

Preface

In the present competitive environment, organizations subcontract items such as power supply units, RF filters, attenuators, and RF amplifiers for delivering cost-effective electronic systems faster without compromising quality and reliability. Entrepreneurs venture into the design, development, and manufacturing of the electronic items. There are also entrepreneurs developing and manufacturing standard Commercially Off-The-Shelf (COTS) items such as DC–AC Inverters, Switched Mode Power Supply (SMPS), and LED lighting units. The COTS items offer second buying option for organizations.

This book presents the methods of applying reliability engineering techniques for the design and development of electronic equipment and COTS items. Reliability mathematics is limited to analyzing field failure data statistically. Adequate information for designing computerized reliability database system to support the application of the techniques is also presented. The presentation is based on Q&R literature, industrial experience in the design of RF Filters [1], and the application of the reliability techniques in the design phase of electronic equipment. The book provides excellent support for electrical and electronics engineering students for their two-credit elective reliability engineering course, bridging academic curriculum with industrial expectations.

Chapter 1 presents the overview of the methods of integrating reliability engineering techniques with the design and development activities of equipment. Chapter 2 explains the reliability related terms associated with the selection of electronic components. The terms are de-rating, ambient temperature, surface temperature, thermal resistance, and junction temperature. The stress factors, the quantum of de-rating, and information for ensuring the reliable application of electronic components are presented in Chap. 3.

Failure Mode and Effects Analysis (FMEA) focusses on the possible failures of equipment for improving reliability and maintainability. Applying FMEA is explained in Chap. 4 with examples from electronic designs benefitting circuit designers. FMEA terms, benefits of FMEA, software support, deriving maintenance flow diagrams, and library of preventive actions are also explained.

Proto-models of equipment are developed using the provisional engineering documents of design stage. Although it is a common practice to apply de-rating to components during design, the portion of failures due to overstresses is still very significant, approximately 25 % [2]. Overstress analysis is conducted on the equipment to ensure that stress applied on parts is within their ratings. The low-cost methods of conducting electrical, thermal, and vibration resonance overstress analyses are explained in Chap. 5 in tutorial form.

The proto-models of equipment are evaluated internally to verify compliance to contractual specifications prior to qualification testing. Reliability improvement tests are part of internal verification testing with the objective of precipitating design errors and achieving first-time acceptance during qualification testing. Performance trend analysis, thermal shock, random vibration, and accelerated burn-in are the reliability improvement tests that are explained with examples in Chap. 6.

No test sequence or pattern of testing can guarantee detection of all deficiencies [3]. Organizing failure data and identifying the root causes of electronic component failures are presented in Chap. 7. Approaches for analyzing component failures caused by design errors, manufacturing processes, and defective components are explained.

Reliability database system is essential for integrating reliability techniques concurrently with the design and development activities of electronic equipment. The expertise of QA is made available to circuit designers virtually through the system. Adequate information and guidance are presented for designing the reliability database system in Chap. 8.

Cause analysis and implementing corrective actions for failures are fundamental requirements of analyzing field failure data. Additional engineering benefits could be realized by analyzing accumulated field failure data statistically. Analyzing the failure data of field replaceable electronic items using statistical probability distributions and predicting spares are illustrated with examples in Chap. 9.

The method of conducting life test on switches and electromechanical relays to establish the application reliability of the components for nonstandard loads is explained in Appendix A. The concept of Reliability Growth Testing (RGT) is explained in Appendix B. Computing G_{rms} from Acceleration Spectral Density (ASD) levels for random vibration profiles is explained in Appendix C.

References

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