EconoDUAL™3 Modules

Mounting instructions EconoDUAL™3 modules

Industrial Power

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1 General

IGBT modules are electrostatic sensitive components.

In order to prevent destruction or pre-damage of the components by electrostatic discharge, the components are delivered according to the approved ESD regulations in appropriate ESD protected packaging.

While working with the components, ground straps should be worn and the valid ESD safety instructions should be observed.

Compliance with the requirements for Infineon IGBT modules is assured by the respective reliability tests and the 100 per cent tests carried out in production afterwards.

Maximum permissible values in the respective product datasheets and application notes are absolute limits which generally, even for short times, may not be exceeded as this may lead to destruction of the components.

The application notes in this document cannot cover each type of application and condition.

Hence, the application notes cannot replace a detailed evaluation and examination by you or your technical divisions of the suitability for the targeted applications. The application notes will, therefore, under no circumstances become part of any supplier agreed warranty, unless the supply agreement determines otherwise in writing.

2 Mounting a driver board onto the module

When using an external driver board (not on top of the module), the contact to the gate emitter control pins of the module should be carried out using a twisted-pair gate lead or appropriately positioned copper tracks as short as possible in order to avoid electromagnetic coupling and to minimise stray inductances.

When driver or module adapter boards (PCBs) are used directly on top of the module, the contact joints (=solder points) between PCB and module auxiliary contact should be mechanically relieved in order to disburden the solder connection as far as possible. Relieve of the contact points is carried out by mounting the PCB directly onto the module at the four mounting stand-offs (see figure 1) using self-tapping screws or similar assembly material.

For the development process both evaluation driver boards as well as evaluation module adapter boards (module adapter to hold gate resistors and clamping diodes) are available on request. Further information regarding EconoDUAL™ evaluation drivers is contained in the application note AN2006-04 Evaluation Driver Board for EconoDUAL™ IGBT modules.

Apart from manually driving the screws into the mounting stand-offs an electronically controlled or at least slowly turning electric screwdriver (≤300rpm) is a preferred aid.

