MiniSKiiP mounting instruction

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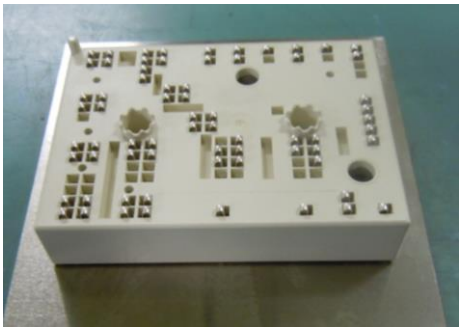
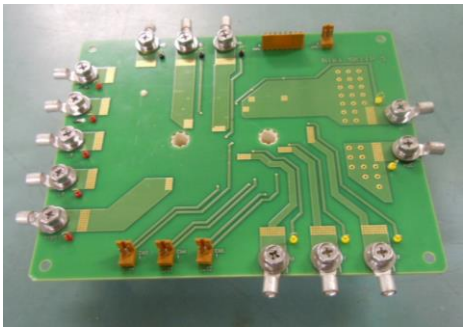
1 MiniSKiiP® contact system

1.1 General information

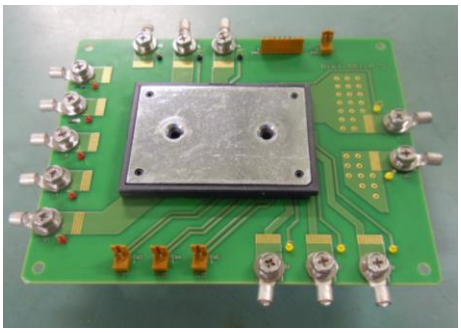
This application note describes the recommended PCBs specification and mounting advises of MiniSKiiP®.
This application note cannot cover every type of application and/or conditions. Therefore, MiniSKiiP® modules, which are used out of mounting process, will not have any warranty and/or guarantee under any circumstances. We recommend you or your technical partners to confirm throughout electro-mechanical evaluation in practical applications.
The MiniSKiiP® provides solder less mounting onto PCB with rugged fast spring contact. Fig.1 shows the procedure for mounting process of MiniSKiiP® and Fig.2 shows the cross section of MiniSKiiP®. Due to DCB ceramic without base plate, it is possible to have low thermal resistance.



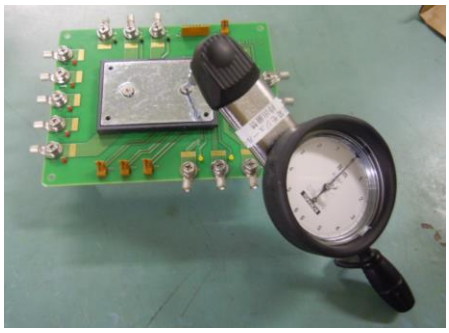
1. Place the MiniSKiiP® on the appropriate heat sink.（0. Print thermal paste on the heat sink or MiniSKiiP® bottom surface.）



2. Contact the MiniSKiiP® spring surface with the PCB landing pad.



3. Place the pressure lid on the PCB.



4. Tighten the screw with the nominal torque 2.0-2.5Nm（in case of a MiniSKiiP®3 type, pre-torque with 1Nm）

Fig.1 Mounting process of MiniSKiiP®

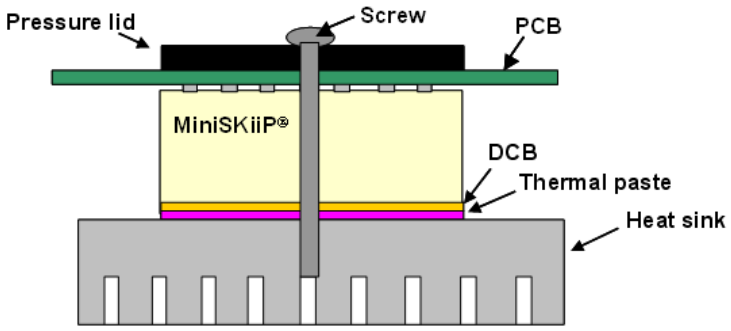


Fig.2 Cross section of MiniSKiiP®

1.2 PCB Specification for the MiniSKiiP® contact system

The material combination between the MiniSKiiP® spring surface and the corresponding contact pad surface of the PCB has an influence to the contact resistance for different currents. Tin Lead alloy (SnPb) is an approved interface for application with MiniSKiiP® modules. Size and position of the PCB landing pads are specified in the dedicated datasheet for each type. To ensure a proper contact, the landing pads and the spring surface should be free of any contamination like of solder stop, solder flux, dust, sweat, oil or other substances. A sufficient plating thickness has to be ensured according to PCB manufacturing process. In order to apply with RoHS rules, the use of the following PCB finish materials can be recommended:

