



EUV & Reticle Automation Solutions

Version 1.0



F O R T R E N D

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Fortrend - About Us

Founded in 1979 in Silicon Valley, USA, Fortrend has always been the top leader in batch wafer transfer technologies, Standard Mechanical Interface (SMIF) technologies, ultra-clean automation solutions, and wafer surface curing processes for the semiconductor and PV industries. Fortrend SMIF products have become the crucial automation connections between process equipment and the factory delivery system and between different processing equipment. Fortrend's standard 200mm and 300mm front end automation modules are readily integrated into processing tools reliably and cost effectively. Fortrend's 3DIC thermal curing tools set the industrial standards for wafer surface curing processes. Fortrend offers not only standard automation and thermal curing modules, but also custom solutions allowing us to meet custom challenges and difficult configuration requirements quickly with a minimum of expenses. Contact Fortrend and experience our engineering excellence firsthand.

What Set Us Apart

- Original inventor of 200mm SMIF pod loader and micro-environment technology
- Serving 200mm SMIF automation market since 1985 and the dominant solution provider for 200mm SMIF retrofit market today (Over 1,000 load ports delivered since 2008, to 10+ FAB's worldwide)
- Pioneer in new generation solar cell (0.15mm thin) batch handling robot
- Complete reticle handling automation solutions
- Leading EUV mask handling and load ports solutions
- 300mm wafer handling product lines (sorters, EFEM, component modules, and integrated oven systems) introduced in 2008
- Over 30 USA and International patents

What Does Fortrend's EUV and Reticle handling solutions Offer?

Fortrend offers several unique solutions to mask shops and FAB's to improve the performance and yield for Photomask and EUV reticle process, metrology and storage Tools.

Fortrend has developed and improved a number of SMIF load ports, shipping box openers, robotic handling solutions with improved cleanliness and ease of operation to meet the high demands of the industry with the emerging EUV and smaller bandwidth requirements of the next generation Masks and Reticles.

The Benefits

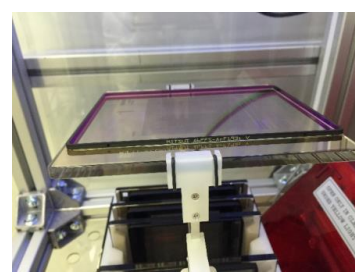
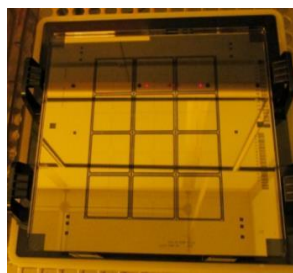
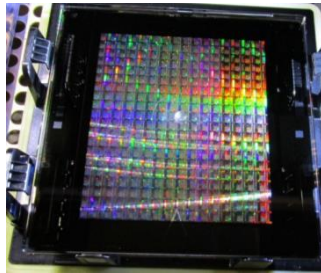
Lowest capital investment and manufacturing cost at highest manufacturing efficiency and production profitability. Fortrend is your one-stop solution provider for all reticle handling and storage requirements.

Value Propositions

1. Shortest development time allowing OEM customers to meet window opportunities and fastest time-to-market
2. Best management solutions to handle complicated reticle handling and storage requirements at lowest cost possible
3. Improved production yields for safe and clean reticle handling and storage
4. Meets and exceeds the most rigorous contamination requirements of reticle from particles, ESD, haze, and human handling
5. Easy and cost effective upgrades of open stage tooling into SMIF compliant tooling.
6. Total solution packages for safe and automated handling of reticles from shipping carriers to custom process pods; to SMIF pods; and to process tools

Mask/Reticles

- Masks or Reticles are used in the Semiconductor Lithographical tools to project the patterns on the wafers during their manufacturing.
- The most common masks used today are the 6" (152.4mm) x 1/4" (6.35mm) thick masks.
- Fortrend manufactures handling equipment for these masks.
- There are two types of 6" mask – the 193 and the EUV mask.
- 193 masks have a pellicle attached to one side to protect the mask from particles.
- EUV masks with and without Pellicles



SMIF Pods & Reticle Boxes

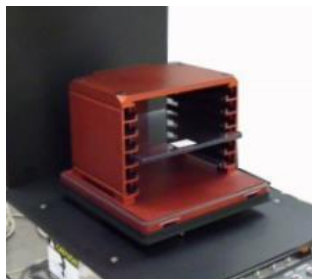
There are 3 types of Reticle/Mask SMIF pods used by SEMI conductor FAB'S and Mask Manufacturers.

- For the Manufacturing of the masks the SEMI E100 RSP 200 SMIF pod is used.
- Inside the Wafer FAB'S the lithographical tools use SEMI E111 single RSP or SEMI E112 Multiple RSP's.
- The next generation EUV tools use SEMI E152 SMIF pods.

Other Lithographical tools from Nikon and Canon use their own Mask boxes.



SEMI E111 150 RSP



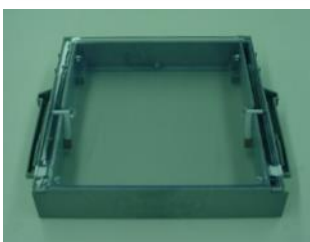
**SEMI E112 150
RSP**



SEMI E100 RSP



**SEMI E152 EUV
Pod**



Nikon Mask Box



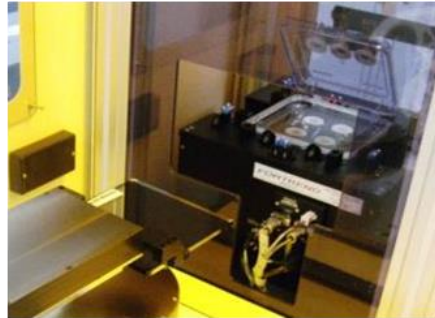
Canon Mask Box

Shipping Boxes & Storage Boxes

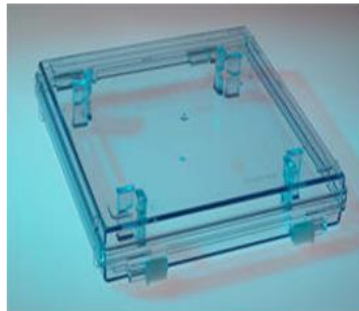
- Both Mask shops and FAB'S store and transport their masks in several types shipping and storage boxes.
- Fortrend has design and built several types automatic box openers to allow access to the masks inside.
- The Blank Box Opener (BBO) is used to open 5 mask blank boxes from the mask makers – Hoya or ShinEtsu.
- Clam Shell Box Openers (CSO) these open shipping boxes from Toppan, DMS, Pozzetta, IBM and others.
- Other storage box openers are available upon request and engineering study.



