CORAL Name: PECVD-Samco-PD220

Location: Bay U8
Tool Category: Deposition, CVD
Contacts: Donal Jamieson, Bob Bicchieri



Contents

Introduction 1
Safety 2
User Qualifications and Responsibilities 2
Operating Procedures 2
Appendices 5
- Software 6
- SAMCO Interface and Data Entry 6
- Set Mode Screen 6
- Program Screen 6
- Main Screen 7
- Recipe Screen 7
- Vacuum Systems 8
- Loadlock 8
- CVD Chamber 8
- Pressure Conversion Chart 10

Introduction

The purpose of the SAMCO PD220-NL Chemical Vapor Deposition system is to deposit semiconductor grade thin films. The films available on the system are: SiN, SiON and SiO_2, SiC and α-Si. In addition, the system utilizes a Loadlock chamber to reduce CVD chamber pump-down times and also to prevent accidental exposure to hazardous gases and deposition by-products when samples are removed from the system.

The SAMCO CVD system consists of 3 main systems, each of which has multiple components. Each system will be discussed in the following SOP.

The system has a number of buttons to the right of the control screen:

- **EMO** – Emergency Machine Off, only to be used in case of danger to operator or maintenance staff.
- **Power On** – Re-energizes system after shutdown.
- **Power Off** – Turns off the power to the system – only qualified staff should press this when system has been shut down correctly.
- Once each side of the Loadlock front panel there is a button to Open and Close the Loadlock chamber lid safely.

Safety

- The PECVD-SAMCO-PD220 system utilizes pyrophoric gas (silane), flammable gas (methane), toxic gas (ammonia) and other inert compressed gases (nitrogen, argon, N_2O, and C_2F_6). Additional hazards present within the system include: compressed air, elevated temperatures, high voltage power supplies and RF radiation. Do not attempt to bypass system interlocks or open panels on the tool.
- The loadlock lid is a pinch point and care should be taken when closing the lid.
- The carrier plates used for every deposition are dangerously hot when removed from the chamber, exercise extreme caution when placing or removing samples from the plates.

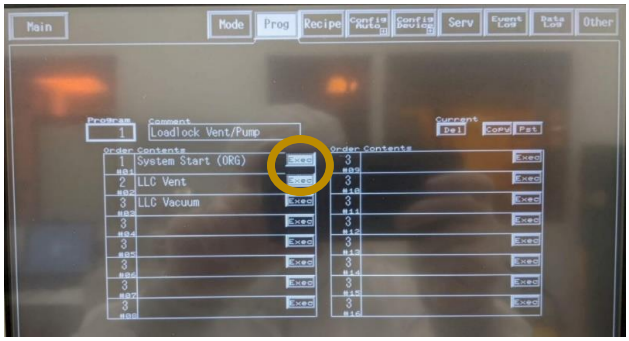
User Qualifications and Responsibilities

- Users must have a PTC approved process prior to training. User will be fully qualified to operate the tool when training is complete and they have demonstrated competence in processing a sample.
- Trying to defeat system interlocks or using the system in a dangerous manner will result in loss of access to the tool.
- Ensure the loadlock lid seal is clear of debris when closing the lid.
- When process run is complete, user should pump the loadlock down. Do not disengage until pumpdown is complete.

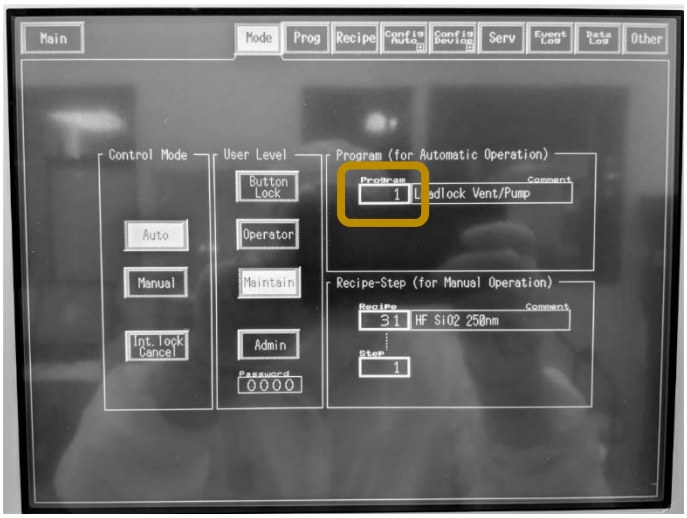
Operating Procedures

1. Reserve and engage the SAMCO on CORAL, Verify the system is not already in use. CORAL disables the lid sensor on the Loadlock, so you must engage in order to complete a process.

