

SEMI E142-0305

SPECIFICATION FOR SUBSTRATE MAPPING

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1 Purpose

1.1 This document defines the data items that are required to report, store and transmit map data for substrates such as wafers, frames, strips and trays.

2 Scope

2.1 This version of the document applies to the substrate types; wafers, frames, strips and trays.

2.2 This document addresses assembly and packaging including the testing of semiconductor devices.

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 This document does not address the transmission, file naming conventions, storage or archiving of substrate maps. These will be addressed in sub-documents of this specification.

4 Referenced Standards

4.1 SEMI Standards

SEMI E39 — Object Services Standard; Concept, Behavior and Services

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

5 Terminology

5.1 Definitions

5.1.1 *bottom side* — the bottom side of the substrate as defined in the corresponding Appendix (Appendix 1, 2, or 3).

5.1.2 *device* — the unit to which the device status code in the map is assigned including, but not limited to: die on a wafer, multi-chip modules, and packages.

5.1.3 *map* — a two-dimensional array of bin codes derived from electrical test data of a substrate including, but not limited to: wafer, tray, strip, or tape.

5.1.4 *substrate* — any carrier of a two-dimensional array of devices including, but not limited to: wafers, trays, strips, tape, panels, or boards.

5.1.5 *top side* — the top side of the substrate as defined in the corresponding Appendix for that substrate (Appendix 1, 2, or 3).

6 Requirements

6.1 This standard defines the data items that are required in a substrate map. This standard places no special requirements on the file naming conventions, storage, or archiving of substrate maps.

7 Conventions

7.1 Object Conventions — This document conforms to the conventions for objects established by SEMI E39, including object diagrams, object terminology, and requirements for standardized objects. Accordingly, notation is based on Unified Modeling Language (UML).

7.2 Object Attribute Representation — The object information models for standardized objects will be supported by an attribute definition table with the following column headings:

<i>Attribute Name</i>	<i>Definition</i>	<i>Access</i>	<i>Requirement</i>	<i>Form</i>
The formal text name of the attribute.	Description of the information contained.	RO or RW	Y or N	(see below)

7.2.1 The Access column uses RO (Read Only) or RW (Read and Write) to indicate the access that service-users have to the attribute.

7.2.2 A 'Y' or 'N' in the requirement (Rqmt) column indicates if this attribute must be supported in order to meet fundamental compliance for the service.

7.2.2.1 The Form column is used to indicate the format of the attribute.

7.2.3 Formal Name of an Object — The text capitalizes formal object name references. Similar to the way capitalization is normally used when discussing entities. When describing something in the general (like cities) lower case is used, but when a specific entity is of interest (New York City), then first letters are capitalized.

7.2.4 Components of Complex Attributes — The names of object attributes defined in tables are left-justified. The individual elements of complex attributes are right-justified in order of appearance below the complex attribute.

7.3 Service Message Representation — Services are functions or methods that may be provided by either the equipment or the host. A service message may be either a request message, which always requires a response, or a notification message, that does not require a response.

7.3.1 Service Definition

7.3.1.1 A service definition table defines the specific set of messages for a given service resource, as shown in the following table:

<i>Message Service Name</i>	<i>Type</i>	<i>Description</i>

7.3.1.2 Type can be either "N" = Notification or "R" = Request & Response.

7.3.1.3 Notification type messages are initiated by the service provider (e.g., the equipment) and the provider does not expect to get a response from the service user. Request messages are initiated by a service user (e.g., the host). Request messages ask for data or an activity from the provider. Request messages expect a specific response message (no presumption on the message content).

7.3.2 Service Parameter Dictionary

7.3.2.1 A service parameter dictionary table defines the description, format and its possible value for parameters used by services, as shown in the following table:

<i>Parameter Name</i>	<i>Description</i>	<i>Format: Possible Value</i>

7.3.2.2 A row is provided in the table for each parameter of a service.

7.3.3 Service Message Definition

7.3.3.1 A service message definition table defines the parameters used in a service, as shown in the following table:

<i>Parameter</i>	<i>Req/Ind</i>	<i>Rsp/Cnf</i>	<i>Comment</i>

7.3.3.2 The columns labeled REQ/IND and RSP/CNF link the parameters to the direction of the message. The message sent by the initiator is called the “Request”. The receiver terms this message the “Indication” or the request. The receiver may then send a “Response” which the original sender terms the “Confirmation”.

