INTERNATIONAL STANDARD

IEC 61182-10

First edition
1999-12

Printed boards – Electronic data description and transfer –

Part 10: Electronic data hierarchy

Cartes imprimées –
Description et transmission de données informatiques –

Partie 10:
Hiérarchie des données électroniques

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Terminology, graphical and letter symbols

For general terminology, readers are referred to IEC 60050: *International Electrotechnical Vocabulary* (IEV).

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams*.

* See web site address on title page.

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CONTENTS

Clause Page

Clause Page

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

PRINTED BOARDS – ELECTRONIC DATA DESCRIPTION AND TRANSFER –

Part 10: Electronic data hierarchy

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61182-10 has been prepared by IEC technical committee 52: Printed circuits.

The text of this standard is based on the following documents:

FDIS	Report on voting
52/831/FDIS	52/839/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

A bilingual version of this standard may be issued at a later date.

The committee has decided that the contents of this publication will remain unchanged until 2004. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

This standard is intended to provide information on a series of data files that contain information, in an organized fashion, to convey the completed design description of a printed board and a printed board assembly. The data may be exchanged between Computer-Aided Design (CAD) Systems, Computer-Aided Engineering (CAE) Systems or Computer Aided Manufacturing (CAM) Systems.

The information about the design is organized into specific category files, where each file has a specific function and is independent of each other. Data exchange for a specific purpose is possible only if the category file information has been prepared in the CAD system or if a user desires to provide certain data to those outside the design function. The information about a unique printed board or printed board assembly is contained in a single file which is headed by “file control information” provided to identify those characteristics contained in the file. Specific rules for syntax are described for each file category as are the methodologies for organizing the information in a cohesive, unambiguous manner.

The format and syntax of EDH consists of statements that are prefaced by a unique “keyword” followed by one or more parameters intended to provide the necessary information. Parameters consist of numeric values and character strings, which maybe general character strings, reserved words, formatted descriptions and/or fixed format messages. Although the language for keywords and parameters is “English” using the ISO 7-bit coded character set (ISO registration number 006), any character set may be used for informational purposes or comment descriptions provided the language has a registration number according to ISO/IEC 646.

EDH category files are a small subset of other neutral design formats. These larger formats are intended to provide and define behavioral characteristics, design rules, simulation parameters, drawing information, timing analysis, etc., some of which may be user proprietary. The EDH category files bear a close relationship with design representation formats such as EDIF (IEC 61690-2) and STEP (ISO 10303, Parts 201 and 210). It is intended for this relationship to be maintained through continued surveillance by the originating committees. Inter-operational ability between these formats is important so that information content is mutually consistent. This coordination is necessary as technology changes require reassessments of keywords and parameters.

PRINTED BOARDS –
ELECTRONIC DATA DESCRIPTION AND TRANSFER –

Part 10: Electronic data hierarchy

1 Scope

This part of IEC 61182 specifies data file formats used to describe printed board and printed board assembly products in sufficient detail for tooling, manufacturing, assembly, and testing requirements. These formats 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 numerically controlled machines.

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

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61182. For dated references subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61182 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(541):1990, *International Electrotechnical Vocabulary – Chapter 541: Printed circuits*

3 Terms and definitions

For the purposes of this part of IEC 61182 and, unless otherwise specified herein, terms and definitions shall be in accordance with IEC 60050(541) and the definitions in the following subclauses.

3.1
filename extension
three-letter acronym used to identify a category file name

3.2
data hierarchy
organized arrangement of data, according to a specific set of rules

3.3
keyword
word, set of words, or acronym used to identify data in the Electronic Data Hierarchy (EDH)

4 General requirements

The EDH specifies data files specifically for the information interchange of data relating to printed board CAD designs that have been completed and are ready for manufacturing expansion (i.e. panelization, process allowance incorporation, tooling feature addition, etc.).

EDH is comprised of ten category files shown in tables 1 and 2. Figure 1 shows the relationship of the ten (10) category files and the communication links that must be established between the files.

Each category file has a specific function or task and is independent of the other. Accordingly, the information interchange for a specific purpose is possible only if the category files required for such a purpose have been prepared. Any data file with a format different from this format can be interchanged as a non-standard category file, if the format has been mutually agreed to by the sending CAD and the receiving CAM workstation.

4.1 Category classification

Table 1 provides the name and purpose of each of the ten files.

Table 1 – EDH file descriptions

Ten category types	
Name of file	**Purpose**
File control information	File control
Management information	CAD data management
Technology information	Board characteristics, design specification, layer definition, etc.
Net information	Net information and signal attributes
Component information	Component list
Primitive figures library	Figure-shape library, hold library, and stack library
Part-shape library	Library of part shapes
Component placement information	List of component locations
Figure information	Figures and figure attributes
Back-annotation information	Component change information and component-pin change information

4.1.1 Categories and contents

Figure 1 shows the relationship of the ten files of the EDH format and the communication links that shall be established between the files.

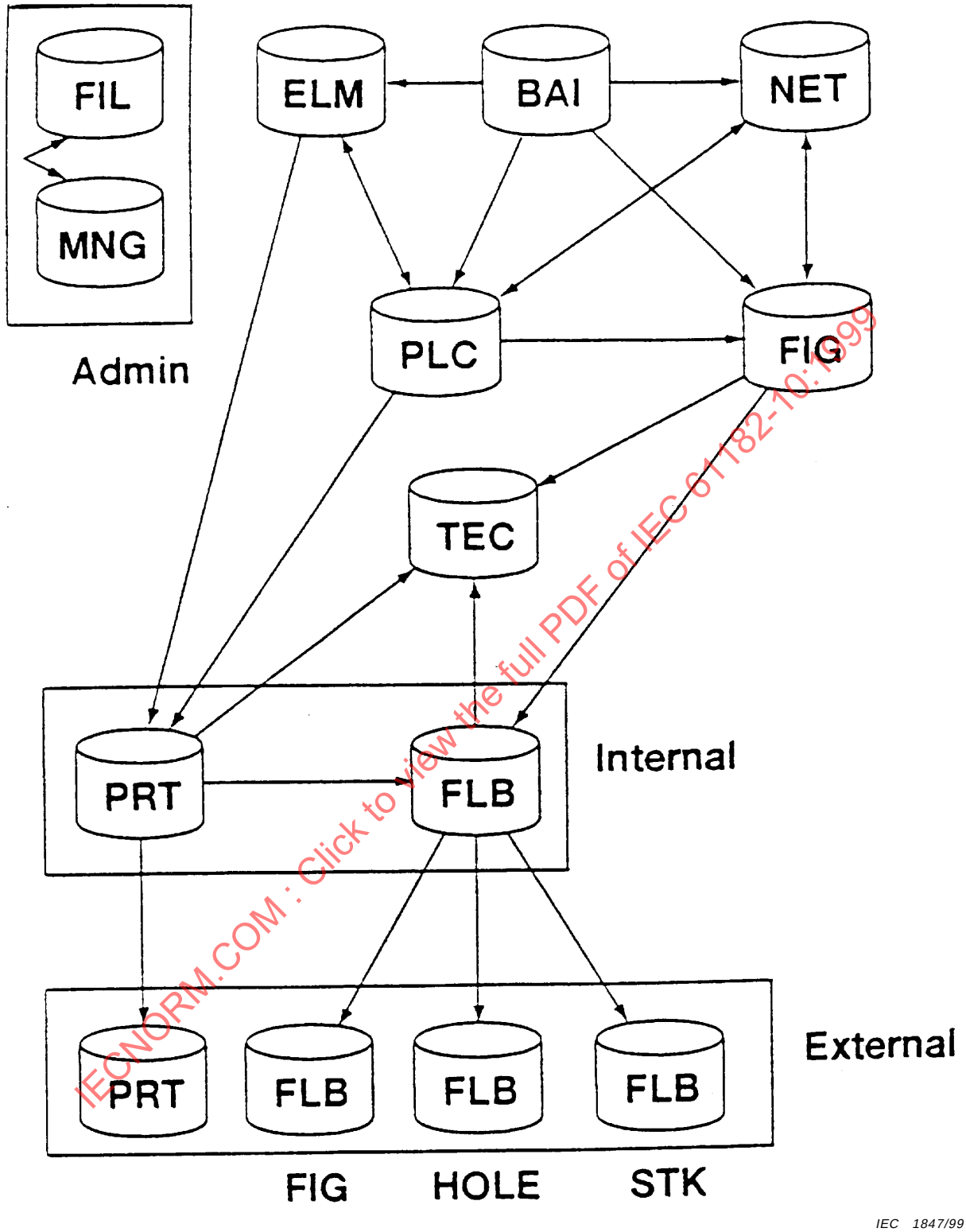


Figure 1 – EDH file structure

Table 2 provides the filename extension and content for each of the ten EDH files.

Table 2 – EDH filename extension and content

Category name (filename extension)	Content
File Control Information (FIL)	– Interface control information (format name, version, output category list, date of creation)
Management Information (MNG)	– Information for CAD data management (board name, name of drawing, identification number)
Technology Information (TEC)	– Board characteristics (board size, number of layers) – Design specification (clearance, line width)
Net Information (NET)	– Net information – Signal attributes (routing limitations)
Component Information (ELM)	– Component description (component identification number, component type, assembly process, catalog number)
Primitive Figures Library (FLB)	– Figure-shape library (definitions of pads) – Hole library (definitions of holes) – Stack library (registration of pins and vias)
Part-shape Library (PRT)	– Part shapes (outlines, pins location, symbol patterns, inhibited areas, character strings)
Component Placement Information (PLC)	– Included components (identification number, registered part-shape name) – Component locations (coordinates, rotation angles, placement layers)
Figure Information (FIG)	– Description of patterns, vias, characters and other figure information – Description of figure attributes (line types, line widths, logical layers, paint-ins)
Back-annotation Information (BAI)	– Description of addition/change/deletion information of components – Description of addition/change/deletion information of component-pins

4.1.2 Description format common to all category files

The following information in tables 3, 4 and 5 are common to all category files.

Table 3 – Format of category file name

Printed board name	Filename extension identifier
Abbreviated name, common to every category file	Unique to each category file

Table 4 – File structure

HEAD: filename extension identifier: _____ start of category file

statement description

.

.

.

END: filename extension identifier: _____ end of category file

Table 5 – Statement format

Keyword: parameter 1, parameter 2, ... ;	
Character string unique within a category file	– To describe in capital letters – Optional when the same keyword is utilized in the preceding statement
Types of parameter descriptions	– Numerical values (integer/real number) – Character strings – Reserved words (e.g. ON, OFF) – Formatted descriptions (location coordinates, angles) – Fixed format messages

4.2 Correlation between referential information

Figures 2, 3, and 4 illustrate the relationship between referential category files; tables 6 and 7 provide information on the key items.

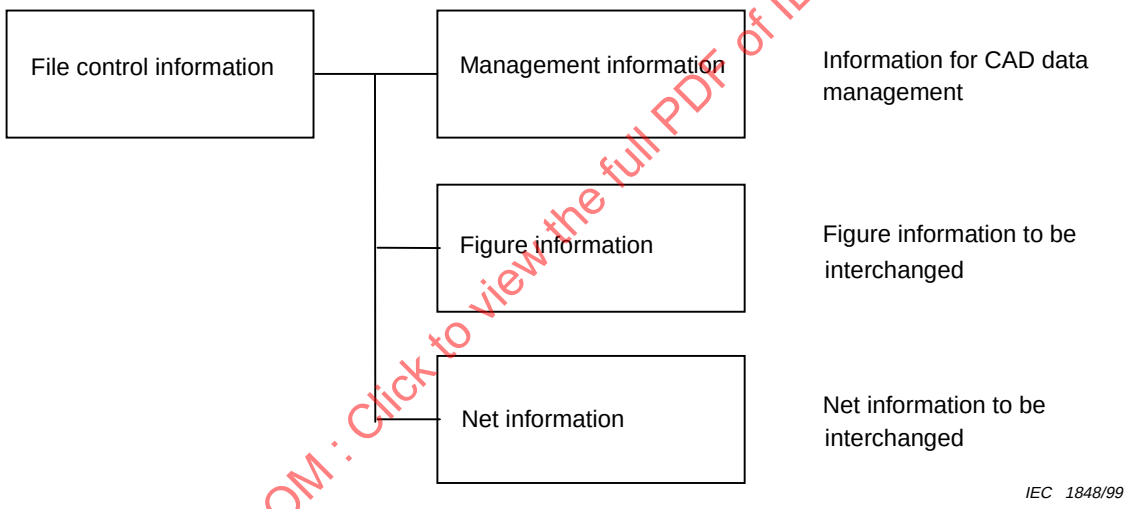
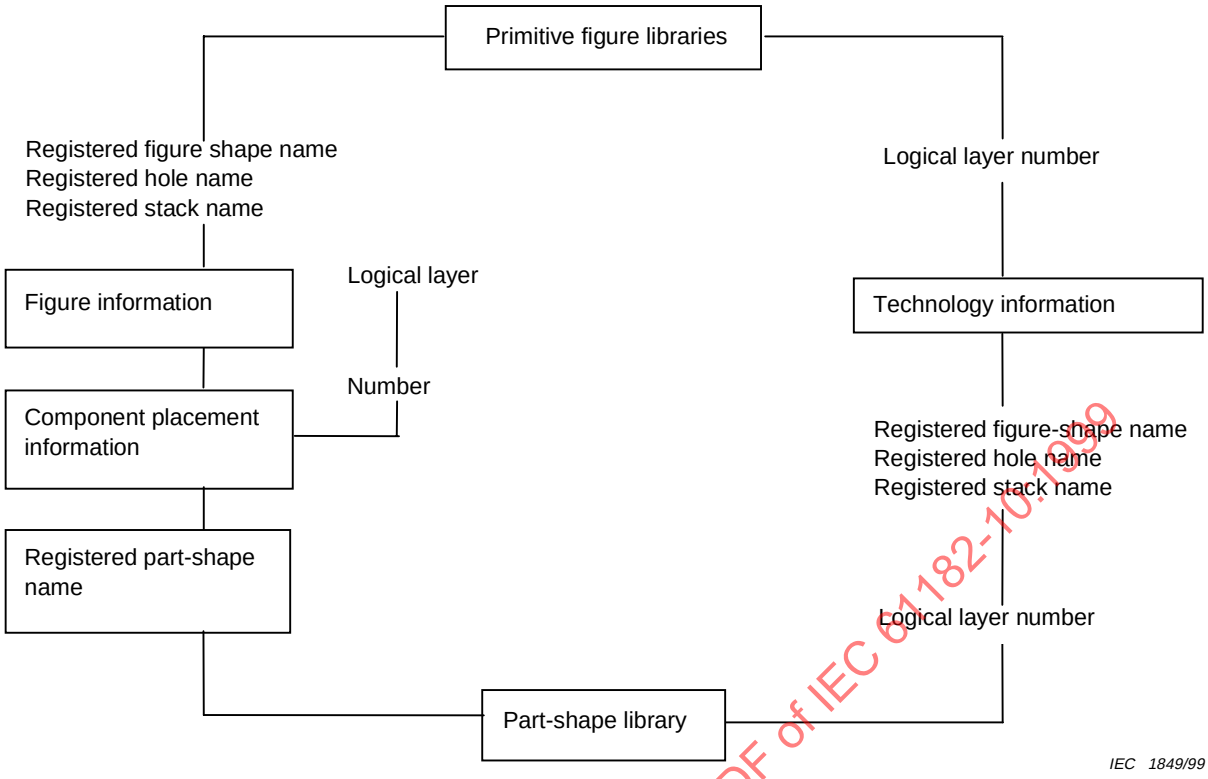
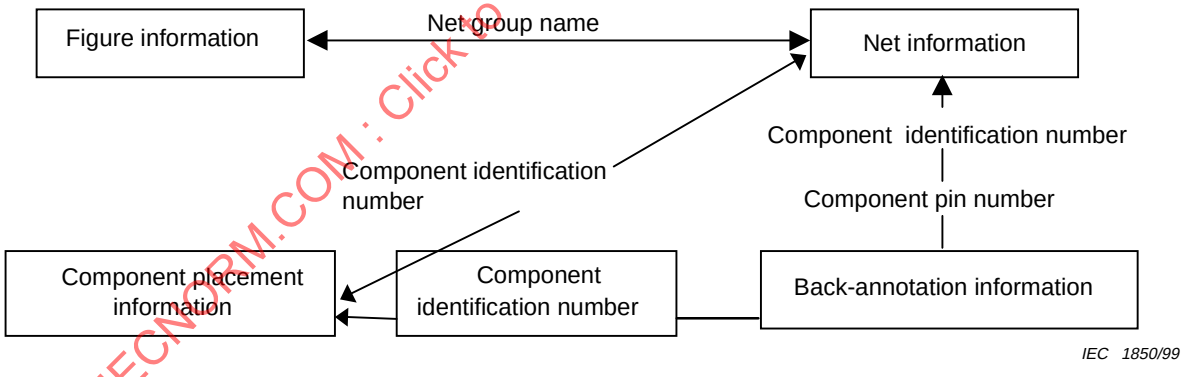


Figure 2 – Correlation between referential category files



Arrows (→): denote the direction of reference

Figure 3 – Correlation between figure-related files



Arrows (→): denote the direction of reference

Figure 4 – Correlation between net-related files

Table 6 – Key items which connect the related category files for figure information interchange

	[Key item]	[Related category]
Figure information	Logical layer number	Technology information
	Registered figure-shape name Registered hole name Registered stack name	Primitive figures libraries
Component placement information	Registered part-shape name	Part-shape library

Table 7 – Key items which connect the related category files for net information interchange

	[Key item]	[Related category]
Net information	Net group name	Figure information
	Component identification number	Component placement information
	Component identification number Component-pin number	Back-annotation information
(when signal attributes are specified)	Logical layer number	Technology information

4.3 Physical layer and logical layer

Figure 5 compares the relationship between a physical layer and a logical layer.

