

GENERAL PROCESS AND OPERATION SPECIFICATION

TYSTAR 3600 MINI TYTAN LPCVD

1. SCOPE

- a. The purpose of this document is to describe requirements and basic operating instructions for TYSTAR 3600 MINI TYTAN. This tool is intended for LPCVD deposition of low-stress silicon nitride Si₃N₄ (LSN) and low temperature oxide (LTO).

2. SAFETY

- a. Be sure that you are trained and signed off to use this equipment per AggieFab policy.
- b. Refer to Safety Features in MINI-TYTAN 3600 FURNACE SYSTEM SUMMARY.
- c. Operating personnel need to be aware of the hazards that they may be exposed to while operating the tool.
 - i. Electrical Hazards: High voltages can exist at the tool, pumps and other areas.
 - ii. Toxic Substance Hazards: wafers may be coated with toxic materials. Exercise caution when handling processed materials.
 - iii. Process Gases: Silane, Dichlorosilane, and Ammonia are used in the system.
 - iv. High Temperature Hazards: quartzware and wafers may be hot after processing. Handle all quartzware with care.
- d. If you are unsure about any procedure or indication while operating this equipment, contact a staff member or trainer for assistance.

3. APPLICABLE DOCUMENTS, MATERIALS AND REQUIREMENTS

- a. For more information about the detailed operation of this tool refer to the TYSTAR operation manual: DCS-30, FCS-10, which are available on the Syncplicity.
- b. Appendix A: Recipe Editing
- c. Appendix B: Wafer Loading/Unloading Procedure

4. OPERATION

Only silicon and quartz wafers which have not been processed previously (including tape, pen markings, photoresist, metals, etc.) and fit securely in an available boat may be processed in the tool.

- a. Login to iLab and start the TYSTAR. This will turn off the interlock and enable gas flow.
 - i. Check the lights of interlock box under subfloor and make sure the green lights are on (Figure 1).



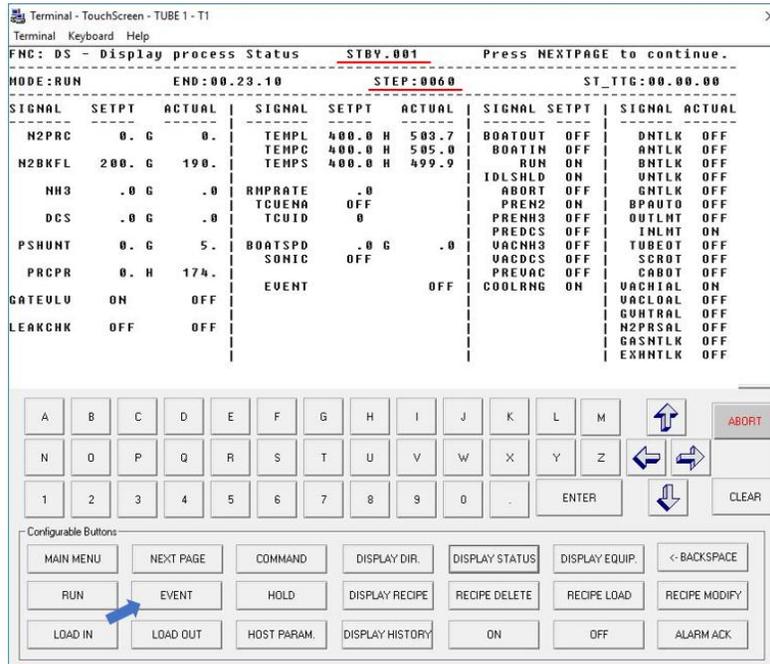
Figure 1. Interlock box under subfloor, showing tool ON iLab status.

- ii. Check exhaust abatement system - Jupiter Scientific Callisto located on the adjacent side of Bay 2. Make sure the green light is on (Figure 2).



