APPLIED MATERIALS®

200mm Ultima Plus / Ultima TE HDP-CVD Centura

Chamber Manual

June 2004 Revision: 001

PUBLICATION HISTORY

Revision:	001
June 2004	
Cleanroom Part No.:	0230-01859
Standard Part No.:	0230-01858
Document Production Number	311-219-01

PART NUMBER HISTORY

Part Number Cleanroom/Standard/ CD-ROM	Date	ECO

3050 Bowers Avenue
Santa Clara, California 95054

3050 Bowers Avenue
Santa Clara, California 95054

Trademarks

The following registered trademarks are some of the trademarks used in Applied Materials manuals.

Name	**Owner**
Baratron®	Registered trademark of MKS Instruments, Inc.
Cajon®	Registered trademark of Swagelok Company
Conflat®	Registered trademark of Varian Associates, Inc.
Convectron®	Registered trademark of Granville-Phillips Company
DRYVAC®	Registered trademark of Leybold Vacuum Products Inc.
FastRegen™	Trademark of the CTI Cryogenics, Inc.
Freon®	Registered trademark of E.I. DuPont de Nemours & Co., Inc.
Kalrez®	Registered trademark of E.I. DuPont de Nemours & Co., Inc.
Kovar®	Registered trademark of Westinghouse Electric Corporation
Krytox®	Registered trademark of E.I. DuPont de Nemours & Co., Inc.
Lucite®	Registered trademark of E.I. DuPont de Nemours & Co., Inc.
Procomm®	Registered trademark of DATASTORM Technologies Inc.
Pyrex®	Registered trademark of Corning Glass Works
Q-tip®	Registered trademark of Cheseborough Ponds
RUVAC®	Registered trademark of Leybold Vacuum Products Inc.
Snap-Loc®	Registered trademark of Nor-Cal Products, Inc.
Swagelok®	Registered trademark of Swagelok Company
Scotch-Brite®	Registered trademark of 3M Corporation
Teflon®	Registered trademark of E.I. DuPont de Nemours & Co., Inc.
TRIVAC®	Registered trademark of Leybold Vacuum Products Inc.
Unival®	Registered trademark of Unival Company
VCR®	Registered trademark of The Swagelok Company
VCO®	Registered trademark of The Swagelok Company
Vespel®	Registered trademark of DuPont de Nemours & Co., Inc.
Viton®	Registered trademark of E.I. DuPont de Nemours & Co., Inc.
Windows NT®	Registered trademark of Mirosoft Corporation.
X-Acto®	Registered trademark of Hunt Manufacturing Co.

Acronyms

The following acronyms are used in this manual.

Acronym	**Definition**

Table of Contents

List of Figures

List of Tables

1 Functional Description

The Ultima Plus and Ultima TE High Density Plasma (HDP) Chemical Vapor Deposition (CVD) Chamber has the advantage of performing in-situ simultaneous deposition and sputter etch. The key hardware systems include the turbo pump, variable RF power delivery, gas distribution, electrostatic chuck (ESC), and independent helium cooling (IHC). The turbo pump enables the chamber to operate in the 10^{-3} Torr range to achieve the necessary sputter etching regime, and is centrally mounted for symmetric pumping. The bias RF generator delivers capacitively coupled energy to the ESC for sputtering. There are two independent source RF generators that deliver variable inductively coupled power to the chamber through the top and side coils. This split coil concept allows the plasma density to be tuned for different processes. The gas distribution system symmetrically introduces gases into the chamber to achieve uniform process parameters. The gases are delivered to the chamber through nozzles located at the top and side, which allows the process to be easily tuned and optimized. Silane and oxygen are introduced separately into the chamber to prevent upstream reaction. The monopolar designed Blue ^{TM} ESC holds the wafer, allowing helium backside cooling to be supplied. The IHC unit delivers helium to two separate zones of the ESC for tuning and controlling the temperature and temperature uniformity.

Another key of the Ultima Plus and Ultima TE HDP-CVD is the use of a remote Plasma Clean Source (RPS). This technology delivers a residue free clean process, thus eliminating process kit consumable, aluminum fluoride contamination, and the need to protect the ESC during the cleaning step. This clean significantly lowers green house warming emissions by fully disassociating the clean gas. The cleaning gas is delivered through from the top of the chamber provding for the most efficient method in cleaning the chamber.

This chapter describes the Ultima Plus HDP-CVD chamber assemblies and subassemblies and any mainframe features unique to the Ultima Plus HDP-CVD chamber. This chapter includes the following sections:

1.1 Ultima Plus HDP-CVD Chamber

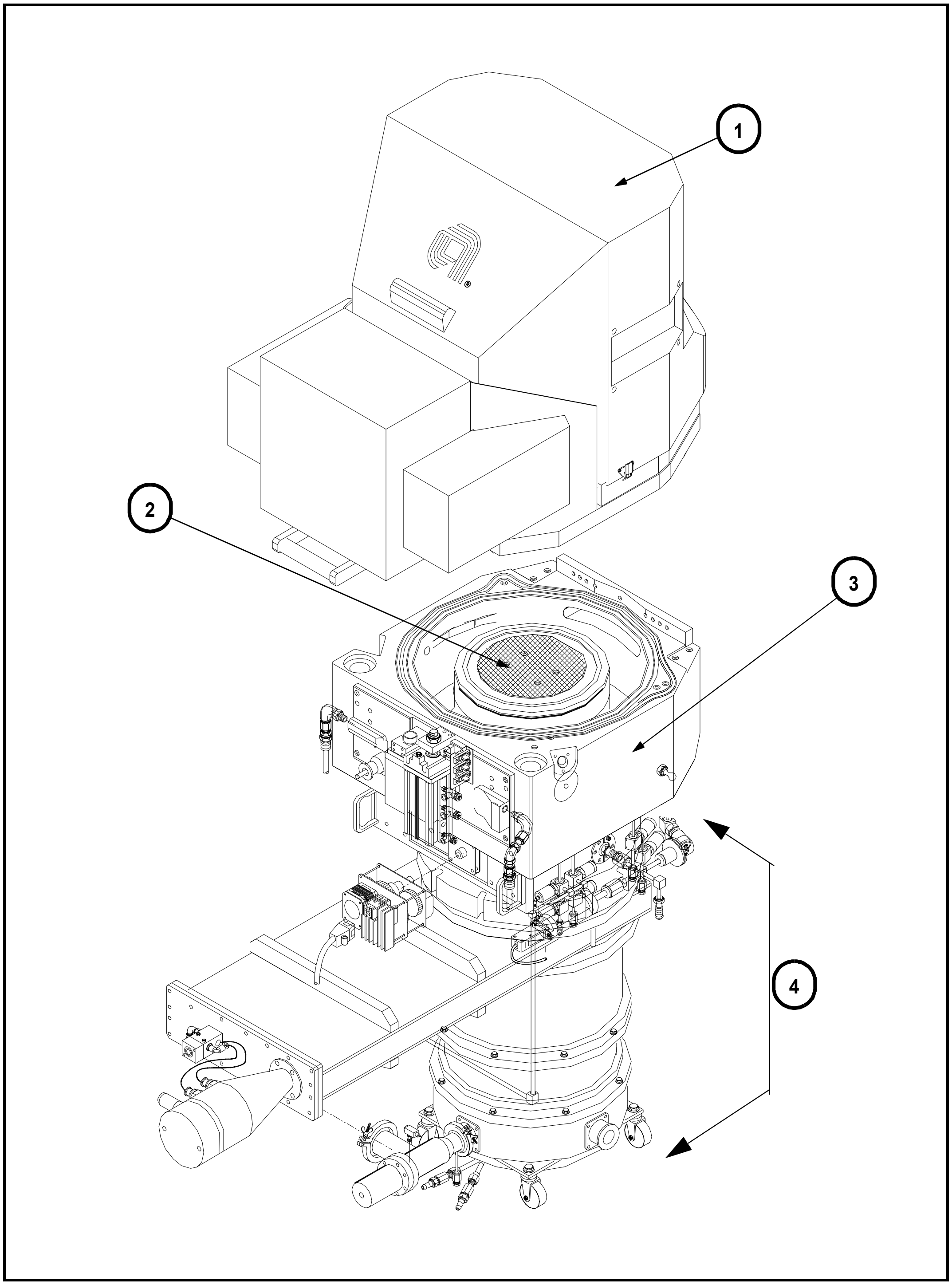


Figure 1-1. HDP Chamber Assembly

Table 1-1. Ultima Plus Chamber Assembly

No.	Item	Description
1	Upper Chamber Assembly	The Upper Assembly is built around a ceramic dome that is used for containing the HDP process. The top and side coils are located in the upper chamber. They deliver variable RF power. The power is delivered through the local match assemblies. There are four heaters, all powered from the source conditioning box mounted to the upper chamber. Gases are delivered to the chamber through the gas distribution ring and top nozzle assembly. The upper chamber assembly 's temperature is controlled using coolant from the heat exchanger. Also, the remote clean source is housed in the upper chamber assebly
2	Cathode Assembly	The Aluminum Cathode body houses the Blue ESC used for clamping the wafer, transferring dual zone helium cooling to the backside of the wafer and delivering bias power to the wafer for sputtering. The Blue ESC sits within a ceramic isolator enabling the ESC to be RF “Hot” while the cathode base is grounded to the chamber. A Pneumatic wafer lift mechanism is used for up and down wafer movements utilizing ceramic lift pins. The cathode assembly is temperature controlled using coolant from the heat exchanger.
3	Chamber Body	The chamber body is a machined piece of aluminum that allows for symmetric pumping. Cooling channels exist for coolant temperature control. Process gases are routed through the body to the upper chamber. Helium cooling is routed through the body to the cathode. The upper chamber is attached to the body with hinges and dual lift cylinders, which opens toward the transfer chamber allowing maximum clearance for service. The lower chamber is mounted to the bottom of the chamber body.
4	Lower Chamber Assembly	Contains the direct drive throttle valve, gate valve assembly, turbo pump assembly, rough line, and vacuum forelines.

