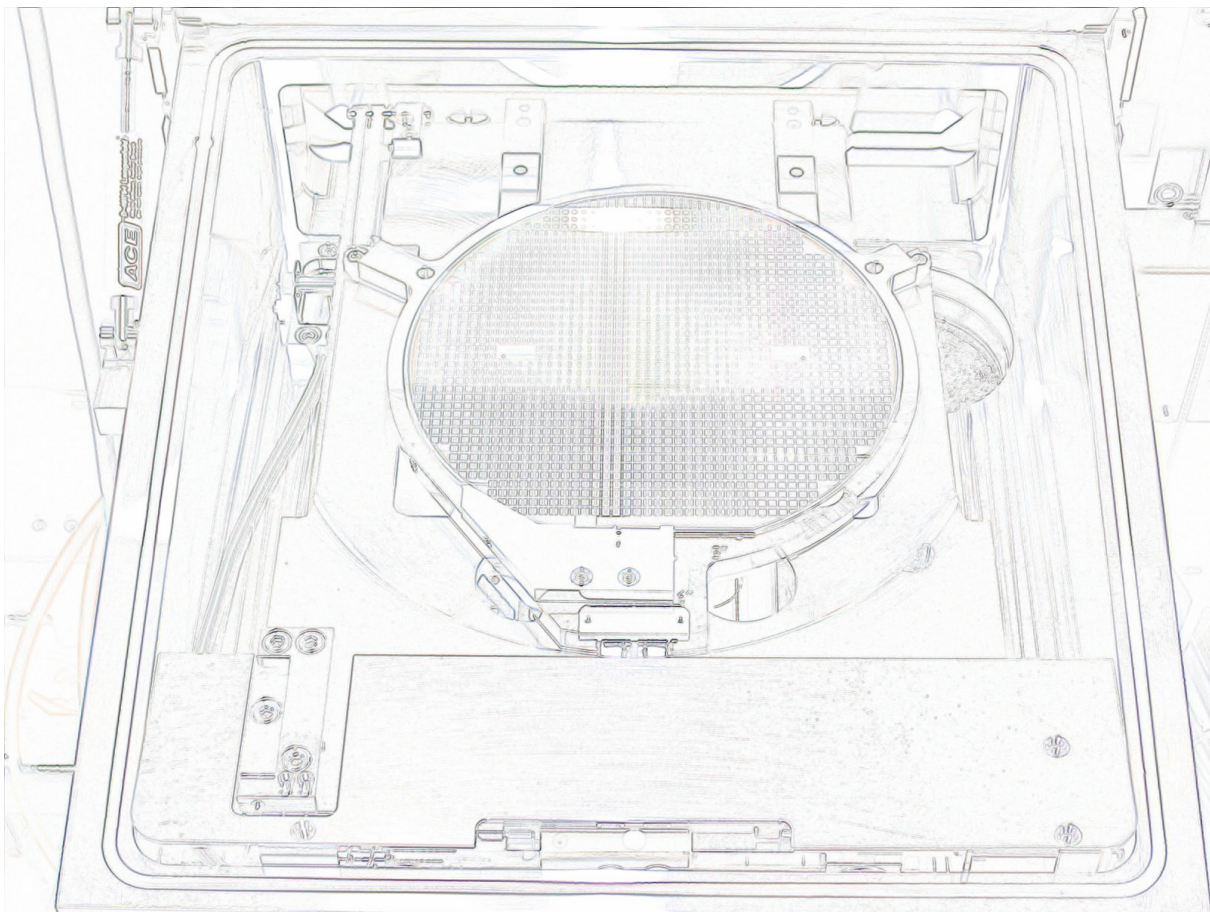


Raith

Innovation from a world leader in
e-beam lithography and
semiconductor navigation solutions



