

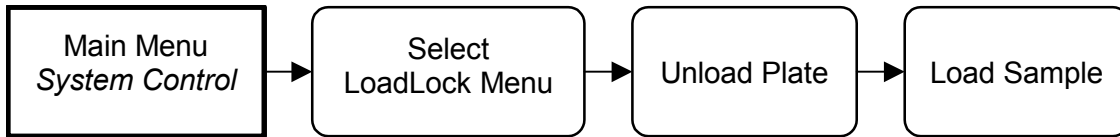
# Unifilm Technology PVD-300 Sputter Deposition Operation Instructions

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Anything that is **ITALICS** means that you should press that button on the screen.

If at any time, you cannot follow these instructions because there is a problem with the tool, or, you get in a situation where you are unsure how to proceed, you must contact Devin Brown (5-4220) for help. If Devin is unavailable, contact Joel Pikarsky (5-0910).

## Loading samples



1. Operator input is performed via the touch screen monitor. If the computer monitor screen saver is on, simply touch the screen.

TIP: The screen is a little finicky and takes some getting used to (you aren't doing anything wrong). Over time, you will learn where the "sweet spots" are and it will be less frustrating. It helps if you are deliberate in your finger touching, by approaching from far away and then retracting your finger to a far away position. If you leave your finger near the screen, you will tend to accidentally select unwanted items.

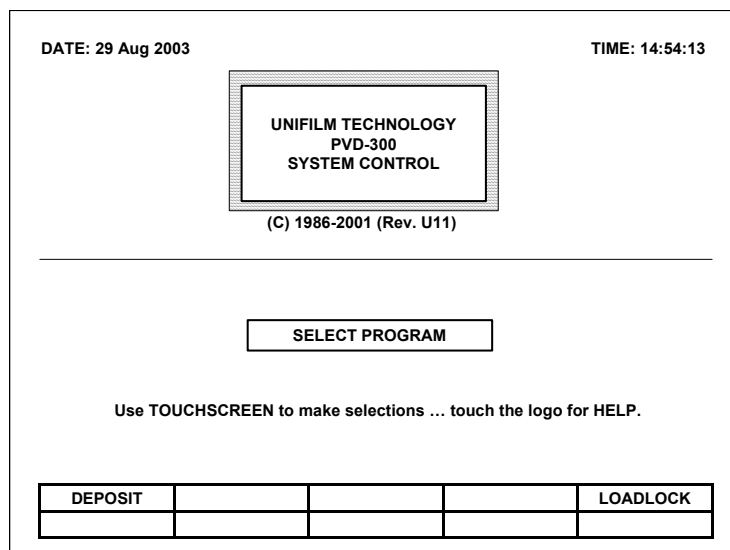
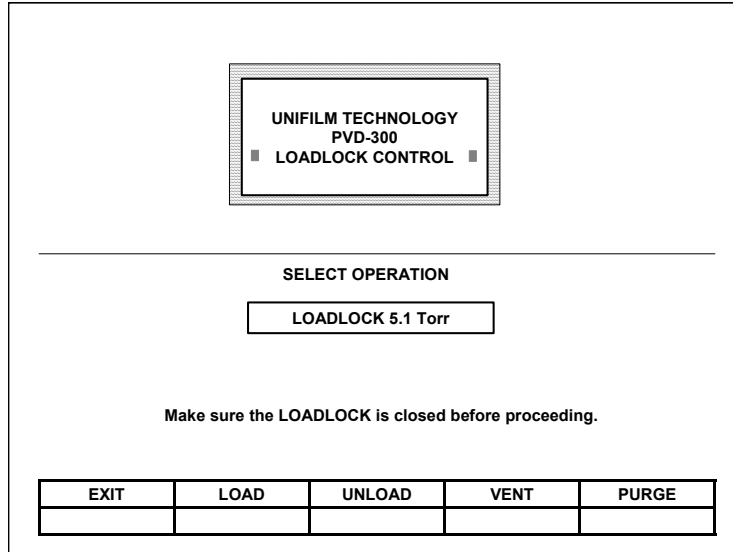


