

SOP: General Operation of Bruker Dimension Icon

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¹ SOP adapted from the NanoScope 10.0 R1 Software User Guide.

Startup

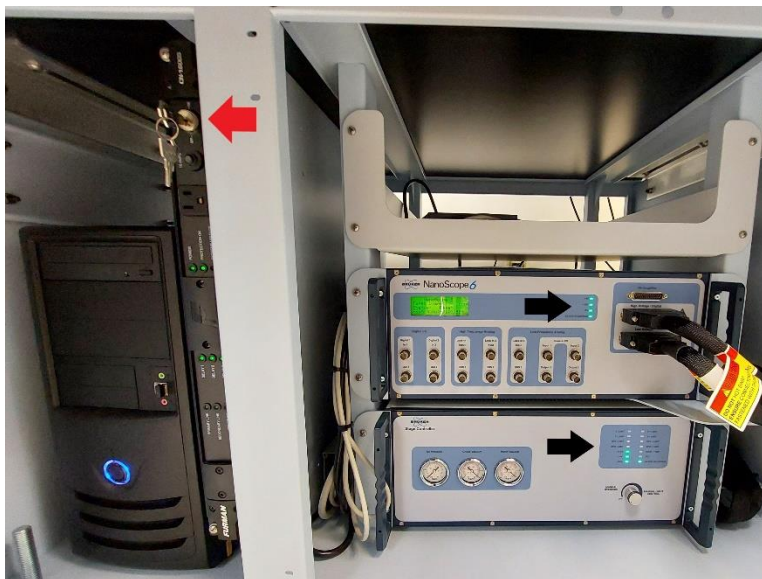


Figure 1 Workstation Console Cabinet

Workstation Console Cabinet. The left-hand side contains the workstation and power conditioner. The right-hand side contains the NanoScope 6 controller (Top) and the Icon Stage Controller (Bottom). The red arrow illustrates the location of the power conditioner's control switch. Black arrows illustrate locations of the indicator lights

1. To begin start-up sequence, rotate the power conditioner's control Switch 180 degrees clockwise. (Red Arrow Figure 1)
2. Wait approximately 2 minutes for power start-up sequence to complete. The sequence is completed when the indicator panel lights of both control boxes are illuminated. (Black Arrows Figure 1)
3. Launch Nanoscope Control Software. (Figure 2)
4. Select experiment type.
5. Verify there are no foreign object present on the granite slab.
6. When prompted by the software, initialize the stage.