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

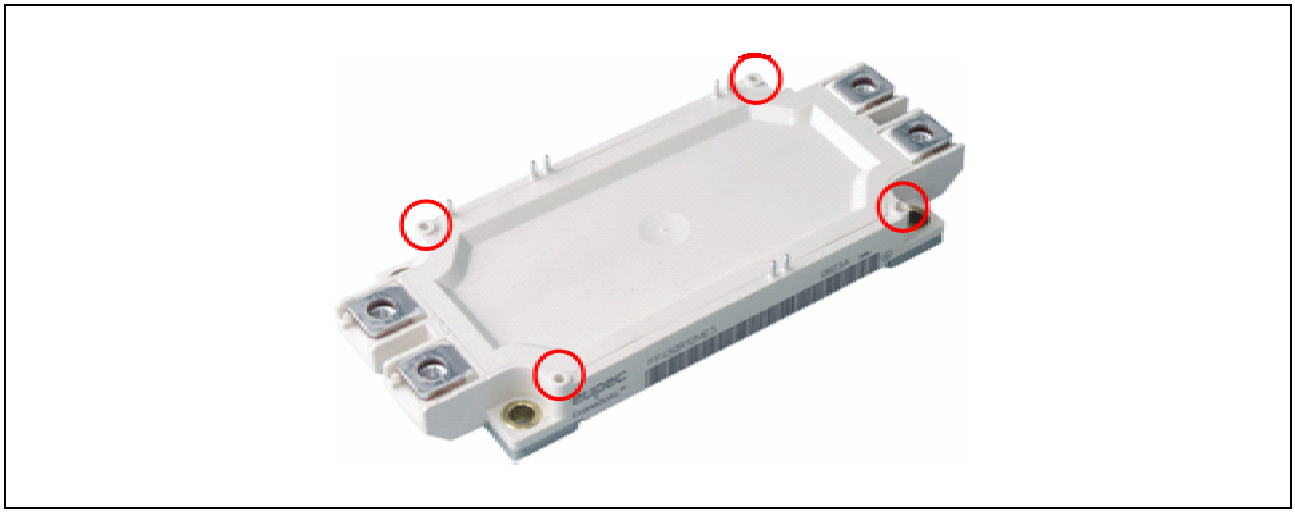

Bild 1 EconoDUAL™3 module PCB mounting stand-off

The effective length of the screw thread entering the mounting stand-off should be of a minimum length of l_{min}≥4mm and a maximum length of l_{max}≤10mm giving consideration to the PCB thickness and the weight of the driver PCB.

The initial 1.5mm of the mounting stand-off serve guidance only and cannot take any force. The thread in the plastics will form itself by driving in the screws. Recommended self-tapping screws are for example

- Ejot PT WN 1451 K25x10 A2K :M_{max}=0.45Nm ±10%
- Ejot DELTA PT WN 5451 K25x8 :M_{max}=0.4Nm ±10%

Metrical screws M2.5*X could also be used e.g. M2.5*8 or M2.5*10 depending of the used PCB thickness.

To avoid damage or splitting of the stand-off, straight insertion of the screw into the stand-off has to be observed during assembly.

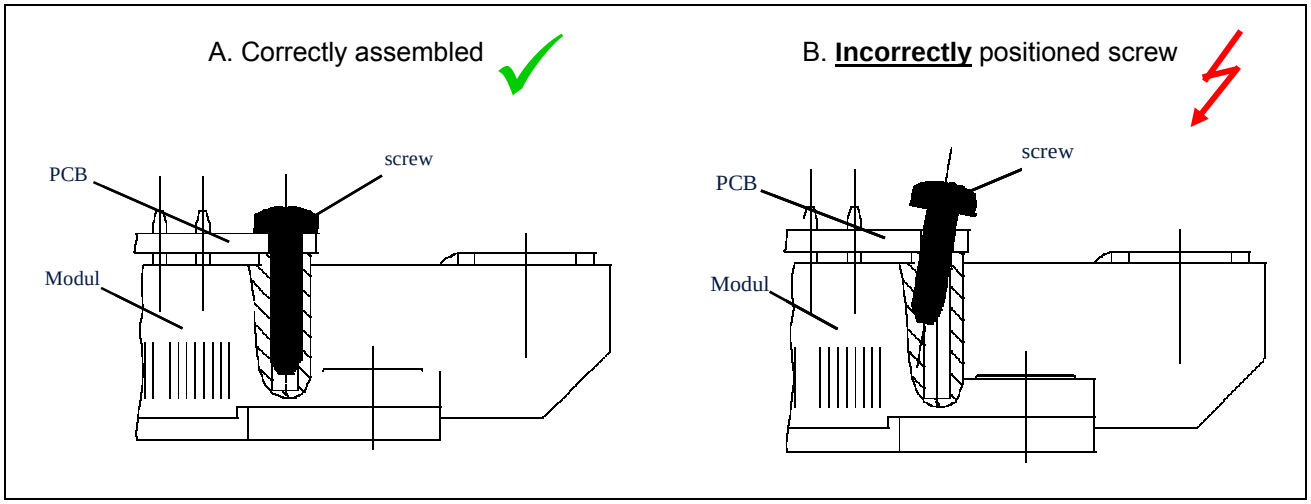

Figure 2 **A. Correctly assembled screw into the mounting stand-off**

B. Incorrectly positioned screw into the mounting stand-off

The recommended screws and torques are based on laboratory tests. Depending on screws and tools used it may be necessary to adapt the assembly process accordingly.

After mounting the PCB the solder process (manual soldering, selective soldering or wave soldering) may begin. When adhering to this sequence of assembly, the mechanical strain to the solder points can be minimised.

If the modules, before they enter the soldering process, are pre-heated with the aid of heat plates below the base plate or by circulating air, this process must be adjusted such that a pre-heat temperature of T≤150°C for t≤30min is not exceeded.