IBM Blue Shipping Box



Clam Shell Box Opener



DMS/Pozzetta Shipping Box



Hoya & ShinEtsu Blank Boxes



Blank Box Opener

Lamina 200 Series Reticle Sorters

- Fortrend offers a number of different configurations of the Lamina Reticle Sorter to meet customer transfer requirements, floor space, value added options and special design needs of the customer.
- For the Lamina 200 Series Sorter system Fortrend recognizes the need to maintain a high standard of cleanliness within the system when handling the 193 and EUV masks and the need to handle standard masks from shipping boxes that do not meet the ISO class 1 cleanliness requirements.



Lamina 204

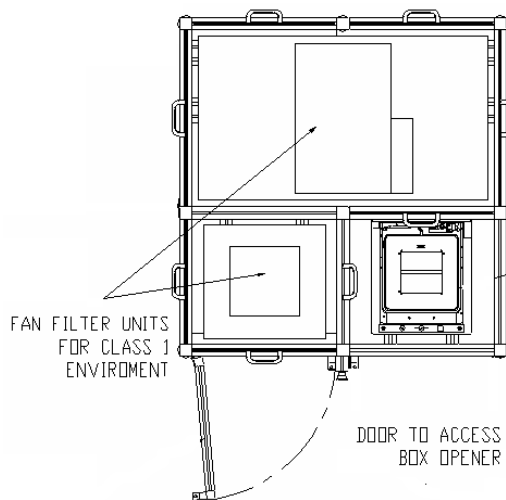
- To achieve this Fortrend recommends that the Lamina sorter system uses isolation chambers to reduce to introduction of contamination from the shipping boxes into the mask handling area.
- Options within the system include:
 - Fully automated mask/reticle transfer systems
 - ISO-Class 1 cleanliness
 - Integrated ionizers to meet SEMI E78 ESD “Level1” standard
 - Meet SEMI S2/S8, and European CE standards
 - Turn/Flip Modules (Rotate Mask 0° to 360°; Flip Masks 0° to 180°)
 - Automated box openers: 150mm and 200mm SMIF pods (single and multiple), ASML, Nikon, Cannon, HOYA, Toppan, DNP, TMC, ShinEtsu, DMS, and others, available in any combinations.
 - BCR/OCR reader, RFID reader/writer, Turn tables, Particle Inspection systems, Bright light Review and N2 Blow off
 - SECS/GEM Interface

Lamina 200 Series Sorter Configurations

The Lamina 200 Series tools are available in a number of configurations to suit the number of input stations (Shipping box openers and SMIF pod openers) and value-added modules (Turn/Flip, Turntables, Bar code readers, Bright light inspection Modules, etc.). All the systems are based around an ISO Class 1 Robot either on a robot track or in a fixed position.

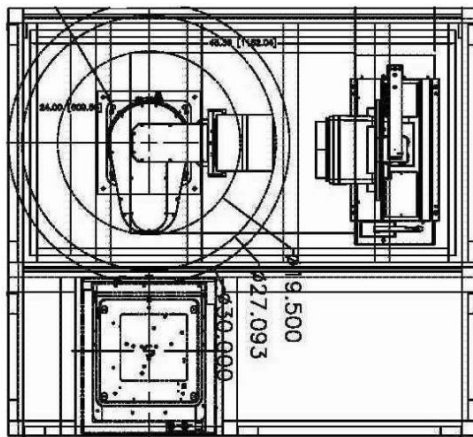
The Lamina sorters can be an inline or multiple side configurations depending upon the end users floor space and access to the tool. The following are examples of tool layouts available:

Lamina 202 Inline



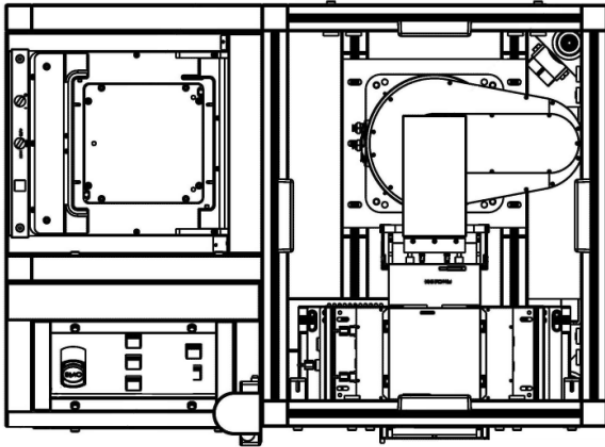
RSP 200 to "Hoya" Blank Box

Lamina 202 Fixed Robot



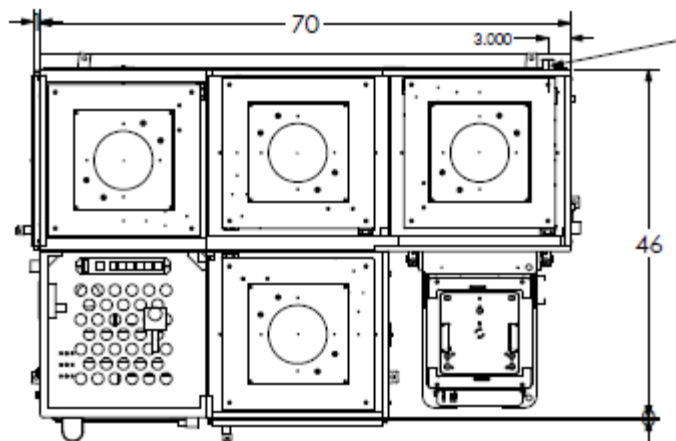
RSP 200 to "Hoya" Blank Box

Lamina 202 Fixed Robot



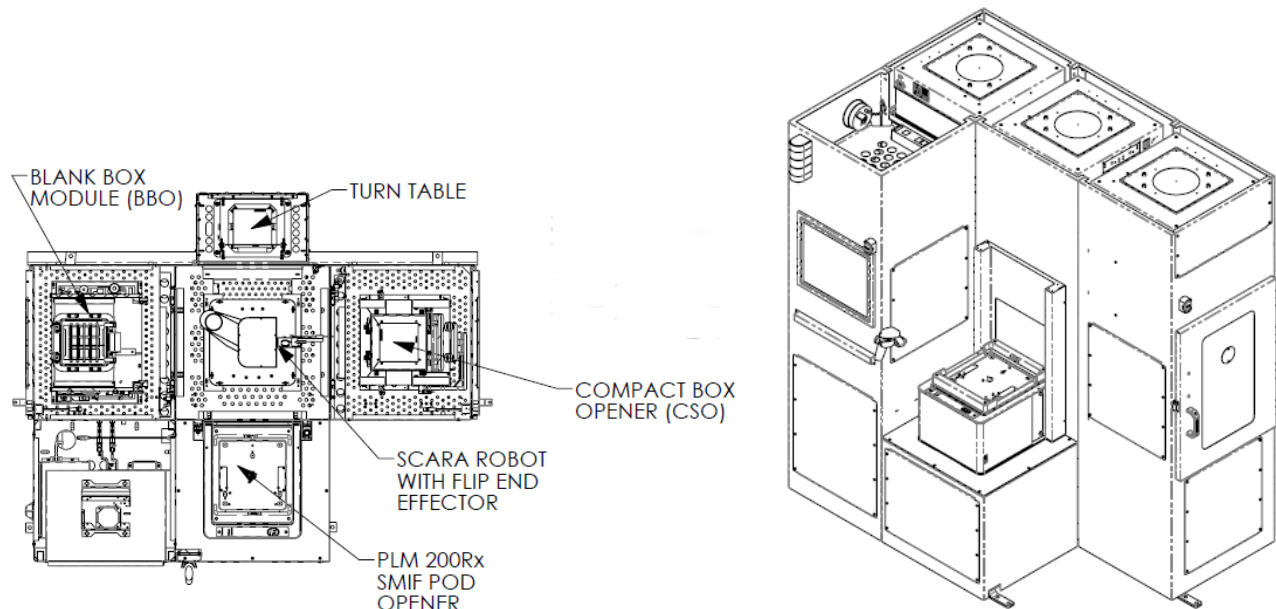
RSP 150 to Nikon Box with Turn Table

Lamina 203 Fixed Robot



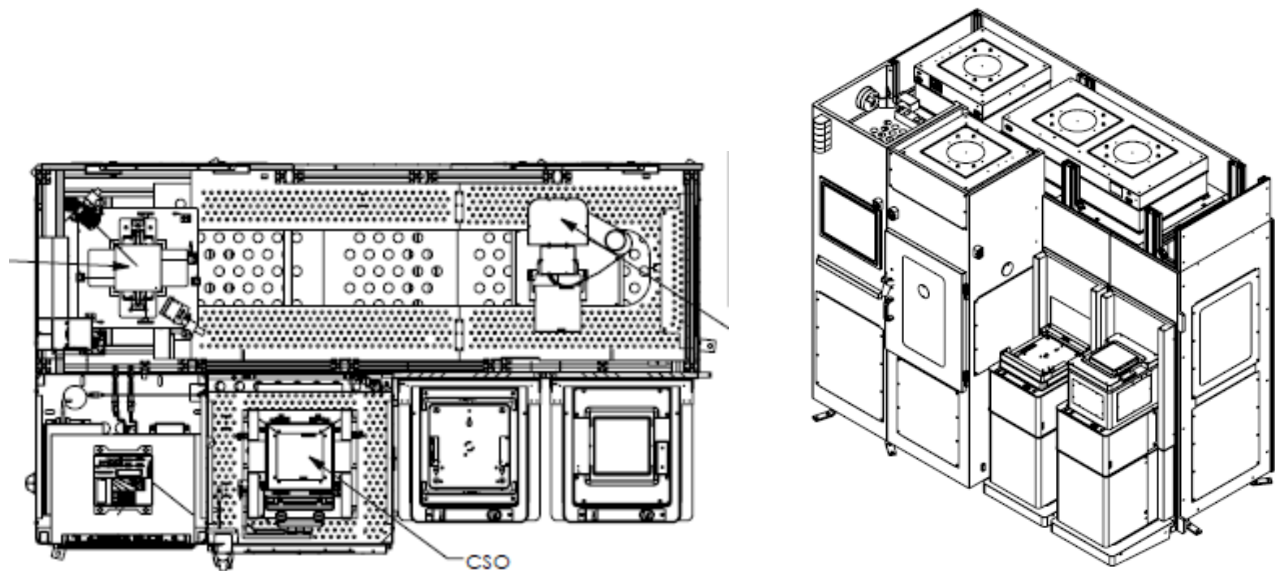
RSP 200, Pozzetta Clam shell box, Hoya Blank Box with Turn/Flip

Lamina 203 Fixed Robot



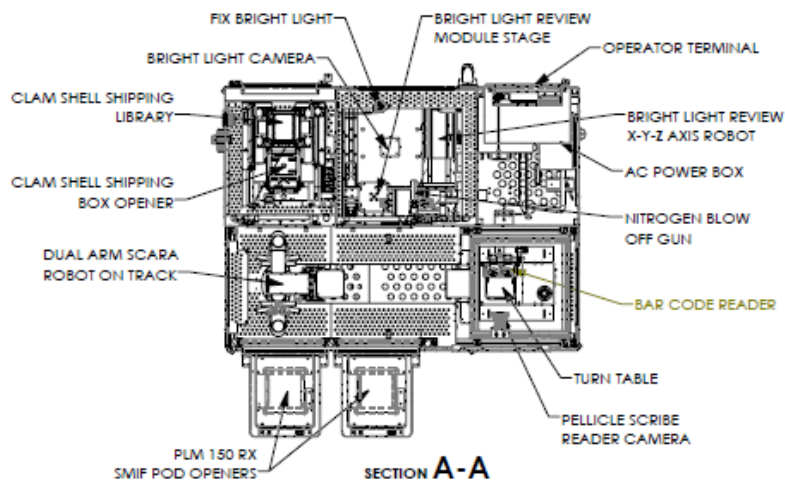
RSP 200, Pozzetta Clam shell box, Hoya Blank Box with Turn Table and Flipper Robot

