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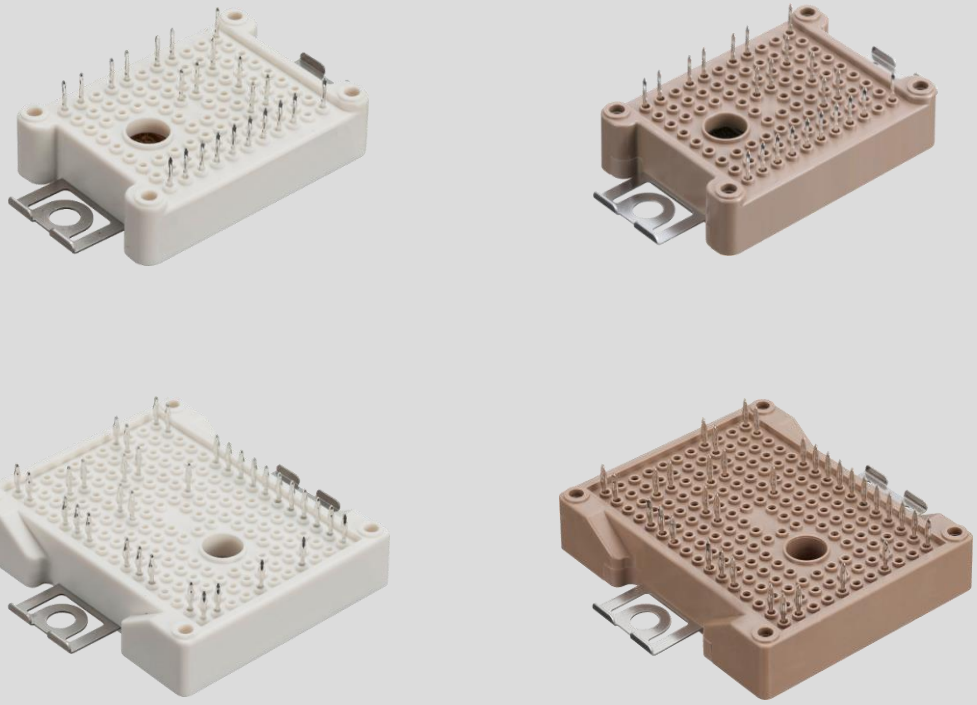


Fuji Industrial IGBT Module
Small Package Press Fit Type
(M726, M727, M730, M731)

Mounting Instruction

Mar. 2022

Fuji Electric Co., Ltd.

MT6M09794h

CONTENTS

1. Scope of application

This document describes how to safely mount and use press fit type of Small Package products for the following part numbers shown in Table 1.
Press fit type : Products that can be mounted solder less to printed circuit board (PCB)

Press fit terminals have the special shape shown in Fig.1. When the press fit terminal is pressed into the PCB, contact pressure is applied from both sides of the terminals, and they were deformed and inserted as shown in Fig. 2. The deformation pressure makes it possible to mount the product on the PCB solderless.

When handling the product, in addition to the contents described in this document, please check the Warning and Caution in the product specification too.

Fig.1 Press fit terminal

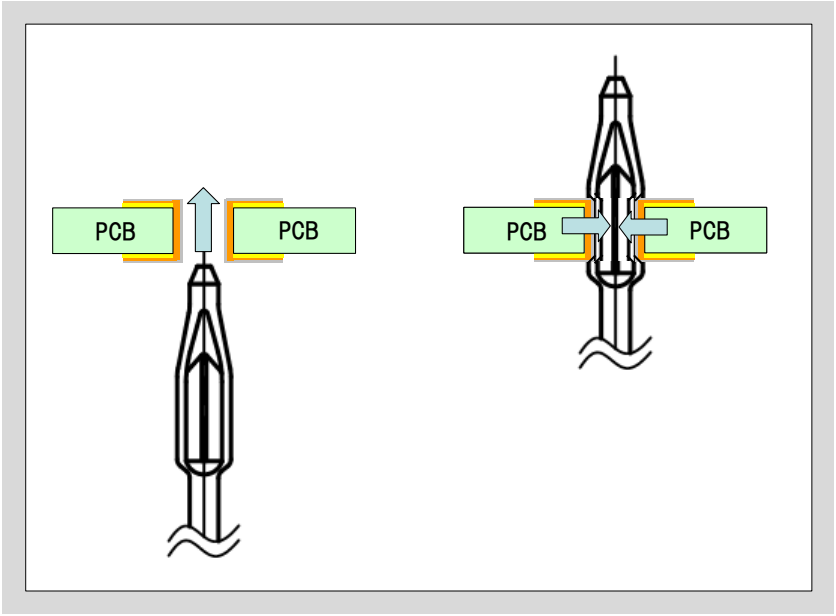
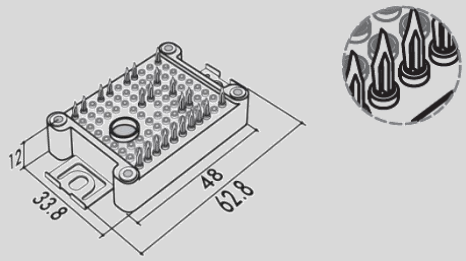
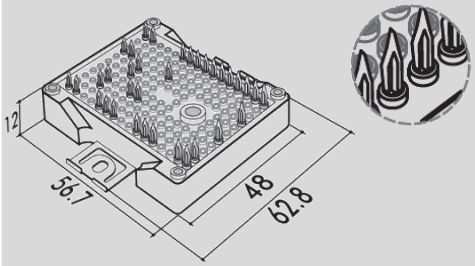


Fig.2 Terminal shape before and after the press-in process to the printed circuit board

The target part numbers of this mounting instruction are as follows.

Table 1 Scope of application of this mounting instruction

Applicable model			Package outlines
Package name	Series	Part number(Examples)	
M726	V-series	7MBRxxVKA060-5x 7MBRxxVKA120-5x	
M730	X-series	7MBRxxXKA065-5x 7MBRxxXKA120-5x	
M727	V-series	7MBRxxVKB060-5x 7MBRxxVKB120-5x	
M731	X-series	7MBRxxXKB065-5x 7MBRxxXKB120-5x 7MBRxxXRKB120-5x	

The A and B of the part numbers VKA (XKA) and VKB (XKB, XRKB) indicate the press fit type.

2. Mounting the module to printed circuit board

2-1. Requirements for printed circuit board

Table 2 and Fig.3 show the recommended specifications of a printed circuit board (PCB).

< Requirements for the PCB material >

Double-sided PCB in accordance with IEC 60249-2-4 or IEC 60249-2-5.

Multilayer PCB in accordance with IEC 60249-2-11 or IEC 60249-2-12.

For example, the end hole diameter should be in the range of 0.99mm to 1.09mm with properly Sn/Cu plated sidewall. If the diameter is too small, problems such as damage to the terminals and PCBs may occur during the press-in process. On the other hand, if the diameter is too large, a gap will be created between the terminal and the PCB, causing problems such as vibration and shock, resulting in reduced reliability.

