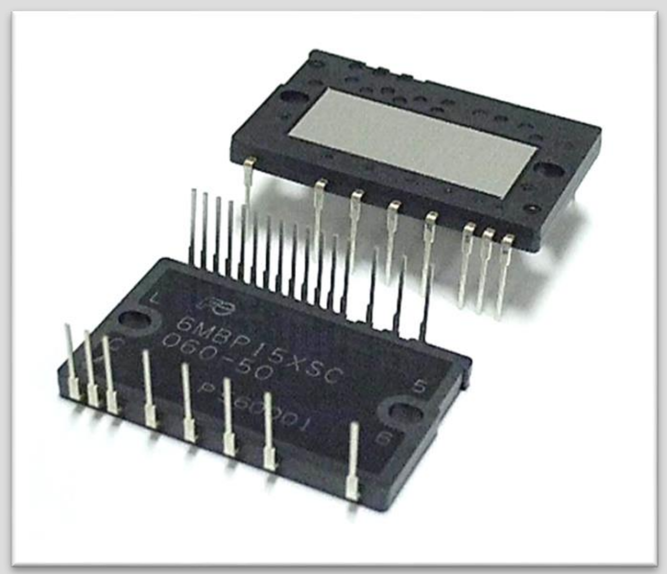

Fuji Small IPM (Intelligent Power Module)
P633A series
6MBP**XS*060-50

Mounting Instruction

15th of June, 2020 Rev.0

Fuji Electric Co., Ltd.

MT6M15589

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⚠Cautions

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The products introduced in this Instruction are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
・Inverter for Compressor motor, or fan motor for Room Air Conditioner
・Inverter for Compressor motor for heat pump application, etc

If you need to use a product in this Instruction for equipment requiring higher reliability than normal, such as for the equipment listed below, it is imperative to contact Fuji Electric Co., Ltd. to obtain prior approval. When using these products for such equipment, take adequate measures such as a backup system to prevent the equipment from malfunctioning even if a Fuji's product incorporated in the equipment becomes faulty.
・Transportation equipment (mounted on cars and ships)　・Trunk communications equipment
・Traffic-signal control equipment　・Gas leakage detectors with an auto-shut-off feature
・Disaster prevention / security equipment　・Safety devices, etc

Do not use products in this Instruction for the equipment requiring strict reliability such as the following and equivalents to strategic equipment (without limitation).
・Space equipment　・Aeronautic equipment　・Nuclear control equipment
・Submarine repeater equipment　・Medical equipment, etc

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This chapter describes the precautions during transportation and storage for the product (Small IPM).

1. Precautions during transportation and storage

- The Small IPM should be stored at a normal temperature of 5 to 35℃ and relative humidity of 45 to 75%, otherwise the product might be corroded or destructed, or it's life time might be shorter. 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 leads.

- In case of storage environment with rapid temperature changes, condensation will be occurred on the surface of the Small IPM. In order to avoid the condensation, the Small IPM shall be stored in steady temperature environment.

- The Small IPM should not stored or used in an environment where it is exposed to acids, organic substances, or corrosive gas (hydrogen sulfide, sulfurous acid gas etc.) or in a dusty place.

- When stored, it is necessary to prevent external pressure to the Small IPM. Stacking that may deform the outer box shall be avoid even when it is packed in the outer box.

- Transport the cardboard box with the appropriate side facing up. Otherwise, unexpected stress may be applied to the Small IPM, which may cause bending of the terminals or distortion in the resin package of the product. In addition, throwing or dropping the product can cause significant damage to the product. Also, it is necessary to pay attention to rain and freezing to avoid wetting, as it may cause damage or destruction. The environmental conditions such as temperature and humidity during transportation described in the specifications shall be strictly observed.

- The Small IPM should be stored with the lead terminals remaining unprocessed. It is necessary to avoid rusting etc. due to scratches during processing, resulting in poor soldering.

- The containers and bags for storing the Small IPM should be non-static or conductive.

- Under the above storage condition, use the Small IPM within one year.

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This chapter describes the precautions in unpacking for the product (Small IPM).

