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.

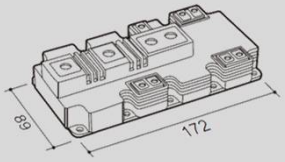
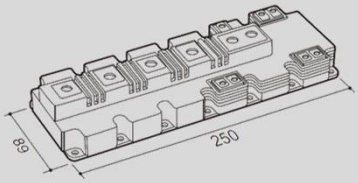
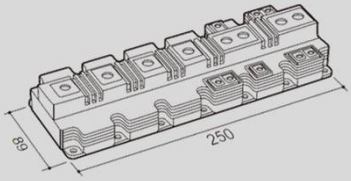
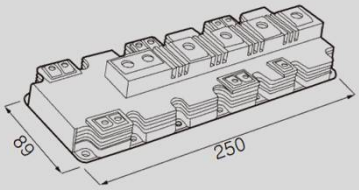
MT5Q01780 b

CONTENTS

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 (-80) are not applicable to this instruction.

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	2MBIxxxxXXG170-xx	
M404	V-series	4MBIxxxxVx-120Rx-xx 4MBIxxxxVx-170Rx-xx 4MBIxxxxVx-120-xx	

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

Note) PrimePACKTM is a registered trademark of Infineon Technologies.

2.Mounting the module to heat sink

2-1. Mounting to heat sink

The heat dissipation of the IGBT module depends on the position of the IGBT 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 IGBT module on the heat sink.

Since the heat dissipation of the IGBT module changes depending on the mounting position of the IGBT 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 IGBT modules are mounted on the same heat sink, the distance between IGBT 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 product is mounted must meet the conditions shown in Table 2.

Excessive convex warpage may cause isolation breakdown of this product, resulting in a serious accident. Excessive concave warpage or distortion may create gaps between the product 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(*Rz*)
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.

