Mounting instruction of PressFIT-pin type Small-PIM

Revised Records

Date	Version	Contents
Apr.-25th-2013	1.0	-
May-9th-2013	1.1	Change of press-in force
June-5th-2014	1.2	Module Mounting process to a heat sink, PCB fixing process to the module and the heat sink
Jan.-27th-2016	1.3	Attention about thermal paste
Oct.-28th-2016	1.4	Attention about thermal paste
Nov.-30th-2017	1.5	Revised minimum end hole diameter of PCB
Oct.-10th-2018	1.6	added section 13

CONTENTS		Page

1 General Information

This application note describes the recommended PCBs specification and advises for mounting/removing process of Fuji Electric (here in after Fuji) PressFIT-pin type Small-PIM. It is called Small-PressFIT in this report.

This application note cannot cover every type of application and/or conditions. Therefore, Fuji Small-PressFIT, which is used out of these suggestions on PCB and 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 PressFIT technology provides solder less mounting onto PCB with low resistive stable contact. A PressFIT pin before insertion has opened shape as shown in Fig.1. After press-in processes, which are described in later section, the pin is closed by the contact pressure from both sides (Fig.2). During the press-in process, mechanical deformation of pin and materials of the PCB hole sidewall form cold-welding joints, it is possible to have low resistivity and stable contact with this new technology.

Fig.1 PressFIT pin

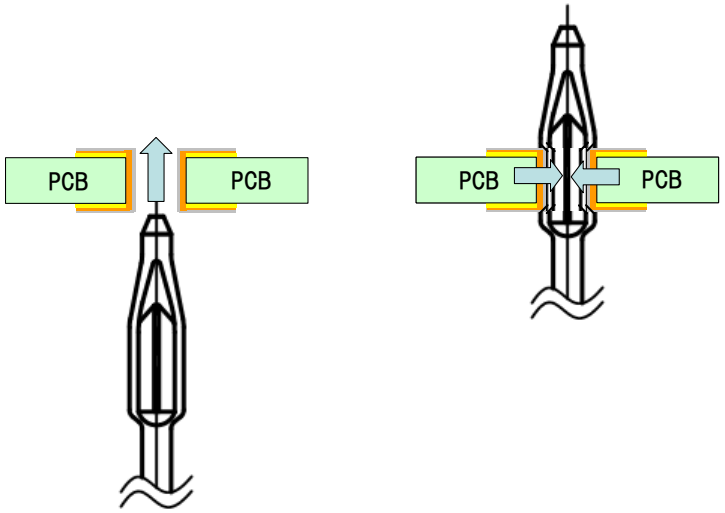


Fig.2 Closed pin shape after mounted onto the PCB

2 Requirements for PCBs

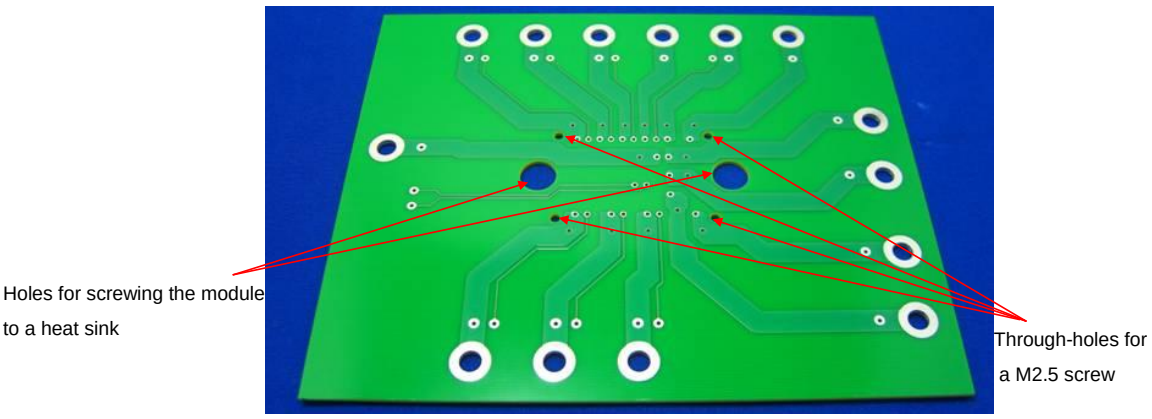


Fig. 3 An example of a PCB

This chapter describes the PCB recommendation for the Small-PIM.