Table 2 Requirements for a printed circuit board

	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	Electroless tin plating(recommended)		
Metallization of terminals	Electrolytic tin plating		
PCB thickness		1.6mm	＜2.0mm
PCB material	FR4		

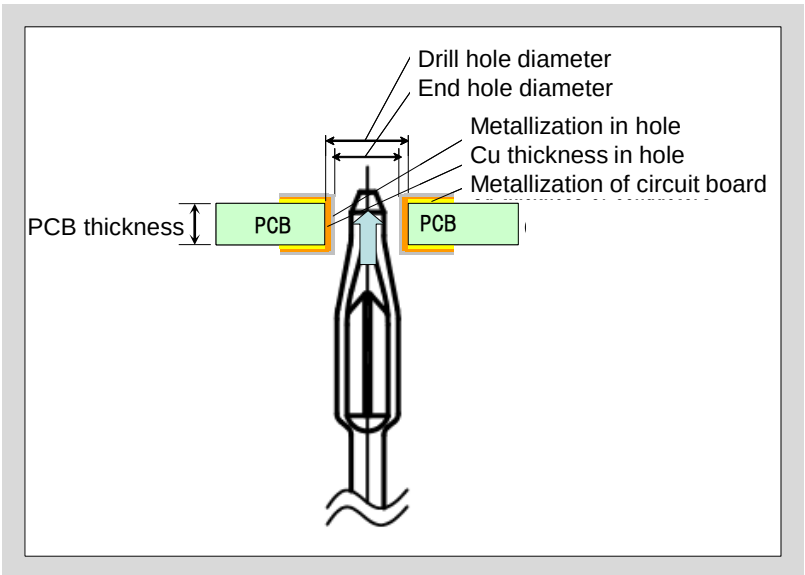


Fig.3 Description of each dimension

The recommended thickness of PCB is 1.6 mm. In the case of the thickness is 2.0 mm or more, please confirm the reliability. The recommended specifications in Table 2 is evaluated based on IEC60352-5. When using a PCB other than the recommended specifications, evaluation is required.

Fig.4 shows an example of a PCB. This is a PCB for verification purpose, not an actual PCB for application.

As shown in Fig.4(1), the PCB requires 2 holes for mounting the module to the heat sink.

Also, as shown in Fig.4(2), the PCB requires 4 holes for M2.5 screws to mount the PCB to the module. These 4 holes are also used as holes for the guide pins to pass through during the press-in process (see Fig.6(a) below). Therefore, these holes are necessary even if you are not mounting the PCB to the module by screws. The diameter of these 4 holes should have sufficient margin for mounting.

As shown in Fig.4(3), the PCB requires the same number of end holes as the number of terminals.

During the press-in process, relieve the mechanical stress on the PCB and it's surface mounted components by making contact between the lower and upper tool first. During the press-in and press-out process, the PCB around the press fit terminals will be distorted. Do not mount components around the terminals to prevent damage to them. Generally, it is recommended to secure a distance of 5mm from the center of the terminals.

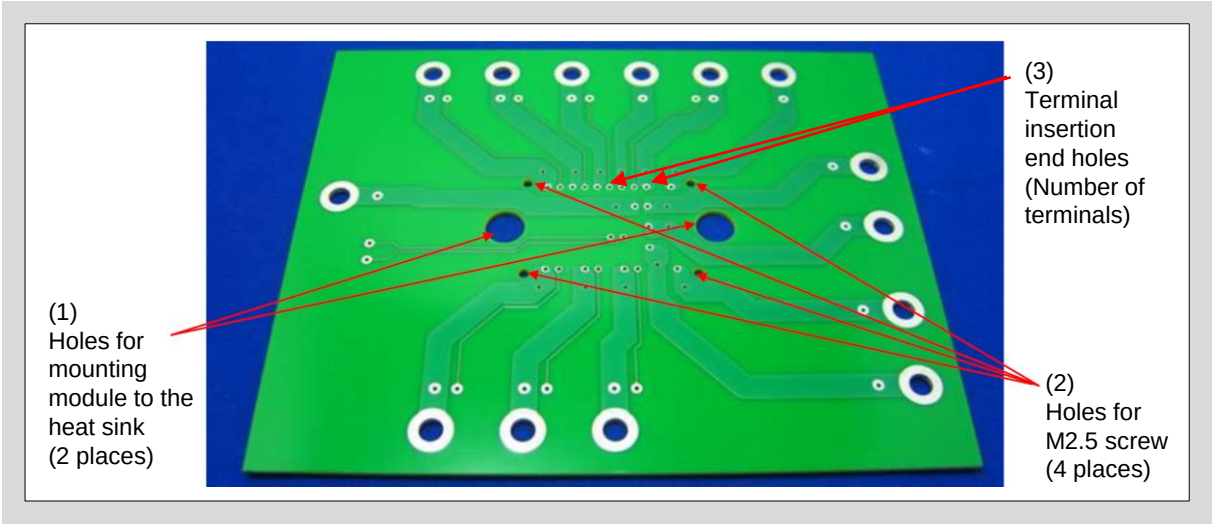


Fig.4 An example of a printed circuit board

2-2. The press-in and press-out process of printed circuit board

This section describes the procedure of the press-in and press-out process of PCB.

When mounting the module to the PCB, press-in with the press-in speed and average press-in force per terminal according to the end hole diameter shown in Table 3.

Table 3 Recommended press-in speed and average press-in force per terminal according to the end hole diameter

Recommended press-in speed	25mm/min	
End hole diameter	0.99mm(Min.)	1.09mm(Max.)
Average press-in force per terminal	Typ. 100N	Typ. 60N

If the press-in force is too low, there will be issues with the contact between PCB and the module terminals. On the other hand, if the press-in force is too high, it can damage the PCB and other mounted components.

Therefore, it is recommended to use dedicated machine and tools for the press-in and press-out process. Fig.5 shows a photo of the recommended press machine. It is also recommended to use the press-in and press-out tools described in the latter section.

The press-in speed varies depending on the diameter of the end hole of the PCB used.

Note1) Insertion is possible without problems if there is a maximum load of 4kN.

Note2) However, please confirm the maximum load per module that is actually applied to avoid damage to the module and PCB.

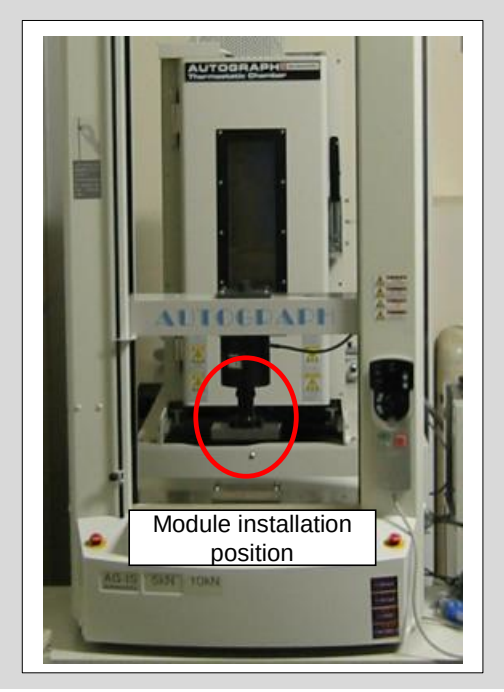


Fig.5 Recommended press machine

2-2-1. Press-in / press-out tool

Fig.6-8 show the examples of press-in and press-out tools. During the press-in process, pass the lower tool guide pins through the hole for the guide pins of the PCB.

