Fuji Electric
Innovating Energy Technology

Fuji Industrial IGBT Module
PrimePACK™
(M271, M272, M291, M404)

Mounting Instruction

Note) PrimePACK™ is a registered trademark of Infineon Technologies.

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Fuji Electric Co., Ltd.

MT5Q01780e

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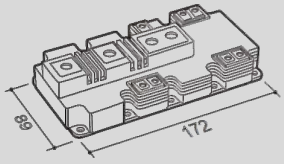
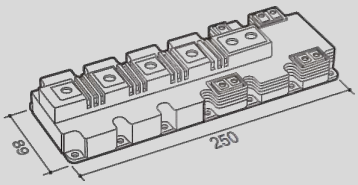
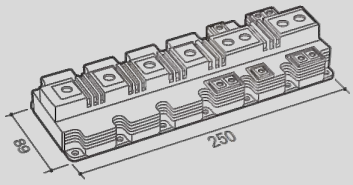
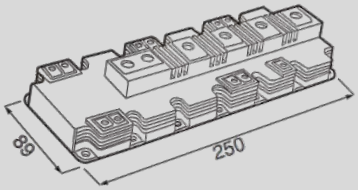
1. Scope of application

This document describes how to safely mount and use PrimePACK™ products for the following part numbers shown in Table 1. TIM products (-81) are not applicable to this instruction.

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

Table 1 Scope of application of this mounting instruction

Applicable model			Package Outlines
Package name	series	Part number	
M271	X-series	2MBIxxxxXXA120x-xx 2MBIxxxxXXA170-xx 2MBIxxxxXXE120x-xx 2MBIxxxxXXE170-xx	
	V-series	2MBIxxxxVXA-120x-xx 2MBIxxxxVXA-170x-xx 1MBIxxxxVXA-120xx-xx 1MBIxxxxVXA-170xx-xx	
M272	X-series	2MBIxxxxXXF120x-xx 2MBIxxxxXXF170-xx 2MBIxxxxXXB120x-xx 2MBIxxxxXXB170-xx	
	V-series	2MBIxxxxVXB-120x-xx 2MBIxxxxVXB-170x-xx 1MBIxxxxVXB-120xx-xx 1MBIxxxxVXB-170xx-xx	
M291	X-series	2MBIxxxxXXG120x-xx 2MBIxxxxXXG170-xx 2MBIxxxxXRXG120-xx	
M404	V-series	4MBIxxxxVx-120Rx-xx 4MBIxxxxVx-170Rx-xx 4MBIxxxxVx-120-xx	

Note) PrimePACKTM is a registered trademark of Infineon Technologies.

2. Mounting to heat sink

2-1. Mounting to heat sink

The heat dissipation of the module depends on the position of the module on the heat sink, the thermal characteristics such as the thermal conductivity of the heat sink, and the cooling method such as air cooling by a fan.

This section describes the mounting of the module on the heat sink.

Since the heat dissipation of the module changes depending on the mounting position of the module, the following points should be considered.

(1) IGBT module should have thermally optimized layout on heat sink according to the mechanical-thermal design so that the modules have good heat spread to minimize the thermal resistance.

(2) When multiple modules are mounted on the same heat sink, the distance between modules should be optimized based on the mechanical-thermal design and the estimated total power dissipation of each module in order to avoid the thermal coupling effect between adjacent modules.

2-2. Surface conditions of heat sink

The heat sink on which the module is mounted must meet the conditions shown in Table 2.

Excessive convex warpage may cause isolation breakdown of this module, resulting in a serious accident. Excessive concave warpage or distortion may create gaps between the module and the heat sink, resulting in poor heat dissipation and may lead to thermal destruction.

Table 2 Surface conditions of heat sink

	Base plate size	Surface flatness of heat sink	Heat sink surface roughness(R_Z)
M271	172mm × 89mm	≦30μm	≦10μm
M272,M291,M404	250mm × 89mm	≦50μm	≦10μm

Definition of heat sink surface roughness and surface flatness

1. Refer to ISO4287 for the surface roughness (R_Z) of the heat sink.
2. The surface flatness of the heat sink should be 30 µm or less for M271 and 50 µm or less for M272, M291 and M404, with respect to the size of the base plate.

