



SEMI P10-92

SPECIFICATION OF DATA STRUCTURE FOR PHOTOMASK ORDER ENTRY

1. Introduction

This data structure specification is intended to facilitate the transmittal of mask order data between software systems to allow automated order placement by mask customers and to allow the automatic processing of such orders by mask shops.

By using this standardized structure, software written independently for either mask customers or mask shops should be able to communicate unambiguously with software written by other parties.

This structure only defines the data format for the transmitted file. No particular database or programming language is specified by this standard. The order entry file is to be transmitted as an ASCII file. As such, it is compatible with the SECS-II standard.

2. Applicable Standards

2.1 ASTM Standards¹

F 127 Definition of Terms Relating to
 Photomasking Technology

2.2 SEMI Standards

SEMI P1 Specifications for Hard Surface Photomask
 Substrates

SEMI P2 Specifications for Chrome Thin Films for
 Hard Surface Photomasks

3. Restrictions

3.1 For a given customer, all pattern file names must be unique. (i.e., Pattern files which are different may not have the same name.)

3.2 For a given customer, all job file names must be unique. (i.e., Job files which are different may not have the same name.)

3.3 For a given customer, each mask set must have a unique identification.

3.4 For a given customer, each magnetic tape must have a unique identification.

4. Instructions And Conventions:

4.1 Each record in the file will be composed of a specific keyword identifier followed by a data value, and will be terminated by a carriage return and/or linefeed.

4.2 Only records which are required to specify the order need to be included in the transmitted order entry file, but each record included must appear in the sequence shown in the syntax specification.

4.3 Subsequent modifications or additions to the mask set require transmittal of all the information for the specific masks involved. Masks previously ordered which are not affected by the new order transmission may have their <mask_definition>, <mask_group> or <mask_set> omitted as appropriate.

4.4 Options are specified hierarchically such that those specified at a higher level are the default for all masks below, unless overridden at a lower level. The hierarchy is such that mask set options override mask group options, followed by mask definition, cell definition, cell instance, pattern group definition, and pattern definition.

4.5 Mask groups describe sets of masks which are similarly constructed. In simple cases there will be only one mask group per mask set. Multiple mask groups will be needed to describe mix-and-match sets, or for situations within a mask set where different features are required on some masks.

4.6 Pattern group definitions are intended for patterns which are similarly placed on all or most masks within a mask group (e.g. primary pattern files or test pattern files).

4.7 Cell definitions describe the construction of clusters of pattern groups and/or other cells. The `PLACEMENT_TOP_CELL` under a mask group describes the overall layout of the cells on all masks within the mask group.

4.8 Within a given mask set, each mask must have a unique identification (`MASK_ID`), independent of any titles on the mask.

¹ American Society for Testing & Materials, 1916 Race Street, Philadelphia, PA 19103



4.9 The MASK_ID's defined under a mask group specify the masks to be built. The MASK_ID's also identify which patterns are to appear on the mask.

A pattern is placed on the mask if and only if the MASK_ID matches the LEVEL_ID of a pattern referenced under the mask group's PLACE-MENT_TOP_CELL.

4.10 CELL_INSTANCE and PATTERN_GROUP_INSTANCE LOCATION's position the center of the patterns relative to the center of the CELL_ID referencing them. The cell referenced by the PLACE-MENT_TOP_CELL is positioned at the center of the mask.

4.11 Job file data may be supplied in place of cell and pattern group data. In this case, the MASK_ID is understood to correspond to the job level used in the job file.

4.12 LOCATION's of reference marks, mask titles and vendor-supplied barcodes are relative to the center of the mask.

4.13 All data in the structure will be in ASCII. The keyword in each record must include only upper case alphabetic characters and underscore.

4.14 Records (keyword, data value, comment and new line) may not exceed 80 characters. Some records may be repeated (e.g., BUSINESS_ADDRESS) in order to allow for longer field requirements; these are explicitly indicated in the syntax specification.

4.15 Comments may be included in records by preceding them with an exclamation point (!). Any data following an exclamation point and preceding a carriage return and/or linefeed will be ignored. Such comments are included in the 80 character record limit. If a record starts with an exclamation point, the entire record will be ignored. Only printable ASCII characters (plus spaces and tabs) are permitted in comments. Comments are for development and diagnostic purposes only. In commercial use, comments may always be ignored by the recipient without consequence. On the other hand, ADDITIONAL_..._INFO records must be evaluated by the recipient and applied to the masks being ordered, and may justify delay in mask delivery.

