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*THE INSTITUTE FOR  
INTERCONNECTING  
AND PACKAGING  
ELECTRONIC CIRCUITS*

# IPC-D-352

## Electronic Design Data Description for Printed Boards in Digital Form

### **ANSI/IPC-D-352**

Original Publication  
August 1985

A standard developed by the Institute for Interconnecting  
and Packaging Electronic Circuits

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

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## Acknowledgment

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# Electronic Design Data Description for Printed Boards

## 1.0 SCOPE

The information contained in this standard is intended to describe the relationship between the elements used in the electromechanical design and packaging of electronic products using printed boards as the major form of interconnection. Included in these descriptions are the logical and physical elements necessary as input to a design system, as well as the network or interconnection description between the various electronic parts. It is further intended that this structure provides the capability for describing all elements in their final form upon design completion.

The logical and physical elements used in the electronic design process shall be described in digital form in order to enable the data exchange and archiving capability between systems which support design, manufacture, assembly, and test.

**1.1 Format Compatibility** The concepts detailed in this standard are supplemented by the descriptions defined in other companion IPC standards. It is the intent that the family of IPC-D-35X standards detail the various record formats.

Data redundancy is kept to a minimum by using various standards for appropriate data descriptions dependent upon the use of the data.

The following shows the correlation between the IPC standard and the record formats that are defined in each particular standard.

### IPC-D-35X

#### Standards      Record Description

|                  |                                    |
|------------------|------------------------------------|
| <b>IPC-D-350</b> | Artwork Records                    |
| <b>IPC-D-350</b> | Board Description Records          |
| <b>IPC-D-351</b> | Schematic Drawing Records          |
| <b>IPC-D-351</b> | Master Drawing Records             |
| <b>IPC-D-351</b> | Assembly Drawing Records           |
| <b>IPC-D-351</b> | Miscellaneous Part Drawing Records |
| <b>IPC-D-352</b> | Electrical Description Records     |
| <b>IPC-D-352</b> | Bill of Material Records           |
| <b>IPC-D-353</b> | Testing Format Records             |
| <b>IPC-D-354</b> | Library Description Records        |

The electronic design description for a single design may contain different information at various points in the design cycle. Initially, board description records may contain only

board outline and blocked area information; part description information in either library records or miscellaneous part drawing records; electrical description records describe the electrical associativity of the parts.

Once a design is completed, board description records are supplemented with conductor routing information, hole information, and other data necessary to fabricate printed wiring boards. The data base can be added to as necessary in order to provide reference designator information for schematic drawing records, or any other data necessary for the intent of the user's data base.

Users are encouraged to maintain data in a form that is self-sufficient, and is not impacted by changes in supplementary data used in the design process. Thus, library description records may be repeated on archived data. All records shall be in the appropriate format defined in the IPC standard related to the particular record type.

## 2.0 APPLICABLE DOCUMENTS

The following documents, of the issue currently in effect, form a part of this standard to the extent specified herein.

### 2.1 IPC<sup>1</sup>

**IPC-T-50** Terms and Definitions

**IPC-D-300** Printed Board Dimensions and Tolerances

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

**IPC-D-325** Printed Board Documentation

**IPC-D-350** Printed Board Description in Digital Form

**IPC-D-351** Printed Board Drawings in Digital Form

**IPC-D-353** Automatic Test Information Description in Digital Form

**IPC-D-354** Library Format Description for Printed Board Digital Data Bases

### 2.2 American National Standards Institute<sup>2</sup>

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

**ANSI X3.12** Subroutine Record Format Standardization

1. Publications are available from the IPC, 2215 Sanders Road, Northbrook, IL, 60062-6135

2. To obtain documents, write: American National Standards Institute, 1430 Broadway, New York, NY 10018

**ANSI X3.22** Recorded Magnetic Tape for Information Interchange, 1973

**ANSI X3.26** Hollerith Punched Card Code, 1970

**ANSI X3.39** Recorded Magnetic Tape

**ANSI X3.54** Recorded Magnetic Tape

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

**ANSI Y32.1** Logic Diagram Standards

**ANSI Y32.16** Electrical and Electronic Reference Designations

**ANSI Z210.1** Metric Practice Guide (ASTM E380-72)

## 2.3 Department of Defense<sup>3</sup>

**W-T-0051** Tape, Electronic Data Processing, 1971

**DOD-STD-100** Engineering Drawings

## 3.0 TERMS AND DEFINITIONS

Unless otherwise specified herein, terms and definitions shall be in accordance with IPC-T-50, ANSI X3.12, and the following:

**3.1 Annotation** Text or legend pertinent to a design; text may appear as data related to legend on a printed wiring board, lettering on a drawing, or other types of symbols.

**3.2 Comment Records** A record that provides, or refers to, additional descriptive material needed to further clarify the control of the data set.