Lamina 203 Inline



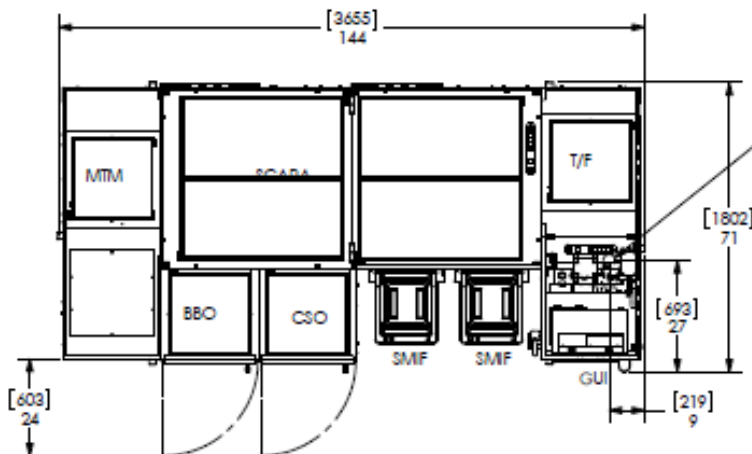
RSP 150, RSP 200, DMS Clam shell box, Turn/Flip module with BCR

Lamina 203 Inline



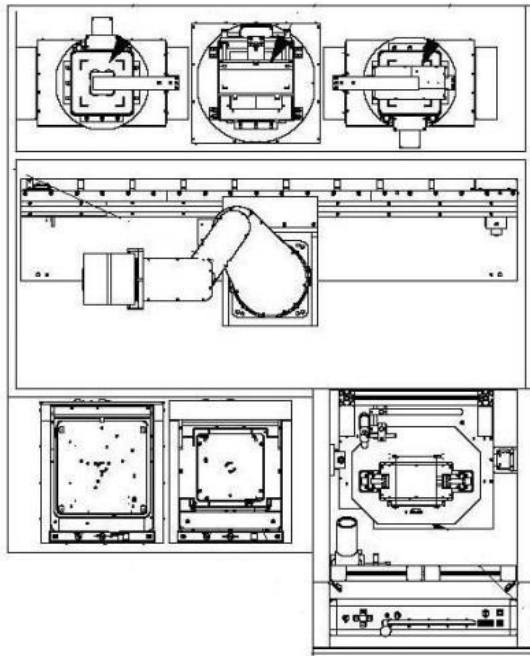
2x RSP 150, DMS Clam shell box with 6 position Auto loader , Bright Light Review module with N2 Blow off, Turn Table with BCR

Lamina 204 Inline



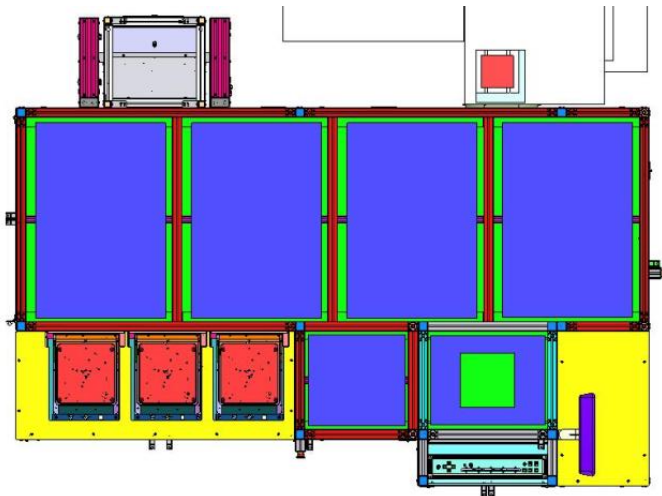
2x RSP 200, Gudeng Clam shell box, Hoya Blank Box Opener, Turn/Flip Module with BCR and Thickness Measurement Module

Lamina 205 Inline



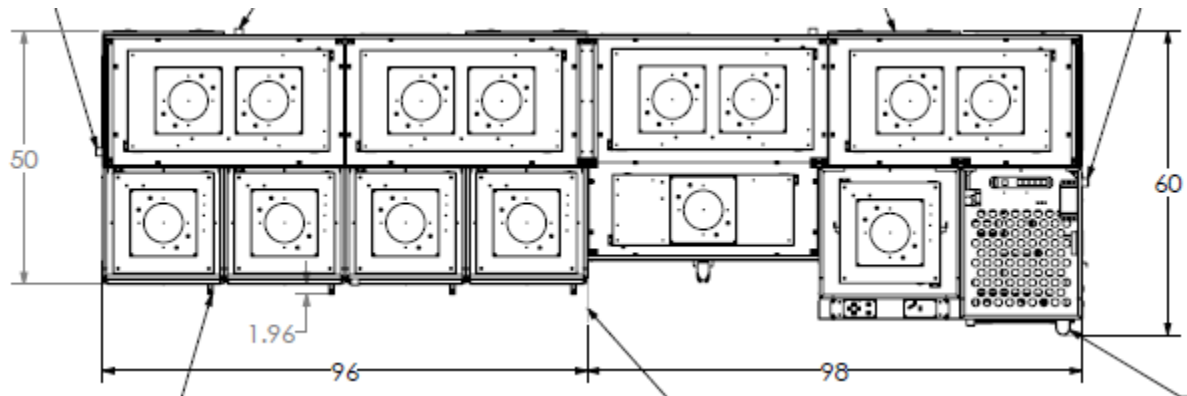
RSP 150, RSP 200, Pozzetta Clam shell box, Hoya Blank Box Opener, ShinEtsu Blank Box Opener, Bright Light review Module with N2 Blow Off

Lamina 205 Inline



3x RSP 200, Pozzetta Clam shell box, Hoya Blank Box Opener, 30 Mask Storage Buffer, Bright Light review Module with N2 Blow Off

Lamina 206 Inline



2x EUV/RSP 200, Pozzetta Clam shell box, DMS Clam shell box, IBM Blue Clam shell box, Hoya Blank Box Opener, Bright Light review Module with N2 Blow Off, Turn/Flip Module with OCR and Bar Code readers

