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Substrate Mapping

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Substrate Mapping

Substrate Mapping is commonly used in manufacturing environments where substrates, such as panels, carriers, or base materials, contain multiple units arranged in a defined layout. Similar to wafer mapping in the semiconductor industry, substrate mapping provides a structured and visual way to represent the condition, status, or performance of each unit within a substrate.

A substrate map is a graphical representation of the substrate layout, where each unit (e.g., position, slot, or cell) is displayed within a grid or panel structure. Each unit can be associated with relevant data such as inspection results, processing status, defects, measurements, or material attributes. This information is typically visualized using color-coding or a value, allowing users to quickly interpret spatial patterns and identify anomalies.

Substrate maps are particularly useful for analyzing variations across a substrate. For example, clusters of defects or performance deviations in specific regions may indicate issues related to equipment, process conditions, or material inconsistencies. By preserving the spatial relationship between units, substrate mapping enables more effective root cause analysis and process optimization.

These maps are generated using mapping tools that combine configuration definitions with collected data. Statistical methods and visualization techniques can be applied to enhance the interpretation of results, such as identifying trends, densities, or recurring patterns across multiple substrates.

A substrate map highlights defective or non-conforming units and provides actionable spatial insight into the manufacturing process. It supports quality control, traceability, and continuous improvement by enabling users to monitor and analyze substrate-level data efficiently.

Overview

This tutorial provides an overview of the purpose and concepts behind the following entities: [Substrate Map](#) and [Substrate Map Mask](#). It also includes a step-by-step operational guide that walks you through the complete process, from defining a Substrate Map in the system to updating Bin Code values, creating and adding a **Substrate Map Mask**, creating a new Overlay, and exploring the features used to track changes in a **Substrate Map**.