Fig. 3 shows an example of a PCB. *It is a temporary PCB for measurement, is not an actual PCB for inverter application. The PCB needs 2 holes for screwing the module to a heat sink. The distance between two holes is 53.0±0.1mm. The PCB needs 4 through-holes for M2.5 screw fixing the PCB to the module.

Table 1. Requirements for PCBs

	min.	typ.	max.
Drill hole diameter	1.12mm	1.15mm	
Cu thickness in hole	25μm		50μm
Metallization in hole			15μm
End hole diameter	0.99mm		1.09mm
Cu thickness of conductors	35μm	70μm 105μm	400μm
Metallization of circuit board	Tin (chemically)		
Metallization of pin	Tin (galvanic)		
PCB material	FR4		

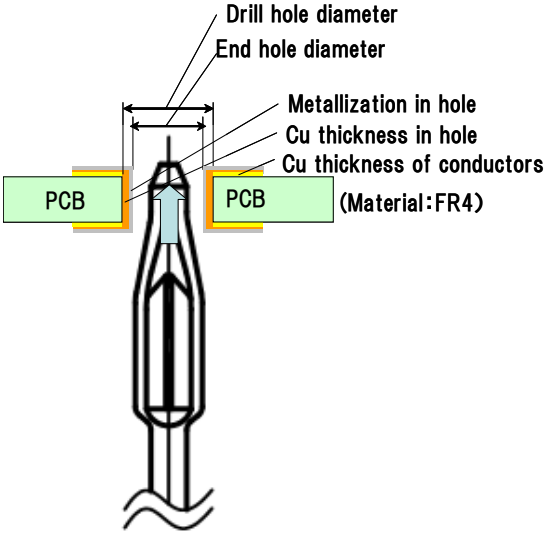


Fig. 4 Description of each dimension

PCB should have been designed within criteria in the Table1. For example, end hole diameter should be a range of 0.99mm to 1.09mm with properly Sn/Cu plated sidewall as described in the figure. When it smaller, mechanical issue in the press-in process would be found, on the other hands, if it bigger, contact reliability may have concerns.

These results were experimentally obtained based from IEC60352-5. The evaluation is separately needed if PCBs which have out of these parameters.

PCB should have holes for guide pins of press-in tools with a specific position, hole diameter so that press-in lower and upper tool contact first and absorb the insertion force to protect PCB and its surface mounted devices from mechanical stress during press-in process.

In order to avoid risk of mechanical damage of other components mounted on PCB surface, we recommend reserving specific area, which would have high strain during press-in and/or push-out process. Basically, we recommend reserving 5mm in distance from the center of PressFIT pins.

3 Mounting and removing process of PCB

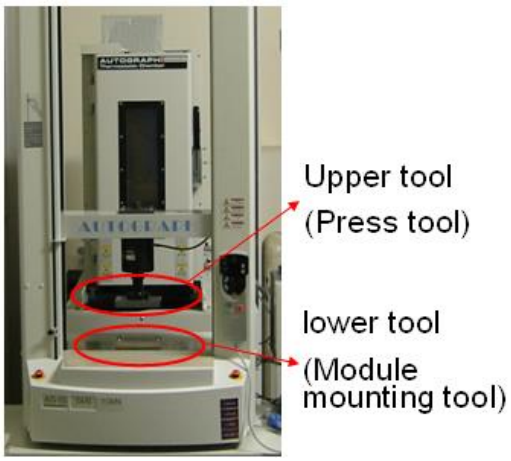


Fig. 5 PCB Mounting and removing machine

The procedure for mounting process of PCB is described in this section. Small-PressFIT should be inserted within a specific range of mounting speed and force. If mounting force were below the limit, the module would have issue in low resistive and stable contact. On the other hand, mechanical damage on PCB and other parts mounted on the surface would be expected if too much press-in force.