Figure 2 Nanoscope Icon

Nanoscope Main Screen Elements

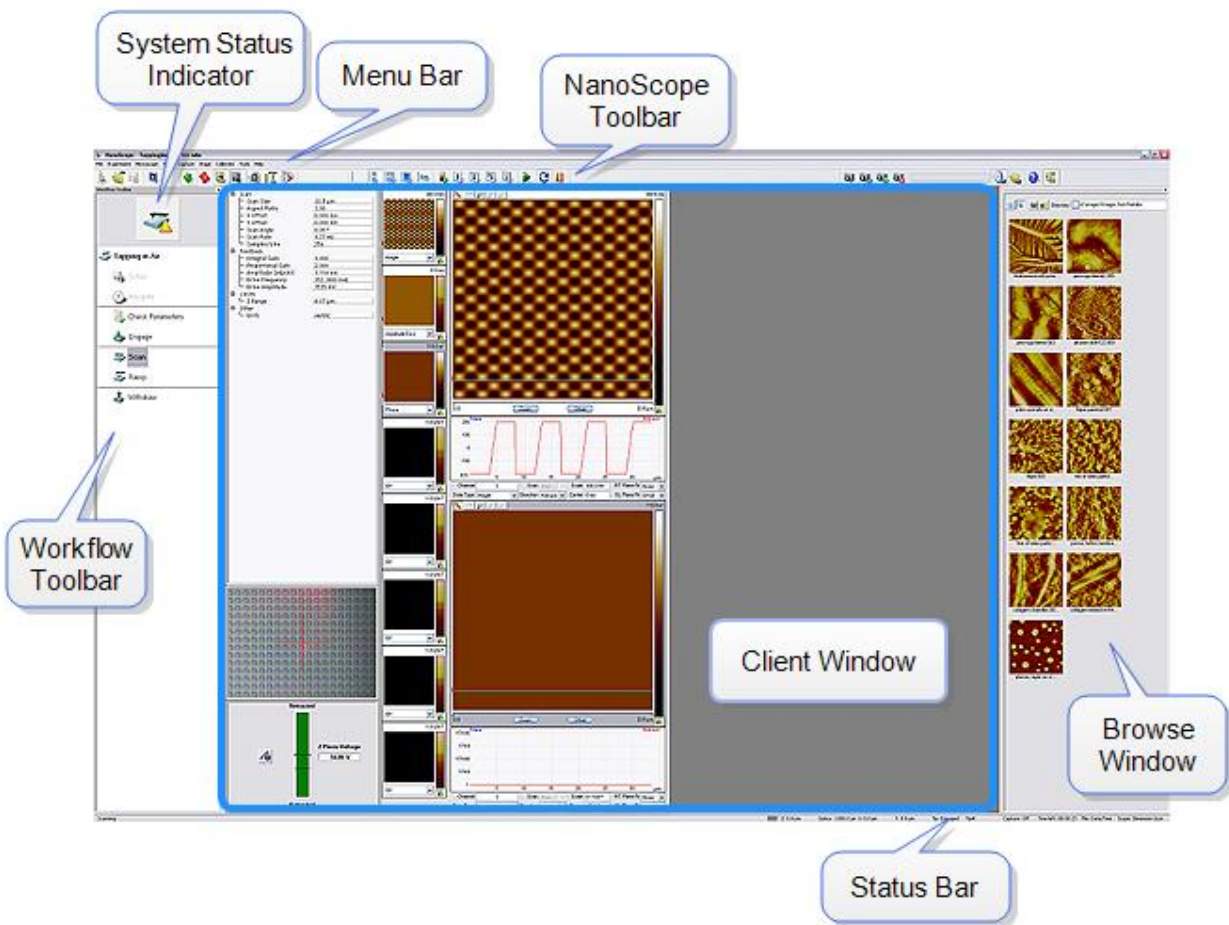


Figure 3 Nanoscope Software Main Screen Elements

Main Screen Elements

- **The Menu Bar:** A group of items for executing commands or viewing files.
- **The Nanoscope Toolbar:** A group of icons for executing commands or viewing dialog boxes to configure input parameters.
- **System Status Indicator:** Window that prominently displays the engage status as well as crucial system status information that affects operation.
- **The Workflow Toolbar:** The left pane in the NanoScope window. The Workflow Toolbar sequentially organizes the steps (work) needed to perform your experiment.
- **The Client Window:** A central window for viewing all Realtime and offline graphical displays, input parameters, results parameters and graphs.
- **The Browse Window:** A dockable window in the client window for browsing files. Available in list or thumbnail format.
- **The Status Bar:** A read only list that displays the stage X, Y, Z coordinates and enabled functions (e.g., Capture: On).

General Operations



For additional information please refer to the basic training videos provided by Bruker. (Icon Probe Load & Laser Align Video, Icon Basic Contact Video, Icon Basic Tapping Video, Scanasyt PFT Video)

In general AFM operation is a process of into several sequential procedures. Nanoscope control software provides a logical workflow which help facilitates proper procedure execution. The general order of procedures follows below.

1. Select experiment / feedback type
2. Prepare and load the sample
3. Select a probe
4. Prepare and load probe holder
5. Install Probe Holder on the SPM scanner head
6. Identify the probe
7. Align the Laser onto selected probe using either the shadow method or the alignment station.
8. Align the photodetector
9. *If using a conventional tapping mode, tune the cantilever resonance*
10. Check initial scan parameters
11. Engage, scan & withdraw.

