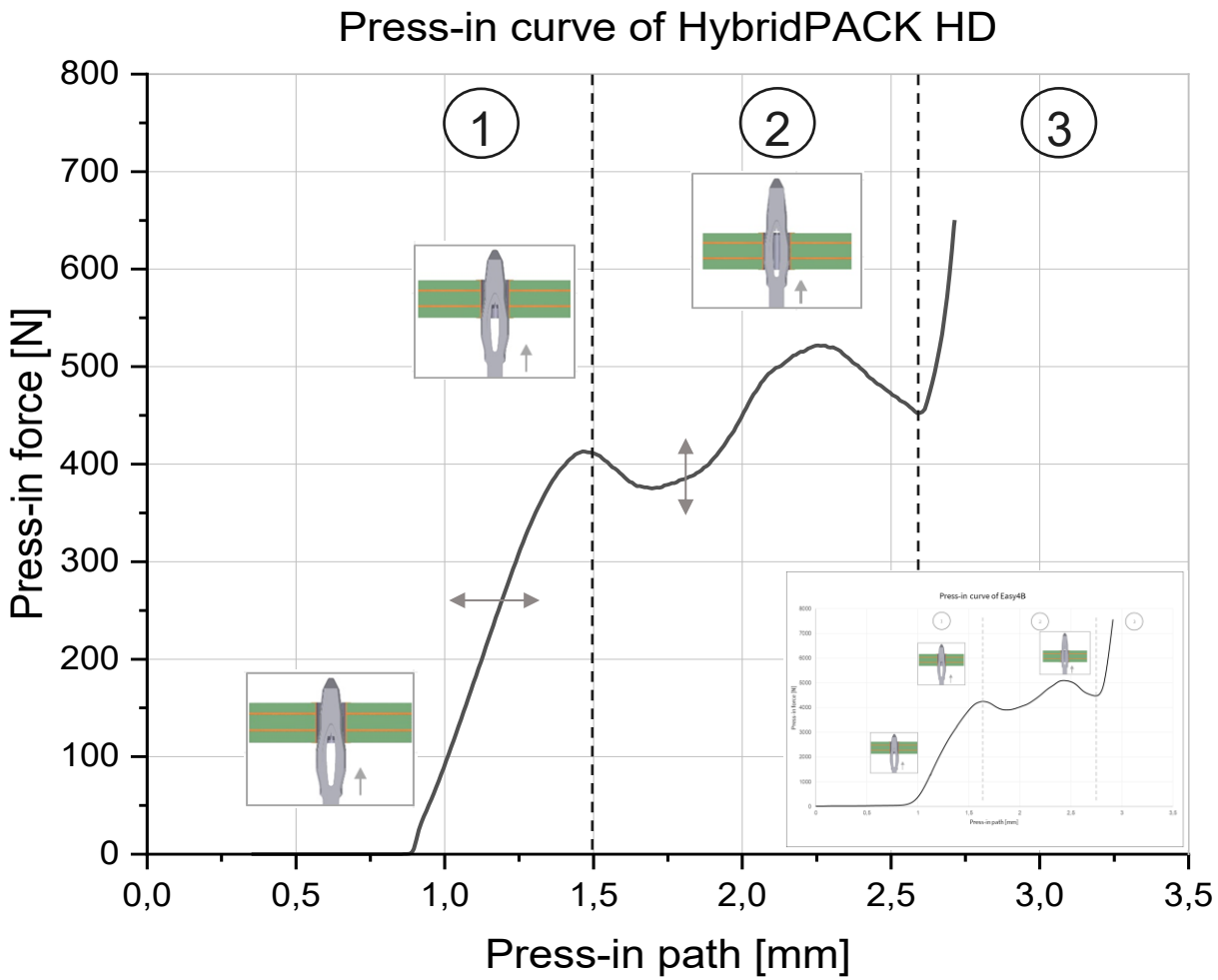
5



Simplified representation

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HybridPACK™ HD – Exemplary Press in force diagram and basic hints



- The fundamental expected profile of the press-in forces, forces=f(press-in path), is exemplary illustrated in the diagram.
- This diagram encompasses all the characteristics that the module with its PressFIT aux pins may exhibit during the press-in process and can be used as a basic indication.
- The resulting press-in forces fundamentally depend on various other parameters and boundary conditions, such as the finished hole diameter of the printed circuit board, the material, the quality of the surface finish, the press-in speed, and other factors.
- Based on those variation of parameter in individual PressFIT components a slight shift in X and Y direction of the press-in force may observe.
- The depicted press-in curves apply in the absence of the plug-in current sensor module.

NOTE: It must be ensured, via the fixture, that the pin is properly aligned with the PCB hole to prevent risk of non proper PressFIT connection and/or pre-damages at the module pin or the PCB.

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HybridPACK™ HD – PressFIT basic hints

The first phase indicates the beginning of the PressFIT zone within the plated trough holes of a PCB. The PressFIT zone first comes in contact with the plated through hole of the PCB, and is then deformed to a certain extent by the plated through holes when the module is pressed down. At this moment, the press-in force increases evenly.

The first curve peak is caused by the geometry of the PressFIT zone. Depending on the metallization, stiffness and especially the final diameter of the PCB hole, this peak is more or less pronounced in the curve. The smalle the holes, the more visible this peak will be. Furthermore, a small diameter hole leads to a steep rise in the press-in force.

In the second phase, the press-in force decreases until the second peak is reached. At this point, the PressFIT pins are pressed to the final position with the widest circumference of the PressFIT pin, and subjected to the maximum permissible deformation. The press-in contact zone is then completely within the plated through hole of the PCB.

The subsequent third phase is generated by the contact of the distance keeper with the PCB. In this example, the effective part of the press-in process is successfully completed at the slope change, at about z = 2.7 mm.

