The Institute for
Interconnecting
and Packaging
Electronic Circuits

IPC-D-279

Design Guidelines for Reliable Surface Mount Technology Printed Board Assemblies

IPC-D-279

July 1996

2215 Sanders Road
Northbrook, Illinois
60062-6135

Tel 847 509.9700
Fax 847 509.9798
URL: http://www.ipc.org

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Design Guidelines for Reliable Surface Mount Technology Printed Board Assemblies

1.0 SCOPE

This document establishes design concepts, guidelines, and procedures intended to promote appropriate 'Design for Reliability (DfR)' procedures and to ensure reliable printed wiring assembly (PWA) characteristics. The major focus of the information presented is directed toward those PWAs that have surface mount (SM) components, either totally, or intermixed with through-hole components, mounted on one or both sides of the mounting structure.

1.1 Purpose The definition of reliability in this document is:

> *Reliability* is the ability of a product to function under given conditions and for a specified period of time without exceeding acceptable failure levels.

This document addresses reliability-related aspects of product design, process design, as well as material/component selection and qualification. This document identifies appropriate existing IPC documents for basic detailed information.

The effort of this document is directed at SMT; the interconnect structure and the solder joint will receive most of our attention.

1.2 Design Philosophy Before the product design effort can begin, the designers of the product and assembly process need to know the customer's reliability requirements for the product. These requirements should be defined and ranked by a concurrent engineering or cross-functional team through a process such as Quality Function Deployment (QFD), used to capture the voice of the customer.

1.2.1 Establishing the Design Team The design team can include but is not limited to the members who participate in at least the design activities identified in Table 1-1. In this table, DfA/M stands for Design for Assembly/Manufacturability, DfT for Design for Testability, DfR for Design for Reliability.

The design team can consider the general design guidelines and issues presented in the body of this document as a methodology for achieving its reliability goals. Figure 1-1 illustrates the general design steps and process flow using concurrent engineering. Figure 1-2 illustrates the interactive nature of the design for reliability process.

1.2.2 Defining Reliability Requirements The basic reliability requirements to be defined include:

Table 1–1 The Design Team

Design/Engineering Function		Team Inprovement Area		
Product	(QFD)	(DfA/M)	(DfT)	(DfR)
Circuit	(QFD)	(DfA/M)	(DfT)	
Printed board		(DfA/M)	(DfT)	(DfR)
Thermal	(QFD)			(DfR)
EMC, EMI, ESD	(QFD)		(DfT)	(DfR)
Mechanical	(QFD)	(DfA/M)	(DfT)	(DfR)
Software	(QFD)		(DfT)	
Marketing	(QFD)			
Process/ manufacturing	(QFD)	(DfA/M)		
Test	(QFD)		(DfT)	(DfR)
Package/component		DfA/M)	(DfT)	
Field Service	(QFD)		(DfT)	
Purchasing		(DfA/M)		
Material	(QFD)	(DfA/M)	(DfT)	(DfR)
Reliability	(QFD)	(DfA/M)	(DfT)	(DfR)
Regulations	(QFD)		(DfT)	
Upper management	(QFD)	Conceptual Design and Cultural Change		

- years of service
- acceptable failure rate(s)/probability(ies) as a function of time
- repair/replacement/upgrade/service/maintenance/ warranty strategy
- life cycle environment(s)
- definition of acceptable performance
- criticality of function(s)
- available test equipment

1.2.3 Understanding the Product Life Cycle The life cycle begins at the component level (including the printed board) and continues through the assembly level; the life cycle includes exposure to the following environments:

- assembly/process
- testing
- storage
- transportation
- operating