If you need the details of the tool or the CAD data, please contact our sales department.

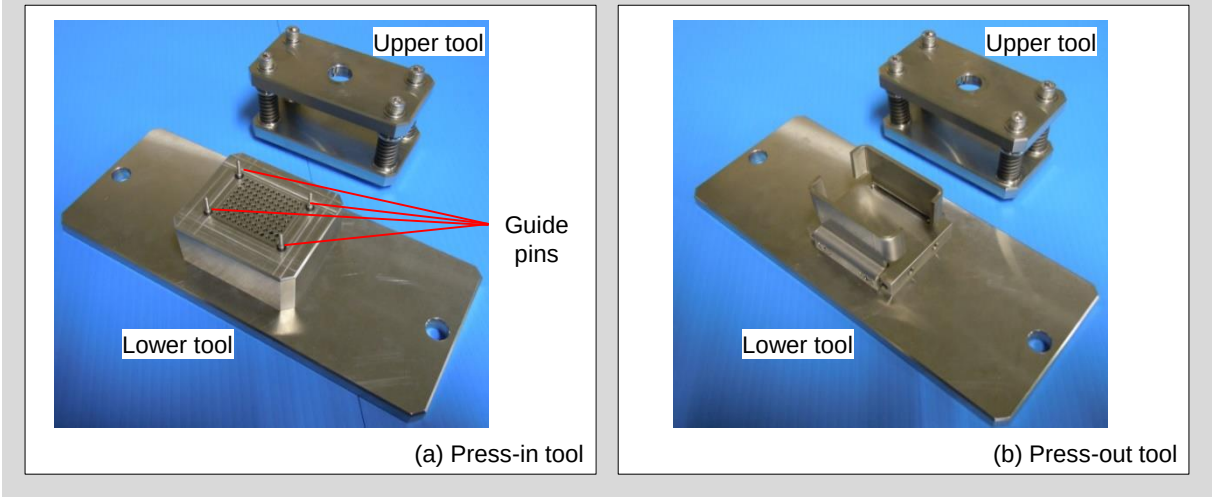


Fig.6 Examples of press-in/press-out tool (M726,M730)

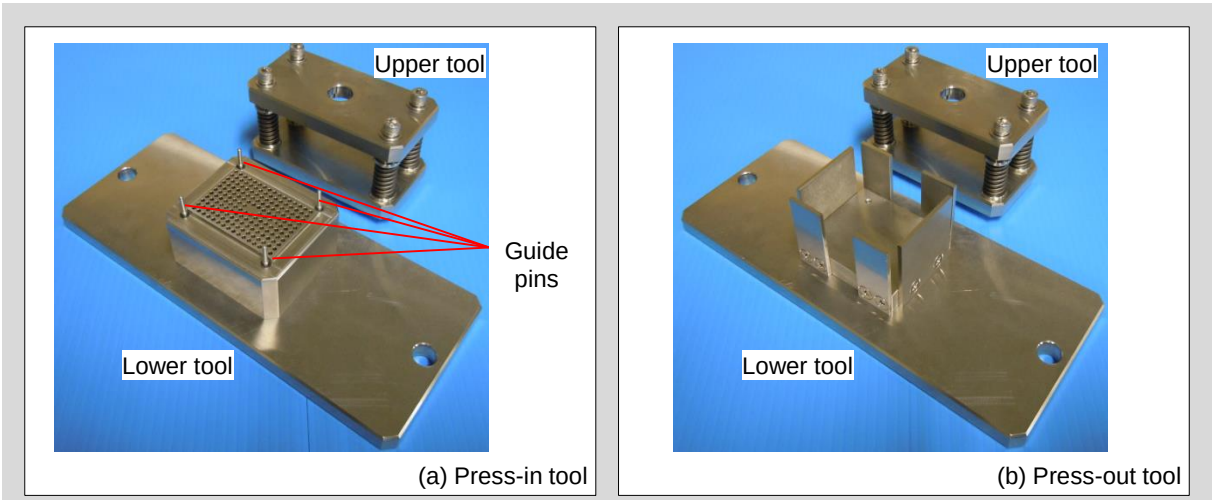


Fig.7 Examples of press-in/press-out tool (M727,M731)

Fig.8 Backside of upper tool

2-2-2. Example of press-in process

Fig.9(a)-(d) show the example of press-in process.

(a) Set the press-in upper tool and lower tool on the press machine.

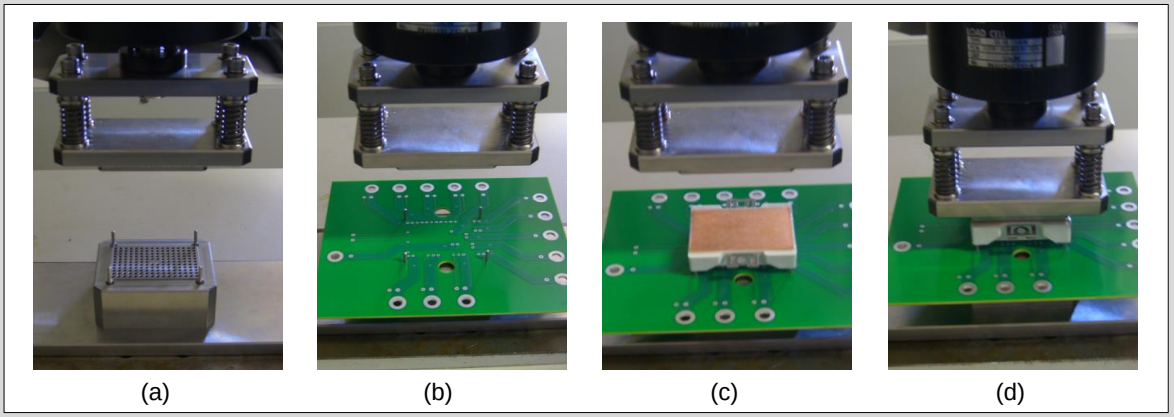
(b) Set the PCB by aligning the PCB hole for the guide pins with the guide pins of the lower tool.

(c) Set the module by aligning the terminals of the module with the end holes of the PCB.

(d) Press the module with the recommended load and speed.

Note1) If the product is pressed unevenly, make sure that there is no damage to the isolation substrate of the product.

Note2) After inserting the terminals into the PCB, the height of the terminals may vary by about 0.8mm, but it will not affect the module's functionality.



(a) (b) (c) (d)

Fig.9 Example of press-in process

2-2-3. Example of press-out process

Fig.10(a)-(d) show the example of press-out process.

