EVG 610 bond aligner User Manual

Version of 2024-09-26.

1. Introduction

This manual explains how to operate the EVG 610 wafer bond aligner to mount two wafers, with fine alignment, on the EVG bonding fixture. After the alignment and mounting sequence, the fixture is loaded in the EVG 510 wafer bonder equipment for further processing.

The equipment can align and mount both 4inch and 6inch wafers but the chuck and fixture are specific to each wafer diameter and will need to be exchanged by the operator.

Note: The EVG 610 has two additional functions that will use different set of tools and that are not described in this manual:

1) Mask-aligner functions to expose wafers with i-line photoresist/illumination.

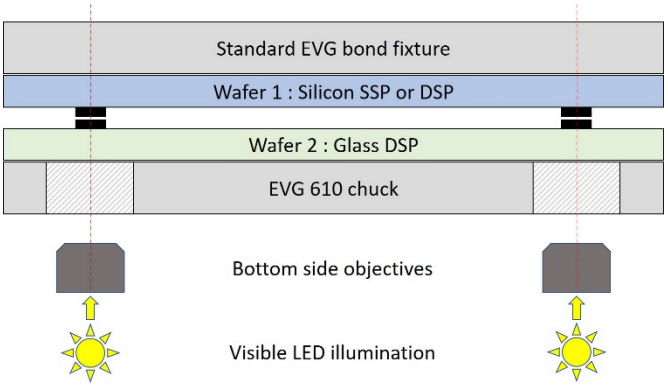
2) Silicon direct bond (SDB) function to align and bond wafers inside the aligner by applying a small pressure on the stack of wafers.

2. Alignment mode options and requirements

The EVG 610 can align wafers with different methods which all have specific requirements in terms of wafer material and alignment marks side and position.

Make sure to respect these requirements!

A. Silicon / Glass, visible illumination

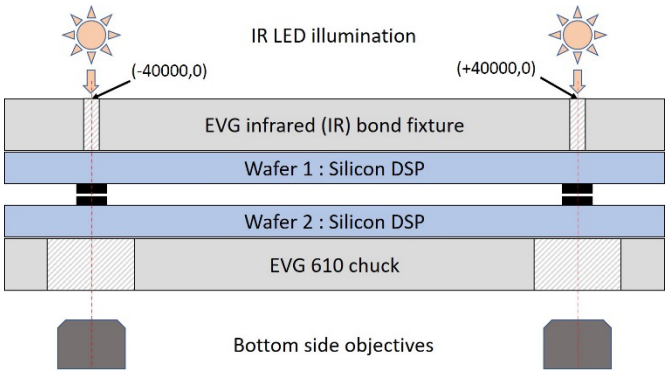


This configuration is used when one of the two wafers is transparent to visible illumination. It is the default for anodic bonding of borofloat and silicon wafers but can potentially be used with other types of bonding method.

Requirements:

- The glass wafer is double-side polished (DSP).
- Alignment marks are present on the bond interface of both wafers.
- Marks position on both the left and right side of the wafer are within **+/- 15000 < X < +/- 45000 [um],** and **+/- 10000 < Y < +/- 10000 [um].**

B. Silicon / Silicon, IR illumination

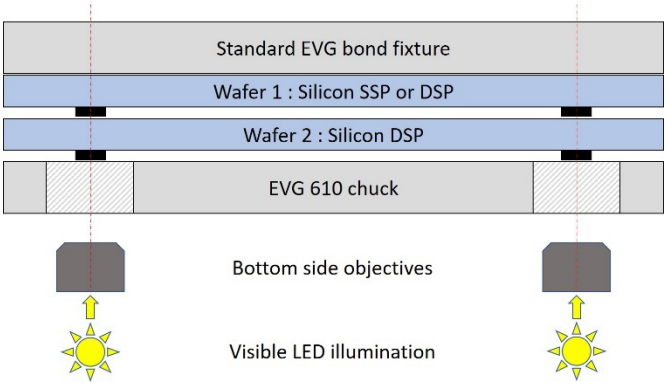


This configuration is used when both wafers are silicon, opaque to visible illumination but transparent to infrared (IR). In this configuration, a specific fixture with see-through holes is used and an IR light source is used to illuminate through both wafers.

Requirements:

- Both silicon wafers are double-side polished (DSP).
- Alignment marks are present on the bond interface of both wafers.
- Marks position are restricted to specific positions: **(-40000, 0) and (+40000, 0) [um].**

C. Silicon / Silicon, visible illumination



This configuration is used when both wafers are silicon, opaque to visible illumination and that the IR illumination option cannot be used (SSP wafers, mark position not available, IR absorbing metal layer, etc…). The fabrication will require additional process steps since the alignment marks will need to be replicated on the opposite side of wafer 2.

Requirements:

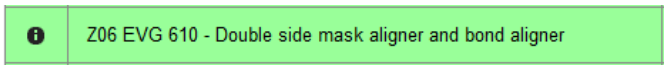
- The bottom silicon wafer (wafer 2) is double-side polished (DSP).
- Alignment marks are present on the bond interface of wafer 1, and on the opposite side of wafer 2.
- Marks position on both the left and right side of the wafer are within **+/- 15000 < X < +/- 45000 [um],** and **+/- 10000 < Y < +/- 10000 [um].**

In this operation mode, the first wafer is loaded and the alignment mark positions are found with the bottom side objectives. The positions are recorded by placing a visual indicator on the mark (crosshair) or by grabbing an image (overlay). The second wafer is then loaded and aligned wither with the crosshair or the overlay image.

3. Login on CAE

Login with your “CMi” username and password on the Zone 06 CAE accounting computer.

