Application Note AN 2012-05
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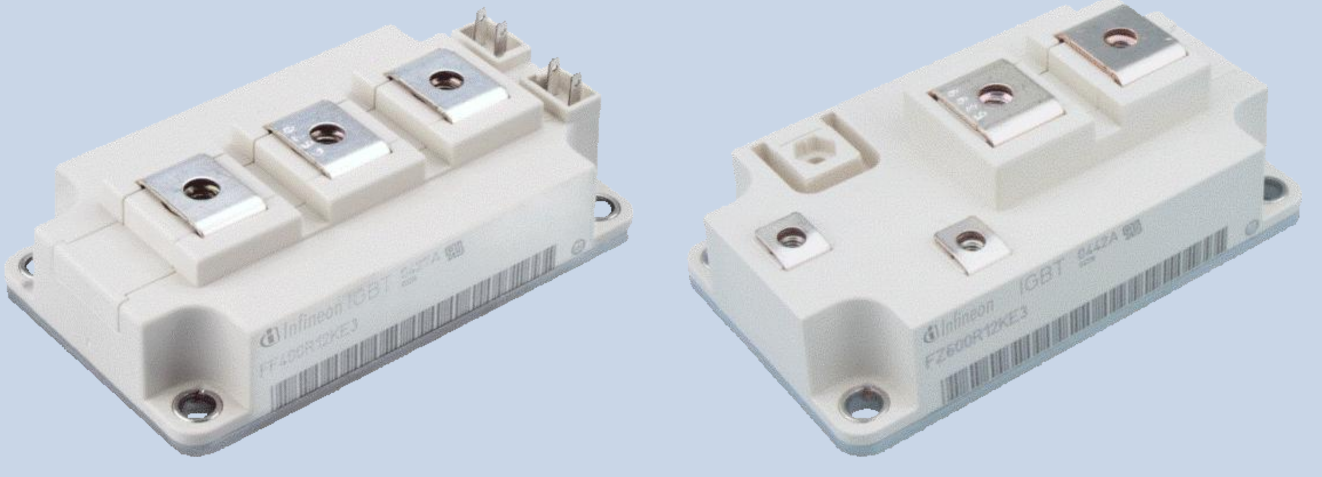
AN2012-05 - 62mm Modules Application and Assembly Notes



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62mm modules
Application and assembly notes

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1. General

These notes AN2012-05 Rev.1.2 for the application and assembly of Infineon 62mm modules, replaces AN2012-05 Rev.1.1., AN2012-05 Rev.1.0 and AN2002-08 Rev. V1.0.

62mm power semiconductors are electrical components.

Important aspects in the construction of the mechanical layout include the application conditions at which the components are put to use. These application conditions must be observed in the mechanical as well as the electrical design, the thermal design and the lifetime of the power modules based on the applied load profiles.

The notes and recommendations in this document cannot cover all and every application and condition. The assembly and application notes AN2012-05 Rev.1.2, therefore, will in no way replace a thorough assessment and evaluation of the suitability for the purpose envisaged by the user with the technical departments. Hence, the application notes do under no circumstances become part of the supply contractual warranty, unless the supply contract determines any different in writing.

2. Supply qualities

All IGBT modules undergo a final test before delivery according to IEC60747-9 and IEC60747-15. Inwards goods tests of the components at the recipient's site are therefore not required.

After an additional and final visual inspection, the components ready for shipping are packaged in an ESD protected transport box. Concaves and / or elevations of the baseplate in the µm-range are permissible within valid Infineon specification limits and therefore bear no influence on the thermal, electrical or reliability characteristics of the power modules.

Once the user has removed the components from the ESD protected shipping box, further processing should occur in accordance with the directive according to chapter 4.

3. Storage and transportation of 62mm modules

During transportation and storage of the modules, extreme forces such as shock and / or vibration loads are to be avoided as well as extreme environmental influences outside those storage conditions recommended by Infineon [1].

Storing the modules at those temperature limits specified by the data sheet is possible but not recommended.

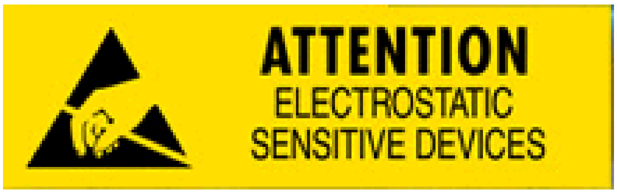
The storage time at the recommended storage conditions according to [1] should not be exceeded.

A pre-dry process of the module packages before assembly, as is recommended with moulded components like microcontrollers or TO-packages, is not required with 62mm modules if proper storage conditions are applied.

4. IGBT modules are electrostatic sensitive devices (ESD)

IGBT semiconductors are electrostatic sensitive devices which require to be handled according to the ESD directives. Uncontrolled discharge, voltage from non-earthed operating equipment or personnel as well as static discharge or similar effects may destroy the devices. The gate-emitter control terminals are electrostatic sensitive contacts. Take care not to operate or measure IGBT modules with open circuit gate-emitter terminals.

Electrostatic discharge (ESD) may partially or even completely damage IGBT modules.



The user must observe all precautions in order to avoid electrostatic discharge during handling, movement and packing of these components.

Important notice:

In order to avoid destruction or pre-damage of the power semiconductor components through electrostatic discharge the devices are delivered in suitable ESD packaging according to the ESD directives.
The installation of ESD workstations is required to unpack the modules and thus remove the ESD protection as well as handling the unprotected modules.

- Subsequent work steps are only to be carried out at special work stations complying with the following requirements

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

- All transport equipment and PCBs have to be brought to the same potential prior to further processing of the ESD sensitive components.

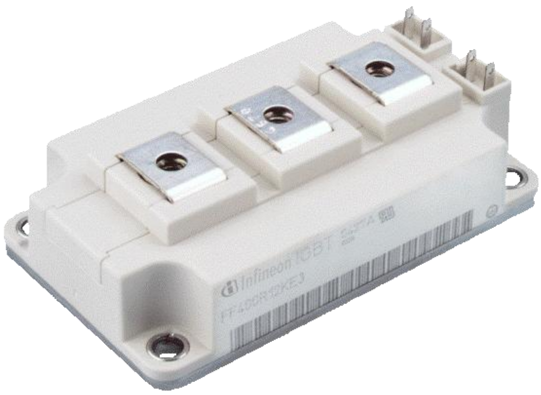
Further information can be derived from the standards in their current versions.

- 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 IEC801-2

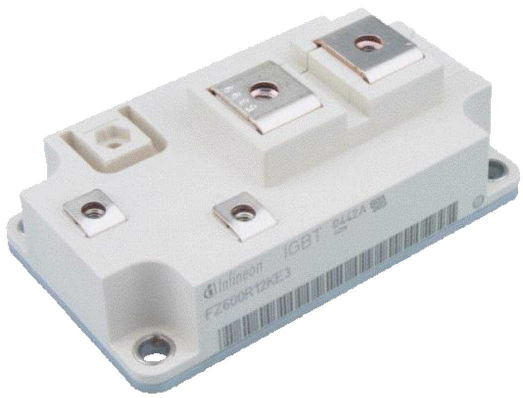
5. Module labelling, RoHS & Green Product

Infineon 62mm C-series modules comply with the directives according to RoHS and are marked as >>Green Products<< with a G as part of the module label. Data sheets listing product materials, Material Datasheet, may be ordered from Infineon.

A. 62mm halfbridge package



B. 62mm single switch package



Datecode	Datecode RoHS compliant
YYWW →	GYYWW

RoHS

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

Fig. 1: Green Product designation on 62mm module

6. Module selections

62mm modules are available in the most varied configurations as well as voltage and current ranges with differently optimised IGBTs and diodes.

The complete product overview and a selection and simulation program, IPOSIM, are available online at www.infineon.com.

Maximum values in the product datasheets and application notes are absolute values, which - even for brief periods - must not be exceeded, as this may cause pre-damage or destruction of the components.
Further information can be obtained from the application notes [2].

Selecting the most suitable component requires the consideration of various criteria. The overview below in figure 2 and figure 3 serves as a first illustration and hint.

