

SEMI P42-0304

SPECIFICATION OF RETICLE DATA FOR AUTOMATIC RECIPE TRANSFER TO WAFER EXPOSURE SYSTEM

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1 Purpose

1.1 This specification defines a common data interface, which consists of frame information of reticle data, in order to prepare recipes for wafer exposure tools. By utilizing this interface, it becomes possible to carry out data handling between design and wafer manufacture so that the data can be reused during recipe making of wafer exposure tools. This standard is intended to assist automatic recipe generation of wafer exposure tools.

2 Scope

2.1 This standard details frame information in automatic recipe preparation for wafer exposure equipment. This standard focuses on communication interface in work flow of design, mask manufacturing, and wafer manufacturing processes.

2.1.1 This standard defines the items of the required and common design information at a reticle design and a recipe preparation for wafer exposure equipment.

2.1.2 This standard defines a data interface, which can be commonly used independently to the suppliers and models of exposure equipment.

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3 Limitations

3.1 This data interface is expandable (an item addition and a user definition are enabled) instead of fixed, and serves as a form with flexibility.

3.2 This standard uses the current XML standard to describe a reticle data interface.

3.3 This standard does not provide the definition of the handling interface of device design data. Only the data interface specific to frame data information is defined.

3.4 The wafer map information by reticle frame data and the wafer, which exposure equipment uses, are defined in this standard.

3.5 This standard includes the handling items of the related information for reticle exposure and a mark formation process (reticle) required for automatic recipe preparation.

3.6 Recipe preparation is shown in Figure 1. This document focuses on reticle data management (RDM) interface (IF) as indicated in Figure 1.

4 Referenced Standards and Documents

4.1 JEITA Document¹

Reticle Data Management Guideline Ver.1.0 (2001) — (<http://jeita-smtc.elisasp.net/>)

¹ Japanese Electronic and Information Technology Industries Association, Tokyo Chamber of Commerce and Industry Bldg. 2-2, Marunouchi 3-chome, Chiyoda-ku, Tokyo 100-0005, Japan, <http://www.jeita.or.jp>

4.2 World Wide Web Consortium Documents²

Extensible Markup Language (XML) 1.0 (Second Edition) — W3C, 6 October 2000 (<http://www.w3.org/TR/2000/REC-xml-20001006>)

Extensible Markup Language (XML) 1.1 — W3C, 15 October 2002 (<http://www.w3.org/TR/2002/CR-xml11-20021015>)

Extensible Markup Language (XML) 1.1 — 15 October 2002, John Cowan (<http://www.w3.org/TR/2002/CR-xml-names11-20021218/>)

Namespaces in XML — W3C, 14 January 1999 (<http://www.w3.org/TR/1999/REC-xml-names-19990114/>)

XML Schema Part 0: Primer — W3C, 2 May 2001 (<http://www.w3.org/TR/xmlschema-0/>)

XML Schema Part 1: Structures — W3C, 2 May 2001 (<http://www.w3.org/TR/xmlschema-1/>)

XML Schema Part 2: Datatypes — W3C, 2 May 2001 (<http://www.w3.org/TR/xmlschema-2/>)

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

5 Terminology

5.1 Definitions

5.1.1 *alignment mark design* — the information related to wafer alignment marks placed on the reticle for exposure on the wafer.

5.1.2 *alignment mark ID* — identifier for each wafer alignment mark.

5.1.3 *alignment mark information* — information related to alignment marks.

5.1.4 *alignment USE Mark* — information of alignment marks in the layer used for wafer alignment.

5.1.5 *barcode* — the barcode that is used for identification of reticle.

5.1.6 *edge clearance* — the area that cannot be used for production. It is expressed by the distance from a Wafer edge. The value reduces the effective exposure area of wafer radius (half of diameter).

5.1.7 *formulation information* — information related to the reticle frame design data.

5.1.8 *frame information* — the CAD design information of a reticle. It includes information about the part that does not depend on circuit figures of a chip, the frame of a rectangular area, and alignment marks and barcode, and the information of the marks of all layers.

5.1.9 *group* — character string used for grouping alignment marks if required.

5.1.10 *machine type information* — target machines for using the reticle frame design information.

5.1.11 *mark use rule* — name of the file containing the wafer alignment mark selection rule to be applied for the subject layer.

5.1.12 *projection magnification* — projection magnification of a reticle.

5.1.13 *reticle design* — reticle design information.

5.1.14 *reticle ID* — identifier for each reticle.

5.1.15 *reticle information* — information related to reticles.

5.1.16 *reticle mark* — mark used for alignment of a reticle.

