

- SCOPE: Explanation of the process and use of solder die attach in high power applications.

Power Semiconductor devices are common in electronic equipment running greater than 10 Watts. These devices are found in inverters, converters, diodes, MOSFET and IGBT modules, and are utilised in locomotive, automotive, renewable energy and HVDC applications. The high frequency switching and current capability of these devices means that solder is the most common form of metal-to-metal joining, as it provides the most reliable and efficient means of conducting both thermally and electrically.



Die attach is the process of affixing a silicon die or chip to a lead frame, substrate or similar packaging, with either adhesive, conductive adhesive or solder. A die attach bond is usually between the back of a silicon die and the metallic surface of a leadframe or substrate.

Power semiconductor packages are subjected to extensive thermal energy and thermal cycling during normal operation. To effectively dissipate this heat energy, metal solder is the chosen method of die attach. Solder die attach also provides strong mechanical strength and fatigue resistance, which is a crucial property to have, considering the mechanical and thermal stresses that a power module would typically see in its working life.



Solder is used typically in three forms for solder die attach: preforms, wire or paste.

- **Preforms**

Preforms are typically used in batch production, The solder is in a solid state, and is usually the same dimensions in X&Y as the die being attached. These can be supplied in bulk (glass vials) or in Waffle Packs. The bond line thickness of the solder joint is determined by the thickness of the preform solder. An inline oven or vacuum solder reflow oven is typically used for this process.



- **Wire**

Wire is dispensed with an accurate wire feed system onto a preheated leadframe, with a combination of a 'spanker' or bond force. The melted solder wire is formed into the desired shape for the die or component being attached.

- **Paste**

Small particles of solder are mixed with liquid flux to form a paste. This is either dispensed or screen printed onto a leadframe and processed in a similar way to preforms. Because of the liquid flux additive that helps wettability, an aqueous cleaning stage is needed post solder process to remove the flux residue.

Solder alloys used in die attach have a melting point (liquidus) of around 275 - 345°C. Because of the higher junction temperatures of power semiconductor devices, higher melting point solders are need to reduce joint failure.