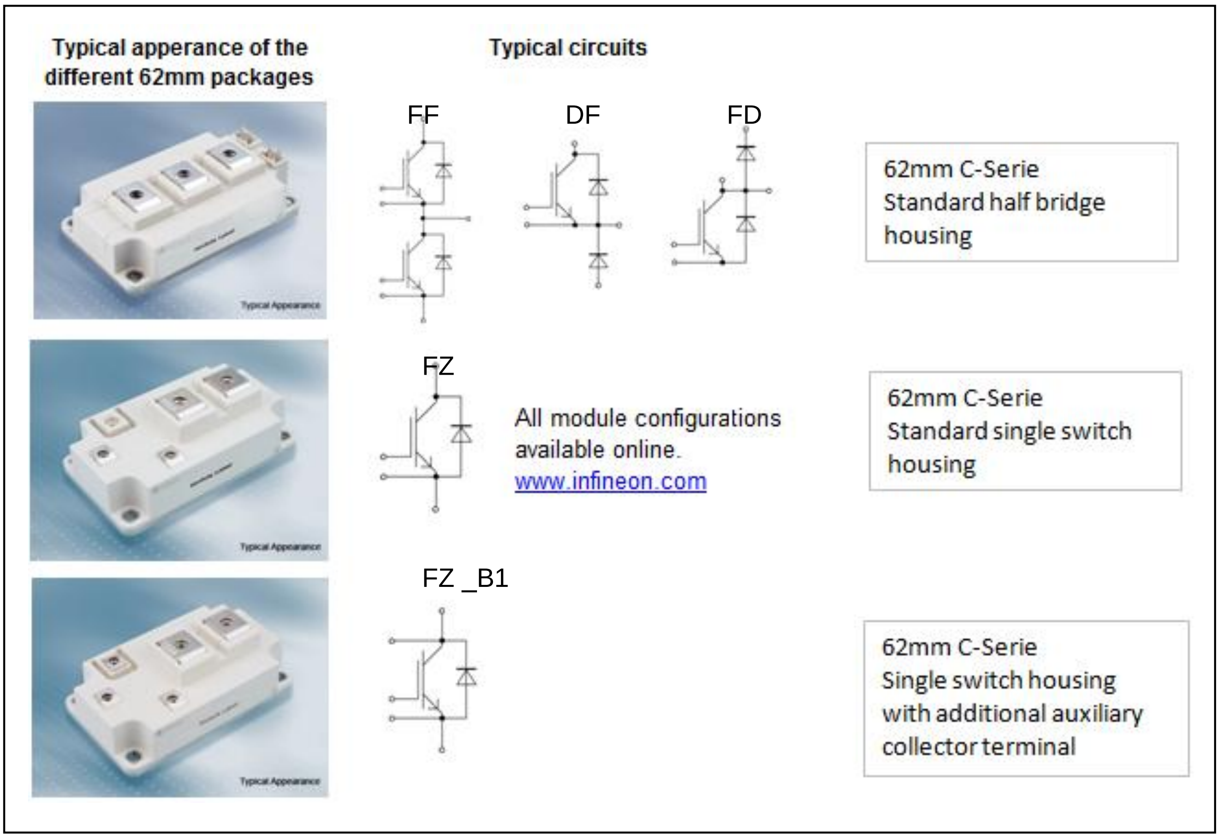


Fig. 2: Typical 62mm module package variants

FF 450 R 12 K T 4	
FF	FF= half bridge (two IGBT´s and FWD´s)
FZ	single switch (one IGBT and FWD)
FD	chopper module
DF	chopper module
DZ	single diode module
450	max. DC collektor current (A)
R	reverse conducting
S	fast diode
12	collektor emitter voltage in 100V
K	mechanical construction
T	fast switching trench/fieldstop IGBT
E	low saturation trench/fieldstop IGBT
P	soft switching trench/fieldstop IGBT
S	fast short tail IGBT
1...n	internal reference numbers e.g. 4=IGBT 4th generation
P	module with already applied thermal interface material (IFX TIM)
_S4	insulation test voltage Viso=4kV$_{RMS}$, f=50Hz, t=1min
_E	dual module with common emitter
_G	module in big housing
_B1	single switch with auxiliary collector
_B2	module with M5 nuts
_B5	single switch with addional series diode

Table 1: 62mm module designation overview

6.1 Selecting the module voltage class (V_{CES}) and the operation of modules at elevated heights

When selecting the appropriate voltage class, the IGBT has to exhibit a blocking capability appropriate to the application 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 collector-emitter voltage (V_{CES}) must not be exceeded even for short periods during switching and has to be considered in the selection of a suitable IGBT voltage class over the entire temperature range.

As a guideline to select a possible IGBT voltage class the following assumption [9] is suitable.

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

with S = safety margin in %.

Nominal supply voltage $U_{Nom,RMS}$ ±10%	U_{DC} nominal DC-link voltage	Preferred IGBT voltage class (two level) V_{CES}
230V_{RMS}	360V	600V or 650V
400V_{RMS}	620V	1,2kV
690V_{RMS}	1070V	1,7kV

Table 2: IGBT blocking capability as a selection criterion of the supply voltage

The Collector-emitter overvoltage shoot (ΔU_{CE}) of the IGBT during turning off, affected by the collector current slope ($\frac{di_C}{dt}$) and the parasitic inductances (L_σ), must be considered by selecting a proper voltage class.

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

Operation of power semiconductor components above normal heights e.g. at heights >2000m above sea level or operation of power semiconductor components at high DC voltages may necessitate in limiting the operating range.

- Due to the lower air pressure the cooling capability of air cooling systems needs to be evaluated.
- The isolation properties, especially the clearance distances need to be adjusted due to the lower dielectric strength of the air. See also Chapter 7.
- Possible statistical failure rates due to the operation of the power semiconductors at elevated heights (cosmic radiation) and / or at high voltage have to be considered when selecting a suitable voltage class and generally during the design phase.
- With operating temperatures T <25°C, the reduced blocking capability typical for IGBTs and the switching behaviour of the components at these temperatures in the particular application has to be kept in mind and should be studied independently in the user's design. The specification of the blocking capability in dependence of the temperature T = -40°C to T = +25°C is available upon request through your sales representative for Infineon power devices.

The power cycling capability for the envisaged lifetime needs to be calculated on the basis of the load profile. Further information on the subject is available on request and in [3].

6.2 Climatic conditions during active, current carrying operation of 62mm Modules

62mm modules are not hermetically sealed. The housings and the molding compound, used for the electrical isolation within the housing, are permeable for humidity and gases in both directions. Therefore humidity differences will be equalized in both directions.

Corrosive gases must be avoided during operation and storage of the devices. The climatic conditions for Infineon 62mm Modules in active, current carrying operation are specified as per EN60721-3-3 class 3K3 for fixed installations.

The operation of the modules in humid atmosphere caused by condensation and/or the operation in climatic conditions beyond class 3K3 of EN60721-3-3 must be avoided and additional countermeasures need to be taken in such cases.

Corrosive gases must be avoided in any case during operation as well as in storage conditions.

7. Module creepage and clearance distances

When calculating the isolation characteristics, consider the application specific standards, particularly regarding clearance and creepage distances.

The module-specific 62mm C-series package drawings can be taken from the datasheets or can be acquired in electronic form as a CAD file via your sales partner for Infineon modules.

In particular with the selection of the bolts and washers, clearance and creepage distances must be considered. Please also note the information in Chapter 6.1. In order to suit the application requirements here, if necessary, avoid electrically conducting components or plated-through holes or take isolation measures, e.g. lacquer.

Clearance and creepage distances indicated in the 62mm module datasheets are those specified with the not assembled and unconnected module. These values are the existing shortest clearance and creepage distances for pollution degree 2 in accordance with IEC60664-1. The following tables show an overview of these clearance and creepage distances of the different package variants.

7.1 Clearance and creepage distances 62mm half bridge housing (FF, FD, DF)

Description	Values	Remark
a. Creepage distance: Contact to heatsink	29mm	from 4 to module mounting hole, from 6 to module mounting hole
b. Creepage distance: Contact to contact	23mm	from 3 to 5, from 3 to 7
c. Clearance: Contact to heatsink	23mm	from 4 to module mounting hole, from 6 to module mounting hole
d. Clearance: Contact to contact	11mm	from 3 to 5, from 3 to 7

Table 3: Clearance and creepage distances 62mm half bridge housing

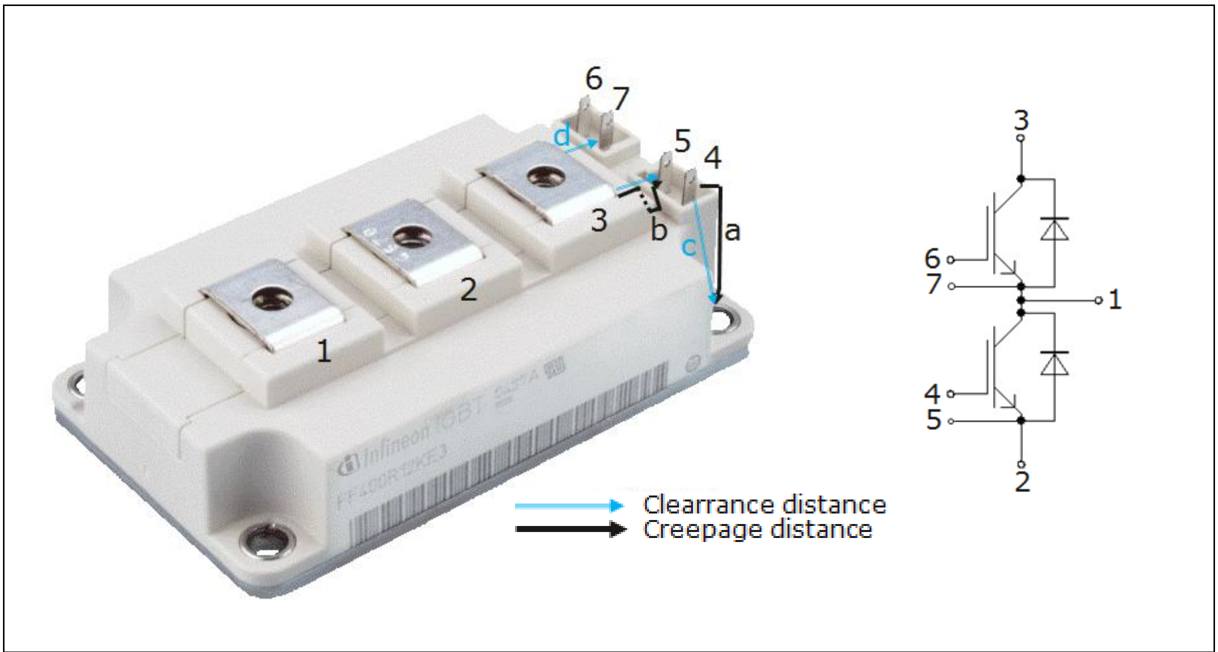


Fig. 3: Shortest creepage distances of the not assembled and unconnected 62mm half bridge package

7.2 Clearance and creepage distances 62mm single switch package (FZ)

Description	Values	Remark
a. Creepage distance: Contact to heatsink	25mm	from 5 to module baseplate
b. Creepage distance: Contact to contact	19mm	from 2 to 3
c. Clearance: Contact to heatsink	25mm	from 5 to module baseplate
d. Clearance: Contact to contact	14mm	from 2 to 3
d_1. Clearance: Contact to contact	10mm	from 4_1 to 5 (only with B1 modules)

Table 4: Clearance and creepage distances 62mm single switch package

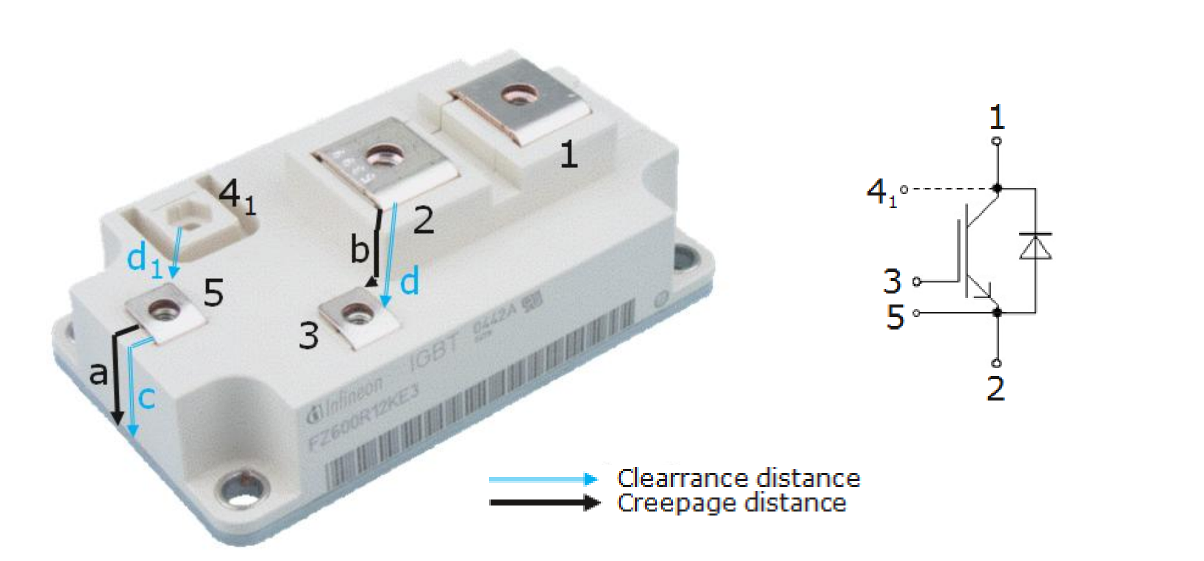


Fig. 4: Shortest creepage distances of the not assembled and unconnected 62mm single switch package

In any case, clearance and creepage distances in the application are to be examined and to be compared with the requirements from the user-specific standards and, if necessary, to be assured by design measures.