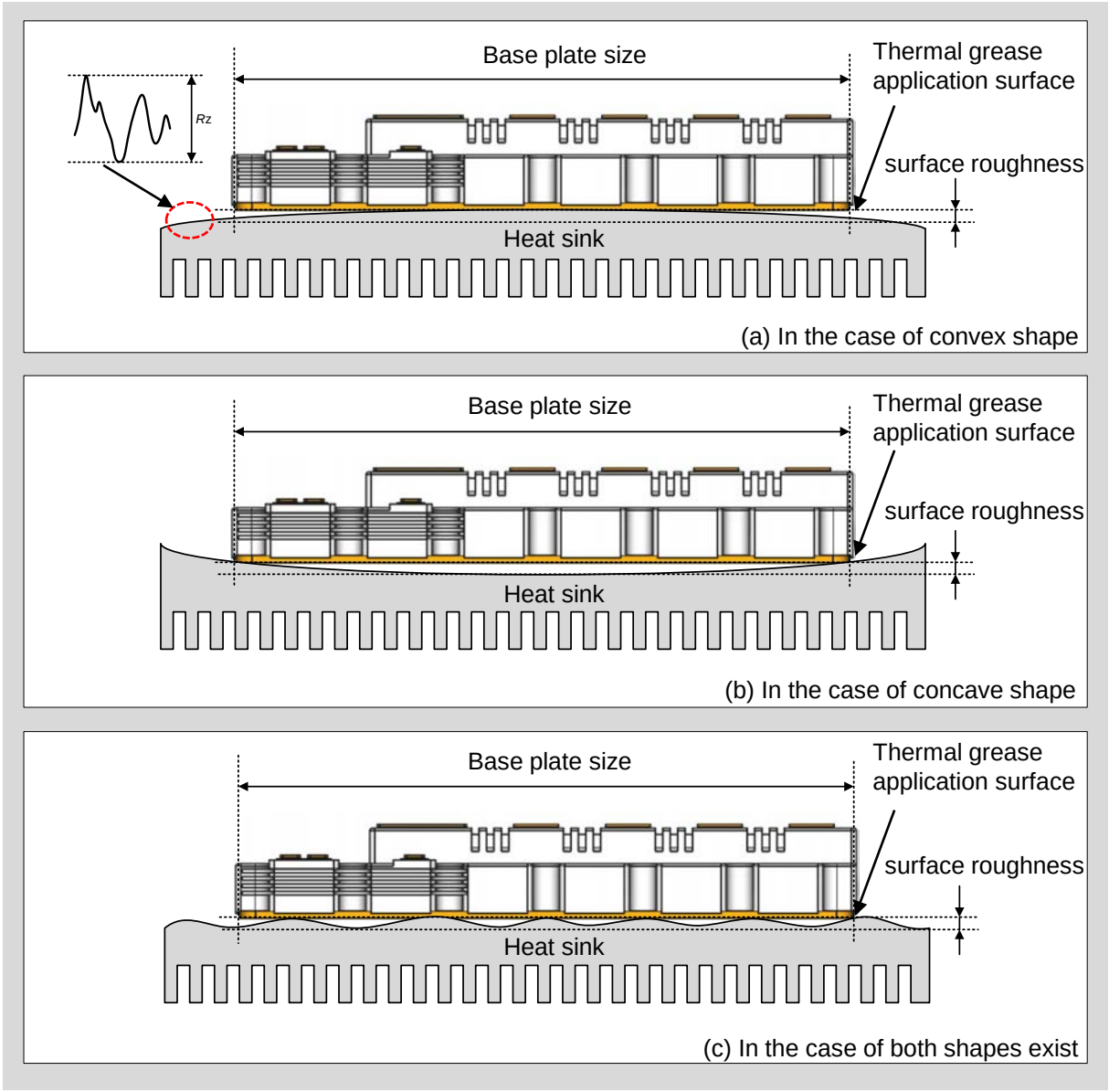


Fig.1 Heat sink surface flatness and roughness

2-3. Application of thermal grease

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

Improper thermal grease characteristics, application amount, and application method can lead to thermal breakdown due to deterioration of heat dissipation caused by thermal grease not spreading sufficiently throughout the module, or to a reduction in module life due to degradation or depletion of thermal grease during high temperature operation or temperature cycling. Pay attention to the selection and application method of the thermal grease.

Assuming that the thickness is uniform, the required amount (weight) of thermal grease can be calculated from the following formula.