4.16 Spaces or tabs preceding the keyword will be ignored. At least one space or tab must precede the data field. Spaces and tabs imbedded in alphanumeric data fields will be preserved. Spaces or tabs may not be imbedded within numeric data values, but may be used to separate data values in multi-value data fields. At least one comma must appear between adjacent data values in multi-value data fields; more than one comma may not

appear between adjacent data values. Spaces or tabs trailing the last data value in a data field will be ignored.

4.17 All numeric record values which require units will be in metric unless otherwise specified in the attached "TERMINOLOGY". Units of length or position will be in microns unless otherwise specified.

4.18 Dates will be in the numeric format DD-MM-YYYY. Times will be in the format HH:MM:SS OR HH:MM. Within the transmitted file, times and dates will always be Greenwich mean time.

4.19 Sizing to achieve a CD_TARGET from a CD_DATA must be applied to all pattern files hierarchically affected by the CD_TARGET record.

4.20 The keyword identifier "INCLUDE" may appear anywhere within the data structure and will cause inclusion of the file specified by the data value at that location within the structure. The referenced filename must be unique among files transmitted by the customer. INCLUDE filenames will always have be alphanumeric, followed by the extension ".INC".

4.21 Future modifications to the order entry data structure must provide for upward compatibility.

4.22 Since complex data manipulation operations are composed of simple binary and unary operations, intermediate files will need to be named. These names may be comprised of any printable ASCII characters, and must be unique within all revisions of the <mask_set>.

4.23 Binary data manipulation operations expect operands (input pattern files) to align center-to-center. This requires that DATA_PATTERN_WINDOW be defined for patterns which do not contain an explicit record of file extents.

5. Syntax Specification

The following specifies the syntax for the mask order entry structure. The record order is specific; records must appear in the sequence shown. Terminology for the individual records and their allowed data values are specified under "TERMINOLOGY".

5.1 *Syntax Symbol Definition* - The lower case syntactic names within <> are used to refer to collections of records. The use of {} around records or collections of records means an arbitrary number of repetitions of the records, including none at all. The use of [] around a record or collection of records means that the collection is optional.

5.2 *Record Syntax* - A keyword is followed by a data field which is followed by an optional comment. The record is terminated by a carriage return and/or linefeed. Each of these elements may be preceded by any combination

of spaces or tabs, which will be ignored. At least one space or tab is required preceding the first data value in the record. An exclamation point (!) is required to initiate a comment. Exclamation points, carriage returns, and linefeeds are not allowed in keywords, data values or comments. Note that a record consisting of a comment only is also allowed. The syntax for individual records is defined as:

```
<record> = [[<separator>] <keyword>
            <separator> {<separator>} <data_field>]
            [[<separator>] !<comment>]
            {<separator>} <new_line>
```

where "separator" is a space or a tab, "comment" is any string of printable ASCII characters (plus spaces and tabs), and "new_line" is a carriage return, linefeed or both.

5.3 Multi-value Data Field Syntax - When data_field is for (x,y) pairs or (x1,y1,x2,y2) double pairs (see TERMINOLOGY), the individual values must be separated by a comma and any combination of spaces or tabs. One

comma is required between each data_value, but not more than one comma. Two commas without an intervening data value are not permissible.

(x,y) = value {separator} comma {separator} value

(x1,y1,x2,y2) = (x1,y1) {separator} comma {separator} (x2,y2)

For data manipulation operations, three- and six- value data fields are also allowed:

(x,y,z) = (x,y) {separator} comma {separator} (z)

(x,y,x1,y1,x2,y2) = (x,y) {separator} comma {separator} (x1,y1,x2,y2)