When press-in, we recommend using the equipment as shown in Fig.5 to have accurate control in force control. We also recommend using specific press-in and push-out tools provided in the latter section. Typical press-in speed is 25mm/min. to have low and stable contact and avoid module and/or PCB destruction. Typical press-in force is varying with end hole diameter of your PCB.

Recommended press-in force/1module is calculated as below;

Press-in force/1 module = 60 ~ 100 N x pin number

*Press-in force/1 module cannot exceed 4kN in order to avoid module and/or PCB destruction.

4 Example of tools for PCB press-in and push-out

Figures 6(a)-(e) are example of press-in and push-out tool set. Please contact us to know detail of the tools or get CAD data of drawings.

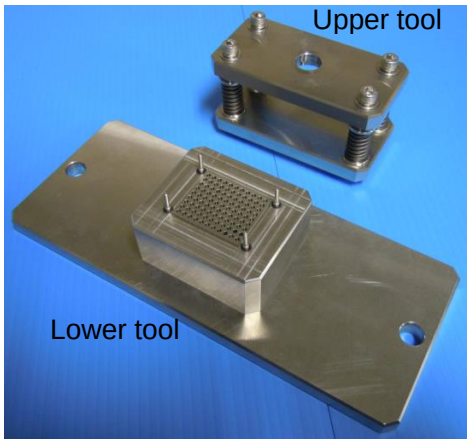


Fig.6(a) press-in tool set for Type1

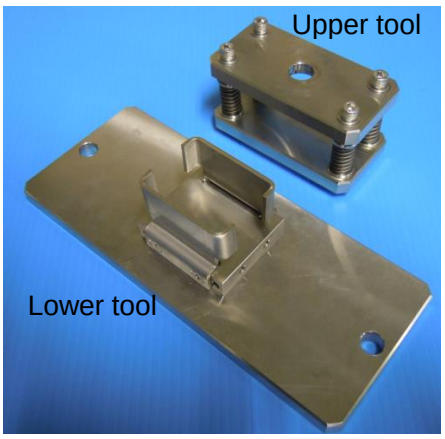


Fig.6(b) press-out tool set for Type1

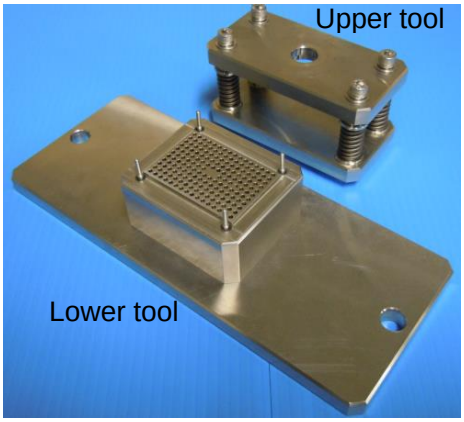


Fig.6(c) press-in tool set for Type2

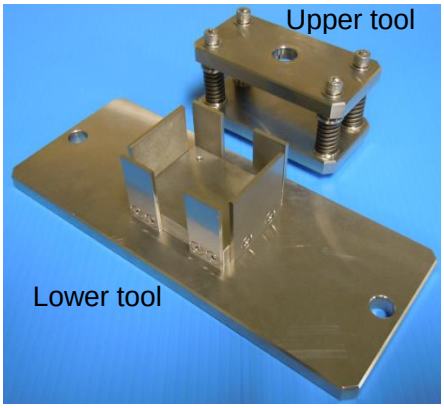


Fig.6(d) press-out tool set for Type2

Fig.6(e) backside of upper tool

5 Example of mounting process of the module into the PCBs; Press-in

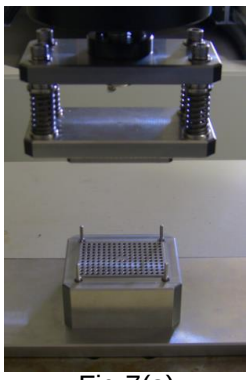


Fig.7(a)