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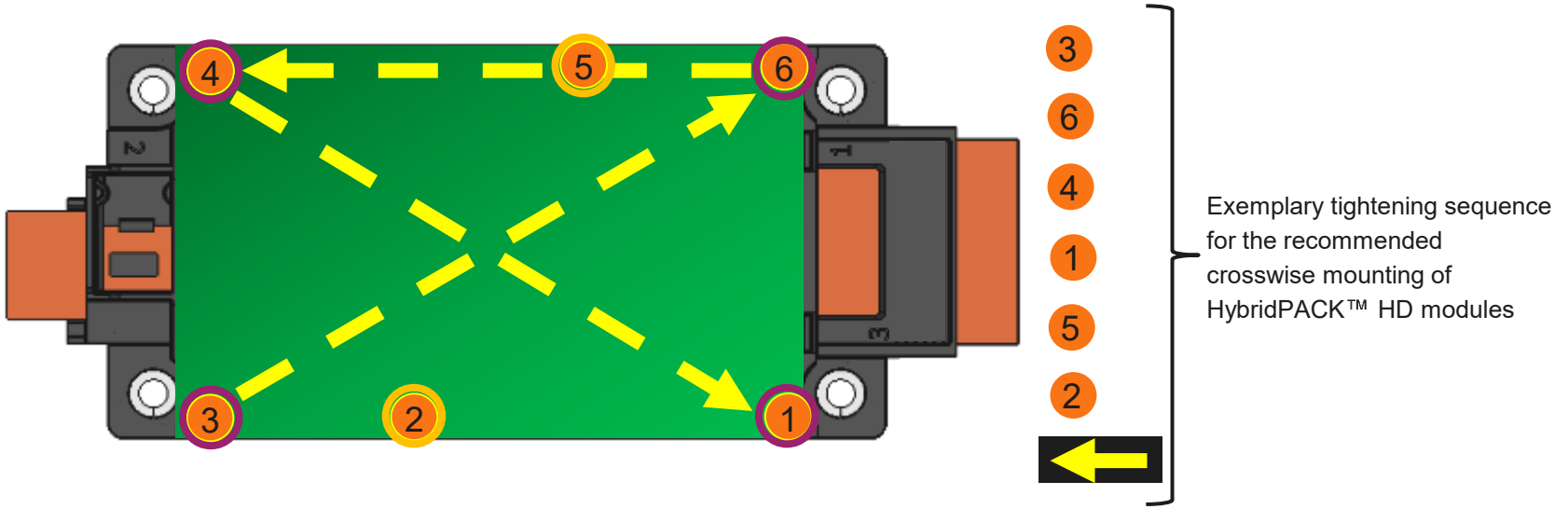
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HybridPACK™ HD – Recommended Sequence for Gate Driver Board Mounting

The power module PCB screw stand-off are designed for self tapping Screw Type: EJOT Delta PT WN5451 30x10

Stand of 2 and 3 fixing stand-off for the PCB/GDU

Stand off 1; 3; 4; 6 used for fixing for the PCB/GDU
+ reference for PCB/module position for alignment for the press-fit process.
Diagonally arranged standoffs are to be used for alignment.
e.g. 1 and 4.



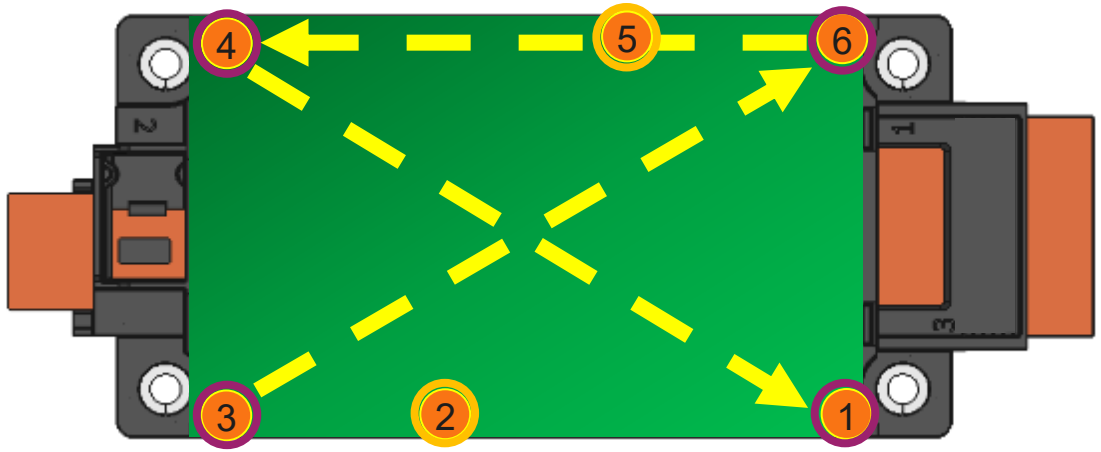
- An electronically speed controlled screwdriver is the preferred aid for this purpose.
- Due to the lack of accuracy, the use of a pneumatic screwdrivers is not recommended.
- The initial 1.5 mm (approximately) of the mounting stand-off, which can be seen in the drawing, serve as guidance and cannot take any force.
- 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.
- Within the screwing process there are no pauses recommended, like screw tightening in several steps.
- The max length of the self tapping screw thread entering the mounting stand-off should be a maximum screw in depth of 8.5mm
- Furthermore, a straight insertion of the screw into the stand-off must be observed during assembly.

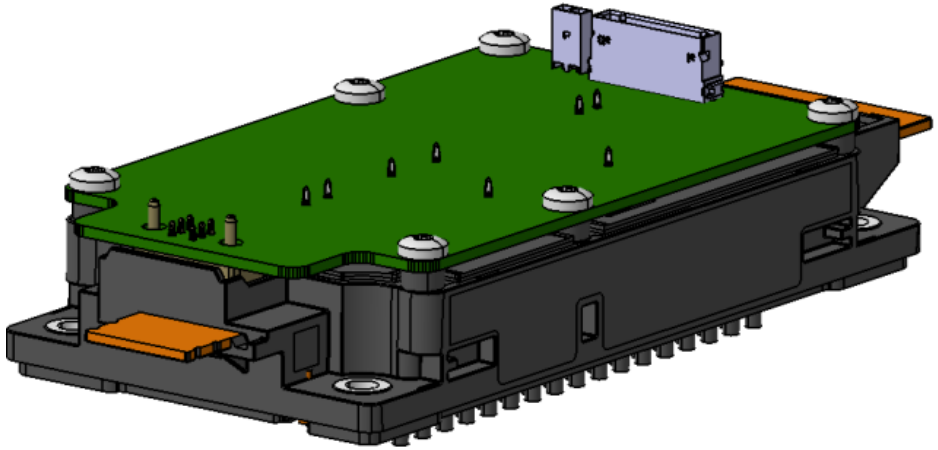
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HybridPACK™ HD – Pre-assembling Power Module