7.3.3.3 The following codes appear in the REQ/IND and RSP/CNF columns and are used in the definition of the parameters (eg., how each parameter is used in each direction):

M	Mandatory Parameter — Must be given a valid value.
C	Conditional Parameter — May be defined in some circumstances and undefined in others. Whether a value is given may be completely optional or may depend on the value of the other parameter.
U	User-Defined Parameter.
-	The parameter is not used.
=	(For response only.) Indicates that the value of this parameter in the response must match that in the primary (if defined).

8 Overview

8.1 Substrate maps are two dimensional arrays of data that correspond to a physical substrate which may be a wafer, strip or tray as shown in the Appendices. It is expected that other substrate types will be added to subsequent releases of this standard.

8.2 The data items are defined as attributes of the objects shown in Figure 1 Map Data Object Model.

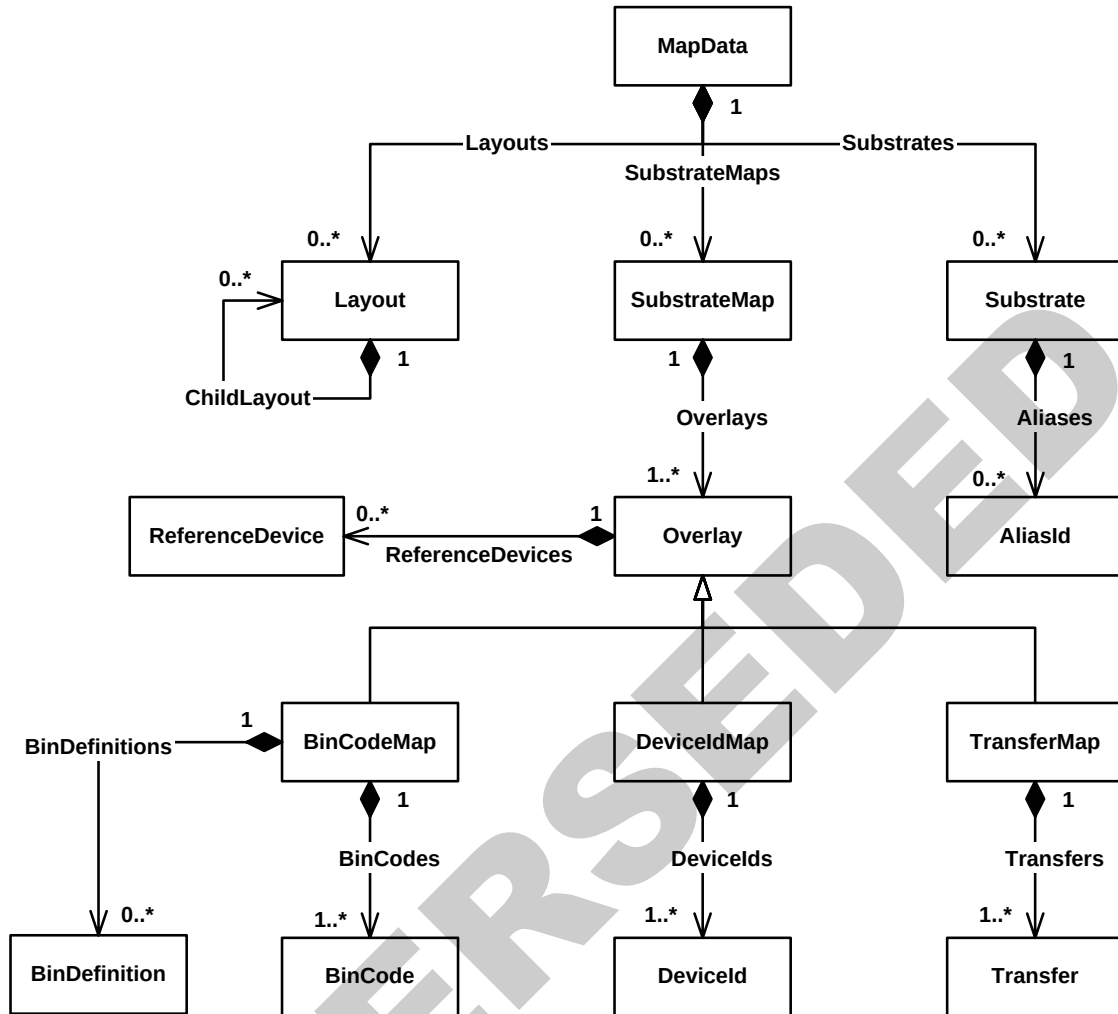


Figure 1
Map Data Object Model

9 MapData

9.1 The MapData object contains a list of zero or more Layout objects, a list of zero or more SubstrateMap objects and a list of zero or more Substrate objects.