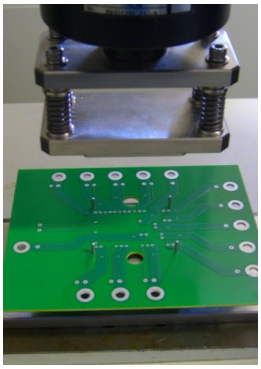


Fig.7(b)

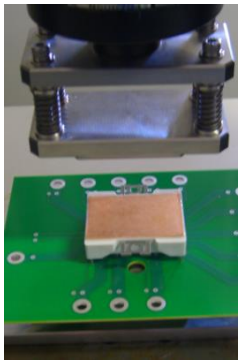


Fig.7(c)

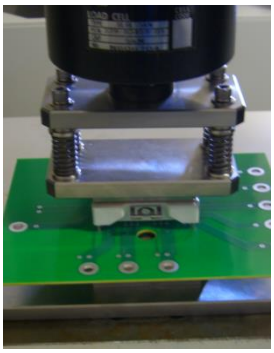


Fig.7(d)

Fig.7 Example of Press-in Process

Figures 7(a)-(d) are example of mounting process of the module into the PCB:press-in process. (a): set an upper tool and a lower tool on the machine, (b): set a PCB on the lower tool, (c): set a module on the PCB, (d): press the backside of the module by the upper tool to press-in the module to the PCB.

6 Example of removing process of the module from the PCBs: Push-out

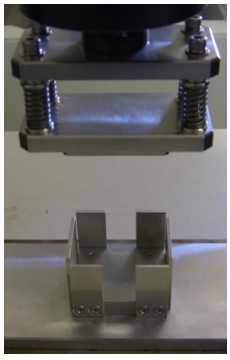


Fig.8(a)

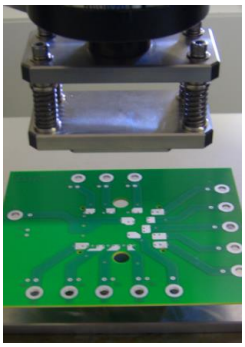


Fig.8(b)

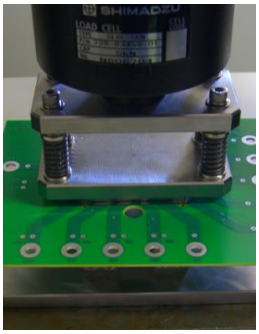


Fig.8(c)

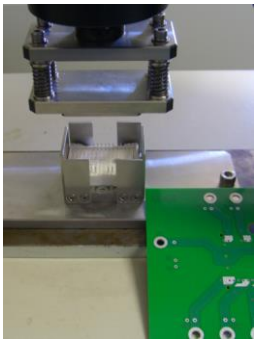


Fig.8(d)

Fig.8 Example of Push-out Process

Figures 8(a)-(d) are example of push-out process. (a): set an upper tool and a lower tool on the machine, (b): set a module and a PCB on the lower tool, (c): press PressFIT pins of the module by the upper tool to push-out the module from the PCB, (d): the module is removed from the PCB and drops into the lower tool.

