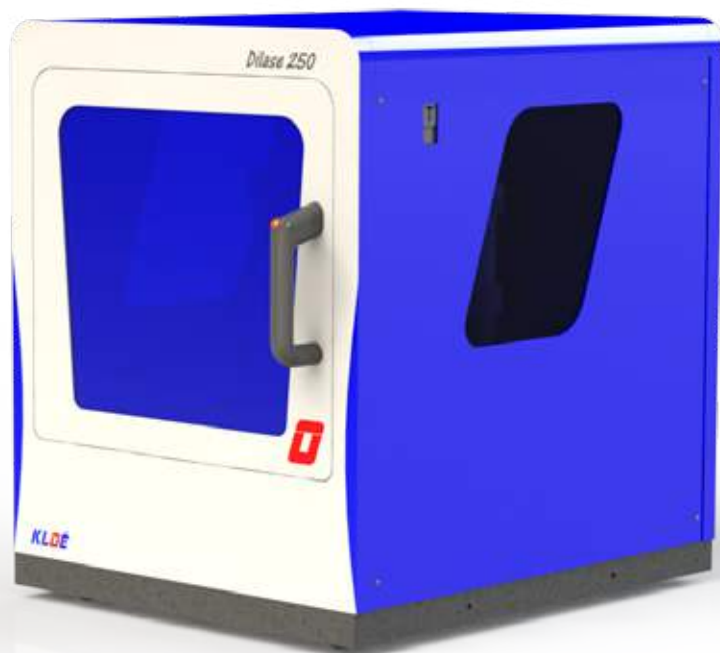


# *Dilase 250*

**User Manual  
N° 20131217**



## WARRANTY

The Dilase 250 is guaranteed for one year (from the installation date). This warranty covers material and / or manufacturing defaults if the equipment is used under normal conditions.

KLOE SA will thus repair or replace any part of Dilase 250 proven to be defective during the warranty period, insofar as the equipment has been normally used.

Any intervention from an external person non-authorized by the company KLOE SA, intended to modify or repair the equipment Dilase 250, immediately voids the warranty.

The manufacturer KLOE SA is not liable for any indirect damages. In case of malfunctioning of the equipment or getting information and / or utilization advices, please contact KLOE company. All defective parts must be returned after agreement reached with the sales service of KLOE SA to the following address :

**KLOE SA  
S.A.V**

**1068 rue de la vieille poste  
34000 MONTPELLIER**

**Tél. : +(33) (0)4 67 82 19 10  
Fax : +(33) (0)4 67 73 14 85  
E-mail : kloee@kloe.fr**

### **WARNING :**

KLOE SA company can not guarantee the accuracy and reliable functioning of the machine if the normal conditions of use specified in the Dilase 250 manual are not respected. Framed annotations throughout this manual should be read and scrupulously followed.

## CLAIMS

For information, KLOE SA does not assume damage risk during transport.

During the warranty period, KLOE SA will repair or replace any damaged parts for free unless it seems to result from abnormal use of the equipment.

In case of malfunctioning of the equipment, the company KLOE SA may appoint a person to carry out any repairs : in this case, the costs relating to the intervention during the guarantee period will be covered by KLOE SA, except if the malfunction seems to result from a non respect of the normal conditions of use of the Dilase 250 defined by the manufacturer.

For each complaint, KLOE SA company will determine the origin and causes of the failure in order to determine the responsibilities involved. In case of non-compliance with normal use conditions of the equipment, any repaired part will be returned after receiving the shipping fees prepayment.

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## 1. DEFINITION OF THE EQUIPMENT

### 1.1 Introduction

The Dilase 250 is a direct laser photolithography equipment, designed to materialize relief patterns in photoresist by a photopolymerization process induced by a UV laser beam, and according to the following principles :

- Contouring writing mode on both XY trajectories axis.
- Dynamic and continuous vectorial writing mode.
- Writing on planar substrates, maximum of 4-inch diameter for circular substrates (4 inches silicon wafer type) and up to 5 inches for rectangular substrates (5 inches mask type).
- Writing in negative / positive resins, photosensitive at the wavelength of the equipment.
- Writing for producing all patterns sizes on the nominal width basis of 2 $\mu$ m laser spot.

The Dilase 250 is an automated equipment controlled by a user-friendly and intuitive software interface, a keyboard, a widescreen (22 inches diagonal type) and a start control box for the general start-up of the machine.

**The software suite** of the Dilase 250 is composed of four applications, which allow patterns design and creation (« KloeDesign »; « Dfl Creator »), and also to control the equipment and the automated writing of these patterns in a photosensitive material (« DilaseSoft 250 »; « Trajectory Tracking »).

Depending on configuration, one Dilase 250 is equipped with **ONE** laser source (375nm or 405nm depending on model) and **ONE** optical treatment line (2 $\mu$ m laser spot at minimum).

**The optical treatment line** ensures the shaping of the beam to obtain the specified laser spot width : the Dilase 250 has an optical treatment line ensuring a minimum beam size of 2 $\mu$ m. It is also equipped with a set of XY motorized stages that provide a working surface of 100mm x 100mm with a positioning accuracy of 100 nm.

**A chuck**, positioned on the XY motion system, ensures maintaining substrates (compatible with the equipment) for the whole duration of a writing process with help of vacuum.

## 1.2 Specifications

<b>DILASE 250</b>	
<b>MOTORIZED STAGES</b>	
Travel range	100 mm x 100 mm
Type	Linear Motors
Resolution	100nm
Accuracy	+/- 3µm
Repeatability	100nm
Encoder	Linear optical
Straightness / Flatness	10µm +/- 2µm
Yaw	+/- 5 arcsec
Pitch	+/- 5 arcsec
Orthogonality	5 arcsec
Maximum writing velocity	100mm/sec
<b>LASER SOURCE</b>	
Type	Laser diode
Laser wavelength	375 nm or 405 nm
Nominal power	16 mW or 100 mW
Beam diameter	1.3 mm
Divergence	0.6 mrad
M <sup>2</sup>	# 1.35
<b>OPTICAL TREATMENT LINE 1</b>	
Laser spot size after focusing	2µm to 100µm (+/-250nm)
<b>FOCUSING HEAD</b>	
Enlargement	X10
N.A.	0.25

<b>DILASE 250</b>	
<b>VIDEO CAMERA VISUALIZATION</b>	
Video Camera type	CMOS
Illumination source	White illumination composed of LEDs
<b>DIMENSIONAL DATAS</b>	
Length	550 mm
Width	600 mm
Height	575 mm
Weight	110kg / 240lbs
<b>COMPUTER INTERFACE</b>	
Screen type :	Flat LCD 22"
Control :	Standard Keyboard and Mouse
Software included :	Kloé Design ; Dfl Creator ; DilaseSoft 250 ; Trajectory Tracking
PC type :	Standard PC
Hard Drive memory capacity :	500Go
RAM memory capacity :	4Go
Operating System :	Windows 7
External disk drive :	Drive CD and DVD
<b>ELECTRIC FEATURES</b>	
Power Requirements	AC 230V 50/60Hz – 10A
<b>ENVIRONMENT</b>	
Operating temperature	21° +/- 1°
Humidity	35% +/-5%

### 1.3 Physical description of the equipment



Figure 1 : Overview of the Dilase 250

#### 1.3.1 Description of the Dilase 250 front view

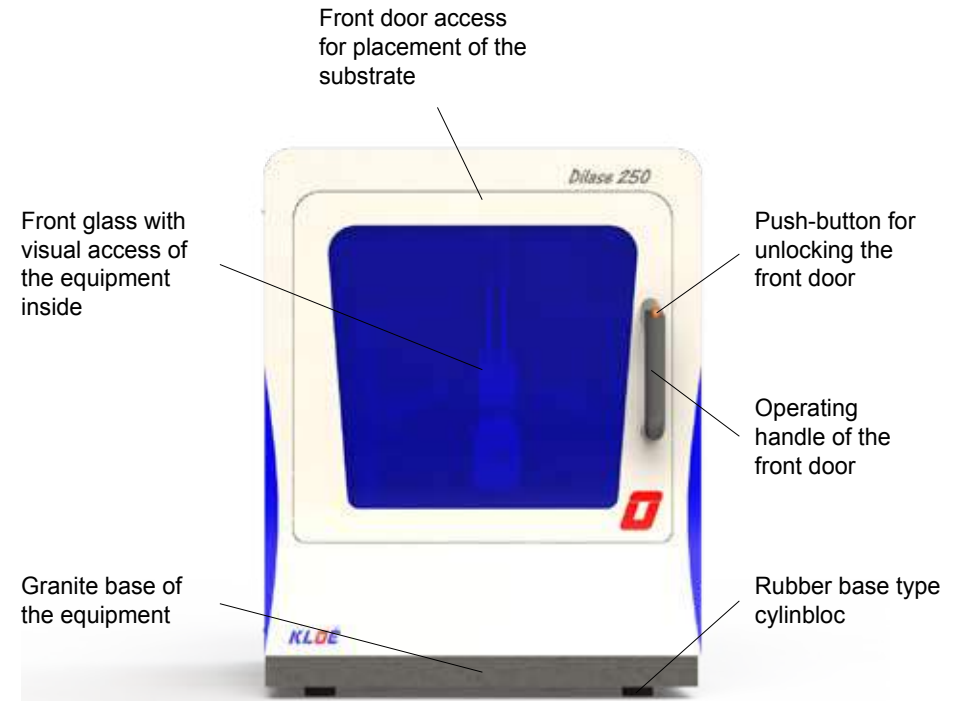
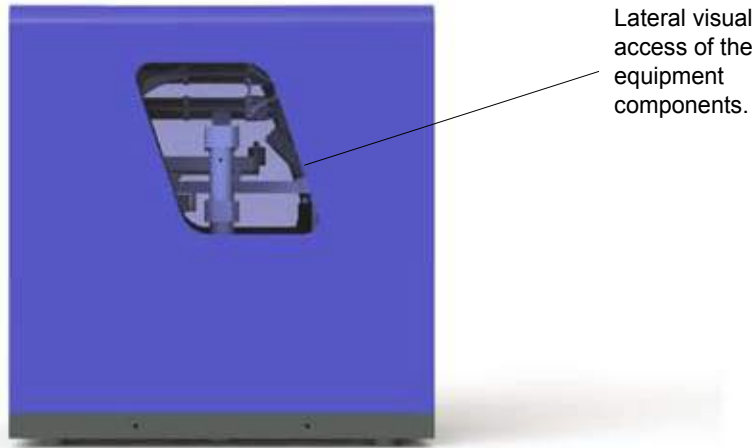
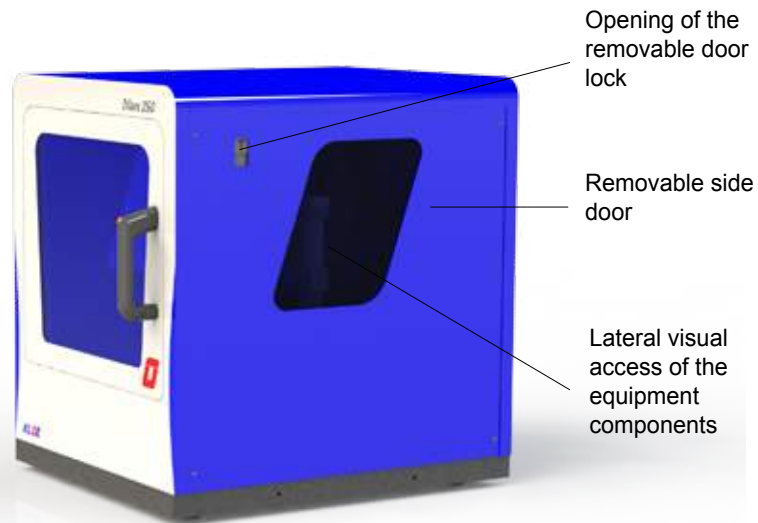