5.1.17 *reticle mark ID* — identifier for each reticle alignment mark.

5.1.18 *reticle mark type* — type of reticle alignment mark.

5.1.19 *reticle name* — names for reticle identification.

² World Wide Web Consortium (W3C), <http://www.w3c.org>

- 5.1.20 *reticle projection magnification* — magnification of projection lens used by the exposure tool.
- 5.1.21 *reticle size* — size of reticle blank.
- 5.1.22 *reticle type* — type of reticle.
- 5.1.23 *shot* — an area exposed by a lithography system on a wafer with a single flash or scan.
- 5.1.24 *shot area* — an area divided with masking blades on reticle. It is exposed as a single shot.
- 5.1.25 *shot area ID* — identifier for identifying shot areas.
- 5.1.26 *shot area information* — information related to the rectangular area used for exposure at a time.
- 5.1.27 *shot area position shift* — shifting measure of the reference position of a shot area with the reference position of a shot on a wafer.
- 5.1.28 *shot area shift* — a coordinate of a reference position of the shot area, relative to a reference position of a frame.
- 5.1.29 *shot area size* — size of an area of a rectangle used as a shot area. It is expressed with size of X and Y directions.
- 5.1.30 *shot ID* — identifier for each shot.
- 5.1.31 *shot information* — information related to shots.
- 5.1.32 *shot location* — the coordinate of the shot expressed based on the matrix arrangement for a shot on a wafer.
- 5.1.33 *shot map* — information related to shots exposed on a wafer.
- 5.1.34 *shot map array* — maximum number of shots for the matrix arrangement. It will be expressed as the number of shots in the X and Y directions.
- 5.1.35 *shot map information* — information related to shot arrays on a wafer.
- 5.1.36 *shot map offset* — translational offset for a shot arrangement on wafer relative to a reference position on the wafer.
- 5.1.37 *shot position* — the coordinate of a reference position of the shot relative to a reference position of the wafer.
- 5.1.38 *step pitch* — a pitch of matrix arrangement for a shot. The pitch for the X and Y directions can be different.
- 5.1.39 *use exposure machine* — information related to equipment used for exposure.
- 5.1.40 *wafer information* — information related to the target wafer for processing.
- 5.1.41 *wafer mark* — a mark formed on a wafer for the purpose of wafer alignment. It can be used to align the wafer, where reticle image will be projected.
- 5.1.42 *wafer mark position* — the mark coordinate origin as defined by the equipment. It is expressed as coordinate relative to a reference position of the shot that exposes a wafer mark or a wafer reference position.
- 5.1.43 *wafer mark type* — type of wafer alignment mark.
- 5.1.44 *wafer rotation* — the direction of wafer rotation. It is defined by exposure tool.
- 5.1.45 *wafer size* — the diameter of a wafer.
- 5.1.46 *wafer thickness* — thickness of the target wafer for processing.
- 5.1.47 *wafer type* — the identification to use notch or OF (orientation flat) as a base for the direction of wafer rotation.
- 5.2 Figure 2 explains the terminology. Figure 2 is an example and shall be treated as a supplement data.

6 Reticle Frame Data

6.1 Reticle frame data is correlated with a hierarchic configuration as shown in Table 1. The item that defines the ID in this table can have several pieces of data. This table is used to generate one recipe of the exposure equipment. The unit of “ μm ” in this table is transcribed as “um”, which can be used as the entry in XML files.

