



IPC-6013C

Qualification and Performance Specification for Flexible Printed Boards

Developed by the Flexible Circuits Performance Specifications Subcommittee (D-12) of the Flexible Circuits Committee (D-10) of IPC

Supersedes:

IPC-6013B - January 2009
IPC-6013A with Amendment 2 -
April 2006
IPC-6013A with Amendment 1 -
January 2005
IPC-6013A - November 2003
Amendment 1 - December 2005
IPC-6013 with
Amendment 1
Includes:
IPC-6013 - November 1998
Amendment 1 - April 2000
IPC-RF-245 - April 1987
IPC-FC-250A - January 1974

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

Contact:

IPC
3000 Lakeside Drive, Suite 309S
Bannockburn, Illinois
60015-1219
Tel 847 615.7100
Fax 847 615.7105

Table of Contents

1	SCOPE	1	3.2.4	Metal Foils	8
1.1	Statement of Scope	1	3.2.5	Metal Planes/Cores	8
1.2	Purpose	1	3.2.6	Base Metallic Plating Depositions and Conductive Coatings	8
1.3	Performance Classification, Board Type, and Installation Usage	1	3.2.7	Final Finish Depositions and Coatings - Metallic and Non-Metallic	8
1.3.1	Classification	1	3.2.8	Polymer Coating (Solder Mask)	12
1.3.2	Printed Board Type	1	3.2.9	Fusing Fluids and Fluxes	12
1.3.3	Installation Uses	1	3.2.10	Marking Inks	12
1.3.4	Selection for Procurement	1	3.2.11	Hole Fill Insulation Material	12
1.3.5	Material, Plating Process and Final Finish	2	3.2.12	Heatsink Planes, External	12
1.4	Terms and Definitions	3	3.2.13	Via Protection	12
1.4.1	As Agreed Upon Between User and Supplier (AABUS)	3	3.2.14	Embedded Passive Materials	12
1.4.2	Button Plating	3	3.3	Visual Examination	12
1.4.3	Coverlay	3	3.3.1	Profile	12
1.4.4	Coverfilm	4	3.3.2	Construction Imperfections	13
1.4.5	Covercoat	4	3.3.3	Plating and Coating Voids in the Hole	16
1.4.6	Cover Material	4	3.3.4	Lifted Lands	17
1.4.7	Target Land	4	3.3.5	Marking	17
1.4.8	Capture Land	4	3.3.6	Solderability	17
1.4.9	Microvia	4	3.3.7	Plating Adhesion	17
1.4.10	Core	4	3.3.8	Edge Board Contact, Junction of Gold Plate to Solder Finish	17
1.5	Interpretation	4	3.3.9	Workmanship	18
1.6	Presentation	4	3.4	Dimensional Requirements	18
1.7	Revision Level Changes	4	3.4.1	Hole Size, Hole Pattern Accuracy and Pattern Feature Accuracy	18
2	APPLICABLE DOCUMENTS	4	3.4.2	Annular Ring and Breakout (External)	19
2.1	IPC	4	3.4.3	Bow and Twist (Individual Rigid or Stiffener Portions Only)	21
2.2	Joint Industry Standards	6	3.4.4	Array Sub-Pallets	22
2.3	Other Publications	6	3.5	Conductor Definition	22
2.3.1	American Society for Testing and Materials	6	3.5.1	Conductor Width and Thickness	22
2.3.2	Underwriters Lab	6	3.5.2	Conductor Spacing	22
2.3.3	National Electrical Manufacturers Association	7	3.5.3	Conductor Imperfections	22
2.3.4	American Society for Quality	7	3.5.4	Conductive Surfaces	23
2.3.5	AMS	7	3.6	Structural Integrity	24
2.3.6	American Society of Mechanical Engineers	7	3.6.1	Thermal Stress Testing	25
2.3.7	Federal	7	3.6.2	Requirements for Microsectioned Coupons or Production Boards	26
3	REQUIREMENTS	7	3.7	Solder Mask Requirements	37
3.1	General	7	3.7.1	Solder Mask Coverage	37
3.2	Materials Used in this Specification	7	3.7.2	Solder Mask Cure and Adhesion	38
3.2.1	Laminates and Bonding Materials	7	3.7.3	Solder Mask Thickness	38
3.2.2	External Bonding Materials	8			
3.2.3	Other Dielectric Materials	8			

