Mounting Instruction
MiniSKiiP

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Keyword: Mounting Instruction MiniSKiiP

1. Related Documents

- Data sheet of MiniSKiiP® power module
- MiniSKiiP® Generation II Technical Explanations
- Technical Explanations Pre-applied Thermal Paste
- Stencil drawings for thermal paste printing

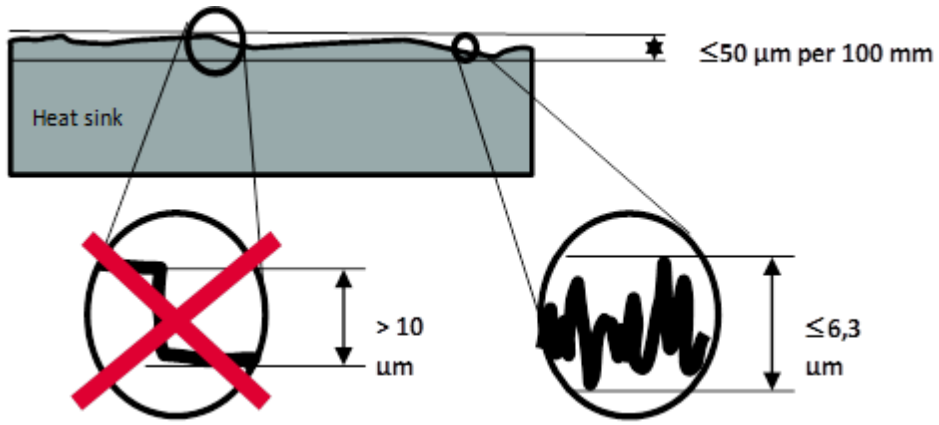
Both documents are available on the SEMIKRON internet page.

2. Surface Specification

To obtain the maximum thermal conductivity of the module, heat sink and module must fulfill the following specifications.

2.1 Heat Sink

Figure 1: Heat sink surface specification



- Heat sink must be free from grease and particles
- Unevenness of heat sink mounting area must be ≤ 50 µm per 100 mm (DIN EN ISO 1101)
- RZ ≤ 6.3 µm (DIN EN ISO 4287)
- No steps > 10 µm (DIN EN ISO 4287)

2.2 Mounting Surface

The mounting surface of MiniSKiiP® module must be free from grease and all kind of particles. MiniSKiiP® is using DBC with a gold flash finish (NiAu). Fingerprints or discolorations (Figure 2) on the bottom side of the DBC do not affect the thermal behaviour and can not be rated as a failure criteria.

Due to rework or a second cleaning process, there might be imperfections of the NiAu flash on the bottom side of the DBC. An imperfection on the NiAu flash does not affect the thermal behaviour (Figure 3). The NiAu flash is only required on the top side of the DBC serving the function of spring landing pads. The bottom side is only gold flashed due to the flash process. A single side flash would be much more costly to realize.

Due to the manufacturing process, the bottom side of the MiniSKiiP® may exhibit scratches, holes or similar marks. The following figures are defining surface characteristics, which do not affect the thermal behaviour. Distortions with higher values as specified can be rated as failure.

Figure 2: NiAu DCB with fingerprints or discoloration

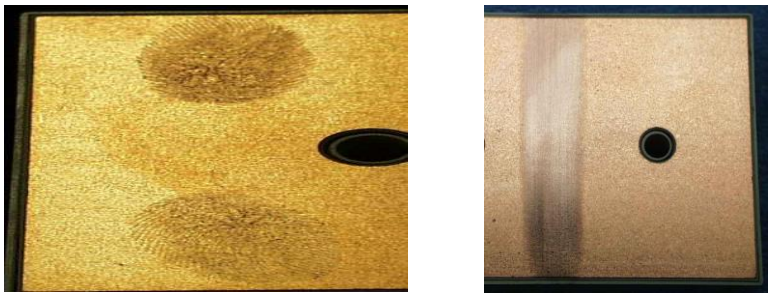


Figure 3: Bottom surface NiAu DBC after rework

The MiniSKiiP® bottom surface must in any case comply with the following specification (Figure 4 to 6)

Figure 4: Scratches on the MiniSKiiP bottom surface

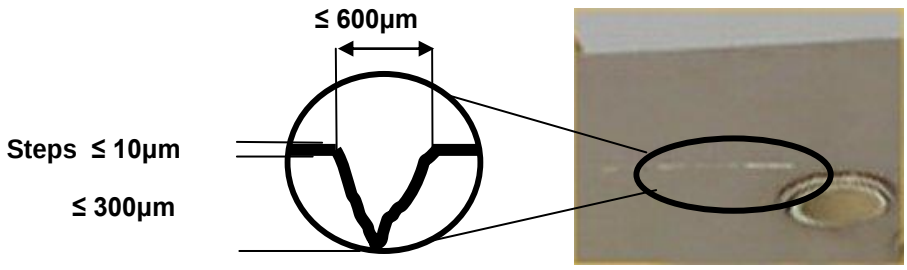


Figure 5: Etching hole (hole down to substrate level) in the MiniSKiiP bottom surface