1.2 Ultima Plus Upper Chamber Assembly

This section will describe the AE Flourine Generator and other hardware improvements to the Ultima upper chamber assembly. All other components to the upper chamber is described in the *Centura Ultima HDP-CVD Chamber Manual.*

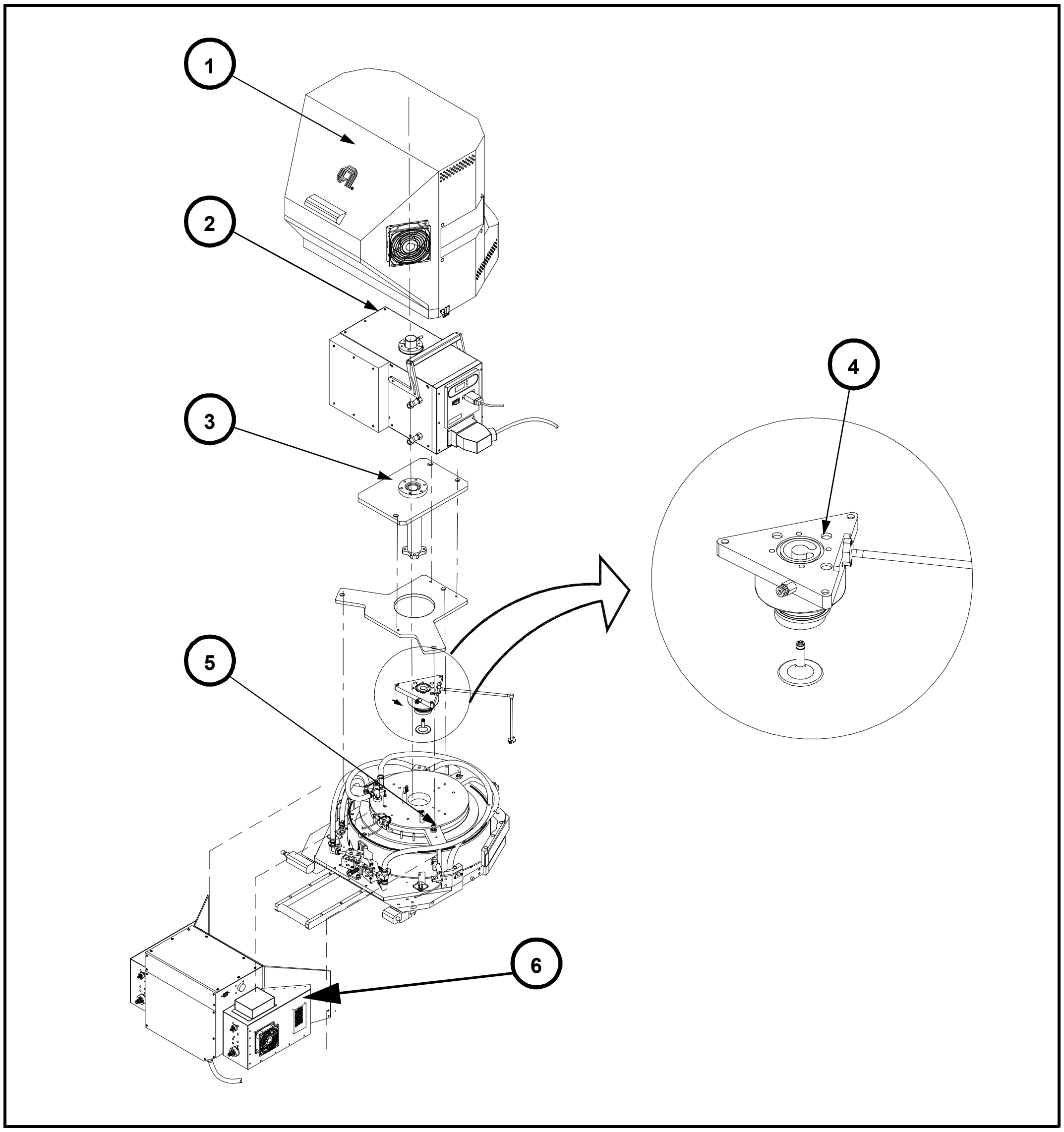


Figure 1-2. Ultima Plus Upper Chamber

Table 1-2. Ultima Plus Upper Chamber

No	Item	Description
1	Chamber Lid Cover	Upper chamber cover that encloses RPS, gas lines, RF coils for upper chamber.
2	RPS	Atomic Flourine Generator. This replaces the microwave clean in the ultima chamber. This more efficient desgn is a complete standalon unit.
3	RSP Mounting brackets	Mounting hardware used for RPS Unit.
4	Top Gas feed and clean port	Where top deposition gases and clean gases enter the chamber. Top Baffle piston o-ring location has been modified to allow better venturi vacuum seal.
5	Top Coil Assembly	New Top coil assembly with larger opening for top gas feed.
6	Balanced Side Match	The side match is designed to revome the induced DC bias on the side coil when side RF is ON.

1.2.1 Top Lid Assembly

Top Lid Assembly is a major part of the Upper Chamber assembly. Top Lid assembly houses Dome Temperature Control components, such as electrical heaters, TCs and Heat Exchanger lines, and Top and Side RF coils.

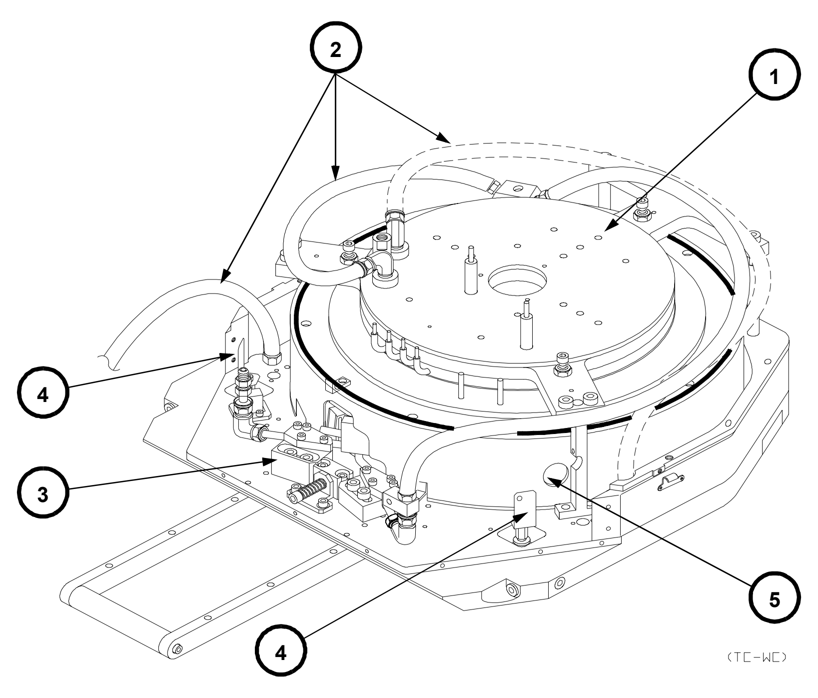


Figure 1-3. Top Lid Assembly

Table 1-3. Top Lid Assembly

No.	Item	Description
1	Top Plate Assembly	Contains the top source antenna for RF delivery, various plates, sheets for temperature control and RF isolation.
2	Cooling Water Hoses	Provides and distributes cooling water from Hot loop heater exchanger to the upper lid, the ground shield assembly, side coil assembly and top plate assembly.
3	Side Coil Tension/Insulator Lock Assembly	Ensures that the side coil has the correct amount of tension on the ceramic dome and also ensures it is sufficiently insulated from other components.
4	RF Connector (2×)	Distributes RF to the top and side coils
5	TC Sensor Port (zone 4)	Measures the temperature at the side coil assembly.

1.2.2 Source Conditioning Box

The Source Conditioning box is utilized to ensure proper separation of several electrical signals, including communication signals. The Source Conditioning Box also houses Venturi Vacuum assembly. Additionally, it serves as a Terminal Block for the AC supply for all Dome heaters, primary and Secondary TC connections, Top Lid assembly interlocks and communication signals for Local Matches.

TABLE 1

FROM		TO	
ITEM 99	SIDE TC	DOME TEMP. CTRL	4-SIDE
ITEM 99	SIDE TC	DOME TEMP. CTRL	4-SPARE
ITEM 101	CTR HEATER	DOME TEMP. CTRL	TB2-1
ITEM 101	CTR HEATER	DOME TEMP. CTRL	TB2-2
ITEM 102	CTR TC	DOME TEMP. CTRL	1-CTR
ITEM 102	CTR TC	DOME TEMP. CTRL	1-SPARE
ITEM 104	GND TC	DOME TEMP. CTRL	3-GND
ITEM 104	GND TC	DOME TEMP. CTRL	3-SPARE
ITEM 100	TOP TC	DOME TEMP. CTRL	2-TOP
ITEM 100	TOP TC	DOME TEMP. CTRL	2-SPARE
ITEM 100	TOP TC (GND WIRE)	DOME TEMP. CTRL	GND2
ITEM 34	SIDE HEATER	DOME TEMP. CTRL	TB2-7
ITEM 34	SIDE HEATER	DOME TEMP. CTRL	TB2-8
ITEM 100	OVERTEMP	DOME TEMP. CTRL	OT-1
ITEM 100	OVERTEMP	DOME TEMP. CTRL	OT-2
ITEM 100	OVERTEMP (GND WIRE)	DOME TEMP. CTRL	GND1
ITEM 192	P1 - LEAK DETECTOR	ITEM 193	J1
ITEM 193	J4	DOME TEMP. CTRL	INTLK
ITEM 193	SW1-COVER	ITEM 97	SW1
ITEM 193	SW1-LID	ITEM 97	SW2
ITEM 193	SW3-COVER	ITEM 97	SW3

TABLE 2

FROM	TO	FROM	TO
TOP COIL (ITEM 161)	E1 (ITEM 51)	TB2 (ITEM 161)	TB2-6 (DOME TEMP CTRL)
TOP COIL (ITEM 161)	E2 (ITEM 51)	TB2 (ITEM 161)	TB2-5 (DOME TEMP CTRL)
GND SHLD (ITEM 162)	E6 (ITEM 50)	TB2 (ITEM 162)	TB2-4 (DOME TEMP CTRL)
GND SHLD (ITEM 162)	E7 (ITEM 50)	TB2 (ITEM 162)	TB2-3 (DOME TEMP CTRL)
JUMPER (ITEM 160)	E3 (ITEM 51)	JUMPER (ITEM 160)	E1 (ITEM 51)
JUMPER (ITEM 160)	E2 (ITEM 51)	JUMPER (ITEM 160)	E4 (ITEM 51)

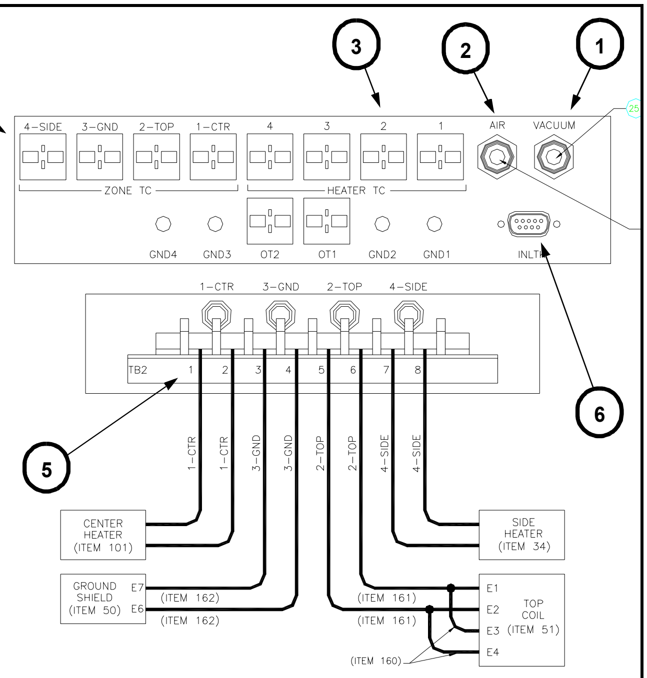


Figure 1-4. Source Conditioning Panel

Table 1-4. Source Conditioning Panel

No.	Item	Description
1	Vacuum	Venturi vacuum for top nozzle assembly.
2	Clean Dry Air (CDA) connection	Injects CDA into the vacuum supply via the venturi effect.
3	Dual TC Function	Connection port for secondary TC components.
4	Zone TC	Connection port for the Primary TC components.
5	Terminal Block	AC connection for center heater, ground shield, side heater, and top plate.
6	Interlock	Connection port for cover/lid harness interlock harness assembly.

