

Fuji Industrial IGBT Module

Solder pin type

EconoPIM™ (M711, M712, M719, M720)

EconoPACK™ (M633, M636, M668, M669, M1203)

Mounting instructions

EconoPIM™ and EconoPACK™ are registered trademark of Infineon Technologies AG, Germany.

CONTENTS

1. Scope of application	2
2. Related Types	3
3. Mounting to heat sink	5
3-1. Surface conditions of heat sink	5
3-2. Application of thermal grease	6
3-3. Screw tightening to heat sink	8
4. Mounting the module to printed circuit board	9
4-1. Soldering to printed circuit board	9
4-2. Screw tightening to printed circuit board	10
5. Warning	12
6. Storage and transportation notes	13
7. Stencil mask drawings	14

1. Scope of Application

This document provides information how to mount and use the solder pin type EconoPIM™ and EconoPACK™ products of Fuji Electric.

Please refer to chapter 2 for identifying the related module types.

When handling the products, please follow beside the descriptions within this document, additionally the Warning and Caution of the delivery specifications of the related products.

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2. Related types

The mounting instruction applies to the following module types:

Table 1 EconoPIM™ (PIM with built-in converter circuit and brake circuit)

		650V (X series)	600 V (V series)	1200V (X series)	1200V (V series)
M711 (Type A)	25A				7MBR25VA-120-50
	35A				7MBR35VA-120-50
	50A		7MBR50VA-060-50		
M712 (Type B)	35A				7MBR35VB-120-50
	50A				7MBR50VB-120-50
	75A		7MBR75VB-060-50		7MBR75VB-120-50
	100A		7MBR100VB-060-50		
M719 (M type)	25A				7MBR25VM-120-50
	35A			7MBR35XMA120-50	7MBR35VM-120-50
	50A	7MBR50XMA065-50		7MBR50XMA120-50	7MBR50VM-120-50
	75A	7MBR75XMA065-50		7MBR75XME120-50	
M720 (N type)	50A				7MBR50VN-120-50
	75A	7MBR75XNA065-50		7MBR75XNA120-50	7MBR75VN-120-50
	100A	7MBR100XNA065-50		7MBR100XNA120-50	7MBR100VN-120-50
	150A	7MBR150XNA065-50		7MBR150XNE120-50	7MBR150VN-120-50
M719 (P type)	25A				7MBR25VP-120-50
	35A			7MBR35XPA120-50	7MBR35VP-120-50
	50A	7MBR50XPA065-50	7MBR50VP-060-50	7MBR50XPA120-50 7MBR50XPE120-50	7MBR50VP-120-50
	75A	7MBR75XPA065-50	7MBR75VP-060-50	7MBR75XPE120-50	
	100A	7MBR100XPE065-50	7MBR100VP-060-50		
M720 (R type)	50A				7MBR50VR-120-50
	75A			7MBR75XRA120-50 7MBR75XRE120-50	7MBR75VR-120-50
	100A	7MBR100XRA065-50	7MBR100VR-060-50	7MBR100XRA120-50 7MBR100XRE120-50	7MBR100VR-120-50
	150A	7MBR150XRA065-50 7MBR150XRE065-50	7MBR150VR-060-50	7MBR150XRE120-50	7MBR150VR-120-50

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Table 2 EconoPACK™ (6-in-1)

		650V (X series)	600 V (V series)	1200V (X series)	1200V (V series)
M636(V) M669(X)	50A		6MBI50VA-060-50		6MBI50VA-120-50
	75A		6MBI75VA-060-50		6MBI75VA-120-50
	100A		6MBI100VA-060-50	6MBI100XAE120-50	6MBI100VA-120-50
M633(V) M668(X)	100A			6MBI100XBA120-50	6MBI100VB-120-50
	150A		6MBI150VB-060-50	6MBI150XBA120-50	6MBI150VB-120-50
	180A				6MBI180VB-120-50 6MBI180VB-120-55
	200A			6MBI200XBA120-50 6MBI200XBE120-50	
				6MBI250XRBE120-50	

