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***MLA150***  
***Maskless Aligner***

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*Doc. No.: DWL-HI-062  
Revision: 8 (Oct 2019)  
Wizard version: 1.5.0*

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# 1 Introduction

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The MLA150 is a high speed direct write lithography tool extended by capabilities formerly only available on Mask Aligners. It can expose the patterns directly without prior fabrication of a mask resulting in a significantly shorter prototyping cycle. It offers topside alignment and backside alignment with high accuracy, and a light source which generates sufficient dose to expose even thick and less sensitive resists. The MLA150 allows using substrates of any size and shape and provides flexible change of pattern, distortion compensation and other software corrections. The system can produce structures down to 1  $\mu\text{m}$ . The alignment accuracy can be as good as 250 nm under optimized conditions.

## 1.1 About this user guide

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This user guide gives information and instructions on how to handle the MLA150 system properly. It is important that every person who intends to work with the system reads this guide in order to avoid possible mishandling leading to damage to the system or to persons. Therefore, by all means, read the safety instructions carefully before starting work with the system. The guide assists the user in performing the exposure procedure beginning at system startup and ending with the exposure procedure itself. The subchapters in *6 Job Setup* build a sequence of tasks that have to be executed in order to prepare the exposure job.

Additionally, you find a description of the system and of the Exposure Wizard. Also, information about system utilities and troubleshooting are given in the final chapters.

Technical data can be found in the related document **Technical Data Sheet**

To facilitate following the instructions and information, a list of conventions indicating the type of information is given here.

**Note:** Indicates that additional information or advice follow to get best results.

1. Signalizes that this is the first step of a step-by-step instruction followed by further steps

✓ Indicates a result which the user can see or hear. It can also just be an intermediate result and can therefore be followed by further steps of the same instruction.

 Indicates that the following information or instruction is an alternative step e. g., to abort a process or to be referred to another instruction or chapter.

## 1.2 Contact

Should you need assistance, please contact your local service office:

### China:

Heidelberg Instruments Service China  
Rm.101, Block 1, Animation Park,  
Yuehai Street, Nanhai Road,  
Nanshan Distr., Shenzhen 518045  
China  
Phone: +86-755-8301599-1 / -2 / -7  
Fax: +86-755-8301599-4  
Email: [service\\_china@himt.de](mailto:service_china@himt.de)

### Europe:

Heidelberg Instruments GmbH  
Service Department  
Tullastraße 2  
69126 Heidelberg  
Germany  
Phone: +49-6221-3430-0  
Fax: +49-6221-3430-30  
Email: [service\\_europa@himt.de](mailto:service_europa@himt.de)

### Japan:

Heidelberg Instruments Service Japan  
Germany Center for Industry & Trade  
1-18-2, Hakusan  
Midori-ku, Yokohama, 226-0006  
Japan  
Phone: +81-45-938-5250  
Fax: +81-45-938-5251  
Email: [service\\_japan@himt.de](mailto:service_japan@himt.de)

### Korea:

Heidelberg Instruments Service Korea  
#316 Expo Officetel, 381  
Mannyeon-dong, Seo-gu  
Deajeon, 35203  
South Korea  
Phone: +82-42-482-1668  
Fax: +82-42-482-1669  
Email: [service\\_korea@himt.de](mailto:service_korea@himt.de)

### Taiwan:

Heidelberg Instruments Service Taiwan  
6F-5, No. 192 DongGuang Road  
Hsinchu City, 30069  
Taiwan  
Phone: +886-3-5715188  
Fax: +886-3-5715388  
E-Mail: [service\\_taiwan@himt.de](mailto:service_taiwan@himt.de)

### USA:

Heidelberg Instruments Inc. USA  
2807 Oregon Court, Unit E2  
Torrance, CA, 90503  
USA  
Phone: +1-310-212-5071  
Fax: +1-310-212-5254  
Email: [service\\_usa@himt.de](mailto:service_usa@himt.de)

You can also reach Heidelberg Instruments via email: [himt@himt.de](mailto:himt@himt.de), or visit our site on the internet: <http://www.himt.de>

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## 1.3 Related documentation

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Heidelberg Instruments offers several further manuals related to the machine and its operation. If you did not get one of these or need an update, please contact Heidelberg Instruments, Germany (*1.2 Contact*). See the list of related documents below:

- **Pre-Installation Guide** Environmental and electrical requirements, sizes and weights of components etc.
- **PI- Site Inspection checklist** Checklist containing questions regarding the conditions of the customer's installation site for the system.
- **Safety guide** Describes necessary safety measures during move-in, installation as well as servicing and maintenance times.
- **Conversion Software Manual** Manual for the HIMT conversion software used for data preparation and fractioning.
- **Design Guide** Instructions on design rules and design creation.
- **Maintenance Guide** Guide for Maintenance and Troubleshooting, as well as an overview of typical service tasks.
- **Technical Data Sheet** Overview of the systems technical data.
- **Quick Guide** Short instructions to execute an exposure.

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## 2 Safety

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The MLA150 protects operators from exposure to laser radiation, dangerous voltages or moving parts while operating the equipment. All moving parts, lasers and their associated optics are enclosed within a flow box. During operation, opening the flow box window will immediately stop any exposure or measurement process.

Still, it is vital that the operators and all other persons who are allowed access to the system have been informed about any remaining risks.

### ***2.1 Intended use and limitations***

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The intended use of the MLA150 lithography system is to expose structures on photosensitive, non-flammable layers which are located on non-flammable substrates. These substrates must not exceed the specified maximum dimensions and must be free of damage such as scratches or cracks.

The MLA150 is intended only for professional use. The related user documentation is part of the product, and the user is under the obligation to read the documentation before using the product.

Every other purpose of use than that stated in this section is prohibited. In case of damage by using the product outside this stated purpose, no liability is assumed by the Heidelberg Instruments Mikrotechnik GmbH.

In addition to the intended use stated above, the following purposes of use are **prohibited** and defined as misuse:

Operation outside the operating data stated in the data sheet or in the sales confirmation.

Operation with materials other than the approved materials.

Change of the factory settings by unauthorized persons.

Use of attachment parts other than Heidelberg Instruments components.

Operation of the system in a potentially explosive environment or aggressive atmosphere.

**No untrained person**, or person not familiar with the contents of the following sections is allowed to operate the system or work in its close environment. If instructions are not followed carefully, danger to personal health and damage to the equipment is at risk.

At all times, follow all warnings and instructions given in this manual, the system software, safety labels on the system, or by our engineers.

## 2.2 Conventions

Throughout this manual there are safety warnings. To classify the degree of danger in each of these situations, this guide uses the conventions defined in ANSI Z535.6-2011:

<b>▲ DANGER!</b>	Danger indicates a hazardous situation, which, if not avoided, will result in death or serious injury.
<b>▲ WARNING!</b>	Warning indicates a hazardous situation, which, if not avoided, could result in death or serious injury.
<b>▲ CAUTION!</b>	Caution indicates a hazardous situation, which, if not avoided, may result in minor or moderate injury.
<b>NOTICE:</b>	Denotes warnings against possible misuse that can lead to machine damage.

Laser beam hazard	Electrical shock hazard	General warning	Toxic hazard	Corrosive material hazard	Flammable material hazard	Pinch point hazard

## 2.3 Laser safety

The MLA150 employs two types of continuous wave lasers, one for position measurement of the stage (interferometer laser), and one for design exposure (exposure laser). When the window is closed, all laser light is blocked or absorbed, and the system is effectively of laser class 1.

When the window is opened for loading or unloading, the interferometer laser beam is accessible. Under this condition, the system has the same laser class as the interferometer laser in use, which is laser class 2.

Laser Type	Wavelength (nm)	Power (mW)	Laser Class
HeNe	632	< 0.6	2

The exposure laser beam is a powerful beam that is usually covered completely by optics covers. Power and wavelength of the exposure laser depend on the specific configuration, but the exposure laser beam is always dangerous for the eye, sometimes also for the skin. Even reflected light may be dangerous.

**If the optics covers are opened, the accessible energy is of the class 4 category (DIN EN-60825-1).**

Laser Type	Wavelength (nm)	Power (mW)	Laser Class
Diode, blue	405	≤ 8000	4
Diode, UV	375	≤ 3000	4

If conditions require the opening of the optics covers, such as for servicing or troubleshooting by trained service personnel, then personnel must observe all precautions required for a laser of above mentioned class in the whole area surrounding the MLA150.

**▲ WARNING!****Eye injuries and/or skin burns!**

Severe damage to the eye and possibly to the skin can be caused by laser radiation of class 3B or 4

- Avoid possible direct or indirect exposure of eyes or skin to laser radiation at all times.
- Do not operate the system with open optics cover if not acting under explicit instruction of an HIMT service engineer.
- Do not enter any area cordoned off by HIMT service engineers during adjustment work.
- Do not put anything reflective or flammable into the beam path.

If the system has to be operated with open optics cover e.g., for trouble shooting:

- Cordon off the area and place warning signs.
- Wear appropriate safety goggles. Note that these cannot protect long against a direct beam but are only meant as protection against stray light! Also keep in mind that you cannot see the laser beam with goggles on, so the risk of skin burns increases.
- Use the lowest possible laser power or reduce the power as far as possible with filters.
- Never leave the laser on when unattended. Make sure only qualified personnel may switch on the laser in such a machine state.
- Do not place reflective objects in, or near the laser beam path. Laser light scattered by reflective objects can be as damaging as the original beam. **Objects such as rings, watchbands, and metal pens or pencils can be hazardous.**

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## 2.4 Electrical safety

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A CEE type 220-240 V, 16 A single-phase cable connector supplies operating power in the MLA. It is also possible to attach a local-type cable to a local-type wall connector. Please refer to the Pre-Installation Guide for details.

**▲ DANGER!**



### Electrical Shock!

Fatal electrical shock and/or severe burns can be caused by the supply voltage of up to 240VAC 16A for the system, and up to 420VAC 32A for certain laser types.

- Never use the equipment if cables or plugs have been damaged.
- Plug the MLA and its components only into approved outlets with correct ground. Power requirements are described in the Pre-Installation Guide.
- Ensure that both the voltage and frequency of a power source match the voltage and frequency stated on the equipment's electrical label.
- Not all power cords have the same current ratings. Household extension cords do not have overload protection and are not meant for use with sensitive electronic equipment. Never use household extension cords for any component of the MLA.
- Always follow the five safety steps if equipment containing electrical circuits with voltages >50VAC has to be opened: disconnect, apply restart lockout, check if equipment is de-energized, ground / short circuit equipment, cover neighboring elements that are still energized
- If access to the interior of any electronics component is necessary while system is in operation, exercise extreme caution. Only qualified service personnel may have access to the interior.

## 2.5 Other risks during operation

**▲ WARNING!**



**Injuries by moving parts or heat!**

If covers are removed, the operator may be exposed to dangerous collisions with moving parts, or heated components.

- Do not remove any covers that are fixed with screws
- Heed the warnings if removing any other covers

**▲ CAUTION!**



**Pinch risk by closing window!**

Mild pinch injuries are possible if fingers are brought between the upper window frame and the window while the window closes. The loading window is driven pneumatically with low pressure. It does not have enough force to injure a body or limb, but skin may be pinched.

- Do not close the window while resting a hand at the upper frame or upper window edge.
- Do not put a hand through the already closing window.

## 2.6 Interlock

To protect the operator from hazards by laser light or moving stage, interlock circuits prevent stage movement and access to laser light as soon as the window opens. A safety switch stops the stage, holding it in position, and closes the laser shutter. If an exposure has been running at that moment, the result is irreversibly lost.

The stage interlock can be overridden by service engineers by a key switch for servicing, together with a confirmation from the menu. While this service mode is activated, the main bar and background of the Exposure Wizard turns red.

**▲ WARNING!**



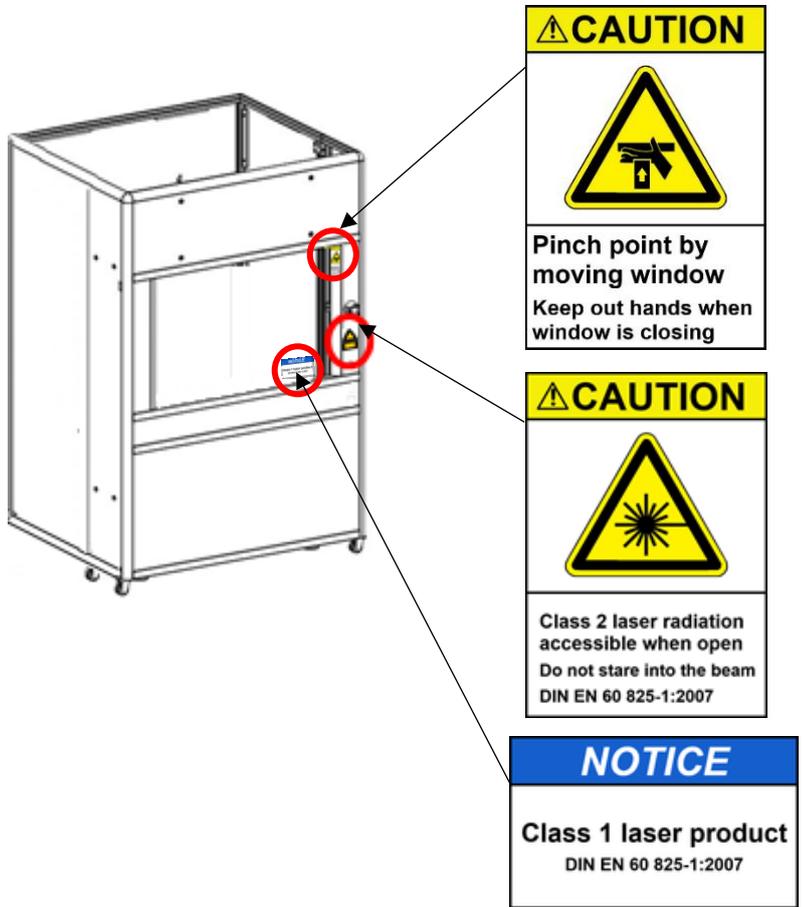
**Injuries by moving parts or laser light!**

While the system is in service mode, dangerous levels of laser light are accessible, and the stage can move with window open. Only HIMT service engineers are allowed to put the machine into service mode.

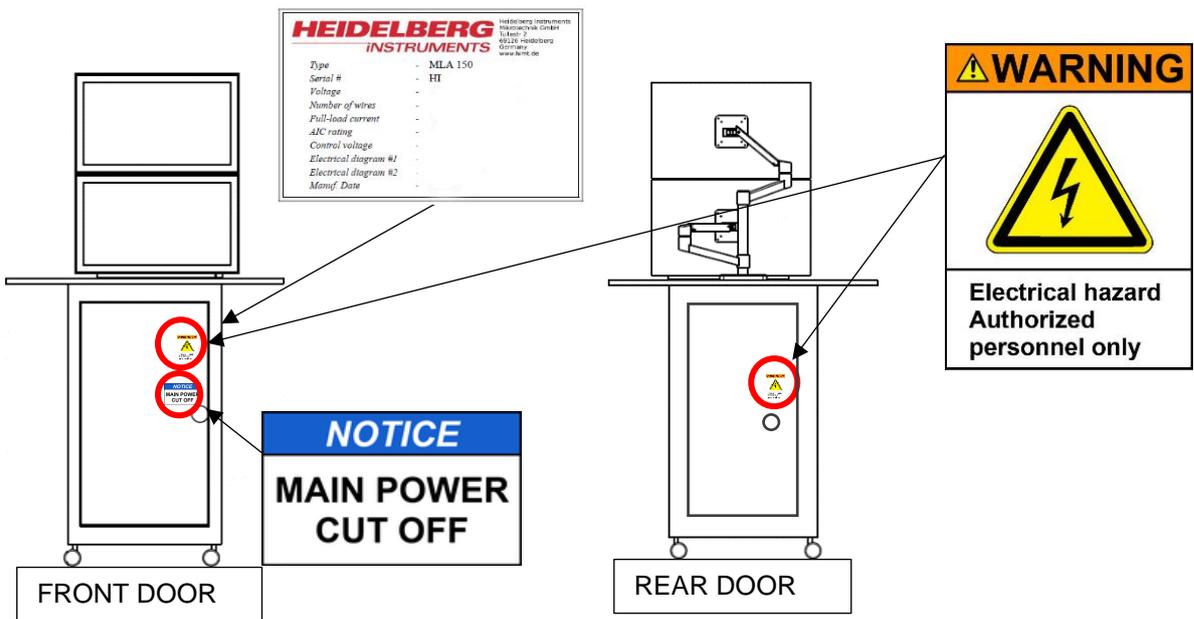
- During servicing or maintenance by service engineers, heed the warnings given in the *Safety Guide*.
- If service mode was left active accidentally, switch back to safe mode and remove the key. Return it to the service local office.

## 2.7 Labels

### Flowbox front

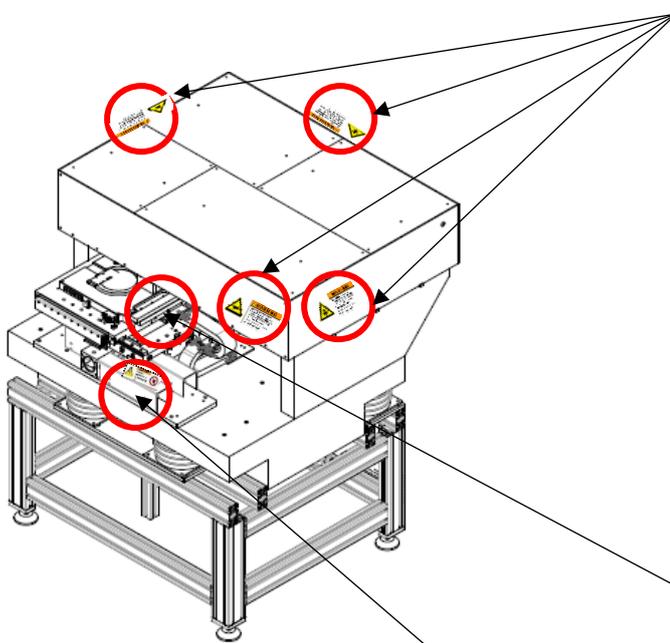


### Electronics Rack



**Optics cover:**

front cover, side covers, rear cover



	<b>⚠ WARNING</b>
	<p>Class 4 laser radiation accessible when open and window interlock defeated or access gained through open flow box cover</p> <p>Avoid exposure to beam</p> <p>DIN EN 60 825-1:2007</p>

	<b>⚠ WARNING</b>
	<p>Invisible class 4 laser radiation accessible when open and window interlock defeated or access gained through open flow box cover</p> <p>Avoid exposure to beam</p> <p>DIN EN 60 825-1:2007</p>

	<b>⚠ CAUTION</b>
	<p><b>Pinch Point</b></p> <p>Keep fingers clear of closing clamp</p> <p>58.7222.50</p>

	<b>⚠ WARNING</b>	
	<p><b>Strong magnetic fields!</b></p> <p>Functioning of medical implants may be disturbed, and objects may be attracted.</p> <p>Wearers of pacemakers must keep a distance of at least 300mm / 12". Be careful when using tools close to the magnets</p>	

Functioning of medical implants may be disturbed, and objects may be attracted. Wearers of pacemakers must keep a distance of at least 300 mm/12". Be careful when using tools close to the magnets.

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## 3 System description

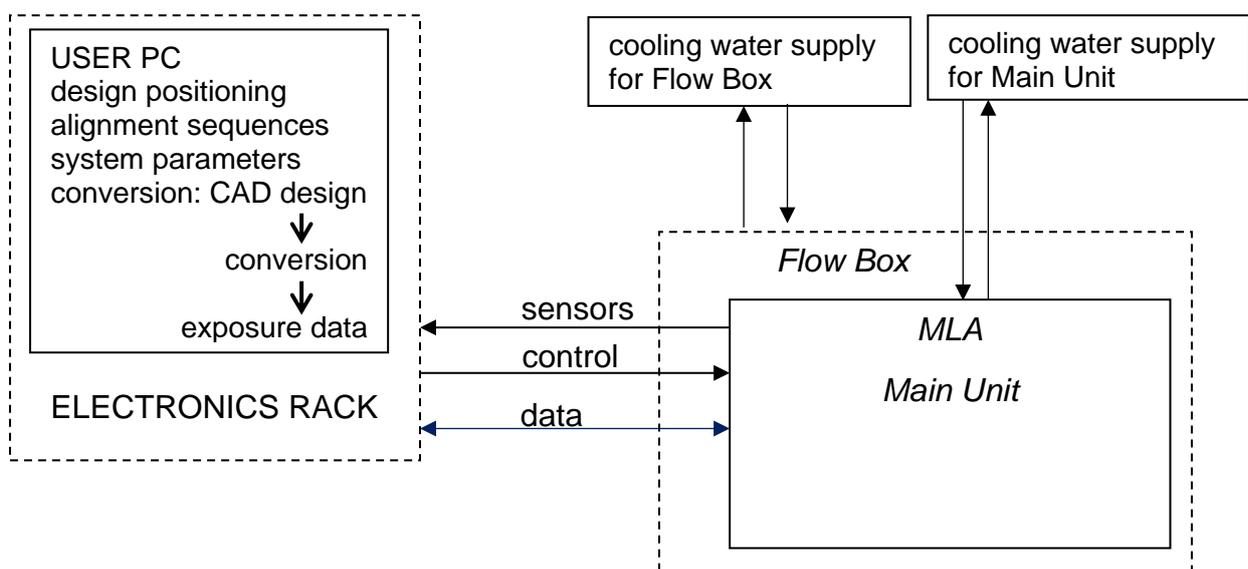
This chapter gives a short description of the MLA150 lithography system. The MLA150 system consists of the following individual components:

- Lithography Unit
- Electronics Rack
- Cooling water supply (not explicitly described in this document)
- Operator workstation

The main principle of the functional interaction between the system components is as follows:

A workstation comprising two computer monitors, a keyboard, a mouse and the User PC, that is located inside the electronics rack, represents the interface between user and system. The user controls the system via our graphical user interface on the User PC. This data is processed by the components located inside the electronics rack such as the stage controller which communicates with the stage and controls its movement based on the feedback given by interferometers that are placed in the main unit.

The system has two cooling water supply units, called chillers. One of them makes sure that the system runs in a stable environment in terms of temperature. The other one serves as cooling unit for the laser and the motors.



**Figure 1: System components**

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## 3.1 Lithography main unit

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The Main Unit comprises the following elements:

- Flow box
- Granite Construction
- Optics System

### 3.1.1 FLOWBOX

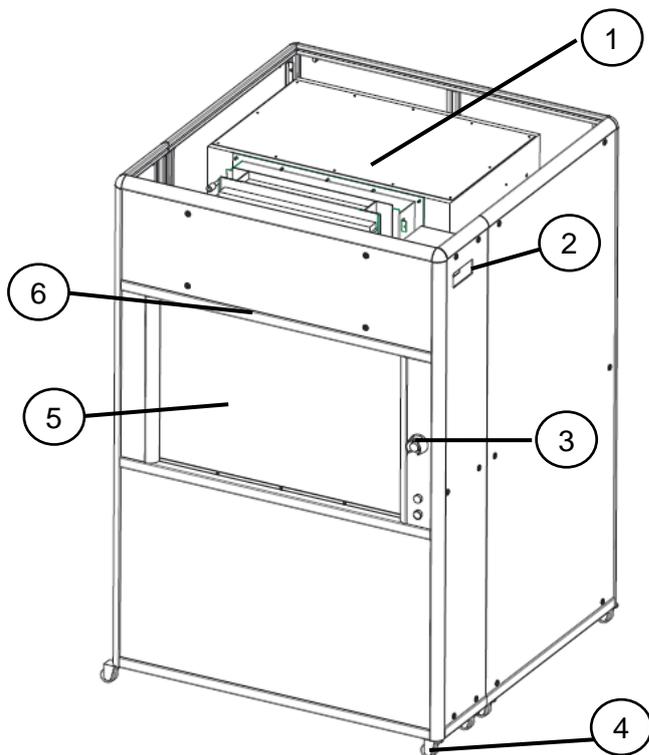
The flow box is the housing of the lithography system and protects the MLA150 from damage. It also provides a stable environment in terms of temperature, laminar flow and clean air. This is of importance because only such a stable environment guarantees constant exposure conditions which guarantees the smallest possible variation of exposure parameters. The covers of the flow box are removable, but only for service purposes.

**WARNING!****Injuries by moving parts or laser light!**

Severe damage to the eye and possibly to the skin can be caused by laser radiation of class 3B or 4

- Do not open the covers of the flow box.
- Flow box covers may be opened only by, or under direct instruction from, experienced service personnel!

**ELEMENTS OF THE LAMINAR FLOW BOX:**



- 1 TEMPERATURE CONTROL UNIT
- 2 DISPLAY
- 3 SWITCH PANEL
- 4 CASTOR WHEEL
- 5 WINDOW
- 6 LIGHT

**Figure 2: Elements of the laminar flow box**

**TEMPERATURE CONTROL UNIT**



- 1 ACTUAL TEMPERATURE
- 2 TARGET TEMPERATURE
- 3 RESET BUTTON
- 4 HEAT OUTPUT REGULATOR

**Figure 3: Temperature control readout**

The flow box is temperature controlled by means of regulated heating of the incoming air. The air is cooled down by the water-cooling unit and then reheated to

the required process temperature. The temperature control unit is located within the top compartment and has a display readout accessible from the outside through a hole in the flow box cover. In case the temperature exceeds +65°C inside the flow box, which can be caused by a malfunction of the fan, the control unit shuts down the heating system. The push button switch turns red. The heating system can be reset by pushing the button once but this should only be done if the reason for the failure is known. The display readout has a small icon in the left, blinking in regular intervals. This icon shows the activity of the heat output regulator. If the icon blinks periodically then the heat regulation works properly. If the icon is illuminated or not illuminated without any periodical change, then the temperature control unit is not working trouble-free anymore. It is recommended to shut down the system and call one of Heidelberg Instruments service offices (see *1.2 Contact*).

### CASTOR WHEELS

The flow box stands on eight castor wheels that have locking brakes to provide a stable position. These castor wheels are not height-adjustable. The machine is leveled by adjusting the four feet.

### SWITCH PANEL

At the front side of the flow box several buttons are located. The button at the top is the emergency off button. For opening and closing the window, the push button is used. The flow box provides a light source for inside, which is, depending on the application, yellow or red light. The light switch is located between the emergency off button and the window push button.



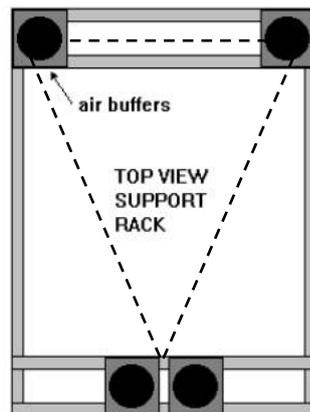
### WINDOW

The window is opened only for loading and unloading purposes. During operation, the window cannot be opened for safety reasons. The push button at the front of the flow box opens and closes the window by means of compressed air. This button is disabled while an exposure is running.

### 3.1.2 SYSTEM COMPONENTS

#### SYSTEM SUPPORT

A heavy-duty aluminum construction and four buffers that are filled with air to ensure vibration isolation support the granite base plate. To avoid any unnecessary bending forces in the base plate, these buffers are arranged in a triangular geometry (the two buffers at the front side are close together and act as one point).



**Figure 4: System support**

#### HEIGHT-ADJUSTABLE FEET

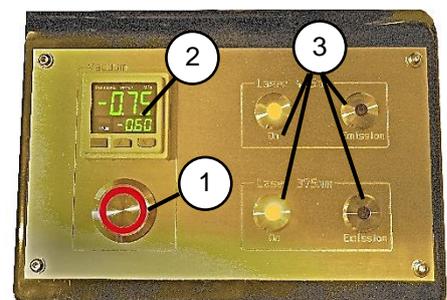
The granite construction stands on four height-adjustable feet. By varying the height of the feet the system is leveled in correspondence with the ground condition in the location the system is installed. The castor wheels of the flow box are not height-adjustable.

#### BASE PLATE (MAIN BLOCK)

The main unit has a granite base that gives stability to the system. It has been selected for its low thermal expansion coefficient. The granite base plate is supported by air buffers that ensure effective vibration isolation and has threaded holes to accept other system components. Medium and high-power lasers are mounted at the bottom of the base plate to minimize heat generation in the areas that are sensitive to heat.

#### OPERATOR PANEL

The operator panel has a push button (1) that opens the vacuum inlet to fix the substrate on the chuck. For observing the vacuum status, a display (2) shows the current vacuum status. However, it is not necessary to observe the status because the wizard informs about vacuum supply problems. The panel also contains two or four LED lights (3) indicating the status of the laser(s). The lights are on throughout the whole exposure procedure. When the window is open, the lights are off indicating that the laser(s) is (are) off (see 4.2.3 Info Section).

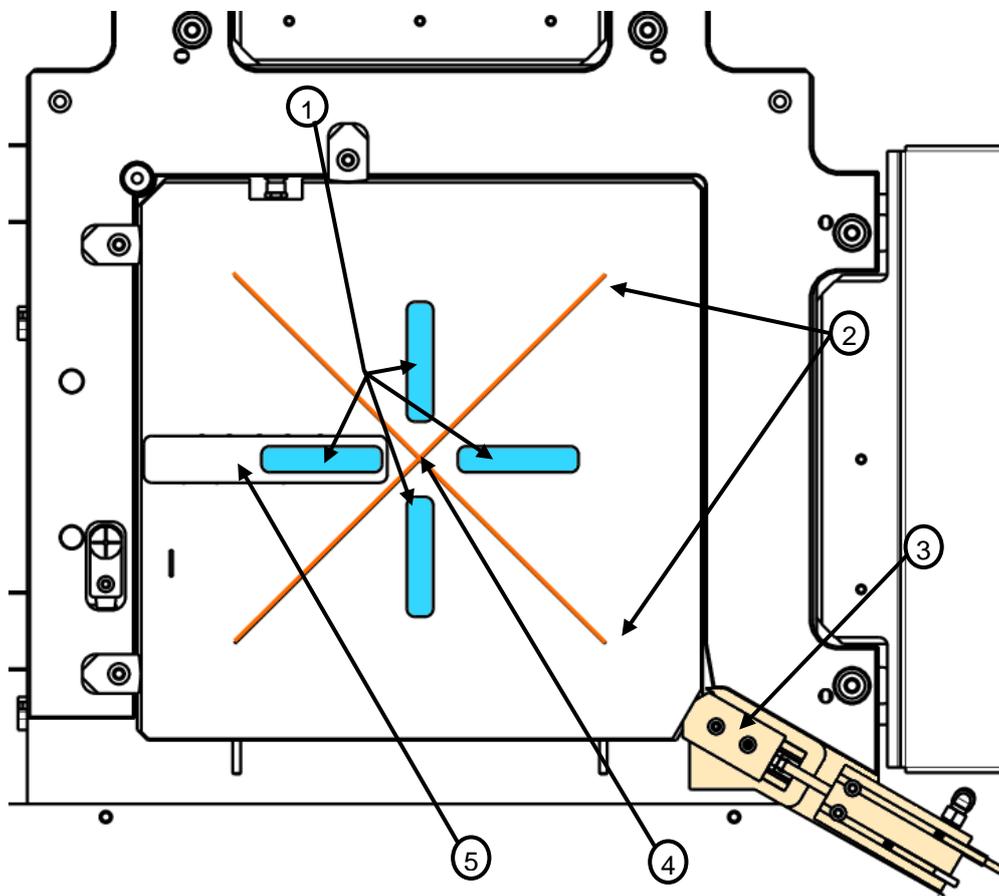


**Figure 5: Operator Panel**

**STAGE SYSTEM**

The stage is equipped with linear motors in both axes. They provide smooth and constant movement with low positioning errors. One air bearing and one roller bearing support the movement in y-direction whereas the x-axis is equipped with two roller bearings.

