

TM Vacuum Sputter System SOP



1 Scope

- 1.1 This document provides the procedures and requirements to operate the TM Vacuum Sputter system.

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3 Reference Documents

3.1 Referenced within this Document

3.1.1 None

3.2 External Documents

3.2.1 None

4 Equipment and/or Materials

- 4.1 TMV Sputtering System
- 4.2 Wafer
- 4.3 Kapton Tape
- 4.4 Nylon Screws

5 Safety

- 5.1 Follow all Nanofab safety procedures.
- 5.2 Place carousel only on clean stainless steel surfaces.
- 5.3 Ask for assistance moving carousel if too heavy to remove/mount alone.
- 5.4 Do NOT use a chair/stool with wheels to stand on while attempting to remove/mount the carousel.
- 5.5 Use only kapton tape or plastic screws to secure samples to the rotating chuck.

6 Setup Procedures

- 6.1 Before using the system, reserve the equipment with on the online reservation system.
- 6.2 Write your name, date, and phone number on the TMV white board.
- 6.3 Record all information on log sheet.

7 Load Samples

- 7.1 Use flash light to check that the carousel is in the load-lock chamber. See *Figure 1, TMV Chambers*.
- 7.2 Check to see that the following buttons are lit on the control panel.
 - [A] load-lock cryo-pump
 - [B] load-lock high-vac valve
 - [C] main chamber cryo-pump
 - [D] main chamber high-vac valve
- 7.2.1 **If not lit, DO NOT** turn on the ion gauge for either the main chamber or the load-lock, and contact the fab staff.
- 7.3 **If there is a reading on top left IG display**, press Chamber Gauge button to turn it OFF. See *Figure 2, Ion Gauges*.
- 7.4 Check reading A on Main Chamber ion gauge; the reading should be 0.0. See *Figure 2*.

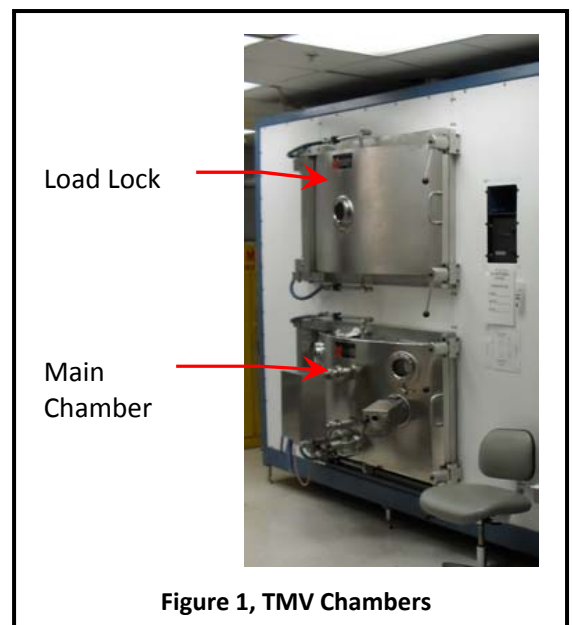
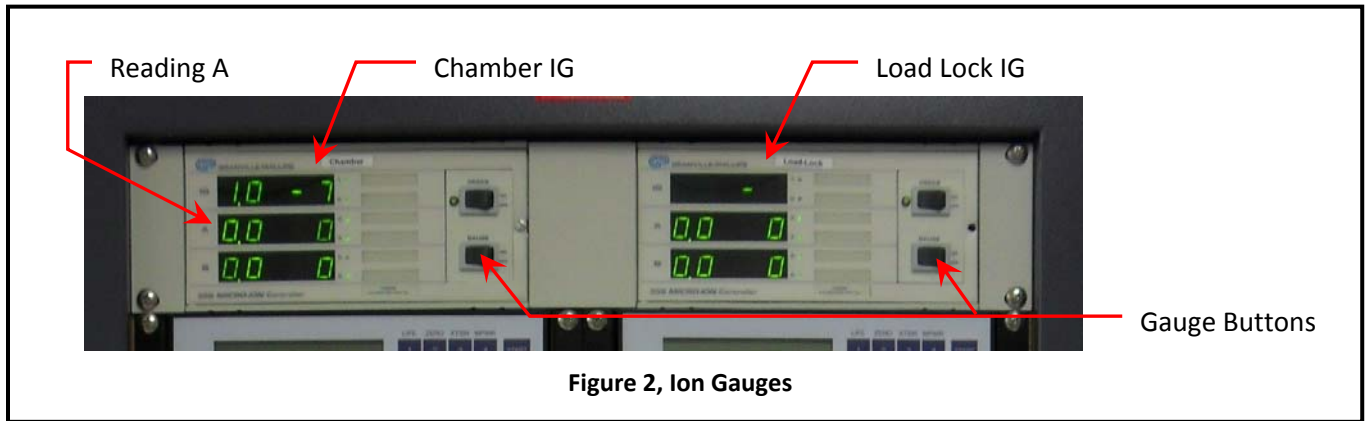


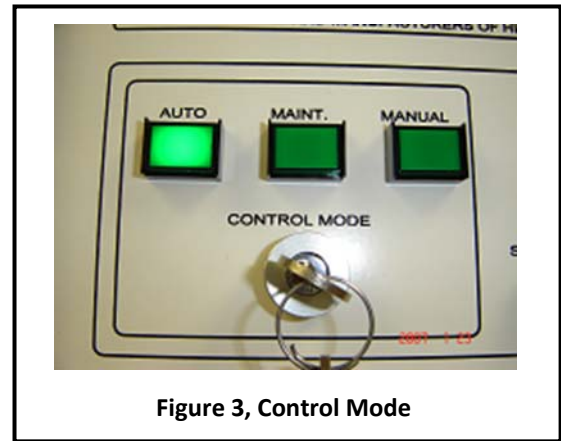
Figure 1, TMV Chambers



- 7.5 **If load-lock Ion Gauge is on (top right IG display),** press Gauge to turn it OFF. See *Figure 2*.
- 7.6 Turn CONTROL MODE key to AUTO position. See *Figure 3, Control Mode*.

NOTE: The AUTO light should be on.