During the entire soldering process care needs to be taken that neither too high a soldering temperature nor too long a process time at the auxiliary pins overheats the plastic case and thus deforms it.

According to IEC 68 section 2, a maximum solder temperature of T=260°C for a maximum process time of t_{max}≤10s has to be observed during the solder process.

Further information regarding solder processes is detailed in the application note AN2005-06 “Soldering Econo und Easy modules”.

3 Condition of the heatsink for module assembly

The power loss occurring in the module has to be dissipated via a heatsink in order not to exceed the maximum permissible temperature specified in the datasheets during switching (Tvjop) in operation.

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

The contact surfaces, the base plate of the module and the surface of the heatsink have to be free of degradation and contamination and should be cleaned with a fresh, lint free cloth.

The contact surface of the heatsink should not exceed the following values referenced to a length of L=100mm:

Surface flatness ≤50µm

Surface roughness Rz≤10µm

The heatsink has to be of sufficient stiffness for the assembly and the subsequent transport in order not to exert additional straining or pulling forces to the base plate of the module. During the entire assembly process the heatsink has to be handled twist free.

4 Application of the thermal compound

Due to the individual surface shape of the module baseplate and the heatsink these do not touch across the entire area so that a certain punctiform separation between the two components cannot be avoided.

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

A well applied layer will fill all cavities and at the same time does not prevent the metallic contact between baseplate and heatsink surface. A compound should be selected which shows permanently elastic features in order to assure a continuously favourable heat transfer resistance. The paste should be applied in a way that no screw holes are contaminated so that bolt torqueses are not degraded.

Common rollers or fine toothed spatulas can be used to apply the thermal grease. The layer thickness of the grease should typically be 50µm to 100µm on the baseplate of the module.

The manual application of the heat conductive paste with a constant layer thickness in the µm-region is problematic of course. The homogeneity and reproducibility of the layer thicknesses is always questionable. Generally the application is sufficient when after tightening the module a small quantity of surplus paste is squeezed out around the sides of the module.

For qualification and verification of the assembly process the imprint of disassembled modules should be checked in a training phase.

For this the thermal grease is to be applied according to the mounting notes. The layer thickness of the paste is correct when after heating up, unbolting and carefully lifting off the module, a branch-like structure can be seen on the baseplate as in figure 3.

In addition, it is possible to check the layer thickness of the thermal compound after application with the aid of a wet film comb.

As a guideline for the required amount of thermal compound for a homogenous layer thickness of 100µm, a volume of V=0.76cm^3 results from an EconoDUAL™3 module with a baseplate size of 62mm*122mm. These volumes can be measured with the aid of a syringe or applied from a tube.

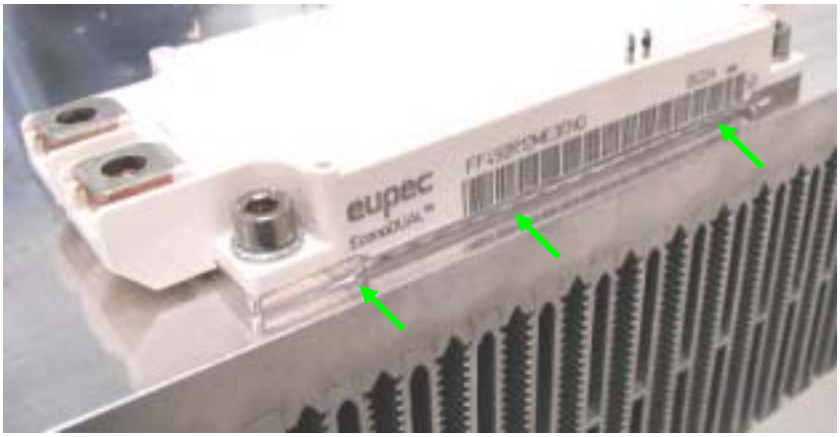

Figure 3 Mounted EconoDUAL™ module with thermal compound oozing out at the side

Recommendable is the application of thermal compound by a screen print process. Apart from an optimised and module specific distribution of the heat conductive paste, a homogenous and reproducible layer thickness application is achievable with this procedure.