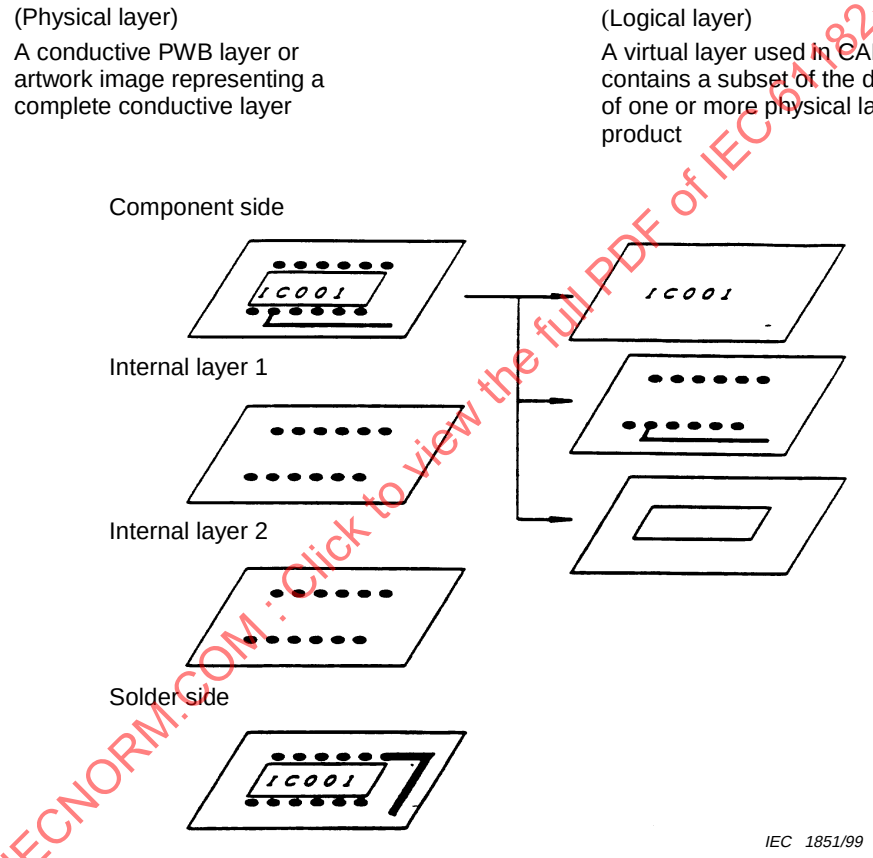


Figure 5 – Physical layer and logical layer

4.3.1 Logical layer definition

LAYER: logical layer number, 1. physical layer number, 2. type code of logical layer, 3. layer priority, 4. positive/negative pattern code, net group name, ...;

4.3.1.1 Physical layer number

Physical layers are numbered consecutively according to the specified view direction (see figure 6)

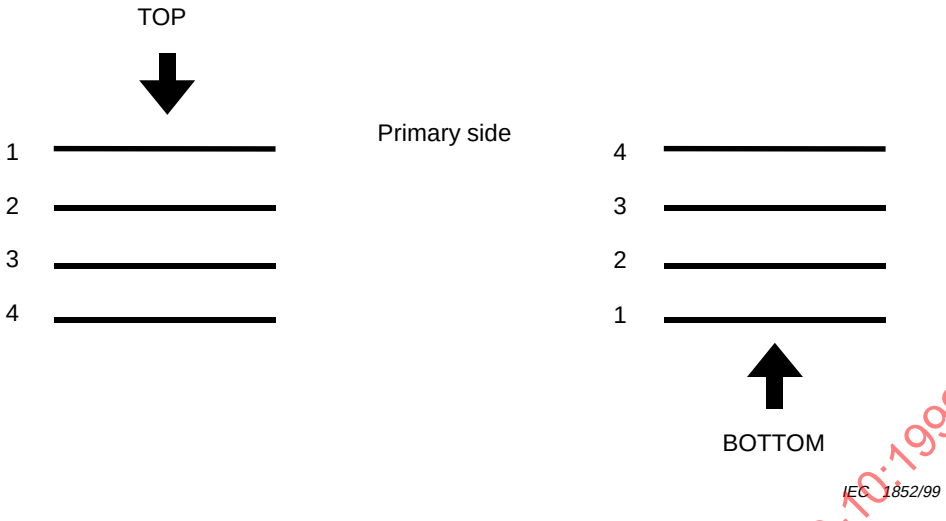


Figure 6 – Physical layer numbering

4.3.1.2 Type codes and contents of logical layers

Table 8 shows the relationship of type codes and the content of logical layers.

Table 8 – Logical layer content

Type code (reserved word)	Content
OUTLINE	Board outline
PART	Component locations
PARTAREA	Allowable area for component location
PARTINH	Inhibited area for component location
PATTERN	Conductor pattern locations
PATAREA	Allowable area for conductor pattern location
PATINH	Inhibited area for conductor pattern location
VIAINH	Inhibited area for via location
PARTFIG	Component outlines

4.3.1.3 Layer priority

Priority for overlapped logical layers.

4.3.1.4 Negative/positive designation

Designation of conductive or non-conductive (clearance) figures layer.

4.4 Negative layer and positive layer

Combining negative and positive layers to form artwork images shall be carried out according to the following rule (see figure 7).

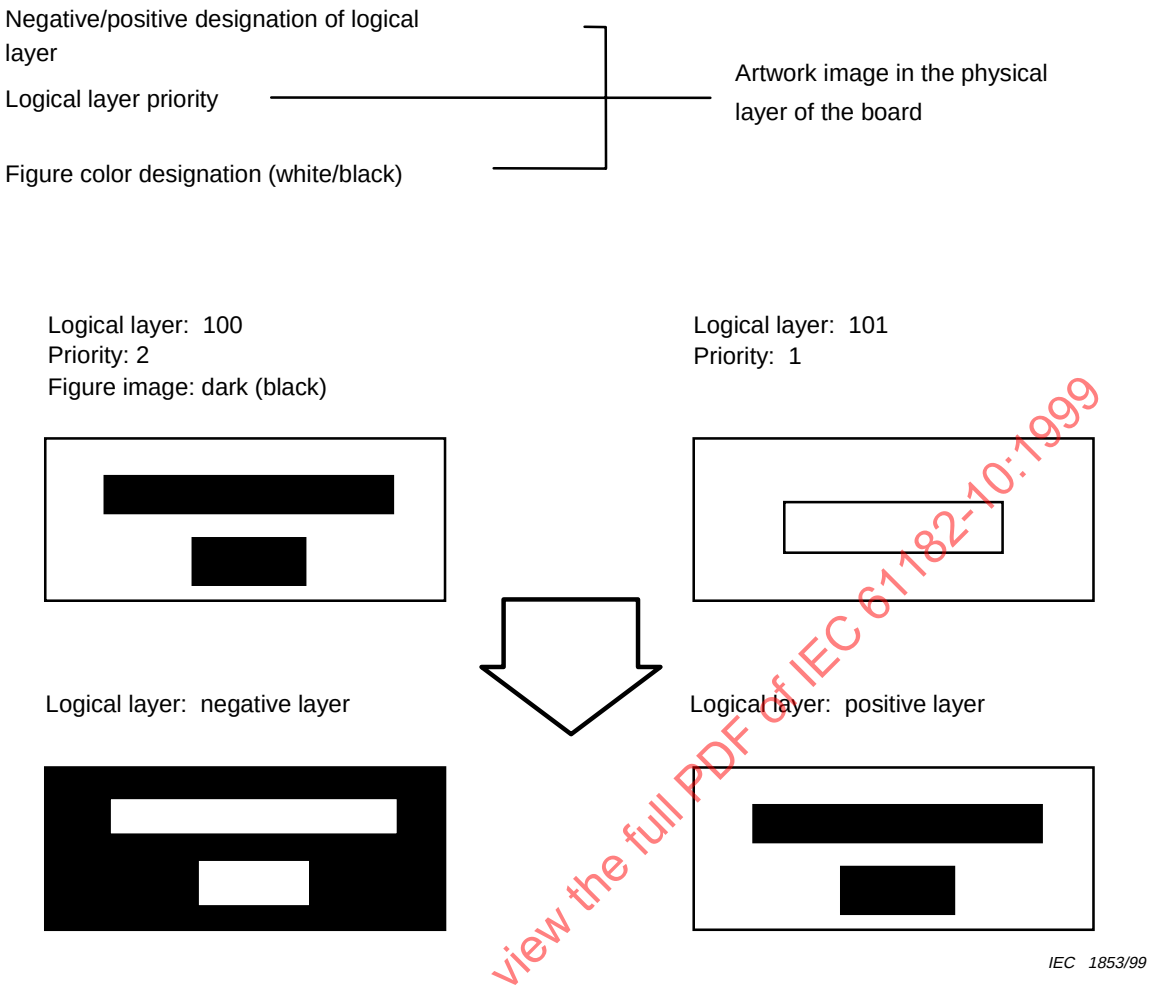


Figure 7 – Concept of negative layer and positive layer

4.5 Layer-to-layer interconnection information

INTERL: logical layer number, physical from-layer number, physical to-layer number;

Layer-to-layer interconnection information is described in the special logical layer which is defined for each via type. The information is defined by describing the range of interconnected layers (from-layer number and to-layer number) (see figure 8).

<Example>

– Blind via Logical layer number: 70 – Physical layer number: 1 – 4
– Buried via Logical layer number: 71 – Physical layer number: 2 – 3
– Through via Logical layer number: 72 – Physical layer number: 1 – 6
– Blind via Logical layer number: 73 – Physical layer number: 5 – 6

[Physical layer] blind via (70) buried via (71) through via (72) blind via (73).

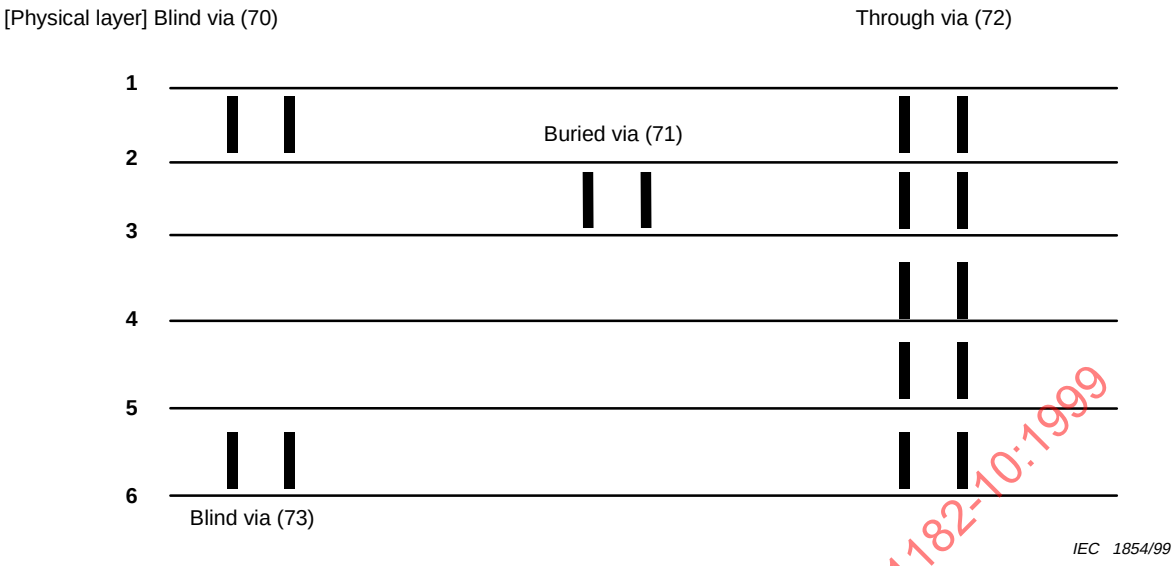


Figure 8 – Layer-to-layer interconnection

4.5.1 Concept of stack information

"Stack" in EDH

A "stack" describes the layer-to-layer interconnection information of a board. Using "stack", various figures such as lands, holes, resist patterns, paste-mark patterns, etc. on each layer can be managed in combination as a set.

Stack expression of layer-to-layer interconnection information:

Define stacks using logical layer number, registered figure-shape name and register hole name

Logical layer number: defined in the technology information file (TEC) in which logical layer to physical layer correspondence and layer-to-layer interconnection data such as through vias, blind vias are defined.

Registered figure-shape name: defined in the figure-shape library in which the shapes of primitive features such as lands are defined.

Registered hole name: defined in the hole library in which hole shapes, etc. are defined.

Stack expression of part-shape information:

Define part shapes such as lands, holes, resist patterns, etc. using registered stack name

Registered stack name: defined in the stack library in which layer-to-layer interconnection information is defined as shown above.

Define figures such as lands, hole, resist patterns, etc. for each component-pin, by locating a proper stack to the pin position.

Stack expression of vias:

The lands in figure 9 are registered shapes for stack incorporation. Figure 10 shows the registration of stacks with no internal connections and with connections to voltage or ground planes.