Figure 1: Main Menu "SYSTEM CONTROL" Display

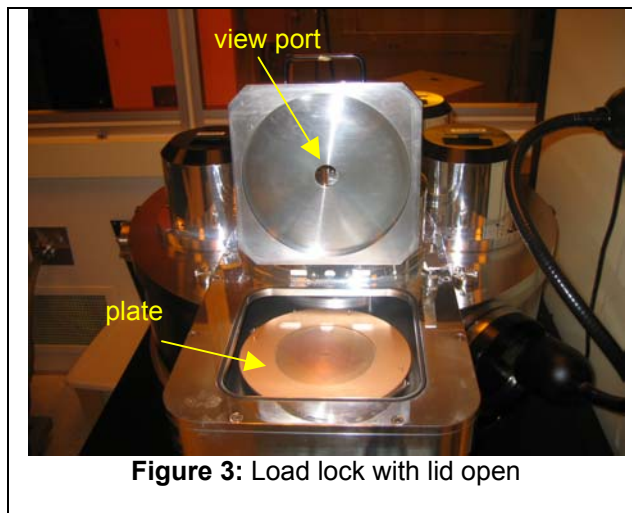
Select  
LoadLock Menu

2. The main menu (see Figure 1) called "SYSTEM CONTROL" shows "DEPOSIT" and "LOADLOCK" at the bottom of the screen. If you see this, press **LOADLOCK**. It is possible that you are already in the LOADLOCK menu (see Figure 2). The LOADLOCK menu will display "LOAD", "UNLOAD", "PURGE", "VENT", etc. at the bottom of the screen. If this is the case, proceed to step #3.



**Figure 2:** LOADLOCK MENU Display

3. Check the Loadlock (LL) view port (see Figure 3) for the presence of a plate
  - a. If there is a plate then go to Load Sample (step #5)
  - b. Otherwise, go to Unload (step #4)



Unload Plate

4. Unload Plate from chamber
  - a. Press **UNLOAD** in the LL menu, then press **1** (or other plate number) in the next screen (see Figure 4).

TIP: The Unifilm PVD-300 normally processes in sequential mode, meaning one wafer at a time. This mode does not allow for wafers to be loaded on adjacent plates because they are exposed to the plasma and would receive uncontrolled deposition. There are only 5 plates, so 3 is the maximum number of non-adjacent wafers which can be loaded, in positions 1, 3, and 5. If you are only processing one or two wafers, you may put them in any combination of non-adjacent positions (e.g. 1 & 3, OR 1 & 5, OR 2 & 4, and so on). Note that there is a 6<sup>th</sup> position that the Quartz Monitor occupies, so this is why 1 and 5 are considered non-adjacent. For more information, see the Unifilm Manual at <http://grover.mirc.gatech.edu/manuals/>.

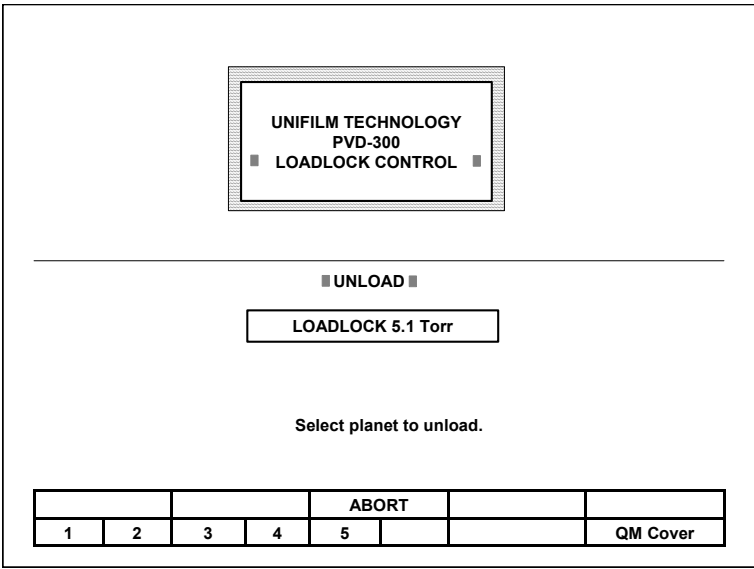
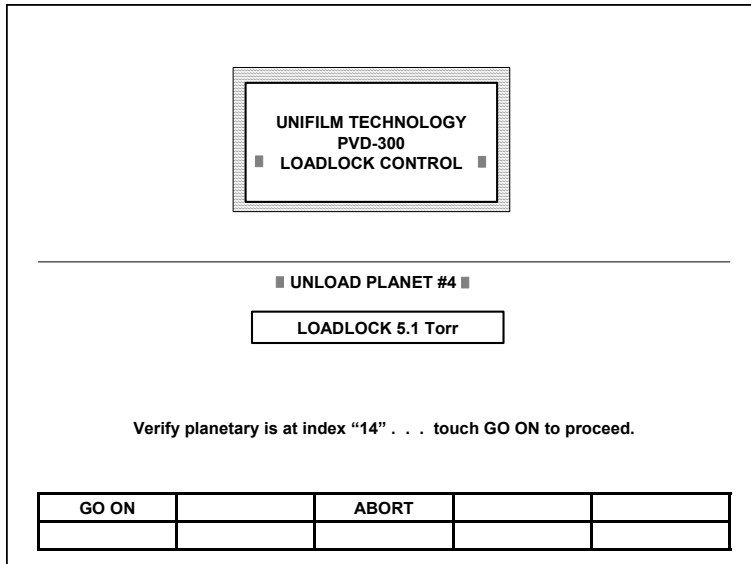