1.2.2.1 Top Nozzle Assembly

The top nozzle assembly provides the center located supply of SiH_4,Ar and NF_3 Clean gases into the chamber. It is utilized to ensure greater process uniformity and efficient chamber cleanoing.

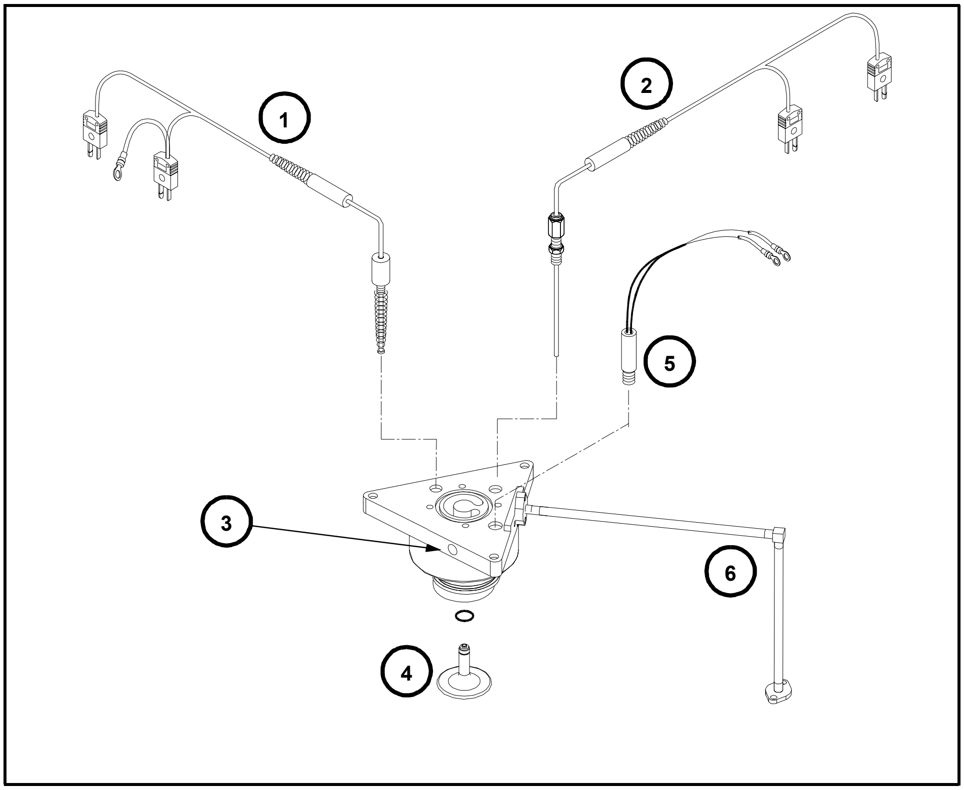


Figure 1-5. Top Nozzle Assembly

Table 1-5. Top Nozzle Assembly

No.	Item	Description
1	Top Coil Dual TC (zone 2)	Provides dual TC function (Primary/Secondary) for accurate and reliable temperature measurement of the top plate assembly.
2	Center Dual TC (zone 1)	Provides dual TC function (Primary/Secondary) for accurate and reliable temperature measurement of the top nozzle area.
3	Venturi Vacuum Connection	Connection point for the vacuum hose which helps to maximize the heat transfer contact area between the dome and the top plate assembly.
4	Center Nozzle	Inputs ,SiH_4 and AR into the top of the dome for process recipes. (PH_3/SiH_4 for PSG) As well as directing the clean gases anularly around the top baffle.
5	Center Heater	200 W/208 VAC heater which heats the center gas feed block. This prevents excess depostion on the center gas fed block.
6	SiH_4 Gas Weldment	Provides SiH_4 and AR to the top nozzle assembly. (PH_3/SiH_4 for PSG)

1.2.2.2 Top Plate Assembly

The Top Plate Assembly includes the components that maintain the temperature of the Dome. Those components include Heat Exchanger connections and electrical heaters. This assembly also houses the top RF coil that is responsible for striking plasma in the chamber.

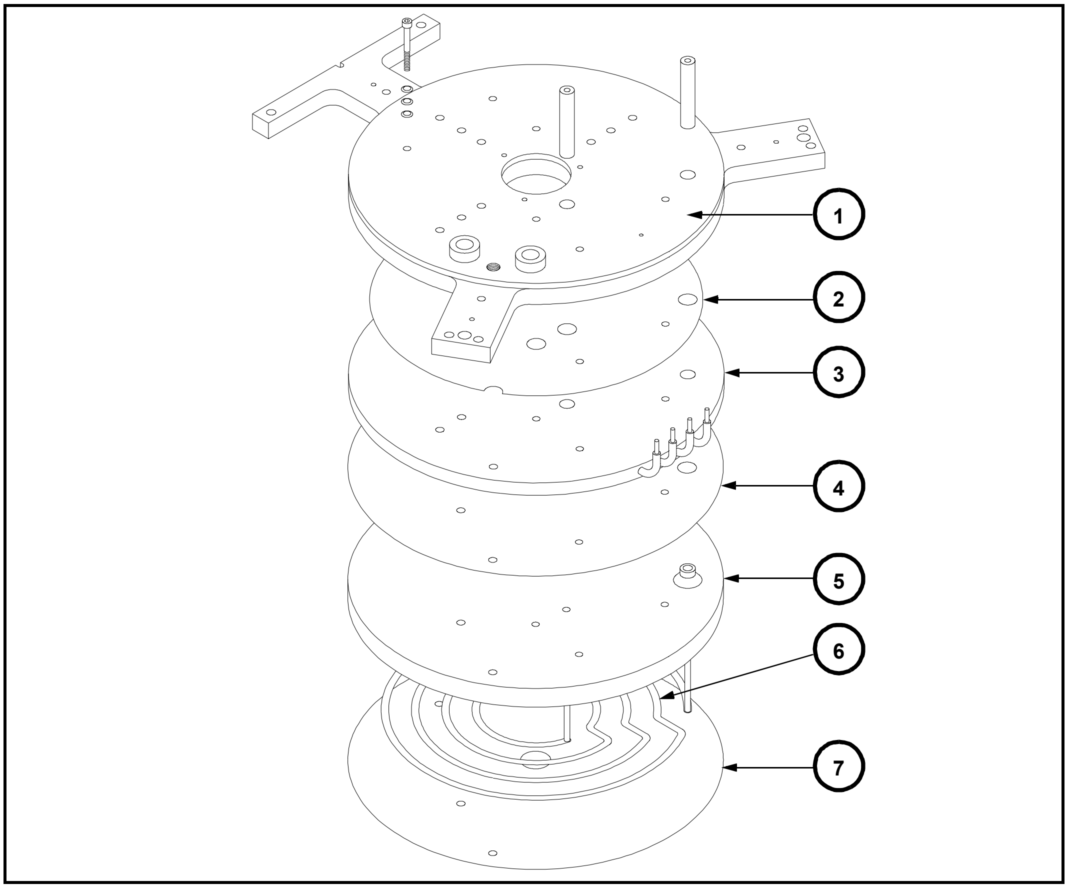


Figure 1-6. Top Plate Assembly

Table 1-6. Top Plate Assembly

No.	Item	Description
1	Water Cooling Plate	Provides cooling water path for top plate assembly.
2	Grafoil Sheet	Used for heat transfer.
3	Heater Plate	Contains two 2.5 kW/208 VAC heaters in series which provide a total of 5 kW/208 VAC.
4	Grafoil Sheet	Used for heat transfer.
5	Aluminum Nitride Plate	Provides isolation for RF (top) and heater transfer.
6	Top RF Coil	The source top coil lies between the Chomerics sheet and the aluminum nitride plate. RF power (up to 5000 watts) is provided to the top coil through the variable frequency (2.0 ± 0.2MHz) RF system.
7	Chomerics Sheet	Used for heat transfer across top of dome.

1.2.2.3 Ground Shield Assembly

The ground shield assembly surrounds the side RF coil and provides the ground path for any stray RF to the chamber body. This assembly also houses additional Dome temperature control component which is Ground Shield Heat Exchanger Ring.

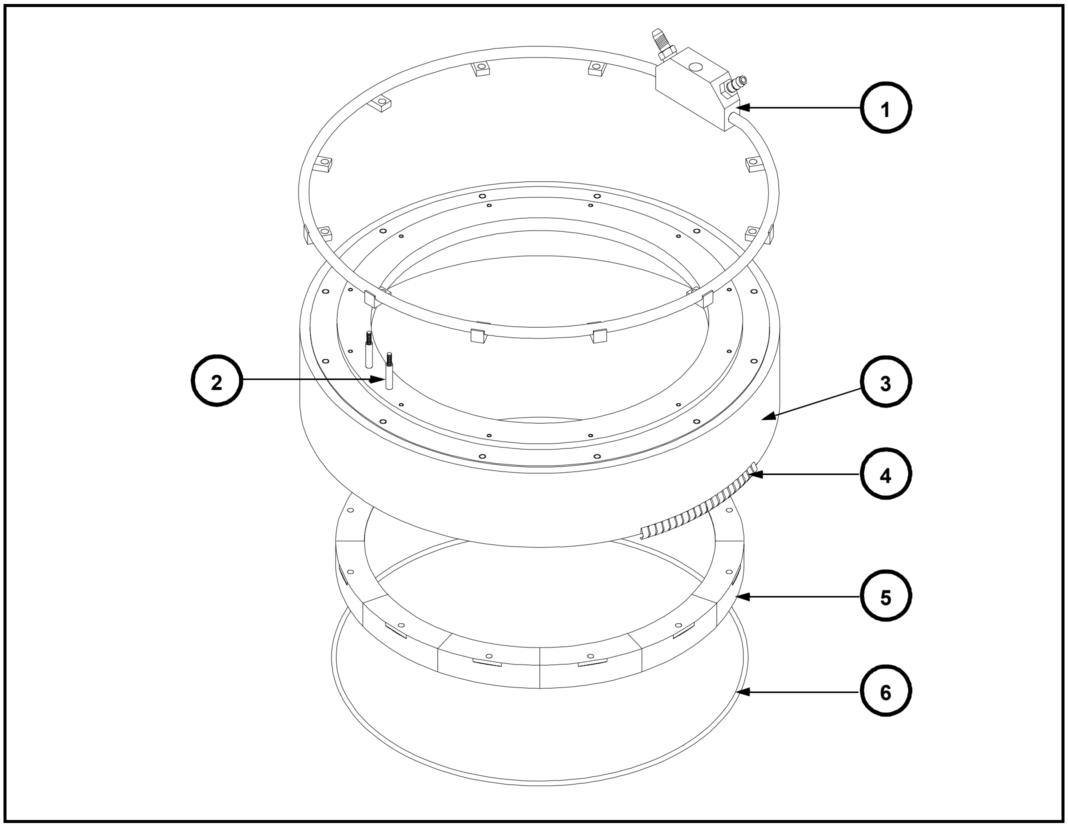


Figure 1-7. Ground Shield Assembly

Table 1-7. Ground Shield Assembly

No.	Item	Description
1	Heat Exchanger Cooling Ring	Used for the flow of heat exchanger fluid to control the ground shield assembly temperature.
2	AC Connection	AC heater connection for the 3 kW/208 VAC Ground Shield Heater (zone 3).
3	Ground Shield	Provides symmetric ground to the side coil and contains the Ground Shield Heater.
4	RF Ground Braid	Ensures proper grounding of RF energy.
5	Graphite Block (12×)	Used for heat transfer and spacing.
6	Viton O-Ring	Ensures concentricity of graphite blocks with the ceramic dome by providing alignment.

