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Book Review

Mechanical Analysis of Electronic Packaging Systems, by Stephen A. McKeown. Marcel-Dekker; ISBN: 0-8247-7033-1, Hardcover (April 1999); 355 pages. Price: $165.00.

REVIEWED BY A. J. RAFANELLI[1]

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Stephen McKeown's book provides a comprehensive view to electronic systems design from a mechanical engineering point of view. The book is divided into eight chapters. Chapter 1 is an introduction, included is an explanation on packaging levels starting with first level components, progressing to second level module, and ending with third level chassis. It would seem appropriate, given the title of the work, to include a fourth level, i.e., systems. Chapter 1 contains some very nice graphics including a fine illustration of hermetic versus non-hermetic packages. The chapter also includes a concise methodology for performing mechanical analysis.

Chapter 2 discusses analytical tools including hand calculations, symbolic equations, spreadsheets, finite-element analysis (FEM), and custom programs. The chapter ends with a very useful summary of comparisons of all tools discussed citing advantages versus disadvantages.

Chapter 3 discusses thermal performance analysis. The author does a nice job of warning the reader of the limitations in using published/vendor data regarding thermal resistance values for components. As in the previous chapters, the graphics are very good and the equations are clear and concise. Also included in the chapter is a very informative section on fins.

The topic of Chapter 4 is mechanical performance analysis. Some of the strengths include (1) an explanation of modeling (static and dynamic analyses) at component, module, and chassis levels, and (2) a mechanical analysis checklist. This Reviewer's observation is that the latter checklist is reminiscent of a physics of failure (PoF) methodology, although no formal mention of PoF is made in the book. A suggestion would be to include some aspects of PoF in future editions/updates of this book.

Chapter 5 addresses life analysis in terms of cyclic loads including vibration, repetitive mechanical shock, acoustic noise, thermal cycling, and temperature extremes (thermal shock). Also included is a discussion on solder life analysis. The author is complimented for providing sections that discuss low-cycle fatigue analysis approaches for some specific packages such as BGAs (ball grid arrays), leaded chip carriers (LDCCs), and leadless chip carriers (LCCs). Key analytical parameters are nicely highlighted and defined (e.g., critical shear stress, solder joint area/height, lead diagonal, etc). Another interesting and applicable section is provided on combined thermal cycling and vibration. The chapter ends with a concise Life Analysis Checklist that focuses on key parameters in performing analysis for various conditions such as all life, vibration life, random vibration life, solder vibration, etc.

Chapter 6 deals with other analyses that tend to take a ''back seat'' in routine engineering development but in many service environments warrant serious consideration. These include fire-resistance, pressure transducer rupture, humidity analysis, and pressure-drop analysis. The focus on humidity resistance is very timely since plastic encapsulated microcircuits (PEMS) continue to increase in usage rates among many systems in harsh environments. The author does a nice job in providing a reader-friendly presentation of key humidity parameters and calculations.

Chapter 7 provides a rather interesting approach to discussing analysis of test data. Prior to any mention of data analysis techniques, the author leads the chapter with discussion on test plans and approaches. Included are explanations on instrumentation (resolution, sensitivity, repeatability, and accuracy considerations), levels/durations, sample size, and subsequent trade-offs. In other words, the best data analytical tools are no substitute for good test planning and subsequent accurate data.

Finally, Chapter 8 addresses reports and verification. Ingredients for a typical analysis report are provided. Each ingredient is then embellished into a section of the chapter. It only seems appropriate that, after providing key essentials in the overall analytical approach to electronic systems, the final chapter should be on documentation. This reviewer is a strong proponent of engineers utilizing and improving their writing skills. Using the author's guidance, the engineer can provide a strong, lasting record of his/her work, which will reflect the careful effort, exerted.

In summary, Stephen McKeown has provided a handy reference for the execution of mechanical analyses of electronic systems. In addition to being a very good desk reference for the practicing engineer, the book appears to be an invaluable resource tool for graduate students in aiding them with planning and executing a thesis or dissertation project.

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