IPC-2223C

Sectional Design Standard for Flexible Printed Boards

Developed by the Flexible Circuits Design Subcommittee (D-11) of the Flexible Circuits Committee (D-10) of IPC

Supersedes:
IPC-2223B - May 2008
IPC-2223A - June 2004
IPC-2223 - November 1998
IPC-D-249 - January 1987

Users of this publication are encouraged to participate in the development of future revisions.

Contact:
IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105
# Table of Contents

## 1 SCOPE  .......................................................... 1
1.1 Purpose ......................................................... 1
1.2 Classification of Products  .................................. 1
1.2.1 Printed Board Type ........................................ 1
1.2.2 Installation Uses ........................................... 4
1.3 Revision Level Changes ..................................... 4

## 2 APPLICABLE DOCUMENTS  .................................... 4
2.1 IPC ..................................................................... 4
2.2 Joint Industry Standards ..................................... 4

## 3 GENERAL REQUIREMENTS ...................................... 5
3.1 Design Modeling ............................................... 5
3.2 Design Layout .................................................. 5
3.2.1 Mechanical Layout Efficiency (Consider Final Panelization)  ........................................... 5
3.2.2 Fabrication Drawing Recommendations ............. 5
3.3 Schematic .......................................................... 5
3.4 Test Requirement Considerations .......................... 6
3.4.1 Environmental ............................................... 6
3.4.2 Mechanical/Flexural ....................................... 6

## 4 MATERIALS ....................................................... 6
4.1 Material Selection ............................................. 6
4.1.1 Material Options ............................................ 7
4.2 Dielectric Materials (Including Prepreg and Adhesives)  ................................................... 8
4.2.1 Preimpregnated Bonding Material (Prepreg)  .... 8
4.2.2 Adhesives (Liquid) ......................................... 8
4.2.3 Flexible Adhesive Bonding Films (Cast Adhesive or Bondply) .............................................. 8
4.2.4 Conductive Anisotropic Adhesives .................. 8
4.2.5 Cover Materials ............................................. 9
4.3 Conductive Materials (Surface Finishes) ............... 10
4.3.1 Electrolytic Copper Plating ............................ 10
4.3.2 Nickel Plating ................................................ 10
4.3.3 Tin-Lead Plating ............................................ 10
4.3.4 Solder Coating ............................................... 10
4.3.5 Other Metallic Coatings ................................. 10
4.3.6 Electronic Component Materials (Buried Resistors and Capacitors) ..................................... 11
4.3.7 Conductive Coatings for Shielding .................. 11
4.4 Organic Protective Coatings ............................... 11
4.4.1 Solder Mask .................................................... 11
4.4.2 Conformal Coating ......................................... 11
4.5 Marking and Legend .......................................... 11

## 5 MECHANICAL AND PHYSICAL PROPERTIES .... 12
5.1 Fabrication Requirements ................................... 12
5.1.1 Bare Printed Board Fabrication ......................... 12
5.1.2 Roll to Roll Fabrication ................................... 12
5.2 Product/Printed Board Configuration .................. 12
5.2.1 Circuit Profile (Outline) ................................... 12
5.2.2 Rigid Area Considerations ............................... 13
5.2.3 Flexible Areas ............................................... 14
5.2.4 Preforming Bend ............................................ 18
5.2.5 Differential Lengths ....................................... 19
5.2.6 Shielding ...................................................... 22
5.2.7 Ground/Power Plane ...................................... 22
5.2.8 Stiffeners and Heat Sinks ................................. 22
5.2.9 Strain Relief Fillet Guidelines for Flexible and Rigid-Flex Printed Boards .......................... 22
5.3 Assembly Requirements .................................... 23
5.3.1 Mechanical Considerations ............................. 23
5.3.2 Array Sub-Pallets for Flexible and Rigid Printed Boards .................................................. 23
5.3.3 Single Part Sub-Pallets ................................... 23
5.3.4 Non-Palletized Flexible and Rigid-Flex Printed Boards .................................................. 23
5.3.5 Moisture ....................................................... 23
5.3.6 Infrared Preheats and Reflow .......................... 24
5.3.7 Adhesive Tg ................................................... 24
5.4 Dimensioning ................................................... 24
5.4.1 Datum Features .......................................... 24

## 6 ELECTRICAL PROPERTIES .................................. 24
6.1 Electrical Considerations ................................... 24
6.2 Impedance and Capacitance Control .................... 24

## 7 THERMAL MANAGEMENT ..................................... 25

## 8 COMPONENT AND ASSEMBLY ISSUES ............... 25
8.1 General Placement Requirements .......................... 25
8.2 Standard Surface Mount Requirements .................. 25
8.3 Lands for Surface Mounting ................................. 25
8.4 Constraints on Mounting to Flexible Sections ........... 25
8.5 Interfacial Connections .................................... 25
8.6 Offset Lands ..................................................... 25

## 9 HOLES/INTERCONNECTIONS ............................... 25
9.1 General Requirements for Lands with Holes .... 25
9.1.1 Land Requirements ......................................... 26
9.1.2 Annular Ring Requirements ............................ 26
Tables

Table 4-1 Characteristics of Typical Flexible Dielectrics ..... 9
Table 4-2 Minimum Average Copper Thickness, mm [in] .............................................................. 10
Table 9-1 Minimum Standard Fabrication Allowance for Interconnection Lands, mm [in] .................................................. 26
Table 9-2 Nonfunctional Land Considerations ............... 27
Sectional Design Standard for Flexible Printed Boards

1 SCOPE

This standard establishes the specific requirements for the design of flexible printed circuit applications and its forms of component mounting and interconnecting structures. The flexible materials used in the structures are comprised of insulating films, reinforced and/or non-reinforced, dielectric in combination with metallic materials. These interconnecting boards may contain single, double, multilayer, or multiple conductive layers and can be comprised wholly of flex or a combination of both flex and rigid.

1.1 Purpose  The requirements contained herein are intended to establish specific design details that shall be used in conjunction with IPC-2221 and may also be used in conjunction with IPC-2222 for the rigid sections of rigid-flex circuits.

1.2 Classification of Products  Classification type and use of products shall be in accordance with IPC-2221 and as stated in 1.2.1 and 1.2.2.

1.2.1 Printed Board Type  This standard provides design information for different flexible and rigid-flex printed board types. Printed board types are classified as:

Type 1  Single-sided flexible printed board containing one conductive layer, with or without stiffener, and constructed using an adhesive or adhesiveless substrate (see Figure 1-1 and Figure 1-2).

![Figure 1-1 Type 1 Single-sided Flexible Printed Board - Adhesive Substrate Construction](image1)

![Figure 1-2 Type 1 Single-sided Flexible Printed Board - Adhesiveless Substrate Construction](image2)