

# SEMI P45-0421

## SPECIFICATION FOR JOB DECK DATA FORMAT FOR MASK TOOLS

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### 1 Purpose

1.1 This Document defines the common job deck data format specifications for mask tools, namely ‘MALY’.

### 2 Scope

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

**NOTICE:** SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

### 3 Limitations

3.1 This Standard does not include the job deck data specification different in each mask tool.

### 4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI P39 — Specification for OASIS® – Open Artwork System Interchange Standard

SEMI P44 — Specification for Open Artwork System Interchange Standard (OASIS®) Specific to Mask Tools

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

### 5 Terminology

5.1 *Abbreviations and Acronyms*

5.1.1 *MALY* — mask layout data format

5.1.2 *OASIS®* — Open Artwork System Interchange Standard

5.1.3 *OASIS.MASK* — Open Artwork System Interchange Standard (OASIS®) specific to Mask Tools

5.2 *Definitions*

5.2.1 *mask* — a photomask for one layer.

5.2.2 *mask set* — a set of masks necessary to manufacture a semiconductor product.

5.2.3 *parameter* — parameters necessary for drawing masks such as the size of mask and the reference point of placement.

5.2.4 *structure* — a group of patterns placed on masks, a cell in OASIS.MASK.

5.2.5 *structure group* — a group of structures with identical drawing condition.

5.2.6 *title* — character strings which identify masks such as the drawing date, the serial number, and the product name.

### 6 Requirements

6.1 *Outline*

6.1.1 MALY is a text file format which defines the mask layout data necessary for mask tools. It is possible to combine this format with the various parameters for creating job deck data in mask tools.