- 7.7 If load lock AUTO PUMP is on, turn it OFF. See *Figure 4, Load Lock Control Panel*.
- 7.8 Press AUTO VENT on the Load-lock panel. See *Figure 4*.
- 7.8.1 If AUTO VENT does not work, (light does not come on, no gas sound), press TRANSFER GATE VALVE CLOSE, then try AUTO VENT again.
- 7.9 If AUTO VENT still does not work, put the key in MANUAL mode.

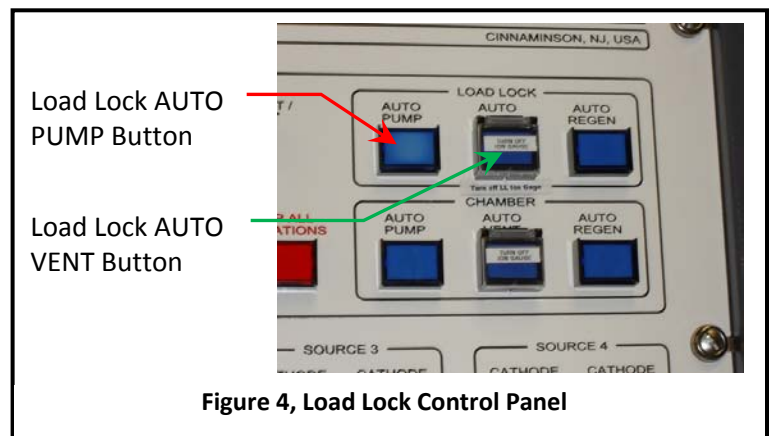


- 7.9.1 Close the load-lock high-vac valve (light off).
- 7.9.2 Open the load-lock vent valve (light on).
- 7.9.3 Close the load-lock vent valve after the door opens (light off).
- 7.9.4 Return the key to AUTO mode.

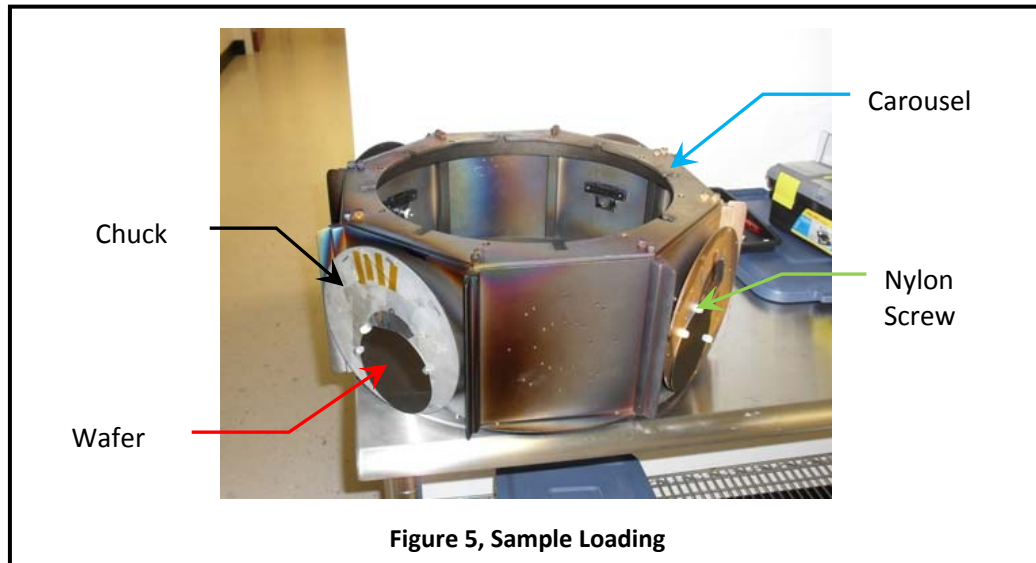
- 7.10 Once the load lock door pops open, press AUTO VENT again to stop the nitrogen flow.

NOTE: Pay attention to glove cleanliness when handling the carousel so as not to contaminate your sample.

NOTE: If you are only using 1 or 2 chucks, you may load the wafers onto the chuck(s) without removing the carousel.



- 7.11 If you are using more than 2 chucks, remove the carousel from the load-lock.
- 7.11.1 Lift the carousel off the pins.



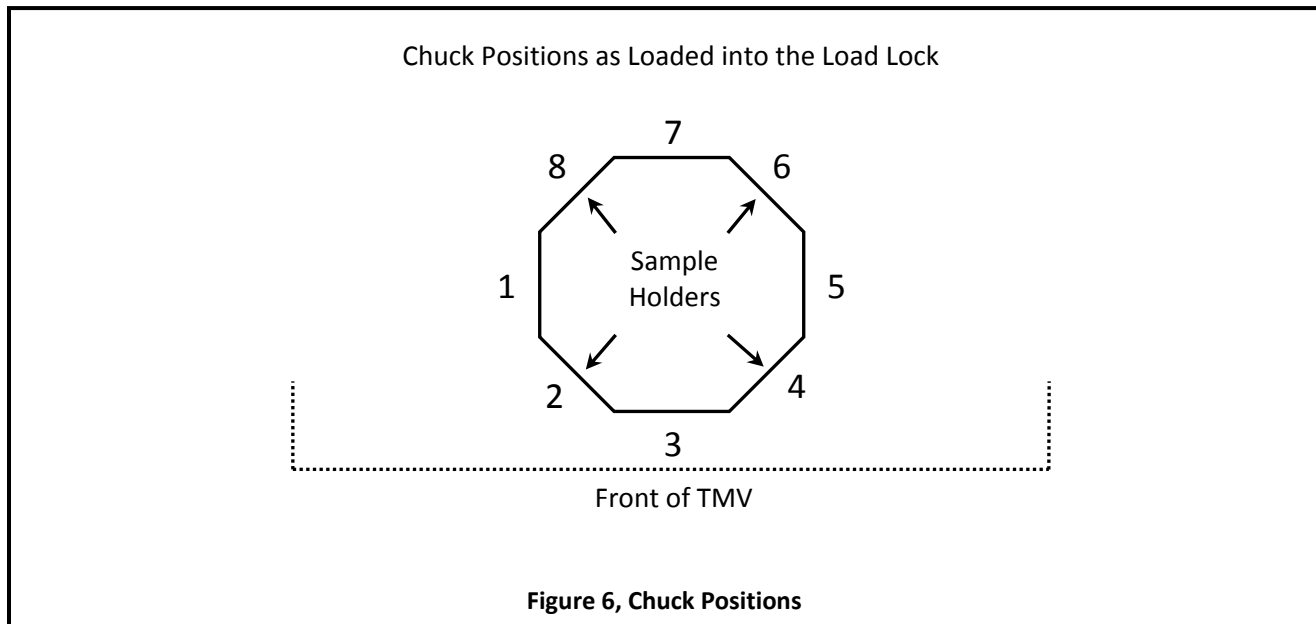
7.11.2 Rotate the carousel 1/16 of a turn.

