



**IPC-2581B**  
**2013 - September**  
**Generic Requirements for**  
**Printed Board Assembly Products**  
**Manufacturing Description Data**  
**and Transfer Methodology**

Supersedes IPC-2581A  
May 2012

*A standard developed by IPC*

*Association Connecting Electronics Industries*





IPC-2581B

# **Generic Requirements for Printed Board Assembly Products Manufacturing Description Data and Transfer Methodology**

Developed by Product Data Description (Laminar View) Subcommittee  
(2-16) of the Electronic Product Data Description Committee (2-10) of  
IPC

***Supersedes:***

IPC-2581A - May 2012  
IPC-2581 with Amendment 1 -  
May 2007  
IPC-2581 - March 2004

**Contact:**

IPC  
3000 Lakeside Drive, Suite 309S  
Bannockburn, Illinois  
60015-1249  
Tel 847 615.7100  
Fax 847 615.7105

## Acknowledgment

Any document involving a complex technology draws material from a vast number of sources. While the principal members of the Product Data Description (Laminar View) Subcommittee (2-16) of the Electronic Product Data Description Committee (2-10) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

---

### Electronic Product Data Description Committee

Chair  
Karen McConnell  
Northrop Grumman Corporation

Vice Chair  
Gary Ferrari  
FTG Circuits

### Product Data Description (Laminar View) Subcommittee

Chair  
Karen McConnell  
Northrop Grumman Corporation

### Technical Liaison of the IPC Board of Directors

Bob Neves  
Microtek Laboratories

---

### Product Data Description (Laminar View) Subcommittee

Edward Acheson, Cadence Design Systems Inc.

Abhay Agarwal, Cadence Design Systems Inc.

Kjell Asp, Ericsson AB

Richard Attrill, Polar Instruments Inc.

Mike Buetow, UPMedia

Tony Calitri, Cisco Systems, Inc.

Mark Caradonna, PTC

Gary Carter, Fujitsu Network Communications

Joseph Clark, DownStream Technologies, LLC

Amy Clements, Zuken USA, Inc.

Larry Frost, Sanmina Corporation

Paul Gingras, KAW/USA

Terry Hoffman, Cisco Systems

Dana Korf, Huawei Technologies Co., Ltd.

Humair Mandavia, Zuken USA, Inc.

Karen McConnell, Northrop Grumman Corporation

John Milks, Adiva Corporation

William Newhard, DownStream Technologies, LLC

James Pierce, Axiom Electronics, LLC

Hemant Shah, Cadence Design Systems Inc.

Chris Shaw, Fujitsu Network Communications

Norwood Sisson, Norwood Sisson & Associates

Joe Socha, Sedona International Inc.

Karel Tavernier, Ucamco

Steve Watt, Zuken USA, Inc.

Iain Wilson, Iron Atom

Jamie Wise, WISE Software Solutions Inc.

Joe Zaccari, Screaming Circuits

## TABLE OF CONTENTS

1	SCOPE.....	1
1.1	Focus and intent.....	1
1.2	Notation .....	1
2	APPLICABLE DOCUMENTS.....	2
2.1	Documentation conventions .....	2
3	REQUIREMENTS .....	5
3.1	Rules concerning the use of XML and XML Schema.....	7
3.1.1	File readability and uniformity.....	7
3.1.2	File markers.....	7
3.1.3	File extension .....	7
3.1.4	File remarks.....	7
3.1.5	Character set definition .....	7
3.2	Data organization and identification rules .....	7
3.2.1	Naming elements within a 258X File.....	8
3.2.2	The Use of XML elements and types.....	8
3.2.3	Attribute base types (governing templates).....	8
3.2.4	Coordinate system and transformation rules .....	10
3.3	Transformation characteristics (Xform).....	11
3.3.1	The x and y Offset attributes .....	12
3.3.2	The rotation attribute.....	12
3.3.3	The mirror attribute .....	13
3.3.4	The scale attribute .....	13
3.3.5	The x and y Location attributes .....	13
3.4	Substitution groups .....	14
3.4.1	ColorGroup.....	16
3.4.2	Feature .....	16
3.4.3	Fiducial.....	16
3.4.4	FirmwareGroup.....	17
3.4.5	FontDef.....	18
3.4.6	LineDescGroup.....	18
3.4.7	FillDescGroup.....	19
3.4.8	PolyStep .....	19
3.4.9	Simple .....	20
3.4.10	StandardPrimitive.....	20
3.4.11	StandardShape.....	22
3.4.12	UserPrimitive .....	22
3.4.13	UserShape.....	23
4	CONTENT .....	24
4.1	Content: FunctionMode .....	25
4.1.1	USERDEF mode.....	26
4.1.2	DESIGN mode .....	26