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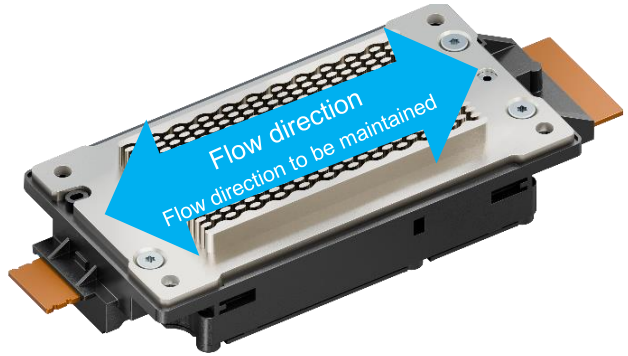
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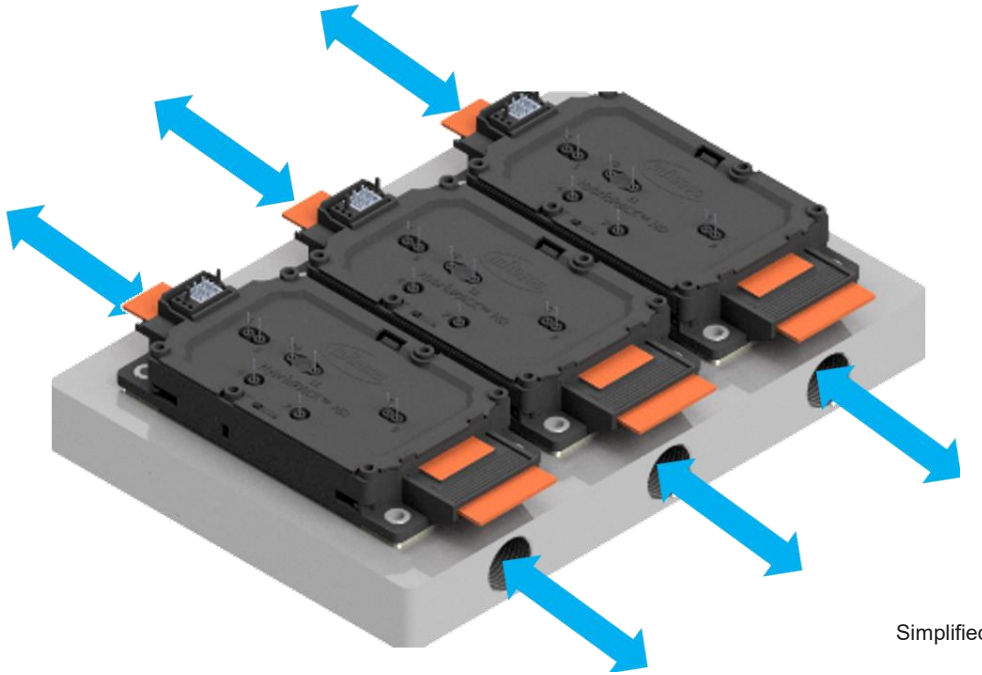
HybridPACK™ HD
Cooling and Heatsink Assembly Consideration

HybridPACK™ HD – General Hints for the Cooling System

The module power losses must be dissipated in order not to exceed the maximum permissible operating temperature specified in the datasheet. Therefore, the design of cooling system/heat sink is of great importance. The HybridPACK™ HD has an optimized PinFin array on the baseplate, which makes liquid cooling very effective. The baseplate is made of copper (Cu) material with a nickel (Ni) plating. The PinFin structure is suitable for cooling fluids like water ethylene glycol mixture. The fluid mixture requires also an appropriate corrosion protection.



Simplified representation



Simplified representation

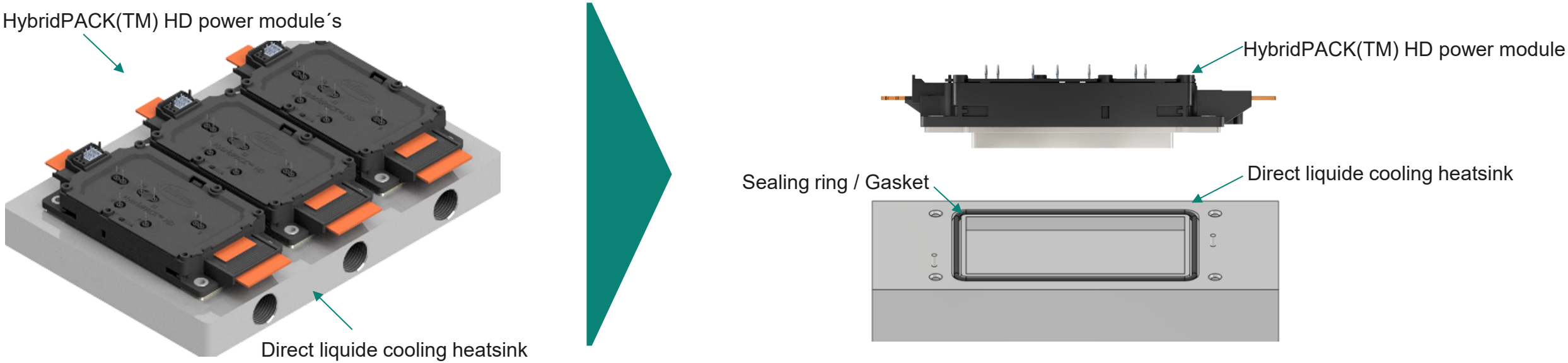
The optimized PinFin structure of the module baseplate supports the flow direction from the short side of the module to the opposite short side of the module. This flow direction for each individual HybridPACK™ HD in the system will result in the parallel flow direction. For the maximum pressure in the cooling circuit and the pressure drop in cooling circuit refer to the valid datasheet.