7.11.3 Slide the carousel down off of it's mount.

7.12 Load samples on rotating chucks. See *Figure 5*.

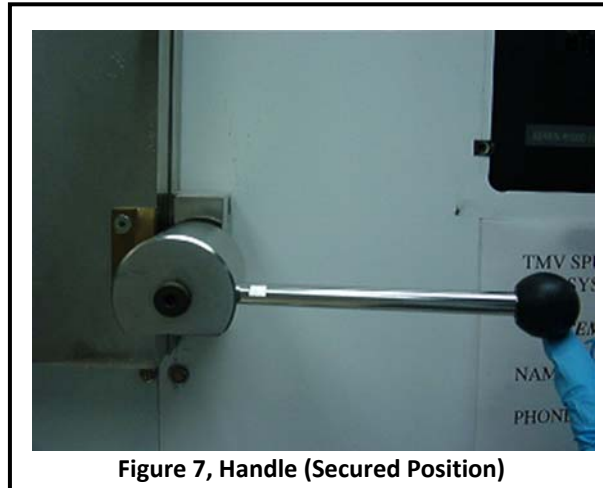
NOTE: Only 2 of the chucks are able to rotate. If you need chuck rotation, load your samples on the chucks with small gears on the back.

7.12.1 Attach samples on the chuck with the nylon screws or kapton tape.



NOTE: The nylon screws are located in the small black toolbox.

7.13 Note the position of your samples on the carousel. See *Figure 6, Chuck Positions*.



7.14 Mount the carousel in the load lock (ask for help from others).

7.14.1 Slide the carousel up over the mounts.

7.14.2 Rotate the carousel 1/16 of a turn.

7.14.3 Bring the carousel down on the mount pins.

7.15 Close the load-lock door. See *Figure 7, Handle (Secured Position)*.

7.15.1 Secure the bottom door handle. Do NOT overtighten.

7.15.2 Do NOT use the top locking handle.

8 Pump Down the Load-lock Chamber

8.1 Turn on the Nitrogen Gas.

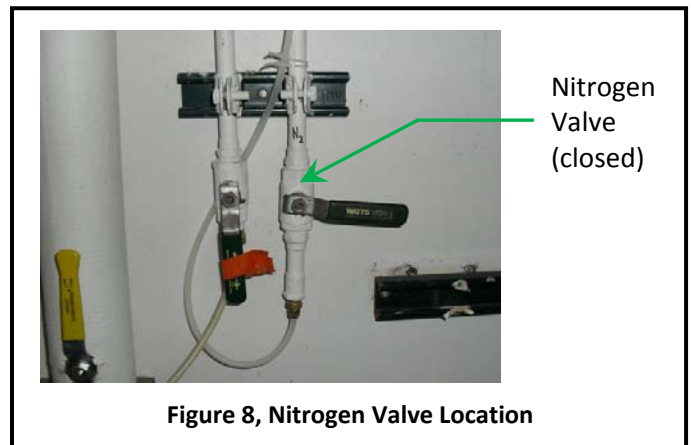
8.1.1 Open the N₂ valve. See *Figure 8, Nitrogen Valve Location*.

NOTE: The N₂ valve is located on the wall behind the TMV.

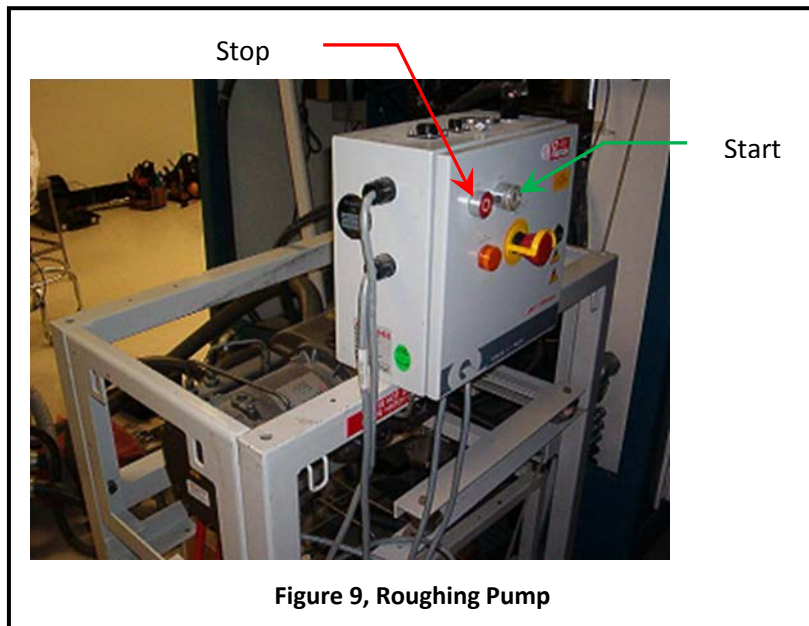
NOTE: Open = handle vertical. Closed = handle horizontal.

