Accelerating the next technology revolution

EUV Mask Standards Update

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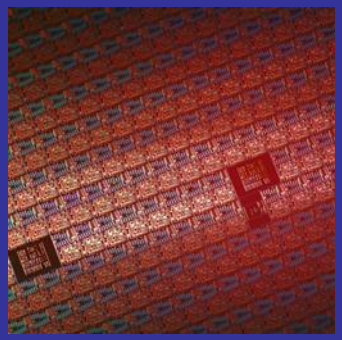


Outline

- **Status of mask related standards**
- **E152 EUV-pod standard revisions**
- **Differences between Type-A and Type-B**

EUV Mask Standard Status

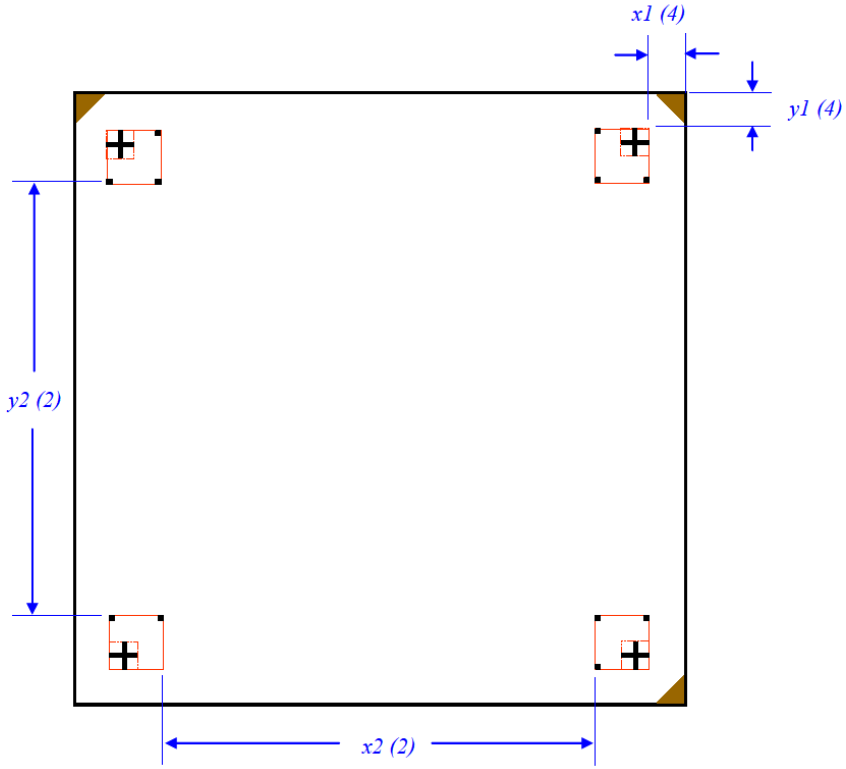
- **E152 EUV-pod standard revision is immediately needed.**
  - Among nearly ten updates, the two most important are additions of reticle purge ports, and safeguard features for positive identification of carrier or mask (RFID, info pad configuration).
  - The yellow ballot is open for voting from 9/12 to 10/12.
  - Review / adjudication will be on 10/26 in SEMI Fall Standard Meeting, Santa Clara, CA
- **P37 blank standard TF activity is low, but no urgent need.**

  (P38 was merged to P37 in last revision.)
  - *Integrated mask reflectivity* is proposed, vs. reflectivity at mask level as currently defined.
  - No consensus has been reached to move forward.
- **P48 fiducial mark standard implementation is at works between users and blank suppliers.**
- **P40 EUV mask mounting and T16 data matrix fall in background.**