1.2.2.4 Side Coil

The Side Coil assembly includes the Side Coil, Side Coil AC Heater and Side Coil TC. Side Coils main purpose is to sustain plasma in the chamber using RF energy. The Side Coil wraps around the Ceramic Dome and emanates the RF energy through it.

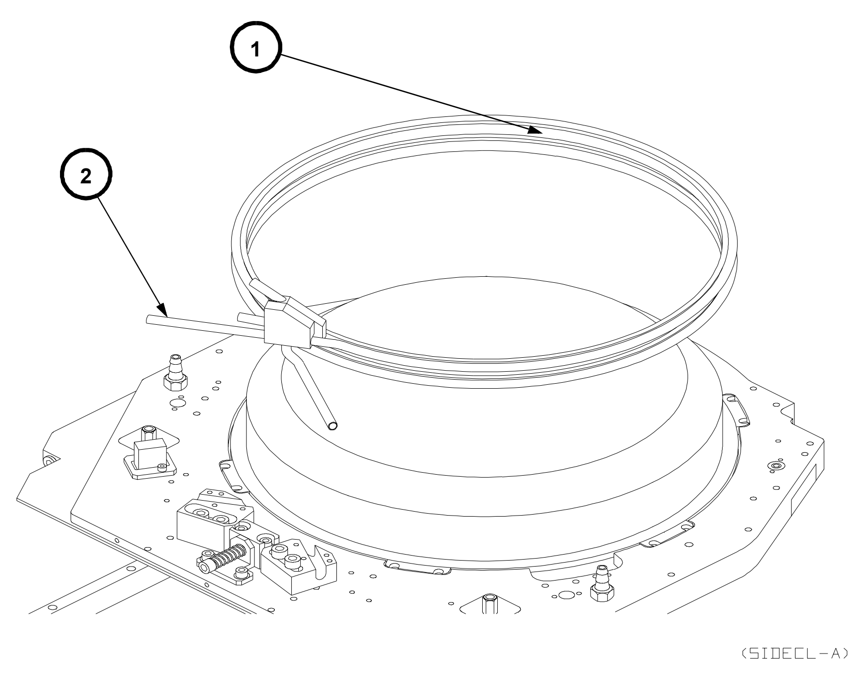


Figure 1-8. Side Coil Assembly

Table 1-8. Side Coil Assembly

No.	Item	Description
1	Side Coil Heater	Consists of two cable heaters soldered or brazed into the copper frame. It is used to maintain the dome temperature during wafer processing. Each cable heater emits 2400 watts of power for a total of 4800 watts.
2	Side RF Coil	Carries RF power around the side of the dome. The tube allows the passage for heat exchanger fluid for cooling heat transfer.

1.2.2.5 Ceramic Dome

The Ceramic Dome encloses the process environment inside the chamber. Sufficient sealing is provided between the Dome and the chamber to ensure vacuum integrity inside the chamber.

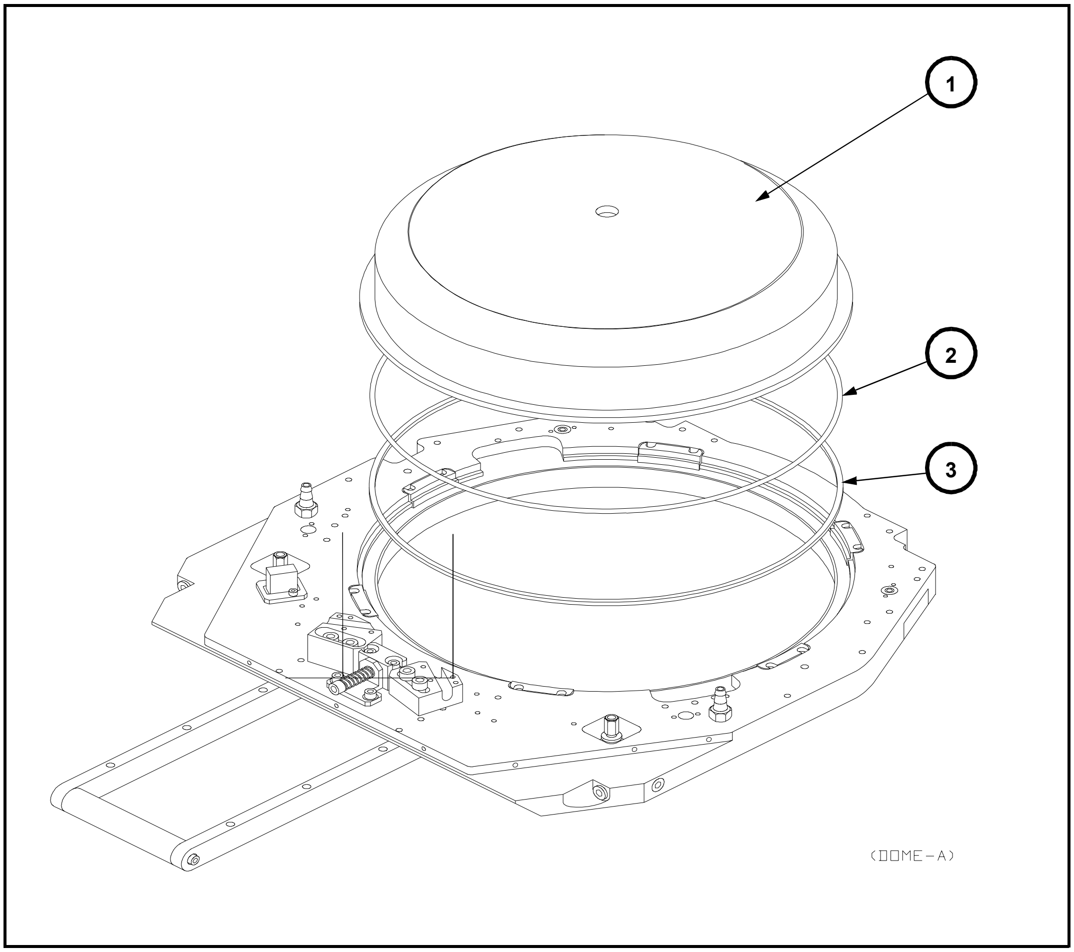


Figure 1-9. Ceramic Dome

Table 1-9. Ceramic Dome

No.	Item	Description
1	Ceramic Dome	Region where process occurs. It is the base for the other components; top coil, side coil, top nozzle, etc.
2	Chemraz O-Ring	Provides a barrier and sealing surface.
3	Teflon Ring	Barrier against Fluorine attack during clean.

1.2.2.6 Gas Distribution Ring

The gas Distribution Ring supplies the process gases to the chamber. It houses either 18 or 24 ceramic gas supply nozzles, 12 (16 for 24 nozzle gas ring) nozzles supply SiH_4/Ar to the chamber and 6 (8 for 24 nozzle gas ring) nozzles supply O_2 to the chamber. Internal SiH_4/Ar channel transfers the gases to the gas nozzles.

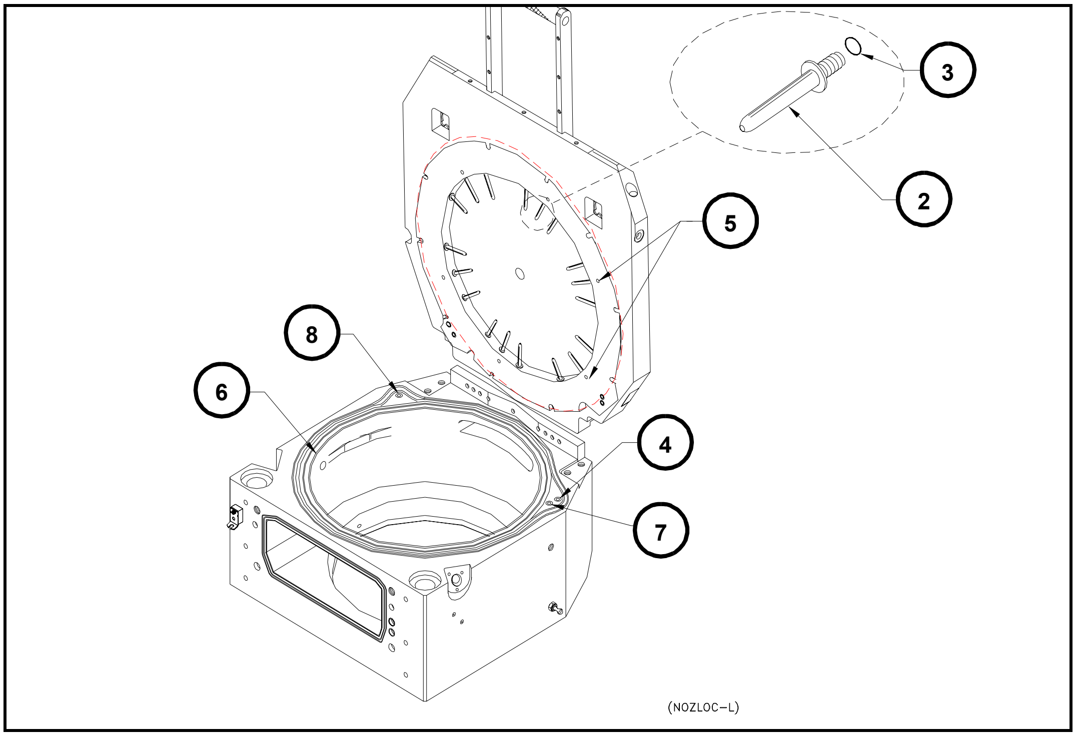


Figure 1-10. Chamber Body and Gas Distribution Ring

Table 1-10. Chamber Body and Gas Distribution Ring

No.	Item	Description
2	Gas Nozzles	Provides path for process gases to the chamber.
3	Teflon Washers	Provide a seal for the nozzle to the Gas Distribution Ring, preventing gas from entering the chamber through the threads.
4	Top SiH_4 Gas Feed Through	Supply feed for process SiH_4 to top nozzle assembly. Ar is also supplied through the Top SiH_4 Gas Feed Through. For PSG processing top PH_3/SiH_4 will also be supplied here.
5	O_2 Supply Holes	Path for Oxygen to flow into gas distribution ring from the O_2 channel.
6	O_2 Channel	Oxygen is distributed to the gas distribution ring through this channel. The gas is supplied from two separate inputs to the chamber body. For FSG processing, SiF_4 will be supplied through the Oxygen Channel with the O_2.
7	Side SiH_4 Gas Feed Through	Supply feed for process SiH_4 to the Gas Distribution Ring. Ar is also supplied through the Side SiH_4 Gas Feed Through. For PSG processing top PH_3/SiH_4 will also be supplied here.
8	Top O_2 Gas Feed Through	Supply feed for process O_2 to top nozzle assembly.