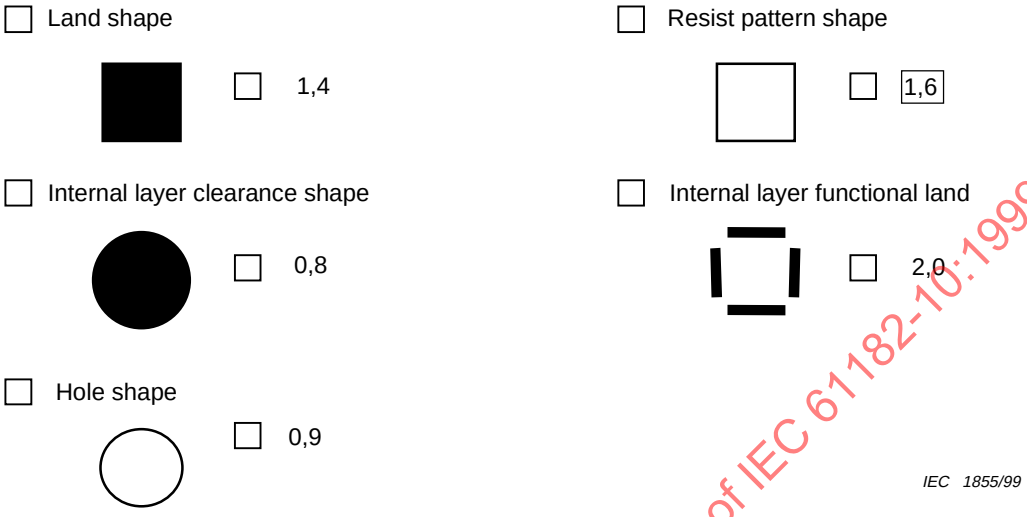


Figure 9 – Registration of shapes

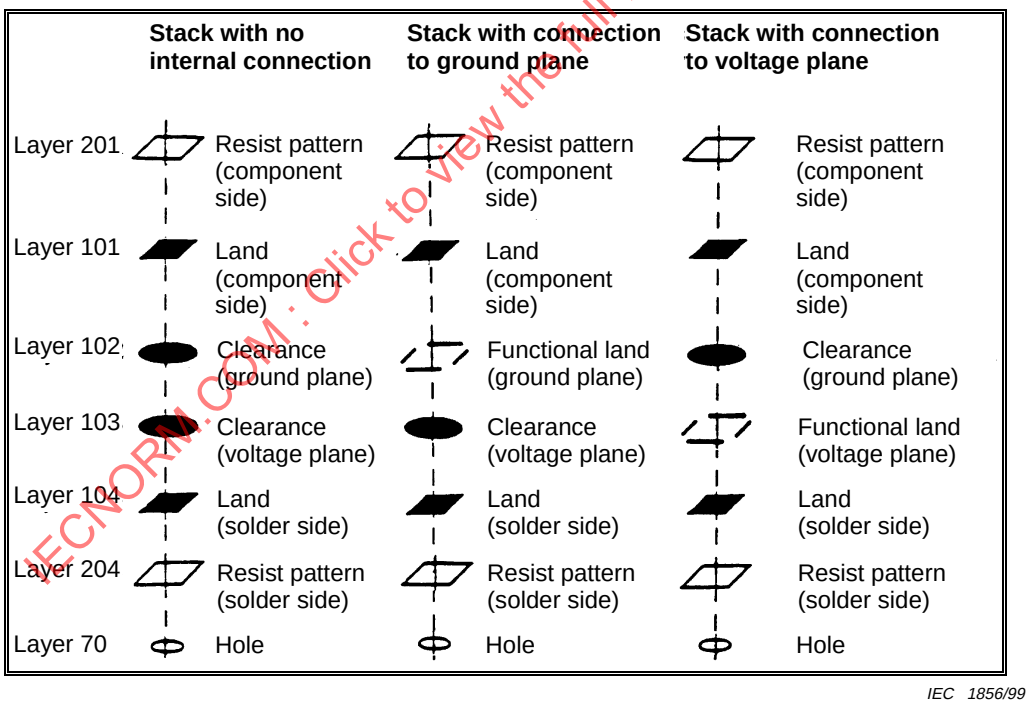


Figure 10 – Registration of stacks

4.6 Part information

Figure 11 shows an example of the dual-inline-package land pattern for various layers. Figure 12 shows the details of land to individual pin relationship.

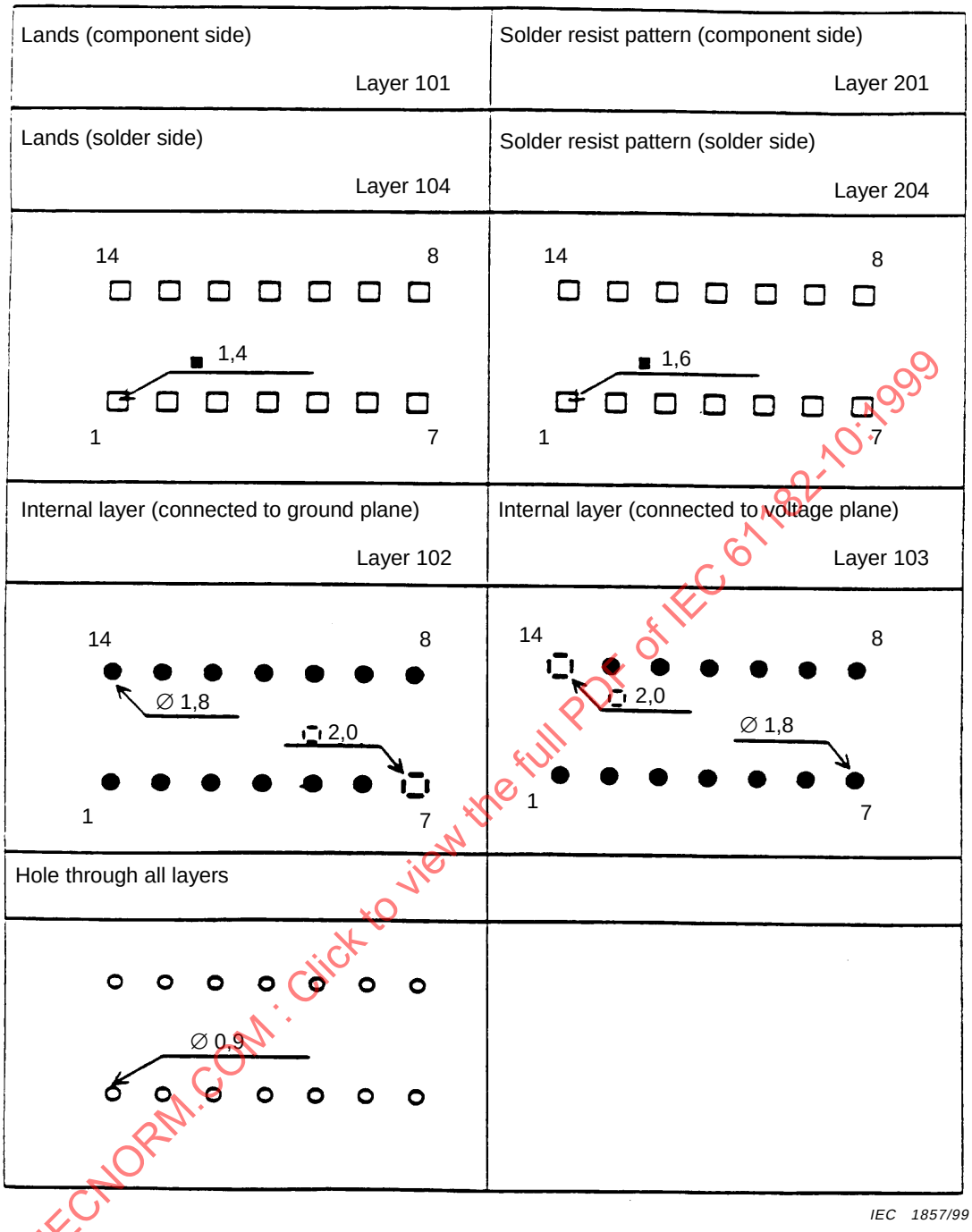
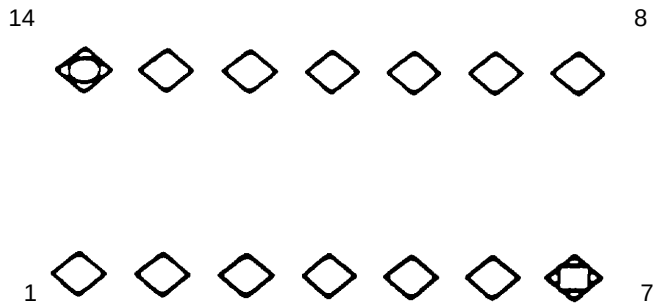


Figure 11 – Part-shape specification

Name of part-shape library	EDH – PRT
Registered part-shape name	DIP14



Pins 1-6, 8-13
Locate stacks with no internal connection

Pin 7
Locate a stack with a land connected to ground plane

Pin 14
Locate a stack with a land connected to voltage plane

IEC 1858/99

Figure 12 – Registration of part shape

5 General specification

5.1 Syntactical rules in this document used to describe the EDH format

5.1.1 Syntax notation characters

The syntax notation characters and their meanings are shown in table 9.

Table 9 – Syntax notation characters for this document

	Character	Meaning
Pair of square brackets	[ ]	May be omitted
Pair of braces	{ }	Mandatory to enter some designation
Underline	____	Default value
Replication character	.....	Denotes option to repeat description given just previously

5.1.2 Examples

$\left\{\begin{matrix} A \\ B \\ C \end{matrix}\right\}$ Either A, B or C shall be entered

$[A]$ A may be entered, and if not entered, it means no description

$\left[\left\{\begin{matrix} A \\ B \\ C \end{matrix}\right\}\right]$ Either A, B or C may be entered, and if no other is entered, it means no description

$\left[\left\{\begin{matrix} A \\ \underline{B} \\ C \end{matrix}\right\}\right]$ Either A, B, or C may be entered, and if nothing is entered, it is B

Parameter: an arbitrary number of parameters can be described by using commas between parameters.

Numerals: an arbitrary number of numerals can be described.

5.2 Types of standard category files

The EDH format is comprised of ten standard category files. Every category file has common formats (see table 3).

5.2.1 File format

The file is the text file, the format of which shall conform to the requirements of the operating system being used: MS-DOS or UNIX.

5.2.2 Filename

The filename of a standard category file consists of an abbreviated name of the printed board assembly (PBA) and a filename extension identifier which is unique for each category file.

Abbreviated name of PBA: filename extension identifier

5.2.3 Abbreviated name of a printed board assembly

The name can range from one to eight alphanumeric characters in length, and shall be the same in all standard and non-standard category files.

5.2.4 Filename extension identifier

The types of standard category file and their extension identifier are shown in table 10.

Table 10 – Standard category files and their extension identifiers

Number	Standard category file	Filename extension identifier
1	File control information file	FIL
2	Management information file	MNG
3	Technology information file	TEC
4	Net information file	NET
5	Component information file	ELM
6	Primitive figure library file	FLB
7	Part-shape library file	PRT
8	Component placement information file	PLC
9	Figure information file	FIG
10	Back-annotation file	BAI

5.3 Syntax used in category files

Each file is composed of two or more statements.

A statement is generally started by a keyword, followed by none, one or more parameters, and terminated by a semicolon (;) and a line feed.

Keywords are reserved character strings (see figure 13 for the format structure).

Parameters consist of numeric values and character strings. The character strings are classified according to general character strings, reserved words, formatted descriptions, and fixed format messages.

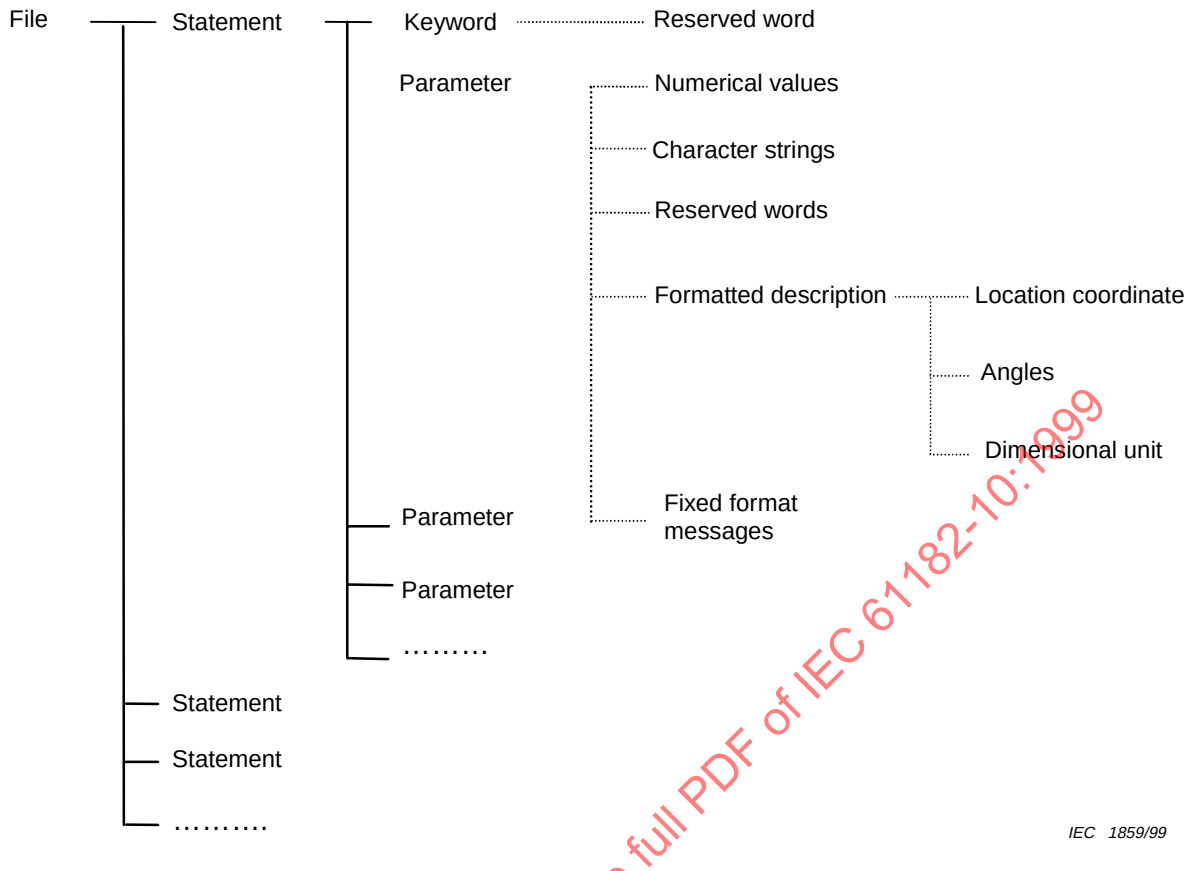


Figure 13 – Format structure

5.3.1 Record descriptions

5.3.1.1 General format of statements

[Keyword] [: Parameter. ····]:

NOTE 1 A statement is the description unit which is headed by a keyword and ended by a semicolon. Statements may be described in one or more lines, and line feed character is ignored in their interpretation.

NOTE 2 Keywords are reserved words and indicate the operation to be executed. When two or more statements with the same keyword continue successively, the keyword in the second and subsequent statements may be omitted.

NOTE 3 Preceded by a keyword and a colon (:), one or more parameters can be described. Commas (,) are required between parameters. In certain cases, some parameters are not required to be entered. If a parameter and all subsequent parameters are not required, these parameters, including commas, may be omitted.

[:] is a delimiter between keyword and parameter.

[,] is a delimiter between parameters.

5.3.1.2 Restrictions on statement formats

The maximum statement length shall be 256 bytes including line feed character.

Keywords or parameters shall be kept together within a line (and shall not be broken up over to two or more lines).

5.3.1.3 Examples

```
ENDFIG:                 ---------  Statement with no parameter
LAYER: 1,1,SILK;        ---------  Statement with some parameters
    : 2,6,SILK;         ---------  Statement where the keyword is omitted
WIDTH: ,,0,2,15;        ---------  Statement where some parameters are omitted

FILE: MNG,              ---------  Record described in two lines
     NET;               ---------  Record which includes special characters
DRAW:"BY" "EDH";
```

5.3.2 Parameters

Preceded by a keyword and a colon (:), one or more parameters may be described. Commas (,) are required between parameters. The types of parameter are shown in table 11.

Table 11 – Types of parameters

Number	Type	Explanation
1	Numerical value	Describe numerical values
2	Character string	Describe arbitrary character strings
3	Reserved word	Describe word from reserved words
4	Formatted description	Describe data in specified format
5	Fixed format message	Describe message defined in fixed format

5.3.3 Numerical values

Numerical values consist of integers and real numbers, and also positive and negative numbers.

In this format, integers are included in the real number category (see figure 14).