2. Precautions in unpacking

1 Removing the pin from the tube

- The Small IPMs are packaged in tubes that are pinned at both ends.
- Remove the pin on one side to pick out the product from the tube.
- If the pin and the Small IPM are in contact with each other when removing the pin, a strong shock might be applied to the product, which may cause deformation or damage to the Small IPM terminals. Make a gap between the pin and the Small IPM when removing the pin.
- The recoil of removing the pins may cause deformation or damage to the terminals of the Small IPM, so remove the pins with holding them.
- If the product falls out from the tube when removing the pins, it may cause a strong impact to the product, causing the product terminals to be deformed or damaged. Remove the pin with the tube opening facing up.
- It is recommended to use a remover (removal jig) to remove the pins. Page 2-2 shows how to remove the pins using the remover.

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- Pin removing method using remover (removal jig)

① Make a gap between the pin and the product. (See Fig. 2-1)

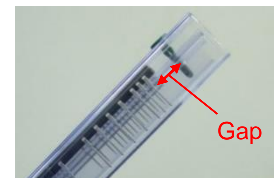

Fig. 2-1 Gap between the pin and the Small IPM

② Push the pointed end of the pin with your index finger, and make a gap between the pin and the tube to insert the remover removal part as shown in Figure 2-2. (See Fig. 2-3)

Fig. 2-2 Example of remover (removal jig)

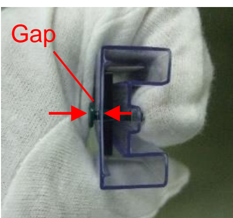

Fig. 2-3 Gap between the pin and the tube

③ Insert the removal part of the remover into the gap between the pin and the tube. (See Fig. 2-4)

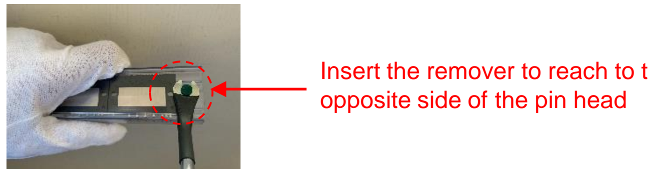

Fig. 2-4 Insert remover

④ Hold the pin with your finger and remove the pin with the tube opening facing up. (See Fig. 2-5, 2-6)

Fig. 2-5 How to hold the pin

Fig. 2-6 Tube opening orientation

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2 Picking out the Small IPM from the stick

- Since the elements installed in the Small IPM are extremely weak to electrostatic discharge, appropriate ESD countermeasures are necessary in the assembly environment within the range described in the specifications. In particular, when picking it out from the tube, it may cause the most electrical damage to the product.

- When picking out the Small IPM, do not strongly collide the Small IPM with each other or touch the Small IPM terminals to the tube. A strong impact on the Small IPM may cause deforming or damage of the terminals of the Small IPM.

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This chapter describes the through hole design for PCB attaching to the product (Small IPM).

3. Through hole design for PCB

Figures 3-1 to 3-4 show examples of recommended through hole dimensions and through hole layout designs.

- The through hole dimensions are the inner diameter after plating (dimension unit: mm).
- If the terminal cross-sectional dimensions / through hole clearance is too large, solderability may be impaired. Also, if the land diameter is too large, solder bridges are likely to occur.
- The hole size and land size should be optimized as appropriate, taking into consideration the printed circuit board processing accuracy and mounting method.

