# EconoPACK™ and EconoPIM™ Series

## Application and Installation Notes

## About this document

### Scope and purpose

**This application note provides a guideline how to use and implement Econo modules.**
**This Application Note includes the necessary technical information for users to realize a smooth system design with EconoPIM™ and EconoPACK™ modules. It is recommended to read through this document before starting the design with Econo modules.**

### Intended audience

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

## Table of Contents

**About this document** ..... **1**
**Table of Contents** ..... **1**
**1 General** ..... **3**
**2 Delivery quality** ..... **4**
**3 Module storage and transport** ..... **5**
**4 IGBT modules are electrostatically sensitive devices (ESD)** ..... **6**
**5 Module identification** ..... **7**
**6 Module selection** ..... **8**
6.1 Selecting the module voltage class ($V_{CES}$) and high-altitude module operation ..... 9
6.2 Climatic conditions in the active, current-carrying operation of EconoPACK™ and EconoPIM™ modules ..... 11
**7 Module clearance and creepage distances** ..... **12**
**8 Mounting a PCB onto the IGBT module** ..... **13**
8.1 Contacting the board with PressFIT pins ..... 13
8.2 Contacting the board with solder pins ..... 13
8.3 Soldering EconoPIM™ and EconoPACK™ modules ..... 14
8.4 Mechanical relief on the PCB ..... 14
**9 Mounting the module to the heatsink** ..... **17**
9.1 Condition of the heat sink for module mounting ..... 17
9.2 Thermal Interface Material ..... 18
9.2.1 Infineon Thermal Interface Material – IFX TIM ..... 18
9.2.2 Applying standard thermal grease using the stencil printing method ..... 18
9.2.3 Alternative method for applying standard thermal grease ..... 20
9.3 Mounting the module to the heat sink ..... 21
**10 Use under vibration and shock loads** ..... **24**
**11 References** ..... **25**

**Revision History .....26**

- ΕχονοΠΑΧΚ□ ανδ ΕχονοΠΙΜ□ Σεριεσ

# 1 General

EconoPACK™ and EconoPIM™ series power semiconductor modules are electrical components.

An important aspect in the design of the mechanical structure is the conditions of use of the components [8]. These application conditions must be considered both in the mechanical design and the electrical design.

The advice and the recommendations in this document can not cover all types of applications and conditions. The installation and operating instructions in the AN2017-03 therefore do not replace a thorough assessment and verification of the suitability for the intended use by the user through its technical departments.

# 2 Delivery quality

Since all IGBT modules are tested prior to delivery in a final test in accordance with IEC 60747-9 and IEC 60747-2 (at $T_{vj}$ = 25°C unless otherwise specified), there is no need for users to test the devices.

After a final visual inspection, the devices are packaged in a protected shipping box before delivery. Depressions and/or elevations in the micron range are within the applicable Infineon specification limits, and do not affect the thermal, electrical or reliability characteristics of copper base plates for power modules.

After removing the devices from the protected shipping box, the user must observe the guidelines in section 4 for further processing.

# 3 Module storage and transport

During transport and storage of the module, extreme forces caused by shock and/or vibration must be avoided. The same applies to extreme environmental conditions exceeding the recommended Infineon storage conditions according to [1].

While modules may be stored at the temperature thresholds specified in the data sheet, this is not recommended.

The storage period in accordance with the recommended storage conditions according to [1] should not be exceeded.

# 4 IGBT modules are electrostatically sensitive devices (ESD)

IGBT semiconductors are electrostatically sensitive devices that must be handled according to ESD guidelines. Uncontrolled discharging, voltages from ungrounded equipment and people, as well as static discharges or similar influences can destroy these devices. The gate-emitter control terminals are the electrostatic sensitive contacts. It is important to ensure that IGBT modules are not operated or measured with open gate emitter connections.

Electrostatic discharge (ESD) can pre-damage IGBT modules or even destroy them.




Users must take care to avoid electrostatic discharge during handling, forwarding and packaging of these devices.

Important notes:

To prevent electrostatic discharge from destroying or pre-damaging the power semiconductors, the components are delivered in suitable packaging according to ESD guidelines.

ESD workstations are required to remove modules from their packaging and for handling the unprotected modules.

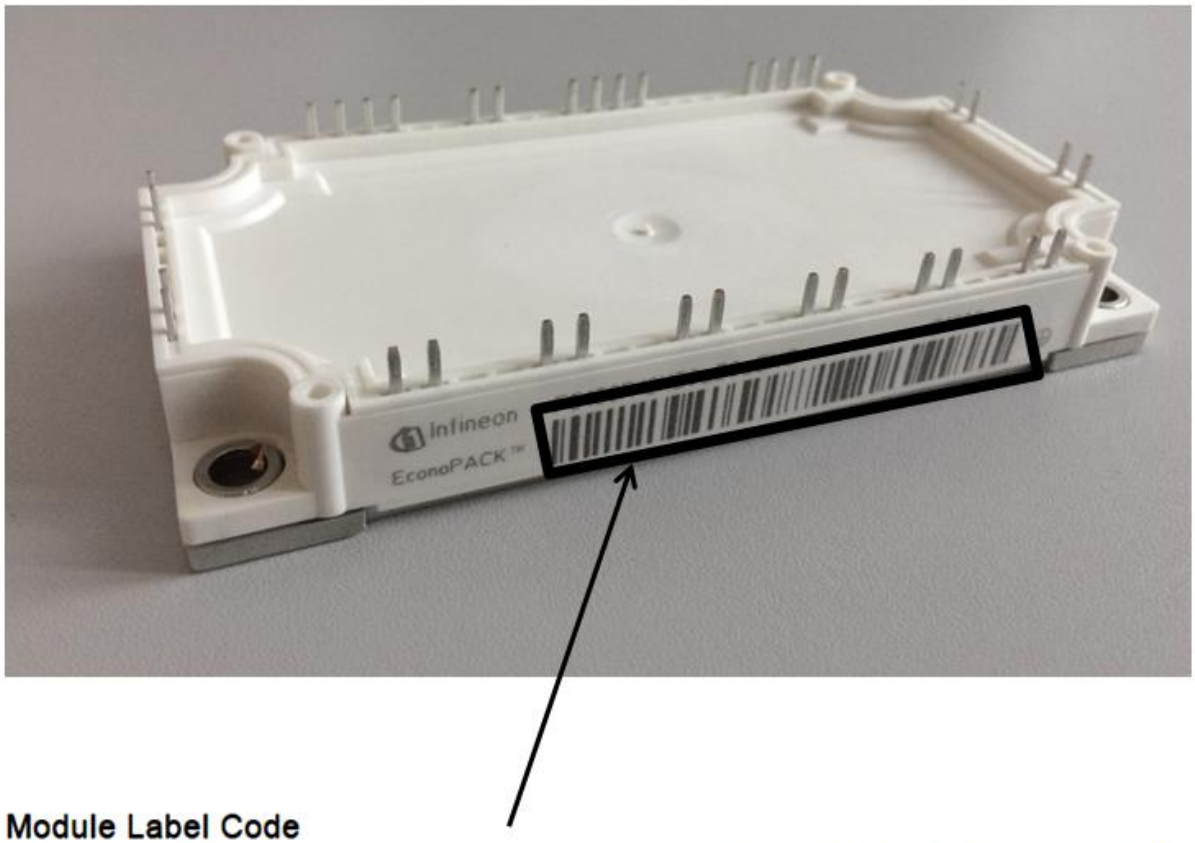
- All subsequent steps may only be performed on specialized workstations meeting the following requirements:
  - High-impedance ground connection
  - conductive working surface
  - ESD wrist straps
  - etc.
- All means of transport and PCBs must be brought to the same potential before further processing of the ESD components.

For more information, please refer to the applicable standards.