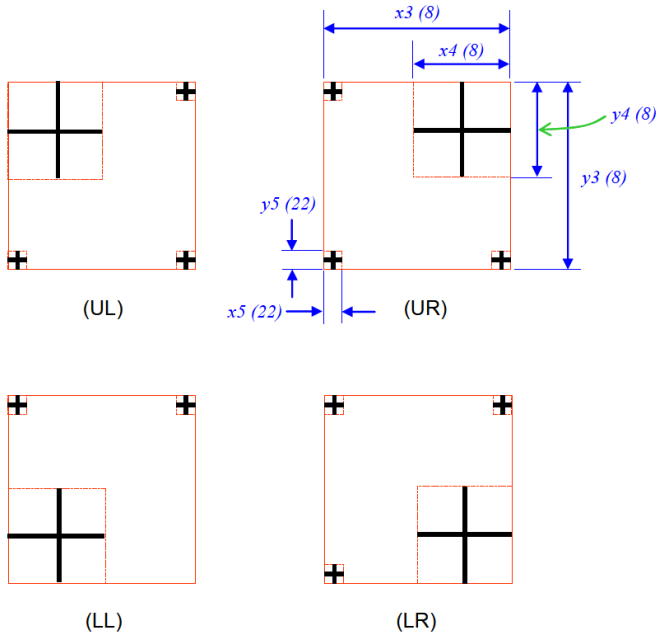
P48 Fiducial Mark Standard is Active, for Mask Blank Defect Mitigation

Key challenges for implementation of defect mitigation strategy

1. Accurate defect location measurement
2. Robust mark fabrication
3. Low defect ML blank



Fiducial mark layout: the central 131.5x131.5mm area is free of any mark.



Layout of coarse and fine marks for each of the four (4) fiducial marks

EUV Reticle Carrier Essential

- **EUV reticle carrier uses a *pod-in-pod* structure.**
  - Inner pod acts as “removable pellicle,” separating from mask only during exposure.
  - Outer pod is NOT new, >90% identical to RSP200 (optical mask pod).
  - Shares exterior interfaces of RSP200 loadport. But, need new capability to handle inner pod and mask once outer pod is opened.
  - Support (optical carrier) over head transport automation.
- **Masks transferred to vacuum tools with inner pod on**
  - Non-vacuum tool implementation has more flexibility, like inspection, cleaning…
- **When outside of tools, mask should always sit in a complete set of EUV carrier, not just inner pod.**

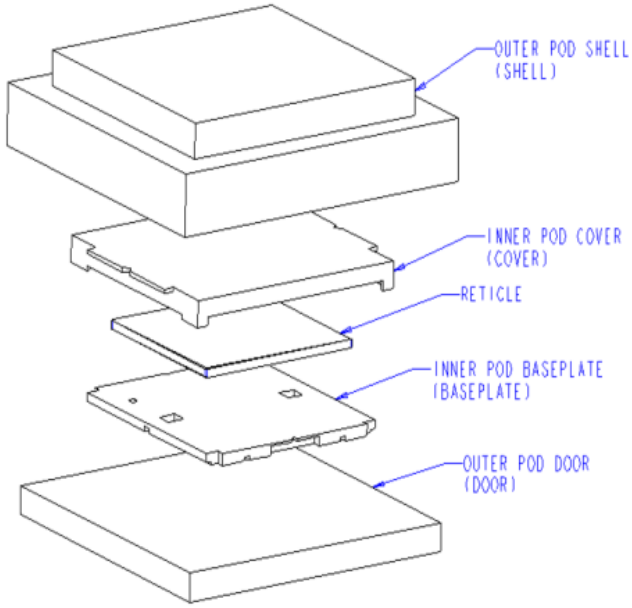


Figure 1. Concept of EUV reticle carrier

Ballot of E152 EUV-pod Standard Revision Open for Vote Until 10/12

Please cast your vote -

http://dom.semi.org/web/wstandards.nsf/NTB2?openview&count=1000&restricttocategory=Physical Interfaces & Carriers (6-11)

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DRAFT
Document Number: 5262
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SEMI Draft Document 5262
REVISION TO SEMI E152-0709, MECHANICAL SPECIFICATION OF EUV POD FOR 150 mm EUVL RETICLES

1 Purpose

1.1 This standard specifies EUV Pod for the 150 mm Extreme Ultraviolet Lithography (EUVL) reticle, used to ship, transport and store a 6-inch reticle. The EUV Pod consists of an outer pod and a protective inner pod. The EUV Pod is to be used when a conventional reticle carrier does not meet the requirements of EUVL.