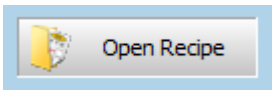
Select the “EVG 610 – Double side mask aligner and bond aligner”



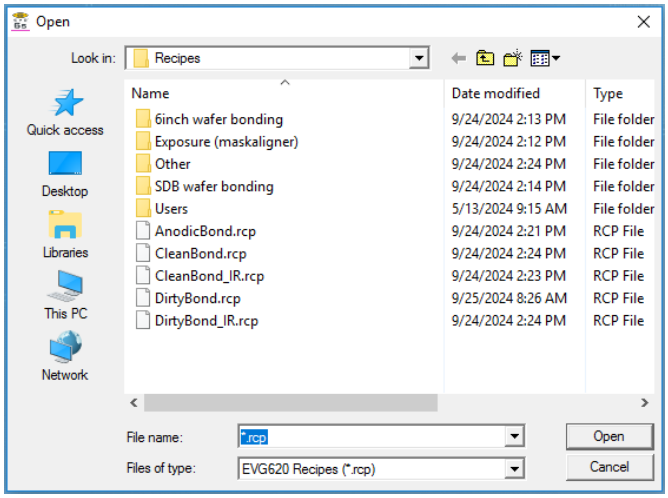
4. Starting a job with the EVG 610 User Interface

The EVG 610 user interface should be always opened. At the bottom of the user interface, different tabs are available, but only **“Recipes”**, that should be active by default, is used by the operator.

Recipes are loaded into the main window by clicking on:



Five recipes will be available in the main “Recipes” folder:



! Do not change the parameters in the recipes unless it has been discussed and approved by the Staff. User-modified recipes should be saved in the “User” folder!

In details:

- AnodicBond.rcp: To align a silicon and a glass wafers with the EVG 510 tools (fixture and quartz plate) dedicated to the anodic bonding method. **Alignment method “A” is used.**
- DirtyBond.rcp: To align opaque wafers (silicon mainly) with the EVG 510 tools (fixture and quartz plate) dedicated to the “dirty” bonding method (using an

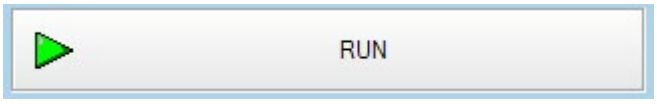
intermediate glue at the bonding interface). **Alignment method "C" is used.**

- DirtyBond_IR.rcp: To align opaque wafers (silicon mainly) with the EVG 510 tools (fixture and quartz plate) dedicated to the "dirty" bonding method. **Alignment method "B" is used.**
- CleanBond.rcp: To align opaque wafers (silicon mainly) with the EVG 510 tools (fixture and quartz plate) dedicated to the "clean" bonding method (direct contact). **Alignment method "C" is used.**
- CleanBond_IR.rcp: To align opaque wafers (silicon mainly) with the EVG 510 tools (fixture and quartz plate) dedicated to the "clean" bonding method. **Alignment method "B" is used.**

Some process parameters (alignment gap, WEC and contact force) will be slightly adjusted in the 5 recipes but, other than the alignment illumination & method, **the main difference will be the management of the spacers (flags):**

- AnodicBond.rcp: Spacers are introduced between the two wafers after the WEC and alignment.
- DirtyBond.rcp: Spacers are not used to avoid contamination from the polymer used as adhesive.
- CleanBond.rcp: Spacers are introduced between the two wafers before the WEC and alignment. The wafers are never taken directly in contact with each other to prevent the initiation of bonding before the alignment sequence.

Once the recipe has been selected, it will be started by clicking on:



5. Sequence example: silicon to silicon with overlay alignment (alignment method "C")

This sequence consists in a series of 27 steps that will be detailed below.

Make sure to follow all the steps until the end of the process!

To help you progress through the steps, indications will be given in textual format, with an image and a small animation of the task to be performed.

Once completed, the operator can move to the next step by clicking on "Continue". Some steps, such as alignment, can be repeated if the user is not satisfied with the results by clicking on "Undo".

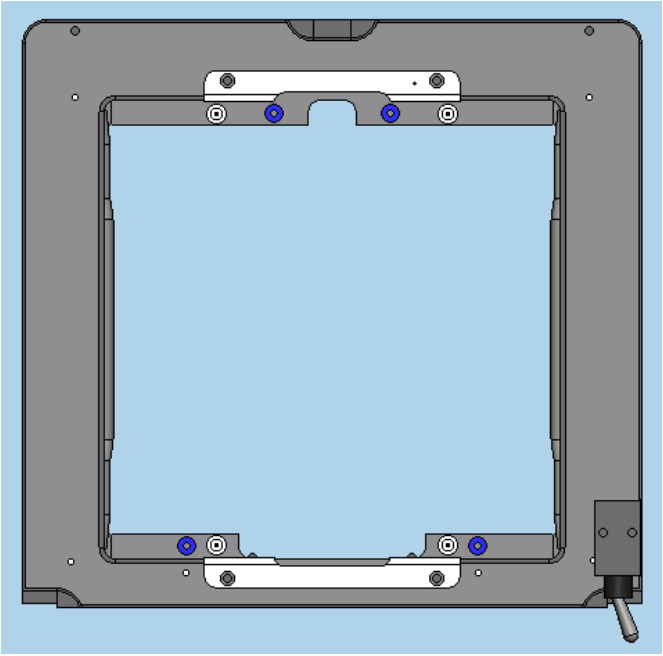
An overview of the user interface (UI) during the running recipe sequence is available at the end of this guide.