**3.3 Complex or Composite Records** A term used to define a collection of records that make up an electrical pattern or function used repeatedly in a design. Both the definition and relationship of such records are covered and referred to as subroutine definition and subroutine definition call.

**3.4 Component Electrical Description Record** A type record detailing the electrical description information for a particular component describing the device type, as well as the number of I/O elements and the interchangeability of both I/O terminations and internal logic.

**3.5 Component/Pin Location Records** A type of record that defines the relationship of the input-output terminations for an electrical part.

**3.6 Data Information Module (DIM)** A group of records which contain related data intended to describe a specific function or task.

**3.7 Data Layer** A special group of related records within any individual Data Information Module.

**3.8 Design Electrical Description Record** A standard record format used to describe the associativity between the electrical functions being implemented into a single data base describing a unique electronic assembly.

**3.9 Job Set** A group of one or more Data Information Modules.

**3.10 Modal Form** The technique where the description of a unique feature in a data base (interconnection, single identification, conductor width restrictions, etc.) or other pertinent information is given only once at the beginning of a related set of data.

**3.11 Parameter Record** A record that defines the characteristics of a subsequent set of records, such as job identification, electrical description, tolerances, etc. Parameter records direct the computer program on how to interpret the records that follow in the job stream.

**3.12 Subroutine** As noted in ANSI X3.12 but defined using IPC record format descriptions. This record type provides a framework for constructing complex or composite records.

**3.13 Subroutine Call** As noted in ANSI X3.12 but defined using IPC record format. This record type provides a framework for the manner in which complex or composite records are used in the data stream.

## 4.0 GENERAL REQUIREMENTS

Each design shall be described as a separate set of data called a job set. A design data job set may include data record descriptions defined in other IPC-D-35X standards.

**4.1 Data Hierarchy** Electronic interconnection products shall be described in data records within a hierarchical structure as shown in Figure 4-1. The formats of the records applying to electrical description are specified herein.

**4.1.1 Job Set Definition** The job set is headed by a job record (paragraph 5.1) and ended by an end of job record (paragraph 5.1.1 ). A job set shall consist of one or more

3. To obtain documents, write: Naval Publications & Forms Center, 5801 Tabor Road, Philadelphia, PA 19120.

| JOB   |                        |
|-------|------------------------|
| DIM K | EXTERNAL SUBROUTINES   |
| DIM L | INTERNAL SUBROUTINES   |
| DIM G | ELECTRICAL DESCRIPTION |
| DIM A | ARTWORK                |
| DIM B | BOARDS                 |
| DIM C | SCHEMATIC              |
| DIM D | MASTER DWG             |
| DIM E | ASSY DWG               |
| DIM F | PARTS                  |
| DIM F | PARTS                  |
| DIM F | PARTS                  |
| 999   |                        |

DESIGN DATA INFORMATION MODULES

IPC-352-4-1

Figure 4-1 Hierarchy of Data in a Job Set.

Data Information Modules that pertain to a single electronic interconnection product. Each different Data Information Module may occur only once in a job set, except DIM F. Each DIM shall contain a number (NUM parameter record; see paragraph 5.5), The DIM shall also contain title (paragraph 5.4) and revision (paragraph 5.6) parameter records.

**4.1.2 Data Information Module Definition** Design Data Information Modules (codes DIM K, DIM C, DIM B, and DIM G) are composed of data records, parameter cards, and comment records, all of which are used to describe a particular design. See Figure 4-2.

**4.1.3 Circuit Topology** When circuit topology information from DIM A artwork records is used to restrict the design implementation, interpretation shall be in accordance with IPC-D-350 requirements. This feature is usually required to restrict conductor routing to various specific areas or locations, or to implement changes in existing design.

