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IPC-2588

Sectional Requirements for Implementation of Part List Product Data Description



Endorsed by the International
Electronics Manufacturing
Initiative (iNEMI)

IPC-2588

May 2007

A standard developed by IPC

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Developed by the CAD/CAM Convergence Subcommittee (2-17) of the
Data Generation and Transfer Committee (2-10) 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

Acknowledgment

Any document involving a complex technology draws material from a vast number of sources. While the principal members of the CAD/CAM Convergence Subcommittee (2-17) of the Data Generation and Transfer 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.

Data Generation and Transfer Committee

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Lockheed Martin

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Sectional Requirements for Implementation of Part List Product Data Description

INTRODUCTION

This standard is part of the IPC-2580 series of standards. These standards specify a data file format used to describe printed board and printed board assembly products with details sufficient for tooling, manufacturing, assembly, inspection and testing requirements. The format may be used for transmitting information between a printed board designer and a manufacturing or assembly facility. The files are also useful when the manufacturing cycle includes computer-aided processes and numerical control machines.

The IPC-2580 format requirements are provided in a series of standards focused on design printed board fabrication, assembly, inspection, and testing. This standard series consists of a generic standard (IPC-2581) which contains all the general requirements. There are seven sectionals that are focused on the details necessary to accumulate information in a single file that addresses the needs of the manufacturing disciplines producing a particular product.

The sectional standards (IPC-2582 through 2588) paraphrase the important detailed requirements and provide suggested usage and examples for the topic covered by the sectional standard. The information can be used for both manual and for digital interpretations. The data is defined in either English or International System of Units (SI) units.

1 SCOPE

This standard (IPC-2588) provides the information on parts lists/ bill of materials for product data description and may be used for the ordering request for quote or asking for changes to a particular printed board or printed board assembly. Since the requirements are important to every file in order to understand the file usage, the XML schema is reused in every Business to Business transaction. This standard calls out the details defined in the generic standard (IPC-2581) that are required to accomplish these focused tasks.

1.1 Intent

The IPC-2581 contains all the requirements necessary to build an electronic product. The cardinality indicated in the IPC-2581 may be superseded by a restriction of an attribute (enumerated string ID) or indication of a requirement that is noted as being optional in the generic standard, however this standard makes the requirement mandatory based on the supply chain communication need.

In order to assist the users of this standard, all the applicable XML schema elements that apply to the Parts List or Bill or Material of Product Data Description Function are listed in Appendix A. The list is grouped by topics and shows the Absolute Path for the elements that pertain to the focus of this standard. If the Parent element is not present no children are to be considered in the implementation, however all Attributes identified for a particular element **shall** follow the cardinality of the IPC-2581 unless a restriction is stated in this standard.

1.2 Interpretation

"Shall", the emphatic form of the verb, is used throughout this standard whenever a requirement is intended to express a provision that is mandatory. Deviation from a **shall** requirement is not permitted, and compliance testing is required in order to demonstrate that the XML instances are correct according to the W3C directives and this standard. The XML schema **shall** be the method to check syntax and semantics. Any appropriate software tool that prompts the user, to correct the ambiguity or to insert missing information, may be used for this purpose.

The words "should" and "may" are used whenever it is necessary to express non-mandatory provisions.

"Will" is used to express a declaration of purpose.

To assist the reader, the word **shall** is presented in bold characters

2 APPLICABLE DOCUMENTS

The following documents contain requirements which, when referenced, constitutes provisions of IPC-2588. 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 additions 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-2581 *Generic Requirements for Printed Board Assembly Products Manufacturing Description Data and Transfer Methodology*
- IPC-2582 *Sectional Requirements for Implementation of Administrative Methods or Manufacturing Data Description*
- IPC-2589 *Sectional Requirements - Activity Model for Printed Board Assembly Products Manufacturing*

3 REQUIREMENTS

The requirements of IPC-2581 are a mandatory part of this standard. That document describes the generic requirements for the converged GenCAM and ODB++ formats. The generic details specifically provide data related to design, printed board manufacturing, assembly and test.