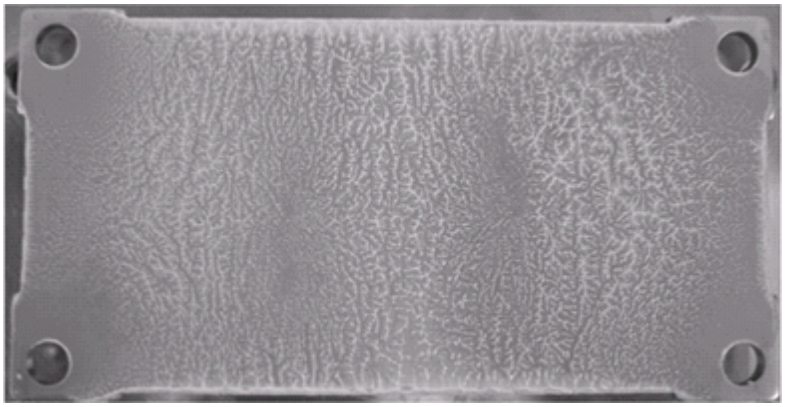

Figure 4 Print image of a disassembled EconoDUAL™ with branch-like structre of the thermal compound

Further notes regarding the application of screen print templates for the application of thermal grease can be found in the application note „AN2006-02 Application of silk screen”.

5 Bolts to mount modules to the heatsink

To mount the modules the following is recommended: DIN M5 bolts which comply at least with class 6.8, for example, according to DIN 912 (ISO4762), ISO 7380, DIN 6912, DIN 7984 in combination with a suitable washer and spring washer, for example, according to DIN 433 or DIN 125 or complete combination bolts.

The clearance and creepage distances specified in the EconoDUAL™ datasheets are the shortest clearance and creepage distances existing at the unassembled and unconnected module.

When selecting suitable M5 screws, washers and spring washers to mount the modules, it is recommended to consider the resulting clearance and creepage distances between the power terminal and the nearest bolt head or washer during the development phase and according to the valid Standards.

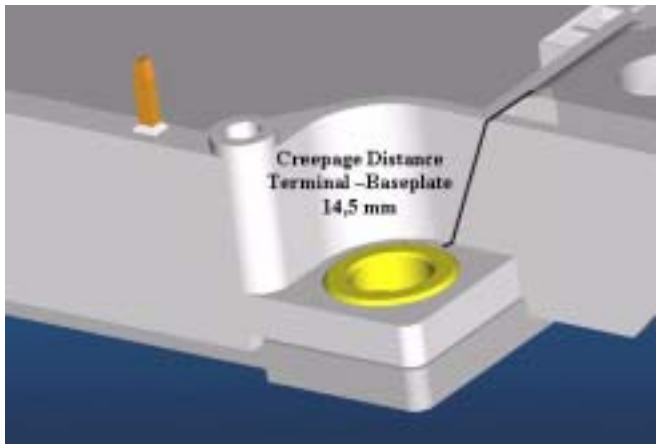

Figure 5 EconoDUAL™ creepage distance from power terminal to the mounting bush

6 Mounting modules to the heatsink

Mounting the module has to occur within the permissible module tolerances. Further information and drawings regarding the modules are given in the relevant datasheets.

The clamping force of the module resulting from the assembly process to the heatsink depends on the torque applied and the condition of the heatsink material. The following torque values specified in the datasheet result from steel bolts in aluminium heat sinks with a dry M5 thread and their typical friction factors of μ_G=0.2…μ_G=0.25 (μ_G=friction coefficient thread in heatsink):

M_{min}=3Nm to M_{max}=6Nm.

The module fastening bolts are to be tightened uniformly in the recommended sequences with the specified torque.

Other material combinations of bolts and/or heatsink material may require an adaptation of the mechanical parameters.

