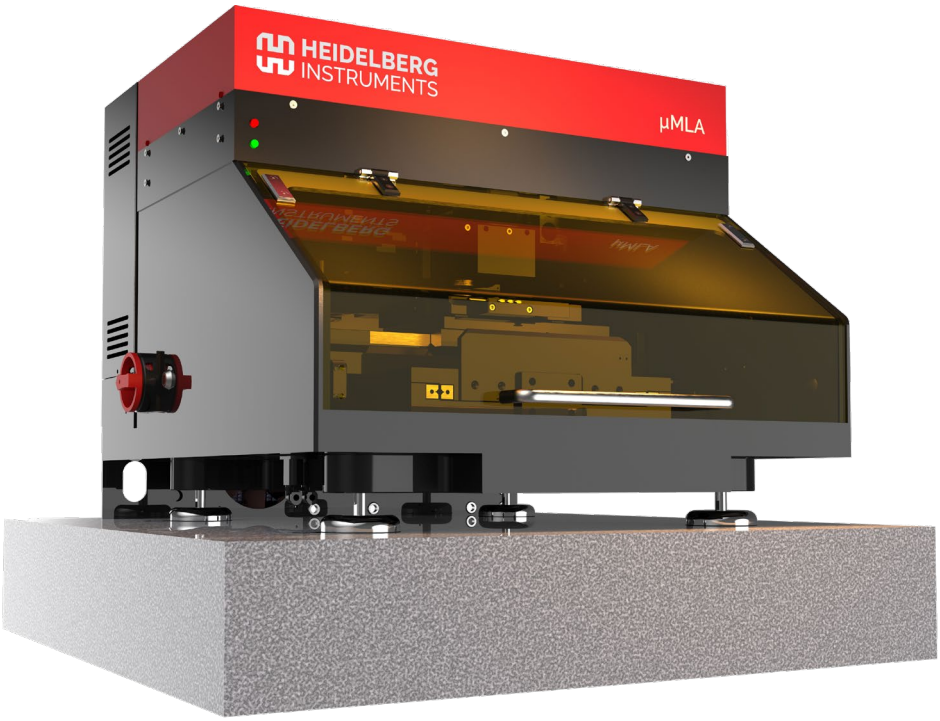
HEIDELBERG INSTRUMENTS

Operator's Guide



µMLA

Disclaimer

This document is only valid for the system configuration stated on this page. If your system has a different configuration, contact Heidelberg Instruments Mikrotechnik GmbH for a document matching your configuration.

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1 Introduction

The µMLA is a high-speed, maskless direct-writing lithography system. Direct writing technology has the advantage of increasing the effective throughput as well as cost savings.

The system is developed to expose substrates with a photoresist coating. The system can process different substrate sizes. The system also provides pattern changes, distortion correction, and other software-driven corrections.

The system is equipped with an integrated ejector, which is connected to the pneumatics system of the machine and which creates the vacuum for properly fixing the substrates. Optionally, an external vacuum pump can be connected if needed.

The system is equipped with one exposure LED. The exposure LED is a 390 nm ultraviolet LED. For more information, see the *Technical Data Sheet*.

The system can be upgraded with an additional exposure laser upon customer request.

The MLA Menu control software implements a graphical user interface. The control software allows to control and monitor the system and to set up and execute the applications.

The system is equipped with a pneumatic autofocus. The pneumatic autofocus uses compressed air to regulate the distance between the write head and the substrate.

The system is equipped with an optical autofocus. The optical autofocus provides superior focus stability and enables the system to expose very small surfaces. The operator can switch between the autofocus modes to meet the individual requirements of the application.

The system is equipped with the basic grayscale exposure mode. The basic grayscale exposure mode enables the system to write complex topographies for micro-optical components or other grayscale applications. The write beam intensity can be modulated in 128 levels to expose thick resists with grayscale layouts. For the definition of the grayscale layouts, the system uses the BMP format and the DXF format.

The system is delivered with an antivibration table. The antivibration table reduces vibrations that can affect the exposure quality. Additionally, the antivibration table serves as user PC table.

1.1 About this guide

Chapter 1: Introduction

Provides general information about this guide and a list of related documents.

Chapter 2: General safety information

Contains important information about safety precautions and recommendations to operate the system safely, properly, and economically.

Chapter 3: System

Contains detailed, illustrated system descriptions and provides an overview of the system components.

Chapter 4: Exposure Wizard

Contains an overview of the exposure wizards of the µMLA control software.

Chapter 5: Turn on/off the system

Contains step-by-step instructions about how to start, stop, and power down the system.

Chapter 6: Set up jobs

Contains step-by-step instructions about how to set up and execute exposure jobs.

Chapter 7: Utilities and Tools

Contains an overview of the utilities and tools of the µMLA control software.

Chapter 8: Advanced functions for staff users

Contains an overview of the advanced functions accessible to the staff user group.

Chapter 9: Troubleshooting

Contains troubleshooting and an overview of important information your local Heidelberg Instruments Mikrotechnik Customer Service Center requires when providing assistance.

Chapter 10: Operator Maintenance

Contains information about maintenance tasks that can be performed by the operator.

The illustrations, photos, and screenshots are exemplary pictures and can deviate from the delivered products.

1.2 Related documentation

The user manual consists of several related parts addressing the system configuration, safe and correct operation, and other important topics. If you did not receive any of the following user manual parts or if you want to order a replacement, contact Heidelberg Instruments Mikrotechnik, Germany.

Pre-installation guide

This guide contains detailed information about the system requirements. Also, this guide provides information about the sizes and weights of the components as well as other information relevant for installing the system.

Safety guide

This guide contains information about potential hazards (health, physical, and environmental) of the system. This guide provides you with the information necessary to safely move in, install, operate, and maintain the system.

Conversion software guide

Manual for the HIMT conversion software used for data preparation and fractioning

Design creation guide

This guide contains general rules, specific restrictions, and best-practice recommendations for creating designs. Also, this guide lists the supported design formats.

Technical datasheet

This sheet contains the system specifications and summarizes the performance and other characteristics of the system. Also, this sheet lists the technical requirements of the system.

2 General safety information

2.1 Intended use

If not stated otherwise in the signed purchase contract, the intended use of Heidelberg Instruments lithography systems is exclusively 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.

Heidelberg Instruments lithography systems are 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.

Usage for other purposes than those stated in this section is prohibited. No liability is assumed by Heidelberg Instruments Mikrotechnik GmbH for damages caused by the usage of the system outside of its stated purpose.

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

- Operation outside the operating conditions stated in the *Technical Datasheet* or 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 those provided by Heidelberg Instruments Mikrotechnik GmbH.
- Operation of the system in a potentially explosive environment or aggressive atmosphere.

2.2 Limitations

This section gives an overview of the limitations that must be considered when working with the system.

2.2.1 SYSTEM BOUNDARIES

This guide refers solely to the lithography system as well as any peripheral components provided by Heidelberg Instruments Mikrotechnik GmbH (e.g., robot handler, heat exchangers, transformers, vacuum pumps).

It explicitly excludes the installations required at the facility to run the machine (e.g., electrical power, compressed air, vacuum, water). Responsibility for the safety of the installations lies within the system owner.

2.2.2 ACCESS RESTRICTIONS

No untrained, under-age or person that has not read and understood the contents of this guide and any other relevant part of the user manual is allowed to operate the system. If instructions are not followed carefully, danger to personal health and damage to equipment can occur.

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

The system may only be used for the lithographic exposures or measurement processes it was manufactured for, as stated in the descriptions of this manual and all related documentation (including purchase documents and acceptance report). Do not use damaged or broken substrates or substrates that may cause stray reflections of the writing beam.

2.3 Notation

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

⚠ DANGER	Indicates a hazardous situation that, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a hazardous situation that, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.
NOTICE	Used to address practices not related to personal injury.

Additional terminology conventions used in this manual are:

NOTE

Gives advice or hints to help the user to find the best solutions for the task at hand.

Also, in some parts of this user manual, general information is given using special symbols as wildcards. These wildcards stand for entries that depend on the specific application. The wildcards used in this manual are:

<....>	The text between the angular brackets denotes which information is expected here. The brackets are part of the wildcard and do not occur in the final text.
$	Each of these symbols stands for a single text character.
#	Each of these symbols stands for a single digit.

The definitions *left* and *right* refer to the front of the machine.

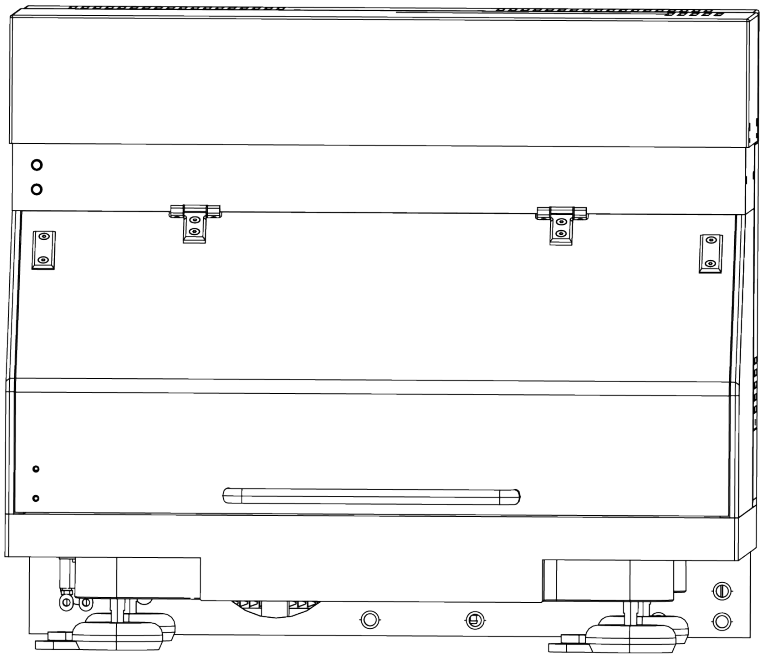


Fig. 1: Orientation sketch

2.4 Precautions and safety

To reduce the risk of serious injury to yourself and others, read and understand the safety instructions before installing, commissioning, operating, or maintaining the system.

Make sure that everyone reads the safety instructions before working with or on the system. Also, consider the risks that may be present as a result of individual conditions.

The system is designed to allow safe access to all areas where access is required during regular operation. Technical protective measures are implemented with protective devices, such as covers and interlocks. To minimize the residual risks, all lasers, LEDs, associated optics, and moving parts are enclosed within housings to protect operators from exposure to laser radiation, LED radiation, and dangerous movement or voltages. During exposures or stage movement, the cover lid can be opened. Opening the cover lid stops the laser or LED emission and prevents any stage movement.

⚠ DANGER

Risk of severe injuries when opening housings or covers

There is a risk of severe injuries from various sources if protective housings or covers are opened during operation.

Do not open any housings or covers that can only be opened by using tools.

2.4.1 LED SAFETY

The µMLA uses LEDs of class 2 (according to DIN EN-62471-2) as exposure light sources. Unprotected exposure to the unmodified beam of these LEDs is dangerous for the eye. Even scattered light can be dangerous. Therefore, the exposure optics of the system are enclosed in a separate interlocked housing.

While the housing is closed, no LED light is emitted or accessible outside of the system, and the system has a safety classification corresponding to class 1.

The specific LED classes involved in the safety classification of the µMLA are:

Operation state	Description of system state	Relevant LED class*	Required precautions
• Job running, • Idle time	System housing and optics covers closed	**1**	None
• Loading • Unloading • Operator maintenance • Service	Cover lid open, exposure beam blocked by shutter, optics cover box closed **Service:** Housing panels and optics box panels might have to be opened, exposure beam accessible.	**2**	Avoid exposure of the eyes

Tab. 1: Systems LED safety classification and required precautions in specific operation states

* This table only denotes the LED safety class that corresponds to the machine safety classification in the respective state and determines the required precautions. It does not represent a classification of the system as the underlying norms apply only to lasers.

For more information about the LEDs utilized in your system, see the *Technical Datasheet*.

2.4.2 ELECTRICAL SAFETY

The system is equipped with a 3-pin, 1-phase IEC-C14 connector (230 V). The current rating of the machine is up to 10 A.

If the local power connectors differ, an appropriate adapter cable can be attached. If required, a transformer may be used to supply the machine with the correct phase voltage.

⚠ DANGER

Electrical shock!

Fatal electrical shock and/or severe burns can be caused by the system power supply voltage, any power supply to peripheral components, or the internal 230V power supplies.

- Do not use the equipment if cables or plugs have been damaged.
- Only plug the µMLA and its components into approved outlets with the correct ground.
- Ensure that both 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. Do not use household extension cords for any component of the µMLA.
- Do not remove any covers of the system apart from those explicitly stated in this manual. Open covers can make lethal voltages accessible.
- Only Heidelberg Instruments service engineers should perform any tasks that include the removal of such a cover while the system is connected to power.

2.4.3 OTHER SAFETY RISKS DURING OPERATION

⚠ WARNING

Medical implant failure due to magnetic and electromagnetic fields!

The functioning of medical implants (e.g. pacemakers) and other sensitive equipment may be disturbed by the fields of the stage's magnet rails if coming close to them.

Tell bearers of medical implants to keep a minimum distance of 0.3m (12") from the magnets at all times.

⚠ WARNING

Injuries / dangers (poisoning, flammability) by coolant additives!

Depending on the cooling fluid selected by the customer, additional safety risks may apply.

Before deciding on a coolant or doing any refilling, refer to the manufacturer manuals and the coolant / additives safety data sheets for further information.

2.4.4 INTERLOCK AND SERVICE MODE

To protect the operator from hazards by laser light, LED light, or stage movement, an interlock circuit prevents stage movement and access to the exposure beams while the cover lid is open. The cover lid can be opened at any time. Opening the cover lid stops laser emission, LED emission, and prevents any stage movement.

The interlock can be overridden only by a Heidelberg Instruments Mikrotechnik service engineer. In this state, the system has to be considered unsafe and the safety measures described in the *Safety Guide* for servicing periods have to be followed.

2.4.5 EMERGENCY SHUT-OFF

NOTICE

Emergency shut-off can damage the system.

The emergency shut-off can cause damage to electrical circuits and other critical components because power is interrupted without an orderly shutdown.

Only use the emergency shut-off in the event of emergency or danger. To turn off the machine normally, put the machine to standby mode. For maintenance and servicing, orderly shut down the system.

In the event of emergency or danger, unplug the power cable or turn the main switch to the OFF position. Then, turn the interlock key switch 90° counterclockwise. The interlock key switch stops LED emissions even if the interlock circuit is not interrupted.

The main switch and the interlock key switch are located on the left side of the machine.

By turning the main switch to the OFF position or unplugging the power cable, the machine is completely shut down.

By turning the interlock key switch, LED emissions are stopped even if the machine is accidentally turned on again.

2.5 Safety labels

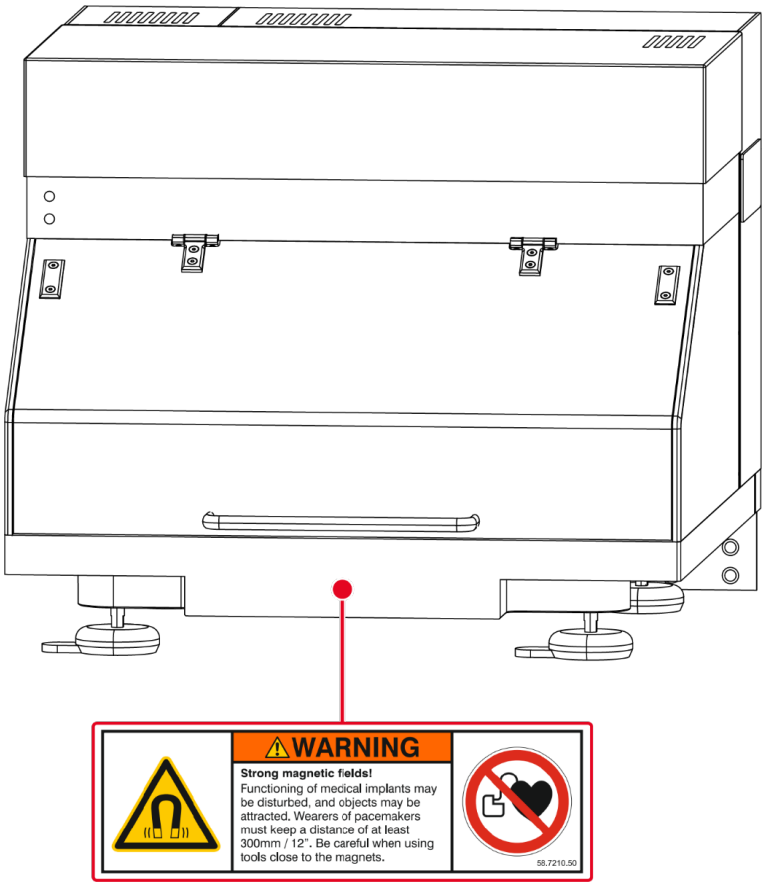


Fig. 2: Safety labels at the front of the machine

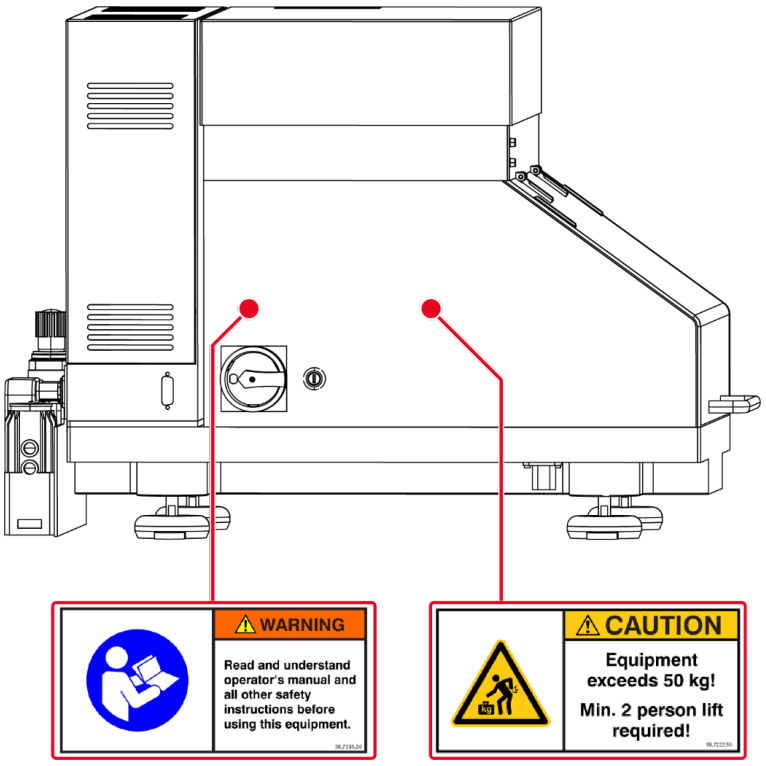


Fig. 3: Safety labels at the left side of the machine

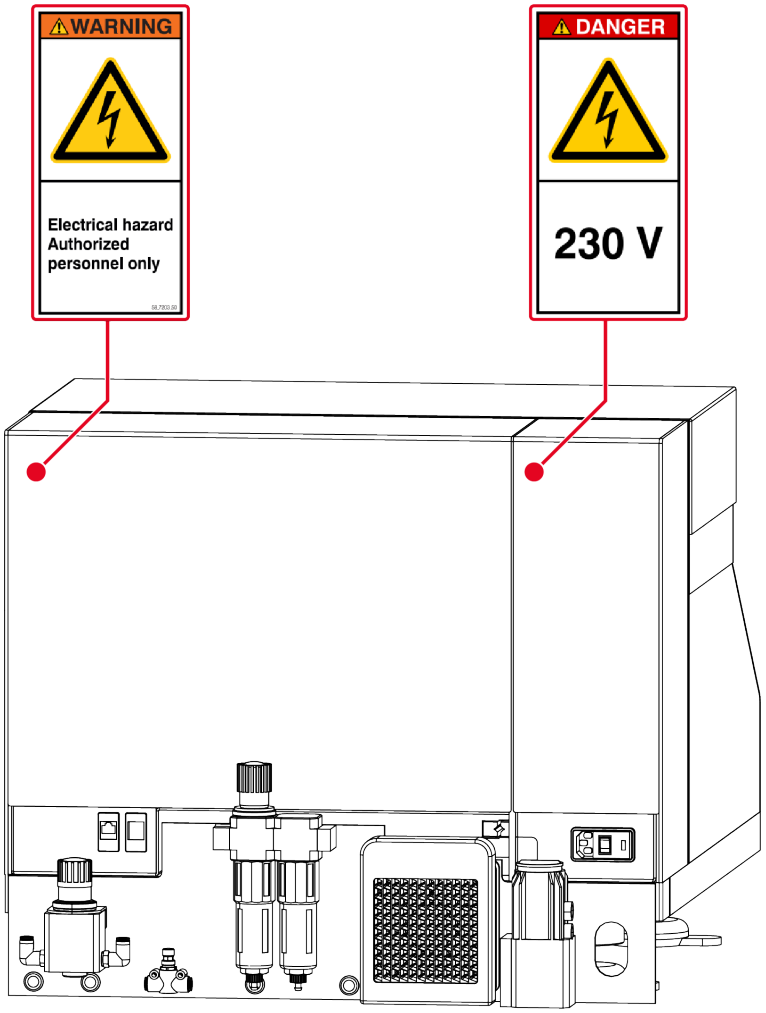


Fig. 4: Safety labels at the rear of the machine

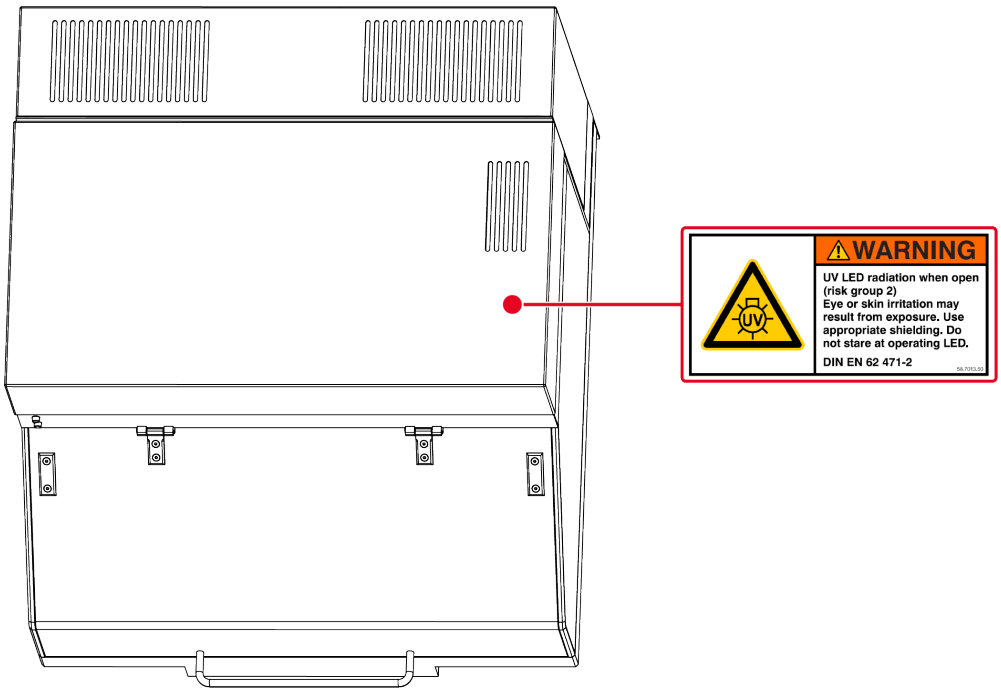


Fig. 5: Safety labels at the top of the machine

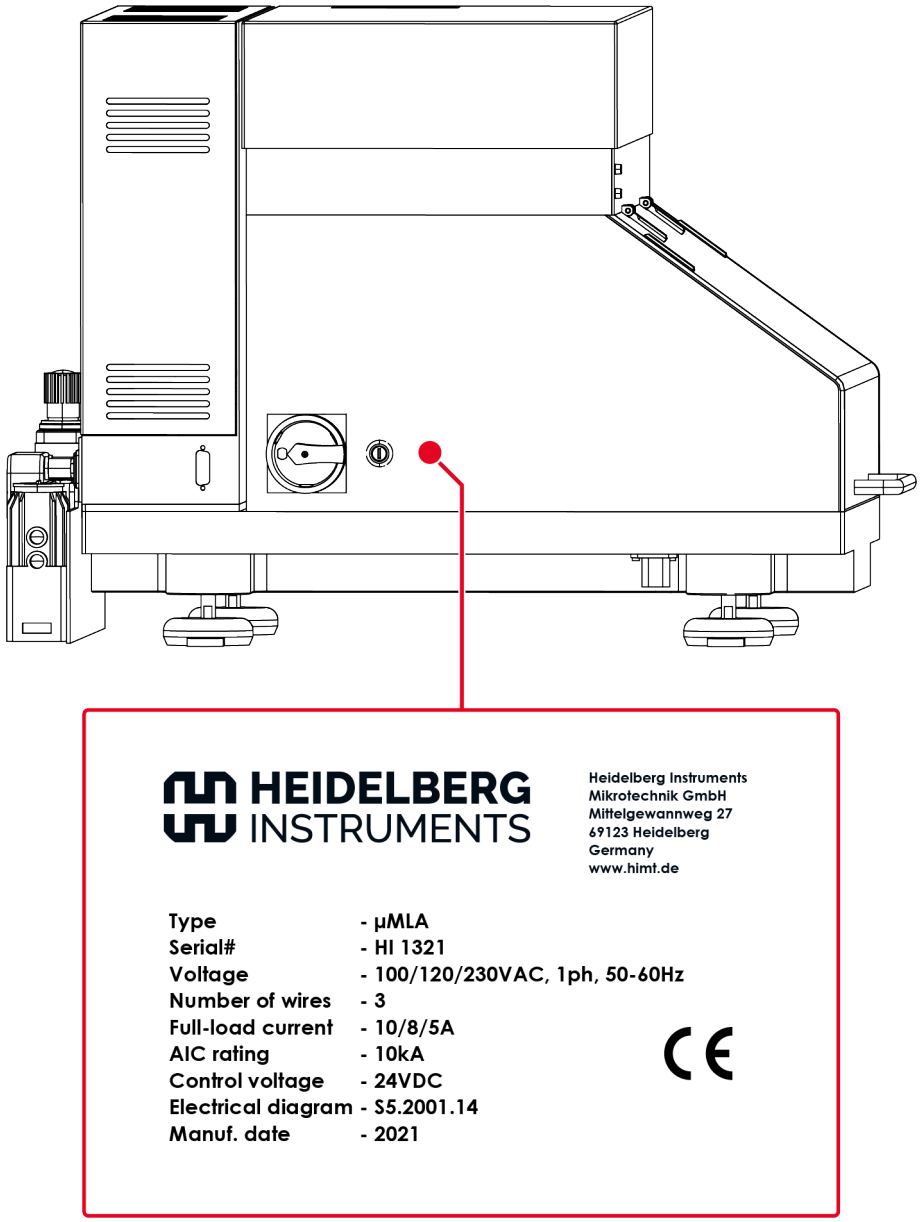


Fig. 6: Type plate at the left side of the machine

3 System

The system consists of the following system components:

- The main unit, which consists of the base, stage, and optics system.
- The machine control inside the machine.
- The electronics inside the machine.