Thermal grease weight (g) x 10^4	=	Thermal grease thickness (μm)	x	Base plate area of module (cm^2)	x	Density of thermal grease (g/cm^3)

The stencil method of application is recommended to control proper thickness (Fig.2). The recommended stencil mask pattern (Table 3) can be provided upon request.

The spreading of thermal grease can be checked by removing the module after mounting. Make sure that the thermal grease is well spread over the entire module mounting surface.

When applying thermal grease, should check not only the spread of the thermal grease over the entire surface of the module, but also the heat dissipation of the module.

Fuji Electric confirmed that the spreading which is not a problem in actual use using ELECTROLUBE's HTC thermal grease with our specified stencil masks and heat sinks of the shape described in our specifications. Table 4 shows typical characteristics of HTC thermal grease.

Additionally, the use of phase change thermal interface material and thermal sheet may cause excessive stress on the module as described below.

- Phase change thermal interface material :

When the grease solidifies, its hardness increases significantly compared to normal thermal grease. If there is a step between the fastening points due to the grease, the module may be subjected to excessive stress at the step when fastening the module. To reduce module stress during fastening, consider measures such as increasing the fastening torque in stages, fastening while heating and softening the grease. After the grease softens and spreads, the tightening torque may decrease. Consider measures such as retightening within the specified torque range or using spring washers.

- Thermal sheet :

If there is a step between the fastening points due to the sheet, the module may be subjected to excessive stress at the step when fastening the module. Please consider placing the sheet over the entire backside of the module, including around the heat sink fastening screw holes.

The above explanation shows the basic concept of thermal grease, but when using it, customer is responsible for making the decision to apply it with sufficient application verification.

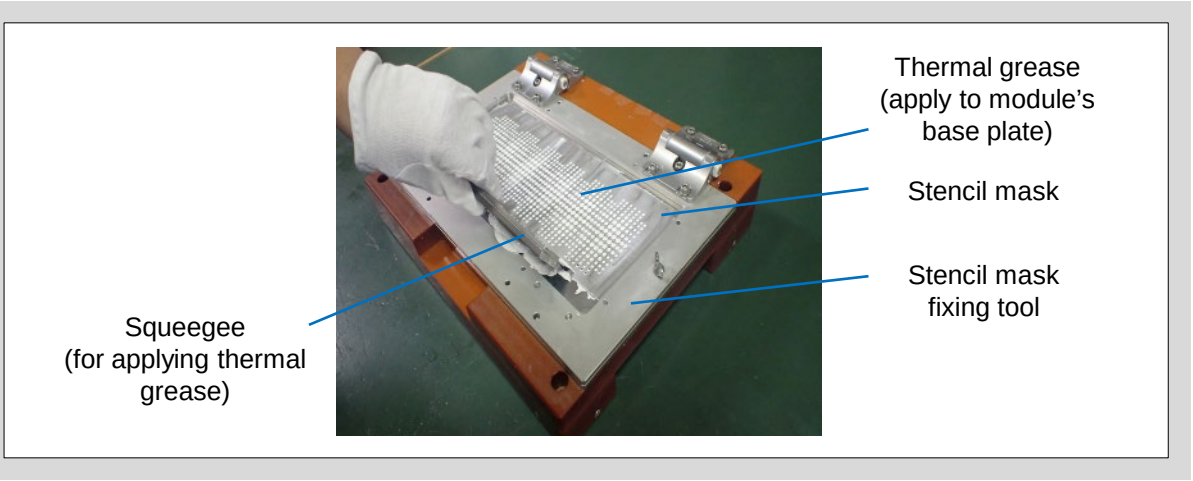


Fig.2 Thermal grease application

Table 3 Recommended stencil mask pattern and applicable package number

Stencil mask pattern	Applicable package number
Type A	M271
Type B	M272, M291, M404

Table 4 Typical characteristics of HTC thermal grease and recommended thickness

	Unit	Value
Viscosity (23deg.C, 1RPM)	Pa･s	202 ~ 205 *
Thermal conductivity	W/m･K	0.9 *
Average thickness after spreading	μm	100 +/- 30

