IPC-2518A

Sectional Requirements for Implementation of Part List Product Data Description [PTLST]

“The data model of this standard shall be in effect until 2001-12.” At that time, the committee will consider changes, revision, other actions.
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- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
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- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

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

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Adopted October 6, 1998

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Thank you for your continued support.
GenCAM

[PTLST]

Sectional Requirements for Implementation of Part List Product Data Description

A standard developed by the Computerized Data Format Standardization Subcommittee (2-11) of the Data Generation and Transfer Committee (2-10) of the Institute for Interconnecting and Packaging Electronic Circuits.

The GenCAM format is intended to provide CAD-to-CAM, or CAM-to-CAM data transfer rules and parameters related to manufacturing printed boards and printed board assemblies. The requirements of IPC-2511 are a mandatory part of this sectional standard.

This standard is part of the GenCAM 1.5 release.

“The data model of this standard shall be in effect until 2001-12.” At that time, the committee will consider changes, revision, other actions.

Users of this standard are encouraged to participate in the development of future revisions.

Contact:

IPC
2215 Sanders Road
Northbrook, Illinois
60062-6135
Tel 847 509.9700
Fax 847 509.9798
Acknowledgment

Any Standard involving a complex technology draws material from a vast number of sources. While the principal members of the IPC Data Generation and Transfer Committee of the IPC Data Transfer Solution DTS Subcommittee 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
- **Chairman**: Harry Parkinson
- **Digital Equipment**

### Data Transfer Solution DTS Subcommittee
- **Chairman**: Harry Parkinson
- **Digital Equipment**

### Technical Liaisons of the IPC Board of Directors
- **Stan Plzak**: Pensar Corp.
- **Peter Bigelow**: Beaver Brook Circuits Inc.

#### Special Note of Thanks

**Key Individuals** — An executive group of personnel from different computer disciplines helped to make this document possible. To them and their dedication, the IPC extends appreciation and gratitude. These individuals are:

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- Doug Helbling, Intel
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- Michael McLay, NIST
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- Taka Shioya, Solectron
- Craig Carlson Stevermer, Infinite Graphics
- Eric Swenson, Mitron Corporation
- Sasha Wait, Myrus Design
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Sectional Requirements for Implementation of Parts List
Product Manufacturing Data Description (PTLST)

1 SCOPE

This standard specifies data formats used to describe parts lists and bill of material generation methodologies. These formats may be used for transmitting information between printed board designers, board fabricators, and assembly manufacturers.

The information can be used for both manual and for digital interpretations. The data may be defined in either English or SI units.

1.1 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 test modules (CTMs) developed to check syntax and semantics, will prompt the user to correct the ambiguity, or to insert missing information.

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.

1.2 Parts List Product Manufacturing Focus

The GenCAM format requirements are provided in a series of standards focused on printed board manufacturing, assembly, inspection, and testing. The generic standard (IPC-2518) provides information on requirements focused on parts lists or bill of material methodology. The generic standard, IPC-2511, contains general requirements and is a mandatory part of this standard. Suggested usage and examples for parts lists are contained in this standard.

2 APPLICABLE DOCUMENTS

The following documents contain provisions which, through reference in this text, constitutes provisions of IPC-2518. At the time of publication, the editions indicated were valid. All documents are subject to revision and parties to agreements based on this generic standard are encouraged to investigate the possibility of applying the most recent additions of the documents indicated below.

<table>
<thead>
<tr>
<th>Document</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPC-T-50</td>
<td>Terms and Definitions for Interconnecting and Packaging Electronic Circuits</td>
</tr>
<tr>
<td>IPC-2511</td>
<td>Generic Requirements for Implementation of Product Manufacturing Description Data and Transfer</td>
</tr>
<tr>
<td>IPC-2512</td>
<td>Sectional Requirements for Implementation of Administrative Methods for Manufacturing Data Description</td>
</tr>
<tr>
<td>IPC-2513</td>
<td>Sectional Requirements for Implementation of Drawing Methods for Manufacturing Data Description</td>
</tr>
</tbody>
</table>
3 REQUISITIONS

The IPC-2511 document describes the generics requirements of the GenCAM format. The format specifies details specifically for information interchange of data related to printed board manufacturing, assembly and test.

GenCAM is comprised of twenty sections as described in the generic GenCAM standard, IPC-2511. The sections are shown in Tables 3-1 and 3-2 of the IPC-2511.

Each section has a specific function or task respectively and is independent of each other. Accordingly, the information interchange for a specific purpose is possible only if the sections required for such a purpose have been prepared.

3.1 Categories and Content

Table 3-1 provides the section names that are appropriate for the list of material. There are two unique functions that can be defined by the use of these sections of the GenCAM system.

Table 3-1 indicates the relationships of the requirements for various sections 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 section. A dash signifies an extraneous section (unnecessary); CTMs will not reject file summaries if extraneous sections are present.

The table signifies two requirement conditions separated by a “/”. The first representation of requirements is intended to convey those GenCAM sections that shall be available as the initial input to the Assembly processes. The second instance of a requirement is to signify those data that shall be available once the processing descriptions have been completed.