2 Scope

2.1 This standard is intended to set an appropriate level of specification that places minimal limits on innovation while ensuring modularity and their inter-changeability at all mechanical interfaces. Many requirements given in this specification are in the form of maximum or minimum dimensions with very few required surfaces. No material requirements or micro-contamination limits are given in this specification.

2.2 Because of high attenuation feature of EUV light, a conventional pellicle film cannot be placed in front of EUVL reticles. The inner pod is to protect reticles from particle contamination.

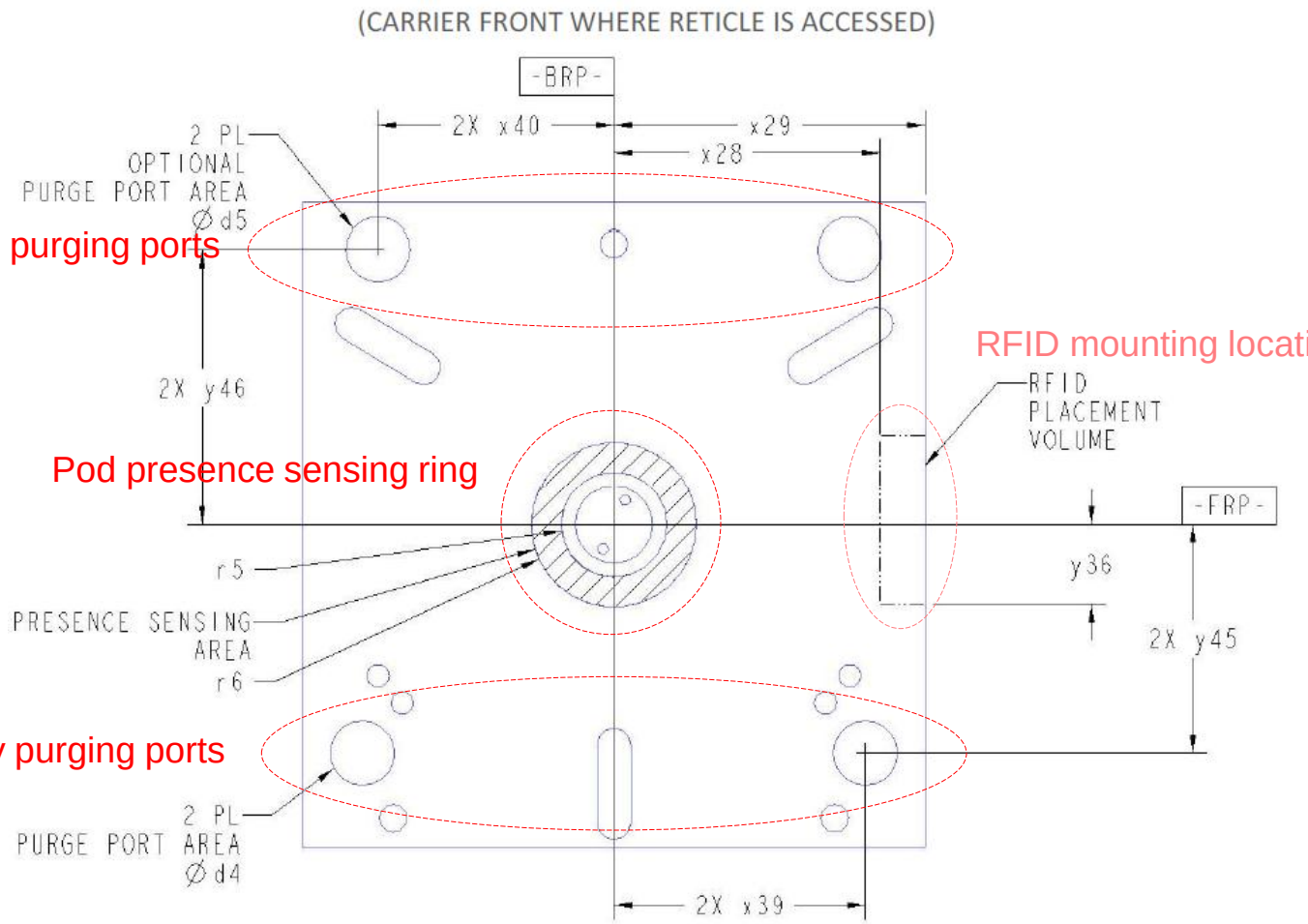
2.3 The EUV Pod has the following components and sub-components. The baseplate of inner pod has two possible configurations depending on the intended usage. They are designated Type A and Type B. Detail configuration

