ADT Dicing Saw Operation

Overview

This procedure covers the configuration and operation of the ADT Dicing Saw.

Restrictions & Precautions

- Always wear gloves when operating working in the dicing lab as there is the potential for arsenic exposure.
- Never put your hands near moving parts especially the blade.
- Always open the spindle cover from the top.

Operation

Install Your Blade and Flange

1. For proper blade selection, reference the table posted in the dicing room or on the Wiki. Proper flange selection (using standard blades) is based on the thickness of the material being cut:

    - <700 µm= 53 mm flange
    - 700 µm – 1.2 mm= 52 mm flange
    - 1.2 – 1.7 mm= 51 mm flange
    - 1.7 – 2.7= 49 mm flange
    - 2.7 – 3.7= 47 mm flange

2. Select the flange you require; it should be separated into two pieces. Place the back of the flange one the table and load your blade on to it using tweezers. Place the other half of the flange on top and press down firmly on the outer diameter (not on the blade), the flange assembly should snap together.

    NOTE: If the flange is not in 2 pieces, get the flange separation tool (black disk with 3 pins) and insert it into the back of the flange lining up the 3 pins on the tool with the three holes on the flange. Set them down on the table with the tool on the bottom. Now press down on the inner diameter of the hub to separate the flange.

3. Login in to the tool with your username/password.

4. Look at the light tower on the tool, is the yellow light solid or flashing? If it is solid, proceed to the next step. If it is flashing:

    a) Right click on the 'Blade' icon in the lower left corner of the screen and select 'Blade Info'
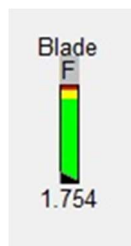
    b) Click 'Cancel' in the window that appears. The light tower should be solid yellow now.

5. Right click on the blade icon in the lower left corner of the screen and select 'Blade Change'.

6. Open the dicing saw cover and place the interlock defeating key in the door interlock.

7. Carefully pull the spindle cover lock to the left and open the spindle cover.

8. Grab your blade/flange (with the grabbing tool or hand) and CAREFULLY place it onto the spindle. Do not come in at an angle! This should require very little force. If the flange doesn't easily slide onto the spindle, **please contact Staff immediately**.

9. Once you have installed your blade and flange onto the spindle you must secure it with the lock nut. To do this:

   a) Place the lock nut on the torque driver with the side labeled 'REAR' facing down (towards the handle of the torque wrench).
   b) Line up any of the two holes on the lock nut with the two pins on the two-piece torque driver.
   c) While holding the lock nut on the torque driver, insert the hex head tip of the torque driver into the hole on the spindle hub.
   d) While holding the torque driver in place on the ridged section with one hand, turn the front part of the torque driver clockwise with the other hand to thread on the lock nut. Once the lock nut is hand tight you'll have to crank on the torque driver until you hear a click. That should be the appropriate amount of torque to keep the flange on the spindle.
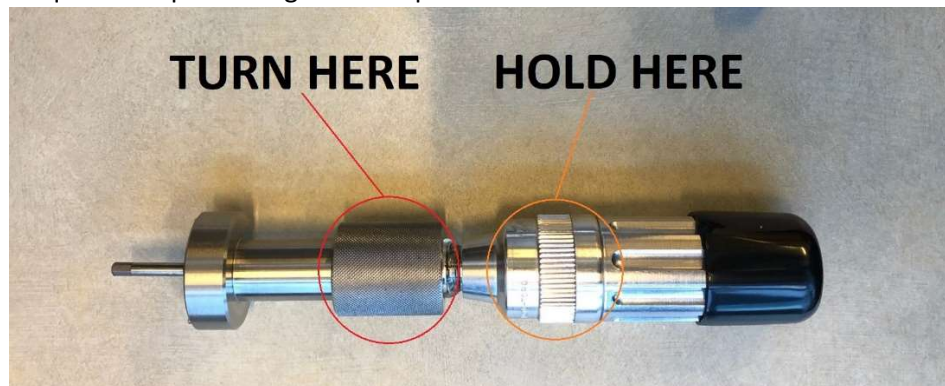
   e) Verify you installed the lock nut correctly, the side labeled 'REAR' should be facing outward.

10. Close the spindle cover and lock it.

11. From the 'Blade Selection' drop down menu, choose blade you just installed. If you are using a different flange diameter from the one selected in the software, click the 'Change Flange' box and manually enter in the new flange diameter. Click 'OK' and then click 'Finish' in the lower left dialogue box.

12. DO NOT STICK YOUR HANDS INTO THE SYSTEM! The saw will eventually start to rotate and go through its blade exposure measurement sequence.