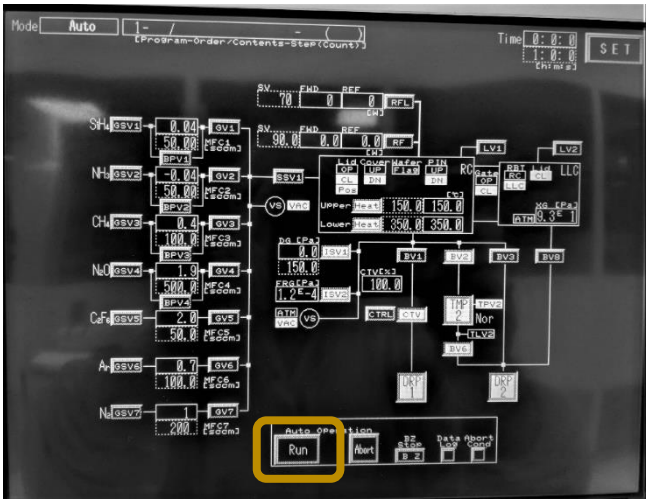
2. Loading a Sample: Navigate to the Program screen (**Prog**) and select Program 1 – Loadlock Vent/Pump. Highlight the **Exec** button for the System Startup and LLC Vent steps, and deselect the LLC Vacuum step.



3. Switch to the **Mode** screen and select Program 1.



4. Touch the **Main** button to move to the Main screen and press the **Run** button to begin the Program.



5. Once the Loadlock is vented the system will beep several times and you must briefly press both **LLC Lid Open/Close** buttons simultaneously to open the Loadlock chamber lid.

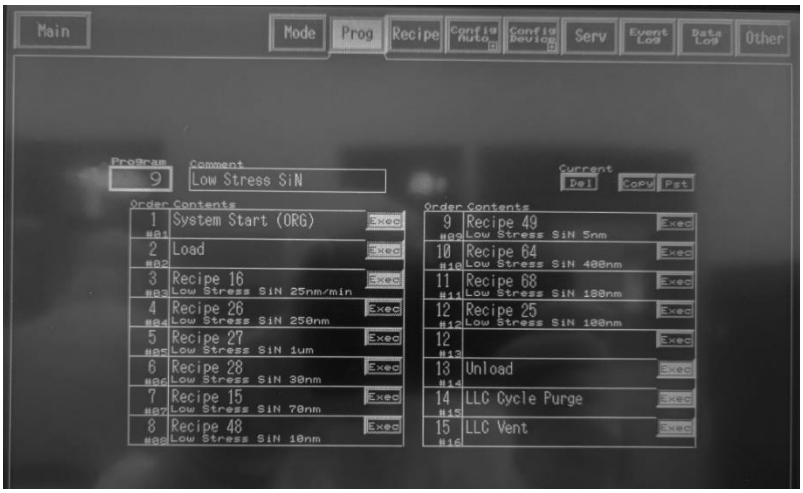


6. Load your samples onto the appropriate carrier wafer. For SiN, SiON and SiO_2 use the SiC (dark grey) carrier, for α-Si and SiC use the AlN (brown) carrier.