Figure 2 : Front panel of the Dilase 250

### 1.3.2 Description of the side panels



**Figure 3 : Left side panel of the Dilase 250**



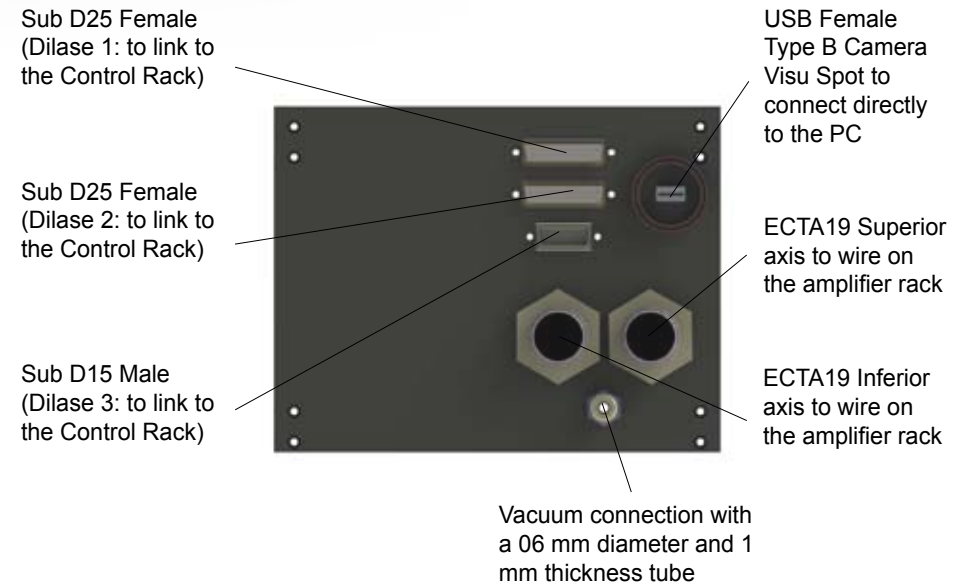
**Figure 4 : Right side panel of the Dilase 250**

This panel consists of a removable door that may be removed with the help of the side door opening key, providing access to the interior of the machine for maintenance operations. This opening system is also existing on the left side door of the equipment.

### 1.3.3 Description of the backside panel



**Figure 5 : Backside panel of the Dilase 250**



**Figure 6 : Details of the Dilase 250 backside connectors**



### 1.3.4 Description of the start control box

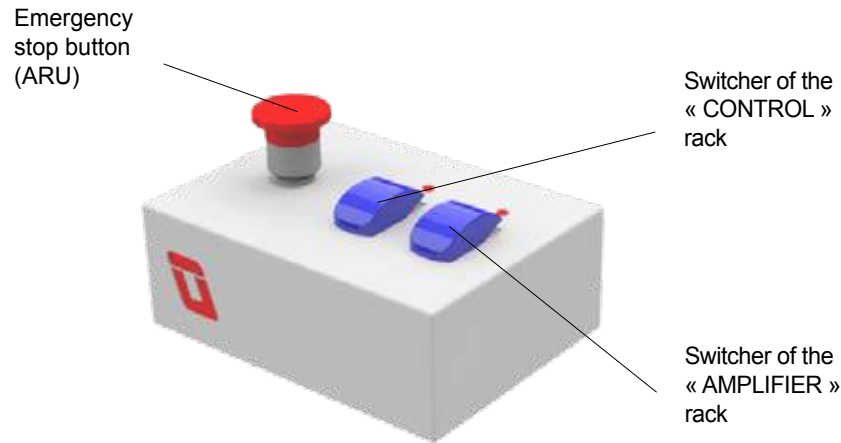


Figure 7 : Start control box of the Dilase 250

#### 1. Emergency stop button (ARU)

This push button is used to cut the main power supply of the equipment and therefore to immediately and totally stop lithography currently in process, in order to stop an abnormal functioning or prevent any danger for the operator.

#### Procedure to restart the DILASE 250 after activating the emergency stop button :

- First, be sure that you identified and fixed the problem that prompted the operator to activate the button.
- Set the « CONTROL » and « AMPLIFIER » switches of the start control box in position OFF.
- Turn the computer workstation completely off.
- Unlock the emergency stop button by turning the top red part a quarter to the right: it automatically returns into the normal position.
- Turn the computer workstation on and wait until the operating system is fully charged.

- Set the « CONTROL » and « AMPLIFIER » switches of the start control box in position ON.
- Start the control software « DilaseSoft 250 ».
- Perform the start up procedures described in section 1.5.3.

2. **Start control box**
3. **Switcher of the « CONTROL » rack**
4. **Switcher of the « AMPLIFIER » rack**

### 1.3.5 Description of the « CONTROL » Electronic Rack



Figure 8 : Front of the Dilase 250 control rack

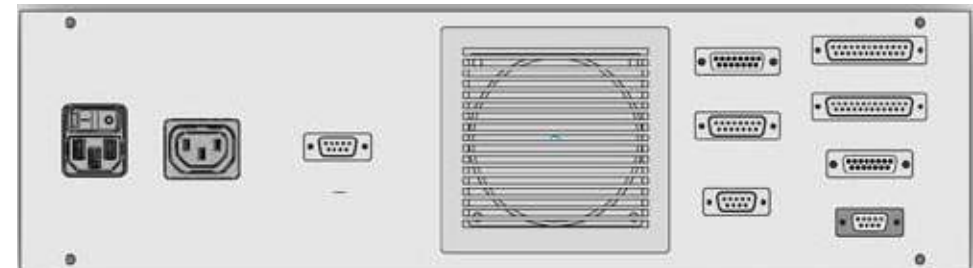


Figure 9 : Backside of the Dilase 250 control rack

Electric grid connection.

IEC connector 220-230V 50Hz with a plug, a switch and a fuse holder, used to connect the machine to the mains.

### 1.3.6 Description of the « AMPLIFIER » Electronic Rack

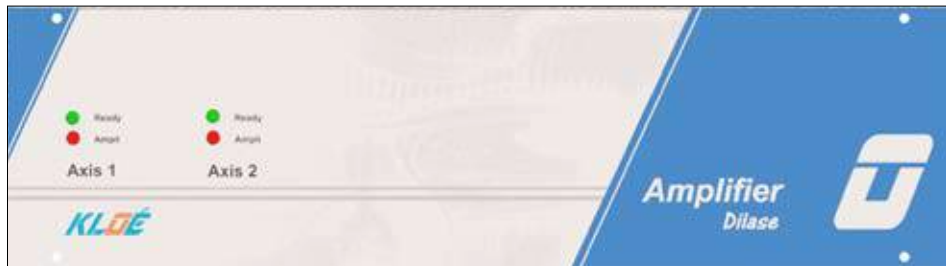


Figure 10 : Front of the Dilase 250 amplifier rack



Figure 11 : Backside of the Dilase 250 amplifier rack

### 1.3.7 Description of the computer station

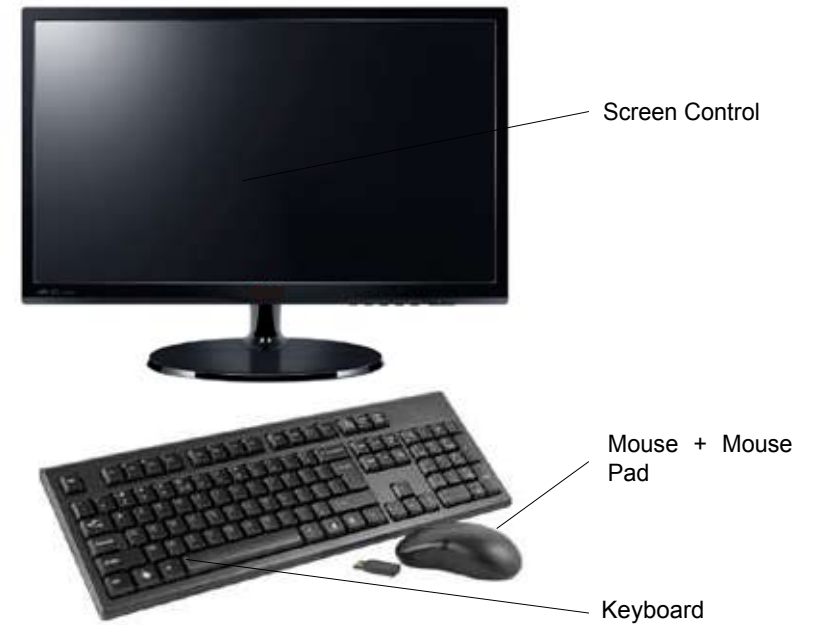


Figure 12 : Overview of the Dilase 250 control computer station

**Flat LCD screen 22 inches**

VGA interface screen.

The screen allows visualizing all the command and control elements of equipment under Windows 7.

**Keyboard**

AZERTY keyboard, with 107 keys & USB interface, to connect behind the PC.

**Mouse & Mouse pad**

Laser mouse, 5 button

## □ **PC**

The PC turns on by the main button on the front.

The backside connectors allow the users to connect :

- Mouse, Keyboard (USB interface)
- Screen (VGA connector on the motherboard)
- « CONTROL » Electronic management box (USB interface)
- Video Camera for visualization (USB interface)
- Focal length (USB interface)
- RS232
- Additional connector DILASE 1 (SUBD25)
- Additional connector DILASE 2 (SUBD25)
- Additional connector DILASE 3 (SUBD15)

The PC has a reader / DVD burner in front, and various interfaces for connecting data storage media (eg USB).

## 1.4 **Installation**

### 1.4.1 **Setting up of the equipment**

The Dilase 250 is a table-top equipment; it means that it can be installed on any worktop supporting a weight of about 100kg over a minimum surface area of 550mm x 670mm.

The equipment rests onto six fulcrums.

The area or coating, on which the machine will be positioned, should be mounted on four feet and should not have local deformation that could degrade the stability of this surface. A standard optical table is recommended because of its anti-vibration and damping performances.

During the first installation, **the components of the Dilase 250 should be transported and brought individually** in the room where it will be installed.

Ensure that **the way to reach the installation room is cleared** and have enough place for all the Dilase 250 components and for the equipment required for its assembly and installation.

During the assembly, take always care of applying lifting forces at its base (granite) and not on its cover components.

## **The Dilase 250 is composed of five distinct elements :**

- **A protective external cover** in which is integrated a removable side door and visualization windows.

This cover is composed of 5 units :

- A front panel
- A backside panel
- A top cover
- Two removable side doors
- An internal framework

- **An opto-mechanical set** (optic, lasers and maintenance modules) fixed on an aluminum structure.

- **An electromechanical set** (motors, sensors, driving screw) fixed on an aluminum structure.

- **An aluminum structure** placed on a granite marble, composed of a structure dedicated to optical and lithographic functionalities.

- **A granite base**, on which are fixed all the Dilase 250 components. There are attachment points on the marble edge to put lifting eyebolts and proceed to the handling. The marble base displacement should be imperatively realized by a professional accompanied by a representative of Kloe's company and, with an appropriate lifting tool.

- A PC set : PC – screen - keyboard are to be positioned on a work plan.

- **Two electronic racks** (CONTROL and AMPLIFIER) should be positioned next to the Dilase 250. It can be placed on the ground or on a work plan, on edge or flat.