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HybridPACK™ HD – General Hints for the Cooling System

- Infineon offers tools and services to support the design-in process for Infineon power semiconductor modules.
- The HybridPACK™ HD power module baseplate is designed with a flat region at the base plate surrounding the entire PinFin area, which is called the sealing area.
- This sealing area is required to seal the interface between the module baseplate and the heat sink—as well as the cooling system—using a suitable seal, thereby preventing leakage.
- For module tests an EPDM gasket from the company Hutchinson with the compound number 15549 were used. The exemplary defined gasket, used for the sealing of the HybridPACK(TM) HD power module, are intended solely to provide basic, qualitative test results
- The depicted gasket in the pictures do not represent any gasket recommendation. They are intended to visually document assembly guidelines only.
- Gasket and sealing rings, such as those exemplifying the requirements for the application and integrating a series production manufacturing processes for Infineon power semiconductor modules, must be developed by the user, under their own responsibility.



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HybridPACK™ HD - Module assembly onto the heatsink

The module assembly must comply with the tolerances specified in the module datasheets. Module-specific outline drawings can be taken from the datasheets. For the nominal dimensions of the module threaded holes in the heat sink, it is recommended to consider a tolerance of ± 0.1 mm.

Bolt mounting of the module onto the heatsink has to be done in such way that the sum of all the occurring forces does not exceed the yield point of the material of the joined parts. Setting devices, such as spring washers, increase the elasticity of the connection and can compensate for the settling effects. Thereby, the pre-tension force is largely retained, and any loosening of the assembly is counteracted.

Note: Loosening of the module screws due to thermo-mechanical load during operation must be avoided.

Threads have to be clean and not lubricated or contaminated. When screwing to the heatsink, the minimum screw length has to be chosen depending on the heatsink, the thickness of the selected washer, and toothed or spring washers.

All mounting screws have to be uniformly tightened with the specified mounting torque. A preferred tool for this is an electronically controlled, or at least slow moving, electrical screwdriver. The work can also be accomplished manually using a torque wrench. Pneumatic screwdrivers should not be used because of their lack of accuracy and precision.

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HybridPACK™ HD
Technical data of the mounting bolts for the Module assembly onto the heatsink

Description	Value	
Mounting bolt	M4	(1)
Recommended torque	Refer to the module datasheet	(2)
Recommended property class of the bolt	≥ 8.8	
Minimal thread length into the heatsink	1.6 – 2.2 *d	(3)

1. According to ISO4762, DIN6912, DIN7984, ISO14581, or DIN7991 in combination with a suitable washer and a toothed washer. For example, according to DIN433 or DIN125 or a complete combination bolt according to DIN6900 is recommended for module assembly.

2. Threads should be clean and not lubricated or contaminated by thermal grease.

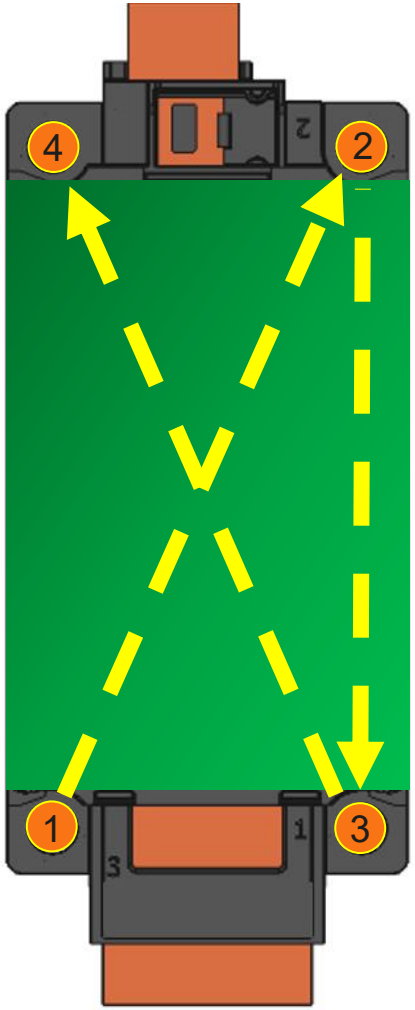
3. Into aluminum – according to technical literature depending on the material properties of the heatsink and the screw, d = diameter of the bolt.

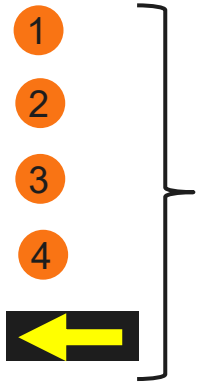
Other material combinations of bolts and/or heatsink material may require adjusting the mechanical parameters and evaluating the corrosion stability. The module mounting bolts are to be tightened evenly crosswise with a torque within the specified limits.

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HybridPACK™ HD
Recommended Sequence for the Module assembly onto the heatsink





Screw positions and the recommended cross wise sequence for the two steps fixing process.

For the best thermal contact between the module and the heatsink, the following procedure is recommended when tightening the bolts:

1. Place the module with the pre-assembled GDU-PCB to the pre-assembled cooling plate, after the recommended gasket is applied, onto the clean heatsink and fix it by inserting two screws approximately until half their length.
2. Follow by the other screws also to approximately half their length.
3. Tighten all screws crosswise hand-tight (~0.5Nm) in the sequence: bolt 1 - 2 - 3 - 4
4. Tighten bolts crosswise with the recommended torque (2Nm) specified in the datasheet in the same sequence. For example, bolt 1 - 2 - 3 - 4

Exemplary tightening sequence for the recommended crosswise mounting of HybridPACK™ HD modules