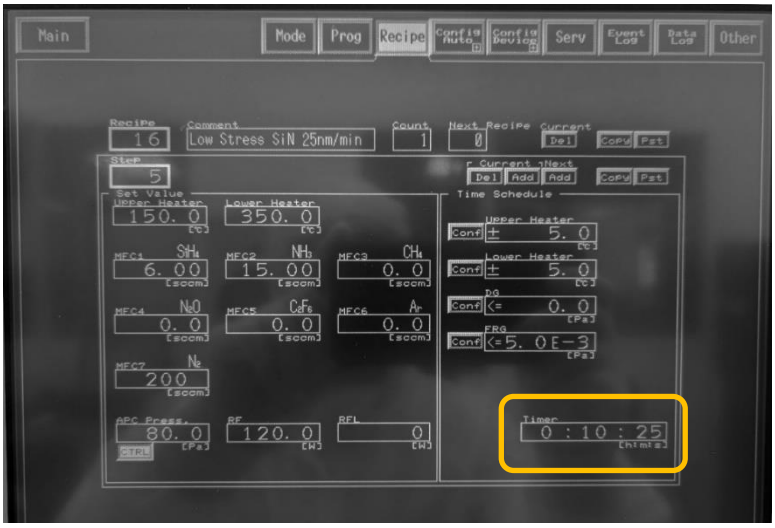
7. Check that the loadlock seal is clear of particles and debris. Press and hold both **LLC Lid Open/Close** buttons until the Loadlock chamber lid is closed.

Running a Recipe:

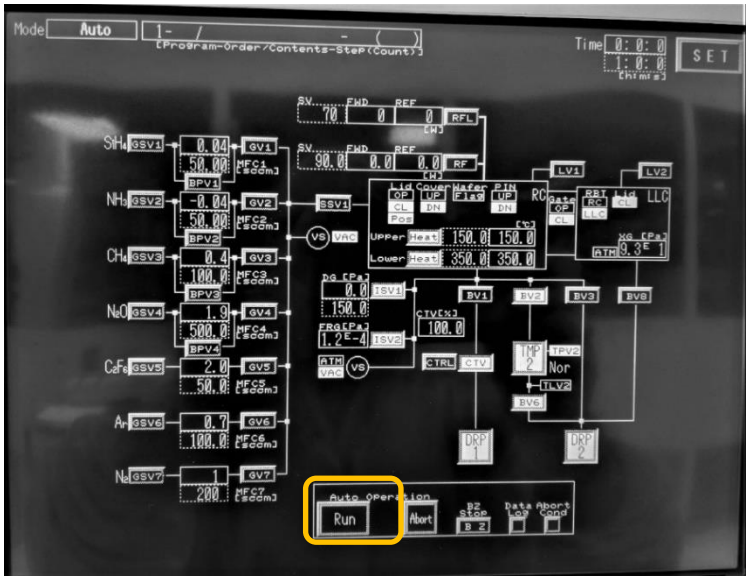
1. Navigate to the Program screen (**Prog**) and select correct Program for the film you wish to deposit.



2. Select the recipe required to achieve the correct film thickness.
3. Check the **System Start**, **Load**, **Unload**, **LLC Cycle Purge** and **LLC Vent** steps are selected
4. Switch to the **Recipe** screen and edit the recipe time if necessary.



5. Touch the **MAIN** button to move to the Main screen and press the **RUN** button to begin the Program.

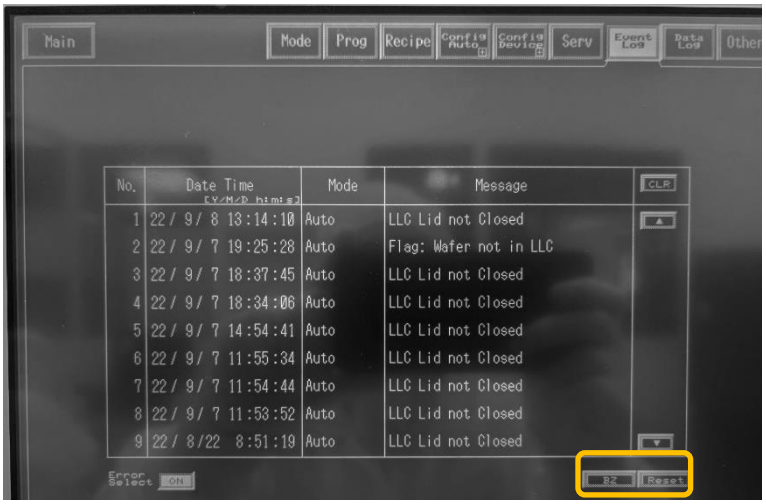


6. When the Program is complete, the system will beep several times and you may remove your sample from the Loadlock. Use tweezers and take care not to touch the hot carrier with your gloved hand.
7. Run the LLC Vent/Pump program again to pump the Loadlock back to base pressure.
8. Disengage the SAMCO CVD system on CORAL.