Operation Manual

Loadlock

Product:	Loadlock
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Statement

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1 Introduction

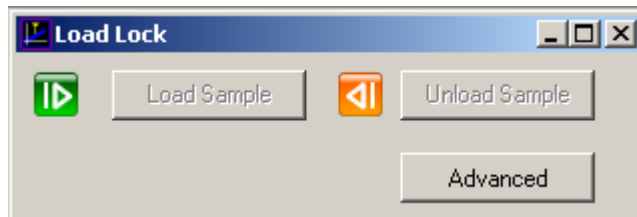


If you were referred to this document by a software error message, the system should be treated as though it were in an EMERGENCY STATE. Exercise care because serious mechanical damage could occur depending on the status of the system. Error messages could be displayed while using the tool, or when starting the software because the software looks for stored errors when initializing.

In this case refer immediately to section [First aid steps](#).

The RAITH150 system comes with a Loadlock to load and unload samples carried on a sample holder. The hardware itself is controlled by a software module to initiate the load or unload sequence a software module, to setup the system, and to aid the user in case of an error.

Figure 1: Dialog of Loadlock module.



2 Loadlock procedures

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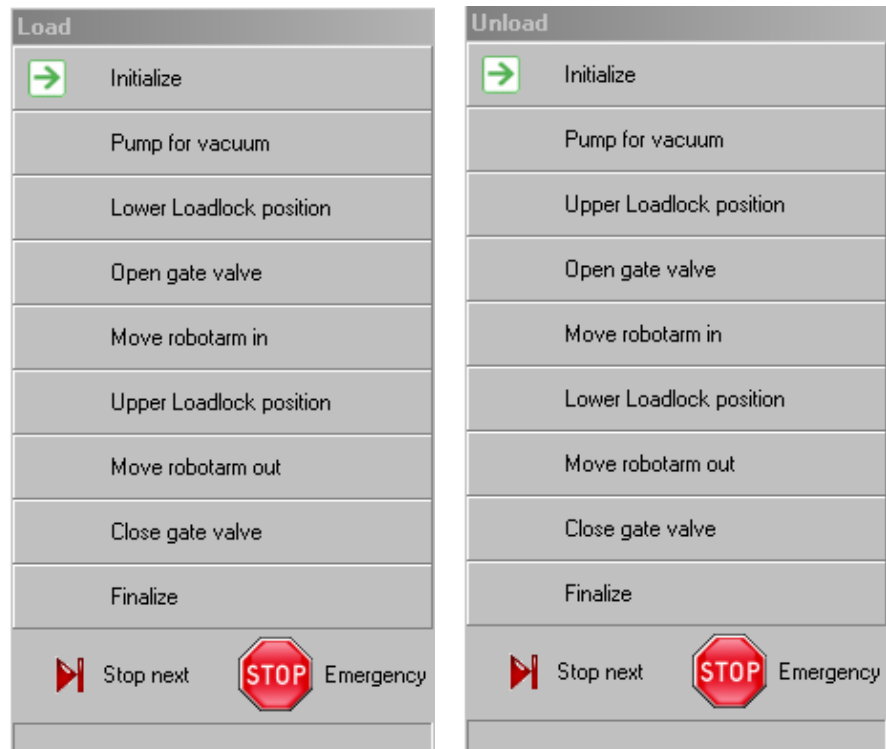
2.1 Sample exchange

This section describes both the automatic sample load as well as the unload procedures.

If the sample status is correct, you have either the possibility to load or unload sample by choosing the **Load Sample** or **Unload Sample** command. Both commands are disabled, if the sample status is undefined. In this case, log on as a system level user and redefine the actual sample status (see section [Settings](#)).

After starting either the automatic load or the unload procedure, a status window appears showing the progress in single steps. After completing the procedure the window is closed and the Raith software can be used again. In general, the system is equipped with an error handling. If an error occurs, the system starts a routine trying to bring out the system out of its state.

Figure 2: Window showing the progress of load and unload procedure.



One can interrupt the automatic load procedure by pressing **Stop next** or **Stop Emergency**.