The XML schema of the 2581 consists of six major Elements each of which have several children who then become new parent elements. Several of these major elements and their associated new parents are defined in other sectionals. The requirements of IPC-2582 are also a mandatory part of the parts list product data description standard to the extent of their description and any restrictions contained in this standard.

Each of the standards and the elements defined therein has a specific function or task respectively, and although they may at times be used independently, they become an important addition to the requirements of the board fabrication descriptions. As such the following paragraphs provide the total requirements for the three types of board fabrication files that are supported by the principles of the IPC-2581.

Accordingly, the information interchange for the specific purpose of printed board fabrication is only possible if all the XML instances have been properly prepared for such a purpose.

3.1 Terms and Definitions

The definition of all terms **shall** be in accordance with IPC-T-50 and the following. A term number at the end of a line indicates that it is a reproduction from IPC-T-50 to assist the reader in interpretation of this standard.

3.1.1 Add-On Component

30.0019

Discrete or integrated packaged or chip components that are attached to a film circuit in order to complete the circuit's function.

3.1.2 Base Material

40.1334

The insulating material upon which a conductive pattern may be formed. (The base material may be rigid or flexible, or both. It may be a dielectric or insulated metal sheet.)

3.1.3 Component**30.0236**

An individual part or combination of parts that, when together, perform a design function(s).

3.1.4 Embedded Component**30.0436**

A discrete or active component that is fabricated as an integral part of a printed board.

3.1.5 Solder Resist**47.1674**

A heat-resisting coating material applied to selected areas to prevent the deposition of solder upon those areas during subsequent soldering.

3.2 Categories and Content

Table 3-1 provides the major functions that **shall** be addressed by IPC-2588. The descriptions relate to the appropriate information needed by most of the sectional standards. There are four (4) unique functions that can be defined by the use of the XML elements and the resulting XML instances. Each of the functions has additional child elements that may or may not be present as determined by the purpose of the data file, the maturity of the file, and the supply chain business transaction usage.

Table 3-1 indicates the relationships of the requirements for various elements and topics within the descriptions for a particular process. The letter "M" signifies a mandatory requirement. The letter "O" signifies an optional characteristic that may or may not be pertinent to the particular file or data interchange. A dash signifies an extraneous section (unnecessary). Although software tools used to parse the file will permit the extraneous data it is recommended that only the requirements identified as mandatory or optional are included in the file in order to reduce file size transfer.

Table 3-1 File Segmentation and Functional Requirements

Name	Full	Design			Fabrication			Assembly			Test		
		1	2	3	1	2	3	1	2	3	1	2	3
Content Elements	M	M	M	M	M	M	M	M	M	M	M	M	M
Logistic Header Elements	M	M	M	M	M	M	M	M	M	M	M	M	M
History Record Elements	M	O	M	M	O	M	M	O	M	M	O	M	M
Bill of Material Elements	M	O	M	M	O	M	M	M	M	M	-	-	O
BomHeader	M	O	M	M	O	M	M	M	M	M	-	-	O
BomItem	M	O	M	M	O	M	M	M	M	M	-	-	O
BomItemRefDes	M	O	M	M	O	O	M	M	M	M	-	-	O
BomItem Characteristics	O	-	O	O	-	-	O	O	O	M	-	-	-
Approved Vendor List	M	-	O	O	O	M	M	M	M	M	-	-	O
AVL Header	M	-	O	O	O	M	M	M	M	M	-	-	O
AVL Item	M	-	O	O	O	M	M	M	M	M	-	-	-

The correlation between the various descriptions identified in this standard is indicated in Figure 3-1. This shows the relationship of personnel, ordering data, and CAD data that should be associated with every 2581 file.