3.1 Front

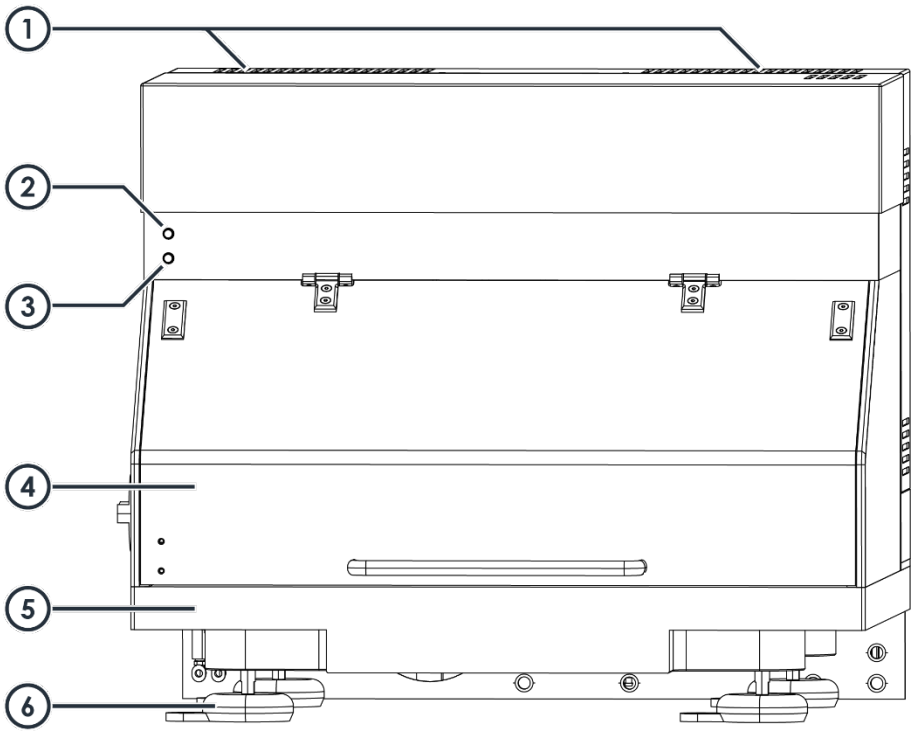


Fig. 7: Front of the machine

1	Ventilation grilles	**4**	Cover lid with safety interlock circuit
2	Power LED	**5**	Base system plate
3	Interlock Circuit LED	**6**	Height-adjustable feet

At the front of the machine, you find the cover lid with the interlock circuit, the Interlock Circuit LED, and the Power LED. The Interlock Circuit LED indicates if the interlock circuit is interrupted. The Power LED indicates if the machine is supplied with power.

The cover lid is not locked while the stage moves, or during the exposure process. If you open the cover lid during the exposure process, the interlock circuit stops laser emissions and prevents stage movement.

3.2 Rear

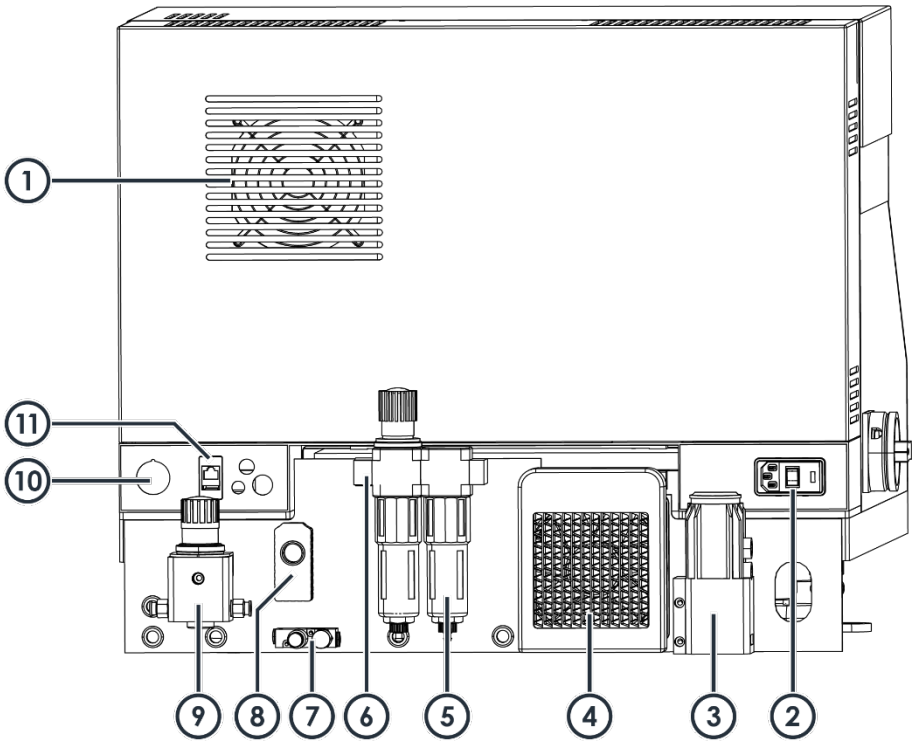


Fig. 8: Rear of the machine

1	Ventilation grille	**7**	Ejector pressure regulator
2	Power supply switch	**8**	Ejector
3	Coolant reservoir	**9**	Manometer for autofocus
4	LED heat exchanger	**10**	USB Network connectors
5	Compressed air regulator	**11**	LAN Network connector
6	Compressed air inlet		

At the bottom right of the machine, you find the power supply switch and the main unit power connector with the fuse.

Next to the power supply switch, you find the coolant reservoir for the exposure LED. You need to refill the coolant every half year.

Next to the coolant reservoir, you find the heat exchanger of the exposure LED coolant circuit.

At the bottom center of the machine, you find the compressed air regulator for the chuck vacuum and the pneumatic autofocus. The compressed air regulator is equipped with a particle filter and a manometer.

At the bottom left of the machine, you find the ejector. The ejector uses compressed air to create the chuck vacuum.

Below the ejector, you find the ejector pressure regulator for the chuck vacuum. You can adjust the strength of the chuck vacuum with the pressure regulator.

In the bottom right corner of the machine, you find the manometer for the compressed air of the autofocus.

Above the manometer for the compressed air of the autofocus, you find the network connector for LAN and the high-resolution camera.

Next to the network connectors for LAN and the high-resolution camera, you find the USB network connector for the DMD, the overview camera, and the lens.

3.3 Left

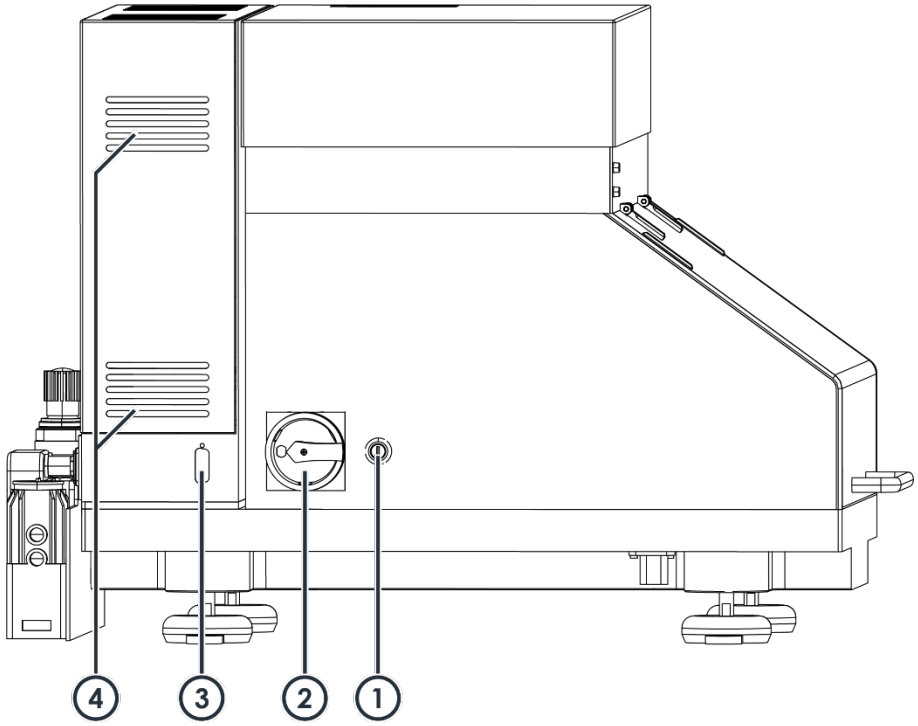


Fig. 9: Left side of the machine

1	Interlock key switch	**3**	Interlock circuit override
2	Main switch	**4**	Ventilation grilles

On the left side of the machine, you find the main switch and the interlock key switch. With the interlock key switch, you can stop laser emissions even if the interlock circuit is not interrupted. The interlock key switch only stops laser emissions but does not prevent stage movement.

Next to the main switch, you find the interlock circuit override. Heidelberg Instruments Mikrotechnik service engineers can use the interlock circuit override to override the stage interlock.

3.4 Interior

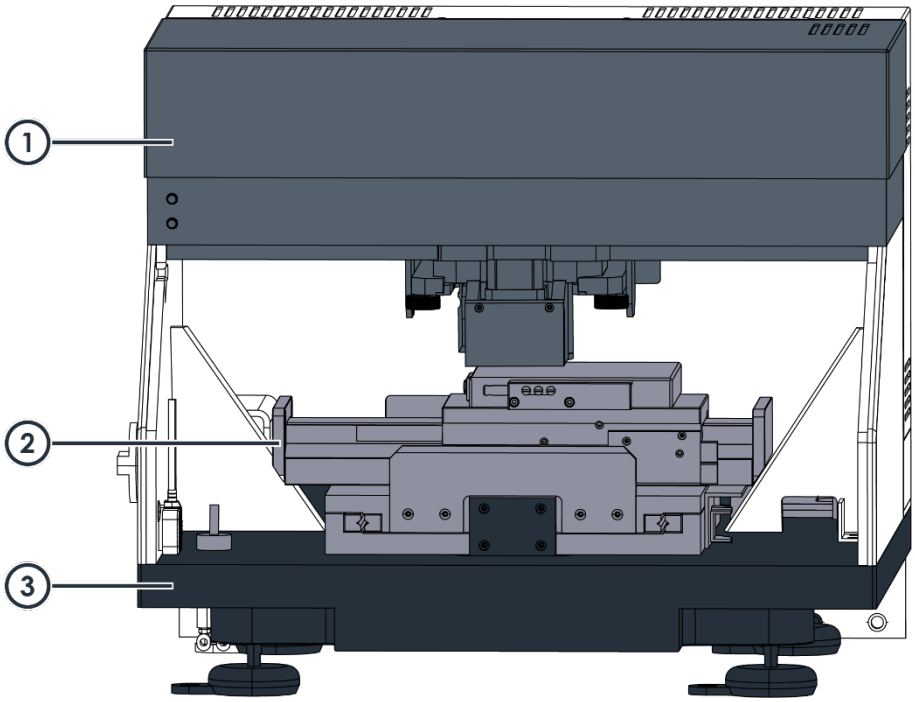


Fig. 10: Interior of the machine

1	Optics system	**3**	Base system
2	Stage system		

Inside the machine housing, you find the main unit.

The main unit consists of the following components:

- Base system
- Stage system
- Optics system

3.4.1 BASE SYSTEM

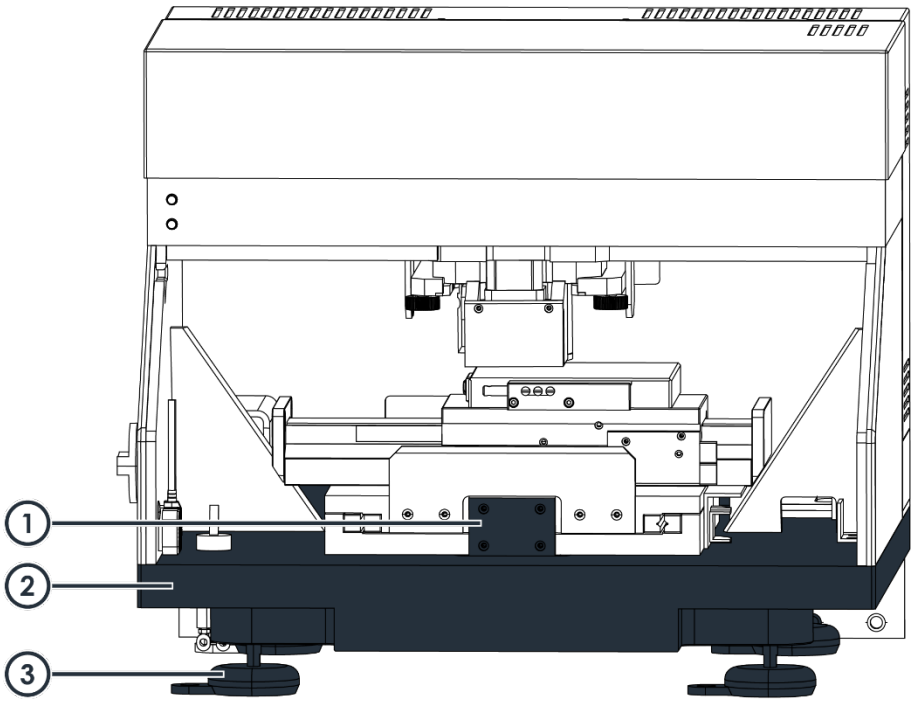


Fig. 11: Interior of the machine – Base system

1	Transportation lock	**3**	Height-adjustable feet
2	Main unit plate		

The base system consists of the main unit plate which is mounted on 4 height-adjustable feet. The main unit plate is precision polished to provide uniform properties for the stage. Damages to these surfaces may degrade the patterning quality.

At the front of the main unit plate, you find the transportation lock that you use to secure the stage when transporting the machine.

3.4.2 STAGE SYSTEM

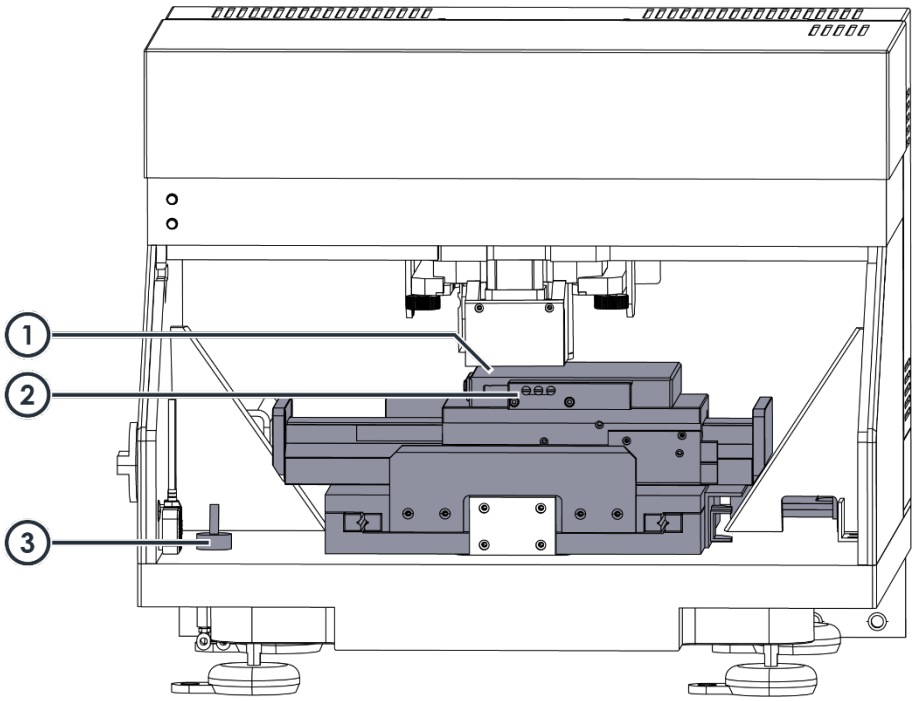


Fig. 12: Interior of the machine – Stage system

1	Chuck	**3**	Vacuum switch
2	Vacuum zone selection screws		

The stage system is mounted on the main unit plate and is equipped with linear motors in both axes. They provide smooth and constant movement with low positioning errors. Air bearings support the movement in y-direction whereas the x-axis is equipped with roller bearings.

On the stage, a chuck is fixed. The chuck has vacuum openings to create a vacuum that holds the substrate in place tightly.

At the front of the stage, you find the vacuum zone selection screws. With the vacuum zone selection screws, you control which zones of the chuck vacuum are active.

In the front left corner of the main unit plate, you find the switch that you use to switch on the chuck vacuum.

The stage coordinate system is rotated by 90° clockwise (+90°). On the stage, the x-axis directs from the back to the front and the y-axis directs from the left to the right.

Fig. 13: Stage coordinate system

The rotation is relevant when you load substrates. Also, the rotation is relevant when you navigate via the camera image in the control software. In the camera image, the x-axis directs from the left to the right and the y-axis directs from the bottom to the top.

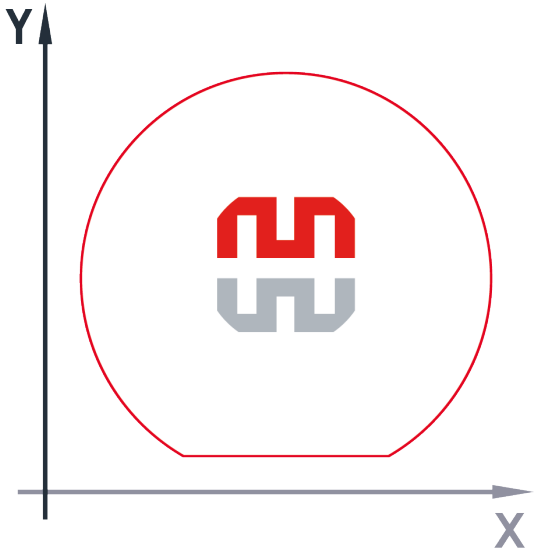


Fig. 14: Camera coordinate system

3.4.3 OPTICS SYSTEM

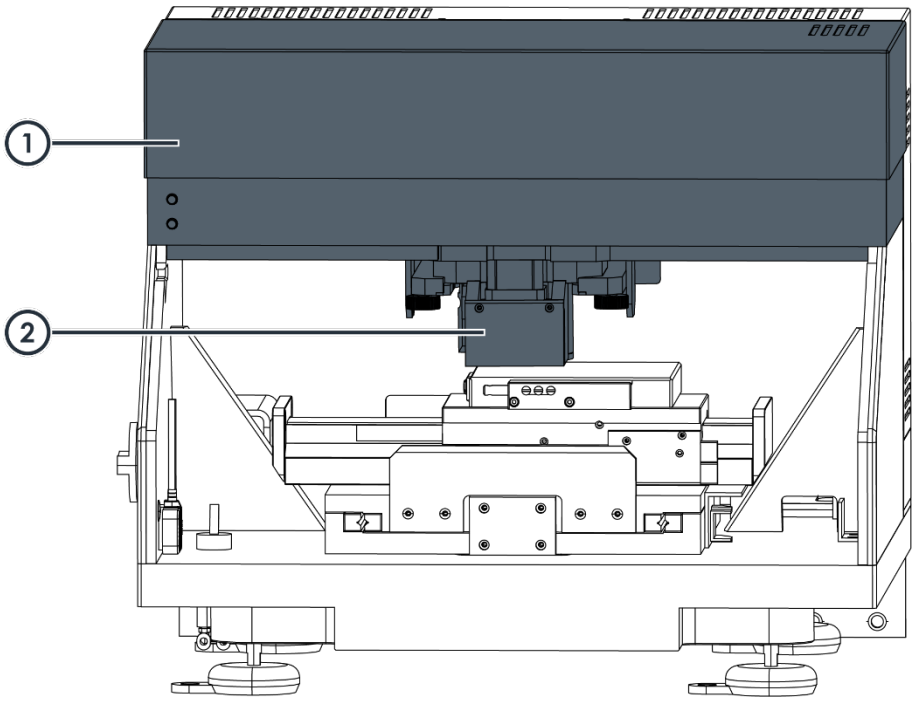


Fig. 15: Interior of the machine – Optics system

1 Exposure optics **2** Write head

The optics system consists of the following components:

- Exposure optics
- Write head

EXPOSURE OPTICS

The exposure optics is located in a fully enclosed housing above the main unit plate.

The exposure optics consists of the following components:

- Exposure laser:

  The optional exposure laser is characterized by high reliability, a long lifetime, and a low noise level. The laser light is emitted by the laser diodes, coupled in an optical fiber, and projected on the substrate.

- Exposure LED:

  The system is equipped with a water-cooled exposure LED. The light of the LED is projected on the Digital Mirror Device.

- Digital Mirror Device (DMD):

  The DMD is an electrical input and optical output micro-electric-mechanical system for spatial light modulation. The DMD modulates the write beam so that the laser (or LED) light projects and transfers a light pattern onto the positive or negative resist on the substrate surface.

- Optical elements:

  Several optical elements guide the modulated write beam through the optics system before the write beam passes the write head and is projected onto the substrate.

- Optics:

  The optics project the light pattern onto the substrate.

- Camera system:

  With the camera system, you can inspect the substrate, perform layer alignments, and carry out high-precision measuring processes. You control the camera system by using the control software.

The camera system consists of the following cameras:

- High-resolution camera
- Overview camera

The high-resolution camera shows more detail than the overview camera, but it covers a much smaller area. You use the high-resolution camera to inspect structures on the substrate.

The overview camera shows less detail than the high-resolution camera, but it covers a much larger area. You use the overview camera to find alignment marks on the substrate. Note that the overview camera does not cover the entire substrate area because of technical limitations.

The field of view of the camera system depends on the camera and the write mode.

The following table shows the field of view dimensions of the camera system for the different write modes:

Camera type	Write Mode I	Write Mode II
High-resolution camera	150 µm × 110 µm	384 µm × 288 µm
Overview camera	13 mm × 10 mm	13 mm × 10 mm

Tab. 2: Camera system – Field of view dimensions

WRITE HEAD

The write head is mounted at the bottom of the exposure optics housing.

The write head contains the following elements:

- Write lens:

  The write lens is the last optical element in the exposure beam path before the beam leaves the optics system.

- Pneumatic autofocus:

  The pneumatic autofocus keeps 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. Then, pressure builds up between the write head and the substrate. The pressure is monitored by a pressure sensor.

- Optical autofocus:

  The optical autofocus controls the position of the write lens with high precision. The optical autofocus is intended for applications that require high resolution.

3.5 Machine control

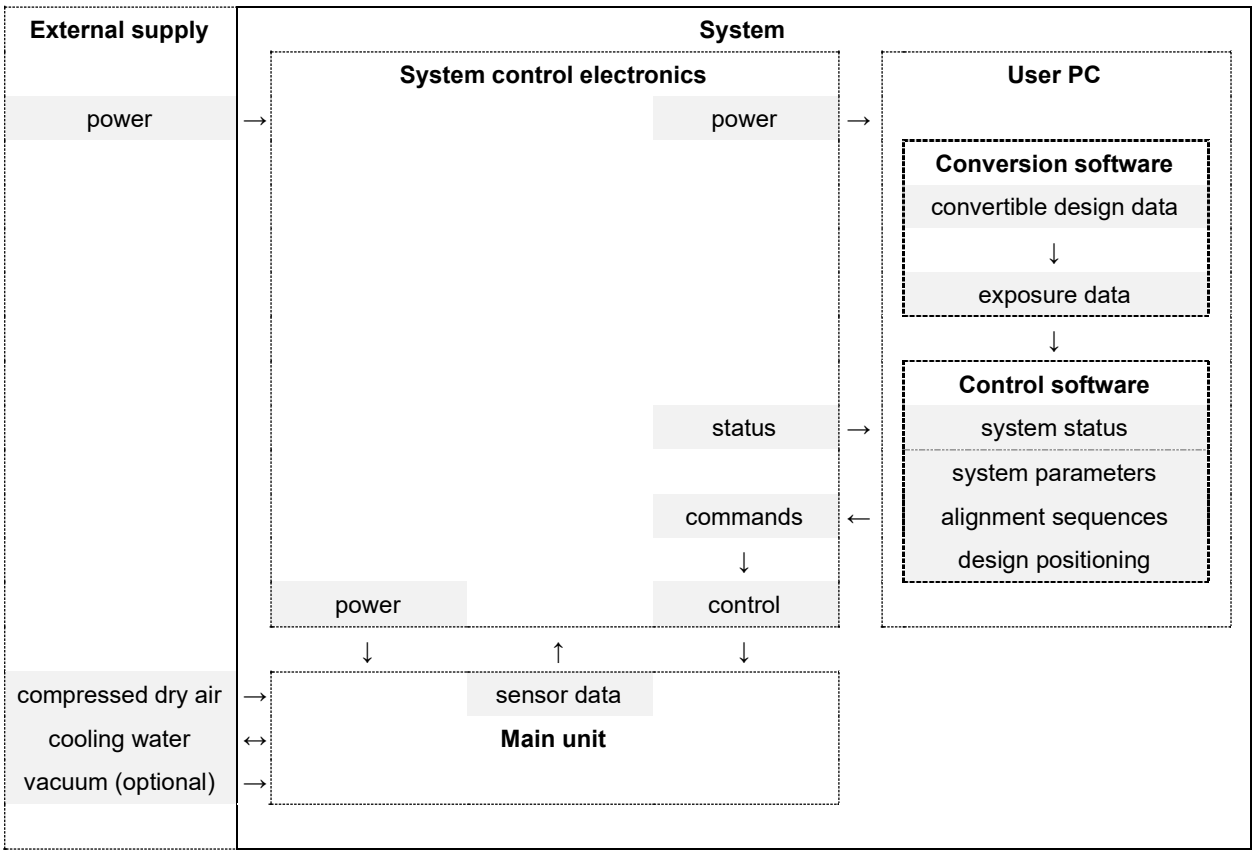


Fig. 16: Machine control – System components and functions

3.6 Electronics

The electronics consist of the following components:

- Central control unit
- Stage controller
- Power supply
- System network switch
- User PC

3.6.1 CENTRAL CONTROL UNIT

The central control unit controls the motors of the machine. The motors are used in various functions throughout the system, for example, to control the positions of the optical elements to the selected write modes.

The central control unit also controls the pneumatic autofocus system. The central control unit receives sensor data about the air pressure. According to the sensor data, the central control unit adjusts the air pressure for the pneumatic autofocus.

3.6.2 STAGE CONTROLLER

The stage controller controls the stage and monitors its position. Based on the received data, the stage controller coordinates and drives the stage.

In addition, the stage controller generates the trigger signals, which control the data clock and the intensity level of the write beam and which control the Digital Mirror Device (DMD). In this way, the stage controller operates the exposure.

3.6.3 POWER SUPPLY

The power supply controls the power distribution for all components of the system.