Table 1 MapData Attributes

Attribute Name	Definition	Access	Reqd	Form
FormatRevision	Specifies the exact name and revision of the format used to represent substrate map data. This field can be used by a parser to automatically determine the format of the remaining substrate map data.	RO	N	Text

10 Layout

10.1 The Layout object defines the logical and physical dimensions of two-dimensional array of devices to which a SubstrateMap may be assigned. A substrate must have a top level layout that defines the size of the substrate itself. Any layout object can reference other child layout objects. In this way complex assemblies may be represented. See the examples in Related Information 1.

Table 2 Layout Attributes

Attribute Name	Definition	Access	Reqd	Form
LayoutId	The layout identifier. This must be unique within the scope of MapData.	RO	Y	Text
DefaultUnits	The units in which physical dimensions and coordinates are represented unless otherwise specified.	RO	Y	Text
Dimension	The number of columns (X-axis) and rows (Y-axis) in the layout. If this is the top level layout then X = 1, Y = 1.	RO	Y	LogicalCoordinates (see Table 3)
DeviceSize	The X and Y dimensions of the device. If this is the top level layout, then this defines the size of the substrate itself. If not present, then DeviceSize is not defined.	RO	N	XYDimensions (see Table 4)
StepSize	The distance from a reference point on one device to the same reference point on the adjacent device. StepSize – DeviceSize is equal to the “street” width between devices. If not present, then StepSize is not defined.	RO	N	XYDimensions (see Table 4)
LowerLeft	The distance in microns of the lower left corner of this layout from the lower left corner of the parent layout. If this is the top level layout, then LowerLeft.X = 0 and LowerLeft.Y = 0. If not present, then LowerLeft.X = 0 and LowerLeft.Y = 0.	RO	N	XYDimensions (see Table 4)
Z	The logical and physical height of the device above (or below) the parent layout. If this is the top level layout, then Z.Order = 0 and Z.Height = 0. If not present, then Z.Order = 0 and Z.Height = 0.	RO	N	ZDimensions (see Table 5)
TopImage	Name of an image file showing the top side of an individual device in the layout.	RO	N	Text
BottomImage	Name of an image file showing the bottom side of an individual device in the layout.	RO	N	Text
ProductId	Product identifier for a device in this layout.	RO	N	Text
TopLevel	TopLevel = True implies that this is a top level layout. TopLevel = False implies that this layout is the child of another layout. If this is the top level layout, then TopLevel = True. If not present, then TopLevel = False. TopLevel may be omitted from child layouts.	RO	N	Boolean

Table 3 LogicalCoordinates Type

Attribute Name	Definition	Access	Reqd	Form
X	The column or X logical coordinate, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection.	RO	Y	Integer
Y	The row or Y logical coordinate, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection.	RO	Y	Integer

Table 4 XYDimensions Type

Attribute Name	Definition	Access	Reqd	Form
X	The physical offset from the origin along the X axis, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection.	RO	Y	Floating point value
Y	The physical offset from the origin along the Y axis, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection.	RO	Y	Floating point value
Units	The units in which X and Y coordinates are represented. If omitted then the Layout, DefaultUnits is used.	RO	N	Text

Table 5 ZDimensions Type

Attribute Name	Definition	Access	Reqd	Form
Order	The order of the layouts in the Z dimension, according to the values of SubstrateMap coordinate attributes; SubstrateSide, and Orientation. Layouts with higher values for Order are in front of those with smaller values. If this is the top level layout, then Order = 0. If not present, then Order = 0.	RO	N	Integer
Height	The height of the device above (or below) the parent layout, according to the values of SubstrateMap coordinate attributes; SubstrateSide, and Orientation. If this is the top level layout, then Height = 0. If not present, then Height = 0.	RO	N	Floating point value
Units	The units in which Height is represented. If omitted then the Layout.DefaultUnits is used.	RO	N	Text

11 Substrate

11.1 The Substrate object identifies a substrate to which a SubstrateMap may be assigned. A Substrate object may have one or more AliasId objects.

Table 6 Substrate Attributes

Attribute Name	Definition	Access	Reqd	Form
SubstrateType	The type of substrate. A choice of 'Wafer', 'Frame', 'Strip' or 'Tray'.	RO	Y	Text
SubstrateId	The substrate identifier.	RO	Y	Text 1 to 32 characters
LotId	Production lot identifier for this data.	RO	N	Text 1 to 32 characters
CarrierType	The type of wafer carrier, e.g. 'Cassette', 'FOUP', etc.	RO	N	Text
CarrierId	A character code that may be printed or encoded on the substrate carrier, which uniquely identifies the substrate carrier.	RO	N	Text 1 to 32 characters
SlotNumber	This identifies the slot in the carrier in which the substrate is placed.	RO	N	Positive Integer
SubstrateNumber	Identifies the substrate within a lot.	RO	N	Positive Integer

