

IPC-2581B-WAM1

2016 - December

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

Supersedes IPC-2581B

September 2013

An international standard developed by IPC

Association Connecting Electronics Industries



The Principles of Standardization

In May 1995 the IPC's Technical Activities Executive Committee (TAEC) adopted Principles of Standardization as a guiding principle of IPC's standardization efforts.

Standards Should:

- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

Standards Should Not:

- Inhibit innovation
- Increase time-to-market
- Keep people out
- Increase cycle time
- Tell you how to make something
- Contain anything that cannot be defended with data

Notice

IPC Standards and Publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards and Publications shall not in any respect preclude any member or nonmember of IPC from manufacturing or selling products not conforming to such Standards and Publication, nor shall the existence of such Standards and Publications preclude their voluntary use by those other than IPC members, whether the standard is to be used either domestically or internationally.

Recommended Standards and Publications are adopted by IPC without regard to whether their adoption may involve patents on articles, materials, or processes. By such action, IPC does not assume any liability to any patent owner, nor do they assume any obligation whatever to parties adopting the Recommended Standard or Publication. Users are also wholly responsible for protecting themselves against all claims of liabilities for patent infringement.

IPC Position Statement on Specification Revision Change

It is the position of IPC's Technical Activities Executive Committee that the use and implementation of IPC publications is voluntary and is part of a relationship entered into by customer and supplier. When an IPC publication is updated and a new revision is published, it is the opinion of the TAEC that the use of the new revision as part of an existing relationship is not automatic unless required by the contract. The TAEC recommends the use of the latest revision. Adopted October 6, 1998

Why is there a charge for this document?

Your purchase of this document contributes to the ongoing development of new and updated industry standards and publications. Standards allow manufacturers, customers, and suppliers to understand one another better. Standards allow manufacturers greater efficiencies when they can set up their processes to meet industry standards, allowing them to offer their customers lower costs.

IPC spends hundreds of thousands of dollars annually to support IPC's volunteers in the standards and publications development process. There are many rounds of drafts sent out for review and the committees spend hundreds of hours in review and development. IPC's staff attends and participates in committee activities, typesets and circulates document drafts, and follows all necessary procedures to qualify for ANSI approval.

IPC's membership dues have been kept low to allow as many companies as possible to participate. Therefore, the standards and publications revenue is necessary to complement dues revenue. The price schedule offers a 50% discount to IPC members. If your company buys IPC standards and publications, why not take advantage of this and the many other benefits of IPC membership as well? For more information on membership in IPC, please visit www.ipc.org or call 847/597-2872.

Thank you for your continued support.



IPC-2581B-WAM1

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-2581B - September 2013
IPC-2581A - May 2012
IPC-2581 with Amendment 1 -
May 2007
IPC-2581 - March 2004

Contact:

IPC
3000 Lakeside Drive, Suite 105N
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

This Page Intentionally Left Blank

Acknowledgment

Any document involving a complex technology draws material from a vast number of sources across many continents. 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	Product Data Description (Laminar View) Subcommittee	Technical Liaison of the IPC Board of Directors
Chair Gary M. Ferrari FTG Circuits	Chair Karen McConnell Northrop Grumman Corporation	Bob Neves Microtek (Changzhou) Laboratories

Product Data Description (Laminar View) Subcommittee

Edward Acheson, Cadence Design Systems Inc.	Innovators, Ltd.	Hemant Shah, Cadence Design Systems Inc.
Craig Armenti, Zuken USA, Inc.	Ronny Kovartovsky, Frontline PCB Solutions	Chris Shaw, Fujitsu Network Communications
Kjell Asp, Ericsson AB	Kevin Kusiak, Lockheed Martin Space Systems Company	Rainer Taube, Taube Electronic GmbH
Jimmy Baccam, Lockheed Martin Missiles & Fire Control	Jeff Lewis, Holaday Circuits Inc.	Karel Tavernier, Ucamco
Robert Bagsby, Rockwell Collins	Humair Mandavia, Zuken USA, Inc.	Denise Turley, Fujitsu Network Communications
Tomas Bergsten, Ericsson AB	Jason Marsh, Nextflex	John Vaughn, Fujitsu Network Communications
Gary Carter	Karen McConnell, Northrop Grumman Corporation	Wenju Wang, Cadence Design Systems Inc.
Max Clark, Mentor Graphics Corporation	Kristopher Moyer, Aerojet Rocketdyne	Steve Watt, Zuken USA, Inc.
Joseph Clark, DownStream Technologies, LLC	William Newhard, DownStream Technologies, LLC	Jamie Wise, WISE Software Solutions Inc.
Amy Clements, Zuken USA, Inc.	Sheldon Parnes, Ansys	
Larry Frost, Sanmina Corporation	James Pierce, Axiom Electronics, LLC	
Terry Hoffman, Cisco Systems Inc.		
Satoshi Kojima, NEC Solution		

A special note of thanks goes to the following individuals for their dedication to bringing this project to fruition. We would like to highlight those individuals who made major contributions to the development of this standard.