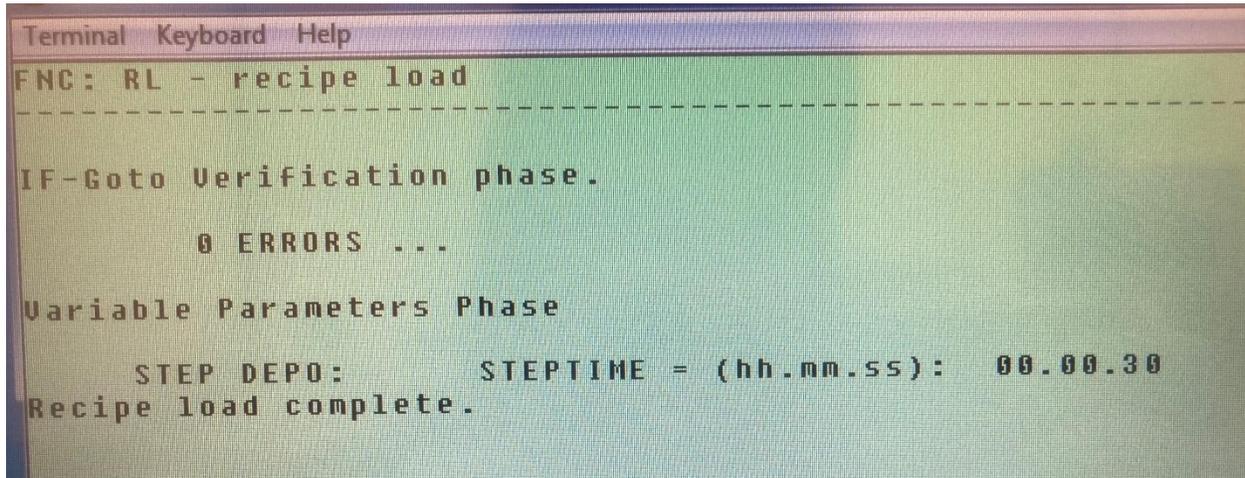
Figure 2. Exhaust abatement system (Jupiter Scientific) with green light on.

- b. Use the stylus to tap the FCS-10 (Furnace Control System) computer screen on the front of the tool to wake it up.
 - i. Do not operate the tool using the free-standing DCS-30 (Data Capture System) computer.
- c. Press *DISPLAY STATUS* to show the current state and set points.
- d. Verify STBY.00x is running and held at STEP: 0060. Press *EVENT* to continue the remaining backfill steps of the “STBY.00x” recipe.



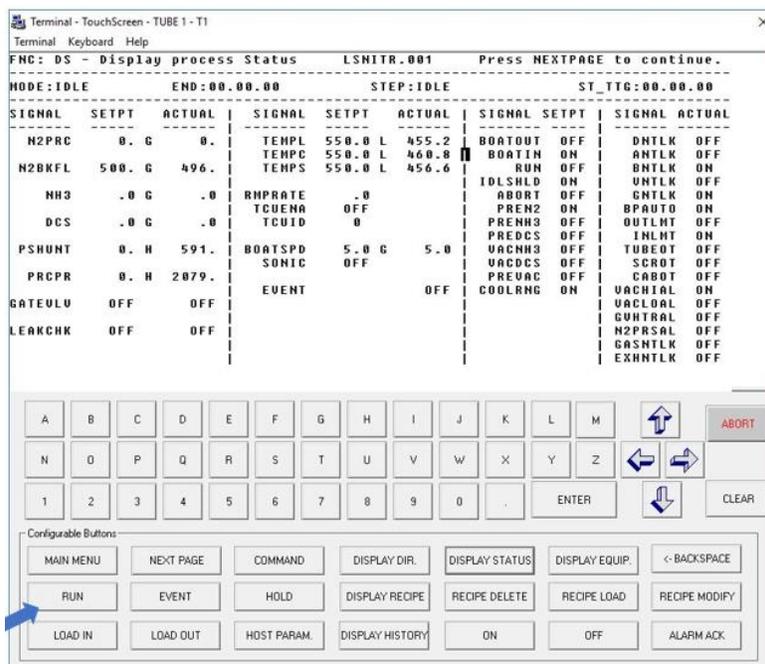
- e. Check for tool IDLE state on *DISPLAY STATUS* view.
- f. Press *MAIN MENU* to navigate to the main screen.
- g. **IF AND ONLY IF** edits to the standard AggieFab recipes are desired, follow **Appendix A: Recipe Editing** for detailed steps on changing recipe parameters, including temperature, pressure, and gas flows. This is only for experienced users and requires additional training. **DO NOT EDIT DEPOSITION TIME!**

- h. Press the *RECIPE LOAD* soft button,
- i. Use the arrows to navigate to the desired recipe (LSNITR.001 or STNITR.001 for Tube 1, LTO.003 for Tube 3). Press *ENTER* twice (slowly) to select and wait for system to load recipe.
- j. The recipe will load, and the system will check for process errors. Here, the user will be prompted for a deposition time (*STEP DEPO*). Enter the desired deposition time in HH.MM.SS format and press enter.