8.2 Press Load lock AUTO PUMP. See *Figure 4, Load Lock Control Panel*.

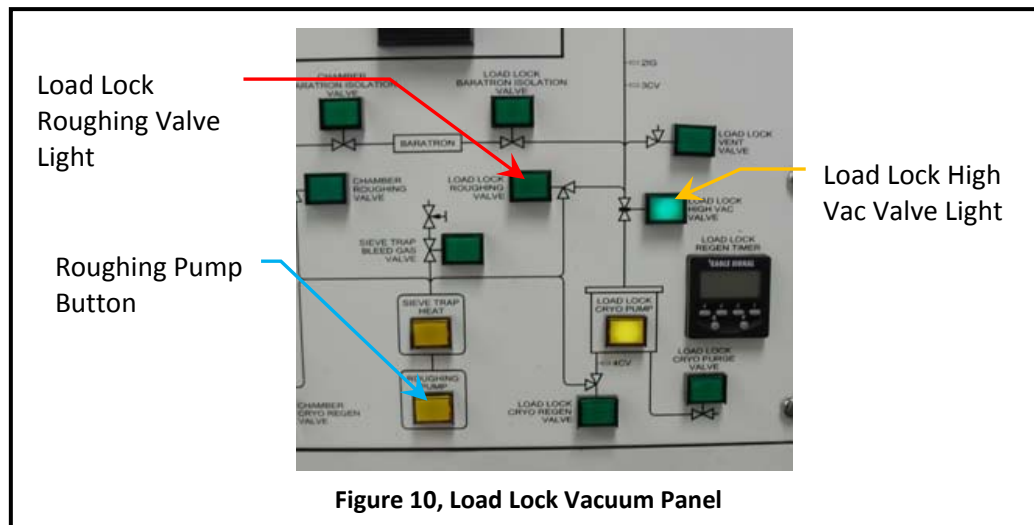
NOTE: The light for the Roughing Pump will come on.



8.3 Press START on the Roughing Pump control box. See *Figure 9, Roughing Pump*.



NOTE: Within 30 seconds the load lock handle will fall. This indicates that load-lock is pumping down.



NOTE: After about 8 minutes the LOAD LOCK ROUGHING VALVE light will be OFF (automatically) and LOAD LOCK HIGH VAC VALVE light will be ON.

- 8.4 Turn off the roughing pump by pressing ROUGHING PUMP on the front control panel. See *Figure 10, Load Lock Vacuum Panel*.
- 8.5 Set the timer for 10 minutes. See *Figure 11, Timer*.
- 8.6 Turn off Nitrogen.
 - 8.6.1 Close the N2 valve. See *Figure 8, Nitrogen Valve Location*.
- 8.7 Start the timer.



- 8.8 Fill out the log book while the load-lock is pumping down.
- 8.9 When the 10 minutes are up, press GAUGE on the load-lock ion gauge to turn it on. See *Figure 2, Ion Gauges*.

9 Transfer Carousel to the Main Chamber



CAUTION



The Ion Gauges are extremely sensitive. They should only be turned on when the machine is under high vacuum and not sputtering.

- 9.1 Transfer to the main chamber may begin once the load lock IG pressure is less than 3×10^{-6} Torr.
- 9.2 Press GAUGE on the Main Chamber Ion Gauge to turn it ON. See *Figure 2*.
- 9.3 On the TMV computer (monitor) go to the MAIN MENU.
- 9.4 Click “Substrate Transfer Control”. See *Figure 12, Main Menu*.

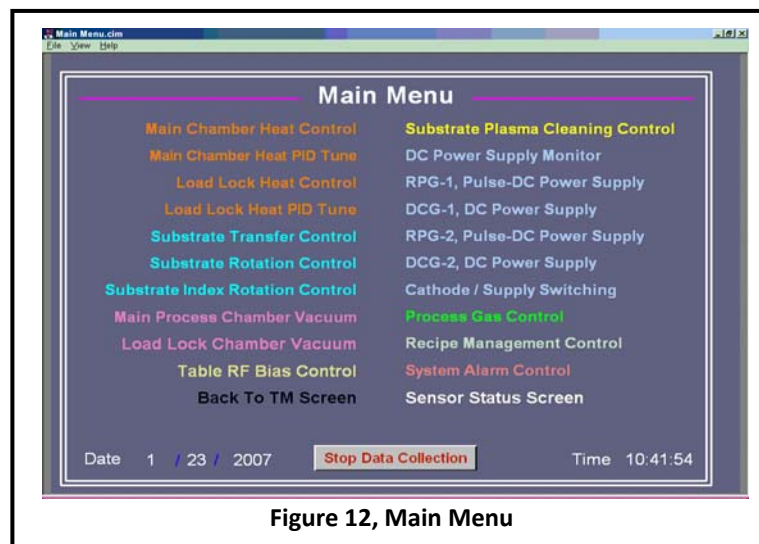


Figure 12, Main Menu

NOTE: You will see Load lock, chamber and gate valve animated photographs here.

NOTE: You can see if the gate valve is open or closed on this screen. Red = closed, Gray = open.

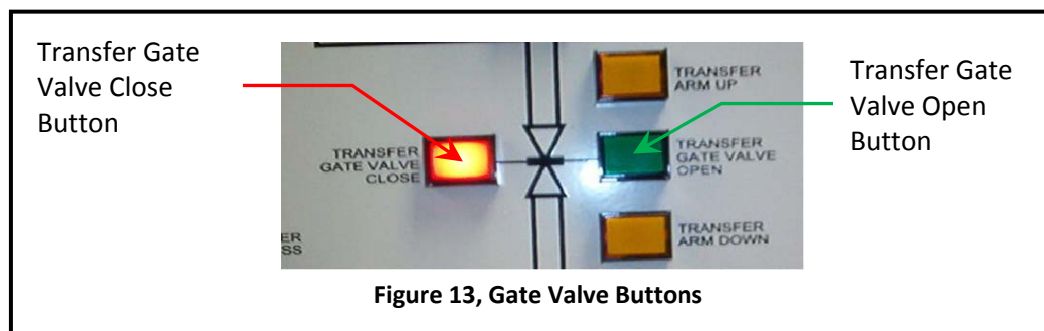
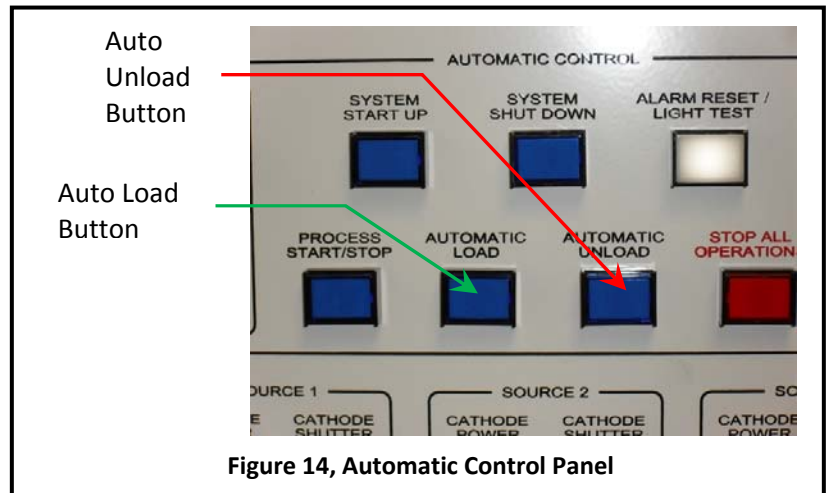


Figure 13, Gate Valve Buttons

- 9.5 Press the TRANSFER GATE VALVE OPEN on the front panel (manually). See *Figure 13, Gate Valve Buttons*.