8. Module assembly and connections

All protective measures against electrostatic discharge during handling and assembly of the IGBT modules have to be taken by the user. See also section 4.

8.1 Quality of the heatsink surface for module assembly

The energy occurring as losses in the module must be dissipated by a suitable heatsink, in order not to exceed the maximum temperature during switching operation (T_{vjop}), specified in the datasheets. In addition see [4]. The quality of the heatsink surface within the space of the module placement is of great importance, since this contact between the heatsink and the module is of crucial influence to the heat dissipation of the module.

For optimal heat dissipation the condition of the contact area of the heatsink to each 62mm module may not exceed the following values.

62mm module 61.4mm x 106.4mm: Surface flatness ≤30µm
62mm module 61.4mm x 106.4mm: Surface roughness R_z ≤10… 15µm

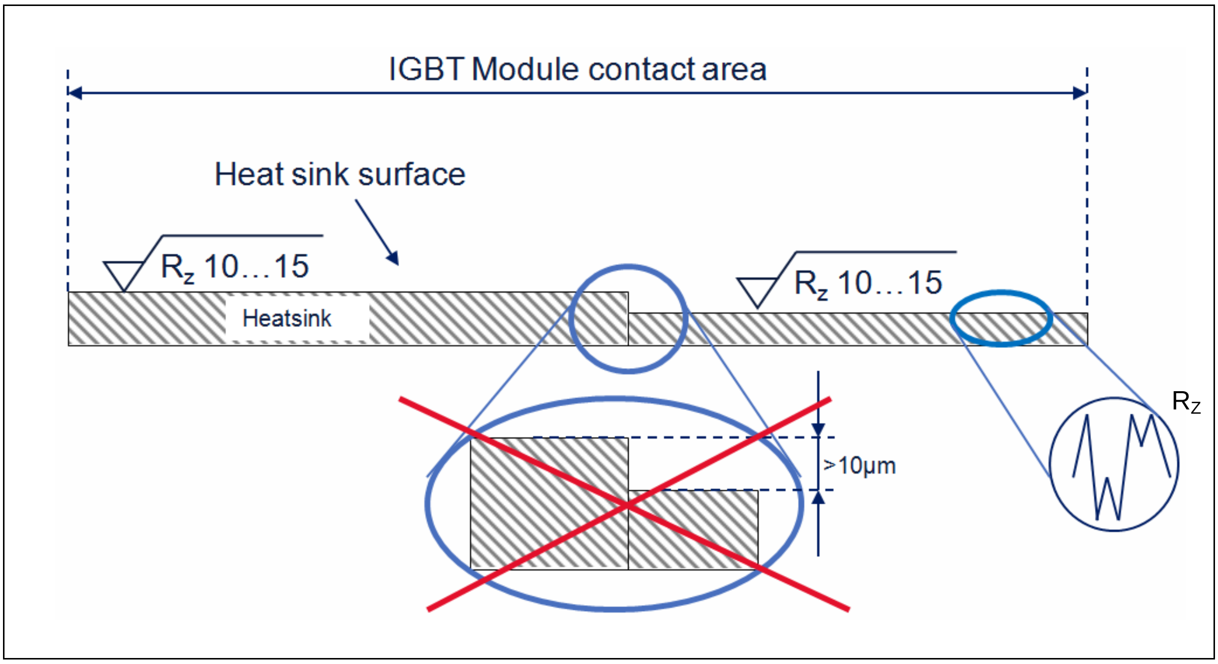


Fig. 5: Recommendation for the condition of the heatsink surface before module assembly

The contact areas, the baseplate of the module and the surface of the heatsink must be free of damage and contamination, which would worsen the thermal contact. Before the module is mounted it is recommended to clean the contact areas with a lint free cloth.

The heatsink must be of sufficient stiffness for the assembly and the subsequent transport, so it will not exert additional mechanical stresses on the baseplate of the module. During the entire assembly process the heatsink must rest free of twisting, e.g. on a suitable carrier jig.

8.2 Thermal interface material

Due to the individual surface shape of the module baseplate and the heatsink, these do not seat solidly across the entire area, so that it cannot be avoided that gaps will form between the two components over parts of the contact surface.

To dissipate the losses occurring in the module and to allow a good flow of heat into the heatsink, all the voids will need to be filled with a suitable heat-conductive material.

The thermally conductive material should have long-term stability properties appropriate to the application and ensure a consistently good thermal contact resistance. Also it should be applied so that the mounting holes are not contaminated and, thus, torque values falsified.

8.2.1 Infineon's thermal interface material – IFX TIM

For maximum long-term stability and thermally excellent properties Infineon has developed a material optimised for IGBT power modules called IFX TIM.

62mm modules may be purchased with IFX TIM applied in an optimised structure from your Sales partner for Infineon components. These bear the addition P in the type designation.

Further information can be found in [5].

Example of a print image on the baseplate of an IGBT module after the IFX TIM material has been applied.

Fig. 6: 62mm module with IFX TIM

If you are using 62mm modules which have IFX TIM already applied, modules with the extension P, then please continue with section 8.3.

8.2.2 Application of standard thermal paste in a screen printing processes

When using 62mm modules in which the thermal interface material - IFX TIM – has not been applied by the manufacturer, the user himself has to select and qualify the thermal paste used for suitability and long-term stability.

To apply the heat conductive material, e.g. thermal grease in combination with the screen printing the suitability has to be verified independently and individually by the user.

To achieve an optimal result, the module, the geometry of the application, the contact area of the heatsink, as well as the applied material have to be considered as one unit.

To apply thermal paste manually with a layer thickness in the µm-range is inherently problematic because an optimally filled layer should close all gaps but not prevent the metallic contact between the baseplate and heatsink surface. Therefore it is recommended to apply thermal grease with a stencil printing process. With this method it is possible not only to have a customised application according to the type of module but a reproducible adjustment of the layer thickness..

Further information on the use of screen printing stencils for the application of thermal compound can be seen in the guidelines [6].

The module-specific drawings of a printing stencil can be obtained from the distribution partner for Infineon modules.

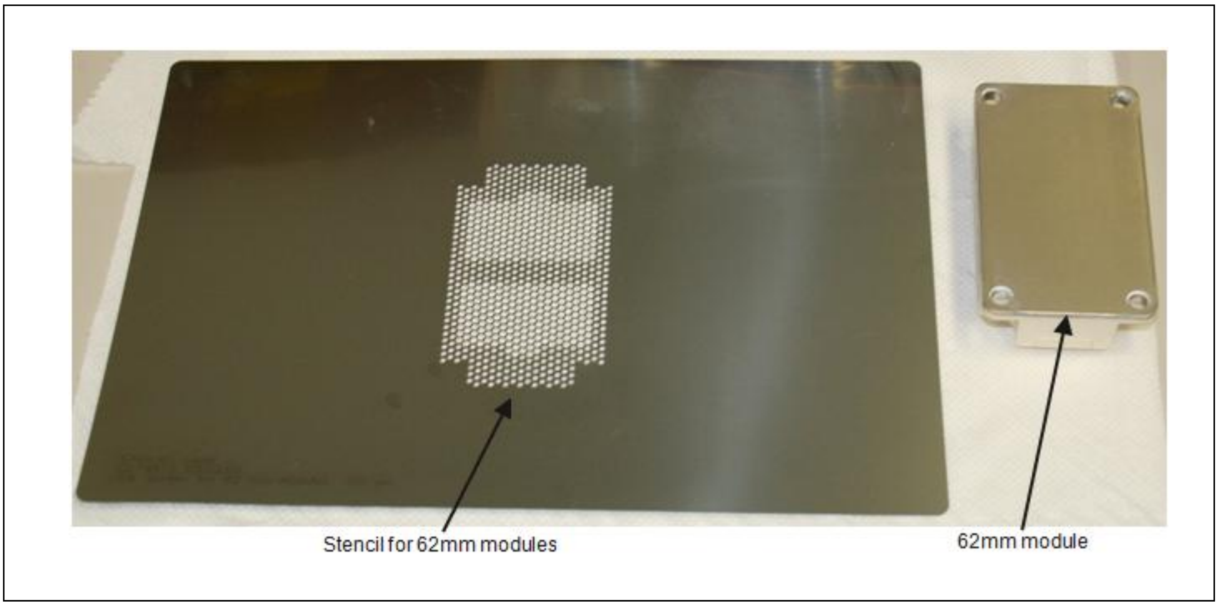
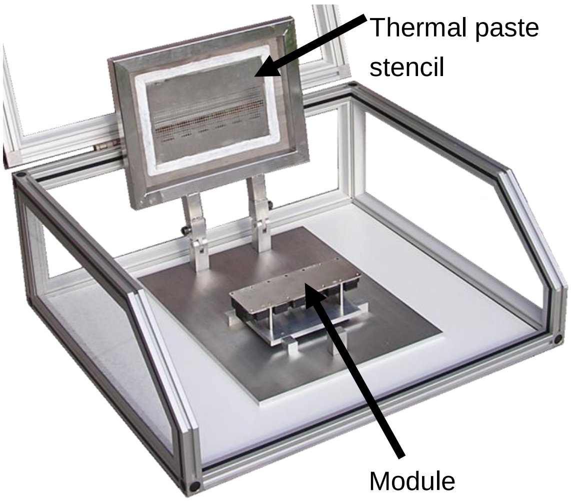


Fig. 7: Stencil for Infineon 62mm modules

The following pictures show examples of screen printing thermal paste.