Steps in details:

Step 1: "Configure Optic" → **no action needed** (topside optics are removed by default)

Step 2: "Move Tray Out" → **Pull the tray our completely**

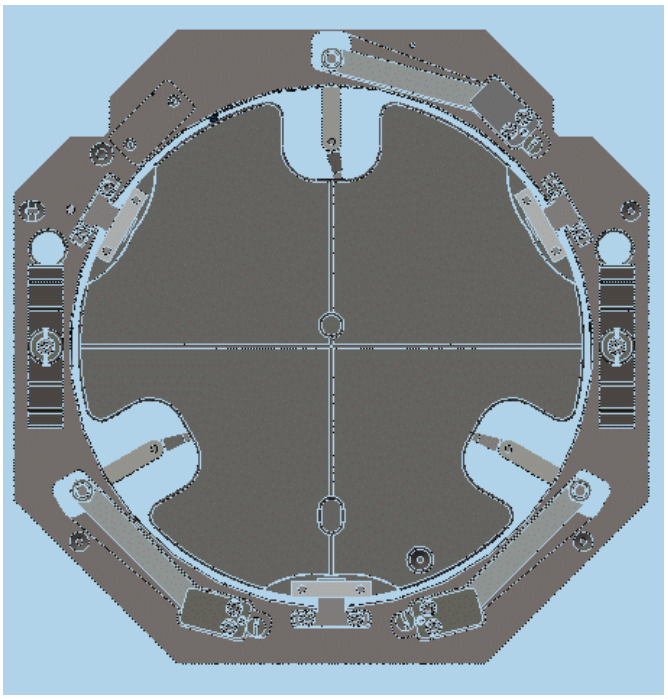
Step 3: "Insert Adapter Frame" → **no action needed** (frame already inserted)



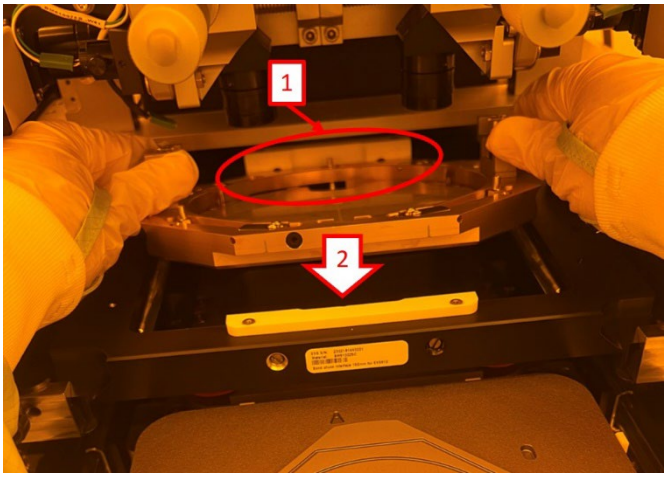
Step 4: "Fix Adapter Frame" → **no action needed** (frame already fixed)

Step 5: "Insert Bond Tool" → **Insert the fixture**

The schematic (view from the top) depicts how the fixture should be inserted into the frame. Pay attention to the position of the spacers.



The fixture is first pushed in to contact the back of the fixture with the frame (see [1] in the picture below), and then the front section is pushed down (see [2]) to fit correctly inside the frame.



Step 6: "Remove Clamps" → **Rotate the clamp knobs as depicted in the animation.**

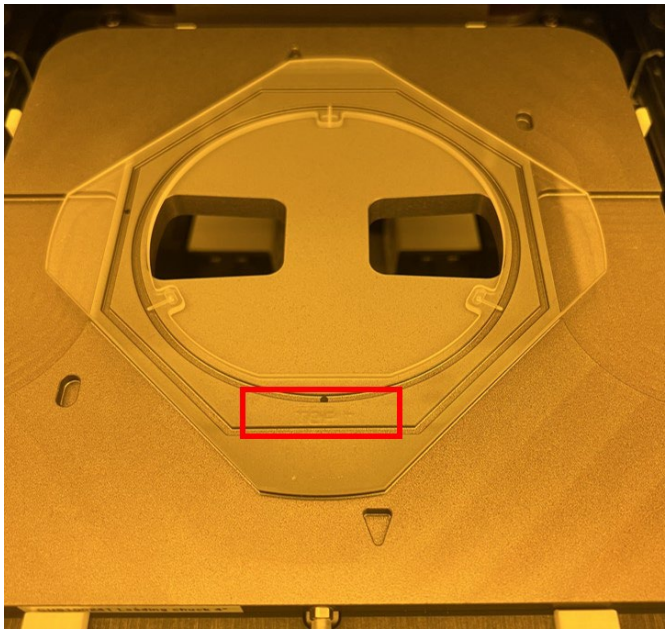
Warning: Make sure that the clamps are out by also checking visually. Clamps that are still in can damage the tool and the first loaded wafer!

Step 7: "Remove Separation Spacer" → **Push the spacer levers as depicted in the animation.**

Step 8: "Insert Chuck, Connect Vacuum" → **no action needed** (chuck and vacuum already mounted)

Step 9: "Insert Ruler" → **!Read below!**

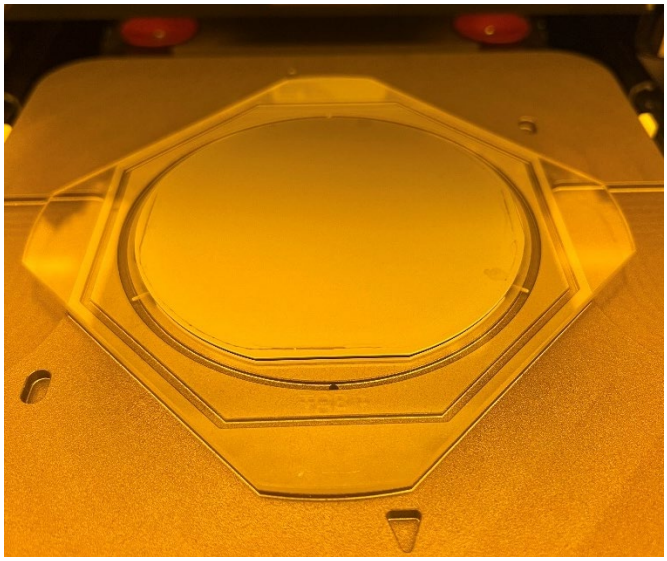
The ruler is a simple tool to align the wafer on the chuck. Since it is extremely clunky to use, we will not insert it. Instead we are going to insert the quartz plate at that step, as shown below:



Warning: The operator should be able to read "TOP" in the frame highlighted in the image above. If it is inverted, then the orientation of the quartz plate is wrong!