7 Fixing a PCB to the Module

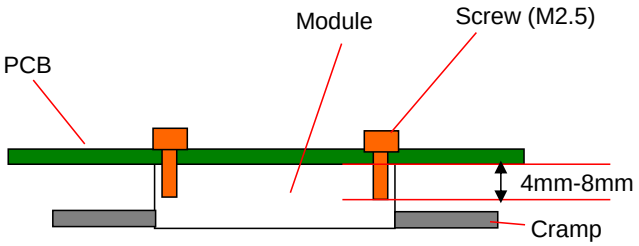


Fig. 9(a)Fix a PCB to the module by screws

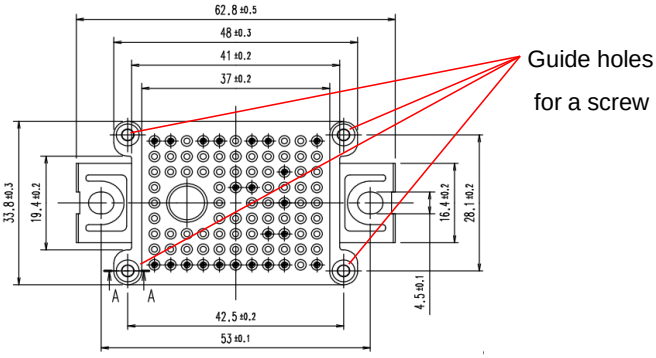


Fig. 9(b)Guide holes for a screw (1B)

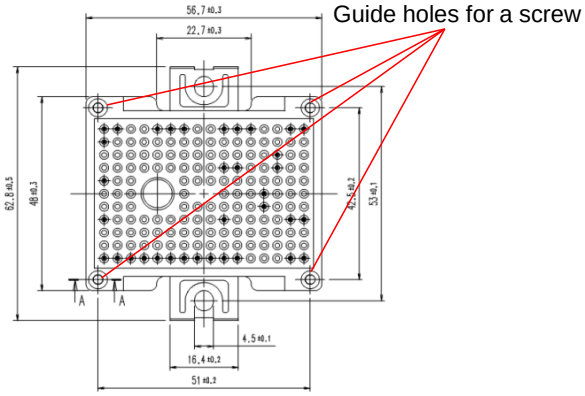


Fig. 9(c)Guide holes for a screw (2B)

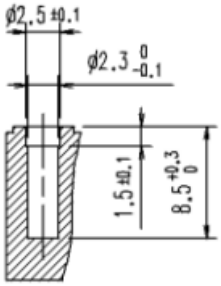


Fig. 9(d)Cross section of a guide hole

After PCB mounting process, it is recommended to fix a PCB to the module by screws because of the press-fit contact reliability. Fig. 9(a) shows an example of fixing process. M2.5 screws are suitable. The effective length of a screw except the PCB thickness, have to be 4.0-8.0mm. Screwdriver speed n must be smaller than 300rpm, screw driver torque; 0.4Nm±10% is recommended.

8 Requirements for a Heat Sink

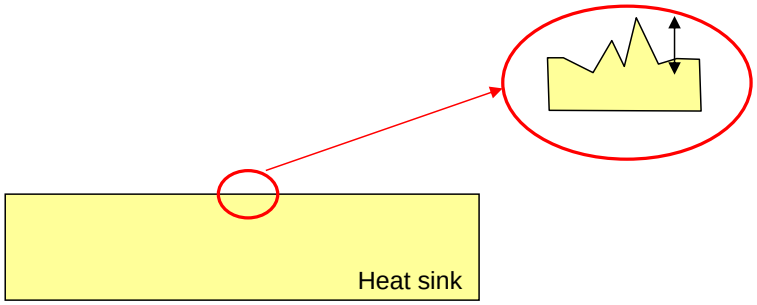


Fig. 10(a) Roughness of a heat sink

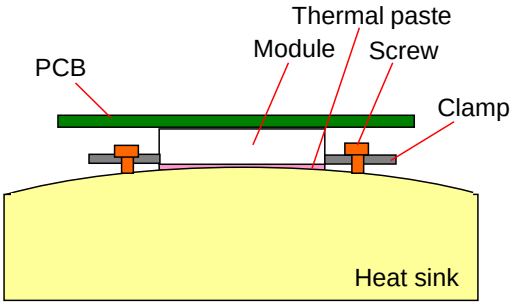


Fig. 10(b) Flatness of a heat sink

A heat sink for module assembly must fulfill below surface condition.

(1)The roughness of a heat sink must be smaller than 10μm.

(2)The heat sink flatness based on a length of 100mm must be smaller than 50μm.

*The flatness must be less than above value in the module mounting area including two screw clamps.