Table 3 EconoPACK™ (12-in-1)

		650V (X series)	600 V (V series)	1200V (X series)	1200V (V series)
M1203	50A				12MBI50VN-120-50
	75A				12MBI75VN-120-50
	100A				12MBI100VN-120-50

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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 $10\mu\text{m}$ or less.
 2. The surface flatness of the heat sink should be $50\mu\text{m}$ 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 $50\mu\text{m}$ or less.
- * The flatness must satisfy the above value within the entire module mounting area including the two screw clamps.

Fig.1 shows the definition of surface roughness and flatness of the heat sink.

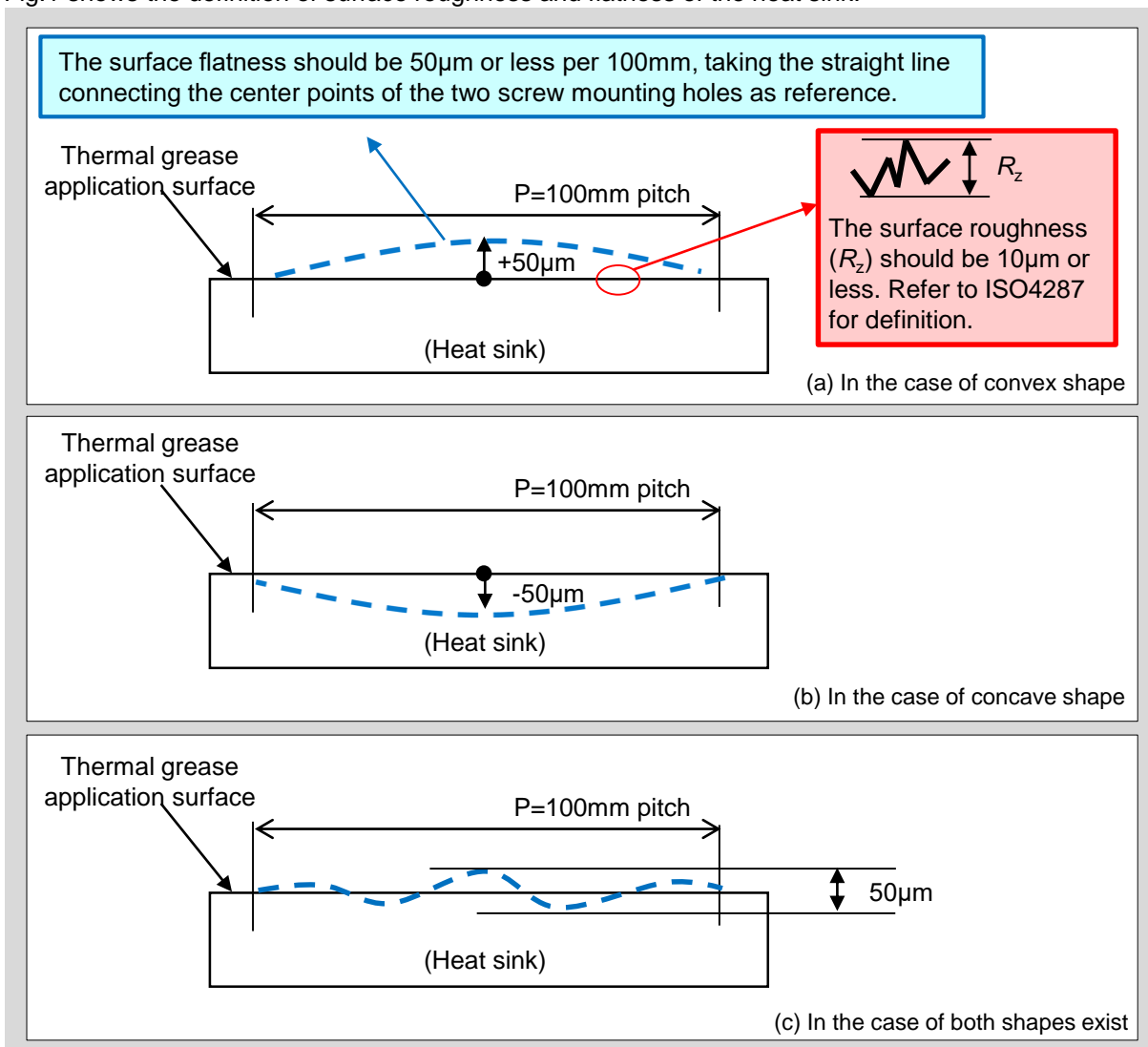


Fig.1 Heat sink surface flatness and roughness

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. Thermal grease should be applied to the mounting surface of the product.

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 product, or to a reduction in product 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.

$$\text{Thermal grease weight (g) } \times 10^4 = \text{Thermal grease thickness } (\mu\text{m}) \times \text{Base plate area of module (cm}^2\text{)} \times \text{Density of thermal grease (g/cm}^3\text{)}$$

The stencil method of application is recommended to control proper thickness (Figure. 2). The recommended stencil mask pattern (Table 4) can be provided upon request.

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