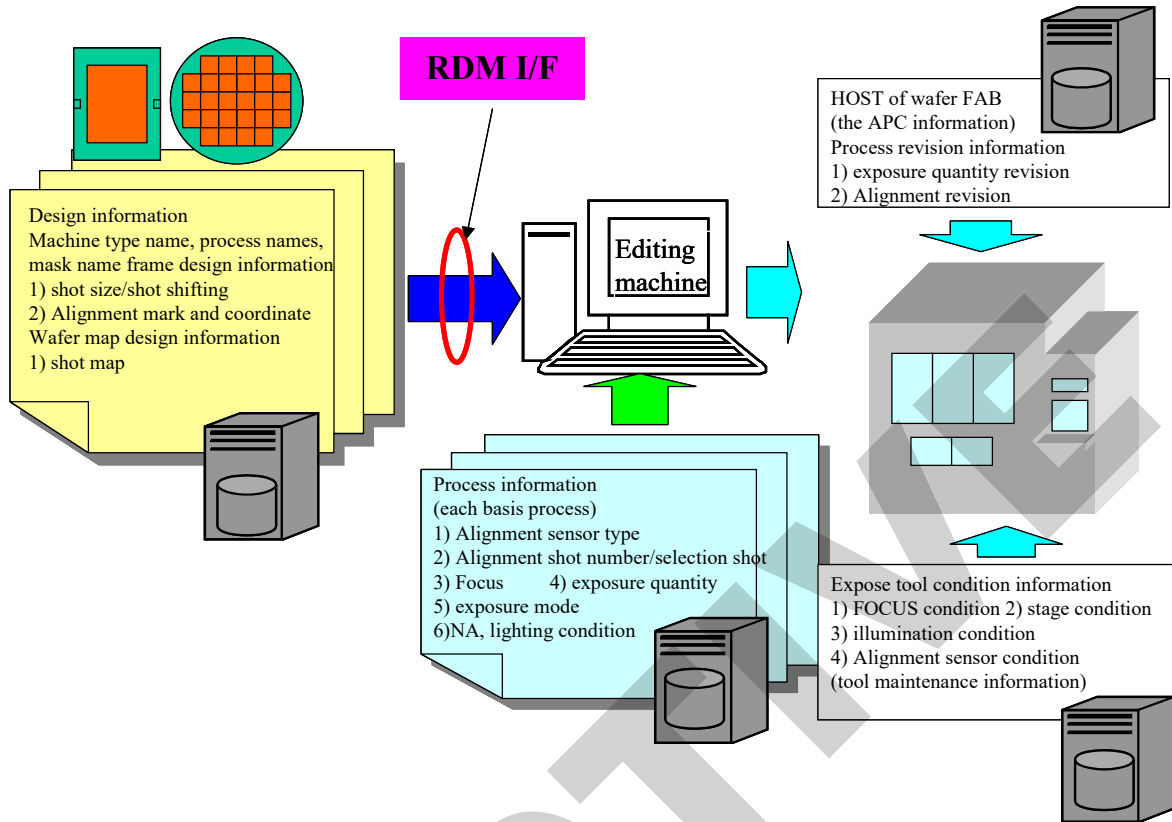


Figure 1
Recipe Preparation of Exposure Machine

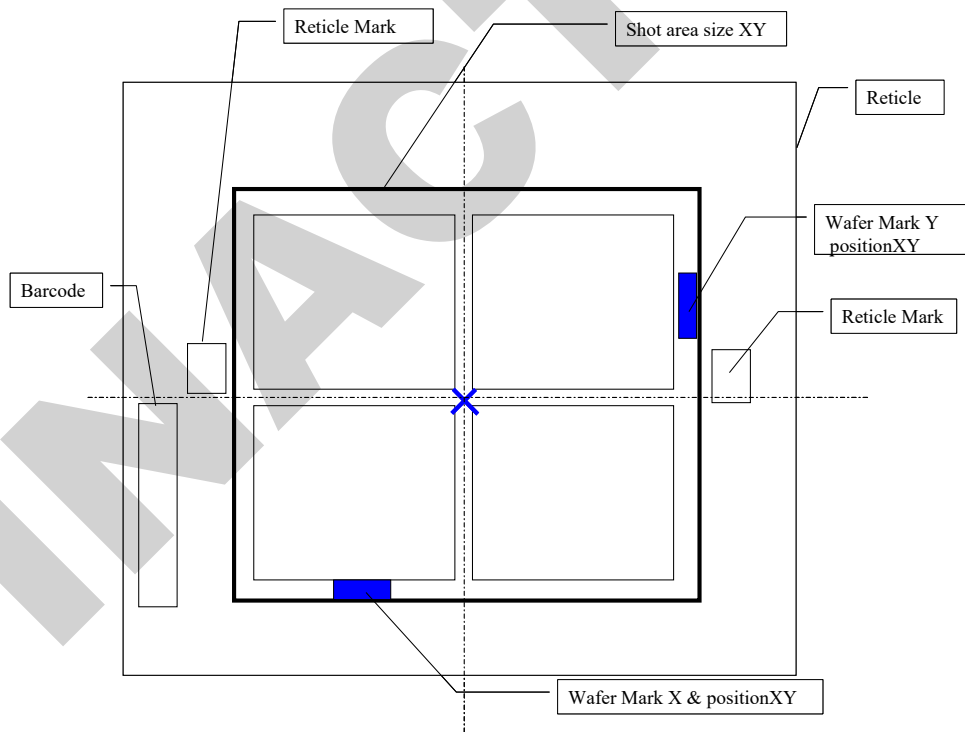
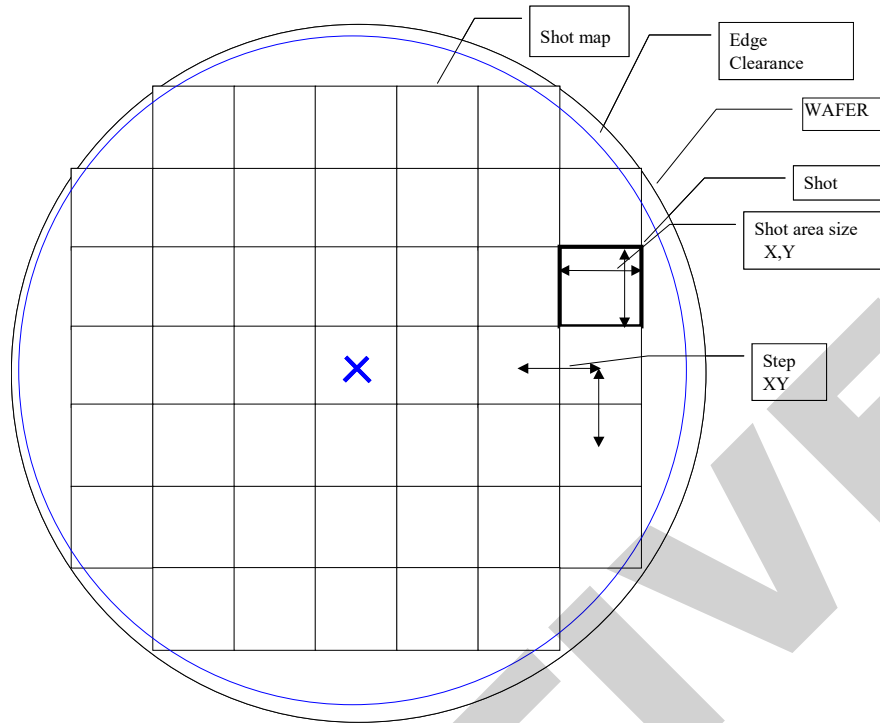