1.2.3 Lower Chamber Assembly

This section contains discussion on the items that maintain and measure vacuum in the process chamber, and supply process and cleaning gases. cathode assembly and bias RF components will also be described in this section.

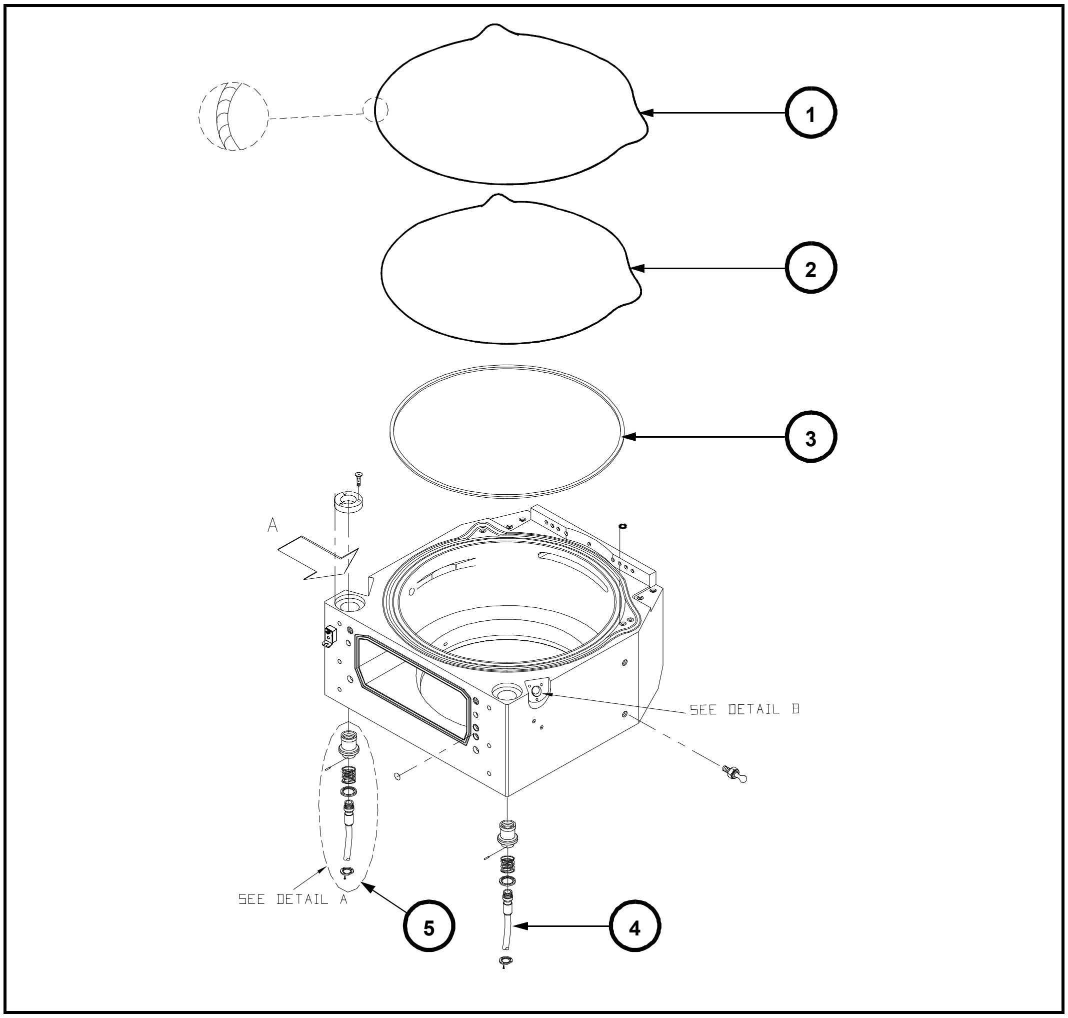


Figure 1-11. Chamber Body Assembly

Table 1-11. Chamber Body Assembly

No.	Item	Description
1	RF Braid	Provides ground path from body to lid.
2	Chamber O-ring	Provides vacuum seal from atmosphere between the body and lid.
3	Teflon Seal	Provides isolation of oxygen gas channel from chamber.
4	Top RF Supply Connector	Provides connection point to supply RF to the lid assembly for the top coil.
5	Side RF Supply Connector	Provides connection point to supply RF to the lid assembly for the side coil.

1.2.3.1 Chamber RF Supply

The RF power is transferred to the process chamber via coaxial cable. The connection of the cable to the chamber is spring loaded to ensure proper cable mounting.

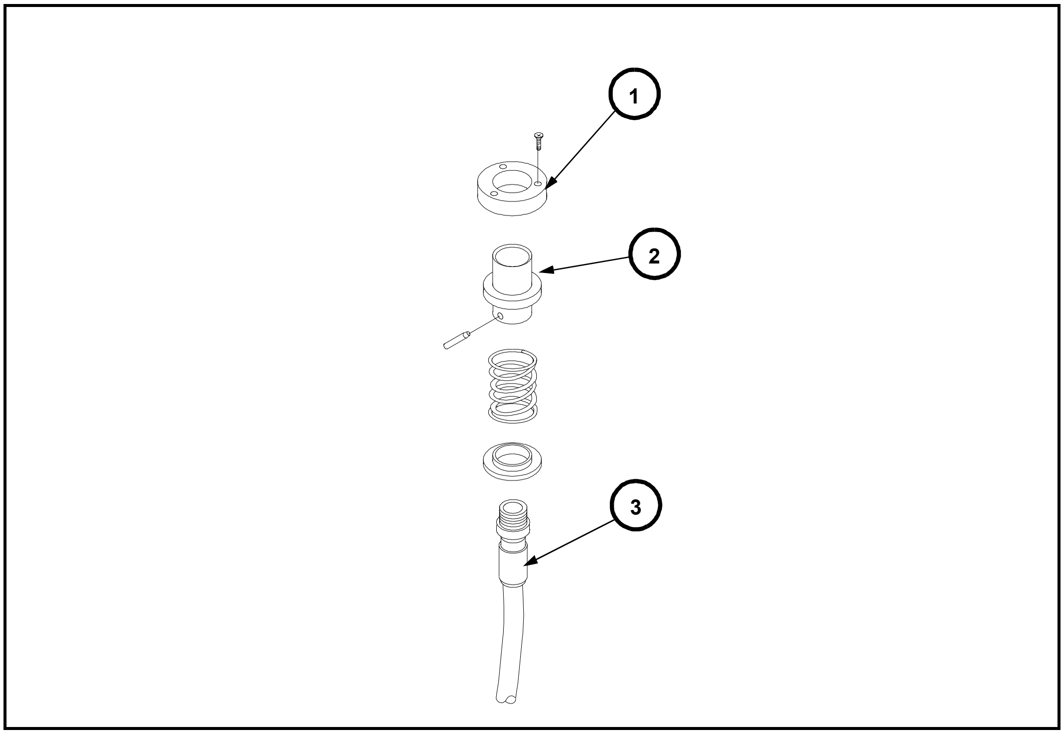


Figure 1-12. Chamber RF Supply (Top and Side)

Table 1-12. Chamber RF Supply (Top and Side)

No.	Item	Description
1	RF Cover	Helps contain chamber RF supply assembly.
2	RF Insulator	Provides insulation for RF energy.
3	Chamber RF Cable	Provides RF supply to chamber.

1.2.3.2 Viewport/Manometer

Chamber viewport is used to observe plasma. Dual manometer assembly is used to measure Chamber pressure. 100 mTorr manometer is used to measure the pressure during process while 10Torr manometer is used to measure pressure during clean step.