The stage carries the frame in which the chuck is located. The open frame chuck features a vacuum suction hole in the center and four small vacuum slits through which the vacuum reaches the substrate. One of the viewing slots is surrounded by a recess in which the adjustment aid is inserted to provide proper substrate placing on the chuck. The chuck can be exchanged by using the pressure clamping. The substrate is hold down and kept it in place by vacuum suction. The chuck features a vacuum suction hole in the center and four small vacuum slits through which the vacuum reaches the substrate.



- 1 VIEWING SLOTS
- 2 VACUUM SUCTION SLITS
- 3 PRESSURE CLAMPING
- 4 VACUUM SUCTION HOLE
- 5 RECESS FOR ADJUSTMENT AID



### 3.1.3 OPTICS SYSTEM

#### DIGITAL MICROMIRROR DEVICE (DMD)

The DMD is an electrical input and optical output micro-electric-mechanical system for spatial light modulation. It is composed of an array of micro light switches containing individually controlled micro mirrors which correspond to the pixels in the image to be displayed. Laser light is modulated by this device to project and transfer a pattern into positive or negative resist.

#### LASER UNIT AND OPTICAL ELEMENTS FOR BEAM GUIDANCE

The laser beam is emitted by several laser diodes, coupled in an optical fiber and projected on the DMD. The optical elements guide the modulated light through the system. The light beam passes the write head and is finally projected on the substrate.

#### CAMERA UNIT

The camera unit comprises one camera with low resolution, one with high resolution and one overview camera. The cameras feature a light source and are used for accurate alignment of a design with existing structures. Here, the High Res or the Low Res cameras are the appropriate choice due to their higher resolution compared to the overview camera. When the alignment marks are larger than the field of view of the High Res camera, switching to the Low Res camera is recommended. The overview camera can also be selected for alignment, but the accuracy is limited by its resolution (~50 µm). Therefore, this choice might be used for coarse structures. Keep in mind that the overview camera does not show the complete surface of the substrate due to mechanical limits. Systems with backside alignment have a second camera unit for back side viewing mounted inside the stage looking to the substrate.

Camera type	Field of View (size of the substrate area that can be seen)	
	Top Surface	Back Surface
High Res	190 µm x 140 µm	-
Low Res	640 µm x 480 µm	640 µm x 480 µm
Overview	12 mm x 9 mm	top side only

\*Overview cannot access the entire surface of the substrate due to mechanical limits.

**Table 1: Field of view (top side, back side)**

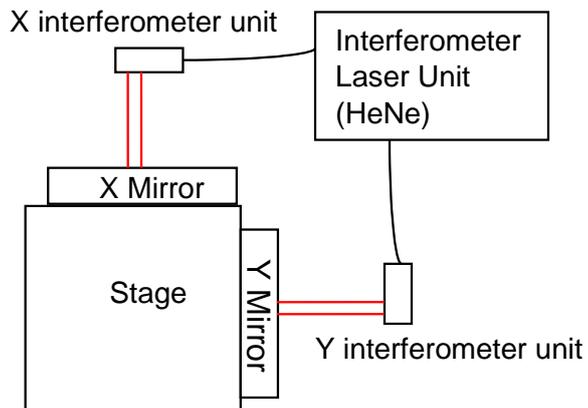
#### PNEUMATIC AUTOFOCUS

The pneumatic autofocus serves to keep the focal point of the write beam stable on the surface of the substrate. For probing the distance, compressed air passes through the write head and leaves it through a nozzle. Once the write head is close enough to the substrate, a pressure builds up between the nozzle and the substrate, which is monitored by a pressure sensor. The pressure sensor transmits the signal to a controller which regulates the distance to the substrate. The defocus value shows the focus position of the write head with respect to the offered defocusing

range [-10 to 10]. This range is necessary to adapt the focus distance to an appropriate value which mainly depends on resist thickness and thus varies.

### INTERFEROMETER

The laser interferometer is an optical device for measuring the stage position. The machine achieves its required positioning precision with this important element.



**Figure 7: Interferometer function**

## 3.2 Electronics rack

The electronics rack consists of several units. These units drive and control the system and provide communication with the operator of the system. The following electronic units are located inside the electronics rack:

### 1 USER PC WITH CONVERSION

The **User PC** is a communication interface between user and system by means of the graphical user interface (GUI). The User PC runs Linux on a virtual machine which runs the conversion software. This software is necessary for design conversion. Design files in Gerber, DXF, CIF or GDSII are converted into a machine file format which can be read by the MLA system.

### 2 POWER SUPPLY AND EMERGENCY STOP MODULE

This unit is for power distribution. It also contains the buttons for Power On (green) and Power Off (red).

### 3 STC-RACK

The **STC-Rack** controls the several motors and the autofocus system.

### 4 INTEGRATED NETWORK HUB

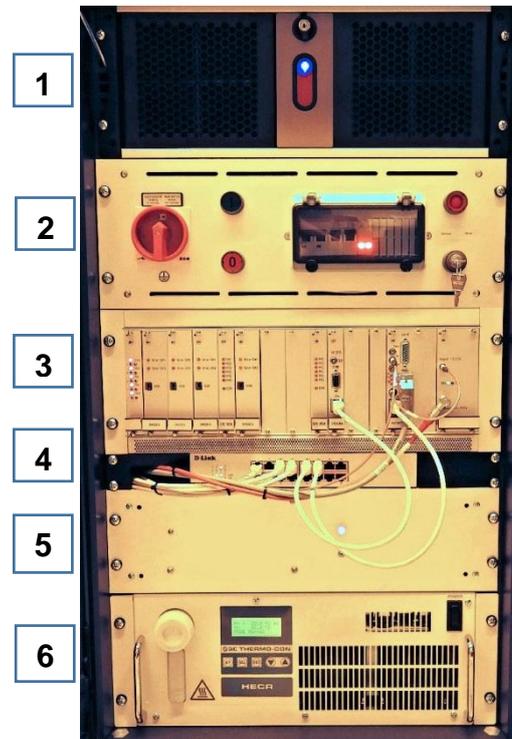
The **Integrated Network Hub** connects the multiple devices and make them work together on a single network.

### 5 STAGE CONTROLLER

The **Stage Controller** drives the stage, reads the interferometer data, triggers the laser and the DMD (digital micromirror device)

### 6 STAGE AND LASER CHILLER

This chiller is integrated into and powered via the electronics rack. It serves as cooling unit for the laser and the stage.

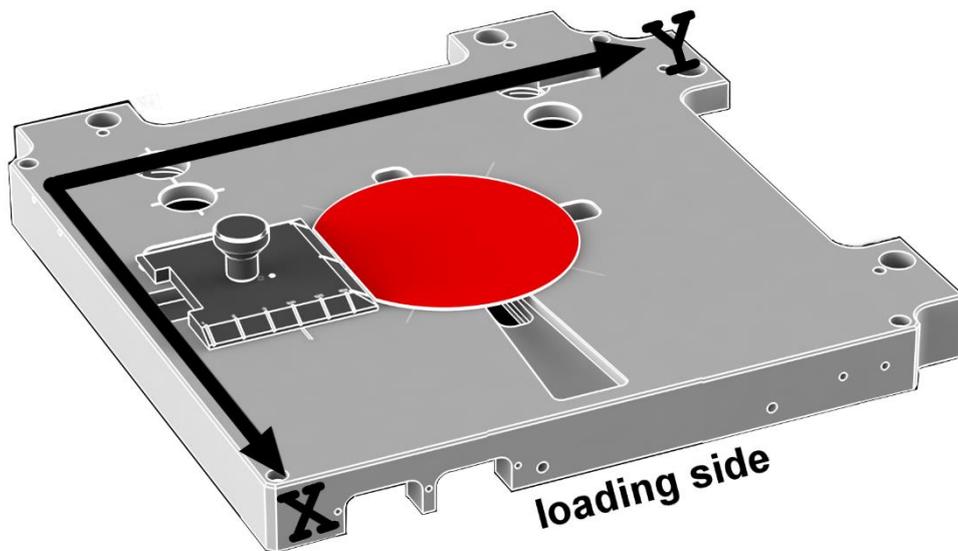


**Figure 8: Electronics rack**

### 3.3 Orientation of stage and design

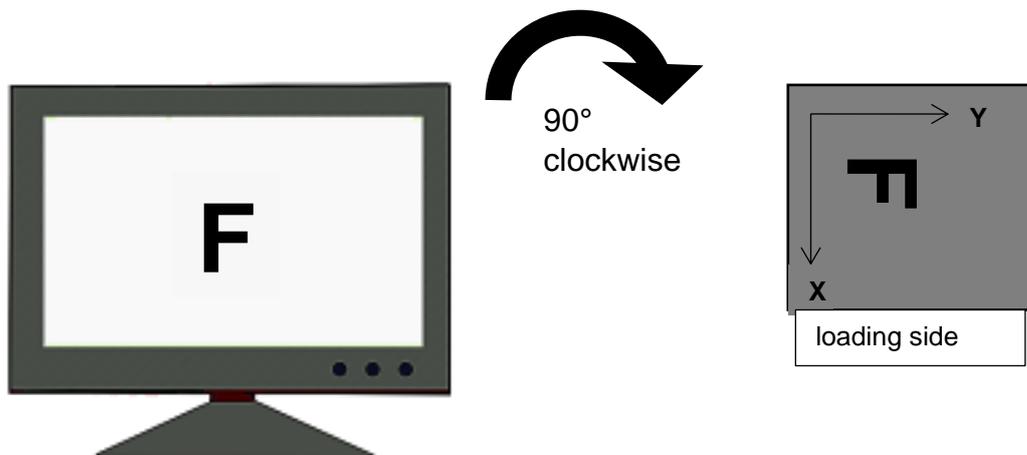
It is important to load the substrate with the correct orientation on the center of the chuck. The coordinate system of the design to be exposed must match the direction and orientation of structures already exposed on the substrate.

The coordinate system of the stage is oriented such that the y-axis corresponds to a left-right movement and the x-axis to a backward-forward movement (see Figure 9) when standing in front of the machine.



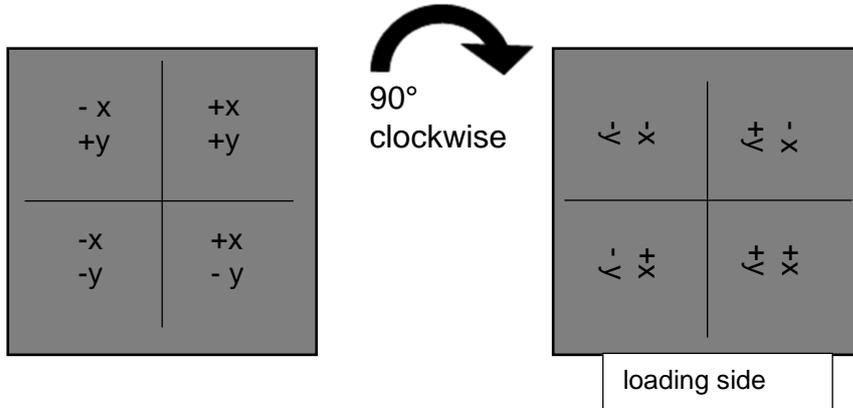
**Figure 9: Orientation of stage and design**

The design is exposed rotated by 90 degrees in clockwise direction (Figure 10).



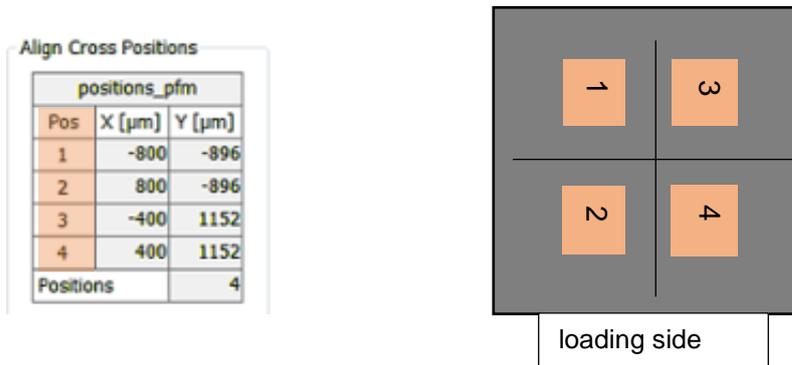
**Figure 10: Machine-related design rotation**

Thus, the coordinate system of the design is also arranged rotated by 90 degrees clockwise (Figure 11).



**Figure 11: Rotation of coordinate system on chuck**

For easier orientation on the chuck regarding the design coordinates, the following figure gives an example of alignment crosses and their location on the substrate.



**Figure 12: Location of coordinate pairs**

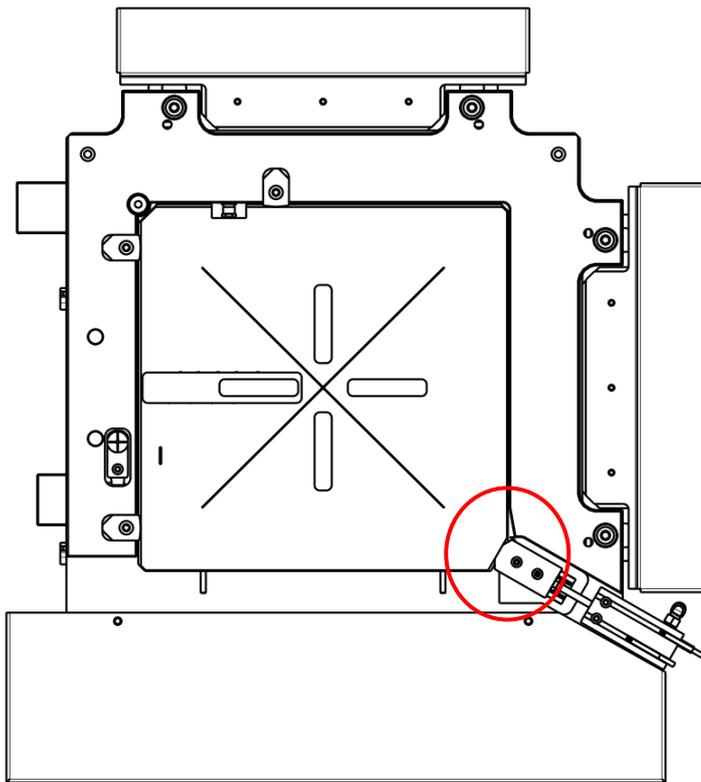
## 3.4 Chuck exchange

1. To install a different chuck, loosen the clamp by flipping the chuck pressure switch so that the pressure supply of the clamping is interrupted.
2. Take the chuck off the frame.
3. Put the other chuck into the frame.
4. Remove your fingers from the chuck and do not touch the clamp.

**CAUTION!****Pinch point at pressure clamping!**

Keep fingers away from the clamp when flipping the switch for closing the clamp.

5. Flip the switch again, so that the pressure supply is released.



*Figure 13: Pinch point at pressure clamp*

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# 4 Wizard description

The MLA150 offers quick setup of exposure and alignment aided by the **Exposure Wizard**. This intuitive user interface guides the operator through the steps of an exposure set up. To start the wizard, double-click on the link icon.

## 4.1 Overview: Exposure Wizard

The **Exposure Wizard** has its own window. This window stays open throughout the entire configuration and exposure procedure (Figure 14). It contains the following main elements:

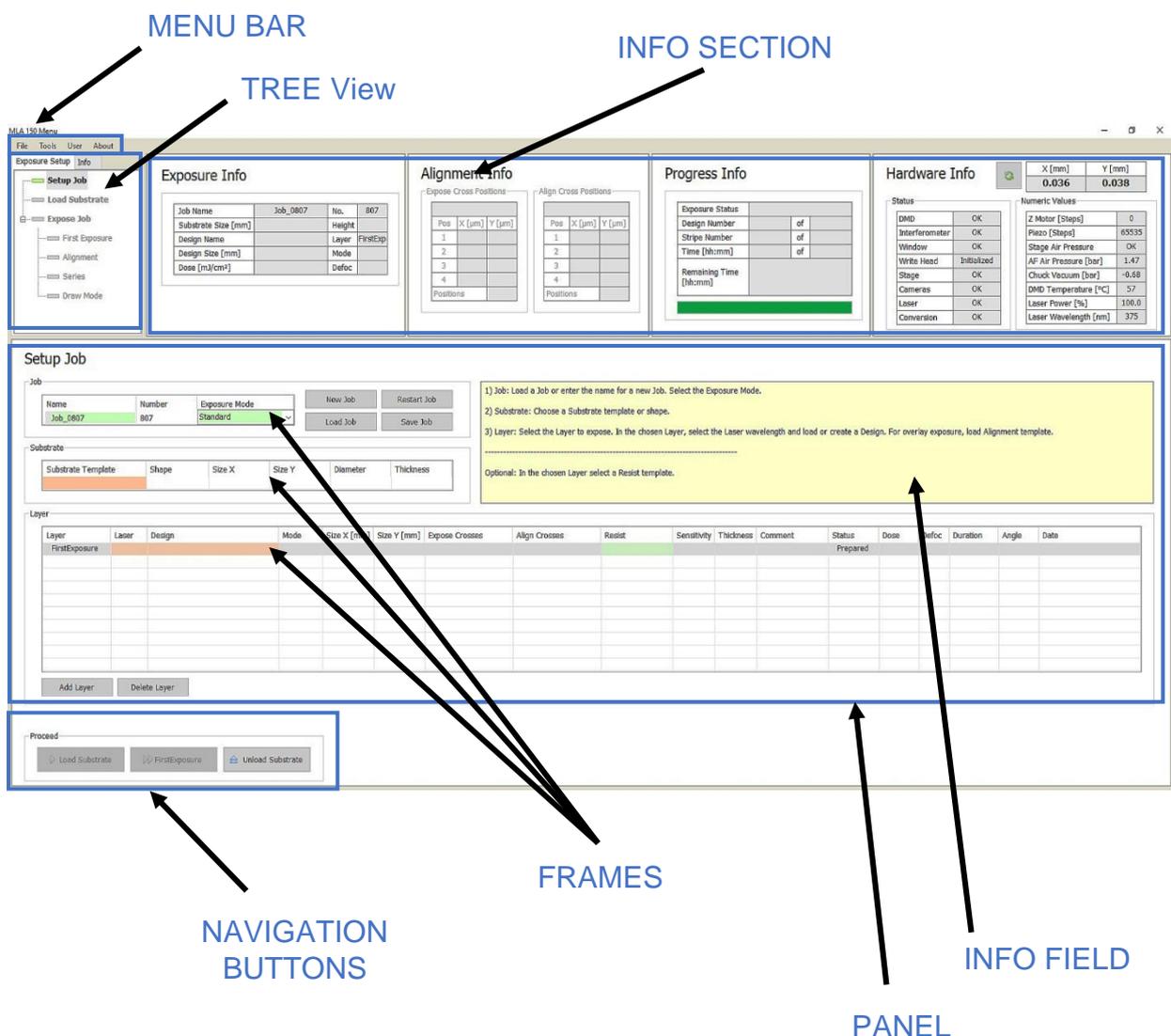


Figure 14: Wizard window overview

**MENU BAR**

The menu bar is located at the top of the window, offering several menu utilities.

**INFO SECTION**

The info block gives information about the hardware condition and the progress or status of the current exposure setup.

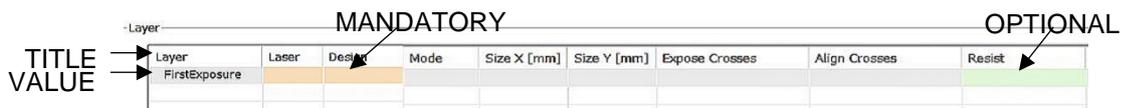
**PANEL**

The panel is located below the info section. This panel changes according to the tasks that the system has to perform. In figure 14 the panel's name is **Setup Job** panel. Inside the panel are buttons and frames.

**FRAME**

The panel contains frames e.g., the Layer frame, where the design file and other options are selected. The frame has mandatory fields that have to be filled with values, and fields that can be filled optionally. The mandatory fields are highlighted in orange and turn green once a value has been entered. The optional fields are highlighted in green before and after the entry of values.

Throughout this manual you find instructions like "double-click **Design**". In this case, you are instructed to double-click the value field with the title **Design** not the word **Design**.



**BUTTONS**

A click on these buttons usually opens another window where you can select items or set options

**NAVIGATION BUTTONS (PROCEED FRAME)**

At the bottom of the wizard window, you find navigation buttons e.g., **Load Substrate** or **Continue**. The functions and names of the buttons depend on the selected exposure mode. These buttons can stay disabled until certain tasks are finished.

**INFO BOX**

Every panel contains a yellow text box, giving information and instructions on the current task.

**TREE VIEW**

A tree view shows the procedure steps the system has to execute. T (refer 4.2 *Static Wizard Elements* for more details).

**INFO SECTION**

The info section contains four blocks giving information on system conditions as well as information on the current exposure process.

In the following subchapter, you find detailed information about the Exposure Wizard elements.

## 4.2 Static wizard elements

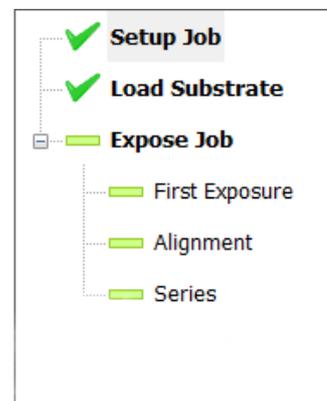
### 4.2.1 MENU BAR

<b>File→Exit:</b>	To leave the wizard and close the window
<b>Tools→Control Panel:</b>	Activates the Control Panel (see 7.1 Control Panel)
<b>Tools→Initialize Backside Lens</b>	To initialize the lens for the backside function. In the dialog window, click <b>Yes</b> to start the initialization process.
<b>Tools→Initialize Stage:</b>	To initialize the stage in case the hardware info shows that it is not initialized. In the dialog window, click <b>Yes</b> to start the initialization process.
<b>Tools→Backup</b>	For back up of system files.
<b>Tools→Laser Measurement</b>	To measure the laser power in order to compare it with the value measured during the most recent laser calibration procedure.
<b>Tools→Large Camera Defoc</b>	In Alignment Mode, the focus settings can be switched to larger camera defocus with a wider defocus range.
<b>Tools→Logging</b>	Required for HIMT Service only. Do not change the settings as long as no service engineer demands it.
<b>Tools→Beam Offset</b>	To measure and adjust the beam offset.
<b>User Management→ChangeUser:</b>	For changing the user type.
<b>Info→Exposure info</b>	Shows information about recent exposure jobs.
<b>Info→Startup info</b>	Shows information about the condition of the system after startup.

### 4.2.2 TREE VIEW

The tree view shows the steps to be completed with the wizard from job setup to exposure and unloading. It is a graphical representation of the sequence of panels making up one exposure job. As a kind of panel map it can be taken for orientation.

The green rectangle shows the options available in the selected Exposure Mod. The green tick indicates that the task is done.



### 4.2.3 INFO SECTION

The Info Section consists of four subsections:

- Exposure Info
- Alignment Info
- Progress Info
- Hardware Info

#### Exposure Info

Exposure Info			
Job Name	Job_1074	No.	1074
Substrate Size [mm]		Height	
Design Name		Layer	FirstExp
Design Type		Convert	
Design Size [mm]		Mode	
Dose [mJ/cm <sup>2</sup> ]		Defoc	

- **Job Name** is a combination of the word job and the job number. It is editable in the **Job** frame by double-clicking into the **Job Name** value field.
- **No.** shows the auto-incrementing number of the job, it is not editable.
- **Substrate Size[mm]** shows the size of the substrate that is currently loaded.
- **Design Name** shows the name of the design that is currently loaded.
- **Design Type** shows if it is a binary file or not.
- **Convert** shows the type of conversion process, online or offline, depending on the design type.
- **Design Size [mm]** shows the size of the design.
- **Dose [mJ/cm<sup>2</sup>]** shows the exposure energy for the current job.
- **Height** shows the height of the substrate on the chuck.
- **Layer** shows the layer that is currently being prepared for exposure.
- **Mode** shows the exposure quality level chosen at conversion. **Quality** means high level, **Fast** means lower quality level but faster completion.

- **Defoc** shows the defocus value selected for the current exposure. The defocus with a range between -10 to 10 allows for fine tuning of the exposure focus (for more information see 3.1.3 *Optics System: Pneumatic Autofocus*). This value can be adjusted before starting the design exposure (6.9 *Expose Design*)

### Alignment Info

The screenshot shows a dialog box titled "Alignment Info" with two panels. The left panel, "Expose Cross Positions", contains an empty table with columns "Pos", "X [μm]", and "Y [μm]". The right panel, "Align Cross Positions", contains a table with the title "positions\_pfm" and the same columns. It lists four positions with their respective X and Y coordinates.

Pos	X [μm]	Y [μm]
1	-800	-896
2	800	-896
3	-400	1152
4	400	1152
Positions	4	

This info box shows two tables:

**Expose Cross Positions** shows the positions of the alignment crosses set during the setup of the layer previous to the layer with the design that is to be aligned. For instance, when setting up the First Exposure job the coordinates of the exposure crosses for the next layer can be determined and exposed together with the First Exposure layer.

**Align Cross Positions** shows the positions of the alignment crosses taken from the template file. For orientation regarding the location of the coordinate pairs on the substrate see 3.3 *Orientation of Stage and Design*.

### Progress Info

The screenshot shows a dialog box titled "Progress Info" containing a table with exposure details and a progress bar below it.

Exposure Status	Ready		
Design Number	1	of	1
Stripe Number		of	34
Time [hh:mm]		of	00:01
Remaining Time [hh:mm]			

The **Progress Info** box gives information about the progress of the exposure.

- **Exposure Status** shows the status of the exposure job.
- **Design Number** shows the number of the design that is being exposed.
- **Stripe Number** shows which stripe is being exposed at the moment.
- **Time [hh:mm]**. shows the time that the exposure takes in total.
- **Remaining Time [hh:mm]** shows the time that the exposure is still requiring to be finished.

**Hardware Info**

The Hardware Info window contains the following elements:

- Refresh Button:** A button labeled "REFRESH" with a circular arrow icon.
- Stage Position:** Two input fields labeled "X [mm]" and "Y [mm]" with the value "0.000" displayed in each. A label "STAGE POSITION" has arrows pointing to both fields.
- Status Table:**

Status	
DMD	OK
Interferometer	OK
Window	OK
Write Head	OK
Stage	OK
Cameras	OK
Laser	OK
Conversion	OK
- Numeric Values Table:**

Numeric Values	
Z Motor [Steps]	41303
Piezo [Steps]	33903
Stage Air Pressure	OK
AF Air Pressure [bar]	1.47
Chuck Vacuum [bar]	-0.68
DMD Temperature [°C]	60
Laser Power [%]	100.0
Laser Wavelength [nm]	375

The **Hardware Info** box shows important information about the system status. The **Refresh** button updates the information stated in the tables. The **Stage Position** fields show the x-coordinate and the y-coordinate of the current stage position. A click on **Refresh** updates the fields to show the current position.

The **Status list** informs about the status of the system devices. If any status shows red instead of **OK**, click **Refresh**. If the status is still the same, go to the **Info Tab** and click **Status Messages**. Here, you can see why the status does not show **OK**.

The **Numeric Values** list shows the condition of the system parts in numeric values. These values are only interesting for service staff. If any of the numeric values is not in the normal range, the **Status** list shows red instead of **OK**.

## 4.2.4 EXPOSURE INFO

By selecting **Info** → **Exposure Info** from the menu bar, a table opens containing a list of exposure jobs recently done and their exposure data. The page features a search bar for easy retrieval of exposure information.

User	JobName	#Job	JobMode	Layer	Wavelength	DesignName	Date	Time	Defoc	Dose	Duration	AlignCrosses	ExposeCrosses	Angle	Scaling	Shearing	ExpMode	Status	UserMode	Comment
Service	Job_0720	730	Alignment	2	405	HMT_MLA1000_L2	20170710	10:35:10	-2	200	00:00:22	MLA1000		0.043	1.000000 / 1.000000	0.000	Quality	Exposed	Service	
Service	Job_0729	729	Series	1	405	MLA1000_L1	20170710	10:03:15	-2	70	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Service	
Service	Job_0729	729	Series	1	405	MLA1000_L1	20170710	10:02:58	-2	65	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Service	
Service	Job_0729	729	Series	1	405	MLA1000_L1	20170710	10:02:42	-2	60	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Service	
Service	Job_0729	729	Series	1	405	MLA1000_L1	20170710	10:02:25	-2	55	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Service	
Service	Job_0729	729	Series	1	405	MLA1000_L1	20170710	10:02:08	-2	50	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Service	
Service	Job_0729	729	Series	1	405	MLA1000_L1	20170710	10:01:51	-2	45	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Service	
Service	Job_0729	729	Series	1	405	MLA1000_L1	20170710	10:01:34	-2	40	00:00:00			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Service	
Standard	Job_0727	727	Alignment	2	405	HMT_MLA1000_L2	20170707	17:22:16	-2	200	00:00:21	MLA1000		2.723	1.000000 / 1.000000	0.000	Quality	Exposed	Standard	
Standard	Job_0726	726	FirstExposure	1	405	MLA1000_L1	20170707	17:14:15	0	200	00:00:15			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Standard	
Standard	Job_0725	725	Series	1	405	MLA1000_L1	20170707	17:12:12	-2	50	00:00:00			0.000	0.000000 / 0.000000	0.000	Quality	Cancelled	Standard	
Standard	Job_0724	724	Series	1	405	MLA1000_L1	20170707	17:08:28	-2	50	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Standard	
Standard	Job_0724	724	Series	1	405	MLA1000_L1	20170707	17:08:12	-2	50	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Standard	
Standard	Job_0724	724	Series	1	405	MLA1000_L1	20170707	17:07:55	-2	50	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Standard	
Standard	Job_0724	724	Series	1	405	MLA1000_L1	20170707	17:07:38	-2	50	00:00:16			0.000	0.000000 / 0.000000	0.000	Quality	Exposed	Standard	

## 4.2.5 STARTUP INFO

**Note:** If the Hardware Info Section shows red, open the Info Tab and check the startup messages to locate the problem.