TTER (YELLOW) BALLOT

Summary of E152 Revision

- **Additions** are primarily specified in Sections 5.10.3, 5.16, 5.17, Tables 1 and 3, and Figure 10:
  - (2) primary and (2) optional purge port locations / areas
  - (1) carrier presence sensing ring / area
  - (8) carrier info pad configurations
- **Improvements** are primarily made in Sections 4.2.6, 5.5, 5.10.2, Tables 1, 2 and 3, Figures 6, 9, and 10:
  - Clarification of carrier orientation
  - Clarification of reticle positioning on inner pod baseplate
  - Clarification of outer pod door force and torque
  - Clarification RFID location in outer pod door
  - Correction of KC pin specifications
  - Specification of OHT flange height

Additions to E152 Standard for Reticle Purging



Two optional purging ports

RFID mounting location

Pod presence sensing ring

Two primary purging ports

Figure 10
Bottom View of Outer Pod Door

Additions to E152 Standard for Carrier / Reticle Management

Manage by RFID and Info pad configurations

- RFID location standardized
- Eight (8) possible info-pad configurations defined
- How to use them is all up to end users

Table 3 Info Pad Assignment

Configuration	*Info Pad*			
	A	*B*	*C*	*D*
EUV-1	●	●	○	○
EUV-2	○	○	○	○
EUV-3	●	○	○	○
EUV-4	○	●	○	○
EUV-5	●	●	●	○
EUV-6	○	○	●	○
EUV-7	●	○	●	○
EUV-8	○	●	●	○