At the bottom left side of the machine, you find the main switch.

At the bottom right at the rear of the machine, you find the power supply switch.

3.6.4 SYSTEM NETWORK SWITCH

The components of the system communicate via a dedicated, internal LAN (local area network). To enable communication between the components, all components are connected to the system network hub. To enable communication with the external facility network, the system supports dual networking.

NOTICE

Risk of malfunction and delay

If you connect components that are not part of the system to the system network hub or if you connect the system network hub directly to the facility network, data processing, and command transfer can be disturbed, which can result in malfunction or delay.

Do not connect any non-system components to the system network hub.

Do not connect the system network hub directly to the facility network.

3.6.5 CONVERSION PC

The conversion PC is emulated on the user PC via VirtualBox. The conversion PC is running under the Linux operating system. On the conversion PC, the conversion software is installed. The conversion software converts the design data into the machine-specific format so that the design can be processed by the system.

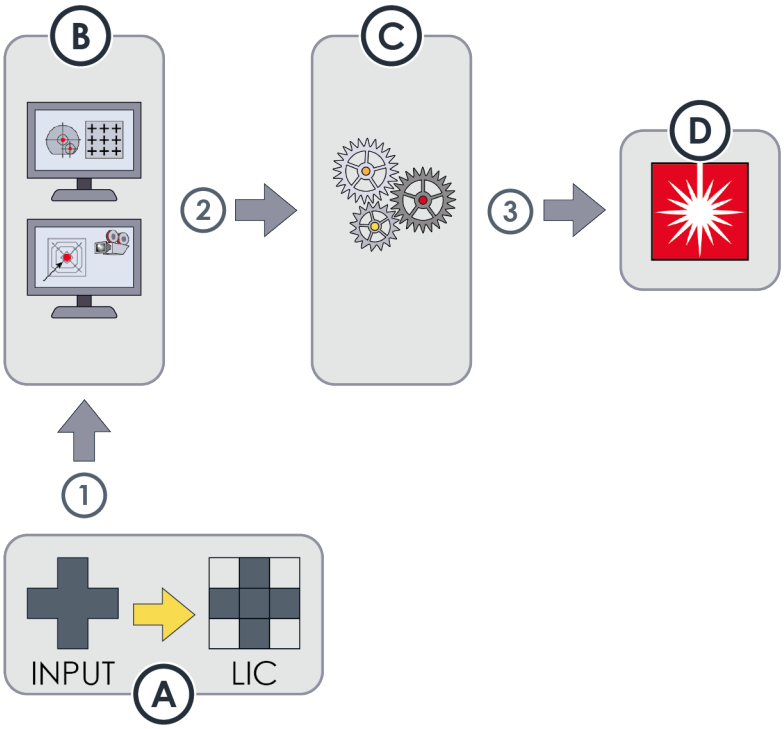


Fig. 17: Conversion of design data and design processing

The conversion software **[A]** converts input files into machine-readable design data. The design data is made available **[1]** to the control software **[B]**. The control software can access and load the design data on demand. In the control software, you can position the design on a map and configure the map settings for exposure. When you start the exposure, the control software sends **[2]** the required commands to the system control electronics **[C]**. The system control electronics controls **[3]** the main unit **[D]** during exposure.

3.6.6 USER PC

The user PC is running under the Windows operating system. The user PC provides the control software with a graphical user interface where you can control and monitor the system. With the control software, you can control and monitor the system. Also, you use the control software to edit, manage, and execute exposure, measurement, and alignment jobs. For the jobs, you can select the designs that are already converted by the conversion software.

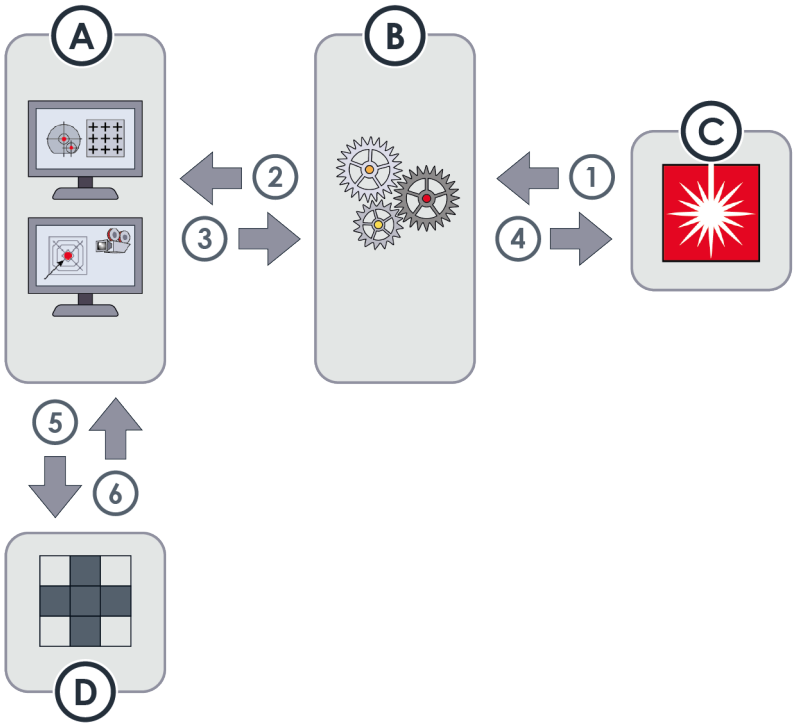


Fig. 18: Control and data processing

The control software **[A]** is connected via the system control electronics **[B]** with the main unit **[C]**. The main unit continuously sends **[1]** sensor data and status information which is forwarded **[2]** to the control software so that you can monitor the system. Via the control software, you can send **[3]** commands to control **[4]** the main unit.

When you set up exposure jobs, the control software sends a request **[5]** to the conversion software **[D]** to access the converted design data **[6]**. Then, you can place the converted design in the exposure job and configure the exposure job. Then, you can start the exposure. After you started the exposure, the control software sends **[3/4]** the related commands to the main unit so that the application is executed.

The user PC is set up as a gateway PC. If enabled and configured at your facility, other PCs can access remotely via LAN.

3.7 Software

The conversion software and the control software are essential for operating the machine. Other utility software may be preinstalled, such as PDF Reader software.

On the desktop of the user PC, you usually find desktop shortcuts for the conversion software and the control software. You can use the desktop shortcuts as usual to start the software. If the desktop shortcuts are not available, you can use the Start menu to start the software. Also, you can create and manage desktop shortcuts as desired, as on every Windows PC.

3.7.1 CONVERSION SOFTWARE

You use the conversion software to convert image files, such as CAD data or bitmap images, into the machine-specific format so that the design can be processed by the system.

In the conversion software, you can import image files of the supported file formats to compile designs. For the designs, you can already set relevant preprocessing parameters. Finally, you convert the design for later use by the control software.

The system uses the following conversion software: APP

3.7.2 CONTROL SOFTWARE

You use the control software to control and monitor the system. You can create, edit, manage, and execute exposure jobs, measurements, and alignments. You can use the converted design data to set up exposure jobs. Also, you can preconfigure recipes with custom settings for frequently used applications. To start and execute common applications, the control software offers wizards that guide you through the processes step by step.

Administrators use the control software to create presets for shared application objects, to administer users and user access rights, and to check the status of the system devices.

The system uses the following control software: MLA Menu

3.7.3 TEAMVIEWER SOFTWARE

The TeamViewer software is preinstalled. You can use the TeamViewer software to invite a Heidelberg Instruments Mikrotechnik service engineer to attend a remote service session.

You can start the TeamViewer session by double-clicking the desktop shortcut or via the Start menu. When the software is started, navigate to the Remote Control tab of the main interface. There, you find your Team Viewer ID and your temporary password. With this information, you can allow a Heidelberg Instruments Mikrotechnik service engineer remote control.

For more information, see the documentation of the manufacturer.

NOTICE

Do not update the factory-installed TeamViewer software

Updating the TeamViewer software can cause compatibility issues.

An update of the TeamViewer software should be performed only in consultation with the Heidelberg Instruments Mikrotechnik Customer Service.

3.7.4 ANYDESK SOFTWARE

The AnyDesk software is preinstalled. You can use the AnyDesk software to invite a Heidelberg Instruments Mikrotechnik service engineer to attend a remote service session.

You can start the AnyDesk session by double-clicking the desktop shortcut or via the Start menu. When the software is started, you find your AnyDesk ID in the AnyDesk window. With this information, you can invite a Heidelberg Instruments Mikrotechnik service engineer to a remote service session.

For more information, see the documentation of the manufacturer.

3.8 Activate/deactivate vacuum zones

This chapter explains how to activate and deactivate the vacuum zones of the chuck vacuum.

NOTE

In the center of the chuck, you find 4 vacuum holes. These vacuum holes are always active when the chuck vacuum is switched on.

If you use substrates smaller than 2 inches, make sure that the 4 vacuum holes in the center of the chuck are completely covered by the substrate.

Perform the following steps to activate and deactivate vacuum zones:

1. Switch off the vacuum with the vacuum switch.
2. Check the positions of the vacuum zone selection screws.

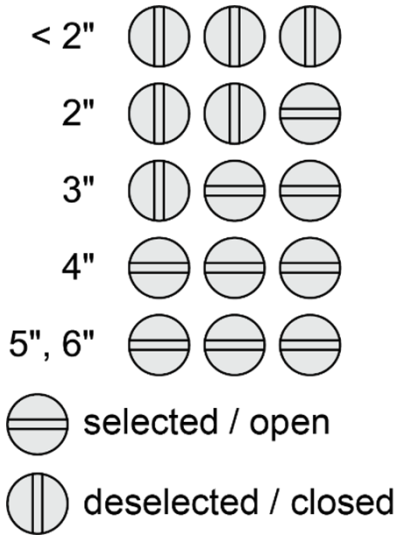


Fig. 19: Vacuum zone selection

3. Activate the vacuum zones that are required for the current substrate size by opening the relevant vacuum zone selection screws.

4. Deactivate the vacuum zones that are not required for the current substrate size by closing the relevant vacuum zone selection screws.
5. Switch on the vacuum with the vacuum switch.

3.9 Use alignment pins

3.9.1 POSITION ALIGNMENT PINS

You can use alignment pins when loading the substrate. The alignment pins help you to place the substrate on the chuck correctly. The positioning of the alignment pins varies depending on the type and the size of the substrate.

The following figure shows the correct positioning of the alignment pins for different substrate types and sizes.

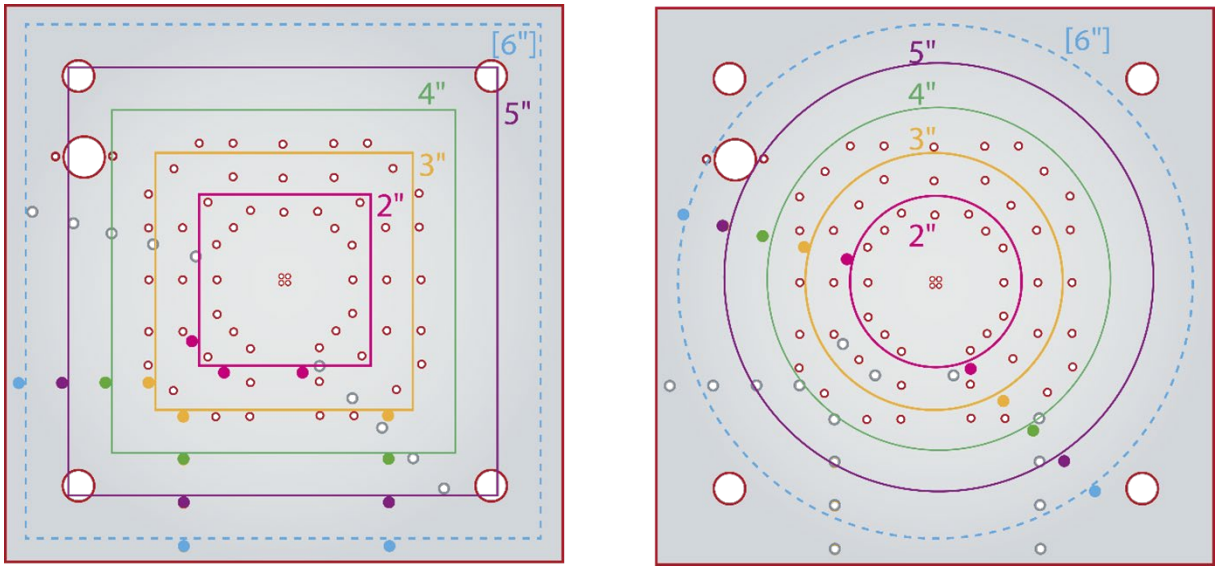


Fig. 20: Alignment pins positioning

NOTE

The µMLA standard configuration supports substrates up to 5 inches in size.

However, you can purchase an upgrade for the exposure area to support 6-inch substrates.

3.9.2 REMOVE ALIGNMENT PINS

NOTICE

Make sure to remove all alignment pins.

Unremoved alignment pins can cause severe damage to the write head and other critical system components.

Always remove all alignment pins from the chuck before starting the exposure process.

Due to the small size of the alignment pins, it is recommended to use the pin removal tool.

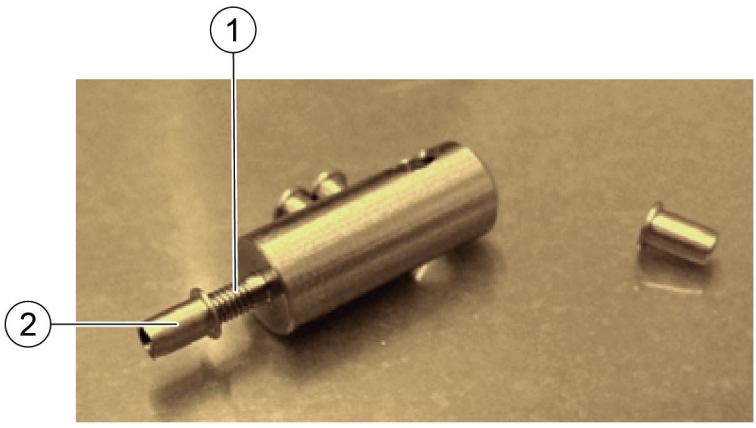


Fig. 21: Pin removal tool

1 Thread **2** Alignment pin

Perform the following steps to remove alignment pins from the chuck:

1. Take the pin removal tool.
2. Screw the threaded end of the tool into the alignment pin on the chuck.

✓ The tool is fixed inside the pin.

3. Pull out the tool together with the pin.
4. Unscrew the pin from the tool.
5. Repeat step 1 to step 4 for all alignment pins.
6. Make sure that no alignment pin is left on the chuck.

4 Exposure Wizard

The µMLA control software offers a quick setup of exposures and alignments, aided by the Exposure Wizard. This intuitive user interface guides the operator through the steps of an exposure setup. To start the wizard, you only have to double-click the link icon.

NOTE

Note that the following section may describe features, options, or objects that require extended user rights.

4.1 Exposure Wizard: Overview

The Exposure Wizard has its own window. This window stays open throughout the whole configuration and exposure procedure. It contains the following main elements:

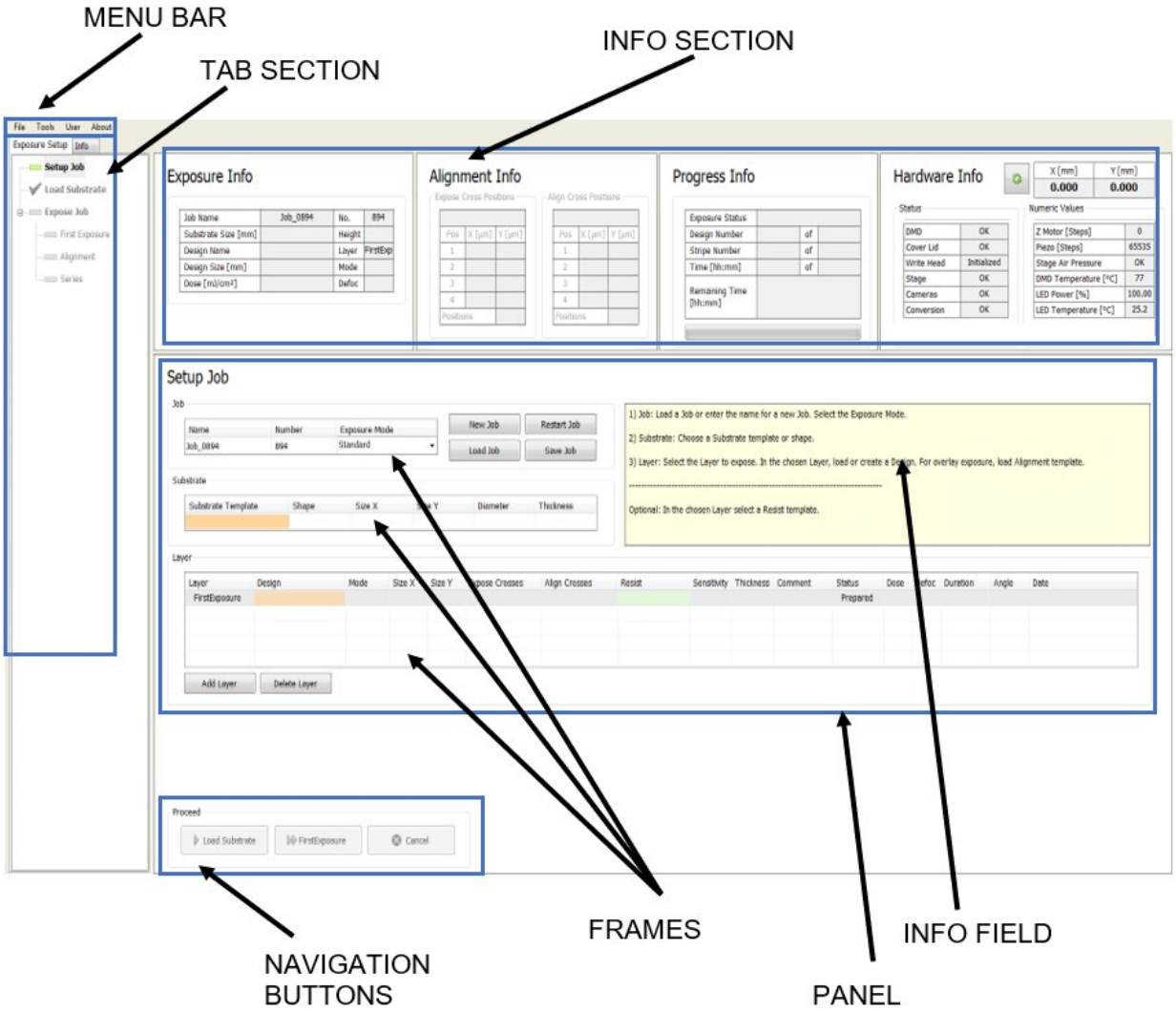


Fig. 22: Exposure Wizard

MENU BAR

The menu bar is located at the top of the window, offering a couple of 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. For example, the figure above shows the Set Up panel. Inside the panel are buttons and frames.

FRAME

The panel contains frames, for example, the Layer frame, where you select the design file and other options. 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

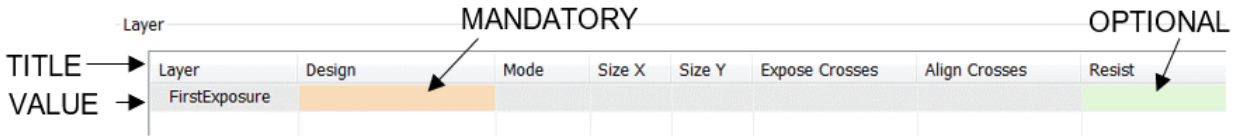


Fig. 23: Exposure Wizard - Buttons

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

NAVIGATION BUTTONS

At the bottom of the wizard window, you find navigation buttons, for example, **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.

TAB SECTION

A block with two tabs is located below the menu bar. In one tab (Exposure Setup), a tree view shows the procedure steps that the system has to execute. The other tab (Info) shows a list of startup messages.

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

4.1.1 MENU BAR

File	
Exit	Terminate the wizard and close the window.
Tools	
LED Measurement	Measure the power of the LED in order to compare it with the value measured during the most recent calibration procedure.
Initialize Stage	Initialize the stage in case the hardware info shows that it is not initialized.
Large Camera Defoc	In Alignment Mode, the focus settings can be switched to larger camera defocus with a wider defocus range. This option is only available in Alignment Mode.
Backup	Back up your system files.
Logging	This option is required for HIMT Service only. Do not change the settings as long as no service engineer demands it.
Beam Offset	Measure and adjust the beam offset.
User	
Change User	Change the user type.

Tab. 3: Menu Bar – Buttons

4.1.2 TAB SECTION

EXPOSURE SETUP TAB

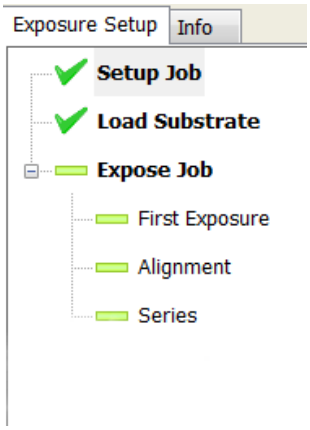


Fig. 24: Exposure Wizard – Exposure Setup tab

The **Exposure Setup Tab** shows a tree view of 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 that make 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.

INFO TAB

The **Info Tab** shows a list of messages informing the user about recent exposures and the condition of the system after startup.

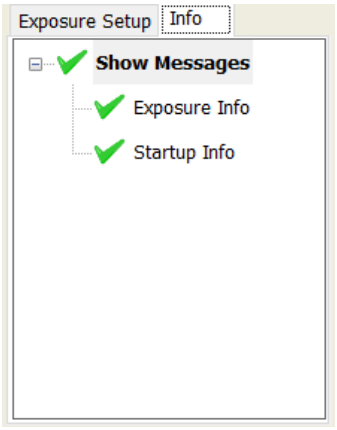


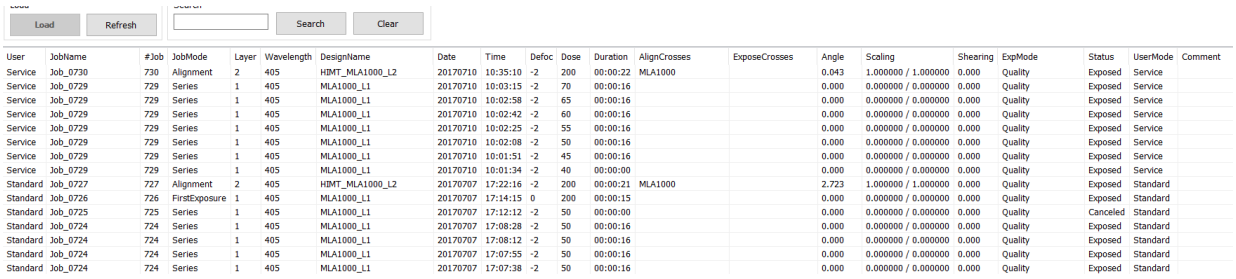
Fig. 25: Exposure Wizard – Info tab

NOTE

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

EXPOSURE INFO

By clicking **Exposure Info**, 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_0730	730	Alignment	2	405	HIMT_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	HIMT_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	Canceled	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	

Fig. 26: Exposure Wizard – Exposure Info

STARTUP INFO

The control system checks the communication between the electronics and the hardware components. A list gives an overview of the components and their functional status. All list items should be marked green. If there are items showing a red cross, 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!

Fig. 27: Exposure Wizard – Startup Info

4.1.3 INFO SECTION

The Info Section consists of four subsections:

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

EXPOSURE INFO

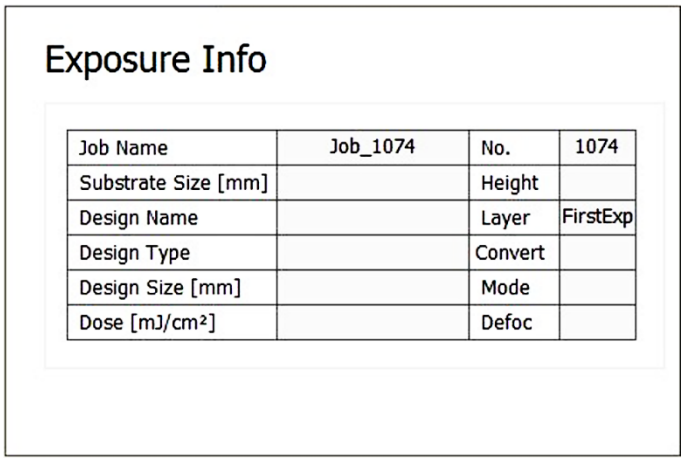


Fig. 28: Info section – Exposure Info

Object	Description
Job Name	Shows the job name. The job name is a combination of the word job and the job number. You can edit the job name by double-clicking into the **Job Name** field in the Job frame.

No.	Shows the auto-incrementing number of the job.
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 Size [mm]	Shows the size of the design.
Design Type	Shows if the design is a binary file.
Dose [mJ/cm²]	Shows the light intensity that is set for the exposure. The necessary intensity depends on the write mode. Also, the necessary intensity depends on the resist thickness and sensitivity. So, you must work out the necessary intensity by exposure series with varying intensity.
Height	Shows the thickness of the substrate.
Layer	Shows the layer that is currently being prepared for exposure.
Mode	Shows the exposure quality level chosen at conversion: • **Quality**: Exposes the substrate with maximum quality but increases the exposure time. • **Fast**: Exposes the substrate with lower quality but decreases the exposure time.
Defoc	Shows the defocus value that is selected for the current exposure. The defoc with a range between `-10` to `10` allows fine-tuning of the exposure focus. This value can be adjusted before starting the design exposure.

Tab. 4: Exposure Info – Display objects

ALIGNMENT INFO

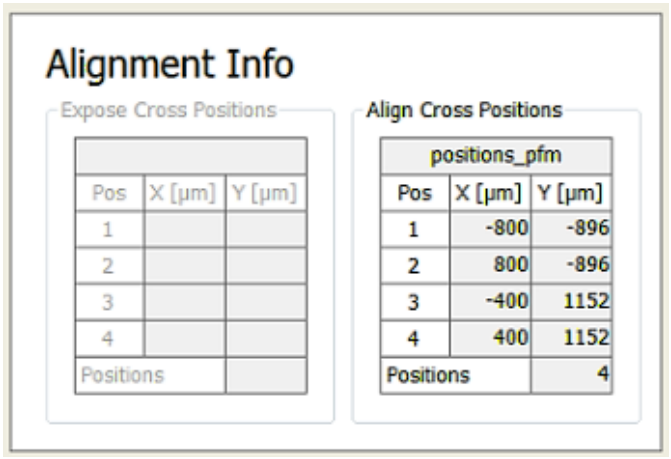


Fig. 29: Info section –Alignment Info

Frame	Description
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.

Tab. 5: Alignment Info – Frames

PROGRESS INFO

The Progress Info provides information about the progress of the exposure process.

