ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES®

JPCA

IPC/JPCA-4104

Specification for High Density Interconnect (HDI) and Microvia Materials

Developed by the Microvia/High Density Interconnect Materials Subcommittee (D-42) of the High Density Interconnect (HDI) Committee (D-40) of IPC and the Build-Up PWB Committee of JPCA

Users of this standard 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

JPCA
2F, Kairo Kaikan
12-2, Nishiogikita 3-chome
Suginami-Ku, Tokyo 167-0042
Japan
Tel 011 81/3-5310-2020
Fax 011 81/3-5310-2021

Foreword

IPC-4104 was developed with consideration to High Density Interconnect (HDI) layers that use modified ‘‘conventional’’ plated-through hole (PTH) processes and chemistries. The industry does not yet have enough experience to develop specification standards for materials used to make HDI layers. The added layers are formed by novel processes that are drastically different from ‘‘conventional’’ PTH constructions (i.e., non-plated copper processes). As experiences are gathered, additional specifications may be added. In the meantime, the customer and manufacturer should work together to set the criteria for acceptance of product using the new technologies.

Table of Contents

1 SCOPE ... 1
1.1 General ... 1
1.2 Designation System ... 1
1.2.1 Dielectric Insulator Designations ... 3
1.2.2 Conductor Designations ... 4
1.2.3 Dielectric with Conductor Designations ... 5
1.3 Application Levels ... 6

2 APPLICABLE DOCUMENTS ... 6
2.1 IPC ... 6
2.2 American Society for Testing and Materials (ASTM) ... 7
2.3 Underwriters Laboratories (UL) ... 7
2.4 American National Standards Institute (ANSI) ... 7

3 REQUIREMENTS ... 7
3.1 Terms and Definitions ... 7
3.1.1 Microvia (Build-Up Via) ... 7
3.1.2 High Density Interconnection (HDI) (Build-Up PCB) ... 7
3.2 Specification Sheets ... 7
3.3 Manufacturer's Quality Profile ... 7
3.4 Qualification (Characterization) Testing ... 7
3.4.1 Material Qualification ... 7
3.4.2 Qualification Testing Dielectric Materials ... 9
3.4.3 Qualification Testing of Conductive Materials ... 9
3.5 Verification of Material Supplier's Quality System ... 9
3.6 Conflict ... 9
3.7 Materials ... 9
3.7.1 Dielectric Materials ... 10
3.7.2 Materials for Conductive Paths (In-Plane or Inter-Plane) ... 10
3.7.3 Materials with Dielectric and Conductive Functionality ... 10
3.8 General Acceptability ... 10
3.8.1 Dielectric and Conductive Materials ... 10
3.8.2 Inspection Lot ... 11
3.8.3 Visual Properties ... 11
3.8.4 Dimensional Requirements ... 13
3.9 Mechanical Requirements ... 14
3.9.1 Mechanical Requirements of Dielectric Materials ... 14
3.9.2 Mechanical Requirements of Conductive Materials ... 15
3.9.3 Mechanical Requirements of Dielectrics with Conductive Materials ... 15
3.10 Chemical Requirements ... 15
3.10.1 Chemical Requirements of Dielectric Materials ... 15
3.10.2 Chemical Requirements of Conductive Materials ... 15
3.10.3 Chemical Requirements of Dielectrics with Conductive Materials ... 16
3.10.4 Chemical Resistance of Dielectrics and Conductors ... 16
3.11 Electrical Requirements ... 16
3.11.1 Electrical Requirements of Dielectric Materials ... 16
3.11.2 Electrical Requirements of Conductive Materials ... 16
3.11.3 Electrical Requirements of Dielectric with Conductive Materials ... 16
3.12 Environmental Requirements ... 17
3.12.1 Environmental Requirements of Dielectric Materials ... 17
3.12.2 Environmental Requirements of Conductive Materials ... 17
3.12.3 Environmental Requirements of Dielectrics with Conductive Materials ... 17
3.13 Non-Nutrient ... 17
3.14 Workmanship ... 17
3.15 Material Safety Data Sheets (MSDS) ... 17
3.16 Shelf Life ... 17
3.17 Marking ... 18

4 QUALITY ASSURANCE PROVISIONS ... 18
4.1 Quality System ... 18
4.2 Responsibility for Inspection ... 18
4.2.1 Test Equipment and Inspection Facilities ... 18
4.2.2 Standard Laboratory Conditions ... 18
4.3 Qualification (Characterization) Testing ... 18
4.3.1 Samples ... 18
4.3.2 Structurally Similar Construction ... 18
4.3.3 Tolerances ... 18
4.4 Quality Conformance Inspection ... 18
4.4.1 Frequency ... 18
4.4.2 Inspection of Product for Delivery ... 18
4.4.3 Acceptance Criteria ... 18
4.4.4 Rejected Lots ... 18
4.5 Statistical Process Control (SPC) ... 19