- IEC 61340-5-2, Electrostatics–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 with IEC 801-2

# 5 Module identification

Infineon EconoPACK™ and EconoPIM™ Series modules are clearly marked with a product label (Figure 1). For more information and material content data sheets, contact your Infineon distribution partners and sales offices.




**Module Label Code**

**Barcode Code 128**

Sample
00000123456000000000000

| Content of the Code | Digit |
|---|---|
| Module Serial Number | 1 - 5 |
| Module Material Number | 6 - 11 |
| Production Order Number | 12 - 19 |
| Datecode (Production Year) | 20 - 21 |
| Datecode (Production Week) | 22 - 23 |

**Figure 1 Example: EconoPACK™ and EconoPIM™ Series module label**

# 6 Module selection

For a complete product overview as well as a selection and simulation program (IPOSIM), visit www.infineon.com.

The maximum values in the different product data sheets and the application notes are absolute limits which must not be exceeded, even for short periods of time, because this would pre-damage or even destroy the devices.

For more information, please refer to the application notes [2].

Different criteria must be taken into consideration when selecting the ideal device. Figure 2 and Figure 3 provide orientation and explanations.

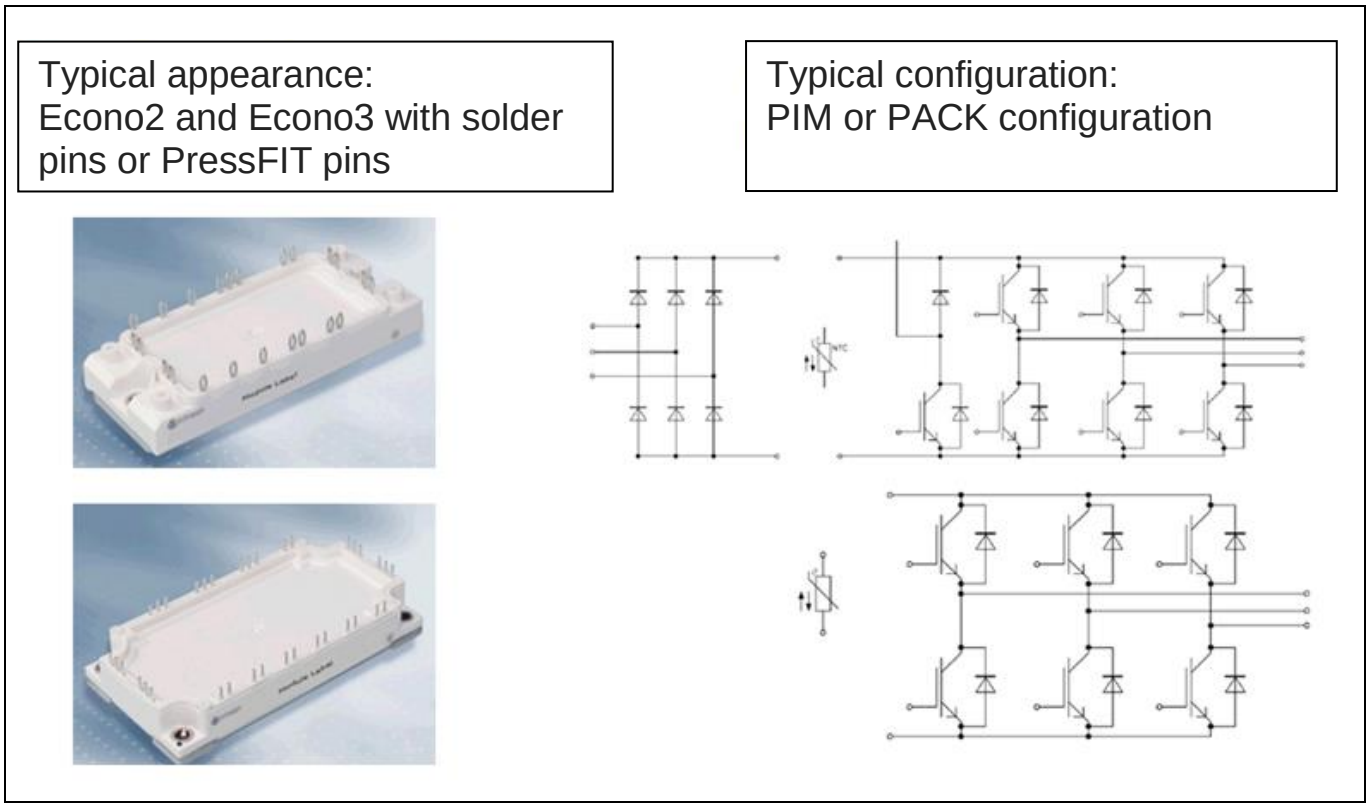



**Figure 2 Typical appearance of EconoPACK™ and EconoPIM™ series and typical module configuration**

| I | FS | 150 | B | 12 | N3 | E | 4 | | B31 | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| I | | | | | | | | | | Module with current sense shunts |
| | FS | | | | | | | | | SixPACK |
| | FP | | | | | | | | | PIM |
| | FF | | | | | | | | | Half-Bridge |
| | F4 | | | | | | | | | H-Bridge |
| | | 150 | | | | | | | | Max. Collector continuous current [A] |
| | | | R | | | | | | | Reverse-Conducting |
| | | | B | | | | | | | Module with current sense shunts |
| | | | | 12 | | | | | | Collector emitter voltage in 100V |
| | | | | | K | | | | | Mechanical construction Econo2/Econo3 (before) |
| | | | | | N2/N3 | | | | | Mechanical construction Econo2/Econo3 (now) |
| | | | | | | T | | | | Fast trench IGBT |
| | | | | | | E | | | | Low sat and fast trench IGBT |
| | | | | | | | 1...n | | | Internal reference numbers indicating technology generation |
| | | | | | | | | P | | Module with pre-applied thermal interface material |
| | | | | | | | | | Bxx | Design variant |

**Figure 3 EconoPACK™ and EconoPIM™ Module Name Overview**

Almost all EconoPACK ™ and EconoPIM ™ -Series modules have an NTC temperature sensor, which is located within the device with a functional separation. For further information about using integrated NTC`s, see [9].

## 6.1 Selecting the module voltage class ($V_{CES}$) and high-altitude module operation

When selecting the appropriate voltage class, the IGBT must have a blocking capability that is suitable for the application and its conditions.

Table 2 shows possible IGBT voltage classes for different supply voltages. This table can be used for an initial IGBT module selection. The maximum permissible collector-emitter voltage ($V_{CES}$) must not be exceeded even for a short time (e.g. during switching). This must be considered for the entire temperature range when selecting a suitable IGBT voltage class.

The following assumption [8] is suitable as a guide for selecting a potential IGBT voltage class:

$$U_{DC} = \sqrt{2} * U_{Nom,RMS} * \left[1 + \frac{S}{100\%}\right] \qquad (1)$$

with $S$ = Safety margin in [%]

**Table 1 IGBT blocking capability as a selection criterion for the supply voltage**

| Supply voltage $U_{Nom,RMS} \pm 10\%$ | $U_{DC}$ nominal DC-link voltage | Typical IGBT voltage class (two level) $V_{CES}$ |
|---|---|---|
| **230 $V_{RMS}$** | ~ 360 V | 600 V or 650 V |
| **400 $V_{RMS}$** | ~ 620 V | 1.2 kV |
| **690 $V_{RMS}$** | ~ 1070 V | 1.7 kV |

The transient collector-emitter voltage overshoot ($\Delta U_{CE}$) at switch-off resulting from the current rate of rise ($\frac{di_C}{dt}$) in combination with the parasitic inductance ($L_\sigma$) of the IGBT must be considered when selecting an appropriate voltage class.

$$\Delta U_{CE} = -L_\sigma * \frac{di_C}{dt} \quad (2)$$

When power devices are used in geographical altitudes above mean sea level (MSL), e.g. at altitudes > 2000 m above sea level or at high DC voltages, restrictions of the operating range may become necessary.