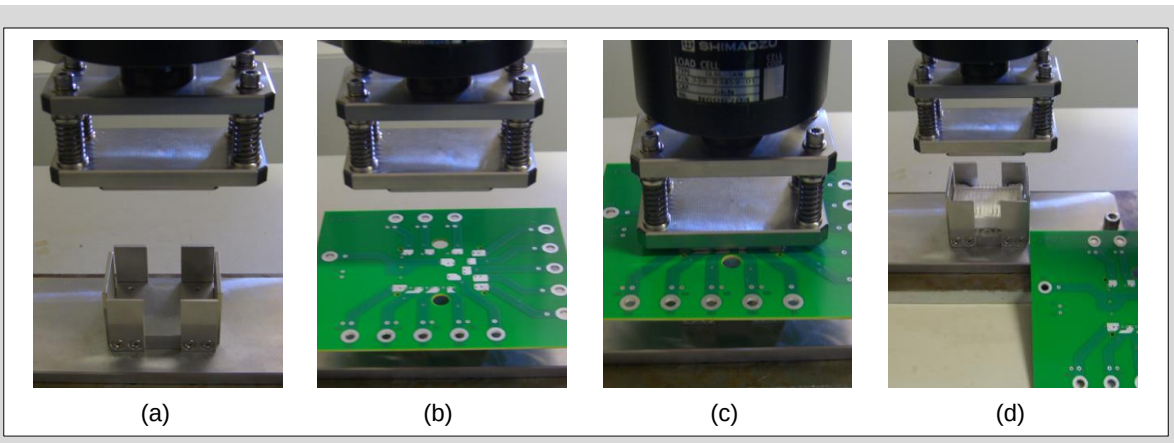
(a) Set the press-out upper tool and lower tool on the press machine.

(b) Set the PCB mounted module on the lower tool.

(c) Press the terminals of the module with the upper tool

(d) The module is removed from the PCB and drops onto the lower tool.

Note) The removed module cannot be reused.



(a) (b) (c) (d)

Fig.10 Example of press-out process

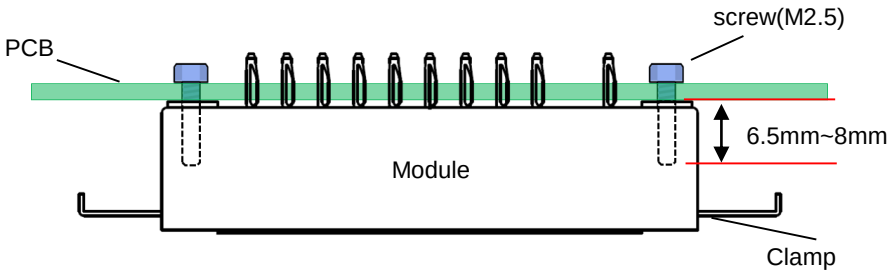
2-3. Fixing a printed circuit board to the module

To ensure the contact reliability between the terminals and PCB, it is possible to fix the PCB to the module by screws after the press-in process. Fig11(a) shows an example of the fixing process.

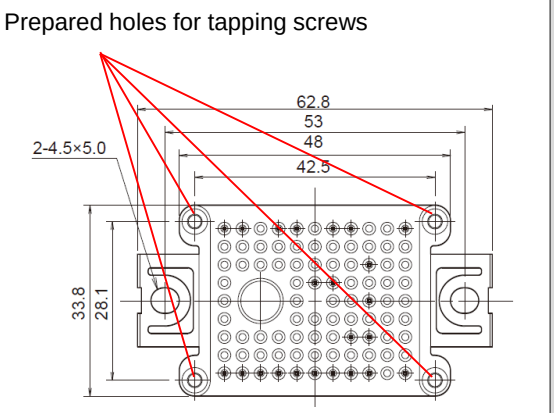
Use M2.5 self-tapping screws (JIS type 2 tapping screws).

The effective length of the screw, excluding the thickness of the PCB, should be 6.5-8.0 mm.

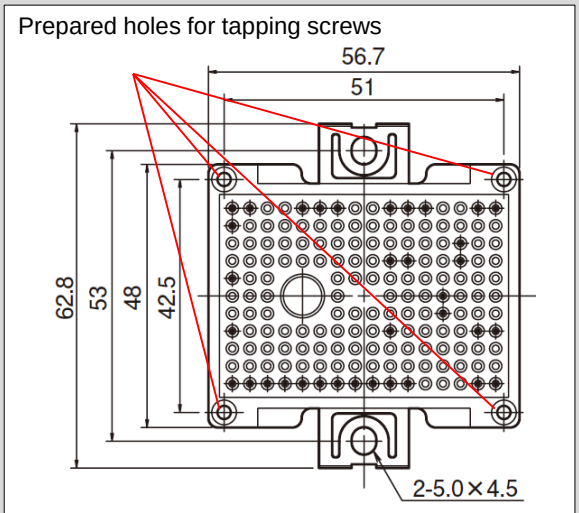
The screwdriver speed must be less than 300rpm. The recommended screw driver torque is 0.4Nm±10%.



(a) Fixing a printed circuit board to the module with screws



(b) Prepared holes for tapping screws (M726,M730)



(c) Prepared holes for tapping screws (M727,M731)

Fig.11 Fixing a printed circuit board to the module

3. Mounting to heat sink

3-1. Surface conditions of heat sink

Design the heat sink so that the following surface conditions are satisfied. If the roughness and flatness do not satisfy the conditions, it may cause an increase in contact thermal resistance, or insulation failure due to package cracking.

1. The surface roughness(R_z) of the heat sink should be 10μm or less.
2. The surface flatness of the heat sink should be 50μm or less in absolute value per 100mm, taking the straight line connecting the center points of the two screw mounting holes as reference. Here, "+" (plus) is defined when the heat sink has a convex shape, and "-" (minus) is defined when the heat sink has a concave shape. If both shapes exist, the sum of the absolute values of the maximum and minimum values should be 50μm or less.

* The flatness must satisfy the above value within the entire module mounting area including the two screw clamps.

Fig.12 shows the definition of surface roughness and flatness of the heat sink.