5 PREPARATION FOR DELIVERY 19
5.1 Packaging 19
6 NOTES 19
6.1 Ordering Data 19
6.2 References 19
APPENDIX A 20

Figures

Figure 1-1 Cross-Section of a General HDI with Microvias 2
Figure 1-2 Cross-Sectional Views of Methods to Make HDI with Microvias 2
Figure 1-3 IC Chip Carrier on HDI/Microvia Substrate (Application I) 6
Figure 1-4 BGA Package (on MCM-L Substrate Using HDI-PCB Technology) (Application I) 6
Figure 1-5 PCB-HDI/Microvia Substrate Application H) 6
Figure 3-1 Layout of Materials Section 9
Figure 3-2 Visual Properties 11
Figure 3-3 Dimensional Requirements 13
Figure 3-4 Mechanical Requirements 14
Figure 3-5 Chemical Requirements 15
Figure 3-6 Electrical Requirements 16
Figure 3-7 Environmental Requirements 17

Tables

Table 1-1 Sample Dielectric Insulator Designation 3
Table 1-2 Sample Conductor Designation 4
Table 1-3 Sample Dielectric with Conductor Designations 5
Table 3-1 Reference Information and Test Frequency of Materials 8
Table 3-2 Visual Inspection Criteria of Dielectrics (Maximum Allowable Points) 11
Table 3-3 Sample Point Counts for Voids and Inclusions 12
Table 3-4 Visual Inspection of Solid Conductor Material (Maximum Allowable Points) 12
Table 3-5 Point Counts for Scratches for Solid Conductor Material 12
Table 3-6 Point Count for Pin Holes & Porosity 13

Specification for High Density Interconnection (HDI) and Microvia Materials

1 SCOPE

This document describes various materials that can be used for the fabrication of high density interconnection (HDI) and microvias. It provides information on general classifications and associated characteristics of HDI materials. The document **shall** be used as a qualification and conformance standard for designers and users when designing or constructing HDI and microvias.

This document contains material designation, conformance (requirements), qualification (characterization), and quality assurance requirements. IPC-4104 should be used in conjunction with IPC-2315 and IPC-6016.

1.1 General This document covers the requirements for dielectric and conductive materials that are used with conventional core materials for the manufacture of HDI. The added HDI layer(s) is ≤0.15 mm in thickness.

A microvia substrate contains reduced geometries. The microvia is used to reduce size and weight and enhance electrical performance. Its nature also allows innovation in three-dimensional packaging. A microvia substrate represents the combination of multichip modules (MCM) and conventional PCB manufacturing technologies (see Figure 1-1).

Microvias are the PCB technology solution in the form of blind and buried vias ≤0.15 mm in diameter and pad diameters ≤0.35 mm. These vias are the central characteristic of HDI, as shown in Figure 1-2.

1.2 Designation System The system in 1.2.1 through 1.2.3 identifies materials used for HDI structures. This is a general identification system and does not in any way imply that all the permutations of properties and forms exist. See the series of specification sheets at the end of this document for the specific materials available. Each specification sheet outlines engineering and performance data for materials that can be used to manufacture HDI. These materials include dielectric insulators, conductors, and dielectric/conductor combinations. The specification sheets are provided with letters and numbers for identification and ordering purposes. For example, a user wishing to order from specification sheet 1 would substitute the number ''1'' for the ''S'' in the designation examples (i.e., IPC-4104/1) shown in 1.2.1 through 1.2.3. To start the ordering process, one can use the specification sheets in this document in combination with relevant IPC documents for each material sets (i.e., IPC-CF-148, IPC-MF-150, or IPC-4101).

The materials contained in this standard represent general material categories. As new materials become available, they will be added to future revisions. Users and material developers are encouraged to supply information on new materials for review by the IPC Microvia/High Density Interconnect Materials Subcommittee (D-42). Users who wish to invoke this specification for materials not listed **shall** list a zero for the specification sheet number (IPC-4104/0).

The committee may approve new or revised specification sheets independent from revision of the document text. When this occurs, the new or revised specification sheet **shall** be printed and made available through IPC-4104. The effective date of the new or revised specification sheet **shall** be clearly indicated on the individual sheet. Specification sheets **shall** be transferred from IPC-4104 to the appropriate parent document whenever that document is revised.

The designation system recognizes three general material types used in manufacturing HDI:

- Dielectric insulators only
- Conductors only
- Combinations of conductors and insulators

The first level of the designations system is the material type.

Level 1 Material Type
IN = Dielectric Insulator
CD = Conductor
CI = Conductor and Insulator

The other levels used to designate a particular material depend upon Level 1. Table 1-1, Table 1-2, and Table 1-3 illustrate the designation system for each of the material types. The designation listed in the specification sheets can be used to determine the exact material construction by first looking at the Level 1 designation (IN, CD, or CI) and then looking in the correct section (1.2.1, 1.2.2. or 1.2.3) for that material type. These sections contain the description of the remaining designation levels with an example table to aid in deciphering the designation.

The default designations are non-photoimageable and unreinforced. They will not be used as descriptors for simplicity (see Table 1-1, Table 1-2, and Table 1-3).