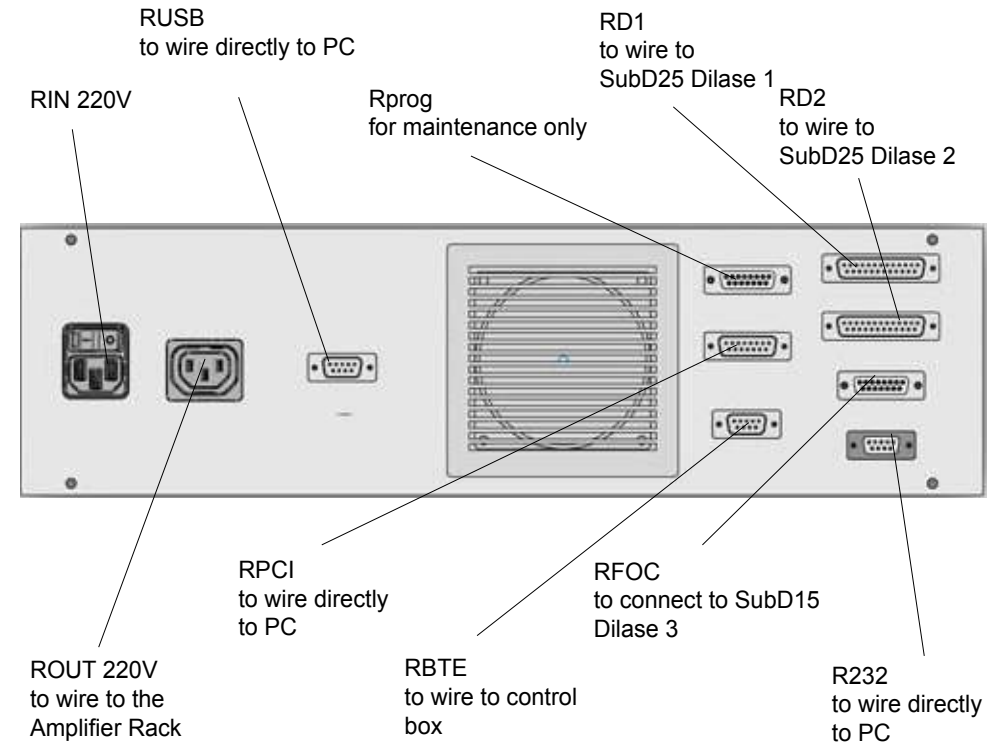
**The different elements listed above must be installed in the following order :**

- The Dilase 250 should be installed first: define its place on a work plan and, if possible, check its horizontality.
- Then the COMPUTER STATION must be positioned close to the Dilase 205 and enable the operator to easily access all the control units, but should also allowing an excellent visibility of the operations performed by the machine.
- ALL THE ELECTRONIC RACKS can be installed stacked flat or on the floor and, on the edge if necessary to occupy the smallest space possible. Position the racks to keep the front, equipped with control lights, visible and facing the operator. Place them near the equipment within the limits of available cable lengths.
- The electrical control and power cables must be installed as described in the section 1.4.2. Once all the wires connected, turn the safety switches ON of each rack and turn on the computer station.

**1.4.2 Connections of the Dilase 250**

The place where will be installed the Dilase 250 must have the following connections :

- Connection to the electric main, type AC 230V 50/60Hz - 10A.
- Connection to the vacuum network by hose Ø6 thick. 1mm.



**Figure 13 : Installation and electrical connections of the control rack**

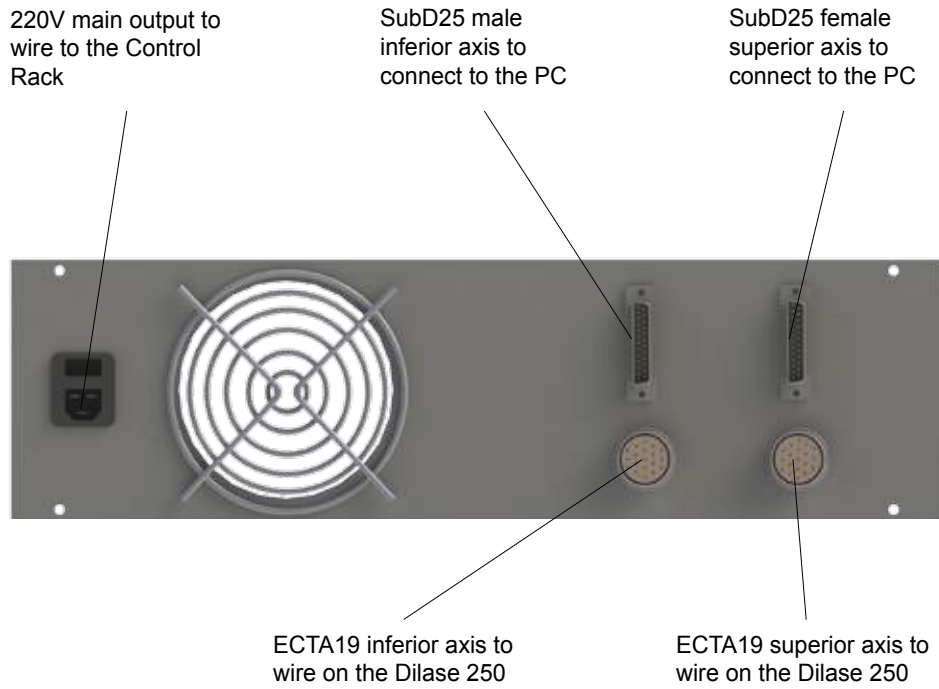


Figure 14 : Installation and electrical connections of the amplifier rack

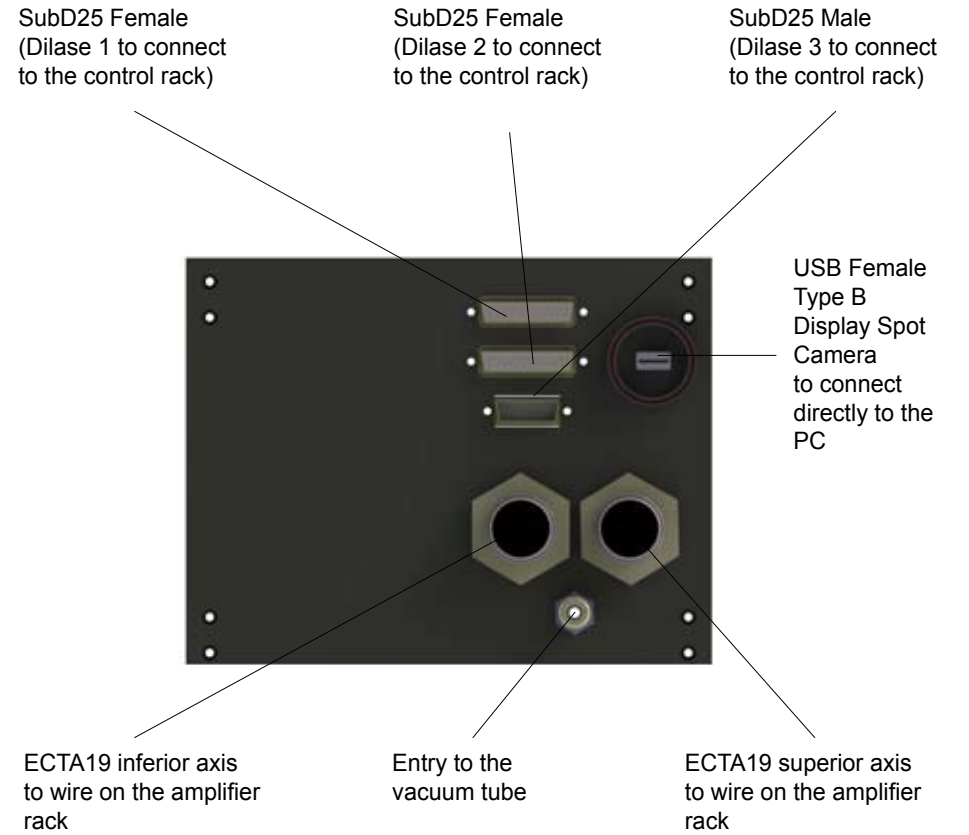


Figure 15 : Installation and electrical connections of the Dilase 250 backside

## 1.5 Commissioning

### 1.5.1 Functional tests

Before each start up of the Dilase 250, it is important to ensure the following points :

- The machine must be perfectly stable on its six fulcrums (rubber bases located under the surface of the granite base).
- Ensure the stability of the work plan on which stands the Dilase and the best horizontal position possible.
- Make sure that the power cable at the backside of the control electronic rack is well connected to the grid.
- Make sure that the power cable at the backside of the control amplifier rack is connected to the grid.
- Also ensure that the computer station (PC + monitor) is well connected to the grid.
- Make sure the connection with the vacuum network was successful.
- Make sure the machine is not in support or in contact with walls elements, storage units (enclosure...) or with other equipment which could transmit vibrations or exerting mechanical stresses that may damage the operation of this equipment.
- Ensure that all components of the machine cover are properly installed and assembled.
- Make sure that nothing is interfering with opening and closing the front door.

### 1.5.2 The chuck for lithography preparation

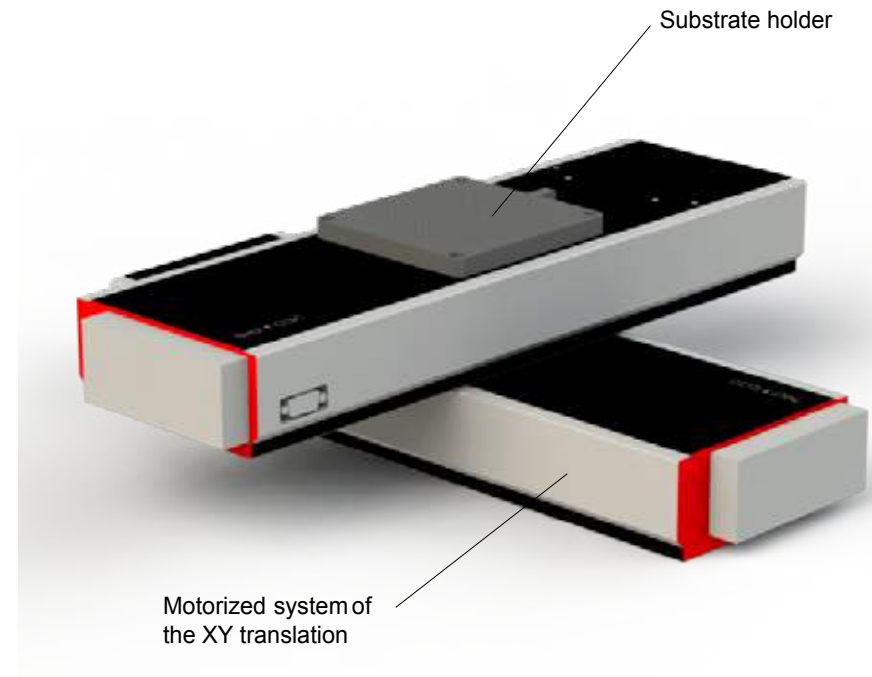


Figure 16 : Overview of the Dilase 250 chuck

The Dilase 250 is equipped with a metal chuck on motorized tables, it ensures the positioning and maintaining of the substrates coated with photoresists. A vacuum chamber system allows the maintaining in a stationary position of any of substrate with a flatness tolerance better than 10µm.

**The vacuum chamber permits to homogeneously supply (through holes) a air flow suction to the dedicated area for the substrates positioning.**

This sample holder accepts circular substrates with a maximum diameter of 100mm (typically silicon wafer 4 inches) and the maximum dimensions of square substrates is possible for typically 5 inches Quartz masks.

The arrival of the main vacuum in the chuck is made via a flexible tube connected to the connector on the side of the chuck. When the vacuum is properly activated, the substrate is solidary with its holder support.

**NOTE :**

For all substrates of size inferior to 100mm x 100mm, it is necessary to EFFECTIVELY AND IN A NON-DESTRUCTIVE WAY to block off the air holes uncovered by the substrate, in order to ensure a sufficient vacuum.

Otherwise, because of the pressure loss, the substrate will not be immobile and, the predicted resolutions and other performances under important accelerations cannot be guarantee. It could also directly put the equipment in error because of vacuum default.

In case of regular use of a given substrate size, below the maximum sizes mentioned above (example : 2 inches), Kloe can provide a specific adapter (consult us), to simplify the work.

Otherwise, this holes obstruction can be efficiently done by using small and planar substrates with an appropriate size.