- When air cooling is used, the cooling capacity of the overall system must be considered due to the lower air pressure.
- The insulating properties (especially those of the air gap) must be adjusted due to the lower dielectric strength of air, see also Section 7.
- Possible statistical failure rates due to the use of power devices at high altitude (cosmic radiation) and / or high voltage must be considered when selecting a suitable voltage class and during the design phase.
- With operating temperatures of T < 25°C, the reduced blocking capability typical of IGBTs and the switching behavior of the devices with these temperatures must be considered in the application and investigated separately by users, with respect to the user design, at their own risk.
  The blocking capability depending on the temperature of T = -40°C to T = 25°C is available on request from your Infineon power device distributor.

The cycling capability for the desired service life must be considered in the selection of the device, depending on the load profile.

## 6.2 Climatic conditions in the active, current-carrying operation of EconoPACK™ and EconoPIM™ modules

EconoPACK™ and EconoPIM™ modules are not hermetically sealed. The cases and the single-layer grouting used for electrical insulation in the module are permeable to moisture and gases in both directions. This means that moisture differences can be compensated in both directions.

In active, current-carrying operation, EconoPACK™ and EconoPIM™ modules from Infineon are specified for climatic conditions according to IEC 60721-3-3 with the classification of environmental conditions for stationary use according to class 3K22.

The modules may not be exposed to moisture (e.g. dew or condensation) and climatic conditions which go beyond the category 3K22 of IEC 60721-3-3 must be avoided by taking additional measures for every application.

Harmful gases must be avoided during operation and storage.

# 7 Module clearance and creepage distances

When specifying the insulation properties, application-specific standards must be observed, particularly with regard to the clearance and creepage distances.

The module-specific EconoPACK™ and EconoPIM™ series case drawings can be taken from the data sheets.

Specifically, the clearance and creepage distances must be considered when selecting screws and washers. Please note the information provided in Section 6.1. Depending on the requirements of each application, electrically conducting components or vias should be avoided or insulation should be provided, for example by painting the relevant surfaces.

The clearance and creepage distances specified in EconoPACK™ and EconoPIM™ series data sheets specify the shortest clearance and creepage distances for mounted module at a contamination level of 2 according to IEC60664-1. This is shown in Figure 4.

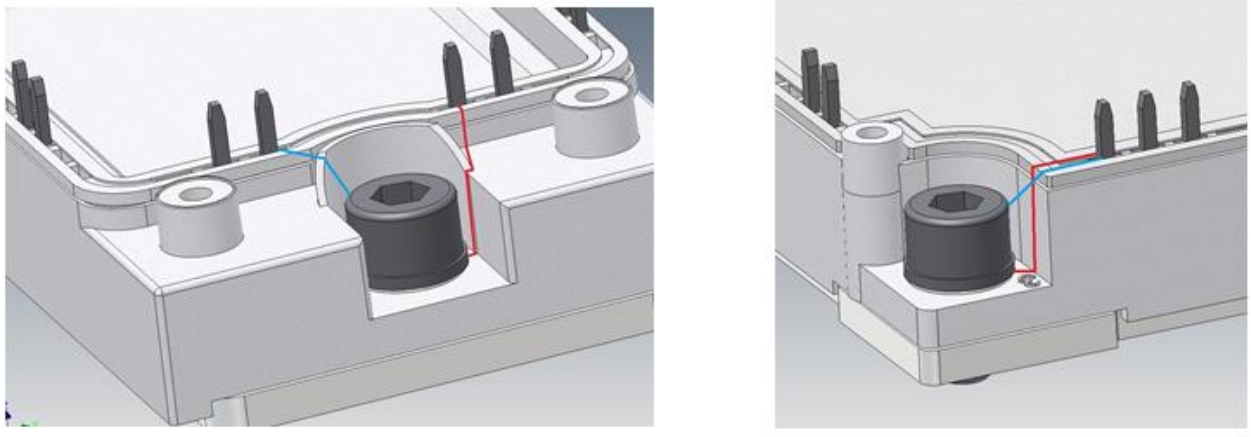


**Figure 4 Typical EconoPACK™2 and EconoPACK™3 module (blue = clearance distance ; red = creepage distance)**

**Table 2 Data sheet specifications for clearance and creepage distances**

| | | | | |
|---|---|---|---|---|
| **Creepage distance** | **Terminal to heat sink** | | 10.0 | mm |
| **Clearance distance** | **Terminal to heat sink** | | 7.5 | mm |
| **Comparative tracking index** | | CTI | >200 | |

In each case, the application's clearance and creepage distances must be verified, compared with the requirements of the application-specific standards and ensured by design measures if necessary.

# 8 Mounting a PCB onto the IGBT module

**Users must take precautions against electrostatic discharges that may occur when touching or processing IGBT modules. See Section 4 for more information.**

The PCB must be dimensioned to ensure safe device operation.

For more information, please refer to application notes in [6] and [7].

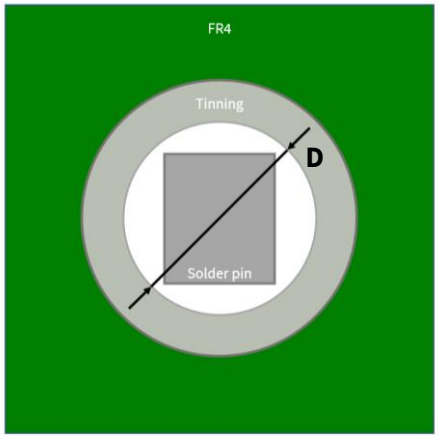
## 8.1 Contacting the board with PressFIT pins

Infineon's PressFIT contact technology for power electronics modules allows fast and safe cold-welded connections for standard FR4 PCBs with immersion tin surfaces. The preparation of printed circuit boards is described in detail in AN2007-09.

## 8.2 Contacting the board with solder pins

The final minimum hole diameter of the PCB through hole is determined considering the pin circumcircle and tolerances. To mechanically fit the module into the PCB, a final minimum hole diameter of 1.5 mm is recommended for solder pins of EconoPACK™ and EconoPIM™ series products.

The final hole diameter of the plated through holes is defined as “D=1.5 mm + X” as shown in Figure 5.




**D=1,5 mm + X**

**Figure 5 Cross-section of a solder pin**

Due to the dependence on several factors, such as the PCB type, thickness, plating, production tolerances, solder process, or solder alloy used, the parameter “X” must be determined by the customers, to ensure a good soldering result and a reliable long-term connection. In this case, it is recommended to refer to the standard IPC 2222.

The final hole size must be defined carefully. If its diameter is too large, it can be challenging to ensure a solid electrical and mechanical connection between the pin and the board.

When assembling several modules on a single PCB, the height tolerance of the modules must also be considered during the mounting procedure, to avoid mechanical deformation of the PCB or unwanted forces on the modules.

## 8.3 Soldering EconoPIM™ and EconoPACK™ modules

The control and power terminals of EconoPACK™ and EconoPIM™ series modules have a solderable surface that allows contact through suitable soldering methods.

After placing the PCBs, the connection can be made through manual soldering, automatic selective soldering, wave soldering, or other methods.

If the modules are preheated before they are soldered to the printed circuit board, it must be ensured that the maximum preheating temperature of $T_{max}$=125°C is not exceeding the duration of t=30 minutes

During the entire soldering process, it must be ensured that the process parameters, the solder temperature and the time the modules are in touch with the contacts do not deform or damage the plastic housing. A maximum soldering temperature of T = 260 °C ± 3 °C is permissible for a maximum duration of $t_{max}$ < 10s ± 1s according to IEC 60068-2-20.

Different process parameters must be tested by users at their own risk and can be evaluated in cooperation with Infineon. It is expected that the components are free from defects and treated properly.