6.1.2 MALY does not depend on mask tools. MALY is the common job deck data format among mask tools.

6.1.3 This format defines a portion of the data required for job deck generation in mask tools.

6.1.4 This format defines mask layout information such as chip positions and title positions.

6.1.5 The position of MALY in mask data preparation is shown in Figure 1.

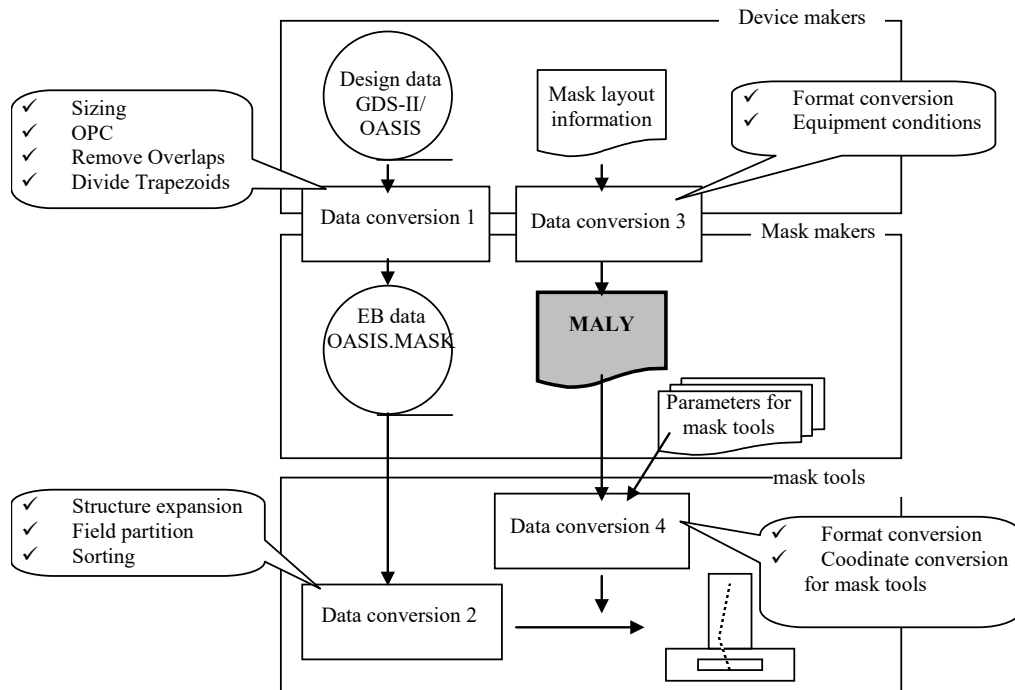


**Figure 1**  
**Position of MALY**

## 6.2 Fundamental Concepts

### 6.2.1 File Composition

6.2.1.1 Figure 2 shows the file composition of MALY. MALY is a file used to create job decks in combination with parameter files for mask tools. MALY defines parameter data, structure positioning data, and title positioning data. It is possible to define a number of masks in a MALY file. Parameter files contain the specific job deck data for mask tools except the mask layout data. The content and the number of files are different in each mask tool.