Figure 2
Explanation for Terminology

Table 1 Reticle Frame Data

Item				Data Type	Unit	The Entry Example
Formulation information	Date			Date Time	----	1999-05-31T13:20+08:00
	Person			string	----	HIGASHINO
Use exposure machine	Machine type information (1 – ∞)			string	----	
Shot map	Wafer information	Wafer type		string	----	SEMI,JEIDA,OF,notch
		Wafer size	Size	unsignedInt	----	150,200,300,5,6,8,12
			UnitType	string	mm/um/inch	mm,inch
		Edge Clearance	Clearance	Double	----	3.0
			UnitType	string	mm/um/inch	mm
		Wafer thickness	Thickness	unsignedInt	----	725
			UnitType	string	mm/um/inch	um
	Wafer Rotation			unsignedInt	deg	0,90,180,270,xxx
	Shot Map information	Step Pitch	X	Double	----	X size
			Y	Double	----	Y size
			UnitType	string	mm/um/inch	
		Shot Map array	C	unsignedInt	----	Col
			R	unsignedInt	----	Row
		Shot Map offset	X	Double	----	X offset
			Y	Double	----	Y offset
	UnitType		string	mm/um/inch		
	Shot area information (1 – ∞)	Shot area ID		ID	----	Uniqueness ID
		Reticle ID		string	----	Reticle information Reticle ID
		Shot area size	X	Double	----	X size
			Y	Double	----	Y size
			UnitType	string	mm/um/inch	
		Shot area shift	X	Double	----	X shift
			Y	Double	----	Y shift
			UnitType	string	mm/um/inch	
		Shot area position shift	X	Double	----	X position
			Y	Double	----	Y position
			UnitType	string	mm/um/inch	
Shot information (1 – ∞)	Shot ID		ID	----	Uniqueness ID	
	Shot area ID		string	----	Shot area information Shot area ID	
	Shot Location	C	unsignedInt	----	Column	
		R	unsignedInt	----	Row	
	Shot position	X	Double	----	X position	
		Y	Double	----	Y position	
Reticle design	Reticle information (1 – ∞)	Reticle ID		ID	----	Uniqueness ID
		Reticle name		string	----	
		Bar code		string	----	ex. Code39
		Reticle size	Size	unsignedInt	----	230,5,6
			UnitType	string	mm/um/inch	mm,inch

Item		Data Type	Unit	The Entry Example
		Reticle Type	string	----
		Reticle Mark ID	string	----
		Reticle Mark Type	string	----
		Projection Magnification	unsignedInt	----
Alignment Mark design	Alignment Mark information (0 – ∞)	Alignment Mark ID	ID	----
		Group	string	----
		Wafer mark type	string	----
		Wafer mark position	X	Double
			Y	Double
			X	Double
			Y	Double
		UnitType		string
		Comment		string
		UnitType		mm/um/inch
Alignment USE Mark	Alignment Mark information (0 – ∞)	Alignment Mark ID	ID	----
		Group	string	----
		Wafer mark type	string	----
		Wafer mark position	X	Double
			Y	Double
			X	Double
			Y	Double
		UnitType		string
		Comment		string
		UnitType		mm/um/inch