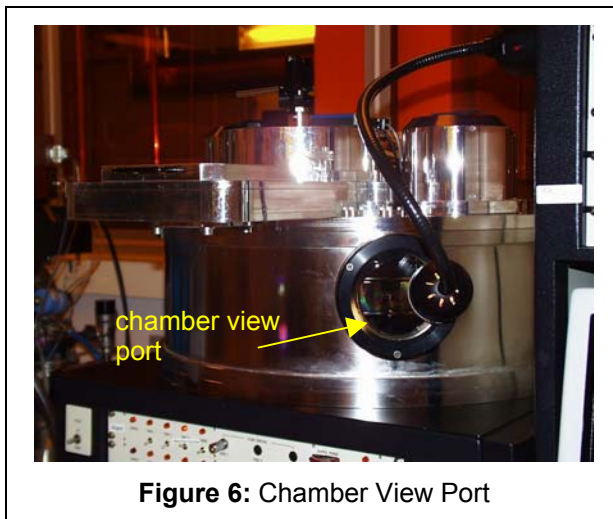
Figure 4: The Unload Screen

- b. The monitor will prompt you to “Verify planetary is at index XX” (see Figure 5). Verify the planetary index XX in the chamber view port (see Figure 6) and press **GO ON**.

TIP: The first number in the index represents the source or load lock position. The second number represents the plate. For instance, an index of “13” means that plate 3 is under port 1 (which is the load lock). An index of “45” means that plate 5 is under port 4 (which currently is Aluminum or Chromium.)

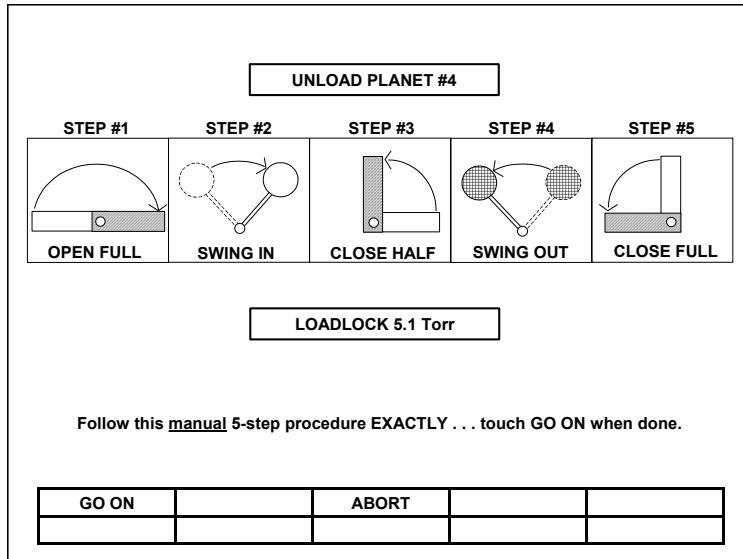


**Figure 5:** The Unload Process: Index Verification Screen



**Figure 6:** Chamber View Port

- c. You will now be prompted to physically unload a plate (see Figure 7). Follow the diagram and directions EXACTLY!! on the screen to unload a plate from the chamber to the LL. Take this step seriously! You will damage the LL if you do not. Damaging the tool will result in loss of access and will require re-training.



**Figure 7:** The Plate Unload Procedure Screen

- d. After pressing **GO ON**, the LL will vent automatically on it's own. Proceed to step #5.