9 Application of Thermal Paste

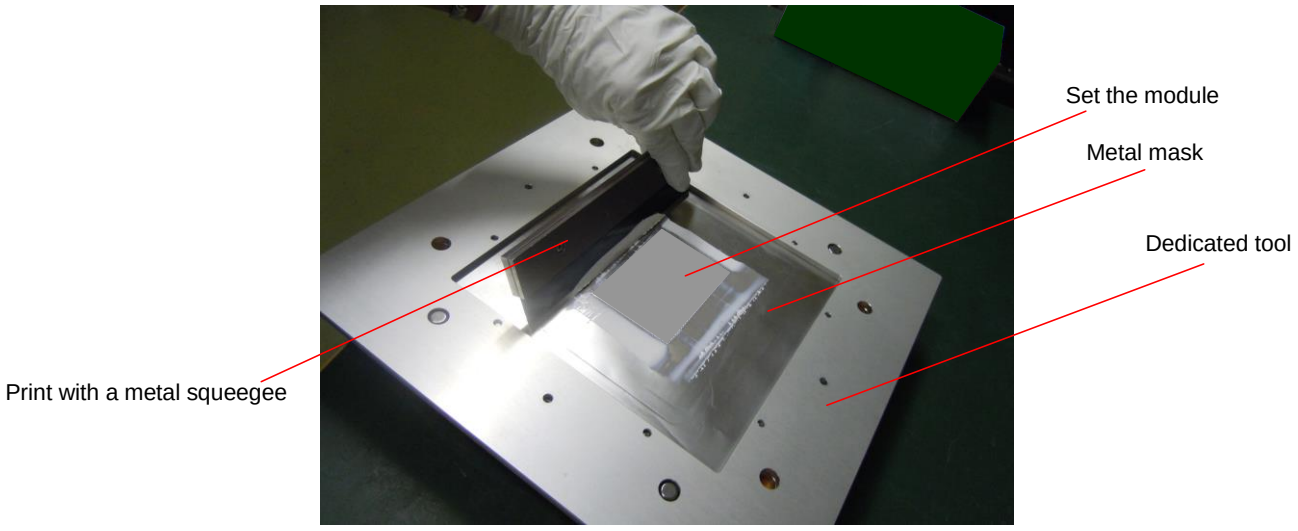


Fig.11 Stencil printing process

Thermal paste thickness strongly affects the thermal resistivity between the module and a heat sink. Stencil printing process is recommended to control thermal paste thickness. Fig. 11 shows an example of stencil printing process. Thermal paste thickness 80μm is recommended.

An example of recommendation thermal paste is indicated in table 2.

Table 2 Example of thermal paste

Model	Manufacturer
G-776	Shin-Etsu Chemical Co., Ltd.
TG320	NIHON HANDA Co.,Ltd.

10 Mounting the Module to a Heat Sink

In case of mounting on a heat sink, use thermal paste to secure thermal conductivity. If the thermal paste amount was not enough or applying method was not suitable, its spreading will not be enough, then thermal conductivity will be worse and thermal run away destruction may occur. Confirm spreading condition of the thermal paste. Power cycle capability is possibly decreased due to deterioration or depletion of the thermal paste in high temperature operation if an improper thermal paste is used. Please pay careful attention to selection of a proper thermal grease.

(Spreading condition of the thermal paste can be confirmed by removing the module after mounting.)