4.2 Basic Record Types

4.2.1 Parameter Records (Section 5.0)

4.2.2 Comment Records (Section 6.0)

4.2.3 Component Pin Records (Section 9.0)

4.2.4 Component Electrical Description Record (Section 8.0)

4.2.5 Design Electrical Description Records (Section 7.0)

| DIM G            |                                                               |
|------------------|---------------------------------------------------------------|
| GENERAL COMMENTS | GENERAL COMMENTS, PARAMETER CARDS AND SUBROUTINES             |
| P TITLE          |                                                               |
| P NUM            |                                                               |
| P REV            |                                                               |
| SUBROUTINES      |                                                               |
| P DESRL 200      | GENERAL DESIGN RULES THAT APPLY TO THE TOTAL BOARD            |
| P DESRL 400      |                                                               |
| P DESRL 500      |                                                               |
| P DESRL 600      |                                                               |
| P DESRL 100      | CONDUCTOR DESIGN RULES RELATED TO SPECIFIC NODES              |
| P NNAME          |                                                               |
| P DESRL 100      |                                                               |
| P NNAME          |                                                               |
| P DESRL 100      | LAND OR HOLE DESIGN RULES RELATED TO SPECIFIC COMPONENT PARTS |
| P NNAME          |                                                               |
| P DESRL 300      |                                                               |
| P PNAME          |                                                               |
| P DESRL 300      | SPECIAL FILES FOR LOGIC AND REFERENCE DESIGNATOR IDENTIFIERS  |
| P PNAME          |                                                               |
| P DESRL 300      |                                                               |
| P PNAME          |                                                               |
| P LNAME          | COMPONENT ELECTRICAL DESCRIPTION RECORDS                      |
| P RDES           |                                                               |
| 610              |                                                               |
| 611              |                                                               |
| 612              | DESIGN ELECTRICAL DESCRIPTION RECORDS                         |
| 613              |                                                               |
| 620              |                                                               |
| 621              |                                                               |
| 620              | COMPONENT/ELEMENT LOCATION RECORDS                            |
| 620              |                                                               |
| 620              |                                                               |
| 620              |                                                               |
| 630              | BOARD DESCRIPTION RECORDS                                     |
| 631              |                                                               |
| 630              |                                                               |
| 630              |                                                               |
| DIM B            |                                                               |
| 422              |                                                               |

IPC-352-4-2

Figure 4-2 Example of Electrical Design Description

4.2.6 Complex or Composite Records (Section 10.0)

4.2.7 End of Data Records (Section 5.1.1)

**4.3 Data Set Descriptions** The information in the electronic design job set shall describe all features, groups of features, and the electrical associativity of the elements that are part of the design. In addition, the job set shall also contain the physical descriptions necessary to define the mechanical relationship of the electronic and non-electronic parts that make up the electromechanical assembly. When information is required in the job set that describes elements of the electromechanical design where the format is documented in companion D-35X standards, the format of the data shall be as described in those standards.

**4.3.1** The information to be communicated shall explicitly describe absolute (not incremental) data values, the contour and location of the mechanical elements of the design, or the composite physical attributes of an electronic assembly.

**4.3.2** The location of each of the individual elements of a composite element shall be defined with reference to the composite element datum, using appropriate data records.

**4.3.3** Individual elements within the data set, whether electrical description, or physical/mechanical description, shall be defined in the job set within the Data Information Module that has primary jurisdiction over the data. Correlation between electrical and mechanical elements shall be maintained through the use of unique (reference designator) or standard (logic type, part type) descriptions.

#### 4.4 Data Orientation (see Figure 4-3)

**4.4.1** All data relating to the physical description of an electronic interconnection product shall be viewed from the side of the assembly that contains the components, looking through to the opposite side. For those electronic assemblies that have components on more than one side, any side may be designated as the primary side; the opposite side shall be designated as the secondary side. The primary side shall be defined as layer 1. Physical layers may be conductive or non-conductive as required to describe the physical or electrical properties of the interconnection product.

**4.4.2** When coordinates are used to describe physical information, the origin shall be the same for all layers of interconnection description within a Data Information Module (DIM) and shall follow the standard Cartesian coordinate reference system. Positive and negative X-Y values are permitted.

**4.4.3** All location data shall be defined at 1:1 scale.

**4.4.4** Physical layers shall be numbered consecutively starting from the primary side as layer 1. (See IPC-D-325.)

**4.5 Transfer Media and Data Formats** The data shall be restricted to the printable ASCII character set, and be transmitted on standard 80 column punched cards, on magnetic tape (7 or 9 track), or on other communications interfaces, such as disk (removable, hard or floppy) which shall be mutually agreed to by the sender and receiver.

**4.5.1 Punched Cards** Punched cards shall conform to the requirements of ANSI X3.26.

#### 4.5.2 Magnetic Tape

**4.5.2.1** Unrecorded tape shall conform to W-T-0051.

**4.5.2.2** Nine-track recording tape shall conform to ANSI X3.22 for 800 CPI, X3.39 for 1600 CPI and X3.54 for 6250 CPI.

**4.5.2.3** Seven-track recording tape shall be NRZI compatible, 800 BPI and odd parity. The ASCII characters shall be recorded as shown below.

|                         | TRACK |    |    |    |    |    |    |  |
|-------------------------|-------|----|----|----|----|----|----|--|
|                         | C     | B  | A  | 8  | 4  | 2  | 1  |  |
| X = 1st ASCII char      | P     | D  | X7 | X6 | X5 | X4 | X3 |  |
| Y = 2nd ASCII char      | P     | X2 | X1 | D  | Y7 | Y6 | Y5 |  |
| Z = 3rd ASCII char      | P     | Y4 | Y3 | Y2 | Y1 | D  | Z7 |  |
| D = Don't care (1 or 0) | P     | Z6 | Z5 | Z4 | Z3 | Z2 | Z1 |  |
| P = Parity              | etc.  |    |    |    |    |    |    |  |