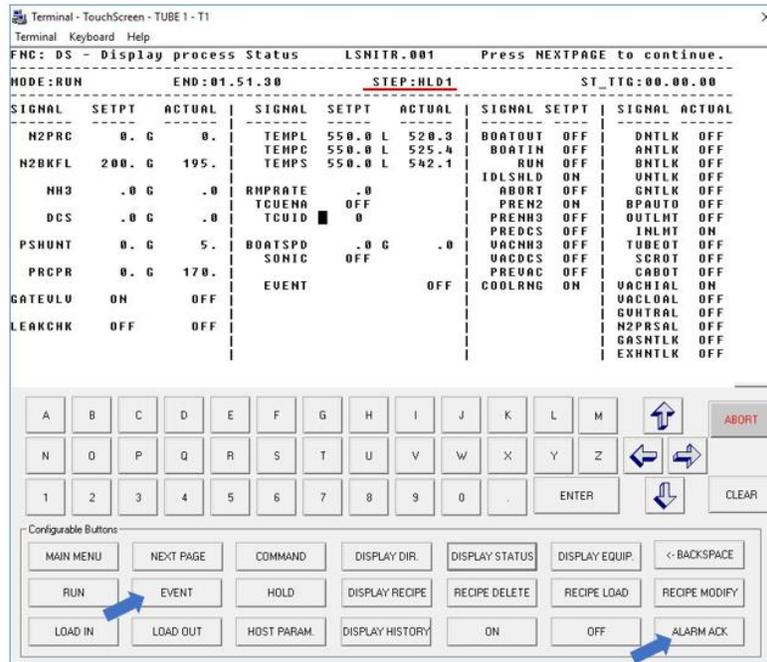
This image shows a 30 second deposition being entered.

- k. Press *MAIN MENU*, press *RUN* to start the loaded recipe. Navigate to the current status screen by pressing *DISPLAY STATUS*.



- l. Tube will be backfilled with nitrogen and cantilever will move out. The cantilever will reach the outer limit and the alarm will sound at STEP: LDWF.

- m. Press *ALARM ACK* to silent the alarm and *HOLD* to pause the timer. Wait 10 minutes for wafers/boat to cool down.
- n. Follow Appendix B: Wafer Loading/Unloading to load your process wafers into the boat and load the filled boat onto the cantilever.
- o. When wafer loading is complete, press *RUN* to restart the timer and *EVENT* to trigger the cantilever to move back in and the door to close.
- p. Wait for door close and pump down, when PRCPR value reaches < 20 mTorr the tool can be left to run the remaining pump/purge and deposition steps. When deposition is complete, the alarm will sound at STEP: HLD1.



- q. Press *ALARM ACK* to silence the alarm. Press *EVENT* to trigger the unloading process at STEP: BKF1.
- r. The cantilever will reach the outer limit and the alarm will sound at the unload step (STEP: ULWF for Tube 1 and STEP: UNLD for Tube 3).
- s. Press *ALARM ACK* to silence the alarm and *HOLD* to pause the timer. Wait 10 minutes for wafers/boat to cool down.
- t. Follow Appendix B: Wafer Loading/Unloading to unload the boat from the cantilever and remove your process wafers.
- u. Place the boat back, press *RUN* to restart the timer, and *EVENT* to trigger the cantilever to move back in. Process will continue to recipe end and state IDLE.
- v. Press *MAIN MENU*, then *RECIPE LOAD*. Arrow to the standby recipe (STBY.001 for Tube 1 or STBY.003 for Tube 3) and press *ENTER* twice to load.
- w. Press *RUN* to begin the standby recipe, and *DISPLAY STATUS* to change the view back to the status screen.