A. Thermal paste applicator



B. Applying thermal paste

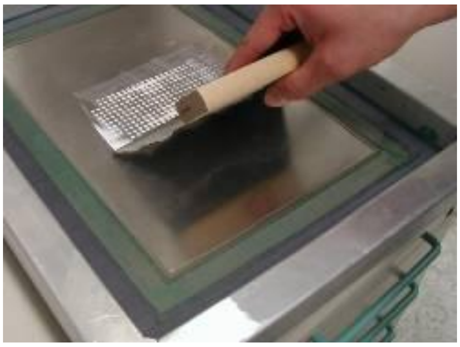


Fig. 8: A. Example of an applicator jig to spread thermal paste in a screen printing process, detailing a module baseplate.
B. Application of thermal grease using s stencil

1. Clean the stencil of possible thermal grease residues. This step can be carried out with suitable solvents. Observe the safety regulations when handling these materials.
2. Align stencil and module. Perhaps with a jig holding the module as shown in Figure 8.A.
3. Lower the stencil onto the module baseplate
4. Apply the thermal paste over the stencil, see 8.B. It is imperative that all stencil holes are filled with thermal paste.
5. Lift the template and remove the module
6. Visual inspection after application of the material ensures that every point of the template is filled. The application of paste itself using a template, especially when performed manually, can be affected by a poor alignment of the stencil and small variations in the amount of paste, and thus increase the expected temperature by a few degrees.
7. The measurement of the thickness of the deposited material is therefore strongly recommended and ensures that an adequate amount of material was applied.

When applying the paste with the aid of a tool on the template, the possible wear of the template and the possible concomitant reduction in the layer thickness is to be checked at intervals. Templates are to be replaced if they no longer have the predetermined thickness.

8.2.3 Alternative ways to apply standard thermal paste

When using 62mm modules in which the thermal interface material - IFX TIM – has not been applied by the manufacturer, the user himself has to select and qualify the thermal paste used for suitability and long-term stability.

If it is not possible to apply the standard thermal compound by the recommended screen printing process, the paste can alternatively be applied manually. Typically a uniform layer thickness of 50-100µm thermal paste is sufficient on the baseplate of the module. The suitability and long-term stability of the thermal compound used and its application is to be qualified by the user.

Here a guideline for the required amount of paste and the subsequent layer thickness
d= 50µm: $V \approx 0.33 cm^3$,
d=100µm: $V \approx 0.66 cm^3$.
This amount can be measured from a syringe or applied from a tube.

Common rollers or fine toothed spatulas like notched trowels can be used to apply the thermal grease. The homogeneity and reproducibility of the self-adjusting layer thicknesses in manual application is subject to large tolerances. With the help of a wet film gauge the thickness can be checked after applying the thermal compound, see Figure 9.

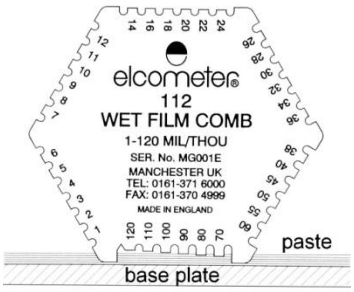


Fig. 9: Wet film gauge to check the layer thickness of the thermal compound

The application guidelines, the thermal contact and the long-term stability of the thermal interface materials to be considered in the selection must always be qualified by the user for the proposed procedure and the intended application and may be discussed with the compound manufacturer.

8.3 Module assembly onto the heatsink

The module assembly must comply with the tolerances specified in the module datasheets. The module-specific outline drawings can be taken from the datasheets or are available in electronic form as a CAD-file from your sales partner for Infineon modules.

The torque values and guidelines apply to the use of IFX TIM or standard thermal paste.

The bolt mounting of the module on the heatsink has to be such that the sum of all occurring forces does not result in exceeding the yield point of the joined parts. Setting devices, such as spring washers, will increase the elasticity of the connection and thus compensate the settling effects. Thereby the pre-tension force will largely be retained, and thus a loosening of the assembly counteracted.

The tightening torque must be chosen so that the applied pre-tension force leads to a pure frictional bond of the components. Knowledge of the friction coefficient μ is a prerequisite to accurately determine preload and tightening torque. The friction depends on many different factors, such as material combination, surface, lubrication, temperature, etc. The torque values in table 5 are specified for the typical, clean combination of aluminium heatsink with galvanized M6 steel screw and a friction coefficient of $\mu_G \approx 0.14$. Should the coefficient of friction differ in the real construction, the torque must be adjusted accordingly. It is recommended to tighten the bolts with a torque close to the maximum recommended torque M_{max}. This maximum torque must not be exceeded.

Description	Value	Note
Mounting bolt	M6	1.
Maximum recommended torque	M_{max} = 6Nm	2.
Recommended property class of the bolt	8.8	3.
Minimal thread length into the heatsink	1.6 x d = 9.6mm	4.

Table 5: Technical data of the mounting bolts

1. according to ISO4762, DIN6912, DIN7984 ISO14581 or DIN7991 in combination with a suitable washer, e.g.. according to DIN433 or DIN125 or complete combination bolts according to DIN6900, recommended for module assembly.

2. calculated for a friction coefficient of μ_G=0.14 (thread clean and dry, aluminium heatsink, bolt acc. to ISO14581, zinc-galv., thread rolled). The torque used should be approx. max torque.

3. at least 6.8

4. into aluminium; according to technical literature

Other material combinations of bolts and / or heatsink material may require an adjustment of the mechanical parameters and an evaluation of the corrosion stability.

The module mounting bolts are to be tightened evenly crosswise with a torque inside the specified limits.

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

1. Place the module, with the heat transfer compound applied, onto the clean heatsink and fixes it by inserting two screws approximately half length.

2. Followed by the other screws about half length

3. Tighten all screws crosswise hand-tight (0.5 Nm) in the following sequence
e.g. bolt No. 1 - 2 - 3 - 4 (see Figure 10)

When using Infineon modules with the thermal interface - IFX TIM - already applied by the manufacturer continue with step 4.

If you do <u>not</u> use the already applied IFX TIM material recommended by Infineon, then, depending on the viscosity of any alternative material, an additional intermediate step 3.a. may be necessary. For example with high viscosity material, to give the thermal paste the chance to flow during the tightening and so to adapt the module baseplate to the heatsink contour. Then continue with step 4.

3.a. Tighten bolts crosswise with 0.5 ... 1Nm in the same sequence with subsequent retention time.
e.g. bolt No. 1 - 2 - 3 - 4

The retention time depends on the material used and is determined in the user's own responsibility by investigation / experiments with the favoured material. As a guide for initial investigation during the development phase, a retention time of about 10min to 20min can be expected.

4. Tighten bolts crosswise with 3Nm - 6Nm in the same sequence
e.g. bolt No. 1 - 2 - 3 - 4

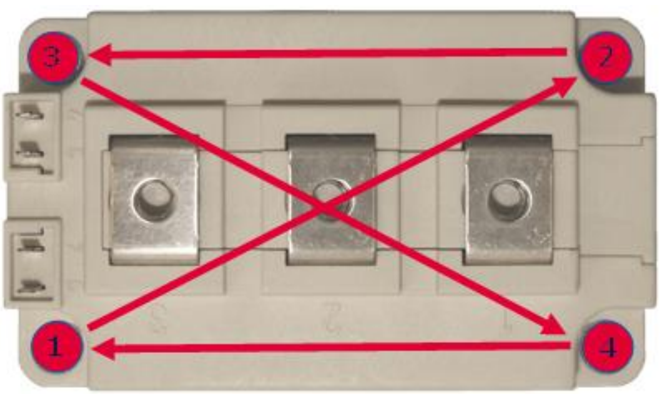


Fig. 10: Tightening sequence when mounting the module

The tightening sequence is the same for all 62mm modules and types.

When using standard thermal compound, it may be necessary, depending on the nature of the paste, to check the tightening torques for the correct value of the bolts after a burn-in period. When using phase change film for heat conduction instead of thermal grease it is recommended that the additional verification step must be carried out. The use of solid foil cannot be recommended due to unsuitable properties for power devices.

For the qualification and verification of the assembly process and the suitability of the thermal design some experiments and measurements are essential with the thermal compound or an alternative material provided. The maximum junction temperature occurring under application conditions is to be reviewed by thermal measurements. The maximum junction temperature (T_{vjop}) in pulsed operation must not exceed the specified maximum junction temperature in the datasheets [4]!

For thermal measurements close to the chip, it is necessary to place the sensor probe under the chip, like in figure 11. Knowledge of the exact chip positions is essential. The module-specific chip positions may be enquired via the distribution of Infineon IGBT power modules.

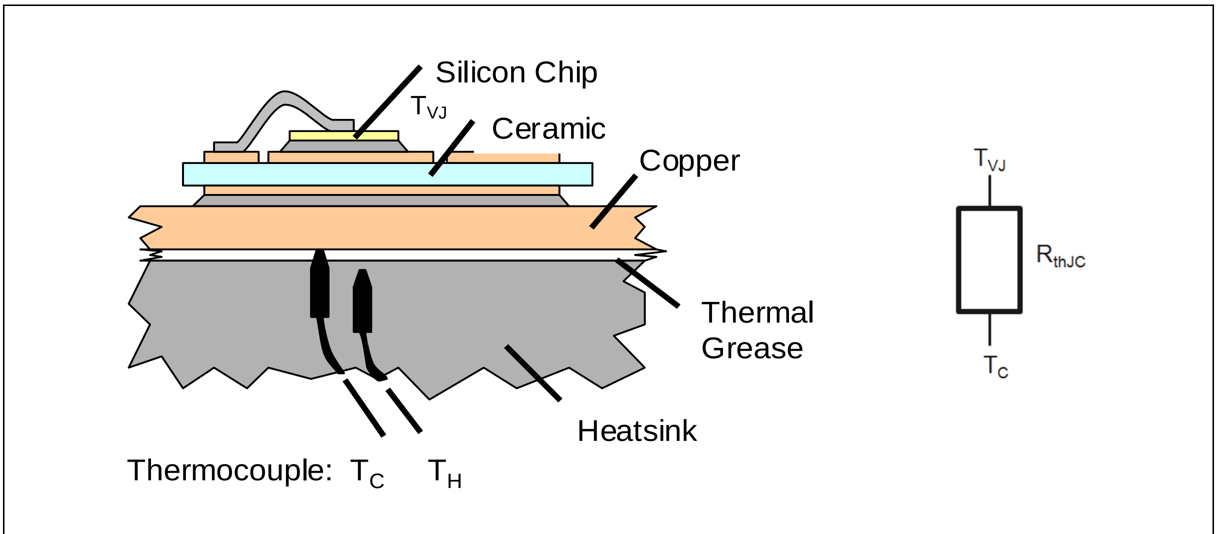


Fig. 11: Example of temperature measurement set-up using a thermo-couple

The junction temperature T_{VJ} can be determined by the formula (2). The switching and conduction losses (P_V) as well as the baseplate (T_C) temperature must be given for the calculation:

$$T_{VJ} = T_C + P_V \cdot R_{thJC} \tag{2}$$

T_{VJ}: junction temperature (virtual)
T_C: case temperature
P_V: total power losses
R_{thJC}: thermal resistance, junction to case

8.4 Connection and assembly of the power terminal busbars

The module must be connected within the permissible module tolerances specified in the outline drawings in the respective datasheets. The position and tolerance of adjacent components such as PCBs, DC-bus, mounting bolts or cables has to be designed such that, after the connection, no sustained effect on the static and / or dynamic tensile forces are exerted on the terminals.