4.1.3	FABRICATION mode .....	27
4.1.4	ASSEMBLY mode .....	27
4.1.5	TEST mode .....	27
4.2	Function levels .....	27
4.2.1	USERDEF Mode Level 1 .....	28
4.2.2	Design Levels .....	29
4.2.3	Fabrication Levels .....	31
4.2.4	Assembly Levels .....	33
4.2.5	Test Levels .....	35
4.3	Content: StepRef .....	37
4.4	Content: LayerRef .....	38
4.5	Content: BomRef .....	38
4.6	Content: AvlRef .....	39
4.7	Content: DictionaryStandard .....	39
4.7.1	StandardPrimitive: Butterfly .....	40
4.7.2	StandardPrimitive: Circle .....	42
4.7.3	StandardPrimitive: Contour .....	43
4.7.4	StandardPrimitive: Diamond .....	46
4.7.5	StandardPrimitive: Donut .....	47
4.7.6	StandardPrimitive: Ellipse .....	49
4.7.7	StandardPrimitive: Hexagon .....	50
4.7.8	StandardPrimitive: Moire .....	52
4.7.9	StandardPrimitive: Octagon .....	53
4.7.10	StandardPrimitive: Oval .....	54
4.7.11	StandardPrimitive: RectCenter .....	56
4.7.12	StandardPrimitive: RectCham .....	58
4.7.13	StandardPrimitive: RectCorner .....	60
4.7.14	StandardPrimitive: RectRound .....	62
4.7.15	StandardPrimitive: Thermal .....	64
4.7.16	StandardPrimitive: Triangle .....	66
4.8	Content: DictionaryUser .....	68
4.8.1	UserPrimitive, Simple .....	69
4.8.2	UserPrimitive: Text .....	75
4.8.3	UserPrimitive: UserSpecial .....	78
4.9	Content: DictionaryFont .....	79
4.9.1	FontDefEmbedded .....	80
4.9.2	FontDefExternal .....	81
4.9.3	FontDef: Glyph .....	81
4.9.4	FontDef: Glyph combination .....	82
4.10	Content: DictionaryLineDesc .....	82
4.10.1	LineDesc .....	84
4.10.2	LineDescRef .....	85
4.11	Content: DictionaryFillDesc .....	86
4.11.1	FillDesc .....	87

4.11.2	FillDescRef .....	89
4.12	Content: DictionaryColor .....	90
4.12.1	Color.....	91
4.12.2	ColorRef .....	91
4.13	Content: DictionaryFirmware .....	92
4.13.1	CachedFirmware.....	93
4.13.2	FirmwareRef .....	93
5	LOGISTIC HEADER .....	94
5.1	LogisticHeader .....	94
5.2	Role .....	95
5.3	Enterprise .....	96
5.4	Person .....	98
6	HISTORY RECORD.....	100
6.1	HistoryRecord .....	100
6.2	FileRevision .....	101
6.3	SoftwarePackage .....	102
6.4	ChangeRec .....	103
7	BOM (Material List).....	104
7.1	BOM Header .....	106
7.2	BomItem .....	106
7.2.1	BomDes.....	108
7.2.2	Characteristics .....	114
8	ELECTRONIC COMPUTER AIDED DESIGN (ECAD) .....	118
8.1	CadHeader.....	118
8.1.1	Spec .....	119
8.1.2	Property.....	133
8.1.3	ChangeRec.....	134
8.2	CadData.....	135
8.2.1	Layer .....	137
8.2.2	Stackup .....	143
8.2.3	Step.....	151
8.2.4	DfxMeasurementList .....	204
9	APPROVED VENDOR LIST (AVL).....	207
9.1	AvlHeader .....	208
9.2	AvlItem.....	209
9.2.1	AvlVmpn .....	209
10	GLOSSARY .....	212
10.1	Process Flow Descriptions .....	212
10.2	Terms and Definitions .....	212
10.3	Enumerated strings of 2581.....	213
11	REFERENCE INFORMATION.....	214
11.1	IPC .....	214
11.2	American National Standards Institute .....	214