For more information about the soldering processes, please refer to AN2005-06.

## 8.4 Mechanical relief on the PCB

After contacting the connection pins with the PCB, as described in Sections 8.1 and 8.2 mechanically relieving the contact points between the board and the module is recommended. The contact points should be relieved by attaching PCB directly on the module at the 4 fixing points (Figure 6) using self-tapping or metric screws.

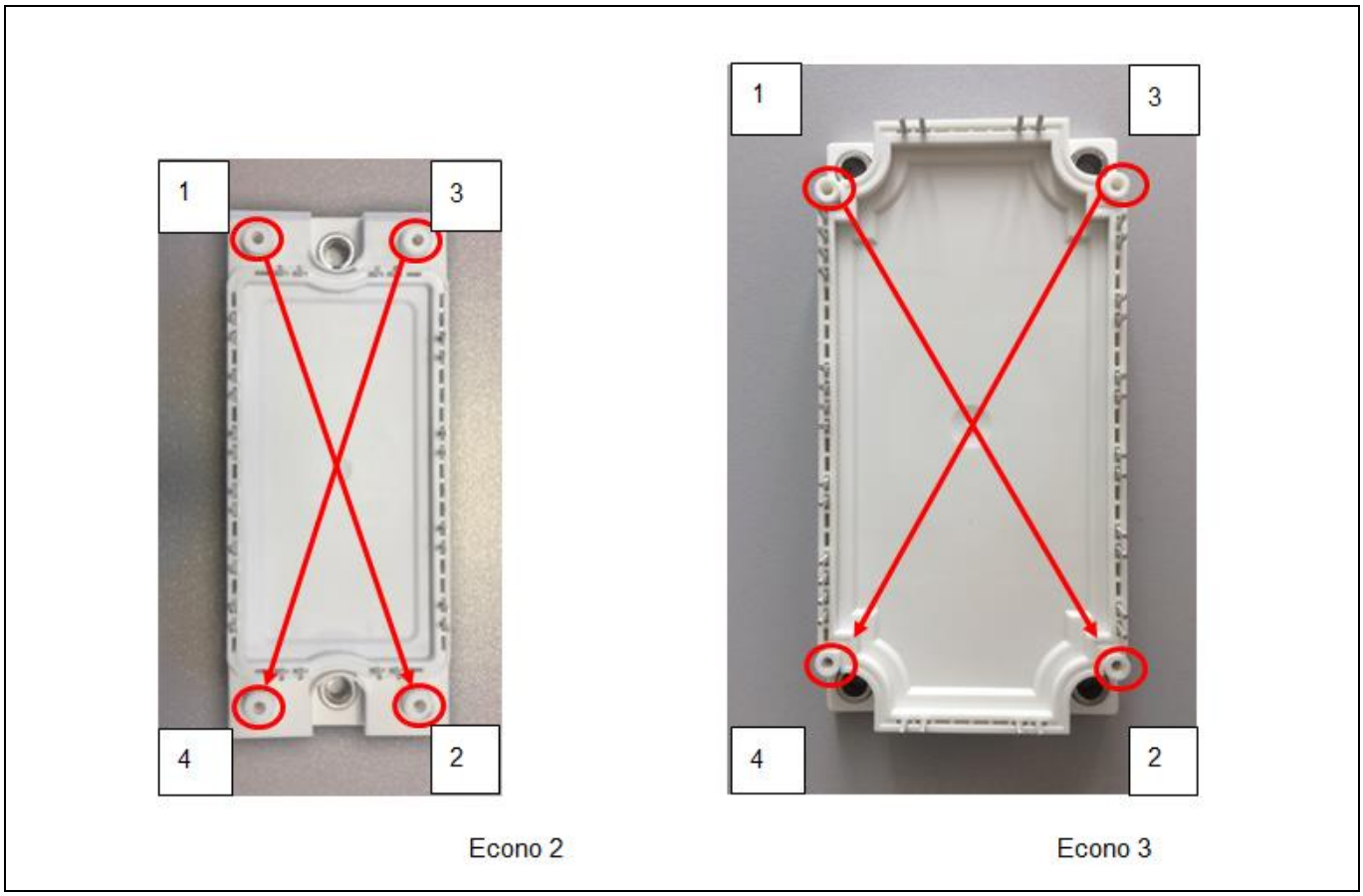



**Figure 6 EconoPACK™ and EconoPIM™ series**

Taking the thickness of the board into account, the screw thread extending into the mounting tube should have an effective minimum length of $l_{min} \geq 4$mm and an effective maximum length of $l_{max} \leq 10$mm.

The first 1.5 mm of the mounting tube are for guiding purposes and cannot absorb forces. The thread in the plastic is created automatically as the screws rotate. Self-tapping screws or metric screws can be used.

Use of metric screws: M 2.5 x 8 or M 2.5 x 10

Recommended self-tapping screw types:

EJOT PT K 25 x 10 Art. No. 4012470801 at 500 revolutions with a recommended maximum torque of 0.5Nm.

EJOT DELTA PT 25 x 10 Art. No. 4229110801 at 500 revolutions with a recommended maximum torque of 0.5Nm.

To avoid damaging or bursting the receiving tube, it should be ensured that the screw is inserted into the tube in a straight manner (Figure 7).

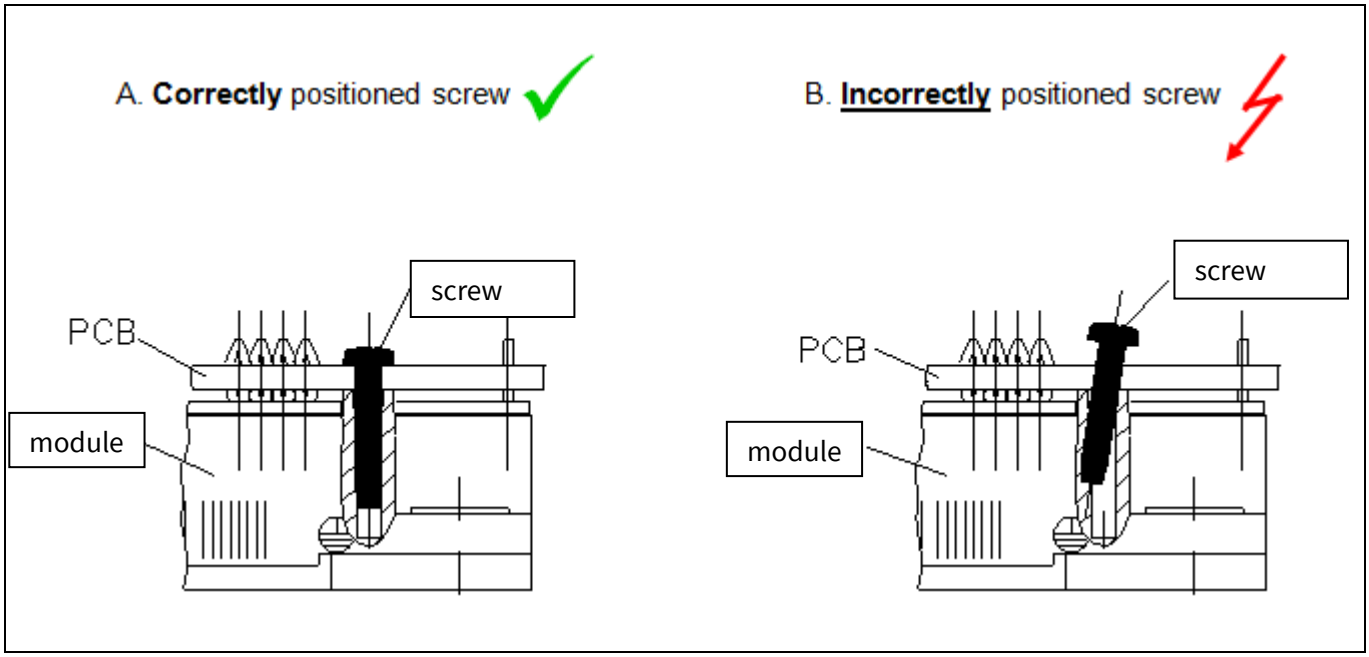



**Figure 7 EconoPACK™ series with PressFIT contacts connected with a circuit board**

The recommended screws are based on laboratory tests. Depending on the screw or tool used, it may be necessary to adjust the tightening process.