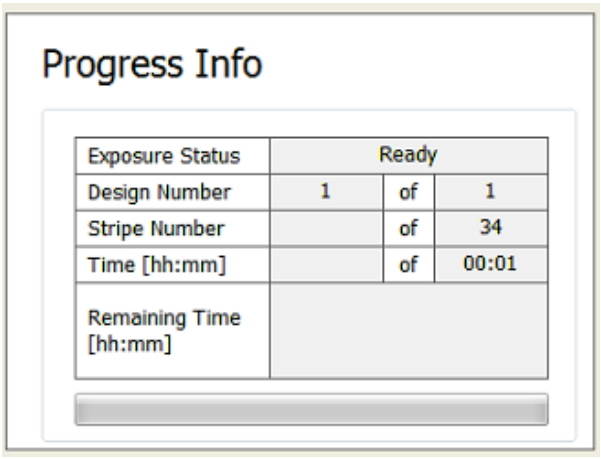


Fig. 30: Info section – Progress Info

Object	Description
Exposure Status	Shows the status of the exposure job.
Design Number	Shows the number of the design that is being exposed.
Stripe Number	Shows the size of the substrate that is currently loaded.
Time [hh:mm]	Shows the estimated exposure time.
Remaining Time [hh:mm]	Shows the remaining exposure time.

Tab. 6: Progress Info – Display objects

HARDWARE INFO

The Hardware Info shows information about the system status.

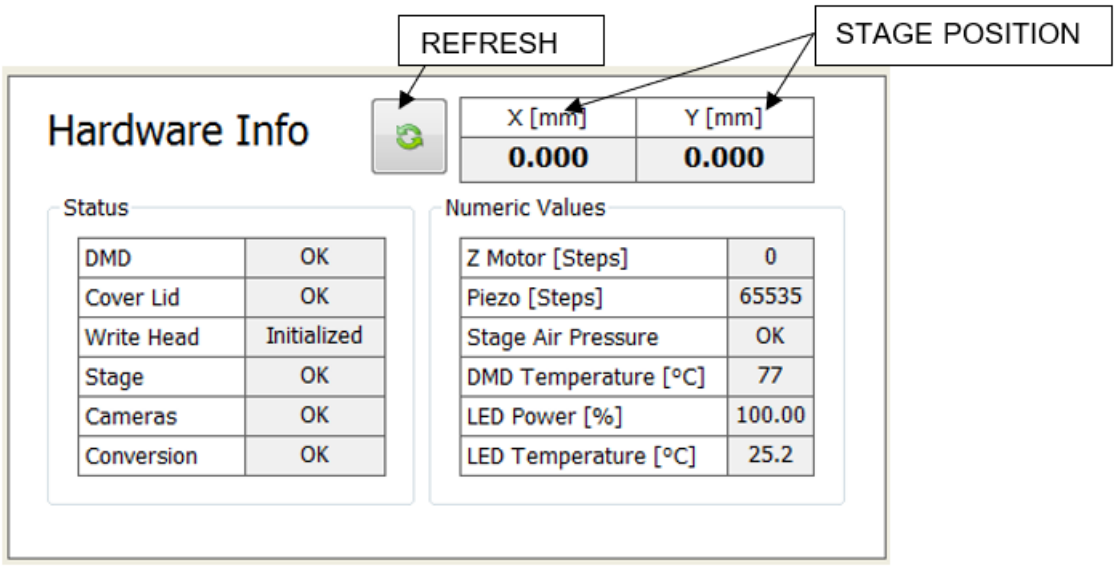


Fig. 31: Info section – Hardware Info

Object	Description
Refresh	Refresh the display to the current data.
Stage Position fields	Show the x-coordinate and the y-coordinate of the current stage position.

Tab. 7: Hardware Info – Display objects

Frame	Description
Status	Shows the status of the system devices. If a parameter displays a red cross, click Refresh. If the status does not change, go to **Info Tab** » **Status Messages** and check for error messages.
Numeric Values	Shows numeric values for various system components. This information is only relevant for Heidelberg Instruments Mikrotechnik service engineers

Tab. 8: Hardware Info – Frames

4.2 Tooltips

The wizard features tooltips. Tooltips are 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 o 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 fulfill the respective task.

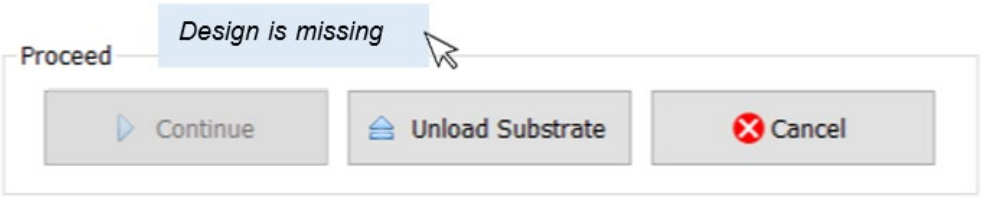


Fig. 32: Exposure Wizard – Tooltip

4.3 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 to indicate which part of the substrate is currently visible in the camera image.

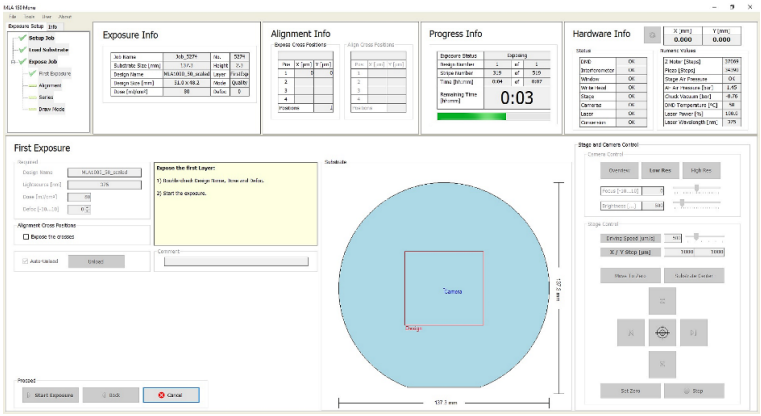


Fig. 33: Exposure Wizard – Substrate representation

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

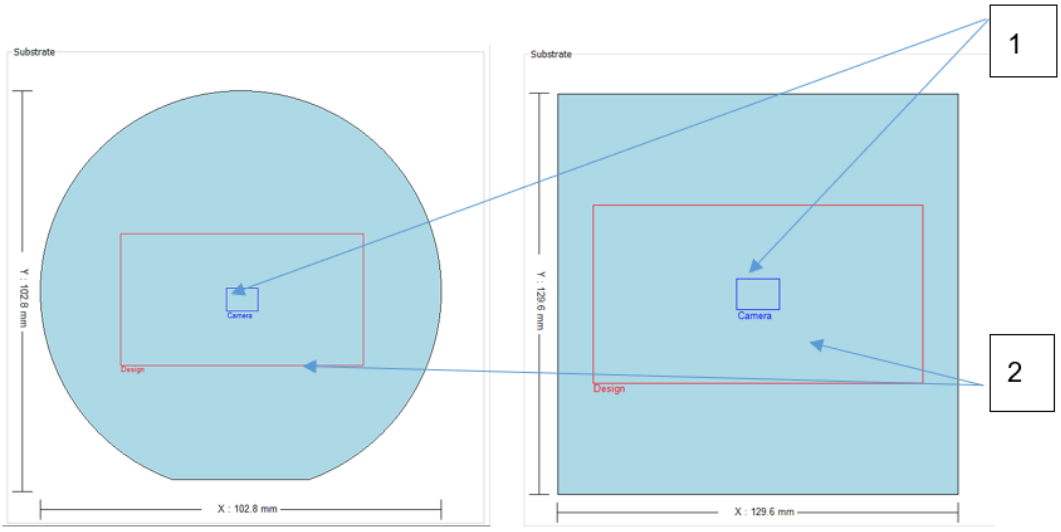


Fig. 34: Substrate representation – Substrate visualization

1 Field of view **2 Design**

The horizontal and vertical measure 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.

4.4 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.

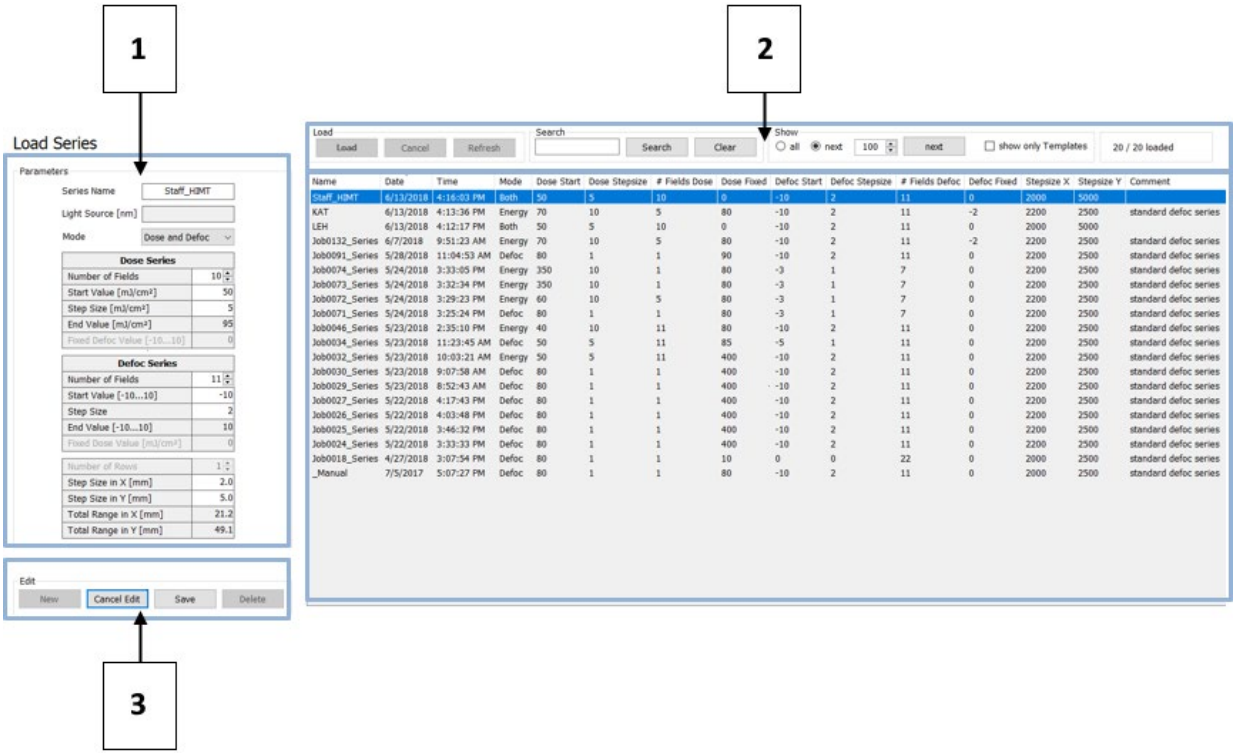


Fig. 35: Exposure Wizard – Loading panel

1 Parameters frame
2 Loading panel
3 Edit frame

4.4.1

4.4.2 LOAD FRAME

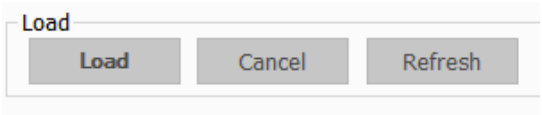


Fig. 36: Loading Panel – Load frame

Object	Description
Load	Load the item that is selected in the Designs list.
Cancel	Cancel the loading procedure and return to the previous panel.
Refresh	Refresh the display to the current data.

Tab. 9: Load Frame – Control objects

4.4.3 SEARCH FRAME

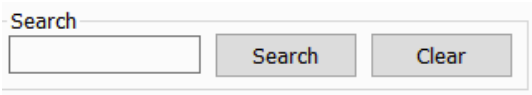


Fig. 37: Loading Panel – Search frame

Object	Description
Search	Enter an item name in the input field to narrow the list of displayed items. Then, click **Search** to start the search.
Clear	Clear the **Search** input field.

Tab. 10: Search Frame – Control objects

4.4.4 SHOW FRAME

Fig. 38: Loading Panel – Show frame

Object	Description
all	Select this option to show all items in the Designs list.
next	Select this option to only show a certain number of items in the Designs list. You can set the number of items that you want to show in the input field next to the radio button.
next (button)	Show the selected items.
show only Templates	Select this option to only show templates in the Designs list.

Tab. 11: Show Frame – Control objects

4.4.5 PARAMETERS FRAME

You find the Parameters frame left of the Loading panel. In the Parameters frame, new templates can be created, or the existing ones can be changed. These tables are explained in the respective chapters where loading or template set up are described.

The control and display objects of the frame are fitted to the context. So, the available control and display objects can vary.

4.4.6 EDIT FRAME

Fig. 39: Loading Panel – Edit frame

Object	Description
New	Add a new item to the Designs list.
Edit	Edit the item that is selected in the Designs list.
Save	Save your changes.
Delete	Delete the item that is selected in the Designs list.

Tab. 12: Edit Frame – Control objects

4.4.7 DESIGNS LIST

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	

Fig. 40: Loading Panel – Designs list

The Designs list shows all designs available or the items that are saved as templates. All information and parameters are listed in the columns of the table.

5 Turn on/off the system

- You find the interlock key switch and the main switch on the left side of the machine.

  For more information, see "Left", page 15.
- You find the power supply switch at the rear of the machine.

  For more information, see "3.2 Rear", page 14.

NOTICE

Updates of driver software can disrupt system stability!

Whenever Windows offers updates, only select important updates.

Never change the settings for automatic updates to fully automatic.

Do not select updates of device drivers, for example, video and network

5.1 Turn on the system

- If the system is in standby mode: proceed with step 3.
- If the system is shut down completely: start with step 1.

NOTE

If you want to restart the system immediately after putting it to standby mode, wait 30 seconds after switching the power supply switch to the 0 position.

1. Switch on main the power supply by turning the main switch to the ON position.
2. Turn the interlock key switch 90° clockwise.
3. Switch the power supply switch at the rear of the machine to the I position

✓ The power LED lights up.

4. Make sure that air pressure for the stage is applied and that the cover lid is closed.

✓ The interlock circuit LED does not light up.

5. Power up the processing unit according to the manufacturer's instructions.
6. Start the Exposure Wizard by clicking the shortcut icon on the desktop.

   For more information, see "4.1 Exposure Wizard: Overview", page 30.

NOTE

When starting the wizard after a shutdown, the startup takes approximately a minute due to the necessary initialization processes.

✓ The camera software starts at the same time as the wizard.

NOTE

Do not close the camera window while the wizard is running. The wizard may crash and has to be restarted.

7. Once the startup sequence is finished, run a stage initialization (**Tools** » **Initialize Stage**).

✓ The system is ready for exposure job setup.

5.2 Put the system to standby mode

Perform the following steps to put the system to standby mode:

1. Terminate the wizard (**File** » **Exit**).

✓ The wizard is terminated after all background processes are shut down, which takes approximately 10 seconds.

2. Switch the power supply switch at the rear of the machine to the 0 position.

✓ The power LED does not light up.

3. Shut down the user PC according to the manufacturer's instructions.

Now, the system is in standby mode.

5.3 Shut down the system

NOTE

In general, the system should only be shut down completely if absolutely necessary. Keeping the system in standby mode enhances system stability.

Perform the following steps to shut down the system:

1. Put the system to standby mode.
2. Turn the interlock key switch 90° counterclockwise.
3. Turn the main switch to the OFF position.

Now, the system is completely shut down.

5.4 Shut down the system for service

Perform the following steps to shut down the system for service:

1. Shut down the system.
2. Secure the main switch in the OFF position.

   The main switch is equipped with holes for a padlock.

Fig. 41: System shutdown – Main switch

5.5 Log in

When the wizard is completely started, the *UserLogin* dialog box opens.

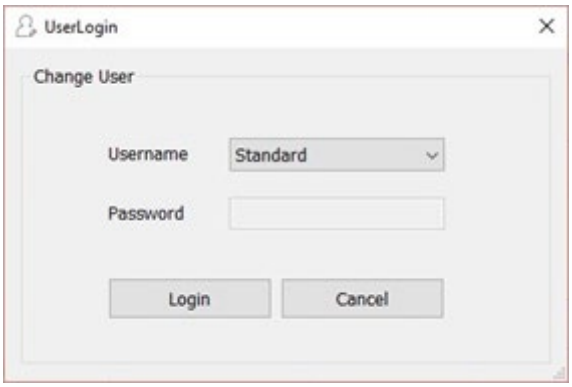


Fig. 42: User login – UserLogin dialog box

Perform the following steps to log in:

1. Select the required user role from the **Username** drop-down list.

   The following list shows the standard user roles:

   - **Standard**: This user role is the default user role when opening the menu. The Standard user role does not require a password and can set up and execute exposure procedures.
   - **Staff**: This user role can create resist templates, job templates, and change several system settings.
   - **Service**: This user role is restricted to Heidelberg Instruments Mikrotechnik service engineers, who carry out service, maintenance, and repair tasks on the system.

2. Enter your password in the **Password** field, if required.
3. Click **Login**.

✓ The *UserLogin* dialog box closes

Now, you are logged in with the selected user role.

5.6 Change users

Perform the following steps to change the user role:

1. Select **User** » **Change User** from the menu bar.

The *UserLogin* dialog box opens.

2. Select the required user role from the **Username** drop-down list.

   The following list shows the standard user roles:

   - **Standard**: This user role is the default user role when opening the menu. The Standard user role does not require a password and can set up and execute exposure procedures.
   - **Staff**: This user role can create resist templates, job templates, and change several system settings.
   - **Service**: This user role is restricted to Heidelberg Instruments Mikrotechnik service engineers, who carry out service, maintenance, and repair tasks on the system.

3. Enter your password in the **Password** field, if required.
4. Click **Login**.

✓ The *UserLogin* dialog box closes

Now, you are logged in with the selected user role.

6 Set up jobs

The µMLA control software provides an exposure wizard to assist in executing exposures. The wizard guides you through the process of exposing a substrate step by step. The following subchapters build a sequence of actions that have to 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 that shows the way through the individual wizard panels.

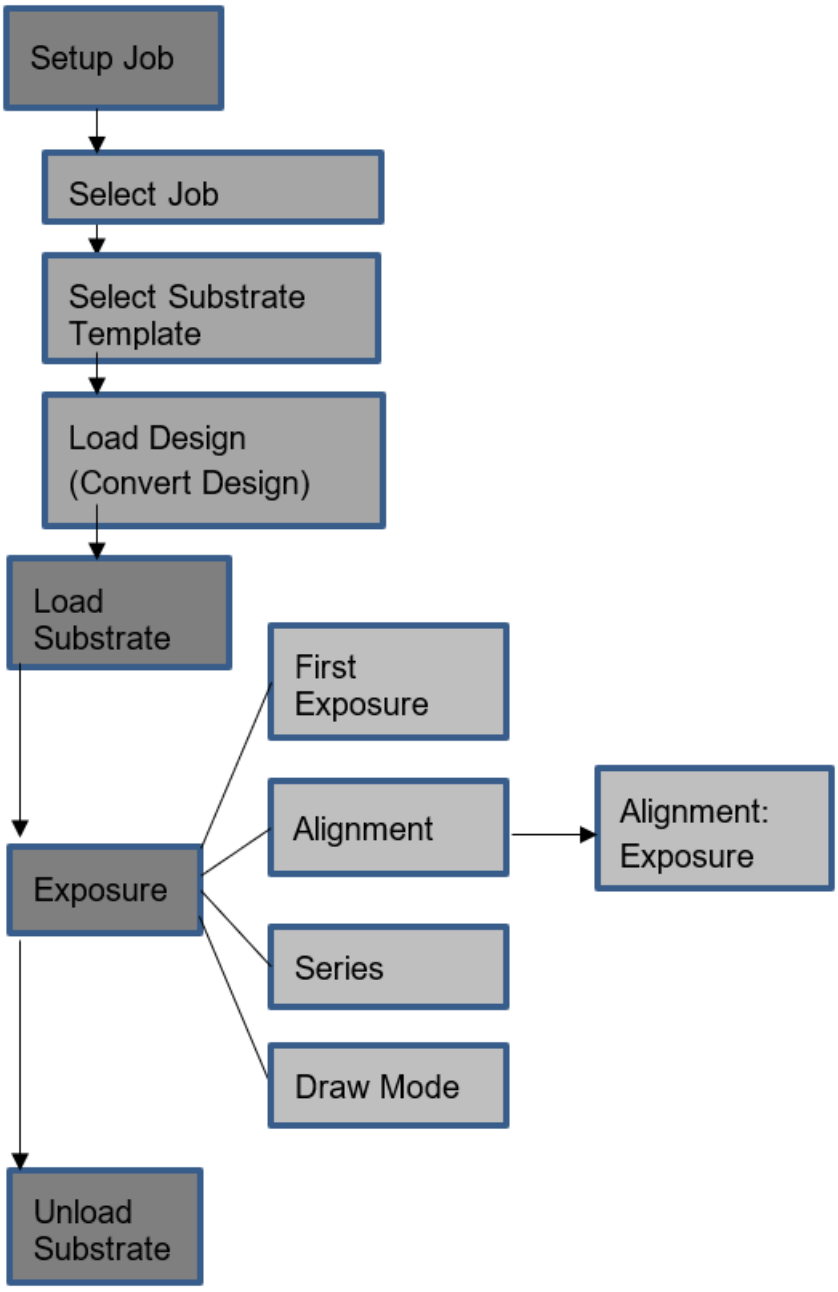


Fig. 43: Exposure Wizard – Panel map

6.1 Select job

1. Double-click the MLA Menu shortcut icon on the desktop to start the Exposure Wizard.

✓ The Exposure Wizard opens.

✓ A new job is created with a job name and a job number.

NOTE

The job number increments automatically with each job and cannot be changed.

2. If you want to change the job name, enter the new job name in the **Name** field.

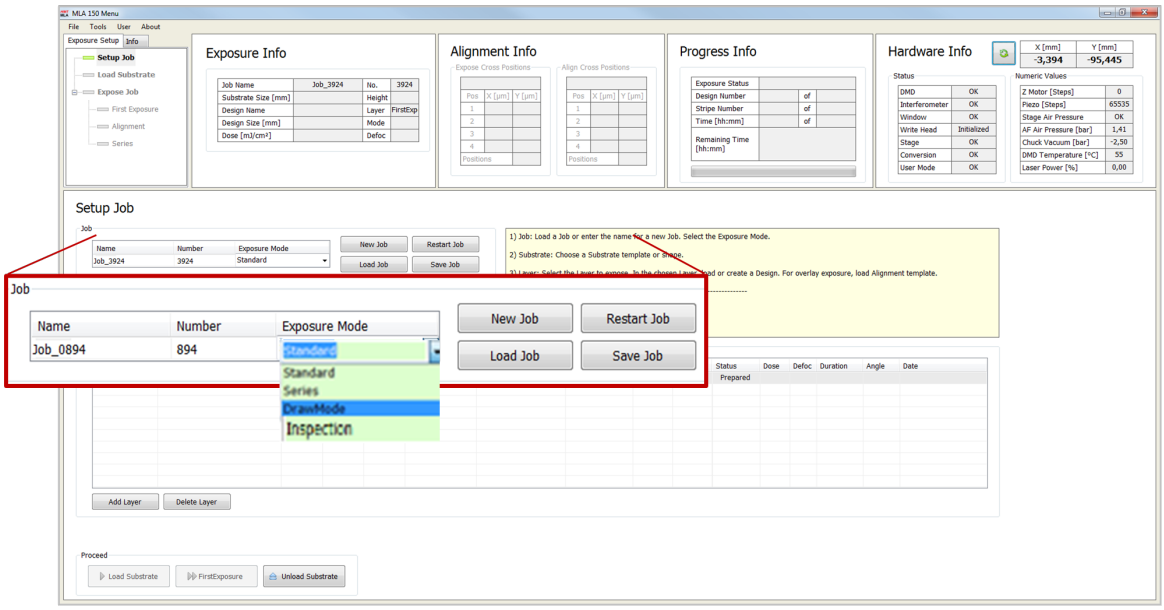


Fig. 44: Exposure Wizard – Select job

3. Select the exposure mode from the **Exposure Mode** drop-down list.

   You have the following options:

   - **Standard**: Select this mode to expose a single design for each layer. Overlay exposures are possible in this mode.
   - **Series**: Select this mode to set up an exposure series with varying parameters, such as dose and defoc.
   - **Draw Mode**: Select this mode to create rectangles, circles, or ellipses of arbitrary size limited only by the camera field. You can also use this mode to create connections between structures or repair imperfections in structures of an exposed layer.
   - **Inspection**: Select this mode to inspect and measure the exposed structure.

4. If you want to load an existing job, click **Load Job**.
5. If you want to repeat a job, for example, to expose another layer, click **Restart Job**.

   A new job is created with the same settings but a new job name and job number.

6. If you want to create a new job after finishing an exposure job, click **New Job**.

Now, the exposure job is selected.

Continue with the steps below.

6.2 Select substrate template

The system offers a list of substrate templates. If the required substrate template is not available in the list, users with extended user rights can add new substrate templates.

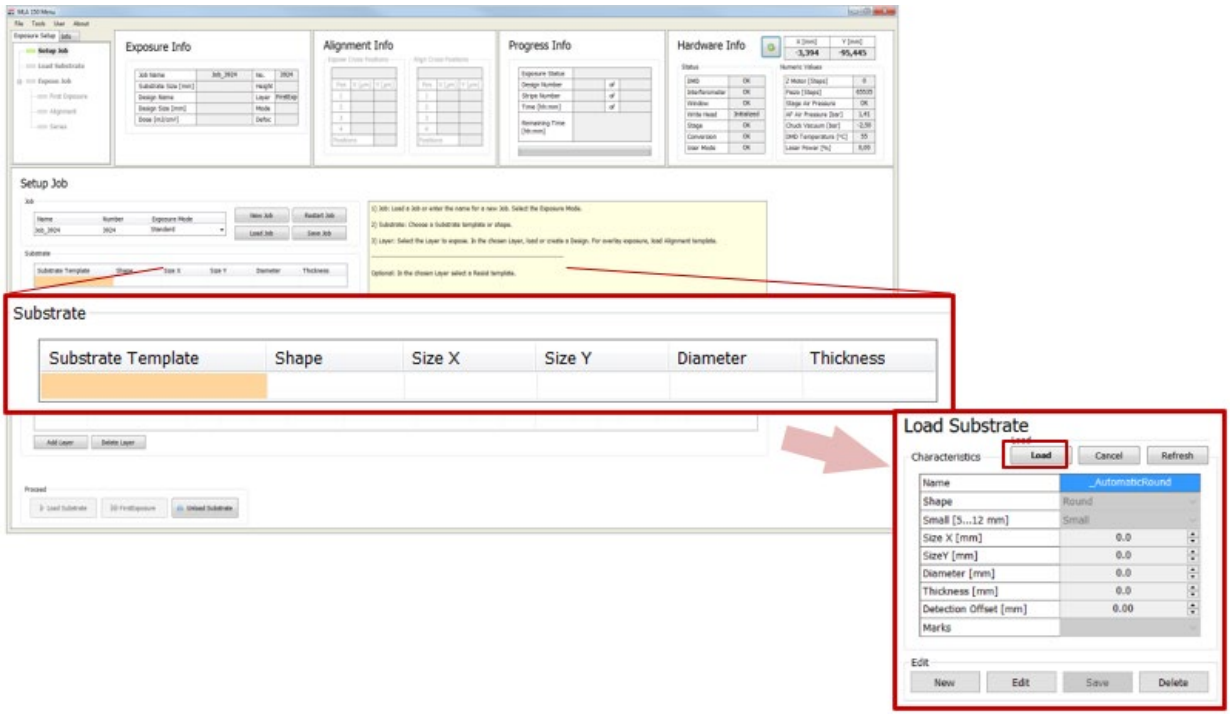


Fig. 45: Exposure Wizard – Substrate frame

Perform the following steps to select a substrate template:

1. Double-click the **Substrate Template** field in the Substrate frame.

✓ The *Load Substrate* dialog box opens.

