Bachelor project Statistics

Correct modelling of the lifetime distribution of solder joints of new generation semiconductor devices

Keywords Reliability, solder joints, advanced semiconductors, accelerated stress testing, smallest extreme value distribution, lognormal distribution

Introduction

NXP is a semiconductor company producing products for mobile applications like tablets and mobile phones, for automotive, for bank cards, passports and more applications. All customers are companies and these are very demanding on quality and reliability. Before customers are willing to use NXP devices in their application a solid proof on the lifetime of the product has to be provided.

Problem description

NXP has to prove delivered devices will survive the guaranteed lifetime in its intended application. This also applies to the solder joints connecting the device to the PCB (Printed Circuit Board). Solder joints degrade during lifetime. The device is not functional when the first solder joint breaks. With ever progressing reduction of the sizes of semiconductor devices solder joints are getting smaller and become a critical element. Many semiconductor companies and their customers are facing this problem.

Based on accelerated stress tests it has to be proven that at maximum a low fraction of the devices will not survive the stated lifetime with 95% confidence. Traditional ways of analyzing and modelling the data are not satisfactory anymore. A new way has to be developed. The traditional way of working does not take a failure free lifetime into account. From physical reasoning a failure free lifetime is plausible, but it is not yet proven. Also historical data frequently shows that the fit of the assumed lifetime distribution gives a systematic deviations in the lower part of the distribution. The assumed lifetime distribution is suggested by international industrial standard like form JEDEC.

Assignment

To explore the subject a literature review on lifetime distributions in general and on the smallest extreme value and lognormal distribution in particular should be started. Interviews with reliability engineers and an introduction to the reliability lab and the way stress tests are executed is part of the first period. Knowing the basics of the problem it is your task to develop some applicable analyses to model the data from stress tests. Part of this should be done using reliability theory and by theoretical deduction. Many datasets are available to test and fine tune the model. Simulations can also be considered. Additional datasets can be gathered if needed.

Miscellaneous

Many datasets from the past are available. New experimental data can be gathered if needed.

An industrial statistician and subject matter experts at NXP are available as coach for the Master's student.

A standard working place at NXP can be provided.