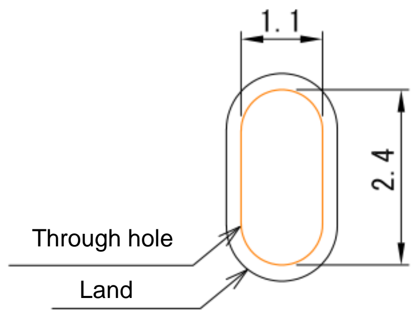

Fig. 3-1 Control side through hole dimensions

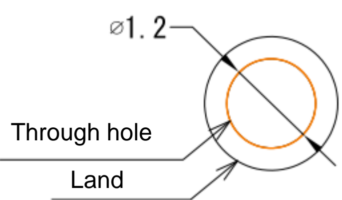

Fig. 3-2 Power side through hole dimensions

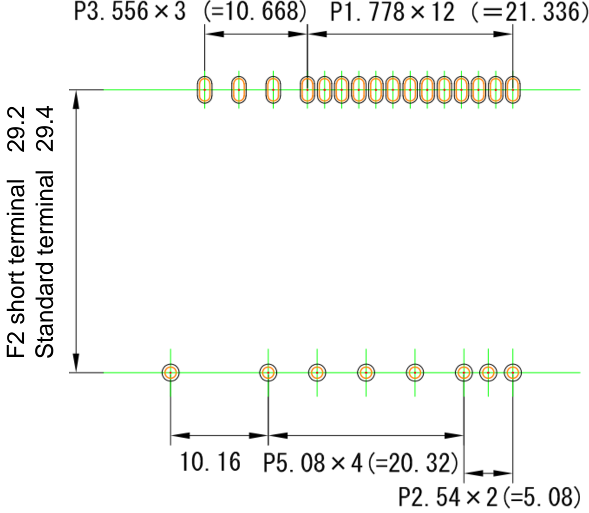

Fig. 3-3 Through hole layout with standard terminals and short terminals

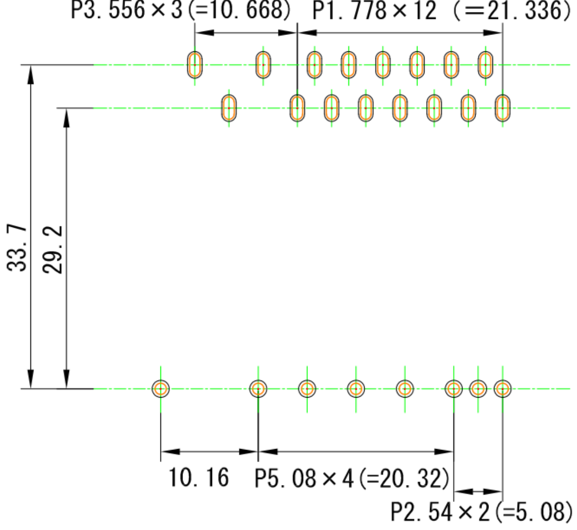

Fig. 3-4 Through hole layout with zigzag pattern terminal

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This chapter describes the spacer for PCB attaching to the product (Small IPM).

4. Spacer

- When using spacer between the PCB and the Small IPM for alignment during soldering to printed circuit board, it is recommended to support the Small IPM at the hatched area as shown in Fig. 4-1.
- The spacer should be made of resin or metal, and select a material that does not cause contamination or corrosion.

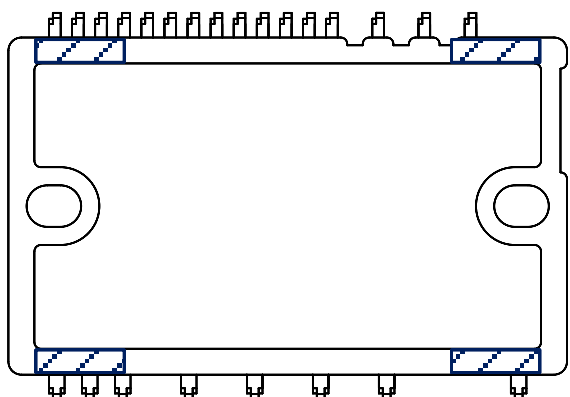

Fig. 4-1 Spacer installation position (recommended)

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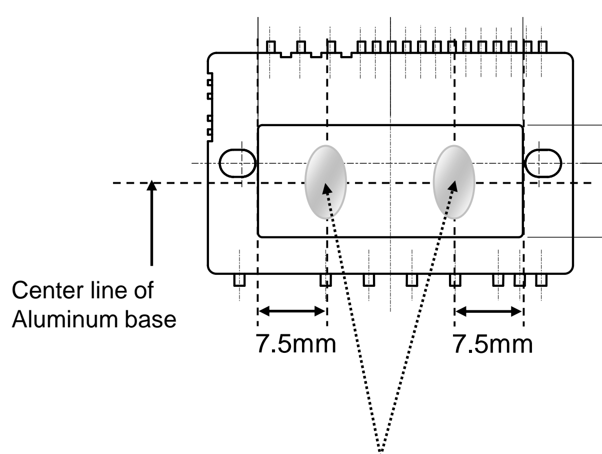
This chapter describes the Compound application for the product (Small IPM).