2. Select the substrate size or substrate shape from the list. For example, if you want to load a wafer, select `automatic_round`.
3. Click **Load**.

✓ The parameters of the selected substrate template are shown in the Substrate frame.

✓ The **Substrate Template** field is highlighted in green.

Now, the substrate template is selected.

Continue with the steps below.

6.3 Load designs

This section contains information about how to load designs in different exposure modes.

You can only load designs that are already converted. For more information about how to convert designs, see "6.4 Convert designs", page 52.

NOTE

You do not need to load a design if you are using Draw Mode. If you are using Draw Mode, skip the following steps.

6.3.1 STANDARD: FIRST EXPOSURE

1. Double-click the **Design** field in the Layer frame.

✓ The Design list opens.

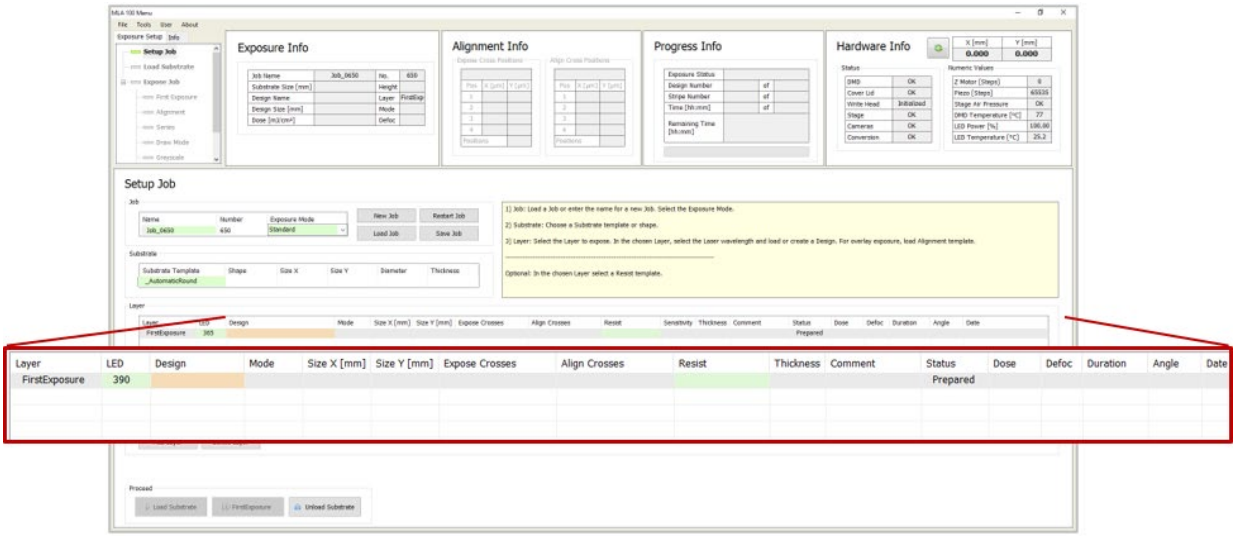


Fig. 46: Exposure Wizard – Layer frame – First exposure

2. Select the design that you want to load in the Design list.
3. Click **Load**.

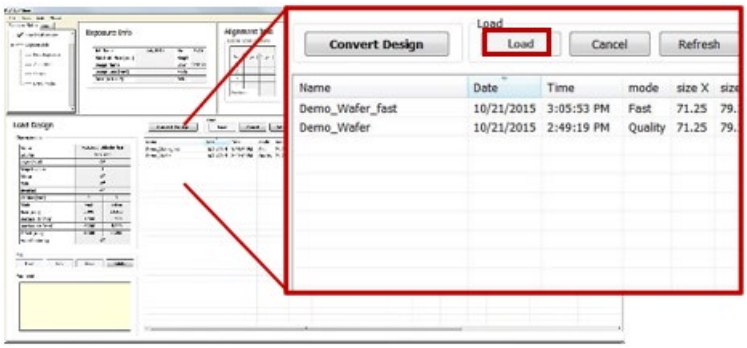


Fig. 47: Exposure Wizard – Design list

✓ The Design list closes.

✓ The design is shown in the **Design** field in the Layer frame.

✓ The **Design** field in highlighted in green.

4. If you want to load a resist type, double click the **Resist** field in the layer frame. Then, select the appropriate resist type for your application.

✓ The selected resist type is shown in the Resist field.

✓ The thickness of the selected resist type is shown in the **Thickness** field.

5. If you want to load a template for a set of alignment marks, double-click the **Expose Crosses** field. Then, select a template from the list.

✓ The selected alignment marks template is shown in the **Expose Crosses** field.

Now, the design is loaded.

You can continue with loading the substrate. For more information, see "Load substrates", page 54.

6.3.2 STANDARD: ALIGNMENT

For aligned exposures, Layer 2 is the first layer for that you can choose a design. On Layer 1, the alignment marks are exposed.

1. Double-click the **Design** field in Layer 2 in the Layer frame.

✓ The Design list opens.

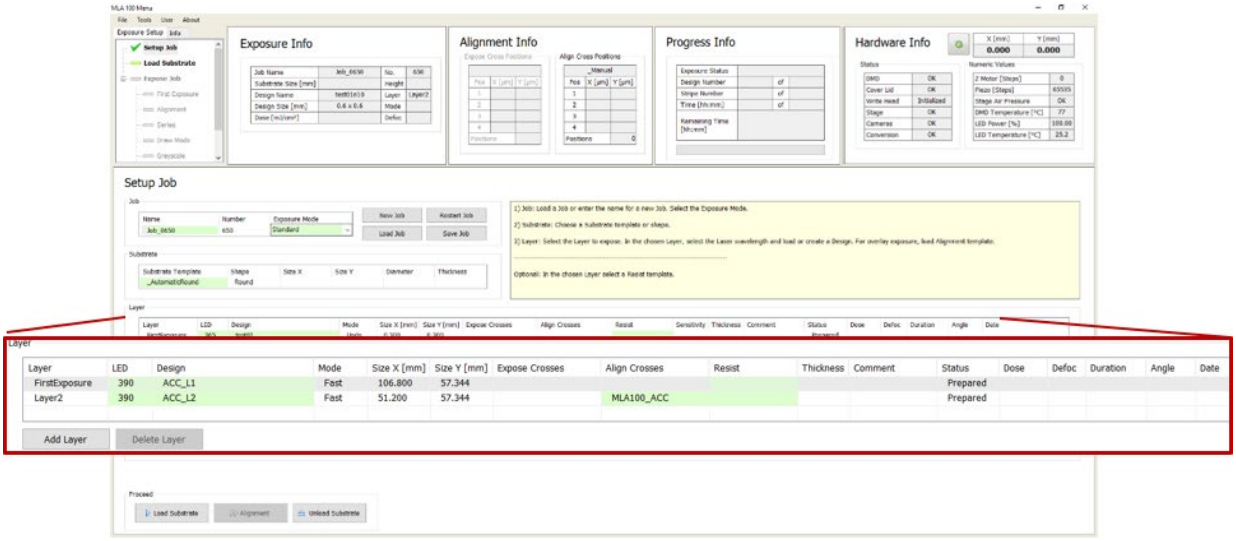


Fig. 48: Exposure Wizard – Layer frame - Alignment

2. Select the design that you want to load in the Design list.
3. Click **Load**.

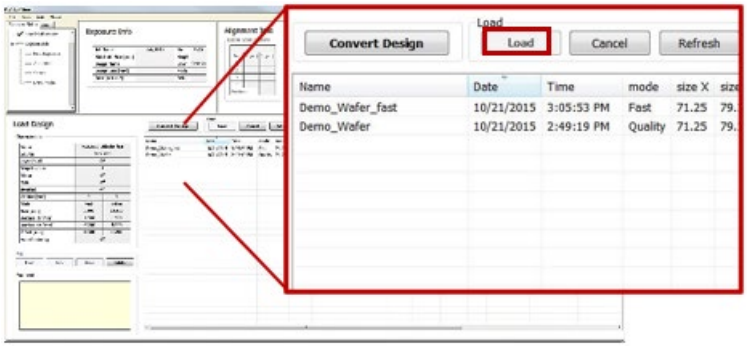


Fig. 49: Exposure Wizard – Design list - Alignment

✓ The Design list closes.

✓ The design is shown in the **Design** field in the Layer frame.

✓ The **Design** field in highlighted in green.

4. Double-click the **Align Crosses** field.

✓ The alignment mark templates list opens.

5. Select the alignment marks template that you want to use.

   A special template called `_Manual.xml` is offered for cases in which the alignment mark 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. For more information, see "6.7 Set up overlay alignment", page 60.

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

Fig. 50: Exposure Wizard – Alignment mark templates

6. Click **Load**.

✓ The alignment mark templates list closes.

✓ The design is shown in the **Alignment Crosses** field in the Layer frame.

✓ The **Alignment Crosses** field in highlighted in green.

7. If you want to load a resist type, double click the **Resist** field in the layer frame. Then, select the appropriate resist type for your application.

✓ The selected resist type is shown in the Resist field.

✓ The thickness of the selected resist type is shown in the **Thickness** field.

Now, the design is loaded.

NOTE

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

You can continue with loading the substrate. For more information, see "6.5 Load substrates", page 54.

6.3.3 SERIES

In the Series exposure mode, the template and design files are selected automatically when selecting Series from the Exposure Mode drop-down list. For more information, see "6.1 Select job", page 47.

The Layer frame turns into the Series frame with different parameters than displayed in the Layer frame.

Fig. 51: Exposure Wizard – Series frame

If you need a different design file for your series exposure, load a new design. For more information, see "6.3.1 Standard: First exposure", page 49.

6.4 Convert designs

This section contains information about how to convert a design.

If you loaded an already converted design from the Design list, skip the following steps.

Perform the following steps to convert a design:

1. Double-click the **Design** field in the Layer frame.

✓ The Design list opens.

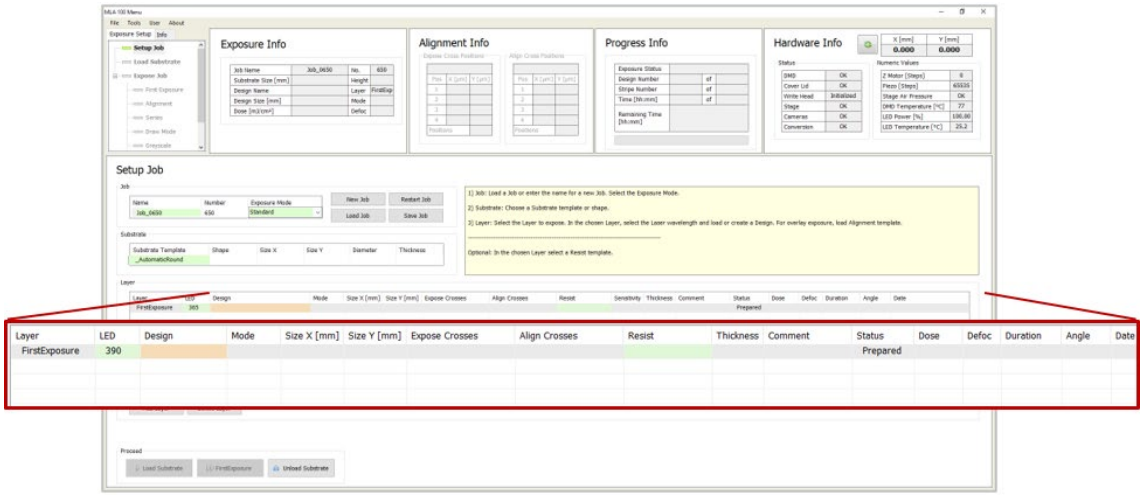


Fig. 52: Exposure Wizard – Layer frame – First exposure

2. Click **Convert Design**.

✓ The conversion software window opens.

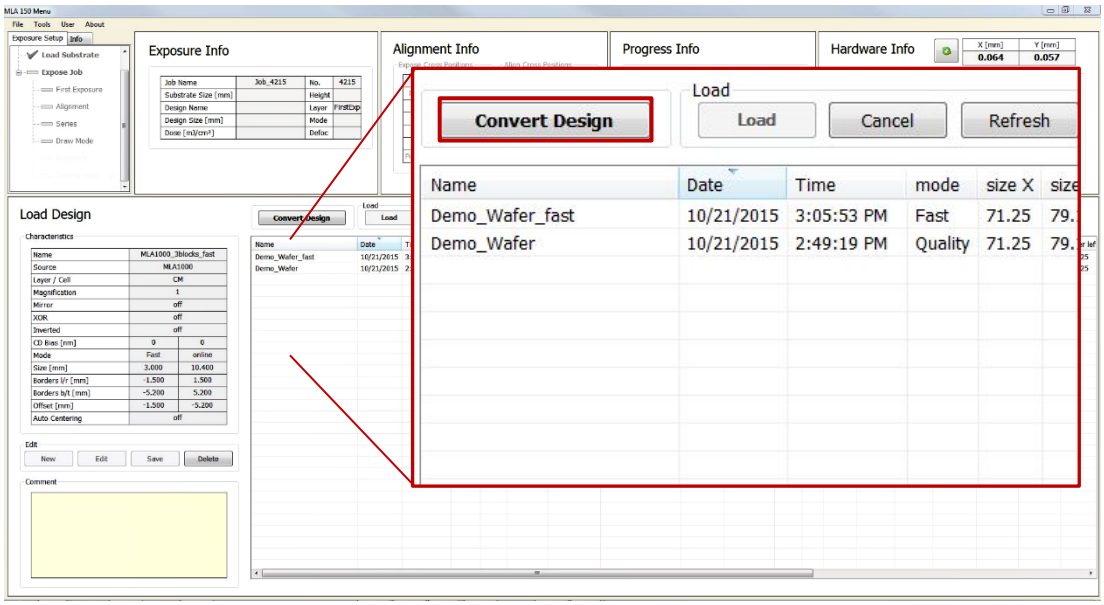


Fig. 53: Exposure Wizard – Design list

3. Select **File** » **New Job** in the menu bar.

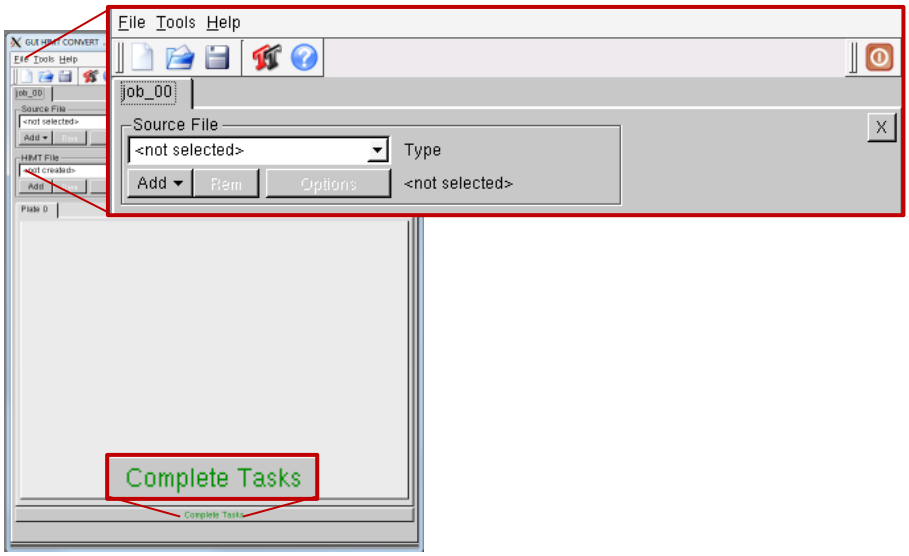


Fig. 54: Conversion software window – Convert design

4. Enter the job name.
5. Click **OK**.
6. Click **Add**. Then, select a design format.

✓ A directory opens that contains the source files for the selected design format.

NOTE

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>*.

7. Select the file that you want to convert into the LIC file format.
8. If necessary, change settings and/or use the viewer application.

   For more information, see the *Conversion Job Manager*.
9. Click **Complete Tasks** to save the conversion job settings and proceed to the expose job setup.
10. Click **Finish** in the dialog box.

✓ The conversion software window closes.

11. Click **Refresh** in the Design list.

Now, the converted design is shown in the Design list and can be loaded. For more information about how to load a design, see "6.3 Load designs", page 49.

6.5 Load substrates

NOTICE

Observe the general guidelines for handling substrates.

- Do not expose the substrate to white light.
- Do not touch the surface on areas that are to be exposed.
- Avoid scratches on both the upper and lower surface.
- Make sure that both the stage and the substrate are clean.

Perform the following steps to load the substrate:

1. Click **Load Substrate** to move the stage into the loading position.

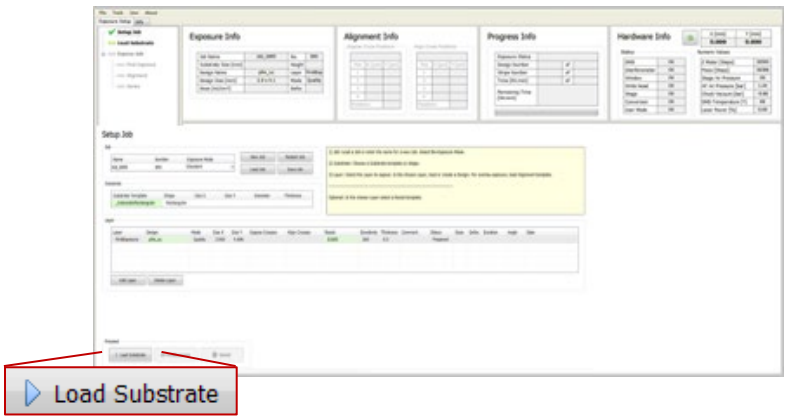


Fig. 55: Set Up Job panel – Load Substrate

2. Make sure that the white light is switched off.

✓ Only the appropriate safelight is switched on.

3. Take the substrate out of the container.

4. Open the cover lid.
5. Carefully place the substrate correctly oriented on the stage.

   You can use alignment pins to orient the substrate correctly. For more information about how to position alignment pins, see "3.9.1 Position alignment pins", page 28.
6. Switch on the vacuum with the vacuum switch.
7. Make sure that the substrate is held firmly in place.

✓ When you gently try to push the substrate sideways, the substrate does not move.

Troubleshooting if the substrate moves:

- Check the stage and the substrate for dirt.
- Check the substrate for scratches.
- Try using a different substrate.
- Try increasing the ejector flow.

  For more information, see "10.4 Adjust the ejector flow", page 92.

Troubleshooting if the substrate is too small and vacuum holes remain open:

- Make sure that you have chosen the correct substrate size for the application.
- Deactivate the surrounding vacuum zones via the vacuum zone selection screws.

  For more information, see "3.8 Activate/deactivate vacuum zones", page 27.
- Try to cover the remaining vacuum holes, for example, with thick foil.

8. If you used alignment pins, make sure that all alignment pins are removed from the stage. For more information about how to remove alignment pins, see "3.9.2 Remove alignment pins", page 28.
9. Close the cover lid.
10. Make sure the interlock lamp is off.

✓ The system searches for the center of the substrate and provides information about the progress via a message box.

If you wish to abort the Find Plate Center procedure, click **Stop** in the message box and start the loading process again.

Now, the substrate is loaded.

Continue with one of the following steps:

- In Standard Mode with overlay alignment, the Alignment panel opens.

  Continue with settings up an overlay alignment exposure. For more information, see "6.7 Set up overlay alignment", page 60.
- In Standard Mode without overlay alignment, the Exposure panel opens.

  Continue with the first exposure. For more information, see "6.8.1 First Exposure procedure", page 63.
- In Series Mode, the Series panel opens.

Continue with a series exposure. For more information, see "6.8.3 Exposure Series procedure", page 66.

6.6 Draw structures

This chapter explains how to draw structures in Draw Mode.

In the Procedure frame of the Draw Mode panel, select the shape that you want to draw.

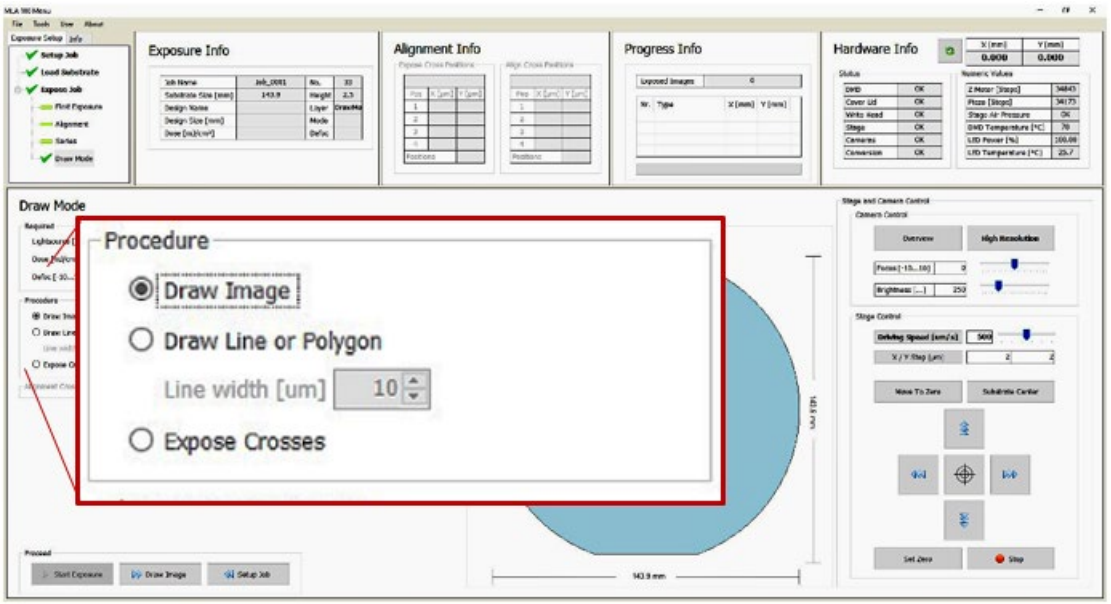


Fig. 56: Draw Mode panel – Procedure frame

Object	Description
Draw Image	Select this option to use the shapes that are offered in the camera window: • Rectangle • Ellipse • Circle • Bitmap file
Draw Line or Polygon	Select this option to draw lines or polygons (lines with more than two points). You can set the line width in the **Line width** field.
Expose Crosses	Select this option to expose crosses 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.

Tab. 13: Procedure frame – Control objects

6.6.1 DRAW IMAGE

Perform the following steps to draw images:

1. Select **Draw Image** in the Procedure frame of the Draw Mode panel.
2. Select the area in that you want to draw the image in the Camera window.

   You can use the controls in the Stage and Camera Control frame to move the camera image.
3. Select the shape that you want to draw in the Camera window.

NOTE

You can also load a bitmap file by clicking **Load** and selecting the file. To directly load a bitmap file click **BMP** located below the structure icons.

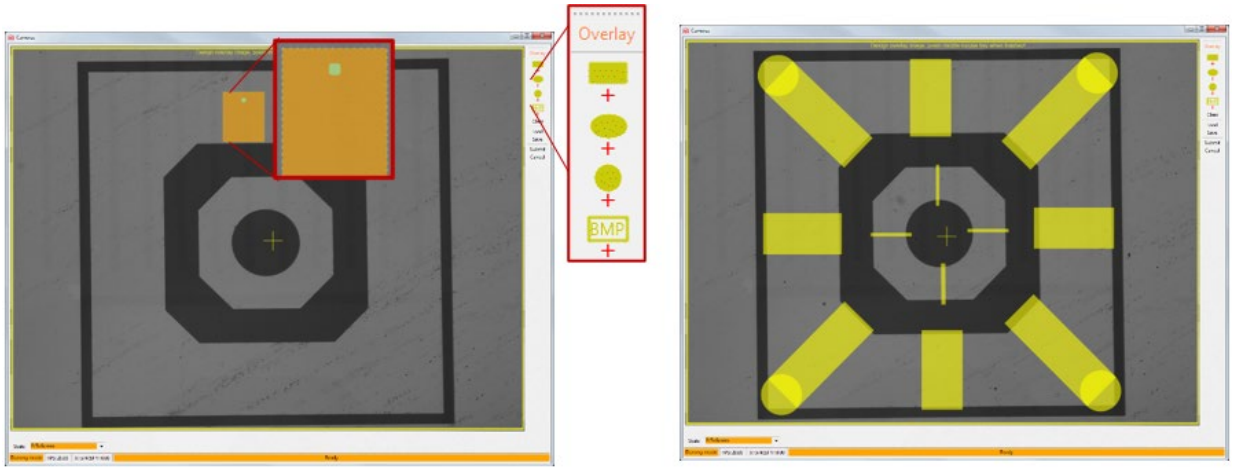


Fig. 57: Draw Mode panel – Draw images

4. Move the image to the desired position.

   You have the following options:
   - You can drag and drop the image to the desired position.
   - You can rotate the image by clicking the green dot. Then, you can drag the green dot to rotate the image.
5. If you want to save the image, click **Save**.

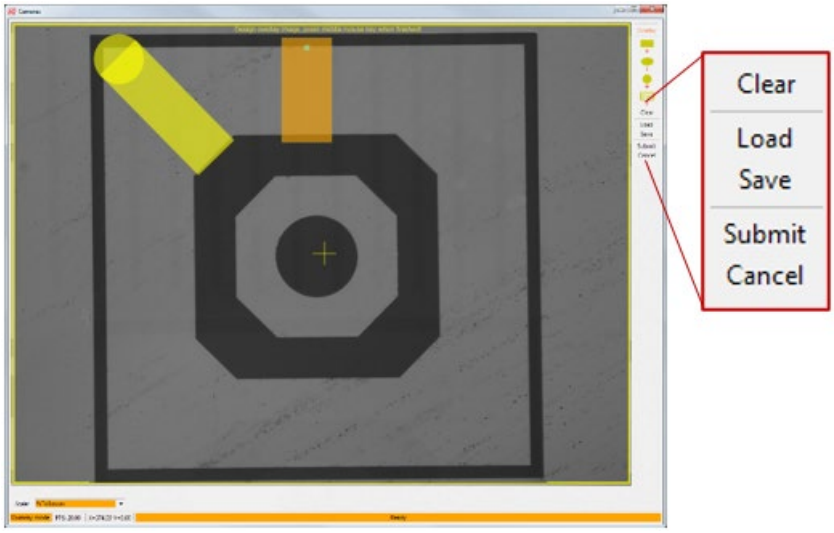


Fig. 58: Draw Mode panel – Save images

6. If you want to clear the image, click **Clear** in the menu bar of the Camera window.
7. Click **Submit** in the menu bar of the Camera window.