<table>
<thead>
<tr>
<th>File Identifiers</th>
<th>Parts List Drawing</th>
<th>Parts List</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEADER</td>
<td>M/M</td>
<td>M/M</td>
</tr>
<tr>
<td>ADMINISTRATION</td>
<td>M/M</td>
<td>M/M</td>
</tr>
<tr>
<td>PRIMITIVES</td>
<td>O/O</td>
<td>-/-</td>
</tr>
<tr>
<td>ARTWORKS</td>
<td>O/O</td>
<td>-/-</td>
</tr>
<tr>
<td>LAYERS</td>
<td>-/-</td>
<td>-/-</td>
</tr>
<tr>
<td>PADSTACKS</td>
<td>-/-</td>
<td>-/-</td>
</tr>
<tr>
<td>PATTERNS</td>
<td>-/-</td>
<td>-/-</td>
</tr>
<tr>
<td>PACKAGES</td>
<td>-/-</td>
<td>-/-</td>
</tr>
<tr>
<td>FAMILIES</td>
<td>-/-</td>
<td>-/-</td>
</tr>
</tbody>
</table>
The correlation between the various descriptions identified in this standard are indicated in Figure 3-1. This shows the relationship of the various parts list data.

![Diagram showing parts list activity requirement]

### 4 GENERAL RULES

The following details reflect the rules used in GenCAM to meet the requirements for list of material. 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 GenCAM described in IPC-2511 are required.

Wherever necessary, detailed descriptions or definitions of the entities, attributes or characteristics are described according to the following issues detailed in Table 4-1 and descriptions.
### Table 4-1 Assembly Parts List Keyword Identifier

<table>
<thead>
<tr>
<th>Need Identifier</th>
<th>Section</th>
<th>Keyword Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Number</td>
<td>DEVICES</td>
<td>DEVICE.PART.&lt;enterprise.part_id&gt;</td>
</tr>
<tr>
<td>Package Description</td>
<td>DEVICES</td>
<td>DEVICE.&lt;package_ref&gt;</td>
</tr>
<tr>
<td>Supplier Part Number</td>
<td>DEVICES</td>
<td>DEVICE.PART.&lt;enterprise_ref&gt;</td>
</tr>
<tr>
<td>Alternate Parts</td>
<td>DEVICES</td>
<td>DEVICE.ALTERNATE</td>
</tr>
<tr>
<td>Aliases or part substitution</td>
<td>DEVICES</td>
<td>DEVICE.ALIAS</td>
</tr>
<tr>
<td>Device Quantity</td>
<td>COMPONENTS</td>
<td>Count the total instances of COMPONENT.DEVICEREF.&lt;part_ref&gt;</td>
</tr>
<tr>
<td>Part Reference Designators</td>
<td>COMPONENTS</td>
<td>COMPONENT.&lt;ref_desg&gt;</td>
</tr>
<tr>
<td>Part Specifications</td>
<td>DRAWINGS</td>
<td>DRAWING.&lt;drawing_type&gt; = SPECIFICATION</td>
</tr>
<tr>
<td>Item Number</td>
<td></td>
<td>The item number is not tracked within the GENCAM file. It is a function of the ERP system.</td>
</tr>
<tr>
<td>Assembly Part Number</td>
<td>HEADER</td>
<td>ASSEMBLY.&lt;assembly_id&gt;</td>
</tr>
<tr>
<td>Assembly Variation/Configuration</td>
<td>HEADER</td>
<td>ASSEMBLY&lt;assembly_id&gt; using a different number for the assembly.</td>
</tr>
<tr>
<td></td>
<td>BOARDS</td>
<td>ASSEMBLY.USING.&lt;group&gt; is then used to select a different set of devices to populate the board.</td>
</tr>
<tr>
<td>Part Classification</td>
<td>DEVICES</td>
<td>DEVICE.&lt;device_type&gt;</td>
</tr>
<tr>
<td>Package</td>
<td>PACKAGES</td>
<td>PACKAGE.&lt;package_name&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PACKAGE.&lt;package_type&gt;</td>
</tr>
<tr>
<td>Mechanical part</td>
<td>MECHANICALS</td>
<td>MECHANICAL.&lt;part_name&gt;</td>
</tr>
<tr>
<td>Mechanical part quantity</td>
<td>COMPONENTS</td>
<td>Count the total instances of COMPONENT.MECHANICALREF.&lt;mechpart_ref&gt;</td>
</tr>
<tr>
<td>Engineering Change Effects</td>
<td>CHANGES</td>
<td>CHANGE.ADD</td>
</tr>
<tr>
<td>Corrections To Previously Sent Data</td>
<td></td>
<td>CHANGE.DELETE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHANGE.RENAME</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHANGE.ADDPRODUCT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHANGE.DELETEPRODUCT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHANGE.RENAMEPRODUCT</td>
</tr>
</tbody>
</table>

## 5 MODELING

The data files of GenCAM may be mapped to the information models. Information models are developed to ensure that complete mapping is capable between the information provided within the GenCAM characteristics. The correlation is provided in the activity models shown in IPC-2519.