* Excerpt from HTC Technical Data Sheet

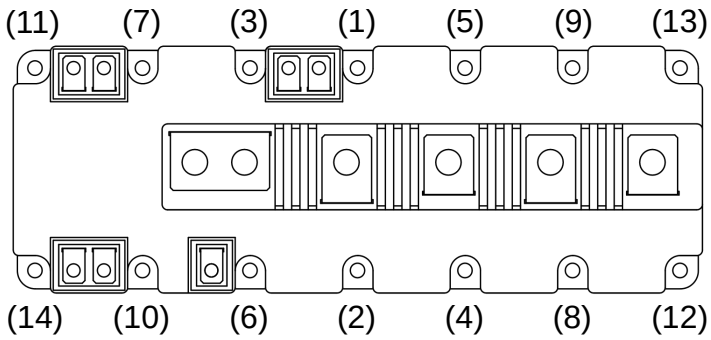
2-4. Screw fastening to heat sink

This section describes how to tighten the screws when mounting the module to heat sink.

1. Perform temporary tightening with 0.5N･m. Fig.3 shows the tightening sequence.
2. Perform final tightening in the same sequence as temporary tightening. The final tightening torque should be within 3.0 – 6.0N･m.

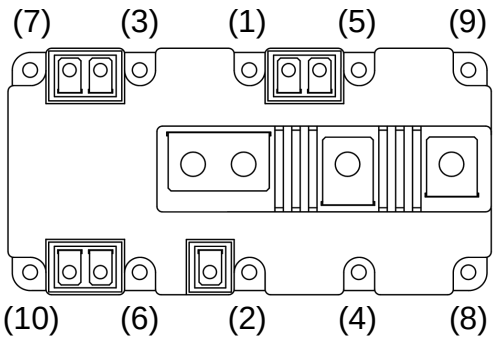
Fuji Electric conducts quality verification using the following screws and washers.

- M5 bolt with built-in washer, Strength class 10.9 with black oxide film
  (Spring washer dimensions : JIS1251, Flat washer dimensions : JIS1256)



	Tightening torque	Tightening sequence
Temporary tightening	0.5±0.1 N･m	(1) → (14)
Final tightening	3.0 - 6.0 N･m	(1) → (14)

(a) M272,M291,M404



	Tightening torque	Tightening sequence
Temporary tightening	0.5±0.1 N･m	(1) → (10)
Final tightening	3.0 - 6.0 N･m	(1) → (10)

(b) M271

Fig. 3 Tightening torque and tightening sequence

3. Bus bar connection

3-1. Maximum allowable strength and application direction when mounting bus bar

If excessive stress (tension, pushing, bending) is applied to the main terminal and control terminal, the terminal may be deformed and the case resin may crack, leading to poor contact and poor insulation. The maximum allowable strength and application direction when mounting bus bar is shown in Table 5.