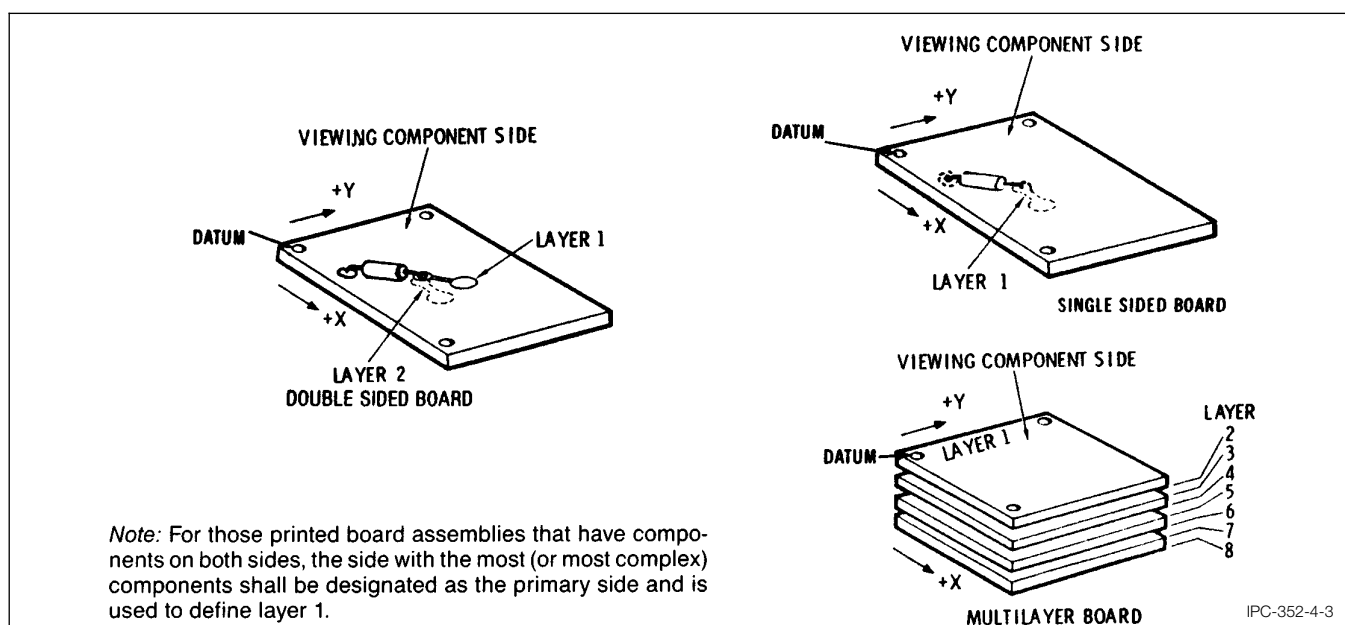


Figure 4-3 Printed Wiring Viewing



### Table 5-1 Record Interrelationship

| Record Type | Code Ltr. | DIM Identifier                       | IPC Standard |
|-------------|-----------|--------------------------------------|--------------|
| P DIM       | A         | Artwork Records                      | IPC-D-350    |
| P DIM       | B         | Board Description Records            | IPC-D-350    |
| P DIM       | C         | Schematic Drawing Records            | IPC-D-351    |
| P DIM       | D         | Master Drawing Records               | IPC-D-351    |
| P DIM       | E         | Assembly Drawing Records             | IPC-D-351    |
| P DIM       | F         | Miscellaneous Part Drawing Records   | IPC-D-351    |
| P DIM       | G         | Electrical Description Records       | IPC-D-352    |
| P DIM       | H         | Bill of Material Records             | IPC-D-352    |
| P DIM       | J         | Testing Format Records               | IPC-D-353    |
| P DIM       | K         | External Library Description Records | IPC-D-354    |
| P DIM       | L         | Internal Job Library Description     | IPC-D-354    |

[illegible]

Figure 5-3 Parameter—"UNITS"

**5.4 Parameter—TITLE** (See Figure 5-4). The word “TITLE” in columns 4-8, preceded by a “P” in column 1, shall indicate the title of a Data Information Module defined by a “DIM” parameter record (electrical board title). Columns 10 through 72 shall contain the title. Titles requiring more than one line of text shall use an additional title record for each additional line of text (see Figure 7-1). Any printable ASCII characters may be used.

The title record shall follow directly after (except for comment records) the DIM record, and relate only to that particular Data Information Module. There may be several title records in a complete job set.

**5.5 Parameter—NUM** (See Figure 5-4). The word “NUM” in columns 4-6, preceded by a “P” in column 1 shall indicate the part number for a Data Information Module defined by a DIM parameter record (electrical design number). Columns 10 through 72 contain the number which shall be left justified of the data subset. Any printable ASCII characters may be used.