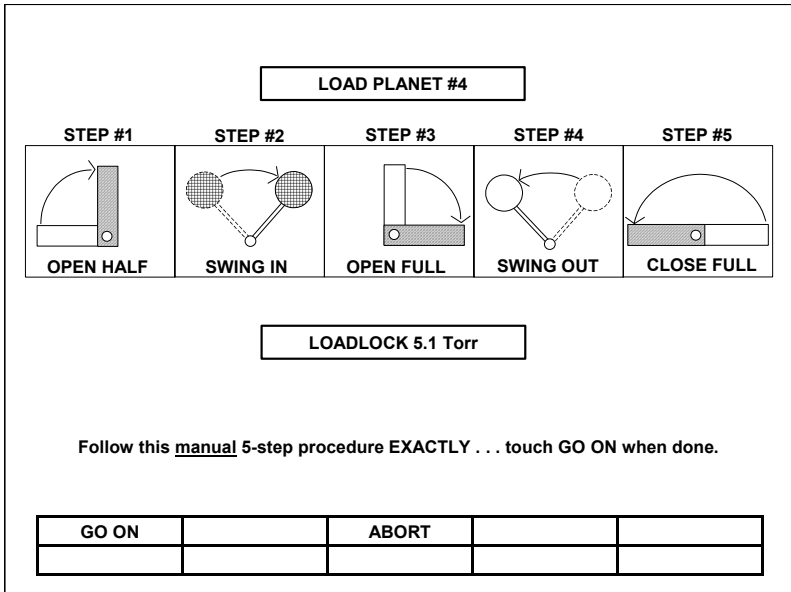
Load Sample

5. Load Sample

- a. Open LL lid and place sample onto plate. If you have skipped here from step #3, and the LL lid is under vacuum and will not open, you will need to vent it first. Press **VENT** and then place sample onto plate.
- b. Press **LOAD**, then press **1** (or other plate number)
- c. Hold down the lid to stow (pump down) the LL.

TIP: The monitor will request when it wants the operator to hold down the lid to stow the LL. During this time, Nitrogen is being vented into the LL. So when the operator holds down the lid, the pressure will increase above atmosphere. The tool senses this pressure increase and therefore knows that the lid is being held shut and it is safe to begin pumping. Occasionally, the weight of the lid is enough to cause a pressure increase without the operator holding it down. This will cause a premature pump down of the LL before the user has a chance to load their sample. Usually this occurs while the operator is not looking at the monitor and is busy preparing their sample. If this happens, no problem, just press **VENT**.

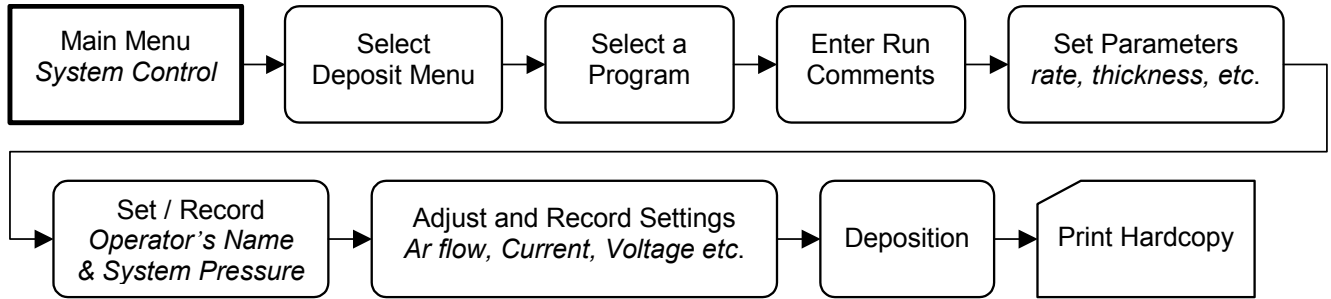
- d. Verify the planetary index XX in the chamber view port, then press **GO ON**.
- e. You will now be prompted to physically load a plate (see Figure 8). Follow the directions EXACTLY!! on the screen to load the plate, with your sample, from the LL to the chamber. Take this step seriously! You will damage the LL if you do not.



**Figure 8:** The Plate Load Procedure Screen

- 6. Repeat steps 4 & 5 for additional wafers if necessary.
- 7. **EXIT** the Load Lock

# Metal Deposition



Select Deposit Menu

1. From the main menu (see Figure 1) called "SYSTEM CONTROL" press **DEPOSIT**.

Select a Program

2. Select your program e.g., **CM-seed**. You can toggle between program menu pages by pressing **MENU x of 2**. (see Figure 9)

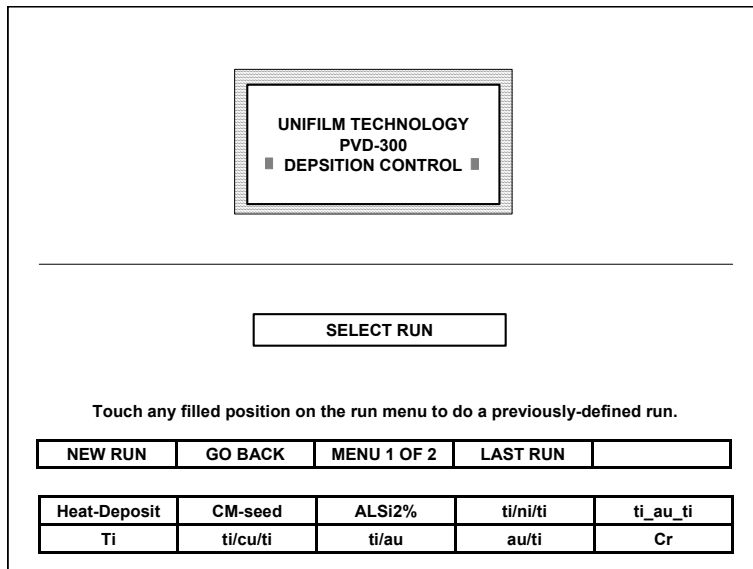


Figure 9: Deposit Menu "DEPOSITION CONTROL"