5. SIGNATURES AND REVISION HISTORY

- a. Author of this document: Hui Chen
- b. Author Title or Role: Research Associate Engineer
- c. Date: September 5, 2019
- d. Revision: A

Approvals:

Technical Manager Signature: 

Date: **9 August 2021**

Revision History:

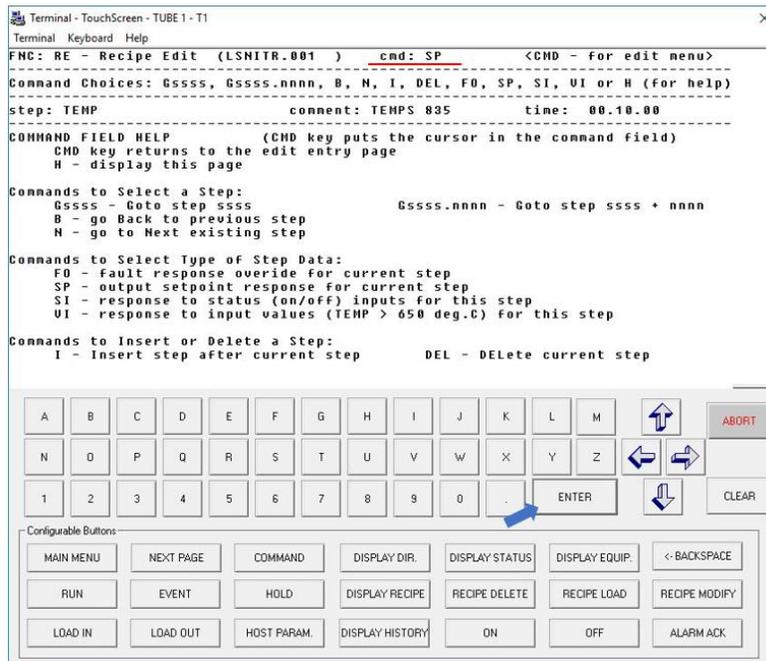
Revision	Author	Date	Change
Original Issue	Hui Chen	September 5, 2019	
Rev A	Hui Chen	September 5, 2019	
Rev B	Megan Makela	March 5, 2021	
Rev C	C. J. Karber	August 5, 2021	Variable DEPO step.
Rev D			
Rev E			

Appendix A - Recipe Editing

NOTE: Recipe editing can only be done at the IDLE state by experienced users with additional training using the FCS-10 touchscreen computer. Follow standard process operation to place tool in IDLE before attempting to edit a recipe.

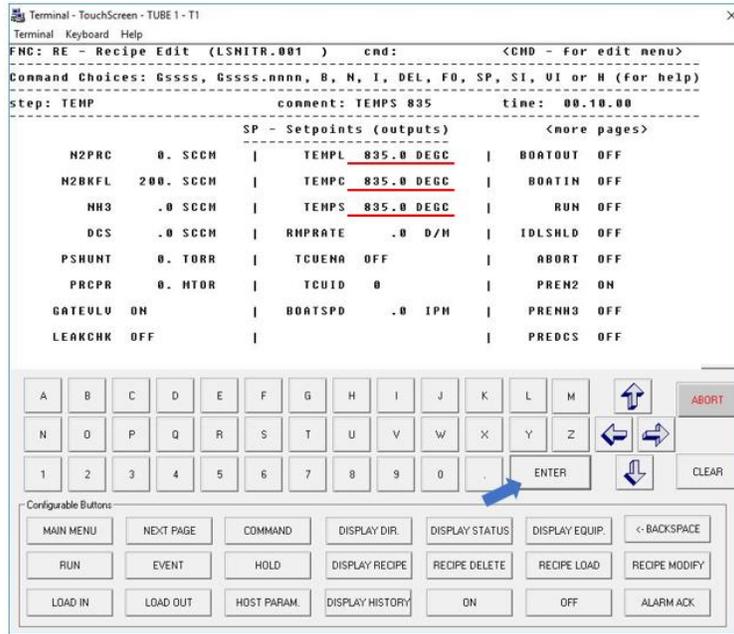
Tube 1 Low-Stress Nitride (LSN) – “LSNITR.001”

1. For Filename:, enter “LSNITR.001” and press *ENTER*.
2. In the cmd: field, enter “Gxxxx”, where “xxxx” is the step name, and press *ENTER* to go to the step you wish to edit.
3. In the cmd: field, enter “SP” and press *ENTER* to edit set points for the step.