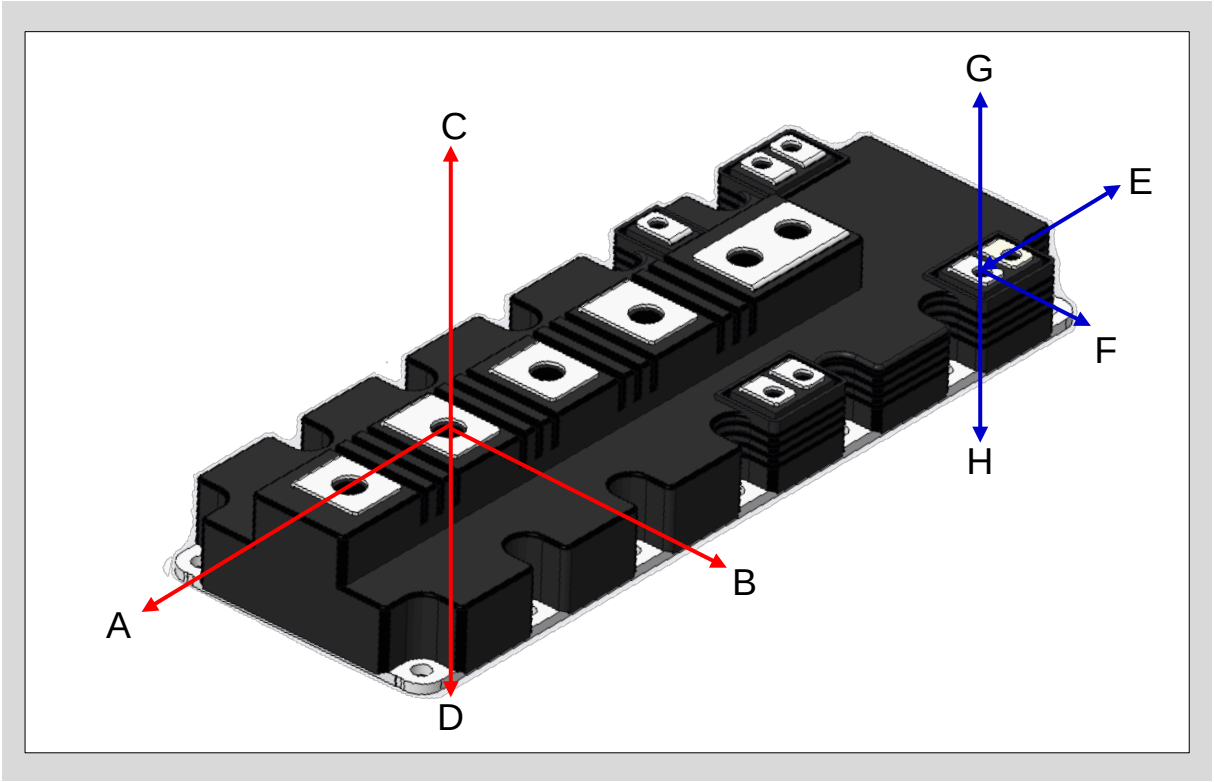


Fig.4 Allowable strength and application direction

Table 5 Allowable strength and application direction

Application direction	Strength *
A	±100N
B	±100N
C	100N
D	500N
E	±20N
F	±20N
G	50N
H	200N

* Strength in the table indicates the mechanical capability for a short period during mounting process.

3-2. Bus bar connection

The control terminals have to be connected according to general ESD guidelines. No load current is permitted to flow through any of the control terminals. It is recommended to use the intermediate post as shown in Fig.5 for connection to the main terminal. This is especially important if the modules or bus bars are subjected to vibration.

Note) It is recommended to place the module (main terminals) under compression when connecting the bus bar. The maximum strength should not exceed the value shown in Table 6.

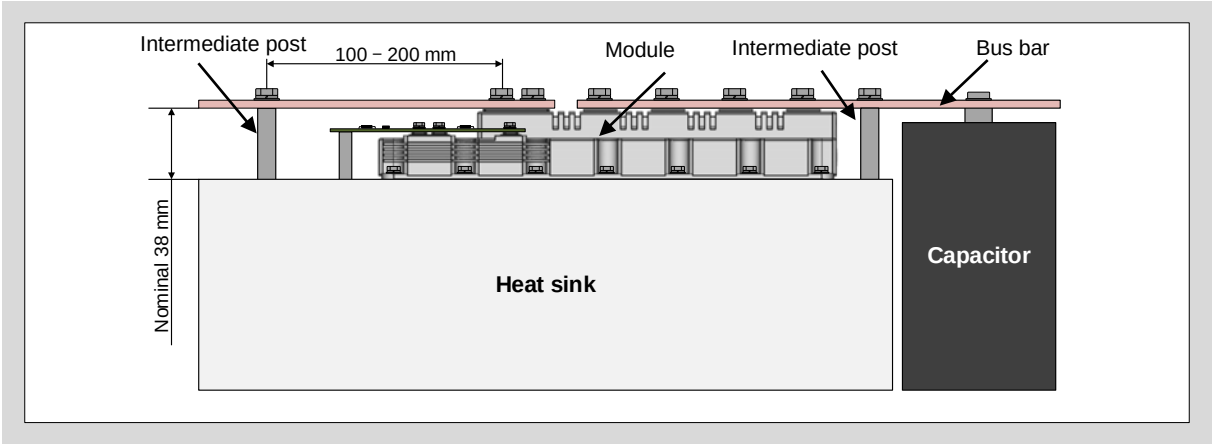


Fig.5 Example of connecting to bus bar without applying stress to the terminals (M272)

Table 6 Screw size and torques

		M271, M272, M291, M404
Main terminal	Screw size	M8
	Screw length	max=16mm+(Bus bar thickness)+(Washer thickness)+(Spring washer thickness) min=11mm+(Bus bar thickness)+(Washer thickness)+(Spring washer thickness)
	Tightening torque	8.0 - 10.0 N・m
Control terminal	Screw size	M4
	screw length	max=8mm+(Bus bar thickness)+(Washer thickness)+(Spring washer thickness) min=6mm+(Bus bar thickness)+(Washer thickness)+(Spring washer thickness)
	Tightening torque	1.8 - 2.1N・m
Tightening to heat sink	Screw size	M5
	Tightening torque	3.0 - 6.0 N・m

