SEMI E142-0224
SPECIFICATION FOR SUBSTRATE MAPPING

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NOTICE: The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONs, lists) therein. The paragraph symbol (¶) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§ and ¶¶) the symbols are used to reference more than one section or paragraph, respectively.

1 Purpose

1.1 This Specification 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 Specification applies to the substrate types: Wafers, Frames, Strips, and Trays.

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

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 Specification does not address the transmission, file naming conventions, storage, or archiving of substrate maps. These are addressed in Subordinate Standards of this Specification.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI E5 — Specification for SEMI Equipment Communications Standard 2 Message Content (SECS-II)

SEMI E39 — Specification for Object Services: Concept, Behavior, and Services

4.2 *IETF® Documents*[1]

RFC 2396 — Uniform Resource Identifiers (URI) Update 1738[2]

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

5 Terminology

5.1 *SEMI Standards Compilation of Terms*

5.1.1 Definitions of descriptions of many of the terms used in this Specification can be found in the SEMI Standards Compilation of Terms, available on the SEMI Web site, http://www.semi.org.

5.2 *Definitions*

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

5.2.2 *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.

[1] Internet Engineering Task Force, IETF Administration LLC, 1000 N West Street, Suite 1200, Wilmington, DE 19801, USA; Telephone: +1.510.492.4080, Fax: +1.510.492.4001, http://www.ietf.org. IETF trademark is owned by the IETF Trust.

[2] W3C August 1998, ftp://ftp.isi.edu/in-notes/rfc2396.txt

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5.2.3 *frame* — a wafer mounted on a film frame so that it may be diced and the die picked and placed in a package.

5.2.4 *layout* — the logical and physical dimensions of two-dimensional array of devices to which a map may be assigned.

5.2.5 *map* — a two-dimensional array of data for a specific layout on a substrate.

5.2.6 *panel* — a rectangular or square substrate on which an array of devices are fabricated.

5.2.7 *printed circuit board (PCB)* — printed circuit board with circuitry to interconnect devices mounted on it meet a specific application.

5.2.8 *strip* — a leadframe, board, or other container on which an array of devices are fabricated. [SEMI G84]

5.2.9 *substrate* — as defined in the SEMI Standards Compilation of Terms.

5.2.10 *substrate layouts* — a tree of layouts that share a common 'root' or 'top level' layout.

5.2.11 *tape and reel (TnR)* — a tape wound on a reel that contains one or more rows of pockets where packages may be placed or picked. The reel is marked with an identifier. The pocket column is marked with a sequential number.

5.2.12 *top level layout* — the layout that defines the size of the substrate itself, for example, the wafer diameter or the strip length and width.

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

5.2.14 *tray* — an array of devices held in fixed locations by a device carrier such as a waffle pack, gel pack, JEDEC tray, burn-in tray, etc. This array of devices may be considered a substrate for the purposes of substrate mapping.

5.2.15 *wafer* — a round substrate on which an array of devices are fabricated.

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 Specification 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:

Attribute Name	*Definition*	*Access*	*Requirement*	*Form*
The formal text name of the attribute.	Description of the information contained.	RO or RW	Y or N	(refer to 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.

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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:

Message Service Name	*Type*	*Description*

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:

Parameter Name	*Description*	*Format: Possible Value*

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:

Parameter	*Req/Ind*	*Rsp/Cnf*	*Comment*

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 (e.g., 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.

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=	(For response only.) Indicates that the value of this parameter in the response must match that in the primary (if defined).

7.3.3.4 Note that the words ‘must’, ‘will’, and ‘requires’ are used in the conventions section to illustrate the logical results of table organization. Such statements should not be considered requirements.

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 are added to subsequent releases of this Specification.