### 1.5.3 Start up procedures

After making sure that the chuck is positioned according to the recommendations in the previous paragraph, the following startup procedure can take place :

- First, check that the emergency stop button is deactivated (in high position).
- Check that the vacuum system is connected to the equipment.
- Successively put into the ON position the two switches on the control power box (CONTROL and AMPLIFIER).
- Turn on the computer station (PC + monitor).

**Wait until the complete start of the machine and the computer station.**

**Any use of the equipment during the start-up time corresponds to an abnormal use of the equipment which performances / consequences are not guaranteed by the manufacturer.**

- Depending on the configuration, it may be necessary to manually launch the **DilaseSoft 250** Control software.
- **THE EQUIPMENT IS NOW READY TO WORK AND MUST BE INITIALIZED.**
- The equipment initialization is a necessary step which can only be made once the computer station started.
- For the Dilase 250, this initialization is started manually by the operator in using the control software DilaseSoft 250 while it is active. All functions of this interface are blocked until the complete initialization.
- From the interface, in the « **Initialization** » area, click « **Browse** » and choose the standard initialization of the equipment (« **Standard Initialization D250** »).
- From the interface, in the « Initialization » area, select the initialization to use among the drop-down list of choices.

**NOTE :**

This motors initialization phase can generate motions of each axis, fast and brief, with possibly important accelerations. This results in violent shakings of motors that can give slight movements to the machine. This is a normal phenomenon, but **only** during initialization phase.

- Wait until the interface unlocks and becomes active.

Once the engine immobilized, the initialization phase completed : the Dilase 250 is operational and ready to be used.

At this step, the operator can access to all of the interface functions :

- Move the XY motion system.
- Load / unload a sample.
- Define an original positioning.
- Activate / deactivate the laser beam.
- Use the camera visualization system.
- Adjust the focusing height to the substrate.
- Load a \*.LWO file.
- Set up the equipment with lithography parameters.

Only the « Start » action, which commands the system to start a writing lithographic task, can remain inactive until a \*.LWO file is loaded and the laser preheated.

See Section 2.4 for information on procedures to follow in order to load a sample and proceed to a complete lithographic writing.

In all cases, before starting a lithographic writing process, the operator must define the basic parameters of lithography, which are :

- The focusing height.
- The writing velocity.
- The energy dose to apply to the resin during the writing.

See section 2.5 for more information about the procedures to follow in order to set the lithography parameters.

## 2. PROCEDURE FOR THE USE OF THE DILASE 250

### 2.1 Conditions of use provided by the manufacturer

To resume, the Dilase 250 is a photolithography equipment by direct laser writing : it is dedicated to the realization of microscale patterns by photopolymerization induced by laser beam on photoresists, according to the following principles :

- In vector mode on the XY motions planes, or in scanning mode.
- In dynamic and continuous writing.
- On flat substrates.
- In using negative or positive photosensitive resins to 375nm or 405 nm.
- For producing patterns of all sizes composed by 2µm to 100µm width patterns with the equipment's optical treatment line.

### 2.2 Definition of the workstations occupied by the operators

In normal mode of functioning, the operator in charge of the work on the Dilase 250 has to stand up **in front of the computer station and must have a direct view of the equipment.**

**He must be installed properly to access to all the elements of the computer station (keyboard, mouse, screen) and the control box.**

In this position, he can :

- Perform the lithographic settings processes with the control software « DilaseSoft 250 ».
- Follow the motorized stages positioning and their movements during the writing.
- Make the focusing adjustments of the laser spot through the camera.
- Have a direct visual access on the motorized stages motions.

All the general safety equipment have also been designed and positioned to be easily reachable from that position.



### 2.3 Conduct of the general operations to be performed

The main steps needed to achieve a lithographic pattern with the Dilase 250 are :

1. Have a \*.LWO file containing the trajectories to follow to draw the patterns.
2. Define the lithography settings of the equipment : writing velocity, writing power level.
3. Adjust the focal length of the focusing lens to the thickness of the stacking used, resin(s) and substrate included.
4. Define the reference center of the XY plan within which the motorized plates move to write the pattern, in order to match the file reference center to write.
5. Place the coating resin substrate on the chuck : the lithography sequence can be launched.

### PROCEDURE TO CREATE A .LWO FILE

A \*.LWO file is **the only file type readable** by the equipment Dilase 250: this type of file is generated exclusively with the design software KloeDesign which allows to :

- Create, manipulate and simulate complex patterns based on simple elements accessible from the libraries of software, such as a straight line, an arc ...
- Convert DXF and GDS files to \*.LWO format.

The creation of \*.LWO file is generated as follows :

- Open the software interface « KloeDesign ».
- Import a design to convert (DXF / GDS) or create one by combining simple patterns (lines, arcs, surfaces ...).
- Save, if necessary, the design pattern as \*.LWI2D file.
- Generate LWI2D writing trajectories pattern then export in \*.LWO

The \*.LWO file is then ready to be read by the control software interface « DilaseSoft 250 ».

Before processing the lithography of any new files, it is recommended to pre-test the main writing file during a “ simulation ”, it means without writing directly on a coated substrate with resin: this will ensure if the file in question is writable (correctly interpreted by the machine). For example, it does not exceed the courses authorized by the motorized stages and synchronize correctly the laser pulses with the trajectories.

This method can be as useful as economical because it allows to anticipate potential conception errors that could be encountered during the preparation of the \*.LWO with the software « KloeDesign ».

**NOTE :**

Before launching the definitive writing, the operator can, at any time, move the motorized stages and have the flexibility to do all the preparation he wants.

Point to consider: the origin defined by the user on the Software KloeDesign will correspond to the origin on DilaseSoft.

## 2.4 Procedure for processing a substrate

This section discusses in detail the procedure to follow to proceed the complete realization of a lithography pattern on photoresist with the Dilase 250. The understanding of this section is based on Section 2.3 and the Section 2.5 which describe the organs settings and the logic of the equipment use.

### 1. TURNING ON OF THE MACHINE

- Turn on the computer station (PC + monitor).
- Turn on the power switches of the equipment (CONTROL and AMPLIFIER) on the start control box (→ cf. Section 1.4.2).
- Launch the control software manually from the desktop of the computer station.

### 2. INITIALIZATION OF THE MOTORIZED STAGES

- Select the desired initialization file available in the list.
- Once the file is selected, start the initialization by clicking on the button « Initialize the stages ».
- The motors start moving : the windows « Initializing motorized stages in process » and « Initializing focusing head in process » appears.
- The initialization is complete when the motors stop and when the windows closes.

### 3. LOADING OF THE SAMPLE

- Press the pushbutton of the front handle and let it held to unlock the door opening.
- The front door is then unlocked and the user has access to the substrate holder.
- Place the coated substrate on the suction surface ensuring ALL the holes are clogged.
- Close the front door, the lock is automatic.

### IMPORTANT :

During the loading of the substrate coated by resin, it is important to ensure the cleanliness and flatness of the substrate backside: traces or residues of resin on the back can significantly affect the cleanliness of the chuck. In leaving a deposit on it, the surface flatness could be distorted. It could put the equipment in error for lack of vacuum and consequently compromising machine performance and the lithography result.

### TO KNOW :

The interface is intentionally inactive when the equipment is busy executing actions. When the initialization phases are completed and the door is closed, the interface is entirely reactivated and operational again.

### 4. DETERMINATION OF THE FOCUSING HEIGHT

Refer to Section 2.5.1 which explains in details how to determine the focal length of the focusing lens.

### 5. DETERMINATION OF LITHOGRAPHY PARAMETERS

Refer to the Section 2.5.2 which explains in detail how to determine the lithography settings that accompany any lithographic sequence.

### 6. DEFINITION OF THE ORIGIN REFERENCE FRAME

Each file of conception for lithography includes a lithographic origin. Regardless the pattern size to accomplish, it is necessary to define the reference origin of the motor stages before every writing in order to permit the writing of one/several pattern(s) on a substrate surface:

- Whether to define a specific area in which the pattern must be written.
- Or to ensure that the pattern(s) can be written entirely within the delimited surface by the motor courses.

### To do this :

- With the help of the motion arrow keys (Up, Down, Left, Right) visible in the interface area « Control of the motorized stages », put the motors in motion until the point which will define the origin.

- Reset the motors from the interface by clicking on « RAZ », present in this same area. The current point position of the XY motion system at this precise time takes the coordinates values {X = 0, Y = 0}: the motors origin for the next pattern to realize is then defined.
- The trajectories in the file and realized by the motors will be run in reference of this origin.

## 7. LOADING OF THE MAIN FILE

- Load the file corresponding to the pattern to realize from the software interface by clicking on “ Add ” in the lithography area.
- Define the writing velocity and the energy power dose to apply during the writing.
- Launch the file from the software interface with the button « Start ».

## 8. MONITORING OF THE LITHOGRAPHIC STEP

- The equipment works automatically and does not need the operator manipulation while the writing is in process.
- A window will be open to show to the user an approximate ending process time and permits at any time to have a good view of the writing progress of the current file.

## 9. END OF THE PROCEDURE

- Once the writing finished, a message from the interface informs the operator that the writing laser sequence is done. This message also informs the real writing time needed for the realization of the file(s).
- Close this message by clicking on « Close ».

## 10. UNLOADING THE SAMPLE

- To collect the substrate, click on the pushbutton located on the front handle and let it held to unlock the door opening.
- The system thus stops moving and the substrate can then be removed.
- Take back the substrate.

## 2.5 Description and setting of the lithographic parameters

To realize a lithographic writing as described above, you might have to do some settings to specify the parameters used in the final procedure.

These presettings, which would require preliminary lithographic writings, are :

- The determination of the focal length position of the focusing lens**, described as the 3rd step of the operations to be realized (see section 2.3).
- The definition of the lithographic parameters**, described as the 2nd step of the operations to be realized (see section 2.3).

### 2.5.1 Height focusing setting

The Dilase 250's optic line realizes a specific optic treatment of the laser beam which permits to obtain a defined size spot in the focal plan of the optic focusing: it is essential to match the resin plan to expose (or the substrate plan) with the focal plan of the focusing head, but with a certain tolerance (called « height form factor »), to benefit from the nominal size set for the spot.

To benefit of the flexibility of adapting the focusing height at different variables such as thickness of the substrates used or the width deposited resin, the focusing head is linked to a motion motorized system along the exposing axis of the resin (axis normal of the substrate). The focusing height can be adjusted manually by requesting the arrows in the « Control focus panel » of the software general interface.

#### **IMPORTANT :**

The focal distance of the focusing lens is an essential element: its setting and control permits to ensure the compliance of a lithographed pattern with the specifications expected.

The optimal focusing height for a given substrate is precisely determined by writing a set of files, similar in trajectories traveled and in lithographic settings, which permits to photowrite a pattern with different focusing height settings.

This protocol allows to browse different settings and to quantify the qualitative impact of the pattern resolution photoinscribed.

This method needs a resin coated substrate, a chemical revelation of the photoinscribed patterns on the substrate, and microscopic observations to determine the optimal setting of the focusing height.

**TO KNOW :**

The focusing height is a unit which stays unchanged if the writing conditions and the procedure stay the same (same substrate, same power, same velocity, same resin used, etc...). It is not necessary to re-calibrate it at every switch-on of the machine or at every loading of new sample, if these parameters are unchanged.

1. To start the automated procedure for determining the optimal focal distance, select « Automatic Test » in the general software interface. This allows you to configure the equipment to research a focus height depending on the substrate inserted.

The principle of the automatic is as follows :

It consist in automatically vary, for an adapted increment, the focus height for each new \*.LWO present in the list of files into the area « Lithography » wich must be sequentially written. This height increment is defined by the operator and is function of the amplitude of variation that the operator wishes to cover. The first file in the list will be executed at the focus value set as a reference value, that is to say the current position. At the end of the execution of the first file, the system will then set a new value for the focus height equal to the first MORE or LESS ONCE the increment value defined by the operator and will proceed to the writing of the second file, and so on ( + / - 2 times the third file , + / - 3 times the fourth ,etc.).