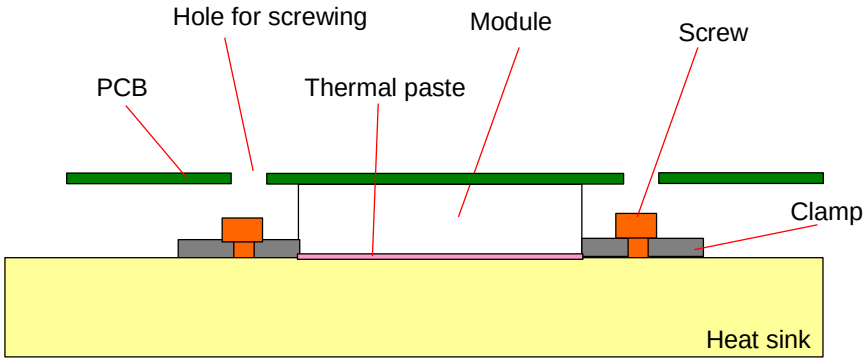
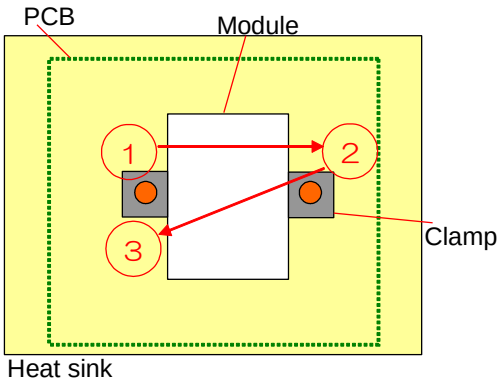


Fig.12(a) Mount the module to a heat sink



1; Pre-screwing by torque 0.5Nm
2; Screwing by torque 1.3-1.7Nm
3; Screwing by torque 1.3-1.7Nm

Fig.12(b) Recommended sequence of screwing (1B, 2B)

Fig. 12 shows an example of mounting process by screwing. If mounting process is applied after soldering, a PCB must have two holes for screwing. M4 screws and ϕ9mm washers are recommended. Recommend screw torque and screw sequence is shown in fig. 12(b). In the screwing process, the module should be held in place in order not to lean.

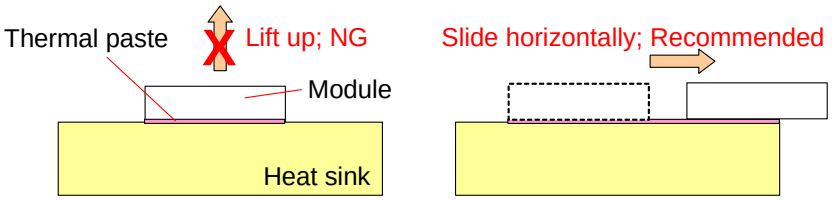


Fig. 13(a)

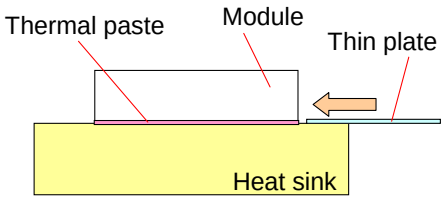


Fig. 13(b)

Fig. 13 An example of removal process after the screwing

Fig. 13(a); Slide the module horizontally to the outside of the heat sink carefully, don't lift up.

Fig. 13(b); Insert a thin plate between the module and the heat sink carefully.

After the module has been set on the thermal paste, it is possible to remove the module from the heat sink before the module is screwed to the heat sink.

After the screwing, it is not recommended to remove the module from the heat sink because it causes a module failure arising from a module structure deformation.

In case of removing the module from the heat sink, please try below methods. It needs special attention for the removal process to avoid module destruction or failure. It is recommended to check the isolation of the module after the removal process.

11 Fixing a PCB to a Heat Sink

To ensure solder joint reliability against vibration, it is good to fix a PCB to a heat sink by spacers and screws. Fig. 14 shows an example of fixing process.

The arrangement of a spacer is restricted to avoid excess stress of solder joint. The distance between the module outer edge and the spacer center line must be more than 5.0cm in case that fixing process is after soldering. In case that fixing process is before soldering, the distance less than 5.0cm is allowable.

