

This quick guide provides brief instruction on handling the scanning probe microscope (SPM), model Dimension ICON. For more details, the user is encouraged to visit the manual on the official Bruker webpage.

## Scanning Probe Microscope – Bruker Dimension ICON

### Analysis type: ScanAsyst-Air Mode

#### Acoustic hood

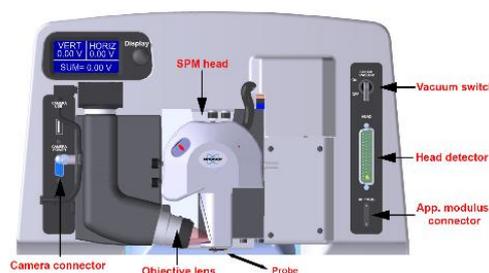
1. Open the acoustic hood using the Hex key with counterclockwise rotation and lift the enclosure.
2. **Carefully** bring out the standard cantilever holder (inside the flat box) and cantilever holder stand (Ø 2.5-inch black cylinder block) for mounting the cantilever.

#### Cantilever preparation

1. Select the proper cantilever holder from the flat box. In the box, there is one holder with gold-plated spring for the torsional mode (sideway excitations) and two silver-plated ones for normal modes. The silver-plated holder with × mark on it might give noisy results for some measurements, but for ScanAsyst is completely fine.
2. The cantilever holder stand has three stations for different tip holders: (a) standard AFM, (b) fluid imaging AFM, and (c) STM. A small, raised block in the center of the gold connector identifies the standard AFM load station.
3. Gently install the selected cantilever holder onto the proper station (in most of the cases, onto the standard station) to avoid damaging pin. Check the distance of the holes on the cantilever holder to insert it into the proper pins.
4. Select the ScanAssyst cantilever from the white plastic box on the table.
5. Select a cantilever from the correct gel-pack box. **Notice** that direction of the tip in the box provides the information about its condition: vertical (↑) is **new**, tilted (↗) is **used and still useable**, horizontal (→) is **broken**.
6. Using a sharp tweezer, grasp the cantilever firmly on the sides and then mount it on the cantilever.
7. Supporting with **two fingers**, hold the cantilever holder from sides when fixing the cantilever with a probe clamp.

#### Mounting the cantilever on the SPM head

1. Loosen (counterclockwise) the screw located on the right side of the SPM head dovetail to release the SPM head. Then carefully slide the head up and out of the dovetail groove.
2. Mate the cantilever holder sockets to the SPM headpins to install the cantilever holder.
3. Verify the AFM cantilever holder mounts flat against each pin on the end of the head. Also, verify the tip points down and away from the head. The end of the cantilever must point in the direction of the optics assembly.
4. Carefully slide the Dimension SPM head down into the dovetail groove.
5. Gently tighten (clockwise) the screw located on the right side of the SPM head dovetail to lock the head.



#### Starting the ICON System

1. Open the left cabinet below the workstation, turn ON controller (Furman box), and PC. Write the password down (shown with the label on the PC monitor). Check the pneumatic suspension of the ICON system by pressing the silver plate below the system (it should return automatically to its original position). Start **NanoScope SW** with a double click on the desktop icon.

#### Selecting the experiment

1. In the **Select Experiment** window; in the **Select From, Choose and Experiment Category**, click on icon **ScanAsyst**. In the **Select Experiment Group**, choose **ScanAsyst in Air**. In the **Select Experiment**, choose **ScanAsyst in Air** and confirm it by pressing the **Load Experiment** button.
2. When the experiment is loading, the **Status Log** shows the progress of a startup procedure.
3. If the ICON system was powered down when starting the analysis, **Error Log** and **Stage Initialization** appears. Click Yes when **Initialize the stage now** appears and close **Error Log** with ×.
4. Then the stage window asks **Would you like to return to original X, Y stage, and optical positions?** Click **YES**.
5. Create a capture directory by clicking on the folder icon; create a folder on your **surname\_#user** (i.e. Kolar\_13229).

#### System alignment

1. The **Setup** page with ICON system alignments automatically opens – it is important to follow the procedure step by step:
  - a. In **Probe Setup**, click on the **LoadProbe**:
    - i. The **Probe Configuration** tab appears. In the **Probe Select** section, roll-down the menu of **New Probe of type** and choose **ScanAsyst-Air** (it is the very first item in the list).
    - ii. Confirm the selection by pressing the **Return and Save Changes** button.