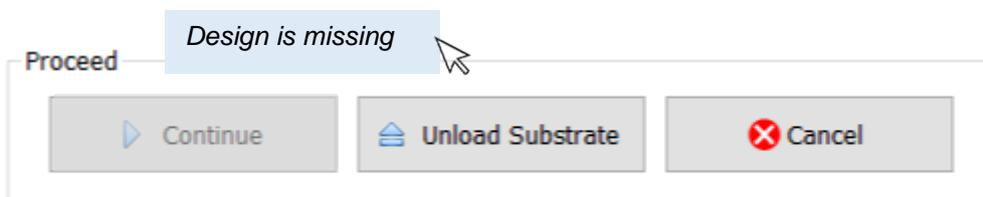
The control system checks the communication between the electronics and the hardware components. A list gives an overview of the components and their function status. All list items should be marked green. If there are items showing a red cross, wait a couple of minutes so that the user menu can complete startup. If there is still a red cross, restart the user menu and in case the red cross is still visible, switch off and on the system. In cases in which this procedure does not lead to success, call Heidelberg Instruments Service. If the stage shows a red cross, try to initialize the stage with **Tools** → **Initialize Stage**.

S...	Device	Messages
✓	System Configuration	- loaded
✓	DMD	- configuration loaded- created DMD (64bit)
✓	Stage	- Spii xml file loaded- connected- stage is commutated
✓	Conversion Interface	- starting conversion interface- conversion xml file loaded
✓	SSH	- SSH xml file loaded
✓	Exposure Configuration	- job xml file loaded- 10mm.xml loaded
✓	Writehead	- connected over COM port - v1.70- mode: M0
✓	Light Source	- Laser loaded from hardware.xml file
✓	Camera Interface	- firefips xml file loaded- created firefips interface- camera xml file loaded- cameras xml file loaded
✓	CPU Cores Distribution	- VM processes unaccessible: No cores distribution done!

## 4.3 Tooltips

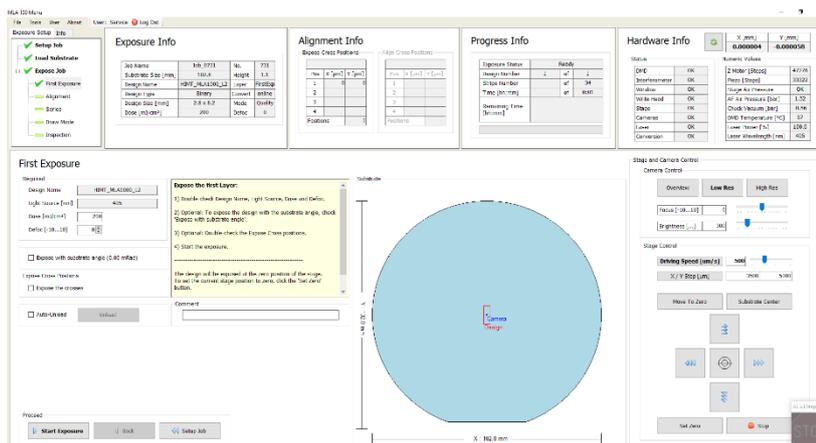
The wizard features tooltips. Tooltips are also elements of a graphical user interface, but they are not static such as the menu bar or informative fields. The tooltip appears when the user hovers over an item in the GUI without clicking on it. It disappears when leaving the surrounding of the item or clicking on it.

If one of the navigation buttons in the lower part of the wizard window is grayed out, it is not possible to proceed with the task. When hovering over the Proceed frame containing the navigation buttons, a tooltip informs about missing information that is required to fulfil the respective task.

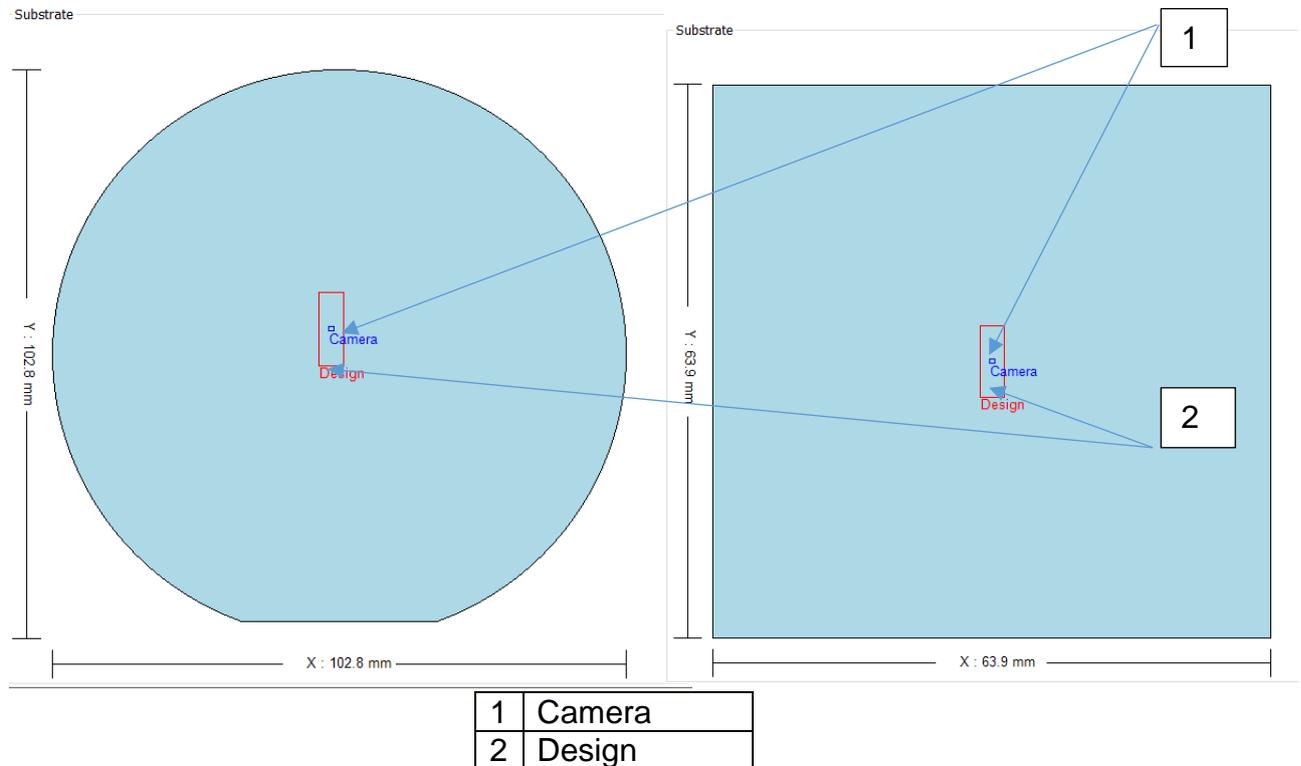


## 4.4 Substrate representation

In the menu panel, you find a simple graphical depiction of the substrate showing the design position on the substrate. The position of the camera is also displayed in order to see which part of the substrate is currently visible in the camera image.



Depending on the kind of substrate shape (round or rectangle) the menu offers two different substrate visualizations. On the substrate, the design position and size are displayed by a red rectangle. The camera is depicted as a blue rectangle.



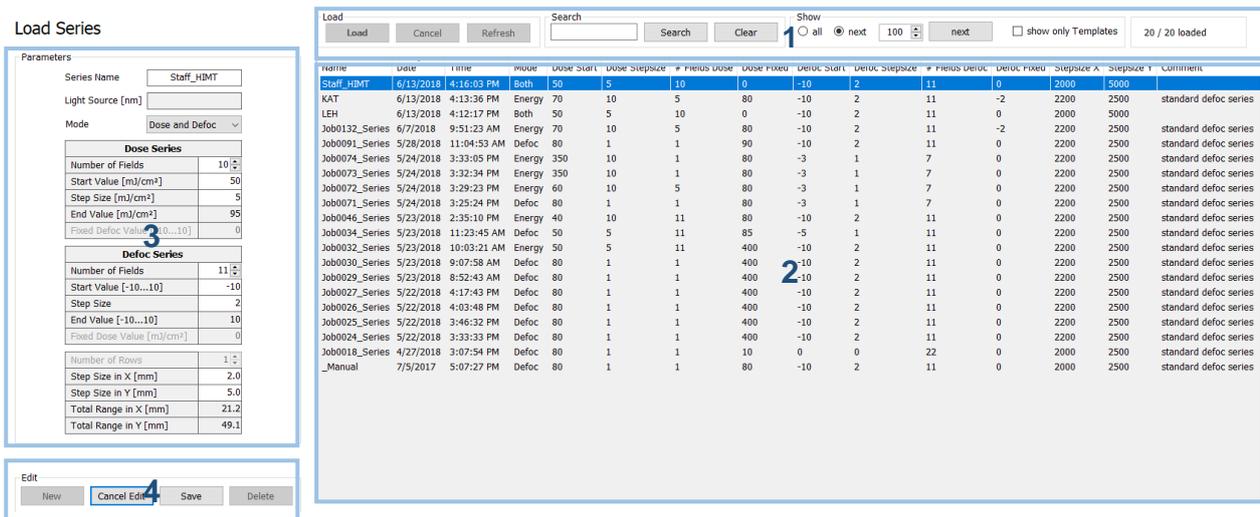
The horizontal and vertical solid lines indicate the real size of the substrate. The size of the design representation and the size of the camera are scaled in relation to these measure lines.

To move the design to a certain position on the substrate, use the **Control Panel**. Alternatively, drag the camera rectangle to the desired location. The design follows when the camera position is set to zero by clicking **Set zero** in the **Control Panel**.

## 4.5 Loading panels

Loading panels are part of the wizard. For design loading, job loading and template loading (series, substrate, resists) the sheets for loading contain a list of existing items but it is also possible to set up new templates or save new designs.

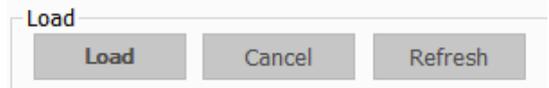
All loading panels are arranged in the same way.



(1) At the top there is a bar with buttons, text fields, radio buttons or checkboxes.

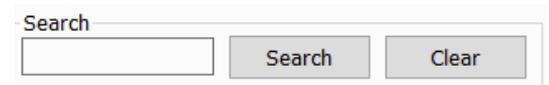
### Load frame

- Load** To load an item to step in the current application
- Cancel** To cancel the loading procedure and go back to the previous panel
- Refresh** To refresh the list.



### Search Frame

- Search** To search for a listed item, enter the name in the text fi
- Search** To start the searching process.
- Clear** To clear the content of the search text field.



### Show frame

- all** To show the entire list.
- next** To determine the next number of items by the value selected from the drop-down list.
- next (button)** To show the selected items.
- Show only templates** To only list up items of the type "template".



(2) Below this bar a list shows all designs available or the items that are saved as template. All information and parameters are listed in the columns of the table.

Name	Date	Time	Shape	Size Type	Size x	Size y	Diameter	Thickness	Focus Offset	Detection Offset	Marks	Comment
_Automatic rectangular	6/23/2016	3:41:38 PM	Rectangular	Undefined	0	0	0	0	0	0	Undefined	
_Automatic round	7/7/2016	9:45:50 AM	Round	Undefined	0	0	0	0	0	0	Undefined	
Large	6/22/2016	7:10:40 PM	Rectangular	Standard	180	180	0	0	0	0	Undefined	
Mask 2_5 inch	5/24/2018	11:50:25 AM	Rectangular	Standard	62.8	62.8	0	1.3	0	1.5	Undefined	
Mask 4 inch	3/9/2016	3:00:47 PM	Rectangular	Standard	100.4	100.4	0	2	0	0	Undefined	
Mask 4.5 inch	7/18/2016	3:31:52 PM	Rectangular	Standard	114.3	114.3	0	0	0	0	Undefined	
Mask 5 inch	4/11/2016	11:12:06 AM	Rectangular	Standard	125.5	125.5	0	3	0	-0.5	Undefined	
Mask 6 inch	1/18/2017	11:16:02 AM	Rectangular	Standard	152.4	152.4	0	2	0	0	Undefined	
Mask 9 inch	9/28/2016	11:48:47 AM	Rectangular	Extended	228.6	228.6	0	0	0	0	Undefined	
Small	4/5/2016	10:33:51 AM	Rectangular	Small	5	5	0	0	0	0	Undefined	
Wafer 2 inch	4/5/2016	10:28:36 AM	Round	Standard	0	0	50.8	0.28	0	0	Undefined	
Wafer 3 inch	4/5/2016	10:29:13 AM	Round	Standard	0	0	76.2	0.38	0	0	Undefined	
Wafer 4 inch	6/23/2016	4:15:53 PM	Round	Standard	0	0	101.6	0.52	0	0	Undefined	
Wafer 5 inch	4/5/2016	10:31:17 AM	Round	Standard	0	0	125	0.625	0	0	Undefined	
Wafer 6 inch	3/20/2017	4:29:18 PM	Round	Standard	0	0	150	0	0	-1.8	Undefined	
Wafer 8 inch	6/17/2016	1:49:50 PM	Round	Extended	0	0	200	0	0	0	Undefined	

(3) In the left part of the panel, a table with parameters is given. In this table new templates can be created, or the existing ones can be changed. These tables are explained in the respective chapter where loading and template setup are described.

(4) Below this table, buttons arranged in the **Edit frame** allow to make changes in the table.



**Edit frame**

- New** To set up a new item for the list (template or design).
- Edit** To edit existing designs.
- Save** To save the newly created or edited item.
- Delete** To delete the item from the list.

**Note:** Some of the functions are restricted to Staff user group.

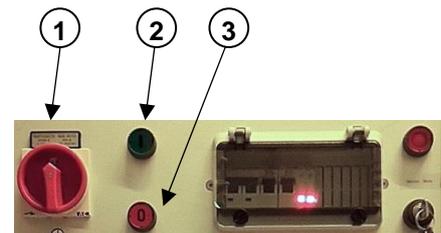
# 5 System startup

This chapter describes how to power up and power down the MLA150. For powering up and down the system the buttons at the front of the electronics rack are used.

## 5.1 Powering up

### Powering up the system:

1. If not already done, switch on the main switch at the electronics rack. Allow 60 seconds to boot the power supply.
2. Switch on the User PC.
3. To switch on the system power, press the **On (I)**-button at the electronics rack.



1	main switch
2	On (I)
3	Off (O)

- ✓ You can hear one click and another click 3 seconds later.

### In case the system was switched off by using the **EMERGENCY OFF** button:

1. Release by turning it in the direction indicated on the button. Otherwise the system power cannot be switched on.
  2. Press the green **On (I)**-button in the electronics rack.
- ✓ You can hear one click and another click 3 seconds later.
- Note:** If power is not coming up, check whether the main switch in the electronics rack is turned off. Turn on the main switch again!
3. Switch on the displays and the User PC, if they are not running.



### In case the power supply was interrupted (e.g. by a blackout)

1. Press the green **On (I)**- button.
- ✓ You can hear one click and another click 3 seconds later
2. Reboot the User PC.

### Starting the *Exposure Wizard*:

1. Click the shortcut of the MLA150 menu at your desktop.
- ✓ At each startup, the menu checks for initializations of necessary components. A window shows the status of hardware initialization

---

## 5.2 Powering down

---

### Powering down in emergency case:

In case of emergency, press the **EMERGENCY OFF** button at the front of the flow box.

### Standard power down procedure

1. Close the *Exposure Wizard* by selecting **File**→**Exit** from the menu bar.
  2. Shut down the User PC.
  3. Press the red **Off (0)** – button at the electronics rack.
- ✓ The system shuts down.

### Complete Shutdown

Execute the standard power down procedure and then turn off the main switch that is located on the front of the power distribution rack in the electronics rack (see 3.2 *Electronics Rack*).

- Note:**
- In general, the system should be powered down completely only if absolutely necessary. If the exposure laser is off, idle power consumption of the system is low, and keeping it in standby enhances stability.
  - We do not recommend to power down the system if the idle time period is less than one week.

### Powering down for maintenance

The main switch of the power supply module in the electronics rack is equipped with holes for a padlock. If the system is powered down for maintenance or servicing, after above steps, secure the main switch in the Off position with such a padlock.



## 5.3 User login

There are three user log-in types available. Standard, Staff and Service:

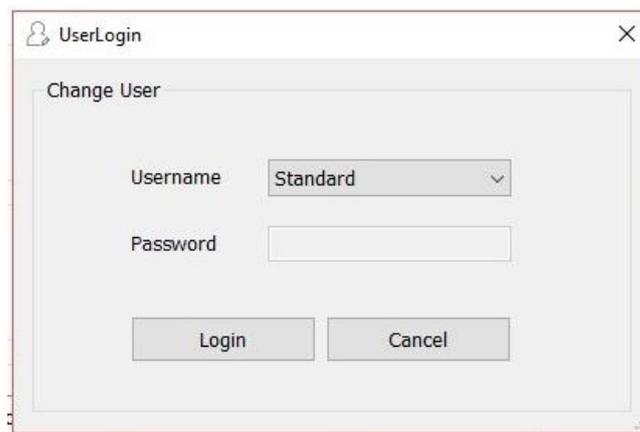
**Standard** is the default user type when opening the menu. No password is required and the user can set up and execute exposure procedures.

**Staff** requires the entering of a password. This user type has the permission to create resist templates, job templates and edit a few settings.

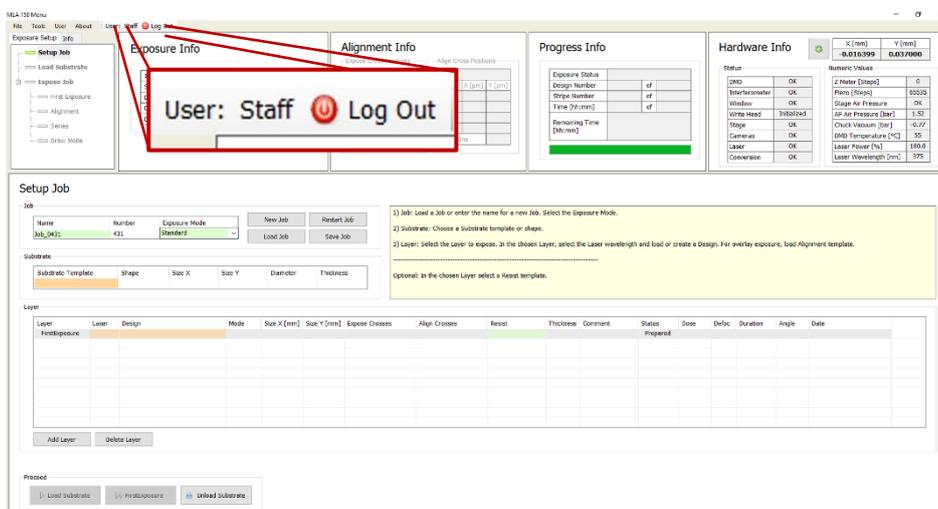
**Service** user type is for HIMT service staff only.

For switching user types follow the instruction below:

1. Select **User→Change User** from the menu bar. A login window opens.
2. Select the user type from the drop-down list and enter the password, if required.
3. Click the **Login** button.



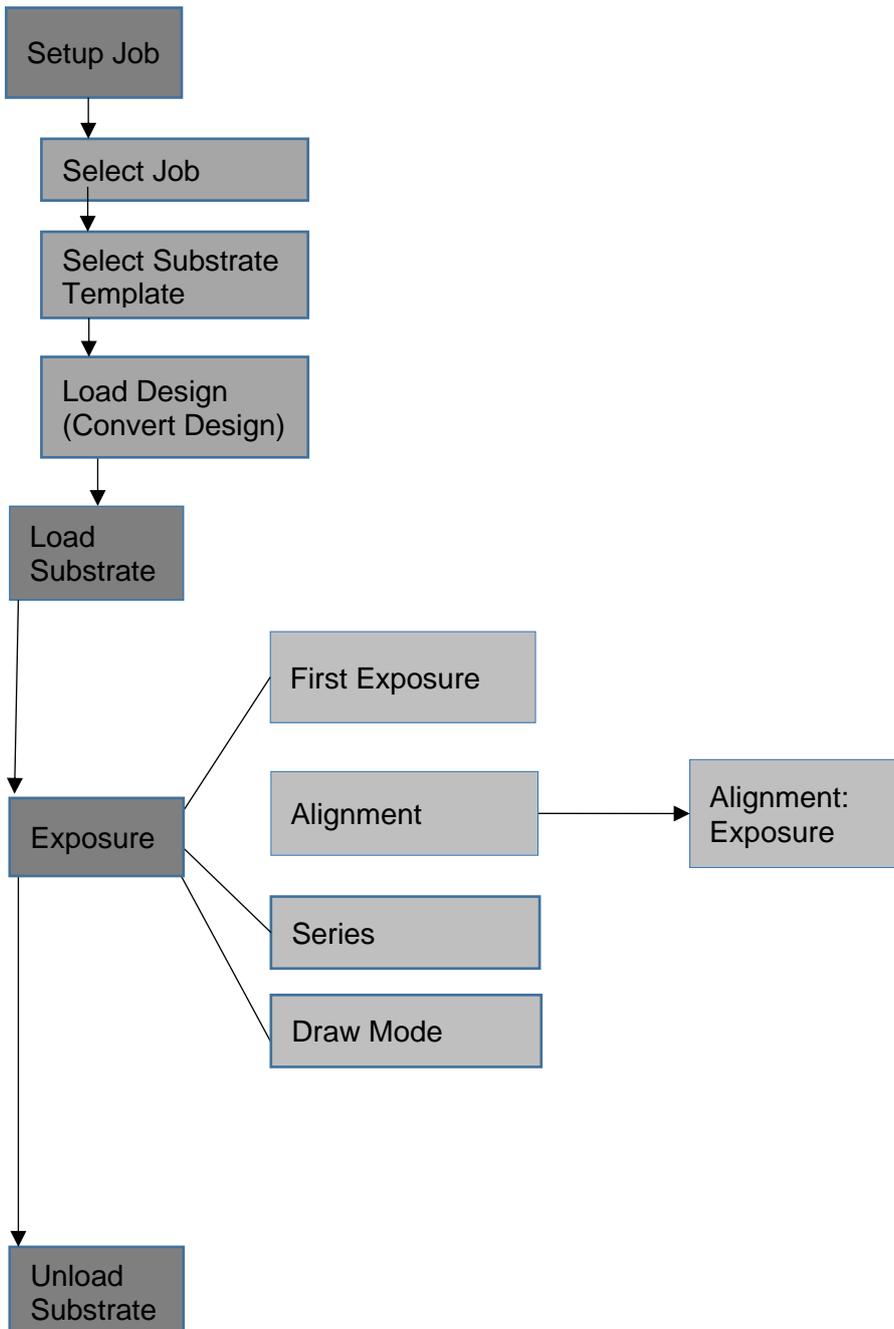
If the active user type is switched to Staff, this is indicated in the menu bar together with a logout button.



**BLANK PAGE**

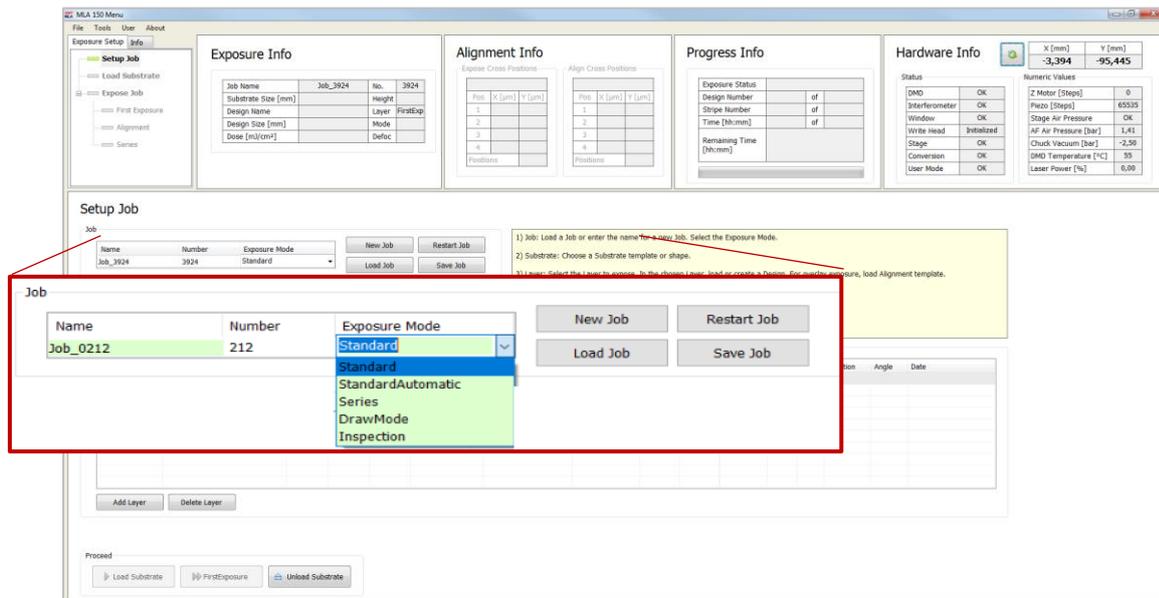
# 6 Job setup

As mentioned before (4 Wizard Description), the MLA150 provides an exposure wizard that guides the user through the steps needed to perform an exposure. The following subchapters build a sequence of actions that must be executed one after the other. To use the wizard efficiently, follow the instructions given in this chapter. The following figure is a “panel map” showing the way through the wizard panels.



## 6.1 Select job

- To start the wizard, double-click the MLA shortcut icon on the desktop.
  - ✓ The **Exposure Wizard** opens and automatically creates a new job. This job has a **Name** and a **Number**. The name is editable and can be changed by clicking into the **Name** field. The number is fixed and auto-incrementing.



- From the dropdown list, select one of the available exposure modes:

- Standard:** To expose a single design for each layer. Overlay exposures are possible in this mode.
- Series:** To expose designs (e.g. dose test) several times at different positions with varying parameters (dose or/and defoc). It can also be used for finding the appropriate dose and defoc relation for the exposure.
- Draw Mode:** To create boxes, circles or ellipses of arbitrary size limited only by the camera field. Used for creating connections between structures or for repairing imperfections in structures of an exposed layer.
- Inspection:** To inspect and measure the exposed structure.

If you do not intend to use the new job, you can also choose from the following options:

### Continue or repeat a job:

Click **Load Job**. A list appears from where you select the required job.

### Repeat an exposed layer of that job:

Click **Restart Job** and select the job you would like to repeat. The process data of the selected job is deleted, and a new job is set up with the same settings but with a new job name/number.

**Start another new job after you have finished an exposure job:**

Click **New Job**. The new job has a new number and a new, but editable, name. Continue with the instructions for a new job.

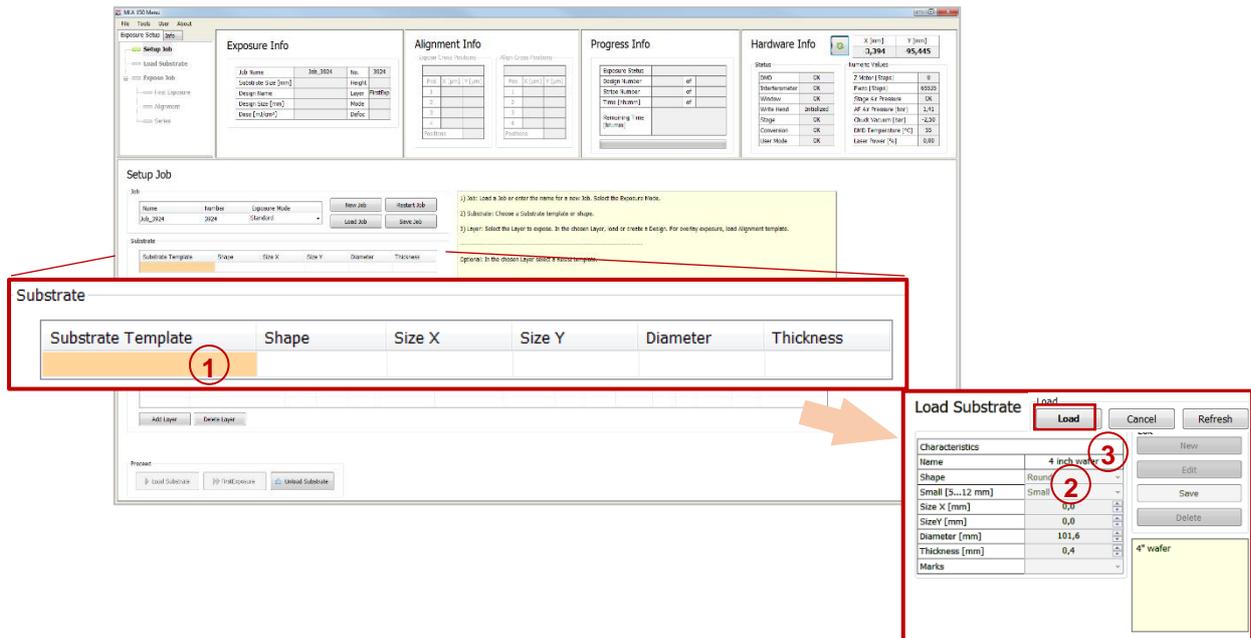
After you have set up the desired job, choose the appropriate substrate and the corresponding substrate template at the system (see 6.2 Select substrate template).

## 6.2 Select substrate template

The system also needs the information about the chosen substrate. It offers a list of templates. In case the required template is not available in the list, it is possible to load a new substrate template (only for authorized users).

For selecting a substrate template, follow these instructions:

In the **Substrate** frame:



1. Double-click into the value field titled **Substrate Template**.
  2. From the list, select your substrate size or shape e.g., automatic\_round if you intent to load a wafer.
  3. Above the list, click **Load**.
- ✓ The Substrate frame now displays the selected substrate size or shape and the field is highlighted in green. The task of substrate template selection is done. If a substrate size was selected, the fields Size X, Size Y, Diameter and Thickness are filled with the corresponding value.

