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# Chapter 5

## Cooling Design

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### 1 Cooler (Heat Sink) Selection Method

- To safeguard operation of the IGBT, make sure the junction temperature  $T_j$  does not exceed  $T_{jmax}$ . Cooling should be designed in such a way that ensures that  $T_j$  is always below  $T_{jmax}$  even in abnormal states such as overload operation as well as under the rated load.
- Operation of IGBT at temperatures higher than  $T_{jmax}$  could result in damage to the chips. In the IPM, the  $T_{jOH}$  protection function operates when the chip temperature of IGBT exceeds  $T_{jmax}$ . However, if the temperature rises too quickly, the chip may not be protected.
- Likewise, note that the chip temperature of FWD should not exceed  $T_{jmax}$ .
- When selecting the cooler (heat sink), always measure the temperature directly under the center of the chip. The Econo IPM series in particular is designed with operational preconditions for servo applications, etc., in which the temperature increases/decreases in a short time, so care is required in regard to heat accumulation when using under other conditions. As the structure and design place special importance upon compactness, there is a tendency for heat to accumulate in the power chip located at the center. For the chip layout, refer to the IPM internal structure drawing: MT6M5313. For the concrete design, refer to the following document.

“IGBT MODULE APPLICATION MANUAL REH984”

- Contents:
- Power dissipation loss calculation
    - Selecting heat sinks
    - Heat sink mounting precautions
    - Troubleshooting

### 2 Notes on Heat Sink Selection

How to select heat sinks is described in the manual REH982. Note also the following points.

- Flatness of the heat sink surface

Flatness between mounting screw pitches: 0 to +100  $\mu\text{m}$ , roughness: 10  $\mu\text{m}$  or less

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  $\mu\text{m}$  or more, the copper base of the IPM is deformed and cracks could occur in the internal isolating substrates.

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