Enter Run Comments

3. Enter any comments you wish in the Chamber Load screen (see Figure 10) and then press **GO ON**.

ti/au				
<b>CHAMBER LOAD</b>				
<u>PROJECT</u>	<u>SUBSTRATES</u>	<u>PLANETS</u>	<u>COMMENTS</u>	
ti_au	4inch	3,5		
<b>RUN LOG</b>				
Touch CHAMBER LOAD or RUN LOG to edit . . . touch GO ON to proceed.				
GO ON	GO BACK	CLEAR	CHAMBER LOAD	RUN LOG
		LOADLOCK		

**Figure 10:** The Chamber Load Screen

Set Parameters  
rate, thickness, etc.

4. The previously defined program is now displayed (see Figure 11), you may accept the predefined parameters as is and proceed by pressing **GO ON**. If you wish to modify the deposition rate, thickness, target source, or planet positions, press **GO BACK** repeatedly to place the cursor over the following items.
  - a. Select Source: **Cu-DC1-2-C**
    - i. **Cu** specifies the source material (i.e. Copper).
    - ii. **DC1** means DC power supply 1. This is currently the only option available.
    - iii. **2** means the copper target is in source position two. There is no source position one. The LL occupies position one.
    - iv. **C** is the calibration version.
  - b. Select Mode: **S4-3-A**
    - i. **S** signifies sequential mode. Wafers are processed one at a time and only on non-adjacent plates.
    - ii. **4** signifies 4" diameter wafers. It is appropriate to use this for samples less than 4" in size.
    - iii. **3** means 3 stop and spin positions.
    - iv. **A** is the mode version.
  - c. Select desired planets: **1,3**, then press **ENTER**.
  - d. Select total Thickness (Å): **2000**
  - e. Select Peak Rate (Å/m): **800**

TIP: The deposition profile has a Gaussian distribution with the peak deposition rate occurring directly under the center of the target. The wafer is rotated as well as moved back and forth under the target in an orbital path to achieve an uniform film. Therefore, you cannot divide the total thickness by the peak rate to obtain the total time of deposition. You can divide the total thickness by the peak rate,

and then multiply by 6 to get an approximate deposition time. However, while you are at the computer monitor, the program automatically calculates and displays the total deposition time for you. For more information, see the Unifilm Manual at <http://grover.mirc.gatech.edu/manuals/>.

- f. Press **DONE**.
- g. Press **GO ON**.

NEW RUN

SOURCE (0.50")					PLANETARY (6X)		DEPOSITION		
NO.	Type	Mode	Pos	Cal	Mode	Planets	Thickness(Å)	Rate(Å/m)	Time(m)
1	Ti	DC1	5	A	S4-3-A	3	600 @ 1X	1000	3.34

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RUN MODE IS MANUAL

OPERATOR'S NAME

MiRC

PRESSURE (Torr)

7.57E-8

Touch START RUN to begin the deposition sequence.

START RUN	GO BACK		CHAMBER LOAD	RUN LOG
EXIT RUN		EDIT RUN		SAVE RUN
		LOADLOCK		

**Figure 11:** Operator's Name and System Pressure Menu

Set / Record  
Operator's Name  
& System Pressure

5. For operator name, "MiRC" is fine, so press **GO ON**.
6. Check chamber pressure (as shown in Figure 12). The pressure shown is the recommended base pressure before commencing the run. 1E-6 is typical. If the pressure is close to 1E-6 or less than 1E-6 Press **GO ON**.

TIP: The pressure during processing is 2E-3 or higher, which is 3 orders of magnitude above 1E-6. The main concern for a low initial base pressure is gas or particle contamination. Use your own judgment and experience as to what an acceptable base pressure is for your process.