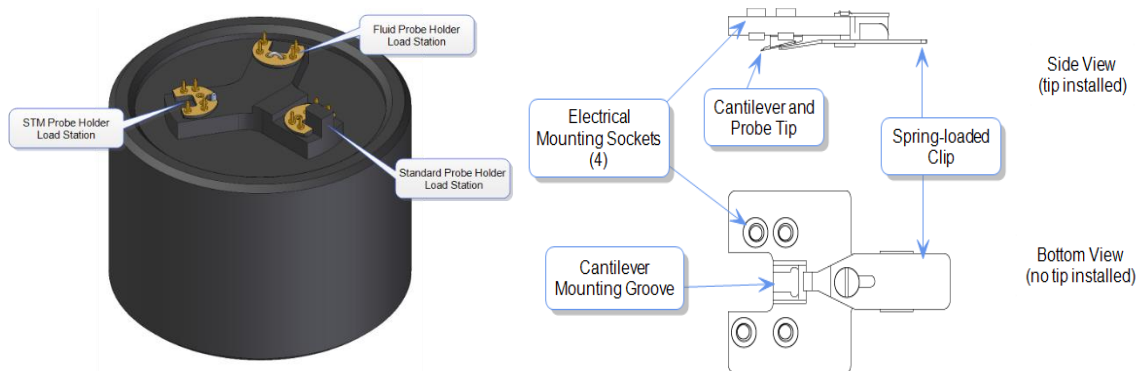
Select Experiment

1. Click **Experiment > Select Experiment** or the **Select Experiment** icon in the top left of the NanoScope software window. This opens the Select Experiment Form Select Experiment Form. (Figure 4)
2. Use form to select a previously saved experiment configuration or by choose **1** Experiment Category, **2** Experiment Group & **3** Experiment to use one of the pre-loaded workspaces.
3. Click Load Experiment.

Figure 4 Select Experiment Form

Prepare and Load the Probe Holder

Install probe substrates face-up so the tip points away from the probe holder. This ensures that the cantilever and tip face toward the sample once the probe holder is mounted on the scanner.



To Install a probe on to the AFM probe holder:

Many probe substrates have multiple cantilevers per substrate. Some have cantilevers on both ends. It is often necessary to identify the desired probe using an optical microscope.

1. Using sharp tweezers, grab the probe substrate firmly by the sides and lift it free from the wafer or gel-pack. (In gel packs the tip ends are pointing upward and do not need to be turned over before being placed onto cantilever holder)
2. Press down and slide back the spring clip of the standard AFM probe holder.
3. Orient the cantilever intended for imaging away for the cantilever holder, and place the substrate in the AFM probe holder groove.
4. Carefully manipulate the substrate until it is flush against the back edge and laying flat in the probe holder groove
5. Press the spring-loaded probe clip down, gently push forward over the substrate, and release the spring clip to hold the substrate securely in the groove.

Install the Probe Holder onto the SPM Scanner

1. Verify that adequate space exists to safely load the without touching the sample surface
 - a. Tip to sample distance can be increased by selecting **Microscope > Withdraw** several times or by selecting **Navigate > Focus Surface** and raising the Z-stage upward.
2. Unlock and lift the scan head out of the dovetail groove
 - a. Turn the dovetail release screw located on the right side of the scanner dovetail clockwise to unlock the scan head.
 - b. Carefully slide the scan head up and out fo the dovetail groove.
3. Mate the probe holder sockets to the pins on the scan head.
 - a. Verify the tip points down and away from the scanner The end of the cantilever must point in the direction of the optics assembly
 - b. Verify the AFM probe holder mounts flat against each pin on the end of the scan head.
4. Replace and secure the scan head into the dovetail groove.
 - a. **Carefully** slide the scanner down into the dovetail groove. Make sure to guide the scan head to the bottom of the groove. **Do not drop or mechanically shock the scan head!**
 - b. Tighten dovetail release screws (turn counter-clockwise)

Align the Laser

To align the laser on the AFM probe, click the **Setup** button in the **Workflow toolbar**. Laser alignment can be completed using either the shadow method procedure or with the assistance of the alignment station. The laser control knobs are located on the top of the scan head. A diagram printed on the scan head illustrates the movement direction of the laser when the control knobs rotated clockwise.

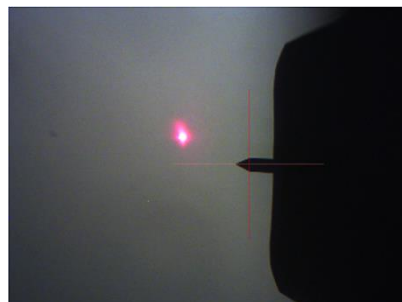
Alignment Station



Caution: Do not use the Alignment Station when using the Fluid or other specialty probe holders.



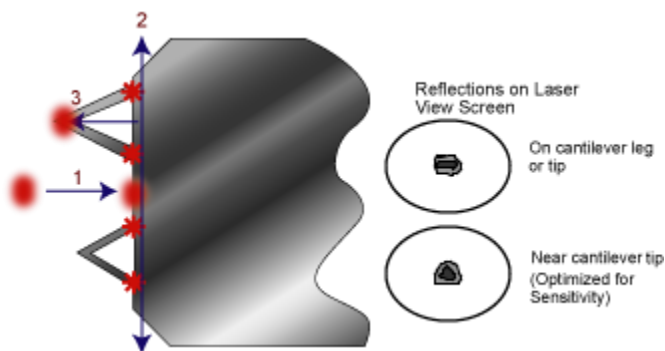
To use the Alignment Station, click the Alignment Station Icon. The stage will position the scan head above the Alignment Station mirror. When stage movement is complete, use the focus control buttons to bring the cantilever and laser spot into focus, then use the laser control knobs to position the laser spot onto the free end of the desired cantilever.