NOTE: You will hear a loud noise of the valve opening.

9.5.1 Check on the monitor to see if the gate valve is open or closed.



NOTE: If gate valve is Open then proceed to next step otherwise contact nanofab staff.

9.6 Press AUTO LOAD button on the control panel. See *Figure 14, Automatic Control Panel*.

NOTE: On the Computer Screen you will see animated pictures of carousel transferring to the main chamber.

NOTE: The transfer process will take about 5 minutes.

NOTE: The software will say “Transfer Arm is not at Home” during the transfer.

9.6.1 Wait until the software says “Transfer Arm Is At Home”.

9.7 When the Transfer Arm has returned home, press TRANSFER GATE VALVE CLOSE on the front panel. See *Figure 13, Gate Valve Buttons*.

NOTE: You will hear loud noise of gate valve closing.

9.8 Wait till Chamber IG pressure is below 9×10^{-7} Torr. See *Figure 2, Ion Gauges*.

NOTE: This is called the base pressure.

9.9 Write this value in the log book.

10 DC Sputter

10.1 Turn OFF the Main Chamber ion gauge by pressing the gauge switch. See *Figure 2*.

NOTE: There should be no reading on the IG display.

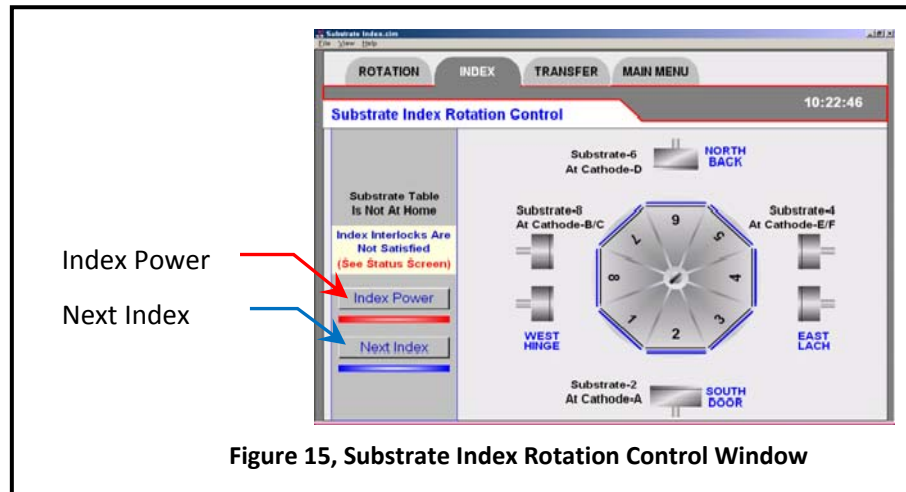
10.2 Rotate the control mode key to the MANUAL position. See *Figure 3, Control Mode*.

10.3 Go to the Main Menu.

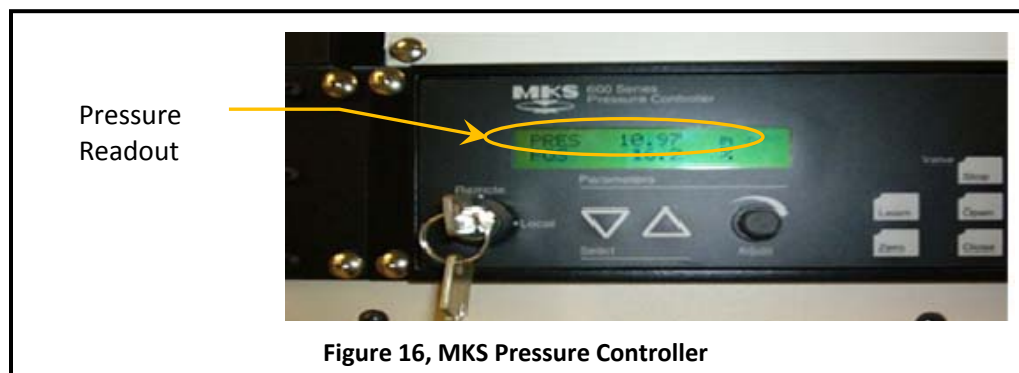
10.4 From the Main Menu on the computer click “Substrate Index Rotation Control”. See *Figure 12, Main Menu*.

10.5 Click INDEX POWER. See *Figure 15, Substrate Index Rotation Control Window*.

- 10.6 Wait for carousel to stop (on the picture).
- 10.7 Check your sample position inside the main chamber using the flashlight.
- 10.8 Note the chuck number on the carousel.
- 10.9 Click NEXT INDEX to bring the samples in front of your desired metal target. See *Figure 22, TMV Target Positions*.
- 10.10 Click on MAIN MENU.
- 10.11 Click on PROCESS GAS CONTROL from the MAIN MENU.



- 10.11.1 Click on CHAMBER BARATRON VALVE.
- 10.11.2 Wait for 10 seconds until the indicator on the control panel lights up and stops blinking.
- 10.11.3 Click on REMOTE PRESSURE SET POINT OFF.



- 10.11.4 Click on the SET PRESSURE VALUE. See *Table 3, DC Sputter Parameters*.
 - 10.11.4.1 Type 10 to get 10 mTorr pressure.
 - 10.11.5 Click CHAMBER PROCESS GAS.
 - 10.11.6 Click INDIRECT.
 - 10.11.7 Click GAS-3 (Ar gas).
- NOTE: Flow rate of Argon is 150 sccm.

10.11.8 If reactive sputtering with O₂, click GAS 2.

10.11.8.1 See staff for assistance switching from O₂ to N₂.

10.12 Read the chamber pressure on MKS Pressure controller. See *Figure 16, MKS Pressure Controller*.

NOTE: The reading should match the pressure you entered in step 10.11.4.1.