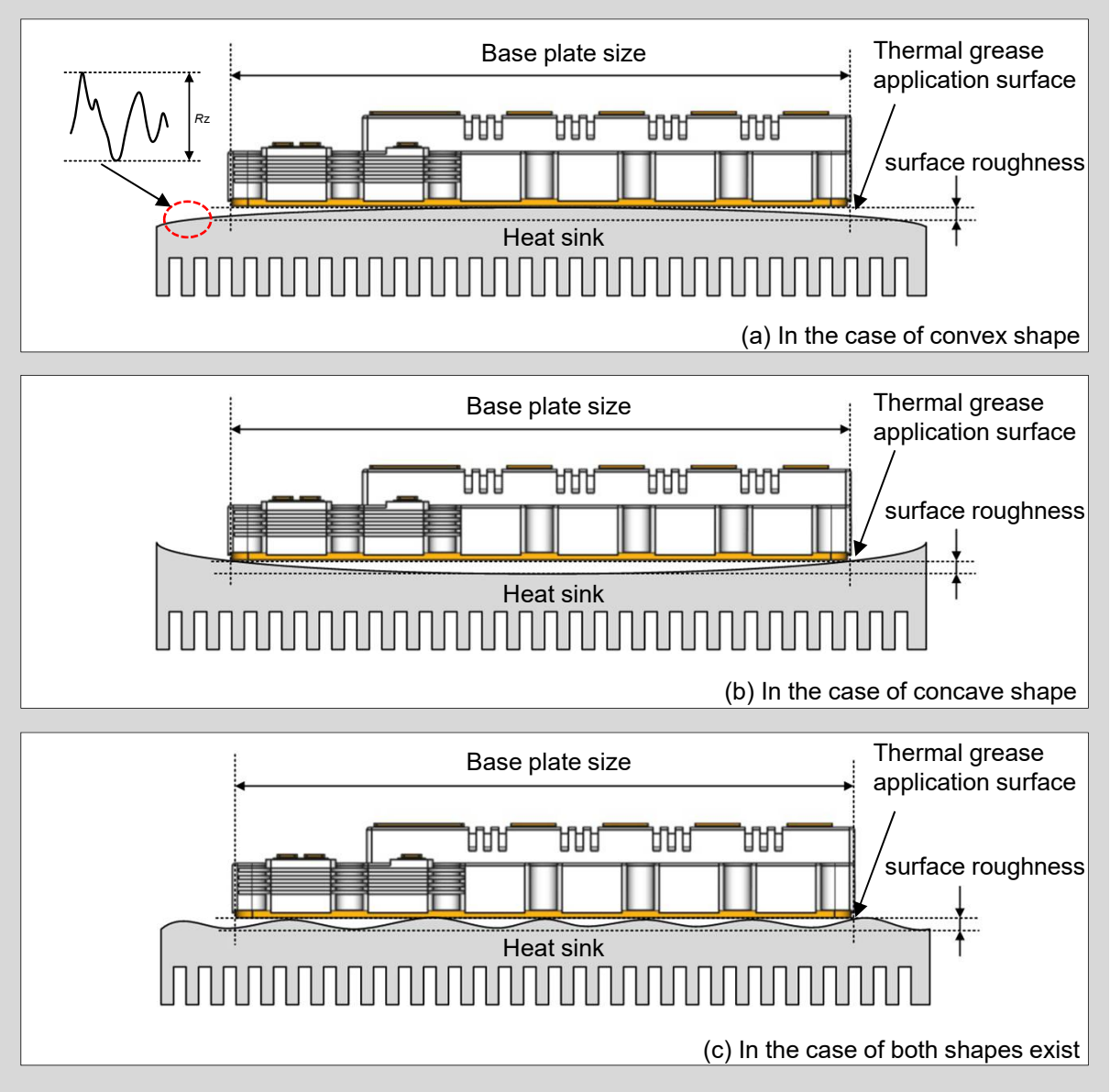


Fig.1. Heat sink surface flatness and roughness

2-3. Application of thermal grease

Thermal grease must be applied between the 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. You can check the spread of thermal grease by removing the module after mounting.

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

We recommend using the stencil method to control the appropriate thermal grease thickness (Fig.2). The recommended stencil mask drawing is shown in page 12.

If the amount of thermal grease near the product mounting hole is excessive, the thermal grease will act as 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 the product lifetime. Pay close attention to the selection and application method of the thermal grease.

Table 3. Recommended properties of thermal grease

	Unit	Recommended value
Penetration (typ.)	-	>= 338
Thermal conductivity	W/m･K	>= 0.92
Thickness	μm	100 +/- 30

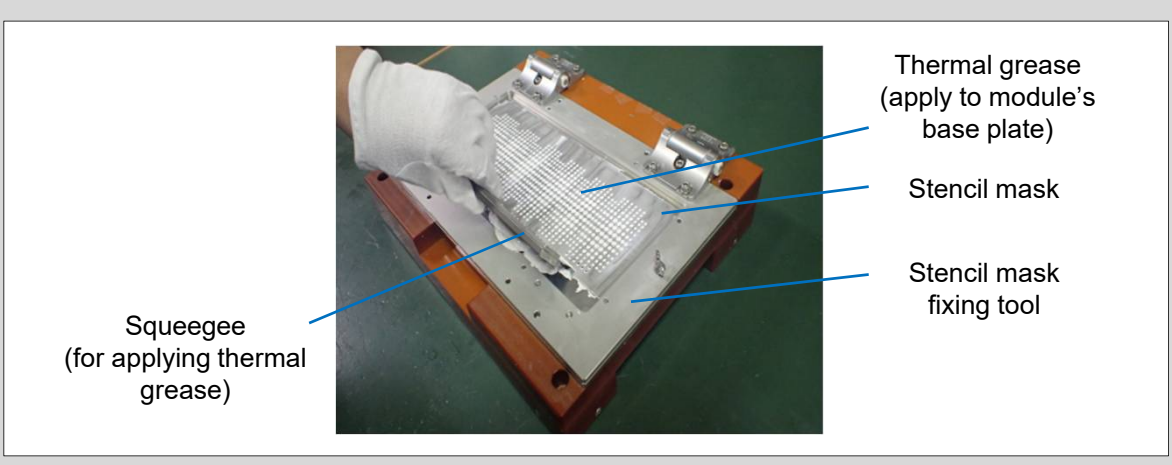
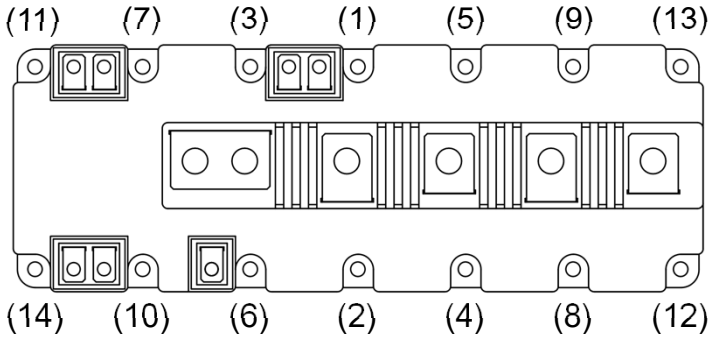