For a good thermal contact to the heatsink the following procedure is recommended when tightening the four M5 fastening bolts.

1. Place the module with the thermal compound applied onto the heatsink and fix with two bolts
2. Fix the bolts with 0.5Nm (hand tight crosswise) in the following sequence

   Bolt number 1 – 2 – 3 – 4
3. Tighten the bolts with 3Nm – 6Nm in the same sequence (crosswise)

   Bolt number 1 – 2 – 3 – 4

Depending on the viscosity of the thermal compound used an intermediate step 2.a. may be required for high viscosity. This will give the thermal compound the chance to flow during the assembly process to the heatsink and adapt to the module base plate and heatsink shape. After a certain pause time, depending on the thermal compound used, step 3 has to be carried out.

2.a. Tighten the screws with approx. 2Nm in the same sequence (crosswise)

Bolt number 1 – 2 – 3 – 4

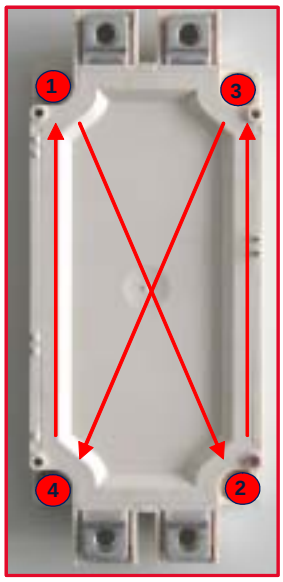

Figure 6 Tightening sequence to mount the module

When using thermal compound, it may be necessary depending on the type of paste to check the tightening torques of the fastening bolts for the correct value after a heat-up test. When using thermal foils instead of heat conductive paste, it is recommended to definitely perform this additional check. The torques given and application notes are valid when using thermal compound. Own tests and measurements with the heat conductive foils envisaged are absolutely necessary!

When selecting the heat conductive paste or heat conductive foil, the thermal contact and long-term stability should be considered and discussed with the manufacturer.

7 Connecting the busbars to the power terminals

Connecting the module has to occur within the permissible module tolerances given in the individual datasheets.

The DC power side should be connected with a laminated DC busbar in order to keep the switching overvoltages as low as possible by minimising the stray inductance. Adherence to the maximum permissible voltage at the power terminals and at the IGBT chip is to be assured according to the individual datasheet (see RBSOA).

For the connection of the power terminals DIN M6 bolts are required which comply at least with class 6.8, in combination with a suitable washer and spring washer or complete combination bolts. These should be tightened with the recommended torque of M_{min}=3Nm to M_{max}=6Nm.

When selecting the bolt length the layer thickness of the connected parts has to be subtracted from the total length of the bolts. 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 forces are not exceeded during assembly or later in operation.

