CASE STUDY

Semiconductor Wearout Life Prediction
Risk Factors Mitigated

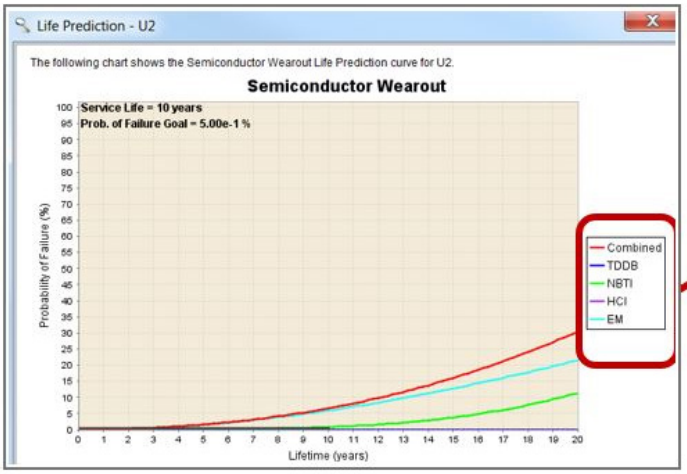
A major auto manufacturer was concerned with the reliability of semiconductor components that are part of a printed circuit board assembly PCBA housed inside a transmission controller under the hood. The unit is exposed to extreme conditions such as high temperature and humidity from heat generated while running and solar heating while parked. The auto manufacturer requested a wearout life prediction analysis on potential high-risk components.

/ Approach

Ansys Reliability Engineering Services (RES) first ran a reliability analysis using Ansys Sherlock simulations on separate semiconductor components that comprise the PCBA, including several components in different technology nodes. These simulations were used to predict the lifetime of the components by accelerating the rate of failure mechanisms. High-risk components were determined based on their process node.

These simulations took into account integrated circuit wearout and aging due to electromigration (EM) of interconnects, time dependent dielectric breakdown (TDDB) of dielectric materials and transistor degradation phenomena such as bias temperature instability (BTI) and hot carrier injection (HCI). Component-level reliability analysis was performed on each component, taking into consideration the operating conditions of the integrated circuit and test conditions as demonstrated by the manufacturer. Results (see below) included failure probability and lifetime prediction for each component due to a combination of the mechanisms mentioned above. This analysis helped identify the component(s) in the PCBA that are susceptible to early wearout failure.

Output-Life prediction plot



Life prediction as a function of four intrinsic semiconductor failure mechanisms

/ Recommendation

- Determine if each component meets the life expectancy of the system.
- Identify contributing factors for each component that drives early life failure.
- Propose changes in operating conditions/parameters that are likely to mitigate the lifetime reduction.

/ Results

Based on the analysis, the customer was able to predict the components that showed early lifetime degradation and was able to mitigate risks by adjusting factors such as voltage, temperature and duty cycle of operation.

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