<i>Attribute Name</i>	<i>Definition</i>	<i>Access</i>	<i>Reqd</i>	<i>Form</i>
GoodDevices	The total number of “good” devices on the substrate. The definition of “good” is beyond the scope of this document.	RO	N	Positive Integer
SupplierName	Name of the supplier of the substrate.	RO	N	Text
CreateDate	Date and time when the map data is acquired: formatted as YYYYMMDDhhmmsscc (year-month-date-hour-minute-second-centisecond).	RO	N	Text
LastModified	Date and time when the map data was last modified: formatted as YYYYMMDDhhmmsscc (year-month-date-hour-minute-second-centisecond).	RO	N	Text
Status	Status of map data supplying process or preceding process.	RO	N	Text

11.2 AliasId

11.2.1 The AliasId object contains other substrate identifiers that may be used to trace the substrate throughout the substrate’s life cycle.

Table 7 AliasId Attributes

<i>Attribute Name</i>	<i>Definition</i>	<i>Access</i>	<i>Reqd</i>	<i>Form</i>
Type	Type of identifier, e.g. “FrontsideId”, “BacksideId”, “WaferId”, “FrameId” .	RO	Y	Text
Value	Value of the identifier.	RO	Y	Text 1 to 32 characters

12 SubstrateMap

12.1 The SubstrateMap object relates to a single substrate and layout and contains a list of one or more Overlay objects. It may also include a substrate type specific object depending on the value of [SubstrateType].

12.2 If there are more than one SubstrateMap assigned to a Substrate and Layout combination they should differ in either their Orientation, OriginLocation or both. For example there may be a map for the top side and one for the bottom side of a Layout.

Table 8 SubstrateMap Attributes

<i>Attribute Name</i>	<i>Definition</i>	<i>Access</i>	<i>Reqd</i>	<i>Form</i>
SubstrateType	A reference to the type of substrate to which the map data applies.	RO	Y	Text
SubstrateId	A reference to the substrate identifier to which the map data applies.	RO	Y	Text 1 to 32 characters
LayoutSpecifier	A reference to the layout to which the map data applies. The LayoutSpecifier defines the full path, using / as a delimiter from the top level layout to the layout to be specified for example; “WaferLayout/L1/DeviceLayout”.	RO	Y	Text
SubstrateSide	Coordinate system attribute that defines the side of the substrate. Restricted to the values; TopSide* Bottom Side * Default value if this item is not present.	RO	N	Text

Attribute Name	Definition	Access	Reqd	Form
Orientation	Coordinate system attribute that defines the orientation of the substrate in relation to the map data. This variable will increase in the right (clockwise) direction from 0°. It is restricted to values from 0°-359°. * Default value if this item is not present is 0°.	RO	N	Integer
OriginLocation	Coordinate system attribute that defines location of the coordinate system origin. Restricted to the values (see Figure A2-1 for an example); LowerLeft* UpperLeft LowerRight UpperRight Center * Default value if this item is not present.	RO	N	Text
AxisDirection	Coordinate system attribute that defines direction in which the Y and X axis, respectively increase. Restricted to the values (see Figure A2-1 for an example); UpRight* DownRight UpLeft DownLeft * Default value if this item is not present.	RO	N	Text

13 Overlay

13.1 The Overlay object is an array of data that corresponds to the dimensions on the Layout to which the containing SubstrateMap is assigned. The specialized objects (e.g. BinCodeMap, DeviceIdMap, TransferMap) are extensions of the Overlay object which each define a different type of data. See the definitions of the specialized objects in the sections below. An Overlay object may have one or more ReferenceDevice objects.

Table 9 Overlay Attributes

Attribute Name	Definition	Access	Reqd	Form
MapName	A name that describes the purpose of the bin codes in the map. Possible examples include: "CellStatus", "DefectCode", "MarkGrade", "PackageGrade", "SortGrade", DeviceId, "Transfer".	RO	Y	Text
MapVersion	The version is used to distinguish between multiple versions of maps for the same substrate with the same MapName.	RO	N	Text

13.2 ReferenceDevice

13.2.1 The ReferenceDevice object defines a reference device on the substrate.

Table 10 ReferenceDevice Attributes

Attribute Name	Definition	Access	Reqd	Form
Coordinates	X and Y coordinate of the reference device to align device matrix on physical substrate with the map data.	RO	Y	LogicalCoordinates (see Table 3)
Position	Offset of the center of a reference device in the X and Y directions from the center of substrate.	RO	N	XYDimensions (see Table 4)