The NUM record shall follow directly after (except for comment records) the TITLE record to which it applies. There may be several NUM records in the job set. However, they must be unique and pertain only to the Data Information Module in which they occur.

|   |   |       |   |               |     |     |        |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|---|---|-------|---|---------------|-----|-----|--------|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| P |   | TITLE |   | IPC           |     | 35X | SAMPLE |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| P |   | TITLE |   | DEMONSTRATION | JOB |     |        |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| C |   |       |   |               |     |     |        |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| P |   | NUM   |   | IPC-B-25-     | 35X |     |        |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| C |   |       |   |               |     |     |        |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| P |   | REV   | A |               |     |     |        |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 1 | 2 | 3     | 4 | 5             | 6   | 7   | 8      | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |

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### Figure 5-4

**5.6 Parameter—REV** (See Figure 5-4). The word “REV” in columns 4-6, preceded by a “P” in column 1, shall indicate the revision identifier of data defined by a DIM parameter record. Columns 10 through 72 shall contain the revision identifier, left justified, of the data subset. Any printable ASCII characters may be used.

The revision record (when used) shall follow the TITLE and NUM parameter records and pertain only to the Data Information Module in which it is referenced.

**5.7 Parameter—DESRL** (See Figure 5-5). The code “DESRL” in columns 4-8, preceded by a “P” in column 1, shall indicate the design rule specifications associated with the electronic interconnection product. Design rules for a particular attribute may appear more than once in the Data Information Module. There is no limit to the total number of design rule parameter records that may be contained in the Data Information Module; however, all design rule parameter records shall be located after the “DIM G” (electrical description) Data Information Module parameter record. Design rules shall be modal.

[illegible]

Figure 5-5

Columns 9-11 shall contain a 3-digit design rule number. The following series defines major design rule categories:

- |            |                                    |
|------------|------------------------------------|
| 100 Series | Conductor Design Rules             |
| 200 Series | Clearance Design Rules             |
| 300 Series | Land or Hole Design Rules          |
| 400 Series | Annotation Design Rules            |
| 500 Series | Grids                              |
| 600 Series | Component/Conductor Exclusion Area |

Columns 12-14 shall contain layer information if a design rule is to pertain only to an individual layer. The letter L in Column 12 shall define a layer to which a design rule may apply. This layer may be a circuit layer or a plane. Columns 13 and 14 shall contain the specific layer to which the design rules apply. If no L field is present, the design rule applies to the entire board.

Column 15 shall contain a letter D to define the appropriate dimension. Columns 16-20 shall contain one value interpreted as follows: blanks in all columns 16-20 shall mean that no value is assigned. The rightmost digit of a 5-digit integer shall be established as a 0.0001-inch or 0.001-millimeter. No sign shall appear in the field. If a value is assigned, no blanks shall appear in column 16-20. (The units parameter card shall determine whether customary or metric units are used.)

Columns 31-72 shall contain 3 identical fields of X, Y coordinate information. Each field shall consist of 14 columns (31-44, 45-58, 59-72). The first column of each field shall contain the letter "X." The next column shall contain a "+" or a "-" sign or blank. A blank shall be interpreted as a "+." The sign is followed by five digits. The eighth position of each field (columns 38, 52, and 66) shall be reserved for the letter "Y," followed by a sign column, followed by five digits. Leading zeros may be eliminated; thus, they appear as blank characters.

The first two X and Y fields are used to restrict the area of the board to which the design rules apply. The first X, Y coordinates represent the lower left hand corner of a rectangle; the second X and Y coordinates represent the upper right hand corner of the rectangle. All data pertains to the (0,0) coordinate of the board description data. If no X and Y fields are present (blanks), the design rule applies to the entire board area.

The third X and Y field (columns 59-72) pertains to an offset that may be assigned to the data from the original board information. This feature is useful in order to bring all data into the same reference position when describing data files that have different points of origin. If no X and Y field is present (blank), it signifies that the original board coordinate origin applies.

Note: The information presented in the design rules shall be such that they are interpreted as a minimum end product dimensional requirement.

**5.7.1 Conductor Design Rules** Conductor design rules shall have a 1 in column 9. The second digit (column 10) shall define the conductor line style code definition. This code shall match the descriptions defined for the G code in IPC-D-350 where:

- 0 = user definable rule
- 1 = lines that have round ends where the radius is equal to half the line width

- 2 = conductors that have square ends, the width of the line
- 3 = conductor thickness

The final digit of the conductor design rule (column 11) shall be 0.

Columns 12-14 shall contain layer information if a design rule is to pertain only to an individual layer. Column 12 shall contain the letter L; columns 13 and 14 shall contain the specific layer to which the design rules applies (see paragraph 5.7).