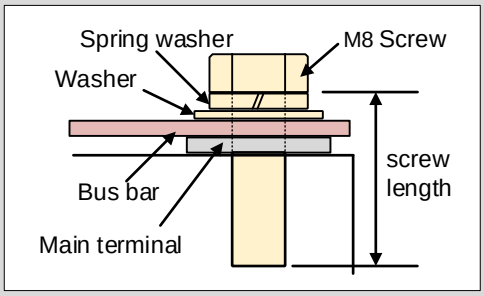


Fig. 6 Definition of screw length (example of main terminal)

4. Warning

(1) If applied bus bars are not suitable, the main terminals may have higher temperature than T_{stg} (Storage temperature). Also the main terminals shall be used within temperature range of T_{stg} .

(2) During tightening, use the tightening torque within the specified value. If the tightening torque of the terminal screw is excessive, insulation failure may occur due to cracking of the case, and if the torque is small, the contact resistance may increase and the heat generation of the terminal may increase. In addition, it is expected that the screws will loosen due to vibrations in the usage environment, so select screws that are difficult to loosen, tighten with appropriate torque, and retighten to prevent loosening.

(3) If the amount of thermal grease near this product mounting hole is excessive, the thermal grease acts as a spacer, hindering the spread of the thermal grease and causing deterioration of heat dissipation. In addition, depending on the type or application method of thermal grease,
deterioration or depletion of thermal grease may occur during high-temperature operation or temperature cycle, which may shorten this product lifetime.
Pay close attention to the selection and application method of the thermal grease.

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

(5) In any environment containing corrosive gases, corrosive liquids, corrosive solids (acids, alkalis, organic substances, etc.,ex: hydrogen sulfide, sulfurous acid gas, cutting fluid, cement powder etc.), this product may oxidize or corrode, resulting in poor contact, disconnection, short circuit, ground fault, etc. In such cases, avoid to use this product as it may cause malfunctions.
In the unlikely event that a short circuit or ground fault occurs to this product, there is a 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.).

(6) If the product is used in a high humidity environment or after storage the equipment after assembling, operate the equipment after sufficiently releasing the moisture.

(7) 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 heatsink, and short circuits or ground faults may occur due to leaks between terminals or creeping discharge. (Even if the dust is an insulating material such as fiber, it may leak due to moisture absorption.)

(8) In general, semiconductor devices have accidental failure modes due to high-speed particles (cosmic rays) derived from space or radiation. The failure rate in this failure mode varies depending on the installation location (latitude, longitude, altitude), installation environment, and operating conditions (voltage). In case the product is used under high altitude and/or voltage condition, please contact to Fuji Electric Co., Ltd.

(9) Clearance distance and creepage distance of this product are designed for adapting use environment in 2000m sea level or below, Fuji Electric Co., Ltd. is not responsible for the use in an environment where the altitude exceeds 2000m above sea level or in an environment where the atmospheric pressure is similarly low.

(10) one of the main terminal screw holes of this product penetrates the case, and the module internal parts (gel, Isolation substrate and chip) are located directly below it. Therefore, if a rod-shaped object such as a screwdriver is inserted into this hole, the internal parts may be significantly damaged. Be careful to treat this product so that no object is inserted into the main terminal screw hole.