All data activities are based on activity models as defined in IPC-2519. The activity models covered by CAD and CAM include the engineering, design, administrative, and fabrication and assembly 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 parts list data.
5.1 Information Models

Information models are also helpful in understanding the requirements of the parts list product manufacturing section. Attribute information is correlated to the parameters of GenCAM as well as to the activity models used to describe parts list data.

EXPRESS is an international information modeling format supported by ISO 10303-11. The graphic representation of EXPRESS is known as EXPRESS-G. Appendix A provides an explanation of the different EXPRESS-G requirements. Figures 5-2 through 5-5 show the EXPRESS-G version of the GenCAM DEVICES, COMPONENTS, and MECHANICALS sections. See www.gencam.org for complete EXPRESS-G model.
Figure 5-2 EXPRESS-G for DEVICES

Note: This model does not address inverse relationships. As such, no statements regarding the cardinality of inverse relationships should be presumed from this model.
Figure 5.3 EXPRESS-G for COMPONENTS
Figure 5-4  EXPRESS-G for MECHANICALS
Figure 5-5 EXPRESS-G for COMPONENT alternatives

Note: This model does not address inverse relationships. As such, no statements regarding the cardinality of inverse relationships should be presumed from this model.
6 SYNTAX AND EXAMPLES

The following data formats represent flat files that may be populated from information models. Where possible, if more that one format exist both will be described, however a preferred format will be designated. The preferred format shall serve to create CTMs for each of the flat files necessary to completely describe the characteristics for administration.

6.1 DEVICES

The DEVICES section holds the device descriptions for all the components used on the board. These keywords apply to the device itself and do not depend upon any characteristic of the printed circuit board (i.e. are independent of PACKAGE). The DEVICES section shall be included and can use some or all of the keywords described below, in any sequence.

7 REPORT GENERATORS

Data can be extracted from GenCAM files 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-2510 standard. Their creation is left to the industry as the need arises.

Figure 7-1 shows an example of an extracted Parts List.

<table>
<thead>
<tr>
<th>Item</th>
<th>Supplier</th>
<th>Part #</th>
<th>Description</th>
<th>Reference Designator</th>
<th>Assembly Variation</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>01</td>
<td>02</td>
</tr>
<tr>
<td>1</td>
<td>Hadco</td>
<td>5101342</td>
<td>Board</td>
<td>BRD1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>NEC</td>
<td>8201342</td>
<td>Board</td>
<td>BRD1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Motorola</td>
<td>1N8378</td>
<td>Diode</td>
<td>DT,D2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Motorola</td>
<td>1N8337</td>
<td>Diode</td>
<td>DT,D2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>HP</td>
<td>5082-2835</td>
<td>Diode Schottky</td>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Dialight</td>
<td>550-3007</td>
<td>Connector, VME 100 pin</td>
<td>J1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Signetics</td>
<td>74HCT125N</td>
<td>IC, Dip</td>
<td>E1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sub</td>
<td>CD74HCT125E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Signetics</td>
<td>74HCT126E</td>
<td>IC, Dip</td>
<td>E2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>Harris</td>
<td>CD74HCT125N</td>
<td>IC, Dip</td>
<td>E2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Kemet</td>
<td>C322C104M5U5CA</td>
<td>Capacitor, .1uF, 50V, Mono</td>
<td>C1-C3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Maxim</td>
<td>MAX238CWG</td>
<td>IC, SMT GULL</td>
<td>E3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Kemet</td>
<td>C12062C104K5RAC</td>
<td>Cap, 1206 .1uF</td>
<td>C4, C5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub</td>
<td>12062R104K9BB0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>BRADY</td>
<td>LAT-1-652-10</td>
<td>Label, 0.25 x 1.875</td>
<td>BRADY</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>BRADY</td>
<td>LAT-1-655-08</td>
<td>Label</td>
<td>BRADY</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 7-1 Parts List Example

8 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.

8.1 IPC (1)

IPC-2221 Design Standard for Rigid Printed Boards and Rigid Printed Board Assemblies
IPC-D-300 Printed Board Dimensions and Tolerances
8.2 American National Standards Institute (2)
- 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

8.3 Department of Defense (3)
- DoD-STD-100 Engineering Drawings

8.4 Electronic Industries Association (4)
- EDIF 4 0 0 Electronic Data Interchange Format

8.5 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

EXPRESS defines data objects and their relationships among data objects for a domain of interests. Some typical applications of data models include supporting the development of databases and enabling the exchange of data for a particular area of interest. As an example, a specific requirement of a database for an audio compact disc (CD) collection is shown in Figure 1.

![Figure A-1 Example of EXPRESS-G Model](image)

Data models are specified in a data modeling language. EXPRESS is a data modeling language defined in ISO 10303-11. One of the advantages of using EXPRESS-G over EXPRESS is that the structure of a data model can be more intuitively presented. A disadvantage of EXPRESS-G is that complex constraints cannot be formally specified. There are specific symbols used in EXPRESS-G notation. The meaning of those symbols is defined in the EXPRESS formatting.