Simplified representation

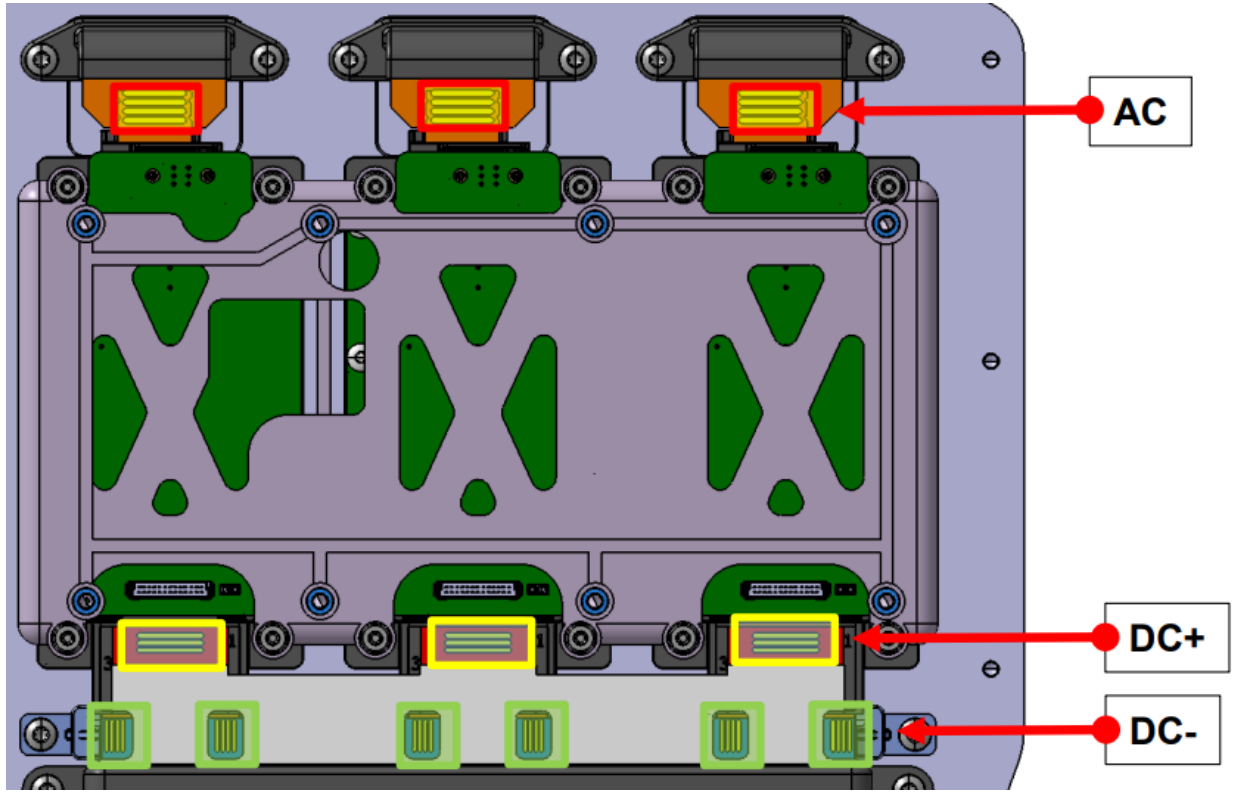
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HybridPACK™ HD
Busbar Consideration

HybridPACK™ HD – Basic Recommendation for laser welding module power tabs

The HybridPACK™ HD power connections, thickness=1.5mm, are designed for a laser welding connection. For the laser welding process, follow the standard procedures and safety instructions.



Simplified representation

- For the design-in of a module into a system, note that a minor share of the power semiconductor's power losses and a significant share of the internal busbar losses can be transferred through the power terminals
- Depending on application requirements, the user must individually and independently determine the welding surface area required for the module's load connection to the external busbar to ensure adequate current-carrying capacity.
- A low-inductance DC bus bar connection must be provided to ensure a switching-optimized design. Applicable standards regarding clearance and creepage distances must be taken into account and adhered to.

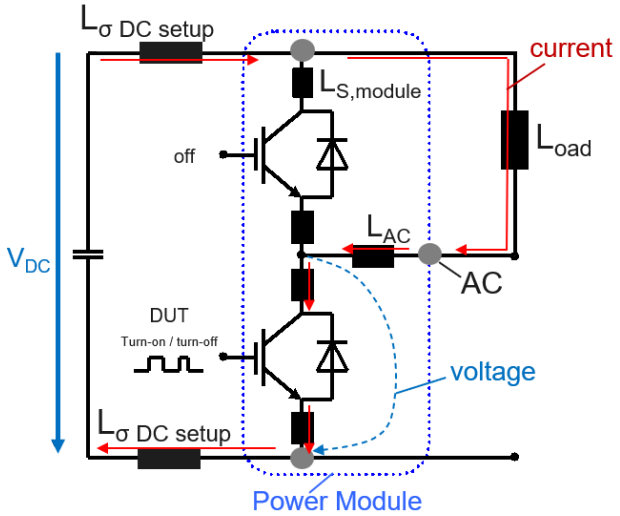
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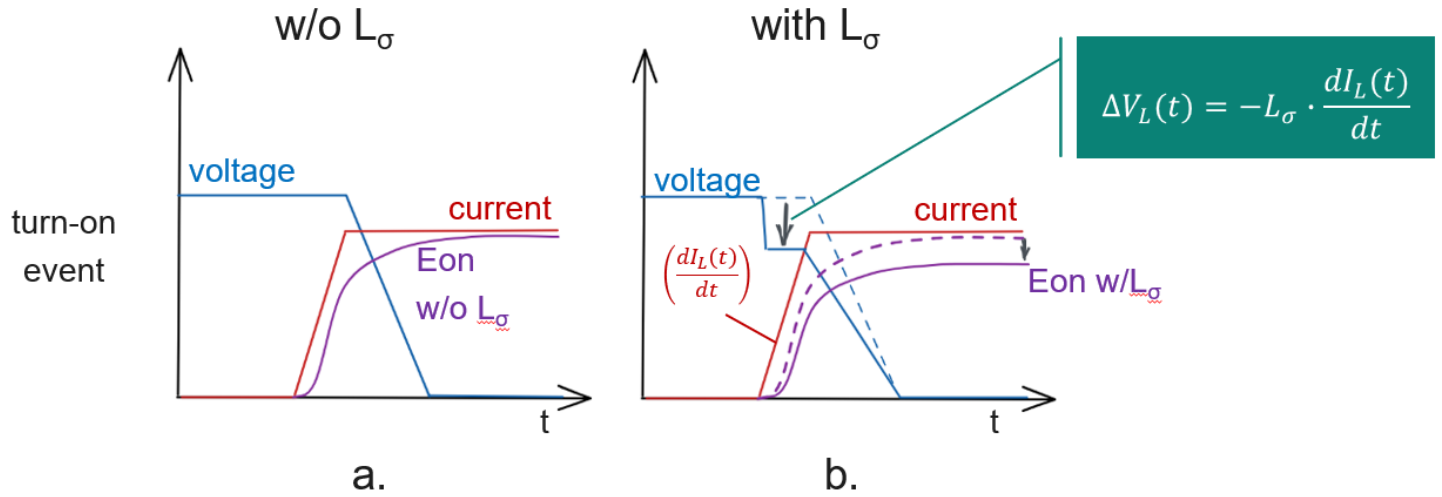
Application tips and recommendations - Basic switching tips
Turn-on

Dynamic behavior and thus energy per pulse strongly depend on a variety of application-specific operating conditions such as gate driving circuit, layout, gate resistance, magnitude of voltages and currents to be switched, and the junction temperature. Therefore, the datasheet values provide an indication of the switching performance of the power module under nominal conditions.