Shadow Procedure

The user aligns the laser by moving the laser beam relative to the cantilever while observing the laser spot on the granite surface (a piece of white paper also works well) below the scan head. If the laser is not on the cantilever or probe substrate, the laser appears as a bright red spot on the surface below. When the laser is aligned on the cantilever, a shadow appears on the surface below. The 3 step shadow alignment procedure is illustrated below for a probe substrate with 2 triangular cantilevers.

1. Move the laser horizontally to find the edge of the probe substrate, position the laser so the spot is very close or partially clipped by the substrate edge
2. Move the laser spot vertically to locate the center of the desired cantilever. (top cantilever in this illustration)
3. Move the laser spot close to the free end of the cantilever.

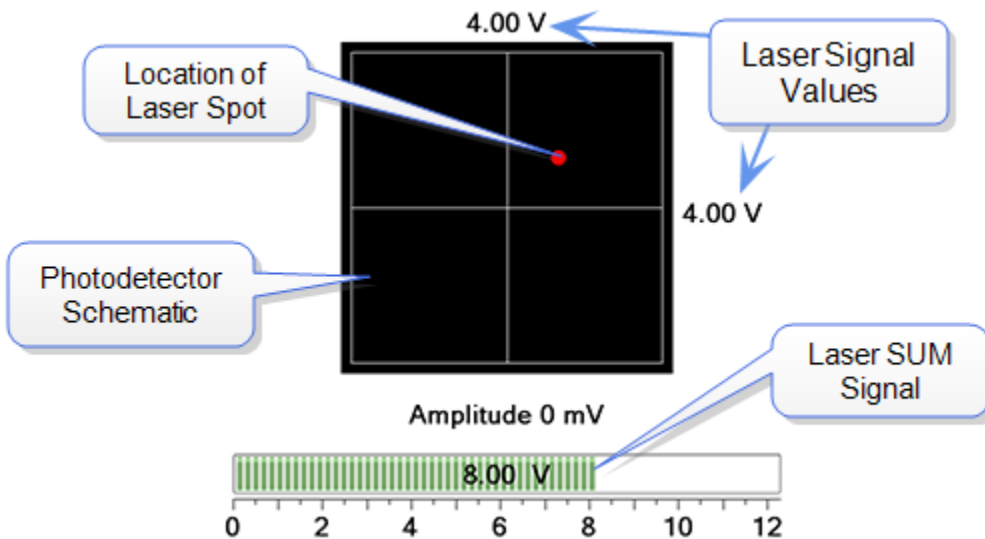


Adjust the Photodetector

Once the laser is in place on the cantilever, adjust the photodetector position to obtain an adequate sum signal and properly orient the laser spot on detector quadrants.

1. Verify a laser spot is visible on the filter screen located on the front face of the scan head.

2. Verify that a laser sum signal greater than 0.5 V. Sum signal can be viewed on the Dimension ICON LCD panel or in the **Workflow Toolbar** -> **Setup** view
3. Center the laser detector signal in the photodetector schematic using the photodetector adjustment knobs located on the left side of the scan head.



Locate The Tip

In this section, the tip position is determined using the integrated optical microscope. The tip position (Z height) is located using optical focal distance measurements.

1. Enter Setup view, **Workflow Toolbar** → **Setup** view
2. If the scan head is above the alignment station, click **Return from the Alignment Station** button in the Focus Tip Panel
3. Zoom out as far as possible (Zoom level 0) using the **Zoom Out** button
4. Using either the trackball or the on screen focus controls move the optics up or down to focus on the cantilever.
5. On the video panel, click on the tip location to place the crosshair over the end of the cantilever where the probe tip is located.

Focus on the Sample Surface.

In this step the Z axis is moved to focus on the sample surface.



The Z axis moves both the optics and the scan head; Care should be taken to avoid overshooting the focus and crashing the tip into the sample.



When working with thin / transparent or low contrast samples it may be beneficial to focus on the sample edge.



For certain sample types it may be helpful to focus the tip reflection instead of the sample surface. The focus target can be toggle with controls in the Navigate view.