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

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 5 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 product 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 product may be subjected to excessive stress at the step when fastening the product. To reduce product 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 product may be subjected to excessive stress at the step when fastening the product. Please consider placing the sheet over the entire backside of the product, 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.

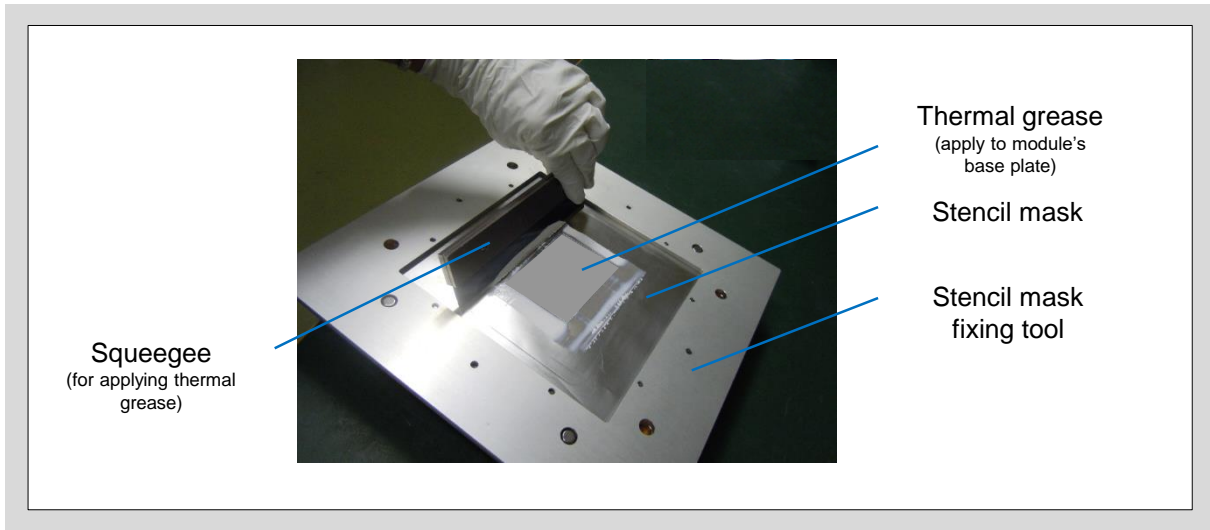


Fig.2 Thermal grease application

Table 4 Recommended stencil mask pattern and module package number

Stencil mask pattern	Module package number
Type A	M711, M719, M636, M669
Type B	M712, M720, M633, M668, M1203

Table 5 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

3-3. Screw tightening to heat sink

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

1. Use M5 screws to fix the module to heat sink.
2. To fix the module with even force, first perform temporary tightening with $0.5\text{N}\cdot\text{m}$. Fig.3 shows the tightening sequence.
3. Perform final tightening in the same sequence as temporary tightening. The final tightening torque should be within the following range. V-series: $2.5 \sim 3.5 \text{ N}\cdot\text{m}$, X-series: $2.5 \sim 6.0 \text{ N}\cdot\text{m}$.