5. Compound application

- In order to obtain effective heat dissipation, thermal compound with good thermal conductivity should be applied uniformly with +50μm thickness on the contacting surface between the Small IPM and heat sink. Refer to the following Fig. 5-1 for an application position and application quantity.
- The recommended compound shown below is an example. When using a hard compound material, check the spread of the compound after mounting.
- For the stencil mask used when applying the thermal compound, refer to the appendix at the end of this document.
- In the case of liquid cooling, the difference between the heat sink temperature and the temperature inside the Small IPM (temperature gradient) becomes large. When fixing the Small IPM, secure a thermal compound coating amount that can absorb the strain due to the difference in thermal expansion when the temperature gradient is large.
- In the case of a multiple structure heat sink, the number of fastening parts increases and heat transfer (diffusion) becomes uneven. Therefore, it is necessary to design for suppression the distortion, such as securing the thermal compound coating amount in consideration of the generated distortion.



Thermal compound

Recommended:
Product name :Shin-Etsu Chemical Co., Ltd. Oil compound G-747
Application position : 7.5mm apart from the edge of aluminum base
Application quantity : 0.03g

Fig. 5-1 Recommended an application position and application quantity

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This chapter describes the heat sink selection for the product (Small IPM).

6. Heat sink selection

1 Selection

- Please make sure that the junction temperature Tj should not exceed the maximum junction temperature Tj(max) for safe operation. Cooling device (heat sink) should be designed to ensures that Tj is always below Tj(max).
- If the IGBT or FWD junction temperature is higher than Tj(max), it might cause damage to the chips. Some types of the Small-IPM have the over-heating (OH) protection function which works when the IGBT junction temperature exceeds Tj(max). However, if the temperature rises too quickly, the OH protection might not work.
- When selecting a cooling device (heat sink), please verify the chip temperature Tj by measuring Tc at the position shown in Figure 6-1, and calculating the Tj from device power dissipation and thermal resistance. In addition, this product has a built-in temperature sensor, and Tj can be confirmed by the analog voltage that is output according to the LVIC chip temperature. Please refer to it when selecting the cooling device (heat sink).
- For more detail design, please refer “IGBT Module Application Manual (REH984c)” and “Small IPM Application Manual (MT6M12343)”.

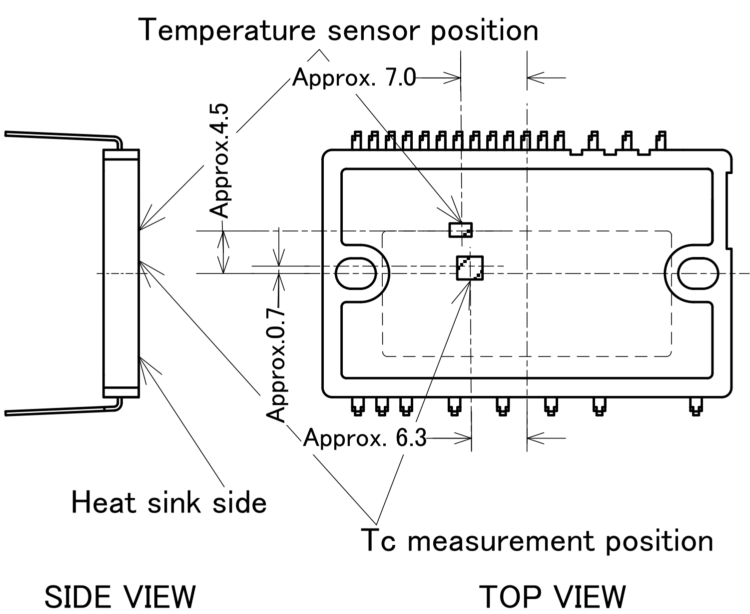

Fig. 6-1 Temperature sensing and Tc measurement points

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2 Shape

- As shown in Fig. 6-2, the heat sink flatness should be from 0μm/100mm to +100μm/100mm, and the surface roughness (Rz) should be less than 10 μm.
- If the heat sink surface is concave, a gap occurs between the heat sink and the IPM, leading to deterioration of cooling efficiency.
- If the flatness is +100 μm or more, the aluminum base of the IPM is deformed and cracks could occur in the internal isolating substrates.

