App Note 3505: Assembling High-Lead (Pb) DS2502 Flip-Chips in a Pb-Free Assembly Flow

Usage of lead (Pb) in electrical and electronic components has recently been prohibited by the European Union through the Restriction of Hazardous Substances Directive (RoHS). Because of these regulations, assembly processes must become lead-free (Pb-free). Although the DS2502 flip-chip die are exempt from the RoHS regulations, they have been successfully assembled in a Pb-free reflow process. This application note details the Pb-free assembly process used, and the reliability stresses encountered after the assembly. Due to the RoHS directive, many assembly processes must be performed using Pb free solder in a Pb free reflow process. Dallas Semiconductor assembled 396 flip-chips using a 250C peak reflow temperature assembly process. After the assembly, the flip-chips were subject to industry standard reliability stresses. The DS2502 flip-chip die had zero critical failures and passed the reliability evaluation. It is therefore determined that the DS2502 flip-chip die are acceptable for use in a Pb free reflow assembly process using the parameters listed in this document.

Introduction

Recent regulations from the European Union limit the usage of lead (Pb) in electrical and electronic components. These regulations are formally referred to as Directive 2002/95/EC, but commonly referred to as the Restriction of Hazardous Substances Directive (RoHS). Included with the RoHS is an annex (page 5) that lists all the exemptions to the directive. Item 7 of the annex states: "Lead in high melting temperature type solders (i.e. Tin-lead solder alloys containing more than 85% lead)." Dallas bump technology, commonly known as "flip-chip", is RoHS exempt due to the high melting point, 95% lead (Pb), solder bump construction. For a detailed analysis of the DS2502 material content, a copy of the hazardous content for the DS2502 is included in **Appendix A**.

Due to the RoHS directive, many assembly processes must be performed using Pb-free solder in a Pb-free reflow process. The DS2502 has successfully passed reliability stresses after being assembled in a Pb-free process. This document describes the reflow process used and the reliability stresses involved.

Pb-Free, Board Assembly Reflow Process

The DS2502 flip-chip boards were assembled using high-temp, FR4 PC board material with a

Tg > 170° C. The CAD drawing for this board is included in **Appendix B**. The flip chips were attached to the board using Indium5.1 Pb-free solder paste from Indium Corporation of America® (refer to the Indium5.1LS product data sheet). The DS2502 boards were sent through a 5-zone BTU model SSA 70 reflow oven for assembly. The conveyor in the oven was set to 25 inches per minute, and zones 1 to 5 were 185° C, 200° C, 215° C, 270° C, and 300° C, respectively. The peak reflow temperature was 250° C. The reflow profile is shown below in **Figure 1**, and also in **Appendix C**.