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)

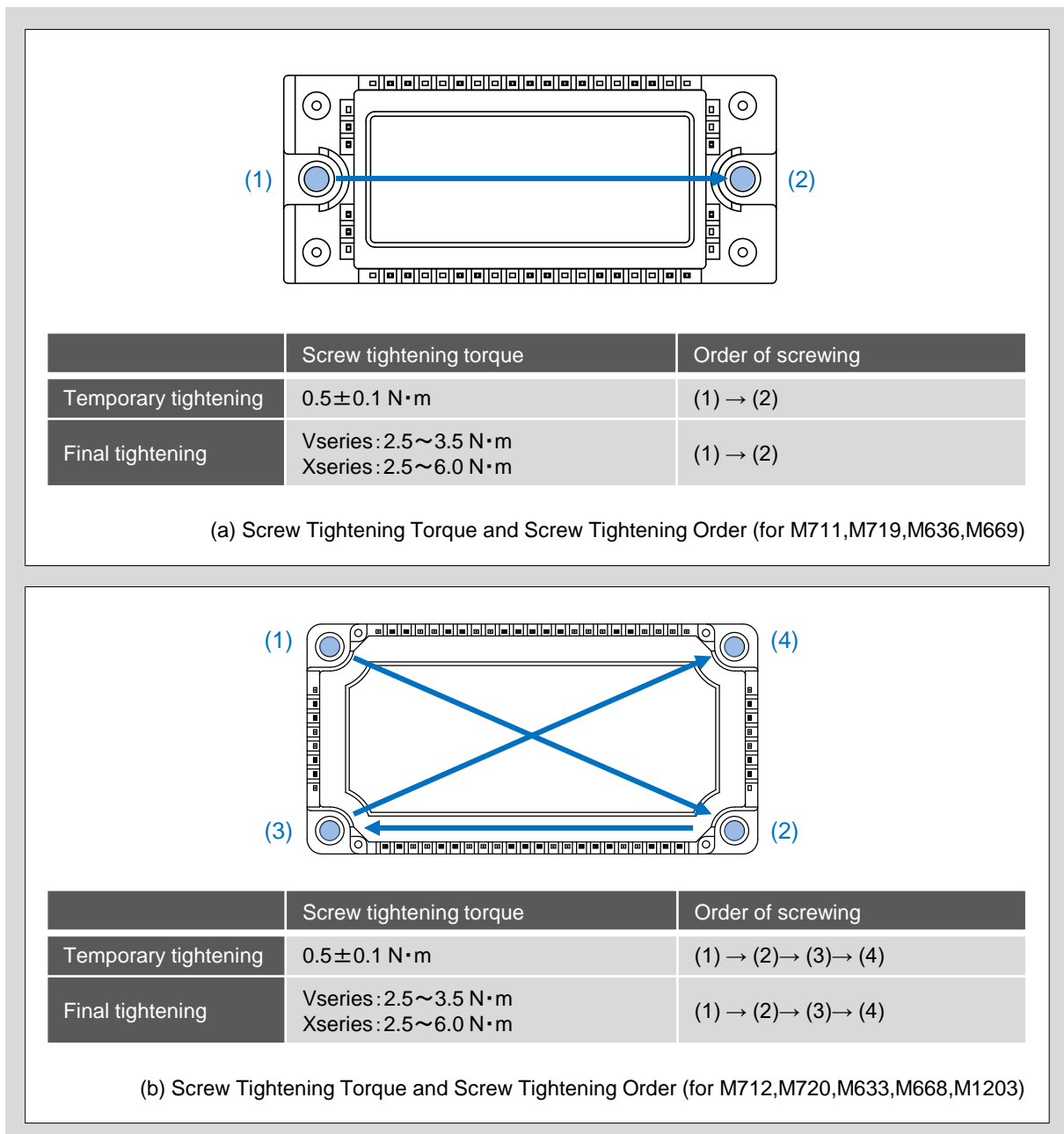


Fig. 3 Screw Tightening Torque and Screw Tightening Sequence

4. Mounting the module to printed circuit board

4-1. Soldering to printed circuit board

The recommended soldering conditions for mounting a printed circuit board (PCB) on the module are shown below.

Terminal temperature: $245 \pm 5^{\circ}\text{C}$

Time: 5 ± 0.5 sec

However, since the definition of the recommended soldering temperature is "terminal temperature", it is different from the set temperature of the soldering machine. Set the soldering unit temperature to suit the heat capacity of your PCB. Before soldering, make sure that the temperature of the resin part at the base of the product terminal is 260°C or less.

4-2. Screw tightening to printed circuit board

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

1. Use M2.5 self-tapping screws to fix the module to the heat sink.
2. To secure the module with equal force, first perform temporary tightening with a torque of 1/3 of the final tightening torque in the order shown in Fig. 4.
3. Next, perform the full tightening in the same order as the temporary tightening. Make sure that the final tightening torque is within the range of 0.4 to 0.5 N·m.