Fig.2. Thermal grease application

2-4. Screw tightening to heat sink

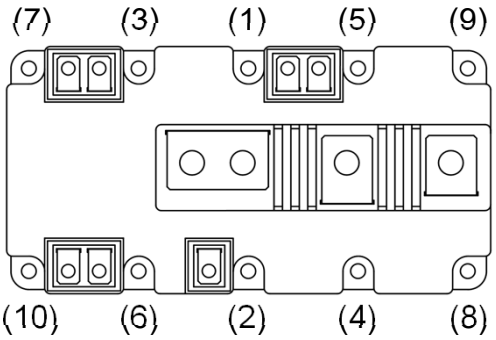
This section describes how to tighten the screws when mounting the module to heat sink.

1. Perform temporary tightening with 1/3 of the final tightening torque. 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 – 6.0Nm.



	Tightening torque	Tightening sequence
Temporary tightening	1/3 of the final tightening torque	(1) → (14)
Final tightening	3.0 - 6.0Nm	(1) → (14)

(a) Screw tightening torque and screw tightening sequence (M272,M291,M404)



	Tightening torque	Tightening sequence
Temporary tightening	1/3 of the final tightening torque	(1) → (10)
fFnal tightening	3.0 - 6.0Nm	(1) → (10)

(b) Screw tightening torque and screw tightening sequence (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 3.

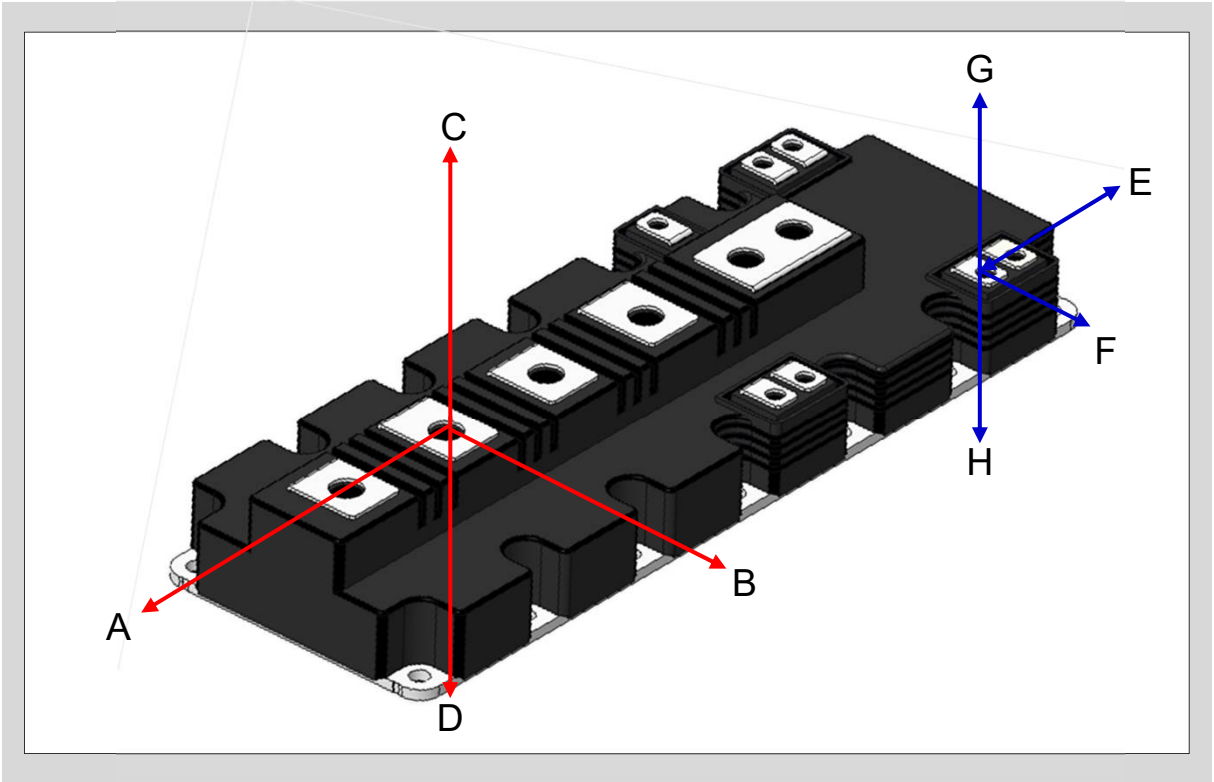


Fig.4 Allowable strength and application direction

Table 3. Allowable strength and application direction

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

Note) 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 3.

