SEMI P44-0708
SPECIFICATION FOR OPEN ARTWORK SYSTEM INTERCHANGE STANDARD (OASIS™) SPECIFIC TO MASK TOOLS

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1 Purpose

1.1 This document defines the common mask data format specifications based on OASIS for mask tools, namely "OASIS.MASK."

2 Scope

2.1 OASIS.MASK specification applies to the input data format for mask tools.

NOTICE: This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the users of this standard to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 In the future, a part of restrictions on OASIS.MASK may be relaxed, and OASIS.MASK specification may be extended. In view of this possible enhancement of the specification, mask tools, EDA software, and other products, which support OASIS.MASK format, are advised to parameterize these restrictions (see Figure 1). The details of these restrictions are shown in § 6.

3.2 This document will always be required to remain compliant with SEMI P39 OASIS, so that this document is always a formal subset of SEMI P39 OASIS.

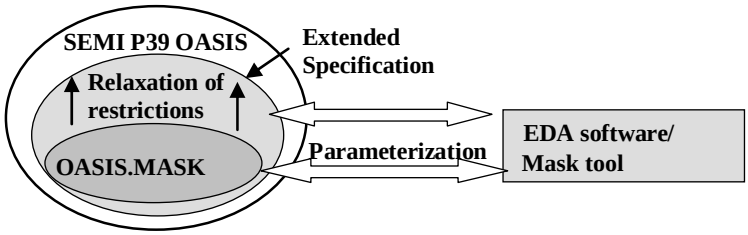

Figure 1
Extension of OASIS.MASK specification

4 Referenced Standards and Documents

4.1 *SEMI Standards*

SEMI P39 — OASIS™ – OPEN ARTWORK SYSTEM INTERCHANGE STANDARD

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *OASIS™* — Open Artwork System Interchange Standard

5.1.2 *OASIS.MASK* — Open Artwork System Interchange Standard (OASIS™) specific to mask tools

5.1.3 *VSB* — Variable Shaped Beam

5.1.4 *UTC* — Coordinated Universal Time

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5.1.5 *EDA* — Electronic Design Automation

5.2 *Definitions*

5.2.1 *cell size* — width and height of cell that is defined by S_BOUNDING_BOX of PROPERTY record.

5.2.2 *chip window* — a drawing area of mask tools.

5.2.3 *data compaction* — expressions for reducing the data of repetition, modality, *et al*.

5.2.4 *empty cell* — a cell which has no figure in itself or in any cells under the cell.

5.2.5 *figure operation* — operations of modifying a figure, required when converting a layout data to a mask data.

5.2.6 *mask restrictions* — restrictions on OASIS format which enables to input the mask data to mask tools.

5.2.7 *localization* — grouping cells according to the specified area size for the efficiency improvement of the input process and the parallel processing of OASIS.MASK. The records of each cell group are also localized in the OASIS.MASK file.

5.2.8 *localization area* — an area which contains one of the cell groups divided by the localization.

5.2.9 *localized cell* — a cell which is placed in single localization area.

5.2.10 *common cell* — a cell which is placed in multiple localization areas.

5.3 *Symbols*

5.3.1 *A* — acceptable record

5.3.1.1 The records generated as needed in the input data for mask tools by the software. The mask tools perform processing according to the contents of the records.

5.3.2 *I* — ignore record

5.3.2.1 The records that may be generated in the input data for mask tools by the software, but will be ignored by the mask tools. The mask tools do not respond to the records.

5.3.3 *M* — mandatory record

5.3.3.1 The records that must be generated in the input data for mask tools by the software. If the records do not exist, the mask tools treat it as an error.

5.3.4 *X* — prohibited record

5.3.4.1 The records prohibited to exist in the input data for mask tools. If the records exist, the mask tools treat it as an error.

6 Requirements

6.1 *Concept of OASIS.MASK*

6.1.1 The concept of OASIS.MASK is shown in Figure 1. OASIS.MASK is a format that defines restrictions to the OASIS format for mask tools. Therefore, OASIS.MASK can be used without modifying OASIS tools.

6.2 *OASIS Format Specification*

6.2.1 See SEMI P39 for OASIS Format Specification.

6.2.2 *Additional Records in OASIS.MASK*

6.2.2.1 In OASIS.MASK, following user properties are added to PROPERTY record.

6.2.3 *File-Level Properties*

6.2.3.1 The following file-level properties can be specified only once immediately after the START record.

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6.2.3.2 *P44_FORMAT*

6.2.3.2.1 This property declares the format type of mask restrictions. Its value consists of a single a-string record. With this specification, the value is "1." It is a mandatory record in OASIS.MASK.

6.2.3.3 *P44_CHIP_WINDOW*

6.2.3.3.1 This property declares the size of a window in terms of the coordinate system of the top cell. Its value consists of four signed-integer records, <*x1*>, <*y1*>, <*x2*>, and <*y2*>. <*x1*> is the *x*-coordinate of the lower left corner of a window, <*y1*> is the y-coordinate of that lower left corner, <*x2*> is the *x*-coordinate of the upper right corner, and <*y2*> is the *y*-coordinate of that upper right corner. It is a mandatory record in OASIS.MASK.