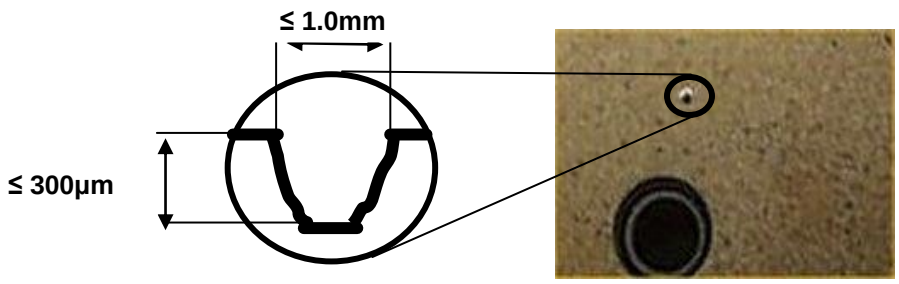
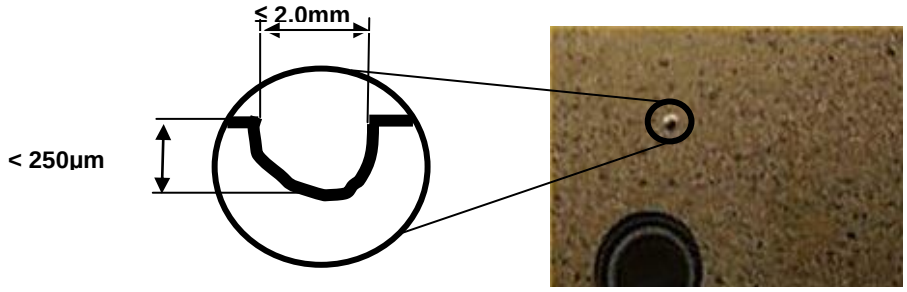
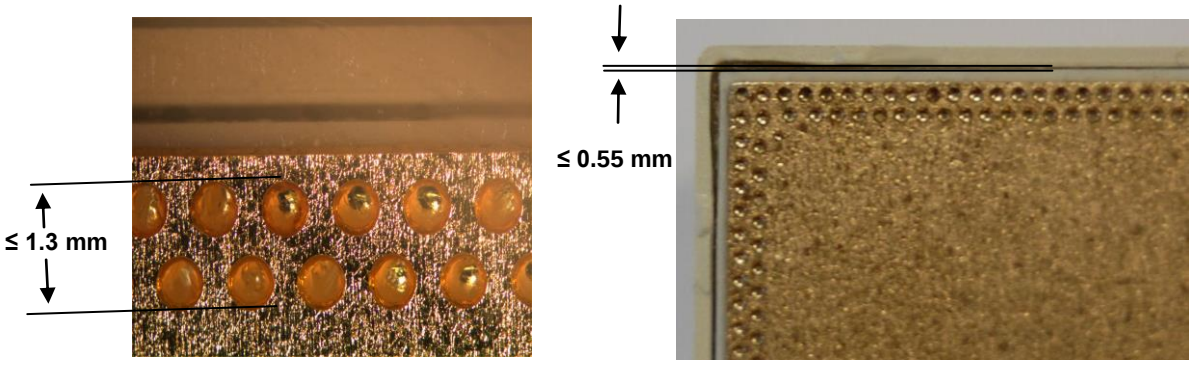


Figure 6: Etching hole (hole not down to substrate level) in the MiniSKiiP bottom surface



Etched dimples on the edge of the DBC are reducing stress between the copper layer and the ceramic substrate (Figure 7). Usually dimples have a diameter of approximately ∅ ≈ 0.6 mm and a depth of approximately 0.3 mm. Since dimples are never below any IGBT or diode chip, there is no influence on the thermal resistance.

Figure 7: Dimples in the MiniSKiiP bottom surface (left) / Variance of the DBC position (right)



Due to the manufacturing process, the position of substrate in the plastic housing may vary. The maximum tolerable gap between housing and substrate is 0.55 mm.

