IPC/JPCA-2291

Design Guideline for Printed Electronics

Developed by the Printed Electronics Design Subcommittee (D-61) of the Printed Electronics Committee (D-60) of IPC

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 Purpose ............................................................. 1
1.2 Intent ...................................................................... 1
1.3 Printed Electronics Document Hierarchy ................. 1
1.4 Qualification .......................................................... 2
1.5 Procurement Documentation .................................... 2
1.6 As Agreed Upon Between User and Supplier (AABUS) . 2
1.7 Interpretation ........................................................ 2
1.8 Presentation .......................................................... 2

2 APPLICABLE DOCUMENTS ........................................... 2
2.1 IPC ......................................................................... 2
2.2 NCSL International ................................................ 2
2.3 ISO ......................................................................... 2

3 TERMS AND DEFINITIONS ........................................... 3
3.1 base material* ....................................................... 3
3.2 barrier ..................................................................... 3
3.3 fiducial mark .......................................................... 3
3.4 functional biologically active material ...................... 3
3.5 functional chemically active material ....................... 3
3.6 functional conductive material .................................. 3
3.7 functional dielectric material .................................... 3
3.8 functional material ................................................... 3
3.9 functional optically active material ......................... 3
3.10 functional semiconductive material ....................... 3
3.11 functional thermally active material ...................... 4
3.12 hybrid structure .................................................... 4
3.13 in-body ............................................................... 4
3.14 nonfunctional material .......................................... 4
3.15 nonprinted conductor ............................................ 4
3.16 on-body .............................................................. 4
3.17 printed electronics based devices ......................... 4
3.18 printed electronics based material ......................... 4
3.19 printed electronics based process ......................... 4
3.20 printed electronics based final products .................. 4
3.21 printed electronics based modules and units ........... 4
3.22 printed electronics through-hole ......................... 4
3.23 printed electronics via .......................................... 4
3.24 surface finish ...................................................... 4

4 DESIGN PROCESS FLOW ............................................. 5
4.1 Printed Electronics Design Process Flow Stages ......... 5
4.1.1 Function and Purpose Definition ......................... 6
4.1.2 Performance Specifications ............................... 7
4.1.3 Materials Selections .......................................... 8
4.1.4 Design and Architecture .................................... 9
4.1.5 Manufacturing Process Layout ......................... 18
4.1.6 Cost Analysis .................................................. 20
4.1.7 Final Device, Module and Unit, and Product ....... 21

5 NOTES ....................................................................... 23
5.1 Data Conversion Initiative Background ................... 23

6 REFERENCES ................................................................. 23

Figures
Figure 1-1 Hierarchy for IPC/JPCA Printed Electronics Documents .......................................................... 1
Figure 1-2 Future Hierarchy for IPC/JPCA Printed Electronics Documents ........................................... 1
Figure 4-1 Printed Electronics Design Process Flow ...... 5
Figure 4-2 Base Materials Family Designation ............. 8
Figure 4-3a Single Layer – Single-Sided Topology ........ 9
Figure 4-3b Single Layer – Single-Sided Topology .......... 9
Figure 4-4a Single Layer – Single-Sided with Printed Jumpers Topology ............................................. 9
Figure 4-4b Single Layer – Single-Sided with Printed Jumpers Topology ............................................. 10
Figure 4-5a Single Layer – Double-Sided Topology ...... 11
Figure 4-5b Single Layer – Double-Sided Topology ...... 11
Figure 4-6a Multiple Layer – Single-Sided Topology ...... 12
Figure 4-6b Multiple Layer – Single-Sided Topology ...... 12
Figure 4-7a Multiple Layer – Double-Sided Topology ..... 14
Figure 4-7b Multiple Layer – Double-Sided Topology ..... 14
Figure 4-8 Definitions of Printed Layer and Feature Attributes ......................................................... 16
Figure 4-9a Hybrid Single Layer – Single-Sided Topology ................................................................. 17
Figure 4-9b Hybrid Single Layer – Single-Sided Topology ................................................................. 17
Figure 4-10a Hybrid Multiple Layer – Single-Sided Topology ......................................................... 17
Figure 4-10b Hybrid Multiple Layer – Single-Sided Topology ......................................................... 17
Figure 4-11 Hybrid Structure – Printed Component with Nonprinted Microelectronics Topology ............................................. 18
Figure 4-12 Example Printed Electronics Manufacturing Process Layout .................. 19
Figure 4-13 Design Data Conversion Flow ..................... 21
Figure 4-14 Design Data Verification Flow ................... 22

Tables
Table 4-1 Printed Electronics – Design for Purpose ...... 6
Table 4-2 Performance Specifications ....................... 7
Table 4-3 Printed Electronics Materials .................... 8
Table 4-4 Single Layer – Single-Sided Design .......... 9
Table 4-5 Single Layer – Single-Sided with Jumper Design .............................................. 11
Table 4-6 Single Layer – Double-Sided Design .......... 11
Table 4-7 Multiple Layer – Single-Sided Design .......... 13
Table 4-8 Multiple Layer – Double-Sided Design ...... 15
Table 4-9 Interfaces and Interconnects ...................... 15
Table 4-10 Single Layer – Single-Sided Hybrid Structure Design .............................................. 17
Table 4-11 Multiple Layer – Single-Sided Hybrid Structure Design .............................................. 18
Table 4-12 Manufacturing Process Layout Parameters .. 19
Table 4-13 Processing Technologies and Testing Parameters .............................................. 20
Table 4-14 Cost Analysis Parameters ....................... 20
Table 4-15 Design Data to Fabricate Printed Structures .............................................. 22


DESIGN GUIDELINES FOR PRINTED ELECTRONICS

1 SCOPE

This guideline provides an overview of the design process flow for printed electronics based devices, modules and units, and final products.

1.1 Purpose The purpose is to present the framework of the design process flow for individuals to manufacture printed electronics based devices, modules and units, and final products.

1.2 Intent The intent of IPC/JPCA-2291 is to establish a design process flow that will facilitate and improve the practice of printed electronics design. IPC/JPCA-2291 identifies documents such as standards that can be used to assist during the design process flow. In general IPC/JPCA-2291 contains generic information that is sufficient for printed electronics design by the product designer.

The subcommittee members that developed IPC/JPCA-2291 acknowledge that individual companies may require additional information than that reported within this document. Therefore, IPC/JPCA-2291 and documents specified within it may only reflect a subset of those required by members of the supply chain.

IPC/JPCA-2291 is “generic” because it specifies only information which forms the basis for further specific declarations. It is therefore intended to be used in conjunction with other documents as needed. Also, part of the intent is to provide mechanisms for securing the integrity of the information exchanged between supply chain members.

1.3 Printed Electronics Document Hierarchy The IPC/JPCA printed electronics standards development subcommittees have established a hierarchy as presented in Figure 1-1 based on the existing initiatives. It was structured to enable the greatest flexibility for the emerging field of printed electronics. The subcommittees plan to revisit it frequently and modify it as necessary during the growth of the field and technologies transition from R&D to commercialization.

As the documents listed in Figure 1-1 are completed, new standards projects may be undertaken by the subcommittees. Proposed projects will be listed as shown in Figure 1-2; a project was proposed that addresses manufacturing processes and platforms. In addition to initiating new project topics, subcommittees may also be actively preparing a revision of a previously approved standard based on recent subcommittee member comments as well as general industry trends.