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Table of Contents

Chapter 1  Overview
Introduction .................................................. 10
Intended Readers ........................................... 10
Versioning .................................................... 10
Updates ........................................................ 12
   November 2007 ............................................. 12
   September 2007 ............................................. 12
   August-December 2005 ................................... 13
   September 2004 ............................................ 13
   July 2004 ..................................................... 13
   February 2004 .............................................. 14
   November 2003 ............................................. 14
   June 2003 ..................................................... 14
   March 2002 ................................................... 15
   September 2001 ............................................. 15
   August 2001 .................................................. 16
   September 2000 ............................................. 16
   February 2000 .............................................. 17
Conventions and Terminology ................................ 17

Chapter 2  Design Principles
File System .................................................... 18
   Hierarchy ...................................................... 18
   Mandatory / Optional Files ................................ 18
Legal Entity Names ............................................ 18
Readable ASCII files ........................................ 19
Units of Measurement ........................................ 19
Large File Compression ..................................... 19
Sum File ....................................................... 20
Structured Text files ......................................... 20
Line Record Text files ....................................... 21
Angles .......................................................... 22
Rotation / Mirroring ......................................... 22
Coordinates .................................................... 22
Symbols ........................................................ 22
   Standard Symbols .......................................... 23
   Special (User-Defined) Symbols ......................... 24
Symbol Characteristics .......................................................... 25
Rounded/Chamfered Rectangles ............................................... 26
Shape ..................................................................................... 26
Shapelist .................................................................................. 26
Order of Holes/Islands in Surfaces .......................................... 26

Chapter 3 Job Tree
Job Overview ............................................................................. 28
Charts ......................................................................................... 29

Chapter 4 Job Entity Database
steps (See Chapter 5) ................................................................. 35
symbols (System and User Symbols) ........................................ 35
attrlist (Attribute List) ............................................................. 35
features (Symbol Features) ....................................................... 36
matrix (Job Matrix) ................................................................. 36
  New Layer Types Required for GenFlex 6.4 ......................... 39
  New Fields in Layer Group Required for GenFlex 6.4 ............ 40
misc (Miscellaneous) ............................................................... 40
  attrlist (Attributes Used in Job) ............................................. 40
  last_save (Last Time Job Saved) ........................................... 41
  info (Basic Job Information) ................................................ 41
  userattr (User Attributes) .................................................... 42
wheels (Gerber and tool wheels) .............................................. 44
  attrlist (Attributes Values) .................................................. 44
dcodes (Wheel Dcodes Definition) ......................................... 44
forms (Work Forms) ............................................................... 45
  dat/files/<file_name> (Image File) ....................................... 45
  dat(hdr (Data Header) .......................................................... 46
  def/hdr (Definition Header) ................................................ 46
  <help_name> (Help Text) ..................................................... 51
  <Pixmap_name> (Pixmap Field File) ...................................... 51
flows (Job Process Charts) ..................................................... 52
  dathdr (Data Header) ............................................................ 52
  defhdr (Definition Header) ................................................. 53
fonts (Fonts used in Job) ....................................................... 56
  standard (Standard Font) ..................................................... 56
  SHX Fonts Directory (AutoCAD vector) (GenFlex 6.4) ......... 57
stackups .................................................................................... 57
| attrlist (Attribute List)               | 57 |
| fill_table (Prepeg Combinations)       | 58 |
| material (Material Specifications)     | 60 |
| stackup (Build)                       | 64 |
| imp (Impedance)                       | 67 |
| input                                 | 68 |
| output                                | 68 |
| snapshot (Measurement Information)     | 68 |
| user                                  | 69 |
| extension                             | 69 |

**Chapter 5  Job>steps Entity**

- Required for GenFlex 6.4 .................................................. 70
- Layer Profiles File ..................................................... 70
- Layer Profiles File (Encrypted File) .................................. 70
- Footprint Description File (GenFlex 6.4) ............................ 70
- Footprint Description File ............................................... 70
- stephdr (Step Header) ................................................... 71
- attrlist (Attribute List) ............................................... 73
- layers (See Chapter 6) .................................................. 73
- Netlists ........................................................................ 73
- Required for GenFlex 6.4 ............................................... 73
- cadnet / netlist (CADnet) ............................................... 74
- refnet / netlist (Reference) .......................................... 77
- curnet / netlist (Current) ............................................ 78
- profile (Outline Shape of Step) ....................................... 78
- bom (Bill of Materials) ................................................ 79
- bom ........................................................................... 79
- files (Source Files) ..................................................... 83
- eda (Electronic Design Automation) .................................... 83
- data ............................................................................. 83
- vpl_pkgs .................................................................. 91
- net_prp (Net Type) Clearances Records .............................. 92
- chk (Checklists) (See Chapter 9) ..................................... 97
- et (See Chapter 10) ..................................................... 97
- cdrsr (AOI Panelization) ............................................... 98
- reps (Reports) ........................................................... 100
Chapter 6  Job>steps>layers Entity

Requiring Implementation for GenFlex 6.4 ........................................... 103
Partial S&R Data File ................................................................. 103
Partial S&R Data File & Layer Profile Reference Number (Encrypted Files) .......................... 103
Scaling per Step Data File (Implemented in Genesis v9.3b also) .................................. 103
Scaling per Step Data File (Encrypted File) ........................................... 104
Dimension File (Encrypted File) ...................................................... 104
attrlist (Attribute List) ................................................................. 108
features ................................................................. 108
Changes Required for GenFlex 6.4 .................................................. 117
components ................................................................. 119
components3 ................................................................. 121
tools (Drill Tools) ................................................................. 123
camtek ................................................................. 124
attrlist (Attribute List) ................................................................. 127
cdrhdr (CDR14 Header) .............................................................. 128
cdr14_stp_main (CDR14 Main Step) ............................................... 133
crd14_stp_pos (CDR14 Positive Step) ............................................... 133
crd14_stp_neg (CDR14 Negative Step) ............................................... 133
clone_<step_name> (S&R Exclusion Zones) ....................................... 134
user_def_<step_name> (Steps in AOI) ............................................ 134
user_def_<step_name>_pos (Steps - AOI) .......................................... 134
<set_name>/cdrhdr (CDR Header) ................................................... 135
<set_name>cdrrdr2 (CDR14 Header - Additional) .................................. 136
steps/cdr14_stp_main (cdr Graphic Data) .......................................... 141
cdr14_stp_pos (Empty) ............................................................. 142
cdr14_stp_neg (Empty) ............................................................. 142
clone_<step_name> (Inspection Areas) ............................................ 142
clone_<step_name>_pos (Automatic Inspection Area) ................................ 143
cdr14_stp_on_clones (Non-stp&rpt Zones) ....................................... 143
user_def_<step_name> (AOI Panelization) .......................................... 144
user_def_<step_name>_pos (AOI Panelization) ..................................... 144
lpd (Layer Production Data) ......................................................... 145
LPD ................................................................. 145
LPD_MULTIPLE ................................................................. 148
mania (MANIA Automatic Optical Inspection) ....................................... 155
DI (Orbotech Direct Imaging Interface) ............................................ 156
Description ................................................................. 156
notes (Electronic Job Notes) ......................................................... 158
relations (Connections between Features) .......................................... 159
Chapter 7  
**NCD Entity**

Required for GenFlex 6.4 ........................................ 164

- New fields in NCD files (Implemented in Genesis v9.3b also) .......... 164
- header ........................................ 165
- table ........................................ 171
- order ........................................ 173
- drill file .................................... 173
- NC File ..................................... 175

Chapter 8  
**NCR Entity**

- NCR header ...................................... 177
- table ........................................ 180
- order ........................................ 181
- rout file ..................................... 182
- NC File ..................................... 184

Chapter 9  
**Job>steps>chk (Checklists)**

Required for GenFlex 6.4 ........................................ 185

- Header File for each checklist .................................... 185
- Encrypted Checklists ........................................ 185
- def/hdr_p ..................................... 185
- res/hdr_p ..................................... 186
- report/tags_p .................................. 186
- report/text_p .................................. 187
- disp_p ....................................... 188
- meas_p ....................................... 189

Chapter 10  
**Job>Steps>et (Electrical Test)**

- <etset_name>/hdr ................................... 190
- <split_name>/hdr ................................ 191
- <split_name>/mapping ................................ 193
- <split_name>/net_ext ................................ 195
- <split_name>/pin_rules ............................. 195
Chapter 11  Symbol Definitions

Standard Symbols .......................................................... 202
  Round ................................................................. 202
  Square ............................................................... 202
  Rectangle ............................................................ 202
  Rounded Rectangle .................................................. 203
  Chamfered Rectangle ................................................ 203
  Oval ................................................................. 203
  Diamond ............................................................. 204
  Octagon .............................................................. 204
  Round Donut .......................................................... 204
  Square Donut ......................................................... 205
  Square/Round Donut .................................................. 205
  Rounded Square Donut ............................................... 205
  Rectangle Donut ...................................................... 206
  Rounded Rectangle Donut ............................................ 206
  Oval Donut ........................................................... 206
  Horizontal Hexagon ................................................... 207
  Vertical Hexagon ....................................................... 207
  Butterfly .............................................................. 207
  Square Butterfly ..................................................... 208
  Triangle .............................................................. 208
  Half Oval .............................................................. 208
  Round Thermal (Rounded) ............................................. 209
  Round Thermal (Squared) ............................................. 209
  Square Thermal ....................................................... 209
  Square Thermal (Open Corners) .................................... 210
  Square-Round Thermal ................................................ 210
  Rectangular Thermal .................................................. 210
  Rectangular Thermal (Open Corners) .............................. 211
  Rounded Square Thermal ............................................. 211
  Rounded Square Thermal (Open Corners) .......................... 212
  RoundedRectangle Thermal ............................................ 212
  RoundedRectangle Thermal (Open Corners) .......................... 213
  Oval Thermal ........................................................ 213
  Oval Thermal (Open Corners) ........................................ 214
  Ellipse .............................................................. 214
  Moire ............................................................... 214
  Hole ................................................................. 215
Null ................................................................. 215
Rotated Standard Symbols ................................. 215

Appendix A  System Attributes
Attribute List .................................................. 216

Appendix B  System Attributes for Genesis
Attribute List .................................................. 261

Appendix C  Frequently Asked Questions
Chapter 1  

Overview

Introduction

This book contains the full description of the ODB++ CAD/CAM/DFM data exchange format. ODB++ is widely accepted within the electronics industry as an efficient way to move printed circuit bare-board, assembly and test data on the manufacturing-engineering level within design/manufacturing supply chains. It is designed as a simple yet comprehensive description of all entities needed in the manufacturing of a printed circuit board.

Intended Readers

This book is intended for those interested in implementing the ODB++ format, for CAD/CAM applications and for interfacing to logistical supply-chain processes.

Versioning

This specification describes the latest version of ODB++. Subsequent updates to the specification will follow sequentially, independent of software program versions. The following tables describe Valor/Frontline products/releases and the ODB++ versions supported.

<table>
<thead>
<tr>
<th>Product</th>
<th>Release</th>
<th>Supported ODB++ Versions (Up to and including)</th>
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<tbody>
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<tr>
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<td>7.5</td>
<td>6.5(^1)</td>
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<tr>
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<td>7.3</td>
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<tr>
<td>Trilogy/Enterprise</td>
<td>6.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>
Chapter 1 Overview

Versioning

1 ODB++ version 6.4 and 6.5 files generated from the Frontline GenFlex product may contain a layer type **MASK** not presently supported by Enterprise / Trilogy version. A dialog box appears informing the user that the unknown layer will be changed to **DOCUMENT** and the context of the layer changed to **MISC**. Data contained in **ADD_TYPE** and **COLOR** is lost.

As of ODB++ version 7.0, the layer type **MASK** is fully supported along with user-defined layer subtypes.

<table>
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<th>Release</th>
<th>Supported ODB++ Versions (Up to and including)</th>
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<tr>
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</tr>
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<td>1.4</td>
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<tr>
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<td>9.6</td>
<td>6.2 (reads 6.3, exports 6.2)²</td>
</tr>
<tr>
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<td>9.5</td>
<td>6.2 (reads 6.3, exports 6.2)²</td>
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<td>6.2 (reads 6.3, exports 6.2)²</td>
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<td>9.2</td>
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<td>6.2 (reads 6.3, exports 6.2)²</td>
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<td>9.1c</td>
<td>6.2 (reads 6.3, exports 6.2)²</td>
</tr>
<tr>
<td>Genesis</td>
<td>9.2b</td>
<td>6.2 (reads 6.3, exports 6.2)²</td>
</tr>
</tbody>
</table>
Chapter 1 Overview

Updates

This section lists the changes made to ODB++ and to the documentation since February 2000.

**ODB++ V.7.0 November 2007**

(Released as V.7.1 for documentation purposes only.)

- Entity names must not begin with the characters hyphen (-) or plus (+). This is in addition to the previously not allowed character, dot (.).
- System attributes are no longer considered core entities, and may differ between Trilogy / Enterprise and Genesis applications. For a current list of supported attributes, see System Attributes and System Attributes for Genesis, respectively.

**ODB++ V.7.0 September 2007**

<jobj_name>/steps/<step_name>/stephdr STEP-REPEAT array

- Steps rotated at any angle are supported. See the STEP-REPEAT array, ANGLE parameter.
- Flipped steps are supported. See the STEP-REPEAT array, FLIP parameter.

**Chapter 1  Overview
Updates**

- **Feature transformation functionality** allows for any angle rotation for pad and text features, including barcode; and the resizing of features, instead of creating special symbols. See the `orient_def` parameter for `pad`, `text` and `barcode` features.

- **Features and coordinates** are saved in the units in which they were created to eliminate the loss of precision due to rounding. See the example under `features`.

- **Checklists can be read in both inches and millimeters.** See the example under `meas_p`.

- **User-defined layer types** are permitted in the layer field `ADD_TYPE`.

Eight new semi-standard symbols added:

- Square/Round Donut
- Rounded Square Donut
- Rectangle Donut
- Rounded Rectangle Donut
- Oval
- Rounded Square Thermal / Rounded Square Thermal (Open Corners)
- Rounded Rectangle Thermal / Rounded Rectangle Thermal (Open Corners)
- Oval Thermal / Oval Thermal (Open Corners)

**ODB++ V.6.5  August-December 2005**

Layer Production Data parameters have been updated for the `LPD` file and an inclusive `LPD_MULTIPLE` file has been added. See “lpd (Layer Production Data)” on page 145.

Supplementary files added to support Orbotech DI machines. *Used by Frontline applications only.* See “DI (Orbotech Direct Imaging Interface)” on page 156.

**ODB++ V.6.4  September 2004**

Layer type `MASK` has been added to the job matrix to accommodate the Frontline GenFlex product along with the two layer fields: `ADD_TYPE` and `COLOR`. See `MASK`, `ADD_TYPE` and `COLOR` in Job Matrix.

**ODB++ V.6.3  July 2004**

`CNSA_NET_TYPE_CLEARANCES` dependent upon area constraints have been greatly expanded to facilitate those clearances used by Cadence Allegro. In order to maintain backward compatibility and reduce the number of redundant records which could result, `CNSA_KEY_NET_TYPE_CLEARANCES` has been added to assign a name, `main_set_name = <set name>` to an existing record of net type.
clearances with the same key values (i.e. constr_area, net_type1, net_type2, and layers). This <set name> is used to create new clearance records with the same specified clearances as those found in main_set_name. See “Dependent Upon Constraint Area” on page 93 and CNSA_KEY_NET_TYPE_CLEARANCES.

**ODB++ V.6.2 February 2004**

Two record types added to the net_prp file:

- **NET_ELECTRICAL_PARAMETERS** contains the electrical parameters of a net designated by set_name read from Cadence Allegro.
- **NET_ECSET_ENTRY** links a specific CAD net to an electrical parameter set.

See “Net Type Electrical Parameter Set” on page 96 and “Electrical Set Entry Record” on page 97.

**November 2003**

Description Aliases, added to the BOM entity to enable 10 descriptive CPN fields and 10 descriptive MPN fields to be replaced with user-defined fields in any of the possible languages of Environment Variable GENESIS_LANG. See “# Description Aliases” on page 79.

**NET_TYPE_CLEARANCES** as well as **NET_TYPE_PHYSICAL_PARAMS** can now be dependent upon “constraint areas”. See “Dependent Upon Constraint Area” on page 93.

**ODB++V.6.1 (B.06) June 2003**

The following ODB++ entities have been affected by encryption:

- `<job_name>/steps/<step_name>/eda/vpl_pkgs` (See “vpl_pkgs” on page 91.)
- `<job_name>/steps/<step_name>/layers/<layer_name>/components3` (See “components3” on page 121.)
- `<job_name>/steps/<step_name>/chk/<checklist_name>/actions/<action_num>/def/hdr_p` (See “def/hdr_p” on page 185.)
- `<job_name>/steps/<step_name>/chk/<checklist_name>/actions/<action_num>/res/hdr_p` (See “res/hdr_p” on page 186.)
- `<job_name>/steps/<step_name>/chk/<checklist_name>/actions/<action_num>/res/report/text_p` (See “report/text_p” on page 187.)
- `<job_name>/steps/<step_name>/chk/<checklist_name>/actions/<action_num>/res/sres/<layer_name>/meas_p` (See “meas_p” on page 189.)

The **components3** file replaces components2 representing component data after processing with Assembly Merge (BOM Merge, Library Merge and Board Merge). See “components3” on page 121.

The following ODB++ entities have had the letter ‘p’ appended to their names.

- `<job_name>/steps/<step_name>/chk/<checklist_name>/actions/<action_num>/res/report/tags_p`
- `<job_name>/steps/<step_name>/chk/<checklist_name>/actions/<action_num>/res/sres/<layer_name>/disp_p`
Chapter 1  Overview
Updates

**ODB++ V.6.0 March 2002**

<job_name>/stackups/<stackup_name>/stackup

Addition of a sub_lam record.

<job_name>/steps/<step_name>/netlists/cadnet/netlist

New parameter added to net point description:

<table>
<thead>
<tr>
<th>is_shrink</th>
<th>Y - point size was shrunk to fit solder-mask opening.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N - point size is limited only by pad size.</td>
</tr>
</tbody>
</table>

**ODB++ V.6.0 September 2001 (B.04)**

<job_name>/steps/<step_name>/layers/<layer_name>/cdr_sets/<set_name>/cdrhdr2

- These (“<set_name>cdrhdr2 (CDR14 Header - Additional)” on page 136) are CDR parameter values in addition to those in “<set_name>cdrhdr (CDR Header)” on page 135. All the files under the cdr_sets directory are new, as below:

  .../cdrhdr
  .../cdrhdr2
  .../steps/cdr14_stp_main
  .../steps/cdr14_stp_pos
  .../steps/cdr14_stp_neg
  .../steps/clone_<step_name>
  .../steps/clone_<step_name>_pos
  .../steps/cdr14_stp_on_clones
  .../steps/user_def_<step_name>
  .../steps/user_def_<step_name>_pos

<job_name>/steps/<step_name>/layers/<layer_name>/cdr14

- The following directories (“user_def_<step_name> (Steps in AOI)” on page 134) have been introduced:

  .../steps/user_def_<step_name>
  .../steps/user_def_<step_name>_pos

<job_name>/steps/<step_name>/layers/<layer_name>/ncd/<ncd-set_name>/header

NCD header and related NCD entities introduced, as follows:

  Header - .../<layer name>/ncd/<ncd-set name>/header
  Table - .../<layer name>/ncd/<ncd-set name>/table
  Drill - .../<layer name>/ncd/<ncd-set name>/drill.<split number>.<stage number>

<job_name>/steps/<step_name>/layers/<layer_name>/ncr/<ncr-set_name>/header

NCR header - .../<layer name>/ncr/<ncr-set name>/header

<job_name>/steps/<step_name>/layers/<layer_name>/tools

Drill Tool entity - .../<layer name>/tools
August 2001

To save the new types of results (Scalar and Text) generated from the two DFM functions `ODB_LAYER_GET_SHAPE_COMP` and `ODB_RES_SET_MEAS_ID_TEXT` with the rest of the results of a checklist, letters that indicate these types have been added to the job file:

```
<job_name>/steps/<step_name>/chk/<checklist_name>/actions/
<action_num>/res/sres/<layer_name>/meas
```

Changes/additions are underlined in the Measurement Identification Structure:

```
<meas_num> <cat_num> <disp_num> <alarm> <ftype1> <fsym1> <ftype2> <fsym2>
```

- `<meas_num>` Serial number of measurement (0 and up). A dash (-) prefix signifies a reference measurement.
- `<cat_num>` Category number (0 and up) which must refer to a valid category in the `res/hdr` file.
- `<disp_num>` The display record number (0 and up) which must refer to a valid category in the `res/sres/<layer_name>/disp` file.
- `<alarm>` N (no alarm) or Y (alarm). Action may generate alarm measurements which can be listed together with tags, in the textual report.
- `<ftype>` Type of feature which contributed to the measurement:
  - L Line
  - P Pad
  - S Surface
  - A Arc
  - T Text feature
  - C Component (top)
  - c Component (bottom)
  - N Net
  - D Diff. pair
  - X Free text
  - V Scalar value
  - U Unit-sensitive scalar value
  - Q Square area scalar value
- `<fsym>` Symbol of feature/component which contributed to the measurement:
  - For L, P, S, A and T - name of a valid symbol
  - For C or c - reference designator of the component
  - For N - name of the net
  - For D - name of the differential pair net
  - For X - a text string (without spaces)
  - For V, U and Q - a scalar value

ODB++ V.5.3

```
<job_name>/steps/<step_name>/chk/<checklist_name>/actions/<action_num>/res/
sres/<layer_name>/meas
```

- New symbols for `<ftype>` and `<fsym>`. See “meas_p” on page 189.

```
<job_name>/steps/<step_name>/eda/data
```

- New net Attributes. See “Job>Steps>et (Electrical Test)” on page 190.

```
<job_name>/steps/<step_name>/eda/net_prp
```
Chapter 1 Overview
Conventions and Terminology

• New net type clearances. See “<job_name>/steps/<step_name>/eda/net_prp” on page 92.

ODB++ V.5.2  February 2000

<job_name>/steps/<step_name>/stephdr

• Two new fields added (AFFECTING_BOM & AFFECTING_BOM_CHANGED). See “stephdr (Step Header)” on page 71.

<job_name>/steps/<step_name>/eda/data

• Two new fields added to the PIN Record Structure (<etype> & <mtype>). See “Job>Steps>et (Electrical Test)” on page 190.

<job_name>/steps/<step_name>/netlists/cadnet/netlist

• New parameters added to the Netlist (x, e, & by). See “Netlists” on page 73.

<job_name>/steps/<step_name>/layers/<layer_name>/components2

• New Job Entity. The components file describes the original EDA data for a component, while the components2 file represents component data after processing with Assembly Merge (BOM Merge, Library Merge and Board Merge).

Conventions and Terminology

Entity Definitions

Core

Data entities marked as "core" contain data that form an essential part of modelling the Printed Circuit Assembly (including all aspects of the PCB bare-board). In essence, "core" entities contain all the information necessary for CAM systems to prepare PCB fabrication and assembly operations.

Supplementary

Non-core entities (supplementary) are included in the ODB++ format to support certain CAM and DFM functions specific to certain solution vendors. These supplementary entities are open to all, and are maintained in accordance with the specification, in the same way as the “core” entities.

Hyperlinks

The “Charts” on page 29 are tree-charts that describe the structure of each entity in a job. Blue nodes, usually at the end-nodes of the trees, are hyperlinked. Click to jump to the detailed description of the entity/element.
Chapter 2  

Design Principles

File System

Hierarchy

ODB++ uses a standard file system structure. A job in ODB++ is represented by a stand-alone directory tree that can be transferred between systems without any loss of data.

The advantages of a directory tree compared to one large file are apparent when a job is being read from disk or saved to disk. The flexible tree structure allows only a small part of the job to be read/saved, avoiding the overhead of reading and writing a large file.

When a job tree has to be transferred to another system, standard ‘tar’ and compression utilities can be used to convert a directory tree into one flat file.

Mandatory / Optional Files

The following list specifies the files that are mandatory, while those not mentioned are optional:

For the Job:

job/matrix/matrix

For each Step defined in the Matrix:

job/steps/<step_name>/stephdr

For each Layer defined in the Matrix:

job/steps/<step_name>/layers/<layer_name>/features or job/steps/<step_name>/layers/<layer_name>/features.Z

There are also links between files that are implicitly defined in the ODB++ definition which create dependencies between one file and another. For example, the /<step_name>/layers/comp+_top/components file contains links to /stepname/eda/data.

Legal Entity Names

<table>
<thead>
<tr>
<th>Job name</th>
<th>Layer name</th>
<th>Attribute name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step name</td>
<td>Symbol name</td>
<td>Attribute string</td>
</tr>
</tbody>
</table>

ODB++ entity names must follow these rules:
The length of any name should not exceed 64 characters. However, user attribute strings (not names) are determined by the \texttt{MAX\_LEN, MIN\_LEN} fields in the \texttt{<job\_name>/misc/userattr} Job File (see \texttt{<job\_name>/misc/userattr}).

Use only the following:
- lower case letters ('a' through 'z')
- digits ('0' through '9')
- punctuation - dash (-), underscore (_), dot (.) and plus (+)
- Names must not start with dot (.), hyphen (-), or plus (+) with the exception of attributes which can start with (.)

**Readable ASCII files**

All files in ODB++ are readable ASCII files except those which are Intellectual Property (IP) of Valor Computerized Systems. (This includes Valor VPL packages and checklist data structure.) This concept provides the advanced user with the capability to read database files for understanding. In contrast, binary databases which are still used in older systems prevent the user from reading database files directly and require a special extraction program to retrieve all or part of the database.

In all files, the \# character specifies a comment. Lines which start with this character are ignored by the system and are only used for readability.

The line separator can be either \texttt{<LF>} or \texttt{<CR><LF>}, depending on operating system and platform.

**Units of Measurement**

All units are either imperial units (inches, mils) or metric (mm, micron), depending upon the units directive placed at the beginning of the file. If not defined, the default is imperial.

System resolution is 1/10160 mil or 1/400 of a micron. As a result, minimum line width is 1/400 of a micron wide. Minimum measurable distance, or placement tolerance for any feature is also 1/400 of a micron.

**Large File Compression**

One of the reasons vendors have chosen binary databases in the past was the need to conserve space on hard disks. Modern compression techniques are available today and provide excellent compression ratios, especially for ASCII files with repetitive patterns. Large files in ODB++ are saved in standard UNIX compress format. The compression is optional, and any reader of ODB++ database should expect some files to be in either compressed format (.Z suffix) or without compression. The files which are potentially compressed are clearly identified in the following material.
Sum File

Many of the files in ODB++ have an attached hidden file which provides information about them. The name of the attached file is:

\[ .<name>.sum \]

The file contains the following information:

**Size** - size of the data file

**Sum** - checksum of the file (can be enabled/disabled as a configuration parameter)

**Date** - date in which the file was written, where
- format is mm/dd/yy before software version 4.3
- format is mm/dd/yyyy after version 4.3

**Time** - time of writing

**Version** - version of the software in which the file was saved

**User** - user operating the software when file was last saved

**Note** No verification of the size and sum is done today when the file is read by the system. This was intended to allow advanced users to modify files manually in extreme cases.

Example of a sum file:

```
SIZE=274
SUM=-1
DATE=05/24/97 (after version 4.3 = 05/24/1998)
TIME=20:05:10
VERSION=03.02 (BUILD 00 FOR HP-UX)
USER=MOSHIK
```

Structured Text files

To improve readability, many of the small files in ODB++ contain expressions of the type:

\[ <var>=<value> \]

The main advantages of this structure is readability. The user can open a file and understand its contents without having to refer to external sources.

Example (from the `stephdr` file):

```
X_DATUM=0.3
```

A more elaborate structure, which appears in some structured files, describes arrays. Arrays are lists of elements, each one containing several fields. An array element has the following structure:

```
<array_name> {
    <var>=<value>
    <var>=<value>
    ....
}
```
This element will appear a number of times, each time defining an element of the array.

Example (from the matrix file):

```
 LAYER {
   ROW=1
   CONTEXT=BOARD
   TYPE=COMPONENT
   NAME=COMP_+_TOP
   POLARITY=POSITIVE
   START_NAME=
   END_NAME=
   OLD_NAME=
   ADD_TYPE=MICRO_VIA
   COLOR=606090
 }
```

**Line Record Text files**

Some of the files in the database are relatively large and saving them as structured text files is impractical. These files are saved as line record text files. Each line contains a multitude of fields, typically separated by space characters. Reading or writing such files without proper reference information is more difficult. Typically, the first character or word in each line defines the type of record which the line describes. In many cases, the line order is important. Certain lines require that the following line will exist in a particular sequence.

The maximum characters in one line are, in general, 500 characters, however there are exceptions. Any line over the defined limit will be truncated.

Example (from the feature file):

```
# Feature symbol names
#
$0 r50
$1 r70
$2 r80
$3 r93
$4 ths80x60x0x4x15
#
# Feature attribute names
#
@0 .geometry
@1 .pad_usage
#
# Feature attribute text strings
#
&0 systest_board
&1 term_1
&2 via_1
#
# Layer features
#
```
Chapter 2  Design Principles

Angles

Angles are mainly used to position spokes of thermals and to rotate SMDs. The following rules apply:

- Angle values are expressed as integers within the range 0-359, with angle 0 due East with positive values measured counter-clockwise.
- Angles for rectangular thermals can be in 45 degree increments only, whereas they can be other than multiples of 45 degrees in square/round thermals (when not in 45 degrees, the spoke gap will lie along a line extending from the center).
- When the start and end-point of an arc coincide, it is considered a 360 degree arc. There are no single-point arcs in ODB++.

Rotation / Mirroring

- Feature pads are oriented at 90 degree increments, rotated clockwise.
- Mirroring is only on the X axis (left to right, changing X coordinates).
- Diagonal square lines look like rotated rectangles; the endpoints are also rotated (they are not orthogonal).

Coordinates

- Coordinate units in feature and symbol files are given in inches with a decimal point. Coordinates are always expressed in inches; but symbol sizes are expressed in microns.
- When you specify an x,y location for a text string the bottom left of the first character is positioned at the coordinates.
- Point coordinates in a netlist file represent the center of pads.

Symbols

Symbols define a wide variety of shapes (see below) that are mostly used to draw pads. A symbol is an ODB++ entity that is defined once and used many times in order not to repeat the definition of a group of features in a layer. A symbol contains a ‘features’ file that has a number of primitive features (such as pad, line, surface, arc, etc.) that compose the symbol in a layer.
A symbol can be referenced from a number of layers in the job at different coordinates. Changing the symbol definition will automatically cause all its representations in the layer/s to change accordingly.

ODB++ supports the following types of symbols:

- Standard
- Special (User-Defined)

**Standard Symbols**

Standard symbols are generated dynamically by the system from their names. They do not require a special graphic symbol entity to be saved in the database. They are round, square or parametric shapes.

For lines, symmetric symbols (where width=height) draw lines with width equal to the width of the symbol, as in figure below:

Width of a line is the width of the symmetric symbol used to draw it.

For example, \texttt{r30} is automatically generated as a circle feature with a diameter of 30 (mils), \texttt{s200} is a square with a 200 (mils) diameter (side of square).

Arcs can be drawn with round symbols only.

Pads can be drawn with any symbol. Examples of symbols to draw pads are rectangles = \texttt{rect width x height} (e.g., \texttt{rect100x200}), ovals = \texttt{oval width x height} (e.g \texttt{oval77x90}), octagons = \texttt{hex_s width x height x corner size} (e.g. \texttt{hex_s30x50x12}), and many more.

Units are in imperial units (inches mils).
For example to define a round capped line of width 10 mils, use the symbol ‘r10’. To define the same type line but with a width of 20 mils, specify ‘r20’. To define a square capped line with a width of 10 mils, use ‘s10’.

Drawing a line with an asymmetric symbol generates a one-pixel line ending with the symbol at both ends.

Standard symbols are all positive filled shapes. Holes in symbols are see-through by definition. The internal implementation of complex symbols uses arcs or contour data with cutouts.

**Special (User-Defined) Symbols**

Special symbols are user-defined symbols which have a full graphical description stored in feature files in the job’s symbols subdirectory. They can contain any number of features. Special symbols are defined for a job usually for shapes not found among the standard symbols. Special symbol names cannot be identical to those reserved for standard symbols.

User-defined symbols can be saved within the system and used when needed. The system recalls the graphic shape defined by the user.

**Note** It is always preferable to use a standard symbol, where possible. Special symbols are represented by contours in the shapes list of layer features. Contours require more memory than standard symbols and a great number of them will slow down system processing.

Special symbols are not scalable, such as standard symbols. The reason is that a specific feature file definition is created for each special symbol that defines its shape. Therefore, you need to create a new symbol for each set of parameters. It is preferable to name the symbol to indicate its dimensions.

The figure shows an arrow whose origin (0,0) is at the tip of the butt.

This special symbol is drawn from lines (standard symbols)

When inserting this symbol, the insertion point is at 0,0. This means it is a left arrow.
Symbol Characteristics

Asymmetric vs. Symmetric

When asymmetric symbols (such as rectangles) are used to draw diagonal lines, the lines are single-pixel lines whose end-points are the symbols used to draw the lines (see figure below).

When drawn orthogonally (horizontal: \( y_{\text{start}} = y_{\text{end}} \), or vertical: \( x_{\text{start}} = x_{\text{end}} \)) the output line has the height/width of the asymmetric shape from start point to end point (the line is created by “dragging” the symbol from one end of the line to the other in the same orientation as it was placed).

For example, if the symbol in the figure is dragged vertically, the width of the line will be the width of the symbol. If dragged horizontally, the width will be the height of the symbol.

Note Single-pixel line width is expressed in the internal software resolution of 10160 pixels = 1 mil, or 400 Pixels = 1 micron, meaning that single-pixel lines are 1/400 of a micron wide.

If the symbol used to draw a line is symmetrical (square or round) the generated line is the side or diameter of the symbol. A round symbol (whose name starts with r) generates round line ends, a square symbol (s) generates square line ends.

For arcs, only round symbols can be used.

Holes in surface features are transparent (empty).

Dimensions of standard symbols can be in non-integers with resolutions up to 1/100 mils.

Symbol \( \bullet \) is a legal entity represented by a single pixel width.

The standard Octagon symbol corner size is the distance between the bounding box corner and the vertex.
**Rounded/Chamfered Rectangles**

The corners of rounded/chamfered rectangles can be specified in ascending order counter-clockwise, starting from the top-right corner, as in the following figure:

Rectangle with top right corner chamfered is indicated by: \texttt{rect100x50xc8x1} (1 indicates top-right corner).

**Shape**

An internal geometrical entity (that may consist of a number of features) used by the system during algorithmic operations. Shapes are always positive. They include points, segments, curves, lines, arcs, squares, rectangles and contours. For example, a shape can be a contourized shaved pad that consists of a pad and a feature that shaves it.

**Shapelist**

An internal data structure which, during analysis, is created for a layer upon demand. The shapelist simplifies the representation of a layer within the system by dealing with multiple polarities, odd shape symbols, etc. A Shapelist can be deleted to improve memory usage; it will be rebuilt by the system automatically when needed.

**Order of Holes/Islands in Surfaces**

The order of containment of holes and islands within surfaces determines their natural order. The outermost island comes first. Islands precede holes that are
contained in them. Holes precede islands that are contained in them. Take, for example, the following containment order:

\[
\text{Island A} \quad \text{Hole B} \quad \text{Island C} \quad \text{Island D} \quad \text{Hole E}
\]

Natural Order: \(A \ B \ C \ D \ E\)

Island D is separate from Island A
Chapter 3  

Job Tree

Job Overview

An ODB++ job can include a number of entities, accessed by a specified editor represented by icons in the Engineering Toolkit. (All entities, including those not supported by the Graphic User Interface (GUI), are discussed in “Charts” on page 29.) The following are currently supported in the GUI:

- **Steps**, which are multi-layer entities (e.g. a single image, a sub panel array, a production panel or a multi layer coupon). Each step contains a collection of layers. Layers are two-dimensional sheets, containing graphics, attributes and annotation. Layers express physical board layers, mask layers, NC drill and rout layers and miscellaneous drawings. All steps in one job have the same list of layers, albeit the contents may be totally different.

- **A Matrix**, in which the rows are the job layers and the columns are the job steps. The matrix contains for each row additional information such as the type, polarity and context. The matrix is also crucial in defining the physical order of the layers and the relation of drill layers (through, blind, buried, etc.).

- **Symbols**, single layer graphic entities which can be referenced from within any graphical layer in a step.

- **Work Forms**, user defined collection of fields (textual and graphical) and buttons.

- **Attributes**, user-defined attributes to facilitate automation.

- **Wheels**, aperture tables created in the Wheel Editor Popup.

- **Input**, automatically identifies the format type of the incoming data (Gerber, Excellon drill, etc.) and interprets the Gerber wheel based on predefined wheel templates.

- **Output**, multiple format translators to choose the output device.

- **User**, where user can store his own files.
Stackups and Work Flows may appear if the job contains legacy data.

Each Step entity contains, in addition to general information and the list of layers, several other important subentries:

- Step & repeat information (in the stephdr file), specifying any previous steps which are included in this one and their relative location and orientation.
- Up to three netlists of the step (CAD netlist, reference netlist and current netlist).
- An EDA object, containing data regarding the component packages and pins. It also contains information about the relation of features in the board layers to specific design nets and properties imported from the EDA system.
- An unlimited number of checklists, each one is composed of analysis or DFM actions. An action contains the definitions (parameters to run with) and the results (measurements) of the last successful run.
- A profile which is a schematic border around the step.

Charts

An ODB++ job is a directory, containing a large number of sub-directories. The following charts describe all main- and sub-directories in chart form. Click on blue nodes to jump to a full description of that entity. Users can create additional directories—for example, xml, whltemps, etc.—as long as they do not conflict with ODB++ standard directories. Directories, no longer supported, may appear in ODB++ jobs containing legacy data. This is noted in the specification.

- indicates a Core entity that contains data essential to modelling a PCB.
- indicates a Supplemental entity with ODB++ format that supports certain CAM and DFM functions.
Chapter 3 Job Tree

Charts

Job Chart

Blue boxes are hyperlinked to the description of the entity.

Red ‘C’ diamonds indicate a Core entity.

Green ‘S’ ellipses indicate a Supplementary entity.

<job_name>

<step_name>

<symbol_name>

<attribute_name>

last_save

userattr

<wheel_name>

<form_name>

<flow_name>

<standard>

<stackup_name>

input

output

user

ext
Chapter 3 Job Tree
Charts

Job>steps

Job>steps>layers

Click for cdr12/cdr_sets Chart

Click for NCR/NCD Chart
Chapter 3 Job Tree
Charts

Job>steps>chk (Checklist)

<checklist_name>

actions

<action_number>

res

... 

def

hdr

(hdr)

report

(tags)

(res)

report

(tags)

sres

<layer_name>

... 

Job>steps>et (Electrical Test)

<etset_name>

netlist

* Netlist is identical in type to the other netlists.

See below

... 

Job>steps>et<split_name>

<split_name>

hdr

(mapping)

<split_name>

net_ext

(pin_rules)

<split_name>

adapter_top

(desc)

<split_name>

const_drill

(layer_name)

<split_name>

adapter_bot

(desc)

<split_name>

const_drill

(layer_name)

<split_name>

pins

<split_name>

output
**ncr - ncd**

- ncr
  - `<ncr_set name>`
    - header
    - order
    - table
- ncd
  - `<ncd_set name>`
    - header
    - order
    - table

**cdr14 - cdr_sets**

- cdrhdr
  - cdr14
    - steps
      - `<layer_name>`

- cdrhdr
  - cdr_sets
    - `<set name>`
      - steps
Chapter 4  

Job Entity Database

This chapter describes in detail each element of the Job Entity database.

steps (See Chapter 5)

symbols (System and User Symbols)

attrlist (Attribute List)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path:</td>
<td>&lt;job_name&gt;/symbols/&lt;symbol_name&gt;/attrlist</td>
</tr>
</tbody>
</table>

This file contains the values for attributes (system and user) of a symbol.
For a list of symbols, see “Symbol Definitions” on page 202.

Example

```plaintext
.out_break  = no
.out_scale  = no
.break_away = no
.fill_dx    = 0.100000
.fill_dy    = 0.100000
.image_dx   = -1.000000
.image_dy   = -1.000000
.connector  = no
.target     = no
.component   =
.comment    =
hole_type   = plated
.serial_number = 15
```
Chapter 4  Job Entity Database

matrix (Job Matrix)

This file contains all the information which represents the Job Matrix. The Job Matrix is a two-dimensional array, where columns are steps - multi-layer entities (such as single images, sub panel arrays, production panels and coupons) and rows are layers - sheets on which elements are drawn for plotting, drilling and routing or assembly.

Each job can contain only one matrix file. The library job can contain several matrices.

Example

```
STEP {
    COL=1
    NAME=PCB
}
STEP {
    COL=2
    NAME=PANEL
}
```
... 

```text
LAYER {
  ROW=1
  CONTEXT=BOARD
  TYPE=COMPONENT
  NAME=COMP_+_TOP
  POLARITY=POSITIVE
  START_NAME=
  END_NAME=
  OLD_NAME=
  ADD_TYPE=
  COLOR=606090
}
LAYER {
  ROW=2
  CONTEXT=BOARD
  TYPE=SILK_SCREEN
  NAME=SST
  OLD_NAME =
  POLARITY=POSITIVE
  START_NAME=
  END_NAME=
  OLD_NAME=
  ADD_TYPE=
  COLOR=606090
}
...
```

The file contains two arrays: **STEP** and **LAYER**

Fields in the **STEP** array:

<table>
<thead>
<tr>
<th>COL</th>
<th>The number of the column in the matrix. Columns must be unique positive numbers (1 and above). Gaps are allowed between columns, causing vertical gaps to be created between steps in the displayed matrix.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>The name of the step, according to the legal entity names described earlier. Each named step MUST have a step entity defined under the steps directory of the job, otherwise the job may be unreadable.</td>
</tr>
</tbody>
</table>

Fields in the **LAYER** array:

<table>
<thead>
<tr>
<th>ROW</th>
<th>The number of the row in the matrix. Rows must be unique positive numbers (1 and above). Gaps are allowed between rows, causing horizontal gaps to be created between layers in the displayed matrix.</th>
</tr>
</thead>
</table>
| CONTEXT | The layer context must be one of the two values:
  - **BOARD** A layer which participates in the actual board production
  - **MISC** Any other layer which is used for drawings, testing, etc. |
## Chapter 4  Job Entity Database

### matrix (Job Matrix)

The layers should be ordered according to the stackup of the board, such as:

<table>
<thead>
<tr>
<th>TYPE</th>
<th>The layer type must be one of the following values:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNAL</td>
<td>A layer used for regular signal transfer</td>
</tr>
<tr>
<td>POWER_GROUND</td>
<td>A plane layer, used for power or ground signals</td>
</tr>
<tr>
<td>MIXED</td>
<td>A combination of a signal and a plane layer</td>
</tr>
<tr>
<td>SOLDER_MASK</td>
<td>A layer used for solder mask application</td>
</tr>
<tr>
<td>SOLDER_PASTE</td>
<td>A layer used for depositing solder paste for assembly</td>
</tr>
<tr>
<td>SILK_SCREEN</td>
<td>A layer used for application of text legend</td>
</tr>
<tr>
<td>DRILL</td>
<td>A layer used to produce drill programs</td>
</tr>
<tr>
<td>ROUT</td>
<td>A layer used to produce rout program</td>
</tr>
<tr>
<td>DOCUMENT</td>
<td>A layer used for drawings, testing, auxiliary processes, etc.</td>
</tr>
<tr>
<td>COMPONENT</td>
<td>A layer containing components locations and outlines.</td>
</tr>
<tr>
<td>MASK</td>
<td>A layer containing additional information used by the Frontline GenFlex product.</td>
</tr>
</tbody>
</table>

| NAME      | The name of the layer, according to the legal entity names described earlier. Each named layer MUST have a layer entity defined under the layers directory of each step in the job, otherwise the job may be unreadable. |

| OLD_NAME  | The previous name of the layer. When this field has a value it means that a matrix layer has been renamed and this value is its old name. If the field is blank it means the layer has not been renamed. |

| POLARITY  | This parameter describes the polarity of a whole layer. It is applied to the image when output (to a photoplotter for example). The layer polarity must be one of the two values: |
| POSITIVE | A copper layer in which features represent copper |
| NEGATIVE | A copper layer in which features represent laminate |

| START_NAME, END_NAME | These fields are only active for drill and rout layers. They specify the span of the drill or rout, in case it is partial (e.g. blind or buried via layers). Each field must be a valid board layer name. When the fields are empty, START_NAME is assumed to be the first board layer (which is not a drill or rout layer) and END_NAME is assumed to be the last board layer (which is not a drill or rout layer). |

| ADD_TYPE | The layer subtype names—for example, COVERLAY, RCOAT, PUNCH, STIFFENER, BEND_AREA, and PSA. The TYPE field of these types is one of the existing types (SM, ROUT, etc.). |

### Note: In V6.x, only basic support for these fields was available, and data was stored on DOC layers. As of V7.0, this field is user-defined, making other subtypes, such as MICRO_VIA, POWER, GROUND, etc. possible, and the user-define hierarchy is maintained. |

| COLOR     | The RGA representation in percent of the color for display of the layer. |
New Layer Types Required for GenFlex 6.4

Several layer types were added to GenFlex to meet the unique needs of the Flex industry:

Mask - Base type for all mask types
Coverlay - (Base type: solder_mask) Clearances of a coverlay layer
Covercoat - (Base type: solder_mask) Clearances of a covercoat layer
Punch - (Base type: rout) The pattern to be punched by a die-cut fixture
Stiffener - (Base type: mask) Shapes and locations where stiffener material will be placed on the PCB
Bend Area - (Base type: mask) For labeling areas on the PCB that will be bent when the PCB is in use
PSA (Pressure Sensitive Adhesive) - (Base type: mask) Shapes and locations where PSA material will be placed on the PCB
Area - (Base type: document) Area definition.
Exposed Area - (Base type: document) Define the exposed area of an inner layer, and the solder mask/coverlay of the exposed area.
Signal Flex - (Base type: signal) Signal layer for flex board.
Power Ground Flex - (Base type: pg) Power ground layer for flex board.
Mixed Flex - (Base type: mixed) Mixed layer for flex board.
Drawing - (Base type: Doc) Drawing layer definition

Plating_mask (Base type: Mask) Defines which features in the adjacent copper layer should be plated
Immersion_mask (Base type: Mask) Defines which features are to be covered during immersion gold process
Osp_mask (Base type: Mask) Defines which features are to be covered with osp finish
Silver_mask (Base type: Mask) Defines the silver mask of the adjacent copper layer.

New types are used in a file `<job_name>/matrix` as an additional values to the layer parameter type (TYPE = Stiffener).

**New Fields in Layer Group Required for GenFlex 6.4**

**Attached layers** – List of layers attached to an area layer.

New field is used in the file `<job_name>/matrix`, in the layer group.

**Orientation** – Defines the orientation of a layers.

Options are: NOT_DEFINED, UPWARDS, DOWNWARDS

Default value: NOT_DEFINED.

**misc (Miscellaneous)**

**attrlist (Attributes Used in Job)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>Yes</td>
</tr>
<tr>
<td>Path</td>
<td><code>&lt;job_name&gt;/misc/attrlist</code></td>
</tr>
</tbody>
</table>

This file contains the values for attributes (system and user) of a job. Only attributes (system and user) that have been defined are stored in the job.

**Example**

```plaintext
.customer = abc
customer = no
target = no
```

The file contains lines of the form:

```plaintext
<attribute> = <value>
```

System attributes for a job include:

```plaintext
.customer
comment
.primary_side
```
Chapter 4  Job Entity Database
misc (Miscellaneous)

last_save (Last Time Job Saved)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line record text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
</tbody>
</table>

This file is written each time a “save” operation is done on a job. It records the time of the save operation.

Example

961224.183210

The file has one line of the format yyyymmdd.hhmmss.

info (Basic Job Information)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line record text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
</tbody>
</table>

This file is written each time a “save” operation is done on a job. It records basic information on the job.

When a job is “opened” within a Valor application, the MAJOR_VERSION information is read to ensure that it is compatible with the application. If the MAJOR_VERSION number saved in the info file is greater than the number of the highest supported MAJOR VERSION, the application does not open the job and an error message is displayed.

Example

JOB_NAME=k10025_cd2
ODB_VERSION_MAJOR=6
ODB_VERSION_MINOR=2
ODB_SOURCE=Zuken BD
CREATION_DATE=20030727.091213
SAVE_DATE=20030727.091230
SAVE_APP=Trilogy 5000 7.0
SAVE_USER=mikel
where:

- **JOB_NAME** is the name of the job.
- **ODB_VERSION_MAJOR** is the major version designation such as ‘6’ in Version 6.2.
- **ODB_VERSION_MINOR** is the minor version designation such as ‘.2’ in Version 6.2.
- **ODB_SOURCE** is the source of data, typically a CAD/EDA system name.
- **CREATION_DATE** and **SAVE_DATE** follow the format `yyyyMMdd.hhmmss`.
- **SAVE_APP** is the name and number of the application in which the job was saved along with the currently running software version.
- **SAVE_USER** is the login name of the user saving the file.

### userattr (User Attributes)

<table>
<thead>
<tr>
<th>Type</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(&lt;job_name&gt;/misc/userattr)</td>
</tr>
</tbody>
</table>

This file contains a list of the user attributes which were defined in the library at the time the job was created. It is read each time when the job is opened. All user attributes, for all entities are listed here.

#### Example

```plaintext
BOOLEAN {
    NAME=CONNECTOR
    PROMPT=CONNECTOR :
    ENTITY=ALL
    DEF=NO
}
```

#### Description

The file contains several arrays. Each array corresponds to one type of attribute:

- **BOOLEAN**
- **TEXT**
- **OPTION**
- **INTEGER**
- **FLOAT**

Fields for a structure of type **BOOLEAN**:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>The name of the attribute</td>
</tr>
<tr>
<td>PROMPT</td>
<td>The prompt used on the screen when this attribute is displayed</td>
</tr>
<tr>
<td>ENTITY</td>
<td>The entities for which this attribute is applicable. A semi colon separated list of entity types of: job, step, symbol, layer, stackup, wheel, feature, component</td>
</tr>
<tr>
<td>DEF</td>
<td>Default value (NO or YES)</td>
</tr>
</tbody>
</table>
Fields for a structure of type **TEXT**:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>The name of the attribute</td>
</tr>
<tr>
<td>PROMPT</td>
<td>The prompt used on the screen when this attribute is displayed</td>
</tr>
<tr>
<td>MIN_LEN</td>
<td>Minimum length of the text attribute</td>
</tr>
<tr>
<td>MAX_LEN</td>
<td>Maximum length of the text attribute</td>
</tr>
<tr>
<td>ENTITY</td>
<td>See ENTITY for BOOLEAN</td>
</tr>
<tr>
<td>DEF</td>
<td>Default value</td>
</tr>
</tbody>
</table>

Fields for a structure of type **OPTION**:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>The name of the attribute</td>
</tr>
<tr>
<td>PROMPT</td>
<td>The prompt used on the screen when this attribute is displayed</td>
</tr>
<tr>
<td>OPTIONS</td>
<td>A semi colon (;) separated list of options</td>
</tr>
<tr>
<td>DELETED</td>
<td>A semi colon (;) separated list of the values YES and NO. This corresponds to the list of options, possibly causing an option to be deleted (YES value)</td>
</tr>
<tr>
<td>ENTITY</td>
<td>See ENTITY for BOOLEAN</td>
</tr>
<tr>
<td>DEF</td>
<td>Default value</td>
</tr>
</tbody>
</table>

Fields for a structure of type **INTEGER**:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>The name of the attribute</td>
</tr>
<tr>
<td>PROMPT</td>
<td>The prompt used on the screen when this attribute is displayed</td>
</tr>
<tr>
<td>MIN_VAL</td>
<td>Minimum value for the integer attribute</td>
</tr>
<tr>
<td>MAX_VAL</td>
<td>Maximum value for the integer attribute</td>
</tr>
<tr>
<td>ENTITY</td>
<td>See ENTITY for BOOLEAN</td>
</tr>
<tr>
<td>DEF</td>
<td>Default value</td>
</tr>
</tbody>
</table>

Fields for a structure of type **FLOAT**:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>The name of the attribute</td>
</tr>
<tr>
<td>PROMPT</td>
<td>The prompt used on the screen when this attribute is displayed</td>
</tr>
<tr>
<td>MIN_VAL</td>
<td>Minimum value for the float attribute</td>
</tr>
<tr>
<td>MAX_VAL</td>
<td>Maximum value for the float attribute</td>
</tr>
<tr>
<td>ENTITY</td>
<td>See ENTITY for BOOLEAN</td>
</tr>
<tr>
<td>DEF</td>
<td>Default value</td>
</tr>
<tr>
<td>UNITS</td>
<td><strong>NO_UNITS, INCH MM or MIL_MICRONS</strong>. Affects the way the value is displayed (digits after the decimal point).</td>
</tr>
</tbody>
</table>


**wheels (Gerber and tool wheels)**

**attrlist (Attributes Values)**

- **Type:** Structured Text
- **Compression:** None
- **Sum file:** Yes
- **Path:** `<job_name>/wheels/<wheel_name>/attrlist`

This file contains the values for attributes (system and user) of a wheel.

**Example**

```
comment=<company> wheel
```

**dcodes (Wheel Dcodes Definition)**

- **Type:** Line Records Text
- **Compression:** None
- **Sum file:** Yes
- **Path:** `<job_name>/wheels/<wheel_name>/dcodes`

This file saves a wheel which is used during Gerber input.

**Example**

```
dcode10 r12
  0 no_mirror
dcode11 r50
  0 no_mirror
dcode12 r60
  0 no_mirror
dcode13 r10
  0 no_mirror
dcode14 r70
  0 no_mirror
dcode15 r80
  0 no_mirror
dcode17 r5
  0 no_mirror
```

Each line in the file has the format:

```
dcode<n> <symbol_name> <angle> <mirror>
```
Where:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>Dcode number</td>
</tr>
<tr>
<td>sym_name</td>
<td>Symbol name</td>
</tr>
<tr>
<td>angle</td>
<td>Always 0 (reserved for future use)</td>
</tr>
<tr>
<td>mirror</td>
<td>Always no_mirror (reserved for future use)</td>
</tr>
</tbody>
</table>

---

**forms (Work Forms)**

**dat/files/<file_name> (Image File)**

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>XPM or TIFF</td>
</tr>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/forms/&lt;form_name&gt;/dat/files/&lt;file_name&gt;</td>
</tr>
</tbody>
</table>

This file corresponds to a form field of the type picture or drawing. It contains a graphical image which is stored in this field. The name of the file must be the same as the name of the field.

**Example**

```c
/* XPM */
static char * gns- genesis186d4.1071 [] =
{
  /* width height ncolors cpp [x_hot y_hot] */
  "181 172 3 1 0 0",
  /* colors */
  " c #EBEBF0CFCF",
  "! c #FCFC00000000",
  "# c #00000000FCFC",
  /* pixels */
  " !!!!!!!!!!!!!!!!!!!!!!!!!!!",
  " !!!!!!!!!! !!!!!!!!!!!!!!!!",
  " !!!!!!!!!! !!!!!!!!!!!!!!!!",
  ....
  " !!!!!!!!!!!!!!!!!!!!!!!!!!!"};
```

**Full Description**

The system currently recognizes 2 standard formats for graphical images:
Chapter 4  Job Entity Database
forms (Work Forms)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>XPM</strong></td>
<td>X11 pixmap, created by the HP Vueicon program</td>
</tr>
<tr>
<td><strong>TIFF</strong></td>
<td>Tagged Image File Format, created by various packages</td>
</tr>
</tbody>
</table>

**dat/hdr (Data Header)**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path:</td>
<td>&lt;job_name&gt;/forms/&lt;form_name&gt;/dat/hdr</td>
</tr>
</tbody>
</table>

This file contains the textual contents for various fields in a Work Form. It is updated each time the form contents is changed.

**Example**

```
STEP=pcb
LAYER_1=L1
1_MIN_P2P=3
1_TYP_P2P=5
1_MIN_P2C=3
1_TYP_P2C=5
1_MIN_C2C=4
1_TYP_C2C=6
```

Each line of the file has the following structure:

```
<field> = <value>
```

Where:

<table>
<thead>
<tr>
<th><strong>&lt;field&gt;</strong></th>
<th>The internal (not displayed) name of the form field. This name must exist inside the definition portion of the form.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>&lt;value&gt;</strong></td>
<td>The string which represents the contents of the form field.</td>
</tr>
</tbody>
</table>

**def/hdr (Definition Header)**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path:</td>
<td>&lt;job_name&gt;/forms/&lt;form_name&gt;/def/hdr</td>
</tr>
</tbody>
</table>

---

ODB++ Specification 46
This file contains the definition of Work Form fields, including their types, geometry, action, etc.