13. Once it says 'Blade change completed' inside the dialogue box you can check the three water sources.

Adjust the Cut Water

1. BE EXTREMELY CAREFUL! The spindle is still rotating! Carefully pull the spindle cover lock to the left and, handling from the top, open the spindle cover

2. Click on 'Water Adj' to turn on the three different water sources.

Verify that the water flow rates are approximately:

- Cut Water= 0.9 LPM

- Clean/Wash= 0.8 LPM

- Spray Bars= 0.8 LPM

You can change the flow rates by adjusting the three small regulator knobs below and behind the computer monitor. If you are using flow rates different than those listed above, make sure to return the flow rates to their default values before ending your dicing session.

3. Next, verify that the Cut water is being forked by the blade (you should see a stream of water in front of the blade and one behind it). The Cut water should be hitting the blade/flange at approximately 7pm if the blade was a clock. If adjustments are needed, you can move the Cut water nozzle by holding the knob behind the nozzle with one hand and turning the top knob above counter clockwise. This will unlock the Cut water nozzle and give you free range of motion. Make sure you do not rotate the Cut water nozzle up into the blade! Once the Cut water looks good you can lock it in place by turning the top knob clockwise until it's tight.

4. Once the water situation looks good, click on 'Water Adj' to turn off the water.

5. Right click on the spindle speedometer in the top right of the screen and choose 'Operate'. This will turn the spindle off.
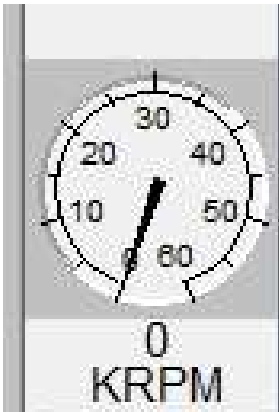
6. Once the spindle has reached 0 RPM; close the spindle cover and lock, remove the interlock key and close the dicing saw cover fully.

Initialize System

1. After your initial blade change you must go to User =>System Init. This will initialize the chuck and saw and get the system ready to accept your sample.

2. Once, the screen stops flashing yellow you can choose one of two routes. You can either create or load a recipe or load your sample.

Create a Recipe

1. To create a recipe, click on the Programming Workspace icon.
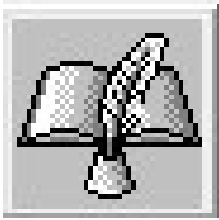
2. In order to create a recipe in the software you must duplicate an old recipe. You can either duplicate a group/company member's recipe or open the 'RECIPES' folder on the left hand side of the software and select 'Recipe_TEMPLATE'.

   NOTE: If you are dicing a 200 mm (8") wafer, select 'Recipe_TEMPLATE_Wfr'.

3. Click 'Duplicate Recipe' and create a recipe name. Make sure you save your recipe in any other folder besides the 'RECIPES' folder. You can either find your folder by using the drop down menu or you can create a new folder name by typing into the 'Folder' box. Click 'Ok'.

4. There are five parameters you need to enter on your "homepage":

   • Blade (double click entry box to access drop down menu). You will get a "Wrong mounted blade error" if the blade description you select does not match exactly with the blade you selected in Step 9.

   • Wafer Width (front to back) and Length (left to right) (make sure orientation is correct if you're dicing a rectangular or elongated sample)

     NOTE: For 200 mm wafer recipes you must input Wafer Diameter. You can ignore the Wafer Width and Length settings.

   • Wafer Thickness (it is recommended to add 10% to this value)

   • Tape Thickness (the tape provided is 0.09 mm thick)

5. Click on the "Air" section of the recipe navigation tree to get to the 'General' tab for your recipe. If the navigation tree is not expanded, click on the + symbol. There are seven parameters you need to enter in the 'General' tab:
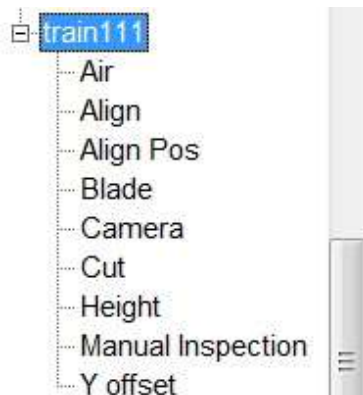
- Cutting Speed - How fast the saw travels across your sample there are ranges developed here at UCSB which are posted on the wall to the left of the saw. As a general rule of thumb start on the slower side of the range and verify cut quality before turning up the speed.

- Cut Entry Speed – How fast the saw travels at the beginning of a cut. It is recommended to set this the same as the cutting speed.