6.2.3.4 *P44_VERSION*

6.2.3.4.1 This property declares the version of OASIS.MASK specification. Its value consists of a single a-string record. With this specification, the value is "2.0." It is a mandatory record in OASIS.MASK.

6.2.3.5 *P44_FILE_SIZE*

6.2.3.5.1 This property declares the file size by the number of bytes. Its value consists of a single unsigned-integer record. It is a mandatory record in OASIS.MASK.

6.2.3.6 *P44_TOP_CELL_NUMBER*

6.2.3.6.1 This property declares the reference number of the top cell to accelerate the search of the top cell. Its value consists of a single unsigned integer record. It is a mandatory record in OASIS.MASK.

6.2.3.7 *P44_CONVERSION_TOOL*

6.2.3.7.1 This property declares the name and the version number of the conversion tool which outputs the OASIS.MASK file. Its value list consists of the following 2 fields: <name> <version>. The name and version fields are a-strings. It is an optional record in OASIS.MASK.

6.2.3.8 *P44_CONVERSION_DATE*

6.2.3.8.1 This property declares the date when the OASIS.MASK file is output. Its value consists of the following 3 fields: <date> <time> <zone>. The date field is an a-string representing the date in the form of DD-MM-YYYY. DD, MM, and YYYY represent the day, month, and year respectively. The time field is an a-string representing the date in the form of HH:MM:SS. HH, MM, and SS represent the hour, minute, and second respectively. The zone field is a real number representing the time difference with UTC. The unit of the time difference is hour. It is a mandatory record in OASIS.MASK.

6.2.3.9 *P44_BOUNDING_BOX_MAX*

6.2.3.9.1 This property declares the upper limit of the cell bounding box permitted in any cell except the top cell. This property declares not the largest cell bounding box but the upper limit of the cell bounding box except the top cell. Its value list consists of the following 2 fields: <width> <height>. The width and height fields are unsigned-integers. It is a mandatory record in OASIS.MASK.

6.2.3.10 *P44_LOCALIZATION*

6.2.3.10.1 This property declares the upper limit of the localization area size, the upper limit of the CELL records volume of localized cells in each localization area and common cells, the count of localization areas actually defined in the OASIS.MASK file, and the byte offset from the beginning of the file (byte 0) to the CELLNAME record of the top cell. Its value list consists of the following 6 fields: <localization-width> <localization-height> <localized-cell-volume> <common-cell-volume> <localization-area-count> <topcell-offset>. All fields are unsigned-integers. Use of localization is optional. If this property is defined, the OASIS.MASK file is localized in a manner as specified by the property. Otherwise, the OASIS.MASK file is not localized.

6.2.3.11 *P44_GEOMETRY_OFFSET_AVAILABLE*

6.2.3.11.1 This property indicates whether or not P44_GEOMETRY_OFFSET properties appear in CELLNAME records. Its value list consists of a single unsigned-integer. A value of 0 means that P44_GEOMETRY_OFFSET properties are not provided. A value of 1 means that P44_GEOMETRY_OFFSET properties are provided for every CELLNAME record excluding the top cell and the bottom level cells. It is a mandatory record in OASIS.MASK.

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6.2.4 *Cell-Level Properties*

6.2.4.1 These properties are cell-level user properties and can be specified immediately after the corresponding CELLNAME record.

6.2.4.2 *P44_GEOMETRY_COUNT*

6.2.4.2.1 This property declares the total count of the RECTANGLE record, the TRAPEZOID record, and the CTARPEZOID record in each cell and appears only once immediately after the corresponding CELLNAME record. It includes only cell-native geometry and does not include expansion of repetitions. Its value list consists of a single unsigned-integer. It is a mandatory record in OASIS.MASK.

6.2.4.3 *P44_GEOMETRY_OFFSET*

6.2.4.3.1 This property declares the byte offset from the beginning of the corresponding CELL record to the first geometry record or the CBLOCK record to which geometry records are stored in the cell. In case that this property is present, all PLACEMENT records in each cell are gathered and appear before geometry records (RECTANGLE/TRAPEZOID/CTRAPEZOID). If the CBLOCK record is used with this property, the PLACEMENT records and geometry records cannot be contained in single CBLOCK. It appears only once immediately after the corresponding CELLNAME record. Its value list consists of a single unsigned-integer. Whether this property is defined or not depends on P44_GEOMETRY_OFFSET_AVAILABLE.

6.2.4.3.2 The value of the byte offset is zero (0) when there is no geometry record in the cell.

6.2.4.3.3 Note that this property is unnecessary for the top cell and the bottom level cells.

6.2.4.4 *P44_LOCALIZATION_AREA*

6.2.4.4.1 This property declares the bounding box of a localization area with other associated properties. It appears immediately after the CELLNAME record of the top cell and may be repeated if there are multiple localization areas. Its value list consists of the following 10 fields: <lower-left-x> <lower-left-y> <upper-right-x> <upper-right-y> <cell-offset> <cell-volume> <cellname-offset> <cellname-volume> <placement-offset> <placement-count>.