3. Assembly

3.1 Application of Thermal Paste

A thin layer of thermal paste should be applied to the heat sink surface or module bottom surface. SEMIKRON recommends screen printing for applying the thermal paste. The screen printing process offers reproducibility and accuracy of the thickness of the paste. The following values are valid for the resultant continuous layer thickness of thermal paste and recommended for „Silicone Paste P 12" from WACKER CHEMIE applied with screen printing process:

MiniSKiiP® II 0:	23 µm – 43 µm
MiniSKiiP® II 1:	20 µm – 40 µm
MiniSKiiP® II 2:	45 µm – 65 µm
MiniSKiiP® II 3:	30 µm – 50 µm

SEMIKRON has qualified the MiniSKiiP® power modules under the above mentioned conditions. It is the customer's responsibility to qualify his own paste printing process as deviations from the recommended process may impact reliability or technical performance of the modules. If using screen printing tool for applying the thermal paste, the initial thickness of the patterns must be considered and adjusted accordingly. Applying paste by a hard rubber roller might be applicable but usually has to be handled with extra care for acceptable results. In any case a thickness check should be done to verify the thermal paste thickness. Recommended tool for thickness check would be the gauge from ZEHNTNER called "Wet Film Wheel" as shown below.

For information on qualification of the thermal paste printing process please contact SEMIKRON.

Figure 8: Wet film wheel Zehntner Type ZWW2102

3.2 Pre-applied Thermal Paste

SEMIKRON offers MiniSKiiP® power modules with following two different types of pre-applied thermal paste.

- Wacker P12 (silicone-based)
- Electrolube HTC (non-silicone-based)

Figure 9: MiniSKiiP with pre-applied thermal paste

The thermal paste is applied to the modules by SEMIKRON prior to shipment for eliminating the critical process step from the customer's manufacturing process.

Further advantages of pre-applied thermal paste are:

- Efficient, reproducible and controllable module assembly process
- Optimum thickness of thermal paste layer leading to lower thermal resistance
- High degree of process reliability using an automated and monitored screen-printing process

3.3 Mounting the MiniSKiiP®

- Place the MiniSKiiP® module on the heat sink - make sure the heat sink hole lines up with the mounting hole in the module, and module is orientated properly (i.e. corner pin in the correct location on the heat sink). Do not move the module after placing on heat sink.
- Place PCB down on the module - visually confirm the corner pin comes through the PCB hole.
- Place the pressure lid - make sure the corner pin aligns properly into the pressure lid
- Insert and tighten screw(s) with the nominal torque.

  Housing sizes 0, 1, and 2 : 2.0 Nm < M < 2.5 Nm (Figure 10).
  Housing size 3 : first tighten both screws with max. 1 Nm and then continue with nominal torque 2.0 Nm < M < 2.5 Nm (Figure 11).

Figure 10: Mounting of MiniSKiiP with housing size 0, 1 and 2

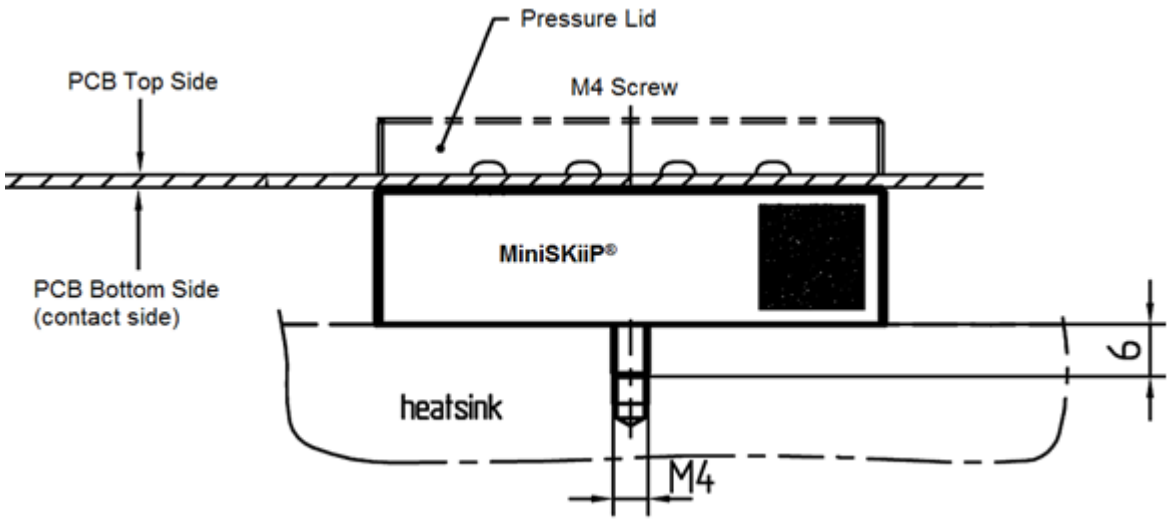
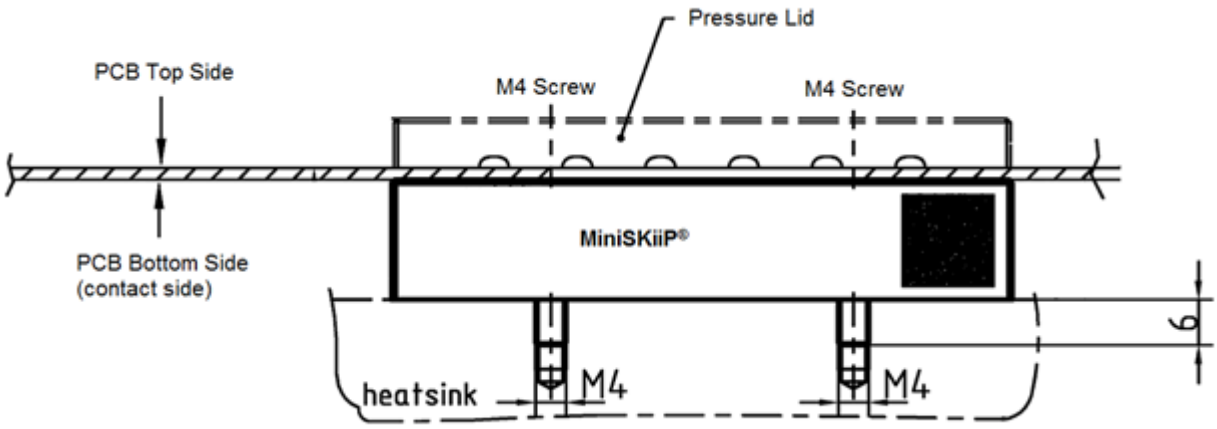