- ♦ Nickel Gold flash (NiAu)
- ♦ Hot Air Levelling Tin (HAL Sn)
- ♦ Chemical Tin (Chem.l Sn)

If other surface finishing technologies are to be used in the production of printed circuit boards, they will have to be tested and qualified.

2 Assembly Instructions

2.1 Preparation, surface specification

The thermal resistance between MiniSKiiP® DCB and heat sink depends on surface specification of heat sink and DCB. To obtain the maximum thermal conductivity of the module, heat sink and module must fulfill the following specifications.

2.1.1 Heat sink

- 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)
- Roughness „Rz“ ≤ 6.3 µm (DIN EN ISO 4287)
- No steps > 10 µm (DIN EN ISO 4287)

If the surface of the heat sink does not match the above requirements, then attaching (clamping) MiniSKiiP® to it will place extreme stress on the DCB substrate situated under the module’s chips, possibly destroying this insulating material.

2.1.2 Mounting surface

The mounting surface of MiniSKiiP® module must be free from grease and all kind of particles. MiniSKiiP® is using DCB with a gold flash finish (NiAu) due to stable contact resistant. The NiAu flash is only required on the top side of the DCB 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. Therefore, fingerprints or discoloration (Fig.3) on the bottom side of the DCB does not affect the thermal behavior and can not be rated as failure criteria. Due to rework or a second cleaning process there might be imperfections of the NiAu flash on the bottom side of the DCB. An imperfection on the NiAu flash does not affect the thermal behavior (Fig.4).

Fig.3 NiAu DCB with fingerprints or discoloration

Fig.4 Bottom Surface NiAu DCB after rework

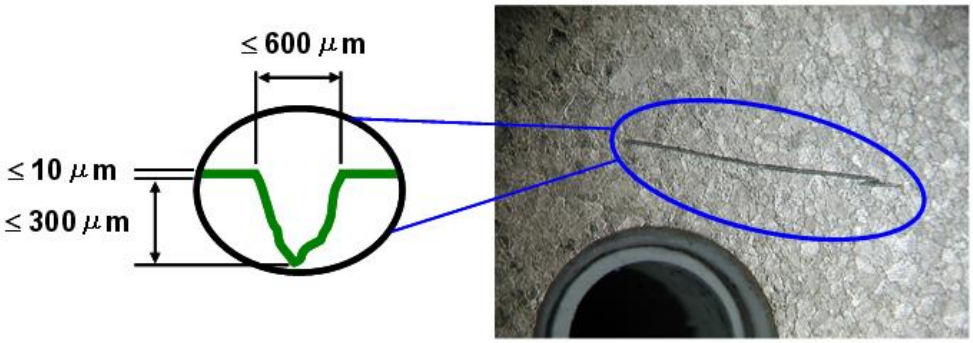


Fig.5 Scratches on the MiniSKiiP® bottom surface

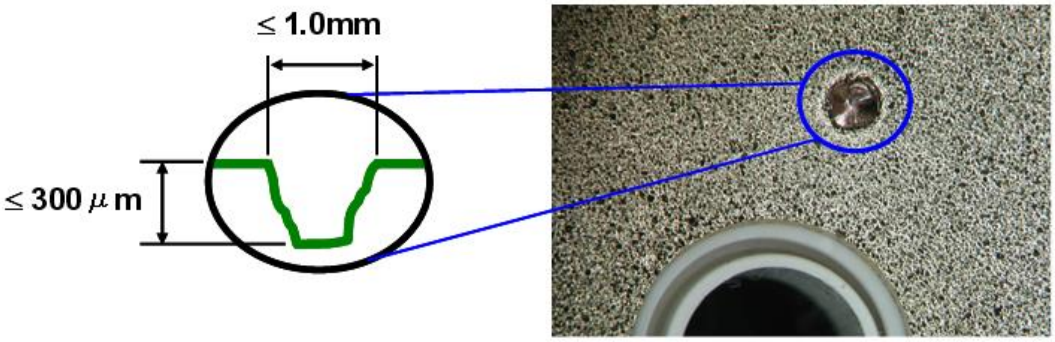


Fig.6 Etching hole (hole down to substrate level) in the MiniSKiiP® bottom surface