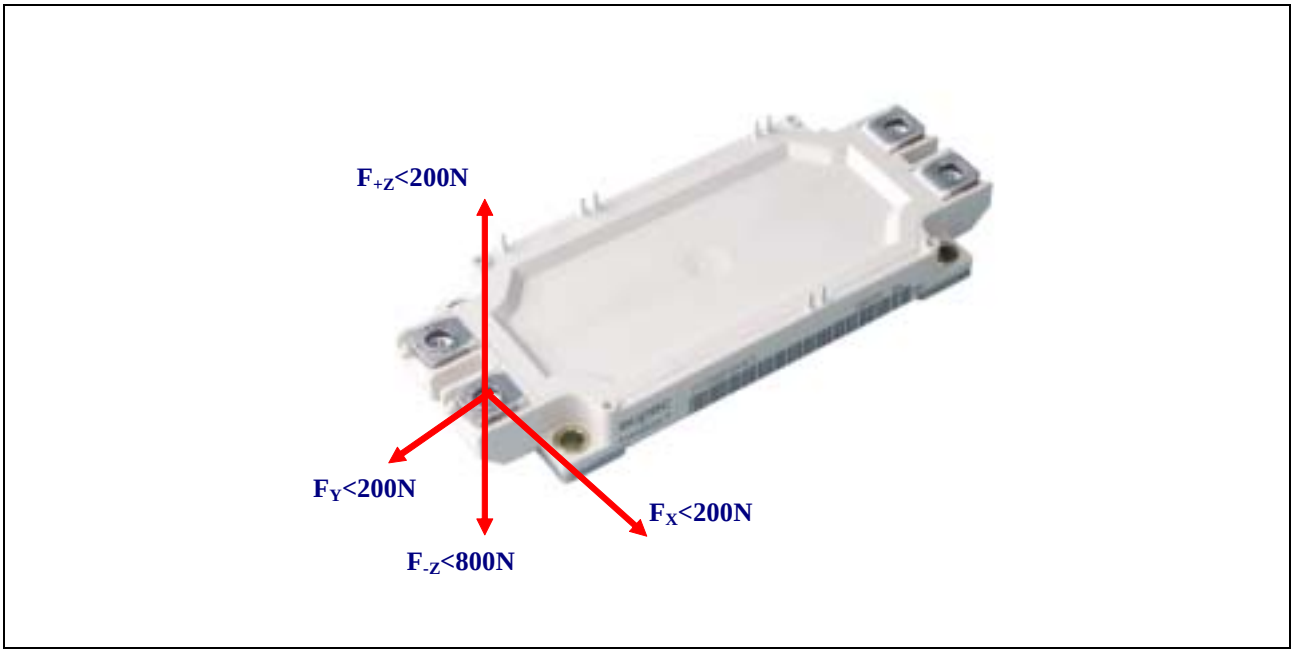

Figure 7 Maximum permissible pull and push forces at the power terminal of the EconoDUAL™

7.1 Connecting the power terminals with ideal strain relief

To terminate the power terminals with the best possible strain relief, an assembly according to the concept drawings figure 8 and figure 9 is recommended.

Including all tolerances the mounting block should be approx. 0.5mm lower than the height of the power terminals in order to ideally give a pre-tension to the power terminals.