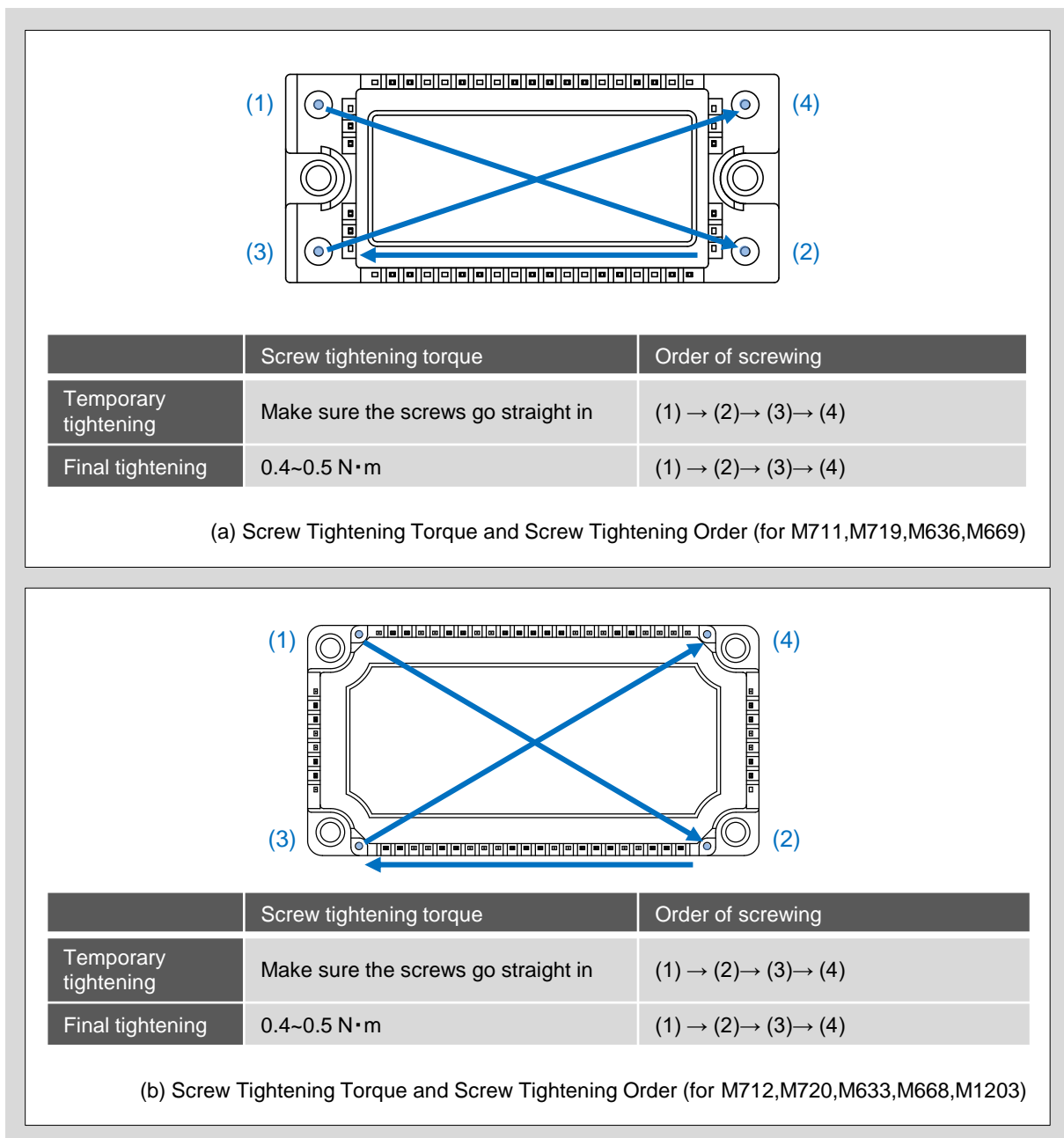


Fig. 4 Screw Tightening Torque and Screw Tightening Sequence

4. As shown in Fig.5, use screws with a diameter of 2.4 to 2.6 mm and a length of 7.0 to 10.0 mm from the underside of the PCB.
5. Manual screwing is recommended. When using an electric screwdriver, optimize the parameters such as tightening conditions to avoid mechanical damage. Check that the product is not damaged after tightening. Also, the screwing speed should not exceed 300 rpm. It may result in mechanical damage as shown in Fig.6.