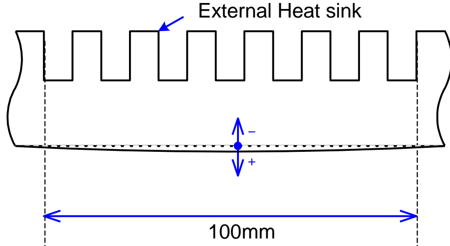
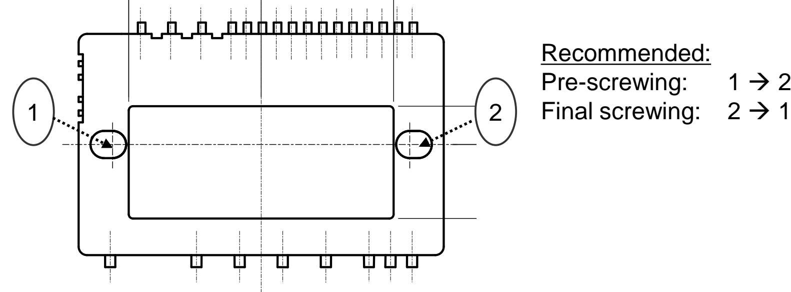


Fig. 6-2 The measurement point of heat sink flatness

3 Mounting (tightening)

- When mounting the Small IPM to a heat sink, the following fastening order is recommended. Uneven fastening due to excessive torque might lead to destruction or degradation of the chip.
- Standard: Metric screw JIS B 1111
- Screw length: 8mm
- Screw head shape: Pan shape (head diameter 5.5 mm)
- Material: Stainless
- Use flat washers (JIS B1258 recommended). Washer head type screws can be used as well.
- The mounting (tightening) that support the load of structure such as heat sink or printed circuit board by Small IPM should be avoided.
- When mounting this Small IPM together with other components to the heat sink, ensure the flatness of the components mounted on the board before mounting.



Note: the pre-screwing torque is set to 30% of the maximum torque rating.

Fig. 6-3 Recommended screw fastening procedure

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This chapter describes the soldering to printed circuit board for the product (Small IPM).

7. Soldering to Printed Circuit Board

- The device temperature during soldering might exceed the maximum storage temperature. To prevent damage to the device and to ensure reliability, please use the following soldering temperature.

Table 7.1 Soldering temperature and duration

	Methods	Soldering Temp. & Time	Note
a	Solder dipping / Soldering iron	260±5℃, 10±1sec.	
b	Solder dipping / Soldering iron	350±10℃, 3.5±0.5sec.	

- A stopper is provided on the terminal to prevent the immersion depth of the terminal from coming too close to the product body. Use this stopper to secure the required distance from the printed circuit board and prevent the product body from being immersed in the solder bath during flow soldering.
- It is not recommended to reuse the device after it is removed from the circuit board. There is a possibility that the removed device was subjected to thermal or mechanical damage during the removal process.