Now, the image is submitted.

You have the following options:

- You can draw more structures.
- You can start the exposure procedure. For more information, see "6.8.4 Draw Mode exposure procedure", page 68.

6.6.2 DRAW LINE OR POLYGON

Perform the following steps to draw lines or polygons:

1. Select **Draw Line or Polygon** in the Procedure frame of the Draw Mode panel.
2. Move the camera to the position where you want to set the first point of the line or polygon.

   You can use the controls in the Stage and Camera Control frame to move the camera image.
3. Click **Set Point**.

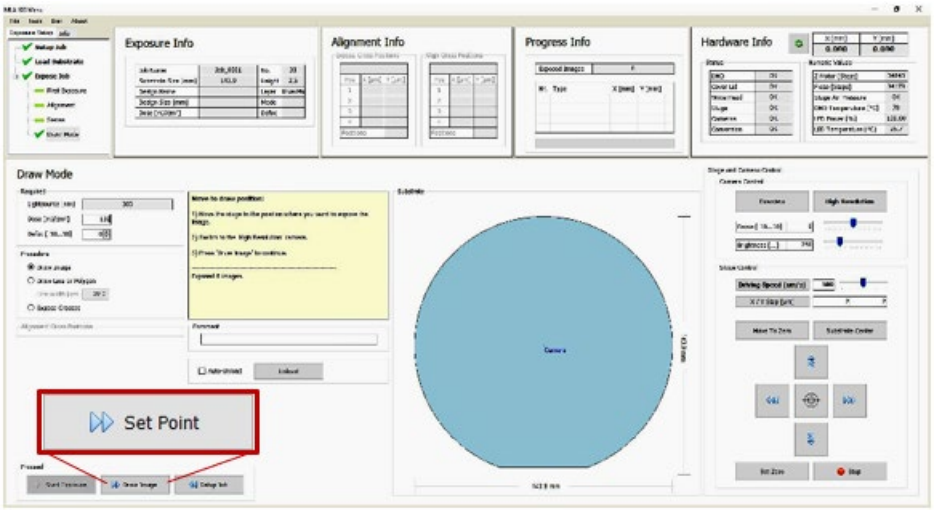


Fig. 59: Draw Mode panel – Draw Line or Polygon

✓ A crosshair appears in the Camera window.

4. Left-click on the position where you want to set the first point of the line or polygon.

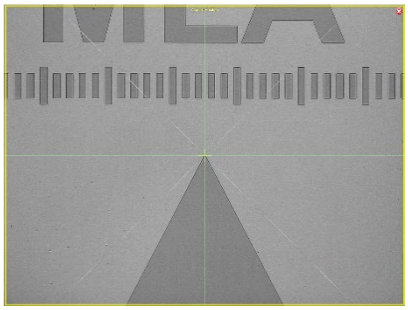


Fig. 60: Draw lines or polygons – Set point

5. Move to the next point of the line/polygon by using the arrow buttons of the Control Panel.
6. Click **Set Point** and repeat the set point procedure.
7. Click **Accept line**.
8. To draw a polygon, go on with the set point procedure and click **Accept Polygon** to submit the polygon drawing.

Now, the line or polygon is submitted.

You have the following options:

- You can draw more structures.
- You can start the exposure procedure. For more information, see "6.8.4 Draw Mode exposure procedure", page 68.

6.6.3 EXPOSE CROSSES IN DRAW MODE

Perform the following steps to expose alignment crosses in Draw Mode:

1. Select **Expose Crosses** in the Procedure frame of the Draw Mode panel.

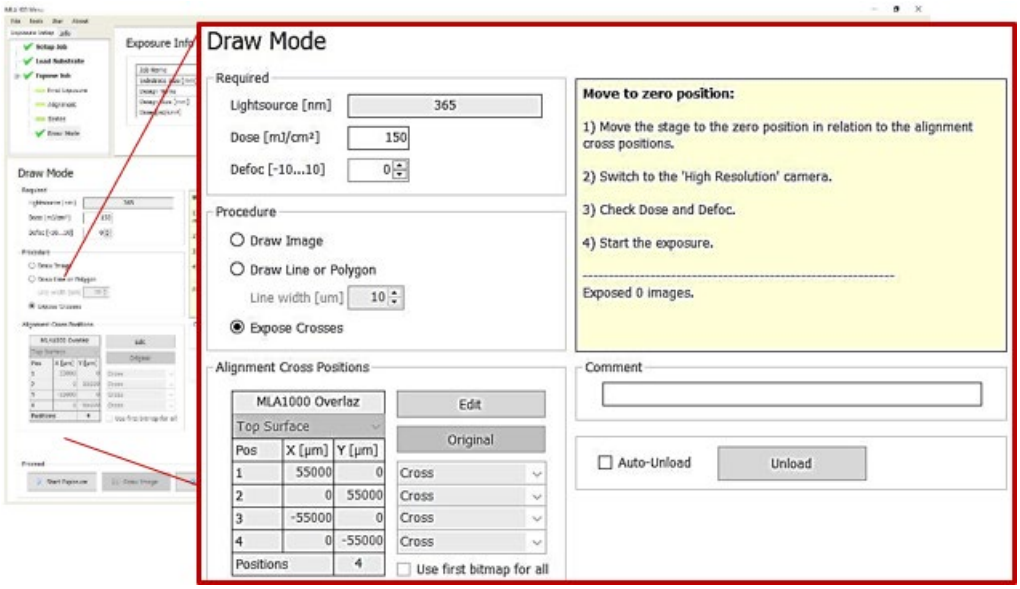


Fig. 61: Draw Mode panel – Expose Crosses

2. If not selected in the Setup panel, a bitmap file must be selected for every cross position:
    1. Click **Edit** and select a template for every cross position. To select the same file for every position, select the **Use first bitmap for all** checkbox.
    2. Enter the positions into the table.
    3. Click **Edit** again, to leave the editing mode.

NOTE

Click **Edit** to change the template that was selected in the Setup panel.

To restore the original alignment cross positions from the selected file, click **Original**.

Now, the alignment cross positions are set.

Continue with the exposure procedure. For more information, see "6.8.4 Draw Mode exposure procedure", page 68.

6.7 Set up overlay alignment

This section explains how to set up and execute an overlay alignment exposure. If you do not want to set up an overlay alignment, skip the following steps.

With the µMLA, you can execute precise alignment exposures to achieve the best results. For using the available alignment modes, choose standard exposure mode in the Setup Job panel.

The alignment function offers the following alignment modes:

- **Cross Alignment**: Use this mode to automatically detect alignment crosses. It is recommended to use Cross Alignment mode.
- **Manual Alignment**: Use this mode to manually detect alignment crosses if automatic cross detection fails.

6.7.1 SET UP PARAMETERS

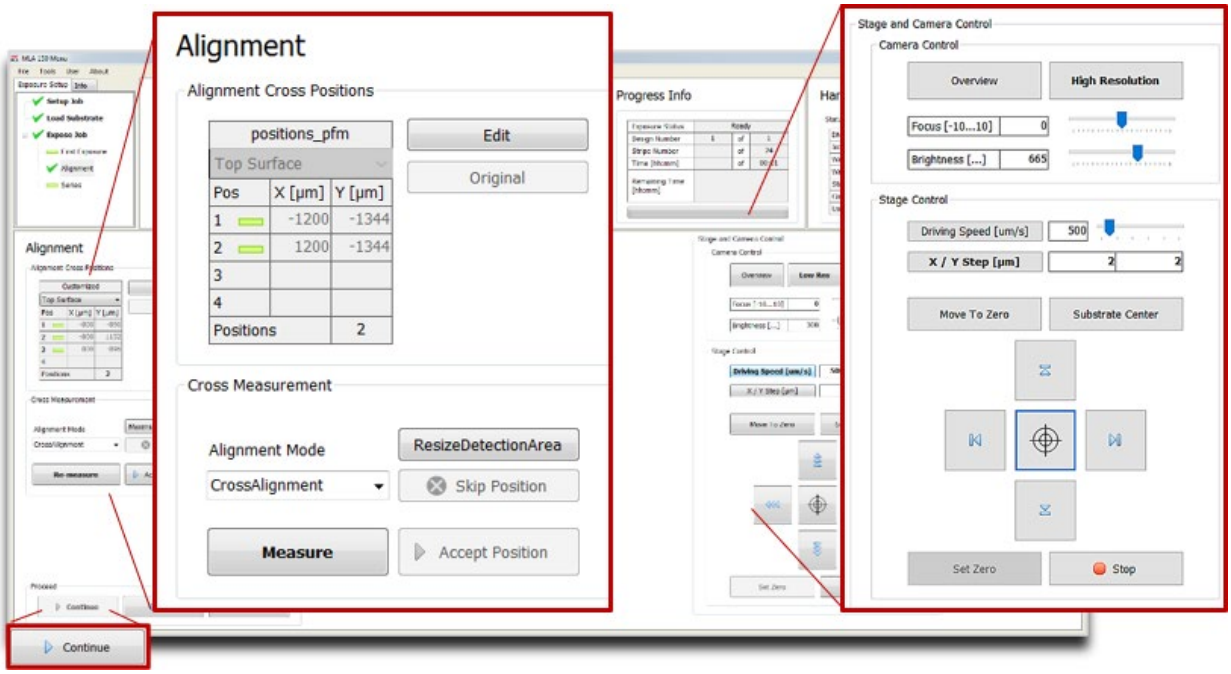


Fig. 62: Exposure Wizard – Overlay Alignment

Perform the following steps to execute an overlay alignment procedure:

1. Select the high-resolution camera in the Camera Control frame.
2. Select the alignment mode from the **Alignment Mode** drop-down list in the Cross Measurement frame.

   You can select a different alignment mode for each alignment cross position.
3. Check the alignment cross positions in the Alignment Cross Positions frame.
4. If you want to edit alignment cross positions, perform the following steps:
   1. Select the relevant alignment cross position from the list in the Alignment Cross Positions frame.
   2. Click **Edit**.
   3. Enter the x-coordinate and y-coordinate of the new position.

      To delete one of the 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.
   4. Click **Save**.

   ✓ The positions are stored in a temporary file. After the exposure process starts, the temporary file is saved as a template.
   5. Perform step 1 to steps 3 for each alignment cross position that you want to edit.
   6. If you want to restore the original alignment cross positions, click **Original**.

If you selected the template `_Manual.xml` was selected, all alignment cross positions have to be set manually via the edit function.

✓ The alignment cross positions are edited.

Now, the parameters are setup up.

Continue with the steps below.

6.7.2 EXECUTE MEASUREMENT

Perform the following step to execute measurements:

1. Move the camera to the first alignment cross.

   You use the stage and camera controls in the Control Panel to move the camera. For more information, see "7.1 Control panel", page 71.

NOTE

For fine positioning use the arrow buttons. You can switch between continuous movement (jogging) and stepwise movement.

In step mode enter the step size [µm] for X and Y direction into the corresponding fields.

In the jogging mode, change the driving speed [µm/s] either by using the slider or by clicking into the corresponding field and entering the speed manually. Alternatively, click into the slider field and use the arrow keys for setting the speed.

2. If you use **Cross Alignment** mode, perform the following steps:
   1. Click **Measure**.
   ✓ The system measures the position of the alignment cross.
   ✓ The system moves the alignment cross into the center of the camera window.
   2. Check the position of the alignment cross.
   3. Click **Accept position**.
   ✓ In the **Pos** column in the Alignment Cross Positions frame, a tick mark indicates that the relevant position was accepted.
   ✓ The procedure continues with the next alignment cross.
   4. Perform step 1 to step 3 for all alignment crosses that you want to measure.

✓ All alignment crosses are measured.

3. If you use **Manual Alignment** mode, perform the following steps:
   1. Click **Measure**.
   ✓ In the camera window, a crosshair is shown.
   2. Move the crosshair to the alignment cross position that you want to set.
   3. Left-click to set the alignment cross position.
   ✓ The crosshair turns from green to orange.

4. Perform step 1 to step 3 for all alignment crosses that you want to measure.

✓ All alignment crosses are measured.

4. If you want to center an alignment cross position in the camera window, click **Center Cross**.
5. If you want to skip an alignment cross position, click **Skip Position**.

✓ The relevant alignment cross position is skipped.

✓ In the **Pos** column in the Alignment Cross Positions frame, a red cross indicates that the relevant position was skipped.

6. Click **Continue**.

✓ The Alignment: Exposure panel opens.

Continue with the overlay alignment exposure. For more information, see "6.8.2 Overlay Exposure procedure", page 65.

6.8 Expose designs

This section explains how to execute exposures in different exposure modes.

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 defoc 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.

6.8.1 FIRST EXPOSURE PROCEDURE

You start the First Exposure procedure in the First Exposure panel.

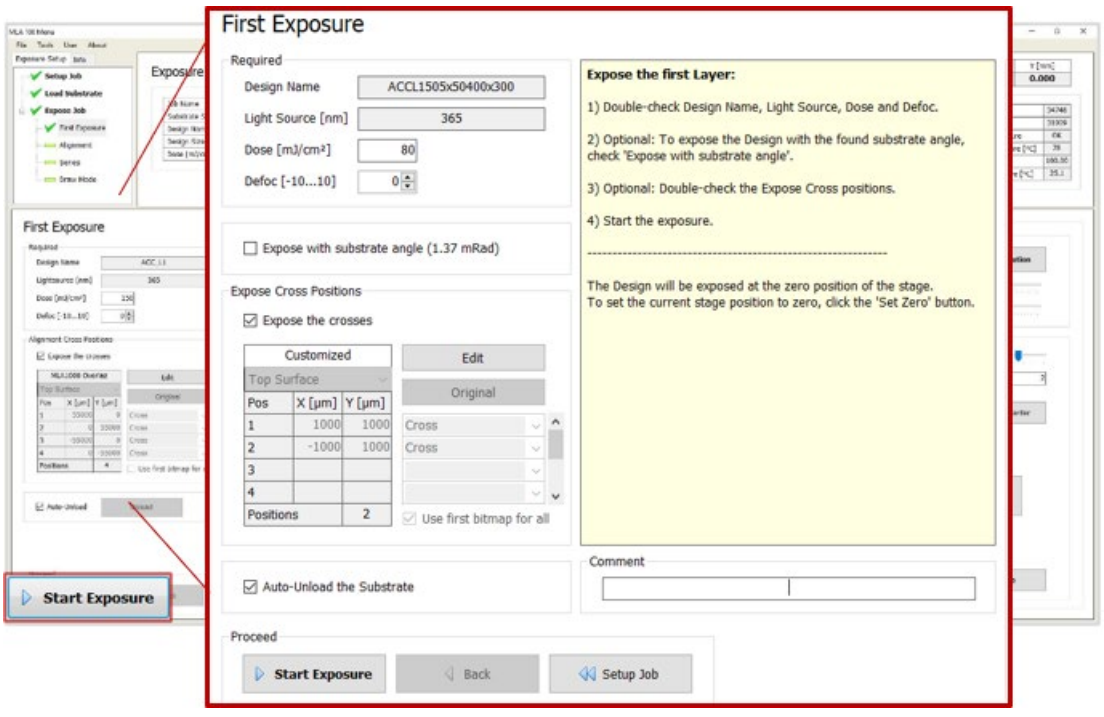


Fig. 63: Exposure Wizard – First Exposure

Perform the following steps to start the First Exposure procedure:

1. Check the design name in the Required frame.
2. Enter the dose value in the **Dose** field.
3. Enter the defoc value in the **Defoc** field.
4. If you want to automatically unload the substrate after the exposure procedure is complete, select the *Auto-Unload* checkbox.
5. If you want to expose alignment crosses, select the **Expose the crosses** checkbox.

   For more information about how to select an alignment cross positions template, see "6.3.1 Standard: First exposure", page 49.

   – If you want to edit the alignment cross positions, click **Edit**.
   – If you want to restore the original alignment cross positions, click **Original**.
6. Click **Start Exposure**.

✓ The exposure procedure starts.

NOTE

If the process requires your decision, the process is put on hold and a dialog box opens.

Read the message in the dialog box carefully. Then, decide to accept or reject.

When the exposure procedure is complete, you can continue with unloading the substrate.

6.8.2 OVERLAY EXPOSURE PROCEDURE

You start the Overlay Exposure procedure in the Alignment Exposure panel.

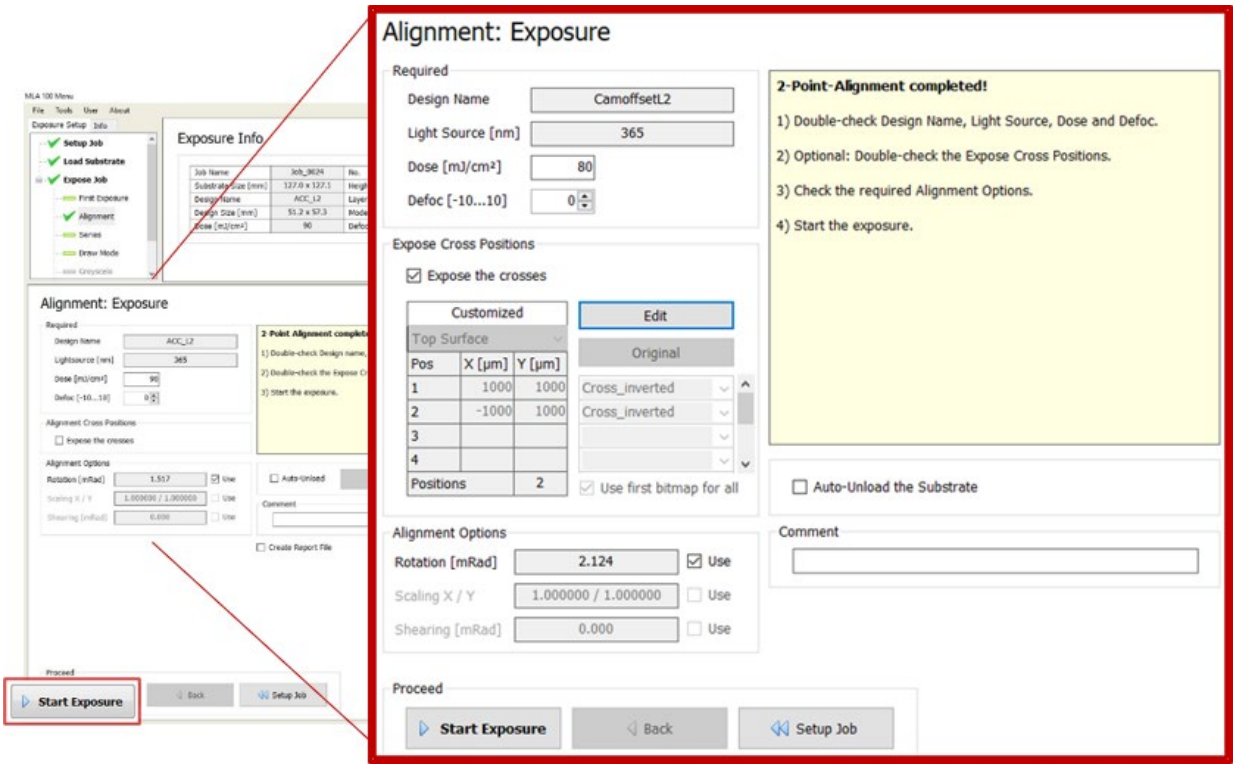


Fig. 64: Exposure Wizard – Alignment Exposure

Perform the following steps to start the Overlay Exposure procedure:

1. Check the design name in the Required frame.
2. Enter the dose value in the **Dose** field.
3. Enter the defoc value in the **Defoc** field.
4. Check the alignment cross positions in the Expose Cross positions frame.
5. If you want to automatically unload the substrate after the exposure procedure is complete, select the *Auto-Unload* checkbox.
6. Click **Start Exposure**.

✓ The exposure procedure starts.

NOTE

If the process requires your decision, the process is put on hold and a dialog box opens.

Read the message in the dialog box carefully. Then, decide to accept or reject.

When the exposure procedure is complete, you can continue with unloading the substrate.

6.8.3 EXPOSURE SERIES PROCEDURE

You start the Exposure Series procedure in the Series panel.

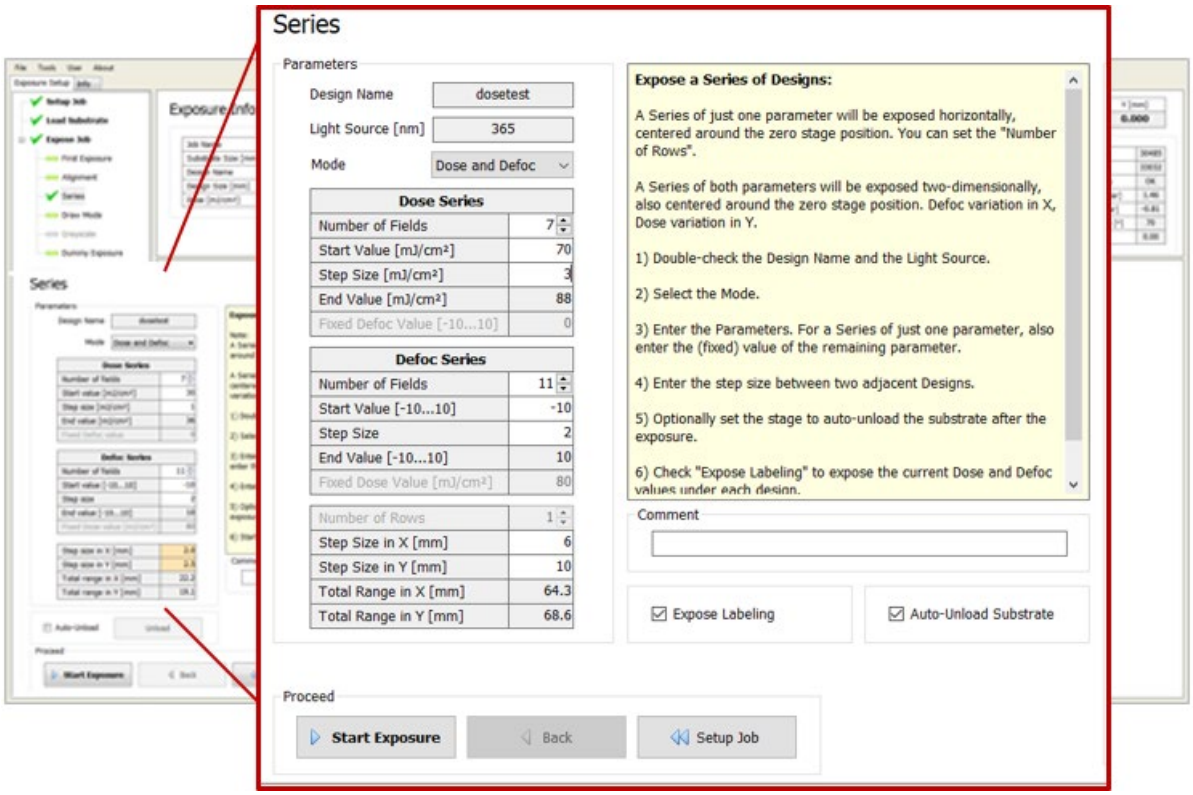


Fig. 65: Exposure Wizard – Exposure Series

Perform the following steps to start the Exposure Series procedure:

1. Check the design name in the Required frame.
2. Select the exposure series mode from the **Mode** field in the Parameters frame.

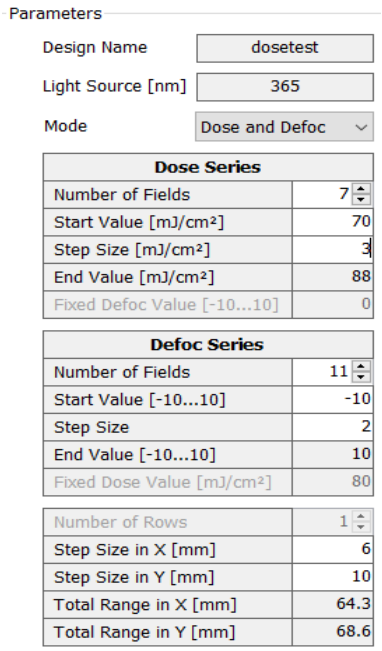


Fig. 66: Exposure Series – Parameters frame

You have the following options:

1. Select **Dose** to start a dose series with incrementing dose values.
– Set the number of fields that you want to expose in the **Number of Fields** field.
– Set the starting dose value in the **Start Value** field.
– Set the step size for the dose value in the **Step Size** field.

   Note that the defoc value cannot be changed when executing a dose series exposure.

2. Select **Defoc** to start a defoc series with incrementing defoc values.
– Set the number of fields that you want to expose in the **Number of Fields** field.
– Set the starting defoc value in the **Start Value** field.
– Set the step size for the defoc value in the **Step Size** field.

   Note that the dose value cannot be changed when executing a defoc series exposure.

3. Select **Dose and Defoc** to start a dose and defoc series with incrementing dose and defoc values.
– Set the number of fields that you want to expose in the **Number of Fields** field.
– Set the starting dose value in the **Start Value** field.
– Set the step size for the dose value in the **Step Size** field.
– Set the starting defoc value in the **Start Value** field.
– Set the step size for the defoc value in the **Step Size** field.

3. Set the Step size in x- and y-direction table at the bottom of the Parameters frame.

   You can also set the number of rows for dose exposure series or defoc exposure series. Note that this is not possible for dose and defoc exposure series.

4. If you want to write the parameters dose and defoc in plain text below the exposed field on the wafer, select the **Expose Labeling** checkbox. This does not increase the exposure time.

Fig. 67: Exposure Series – Expose Labeling

Note that the step size has to be increased so that the label fits below each field. The **Step Size** field is highlighted in orange if the step size is too low. With labeling exposure activated, the **Total Range** is increased.

5. If you want to automatically unload the substrate after the exposure procedure is complete, select the *Auto-Unload* checkbox.
6. Click **Start Exposure**.

✓ The exposure procedure starts.

NOTE

If the process requires your decision, the process is put on hold and a dialog box opens.

Read the message in the dialog box carefully. Then, decide to accept or reject.

When the exposure procedure is complete, you can continue with unloading the substrate.

6.8.4 DRAW MODE EXPOSURE PROCEDURE

You start the Draw Mode Exposure procedure in the Draw Mode panel.