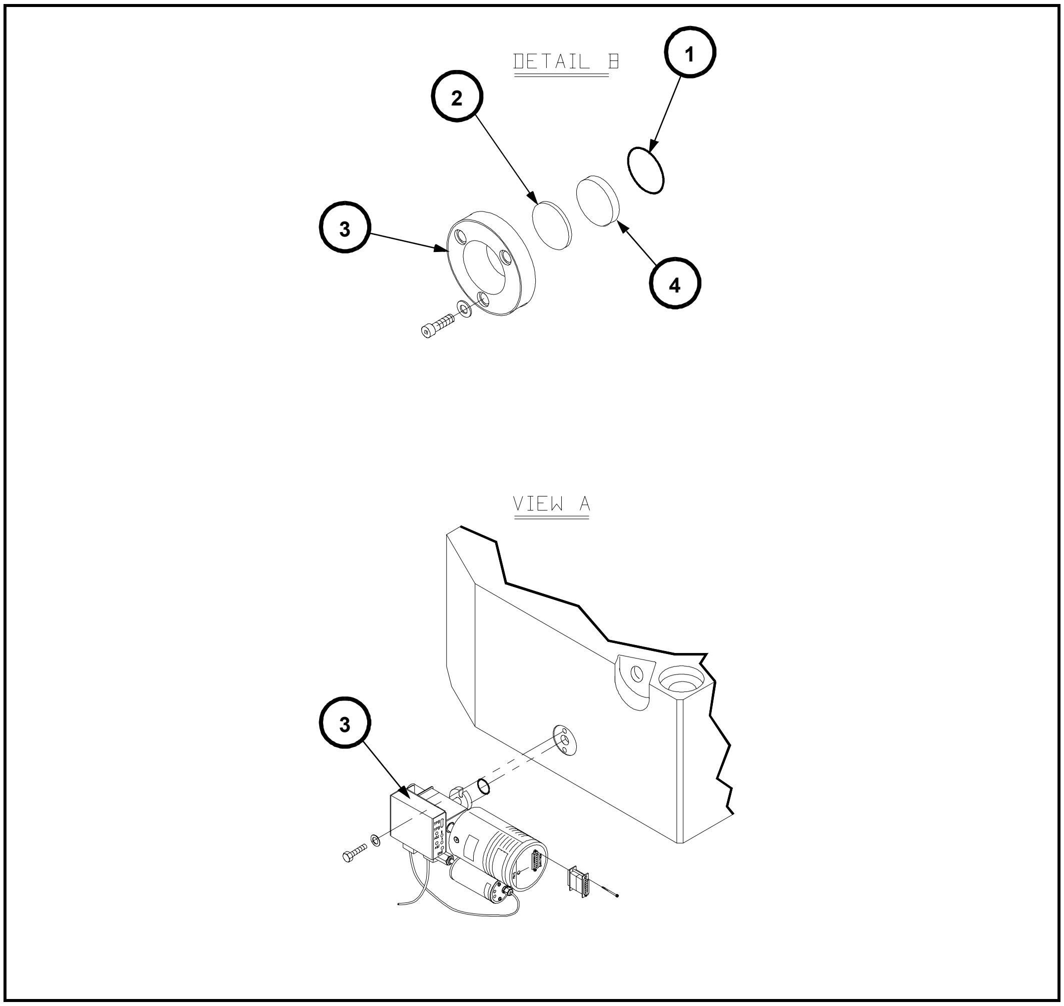


Figure 1-13. Viewport/Manometer

Table 1-13. Viewport/Manometer

No.	Item	Description
1	Chemraz O-ring	Provides barrier and sealing surface.
2	UV Filter	Provides protection from UV light.
3	Viewport Bracket	Contains and seals viewport assembly.
4	Sapphire Window	Provides clear view of process reaction.
5	10 Torr + 100 mTorr Manometer	Dual Manometer that monitors chamber pressure.

THIS PAGE INTENTIONALLY LEFT BLANK.

1.2.3.3 Cathode Assembly

The Cathode assembly performs several functions during wafer processing. It holds the wafer in place by means of ESC, houses lift assembly, transfers the heat from the wafer using the backside helium cooling and Heat Exchanger cooling fluid that channels through the cathode body. The bias RF power is supplied to the cathode and assists in sustaining the plasma and developing the DC bias on the wafer.

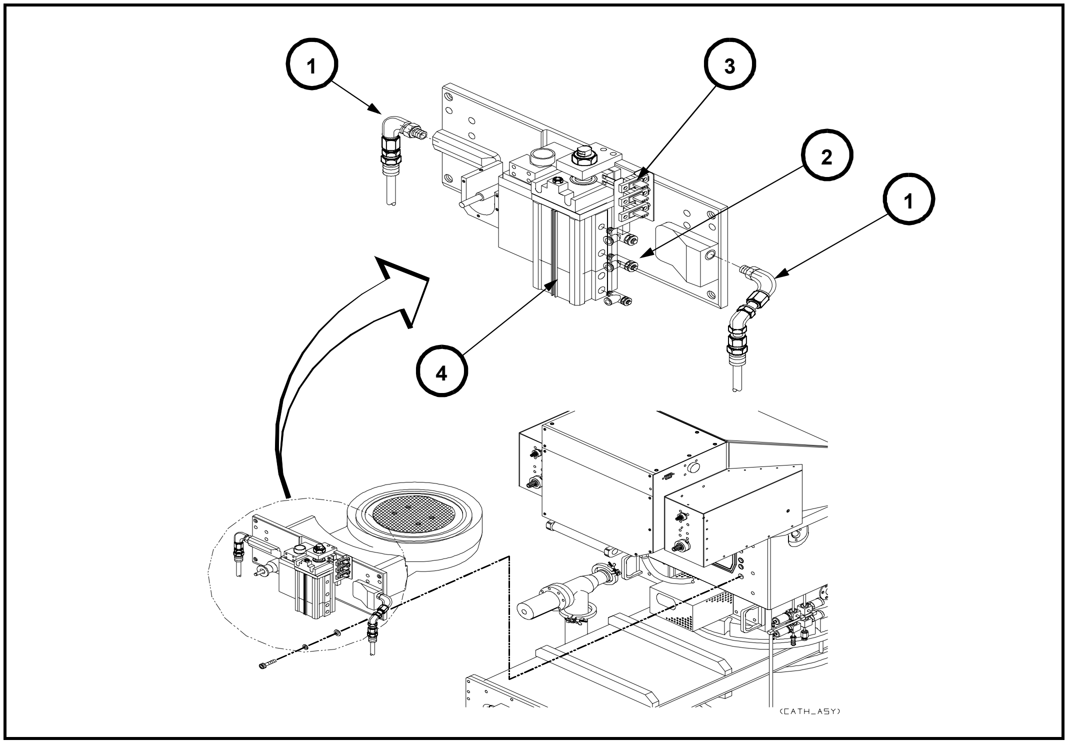


Figure 1-14. Cathode Assembly (View 1)

Table 1-14. Cathode Assembly (View 1)

No.	Item	Description
1	Cathode Cooling Water	Provides the path into the cathode assembly for temperature from the hot loop of the SMC heatexchanger. (typically 70C)
2	Lift Speed Adjustment Knobs	Controls the speed to the wafer lift.
3	Lift Opto Sensors	Determines the position of the actutor lift flags
4	Lift Actuator Assembly	The 3-position pneumatic cylinder for the wafer lift f flags lie on the side of the cathode. The lift pins are in a vacuum area equal to the chamber pressure and are isolated from the plasma. The wafer lift fingers are independently connected to the spider. The spider is connected to an individual air cylinder with a concentric shaft.

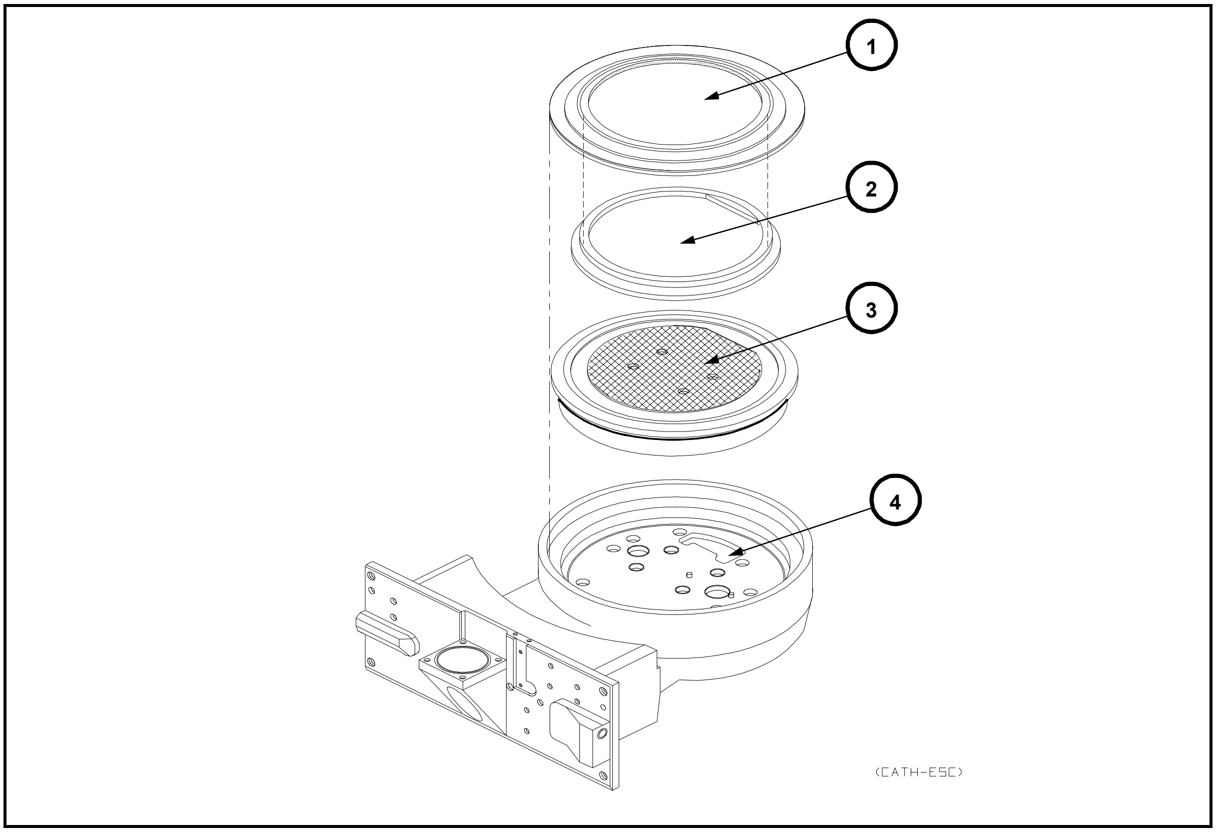


Figure 1-15. Cathode Assembly (View 2)

Table 1-15. Cathode Assembly (View 2)

No.	Item	Description
1	Ceramic Cover	The ceramic cover is generic. The cover extends from the collar to edge of the cathode assembly. Its primary purpose is to protect the lower chamber from the effects of the plasma.
2	Ceramic Collar	The annular ceramic collar is size and wafer type specific. The collar lies between the ESC and the ceramic cover. Its primary purpose is to protect the ESC flange from the effects of the plasma.
3	Electrostatic Chuck (ESC)	The basic design is that of a uni-polar DC chuck, requiring the plasma created by the inductive source to act as a conductor for the charge on the wafer during both chucking and de-chucking. RF bias is not applied during the chuck or de-chuck steps. Chucking force is affected by the wafer self-bias, which is dependent upon pressure, plasma density and bias power. Adequate force is available over the useful process window. The ESC has dual zone helium cooling for wafer temperature control. The ESC is temperature controlled by coolant from the heat exchanger.
4	Cathode Body	Housing for ESC and process components.