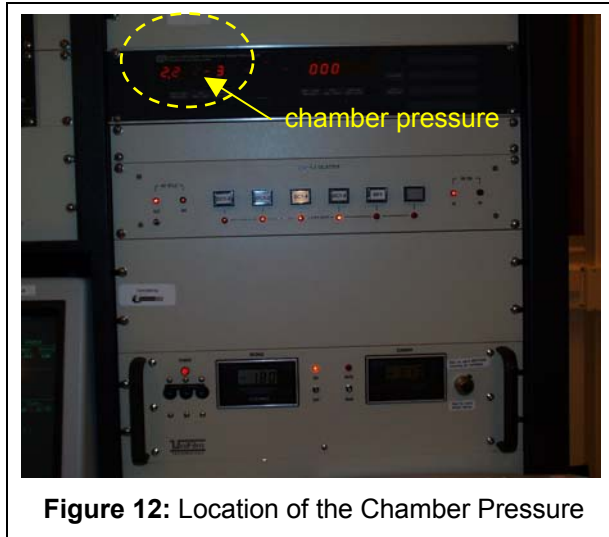


Figure 12: Location of the Chamber Pressure

7. Press **START RUN**.

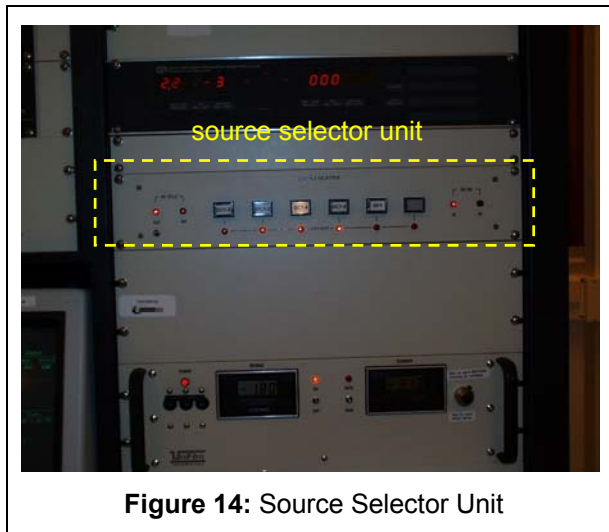
Adjust and Record Settings  
Ar flow, Current,  
Voltage etc.

8. A new screen is displayed as in Figure 13. Check for Planet “Pre-deposit Index XX” in chamber view port (see Figure 6) and press **GO ON**.

NEW RUN				TASK 1 OF 1					
SOURCE (0.50")				PLANETARY (6X)			DEPOSITION		
Type	Mode	Pos	Cal	Mode	Planets	Thickness(Å)	Rate(Å/m)	Time(m)	
Ti	DC1	5	A	S4-3-A	3	600 @ 1X	1000	3.34	
DEPOSITION PARAMETERS									
Pre-deposit Index: 52			Source Selector: DC1-5			Pre-Deposit Time: 1.0			
FLOW			PRESSURE			SOURCE			
O2	N2	Ar	Open	Throttled	Amps	Volts			
n/a	n/a	#3 = 90.1	2.00E-3	5.00E-3	0.593	225			
SOURCE CURRENT: ?									
Touch GO ON if OK.									
GO ON		GO BACK		TASK SUMMARY		CHAMBER LOAD		RUN LOG	
X 0.1A			X 1A			ABORT RUN			
1	2	3	4	5	6	7	8	9 0	

Figure 13: Settings Record Screen (Note: the state of this screen corresponds to step 15.)