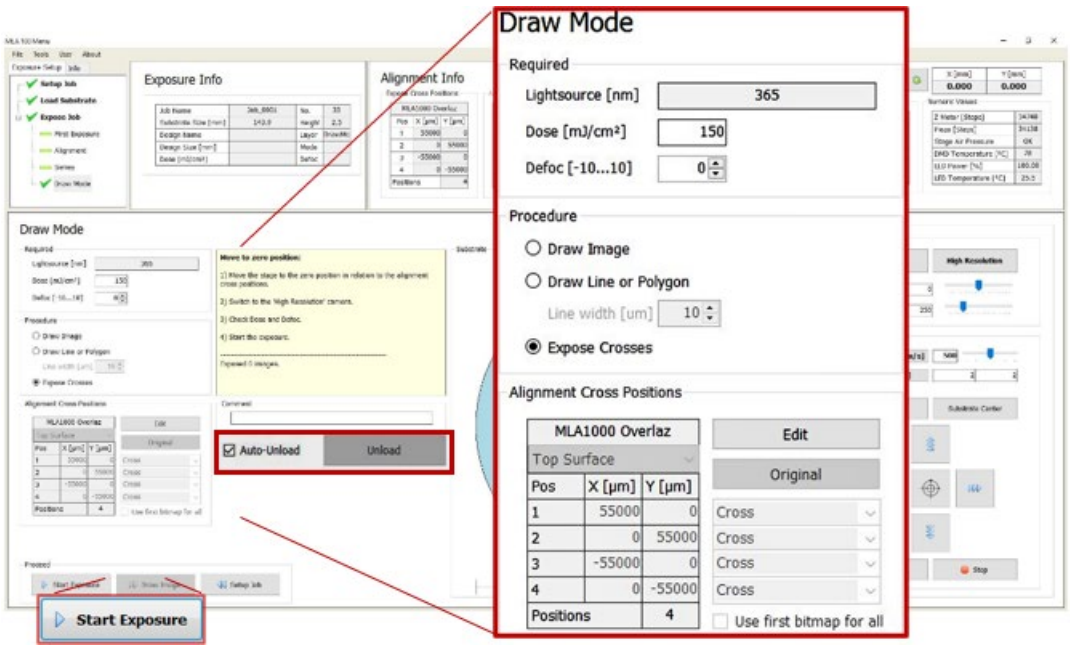


Fig. 68: Exposure Wizard – Draw Mode Exposure

Perform the following steps to start the Draw Mode Exposure procedure:

1. Enter the dose value in the **Dose** field.
2. Enter the defoc value in the **Defoc** field.
3. If you want to automatically unload the substrate after the exposure procedure is complete, select the *Auto-Unload* checkbox.
4. Click **Start Exposure**.

✓ The exposure procedure starts.

NOTE

If the process requires your decision, the process is put on hold and a dialog box opens.

Read the message in the dialog box carefully. Then, decide to accept or reject.

When the exposure procedure is complete, you can continue with unloading the substrate.

6.9 Unload substrates

6.9.1 UNLOAD SUBSTRATES AUTOMATICALLY

The system provides the option to unload the substrate automatically in various contexts by selecting the *Auto-Unload* checkbox.

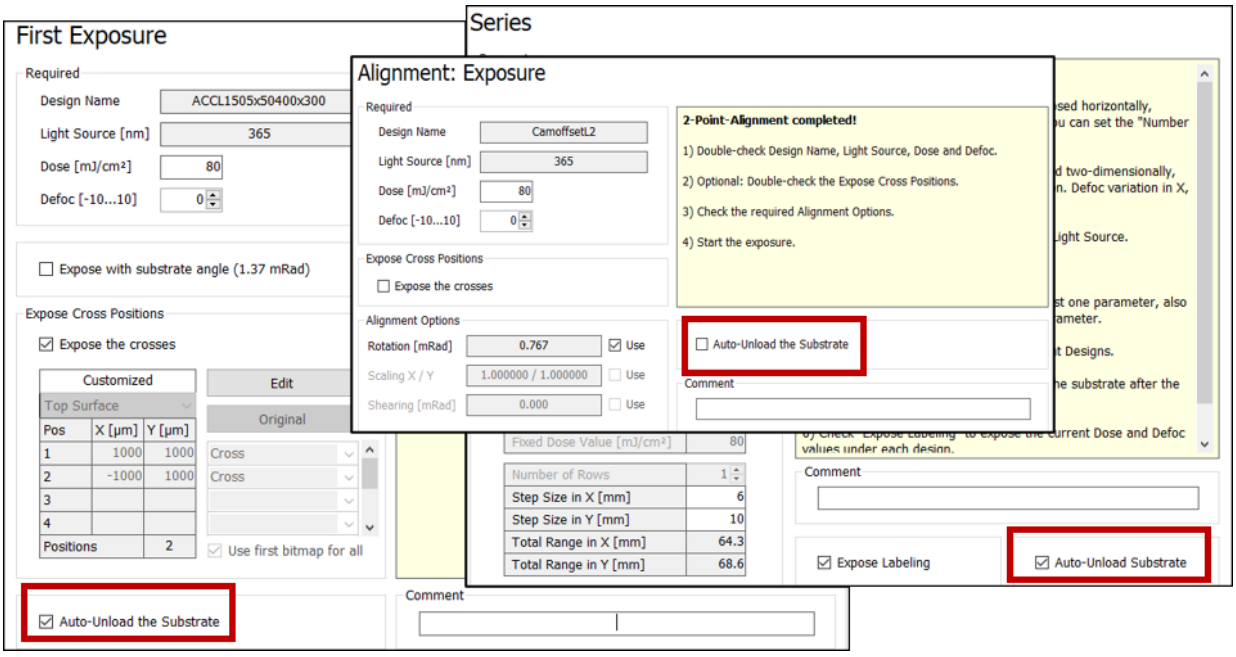


Fig. 69: Exposure Wizard – Auto-Unload checkbox

Above, possible locations of the *Auto-Unload* checkbox are shown. Depending on the exposure mode, the checkbox can be located below the info box or below the parameter setup frames. You can select the *Auto-Unload* checkbox before starting the exposure procedure.

If the *Auto-Unload* checkbox is selected, the system automatically moves the stage into the unloading position directly after the exposure process is finished. 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.

6.9.2 UNLOAD SUBSTRATES MANUALLY

If you do not want to unload the substrate automatically, you can unload the substrate manually.

After an exposure procedure is finished, the *Exposure Finished* dialog box opens.

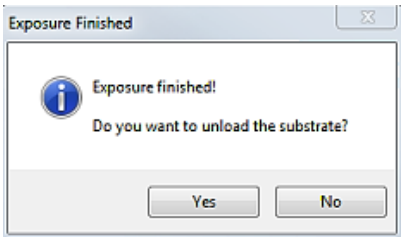


Fig. 70: Exposure Wizard – Exposure Finished dialog box

You have the following options:

- If you want to unload the substrate, click **Yes**. Then, remove the substrate from the chuck.
- If you do not want to unload the substrate, click **No**.

Alternatively, you can click **Unload Substrate** in the Proceed frame at the bottom of the Setup Job panel.

6.9.3 REMOVE SUBSTRATES FROM THE CHUCK

NOTICE

Observe the general guidelines for handling substrates.

- Do not expose the substrate to white light.
- Do not touch the surface on areas that are to be exposed.
- Avoid scratches on both the upper and lower surface.
- Make sure that the stage and the substrate remain clean.

Perform the following steps to remove the substrate from the chuck:

1. Make sure that the white light is switched off.

✓ Only the appropriate safelight is switched on.

2. Open the cover lid.
3. Carefully take the substrate off the chuck and stow it in an opaque box impermeable to light.
4. Close the cover lid.
5. Click **OK** in the Exposure Wizard, if necessary.

✓ The unloading dialog box closes.

7 Utilities and Tools

The μMLA control software offers further elements besides the main menu that facilitate handling the exposure and alignment processes.

7.1 Control panel

The Control Panel provides navigation functions as well as other necessary control functions.

7.1.1 CAMERA CONTROL FRAME

In the Camera Control frame, you can select the available cameras by clicking the corresponding camera button. The information about the field of view of the different cameras helps to make the decision which one to choose for the current application. For alignments, it is recommended to use the High-Resolution camera as its high resolution is best for alignment procedures.

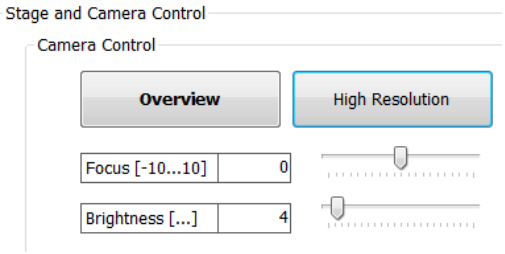


Fig. 71: Control panel – Camera Control frame

The following table shows the field of view dimensions of the cameras for the different write modes:

Camera	Write Mode I	Write Mode II
High-Resolution camera	150 μm × 110 μm	384 μm × 288 μm
Overview camera	13 mm × 10 mm	13 mm × 10 mm

Tab. 14: Camera – Field of view dimensions

Below the camera buttons, you find the **Focus** slider for setting the camera focus and the **Brightness** slider for setting the brightness of the camera image.

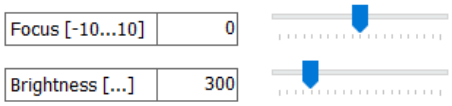


Fig. 72: Control panel – Sliders

In Alignment Mode, for very thick resists the focus can be switched to a larger camera defocus with a wider defocus range by selecting **Tools** » **Large Camera Defoc** from the menu bar. Moving the **Range** slider changes the focus position in a wider range.

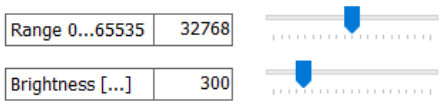


Fig. 73: Control panel – Sliders – Large Camera Defoc

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.

7.1.2 STAGE CONTROL FRAME

The Stage Control frame provides arrow buttons to move the stage. Every click is one movement. They are also used for fine positioning.

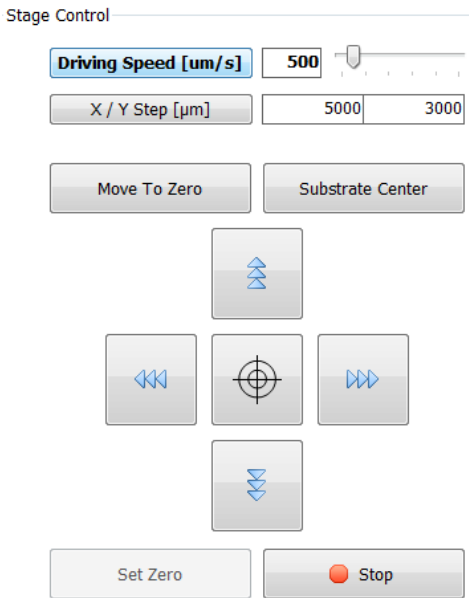
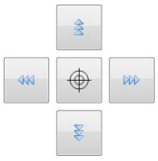


Fig. 74: Control panel – Stage Control frame

Object	Description
Driving Speed	Select continuous stage movement (jog mode).
X/Y Step	Select stepwise stage movement (step mode).
Move To Zero	Move the stage to the (0/0) position.
Substrate Center	Move to the stage to the substrate center.
	Control the stage movement via the arrow buttons.
Set Zero	Set the current position as the (0/0) position.
Stop	Stop any stage movement.

Tab. 15: Stage Control frame – Control objects

The control software offers 2 stage movement modes:

- Continuous movement (jog mode)
- Stepwise movement (step mode)

JOG MODE

In jog mode, you can enter the movement speed in the **Drive Speed** field. Alternatively, you can use the slider to set the movement speed.

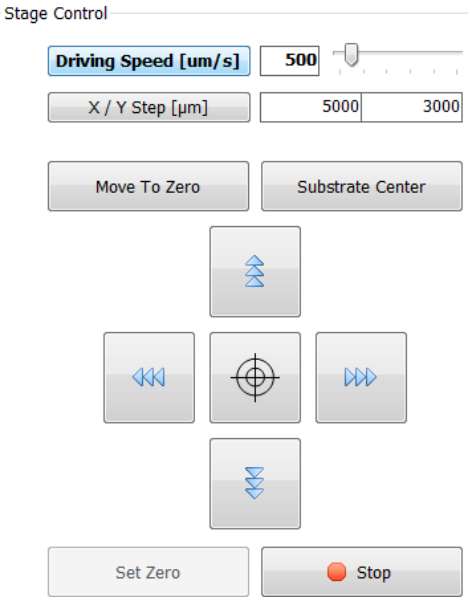


Fig. 75: Control panel – Stage Control frame – Jog mode

STEP MODE

In step mode, enter the step size [µm] 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 fast identification of the mode currently selected.

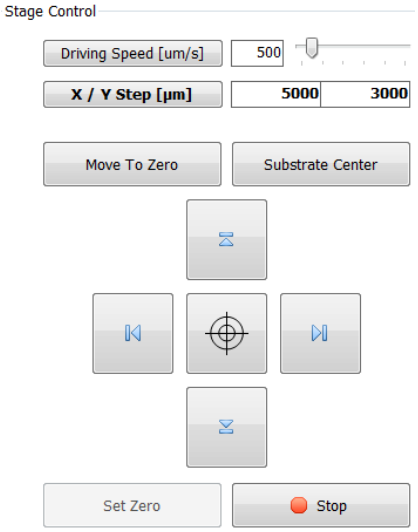


Fig. 76: Control panel – Stage Control frame – Step mode

7.2 Optimize alignment and exposure results

7.2.1 OPTIMIZE ALIGNMENT RESULTS

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 on how to improve the measurement results during the alignment process.

REPEAT THE MEASUREMENT

After the first measurement procedure for a coordinate point is complete, the **Re-Measure** button is shown instead of the **Measure** button.

You can click **Re-Measure** to repeat the measurement procedure. Repeating the measurement procedure can lead to better results.

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**.

ADJUST SETTINGS IN THE CONTROL PANEL

- Adjust the values for focus or brightness to make the finding cross function work more efficiently.
- Select a different camera to get a better view of the substrate.
- In the Stage Control panel, switch between Jog mode and Step mode.

SWITCH TO MANUAL MODE

For each alignment cross, it is possible to switch between the two modes for the alignment procedure. Manual Alignment is the manual mode for cross detection and is provided for exceptional cases in which the automatic detection might not work properly.

For more information about how to use the Manual Alignment mode, see "6.7 Set up overlay alignment", page 60.

7.2.2 OPTIMIZE EXPOSURE RESULTS

Sometimes exposure results can be unsatisfying for the needs of distinctive applications. The system offers a way of optimizing the exposure results. It is possible to adjust the defoc value or the dose value. The following contains information about how to work with these two values to improve exposure results.

The Exposure Wizard offers a series exposure mode. You can use the Series Exposure mode to optimize exposure results by adjusting the defocus value (defoc) and/or the

energy value (dose). You can execute an exposure series to determine the best ratio between these two parameters.

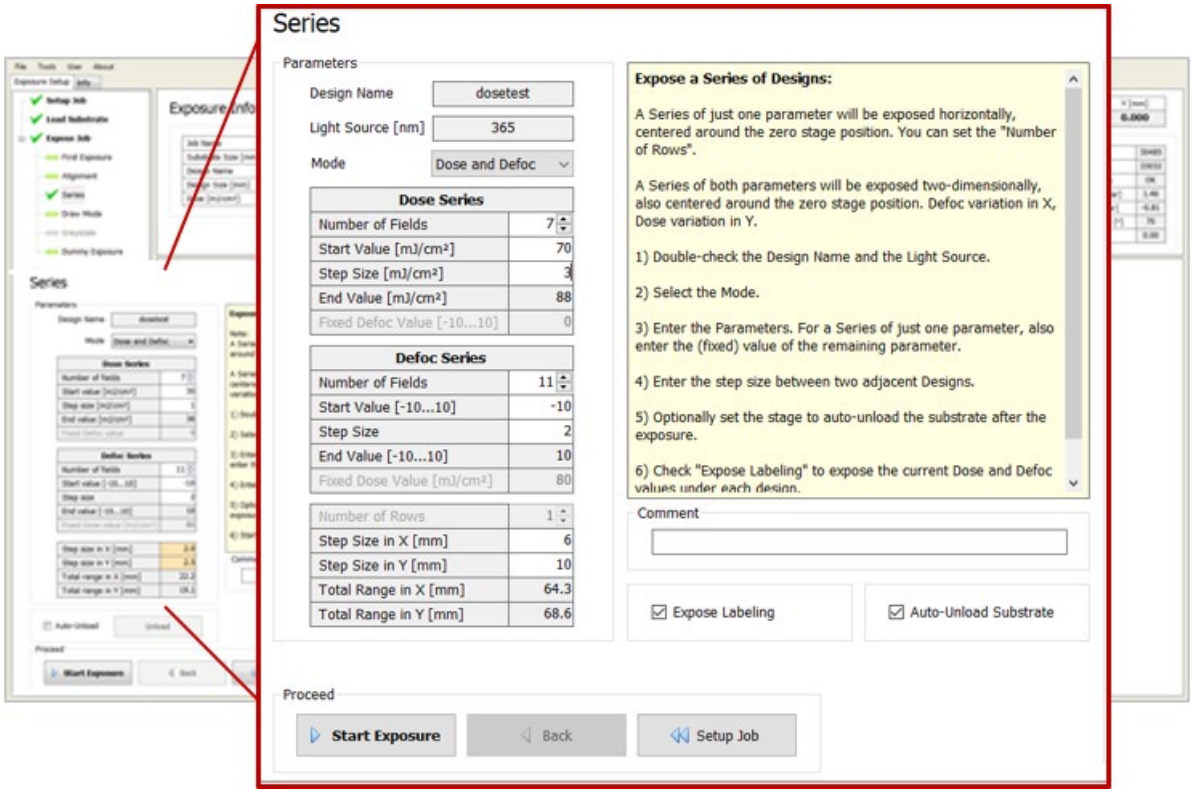


Fig. 77: Exposure Wizard – Exposure Series

For more information about the Exposure Series procedure, see "6.8.3 Exposure Series procedure", page 66.

8 Advanced functions for staff users

This chapter explains wizard functions that require extended user rights and are only available for the **Staff** user role.

8.1 System backup

This chapter explains how to back up the system files. You can access the System Backup window via **Select Tools** » **Backup** in the menu bar.

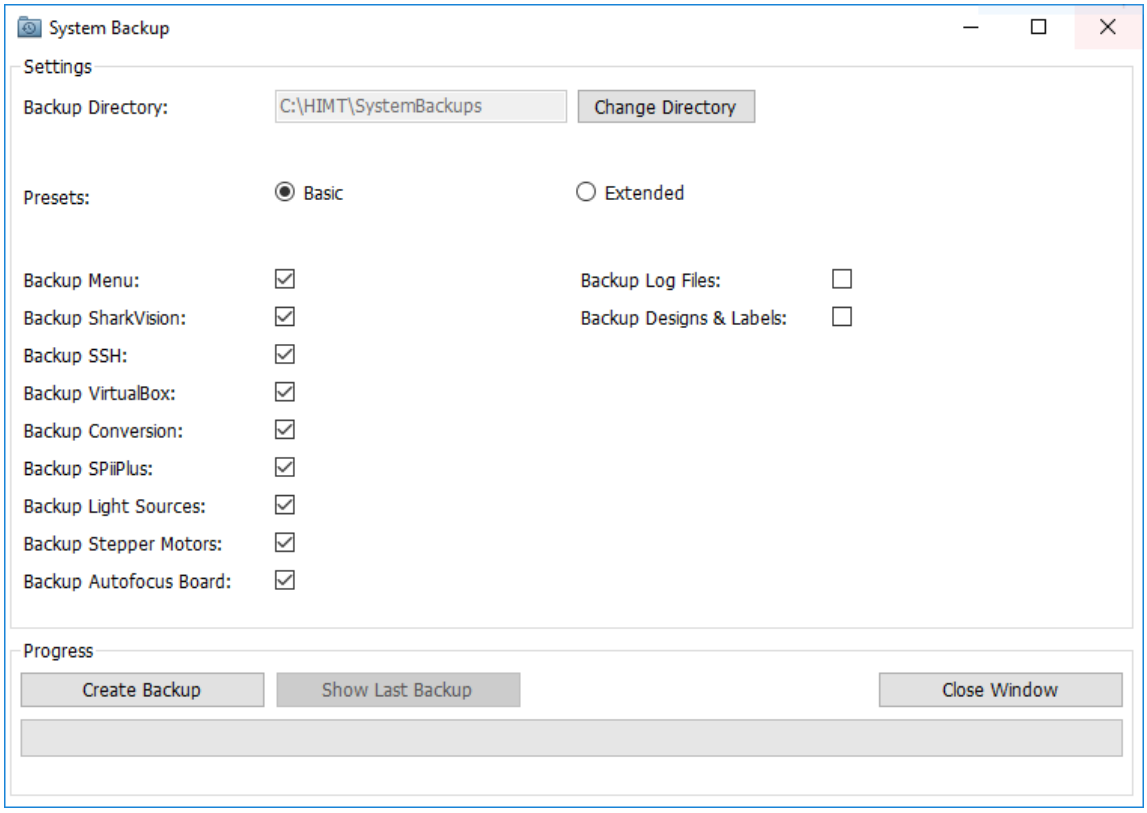


Fig. 78: Advanced functions – System backup

Object	Description
Change Directory	Change the directory for saving the backup files.
Basic	Select all basic backup options.
Extended	Select all extended backup options. Note that the extended backup options require a high memory capacity.
Backup Menu	Select this option to back up the Menu software, including binaries and configuration files.
Backup SharkVision	Select this option to back up the files of the camera software including binaries and configuration files.

Backup SSH	Select this option to back up the user credentials the menu uses to communicate with the Linux in the VirtualBox.
Backup VirtualBox	Select this option to back up various configuration files of the VirtualBox.
Backup Conversion	Select this option to back up the conversion software binaries of Linux, including binaries and configuration files.
Backup SPiiPlus	Select this option to back up the motion controller configuration and program buffers.
Backup Light Sources	Select this option to back up the light source configuration.
Backup Stepper Motors	Select this option to back up the current positions of all stepper motors.
Backup Autofocus Board	Select this option to back up various configuration files of the Autofocus Card.
Backup Log Files	Select this option to back up all log files created by the control software, including Common Log and Job Exposure Logs.
Backup Designs & Labels	Select this option to back up the design files located in `C:\HIMT\Designs`. Note that a backup of the design files may require a large amount of disk space, depending on the design size.

Tab. 16: System backup – Control objects

NOTE

We recommend copying the backup files from the processing unit to an external storage media to prevent data loss in the unlikely case of a total failure of the processing unit.

8.2 Execute LED measurements

This section explains how to measure the LED power. You measure LED power to compare it with the value measured during the most recent calibration procedure.

PRECONDITIONS

Before starting the LED measurement procedure, complete the following tasks:

- Switch off the vacuum.
- Make sure that the stage is empty.

PROCEDURE

Perform the following steps to execute LED measurements:

1. Select **Tools** » **LED Measurement** from the menu bar.

✓ The LED Measurement panel opens.

2. Select the wavelength of the exposure light source from the **Light Source** drop-down list.

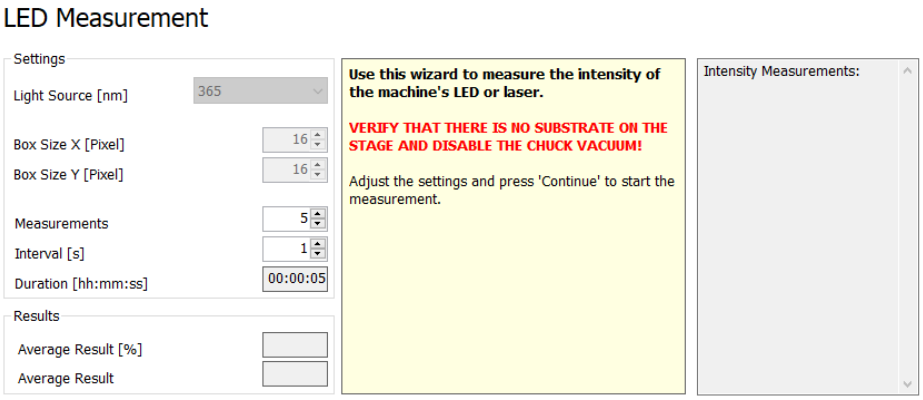


Fig. 79: Advanced functions – LED Measurement panel

3. Enter the number of measurements that you want to execute in the **Measurements** field.
4. Enter the interval between measurements in the **Interval** field. The interval is specified in seconds.
5. Click **Continue**.
6. Check the measurement parameters.
7. Click **Measure**.

✓ The system executes the measurement.

✓ The results of each measurement are shown in the Intensity Measurements list next to the info box.

✓ The average results are shown in the Results frame in the LED Measurement panel.

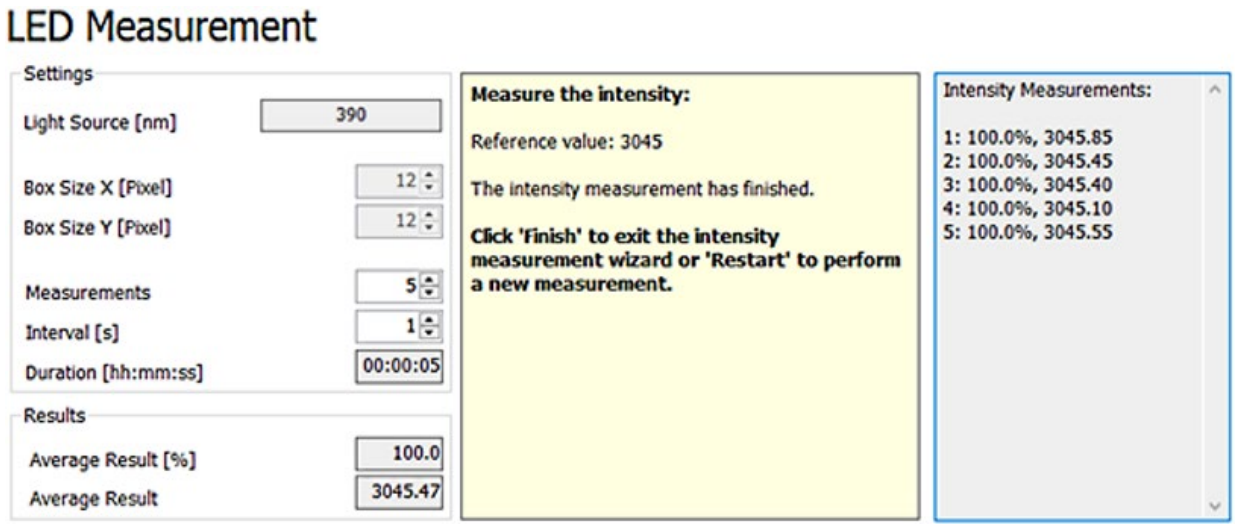


Fig. 80: LED Measurement panel – Results

Now, the LED measurement procedure is complete.

You can continue with the following actions:

- To finish the LED measurement procedure, click **Finish**.
- To repeat the LED measurement procedure, click **Restart**.

8.3 Set up substrate template

This chapter explains how to set up substrate templates in the Load Substrate panel.

8.3.1 LOAD SUBSTRATE PANEL

The Load Substrate panel opens when you click a field in the Substrate Template column in the Setup Job panel.