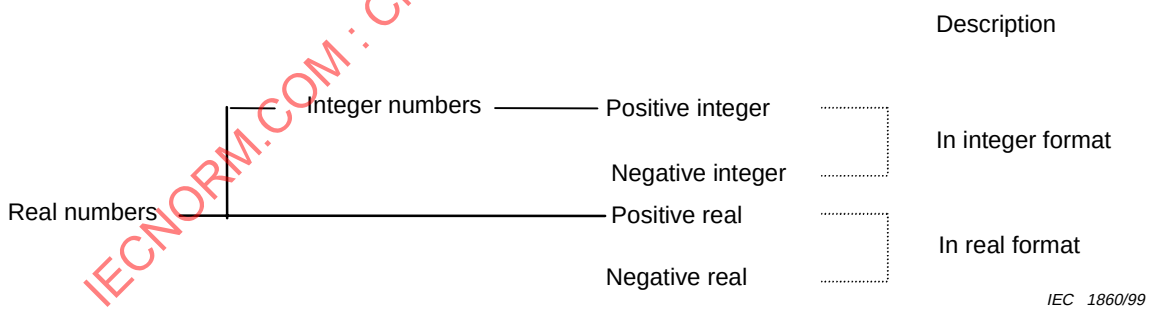


Figure 14 – Numbering convention

5.3.3.1 Description of integer values

The description consists of a plus ("+") or minus ("–") sign and a set of numerals ("0" …."9"). The plus sign may be omitted. Allowable formats are:

XXXX or +XXXX or –XXXX

where

X indicates a numeral.

Examples:

10 +3 –100

5.3.3.2 Description of real values

The description consists of a plus ("+") or minus ("–") sign, a set of numerals ("0" …."9") and a decimal point (","). The plus sign may be omitted. Allowable formats are:

XX.XX or +XX.XX or –XX.XX

where

X indicates a numeral.

Examples:

–1,0 5,0 +0,5 0,001

5.3.4 Character strings

Any printable characters may be used for the description of character strings. When within a character string the delimiters such as blank (" "), comma (","), colon (":"), semicolon (";") and quotation mark (" " ") are included, the character string shall be enclosed wholly by a pair of quotation marks (" " "). If a quotation mark (" " ") is included within a character string, it shall be described with two quotation marks as (" "" ").

Another method of describing character strings which include delimiters is to change the character string to another one which does not include delimiters using XCHAR statement (see 5.6.4). An example is given in table 12.

Table 12 – Description of character strings – Example

Character string	Description
Sample	Sample
String	"String"
Test data	"Test data"
By "EDH"	"BY" "EDH"

5.3.5 Reserved words

Description of a word selected from the reserved words. When a parameter which is to be specified "ON" or "OFF" is not described, it will be assumed to be "OFF".

5.3.6 Formatted description

Data shall be described in the format specified herein.

5.3.6.1 Location data

X real numerals Y real numerals [Z real numerals]

Location data shall be entered in the order of X coordinate value, Y coordinate value and Z coordinate value.

A Z value designates the height data and may be omitted for two-dimensional data description.

Examples:

X10,0Y-20,0 ------- indicates a coordinate (10,0; –20,0)

X0Y0 ------- indicates a coordinate (0,0; 0,0)

X,5Y1,5 ------- indicates a coordinate (0,5; 1,5)

5.3.6.2 Angle data

D real number	R real number	S real number	C real number

The meaning of descriptions is as follows. Θ denotes the value in radians.

D real number describes an angle in degrees. $\Theta = (D/180) * \pi$

R real number describes an angle in radians. $\Theta = R$

S real number describes an angle by the ratio of the length of the vertical side (S) to that of the horizontal side (C) $\Theta = \tan^{-1} (S/C)$

C real number describes an angle by the ratio of the length of the vertical side (S) to that of the horizontal side (C). $\Theta = \tan^{-1} (S/C)$

Examples: descriptions for an angle of 180°.

D180 R3.14159 SOC1

5.3.6.3 Units of linear measurement

Real number	$\left\{ \begin{matrix} M \\ I \end{matrix} \right\}$

Real number: describes the actual dimension of one unit of length in real numbers.

M designates the millimeter unit

I designates the inch unit

Example:

0,001M signifies the unit of 0,001 millimeters or 1 µm.

For example, the description "123.4" means 123,4 µm.

5.3.7 Fixed format messages

Description of a message from messages predefined in a fixed format.

Example: EDH DATA FORMAT

5.4 Coordinate system

Location coordinate shall have the orientation as illustrated below, according to the view direction to the board defined in the technology information file.

All four quadrants are available in data descriptions. Actual locations are obtained from the described coordinate multiplied by the unit of linear measurement (see 5.3.6.3 and figure 15).

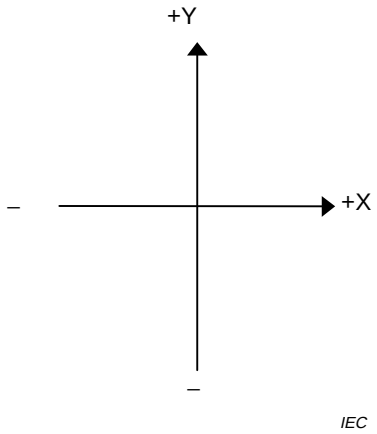


Figure 15 – Coordinate positioning

5.5 Libraries

5.5.1 Types of library

There are four types of library in **EDH DATA FORMAT** which are shown below.

Figure-shape library
Hole library
Stack library
Part-shape library

Each library has its own library name. In this format, only one library for one library type is allowed. The library name is used when the library is called as an external library (see 5.5.2).

5.5.2 Internal libraries and external libraries

The libraries in an intermediate file are called internal libraries. The libraries which may be called out but are not included in an intermediate file are called external libraries.

The internal libraries may be called out whenever needed. On the other hand, the external libraries can be called out only when the external library names are described in management information file (MNG) using "EXTERN" statements.

5.5.3 Priority of library calls

When the same registered library name exists in both an internal library and an external library, the internal library call has priority over the external one.

5.6 General description format

5.6.1 Types of statements

Statement types common to all category files are provided in table 13.

Table 13 – Statement types common for all category files

Number	Statement type	Function	Remark
1	HEAD	Start record of category file	
2	UNIT	Definition of unit of linear measurement	
3	XCHAR	Definition of pairs of characters to be exchanged	
4	COMMENT	Description of comments	
5	END	End record of category file	
6	Comment description	Description of comments	This is not a statement
7	DEFOLD	Definition of grouped old data	Paired with ENDOLD
8	DEFATR	Definition of grouped attributes	Paired with ENDATR

5.6.2 "HEAD" statement

HEAD: Filename extension identifier:

Describe the filename extension identifier specific to the category file, the description of which is going to start.

5.6.3 "UNIT" statement

UNIT: Unit of linear measurement:

For the unit of linear measurement, see 5.3.6.3. The "UNIT" statement shall occur only once preceding the data statements in each category file (except the file for file control information).

5.6.4 "XCHAR" statement

XCHAR: a character before change, a character after change
[, a character before change, a character after change
[,...]];

Pairs of two characters as shown below shall be entered.

A character before change: Define a character to be deleted.

A character after change: Define a character to be added in the change.

Delimiters such as ":", ";", " " shall not be defined.

This statement is applicable only to character strings (and shall not be applied to keywords, reserved words, parameters, etc).

5.6.5 "COMMENT" statement

COMMENT: comment descriptions:

Any character strings are allowed for description.

5.6.6 "END" statement

END: filename extension identifier:

Filename extension identifier specific to the category file shall be entered.

5.6.7 Description of comments

Comments can be described by enclosing the comment strings using a set of characters "/*" and "*/". These types of comments can be located any place where delimiters are allowed to be positioned. Obviously the characters "*/" cannot be included in the comment itself.

Example:

```
FILE : MNG,      /*  MANAGEMENT  */
       NET;      /*  NET  */
```

5.6.8 "DEFOLD" statement

When the old data prior to revision are required to be saved for some reason, the data shall be collected and described between the keywords "DEFOLD" and "ENDOLD".

```
DEFOLD:
old data records
ENDOLD:
```

5.6.9 "DEFATR" statement

The attribute statements may be collected and described as a group between the keywords "DEFATR" and "ENDATR" with an attribute name. Then the attributes may be called from other keywords by using the attribute name.

```
DEFATR: attribute name:
attribute statement
ENDATR:
```

6 File for file control information (FIL)

6.1 General information

The file for file control information shall contain the file information on all other category files. Such files shall exist in any set of category files, and will be accessed first in an attempt to obtain the information on subsequent category files.

6.2 Types of statements

Table 14 provides the statement types permitted in the file for file control information.

Table 14 – Statement types permitted in file for file control information

No.	Statement	Function	Remark
1	HEAD	Start statement of the category file	Mandatory
2	FORMATREV	Name and version level of intermediate data format	Mandatory
3	FORMATLIM	Format statement for character length limitation	Mandatory
4	LIMIT	Maximum length of character string data	Mandatory
5	SYSTEM	Name of file creation system	Mandatory
6	DATE	Date of file creation	Optional
7	AUTHOR	Designer name of file creation system	Optional
8	FILE	Names of available category files	Mandatory
9	EXTERN	Names of external libraries used	Optional
10	NOSTD	Names of available non-standard category files	Optional
11	UNIT	Unit of linear measurement (see 5.3.6.3)	Mandatory
12	COMMENT	Comment descriptions (see 5.3.7)	Optional
13	END	End statement of category file	Mandatory

6.2.1 "HEAD" statement

HEAD: FIL:

6.2.2 "FORMAT" statement

FORMATREV: format name, version level

The FORMATREV statement shall follow immediately after the HEAD statement.

The format name shall be described as EDH.

The version level shall be described in the form of [Vn.m].

where

"n" and "m" are the version number and release number respectively which are determined in each EDH format. Both "n" and "m" are positive integers.

The format LIM defines the relationship for maximum length of various character sets.

FORMATLIM: net max, pin max, co mid max, reg parts, logic lay;

6.2.3 "LIMIT" statement

LIMIT: [A], [B], [C], [D], [E];

The maximum lengths of character strings shown below shall be described in positive integers in A through to E respectively. If a character string is not used, the corresponding maximum length may not be described. If a maximum length of character strings is unknown, a character "?" shall be entered into the corresponding column.

This statement is intended to enable checking the lengths of various names contained in a file to be transferred without having to read category files, whether or not the lengths are allowed in the receiving CAD.

A ------ Maximum character length of the names of net groups.

B ------ Maximum character length of pin numbers.

C ------ Maximum character length of component identification numbers.

D ------ Maximum character length of the registered part-shape names.

E ------ Total number of logical layers.

6.2.4 "SYSTEM" statement

SYSTEM: name of file creation system:

6.2.5 "DATE" statement

DATE: YYYY . MM . DD [. hh . mm . ss] ;

The date of file creation shall be described according to the Gregorian calendar.

YYYY, MM, DD, hh, mm and ss signify the year, the month, the day, the hour, the minute and the second of file creation time respectively.

6.2.6 "AUTHOR" statement

AUTHOR: designer name of file creation system:

6.2.7 "FILE" statement

FILE: filename extension identifier [, . . .] ;

All the filename extension identifiers of the available category files shall be described.

6.2.8 "EXTERN" statement

EXTERN: [A] , [B] , [C] , [D] ;

When external libraries (see 5.5.2) are called, the names of libraries called shall be described here.

A – Part-shape library name

B – Figure-shape library name

C – Hole library name

D – Stack library name

6.2.9 "NOSTD" statement

NOSTD: filename extension identifier [, . . .] ;

All the filename extension identifiers of the existing non-standard category files shall be described. If no non-standard category file exists, this statement may be omitted.

6.2.10 "UNIT" statement

For the description format see 5.6.3. The UNIT statement in this category file defines the default value of unit of linear measurement for all category files. The unit can be redefined in each category file.

6.2.11 "END" statement

END: FIL ;

6.3 Example of file control information

Table 15 is an example of a management information file that describes a file creation system and names of auxiliary files.

Table 15 – Example of file control information

No.	Function	Statement	Example	Remark
1	Start statement of category file	HEAD:	FIL;	Mandatory
2	Name and version level of data format	FORMREV:	EDH1.0;	Mandatory
3	Format for LIMIT statements	FORMLIM:	NETMAX,PINMAX, COMIDMAX,REGPRT-SHP,LOGICLAYRS;	Mandatory
4	Maximum length of character string data	LIMIT:	255,50,50,30,255;	Mandatory
5	Name of file creation system	SYSTEM:	CADENCE.V34;	Mandatory
6	Date of file creation	DATE:	1995.09.22;	Mandatory
7	Designer name of file creation system	AUTHOR:	"HARRY PARKINSON";	Optional
8	Names of available category files	FILE:	ADM,MNG,ELM,NET, TEC;	Mandatory
9	Names of external libraries used	EXTERN:	MYLIB.1,MYLIBA.13, FMYLIB.;	Optional
10	Names of available non-standard category files	NOSTD:	GERBER.14253, DRAWING.EPS,IMAGE.CDR, DUPLEXR.350, SPEC.HPG;	Optional
11	Unit of linear measurement	UNIT:	0.001M;	Mandatory
12	Comment descriptions	COMMENT:	"THE FILE CONTROL INFORMATION INDICATES THAT ALL DIMENSIONS ARE IN METRIC.ON A CADENCE SYSTEM, HARRY PARKINSON";	Optional
13	End statement of category file	END:	FIL;	Mandatory

7 Management information file (MNG)

7.1 General information

The management information file contains the information related to the formal name of the printed board, drawing number, identification number, etc.

7.2 Types of statements

Table 16 provides the statement types permitted in the management information file.

Table 16 – Statement types permitted in the management information file

No.	Statement	Function	Remark
1	HEAD	Start statement of category file	Mandatory
2	NAME	Name of printed board, assembly or array	Mandatory
3	DRAW	Name of drawing	Mandatory
4	EDITION	Identification number	Mandatory
5	DESIGNER	Designer name	Optional
6	OPERATOR	Name of file operator	Optional
7	COMMENT	Comment descriptions (see 5.6.5)	Optional
8	END	End statement of category file	Mandatory

7.2.1 "HEAD" statement

HEAD: MNG ;

7.2.2 "NAME" statement

NAME: name of the printed board ;

or

NAME: name of the printed board assembly ;

or

NAME: name of the printed board array ;

or

NAME: name of the printed board panel ;

Figure 16 shows the relationship of NAME statements.

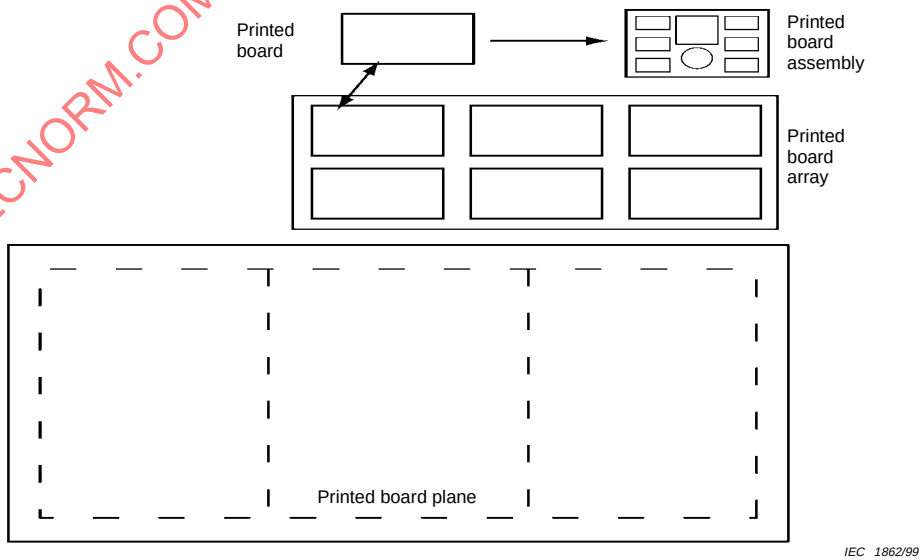


Figure 16 – Name statement

7.2.3 "DRAW" statement

DRAW: name of the drawing ;

7.2.4 "EDITION" statement

EDITION: control number ;

The control number used to manage the changes in circuit logics shall be described here. The contents of a control number shall be determined in the operating CAD system.

7.2.5 "DESIGNER" statement

DESIGNER: name of designer ;

7.2.6 "OPERATOR" statement

OPERATOR: name of file creator ;

The file creator's name of intermediate data base shall be described.