Appendices

Faults

Most common failure: LLC Lid not Closed alarm.
Cause: System not engaged on Coral.
Solution: Go to Event Log screen, silence buzzer, clear alarm, and retry after engaging system.

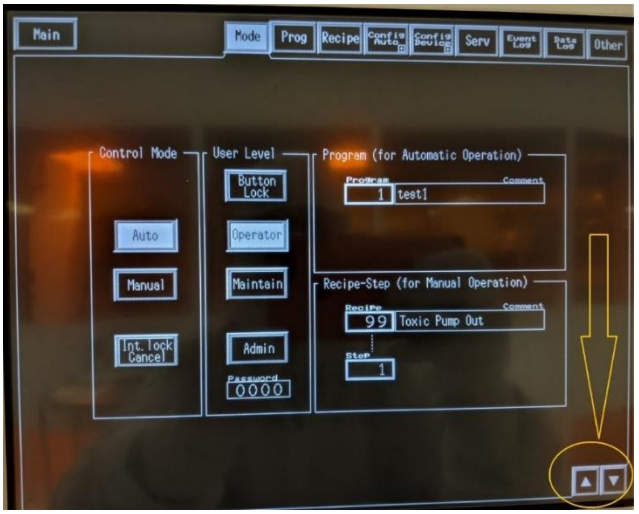


Software

SAMCO Interface and Data Entry

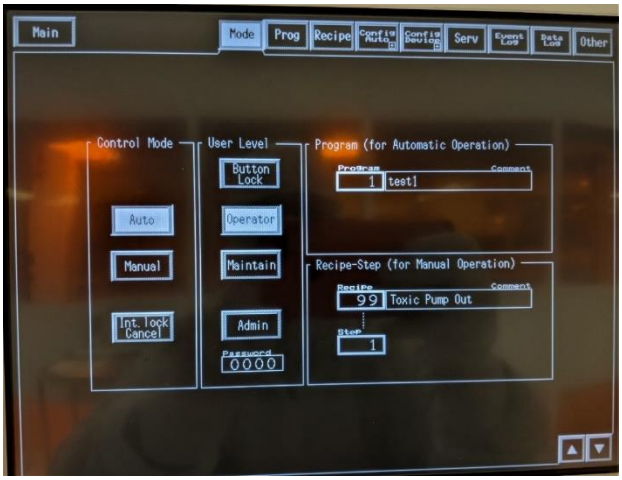
The SAMCO uses a touch screen interface. General options, valve states, and field selection are toggled by touching the appropriate field on the screen.

Alpha-numeric data is entered into the SAMCO control program by selecting the appropriate field using the touch screen, and adjusting the field value using the Up and Down arrows on the lower right of the screen.



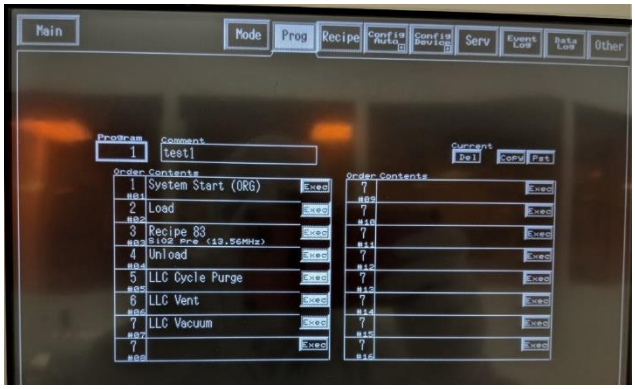
Set Mode Screen

The Set Mode Screen allows access to the Manual method of operating the CVD system, Users must be logged in under Manual mode in order to edit recipe times. Other modes cannot be accessed without the correct password.