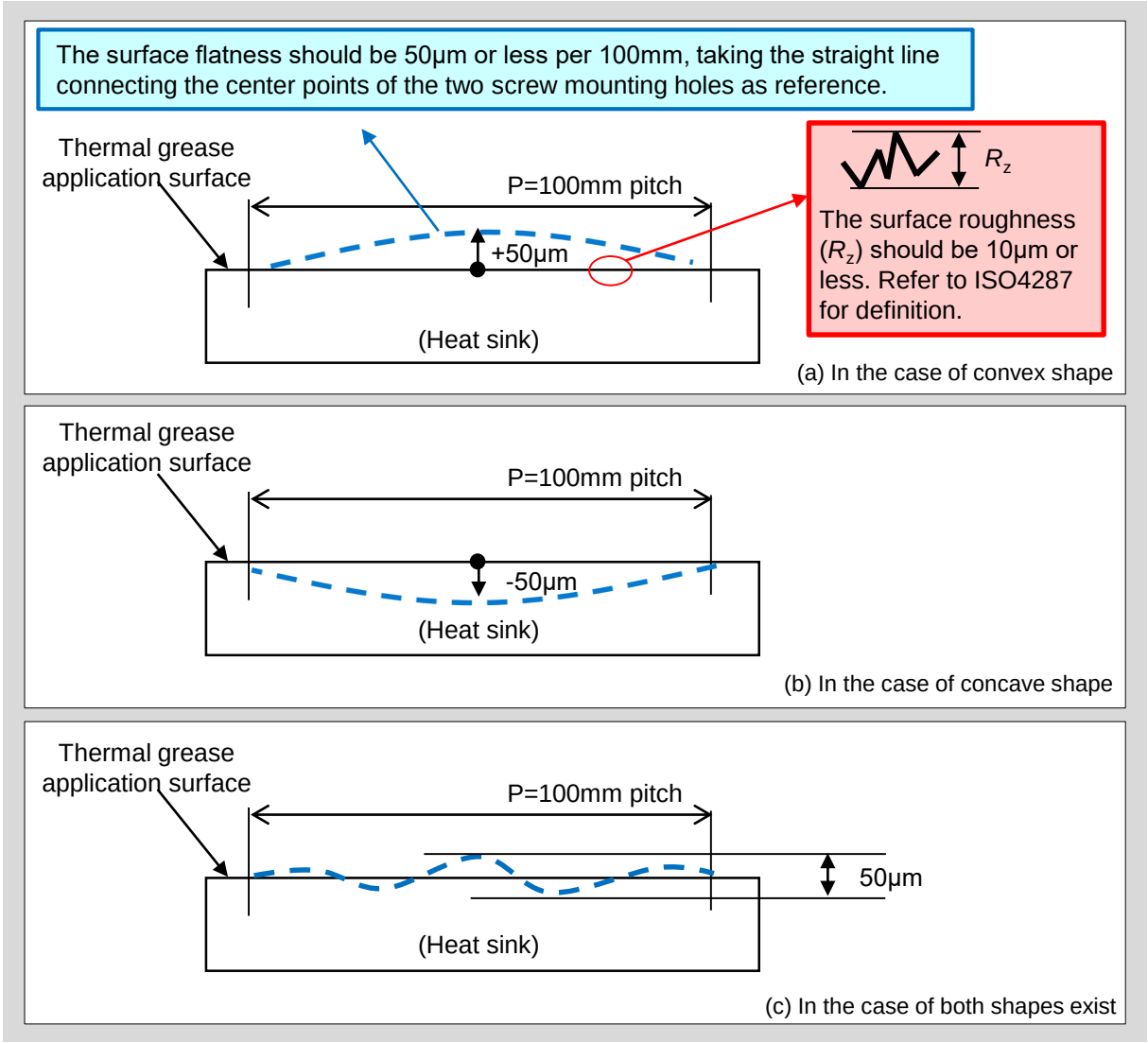


Fig.12 Heat sink surface flatness and roughness

3-2. Application of thermal grease

Thermal grease must be applied between the product mounting surface and the heat sink to ensure heat dissipation from the product to the heat sink.

If the properties, amount, and application method of the thermal grease are not appropriate, it may result in poor heat dissipation and lead to thermal failure. Make sure that the thermal grease is spread over the entire base plate of the product. Also, please check the heat dissipation status of the module by yourself. You can check the spread of thermal grease by removing the module after mounting.

Table 4 shows the recommended thermal grease properties and thickness. Assuming that the thickness is uniform, the required amount (weight) of thermal grease can be calculated from the following formula.

Thermal grease weight (g) = Thermal grease thickness (μm) x Mounting surface area of module (cm^2) x Density of thermal grease (g/cm^3)

We recommend using the stencil method to control the appropriate thermal grease thickness (Fig.13). The recommended stencil mask drawing is shown in page 18.

In addition, depending on the type or application method of thermal grease, deterioration or dry out of thermal grease may occur during high temperature operation or temperature cycle, which may shorten the product lifetime. Pay attention to the selection and application method of the thermal grease.

Table 4 Recommended properties of thermal grease

	Unit	Recommended value
Penetration (typ.)	-	>= 340
Thermal conductivity	W/m･K	>= 1
Thermal grease thickness	μm	>= 80

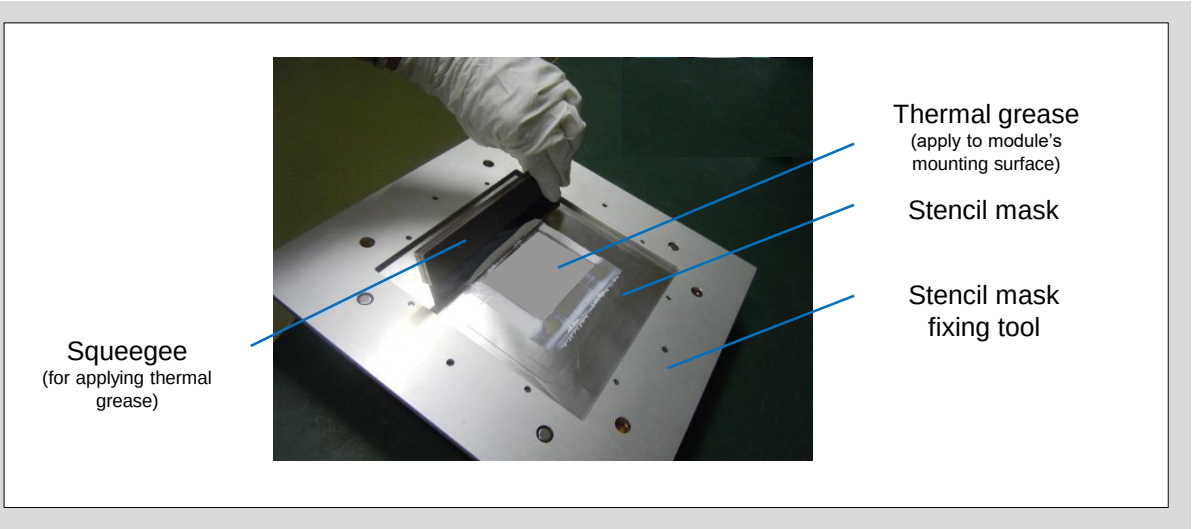
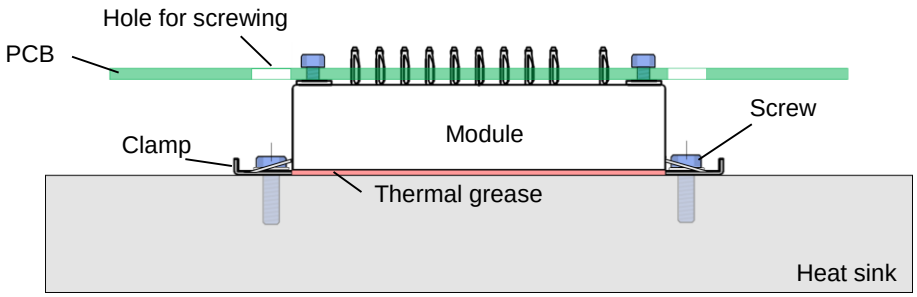