**Example**

```example
form {
  VER=0
  LABEL=analysis_results
  UNITS=I
  W=6500
  H=6500
  ACT=
  CLOSE_ACT=
  AUTO_UPDATE=YES
}
textf STEP {
  g {
    X=0
    Y=5736
    W=3501
    H=385
    BW=1
    BG=999980
    READABLE=YES
    EDITABLE=YES
    LTYPE=L
    FONT=tbr18
    LABEL=Step:
    PIXMAP=
    OR=H
  }
  cb {
    HELP=
    ACT=
  }
  te {
    FONT=tbr18
    NUMROWS=1
    NUMCOLS=0
  }
}
```

The file consists of multiple objects, each one representing one field in the form. The first object contains definitions about the form itself. Its structure is:

```plaintext
form {
  <field> = <value>
  ....
}
```
<field> can be one of the following types:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VER</td>
<td>Version number (Reserved for future use)</td>
</tr>
<tr>
<td>LABEL</td>
<td>Form name, to be displayed in the title bar</td>
</tr>
<tr>
<td>UNITS</td>
<td>Should be 0 (Reserved for future use)</td>
</tr>
<tr>
<td>W</td>
<td>Width of the form, in mils (0.001”)</td>
</tr>
<tr>
<td>H</td>
<td>Height of the form, in mils (0.001”)</td>
</tr>
<tr>
<td>ACT</td>
<td>Name of a call back to be activated each time the form is displayed</td>
</tr>
<tr>
<td>CLOSE_ACT</td>
<td>Name of a call back to be activated each time the form is closed.</td>
</tr>
<tr>
<td>AUTO_UPDATE</td>
<td>YES if the form definition is to be updated from the library each time the form is opened. NO if the form definition should not be affected by library changes.</td>
</tr>
</tbody>
</table>

Each following object has the following structure (note that not all substructure appear for each object):

```
<type> <name> {
  g {
    <field> = <value>
    ....
  }
  cb {
    <field> = <value>
    ....
  }
  te {
    <field> = <value>
    ....
  }
  ce {
    <field> = <value>
    ....
  }
  se {
    <field> = <value>
    ....
  }
}
```

<type> can be one of the following values:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sep</td>
<td>A separator object</td>
</tr>
<tr>
<td>label</td>
<td>A label object</td>
</tr>
<tr>
<td>textf</td>
<td>A text field object</td>
</tr>
<tr>
<td>choice</td>
<td>A radio, set or option menu object</td>
</tr>
<tr>
<td>picture</td>
<td>A graphical image</td>
</tr>
<tr>
<td>drawing</td>
<td>A graphical image</td>
</tr>
<tr>
<td>scale</td>
<td>A slider field</td>
</tr>
<tr>
<td>button</td>
<td>A push button object</td>
</tr>
</tbody>
</table>
The following table represents the mapping between object types and the substructures which appear in its definition:

<table>
<thead>
<tr>
<th></th>
<th>g</th>
<th>cb</th>
<th>te</th>
<th>ce</th>
<th>se</th>
</tr>
</thead>
<tbody>
<tr>
<td>sep</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>label</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>textf</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>choice</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>picture</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>drawing</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>scale</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>button</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The fields which are available inside each structure are described below. The g (geometry) fields:

- **X**: X coordinate of the field lower left (in mils)
- **Y**: Y coordinate of the field lower left (in mils)
- **W**: Width of the field (in mils)
- **H**: Height of the field (in mils)
- **BW**: Border width (in screen pixels)
- **BG**: Background color (A 6 digit number - rrggb):
  - **rr**: red value between 0 and 99
  - **gg**: green value between 0 and 99
  - **bb**: blue value between 0 and 99
- **READABLE**: YES - if the field contents are to be displayed!
  - NO - if the field contents have to be hidden
- **EDITABLE**: YES - if the field can be edited on screen by the operator
  - NO - if the field is for display only
- **LTYPE**: L - for a textual label
  - P - for a pixmap logo
- **FONT**: The font used for the label. A string of the type xzynn where:
  - **x**: t(imes), h(elvetica) or c(ourier)
  - **y**: b(old) or m(edium)
  - **z**: r(egular) or i(italic)
  - **nn**: number of points (10, 12, 14, 18 or 24).
  - 1 point = 1/72”.
- **LABEL**: The text to be displayed in the label
- **JUSTIFY**: The justification of the text in the field (CENTER, LEFT or RIGHT)
- **PIXMAP**: The name of the pixmap used if LTYPE=P. The pixmap resides in the def/pixmaps directory of the form.
- **OR**: orientation of the field (relevant for compound field such as text or choice).
  - H for horizontal
  - V for vertical.
Chapter 4  Job Entity Database forms (Work Forms)

The **cb** (callback) fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HELP</td>
<td>The name of the help file for the field (inside the <code>def/help</code> directory)</td>
</tr>
<tr>
<td>ACT</td>
<td>The name of the activation callback field (inside the <code>def/cb</code> directory)</td>
</tr>
</tbody>
</table>

The **te** (text extension) fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FONT</td>
<td>Font of the user entered text. See FONT in the <code>g</code> (geometry) section above.</td>
</tr>
<tr>
<td>NUMROWS</td>
<td>Number of rows in the field (1 for single line, 2 for multi line)</td>
</tr>
<tr>
<td>NUMCOLS</td>
<td>Should be 0 (Reserved for future use)</td>
</tr>
<tr>
<td>TYPE</td>
<td>Has one of the following values: TEXT Free text, INT Integer values, FLOAT Floating point (real) values, DATE Legal date values, TIME Legal time values</td>
</tr>
<tr>
<td>MIN</td>
<td>Minimal value for type INT or FLOAT</td>
</tr>
<tr>
<td>MAX</td>
<td>Maximal value for type DATE or TIME</td>
</tr>
<tr>
<td>MIN_DATE_TIME</td>
<td>Maximal value for type DATE or TIME</td>
</tr>
<tr>
<td>TEXT_FORMAT</td>
<td>NONE, UPPER_CASE or LOWER_CASE</td>
</tr>
<tr>
<td>DATE_FORMAT</td>
<td>DD/MM/YY, MM/DD/YY or YY/MM/DD</td>
</tr>
<tr>
<td>TIME_FORMAT</td>
<td>HH:MM:SS</td>
</tr>
</tbody>
</table>

The **ce** (choice extension) fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTYPE</td>
<td>L for textual options, P for pixmap (logos) options</td>
</tr>
<tr>
<td>NODE</td>
<td>R for a radio choice field (one of many), S for a set choice field (some or many), M for an option menu choice field (one of many)</td>
</tr>
<tr>
<td>OR</td>
<td>Orientation of the options in the field. H for horizontal, V for vertical</td>
</tr>
<tr>
<td>NUMCOLS</td>
<td>Number of columns for options</td>
</tr>
</tbody>
</table>

The **se** (scale extension) fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN</td>
<td>Minimal value of the slider</td>
</tr>
<tr>
<td>MAX</td>
<td>Maximal value of the slider</td>
</tr>
<tr>
<td>RADIX</td>
<td>Radix value (Currently must be 0)</td>
</tr>
</tbody>
</table>
<help_name> (Help Text)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Free Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path:</td>
<td><code>&lt;job_name&gt;/forms/&lt;form_name&gt;/def/help/&lt;help_name&gt;</code></td>
</tr>
</tbody>
</table>

Contains help text to be used by the user who views the form. This file is only a part of the form definition in the library and is not copied into the form copy inside the job.

**Example**

This field must be filled by the letters A,B,C or D

The file has a free text format.

<pixmap_name> (Pixmap Field File)

<table>
<thead>
<tr>
<th>Type:</th>
<th>XPM format.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path:</td>
<td><code>&lt;job_name&gt;/forms/&lt;form_name&gt;/def/pixmaps/&lt;pixmap_name&gt;</code></td>
</tr>
</tbody>
</table>

This file is used for fields which are of LTYPE=P ( pixmap ). It contains the graphical image to be displayed.

**Example:**

```c
/* XPM */
static char * logo [] = {
  /* width height
  ncolors cpp [x_hot
  y_hot] */
  "66 48 6 1 0 0",
  /* colors */
  " s iconColor2m whitec white",
  ". c #000000000000",
  "X c #FC6C6C6C6C6D4D",
  "o s iconColor5m blackc blue",
  "0 s iconColor3m blackc red",
  "+ s iconColor8m blackc magenta",
  /* pixels */
```
Chapter 4  Job Entity Database  
flows (Job Process Charts)

No longer supported. However, this entity may appear in jobs containing legacy data.

dat/hdr (Data Header)

Type: Line Record Text  
Compression: None  
Sum file: No  
Path <job_name>/flows/<flow_name>/dat/hdr

This file represents the current state of a Work Flow. It contains a subset of the stages defined in the flow definition section and for each stage it holds information about status, date time, and operator.

Example

S0 = START-837427680-john END-837427684-john
S1 = START-837427689-john END-837427693-john
S2 = START-837427698-john END-837427703-john
S3 = Y
S9 = START-837427713-james END-837427717-james
S5 = S6 = START-837427722-james END-837427727-james
S10 = START-837427731-mary END-837427736-mary
S4 = START-837427740-mary
S7 = Minor
S11 = 61
Each line of the file has the following structure:

\[
\text{<stage>} = \text{<value>}
\]

Where:

<table>
<thead>
<tr>
<th>&lt;stage&gt;</th>
<th>The internal (not displayed) name of the flow stage. This name must exist inside the definition portion of the flow.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;value&gt;</td>
<td>A string which differs according to the type of the stage (see below).</td>
</tr>
</tbody>
</table>

\text{<value>} can be:

For a stage of type Condition:

- \text{Y} for yes
- \text{N} for no

For a stage of type Switch:

One of the values allowed for the switch, according to the definition part of the flow.

For a stage of type Stage or Subflow:

- \text{START-time-operator}
- \text{END-time-operator}

\text{Note} 1) time is UNIX time (seconds starting January 1st, 1970)
2) the END string may not appear for stages in progress
3) both START and END may not appear for stages not started yet

**def/hdr (Definition Header)**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/flows/&lt;flow_name&gt;/def/hdr</td>
</tr>
</tbody>
</table>

This file describes the structure of a Work Flow, including all the stages, the relation between them, and various additional information.
Example

flow 0 {
  VER=0
  LABEL=producibility_flow
  AUTO_UPDATE=NO
  MAX_SUBFLOW_LEVEL_ID=1
}

stage 2 {
  LEVEL_ID=1
  NAME=S0
  LABEL=
  TEXT=EDA Input
  FORM=
  GATE=OR
  HELP=
  PRE0=1
  STAGE_ACT=
  OPEN_ACT=
  CLOSE_ACT=
  NEW_LEVEL_ID=0
}

... switch 11 {
  LEVEL_ID=1
  NAME=S7
  LABEL=
  TEXT=Determine Action
  FORM=
  GATE=OR
  HELP=
  PRE0=8
  PRE1=9
  PRE2=10
  PRE3=
  STAGE_ACT=
  OPEN_ACT=
  CLOSE_ACT=
  NEW_LEVEL_ID=0
}

The file consists of the following structures:

  <type> <serial> { 
    fields;
    ...
  }

Where:
<type> is one of:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>flow</td>
<td>Appears once as the first entity of the flow definition</td>
</tr>
<tr>
<td>stage</td>
<td>Appears as many times as needed to represent a stage in the process.</td>
</tr>
<tr>
<td>cond</td>
<td>Appears as many times as needed to represent a condition.</td>
</tr>
<tr>
<td>switch</td>
<td>Appears as many times as needed to represent a switch between multiple stages in the process</td>
</tr>
<tr>
<td>subflow</td>
<td>Appears as many times as needed to represent a composite flow which makes this stage.</td>
</tr>
</tbody>
</table>

<serial> is a unique number identifying the stage for the purpose of referencing from other stages.

The fields of a structure of type flow:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VER</td>
<td>Version number (Reserved for future use)</td>
</tr>
<tr>
<td>LABEL</td>
<td>Flow name to be displayed in the title row</td>
</tr>
<tr>
<td>AUTO_UPDATE</td>
<td>Reserved for future use. Should be set to NO</td>
</tr>
<tr>
<td>MAX_SUBFLOW_LEVEL_ID</td>
<td>Used internally. Should be set to 1.</td>
</tr>
</tbody>
</table>

The fields of all other structures:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEVEL_ID</td>
<td>0 for the first structure (which represents the flow) 1 for all other stages.</td>
</tr>
<tr>
<td>NAME</td>
<td>Internal name of the stage. Used for references from the data section of the Work Flow.</td>
</tr>
<tr>
<td>LABEL</td>
<td>Only for subflow stages. The name of the lower level flow which represents this stage.</td>
</tr>
<tr>
<td>TEXT</td>
<td>The actual text which is displayed on the screen for this stage</td>
</tr>
<tr>
<td>FORM</td>
<td>An optional Work Form which is attached to the stage</td>
</tr>
<tr>
<td>GATE</td>
<td>One of the following values: OR - A stage can be started when at least one of its parents was finished. AND - A stage can be started when all its parents were finished.</td>
</tr>
<tr>
<td>HELP</td>
<td>A name of a file which provides information about the stage and can be displayed when the Work Flow is viewed. The file is a part of the Work Flow definition in the flows/flow_name/def help code directory in the library.</td>
</tr>
<tr>
<td>PRE&lt;n&gt;</td>
<td>Up to 10 (n = 0 to 9) parents of this stage. The value for this field must be a valid serial number of the parent. If the parent is a condition or a switch, the serial number will be followed by the value for which this is the child.</td>
</tr>
</tbody>
</table>

Example

```
switch 11 {
  ...
```
fonts (Fonts used in Job)

standard (Standard Font)

<table>
<thead>
<tr>
<th>Type</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/fonts/standard</td>
</tr>
</tbody>
</table>

This file describes the vector representation of all the characters which can be a part of a text feature inside a layer. The system currently supports one font, named standard.

Example

```
XSIZE 0.302000
YSIZE 0.302000
OFFSET 0.000000
CHAR!
LINE 0.000000 0.000000 0.000000 0.200000 P R 0.012000
LINE 0.000000 -0.100000 0.000000 -0.100000 P R 0.012000
ECHAR
...```

STAGE_ACT

The name of a callback to be executed when a stage changes its status. This field is only used in the main subflow of the flow, which is always the second structure. Callbacks are executed from the def/cb directory in the corresponding flow in the library and are not residing inside the job itself.

OPEN_ACT

The name of the callback to be executed when the flow is displayed. Same rules as STAGE_ACT.

CLOSE_ACT

The name of the callback to be executed when the flow is closed. Same rules as STAGE_ACT.

NEW_LEVEL_ID

For internal use. Must be 1 for the first stage structure and 0 for the rest.
The file consists of a header containing global parameters followed by a collection of character blocks.

The header block consists of 3 lines:

<table>
<thead>
<tr>
<th>XSIZE &lt;size&gt;</th>
<th>Horizontal size of a character, in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>YSIZE &lt;size&gt;</td>
<td>Vertical size of a character, in inches</td>
</tr>
<tr>
<td>OFFSET &lt;size&gt;</td>
<td>Horizontal Distance between the end of one character block and the beginning of the next one.</td>
</tr>
</tbody>
</table>

The character block consists of the following lines:

| CHAR <char> | Defines the ASCII character which is defined by this block |
| LINE <xs> <ys> <xe> <ye> <pol> <shape> <width> | A definition of a line between (xs,ys) and (xe,ye). All coordinates are in inches. <pol> is the polarity of the line (P for positive, N for negative). <shape> is the shape of the ends of the line (R for rounded, S for square). <width> is the line width in inches |
| ECHAR | Ends the definition of a character |

Note The origin of each character is at the lower left corner. For best results, font definition should include all ASCII characters.

**SHX Fonts Directory (AutoCAD vector) (GenFlex 6.4)**

To implement AutoCAD (.SHX) vector font a new directory `<job_name>/fonts_ex/shx/` is used to keep font files (filename.shx). (Downgrade will delete the directory)

**stackups**

No longer supported. However this entity may appear in jobs containing legacy data.

**attrlist (Attribute List)**

| Type: | Structured Text |
| Compression: | None |
This file contains the values for attributes (system and user) of a stackup.

**Example**

```
comment = Final Stackup
```

<table>
<thead>
<tr>
<th>Sum file:</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path</td>
<td><code>&lt;job_name&gt;/stackups/&lt;stackup_name&gt;/attrlist</code></td>
</tr>
</tbody>
</table>

- **fill_table (Prepeg Combinations)**

  Contains the `fill_table` active at the time that the stackup was saved. The `fill_table` is the list of prepreg combinations which may be placed between foil layers.

  **Example**

  ```
  # A - ounce range for first facing copper
  # B - Copper area for first facing copper (percentage)
  # C - Position of first layer (Inner, Outer, Any)
  # D - ounce range for second facing copper
  # E - Copper area for second facing copper (percentage)
  # F - Position of second layer (Inner, Outer, Any)
  # G - Thickness of fill
  # H - Positive tolerance on width of fill
  # I - Negative tolerance on width of fill
  # J - ordered list of names of sheets in fill
  
  begin_fill
  fill ((0-10oz 0-100 any)   (0-10oz  0-100 any)   (2  0.5 0.5)
(1080))
fill ((1-1oz  0-100 out)   (0.5-1oz 0-100 inner) (7  1   1)
(113 116))
  ```
fill ((1-1oz  0-100 inner) (1-1oz   0-100 inner) (113 113))
fill ((1-1oz  0-100 inner) (1-1oz   0-100 inner) (7628 7628))
fill ((1-1oz  0-100 out)  (1-1oz   0-100 inner) (116 116))
fill ((1-2oz  0-100 any)   (1-2oz   0-100 any)   (7628 7628 7628))
fill ((3-4oz  0-100 any)   (3-4oz   0-100 any)   (7628 7628 7628))
fill ((1-2oz  0-100 any)   (1-2oz   0-100 any)   (7629 7629 7629))
fill ((1-2oz  0-100 any)   (1-2oz   0-100 any)   (113 7628 113))
fill ((0.5-1oz 0-100 out)  (1-2oz   0-100 inner) (106 7628 106))
end_fill

The first record describes a 2 mil thick fill:
fill ((0-10oz 0-100 any)   (0-10oz  0-100 any)   (2 0.5 0.5) (1080))

It consists of single sheet of 1080.
It provides a 2 mil spacer between two copper foils with a positive and negative tolerance of 0.5 mils.

Constructed Fill record
The second record describes a 7 mil thick fill:
fill ((1-1oz  0-100 out)   (0.5-1oz 0-100 inner) (7 1 1) (113 116))

– It consists of a sheet of 113 over a sheet of 116.
– It provides a 7 mil spacer between two copper foils with a positive and negative tolerance of 1 mil.
– It may only be used between 1oz copper foil outer layer and 0.5-1oz foil inner layer. It may not be used between other types of foils, or foils located in different layers than those specified (unless the same prepreg combination appears in another record).

The fill records are delimited by **begin_fill** at the beginning and **end_fill** at the end.

The fill records are of the form:
fill ((A B C)   (D E F)   (G H I) (J))

Where the letters contain the following fields:

<table>
<thead>
<tr>
<th>A</th>
<th>Ounce range for first facing copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Copper area for first facing copper (percentage)</td>
</tr>
<tr>
<td>C</td>
<td>Position of first layer (Inner, Outer, Any)</td>
</tr>
<tr>
<td>D</td>
<td>Ounce range for second facing copper</td>
</tr>
<tr>
<td>E</td>
<td>Copper area for second facing copper (percentage)</td>
</tr>
<tr>
<td>F</td>
<td>Position of second layer (Inner, Outer, Any)</td>
</tr>
</tbody>
</table>
Chapter 4  Job Entity Database

stackups

General rules

The prepregs which appear in column J must also appear in the 'material' file. There must also be a material of this kind in the bill file of the construct. The foils described in columns A, B, C may be placed either over or under the prepreg sheet combination. The ounce range and the copper area range should be complete as possible.

Actual copper area calculations are not made on the panels (this allows stackups to be designed prior to panelization).

Instead, the following copper area percentage values are automatically assigned to foils, according to the layer type:

<table>
<thead>
<tr>
<th>Layer type</th>
<th>Assigned copper area</th>
</tr>
</thead>
<tbody>
<tr>
<td>signal</td>
<td>20%</td>
</tr>
<tr>
<td>mixed</td>
<td>50%</td>
</tr>
<tr>
<td>power and ground</td>
<td>80%</td>
</tr>
</tbody>
</table>

material (Material Specifications)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/stackups/&lt;stackup_name&gt;/material</td>
</tr>
</tbody>
</table>

Contains the contents of the generic material file contents at the time that the stackup was saved.

Example

```
pile_begin
#
# Description of foil records
#
# A - Name of foil
# B - Thickness (in ounces) & +/- tolerances
# C - Color in Genesis display
# D - Ductility (HTE or STD)
# E - Resistance (in ohms)
```
Foil Record

The first record describes a conductive foil:

```
elem (Simple (Foil (1oz (1 0 0) 856700 STD)))
```

- Its name is 1oz
- Its weight is one ounce with positive and negative tolerances of zero
- It will be displayed in a color whose Genesis number is 856700
- It has standard ductility (valid options: STD, HTE)

Prepreg Record

The fourth record describes a prepreg:

```
elem (Simple (Prepreg (7628 (7 0.5 0.8) 9900 4.2 20 10 0)))
```

- Its name is 7628

---

Foil Record

The first record describes a conductive foil:

```
elem (Simple (Foil (1oz (1 0 0) 856700 STD)))
```

- Its name is 1oz
- Its weight is one ounce with positive and negative tolerances of zero
- It will be displayed in a color whose Genesis number is 856700
- It has standard ductility (valid options: STD, HTE)

Prepreg Record

The fourth record describes a prepreg:

```
elem (Simple (Prepreg (7628 (7 0.5 0.8) 9900 4.2 20 10 0)))
```

- Its name is 7628

---
It is 7 mils thick, with a positive tolerance of 0.5 mils and a negative tolerance of 0.8 mils.

It will be displayed in a color whose Genesis number is 009900.

It has a dry permittivity value of 4.2.

It has 20% resin content (by weight).

It has a dry weight value of 10.

It has a conductivity value of 0 (zero).

**Laminate Record**

The seventh record describes a laminate.

```
elem (Simple (Laminate (Lam/40 (40 0 0 ) 505050 4.6 0 30 0)))
```

- Its name is Lam/40.
- It is 40 mils thick with positive and negative tolerances of zero mils.
- It will be displayed in a color whose Genesis number is 505050.
- It has a dry permittivity value of 4.6.
- It has a 0% resin content (by weight).
- It has a dry weight value of 30.
- It has a conductivity value of 0 (zero).

**Core Record**

The ninth record describes a copper clad laminate core.

```
elem (Compound (Core fr4/40_1/1 (42.8 0 0) (Foil 1oz) (Lam Lam/40) (Foil 1oz)))
```

- Its name is fr4/40_1/1.
- It is 42.8 mils thick with positive and negative tolerances of zero mils.
- It is constructed of the following layers:
  - A layer of a foil material as described in the first record.
  - A layer of a laminate as described in the third record.
  - A layer of a foil material as described in the first record.

**RCC Record**

Below is a sample record describing the RCC material:

```
elem (Compound (RCC 1825 (1.4 0 0) (Foil (0.5 (0.5 0 0) 856700 STD 0)) (Resin (RES02 (0.7 0.1 0.1) 99 3.43 100 5 0)) (NULL)))
```

The name of the record is 1825. It is 1.4 mils thick with positive and negative tolerances of zero mils. It is constructed of the two following layers:

- A layer of a foil material.
- A layer of a resin material.

**File Structure**

There are three kinds of `elem` records in the file:
1. For foil records
2. For laminate and prepreg records
3. For compound records (Core, RCC).

Foil records are of the following structure:
\texttt{elem (Simple (A (B (C) D E)))}

Where the letters refer to the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Name of foil</td>
</tr>
<tr>
<td>B</td>
<td>Thickness (in ounces) &amp; +/- tolerances</td>
</tr>
<tr>
<td>C</td>
<td>Color in Genesis display</td>
</tr>
<tr>
<td>D</td>
<td>Ductility (HTE or STD)</td>
</tr>
<tr>
<td>E</td>
<td>Resistance (in ohms)</td>
</tr>
</tbody>
</table>

Laminate and prepreg records are of the following form:
\texttt{elem (Simple (A (B (C) D E F G H)))}

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Prepreg or Laminate</td>
</tr>
<tr>
<td>B</td>
<td>Name</td>
</tr>
<tr>
<td>C</td>
<td>Thickness (in mils) &amp; +/- tolerances</td>
</tr>
<tr>
<td>D</td>
<td>Color in Genesis display</td>
</tr>
<tr>
<td>E</td>
<td>Dry permittivity</td>
</tr>
<tr>
<td>F</td>
<td>Resin percentage (by weight)</td>
</tr>
<tr>
<td>G</td>
<td>Dry weight</td>
</tr>
<tr>
<td>H</td>
<td>Conductivity</td>
</tr>
</tbody>
</table>

Compound records are of the following form:
\texttt{elem (Compound (Core A (B) (C D) (E F) (G H)))}

\texttt{or}
\texttt{elem (Compound (RCC A (B) (C D) (E F))())}

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Name</td>
</tr>
<tr>
<td>B</td>
<td>Total Thickness (in mils) &amp; +/- tolerances</td>
</tr>
<tr>
<td>C</td>
<td>Type of top layer</td>
</tr>
<tr>
<td>D</td>
<td>Name of top layer</td>
</tr>
<tr>
<td>E</td>
<td>Type of middle layer</td>
</tr>
<tr>
<td>F</td>
<td>Name of middle layer</td>
</tr>
<tr>
<td>G</td>
<td>Type of bottom layer</td>
</tr>
<tr>
<td>H</td>
<td>Name of bottom layer</td>
</tr>
</tbody>
</table>

\textbf{Note} The \texttt{(G H)} expression is omitted for single sided clad cores and RCC.

General rules:
- The first line of the file and the last line of the file open and close a block.
• Each of the middle lines is a record describing a type of material.
• Any material that appears in a core must be defined as a record by itself as well.
• Material names are limited in length to 16 characters.

**RCC Record**

An RCC material is defined as a compound material, similar to Core. It consists of two layers - Foil and Resin.

### stackup (Build)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/stackups/&lt;stackup_name&gt;/stackup</td>
</tr>
</tbody>
</table>

Describes the build of a stackup.

**Example**

target (112 12 12)
# width height ffu plate_thick mask_thick thick_type vendor layer_match
stk_info 18 24 0 5 2 Laminate Any Yes (drill drill1 drill2 drill3 drill4) (drill drill1)
# The previous line indicates that:
# 18 24: the stackup is made of sheets which are 18 x 24.
# 5: the plating thickness of external layers is 5 mils
# 2: the solder mask thickness is 2 mils
# Laminate: the method for measuring thickness is laminate to laminate
# Any: materials from Any vendor may be used in the stackup
# Yes: one to one correspondence between foil board layers and stackup foil layers.
# (drill drill1 drill2 drill3 drill4): drill layers for sequential lamination.
# (drill drill1): microvia drill layers.
# min sheets max sheets
valid 2 3
# The previous line dictates that the minimum number of prepreg sheets used
# to separate layers is two and the maximum is three.
begin_pile
# thickness is_mirror construct cost resin_Er copper_loss
pile_info (105.7 9.9 9.9) Yes FR-4 11.983 0 0
begin_materials
# A - width
# B - height
# C - cost
# D - Reserved for future use
# E - material (Foil, Prepreg, Laminate, Core)
# F - weave (Vertical, Horizontal Null)
# G - thickness & +/- tolerances
# H - vendor
# I - generic name (from 'material' file)
# J - catalog number (Less than 16 characters preferred)
# K - construct
# L - Whether material is upsidedown in stackup

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>mat</td>
<td>(18 24 0.091 1 Foil None (1 0 0) A 1oz C90126 FR-4 No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 1.58 1 Prepreg None (1.8 0.26 0.26) B 106 Z1261 FR-4 No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 1.58 1 Prepreg None (1.8 0.26 0.26) B 106 Z1261 FR-4 No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 0.139 1 Core None (8.2 1.5 1.5) B 8_1/1 H90120 FR-4 No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 1.2 1 Prepreg None (9.8 0.4 0.4) B 7628_10 Z0044 FR-4 No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 0.139 1 Core None (8.2 1.5 1.5) B 8_1/1 H90120 FR-4 No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 1.2 1 Prepreg None (9.8 0.4 0.4) B 7628_10 Z0044 FR-4 No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 1.2 1 Prepreg None (9.8 0.4 0.4) B 7628_10 Z0044 FR-4 No)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 1.2 1 Prepreg None (9.8 0.4 0.4) B 7628_10 Z0044 FR-4 Yes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 1.58 1 Prepreg None (1.8 0.26 0.26) B 106 Z1261 FR-4 Yes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 1.58 1 Prepreg None (1.8 0.26 0.26) B 106 Z1261 FR-4 Yes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mat</td>
<td>(18 24 0.091 1 Foil None (1 0 0) A 1oz C90126 FR-4 Yes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

end_materials
end_pile

sub_lam ((drill Auto Foil) (drill1 Auto Foil) (drill2 Foil Foil) (drill3 Sheet Foil) (drill4 Mixed Sheet))

**Explanation**

A sub_lam record describes the lamination type of each layer from the sequential lamination list.

A layer record of the form (layer lamination top_lamination):

- **Layer** - drill or rout layer from the sequential lamination list
- **Lamination** - lamination type of the subassembly. Options are: Auto, Foil, Sheet, Mixed.
- **Top_lamination** - when the lamination is Mixed, top_lamination defines the lamination type of the top layer. Options are: Foil, Sheet

The stackup file contains the following records:

- A target record of the form target <target thickness> <positive tolerance> <negative tolerance> where all units are in mils.
- A stk_info record of the form:

  stk_info <width> <height> <unused value> <plate_thick> <mask_thick> <thick_type> <vendor> <layer_match>

  Where the width and height values are the width and eight of the sheets the stackup is made of.

- The unused value is a numeric value reserved for future use.
• The **thick_type** indicates the method used for measuring stackup thickness.

  **vendor** is a vendor name if materials in the stackup are from a particular vendor, or any if materials may come from any vendor.

  **lyr match** indicates whether there is a one to one correspondence between foil board layers and stackup foil layers.

Sequential lamination layers are drill and rout layers that generate sequential lamination requirements.

A **pile** record which is delimited by lines of **begin_pile** and **end_pile**. Containing the subrecords:

**pile_info** which is a record of the form:

```
pile_info (<thickness>) <is_mirror> <construct> <cost> <resin Er> <copper loss>
```

Where:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>thickness</td>
<td>is the calculated thickness of the stackup with tolerances</td>
</tr>
<tr>
<td>is_mirror</td>
<td>indicates whether the stackup is 100% symmetric</td>
</tr>
<tr>
<td>construct</td>
<td>indicates the make of the construct in the stackup</td>
</tr>
<tr>
<td>cost</td>
<td>the sum of the cost of all materials in the stackup</td>
</tr>
<tr>
<td>resin Er</td>
<td>the relative permittivity of the resin used in the resin system of the construct</td>
</tr>
<tr>
<td>copper_loss</td>
<td>the thickness of copper lost in internal layers due to processing. This value may also be positive, indicating that internal layers have been plated.</td>
</tr>
</tbody>
</table>

A **materials** sub-record delimited by **begin_materials** and **end_materials** containing **mat** records of the form:

```
mat (A B C D E F (G) H I J K L)
```

Where the letters contain the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>width</td>
</tr>
<tr>
<td>B</td>
<td>height</td>
</tr>
<tr>
<td>C</td>
<td>cost</td>
</tr>
<tr>
<td>D</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>E</td>
<td>material (Foil, Prepreg, Laminate, Core, RCC)</td>
</tr>
<tr>
<td>F</td>
<td>weave (Vertical, Horizontal Null)</td>
</tr>
<tr>
<td>G</td>
<td>thickness &amp; +/- tolerances</td>
</tr>
<tr>
<td>H</td>
<td>vendor</td>
</tr>
<tr>
<td>I</td>
<td>generic name (from 'material' file)</td>
</tr>
<tr>
<td>J</td>
<td>catalog number (Less that 16 characters preferred)</td>
</tr>
<tr>
<td>K</td>
<td>construct</td>
</tr>
<tr>
<td>L</td>
<td>Whether material is upside-down in stackup</td>
</tr>
<tr>
<td>M</td>
<td>Which foils of a core are completely etched off (None, Top, Bottom, Both)</td>
</tr>
</tbody>
</table>
Note Material type (prepeg, laminate, foil, core, RCC) may be abbreviated to three letters (pre, lam, foi, cor, RCC).

**imp (Impedance)**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path:</td>
<td>&lt;job_name&gt;/stackups/&lt;stackup_name&gt;/imp</td>
</tr>
</tbody>
</table>

Contains the impedance requirements and results of the stackup.

**Example**

```
# A - Allowed change to line width  
# B - Units of allowed change (``Inch'' indicated English. -- i.e. mils)  
# C - Width variation of lines  
# D - Units of width variation of lines (``Inch'' indicated English. -- i.e. mils)  
# E - Etch factor (Trapezoidal factor of lines due to etch process) in mils  
# F - Relative Permittivity of soldermask  
# G - Impedance frequency (in MHZ)  
# A B C D E F G H I  
imp_info 1 Inch 1 Inch 1 1 1 3 100  
imp_begin  
# A - Impedance model  
# B - Reference layer  
# C - Impedance layer  
# D - Second Impedance layer (For broadside differential models)  
# E - Second Reference layer (For Microstrip models)  
# F - Original line width (in mils)  
# G - Current Line width (in mils)  
# H - Calculated impedance with tolerances (in ohms)  
# I - Desired impedance with tolerances (in ohms)  
# J - Original spacing (in mils) - for differential models  
# K - Current spacing (in mils)  
# L - Tolerance of current width (in mils)  
# A B C D E F G H I  
imp (Surface_Microstrip (12) (11) () () 6 6 (98.3 4.9 4.9) (90 0 0) 0 02)  
imp (Dual_Stripline (13) (14) () (16) 6 6 (138.8 13.8 13.8)  
```
13.8) (90 0 0) 0 01
imp (Dual_Stripline (13) (15) () (16) 6 6 (138.8 13.8
13.8) (0 0 0) 0 01)
imp (Dual_Stripline (17) (18) () (110) 6 6 (138.8 13.8
13.8) (0 0 0) 0 01)
imp (Dual_Stripline (17) (19) () (110) 6 6 (138.8 13.8
13.8) (0 0 0) 0 01)
imp (Surface_Microstrip (111) (112) () () 6 6 (98.3 4.9 4.9)
(0 0 0) 0 01)
imp_end
The impedance records are of the following form:
    imp (A (B) (C) (D) (E) F G (H) (I) J K L)
Where the letters contain the following fields:

<table>
<thead>
<tr>
<th>Letter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Impedance model</td>
</tr>
<tr>
<td>B</td>
<td>Reference layer</td>
</tr>
<tr>
<td>C</td>
<td>Impedance layer</td>
</tr>
<tr>
<td>D</td>
<td>Second Impedance layer (For broadside differential models)</td>
</tr>
<tr>
<td>E</td>
<td>Second Reference layer (For Microstrip models)</td>
</tr>
<tr>
<td>F</td>
<td>Original line width (in mils)</td>
</tr>
<tr>
<td>G</td>
<td>Current Line width (in mils)</td>
</tr>
<tr>
<td>H</td>
<td>Calculated impedance with tolerances (in ohms)</td>
</tr>
<tr>
<td>I</td>
<td>Desired impedance with tolerances (in ohms)</td>
</tr>
<tr>
<td>J</td>
<td>Original spacing (in mils) for differential models</td>
</tr>
<tr>
<td>K</td>
<td>Current spacing (in mils)</td>
</tr>
<tr>
<td>L</td>
<td>Tolerance of current width (in mils)</td>
</tr>
</tbody>
</table>

**input**

Location of input files when saved to a job.

**output**

**snapshot (Measurement Information))**

| Path | <job_name>/output/snapshots/<snapshot_name> |
A snapshot is a screen capture function available in the Graphic Station for the purpose of recording images, notes and measurement details of category violations in analysis. Each snapshot, consisting of four files each (see list below), is stored in a directory under its own name `<snapshot_name>`. The snapshot name also becomes the name of the four files, each with the appropriate extension. Each snapshot directory consists of the following files:

- `<snapshot_name>.gif` (image in GIF format)
- `<snapshot_name>.nte` (user notes typed in the Snapshot popup)
- `<snapshot_name>.txt` (measurement information)
- `<snapshot_name>.xpm.gz` (gzipped image in XWindows color bitmap format)

**user**

Location to store user files.

**extension**
Chapter 5  

Job>steps Entity

Required for GenFlex 6.4

- Layer Profiles File
- Layer Profiles File (Encrypted File)
- Footprint Description File (GenFlex 6.4)
- Footprint Description File

Layer Profiles File

Profiles data is saved under the step directory in a new file called lyr_profiles_p.
Layers profiles file is a standard feature file, which includes surface features only (multi islands and multi holes). Each surface describes one layer profile. Each feature has an attribute lyr_prf_ref with reference value = 1,2,3, etc. which is the reference for layers to use a surface as the layer profile.
(Downgrade will delete the file)

Layer Profiles File (Encrypted File)

<job_name>/steps/<step_name>/lyr_profiles_p

Footprint Description File (GenFlex 6.4)

Footprint – an extension data that can replace the profile. Define per step. File is saved under the step directory in a new file called footprint_p. The file structure is the same as it is in profile file. (Downgrade will delete the file) (See “profile (Outline Shape of Step)” on page 78.)

Footprint Description File

<job_name>/steps/<step_name>/footprint_p
**stephdr (Step Header)**

This file contains data which is common to the whole step. This includes the step & repeat array for nest steps.

**Example**

```plaintext
X_DATUM=0
Y_DATUM=0

STEP-REPEAT {
  NAME=1UP
  X=1.5
  Y=1.6
  DX=1.2
  DY=1.2
  NX=6
  NY=6
  ANGLE=0
  FLIP=NO
  MIRROR=NO
}

TOP_ACTIVE=1
BOTTOM_ACTIVE=1
RIGHT_ACTIVE=1
LEFT_ACTIVE=1
ONLINE_DRC_NAME=
ONLINE_DRC_MODE=DISABLED
ONLINE_DRC_STAT=RED
ONLINE_DRC_TIME=0
ONLINE_DRC_BEEP_VOL=2
ONLINE_DRC_BEEP_TONE=500
ONLINE_NET_MODE=DISABLED
ONLINE_NET_STAT=RED
ONLINE_NET_TIME=0
ONLINE_NET_BEEP_VOL=2
ONLINE_NET_BEEP_TONE=1000
AFFECTING_BOM=
AFFECTING_BOM_CHANGED=0
```
The file consists of several fields and an array of `STEP-REPEAT` records. The fields are:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X_DATUM</td>
<td>x datum point (used for step &amp; repeat)</td>
</tr>
<tr>
<td>Y_DATUM</td>
<td>y datum point (used for step &amp; repeat)</td>
</tr>
<tr>
<td>X_ORIGIN</td>
<td>x origin point</td>
</tr>
<tr>
<td>Y_ORIGIN</td>
<td>y origin point</td>
</tr>
<tr>
<td>TOP_ACTIVE</td>
<td>active area for step &amp; repeat (positive distance from the top edge)</td>
</tr>
<tr>
<td>BOTTOM_ACTIVE</td>
<td>active area for step &amp; repeat (positive distance from the bottom edge)</td>
</tr>
<tr>
<td>RIGHT_ACTIVE</td>
<td>active area for step &amp; repeat (positive distance from the right edge)</td>
</tr>
<tr>
<td>LEFT_ACTIVE</td>
<td>active area for step &amp; repeat (positive distance from the left edge)</td>
</tr>
<tr>
<td>ONLINE_DRC_NAME</td>
<td>The name of the checklist (if any) used for on-line DRC</td>
</tr>
<tr>
<td>ONLINE_DRC_MODE</td>
<td>One of DISABLED, DEFERRED or IMMEDIATE</td>
</tr>
<tr>
<td>ONLINE_DRC_STAT</td>
<td>One of RED, YELLOW or GREEN</td>
</tr>
<tr>
<td>ONLINE_DRC_TIME</td>
<td>The last time check all was done for on-line DRC</td>
</tr>
<tr>
<td>ONLINE_DRC_BEEP_VOL</td>
<td>Beep volume for immediate on-line DRC (0 to 3)</td>
</tr>
<tr>
<td>ONLINE_DRC_BEEP_TONE</td>
<td>Beep tone for immediate on-line DRC (200 to 1500)</td>
</tr>
<tr>
<td>ONLINE_NET_MODE</td>
<td>One of DISABLED, DEFERRED or IMMEDIATE</td>
</tr>
<tr>
<td>ONLINE_NET_STAT</td>
<td>One of RED, YELLOW or GREEN</td>
</tr>
<tr>
<td>ONLINE_NET_TIME</td>
<td>The last time check all was done for on-line netlist</td>
</tr>
<tr>
<td>ONLINE_NET_BEEP_VOL</td>
<td>Beep volume for immediate on-line netlist (0 to 3)</td>
</tr>
<tr>
<td>ONLINE_NET_BEEP_TONE</td>
<td>Beep tone for immediate on-line netlist (200 to 1500)</td>
</tr>
<tr>
<td>AFFECTING_BOM</td>
<td>Name of BOM last used in BOM_MERGE</td>
</tr>
<tr>
<td>AFFECTING_BOM_CHANGED</td>
<td>Indicates whether AFFECTING_BOM was changed since last BOM_MERGE. (This requires that BOM_MERGE must be redone before retrieving information relating to BOM, such as Edit&gt;Component&gt;Set Chosen AVL.) If you attempt to retrieve info without performing BOM_MERGE, you will be required to confirm the action.</td>
</tr>
</tbody>
</table>

For the `STEP-REPEAT` array, the fields are:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>Name of the step to be included in the current one (must be a valid step in the same job, without nesting)</td>
</tr>
<tr>
<td>X</td>
<td>Start X coordinate for placement of datum point of nested step</td>
</tr>
<tr>
<td>Y</td>
<td>Start Y coordinate for placement of datum point of nested step</td>
</tr>
<tr>
<td>DX</td>
<td>Horizontal distance between datum points (when angle = 0)</td>
</tr>
<tr>
<td>DY</td>
<td>Vertical distance between datum points (when angle = 0)</td>
</tr>
</tbody>
</table>
attrlist (Attribute List)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path</td>
<td><code>&lt;job_name&gt;/steps/&lt;step_name&gt;/attrlist</code></td>
</tr>
</tbody>
</table>

This file contains the values for attributes (system and user) of a step.

Example

```
.out_drill_full = no
.out_drill_optional = no
.out_rout_optional = no
.fs_direction_top = left2right
.fs_direction_bottom = right2left
.comment = Production Step
```

layers (See Chapter 6)

Netlists

Required for GenFlex 6.4

In ODB++, a testable inner net point has the line prefix @t. Also, the ODB++ code describing the net point contains the name of the layer in which it is located. A highlighted sample ODB++ file is given below.

<table>
<thead>
<tr>
<th>NX</th>
<th>Number of repetitions horizontally</th>
</tr>
</thead>
<tbody>
<tr>
<td>NY</td>
<td>Number of repetitions vertically</td>
</tr>
<tr>
<td>ANGLE</td>
<td>Rotation angle of the steps (0-360 degrees)*</td>
</tr>
<tr>
<td>FLIP</td>
<td>A two identical steps to be placed on a panel in such a way that on the same side it contains the top of one step and the bottom of the other.</td>
</tr>
<tr>
<td>MIRROR</td>
<td>YES for mirror (around X axis), NO for no mirror</td>
</tr>
</tbody>
</table>

* Any angle rotation is expressed in the Info Command Interface for Data type: REPEAT and SR for the Step entity and in the Info output file, `-t <step> -d REPEAT` and `-t <step> -d SR`, respectively.
In the netlist description

- The line prefix @t (highlighted in yellow)
- The words "l1", "l2", and "buried" are the layer names in which these net points are located. These layer names are highlighted in grey, and do not appear in lines that do not describe testable inner net points.
- Side Flags labels for testable inner net points (highlighted in red)
  - T - Top Test Points
  - D - Down Test Points
  - B - Both Test Point
- For testable inner net points, the layer name is listed immediately after the side flag (T,D,B). This is visible above, where the grey-shaded boxes with line names appear immediately after the red-shaded side flags.

\[ \text{cadnet / netlist (CADnet)} \]

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path:</td>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/netlists/cadnet/netlist</td>
</tr>
</tbody>
</table>
This file represents a netlist as it was read from an external CAD system. A netlist is a collection of nets, each one referencing a group of points.

**Definitions**

- **Basic Netlist** - contains only drill holes stored for drilled SMD pads.
- **Extended Netlist** - contains both holes and drilled SMD.
- **Extended Netpoint** - drill hole which has associated SMD pads.
- **Complex Netpoint** - consists of both the hole and drilled SMD's, as stored in the netlist.
- **Netpoint Extension** - drilled SMD pad stored in netlist together with the drill hole.
- **Test Side** - of net-point is stored in netlist and determined by the Netlist Optimizer (cannot be changed except with the Electrical Testing Manager (ETM)).

**Example**

```
H optimize n
$0 &IN1096
$1 &IN1526
$2 &IN289
$3 &IN312
$4 &IN338
$5 &IN340
$6 $NONE$
...
#
#Netlist points
#
0 0.002 4.96 -2.64 T e e staggered 0 0 0
0 0.002 4.94 -2.4775 T e e staggered 0 0 0
0 0.002 4.945 -2.575 B e e staggered 0 0 0
1 0.002 4.31 -4.045 T e e staggered 0 0 0
1 0.002 4.27 -3.893 T e e staggered 0 0 0
```

**Note**

When a feature does not have a net defined it is assigned to **NET $NONE$**. All non-assigned features are defined as **NET $NONE$** (see “NET - Electrical Net Record” on page 86).

The first line of the file has the form:

```
H optimize <y|n>
```

- **y** - if netlist was optimized by the netlist optimizer
- **n** - if netlist was not optimized

For CAD netlist, the net will always be non-optimized.

The next section of the file contains the nets, in the following format:

```
$<serial_num> <net_name>
```
Chapter 5  Job>steps Entity
Netlists

Where:

| <serial_num> | is the net serial number, starting with 0 |
| <net_name>   | is the original net name as read from CAD |

Net names are for reference only. Every <serial_num> net is considered a different electrical net, and should be electrically isolated from all different <serial_num> nets. Ideally, each and every <serial_num> net should have a different <net_name>.

The last section contains the net points. Each one has the following format:

```
<net_num> <radius> <x> <y> <side> [ <w> <h> ] <epoint> <exp> [ <c> ]
[staggerred <sx> <sy> <sr>] [v] [f] [t] [m][<x>] [<e>] [<by>]
```

Where:

<table>
<thead>
<tr>
<th>net_num</th>
<th>The number of the net (start from -1), corresponding to the previously defined netlist section (when a feature does not belong to a net it is defined as $NONE$). Net numbers start from -1 (-1 represents a tooling hole).</th>
</tr>
</thead>
<tbody>
<tr>
<td>radius</td>
<td>Drill radius (inches) or 0.002 for SMD pads</td>
</tr>
<tr>
<td>x,y</td>
<td>point coordinates (inches)</td>
</tr>
<tr>
<td>side</td>
<td>T for top</td>
</tr>
<tr>
<td></td>
<td>D for bottom</td>
</tr>
<tr>
<td></td>
<td>B for both</td>
</tr>
<tr>
<td>w,h</td>
<td>Width and height of non-drilled pads (only when radius = 0)</td>
</tr>
<tr>
<td>epoint</td>
<td>e for net end point</td>
</tr>
<tr>
<td></td>
<td>m for net mid point</td>
</tr>
<tr>
<td>exp</td>
<td>e for solder mask exposed point</td>
</tr>
<tr>
<td></td>
<td>c for solder mask covered point</td>
</tr>
<tr>
<td></td>
<td>p for solder mask covered primary point on top layer</td>
</tr>
<tr>
<td></td>
<td>s for solder mask covered secondary point on bottom layer</td>
</tr>
<tr>
<td>c</td>
<td>Comment point</td>
</tr>
<tr>
<td>sx,sy</td>
<td>Coordinates of staggered point</td>
</tr>
<tr>
<td>sr</td>
<td>Radius of staggered point</td>
</tr>
<tr>
<td>v</td>
<td>v for a via point</td>
</tr>
<tr>
<td>f</td>
<td>Fiducial point</td>
</tr>
<tr>
<td>t</td>
<td>Test point</td>
</tr>
<tr>
<td>m</td>
<td>Appears when a netlist point is designated as a test point by assigning it the .critical_tp attribute. Normally this is applied to mid-points that need to be tested. The Netlist Optimizer determines mid-points to be not testable unless assigned this attribute. If both .non_tp and .critical_tp are assigned to the same point, .critical_tp takes precedence and the mid point is tested. In case of a drilled pad, the attribute must be added to the drill hole.</td>
</tr>
<tr>
<td>x</td>
<td>‘x’tended’ appears if net point is extended</td>
</tr>
<tr>
<td>e</td>
<td>‘&lt;Extension&gt;’ appears if net point is an extension</td>
</tr>
</tbody>
</table>
### Chapter 5  Job>steps Entity

#### Netlists

**Example** - `arsize_top / arsize_bot`  
```
4 0.023622 0.726 0.3351969 B m e arsize_top=0.016378 arsize_bot=0.0161873
4 0.015748 0.7460787 0.5300787 B e e by=a arsize_top=0.011752 arsize_bot=0.0116406
4 0.011811 0.0358425 0.1450394 B m c arsize_top=0 arsize_bot=0
```

**Example** -  
```
0 0.00675 0.8 3.3 B m e v x by=b
0 0 2.5 3.214393 T 0.04242 0.04242 e s staggered 0 0.01325 0 e by=c
```

A net point description for an extended point does not have to be grouped together in the netlist file.

#### refnet / netlist (Reference)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path</td>
<td><code>&lt;job_name&gt;/steps/&lt;step_name&gt;/netlists/refnet/netlist</code></td>
</tr>
</tbody>
</table>

This file contains the reference netlist for the step. A reference netlist can be copied from the CAD netlist, the current netlist or the current-based-cad netlist.

![Diagram of netlists and refnet]

by { c s b n }  
- c - test from component side  
- s - test from solder side  
- b - test from both sides  
- a - test from any one side.  
- n - side not defined  
(if `<by` value not defined, n is assumed)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>arsize_top</td>
<td>'Annular Ring size for Top' represents the minimum width of exposed copper (from solder mask) around a drill hole on the top outer layer.</td>
</tr>
<tr>
<td>arsize_bot</td>
<td>Same as for arsize_top but for bottom part of the hole. If hole does not go through top / bottom layer, the corresponding parameter (arsize_top / arsize_bot) should not be defined or set to 0. Parameters are keyword parameters and may be placed at any place after the positional ones.</td>
</tr>
<tr>
<td>is_shrink</td>
<td>Y - point size was shrunk to fit solder-mask opening. N - point size is limited only by pad size.</td>
</tr>
</tbody>
</table>
**curnet /netlist (Current)**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path:</td>
<td><code>&lt;job_name&gt;/steps/&lt;step_name&gt;/netlists/curnet/netlist</code></td>
</tr>
</tbody>
</table>

This file contains the Current netlist for the step. This is a temporary netlist that exists in the system memory only and is never saved with the job. It is extracted from the board layer in its current edited state, and always reflects any edits or modifications.

**profile (Outline Shape of Step)**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path:</td>
<td><code>&lt;job_name&gt;/steps/&lt;step_name&gt;/profile</code></td>
</tr>
</tbody>
</table>

The profile provides the outline shape of the step. It is required by many operations. A profile can be one closed polygon shape.

**Example**

```
# Layer features
#
S P 0
OB 0 0 I
OS 0 10
OS 10 10
OS 10 0
OS 0 0
OE
SE
```

The profile consists of one positive surface feature. Refer to the description of surface features inside the description of `<job_name>/steps/<step_name>/layers/<layer_name>/features` (“features” on page 108).
bom (Bill of Materials)

◆ bom

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path:</td>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/boms/&lt;bom_name&gt;/bom</td>
</tr>
</tbody>
</table>

Example

# Header Parameters

HEADER
BRD
REV
HEADER_END

# Description Aliases

DESC_ALIASES
LANG fr
INDEX 1 CPN Cout
INDEX 1 CPN Cost
INDEX 1 MPN Benefice
INDEX 1 MPN Profit Margin
DESC_ALIASES_END

# Reference Descriptors and matching Customer Parts

RD_CPN
REF XTAL1
LNFILE 5 Rev14.v1 (where 5 is the source line number and Rev14.v1 is the source BOM)
CPN 004-020-101
LNFILE 5 Rev14.v1

REF Y8
LNFILE 7 Rev14.v1
CPN 004-040-101
LNFILE 7 Rev14.v1

RD_CPN_END

# Customer Parts and matching Manufacturer Parts

CPN_MPN
CPN 004-020-101
LNFILE 5 Rev14.v1
VPL_MPN
VPL_VND TOYOCOM
MPN TQC-216C-6R
LNFILE 5 Rev14.v1
VND TOYOCOM
LNFILE 5 Rev14.v1
QLF 0
CHS 1

CPN 004-020-101
LNFILE 5 Rev14.v1
VPL_MPN
VPL_VND VF
MPN VM6S-20.0000-16PF
LNFILE 6 Rev14.v1
VND VALPEY-FISHER
LNFILE 6 Rev14.v1
QLF 0
CHS 0

CPN_MPN_END

# Customer Parts and description
CP
CPN 004-020-101
LNFILE 5 Rev14.v1
IPN
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
PKG
LNFILE 0 Rev14.v1
QNT 1
ITEM 0

CPN 004-040-101
LNFILE 7 Rev14.v1
IPN
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
LNFILE 0 Rev14.v1
DSC
Description

The file is divided into four sections. Each section starts with a header (equivalent to section name) and ends with name_END.

**HEADER section**

Contains two parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRD</td>
<td>Board number</td>
</tr>
<tr>
<td>REV</td>
<td>Revision</td>
</tr>
</tbody>
</table>

Source information for those parameters indicated in each section are saved in the corresponding files sub-directory (for example, LNFILE 5 Rev14.v1 (where Rev14.v1 is the source file and 5 is the source line number)).

**DESC_ALIASES section**

Contains seven parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LANG</td>
<td>One of the possible languages allowed by environment variable GENESIS_LANG.</td>
</tr>
<tr>
<td>INDEX</td>
<td>A numeral, 1-10 corresponding to the 10 descriptions in the BOM to replace DESC&lt;index&gt;.</td>
</tr>
<tr>
<td>CPN</td>
<td>The alias for the CPN field in the BOM in the selected language.</td>
</tr>
<tr>
<td>CPN</td>
<td>The alias for the CPN field in the BOM in English.</td>
</tr>
<tr>
<td>INDEX</td>
<td>A numeral, 1-10 corresponding to the 10 descriptions in the BOM to replace PART_DESC&lt;index&gt;.</td>
</tr>
<tr>
<td>MPN</td>
<td>The alias for the MPN field in the BOM in the selected language.</td>
</tr>
<tr>
<td>MPN</td>
<td>The alias for the MPN field in the BOM in English.</td>
</tr>
</tbody>
</table>
**RD_CPN section**
Contains the Reference Descriptors and their matching Customer Parts:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>REF</td>
<td>Reference designator name</td>
</tr>
<tr>
<td>CPN</td>
<td>Customer part number</td>
</tr>
</tbody>
</table>

*LNFILE* is saved for all parameters.

**CPN_MPN section**
Contains Customer Parts and their matching Manufacturer Parts:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPN</td>
<td>Customer Part Number</td>
</tr>
<tr>
<td>VPL_MPN</td>
<td>MPN from the VPL database corresponding to original MPN (as determined in BOM Validation)</td>
</tr>
<tr>
<td>VPL_VND</td>
<td>Manufacturer from the VPL corresponding to original Vendor (as determined in BOM Validation)</td>
</tr>
<tr>
<td>MPN</td>
<td>Manufacturer Part Number</td>
</tr>
<tr>
<td>VND</td>
<td>Manufacturer (Vendor) name</td>
</tr>
<tr>
<td>QLF</td>
<td>Qualify - whether the part <em>(MPN+VENDOR)</em> is qualified for production:</td>
</tr>
<tr>
<td></td>
<td>-1  - Not qualified</td>
</tr>
<tr>
<td></td>
<td>0   - Unknown</td>
</tr>
<tr>
<td></td>
<td>1   - Qualified</td>
</tr>
<tr>
<td>CHS</td>
<td>Chosen - if this part is chosen from among the alternate parts for the CPN. Only one can be Chosen.</td>
</tr>
</tbody>
</table>

*LNFILE* is saved for **CPN MPN VND**

**CP section**
Contains Customer Parts and their description:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPN</td>
<td>Customer Part Number</td>
</tr>
<tr>
<td>IPN</td>
<td>Internal Part Number</td>
</tr>
<tr>
<td>DSC</td>
<td>Up to 5 descriptions</td>
</tr>
<tr>
<td>PKG</td>
<td>Package name</td>
</tr>
<tr>
<td>QNT</td>
<td>Reference Designator quantity</td>
</tr>
<tr>
<td>ITEM</td>
<td>Item number</td>
</tr>
</tbody>
</table>

*LNFILE* is saved for **CPN IPN DSC PKG**
files (Source Files)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Directory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td><code>&lt;job_name&gt;/steps/&lt;step_name&gt;/boms/&lt;bom_name&gt;/files</code></td>
</tr>
</tbody>
</table>

The files sub-directory contains the source files that generated the BOM entity (BOM and AVL).

eda (Electronic Design Automation)

data

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>Yes</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td><code>&lt;job_name&gt;/steps/&lt;step_name&gt;/eda/data</code></td>
</tr>
</tbody>
</table>

This file contains information which is read from the EDA system database directly. It covers the library of CAD and user-defined VPL packages, their outlines and properties, net connectivity information and more.

**Example**