Step 10: "Load Top Substrate" → **Load wafer 1 on the three contact points.**

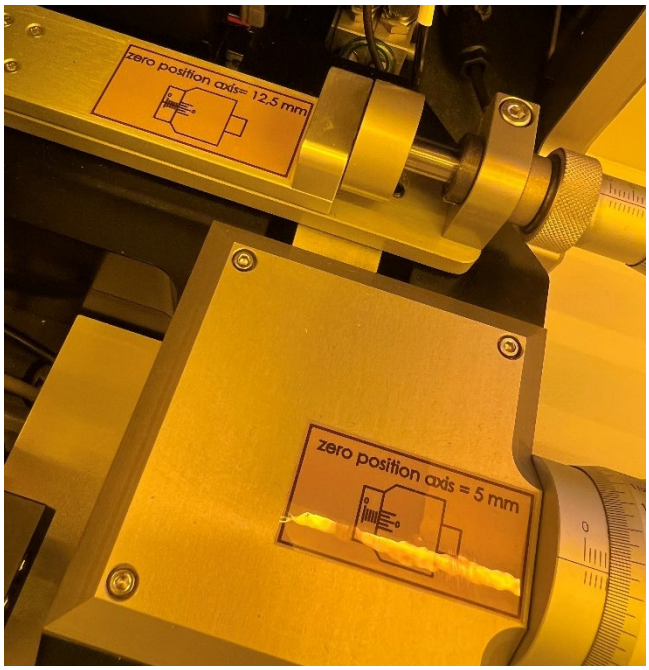
The substrate is loaded with the bond interface facing **DOWN**. Make sure to align the flat with the quartz plate.



Step 11: "Remove Ruler" → **no action needed**

Step 12: "Load Tray In" → **Push the tray all the way in the machine.**

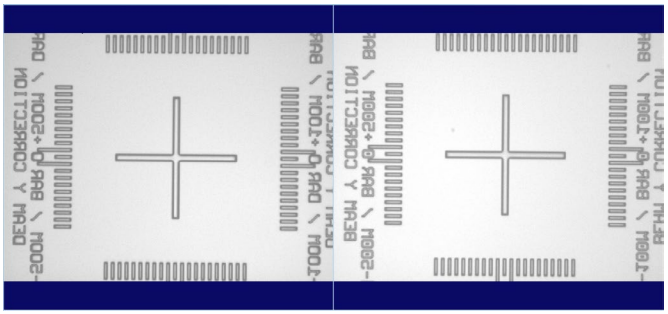
Step 13: "Move Stage In Center Position" → **Adjust the knobs as required.**

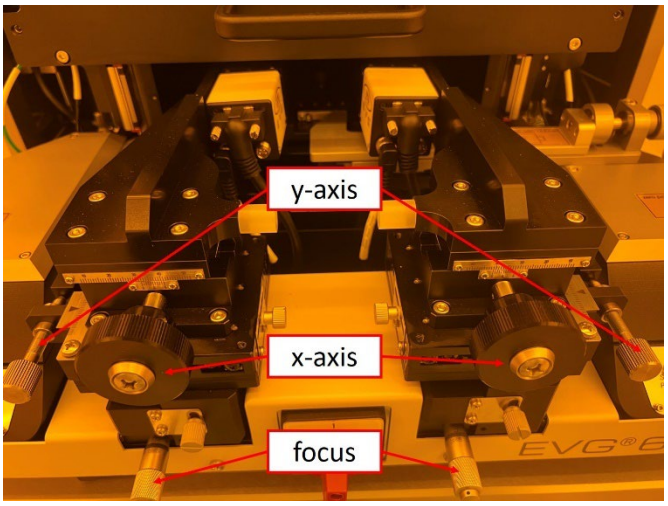


x- and y-axis zero positions are 5mm, theta-axis zero position is 12.5mm.

The wafer will now be pushed in contact with the fixture (Wedge Compensation …).

Step 14: "Adjust Microscope" → **Adjust the position and focus of the bottom-side left and right microscope objectives until the alignment marks are centred in the field of view.**

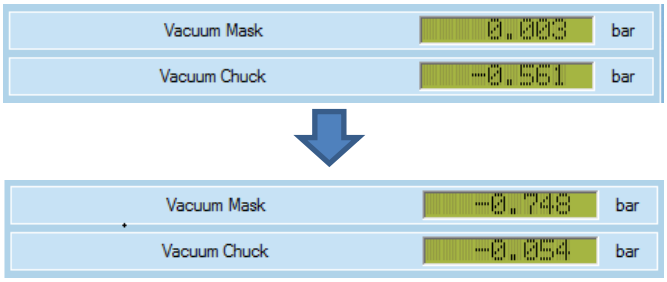




Warning: The backside microscopes x- and y-position should no-longer be moved after this step!

Step 15: "Adjust Substrate Focus" → **Optimize the focus**

In that step, wafer N°1 is transferred from the chuck to the fixture:



Step 16: "Adjust Overlay" → **no action needed**

Step 17: "Move Tray Out" → **Pull the tray our completely**

Step 18: "Insert Ruler" → **no action needed**

The quartz plate is already on the chuck. Do not use the ruler!