10.13 Switch ON the MDC Stepper Motor control if using chuck rotation. See *Figure 17*.



Figure 17, MDC Stepper Motor Controller

NOTE: The power switch is located on the back lower right side of the controller.

10.13.1 Using the flashlight, check inside the chamber (through the window) to see if your samples are at desired location and the chuck is rotating.

10.14 Click on MAIN MENU.

10.15 From the main menu, click on CATHODE/SUPPLY SWITCHING.

10.15.1 Ensure that the picture of the target you see on the monitor matches with the white board on TMV.

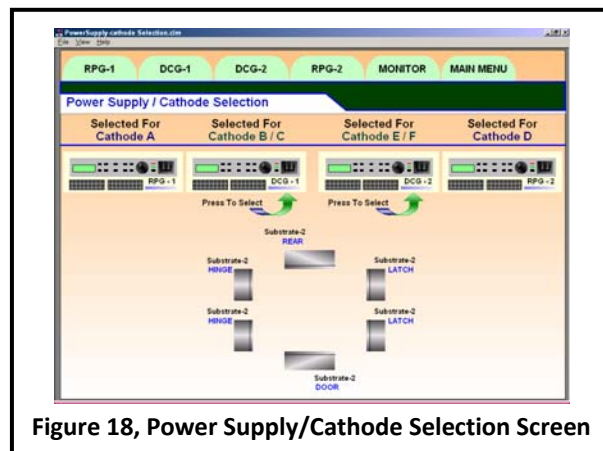


Figure 18, Power Supply/Cathode Selection Screen

NOTE: Each target lists the power supply that connects to it.

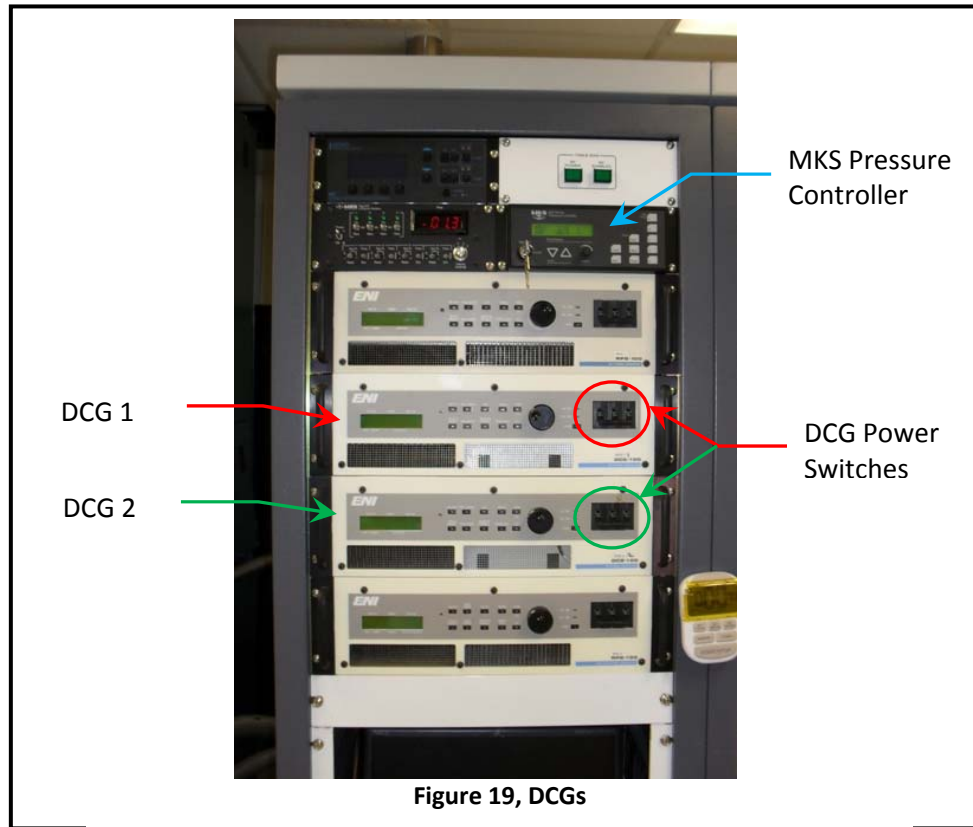
10.15.2 Click on the desired metal target.

10.15.3 Make sure the connection is between DCG-1 / DCG-2 and the desired metal target and there is NO OTHER connection to any other metal target.

10.15.4 If the connection is in RPG-1 or RPG-2 then click on the generator picture.

NOTE: The connection will switch to DCG.

10.16 Turn on the DCG (either DCG-1 or DGC-2). See *Figure 19*.



10.16.1 Wait a few moments till the generator is ready.

NOTE: The power supply display will indicate that it is stable.

10.17 Back on the computer monitor, click on the appropriate DCG tab.

10.18 Click on the number next to TYPE IN SETPOINT.

Table 1, Power Setpoints		
Power (Watts)	Set Point DCG	Set Point RPG
50 (max power for liftoff)	0.94	0.42
100	1.92	0.92
150	2.88	1.4
200	3.86	1.9
250	4.85	2.38
300 (do not exceed 300 W)	5.84	2.87

10.18.1 Adjust the number till you get the desired power for your sputtering. See *Table 1, Power Setpoints*.



CAUTION
DO NOT exceed 300W
(50 W max for liftoff, photoresist will hard bake at higher power)



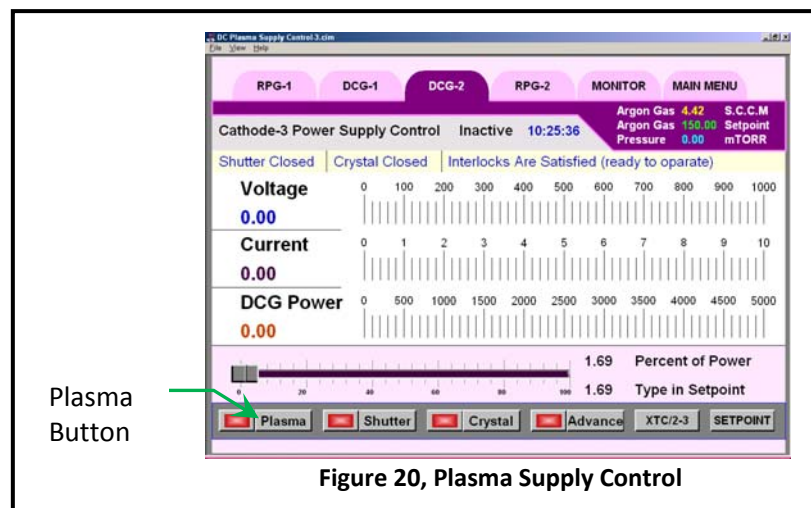
10.19 On the computer monitor, click on PLASMA to begin sputtering. See *Figure 20*.