7.2.7 "END" statement

END: MNG ;

7.3 Example of management information file

Table 17 is an example of a management information file that describes the project and the person responsible for development, transfer and acceptance.

Table 17 – Management information file

No.	Function	Statement	Example	Remark
1	Start of statement	HEAD:	ADM;	Mandatory
2	Exchange character	XCHAR:		Optional
3	Statement for individuals	FORMAT:	NAME,COMPANY,ADDRESS,PHONE,FAX, EMAIL,TITLE;	Mandatory
4	Designer name	DESIGNER:	HARRY PARKINSON,DIGITAL EQUIPMENT,"30 Coburn Avenue.Nashua.NH03063", (603)884-6760,(603)884-1036,_,CONSULTING ENGINEER;	Optional
5	Sender of data	SENDER:	GARY FERRARI, TECH CIRCUITS,"340 QUINNPIAC STREET. P.O. BOX 309.WALLINGFORD.CT 06492-4050",(203)269-3311,(203)284-9389,_, Engineer;	Optional
6	Receiver of data	RECEIVER:	STEVE CLAYDEN, CONTINENTAL CIRCUITS,_ (602)268-3461,(602)268-1775,_,_,;	Optional
7	Engineer responsible for project	ENGINEER:	JOHN MINCHELLA, CELESTICA INC.,"44 DON MILLS ROAD NORTH YORK.ON M3C 1V7.CANADA",(416)448-5787,(416)448-5249,_,_;	Optional
8	Shipping individual and address to be sent to	SHIPTO:	JOHN DUNKLE,_,_, _(702)967-4519,_,_,_SHIPPING CLERK;	Optional
9	Acceptance of product by QA	ACCEPT:	CYNTHIA FROST,_,_(703)255-0469,_,QA INSPECTOR;	Optional
10	Format for identification	FORMATPROJ:	NAME,NUMB.,REVLVL, DATE;	Mandatory
11	Project identification	PROJID:	DUPLEXR,49763,C1, 1994.04.12;	Optional
12	Printed board identification	BORDID:	DUPLEXR,BD45942,C, 1994.03.31;	Optional
13	Printed board sub-array drawing	DRAWSUB	"DUPLEXR ASSEMBLY DRAWING", 49625, 1995.01.07;	Optional
14	Printed board panel drawing	DRAWPAN	"DUPLEXR PANEL DRAWING",5496375A,1995.02.11;	Optional
15	Assembly identification	ASMID:	DUPLEXR,ASM89423,/, 1994.5.09;	Optional
16	Drawing identification	DRAW:	"DUPLEXR MASTER DRAWING",49676542,A, 1994.02.23;	Optional
17	Comment description	COMMENT:	"THE INDIVIDUALS SHOWN IN THE ADMINISTRATION FILE ARE THOSE WHO ARE INVOLVED IN MOVING THE DATA AND THE PRODUCT BETWEEN DESIGN AND MANUFACTURING AND ACCEPTANCE OF THE PRODUCT";	Optional
18	Comment description	COMMENT:	"THIS PROJECT IS PART OF THE COMMUNICATION DEPT VOICE CODING EQUIPMENT #49763. THE CUSTOMER IS THE XYZ COMPANY.";	Optional
19	End of administrative file	END:	ADM;	Mandatory

8 Technology information file (TEC)

8.1 General information

The technology information file contains the information related to the board specification, number of layers, the default values of line width and conductor spacing, the definitions of logical layers, etc.

8.2 Types of statements

Table 18 provides the statement types permitted in technology information files.

Table 18 – Statement types permitted in basic information files

No.	Statement	Function	Remarks
1	HEAD	Start record of category file	Mandatory
2	VIEW	View direction for data orientation	Mandatory
3	BOARD	Name of board specification	Mandatory
4	LAYNO	Maximum number of physical layers and logical layers	Mandatory
5	LAYER	Definition of logical layer (layer information)	Mandatory
6	INTERL	Definition of logical layer (inner layer information)	Mandatory
7	VIA	Definition of standard via information	Optional
8	GRID	Definition of standard grid dimensions for component locations and via locations	Optional
9	AREA	Definition of data area	Mandatory
10	CLEAR	Default value of clearance	Mandatory
11	WIDTH	Default value of line width	Mandatory
12	UNIT	Definition of unit of linear measurement (see 5.6.3)	Mandatory
13	COMMENT	Comment descriptions (see 5.6.5)	Optional
14	END	End record of category file	Mandatory

8.2.1 "HEAD" statement

HEAD: TEC;

8.2.2 "VIEW" statement

$$VIEW \left\{ \begin{matrix} TOP \\ BOT \end{matrix} \right\} \quad ;$$

The view direction to which the coordinate system is determined, shall be described using the following reserved words:

"TOP" for the coordinate determined viewing from the component side.

"BOT" for the coordinate determined viewing from the solder side.

8.2.3 "BOARD" statement

BOARD: name of board specification;

The specification name for the bare board shall be described here.

8.2.4 "LAYNO" statement

LAYNO: total number of physical layers, maximum number of logical layers

Total number of physical layers: the total number of conductor layers of the board shall be described in positive integer.

Maximum number of logical layers: the maximum of the logical layer numbers shall be described here.

8.2.5 "LAYER" statement

LAYER: logical layer number, physical layer number, type of layer, layer priority, [negative/positive designation], [net group name...];

Logical layer number: the logical layer number of the data described shall be entered in positive integer.

Physical layer number: the physical layer number of the data described shall be entered in positive integer. If the same data is described on all physical layers, then "0" shall be entered.

Type of layer: the type of logical layer shall be entered according to table 19.

Layer priority: the priority of logical layers shall be entered.

Negative/Positive designation: "N" for negative pattern or "P" for positive pattern shall be entered.

Net group name: the name of the net group shall be entered when the data describes a layer where almost all of its area is conductive. One or more names may be entered. The names are effective only when the logical layer type is "PATTERN".

Table 19 – Types of logical layers

Layer type	Designation	Remarks
Board outlines	OUTLINE	Common data for all layers
Conductor patterns	PATTERN	For arbitrary layers
Solder resist patterns	RESIST	For outer layers
Symbol mark patterns	SILK	For outer layers
Paste mark patterns	PASTE	For outer layers
Component locations	PART	For arbitrary layers
Registration marks	PILOT	For arbitrary layers
Allowable component location area	PARTAREA	Common data for all layers
Inhibited component location area	PARTINH	For outer layers
Allowable conductor location area	PATAREA	Common data for all layers
Inhibited conductor location area	PATINH	For arbitrary layers
Inhibited via location area	VIAINH	For arbitrary layers
Dimension lines	MEASURE	For arbitrary layers
Part outlines	PARTFIG	For outer layers
Layer for user use	USER	For arbitrary other uses

8.2.6 "INTERL" statement

INTERL: logical layer number, physical from-layer number, physical to-layer number

Logical layer number: the logical layer number of the data described shall be entered in positive integer.

Physical from-layer number and physical to-layer number: the range of physical layers shall be described by the from-layer number and the to-layer number both in positive integer.

8.2.7 "VIA" statement

VIA: stack identification number of standard via [maximum number of via generation], [minimum number of via generation];

Stack identification number of standard via: the registered name of the stack to be used for standard via generation in autorouting shall be described.

Maximum number of via generation: maximum number of generated vias is described. No description means no limitation.

Minimum number of via generation: minimum number of generated vias.

8.2.8 "GRID" statement

GRID: standard grid dimension for component locations, standard grid dimension for via locations;

Standard grid dimension for component locations: the standard grid dimension for components placement which is used, such as in component placement program, shall be entered in positive real number.

Standard grid dimension for via locations: the standard grid dimension for vias generation which is used, such as in pattern routing program, shall be entered in positive real number.

8.2.9 "AREA" statement

AREA: minimum X coordinate, minimum Y coordinate, maximum X coordinate, maximum Y coordinate;

8.2.10 "CLEAR" statement

CLEAR: physical layer number, element 1, element 2, minimum conductor spacing;

The minimum clearance between element 1 and element 2 shall be specified. When two or more values are specified for one type of clearance, the latest value shall be effective. The clearances between conductors and the inhibited areas are allowed to be zero.

Physical layer number: the physical layer number on which the minimum clearance specification is applied shall be entered in positive integer. When it is necessary to apply the specified value to all physical layers, zero must be entered.

Element 1, element 2: type names of elements between which the minimum clearance requirements are applied shall be entered according to table 20.

Minimum clearance: the default value of minimum allowable clearance shall be entered in positive real number.

Table 20 – Elements to which the clearance specification is applied

Element type	Designation	Remark
Hole	HOLE	
Line segment	SEG	
Land	LND	
Via	VIA	
Part	PRT	
Solder resist	RES	
Symbol mark	SLK	
Paste mark	PAS	
All of the above	ALL	

8.2.11 "WIDTH" statement

WIDTH: signal line width, power line width, ground line width, logical layer number;

Various types of line widths are specified here. When two or more values are described for one type of width, the latest value shall be valid.

Signal line width: the default value of signal line width shall be entered in positive real number.

Power line width: the default value of power line width shall be entered in positive real number.

Ground line width: the default value of ground line width shall be entered in positive real number.

Logical layer number: the logical layer number on which the default values of line widths are defined shall be entered in positive integer. When the specified values should apply to all logical layers, zero shall be entered.

Different line widths may be specified for different logical layers belonging to the same physical layer.

8.2.12 "UNIT" statement

The unit of linear measurement shall be described. The description format is shown in 5.6.3. If the unit description is absent here, the unit defined in the file for file control information is effective.

8.2.13 "END" statement

END: TEC;

9 Net information file (NET)

9.1 General information

The information in this file is mainly extracted from the schematic drawing of circuit logics, describes the groups of component pins which shall be equipotential and are intended to be connected by nets, and describes groups of unused pins.

9.1.1 Type of information

There are five types of information which can be described in the net file. They are given below.

Net information: description of pin groups which are intended to be connected together.

Information for connecting different nets: description of connections between nets which are both equipotential.

Leaded pin information: description of single pins which have no connection to other pins and have only leads for access.

Unused pin information: description of unused pin groups.

Signal attribute information: description of signal types, limitations for pattern routing rule or other attributes for each net. This information is used in auto-routing or simulation.

9.1.2 Old and new NET data information

Unless otherwise specified, the newest data in this file will be transferred.

When old data, which are in an as-received state and have not been changed, require transferring, the special description format (DEFOLD and ENDOLD statements) shall be used.

Confirmation of matching of back-annotation information is possible when both old and new data are transferred.

9.1.3 Description of signal attributes

The assignment of the signal attributes shown below are possible for each net:

– two or more different attributes for equipotential signals such as one-point grounding;
– common attributes to two or more signals such as paired wiring;
– different attributes for different layers (for MLB description);
– routing limitations for high-speed circuits such as ECL circuits;
– signal priority for routing such as prior CLOCK signal.

The signal attribute descriptions shall be located prior to the calling descriptions for the attributes.

The description of attributes may be omitted, and when attributes are absent all net information is controlled by the board specification, such as line widths, stack identification number of standard via, logical layer numbers on which wirings are routed, and clearances, which are defined in the technology information file.

9.2 Correlation between category files

Figure 17 shows the correlation between various category files.

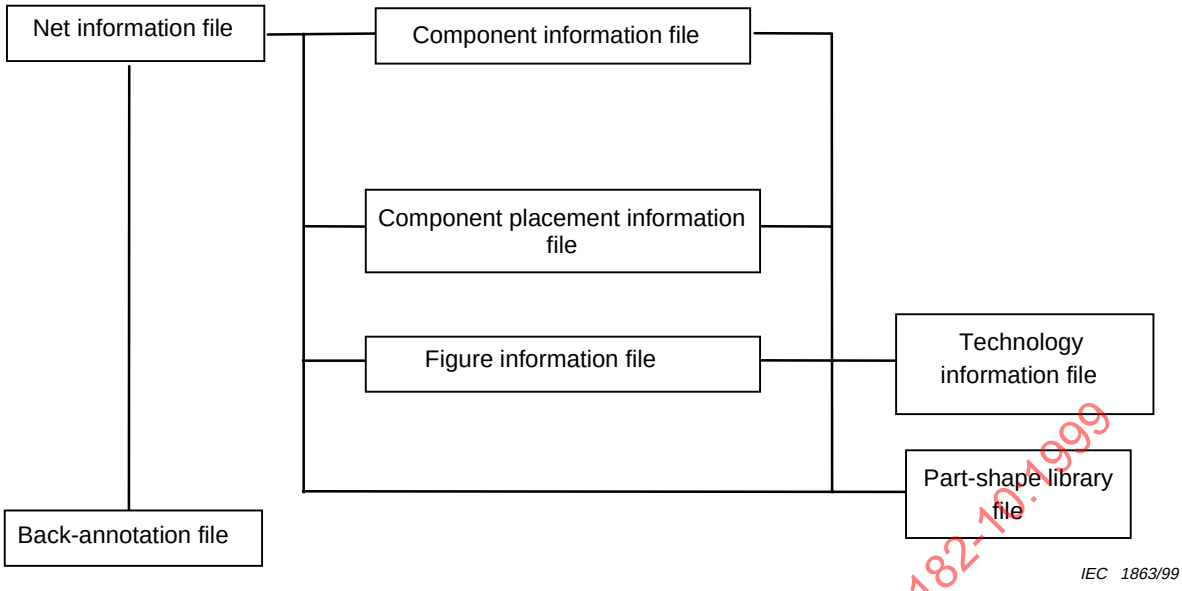


Figure 17 – File correlation with net file

9.3 File format

"Net group name" is the key required to connect net information and figure information.

"Signal attribute name" is given to a group of signal attributes for single net or two or more nets with common attributes.

Table 21 shows the order of the net file format.

Table 21 – Net file format order

No.	Statement	Function	Remark
1	HEAD: NET;	Start of category file	
2	DEFATR:	Signal attribute name	Description of signal attributes
3	ENDATR:		..end data
4	NET:	Net group name	Signal attribute name, description of net information
5	JOINT:		Description of information connecting different nets
6	DROP:		Description of leaded pins information
7	UNUSE		Description of unused pins
8	END: NET;		

9.4 Types of statements

Table 22 indicates the type of statement that may be made in the NET file. References to explanatory paragraphs are provided.

Table 22 – Type of statement

Subclause	Statement	Description	Remark
9.5.1	Elements of net information		
9.5.1.1	NET	Net connection equipotential pins	Mandatory
9.5.1.2	JOINT	Component pin connecting different nets	
9.5.1.3	DROP	Component single pins with lead non-connected unused pins	
9.5.1.4	UNUSE	Unused pins	
9.5.2	Elements of signal attribute		
9.5.2.1	DEFATR	Start of signal attribute definitions	
9.5.2.2	ENDATR	End of signal attribute definitions	
9.5.2.3	WDTBL	Line-width group definitions for each logical layer	
9.5.2.4	CLTBL	Clearance group definitions between figures for each logical layer	
9.5.2.5	CLASS	Designation attributes for signal types	
9.5.2.6	GLAYER	Routing layers for signal patterns	
9.5.2.7	GWIDTH	Line-width group to be used	
9.5.2.8	GCLEAR	Clearance group to be used	
9.5.2.9	VIA	Limitations for via generation	
9.5.2.10	LENGTH	Limitations for total line length	
9.5.2.11	SAMELEN	Limitations for lines of equilength routing	
9.5.2.12	PAIRLEN	Limitations for paired lines	
9.5.2.13	PARALEN	Limitations for lines routed in parallel	
9.5.2.14	TBRCHLEN	Limitations for branched lines	
9.5.2.15	NETORDER	Routing priority order of nets	
9.5.2.16	PINORDER	Routing priority order of pins within a net group	
9.5.2.17	SMDLEAD	Limitations for lead direction connecting to SMD land	
9.5.2.18	PINDIREC	Limitations for pin direction from component body	
9.5.2.19	TARGET	Specifying signal connecting target	
9.5.2.20	SHIELD	Specifying guard pattern generation	

9.5 Statement description format

9.5.1 Net information

9.5.1.1 Nets connecting component pins

The component pins which are all equipotential and designed to be connected together shall be described in this statement.