Step 19: "Load Bottom Substrate" → **Load wafer 2 on the three contact points.**

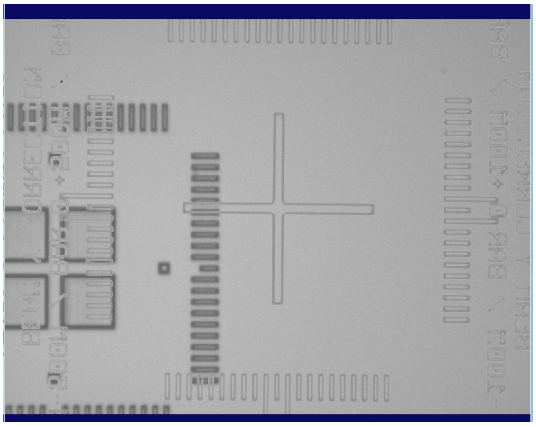
The substrate is loaded with the bond interface facing **UP**. Make sure to align the flat with the quartz plate.

Step 20: "Remove Ruler" → **no action needed**

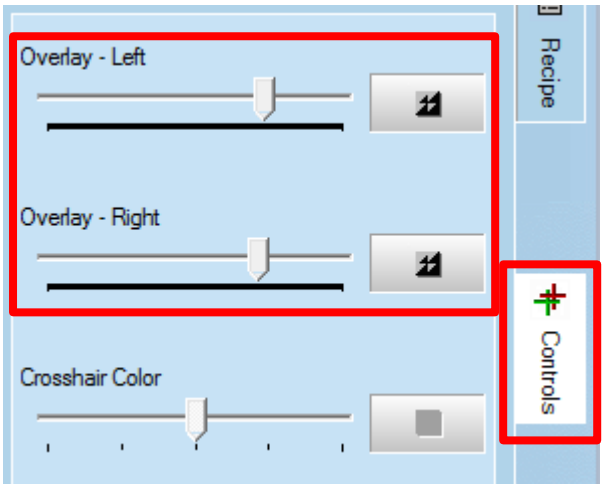
Step 21: "Load Tray In" → **Push the tray all the way in the machine.**

Step 22: "Prealign Substrate" → **Adjust overlay transparency and align wafer 2**

Wafer 2 should now be visible in the field of view of the microscope objectives, assuming the alignment marks have been correctly replicated on the wafer backside.

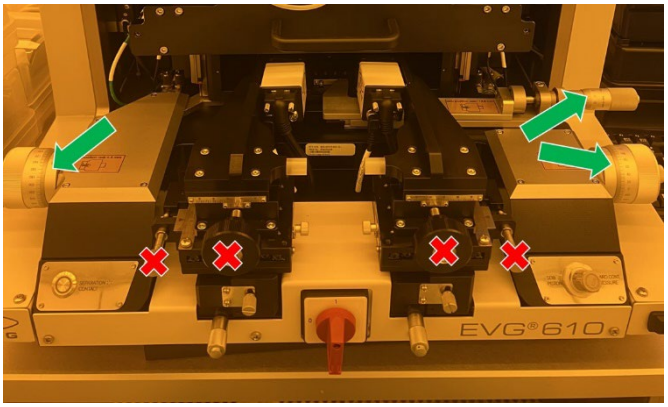


If wafer 2 is not visible, it means that the overlay transparency settings are not set correctly. These settings are found in the “Controls” advanced settings (right side of the screen). The button changes the polarity of the transparency (either dark or clear pixels become transparent), while the sliders control the level of transparency.

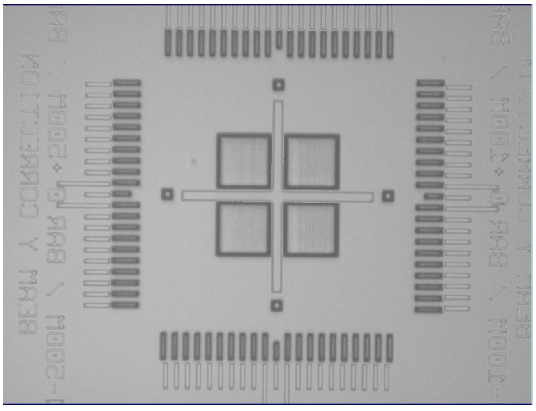


The wafer is moved with the stage knobs on both side of the machine!

Warning: Make sure not to touch the objective knobs!!



Move the wafer until it is correctly prealigned on both sides.



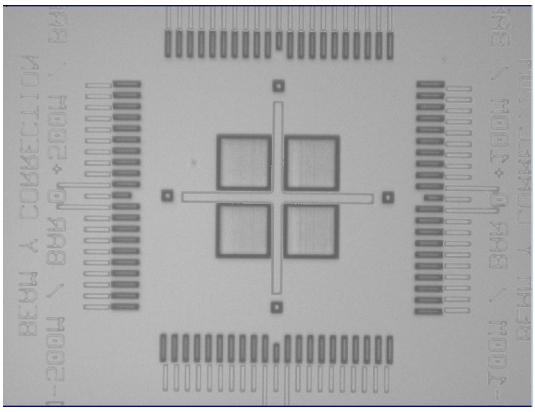
After this step, wafer 2 will be pushed against wafer 1 (Wedge Compensation …). It might move from the pre-align position at this step.

Step 23: “Align Substrate” → **Align wafer 2 with the overlay**

Repeat the alignment as in the previous step.

Warning: Wafer 2 will now be moved in contact with wafer 1. Unfortunately, due to the weak vacuum with the quartz plate, it might slide at that point. The observed shift is usually reproducible, and it can be compensated by repeating step 23 (click undo) and introducing an offset.

Step 24: “Check Contact Mode” → **Repeat step 23 with an alignment offset until the wafers are correctly aligned.**



Step 25: “Insert Clamps” → **Insert clamps as shown in the animation**

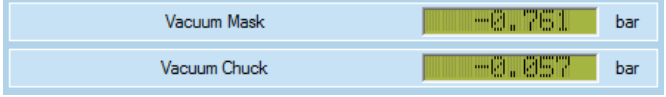
Make sure to push the clamp knobs all the way down in order not to touch the quartz plate during rotation.