Lamina SMIF and Shipping Box Openers

Fortrend offer a range of 150, 200 and EUV SMIF pod openers



PLM 150Rx



PLM 200Rx

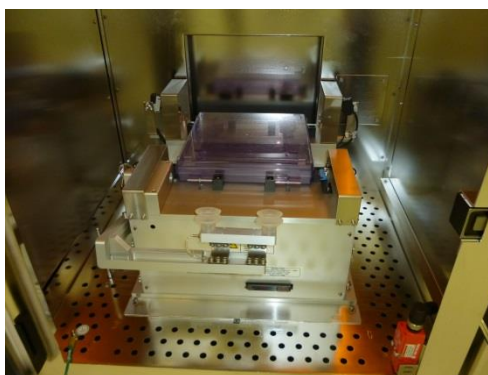


PLM EUV

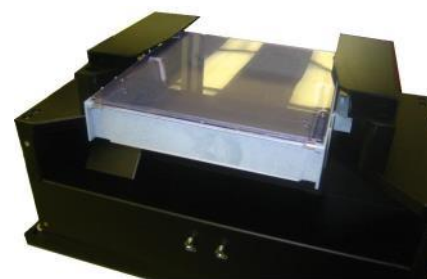
The Lamina series systems can be fitted with automated Openers for the majority of Reticle shipping and storage boxes currently available. The box types can be clam shell or lift off lids, Lithographical tool Reticle Cartridges, etc.



Blank Box opener



Clam Shell Box Opener



Nikon Box Opener

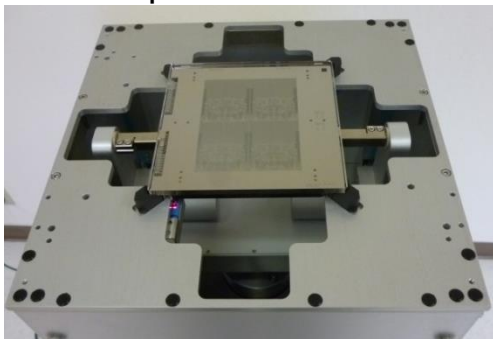
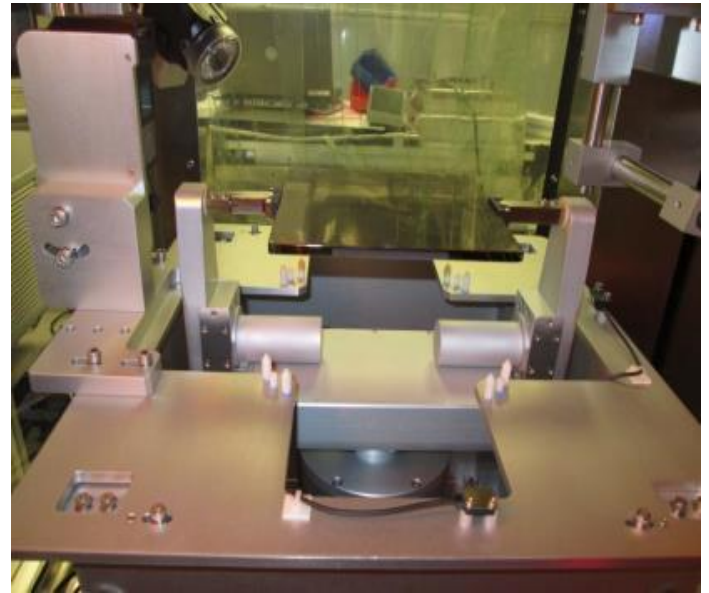
Details of the different opener options can be found in the Lamina Reticle Product Catalog.

Lamina Optional Modules

Turn/Flip Robot

Integrated Turn/Flip Module designed to orientate and flip the Mask/Reticles

- Turn at 90°, 180°, 270°, 360°
- Flip 180°
- Mask present Sensor
- Pellicle Detection & Orientation Sensors
- Side grip End Effector
- All Mechanism below mask
- Meets ISO Class 1 environmental
- Optional Joystick control for manually manipulating Masks for visual inspection



Item		Specification
Model		Turn/Flip Robot
Reticle Size		152 x 152 mm
Motion Range	T-axis	360 °
	Z-axis	300 mm
Repeatability	T-axis	± 0.02
	Z-axis	± 0.1mm
Payload		2kg
Motor		AC Servo motor
Cleanliness		ISO Class1
Weight		About 55 Kg
Teaching Pendant		UNIVERSAL With EMO, Dead Man Switch
MTBF		≥ 8,000 hrs.
MTTR		≤ 2 hrs.
Robot Controller		19" Rack Mount

Turn Tables & Hand-Off Stations

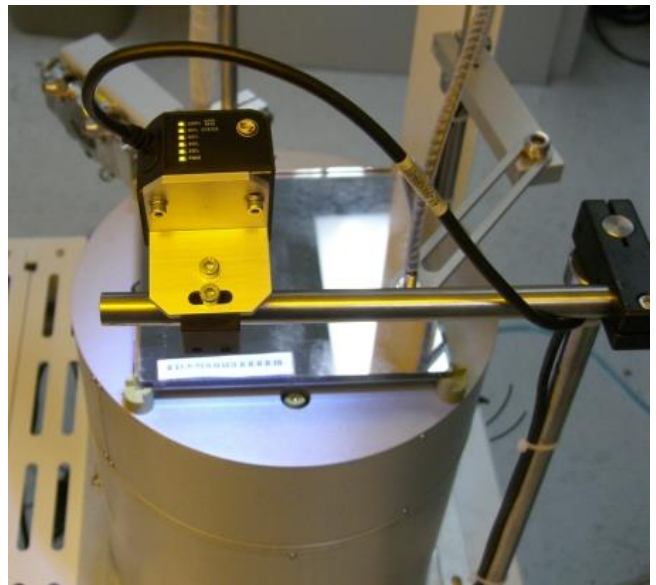
Fixed Hand-Off Station

- Stage used for Re-gripping Mask between stations
- Mask presence sensors
- Optional Bar code Reader can be installed.
- Pellicle Present sensors optional
- ISO Class- 1 cleanliness