```plaintext
# HDR Mentor Boardstation database
LYR sst sst+1 sigt sig2 sig3
  sig4 sig7 sig8 sig9 sigb smt smb
  drill spt ssb spb ssb+1 pg6 pg5
# PRP MILLING_ORIGIN 'MILLING 0 0.0 0' 0 0
PRP DRILL_ORIGIN '' 0 0
PRP FIXED_COMPONENT_LOCATION 'M3,m1' 1
...
#
#Net attribute names
```
Chapter 5  Job>steps Entity

da (Electronic Design Automation)

# @0 .critical_net
# @1 .diff_pair
# @2 .net_type
# @3 .electrical_class
# @4 .dpair_gap
# @5 .eclass-rise_time
# @6 .eclass-max-stub-length
#
#
# Net attribute text strings
#
# &0 DEFAULT
# &1 clocks
# &2 EC_PUA
# &3 local
...

# NET 0
NET /D_CL_TX_CLK ;0,2=1,3=2,5=1.500000
SNT TOP T 16 0
FID C 2 33
FID C 10 33
FID C 13 30
...

# PKG 1
PKG *PDXC-L10/HX-L127W51T97 0.1 -0.25 -0.145 0.25 0.145
RC -0.25 -0.1 0.5 0.2
PIN 1 T -0.2 -0.1105 0 E S
RC -0.2125 -0.145 0.025 0.069
PIN 3 T -0.1 -0.1105 0 E S
RC -0.1125 -0.145 0.025 0.069
PIN 5 T 0 -0.1105 0 E S
RC -0.0125 -0.145 0.025 0.069
PIN 7 T 0.1 -0.1105 0 E S
RC 0.0875 -0.145 0.025 0.069
PIN 9 T 0.2 -0.1105 0 E S
RC 0.1875 -0.145 0.025 0.069
PIN 2 T -0.2 0.1105 0 E S
RC -0.2125 0.076 0.025 0.069
PIN 4 T -0.1 0.1105 0 E S
RC -0.1125 0.076 0.025 0.069
PIN 6 T 0 0.1105 0 E S
RC -0.0125 0.076 0.025 0.069
PIN 8 T 0.1 0.1105 0 E S
RC 0.0875 0.076 0.025 0.069
PIN 10 T 0.2 0.1105 0 E S
RC 0.1875 0.076 0.025 0.069
#

# PKG 2
PKG *MBCY-T2/XC-L80W80T115 0.1377953 -0.1574803 -0.1574803
0.1574803
0.1574803
CR  0  0  0.1574803
PIN P T  0.0688976  0  0  E T
CR  0.0688976  0  0.011811
PIN N T -0.0688976  0  0  E T
CR -0.0688976  0  0.011811

`# FGR 1907`  
FGR TEXT
PRP string '030'
FID C 14 11018
FID C 14 11018

The file consists of records of the following types:
Main Records:

<table>
<thead>
<tr>
<th>HDR</th>
<th>File Header</th>
</tr>
</thead>
<tbody>
<tr>
<td>LYR</td>
<td>Layer Names</td>
</tr>
<tr>
<td>NET</td>
<td>Electrical Net Record</td>
</tr>
<tr>
<td>SNT</td>
<td>Subnet Record</td>
</tr>
<tr>
<td>PKG</td>
<td>Package Record</td>
</tr>
<tr>
<td>PIN</td>
<td>Pin Record</td>
</tr>
<tr>
<td>FGR</td>
<td>Feature Group Record</td>
</tr>
<tr>
<td>FID</td>
<td>Feature ID record</td>
</tr>
<tr>
<td>PRP</td>
<td>Property record</td>
</tr>
</tbody>
</table>

**Net Attributes Header:**

This header contains a table of net attribute names as well as a table of all net attribute values that are strings. The structure of the net attributes header is the same as that for features and components, except that each line begins with #.

`#Net attribute names`
`#@<num1> <attribute_name>`
`#@<num2> <attribute_name>`
`#Net attribute text strings`
`#&<num3> <string>`

**Usage:** `<num1>,<num2>=<num3>`

**Outline Records:**

<table>
<thead>
<tr>
<th>CR</th>
<th>Circle record</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQ</td>
<td>Square Record</td>
</tr>
<tr>
<td>RC</td>
<td>Rectangle record</td>
</tr>
<tr>
<td>CT, OB, OS, OC, OE, CE</td>
<td>Contour record</td>
</tr>
</tbody>
</table>

Following is the format and description of each record.

**HDR - File Header**

This record contains the EDA system which was the source of the data.
**Structure:**

`HDR <source>`

Where:

- `<source>` can be:
  - "Mentor Boardstation neutral file"
  - "Mentor Boardstation database"
  - "Cadence Allegro extract file"
  - "Zuken Redac CADIF file"
  - "PADS PowerPCB"

**LYR - Layer Names**

This record contains the names of the layers which are referenced in FID records later.

`LYR <name1> .... <namen>`

Where:

- `<namex>`: A legal name of a layer listed in the job matrix

**NET - Electrical Net Record**

This record contains a start record of an electrical net. Each net consists of one NET line and 0 or more SNT records.

`NET <name>`

Where:

- `<name>`: The name of the net as defined in the EDA system
- `<attributes>`: This data is the same as for feature attributes (in the features file). It consists of comma separated list of values. Each can be:
  - `n`: indicating that (boolean) attribute `n` is set
  - `n=m`: indicating that option attribute `n` has value `m`
  - `n=i`: indicating that integer attribute `n` has value `i`
  - `n=f`: indicating that floating attribute `n` has value `f`
  - `n=s`: indicating that text attribute `n` has header value `s`

Note: `n` must match a `@` record in the attribute header; `s` must match a `&` record in the attribute header.

Net names are for reference only. Every NET record is considered a different electrical net, and should be electrically isolated from all NET records. Ideally, the `<name>` should be unique across all NET records.

When a feature does not have a net defined it is assigned to `NET $NONE$`. All unassigned outer layer pads are defined as `NET $NONE$`. With more than one `$NONE$` net, each is disconnected from the other. Any two points of a `$NONE$` net can be connected or disconnected, depending on the design.

In the Compare function of the Netlist Analyzer, disconnected `$NONE$` nets are not reported as opens. Shorts between `$NONE$` nets and other nets are reported. If no special treatment is done on the Xpert then if a `$NONE$` net points form more than one net typically they will all be reported as a large `$NONE$` net broken into subnets.
**SNT - Subnet Record**

This record contains a portion of a net. This portion can be:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>toeprint</td>
<td>A connection of a component pin to the board</td>
</tr>
<tr>
<td>via</td>
<td>A connectivity padstack between layers</td>
</tr>
<tr>
<td>trace</td>
<td>A collection of lines/arcs leading from point to point</td>
</tr>
<tr>
<td>plane</td>
<td>A surface used for connectivity purposes</td>
</tr>
</tbody>
</table>

Each subnet record is followed by zero or more FID records mapped to the board features which are part of this subnet.

**Structure for toeprint:**

SNT TOP <side> <comp_num> <pin_num>

Where:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;side&gt;</td>
<td>T for TOP, B for bottom</td>
</tr>
<tr>
<td>&lt;comp_num&gt;</td>
<td>Number of component in the components file (comp_+<em>top/components or comp</em>+_bot/components)</td>
</tr>
<tr>
<td>&lt;pin_num&gt;</td>
<td>Number of pin in the component</td>
</tr>
</tbody>
</table>

**Structure for via**

SNT VIA

**Structure for trace**

SNT TRC

**Structure for plane**

SNT PLN <fill_type> <cutout_type> <fill_size>

Where:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;fill_type&gt;</td>
<td>S for solid, H for hatched, O for outline</td>
</tr>
<tr>
<td>&lt;cutout_type&gt;</td>
<td>C for circle, R for rect, O for octagon, E for exact</td>
</tr>
<tr>
<td>&lt;fill_size&gt;</td>
<td>Size in inches of fill brush</td>
</tr>
</tbody>
</table>

**Note**  The values for SNT PLN must appear with legal values, but the software does not consider them internally.

**PKG - Package Record**

This record contains a definition of a package, which is the generic shape of a component (e.g. each component refers to a package).

Each **PKG line must** be followed immediately by an outline record/s, 0 or more property (PRP) records and 0 or more PIN records.

**Structure:**

PKG <name> <pitch> <xmin> <ymin> <xmax> <ymax>
Where:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;name&gt;</td>
<td>The name of the package as defined in the EDA system (geometry in Mentor terms, SYM_NAME in Cadence terms)</td>
</tr>
<tr>
<td>&lt;pitch&gt;</td>
<td>Distance between center of closest pins, in inches</td>
</tr>
<tr>
<td>&lt;xmin&gt;, &lt;ymin&gt;, &lt;xmax&gt;, &lt;ymax&gt;</td>
<td>Bounding box of package, relating to package datum</td>
</tr>
</tbody>
</table>

**Note**  
ODB++ requires closed geometries (polygons must be closed).

**PIN - Pin Record**  
This record contains a definition of a pin, which belongs to a package.

Each pin is followed by (an) outline record(s).

**Structure:**

```
PIN <name> <type> <xc> <yc> <fhs> <etype> <mtype>
```

Where:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;name&gt;</td>
<td>The name of the pin as defined in the EDA system</td>
</tr>
</tbody>
</table>
| <type>    | T for thru-hole  
            (top--->bottom)  
            B for blind  
            (<top--->inner or inner--->bottom)  
            S for surface  
            (<top--->top or bottom--->bottom) |
| <xc> <yc> | Center of pin, relating to package datum                                     |
| <fhs>     | Finished hole size  
            (Unused at the moment - should be 0)                                   |
| <etype>   | PIN Electrical Type:  
            E - Electrical; M - Non-Electrical (Mechanical); U - Undefined         |
| <mtype>   | PIN Mount Type:  
            S - SMT.  
            D - Recommended SMT pad (where the pin size is the recommended pad size and not the pin size).  
            T - Thru-hole.  
            R - Thru-hole where the pin size is the recommended hole size and not the pin size.  
            P - Pressfit.  
            N - Non board, pins without contact area with the board. Used in components with lead forms of types: Solder Lug, High Cable, or Quick Connect.  
            H - Hole, for physical holes that appear without the physical pin.  
            U - Undefined.                                           |

By default, the last two parameters (<pin_type> and <pin_mount_type>) are defined as ‘U’ (Unknown) Only for packages that are imported from the VPL database are they defined otherwise.
Chapter 5  Job>steps Entity  
edas  (Electronic Design Automation)

**FGR - Feature Group Record**

This record contains the definition of a group of related features (e.g. the strokes of a text record).

Each FGR line is followed by zero or more FID records mapped to the board features which are part of this subnet.

**FGR <type>**

Where:

- **<type>** Only allowed value is TEXT

**FID - Feature ID Record**

This record contains a link to a feature in the board. The record is used to connect subnets and feature groups to the board features which are part of them.

**FID <type> <lyr_num> <f_num>**

Where:

- **<type>**   
  C - copper  
  L - laminate  
  H - hole  

- **<lyr_num>** A layer number (0 ... n-1) corresponding to the names of layers in the LYR record described earlier

- **<f_num>** A feature number (0 ... n-1) corresponding to the feature record sequence in the features file*.

* See below for example of f_num sequence in a feature file:

```
#Layer features
#
P 4.057087 4.5 6 P 0 0;1=6,3=0  #f_num = 0
P 4.057087 4.57874 6 P 0 0;1=6,3=0  #f_num = 1
P 4.057087 3.633858 6 P 0 0;1=6,3=0  #f_num = 2
P 4.057087 3.712598 6 P 0 0;1=6,3=0  #f_num = 3
```

**PRP - Property Record**

This record represents a property of the board, a net, a package or a feature group. A property consists of a name, a string value and 0 or more floating numbers.

**PRP <name> '<value>' n1 n2 ...**

Where:

- **<name>** The name of the property
- **<value>** The string of the property (between quotes)
- **n1, n2, ...** The floating numbers to be kept in the property

**Outline Records**

Outline records must follow a PKG or PIN record. They describe the shape of the package/pin.
Note  A PKG record must have an outline record as the immediate next entry  
(an outline record can be more than one line). A PIN record does require  
an outline record but not immediately after.

A shape can consist of a simple shape (circle, square, rectangle) or a complex  
contour.

CR - Circle record
   CR <xc> <yc> <radius>

SQ - Square Record
   SQ <xc> <yc> <half side>

RC - Rectangle record
   RC <lower_left_x> <lower_left_y> <width> <height>

CT ... CE - Contour record

The structure of a contour record is the same as a surface feature in the features  
file and is restricted by the same limitations.

A contour consists of one or more polygons.

- Intersection is not allowed between edges of the same polygon
- Intersection is not allowed between edges of different polygons
- The polygons must form a closed shape
- Holes must be graphically contained inside island polygons
- The curves must be consistent (the start, end, and center point must  
  construct a legal curve).

A polygon starts with OB command, contains OS (segment) or OC (curve)  
commands and ends with an OE command.

OB <start_x> <start_y>  I/H  (I=island, H=hole)

OS <end_x> <end_y>

OC <end_x> <end_y>  <center_x> <center_y> <cw> (cw = Y or N)

OE

Net Attributes

The net attributes are found in the file “data”, under the EDA directory of the job.  
Each net can have attributes in the same way it is done for features and  
components. That is, each net name may be followed by a semi-colon followed by  
net attribute values, i.e., ‘NET <net_name> ; <net attributes>’

Also, in the EDA ‘data’ file, the net attributes header is found. This header contains  
a table of net attribute names as well as a table of all net attribute values that are  
strings. The structure of the net attributes header is exactly like the one used for  
features and components. The only difference is that for net attributes the header is  
commented (with #), in order to be read by Enterprise versions prior to v5.3. The  
header is located before the first net record.

For example:
NET /D_CL_TX_CLK;0,2=1,3=2,5=1.500000
This should be interpreted as follows:
Net named ‘/D_CL_TX_CLK’ has the following attributes:
• attribute #0,
• attribute #2, value: 1
• attribute #3, value: 2
• attribute #5, value: 1.5
A look at the attribute header reveals the following:
• attribute #0 is .critical_net, which is boolean, thus its appearance means: TRUE.
• attribute #2 is .net_type, which is of type string; its value is index 1, i.e., “clocks”.
• attribute #3 is .electrical_class, which is of type string; its value is index 2, i.e., “EC_PUA”.
• attribute #5 is .eclass_rise_time, which is float and its value is 1.5.

vpl_pkgs

<table>
<thead>
<tr>
<th>Type:</th>
<th>Encrypted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>No</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/eda/vpl_pkgs</td>
</tr>
</tbody>
</table>

This file contains encrypted information relating to the library of VPL packages taken from the Valor Parts Library.
net_prp (Net Type) Clearances Records

The EDA directory of the job, contains a file named net_prp. This file contains net type clearances. Versions prior to V5.3 are not aware of its existence, and thus cannot take advantage of it. There are two types of net type clearance records:

- Independent of constraint area

  NET_TYPE_CLEARANCES.

- Dependent upon constraint area.
  (Ignored by software versions prior to V7.1.)

The structure of this file is a list of net type clearance, net type physical and/or electrical parameter records.

**Independent of Constraint Area**

```
NET_TYPE_CLEARANCES {
  net_type1 = <net type 1>
  net_type2 = <net type 2>
  layers = <layer names>
  via2via = <clearance>
  trace2trace = <clearance>
  via2trace = <clearance>
  pin2pin = <clearance>
  via2pin = <clearance>
  trace2pin = <clearance>
  plane2plane = <clearance>
  via2plane = <clearance>
  trace2plane = <clearance>
  pin2plane = <clearance>
}
```

*net type 1* and *net type 2* are either net types that are supposed to be defined in the ‘data’ file, or an asterisk ‘*’.

*<layer names>* is either a list of the job layer names (separated by semi-colons ‘;’) or an asterisk ‘*’.

The 10 clearances that come after are optional. If exist, they are given in inches.

**Examples:**

```
NET_TYPE_CLEARANCES {
  net_type1 = local
  net_type2 = clock
  layers = sigt;sig4
  via2via = 0.005000
  trace2trace = 0.005000
```
NET_TYPE_CLEARANCES {
  net_type1 = local
  net_type2 = *
  layers = *
  via2via = 0.005000
  trace2trace = 0.005000
  ...
}

CNSA_NET_TYPE_CLEARANCES {
  constr_area = <area name>
  net_type1 = <net type 1>
  net_type2 = <net type 2>
  layers = <layer names>
  via2via = <clearance>
  trace2trace = <clearance>
  via2trace = <clearance>
  pin2pin = <clearance>
  via2pin = <clearance>
  trace2pin = <clearance>
  plane2plane = <clearance>
  via2plane = <clearance>
  trace2plane = <clearance>
  pin2plane = <clearance>
  bb_via2bb_via = <clearance>
  bb_via2line = <clearance>
  bb_via2smd_pin = <clearance>
  bb_via2shape = <clearance>
  bb_via2tst_pin = <clearance>
  bb_via2tst_via = <clearance>
  bb_via2thru_pin = <clearance>
  bb_via2thru_via = <clearance>
  line2line = <clearance>
  line2smd_pin = <clearance>
  line2shape = <clearance>
  line2tst_pin = <clearance>
  line2tst_via = <clearance>
  line2thru_pin = <clearance>
  line2thru_via = <clearance>
  shape2smd_pin = <clearance>
  shape2shape = <clearance>
  shape2tst_pin = <clearance>
  shape2tst_via = <clearance>
  shape2thru_pin = <clearance>
  shape2thru_via = <clearance>
  smd_pin2smd_pin = <clearance>
  smd_pin2tst_pin = <clearance>
  smd_pin2tst_via = <clearance>
  smd_pin2thru_pin = <clearance>
  smd_pin2thru_via = <clearance>
  ...

Dependent
Upon
Constraint
Area

Clearances for Mentor jobs. (Also applies to Cadence jobs created in V7.2 or earlier.

Clearances from bb_via2bb_via to bb_via2tst_pad are for Cadence jobs from V7.3.

...
smd_pin2thru_via = <clearance>
tst_pin2tst_pin = <clearance>
tst_pin2tst_via = <clearance>
tst_pin2thru_pin = <clearance>
tst_pin2thru_via = <clearance>
tst_via2tst_via = <clearance>
tst_via2tst_pin = <clearance>
tst_via2thru_via = <clearance>
thru_pin2thru_pin = <clearance>
thru_pin2thru_via = <clearance>
thru_via2thru_via = <clearance>
hole2hole = <clearance>
hole2owire = <clearance>
owire2owire = <clearance>
dwire2hole = <clearance>
dwire2owire = <clearance>
thru_pin2bond_pad = <clearance>
smd_pin2bond_pad = <clearance>
thru_via2bond_pad = <clearance>
bond_pad2bond_pad = <clearance>
bond_pad2line = <clearance>
bond_pad2shape = <clearance>
bb_via2bond_pad = <clearance>
tst_pin2bond_pad = <clearance>
tst_via2bond_pad = <clearance>
dpair_sep_prim = <clearance>
dpair_spe_scnd = <clearance>

<area_name> is the name of the constraint area (an arbitrary string of less than 65 characters or an asterisk “*”).

<dpair_sep_prim> and <dpair_sep_scnd> are determining clearances for differential pair nets, regardless of feature type. These fields are optional. When they exist, they are expressed in inches.

Other fields are the same as in NET_TYPE_CLEARANCES.

Examples:

CNSA_NET_TYPE_CLEARANCES {
  constr_area = AGP-EDGE-AREA
  net_type1 = NO-TYPE
  net_type2 = NO-TYPE
  layers = top
  tst_via2tst_via = 0.010000
  line2line = 0.010000
  tst_via2line = 0.008000
  smd_pin2smd_pin = 0.025000
  smd_pin2tst_via = 0.025000
  line2smd_pin = 0.009700
  shape2shape = 0.010000
  shape2tst_via = 0.006000
  line2shape = 0.010000
  shape2tst_pin = 0.010000
  dpair_sep_prim = 0.005000
}
dpair_sep_scnd = 0.050000
}

CNSA_NET_TYPE_CLEARANCES {
    constr_area = *
    net_type1 = *
    net_type2 = *
    layers = int4
    tst_via2tst_via = 0.005000
    line2line = 0.010000
    bb_via2line = 0.007000
    thru_pin2thru_via = 0.005000
    smd_pin2thru_via = 0.005000
    line2smd_pin = 0.007000
    shape2shape = 0.010000
    shape2tst_via = 0.008000
    line2smd = 0.010000
    shape2smd_pin = 0.010000
    dpair_sep_prim = 0.005000
    dpair_sep_scnd = 0.050000
}

CNSA_KEY_NET_TYPE_CLEARANCES {
    constr_area = <area name>
    net_type1 = <net type1>
    net_type2 = <net type2>
    layers = <layer names>
    main_set_name = <set name>
}

<main_set_name> is the name of the set assigned to the CNSA_NET_TYPE_CLEARANCES set with the same values of constr_area, net_type1, net_type2 and layers.

CNSA_KEY_NET_TYPE_CLEARANCES {
    constr_area = <area name>
    net_type1 = <net type1>
    net_type2 = <net type2>
    layers = <layer names>
    set_name = <set name>
}

<set_name> is the name of the new set with the same clearances as the one named main_set_name.

CNSA_NET_TYPE_PHYSICAL_PARAMS {
    constr_area = <area name>
    net_type = <net type>
    layers = <layer names>
    min_line_width = <parameter value>
    min_neck_width = <parameter value>
    max_line_length = <parameter value>
}
<area_name> is the name of the constraint area (an arbitrary string of less than 65 characters or an asterisk ‘*’).

<net type> is either the net type that is supposed to be defined in the ‘data’ file, or an asterisk ‘*’.

<layer names> is either a list of the job layer names (separated by semi-colons ‘;’) or an asterisk ‘*’.

The three parameter values are optional. If they exist, they are given in inches.

**Note**  
The net type physical parameters record is ignored by software versions prior to V7.1.

**Examples:**
```
CNSA_NET_TYPE_PHYSICAL_PARAMS {
    constr_area = BGA-080-AREA
    net_type = 36MIL-TRACE
    layers = bottom
    min_line_width = 0.005000
    min_neck_width = 0.004000
    max_line_length = 0.100000
}
```
```
CNSA_NET_TYPE_PHYSICAL_PARAMS {
    constr_area = *
    net_type = *
    layers = top
    min_line_width = 0.005000
    min_neck_width = 0.004000
    max_line_length = 0.100000
}
```

**Net Type**

**Electrical Parameter Set**

```
NET_ELECTRICAL_PARAMS {
    ecset_name = <set name >
    dpair_prim_gap = <parameter value>
    dpair_line_width = <parameter value>
    dpair_neck_gap = <parameter value>
    dpair_neck_width = <parameter value>
    dpair_coupled_tol_min = <parameter value>
    dpair_coupled_tol_pl = <parameter value>
    dpair_minimum_spacing = <parameter value>
    dpair_gather_control = <parameter value>
    dpair_max_uncoupled_len = <parameter value>
    dpair_phase_control = <parameter value>
    dpair_phase_tolerance_min = <parameter value>
    dpair_phase_tolerance_pl = <parameter value>
}
```

<set name> is the name of the electrical parameters set as read from Cadence Allegro. All parameter values are optional. If they exist, they are expressed in inches.
Example:

```
NET_ELECTRICAL_PARAMS {
    ecset_name = DP-IBM-6GAP
    dpair_prim_gap = 0.006000
    dpair_line_width = 0.004000
    dpair_neck_gap = 0.000000
    dpair_neck_width = 0.004000
    dpair_coupled_tol_min = 0.000100
    dpair_coupled_tol_pl = 0.000100
    dpair_minimum_spacing = 0.005800
    dpair_gather_control = 0.000000
    dpair_max_uncoupled_len = 0.100000
    dpair_phase_control = 0.000000
    dpair_phase_tolerance_min = 0.000000
    dpair_phase_tolerance_pl = 0.000000
}
```

Electrical Set Entry Record

Electrical set entry record is intended to link CAD net and electrical parameter set. The record has the following structure:

```
NET_ECSET_ENTRY {
    net_name = <net name>
    ecset_name = <set name>
}
```

- `<net name>` is the name of the CAD net (not a type as for other records in the file)
- `<set name>` is the name of the electrical parameters set (the same name as mentioned in the `ecset_name` field of `NET_ELECTRICAL_PARAMS`)

Example:

```
NET_ECSET_ENTRY {
    net_name = SC_D_SCSI_SEL_N
    ecset_name = DP-IBM-6GAP
}
```

chk (Checklists) (See Chapter 9)

et (See Chapter 10)
**cdrsr (AOI Panelization)**

This file describes the AOI panelization - a panelization which may be defined for AOI purposes, for the duplication of inspection areas and exclusion zones during the process of preparing CDR setup for Orbotech AOI machines.

**Example:**

```plaintext
PANELIZATION=USER_DEFINE
D

PCB {
  X_DATUM=3.219249311023622
  Y_DATUM=3.702147440944882
  X_MIN=1.797249606299212
  Y_MIN=2.280147834645669
  X_MAX=4.568325787401575
  Y_MAX=5.561685433070866
  SNAP=0
  INSPECT=0
  NAME=1
  STEP=

  STEP-REPEAT {
    NAME=
    X=3.219249311023622
    Y=3.702147440944882
    DX=4.995229330708661
    DY=-0.0364615157480315
    NX=2
    NY=1
    ANGLE=0
    MIRROR=NO
  }
}

USE_STEPS=
GENESIS_VERSION=
```

<table>
<thead>
<tr>
<th>Type</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>Yes</td>
</tr>
<tr>
<td>Path</td>
<td><code>&lt;job_name&gt;/steps/&lt;step_name&gt;/cdrsr</code></td>
</tr>
</tbody>
</table>
### Description

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PANELIZATION</td>
<td>Implies that the AOI panelization is used for CDR purposes.</td>
</tr>
<tr>
<td>USER_DEFINED</td>
<td></td>
</tr>
<tr>
<td>PCB</td>
<td>Array defining the PCBs which consist of the AOI panelization.</td>
</tr>
<tr>
<td>USE_STEPS</td>
<td>Field not in use.</td>
</tr>
<tr>
<td>GENESIS_VERSION</td>
<td>Field not in use.</td>
</tr>
</tbody>
</table>

### PCB Array Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X_DATUM</td>
<td>x datum point (used for step &amp; repeat)</td>
</tr>
<tr>
<td>Y_DATUM</td>
<td>y datum point (used for step &amp; repeat)</td>
</tr>
<tr>
<td>X_MIN</td>
<td>minimal x coordinate of PCB (for defining PCB dimensions)</td>
</tr>
<tr>
<td>Y_MIN</td>
<td>minimal y coordinate of PCB (for defining PCB dimensions)</td>
</tr>
<tr>
<td>X_MAX</td>
<td>maximal x coordinate of PCB (for defining PCB dimensions)</td>
</tr>
<tr>
<td>Y_MAX</td>
<td>maximal y coordinate of PCB (for defining PCB dimensions)</td>
</tr>
<tr>
<td>SNAP</td>
<td>0. Field not in use.</td>
</tr>
<tr>
<td>INSPECT</td>
<td>0. Field not in use.</td>
</tr>
<tr>
<td>NAME</td>
<td>PCB name as given during definition of AOI panelization. Names are restricted to integer numbers (&gt;= 1).</td>
</tr>
<tr>
<td>STEP</td>
<td>Field not in use.</td>
</tr>
<tr>
<td>STEP-REPEAT</td>
<td>Array defining the step&amp;repeat of the PCB in the panel. Similar to the STEP-REPEAT array in &lt;job_name&gt;/steps/&lt;step_name&gt;/stephdr.</td>
</tr>
</tbody>
</table>

### STEP-REPEAT Array Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>Field not in use. The NAME field as it appears in the PCB array is used instead.</td>
</tr>
<tr>
<td>X</td>
<td>Start X coordinate for placement of datum point of step.</td>
</tr>
<tr>
<td>Y</td>
<td>Start Y coordinate for placement of datum point of step.</td>
</tr>
<tr>
<td>DX</td>
<td>Horizontal distance between datum points (when angle = 0).</td>
</tr>
<tr>
<td>DY</td>
<td>Vertical distance between datum points (when angle = 0).</td>
</tr>
<tr>
<td>NX</td>
<td>Number of repetitions horizontally.</td>
</tr>
<tr>
<td>NY</td>
<td>Number of repetitions vertically.</td>
</tr>
<tr>
<td>ANGLE</td>
<td>Rotation angle of the steps (0, 90, 180 or 270 degrees).</td>
</tr>
<tr>
<td>MIRROR</td>
<td>YES for mirror (around X axis), NO for no mirror.</td>
</tr>
</tbody>
</table>
**reps (Reports)**

**Type:** Line Record Text

**Compression:** None

**Sum file:** No

**Path:** `<job_name>/steps/<step_name>/reps/<rep_name>`

### Example

```
TTL Library Merge Report
MSV 0
CAT No package in library
CAT No part in library
CAT Ambiguous package
CAT No pin 1
CAT No BOM data
CAT No vendor name
CAT No vendor code
CAT Placement mismatch (one)
CAT Placement mismatch (all)
CAT Inconsistent package rotation
CAT CAD/VPL pin count mismatch
CAT Package found
CAT Placement successful
_END_CAT

ITM 2 1
TXT VCODE: DALE, MPN: HAZ470MBABRAK
VAL S C388
LYR comp_+_top
AUX art.3
LIM 25222200 6146800 25831800 6553200
SHP S RC 2.4825 0.605 0.06 0.04
ITM 2 1
TXT VCODE: DALE, MPN: HAZ470MBABRAK
VAL S C389
LYR comp_+_top
AUX art.3
LIM 24968200 12623800 25577800 13030200
SHP S RC 2.4575 1.2425 0.06 0.04
```

### Description

**TTL - Report Title**

`<title>`

String serving as the report title (for display and for output).

**MSV - Maximum Severity**
### MSV <sev>

| <sev> | An integer (0, 1, or 2) indicating the highest severity level of any item in the report: 0 = error (highest possible severity) 1 = warning 2 = informational. |

### CAT - Category name

**CAT <name> ...**

_END_CAT - End of categories list

| <name> | String serving as the printed/displayed name for this category. The list of categories ends with _END_CAT and categories are later referenced by their index in this list, starting with 1. |

### ITM - Item entry

**ITM <cat> <sev>**

| <cat> | Index of the category to which this item belongs, in the category listing. |
| <sev> | Severity of this item: 0 - error 1 - warning 2 - informational An ITM record is followed by data pertaining to this item up to the next ITM record or the end of the file. |

### TXT - Item text description

**TXT <string>**

| <string> | A text string describing this item. If omitted, the item's description will be the name of the category to which this item belongs. |

### VAL - Item value record

**VAL S <str>**

**VAL I <intval>**

**VAL D <floatval>**

| <str> | String value |
| intval> | Integer value |
| <floatval> | Floating-point value |

All, some, or none of these records can be present for any item. How the values are interpreted, depends on the viewing method of the report in the code and cannot be modified.

### LYR - Item layer
LYR <lyrname>

<lyrname> Name of a layer in the job's matrix. This layer is the primary layer associated with the item.

AUX - Auxiliary layers

AUX <lyrname1> <lyrname2> ...

<lyrname1>, <lyrname2> etc. Names of layers in the job matrix. These layers serve as ‘auxiliary layers’ for this item, usually meaning that they will also be displayed when the item is displayed graphically.

LIM - Item limits record

LIM <xmin> <ymin> <xmax> <ymax>

<xmin>, <xmax> Lower and upper limits for the X-axis of the graphical display area for this item.

<ymin>, <ymax> Lower and upper limits for the Y-axis.

Note The limits define a “window” on the board where the location and size of the window are dependent on the type of report item. The report viewing functions of the Engineering Toolkit will zoom to an area twice the size of this window when the report item is highlighted. When the report items are components, the shape and the limits are based on the component body outline. In cases where the limits are not set (that is, xmin=xmax), the window is based on the “shape” borders.

Note See “Units of Measurement” on page 19.

SHP - Item shape record

SHP S <shaperec>

<shaperec> One of the following:
CR - Circle record
SQ - Square Record
RC - Rectangle record
CT...CE - Contour record
Chapter 6  

Job>steps>layers Entity

Requiring Implementation for GenFlex 6.4

- Partial S&R Data File
- Partial S&R Data File & Layer Profile Reference Number (Encrypted Files)
- Scaling per Step Data File (Implemented in Genesis v9.3b also)
- Scaling per Step Data File (Encrypted File)
- Dimension File (Encrypted File)

Partial S&R Data File

Partial S&R data is saved under the layer directory in a new file called layerhdr_p. The file structure is the same as a STEP-REPEAT section in stphdr file. The data is used instead of S&R data of the step for display and/or output the layer. File uses only lowest level of steps and their transformations to the panel. In addition the file includes a parameter PRF_REF_NUM = xxx where: xxx = 1,2,3, etc. is a reference number to define a certain layer profile (see lyr_profiles_p file).
(Downgrade will delete the file) (See “stephdr (Step Header)” on page 71.)

Partial S&R Data File & Layer Profile Reference Number (Encrypted Files)

<job_name>/steps/<step_name>/layers/<lyr_name>/layerhdr_p

Scaling per Step Data File (Implemented in Genesis v9.3b also)

Scaling data is saved under the layer directory in a new file called subsrdata_p.
The file structure includes a SUBSR sections:

```plaintext
SUBSR {
    STEP=PCB
    XA=0.0218488188976378
    YA=0.01848740157480315
    XSCALING=1.001
    YSCALING=1.001
}
```
(Downgrade will delete the file)
Scaling per Step Data File (Encrypted File)

<job_name>/steps/<step_name>/layers/<layer_name>/subsrdata _p

Dimension File (Encrypted File)

<job_name>/steps/<step_name>/layers/<layer_name>/dimension_p

Description of the Dimension File

File name: “dimension”

File location: Inside a layer directory that is inside a step.

Header

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version</td>
<td>Version number of file. This value is currently unused. It may be used in the future if the data format of the dimension entity changes</td>
</tr>
<tr>
<td>Scale Percent</td>
<td>Indicates the scaling of the drawing as a percentage</td>
</tr>
<tr>
<td>PS_SIZE</td>
<td>The name of the postscript page size of the drawing</td>
</tr>
<tr>
<td>PS_ORIENTATION</td>
<td>Landscape or Portrait</td>
</tr>
<tr>
<td>Paper Width</td>
<td>Paper width in inches</td>
</tr>
<tr>
<td>Paper Height</td>
<td>Paper height in inches</td>
</tr>
<tr>
<td>Paper Pos X &amp; Paper Pos Y</td>
<td>The coordinates of the lower left corner of the page</td>
</tr>
<tr>
<td>Paper_*_Margin</td>
<td>The top</td>
</tr>
<tr>
<td>Active_*</td>
<td>The coordinates of the active area of the drawing. (This is the region where the actual drawing is supposed to be drawn)</td>
</tr>
<tr>
<td>Line width</td>
<td>The width (in points) of the dimension drawing lines</td>
</tr>
<tr>
<td>Post_Decimal_Dist</td>
<td>The number of places after the decimal point to be used for distances</td>
</tr>
<tr>
<td>Post_Decimal_Pos</td>
<td>The number of places after the decimal point to be used for locations</td>
</tr>
<tr>
<td>Post_Decimal_Angle</td>
<td>The number of places after the decimal point to be used for angles</td>
</tr>
<tr>
<td>FONT</td>
<td>The name of the font to use for the drawing</td>
</tr>
<tr>
<td>FONT_WIDTH</td>
<td>The width of the font in points</td>
</tr>
</tbody>
</table>
Sample Header:

```
VERSION=1
SCALE_PERCENT=300
PS_SIZE=A4
PS_ORIENTATION=LANDSCAPE
PAPER_WIDTH=12
PAPER_HEIGHT=8.3
PAPER_POS_X=-1.0
PAPER_POS_Y=-0.8
PAPER_TOP_MARGIN=0.1
PAPER_BOTTOM_MARGIN=0.1
PAPER_LEFT_MARGIN=0.1
PAPER_RIGHT_MARGIN=0.1
ACTIVE_X00=0.3
ACTIVE_Y00=0.3
ACTIVE_X11=1.9
ACTIVE_Y11=1.9
LINE_WIDTH=0.22
POST_DECIMAL_DIST=3
POST_DECIMAL_POS=3
POST_DECIMAL_ANGLE=3
FONT=SIMPLEX.SHX
FONT_WIDTH=4.6
FONT_HEIGHT=4.6
EXT_OVERLEN=0.04
CENTER_MARKER_LEN=0.05
BASELINE_SPACING=0.012
DIMENS_COLOR_FEATURE=757575
DIMENS_COLOR_DIMENS=9900
DIMENS_COLOR_DIMENS_TEXT=99
DIMENS_COLOR_PROFILE=990000
ORIGIN_X=0.0
ORIGIN_Y=0.2
```

<table>
<thead>
<tr>
<th>Font Height</th>
<th>The height of the font in points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext_Overlen</td>
<td>How far the extension lines extend past the dimension line</td>
</tr>
<tr>
<td>Center Marker Len</td>
<td>The length of the center marker in file units</td>
</tr>
<tr>
<td>Baseline Spacing</td>
<td>The spacing to be used between measurements in Baseline dimensions</td>
</tr>
<tr>
<td>Dimens Color Feature</td>
<td>The output color of layer features</td>
</tr>
<tr>
<td>Dimens Color Dimensions</td>
<td>The output color of dimensions</td>
</tr>
<tr>
<td>Dimens Color Dimensions Text</td>
<td>The output color of dimension text</td>
</tr>
<tr>
<td>Dimens Color Profile</td>
<td>The output color of the profile</td>
</tr>
<tr>
<td>Origin X, Origin Y</td>
<td>The location of the origin of the drawing</td>
</tr>
</tbody>
</table>
Chapter 6  Job>steps>layers Entity
Requiring Implementation for GenFlex 6.4

**Dimension entity**

The dimension entity can include many dimension records of the following format:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>One of horiz, vert, parallel, radial, angle</td>
</tr>
<tr>
<td>vert</td>
<td>parallel</td>
</tr>
<tr>
<td>radial</td>
<td>diam</td>
</tr>
<tr>
<td>angle</td>
<td>center</td>
</tr>
<tr>
<td>Ref[1-3]</td>
<td>Coordinates of reference points of the dimension.</td>
</tr>
<tr>
<td>Line_Pt_x &amp; Line_Pt_y</td>
<td>A point on the line that the text is written on.</td>
</tr>
<tr>
<td>Offset</td>
<td>Offset from measuring location to start drawing line</td>
</tr>
<tr>
<td>Arrow_Pos</td>
<td>Arrows drawn INSIDE or OUTSIDE</td>
</tr>
</tbody>
</table>

The dimension record contains a text record that describes the text label of the dimension. It contains the following fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefix</td>
<td>text to be written before the value</td>
</tr>
<tr>
<td>Value</td>
<td>text to be written for dimension value</td>
</tr>
<tr>
<td>View Units</td>
<td>Whether the units should be written</td>
</tr>
<tr>
<td>Units</td>
<td>One of inch, mm, mil, ym, deg, r, g (ym is microns, r is radians, g is gradians) Radians, gradians and degrees must be used for and may only be used for angular dimensions.</td>
</tr>
<tr>
<td>Outside</td>
<td>Whether the text is to be drawn outside the dimension range (Applies only to horizontal, vertical, angular and parallel dimensions)</td>
</tr>
<tr>
<td>Tol Up &amp; Tol Down</td>
<td>Text to be written for the upper and lower tolerances of the dimension</td>
</tr>
<tr>
<td>Suffix</td>
<td>Text to be written at the end of the measurement text</td>
</tr>
<tr>
<td>Note</td>
<td>Text to be written under the measurement text</td>
</tr>
<tr>
<td>X &amp; Y</td>
<td>Coordinates of the dimension text</td>
</tr>
<tr>
<td>Angle</td>
<td>Angle of the dimension text (in degrees)</td>
</tr>
</tbody>
</table>

Sample dimension record:

```
DIMENSION {
    TYPE=HORIZ
    REFIX=0.56
    REF1Y=0.69
    REF2X=1.30
    REF2Y=0.68
}
```
The DIMENSION record may also contain the coordinates of up to 2 extension lines. This is supported only for angular dimensions. Below is a sample record.

```
EXT_LINE {
  PS_X=-0.43
  PS_Y=0.55
  PE_X=-0.47
  PE_Y=0.58
}
```

**Predefined text symbols support**

As part of the dimension project the support of adding 4 new text symbols is added to dimensions text. These symbols may be used in text string by typing the predefined sequence (like in AutoCAD):

- \( \pm \) - \%\%p
- \( \varnothing \) - \%\%c
- \( \circ \) - \%\%d
- \( \mu \) - \%\%m
### attrlist (Attribute List)

This file contains the values for attributes (system and user) of a layer.

**Example**

```plaintext
.out_mirror = no
.inp_file =
.eda_layers = "signal_2","signal","VIA"
.out_angle = 0.0
.out_polarity = positive
.out_x_scale = 1.000000
.out_y_scale = 1.000000
.out_comp = 0.000000
```

### features

The features file contains most of the graphical information of a layer (except for component layers which have the components file). Special symbols also have a feature file to describe their shape. The feature files have 4 sections:

- **Symbols table**
  
  Contains the names of all the symbols used by the features in the file and corresponding serial numbers for reference by the feature records.

- **Attribute table**
  
  Contains the names of attributes used by the features in the file, and the corresponding serial numbers for reference by the feature records.
Attributes texts
Contains a list of text strings which are values for textual attributes.

Features list
Contains the actual features data

As of ODB++ V.7.0, features and coordinates are saved in the units in which they were created to avoid loss of precision due to rounding. In every features file saved for each layer and special symbol, there can be a line with the units definition to be applied to the features in the file—U <INCH|MM>. If this line does not exist, INCH is assumed. All coordinate values will be interpreted as inches or millimeters. Resize factors for special symbols are interpreted as mils or microns. (Exceptions are discussed where relevant.)

This also applies to semi-standard symbols described at the beginning of the feature file. The format is:

$<serial_number> <symbol_name> [I|M]
I imperial units
M metric units

If no unit type is indicated, I is assumed.

Example

# Units
#U
U MM
......
#
# Feature symbol names
#
$0 r120 #not semi-standard--units are mm as are the layer units
$1 rect20x60 M # rect 20 by 60 microns
$2 rect3x5 I #rect 3 by 5 mils
$3 r10
......
#
# Feature attribute names
#
@0 .smd
@1 .nomenclature
@2 .test_point
@3 .geometry
@4 .pad_usage
......
#
# Feature attribute text strings
#
&0 9796334
&1 fid_0_0_0
&2 moire
&3 p115_115_115_095
...
# Layer features

P -0.198 1.62 1 P 0 3;3=2,4=0
P 0.118 1.62 1 P 0 3;3=25,4=0
L 3.834 -1.16 3.86728 -1.16 2 P 0 ;1,3=0
L 3.86728 -1.16 3.8782 -1.16485 2 P 0 ;1,3=0
...
S P 0
OB -0.013 2.427 I
OS -0.013 2.218
OS -0.263 2.218
OS -0.263 2.427
OS -0.219 2.427
OS -0.219 2.262
OS -0.057 2.262
OS -0.057 2.427
OS -0.013 2.427
OE
SE
...

The following figure describes how symbols are treated. The sample feature file has been stripped of all but the relevant sections for this example:

Note that standard symbols [such as r10 (round 10), s20 (square 20), oval50x30] are not stored in a feature file but are interpreted by the system. Special symbols are user-defined and stored in the Special Symbols directory.
The feature symbol names section:
This section contains the symbols used by features in the file. The format of each line is:

\[$<\text{serial_num}> \ <\text{symbol_name}> \ [I|M]$

See “Symbol Definitions” on page 202 for symbol naming conventions.

The feature attribute names section:
This section defines the names of attributes used by features in the file. The format of each line is:

\[@<\text{serial_num}> \ <\text{attribute_name}>\]

Attribute starting with the dot (.) character are system attributes (some system attributes must be defined for certain processes, such as analysis). Other attributes are user defined attributes.

![Layer-1](image)

```
#Feature attribute names
# @0 .smd
@1 .nomenclature
@2 .test_point
@3 .geometry
@4 .pad_usage
...
#
#Feature attribute text strings
#
&0 9796334
&1 fid_0_0_0
&2 moire
&3 p115_115_115_095
...
#
P -0.198 1.62 16 P 0 3;3=2,4=0
3(.geometry) =2(moire)
```

*When the attribute is of type Option, the reference number points to the attribute options. In the case of .pad_usage these are:
0 - toeprint;
1 - via;
2 - g_fiducial;
3 - l_fiducial;
4 - tooling_hole.
Therefore, 4=0 in the feature record above, means .pad_usage=toeprint

The feature attribute text strings section:
This section contains texts which are values of textual feature attributes. Like its predecessors, the reason for this section is to save the repetition of long texts for each feature which uses it. The format of each line is:

\&<serial_num> <text>

**The features section:**

This is the main section of the features file. It contains all the features in the file. Most features are represented by a single line in the file. Surface features may require multiple lines. The general format of a feature line is:

```
<type> <params> ; <atr>[=]<value>[,...]
```

Where:

**<type>** feature type which can be:
- L Line
- P Pad
- A Arc
- T Text
- B Barcode
- S Surface

**<params>** A different set for each type. See below

**<atr>** An attribute number, referencing an attribute from the feature attribute names section.

**<value>** An attribute value which:
- Is omitted for boolean attributes
- Is a number for integer and float attributes
- Is an option number for an option attribute
- Is a number referencing the feature attribute text strings section for a textual attribute

The **<params>** field:

For line (L) records:
```
<xs> <ys> <xe> <ye> <sym_num> <polarity> <dcode>
```

<table>
<thead>
<tr>
<th>xs, ys</th>
<th>start point</th>
</tr>
</thead>
<tbody>
<tr>
<td>ye, ye</td>
<td>end point</td>
</tr>
<tr>
<td>sym_num</td>
<td>A serial number of the symbol in the feature symbol names section</td>
</tr>
<tr>
<td>polarity</td>
<td>P for positive, N for negative</td>
</tr>
<tr>
<td>dcode</td>
<td>gerber dcode number (0 if not defined)</td>
</tr>
</tbody>
</table>

For pad records:
Example of Pad Records in Feature File

Special pad \texttt{const\_1} at location \(x=1.0, y=2.0\) positive, with \texttt{dcode} 4, is used as an example for different transformations:

\begin{verbatim}
# Feature symbol names
# $0 const_1
P 1.0 2.0 0 P 4 1 # rotated by 90
P 1.0 2.0 0 P 4 8 30.0 # rotated by 30
P 1.0 2.0 -1 0 0.02 P 4 1 # rotated by 90 resized by 0.02 mil
P 1.0 2.0 -1 0 0.02 P 4 8 30.0 # rotated by 30 resized by 0.02 mil
\end{verbatim}

The same information is displayed in the Info Command Interface for Data type: FEATURES and the Info output file, \texttt{-t \langle layer\rangle -d FEATURES}.

For arc (A) records:
Chapter 6  Job>steps>layers Entity
features

For text (T) records:

\[
\begin{align*}
\text{xs, ys} & \quad \text{start point} \\
\text{ye, ye} & \quad \text{end point} \\
\text{xc, yc} & \quad \text{center point} \\
\text{sym_num} & \quad \text{A serial number of the symbol in the feature symbol names section} \\
\text{polarity} & \quad \text{P for positive, N for negative} \\
\text{dcode} & \quad \text{gerber dcode number (0 if not defined)} \\
\text{cw} & \quad \text{Y for clockwise, N for counter clockwise} \\
\end{align*}
\]

For text (T) records:

\[
\begin{align*}
\text{x, y} & \quad \text{text location (bottom left of first character for 0 orientation)} \\
\text{font} & \quad \text{font name (Currently must be 'standard')} \\
\text{polarity} & \quad \text{P for positive, N for negative} \\
\text{orient_def} & \quad \text{text orientation. This value is expressed as:} \\
& \quad \text{0|1|2|3|4|5|6|7|8 <rotation>|9<rotation>} \\
& \quad \text{0 : 0 degrees, no mirror} \\
& \quad 1 : 90 degrees, no mirror \\
& \quad 2 : 180 degrees, no mirror \\
& \quad 3 : 270 degrees, no mirror \\
& \quad 4 : 0 degrees, mirror in X axis \\
& \quad 5 : 90 degrees, mirror in X axis \\
& \quad 6 : 180 degrees, mirror in X axis \\
& \quad 7 : 270 degrees, mirror in X axis \\
& \quad 8 : \text{any angle} \text{ rotation, no mirror} \\
& \quad 9 : \text{any angle} \text{ rotation, mirror in X axis} \\
\text{xsize,ysize} & \quad \text{Character size} \\
\text{width factor} & \quad \text{width of character segment (in units of 12 mils) i.e. 1 = 12 mils, 0.5 = 6 mils} \\
\text{text} & \quad \text{text string.} \\
\text{version} & \quad \text{text field version values:} \\
& \quad 0 \text{ previous version} \\
& \quad 1 \text{ current version} \\
\end{align*}
\]
Example of Text Records in Feature File

The frame on the left shows the text entered in a blank layer in the Graphic Station. Below is the Feature file created for this layer.

The actual text string contained within single quotes (text records can have embedded space characters). Note that the Date format can be: DD/MM/YYYY as of version 4.3

- **T** indicates the record is text.
- The X, Y coordinates locating the bottom left of the first character of the text string.
- X size, Y size of text string (in this case, 200 mils each).
- Width factor=2.00000
- Polarity=Positive
- Orientation=0

For barcode (B) records:

```
<x> <y> <barcode> <font> <polarity> <orient_def> E <w> <h>
<fasc> <cs>
```

See parameters of T (text) records for dynamic values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>x, y</td>
<td>test location (bottom left of first character for 0 orientation)</td>
</tr>
<tr>
<td>barcode</td>
<td>barcode name (currently must be UPC39)</td>
</tr>
<tr>
<td>font</td>
<td>font name (currently must be 'standard')</td>
</tr>
<tr>
<td>polarity</td>
<td>P for positive, N for negative</td>
</tr>
<tr>
<td>orient_def</td>
<td>text orientation: same as for T (text) records</td>
</tr>
<tr>
<td>E</td>
<td>a constant value (reserved for future use)</td>
</tr>
<tr>
<td>w</td>
<td>element width</td>
</tr>
<tr>
<td>h</td>
<td>barcode height</td>
</tr>
<tr>
<td>fasc</td>
<td>Y for full ASCII, N for partial ASCII</td>
</tr>
<tr>
<td>cs</td>
<td>Y for checksum, N for no checksum</td>
</tr>
</tbody>
</table>
For surface (S) records:
A surface is different from other features; it consists of multiple records:

\[ S \text{ <params> ; <atr>=<value>...} \]
\[ \text{<polygon 1>} \]
\[ \text{<polygon n>} \]

SE

The <params> section contains: <polarity> <dcode>

- polarity - P for positive, N for negative
- dcode - gerber dcode number (0 if not defined)

The first line is followed by a list of polygons. Each polygon is a collection of segments (lines without width) and curves (arcs without a width). Polygons must meet the following restrictions:

- Intersection is not allowed between edges of the same polygon.
- Intersection is not allowed between edges of different polygons.
- The polygons must form a closed shape (e.g., a polygon that contains only 2 segments is not valid).
- Holes must be graphically contained inside island polygons. The direction of island must be clockwise and of holes must be counter clockwise.
- The curves must be consistent (the start, end, and center point must construct a legal curve).

If any of the above mentioned violations occurs, the system will not be able to read the file, and will return an error.

The syntax of the polygons description for a surface feature is as follows:

\[ \text{OB} \text{ <xbs> <ybs> <poly_type>} \]
\[ \text{OS} \text{ <x> <y>} \]
\[ \text{OC} \text{ <xe> <ye> <xc> <yc> <cw>} \]
\[ \text{OE} \]

Where:

<table>
<thead>
<tr>
<th>bg</th>
<th>Y for inverted background, N for no background</th>
</tr>
</thead>
<tbody>
<tr>
<td>astr</td>
<td>Y for an addition of a text string</td>
</tr>
<tr>
<td>astr_pos</td>
<td>T for adding the string on top, B for bottom</td>
</tr>
<tr>
<td>Text</td>
<td>text string</td>
</tr>
</tbody>
</table>

For surface (S) records:

A surface is different from other features; it consists of multiple records:

\[ S \text{ <params> ; <atr>=<value>...} \]
\[ \text{<polygon 1>} \]
\[ \text{<polygon n>} \]

SE

The <params> section contains: <polarity> <dcode>

- polarity - P for positive, N for negative
- dcode - gerber dcode number (0 if not defined)

The first line is followed by a list of polygons. Each polygon is a collection of segments (lines without width) and curves (arcs without a width). Polygons must meet the following restrictions:

- Intersection is not allowed between edges of the same polygon.
- Intersection is not allowed between edges of different polygons.
- The polygons must form a closed shape (e.g., a polygon that contains only 2 segments is not valid).
- Holes must be graphically contained inside island polygons. The direction of island must be clockwise and of holes must be counter clockwise.
- The curves must be consistent (the start, end, and center point must construct a legal curve).

If any of the above mentioned violations occurs, the system will not be able to read the file, and will return an error.

The syntax of the polygons description for a surface feature is as follows:

\[ \text{OB} \text{ <xbs> <ybs> <poly_type>} \]
\[ \text{OS} \text{ <x> <y>} \]
\[ \text{OC} \text{ <xe> <ye> <xc> <yc> <cw>} \]
\[ \text{OE} \]

Where:

<table>
<thead>
<tr>
<th>xbs, ybs</th>
<th>polygon start point</th>
</tr>
</thead>
<tbody>
<tr>
<td>poly_type</td>
<td>I for island, H for hole</td>
</tr>
<tr>
<td>x, y</td>
<td>segment end point</td>
</tr>
<tr>
<td></td>
<td>(previous polygon point is the start point)</td>
</tr>
<tr>
<td>xe, ye</td>
<td>curve end point</td>
</tr>
<tr>
<td></td>
<td>(previous polygon point is the start point)</td>
</tr>
<tr>
<td>xc, yc</td>
<td>curve center point</td>
</tr>
<tr>
<td>cw</td>
<td>Y for clockwise, N for counter clockwise</td>
</tr>
</tbody>
</table>
It is recommended that polygons be represented each as a single island, since a multi-island polygon is electrically disconnected. As a single feature, it is supposed to be connected to a single net.

A self intersecting polygon (SIP) is a polygon with two non-consecutive edges (segments or curves) which touch each other. Legal polygons are those whose edges intersect only at endpoints of consecutive edges (see figure on the right).

SIPs are not a good base for mathematical representation. Problematic operations are:

- Resize (enlarge, shrink, change shape)
- Calculation of copper areas (where unambiguous definition of the copper location is essential)

### Changes Required for GenFlex 6.4

The changes in the features file are caused by implementation of the following capabilities:

- Support for any angle rotation of texts
- Support of non-Latin text features
- Support for additional fonts

### Feature Symbol Names section

This section format has not changed. It should be noted that there are a new reserved name to the symbol that is:

- Rotated or SHX or non-Latin text (text parameters are stored in attributes see section 6.2.2)
- Rotated standard symbol (rotation angle (CW) is a part of the symbol name)
- Barcodes CODE-128b, CODE-128c and ECC-200 (barcode parameters are stored in attributes see section 6.2.3)

For example:

```
# Feature symbol names
#
$0 text
$1 text+1
$2 text+2
$3 s100_45
$4 rect20x10_30
$5 barcode
$6 barcode+1
```
Font name in text description record

In addition to ODB++ fonts, described in document 0202, there supported AutoCad fonts (.shx). Font files are stored in the \(<job\_name>/\texttt{fonts\_ex/shx/} \) directory.

Existing format:

\(<x> <y> \texttt{<font\_name> <polarity> <orient> <xsize> <ysize> <width\_factor> <text>}\>\)

Where:

- \(<\texttt{font\_name}>\) - Name of one of font files existing in the directory \texttt{fonts & fonts\_ex/shx}\)

Text specification

Since \(<\text{text}>\) field can contain non-Latin text, and there exist several types of supported fonts, the additional considerations are done for text storage. The text is stored as a multi-byte sequence in encoding that matches the font file. This makes easier to recreate a graphics representation of a text string.

For example, for \	exttt{standard} file (or other existing ODB++ font file format) the encoding is ASCII, which is actually no change in comparison to the past. AutoCAD fonts (.shx) have Windows encoding which is country dependent. For example, Japanese encoding is SJIS, and Chinese encoding is Big5. Text in the feature record is stored in the corresponding encoding. If this text should be further presented in (non-graphic) GUI with other encoding, the information of the original font encoding can be found separately, with the font file description.

Text symbol to represent rotated & SHX & non-Latin text

To represent a text a special symbol with predefined name \texttt{text+nn} is used.

A symbol includes a text built by simple lines to back compatibility. In addition it should include next attributes:

- \(\text{.text}\) = 12345 // Text string
- \(\text{.nomenclature\_type}\) = \texttt{standard} // Font name
- \(\text{.text\_x\_size}\) = 0.200000
- \(\text{.text\_y\_size}\) = 0.200000
- \(\text{.text\_line\_width}\) = 23.622047
- \(\text{.text\_rotation}\) = 30.000000

The attributes saves text parameters used if the text should be modified.

Text symbol to represent barcode

To represent a barcode a special symbol with predefined name \texttt{barcode+nn} is used.

A symbol includes a barcode built by simple lines to back compatibility. In addition it should include next attributes:

- \(\text{.text}\) = 12345 // Text string
- \(\text{.barcode\_type}\) = \texttt{ecc-200} // Barcode type (code128b/code128c/ecc-200)
- \(\text{.barcode\_matrix}\) = 10x10 // Barcode matrix (for type=ecc200)
- \(\text{.barcode\_bg}\) = 1 // Barcode background(1-yes;0-no)
Chapter 6  Job>steps>layers Entity

components

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>Yes</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/layers/&lt;layer_name&gt;/components</td>
</tr>
</tbody>
</table>

Each layer of type component has a unique name: `comp+_top` or `comp+_bot`. There are a maximum of two such layers in each job. Each layer has a components file which contains the information about actual components placed on the layer. The components file contains references to the `<step_name>/eda/data` file described earlier.

**Example**
```
# Component attribute names

@0 .comp_ign_spacing
@1 .no_tp_under
@2 .no_text_under
@3 .thvpad_required
@4 .comp_type
@5 .comp_height
@6 .comp_weight

# CMP 0
CMP 13 -0.04 1.22 270.0 N B70 2248827-0001
;1,2,4=11,5=0.100000,6=0.035273
PRP REFLOC 'IN,0.2,-0.225,270,CC,0.035,0.035,0.009, std,1'
TOP 0 -0.198 1.62 270.0 N 223 0 B70-1
TOP 1 0.118 1.62 270.0 N 223 1 B70-2
TOP 2 -0.04 1.22 270.0 N 466 0 B70-3
```

The components file may have a header, listing names of attributes used by the components in the file and possible textual values. This header is similar to the header of the features file (records starting with the @ and & character) and is described there.
Following the attribute header, components are listed in order, using 3 types of records:

| CMP | Starts a component          |
| PRP | Property of a component     |
| TOP | Toeprint of a component     |

Following is the format and description of each record.

This record contains a definition of a component. Each CMP line is followed by 0 or more property (PRP) records and 0 or more TOP records.

**CMP** `<pkg_ref> <x> <y> <rot> <mirror> <comp_name> <part_name> ;`<attributes>

Where:

- `<pkg_ref>` The number of the package in the eda/data file
- `<x>,<y>` The board location of the component in inches
- `<rot>` The rotation of the component, in degrees, clockwise.
- `<mirror>` N for not mirrored, M for mirrored
- `<comp_name>` component name (reference designator)
- `<part_name>` part identification
- `<attributes>` This data is the same as for feature attributes (in the features file). It consists of comma separated list of values. Each can be:
  - `n` indicating that (boolean) attribute n is set
  - `n=m` indicating that option attribute n has value m
  - `n=i` indicating that integer attribute n has value i
  - `n=f` indicating that floating attribute n has value f
  - `n=s` indicating that text attribute n has header value s

Note: n must match a @ record in the attribute header and s must match a & record in the attribute header.

**TOP** `<pin_num> <x> <y> <rot> <mirror> <net_num> <subnet_num> <toeprint_name>`

Where:

- `<pin_num>` The pin number inside the package of the component
- `<x>,<y>` The board location of the pin in inches
- `<rot>` The rotation of the component, in degrees, clockwise.
- `<mirror>` N for not mirrored, M for mirrored
- `<net_num>` Number of net in the eda/data file
- `<subnet_num>` Number of subnet within referenced net
- `<toeprint_name>` Name of the toeprint
* The **net_num** used in the TOP record corresponds to the sequence of the Net records in the **eda/data** file. The first Net record is **net_num 0**, the second is **net_num 1** and so on.

**Property Record**

This record represents a property of the component.

A property consists of a name, a string value and 0 or more floating numbers.

PRP `<name>` '<value>' n1 n2 ...

Where:

<table>
<thead>
<tr>
<th><strong>&lt;name&gt;</strong></th>
<th>The name of the property</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>&lt;value&gt;</strong></td>
<td>The string of the property (between quotes)</td>
</tr>
<tr>
<td><strong>n1,n2,...</strong></td>
<td>The floating numbers to be kept in the property</td>
</tr>
</tbody>
</table>

**components3**

The **components** file describes the original EDA data for a component, while the **components3** file presents the data after processing with Assembly Merge (Bom Merge, Library Merge and Board Merge).

**Note**  See preceding section for further information on the example below.

**Example**

```plaintext
#  
#Component attribute names  
#  
@0 .comp_polarity  
@1 .comp_height  

# CMP 0  
CMP 0 27.235992 6.19674 270.0 N W3_30B *  
#  
# BOM DATA  
CPN 070-000-016  
PKG  
IPN  
VPL_VND  
```
The component BOM DATA section contains BOM information on component

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPN</td>
<td>Customer part number</td>
</tr>
<tr>
<td>PKG</td>
<td>Package name</td>
</tr>
<tr>
<td>IPN</td>
<td>Internal part number</td>
</tr>
<tr>
<td>DSC</td>
<td>Up to 5 descriptions</td>
</tr>
<tr>
<td>VPL_VND</td>
<td>Manufacturer from the VPL corresponding to original vendor (as determined in BOM Validation)</td>
</tr>
<tr>
<td>VPL_MPN</td>
<td>MPN from the VPL database corresponding to original MPN (as determined in BOM Validation)</td>
</tr>
<tr>
<td>VND</td>
<td>Manufacturer (vendor) name</td>
</tr>
<tr>
<td>MPN</td>
<td>Manufacturer part number</td>
</tr>
<tr>
<td>Qualify</td>
<td>Whether the part (vendor+mpn) is qualified for production: -1 - not qualified 0 - unknown 1 - qualified</td>
</tr>
<tr>
<td>Chosen</td>
<td>If this part is chosen from among the alternate parts for the CPN, only one can be chosen. y - yes, n - no</td>
</tr>
</tbody>
</table>

The MPN line contains the following parameters separated by spaces:

qualify chosen MPN

The section: VPL_VND + VPL_MPN + VND + MPN repeats for all the alternate parts of that CPN.
**tools (Drill Tools)**

This file contains the tools table of a drill layer, initially created during input and further enhanced by the Drill Tools Manager.

**Example**

```
THICKNESS=0.0625
USER_PARAMS=method25

TOOLS {
   NUM=1
   TYPE=VIA
   TYPE2=STANDARD
   MIN_TOL=0
   MAX_TOL=0
   BIT=
   FINISH_SIZE=11.5
   DRILL_SIZE=13.5
}

TOOLS {
   NUM=2
   TYPE=PLATED
   TYPE2=STANDARD
   MIN_TOL=0
   MAX_TOL=0
   BIT=
   FINISH_SIZE=15
   DRILL_SIZE=19
}
```

**Note**  
See “Units of Measurement” on page 19.

The file contains 2 global parameters and a **TOOLS** array.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>THICKNESS</td>
<td>board thickness (mils)</td>
</tr>
<tr>
<td>USER_PARAMS</td>
<td>free text that is used by the hook <code>drill_size</code> when converting finished hole sizes to drilled hole sizes</td>
</tr>
</tbody>
</table>

The fields of the **TOOLS** array structure are:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUM</td>
<td>tool number</td>
</tr>
<tr>
<td>TYPE</td>
<td>one of PLATED, NON_PLATED, VIA</td>
</tr>
</tbody>
</table>
### camtek

The file contains parameters of a Camtek set, describing parameters to be used when testing the layer for this entity.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE2</td>
<td>one of STANDARD, PHOTO, LASER, PRESS_FIT (default: STANDARD) used in the &quot;TOOLS&quot; section of the &quot;tools&quot; file.</td>
</tr>
<tr>
<td>MIN_TOL, MAX_TOL</td>
<td>allowed tolerances (mils)</td>
</tr>
<tr>
<td>BIT</td>
<td>drill bit string</td>
</tr>
<tr>
<td>FINISH_SIZE</td>
<td>finished drill size (mils)</td>
</tr>
<tr>
<td>DRILL_SIZE</td>
<td>calculated drill size (mils)</td>
</tr>
</tbody>
</table>

Type: Structured Text

Compression: None

Sum file: Yes

Path: `<job name>/steps/<step name>/layers/<layer name>/camtek`

### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANGLE</td>
<td>Alignment of panel: rotation value</td>
</tr>
<tr>
<td>MIRROR</td>
<td>Alignment of panel: mirroring value</td>
</tr>
<tr>
<td>X_SCALE</td>
<td>Alignment of panel: X axis scale value</td>
</tr>
<tr>
<td>Y_SCALEL</td>
<td>Alignment of panel: Y axis scale value</td>
</tr>
<tr>
<td>POLARITY</td>
<td>Polarity of panel</td>
</tr>
<tr>
<td>DRILLS</td>
<td>Whether drill holes must be considered?</td>
</tr>
<tr>
<td>ETCH</td>
<td>Value of etch factor</td>
</tr>
<tr>
<td>RESOLUTION</td>
<td>Mania pixel size</td>
</tr>
<tr>
<td>MIN_LINE</td>
<td>Minimal line value</td>
</tr>
<tr>
<td>MIN_SPACE</td>
<td>Minimal space value</td>
</tr>
<tr>
<td>REG_DEFINED</td>
<td>True if registration pins were defined</td>
</tr>
<tr>
<td>REG_X1</td>
<td>X coordinate of first registration pin</td>
</tr>
<tr>
<td>REG_Y1</td>
<td>Y coordinate of first registration pin</td>
</tr>
<tr>
<td>REG_X2</td>
<td>X coord of second registration pin</td>
</tr>
<tr>
<td>REG_Y2</td>
<td>Y coord of second registration pin</td>
</tr>
<tr>
<td>CALIB</td>
<td>Calibration value</td>
</tr>
<tr>
<td>THICKNESS</td>
<td>Board thickness</td>
</tr>
</tbody>
</table>
Example

ANGLE=0
MIRROR=NO
X_SCALE=1
Y_SCALE=1
POLARITY=POSITIVE
DRILLS=NO
ETCH=0
RESOLUTION=1.25
MIN_LINE=0
MIN_SPACE=0
REG_DEFINED=YES
REG_X1=1.552809350393701
REG_Y1=0.2045889763779528
REG_X2=1.475844488188976
REG_Y2=-0.1904967519685039
CALIB=C1
THICKNESS=0
TOLERANCE=0
LAMINATION=SHEET
MACHINE=PANEL
REG_METHOD=1

SCAN_AREA {
  X1=-0.9562419291338583
  Y1=-0.9396204724409449
  X2=1.753758070866142
  Y2=1.065379527559055
}

EXCLUSION {
  X1=-0.4072266732283464
  Y1=0.2558988188976378
  X2=-0.114760531496063
  Y2=0.5381029527559055
}

EXCLUSION {
  X1=0.5471363188976378
  Y1=0.3636495078740157
  X2=0.7626376968503937
  Y2=0.4970551181102362
}

EXCLUSION_C {
  X=0.8190785433070866
}
Translation of AOI-SET Fields into Camtek Output

- **ANGLE=90**: to calculate transformation from panel coords to AOI table coords
- **MIRROR=YES**: to calculate transformation from panel coords to AOI table coords
- **X_SCALE=1.01**: to inf.dat, Layer-info, Xstretch
- **Y_SCALE=1.02**: to inf.dat, Layer-info, Ystretch
- **POLARITY=NEGATIVE**: to allow AOI machine to identify copper
- **DRILLS=NO**: whether to create drill data (drill01.dat)
- **ETCH=1.1**: to inf.dat, Layer-info, Etch
- **RESOLUTION=0.5**: to inf.dat, Layer-info, PixSize
- **MIN_LINE=0**: none
- **MIN_SPACE=0**: none
- **REG_DEFINED=YES**: to inf.dat, Layer-info, Ref_pins
- **REG_X1=1**: to inf.dat, Layer-info, Ref_pins
- **REG_Y1=9**: to inf.dat, Layer-info, Ref_pins
- **REG_X2=9**: to inf.dat, Layer-info, Ref_pins
- **REG_Y2=9**: to inf.dat, Layer-info, Ref_pins
- **CALIB=A0**: to inf.dat, Layer-info, Calib
- **THICKNESS=2.2**: to inf.dat, Layer-info, Thick
- **TOLERANCE=0**: none
- **LAMINATION=FOIL**: out of lamination, layer number and number of layers:
  - inf.dat, Layer-info, Layer_view
  - inf.dat, Layer-info, Layer_pair
- **MACHINE=ARTWORK**: none
- **REG_METHOD=1**: to inf.dat, Layer-info, Align_method
- **SCAN_AREA**: to calculate number of frames and overlap values
  - X1=0.4914508858267717
attrlist (Attribute List)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/layers/&lt;layer_name&gt;/camtek/attrlist</td>
</tr>
</tbody>
</table>

The user attributes are defined by Camtek, and a user attributes ASCII file is normally supplied with the Camtek AOI system. In the inf.dat output file:  
<output_path>/<job name>/<layer number>/<AOI set name>/inf.dat  
the user attribute values appear (as set) in the [Learn Type Definitions] section.

Example

.drc_min_space = 5
.drc_min_width = 7
.drc_add_rad = 2
**cdrhdr (CDR14 Header)**

<table>
<thead>
<tr>
<th>Type: Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression: None</td>
</tr>
<tr>
<td>Sum file: Yes</td>
</tr>
<tr>
<td>Path: <code>&lt;job_name&gt;/steps/&lt;step_name&gt;/layers/&lt;layer_name&gt;/cdr14/cdrhdr</code></td>
</tr>
</tbody>
</table>

This file contains the values for CDR14 parameters of the layer.

**Example**

```
NOM_SPACE=0.02
MIN_SPACE=0.015
NOM_LINE=0.02
MIN_LINE=0.015
MULTI_LINE=YES
MULTI_LINES {
    MIN_WIDTH=0.15
    MAX_WIDTH=0.17
}
MULTI_LINES {
    MIN_WIDTH=0.18
    MAX_WIDTH=0.20
}
...
WORKING_TABLE=24X24
PAIDS {
    SYMBOL_NAME=r100
}
PAIDS {
    SYMBOL_NAME=rect150x120
}
...
STAGES {
    STAGE_NAME=PHOTO
    ETCH_SET=YES
    ETCH=0.005
CLASSES {
    CLASS_NAME=photo1
}
...
TOOLSET_NUMBER=-1
MANUAL_ALIGNMENT {
    IS_USED=YES
OFFSET {
    X=20
    Y=10
}
MIRROR=X
```
ANGLE=270
POLARITY=POSITIVE
}
)
...
DRILLED_STAGE=-1
SCALE {
  X=1
  Y=1
}
SCALE_ORIGIN {
  X=0
  Y=0
}

Description

| NOM_SPACE | Nominal Spacing.  
|           | Valid range is 0.0005..0.128 (inch). 
|           | Null/default value is 0.0.  
| MIN_SPACE | Minimal Spacing where MIN_SPACE <= NOM_SPACE.  
|           | Valid range is 0.0005..0.128 (inch) 
|           | Null/default value is 0.0.  
| NOM_LINE  | Nominal Line Width. 
|           | Valid range is 0.0005..0.128 (inch) 
|           | Null/default value is 0.0.  
| MIN_LINE  | Minimal Line Width, where MIN_LINE <= NOM_LINE. 
|           | Valid range is 0.0005..0.128 (inch) 
|           | Null/default value is 0.0.  
| MULTI_LINE | Yes/No. 
|           | Yes - use MULTI_LINES array instead of MIN_LINE  
| MULTI_LINES | Array of a maximum of 4 elements defining multiple line width ranges.  
| WORKING_TABLE | Name of the working table matching the template <w>x<h> 
|               | where w is table width h is table height. Should be defined in the cdr14.ini file.  
| PADS | Array of a maximum 8 elements defining pads symbol names  
| HOLES | Array of a maximum 8 elements defining holes symbol names.  
| CLEARANCES | Array of a maximum of 8 elements defining clearance symbol names.  
| STAGES | Array of a maximum of 10 elements defining working stages parameters.  
| DRILLED_STAGE | Index of the stage in STAGES array which is defined as a drill stage. Null/default value is -1  

**SCALE**

X and Y scale factors applied on output. Valid range is 0.001..9.99 (0.1..999%). Null/default value is 1.0.

**SCALE_ORIGIN**

X and Y scale origin coordinates. Valid range is unlimited. Null/default value is 0.0.

**PANELIZATION**

- **PANEL_DEFINED**: use the genesis automatic panelization.
- **USER_DEFINED**: Use the panelization supplied by user.

**GENESIS_VERSION**

Version of the Genesis software which created the *cdr14* set of the form `<major>.<minor><patch>`.

**MARGINS_SET**

0. Field not in use.

**X_MARGIN**

0. Field not in use.

**Y-MARGIN**

0. Field not in use.

### MULTI_LINES Array Structure:

<table>
<thead>
<tr>
<th>MIN_LINE</th>
<th>Minimal Line Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX_LINE</td>
<td>Maximal Line Width where MIN_LINE &lt;= MAX_LINE and MIN_LINE &lt;= NOM_LINE. Valid range is 0.0005..0.128 (inch). Null/default value is 0.0</td>
</tr>
</tbody>
</table>

* MULTI_LINES pairs should be defined in the order of MIN_WIDTH increasing.

### PADS/HOLES/CLEARANCES Arrays Structure

**SYMBOL_NAME**

Feature symbol name.

### STAGES Array Structure

<table>
<thead>
<tr>
<th>STAGE_NAME</th>
<th>Working stage name. Should be defined in the <em>cdr14.ini</em> file.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETCH_SET</td>
<td>Yes/No. Yes - use the ETCH value. No - use the default ETCH value defined for the stage in the <em>cdr14.ini</em> file instead.</td>
</tr>
<tr>
<td>ETCH</td>
<td>Etch value. Valid range is -255.0..255.0 (inch). Null/default value is 0.0.</td>
</tr>
<tr>
<td>CLASSES</td>
<td>Class names for the stage. Array for a maximum of 5 elements.</td>
</tr>
<tr>
<td>DRILL_LAYER</td>
<td>Name of the drill layer. Relevant only for stage defined as drill stage.</td>
</tr>
<tr>
<td>TOOLSET_NUMBER</td>
<td>Toolset number used for the stage alignment, should be defined in the <em>cdr14.ini</em> file. Null/default value is -1.</td>
</tr>
</tbody>
</table>
**MANUAL_ALIGNMENT**  Stage alignment used if no toolset defined.

**DRILL_LAYERS**  Names of drill layers. In case of multiple drill layers, names are separated by semi-colons (;)

* Either **TOOLSET_NUMBER** or **MANUAL_ALIGNMENT** should be defined for each stage.

**MANUAL_ALIGNMENT** Structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS_USED</td>
<td>Yes/No.  Yes = use manual alignment instead of toolset.</td>
</tr>
<tr>
<td>OFFSET</td>
<td>X and Y alignment offsets.</td>
</tr>
<tr>
<td>MIRROR</td>
<td>None/X/Y/Both.</td>
</tr>
<tr>
<td>ANGLE</td>
<td>0/90/180/270 measured in degrees CW (clockwise).</td>
</tr>
<tr>
<td>POLARITY</td>
<td>Positive/Negative.</td>
</tr>
</tbody>
</table>

**Translation of CDR-SET Fields into AOIProg Commands**

<table>
<thead>
<tr>
<th>CDR-SET Field</th>
<th>AOIProg Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOM_SPACE=0.008</td>
<td>SPACE = 8.000</td>
</tr>
<tr>
<td>MIN_SPACE=0.007</td>
<td>MSPACE = 0.875 (= MIN_SPACE/NOM_SPACE.</td>
</tr>
<tr>
<td></td>
<td>if MIN_SPACE not set,</td>
</tr>
<tr>
<td></td>
<td>cdr14_min_spacing_factor cfg value</td>
</tr>
<tr>
<td></td>
<td>is taken)</td>
</tr>
<tr>
<td>NOM_LINE=0.008</td>
<td>LINE = 8.000</td>
</tr>
<tr>
<td>MIN_LINE=0.007</td>
<td>MLINE = 0.875 (= MIN_LINE/NOM_LINE.</td>
</tr>
<tr>
<td></td>
<td>if MIN_LINE not set,</td>
</tr>
<tr>
<td></td>
<td>cdr14_min_line_factor cfg value</td>
</tr>
<tr>
<td></td>
<td>is taken)</td>
</tr>
<tr>
<td>MULTI_LINE=NO</td>
<td>No direct translation to AOIProg command.</td>
</tr>
<tr>
<td>WORKING_TABLE=24x24</td>
<td>Appears as a comment in AOIProg file.</td>
</tr>
<tr>
<td>PADS {</td>
<td>PAD = 1:100.000, 1:200.000</td>
</tr>
<tr>
<td>SYMBOL_NAME=r100</td>
<td>}</td>
</tr>
<tr>
<td>PADS {</td>
<td>}</td>
</tr>
<tr>
<td>SYMBOL_NAME=r200</td>
<td>}</td>
</tr>
<tr>
<td>HOLEs {</td>
<td>}</td>
</tr>
<tr>
<td>SYMBOL_NAME=r50</td>
<td>}</td>
</tr>
<tr>
<td>HOLEs {</td>
<td>}</td>
</tr>
<tr>
<td>SYMBOL_NAME=r75</td>
<td>}</td>
</tr>
<tr>
<td>STAGES {</td>
<td>}</td>
</tr>
<tr>
<td>STAGE_NAME=COPPER</td>
<td>}</td>
</tr>
<tr>
<td>ETCH_SET=YES</td>
<td>}</td>
</tr>
<tr>
<td>ETCH=0.0005</td>
<td>}</td>
</tr>
</tbody>
</table>

| ETCH\COPPER = 0.500 |
Chapter 6 Job>steps>layers Entity
cdrhdr (CDR14 Header)

CLASSES {
  CLASS_NAME=c_sig_cop
}
DRILL_LAYER=drl

TOOLSET_NUMBER=99
  TOOL\COPPER = 99, 10000.00,10000.0, H, RCCW270
  (where 10000.00,10000.0, H, RCCW270 are the Toolset parameters)

MANUAL_ALIGNMENT {
  IS_USED=YES
  OFFSET {
    X=10
    Y=10
  } MIRROR=Y
  ANGLE=90
  POLARITY=POSITIVE
}

If toolset alignment, IS_USED set to NO

The MANUAL_ALIGNMENT structure, together with the layer’s alignment targets, determine the AOIProg’s CT and TT commands:

| CT \COPPER = 9000.000:9000.000:1:133.000, 1000.000:9000.000:1:133.000 |
| TT \COPPER = 1000.000:1000.000:1, 1000.000:9000.000:1, H, RCCW270 |

DRILLED_STAGE=0
  No direct translation to AOIProg command

SCALE {
  X=1
  Y=1
}
  No direct translation to AOIProg command

SCALE_ORIGIN {
  X=0
  Y=0
}
  No direct translation to AOIProg command

PANELIZATION=PANEL_DEFINED
GENESIS_VERSION=08.01DV
MARGINS_SET=0
X_MARGIN=0
Y_MARGIN=0
INSPECTED_STEPS=pcb
  The steps that are translated into PCB/RPCB AOIProg commands.

CLASS\COPPER = c_sig_cop:drl
CLASS \COPPER = c_sig_cop:drl

In case of more than one drill layer, all defined drill layers are merged into a single temporary layer named mdxxxxx

CLASS\COPPER = c_sig_cop:drl
### cdr14_stp_main (CDR14 Main Step)

This step holds the cdr14 graphic data. Inspection areas and exclusion zones are placed in the \texttt{lyr\_area} layer and alignment targets are placed in the \texttt{lyr\_targ} layer.

See “stephdr (Step Header)” on page 71 for step structure and “Job>steps>layers Entity” on page 103 for layer structure.

This step contains the steps described below, optionally step&repeated.

### cdr14_stp_pos (CDR14 Positive Step)

This step contains the inspection areas represented as positive features (a rectangular surface) in its \texttt{lyr\_area} layer. This step can be placed by a maximum of one step&repeat command.

### cdr14_stp_neg (CDR14 Negative Step)

This step contains the non-step&repeated exclusion zones as a negative feature (a rectangular / polygonal surface or round pad) in its \texttt{lyr\_area} layer.
**clone_<step_name> (S&R Exclusion Zones)**

These steps contain the step&repeated exclusion zones as negative features (rectangular/polygonal surface or round pad) in its lyr_area layer. These steps are step&repeated with respect to the corresponding step <step_name>.

**user_def_<step_name> (Steps in AOI)**

These steps are created only in case AOI panelization was defined using the CDR interface (see “cdrsr (AOI Panelization)” on page 98). These steps replace the clone_<step_name> steps. <step_name> is the step identification as supplied by the AOI panelization.

**user_def_<step_name>_pos (Steps - AOI)**

These steps are created only in case AOI panelization was defined using the CDR interface (see “cdrsr (AOI Panelization)” on page 98). These steps replace the clone_<step_name>_pos steps.
<step_name> is the step identification as supplied in the AOI panelization.

<set_name>/cdrhdr (CDR Header)

Type: Structured Text
Compression: None
Sum file: Yes
Path: <job_name>/steps/<step_name>/layers/<layer_name>/cdr_sets/<set_name>/cdrhdr

This entity is as described in “cdrhdr (CDR14 Header)” on page 128.
**<set_name>cdrhdr2 (CDR14 Header - Additional)**

<table>
<thead>
<tr>
<th>Type: Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression: None</td>
</tr>
<tr>
<td>Sum file: Yes</td>
</tr>
<tr>
<td>Path: <code>&lt;job_name&gt;/steps/&lt;step_name&gt;/layers/&lt;layer_name&gt;/cdr_sets/&lt;set_name&gt;/cdrhdr2</code></td>
</tr>
</tbody>
</table>

This file contains values for CDR parameters of a layer, in addition to those in “<set_name>/cdrhdr (CDR Header)” on page 135.

**Example:**

```
LAYER_TYPE=IL
PATTERN_TYPE=POWER_GROUND
POLARITY=NEGATIVE

FEATURES {
  FTRS_YN {
    VALUE_STATUS=AUTO_SETUP
    PADS=NO
    LINES=NO
    CLEARANCES=YES
    NPFS=NO
    THERMALS=YES
    SMDs=NO
    THROUGH_HOLES=NO
    MICRO_VIAS=NO
    BLIND_VIAS=NO
    CROSS_HATCH=NO
  }
  NOM_NFP_SPACING=0
  MIN_NFP_SPACING=0
  NOM_AR=0
  MIN_AR=0
  NOM_LASER_DRL=0
  MIN_LASER_DRL=0
}

HISTOGRAMS {
  HIST {
    H_TYPE=THERMAL
    H_SHAPE_TYPE=MERGED
    SORT_TYPE=WIDTH
    RESOLUTION=0.00025
    DRILL_LYR_HIST=
  }
```

---

*ODB++ Specification 136*
H_CALCULATED=YES
DATA {
  SIZE=0.09
  COUNT=206
}
DATA {
  SIZE=0.095
  COUNT=10
}
DATA {
  SIZE=0.1
  COUNT=120
}
}
HIST {
  H_TYPE=CLEARANCE
  H_SHAPE_TYPE=MERGED
  SORT_TYPE=WIDTH
  RESOLUTION=0.00025
  DRILL_LYR_HIST=
  H_CALCULATED=YES
}
DATA {
  SIZE=0.04
  COUNT=11942
}
DATA {
  SIZE=0.06
  COUNT=1002
}
}
N_MACHINES=1
MACHINE {
  MACHINE=Vision
  RESOLUTION=0
  RULE_FILE=PGIL.rul
  DATABASE=ALPHA
}
STAGES {
  STAGE_NAME=BARE_COPPER
  PRIORITY=5
  COPPER_WT=0
  MATERIAL=
  PANEL_THICK=0
  N_MACHINES=1
}
MACHINE {
  MACHINE=Vision
}
Chapter 6  Job>steps>layers Entity
<set_name>cdrhdr2 (CDR14 Header - Additional)

TABLE=standard
PIN_SET=
REGISTRATION=PINS
PIN1=FFC
PIN2=F4

Description

Parameter | Description
---|---
LAYER_TYPE | Layer type: OL (outer layer), IL (inner layer), or ILWH (inner layer with holes). Null/default value is IL.
PATTERN_TYPE | Pattern type: SIGNAL, POWER_GROUND, MIXED, LASER_DRILL or PHOTO_VIA. Null/default value is SIGNAL.
POLARITY | Polarity of layer: POSITIVE or NEGATIVE. Null/default value is POSITIVE.
FEATURES | Array for defining the layer's characteristics: features types and nominal values.
HISTOGRAMS | Array for defining feature histograms.
N_MACHINES | The CDR set may contain setup for more than one AOI machine type.
MACHINE | Array for defining machine specific parameters.
STAGES | Array of a maximum of 10 elements defining parameters for working stages, in addition to parameters defined in STAGES array in cdrhdr file.

FEATURES Array Structure

Parameter | Description
---|---
FTRS_YN | Array for defining which feature types exist in the layer.
NOM_NFP_SPACING | Nominal NFP spacing. Valid range is 0.0005...0.128 (inch). Null/default value is 0.0.
MIN_NFP_SPACING | Minimal NFP Spacing where MIN_NFP_SPACE <= NOM_NFP_SPACE. Valid range is 0.0005...0.128 (inch). Null/default value is 0.0.
NOM_AR | Nominal Annular Ring. Valid range is 0.0005...0.128 (inch). Null/default value is 0.0.
MIN_AR | Minimal Annular Ring where MIN_AR <= NOM_AR. Valid range is 0.0005..0.128 (inch). Null/default value is 0.0.
NOM_LASER_DRL | Nominal Laser drill. Valid range is 0.0005...0.128 (inch). Null/default value is 0.0.
MIN_LASER_DRL | Minimal Laser drill where: MIN_LASER_DRL <=NOM_LASER_DRL. Valid range is 0.0005...0.128 (inch). Null/default value is 0.0.
### FTRS_YN Array Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUE_STATUS</td>
<td>Source of feature existence list. Options: NOT_SET, MANUAL_SET, USER_CONFIG or AUTO_SETUP. Null/default value is NOT_SET.</td>
</tr>
<tr>
<td>PADS</td>
<td>Does the layer contain pads? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
<tr>
<td>LINES</td>
<td>Does the layer contain lines? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
<tr>
<td>CLEARANCES</td>
<td>Does the layer contain clearances? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
<tr>
<td>NFPS</td>
<td>Does the layer contain NFPS? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
<tr>
<td>THERMALS</td>
<td>Does the layer contain thermal pads? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
<tr>
<td>SMDS</td>
<td>Does the layer contain SMD pads? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
<tr>
<td>THROUGH_HOLES</td>
<td>Does the layer contain thru-holes? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
<tr>
<td>MICRO_VIAS</td>
<td>Does the layer contain micro vias (laser or photo)? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
<tr>
<td>BLIND_VIAS</td>
<td>Does the layer contain blind vias? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
<tr>
<td>CROSS_HATCH</td>
<td>Does the layer contain cross hatches? Options: YES, NO or UNKOWN. Null/default value is NO.</td>
</tr>
</tbody>
</table>

### Histograms Array Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIST</td>
<td>An array of elements defining feature histograms. Elements may be repeated for every feature type.</td>
</tr>
</tbody>
</table>

### HIST Array Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H_TYPE</td>
<td>Histogram type. Options: PAD, LINE, SMD, NFP, THERMAL, CLEARANCE or DRILL_LAYER.</td>
</tr>
<tr>
<td>H_SHAPE</td>
<td>Histogram shape. Separate histograms may be created for features of different shapes. Options: MERGED, ROUND, SQUARE or RECT. Default value is MERGED, meaning that all features of the same type are counted in a single histogram regardless of their geometrical shape.</td>
</tr>
</tbody>
</table>
### DATA Array Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE</td>
<td>Size of features counted in a histogram row (in inches).</td>
</tr>
<tr>
<td>COUNT</td>
<td>Number of features counted in a histogram row.</td>
</tr>
</tbody>
</table>

### MACHINE Array Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MACHINE</td>
<td>Name of AOI machine. Options: Vision.</td>
</tr>
<tr>
<td>RESOLUTION</td>
<td>Inspection resolution. Null/default value is 0.0.</td>
</tr>
<tr>
<td>RULE_FILE</td>
<td>Name of rule file to be used on AOI Manager to complete pre-setup generated by CDR.</td>
</tr>
<tr>
<td>DATABASE</td>
<td>Name of machine's database, to which learn results should be saved.</td>
</tr>
</tbody>
</table>

### STAGES Array Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAGE_NAME</td>
<td>Working stage name. Should be one of the stage names supported by AOI Manager: BARE_COPPER, BRWN_BLK_OXIDE, TIN_LEAD_BEFORE, TIN_LEAD_AFTER, DBL_TRET_COPPER, DIAZO, SILVER_HALIDE, PHOTORESIST, PHOTOVIA or LASER_DRILL.</td>
</tr>
<tr>
<td>PRIORITY</td>
<td>Processing priority by AOI Manager. Integer number between 1 (highest priority) to 10 (lowest).</td>
</tr>
<tr>
<td>COPPER_WT</td>
<td>Copper weight (in units as entered).</td>
</tr>
<tr>
<td>MATERIAL</td>
<td>Panel material.</td>
</tr>
<tr>
<td>PANEL_THICK</td>
<td>Panel thickness (in inches).</td>
</tr>
</tbody>
</table>
This step holds the **cdr** graphic data. Inspection areas and exclusion zones are placed in the **lyr_area** layer and alignment targets are placed in the **lyr_targ** layer.

See “Job>steps Entity” on page 70 for step structure and “Job>steps>layers Entity” on page 103 for layer structure.

This step contains the steps described below, optionally step&repeated:
**$\text{cdr14\_stp\_pos \ (Empty)}$**

```
<job_name>/steps/<step_name>/layers/<layer_name>/cdr_sets/<set_name>/steps/cdr14\_stp\_pos
```

This step is left empty.

**$\text{cdr14\_stp\_neg \ (Empty)}$**

```
<job_name>/steps/<step_name>/layers/<layer_name>/cdr_sets/<set_name>/steps/cdr14\_stp\_neg
```

This step is left empty.

**$\text{clone\_<step\_name> \ (Inspection Areas)}$**

```
<job_name>/steps/<step_name>/layers/<layer_name>/cdr_sets/<set_name>/steps/clone\_<step\_name>
```

These steps contain step&repeated inspection areas as positive features and step&repeated exclusion zones as negative features (rectangular/polygonal surface or round pad) in its **lyr\_area** layer. These steps are step&repeated with respect to the corresponding step **<step\_name>**.
**clone_<step_name>_pos (Automatic Inspection Area)**

These steps contain the 'automatic' inspection area that covers the whole step area (as defined by the step's profile or the step features' bounding box) as a positive rectangular/polygonal surface in its lyr_area layer.

The clone_<step_name>_pos step appears in a single step&repeat command in the step&repeat table of step clone_<step_name>.

**cdr14_stp_on_clones (Non-stp&rpt Zones)**

This step contains non-step&repeated inspection areas as positive features and non-step&repeated exclusion zones as negative features (rectangular/polygonal surface or round pad) in its lyr_area layer.

This step appears as the last step&repeat command in the step&repeat table of step cdr14_stp_main.
**user_def_<step_name> (AOI Panelization)**

These steps are created only in case AOI panelization was defined using the CDR interface (“cdrsr (AOI Panelization)” on page 98).

These steps replace the clone_<step_name> steps.

<step_name> is the step identification as supplied in the AOI panelization.

**user_def_<step_name>_pos (AOI Panelization)**

These steps are created only in case AOI panelization was defined using the CDR interface (“cdrsr (AOI Panelization)” on page 98).

These steps replace the clone_<step_name>_pos steps.

<step_name> is the step identification as supplied in the AOI panelization.
lpd (Layer Production Data)

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path:</td>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/layers/&lt;layer_name&gt;/lpd or lpd_multiple</td>
</tr>
</tbody>
</table>

Layer Production data contains the plotting parameters for Orbotech plotters stored in one of two possible files—lpd or lpd_multiple. The lpd_multiple file contains lpd settings for all possible plotters; the lpd file contains settings for only the EITHER TYPE plotter. If both lpd and lpd_multiple files exist, the lpd file is ignored.

LPD

Image Production Parameters produced in Genesis are used by Orbotech plotters when processing IMG and OPFX files. When used for IMG output, the file is the /<panel>/<layer>/layerhdr file. The following is a list of elements that appear in the Genesis popup for setting parameters:

<table>
<thead>
<tr>
<th>DEVICE_TYPE</th>
<th>Defines to which plotter the parameters are set. In an lpd file it is always EITHER TYPE. In lpd_multiple it is one of: EITHER TYPE, LP7008, XPRESS, LP5008, DP100 or LP9008.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAS_INPUT</td>
<td>Indicates where production parameters originated. Values: YES, NO</td>
</tr>
<tr>
<td>IS_DEFINED</td>
<td>For internal use. Values: YES, NO</td>
</tr>
<tr>
<td>POLARITY</td>
<td>Determines how to plot the image. Values: POSITIVE—the plot is the same as the entity image on the screen. NEGATIVE—entity image is reversed.</td>
</tr>
<tr>
<td>SPEED</td>
<td>Defines plotter speed. Values: minimum = 0 (automatic), maximum = 255</td>
</tr>
<tr>
<td>XSTRETCH, YSTRETCH</td>
<td>To stretch or shrink (in percent) the X or Y dimension of the plotting entity.</td>
</tr>
<tr>
<td>XSHIFT, YSHIFT</td>
<td>Distance to shift the plotting entity along the X or Y axis in inches.</td>
</tr>
<tr>
<td>XMIRROR, YMIRROR</td>
<td>Mirror the plotting entity along the X or Y axis. If 0, no mirroring occurs.</td>
</tr>
</tbody>
</table>
### Chapter 6  Job>steps>layers Entity

**lpd (Layer Production Data)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COPPER AREA</strong></td>
<td>The copper area calculated during plot pre-processing in square inches.</td>
</tr>
<tr>
<td><strong>XCENTER, YCENTER</strong></td>
<td>Reference line in the X or Y axis around which point stretch begins.</td>
</tr>
<tr>
<td><strong>PLOT_KIND1, PLOT_KIND2</strong></td>
<td>Specifies the type of lpd set. Values: 0—5000 plotter 56—5008 plotter and newer PLOT_KIND2 must be the same as PLOT_KIND1.</td>
</tr>
<tr>
<td><strong>MINVEC</strong></td>
<td>Widen all lines narrower than this width (expressed in mils) by the value defined in ADVEC.</td>
</tr>
<tr>
<td><strong>ADVEC</strong></td>
<td>The extent by which to enlarge lines defined in MINVEC expressed in mils.</td>
</tr>
<tr>
<td><strong>MINFLASH</strong></td>
<td>Widen all pads smaller than this size by the value defined in ADFLASH.</td>
</tr>
<tr>
<td><strong>ADFLASH</strong></td>
<td>The extent by which to enlarge pads defined in MINFLASH.</td>
</tr>
<tr>
<td><strong>CONDUCTOR1</strong></td>
<td>Specific line width to be incremented by 0.5mils.</td>
</tr>
<tr>
<td><strong>CONDUCTOR2</strong></td>
<td>Specific line width to be incremented by 0.5mils.</td>
</tr>
<tr>
<td><strong>CONDUCTOR3</strong></td>
<td>Specific line width to be incremented by 0.5mils.</td>
</tr>
<tr>
<td><strong>CONDUCTOR4</strong></td>
<td>Specific line width to be incremented by 0.5mils.</td>
</tr>
<tr>
<td><strong>CONDUCTOR5</strong></td>
<td>Specific line width to be incremented by 0.5mils.</td>
</tr>
<tr>
<td><strong>MEDIA</strong></td>
<td>Defines the plot media (film type). Values: FIRST, SECOND, THIRD</td>
</tr>
<tr>
<td><strong>RESOLUTION</strong></td>
<td>Resolution for plotting. Values: HALF_MIL, QUARTER_MIL, EIGHTH_MIL, SIXTEENTH_MIL.</td>
</tr>
<tr>
<td><strong>SMOOTHING</strong></td>
<td>To leave a smooth or rough edge on diagonal lines. Values: SMOOTH, ROUGH</td>
</tr>
<tr>
<td><strong>SWAP AXES</strong></td>
<td>To switch the X and Y coordinates of the image before plotting. Values: NO_SWAP, SWAP</td>
</tr>
<tr>
<td><strong>ELPD_IS_DEFINED</strong></td>
<td>Specifies whether extended production data is defined. Values: YES/NO.</td>
</tr>
<tr>
<td><strong>RESOLUTION_VALUE</strong></td>
<td>Numeric resolution value.</td>
</tr>
<tr>
<td><strong>RESOLUTION_UNITS</strong></td>
<td>Units for resolution. Values: MIL/MICRON.</td>
</tr>
<tr>
<td><strong>ENLARGE_POLARITY</strong></td>
<td>To use extended production data only for features of the specified polarity. Values: NONE, POSITIVE, NEGATIVE, BOTH. Does not apply if polarity specified is NONE.</td>
</tr>
<tr>
<td><strong>OTHER_POLARITY</strong></td>
<td>Relevant only if Apply enlarge to is set to positive or negative. Values: SIZE_INVERSELY, LEAVE_AS_IS.</td>
</tr>
<tr>
<td><strong>ENLARGE_PANEL_ELEMENT</strong></td>
<td>Enlarge panel elements as PCB elements. Values: YES/NO.</td>
</tr>
<tr>
<td><strong>ALLOW PCB PANEL OVERLAP</strong></td>
<td>Allow the panel data to overlap the PCB. Values: YES/NO.</td>
</tr>
</tbody>
</table>
**ELEMENT_IMAGE_SYMBOLS**

Enlarge components of the image symbol as regular features. Values: YES/NO.

**ENLARGE_ZERO_LENGTH_VEC**

Consider zero length lines as pads for the purpose of enlarging. Values: YES/NO.

**ENLARGE_SYMBOLS**

Enlarge ALL or SELECTED symbols. If ALL symbols, you are asked to specify by how much to enlarge. Values: NONE, ALL, SELECTED.

**ENLARGE_SYMBOLS_BY**

Specify the degree of enlargement in mils for symbols.

**SELECTED_SYMBOL[1-10]**

Specify the symbol names to be enlarged.

**SYMBOL_ADD[1-10]**

Specify the extent by which to enlarge the symbol of the same index number in mils.

**QUALITY**

Defines the LP9008 plotter working mode. Values: AUTO, FAST, FINE.

**ENLARGE_CONTOURS_BY**

Specify the contour compensation in mils.

---

**Example of LPD**

```
DEVICE_TYPE=EITHER
WAS_INPUT=NO
IS_DEFINED=YES
POLARITY=NEGATIVE
SPEED=0
XSTRETCH=100.12
YSTRETCH=100.23
XSHIFT=0
YSHIFT=0
XMIRROR=2.5
YMIRROR=0
COPPER_AREA=0
XCENTER=0
YCENTER=0
PLOT_KIND1=56
PLOT_KIND2=56
MINVEC=4
ADVEC=1
MINFLASH=7
ADFLASH=1
CONDUCTOR1=5
CONDUCTOR2=6
CONDUCTOR3=7
CONDUCTOR4=0
CONDUCTOR5=0
MEDIA=FIRST
RESOLUTION=QUARTER_MIL
SMOOTHING=SMOOTH
SWAP_AXES=NO_SWAP
ELPD_IS_DEFINED=YES
RESOLUTION_VALUE=0.25
RESOLUTION UNITS=MIL
QUALITY=AUTO
```
ENLARGE_POLARITY=POSITIVE
OTHER_POLARITY=SIZE_INVERSELY
ENLARGE_PANEL_ELEMENTS=YES
ALLOW_PCB_PANEL_OVERLAP=YES
ENLARGE_IMAGE_SYMBOLS=YES
ENLARGE_ZERO_LENGTH_VEC=YES
ENLARGE_SYMBOLS=SELECTED
ENLARGE_SYMBOLS_BY=0
SELECTED_SYMBOL1=DPF.11_11
SYMBOL_ADD1=1
SELECTED_SYMBOL2=E-VGP1
SYMBOL_ADD2=1
SELECTED_SYMBOL3=OCA_IPC_M_SYM
SYMBOL_ADD3=1
SELECTED_SYMBOL4=PET-MARK-X_21
SYMBOL_ADD4=1
SELECTED_SYMBOL5=
SYMBOL_ADD5=0
SELECTED_SYMBOL6=
SYMBOL_ADD6=0
SELECTED_SYMBOL7=
SYMBOL_ADD7=0
SELECTED_SYMBOL8=
SYMBOL_ADD8=0
SELECTED_SYMBOL9=
SYMBOL_ADD9=0
SELECTED_SYMBOL10=
SYMBOL_ADD10=0
ENLARGE_CONTOURS_BY=0

LPD_MULTIPLE

The lpd_multiple file is a structured text file containing parameters for one or more plotter types. The file is structured as follows:

LPD {
The same parameters as in an lpd file.
}
LPD {
    ...
}
Each device type appears only once in the file.

Example

LPD {
    DEVICE_TYPE=EITHER_TYPE
    WAS_INPUT=NO
    IS_DEFINED=YES
    POLARITY=NEGATIVE
    SPEED=0
    XSTRETCH=100.12
    YSTRETCH=100.23
    XSHIFT=0
}
YSHIFT=0
XMIRROR=2.5
YMIRROR=0
COPPER_AREA=0
XCENTER=0
YCENTER=0
PLOT_KIND1=56
PLOT_KIND2=56
MINVEC=4
ADVEC=1
MINFLASH=7
ADFLASH=1
CONDUCTOR1=5
CONDUCTOR2=6
CONDUCTOR3=7
CONDUCTOR4=0
CONDUCTOR5=0
MEDIA=FIRST
RESOLUTION=QUARTER_MIL
SMOOTHING=SMOOTH
SWAP_AXES=NO_SWAP
ELPD_IS_DEFINED=YES
RESOLUTION_VALUE=0.25
RESOLUTION_UNITS=MIL
QUALITY=AUTO
ENLARGE_POLARITY=POSITIVE
OTHER_POLARITY=SIZE_INVERSELY
ENLARGE_PANEL_ELEMENTS=YES
ALLOW_PCB_PANEL_OVERLAP=YES
ENLARGE_IMAGE_SYMBOLS=YES
ENLARGE_ZERO_LENGTH_VEC=YES
ENLARGE_SYMBOLS=SELECTED
ENLARGE_SYMBOLS_BY=0
SELECTED_SYMBOL1=DPF.11_11
SYMBOL_ADD1=1
SELECTED_SYMBOL2=E-VGP1
SYMBOL_ADD2=1
SELECTED_SYMBOL3=OCA_IPC_M_SYM
SYMBOL_ADD3=1
SELECTED_SYMBOL4=PET-MARK-X_21
SYMBOL_ADD4=1
SELECTED_SYMBOL5=
SYMBOL_ADD5=0
SELECTED_SYMBOL6=
SYMBOL_ADD6=0
SELECTED_SYMBOL7=
SYMBOL_ADD7=0
SELECTED_SYMBOL8=
SYMBOL_ADD8=0
SELECTED_SYMBOL9=
SYMBOL_ADD9=0
SELECTED_SYMBOL10=
SYMBOL_ADD10=0
ENLARGE_CONTOURS_BY=0

LPD {
  DEVICE_TYPE=LP5008
  WAS_INPUT=NO
  IS_DEFINED=YES
  POLARITY=NEGATIVE
  SPEED=0
  XSTRETCH=100.12
  YSTRETCH=100.23
  XSHIFT=0
  YSHIFT=0
  XMIRROR=2.5
  YMIRROR=0
  COPPER_AREA=0
  XCENTER=0
  YCENTER=0
  PLOT_KIND1=56
  PLOT_KIND2=56
  MINVEC=4
  ADVEC=1
  MINFLASH=7
  ADFLASH=1
  CONDUCTOR1=5
  CONDUCTOR2=6
  CONDUCTOR3=7
  CONDUCTOR4=0
  CONDUCTOR5=0
  MEDIA=FIRST
  RESOLUTION=QUARTER_MIL
  SMOOTHING=SMOOTH
  SWAP_AXES=NO_SWAP
  ELPD_IS_DEFINED=YES
  RESOLUTION_VALUE=0.25
  RESOLUTION_UNITS=MIL
  QUALITY=AUTO
  ENLARGE_POLARITY=POSITIVE
  OTHER_POLARITY=SIZE_INVERSELY
  ENLARGE_PANEL_ELEMENTS=YES
  ALLOW_PCB_PANEL_OVERLAP=YES
  ENLARGE_IMAGE_SYMBOLS=YES
  ENLARGE_ZERO_LENGTH_VEC=YES
  ENLARGE_SYMBOLS=SELECTED
  ENLARGE_SYMBOLS_BY=0
  SELECTED_SYMBOL1=DPF.11_11
  SYMBOL_ADD1=1
  SELECTED_SYMBOL2=E-VGP1
  SYMBOL_ADD2=1
  SELECTED_SYMBOL3=OCA_IPC_M_SYM
  SYMBOL_ADD3=1
  SELECTED_SYMBOL4=PET-MARK-X_21
  SYMBOL_ADD4=1
SELECTED_SYMBOL5=
SYMBOL_ADD5=0
SELECTED_SYMBOL6=
SYMBOL_ADD6=0
SELECTED_SYMBOL7=
SYMBOL_ADD7=0
SELECTED_SYMBOL8=
SYMBOL_ADD8=0
SELECTED_SYMBOL9=
SYMBOL_ADD9=0
SELECTED_SYMBOL10=
SYMBOL_ADD10=0
ENLARGE_CONTOURS_BY=0
}

LPD {
Device_TYPE=LP7008
WAS_INPUT=NO
IS_DEFINED=YES
POLARITY=NEGATIVE
SPEED=0
XSTRETCH=100.12
YSTRETCH=100.23
XSHIFT=0
YSHIFT=0
XMIRROR=2.5
YMIRROR=0
COPPER_AREA=0
XCENTER=0
YCENTER=0
PLOT_KIND1=56
PLOT_KIND2=56
MINVEC=4
ADVEC=1
MINFLASH=7
ADFLASH=1
CONDUCTOR1=5
CONDUCTOR2=6
CONDUCTOR3=7
CONDUCTOR4=0
CONDUCTOR5=0
MEDIA=FIRST
RESOLUTION=QUARTER_MIL
SMOOTHING=SMOOTH
SWAP_AXES=NO_SWAP
ELPD_IS_DEFINED=YES
RESOLUTION_VALUE=0.25
RESOLUTION_UNITS=MIL
QUALITY=AUTO
ENLARGE_POLARITY=POSITIVE
OTHER_POLARITY=SIZE_INVERSELY
ENLARGE_PANEL_ELEMENTS=YES
ALLOW_FCB_PANEL_OVERLAP=YES
ENLARGE_IMAGE_SYMBOLS=YES
ENLARGE_ZERO_LENGTH_VEC=YES
ENLARGE_SYMBOLS=SELECTED
ENLARGE_SYMBOLS_BY=0
SELECTED_SYMBOL1=DPF.11_11
SYMBOL_ADD1=1
SELECTED_SYMBOL2=E-VGP
SYMBOL_ADD2=1
SELECTED_SYMBOL3=OCA_IPC_M_SYM
SYMBOL_ADD3=1
SELECTED_SYMBOL4=PET-MARK-X_21
SYMBOL_ADD4=1
SELECTED_SYMBOL5=
SYMBOL_ADD5=0
SELECTED_SYMBOL6=
SYMBOL_ADD6=0
SELECTED_SYMBOL7=
SYMBOL_ADD7=0
SELECTED_SYMBOL8=
SYMBOL_ADD8=0
SELECTED_SYMBOL9=
SYMBOL_ADD9=0
SELECTED_SYMBOL10=
SYMBOL_ADD10=0
ENLARGE_CONTOURS_BY=0

LPD {
  DEVICE_TYPE=LP9008
  WAS_INPUT=NO
  IS_DEFINED=YES
  POLARITY=NEGATIVE
  SPEED=0
  XSTRETCH=100.33
  YSTRETCH=99.78400000000001
  XSHIFT=0
  YSHIFT=0
  XMIRROR=2.5
  YMIRROR=0
  COPPER_AREA=0
  XCENTER=0
  YCENTER=0
  PLOT_KIND1=56
  PLOT_KIND2=56
  MINVEC=4
  ADVEC=1
  MINFLASH=7
  ADFLASH=1
  CONDUCTOR1=5
  CONDUCTOR2=6
  CONDUCTOR3=7
  CONDUCTOR4=0
  CONDUCTOR5=0
MEDIA=FIRST
RESOLUTION=EIGHTH_MIL
SMOOTHING=SMOOTH
SWAP_AXES=NO_SWAP
ELPD_IS_DEFINED=YES
RESOLUTION_VALUE=1
RESOLUTION_UNITS=MICRON
QUALITY=FINE
ENLARGE_POLARITY=POSITIVE
OTHER_POLARITY=SIZE_INVERSELY
ENLARGE_PANEL_ELEMENTS=YES
ALLOW_PCB_PANEL_OVERLAP=YES
ENLARGE_IMAGE_SYMBOLS=YES
ENLARGE_ZERO_LENGTH_VEC=YES
ENLARGE_SYMBOLS=SELECTED
ENLARGE_SYMBOLS_BY=0
SELECTED_SYMBOL1=DPF.11_11
SYMBOL_ADD1=1
SELECTED_SYMBOL2=E-VGP1
SYMBOL_ADD2=1
SELECTED_SYMBOL3=OCA_IPC_M_SYM
SYMBOL_ADD3=1
SELECTED_SYMBOL4=PET-MARK-X_21
SYMBOL_ADD4=1
SELECTED_SYMBOL5=
SYMBOL_ADD5=0
SELECTED_SYMBOL6=
SYMBOL_ADD6=0
SELECTED_SYMBOL7=
SYMBOL_ADD7=0
SELECTED_SYMBOL8=
SYMBOL_ADD8=0
SELECTED_SYMBOL9=
SYMBOL_ADD9=0
SELECTED_SYMBOL10=
SYMBOL_ADD10=0
ENLARGE_CONTOURS_BY=0

LPD {

DEVICE_TYPE=DP100
WAS_INPUT=NO
IS_DEFINED=YES
POLARITY=NEGATIVE
SPEED=0
XSTRETCH=100.001
YSTRETCH=100.003
XSHIFT=0
YSHIFT=0
XMIRROR=0
YMIRROR=2.500075
COPPER_AREA=0
XCENTER=2500
YCENTER=2500
PLOT_KIND1=56
PLOT_KIND2=56
MINVEC=4
ADVEC=1
MINFLASH=7
ADFLASH=1
CONDUCTOR1=5
CONDUCTOR2=6
CONDUCTOR3=7
CONDUCTOR4=0
CONDUCTOR5=0
MEDIA=FIRST
RESOLUTION=QUARTER_MIL
SMOOTHING=SMOOTH
SWAP_AXES=NO_SWAP
ELPD_IS_DEFINED=YES
RESOLUTION_VALUE=0.25
RESOLUTION_UNITS=MIL
QUALITY=AUTO
ENLARGE_POLARITY=POSITIVE
OTHER_POLARITY=SIZE_INVERSELY
ENLARGE_PANEL_ELEMENTS=YES
ALLOW_PCB_PANEL_OVERLAP=YES
ENLARGE_IMAGE_SYMBOLS=YES
ENLARGE_ZERO_LENGTH_VEC=YES
ENLARGE_SYMBOLS=SELECTED
ENLARGE_SYMBOLS_BY=0
SELECTED_SYMBOL1=DPF.11_11
SYMBOL_ADD1=0.5
SELECTED_SYMBOL2=E-VGP1
SYMBOL_ADD2=0.5
SELECTED_SYMBOL3=OCA_IPC_M_SYM
SYMBOL_ADD3=0.5
SELECTED_SYMBOL4=PET-MARK-X_21
SYMBOL_ADD4=0.5
SELECTED_SYMBOL5=
SYMBOL_ADD5=0
SELECTED_SYMBOL6=
SYMBOL_ADD6=0
SELECTED_SYMBOL7=
SYMBOL_ADD7=0
SELECTED_SYMBOL8=
SYMBOL_ADD8=0
SELECTED_SYMBOL9=
SYMBOL_ADD9=0
SELECTED_SYMBOL10=
SYMBOL_ADD10=0
ENLARGE_CONTOURS_BY=0
}
**mania (MANIA Automatic Optical Inspection)**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
<tr>
<td>Path</td>
<td>(&lt;job_name&gt;/steps/&lt;step_name&gt;/layers/&lt;layer_name&gt;/mania)</td>
</tr>
</tbody>
</table>

The file contains parameters of a Mania set describing parameters to be used when testing the layer for this entity.