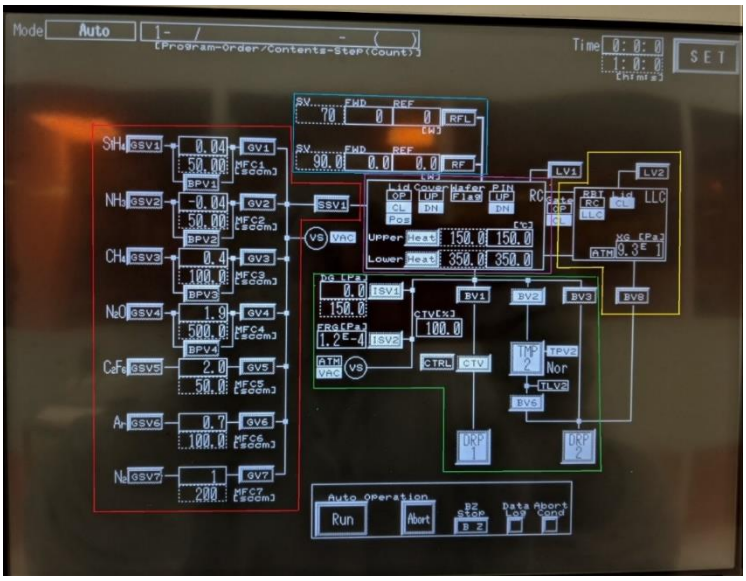
Program Screen

The Program screen allows complete sequences containing all the appropriate steps for etch process to be quickly accessed and run in Automatic Mode. Highlighting the **Exec** button for each step will cause it to be executed in the correct sequence. Multiple recipes may be run on each sample.



Main Screen

The Main screen displays the status of all the valves, pressure gauges, turbo pumps, gas flows, RF power supplies and active recipe. In the figure above, the various sub-systems are highlighted (Color added for clarity. The screen on the tool is monochromatic). The gas delivery system is highlighted in red; the load-lock vacuum system is highlighted in yellow; the main chamber is outlined in purple, the CVD chamber vacuum system is highlighted in green, and the RF system is enclosed by the light blue box.



The Main screen also is used to start a sequence/recipe by pressing and holding the **Run** button in the bottom of the touch screen. If the system has an Alarm status, the Alarm buzzer may be silenced using the **BZ Stop** button.



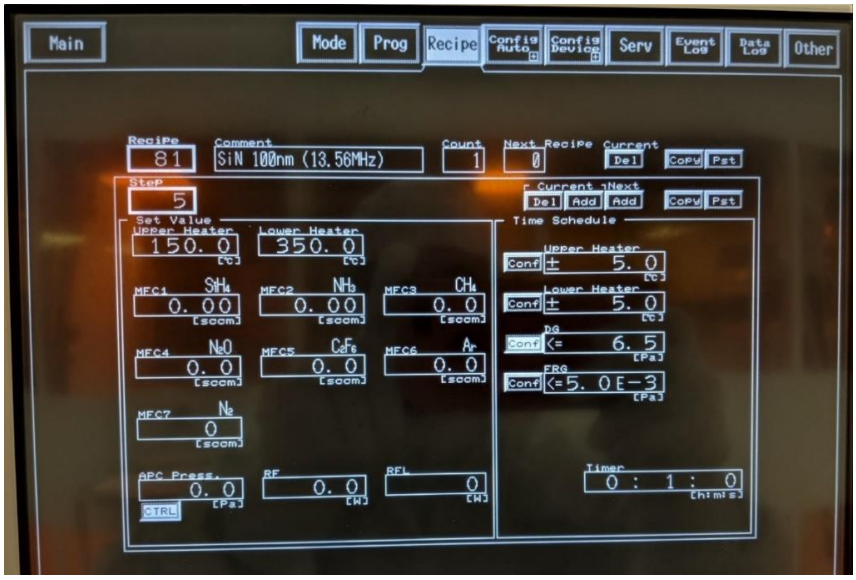
Pressing the **SET** button in the upper right corner of the display switches back to the previous screen



Recipe Screen

Recipes are entered in the Edit Screen.