2. Define a position value of the focus height that will serve as reference value for the setting. This reference value can be the current position or a particular desired position. In the latter case, enter the desired value in the field « Reach » and click on one of the three controls located below (Absolute movement , Relative way-up , Relative way-Down).
3. Select « Up » or « Down » according to the direction of progression desired for the focus height from the first value defined. « Up » will vary the focus height as the focusing head move away from the substrate and the focal length stretches. « Down » will vary the height focus as the focusing head approaches the substrate and the focal length is shortened .

4. Define the variation amplitude of the focus height: this value corresponds to the focal length increment applied to each new file in the list.
5. Load all the files \*.LWO that will perform the test . These files should be preferably all the same in terms of other variables (speed, power). However, they should not be written in the same place, at the risk of overwriting all patterns. To do so, observe an interval from one pattern to another specifying an appropriate offset value X and Y in the table that gather the files to use.
6. Assign to all files the same speed value, and the same energy value. For the writing, the parameters Speed and Energy ( described in the next section ) can be set in a completely arbitrary way, with the only constraints that:
  - The speed is defined as the dose of energy is sufficient to expose the resin .
  - The energy applied is sufficient to expose the resin.
  - The energy applied is not too important to not over expose the resin and significantly degrade the pattern resolution.
7. Start writing by clicking the « Start » button in the « Lithography » area of the general software interface.
8. Once the writing is complete and the substrate recovered, develop the resin through the dedicated chemical. The lithographic patterns must be revealed.
9. Then observe these patterns at the microscope and identify the pattern with the smallest line width AND the best lithographic quality.

### 2.5.1.1 Define the optimal focusing height of the system

Lithography by direct laser writing consists in printing « the shape » of the laser beam in the resin. This shape is defined by the optic presents at the focusing head.

**The focusing height determines the distance between this head and the layout defined by the substrate.**

When this height changes, « the shape » of the laser beam, which prints the resin, also changes.

- At the optimum focusing height, the beam is spread in a straight line with parallel rays, and the printed pattern resulting from this beam is straight and has the nominal size corresponding to the optical line.
- Below the height of optimum focus, the beam is propagated with convergent rays, and the printed pattern resulting from this beam is neither straight, nor at the nominal size but **wider**.
- Beyond the height of optimum focus, the beam is propagated with divergent rays, and the printed pattern resulting from this beam is neither straight, nor at the nominal size but also **wider**.

Thus, when an automatic test of the focusing height is operated, the system tries different focusing heights, in going below and beyond the optimum height.

During the writing of the focal test pattern, it is materialized by patterns which will have wide strokes characteristic of the used focusing height, first wide then thinner then wider again.

**The optimum focusing height enable to obtain the smallest stroke width and the best quality of pattern to each realizations produced in similar writing conditions.**

If none of the pattern can be determined as the one giving the best quality and an optimum stroke width, this can be due to :

- A wrong definition of the lithography settings (insufficient power dose or too important).
- Or an exploration range of the focusing heights badly defined, not going through the optimum focusing height.

Then review these variables and reiterate tests.

### 2.5.1.2 Quick setting of the focusing height

The Dilase 250 is equipped of a visualization system to assist the pattern writing which has to be positioned, in relative manner, according to benchmarks / other patterns already existing in a substrate.

To do this, this equipment has a light source providing uniform illumination of the sample and a camera showing the existing patterns on the substrate. The operator can observed the existing patterns to position the new patterns.

The embedded camera can also be used to determine quickly, but more roughly, an usable focusing height.

**WARNING :**

Using the video camera to determine the focusing height result in a quick but imprecise setting as the video camera cannot provide the sharpness and the resolution adjustment required for certain lithographic writings. However, the camera can set, reliably, a focal value range to scan and avoid working in a range of settings too far from optimal values.

The procedure to follow is :

1. Load a sample (test sample), into the Dilase 250, presenting sufficient contrasted / reflective benchmarks (refer to "procedure for processing a substrate" of the section 2.4 until the point 4) : it must indeed sufficiently reflect the beam from the chosen laser source, or be coated with enough fluorescent resin when illuminated by the laser to show an image usable by the camera.
2. Move the motors with the help of the arrays in the interface area « Control the motorized stages » to bring the reflected sample under de focusing head.
3. Switch on the laser.

A lighting spot appears in the display window camera.

If no lighting spot appears, adjust the focusing height with the help of the arrows in the area « Control of the focusing height » until it appears a punctual and energetic lighting point corresponding to the laser spot (if the focal setting is too far from the nominal value, it is normal to not see the lighting point).

The focusing height is set when the laser spot diameter observable with the video camera seems to be at the smaller size.

Note the « Current position » value of the focal setting in the area « Control of the focusing height » and keep this value for the next lithographic writings.

If the focusing height setting helped with the video camera is insufficient, it is necessary to set this focal value by photoinscription of patterns as described in the section 2.5.1 Setting of the focusing height.

## 2.5.2 Setting of the dynamic lithography parameters

The lithography parameters described in this chapter represent the two adjustable parameters by the operator and subject to his critical judgment in order to obtain the best definition of lithographic patterns.

These are :

- The writing velocity, ie the moving velocity of the XY motion system during a lithographic realization.
- The ratio of the laser power available at the output of focusing lens to expose the photoresist during the writing.

These two parameters, which define the concept of « UV power dose » should be considered as totally linked to get the best patterns resolution possible.

### TO KNOW :

A \*.lwo file loaded in the interface can be affected to only one writing velocity and one power.

However it is possible to load one entire pattern to write with different doses by splitting it into several \*.lwo files, each having a writing velocity and dose of energy defined independently.

## 2.5.2.1 Velocity test

A « velocity test » permits to define what motion velocity will be optimal for achieving a given lithography.

Choosing a writing velocity may depend on several factors mainly related to the operator's choices :

- An expected total writing time.
- The quality of the trajectories to be executed (right angles, low radiuses of curvature are trajectories influenced by the inertia of the system while moving in proportion to the velocity).
- The photosensitivity of the resin.
- The power of the laser source available according to wavelength and the model chosen.

The goal of the « velocity test » is to get the real trajectory closest to the expected trajectory while maintaining a writing time and an optimum lithographic quality.

### PROCEDURE :

#### WARNING :

The focusing height must be adjusted in order to realize this test efficiently (section 2.5.1).

1. Perform steps of the operating mode (Section 2.4) up to step 5.
2. Load all the \*.lwo files that will perform the test. These files should preferably be identical. However, they should not be written in the same place, at the risk of superimpose the writing of the patterns.  
  
Be sure to observe a space between all the patterns in specifying for each ones an offset value of X and Y in the table which gathers the files to use.
3. Set the same « power » value for each files, in order to write patterns in sufficient quality.
4. Then assign a different « velocity » value for each file, in the velocity range eligible and chosen by the operator.

5. Launch the writing by clicking the « Start » button in the « Lithography » interface driver software.
6. The writing of the patterns corresponding to the files is in process.
7. Once the writing is finished, remove the sample from the substrate holder and reveal the sample until the lithographic patterns become observable.
8. Observe the patterns under the microscope and identify the best pattern, the velocity at which it was written corresponding to the optimum write velocity: the velocity of the motors to perform the lithography is now determined.

### 2.5.2.2 Power test

Depending on the photosensitivity of the resin, it may be necessary to adjust and modulate the fraction of the total laser power available needed for this resin: a test of energy permits to define this fraction of power to use in order to obtain the best lithographic rendering.

#### PROCEDURE :

##### **WARNING :**

Previously, the focusing height should be adjusted to conduct this test (Section 2.5.1).

1. Follows the operatory mode steps (section 2.4) until the step 5. The speed used for this test must be constant and can be chosen arbitrarily.
2. Load all the \*.Lwo files that will perform the test. These files should preferably be identical. However, they should not be written at the same place, to avoid the risk of superimposing the writing of all the patterns. So be sure to observe a space between each pattern, by specifying for each one an offset value of X and Y in the table which gathers the files to use.
3. Set the same value « Velocity » for all of these files, determined in order to write patterns in sufficient quality.
4. Launch the writing by clicking the « Start » button in the « Lithography » control software interface.

5. The writing of the patterns corresponding to the files starts.
6. Once the writing is finished, reveal the sample until the lithographic patterns become observable.
7. Observe the patterns under the microscope and identify the pattern having the best resolution, the velocity at which it was written corresponding to the optimum write velocity: the motion velocity of the motors to perform the lithography is now determined.

##### **WARNING :**

Any development of the Dilase 250 optical settings or any maintenance to check the status of optical components or to replace them can be only performed by a technician from Kloé or a corporation mandated to operate on the Dilase 250. UV glasses is mandatory for the work described in the next section and the company Kloé is not responsible of accidents caused by not following basic rules to be respected in the presence of UV radiation.

### 2.5.3 Optical settings

#### 2.5.3.1 Lasers maintenance

The Dilase 250 is delivered with diode laser emitting at a wavelength of 375nm or 405nm (See the specification table in section 1.3 to know the details about the embedded lasers).

To verify the well-functioning of the embedded laser source on the Dilase 250 :

- Start the Dilase 250.
- About 5 minutes after starting the Dilase 250, check the laser power with a power meter adapted that can withstand with high power densities ( $> 1200\text{mW}/\text{cm}^2$ ). Place it directly at the source output.
- If this power is conform to the value of the specified nominal power in the table of specifications, the laser does not require adjustment. Otherwise, lasers may be failing or dying : contact the company Kloé to establish a diagnosis of the defective element(s).

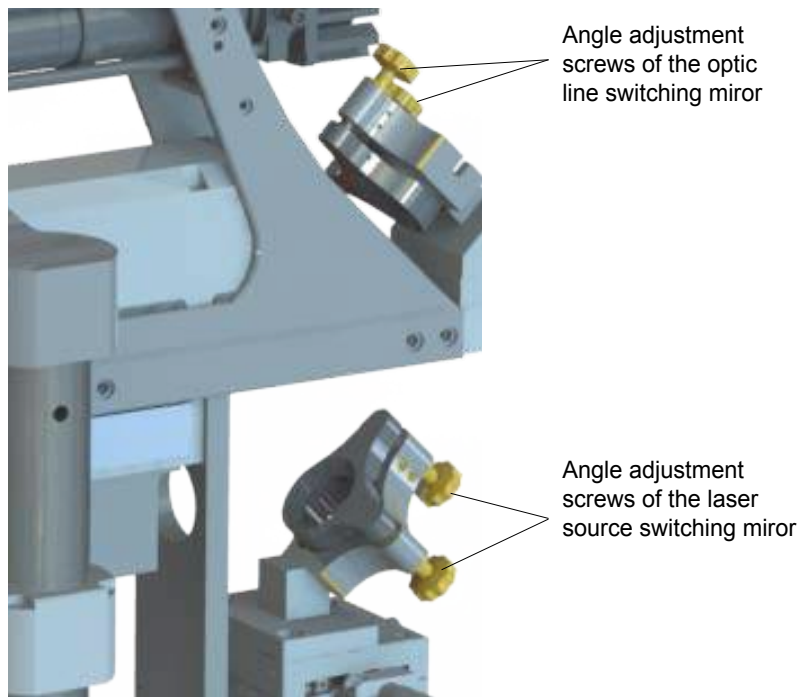
### 2.5.3.2 Setting of the optical treatment switching

The switching system of the laser optical path, which channel the beam until the focusing lens, is factory set to give the maximum performances to the system.

If a power loss is recognized at the output of the focusing head, a check of the alignment should be performed.

Thus, it may be necessary to adjust some settings to correct some misalignments that may occur either due to the aging of laser source, either because of the aging of the equipment, either because of the vibration source related to the environment.

To perform these adjustments of the switching zone, the available settings which can be solicited, are those present on each mirror frame at the rear of the equipment : one in vis-à-vis of the laser source, the other in vis-à-vis of the optical treatment line. Each frame has two fine adjustment screws which permit to change the beam reflected angle.



**Figure 17 : Fine adjustment screws of the Dilase 250 switching mirrors**

A lateral setting is also available to translate the switching mirror frame of the laser source.

