How to protect your scanner

Protection from voltage damage

1. The computer should be on whenever the NanoScope Controller is on.

2. On the scan control panel, use Offset values of 0 whenever possible. Avoid using offset values outside of the range +-150V (or +-30 um for a Dimension scanner) for periods of more than one hour. As soon as possible, reset the offsets to zero. Instead of using a large offset, it is better to withdraw the tip, reposition the sample using the mechanical stage, and then re-engage.

3. Keep the Z-center voltage near 0 (+- 150V is ok, +- 50V is better). Whenever you check the AFM display, please look at the Z-center voltage.

4. Avoid using maximum scan sizes for long periods if not necessary.

Protection from mechanical damage (for Dimension AFMs)

5. When changing samples, **be sure that there is sufficient vertical clearance between the top surface of the sample and the tip** located at the bottom of the Dimension scanner. Look by eye at a glancing angle (level with the sample surface). It may help to hold a white card behind the scanner. If you have any doubt about the clearance, repeat the **Withdraw** command (or give the **Stage – Initialize** command) until the scanner is raised to its maximum height. Then look again to be sure.
When using clamps or weights to hold a sample down, make sure that these objects do not collide with the scanner.

6. **Use the manual trackball the first time you move a new sample** under the scanner. To avoid a possible collision, you can stop the motion easily by releasing the trackball.

7. **Focus carefully on transparent samples.** When working with transparent samples, the reflection from the top surface may be weak. It is sometimes helpful to get a preliminary focus by viewing the sample edge, by finding and viewing debris on the top surface, or by making and viewing a pen mark on the top surface. Learn to recognize the reflection of the tip. If you are focusing on the surface and see the tip reflection, you are too close and need to go up 500 um (typical for Dimension systems).

8. **Check the focus before engaging a new spot on the same sample.**

Good Advice for any brand of AFM

9. Always check the AFM settings yourself. Do not assume the previous user left the AFM in a safe condition.

Explanations, by number.

1. The DSP (Digital Signal Processor) and interface boards inside the computer are extensions of the NanoScope Controller. They must be energized to maintain the NanoScope Controller at proper outputs. Without control from the computer, outputs to the scanner might be at random values (up to +- 220V). Turn the computer on before the NanoScope controller, if possible, or put both the computer and the controller on the same master switch.

2. The scanner uses a piezo crystal to make fine, controlled motions (0.1 nm to 100 um). Piezo crystals can be damaged by having large DC offset voltages applied to them for long periods of time. In the **Realtime – Scan Controls** panel there are parameters called **X offset** and **Y offset**. The voltages which correspond to these values can be seen by selecting **Units = Volts** (instead of **Metric**) in the **Other Controls** panel. Note: the **X offset** and **Y offset** will change when a **Zoom In/Out** or **Offset** command is used.

3. The offset voltage on the Z piezo (reported as an average for each scan line) is displayed by the **Z-center position** indicator bar on the Display monitor. It should also be kept low (between +- 150V) when possible. After engagement, it can be adjusted by using the **Motor/Step Motor** command. The **Tip Up** command makes the Z center voltage go more position. If nothing seems to happen, keep clicking in order to overcome mechanical backlash. Backlash of 4 um is typical for Dimension systems. Another method is to Withdraw and then Engage again. Thermal drift or other reasons may cause the Z-Center to change gradually over time. Z-center may change suddenly if the tip leaves the surface, resulting in a fully retracted Z-piezo (–220V).

4. Some piezo crystals have sensitivities which will allow them to scan much larger than their nominal scan size specification. Running a scanner near maximum scan size over many days may result in a gradual lowering of sensitivity (reduction of scan size), which will be seen as a change in calibration. This slight decrease will tend to level out as the crystal ages.

5. The scanner can be damaged if the sample hits the scanner or tip holder in a horizontal motion.

6. Same as #1. If you use the **Stage – Move To** command, you can stop the stage by pressing the "Pause" key on the keyboard. But it is easier to just let go of the trackball.

7. A vertical crash into the sample surface will almost always break the tip. It is possible to damage the scanner (although this is unlikely if the safety control based on reflected laser power is working properly).

8. Some large samples are not flat. In the Dimension AFM, the SPM stage parameters are normally set so that proper focusing using the **Focus – Surface** command puts the tip 1000 um (1 mm) above the surface. The engage process has two phases: a fast motion that moves the tip down to 100 um and then a slow motion which searches for the surface and finally puts the tip on the surface. If the local surface height increases by more than 100 um from spot 1 to spot 2, and you don't refocus, then the fast motion will crash the tip.

9. People make mistakes.

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prepared by Advanced Surface Microscopy, Inc., based on information obtained from Digital Instruments and our own experience.

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