Column 15 shall contain a letter D to define the appropriate dimension. Columns 16-20 shall contain the dimensional limit of the end product conductor width. Columns 31-72 shall describe the area restrictions and offset information (see paragraph 5.7).

**5.7.1.1 Conductor Design Rule Conditions** The conductor design rule parameter records shall be followed by parameter records identifying the conditions to which the conductor restrictions apply. If the next parameter record is a design rule parameter, the conditions described pertain to the entire board. If parameter NNAME records follow (paragraph 5.8), the design rule for conductor width pertains to those nodes listed in the NNAME records. The letters ALL in columns 9-11, as the node identifier, signify that the conductors pertain to all nodes; the letters RALL in columns 9-12 signify that the design rule pertains to all remaining nodes. Conductor design rule restrictions may also be applied to electronic parts using the "PNAME" parameter record, or the LNAME parameter record using the rules stated in paragraph 5.7.1.1.

**5.7.2 Clearance Design Rules** Clearance design rules shall have a 2 in column 9. The second digit (column 10) shall be according to the following codes:

- 0 = user definable rule
- 1 = conductor to conductor clearances
- 2 = plane to plane clearances
- 3 = land to land clearances
- 4 = land to hole clearances
- 5 = conductor/plane to hole clearances

The final digit of the conductor design rule (column 11) shall be a 0.

Note: The information presented in the design rules shall be such that they are interpreted as a minimum end product dimensional requirement.

Columns 12-14 shall contain layer information if a design rule is to pertain only to an individual layer. Column 12 shall contain the letter L; columns 13 and 14 shall contain the specific layer to which the design rules applies (see paragraph 5.7).

Column 15 shall contain a letter D to define the appropriate dimension. Columns 16-20 shall contain the dimensional limit of the clearance. Columns 31-72 shall describe the area restrictions and offset information (see paragraph 5.7).

Clearance design rules may also be applied to nodes or parts, as indicated in paragraph 5.7.1.1.

**5.7.3 Land/Hole Design Rules** Land to hole relationships shall have a 3 in column 9. The second digit (column 10) shall contain information to the following data related to land shapes.

- 0 = user definable rule
- 1 = circular land shape
- 2 = square land shape
- 3 = circular shape with a centrally located diameter clearance (land eye)
- 4 = square shape with a centrally located diameter clearance (land eye)
- 5 = standard library symbol
- 6 = subroutine symbol

The final digit of the land/hole design rule (column 11) shall be a 0.

*Note:* The information presented in the design rules shall be such that they are interpreted as a minimum end product dimensional allowance.

Columns 15-20 shall contain the land information. Columns 16-20 shall contain the dimensional limits of the land, as shown in accordance with the format described in paragraph 5.7. If a standard symbol is used, column 15 will contain the letter D, followed by the numbers which represent the land feature shape. A “D” in column 15 signifies the dimension of the land in accordance with the format shown in paragraph 5.7. Blanks in columns 16-20 shall mean that no value is assigned. The rightmost digit of the 5-digit integer shall be established as 0.0001-inch or 0.001-millimeter. No sign shall appear in this field. If a value is assigned, no blanks shall appear in columns 16-20. For design rules 350 and 360, the numbers in columns 16-20 shall be the standard library or subroutine number.

Column 21 shall contain the letter H to define the hole size. Columns 22-25 shall contain a value to be interpreted as the finished hole size to be associated with the particular land described. Blanks in columns 22-25 shall mean that no value is assigned. The rightmost digit of the 4-digit integer shall be established as 0.0001-inch or 0.001-millimeter. No sign shall appear in this field. If a value is assigned, no blanks shall appear in columns 22-25.

Column 26 will contain the letter E to define the central eye in a land (doughnut). Columns 27-30 shall contain a value to be interpreted as the size of a central eye in a land (doughnut). Blanks in columns 27-30 shall mean that no

value is assigned. The rightmost digit of the 4-digit integer shall be established as 0.0001-inch or 0.001-millimeter. No sign shall appear in this field. If a value is assigned, no blanks shall appear in columns 27-30.

Columns 31-72 shall describe the area restrictions and offset information (see paragraph 5.7).

*Note:* Land to hole relationships contained in the data shall take precedence over the component library description (user or IPC standard).

**5.7.4 Annotation Design Rules** Annotation design rules shall have a 4 in column 9. The second digit (column 10) defines the font characters in accordance with the following:

- 0 = user definable font
- 1 = all printable characters of the ASCII character set permissible
- 2 = upper and lower case block
- 3 = upper case only
- 4 = lower case only

The final digit of the annotation design rules shall be 0.

Columns 12-14 shall contain layer information if a design rule is to pertain only to an individual layer. Column 12 shall contain the letter L; columns 13 and 14 shall contain the specific layer to which the design rules applies (see paragraph 5.7).