6.2.4.4.2 The bounding box fields are defined with respect to the coordinate system of the top cell and they are signed-integers.

6.2.4.4.3 CELL records of localized cells belonging to a particular localization area are contiguously defined in OASIS.MASK file. Cell-offset is the byte offset from the beginning of the file to the head of the CELL records of localized cells in the particular localization area, and cell-volume is the data volume of the contiguous CELL records of localized cells in the localization area. Cell-offset and cell-volume is zero when there is no localized cell in the localization area.

6.2.4.4.4 CELLNAME records of localized cells are also localized in the same manner. Then, cellname-offset declares the byte offset from the beginning of the file to the head of the CELLNAME records of localized cells belonging to the said localization area, and cellname-volume is the data volume of contiguous CELLNAME records of localized cells in the localization area. Cellname-offset and cellname-volume is zero when there is no localized cell in the localization area.

6.2.4.4.5 Placement records which belong to the same localization area are contiguously defined in the CELL record of the top cell. Placement-offset is the byte offset from the head of the CELL record of the top cell to the head of the PLACEMENT record of the particular localization area. Placement-count is the count of the contiguous PLACEMENT records of the localization area.

6.2.4.4.6 All of cell-offset, cell-volume, cellname-offset, cellname-volume, placement-offset, and placement-count are unsigned integers. This property must be defined for each localization area when an OASIS.MASK file is localized.

6.2.4.4.7 If CBLOCK is used for CELLNAME records with the localization, a CBLOCK record cannot contain CELLNAME records in two or more localization areas. The cell-volume and the cellname volume are the volume after the CBLOCK compression.

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6.2.4.5 *P44_COMMON_CELL*

6.2.4.5.1 This property declares the byte offset and the data volume of CELL records and CELLNAME records of common cells. It appears immediately after the CELLNAME record of the top cell with P44_LOCALIZATION_AREA properties only once. Its value list consists of the following 4 fields: <cell-offset> <cell-volume> <cellname-offset> <cellname-volume>.

6.2.4.5.2 CELL records of common cells are contiguously defined in OASIS.MASK file. Cell-offset is the byte offset from the beginning of the file to the head of the CELL records of the common cells, and cell-volume is the data volume of the contiguous CELL records of the common cells.

6.2.4.5.3 CELLNAME records of common cells are also defined in the same manner. Then, cellname-offset declares the byte offset from the beginning of the file to the head of the CELLNAME records belonging to the said common cells, and cellname-volume is the data volume of contiguous CELLNAME records of the common cells.

6.2.4.5.4 All of cell-offset, cell-volume, cellname-offset, and cellname-volume are unsigned integers. This property must be defined when an OASIS.MASK file is localized and a common cell is placed in the file.

6.2.4.5.5 If CBLOCK is used for CELLNAME records of common cells, a CBLOCK record cannot contain CELLNAME records of localized cells. The cell-volume and the cellname volume are the volume after the CBLOCK compression.

6.2.4.5.6 This property is unnecessary when there is no common cell in OASIS.MASK file.

6.3 *Specification of the Mask Restrictions*

6.3.1 *Concept*

6.3.1.1 The restrictions are common among mask tools.

6.3.1.2 The specification reduces the load in the conversion process of mask tools as much as possible, and aims for the direct input to mask tools.

6.3.1.3 The specification maintains the data compaction expression in OASIS as much as possible.

6.3.2 *Restrictions on Figure Operation*

6.3.2.1 Figure operations described in Table 1 should be executed before generating of OASIS.MASK, since these are not done by mask tools.

6.3.3 *Restrictions on OASIS Record*

6.3.3.1 *Common Restrictions*

6.3.3.1.1 The 63 kinds of characters are allowed to be used for cell names and properties, including uppercase (A–Z), lowercase (a–z), numeric character (0–9), and underline (_).

6.3.3.2 *Individual Restrictions*

6.3.3.2.1 The restrictions on each record of OASIS are shown in Table 2. Also, Table 3 shows restrictions in OASIS.MASK to OASIS Standard Properties. The restrictions on user properties are shown in Table 4.

6.3.3.3 *Restrictions on Cell Hierarchy*

6.3.3.3.1 The restrictions on cell hierarchy of OASIS.MASK are shown in Table 5.

6.3.3.3.2 The restrictions on cell hierarchy of OASIS.MASK are shown in Figure 2.

6.3.3.3.3 An example of cell hierarchy is shown in Figure 3.

6.3.3.3.4 An example of localization is shown in Figure 4.

6.3.3.4 *Restrictions on File Name*

6.3.3.4.1 The restrictions on a file name of OASIS.MASK are shown in Table 6.

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