Try to release the knobs simultaneously on both clamps.

If done properly this action should not induce any loss of the fine alignment.

Step 26: “Check alignment” → **Confirm that the alignment is still OK**

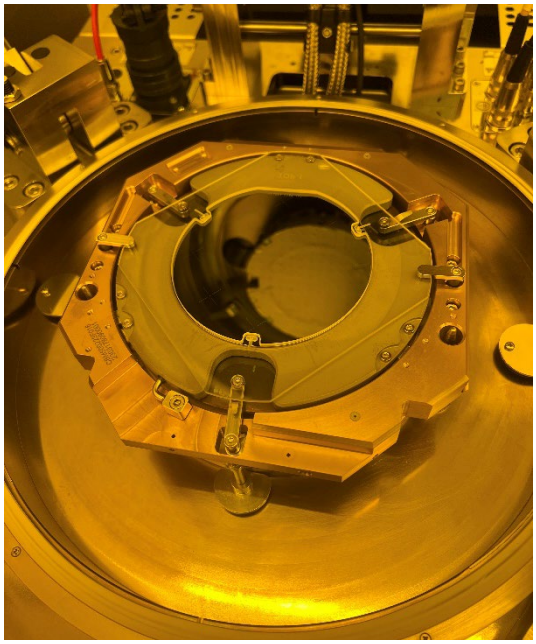
The chuck vacuum (that was holding wafer 2) is removed at that step.



Step 25: “Remove Bond Tool” → **Remove the fixture from the frame**

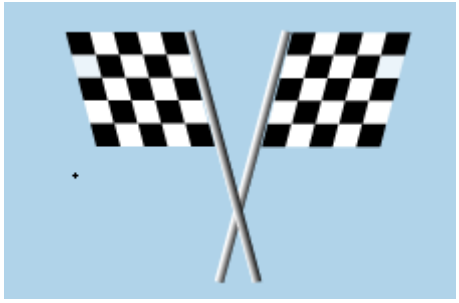
Try to pull up the front of the fixture first. Proceed carefully in order to avoid any shocks that could affect the alignment.

The fixture can then be rotated and transferred to the bonding chamber of the EVG 510 equipment.



Step 26: "Move Tray Out" → **Pull the tray our completely**

Step 27: "End Of Process" → **Press Exit**



Make sure to press "Exit" to complete the sequence and not "Continue", as "Continue" will restart the sequence from step 1!

At that point users may log out of the equipment on CAE.

6. Using the IR illumination (alignment method "B")

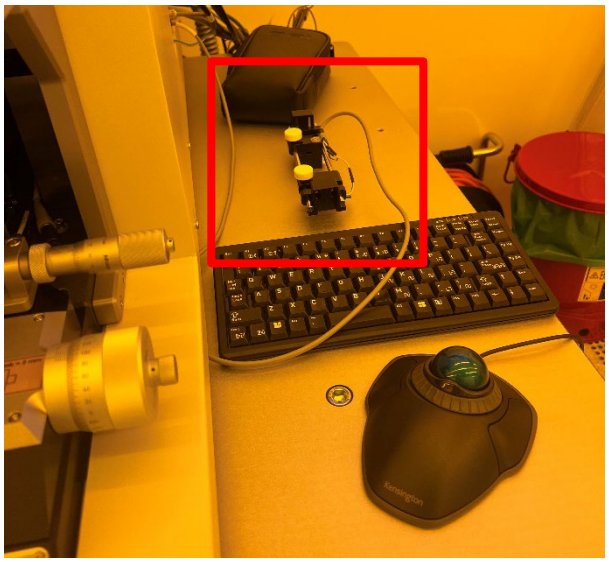
When using the alignment methods "A" and "B", the bottom wafer will be transparent to either visible light (glass wafer) or IR light (silicon wafer). The microscopes will be focussed at the bond interface and both wafers will be visible in live. The use of an overlay (or crosshair) will not be necessary.

When using the "*_IR.rcp" recipes, the sequence of steps will be slightly different.

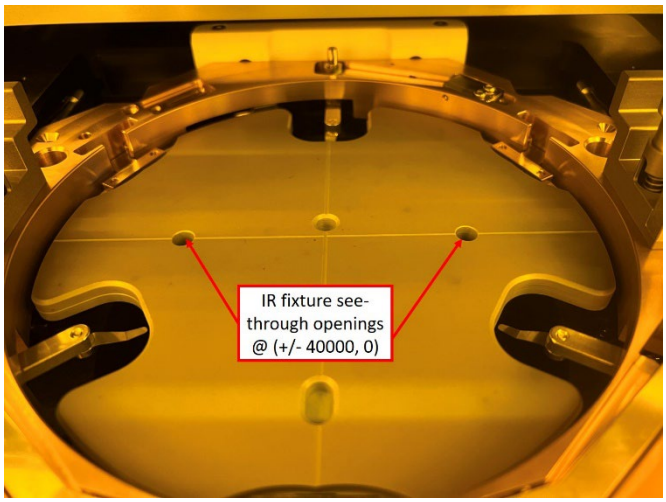
The operator will proceed through the steps, similar to section 5, until both wafers are be loaded (one after the other). Wafer 1 will be fixed by vacuum on the fixture, while wafer 2 will be fixed by vacuum on the chuck.