Columns 15-19 will describe the stroke width in mils. Column 15 shall contain the letter S. Columns 16-19 shall contain one value to be interpreted as the nominal line width where the rightmost digit of the 4-digit integer shall be established as 0.0001-inch or 0.001-millimeter. No sign shall appear in this field. The tolerance on this nominal line width is +0.001 in. (0.025 mm).

Columns 20-24 shall be interpreted as the nominal character height. Column 20 shall contain the letter H. Columns 21-24 shall contain the value to be interpreted as the nominal height where the rightmost digit of the 4-digit integer shall be established as 0.0001-inch or 0.001-millimeter. No sign shall appear in this field. The tolerance on this nominal height shall be +0.002 in. (0.05 mm).

Columns 25-29 shall be interpreted as the character width. Column 25 shall contain the letter W. Columns 26-29 shall contain one value to be interpreted as the nominal character width where the rightmost digit of the 4-digit integer shall be established as 0.0001-inch or 0.001-millimeter. No sign shall appear in this field. The tolerance on the nominal width shall be +0.002 in. (0.05 mm).

Columns 31-72 shall describe the area restrictions and offset information (see paragraph 5.7).

Annotation design rules normally apply to the entire board but may be restricted to layers or specific areas of the board and may not be related to nodes, logic, etc.

**5.7.5 Grid Design Rules** The grid rules shall have a 5 in column 9. The second digit (column 10) shall contain information according to the following conditions:

- 0 = same grid, user defined grid, dimension
- 1 = grid for component placement only
- 2 = grid for conductor routing only
- 3 = grid for hole location
- 4 = grid for test points

Columns 12-14 shall contain layer information if a design rule is to pertain only to an individual layer. Column 12 shall contain the letter L; columns 13 and 14 shall contain the specific layer to which the design rules applies (see paragraph 5.7).

Columns 15-20 shall contain one value to be interpreted as the absolute X dimension for the grid being described. Column 15 shall contain the letter X. Columns 16-20 shall contain a 5-digit number where the rightmost digit of the 5-digit integer shall be established as 0.0001-inch or 0.001-millimeter. No sign shall appear in this field.

Columns 22-27 shall contain one value to be interpreted as the absolute Y dimension for the grid being described. Column 22 shall contain the letter Y. Columns 23-27 shall contain a 5-digit number where the rightmost digit of the 5-digit integer shall be established as 0.0001-inch or 0.001-millimeter. No sign shall appear in this field.

Columns 31-72 shall describe the area restrictions and off-set information (see paragraph 5.7).

Grid design rules normally apply to the entire board but may be restricted to layers or specific areas of the board and may not be related to nodes logic. etc.

**5.7.6 Part Placement or Conductor Routing Restrictions** The 600 series has been reserved for describing the blocked areas that contain conductors, components, or both. The blocked areas shall have a 6 in column 9. The second digit (column 10) shall contain information according to the following conditions:

- 0 = user described conditions
- 1 = conductor blocked areas
- 2 = component blocked areas
- 3 = both conductor and component blocked areas
- 4 = via restricted area

The final digit of the exclusion areas (column 11) shall be 0.

Columns 12-14 shall contain layer information if a design rule is to pertain only to an individual layer. Column 12 shall contain the letter L; columns 13 and 14 shall contain the specific layer to which the design rules applies (see paragraph 5.7).

Columns 31-72 shall contain the X, Y coordinate information to provide the area for exclusion. Exclusion areas for

conductors shall normally be identified using the parameter NNAME records to describe the nodes pertaining to the conductors to be restricted: exclusion for components are normally followed by parameter "PNAME" to identify the parts that shall be restricted to a particular area.

**5.8 Parameter—NNAME** (See Figure 5-6) The code "NNAME" in columns 4-8, preceded by a "P" in column 1, shall indicate the specific node name assigned by a user when. in a particular design, node names must be given a name in addition to their number assignment.

```
C DEFINE THE NAMED NODES CROSS REFERENCE TABLE
P NNAME 0000 UNUSED
P NNAME 0001 GND
P NNAME 0002 VCC
P NNAME 0003 RESET
P NNAME 0007 CLOCK
P NNAME 0008 REST
P NNAME 0011 CLCK'
```

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**Figure 5-6**

Columns 9-13 are reserved for the node identifier. This is the identical identifier described later in the data stream for establishing interconnectivity.

When design rule parameters apply to certain node numbers, the design rule parameter records shall be segmented such that the appropriate node name parameter records follow those design rule parameters to which the rules apply. Since design rules are modal, the last design rule pertains to all remaining nodes.

Columns 15 through 72 have been reserved for user name assignment. The user name shall be left justified. The printable ASCII character set may be used.

*Note:* Users are cautioned to limit the size of this name as this parameter record for node naming can be used in documentation for schematics or testing records.