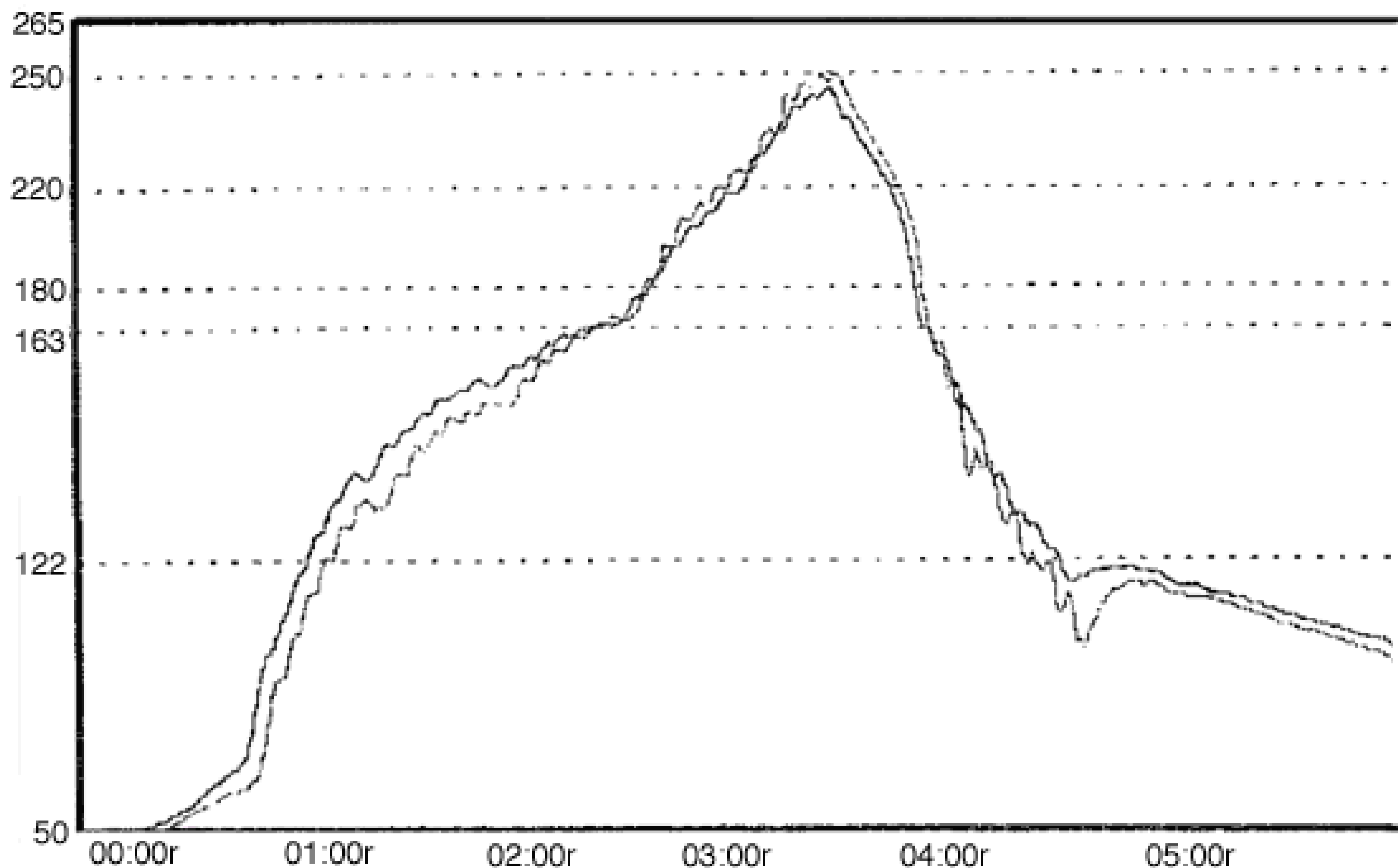

Figure 1. DS2502 Reflow Profile

DS2502 Reliability Stresses

After the Pb-free assembly process, 396 assembled boards were subject to industry-standard reliability stresses. These stresses include operating life, storage life, temperature cycle, temperature humidity bias, and unbiased moisture resistance. The DS2502 flip-chip die had zero critical failures after all tests were completed. The reliability report with all stresses and results included is online.

Summary

Dallas Semiconductor's DS2502 flip-chip die are exempt from the RoHS directive, as stated on line 7 of the RoHS annex. However, the die will still be assembled using a Pb-free reflow assembly process. Dallas Semiconductor assembled 396 flip-chip boards using a 250° C peak reflow temperature assembly process. After the assembly, the boards were subject to industry-

standard reliability stresses. The DS2502 flip-chip die had zero critical failures and passed the reliability evaluation. It is therefore determined that the DS2502 flip-chip die are acceptable for use in a Pb-free reflow assembly process using the parameters listed in this document.