5.4 Mask Order Entry Structure Syntax - The following syntax definition uses the upper case keyword to represent the permissible applications of the corresponding data record within the mask order entry structure.

```
<mask_order> =      START_ORDER SEMI_REVISION CUSTOMER VENDOR
                     FILE_DATE_TIME [OPERATOR_NAME] [XMISSION_ACKNOWLEDGED]
                     {<mask_set>} END_ORDER CHECKSUM

<mask_set> =        MASK_SET_ID <mask_set_options> END_MASK_SET_OPTIONS
                     {<mask_group>} END_MASK_SET

<mask_set_options> = [BUSINESS_CONTACT] {BUSINESS_ADDRESS} {BUSINESS_PHONE}
                     [BILLING_CONTACT] {BILLING_ADDRESS} {BILLING_PHONE}
                     [PRICE_UNITS]
                     [ENGINEERING_CONTACT] {ENGINEERING_ADDRESS}
                     {ENGINEERING_PHONE}
                     [CUSTOMER_COMPUTER_ADDR] [VENDOR_COMPUTER_ADDR]
                     [SHIPPING_CONTACT] {SHIPPING_ADDRESS} {SHIPPING_PHONE}
                     {SHIPPING_METHOD}
                     [SHIP_REGISTR_DATA [<schedule>]]
                     [SHIP_DEFECT_DATA [<schedule>]]
                     [SHIP_CD_DATA [<schedule>]]
                     [SHIP_DATABASE_DATA [<schedule>]]
                     [REPAIRS_AUTHORIZED]
                     [SHIP_REPAIR_DATA [<schedule>]]
                     [SHIP_SURFACE_INSPECTION_DATA [<SCHEDULE>]]
                     [SHIP_THRU_PELLCLE_DATA [<SCHEDULE>]]
                     {<data>}
                     {<standard_pattern>}
                     {<data_manipulation>}
                     [MASK_SET_NAME [MASK_SET_VERSION]]
                     {ADDITIONAL_MASK_SET_INFO}

<schedule> =        [DUE_DATE_TIME_REQUESTED] [DUE_DATE_TIME_COMMITTED]
                     [SHIP_DATE_TIME] [RECEIVE_DATE_TIME]]

<data> =            DATA_MEDIUM [DATA_ID] [DATA_FORMAT] [DATA_DENSITY]
                     {<pattern_data>} {<job_data>} {MEASURE_FILE_NAME}
                     END_DATA_ID
```



<pattern_data> = DATA_PATTERN_NAME PATTERN_FORMAT [DATA_FILE_NUMBER]
[DATA_TOP_CELL] [DATA_LAYER_ID] [DATA_PATTERN_WINDOW]
[PATTERN_UNITS] [PATTERN_CHARACTER_SET]

<job_data> = DATA_JOB_NAME JOB_FORMAT

<standard_pattern> = STD_PATTERN_NAME PATTERN_FORMAT

<data_manipulation> = [AND] [OR] [XOR] [NOT] [MINUS] [SIZING]
[DATA_SCALE_FACTOR] [PATTERN_ADDRESS_SIZE]
[DARK_INTERNAL_WINDOW] [CLEAR_INTERNAL_WINDOW]
[EXTERNAL_WINDOW] [ROTATION] [MIRROR]

<mask_group> = MASK_GROUP_ID [<mask_options>] END_MASK_GROUP_OPTIONS
PLACEMENT_TOP_CELL {<mask_definition>}
{<cell_definition>} {<pattern_group>} END_MASK_GROUP

<mask_options> = [PO_NUMBER] [SO_NUMBER] [ORDER_ID]
[RELEASE_NUMBER] [QUOTE_NUMBER]
[STATUS]
[<schedule>] [LAYER_PRIORITY [ELAPSED_TIME]]
[PRICE]
[MFG_SITE] [MFG_EQUIP]
{PRODUCT_TYPE [QUANTITY] [PRODUCT_AS_CHECKPLATE]]
[JOB_NAME] [JOB_LEVEL]
[RETROFIT_JOB_NAME] [RETROFIT_JOB_LEVEL]
[RETROFIT_MASK_SET] [RETROFIT_MASK_ID]
[RETROFIT_MASK_SET_NAME] [RETROFIT_MASK_SET_VERSION]
[RETROFIT_MASK_NAME]]
{<title_data>}
{<barcode_data>}
[<array_plot>]
{<films>}
[SERIAL_NUMBER]
[MIRROR_MASK]
[GLASS_SIZE] [GLASS_TYPE]
[FLATNESS] [MASK_COATING]
[RESIST_TYPE] [PROCESS]
{TOP_PELLCLE_TYPE [PRICE]}
{BOTTOM_PELLCLE_TYPE [PRICE]}
{GUIDES_REQD [PRICE]}
[REGISTR_ERROR] [REGISTR_ORTHO]
[REGISTR_REF_MASK_ID]
[REGISTR_EQUIP_REQD]
[MASK_REGISTR_MARK [MEASURE_FILE_NAME]
[REGISTR_MARK_SEPARATION REGISTR_MARK_COUNT]]
[DIE_FIT_EQUIP_REQD]
[DIE_FIT_MASK_ID]
[<cd_definition>]
[[MASK_CD_LOCATION] [<cd_description>]]
[MIN_MASK_FEATURE_SIZE]
[<defect_definition>]
[<database_inspection>]
[INSPECTION_REF_LOCATION]
{PACKAGE [MAX_MASKS_IN_PACKAGE]}
[ADDITIONAL_MASK_INFO]