For a design-specific loss determination, experimental investigations in the final target setup are necessary.
A simplified equivalent circuit diagram of a power module in a test setup and a simplified example of turn-on and turn-off events are depicted and the influence of different system stray inductances (Lσ) are illustrated.







Total system stray inductance: Lσ = LS,module + Lσ,DC setup

a. A simplified example of an ideal turn-on event without the influence of Lσ
b. A simplified example of a turn-on event with the influence of Lσ

During a turn-on event, an increased Lσ causes a voltage drop. Due to this reduced voltage across the semiconductor during switching, the resulting E_{on} loss decreases (E_{rec} is neglected).

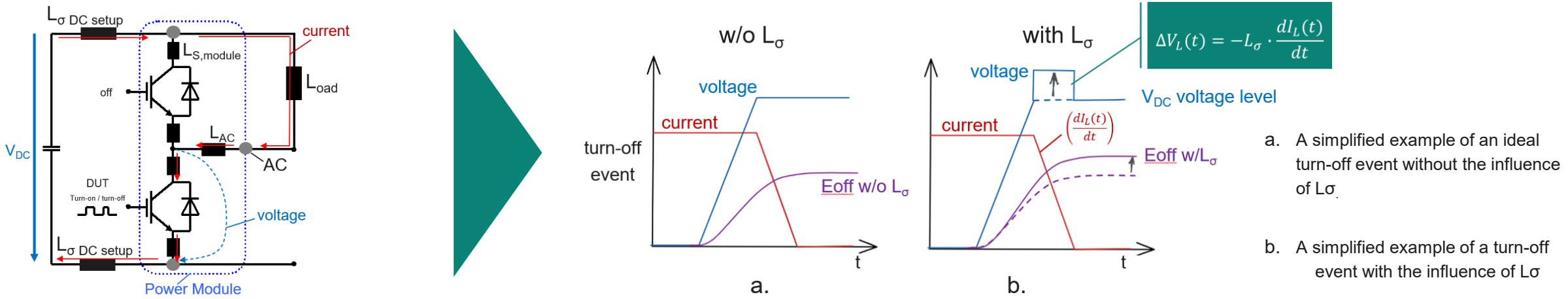
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Application tips and recommendations - General switching tips
Turn-off

In a turn-off event, a stray inductance (Lσ), as can be expected in a real setup, causes a voltage overshoot. Due to this increased voltage across the semiconductor during switching, the resulting E_{off} loss is increased (E_{rec} is neglected),



a. A simplified example of an ideal turn-off event without the influence of Lσ.

b. A simplified example of a turn-off event with the influence of Lσ

Total system stray inductance: Lσ = LS,module + Lσ,DC setup

di/dt in combination with the total leakage inductance reduces the voltage at the switch when turning on but increases the overvoltage at the switch when turning off.
In addition to the influence on switching losses, the speed of switching on and off, the occurrence of the switch-off behavior, and oscillations (EMI) are also becoming increasingly important. Parasitic leakage inductances play an important role.

Module or switch optimizations designed for high system stray inductance are meant to meet higher softness requirements. This function comes at the expense of higher switching losses during the same operation.
Especially when using fast-switching devices such as SiC MOSFETs, a DC link design optimized for low inductivity becomes more important for achieving an optimized setup.

Note: For the DC link inductance, the lower the better is a simple rule for high-efficiency designs
Note: To determine switching losses, measurements in the final DC link design are essential

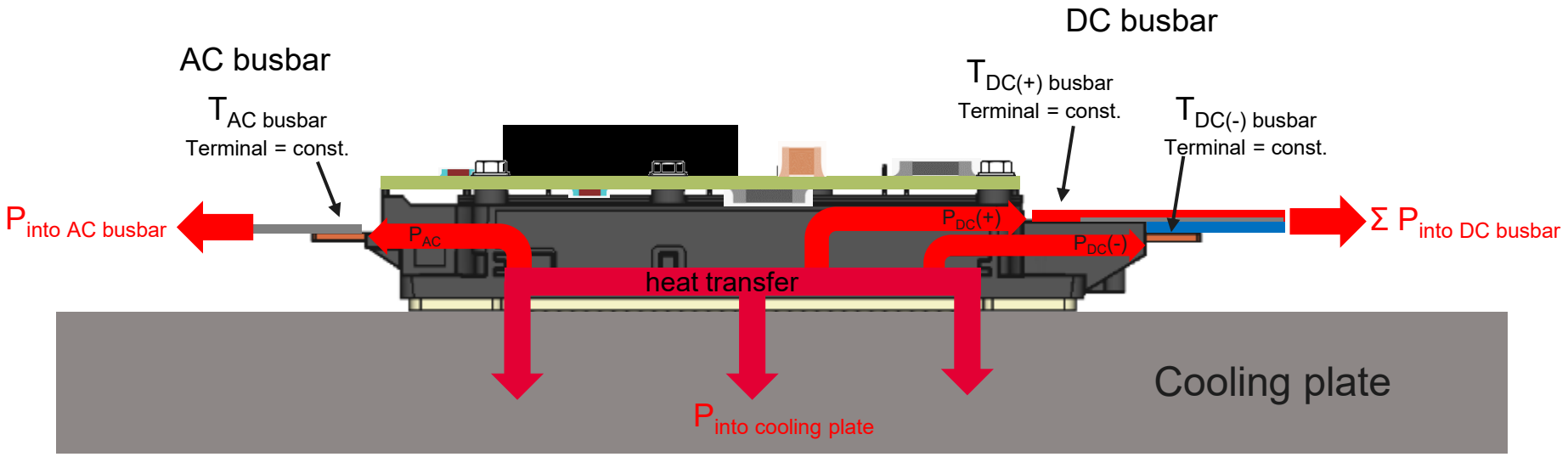
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HybridPACK™ HD
Definition of power loss flow from terminal conciderations

For the design-in of a module into a system, note that a minor share of the power semiconductor's power losses and a significant share of the internal busbar losses can be transferred through the power terminals. The terminal losses may result in a rise in the terminal temperature increases. Its effect on the lifetime of the joint, the insulation of the internal and external busbar, and maybe on the connected DC-link capacitors has to be considered. The figure shows a simplified representation of a possible heat transfer.