To connect the power terminals of 62mm modules M6 and for the B2 version of the modules M5 bolts are required. The bolts should be selected according to ISO4762, DIN7984 or DIN7985 with at least property class 6.8, in combination with a suitable washer and lock washer or combination screws according to DIN6900. These are then tightened with a torque specified in the datasheet. Recommended is the use of a torque value near the maximum torque. The maximum torque values in Table 6 must not be exceeded, however.

The tightening torque must be chosen so that the applied pre-tension force leads to a pure frictional bond of the components. Knowledge of the friction coefficient μ is a prerequisite to accurately determine preload and tightening torque. The friction depends on many different factors, such as material combination, surface, lubrication, temperature, etc. The torque values specified in Table 6 assume a clean pair with a galvanised metric M6 steel bolt. Should the coefficient of friction in the construction differ from this, adjust the torque value accordingly.

	Module type	Terminal	Bolt	Max. torque M_{max} / Nm
1	62mm C-series halfbridge	Power	M6	5
2	62mm C-series halfbridge B2	Power	M5	5
3	62mm C-series single switch	Power	M6	5
4	62mm C-series single switch	Auxiliary	M4	2

Table 6**:** Tightening torque M for the mounting bolts of the electrical connections with a friction coefficient of μ≈0.14 in the terminal thread

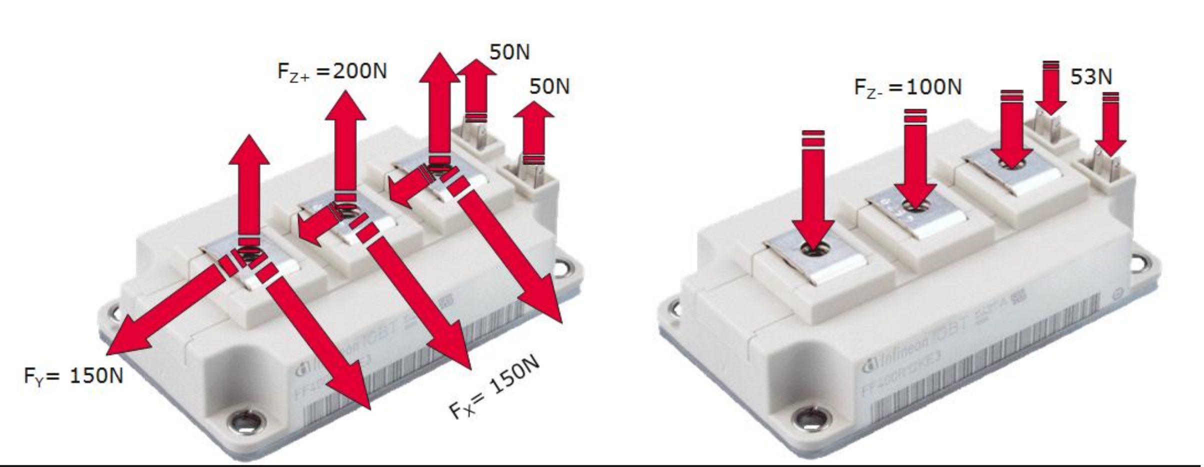
The choice of bolt length depends on the maximum thread depth specified for the module and the gauge of the connecting parts. The sum of these values must not be smaller than the selected bolt thread length. The effective thread length of the bolts into the module power terminals must not exceed the maximum specified depth of 10mm. For single switch auxiliary terminals this is 8mm. Other material combinations of bolts and / or the DC busbar material may require an adjustment of the mechanical parameters and an evaluation of the corrosion stability in combination.

The design of the threaded connection for the power terminals must be such that the sum of all loads occurring does not exceed the yield point of the joined parts. Settling devices will increase the elasticity of the connection and thus compensate the settling effects. Thereby the pre-tension force will largely be retained, and thus a loosening of the assembly is counteracted.

62mm modules

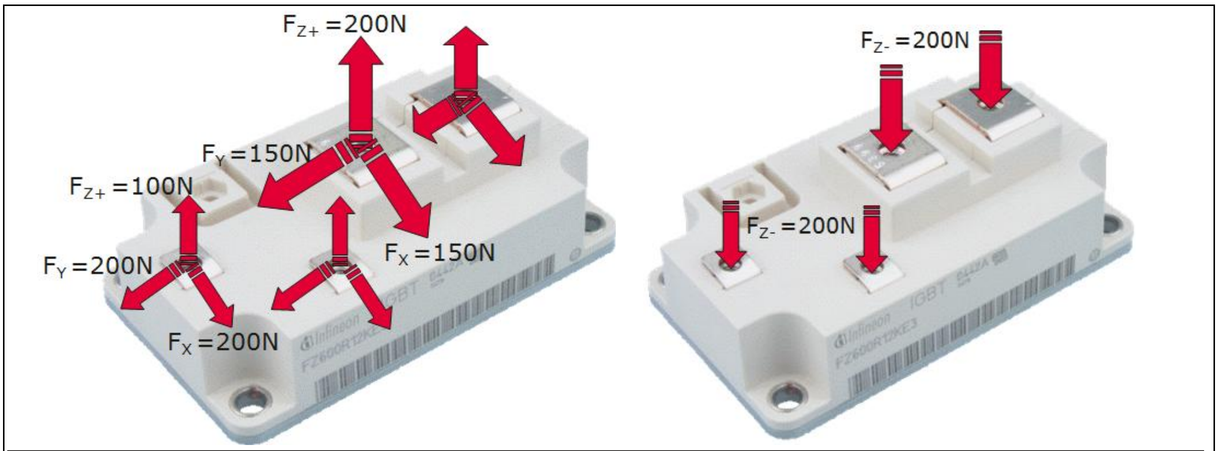
Application and assembly notes

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



Maximum permissible pulling and pushing forces **exclusively** during the assembly process @ T_{amb}=25°C

Fig. 12: Maximum permissible forces during the assembly process at the terminals of a halfbridge 62mm module



Maximum permissible pulling and pushing forces **exclusively** during the assembly process @ T_{amb}=25°C

Fig. 13: Maximum permissible forces during the assembly process at the terminals of a single switch 62mm module

It is recommended to have an assembly which leaves the power and auxiliary terminals permanently free of mechanical stress over the entire temperature range.

Since such an assembly is inherently problematic over the entire temperature range, the construction should be such that the power terminals of all package variants as well as the auxiliary terminals of the single switch variant exhibit a load bias by means of suitable spacers.

It must be ensured that the direction of the bias force always acts in the direction of the baseplate. The suitability of the support must be evaluated individually in the structure.

Static forces in other directions as well as exposure to vibration and / or thermal expansion should be avoided.

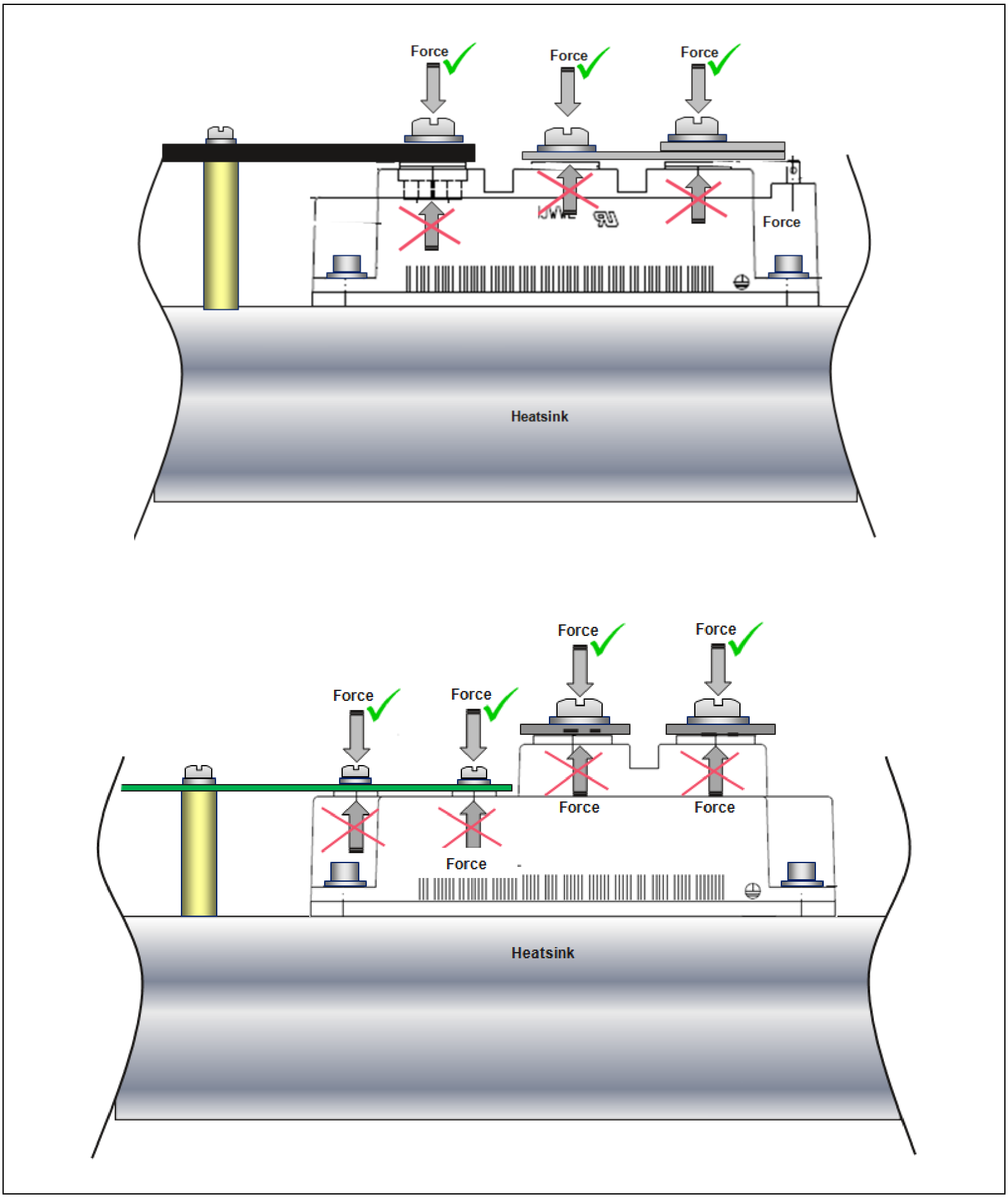


Fig. 14: Module assembly with load bias direction

The DC busbars have to be designed such that the maximum temperature at the power terminals $T_{Terminal}$ =125°C will not be exceeded.