<title_data> = TITLE_TEXT [MASK_GROUP_TITLE]
[TITLE_JUSTIFICATION] [TITLE_LOCATION] [MIRROR_TITLE]
[ROTATE_TITLE] [ROTATE_TITLE_CHARACTERS]

<barcode_data> = [BARCODE_TYPE] [BARCODE_TEXT] [BARCODE_LOCATION]

<array_plot> = SHIP_ARRAY_PLOT [QUANTITY]
[ARRAY_PLOT_SCALE] [ARRAY_PLOT_APPROVAL_REQD]
[PRICE] [<schedule>]

<films> = SHIP_FILM [<schedule>] [QUANTITY]
[FILM_SCALE] [FILM_SIZE] [FILM_COLOR] [FILM_NORMAL_TONE]
[PRICE] [<schedule>]

<cd_definition> = [CD_DATA] [CD_DIGITIZED] [CD_TARGET]
[CD_REFERENCE_ONLY]
[CD_TOLERANCE] [CD_XY_TOLERANCE]
[CD_RANGE] [CD_UNIFORMITY]
[CD_DEVIATION_FROM_TARGET] [CD_DEVIATION_FROM_MEAN]
[CD_STD] [CD_CORRELATION_DATE]
[CD_EQUIP_REQD]

<cd_description> = [CD_FEATURE] [CD_LOCATION_DRAWING] [CD_DRAWING]

<defect_definition> = [VISUAL_INSPECTION_OK] [VISUAL_INSPECTION_REQD]
[AUTO_INSPECTION_REQD]
[DEFECT_SIZE] [DEFECT_SIZE_CL] [DEFECT_SIZE_DK]
[DEFECT_SIZE_CL_ADJ] [DEFECT_SIZE_CL_ADJ_REP]
[DEFECT_SIZE_DK_ADJ] [DEFECT_SIZE_DK_ADJ_REP]
[DEFECT_SIZE_CL_ISO] [DEFECT_SIZE_CL_ISO_REP]
[DEFECT_SIZE_DK_ISO] [DEFECT_SIZE_DK_ISO_REP]
[DEFECT_DENSITY] [DEFECT_COUNT] [DEFECT_COUNT_REP]
[DEFECTIVE_DIE_DENSITY] [DEFECTIVE_DIE_COUNT]
[DEFECTIVE_DIE_COUNT_REP]
[PERCENT_DEFECTIVE_DIE]
[EDGE_RAGGEDNESS] [EDGE_ROUGHNESS]
[SCRATCH_SIZE_FRONT] [SCRATCH_SIZE_BACK]
[INSPECTION_AREA]
[SURFACE_INSPECTION]
[INSPECT_THROUGH_PELLLICLE [<defect_definition>]]
[GOOD_FIELDS]
[DEFECT_EQUIP_REQD]

<database_inspection> = DATABASE_INSPECTION [PRICE]
[DATABASE_SOURCE]
[DATABASE_TOP_CELL DATABASE_LAYER]
[DATABASE_FILE_NAME]
[DATABASE_UNIT] [USER_UNIT]
[DATABASE_WITH_JOB]
[DATABASE_AREA]

<mask_definition> = MASK_ID [MASK_NAME] DELIVERABLE_MASK
<mask_options> END_MASK

<cell_definition> = CELL_ID <pattern_options> END_CELL_OPTIONS
{<cell_instance>} {<pattern_instance>} END_CELL

<pattern_group> = PATTERN_GROUP_ID <pattern_options>
END_PATTERN_GROUP_OPTIONS {<pattern_definitions>}
END_PATTERN_GROUP



<pattern_definitions> =
 LEVEL_ID
 [PATTERN_NAME] [PATTERN_VISUAL_ID] [FIGURE_COUNT]
 [MINIMUM_FEATURE_SIZE {MINIMUM_FEATURE_LOCATION}]
 [OPTICAL_MASK_SET_ID [OPTICAL_MASK_ID]]
 [OPTICAL_MASK_TITLE]
 <pattern_options>
 END_PATTERN_DEFINITION

<cell_instance> =
 CELL_INSTANCE <pattern_options>
 END_CELL_INSTANCE_OPTIONS {<placement>}