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Appendix A. DS2502 Hazardous Content

Environmental Management and Materials Information

Part Number: DS2502X1-00B-00
Package Type: Flip Chip
Lead-Free Qualified: No

Definitions
BCB—Benzocyclobutene
UBM—Under-Bump Metal
RDL—Redistribution Layer

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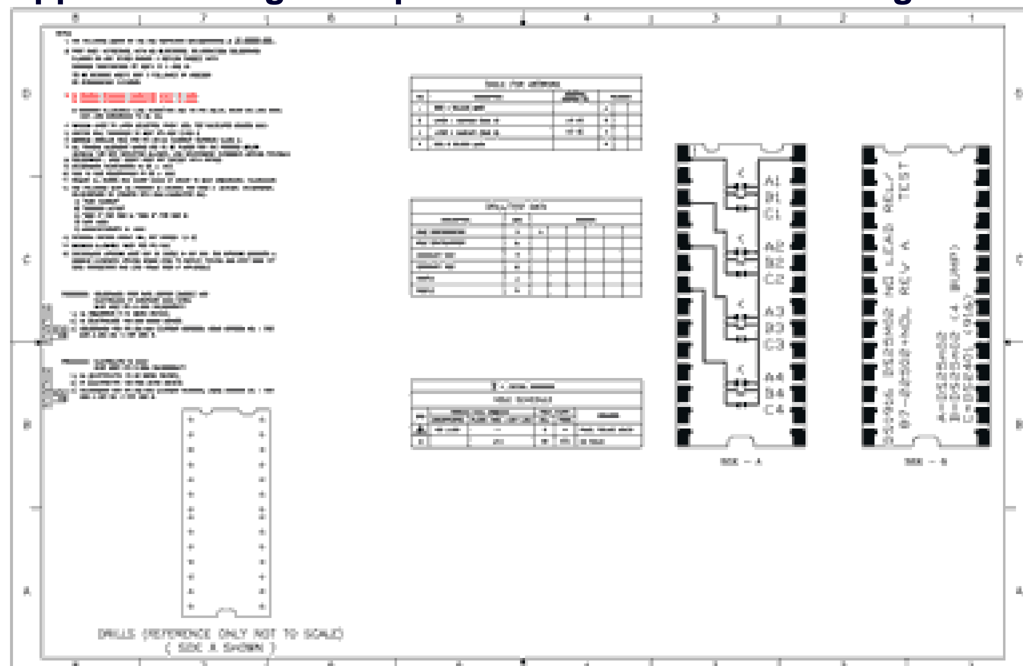
Appendix B. High-Temperature FR4 Material Drawing



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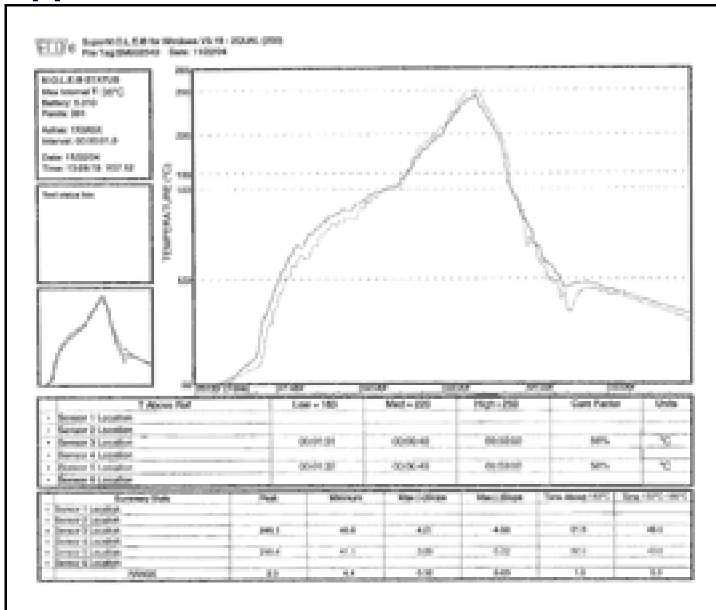
Appendix C. Pb-Free Solder Reflow Profile



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More Information

DS2502: QuickView -- Full (PDF) Data Sheet -- Free Samples