### PROCEDURE :

1. Remove the completely removable door from the right side panel by sliding backwards.
2. Place the head of the power meter directly above the focusing head of the Dilase 250. The head must be aligned with the propagation axis of the optical line.
3. Visualize the signal strength when the laser is turned on (from the area interface « Lasers Control », click on « Laser ON » and adjust the power level up to 100%).
4. First turn SLOWLY and FINELY, in SCREW and UNSCREW only one adjustment screw, starting with the adjustment of the optical line switching mirror (see figure). If no power increase appears, replace the screw in its original position.
5. Repeat the previous step for all the adjustment screws, in starting by the two screws of optical line switching mirror and by ending with laser source switching mirror.
6. If a laser power variation is detected, adjust the screws to have back the laser power maximum.
7. If no change is observed or if the power measured is null :
  - Either the misalignment is too important to be corrected by this basic procedure: in this case, please contact the company Kloé for a diagnostic.
  - Either the laser source stops emitting laser signal.
  - Either the power meter is set on a too high caliber and it does not see the small changes in power. If it cannot be questioned, please contact the company Kloé for a diagnostic.
8. Remove the head of the power meter and close the removable door of the Dilase 250.

#### WARNING :

UV glasses are mandatory for this section, and the company Kloé SA accepts no liability for accidents caused by not following basic rules to keep in the presence of UV radiation.



### 2.5.3.3 Setting of the signal injection in the focusing head

The signal injection system from the optic treatment line in the focusing head is factory set to give the maximum performance to the system.

If, after correcting the switching alignment of the laser source in the optical treatment line, a power loss or a significant degradation of the beam quality **at the exit** of the focusing head is still detected, an adjustment of the signal injection in the head may be required.

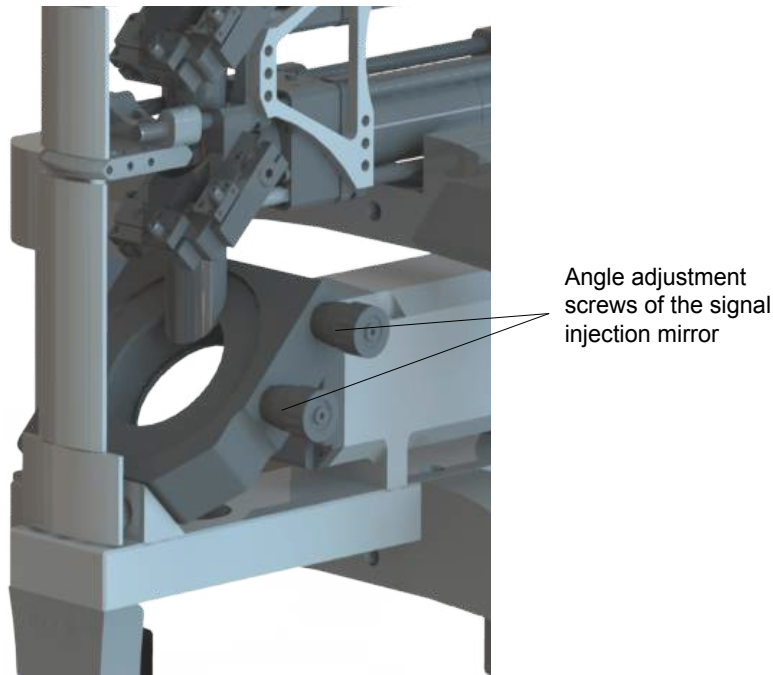


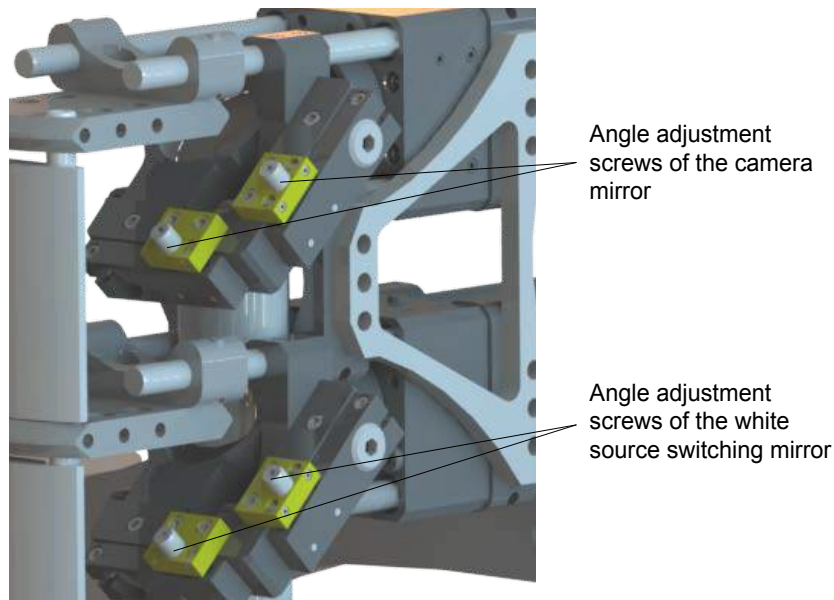
Figure 18 : Fine adjustment screws of the signal injection mirror in the focusing head

### PROCEDURE :

1. Remove completely the removable door from the right side panel by sliding backwards.
2. Turn the focusing head to its highest position (from the interface area « Control of the focusing height », click the arrow « UP » until reaching the top stop).
3. Place the head of the power meter directly above the focusing head of the Dilase 250. The head must be aligned with the propagation axis of the optical line.
4. Visualize the signal strength when the laser is turned on (from the area interface « Lasers Control », click on « Laser ON » and adjust the power level up to 100%).
5. Turn SLOWLY and FINELY, in SCREW and UNSCREW, only one adjustment screw of the signal injection mirror in the focusing head. If no power increase appears, replace the screw in its original position.
6. Repeat the previous step for the other adjustment screws.
7. If no changes appears or the power measured is null :
  - Either the misalignment is too important to be corrected by this basic procedure: in this case, please contact the company Kloé for a diagnostic.
  - Either the laser source stops emitting laser signal.
  - Either the power meter is set on a too high caliber and it does not see the small changes in power. If it cannot be questioned, please contact the company Kloé for a diagnostic.
8. If a laser power variation appears, adjust the screws to have back the laser power maximum.
9. Remove the head of the power meter and close the removable door of the Dilase 250.
10. Place on the chuck a material fluorescent when exposed to the UV as clean room paper.
11. The beam appears as a circular blue spot. Turn the focusing head aperture to stop the beam crossing / motion.
12. If the aperture closes concentrically to the beam, the alignment is correct. If the aperture cut a part of the beam in a non-concentric manner, restart the adjustment of the injection mirror screws.

### 2.5.3.4 Setting of the visualisation system

The visualization system is composed with a white light source and a video camera. These two elements must be optimally adjusted to uniformly illuminate the substrate, and to center the pattern visualization on the video camera sensor.



**Figure 19 : Fine adjustment screws of the reflected lines 1 and 2 mirrors**

The visualization system is factory set and does not need to be specifically adjust for the repositioning applications.

If necessary, it is possible to adjust the angle mirrors of the visualization system by adjusting the screws settings dedicated to this purpose.

### PROCEDURE :

1. Remove completely the removable door from the right side panel by sliding backwards.
2. Open the external window of the video camera (from the software interface in the area « visualization », click on « extern window »).
3. Place a reflective substrate containing a lithographed pattern or a detail that can be observed with relief.
4. Place the focusing head with the help of the arrows from the area « Control of the focusing height », to observe the sharpest image possible.  
  
Finely adjust the sharpness of the image if necessary.
5. With a suitable tool ALLEN 2 type, turn slowly and successively the two adjustment screws of the white light source mirror.  
  
It has the effect of changing the way in which the sample is illuminated.
6. With the same tool, slowly and successively turn the two adjustment screws of the video camera.  
  
This has the effect to modify the centering of the image on the camera sensor, and getting the image as flat as possible.
7. Turn if necessary the aperture stop located near the white light source to change the contrast and the image intensity.
8. Finally, in the area « Visualization », click on « Camera Settings » to access to the settings of the video camera sensibility.  
  
Adjust the software settings of the camera to obtain the sharpest and cleanest image.

## 2.6 Support tools for the patterns visualization and repositioning

The Dilase 250 is equipped with software tools to support the patterns visualization and repositioning dedicated to the superimposing of lithographic patterns.

This assists the operator in lithography procedures : for example when a pattern has to be lithographed according to a pattern already existing on the substrate.

In the repositioning procedures, the main sought function is to define precisely the pattern position to be written to perfectly superimpose it on the existing one, with the best positioning accuracies.

This software tool is based on the ability to pinpoint the existing pattern. That is why the Dilase 250 is equipped with a visualization system composed of a white light source and with an homogenization of the optical illumination, as well as a very fine camera sensor.

### 2.6.1 Visualization system

#### 2.6.1.1 Presentation

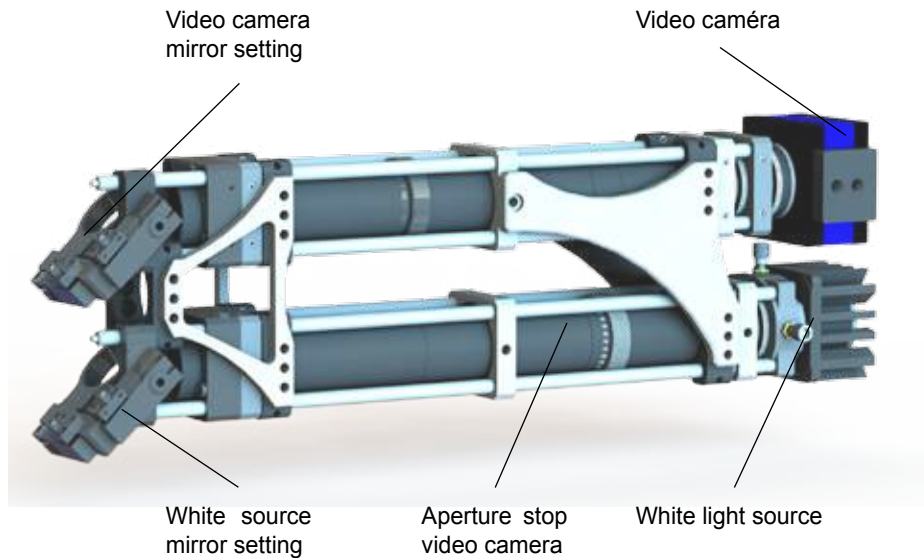


Figure 20 : Global visualisation system

The visualization system is equipped with a white light source propagating in a homogenization optic. This beam is reflected by a first mirror (white source mirror) and is then injected into the focusing head in parallel of the laser signal, in order to illuminate the area of the substrate visualized by the lens.

In this way, a display area can be defined by placing the reference pattern, already presents on the substrate, in the lens field of view.

The substrate reflects the image of the reference pattern illuminated by the beam of light which is projected onto the video camera sensor with an optical magnification of about 15. Thus, the operator can see a sufficient enlarged image of the reference patterns to locate ourselves on a substrate or to start a calibration procedure and proceed in a patterns repositioning.

#### NOTE 1 :

The visualization system uses the same focusing head as used for the direct laser writing. Therefore, it might be necessary to adjust the focusing height based on the wavelength used in either the following cases :

- In writing laser mode, the focusing height must be adapted to the embedded laser source wavelength (375nm or 405nm).
- In visualization mode, the focusing height should be adjusted to an observation at another wavelength.