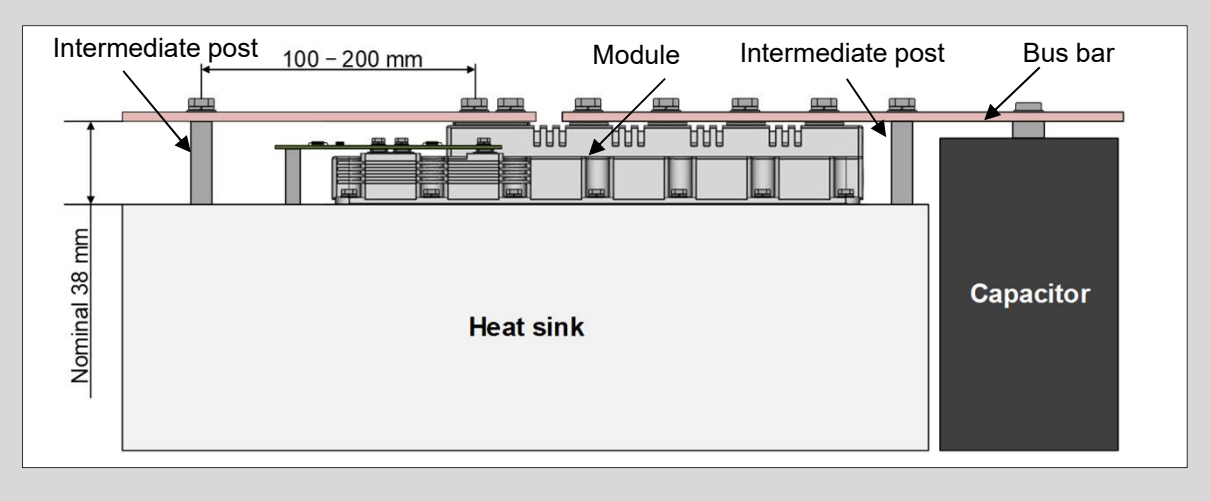


Fig.5 Example of connecting to bus bar without applying stress to the terminals (M272)

Table 4. 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 Nm
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 - 2.1Nm
Tightening to heat sink	Screw size	M5
	Tightening torque	3.0 - 6.0 Nm

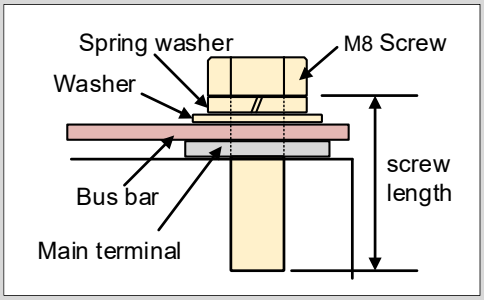


Fig.6 Definition of screw length (example of main terminal)

4. Warning

(1) If the bus bars are not suitable, the main terminals temperature may exceed T_{stg} (storage temperature). Use the main terminals within the range of T_{stg} (storage temperature).

(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 at 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 the appropriate torque, and retighten to prevent loosening.

(3) 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.

(4) If the Printed Circuit Board is not suitable, the main terminals pin temperature may exceed T_{stg} (Storage temperature). Use the main terminals pin within the range of T_{stg} (storage temperature).

(5) 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.).

(6) When using the product, or after storing the equipment following assembling in a high humidity environment, operate the equipment after sufficiently drying 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 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.)

(8) In general, semiconductor devices have random 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 Fuji Electric Co., Ltd.

(9) Dielectric strength decreases in an environment where atmospheric pressure is low, such as when used in highlands. Fuji Electric Co., Ltd. is not responsible for the use in an environment where the altitude exceeds 2000 m above sea level or in an environment where the atmospheric pressure is low.

(10) Do not insert any object into the main terminal screw holes of the product. These screw holes penetrate the case, and the module internal parts (gel, DCB substrate, chip) are located directly below. Therefore, inserting a rod-shaped object such as a screwdriver into this hole may significantly damage the internal parts.