Fig.13 Thermal grease application

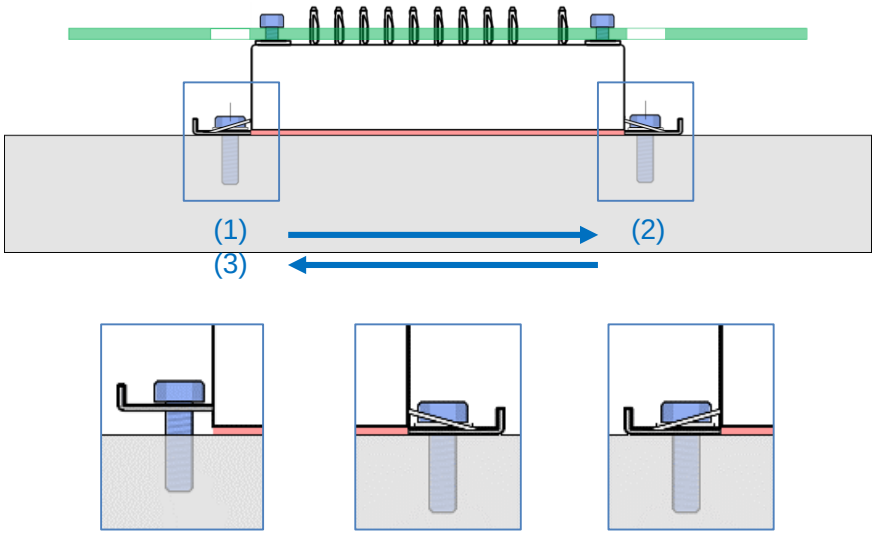
3-3. Mounting the module to heat sink

Fig.14(a) shows an example of mounting process by screwing.

If the mounting process is applied after the press-in process, the PCB must have two holes for screwing. Use M4 screws. For the washer, JIS B1256 O.D. φ9mm is recommended. Select a screw material that will not be damaged by the maximum tightening torque specified in the specifications. During the mounting process, to prevent the module from tilting, the procedure shown in Fig.14(b) is recommended.



(a) Screwing the module to heat sink



(1)Temporary tightening (2) Final tightening (3) Final tightening

	Tightening torque	Tightening sequence
Temporary tightening	Temporarily tighten the screws until the clamp does not tilt.	(1)
Final tightening	1.3 – 1.7Nm	(2) → (3)

(b) Screw tightening torque and screw tightening sequence

Fig.14 Mounting the module to heat sink

After the module has been set on the thermal grease, 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 deformation of the module structure may cause the module to fail.

In the case of removing the module from the heat sink, please use the methods shown in Fig.15. Be careful in the removal process to avoid module destruction or failure. It is recommended to check the isolation of the module after the removal process.

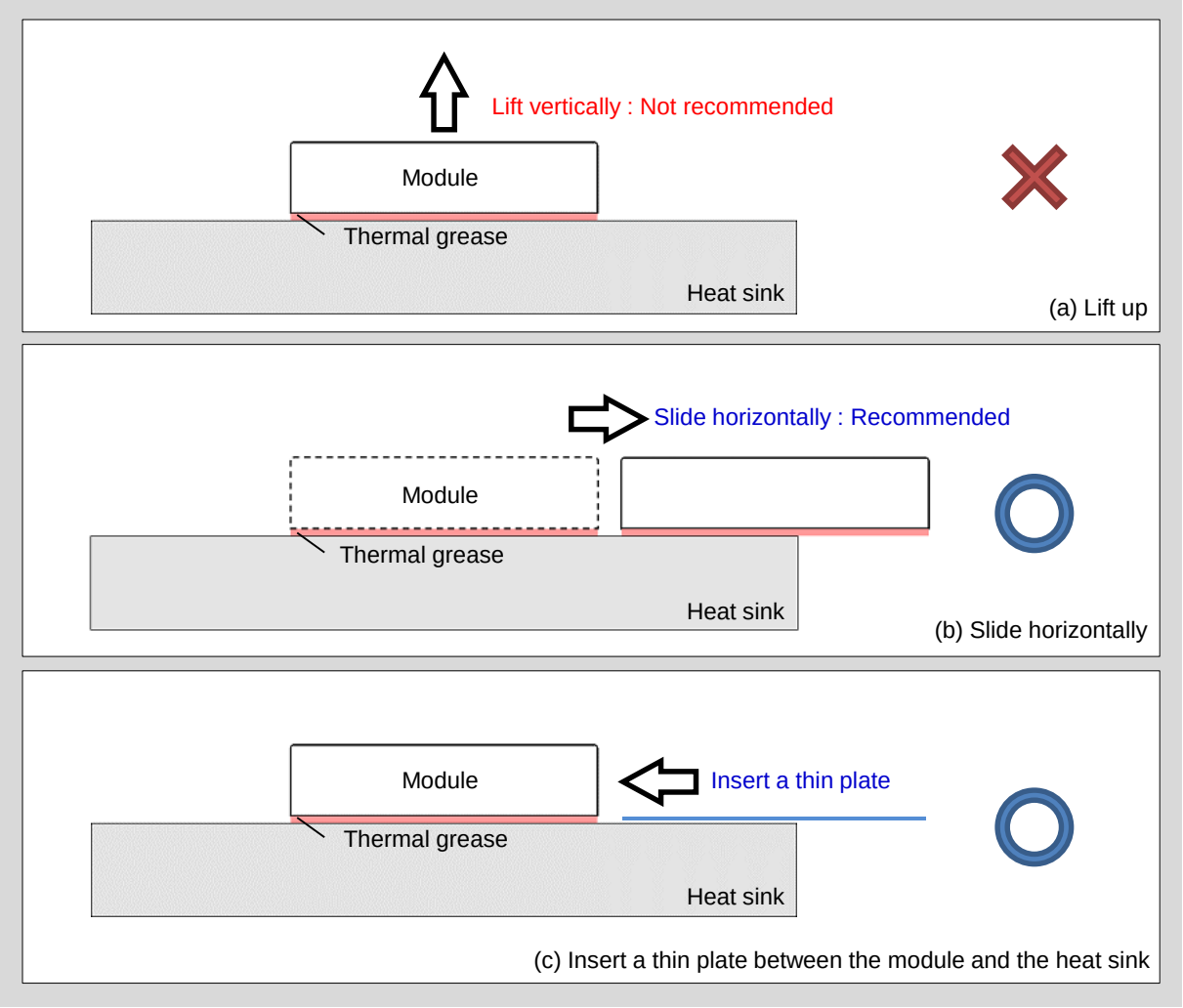


Fig.15 An example of removal process after screwing

3-4. Fixing the printed circuit board to heat sink

To ensure contact reliability against vibration, fix the PCB to the heat sink with spacers and screws. Fig.16 shows an example of the fixing process.

If the module has already been pressed into the PCB prior to the mounting process, the distance between the module outer edge and the spacer centerline should be at least 5.0 cm to avoid excessive stress on the terminals.

In the case of the fixing process is before press-in, distance less than 5cm is allowed.