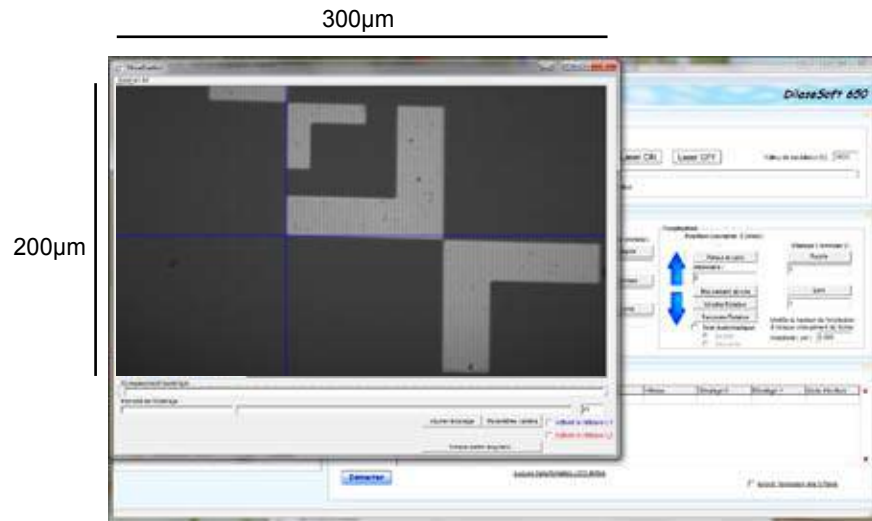
These two focusing heights can be substantially different, it is therefore necessary to work at the focusing heights most suited to the wavelengths used for an optimal functioning in each of these two functioning modes.

#### NOTE 2 :

The visualization system is equipped with a wavelength filter which blocks all wavelengths below 450 nm. Therefore, the majority of resins can be used without risk of being exposed by the lighting system used.

It is therefore compatible to work successively in writing laser mode and in visualization mode laser on the same substrate.

### 2.6.1.2 Fields of view



The visualization system is always accessible from the control interface area « Visualization ».

This system offers a total field of view of 300µm by 200µm, accessible by activating a complete visualization window in clicking on « Extern window » from the same interface area.

Report to the **DilaseSoft 250** manual to get more information on additional functionalities proposed by the interface.

### 2.6.1.3 Repositioning assistance to superimpose patterns

The support software tool has two main functionalities, it allows :

- To identify and view the impact point of the writing laser beam on any substrate.
- To identify a possible lateral or angular offset to be applied in order to align a pattern to be written to a reference pattern already present on the substrate.

The first functionality allows the operator to define on the display screen, the point of impact where the laser beam is irradiated on the resin. This location is shown on the screen by a blue reticle which will be used for the repositioning.

The second functionality permits to compensate for any angular offset that may exist between the real position of the reference pattern visualized by the XY motion system placed on the chuck, and the reference pattern position such that it would be executed by the equipment.

Once this offset known, the equipment can apply it during a run of lithographically pattern writing in order to superimpose the two patterns.

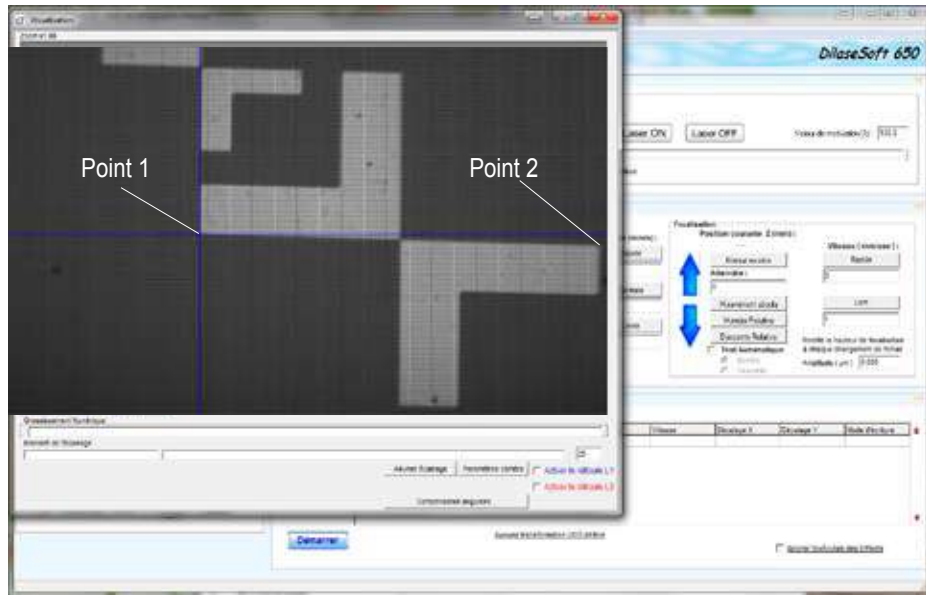
**In a repositioning procedure, a lithographic writing requires a preliminary calibration step to ensure that the real laser impact point corresponds to the theoretical point defined for the realization of the pattern. This calibration step requires the intervention of the operator, and also to procedure to a local lithography on a substrate area to confirm the desired precision.**

**This local lithography is necessary because it permits at the equipment to consider every lithographic process conditions used : thick or thin substrate, transparent or not, thin or thick resin, positive or negative, visibility of the reference patterns, etc...**

### CALIBRATION PROCEDURE OF THE RELOCATION ASSISTANCE TOOL / ANGULAR COMPENSATION :

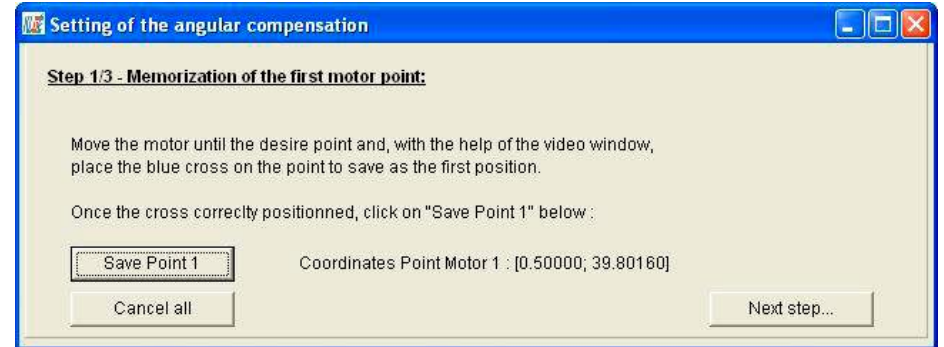
1. Place into the equipment the resin coated substrate on which is the reference pattern dedicated to the calibration.
2. Present it in the field of view of the focusing head.
3. Turn on the light source of the visualization system by clicking «Turn on the light» in the « Visualization » interface area.
4. Place the focusing head at the required height to display an image. The image of the reference pattern appears in the video interface area.
5. Switch on the video display in full screen by clicking on « external window » in the « Visualization » area.
6. Refine if necessary the focusing height in the area « Control of the focusing height » to get the sharpest picture possible.
7. Write this value now named « focalization height CAMERA ».

8. Search precisely the reference pattern on which the operator wishes to be repositioned by moving the motorized stages.
9. Show the calibration cross in the video screen by clicking « Enable the cross ». A blue reticle appears on the video screen.
10. Position the blue reticle center on a specific point of the pattern (right mouse click and slide): this point must be chosen such as its theoretical coordinates (defined by the source file) are known.

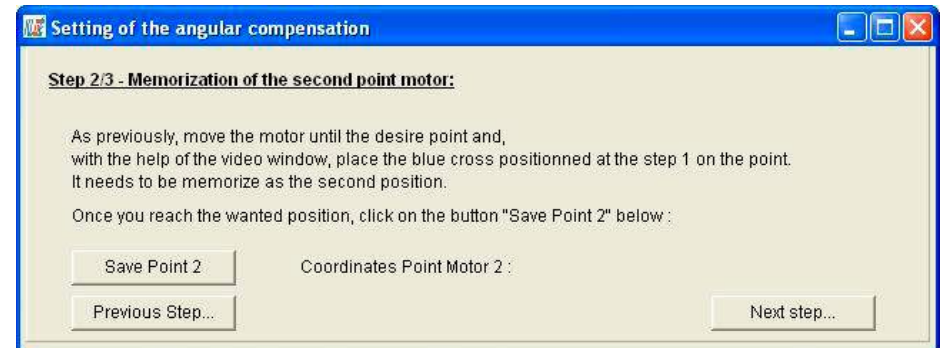


**NOTE :**  
The blue reticle center represents an arbitrary point of the laser beam impact on the pattern.

11. Click on « angular compensation » from the external window to proceed to the correction of the angular displacement.



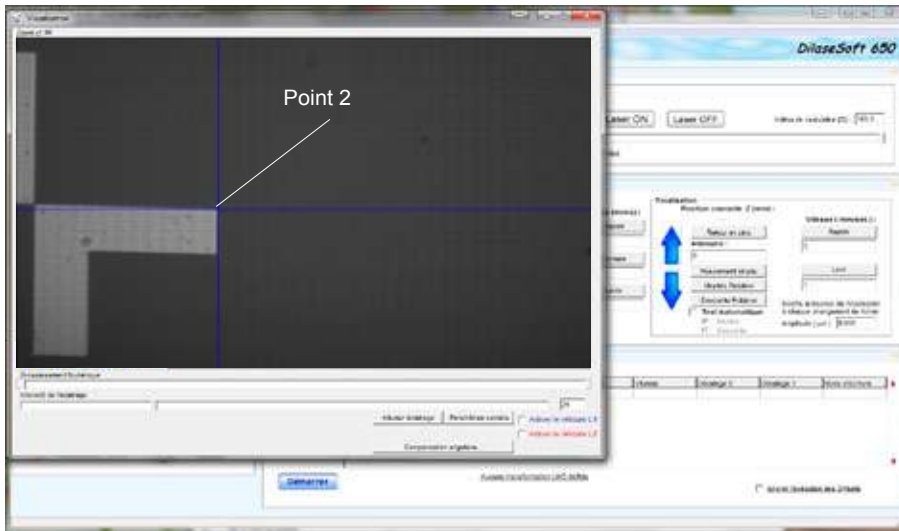
12. A window appears and requests to define a first reference point.
13. Click « Save Point 1 »: the coordinates of the selected point are displayed as seen by the motion system. Then click « next step ».



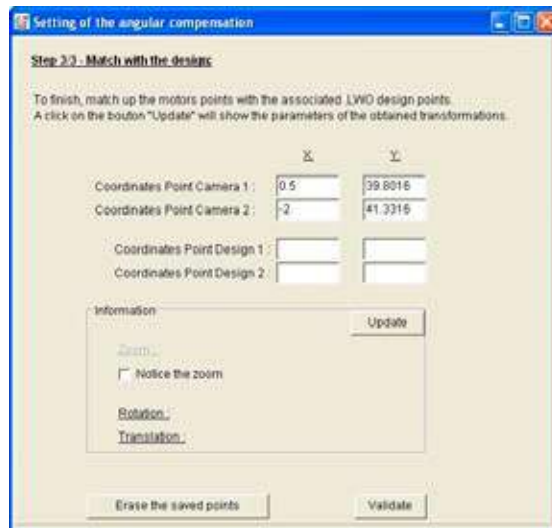
14. Select a second reference point, preferably as far as possible from the point 1, to define a horizontal reference.  
  
These 2 points must also be chosen to make its theoretical coordinates (defined by the source file) known.



15. WITHOUT MOVING THE BLUE RETICLE, match this point with the blue reticle intersection in using the XY motion system.



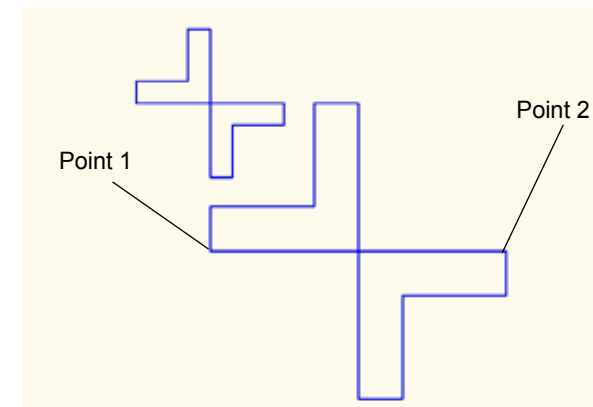
16. Then click on « Save Point 2 »: the coordinates of the selected point, as detected by the motion system, are displayed. Then click « next step ».