10.20 Look through the chamber porthole to see if plasma is formed.

NOTE: The plasma is a purple or blue glow.

NOTE: Also the Voltage should drop when the plasma ignites.

10.20.1 **If yes proceed to next step**, otherwise click on PLASMA again (to Stop) and go to section *13 Troubleshooting*.



10.21 Pre-sputter for desired time (usually 2 min).

NOTE: The Voltage should read between 200-700 Volts and the Current should read between 0.1-0.5 Amps.

10.22 Set timer to the desired sputter time. See *Figure 11, Timer*.

10.23 Press CATHODE SHUTTER button on the front panel. See *Table 2, Cathode Materials*.

NOTE: Shutter should be opened manually from the front panel and not from the software.

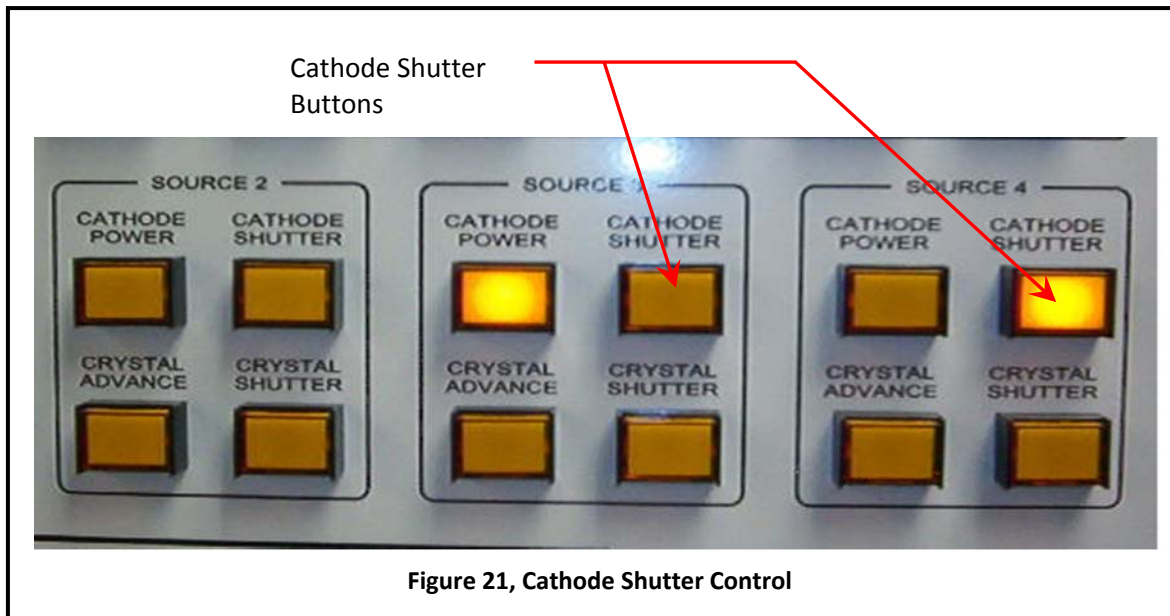
10.24 Start the timer.

10.25 Check inside the chamber from the window if shutter is open fully and if chuck is rotating.

10.25.1 Any abnormalities need to be written on the log book (in comment section).

Target	Cathode Shutter #
Cr	1
TiW	2
Ir	2
Ti	3
Au	4
Pt	4

10.26 When the desired time has elapsed, press CATHODE SHUTTER on the panel manually to close the shutter. See *Figure 21*.



10.27 If more samples on other chucks need to be sputtered with the same target then do the following:

10.27.1 Click MAIN MENU.

10.27.2 Click SUBSTRATE INDEX ROTATION CONTROL.

10.27.3 Click on NEXT INDEX until your samples are in front of desired metal target.

10.27.4 Repeat from Step 10.23.

10.28 When finished sputtering with the target, click on PLASMA (to stop).

10.29 Turn off the DCG power. See *Figure 19*.

10.30 If you need to sputter another layer of different metal then repeat the process from Step 10.14.

10.31 When Sputtering is completely finished, click on MAIN MENU.

10.32 Click on PROCESS GAS CONTROL.

10.32.1 Click on GAS 3 to stop gas flow.

10.32.2 Click on INDIRECT to stop.

10.32.3 Click on CHAMBER PROCESS GAS.

10.32.4 Click on REMOTE PRESSURE SET POINT ON.

10.32.5 Click on CHAMBER BARATRON VALVE.

10.33 Click on MAIN MENU.

10.34 Switch OFF MDC Stepper Motor control. See *Figure 17*.

11 Transfer of Carousel back to Load-Lock

11.1 Make sure the DCG power is off, the gas pressure is zero, and the stepper motor is off.

- 11.2 Press Gauge to turn ON the Main Chamber ion gauge.
- 11.3 On the computer go to the MAIN MENU click “Substrate Transfer Control”.
- 11.3.1 The computer screen should show the transfer gate valve closed (red triangles).
- 11.4 Press TRANSFER GATE VALVE OPEN on the front panel (manually).
- NOTE: You will hear loud noise of valve opening.
- 11.5 Check on the monitor to see if gate valve is open or closed (red triangles are gone).
- 11.5.1 If gate valve is OPEN then proceed to next step otherwise contact fab staff.
- 11.6 Turn the key to AUTO mode on the control panel.
- 11.7 Press AUTO UNLOAD on the control panel.
- NOTE: You will see animated pictures of transfer of carousel from main chamber to load-lock.
- NOTE: The transfer process will take about 5 minutes.
- 11.7.1 Wait until the software says “Transfer Arm is at Home”.
- 11.7.2 Contact staff if transfer fails.
- 11.8 Press TRANSFER GATE VALVE CLOSE on the front panel.
- NOTE: You will hear loud noise of gate valve closing.