## 6.3 Select a series template

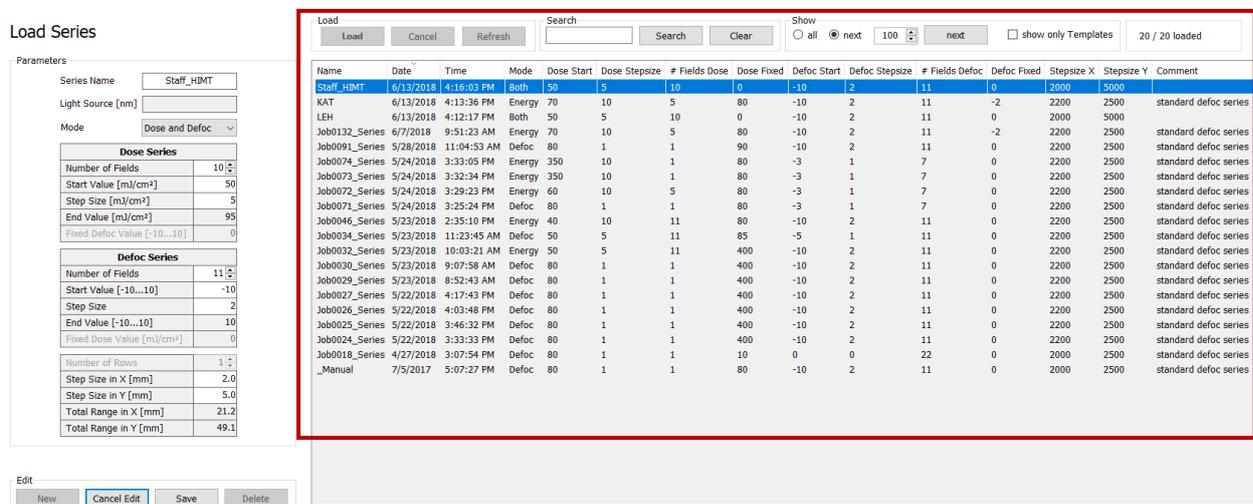
**Note:** Only for series exposures.

In series exposures, the template as well as the design and other parameters are selected in the Series frame.

1. For selecting a new series templates, click into the **Series Template** field.



- ✓ The **Load Series** panel opens.



2. From the list, select a template by highlighting it.
3. Click **Load**.

- ✓ The template name appears in the **Series Template** field and is selected for the current series exposure.

### Set up Series Templates

It also possible to create series templates.

1. Click into the **Series Template** field. The panel opens.
  2. In the **Edit** frame, click New. The table in the left is now editable.
  3. Fill in the information required as stated in the *Series Exposure* section further down.
  4. After completing the table, click **Save**.
- ✓ The template can now be loaded and used for future applications.

## 6.4 Load design

**i** In Draw Mode there is no design loading procedure because this mode is for exposing boxes, circles and ellipses of arbitrary size limited only by the camera field. Skip this subchapter and go to *6.5 Load Substrate*.

After you have selected one of the exposure modes (see *6.1 Select job*) and determined the appropriate substrate template (see *6.2 Select substrate template*), you load the design. For loading a design that is not in the list, follow the instructions given in *6.4 Convert Design*. The following sections contain instructions on design loading. Even though the loading procedures differ only slightly from each other in the different modes, read the section that corresponds to the exposure mode you are about to use.

**i** In the **Layer** frame, the button bar at the bottom offers to copy an entire layer. Mark the layer and click **Copy Layer**. The new layer will be added below the original one. To delete a layer from the list, mark the layer and click **Delete Layer**.

### 6.4.1 STANDARD: FIRST EXPOSURE

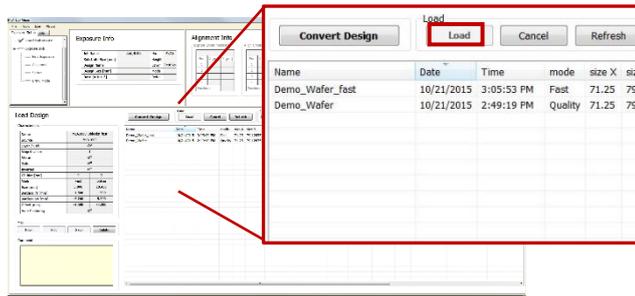
In the **Layer** frame:

1. If available, select a laser from the dropdown list in the **Laser** field.
2. Double-click into the value field titled **Design**. A panel opens containing a list of available design files.

The screenshot displays the MLA150 software interface. At the top, there are several panels: 'Exposure Info', 'Alignment Info', 'Progress Info', and 'Hardware Info'. Below these is the 'Setup Job' panel, which includes fields for Job Name, Substrate Size, Design Name, Layer, and Mode. The 'Layer' table is the central focus, with a red box highlighting the 'Design' column for the 'FirstExposure' layer. Below the table are buttons for 'Add Layer', 'Copy Layer', and 'Delete Layer'. The 'Setup Job' panel also includes a 'Substrate' section with fields for Substrate Template, Shape, Size X, Size Y, Diameter, and Thickness.

3. From the list, select the required design with a left-click.

- Click **Load**. Alternatively, double-click on the design name.



- ✓ The design is now listed in the **Layer** frame.
- Optional: Double-click the value field titled **Resist** and select the appropriate resist type for your application. In the **Thickness** field, the thickness of the resist is displayed. Select the wavelength for the exposure.
 

**Note:** For exposures with grayscale optimization, the corresponding resist must be loaded. In this case, the field is not optional (see next section for grayscale resist loading).
  - Optional: It is possible to load a template for alignment crosses/shapes to be exposed on the layer. To load this template, double-click into the value field titled **Expose Crosses** and select a bitmap template file from the list. If the template size exceeds 800 x 600 px, the system shows a warning.

### 6.4.2 LOADING GRAYSCALE EXPOSURE OPTIMIZATION RESISTS

The system supports grayscale exposures with design of the formats BMP or Grayscale DXF. Loading the design is the same procedure as for binary designs.

If optimization is required, the corresponding resist must be loaded. The resist can be set up and saved only by users with Staff user rights, but users of the Standard login group can select the existing resists for the current job (for more information see 6.9 *Expose design*).

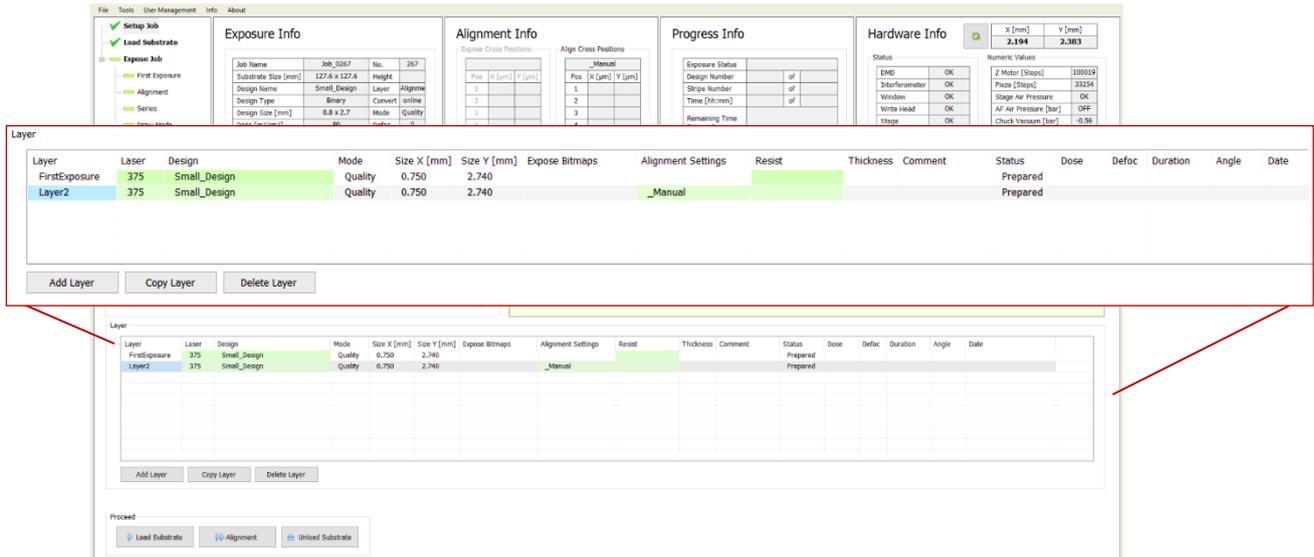
- After having selected the design, in the **Layer** frame, click into the **Resist** value field.
  - From the list, select the required resist and click **Load**.
- ✓ The resist template contains all information for the optimized exposure.

**Note:** Only Staff login group members can set up new grayscale optimization resists.

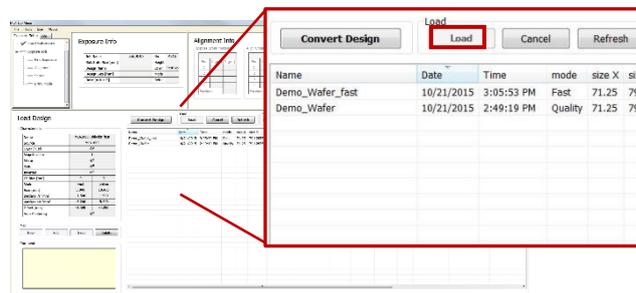
### 6.4.3 STANDARD: ALIGNMENT

For aligned exposures, Layer 2 is the first layer that can be chosen.

**i** Adding an empty layer is easy by clicking **Add Layer**. The new layer will be added below the current one. Alternatively, by double-clicking into the empty range below the actual layers, a new empty layer is added. To copy a layer, click **Copy Layer**.



1. If available, select a laser from the dropdown list in the **Laser** field.
2. Double-click into the value field titled **Design** in Layer 2. A panel opens containing a list of available design files.
3. From the list, select the desired design file with a left-click.



4. Click **Load**. Alternatively, double-click the name.
- ✓ The design is now listed in the Layer frame.
5. Double-click into the value field titled **Alignment Settings**. A list opens showing several templates with the crosses required for alignment procedures. Select one of the templates and click **Load**. The template is used for the alignment procedure.

A special template called `_Manual`. is offered for cases in which the cross positions should be selected in the alignment setup. The exposure is then executed with the manually selected alignment positions which are saved afterwards as `[jobname]_AlignPos_L[No. of layer]` (see below). Additionally, if a different template was selected, alignment positions can be changed or even ignored (see 6.8 Setup overlay alignment).

Filename	Date created	User
<code>_Manual.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions
<code>ACC10.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions
<code>Job0502_AlignPos_L1.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions
<code>Job0562_AlignPos_L1.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions
<code>Job0689_AlignPos_L1.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions
<code>positions_ol.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions
<code>positions_pfm.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions
<code>positions_pfm_3_points.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions
<code>positions_pfm_4_points.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions
<code>zero_cross.xml</code>	3/11/2015 6:35:43 PM	Alignment Positions

- From the list, with a left-click select a template and click **Load**.
- ✓ The template file is now listed in the **Alignment Settings** field.
- Optional: Double-click into the value field titled **Resist** and select the appropriate resist type for your application. In the **Thickness** field the thickness of the resist is displayed. Select the wavelength for the exposure

**Note:** If the first layer does already exist on the substrate, it can be easily skipped.

### 6.4.4 SERIES

In **Series Mode**, the template and design file are selected automatically when choosing **Series Mode** in the **Setup Job** panel (see 6.1 Select job). The **Layer** frame turns into the **Series** frame with different parameters than displayed in the **Layer** frame (see below).

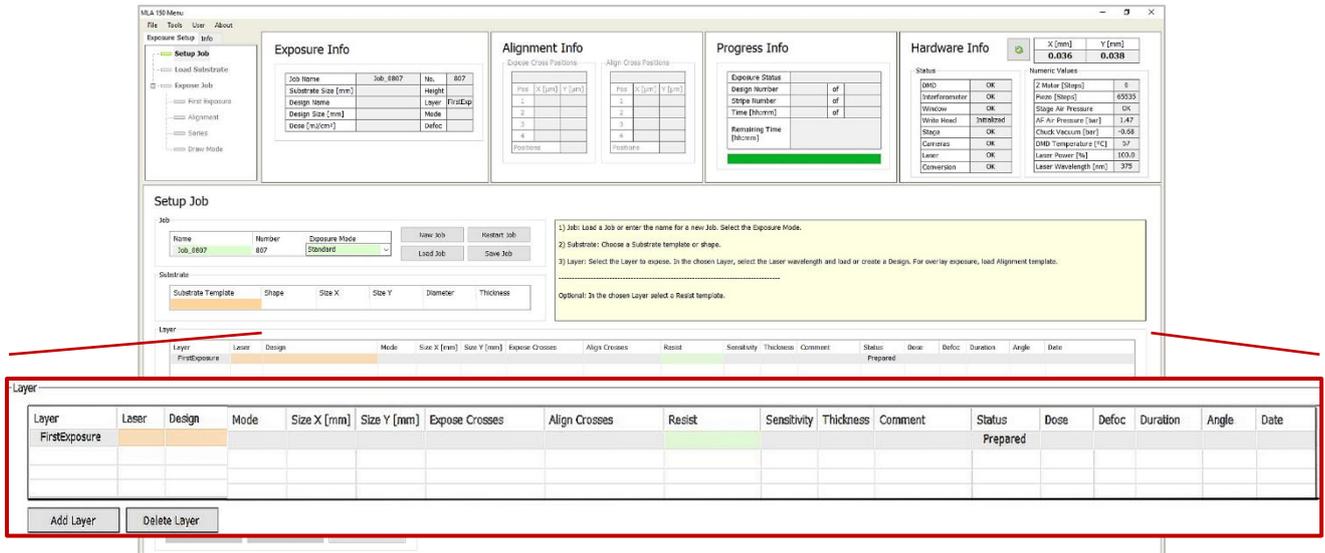
In case you need a different design file for your series exposure, follow the instructions given in 6.4.1 Standard: First Exposure.

Series Template	Series Mode	Laser	Design	Mode	Size X [mm]	Size Y [mm]	Resist	Thickness	Comment	Status	Duration	Angle	Date
<code>_Manual</code>	Defoc	375								Prepared			

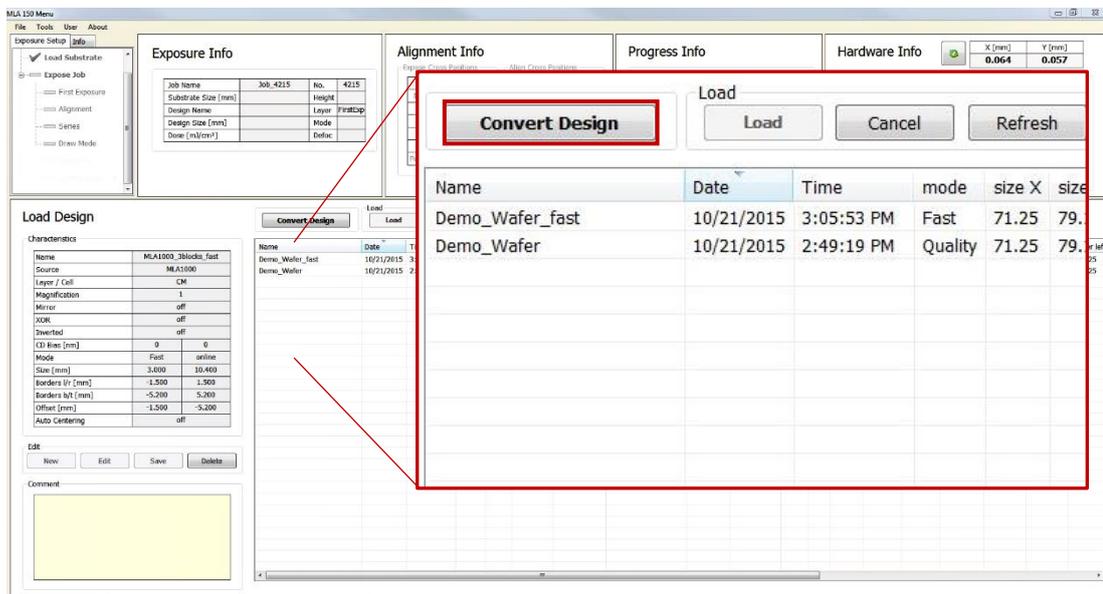
## 6.5 Convert design

If you have chosen a listed design file, skip to the next section *6.6 Load Substrate*. For converting a new design, follow these instructions:

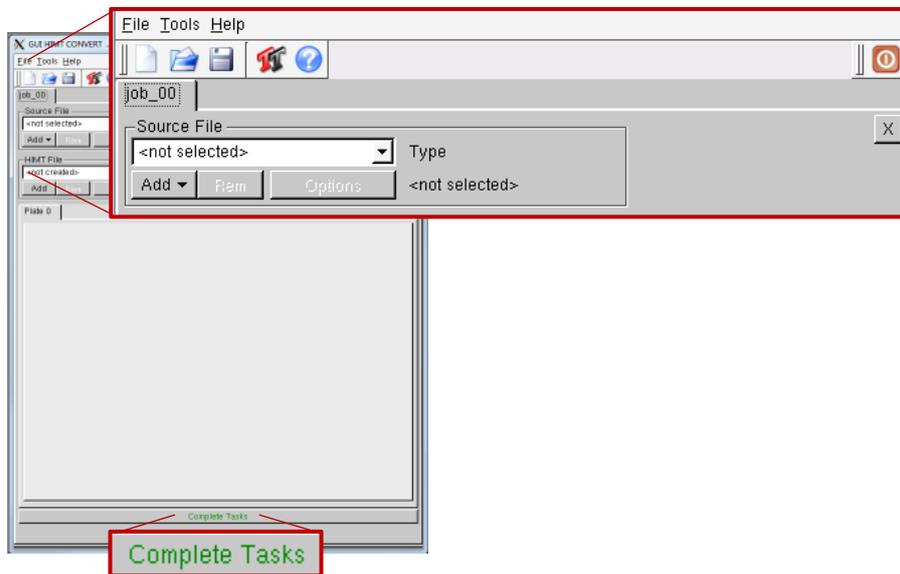
In the **Layer** frame:



1. Double-click into the value field titled **Design**. A page containing a list of designs opens. At the top you find a button bar.
2. Click **Convert Design**. You are led to the conversion software window.



In the **Conversion** window:



3. From the menu bar, select **File → New Job** (alternatively click the sheet icon).
4. You are asked to enter a name for the job. Enter a name and click Ok.
5. Click **Add**, select a design format. A directory opens containing the source files for the selected design format.



To load a design from an external storage media into the corresponding HIMT folder, copy the external design file to the directory:

*HIMT\Designs\<design type>*.

6. From the directory, select the file to be converted into the LIC format.
7. If necessary, change settings and / or use the viewer application (see related document *Conversion Job Manager* for more details).
8. Click **Complete Task**. A message box informs about the completion of the process.
9. If the status bar shows 100%, click **Finish**.
10. Click into the wizard window to refresh the design list or click **Refresh**. The new file is now listed and available for exposure.

## 6.6 Load substrate

After you have chosen the appropriate substrate, selected a substrate template and loaded a design, you can place the substrate on the chuck. The following instructions guide you through the loading procedure. You also get on-screen instructions inside the yellow **Info Box**.

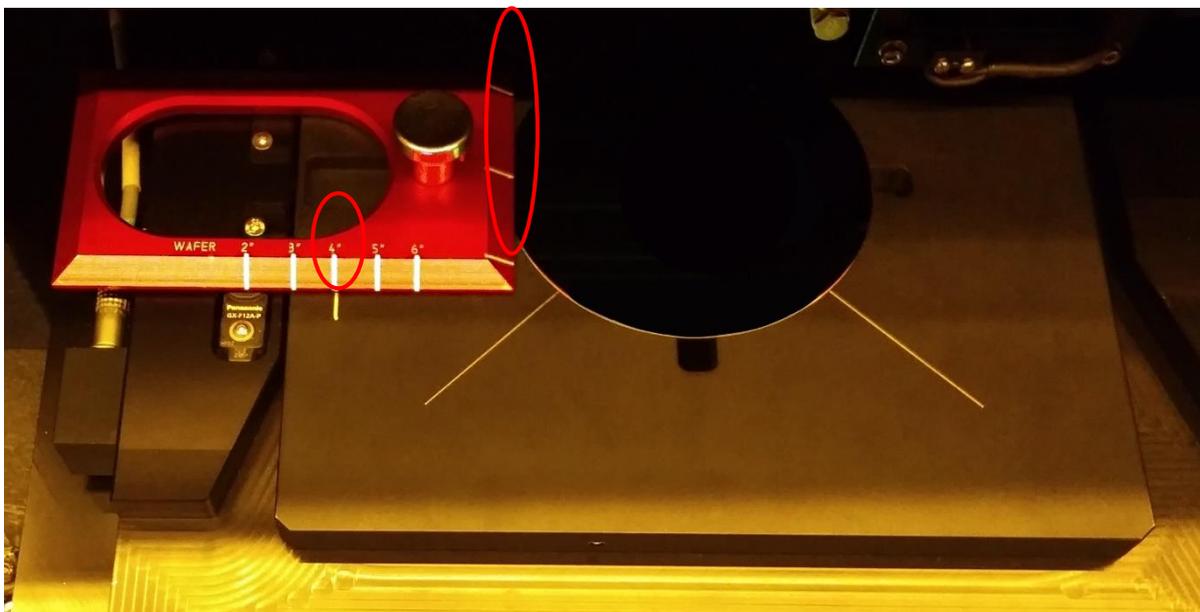
The chuck is designed to facilitate the manual loading process. It has an indentation surrounding one of the four viewing slots for backside alignment. This indentation makes substrate handling on the chuck easier as it offers space for putting the adjustment aid inside.

### ADJUSTMENT AID

The guide bar at the bottom of the adjustment aid is equipped with rest positions corresponding to the different wafer sizes that are possible to be loaded on the chuck. These rest positions are made visible on a measuring scale. On the other edge, some marks help to center the wafer flat.

In the example, the chuck is loaded with a 4" wafer as it can be seen on the measuring scale matching the mark at the chuck.

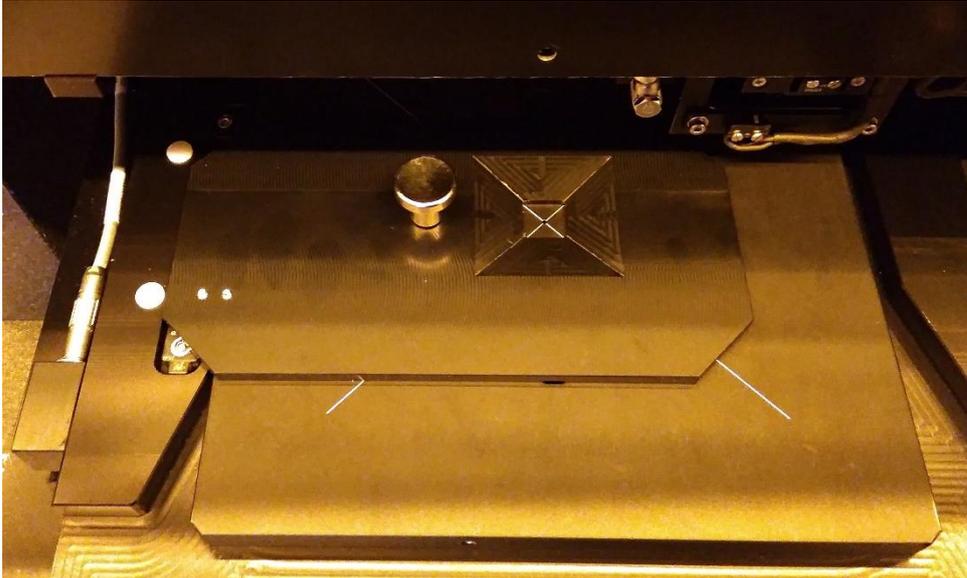
Remove the adjustment aid from the chuck before starting the exposure. To avoid possible damage caused by this adjustment aid, the system is equipped with a monitoring function based on a sensor. The exposure function stays blocked until the tool is removed from the chuck.



**Figure 15: Loading substrates of normal size**

**SMALL SUBSTRATES ADJUSTMENT AID**

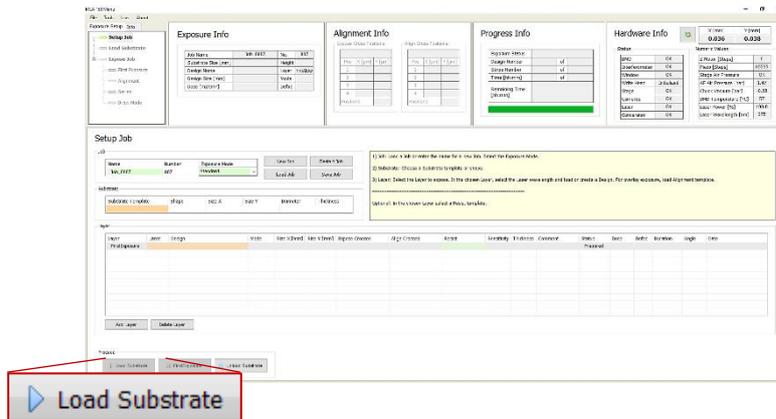
Take the adjustment tool for small substrates and put it onto the chuck so that it fits into the designated recesses. Put the substrate into the hole in the middle of the adjustment tool. Remove the tool from the chuck and switch on the vacuum.



*Figure 16: Loading substrates of small size*

## 6.6.1 STEP-BY-STEP SUBSTRATE LOADING

In the **Setup Job** panel:



1. Click **Load Substrate**. The stage moves to loading position.
- ✓ The wizard moves on to the **Load Substrate** panel. Wait until the movement has stopped.

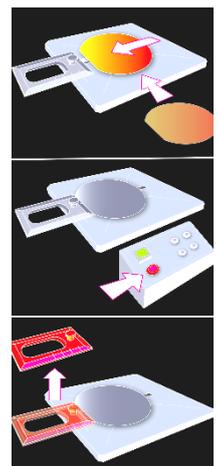
**NOTICE:**

**Resist coated substrates get useless when exposed to white light!**

Non-safe light may only be switched on if all substrates are stored in boxes impermeable to light. Otherwise, the substrates become useless.

**At the lithography main unit:**

2. Push the window button and release it again. The window opens.
3. Place the adjustment aid so that the guide bar at the bottom fits into the indentation at the chuck.
4. Adjust the tool's position to the substrate size.
5. Use a tweezer to grab the substrate and place the substrate on the chuck.
6. At the operator panel press the vacuum button.
7. Make sure that the substrate is held tight by the vacuum.
8. Remove the adjustment aid from the chuck.
9. Check the substrate's orientation (see 3.3 *Orientation of stage and design*).
10. Close the window by pushing and releasing the button. Go back to the User PC.
11. In the **Load Substrate** panel, click **Continue**.
12. Check if the substrate is placed under the write head. If not, see below. If the substrate position is correct, click **Continue**.



**Note:** In case the substrate is not placed under the write head, click **Cancel**. The stage moves back to loading position. Start the loading procedure again and make sure that vacuum is switched on.

**Note:** If the substrate size has not been completely defined in the step of substrate template selection, the system issues a dialog box. Select one of the offered options.

- ✓ The system searches for the center of the substrate (Find Plate Center) and gives information about the progress via a message box. For best results, the process gets repeated several times. If you wish to abort the **Find Plate Center** procedure, click **Cancel**. The system goes back to the **Setup Job** panel and unloads the substrate

**Note:** For small substrates, the automatic center detection does not work. Here, the system asks the user to set the center position manually or to confirm the current position (see 6.6.2 Loading small substrates)

- ✓ The system also detects the flat positions and calculates the rotation angle of the substrate. It is possible to select or deselect the angle for the exposure.

After the successful loading process, the system leads to the next panel:

In Standard Mode with overlay alignment, the **Alignment** panel appears (6.8 Setup Overlay Alignment).

In Draw Mode, the system offers the **Draw Mode** panel for creating boxes, circles and ellipses (6.7 Draw Structures).

In Standard Mode without overlay alignment, you are led directly to the **Exposure** panel (6.9 Expose Design).

In Series Mode, the **Series** panel shows up offering the exposure procedure (6.9.6 Series exposure procedure).

## 6.6.2 LOADING SMALL SUBSTRATES

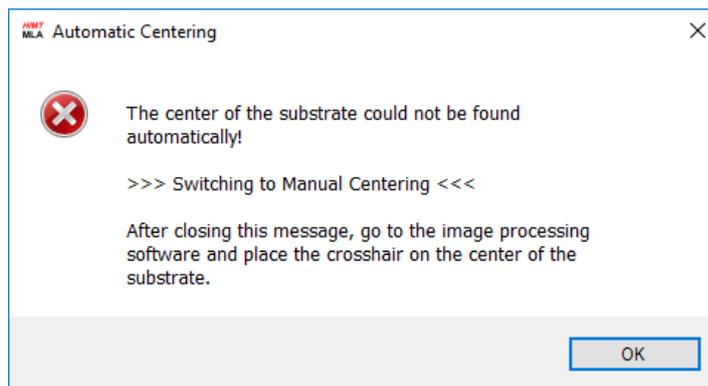
As mentioned in the section above, for small substrates (up to 9 mm) the automatic center detection (Find Plate Center function) might not work.

After having clicked **Continue** in the *Load Substrate* panel (step number 12), the system searches for the center of the substrate. For small substrates this procedure might not work properly. There are three possible result situations:

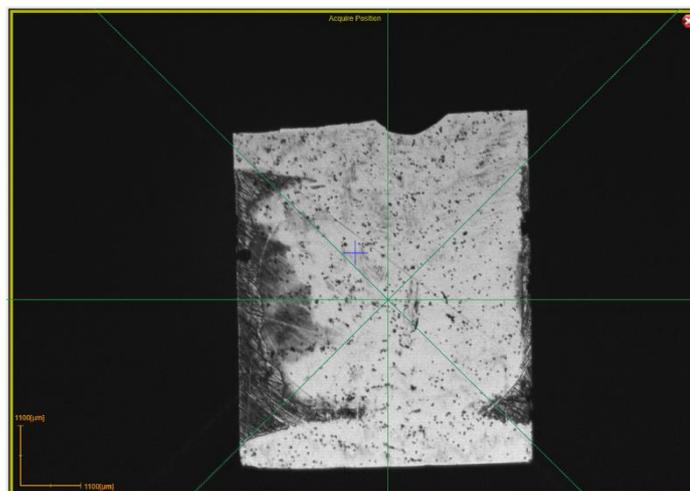
Automatic center detection	Result evaluation	User action
a→Center position found	Correct	No action required
b→Center position found	Not correct	Action required*
c→Center position not found	Warning message issued	Action required*

\* Manual centering is required to set the correct center position of the substrate.