●: Info pad (hole) plugged
○: Info pad (hole) open

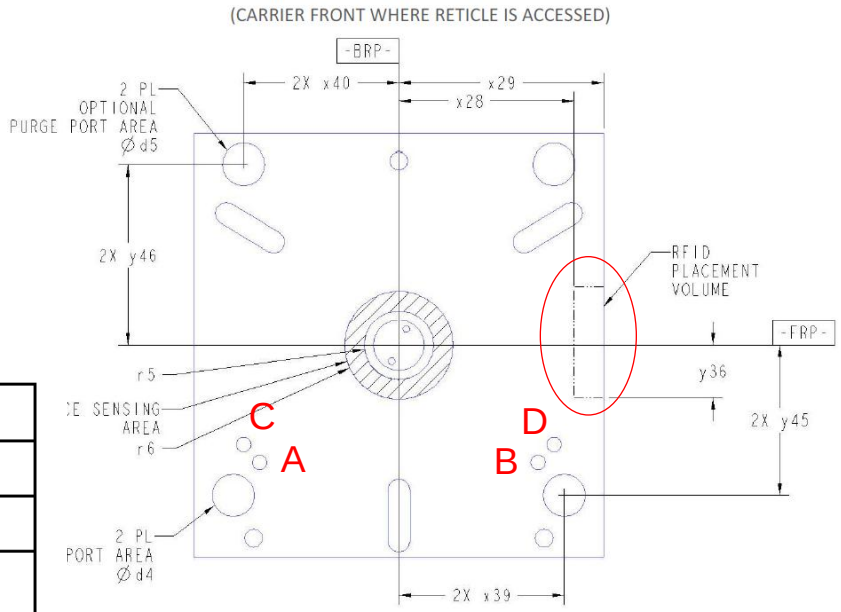


Figure 10
Bottom View of Outer Pod Door

Four (4) Baseplate Differences of Inner Pod Defines EUV-pod to Type-A or Type-B

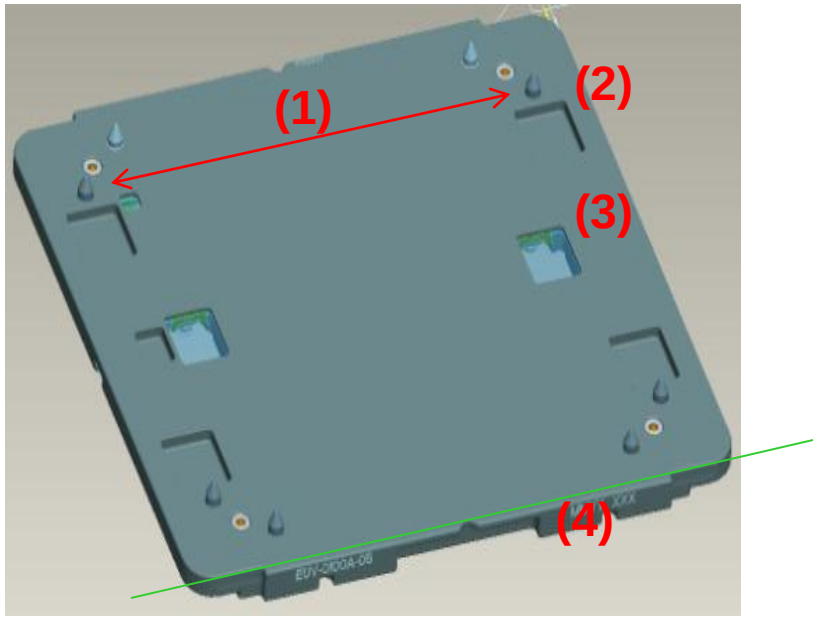
E152 defines two types of inner pod by two hard differences: (1) and (4), and two soft differences: (2) and (3).

Table 2 Type A/B Inner Pod Baseplate Specification

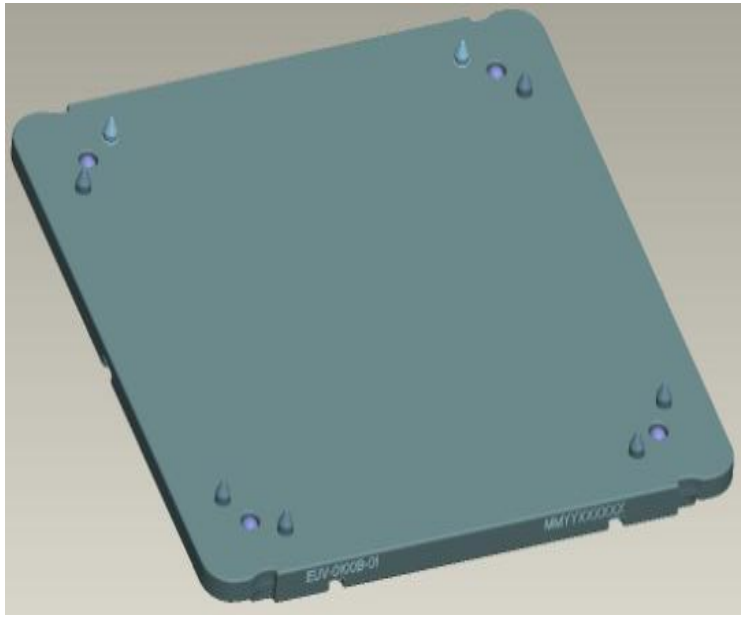
Feature	*Symbol Used*	*Figure*	*Section*	*Specification*		
				Type A	Type B	
Reticle Constraint Location	x1		5.5	76.55 ± 0.04 mm	76.25 ± 0.04 mm	(1)
Reticle Constraint Location	y1		5.5	76.55 ± 0.04 mm	76.25 ± 0.04 mm	
Front Edge Grip Exclusion Volumes		3	5.2	Required	Not Required	(2)
Baseplate Windows		5, 8	5.9	Required	Not Required	(3)
Baseplate Exclusion Volume	y28	5, 8	5.7.1	50.00 ± 0.25 mm	40.00 ± 0.25 mm	(4)
Baseplate Registration Hole Assignments		5, 8	5.14	A, B, C, D, E, F	A, B, C	
Baseplate Corner Notch	x22	5, 8	5.8	72.00 ± 0.20 mm	Prohibited	
Baseplate Corner Notch	y38	5		3.00 ± 0.25 mm	Prohibited	
Secondary Baseplate Exclusion Volume	y5	5	5.7.1	4.6 ± 0.25 mm	Prohibited	
Secondary Baseplate Exclusion Volume	z3	7	5.7.1	6.00 ± 0.25 mm	Prohibited	
Baseplate Notch	y29	5	5.7.1	3.00 ± 0.25 mm	Prohibited	
Cover Edge Limit (above base plate, along x22)	z17	7		5.00 mm, Minimum	Prohibited	
Baseplate Exclusion Volume	x4	5	5.7.1	25.00 ± 0.25 mm	Prohibited	