Simplified representation

HybridPACK™ HD housing is **supporting high currents** up to @ RTI = 220°C

The P_{DC} and P_{AC} losses needs to be concidered while the system design.

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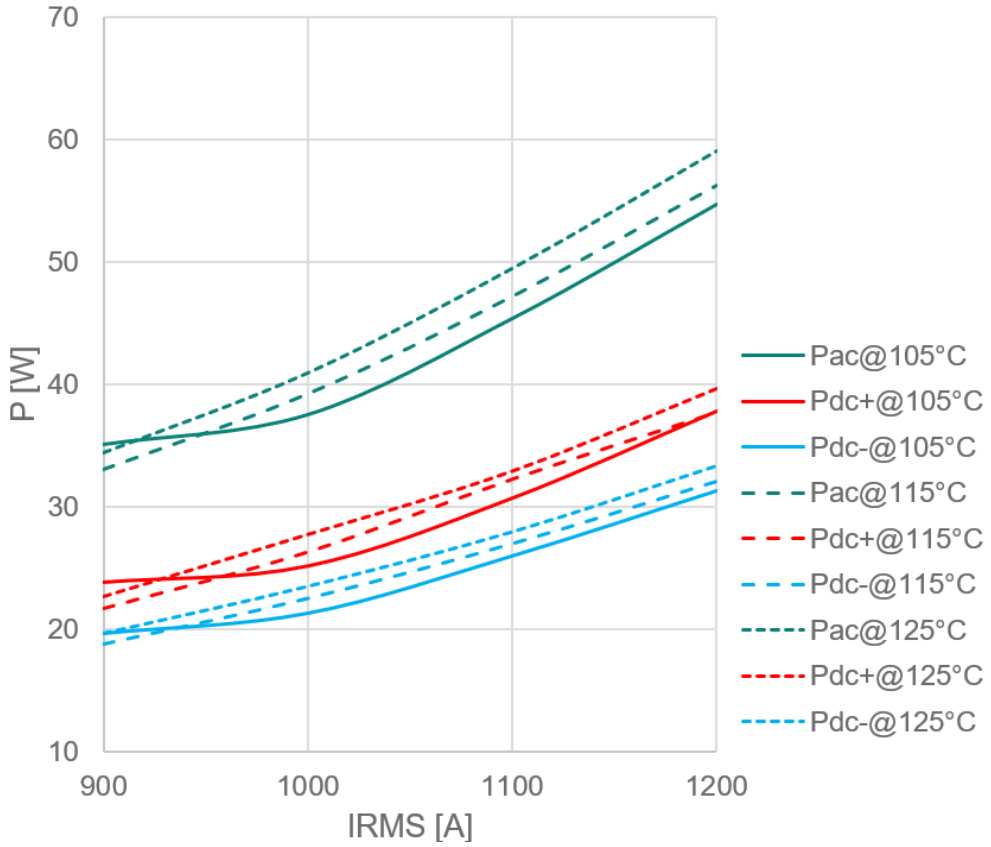
HybridPACK™ HD
Dissipated power from terminal conciderations 900Arms – 1200Arms

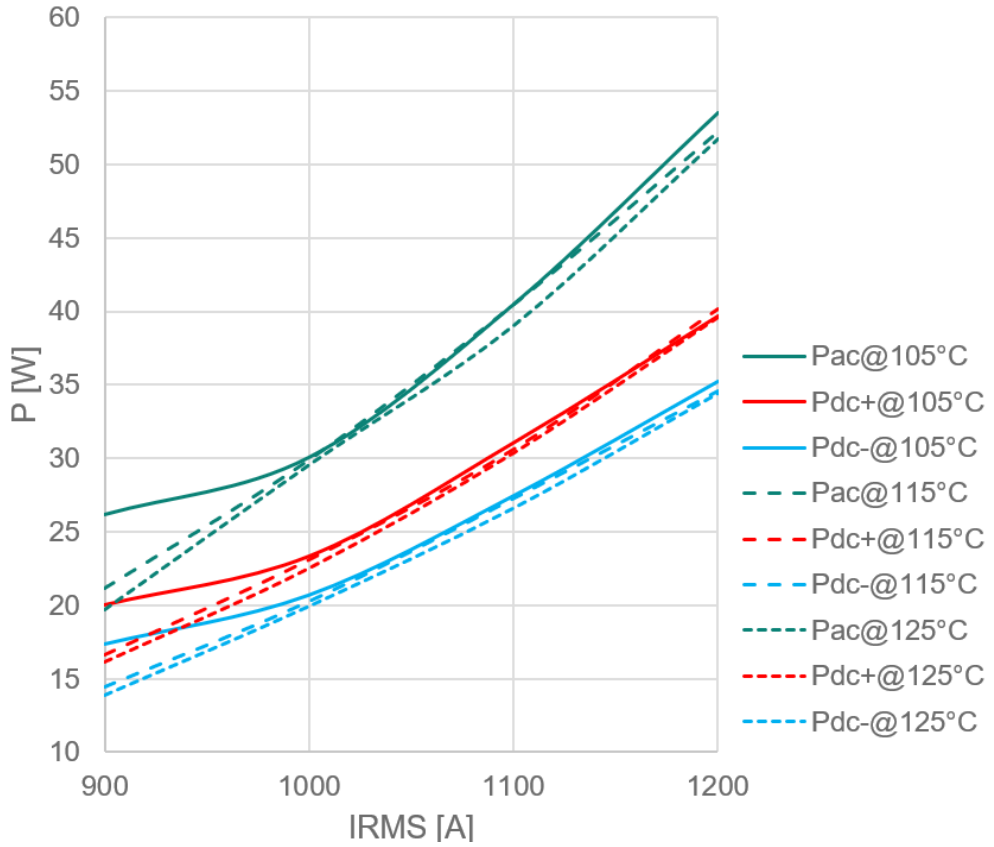
An exemplary simulation of the heat flow under the defined conditions leads to the results shown in the graph. The heatsink temperature and the terminal temperature are defined with constant values. The module components with their current carrying capacity and insulation properties are designed for these conditions.