Turn-Table Hand-Off Station

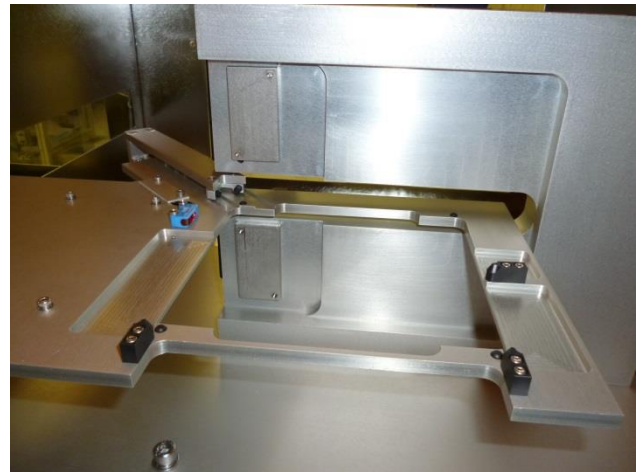
- Used to Swap Reticle grip
- Rotate Mask 90°, 180°, 270° as Required
- Mask presence sensor
- Pellicle sensor optional
- Pneumatic or Electrical versions
- Bar Code Reader optional
- ISO Class- 1 cleanliness



Mask Thickness Measurement Module

Integrated Module for measuring the Thickness of Blank Mask

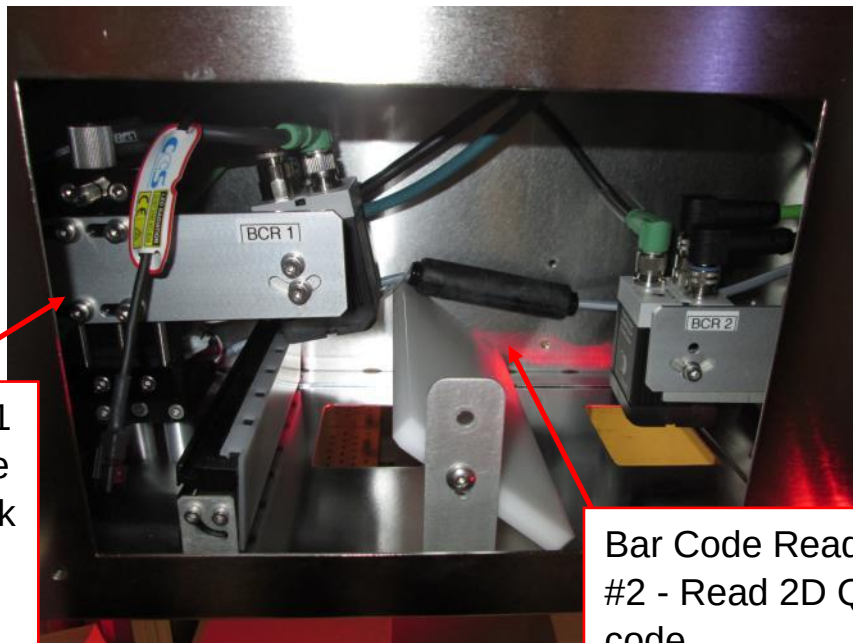
- Precision measurement sensors to verify the thickness of the Photomask.
- Programmable to measure up to 16 different locations over mask surface.
- Thickness logged at each position.
- Average thickness of Mask calculated.
- Static measurement repeatability $\leq 0.05\mu\text{m}$
- Load unload measurement repeatability $\leq 0.2\mu\text{m}$
- Sensor Resolution: $0.02\ \mu\text{m}$



ID Reader Stations

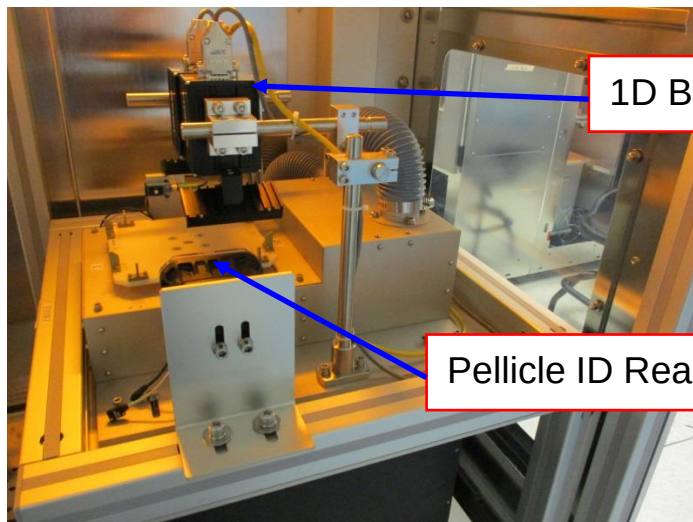
Fortrend ID readers are set up to identify the following types of Bar Code on Masks and Pellicles:

- 1D codes (Nikon, ASML, Canon)
- SEMI T11 Data Matrix
- SEMI T16 Data matrix on EUV Mask
- QR Codes
- OCR Codes



Bar code Reader #1
- Read 1D and Date
present on the mask
present on the
corner of mask