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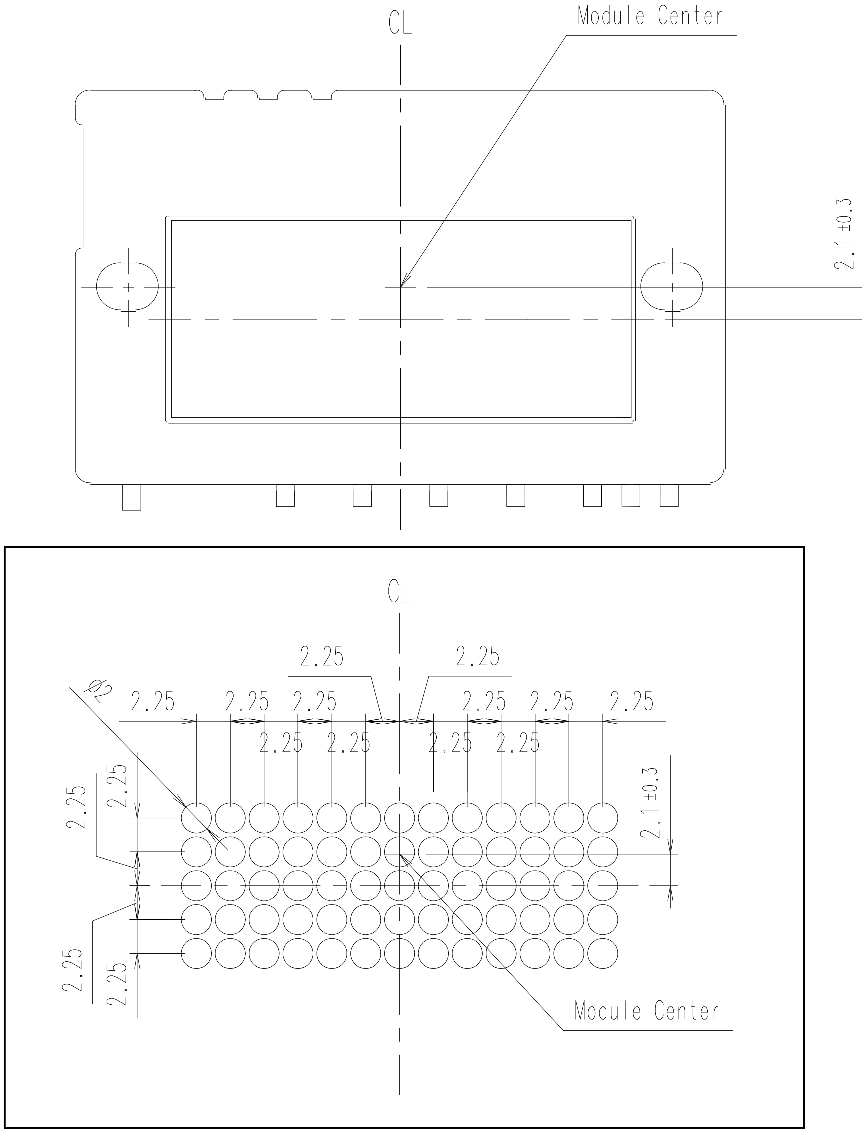
This chapter describes the appendix for mounting of the product (Small IPM).

8. Appendix

1 Stencil mask drawing for thermal compound application (recommended)

Package No. : P633A

This figure shows the view from the aluminum base surface.



※ –·–·–·–·– : Aluminum base centerline

Metal mask thickness: T = 150 μm
(Target compound thickness: T = approx. 75 μm)

Fig. 8-1 Stencil mask drawing for thermal compound application (recommended)

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2 Isolation distance of heat sink

- When this product is mounted on a flat heat sink, there is a possibility that discharge will occur between the lead terminals and the heat sink, so the isolation voltage will be 1.5 kVrms.
- By ensuring a creepage distance of 2.5 mm or more between the lead terminals and the heat sink, the isolation voltage will be 2.5 kVrms.
- By processing the heat sink as follows, it is possible to secure a clearance distance of 5.08 mm or more in accordance with UL508C table 36.3 standard (240 VAC / with surge protection device (SPD)).

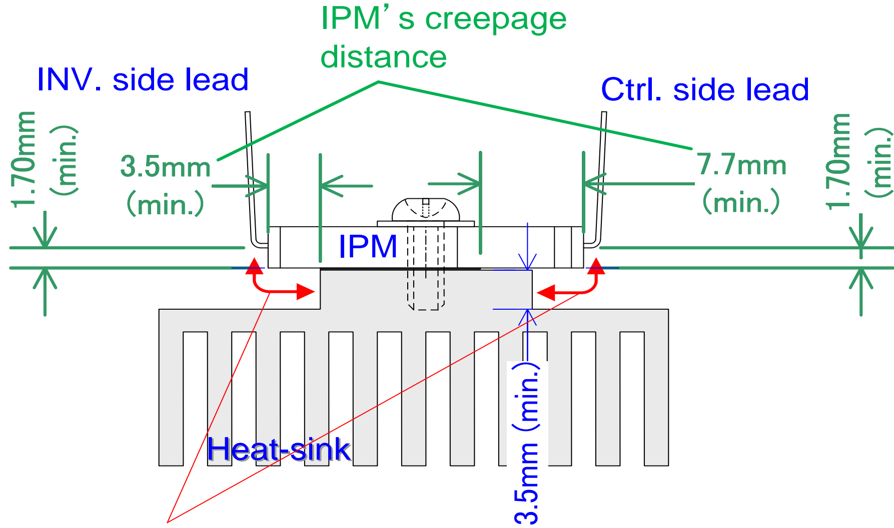

Fig. 8-2 Isolation distance of heat sink

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