1.0 **Equipment Purpose**

1.1 Msink7 is one of the three sinks in Bay 386 in the NanoLab. This document has specific information about msink7 general use MOS and Non-MOS clean processes at this sink.

1.2 Wet Sink7 provides a special application heated bath, a hot phosphoric acid bath, and two room temperature HF tanks (MOS and Non-MOS), as well as two DI water quick dump rinse (QDR) stations at this sink. Each chemical bath and/or tank is clearly labeled.

1.3 **IMPORTANT NOTE:** ABSOLUTELY NO METAL (ANY METAL) LAYER WAFERS AT THIS SINK.

2.0 **Material Controls & Compatibility**

2.1 Only TEFLON tweezers are allowed to be used at this sink.

3.0 **Applicable Documents**

3.1 **Revision History**

3.1.1 [Heated Phosphoric Acid Etching of Silicon Nitride](#) - Concentration and Temperature Control chart.

3.1.2 [Chapter 2.01](#) of the lab manual, which explains wafer boxes, tweezers, and other tool cleaning prior to using VLSI sink

3.1.3 [Chapter 2.02](#) Sinks summary chapter.

4.0 **Definitions & Process Terminology**

4.1 Quick dump rinse (QDR): DI water fills the sink followed by a quick dump to get rid of excess acid and/or contaminants.

4.2 Spin Rinse Dryer (SRD): DI rinse followed by dry cycle. (Use SRD at msink8)

5.0 **Safety**

5.1 Never touch any surface while wearing chemical-resistant gloves that other lab members may come into contact with, such as the table tops, door handles, computer keyboards, face shields, aprons, etc. If you need to step away from the sink at any time, rinse off gloves at the glove wash, dry with techni-cloths, and put away in your drawer or cubbie until you are ready to resume your work at the sink.

5.2 Follow general safety guidelines for the lab safety rules outlined in Chapter 2.3 and the following:

5.2.1 This sink contains a special application heated bath, a hot phosphoric acid bath, and two HF tanks; therefore appropriate safety attire should be worn while working at this station. This means that chemical resistant gloves on top of the nitrile gloves, face shield, and apron have to be worn while working at or around msink7. Do not use metal tweezers at this sink; TEFLON only.
5.2.2 Do not adjust the heater controllers as they have been preset to produce proper bath temperatures.

5.2.3 Only use chemically resistant cassettes provided at the station (Teflon type). Failure to do so can cause damage to the station and/or compromise the operator’s safety. The cassettes for this sink are stored in bins on the sink roof. The MOS-clean cassettes are black Stat-Pro cassettes and are stenciled “7 MOS 7”. There is one set each for 4” wafers and 6” wafers; handles are also in the MOS-clean bin. The non-MOS cassettes are white Teflon and are stenciled “7 MEMS 7” and are in the non-MOS bin along with their handles; both 4” and 6” cassettes.

5.2.4 Dwyer Photohelic Exhaust Flow Meter (Figure 5): Monitors the sink exhaust flow and will shut down all electricity and water to the sink if there is too much or too little flow. An alarm will sound; press the red SILENCE button (Figure 4) and promptly report on FAULTS.

5.2.5 MPC-901 Emergency Alarm (Figure 4): Cuts power to the sink in emergencies. Push the big red STOP button (Figure 4) to cut the power to this sink. Report promptly on FAULTS.

5.2.6 Glove Wash: Located in the front center of this sink; water spray is sensor activated.

6.0 Process Data

6.1 The hot phosphoric bath operates at 160°C and uses 85% phosphoric acid. The 15% water content will gradually decrease during operation at elevated temperatures. The lid should be closed during operation or else the evaporation rate will be too high. Even with the lid closed, the bath will lose water at a significant rate. The flowmeter above the bath controls the drip rate of DI water into the system. Do not touch this flowmeter unless cleared by processtaff to do so, as the flowmeter feedback is not straightforward. A flowmeter reading of 90 corresponds roughly to 5mL/min flowrate. 90-100 is the current default setting for keeping the 160°C bath level. Loss of water will change the etch rate considerably, so it is important to check the bath level before and during processing. Users should note that the tall msink7 cassette holders should not be used in the hot phosphoric bath as they prevent the lid from fully closing.