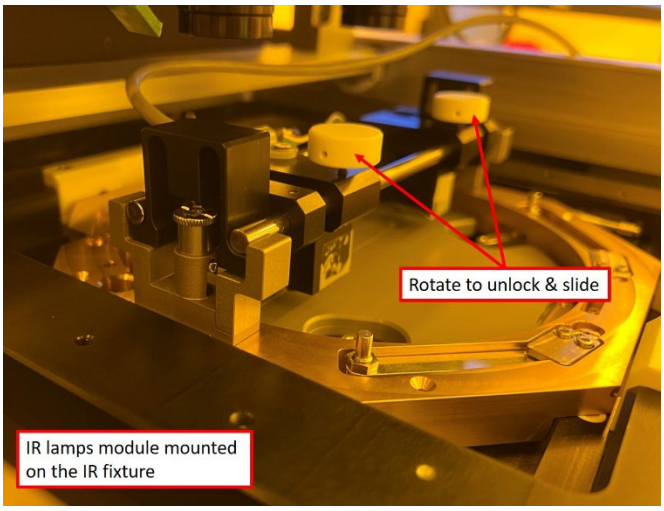
Step: "Move down IR Tool, Align Substrate" → **Install the IR lamp, turn on and adjust IR illumination, align.**

The IR lamp module is stored on the right side of the equipment.

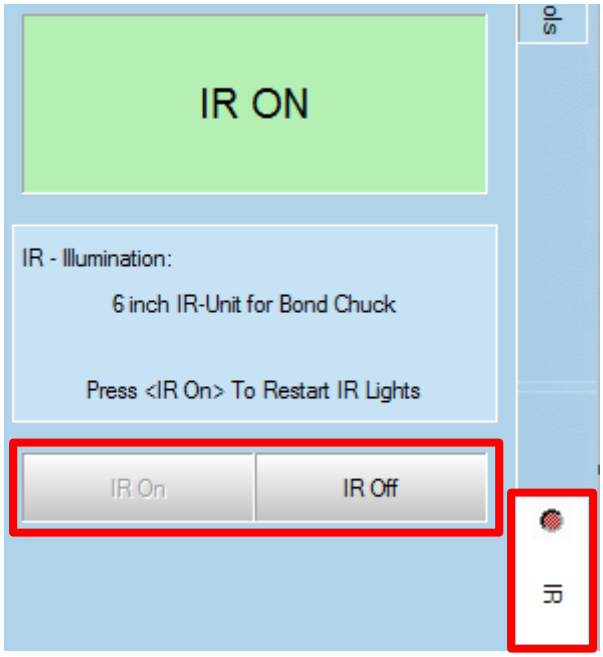


The IR lamp is mounted on top of the fixture. Both lamps can be unlocked and moved on the metal rods to align with the small openings of the IR-dedicated fixture, located @ (+/- 40000,0).

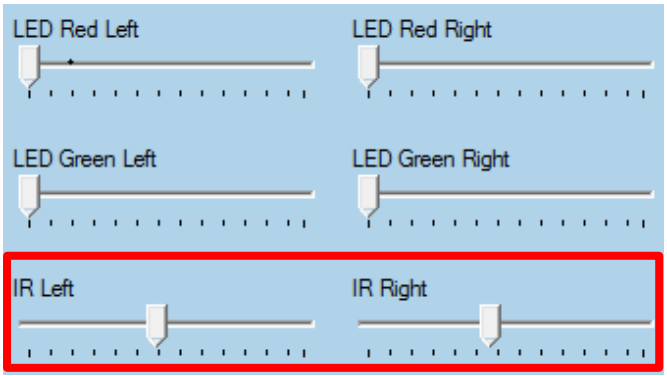




The IR illumination is turned on in the IR advanced settings (right side of the screen).

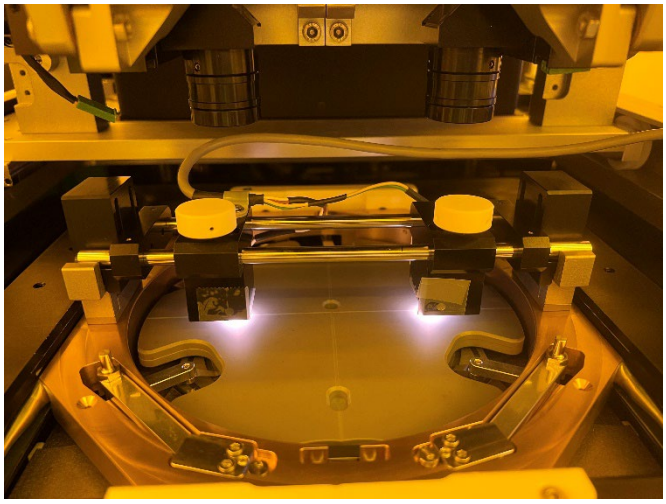


The IR-lamps intensities are adjusted with the slider (bottom right side of the screen).