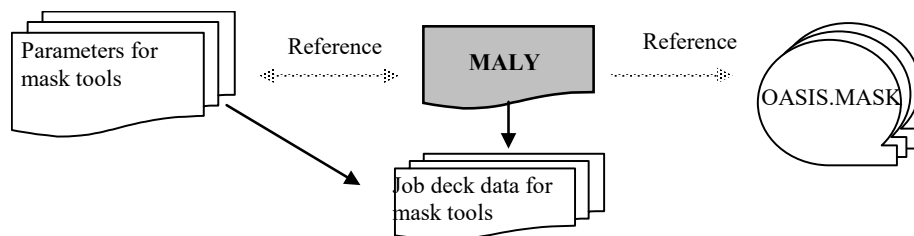


**Figure 2**  
**File Composition**

## 6.2.2 Data Structure

6.2.2.1 Figure 3 shows MALY data items and their relationships.

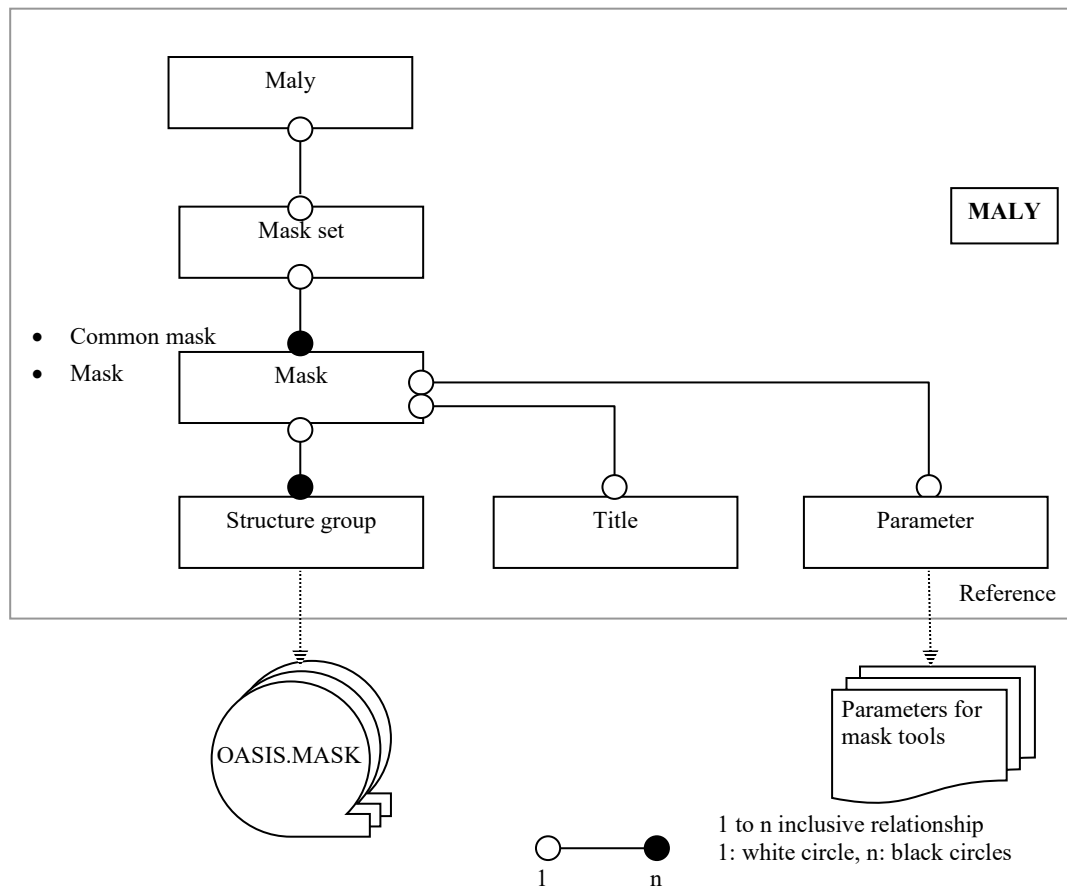


**Figure 3**  
**Data Structure**

## 6.2.3 Preconditions

6.2.3.1 Preconditions of MALY are shown in Tables 1, 2, and 3.

**Table 1 Preconditions of Masks**

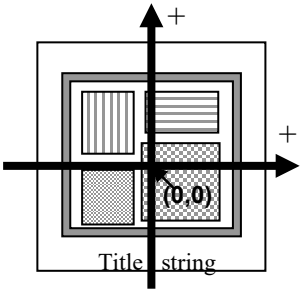
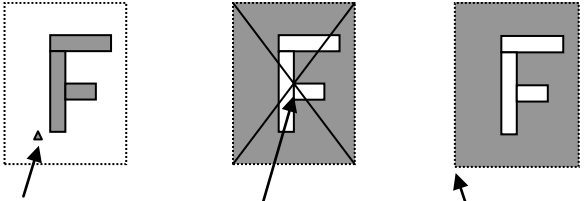
| <i>Item</i>       | <i>Condition</i>                                                                                                        |
|-------------------|-------------------------------------------------------------------------------------------------------------------------|
| Data orientation  | The chrome surface is to be facing upwards (i.e., in the opposite direction to the design data).                        |
| Coordinate origin | The origin is center of the mask.<br> |
| Coordinate space  | Upper right is positive.                                                                                                |
| Rotation          | Not supported.                                                                                                          |
| Mirroring         | Y-axis mirroring based on the mask origin is supported.                                                                 |
| Scaling           | Not supported.                                                                                                          |

**Table 2 Preconditions of Structures**

| <i>Item</i>                  | <i>Condition</i>                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference point of placement | <p>One of the following three items must be selected.</p> <ul style="list-style-type: none"> <li>The origin of the structure.</li> <li>Center of the window defined for the structure.</li> <li>Lower left corner of the window defined for the structure.</li> </ul>  <p>Structure origin      Structure center      Lower left</p> |

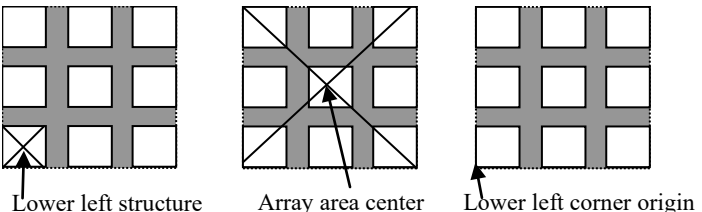
| Item                               | Condition                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reference point of array placement | <p>One of the following three items must be selected.</p> <ul style="list-style-type: none"> <li>Reference point of the lower left structure in the array.</li> <li>Center of the array region.</li> <li>Lower left corner of the array region.</li> </ul>  <p>Lower left structure      Array area center      Lower left corner origin</p> |
| Rotation                           | Allowed for 0, 90, 180 and 270 degrees based on structure origin.                                                                                                                                                                                                                                                                                                                                                              |
| Mirroring                          | Allowed (Y-axis mirroring) based on structure origin.                                                                                                                                                                                                                                                                                                                                                                          |
| Scaling                            | Scaling is based on the reference point of the structure.<br>Scaling does not influence the pitch of the array.                                                                                                                                                                                                                                                                                                                |