To design the power busbars it is necessary to consider not only the current rating but also the additional power loss of the module's terminal connections.

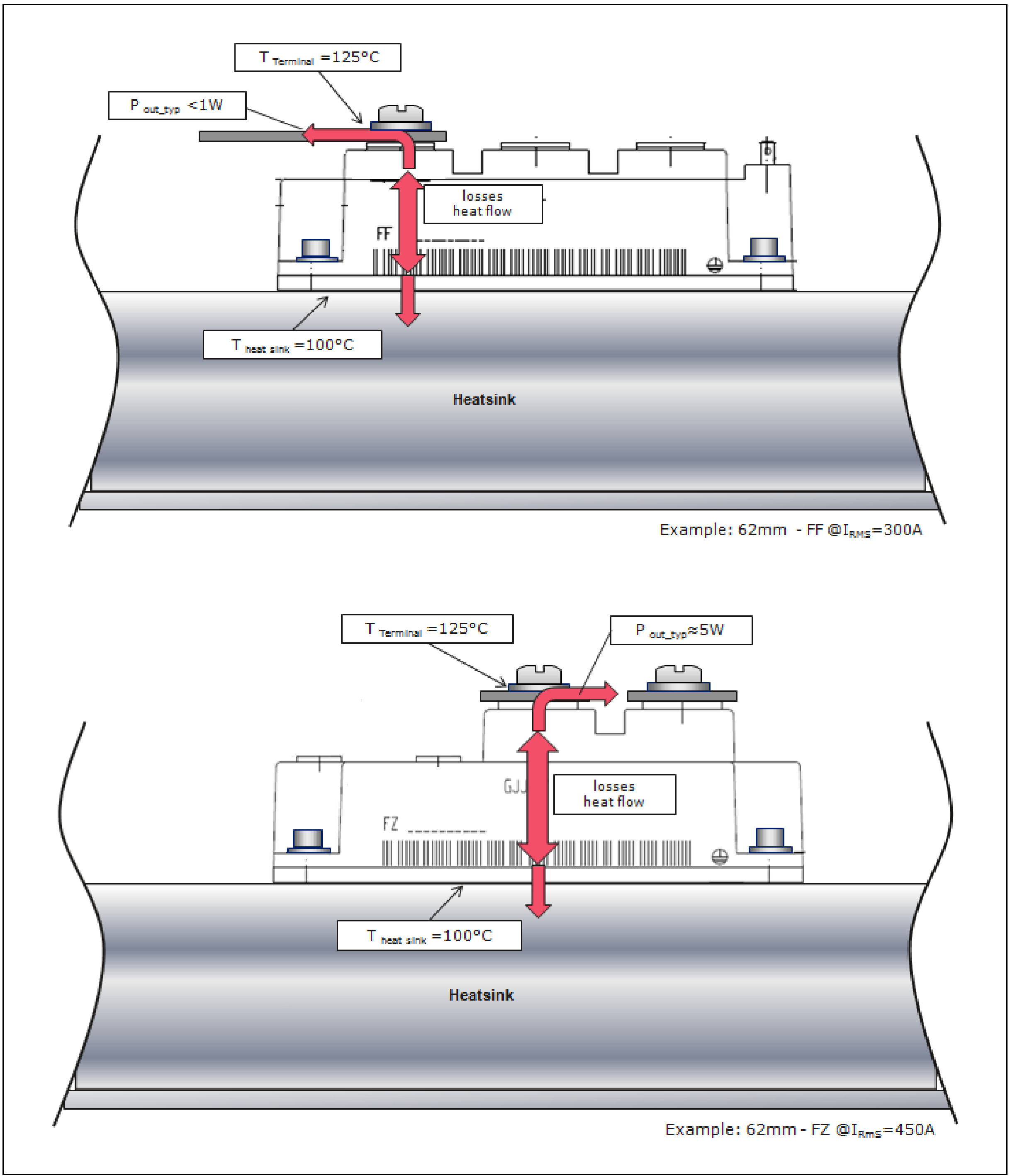


Fig. 15: Heat transfer via the power terminals

8.5 Example of a low inductive DC-bus

In addition to the maximum temperature at the terminals it is mandatory to assure compliance with the maximum collector-emitter voltage (V_{CE}) at the power terminals and, hence, at the IGBT chip corresponding to the respective data sheet, see RBSOA diagram.

It is recommended to connect the DC side via a laminated DC bus bar in order to minimise the systemic switching overvoltage by reducing the leakage inductance as far as possible.

For a low-inductance structure and a symmetric current distribution in the DC-bus circuit a balanced connection design of all modules is recommended. Figure 16 exhibits one possibility.

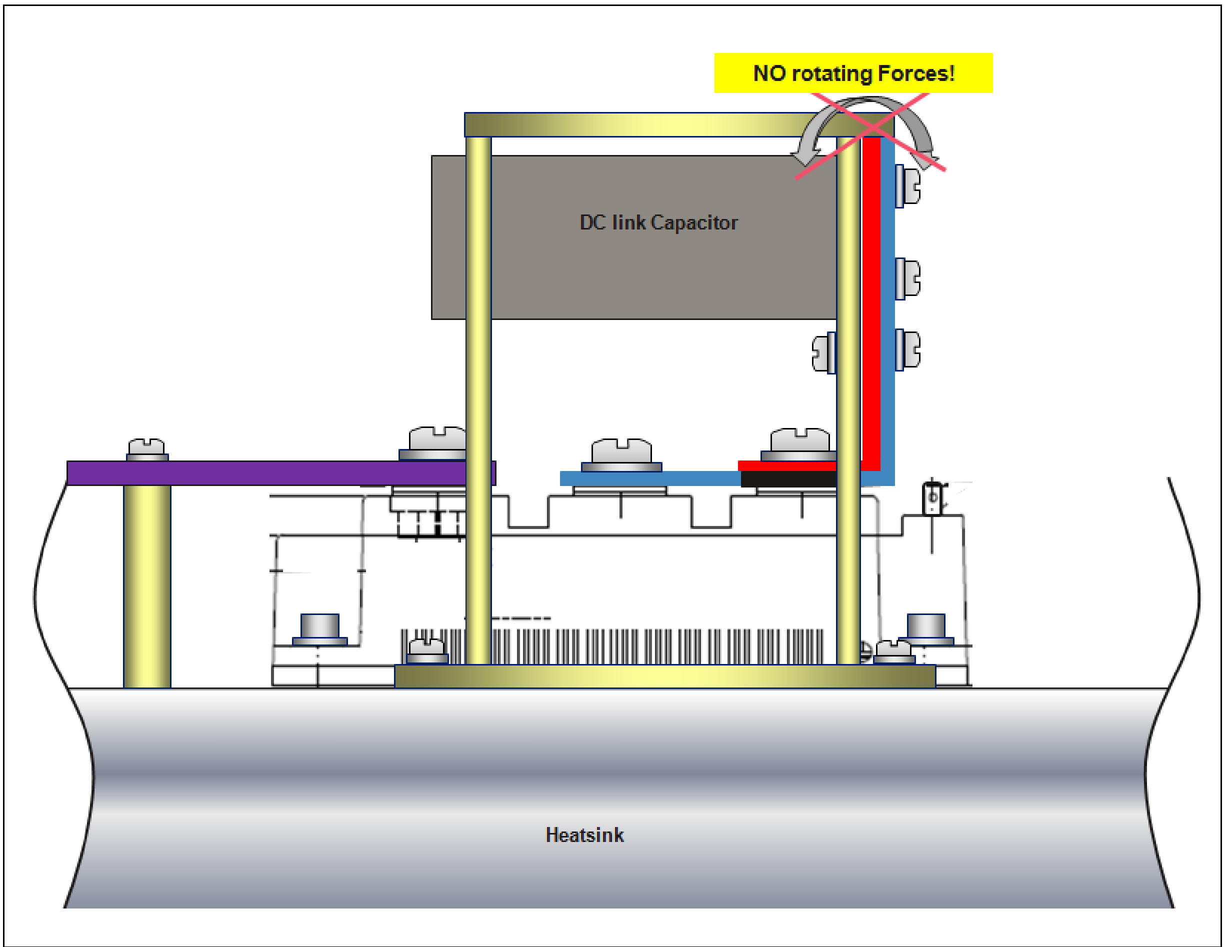


Fig. 16: Example of a low inductive DC-bus design

8.6 Connection and assembly of the IGBT driver

For the safe operation of the components it is important to ensure a sufficiently dimensioned IGBT driver. The gate voltage should be in the range of V_{GE} = +15V / -7V ...-15V. Further information can be found in the application notes [7] and [8]. Please note chapter 4.

The connection of the driver board to the gate-emitter terminals of the module should at least be run as a twisted pair with strain relief or better a strain relieved coaxial cable as short as possible. If the collector voltage potential is used for V_{CEsat} monitoring via an auxiliary collector line and returned to the driver, the auxiliary collector line should be run as far away as possible from the gate-emitter connections in order to prevent signal interference.

If PCBs are used for the module control directly on the module, the terminal connections between the board and the module auxiliary contacts have to be mechanically relieved by supporting the driver board with bolt spacers near the module.