11.3 Department of Defense ..... 215

11.4 Electronic Industries Association ..... 215

11.5 International Organization for Standards (ISO) ..... 215

Appendix A IPC-7351 Naming Convention for Land Patterns ..... 216

Appendix B Panel Instance File ..... 220

Appendix C Potential Reference Designator Assignment for Non Electrical Items ..... 225

# Generic Requirements for Printed Board Assembly Products Manufacturing Description Data and Transfer Methodology

## 1 SCOPE

This standard specifies the XML schema that represents the intelligent data file format used to describe printed board and printed board assembly products with details sufficient for tooling, manufacturing, assembly, and inspection requirements. This format may be used for transmitting information between a printed board designer and a manufacturing or assembly facility. The data is most useful when the manufacturing cycle includes computer-aided processes and numerical control machines.

The data can be defined in either English or International System of Units (SI) units. The format is a convergence of the IPC-2511 "GenCAM" and the Valor Computerized Systems "ODB-X" format structure.

### 1.1 Focus and intent

The generic format requirements are provided in a series of standards focused on printed board manufacturing, assembly, and inspection testing. This standard series consists of a generic standard (IPC-2581) that contains all the general requirements. There are seven sectional standards that are focused on the XML details necessary to accumulate information in the single file, that addresses the needs of the manufacturing disciplines producing a particular product.

The sectional standards (IPC-2582 through 2588) paraphrase the important requirements and provide suggested usage and examples for the topic covered by the sectional standard.

### 1.2 Notation

Although the data would be contained in a single file, the file can have different purposes as described in Section 4. The XML schema used for this standard follows the notations set forth by the W3C and is as follows:

- element – Element appears exactly one time
- element? – Element may appear 0 or 1 times
- element\* – Element may appear 0 or more times
- element+ – Element may appear 1 or more times

Any IPC-258X file is composed of a high level element (IPC-2581) that contains up to six sub-elements:

- Content – information about the contents of the 258X file
- LogisticHeader – information pertaining to the order and supply data
- HistoryRec – change information of the file
- Bom – Bill of Materials (Material List) information
- Ecad – Computer Aided Design (engineering) information
- Avl – Approved Vendors List information



## 2 APPLICABLE DOCUMENTS

The following documents contain requirements which, when referenced, constitutes provisions of IPC-2581. At the time of publication, the editions indicated were valid. All documents are subject to revision and parties entering into agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

The revision of the document in effect at the time of solicitation **shall** take precedence.

**IPC-T-50** *Terms and Definitions for Interconnecting and Packaging Electronic Circuits*

**IPC-2501** *Definition for Web-Based Exchange of XML Data*

**IPC-2524** *PWB Fabrication Data Quality Rating System*

**IPC-2511** *Generic Requirements for Implementation of Product Manufacturing Description Data and Transfer XML Schema Methodology*

**IPC-2571** *Generic Requirements for Electronics Manufacturing Supply Chain Communication - Product Data eXchange (PDX)*

**IPC-2576** *Sectional Requirements for Electronics Manufacturing Supply Chain Communication of As-Built Product Data - Product Data eXchange*

**IPC-2577** *Sectional Requirements for Supply Chain Communication of Manufacturing Quality Assessment - Product Data eXchange (PDX)*

**IPC-2578** *Sectional Requirements for Supply Chain Communication of Bill of Material and Product Design Configuration Data - Product Data eXchange*

**IPC-7351** *Generic Requirements for Surface Mount Design and Land Patterns*

### 2.1 Documentation conventions

The XML file format standard and the XML Schema definition language standard, as defined the by World Wide Web Consortium (W3C), have been adopted by IPC for use in the IPC-2500 series of standards.

In addition to the text based schema notation, this document provides graphical representation of the structure of the file format. The XML diagrams are designed to effectively illustrate the structure and cardinality of elements and attributes that make up any IPC-258X file. The notation in the graphics does not provide a complete visualization of the schema definition for the file format, but it does provide a good top down overview. Should there be any conflict between the graphical notation and the schema notation, the authoritative definition is the schema notation.

Table 1 provides an overview of the graphical notation used in the document.