NET: net group name . [signal attribute name] . [signal name] .
component-pin number . component pin number:

Net group name: unique name for each net (an arbitrary alphanumeric character string).

Signal attribute name: specific signal attribute name for each net (an arbitrary alphanumeric character string).

Signal name: signal identification name defined by user (an arbitrary alphanumeric character string).

Component-pin number: component-pin number of the board (component identification number and pin number in each component).

NOTE 1 Duplication of net group name is not permitted.

NOTE 2 When a signal attribute is omitted, the default value is effective.

NOTE 3 If two or more nets have the same signal name, then these nets are assumed to be all equipotential and connected together.

NOTE 4 A net group name may be the same character string as that of a signal name.

9.5.1.2 Component pins connecting different nets (optional)

If a connection between different nets is provided by specific component pins, the statement below shall be described.

JOINT: net group name , [signal attribute name], [signal name] , component pin number, component pin number , ... ;

NOTE All component pins described shall have the same signal name in the net information.

9.5.1.3 Component single pins with lead non-connected (optional)

Single pins which have no connection to other pins but should nevertheless have leads for access are described.

DROP: , , [signal attribute name], component-pin number, component-pin number, ... ;

9.5.1.4 Unused pins (optional)

Unused pins which have no connection to other pins are described.

UNUSE: , , , component-pin number , component-pin number , ... ;

NOTE The net group name, signal attribute name and signal name are not required here.

9.5.2 Signal attributes

9.5.2.1 Start of signal attribute definitions

DEFATR: [signal attribute name] ;

Signal attribute name: when a signal attribute should be applied for specific nets, the signal attribute name shall be described in an arbitrary alphanumeric character string.

NOTE When signal attributes are defined after the DEFATR statement without a signal attribute name, the attributes defined shall be applied to all nets which are described after the attributes definitions and have no specific signal attribute name.

9.5.2.2 End of signal attribute definitions

ENDATR ;

9.5.2.3 Line-width group definitions

One or more line widths available in routing shall be defined previously for each layer. The line width to be used for a specific net group shall be determined by a following GWIDTH statement using a name of line-width group.

WDTBL:	name of line-width group , logical layer number, maximum line width, [minimum line width] , logical layer number, maximum line width, [minimum line width] .

Name of line-width group: the name is referred to in the line-width limitation statement (GWIDTH) (an arbitrary alphanumeric character string).

Logical layer number: the layer number on which the wiring patterns are located (a positive integer).

Maximum/Minimum line width: the line-width definitions for a specified logical layer (a positive real number). The minimum line width specified may be used for such as neckdown patterns.

9.5.2.4 Clearance group definitions

One or more clearances between figure elements available in routing shall be defined previously for each layer. The clearance to be used for a specific net group shall be determined by a following GCLEAR record using a name of clearance group.

CLTBL: name of clearance group, physical layer number, element 1, element 2, minimum clearance, physical layer number, element 1, element 2, minimum clearance

Name of clearance group: the name is referred to in clearance limitation statement (GCLEAR) (an arbitrary alphanumeric character string).

Physical layer number: the physical layer number on which the minimum clearance requirements are applied shall be entered in positive integer. When it is required that the clearance requirements be applied to all physical layers, then "0" shall be entered.

Element 1, element 2: type names of elements between which the minimum clearance requirements are applied shall be entered according to table 11.

Minimum clearance: the default value of minimum allowable clearance shall be entered in positive real number.

9.5.2.5 Signal types definition

The attribute for the type of electrical signal of the net group shall be described.

CLASS: signal type designation, [signal attribute description, signal attribute description . . .] ;

Signal type designations:

NONE: unused signals
DGSG: digital signals
ANSG: analog signals
HVSG: high-speed digital signals
HFSG: high-frequency signals
VCC: voltage line
GND: ground line
CLK: clock

Signal attribute description: the detail attributes which can be defined arbitrarily by the user.

9.5.2.6 Routing layer assignment

GLAYER: number of layers of logical layer group, logical layer number, logical layer number , . . . ;

Number of layers of logical layer group: the number of layers in the logical layer group on which the routing priority is assigned. When "2" is entered, it means that routing on two logical layers shall have priority.

Logical layer number: the constituent layers of the logical layer group.

9.5.2.7 Limitations for line widths

The line width which should be used for routing nets shall be specified.

GWIDTH: name of line width group;

Name of line-width group: the name has been previously defined in WDTBL statement.

9.5.2.8 Limitations for clearance

The clearance which should be used for routing nets shall be specified.

GCLEAR: name of clearance group;

Name of clearance group: the name has been previously defined in CLTBL statement.

9.5.2.9 Limitation for via generation

The limitations on the number of vias in a net generated in routing shall be specified.

VIA: registered stack name, [maximum number of generation], [minimum number of generation] ;

Registered stack name: stacks are registered in primitive figures libraries. They define figures on each layer and layer-to-layer interconnections for vias. A stack is called out using its registered stack name.

Maximum number of generation: maximum number of via generation shall be entered in positive integer. If absent, it is assumed to be unlimited.

Minimum number of generation: minimum number of via generation shall be entered in positive integer.

9.5.2.10 Limitation for total line length of a net

The limitations for total line length generated in routing nets shall be specified.

LENGTH: maximum line length , [minimum line length] ;

Maximum/Minimum line length: the maximum/minimum of total line length shall be specified in positive real number.

9.5.2.11 Limitations for lines of equilength routing

The limitations on line length generated in equilength routing shall be specified.

SAMELEN: maximum line length , [minimum line length] ;

Maximum/Minimum line length: the maximum/minimum of line length shall be specified in positive real number.

9.5.2.12 Limitations for paired lines

The limitations on line length generated in routing in pair two different signal lines which belong to one net shall be specified.

PAIRLEN: maximum line length, [minimum line length], maximum clearance];

Maximum/Minimum line length: the maximum/minimum of line length shall be specified in positive real number.

Minimum clearance: the maximum clearance between two lines shall be specified in positive real number.

9.5.2.13 Limitation for lines routed in parallel

The limitations on line length of a line routed in parallel to other signal patterns shall be specified.

PARALEN: maximum line length,[minimum line length],[minimum clearance], [logical layer number 1 , logical layer number 2] ;

Maximum/Minimum line length: the maximum/minimum line length shall be specified in positive real number.

Minimum clearance: the minimum clearance between the line and the patterns shall be specified in positive real number.

Logical layer number 1 and 2: the logical layers on which the line and the patterns are located. These are used for checking line length in parallel for the patterns located on different logical layers. When these are not described, the check will be performed only within each logical layer.

9.5.2.14 Limitations for branched lines

The limitations on branched line length in routing nets measured from the "T-branch" point shall be specified.

TBRCHLEN: maximum branch line length, [equilength branch designation]

Maximum branch line length: the maximum branch line length shall be specified in positive real number.

Equilength branch designation:

ON	equilength branching is required.
OFF	equilength branching is not required.

9.5.2.15 Routing priority order of net groups

When the priority in routing order of net groups is required, the priority order of nets shall be specified.

NETORDER: priority order of nets ;

Priority order of nets: the priority order of net groups in routing shall be specified as "1", "2", ..."n" (positive integer) which mean the first priority, the second priority, ... the nth priority respectively.

9.5.2.16 Routing priority order of pins within a net group

When priorities in the routing order of pins within a net group is required, such priority order of pins shall be specified.

PINORDER: pin priority code, [single stroke routing code], [inhibition code for branching within a layer], [allowable length of stub line], [equilength stub line code] ;

Pin priority code:

FREE	routing order may be changed arbitrarily
SEMIFIX	routing order for both ends shall be fixed
FIX	all routing orders shall be fixed

Single stroke routing code:

ON	required
OFF	no requirement

Inhibition code for branching within a layer:

ON	inhibited
OFF	allowed

Allowable length of stub line: the maximum branched line length from the branch point shall be specified in positive real number.

Equilength stub line code:

ON	required
OFF	no requirement

9.5.2.17 Limitations for the lead direction connecting to SMD land

The limitations for the direction of leads within a net group connecting to Surface Mounting Device (SMD) lands and for the clearances between lands and vias, and between lands and leads shall be specified.

SMDLEAD: SMD lead direction code, [minimum clearance between SMD lands and vias], [minimum clearance between SMD lands and leads at land corners]

SMD lead direction code:

FREE	all four directions are allowed
FIX	longitudinal direction only is allowed.

Minimum clearance between SMD lands and vias: the minimum clearance between SMD lands and vias shall be specified in positive real number.

Minimum clearance between SMD lands and leads at land corners: the minimum clearance between SMD lands and connecting leads at land corners shall be specified in positive real number.

9.5.2.18 Limitations for the pin direction from component body

The limitations for the direction of component pins (inside or outside) from the component body included in a net group shall be specified.

PINDIREC: pin direction code , [pin type code] ;

Pin direction code:

OUTSIDE	outside of component body
INSIDE	inside of component body

Pin type code:

ALL	pins of all components
PIN	pins of through-hole mounting components only
SMD	pins of SMD only

9.5.2.19 Signal connecting targets

The target to which the connections have to be made and the layer on which the target exists shall be specified.

TARGET: connection target, [logical layer number , logical layer number . . .] ;

Connection target:

PIN	pin connections
PREASSIGN	preassigned line/area/via connections

Logical layer number: the layer on which the connection target exists.

9.5.2.20 Guard pattern generation

SHIELD: connection group name, [maximum clearance], [minimum clearance] ;

Net group name: the name of the net group which has to be enclosed by guard patterns.

Maximum/Minimum clearance: the maximum and minimum clearances between the guard patterns and the guarded line shall be specified in positive real number.

9.6 Example of "NET" file

```
HEAD:NET;
      XCHAR: #,@,/,_;
      DEFATR:;
            WDTBL:WD01,1,0.3,0.2,
                        2,0.3,0.2,
                        3,0.5,0.3,
                        4,0.5,0.3;
            WDTBL:WD02,1,0.25,0.2,
                        2,0.4,0.35;
            CLTBL:CL01,1,SEG,SEG.Q.2,
                        2,SEG,SEG,0.3,
                        3,SEG,SEG,0.3,
                        4,SEG,SEG,0.2,
                        0,VIA,ALL,0.25,
                        0,LND,ALL,0.25;
            GLAYER:2,1,2,3,4;
            GWIDTH:WD01;
            GCLEAR:CL01;
            SMDLEAD:FREE,0.3,0.25;
      ENDATR:

      DEFATR:A001;
            CLASS:DGSG;
            VIA:STACK2,4,2;
            LENGTH:12.0;
            PINORDER:FREE,ON,OFF,2.54,OFF;
      ENDATR:

      DEFATR:A002;
            CLASS:HVSG;
            GWIDTH:WD02;
            SAMELEN:10.5,10.0;
      ENDATR:

            NET:N001..VCC,1C1.14,C1.1,R1.2;
                :N002..GND.1C1.7,C1.2,R2.1;
                :N003,1001,.1C10.1,1C11.1,1C12.1;
                :N004,A002,SIG1.CN1.20,C20.1,R10.1;
          DROP:...CN1.30,CN1.31,CN2.11,CN2.12;
                :...1C20.2,1C20.3,1C20.4;
                                .
                                .
                                .
            UNUSE:...1C30.5,1C30.6,1C30.7,1C31.8;
                  :...R99.1,R99.2;

END:NET;
```

10 Component information file (ELM)

10.1 General information

In this file, information is given on the components included in a printed board. The uses of this file are as follows:

– a component list supplied by a customer for pattern designing;
– an output on component information generated as a result of pattern designing;
– an output of component information with specified characteristics.

10.2 Correlation between category files

Figure 18 shows the correlation between the component file and other files in the EHS.

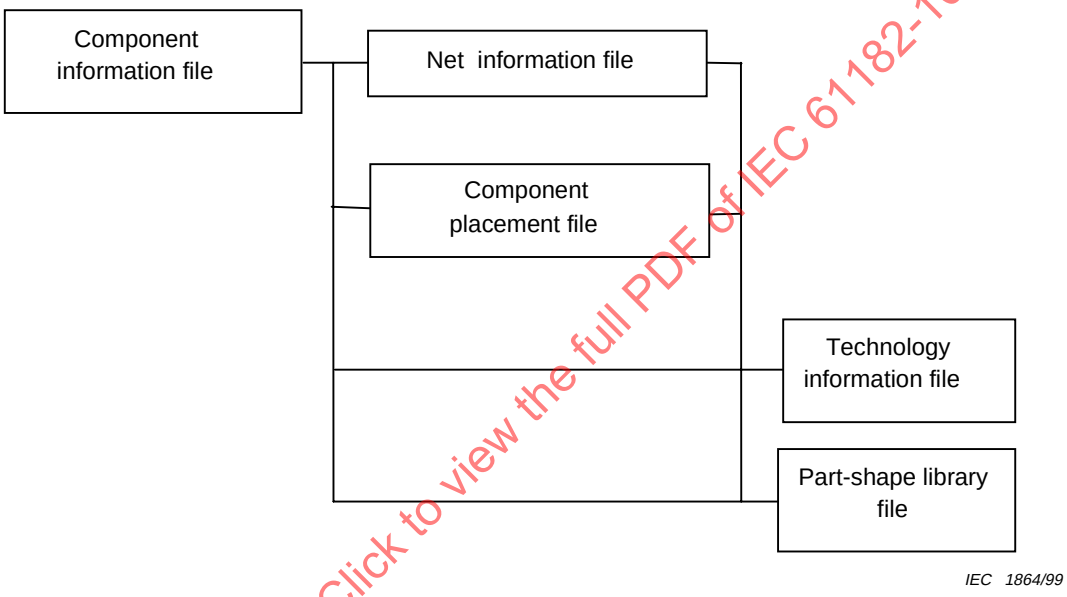


Figure 18 – Component information file correlation

10.3 File format

The "component identification number" is the key required to connect the component information with its location information.

The "registered part-shape name" is the key required to connect the component information with the part-shape library.

```
HEAD: ELM ;
      ELMCMP: component identification number,
              registered part-shape name, . . . . ;
                      ------ descriptions of component characteristics
   .
   .
   .
END: ELM ;
```

10.4 Types of statements

Table 23 shows the type of component information statements and their function.

Table 23 – ELM statement

Number	Statement	Function	Remark
1	ELMCMP	Definitions on component characteristics included on a board	Mandatory
2	XELMCMP	Grouping two or more registered part-shape names, using a component identification number	

10.5 Record description format

10.5.1 "ELMCMP" statement

ELMCMP: component identification number, registered part-shape name,
[component control number], [component assembling process code],
[component type code], [catalog number], [component constants/rating];

Component identification number: unique number for each component (an arbitrary alphanumeric string).

Registered part-shape name: part-shape name registered in the part-shape library (an arbitrary alphanumeric string).

Component control number: user defined control number (an arbitrary alphanumeric string).

Component assembling process code: description code on assembling process for the component (an arbitrary alphanumeric string).

<example> FLOW, RFLW, AX, RD, etc.

Component-type code: Description code on electrical characteristics of the component (an arbitrary alphanumeric string).

<example> IC, R, C, etc.

Catalog number: component manufacturer's name and/or component series name, etc. (an arbitrary alphanumeric string).

Components constants/rating: power consumption, rated voltage etc. (an arbitrary alphanumeric string).

10.5.2 "XELMCMP" statement

XELMCMP: component identification number, registered part-shape name,
[component control number], [component assembling process code],
[component type code], [catalog number], [component constants/rating]

This keyword is used for grouping two or more registered part-shape names for one component identification number. (In this format one component is to be registered with different names according to which board side the component is mounted on. However, sometimes, for example in net information, the component is not distinguished between the two sides of mounting. This is the reason the keyword is required.)

All parameters of "XELMCMP" shall be described in the same format as in the "ELMCMP" statement.

Component identification number shall be defined previously in the "ELMCMP" statement.