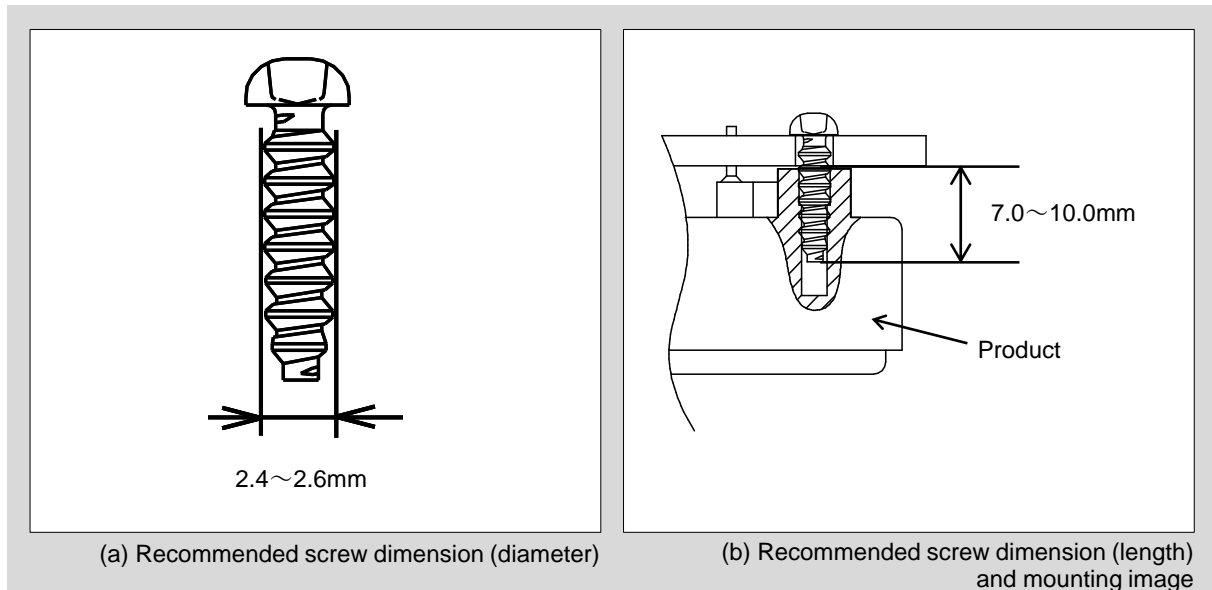


Fig.5 Recommended screw dimensions and mounting image

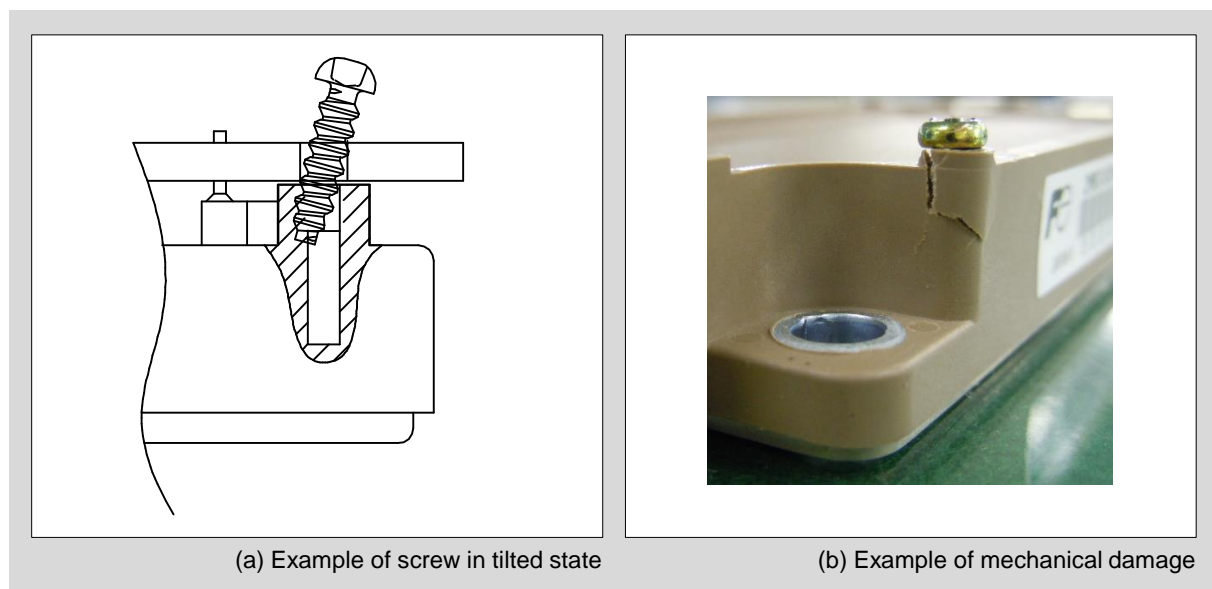


Fig.6 Poor example of screw tightening

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 manual 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 product surface. Therefore, store products in a place with minimal temperature changes.
- (4) During storage, it is important that nothing be placed on top of the products, since this may cause excessive external force on the case.
- (5) Store products 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 products in order to prevent ESD damage.