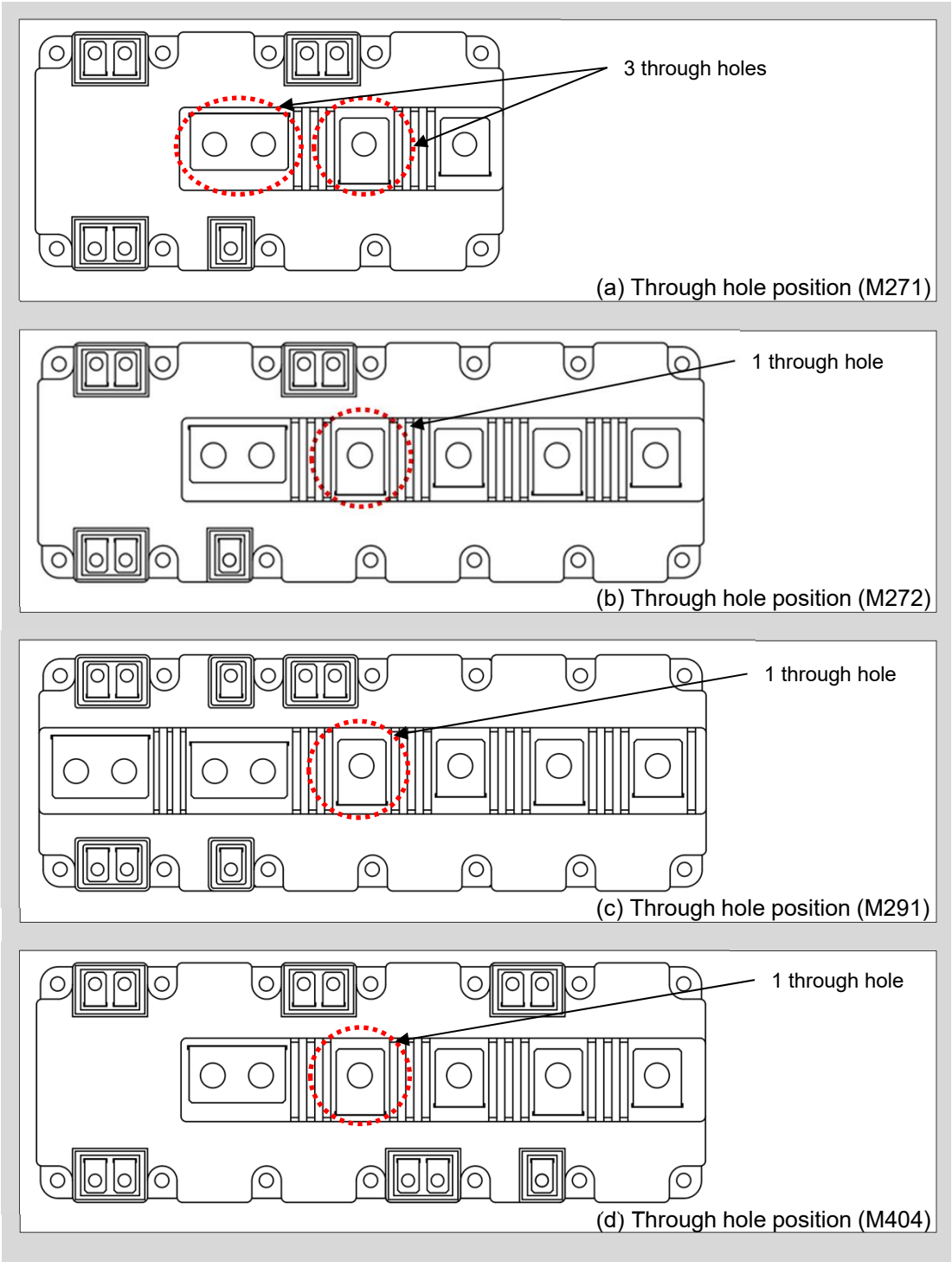


Fig.7 Through hole position

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.