8.6.1 Mounting the driver onto a 62mm single switch (FZ) module

It is recommended to construct a set-up for the power and control terminals which is permanently free of mechanical stress over the entire temperature range.
The driver board (PCB) should be connected via suitable spacers with the auxiliary contacts of the module, see Figure 18. If the driver is used as a common control assembly for several modules, it is mandatory to provide suitable strain relief with bolt spacers.
It must be ensured that the direction of the bias force always acts in the direction of the module baseplate.

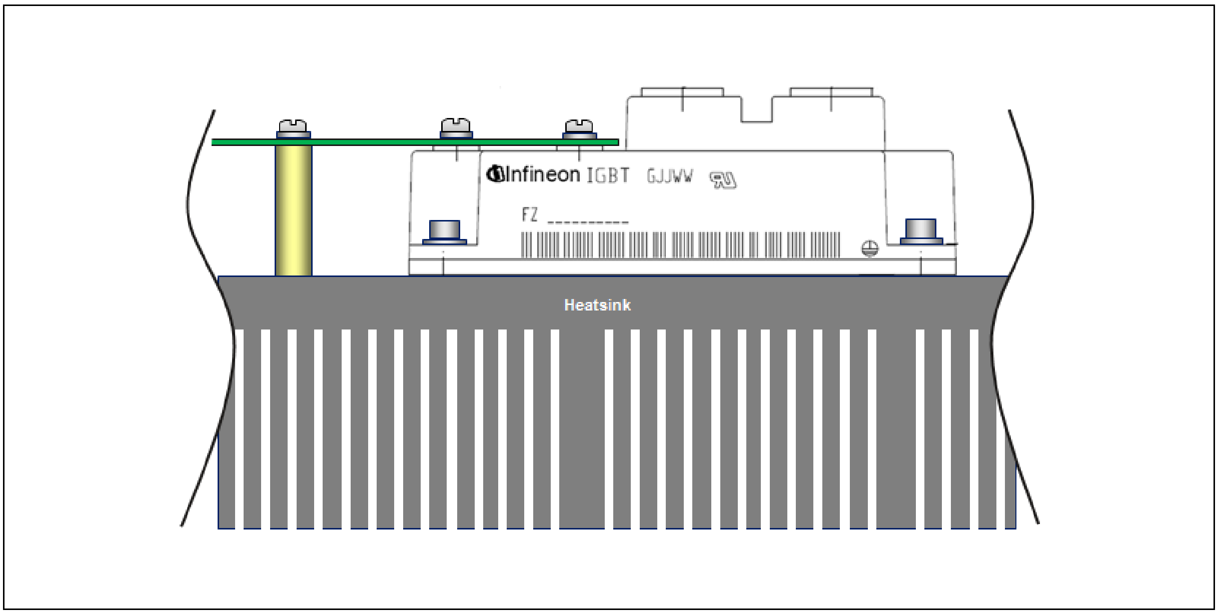


Fig. 17: Example of the assembly of the control terminals when using a driver PCB

The suitability of the strain relief has to be checked and evaluated individually for each design.

8.6.2 Auxiliary terminals of the 62mm (FF, FD, DF) module

The auxiliary terminals and the plastic housing of these terminals in the Infineon 62mm IGBT modules are designed for different contact solutions e.g. single female push-on plugs according DIN46245, female single plugs with equivalent dimension of the given standard or PressFIT single female plugs.

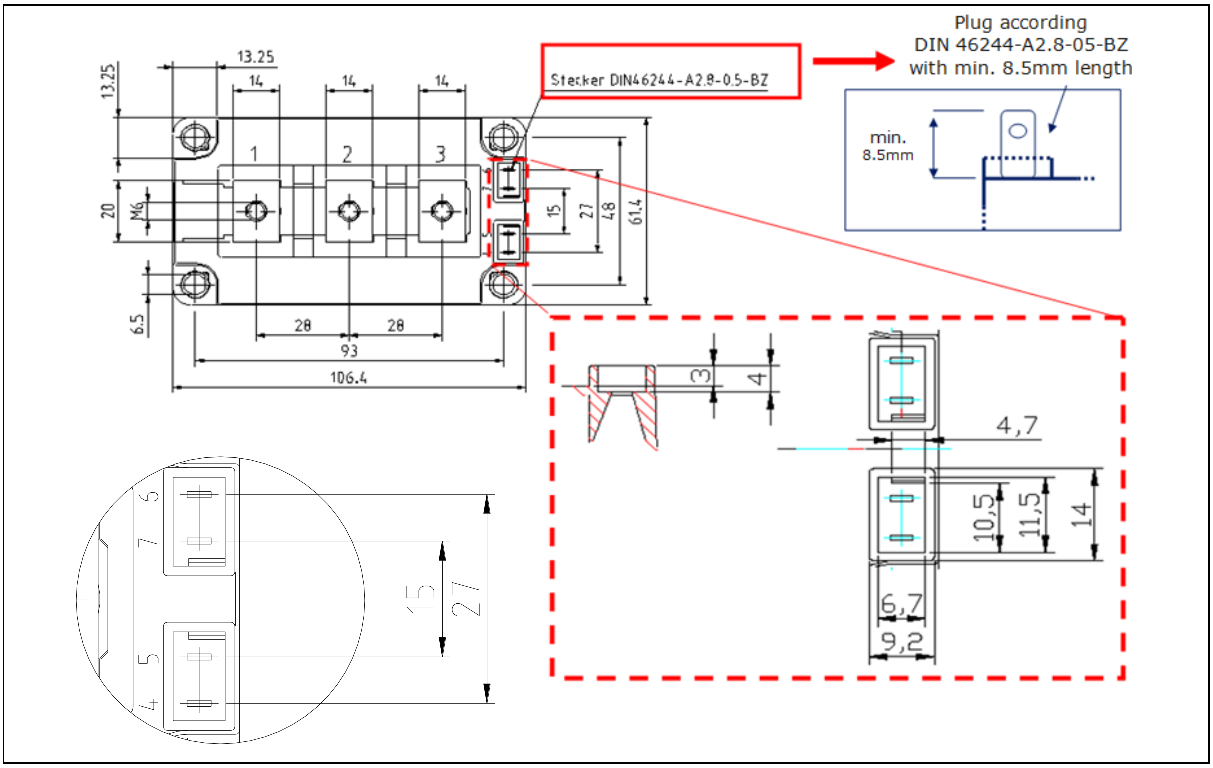


Fig. 18: Dimensioning of the auxiliary terminals on a 62mm halfbridge package variant

The resulting maximum push-on forces per individual module connector with F_{max}=53N during mounting must not exceeded!

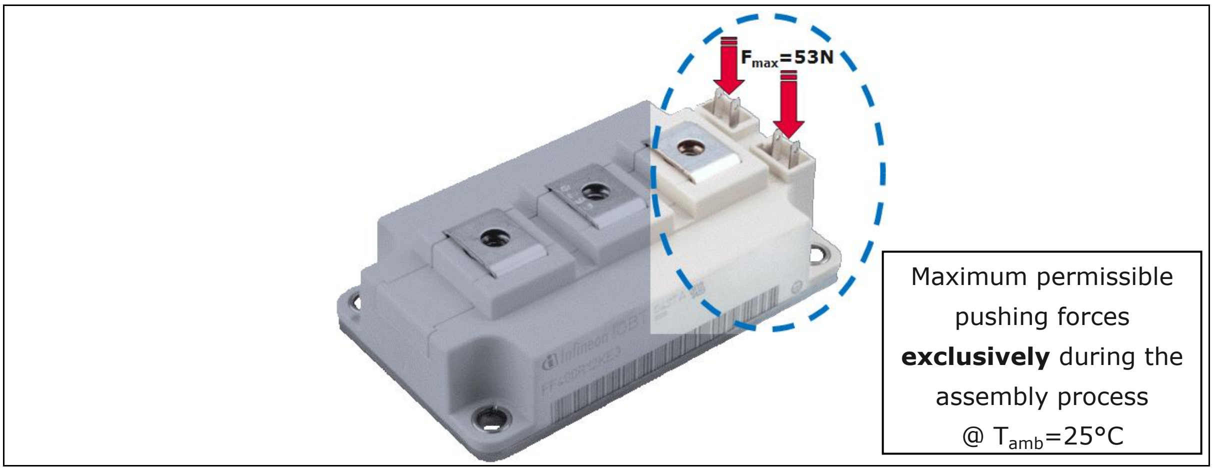


Fig. 19: Details of the maximum push-on force to the auxiliary terminals on a 62mm half bridge package variant

The suitability and reliability of the preferred contact solution has to be checked and evaluated individually for each design by the user.

8.6.2.1 Example 1 - Connecting variants of the 62mm (FF, FD, DF) auxiliary terminals

If an insulated twin female connector, e.g. a formcable from 2E-Mechatronic is used, the plastic housing of the connector will touch the bottom of the control housing and the plastic hook of the terminal housing will look in the 62mm module housing. Further information of these formcable can be found on www.2e-mechatronic.de.

The suitability and reliability of the preferred contact solution has to be checked and evaluated individually for each design by the user.