The through-hole diameter, $d_h$, of the PCB refers to the proposed screw types and the subjected manufacturing tolerances of the module. Using $d_h = 3$ mm as a guide for PCB through-holes is recommended, as shown in Figure 8. For other self-tapping screw types with larger nominal thread size, this indication should be determined and checked again.

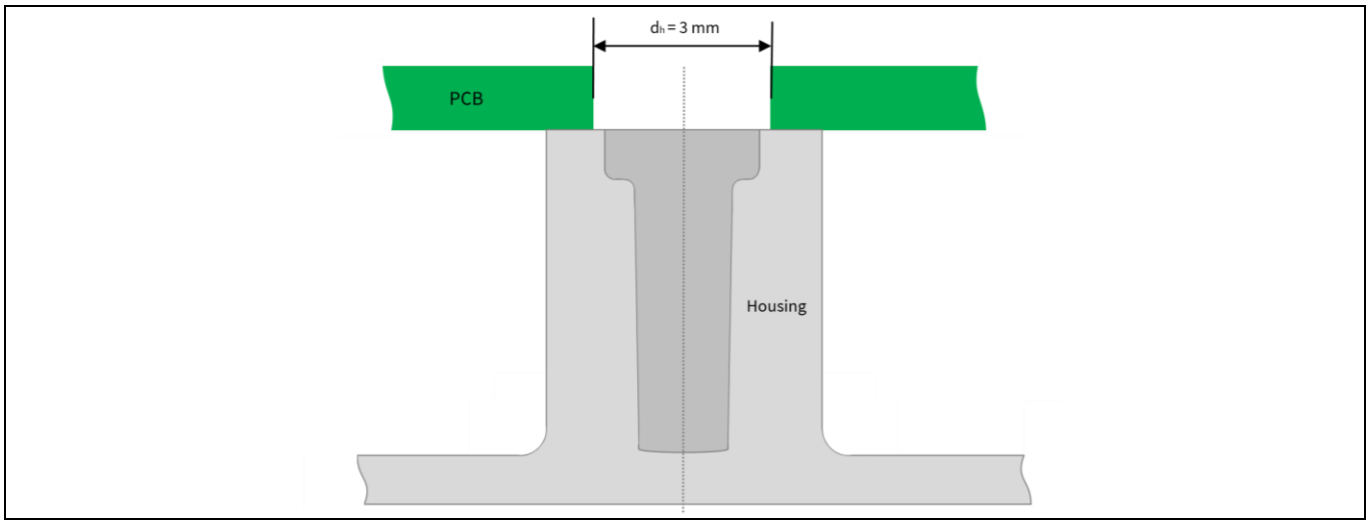



**Figure 8 Recommendation for the PCB through-hole diameter for self-tapping screws**

# 9 Mounting the module to the heatsink

When two or more modules are used in one PCB, care must be taken to ensure that the base plates are on the same level after the soldering or press-fit process. This is necessary so that an optimum connection can be realized from the base plates to the heat sink. Supports between circuit board and heat sink should be positioned so that the heavy components on the circuit board have no effect on the module and on the desired vibration behavior of the entire device. The supports should create a pressure effect on the module. They should not have a traction effect [11].

## 9.1 Condition of the heat sink for module mounting

The power losses occurring in the module have to be transferred into a heat sink to ensure a proper operation of the module within the specified maximum temperature $T_{vjop}$ of the semiconductors and to achieve the intended electrical- and lifetime performance.

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

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

The contact surface of the heat sink should not exceed the following values depending on module length:

- Surface flatness based on a length of 100 mm ≤ 50 µm
- Surface roughness Rz ≤ 10 µm

The heat sink must possess sufficient stiffness for the installation and the subsequent transport in order to avoid exerting additional stretching and/or tensile forces on the bottom plate of the module. During the entire installation process, the heat sink must be handled in a torsion-free manner.

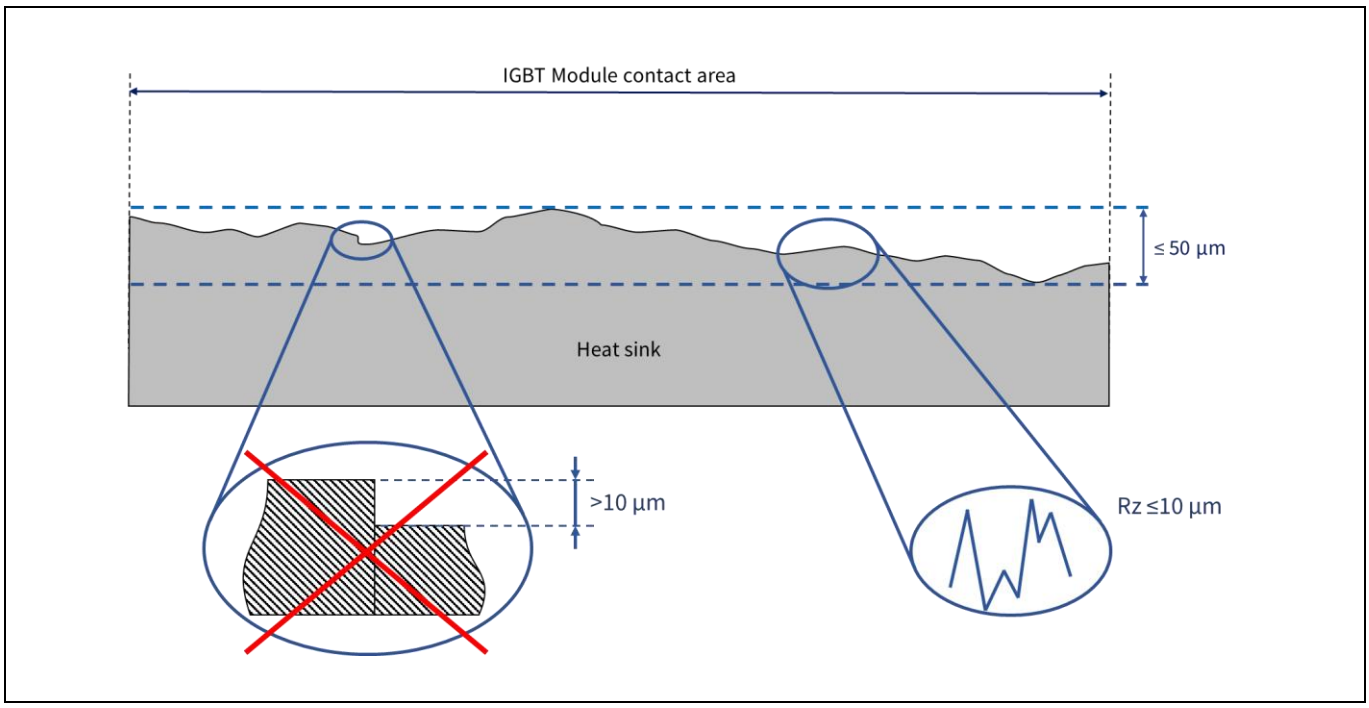



**Figure 9 Recommendation for the quality of the heat sink surface for module installation**

## 9.2 Thermal Interface Material

Due to the different surface shapes of the module base plate and the heatsink, the surfaces are not completely flush with each other and gaps between the 2 components cannot be avoided in places on the contact areas.

To dissipate the losses occurring in the module and to achieve a good heat flow into the heatsink, all spaces should be filled with a suitable heat-conducting material.