```
angle  Alignment of panel: Rotation value.
mirror Alignment of panel: Mirroring value
offset Alignment of panel: Offset value
<mirror> N for not mirrored, M for mirrored
resolution Mania pixel size
scan_area Size of scan area to be used for testing
outdir Location to place output files for the Mania Sapphire AOI machine
size_table Set of legal space and track values
```

**Example**
```
ANGLE=0
MIRROR=NO
OFFSET {
  X=0
  Y=0
}
RESOLUTION=0.8267716535433072
SCAN_AREA {
  X1=-1.613008070866142
  Y1=-1.437398326771653
  X2=2.081300787401575
  Y2=1.52845531496063
}
OUTDIR=/tmp
SIZE_TABLE {
  SPACE=5
  TRACK=20
}
SIZE_TABLE {
```

---

*ODB++ Specification* 155

---

*Chapter 6 Job>steps>layers Entity mania (MANIA Automatic Optical Inspection)*
**DI (Orbotech Direct Imaging Interface)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIDE</td>
<td>Top/Bottom</td>
</tr>
<tr>
<td>PARTNER</td>
<td>Name of the pair layer</td>
</tr>
<tr>
<td>SCALE_MODE</td>
<td>Name of the process for Image Production Parameters (according to configuration)</td>
</tr>
<tr>
<td>SCALE_NAME</td>
<td>No Scale/Fixed Scale/Auto Scale/One Pass Scale/Fixed Measure Scale/Auto Segment Scale</td>
</tr>
<tr>
<td>BOARD_NAME</td>
<td>Name of the PCB Material (according to configuration)</td>
</tr>
<tr>
<td>THICKNESS</td>
<td>PCB Material thickness (inch)</td>
</tr>
<tr>
<td>RESIST_TYPE</td>
<td>Name of the Resist type (according to configuration)</td>
</tr>
<tr>
<td>TREATMENT</td>
<td>Name of the Treatment (used by the DI registration system for selecting targets)</td>
</tr>
<tr>
<td>CLIP_LIMITS</td>
<td>Define clip area</td>
</tr>
<tr>
<td>IMAGE_ROTATE</td>
<td>Panel on the PCB Material 0/90/180/270 measured in degrees CW (clockwise)</td>
</tr>
<tr>
<td>ALIGN</td>
<td>Define alignment (PCB Material on the DI Table)</td>
</tr>
<tr>
<td>REGIST_TOOL</td>
<td>CCD/UV Marker/BEAM</td>
</tr>
<tr>
<td>REGIST_FILE</td>
<td>Name of the registration file for CCD/Beam registration (Not applicable for UV Marker)</td>
</tr>
</tbody>
</table>
**CLIP_LIMITS Array Structure**

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>X_MIN</td>
<td>Minimal X</td>
</tr>
<tr>
<td>Y_MIN</td>
<td>Minimal Y</td>
</tr>
<tr>
<td>X_MAX</td>
<td>Maximal X</td>
</tr>
<tr>
<td>Y_MAX</td>
<td>Maximal Y</td>
</tr>
</tbody>
</table>

**ALIGN Array Structure**

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| USED | No—Alignment not set  
Yes—Alignment is set |
| ALIGN_TRANS | Define alignment transformation of the PCB Material on the table (see below) |
| ALIGN_TOOL | Pins/Ruler/DIM_Late_Select  
(DIM_Late_Select—alignment transformation is set on the DI Manager application.) |
| ALIGN_TYPE | Left/Right/Center/TopLeft_BottomRight (applicable in Ruler only) |
| RULER_NAME | Name of the ruler (applicable in Ruler only) |
| PINSET_NAME | Name of the pin set (applicable in Pins only) |

**ALIGN_TRANS Array Structure**

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>XOFFSET</td>
<td>The X position on the DI Table of the step’s lower left corner after rotation and mirror.</td>
</tr>
<tr>
<td>YOFFSET</td>
<td>The Y position on the DI Table of the step’s lower left corner after rotation and mirror.</td>
</tr>
<tr>
<td>ANGLE</td>
<td>0/90/180/270 measured in degrees CW (clockwise)</td>
</tr>
<tr>
<td>MIRROR</td>
<td>No/Yes</td>
</tr>
</tbody>
</table>

**Example**

```
SIDE=TOP
PARTNER=IN03
PPOCESS=
SCALE_MODE=FIXED MEASURE SCALE
BOARD_NAME=20X16
THICKNESS=0.0787
RESIST_TYPE=ES102
TREATMENT=BRUSHING_LIGHT

CLIP_LIMITS {
    X_MIN=0
    Y_MIN=0
    X_MAX=12
    Y_MAX=16
}
```
**notes (Electronic Job Notes)**

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Line Record Text</td>
</tr>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>Yes</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/layers/&lt;layer_name&gt;/notes</td>
</tr>
</tbody>
</table>

This file contains all the notes added by the user to the graphical layer.

**Example**

866467418,moshik,2.03807, -1.22818,,,,,,First line\nSecond line

Each line in the notes file has the following format:

```
<time>,<user>,<x>,<y>, ,,,,,,<note>
```

Where:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;time&gt;</td>
<td>Last update date UNIX time (seconds starting January 1st, 1970)</td>
</tr>
<tr>
<td>&lt;user&gt;</td>
<td>Last user updating the note</td>
</tr>
<tr>
<td>&lt;x&gt;,&lt;y&gt;</td>
<td>Graphic location, in inches</td>
</tr>
<tr>
<td>&lt;note&gt;</td>
<td>Up to 4 lines of text when the \n character describes the line break</td>
</tr>
</tbody>
</table>
relations (Connections between Features)

This optional file contains all dimension and connections between features in a layer.

**Examples**
```json
"relations" {
  "version"=1
  "rel_type"=DIM
  "dimension" {
    "dmode"=DXDY
    "dx"=0
    "dy"=0.74
    "angle"=0
    "linetype"=HORZ
    "is_special"=0
    "source_f" {
      "type"=FEAT
      "feature" {
        "index"=0
        "mode"=ALL
      }
    }
    "dest_f" {
      "type"=FEAT
      "feature" {
        "index"=1
        "mode"=ALL
      }
    }
  }
  "graphic" {
    "grp-params" {
      "ang_arrmode"=EDGE
      "dim_arrmode"=EDGE
      "ang_boxmode"=SQR
      "dim_boxmode"=SQR
      "inline_mode"=ALL
      "outline_mode"=ALL
      "font_spec"=TMR10
      "text_sufx"=
    }
    "dim_x"=0
    "dim_y"=0.374
    "ang_x"=0
  }
}
```

Type: Structured Text
Compression: None
Sum file: Yes
<job_name>/steps/<step_name>/layers/<layer_name>/relation/relation/relations
"ang_y"=0
}
)

"relations" {
  "version"=1
  "rel_type"=CON
  "connection" {
    "feature-1" {
      "type"=FEAT
      "feature" {
        "index"=3
        "mode"=PS
      }
    }
    "feature-2" {
      "type"=FEAT
      "feature" {
        "index"=4
        "mode"=PE
      }
    }
    "feature-c" {
      "type"=FEAT
      "feature" {
        "index"=-1
        "mode"=ALL
      }
    }
  }
  "mode"=CORNER
  "size1"=0
  "size2"=0
  "type_x"=DIST
  "type_y"=DIST
  "point_rel_2_f1"=ALL
  "func"=LINE2ARC
  "intersect"=0
  "radius"=0
}

"graphic" {
  "grp-params" {
    "ang_arrmode"=EDGE
    "dim_arrmode"=EDGE
    "ang_boxmode"=SQR
    "dim_boxmode"=SQR
    "inline_mode"=ALL
    "outline_mode"=ALL
    "font_spec"=ALL
    "text_sufx"=
  }
  "dim_x"=0
  "dim_y"=0
  "ang_x"=0
### Chapter 6  Job>steps>layers Entity relations (Connections between Features)

The file contains relations in the following structure:

- **version** = always one (for future use)
- **rel_type** = **CON** for connection or **DIM** for dimension.

**connection or dimension structure** = according to type

**graphic structure**:

<table>
<thead>
<tr>
<th>grp-params structure:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ang_arrmode</strong></td>
</tr>
<tr>
<td><strong>dim_arrmode</strong></td>
</tr>
<tr>
<td><strong>ang_boxmode</strong></td>
</tr>
<tr>
<td><strong>dim_boxmode</strong></td>
</tr>
<tr>
<td><strong>inline_mode</strong></td>
</tr>
<tr>
<td><strong>outline_mode</strong></td>
</tr>
<tr>
<td><strong>font_spec</strong></td>
</tr>
<tr>
<td><strong>text_sufx</strong></td>
</tr>
<tr>
<td><strong>dim_x</strong></td>
</tr>
<tr>
<td><strong>dim_y</strong></td>
</tr>
<tr>
<td><strong>ang_x</strong></td>
</tr>
<tr>
<td><strong>ang_y</strong></td>
</tr>
</tbody>
</table>

```c
"ang_y"=0
```
Dimension type structure:

<table>
<thead>
<tr>
<th>dmode</th>
<th>Only DXDY available</th>
</tr>
</thead>
<tbody>
<tr>
<td>dx</td>
<td>Delta x in inches</td>
</tr>
<tr>
<td>dy</td>
<td>Delta y in inches</td>
</tr>
<tr>
<td>angle</td>
<td>Angle if exist</td>
</tr>
<tr>
<td>linetype</td>
<td>For line destinations</td>
</tr>
<tr>
<td></td>
<td>HORZ - horizontal</td>
</tr>
<tr>
<td></td>
<td>VERT - vertical</td>
</tr>
<tr>
<td></td>
<td>DIAG - diagonal</td>
</tr>
<tr>
<td>is_special</td>
<td>Dimension belongs to a symbol predefined source_f or dest_f</td>
</tr>
<tr>
<td>source_f</td>
<td>type is always FEAT feature</td>
</tr>
<tr>
<td></td>
<td>index - feature index in database</td>
</tr>
<tr>
<td></td>
<td>mode - dimension mode</td>
</tr>
<tr>
<td></td>
<td>ALL - all features</td>
</tr>
<tr>
<td></td>
<td>PS - start of feature</td>
</tr>
<tr>
<td></td>
<td>PE - end of feature</td>
</tr>
<tr>
<td>dest_f</td>
<td>type is always FEAT feature</td>
</tr>
<tr>
<td></td>
<td>index - feature index in database</td>
</tr>
<tr>
<td></td>
<td>mode - dimension mode</td>
</tr>
<tr>
<td></td>
<td>ALL - all features</td>
</tr>
<tr>
<td></td>
<td>PS - start of feature</td>
</tr>
<tr>
<td></td>
<td>PE - end of feature</td>
</tr>
</tbody>
</table>

Connection type structure:

| feature-1, feature-2 | Features that are connected in the above feature type |
| feature-c            | Connecting feature in the above feature type(-1 if none) |
| mode                 | Connection mode | ROUND/CORNER/CHAMFER |
| size1                | Chamfer connections |
|                      | if type_x is DIST: distance in x to cut from feature in inches |
|                      | if type_x is ANGLE: angle between chamfer line and feature |
| size2                | Same as above for y |
| type_x               | Chamfer connection if the above size in DIST or ANGLE |
| type_y               | the same as above for y |
### Table

<table>
<thead>
<tr>
<th>point_rel_2_f1</th>
<th>In case of more than one intersection point between features ALL/PS/PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>func</td>
<td>Connection function:</td>
</tr>
<tr>
<td></td>
<td>LINE2ARC - intersection</td>
</tr>
<tr>
<td></td>
<td>LINE2CIRCLE - line tangent to 2 circles</td>
</tr>
<tr>
<td></td>
<td>CIRCLE2LINE - circle tangent 2 two lines</td>
</tr>
<tr>
<td></td>
<td>CIRCLE2CIRCLE - arc tangent 2 two circles</td>
</tr>
<tr>
<td>intersect</td>
<td>For tangent features indication if arcs should be fixed.</td>
</tr>
<tr>
<td>radius</td>
<td>Radius of round intersection and of circle</td>
</tr>
</tbody>
</table>

#### Note

Some of the relations, such as Dimension Types and Connection Types, relate mostly for use in a rout layer, even though they can be used in any other layer. A rout layer should be created exclusively for the definition of a rout.

**NCD Entity** see “NCD Entity” on page 164

**NCR Entity** see “NCR Entity” on page 177
Chapter 7  

**NCD Entity**

The `ncd` set entity contains parameters and data for the Auto Drill Manager.

**Required for GenFlex 6.4**

**New fields in NCD files (Implemented in Genesis v9.3b also)**

File: `<job_name>/steps/<step_name>/layers/<layer_name>/ncd/<ncd_set_name>/header`

A new field `sr_r_command = no/yes` (use R command in excellon S&R replication) is added to the format section.

```plaintext
format {
    ... 
    sr_r_command= YES 
    ... 
}
```

File: `<job_name>/steps/<step_name>/layers/<layer_name>/ncd/<ncd_set_name>/table`

New fields are added:

- `stages = no/yes` - YES if the table was built using `.drill_stage` attribute.
- `by_length = no/yes` - YES if the table was built consider slot length.
- `nibble_type = machine/software/start_end` - START_END is a new option for slot pilot tools creation.
- `ind_sort = 0...` - table entry index.
- `stage_att = [-1,0,1,2]` - value of `.drill_stage` attribute
- `fix_tool_order_neg = -xxx` - used instead of
negative **fix_tool_order**

For example:

```plaintext
stages = YES
by_length = YES
entry {
    ...  
    nibble_type = START_END
    ...  
    ind_sort = 1
    stage_att = 2
    fix_tool_order_neg = -1
}
```

**header**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The **ncd** set entity contains data and parameters for the Auto Drill Manager. This file describes the parameters used for creation of output NC files.

**Note**  
NCD = Numerical Control Drill.

**Example:**

```plaintext
machine=EXCELLON
thickness=0
rout_layer=NCD-R
no_touch_cpr=NO
tent_ar=0.012
num_stages=3
num_splits=1

reg {
    xsize1=24.5
    xsize2=24.5
    ysize=30
    xover=2
    angle=0
    mirror=NO
```
xoff=0
yoff=0
xorigin=0
yorigin=0
version=1
dx1=0
dy1=0
dx2=0
dy2=0
xscale=1.02
yscale=0.99
xscale_o=1.3
yscale_o=-3
}
format {
    format=EXCELLON2
    zeroes=TRAILING
    units=INCH
    tool_units=INCH
    nf1=2
    nf2=4
    decimal=NO
    sr_start_code=25
    modal_ords=YES
    single_sr=NO
    sr_zero_set=NO
    repetitions=SR
    incremental=NO
}
split {
    axis=None
    coord=0
    sign=NEGATIVE
}
optimize {
    break_sr=YES
    optimize=YES
    iterations=10
    reduction_percent=1
    xspeed=400
    yspeed=400
    diag_mode=45ORT
}
z_axis {
    z_head=0
}
time {
    bit_change=0
    tool_change=0
}
tools_assign {
    fixed_tools=NO
    mode=INCREASING_SIZE
start_end {
  with_pilots=NO

  split {
    start=YES
    end=YES
    x=3.5
    y=1.2
    angle=0
    num_cols=0
    dist_type=SPACING
    min_dist=20
    min_hits=0
    min_size=0
    max_size=0
    end2=NO
    x2=0
    y2=0
    angle2=0
    num_cols2=0
  }

  split {
    start=NO
    end=NO
    x=0
    y=0
    angle=0
    num_cols=0
    dist_type=SPACING
    min_dist=0
    min_hits=0
    min_size=0
    max_size=0
    end2=NO
    x2=0
    y2=0
    angle2=0
    num_cols2=0
  }
}

Description

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>machine</td>
</tr>
<tr>
<td>thickness</td>
</tr>
<tr>
<td>rout_layer</td>
</tr>
<tr>
<td>no_touch_cpr</td>
</tr>
<tr>
<td>tent_ar</td>
</tr>
</tbody>
</table>
Chapter 7  NCD Entity

header

<table>
<thead>
<tr>
<th>num_stages</th>
<th>Number of stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>num_splits</td>
<td>Number of splits</td>
</tr>
</tbody>
</table>

REG Structure

<table>
<thead>
<tr>
<th>xsize1</th>
<th>Size of spindle table 1 in X</th>
</tr>
</thead>
<tbody>
<tr>
<td>xsize2</td>
<td>Size of spindle table 2 in X</td>
</tr>
<tr>
<td>ysize</td>
<td>Size of spindle table in Y</td>
</tr>
<tr>
<td>xover</td>
<td>Overlap in table 1 and table 2 in X (used when panel is larger than table)</td>
</tr>
<tr>
<td>angle</td>
<td>Panel angle origin on table</td>
</tr>
<tr>
<td>mirror</td>
<td>Data is to be mirrored when placed on table (Yes/No)</td>
</tr>
<tr>
<td>xoff</td>
<td>Shift of panel in X relative to machine corner</td>
</tr>
<tr>
<td>yoff</td>
<td>Shift of panel in Y relative to machine corner</td>
</tr>
<tr>
<td>xorigin</td>
<td>Shift of zero in X to locate the machine 0</td>
</tr>
<tr>
<td>yorigin</td>
<td>Shift of zero in Y to locate the machine 0</td>
</tr>
<tr>
<td>version</td>
<td>Version of X/Y output that should be created</td>
</tr>
<tr>
<td>dx1</td>
<td>Shift in X to be applied in split situation for table 1</td>
</tr>
<tr>
<td>dy1</td>
<td>Shift in Y to be applied in split situation for table 1</td>
</tr>
<tr>
<td>dx2</td>
<td>Shift in X to be applied in split situation for table 2</td>
</tr>
<tr>
<td>dy2</td>
<td>Shift in Y to be applied in split situation for table 2</td>
</tr>
<tr>
<td>xscale</td>
<td>Scale factor by X</td>
</tr>
<tr>
<td>yscale</td>
<td>Scale factor by X</td>
</tr>
<tr>
<td>xscale_o</td>
<td>X scale anchor</td>
</tr>
<tr>
<td>yscale_o</td>
<td>X scale anchor</td>
</tr>
</tbody>
</table>

Format Structure

Format structure describes the format of output NC file.

<table>
<thead>
<tr>
<th>format</th>
<th>Format type of Output NC file</th>
</tr>
</thead>
<tbody>
<tr>
<td>zeroes</td>
<td>Zeros omitted (Trailing/Leading/None)</td>
</tr>
<tr>
<td>units</td>
<td>Units the drill data is created in (Inch/mm)</td>
</tr>
<tr>
<td>tool_units</td>
<td>Units the drill size is created in (Inch/mm)</td>
</tr>
<tr>
<td>nf1</td>
<td>Numbering format most significant number (M.L) e.g. 2.4</td>
</tr>
<tr>
<td>nf2</td>
<td>Numbering format least significant number (M.L) e.g. 2.4</td>
</tr>
<tr>
<td>decimal</td>
<td>To place a decimal point in the output coordinates</td>
</tr>
<tr>
<td></td>
<td>Yes - places decimal point, for example, X4.345Y2.3</td>
</tr>
<tr>
<td></td>
<td>No – doesn’t place decimal point X210Y340)</td>
</tr>
</tbody>
</table>
Chapter 7  NCD Entity

header

### Split Structure

Split structure describes the panel split when a panel size is larger than a machine table.

<table>
<thead>
<tr>
<th>sr_start_code</th>
<th>Starting code for step &amp; repeat block (Excellon format). Some machines use the M25 code for step &amp; repeat, and others use M31. This value should be 25, or 31.</th>
</tr>
</thead>
</table>
| modal_coords | To remove identical X,Y coordinates. (Yes/No). For example, we have two sets of coordinates: x1=5.4, y1=2.5  
x2=6.3, y2=2.5  
When modal_coords = Yes, the following results in the file:  
X5.4Y2.5  
X6.3 |
| single_sr | Applies to a step & repeat block that has only one 'repeat'. Yes - that repeat will be placed within a step & repeat block. In Excellon format it means that it will be inside a M25 block. (Yes/No). |
| sr_zero_set | Sets step & repeat block location relative to datum. Yes - sets all the coordinates of a step & repeat block relative to a specified datum. (Yes/No). |
| repetitions | Repetitions type:  
SR – Step & repeat blocks  
Subroutine – subroutines (only in Hitachi format) |
| incremental | Yes - each point's coordinates are given as an increment to a previous point. |

### Optimize Structure

Optimize structure contains parameters that affect drill optimization algorithm.

<table>
<thead>
<tr>
<th>break_sr</th>
<th>Break step &amp; repeat (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>optimize</td>
<td>Run drill optimization (Yes/No)</td>
</tr>
<tr>
<td>iterations</td>
<td>Number of iterations for optimization</td>
</tr>
<tr>
<td>reduction_percent</td>
<td>Stop optimization iterations when improvement on any given iteration falls to less than the percent specified.</td>
</tr>
<tr>
<td>xspeed</td>
<td>Relative spindle speed in X</td>
</tr>
</tbody>
</table>
Chapter 7  NCD Entity

header

### Z_AXIS Structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>z_head</td>
<td>Default clearance of tool from board</td>
</tr>
</tbody>
</table>

### Time Structure

Time structure contains values that are used for estimating the drill time display in the Report.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bit_change</td>
<td>Time in minutes for bit change</td>
</tr>
<tr>
<td>tool_change</td>
<td>Time in minutes for tool change</td>
</tr>
</tbody>
</table>

### Tools_assign Section

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fixed_tools</td>
<td>Using fixed tools described in machine file (Yes/No)</td>
</tr>
</tbody>
</table>
| mode      | Tool assignment mode: 
            | INCREASING_SIZE/DECREASING_SIZE/INCREASING_COUNT/DECREASING_COUNT |

### Start_end Section

Start_end section describes parameters for creation of start/end coupon.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>with_pilots</td>
<td>Yes – drill verification holes with their pilot holes. (Yes/No).</td>
</tr>
</tbody>
</table>

Array of split structures always contain two items. The first item describes start/end coupon for first split, and the second item for the second split. This array is contained inside Start_end structure.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>start</td>
<td>Starting hole coupon (Yes/No)</td>
</tr>
<tr>
<td>end</td>
<td>Ending hole coupon (Yes/No)</td>
</tr>
<tr>
<td>x</td>
<td>X coordinate of a first hole in the coupon</td>
</tr>
<tr>
<td>y</td>
<td>Y coordinate of a first hole in the coupon</td>
</tr>
<tr>
<td>angle</td>
<td>Direction of row (column) of holes (in angles)</td>
</tr>
<tr>
<td>num_cols</td>
<td>Number of hole columns</td>
</tr>
<tr>
<td>min_dis</td>
<td>Minimum distance between holes in coupon</td>
</tr>
<tr>
<td>dist_type</td>
<td>Spacing - defines minimum space between holes/slots edges</td>
</tr>
<tr>
<td></td>
<td>Center - defines minimum distance between holes/slots centers</td>
</tr>
<tr>
<td>min_hits</td>
<td>Minimum number of drills. Don’t place a drill on the coupon for tools that have less hits than this number.</td>
</tr>
</tbody>
</table>
Chapter 7  NCD Entity

This file contains the NC table. It consists of an array of records, each one describing a table entry.

Example

```plaintext
entry {
    shape=HOLE
    type=PLATED
    size=30
    touch_copper=NO
    flag=0
    count=1
    finish_size=-9.84251968503937e-005
    min_tol=0
    max_tol=0
    designator=
    slot_len=0
    pilot=NO
    parents=-1
    mode=REGULAR
    spindle_speed=300
    feed_rate=85
    nibble_type=MACHINE
    tool_size=30
    max_hits=500
    stage=2
    rout_mode=SEPARATE
    hits=1
    text_count=3
}
```
## Entry Structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>shape</strong></td>
<td>Hole / Slot</td>
</tr>
<tr>
<td><strong>type</strong></td>
<td>Plated / Non_plated / Via</td>
</tr>
<tr>
<td><strong>size</strong></td>
<td>Drill size</td>
</tr>
<tr>
<td><strong>touch_copper</strong></td>
<td>Yes – there are drills of this size that touch copper</td>
</tr>
<tr>
<td><strong>flag</strong></td>
<td>Drill flag (passed by attributes)</td>
</tr>
<tr>
<td><strong>count</strong></td>
<td>Number of drills/slots</td>
</tr>
<tr>
<td><strong>finish_size</strong></td>
<td>Finish size</td>
</tr>
<tr>
<td><strong>min_tol</strong></td>
<td>Minimum size tolerance</td>
</tr>
<tr>
<td><strong>max_tol</strong></td>
<td>Maximum size tolerance</td>
</tr>
<tr>
<td><strong>designator</strong></td>
<td>Drill designator (comment)</td>
</tr>
<tr>
<td><strong>slot_len</strong></td>
<td>Total slot length</td>
</tr>
<tr>
<td><strong>pilot</strong></td>
<td>Yes - the drill is a pilot drill</td>
</tr>
<tr>
<td><strong>parent</strong></td>
<td>Parent index. Index table row that describes the parent for the pilot drill</td>
</tr>
<tr>
<td><strong>mode</strong></td>
<td>Regular – produce regular drill</td>
</tr>
<tr>
<td></td>
<td>Nibble – produce nibble drill</td>
</tr>
<tr>
<td></td>
<td>Rout – send the drills to a rout layer</td>
</tr>
<tr>
<td><strong>spindle_speed</strong></td>
<td>Spindle speed</td>
</tr>
<tr>
<td><strong>feed_rate</strong></td>
<td>Feed rate</td>
</tr>
<tr>
<td><strong>nibble_type</strong></td>
<td>Nibble type for nibble drills/slots:</td>
</tr>
<tr>
<td></td>
<td>Machine – produce a machine command for the nibble</td>
</tr>
<tr>
<td></td>
<td>Software – produce a sequence of smaller drills by using a nibble algorithm</td>
</tr>
<tr>
<td><strong>rout_mode</strong></td>
<td>Separate (always this value)</td>
</tr>
<tr>
<td><strong>tool_size</strong></td>
<td>Tool size</td>
</tr>
<tr>
<td><strong>max_hits</strong></td>
<td>Maximum hits parameter</td>
</tr>
<tr>
<td><strong>stage</strong></td>
<td>Stage number</td>
</tr>
<tr>
<td><strong>hits</strong></td>
<td>Number of hits</td>
</tr>
<tr>
<td><strong>text_counts</strong></td>
<td>Number of canned text features. If this number &gt;0 the table entry describes a drilled (canned) text rather than a hole.</td>
</tr>
</tbody>
</table>
**order**

<table>
<thead>
<tr>
<th>Type</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>Yes</td>
</tr>
<tr>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/layers/&lt;layer_name&gt;/ncd/&lt;ncd-set_name&gt;/order.&lt;split number&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Split numbers can have values of 1 or 2.

The order file contains records defining the step drilling order in the Auto Drill Manager.

---

**drill file**

<table>
<thead>
<tr>
<th>Type</th>
<th>Line record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>no</td>
</tr>
<tr>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/layers/&lt;layer_name&gt;/ncd/&lt;ncd-set_name&gt;/drill/&lt;split number&gt;.&lt;stage number&gt;</td>
<td></td>
</tr>
</tbody>
</table>

Split numbers can be 1 or 2; stage numbers can be from 1 to 3. Thus, drill file names look like “1.1”, “1.2”, “2.3”

Drill file is an intermediate output file produced by the Auto Drill Manager. This file is translated to an NC file.

**Example**

```
BS pcb
R  0.3496454
  0.574853  90 Y N N N
```
Chapter 7  NCD Entity

drill file

R 0.5470589 0.0137815 0 N Y Y N
R 0.0470589 0.0137815 0 N N Y N
H 4 0.144246 0.032847 N N N Ns
H 2 0.209031 0.202162 N N N N
H 5 0.033487 0.051513 N N N N
BE pcb
S 0 0.383224 0.1250633 0.408224 0.1683646 N N N N
H 4 0.0824924 0.430607 N N N N
H 2 0.2518074 0.3658219 N N N N
H 1 0.492556 0.195215 N N N N
H 4 0.6808214 0.35187 N N N N
H 5 0.1011584 0.5413659 N N N N
H 6 0.8271084 0.504596 N N N N
T 0 1.235303 1.8140007 ' ' 0 N Y N 0 N
T 0 1.187303 1.8860007 ' ' 0 N Y N 0 N
T 0 1.211303 1.8660007 ' ' 0 N Y N 0 N
T 1 2.9772455 1.8220594 'ABC' 0 N N N N N

The file consists of lines. The first letter or two letters of a line define the type:

<table>
<thead>
<tr>
<th>BS</th>
<th>block start record</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>block end</td>
</tr>
<tr>
<td>R</td>
<td>repetition record</td>
</tr>
<tr>
<td>H</td>
<td>hole record</td>
</tr>
<tr>
<td>S</td>
<td>slot record</td>
</tr>
<tr>
<td>T</td>
<td>canned (drilled) text record</td>
</tr>
</tbody>
</table>

**Block start record** - has the format: BS <step_name>; where step_name is the name of step being repeated by this block

**Block end record** - has the format: BE <step_name>; where step_name is the name of step being repeated by this block

**Repetition record** - describes a single repetition of a block. It has the format:

R <dx> <dy> <angle> <mirror> <order> <full> <optional>

<table>
<thead>
<tr>
<th>dx</th>
<th>Offset of this repetition block by X</th>
</tr>
</thead>
<tbody>
<tr>
<td>dy</td>
<td>Offset of this repetition block by Y</td>
</tr>
<tr>
<td>angle</td>
<td>Rotation angle of the step repetition (0, 90, 180, 270)</td>
</tr>
<tr>
<td>mirror</td>
<td>Mirror (Y/N)</td>
</tr>
<tr>
<td>order</td>
<td>Y – an order is set for this repetition (Y/N)</td>
</tr>
<tr>
<td>full</td>
<td>Full step processing (Y/N)</td>
</tr>
<tr>
<td>optional</td>
<td>Optional step processing (Y/N)</td>
</tr>
</tbody>
</table>

**Hole record** - has the format:

H <row_number> <X> <Y> <optional> <basic> <noopt> <noscale>

<table>
<thead>
<tr>
<th>row_number</th>
<th>Row number in the NC table</th>
</tr>
</thead>
<tbody>
<tr>
<td>x, y</td>
<td>Coordinates of the hole</td>
</tr>
</tbody>
</table>
Slot record - has the format:

```
S <row_number> <X1> <Y1> <X2> <Y2> <optional> <basic> <noopt> <noscale>
```

- **row_number**: Row number in the NC table
- **x1, y1**: Coordinates of the start of the slot
- **x2, y2**: Coordinate of the end of the slot
- **optional**: Optional drill (Y/N)
- **basic**: Basic drill (Y/N)
- **noopt**: Don’t optimize this drill (Y/N)
- **noscale**: Don’t scale this drill (Y/N)

Text record - has the format:

```
T <row_number> <X> <Y> <text> <font> <optional> <basic> <noopt> <noscale>
```

- **row_number**: Row number in the NC table
- **x, y**: Coordinates of the hole
- **text**: Text string
- **font**: Text dot matrix (5 – 5x7, 6 – 6x7)
- **optional**: Optional drill (Y/N)
- **basic**: Basic drill (Y/N)
- **noopt**: Don’t optimize this drill (Y/N)
- **noscale**: Don’t scale this drill (Y/N)

**Note** If the text string is empty, that line describes a single line of broken text. Broken text is a text that is output as a sequence of drills rather than a special NC command for text output.

---

### NC File

<table>
<thead>
<tr>
<th>Type</th>
<th>Line record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>No</td>
</tr>
</tbody>
</table>

<job name>/steps/<step name>/layers/<layer name>/ncd/<ncd-set name>/ncf/<split number>.<stage number>
Split numbers can be 1 or 2. Stage numbers can be from 1 to 3. Thus, NC file names look like “1.1”, “1.2”, “2.3”

The NC file is a real output file produced by the Auto Drill Manager. It has a format as requested by a user (e.g., Excellon, Posalux etc.).
Chapter 8  **NCR Entity**

The `ncr set` entity contains parameters and data for the Auto Rout Manager.

### NCR header

<table>
<thead>
<tr>
<th>Type</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>Yes</td>
</tr>
</tbody>
</table>

This file describes the parameters used for creation of output NC files.

**Note**  
NCR = Numerical Control Rout.

**Example**

```plaintext
machine=EXCELLON
thickness=0
drill_layer=NCR-DRILL
sr_zero_drill_layer=
break_sr=NO
ccw=NO
angle_lines=NO
short_lines=NONE
press_down=YES
last_z_up=16
max_arc_ang=180
sep_lyrs=NO

reg {
xsize=30
ysize=50
xover=0
angle=0
mirror=NO
xoff=0
yoff=0
xorigin=0
yorigin=0
version=1
xscale=1
yscale=1
xscale_o=0
yscale_o=0
}
```
Chapter 8  NCR Entity

NCR header

```
format {
    format=EXCELON1
    zeroes=TRAILING
    units=MM
    tool_units=MM
    nf1=3
    nf2=2
    decimal=YES
    sr_start_code=25
    modal_coords=YES
    repetitions=SR
    single_sr=YES
    sr_zero_set=NO
}
```

Description

<table>
<thead>
<tr>
<th>Machine</th>
<th>Machine file name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>Board thickness</td>
</tr>
<tr>
<td>Drill layer</td>
<td>Name of drill layer, where features redirected for drill will be placed</td>
</tr>
<tr>
<td>Sr_zero_drill_layer</td>
<td>Name of a drill layer where a zero pad is located</td>
</tr>
<tr>
<td>Break sr</td>
<td>Break step &amp; repeat (Yes/No)</td>
</tr>
<tr>
<td>Ccw</td>
<td>Machine is in counter-clockwise mode (Yes/No)</td>
</tr>
<tr>
<td>Angle_lines</td>
<td>Replace short lines by angled lines (Yes/No)</td>
</tr>
<tr>
<td>Short_lines</td>
<td>Short lines mode:</td>
</tr>
<tr>
<td>Press_down</td>
<td>Pressure foot down on all tool ups (Yes/No)</td>
</tr>
<tr>
<td>Last_z_up</td>
<td>Last tool up definition (16 for M16 or 17 for M17)</td>
</tr>
<tr>
<td>Max_arc_ang</td>
<td>Maximum angle of arc, any arc that has a sweep more than this value will be subdivided. (0-360)</td>
</tr>
<tr>
<td>Sep_lyrs</td>
<td>Use separate layers when outputting steps with different orientations (Yes/No)</td>
</tr>
</tbody>
</table>

REG

Structure

<table>
<thead>
<tr>
<th>Xsize</th>
<th>Width of machine table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ysize</td>
<td>Height of machine table</td>
</tr>
<tr>
<td>Xover</td>
<td>Not used</td>
</tr>
<tr>
<td>Angle</td>
<td>Panel angle origin on table</td>
</tr>
<tr>
<td>Mirror</td>
<td>Data are to be mirrored when placed on table (Yes/No)</td>
</tr>
<tr>
<td>Xoff</td>
<td>Shift of panel in X relative to machine corner</td>
</tr>
</tbody>
</table>
### Format Structure

Format Structure describes the format of output NC file.

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>yoff</td>
<td>Shift of panel in Y relative to machine corner</td>
</tr>
<tr>
<td>xorigin</td>
<td>Shift of zero in X to locate the machine 0</td>
</tr>
<tr>
<td>yorigin</td>
<td>Shift of zero in Y to locate the machine 0</td>
</tr>
<tr>
<td>version</td>
<td>Version of X/Y output that should be created (1-8)</td>
</tr>
<tr>
<td>xscale</td>
<td>Scale factor by X</td>
</tr>
<tr>
<td>yscale</td>
<td>Scale factor by Y</td>
</tr>
<tr>
<td>xscale_o</td>
<td>X scale anchor</td>
</tr>
<tr>
<td>yscale_o</td>
<td>Y scale anchor</td>
</tr>
<tr>
<td>format</td>
<td>Format type of Output NC file</td>
</tr>
<tr>
<td>zeroes</td>
<td>Zeros omitted (Trailing/Leading/None)</td>
</tr>
<tr>
<td>units</td>
<td>Units in which the output data is created (Inch/mm)</td>
</tr>
<tr>
<td>tool_units</td>
<td>Units for tool definition data (Inch/mm)</td>
</tr>
<tr>
<td>nf1</td>
<td>Numbering format's most significant number (M.L) e.g. 2.4</td>
</tr>
<tr>
<td>nf2</td>
<td>Numbering format's least significant number (M.L) e.g. 2.4</td>
</tr>
<tr>
<td>decimal</td>
<td>To place a decimal point in the output coordinates.</td>
</tr>
<tr>
<td></td>
<td>Yes - places decimal point, for example, X4.345Y2.3</td>
</tr>
<tr>
<td></td>
<td>No – does not place decimal point X210Y340</td>
</tr>
<tr>
<td>sr_start_code</td>
<td>Starting code for step &amp; repeat block (Excellon format). Some machines use</td>
</tr>
<tr>
<td></td>
<td>the M25 code for step &amp; repeat, and others use M31.</td>
</tr>
<tr>
<td></td>
<td>Value should be 25, or 31.</td>
</tr>
<tr>
<td>modal_coords</td>
<td>Modal coordinates (Yes/No). Used to remove identical X,Y coordinates.</td>
</tr>
<tr>
<td></td>
<td>For example, we have two sets of coordinates: x1=5.4, y1=2.5</td>
</tr>
<tr>
<td></td>
<td>x2=6.3, y2=2.5</td>
</tr>
<tr>
<td></td>
<td>When modal_coords = Yes, then the following results in the file: X5.4Y2.5</td>
</tr>
<tr>
<td></td>
<td>X6.3</td>
</tr>
<tr>
<td>single_sr</td>
<td>Applies to a step &amp; repeat block that has only one 'repeat'.</td>
</tr>
<tr>
<td></td>
<td>Yes - that repeat will be placed within a step &amp; repeat block. In Excellon</td>
</tr>
<tr>
<td></td>
<td>format it means that it will be inside a M25 block.</td>
</tr>
<tr>
<td>sr_zero_set</td>
<td>Sets step &amp; repeat block location relative to a pad on a special drill</td>
</tr>
<tr>
<td></td>
<td>layer. Yes - sets all the coordinates of a step &amp; repeat block relative to</td>
</tr>
<tr>
<td></td>
<td>a specified pad or datum.</td>
</tr>
<tr>
<td>repetitions</td>
<td>Repetitions type:</td>
</tr>
<tr>
<td></td>
<td>SR – step &amp; repeat blocks</td>
</tr>
<tr>
<td></td>
<td>Subroutine – subroutines (only in Hitachi format)</td>
</tr>
</tbody>
</table>
This file contains the NC table. It consists of an array of records, each one describing a table entry.

Example
entry {
    type=CHAIN
    step_name=PANEL
    chain=1
    chain2=0
    size=0.02
    comp=LEFT
    path=0.7816070866141732
    count=0
    flag=0
    cw=0
    tool_size=0.02
    dup=NO
    parent=-1
    comp_factor=0.02
    spindle_speed=0
    feed_rate=0
    spiral=NONE
    mode=ROUT
    group=NEW
    order=1
    optional=NO
}
...

Entry Structure

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td>Chain/Hole</td>
</tr>
<tr>
<td>step_name</td>
<td>Name of step</td>
</tr>
<tr>
<td>chain</td>
<td>Chain number</td>
</tr>
<tr>
<td>chain2</td>
<td>Tag for secondary tool for the same chain</td>
</tr>
<tr>
<td>size</td>
<td>Rout size</td>
</tr>
<tr>
<td>comp</td>
<td>Compensation (Left/Right/None)</td>
</tr>
<tr>
<td>path</td>
<td>Total path length (only for chains)</td>
</tr>
<tr>
<td>count</td>
<td>Number of holes</td>
</tr>
<tr>
<td>flag</td>
<td>Rout flag (passed by attributes)</td>
</tr>
</tbody>
</table>

Diagram:

```
<job_name>/steps/<step_name>/layers/<layer_name>/ncr/<ncr-set_name>/table
```

<table>
<thead>
<tr>
<th>Type</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Chapter 8  NCR Entity

order

The order file contains records defining the step processing order in the Auto Rout Manager.

Example

```
entry {
  order_sr {
    line=0
    nx=0
    ny=0
  }
  serial=1
  optional=NO
}
...
```

Description

<table>
<thead>
<tr>
<th>Type</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>Yes</td>
</tr>
<tr>
<td>&lt;job name&gt;/steps/&lt;step name&gt;/layers/&lt;layer name&gt;/ncr/&lt;ncr-set name&gt;/order</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>serial</th>
<th>Serial number of the step</th>
</tr>
</thead>
<tbody>
<tr>
<td>optional</td>
<td>Step is optional (Yes/No)</td>
</tr>
</tbody>
</table>
Chapter 8  NCR Entity

Order_sr  
Structure

<table>
<thead>
<tr>
<th>line</th>
<th>Row Number of step &amp; repeat table</th>
</tr>
</thead>
<tbody>
<tr>
<td>nx</td>
<td>Number of the step by X</td>
</tr>
<tr>
<td>ny</td>
<td>Number of the step by Y</td>
</tr>
</tbody>
</table>

**rout file**

<table>
<thead>
<tr>
<th>Type</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>no</td>
</tr>
</tbody>
</table>

Example

```
BS pcb
R 0.0470589
  0.0137815 0 N N N
R 0.5470589
  0.0137815 0 N N N
R 0.0496454
  0.574853 90 N N N
R 0.3496454 0.574853 90 N N N
R 0.6496454 0.574853 90 N N N
L 2 0 0 0.25 N N N
L 2 0 0.25 0.25 0.25 N N N
L 2 0 0.25 0.25 0.25 0.1 N N N
A 2 0 0.25 0.1 0.15 0 0.15 0.1 N N Y N
L 2 0 0.15 0 0 0 N N N

BE pcb
```

```
BS panel
R 0 0 0 N N N
L 0 0 0.064084 0.678131 0.845691 0.678131 N N N

BE panel
```

```
BS panel
R 0 0 0 N N N
L 1 0 0.674931 0.954491 0.931745 0.803752 N N N

BE panel
```

The file consists of lines. The first letter or two letters of a line define the type:

- **BS** block start record
- **BE** block end
- **R** repetition record
- **H** hole record
**Block start record** - has the format: BS <step_name>, where `step_name` is the name of the step being repeated by this block.

**Block end record** - has the format: BE <step_name>, where `step_name` is the name of step being repeated by this block.

**Repetition record** - describes a single repetition of a block. It has the format:

```
R <dx> <dy> <angle> <mirror> <order> <full> <optional>
```

- **dx** Offset of this repetition block by X
- **dy** Offset of this repetition block by Y
- **angle** Rotation angle of the step repetition (0, 90, 180, 270)
- **mirror** Mirror (Y/N)
- **order** Y – an order is set for this repetition (Y/N)
- **optional** Optional step processing (Y/N)

**Hole record** - has the format:

```
H <row_number> <feed> <X> <Y> <optional> <basic> <noscale>
```

- **row_number** Row number in the NC table
- **feed** Feed rate
- **X, Y** Coordinates of the hole
- **optional** Optional hole (Y/N)
- **basic** Basic hole (Y/N)
- **noscale** Don’t scale this hole (Y/N)

**Line record** - has the format:

```
L <row_number> <feed> <XS> <YS> <XE> <YE> <optional> <basic> <noscale>
```

- **row_number** Row number in the NC table
- **feed** Feed rate
- **XS, YS** Coordinates of the line start
- **XE, YE** Coordinates of the line end
- **optional** Optional rout (Y/N)
- **basic** Basic rout (Y/N)
- **noscale** Don’t scale this feature (Y/N)

**Arc record** - has the format:

```
A <row_number> <feed> <XS> <YS> <XE> <YE> <XC> <YC> <optional> <basic> <cw> <noscale>
```

- **row_number** Row number in the NC table
- **feed** Feed rate
- **XS, YS** Coordinates of the arc start
- **XE, YE** Coordinates of the arc end
NC File

File name is always 1.
NC file is a real output file generated by the Auto Rout Manager. It has a format as requested by a user (e.g., Excellon, Posalux etc.).

### NC File

<table>
<thead>
<tr>
<th>Type</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>no</td>
</tr>
</tbody>
</table>

<job name>/steps/<step name>/layers/<layer name>/ncr/<ncr-set name>/ncr/1

**Table:**

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>xc</td>
<td>Coordinates of the arc center</td>
</tr>
<tr>
<td>yc</td>
<td></td>
</tr>
<tr>
<td>optional</td>
<td>Optional rout (Y/N)</td>
</tr>
<tr>
<td>basic</td>
<td>Basic rout (Y/N)</td>
</tr>
<tr>
<td>cw</td>
<td>Clockwise (Y/N)</td>
</tr>
<tr>
<td>noscale</td>
<td>Don’t scale this feature (Y/N)</td>
</tr>
</tbody>
</table>
Chapter 9  

Job>steps>chk (Checklists)

Required for GenFlex 6.4

- Header File for each checklist
- Encrypted Checklists

**Header File for each checklist**

Each checklist has header file in a new file called `hdr` in the directory `<job_name>/steps/<step_name>/chk/<checklist_name>`. The file should have parameter `SAVE_APP = <Application_name>` Application names for example Genesis, GenFlex, InCAM, etc. Each application should recognize the parameter and decide if the encrypted checklist may be modified and saved.

**Encrypted Checklists**

All created or updated checklists (include VALOR checklists) will be encrypted and saved with names ended by “_p” (example: `hdr_p`) exactly as VALOR does.

---

**def/hdr_p**

<table>
<thead>
<tr>
<th>Type</th>
<th>Encrypted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>Yes</td>
</tr>
</tbody>
</table>

This file contains encrypted information relating to the default values of the action parameters. It also determines the location of the action in the checklist.
**res/hdr_p**

This file contains encrypted information relating to the results of a successful run of an action. It includes the status, date, time and duration of run, a list of generated categories with their characteristics and a list of result attributes generated by the action run.

**report/tags_p**

The tags file is an optional file which links lines in the textual report with graphical locations in the associated step.

**Example**

```
2807 2851 0 -4 0
1237
2851 2900 -0.4 - 3.6 0 1238
2900 2949 -0.4 - 1.4 0 1239
2949 2997 4.1 -1.4
0 1240
2997 3043 3.7 -1 0 1241
3043 3091 4.1 -3.6 0 1242
...
```

Each line in the tags file has the following format:
This file contains encrypted information relating to the free text report created by the analysis or DFM action.
This file contains display records. Display records are groups of layers which will be displayed when a certain measurement is selected. Each measurement (see below) may refer to a display record from this file.

**Example**

```plaintext
DISPLAY {
    L0 = sigt
}
DISPLAY {
    L0 = sigt
    L1 = drill
}
DISPLAY {
    L0 = sigt
    L1 = rout
}
```

The file includes an array of `DISPLAY` records. Each record contains a variable (up to 4) number of layers, tagged L0 to L3. Each layer should reference an existing layer in the job matrix. Nonexisting layers are ignored.
This file contains encrypted information relating to all the measurements which were created for an Action in one sub-result (one layer), for all categories. As of ODB++ version 7.0, checklist measurements generated in millimeters (microns) can be read due to the introduction of a ‘units’ header at the beginning of the results file in the format:

```
U<INCH|MM>
```

These units affect the measurement ID of features and shape coordinates. It does not affect a measurement value which is scalar.

**Example:**
```
#Units
#
U MM
```
```
0 10 0 N P rect120x250
S RC 2.95 1.65 0.12 0.25
1 10 0 N P rect4.724x9.843_30
S RC 2.55 2.45 0.22 0.27
2 10 0 N P rect4.724x9.843_60
S RC 3.74 2.37 0.27 0.22
```

#feature measurement in millimeters
#shape coordinates in millimeters
Chapter 10  \textit{Job>Steps>et (Electrical Test)}

\section*{\texttt{<etset\_name>/hdr}}

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path:</td>
<td>\texttt{&lt;job_Name&gt;/steps/&lt;step_name&gt;/et/&lt;etset_name&gt;/hdr}</td>
</tr>
</tbody>
</table>

All the coordinates in this section are taken to be board coordinates. Within ETM (Electrical Test Manager) we use two coordinate systems: board and adapter coordinates. Board coordinates are the coordinate system found throughout Enterprise / Genesis, whereas Adapter coordinates refer to the coordinate system as they should appear within the adapter. This file provides general information at the \texttt{etset} level.

\textbf{Example}

\begin{verbatim}
X\_DATUM=16.33848897637795
Y\_DATUM=12.99838996062992
WIDTH=7.322835039370079
HEIGHT=5.960630019685039
STATUS=new
NET\_STATUS=undefined
\end{verbatim}

\begin{tabular}{|l|p{10cm}|}
\hline
\textbf{X\_DATUM} & X-coordinate of the datum (inches) \\
\hline
\textbf{Y\_DATUM} & Y-coordinate of the datum (inches) \\
\hline
\textbf{WIDTH} & Total width of the data (inches) \\
\hline
\textbf{HEIGHT} & Total height of the data (inches) \\
\hline
\textbf{STATUS} & New/ready/not_ready \\
\hline
\textbf{NET\_STATUS} & Undefined/ok/disrupted \\
\hline
\end{tabular}
**<split_name> / hdr**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_Name&gt;/steps/&lt;step_name&gt;/et/&lt;etset_name&gt;/&lt;split_name&gt;/hdr</td>
</tr>
</tbody>
</table>

This file provides general information at the split level.

**Example**

```plaintext
ACCESS=grid_grid
ADAPTER=mct_tws
TESTER=mania
STYLE=mania

TRANS_NET2A {
  XC=0
  YC=0
  XOFF=-4.905
  YOFF=-9.633749999999999
  ROTATE=0
  MIRROR=no
}

TRANS_A2NET {
  XC=0
  YC=0
  XOFF=-4.905
  YOFF=-9.633749999999999
  ROTATE=0
  MIRROR=no
}

READY_STATE {
  SPLIT_READY=yes
  NETS_NOT_CHANGED=yes
  ALL_PINS_ASSIGNED=no
  P2G_NOT_CHANGED=yes
  PLATES_READY=no
  FA_DONE=no
  MAP_DONE=no
  DRILL_FILES_READY=no
  OUTPUT_DONE=yes
}

READY=no
COMPONENT_SIDE_UP=no
CHANGED=no

NC_SET_PARAMETERS {
  TYPE=1
}```
This file contains nine global parameters and four arrays.

The global parameters are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCESS</td>
<td>At present only flying probe and universal (grid) testers are supported. Hence the options are: NO_TEST/FP/TOP_GRID/BOT_GRID/GRID_GRID</td>
</tr>
<tr>
<td>ADAPTER</td>
<td>User name for adapter</td>
</tr>
<tr>
<td>TESTER</td>
<td>mania/everett charles/circuitline/luther maelzer/probot/bsl/integritest/microcraft/atg</td>
</tr>
<tr>
<td>STYLE</td>
<td>regular/mania (meaning that the pin can bend)</td>
</tr>
<tr>
<td>READY</td>
<td>No/Yes - for internal use</td>
</tr>
<tr>
<td>COMPONENT_SIDE_UP</td>
<td>No/Yes</td>
</tr>
<tr>
<td>CHANGED</td>
<td>No/Yes - for internal use</td>
</tr>
<tr>
<td>OUT_FORMAT</td>
<td>mania_b640/evc/circuit_line/im-udl/probot/bsl/integritest/microcraft/atl/tf/tti/anl/ipc356/ipcd-356a</td>
</tr>
<tr>
<td>CAR_FORMAT</td>
<td>None/epc/tws2000</td>
</tr>
</tbody>
</table>
The arrays TRANS_NET2A and TRANS_A2NET describe the transformation when converting from Board coordinate system to Adapter coordinate system and vice-versa. Their fields are the standard transformation fields, which are:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XCOORD</td>
<td>X-coordinate of the centre of the transformation</td>
</tr>
<tr>
<td>YCOORD</td>
<td>Y-coordinate of the centre of the transformation</td>
</tr>
<tr>
<td>XOFFSET</td>
<td>X-offset of the transformation</td>
</tr>
<tr>
<td>YOFFSET</td>
<td>Y-offset of the transformation</td>
</tr>
<tr>
<td>ROTATE</td>
<td>(0/1/2/3) x 90°</td>
</tr>
<tr>
<td>MIRROR</td>
<td>No/Yes</td>
</tr>
</tbody>
</table>

The fields of the array READY_STATE are (for internal use only):

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPLIT_READY</td>
<td>No/Yes</td>
</tr>
<tr>
<td>NETS_NOT_CHANGED</td>
<td>No/Yes</td>
</tr>
<tr>
<td>ALL_PINS_ASSIGNED</td>
<td>No/Yes</td>
</tr>
<tr>
<td>P2G_NOT_CHANGED</td>
<td>No/Yes</td>
</tr>
<tr>
<td>PLATES_READY</td>
<td>No/Yes</td>
</tr>
<tr>
<td>FA_DONE</td>
<td>No/Yes</td>
</tr>
<tr>
<td>MAP_DONE</td>
<td>No/Yes</td>
</tr>
<tr>
<td>DRILL_FILES READY</td>
<td>No/Yes</td>
</tr>
<tr>
<td>OUTPUT_DONE</td>
<td>No/Yes</td>
</tr>
</tbody>
</table>

The fields of the array OUTPUT_PARAMETRS and NC_SET_PARAMETRS are:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>0-empty/ 1-text/ 2-integer/ 3-double/ 4-boolean</td>
</tr>
<tr>
<td>NAME</td>
<td>Parameter name</td>
</tr>
<tr>
<td>VALUE</td>
<td>Parameter Value</td>
</tr>
</tbody>
</table>

The fields of the array ADAPTER_POS are:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>REFFERS</td>
<td>Profile/ net_limit</td>
</tr>
<tr>
<td>ALIGN</td>
<td>0-empty, 1-upper-left, 2-upper-mid, 3-upper-right, 4-mid-left, 5-mid-mid, 6-mid-right, 7-lower-left, 8-lower-mid, 9-lower-right</td>
</tr>
</tbody>
</table>

**<split_name> / mapping**

<table>
<thead>
<tr>
<th>Type</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>None</td>
</tr>
<tr>
<td>Sum file</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job_name&gt;/steps/&lt;step_name&gt;/et/&lt;etset_name&gt;/&lt;split_name&gt;/mapping</td>
</tr>
</tbody>
</table>
This file gives general information at the split level.

**Example**

```
<job_name>
```

Each row has the following structure:

```
<id> <board x> <board y> <pin> <grid num> <grid x> <grid y> <assign> <testable side> <side tested> <on annular ring> <net number>
```

<table>
<thead>
<tr>
<th>Id</th>
<th>Board x, board y</th>
<th>Location of the test point on the board</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
<td>Grid num</td>
<td>The number of the grid structure used</td>
</tr>
<tr>
<td>Grid x, grid y</td>
<td>The grid position assigned to this point</td>
<td></td>
</tr>
<tr>
<td>Assign</td>
<td>testable side</td>
<td>The side from where the point can be tested</td>
</tr>
<tr>
<td>side</td>
<td>side tested</td>
<td>The side from where the point should be tested</td>
</tr>
</tbody>
</table>

```
<etset_name>
```

```
<split_name>
```

```
<step_name>
```
on annular ring  Whether the test point is on the annular ring
net number  Corresponds to the number in the netlist

All the sides here refer to the board side (i.e. Top is the component side etc.)