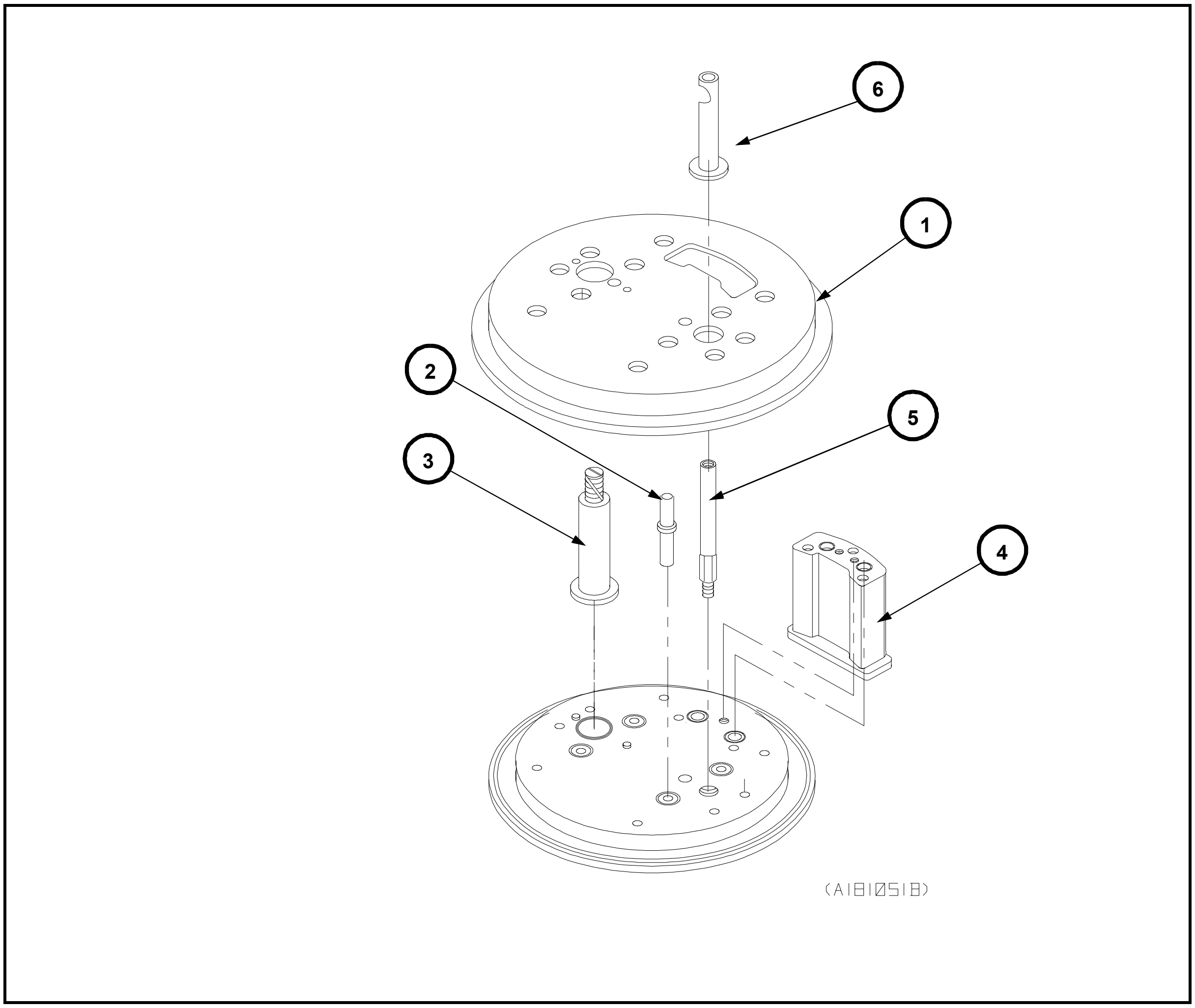


Figure 1-16. Cathode Assembly (View 3)

Table 1-16. Cathode Assembly (View 3)

No.	Item	Description
1	Ceramic Isolator	Isolates the Electrostatic Chuck from the cathode body.
2	Lift Pin Guide	Guides the vertical movement of the lift pins.
3	Helium Feed Through	Provides path for Helium (inner and outer) to Electrostatic Chuck for backside helium cooling of the wafer.
4	Water Manifold	Provides water routing for cathode assembly cooling.
5	RF Feed Through	Provides path for DC/Bias RF power to the Electrostatic Chuck.
6	RF Insulator	Provides insulation for RF post.

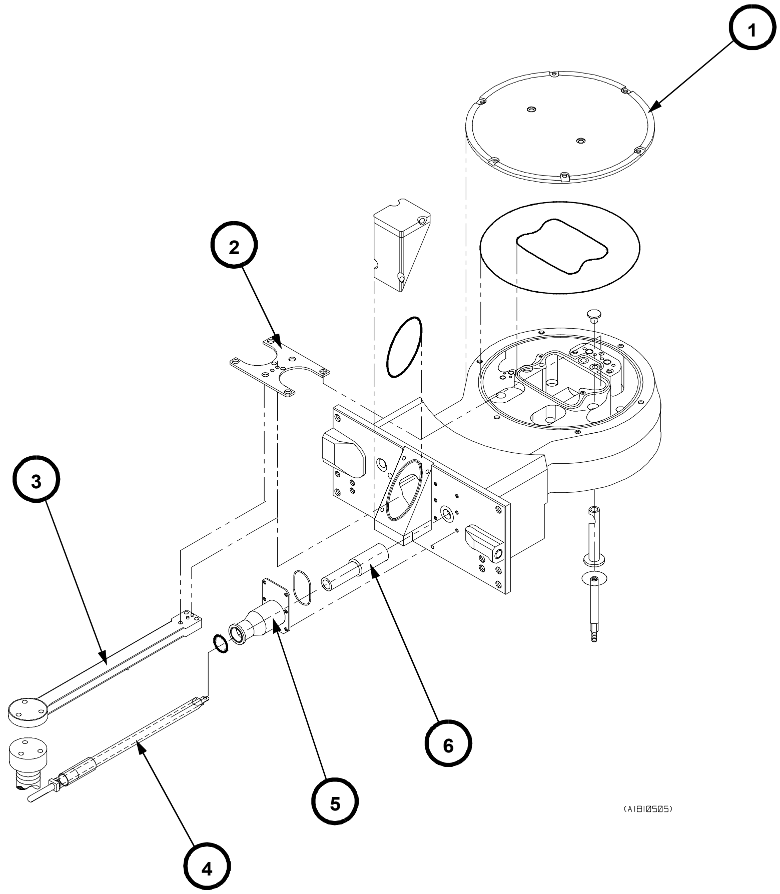


Figure 1-17. Cathode Assembly (View 4)

Table 1-17. Cathode Assembly (View 4)

No.	Item	Description
1	Cathode Bottom Cover Plate	Seals the bottom of the cathode assembly
2	Lift Pin Carrier (Spider)	Contains the 4 Wafer Lift Pins.
3	Lift Arm	Provides the lifting motion for lift pins.
4	Bias RF Post and Insulator	Delivery path of Bias RF/DC power and protective sheath for insulation.
5	Bias RF Adaptor	Connection point for Bias RF match and cathode assembly.
6	Bias Insulator	Provides insulation from Bias RF power.

1.2.3.4 Bias Match

Bias RF Match is an automatic match that is used to match the impedance of the load (chamber+match) to 50Ω value. Power transfer is maximized when the impedance matching is achieved.

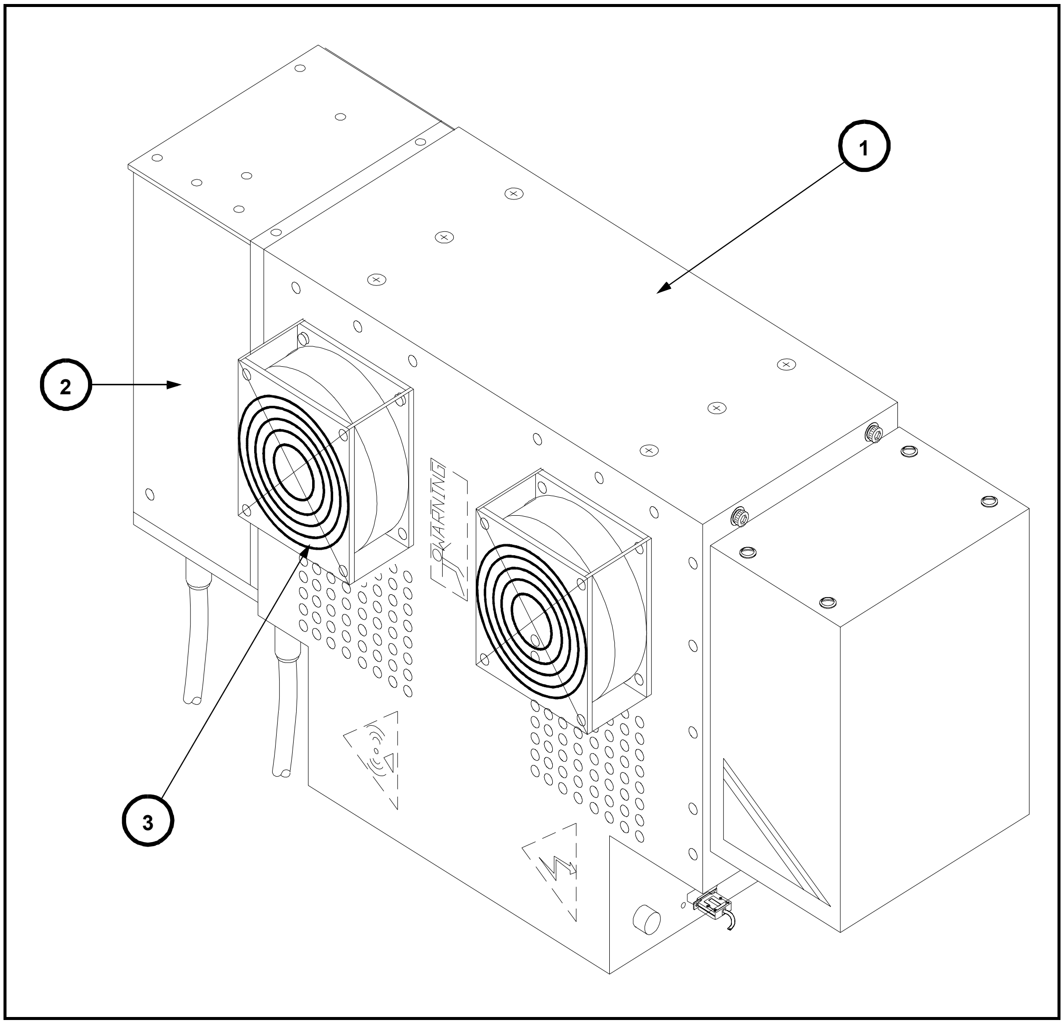


Figure 1-18. Bias RF Match

Table 1-18. Bias RF Match

No.	Item	Description
1	Bias RF Match	The automatic match is supplied with RF power up to 5,000 watts at13.56 MHz match.
2	ESC Power Supply	Provides DC power to chuck wafer.
3	Cooling Fan	Provides air cooling for the Bias RF Match.

1.2.3.5 Chamber Exhaust

Chamber exhaust components discussed in this section are: Throttle Valve, Gate Valve, Turbo Pump and Bypass Foreline. All chamber exhaust components form a pumpstack and all of them are connected to the dry pump.

Gate Valve is used to provide isolation between the chamber and the turbo pump. It is pneumatically actuated and has two positions — open and close.