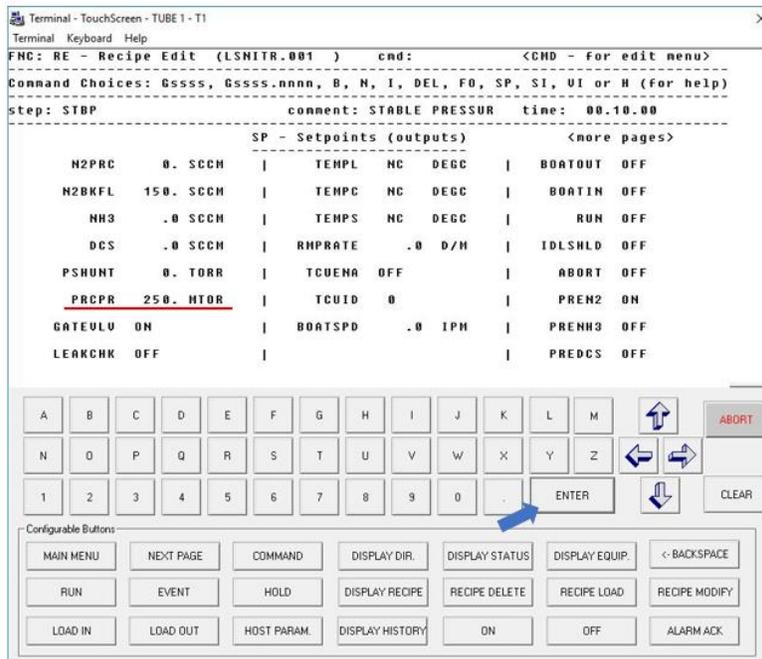
Temperature

1. Enter “GTEMP” in the cmd: field and press *ENTER*. Enter “SP” in the cmd: field and press *ENTER*.
2. Use the arrows to move the cursor to **TEMPL**, enter desired temperature, and press *ENTER*. Repeat for **TEMPC** and **TEMPS**.
 - a. Default temperature is 835°C.



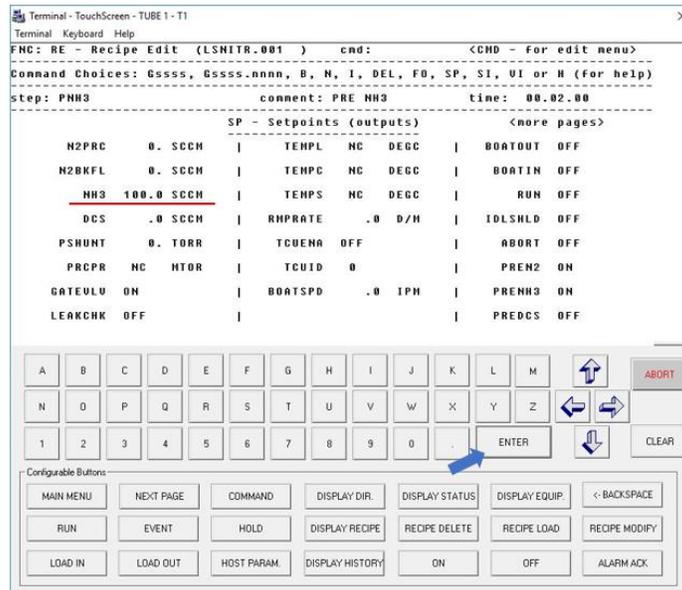
Pressure

1. Enter "GSTBP" in the cmd: field and press *ENTER*. Enter "SP" in the cmd: field and press *ENTER*.
2. Use the arrows to move the cursor to PRCPR, enter desired pressure, and press *ENTER*.
 - a. Default pressure is 250 mTorr.

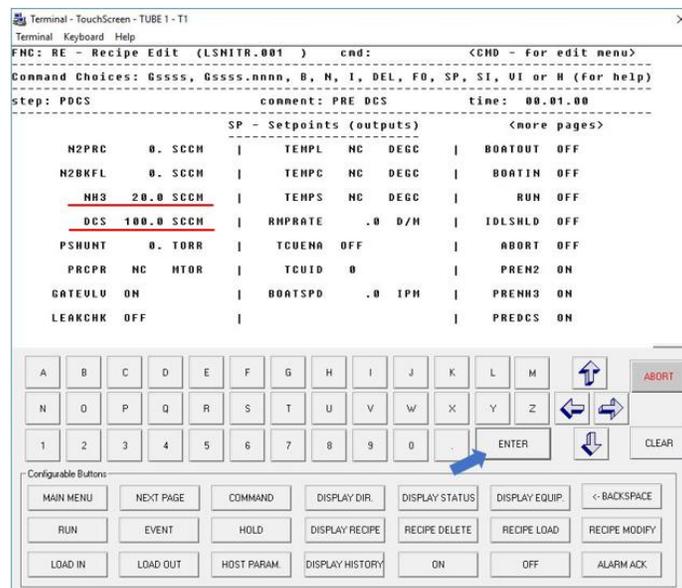


Gas Flow

1. Enter “GPNH3” in the cmd: field and press *ENTER*. Enter “SP” in the cmd: field and press *ENTER*.
2. Use the arrows to move the cursor to NH3, enter desired high flow for NH₃ flow stabilization, and press *ENTER*.
 - a. Default flow rate is 100 sccm.