6.1.1 A fresh hot phosphoric bath will have an etch rate of about 48-50A/min for Si3N4, and ~1A/min for SiO2.

6.1.1.1 Be advised that the bath temperature listed may not be truly accurate without mixing. The thermocouples may rest on the side of the bath, close to the heating coils, resulting in readings much higher than what would be recorded in the center. 20°C variation between wall and center is not uncommon. Users may want to mix the bath during heating and operation to achieve better temperature uniformity.

6.1.1.1.1 When adding or removing wafers to the bath, or mixing bath contents, users will need to place hands above the steaming bath. The steam rising from the bath is not to be ignored. Wear full PPE, making sure to protect the traditionally exposed area between glove and sleeve.

Cleaning baths: stripping a lot of nitride in the bath causes a layer of scum to form at the top of the bath. Users should be prepared to clean the bath ahead of time if they want a truly clean system. Note that RCA-1 and RCA-2 cleans take a few hours each to cool to 50°C from 70°C, so plan accordingly.

7.0 Available Processes, Gases, Process Notes
7.1 Special application heated bath, hot phosphoric acid bath, and two drainable HF tanks are available at this sink as well as two quick dump rinsers to properly clean the wafers prior to going into the 6” or 4” spin rinse dryer at msink8 (msink8srd.).

<table>
<thead>
<tr>
<th>Bath</th>
<th>Chemical</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left-Heated Bath</td>
<td>Special Application Bath</td>
<td>60ºC</td>
</tr>
<tr>
<td>Right-Heated Bath</td>
<td>Hot Phosphoric Acid</td>
<td>160ºC</td>
</tr>
<tr>
<td>Left Non-Heated Tank</td>
<td>Non-MOS clean HF</td>
<td>N/A</td>
</tr>
<tr>
<td>Right Non-Heated Tank</td>
<td>MOS-clean HF</td>
<td>N/A</td>
</tr>
</tbody>
</table>

8.0 Equipment Operation

8.1 The sink operation is relatively easy. The QDR (quick dump rinse) cycle is invoked from a keypad mounted on the face of the station (one for each quick dump rinse tank).

8.2 Control Key Description

8.3 There are six control/displays at this station, see Section 11.0 (Figures & Schematics). The two MPC-100 (Figure 3) control panels are for the heated baths: the one on the left is for the special application heated bath, the one on the right for the hot phosphoric bath. The two MICROKLEEN RINSE (Figure 1) control panels are for the two quick dump rinse (QDR) stations. Each QDR is currently set up for four dump rinse cycles. Wafers are initially showered with DI water followed by four DI fill-dump cycles. These cycles end with wafers submerged in the water for operator to extract and place them in SRD at msink8. See Section 11.0 (Figure & Schematics) for more details. The station performs an automatic self-cleaning, every 60 minutes by one QDR cycle. The MICROTIMER (Figure 2) control panel timers for the HF baths are preset to 15 minutes.

8.4 POWER Turns on the control panel.

8.5 START Begins a process cycle at any of the control/display panels

8.6 STOP/RESET Stops or interrupts a process cycle at any time.

8.7 SAVE/SIL Silences the acid bath alarm.

8.8 HOLD Stops heating the special application heated bath or hot phosphoric acid bath corresponding to the control/display panels. Press HOLD again or RETURN to reactivate the heater.

8.1 DRAIN Press twice to empty the baths/tanks. Make sure chemicals baths are sufficiently cooled down before draining. To only drain a small amount, press the DRAIN button twice, then once again when you want to stop the draining.

8.2 Note: the special application heated bath has been modified to drain by flipping a toggle switch on the panel.

8.3 Quick Dump Rinse Operation

8.3.1 Place wafers in the tank; tank initially should be empty and the lid closed.

8.3.2 Press START button to activate the dump rinse cycle (Figure 1). It will cycle down from 4 to 1 then show 0 in the display window. At the end of the two cycles a beeping alarm will
sound. Press **STOP/RESET** to silence the alarm. Upon completion of four rinse cycles remove wafers and place in **SRD**.