Figure 11: Mounting of MiniSKiiP with housing size 3



The use of an electric power screwdriver is recommended rather than a pneumatic tool. The specified screw parameters are better adjustable and especially the final torque will be reached more smoothly. With pneumatic systems, a shock and a higher torque overshoot by reaching the final (preset) torque due to the behaviour of the clutch can be seen.

A limitation of the mounting screw velocity is recommended to allow the thermal past to flow and distribute equally, especially if a more dense paste is used. If tightened with higher velocity the ceramic may develop cracks due to the inability of the paste to flow as fast as necessary and therefore causing an uneven surface. The values below are valid for Wacker P12 thermal paste and use of an electric drilling tool.

The maximum screw velocity for tightening should not exceed 250 rpm. A soft level out (no torque overshoot) will reduce the stress even further and is preferable.

Due to relaxation of the housing and flow of thermal paste, the loosening torque will be reduced. A value of 1 Nm is still sufficient to ensure a proper thermal contact. The design of the housing, the elastic bending of the metal plate in the pressure lid and the adhesion of the thermal paste still ensure electrical contact and sufficient thermal coupling from module to heat sink. Do not re-tighten the screw to nominal mounting torque value again! A retightening of the screws will put DBC, housing and springs under stress.

For rework or test purposes pressure lid and PCB can be disassembled from the MiniSKiiP® module and can be remounted or replaced. If the module was placed on the wrong position of the heat sink, it could be removed and placed correctly, as long as the MiniSKiiP® has not been screwed to the heat sink. It is possible to remove it with necessary diligence, as the thermal paste causes high adhesion. After the removal, all thermal paste has to be removed carefully from the MiniSKiiP® as well as from the heat sink. Alcohol can be used for cleaning.

If the MiniSKiiP® was assembled for some time, the pressure system has already relaxed. Even though the MiniSKiiP® can be re-assembled, the pressure distribution on the power hybrid might have changed compared to a new module, which can lead to different thermal resistance values compared to those given in the data sheet.

3.4 Mounting Material

SEMIKRON recommendation for mounting screw:

M4 according to DIN 7991 - 8.8, or similar screw with TORX-head.

Strength of screw : "8.8"
Tensile strength : Rm= 800 N / mm²
Yield point : Re= 640 N / mm²

The minimum depth of the screw in the heat sink is 6.0 mm.

3.5 Removing the MiniSKiiP® from the Heat Sink

The thermal paste provides good adhesion between the module and the heat sink. Since the DBC substrates with the chips are not glued to the case, these would stick to the heat sink when the module was removed as soon as the screws are loosened.

There are two proper ways for removing the module:

- Wait 24 hours after the screws have been loosened and then slide the module carefully from the heat sink.
- Heat up the heat sink up to 60 °C after the screws have been loosened and then slide the module carefully from the heat sink.

4. ESD Protection

MiniSKiiP® modules are sensitive to electrostatic discharge. All MiniSKiiP® modules 100% checked for ESD failures and latent ESD defects after assembly. During shipment the MiniSKiiP® is ESD protected by the ESD blister box.

Special care has to be taken when removing the MiniSKiiP® from the ESD blister box. During handling and assembly of the modules use conductive grounded wristlet and a conductive grounded working place all time.

History
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