- For each step in a recipe, the gas flows, step times, RF power, and pressure/gate valve position can be controlled. In addition, steps can be looped and at the completion of this recipe, another recipe can be executed automatically. The recipe ends at the first step in the recipe with a time of 0:00:00.
- The operation of the main gate valve can be controlled in one of two methods: pressure control or position control. In pressure control, the chamber pressure is set and the gate valve position is adjusted to



achieve the desired pressure. In position control, the gate valve position is set and the pressure will vary depending on the gas flow. For process reliability and repeatability, only automatic pressure control is used.

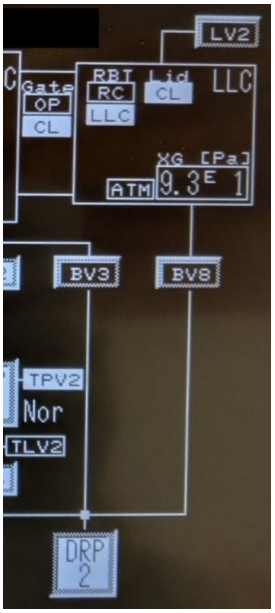
- By using the controls in the upper right-hand corner, entire recipes or a single step of an existing recipe can be copied into the recipe that is being edited.
- The laptop attached to the Samco PECVD system is mainly used to record Log data, but also may be used to Edit, Download, Upload and Back up recipes.

Vacuum Systems

Loadlock

The Loadlock vacuum system serves two purposes:

1) To pump out the Loadlock chamber in order to introduce samples into the main etch chamber.
2) To pump out the CVD chamber when necessary.



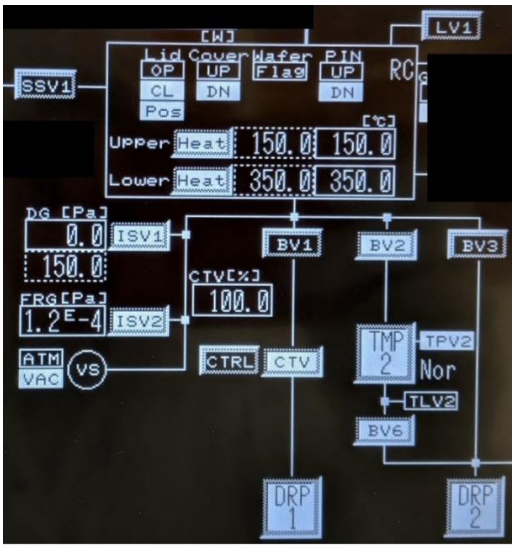
In standby, the Loadlock is pumped using a dry roughing pump (DRP2) through valve BV8. In order to pump the Loadlock chamber from atmospheric pressure to base vacuum, valve BV8 is opened allowing the roughing pump to evacuate the chamber. Pressure gauge XG is used to monitor the Loadlock pressure.

In order to vent the Loadlock, first valve BV8 is closed, then nitrogen is introduced into the chamber through the valve LV2.

The current position of the Robot load arm (RBT) is indicated at the top center of the image, home position is in the Loadlock (LLC), when a wafer carrier is being load into the Reaction Chamber, the RC position will be sensed.

CVD Chamber

The CVD chamber vacuum system is designed to provide a suitable environment for the deposition of thin films and to safely remove the CVD by-products and residual gases from the chamber.



In stand-by, the CVD chamber is pumped using a turbo pump (TMP2) and a dry roughing pump (DRP2) via valves BV2 and BV6. During process, valve BV2 shuts, valve BV1 opens, and the process pressure setpoint is controlled using valve CTV and the dry rough pump DRP1. The conductance through main pressure control valve (CTV) is be controlled via an automatic gate valve controller. The gate valve controller adjusts the position of the CTV to reach and maintain the set pressure of the etch chamber during the etch steps.