17. The coordinates of the selected points, which are detected by the motion system, are displayed in the fields « Coordinates Camera Point ».

Enter now the theoretical coordinates of these same points as defined by the source file in the fields « Coordinates Pattern Point ».

For this, it is possible to open the corresponding \*.LWO file with KloeDesign help and to position the mouse directly on the theoretical points matching to those selected. The current mouse coordinates appear at the bottom of the interface.



**Figure 21 : Pattern overview in KloeDesign for the acquisition of the theoretical coordinates values**

18. Click on « Update ». The tool then calculates the angular compensation to apply in order to proceed of the pattern writing.
19. Click on « Validate » to finish the step of the compensation calculating.
20. Load the \* Lwo file, which has to be lithographed on the reference pattern, in the control area interface « lithography ».
21. Enter the power and velocity values appropriate to the pattern writing.
22. Adjust the focusing height adapted for a lithographic writing (Focusing height Laser).

23. Click « Start ». The writing runs according to the calculated compensation parameters. The pattern to lithography is directly written on the reference pattern with a **standard accuracy of 2µm**. The interface informs the consideration of the compensation parameters in displaying the translation values at the bottom of the area « Lithography ».

**TO KNOW :**

The accuracy obtained by the Dilase 250 when repositioning a pattern on another is ONLY related to the accuracy with which the blue reticle is superimposed on the reference pattern image on the display screen.

24. Get back the sample and reveal it. Observe under the microscope. Note the accuracy of the realized repositioning.

**TO KNOW :**

At this step the calibration procedure of the repositioning assistance tool is done.

The definitive writing of the pattern to lithography on a reference pattern can be realized, with the same accuracy obtained during the calibration.

**IMPORTANT :**

If the associated procedure conditions remain unchanged (substrate, resin, height focus), the calibration is valid for all the following repositionings which have to be realized.

It is not necessary to reposition the blue reticle as the procedure conditions remain unchanged (substrate, resin, focusing LASER height, focusing CAMERA height).

It is not necessary to recalculate the compensation parameters when the reference pattern is changed on a same substrate, IF IT HAS NOT BEEN TAKEN OFF from the machine.

It is imperative to recalculate the angular compensation parameters for each entry / out of the substrate, but not to recalculate the blue reticle position if the substrate is unchanged.

It is possible, even necessary, to increase the repositioning accuracy obtained through a complementary calibration procedure: this calibration permits to refine the reticle position settings and the compensation calculation in order to reposition patterns with a better accuracy than 2 microns.

However, it requires the use of a characterization and measurement tool such as an optical microscope. This calibration is complementary to the standard calibration procedure described above.

**COMPLEMENTARY CALIBRATION PROCEDURE :**

25. After the observations and measures made under the microscope during the previous step, note the residual offset between the two patterns to match, in noting horizontal and vertical offset values.
26. Place again the reference pattern in the equipment and repeat the procedure until the visualization of the pattern on the screen (step 9).
27. Replace the same point 1 as before under the blue reticle.
28. Enter the horizontal and vertical offsets respectively observed in the X and Y fields dedicated to the relative displacement of the interface area « Control of motorized stages ».
29. Click on « Relative motion ». The system moves along the input values.
30. Then move the blue reticle in order to superimpose it at the same recently moved point 1. **DO NOT MOVE AGAIN THE BLUE RETICLE.**
31. Repeat the procedure from step 10 until the visualization of the superimposed patterns with a control and measurement tool (microscope).
32. Repeat the steps 26 to 32 if the accuracy can be refined until you reach the maximum desired precision.

**TO KNOW :**

The accuracy obtained with the Dilase 250 after one or more additional and successive complementary calibration procedures can then reach values inferior to one micron.

### 3. HANDLING

#### 3.1 Handling during the first installation

The Handling of the Dilase 250 and its components, during the first installation, should be realized only by a technician from Kloé SA or a corporation authorized by the manufacturer.

All precautions must be taken to avoid damages on the Dilase 250 and its components during the handling, especially with the lasers sources and, the optical and cover elements.

#### 3.2 Handling after the first installation

Once the Dilase 250 is fully assembled and ready to be used, it should not be shaken with the intention of moving it. No lifting handle is particularly designed for this purpose and should be used to move the equipment. The Dilase 250 framework is not equipped with lifting handle and wheels to move it.

If despite these indications the owner decides to move the Dilase 250, it is necessary to take the following precautions :

- Turn off the power of the equipment.
- Unplug the electrical cable behind the equipment.
- Unplug the hose of the vacuum network behind the equipment.
- Ensure that there are no moving parts inside the equipment which can be damaged during the transport.

Be aware of each of the following points :

- Mobile chuck.
- Motorized stages.
- Coated substrates which can be placed on the chuck.
- Accessories of the manipulation (tweezers, boxes, compensating form templates, pens ...).
- Ensure that the Dilase 250 side door is immobilized in closed position.

#### **ATTENTION :**

It is strongly recommended to realize any handling of the Dilase 250 by the professionals to avoid any risk of accident or damage on the equipment. The company Kloé SA will not take financial responsibility of any repairs or changes in this case.

### 4. ASSEMBLY - DISASSEMBLY

#### 4.1 Assembly at the first installation

The assembly of the Dilase 250 and its components, at the first installation, must be realized only by a technician from KLOE SA or the corporation authorized by the manufacturer to modify or repair the equipment.

All precautions must be taken to avoid damages on the components during their handling, especially with the lasers sources and, the optical and cover elements.

#### 4.2 Assembly - Disassembly after the first installation

Only the cover elements can be assembled and disassembled with **the sole and unique purpose of maintenance of the Dilase 250**, or of its internal or external parts.

Once the Dilase 250 is fully assembled and ready to be used, it should not be shaken with the intention of moving it. No lifting handle is particularly designed for this purpose and should be used to move the equipment. The Dilase 250 framework is not equipped with lifting handle and wheels to move it.

If despite these indications the owner decides to move the Dilase 250, it is necessary to take the following precautions :

- Turn off the power of the equipment.
- Unplug the electrical cable behind the equipment.
- Unplug the hose of the vacuum network behind the equipment.
- Ensure that there are no moving parts inside the equipment which can be damaged during the transport.



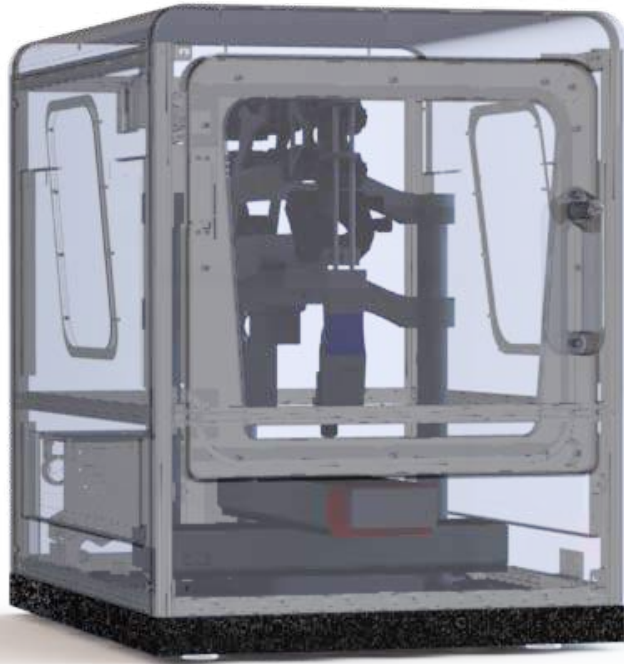


Figure 22 : View through the Dilase 250 cover

**WARNING :**

Each use of the equipment with the cover disassembled corresponds to an abnormal utilization. The company KLOE SA will not take financial responsibility of any repairs or changes in this case.

## 5. MAINTENANCE

### 5.1 Cleaning of opto-mechanical components

To ensure the optimal lifetime of the equipment and components, a regular maintenance is recommended.

The maintenance includes :

- The switching and reflecting mirrors of the beam.
- The chuck.
- The command units of the equipment.

A regular and frequent cleaning of the opto-mechanical components should be realized to ensure the optimal quality of the reflecting laser beams. For this, start with blowing a powerful and brief compressed air spray, every time when it is necessary.

This action is often sufficient to remove most of the impurities that can be deposited on the mirror.

If necessary, use a lens cloth soaked with soft solvent, as isopropanol for exemple, and clean the impurities on the optical components surfaces.

Repeat the operation until you have a perfectly clean surface. Wipe with a clean, dry lens tissue to remove residual traces.

Similarly, clean regularly all mechanical components (frames, laser, etc...) and particularly the granite components inside the equipment to eliminate the impurities like micro dust.

### 5.2 Cleaning of the chuck

Before each use of the chuck and the deposition of resin coated substrate, check the cleanness of the surface. If it is necessary, clean the surface with lens tissue soaked with a soft solvent to eliminate the residues on this surface.

Check also that the resin residues do not block the vacuum holes, which will change the vacuum strength intensity and distribution to hold the substrate by suction.

### 5.3 Cleaning of the command units

Keyboard, mouse, and also front glass, granite table and the units motorized stages clean regularly the screen to minimize the dust. All of these units, except the granites, can be cleaned with an optical tissue soaked with a soft solvent as isopropanol. The granite components can be cleaned by using a vacuum system.

## 6. SOLVING OF THE PROBLEMS

This chapter describes the first level maintenance which can be realized by the operator: it helps the operator to identify and to solve certain problems.

**TO KNOW :**

In most of cases, the electronic and mechanical problems can be solved when you restart the equipment with the startup key.

□ **Other possible problems**

POSSIBLE PROBLEMS	SOLVING OF THE PROBLEMS
No start up of the stages.	The control cards can be in error.  Push the emergency stop button, turn the key a quarter to the left, release the EMERGENCY STOP button and restart the Dilase 250 by turning the key a quarter to the right.
No UV spot visible on the sample or on the camera.	Check if the white lighting is on.  Check the laser beam emission.  Check the mirrors setting.
No interface software access.	The control cards can be in error and block the operating system.  Push the emergency stop button, by turning the key a quarter to the left, release the EMERGENCY STOP button and restart the Dilase 250 by turning the key a quarter to the right.
The sample is not fixedly held on the chuck.	Check the vacuum activation.  Check the holes obstruction of the whole chuck.

POSSIBLE PROBLEMS	SOLVING OF THE PROBLEMS
The writing starts but stops after some trajectories.	Check the *.LWO file by opening it with KloeDesign.  Check that the required velocities are not excessive.
The software interface blocks during or after the writing.	Check the *.LWO file by opening it with KloeDesign.  Check that the required velocities are not excessive.
The laser stays "on" at the end of the writing.	Check the *.LWO file by opening it with KloeDesign.  Check that the required velocities are not excessive.
The lithography result is not conform in terms of trajectories (deformations, vibrations ...).	Check that the substrate is correctly held on the chuck. Otherwise contact the company Kloé if it seems to be an engines problem.

## 7. COMPLIANCE

### THE CE DECLARATION OF CONFORMITY

According to the Directive 98/37/CE of the European Parliament and of the Council of 22 June 1998 regarding the approximation of the Member States laws relating to machinery,

the company :

**Kloé SA**

certifies that the equipment : **Dilase 250, Laser Lithography Equipment with the serial number :**

- meets :
- The regulatory requirements defined in Annex I of the European Directive 98/37/EC.**
  - The rules defined in Annex I introduced into the Employment Law Code with the Article R 233-84.**
  - The Decret rules of the 14th of November 1988 for the protection of persons against electrical dangers.**
  - The Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility.**
  - The European standard NF EN 60 204 on the electrical equipment of machines.**

And that the corresponding technical manufacturing documentation, according to the paragraph 1.7.4 of Annex I of Directive 98/37/EC, was provided to the customer.

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