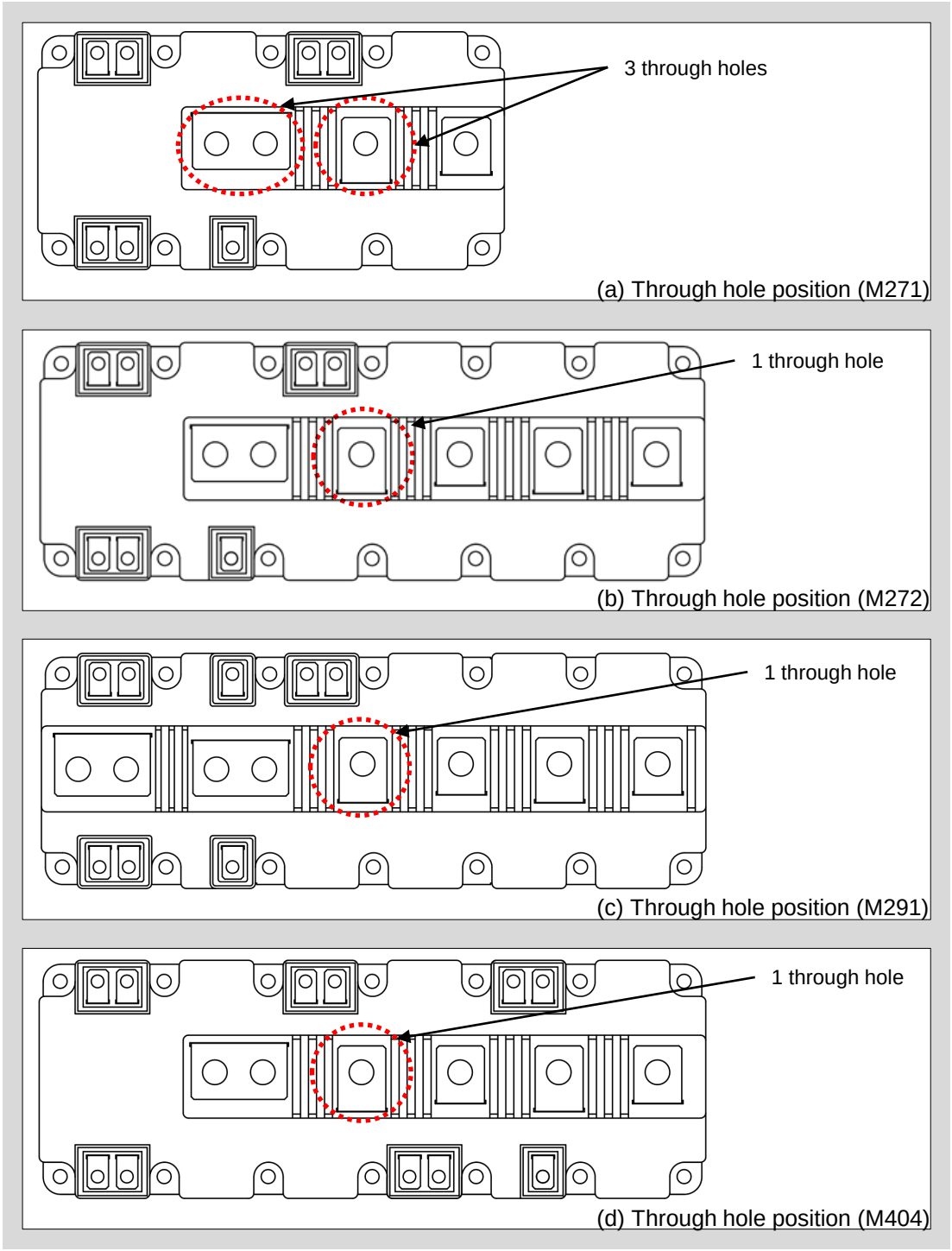


Fig.7 Through hole position

5. Storage and transportation notes

5.1 Storage

(1) The IGBT modules should be stored at an ambient temperature of 5 to 35°C and humidity of 45 - 75%. If the storage area is very dry, a humidifier may be required. In such a case, use only deionized water or boiled water, since the chlorine in tap water may corrode the module terminals.

(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.