### 8.3.3 Note:
Dump the QDR water by pressing the **OPEN** button. This will open the gate at the bottom of the sink to drain the water. Press **STOP/RESET** to close the gate after the water is drained. Leave the QDR with no water in it and with closed lid before leaving the station.

### 8.4 Room Temperature HF Controllers (Microtimer Operation)

#### 8.4.1 Place your wafers in the desired HF acid bath (left bath is designated non-MOS clean, right bath is designated MOS-clean).

#### 8.4.2 Press the **START** button if you wish to use the 15-minute preset timer; use of this is optional (**Figure 2**).

#### 8.4.3 Press **STOP/RESET** button to end or interrupt the cycle.

#### 8.4.4 To reset the timer at end of cycle, press **STOP/RESET** once again.

#### 8.4.5 Remove wafers and rinse in either of the quick dump rinsers (MOS or non-MOS clean.)

**8.4.5.1 Dry wafers in the msink8srd.**

### 8.5 Hot Bath Controller for the Special Application Heated Bath or Hot Phosphoric Bath (MPC-100)

#### 8.5.1 Place your wafers in desired bath, either the special application heated bath (consult with the processtaff before use) or the hot phosphoric bath.

#### 8.5.2 Press time/start button to start the etch process cycle with the preset time and temperature (**Figure 3**).

#### 8.5.3 When your etch is completed after the preset time, hit the TIME **STOP/RESET** button to reset the timer.

#### 8.5.4 Remove your wafers and rinse in quick dump rinse #1 for the special application heated bath or quick dump rinse #2 for the hot phosphoric bath.

### 8.6 Changing Acid(s) in Sink7

#### 8.6.1 Special Application Heated Bath (**Figure 3**):

**8.6.1.1 Press the **HOLD** button once on the MPC-100 temperature controller panel so that the bath temperature will cool down to 60°C. Note: LED light next to **Heat**, under status column, goes off.**

**8.6.1.2 Next, toggle the **DRAIN** switch UP to empty the bath. Rinse bath with DI water after completely drained.**

**8.6.1.3 Toggle the **DRAIN** switch DOWN to close the gate on the bottom of the tank. The bath is now ready to be refilled.**

**8.6.1.4 Press **HOLD** button to restart the heater (if the bath has been refilled.) LED adjacent to **Heat**, under status column, will turn on.**

#### 8.6.2 Room Temperature HF Baths (**Figure 2**):

**8.6.2.1 Press the AMBIENT TANK #1 or #2 **DRAIN** green button.**

**8.6.2.2 Rinse the bath with DI water once the tank is empty.**
8.6.2.3 Press the **AMBIENT TANK #1 or #2 DRAIN** green button again.

8.6.2.4 Fill the non-MOS clean or MOS clean HF in the appropriate acid tank accordingly.
8.6.3 Hot Phosphoric Acid Bath (Figure 3):

8.6.3.1 Press the HOLD button on the MPC-100 temperature controller panel so that the bath temperature will cool down to 74.5°C.

8.6.3.2 Next press the DRAIN button twice to empty the bath. Rinse bath with DI water after completely drained. The drain timer is set for 10 minutes.

8.6.3.3 Press DRAIN button again to close the gate on the bottom of the tank. Fill the bath with new phosphoric acid.

8.6.3.4 Press HOLD button to restart the heater.

8.7 Control Panel Programs are shown in the Appendix

8.7.1 The parameter codes for the programs on the MPC-100 temperature controllers and Microklen Rinse are listed on Tables 1 and 2 in the Appendix. The parameter codes are not to be altered by the NanoLab members. Please use them as your reference check only.

9.0 Troubleshooting Guidelines

9.1 Rinse cycle stopped in the middle QDR cycles: press open to dump the water out. Press stop/reset key followed by restart the dump rinse cycle from the start.

9.2 No Power To Sink: Several issues can shut the system down.

9.2.1 Power To System Off (Fig.4): Press power ON if no issues have been reported on the Wand or if the system is not under technician's control.