The thermally conductive material should have stable long-term properties to ensure the thermal resistance remains on a constant high level. It should be applied in such a way that no screw holes are blocked, avoiding negative effects on tightening torques.

### 9.2.1 Infineon Thermal Interface Material – IFX TIM

Infineon has developed IFX TIM, a material optimized for semiconductor power modules providing long-term stability and thoroughly excellent properties.

EconoPACK™ and EconoPIM™ modules from Infineon distribution partners and sales offices are available with IFX TIM already applied. These modules have the letter P in their type of designation. For more information, please refer to the application note [4].

Figure 10 shows the areas of the Econo2 and Econo3 base plates where TIM is applied.

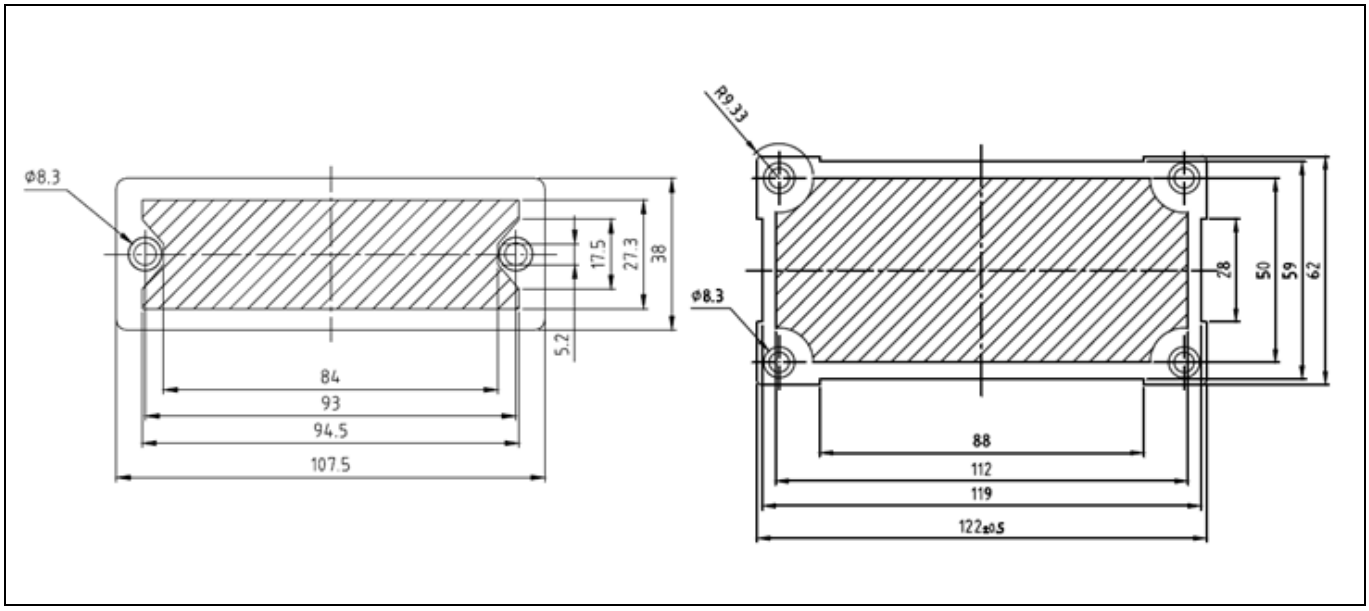



**Figure 10 EconoPACK™ series module with IFX TIM**

For EconoPACK™ and EconoPIM™ series modules with IFX TIM already applied by Infineon continue with Section 9.3.

### 9.2.2 Applying standard thermal grease using the stencil printing method

When using modules where the thermal interface material (IFX TIM) is NOT applied, the user has to select and qualify the thermal interface material considering its suitability for the purpose and long-term stability.

The suitability of applying heat conductive material such as thermal grease using a stencil should be investigated by users at their own risk, in each individual case keeping in mind the conductive material selected and the heat sink surface.

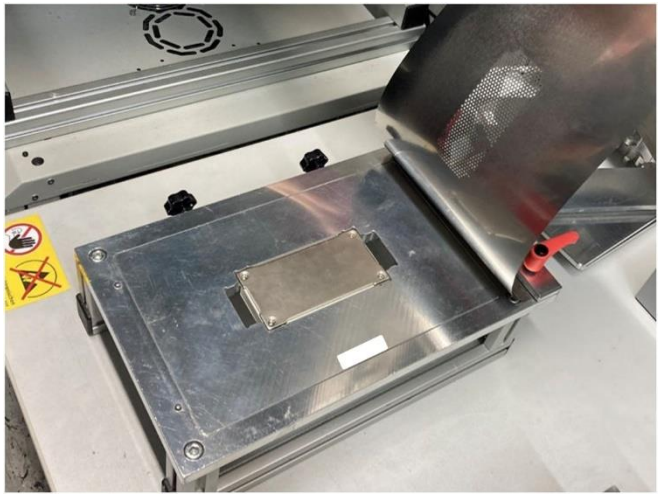
**Mounting the module to the heatsink**

To achieve optimum results, the module, the application geometry, the sink contact surface and the material applied should be considered holistically.

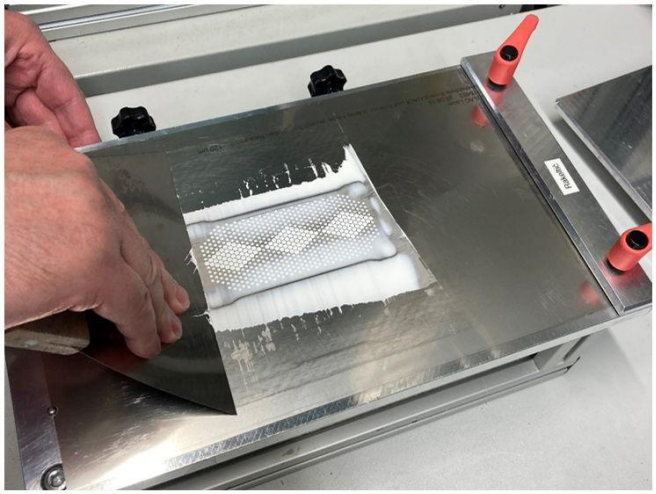
Manual application of thermal grease with a layer thickness in the micrometer range is inherently problematic because a well applied layer should fill all the gaps while allowing the metallic contact between the base plate and heat sink surface. The screen-printing process is, therefore, recommended for applying thermal grease. This method allows the user to achieve optimum thermal grease distribution for the module while defining a layer thickness that can be easily reproduced.

For more information on using stencils or applying thermal grease, please refer to the application notes in [5].

Figure 11 shows examples of how thermal grease can be applied using the template printing method.



a. Thermal grease holding fixture



b. Applying thermal grease

**Figure 11 a) Example of an holding fixture for applying thermal grease**
**b) Application of the thermal grease onto the stencil**

The recommended way to use a holding fixture shown in Figure 11 is as follows:

1. Remove thermal grease residues from the stencil. Cleaning can be done using suitable solvents. Ensure proper alignment for handling these materials must be observed.

2. Align the stencil and the module with each other. You can use a holding fixture that can be inserted into the module as shown in Figure 11a.

3. Lower the stencil onto the module base plate.

4. Apply the heat conducting media through the stencil (see Figure 11b), ensuring that all stencil holes are filled with thermal grease.

5. Fold up the stencil and remove the module.

6. Use a visual inspection after the application of the material to ensure that each point of the stencil is filled. Even when applying thermal paste using a stencil (especially if it is done manually), the expected temperature change can vary by a few Kelvins if the stencil is poorly aligned or if the thermal grease quantity varies slightly.

Measuring the layer thickness of the material applied is, therefore, highly recommended to ensure that an adequate quantity is applied.