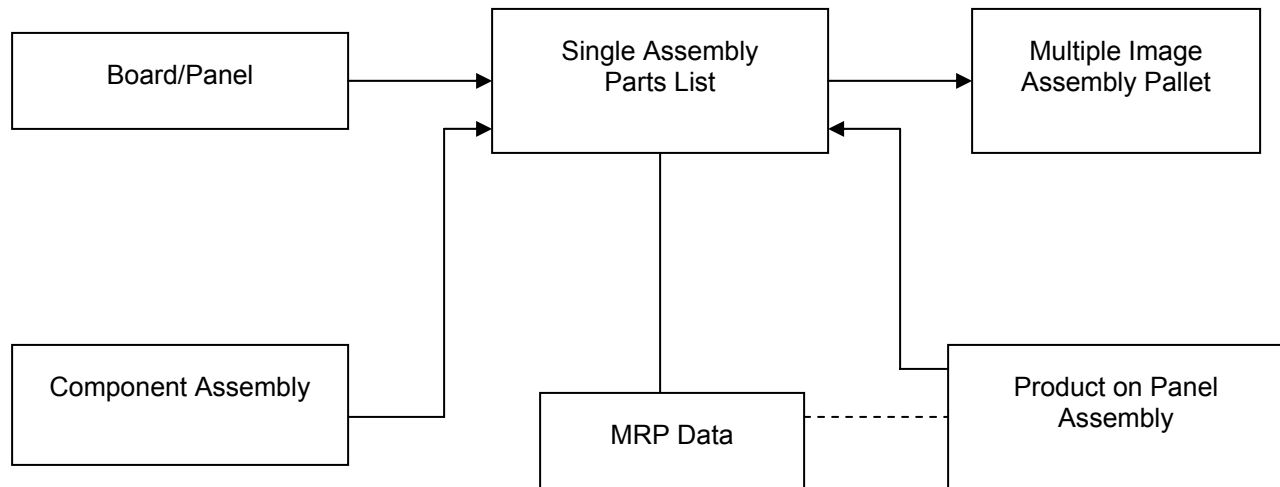


Figure 3-1 Parts List Activity Requirement

4 GENERAL RULES

The following details reflect the rules used in the IPC-2588 sectional to meet the requirements for parts list product data description. These rules are intended to meet the needs of the manufacturer to understand the customer requirements.

Wherever necessary, additional requirements have been detailed to reflect precision. The attributes and rules for the data file are described in IPC-2581 are required. Wherever necessary, detailed descriptions or definitions of the entities, attributes or characteristics are described according to the following paragraphs.

4.1 Parts List / Bill of Material

The Parts List or Bill of Material data is used to establish the relationship between various component parts of both the board and the assembly. There are many BOM sections within a 2581 file, thus the characteristics of the information must be clearly described and have a specific “namespace” to identify the specific BOM information. A file intended for a board manufacturer may contain a Bill of Material that identifies the specific copper, copper clad laminate, prepreg, solder mask, or other specific items needed to produce a particular board type. A Bill of Material for an assembly would include the electronic components, the mechanical components, the bulk material, and any other items needed to make the assembly description valid. It is a mandatory requirement that a reference designator is assigned for all electronic and mechanical components in order to track the information with the schematic diagrams identified for testing.

In order to permit more than one assembly to be contained within a panel, there may be specific BOMs that are identified for a specific assembly part number. It is possible, based on the structure of the `Ecad` file, to have different designs all produced within the same manufacturing panel and it is important that the BOM information is consistent. Although there may be several BOMs within a 2581 file, all references to the suppliers are contained in a single AVL list.

4.2 Content Elements

The `Content` element is a mandatory part of the 2588 file. The information should be consistent with IPC-2581 and the descriptions in IPC-2582. The `Content` element defines the function of the file, and references the major sections of the product description (e.g. `Step`, `Layer`, `Bom` and `Avl`). In addition, there are six dictionaries indicated in `Content` that would contain the pre-described information needed for the file details.