**<split_name> / net_ext**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Line Record Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job Name&gt;/steps/&lt;step_name&gt;/et/&lt;etset_name&gt;/&lt;split_name&gt;/net_ext</td>
</tr>
</tbody>
</table>

This file gives general information regarding the test status of each net in this specific split.

**Example**

```
ET_NET {
    NETNUM=0
    TYPE=all
}

ET_NET {
    NETNUM=1
    TYPE=all
}

ET_NET {
    NETNUM=2
    TYPE=shorts
}
...```

Each array ET_NET has the following structure:

<table>
<thead>
<tr>
<th>&lt;NETNUM&gt;</th>
<th>Number of the net as in the netlist</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;TYPE&gt;</td>
<td>NO_TEST/SHORTS/CONNECT/ALL</td>
</tr>
</tbody>
</table>

**<split_name> / pin_rules**

<table>
<thead>
<tr>
<th>Type:</th>
<th>Structured Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression:</td>
<td>None</td>
</tr>
<tr>
<td>Sum file:</td>
<td>No</td>
</tr>
<tr>
<td>Path</td>
<td>&lt;job Name&gt;/steps/&lt;step_name&gt;/et/&lt;etset_name&gt;/&lt;split_name&gt;/pin_rules</td>
</tr>
</tbody>
</table>

---

**Note:**

- `<job_name>`
- `<step_name>`
- `<etset_name>`
- `<split_name>`
This file lists the rules to be used in assigning pins. The pins themselves are defined in the `<pin_name>` section.

**Example**

```plaintext
RULE {
  NAME=39003
  TYPE=def_smd
  SIDE=both
  PITCH_MIN=0
  PITCH_MAX=0
  SIZE_MIN=0
  SIZE_MAX=0
  DIST_X=0
  DIST_Y=0
  NUM_NEEDED=0
  EQUALS_TO=1
  CONTACT_MIN=0
  ALIGN_MIN=0
  ALIGN_MAX=0
}
```

This file is made up of repetitions of the `RULE` array;

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NAME</strong></td>
<td>Name used to refer to the pin</td>
</tr>
<tr>
<td><strong>TYPE</strong></td>
<td><code>def_smd</code>/  <code>def_pin</code>/ <code>def_over</code>/ <code>smd</code>/ <code>hole</code>/ <code>npth</code>/ <code>comp</code>/ <code>air</code>/ <code>tool</code>/ <code>fp_info</code>/ <code>alignment</code></td>
</tr>
<tr>
<td><strong>SIDE</strong></td>
<td>Side as determined by the placement in the adapter (both/top/bot)</td>
</tr>
<tr>
<td><strong>PITCH_MIN</strong></td>
<td>Minimum pitch required for this pin</td>
</tr>
<tr>
<td><strong>PITCH_MAX</strong></td>
<td>Maximum pitch required for this pin</td>
</tr>
<tr>
<td><strong>SIZE_MIN</strong></td>
<td>Minimum contact size for the pin head</td>
</tr>
<tr>
<td><strong>SIZE_MAX</strong></td>
<td>Maximum contact size for the pin head</td>
</tr>
<tr>
<td><strong>DIST_X</strong></td>
<td>Distance between air-holes</td>
</tr>
<tr>
<td><strong>DIST_Y</strong></td>
<td>Distance between air-holes</td>
</tr>
<tr>
<td><strong>NUM_NEEDED</strong></td>
<td>Minimum number required</td>
</tr>
<tr>
<td><strong>EQUALS_TO</strong></td>
<td>Number of pins equivalent to a compensation post</td>
</tr>
<tr>
<td><strong>CONTACT_MIN</strong></td>
<td>Contact size for flying probe</td>
</tr>
<tr>
<td><strong>ALIGN_MIN</strong></td>
<td>Minimum number of alignment points for flying probe output</td>
</tr>
<tr>
<td><strong>ALIGN_MAX</strong></td>
<td>Maximum number of alignment points for flying probe output</td>
</tr>
</tbody>
</table>

This table shows which field is relevant to each type:

<table>
<thead>
<tr>
<th>TYPE</th>
<th>NAME</th>
<th>SIDE</th>
<th>PITCH</th>
<th>SIZE</th>
<th>DIST</th>
<th>NUM_NEEDED</th>
<th>EQUALS_TO</th>
<th>CONTACT</th>
<th>ALIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>def_smd</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>def_pin</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>def_over</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>smd</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
This file provides general information describing the build-up of the adapter.

**Example**

```
X_MIN=2.605
Y_MIN=0.93375
X_MAX=18.295
Y_MAX=13.56625
```

```
GRID {
  STEP_X=0.1
  STEP_Y=0.1
  X_MIN=1.705
  Y_MIN=-0.03375
  X_MAX=17.395
  Y_MAX=12.66625
}
```

```
HEIGHT=3.75
```

```
PLATES {
  ELEVATION=0.1125
  THICKNESS=0.12
  COUNTER_SINK_TOP_H=0
  COUNTER_SINK_TOP_R=0
  COUNTER_SINK_BOT_H=0
  COUNTER_SINK_BOT_R=0
  PLATE_NAME=tus
  CONST_DRILL=tus.3
  SPEC_PROCESS=none
  MASK_SIZE=0
  GUIDING_MAX_PITCH=0
  GUIDING_DEFL_LIMITS=0
  GUIDING_SMALL_SIZE=0
  GUIDING_BIG_SIZE=0
```
GUIDING_MARGIN=0

TRANS_PLATE {
    XC=0
    YC=0
    XOFF=0
    YOFF=0
    ROTATE=0
    MIRROR=no
}
}

TOOLS {
    NAME=man_tool2
    X=16.9298279527559
    Y=13.91177598425197
}

Note  See “Units of Measurement” on page 19.

This file contains five global parameters and three arrays. The global parameters are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X_MIN, Y_MIN</td>
<td>Bottom left corner of the adapter</td>
</tr>
<tr>
<td>X_MAX, Y_MAX</td>
<td>Top right corner of the adapter</td>
</tr>
<tr>
<td>HEIGHT</td>
<td>Vertical distance from the grid to the board</td>
</tr>
</tbody>
</table>

Numerous grids can be defined. For example double density grids require two definitions of grids each with a step of 100 mil with a 50 mil step between them. The fields of the GRID array are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEP_X, STEP_Y</td>
<td>Grid step in inches</td>
</tr>
<tr>
<td>X_MIN, Y_MIN</td>
<td>Bottom left corner of the grid</td>
</tr>
<tr>
<td>X_MAX, Y_MAX</td>
<td>Top right corner of the grid</td>
</tr>
</tbody>
</table>

The PLATES array has a sub array, TRANS_PLATE. The fields of the PLATES array are:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEVATION</td>
<td>Distance from the board to the plate</td>
</tr>
<tr>
<td>THICKNESS</td>
<td>Thickness of the plate</td>
</tr>
<tr>
<td>COUNTER_SINK_TOP_H</td>
<td>Counter sink depth for the upper side</td>
</tr>
<tr>
<td>COUNTER_SINK_TOP_R</td>
<td>Counter sink drill holes on top layer with a radius less than this value</td>
</tr>
<tr>
<td>COUNTER_SINK_BOT_H</td>
<td>Counter sink depth for the lower side</td>
</tr>
<tr>
<td>COUNTER_SINK_BOT_R</td>
<td>Counter sink drill holes on bottom layer with a radius less than this value</td>
</tr>
<tr>
<td>PLATE_NAME</td>
<td>Name of the plate</td>
</tr>
<tr>
<td>CONST_DRILL</td>
<td>Name of the layer from which the constant drills are taken</td>
</tr>
</tbody>
</table>
The fields of the sub array `TRANS_PLATE` (the transformation parameters for each plate to be used in the output of the drill file) are:

<table>
<thead>
<tr>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPEC_PROCESS</td>
</tr>
<tr>
<td>MASK_SIZE</td>
</tr>
<tr>
<td>GUIDING_MAX_PITCH</td>
</tr>
<tr>
<td>GUIDING_DEFL_LIMITS</td>
</tr>
<tr>
<td>GUIDING_SMALL_SIZE</td>
</tr>
<tr>
<td>GUIDING_BIG_SIZE</td>
</tr>
<tr>
<td>GUIDING_LINE_SIZE</td>
</tr>
<tr>
<td>GUIDING_MARGIN</td>
</tr>
</tbody>
</table>

The fields of the `TOOLS` array are:

<table>
<thead>
<tr>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
</tr>
<tr>
<td>X,Y</td>
</tr>
</tbody>
</table>

**Example**

```
NAME=39003d
TYPE=probe
SYMBOL=oval24.0x24 .0
HEIGHT=3.75
DEFLECTION=0.3
MAN_DEFLECTION=0.3
BOARD_SNAP=pad
GRID_SNAP=grid
CRIMP=0
```
This file contains nine global parameters and one array. The global parameters are:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME</td>
<td>Name of the pin</td>
</tr>
<tr>
<td>TYPE</td>
<td>probe/tooling/align_pt</td>
</tr>
<tr>
<td>SYMBOL</td>
<td>Name of the symbol used to represent the pin in the display</td>
</tr>
<tr>
<td>HEIGHT</td>
<td>Total pin height</td>
</tr>
<tr>
<td>DEFLECTION</td>
<td>Normal maximum deflection allowed</td>
</tr>
<tr>
<td>MAN_DEFLECTION</td>
<td>Maximum deflection possible</td>
</tr>
<tr>
<td>BOARD_SNAP</td>
<td>pad/ npth/ empty/ none</td>
</tr>
<tr>
<td>GRID_SNAP</td>
<td>grid/ gnone</td>
</tr>
<tr>
<td>CRIMP</td>
<td>Not in use</td>
</tr>
</tbody>
</table>

The fields of the MEASURES array are:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFFSET</td>
<td>Distance from the pin head</td>
</tr>
<tr>
<td>DIAMETER</td>
<td>Cross-sectional diameter of the pin at this offset</td>
</tr>
<tr>
<td>SPACING</td>
<td>Required spacing for the pin at this offset</td>
</tr>
<tr>
<td>DRILL_SIZE</td>
<td>Recommended drill size (if zero then the drill size is calculated)</td>
</tr>
</tbody>
</table>
There is also another tree, which has some of the above files. Under `/genesis/sys/hooks/` there is the "et" directory. Here are stored a library of pins and adapters that are generally available.

| et (scripts specifically used in etm) |
| pins (parent pin library) |
| <pin_name> (explained above) |
| adapters |
| <adapter_name> |
| hdr (explained above) |
| pin_rules (explained above) |
| adapter_top |
| desc (explained above) |
| const_drill |
| <layer_name> (according to standard definitions) |
| adapter_bot |
| desc (explained above) |
| const_drill |
| <layer_name> (according to standard definitions) |
| pins (pins defined with rules for each adapter) |
| <pin_name> (explained above) |
Chapter 11  **Symbol Definitions**

**Standard Symbols**

The system supports the following standard (system) symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Round</strong></td>
<td>r&lt;d&gt;</td>
</tr>
<tr>
<td><img src="example.png" alt="Round symbol" /></td>
<td>d - circle diameter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Square</strong></td>
<td>s&lt;s&gt;</td>
</tr>
<tr>
<td><img src="example.png" alt="Square symbol" /></td>
<td>s - square side</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rectangle</strong></td>
<td>rect&lt;w&gt;x&lt;h&gt;</td>
</tr>
<tr>
<td><img src="example.png" alt="Rectangle symbol" /></td>
<td>w - rectangle width, h - rectangle height</td>
</tr>
</tbody>
</table>
Chapter 11  Symbol Definitions

Standard Symbols

Rounded Rectangle

rect\langle w\rangle \times \langle h\rangle \times r\langle rad\rangle \times \langle corners\rangle

- \textit{w} - rectangle width
- \textit{h} - rectangle height
- \textit{rad} - corner radius
- \textit{corners} - a combination of which corners are rounded.
- \textit{x\langle corners\rangle} is omitted if all corners are rounded.

Chamfered Rectangle

rect\langle w\rangle \times \langle h\rangle \times c\langle rad\rangle \times \langle corners\rangle

- \textit{w} - rectangle width
- \textit{h} - rectangle height
- \textit{rad} - corner radius
- \textit{corners} - a combination of which corners are rounded.
- \textit{x\langle corners\rangle} is omitted if all corners are rounded.

Oval

oval\langle w\rangle \times \langle h\rangle

- \textit{w} - oval width
- \textit{h} - oval height
### Diamond

**di\<w>\times\<h>**

- **w** - diamond width
- **h** - diamond height

### Octagon

**oct\<w>\times\<h>\times\<r>**

- **w** - octagon width
- **h** - octagon height
- **r** - corner size

### Round Donut

**donut\_r\<od>\times\<id>**

- **od** - outer diameter
- **id** - inner diameter
# Chapter 11  Symbol Definitions

## Standard Symbols

### Square Donut

**Symbol:** `donut_s<od>x<id>

- `od` - outer diameter
- `id` - inner diameter

### Square/Round Donut

**Symbol:** `donut_sr<od>x<id`

- `od` - outer diameter
- `id` - inner diameter

### Rounded Square Donut

**Symbol:** `donut_s<od>x<id>x<rad>x<corners>`

- `od` - outer diameter
- `id` - inner diameter
- `rad` - corner radius
- `corners` - a combination of which corners are rounded.
- `x<corners>` is omitted if all corners are rounded.

---

**In 7.0**

---

**In 7.0**
### Rectangle Donut

**Symbol:** `donut_rc<ow>x<oh>x<lw>`

- `ow` - outer width
- `oh` - outer height
- `lw` - line width

### RoundedRectangle Donut

**Symbol:** `donut_rc<ow>x<oh>x<lw>x<rad>x<corners>`

- `ow` - outer width
- `oh` - outer height
- `lw` - line width
- `rad` - corner radius
- `corners` - a combination of which corners are rounded.

Note: `x<corners>` is omitted if all corners are rounded.

### Oval Donut

**Symbol:** `donut_o<ow>x<oh>x<lw>`

- `ow` - outer width
- `oh` - outer height
- `lw` - line width
**Horizontal Hexagon**

`hex_l<w>x<h>x<r>`
- `w` - hexagon width
- `h` - hexagon height
- `r` - corner size

**Vertical Hexagon**

`hex_s<w>x<h>x<r>`
- `w` - hexagon width
- `h` - hexagon height
- `r` - corner size

**Butterfly**

`bfr<d>`
- `d` - diameter
Chapter 11  Symbol Definitions
Standard Symbols

**Square Butterfly**

Square Butterfly

Symbol: bfs60

- **bfs**<s>
  - s - size

**Triangle**

Triangle

Symbol: tri130x60

- **tri**<base>x<h>
  - base - triangle base
  - h - triangle height

**Half Oval**

Half Oval

Symbol: oval_h60x30

- **oval_h**<w>x<h>
  - w - width
  - h - height
Chapter 11  Symbol Definitions

Standard Symbols

**Round Thermal (Rounded)**

thr<od>x<id>x<angle>x<num_spokes>x<gap>

- **od** - outer diameter
- **id** - inner diameter
- **angle** - gap angle from 0°
- **num_spokes** - number of spokes
- **gap** - size of spoke gap

Specification of **od** and **id** determine the air gap (size of laminate separation)

**Round Thermal (Squared)**

ths<od>x<id>x<angle>x<num_spokes>x<gap>

- **od** - outer diameter
- **id** - inner diameter
- **angle** - gap angle from 0°
- **num_spokes** - number of spokes
- **gap** - size of spoke gap

Specification of **od** and **id** determine the air gap (size of laminate separation)

**Square Thermal**

s_ths<os>x<is>x<angle>x<num_spokes>x<gap>

- **os** - outer size
- **is** - inner size
- **angle** - gap angle from 0°
- **num_spokes** - number of spokes
- **gap** - size of spoke gap

Specification of **os** and **is** determine the air gap (size of laminate separation)
Chapter 11  Symbol Definitions
Standard Symbols

**Square Thermal (Open Corners)**

Square Thermal (Open Corners) symbol definition:

```
s_tho<od>x<id>x<angle>x<num_spokes>x<gap>
```

- `od` - outer diameter
- `id` - inner diameter
- `angle` - gap angle from 0°
- `num_spokes` - number of spokes
- `gap` - size of spoke gap

Specification of `od` and `id` determine the air gap (size of laminate separation).

**Square-Round Thermal**

Square-Round Thermal symbol definition:

```
sr_ths<os>x<id>x<angle>x<num_spokes>x<gap>
```

- `os` - outer size
- `id` - inner diameter
- `angle` - gap angle from 0°
- `num_spokes` - number of spokes
- `gap` - size of spoke gap

Specification of `os` and `id` determine the air gap (size of laminate separation).

**Rectangular Thermal**

Rectangular Thermal symbol definition:

```
rc_ths<w>x<h>x<angle>x<num_spokes>x<gap>x<air_gap>
```

- `w` - outer width
- `h` - outer height
- `angle` - gap angle from 0°
- `num_spokes` - number of spokes
- `gap` - size of spoke gap
- `air_gap` - size of laminate separation

*`angle` is limited to multiples of 45 degrees.*
**Rectangular Thermal (Open Corners)**

```
rc_tho<w>x<h>x<angle>x<num_spokes>x<gap>x<air_gap>
```

- **w**: outer width
- **h**: outer height
- **angle**: gap angle from 0°
- **num_spokes**: number of spokes
- **gap**: size of spoke gap
- **air_gap**: size of laminate separation

**Rounded Square Thermal**

```
s_ths<os>x<is>x<angle>x<num_spokes>x<gap>x<r<rad>x<corners>
```

- **os**: outer size
- **is**: inner size
- **angle**: gap angle from 0°
- **num_spokes**: number of spokes
- **gap**: size of spoke gap
- **rad**: corner radius
- **corners**: a combination of which corners are rounded. **x<corners>** is omitted if all corners are rounded.
**Rounded Square Thermal (Open Corners)**

**s_ths<os>x<is>x<angle>x<num_spokes>x<gap>x r<rad>x<corners>**

- **os** - outer size
- **is** - inner size
- **angle** - gap angle from 45°
- **num_spokes** - number of spokes
- **gap** - size of spoke gap
- **rad** - corner radius
- **corners** - a combination of which corners are rounded. **x<corners>** is omitted if all corners are rounded.

![Symbol: s_ths](image)

**num_spokes = 4**

**Rounded Rectangle Thermal**

**rc_ths<ow>x<oh>x<angle>x<num_spokes>x<gap>x <lw>xr<rad>x<corners>**

- **ow** - outer width
- **oh** - outer height
- **lw** - line width
- **angle** - gap angle from 0°
- **num_spokes** - number of spokes
- **gap** - size of spoke gap
- **rad** - corner radius
- **corners** - a combination of which corners are rounded. **x<corners>** is omitted if all corners are rounded.

![Symbol: rc_ths](image)

**num_spokes = 4**
**Rounded Rectangle (Open Corners)**

The symbol is defined as:

```
rc_ths<ow>x<oh>x<angle>x<num_spokes>x<gap>x
<lw>x<rad>x<corners>
```

- **ow** - outer width
- **oh** - outer height
- **lw** - line width
- **angle** - gap angle of 45°
- **num_spokes** - number of spokes
- **gap** - size of spoke gap
- **rad** - corner radius
- **corners** - a combination of which corners are rounded. `x<corners>` is omitted if all corners are rounded.

**Oval Thermal**

The symbol is defined as:

```
o_ths<ow>x<oh>x<angle>x<num_spokes>x<gap>x<lw>
```

- **ow** - outer width
- **oh** - outer height
- **angle** - gap angle from 0°
- **num_spokes** - number of spokes
- **gap** - size of spoke gap
- **lw** - line width

**Examples:**

- **ow** = 7.0
- **oh** = 7.0
- **gap** = 0.8
- **lw** = 0.5
- **num_spokes** = 4
**Chapter 11  Symbol Definitions**

**Standard Symbols**

**Oval Thermal (Open Corners)**

- **Symbol**: \[ o_{ths}\text{ow}\text{oh}\text{angle}\text{num_spokes}\text{gap}\text{lw} \]
- **ow**: outer width
- **oh**: outer height
- **angle**: gap angle from 0°
- **num_spokes**: number of spokes
- **gap**: size of spoke gap
- **lw**: line width

**Ellipse**

- **Symbol**: \[ el\text{w}\text{h} \]
- **w**: width
- **h**: height

**Moire**

- **Symbol**: \[ moire\text{rw}\text{rg}\text{nr}\text{lw}\text{ll}\text{la} \]
- **rw**: ring width
- **rg**: ring gap
- **nr**: number of rings
- **lw**: line width
- **ll**: line length
- **la**: line angle

**Number of Rings (nr) = 4**
Chapter 11  Symbol Definitions
Standard Symbols

Rotated Standard Symbols

Prior to V8.0, pads and text could only be rotated in increments of 90 degrees. Angles other than 0, 90, 180 or 270 were considered special symbols, which increase feature data stored in the job, and slow down the data loading process. As of V8.0, the rotation of pads and text at any angle is allowed.

However, for versions prior to V8.0, to create symbols that are rotated at angles that are not in the standard 90 degree increments, a symbol is required to be created for each angle. For example, rect25x50_315 is a standard rectangle rotated around its center to 315 degrees. These symbols are created automatically when specified by name when adding a pad, for example. They can also be resized as needed.

A corresponding feature file containing a single contour representing the symbol must be placed in:
<job_name>/symbols/<symbol_name>/features

Note  Rotation is clockwise.

**Hole**

hole<d>x<p>x<tp>x<tm>

d  - hole diameter
p  - plating status (p(lated), n(on-plated) or v(ia))
tp - + tolerance
tm - - tolerance
This symbol is specifically intended for wheels created by the Wheel Template Editor for drill files.

**Null**

null<ext>

ext  - extension number
This symbol is empty and used as a place holder for non-graphic features.
Appendix A  **System Attributes**

The following table is a combined list of the system attributes currently used by the Enterprise and Trilogy programs. As of V8.0, system attributes are not considered core entities. (See "Entity Definitions" on page 17.) Therefore, for Genesis products, see “System Attributes for Genesis” on page 261.

The columns are:

Attributes - the internal name of the attribute
Type - Float, Integer, Boolean, Text, Option
Entity - the ODB++ entity (such as Job, Step, Feature, Component, Symbol, Wheel, ...) to which the attribute can be assigned.

### Attribute List

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Entity</th>
<th>Description</th>
<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.all_eda_layers</td>
<td>Text</td>
<td>Step</td>
<td>(0 to 1000 characters) This attribute consists of a list of all the layers in the current EDA design (not ODB++). It used in the graphic synchronization with the EDA system.</td>
<td></td>
</tr>
<tr>
<td>.aoi_cpbm</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 255) Obsolete</td>
<td></td>
</tr>
<tr>
<td>.aoi_cpcu</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 255) Obsolete</td>
<td></td>
</tr>
<tr>
<td>.aoi_drbm</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 255) Obsolete</td>
<td></td>
</tr>
<tr>
<td>.aoi_drcu</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 255) Obsolete</td>
<td></td>
</tr>
<tr>
<td>.aoi_value</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 255) Obsolete</td>
<td></td>
</tr>
<tr>
<td>.ar_pad_drill_bottom_max</td>
<td>Float</td>
<td>Feature</td>
<td>(-10 to 1000) Assigned to a drill to define the maximum annular ring size in mils or microns between the drill and the copper of the bottom layer of the drill span.</td>
<td>Max Pad AR Drill Bottom</td>
</tr>
<tr>
<td>Attribute</td>
<td>Type</td>
<td>Entity</td>
<td>Description</td>
<td>Display Name</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------</td>
<td>---------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>.ar_pad_drill_bottom_min</td>
<td>Float</td>
<td>Feature</td>
<td>(-10 to 1000) Assigned to a drill to define the minimum annular ring size in mils or microns between the drill and the copper of the bottom layer of the drill span.</td>
<td>Min Pad AR Drill Bottom</td>
</tr>
<tr>
<td>.ar_pad_drill_inner_max</td>
<td>Float</td>
<td>Feature</td>
<td>(-10 to 1000) Assigned to a drill to define the maximum annular ring size in mils or microns between the drill and the copper of an inner layer in the drill span.</td>
<td>Max Pad AR Drill Inner</td>
</tr>
<tr>
<td>.ar_pad_drill_inner_min</td>
<td>Float</td>
<td>Feature</td>
<td>(-10 to 1000) Assigned to a drill to define the minimum annular ring size in mils or microns between the drill and the copper of an inner layer in the drill span.</td>
<td>Min Pad AR Drill Inner</td>
</tr>
<tr>
<td>.ar_pad_drill_top_max</td>
<td>Float</td>
<td>Feature</td>
<td>(-10 to 1000) Assigned to a drill to define the maximum annular ring size in mils or microns between the drill and the copper of the top layer of the drill span.</td>
<td>Max Pad AR Drill Top</td>
</tr>
<tr>
<td>.ar_pad_drill_top_min</td>
<td>Float</td>
<td>Feature</td>
<td>(-10 to 1000) Assigned to a drill to define the minimum annular ring size in mils or microns between the drill and the copper of the top layer of the drill span.</td>
<td>Min Pad AR Drill Top</td>
</tr>
<tr>
<td>.ar_sm_drill_bottom_max</td>
<td>Float</td>
<td>Feature</td>
<td>(-10 to 1000) Assigned to a drill piercing the bottom layer, to define the maximum annular ring size in mils or microns between the drill and the soldermask on the bottom layer.</td>
<td>Max SM AR Drill Bottom</td>
</tr>
<tr>
<td>.ar_sm_drill_bottom_min</td>
<td>Float</td>
<td>Feature</td>
<td>(-10 to 1000) Assigned to a drill piercing the bottom layer, to define the minimum annular ring size in mils or microns between the drill and the soldermask on the bottom layer.</td>
<td>Min SM AR Drill Bottom</td>
</tr>
</tbody>
</table>
.ar_sm_drill_top_max  Float  Feature (-10 to 1000) Assigned to a drill piercing the top layer, to define the maximum annular ring size in mils or microns between the drill and the soldermask on the top layer.

Max SM AR Drill Top

.ar_sm_drill_top_min  Float  Feature (-10 to 1000) Assigned to a drill piercing the top layer, to define the minimum annular ring size in mils or microns between the drill and the soldermask on the top layer.

Min SM AR Drill Top

.ar_sm_pad_bottom_max  Float  Feature (-10 to 1000) Assigned to a drill piercing the bottom layer, to define the maximum annular ring size in mils or microns between the drilled pad of the bottom layer and the soldermask above.

Max SM AR Bottom

.ar_sm_pad_bottom_min  Float  Feature (-10 to 1000) Assigned to a drill piercing the bottom layer, to define the minimum annular ring size in mils or microns between the drilled pad of the bottom layer and the soldermask above.

Min SM AR Bottom

.ar_sm_pad_top_max  Float  Feature (-10 to 1000) Assigned to a drill piercing the top layer, to define the maximum annular ring size in mils or microns between the drilled pad of the top layer and the soldermask above.

Max SM AR Top

.ar_sm_pad_top_min  Float  Feature (-10 to 1000) Assigned to a drill piercing the top layer, to define the minimum annular ring size in mils or microns between the drilled pad of the top layer and the soldermask above.

Min SM AR Top

.area_name  Text  Feature [0 to 64) Assigned to surface features which are drawn in a process map layer. A process map layer is used in assembly analysis for determining the process type used in the location a measurement is found.

DFx Area Name

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Entity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ar_sm_drill_top_max</td>
<td>Float</td>
<td>Feature (-10 to 1000)</td>
<td>Assigned to a drill piercing the top layer, to define the maximum annular ring size in mils or microns between the drill and the soldermask on the top layer.</td>
</tr>
<tr>
<td>ar_sm_drill_top_min</td>
<td>Float</td>
<td>Feature (-10 to 1000)</td>
<td>Assigned to a drill piercing the top layer, to define the minimum annular ring size in mils or microns between the drill and the soldermask on the top layer.</td>
</tr>
<tr>
<td>ar_sm_pad_bottom_max</td>
<td>Float</td>
<td>Feature (-10 to 1000)</td>
<td>Assigned to a drill piercing the bottom layer, to define the maximum annular ring size in mils or microns between the drilled pad of the bottom layer and the soldermask above.</td>
</tr>
<tr>
<td>ar_sm_pad_bottom_min</td>
<td>Float</td>
<td>Feature (-10 to 1000)</td>
<td>Assigned to a drill piercing the bottom layer, to define the minimum annular ring size in mils or microns between the drilled pad of the bottom layer and the soldermask above.</td>
</tr>
<tr>
<td>ar_sm_pad_top_max</td>
<td>Float</td>
<td>Feature (-10 to 1000)</td>
<td>Assigned to a drill piercing the top layer, to define the maximum annular ring size in mils or microns between the drilled pad of the top layer and the soldermask above.</td>
</tr>
<tr>
<td>ar_sm_pad_top_min</td>
<td>Float</td>
<td>Feature (-10 to 1000)</td>
<td>Assigned to a drill piercing the top layer, to define the minimum annular ring size in mils or microns between the drilled pad of the top layer and the soldermask above.</td>
</tr>
<tr>
<td>area_name</td>
<td>Text</td>
<td>Feature [0 to 64)</td>
<td>Assigned to surface features which are drawn in a process map layer. A process map layer is used in assembly analysis for determining the process type used in the location a measurement is found.</td>
</tr>
</tbody>
</table>
### .array_with_rotation

**Type:** Boolean  
**Entity:** Step  
**Description:** (Default=No)  
If Yes, this step is a multi-panel array, with the same panel possibly appearing in 180-degree rotation to itself.

### .artwork

**Type:** Text  
**Entity:** Feature  
**Description:** (0-1000)  
Indicating to which entity the feature belongs (component, package, net, board).

### .assembly_proc_bottom

**Type:** Text  
**Entity:** Step  
**Description:** (0 to 20)  
Default assembly process for the bottom side, to be used when there is no specific area defined in the process map layer (or no process map layer at all).

### .assembly_proc_top

**Type:** Text  
**Entity:** Step  
**Description:** (0 to 20)  
Default assembly process for the top side, to be used when there is no specific area defined in the process map layer (or no process map layer at all).

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Entity</th>
<th>Description</th>
<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.axi_direction</td>
<td>Option</td>
<td>Feature</td>
<td>Defines the angle at which a board is inserted into a 5DX machine. Values are translated as 0, 90, 180, 270 degrees.</td>
<td></td>
</tr>
<tr>
<td>.bit</td>
<td>Text</td>
<td>Feature</td>
<td>(0 - 64)</td>
<td></td>
</tr>
<tr>
<td>.board_mark</td>
<td>Option</td>
<td>Feature</td>
<td>(bbm, gpm)</td>
<td></td>
</tr>
</tbody>
</table>
|                            |         |         | In Vi-Technology output, this controls whether a step or a panel needs to be inspected:  
|                            |         |         | **bbm** - This feature is a bad board mark. Skip inspection of the step.  
|                            |         |         | **gpm** - This feature is a good panel mark. The panel can be accepted for printing without scanning its steps for bad board marks.  
|                            |         |         | **Note:** From V7.6 this replaces the obsolete attribute `.skip_indicator`. |              |
| .board_thickness           | Float   | Job     | (0.0 to 10.0; default = 0.0)  
|                            |         |         | Total thickness of the board expressed in inch or mm. |              |
## Appendix A  System Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Entity</th>
<th>Description</th>
<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.bond_name</td>
<td>Text</td>
<td>Feature</td>
<td>Name of the wire bond.</td>
<td>Name of wire bond</td>
</tr>
<tr>
<td>.bonding_profile</td>
<td>Text</td>
<td>Feature</td>
<td>Name of the bonding profile.</td>
<td>Bonding profile</td>
</tr>
<tr>
<td>.break-away</td>
<td>Boolean</td>
<td>Symbol</td>
<td>(Default = No) Assigned to a symbol representing a break-away to be inserted into any line or arc of the rout path. When adding a break-away symbol through dimensions, it automatically adjusts to the line or arc angle, breaks that feature (in the breaking points defined in that symbol with the .brk_pnt attribute), and adds all the necessary connections and dimensions.</td>
<td></td>
</tr>
<tr>
<td>.brk_point</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to a pad or a dpoint in a break-away symbol (that was given the attribute .break-away). When adding the line/arc is broken at the connection point with the dpoint that has the .brk_point attribute. In each break-away symbol there should be two points with this attribute.</td>
<td></td>
</tr>
<tr>
<td>.cad_local_footprint_change</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Indicates whether there has been a local change to a pad code in the local design.</td>
<td>CADStar Pad Change</td>
</tr>
<tr>
<td>.cad_package_name</td>
<td>Text</td>
<td>Comp.</td>
<td>(0-10000) Contains the full CAD package name of a Cadstar component. This name can be longer than the Valor package name which is limited to 64 characters.</td>
<td>CADStar Package Name</td>
</tr>
<tr>
<td>.cad_part_override</td>
<td>Text</td>
<td>Comp.</td>
<td>(0-64) Assigns component properties in accordance with data received from the ASSY_PN_OVERRIDE property.</td>
<td>CAD Part Varient Support</td>
</tr>
<tr>
<td>.center_fiducial</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Specifies component is expected to have a fiducial at its center.</td>
<td>Center Fiducial Required</td>
</tr>
</tbody>
</table>
### Appendix A  System Attributes

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
</table>
| **.color** | Text Feature; Comp. (0 to 1000 for each color) Can be attached to any feature or component to define the color to be used in plotting a layer in HPGL-1 or 2. The format is `rrggbb` (where `r`=red, `g`=green, `b`=blue). | White - `.color = "999999"`  
Black - `.color = "000000"`  
Red - `.color = "990000"`  
Green - `.color = "009900"`  
Yellow - `.color = "009999"`  
Blue - `.color = "000099"`  
Magenta - `.color = "990099"`  
Cyan - `.color = "999900"` |
| **.comment** | Text Job; Step; Layer; Wheel; Symbol; Stackup (0 to 500) Used for general textual comments. | |
| **.comp** | Option Feature (none; right; left) For a chained feature, this attribute sets the offset of the cutting tool from the rout path. Three options:  
- None - in center of the rout path  
- Left - to the left of the rout path in the direction of cutting  
- Right - to the right of the path | |
<p>| <strong>.comp_height</strong> | Float Comp. (0.0 to 10.0) Stores the height of the component above the board surface expressed in inch or mm. | |</p>
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.comp_height_area</td>
<td>Integer</td>
<td>(0.0 to 1000000.0; default=0) The Cadence Allegro interface uses this attribute to assign the same ID to a component under which there is an area with space for a shorter component, and to the feature that defines the area. This is to avoid reporting this component as violating the height restrictions of the area, and only report violations for other components that are to be placed in the area under this component.</td>
</tr>
<tr>
<td>.comp_htol_minus</td>
<td>Float</td>
<td>(0.0 - 10.0) Contains the minus tolerance for component height expressed in inch or mm, used for calculation of plug-in boards.</td>
</tr>
<tr>
<td>.comp_htol_plus</td>
<td>Float</td>
<td>(0.0 - 10.0) Contains the plus tolerance for component height expressed in inch or mm, used for calculation of plug-in boards.</td>
</tr>
<tr>
<td>.comp_ign_spacing</td>
<td>Boolean</td>
<td>(Default = No) This attribute, when set, disables spacing checks on a component during assembly analysis. It is used for printed components which have no actual body</td>
</tr>
<tr>
<td>.comp_ignore</td>
<td>Boolean</td>
<td>(Default=No) Determines whether the component is to be ignored when calculating statistics, or during certain operations, such as Analysis.</td>
</tr>
<tr>
<td>.comp_mount_type</td>
<td>Option</td>
<td>(Other; SMT; THMT; PressFit) Indicates whether the component is a surface mount, through-hole mount, press-fit or other. (SMT;THMT;PRESSFIT)</td>
</tr>
<tr>
<td>.comp_name</td>
<td>Text</td>
<td>Name of the die component on the HDI technology layer. Name of die component</td>
</tr>
</tbody>
</table>

Appendix A  System Attributes

ODB++ Specification 222
## .comp_polarity

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Entity</th>
<th>Description</th>
<th>Display Name</th>
</tr>
</thead>
</table>
| .comp_polarity | Option   | Comp.  | Assigned to components when packages are imported from the VPL (Valor Parts Library) with the value of:  
- POLARIZED, has a specific pin designated as pin #1.  
- NON_POLARIZED has no specific pin #1.  
A component without this attribute means that its package was not imported from the VPL. | Polarity     |

## .comp_type

<table>
<thead>
<tr>
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<th>Display Name</th>
</tr>
</thead>
</table>
| .comp_type  | Option   | Comp.  | This attribute is very important for determining dynamic categories during assembly analysis. It represents the type of the component.  
- axial  
- bga  
- cbga  
- cob  
- dip  
- discrete  
- discrete402  
- discrete603  
- label  
- pga  
- pihconn  
- pihmisc  
- plc  
- pqfp  
- printed  | Type I                                                                 |
### Appendix A  System Attributes

<table>
<thead>
<tr>
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<th>Description</th>
<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.comp_type2</td>
<td>Option</td>
<td>Comp.</td>
<td>Options&lt;br&gt;- axial&lt;br&gt;- axial-large&lt;br&gt;- bga&lt;br&gt;- cbga&lt;br&gt;- cob&lt;br&gt;- csp&lt;br&gt;- dip&lt;br&gt;- dip300&lt;br&gt;- dip600&lt;br&gt;- discrete&lt;br&gt;- discrete201&lt;br&gt;- discrete402&lt;br&gt;- discrete603&lt;br&gt;- electro-mech&lt;br&gt;- flipchip&lt;br&gt;- label&lt;br&gt;- lcc&lt;br&gt;- lqfp&lt;br&gt;- pconn&lt;br&gt;- pga&lt;br&gt;- pihconn-inline&lt;br&gt;- pihconn-rt-angle&lt;br&gt;- pihmisc&lt;br&gt;- pin-polar</td>
<td>Type II</td>
</tr>
</tbody>
</table>

This attribute represents the type of the component used in dynamic categories during assembly analysis when user attribute, `.comp_type`, is not defined and at least one component in the step has this attribute. (.comp_type, if also present, is ignored.) **Important**: Do not use the underscore `"_"` character in the Type values of this attribute.

| .comp_variant_list | Text      | Comp.  | (0 - 1000) Consists of a list of variants where a component is used.         | Variant List |

<p>| .comp_weight       | Float     | Comp.  | (0.0 - 1000.0) Stores the weight of the component (in ounces) for the purpose of the total weight calculation. | Weight       |</p>
<table>
<thead>
<tr>
<th>Attribute</th>
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<th>Description</th>
<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.copper_weight</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 1000.0; default = 1.0) The weight in ounces of one square foot of copper.</td>
<td></td>
</tr>
<tr>
<td>.critical_net</td>
<td>Boolean</td>
<td>Feature; Net</td>
<td>Specifies critical nets.</td>
<td>SQA Critical Net</td>
</tr>
<tr>
<td>.critical_tp</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to the mid-point of a netlist to force it to become a testpoint (it will not be removed by the Netlist Optimizer). If both .non_tp and .critical_tp are assigned to the same point, .critical_tp takes precedence and the mid point is tested. In case of a drilled feature the attribute must be added to the drill hole.</td>
<td>Netlist Critical Midpoint Output</td>
</tr>
<tr>
<td>.cu_base</td>
<td>Boolean</td>
<td>Layer</td>
<td>(Default = No) This attribute indicates to an analysis action (Signal Layer Checks or Power &amp; Ground Checks) that the specific via layer is built in such a way that it necessitates a copper pad on each layer of the stackup, since the vias are drilled and filled (rather than plated), and the pads are an essential element in ensuring connectivity.</td>
<td></td>
</tr>
<tr>
<td>.current_variant</td>
<td>Text</td>
<td>Step</td>
<td>(0 - 100) Consists of the name of the current variant for a step.</td>
<td></td>
</tr>
<tr>
<td>.customer</td>
<td>Text</td>
<td>Job</td>
<td>(0 - 100) This attribute is used for information purposes. It is used specifically in the input process when processing the lyr_rule file.</td>
<td></td>
</tr>
<tr>
<td>.cut_line</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 - 100000; default = 0) Assigned to lines added in the creation of film layers by the film optimization algorithm. The attribute is given to three kinds of lines: - frame of the film - cutting lines inside the film - frame of each layer inside the film.</td>
<td>Film Optimization Cut Line</td>
</tr>
<tr>
<td>.data_source</td>
<td>Text</td>
<td>Job; Step</td>
<td>(0 - 100) The source of the data. For example, Cadence, Mentor.</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix A System Attributes

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>.desc1....10</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 - 1000) The line mode command <code>comp_attr_from_desc_param</code> can be used to store the values in the ten BOM description fields into the corresponding one of these ten description attributes.</td>
<td>General Description 1....10</td>
</tr>
<tr>
<td>.design_center</td>
<td>Text</td>
<td>Step</td>
<td>(0 - 100) The design center from which the job originated.</td>
<td></td>
</tr>
<tr>
<td>.design_origin_x</td>
<td>Integer</td>
<td>Job</td>
<td>(-254000000 to 254000000) Defines the design origin X coordinate. Currently, it is automatically set in the CADIF input process.</td>
<td></td>
</tr>
<tr>
<td>.design_origin_y</td>
<td>Integer</td>
<td>Job</td>
<td>(-254000000 to 254000000) Defines the design origin Y coordinate. Currently, it is automatically set in the CADIF input process.</td>
<td></td>
</tr>
<tr>
<td>.diff_pair</td>
<td>Text</td>
<td>Net</td>
<td>(0 to 64) Differential pair name associating two nets that must be routed together.</td>
<td></td>
</tr>
<tr>
<td>.dpair_gap</td>
<td>Float</td>
<td>Net</td>
<td>(0.0 to 10.0) Spacing gap value expressed in inch or mm specifying the spacing between differential pair nets.</td>
<td></td>
</tr>
<tr>
<td>.drc_add_rad</td>
<td>Integer</td>
<td>Mania_AOI</td>
<td>(0 to 100; default = 2) For AOI - add lines with this radius when adding shapes.</td>
<td></td>
</tr>
<tr>
<td>.drc_assembly_lyrs</td>
<td>Option</td>
<td>Feature</td>
<td>(Top; Bottom; Both) In Component Analysis, specifies whether the keepout/keepin area applies to Top, Bottom, or Both component layers. In Testpoint Analysis, as above to outer layers.</td>
<td>Assigned Area to Component Side</td>
</tr>
<tr>
<td>.drc_bend_keepout</td>
<td>Boolean</td>
<td>Feature</td>
<td>NOT USED</td>
<td></td>
</tr>
<tr>
<td>.drc_board</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to a DRC area defined for the whole board.</td>
<td></td>
</tr>
<tr>
<td>.drc_comp_height</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigns component height restriction to a keepin/keepout area.</td>
<td>Component Height for Area</td>
</tr>
<tr>
<td>Attribute</td>
<td>Type</td>
<td>Entity</td>
<td>Description</td>
<td>Display Name</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------</td>
<td>------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>.drc_comp_height_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all component height restriction keepin/keepout areas are stored.</td>
<td></td>
</tr>
<tr>
<td>.drc_comp_keepin</td>
<td>Boolean</td>
<td>Feature</td>
<td>Defines an area as the board’s component placement keepin boundary.</td>
<td>Component Keep In</td>
</tr>
<tr>
<td>.drc_comp_keepin_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all component keepin areas are stored.</td>
<td></td>
</tr>
<tr>
<td>.drc_comp_keepout</td>
<td>Boolean</td>
<td>Feature</td>
<td>Defines an area as the board’s component placement keepout boundary.</td>
<td>Component Keep Out</td>
</tr>
<tr>
<td>.drc_comp_keepout_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all component keepout areas are stored.</td>
<td></td>
</tr>
<tr>
<td>.drc_etch_lyrs</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 1000) Value = layer names separated by semi-colons (;). User-defined attribute for user to specify name of layers in which to activate keepin/keepout areas. For example, when .drc_etch_lyrs = pg1;pg2, this enables you to select/highlight (on the relevant document layer) keepin/keepout areas that are active in layers pg1, pg2. The attributes: .drc_etch_lyrs_bit and .drc_etch_lyrs must both specify the same layers. If there is a discrepancy between the two, then .drc_etch_lyrs_bit is the determining attribute.</td>
<td>DFx Area Layers by Name</td>
</tr>
<tr>
<td>.drc_etch_lyrs_all</td>
<td>Boolean</td>
<td>Feature</td>
<td>Defines a keepin/keepout area as effective on all layers.</td>
<td>DFx Area All Layers</td>
</tr>
</tbody>
</table>
### Appendix A  System Attributes

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>.drc_etch_lyrs_bit</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 64) Values = string consisting of ‘0’ and ‘1’ characters. Allows the keepin/keepout area to apply only to specified board layers. The attribute’s length is equal to the number of board layers. 0 = ignore layer, 1 = activate areas in that layer</td>
<td>DFx Area Selected Layers</td>
</tr>
<tr>
<td>.drc_max_height</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 to 10.0) Stores the maximum height of components to be allowed in a height restriction area (area with .drc_comp_height attribute) expressed in inch or mm.</td>
<td>Maximum Height for Component</td>
</tr>
<tr>
<td>.drc_mech</td>
<td>Boolean</td>
<td>Feature</td>
<td>obsolete</td>
<td></td>
</tr>
<tr>
<td>.drc_min_height</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 to 10.0) Stores the minimum height of components to be allowed in a height restriction area (area with .drc_comp_height attribute) expressed in inch or mm.</td>
<td>Minimum Height for Component</td>
</tr>
<tr>
<td>.drc_min_space</td>
<td>Integer</td>
<td>AOI</td>
<td>(1 to 100; default = 5) Minimum spacing. (Obsolete)</td>
<td></td>
</tr>
<tr>
<td>.drc_min_width</td>
<td>Integer</td>
<td>AOI</td>
<td>(1 to 100; default = 7) Minimum track width. (Obsolete)</td>
<td></td>
</tr>
<tr>
<td>.drc_pad_keepout</td>
<td>Boolean</td>
<td>Feature</td>
<td>Specifies area to be used as pads keepout boundary.</td>
<td>Pad Keep Out</td>
</tr>
<tr>
<td>.drc_pad_keepout_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all pad keepout areas are stored. Default as defined in the drc_pad_keepout configuration parameter.</td>
<td></td>
</tr>
<tr>
<td>.drc_plane_keepout</td>
<td>Boolean</td>
<td>Feature</td>
<td>Specifies area to be used as planes keepout boundary</td>
<td>Plane Keep Out</td>
</tr>
<tr>
<td>.drc_plane_keepout_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all plane keepout areas are stored.</td>
<td></td>
</tr>
<tr>
<td>.drc_ref_des</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 100) Assigned to DRC areas defined for components.</td>
<td></td>
</tr>
<tr>
<td>Attribute</td>
<td>Type</td>
<td>Entity</td>
<td>Description</td>
<td>Display Name</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------</td>
<td>--------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>.drc_route_keepin</td>
<td>Boolean</td>
<td>Feature</td>
<td>Specifies areas to be used as the rout keepin boundary (rout=lines, arcs, vias, pads and surfaces on signal and/or power&amp;ground layers).</td>
<td>Route Keep In</td>
</tr>
<tr>
<td>.drc_route_keepin_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all rout keepin areas are stored.</td>
<td></td>
</tr>
<tr>
<td>.drc_route_keepout</td>
<td>Boolean</td>
<td>Feature</td>
<td>Specifies areas to be used as the rout keepout boundary (rout=lines, arcs, vias, pads and surfaces on signal and/or power&amp;ground layers).</td>
<td>Route Keep Out</td>
</tr>
<tr>
<td>.drc_route_keepout_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all rout keepout areas are stored.</td>
<td></td>
</tr>
<tr>
<td>.drc_tp_keepin</td>
<td>Boolean</td>
<td>Feature</td>
<td>Defines areas to be used as testpoint keepin area boundaries.</td>
<td>Testpoint Keep In</td>
</tr>
<tr>
<td>.drc_tp_keepin_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all testpoint keepin areas are stored.</td>
<td></td>
</tr>
<tr>
<td>.drc_tp_keepout</td>
<td>Boolean</td>
<td>Feature</td>
<td>Specifies areas to be used as the testpoint keepout boundary.</td>
<td>Testpoint Keep Out</td>
</tr>
<tr>
<td>.drc_tp_keepout_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all testpoint keepout areas are stored.</td>
<td></td>
</tr>
<tr>
<td>.drc_trace_keepout</td>
<td>Boolean</td>
<td>Feature</td>
<td>Defines areas to be used as trace keepout boundaries (traces=lines and arcs on signal and/or power&amp;ground layers).</td>
<td>Trace Keep Out</td>
</tr>
<tr>
<td>.drc_trace_keepout_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all traces keepout areas are stored.</td>
<td></td>
</tr>
<tr>
<td>.drc_via_keepout</td>
<td>Boolean</td>
<td>Feature</td>
<td>Defines areas to be used as vias keepout boundaries.</td>
<td>Via Keep Out</td>
</tr>
<tr>
<td>.drc_via_keepout_lyr</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 64) Stores name of document layer in which all vias keepout areas are stored.</td>
<td></td>
</tr>
</tbody>
</table>
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<table>
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<tr>
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</thead>
<tbody>
<tr>
<td><code>.drill</code></td>
<td>Option</td>
<td>Feature</td>
<td>(plated; non_plated; via) Assigned to hole features in drill layers. It defines the type of the drill and is used extensively during fabrication analysis.</td>
<td>Drill Type</td>
</tr>
<tr>
<td><code>.drill_flag</code></td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000; default = 0) Used by the Auto Drill Manager. It is an integer feature attribute that should be used on the drill layer. When the Auto Drill Manager package creates the NC Drills table it separates the different drills based on several values: size, drill type and also the value of this attribute. This is useful in cases where specific drills need to be treated in a specific way.</td>
<td></td>
</tr>
<tr>
<td><code>.drill_layer_direction</code></td>
<td>Option</td>
<td>Layer</td>
<td>(top2bottom, bottom2top) Whether a pad is reported as on the top or bottom of the drill layer is determined by this attribute. If set to bottom2top, pads on the bottom are reported at ‘top’.</td>
<td></td>
</tr>
<tr>
<td><code>.drill_noopt</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Used by the ‘Auto Drill Manager’. Feature attribute that is used on the drill layers. Setting a group of drills with this value will force the drill optimizer to keep the order within that group. This is important for preventing the drill path to pass through mechanical pins.</td>
<td></td>
</tr>
<tr>
<td><code>.drill_sr_zero</code></td>
<td>Option</td>
<td>Feature</td>
<td>(1; 2; 3) Used in the Auto Drill Manager to be assigned to a single drill feature in the PCB step. If a single feature in a step is assigned, it is used for setting the 'step &amp; repeat zero offset' of that step. That is, that feature will receive the coordinates - (0,0) in the step &amp; repeat block, and all other coordinates will be relative to it. In order for this attribute to be used, other configuration parameters of the package should be set.</td>
<td></td>
</tr>
</tbody>
</table>
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</tr>
</thead>
<tbody>
<tr>
<td><code>.drill_stage</code></td>
<td>Option</td>
<td>Feature</td>
<td>(1;2;3) Used in the Auto Drill Manager on the drill layer. This attribute</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>receives three values - '1', '2', and '3', specifying the drill stage of</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>that specific drill hole/slot.</td>
<td></td>
</tr>
<tr>
<td><code>.dxf_dimension</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned during DXF file input to mark its features as part of a DXF</td>
<td>DXF Dimension</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dimension entity.</td>
<td></td>
</tr>
<tr>
<td><code>.eclass_accumulative_parallel_dist_list</code></td>
<td>Text</td>
<td>Net</td>
<td>(0 - 255) List of electrical class rules (blank-separated) defining the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>maximum distance between the two traces of nets considered parallel in the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>accumulative categories of ‘Parallel Nets’.</td>
<td></td>
</tr>
<tr>
<td><code>.eclass_accumulative_parallel_max_length_list</code></td>
<td>Text</td>
<td>Net</td>
<td>(0 - 255) List of electrical class rules (blank-separated) defining the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>maximum distance between the two traces of nets considered parallel in the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>accumulative categories of ‘Parallel Nets’.</td>
<td></td>
</tr>
<tr>
<td><code>.eclass_impedance</code></td>
<td>Float</td>
<td>Net</td>
<td>(0.0 to 1000.0) Electrical class rule</td>
<td></td>
</tr>
<tr>
<td><code>.eclass_individual_parallel_dist_list</code></td>
<td>Text</td>
<td>Net</td>
<td>(0 - 255) List of blank-separated electrical class rules- defines the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>separation distance within which two traces are considered parallel. Each</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>parallel section in a net, if more than one, is checked separately against</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the value of this attribute.</td>
<td></td>
</tr>
<tr>
<td><code>.eclass_individual_parallel_max_length_list</code></td>
<td>Text</td>
<td>Net</td>
<td>(0 - 255) List of electrical class rules (blank-separated). - defines the</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>maximum length that two nets can run parallel to each other. Each parallel</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>section in a net, if more than one, is checked separately against the value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>of this attribute.</td>
<td></td>
</tr>
<tr>
<td>Attribute</td>
<td>Type</td>
<td>Entity</td>
<td>Description</td>
<td>Display Name</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------------</td>
<td>--------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>.eclass_individual_parallel_min_jog_list</td>
<td>Text</td>
<td>Net</td>
<td>(0 - 255) List of electrical class rules (blank-separated) - defines the distance parallel traces that deviate must maintain the deviation before it is considered a break in parallelism. Each parallel section in a net, if more than one, is checked separately against the value of this attribute.</td>
<td></td>
</tr>
<tr>
<td>.eclass_max_stub_length</td>
<td>Float</td>
<td>Net</td>
<td>(0.0 to 100.0) Electrical class rule - high limit of the stub length expressed in inch or mm.</td>
<td></td>
</tr>
<tr>
<td>.eclass_max_via_count</td>
<td>Integer</td>
<td>Net</td>
<td>(0 to 1000) Maximal number of vias on the nets.</td>
<td></td>
</tr>
<tr>
<td>.eclass_min_stub_length</td>
<td>Float</td>
<td>Net</td>
<td>(0.0 to 100.0) Electrical class rule - low limit of the stub length expressed in inch or mm.</td>
<td></td>
</tr>
<tr>
<td>.eclass_rise_time</td>
<td>Float</td>
<td>Net</td>
<td>(0.0 to 100.0) Electrical class rule specifying the interval of a rising signal transition (low to high)</td>
<td></td>
</tr>
<tr>
<td>.eclass_voltage_swing</td>
<td>Float</td>
<td>Net</td>
<td>(0.0 to 100.0) Electrical class rule</td>
<td></td>
</tr>
<tr>
<td>.ecmp_layer_tech</td>
<td>Option</td>
<td>Layer</td>
<td>(none, additive, subtractive) Assigns a technology type attribute to an embedded components layer used in the Embedded Passives check.</td>
<td></td>
</tr>
<tr>
<td>.ecmp_max_value</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 to 1000000.0) Maximum nominal value received at input (its value plus a tolerance).</td>
<td></td>
</tr>
<tr>
<td>.ecmp_min_value</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 to 1000000.0) Minimum value received at input (its value minus a tolerance).</td>
<td></td>
</tr>
<tr>
<td>.ecmp_name</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 64 characters) Name assigned to an embedded passive feature.</td>
<td></td>
</tr>
<tr>
<td>.ecmp_type</td>
<td>Option</td>
<td>Feature</td>
<td>(resistor; capacitor) Assigns a component type to an embedded component.</td>
<td></td>
</tr>
<tr>
<td>Attribute</td>
<td>Type</td>
<td>Entity</td>
<td>Description</td>
<td>Display Name</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>--------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>.ecmp_value</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 to 1000000.0) Embedded passive nominal value. For resistors it is the resistance in ohms.</td>
<td></td>
</tr>
<tr>
<td>.eda_dimension_id</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 - 100000; default = 0) Assigns system-generated ID to dimensions</td>
<td></td>
</tr>
<tr>
<td>.eda_layers</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 1000) Contains the EDA system layer names which compose a physical layer. It is loaded during the direct EDA translation and is used for graphic synchronization with the EDA system.</td>
<td></td>
</tr>
<tr>
<td>.electrical_class</td>
<td>Text</td>
<td>Net</td>
<td>(0 to 64) Electrical class name associating a net with a set of electrical call rules. Electrical class rules include physical and electrical limitations required to assure and analyze the signal integrity of a high speed net.</td>
<td></td>
</tr>
<tr>
<td>.et_adjacency</td>
<td>Float</td>
<td>Layer</td>
<td>(1.0 to 1000.0; default = 20.0) A distance value (per layer) to use in netlist adjacency calculation for moving probe testers (currently BSL and PROBOT).</td>
<td></td>
</tr>
<tr>
<td>.et_align</td>
<td>Boolean</td>
<td>Feature</td>
<td>Determines that a feature will be used as an alignment target for PROBOT output</td>
<td></td>
</tr>
<tr>
<td>.extended</td>
<td>Integer</td>
<td>Feature</td>
<td>(-1 to 100000; default = 0) Assigned to construction features (lines and pads) added to assist in the generation of a rout path. These features have zero width and are not output to the rout machine as regular features. They are used, for example, as source elements from which to create actual features by dimensions. If the attribute value is not zero then the feature is an extended feature and the decimal value is its serial value in the layer (to be referenced in dimension creation).</td>
<td></td>
</tr>
</tbody>
</table>
### System Attributes

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><code>.fab_drc</code></td>
<td>Text</td>
<td>Step</td>
<td>(0 to 20) Stores the default DRC area name. This name is applied when no specific area is defined in the DRC map layer, or no such map layer at all. If the value of this attribute is not defined, then the default DRC name is applied from the configuration variable <code>default_fab_drc</code>.</td>
<td></td>
</tr>
<tr>
<td><code>.feature_ignore</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Copper features with this attribute are ignored in analysis actions. (Currently implemented for rout tests only.)</td>
<td></td>
</tr>
<tr>
<td><code>.feed</code></td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000; default = 0) For a chained feature, this attribute sets the table feed rate when routing.</td>
<td></td>
</tr>
<tr>
<td><code>.fiducial_name</code></td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 64) This attribute is used for <code>etec</code> output format. A pad that was given a fiducial name is used for registration between layers.</td>
<td></td>
</tr>
<tr>
<td><code>.fiducial_rdlist</code></td>
<td>Text</td>
<td>Feature</td>
<td>(0 - 1000) This attribute is assigned local fiducial features. It can consist of a list of REFDES (separated by semicolons ';'); a list of the component/s using this local fiducial.</td>
<td></td>
</tr>
<tr>
<td><code>.fill_dx</code></td>
<td>Float</td>
<td>Symbol</td>
<td>(0.000001 to 50.0; default = 0.1) This attribute is used as the default horizontal distance between symbols when the symbol is used for pattern filling.</td>
<td></td>
</tr>
<tr>
<td><code>.fill_dy</code></td>
<td>Float</td>
<td>Symbol</td>
<td>(0.000001 to 50.0; default = 0.1) This attribute is used as the default vertical distance between symbols when the symbol is used for pattern filling.</td>
<td></td>
</tr>
<tr>
<td><code>.foot_down</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>(Default=No) Attached to feature it causes a <code>foot_down_cmd</code> to be generated by the Auto Rout Manager in the rout file just before the feature. Used only for Excellon files (ignored for other formats).</td>
<td></td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>.fs_direction_bottom</td>
<td>Option</td>
<td>Step</td>
<td>(Right2Left; Left2Right; Top2Bottom; Bottom2Top). This attribute is used for the thieving pad check in assembly analysis. It determines the flow direction for the bottom layer. Thieving pad check is required for some components during the flow solder process.</td>
<td></td>
</tr>
<tr>
<td>.fs_direction_top</td>
<td>Option</td>
<td>Step</td>
<td>(Left2Right; Right2Left; Top2Bottom; Bottom2Top) This attribute is used for the thieving pad check in assembly analysis. It determines the flow direction for the top layer. Thieving pad check is required for some components during the flow solder process.</td>
<td></td>
</tr>
<tr>
<td>.full_plane</td>
<td>Boolean</td>
<td>Feature</td>
<td>NOT USED</td>
<td></td>
</tr>
<tr>
<td>.gencad_device_ntol</td>
<td>Float</td>
<td>Comp.</td>
<td>0 - 1000000; default = 0.0) This is a real value expressing the percent of the value to use as a tolerance (negative tolerance). This is used for all devices: Range of characters: all floating point numbers.</td>
<td></td>
</tr>
<tr>
<td>.gencad_device_ptol</td>
<td>Float</td>
<td>Comp.</td>
<td>(0 - 1000000; default = 0.0) This is a real value expressing the percent of the value to use as a tolerance (positive tolerance). This is used for all devices:</td>
<td></td>
</tr>
<tr>
<td>.gencad_device_style</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 - 64) This attribute is an enhancement of .gencad_device_type and is used to store the style of the component as defined in GenCAD (such as, NPN, PNP, NFET, PFET, NJFET, PJFET, TTL, CMOS and ECL)</td>
<td></td>
</tr>
<tr>
<td>.gencad_device_type</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 - 64) Stores the type of the component as defined in GenCAD (such as, RES, VRES, DIODE, ZENER, LOGIC, SWITCH, CONN, etc.).</td>
<td></td>
</tr>
<tr>
<td>.gencad_device_value</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 - 64) Stores the electrical value of a component.</td>
<td></td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>.geometry</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 500) Contains the name of the padstack which created this feature. It is loaded during direct EDA translation. For layers which are created from component layers during the 'Draw to Layer' operation, the attribute will contain (for centroid pads) useful information on the component, package and part name.</td>
<td></td>
</tr>
<tr>
<td>.global_camtek_aoi</td>
<td>Text</td>
<td>Job</td>
<td>(0-80) Contains the name of the AOIset to be assigned to each layer upon layer selection in the CAMTEK AOI Interface. Once a name is defined, the AOIset field in the CAMTEK popup will be filled with this name and a new AOIset created in the layer (if already exists, the AOIset will become the current set). The value in this attribute overrides the value defined in the configuration parameter <code>camtek_def_aoi</code>, but if no value is specified in this attribute, the <code>camtek_def_aoi</code> value will apply.</td>
<td></td>
</tr>
<tr>
<td>.gold_plating</td>
<td>Boolean</td>
<td>Feature</td>
<td>This attribute should be attached (manually) to features which are a part of a gold plated connector. It is used during auto-panelization to orient the gold plated area toward the extreme side of the panel.</td>
<td></td>
</tr>
<tr>
<td>.guard_comp</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Assigned to a component that &quot;guards&quot; other components. If TRUE, this component is considered a &quot;guard component&quot; (that is, not likely to be knocked off the board accidentally. To be used in future actions.)</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix A  System Attributes

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</tr>
</thead>
<tbody>
<tr>
<td>.hatch</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to hatched planes [filled with lines (hatches) or cross lines (cross-hatch) instead of solid copper]. The lines which make up the border and fill the surface are hatches.</td>
<td></td>
</tr>
<tr>
<td>.hatch_border</td>
<td>Boolean</td>
<td>Feature</td>
<td>The lines making up the border of a surface.</td>
<td></td>
</tr>
<tr>
<td>.hatch_serrated_border</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to features that are added for partial hatch. The difference between regular hatch and partial hatch is that in partial hatch the cells along the border that intersect the border line are filled; the feature(s) that fill these cells are assigned this attribute.</td>
<td></td>
</tr>
<tr>
<td>.hdi_assembly_tech</td>
<td>Option</td>
<td>Layer</td>
<td>(None, WireBond, FlipChip, Hybrid) The attribute defines the type of HDI assembly technology identified in the job. If None, the special layer is not created.</td>
<td>HDI assembly technology</td>
</tr>
<tr>
<td>.hdi_drc</td>
<td>Text</td>
<td>Step</td>
<td>(0 to 20) Default area name applied to all HDI measurements.</td>
<td></td>
</tr>
<tr>
<td>.hp3070_comment</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 - 64) Allows the contents of the attribute field to be appended to a component record (preceded by a &quot;!&quot;). For example: C1 PN&quot;11_215705&quot; &quot;11_215705 POLCAP_10UF,20%,10V TOP&quot;; 1 comment</td>
<td></td>
</tr>
<tr>
<td>.hp3070_common_pin</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 to 16). For the device SWITCH this is used to designate the COMMON pin.</td>
<td></td>
</tr>
<tr>
<td>.hp3070_contact_pin</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 to 16). For the device SWITCH this is used to designate the CONTACT pin.</td>
<td></td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td><code>.hp3070_device</code></td>
<td>Text</td>
<td>Comp.</td>
<td>The device of the component, one of the following:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- CAPACITOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- CONNECTOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- DIODE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- FET</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>- FUSE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- INDUCTOR</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- JUMPER PIN</td>
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<td></td>
<td></td>
<td></td>
<td>- LIBRARY</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- POTENTIOMETER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- RESISTOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- SWITCH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- TRANSISTOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- ZENER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All other components will be categorized as Undefined.</td>
</tr>
<tr>
<td><code>.hp3070_fail_msg</code></td>
<td>Text</td>
<td>Comp.</td>
<td>(0-64)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the failure message associated with the component.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>This applies to all device types. In output of HP3070 formats, the text</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>field (within quotes) consisting of the Part number and this error</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>message will be truncated to 40 characters.</td>
</tr>
<tr>
<td><code>.hp3070_hi_value</code></td>
<td>Float</td>
<td>Comp.</td>
<td>(0-100000.0; default = 0.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the upper test limit of the device. Its specific meaning is</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dependent on the device type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- For DIODE: Upper test limit, in volts for the diode's forward bias</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>voltage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- For FET: The high resistance limit in ohms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- For TRANSISTOR: The high limit for the transistor beta.</td>
</tr>
<tr>
<td><code>.hp3070_lo_value</code></td>
<td>Float</td>
<td>Comp.</td>
<td>(0-100000.0; default = 0.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the lower test limit of the device. Its specific meaning is</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>dependent on the device type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- For DIODE: Lower test limit, in volts, for the diode's forward bias</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>voltage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- For FET: The low resistance limit in ohms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- For TRANSISTOR: The low limit for the transistor beta.</td>
</tr>
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<tbody>
<tr>
<td>.hp3070_probe_access</td>
<td>Text</td>
<td>Feature; Comp.</td>
<td>(0-64) Specifies the probe access for the component and toeprint. This value will be applied to ALL the pins of the component. Known values are: PREFERRED, NO_PROBE, TOP, TOP NO_ACCESS, BOTH MANDATORY, and MANDATORY NO_MANUAL though other values are possible. If toeprints are assigned this attribute, their settings override the component setting.</td>
<td></td>
</tr>
<tr>
<td>.hp3070_seriesr</td>
<td>Float</td>
<td>Comp.</td>
<td>(0-100000.0; default = 0.0) For INDUCTOR devices this is used to specify the series resistance (in Ohms).</td>
<td></td>
</tr>
<tr>
<td>.hp3070_test</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default=No) Determines that a component be tested. This attribute applies to all device types. Devices of type CONNECTOR must be NT (Not Tested).</td>
<td></td>
</tr>
<tr>
<td>.hp3070_tol_neg</td>
<td>Float</td>
<td>Comp.</td>
<td>(0-100; default = 0.0) This is a real value expressing the percent of the value to use as a tolerance (negative tolerance). This is used for devices: - CAPACITOR - RESISTOR - INDUCTOR - ZENER - POTENTIOMETER</td>
<td></td>
</tr>
<tr>
<td>.hp3070_tol_pos</td>
<td>Float</td>
<td>Comp.</td>
<td>(0-100; default = 0.0) This is a real value expressing the percent of the value to use as a tolerance (positive tolerance). This is used for the devices: - CAPACITOR - RESISTOR - INDUCTOR - ZENER - POTENTIOMETER</td>
<td></td>
</tr>
<tr>
<td>Attribute</td>
<td>Type</td>
<td>Entity</td>
<td>Description</td>
<td>Display Name</td>
</tr>
<tr>
<td>------------------</td>
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<td>-----------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>.hp3070_type</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 - 8) The type of device:. For CAPACITOR: - F = Capacitor Value is Fixed. - V = Capacitor Value is Variable. For FET: - N = N-Channel Field Effect Transistor - P = P-Channel Field Effect Transistor For INDUCTOR: - F = Inductor value is Fixed - V = Inductor value is Variable For JUMPER: - O or OPEN = Jumper is Open - C or CLOSED = Jumper is Closed For RESISTOR: - F = Resistor value is Fixed - V = Resistor value is Variable For TRANSISTOR: - N = Transistor is an NPN - P = Transistor is a PNP Range of characters: 0-8</td>
<td></td>
</tr>
<tr>
<td>.hp3070_value</td>
<td>Text</td>
<td>Comp.</td>
<td>(0-16) The value of the component. The meaning varies depending on the component device. For CAPACITOR it is used for capacitance (in Farads). For INDUCTOR it is the inductance (in Henries). For PIN LIBRARY it is used for the PN (Part Name). For the devices POTENTIOMETER and RESISTOR, it is used for the device’s resistance. For the ZENER device it specifies the breakdown voltage (in Volts).</td>
<td></td>
</tr>
<tr>
<td>.ignore_net</td>
<td>Boolean</td>
<td>Net</td>
<td>When this attribute is assigned to a net, it is ignored during Testpoint Allocation Analysis. No potential testpoints are assigned, they are not reported in the ‘Nets without Potential TPs’ category, the Testpoints Allocation Report, or in “Total Number of Nets.”</td>
<td></td>
</tr>
</tbody>
</table>
## System Attributes

<table>
<thead>
<tr>
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<th>Type</th>
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<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.image_dx</td>
<td>Float</td>
<td>Symbol</td>
<td>(-1.0 to 50.0; default = -1.0) These values are set when inputting Image files into the system. They contain the datum point of an Image special symbol entity used to set the datum when performing output back into Image format. These values should not be changed by the user as this can cause data corruption.</td>
<td></td>
</tr>
<tr>
<td>.image_dy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.imp_line</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to lines which are impedance-controlled. When set, it prevents the lines from being rerouted or thinned during signal layer optimization.</td>
<td></td>
</tr>
<tr>
<td>.ind_orient_req</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Indicates that the component requires silkscreen orientation indication. (To be used in future actions.)</td>
<td></td>
</tr>
<tr>
<td>.inp_file</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 500) Contains the name of the file (Gerber, Drill) from which the data was input into the layer.</td>
<td></td>
</tr>
<tr>
<td>.is_burried</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Assigned to buried components specifically input from CADIF files in order to mark them as buried. This attribute, although specifically designed for CADIF files, can be used in any other function or script. Note that the attribute name is misspelled, but that is its name.</td>
<td></td>
</tr>
<tr>
<td>.is_capped</td>
<td>Boolean</td>
<td>Feature</td>
<td>Used on via pads on top &amp; bottom signal layers to indicate that the via is capped on this side.</td>
<td></td>
</tr>
<tr>
<td>.is_shadowed</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Components with this attribute are considered for the Shadowing categories, as the shadowed component.</td>
<td></td>
</tr>
<tr>
<td>.is_wirebonded</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Defines a component to be wirebonded. Currently, it is set in the CADIF input process.</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix A  System Attributes

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<tbody>
<tr>
<td><code>.label_clearance</code></td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Assigned to components which are not allowed to be too close to a glued label (e.g. fine pitch SOIC components). During the component analysis, these components are checked vs. the label components.</td>
</tr>
<tr>
<td><code>.layer_dielectric</code></td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 0.5 inch; default = 0.0001) Specifies the dielectric thickness below a layer expressed in inch or mm.</td>
</tr>
<tr>
<td><code>.layer_hdi_type</code></td>
<td>Option</td>
<td>Layer</td>
<td>(Buildup; Core) Distinguishes buildup layers from core layers in HDI jobs. Some HDI categories are relevant to buildup or core layers but not to both. Therefore, it is important to set this value appropriately.</td>
</tr>
<tr>
<td><code>.layer_class</code></td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 1000) Used to differentiate between layers. It enables you to set different ERF ranges for inner layers than for outer layers.</td>
</tr>
<tr>
<td><code>.local_fiducial_dist</code></td>
<td>Float</td>
<td>Comp.</td>
<td>(0.0 to 100.0) Defines the allowed distance of fiducials from the outline of the components which require local fiducials (See <code>.num_local_fiducial</code>). If set to 0, the fiducials must be included INSIDE the outline. Distance expressed in inch or mm.</td>
</tr>
<tr>
<td><code>.lpol_done</code></td>
<td>Boolean</td>
<td>Layer</td>
<td>(Default = No) Indicates to the output that polarity sort according to a format has already been done during film optimization.</td>
</tr>
<tr>
<td><code>.lpol_surf</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>(Default = No) Indicates surface modified by layer polarity reduction algorithm.</td>
</tr>
<tr>
<td><code>.machine_pkg</code></td>
<td>Text</td>
<td>Comp.</td>
<td>(0 - 100) Assigned to a component to indicate the name of a corresponding package in the assembly machine libraries.</td>
</tr>
</tbody>
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### Appendix A  System Attributes

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<tbody>
<tr>
<td>.mechanical</td>
<td>Boolean</td>
<td>Comp</td>
<td>Components with this attribute are placed in the <strong>MECHANICAL</strong> section of the GenCAD output file when the GenCAD output parameter <strong>Mechanical Components</strong> is set to Attribute.</td>
<td></td>
</tr>
<tr>
<td>.merge_processes</td>
<td>Text</td>
<td>Step</td>
<td>(0 - 64) A list of the last three merge actions in the order in which they were run. The list is updated each time a merge (BOM, Library, Board) is run. It is for informational purposes and does not have to be changed by the user.</td>
<td></td>
</tr>
<tr>
<td>.min_line_width</td>
<td>Float</td>
<td>Net.</td>
<td>(0.0 - 100.0) Assigned to nets that should have a minimum trace width, i.e. each line of the net should have a width of at least this value expressed in inch or mm. If such nets have a split (the net traces split and then meet again) the sum of the split traces should be at least this value.</td>
<td></td>
</tr>
<tr>
<td>.mount_hole</td>
<td>Boolean</td>
<td>Feature</td>
<td>Used on drill features to indicate that they are mounting holes.</td>
<td></td>
</tr>
<tr>
<td>.mount_stage</td>
<td>Integer</td>
<td>Comp.</td>
<td>(0 - 255; default = 0) User-defined integer used to assign machine number in the assembly line where component is to be placed.</td>
<td></td>
</tr>
<tr>
<td>.n_electric</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to a feature, defines it as non-electric (it is not considered for the current netlist for the step).</td>
<td></td>
</tr>
<tr>
<td>.needs_guarding</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Yes - this component needs to be protected by guard components (see .guard_comp) else it is likely to be knocked off the board accidentally.</td>
<td></td>
</tr>
<tr>
<td>.net_length_max</td>
<td>Float</td>
<td>Net.</td>
<td>(0.0 to 100.0) High limit of net length expressed in inch or mm.</td>
<td></td>
</tr>
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<tr>
<td>.net_length_min</td>
<td>Float</td>
<td>Net</td>
<td>(0.0 to 100.0) Low limit of net length expressed in inch or mm.</td>
<td></td>
</tr>
<tr>
<td>.net_name</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 64) Set by the netlist layer. Contains the net name.</td>
<td></td>
</tr>
<tr>
<td>.net_physical_type</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 64) Physical type of constraint area used for search in table that contains physical parameters of nets.</td>
<td></td>
</tr>
<tr>
<td>.net_point</td>
<td>Boolean</td>
<td>Feature</td>
<td>When assigned to a pad in an inner layer, defines the pad as an internal test point.</td>
<td></td>
</tr>
<tr>
<td>.net_spacing_type</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 64) SQA area name of an SQA area map.</td>
<td></td>
</tr>
<tr>
<td>.net_type</td>
<td>Text</td>
<td>Net</td>
<td>(0 to 64) A name for the type of net. The .net_type attribute can reference the set of routing rules for a net.</td>
<td></td>
</tr>
<tr>
<td>.neutralization_angle</td>
<td>Float</td>
<td>Comp.</td>
<td>(0.0-360.0) An attribute attached to each Rotation Neutralization processed component stating the angle of rotation counter-clockwise from Valor standard orientation.</td>
<td></td>
</tr>
<tr>
<td>.neutralization_info</td>
<td>Text</td>
<td>Step</td>
<td>(0 - 200) Attached to the step where Rotation Neutralization has been performed. This attribute contains the information &lt;CPL</td>
<td>CAD&gt;;&lt;DataCenter&gt;;Site. Site is read from configuration parameter organization of the computer where Rotation Neutralization was performed.</td>
</tr>
<tr>
<td>.neutralization_reviewed</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Attached to each component in a package reviewed in Rotation Neutralization, i.e. a package not accepted automatically as being Known or Safe or by clicking Accept Category.</td>
<td></td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>.neutralization_ss_layers</td>
<td>Text</td>
<td>Step</td>
<td>(0 to 200) Attached to the step where <strong>Rotation Neutralization</strong> has been performed. This attribute designates which layers are to be considered the silkscreen layers.</td>
<td></td>
</tr>
<tr>
<td>.no_copper_shape_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) This attribute indicates that the component should not have copper pads or surfaces underneath it. See also .no_trace_under.</td>
<td></td>
</tr>
<tr>
<td>.no_fiducial_check</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Components with this attribute are not checked for the “Component Covers Fiducial” category, or for any of the categories under the Coverage test.</td>
<td></td>
</tr>
<tr>
<td>.no_hole_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) If Yes, no drill holes are allowed under this component.</td>
<td></td>
</tr>
<tr>
<td>.no_pop</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) A RefDes with the attribute .no_pop (non populated) declares a component as being not populated for the current version of the BOM. When attributed as .no_pop (Yes), even though the component is defined in the CAD data it will not be placed during the assembly process.</td>
<td></td>
</tr>
<tr>
<td>.no_protrude_board</td>
<td>Boolean</td>
<td>Comp</td>
<td>Indicates that component pin length (as defined by attribute .pin_length) should be less than the board thickness so that the pins do not protrude from the other side of the board.</td>
<td></td>
</tr>
<tr>
<td>.no_text_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Assigned to a component, does not allow silk screen text to be placed under the component outline. Printed components (e.g. edge connectors) may not have this attribute.</td>
<td></td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>.no_tp_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Assigned to a component, does not allow testpoints to be placed under the component outline. Printed components (e.g. edge connectors) may not have this attribute.</td>
<td></td>
</tr>
<tr>
<td>.no_trace_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Yes - traces are NOT allowed under the component except for those that touch the component's toeprint pads and exit the component on that toeprint's side.</td>
<td></td>
</tr>
<tr>
<td>.no_uncap_via_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Yes - uncapped vias are NOT allowed under this component.</td>
<td></td>
</tr>
<tr>
<td>.nomenclature</td>
<td>Boolean</td>
<td>Feature</td>
<td>Defines a feature as a nomenclature (legend) feature. This attribute affects the fabrication analysis by directing spacing checks between such features into a new category (Text to text).</td>
<td></td>
</tr>
<tr>
<td>.non_tp</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to a feature causes it NOT to be considered as a net testpoint. It is used for connectivity calculation but is not used as a test point (bare board testing).</td>
<td></td>
</tr>
<tr>
<td>.num_local_fiducials</td>
<td>Integer</td>
<td>Comp.</td>
<td>(0 to 20; default = 0) Defines how many local fiducials are expected to be inside or near a component. This is checked during Fiducial Analysis.</td>
<td></td>
</tr>
<tr>
<td>.orbotech_plot_stamp</td>
<td>Boolean</td>
<td>Feature</td>
<td>NOT USED</td>
<td></td>
</tr>
<tr>
<td>.orig_surf</td>
<td>Integer</td>
<td>Feature</td>
<td>(0-2147483647; default = 0) Identifies original surface which will be rebuilt.</td>
<td></td>
</tr>
<tr>
<td>.otherside_keepout</td>
<td>Option</td>
<td>Comp.</td>
<td>(full_area; pins_only; pads only) Defines for components whether the other side of the board may also contain components in the same area.</td>
<td></td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td><code>.out_angle</code></td>
<td>Option</td>
<td>Layer</td>
<td>Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the 'step' to be translated.</td>
<td></td>
</tr>
<tr>
<td><code>.out_break</code></td>
<td>Boolean</td>
<td>Feature; Symbol</td>
<td>(Default = No) Feature and symbol attribute. When assigned to a specific feature using a special symbol, the feature will be broken into its primitives in the output translation stage, regardless of the settings of other output parameters. If the attribute is set for a special symbol (entity attribute) then all features that use these symbols will always be broken into primitive features in the output translation stage, regardless of the settings of any other output parameters.</td>
<td></td>
</tr>
<tr>
<td><code>.out_comp</code></td>
<td>Float</td>
<td>Layer</td>
<td>(-100.0 to 100.0; default = 0.0) Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the 'step' to be translated.</td>
<td></td>
</tr>
<tr>
<td><code>.out_drill_full</code></td>
<td>Boolean</td>
<td>Step</td>
<td>(Default = No) The STEP entity attribute used by the Auto Drill Manager. This attribute can be used for drilling coupon STEP's that need to be fully drilled before continuing to the next step &amp; repeat entity.</td>
<td></td>
</tr>
<tr>
<td><code>.out_drill_optional</code></td>
<td>Boolean</td>
<td>Feature; Step</td>
<td>(Default = No) Used by the 'Auto Drill Manager'. Both a STEP entity and feature attribute. If the drill feature is set with this attribute it will have the '/' command prefix in the final output file, indicating that the drill is optional. If a step entity attribute is set, then all the commands that are part of that step will have the '/' command prefixed. Thus, the whole step is optional.</td>
<td></td>
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<tbody>
<tr>
<td><code>.out_drill_order</code></td>
<td>Integer</td>
<td>Step</td>
<td>(-10000 to 10000; default = 0) The STEP entity attribute used by the Auto Drill Manager. The attribute controls the order in which the steps will be drilled. Thus, who is first, second,...etc. The attribute has the following valid values: 0 - no special order for that step 1 - first 2 - second 3 - and above - order from the beginning -1 - last -2 - one before last -3 - and on (drill order from the end)</td>
<td></td>
</tr>
<tr>
<td><code>.out_flag</code></td>
<td>Integer</td>
<td>Feature</td>
<td>(-1 to 1000000; default = -1) Used for Excellon translation.</td>
<td></td>
</tr>
<tr>
<td><code>.out_mirror</code></td>
<td>Boolean</td>
<td>Layer</td>
<td>(Default = No) Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the 'step' to be translated.</td>
<td></td>
</tr>
<tr>
<td><code>.out_name</code></td>
<td>Text</td>
<td>Step</td>
<td>(0 to 64) Entity attribute that is used by the Image output translator. If this attribute is not an empty string it will serve as the entity name on the Image system. If it is an empty string the original system entity name will be used. This attribute is important in ases where the Genesis name does not form a legal Image name. If this attribute is not set, the Genesis output translator decides about the new name with its own internal algorithm.</td>
<td></td>
</tr>
<tr>
<td><code>.out_orig</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Sets an origin point for the layer data that is transmitted to the NC routing machine.</td>
<td></td>
</tr>
<tr>
<td><code>.out_polarity</code></td>
<td>Option</td>
<td>Layer</td>
<td>(Positive; Negative) Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the step to be translated.</td>
<td></td>
</tr>
<tr>
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</tr>
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<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>.out_rout_optional</td>
<td>Boolean</td>
<td>Feature; Step</td>
<td>(Default = No) Used by the Auto Drill Manager. Both a STEP entity and feature attribute. If drill feature is set with this attribute it will have the '/' command in front of it in the final output file. This means that the drill is optional. If a step entity attribute is set then all the commands that are part of that step will have the '/' command at the beginning. Thus, the whole step is optional.</td>
<td></td>
</tr>
<tr>
<td>.out_rout_order</td>
<td>Integer</td>
<td>Step</td>
<td>(-10000 to 10000; default = 0) STEP entity attribute used by the Auto Drill Manager. The attribute controls the order in which the steps will be drilled. Thus, who is first, second, etc. The attribute has the following valid values: 0 — no special order for that step 1 — first 2 — second 3 and above — order from the beginning -1 — last -3 and on — drill order from the end</td>
<td></td>
</tr>
<tr>
<td>.out_scale</td>
<td>Boolean</td>
<td>Feature; Symbol</td>
<td>(Default = No) Feature and symbol attribute. In the output translation package there is a special parameter that controls the way features will be scaled. In two of the options the user can specify whether certain features can be scaled or not. This is important in cases where special registration targets would not be scaled together with all the other features. This special output option applies only to features that have this attribute set. In case of a special symbol, the customer can set the attribute, and by this control the scaling of all features that use this symbol.</td>
<td></td>
</tr>
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<td>-----------------------------------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><code>.out_x_scale</code></td>
<td>Float</td>
<td>Layer</td>
<td>(0.000001 to 5.0; default = 1.0) Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the step to be translated.</td>
<td></td>
</tr>
<tr>
<td><code>.out_y_scale</code></td>
<td>Float</td>
<td>Layer</td>
<td>(0.000001 to 5.0; default = 1.0) Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the step to be translated.</td>
<td></td>
</tr>
<tr>
<td><code>.output_dcode</code></td>
<td>Integer</td>
<td>Feature</td>
<td>(0-1000000) Assigned to features to provide action codes for an assembly machine, such as the GSI Lumenics laser cutter.</td>
<td></td>
</tr>
<tr>
<td><code>.package_version</code></td>
<td>Text</td>
<td>Comp.</td>
<td>(0 to 50) Used for Zuken Board Designer translation.</td>
<td></td>
</tr>
<tr>
<td><code>.pad_usage</code></td>
<td>Option</td>
<td>Feature</td>
<td>(toeprint; via; g_fiducial; l_fiducial; tooling_hole) This attribute defines the specific usage of a pad. It is loaded during the direct EDA translation and by the attribute derivation script.</td>
<td></td>
</tr>
<tr>
<td><code>.part_desc1...10</code></td>
<td>Text</td>
<td>Comp.</td>
<td>(0 to 1000) The line mode command <code>comp_attr_from_desc_param</code> can be used to store the values in the ten BOM description fields into the corresponding one of these ten part description attributes.</td>
<td></td>
</tr>
<tr>
<td><code>.patch</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to patches added by the pinhole elimination DFM action.</td>
<td>Copper Patch</td>
</tr>
<tr>
<td><code>.pattern_fill</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to features which are added during a pattern fill operation, either manually or through the Copper Balance DFM action.</td>
<td>Film Optimization Cut Line</td>
</tr>
<tr>
<td><code>.pf_optimized</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>(Yes, No) This attribute is attached to a modified padstack on the pad in the matching drill layer when padstack optimization is implemented.</td>
<td></td>
</tr>
</tbody>
</table>
### System Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Entity</th>
<th>Description</th>
<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.physical_type</td>
<td>Text</td>
<td>Net</td>
<td>(0 to 64) Physical type of net.</td>
<td></td>
</tr>
<tr>
<td>.pilot_hole</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000; default = 0) Attribute assigned to pads that are pilot holes in a chain (holes that are drilled in each tool down in the chain rout path before routing the chain). Pilot holes are set from the chaining popup. The value of the attribute is the serial chain number to which the pilot hole belongs. When merging or inserting chains, the pilot holes are updated automatically.</td>
<td></td>
</tr>
<tr>
<td>.pin_length</td>
<td>Float</td>
<td>Comp.</td>
<td>(0.0-10.0) The length of the component pins expressed in inch or mm. (Relevant to TH pins.)</td>
<td></td>
</tr>
<tr>
<td>.pin_name</td>
<td>Text</td>
<td>Comp.</td>
<td>Name of the die bumps.</td>
<td>Name of die bump</td>
</tr>
<tr>
<td>.pitch</td>
<td>Float</td>
<td>Feature</td>
<td>NOT USED</td>
<td></td>
</tr>
<tr>
<td>.plated_type</td>
<td>Option</td>
<td>Feature</td>
<td>(Standard, Press_fit) Defines plated hole type in drill layers using the Attributes popup or the Drill Tool Manager.</td>
<td></td>
</tr>
<tr>
<td>.polarity_marker</td>
<td>Integer</td>
<td>Comp.</td>
<td>(1-10000; default = 1) An attribute indicating which pin of the component is Pin 1.</td>
<td></td>
</tr>
<tr>
<td>.primary_side</td>
<td>Option</td>
<td>Job</td>
<td>(Top; Bottom) Indicates the primary side for this job.</td>
<td></td>
</tr>
<tr>
<td>.rot_correction</td>
<td>Integer</td>
<td>Comp.</td>
<td>(0-359) Component machine rotation correction to apply.</td>
<td></td>
</tr>
<tr>
<td>.rout_chain</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000; default = 0) Contains the serial number of the chain to which the feature belongs. Features belonging to that chain are rearranged in the features database according to their order inside the chain. Additional attributes that are added to a chained feature: .feed, .speed, .rout_flag, .comp</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix A  System Attributes

<table>
<thead>
<tr>
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<th>Type</th>
<th>Entity</th>
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<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.rout_flag</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000; default = 0). For each chained feature this attribute represents a numeric value supplied to a chain to provide data for the automatic process of the Auto Rout Manager.</td>
<td></td>
</tr>
<tr>
<td>.shave</td>
<td>Boolean</td>
<td>Feature</td>
<td>(Default = No) Assign to all the shaves (negative merges) that the silk screen optimization adds in merge mode.</td>
<td></td>
</tr>
<tr>
<td>.sip</td>
<td>Option</td>
<td>Feature</td>
<td>(Detected / Repaired). Indicates whether the SIP (self-intersecting polygon) has been detected or repaired.</td>
<td></td>
</tr>
<tr>
<td>.sliver_fill</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to all the fills added by the sliver fill DFM actions.</td>
<td></td>
</tr>
<tr>
<td>.smd</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to outer layer pads designated as toeprints which are lands for SMD components. It is set by the ‘Set SMD Attribute’ Cleanup Action.</td>
<td></td>
</tr>
<tr>
<td>.smt_direction_bottom</td>
<td>Option</td>
<td>Step</td>
<td>(Left2Right; Top2Bottom; Right2Left; Bottom2Top) Defines the direction of the SMT process flow on the bottom side.</td>
<td></td>
</tr>
<tr>
<td>.smt_direction_top</td>
<td>Option</td>
<td>Step</td>
<td>(Left2Right; Top2Bottom; Right2Left; Bottom2Top) Defines the direction of the SMT process flow on the top side.</td>
<td></td>
</tr>
<tr>
<td>.source_llayer</td>
<td>Text</td>
<td>Feature</td>
<td>(0-64) This attribute is used by the Enterprise Mentor EDA translator to identify the “Source Logical Layer” of features (traces) appearing on signal or mixed layers. The translator uses this attribute in a filtering stage that addresses pad/signal mapping.</td>
<td></td>
</tr>
<tr>
<td>.spacing_req</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 to 100.0) (units = mils or microns)</td>
<td></td>
</tr>
<tr>
<td>.speed</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000; default = 0) For a chained feature this attribute sets the spindle speed (in revolutions per minute) when routing.</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix A  System Attributes

<table>
<thead>
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<th>Entity</th>
<th>Description</th>
<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.spo_h_fact</td>
<td>Float</td>
<td>Feature;</td>
<td>(0.3 &lt;-&gt; 2.0; default = 0.8) When .spo_h_mode = Factor, .spo_h_fact specifies the factor by which paste pad heights are sized relative to their SMD pads. For example, 0.9 means height is 90% of SMD pad.</td>
<td>Comp.</td>
</tr>
<tr>
<td>.spo_h_mode</td>
<td>Option</td>
<td>Feature;</td>
<td>(Distance, Factor, Value) Defines how heights of paste pads are sized: by distance, factor or value.</td>
<td>Comp.</td>
</tr>
<tr>
<td>.spo_h_val</td>
<td>Float</td>
<td>Feature;</td>
<td>(-500 to +500; default = 5) When .spo_h_mode = Distance, .spo_h_val is the reduction/expansion in mils or microns of the paste pad width relative to the SMD pad width. For example, .sp_h_val = 5.0 mils shrinks paste pad by 5.0 mils (2.5 mils on each side) relative to SMD pad width. Positive number results in smaller paste pad, negative number in larger paste pad. When .spo_h_mode = Value, .spo_h_val becomes the absolute width of the paste pad (for example, 5.0 mils becomes the actual width of the paste pad).</td>
<td>Comp.</td>
</tr>
<tr>
<td>.spo_move_center</td>
<td>Float</td>
<td>Feature;</td>
<td>(range: -500 to 500, default=0) To move the paste pad from the SMD pad center. A positive value will move the paste from the component center out. A negative value will move the paste towards the component center. Values expressed in mils or microns.</td>
<td>Comp.</td>
</tr>
<tr>
<td>.spo_p_fact</td>
<td>Float</td>
<td>Feature;</td>
<td>(0.3 &lt;-&gt; 2.0; default=0.8) When .spo_p_mode = Factor, .spo_p_fact specifies the factor by which paste pad heights are sized relative to their SMD pads. For example, 0.9 means area is 90% of SMD pad.</td>
<td>Comp.</td>
</tr>
<tr>
<td>.spo_p_mode</td>
<td>Option</td>
<td>Feature;</td>
<td>(Distance, Area) Defines how paste pads for non-standard symbol SMD pads are sized: by distance, or area.</td>
<td>Comp.</td>
</tr>
</tbody>
</table>
### Appendix A  System Attributes

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>.spo_p_val</td>
<td>Float</td>
<td>Feature; Comp.</td>
<td>( -500 to 500; default=5) When .spo_p_mode = Distance, .spo_p_val is the reduction/expansion of the paste pad width relative to the SMD pad width expressed in mils or microns. For example, .sp_p_val = 5.0 mils shrinks paste pad by 5.0 mils (2.5 mils on each side) relative to SMD pad width. Positive number results in smaller paste pad, negative number in larger paste pad.</td>
<td></td>
</tr>
<tr>
<td>.spo_s_fact</td>
<td>Float</td>
<td>Feature; Comp.</td>
<td>(0.3 &lt;-&gt; 2.0; default=0.8) When .spo_s_mode = Factor, .spo_s_fact specifies the factor by which paste pad heights are sized relative to their non-standard SMD pads. For example, 0.9 means height is 90% of SMD pad.</td>
<td></td>
</tr>
<tr>
<td>.spo_s_mode</td>
<td>Option</td>
<td>Feature; Comp.</td>
<td>(Distance, Factor, Value, Area) Defines how heights of paste pads for symmetric SMD pads are sized: by distance, factor, value, area.</td>
<td></td>
</tr>
<tr>
<td>.spo_s_val</td>
<td>Float</td>
<td>Feature; Comp.</td>
<td>( -500 to 500; default=5) When .spo_s_mode = Distance, .spo_s_val is the reduction/expansion expressed in mils or microns of the paste pad width relative to their non-standard SMD pad width. When .spo_h_mode = Value, .spo_h_val becomes the absolute size of the paste pad.</td>
<td></td>
</tr>
<tr>
<td>.spo_shape</td>
<td>Text</td>
<td>Feature; Comp.</td>
<td>Specifies the symbol to be used as the solder paste pad applied to a feature (smd pad) or to the toeprints of a component. The initial orientation of the symbol is also affected by the .spo_shape_rotate attribute when defined.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix A  System Attributes

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>.spo_shape_rotate</td>
<td>Float</td>
<td>Feature; Comp.</td>
<td>(0 to 360; default = 0) Specifies the initial rotation of the symbol defined in the .spo_shape attribute. Both .spo_shape_rotate and .spo_shape should appear as a pair at the level at which they are activated (component or feature). This means, for example, that an .spo_shape_rotate defined without a corresponding .spo_shape in the feature level is ignored.</td>
<td></td>
</tr>
<tr>
<td>.spo_shape_stretch</td>
<td>Boolean</td>
<td>Feature; Comp.</td>
<td>(Default = No) Specifies that the symbol defined in .spo_shape is to be stretched to fit the copper pad dimensions. The stretch limits are determined by applying the SPO width and height parameters (pp_w_<em>, pp_h_</em>) or attributes (.spo_w_<em>, .spo_h_</em>) on the copper pad bounding box. Both .spo_shape_stretch and .spo_shape should appear as a pair at the level at which they are activated (component or feature). This means, for example, that an .spo_shape_stretch defined without a corresponding .spo_shape in the feature level is ignored.</td>
<td></td>
</tr>
<tr>
<td>.spo_w_fact</td>
<td>Float</td>
<td>Feature; Comp.</td>
<td>(0.3 &lt;-&gt; 2.0; default=0.8) When .spo_w_mode = Factor, .spo_w_fact specifies the factor by which paste pad widths are sized relative to their SMD pads. For example, .spo_w_fact = 0.9 width of paste pad is 90% of width of SMD pad.</td>
<td></td>
</tr>
<tr>
<td>.spo_w_mode</td>
<td>Option</td>
<td>Feature; Comp.</td>
<td>(Distance; Factor; Value; Area) Defines how widths of paste pads are sized: by distance, factor or value.</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix A  System Attributes

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><code>.spo_w_val</code></td>
<td>Float</td>
<td>Feature, Comp.</td>
<td>(-500 to 500; default=5) When <code>.spo_w_mode</code> = Distance, <code>.spo_w_val</code> is the reduction/expansion expressed in mils or microns of the paste pad width relative to the SMD pad width. For example, <code>.sp_w_val</code> = 5.0 mils shrinks paste pad by 5.0 mils (2.5 mils on each side) relative to SMD pad width. Positive number results in smaller paste pad, negative number in larger paste pad. When <code>.spo_w_mode</code> = Value, <code>.spo_w_val</code> becomes the absolute width of the paste pad (for example, 5.0 mils becomes the actual width of the paste pad).</td>
<td></td>
</tr>
<tr>
<td><code>.src_orientation</code></td>
<td>Integer</td>
<td>Comp.</td>
<td>(-1 to 3; default = -1) Defines the zero orientation of this component relative to its orientation in the packages database. That is, the orientation of the component on the automated assembly tape, or (for manually inserted components) the orientation in which pin #1 is &quot;in the same position&quot; for all similar components.</td>
<td></td>
</tr>
<tr>
<td><code>.station</code></td>
<td>Text</td>
<td>Comp.</td>
<td>NOT USED (Min_len= 0, Max_len = 255)</td>
<td></td>
</tr>
<tr>
<td><code>.string</code></td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 1000) For nomenclature features, the value of this attribute is the original text string which the feature is part of. During EDA input, all occurrences of the asterisk character ‘<em>’ are replaced by the hyphen character ‘-’ (the reason: when filtering, the asterisk character ‘</em>’ is used to denote any substring match).</td>
<td></td>
</tr>
<tr>
<td>Attribute</td>
<td>Type</td>
<td>Entity</td>
<td>Description</td>
<td>Display Name</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------</td>
<td>---------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>.string_angle</td>
<td>Float</td>
<td>Feature</td>
<td>For nomenclature features, the value of this attribute is the original (in the input file) text rotation angle which the feature is part of. This attribute is assigned to translated jobs of formats: Cadence Allegro BRD/APD, Mentor BoardStation, PADS PowerPCB.</td>
<td></td>
</tr>
<tr>
<td>.string_justification</td>
<td>Option</td>
<td>Feature</td>
<td>String justification: tl, tc, tr, cl, cc, cr, bl, bc, br tl, tc, tr—top-left, top-center, top-right cl, cc, cr—center-left, center-center, center-right bl, bc, br—bottom-left, bottom-center, bottom-right (Default = bl)</td>
<td></td>
</tr>
<tr>
<td>.string_mirrored</td>
<td>Boolean</td>
<td>Feature</td>
<td>(No, Yes) Assigned to mirrored strings.</td>
<td></td>
</tr>
<tr>
<td>.tear_drop</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to features which are added during a tear drop operation, either manually or through the Teardrop Creation DFM action.</td>
<td></td>
</tr>
<tr>
<td>.technology</td>
<td>Text</td>
<td>Job</td>
<td>(0 - 100) Defines the technology used in creating the job. Currently it is set automatically in the CADIF process.</td>
<td></td>
</tr>
<tr>
<td>.test_point</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to features which are used for In-Circuit Testing operations. It is loaded during the direct EDA translation and is used during the Testpoint Analysis action. Also supported in Zuken BD.</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix A  System Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
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<th>Display Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>.test_potential</td>
<td>Option</td>
<td>Feature</td>
<td>An attribute attached to features being considered as testpoints (potential testpoints) for In-Circuit Testing operations. It is assigned either by the Testpoint Allocation Action or manually by the user.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>potential_tp_by_analysis</strong> - a feature meeting all criteria of the Testpoint Allocation Action.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>potential_tp_manually</strong> - a feature to be used as a testpoint though it does not meet all criteria.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>not_potential_tp_manually</strong> - a feature not to be used as a testpoint even though it meets all criteria.</td>
<td></td>
</tr>
<tr>
<td>.testpoint_count</td>
<td>Integer</td>
<td>Net</td>
<td>(-1 to 10000)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specifies the number of testpoints expected on this net. If this variable is not defined, or its value is -1, the number of expected testpoints in unlimited. A value of -1 is given to a net that does not require a specific number of test points. When the Num-verify test is run, it ignores such nets (even when the ERF variable v_testpoint_count_default is defined).</td>
<td></td>
</tr>
<tr>
<td>.testpoint_name</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 64)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Name of the testpoint.</td>
<td></td>
</tr>
<tr>
<td>.thvpad_required</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Assigned to components which require a thieving pad check during the Padstack Analysis action (e.g. fine pitch SOIC).</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix A  System Attributes

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>.toep_nochk_o_side</td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Default = No) Assigned to components so that their toeprints on the opposite side will be excluded from the Toeprint to Toeprint category measurement results in Padstack Analysis, and from the Component to Toeprint category in Component Analysis. Important Note: This attribute is applied only when the following ERF variables are set: c2toep_by_comp=1 (in component.erf) toep2toep_by_comp=1 (in padstack.erf)</td>
<td></td>
</tr>
<tr>
<td>.toep_spacing_req</td>
<td>Float</td>
<td>Comp.</td>
<td>(1 to 100; default = 5) Assigned to components for reporting in the Toeprint to Toeprint category in the Signal Layers Check in Analysis. It defines the maximum spacing expressed in inch or mm within which to report pad to pad spacing measurements. Units expressed in inch or mm.</td>
<td></td>
</tr>
<tr>
<td>.tooling_hole</td>
<td>Boolean</td>
<td>Feature</td>
<td>Used on drill features to indicate that they are tooling holes.</td>
<td></td>
</tr>
<tr>
<td>.user_bom_rev</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 - 1000) Used to describe user modified component extensions. Although a user can set a component to a different CPN by using the Set CPN function, this attribute disappears when BOM Merge is performed.</td>
<td></td>
</tr>
<tr>
<td>.variant_list</td>
<td>Text</td>
<td>Job</td>
<td>(0 - 1000) Consists of a list of all possible variants of a job.</td>
<td></td>
</tr>
<tr>
<td>.vcut</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to rout features that are cut in a V-shape (such as in the figure). Another machine performs the V-shape cutting.</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix A  System Attributes

<table>
<thead>
<tr>
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<th>Type</th>
<th>Entity</th>
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</tr>
</thead>
<tbody>
<tr>
<td><code>.via_type</code></td>
<td>Option</td>
<td>Feature</td>
<td>(Drilled; Laser; Photo) Assigned to via drills for the classification of various via pad and via drill categories in the HDI analysis.</td>
<td></td>
</tr>
<tr>
<td><code>.viacap_layer</code></td>
<td>Option</td>
<td>Step</td>
<td>(Top; Bottom; Both; None; default = None) Defines on which layer via capping can occur, if any.</td>
<td></td>
</tr>
<tr>
<td><code>.wheel_type</code></td>
<td>Option</td>
<td>Wheel</td>
<td>(Gerber; Tools) Specifies for a wheel whether it is used for Gerber files translation or for drill file translation.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B  

**System Attributes for Genesis**

The following table is a list of the system attributes currently used by Genesis programs.
The columns are:
- **Attributes** - the internal name of the attribute
- **Type** - Float, Integer, Boolean, Text, Option
- **Entity** - the ODB++ entity (such as Job, Step, Feature, Component, Symbol, Wheel, ...) to which the attribute can be assigned.

**Attribute List**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Entity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.action_mask_layer</td>
<td>Integer</td>
<td>Layer</td>
<td>Name of the mask layer.</td>
</tr>
<tr>
<td>.action_mask_layer_type</td>
<td>Text</td>
<td>Layer</td>
<td>Sets the type of mask: inclusion or exclusion.</td>
</tr>
<tr>
<td>.array_with_rotation</td>
<td>Boolean</td>
<td>Step</td>
<td>If TRUE, this step is a multi-panel array, with the same panel possibly appearing in 180-degree rotation to itself</td>
</tr>
<tr>
<td>.assembly_proc_bottom</td>
<td>Text</td>
<td>Step</td>
<td>Default assembly process for the bottom side, to be used when there is no specific area defined in the process map layer (or no process map layer at all)</td>
</tr>
<tr>
<td>.assembly_proc_top</td>
<td>Text</td>
<td>Step</td>
<td>Default assembly process for the top side, to be used when there is no specific area defined in the process map layer (or no process map layer at all).</td>
</tr>
<tr>
<td>.avoid_shave</td>
<td>Boolean</td>
<td>Feature</td>
<td>(Yes, No) If set, tells a DFM action not to shave a pad with this attribute.</td>
</tr>
<tr>
<td>.bit</td>
<td>Text</td>
<td>Feature</td>
<td>(0 - 64) Contains the drill designator which is set to each tool in the Drill Tools Manager.</td>
</tr>
<tr>
<td>.board_thickness</td>
<td>Float</td>
<td>Job</td>
<td>(0.0 to 10.0) Total thickness of the board.</td>
</tr>
</tbody>
</table>
### Appendix B  System Attributes for Genesis

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Entity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>.breakAway</code></td>
<td>Boolean</td>
<td>Symbol</td>
<td>Assigned to a symbol representing a break-away to be inserted into any line or arc of the rout path. When adding a break-away symbol thru dimensions, it automatically adjusts to the line or arc angle, breaks that feature (in the breaking points defined in that symbol with the <code>.brk_pnt</code> attribute), and adds all the necessary connections and dimensions.</td>
</tr>
<tr>
<td><code>.brk_point</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to a pad or a dpoint in a break-away symbol (that was given the attribute <code>.breakAway</code>). When adding the break-away to the line/arc in the layer, thru dimensions, the line/arc is broken at the connection point with the dpoint that has the <code>.brkpnt</code> attribute. In each break-away symbol there should be two points with this attribute.</td>
</tr>
<tr>
<td><code>.canned_text</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Indicates that a text is drilled (applies to features).</td>
</tr>
<tr>
<td><code>.cdr_mirror</code></td>
<td>Text</td>
<td>Layer</td>
<td>The mirroring of a layer for AOI inspection is set in the <code>.cdr_mirror</code> layer attribute. If <code>Yes</code>, the layer is mirrored for AOI inspection. If <code>No</code>, the layer is not mirrored. If unset, the mirroring of the layer is assumed to be the opposite of mirroring for plotting. The mirroring used for plotting is deduced from the combination of two factors: the value of the layer attribute <code>.out_mirror</code>, and the existence of mirroring in the Image Production layer parameters. The table below summarizes the possibilities.</td>
</tr>
<tr>
<td><code>.cdr_val</code></td>
<td>Integer</td>
<td>Feature</td>
<td>(-1 to 100000)</td>
</tr>
<tr>
<td><code>.cdr14_stages</code></td>
<td>Text</td>
<td>Feature</td>
<td>(0 - 400) Assigned to alignment target features, and describes the work stage(s) for which the target was set.</td>
</tr>
<tr>
<td><code>.cdr14_zone_type</code></td>
<td>Text</td>
<td>Feature</td>
<td>(0 - 30) Assigned to features representing exclusion zones, describing zone type as set by the operator.</td>
</tr>
<tr>
<td><code>.center_fiducial</code></td>
<td>Boolean</td>
<td>Comp.</td>
<td>(Yes, No) Specifies component is expected to have a fiducial at its center.</td>
</tr>
</tbody>
</table>
### Appendix B  System Attributes for Genesis

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<tbody>
<tr>
<td>.color</td>
<td>Text</td>
<td>Feature</td>
<td>Color can be attached to any feature or component to define the color to be used in plotting a layer in HPGL-1 or 2. The format is \texttt{rrggbb} (where (r)=red, (g)=green, (b)=blue). White: (\texttt{.color = &quot;999999&quot;}) Black: (\texttt{.color = &quot;000000&quot;}) Red: (\texttt{.color = &quot;990000&quot;}) Green: (\texttt{.color = &quot;009900&quot;}) Yellow: (\texttt{.color = &quot;009999&quot;}) Blue: (\texttt{.color = &quot;000099&quot;}) Magenta: (\texttt{.color = &quot;990099&quot;}) Cyan: (\texttt{.color = &quot;999900&quot;})</td>
</tr>
<tr>
<td>.combined_size</td>
<td>Float</td>
<td>Feature</td>
<td>Keep the original size for combined tools. If the tool is the combined drill size, the attribute equals the combined drill size. For non-combined tools, the attribute is undefined.</td>
</tr>
<tr>
<td>.comment</td>
<td>Text</td>
<td>Job</td>
<td>Used for general textual comments.</td>
</tr>
<tr>
<td>.comp</td>
<td>Option</td>
<td>Feature</td>
<td>For a chained feature, this attribute sets the offset of the cutting tool from the rout path. Three options: - None - in center of the rout path - Left - to the left of the rout path in the direction of cutting - Right - to the right of the path</td>
</tr>
<tr>
<td>.comp_height</td>
<td>Float</td>
<td>Comp.</td>
<td>Stores the height of the component above the board surface.</td>
</tr>
<tr>
<td>.comp_htol_minus</td>
<td>Float</td>
<td>Comp.</td>
<td>Contains the minus tolerance for component height, used for calculation of plug-in boards.</td>
</tr>
<tr>
<td>.comp_htol_plus</td>
<td>Float</td>
<td>Comp.</td>
<td>Contains the plus tolerance for component height, used for calculation of plug-in boards.</td>
</tr>
<tr>
<td>.comp_ign_spacing</td>
<td>Boolean</td>
<td>Comp.</td>
<td>This attribute, when set, disables spacing checks on a component during assembly analysis. It is used for printed components which have no actual body</td>
</tr>
<tr>
<td>.comp_ignore</td>
<td>Comp.</td>
<td></td>
<td>Determines whether the component is to be ignored when calculating statistics, or during certain operations, such as Analysis.</td>
</tr>
<tr>
<td>.comp_mount_type</td>
<td>Option</td>
<td>Comp.</td>
<td>This attribute indicates whether the component is a surface mount, through-hole mount, press-fit or other. (SMT;THMT;PRESSFIT)</td>
</tr>
</tbody>
</table>
### Appendix B  System Attributes for Genesis

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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.comp_type</td>
<td>Option</td>
<td>Comp.</td>
<td>This attribute is very important for determining dynamic categories during assembly analysis. It represents the type of the component. This attribute is only used if both .comp_type and .comp_type2 (see below) are not present. <strong>Note:</strong> Do not use the underscore “_” character in the Type values of this attribute.</td>
</tr>
<tr>
<td>.comp_weight</td>
<td>Float</td>
<td>Comp.</td>
<td>Stores the weight of the component (in ounces) for the purpose of the total weight calculation.</td>
</tr>
<tr>
<td>.connection_id</td>
<td>Integer</td>
<td>Feature</td>
<td>In JTAG operations, all traces and pads electrically connected to a cut polyline are assigned the attribute .connection_id. This attribute is used to aid in reconnecting the traces. Its value is the value of the attribute .jtag_component_id * 100, plus a value that relates to the internal index of the originating JTAG pad.</td>
</tr>
<tr>
<td>.copper_weight</td>
<td>Float</td>
<td>Layer</td>
<td>The weight in ounces of one square inch of copper.</td>
</tr>
<tr>
<td>.critical_net</td>
<td>Boolean</td>
<td>Feature/Net</td>
<td>Specifies critical nets.</td>
</tr>
<tr>
<td>.critical_tp</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to the mid-point of a netlist to force it to become a testpoint (it will not be removed by the Netlist Optimizer). If both .non_tp and .critical_tp are assigned to the same point, .critical_tp takes precedence and the mid point is tested. In case of a drilled feature the attribute must be added to the drill hole.</td>
</tr>
<tr>
<td>.cu_base</td>
<td>Boolean</td>
<td>Layer</td>
<td>This attribute indicates to an analysis action (Signal Layer Checks or Power &amp; Ground Checks) that the specific via layer is built in such a way that it necessitates a copper pad on each layer of the stackup, since the vias are drilled and filled (rather than plated), and the pads are an essential element in ensuring connectivity.</td>
</tr>
<tr>
<td>.customer</td>
<td>Text</td>
<td>Job</td>
<td>(0 to 100) This attribute is used for information purposes. It is used specifically in the input process when processing the lyr_rule file.</td>
</tr>
</tbody>
</table>
### Appendix B  System Attributes for Genesis

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</tr>
</thead>
<tbody>
<tr>
<td>.cut_line</td>
<td>Integer</td>
<td>Feature</td>
<td>Assigned to lines added in the creation of film layers by the film optimization algorithm. The attribute is given to three kinds of lines:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- frame of the film</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- cutting lines inside the film</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- frame of each layer inside the film.</td>
</tr>
<tr>
<td>.deferred</td>
<td>Boolean</td>
<td>Feature</td>
<td>Indicates a plot stamp feature is flagged as deferred while being output to LP7008 and DP100.</td>
</tr>
<tr>
<td>.depth</td>
<td>Float</td>
<td>Layer</td>
<td>(1.0 - 1000.0) Depth of drill layer in mils (applies to layers)</td>
</tr>
<tr>
<td>.design_center</td>
<td>Text</td>
<td>Step</td>
<td>(0-100) The design center from which the job originated.</td>
</tr>
<tr>
<td>.design_origin_x</td>
<td>Integer</td>
<td>Job</td>
<td>(minus 254000000 to plus 254000000) Defines the design origin X coordinate. Currently, it is automatically set in the CADIF input process.</td>
</tr>
<tr>
<td>.design_origin_y</td>
<td>Integer</td>
<td>Job</td>
<td>(minus 254000000 to plus 254000000) Defines the design origin Y coordinate. Currently, it is automatically set in the CADIF input process.</td>
</tr>
<tr>
<td>.drc_add_rad</td>
<td>Integer</td>
<td>Mania_</td>
<td>(0 to 100) For AOI - add lines with this radius when adding shapes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AOI</td>
<td></td>
</tr>
<tr>
<td>.drc_min_space</td>
<td>Integer</td>
<td>Mania_</td>
<td>(1 to 100) Minimum spacing. (Obsolete)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AOI</td>
<td></td>
</tr>
<tr>
<td>.drc_min_width</td>
<td>Integer</td>
<td>Mania_</td>
<td>(1 to 100) Minimum track width. (Obsolete)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AOI</td>
<td></td>
</tr>
<tr>
<td>.drill</td>
<td>Option</td>
<td>Feature</td>
<td>(plated; non_plated; via) Assigned to hole features in drill layers. It defines the type of the drill and is used extensively during fabrication analysis.</td>
</tr>
<tr>
<td>.drill_flag</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000) Used by the Auto Drill Manager. It is an integer feature attribute that should be used on the drill layer. When the Auto Drill Manager package creates the NC Drills table it separates the different drills based on several values: size, drill type and also the value of this attribute. This is useful in cases where specific drills need to be treated in a specific way.</td>
</tr>
<tr>
<td>.drill_noopt</td>
<td>Boolean</td>
<td>Feature</td>
<td>Used by the 'Auto Drill Manager'. Feature attribute that is used on the drill layers. Setting a group of drills with this value will force the drill optimizer to keep the order within that group. This is important for preventing the drill path to pass through mechanical pins.</td>
</tr>
</tbody>
</table>
## Appendix B  System Attributes for Genesis

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</tr>
</thead>
<tbody>
<tr>
<td>.drill_sr_zero</td>
<td>Option</td>
<td>Feature</td>
<td>Used in the Auto Drill Manager to be assigned to a single drill feature in the PCB step. If a single feature in a step is assigned, it is used for setting the 'step &amp; repeat zero offset' of that step. That is, that feature will receive the coordinates - (0,0) in the step &amp; repeat block, and all other coordinates will be relative to it. In order for this attribute to be used, other configuration parameters of the package should be set.</td>
</tr>
<tr>
<td>.drill_stage</td>
<td>Option</td>
<td>Feature</td>
<td>Used in the Auto Drill Manager on the drill layer. This attribute receives three values - '1', '2', and '3', specifying the drill stage of that specific drill hole/slot.</td>
</tr>
<tr>
<td>.dxf_dimension</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned during DXF file input to mark its features as part of a DXF dimension entity.</td>
</tr>
<tr>
<td>.eda_layers</td>
<td>Text</td>
<td>Job</td>
<td>Contains the EDA system layer names which compose a physical layer. It is loaded during the direct EDA translation and is used for graphic synchronization with the EDA system.</td>
</tr>
<tr>
<td>.entity_version</td>
<td>Integer</td>
<td>Step, Symbol</td>
<td>Counts the number of changes made in an entity (applies to steps and symbols). <strong>Note</strong> - Do not modify!</td>
</tr>
<tr>
<td>.et_adjacency</td>
<td>Float</td>
<td>Layer</td>
<td>A distance value (per layer) to use in netlist adjacency calculation for moving probe testers (currently BSL and PROBOT).</td>
</tr>
<tr>
<td>.et_align</td>
<td>Boolean</td>
<td>Feature</td>
<td>Determines that a feature will be used as an alignment target for PROBOT output</td>
</tr>
<tr>
<td>.et_stamp</td>
<td>Boolean</td>
<td>Feature</td>
<td>A feature tagged with this attribute is used as a stamp point in Hioki output.</td>
</tr>
<tr>
<td>.etch_comp_addition</td>
<td>Boolean</td>
<td>Feature</td>
<td></td>
</tr>
<tr>
<td>.etm_adapter_h</td>
<td>Integer</td>
<td>Step</td>
<td>Adapter Height in Mils.</td>
</tr>
<tr>
<td>.etm_constant_drill_usage</td>
<td>Option</td>
<td>Feature</td>
<td>(plate; cs_board; cs_grid; test)</td>
</tr>
<tr>
<td>.etm_height</td>
<td>Float</td>
<td>Layer</td>
<td>For the Job to Adapter option. Defines the height of the plate in the adapter represented by the given layer.</td>
</tr>
<tr>
<td>.etm_mirror</td>
<td>Boolean</td>
<td>Layer</td>
<td>For the Job to Adapter option. Updates the mirror of the drill output transformation for the required plate.</td>
</tr>
<tr>
<td>.etm_pin_name</td>
<td>Text</td>
<td>Feature</td>
<td>(0-64) ETM pin name.</td>
</tr>
<tr>
<td>.etm_pin_style</td>
<td>Option</td>
<td>Step</td>
<td>(Regular, Mania) ETM Pin Guiding Style.</td>
</tr>
</tbody>
</table>
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<tbody>
<tr>
<td>.etm_prim_sink_h</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 1000.0) For the Job to Adapter option. Defines the depth of the countersink from the board side of the plate for the required plate.</td>
</tr>
<tr>
<td>.etm_prim_sink_r</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 1000.0) Countersink Threshold radius on the primary side. (ET)</td>
</tr>
<tr>
<td>.etm_prim_sink_s</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 1000.0) Countersink drill size on primary side. (ET)</td>
</tr>
<tr>
<td>.etm_repair_fmt</td>
<td>Option</td>
<td>Step</td>
<td>ETM Repair file format. Options: None, EPC (note that it is ‘repear’ in the attribute name)</td>
</tr>
<tr>
<td>.etm_rotate</td>
<td>Option</td>
<td>Layer</td>
<td>(0; 90; 180; 270) For the Job to Adapter option. Defines the rotation of the drill output transformation for the given plate definition.</td>
</tr>
<tr>
<td>.etm_sec_sink_h</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 1000.0) For the Job to Adapter option in the ETM. Defines the depth of the countersink for the grid side of the required plate.</td>
</tr>
<tr>
<td>.etm_sec_sink_r</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 1000.0) (ETM). Countersink Threshold radius on secondary side.</td>
</tr>
<tr>
<td>.etm_sec_sink_s</td>
<td>Float</td>
<td>Layer</td>
<td>For the Job to Adapter option. Not used.</td>
</tr>
<tr>
<td>.etm_shift_x</td>
<td>Float</td>
<td>Layer</td>
<td>(-100000.0 to 100000.0) For the Job to Adapter option in the ETM. Defines the x offset of the drill output transformation for the given plate (represented by the layer to which it is assigned).</td>
</tr>
<tr>
<td>.etm_shift_y</td>
<td>Float</td>
<td>Layer</td>
<td>(-100000.0 to 100000.0) For the Job to Adapter option in the ETM. Defines the y offset of the drill output transformation for the given plate (represented by the layer to which it is assigned).</td>
</tr>
<tr>
<td>.etm_step_x</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 1000.0) For the Job to Adapter option in the ETM. Defines the step of the grid being defined on the x axis.</td>
</tr>
<tr>
<td>.etm_step_y</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 1000.0) For the Job to Adapter option in the ETM. Defines the step of the grid being defined on the y axis.</td>
</tr>
<tr>
<td>.etm_tester</td>
<td>Text</td>
<td>Step</td>
<td>(0-64). Options Mania; Everett Charles; Circuitline; Luther; Maelzer; Probot; BSL; IntegriTest; MicroCraft; ATG. ETM tester name.</td>
</tr>
<tr>
<td>.etm_thickness</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 to 1000.0) For the Job to Adapter option in the ETM. Specifies the thickness of the plate being defined.</td>
</tr>
</tbody>
</table>
### Appendix B  System Attributes for Genesis

#### Attribute Type Entity Description

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>.extended</td>
<td>Integer</td>
<td>Feature</td>
<td>Assigned to construction features (lines and pads) added to assist in the generation of a rout path. These features have zero width and are not output to the rout machine as regular features. They are used, for example, as source elements from which to create actual features by dimensions. If the attribute value is not zero then the feature is an extended feature and the decimal value is its serial value in the layer (to be referenced in dimension creation).</td>
</tr>
<tr>
<td>.feed</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000) For a chained feature, this attribute sets the table feed rate when routing.</td>
</tr>
<tr>
<td>.fiducial_name</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 64) This attribute is used for etec output format. A pad that was given a fiducial name is used for registration between layers.</td>
</tr>
<tr>
<td>.fill_dx</td>
<td>Float</td>
<td>Symbol</td>
<td>(0.000001 to 50.0) This attribute is used as the default horizontal distance between symbols when the symbol is used for pattern filling.</td>
</tr>
<tr>
<td>.fill_dy</td>
<td>Float</td>
<td>Symbol</td>
<td>(0.000001 to 50.0) This attribute is used as the default vertical distance between symbols when the symbol is used for pattern filling.</td>
</tr>
<tr>
<td>.flipped_of</td>
<td>Text</td>
<td>Step; Layer</td>
<td>This attribute defines a STEP as a flipped step. When attached to a LAYER, it indicates that the layer was created as a result of (layer) flipping. The attribute value is the name of the original (unflipped) layer. This is done in order to keep the elements of the original layer.</td>
</tr>
<tr>
<td>.flipped_out_of_date</td>
<td>Boolean</td>
<td>Step</td>
<td>No (default) = indicates that the flipped step is an accurate copy of the original step. Yes = indicates that the flipped step is no longer an accurate copy of the original step. One or the other has changed since the first flipping operation that created the step.</td>
</tr>
<tr>
<td>.foot_down</td>
<td>Text</td>
<td>Feature</td>
<td>Attached to feature it causes a foot_down_cmd to be generated by the Auto Rout Manager in the rout file just before the feature. Used only for Excellon files (ignored for other formats).</td>
</tr>
<tr>
<td>.fs_direction_bottom</td>
<td>Option</td>
<td>Step</td>
<td>(Left2Right; Right2Left; Top2Bottom; Bottom2Top). This attribute is used for the thieving pad check in assembly analysis. It determines the flow direction for the bottom layer. Thieving pad check is required for some components during the flow solder process.</td>
</tr>
<tr>
<td>.fs_direction_top</td>
<td>Option</td>
<td>Step</td>
<td>(Left2Right; Right2Left; Top2Bottom; Bottom2Top) This attribute is used for the thieving pad check in assembly analysis. It determines the flow direction for the top layer. Thieving pad check is required for some components during the flow solder process.</td>
</tr>
<tr>
<td>.full_plane</td>
<td>Boolean</td>
<td>Feature</td>
<td>NOT USED</td>
</tr>
<tr>
<td>Attribute</td>
<td>Type</td>
<td>Entity</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------</td>
<td>---------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>.generated_net_point</td>
<td>Boolean</td>
<td>Feature</td>
<td>Openings in the solder mask covering the outer layer which expose locations that could be used as test points are inserted into the layer as rectangular, square or round pads, and marked with the attribute <code>.generated_net_point</code>.</td>
</tr>
<tr>
<td>.geometry</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 100) Contains the name of the padstack which created this feature. It is loaded during direct EDA translation. For layers which are created from component layers during the 'Draw to Layer' operation, the attribute will contain (for centroid pads) useful information on the component, package and part name.</td>
</tr>
<tr>
<td>.global_camtek_aoiset</td>
<td>Text</td>
<td>Job</td>
<td>(0-80) Contains the name of the AOIset to be assigned to each layer upon layer selection in the CAMTEK AOI Interface. Once a name is defined, the AOIset field in the CAMTEK popup will be filled with this name and a new AOIset created in the layer (if already exists, the AOIset will become the current set). The value in this attribute overrides the value defined in the configuration parameter <code>camtek_def_aoiset</code>, but if no value is specified in this attribute, the <code>camtek_def_aoiset</code> value will apply.</td>
</tr>
<tr>
<td>.gold_plating</td>
<td>Boolean</td>
<td>Feature</td>
<td>This attribute should be attached (manually) to features which are a part of a gold plated connector. It is used during auto-panelization to orient the gold plated area toward the extreme side of the panel.</td>
</tr>
<tr>
<td>.guard_comp</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Assigned to a component that “guards” other components. If TRUE, this component is considered a &quot;guard component&quot; (that is, not likely to be knocked off the board accidentally. To be used in future actions.)</td>
</tr>
<tr>
<td>.hatch</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to hatched planes [filled with lines (hatches) or cross lines (cross-hatch) instead of solid copper]. The lines which make up the border and fill the surface are hatches.</td>
</tr>
<tr>
<td>.hatch_border</td>
<td>Boolean</td>
<td>Feature</td>
<td>The lines making up the border of a surface.</td>
</tr>
<tr>
<td>.hatch_serrated_border</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to features that are added for partial hatch. The difference between regular hatch and partial hatch is that in partial hatch the cells along the border that intersect the border line are filled; the feature(s) that fill these cells are assigned this attribute.</td>
</tr>
<tr>
<td>.hp3070_common_pin</td>
<td>Text</td>
<td>Comp.</td>
<td>(0-16). For the device SWITCH this is used to designate the COMMON pin.</td>
</tr>
<tr>
<td>.hp3070_contact_pin</td>
<td>Text</td>
<td>Comp.</td>
<td>(0-16). For the device SWITCH this is used to designate the CONTACT pin.</td>
</tr>
</tbody>
</table>
### Appendix B  System Attributes for Genesis

<table>
<thead>
<tr>
<th>Attribute</th>
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</tr>
</thead>
<tbody>
<tr>
<td>.hp3070_device</td>
<td>Text</td>
<td>Comp.</td>
<td>(0 -16) The device of the component, one of the following: All other components will be categorized as Undefined.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- CAPACITOR - LIBRARY</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- CONNECTOR - POTENTIOMETER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- DIODE R</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- FET - RESISTOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- FUSE - SWITCH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- INDUCTOR - TRANSISTOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- JUMPER PIN - ZENER</td>
</tr>
</tbody>
</table>

| .hp3070_fail_msg | Text    | Comp.  | (0-64) Specifies the failure message associated with the component. This applies to all device types. In output of HP3070 formats, the text field (within quotes) consisting of the Part number and this error message will be truncated to 40 characters. |

| .hp3070_hi_value | Float   | Comp.  | (0-100000.0) Specifies the upper test limit of the device. Its specific meaning is dependent on the device type.                          |
|                 |         |        | - For DIODE: Upper test limit, in volts for the diode's forward bias voltage.                                                            |
|                 |         |        | - For FET: The high resistance limit in ohms.                                                                                           |
|                 |         |        | - For TRANSISTOR: The high limit for the transistor beta.                                                                                |

| .hp3070_lo_value | Float   | Comp.  | (0-100000.0) Specifies the lower test limit of the device. Its specific meaning is dependent on the device type.                          |
|                 |         |        | - For DIODE: Lower test limit, in volts, for the diode's forward bias voltage.                                                            |
|                 |         |        | - For FET: The low resistance limit in ohms.                                                                                             |
|                 |         |        | - For TRANSISTOR: The low limit for the transistor beta.                                                                                 |

| .hp3070_probe_access | Text    | Comp.  | (0-64) Specifies the probe access for the component and toeprint. This value will be applied to ALL the pins of the component. Known values are: PREFERRED, NO_PROBE, TOP, TOP NO_ACCESS, BOTH MANDATORY, and MANDATORY NO_MANUAL though other values are possible. If toeprints are assigned this attribute, their settings override the component setting. |

| .hp3070_seriesr   | Float   | Comp.  | (0-100000.06) For INDUCTOR devices this is used to specify the series resistance (in Ohms).                                             |

| .hp3070_test      | Text    | Comp.  | Determines that a component be tested. This attribute applies to all device types. Devices of type CONNECTOR must be NT (Not Tested). |
### Appendix B  System Attributes for Genesis

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<tr>
<th>Attribute</th>
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</thead>
<tbody>
<tr>
<td>.hp3070_tol_neg</td>
<td>Float</td>
<td>Comp.</td>
<td>(0-100) This is a real value expressing the percent of the value to use as a tolerance (negative tolerance). This is used for devices:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- CAPACITOR - RESISTOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- INDUCTOR - ZENER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- POTENTIOMETER</td>
</tr>
<tr>
<td>.hp3070_tol_pos</td>
<td>Float</td>
<td>Comp.</td>
<td>(0-100) This is a real value expressing the percent of the value to use as a tolerance (positive tolerance). This is used for the devices:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- CAPACITOR - RESISTOR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- INDUCTOR - ZENER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- POTENTIOMETER</td>
</tr>
<tr>
<td>.hp3070_type</td>
<td>Text</td>
<td>Comp.</td>
<td>The type of device:.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For CAPACITOR:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- F = Capacitor Value is Fixed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- V = Capacitor Value is Variable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For FET:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- N = N-Channel Field Effect Transistor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- P = P-Channel Field Effect Transistor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For INDUCTOR:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- F = Inductor value is Fixed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- V = Inductor value is Variable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For JUMPER:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- O or OPEN = Jumper is Open</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- C or CLOSED = Jumper is Closed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For RESISTOR:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- F = Resistor value is Fixed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- V = Resistor value is Variable</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For TRANSISTOR:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- N = Transistor is an NPN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- P = Transistor is a PNP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range of characters: 0-8</td>
</tr>
<tr>
<td>.hp3070_value</td>
<td>Text</td>
<td>Comp.</td>
<td>(0-16) The value of the component. The meaning varies depending on the component device. For CAPACITOR it is used for capacitance (in Farads). For INDUCTOR it is the inductance (in Henries). For PIN LIBRARY it is used for the PN (Part Name). For the devices POTENTIOMETER and RESISTOR, it is used for the device’s resistance. For the ZENER device it specifies the breakdown voltage (in Volts).</td>
</tr>
</tbody>
</table>
### Table: System Attributes for Genesis

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<tr>
<td>.ignore_action</td>
<td>Boolean</td>
<td>Feature</td>
<td>This attribute can be assigned to individual features. Any feature possessing this attribute is ignored by the action. This attribute is useful if a specific feature has none of the other attributes defined in the ERF variable .v_ignore_attrs. The .ignore_action attribute must be specified in the list of attributes defined in .v_ignore_attrs to enable it.</td>
</tr>
<tr>
<td>.image_dx, .image_dy</td>
<td>Float</td>
<td>Symbol</td>
<td>These values are set when inputting Image files into the system. They contain the datum point of an Image special symbol entity used to set the datum when performing output back into Image format. These values should not be changed by the user as this can cause data corruption.</td>
</tr>
<tr>
<td>.imp_line</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to lines which are impedance-controlled. When set, it prevents the lines from being rerouted or thinned during signal layer optimization.</td>
</tr>
<tr>
<td>.ind_orient_req</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Indicates that the component requires silkscreen orientation indication. (To be used in future actions.)</td>
</tr>
<tr>
<td>.infeed_speed</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000)</td>
</tr>
<tr>
<td>.inp_file</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 480) Contains the name of the file (Gerber, Drill) from which the data was input into the layer.</td>
</tr>
<tr>
<td>.inp_net_name</td>
<td>Text</td>
<td>Feature</td>
<td>(0 to 100) This attribute contains netlist information sent by the DPF input translator.</td>
</tr>
<tr>
<td>.inp_x_scale, .inp_y_scale</td>
<td>Float</td>
<td>Layer</td>
<td>(-9.99999 to 9.99999) These attributes are used in input and output for NEC format. During NEC input, the values of the GSCL NEC command are stored in them. The NEC output writes the GSCL command to the output file is the values are other than 1.</td>
</tr>
<tr>
<td>.is_buried</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Assigned to buried components specifically input from CADIF files in order to mark them as buried. This attribute, although specifically designed for CADIF files, can be used in any other function or script. Note that the attribute name is misspelled, but that is its name.</td>
</tr>
<tr>
<td>.is_capped</td>
<td>Boolean</td>
<td>Feature</td>
<td>Used on via pads on top &amp; bottom signal layers to indicate that the via is capped on this side.</td>
</tr>
<tr>
<td>.is_shadowed</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Components with this attribute are considered for the Shadowing categories, as the shadowed component.</td>
</tr>
<tr>
<td>.jtag_component_id</td>
<td>Integer</td>
<td>Feature</td>
<td>(1 to 100) Component ID numbers are assigned to each JTAG feature using this attribute. All pads belonging to the same JTAG feature share the same ID number.</td>
</tr>
</tbody>
</table>
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</tr>
</thead>
<tbody>
<tr>
<td>.label_clearance</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Assigned to components which are not allowed to be too close to a glued label (e.g. fine pitch SOIC components). During the component analysis, these components are checked vs. the label components.</td>
</tr>
<tr>
<td>.layer_class</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 1000)</td>
</tr>
<tr>
<td>.layer_dielectric</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0001 to 0.5 inch)</td>
</tr>
<tr>
<td>.layer_hdi_type</td>
<td>Option</td>
<td>Layer</td>
<td>(Buildup; Core)</td>
</tr>
<tr>
<td>.local_fiducial_dist</td>
<td>Float</td>
<td>Comp.</td>
<td>(0.0 to 100.0)</td>
</tr>
<tr>
<td>.lpol_done</td>
<td>Boolean</td>
<td>Layer</td>
<td></td>
</tr>
<tr>
<td>.lpol_surf</td>
<td>Boolean</td>
<td>Feature</td>
<td></td>
</tr>
<tr>
<td>.merge_processes</td>
<td>Text</td>
<td>Step</td>
<td></td>
</tr>
<tr>
<td>.mount_hole</td>
<td>Boolean</td>
<td>Feature</td>
<td></td>
</tr>
<tr>
<td>.n_electric</td>
<td>Boolean</td>
<td>Feature</td>
<td></td>
</tr>
</tbody>
</table>
| .naming_convention         | Option   | CAMTEK-AOISET | (Numeric; Layer name)                                                                                                                      | When set to **Numeric** (default), the output directory for each layer is a number.  
When set to **Layer name**, output directory for each layer is the layer name. |
| .nec_cbnk_blank_name       | Text     | Layer      |                                                                                                                                             | Contains blank records derived from CBNK records during NEC input translation. |
| .nec_n1_draw_num           | Text     | Layer      | (0 to 20)                                                                                                                                     | Contains drawing number and version number derived from N1 records during NEC input translation. |
| .nec_n1_rev                | Text     | Layer      | (0 to 2)                                                                                                                                     | Contains revision number derived from N1 records during NEC input translation. |
| .nec_n2_draw_num           | Text     | Layer      | (0 to 20)                                                                                                                                     | Contains drawing number and version number derived from N2 records during NEC input translation. |
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</thead>
<tbody>
<tr>
<td>.nec_n2_rev</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 2) Contains revision number derived from N2 records during NEC input translation.</td>
</tr>
<tr>
<td>.nec_n3_edit_level</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 1) min_length=0; max_length=1 Contains editing level information derived from N3 records during NEC input translation.</td>
</tr>
<tr>
<td>.nec_n3_lyr_type</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 3) min_length=0; max_length=3 Contains layer type information derived from N3 records during NEC input translation.</td>
</tr>
<tr>
<td>.nec_n3_pol</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 1) min_length=0; max_length=1 Contains polarity information derived from N3 records during NEC input translation.</td>
</tr>
<tr>
<td>.nec_n3_prod_rev</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 2) min_length=0; max_length=2 Contains production revision information derived from N3 records during NEC input translation.</td>
</tr>
<tr>
<td>.nec_n3_target_layer</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 2) min_length=0; max_length=2 Contains target layer information derived from N3 records during NEC input translation.</td>
</tr>
<tr>
<td>needs_guarding</td>
<td>Boolean</td>
<td>Comp.</td>
<td>True - this component needs to be protected by guard components (see .guard_comp) else it is likely to be knocked off the board accidentally.</td>
</tr>
<tr>
<td>net_point</td>
<td>Boolean</td>
<td>Feature</td>
<td>When assigned to a pad in an inner layer, defines the pad as an internal test point.</td>
</tr>
<tr>
<td>net_type</td>
<td>Text</td>
<td>Net</td>
<td>(0 to 64) A name for the type of net. The .net_type attribute can reference the set of routing rules for a net.</td>
</tr>
<tr>
<td>neutralization_angle</td>
<td>Float</td>
<td>Comp.</td>
<td>(0.0-360.0) An attribute attached to each Rotation Neutralization processed component stating the angle of rotation counter-clockwise from Valor standard orientation.</td>
</tr>
<tr>
<td>neutralization_info</td>
<td>Text</td>
<td>Step</td>
<td>Attached to the step where Rotation Neutralization has been performed. This attribute contains the information &lt;CPL</td>
</tr>
<tr>
<td>neutralization_reviewed</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Attached to each component in a package reviewed in Rotation Neutralization, i.e. a package not accepted automatically as being Known or Safe or by clicking Accept Category.</td>
</tr>
<tr>
<td>neutralization_ss_layers</td>
<td>Text</td>
<td>Step</td>
<td>(0 to 200) Attached to the step where Rotation Neutralization has been performed. This attribute designates which layers are to be considered the silkscreen layers.</td>
</tr>
<tr>
<td>nfp</td>
<td>Boolean</td>
<td>Feature</td>
<td>Indicates that a pad is not functional (applies to features).</td>
</tr>
</tbody>
</table>
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</tr>
</thead>
<tbody>
<tr>
<td>.no_fiducial_check</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Components with this attribute are not checked for the “Component Covers Fiducial” category, or for any of the categories under the Coverage test.</td>
</tr>
<tr>
<td>.no_hole_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>If TRUE, no drill holes are allowed under this component.</td>
</tr>
<tr>
<td>.no_text_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Assigned to a component, does not allow silk screen text to be placed under the component outline. Printed components (e.g. edge connectors) may not have this attribute.</td>
</tr>
<tr>
<td>.no_tp_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Assigned to a component, does not allow testpoints to be placed under the component outline. Printed components (e.g. edge connectors) may not have this attribute.</td>
</tr>
<tr>
<td>.no_uncap_via_under</td>
<td>Boolean</td>
<td>Comp.</td>
<td>TRUE - uncapped vias are NOT allowed under this component.</td>
</tr>
<tr>
<td>.non_tp</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to a feature causes it NOT to be considered as a net testpoint. It is used for connectivity calculation but is not used as a test point (bare board testing).</td>
</tr>
<tr>
<td>.notest_req</td>
<td>Boolean</td>
<td>Feature</td>
<td>Any pad assigned with this attribute will not be tested. If it is tested by other means, drop back will be performed.</td>
</tr>
<tr>
<td>.num_local_fiducials</td>
<td>Integer</td>
<td>Comp.</td>
<td>Defines how many local fiducials are expected to be inside or near a component. This is checked during Fiducial Analysis.</td>
</tr>
<tr>
<td>.numbered_layer</td>
<td>Text</td>
<td>Layer</td>
<td>(0 to 500) This attribute marks a layer as a numbered layer in PCB Numbering.</td>
</tr>
<tr>
<td>.orbotech_plot_stamp</td>
<td>Boolean</td>
<td>Features</td>
<td>NOT USED</td>
</tr>
<tr>
<td>.orig_surf</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 -1000000) Identifies original surface which will be rebuilt.</td>
</tr>
<tr>
<td>.otherside_keepout</td>
<td>Option</td>
<td>Comp.</td>
<td>(full_area; pins_only) Defines for components whether the other side of the board may also contain components in the same area.</td>
</tr>
<tr>
<td>.out_angle</td>
<td>Option</td>
<td>Layer</td>
<td>(0.0; 90.0; 180.0; 270.0) Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the ‘step’ to be translated.</td>
</tr>
<tr>
<td>.out_break</td>
<td>Boolean</td>
<td>Symbol</td>
<td>Feature and symbol attribute. When assigned to a specific feature using a special symbol, the feature will be broken into its primitives in the output translation stage, regardless of the settings of other output parameters. If the attribute is set for a special symbol (entity attribute) then all features that use these symbols will always be broken into primitive features in the output translation stage, regardless of the settings of any other output parameters.</td>
</tr>
<tr>
<td>.out_comp</td>
<td>Float</td>
<td>Layer</td>
<td>(-100.0 to 100.0) Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the ‘step’ to be translated.</td>
</tr>
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<tbody>
<tr>
<td><code>.out_drill_full</code></td>
<td>Boolean</td>
<td>Step</td>
<td>The STEP entity attribute used by the Auto Drill Manager. This attribute can be used for drilling coupon STEPs that need to be fully drilled before continuing to the next step &amp; repeat entity.</td>
</tr>
<tr>
<td><code>.out_drill_optional</code></td>
<td>Boolean</td>
<td>Step</td>
<td>Used by the 'Auto Drill Manager'. Both a STEP entity and feature attribute. If the drill feature is set with this attribute it will have the <code>/</code> command prefix in the final output file, indicating that the drill is optional. If a step entity attribute is set, then all the commands that are part of that step will have the <code>/</code> command prefixed. Thus, the whole step is optional.</td>
</tr>
<tr>
<td><code>.out_drill_order</code></td>
<td>Integer</td>
<td>Step</td>
<td>The STEP entity attribute used by the Auto Drill Manager. The attribute controls the order in which the steps will be drilled. Thus, who is first, second,, etc. The attribute has the following valid values: 0 - no special order for that step 1 - first 2 - second 3 - and above - order from the beginning -1 - last -2 - one before last -3 - and on (drill order from the end)</td>
</tr>
<tr>
<td><code>.out_flag</code></td>
<td>Integer</td>
<td>Feature</td>
<td>Used in Excellon translation. If set is will dictate the dcode number.</td>
</tr>
<tr>
<td><code>.out_mirror</code></td>
<td>Boolean</td>
<td>Layer</td>
<td>Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the 'step' to be translated.</td>
</tr>
<tr>
<td><code>.out_name</code></td>
<td>Text</td>
<td>Step</td>
<td>Entity attribute that is used by the Image output translator. If this attribute is not an empty string it will serve as the entity name on the Image system. If it is an empty string the original system entity name will be used. This attribute is important in cases where the Genesis name does not form a legal Image name. If this attribute is not set, the Genesis output translator decides about the new name with its own internal algorithm.</td>
</tr>
<tr>
<td><code>.out_nc_ignore</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Indicates a feature is not output during drill or rout process.</td>
</tr>
<tr>
<td><code>.out_nc_verify</code></td>
<td>Boolean</td>
<td>Feature</td>
<td>Prevents the output of drill/rout coupons. Features bearing this attribute are updated during drill/rout output procedures.</td>
</tr>
<tr>
<td><code>.out_polarity</code></td>
<td>Option</td>
<td>Layer</td>
<td>Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the step to be translated.</td>
</tr>
</tbody>
</table>
### Appendix B  System Attributes for Genesis

<table>
<thead>
<tr>
<th>Attribute</th>
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<tbody>
<tr>
<td>.out_rout_optional</td>
<td>Boolean</td>
<td>Step</td>
<td>Used by the Auto Drill Manager. Both a STEP entity and feature attribute. If drill feature is set with this attribute it will have the '/' command in front of it in the final output file. This means that the drill is optional. If a step entity attribute is set then all the commands that are part of that step will have the '/' command at the beginning. Thus, the whole step is optional.</td>
</tr>
<tr>
<td>.out_rout_order</td>
<td>Integer</td>
<td>Step</td>
<td>STEP entity attribute used by the Auto Drill Manager. The attribute controls the order in which the steps will be drilled. Thus, who is first, second,,etc. The attribute has the following valid values: 0 — no special order for that step 1 — first 2 — second 3 and above — order from the beginning -1 — last -3 and on — drill order from the end</td>
</tr>
<tr>
<td>.out_scale</td>
<td>Boolean</td>
<td>Symbol</td>
<td>Feature and symbol attribute. In the output translation package there is a special parameter that controls the way features will be scaled. In two of the options the user can specify whether certain features can be scaled or not. This is important in cases where special registration targets would not be scaled together with all the other features. This special output option applies only to features that have this attribute set. In case of a special symbol, the customer can set the attribute, and by this control the scaling of all features that use this symbol.</td>
</tr>
<tr>
<td>.out_x_scale</td>
<td>Float</td>
<td>Layer</td>
<td>(0.000001 to 5.0) Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the step to be translated.</td>
</tr>
<tr>
<td>.out_y_scale</td>
<td>Float</td>
<td>Layer</td>
<td>(0.000001 to 5.0) Layer entity attributes with default values that are used by the output translator. These values populate the output screen when selecting the step to be translated.</td>
</tr>
<tr>
<td>.pad_usage</td>
<td>Option</td>
<td>Feature</td>
<td>(toeprint;via;g_fiducial;l_fiducial;tooling_hole) This attribute defines the specific usage of a pad. It is loaded during the direct EDA translation and by the attribute derivation script.</td>
</tr>
<tr>
<td>.patch</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to patches added by the pinhole elimination DFM action.</td>
</tr>
<tr>
<td>.pattern_fill</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to features which are added during a pattern fill operation, either manually or through the Copper Balance DFM action.</td>
</tr>
</tbody>
</table>
### Appendix B  System Attributes for Genesis

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<tbody>
<tr>
<td>.pilot_hole</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000) Attribute assigned to pads that are pilot holes in a chain (holes that are drilled in each tool down in the chain rout path before routing the chain). Pilot holes are set from the chaining popup. The value of the attribute is the serial chain number to which the pilot hole belongs. When merging or inserting chains, the pilot holes are updated automatically.</td>
</tr>
<tr>
<td>.plated_type</td>
<td>Option</td>
<td>Feature</td>
<td>Defines plated hole type in drill layers using the Attributes popup or the Drill Tool Manager.</td>
</tr>
<tr>
<td>.pnl_class</td>
<td>Text</td>
<td>Step</td>
<td>(0-64) The value of the attribute is the name of the panel class whose parameters were used by the Automatic Panelization algorithm. Used only when the step is created by the Automatic Panelization Package.</td>
</tr>
<tr>
<td>.pnl_pcb</td>
<td>Text</td>
<td>Step</td>
<td>(0-64) The value of the attribute is the name of the panelized PCB whose parameters were used by the Automatic Panelization algorithm. Used only when the step is created by the Automatic Panelization Package.</td>
</tr>
<tr>
<td>.pnl_place</td>
<td>Text</td>
<td>Step; Feature</td>
<td>(0-64) Applies to STEP and FEATURE. The value of the attribute is the name of the placement rule used when an element was added to the panel overlay. Used only when an element is added to the panel overlay by the Automatic Panelization Package.</td>
</tr>
<tr>
<td>.pnl_scheme</td>
<td>Text</td>
<td>Step</td>
<td>(0-64) The value of the attribute is the name of the panelization scheme whose rules were used in creating the panel overlay. Used only when the panel step was created by the Automatic Panelization Package.</td>
</tr>
<tr>
<td>.polarity_marker</td>
<td>Integer</td>
<td>Comp.</td>
<td>(1-10000) An attribute indicating which pin of the component is Pin 1. (Default=1)</td>
</tr>
<tr>
<td>.primary_side</td>
<td>Option</td>
<td>Job</td>
<td>(Top; Bottom) Indicates the primary side for this job.</td>
</tr>
<tr>
<td>.rotated_of</td>
<td>Text</td>
<td>Step</td>
<td>(0-64) Source step of a rotated step</td>
</tr>
<tr>
<td>.rotation_angle</td>
<td>Float</td>
<td>Step</td>
<td>(-360.0 to 360.0) Angle of rotation (in degrees) that this step was rotated (applies to steps)</td>
</tr>
<tr>
<td>.rout_chain</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000) Contains the serial number of the chain to which the feature belongs. Features belonging to that chain are rearranged in the features database according to their order inside the chain. Additional attributes that are added to a chained feature: .feed, .speed, .rout_flag, .comp</td>
</tr>
</tbody>
</table>
### Appendix B  System Attributes for Genesis

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<tbody>
<tr>
<td>.rout_cutoff_feed</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 - 100000) For a chained surface feature, defines the feed of the chain cutoff.</td>
</tr>
<tr>
<td>.rout_flag</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 to 100000). For each chained feature this attribute represents a numeric value supplied to a chain to provide data for the automatic process of the Auto Rout Manager.</td>
</tr>
<tr>
<td>.rout_plated</td>
<td>Boolean</td>
<td>Feature</td>
<td>Indicates a plated feature on a rout layer. Note: The .drill attribute can still be used in rout layers, but the .rout_plated attribute takes precedence if both exist.</td>
</tr>
<tr>
<td>.rout_plunge_feed</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 - 100000) For a chained surface feature, defines the feed of the chain plunge.</td>
</tr>
<tr>
<td>.rout_plunge_mode</td>
<td>Option</td>
<td>Feature</td>
<td>(none;straight;overlap;arc;diag;diag_ang) For a chained surface feature, defines the mode of the chain plunge.</td>
</tr>
<tr>
<td>.rout_plunge_val_a</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 - 100.0) For a chained surface feature, defines one the chain plunge parameters.</td>
</tr>
<tr>
<td>.rout_plunge_val_b</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 - 100.0) For a chained surface feature, defines one the chain plunge parameters.</td>
</tr>
<tr>
<td>.rout_plunge_val_c</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 - 100.0) For a chained surface feature, defines one the chain plunge parameters.</td>
</tr>
<tr>
<td>.rout_plunge_val_d</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 - 100.0) For a chained surface feature, defines one the chain plunge parameters.</td>
</tr>
<tr>
<td>.rout_plunge_val_e</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 - 100.0) For a chained surface feature, defines one the chain plunge parameters.</td>
</tr>
<tr>
<td>.rout_plunge_val_f</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 - 100.0) For a chained surface feature, defines one the chain plunge parameters.</td>
</tr>
<tr>
<td>.rout_plunge_val_v1</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 - 90) (grad) For a chained surface feature, defines one the chain plunge parameters.</td>
</tr>
<tr>
<td>.rout_plunge_val_v2</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 - 90) (grad) For a chained surface feature, defines one the chain plunge parameters.</td>
</tr>
<tr>
<td>.rout_pocket_direction</td>
<td>Option</td>
<td>Feature</td>
<td>(standard; opposite) For a chained surface feature, this attribute defines the rout direction of the chain pocket.</td>
</tr>
</tbody>
</table>
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<tr>
<td>.rout_pocket_feed</td>
<td>Integer</td>
<td>Feature</td>
<td>(0 - 100000) For a chained surface feature, defines the feed of the chain pocketing.</td>
</tr>
<tr>
<td>.rout_pocket_mode</td>
<td>Option</td>
<td>Feature</td>
<td>(none; concentric) For a chained surface feature, defines the mode of the chain pocket.</td>
</tr>
<tr>
<td>.rout_pocket_overlap</td>
<td>Float</td>
<td>Feature</td>
<td>(minus100.0 to plus 100.00) For a chained surface feature, defines one of the chain plunge parameters.</td>
</tr>
<tr>
<td>.rout_tool</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 - 100.0) For a chained surface feature, defines the tool size for the outline and plunge rout path.</td>
</tr>
<tr>
<td>.rout_tool2</td>
<td>Float</td>
<td>Feature</td>
<td>(0.0 - 100.0) For a chained surface feature, defines the tool size for the pocket (rout to dust) rout path.</td>
</tr>
<tr>
<td>.rout_type</td>
<td>Option</td>
<td>Feature</td>
<td>(regular; pocket) For a chained feature, defines the type of chain.</td>
</tr>
<tr>
<td>.se_coupon</td>
<td>Option</td>
<td>Step</td>
<td>(none; drill; rout) Defines a step as a start/end coupon of a certain type.</td>
</tr>
<tr>
<td>.se_coupon_direct</td>
<td>Option</td>
<td>Layer</td>
<td>(0;90;180;270) Define the direction from the start point to the next point in start/end coupon.</td>
</tr>
<tr>
<td>.se_coupon_dist</td>
<td>Float</td>
<td>Layer</td>
<td>(0 - 10000) Distance is measured between drill/slot edges or centers in start/end coupon.</td>
</tr>
<tr>
<td>.se_coupon_dist_type</td>
<td>Option</td>
<td>Layer</td>
<td>(Spacing; Center) Distance is measured between drill/slot edges or centers in start/end coupon.</td>
</tr>
<tr>
<td>.se_coupon_max_size</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 - 10000.0) No verification holes will be created. for all tool sizes greater than this parameter (mils/microns).</td>
</tr>
<tr>
<td>.se_coupon_method</td>
<td>Option</td>
<td>Layer</td>
<td>(None; Auto; From Point) Drill/slot location calculation method in start/end coupon.</td>
</tr>
<tr>
<td>.se_coupon_min_hits</td>
<td>Integer</td>
<td>Layer</td>
<td>(0 - 10000) Start/end drill coupon. If number of drills of certain tool is less than required quantity, the verification holes of this size will not be created.</td>
</tr>
<tr>
<td>.se_coupon_min_size</td>
<td>Float</td>
<td>Layer</td>
<td>(0.0 - 10000.0) No verification holes will be created. for all tool sizes less than this parameter (mils/microns).</td>
</tr>
<tr>
<td>.se_coupon_mode</td>
<td>Option</td>
<td>Step</td>
<td>(Start_End; Start; End) Defines the start/end coupon mode.</td>
</tr>
<tr>
<td>.se_coupon_order</td>
<td>Integer</td>
<td>Step</td>
<td>(1 - 100) Sequential order of the start/end coupon steps of the same type and mode.</td>
</tr>
</tbody>
</table>
# Appendix B System Attributes for Genesis

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<tbody>
<tr>
<td>.se_coupon_slot_angle</td>
<td>Float Layer</td>
<td>(0.0 - 360.0)</td>
<td>Slot angle in start/end coupon (degrees).</td>
</tr>
<tr>
<td>.se_coupon_slot_length</td>
<td>Float Layer</td>
<td>(0.0 - 10000.0)</td>
<td>Slot length for start/end coupon (mils/microns).</td>
</tr>
<tr>
<td>.se_coupon_split_num</td>
<td>Option Step</td>
<td>(1;2)</td>
<td>A split number the start/end coupon belongs to.</td>
</tr>
<tr>
<td>.sequential_lamination</td>
<td>Boolean Layer</td>
<td>(No, Yes)</td>
<td></td>
</tr>
<tr>
<td>.shave</td>
<td>Boolean Feature</td>
<td>Assigned to all the shaves (negative merges) that the silk screen optimization adds in merge mode.</td>
<td></td>
</tr>
<tr>
<td>.sliver_fill</td>
<td>Boolean Feature</td>
<td>Assigned to all the fills added by the sliver fill DFM actions.</td>
<td></td>
</tr>
<tr>
<td>.smd</td>
<td>Boolean Feature</td>
<td>Assigned to outer layer pads designated as toeprints which are lands for SMD components. It is set by the ‘Set SMD Attribute’ Cleanup Action.</td>
<td></td>
</tr>
<tr>
<td>.smt_direction_bottom</td>
<td>Option Step</td>
<td>(Left2Right; Top2Bottom; Right2Left; Bottom2Top)</td>
<td>Defines the direction of the SMT process flow on the bottom side.</td>
</tr>
<tr>
<td>.smt_direction_top</td>
<td>Option Step</td>
<td>(Left2Right; Top2Bottom; Right2Left; Bottom2Top)</td>
<td>Defines the direction of the SMT process flow on the top side.</td>
</tr>
<tr>
<td>.source_llayer</td>
<td>Text Feature</td>
<td>(0-64)</td>
<td>This attribute is used by the Enterprise Mentor EDA translator to identify the “Source Logical Layer” of features (traces) appearing on signal or mixed layers. The translator uses this attribute in a filtering stage that addresses pad/signal mapping.</td>
</tr>
<tr>
<td>.source_name</td>
<td>Text Step; Symbol</td>
<td>(0-64)</td>
<td>The name of the source step (or symbol) of a flipped step (or symbol).</td>
</tr>
<tr>
<td>.spacing_req</td>
<td>Float Feature</td>
<td>(0.0 &gt; 100.0)</td>
<td>Specifies required spacing from a feature.</td>
</tr>
<tr>
<td>.speed</td>
<td>Integer Feature</td>
<td>(0 to 100000)</td>
<td>For a chained feature this attribute sets the spindle speed (in revolutions per minute) when routing.</td>
</tr>
<tr>
<td>.spo_h_fact</td>
<td>Integer Feature, Comp.</td>
<td>(0.3 &lt;-&gt; 2.0)</td>
<td>When .spo_h_mode = Factor, .spo_h_fact specifies the factor by which paste pad heights are sized relative to their SMD pads. For example, 0.9 means height is 90% of SMD pad.</td>
</tr>
<tr>
<td>.spo_h_mode</td>
<td>Integer Feature, Comp.</td>
<td>(values = Distance, Factor, Value)</td>
<td>Defines how heights of paste pads are sized: by distance, factor or value.</td>
</tr>
</tbody>
</table>
**Attribute** | **Type** | **Entity** | **Description**
--- | --- | --- | ---
.spo_h_val | Integer Feature, Comp. | (-500 to +500) | When .spo_h_mode = Distance, .spo_h_val is the reduction/expansion of the paste pad width relative to the SMD pad width. For example, .sp_h_val = 5.0 mils shrinks paste pad by 5.0 mils (2.5 mils on each side) relative to SMD pad width. Positive number results in smaller paste pad, negative number in larger paste pad. When .spo_h_mode = Value, .spo_h_val becomes the absolute width of the paste pad (for example, 5.0 mils becomes the actual width of the paste pad). |
.spo_move_center | Integer Feature, Comp. | (range: -500 to 500) | To move the paste pad from the SMD pad center. A positive value will move the paste from the component center out. A negative value will move the paste towards the component center. |
.sr pcb | Boolean Step | (0.0 to 1000.0) | Indicates the name of the pcb step placed in the panel by automatic panelization. |
.src_orientation | Integer Comp. | (-1 to 3) | Defines the zero orientation of this component relative to its orientation in the packages database. That is, the orientation of the component on the automated assembly tape, or (for manually inserted components) the orientation in which pin #1 is "in the same position" for all similar components. |
.step_numbering | Text Feature | (0 to 500) | Text features used for PcB numbering are assigned this attribute. |
.string | Text Feature | (0 to 1000) | For nomenclature features, the value of this attribute is the original text string which the feature is part of. During EDA input, all occurrences of the asterisk character '*' are replaced by the hyphen character '-' (the reason: when filtering, the asterisk character '*' is used to denote any substring match). |
.string_angle | Float Feature | (0 to 360) | For nomenclature features, the value of this attribute is the original (in the input file) text rotation angle which the feature is part of. This attribute is assigned to translated jobs of formats: Cadence Allegro BRD/APD, Mentor BoardStation, PADS PowerPCB. |
.surface_outline_widths | Float Feature | (000.1 > 100.0) | Assigned to area shapes created from closed polylines. Value=width of the dource polyline. |
.tampering_feature | Boolean Feature | (No, Yes) | If set, indicates a tapered feature. |
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<tr>
<td>.tear_drop</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to features which are added during a tear drop operation, either manually or through the Teardrop Creation DFM action.</td>
</tr>
<tr>
<td>.test_point</td>
<td>Boolean</td>
<td>Feature</td>
<td>Assigned to features which are used for In-Circuit Testing operations. It is loaded during the direct EDA translation and is used during the Testpoint Analysis action. Also supported in Zuken BD.</td>
</tr>
<tr>
<td>.test_potential</td>
<td>Option</td>
<td>Feature</td>
<td>An attribute attached to features being considered as testpoints (potential testpoints) for In-Circuit Testing operations. It is assigned either by the Testpoint Allocation Action or manually by the user.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>potential_tp_by_analysis</strong> - a feature meeting all criteria of the Testpoint Allocation Action.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>potential_tp_manually</strong> - a feature to be used as a testpoint though it does not meet all criteria.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>not_potential_tp_manually</strong> - a feature not to be used as a testpoint even though it meets all criteria.</td>
</tr>
<tr>
<td>.test_req</td>
<td>Boolean</td>
<td>Feature</td>
<td>(No, Yes) Must test any pad marked with this attribute. If the test fails, drop back is performed.</td>
</tr>
<tr>
<td>.text</td>
<td>Text</td>
<td>Symbol</td>
<td>(0 to 1000) Size of text content.</td>
</tr>
<tr>
<td>.text_line_width</td>
<td>Float</td>
<td>Symbol</td>
<td>(0.0 to 100.0) Text line width.</td>
</tr>
<tr>
<td>.text_rotation</td>
<td>Float</td>
<td>Symbol</td>
<td>(0.0 degrees to 360.0 degrees) Angle of text rotation.</td>
</tr>
<tr>
<td>.text_x_size</td>
<td>Float</td>
<td>Symbol</td>
<td>(0 &lt; size &lt; 0.2 inches) Text character size in the X dimension. Relevant if text type = ‘string’.</td>
</tr>
<tr>
<td>.text_y_size</td>
<td>Float</td>
<td>Symbol</td>
<td>(0 &lt; size &lt; 0.2 inches) Text character size in the Y dimension. Relevant if text type = ‘string’.</td>
</tr>
<tr>
<td>.thvpad_required</td>
<td>Boolean</td>
<td>Comp.</td>
<td>Assigned to components which require a theiving pad check during the Padstack Analysis action (e.g. fine pitch SOIC).</td>
</tr>
<tr>
<td>.tie</td>
<td>Boolean</td>
<td>Feature</td>
<td>(No, Yes)</td>
</tr>
<tr>
<td>.tiedown</td>
<td>Boolean</td>
<td>Feature</td>
<td>(No, Yes)</td>
</tr>
<tr>
<td>.toep_spacing_req</td>
<td>Float</td>
<td>Comp.</td>
<td>(1 to 500) Assigned to components for reporting in the Toeprint to Toeprint category in the Signal Layers Check in Analysis. It defines the maximum spacing within which to report pad to pad spacing measurements. Units: inch/mm</td>
</tr>
<tr>
<td>.tooling_hole</td>
<td>Boolean</td>
<td>Feature</td>
<td>Used on drill features to indicate that they are tooling holes.</td>
</tr>
</tbody>
</table>
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<tr>
<td>.transform_data</td>
<td>Text</td>
<td>Step</td>
<td>This attribute is necessary for rebuilding dependent steps. If the attribute exists in the step, Genesis saves the data necessary for rebuilding dependent steps, and enables the automatic update of dependent steps. If the attribute does not exist (old jobs), automatic update is canceled. The data necessary for rebuilding dependent steps is not saved.</td>
</tr>
<tr>
<td>.via_type</td>
<td>Option</td>
<td>Feature</td>
<td>(Drilled; Laser; Photo) Assigned to via drills for the classification of various via pad and via drill categories in the HDI analysis.</td>
</tr>
<tr>
<td>.viacap_layer</td>
<td>Option</td>
<td>Step</td>
<td>(Top; Bottom; Both; None) Defines on which layer via capping can occur, if any.</td>
</tr>
<tr>
<td>.wheel_type</td>
<td>Option</td>
<td>Wheel</td>
<td>(Gerber; Tools) Specifies for a wheel whether it is used for Gerber files translation or for drill file translation.</td>
</tr>
</tbody>
</table>
Appendix C  Frequently Asked Questions

C.1.  Why is the database in ASCII?

An ASCII database provides the user with numerous advantages:

• It is easy to read and understand
• Translators to and from the database formats are easier to write
• The data is portable between different architectures, independent of byte order, floating point formats, etc.

By compressing the ASCII files using standard compress commands, the size of the data is even smaller than the binary equivalent! This is due to the fact that the compression algorithm is adaptive and work very well when certain strings are repeated.

C.2.  When I wish to rotate a feature pad by 90 degrees is the aperture rotated left or right?

Clockwise.

C.3.  Regarding donuts, butterflies, thermals, and moires, do any of these symbols have negative components?

Standard symbols are all positive. All holes in symbols are see-thru by definition.

C.4.  When the start and end-points of a feature coincide, is this considered a 360-degree arc or a single point? Can I draw an arc with a square symbol?

A 360-degree arc; there are no single point arcs in the ODB++ database. Arcs can be drawn only with a round symbol.

C.5.  When I specify an x,y location for text where will the text string be located?

The x,y coordinates will determine the bottom left corner position of the first character of the text string.

C.6.  What is the meaning of the optimize field in a netlist file?

It indicates that the net has been optimized by the Netlist Optimizer function and the end-point markers have been removed from mid-points.

C.7.  In a netlist file, how is the radius field supposed to be set for drills of 0.002 inches thru non-SMDs?

The radius field will be 0.001 mils in this case.

C.8.  In a netlist file, what does the term staggered points mean?

These are points that have been staggered by the staggering algorithm to make them accessible to test probes.
C.9. **For rectangular thermals can I define spoke angles at other than multiples of 45 degrees?**

Rectangular thermals cannot have spoke angles of 45 degrees, only square/round thermals can have angles that are non-multiples of 45 degrees.

C.10. **Can feature files of user-defined symbols contain references to other user-defined symbols?**

Yes, they can. But recursion, direct or indirect is not allowed.

C.11. **Regarding surfaces, is there a particular order in specifying holes and islands?**

The order of containment must be preserved. Islands precede holes that are contained in them. Holes precede islands that are contained in them. Take, for example, the following containment order:

![Image of containment order](image-url)

C.12. **Regarding surfaces, does the outermost island come first?**

Yes.

C.13. **Regarding rounded or chamfered rectangles, how do I specify corners?**

Corners must be specified in ascending order, starting from #1 the top-right corner going counter-clockwise (that is, top-left corner=2, bottom-left=3, etc.).

C.14. **If I want to offset a rectangular pad in X or Y, should I a symbol and use the standard valor definitions to create the offset. As an example, suppose we have a rect pad 70x50 with an X offset of 5. The feature file for the symbol I create would contain:**