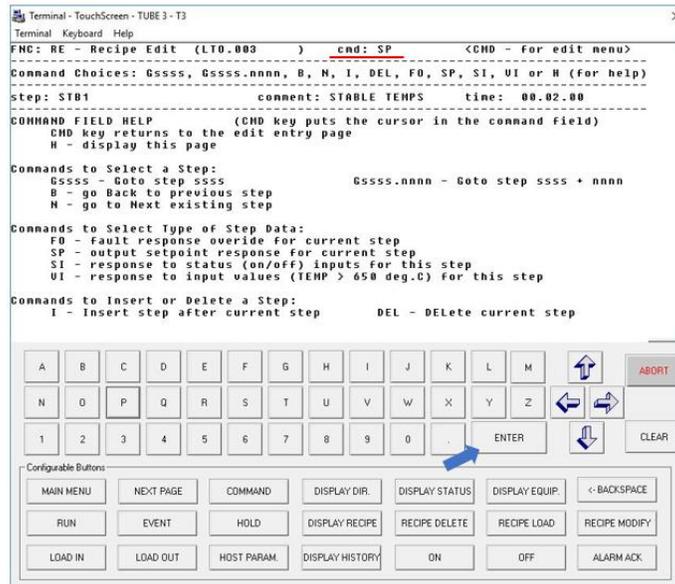


3. Enter “GPDACS” in the cmd: field and press *ENTER*.
4. Use the arrows to move the cursor to NH3 and enter desired flow rate. Arrow down to DCS, enter desired flow rate, and press *ENTER*.
 - a. Default NH₃ flow rate is 20 sccm.
 - b. Default DCS flow rate is 100 sccm.



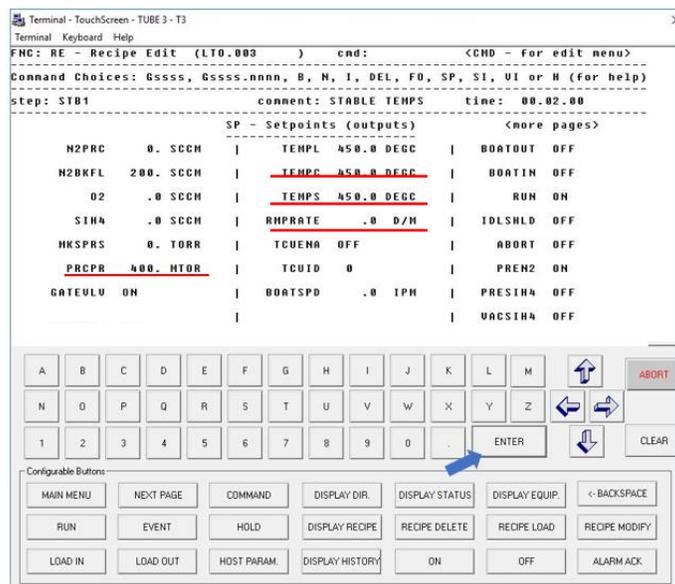
Tube 3 Low-Temperature Oxide (LTO) – “LTO.003”

1. For Filename:, enter “LTO.003” and press *ENTER*.
2. In the cmd: field, enter “Gxxxx”, where “xxxx” is the step name, and press *ENTER* to go to the step you wish to edit.
3. In the cmd: field, enter “SP” and press *ENTER* to edit set points for the step.