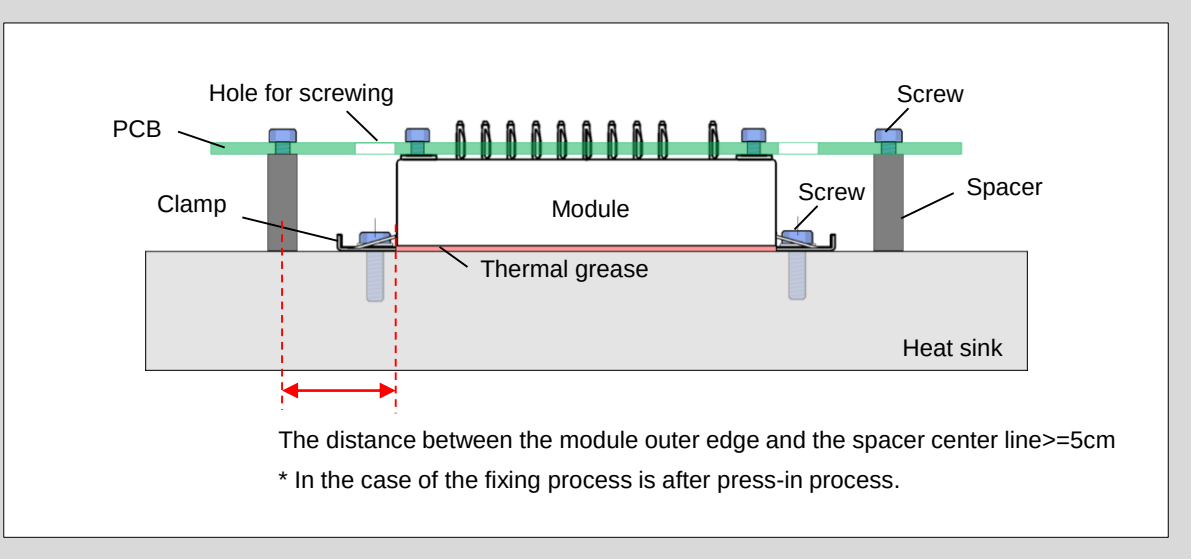
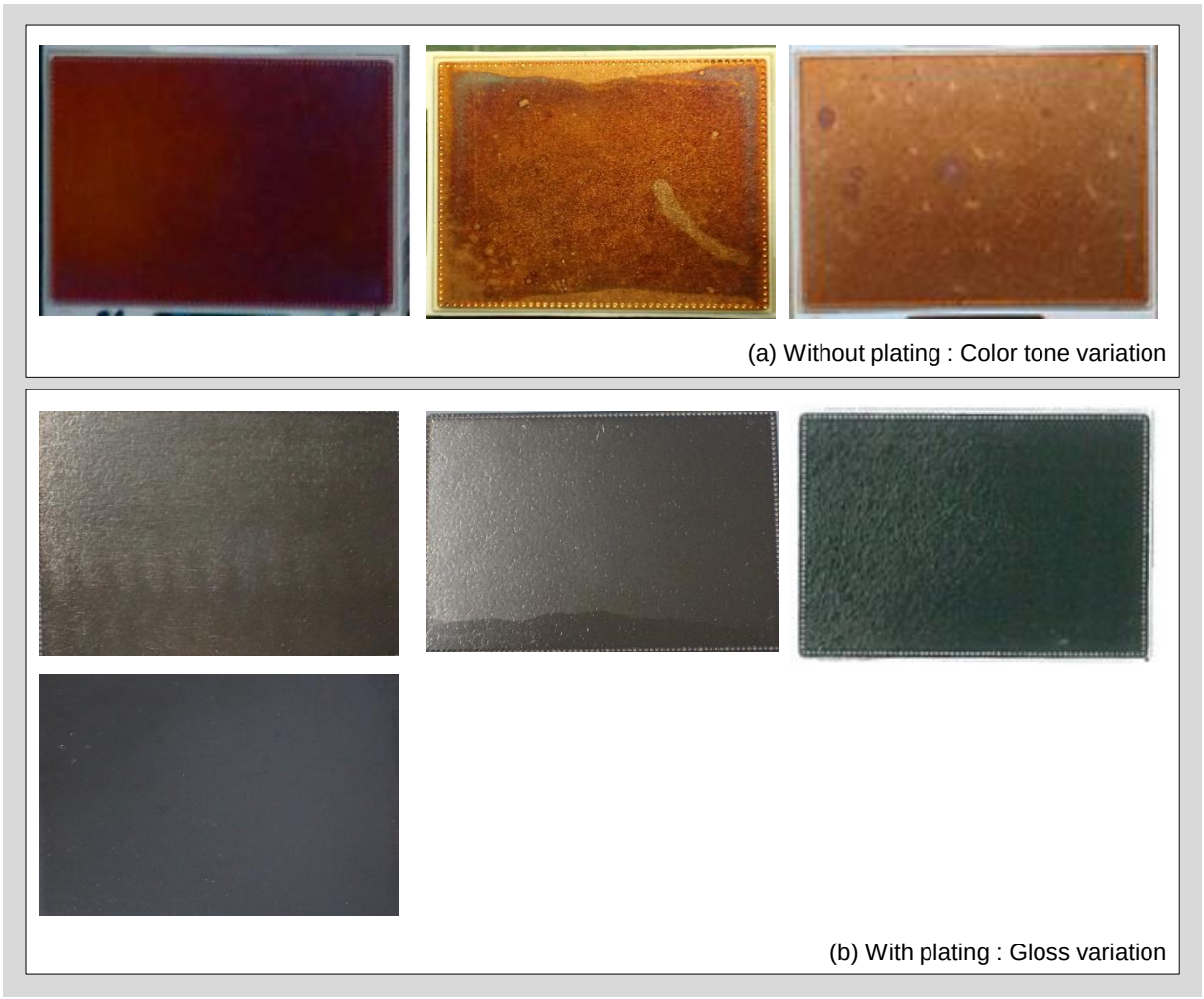


Fig.16 Fixing the printed circuit board to heat sink

4. Color tone of mounting surface

Discoloration and/or color tone variation on the mounting surface may occur, but does not affect the thermal characteristics.

Fig.17 shows examples of discoloration and color tone variation.



(a) Without plating : Color tone variation

(b) With plating : Gloss variation

Fig.17 Examples of discoloration and color tone variation on the mounting surfaces which do not affect the thermal characteristics

5. Warning

(1) If the printed circuit board is not suitable, the terminals temperature may exceed the storage temperature. Use the terminals within the range of storage temperature.

(2) If longer screws than the allowable length described in this specification are used, the product may be damaged, causing ground faults and poor insulation. In that case, Fuji Electric Co., Ltd. Is not responsible for the matter.

(3) In any environment containing acids, alkalis, organic substances, corrosive gases (hydrogen sulfide, sulfurous acid gas, etc.) and corrosive liquids (cutting fluid, etc.), this product may oxidize or corrode, resulting in poor contact, disconnection, short circuit, ground fault, etc. In such cases, avoid using this product as it may cause malfunctions. In the unlikely event that a short circuit or ground fault occurs, there is secondary risk of smoke, fire, or explosion, etc. If this product is used under conditions containing these corrosive substances, Fuji Electric Co., Ltd. is not responsible regardless of the conditions (temperature, humidity, concentration, etc.).