4.3 Logistic Header Elements

The `LogisticHeader` information **shall** be in compliance with IPC-2581. The `LogisticHeader` element consists of information about the owner of the IPC-2581 file. It can be used for configuration management or contact information. The enterprise is also linked to the Bill of Material and the Approved Vendor List (IPC-2588).

The `LogisticHeader` describes information pertaining to ordering and delivery. This includes the role played by the individual providing ordering and delivery information, the title of the person responsible and the address and particulars of the enterprise.

4.4 History Record Elements

The `HistoryRecord` descriptions **shall** be in compliance with IPC-2581. The `HistoryRecord` element consists of changes performed on the file throughout its history. Several attributes are defined as part of the `History` as well as two elements. These are file revision and change records elements.

4.5 Bill of Material Elements

The Bill of Material descriptions **shall** be in compliance with IPC-2581. The information describes the Bill of Materials for the printed board and printed board assembly. A bill of materials is a list of all the different materials and components to be used in the manufacture of the electronic assembly. The information is arranged by a specific category of material or components and then by the OEM Design Number (ODN). This is the number assigned by the owner of the file. Each ODN has a list of attributes and is accompanied by a list of the various specific uses of the materials or components on the electronic assembly, each with its private name or reference designator.

4.5.1 BomHeader

The `BomHeader` is a mandatory part of the Bill of Material and **shall** be in compliance with the IPC-2581 standard. Each `Bom` in the 2581 file has a `BomHeader` element. There are several attributes of the `BomHeader` which are required and identify the assembly to which the `Bom` pertains.

4.5.2 BomItem

The `BomItem` element information **shall** be in compliance with IPC-2581. Each `BomItem` is a part of the `BomItem` list. A `BomItem` consists of a variety of attributes. `BomItem` contains the reference to the OEM Design Number (ODN), the line item of the ODN, a quantity of parts required, and optional `internalPartNumber` (IPN), description of the `bomItem` and a reference to the package type (`packageRef`). The `BomItem` also contains three additional elements that include the list of reference designators (`RefDes`) associated with the `BomItem`, a list of detail descriptions related to the `BomItem`, and `FirmWare` (Firmware) associated with programming a part that needs those characteristics. Multiple `RefDes` lists may be maintained since there may be several reference designator file locations.

4.5.3 BomItem RefDesc

The `BomItem RefDesc` **shall** be in accordance with the IPC-2581 standard. The `RefDes` is an element that represents the specific reference designator associated with a component that becomes a part of the electronic assembly. This is a mandatory requirement for all `BomItems` that have a reference designator associated with their ELECTRICAL descriptions. In this instance, the standard set of reference designator letters **shall** be used, e.g., R = Resistor, C = Capacitor, CR = Diode etc. The prefix letter M **shall** be used for all MECHANICAL parts; P **shall** be used for all Process MATERIAL `BomItems`; and S for all Software PROGRAMMABLE `bomItems`.

4.5.4 BomItem Characteristics

There are several characteristics that may be attached to a `BomItem`. When this occurs, they **shall** be in compliance with the IPC-2581 standard. A group of specific characteristics applicable to a particular `BomItem`; they all relate to one of the categories to which the `BomItem` belongs. Each

characteristic has its own level of requirements and are defined under the major element Characteristics.

4.6 Approved Vendor List (AVL)

The Approved Vendor List **shall** be in compliance with the IPC-2581 standard. The `Avl` element contains the list of matching manufacturer's part numbers (MPNs) and vendor information of certain component part number's (CPN). Although there are several Bill of Materials (Bom's) there is only one approved vendor list except that the information is segmented by names of the files.

4.6.1 AVL Header

Every Approved Vendor List must have a Header. The `AvlHeader` information **shall** be in accordance with the IPC-2581 standard. The `AvlHeader` element defines the characteristics of the Avl information contained in the specific `Avl` file. Its occurrence is related to the name associated with the Avl file and may have different source information based on the purpose of the specific `Avl`. The `dateTime` attribute is used to keep account of changes that may take place in updating the information in the `Avl` file.