9. Select Source by pressing button (e.g. DC1-4) on Source Selector (see Figure 14) and press **GO ON**.

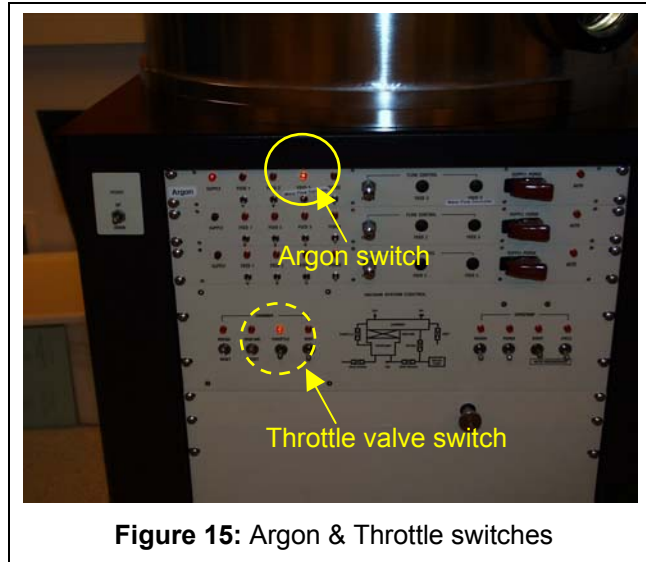


10. Pre-Deposit Time is usually set for 1 minute, adjust as necessary and press **GO ON**.

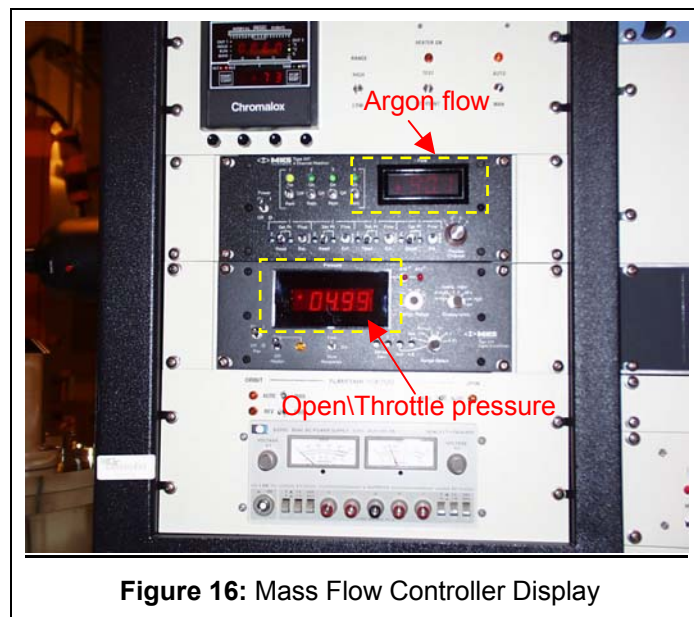
TIP: If the target you are using was installed recently and this is the first time it has been run, there will be a film of the previous metal on the shielding around the new target, some of which will be sputtered off by the plasma. How much is sputtered off, and how long before it is covered by a film from the new metal is not known. Currently it is recommended that the pre-deposit time be set to 3 minutes if the target is being run for the first time after installation.

11. Turn on Argon flow by turning up the switch labeled “Mass Flow Controller” (see Figure 15). If the switch is already up, turn it down and then back up. Check the flow rate of Argon in the Mass Flow Controller display (see Figure 16) to ensure that it is 90 sccm and press **GO ON**.

TIP: Occasionally, all of the lights may be on that are located above the switches in the vicinity of the Argon switch. This occurs when the chamber has been pumped down from atmosphere to Hi Vac. This does not occur during normal operation of the tool, but would occur for instance after a target change. To clear the lights, temporarily push down the switch labeled “Purge” immediately to the right of the Argon switch.



12. Verify the correct Open Pressure (It should be  $2E-3$  Torr. Note: currently the “ $10^{-3}$ ” LED is burnt out.) on the display (see Figure 16) of the MKS 270 Signal conditioner then press **GO ON**.

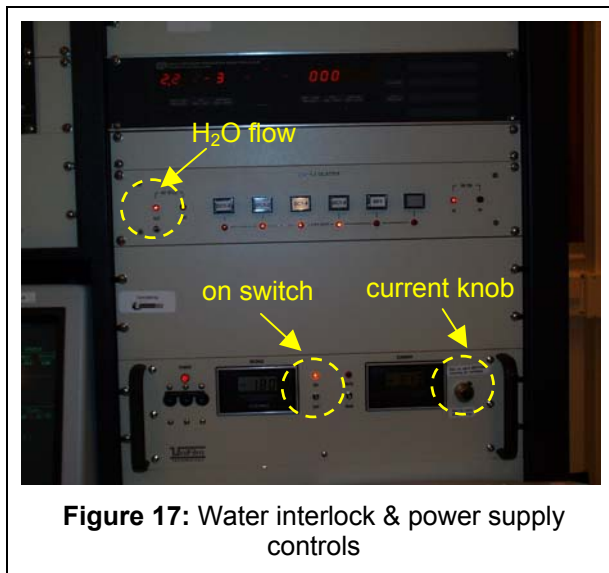


13. Throw the Throttle switch up (see Figure 15) to throttle the High Vac valve. Check the throttle pressure on the MKS 270 Signal Conditioner (see Figure 16). If the pressure matches what the program is requesting, press **GO ON**, and proceed to step #14. If the throttle pressure displayed is not what your program is requesting then:
- Un-throttle by pushing the throttle switch down
  - Turn the throttle knob to adjust the pressure (ONLY DO THIS WHEN UN-THROTTLED!!).

- i. Clockwise (CW) decreases the throttle pressure
- ii. Counter-Clockwise (CCW) increases the throttle pressure
- c. Re-engage the throttle by pushing the Throttle switch up.
- d. repeat steps a,b, & c as necessary to achieve correct throttle pressure.
- e. When finished, press **GO ON**.

TIP: "Throttle" is the act of partially closing the high vacuum valve to effectively reduce the pumping rate of the cryogenic pump, which raises the chamber pressure to the desired point. By rotating the throttle positioner, you are moving a mechanical stop which the high vacuum valve rests against.

- 14. Turn on the H<sub>2</sub>O flow by holding the appropriate switch up (see Figure 17) on the source selector unit until the interlock light comes on.