The **Stop next** button gives any user the possibility to interrupt the procedure by the next safe condition. After pressing **Stop next** the automatic procedure would not be stopped until the current step is finished and the system is in well defined condition. **Stop next** does not generate any errors and user can continue his work as soon as the status window is closed.



The **Stop Emergency** button becomes visible only for system level user and allows stopping the procedures and all motors any time. After pressing the status window will be closed immediately. Other asynchronous procedures like pumping for vacuum continue to work. The **Stop Emergency** button should be used, if one realizes a dangerous course of events during an automatic procedure. After applying this stop command the system may be in critical state and the system level user must bring it in safe condition (section [First aid steps](#)).

2.2 Sample exchange procedure

The following table gives an overview over the single steps that are performed during an automatic sample exchange procedure.

Table 1: Single steps which are executed during load/unload procedure.

Procedure step	Description
Initialize	<ul style="list-style-type: none"> • Executes StartUnLoadScript or StartLoadScript respectively. • Checks system vacuum. • Switches the stage into encoder mode. • Switches beam off. • Turns off the voltage. • Closes the column chamber valve.
Pump for vacuum	Pumps the Loadlock until vacuum is ready.
Lower/Upper Loadlock position	Drives stage to the lower/upper exchange position to ensure that stage is on the right height when robot arm moves in.
Open gate valve	Opens the gate valve. Possible only, if the system vacuum and Loadlock vacuum are ready. Status is indicated also on Loadlock controller.
Move robot arm in	Moves robot arm into the chamber until the inner position is reached. The status that the robot arm is not in its outer position is indicated on the Loadlock controller.
Upper/Lower Loadlock position	Drives stage to the upper/lower exchange position to pick up/release the sample holder from/onto the robot arm.
Move robot arm out	Moves robot arm out of the chamber until the outer position is reached. The status that the robot arm is in its outer position is indicated on the Loadlock controller.
Close gate valve	Closes the gate valve. Possible only, if the robot arm is in its outer position. Status is indicated also on Loadlock controller.
Finalize	<ul style="list-style-type: none"> • Vents the Loadlock. • Opens the column chamber valve. • Executes EndLoadScript or EndUnloadScript respectively. • Switches to laser mode, if possible. <p>Only for load procedure:</p> <ul style="list-style-type: none"> • Shakes the piezos. • Resets the UV adjustment. • Drives stage to home position

2.3 Charging the chuck

Two commands are available to charge or discharge an electrostatic chuck: **Charge Chuck** and **Discharge Chuck**.

Follow the instruction described in the RAITH150 Sample holder manual. While charging the following steps are executed

- The stage drives to into two electrical contacts connecting the chuck with the power supply.
- The chuck is charged. During this step the **Current** LED at the front panel of the Loadlock controller is on. After finishing Current LED is off, but **Voltage** LED is on indicating that chuck is holding its charges.
- Stage drives out of the contacts to disconnect the power supply from the chuck. The chuck is holding the charges, clamping now the wafer.

If the electrostatic chuck could not be charged, for example in case of a short-circuit between chuck and robot arm, the **Current** LED will not switch off. The charging procedure can not be finished successfully in this case.

After unloading the electrostatic chuck, press **Discharge Chuck** and the discharging procedure will start:

- The stage drives into the two electrical contacts connecting the chuck to the ground.
- Stage drives out of the contacts.

3 Error handling

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If you were referred to this document by a software error message, the system should be treated as though it were in an EMERGENCY STATE. Exercise care because serious mechanical damage could occur depending on the status of the system. Error messages could be displayed while using the tool, or when starting the software because the software looks for stored errors when initializing.

In this case refer immediately to section [🌐 First aid steps](#).

Possible reasons for an error message could be:

- a malfunction of the stage or the robot arm,
- the procedure was interrupted (e.g., due to a power failure, etc.)
- a problem in the controlling software.

The exchange procedure (i.e., loading/unloading samples) is a completely automated process. There are various mechanical switches and software checks to ensure the procedures progress without error. The system is in an extremely vulnerable state and must be treated with care because damage could occur resulting in costly repairs and/or considerable down time.