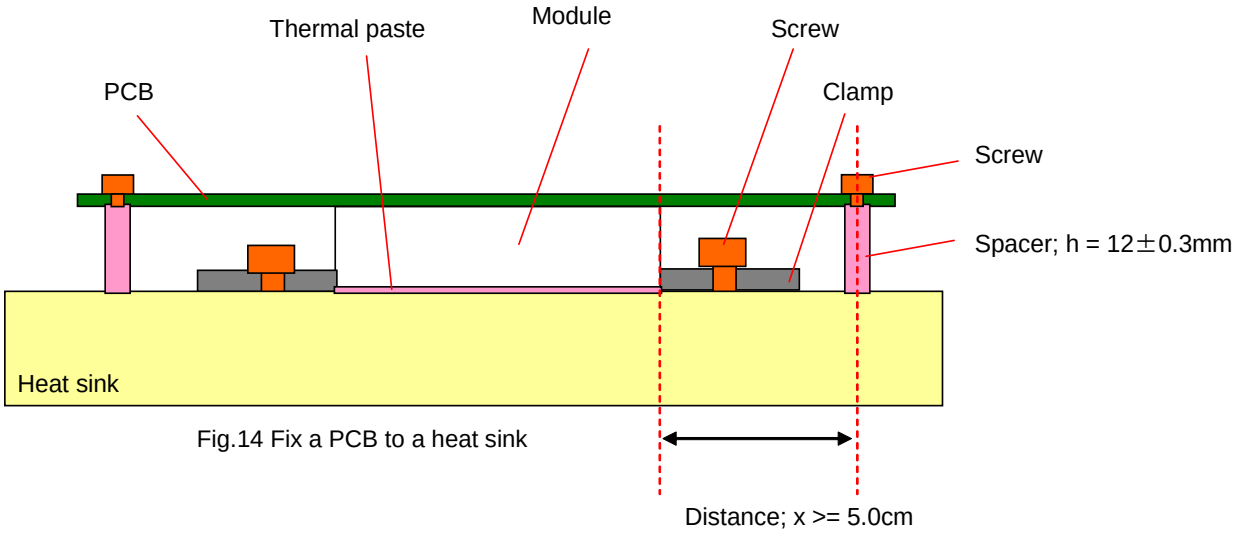


Fig.14 Fix a PCB to a heat sink

12 Storage and Transport condition

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

(2) Store modules in a place with few temperature changes in order to avoid condensation on the module surface.

(3) Avoid exposure to corrosive gases and dust.

(4) Avoid excessive external force on the module.

(5) Store modules with unprocessed terminals.

(6) Do not drop or otherwise shock the modules when transporting.

13 Mounting surface

Fingerprints and/or discoloration on the mounting surface do not affect the thermal behavior.
The following figure (Figure 15) defines surface characteristics, which do not affect the thermal behavior.

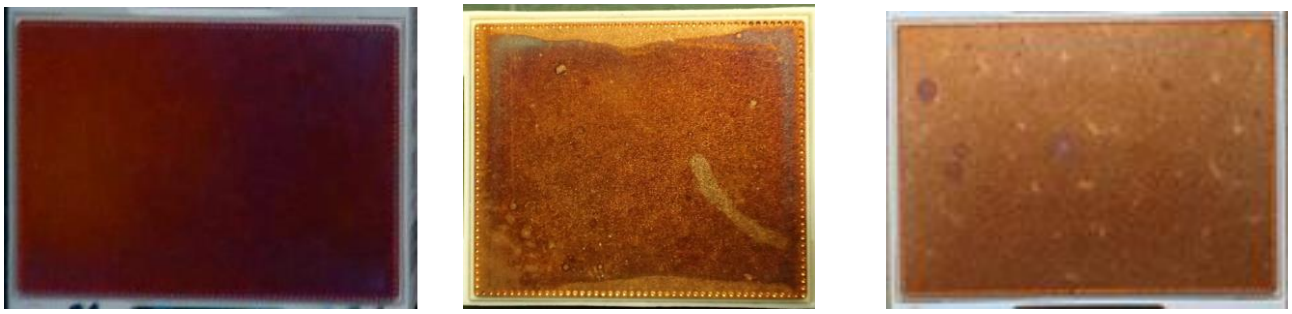


Figure 15 examples of discoloration on mounting surfaces which do not affect the thermal behavior

WARNING

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   ・Medical equipment.

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