<pattern_instance> =
 PATTERN_GROUP_INSTANCE <pattern_options> {<placement>}

<placement> =
 [LOCATION [STEPPING_DISTANCE STEPPING_COUNT]]
 [ARRAY_DIAMETER ARRAY_CENTER[ARRAY_DIAMETER_INCLUSIVE]]
 [DATA_OFFSET]
 {DROPOUT [SCRIBE_TONE SCRIBE_INSIDE_CORNERS
 SCRIBE_OUTSIDE_CORNERS]}
 [LOCATION_SPEC] {CD_MEASURE_DIE}

<pattern_options> =
 [PATTERN_ADDRESS_SIZE] [SCALE_FACTOR]
 [DIGITIZED_DATA_DARK]
 [STRIPE_HEIGHT]
 [UNSCALED_PATTERN_SIZE]
 [SURROUNDING_TONE SURROUNDING_WIDTH
 SURROUNDING_HEIGHT]
 [MIRROR_PATTERN]
 [SHIP_PATTERN_PLOT [PRICE] [QUANTITY] [<schedule>]]
 [PATTERN_PLOT_SCALE] [PATTERN_PLOT_NORMAL_TONE]
 [PATTERN_PLOT_APPR_REQD]
 {<films>}
 [CELL_REGISTR_MARK [MEASURE_FILE_NAME]
 [REGISTR_MARK_SEPARATION REGISTR_MARK_COUNT]]
 [DIE_FIT_ERROR] [DIE_FIT_ORTHO]
 [<cd_definition>]
 [{CD_LOCATION} [<cd_description>]]
 [<defect_definition>]
 [<database_inspection>]
 [BUTTING_ERROR]
 {ADDITIONAL_PATTERN_INFO}

6. Terminology

Values in parentheses indicate the only acceptable alternative data values for the record and must be transmitted exactly as shown. (x,y) indicates the acceptable data value must be an ordered pair of dimensions, coordinates, repeat counts, filenames or other parameters. (x,y,z) in-

dicates an ordered triple. (x1,y1,x2,y2) indicates a window with two ordered pairs, (x1,y1) and (x2,y2), describing the lower left and upper right corners respectively. Records without specified alternative values may have any appropriate data value.

ADDITIONAL_MASK_INFO	any information necessary to specify the mask(s) which cannot be specified elsewhere in the order entry structure. ADDITIONAL_MASK_SET_INFO any information necessary to specify the overall mask set which cannot be specified elsewhere in the order entry structure; must be brought to the attention of mask vendor personnel.
ADDITIONAL_PATTERN_INFO	any information necessary to specify the pattern(s) which cannot be specified elsewhere in the order entry structure.
AND	(x,y,z) name of file (x) to be formed by the logical intersection of the digitized geometries in file (y) and file (z). The extents of the pattern file (x) will be the same as for file (y).
ARRAY_CENTER	center of circular array limit, relative to the center of the mask.
ARRAY_DIAMETER	diameter of circular array limit to be applied to pattern files.
ARRAY_DIAMETER_INCLUSIVE (T or F)	If T, then die which are at least partially included within the circular array limit must be included in the array. If F, then only die which are wholly included within the circular array limit may be included in the array.
ARRAY_PLOT_APPROVAL_REQD	customer approval of array map is required before mask making is authorized.
ARRAY_PLOT_SCALE	numeric scale of array map
AUTO_INSPECTION_REQD (T or F)	Automated inspection of the mask for defects is required.
BARCODE_LOCATION	(x,y) location to place the center of the vendor-generated barcode.
BARCODE_TEXT	text to be used by the vendor to build the barcode.
BARCODE_TYPE	(ASM, ASET, CANON, GCA or NIKON, and others on request) encoding system to be used by the vendor to build the required barcode.
BILLING_ADDRESS	address for billing.
BILLING_CONTACT	name of person to contact for billing purposes.
BILLING_PHONE	Phone number for BILLING_CONTACT.
BOTTOM_PELLCLE_TYPE	alphanumeric brand and model of acceptable pellicle for the glass side of the mask. Alternatively, the brand and model of stepper or aligner may be given, with the vendor being free to select any pellicle which meets the equipment manufacturer's requirements.
BUSINESS_ADDRESS	address of person placing the order.
BUSINESS_CONTACT	name of person placing the order.
BUSINESS_PHONE	Phone number for BUSINESS_CONTACT.
BUTTING_ERROR	maximum misalignment of features due to stitching of adjacent fields in the segmented writing of a mask.
CD_CORRELATION_DATE	date of the vendor/customer correlation test to be used in measuring CD's.
CD_DATA	size of critical dimension feature in data (unscaled).
CD_DEVIATION_FROM_MEAN	maximum acceptable deviation of any of the customer-required CD measurements from the mean of those measurements.