(4) This product is not designed for use in a dusty environment. When used in an environment where dust is generated, heat dissipation may deteriorate due to clogging of the heat sink, and short circuits or ground faults may occur due to leaks between terminals or creeping discharge. (even if the dust is insulating materials such as fiber, leakage may occur due to moisture absorption.)

(5) When this product is pressed into the printed circuit board, if there are foreign objects between the product and the press-in tools, the isolation substrate of the product may be damaged and may cause isolation failure. Therefore, take measures against foreign objects during the press-in process.

This manual does not describe all applications and mounting conditions. Therefore, it is necessary to evaluate under actual usage conditions and confirm the mechanical characteristics, electrical characteristics, thermal characteristics, lifetime, etc.
The order in which CONTENTS is described in this manual does not indicate the order in which the products should be mounted. Please consider and decide the installation process.
The applications described in this manual are illustrative of typical applications using Fuji Electric's semiconductor products. This manual do not warrant or grant licenses for the enforcement of industrial property rights or other rights.

6. Storage and transportation notes

6.1 Storage

(1) Please manage the storage location so that the temperature is 5 to 35°C and the humidity is 45 to 75%. If more than a year has passed since the product was manufactured under these storage conditions, confirm that the terminal solderability is not deteriorated before mounting.
(2) Avoid exposure to corrosive gases and dust.
(3) Rapid temperature changes may cause condensation on the module surface. Therefore, store modules in a place with minimal temperature changes.
(4) During storage, it is important that nothing be placed on top of the modules, since this may cause excessive external force on the case.
(5) Store modules with unprocessed terminals. Corrosion may form causing processed connections to have high contact resistance or potential solder defects in later processing.
(6) Use only antistatic containers for storing IGBT modules in order to prevent ESD damage.

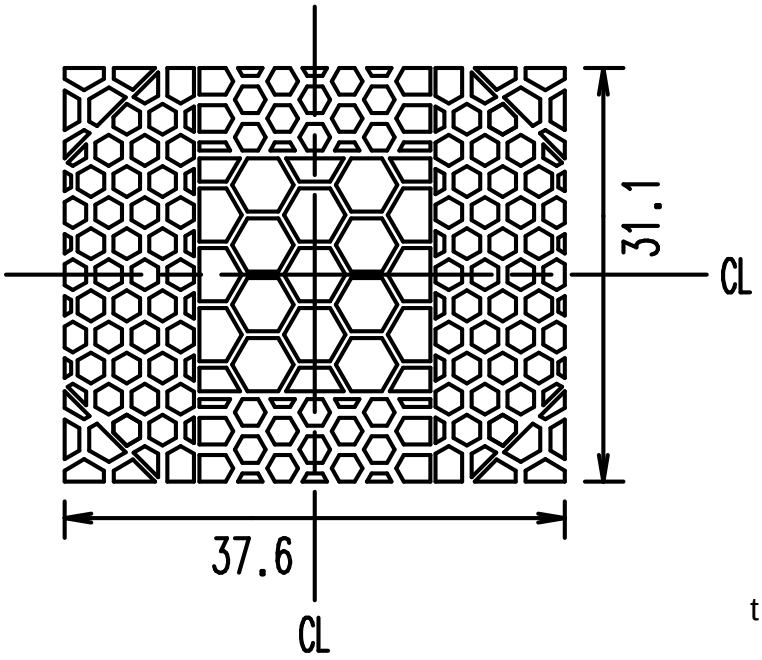
6.2 Transportation

(1) Do not drop or cause impact to the modules which could otherwise cause mechanical stress.
(2) When transporting several modules in the same box or container, provide sufficient ESD padding between the modules to protect the terminals and to keep the modules from shifting.

7. Stencil mask drawing

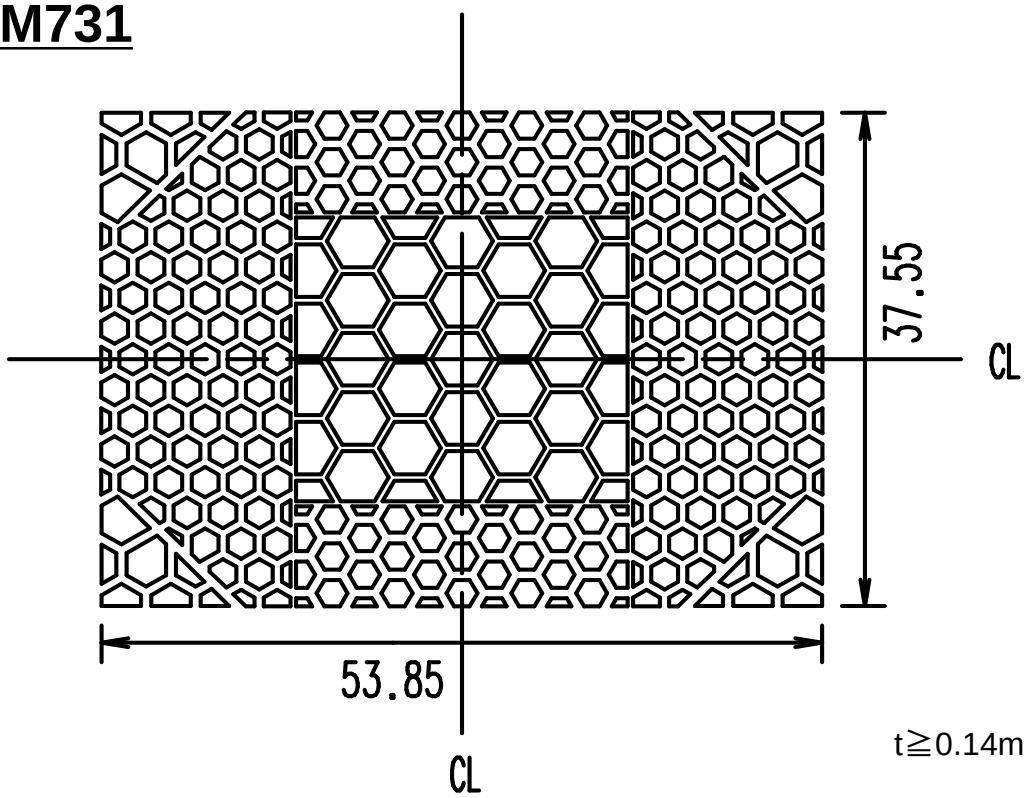
Stencil mask drawing for thermal grease application (recommended)
If you would like to obtain the following data, please contact our sales department.

M726,M730



t≧0.14mm

M727,M731



t≧0.14mm

Warning:

The contents in this manual (product specifications, characteristics, data, materials, structure, etc.) are as of March 2022. The contents are subject to change without prior notice due to changes in product specifications or for other reasons. When using a product described in this manual, please obtain the product's latest specification and check the data.