The first half of this section ([🌐 First aid steps](#)) is intended for anyone having a logon access of User or higher. Steps are explained which determine the error status of the Loadlock. The intent is to learn how to proceed in order to protect the system from further possible damage. Depending on the level of importance, further action may be required to get the system back into normal operation.

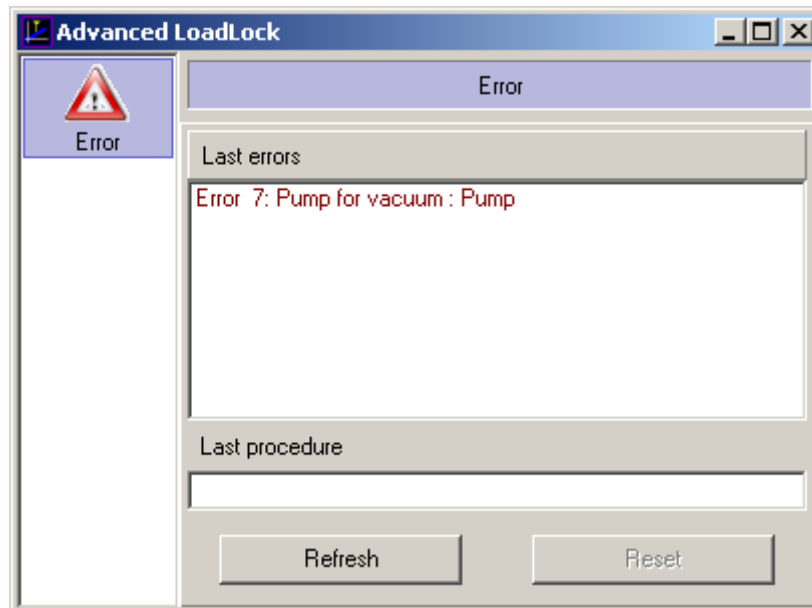
More extensive error determination and correction actions are explained in the last half of this section ([🌐 Error Administration](#)). This section requires a logon access of Expert or System (i.e., the system supervisor or Raith service personnel.)

3.1 First aid steps

STEP 1 ►

Identify the number of the error. If you cannot remember the error number, choose **Advanced** with the Loadlock dialog. Within the following window all errors are listed. The list displays an error number, the main procedure and sub-procedure.

Figure 3: List of all current Loadlock errors.



STEP 2 ►

Follow the appropriate step depending on the error number.

Table 2: List of possible first aid actions.

Error	proceed with step ...
MoveStage2ndPosition	A
MoveRobotArmIn	A
MoveRobotArmOut	A
OpenValve	A
CloseValve	A
Pump for vacuum: VacuumReady	B
MoveStage1stPosition	B
Pump for vacuum	B
Vent	B
Initialize	C
Finalize	C

A

The system is in a critical state because either the Loadlock valve is open or the robot arm is within the chamber. The system could easily be damaged by a false action. As a normal user without administration privileges you should also contact the responsible supervisor. Follow the correct course of action below depending on what has happened.

1) If there is a hardware problem with the stage or the robot arm, inform Raith as soon as possible. Before calling, collect the following detailed information:

- A description of the origin, e.g., power failure, stage problems, robot arm error, etc.

- An image from the internal CCD camera (i.e., the chamber scope.) Press **CTRL + E** on the column control computer to open a dialog window to save an image.
- Obtain a copy of the “RAITH150.vdb” file located in the “C:\RAITH150\bin” directory.

Telephone numbers for Raith Support are listed at the 2nd page of this document.