Figure 3-32	Example of Nonconforming Void in Copper Filled Microvia	35
Figure 3-33	Microvia Contact Dimension	35
Figure 3-34	Metal Core to Plated-Through Hole Spacing	37
Figure 3-35	Measurement of Minimum Dielectric Spacing	37
Figure 3-36	Bending Test	41

Tables

Table 1-1	Default Requirements	2
Table 3-1	Internal or External Metal Planes	8
Table 3-2	Final Finish and Coating Requirements	10
Table 3-3	Surface and Hole Copper Plating Minimum Requirements for Through-Holes	11
Table 3-4	Surface and Hole Copper Plating Minimum Requirements for Buried Vias > 2 Layers, and Blind Vias	11
Table 3-5	Surface and Hole Copper Plating Minimum Requirements for Microvias (Blind and Buried)	11
Table 3-6	Surface and Hole Copper Plating Minimum Requirements for Buried via cores (2 layers)	11
Table 3-7	Covercoat Adhesion	16
Table 3-8	Solder Wicking/Plating Penetration Limits	16

Table 3-9	Plating and Coating Voids Visual Examination	17
Table 3-10	Edge Board Contact Gap	18
Table 3-11	Minimum Etch Annular Ring	19
Table 3-12	Allowable Squeeze-Out of Coverlay Adhesive and Ooze-Out of Covercoat	21
Table 3-13	Minimum Solderable Annular Ring on Land Area	21
Table 3-14	Conductor Spacing Requirements	22
Table 3-15	Plated-Through Hole Integrity After Stress	26
Table 3-16	Cap Plating Requirements	34
Table 3-17	Microvia Contact Dimension	35
Table 3-18	Internal Layer Foil Thickness after Processing	36
Table 3-19	Conductor Thickness after Plating	36
Table 3-20	Solder Mask Adhesion	38
Table 3-21	Dielectric Withstanding Test Voltages	39
Table 3-22	Insulation Resistance	39
Table 4-1	Qualification Testing	43
Table 4-2	C=0 Sampling Plan per Lot Size	46
Table 4-3	Acceptance Testing and Frequency	46
Table 4-4	Quality Conformance Testing	50

Qualification and Performance Specification for Flexible Printed Boards

1 SCOPE

1.1 Statement of Scope This specification covers qualification and performance requirements of flexible printed boards. The flexible printed board may be single-sided, double-sided, multilayer, or rigid-flex multilayer. All of these constructions may or may not include stiffeners, plated-through holes, and blind/buried vias.

The flexible or rigid-flex printed board may contain build up High Density Interconnect (HDI) layers. The printed board may contain embedded active or passive circuitry with distributive capacitive planes, capacitive or resistive components conforming to IPC-6017.

The rigid section of the printed board may contain a metal core or external metal heat frame, which may be active or non-active.

Revision level changes are described in 1.7.

1.2 Purpose The purpose of this specification is to provide requirements for qualification and performance of flexible printed boards designed to IPC-2221 and IPC-2223.

1.3 Performance Classification, Board Type, and Installation Usage

1.3.1 Classification This specification recognizes that flexible printed boards will be subject to variations in performance requirements based on end-use. These performance classes (Class 1, Class 2, and Class 3) are defined in IPC-6011.

1.3.2 Printed Board Type Performance requirements are established for the different types of flexible printed boards, classified as follows:

Type 1 Single-sided flexible printed boards containing one conductive layer, with or without stiffeners.

Type 2 Double-sided flexible printed boards containing two conductive layers with plated-through holes (PTHs), with or without stiffeners.

Type 3 Multilayer flexible printed boards containing three or more conductive layers with PTHs, with or without stiffeners.

Type 4 Multilayer rigid and flexible material combinations containing three or more conductive layers with PTHs.

Type 5 Flexible or rigid-flex printed boards containing two or more conductive layers without PTHs.

1.3.3 Installation Uses

Use A Capable of withstanding flex during installation.

Use B Capable of withstanding continuous flexing for the number of cycles as specified on the procurement documentation.

Use C High temperature environment (over 105 °C [221 °F]).

Use D UL Recognition. See UL 94 and UL 796F.

1.3.4 Selection for Procurement For procurement purposes, performance class and installation usage **shall** be specified in the procurement documentation.

The documentation **shall** provide sufficient information to the supplier so that the supplier can fabricate the flexible printed boards and ensure that the user receives the desired product. Information that should be included in the procurement documentation is shown in IPC-2611 and IPC-2612.

Note: If the drawing specifies the requirement in words, designators are not required.