If the system issues a dialog box informing on the failure of the automatic center detection as well as on how to proceed, take the following action:



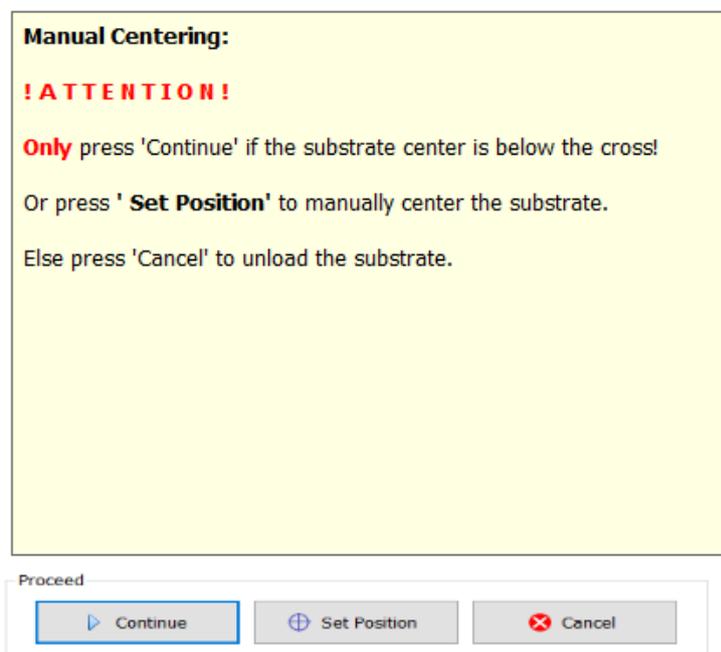
1. Read the instructions given in the info box.
2. Click **Ok** and in the camera window a crosshair appears. Place the crosshair in the center of the substrate.



3. Confirm with a click on the left mouse-button. In the **Load Substrate** panel, the yellow info box issues a warning and gives instructions on how to proceed.
4. Pay attention to the content of the info box. Only click continue if the center is below the crosshair center. Otherwise, click **Set Position** and repeat the manual centering with the crosshair.

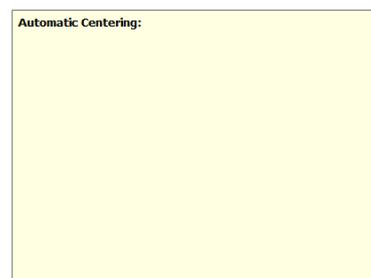
**Note:** The button **Set position** can be used as often as required until the center is set.

## Load Substrate



5. If the substrate center is below the cross and the center is finally found, click **Continue**.
- ✓ The system is executing an automatic centering procedure based on the center position manually set.

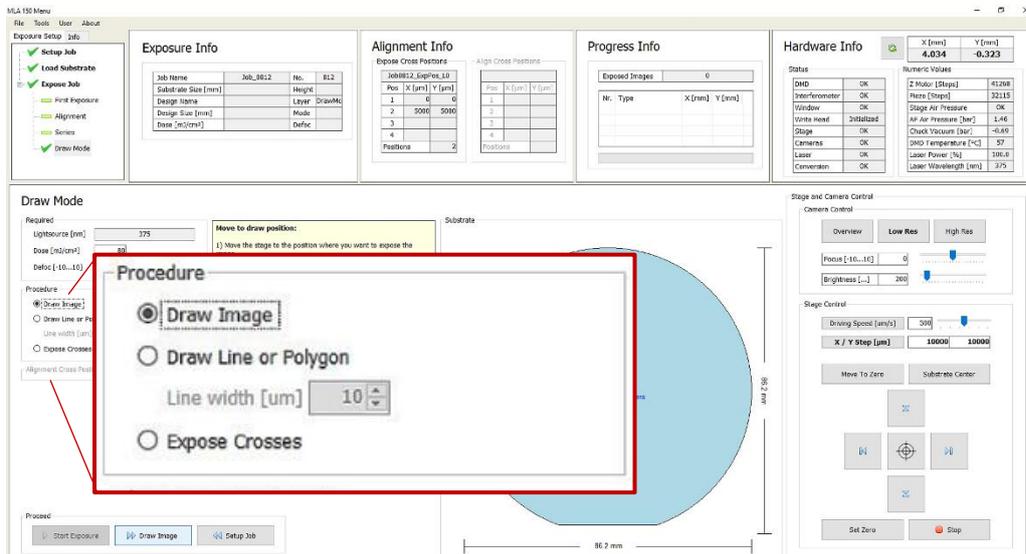
### Load Substrate



## 6.7 Draw structures

After having selected the appropriate substrate, you can start drawing the image.

In the **Draw Mode** panel



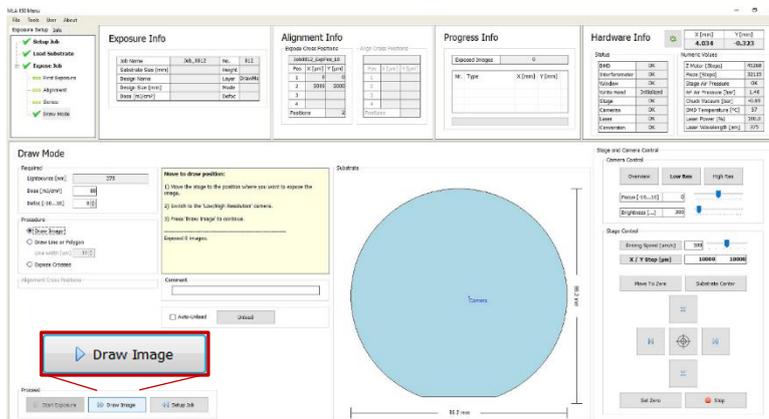
In the **Procedure** frame, select the kind of shape to use for image drawing by activating the corresponding radio button:

**Draw Image:** Activate this option to use the shapes offered in the camera window: rectangle, ellipse, circle or bitmap file.

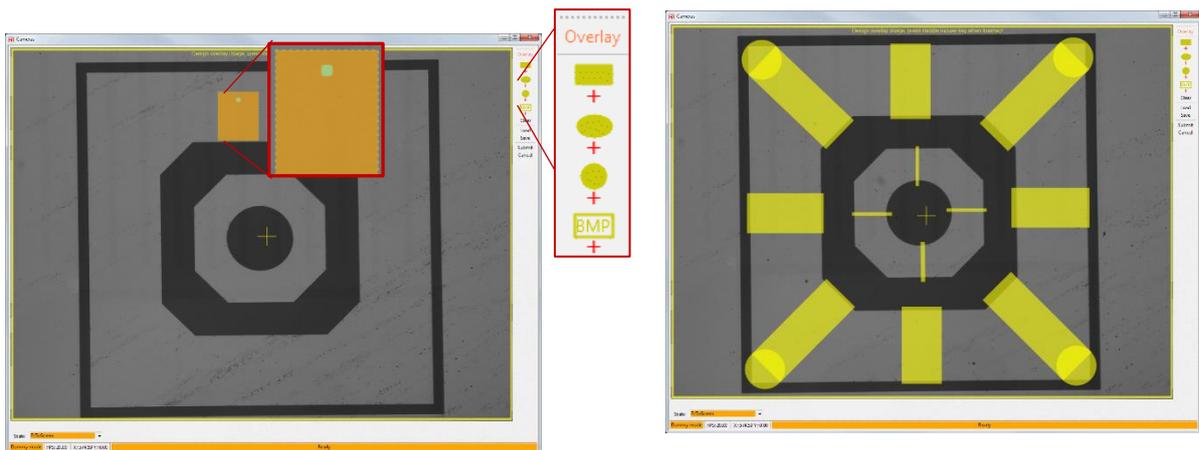
**Draw Line or Polygon:** Use this option to draw lines or polygons (lines with more than two points). Adjust the line width by using the spin control below the radio button.

**Expose crosses:** Use this option to expose crosses or shapes for alignment orientation without the design (in Standard Mode a design has to be loaded). In the Expose Crosses table, you can load the bitmap file for cross exposure. From external storage media, copy the template file to the directory `HIMT\Designs\Bitmap`.

### 6.7.1 DRAW IMAGE

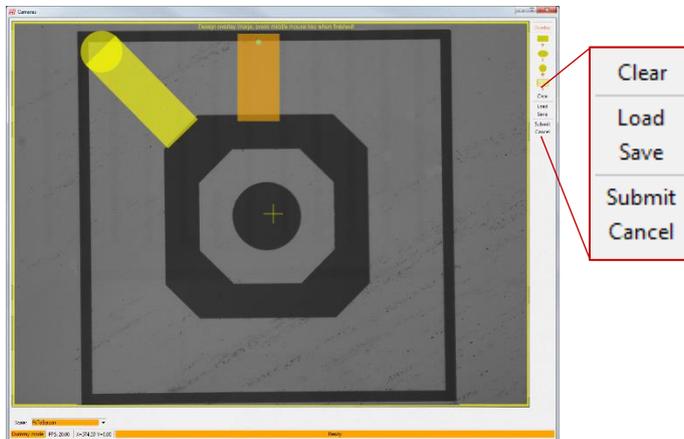


1. Click **Draw Image** and select the area for the structure on the substrate inside the camera window (use the Stage Control section for moving on the substrate).
2. In the camera window select the shapes of the structures that should be drawn onto the substrate by clicking on the corresponding icon.
  - i You can also load an existing file by clicking **Load** and selecting the file from the corresponding folder (usually *C:\HIMT\Designs\Bitmaps*). To directly load a bitmap file, click **BMP** located below the structure icons.
3. To drag the structure to the desired position, click into the structure and move the cursor with the mouse button held down. To rotate the structure, click into the green dot inside the structure and move the cursor without releasing the mouse button until the desired position has been found.



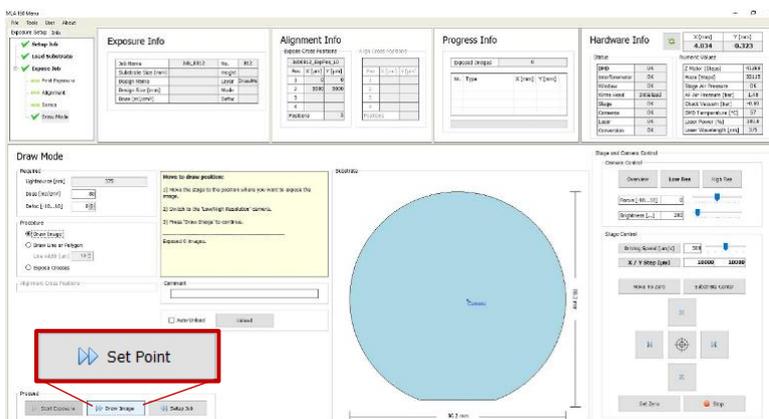
- To confirm the drawn image, click **Submit** in the menu bar of the camera window. To clear the image, click **Clear** and start again.

**i** To save the image, click **Save**, insert a name for the file and save it. To cancel the entire drawing procedure, click **Cancel**.

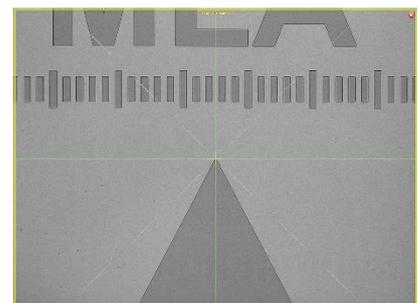


- ✓ After submission of the created image, work with the camera window is done. Return to the wizard window and the Draw Mode panel in which the exposure process can be started (see 6.9.6 Draw Mode exposure procedure).

## 6.7.2 DRAW LINE OR POLYGON

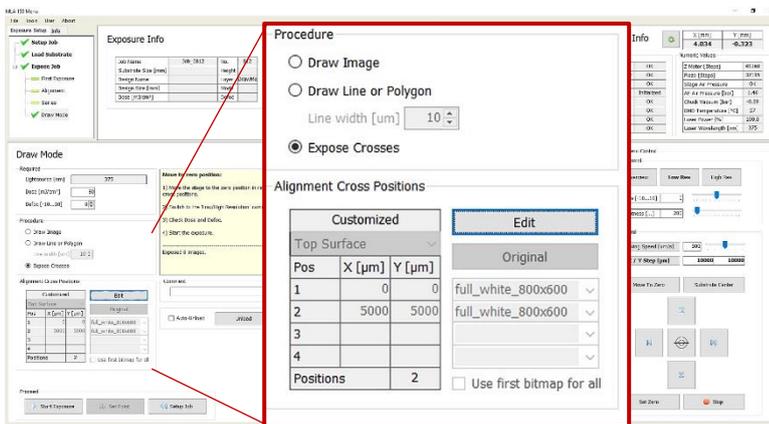


- In the camera window, move to the area near to the position of the first point of the line or polygon, so that it is visible in the camera image.
- Click **Set Point**.
- In the camera window, a crosshair appears. Move the crosshair by moving the mouse to the desired position.



4. Click the left mouse button at the position in which the first point of the line should be set.
  5. Move to the next point of the line/polygon by using the arrow buttons of the Control Panel.
  6. Click **Set Point**. Repeat the set point procedure.
  7. Check the line position in the camera window and click **Accept line**.
  8. To draw a polygon, go on with the set point procedure and click **Accept Polygon** to submit the polygon drawing.
- ✓ After accepting the drawn shapes, work with the camera window is done. Return to the wizard window and the Draw Mode panel in which the exposure process can be started (see 6.9.6 *Draw Mode exposure procedure*)

### 6.7.3 EXPOSE CROSSES IN DRAW MODE



If not selected in the **Setup** panel a bitmap file has to be selected for every cross position:

1. Click **Edit** and select a template for every cross position. For selecting the same file in every position, activate the checkbox **Use first bitmap for all**.
2. Enter the positions into the table.
3. Click **Apply**, to leave the editing mode.

**Note:** Use **Edit** to change the template selection made in the **Setup** panel. Go back to the original positions from the selected file, click **Original**.

---

## 6.8 Setup overlay alignment

---

For exposing the first layer, skip this subchapter and continue with 6.9 *Expose Design*.

The MLA150 is able to execute precise alignment exposures. In order to achieve best results, the system offers top side as well as back side alignment. Back side alignment (BSA) is realized by a separate camera unit for back side viewing that is mounted inside the stage and looks to the substrate. Back side alignment is used in the same way as the normal top side alignment. For using the available alignment modes, choose standard exposure mode in the **Setup Job** panel.

Top side alignment is supported by three different camera types as mentioned before (see 3.1.3 *Optics System*). Back side alignment is supported by one camera. The overview camera is still active but provides only top side view on the substrate.

For alignment, the High Res or the Low Res cameras are the appropriate choice due to their higher resolution compared to the overview camera. When the alignment marks are larger than the field of view of the High Res camera, switching to the Low Res camera is recommended. The overview camera can also be selected for alignment but the accuracy is limited by its resolution (accuracy ~50 µm). Therefore, this choice might be used for coarse structures.

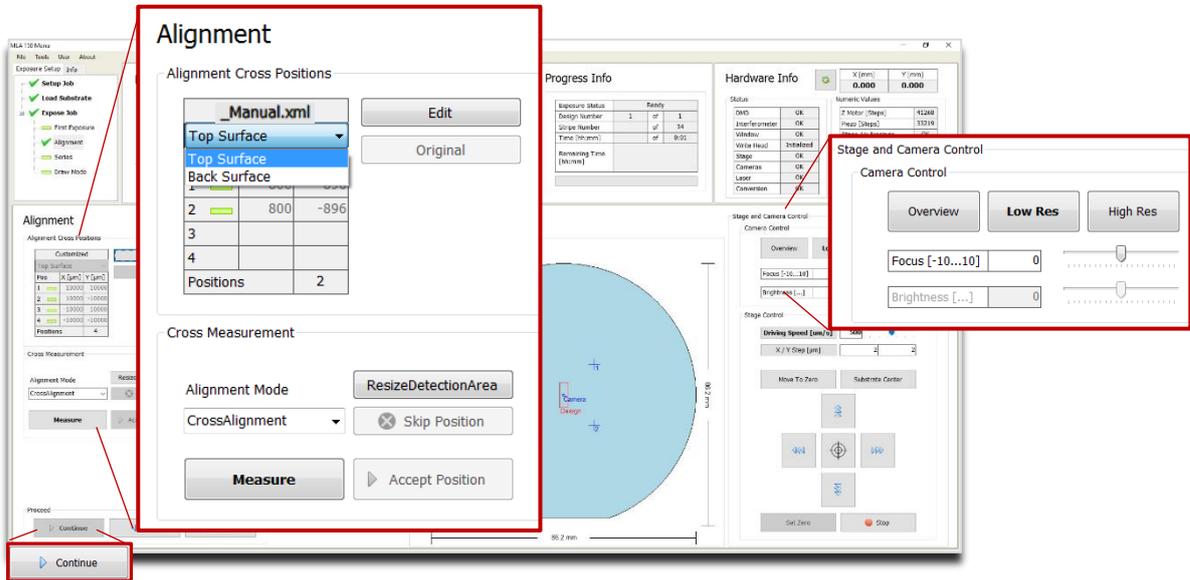
The alignment function offers two different alignment modes, CrossAlignment and ManualAlignment.

- CrossAlignment is an automatic cross detection mode and is recommended to be used as standard mode.
- ManualAlignment is the manual mode for cross detection and is provided for exceptional cases in which the automatic detection might not work properly.

In this chapter, you find the information necessary for executing alignment for overlay exposures. The alignment procedures of top side and back side do not differ from each other, so the following instructions are for both alignment types.

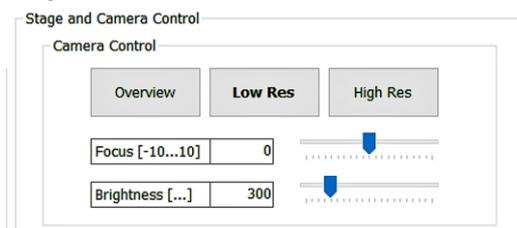
## Alignment Procedure

In the **Alignment** panel:



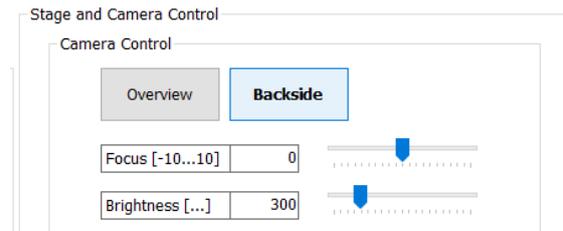
1. If the template `_Manual` for manual setup of the alignment cross coordinates was chosen, select **Top Surface** for top side alignment or **Back Surface** for back side alignment from the dropdown list. The other templates already contain this information.
2. Choose a camera from the **Stage and Camera Control** panel:

### Top Surface



	Field of view
<b>High Res</b>	190 $\mu\text{m}$ x 140 $\mu\text{m}$
<b>Low Res</b>	640 $\mu\text{m}$ x 480 $\mu\text{m}$
<b>Overview*</b>	12 mm x 9 mm

### Back Surface



	Field of view
<b>Backside</b>	640 $\mu\text{m}$ x 480 $\mu\text{m}$
-	-

\*Overview cannot access the entire surface of the substrate due to mechanical limits.

**Note:** Using the **High Res** or **Low Res** camera for alignment is recommended whereas the **Overview** camera might only be useful for alignment procedures with coarse structures.

3. From the **Alignment Mode** dropdown list choose between **CrossAlignment** and **ManualAlignment**. This selection can be made for every single cross position.
4. Double-check the positions of the alignment crosses taken from the template file.

**Editing:** The Edit button is used for changing the alignment cross positions. Click **Edit** and enter new values. To delete one of the cross coordinates, delete the value and leave the field blank. If, for instance, you intend to skip the second cross position in the list, delete the value, copy the value from the third cross position field into it. Leave the third position field blank. To close the editing process, click **Apply**. The positions are stored in a temporary file and turned into a permanent template after exposure start. To restore the original positions from the file, click **Original**.

If the template `_Manual` was selected, set the alignment marks manually by using the **Edit** function. For every alignment cross enter the coordinates and click **Apply** in the end.

5. Use the Stage Control frame of the Control Panel to move the cross into the camera center (see *7.1 Control Panel*).

**Note:** You can switch between continuous movement and stepwise movement. In step mode enter the **step size** [µm] for X and Y direction into the corresponding fields. In the continuous mode, change the **driving speed** [µm/s] either by using the slider or by clicking into the field and entering the speed manually into the corresponding field. Alternatively, click into the slider field to use the arrow keys for setting the speed

6. Determine the alignment marks in:

A CrossAlignment Mode:

Click **Measure**. The system measures the position of the cross and moves it to the center of the camera window. Examine the positions and click **Accept Position** to confirm it. The procedure moves on to the next alignment cross.

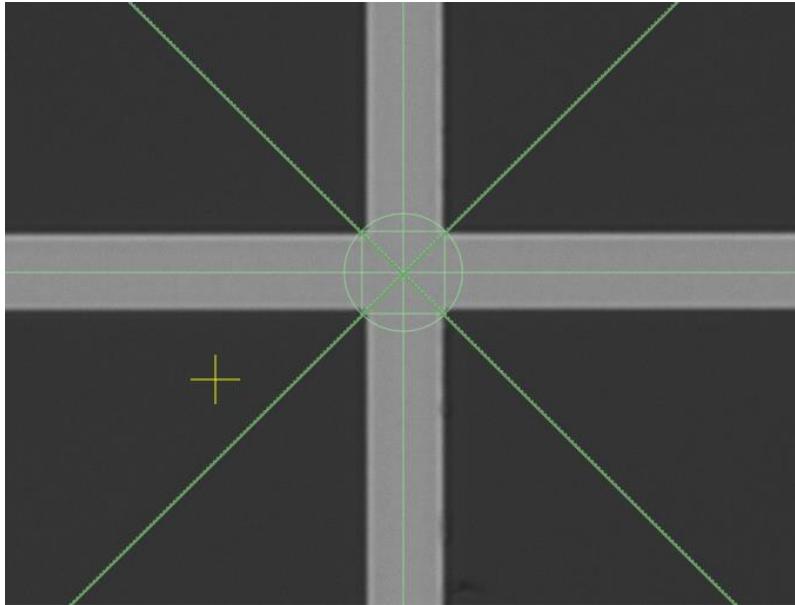
 In case of unsatisfying measurements see *7.2.1 Unsatisfying alignment measurements*.

B ManualAlignment Mode:

Click **Measure**. In the camera window, a crosshair appears. Move the crosshair to the position in which the alignment marks should be set.

Press S (square) or/and or C (circle) on the key board, a rectangle frame or a circular frame appear to support positioning into the center of the cross. Click the left mouse button to fix the position. The crosshair turns orange.

**Note:** The frame can be enlarged or reduced by using the mouse wheel. Pressing C or S again makes the rectangle/circle disappear. To speed up the resizing of the frame, use Ctrl+mouse wheel.



**Figure 17: Manual Alignment with support frame**

To center the position of the alignment mark inside the camera window, click **Center Cross**.

**Note:** It is possible to skip alignment positions by clicking **Skip Position**. This only works if more than two points are available otherwise the button is disabled. In the **Pos** field the rectangle turns red indicating that this coordinate pair was ignored.

7. Repeat the procedure for all alignment cross positions.

8. Click **Continue**.

✓ The design is now prepared for the exposure process. For information on how to start the exposure process, go to *6.9 Expose Design*.

**Note:** Restarting the alignment procedure is possible by clicking **Cancel**. Alternatively, with **Setup Job** the alignment procedure gets cancelled and the Exposure Wizard moves back to the *Setup Job* panel.

## 6.9 Expose design

The system offers two standard exposure modes, one with and the other one without overlay alignment. Additionally, it is possible to execute series exposures in order to determine the appropriate defocus settings and dose settings for the current exposure job. In Draw Mode, you skipped the design loading and created your own structures directly on the substrate inside the camera window (6.7 Draw Structures). The following sections give instructions on how to execute exposures in the different modes.

**Note:** Depending on the system configuration, the autofocus is switched off automatically when no exposure or measurement is running.

### 6.9.1 FIRST EXPOSURE PROCEDURE

After having loaded the design and the substrate, you are in the *First Exposure* panel.

**First Exposure**

**Required**

Design Name: HIMT\_MLA1000\_L2  
 Light Source [nm]: 405  
 Dose [mJ/cm<sup>2</sup>]: 200  
 Defoc [-10...10]: 0

Expose with substrate angle (-2.82 mRad)

**Expose Cross Positions**

Expose the crosses

Pos	X [μm]	Y [μm]
1	0	0
2		
3		
4		

Positions: 1  Use first bitmap for all

**Expose the first Layer:**

- 1) Double-check Design Name, Light Source, Dose and Defoc.
- 2) Optional: To expose the design with the substrate angle, check 'Expose with substrate angle'.
- 3) Optional: Double-check the Expose Cross positions.
- 4) Start the exposure.

The design will be exposed at the zero position of the stage. To set the current stage position to zero, click the 'Set Zero' button.

To expose the design with the found substrate angle, activate the 'Expose with substrate angle' checkbox.

Auto-Unload

**Proceed**

1. Double-check the design name and the wavelength.
2. Double-check and, if required, edit the **Dose** by entering the value into the text field.
3. Set the **Defoc** by selecting a value with the spin button [-10 to 10] (extended defocus range [-25 to 25] depends on the resist template, see *note below Fehler! Verweisquelle konnte nicht gefunden werden.*). The defocus allows for fine tuning of the exposure focus.

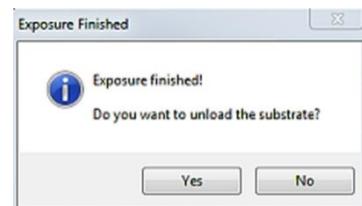
**Note:** The extended defocus range is only available if the corresponding resist was selected. Only users of the Staff user group are allowed to set up such resists (8.5.3 Staff: Exposing with extended defocus range).

4. Optional: Activate **Auto-Unload** (see 6.10 Unload substrate).
5. Optional: Activate **Expose Crosses** if having selected a template before (see 6.4.1 Standard: First Exposure). Use **Edit** to change the coordinates or load a different file. It is also possible to load a template here if not having done it before in the design selection. Use **Original** to reset the coordinates to the values given by the template file.
6. Optional: Activate the **Expose with substrate angle** checkbox if you wish to expose with the rotation angle of the substrate on the chuck.

**Note: Important!** If you activate the **Expose crosses** checkbox, also activate the checkbox **Expose with substrate angle** so that the angle is counted in when exposing the crosses. This is important for correct alignment results.

7. Click **Start Exposure**.

- ✓ The machine is exposing the design. If **Auto-Unload** is not activated, then after completion of the exposure a dialog window pops up asking if the substrate should be unloaded. Click **Yes**, if you want the system to unload the substrate or **No** if the substrate should stay loaded on the chuck e. g., to expose the next layer.



## 6.9.2 GRAYSCALE OPTIMIZED EXPOSURE (OPTIONAL)

The system supports grayscale exposures. After having loaded a grayscale design of the formats BMP or Grayscale DXF, the **First Exposure** panel opens. The procedure is the same as in the **First Exposure** panel for binary designs, unless grayscale dose optimization is required for satisfying exposure results. This can be achieved by changing the distribution of the total dose to the gray value bits (only possible if the corresponding resist was selected, see 6.4.2 Loading grayscale exposure optimization resists).

1. In the **First Exposure** panel you find a **Grayscale Optimization** frame. Within the frame, activate the checkbox **Set individual Doses for each Bitlayer**.

- ✓ A table opens showing the gray value bits in the top row and the corresponding dose values. The distribution of the total dose to the gray values is saved in the template and can be used. It is possible to change this distribution pattern for the

Grayvalue Optimization

Set individual Doses for each Bitlayer

Bit	128	64	32	16	8	4	2	1
%	50.2	25.1	12.5	6.3	3.1	1.6	0.8	0.5
Dose	502.0	251.0	125.5	62.7	31.4	15.7	7.8	5.0
Total Dose	1001.1		Reset Percentages					

current job but cannot be saved to the template.

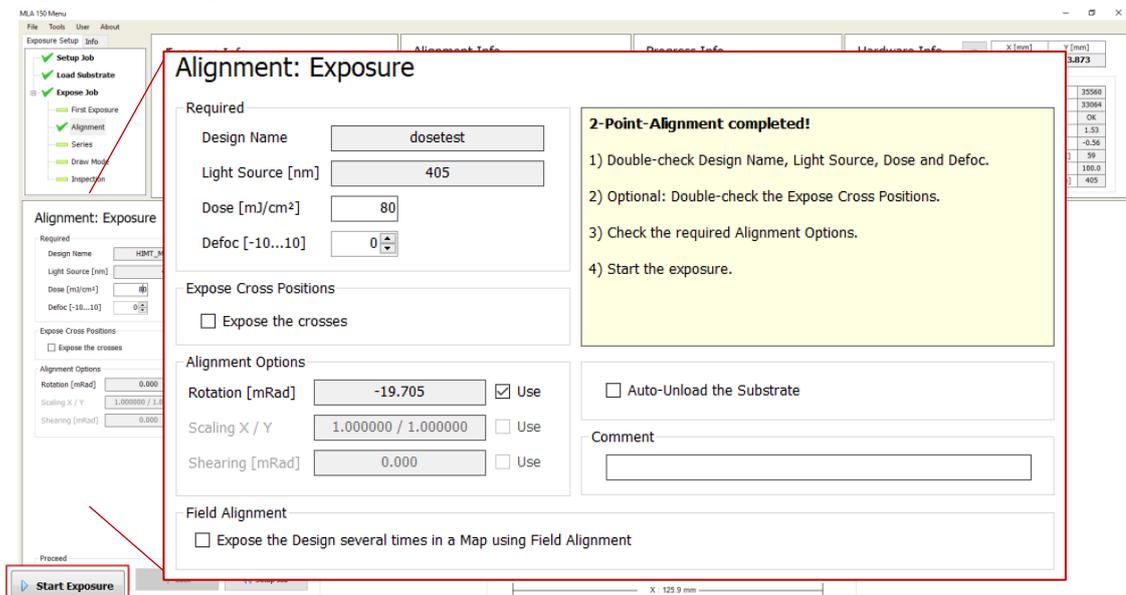
### Changing the distribution pattern for the current job

1. Click into the fields and enter different values to change the distribution of the total dose to the gray value bits.
2. After having distributed the total dose to the grayscale values, you can start the exposure as usual.

### 6.9.3 OVERLAY EXPOSURE PROCEDURE

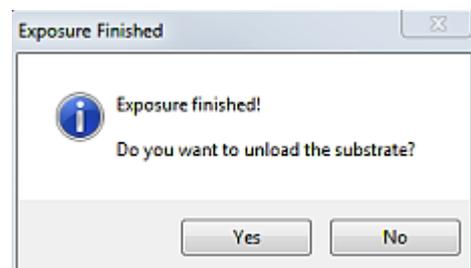
After having loaded the design and the substrate and having prepared the alignment marks, the substrate is ready to be exposed.