- b. In **Align Laser on Probe**:
  - i. Press the **Move to the Alignment Station** button. A warning dialog appears. If the standard cantilever holder is used, confirm the dialog by pressing the **Yes** button. Now the stage will be moved to the Optical Standard. Never use the Optical Standard in the case of an installed fluid cantilever holder!
  - ii. Use laser control knobs located on the top of the scan head, align the red laser spot so it touches the tip of the cantilever (see the instructional video). Front-left knob runs the laser across Y-axis and rear-right knob across X-axis.
  - iii. Use photodetector adjustment knobs located on the left side of the scan head, align the red laser spot to the center of a quad detector (see the instructional video). Voltage differences in both directions (horizontal and vertical) have to be as close to 0 V as possible, and the sum signal should be  $\sim 4 - 5$  V.
- c. In **Focus Tip**:
  - i. Press the **Return from the Alignment Station** button. Confirm it by pressing the **Yes** button.
  - ii. By clicking on the **Focus Controls** icons, focus the cantilever tip in the optical image. Try **Focus Control**  $\uparrow$  first, in the case of no visible change, increase the speed to 20 %, or try to add more **Illumination**.
  - iii. When the tip is in focus, click with the mouse on the optical image to mark its position.

### Sample preparation

1. Put the desired sample in the middle of the stage and turn the vacuum power switch at the upper right corner of the Dimension Icon toggles on. Note that the bottom of the samples should be clean and flat!
2. Click on the **Navigate** icon to move the sample and focus on its surface:
  - a. Move the X-Y stage to align the desired location on the sample under the crosshairs by:
    - i. Using **XY Control** arrows in **Navigate to Scan Centerpoint / Navigate to a region of interest**.
    - ii. Using a trackball: To move long distances – hold the upper left/upper right trackball button (Lock button) down and simultaneously roll the trackball with high speed. Release the button to stop the motors. To move short distances – roll the trackball without holding down any buttons.
  - b. Focus carefully on the sample surface in **Focus Sample / Adjust the focus by moving Scan Head up or down** by clicking on **Scan Head** arrows. **Caution**: Do not crash the tip!
3. Close the acoustic hood enclosure of the ICON system and lock it with the Hex Key.
4. Click on **Check Parameters** and insert your desired inputs, otherwise leave as it is in default.
5. Click on **Engage** to approach (beep tone) the sample surface by tip/cantilever and start the measurement.
6. In the **Force Monitor** window, check the proper shape of a measured curve – compare it with a **Monitor Heart Beat** section in **ScanAsyst Principles of Operation** (in the ICON user manual).
7. Scan and capture to a directory using the icons in the top-right corner of the window.

### Turning the ICON System OFF

1. Press **Withdraw** to release the cantilever from the sample surface.
2. In the **Navigate page / Load Sample**, click on the **Sample Load Position** icon to move the stage from below the scan head.
3. Open the enclosure of the ICON. Flip vacuum switch to the **OFF** position and remove the sample.
4. Close the **NanoScope SW** with the  in the right upper corner of the main window. Turn OFF PC and **controller**.
5. Release the scan head. Remove the cantilever holder and slide the scan head down to the dovetail groove.
6. Similar to step 5, install the cantilever holder on the stand. Hold the cantilever holder in the front part when releasing the clamp.
7. Use tweezers to remove cantilever from the holder. Insert it into the correct position in the gel-box – follow the condition convention: ( $\nearrow$ ) - used but OK, ( $\rightarrow$ ) - broken. Write down the number of the used cantilever into the logbook on the table.
8. Return the cantilever holder to its position in the flat box. Close the cantilever stand and return both boxes inside ICON hood.
9. Close the ICON acoustic enclosure, lock it with the Hex Key. Finally, Clean the workstation (box with cantilevers, samples, etc.).

## Analysis type: Tapping Mode

The principle of scanning probe microscopy is similar for both ScanAsyst and Tapping modes. However, there are few differences in the experiment as follows;

- a. For cantilever preparation, select the **RTESPA** cantilever for Tapping mode.
- b. In the Select Experiment window click **Tapping Mode, Tapping Mode in Air**.
- c. In the Probe Setup\Probe select, roll down and find the **RTESPA-150**.
- d. In Tapping Mode, there is an extra window in the Setup where you should tune the cantilever. To do so, press **Auto-Tune** to find the resonance frequency of the cantilever. If the process was not successful, repeat Auto-Tune or Try Manual Tune.