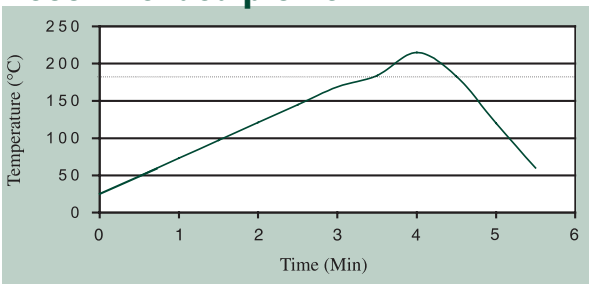
Optimizing Reflow

A typical reflow profile consists of four stages: preheat, soak or dryout, reflow, and cooling. Understanding these four stages is essential when designing an effective thermal profile.

Recommended profile:



Preheat — The objective of the preheat stage is to elevate the board and components to a temperature between 120° and 150°C. This drives off volatile solvents in the paste and attempts to minimize thermal shock on components. A ramp rate of 0.5°–2°C/second is recommended. Too fast a ramp rate can result in solder balls due to spattering caused by rapid outgassing of volatile solvents. Wicking, skewing and additional defects may occur during a fast preheat. Faster ramp rates may be evaluated with respect to process requirements. Contact component suppliers for their recommended ramp rate and observe reflowed boards closely for any defects mentioned above. If a faster ramp rate is required, a compromise may be reached by increasing the peak temperature and/or time above liquidus.

Soak or Dryout — This stage serves to activate the flux and stabilize temperature across the board before entering the reflow zone. The forced air convection reflow ovens of today offer more uniform heat transfer than the infrared ovens commonly used a few years ago. The uniform heating allows a more linear ramp rate right up to liquidus temperature depending on board size, density & oven efficiency. This eliminates the hump or shoulder profile of the past where the board was held at around 150°C for 1 to 2 minutes.

Reflow — Actual soldering occurs in this stage. As the profile moves into the reflow zone, the ramp rate should increase to 2.5°–3.5°C/second up to a peak temperature of 30°–40°C above the liquidus temperature. The time above liquidus should be 30–90 seconds to reduce excessive intermetallic formation which can weaken solder joints. Thermal damage and charring of the post reflow residue can also result from excessive time above liquidus and/or too high a peak temperature.

Cool Down — A cooling rate of <4°C/second is recommended to allow the board to cool quickly, solidify the solder joint and minimize intermetallic growth. Cooling also prevents discharge of flux fumes into the work area and allows manual handling of the boards. A fast cooling rate produces a small, tight grain structure which is desired. Too slow a cooling rate can result in a large grain structure and a weaker, less reliable solder joint.

APPLICATION NOTE

Form No. 98043 R1

www.indium.com askus@indium.com

ASIA: Singapore, Cheongju, Malaysia: +65 6268 8678
CHINA: Suzhou, Shenzhen: +86 (0)512 628 34900
EUROPE: Milton Keynes, Torino: +44 (0) 1908 580400
USA: Utica, Clinton, Chicago, Rome: +1 315 853 4900