In the **Alignment: Exposure** panel



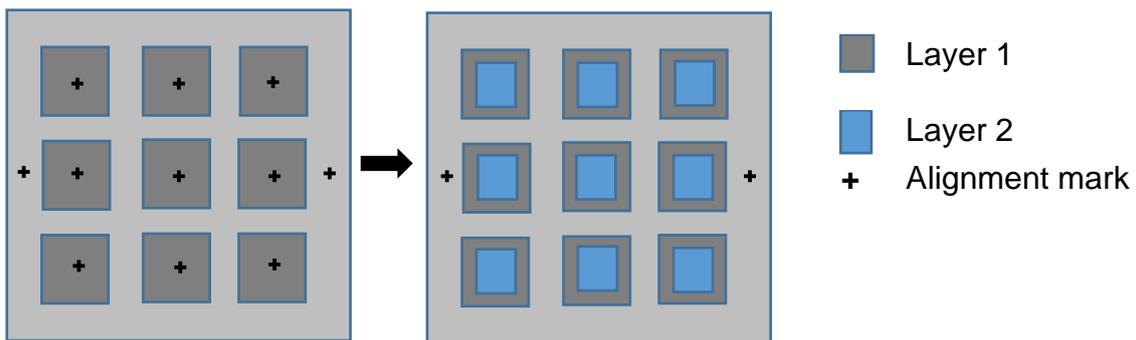
1. Double-check the design name and the wavelength.
2. Double-check and, if required, edit the **Dose** value by entering it into the text field.

3. Set the **Defoc** by selecting a value with the spin buttons [-10 to 10] (extended defocus range [-25 to 25] depends on resist template **Fehler! Verweisquelle konnte nicht gefunden werden.**). The defocus allows for fine tuning of the exposure focus.
  4. Optional: It is possible to load a template for alignment crosses or shapes which are exposed on the layer. To load this template, double-click into the value field titled **Expose Crosses** and select a bitmap template file from the list
  5. Choose from the Alignment Options section:
    - **Rotation** [mRad]: This option is recommended and selected per default. If the Use checkbox is activated, the system includes the rotation of the substrate.
    - **Scaling X/Y**: The system compares the distance measured during alignment with the distance given by the alignment positions (minimum 3 positions). From the deviation a scaling factor results. Based on this, the alignment design is shrunk or stretched in order to match the previous layer.
    - **Shearing** [mRad]: The system compensates small distortions such as a rectangle that appears more like a parallelogram.
  6. Optional: Activate **Auto-Unload**. The system executes the unloading procedure automatically (see 6.10 *Unload substrate*).
  7. Click **Start Exposure**.
- ✓ The machine is exposing the design. If **Auto-Unload** is not activated, then after completion of the exposure a dialog window pops up asking if the substrate should be unloaded. Click **Yes**, if you want the system to unload the substrate or **No** if the substrate should stay loaded on the chuck e. g., to expose the next layer.



### 6.9.4 FIELD ALIGNMENT PROCEDURE (OPTIONAL)

Field alignment is offered by a checkbox in the **Alignment: Exposure** panel. To execute a field alignment, activate the **Field Alignment** checkbox. If there is an array of 3 x 3 fields on each layer, for example to produce microchips, each field is aligned with the field on the previous layer prior to exposing each field several times. The coordinate systems of the design in the first layer is identical to the one of the design in the second layer.



**Figure 18: Alignment marks exposed on first layer and overlay of second layer**

**Follow the steps to prepare and execute a field alignment:**

1. Prepare a first layer with at least two alignment marks outside the array of fields as well as one alignment mark within each field.

**Note:** It is also possible to execute the global alignment in the first layer only with the field alignment marks since only the angle rotation is being measured which requires at least two marks. However, it is recommended to put two alignment marks outside the array of fields since it is crucial that the two marks are positioned as far as possible from each other.

2. Expose and process the substrate.
  - ✓ Now, the first layer is created.
3. Load the substrate again and select a design for the second layer. Choose **Standard** as exposure mode.
4. In the **Alignment** panel execute an alignment as usual (global alignment) based on the alignment marks outside the fields to determine the global alignment angle.
5. Then activate the checkbox **Field Alignment**. A table opens. Here, the information of the cross in each field in layer one must be entered so that the system is able to align both layers with very high accuracy.

Field Alignment

Expose the Design several times in a Map using Field Alignment

Load and Save

Load

Save

Map Parameters

Parameters	X	Y
Number of Fields	9	5
Measure Cross Number	5	3
Step Size [um]	4000	8000
Position of Cross [um]	-100	100

Cross Measurement

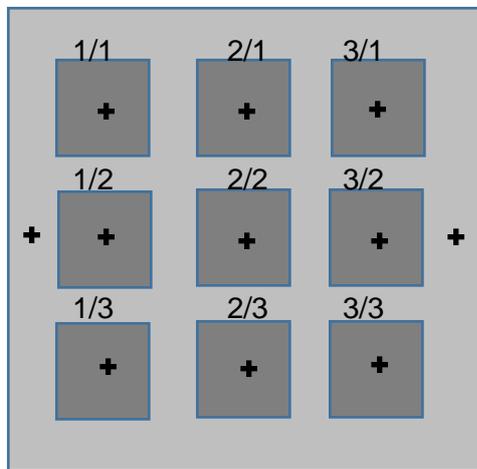
Maximize Detection Area

**Measure**

▶ Accept Position

6. Enter the required information for finding and aligning the crosses of layer one to layer two.

- **Position of Cross**
Enter the positions of the crosses exposed in layer one. The position of each of these crosses refers to the coordinate system of the design in the same field.
- **Number of Fields**
Enter the number of fields in x and in y direction.
- **Step Size X/Y**
Enter the distance of the fields exposed in layer one to each other.
- **Measure Cross Number**
Enter the cross of the field the system should start the alignment procedure with.

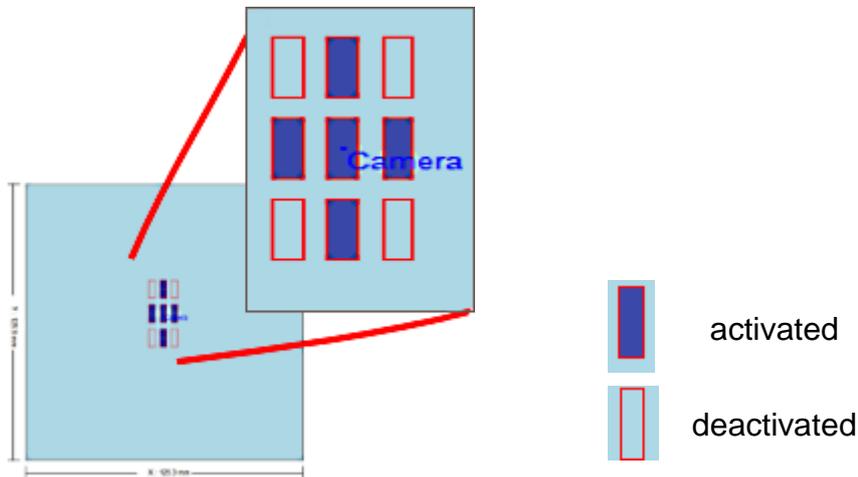


**Figure 19: Order of field counting**

7. After having filled all fields with the required information the system is ready to execute cross alignment again. Start with bringing the cross entered at **Measure Cross Number** into the center of the camera image field. This ensures the correspondence of the cross in the table to the cross in der camera image.
8. Click **Measure**. An automatic cross alignment is executed. To restart the cross-finding procedure, click **Restart** and repeat the procedure.

**Note:** All the crosses are detected automatically in one procedure. It is not necessary to start a measurement procedure for each individual cross.

9. Before starting the exposure, **it is possible to activate and deactivate individual fields**. If one or more of the fields should be left out from exposure, click on the field in the substrate representation.

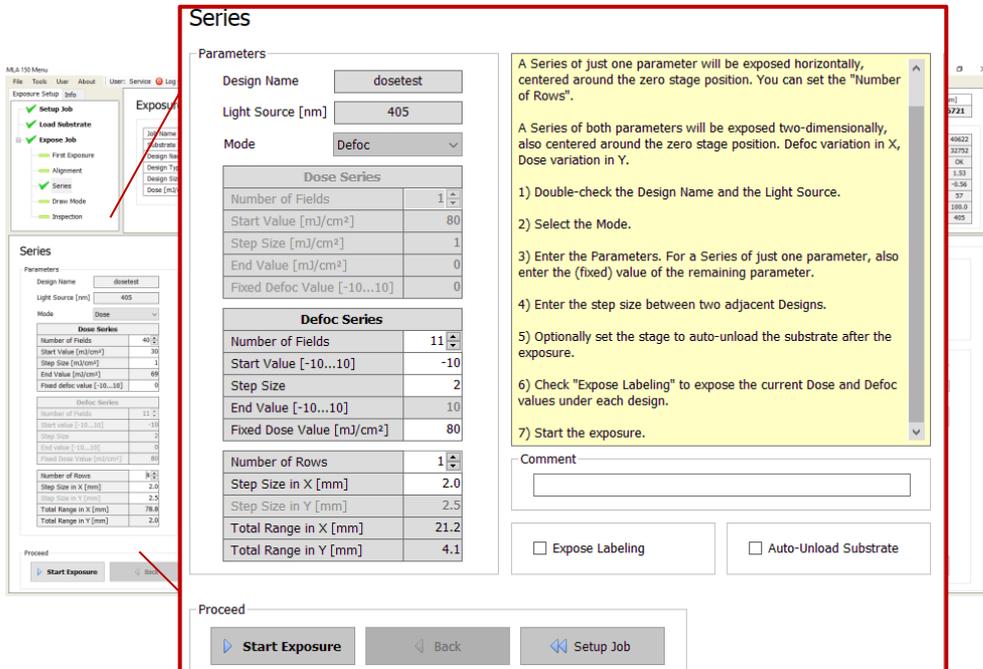


10. To execute the exposure of the second layer, click **Start Exposure**.

- ✓ The system exposes the second layer. Exposed fields are displayed in green. Fields in red indicate that no exposure was executed in these fields. At the end of the procedure, result information is displayed as well as the cause of failures.

### 6.9.5 SERIES EXPOSURE PROCEDURE

After having loaded the substrate and the design, the substrate is ready to be exposed. You are in the **Series** panel of the Series mode.



In this panel, several values have to be set for series exposure. Find the explanation of the panel elements below:

Parameters	
Design Name	dosetest
Light Source [nm]	405
Mode	Dose
Dose Series	
Number of Fields	40
Start Value [mJ/cm <sup>2</sup> ]	30
Step Size [mJ/cm <sup>2</sup> ]	1
End Value [mJ/cm <sup>2</sup> ]	69
Fixed defoc value [-10...10]	0
Defoc Series	
Number of Fields	11
Start value [-10...10]	-10
Step Size	2
End value [-10...10]	0
Fixed Dose Value [mJ/cm <sup>2</sup> ]	80
Number of Rows	
Number of Rows	1
Step Size in X [mm]	2.0
Step Size in Y [mm]	2.5
Total Range in X [mm]	78.8
Total Range in Y [mm]	2.0

**Lightsource:** Check the laser wavelength and if necessary change it.

**Mode:** Three different selections are possible: **Dose**, **Defoc** or **Dose and Defoc**.

**Number of fields:** Use the spin button to select the number of fields to be exposed

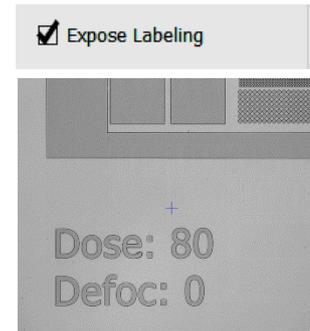
In the **Dose Series** table, you set the parameters for the series with varying energy values.

In the **Defoc Series** table, you set the parameters for exposing the design with varying defocus values. The defocus allows fine tuning of the exposure focus.

In the bottom table, the **Step size** in x and y direction is determined. Here you can also set the number of rows for Dose or Defoc exposure.

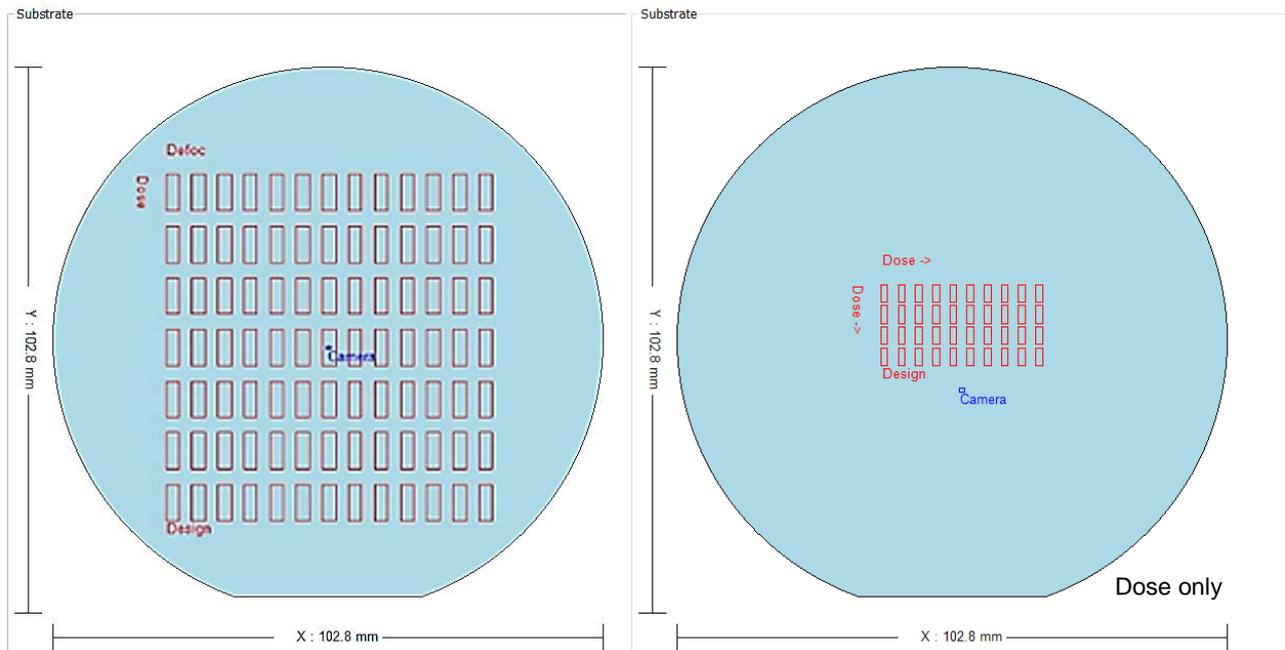
For information about **Auto-Unload** see 6.10 Unload substrate.

It is possible to write the parameters dose and defoc in plain text below the design on the wafer. If the **Expose Labeling** checkbox is activated, an additional exposure is executed to write the parameters below the exposed field. This does not increase the exposure time. Keep in mind, that the step size has to be increased so that the label fits below each field. The **Step Size** field gets highlighted in orange in case the step size is too low. With labeling exposure, the **Total Range** increases.



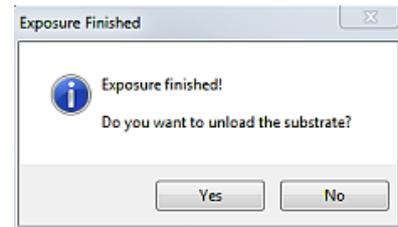
When choosing **Dose Series** only, the **Defoc** value is fixed. The Dose value is fixed when **Defoc Series** is active.

The substrate visualization shows the arrangement of the fields according to the values set in the **Series** panel. This feature facilitates the preparation of series exposures. The horizontal fields are for defocus series and the vertical fields represent the dose fields (see below example left). In **Dose** or **Defoc** Series the number of rows can be adjusted to maximize the area the fields can be arranged (right example). If the fields overlap, the step size has to be changed to a higher value. If the field arrangement exceeds the substrate surface size, the number of fields must be reduced.



1. Select from the options in the **Mode** dropdown list: **Dose**, **Defoc** or **Dose and Defoc**.
2. Set the values required for the selected mode.
3. If desired, activate **Auto-Unload** (see 6.10 Unload substrate).
4. Click **Start Exposure**.

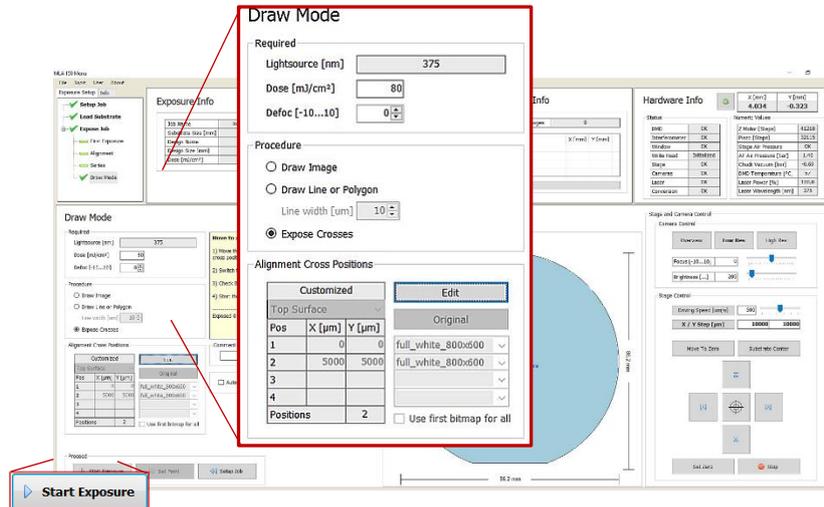
- ✓ The machine is exposing the design. The first field is always converted online, the other fields use the same data offline. If **Auto-Unload** is not activated, then after completion of the exposure a dialog window pops up asking if the substrate should be unloaded. Click **Yes**, if you want the system to unload the substrate or **No** if the substrate should stay loaded on the chuck e. g., to expose the next layer.



## 6.9.6 DRAW MODE EXPOSURE PROCEDURE

After creation and submission of the image, you are still in the Draw Mode panel to start the exposure.

In the *Draw Mode* panel



1. Set the **Dose** value by entering the value into the text field.
  2. Set the **Defoc** by selecting the value with the spin buttons [range -10 to 10] (extended defocus range [-25 to 25] depends on resist template **Fehler! Verweisquelle konnte nicht gefunden werden.**). The defocus allows for fine tuning of the exposure focus.
  3. Optional: Activate **Auto-Unload**. The system executes the unloading procedure automatically (see 6.10 Unload substrate).
  4. Click **Start Exposure**.
- ✓ In the **Progress Info** section the table changes to a list displaying the Draw Mode procedures that are already executed. The most recent one is listed at the top of the list. You also find the information about the type of draw mode image and the coordinates of the center of the image.

## 6.10 Unload substrate

### 6.10.1 USING THE AUTO-UNLOAD FUNCTION

For unloading the substrate, the system provides a function called **Auto-Unload**. This function is selectable by activating a checkbox. Read more in the information below.

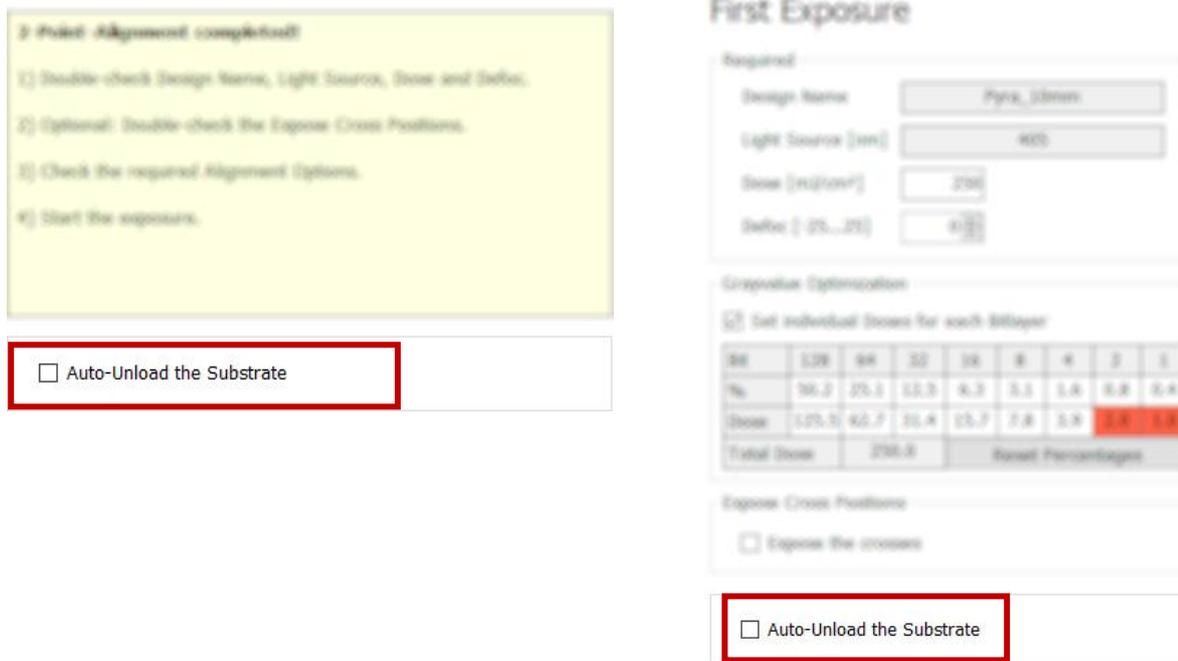


Figure 20: Possible locations of the auto-unload checkbox

#### Auto-Unload checkbox

The **Auto-Unload** function automatically brings the stage into unloading position directly after exposure completion. Activate the Auto-Unload function by clicking into the checkbox **before starting the exposure procedure**. Above, possible locations of the checkbox are shown. Depending on the exposure mode, the checkbox can be located below the info box or below the parameter setup frames. After the unloading procedure is finished, the wizard directly leads you back to the **Setup Job** Panel where you can start a new job with **New Job**. You can take the substrate from the chuck or leave it there for exposing a further layer.

#### Unload Substrate button

The wizard also features an Unload Substrate button that is available in the Setup Job panel.

### 6.10.2 REMOVING THE SUBSTRATE FROM THE CHUCK

To remove the substrate from the chuck, follow the steps below:

1. Push the window button and release it again. The window opens.
2. At the operator panel switch off the vacuum.

**NOTICE:**

**Resist coated substrates get useless when exposed to white light!**

Non-safe light may only be switched on when all substrates are stored in boxes impermeable to light.

Otherwise, the substrates become useless.

3. Carefully take the substrate off the chuck and stow it in an opaque box impermeable to light.
4. Close the window by pushing and releasing the button. If required, click **OK** in the *Exposure Wizard* to close the unloading dialog.

**Note:** This user guide does not give instructions on substrate processing.



# 7 System utilities and tools

The MLA offers further elements beside the main menu that facilitate handling the exposure and alignment processes. Select **Tools**→**Control Panel** from the menu bar to open the panel. The item Control Panel is not available until a substrate has been loaded.

## 7.1 Control Panel

The Control Panel is a utility that provides navigation functions as well as other necessary control functions.

In the **Camera Control** frame, the buttons for selecting the available cameras are arranged. A selection is done by clicking the button for the camera of choice. The camera is then activated. The information below about the field of view of the different cameras helps to select a camera that is appropriate for the current application. Using the **High Res** or **Low Res** camera for alignment is recommended whereas the **Overview** camera can only be useful for alignment procedures with coarse structures.

### Top Surface

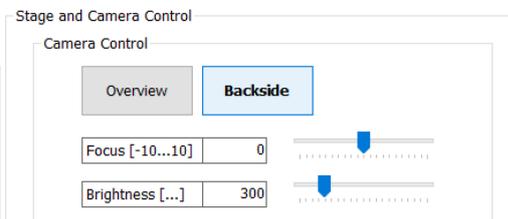


#### Field of view

<b>Low Res</b>	640 µm x 480
<b>High Res</b>	190 µm x 140 µm
<b>Overview*</b>	12 mm x 9 mm

\*Overview cannot access the entire surface of the substrate due to mechanical limits.

### Back Surface



#### Field of view

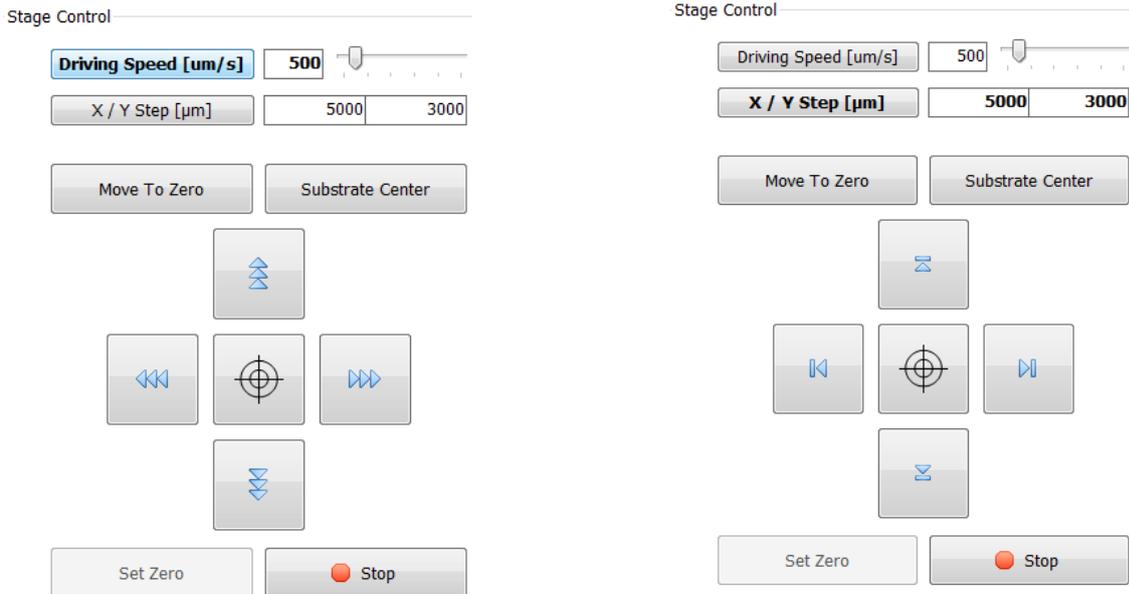
<b>Backside</b>	640 µm x 480 µm
-----------------	-----------------

Below these you find one **Focus** slider for setting the camera focus and a **Brightness** slider for setting the brightness of the camera image. In Alignment Mode, for very thick resists the focus can be switched to larger camera defocus with a wider defocus range by selecting **Tools**→**Large Camera Defoc** from the menu bar. The slider bar is now named **Range**. Moving the slider changes the focus position in a wider range.



Click on the slider and keep the mouse button held down while moving it to the desired value on the slider bar. Alternatively, click on the slider bar and use the cursor keys for moving the slider along the bar. The tick marks on the focus slider bar are for your orientation within the range from -10 to +10 so the center tick mark sets the focus to 0. A positive number brings the camera focus closer to the substrate.

The **Stage Control** frame provides arrow buttons for moving on the substrate surface. Every click is one move. They are also used for fine positioning.



To determine the kind of movement, you can switch between continuous movement and stepwise movement by clicking into the corresponding field. In continuous mode, change the **driving speed** [um/s] either by using the slider or by clicking into the value field and entering the speed manually. Alternatively, click into the slider field and use the arrow keys for setting the speed. In step mode, enter the **step size** [um] for X and Y direction. The arrow buttons for navigation on the substrate surface change their appearance according to the selected mode. This contributes to a fast identification of the mode currently selected.

The **Set Zero** button allows to set an arbitrary point as zero coordinates (not available in Alignment Mode). With **Move To Zero** it is possible to go to the zero point set before. Clicking **Substrate Center** allows to move the field of view to the center of the substrate. To stop any stage movement, make use of the **Stop** button.

## 7.2 *Optimizing alignment and exposure results*

---

### 7.2.1 UNSATISFYING ALIGNMENT MEASUREMENTS

Sometimes the measurements during the alignment process might be unsatisfying due to bad contrast caused by uneven surface conditions or low reflectivity of the substrate. This chapter gives advice how to improve the measurement results during the alignment process.

#### Repeat the measurement

Clicking **Re-Measure** repeats the measurement procedure which can lead to new results. The **Measure** button turns into the **Re-Measure** button after the first measurement procedure for one coordinate point.

#### Change the size of the detection area

For the finding cross function to work properly it is important that the alignment cross fills the entire camera window. If this is not the case, click **ResizeDetectionArea**. Inside the camera window, a rectangle appears showing the new detection area. To enlarge the detection area, click the right bottom corner of the rectangle without releasing the mouse button and drag the corner to the desired size while holding down the mouse button. To maximize the detection area again, click **MaximizeDetectionArea**.

#### Change settings in the Control Panel

- Adjust the values for **Focus** or **Brightness** to make the finding cross function work more efficiently.
- Select **Tools** → **Large Camera Defoc** from the menu bar to extend the camera defocus range. The **Focus** slider bar got renamed into **Range** (see 7.1 Control Panel).
- Choose a different camera, to get a better view on the substrate.

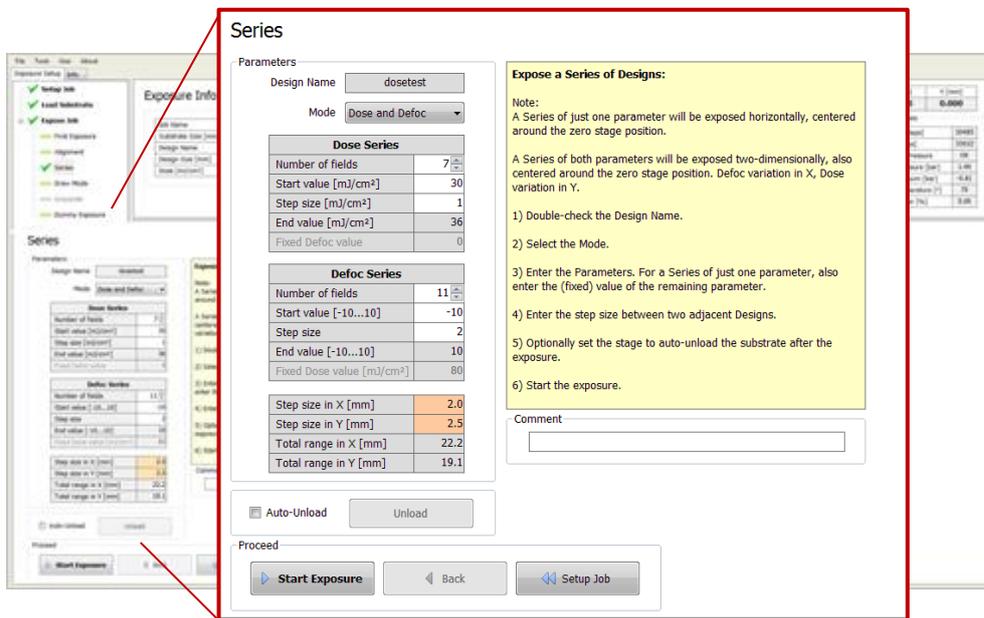
#### Switch to Manual Mode

For every single alignment cross it is possible to switch between the two modes for the alignment procedure. ManualAlignment is the manual mode for cross detection and is provided for exceptional cases in which the automatic detection might not work properly. Switch to ManualAlignment and follow the instructions given in *6.8 Setup Overlay Alignment*.