5.2 Transportation

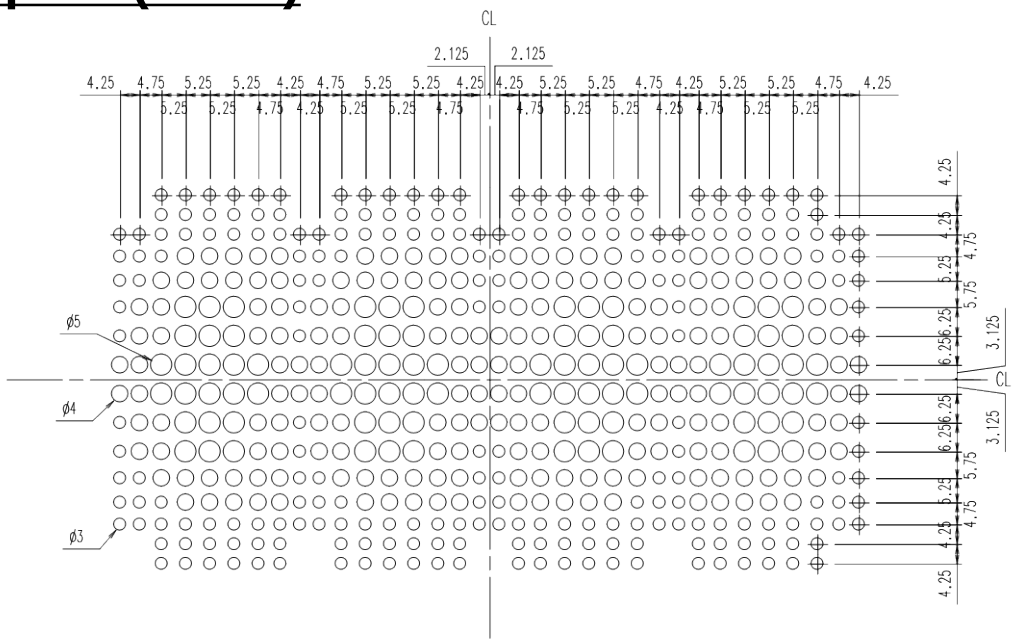
(1) Do not drop or cause impact to the modules which could otherwise cause mechanical stress.

(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.

Appendix : Stencil mask drawing

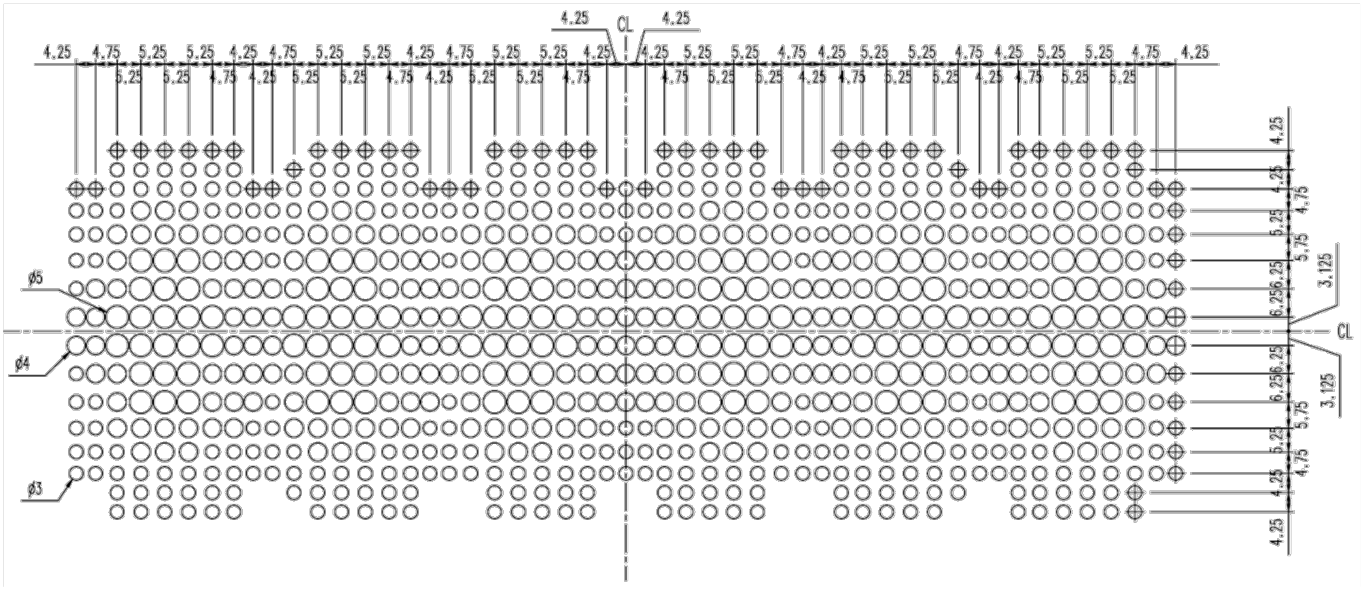
Stencil mask drawing for thermal grease application (recommended)
If you would like to obtain the following data, please contact our sales department.

Type A (M271)



t=0.25mm

Type B (M272,M291,M404)



t=0.25mm

Warning:

The contents in this manual (product specifications, characteristics, data, materials, structure, etc.) are as of June 2025. 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.