Possible stencil wear and accompanying thickness reduction must be checked from time to time by applying thermal grease to the stencil using a tool. Stencils must be replaced if they no longer have the required thickness.

### 9.2.3 Alternative method for applying standard thermal grease

When using modules where the thermal interface material (IFX TIM) is NOT applied by the manufacturer, the user has to select and qualify the thermal interface material with respect to fitness for purpose and long-term stability.

If it is not possible to apply standard thermal grease using the recommended method of stencil printing, the heat transfer medium may be applied manually. Typically, a uniform thermal grease layer thickness of 80-100 µm on the base plate of the module is considered as sufficient basis of testing with varying thermal grease thicknesses. The user must select and qualify the thermal interface material and the process with respect to fitness for purpose and long-term stability at its own risk.

The following volumes can be used as a guideline for the required amount of thermal paste depending on the layer thickness d:

Econo2: d = 80 µm: $V \approx 0{,}32\ cm^3$,

d= 100 µm: $V \approx 0{,}40\ cm^3$,

Econo3: d = 80 µm: $V \approx 0{,}65\ cm^3$,

d = 100 µm: $V \approx 0{,}8\ cm^3$.

This volume may meter from a syringe or applied using a tube.

Common rollers or fine-toothed spatula can be used to apply the thermal grease. The uniformity and reproducibility of the self-adjusting layer thicknesses following manual application is subject to large tolerances. The thickness of the thermal grease after application can be checked using a wet film comb, see Figure 12.

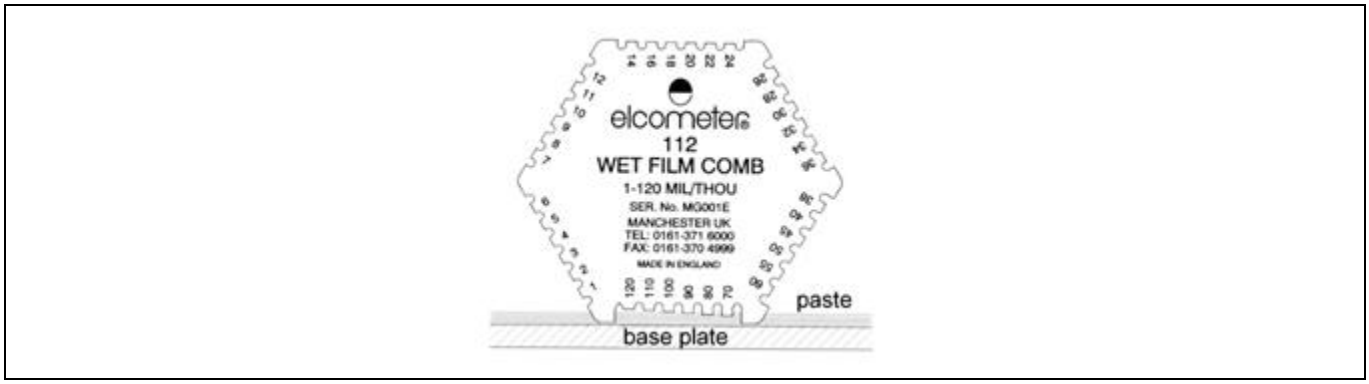



**Figure 12 Wet film comb for measuring thermal grease thickness**

Processing guidelines, thermal contact and long-term stability of thermal materials must be considered. The user must take these aspects into account when selecting these materials depending on the process and the application at its own risk, and also discuss them with the thermal grease manufacturer if necessary.

## 9.3 Mounting the module to the heat sink

Modules must be mounted according to the mechanical tolerances specified in the data sheets. The module-specific case drawings can be taken from the data sheets.

The screw connection for mounting the module to the heat sink must be designed in such a way that the total of all possible loads does not exceed the flow limits of the assembled parts. Friction devices such as spring washers increase the elasticity of the connection and compensate settling effects. This serves to maintain most of the preload force, preserving the connection.

The tightening torque must be selected so that the preload force applied leads to a purely frictional connection of the components. To accurately determine the preload force and the tightening torque, the friction coefficient μ must be known. The friction depends on many different factors, such as material combination, surface, lubrication, temperature, etc. For a typical, clean combination of an aluminum heat sink with a galvanized M6 steel screw, a friction coefficient of $\mu_G \approx 0.14$ can be estimated. If the actual coefficient of friction differs from this standard value, the tightening torque must be adapted accordingly.

Ideally, the screws should be tightened with a torque close to the maximum recommended torque $M_{Max}$. This maximum torque must not be exceeded, however.

**Table 3 Specifications of the fastening screw**

| Description | Values | Comment |
|---|---|---|
| Fastening screw | M5 | 1.) |
| Maximum recommended tightening torque | $M_{max}$ = 6Nm | 2.) |
| Recommended strength class of the screw | 8.8 | 3.) |
| Minimum thread reaches into the heat sink | 1.6 x dia. = 8 mm | 4.) |

1.) According to ISO 4762, DIN 6912, DIN 7984, ISO 14581 or DIN 7991 in combination with a suitable washer, e.g. according to DIN 433 or DIN 125 or complete combination screws according to DIN 6900, recommended for module mounting.

2.) Determined for a friction coefficient of $\mu_G$= 0.14 (screw clean and dry, aluminum heat sink, screw according to ISO 14581, galvanized, rolled thread). The torque applied should be based on the maximum torque.

3.) But at least 6.8

4.) In aluminum; according to the technical literature

Other material combinations of screws and/or heat sink material may require a modification of the mechanical parameters and an evaluation of the corrosion resistance.

The module mounting screws must be uniformly tightened crosswise using a torque within the specified limits.