- Cut Exit Speed – How fast the saw travels at the end of a cut. It is recommended to set this the same as the cutting speed.

- Overcut – The distance that the blade will travel at the different cut entry and exit speeds if they are not set the same as the cutting speed. If all the speeds are set to the same speed, as recommended, set this to 0.

- Overtravel - The distance the saw travels before and after each cut. This parameter prevents the saw from lowering directing onto the edge of your sample (which could potentially break the blade or crack the sample). We generally use an overtravel value of 7mm for any substrate 700um or less. Users dicing thicker samples should increase this value. Make sure you account for the curvature of the blade!

- Spindle Speed - How fast the spindle rotates (kRPMs). Recommended spindle speeds are posted on the same sheet as the cut speeds.

- Height Check Rate – The amount of cuts the saw makes before it moves over the optical sensor to measure the exposure of the blade. The significance of this is that every time the system does an exposure measurement and your blade exposure decreases, the saw lowers to accommodate for the blade wear. If you allow for too many cuts in between measurements (i.e., this value is too high) you will notice that your cuts won't be going all the way through your sample. For harder substrates like sapphire or thick GaN you want the blade exposure to update every 1-2 cuts in order to stay up with the blade wear. For silicon you can turn this value up to 40 or more.

6. Click on the 'angle0/1' tab (0°/Cut #1), there are four parameters you need to enter:

   NOTE: You will only enter Depth and Index for 200 mm wafer recipes.

- Cut Length – This is your sample length plus two times the overtravel. So, for a 100 mm sample with a 10 mm overtravel, this value would be 120 mm.

- Cut No. – The number of cuts you will make at this angle.

- Depth – This is the cut depth. A value of 0 here would place the blade right at the chuck surface. If you are using the provided 0.09 mm thick mounting tape and dicing all the way through your sample, you would set this value to 0.07 mm as we recommend cutting onto the tape 0.02 mm (20 μm).

- Index – This is the distance between cuts in mm.

NOTE: If your device rows/columns have varying spacing, you can either make your cuts manually or insert an extra tab for that angle.

NOTE: Since a 200 mm wafer recipe has no Cut No. parameter, the tool will make as many cuts as it can based on the Index value and the Cut Position (next section).

7. Click on the 'angle 90/2' tab and enter the required values for the same four parameters.

   NOTE: If you required a 3rd cut, right click on either angle tab and use the pop-up menu to add another tab. You can also delete a tab in this menu.
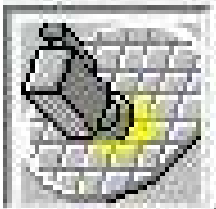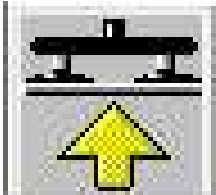
8. Click 'Save'.
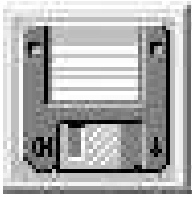
9. Select 'Auto' => 'Define job'. Scroll down and find your recipe. Recipes are in alphabetical order based on groups. Click 'Apply' and then 'Ok'. Make sure your recipe shows up on the top of the software window!

Load and Align Your Sample, Define Cut Positions

1. Click on the Video Workspace icon.

2. Click the 'Load Wafer' icon.

3. Open the chuck cover, ensure that there are no large particles/debris on the chuck. It is recommended to use the DI and compressed air spray gun to clean off the chuck. If you hold down both the water and air buttons simultaneously the gun will act like a pressure washer.

4. Load your tape frame and sample face up (tacky side up!) and slide the two notches of the tape frame underneath the two pin heads at the back of the chuck. There is a magnet in front of the chuck that will help hold the frame in place.

5. Click 'Finish'. Watch your hands! The chuck vacuum will turn on and the chuck will move underneath the camera. You can now close the chuck cover.

6. Click the 'Manual Alignment' icon and follow the directions in the dialogue box on the left. There are various controls at your disposal to navigate across your sample:
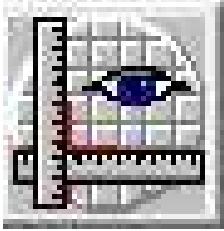

- There are three different camera magnifications; Low, Medium and, High. It is recommended to click on low (L) to start so you have a larger field of view.
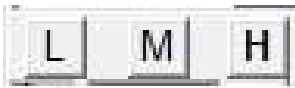

- There are two different types of camera lighting, direct and oblique, each with their own intensity adjustment. A good starting point for the direct lighting intensity is 14. The oblique lighting does not affect the display image but is useful for visually verifying where you are at on the sample chuck.