10.6 Example of "ELM" file

```
HEAD : ELM ;
UNIT : 1M ;
XCHAR : /,_,*,@;
ELMCMP : ICI , DIP016 , 1-001-1 , ICT000 , IC ,
                                    JP54LS138 , 300MA ;
ELMCMP : R25 , RES002 , 3-010-4 , AXTOOO , R
                                    JPRA01 , 5K ;
ELMCMP : IC2 , SOP014 , 2-001-01 , IST000 , IC ,
                                    JP74LS240 , 350MA ;
XELMCMP : IC2 , SOP014B , , ISB000;
  .
  .
  .
END :ELM ;
```

11 Primitive figure libraries file (FLB)

11.1 General information

In this file the primitive figures information needed in describing design data are defined.

11.2 Correlation between category files

Figure 19 shows the correlation between the component file and other files in the EHS.

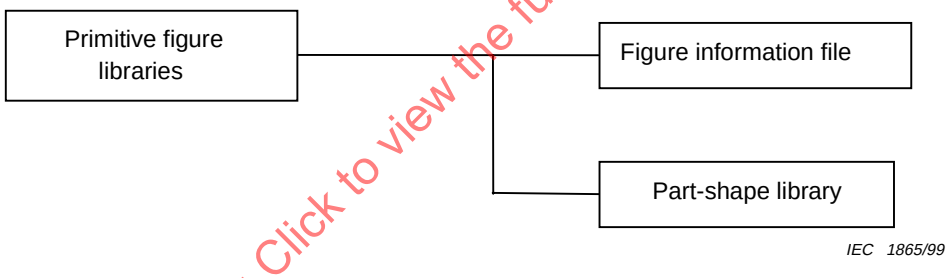


Figure 19 – Primitive figure library file correlation

11.3 Constituents of primitive figures libraries

The primitive figures libraries consist of the following libraries. Table 24 shows the type of libraries that contain figures. Figure 20 shows the relationship between the three library types.

Table 24 – Library types

Library name	Content
Figure-shape library	Primitive figure shapes of lands (or pads)
Hole library	Hole information
Stack library	Set of figure shapes in which shapes for each layer at a hole location are defined together

<Example>

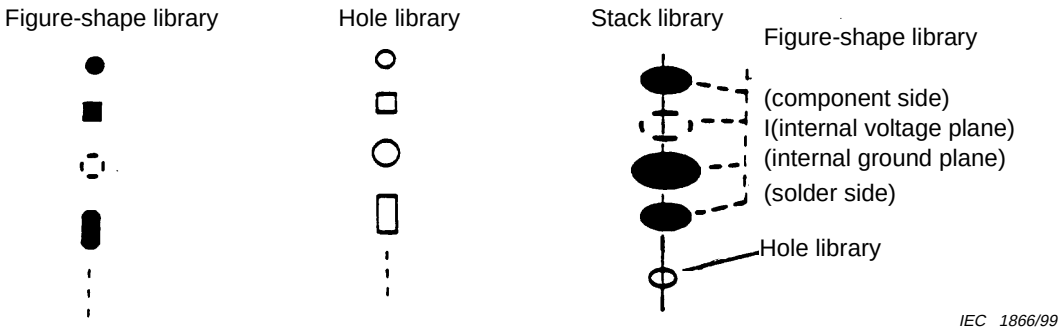


Figure 20 – Example of the three library types

11.4 Types of statements

Table 25 indicates the statement descriptions of the primitive figures libraries.

Table 25 – Primitive figures library statements

Number	Statement	Function	Remark
1	HEAD	Start of file; describe filename extension identifier	Mandatory
2	UNIT	Unit of linear measurement	Mandatory
3	CONTENTS	Describe types of libraries included in category file	Mandatory
4	DEFFLIB	Start of figure-shape library	Mandatory
5	ENDFLIB	End of figure-shape library	Mandatory
6	DEFHLIB	Start of hole library	Mandatory
7	DEFHOLE	Start of hole figure definitions	Mandatory
8	ENDHOLE	End of hole figure definitions	Mandatory
9	ENDHLIB	End of hole library	Mandatory
10	DEFSLIB	Start of stack library	Mandatory
11	DEFSTK	Start of stack definitions	Mandatory
12	STKFIG	Stack figure definitions	
13	STKHOLE	Stack hole definitions	
14	ENDSTK	End of stack definitions	Mandatory
15	ENDSLIB	End of stack library	Mandatory
16	DEFFIG	Start definition of figures	Mandatory
17	ENDFIG	End description of figure information	
18	END	End of this category file	Mandatory

11.5 Figure library central records

11.5.1 "HEAD" record

HEAD: FLB;

11.5.2 "UNIT" record

UNIT; unit of linear measurement;

11.5.3 "CONTENTS" record

CONTENTS: [FIG], [HOLE], [STK] ;

Describe types of libraries included in category file.

FIG: figure-shape library

HOLE: hole library

STK: stack library

<example>

When a file includes a figure-shape library and a hole library only, the description is as below.

CONTENTS: FIG, HOLE;

11.5.4 "END" record

END: FLB;

11.6 Figure-shape library records

11.6.1 Record sequence of figure-shape library

DEFFLIB:

DEFATR
: Descriptions of figure attribute information EXCEPT attributes

: RATS, HEIGHT, LSA, LEA, COND

ENDATR
:
: Repetition of figure attribute information
DEFFIG
:
: Descriptions of figure information
ENDFIG
:
: Repetition of figure information
ENDFLIB;

11.6.2 "DEFFLIB" record

DEFFLIB: figure-shape library name;

11.6.3 "ENDFLIB" record

ENDFLIB;

11.6.4 Example of figure-shape library

Table 26 gives an example of the figure-shape library format.

Table 26 – Example of figure-shape library

	Specification		Shape	Description
1	Name of figure-shape library Registered figure-shape name Size Shape Type	EDH-FLIB CIB-2.0 2,0 mm diameter circle black	2.0  Circle	DEFFLIB: EDH-FLIB; DEFATR: C1-2.0; COL: Black; PNT: Fill....; LWD: 0; ENDATR: DEFFIG: DIB-2.0. ON.ON; CIR: C1-2.0.1.0.XOYO; ENDFIG: ENDFLIB:
2	Name of figure-shape library Registered figure-shape name Size Shape Type	EDH-FLIB SQB-1.4 1,4 mm square black	1.4  Square	DEFFLIB: EDH-FLIB; DEFATR: SQ-1.4; COL: Black; PNT: Fill....; LWD: 0; ENDATR: DEFFIG: SQB-1.4.ON.ON; REC: SQ-1.4,X0.7Y-0.7.XO.7YO.7; ENDFIG: ENDFLIN:
3	Name of figure-shape Library Registered figure-shape name Size Shape Type	EDH-FLIB RECB-0.5-2.0 0.5 (W) × 2.0 (H) rectangle black	W H  Rectangle	DEFFLIG: EDH-FLIB; DEFATR: REC-0.5; COL: Black; PNT: Fill....; LWD: 0; ENDATR: DEFFIG: RECB-0.5-2.0.ON.ON; OBL: REC-0.5,0.25,1.0,XOYO; ENDFIG; ENDFLIB;
	. . .			. . .

11.7 Hole library records

11.7.1 Record sequence of hole library

DEFHLIB
DEFHOLE
: Description of hole figure information
ENDHOLE
: Repetition of hole figure information
ENDHLIB

11.7.2 "DEFHLIB" record

DEFHLIB: hole library name;

11.7.3 "DEFHOLE" record

DEFHOLE: Registered hole name, logical layer number, [no-plating code], [description-1],...[description-10]:

Logical layer number: the layer number defined by keyword INTERL.

No-plating code: no description means "to be plated"

$\left\{\begin{matrix} \overline{OFF} \\ ON \end{matrix}\right\}$ to be plated

no plating

Description 1 to 10: the description hole names are reserved for the user's arbitrary hole definitions.

11.7.4 "ENDHOLE" record

ENDHOLE;

11.7.5 "ENDHLIB" record

ENDHLIB;

11.7.6 Example of hole library

Table 27 gives an example of the hole library.

Table 27 – Example of hole library

	Specification		Shape	Description
1	Name of hole library Registered hole name Size Shape Type	EDH-HLIB C1 0.9 0,9 mm diameter circle to be plated	∅ 0,9TH 	DEFHLIB: EDH-HLIB; DEFHOLE: C1-0.9TH,70,OFF; CIR: .0.45.XOYO; ENDHOLE: ENDHLIB:
2	Name of hole library Registered hole name Size Shape Type	EDH-HLIB REC-2.0-1.0 2,0 (W) × 1.0 (H) rectangle no plating	W H  Rectangle W: 2,0 mm H:1,0 mm	DEFHLIB: EDH-HLIB; DEFATR: HLWO; COL: Black; PNT: OFF....; ENDATR: DEFHOLE: REC-2.0-1.0,70.ON; OBL: HLWO,1.0,0.5,XOYO; ENDHOLE: ENDHLIB:
3	Name of hole library Registered hole name Size Shape Type	EDH-HLIB CI-3.0NTH 0,9 mm diameter circle no plating	3,0 NTH 	DEFHLIB: EDH-HLIB; DEFHOLE: C1-3, ONTH, 70.ON; CIR: ,1.5,XOYO; ENDHOLE: ENDHLIB:

11.8 Stack library records

11.8.1 Record sequence of stack library

DEFSLIB

DEFSTK

STKFIG Description of a stack information

STKHOLE

ENDSTK

:

: Repetition of stack information

:

ENDSLIB

11.8.2 "DEFSLIB" record

DEFSLIB: stack library name;

11.8.3 "DEFSTK" record

DEFSTK: registered stack name, [description –1],...[description –10];

Description 1 to 10: the description stack names are reserved for the user's arbitrary stack definitions.

11.8.4 "STKFIG" record

STKFIG: logical layer number, registered figure-shape name, attribute name, [logical layer number, registered figure-shape name, attribute name,]---;

Registered figure-shape name: the name shall be defined in shape library previously.

Attribute name: described by specifying the attribute group in which continuity or rotation attributes are defined.

11.8.5 "STKHOLE" record

STKHOLE: registered hole name;

Registered hole name: the name shall be defined in hole library previously.

11.8.6 "ENDSTK" record

ENDSTK;

11.8.7 "ENDSLIB" record

ENDSLIB;

12 Part-shape library file (PRT)

12.1 General information

The part-shape library file contains the shape information of parts which are needed in describing the design data of a printed wiring board.

12.1.1 Rules for part-shape library definition

a) Part shape shall be defined for each layer on which the part is mounted. (In the case where the same type of component is mounted on both the front and the back, different part shapes shall be defined for each side).

b) The logical layers shown below shall not be used in the part-shape library:

   1) board outlines;

   2) component locations;

   3) allowable area for component locations;

   4) inhibited area for component locations;

   5) allowable area for conductor locations.

12.2 Correlation between category files

Figure 21 shows the correlation between the part-shape library file and other EHS files.

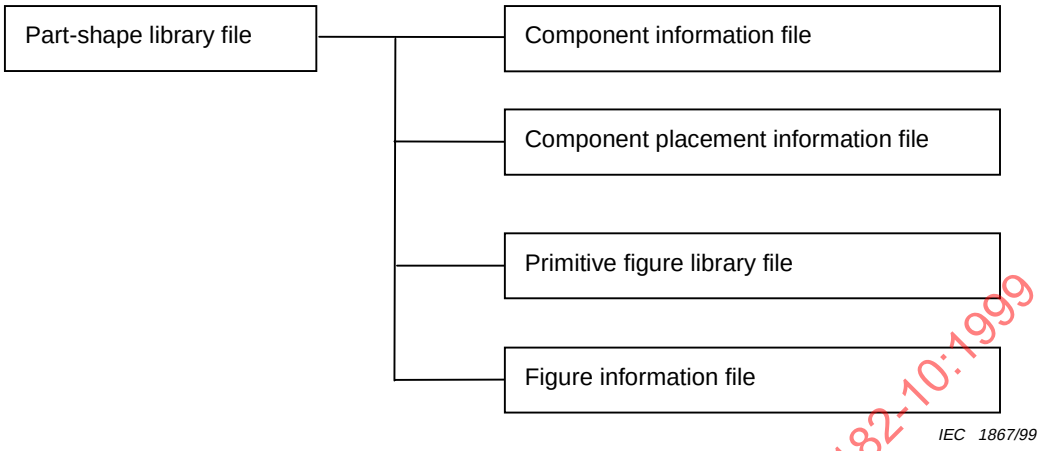


Figure 21 – Part-shape library file correlation

12.3 Elements included in part-shape library file

Figure 22 shows an example of the elements used to describe a 14-pin dip.

ELEMENTS FOR 14-PIN DIP IC	
Component side	
Land	: 1,4 mm square
Solder resist clearance	: 1,5 mm square
Solder side	
Land	: 1,4 mm square
Solder resist clearance	: 1,5 mm square
Component side, marking	: arbitrary
Part outline	: arbitrary
Holes	: ∅0,9 mm to be plated

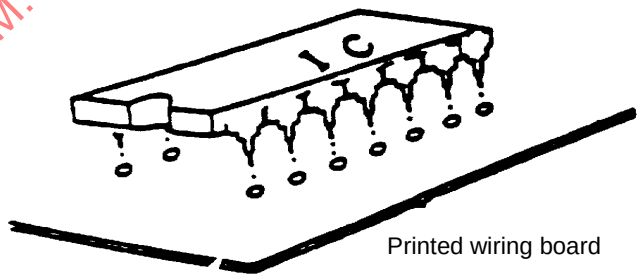


Figure 22 – Dip part-shape library example

12.4 Library items and contents

Table 28 shows the part-shape library items and their contents.

Table 28 – Part-shape library items and contents

#	Item	Contents
1	Basic information – 1	Registered part-shape name. Logical layer number on which part is mounted: Component name, number of pins, stack non-use code, unit of linear measurement
2	Basic information – 2	Part mounting position datum: – generating position of component identification number; – generating position of component name; – generating position of character string 1; – generating position of character string n.
3	Basic information – 3	Component control number Component mounting-type code Component-type code Catalog number Component use-inhibiting code Name of registrant
4	Inhibited area	Logical layer number Type of inhibited area (via or line inhibited) Figure information
5	Part outline	Figure information Height (min./max.)
6	Stack	Registered stack name Location coordinate (pin number)
7	Hole	Registered hole name Location coordinate (pin number)
8	Land	Registered figure-shape name Attribute name Location coordinate (pin number) Figure information
9	Solder resist pattern	Registered figure-shape name Attribute name Location coordinate Figure information
10	Cream solder pattern	Registered figure-shape name Attribute name Location coordinate Figure information
11	Internal layer	Registered figure-shape name Attribute name Location coordinate Figure information
12	Symbol marking pattern	Shall conform to requirements specified in clause 14 (figure information)
13	Text	Shall conform to requirements specified in clause 14 (figure information)
14	Dimension line	Shall conform to requirements specified in clause 14 (figure information)
15	Conductor line	Shall conform to requirements specified in clause 14 (figure information)
NOTE The library items and contents relating to wire bonding and test points will be considered in the next version of this format.		

12.5 Record sequence of part-shape library

Table 29 shows the record sequences of the part-shape library statements.

Table 29 – Record sequences of part-shape library statements

No.	Statement	Function	Remark
1	HEAD	Start of file; describe filename extension identifier	Mandatory
2	DEFPLIB	Start part-shape library	Mandatory
3	DEFPRT	Define part description	Mandatory
4	PRTDF1	Description of part shape	Mandatory
5	PRTDF2	Description of part shape	Mandatory
6	PUTSTK	Stack definition	Mandatory
7	PUTHOL	Hole definition	Mandatory
8	PUTFIG	Description of figure information	Mandatory
9	ENDPRT	Completion of part description	Mandatory
10	:	Repetition of part shape (numbers 3 to 9)	Mandatory
11	ENDPLIB	End of part-shape library file	Mandatory
12	END;	End of this category file	Mandatory

12.6 Record descriptions

12.6.1 "DEFPLIB" record

DEFPLIB: part-shape library name;

12.6.2 "DEFPRT" record

DEFPRT: registered part-shape name, logical layer number on which part is mounted, [component name], [number of pins], [stack non-use code], [unit of linear measurement];

Logical layer number on which part is mounted: describes the logical layer number of the side of the board on which the part is mounted.