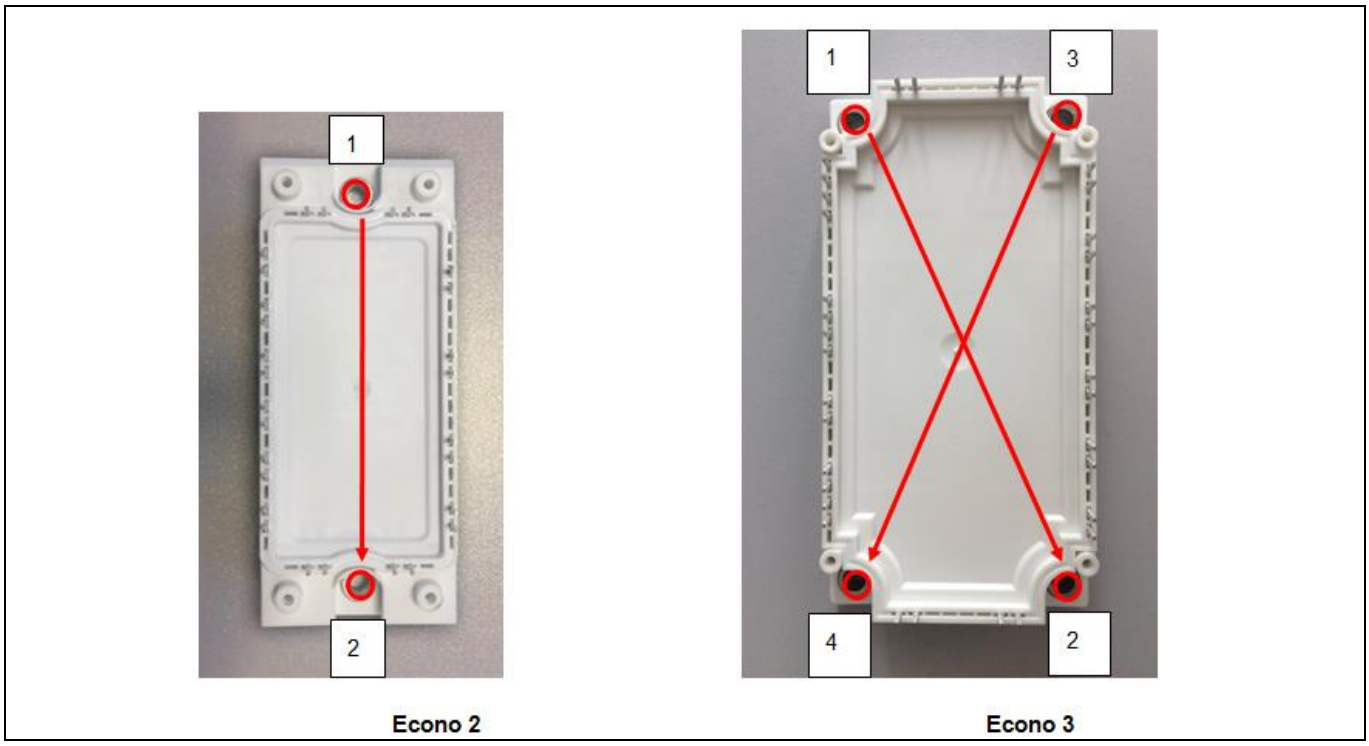



**Figure 13 Screw sequence for module mounting**

For optimal thermal contact of the module on the heat sink, the following procedure is recommended when tightening the fastening screws - 1 to 4 for Econo3 and 1 to 2 for Econo2 (Figure 13).

1. Place module with the thermal grease applied onto the clean heat sink and fix in place using two screws screwed in by about half their length.

2. With Econo3, screw in the remaining screws by about half their length.

3. For the Econo3, tighten all screws crosswise using a torque of approximately 0.5 Nm in the following sequence: e.g. screw No. 1 - 2 - 3 - 4 (see Figure 13).

When using Infineon modules where the thermal interface - IFX TIM - has already been pre-applied, you can continue with step 4.

If you do NOT use the IFX TIM material recommended and pre-applied by Infineon, an additional intermediate step 3.a may be required depending on the viscosity of the alternative material used (e.g. in case of high viscosity) to allow the thermal grease to flow as the screws are tightened, adapting to the contours of the module base plate and the heat sink. Then, proceed to step 4.

3.a. After a pause, tighten the screws crosswise to approximately 0.5 Nm in the same sequence.

The pause depends on the material used and must be determined by the user at its own risk based on examinations/tests with the preferred material. As a guide for the initial investigations during the development phase, a pause of 10 to 20 minutes can be assumed.

e.g. screw No. 1 - 2 - 3 - 4

4. Tighten the screws crosswise to 3 - 6Nm in the same sequence.

e.g. screw No. 1 - 2 - 3 - 4

The tightening sequence should be applied for all EconoPACK™ and EconoPIM™ series modules.

**Mounting the module to the heatsink**

When using standard thermal grease, it may be necessary to check the tightening torque of the fixing screws after a heat test depending on the type of grease used. It is highly advisable to perform this step if you use phase change films for thermal conduction instead of thermal grease. Silicone films are not suitable for power devices and are therefore not recommended.

Users should carry out their own tests and measurements with their preferred thermal grease or an alternative material for qualifying and verifying the mounting process and the suitability of the thermal design. The maximum junction temperature should be determined by means of thermal measurements under normal operating conditions. The maximum junction temperature may not exceed the junction temperature ($T_{vjop}$) specified in the data sheets in pulse mode [3]!

For a thermal measurement as close to the chip as possible, it is necessary to position the probe under the chip to be measured (Figure 14). Knowledge of the exact chip positions is therefore indispensable.

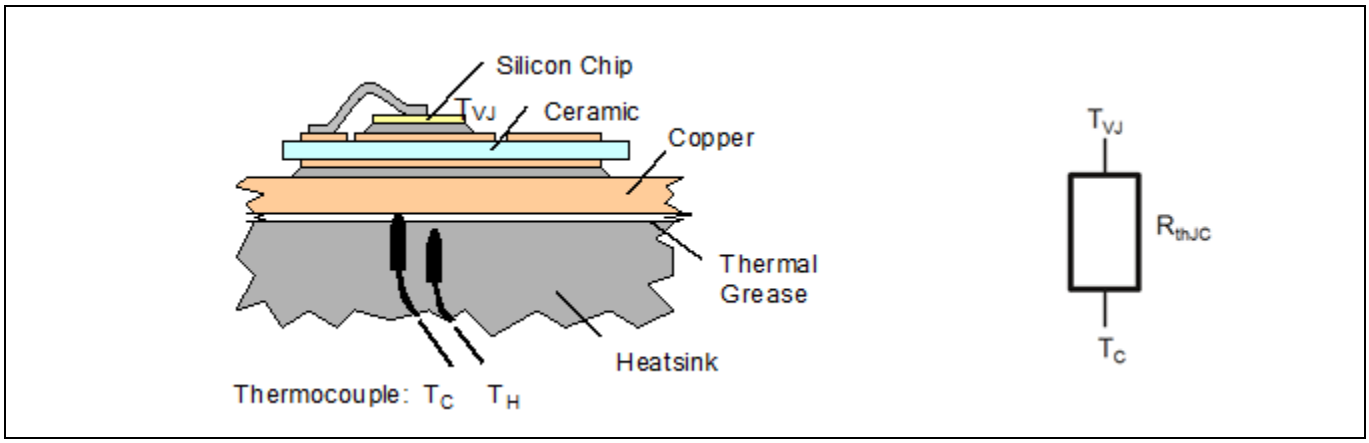



**Figure 14 Example of the arrangement of the temperature sensor in a thermal measurement**

The junction temperature $T_{VJ}$ can be determined as follows if the actual switching and conduction losses ($P_V$) and the base plate temperature ($T_C$) are known:

$$T_{VJ} = T_C + P_V \cdot R_{thJC} \quad (2)$$

$T_{VJ}$: Junction temperature (virtual)

$T_C$: base plate temperature

$P_V$: Total power loss

$R_{thJC}$: Thermal resistance, junction to case

# 10 Use under vibration and shock loads

The modules of the EconoPACK™ and EconoPIM™ series have a mechanical design corresponding to the state of the art, which was developed with the clear focus of providing maximum mechanical ruggedness to the application.

Vibration and shock should be avoided.

The effects of permanent mechanical stresses, particularly recurring stresses such as vibration and shock, on the module are highly dependent on the mechanical design and the load profile of the application.

The suitability of these modules for use under such specific mechanical loads must therefore be investigated and qualified by the user at its own risk for its specific design and the load profile occurring in the intended application.

# 11 References

[1] TR14 Storage of Products supplied by Infineon Technologies

[2] AN2011-05 Industrial IGBT Modules - Explanation of Technical Information

[3] AN2008-01 Definition and use of junction temperature values

[4] AN2012-07 Modules with pre-applied Thermal Interface Material

[5] AN2006-02 Application of screen print templates

[6] AN2006-01 Driving IGBT`s with unipolar gate voltage

[7] AN2007-04 Deadtime calculation

[8] Infineon Technologies IGBT Modules -Technologies, Driver and Application, A.Volke, M.Hornkamp, ISBN 978-3-00-032076-7

[9] AN2009-10 Using the NTC inside a power electronic module

[10] AN2005-06 Soldering of Econo and Easy modules

[11] AN2007-09 PressFIT mounting technology

Mounting instruction for PressFIT modules with forked pins

# Revision History

| Document version | Date of release | Description of changes |
|---|---|---|
| 1.0 | 2017-03 | Initial version |
| 1.1 | 2023-08 | Additional recommendations regarding PCB mounting<br>Extended guideline for applying thermal grease |

**Edition 2023-08-02**

**Published by**

**Infineon Technologies AG**

**81726 Munich, Germany**

**© 2023 Infineon Technologies AG. All Rights Reserved.**

**Do you have a question about this document?**

**Email: erratum@infineon.com**

**Document reference**

**AppNote Number 2017-3**

**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 types 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 can reasonably be expected to result in personal injury.