- There are two sets of controls for chuck/camera movement:

    ❖ The 4 arrows. These are used to move around the chuck. Click on the letter in the center to change the movement mode; S= Slow, P= Pixel, I= Index, F=Fast
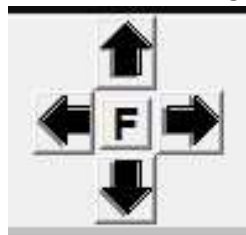
    ❖ The curved arrows with the 2 bold arrows. The curved ones are used for rotation and the bold ones are used for camera focus. Click on the letter in the center to change the movement mode; S= Slow, P= Pixel, A= Angle, F=Fast
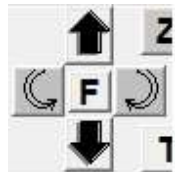
- You can also adjust the size of the blue box around the crosshair by clicking on it and dragging it.

7. Move to either a flat edge or some features on your sample and adjust the rotation to get things looking straight.

8. Now locate a right alignment point (double click on a feature to automatically move the green crosshair). Once you have selected your right alignment point click 'Next'. The camera will automatically move to the left side of your sample and prompt you to select a left alignment point. Make sure you select a feature in the same row as the one you selected for your right alignment mark otherwise you could cross align rows. Click 'Next' and your sample will be aligned to your two selected points. Click 'Finish' to complete alignment or click 'Next' to make adjustments to alignment marks.

9. After finishing alignment, you will be prompted to 'Define Cut Position'. This is the spot where the saw will first enter your sample. Your top most cut. If you are dicing a full wafer or non-rectangular piece, make sure you define this cut position, in X, at the right most part of your sample. When you define this point every cut will start at this position in the X dimension. If you define this position at the edge of your sample where the diameter is smaller you will cause the saw to come down on your sample in areas where the diameter is larger. So for a full wafer you would:

   - Move the crosshair to the far right apex of your wafer

   - Click on X/Xr until Xr=0

   - Locate the top dicing lane and center the crosshair in it (in the Y) at high mag

   - Enter 0 in the Xr field. Do not click Xr!

   NOTE: For 200 mm wafer recipes you just need to locate the middle of the dicing lane for your top most cut. You do not need to be at the sample edge or perform the X/Xr operation.

10. Click 'Finish' and a cut map of all your cuts will appear on the sample representation in the software (top left corner of the screen). Ensure that all the cuts are in the appropriate spots. To do this, move back over to the middle of your wafer or sample. Change the movement mode to 'Index' by clicking on the letter in the middle of the four movement arrows until you see 'I'. Once you're in 'Index mode' every time you click the up or down of the movement arrows the camera will jump from cut to cut across your sample. Verify every cut position looks right. To make changes to the cut map, you will have to go back to the programming workspace and edit (and save) your recipe. Once you're done with the edit you must reload the recipe and click 'Manual Alignment' again. The camera should move to the original cut position. Click 'Finish' and the new cut map will appear.

11. You now need to set up the cut map for your second angle (90°). Set the rotation arrows' movement mode to 'Angle', 'A'. Now when you press a rotation arrow your sample will rotate 90°. Select the left rotation arrow (counterclockwise) so that your wafer flat is on the left.

12. Click the 'Manual Alignment' icon again. You do not need to perform alignment at the second angle but <u>you do need to perform this step or you will get an error when you go to cut your wafer</u>. Just click; Next, Next, and Finish.
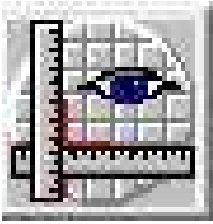

13. You will now need to define your cut position for this second angle, repeat Steps 9 & 10.

   IMPORTANT: There is a glitch in the software due to an update. In order to get the second cut map to appear you will need to move the slide on the camera position window.

Manual Y-Offset Correction

Before dicing your wafer, it is recommended you do "manual y-offset". This is especially true if you look at the log book and the previous user brought in their own blade (a non 2.187 blade). This means that the cut street could be off by a couple millimeters in the y dimension from where you set it. To do this you will make a test cut into the tape for a coarse correction and then into a non-critical section of your sample for a fine correction.

1. Depending on where you will make the test cut into your sample, you made need to rotate it 90° (back to its original loading position). Set the rotation arrows' movement mode to 'Angle', 'A'. Select the right rotation arrow (clockwise) so that your wafer flat is facing the front of the system.