## 7.2.2 UNSATISFYING EXPOSURE RESULTS

Sometimes exposure results can be unsatisfying for the needs of distinctive applications. The MLA150 offers a way of optimizing the exposure outcomes. It is possible to adjust the Defoc value or the Dose value. The following section gives details about how to work with these two values in order to improve exposure results.

The Exposure Wizard offers a series exposure mode (6.8.3 Series Exposure Procedure). This utility can be used to optimize exposure results by adjusting the defocus value (Defoc) and/or the energy value (Dose). In order to find the best ratio between these two parameters a series of exposures with different values can be executed.



For more information see the relevant chapter on series exposures.

### 7.2.3 SET ALIGNMENT ANGLE

It is possible to set an angle manually with only one alignment mark. This might be required if the substrate is too small for more than one alignment mark.

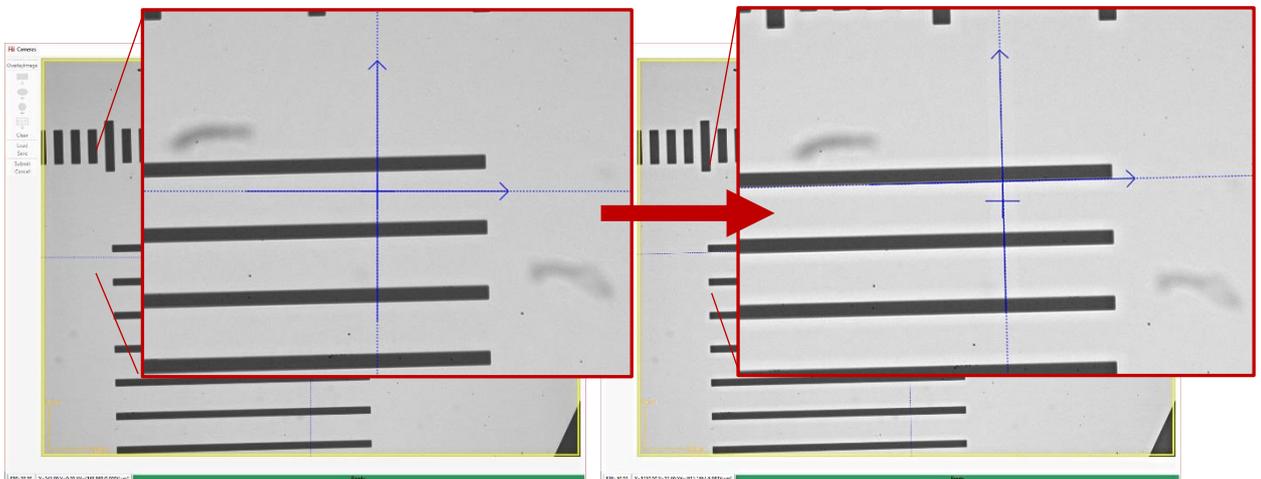
In the **Cross Measurement** frame in the **Alignment panel** click **Set Angle**.

1. In the camera window, you see a green crosshair. Drag the crosshair to the measurement area.
2. Now you see blue coordinate axes that can be moved or rotated.

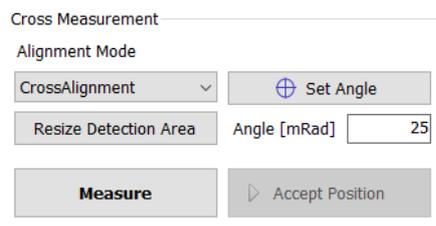
To move the axes pixelwise, use the arrow keys.

To rotate the axes by 1 mRad, use Ctrl+ up/down arrow keys.

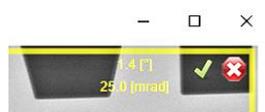
To rotate the axes by 0.1 mRad, use alt+ up/down arrow keys.



- i** It is also possible to just enter the required angle manually into the **Angle (mRad)** field in the **Cross Measurement** frame.



3. To submit the angle, click the green tick mark in the upper right corner of the camera image.



- ✓ The angle is now calculated and can be used for exposures. The rotation angle is shown in the **Angle (mRad)** field. It is possible to select or deselect the angle for individual exposures.

## 7.2.4 ADJUST BEAM OFFSET

(see Advanced functions for Staff user group)

## 7.3 Back side alignment

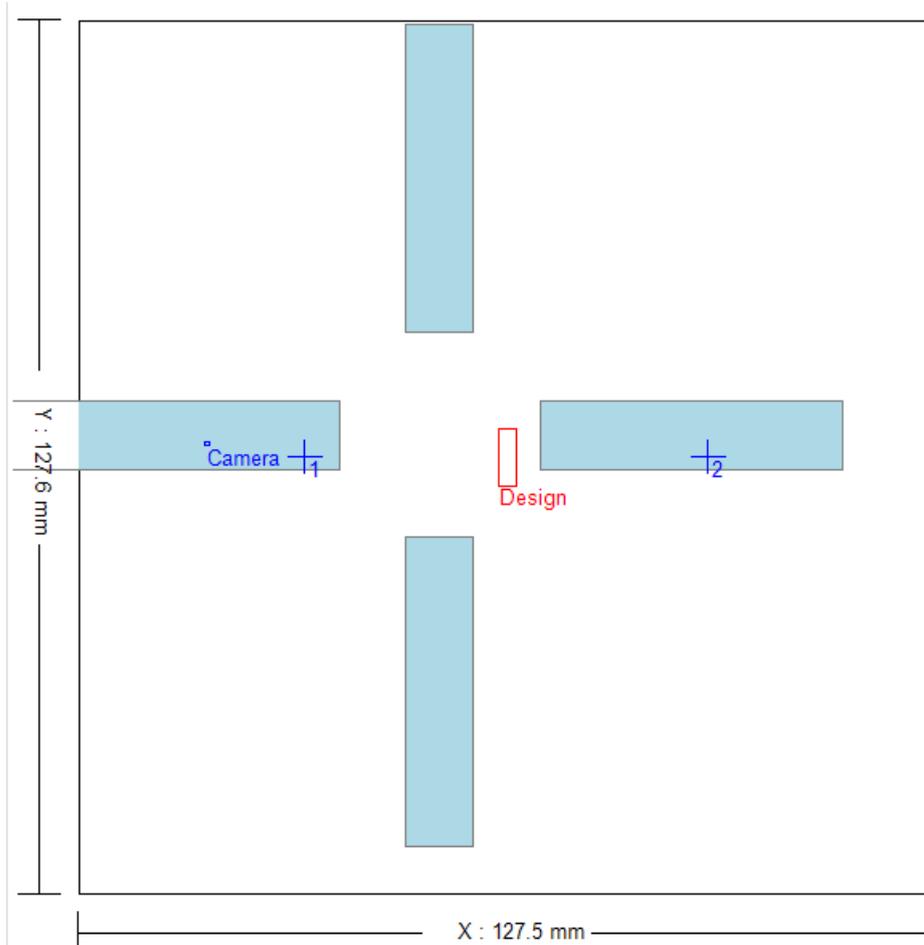
The following section informs about the back side alignment (BSA) preparation and exposure procedure.

### 7.3.1 OVERVIEW OF BSA MARKER ZONES

The MLA150 comes with a multi-purpose chuck ready to expose both large and small substrates.

For BSA, the chuck provides four designated openings. Markers located in these areas are detected by the BSA camera system and used for alignment.

Each opening is 10 mm wide and 46 mm or 76 mm long. The first edge is located 12 mm or 14.5 mm from the center of the chuck. The BSA markers can be positioned anywhere in this area.

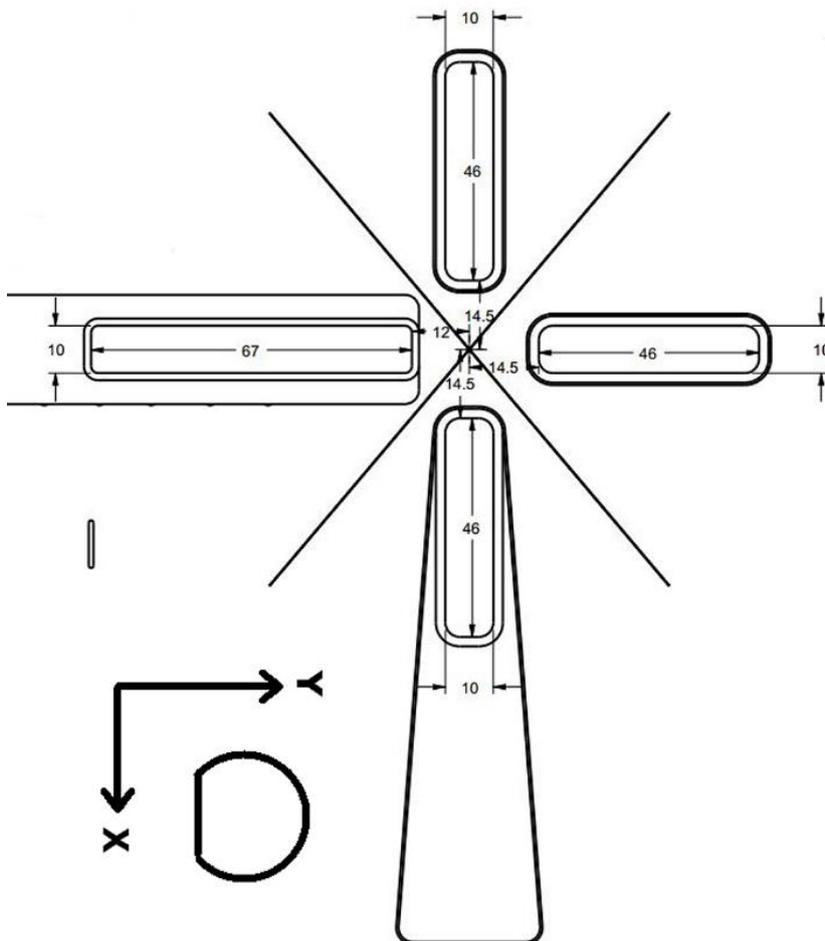


**Figure 21: Back side alignment field of view**

For easy handling and good resolution, Heidelberg Instruments recommends to position the markers on the main axis and about 10 mm from the edge of the wafer. Proposal for marker: cross of size 300  $\mu\text{m}$  x 300  $\mu\text{m}$ , Linewidth 20  $\mu\text{m}$ .

Proposal for marker positions (x/y):

Wafer size	Marker 1 [mm]	Marker 2 [mm]	Marker 3 [mm]	Marker 4 [mm]
2 inch	+20 / 0	-20 / 0	0 / +20	0 / -20
3 inch	+28 / 0	-28 / 0	0 / +28	0 / -28
4 inch	+40 / 0	-40 / 0	0 / +40	0 / -40
5 inch	+44 / 0	-44 / 0	0 / +44	0 / -44



**Window**

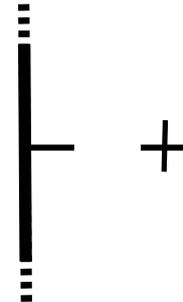
Figure 22: BSA marker zones overview

### 7.3.2 BSA EXPOSURE PREPARATION

Back side alignment is mainly done in two steps. Follow the instructions on the BSA exposure steps

**Step 1:**

1. Expose the pattern on side A with the BSA markers.
2. Position your markers inside the BSA marker zones. The recommended cross linewidth is 20  $\mu\text{m}$ .
3. Prepare a strategy to find the markers during alignment:
  - a larger cross is easier to find
  - add small marks for orientation
4. When using the mirror function during design import, remember to click **update to all layers**.

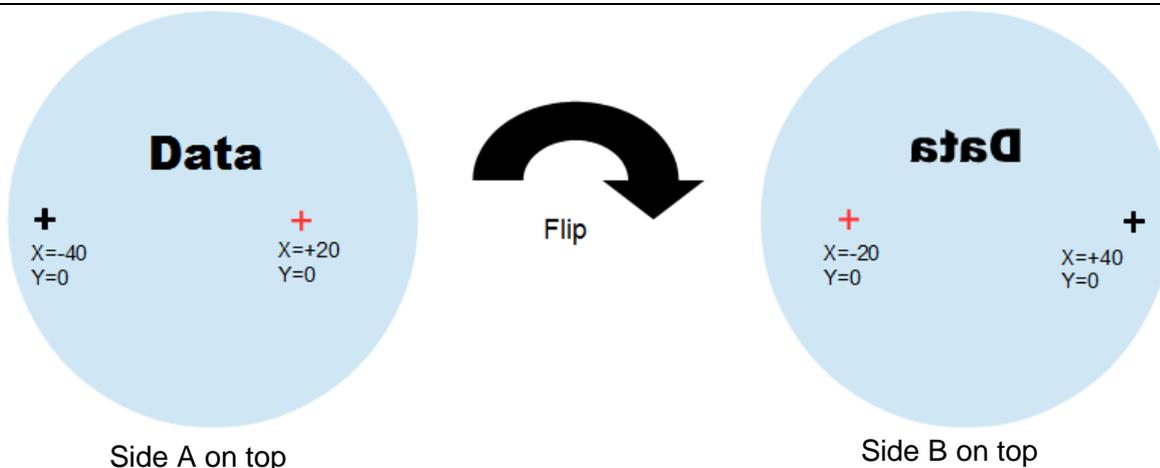


**Step 2:**

1. After processing of side A, position wafer on chuck with side B on top
2. Remove the inlets of the required BSA holes in the chuck.
3. Define your default marker positions in the MLA150 menu. Select **Backside Camera** for this measurement.
4. Execute alignment exposure as usual.

**The coordinate system of the MLA does not change during back side alignment. Reference is always the top of the wafer. This means:**

The x-coordinate changes prefix on the back side of the wafer. A marker that was written to position +x is now at position -x. When you use the control panel for movements, the camera picture will move to the left when you click the "to the right" button.



**Figure 23: Orientation on wafer for BSA**

# 8 Advanced functions for Staff user group

There are three user log-in types available. Standard, Staff and Service:

**Standard** is the default user type when opening the menu. No password is required, and the user can set up and execute exposure procedures.

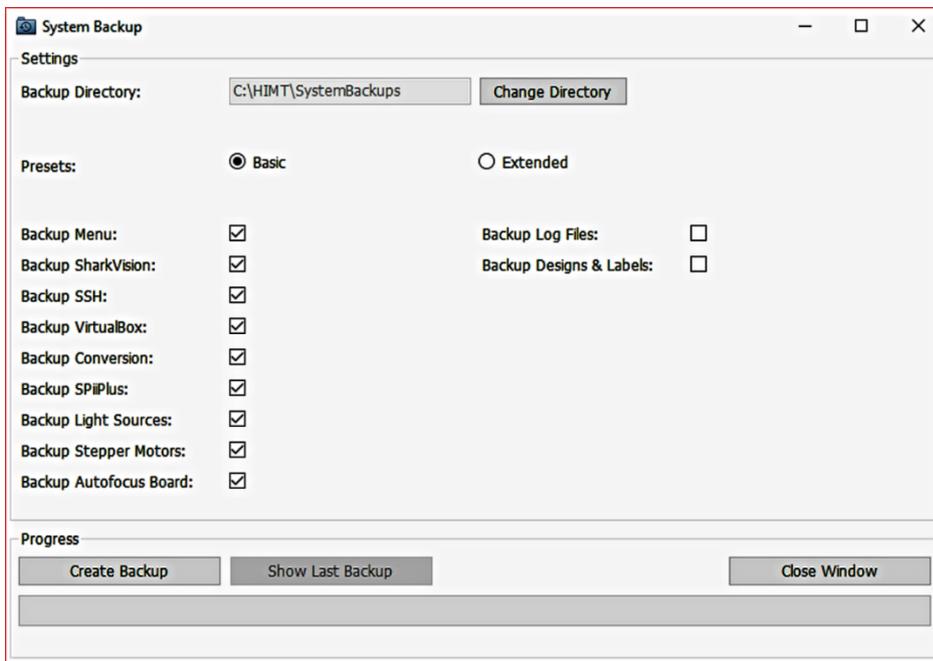
**Staff** requires the entering of a password. This user type has the permission to create resist templates, job templates, substrate templates and edit a few settings.

**Service** user type is for HIMT service staff only.

This subchapter is about wizard functions that are only available and editable for members of the Staff user group.

## 8.1 Staff: Backup settings

The Staff user type can back up the system files. Select **Tools**→**Backup** from the menu bar.



**Note:** We recommend copying the backup files from the User PC to an external storage media to prevent data loss in the unlikely case of a total failure of the User PC.

- Changing the directory for saving the backup files

- Selecting and deselecting items to be saved. The preset items are divided into two parts: Basic and Extended. Extended presets require high memory capacity.

### Basic

<b>Backup Menu</b>	Saves the MLA150 Menu software, including binaries and configuration files
<b>Backup Sharkvision</b>	Saves files of the camera software including binaries and configuration files.
<b>Backup SSH</b>	Saves the user credentials the menu uses to communicate with the Linux in the VirtualBox.
<b>Backup Virtualbox</b>	Save some configuration files of the VirtualBox
<b>Backup Conversion.</b>	Saves the conversion software binaries of Linux, including binaries and configuration files
<b>Backup SPiiPlus.</b>	Saves the motion controller configuration and program buffers
<b>Backup Light Source</b>	Saves laser specific configuration data.
<b>Backup Stepper Motors</b>	Saves the current positions of all stepper motors.
<b>Backup Autofocus Board</b>	Saves some configuration files of the Autofocus Card.

### Extended

<b>Backup Log Files</b>	Save all log files created by the MLA150 software, including Common Log and Job Exposure Logs
<b>Backup Designs&amp;Labels</b>	Saves design files located in C:\HIMT\Designs. <b>Note:</b> May require a large amount of disk space, depending on the design size.

## 8.2 Staff: Laser measurement

Staff users can measure the laser power to compare it with the value measured during the most recent laser calibration procedure.

**Prerequisite:** Before starting the measurement procedure complete the following actions:

- switch off the vacuum
- make sure that the stage is empty

1. Select **Tools**→**Laser Measurement** from the menu bar. A **Laser Measurement** panel opens.

2. In the **Laser Measurement** panel select the wave length of the **Light Source** from the drop-down list.
3. Select the number of **Measurements** as well as the **Interval** between the measurements. It is common to set more than one measurement in order to calculate the average value.

**Laser Measurement**

<p>Settings</p> <p>Light Source [nm] <input type="text" value="375"/></p> <p>Box Size X [Pixel] <input type="text" value="12"/></p> <p>Box Size Y [Pixel] <input type="text" value="12"/></p> <p>Measurements <input type="text" value="5"/></p> <p>Interval [s] <input type="text" value="1"/></p> <p>Duration [hh:mm:ss] <input type="text" value="00:00:05"/></p> <p>Results</p> <p>Average Result [%] <input type="text"/></p> <p>Average Result <input type="text"/></p>	<p>Use this wizard to measure the intensity of the machine's LED or laser.</p> <p><b>VERIFY THAT THERE IS NO SUBSTRATE ON THE STAGE AND DISABLE THE CHUCK VACUUM!</b></p> <p>Adjust the settings and press 'Continue' to start the measurement.</p>	<p>Intensity Measurements:</p> <div style="border: 1px solid gray; height: 100px;"></div>
---	---	---

Proceed

4. Click **Continue**. The system prepares for measurement start.
5. Check the settings and click **Measure**.
- ✓ The system executes the measurement. The results of the individual measurement can be viewed in a list next to the yellow info box. The average results are shown in the **Results** frame of the **Laser Measurement** panel.

- To finish the action, click **Finish**. To repeat the measurement click **Restart** and start a new measurement.

### Laser Measurement

<p>Settings</p> <p>Light Source [nm] <input type="text" value="375"/></p> <p>Box Size X [Pixel] <input type="text" value="12"/></p> <p>Box Size Y [Pixel] <input type="text" value="12"/></p> <p>Measurements <input type="text" value="5"/></p> <p>Interval [s] <input type="text" value="1"/></p> <p>Duration [hh:mm:ss] <input type="text" value="00:00:05"/></p> <p>Results</p> <p>Average Result [%] <input type="text" value="100.0"/></p> <p>Average Result <input type="text" value="3045.47"/></p>	<p><b>Measure the intensity:</b></p> <p>Reference value: 3045</p> <p>The intensity measurement has finished.</p> <p><b>Click 'Finish' to exit the intensity measurement wizard or 'Restart' to perform a new measurement.</b></p>	<p>Intensity Measurements:</p> <ul style="list-style-type: none"><li>1: 100.0%, 3045.85</li><li>2: 100.0%, 3045.45</li><li>3: 100.0%, 3045.40</li><li>4: 100.0%, 3045.10</li><li>5: 100.0%, 3045.55</li></ul>
---	---	---

Proceed

<input type="button" value="▶ Finish"/>	<input type="button" value="▶▶ Restart"/>	<input type="button" value="✕ Cancel"/>
---	---	---

## 8.3 Staff: Setting up substrate templates

For users of the Staff group it is possible to set up substrate templates to be used for exposure procedures.

In the Setup Job panel, double-click into the field of the **Substrate Template** column.

Substrate

Substrate Template	Shape	Size X	Size Y	Diameter	Thickness

✓ The Load Substrate panel opens where you select the substrate for the exposure from.

**Load Substrate**

Characteristics

Name	Wefer 4 inch
Shape	Round
Small [5...9 mm]	Standard
Size X [mm]	0.0
Size Y [mm]	0.0
Diameter [mm]	101.6
Thickness [mm]	0.5
Detection Offset [mm]	0.00
Marks	
Autofocus Mode	Optical
Check with Overview Camera	<input type="checkbox"/>
Skip Find Plate Center	<input type="checkbox"/>
Focus Offset X / Y [mm]	0.0 0.0
Focus Offset Z [mm]	0.000
Max Velocity [mm/s]	0.0
Regular Use AF Air Pressure	<input type="checkbox"/>

Edit

New Cancel Edit Save Delete

Load

Search

Name	Date	Time	Shape	Size Type	Size x	Size y	Diameter	Thickness	Focus Offset	Detection Offset	Marks	Autofocus Mode	Check with Overview Cam.	Skip Find Plate Center	Regular Use AF Air
_Automatic rectangular	6/23/2016	3:41:38 PM	Rectangular	Undefined	0	0	0	0	0	0	Undefined	Default	False	False	True
_Automatic round	7/7/2016	9:45:50 AM	Round	Undefined	0	0	0	0	0	0	Undefined	Default	False	False	True
Large	6/22/2016	7:10:42 PM	Rectangular	Standard	180	180	0	0	0	0	Undefined	Default	False	False	True
Mask 2_5 inch	3/28/2019	9:10:36 AM	Rectangular	Standard	63.5	63.5	0	1.3	0	-0.35	Undefined	Optical	False	False	True
Mask 2_5 inch pneumatic	3/28/2019	9:07:33 AM	Rectangular	Standard	62.8	62.8	0	1.3	0	-0.35	Undefined	Pneumatic	False	False	True
Mask 4 inch	3/28/2019	9:06:54 AM	Rectangular	Standard	100.4	100.4	0	2	0	0	Undefined	Optical	False	False	True
Mask 4 inch pneumatic	3/29/2019	2:36:56 PM	Rectangular	Standard	100.4	100.4	0	2	0	0	Undefined	Pneumatic	False	False	True
Mask 5 inch	3/28/2019	9:18:06 AM	Rectangular	Standard	127	127	0	3	0	-0.5	Undefined	Optical	False	False	True
Mask 5 inch pneumatic	3/28/2019	9:07:55 AM	Rectangular	Standard	125.5	125.5	0	3	0	-0.5	Undefined	Pneumatic	False	False	True
Mask 6 inch	3/28/2019	9:08:01 AM	Rectangular	Standard	152.4	152.4	0	2	0	0	Undefined	Optical	False	False	True
Mask 9 inch	3/28/2019	9:08:07 AM	Rectangular	Extended	228.6	228.6	0	0	0	0	Undefined	Optical	False	False	True
Small	3/28/2019	9:08:13 AM	Rectangular	Small	5	5	0	0	0	0	Undefined	Optical	False	False	True
Wafer 2 inch	3/28/2019	9:08:24 AM	Round	Standard	0	0	50.8	0.28	0	0	Undefined	Optical	False	False	True
Wafer 3 inch	3/28/2019	9:08:31 AM	Round	Standard	0	0	76.2	0.38	0	0	Undefined	Optical	False	False	True
Wafer 4 inch	3/28/2019	9:08:43 AM	Round	Standard	0	0	101.6	0.52	0	0	Undefined	Optical	False	False	True
Wafer 5 inch	3/28/2019	9:08:47 AM	Round	Standard	0	0	125	0.625	0	0	Undefined	Optical	False	False	True
Wafer 6 inch	3/28/2019	9:08:59 AM	Round	Standard	0	0	150	0	0	-1.8	Undefined	Optical	False	False	True
Wafer 8 inch	3/28/2019	9:09:03 AM	Round	Standard	0	0	200	0	0	0	Undefined	Optical	False	False	True

### 8.3.1 STAFF: BASIC FUNCTIONS OF THE LOAD SUBSTRATE PANEL

#### Load Substrate

Characteristics

Name	Mask 2_5 inch
Shape	Rectangular
Small [5...9 mm]	Standard
Size X [mm]	62,8
Size Y [mm]	62,8
Diameter [mm]	0,0
Thickness [mm]	1,3
Detection Offset [mm]	-0,35
Marks	

Advanced Parameters

Autofocus Mode	Default
Check with Overview Camera	<input type="checkbox"/>
Skip Find Plate Center	<input type="checkbox"/>
Focus Offset X / Y [mm]	0,0 0,0
Focus Offset Z [mm]	0,000
Max Velocity [mm/s]	0,0
Regular Use AF Air Pressure	<input checked="" type="checkbox"/>

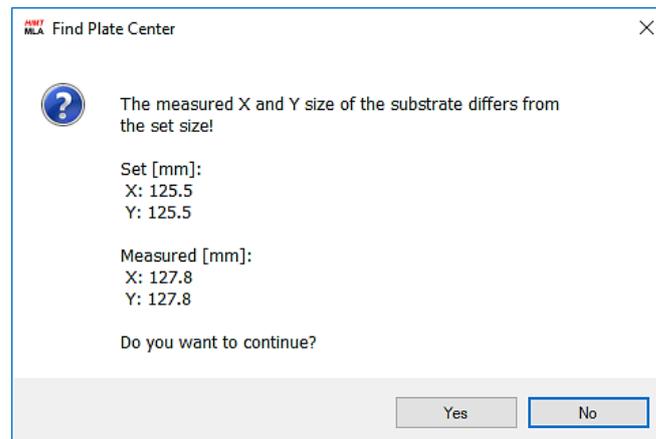
Edit

New Edit Save Delete

Comment

<b>Characteristics frame</b>	
<b>Name</b>	Enter a name for the substrate template.
<b>Shape</b>	Select if it is a Wafer or a rectangular substrate.
<b>Small</b>	There are three categories of size: small (5-9 mm), standard (10-180 mm) and Extended (181-230 mm). The category is set automatically when the size of the substrate is entered the respective fields.
<b>Size X</b>	Enter the size in X direction.
<b>Size Y</b>	Enter the size in Y direction.
<b>Diameter</b>	Enter the diameter of the wafer.
<b>Thickness</b>	Enter a value for the height of the wafer.
<b>Detection Offset</b>	Due to a machine offset the size of the substrate entered might differ from the size measured by the system during the loading process.

1. To set up a new substrate, click **New** in the **Edit** frame.
2. Fill in the fields in the table.
3. Save the substrate template.
- ✓ A new template is set up that can be used by any user group now.
4. Start a loading procedure and select the new template in the Substrate frame.
5. Load the substrate.
- ✓ During the loading procedure, the system measures the size of the substrate. After the procedure is finished, a dialog box informs about the size detected and the possible deviation to the size set in the table.

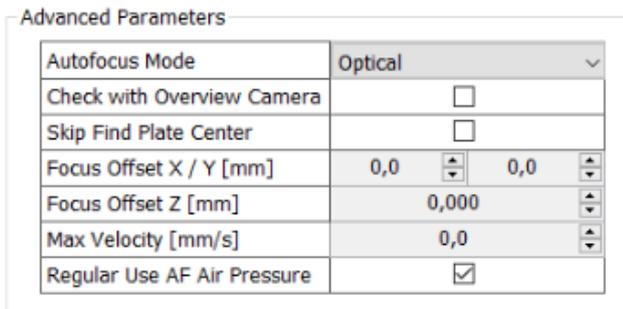


Decide if you want to continue or not. If you decide to stop the procedure because of the deviation, go back to the **Load Substrate** panel and adjust the detection offset (see next subchapter).

**Note:** It is possible to continue with the deviation but keep the deviation in mind.

### 8.3.2 STAFF: ADVANCED FUNCTIONS OF THE LOAD SUBSTRATE PANEL

**Note:** All of these options, except the Autofocus Mode, demand a high level of knowledge and experience. Before using one or all these functions it is recommended to contact the local Heidelberg Instruments service office for discussing the options with respect to the current application.



**Autofocus Mode** This option is for selecting the autofocus mode from the drop-down list. Here, two options are available: optical and pneumatic.

**Check with Overview Camera** Activate this checkbox to check the substrate with the overview camera before focusing (same procedure as loading small substrates).

**Skip Find Plate Center** **NOTICE:** **Increased risk of nozzle crash**  
Without executing the find plate center procedure a stable focus throughout the entire surface cannot be guaranteed which increases the risk of a nozzle crash.

When activating this checkbox, the find plate center procedure is skipped. Activating this option is not recommended due to the risk of nozzle crashing and should only be considered for special applications after having contacted Heidelberg Instruments service office.

**Focus Offset X/Y [mm]** **NOTICE:** **Increased risk of nozzle crash**  
When using the focus offset function keep in mind that the risk of nozzle crash is increased. Check the offset twice before execution.

An offset for focusing can be set here in x- and y-direction.

**Focus Offset Z [mm]** **NOTICE:** **Increased risk of nozzle crash**  
When using the focus offset function keep in mind that the risk of nozzle crash is

increased. Check the offset twice before execution.

An offset in z-direction can be set here. This option is intended for special applications and should only be used after consulting Heidelberg Instruments Service department.

---

**Max. Velocity**  
**[mm/s]**

The travel velocity of the stage can be reduced here. Some applications might demand lower travel velocities.