8.2 The data items are defined as attributes of the objects shown in 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*

10 Layout

10.1 The full definition of a substrate layout is tree of the layouts that share a common ‘root’ or ‘top level’ layout. Each Layout object defines the logical and physical dimensions of two-dimensional array of devices to which a SubstrateMap may be assigned. Any layout object can reference other child layout objects. The top level layout defines the overall size of the substrate that is being mapped (e.g., the Wafer diameter or the Strip length and width). The ‘top level’ layout can be quickly found amongst the list of layouts by filtering on TopLevel=True. Only one layout in the tree of layouts for a substrate may have TopLevel=True. Any layout object can reference other child layout objects. In this way complex assemblies may be represented. A layout may be flagged as a ‘package’ (Package=True) layout indicating that devices at that level in the layout hierarchy may be singulated and function independently (e.g., an advanced package assembled on a Strip). Refer to the examples in Related Information 1.

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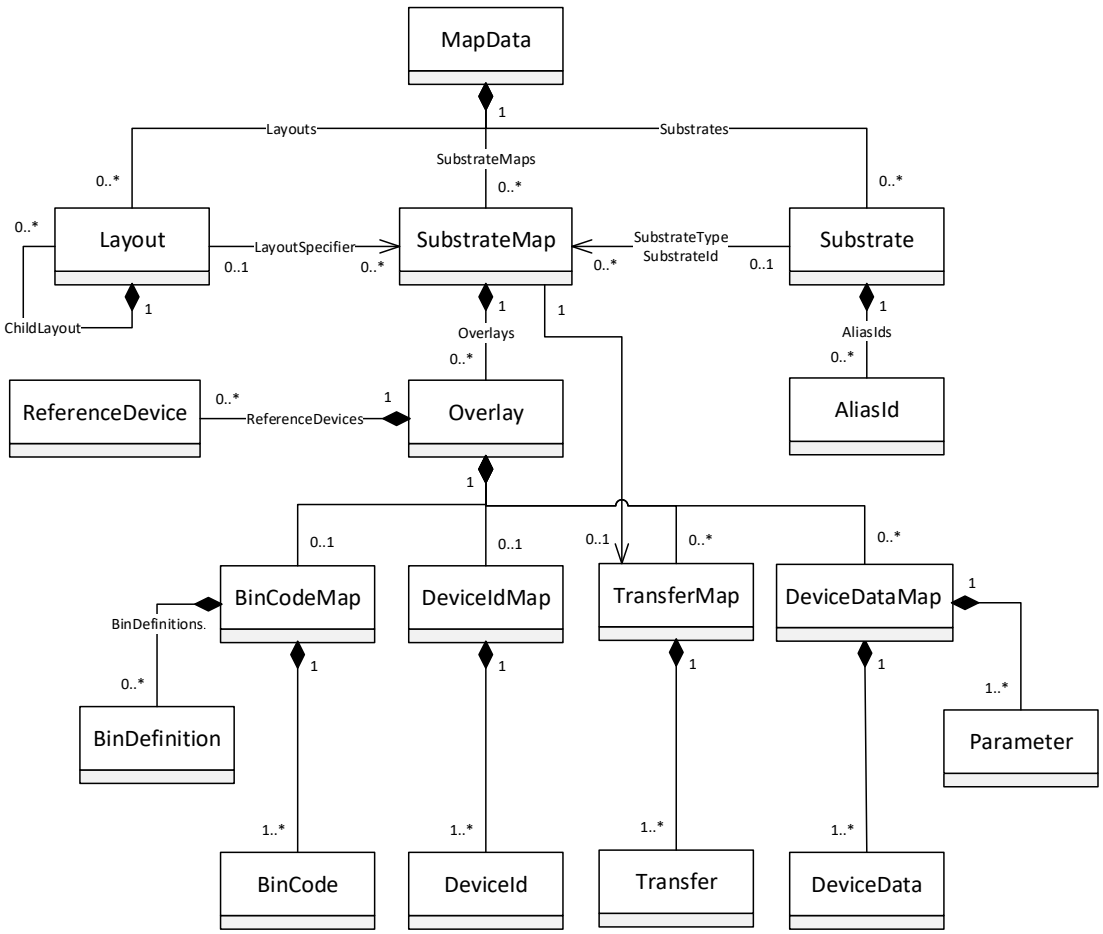