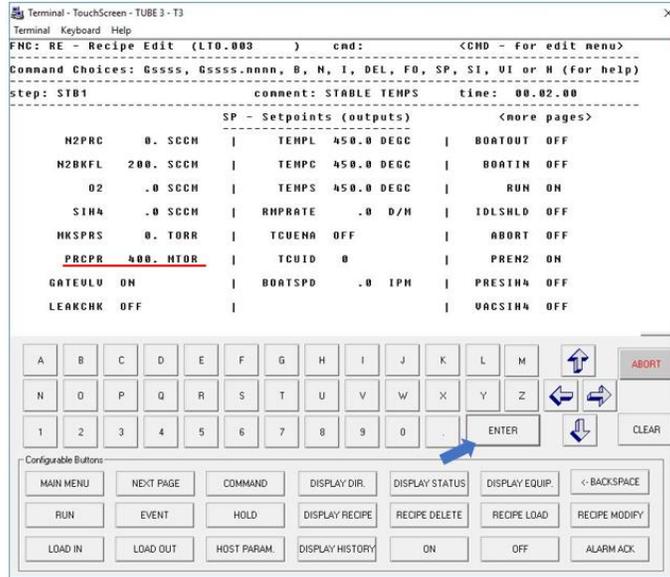
Temperature

3. Enter “GSTB1” in the cmd: field and press *ENTER*. Enter “SP” in the cmd: field and press *ENTER*.
4. Use the arrows to move the cursor to TEMPL, enter desired temperature, and press *ENTER*. Repeat for TEMPC and TEMPS.
 - a. Default temperature is 450°C.



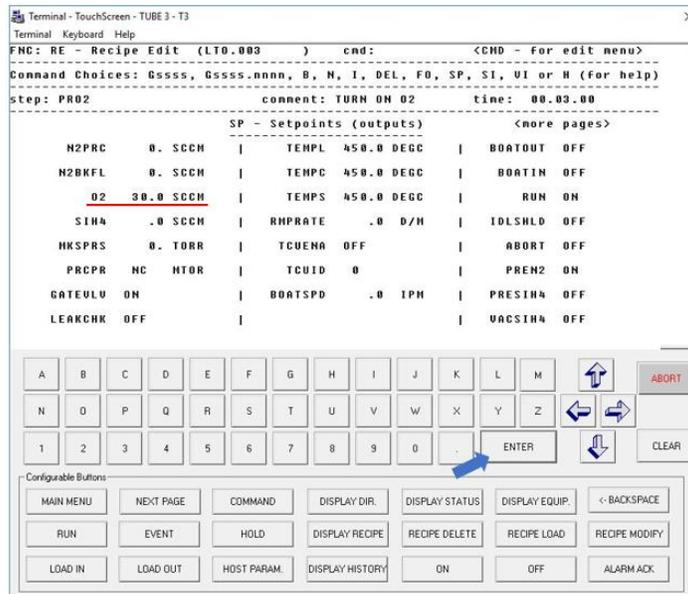
Pressure

3. Enter “GSTB1” in the cmd: field and press *ENTER*. Enter “SP” in the cmd: field and press *ENTER*.
4. Use the arrows to move the cursor to PRCPR, enter desired pressure, and press *ENTER*.
 - a. Default pressure is 400 mTorr.



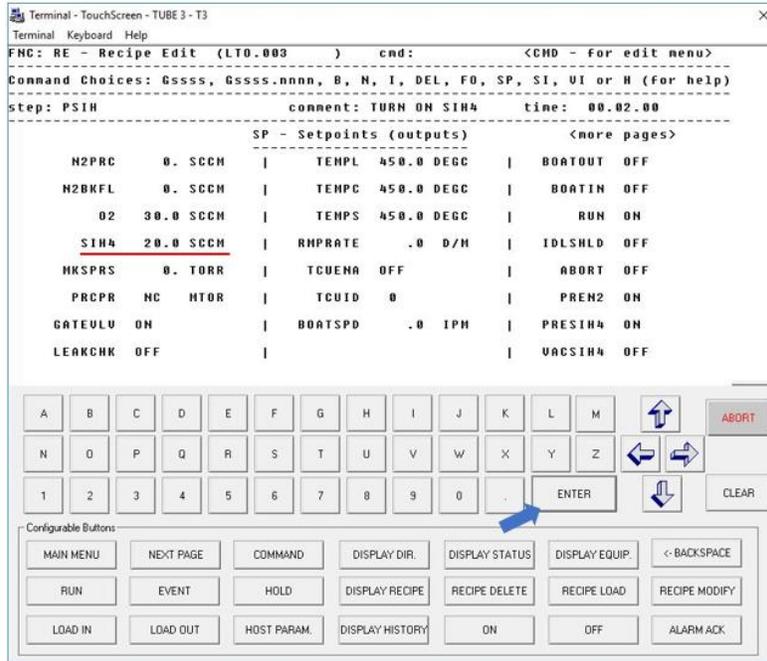
Gas Flow

5. Enter “GPRO2” in the cmd: field and press *ENTER*. Enter “SP” in the cmd: field and press *ENTER*.
6. Use the arrows to move the cursor to O2, enter desired O₂ flow rate, and press *ENTER*.
 - a. Default flow rate is 30 sccm.