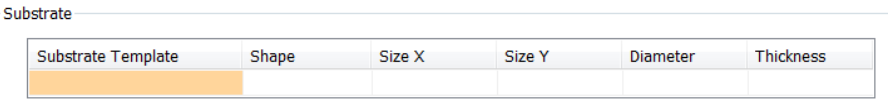


Fig. 81: Setup Job Panel – Substrate Template column

BASIC OPTIONS

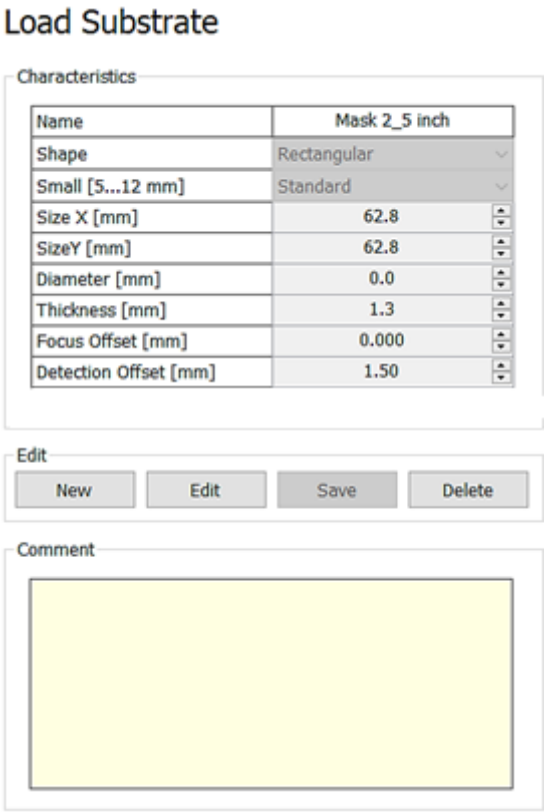


Fig. 82: Load Substrate panel – Basic options

Object	Description
Name	Enter a name for the substrate template.
Shape	Select the substrate shape.

Small	There are 3 substrate size categories: • **Small** (5-9 mm) • **Standard** (10-180 mm) • **Extended** (181-230 mm) The value is set automatically when you enter the substrate size in the **Size X** and **Size Y** fields.
Size X	Enter the substrate size in x-direction.
Size Y	Enter the substrate size in y-direction.
Diameter	Enter the diameter of the wafer.
Thickness	Enter the thickness of the substrate.
Detection Offset	Due to a machine offset the size of the substrate entered might differ from the size measured by the system during the loading process.
New	Create a new substrate template.
Edit	Edit the selected existing substrate template.
Save	Save the substrate template.
Delete	Delete the selected substrate template.

Tab. 17: Load Substrate panel – Basic options – Control objects

ADVANCED OPTIONS

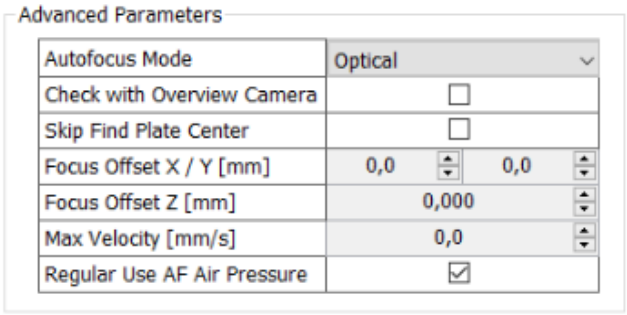


Fig. 83: Load Substrate panel – Advanced options

Object	Description
Autofocus Mode	Select the autofocus mode from the drop-down list.
Check With Overview Camera	Select this option to check the substrate with the overview camera before focusing (same procedure as loading small substrates).
Skip Find Plate Center	Select this option to skip the find plate center procedure. ***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.

	Use this option only for special applications after contacting your local Heidelberg Instruments Mikrotechnik Customer Service Center.
Focus Offset X/Y	Set the focus offset in x- and y-direction. ***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.
Focus Offset Z	Set the focus offset in z-direction. ***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. Use this option only for special applications after contacting your local Heidelberg Instruments Mikrotechnik Customer Service Center.
Max Velocity	Reduce the travel velocity of the stage. Some applications may require a reduced travel velocity
Regular Use AF Air Pressure	Activates or deactivates the compressed air for the pneumatic autofocus: • Selected: The compressed air for the pneumatic autofocus is switched on. • Deselected: The compressed air for the pneumatic autofocus is switched off.

Tab. 18: Load Substrate panel – Advanced options – Control objects

8.3.2 SET UP TEMPLATE

1. Click a field in the Substrate Template column in the Setup Job panel.

✓ The Load Substrate panel opens.

2. Click **New** in the Edit frame.
3. Set the substrate parameters in the Characteristics frame.
4. Set the advanced substrate parameters in the Advanced Parameters frame, if required.
5. Click **Save** in the Edit frame.

✓ The new substrate template is created.

✓ The new substrate template can be used by other users.

6. Start a loading procedure and select the new template in the Substrate frame.

7. Load the substrate.

✓ During the loading procedure, the system measures the substrate size.

✓ The Find Plate Center dialog box opens and notifies you about the detected substrate size and possible deviations from the size set in the table.

Now, the procedure is finished.

You have the following options:

- Click **Yes** to continue.

  You can continue even if a deviation occurred.

- Click **No** to stop the procedure if a deviation occurred.

  You return to the Load Substrate panel and adjust the detection offset in the Characteristics frame.

8.4 Set up resist templates

This chapter explains how to set up resist templates in the Load Resist panel.

8.4.1 LOAD RESIST PANEL

The Load Resist panel opens when you click a field in the Resist column in the Setup Job panel.

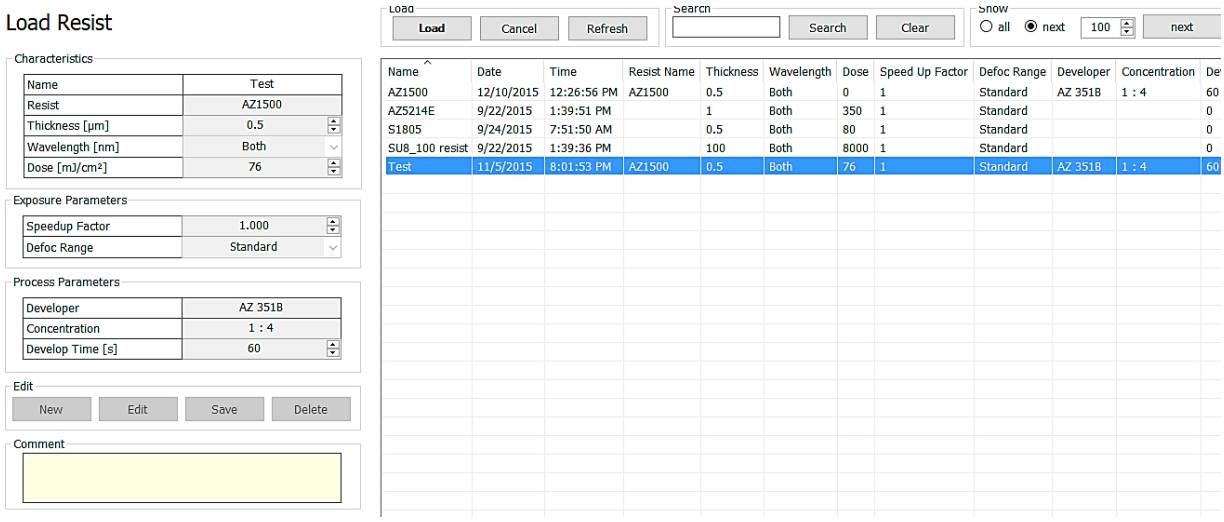


Fig. 84: Advanced functions – Load Resist panel

Object	Description
Name	Enter a name for the resist template.
Resist	Enter the resist type.
Thickness	Enter the thickness of the resist.
Wavelength	Select the exposure light sources for which the resist is available.
Dose	Enter the dose that is used for exposing the resist.
Speedup Factor	Enter the speedup factor.

	At a 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, do not set a speedup factor higher than 1.
Defoc Range	Choose between Standard (-10 to 10) and Extended (-25 to 25). For more information about exposures with extended defocus range, see "8.4.3 Exposing with extended defocus range", page 84.
Developer	Enter the developer name.
Concentration	Enter the concentration.
Develop Time	Enter the development time.
New	Create a new resist template.
Edit	Edit the selected resist template.
Save	Save the resist template.
Delete	Delete the selected resist template.

Tab. 19: Load Resist panel – Control objects

8.4.2 SET UP TEMPLATE

Perform the following steps to set up a resist template:

1. Click a field in the Resist column in the Setup Job panel.

✓ The Load Resist panel opens.

2. Click **New** in the Edit frame.
3. Set the resist parameters in the Characteristics frame.
4. If you want to change the speedup factor, enter the new speedup factor in the **Speedup Factor** field.
5. Select **Standard** from the **Defoc Range** drop-down list.
6. Set the process parameters in the Process Parameters frame, if required.
7. Click **Save** in the Edit frame.

✓ The new resist template is created.

Now, the new resist template can be used by other users.

8.4.3 EXPOSING WITH EXTENDED DEFOCUS RANGE

This section explains how to set up resist templates with an extended defocus range. You use exposure with an extended defocus range, for example, to expose deeper into the resist.

NOTE

This function serves for extending the exposure defocus range and is not to be confused with the Large Camera Defoc function for extending the camera defocus range during alignment. These are two different functions.

Perform the following steps to set up a resist template with an extended defocus range:

1. Click a field in the Resist column in the Setup Job panel.

✓ The Load Resist panel opens.

2. Click **New** in the Edit frame.
3. Set the resist parameters in the Characteristics frame.
4. If you want to change the speedup factor, enter the new speedup factor in the **Speedup Factor** field.
5. Select **Large** from the **Defoc Range** drop down list.
6. Set the process parameters in the Process Parameters frame, if required.
7. Click **Save** in the Edit frame.

✓ The new resist template is created.

Now, the new resist template can be used by other users.

8.5 Execute beam offset calibration

NOTE

This function is for seasonal drifts. In general, these are below 1 µm. When observing huge offsets, please double-check your alignment marks and positions. When in doubt, contact your local Heidelberg Instruments Mikrotechnik Customer Service Center.

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, the calibration of the write beam is crucial.

To determine 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_uMLA_Camoff_L1` and `HIMT_uMLA_Camoff_L1` 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.

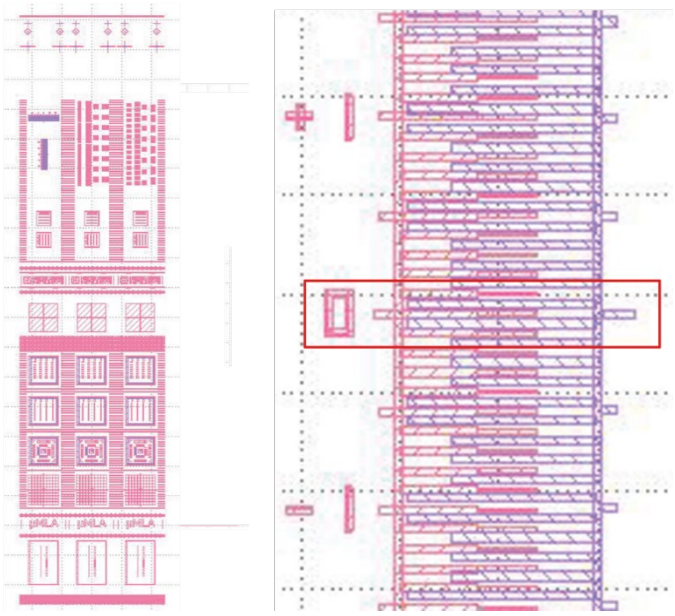


Fig. 85: Vernier scale test pattern

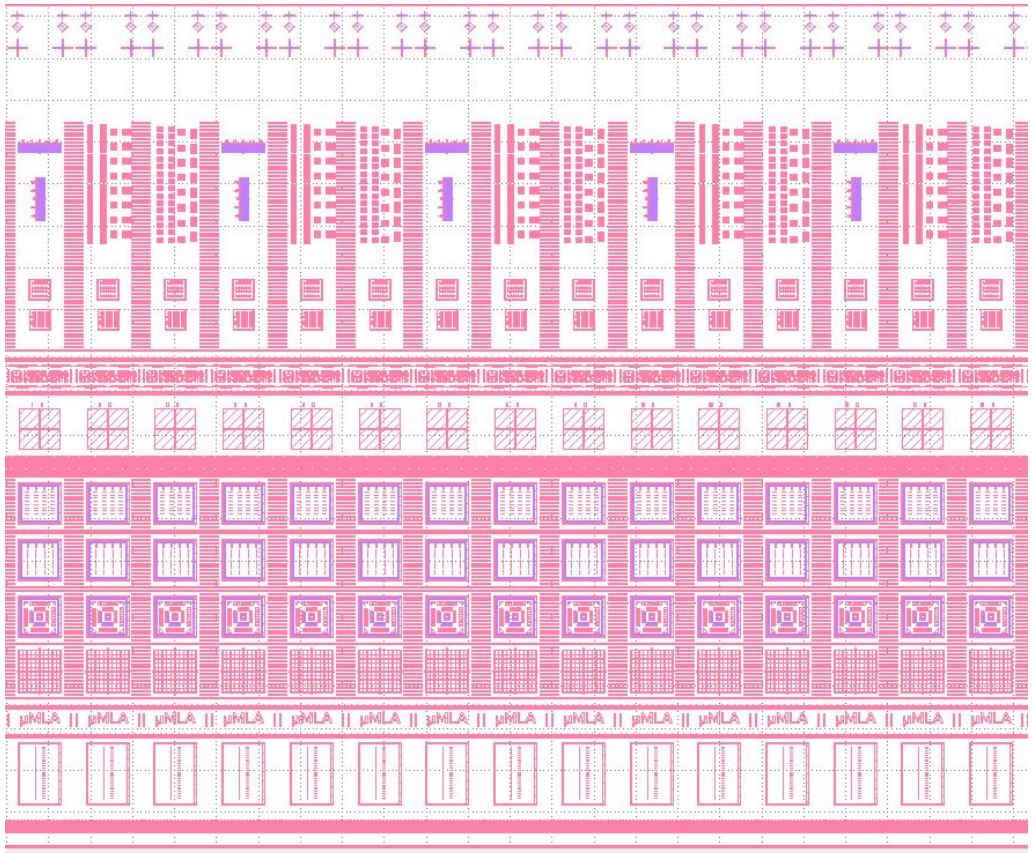


Fig. 86: FAT test pattern

Perform the following steps to execute beam offset calibrations:

1. Execute an overlay exposure.

For more information about how to execute an overlay procedure, see "6.8.2 Overlay Exposure procedure", page 65.

2. After the 2 layers are exposed, check the exposure result either by one of the cameras in the system or with a microscope. Inspect the pattern and determine the beam offset by reading off the nonius.
3. Read off the offset from the Vernier scale.
4. Select **Tools** » **Beam Offset** from the menu bar.
5. Enter the value into the **Displacement X** and **Displacement Y** fields. The system calculates the absolute beam offset automatically.

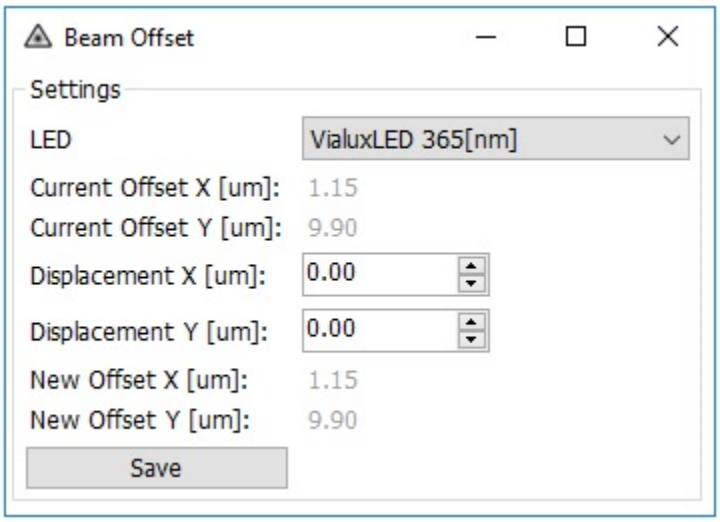


Fig. 87: Advanced functions – Beam offset calibration

6. Click **Save**.

✓ The new beam offset is now included into the system operations.

9 Troubleshooting

9.1 Functional problems

Problem	The system does not start; the power indication lamp is off
Possible Causes	• facility power down • main fuse blown
Remedies	• check facility power • check fuse

Problem	CAD design / LIC file folder cannot be found
Possible Causes	• stored in the wrong directory • wrong name chosen
Remedies	• make sure the design is stored in `C:\HIMT\designs` and the name of the LIC target directory complies with the file name rules of Linux and Windows (no distinguishing between capitals and normal letters)

Problem	Exposure does not start
Possible Causes	• air pressure low • lid not closed properly • design data directory was renamed, or contents have been corrupted • software hung up
Remedies	• check air pressure (see system installation instructions on required values) • check on interlock lamp • reconvert design • reboot system

Problem	Exposure was interrupted, stage motors are disabled
Possible Causes	• air pressure low • lid was opened • motor capability to maintain stage speed against vibration/shock was exceeded • system is not well leveled

Remedies	• check air pressure (see system installation instructions on required values) • check on interlock lamp before starting a new exposure • reset stage (menu **Tools** » **Initialize Stage**) • check and improve leveling as described in the system setup section

9.2 Exposure result problems

Problem	Plate is blank
Possible Causes	• structures too small • energy too low • developer too old/wrong type/wrong mixture • LED off or damaged
Remedies	• check design against design rules and lens resolution • try higher energies • use fresh developer • check if light can be seen in the monitor during exposure

Problem	Plate is completely exposed
Possible Causes	• stray light • old materials
Remedies	• check for possible stray light sources and eliminate them • use a fresh batch of plates and fresh chemicals

Problem	Some structures are missing
Possible Causes	• structures do not comply with design rules or are too small • developer or chrome etch old • air bubbles in structures during etching
Remedies	• check design against design rules and lens resolution • use fresh chemicals • avoid drying of the substrate between developing and etching, or water the plate thoroughly before etching

Problem	Design is shifted
Possible Causes	• wrong selection of design origin • wrong entry of coordinates during alignment
Remedies	• check design

	• check wizard entries

Problem	Design looks completely mixed up
Possible Causes	• vacuum off
Remedies	• check vacuum pump and vacuum on stage

Problem	Design stretched or shrunk compared to the previous layer
Possible Causes	• previous layer not exposed with µMLA, coordinate system units do not match
Remedies	• shrink or stretch design to compensate

9.3 Advanced troubleshooting

Please include the following information when contacting your local Heidelberg Instruments Mikrotechnik Customer Service Center:

- Information on settings of compressed air regulators
- Any error codes and error descriptions provided by the wizard
- The wizard version that is shown when clicking **About** in the Menu bar
- Screenshots, pictures, or descriptive sketches of the problem, if available
- If the problem refers to an exposure, create an extended report file by activating the **create detailed report file** option.
- Send the folder `C:\HIMT` in archived form (.zip, .rar) to your local Heidelberg Instruments Mikrotechnik Customer Service Center. If the file gets too large or archiving takes too long, omit the subfolder `LICSources`.

10 Operator maintenance

10.1 Clean the system

The system covers, ventilation grilles, and internal surfaces should be cleaned regularly to avoid the transfer of particles onto the substrate.

- Only use a clean, lint-free cloth to clean system covers, ventilation grilles, and internal surfaces.
- In case of stronger contamination, wet the cloth slightly with lid soap suds.

NOTICE

Contaminations can damage the air bearings.

The base on which the air bearings are traveling can be contaminated with oil or fat, for example, due to touching with bare hands.

If the air bearing base is contaminated with oil or fat, the air bearings can be damaged by stuck particles.

Clean the air bearing base with a clean, lint-free cloth and isopropanol.

10.2 Refill the coolant

The cooling system needs to be checked every month. In case the coolant level is low, refill the reservoir (see spare parts list for reorder details).

The coolant reservoir is located at the rear of the machine. For more information, see "3.2 Rear", page 14.

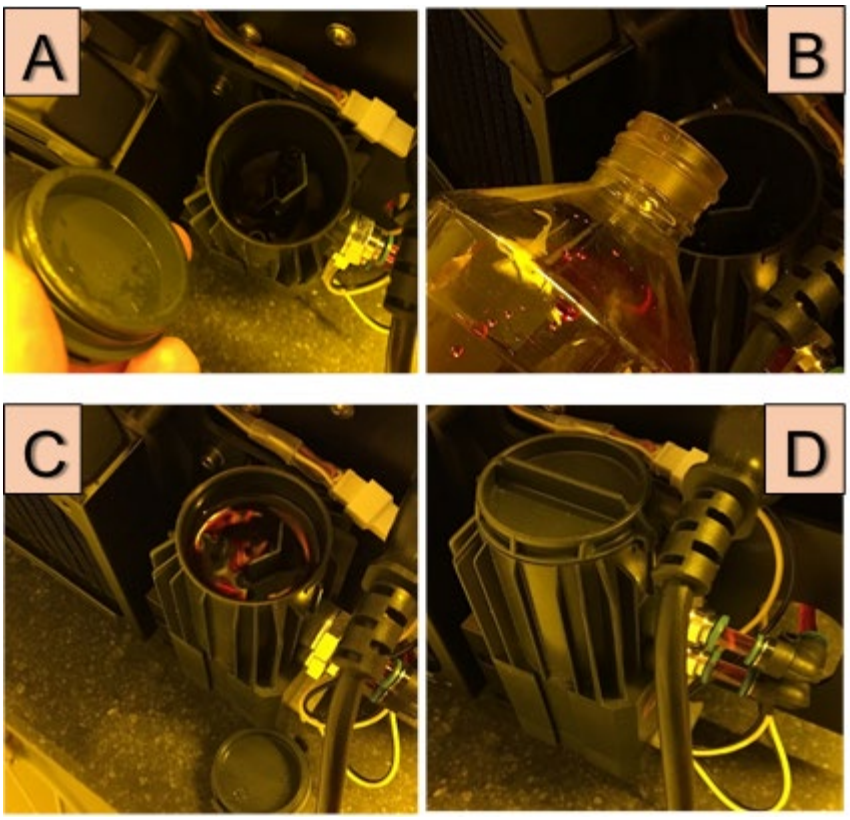


Fig. 88: Check and refill the coolant

Perform the following steps to refill the coolant:

1. Open the reservoir by turning and then pulling the cap **[A]**.
2. Check the coolant level.
3. Take the bottle of coolant.
4. Turn on the coolant pump.
5. Fill the coolant into the reservoir **[B]** until a level of approximately 1.5 cm below the reservoir rim is reached **[C]**.
6. Close the reservoir **[D]**.

✓ The coolant system is ready for use.

10.3 Level the machine

The main unit of the machine is mounted on 4 height-adjustable feet. You use the height-adjustable feet to level the machine. Leveling the machine is important for the proper function of the system and for good exposure results.

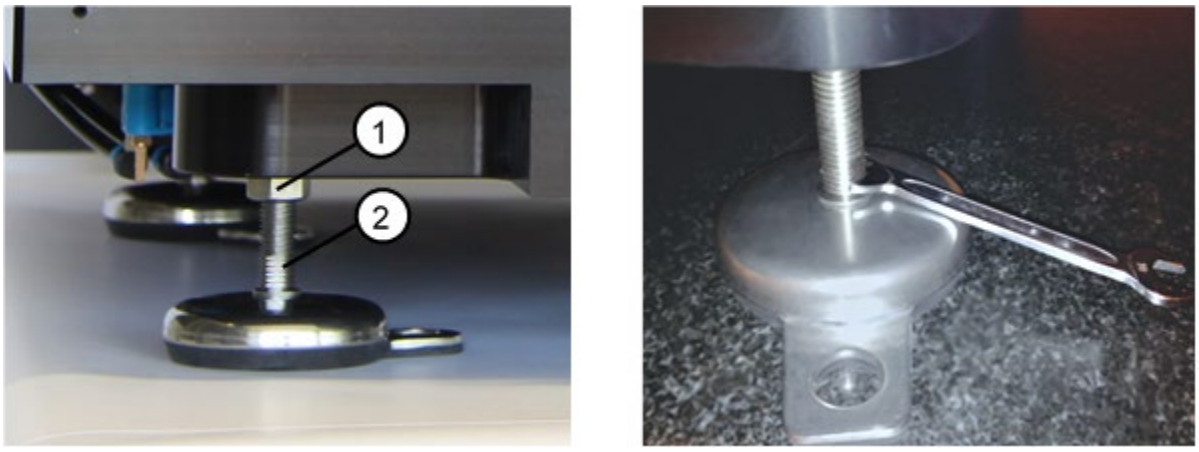


Fig. 89: Level the machine

1 19 mm wrench **2** 10 mm wrench

Perform the following steps to level the machine:

1. Check if the main unit stands firmly on all 4 feet.
2. Check the leveling with a spirit level.
3. Take a 19 mm wrench.
4. Release the countering bolt of the foot that you want to adjust.
5. Adjust the height of the foot by using a 10 mm wrench.
6. Repeat step 3 to step 5 for every foot that you want to adjust.

10.4 Adjust the ejector flow

If the substrate is not held firmly in place by the chuck vacuum, check the ejector flow.

You find the ejector pressure regulator with the adjustment screw for the ejector flow at the rear of the machine.

You can turn the adjustment screw to adjust the ejector flow until the substrate is held firmly in place by the chuck vacuum.

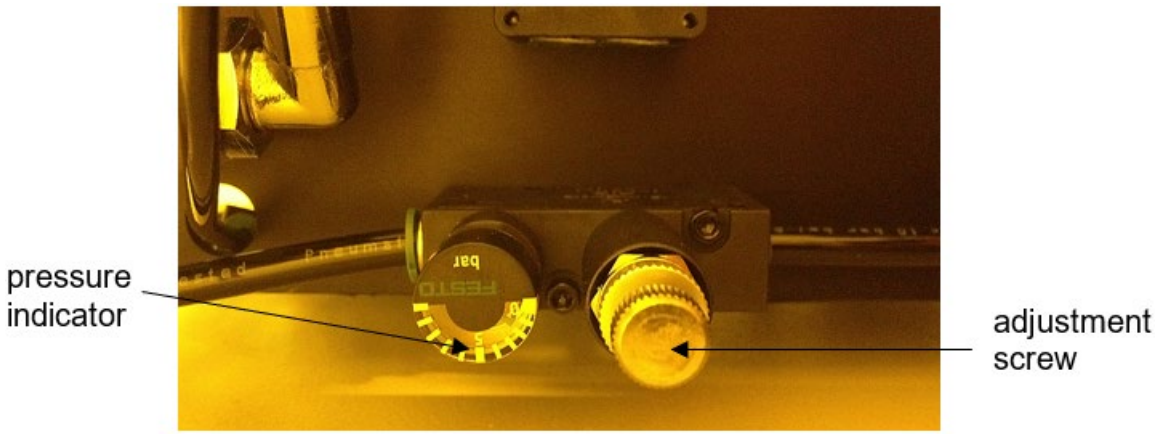


Fig. 90: Ejector pressure regulator with adjustment screw