**Table 3 Preconditions of Titles**

| Item                         | Condition                                                                                                                                                                                                                      |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Font                         | Standard font or specific font for mask tools must be selected.                                                                                                                                                                |
| Size                         | Height, width, and pitch of the standard font are fixed to 1 mm.<br>The size of the specific font for mask tools depends on the specification of mask tools.                                                                   |
| Reference point of placement | Reference point is center of the entire character string.<br>                                                                              |
| Rotation                     | The entire character string rotates every 90 degrees based on the reference point of the title. Counterclockwise rotation is positive.<br> |
| Mirroring                    | Y-axis mirroring based on the reference point is possible.<br>With the chrome side facing upward, a readable character orientation is standard.                                                                                |
| Scaling                      | Not supported.                                                                                                                                                                                                                 |

## 6.2.4 Range of Parameter Specification

6.2.4.1 The ranges of parameter specification are shown in Table 4.

**Table 4 Ranges of Parameter Specification**

| <i>Item</i>                                        |                                    | <i>Limits</i>                                                                                                                                                                      |
|----------------------------------------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MALY file                                          | Length of the file name            | 64 (not including the directory names)                                                                                                                                             |
|                                                    | Usable characters                  | The following characters may be used.<br>A–Z a–z 0–9, . _<br>The following characters may not be used.<br>! " # \$ % & ' ( ) * + , - / : ; < = > ? @ [ \ ] ^ {   } ~ [space] [tab] |
| OASIS.MASK file                                    | Number of reference files          | Unlimited                                                                                                                                                                          |
|                                                    | Length of the file name            | 64 (not including the directory names) or<br>256 (including the directory name)                                                                                                    |
|                                                    | Usable characters                  | The following characters may be used.<br>A–Z a–z 0–9 . _<br>The following characters may not be used.<br>! " # \$ % & ' ( ) * + , - / : ; < = > ? @ [ \ ] ^ {   } ~ [space] [tab]  |
| Mask                                               | Length of the mask name            | 32                                                                                                                                                                                 |
|                                                    | Usable characters                  | The following characters may be used.<br>A–Z a–z 0–9 . _<br>The following characters may not be used.<br>! " # \$ % & ' ( ) * + , - / : ; < = > ? @ [ \ ] ^ {   } ~ [space] [tab]  |
|                                                    | Mask size                          | 5, 6, 7, 8, or 9 (25.40 mm units), round masks, specific width and height                                                                                                          |
|                                                    | Number of masks                    | Unlimited                                                                                                                                                                          |
| Structure group                                    | Length of the structure group name | 64                                                                                                                                                                                 |
|                                                    | Usable characters                  | The following characters may be used.<br>A–Z a–z 0–9 . _<br>The following characters may not be used.<br>! " # \$ % & ' ( ) * + , - / : ; < = > ? @ [ \ ] ^ {   } ~ [space] [tab]  |
|                                                    | Number of structure group          | Unlimited                                                                                                                                                                          |
| Structure                                          | Length of structure name           | 256; based on OASIS.MASK standard                                                                                                                                                  |
|                                                    | Usable characters                  | A–Z, a–z, 0–9 and _ based on OASIS.MASK standard                                                                                                                                   |
|                                                    | Number of placements               | Unlimited                                                                                                                                                                          |
|                                                    | Coordinates of placements          | Range: within the mask size                                                                                                                                                        |
|                                                    | Scaling                            | Scaling does not influence the array pitch.                                                                                                                                        |
|                                                    | Number of array repetitions        | Unlimited                                                                                                                                                                          |
|                                                    | Array pitch                        | Units: $\mu\text{m}$ , positive values only                                                                                                                                        |
| Property<br>(common to DNAME,<br>MNAME, and ENAME) | Length of property name            | 64                                                                                                                                                                                 |
|                                                    | Usable characters                  | The following characters may be used.<br>A–Z a–z 0–9 _<br>The following characters may not be used.<br>! " # \$ % & ' ( ) * + , - / : ; < = > ? @ [ \ ] ^ {   } ~ [space] [tab]    |