Component name: the name and type number of component.

Number of pins: the total number of pins to which specific pin names are given.

Stack non-use code: describe use or non-use of stacks.

$\left\{\begin{matrix} OFF \\ ON \end{matrix}\right\}$ stacks are used / stacks are not used

For unit of linear measurement, see 5.3.6.3.

12.6.3 "PRTDF1" record

PRTDF1: part mounting position datum, [generating position of character string of component identification number], [generating position of character string of component name], [generating position of character string 1,---];

Part mounting position datum: position datum of the part which is used in part mounting operation.

Generating position of component identification number: image-generating position of component identification number (or reference number).

Generating position of component name: image-generating position of component name.

Generating position of character string 1-n: image-generating position of arbitrary character strings (may be omitted).

12.6.4 "PRTDF2" record

PRTDF2: [component control number], [component mounting type code], [component type code], [catalog number], [component use-inhibiting code], [name of registrant];

Component control number: description of user-defined component number

Component mounting type code: used in part assembling process. For example:

radial lead: RA axial leads: AX

chip types: CH others: EX

Component type code: component type or characteristics. For example: IC, CN, R, C.

Catalog number: catalog number, specification number, etc.

Component use-inhibiting code: component using allowed or inhibited.

$\left\{ \begin{matrix} ON \\ OFF \end{matrix} \right\}$ component using inhibited

component using allowed

Name of registrant: description of registrant

12.6.5 "ENDPRT" record

ENDPRT;

12.6.6 "ENDPLIB" record

ENDPLIB;

13 Component placement file (PLC)

13.1 General information

The information in this file describes the components included in a printed board and their locations on the board. This information can be used for interchange of the preliminary component layouts before pattern designing, and of the resultant layouts after the designing.

The shapes of components are defined in the part-shape library and can be called using their registered part-shape names.

Regarding matching with the back-annotation information, the component placement file shall be renewed for final component location after the back-annotation procedures are performed.

13.2 Correlation between category files

Figure 23 shows the correlation between the component placement file and other EHS files.

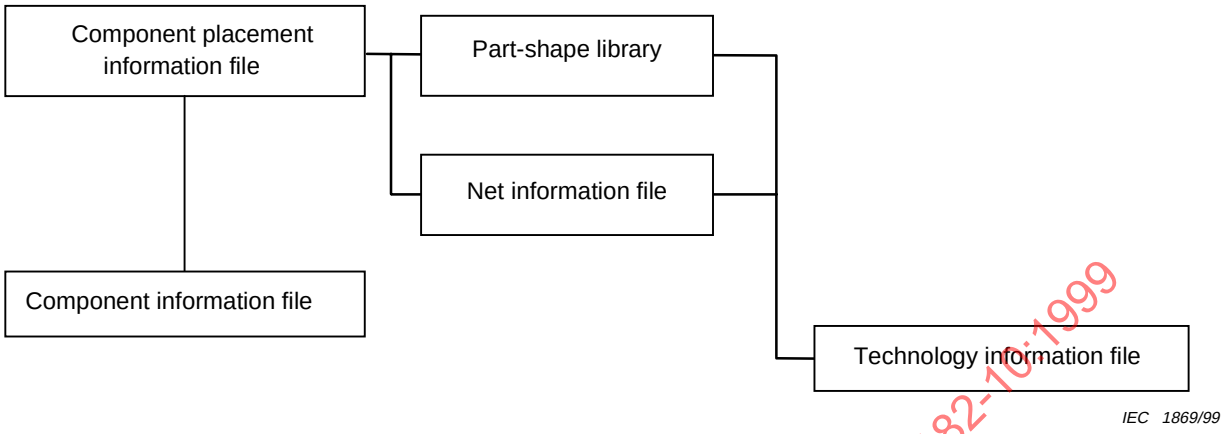


Figure 23 – Component placement file correlation

13.3 File format

The "component identification number" is the key required to connect the component placement information with the component information.

The "registered part-shape name" is the key required to connect the component placement information with the part-shape library.

HEAD	PLC	PLC
PLCCMP	Component identification number Registered part-shape name ------ Descriptions of component characteristics	
END	PLC	

13.4 Type of statement

Table 30 – Component placement file – Type of statement

No.	Statement	Function	Remark
1	PLCCMP	Descriptions of component placement on a board	Mandatory

13.5 Record description format

13.5.1 Part placement data

PLCCMP	Component identification number, registered part-shape name [component name, location coordinate] Rotation angles Logical layer number component to be mounted [location-fixed component code]

Registered part-shape name: part-shape name registered in part-shape library (an arbitrary alphanumeric string).

Component name: name given in a schematic drawing (an arbitrary alphanumeric string).

Location coordinate: location coordinates of the component.

Rotation angle: rotation angle of the component.

Logical layer number part to be mounted: logical layer number on which the component is designed to be mounted

Location-fixed component code:

$\left\{\begin{matrix}\underline{FREE}\\FIXED\end{matrix}\right\}$ component location is free

component location is fixed as specified

13.6 Example of "PLC" file

```
HEAD: PLC:
      UNIT: 1M
      XCHAR:/,_,*,@;
      PLCCMP: 1C1, DIPO14, 74LS91,
                  X12.08Y25.40.D90.00,1,FIX;
      PLCCMP: IC2, SOP16B, 74LS145J,
                  X140.16Y275.92, D90.00,6,FREE;

END:PLC:
```

14 Figure information file (FIG)

14.1 File description concept

14.1.1 List of keywords in "FIG" file

Table 31 shows the keywords in the figure information file.

Table 31 – Figure information keywords

Primitive figures	
CIR	Circles
OBL	Squares
REC	Rectangles
PLY	Polygons
LIN	Lines
TXT	Texts
Logical layer assignment	
LAY	Change of logical layer assignment
Features grouping	
DEFFIG	Grouping of primitive figures
ENDFIG	
DEFSFIG	Grouping of electrically connected figures
ENDSFIG	Description of connection points
POINT	Attributes
DEFATR	
ENDATR	Grouping of figures belonging to one component
DEFPFIG	
ENDPFIG	
Library call	
PUTFIG	Primitive figures
PUTSTK	Stacks
PUTHOL	Holes
Library call and exchange	
XPUTFIG	Primitive figures
XPUTSTK	Stacks
Attributes	
COL	Color
PNT	Paint-in
LWD	Line width
LKD	Line type
LED	Line end
TXAHGT	Text height
TXAROT	Text rotation
TXAFNT	Text font
TXAWDR	Character width adjustment
TXASPR	Character pitch adjustment
TXALWD	Character stroke width
TXAORG	Origin of a character string
TXTATR	Collective attribute of text attributes
RATS	Rats nest
HEIGHT	Height from the printed board
ROTATE	Rotation
SCALE	Scale factor
LSA	Start point of a line
LEA	End point of a line
COND	Electrically conductive or non-conductive

14.1.2 Priority of land descriptions

Land information in each logical layer shall have priority to stack information, when both items of information are defined at the same position. Whether any difference exists or not shall be determined for the same logical layer number and the same position.

14.1.3 Component definitions

Components shall be defined separately for each mounting side. The definition for a component to be mounted on the front of a board shall be different from that for the same component to be mounted on the back.

14.1.4 Description of electrically connected figures

Figures shall be grouped using a key of net group name. Electrically connected figures with the same net group name and with the same signal attributes shall be combined to form one figure group.

<example>

```
DEFSFIG  :  S1 ;
  LAY    :  1 ;
  LIN    :  attribute, .... ;
  PUTSTK :  registered stack name, .... ;
       ENDSFIG  ;
```

14.1.5 Description of height limitations

Height limitations shall be described in a logical layer of inhibited area for component locations. In this logical layer, both location inhibited areas and location restricted areas (conditionally inhibited areas) can be described. The height limitations shall be applied to the location-restricted areas.

<format>

Keyword : from-height, to-height, range designation ;

Range designation:

$$\left\{\begin{matrix}\underline{INCL}\\EXCL\end{matrix}\right\}$$

where

INCL: inhibited inside the range specified by from-height and to-height;

EXCL: inhibited outside the range specified by from-height and to-height

14.1.6 Priority of keywords

Keyword information could be defined twice or more with different contents. For example, a figure color designation (black or white) can be defined in a figure information group, and can also be specified when the figure group is called. Basically, the latest information shall have priority. In the calling procedure the specification of calling shall have priority over that which is called.

14.1.7 Priority of overlapping positive/negative patterns

a) When the relevant logical layers are different on the same physical layer, the priority depends on the logical layer priority which is defined in the technology information file using keyword LAYER. When the logical layer priority is on the same level, the latest positive/negative definition has priority over the other definitions.

b) When there exist both positive and negative patterns in the same logical layer, the latest data has priority over the preceding data.

NOTE This criterion may sometimes be ambiguous, and thus it is preferable to describe negative figures and positive figures in two different logical layers and to define previously the layer priority.

14.1.8 Description of dimension lines

Dimension lines shall be described by a block of line statements in a logical layer for dimension lines.

14.1.9 Method for specifying default values of attributes

Default values of attributes for a specific information shall be defined in the information blocks starting with the keyword of DEFxxx and ending with the keyword of ENDxxx. If an attributes information group is defined without any attribute name, the definitions will be assumed to be the default attributes values for the block or the group to which the attributes group belongs. This type of definition may occur two or more times in a block or group. In this case the latest definition shall be valid.

<example>

```
DEFFLIB :  . . .
 DEFATR :  ;
   COL   :  BLACK ;     attributes definitions without attribute name.
   PNT   :  FILL ;       these will be assumed to be the default values in
   LWD   :  0 ;          the block starting with DEFFLIB.
 ENDATR ;

 DEFFIG :  . . .
   CIR   :  . . .
 ENDFIG ;
```

14.2 Primitive figures

Primitive figures shall be used with line width attribute and/or paint-in attribute. The primitive figures description without attributes cannot have any real image, which means no definition.

14.2.1 Circle (see figure 24)

CIR: attribute name, radius, center coordinate ;

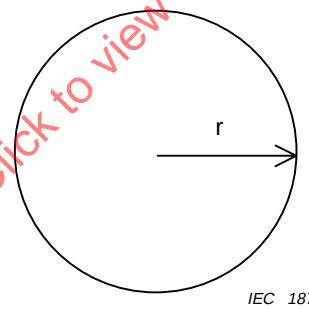


Figure 24 – Circle

14.2.2 Square (see figure 25)

OBL: attribute name, a half of X-side length, a half of Y-side length, center coordinate ;

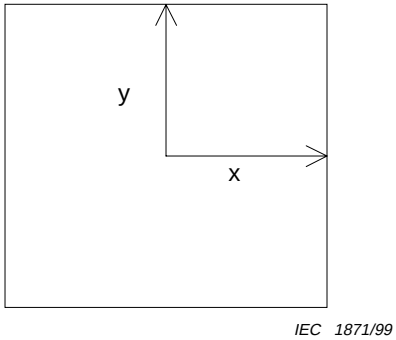


Figure 25 – Square

14.2.3 Rectangle (see figure 26)

REC: attribute name, first end-point coordinate of a diagonal,
second end-point coordinate of the diagonal ;

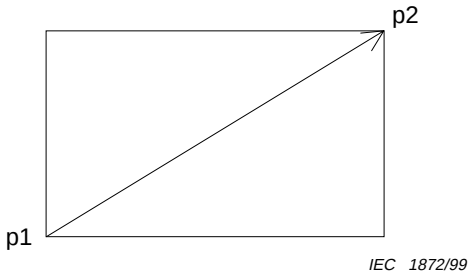


Figure 26 – Rectangle

14.2.4 Polygon (see figure 27)

PLY: attribute name, start-point coordinate [special point code], middle-point
(or end-point) coordinate ...;

Special point code: the point described after the code means as follows:

when the code is

S: the start of the perimeter of internal void;

R: the center of circular arc moving clockwise;

L: the center of circular arc moving counter clockwise.

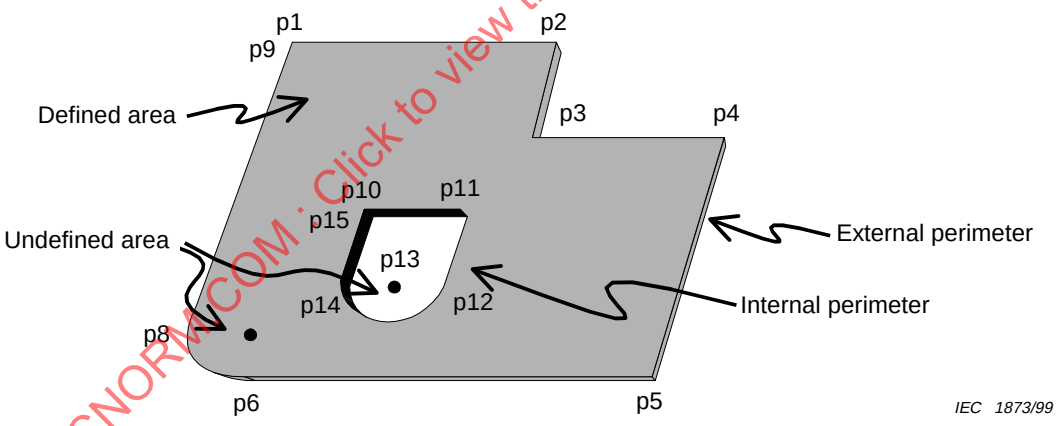


Figure 27 – Polygon

14.2.5 Line

LIN: attribute name, start-point coordinate [special point code], middle-point or
end-point) coordinate ...;

Special point code: the point described after the code means as follows:

when the code is

S: the start point of the line;

R: the center of circular arc moving clockwise;

L: the center of circular arc moving counter-clockwise.

14.2.6 **Text** (see figure 28)

TXT: attribute name, start-point coordinate, text strings ;

Control codes shall not be included in the text strings.

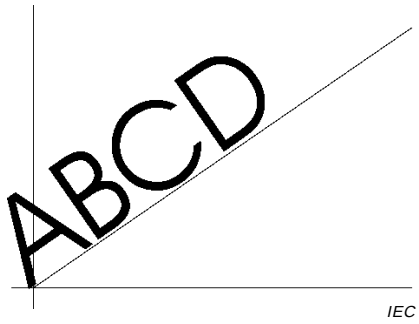


Figure 28 – Text

14.3 Attributes

14.3.1 Color designation attributes

COL : color designation ;

Color designation:{BLACK or WHITE}

NOTE BLACK means black or dark and WHITE means transparent or non-BLACK.

14.3.2 **Paint-in attributes** (see figures 29 and 30)

PNT: paint-in designation, [X-pitch], [Y-pitch], [line width], [angle]

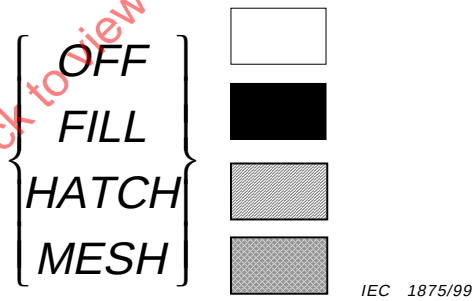


Figure 29 – Paint-in designation

<example> paint-in designation = MESH

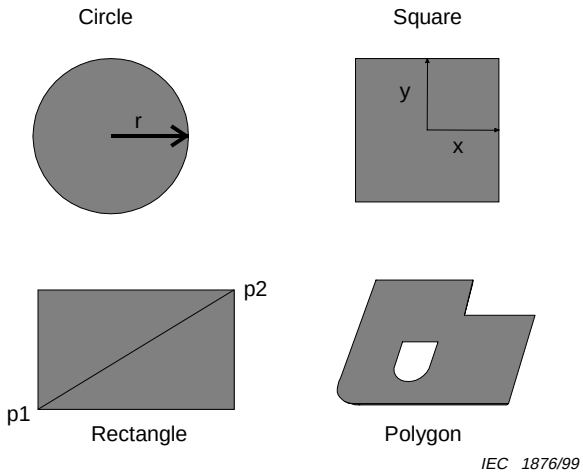


Figure 30 – Paint-in mesh