For other operating conditions, the thermal situation needs to be evaluated individually.

$105°C \leq T_{busbar} \leq 125°C$

selected worst case conditions





The application conditions are arbitrarily selected.

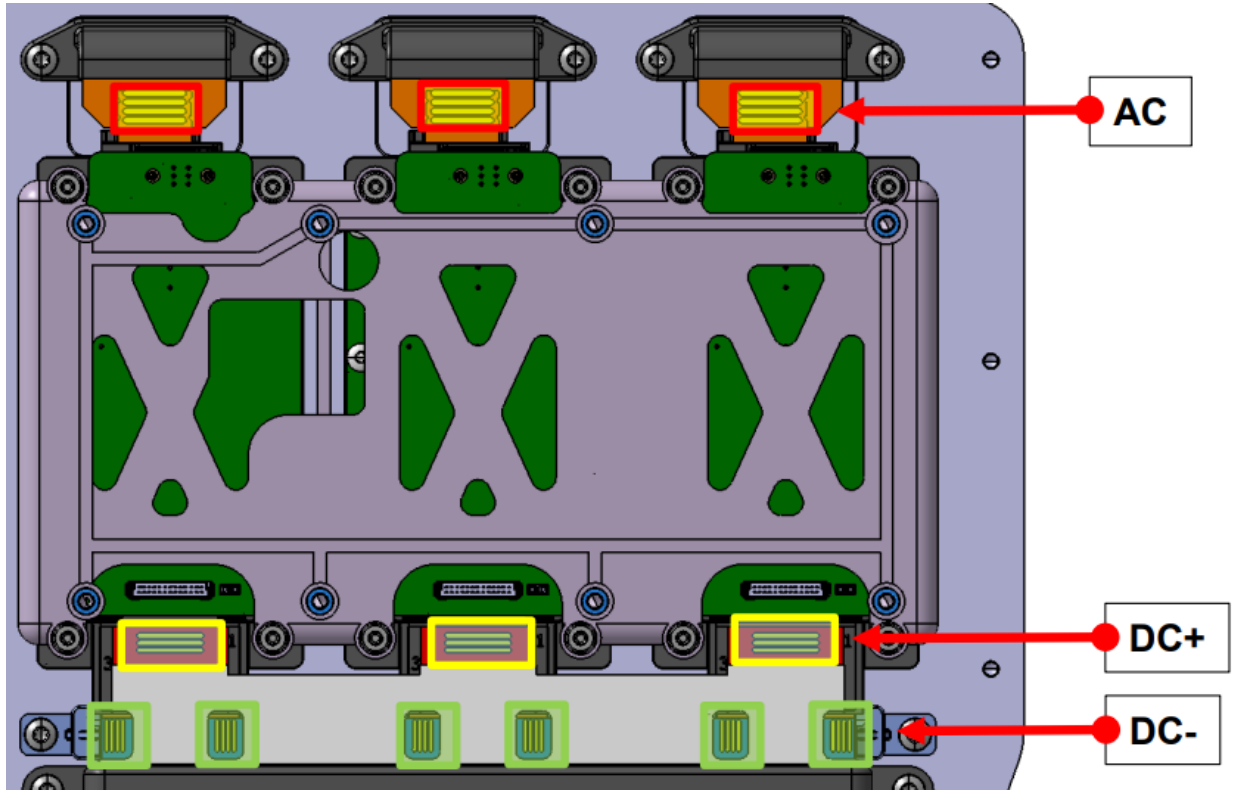
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HybridPACK™ HD
Busbar Laser Welding Consideration

HybridPACK™ HD – Basic Recommendation for laser welding module power tabs

The HybridPACK™ HD power connections, thickness=1.5mm, are designed for a laser welding connection. For the laser welding process, follow the standard procedures and safety instructions.



Simplified representation

- Depending on application requirements, the user must individually and independently determine the welding surface area required for the module's load connection to the external busbar to ensure adequate current-carrying capacity.
- The user is responsible for qualifying and implementing the integration of the laser welding process into the series production of the complete system in accordance with the specifications of the manufacturing concept.

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HybridPACK™ HD
Basic Recommendation for laser welding of the module power tabs

Basic recommendations for laser welding the power terminals on the HybridPACK™ HD modules:

1. Shielding concept for frame-based power modules focusing on flexibility. Full cover mask to be independent from laser welding equipment
2. Variation of copper tab thickness up to 1.5mm (ratio of joining partners 1:1
3. Surface:
    - A not coated surface bare Cu surface is recomended.
    - Recommended copper alloys for external busbars are
        - cw004a (Cu-ETP)
        - cw008a (Cu-OF)
        - cw020a (Cu-HCP)
    - Analyze the influence of possible layer like oxide and/or possible contamination from metal treatment processes for a proper welding quality.
4. It is recommended to use welding speeds of approx. 300mm/s, in order to reduce the heat transfer per area. For laser welding speed a proper laser welding power is required. Laser Power ≥ 8kW is recommended.
5. It is recommended to weld the two joining partners, the external AC and DC busbar´s and the module power tab´s, without any gap between. To prevent those gaps between the joining partners, they must be pressed together. During assembly, the tensile and compressive forces acting on the power contacts during the joining and pressing of the parts to be welded must not be exceeded.
6. Focus on pores, voids and cracks in weld seam
7. Perform visual inspection, including high speed camera, USM, cross sections and weld depth measurement, Optical Coherence Tomography (OCT)
8. Further information can be used from the ISO 13919-2

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HybridPACK™ HD
Maximum forces at the terminals during the assembly process

The connecting parts must be mounted onto the electrical contacts such that the specified maximum permissible forces are not exceeded during the assembly process.



The force specifications are valid independently for each respective direction, without the need to apply a counterforce.

Ta=RT

Simplified representation

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Revision history

Document revision	Date	Description of changes
0.1	2026-06-05	Initial Version

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