2) If the procedure has been interrupted by a power failure, proceed as follows:

- Login at a System or Expert account level.
- On the **Loadlock** window, choose **Advanced > Single steps**.
- Choose the command **Open Loadlock Valve**. The opened status of the valve should now be correctly indicated on the front panel of the Loadlock controller drawer on the Raith electronics rack.
- Press the **Release t-Axis** button and move the robot arm with the Joystick as far as possible in its outer (or “docked”) position. The outer position is reached when the red LED on the front panel of the Loadlock controller is OFF.
- Look to verify that the robot arm within the Loadlock. Choose the command **Close Loadlock Valve**. The status LED on the Loadlock controller should also change.
- Finally, use **Vent the Loadlock** to shut down the Loadlock vacuum pumps and vent the Loadlock.
- Reset system error status as described under Step 3, given below.

B These errors indicate that the turbo pump is running. Most probably the error was caused by a power failure. Follow the steps below to shut down the vacuum pumps to prevent overheating.

- Login at a System or Expert account level.
- On the **Loadlock** window, choose **Advanced > Single steps**.
- Finally, use **Vent the Loadlock** to shut down the Loadlock vacuum pumps and vent the Loadlock.
- Reset system error status as described under Step 3, given below.

C This error indicates that the system has been interrupted during the initial stages of the load or unload procedure. Simply reset the error status as described under Step 3 and proceed as normal.

STEP 3 ►

If the origin for the error has been eliminated, you can reset the system for normal operation. Login at a System or Expert account level and

choose **Advanced > Single steps > Reset** on the **Loadlock** window. Logout and restart the RAITH150 software.



Do not reset error status before origin of error is found. The system must be treated with care because damage could occur resulting in costly repairs and/or considerable down time.

3.2 Error Administration

Table 3: List of possible first aid actions.

Error	Reason / Procedure
MoveStage2ndPosition or MoveStage1stPosition	Reasons: The desired position can not be reached within decoder tolerance or timeout for stage is exceeded. Procedure: 1. Release T axis, 2. Move robot arm out by joystick or Single Step command. 3. Close gate valve. 4. Vent. 5. Search for origin, inform Raith.
MoveRobotArmIn or MoveRobotArmOut	Reasons: Inner/Outer position can not be reached, corresponding switch is not touched, and timeout for stage is exceeded. Procedure: 1. Release T axis. 2. Move robot arm out by joystick or Single Step command. 3. Close gate valve. 4. Vent. 5. Search for origin, inform Raith.
OpenValve	Reasons: No connection to Loadlock controller or Loadlock vacuum not ready. Procedure: 1. Vent. 2. Search for origin.
CloseValve	Reasons: No connection to Loadlock controller or robot arm is not in its outer position. Procedure: 1. Call Raith immediately.
Pump for vacuum: VacuumReady	Reasons: No connection to column computer, leak at Loadlock, Loadlock vacuum pump not functioning Procedure: 1. Check if stage is in outer position. 2. Check if gate valve is closed. 3. Vent. 4. Search for origin.
Pump for vacuum	Reasons: No connection to column computer. Procedure: 1. Search for origin.
Vent	Reasons: No connection to column computer, robot arm not in its outer position or gate valve is opened.

4 Advanced operations

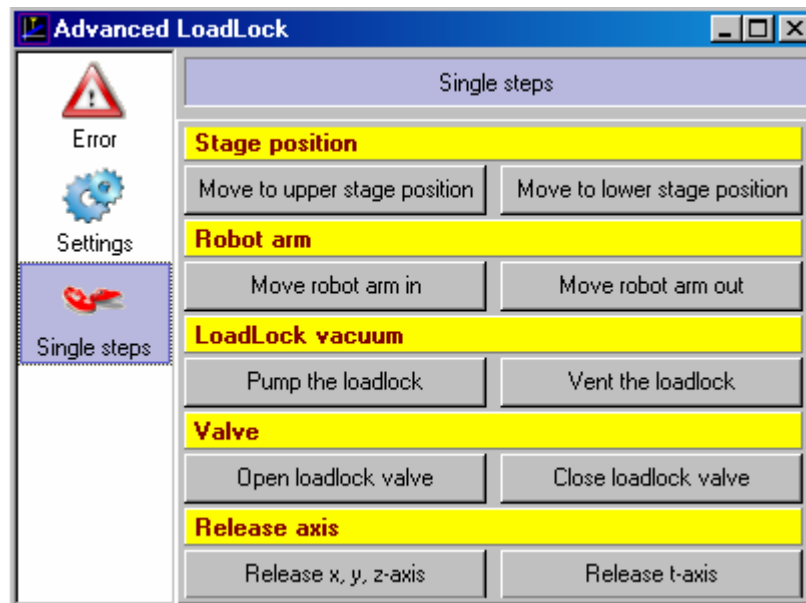
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4.1 Single Steps