---

**Regular Use AF**  
**Air Pressure**

Some applications demand a switch-off of the air pressure in the nozzle. To switch off the air pressure, uncheck the checkbox.

---

## 8.4 Staff: Adjusting Detection Offset

---

Due to a possible machine offset, the size measured by the system may differ from the size given by the manufacturer. If the measurement result during the loading procedure shows such a deviation via a message box, it is possible to adjust the detection offset. Once adjusted, the offset is saved in the substrate template and valid for the jobs in which the template is used.

1. Note down or keep in mind the values given in the issued message that informs about the deviation.
2. In the **Load Substrate** panel, go to the **Detection Offset** field (see previous subchapter) and exchange the value to the deviation given by the measurement.

**Example:**

Size by manufacturer: X= 125.5, Y=125.5

Size measured by the system: X= 127.8, Y=127.8

Detection Offset: -2.3 mm

- ✓ The system works with the offset, when loading this template. The template can be used by all user groups.

## 8.5 Staff: Functions of the Load Resist panel

For members of the Staff login, it is possible to set up new resists or change existing ones.

Layer

Layer	Laser	Design	Mode	Size X [mm]	Size Y [mm]	Expose Crosses	Align Crosses	Resist
FirstExposure	375	HIMT_MLA1000_Q	Quality	3.000	10.960			AZ1500

In the Layer frame of the Setup Job panel the Resist column is optional for usual exposures. By clicking into the value field, the system forwards the user to the Load Resist panel in which resists can be setup, changed and saved.

**Load Resist**

**Characteristics**

Name	SU8_150
Resist	SU8
Thickness [µm]	150.0
Wavelength [nm]	375
Dose [mJ/cm²]	5000
Defoc	10

Set individual Doses for each Bitlayer

**Exposure Parameters**

Speedup Factor	1.000
Defoc Range	Large
Focus Depth	Large

**Process Parameters**

Developer	Large
Concentration	pure
Develop Time [s]	2700

**Edit**

New Cancel Edit Save Delete

**Comment**

postbake 5min@65C 5min ramp to 90C 25min@90C

**Load**      Show  all  next 100

Name	Date	Time	Resist Name	Thickness	Wavelength	Dose	Defoc	Speed Up Factor	Defoc Range	Focus Dep
AR4400_28um	2/15/2017	2:34:06 PM	AR4400	28	Both	250	0	1	Standard	Standard
AZ1500	2/15/2017	2:34:08 PM	AZ1500	0.5	Both	80	0	1	Standard	Standard
AZ1505_0.5um	2/15/2017	2:34:08 PM	AZ1505	0.5	405	80	0	1	Standard	Standard
AZ1512HS_1.4um	2/15/2017	2:34:08 PM	AZ1512HS	1.4	405	66	0	1	Standard	Standard
AZ1518_1.8um	2/15/2017	2:34:08 PM	AZ1518	1.8	375	14	0	1	Standard	Standard
AZ15nXT_10um	2/15/2017	2:34:08 PM	AZ12nXT	10	375	400	0	1	Standard	Standard
AZ15nXT_12um	2/15/2017	2:34:08 PM	AZ15nXT	12	Both	550	0	1	Standard	Standard
AZ433_4.3um	2/15/2017	2:34:08 PM	AZ4533	4.3	405	155	0	1	Standard	Standard
AZ4562_20um	2/15/2017	2:34:08 PM	AZ4562	20	Both	550	0	1	Standard	Standard
AZ4562_62.um	2/15/2017	2:34:08 PM	AZ4562	6.2	405	200	0	1	Standard	Standard
AZ4620_40um	2/15/2017	2:34:08 PM	AZ4620	40	Both	1500	0	1	Standard	Standard
AZ5214E_1um	2/15/2017	2:34:08 PM	AZ5214E	1	Both	350	0	1	Standard	Standard
AZ6632_6um	2/15/2017	2:34:08 PM	AZ6632	6	405	300	0	1	Standard	Standard
AZ9221_4um	2/15/2017	2:34:08 PM	AZ9221	4	405	190	0	1	Standard	Standard
AZ9260_6um	2/15/2017	2:34:08 PM	AZ9260	6	405	500	0	1	Standard	Standard
AZ9260_7um_on_Texture	2/15/2017	2:34:10 PM	AZ9260	7	Both	400	0	1	Standard	Standard
AZECI3007_1um	2/15/2017	2:34:10 PM	AZ ECI3007	1	405	160	0	1	Standard	Standard
AZECI3027_2um	2/15/2017	2:34:10 PM	AZ ECI3027	2	405	320	0	1	Standard	Standard
AZECI3027_5um	2/15/2017	2:34:10 PM	AZ ECI3027	5	405	800	0	1	Standard	Standard
AZnLOF2070	2/15/2017	2:34:10 PM	AZnLOF2070	7	375	400	0	1	Standard	Standard
AZF4000_20um	2/15/2017	2:34:10 PM	AZ P4000	20	405	1800	0	1	Standard	Standard
AZF4000_5um	2/15/2017	2:34:10 PM	AZ P4000	5	405	500	0	1	Standard	Standard
FocusDepth_20	12/14/2018	6:34:58 PM	SU8	150	375	500	0	1	Standard	Extrolant
GS_Test	4/26/2018	9:47:36 AM	AZ4562	10	Both	1000	0	1	Standard	Standard
HD_4100_6um	2/15/2017	2:34:10 PM	HD-4100	6	375	400	0	1	Standard	Standard
HD_4100_8um	2/15/2017	2:34:10 PM	HD-4100	8	375	400	0	1	Standard	Standard
IX845_1.2um	2/15/2017	2:34:10 PM	IX845	1.2	375	140	0	1	Standard	Standard
Job0138_LD	4/8/2019	3:31:52 PM	Automatic Resist	0	Both	80	0	1	Standard	Standard

On the left side, parameters are grouped in frames. On the right side of the panel, a button bar in the top and a list of existing resists below are available (more information about functions in the loading panel in 4.5 Loading panels).

The following parameters are grouped in the frames on the left:

Characteristics frame	
<b>Name</b>	Enter a name for the new resist
<b>Resist</b>	Enter the type of resist in use.
<b>Thickness</b>	Enter the thickness of the resist.
<b>Wavelength</b>	Select if the resist template is appropriate for both laser types available or just for one.
<b>Dose</b>	Enter the dose to be exposed with.
Grayscale Optimization	
(see section for resists with optimized grayscale exposure)	

**Exposure Parameters**

**Speedup Factor** At Speedup Factor higher than 1, the stage moves faster. This saves exposure time when using high doses but reduces the exposure quality. If exposure quality is crucial, leave the factor at 1.

---

**Defoc Range** Choose between Standard and Extended (see 8.5.3 Staff: Exposing with extended defocus range).

---

**Focus depth** Function for increasing the focus depth with the purpose of gaining steeper edges (see 8.5.4 Staff: Focusing with increased focus depth).

---

**Process Parameters**

Enter the information for processing. It might be helpful to the users.

### 8.5.1 STAFF: SETTING UP NEW RESIST TEMPLATES

1. In the **Edit** frame, click **New** to set up a new resist template name it.
  2. Enter the dose and other information into the table in the **Characteristics** frame.
 

**Note:** To find the appropriate total dose it is recommended to execute a series exposure beforehand!
  3. If it is no resist for exposing grayscale designs, leave out this frame and uncheck the checkbox if required. For grayscale resists, refer to the respective section.
  4. In the Exposure Parameters frame set the Speed Factor if required and select the Defoc Range (Large or Standard).
  5. If all parameters are set, click **Save** to save the resist.
- ✓ The resist template is now listed and can be loaded by standard users for the exposure job.

### 8.5.2 STAFF: SETTING UP RESIST TEMPLATES FOR GRAYSCALE OPTIMIZATION (OPTIONAL)

The system supports grayscale exposures with design of the formats BMP or Grayscale DXF. Loading the design is the same procedure as in the **First Exposure** panel for binary designs, unless grayscale dose optimization is required for a satisfactory exposure result.

For grayscale exposures it is possible to change and save the dose values for the individual gray values for future exposures. This is done in the **Load Resist** panel. The information is saved in the resist templates.

1. In the **Edit** frame, click **New** to set up a new resist template for grayscale optimization and name it.
2. Enter the dose and other information into the table in the **Characteristics** frame.

**Note:** To find the appropriate total dose it is recommended to execute a series exposure beforehand!

3. In the **Grayscale Optimization** frame, activate the checkbox **Set individual Doses for each Bitlayer**.
- ✓ A table opens showing the gray value bits in the top row. Here, it is possible to assign new dose values to the grayscale value.

Grayvalue Optimization

Set individual Doses for each Bitlayer

Bit	128	64	32	16	8	4	2	1
%	50.2	25.1	12.5	6.3	3.1	1.6	0.8	0.5
Dose	502.0	251.0	125.5	62.7	31.4	15.7	7.8	5.0
Total Dose	1001.1		Reset Percentages					

4. Distribute the dose to the individual grayscale values by changing the values in the Dose row or by changing the percentage in the %-row.
  5. After having distributed the total dose to the grayscale values, save the resist with **Save**.
  6. Enter other missing information in the frames, if required.
- ✓ The resist template is now listed and can be loaded by standard users for the exposure job

### 8.5.3 STAFF: EXPOSING WITH EXTENDED DEFOCUS RANGE

- i This function serves for extending the exposure defocus range and is not be confused with the Large Camera Defoc function for extending the camera defocus range during alignment (see 7.1). These are two different functions.

Staff users can set up new resist templates and extend the exposure defocus range e. g., for exposing deeper into the resist. The range changes from the standard range (10 to 10) to the extended range of -25 to 25. Follow the steps below to set up a resist for exposure jobs with an extended defocus range:

1. In the **Edit** button bar, click **New**.
1. Enter a name and select the values required in the **Characteristics** frame.
2. In the **Exposure Parameters** frame, select **Large** from the drop-down list.

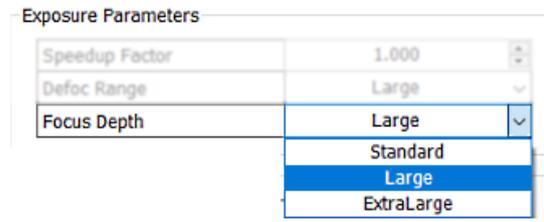
3. To confirm the setup of the new resist template, click **Save**.
- ✓ The resist template is now listed and can be loaded by standard users for the exposure job.

Name	Date	Time	Resist Name	Thickness	Wavelength	Dose	Smear Distance	Defoc Range	Developer	Concentration	Develop Time	Comment
AZ1500	7/22/2016	10:41:50 AM	AZ1500	0.5	375	80	1	Standard	AZ3518	1:4	60	HMT standard
AZ1500_Large	7/4/2017	4:39:41 PM	AZ1500	0.5	375	80	1	Large	AZ3518	1:4	60	HMT standard for testing the large defoc range
Smear_1	4/24/2017	4:41:26 PM	AZ1500	0.5	Both	510	1	Standard	AZ3518	1:4	60	HMT standard

**Note:** These steps are also applicable for just setting up a new resist template without extended defocusing values. In this case, select **Standard** from the **Defoc Range** drop-down list (see 8.5.1 *Staff: Setting up new resist templates* for more information on resist template set up.).

### 8.5.4 STAFF: FOCUSING WITH INCREASED FOCUS DEPTH

In the **Load Resist** panel the **Exposure Parameters** frame contains a function for increasing the focus depth with the purpose of gaining steeper edges. **The increased focus depth is accompanied by a reduction of the resolution and a rise of exposure time.**



1. Open the drop-down list.
2. From the items, select the focus depth necessary for the application the resist template is created for.
  - **Standard:** focus depth does not differ from the standard depth.
  - **Large:** focus depth is increased, edges become steeper (the dose is adjusted automatically).
  - **Extra Large:** maximum focus depth, edges become steep (the dose is adjusted automatically).
3. Check the parameters and save the settings in the resist template.

**Note:** Consider that the exposure time increases to a small extent with larger focus depth.

## 8.6 Staff: Calibrate beam offset

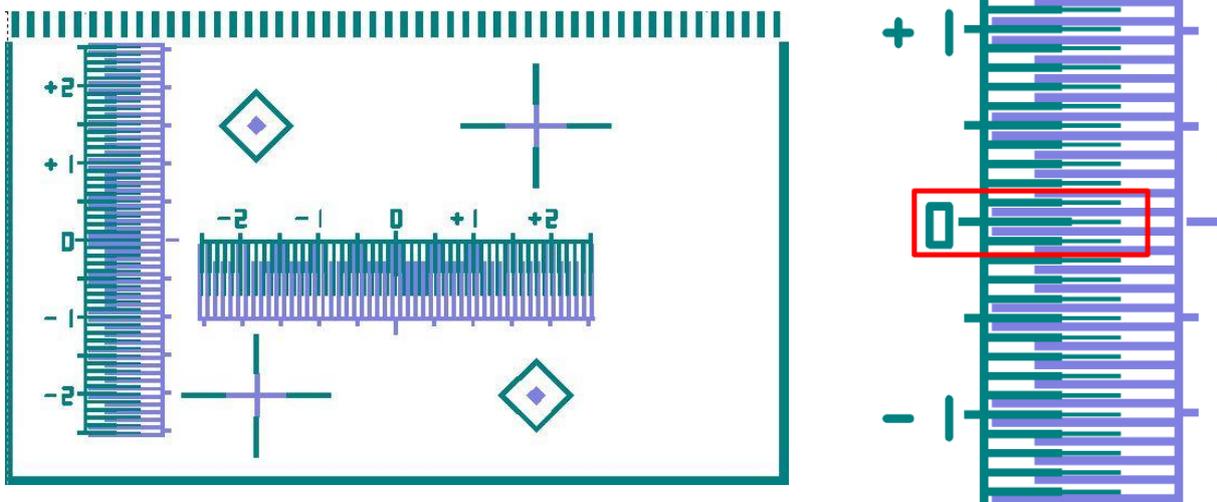
**Note:** This function is for seasonal drifts. In general, these are below 1  $\mu\text{m}$ ! When observing huge offsets, please double-check your alignment marks and positions. When in doubt, contact HIMT service.

It is possible to re-calibrate the beam offset. This is important for exposures done relative to existing structures (overlay). Displacements lead to a systematic shift in the overlay. For this reason, determination and calibration of the laser beam is crucial.

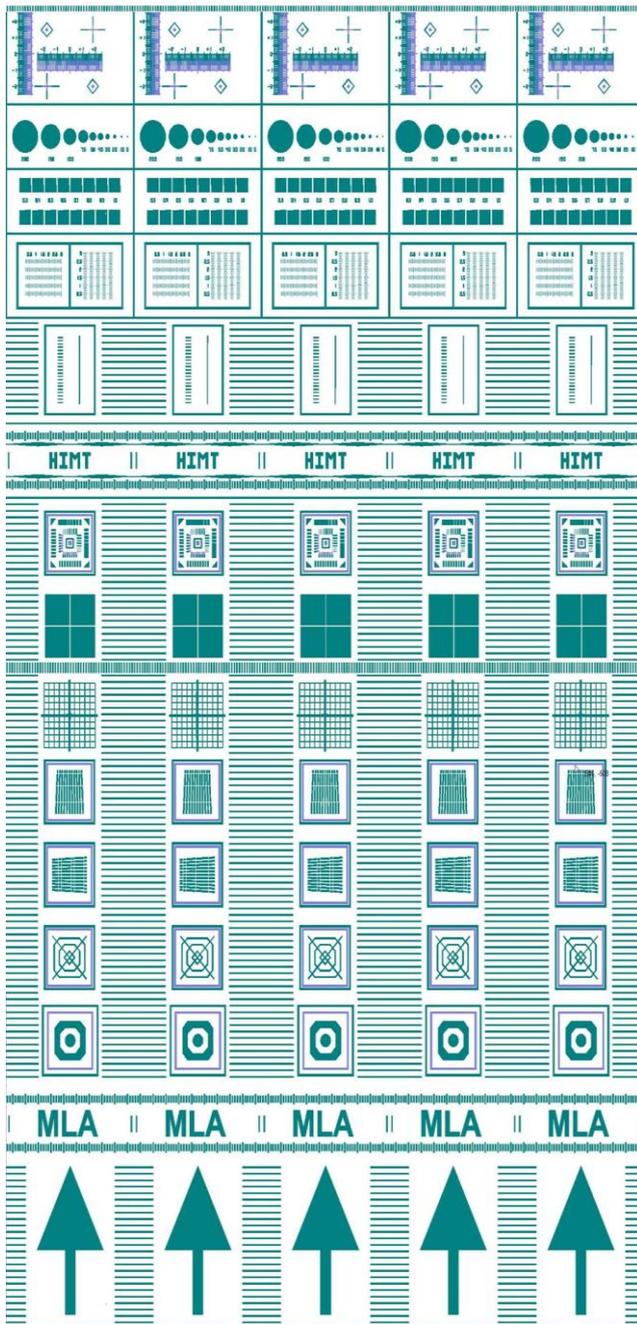
For determination of the offset, two layers are necessary that are brought together by overlay alignment. The pattern used for the factory acceptance test to determine alignment accuracy is ideal for checking the beam offset. It features a Vernier scale from which the user can read off the displacement in both directions (X and Y).

**Note:** Use *HIMT\_BeamOffset1* and *HIMT\_BeamOffset2* from the designs list.

Each layer contains one part of the Vernier scale in each axis. One layer contains the (fixed) ruler and the other one contains the (sliding) secondary scale.



**Figure 24: Vernier scale in test pattern**



**Figure 25: FAT test pattern**

**Execute a beam offset calibration**

1. Execute an overlay exposure following the instructions on executing an overlay exposure.
2. After having exposed the two layers, use the **Inspection** mode to determine the offset. In the **Setup Job** panel choose **Inspection** from the **Exposure Mode** drop-down list.

Setup Job

**Job**

Name	Number	Exposure Mode
Job_0598	598	Inspection

**Substrate**

Substrate Template	Shape	Size X	Size Y	Diameter	Thickness
Mask_2_5 inch	Rectangular	62.8	62.8		1.3

New Job    Restart Job

Load Job    Save Job

1) Job: Load a Job or enter the name for a new Job. Select the Exposure Mode.  
2) Substrate: Choose a Substrate template or shape.

**Proceed**

▶ Load Substrate    ▶▶ Inspection    ◀ Unload Substrate

3. Click **Inspection** in the **Proceed** navigation buttons frame.

4. The **Inspection Mode** panel opens. Here, it is possible to inspect the pattern by moving the stage with the substrate visualization or with the Control Panel.

Inspection Mode

**Inspection Mode:**

Inspect the Substrate by moving the Stage with the Substrate Visualization or with the Stage Control Panel.

---

**Golden Plate Measurement:**

[Click to expand](#)

**Substrate**



Y : 63.7 mm

X : 63.7 mm

**Metrology**

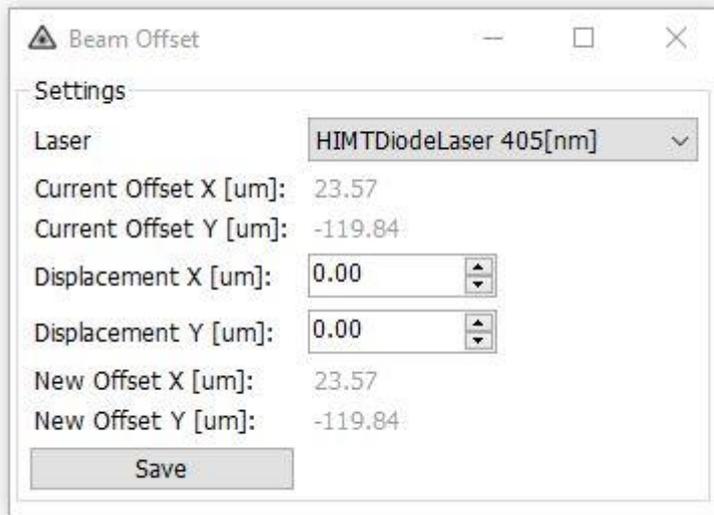
Golden Plate Measurement

**Proceed**

▶ Inspection    ◀ Back    ◀◀ Setup Job

5. After having read off the offset from the Vernier scale, from the menu bar open **Tools** → **Beam Offset**.

6. Enter the value into the respective fields **Displacement X** and **Displacement Y**. The system calculates the absolute beam offset automatically.



7. Click **Save**.

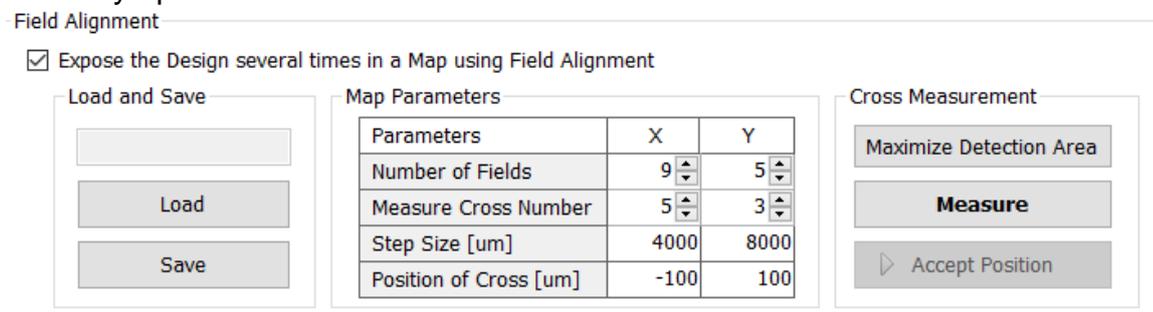
✓ The determined beam offset is now included into system operations.

## 8.7 Staff: Setting up Field Alignment templates

As mentioned above in 6.9 *Expose design*, field alignments can be executed to ensure higher accuracy for special applications.

Staff user group members are allowed to set up and save templates that can be used by **Standard** users.

After having entered all information and before starting the exposure, it is possible to save the content of the table by clicking **Save**. The corresponding folder in the HIMT directory opens. Save the file there.



### Look up the log file for Field Alignment Exposures

Go to *HIMT/LogFiles/Exposure Log*

In the Exposure Log folder is a list with job files. Open the file of your choice and scroll to the end in the document. There is a section containing a summary of parameters of the Field Alignment executed in the job.

## 8.8 Staff: Setting up alignment cross templates

For staff users it is possible to setup templates for alignment settings. Follow the steps below to setup templates to be used for alignment procedures:

When setting up a layer for exposure in the **Setup Job** panel, alignment settings can be made in the Layer frame.

1. In the Layer frame double-click into the **Alignment Settings** field.

Layer

Layer	Laser	Design	Mode	Size X [mm]	Size Y [mm]	Expose Bitmaps	Alignment Settings	Resist	Thickness	Comment	Status
FirstExposure	375	Small_Design	Quality	0.750	2.740						Prepared
Layer2	375	Small_Design	Quality	0.750	2.740						Prepared

2. The **Load Alignment Settings** panel opens, where Standard users select an existing alignment template for exposure.
3. Staff users can setup and save templates in the same panel, but in the left part.

The screenshot shows the 'Load Alignment Settings' dialog box. On the left, there is a sidebar with 'Alignment settings' and 'Edit' buttons. The main area contains a table with columns: Name, Date, Time, X1, Y1, X2, Y2, X3, Y3, X4, Y4, X5, Y5, X6, Y6, X7, Y7, X8, Y8, #Positions, Camera Mode, Camera, Correction, QR, X, Y, Comment. The 'Edit' section is highlighted with a red box.

4. Click **New** in the **Edit** button bar. The table with the cross positions is editable now. In the header cell enter a name for the template.
5. From the drop-down list, select if topside or back side alignment is made using this template.
6. Fill the table cells with coordinates of the cross positions. At least one position must be given.
7. In the **Camera for Alignment frame**, select the camera to be used for finding the alignment crosses. Per default the Low Res camera is selected.

8. In the **Alignment Correction Options** frame, select if Rotation, Scaling or Shearing should be applied. Activate the corresponding checkboxes:
  - **Rotation** [mRad]: Is selected per default. The system includes the rotation of the substrate. Do only deactivate this option if absolutely necessary. It is recommended to keep the checkbox activated.
  - **Scaling X/Y**: The system compares the distance measured during alignment with the distance given by the alignment positions (minimum 3 positions). From the deviation a scaling factor results. Based on this, the alignment design is shrunk or stretched in order to match the previous layer.
  - **Shearing** [mRad]: The system compensates small distortions such as a rectangle that appears more like a parallelogram.
9. Check the data entered and click **Save**. The template is now added to the list and can be loaded by all user groups.

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# 9 Operator maintenance and troubleshooting

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This chapter contains some notes on daily maintenance by the operator as well as some troubleshooting for the most common problems. For more in-depth maintenance and troubleshooting information, refer to the related document *Maintenance Guide*.

## 9.1 Operator maintenance

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MLA systems require some minimal operator maintenance that does not involve opening any covers or protective panels and can be done by any trained operator. These tasks are described below.

### SYSTEM CHECKS

Before operation the following routine maintenance should be performed:

1. Clean the chuck surface with a dry clean wipe. Never use Acetone! If more thorough cleaning is required, use industry-grade ethanol or isopropanol.
2. Verify that the clean room conditions are within the limits given in the *Technical Data* section.
3. Make sure nothing is placed inside the system that obstructs stage movement.
4. Check coolant level and temperature of the stage/laser chiller inside the electronics rack. If the level of coolant is below its minimum mark, add clean, demineralized water. Do NOT use DI water!

### ENVIRONMENTAL ADJUSTMENT

1. Allow room humidity to come within the specified range before using the MLA150.
2. If temperature is out of range, determine how long this condition has prevailed.
3. Adjust room temperature to within the specified temperature range and allow the MLA150 to stabilize.
4. For stabilization of the system, allow an amount of time at least equal to the time the temperature was out of range.

**NOTICE:**

**During exposure, the most accurate results are obtained when the environment remains at a constant temperature and humidity.**

To achieve the optimum accuracy, the substrate requires thermal stabilization before exposure. This might take some time depending on the material, thickness and actual temperature.

The set temperature of the flow box should correspond to the default room temperature to minimize thermal effects.

## **9.2 Troubleshooting**

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This section suggests corrective action for known issues.

### **MOUSE DOES NOT MOVE**

- Switch on the monitor. In certain systems, the mouse is connected to the monitor. If the monitor is switched off or in sleep mode, the mouse is inactive as well.

### **THE MLA150 DOES NOT EXPOSE**

- Verify that the AC power cord is plugged into the wall outlet and that the outlet is receiving power.
- Check whether the laser is switched on and running (see if LED is on).
- Verify that the loading window is completely closed.
- Try rebooting the system.

### **LINES NOT TO SIZE**

- Line thickness problems may have the following causes:
- Poor developing chemicals
- Wrong developing speed
- Wrong resist type or thickness
- Focus or energy setting incorrect
- Out of date resist

### **THE MLA150 STOPS ANYTIME DURING THE EXPOSURE**

- The MLA150 reached an end switch because the imaging area was set incorrectly
- The interferometer head is broken
- The conversion encountered a problem

### **SUBSTRATES COME OUT COMPLETELY CLEAR**

- Laser might be off. Check laser status at LED. If LED is not illuminated, laser is not running.

### **BAD ALIGNMENT ACCURACY**

- Check stability of flow box temperature
- Check vacuum quality, make sure no vibrations are transferred via vacuum
- Check stage vibrations
- Check for drift in position measurement with stage standing still in home position to find if interferometer laser has to be replaced

### SCRATCH MARKS ON WAFER EDGE

- Edge beads are not removed. Remove edge beads with the appropriate method to provide uniform thickness of coating across the wafer.

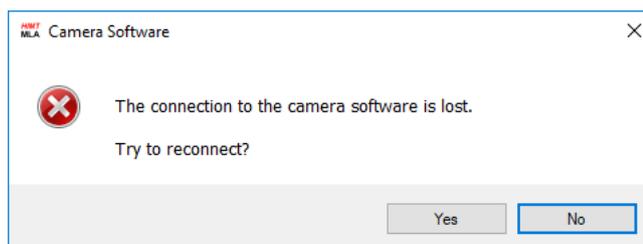
### CAMERA SOFTWARE DOES NOT RESPOND (HANG-UP)

- Use the small window to close the camera software. Then, in the wizard, use a button or perform an action which the camera software is necessary for. A message pops up asking if a reconnection should be tried. Click **Yes** to reconnect the system to the camera software. If you click **No**, the message closes and won't return. It only pops up again, when using the **Refresh** button in the **Hardware Info** section of the wizard.

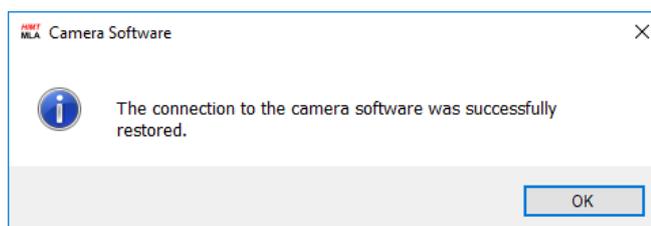
## 9.3 Error messages

### Camera software

If the connection to the camera software gets lost, an error message dialog informs about it.



1. If a reconnection is required, click **Yes**. Otherwise click option **No**.
2. When the reconnection is established, in the wizard use a button or perform an action which the camera software is necessary for.
3. Another message pops up to inform about the status of the camera software.

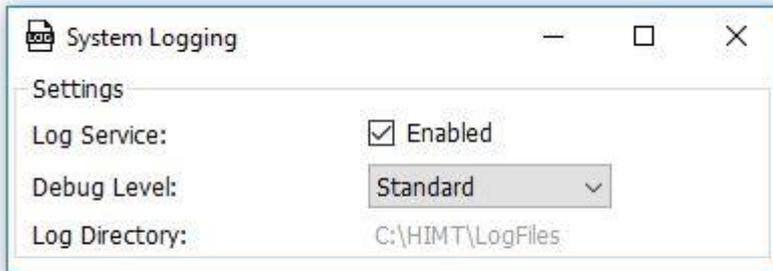


## 9.4 Changing the level of logging

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The scope of logging is set by an HIMT engineer during installation. It can be changed if this is required. Only change anything when asked or if you require this for reasons of memory space. Leave the Log Service activated at any other time.

Inform our service staff before making any changes.



## 9.5 TeamViewer software

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**Note:** Do not update the version that was factory-installed, unless you are requested to do so by HIMT service.

10 On the desktop, you find the icon for the TeamViewer Software. This software enables the service engineer to access the system via remote connection. It might be possible that the service person asks for the system's access data.

4. Start TeamViewer QS by clicking on the shortcut icon on the desktop.
5. Pass on the access information to the service person. Both, ID and password are required.

**Note:** Keep in mind that the password is regenerated during the start of TeamViewer QS and differs from the one displayed during the previous start.

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