```
# Symbol name
#
$0 rect70x50
#
# Pad definition
#
P .005 .0 0 0 0
Is this correct?
```

Instead of defining your own symbols with offsets, you should use the standard rect symbol and offset the coordinate that references it (in the layer features file).
Appendix C  Frequently Asked Questions

C.15. **Why are user-defined symbols not scalable? This means that for every pad size which does not fit in the standard I will have to create a new symbol.**

   Yes, that is right. User-defined special symbols cannot be scaled as standard symbols can. You need to create a new symbol for each set of parameters (make the name signify the dimensions of the symbol, such as: rect70x50, rect50x30, etc.). See “Symbols” on page 22 for further details.

C.16. **Regarding properties (PRP) on components, is there a list of properties that are recognized by the system (such as with system attributes). Where can I find it? The same goes for PRP in the eda/data file.**

   There is no list of predefined properties in the ODB++ database. These are EDA-specific. When we input Mentor data we read all the properties of the components in the data. These properties are shown when displaying a component in the Graphic Station. They can also be used to automatically set an attribute by calling a function that maps properties to attributes.

C.17. **When defining a PKG record (using /steps/step_name/eda/data), it seems that ODB++ expects closed geometries. Is it critical to have only closed elements?**

   Yes, you should close all polygons.

C.18. **In what order should the matrix layers be in?**

   The layers should be ordered according to the stackup of the board: i.e. comp_+top, sigt.. sigb, comp_+bot, drill, drill_1to5, etc.

C.19. **I have problems with the /steps/step_name/eda/data in the PKG section?**

   A PKG record must be followed (the next line) by an outline record. Check for some PKG records that have PRP’s before the outline and make sure you have an outline defined.

C.20. **How are the net_num records numbered?**

   The net_num used in the TOP record corresponds to the sequence of the Net records in the eda/data file. The first Net record is net_num 0, the second is net_num 1 and so on.

C.21. **We have an elaborate tool set to define routing slots and milling contours. How is this data written to ODB++?**

   Milling (referred to as routing in Fabrication, and not to be confused with routing of traces in design) is handled by defining a ‘rout’ layer (similar to a drill layer). The features in this layer correspond to the outline of the shapes that need to be cut out. A rout layer is like any other layer, but in order for it to be used during fabrication, should contain only lines, arcs and circular pads (rout machines can also drill).

C.22. **What net do I assign to points that have no net defined?**

   All features which do not have a net defined should be assigned to net $NONE$ which should be defined in the eda/data file. You must add the net and all it’s points to the CADnet.
C.23. Is there any restriction on the maximum line length in an ODB++ file? Can comment lines be more than 500 characters?

The restrictions are different for different files. In general 500 characters are the limit, but there are exceptions. Any line over the defined limit will be read with the remainder of the line ignored, so comments can be longer than the limit.