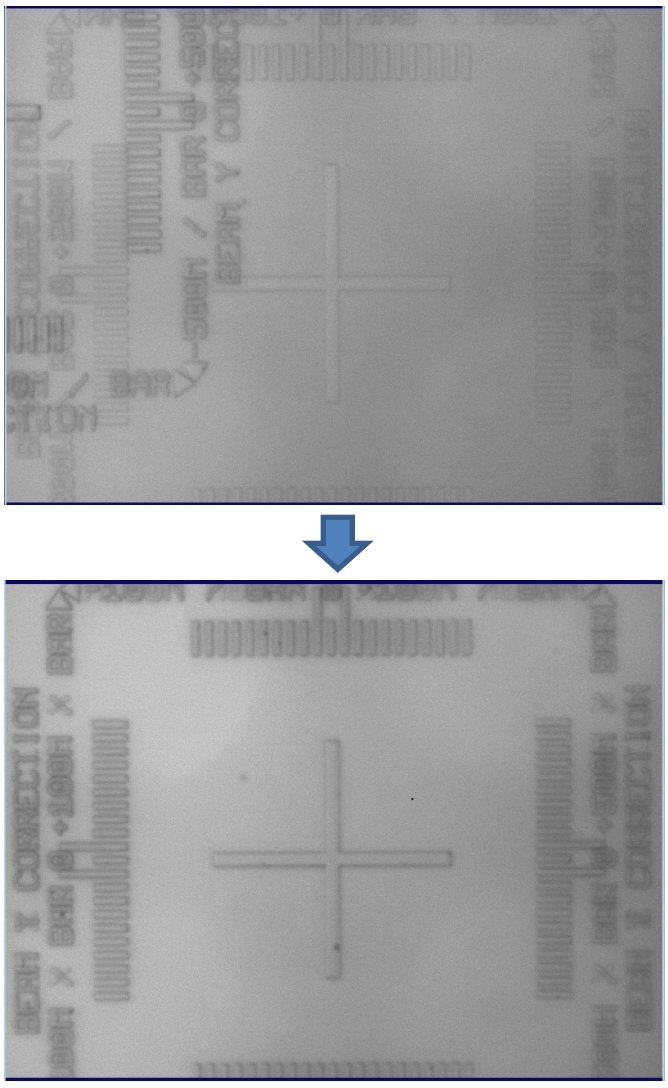


Warnings:

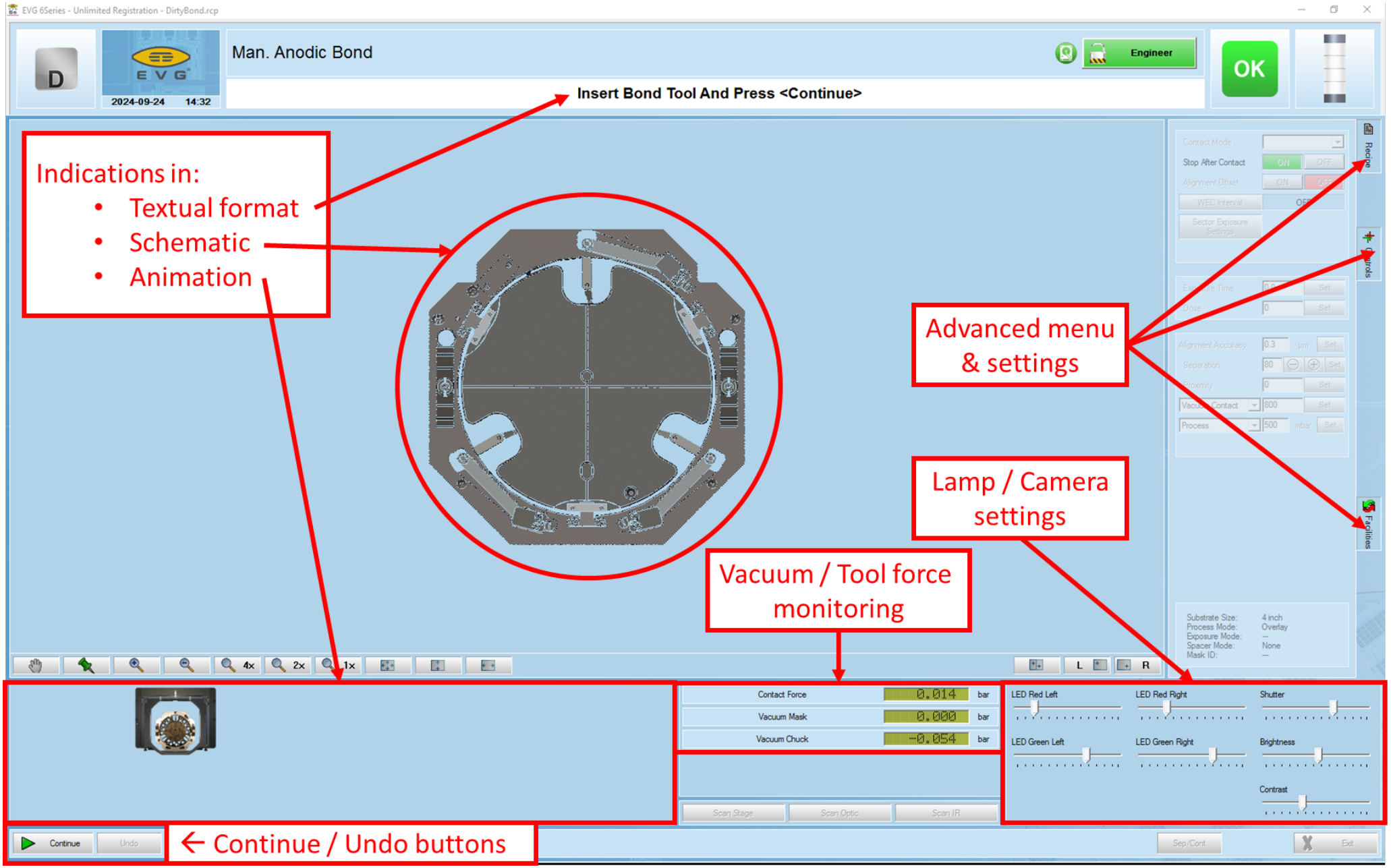
- **Do not stare directly into the IR-lamps. It may be harmful to your eyes!**
- **The IR-lamps are getting very hot. Do not touch the lamp units.**



Move wafer 2 with the stage knobs until you are happy with the alignment results.



You will then proceed with clamping and removing the fixture.


Man. Anodic Bond
Engineer
OK
Insert Bond Tool And Press <Continue>
Indications in:
• Textual format
• Schematic
• Animation
Advanced menu & settings
Lamp / Camera settings
Vacuum / Tool force monitoring
Contact Force
Vacuum Mask
Vacuum Chuck
LED Red Left
LED Red Right
Shutter
LED Green Left
LED Green Right
Brightness
Contrast
Continue
Undo
← Continue / Undo buttons