2. Click the' Manual Y-Offset' icon (to the right of manual alignment). The software will prompt you to move to a "single cut position and click next". It is recommended you do this in two steps.
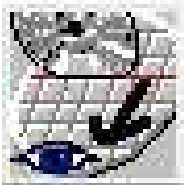
3. For your first cut, move the camera somewhere above or below your sample (into the tape). This will prevent any damage to devices if the previous user created a large offset. Click 'Next' and the software will prompt you to turn on the spindle (if it isn't on already).

4. Once you click 'Ok' the saw will do one more exposure update and make a cut where you initially moved the camera to. Once the saw is done with the cut the camera will move back over it. If you do not see a cut on the screen you'll have to move the camera up or down to find it.

5. Once you do see the cut, place the green crosshairs right in the middle of the cut street. You can click and drag the blue box for reference and also to measure the cut width. Once the green crosshairs are centered on the cut click 'Finish'. Your coarse manual y-offset will be completed.

At this point your alignment can still be off by 5-10um because the tape will pull apart when cut which makes it hard to find the exact middle.

6. If you want even better alignment click 'Manual y-offset' again and move somewhere on your sample without any important features or devices. Click 'Next' and the saw will make another cut. Now that it is cutting into something more rigid you'll be able to align the green crosshairs more accurately. Once the green crosshairs are centered on the cut click 'Finish'. Your fine manual y-offset will be completed and you are ready to cut your sample.

Cut Wafer

1. Perform any final verifications on your sample.
2. Click the 'Wafer Full Cut' button (red wafer icon near the top right of the screen) the saw will start cutting.
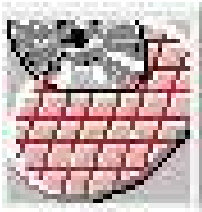
FINAL VERIFICATION TIP: Clicking the 'Wafer Full Cut' button during a cut will cause the saw to finish the current cut and then bring the camera back over it once it's completed. This is a good way of doing one last verification that the saw is cutting in the right position. This is not necessary and you should be fine as long as you previously verified your cuts after defining the cut position and you completed your manual y-offset alignment. Click the 'Wafer Full Cut' button to resume.

FINISHING UP

1. Once all the cuts have been performed the system will prompt you to unload your sample. Open the chuck cover and rinse and dry your sample with the DI and compressed air spray gun.
2. Click finish to release the chuck vacuum and unload the tape frame.
3. Right click on the blade icon in the lower left corner of the screen and select 'Blade Change'.
4. Open the dicing saw cover.
5. Carefully pull the spindle cover lock to the left and open the spindle cover (from the top).
6. Get the two-piece torque wrench tool and insert it into the hub lining up the pins. Hold the back part of the wrench in place with one hand and turn the front part of the wrench counter-clockwise with the other hand to loosen and remove the lock nut.
7. Grab your blade/flange (with the grabbing tool or hand) and CAREFULLY remove it from the spindle. Place it on the table and release it from the grabbing tool.
8. Close the spindle and dicing saw covers.
9. Click 'Cancel' in the blade change window.
10. Logout of the system, select User=> Logout & Login.
11. Get the flange separation tool (black disk with 3 pins) and insert it into the back of the flange lining up the 3 pins on the tool with the three holes on the flange. Set them down on the table with the tool on the bottom. Now press down on the inner diameter of the hub to separate the flange.
12. Remove your blade and placed the 2 flange pieces back in the correct wooded box.
13. Fill out the log book.

MANUAL DICING

1. Install blade and flange, adjust the cut water, and initialize the system.
2. You must create (or modify) a recipe with the correct parameters.
   - For each angle you need to enter at least 1 cut.
   - If possible you should enter a correct index value.
   - If you are only dicing at one angle, you need to delete the other angle(s) (right click on tab).
3. Perform manual alignment and define the cut position (for each angle). When defining the cut position, you must define it at the right most part of your sample (refer to this SOP for proper steps).
   NOTE: It is recommended that you accurately define the cut position even though you will be cutting manually.
4. Perform coarse and fine manual Y-offset correction.
5. You are now ready to perform single cuts using the manual Y-offset correct:
   a) You can use index movement to get to the first cut quickly.
   b) Place the green crosshairs right in the middle of the cut street.
   c) Click 'Next' and a single cut will be made.
   d) The camera will return to the cut after and the crosshairs should be in the middle in the cut. Make any fine adjustments to the crosshair positon if needed.
   e) <u>You must click 'Finish'. If you do not, you will be changing the manual Y-offset correction for any subsequent cuts.</u> **THIS IS BAD!**
   f) Repeat the above steps for any additional cuts. If you need to make cuts at another angle use angle rotation movement.
6. Click the 'Unload Wafer' icon.
7. Follow the steps in the 'Finishing Up' section of this SOP.