4.6.2 AVL Item

A specific correlation exists between every `BomItem` and the AVL list through the element `AvlItem`. The `AvlItem` is a mandatory requirement and **shall** be in compliance with the IPC-2581 standard. The `AvlItem` element consists of specific approved vendor information related the Bom data items and the part numbers (`OEMDesignNumber`) specified by the originator of the IPC-2581 file. Each `AvlItem` instance starts with its own `AvlDataHeader` in order to establish the relationship with the appropriate Bom. The grouping of `AvlItem`'s provides the information on the individual relationship to vendor manufacturing part numbers (`AvlVmpnList`).

5 MODELING

The data files of the 2588 may be mapped to a UML data model. Data models are developed to ensure that complete mapping is capable between the information provided within the 2588 characteristics. The correlation is provided in the activity models shown in IPC- 2589.

All data activities are based on activity models as defined in IPC-2589. The activity models covered by CAD and CAM include the engineering, design, administrative, fabrication, assembly and testing characteristics. Each of these sections are intended to be detailed into various levels of activity much like layers of information needed to perform a particular manufacturing process.

Figure 5-1 shows the activity needed to develop administrative data.

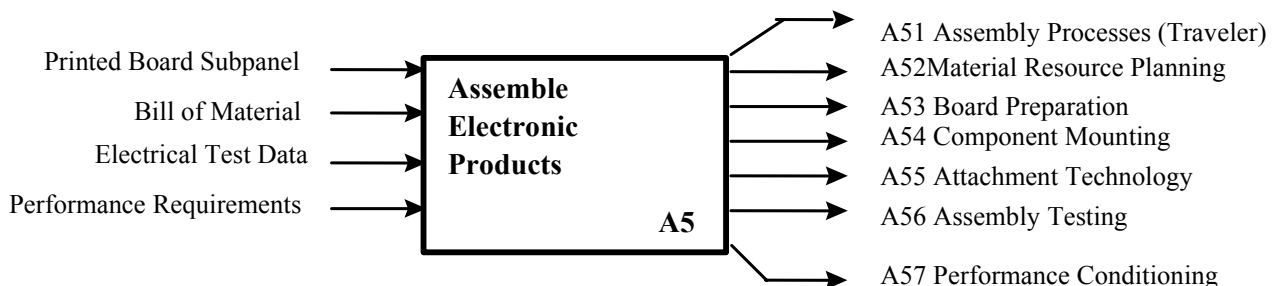


Figure 5-1 Parts List Data

6 REPORT GENERATORS

Data can be extracted from any 2588 file to produce various formats that are commonly used in the electronics industry. The types of reformatting can be used for electronic data transfer to tools or to facilitate inspection and human interpretation of text and/or graphic rendering. Note that no extraction tools are included in the IPC-258X standard. Their creation is left to the industry as the need arises.

Figure 6-1 shows an example of an extracted Parts List.

PARTS LIST, 15000173, Revision B2, 7-JAN-97								
Item	Supplier	Part #	Description	Reference Designator	Assembly Variation Quantity			
					01	02	03	04
1	Hadco	5101342	Board	BRD1	1	1		
2	Nec	8201342	Board	BRD1			1	1
3	Motorola	1N6378	Diode	D1,D2	2	2		
4	Motorola	1N6337	Diode	D1,D2			2	2
5	HP	5082-2835	Diode Schottky	D3	1	1	1	1
6	Dialight	550-3007	Connector, VME 100 pin	J1	1	1	1	1
7	Signetic	74HCT125N	IC, Dip	E1	1	1	1	1
Sub	Harris	CD74HCT125E						
8	Signetic	74HCT126E	IC, Dip	E2	1	1		
9	Harris	CD74HCT125N	IC, Dip	E2			1	1
10	Kemet	C322C104M5U5CA	Capacitor, .1uF, 50V, Mono	C1-C3	3	3	3	3
11	Maxim	MAX238CWG	IC, SMT GULL	E3	1	1	1	1
12	Kemet	C12062C104K5RAC	Cap, 1206 .1uF	C4, C5	2	2	2	2
Sub	MEPCO	12062R104K9BB0						
13	BRADY	LAT-1-652-10	Label, 0.25 x 1.875		1	1	1	1
14	BRADY	LAT-1-655-08	Label		1	1	1	1