| <i>Item</i> |                           | <i>Limits</i>                                                                                                                                                                        |
|-------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Title       | Number of placements      | 6 per mask (total of MASK and CMASK)<br>[Breakdown]<br>Date title: 1 per mask<br>Serial number title: 1 per mask<br>Character string titles: 4 per mask                              |
|             | Coordinates of placements | Range: within the mask size                                                                                                                                                          |
|             | Number of characters      | 64 per title                                                                                                                                                                         |
|             | Usable characters         | The following characters may be used.<br>A–Z 0–9 ! # % & * + , - . / : ; < = > ? @ _ [space]<br>The following characters may not be used.<br>a to z “ \$ ' ( ) [ \ ] ^ {   } ~ [tab] |
|             | Size                      | Units: mm<br>Height, width, and pitch of the standard font are fixed to 1 mm.<br>The size of the specific font for mask tools depends on the specification of mask tools.            |
|             | Angle                     | 0, 90, 180, and 270 only                                                                                                                                                             |
| Mask Tool   | Length of the tool name   | 256                                                                                                                                                                                  |
|             | Usable characters         | The following characters may be used.<br>A–Z a–z 0–9 ; . _ -<br>The following characters may not be used.<br>! " # \$ % & ' ( ) * + , / : < = > ? @ [ \ ] ^ {   } ~ [space] [tab]    |

## 6.3 Description of Records

### 6.3.1 Record Formats

#### 6.3.1.1 Record formats are shown in Table 5.

**Table 5 Record Formats**

| <i>Symbol</i>           | <i>Meaning</i>                                                                                                                                                                                          |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| //                      | This symbol indicates that the remainder of the line will be treated as a comment.                                                                                                                      |
| /* */                   | All text between these symbols will be treated as a comment.                                                                                                                                            |
| [space][tab][line-feed] | These characters are used for punctuation (i.e., separators). However, if enclosed in quotation marks (i.e., “ ”), tab and space will not be considered as separators.                                  |
| + (first column)        | When this character is present in the first column, it will indicate a continuation from the previous line. This feature is kept for upward compatibility with version 1.1 of the standard but useless. |

### 6.3.2 List of Records

6.3.2.1 Records of MALY are shown in Tables 6 through 12.

6.3.2.2 Space between words represent any separator (single or multiple).

**Table 6 Maly Section [MALY]**

| <i>Record Name</i>        | <i>Description</i>                          |
|---------------------------|---------------------------------------------|
| BEGIN MALY version_number | Start of the maly section                   |
| MASK TOOL masktool        | Mask tool(s) intended to use this maly file |
| END MALY                  | End of the maly section                     |

**Table 7 Mask Set Section Records [MASKSET]**

| <i>Record Name</i> | <i>Description</i>            |
|--------------------|-------------------------------|
| BEGIN MASKSET      | Start of the mask set section |
| END MASKSET        | End of the mask set section   |

**Table 8 Common Mask Section Records [CMASK]**

| <i>Record Name</i> | <i>Description</i>               |
|--------------------|----------------------------------|
| BEGIN CMASK        | Start of the common mask section |
| END CMASK          | End of the common mask section   |

**Table 9 Mask Section Records [MASK]**

| <i>Record Name</i>   | <i>Description</i>        |
|----------------------|---------------------------|
| BEGIN MASK mask_name | Start of the mask section |
| END MASK             | End of the mask section   |