9.2.2 Photohelic Differential Pressure Reading (Fig. 5) is outside limits (two red bars): Consult with staff to check house exhaust pressure.
Figure 1 – Quick Dump Rinse (QDR)

Figure 2 – Room Temperature Bath Timer Controller
Figure 3 – Hot Bath Temperature Controller
Figure 4 – Main System Power/Alarm Controller
Figure 5 – Photohelic Differential Pressure Gauge
## Appendix A: Sink Control Settings

### Table 1 - MPC-100 Hot Bath Temperature Controller Codes

<table>
<thead>
<tr>
<th>Timer</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED Displays</td>
<td></td>
</tr>
<tr>
<td>Cr</td>
<td>11</td>
</tr>
<tr>
<td>Pb</td>
<td>1.0</td>
</tr>
<tr>
<td>rE</td>
<td>1.0</td>
</tr>
<tr>
<td>rA</td>
<td>0.0</td>
</tr>
<tr>
<td>OF</td>
<td>0.0</td>
</tr>
<tr>
<td>AC1</td>
<td>00</td>
</tr>
<tr>
<td>AC2</td>
<td>00</td>
</tr>
<tr>
<td>PS</td>
<td>Left bath: 60.0 Right bath: 160.0</td>
</tr>
<tr>
<td>dr</td>
<td>Left bath: 50.0 Right bath: 70.0</td>
</tr>
</tbody>
</table>

### Table 2 - Quick Dump Rinse Codes

<table>
<thead>
<tr>
<th>Cycles</th>
<th>Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED Displays</td>
<td></td>
</tr>
<tr>
<td>CY</td>
<td>2</td>
</tr>
<tr>
<td>FP</td>
<td>45</td>
</tr>
<tr>
<td>dP</td>
<td>5</td>
</tr>
<tr>
<td>Sd</td>
<td>2</td>
</tr>
<tr>
<td>Ad</td>
<td>0</td>
</tr>
<tr>
<td>n2</td>
<td>n</td>
</tr>
<tr>
<td>Ac</td>
<td>0</td>
</tr>
<tr>
<td>PC</td>
<td>5</td>
</tr>
<tr>
<td>Pn</td>
<td>1</td>
</tr>
<tr>
<td>nb</td>
<td>0</td>
</tr>
<tr>
<td>SL</td>
<td>1</td>
</tr>
</tbody>
</table>

**Note:** Do not change the recipes. The factory set up codes will be impacted.
11.0  **Appendix B: Deck Hose Instructions**

11.1  The de-ionized (DI) water deck hose for the sinks is ALWAYS available for emergencies; it provides a good safety backup in the event of exposure to chemicals.

11.2  If this hose (the black curly cord) develops a leak, please observe the following procedure:

11.3  Locate the self-closing, stainless steel "quick connect" fitting at the end of the black curly cord.

   11.3.1  Caution! This hose is under pressure, so be sure to wear the following safety apparel before proceeding further (as the water will spurt a bit):

   11.3.1.1  Face shield

   11.3.1.2  Lab apron

   11.3.1.3  Chemical resistant gloves

   11.3.2  Depress the "quick connect" locking mechanism. The fitting should snap apart quickly, thereby disconnecting the deck hose from its base.

   11.3.3  Report as a problem on FAULTS.

   11.3.4  Set the deck hose at the rear of the sink deck for replacement.
NanoLab Qualification Form

Msink7 (General use sink)

(3sink7) (386)

Name __________________________ Office __________________________ Date ________________

Campus Phone __________________________ Home Phone __________________________

Login __________________________ Trainer __________________________

Qualification Test Passed (Signed by Front Desk) __________________________

Oral Qualification Checklist

- What size wafers msink7 handles.
- Describe the MOS and non-MOS cassettes from this sink and where they are kept.
- Which SRD is used to dry wafers from this sink.
- Protection for hands and body.
- What type of tweezers are allowed at this sink.
- Adjusting heater controls.
- A complete dump rinse cycle.
- What to do if it stops in the middle of a quick dump cycle.
- Easy-to-make mistakes that would contaminate sink station.
- Activating the glove wash.
- Loading 6” and 4” cassettes into the proper SRD.
- Dealing with a leaking deck hose.
- Disposing of empty chemical bottles.
- How to cut power to the sinks in an emergency.