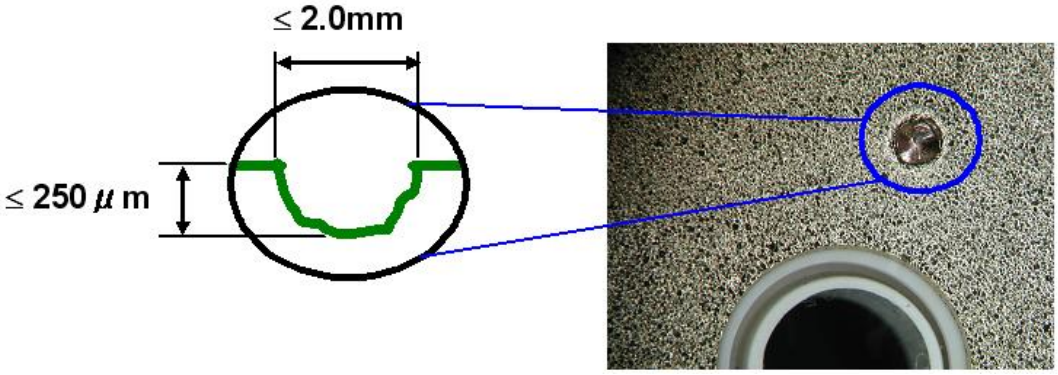


Fig.7 Etching hole (hole not down to substrate level) in the MiniSKiiP® bottom surface

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 behavior (Fig.5 to Fig.7). Distortions with higher values as specified can be rated as failure.

The MiniSKiiP® bottom surface must in any case comply with the following specification (Fig 5 to Fig 7).

Etched dimples on the edge of the DCB reducing stress between the copper layer and the ceramic substrate (Fig. 8 and Fig.9). 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.

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.

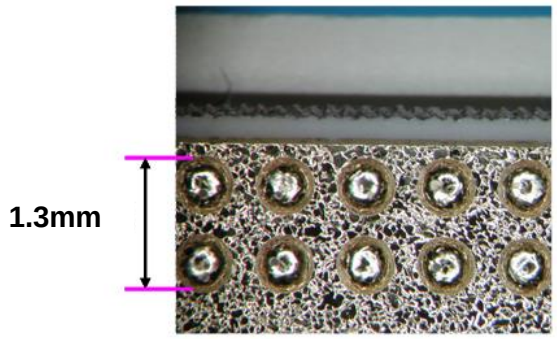


Fig.8 Dimples in the MiniSKiiP® bottom surface

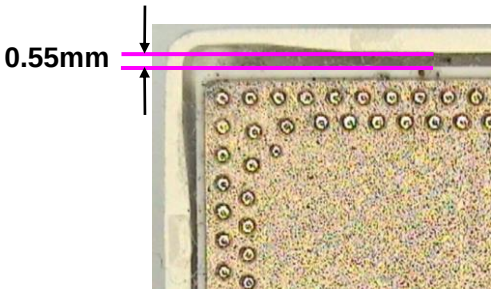


Fig.9 Variance of the DCB position

2.2 Assembly

2.2.1 Application of thermal paste

Thermal paste between heat sink and module bottom surface is strongly recommended to reduce the contact thermal resistance. Screen printing, rollers and spatulas are typical method of thermal paste pasting, however, stencil mask is recommended when target thickness of paste is less than about 100µm. When the module is screwed down, the thermal compound will spread and force out any air, thereby ensuring an even contact.
The stencil mask printing process offers reproducibility and accuracy of the thickness of the paste (Fig.10). The following values are recommended for „Silicone Paste P 12" from WACKER CHEMIE:

MiniSKiiP® 1: 20 µm – 40 µm
MiniSKiiP® 2: 45 µm – 65 µm
MiniSKiiP® 3: 30 µm – 50 µm