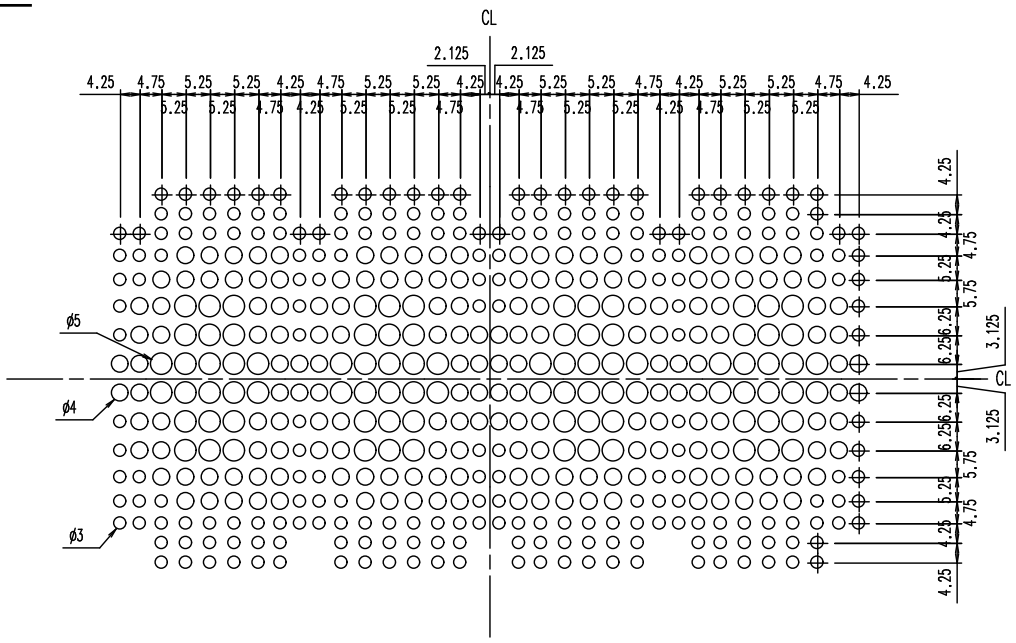
5.2 Transportation

(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.

6. Stencil mask drawing

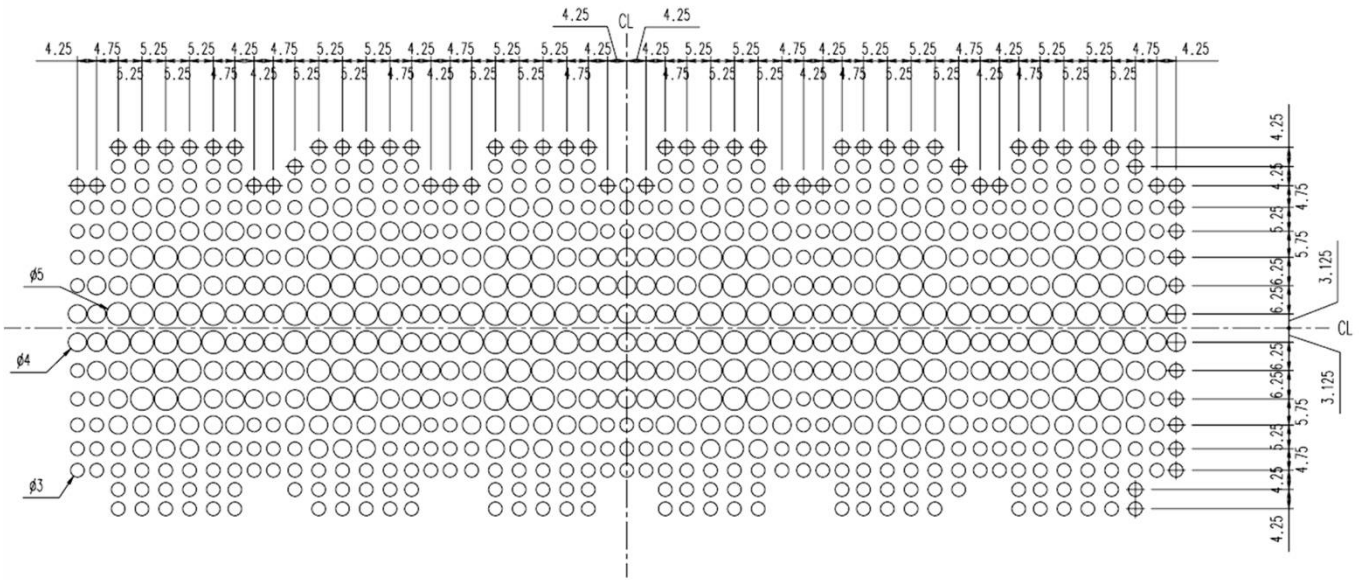
Stencil mask drawing for thermal grease application (recommended)

M271



t=0.2mm

M272, M291, M404



t=0.2mm

Warning:

The contents in this manual (product specifications, characteristics, data, materials, structure, etc.) are as of October 2021. 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.

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.