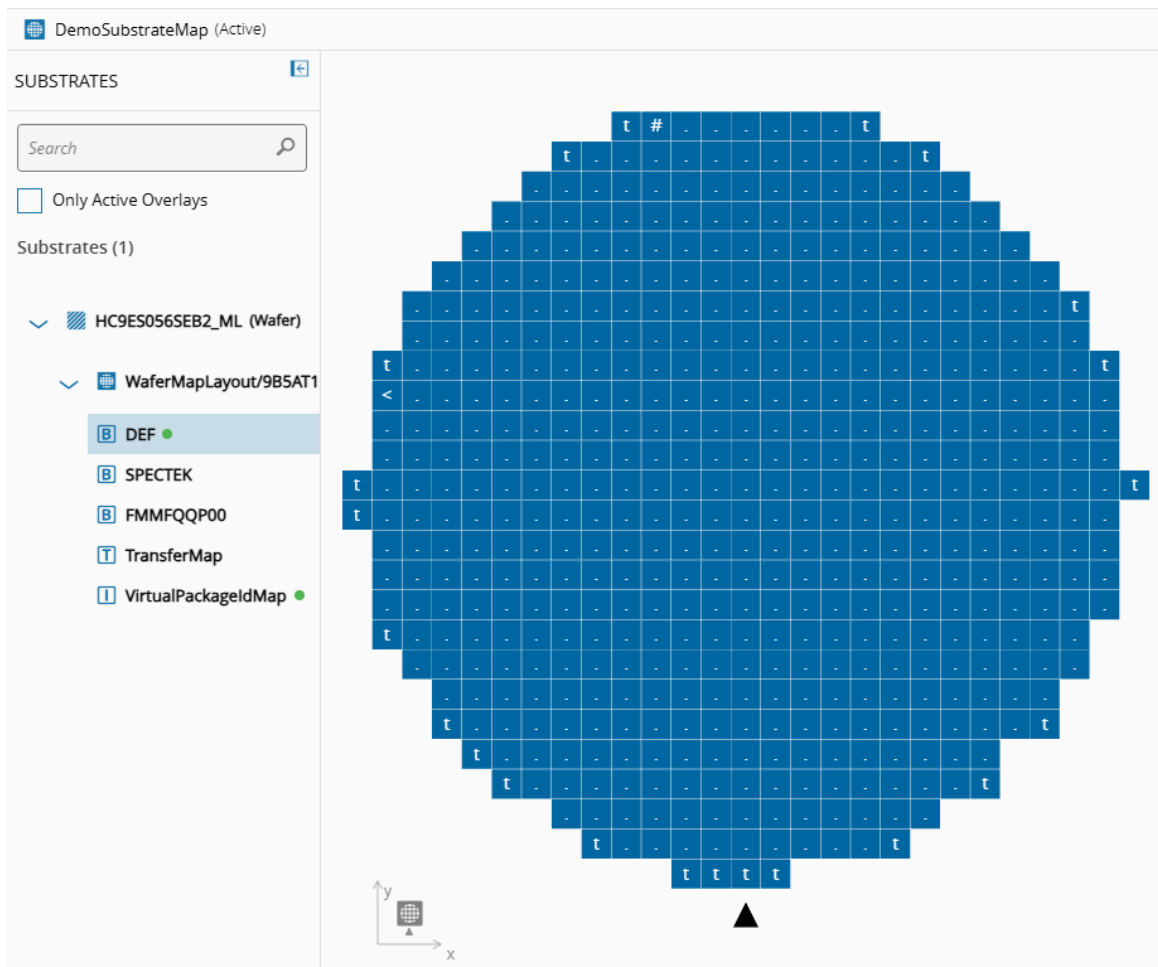
Scenario

The defined scenario explores an operational use case in which a **Substrate Map** is generated from a JSON file. This map provides a graphical representation of a wafer composed of 520 dies, each associated with Bin Code values distributed across multiple Bin Code Maps.

Attached to the **Substrate Map** is the TransferMap, which contains the transfer information for each unit. This allows identification of the exact origin and destination of every die.

Additionally, the map includes a DeviceIDMap, which provides the name of each die.

The following image shows the MES object:



Modeling

This section provides a step-by-step guide to creating a **Substrate Map**.

Before starting the **Substrate Map** creation, ensure that you already have a JSON file compliant with the SEMI E142 structure. If you intend to use **Bin Converters**, they must be created in advance, along with their dependent objects, such as the [SubstrateMapBinQuality](#) Lookup Table.

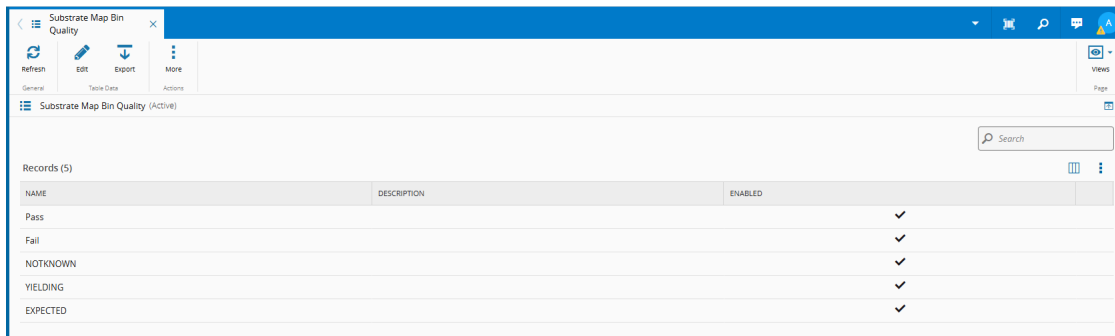
Note

The JSON file follows the SEMI E142 standard, which defines the map data using a structured format composed of three main sections: Layout, Substrates, and SubstrateMaps.

Lookup Table Values

To explore the **Bin Converters** entity, the following configurations were previously made:

- 5 different records to adopt different Bin Quality Values:



NAME	DESCRIPTION	ENABLED
Pass		✓
Fail		✓
NOTKNOWN		✓
YIELDING		✓
EXPECTED		✓

Mask File (XML Format)

This is the [file](#) used to create the map mask.