Close Look at the Differences Between Type-A and -B Baseplates

- (1) - Type-A has 0.3 mm more mask positioning tolerances in all four directions.
- (2) - Five lowered areas for access to mask front edges by end effectors are *"Required"* by Type-A, *"Not Required"* by Type-B.
- (3) - Three windows are *"Required"* for Type-A, *"Not Required"* for Type-B.
  - Optical properties of the windows are not defined by E152. Potential impact is further dedication among Type-A carriers.
- (4) - Type-A has two extend-outs, one at top and another at bottom, *"Prohibited"* for Type-B. And other non-essential differences on the bottom of baseplate for type-identification.



Type-A baseplate



Type-B baseplate

What Were Left Out in Current Revision

- **Eliminate carrier dedication, for a single type EUV-pod**

  Holdout: no single carrier solution demonstrated

- **Optical property of the windows, to eliminate possibility for further carrier dedication among exposure tools.**

  Holdout: requires consensus among exposure tool suppliers

- **RFID data format**

  Holdout: can't standardize a specific type of RF transponder, so its data format, either. It has to be specified between pod suppliers and users.

Commercially Available EUV Pods

E152 EUV-pod standard + **Additional requirement by:** *ASML* *Nikon* *Canon* *SEMATECH* = **Commercial EUV-pod:** *aPod (Type-A w/windows...)* *nPod (Type-A w/windows...)* *cPod (Type-A w/windows...)* *sPod (Type-B w/o windows…)*

Entegris EUV-pod Part Numbers:

Gudeng developed prototype EUV-pods, available for customer evaluations

Supplier Confidential info dropped out

The Bottom Lines

Tool automation:

- ***Exposure tools interface with Type-A only.***
- ***All other tools interface with both Type-A and Type-B carriers, when compliant with E152.***
  - ***Type-A allows more mask positioning errors than Type-B: 0.3 mm more.***
  - ***Type-A allows end-effectors to contact mask front edges. Assess to mask front edges is "Not required" for Type-B.***

Particle protection:

- ***The best Type-A pod that one could possibly build is equal to Type-B, but not to exceed it, based on following three assumptions:***
  - *Mask and pod should not have any relative movement when pod is moved, by securing mask in place as best as possible.*
  - *Robotic fingers should stay away from mask front as far as possible.*
  - *Flatter baseplate provides fuller coverage to mask front than that with lowered areas.*