The CVD chamber is vented with nitrogen through valve LV1 and the chamber pressure sensors DG and FRG can be isolated from the chamber using valves ISV1 and ISV2 respectively. The ionization gauge FRG measures the chamber base pressure during Standby mode, and the process gauge DG provides the feedback necessary to

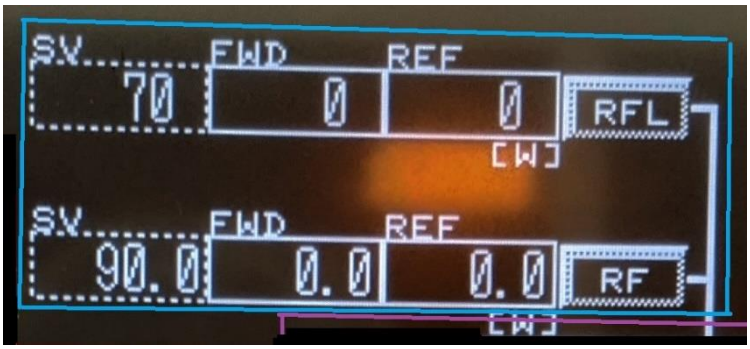
control the position of the main control valve (CTV) during process recipe steps.

The Upper and Lower chamber temperature controls are at the center of the image – typically the Upper chamber is maintained at 150°C and the Lower chamber (i.e., the substrate temperature) is 350°C.

The position of the sensors for the chamber lid, chamber cover, wafer load position , and lift pins are indicated at the top of the image.

1. RF Power Supplies

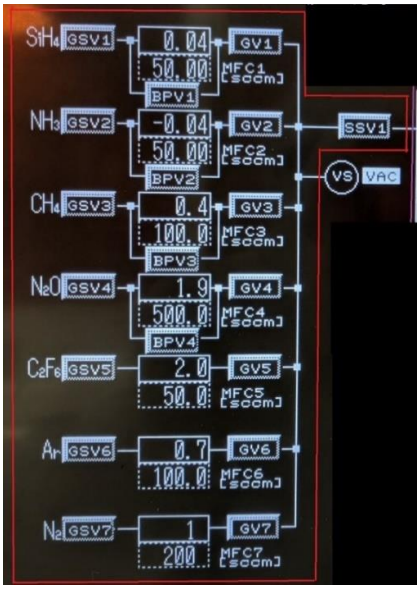
The CVD system contains two RF power supplies, a standard RF delivered at 13.56 MHz, and a lower frequency RF (RFL) at 400 kHz. By choosing different frequencies, some film properties such as deposition rate, uniformity and stress may be adjusted.



For each RF source, the set value (SV), forward power (FWD) and reflected power (REF) are displayed.

2. Gas Delivery System

The CVD system has seven gas lines to deliver the necessary gases to deposit Silicon Nitride, Silicon Oxynitride, Silicon Dioxide, Silicon Carbide and amorphous Silicon. Also supplied to the process chamber are cleaning gases. The gas delivery system is enclosed within the red box.



Each of the six processing lines has an upstream valve (GSV#) and a downstream valve (GV#) associated with it where # designates the line number along with a mass flow controller. The MFC set point is the number within the box with the dashed lines while the actual flow is displayed within the box with the solid lines. All gases are delivered to the Reaction Chamber via the manifold valve SSV1.

The **maximum flow** for each gas is shown in the following table:

Gas #	1	2	3	4	5	6	7
Gas	SiH_4	NH_3	CH_4	N_2O	C_2F_6	Ar	N_2
Max flow (sccm)	50	50	100	500	50	100	200

Pressure Conversion Chart

Pascals	mTorr
0.005	0.0375
0.25	1.875
0.5	3.750
1	7.50
2	15.00
3	22.50
4	30.00
5	37.50
6	45.00
7	52.50
8	60.00
9	67.51
10	75.01
15	112.51
20	150.01
25	187.52
50	375.03
100	750.06
2700	20251.67
100000	750061.68