Figure 1
Map Data Object Model

10.2 The LayoutId attribute identifies the Layout and shall be unique within its parent MapData.

Table 2 Layout Attributes

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
LayoutId	The layout identifier. This shall be unique within the scope of MapData.	RO	Y	Text
DefaultUnits	The units in which physical dimensions and coordinates are represented unless otherwise specified. Restricted to the values; um, mm	RO	Y	Units (as defined in SEMI E5)
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 (refer to 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 (refer to Table 4)

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Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
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 (refer to Table 4)
LowerLeft	The distance 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.X = 0. If not present, then LowerLeft.X = 0 and LowerLeft.X = 0.	RO	N	XYDimensions (refer to 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 (refer to Table 5)
TopImage	URI (refer to W3C RFC 2396 in references for a definition of URI) of an image showing the top side of an individual device in the layout.	RO	N	Text
BottomImage	URI of an image 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 indicates that this is a top level layout. TopLevel = False indicates that this layout is the child of another layout. If this is the top level layout, then TopLevel = True. If the TopLevel attribute is not present, this is the same as TopLevel=False. TopLevel may be omitted from child layouts.	RO	N	Boolean
Package	Package = True indicates that parts at this level of the layout hierarchy are a functional unit that will be used directly in the final application or assembled into more complex parts. Package = False indicates that this level of the layout hierarchy represents a carrier of parts, not an independent functional unit. If not present, then Package = False.	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. (Refer to Appendix 4, Coordinate Systems.)	RO	Y	Integer
Y	The row or *Y* logical coordinate, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection. (Refer to Appendix 4, Coordinate Systems.)	RO	Y	Integer

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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. (Refer to Appendix 4, Coordinate Systems.)	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. (Refer to Appendix 4, Coordinate Systems.)	RO	Y	Floating point value
Units	The units in which *X* and *Y* coordinates are represented. If omitted then the Layout, DefaultUnits is used. Restricted to the values; um, mm	RO	N	Units (as defined in SEMI E5)

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. Restricted to the values; um, mm	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	A reference to the type of substrate to which the map data applies. Refer to § 11.3.1.	RO	Y	Text
SubstrateId	The substrate identifier.	RO	Y	Text 1–80 characters
LotId	Production lot identifier for this data.	RO	N	Text 1–80 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 1–80 characters

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Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
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
GoodDevices	The total number of 'good' devices on the substrate. The definition of 'good' is beyond the scope of this Specification.	RO	N	Positive Integer
SupplierName	Name of the supplier of the substrate.	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

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
Type	Type of identifier (e.g., 'FrontsideId', 'BacksideId', 'WaferId', 'FrameId').	RO	Y	Text
Value	Value of the identifier.	RO	Y	Text 1–32 characters

11.3 The combination of SubstrateType and SubstrateId attributes identify the Substrate and shall be unique within its parent MapData.

11.3.1 Valid values of SubstrateType are: Wafer, Frame, Strip, Tray, tape and reel (TnR), Panel, and printed circuit board (PCB).

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].

12.1.1 The combinations of SubstrateType, SubstrateId and LayoutSpecifier attributes identify the SubstrateMap and shall be unique within its parent MapData.

12.1.2 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

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
SubstrateType	A reference to the type of substrate to which the map data applies. Refer to § 11.3.1.	RO	Y	Text
SubstrateId	A reference to the substrate identifier to which the map data applies.	RO	Y	Text 1–32 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

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Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
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
Orientation	Coordinate system attribute that defines the orientation of the substrate in relation to the map data. This variable increases 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 (refer to 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 (refer to 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. An Overlay object may have one or more ReferenceDevice objects and either a BinCodeMap object, a DeviceIdMap object, a list of one or more TransferMaps, or a list of one or more DeviceDataMap 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 The combination of MapName and MapVersion attributes identify the Overlay and shall be unique within its parent SubstrateMap.