**5.9 Parameter—PNAME** (See Figure 5-7). The word "PNAME" in columns 4-8, preceded by a "P" in column 1 shall indicate a part cross reference.

```
C DEFINE THE PART NUMBER CROSS REFERENCE TABLE
P NNAME 00001 N54S00
P NNAME 00002 N54S04
P NNAME 00003 N54LS283
P NNAME 00004 N54LS74
P NNAME 00005 CAPACITOR
```

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**Figure 5-7**

Columns 11 to 15 shall contain 5 alpha numeric characters defining the device type used in the electrical description record (see paragraphs 7.3 and 8.2.2).

Column 16 shall contain a letter and columns 17 to 72 shall contain information describing the following:

N = the part number

R = reference designator



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C = part cost  
 W = part weight  
 T = technology  
 D = description

Multiple "PNAME" records shall be used when more than one record is required to describe the part.

*Note:* Users are cautioned to limit the size of this description as this information may be used in subsequent documentation or bills of material.

When design rule parameters apply to certain device types the parameter records shall be segmented such that the appropriate part name records follow those design rule parameters to which the rules apply. Since design rules are modal the last design rule pertains to all remaining nodes.

**5.10 Parameter—LNAME** (See Figure 5-8.) The code "LNAME" in columns 4-8, preceded by a "P" in column 1, shall indicate the specific logic name assigned by a user when, in a particular design, more than 5 alphanumeric characters are needed to uniquely identify a logic type.

|                                               |       |       |                     |
|-----------------------------------------------|-------|-------|---------------------|
| C DEFINE THE LOGIC TYPE CROSS REFERENCE TABLE |       |       |                     |
| P                                             | LNAME | A0001 | 2NAND               |
| P                                             | LNAME | B0001 | INVERTER            |
| P                                             | LNAME | C0001 | XXXXXXXXXXXX        |
| P                                             | LNAME | D0001 | J-K FLIP FLOP W/CLR |
| P                                             | LNAME | E0001 | CAPACITOR           |
| P                                             | LNAME | F0001 | CONNECTOR           |

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**Figure 5-8**

Columns 9-13 contain the logic type. This is the identical alphanumeric described later in the data stream for establishing logic type.

When design rule parameters apply to certain logic types, the parameter records shall be segmented such that the appropriate logic type parameter records follow those design rule parameters to which the rules apply. The letters ALL in columns 9-11 or RALL in columns 9-12 may be used to identify multiple logic types (see paragraph 5.7.1).

Columns 15 through 72 have been reserved for user name assignment. The user name shall be left justified. The printable ASCII character set is allowed.

*Note:* Users are cautioned to limit the size of this name as this parameter record for logic naming can be used in documentation for schematics or testing records.

**5.11 Parameter—RDES** (See Figure 5-9.) The code "RDES" in columns 4-8, preceded by a "P" in column 1, shall indicate the specific reference designator assigned when, in a particular design, reference designators require more than 5 characters to uniquely identify a particular designator.

Columns 9-13 are reserved for the reference designator. This is the identical number described later in the data

stream for establishing part identification. When design rule parameters apply to certain specific parts, the parameter records shall be segmented such that the appropriate reference designator parameter records follow those design rule parameters to which the rules apply. The letters ALL in columns 9-11 or RALL in columns 9-12 may be used to identify multiple reference designators (see paragraph 5.7.1).

Columns 15 through 72 have been reserved for user name assignment. The user name shall be left justified. The printable ASCII character set is allowed.

*Note:* Users are cautioned to limit the size of this name as this parameter record for node naming can be used in documentation for schematics or testing records.

## 6.0 COMMENT RECORDS

The letter "C" in column 1 of a record shall indicate "comment." Columns 4 through 72 may be used for comment or descriptive material in any form desired except as otherwise specified herein. Comment records support the numeric data by referencing pertinent descriptive information, specifications and documents. Use of the printable ASCII character set is permitted in comment records. (See Figure 6-1.)

Although the user has the option to add any comment records at any point in the data set, it is recommended that each data set contain some comment records as to how changes of the design must be handled. These comment records may define the limitations as to who has access to the data, provide a date and effectivity for the design, or any other information.

## 7.0 COMPONENT ELECTRICAL DESCRIPTION RECORD (See Figure 7-1)

### 7.1 General Information

**7.1.1 Major Data Areas Within Each Record** The component electrical description record has major data areas as shown in Table 7.1. Subgroups within major areas also follow the same format, however, they are unique to the component electrical description information.

The electrical description records shall consist of 80 columns divided into 4 major areas as shown in Table 7-1.

The operations code for component electrical description is "610."

**7.1.2 Subgroups Within Major Areas** Specific data fields or subgroups exist within the design feature description area (Area 2) and the element pin correlation or location description area (Area 3). Each of these subgroups shall be prefixed by a specific letter. When a prefix letter is