Discoloration in Heatsink Attachment Area of SIM2 Series

The SIM2 series employs the Direct Bonding Copper (DBC) to improve thermal dissipation.

The heatsink attachment area may oxidize and discolor when exposed to air during manufacturing or storage. However, the oxide thickness is very thin and has little effect on thermal resistance.

As shown in Figure 1, the DBC has a three-layer structure of copper (DBC_A), ceramic (DBC_B), and copper (DBC_C), with the heatsink attachment area (DBC_C) exposed.

Therefore, the copper may oxidize and discolor if the heatsink attachment area is exposed to air. The development of oxidation depends on the external environment such as temperature and humidity.

Figure 2 and Figure 3 show examples of a product before oxidation and a product uniformly discolored due to oxidation, respectively. Figure 4 is an example of a product that has been stored in a high-humidity environment, or has residual moisture (including humidity) during the manufacturing process (terminal plating). The peripheral part has mottled discolorations. The components of discolorations in Figure 3 and Figure 4 are both copper oxide.

Figure 1. DBC Structure

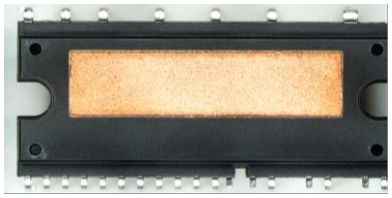

Figure 2. Before Oxidation

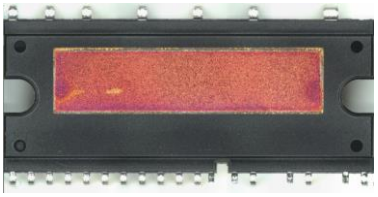

Figure 3. Oxidation 1

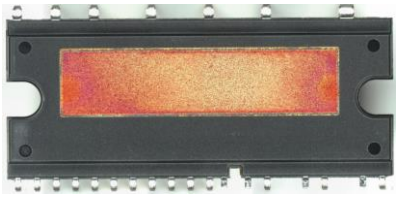

Figure 4. Oxidation 2
(in high-humidity environment)

It is known that if the surface of copper is intentionally oxidized in a harsh environment (e.g., exposed to air at 200 °C for 1 hour), the thickness of copper oxide reaches about 125 nm[(1)]. When the SIM2 series is exposed to such an environment, copper oxide of similar thickness is generated in the attachment area. Even if the thickness of this copper oxide is converted into thermal resistance and added to the thermal resistance of the products, the increase is less than 0.1%. As described above, the discoloration of the heatsink attachment area does not affect the thermal dissipation of products. You can use products without any change.

(1) S. Cho, K. Paik, and Y. Kim, "The effect of the oxidation of Cu−Base Lead Frame on the Interface Adhesion between Cu Metal and Epoxy Molding Compound", IEEE Transactions on Components, Packaging, and Manufacturing Technology−Part B, vol. 20, No.2, May 1997, pp167–175.

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