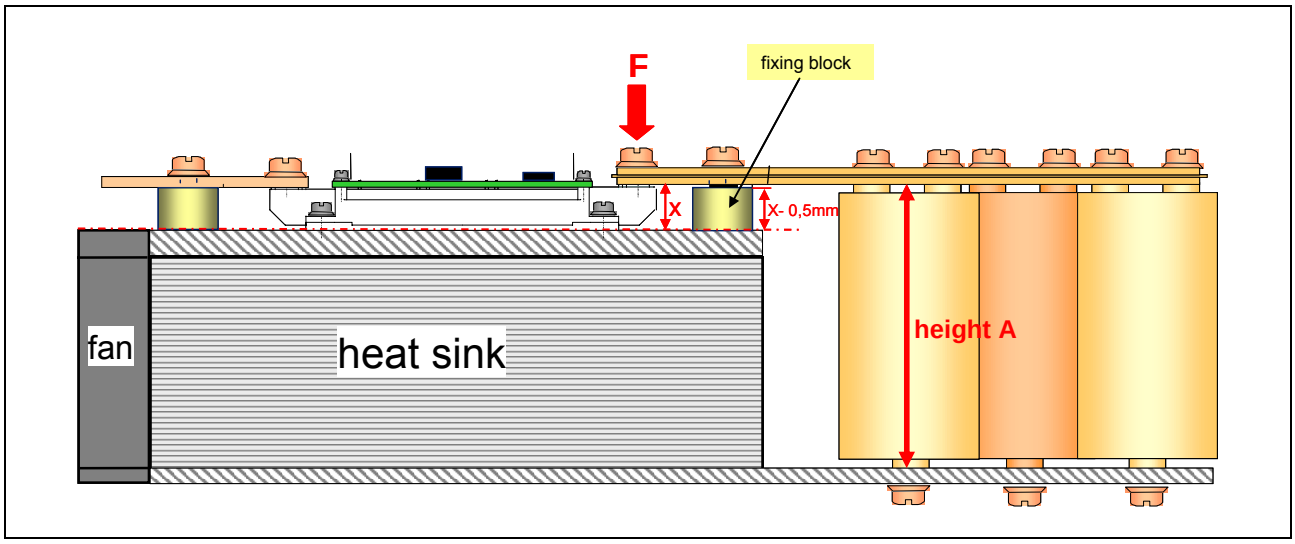

Figure 8 Concept drawing 1 of EconoDUAL™ assembly with ideal strain relief

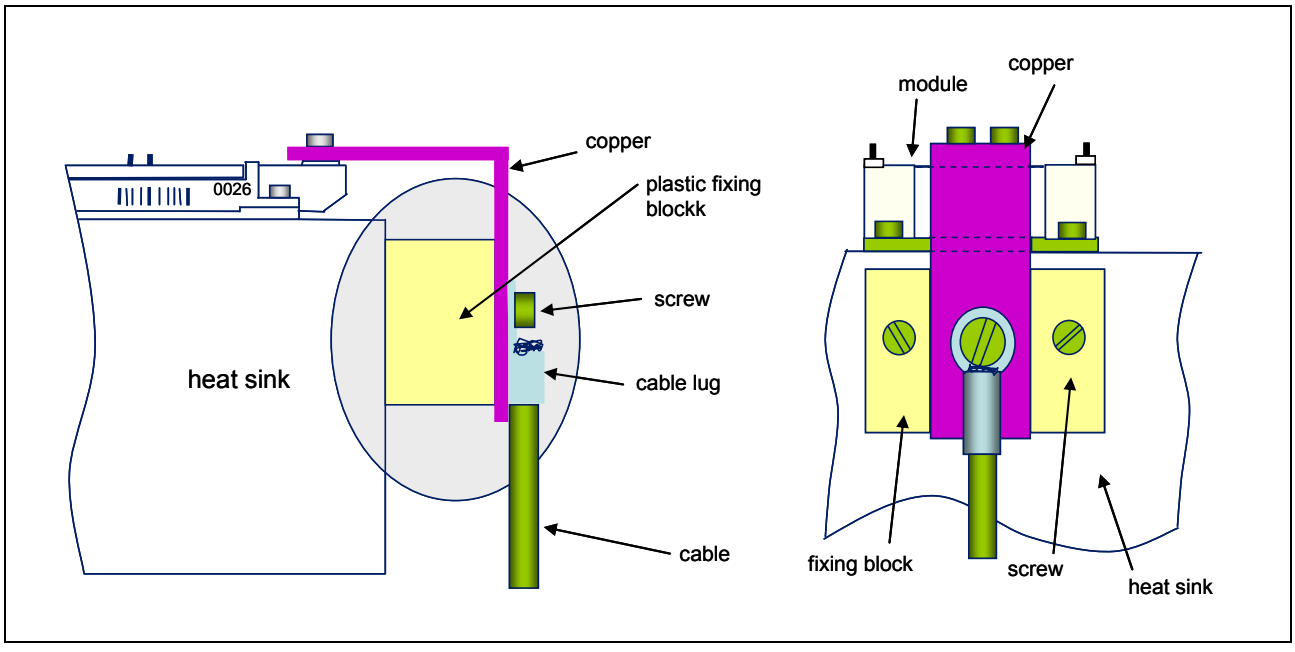

Figure 9 Concept drawing 2 of EconoDUAL™ assembly with ideal strain relief

8 Storage and transport of IGBT modules

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

Storage of the modules at the limits of the temperature specified in the datasheet is possible, however, 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_{maxair}=+40°C

Min. air temperature: T_{minair}=+5°C

Max. relative humidity: 85%

Min. relative humidity: 5%

Condensation: not permissible

Precipitation: not permissible

Iceing: not permissible

Pre-drying of the case prior to the solder process as it is recommended for moulded discrete components (e.g. microcontrollers, TO-cases etc.) is not required for EconoDUAL™3 modules.

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