Figure 6-1 Parts List Example

7 REFERENCE INFORMATION

The following sections define reference documents that are useful in clarifying the products or process of the industry or provide additional insight into the subject of data modeling or released information models.

7.1 IPC

IPC-2221 *Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies*

IPC-2611 *Generic Requirements for Electronic Product documentation*

IPC-2613 *Sectional Requirements for Assembly Documentation (Electronic Printed Board and Module Assembly Descriptions)*

IPC-2615 *Printed Board Dimensions and Tolerances*

IPC-D-310 *Guidelines for Artwork Generation and Measurement Techniques for Printed Circuits*

IPC-D-325 *Documentation Requirements for Printed Boards, Assemblies and Support Drawings*

7.2 American National Standards Institute

ANSI X3/TR-1-77 *American National Dictionary for Information Processing*

ANSI X3.12 *Subroutine Record Format Standardization*

ANSI Y14.5 *Dimensioning and Tolerancing for Engineering Drawing*

ANSI Y32.1 *Logic Diagram Standards*

ANSI Y32.16 *Electrical and Electrical Reference Designators*

ANSI Z210.1 *Metric Practice Guide (ASTM 380-72)*

7.3 Department of Defense

DoD-STD-100 *Engineering Drawings*

7.4 Electronic Industries Association

EDIF 4 0 0 *Electronic Data Interchange Format*

7.5 International Electrotechnical Commission (IEC)

IEC 61182-2 *Generic requirements for printed board and printed board assembly XML descriptions*

7.6 International Organization for Standards (ISO)

ISO STEP Documentation

AP210 *Electronic Printed Circuit Assembly: Drawings and Manufacturing*

AP211 *Electronic PC Assembly, Test Diagnostics & Remanufacture*

AP221 *Process Plant Functional Data & Schematic Representation*

Appendix A

Parts List Product Data Schema

IPC-2581

Content Elements in Accordance with IPC-2582

Logistic Header Elements in Accordance with IPC-2582

History Record Elements in Accordance with IPC-2582

BOM (Bill of Materials)

IPC-2581/Bom

IPC-2581/Bom/BomHeader

IPC-2581/Bom/BomItem

IPC-2581/Bom/BomItem/RefDes

IPC-2581/Bom/BomItem/RefDes/Tuning

IPC-2581/Bom/BomItem/RefDes/Firmware

IPC-2581/Bom/BomItem/RefDes/Firmware/File

IPC-2581/Bom/BomItem/RefDes/Firmware/CachedFirmware

IPC-2581/Bom/BomItem/RefDes/Firmware/FirmwareRef

IPC-2581/Bom/BomItem/Characteristics

IPC-2581/Bom/BomItem/Characteristics/Measured

IPC-2581/Bom/BomItem/Characteristics/Ranged

IPC-2581/Bom/BomItem/Characteristics/Enumerated

IPC-2581/Bom/BomItem/Characteristics/Textual

AVL (Approved Vendor List)

IPC-2581/Avl

IPC-2581/Avl/AvlHeader

IPC-2581/Avl/AvlItem

IPC-2581/Avl/AvlItem/AvlVmpn

IPC-2581/Avl/AvlItem/AvlVmpn/AvlMpn

IPC-2581/Avl/AvlItem/AvlVmpn/AvlVendor