6.2 Transportation

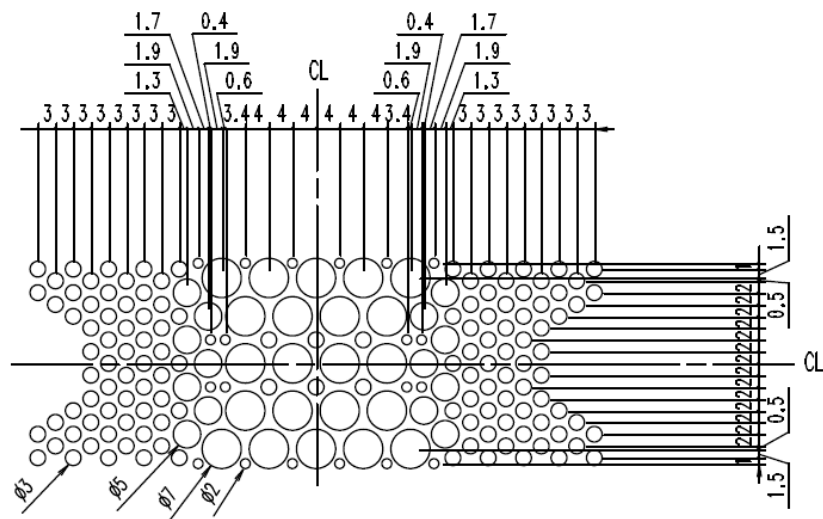
- (1) Do not drop or cause impact to the products which could otherwise cause mechanical stress.
- (2) When transporting several products in the same box or container, provide sufficient ESD padding between the products to protect the terminals and to keep the products from shifting.

7. Stencil mask drawing

Stencil mask drawing for thermal grease application (recommended)

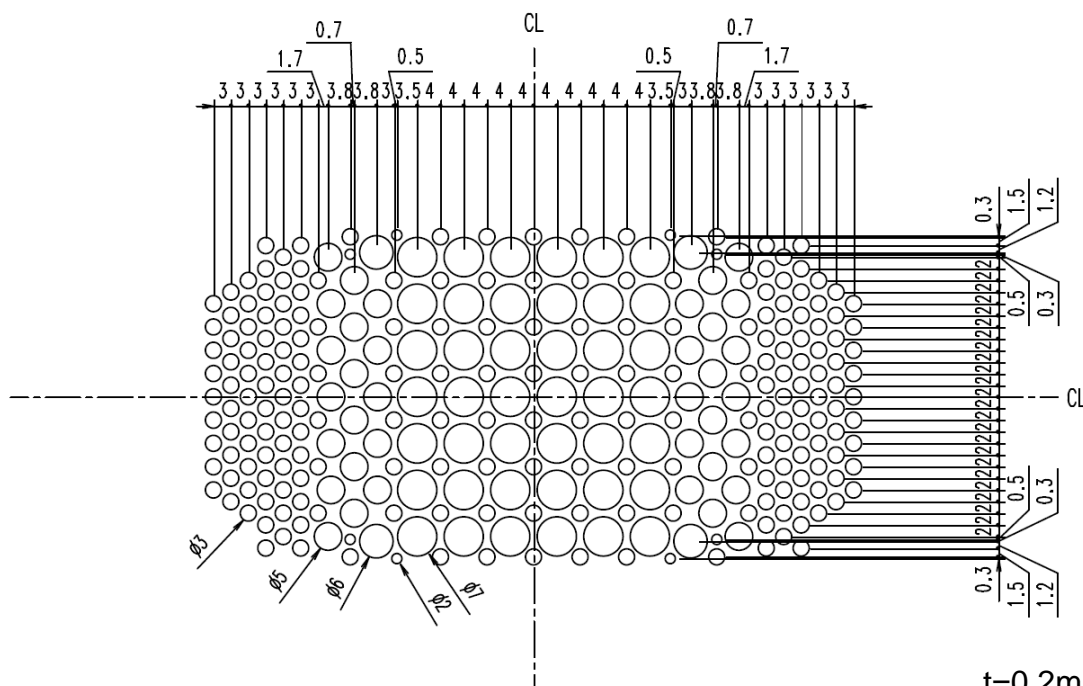
If you would like to obtain the following data, please contact our sales department.

Type A : M711, M719, M636, M669



t=0.2mm

Type B : M712, M720, M633, M668, M1203



t=0.2mm

Warning:

The contents in this manual (product specifications, characteristics, data, materials, structure, etc.) are as of December 2023. 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.