Modeling Notes

The **Substrate Map** creation process requires a JSON file compliant with the SEMI E142 standard. This format defines a structured and extensible way to represent substrate mapping data.

Within this structure, multiple map types, or overlays, can be defined for the same substrate, including:

- `BinCodeMap`: Represents binning results (e.g., pass/fail or quality classification).
- `DeviceIdMap`: Assigns unique identifiers to each device position.
- `TransferMap`: Defines die-to-die or substrate-to-substrate mapping relationships.
- `DeviceDataMap`: Stores parametric or measurement data per device.

The `MapData` field is composed of three main sections:

- `Layouts`: Defines the substrate structure (e.g., wafer layout). Each layout is identified by a `LayoutId` and may include hierarchical definitions such as `ChildLayouts`.
- `Substrate`: Defines the physical substrates using `SubstrateType` and `SubstrateId`, along with optional metadata such as lot or carrier information.
- `SubstrateMaps`: Links a substrate to a layout through `LayoutSpecifier` and contains one or more overlays, where the actual map data is stored.

Useful Documentation

For more information on how to create a Map Definition and configure its main properties, see [CM SEMI E142 schema](#).

Warning

Basic model configurations will not be covered in the execution video.

Execution

In this chapter, the reader is guided through the execution steps for the following scenarios:

- Creating a **Substrate Map**
- Linking a **Substrate Map** to a material and automatically synchronizing material quantity

- Performing Bin Code changes and synchronizing quantities
- Creating and managing overlays
- Creating a **Bin Converter** and executing bin conversion
- Creating and applying a **Substrate Mask**
- Exploring device traceability capabilities

Substrate Map configuration

For this use case, when creating a **Substrate Map** representing a wafer with 520 dies, the following properties must be configured:

Property	Value
Substrate ID	HC9ES056SEB2_ML
Substrate Type	Wafer
Lot ID	HQ33LG7.11
Layout ID	9B5AT15AAA-12-001
Dimension X	27
Dimension Y	26
Z order	0
Device size	11055 x 11055 um
Lower Left	0 x 0 um
Z height	Bottom
Top Level	No
Package	Yes
Ruler Mode	0
Show Ruler by Default	True

Table: Main properties of the Substrate Map

Creating a Substrate Map and linking to a Material

The following video demonstrates how to create a **Substrate Map**.

Once the **Substrate Map** is created, the next step is to associate it with a **Material**. This enables automatic quantity synchronization based on a selected overlay:

Bin Code changes and Quantity Synchronization

Throughout the **Material** lifecycle, devices may change in quality or classification. To reflect these changes, Bin Code values can be updated.

The following video demonstrates how performing a Bin Code change impacts the **Material** quantity after synchronization:

Creating and managing Overlays

The following example shows how to create a new overlay, resulting in a new version of an existing Bin Code Map:

Bin Conversion

To automate Bin Code value changes, **Bin Converters** can be defined and applied. The video below demonstrates how to configure conversion rules and apply them:

Mask creation and application

For bulk Bin Code updates following a specific pattern, a **Substrate Map Mask** can be used. The following video demonstrates how to create and apply a mask:

Device traceability

The system provides multiple traceability mechanisms:

- Device Genealogy
- Device History
- Search.

These are demonstrated in the following video:

Execution Notes

- You can create the **Substrate Map** directly from the material details page while performing **Set Substrate Map**. Instead of creating the **Substrate Map** first, as shown in the video, you can use **Set Substrate Map** and create the map at the same time by uploading the SEMI E142 file.

Additional Note

The Substrate ID mentioned on the Substrate Map must exactly match the Material name where it will be used.

- The Material quantity synchronized through the **Substrate Map** only considers the `pass` units as countable units to be added to the material.
- After changing Bin Code values, access the material details to manually synchronize with **Substrate Map** the specific overlay.
- The Device ID corresponds to the information available in the unit section of the Device ID Map.

Master Data

This is the [Master Data file](#) used to create this model.



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