**Table 10 Parameter Section Records [PARAMETER]**

| <i>Record Name</i>                    | <i>Description</i>                      |
|---------------------------------------|-----------------------------------------|
| BEGIN PARAMETER                       | Start of the parameter section          |
| END PARAMETER                         | End of the parameter section            |
| MASKSIZE size                         | Mask size                               |
| FONT {STANDARD   NATIVE}              | Font setting                            |
| BASE {ORIGIN   CENTER   LOWERLEFT}    | Structure reference point setting       |
| ARYBASE {ORIGIN   CENTER   LOWERLEFT} | Array structure reference point setting |
| ROOT {OASIS.MASK   NATIVE} directory  | Root directory setting                  |
| REFERENCE TOOL file_name              | Reference file setting                  |
| MASKMIRROR {NONE   Y}                 | Mask mirror setting                     |
| RESISTTYPE {POSITIVE   NEGATIVE}      | Resist polarity                         |

**Table 11 Title Section Records [TITLE]**

| <i>Record Name</i> | <i>Description</i>         |
|--------------------|----------------------------|
| BEGIN TITLE        | Start of the title section |
| END TITLE          | End of the title section   |

| Record Name                                                                    | Description                   |
|--------------------------------------------------------------------------------|-------------------------------|
| DATE {[x y [MIRROR {NONE   Y}] [ROTATE angle]]   OFF}                          | Date title setting            |
| SERIAL {[x y [MIRROR {NONE   Y}] [ROTATE angle]]   OFF}                        | Serial number title setting   |
| STRING string x y [SIZE width height pitch] [MIRROR {NONE   Y}] [ROTATE angle] | Optional string title setting |

**Table 12 Structure Group Section Records [STRGROUP]**

| Record Name                                                                                                                                                                                                 | Description                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| BEGIN STRGROUP group_name                                                                                                                                                                                   | Start of the structure group section          |
| END STRGROUP                                                                                                                                                                                                | End of the structure group section            |
| SREF oasis.mask_name structure_name layer<br>ORG x y SIZE x1 y1 x2 y2 [SCALE scale] [GRID value] [ROTATE angle]<br>[MIRROR {NONE   Y}] [DIGITIZED_DATA_DARK {N   Y}]                                        | Structure placement and writing setting       |
| AREF oasis.mask_name structure_name layer<br>ORG x y SIZE x1 y1 x2 y2 [SCALE scale] [GRID value] [ROTATE angle]<br>[MIRROR {NONE   Y}] [DIGITIZED_DATA_DARK {N   Y}]<br>ITERATION xiter yiter xpitch ypitch | Array structure placement and writing setting |
| PROPERTY [DNAME design_name] [MNAME mask_name] [ENAME native_name]                                                                                                                                          | Property setting                              |

### 6.3.3 Maly Section Records

6.3.3.1 When Maly section records are made of multiple keywords, any kind of separator (single or multiple) can be used between words.

#### 6.3.3.2 BEGIN MALY Record

6.3.3.2.1 A BEGIN MALY record represents the start of the maly section.

|                           |                           |
|---------------------------|---------------------------|
| BEGIN MALY version_number | Start of the maly section |
|---------------------------|---------------------------|

*Version\_number* Indicates the version number of the MALY specification. With this Specification, the value is “2.1”.

6.3.3.2.2 In the MALY file, it is necessary to define the BEGIN MALY record once and to begin with this record.

6.3.3.2.3 A MASK TOOL record may appear immediately following the BEGIN MALY record. This record identifies the mask tool(s) for which this maly file is intended.

6.3.3.2.4 The following section may appear between the BEGIN MALY record and the END MALY record.

[MASKSET] Mask set section — it is necessary to define this section once.

#### 6.3.3.3 END MALY Record

6.3.3.3.1 An END MALY record represents the end of the maly section.

|          |                         |
|----------|-------------------------|
| END MALY | End of the maly section |
|----------|-------------------------|

6.3.3.3.2 A section starting with the BEGIN MALY record must end using the END MALY record. In the MALY file, it is necessary to define this record once and to end with this record.