13.3 *ReferenceDevice*

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

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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 (refer to 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 (refer to Table 4)
Name	Descriptive name for the reference (e.g., 'First Device', 'Prober Origin').	RO	N	Text

13.4 *BinCodeMap*

13.4.1 The BinCodeMap object contains a list of zero or more BinDefinition objects and a list of one or more BinCode objects.

Table 11 BinCodeMap Attributes

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
BinType[#1, #2]	The format in which the bincode for each device is represented. The following values are reserved: BinType = 'Ascii': Single ASCII character (1 byte per device) BinType = 'Decimal': 3 digit integer from 000–255 (1 byte per device) BinType = 'HexaDecimal': 2 digit Hexadecimal value from 00–FF (1 byte per device) BinType = 'Integer2': 4 digit Hexadecimal value from 0000–FFFF (2 bytes per device)	RO	Y	Text
NullBin	Code to indicate no device or not measured device in BinCode.Values. It should be represented according to BinType.	RO	Y	Text
MapType	A BinCode object may contains bin code information for a single device, a row of devices or the entire map of devices. The choice depends on whether the primary objective is readability, compactness or flexibility. MapType specifies the map representation type to be used in the BinCode objects contained in the BinCodeMap. The values are limited to the following. MapType='2DArray' – The most readable approach is to represent all the devices in a row in a single BinCode entry. The length of each row and number of rows should correspond with the product of the dimensions of the layouts defined by the LayoutSpecifier attribute, rotated to the coordinate system of the SubstrateMap. Locations in the layout that do not contain a device are assigned to the BinCodeMap.NullBin value. MapType='Row/Column' – Alternatively, a starting *XY* coordinate and length may be specified. This approach offers good readability and a balance between compactness and flexibility. Refer to Figure A1-1a Row/Column Format.	RO	N	String

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Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
MapType cont.	MapType='Array' – For a more compact representation, a single BinCode object can include the entire array of bin codes in row major format starting at the top left. Refer to Figure A1-1b Array Format. MapType= 'Coordinate' – A less compact but more flexible approach is to include a separate BinCode object for each individual device. The *X* and *Y* coordinates shall both be included. Refer to Figure A1-1c Coordinate Format. If omitted the default value is '2DArray'.	RO	N	String

#1 For readability when BinType = 'Decimal' spaces are added between each device and each row of devices should be on a new line.

#2 When BinType = 'Ascii' or 'Hexadecimal' or 'Integer2' there are no spaces between each device and for readability, each row should be on a new line.

13.4.2 *BinCode*

13.4.2.1 The BinCode contains the actual bin code values.

Table 12 BinCode Attributes

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
Values	The concatenation of bin code values represented according to the value of BinCodeMap.BinType. [Values] may contain just one bin code, a row of bin codes or the entire map of bin codes.	RO	Y	Text
X	The *X* coordinate of the device to which the first bin code applies, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection. If omitted the first bincode in each BinCode row corresponds to the device in the first column of the substrate map. It is not permitted to mix BinCode rows using X/Y attributes with BinCode rows not using X/Y attributes within one parent Overlay. (Refer to Appendix 4, Coordinate Systems.)	RO	N	Integer
Y	The *Y* coordinate of the device to which the first bin code applies, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection. If omitted the BinCode row corresponds to the next row of the substrate map starting with the top row. It is not permitted to mix BinCode rows using X/Y attributes with BinCode rows not using X/Y attributes within one parent Overlay. (Refer to Appendix 4, Coordinate Systems.)	RO	N	Integer
Number	The number of contiguous bin codes in the Values attribute. If omitted Number is derived from the length of the Values attribute and the value of BinCodeMap.BinType. For example, if BinCodeMap.BinType = 'HexaDecimal', Number = LengthOf(Values) / 2	RO	N	Integer