7 XML Description (Schema)

7.1 XML description defined from Table 1 is as follows.

```

<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema targetNamespace="file://XML\SEMI_Samples\SemiSEMI"
xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:rfd="file://XML\SEMI_Samples\SemiSEMI">
  <!-- ===== Reticle frame design data information Table ===== -->
  <xsd:element name="rdm" type="rfd:rdmType"/>
  <xsd:complexType name="rdmType">
    <xsd:sequence>
      <xsd:element name="FormulationInformation"
type="rfd:FormulationInformationType"/>
      <xsd:element name="UseExposureMachine" type="rfd:UseExposureMachineType"/>
      <xsd:element name="ShotMap" type="rfd:ShotMapType"/>
      <xsd:element name="ReticleDesign" type="rfd:ReticleDesignType"/>
      <xsd:element name="AlignmentMarkDesign" type="rfd:AlignmentMarkDesignType"/>
      <xsd:element name="AlignmentUSEMark" type="rfd:AlignmentUSEMarkType"/>
    </xsd:sequence>
  </xsd:complexType>
  <!-- ===== FormulationInformation ===== -->
  <xsd:complexType name="FormulationInformationType">
    <xsd:sequence>
      <xsd:element name="Date" type="xsd:date"/>
    </xsd:sequence>
  </xsd:complexType>

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        <xsd:element name="Person" type="xsd:string"/>
    </xsd:sequence>
</xsd:complexType>
<!-- ===== UseExposureMachine ===== -->
<xsd:complexType name="UseExposureMachineType">
    <xsd:sequence>
        <xsd:element name="MachineTypeInfo" type="xsd:string"
maxOccurs="unbounded"/>
    </xsd:sequence>
</xsd:complexType>
<!-- ===== ShotMap ===== -->
<xsd:complexType name="ShotMapType">
    <xsd:sequence>
        <xsd:element name="WaferInformation" type="rfd:WaferInformationType"/>
        <xsd:element name="ShotMapInformation" type="rfd:ShotMapInformationType"/>
        <xsd:element name="ShotAreaInformation" type="rfd:ShotAreaInformationType"
maxOccurs="unbounded"/>
        <xsd:element name="ShotInformation" type="rfd:ShotInformationType"
maxOccurs="unbounded"/>
    </xsd:sequence>
</xsd:complexType>
<!-- ===== -->
<xsd:complexType name="WaferInformationType">
    <xsd:sequence>
        <xsd:element name="WaferType" type="xsd:string"/>
        <xsd:element name="WaferSize" type="rfd:WaferSizeType"/>
        <xsd:element name="EdgeClearance" type="rfd:EdgeClearanceType"/>
        <xsd:element name="WaferThickness" type="rfd:WaferThicknessType"/>
        <xsd:element name="WaferRotation" type="xsd:unsignedInt"/>
    </xsd:sequence>
</xsd:complexType>
<xsd:complexType name="ShotMapInformationType">
    <xsd:sequence>
        <xsd:element name="StepPitch" type="rfd:XYCodeType"/>
        <xsd:element name="ShotMapArray" type="rfd:CRUnitType"/>
        <xsd:element name="ShotMapOffset" type="rfd:XYCodeType"/>
    </xsd:sequence>
</xsd:complexType>
<xsd:complexType name="ShotAreaInformationType">
    <xsd:sequence>
        <xsd:element name="ShotAreaID" type="xsd:ID"/>
        <xsd:element name="ReticleID" type="xsd:string"/>
        <xsd:element name="ShotAreaSize" type="rfd:XYCodeType"/>
        <xsd:element name="ShotAreaShift" type="rfd:XYCodeType"/>
        <xsd:element name="ShotAreaPositionShift" type="rfd:XYCodeType"/>
    </xsd:sequence>
</xsd:complexType>
<xsd:complexType name="ShotInformationType">
    <xsd:sequence>
        <xsd:element name="ShotID" type="xsd:ID"/>
        <xsd:element name="ShotAreaID" type="xsd:string"/>
        <xsd:element name="ShotLocation" type="rfd:CRUnitType"/>
        <xsd:element name="ShotPosition" type="rfd:XYCodeType"/>
    </xsd:sequence>
</xsd:complexType>
<!-- ===== -->

```