12 Unload Samples from the Load-lock

- 12.1 Turn off the load lock ion gauge.
- 12.1.1 Make sure that there is NO reading on load lock ion gauge.
- 12.2 Press AUTO VENT on the load-lock panel.
- NOTE: You will hear loud noise of air rushing to load lock.
- 12.3 Wait for 1-2 min and Load-lock door will OPEN automatically.
- 12.4 Press AUTO VENT on load-lock panel to stop gas flow.
- 12.5 Unload the carousel. Ask for assistance if needed.
- 12.5.1 Remove samples.
- 12.6 Mount the carousel in the load-lock chamber. Ask for assistance if needed.
- 12.7 Put the bottom load-lock locking handle in a horizontal position.
- 12.8 Turn on N2 on wall behind TMV.
- 12.9 Press Auto Pump on the load lock control panel.
- 12.9.1 When the roughing pump light comes on, start the roughing pump.
- 12.10 Once the load lock high-vac valve has opened as indicated on the control panel, turn off the roughing pump.
- 12.11 Turn off the N2 gas.
- 12.12 Turn off the load lock Auto Pump

12.13 Make sure your run has been entered in the log book.

13 Troubleshooting

13.1 Plasma does not Ignite

- 13.1.1 Go to the Process Gas Control page.
- 13.1.2 Click on the pressure set point.
- 13.1.3 Increase the set point.
- 13.1.4 Click Ok.
- 13.1.5 Go back to the DCG page.
- 13.1.6 Click Plasma to start sputtering.
- 13.1.7 Check the Voltage, it should drop to within the 200-700V range when the plasma ignites.
- 13.1.8 If the plasma still does not ignite, try opening the shutter.
- 13.1.9 If the plasma does ignite, close the shutter, if open.
- 13.1.10 Go back to the Process Gas Control page to correct the gas pressure setpoint.

14 Process Notes

14.1 TMV Parameters

Shutter #	Metal	Power (Watts)	Pressure (mTorr)	Time (min)	Thickness (nm)	Dep Rate (nm/min)
1	Cr					
2	TiW					
2	Ir	90	8	8	100	12.5
3	Ti	45	10	5	50	10
4	Au					
4	Pt	90	11	12	240	20

14.2 TMV Target Positions

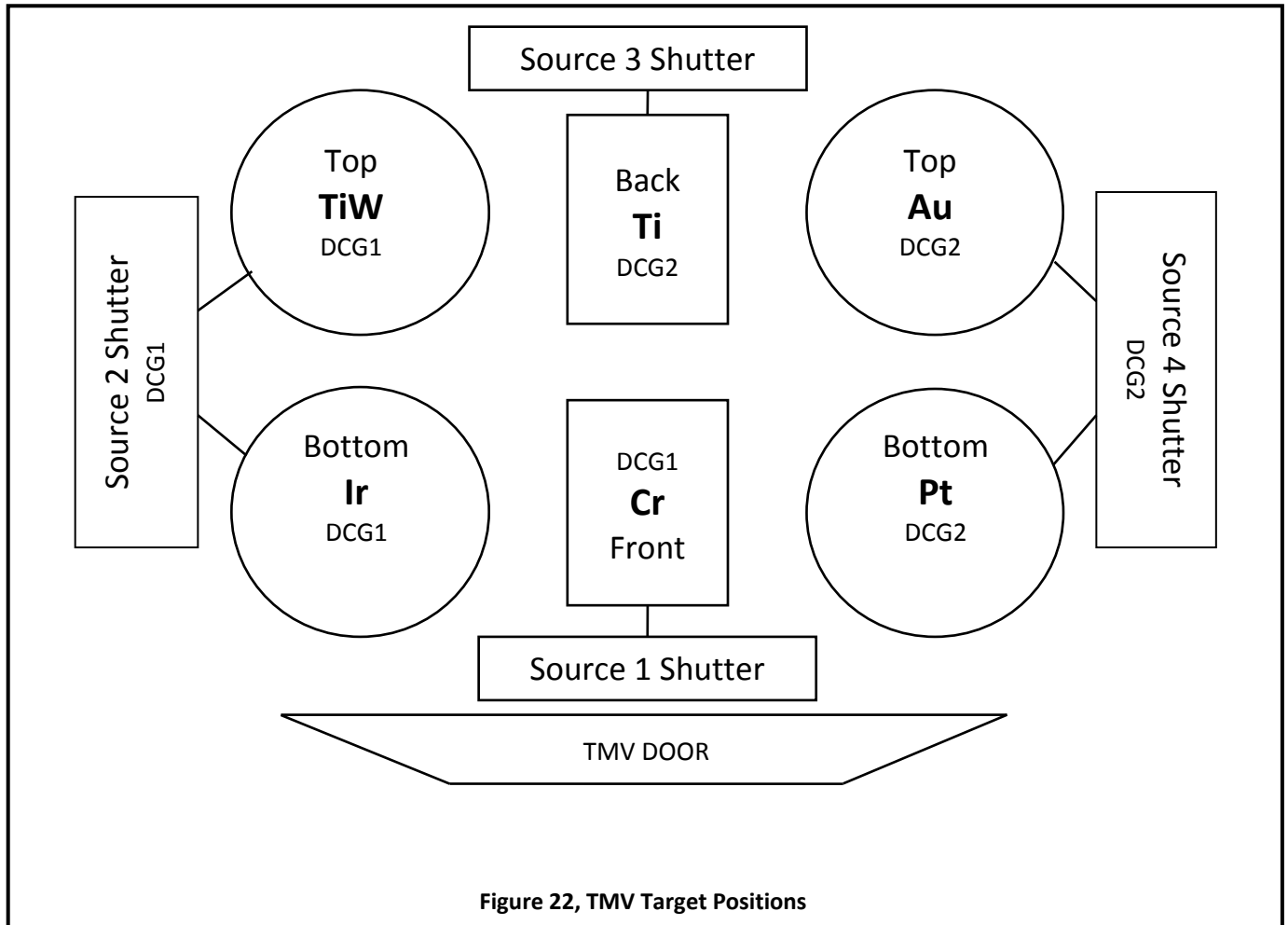


Figure 22, TMV Target Positions

15 Revision History

Rev	Date	Orginator	Description of Changes
1	10 May 2010	L. Williams	Initial release.
2	20 May 2010	Sam Bell	Added figures and tables.