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7. Enter “GPSIH” in the cmd: field and press *ENTER*.
8. Use the arrows to move the cursor to O2 and enter desired flow rate (same as step “GPRO2”). Arrow down to SIH4, enter desired flow rate, and press *ENTER*.
 - a. Default SiH₄ flow rate is 20 sccm.



Appendix B - Wafer Loading/Unloading Procedure

1. Select the correct size boat for your substrate.
 - a. Boats for 2 inch, 3 inch, 4 inch, and 6 inch wafers are available.
2. Place wafers in the wafer boat (Tube 1 LSN) or shroud (Tube 3 LTO) with wafers sitting in the quartz slots. Do not cross slot.
 - a. For Tube 1 LSN, wafers are placed front to back, with polished (to be deposited on) surface facing toward the open end of the tube (viewing corridor).
 - b. For Tube 3 LTO, wafers are placed back to back, with polished (to be deposited on) surface facing out.

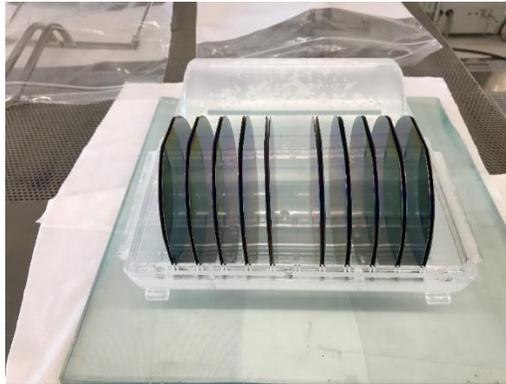


Figure 3. Back to back wafer placement in Tube 3 LTO boat.

3. Place dummy wafers in the extra slots as needed. Tube 1 LSN boats can hold up to 25 wafers and Tube 3 LTO boats can hold up to 26 wafers.
 - a. The end wafers, slot 1 and slot 25 for Tube 1 LSN wafer boat or slot 1 and slot 26 for Tube 3 LTO, are always dummy wafers
4. Use side lift handlers to carefully pick up the boat for loading or unloading.
 - a. The small handler fits Tube 1 LSN boats and the large handler fits Tube 3 LTO boats



Figure 4. Side lift handlers.

- b. For LSN Tube 1, align the handler arms with the two tubes of boat, and insert into the tubes (Figure 5).

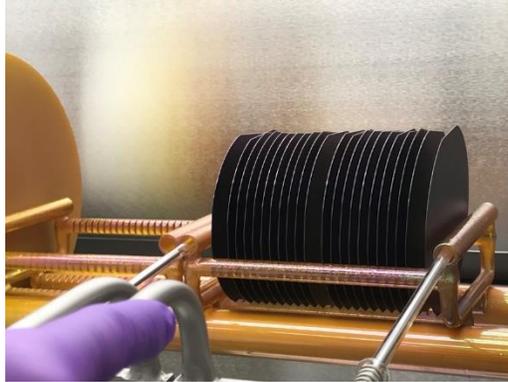


Figure 5. Handler use for Tube 1 LSN boats.

- c. For Tube 3 LTO boats, always use the handler to the upper/top shroud off the boat first, and then move the lower shroud with wafers.

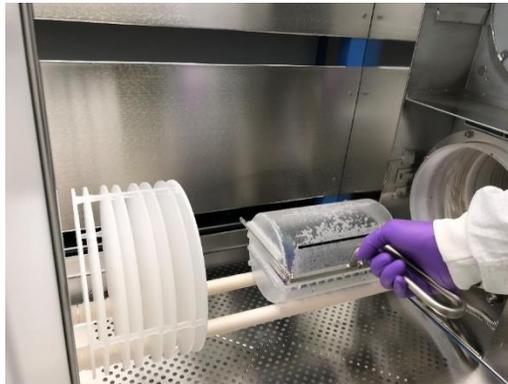


Figure 6. Handler use for Tube 3 LTO boats.

- d. Place the wafer boat/shroud on the cantilever where center of boat/shroud is around 9 inches from baffle plate.



Figure 7. Placement of boat on cantilever.