Bar Code Reader
#2 - Read 2D QR
code

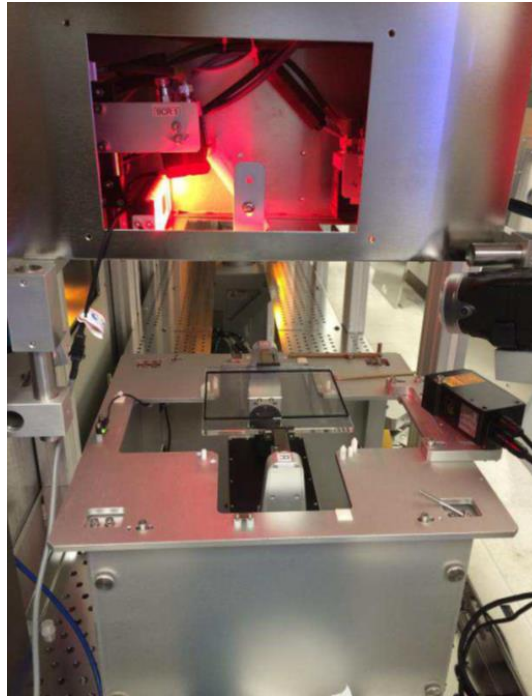


1D Bar Code Reader

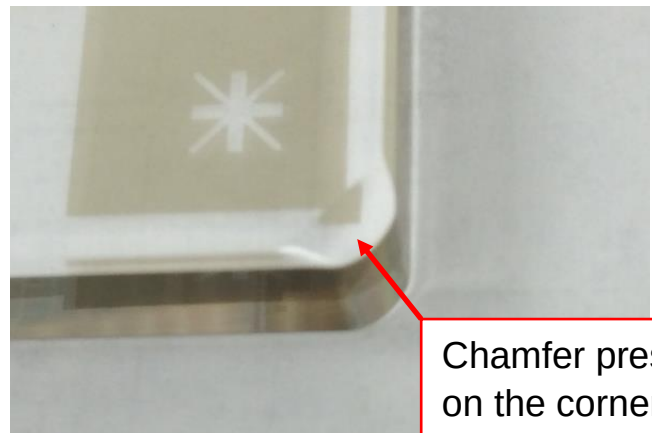
Pellicle ID Reader

Notch Identification Station

The Notch Identification system uses a recognition camera set up to identify which Reticles per SEMI P1 and P37, have the Identification chamfer ground into the corner. Using the system logic the blank mask can be orientated correctly for future operations.



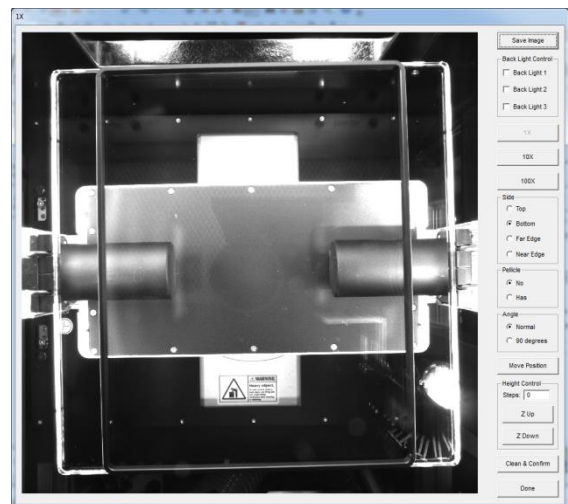
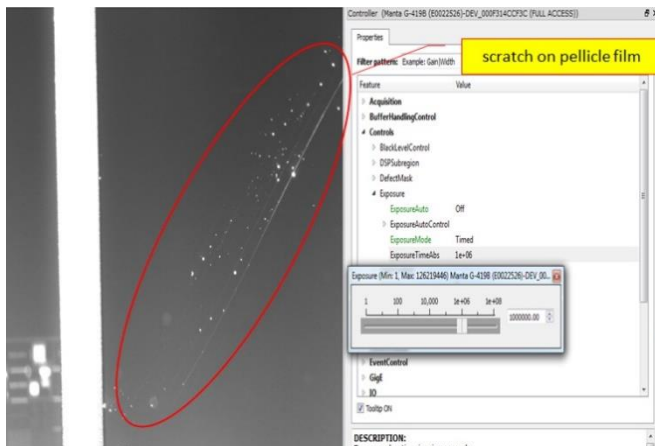
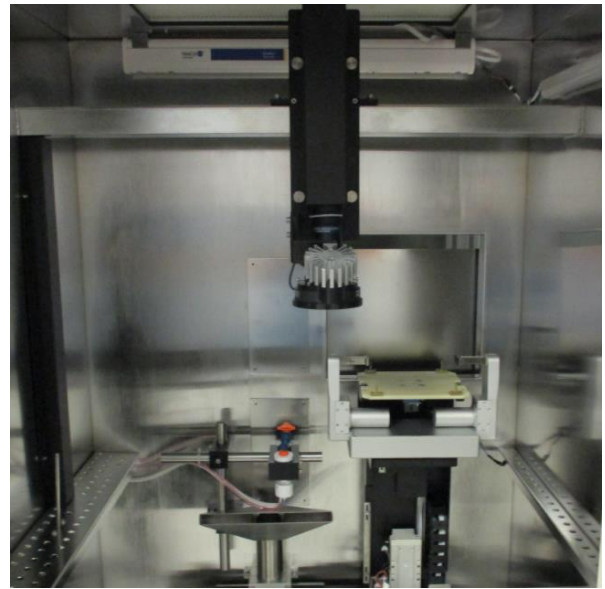
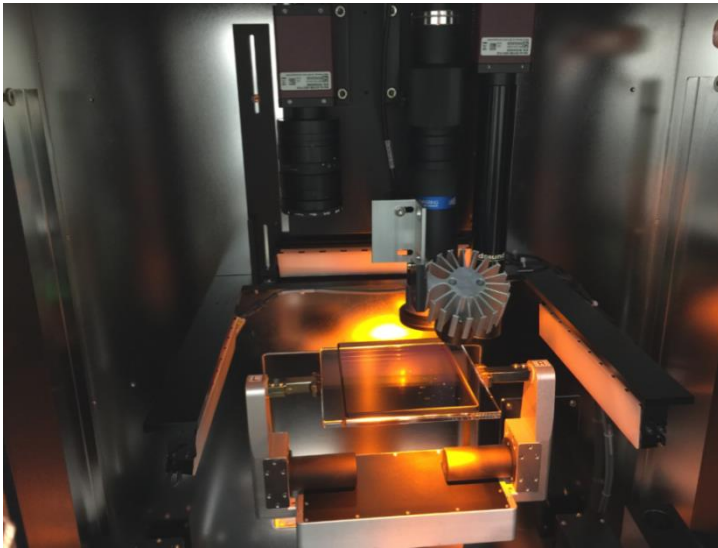
Chamfer Detector



Chamfer present
on the corner of
mask

Bright Light Review Modules

- Integral stage to allow manipulation of mask in 3 axis
- Bright light lamp
- Programmable inspection routines
- Manual control of mask orientation.
- Operator view area built into side of tool, local controls to manipulate Photomask under bright light.
- Optional Camera mounted above station to record Photomask and Pellicle condition with High definition screen capture
- Optional High definition live video feed of Mask surface available
- N2 Blow off Nozzle with programmable cleaning routines to remove some particles



Clam Shell Box Autoloader Module

- Auto loader for Clam Shell boxes
- 6 Shelves
- Integrated Robot to load to Clam Shell Opener
- Auto Door for Operator access
- Box Present indicator Lights



Particle Measurement Modules

- Integral 3rd Party particle Measurement Modules for inline particle detection for incoming and returning Masks.
 - Particle measurement size $\geq 0.5 \mu\text{m}$ dependent upon module used
 - Inspection time <90 seconds Glass and Pellicle



**Dr Schenk Pollux module
for particle size $\geq 10 \mu\text{m}$**



**Horiba DR5 module for
particle size $\geq 0.5 \mu\text{m}$**

FAB RETICLE ROOMS

Reticle SMIF Pod  ***Shipping Box Transfer***

FORTREND Lamina 202

For the FAB Reticle room to automate the transfer of Reticles from Clam Shell shipping/storage boxes to SEMI E111 SMIF pods.