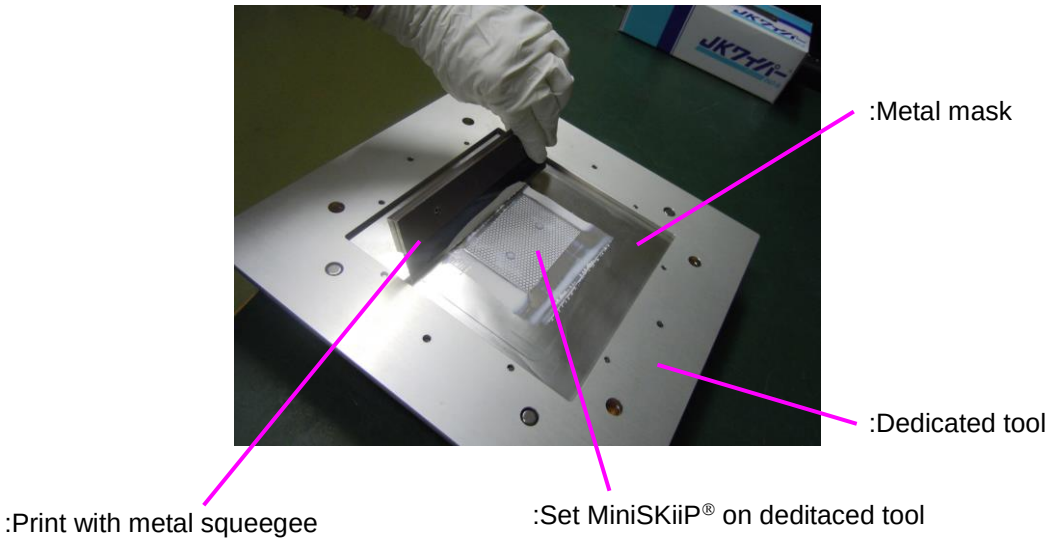


Fig.10 Stencil printing process

2.2.2 Mounting the MiniSKiiP®

Place the MiniSKiiP® on the appropriate heat sink area and tighten the screw with the nominal torque: 2.0 Nm < M < 2.5 Nm.
In case of a MiniSKiiP® 3 type with two screws, first tighten both screws with max. 1 Nm and then continue with nominal torque (2.0 Nm < M < 2.5 Nm).
The use of an electric power screwdriver is recommended over 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 behavior of the clutch can be seen. Therefore, if pneumatic tools are used, parameter optimization and confirmation is recommended in practical installation process by customer. During mounting the MiniSKiiP®, DCB may rotate and damage due to contact with the housing. We recommend using the equipment to have accurate control in force control.

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 DCB, 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.

2.2.3 Mounting material:

Fuji 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.

In case, not recommended screws and/or methods are used in MiniSKiiP® installation process, it may have a risk of mechanical damage and loosening torque. We recommend you to confirm screw types and mounting process in advance. If not recommended screws are to be used in the production, they will have to be tested and qualified.

2.3 ESD protection

MiniSKiiP® modules are sensitive to electrostatic discharge. If excessive static electricity is applied to the control terminals, the devices can be broken. Some countermeasures against static electricity are necessary. All MiniSKiiP® modules 100% checked for ESD failures and latent ESD defects after assembly. During shipment the MiniSKiiP®'s are ESD protected by the ESD Blister box.
Special care has to be used 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.

3 Packing specification

3.1 Packing box

Standard packing boxes for MiniSKiiP®;