1. Click the Navigate icon in the Workflow Toolbar, **Workflow Toolbar → Navigate**
2. Focus on the surface by clicking the **Sample** icon in the **Focus Sample** panel of the Navigate view
3. Focus on the sample surface using either the **Focus: Z motor** arrow controls or by rolling the trackball up or down while pressing the bottom-left button.
4. Use **XY Control** buttons or trackball to position the probe above the location of interest.

Tune the Cantilever (TappingMode AFM)

In TappingMode the cantilever is driven near a resonance frequency with a constant amplitude. The tune procedure optimizes the frequency, amplitude, and phase of the driving of the signal.

1. If the appropriate probe was selected from the probe database during the experiment setup procedure, click the **Autotune** button located on the Tune Cantilever Panel
2. Otherwise, or If Autotune fails, click the **Manual Tune** button to open the **Cantilever Tune** window. (Figure 5)
 - a. **AutoTune** → **Start frequency & End frequency** about 30 % lower and higher respectively than the listed nominal cantilever frequency
 - b. AutoTune → Target amplitude 300 mV default
 - c. Peak offset → 5%
 - d. Click the **Auto Tune button** control to initiate the peak search and tuning.
 - e. If the Auto tune search has returned a satisfactory operating condition, click the Exit button to save the drive parameters and return to the setup.

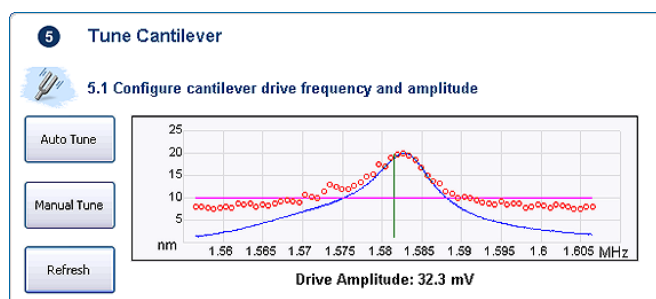


Figure 5 Tune Cantilever Panel

Check Initial Scan Parameters

The **Check Parameter** view highlights an important subset of experiment parameters, and it provides a simple interface for adjusting default values prior to engaging the tip. If using a pre-defined experiment, changes from the default values are highlighted in **yellow**. It is typically recommended to use **Scan size** around 1 μm prior to first engagement.

For additional details about initial parameter setting, refer to information given for the specific imaging modes.

Engage, Scan & Withdraw

Engage



To engage select Microscope → Engage or click the **Engage** Icon in the Workflow Toolbar

There are two types of engage process. Engage mode can be changed in the Engage Settings window.

Microscope → Engage Setting

- **Engage**: available for all probe types; this is the default setting.
- **Smart Engage**: available for certain probes types operating in air.



Smart Engage will find the surface quick than standard **Engage**; however, **Smart Engage** is not recommended for expensive or fragile probes due to a slightly greater change of breakage. **Smart Engage** is not available in fluid media.

Scan



Once engaged, adjust scan parameters as needed using the Scan view to acquire an optimized image. Refer to the appropriate section help documentation or other references for further instructions specific to one of the Imaging Modes.

Withdraw



When imaging is complete, withdraw the tip by selecting Microscope > Withdraw, or the click the Withdraw icon in the Workflow Toolbar. This typically raises the tip 1 mm above the sample.



Although the 1 mm withdraw distance provides enough clearance to loosen the dovetail and remove the SPM scanner, if further distance is desired perform one of the following:

- Select Microscope > Withdraw to raise the Z-stage with the trackball.
- Execute Withdraw from the Workflow Toolbar multiple time

Shutdown (Overview)

1. Remove sample and clean sample chuck if needed
2. Remove tip holder from scan head
3. Remove probe substrate from Tip holder
4. Exit Nanoscope software.
5. Rotate the power conditioner's control Switch 180 degrees counter-clockwise. (Red Arrow Figure 1)

DOs and DON'Ts



- **DO** handle the scanner carefully: hold the scanner securely and avoid hitting the scanner end cap with other objects.
- **DO** lift the Z stage to a clear position before moving the stage in XY.
- **DO** reduce XY CL I gain to 8 when using the fluid probe holder or app mod probe holder.
- **DO** clear out the granite before initializing the stage.



- **DO NOT** apply too much force when mounting the probe holder on the scanner.
- **DO NOT** apply large offsets or maximum scan size for extended periods.
- **DO NOT** drop the head into the dovetail.
- **DO NOT** hot plug/unplug the NS6 cables when the controllers are powered on.
- **DO NOT** to place any objects on the granite base.
- **DO NOT** over tighten the app mode screw to scanner.
- **DO NOT** spill fluid onto the scanner.