**Figure 17:** Water interlock & power supply controls

- 15. Striking the plasma:
  - a. Set the Current knob (see Figure 17) on the power supply to 0.
  - b. Turn the power on by toggling up the On Switch. (see Figure 17)
  - c. Increase current knob slowly, until the current increases > 0.
  - d. Set the current to the value requested on the monitor, then press **GO ON**.
  - e. Verify the voltage is within +/-10V of the voltage displayed on the monitor and press **GO ON**.

TIP: Sometimes the plasma will not strike. If increasing the knob causes only an increase in current while voltage is zero, this means that there is a short somewhere. Usually this is caused by metal flakes shorting the target to ground. If increasing the knob causes an increase in voltage while current is zero, this means there is a very high impedance or open somewhere. (You may notice a distortion in the CRT display. This is being caused by a high E-field from the adjacent power supply.) Sometimes this high impedance is caused by insufficient gas flow or a chamber

pressure which is too low. Check to make sure you have turned on the Argon gas and the Throttle pressure is correct.

Deposition

16. The current status of the deposition will be displayed on the screen as in Figure 18. If you are depositing multiple layers of metal, you will need to repeat steps 8 – 15.

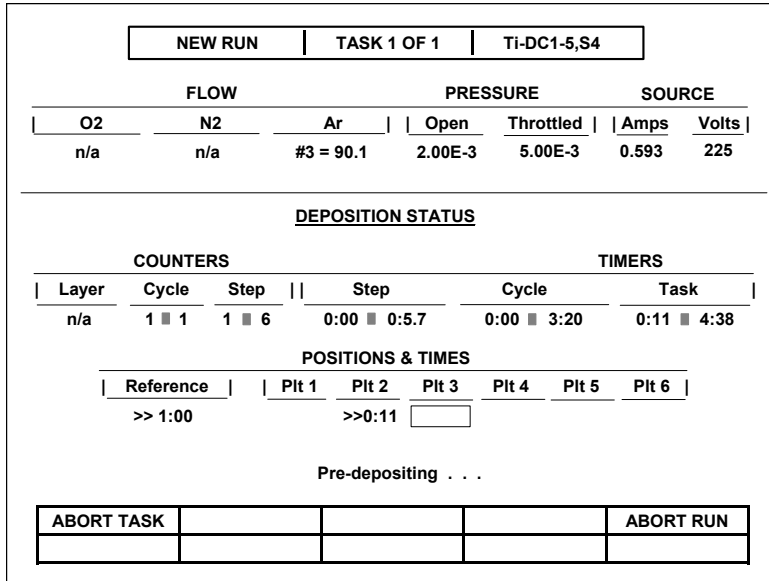


Figure 18: Deposition Status Screen

Print Hardcopy

17. After the deposition is finished you may print a hardcopy of the run conditions if you want by pressing **HARDCOPY** (see Figure 19), otherwise press **RUN COMPLETE**.

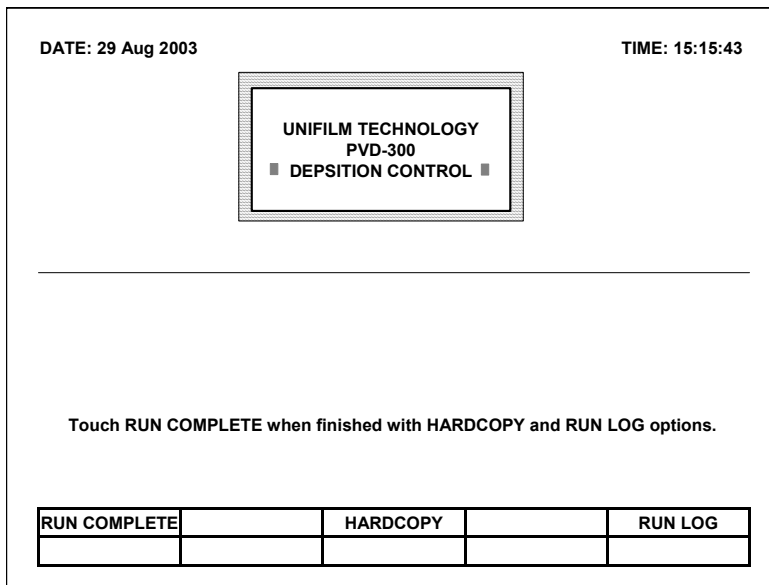


Figure 19: Run Complete / Print Hardcopy Screen

## Unloading samples

1. Press **LOADLOCK**.
2. Press **UNLOAD** to unload samples. (See step #4 of the Loading Samples section for details.)
3. Press **LOAD** to load empty plate back into chamber. (See step #5 of the Loading Samples section for details.) It is acceptable to leave the last plate in the load lock without loading it back into the chamber.