If you are logged in as a system level user, you have the possibility to perform some so called **Single step** operations. The customer can use these commandos to bring the system in safe condition, if the last sample exchange procedure was faulty.

Figure 4: Single steps dialog.



Unlike the automatic load and unload procedures single step operations are not guarded against user's mistakes. Please be careful and check the system conditions before starting next operation.

The following table gives an overview of all single step commandos that are available for the loadlock:

Table 4: List of Single step commands.

Command	Description
Move to upper stage position	Drives stage to the upper exchange position. Order of stage movement: Z-XY.
Move to lower stage position	Drives stage to the lower exchange position. Order of stage movement: Z-XY.
Move robot arm in	Moves the robot arm into the chamber until the inner position and the switch is reached. ⚠ Use this commando if the stage is in the lower exchange position and gate valve is opened.
Move robot arm out	Moves the robot arm out of the chamber until the outer position and the switch is reached. ⚠ Use this commando if the gate valve is opened.
Pump the Loadlock	Starts pumping the Loadlock. No polling of Loadlock state.
Vent the Loadlock	Starts venting the Loadlock. No polling of Loadlock state. ⚠ Use this commando if robot arm is out and gate valve is closed.
Open Loadlock valve	Opens the gate valve. ⚠ Use this commando, if vacuum within Loadlock and main chamber is ok. It is recommended to close the column chamber valve before.
Close Loadlock valve	Closes the gate valve. ⚠ Use this commando, if robot arm is in its outer position.
Release x, y, z-axis	Releases locked X, Y, Z axis.
Release t-axis	Release of locked T axis.

4.2 Settings

If you are logged as system level user, you have the possibility to change some settings related to stage, robot arm position and the sample status.

Figure 5: Settings dialog.

Settings		
Stage position		
Upper/Lower X:	-7.000 mm	Read Set
Upper/Lower Y:	-70.000 mm	Read Set
Upper Z:	12.000 mm	Read Set
Lower Z:	1.000 mm	Read Set
Robot arm position		
Inner:	451.300 mm	Read Set
Outer:	1.000 mm	Read Set
Charge:	0.500 mm	Read Set
Vacuum		
Min Stage:	0.100 mbar	Set
Sample status		
<input checked="" type="radio"/> loaded <input type="radio"/> unloaded <input type="radio"/> undefined		



Changing the settings can result in costly repairs and/or considerable down time.

The following table gives an overview of Loadlock settings.

Table 5: List of Single step commands.

Settings	Description
Stage position	
Upper/Lower X	X position where the robot arm hands over the sample holder to the stage and vice versa.
Upper/Lower Y	Y position where the robot arm hands over the sample holder to the stage and vice versa.
Upper Z	Z coordinate for upper exchange position, has to be above the robot arm when moving in.
Lower Z	Z coordinate for lower exchange position, has to be below the robot arm when moving out.
Robot arm position	
Inner	Position of T axis inside the chamber touching the switch.
Outer	Position of T axis in the Loadlock touching the switch.
Charge	Position of T axis where electrostatic chuck can be charged.
Vacuum	
Min. Stage	Minimum value of system vacuum needed for safely opening the gate valve.
Sample Status	
Loaded	The sample holder is in the stage.
Unloaded	The sample holder is in the Loadlock
Undefined	The sample holder position is not defined.