13.4.3 *BinDefinition*

13.4.3.1 The BinDefinition object describes a bin code that may be present in the map.

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Table 13 BinDefinition Attributes

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
BinCode	A bin category, other that the value assigned to BinCodeMap.NullBin, that may be assigned to a device. It should be represented according to BinCodeMap.BinType.	RO	Y	Unsigned 1 byte integer unless BinCodeMap.Bin Type attribute is 'Integer2', in which case it is a 2 byte integer.
BinCount	The number of devices on the substrate with the specified BinCode. If not present then BinCount is undefined.	RO	N	Positive Integer
BinDescription	A description of the specified BinCode (e.g., '100MHz'). If not present then BinDescription is undefined.	RO	N	Text
BinQuality	Describes the quality of the specified BinCode. The following values are reserved: 'Pass' – Indicates a quality that has commercial value 'Fail' – Indicates a quality that does not have commercial value Other values defined by an application. If not present then BinQuality is undefined.	RO	N	Text
Pick	Pick = True indicates that devices with this BinCode should be processed. Pick = False indicates that devices with this BinCode should not be processed. If not present that Pick=False.	RO	N	Boolean

13.5 *DeviceIdMap*

13.5.1 The DeviceIdMap object contains a list of one or more DeviceId objects.

13.5.2 *DeviceId*

13.5.2.1 The DeviceId object contains the device coordinate and the value of the identifier marked on that device.

Table 14 DeviceId Attributes

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
Value	The device identifier.	RO	Y	Text
X	The *X* coordinate of the device with the substrate oriented, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection. (Refer to Appendix 4, Coordinate Systems.)	RO	Y	Integer
Y	The *Y* coordinate of the device with the substrate oriented, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection. (Refer to Appendix 4, Coordinate Systems.)	RO	Y	Integer

13.6 *TransferMap*

13.6.1 The TransferMap object contains a list of one or more Transfer objects.

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Table 15 TransferMap Attributes

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
FromSubstrateType	The type of substrate from which the devices were transferred. Refer to § 11.3.1.	RO	Y	Text
FromSubstrateId	The identifier of substrate from which the devices were transferred.	RO	Y	Text
FromLayoutSpecifier	The LayoutSpecifier for the SubstrateMap from which the device was picked. The FromLayoutSpecifier 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

13.6.2 *Transfer*

13.6.2.1 The Transfer object defines, for an individual device, the coordinates on the substrate from which the device was picked and the coordinates at which the device was placed on the substrate to which this TransferMap applies.

Table 16 Transfer Attributes

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
FX	The *X* coordinate on the SubstrateMap from which the device was picked, according to the values of coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection, of the SubstrateMap to which the device was transferred. (Refer to Appendix 4, Coordinate Systems.)	RO	Y	Integer
FY	The *Y* coordinate on the SubstrateMap from which the device was picked, according to the values of coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection, of the SubstrateMap to which the device was transferred. (Refer to Appendix 4, Coordinate Systems.)	RO	Y	Integer
TX	The *X* coordinate at which the device was placed on the substrate to which this map applies, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection. (Refer to Appendix 4, Coordinate Systems.)	RO	Y	Integer
TY	The *Y* coordinate at which the device was placed on the substrate to which this map applies, according to the values of SubstrateMap coordinate attributes; SubstrateSide, Orientation, OriginLocation, and AxisDirection. (Refer to Appendix 4, Coordinate Systems.)	RO	Y	Integer

13.7 *DeviceDataMap*

13.7.1 The DeviceDataMap object contains a list of one or more DeviceData objects.

Table 17 DeviceDataMap Attributes

Attribute Name	*Definition*	*Access*	*Reqd*	*Form*
Parameter	List of parameters.	RO	Y	List of Parameter objects
DeviceData	List of one or more DeviceData, one for each device *XY* coordinate in the DeviceDataMap.	RO	Y	List of DeviceData objects

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