Edward Acheson, Cadence Design Systems Inc.	Ronny Kovartovsky, Frontline PCB Solutions	Chris Shaw, Fujitsu Network Communications
Kent Balias, TTM Technologies	Humair Mandavia, Zuken USA, Inc.	John Vaughn, Fujitsu Network Communications
Tomas Bergsten, Ericsson AB	William Newhard, DownStream Technologies, LLC	Steve Watt, Zuken USA, Inc.
Gary Carter	James Pierce, Axiom Electronics, LLC	Jamie Wise, WISE Software Solutions Inc.
Joseph Clark, DownStream Technologies, LLC	Hemant Shah, Cadence Design Systems Inc.	
Terry Hoffman, Cisco Systems Inc.		

This Page Intentionally Left Blank

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
3.1.6	Child Element Order	7
3.1.7	XML Validation and Schema File Location	8
3.2	Naming attributes within a IPC-2581 file	8
3.2.1	Data organization and identification rules	8
3.2.2	The Use of XML elements and types	9
3.2.3	Attribute base types (governing templates)	9
3.2.4	Coordinate system and transformation rules	11
3.3	Transformation characteristics (Xform)	12
3.3.1	The x and y Offset attributes	13
3.3.2	The rotation attribute	13
3.3.3	The mirror attribute	14
3.3.4	The scale attribute	14
3.3.5	The x and y Location attributes	14
3.4	Base Elements	15
3.4.1	Line	15
3.4.2	Arc	16
3.4.3	PolyBegin	17
3.4.4	Polygon	17
3.4.5	Polyline	18
3.4.6	Cutout	19
3.4.7	Outline	20
3.4.8	PinRef	21
3.4.9	Location	21
3.5	Substitution Groups	22
3.5.1	ColorGroup	24
3.5.2	Fiducial	26
3.5.3	FirmwareGroup	26
3.5.4	FontDef	28
3.5.5	LineDescGroup	32
3.5.6	FillDescGroup	34

3.5.7	PolyStep	36
3.5.8	Simple	38
3.5.9	StandardPrimitive	39
3.5.10	StandardShape	64
3.5.11	UserPrimitive	64
3.5.12	UserShape	68
3.5.13	Feature	68
4	CONTENT	69
4.1	FunctionMode	70
4.1.1	Schema Sections	71
4.1.2	Modes	75
4.1.3	FunctionMode Element.....	75
4.2	StepRef.....	77
4.3	LayerRef	77
4.4	BomRef.....	78
4.5	AvlRef	79
4.6	DictionaryStandard	80
4.7	DictionaryUser	81
4.8	DictionaryFont.....	82
4.9	DictionaryLineDesc	83
4.10	DictionaryFillDesc	85
4.11	DictionaryColor	86
4.12	DictionaryFirmware	87
5	LOGISTIC HEADER	88
5.1	LogisticHeader	88
5.2	Role	89
5.3	Enterprise	90
5.4	Person	92
6	HISTORY RECORD	93
6.1	HistoryRecord	93
6.2	FileRevision	95
6.3	SoftwarePackage	95
6.4	ChangeRec.....	97
7	BOM (Material List).....	98
7.1	BOM Header	100
7.2	BomItem	100
7.2.1	BomDes.....	102
7.2.2	Characteristics	110
8	ELECTRONIC COMPUTER AIDED DESIGN (ECAD)	114
8.1	CadHeader.....	114
8.1.1	Spec.....	115
8.1.2	Property.....	135
8.1.3	ChangeRec	136
8.2	CadData.....	137

8.2.1	Layer	139
8.2.2	Stackup	142
8.2.3	Step	149
8.2.4	DfxMeasurementList.....	196
9	APPROVED VENDOR LIST (AVL)	199
9.1	AvlHeader	200
9.2	AvlItem.....	201
9.2.1	AvlVmpn	202
10	GLOSSARY	204
10.1	Process Flow Descriptions.....	204
10.2	Terms and Definitions	205
10.3	Enumerated strings of 2581	206
11	REFERENCE INFORMATION	206
11.1	IPC.....	206
11.2	American National Standards Institute	207
11.3	Department of Defense	207
11.4	Electronic Industries Association	207
11.5	International Organization for Standards (ISO)	207
Appendix A	IPC-7351 Naming Convention for Land Patterns.....	208
Appendix B	Panel Instance File.....	212
Appendix C	Potential Reference Designator Assignment for Non Electrical Items	215
Appendix D	Summary of Changes from Revision B	216

This Page Intentionally Left Blank

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 address 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