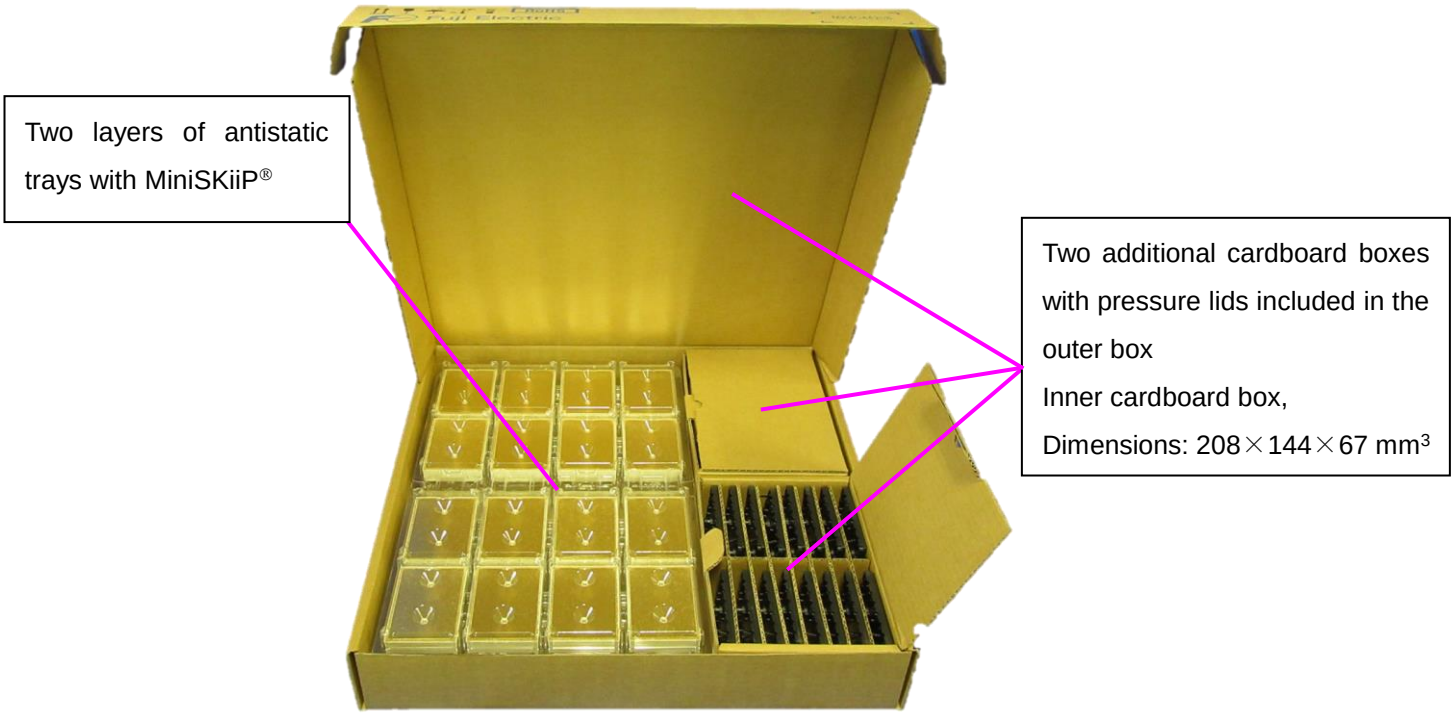


Fig.11 Outer cardboard box, dimensions: 429×450×74 mm³ (l×w×h)

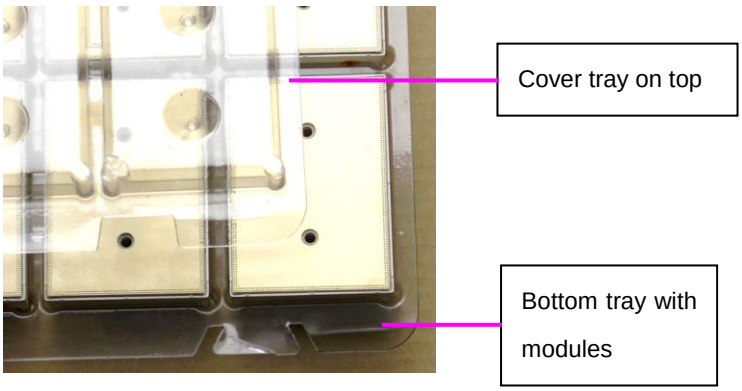


Fig.12 Antistatic tray dimensions:
440×275×30 mm³

Modules: Quantities per package:

MiniSKiiP® 1	2 trays with 40 modules = 120 pcs (≈ 5.7 kg)
MiniSKiiP® 2	2 trays with 24 modules = 72 pcs (≈ 6.4 kg)
MiniSKiiP® 3	2 trays with 16 modules = 48 pcs (≈ 6.6 kg)

Bill of materials:

Boxes: Paper (card board)

Trays: AS-KPET (not electrically chargeable)

3.2 Marking of packing boxes

All MiniSKiiP® packing boxes are marked with a sticker label. This label is placed on the packing box as can be seen in Fig.13：

Fig.13 Place for label on MiniSKiiP® packing boxes

4 Storage Condition

The module should be stored at a standard temperature of 5 to 35°C and humidity of 45 to 75%.
Be careful to contact between terminals of the module and contact pads of PCB if the module has passed over one year from manufacturing date, under the above storage condition.