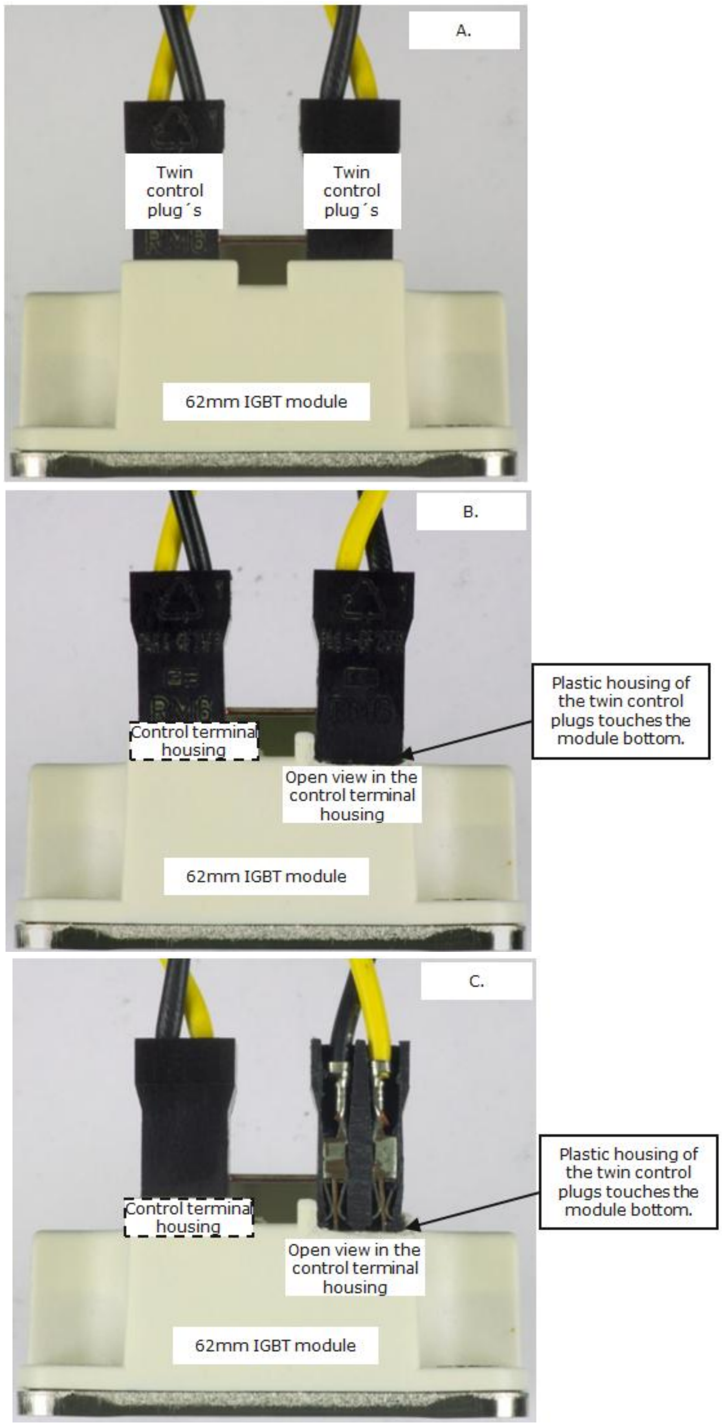


Fig. 20: Details of the maximum push-on force to the auxiliary terminals on a 62mm half bridge package variant

8.6.2.2 Example 2 - Connecting variants of the 62mm (FF, FD, DF) auxiliary terminals

The control contacts in the 62mm IGBT modules are flat push-on connectors according to DIN 46244 – A 2.8–0.5–Bz with a minimum length of 8.5mm.

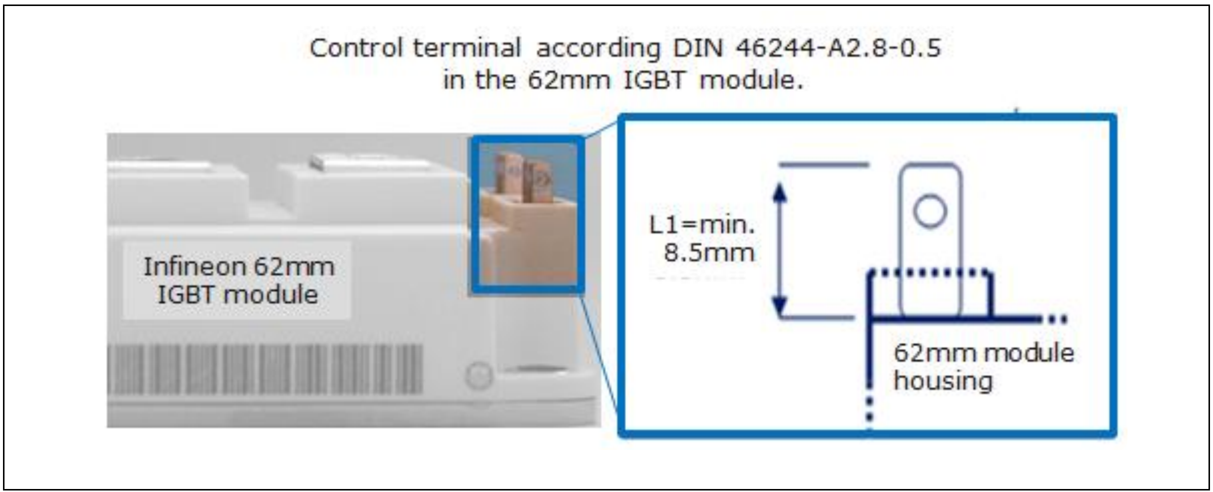


Fig. 21: Details of the auxiliary terminals on a 62mm halfbridge package variant

Standard single female plugs e.g. according DIN46245 or equivalent single plugs are specified with a typical contact length of L2=6.3mm.

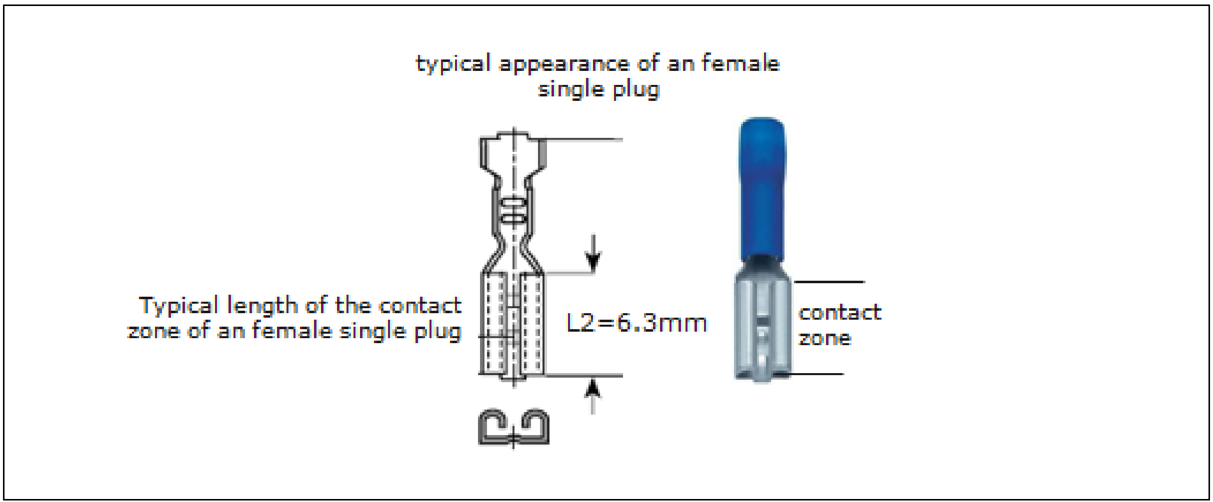


Fig. 22: Details of the auxiliary terminals plug for a 62mm half bridge package variant

The suitability and reliability of the preferred contact solution has to be checked and evaluated individually for each design by the user.

If a standard flat single female connector with a typical length of the contact zone of L2=6.3mm is used, the connector will not touch the bottom of the control housing after proper mounting.

After the correct mounting a distance d=L1-L2, depending on the used female single plug and it´s length L2, will be observable.

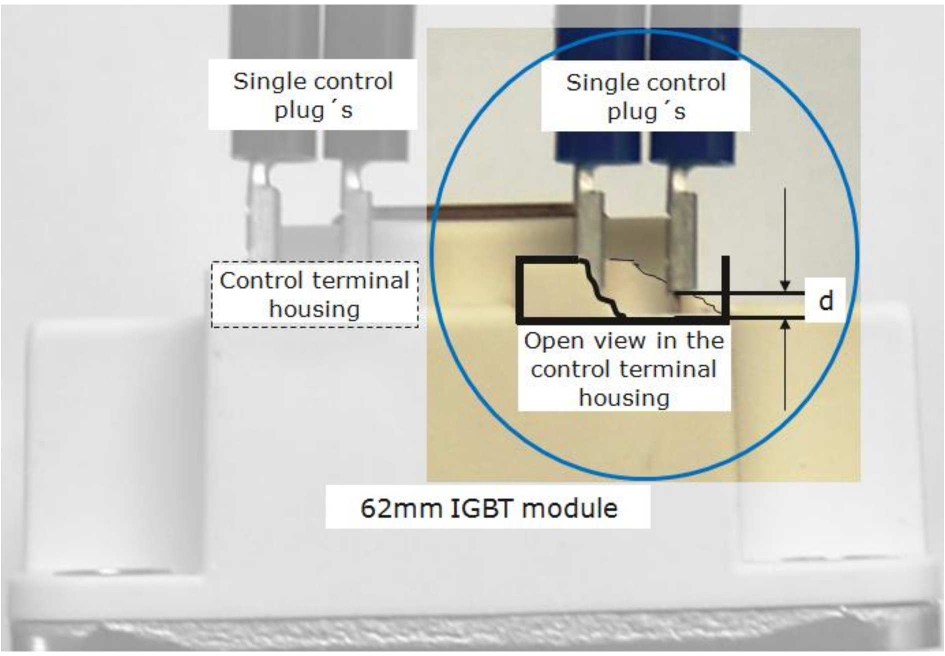


Fig. 23: Details of the connection with a single control plug to the auxiliary terminals on a 62mm half bridge package variant

Observe the maximum push-on force during mounting and the contact zone length of the connector.

8.6.2.3 Example 3 - Connecting variants of the 62mm (FF, FD, DF) auxiliary terminals

The control terminals of the 62mm (FF, FD, DF) modules have surfaces which can be soldered at T=235°C±5°C for 5sek. During the soldering process the ESD protection has to be assured using appropriate soldering processes and tools.

The suitability and reliability of the preferred contact solution has to be checked and evaluated individually for each design by the user.

9. Usage under vibrations- and/or shock conditions

Infineon 62 mm modules have a solid construction in order to guarantee easy handling and a highest possible robustness in the application.

Nevertheless, the maximum values for pull- and push forces at the terminals mentioned in these mounting instructions are permitted only for a one-time, short-term load during the assembly process.

The impact of additional permanent mechanical load to the module, especially repetitive stress by vibration- and shock, is highly depending on the mechanical construction and the load profile of the application and accordingly cannot be generally specified.

The suitability of these modules for use under such specific mechanical stress, including transport, has to be qualified by the user in his assembly, based on his load profile.

10. Paralleling of IGBT modules

In order to increase the power, IGBT modules can be switched in parallel in various configurations. Basically, in such parallel operations of IGBT modules, it is imperative to have a symmetrical construction and triggering of the entire system.

Further instructions and recommendations concerning parallel connections of 62mm IGBT modules are given in [10].

11. References

[1] TR14 Storage of Products supplied by Infineon Technologies

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

[3] AN2010-02 Use of Power Cycling Curves for IGBT4

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

[5] AN2012-07 Modules with pre-applied thermal interface materials

[6] AN2006-02 Application of silk screen

[7] AN2006-01 Unipolar gatevoltage

[8] AN2007-04 Deadtime calculation

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

[10] AN2012-08 Evaluation Adapter Board for 62mm Half Bridge IGBT Modules