Transfer New Reticles from mask shop or storage to SMIF Pods

Return Reticles to mask shop or storage

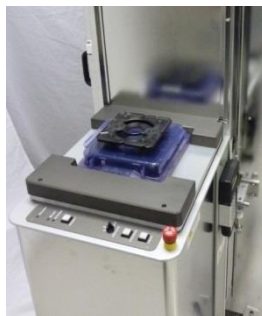
Features:

- PLUS 500 G4 SMIF Arm Load port for transferring Reticle to and from the Shipping box to SMIF Pod.
- Integral Robot arm allows the mask rotated 90°, 180° or 270° and to Flip the mask over for correct orientations in the SMIF pod or Shipping Box.
- SEMI E111 SMIF pod
- TOPPAN, POZZETTA or DMS Clam Shell shipping openers
- SEMI S2, S8, CE
- ISO Class 1 cleanliness
- Small foot print 24" (610mm) × 45" (1143mm) × 72" (1829mm)

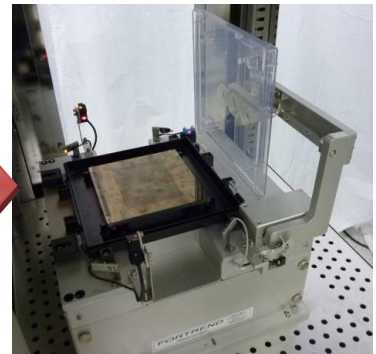


Options:

- RFID Reader/Writer
- Bar code reader (1D & 2D)
- SECS/GEM
- CIM connection



RSP150 SMIF Pod



**Clam Shell Shipping Box
(TOPPAN/POZZETTA/DMS)**

MASK SHOP

Reticle SMIF Pod  **Shipping Box Transfer**

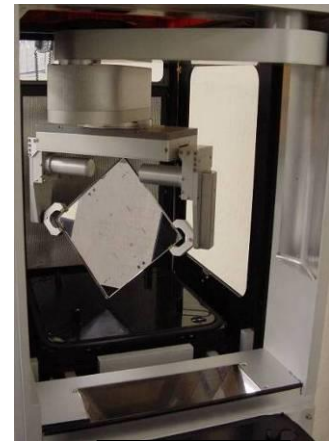
FORTREND Lamina 202

Improve productivity and Yield for the transferring of Masks to and from SMIF pods and shipping boxes with the Fortrend Lamina 202 Mask Sorter.

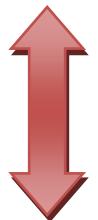
- Transfer **New Mask** to shipping boxes for your customers.
- Transfer customers returned masks to SMIF pods for processing.
- Rotate or Flip **Masks** during manufacture or repair to orientate the masks in the SMIF pod ready for the next process.

Features:

- PLUS 500 G4 SMIF Arm Load port for transferring Reticle to and from the Shipping box to SMIF Pod.
- Integral Robot arm allows the mask rotated 90°, 180° or 270° and to Flip the mask over for correct orientations in the SMIF pod or Shipping Box.
- SEMI E100 SMIF pod
- TOPPAN, POZZETTA or DMS Clam Shell shipping openers
- SEMI S2, S8, CE
- ISO Class 1 cleanliness

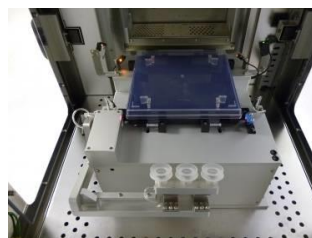


**Turn/Flip
The
Mask**



**200 mm SMIF
Pod**

**Transfer
The
Mask**



**Clam Shell Shipping Box
(TOPPAN/POZZETTA/DMS)**

Options:

- RFID Reader/Writer
- Bar code reader (1D & 2D)
- SECS/GEM
- CIM connection
- GUI user interface

Lamina 200 Series EFEM's

Each of the EFEM's combines one or more of the Fortrend Reticle Modules together with the Fortrend PLUS G4 SMIF arms or Reticle Scara Robot and End Effector to suit the End user or OEM manufactures requirements.

Fortrend's engineering department works closely with OEM's to design and build the EFEM's to their requirements.



Lamina 201 EFEM for EFEM for Zeiss Merit MG45 Mask repair tool, includes PLM 200R, Scara Robot, Auto process tool chamber opening device and auto door to process tool



**Lamina 201 EFEM for HMI Mask Inspection Tool
PLM 200R, Scara Robot, Turn Table, Blank Storage, Bar Code Reader**

Reticle Host Tool SMIF Upgrade Program

Fortrend Reticle Open stage SMIF upgrade program allows customers a cost effective solution to upgrade existing Open stage Mask tools to become SMIF tools to increase the yield from the equipment's without having to purchase the high price OEM upgrade solutions. Fortrend uses a combination of their Reticle SMIF modules to create integrated EFEM's to the host tool.

The lists below are some of the system upgraded in the last 10 years:

- **PK/L CP6000I Etching Tools**
- **Hitachi CD-SEM**
- **Lasertech MD inspection tool**
- **Veeco Inspection tool**
- **Pellicle Mounter Input Stations**
- **Plasma-Therm Dry Etchers**
- **SigmaMeltec SFD, SFB, and SFR tools**
- **JEOL SEF**
- **KLA Starlight**
- **KLA Terascan 5XX**
- **Oxford PlasmaPro**
- **Zeiss AIMS**
- **Leica LMS I-Pro**
- **AMAT Etec Tetra Tools**
- **SFI (Tegal) Endeavor EUV Tools**
- **Nanotech SC-1 Wet Bench Unload Stations**
- **Wacom Wet Bench Unload Stations**



KLA Starlight

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