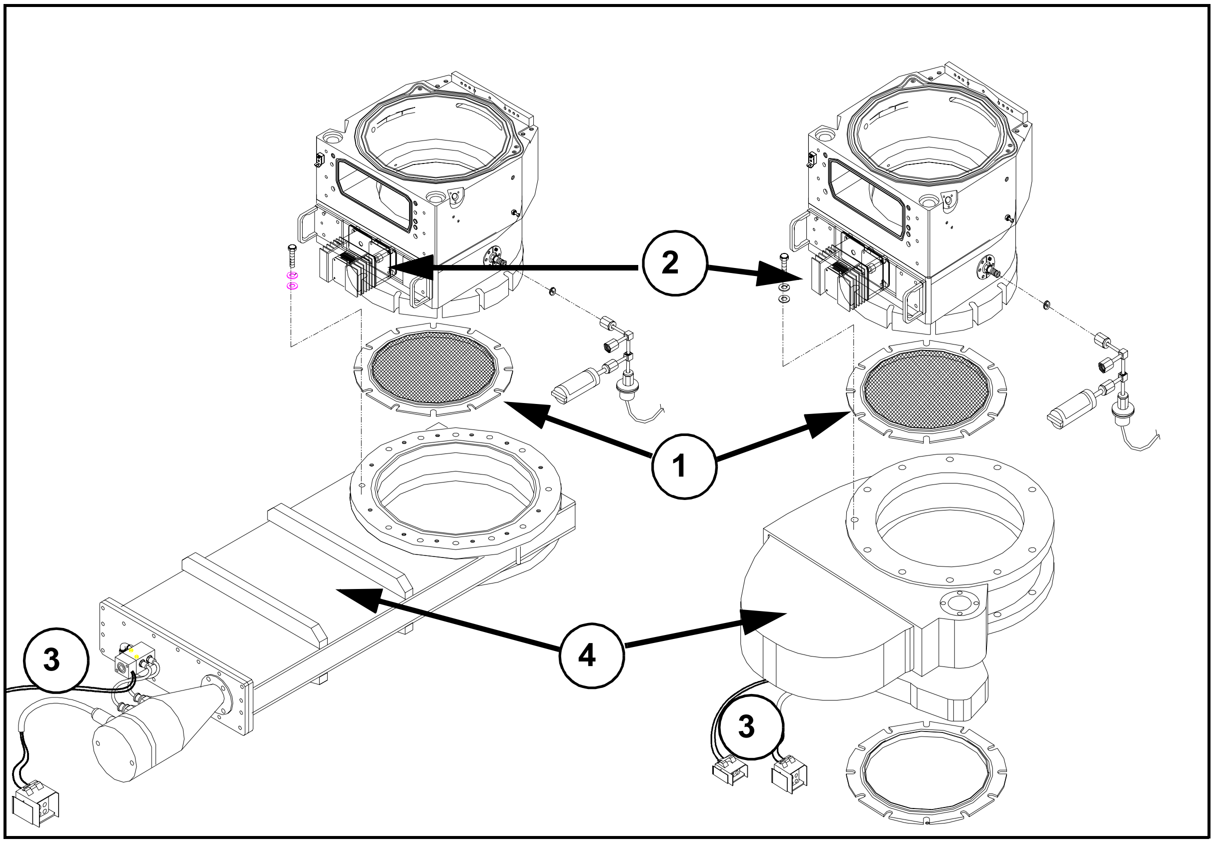


Figure 1-19. Gate Valve

Table 1-19. Gate Valve

No.	Item	Description
1	Aluminum Turbo screen	The turbo screenis made of aluminum and has been placed above the gate valve. This is to aid in cleaning the screen during chamber clean process. Which in turn reduces the particles generated from deposition on screens in the turbo.
2	Turbo Throttle valve	Chamber pressure control is achieved by the Turbo throttle (butterfly) valve and direct drive throttle valve stepper motor.
3	Open/Close and Sensors	Connectors where the open and close signals are sent to the gate valve as well as the sensors back to the system.
4	Gate Valve Assembly	The Ultima Plus lower chamber has two types of gate valves to choose from . The gate valve can either be an HVA valve (left) or Pendulum Gate valve (right) .

Turbo Pump is used to bring the chamber pressure to much lower value that can be achieved by using the dry pump alone. It is not an atmospheric turbo pump, therefore, the initial pump down of the chamber should be done through the Bypass Foreline, until the pressure in the chamber is approximately 150 mTorr–200 mTorr. This routine is performed automatically when Chamber Pump Down is selected

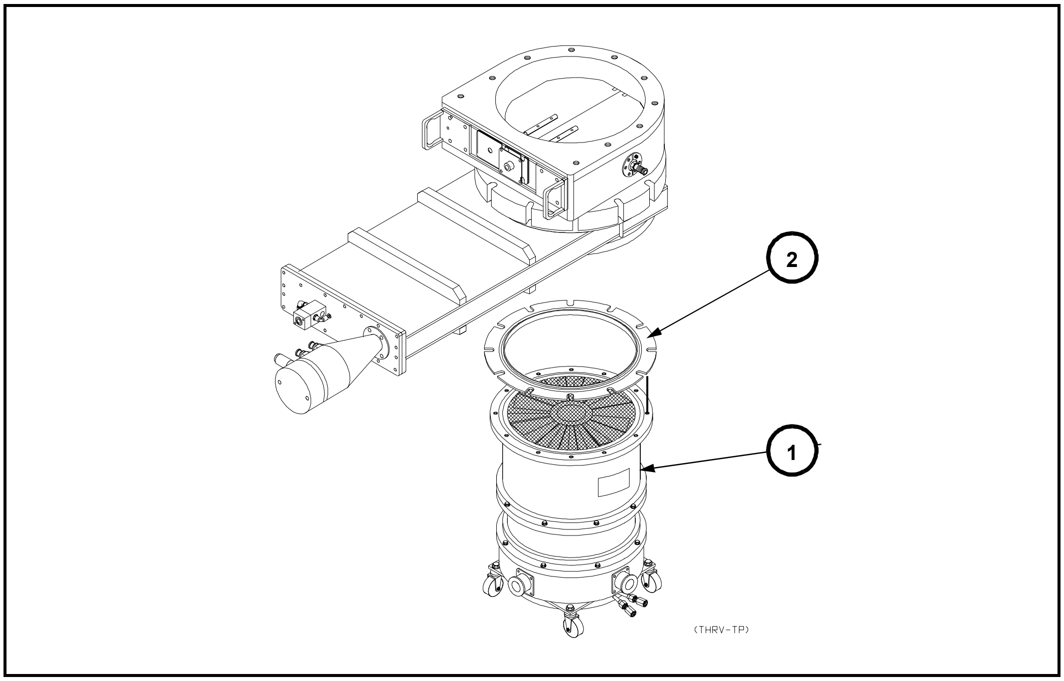


Figure 1-20. Turbo Pump Assembly

Table 1-20. Turbo Pump Assembly

No.	Item	Description
1	Turbo Pump	The turbo pump for the Ultima plus chamber maintains the process chamber pressures in the sub 10^{-3} Torr range. The rotor is supported by magnetic bearings without any mechanical contact and requires no lubrication oil. The magnetic bearing consists of five pairs of active magnetic bearings. A visual flowmeter downstream of the turbopump is interlocked to ensure a minimum coolant flow of approximately 1 gpm. The flowmeter is designed to allow a specific flow rate at a minimum input water pressure of 60 psi. Nitrogen is supplied to each turbopump from the facilities N_2 manifold for the mainframe. The gas supply is regulated to 7 psi and is actuated by a common pneumatics valve. The turbopump has an N_2 flowmeter with a typical adjustment of 25 sccm. The bypass around the flowmeter includes an electrovalve which allows for a high flow of N_2 to be introduced behind the turbopump in the event of a power loss.
2	Spacer	Insert between gate valve and turbo pump.

Rough Pump Foreline or Bypass Foreline is used for initial chamber pump down before the Turbo Pump can be used. It is also used during the clean steps when the turbo pump is isolated and pressure control is achieved by Rough Throttle Valve.

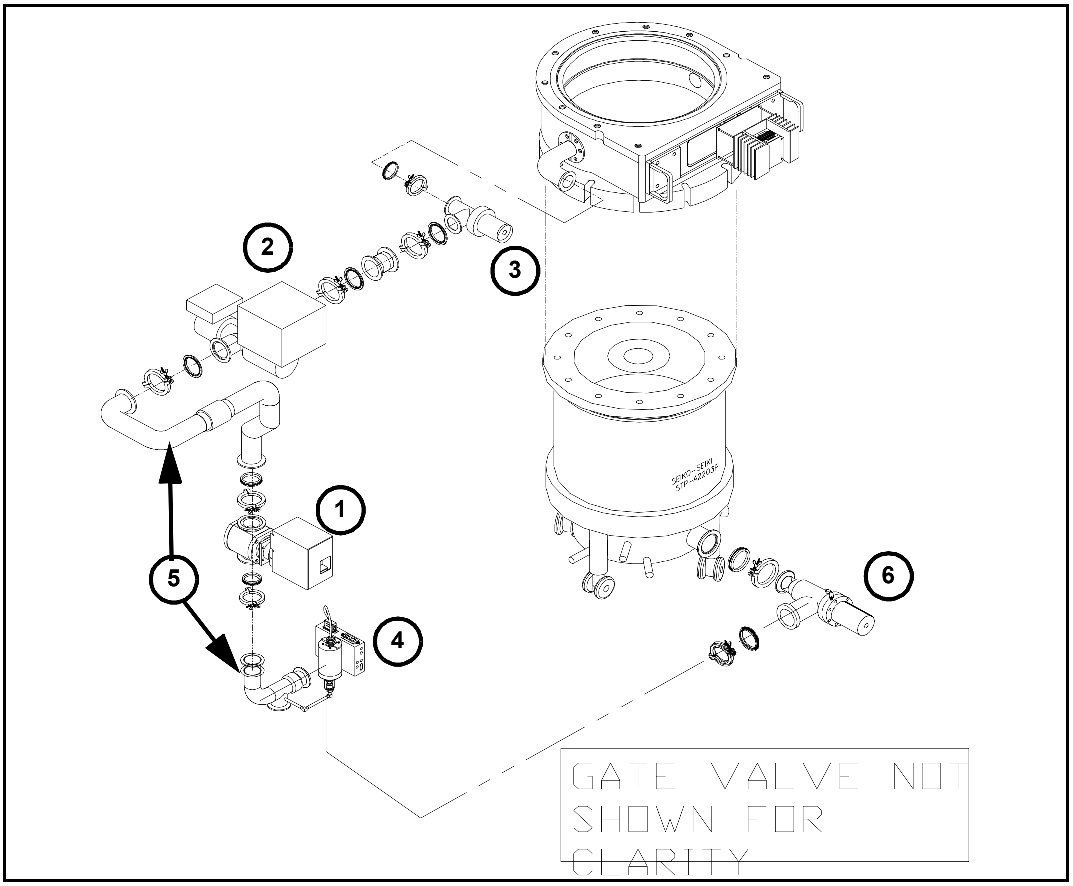


Figure 1-21. Turbo Pump/Rough Pump Foreline

Table 1-21. Turbo Pump/Rough Pump Foreline

No.	Item	Description
1	Rough Throttle Valve	Controls chamber pressure via the roughing pump foreline.
2	IR Diagnostics	Used during the chamber cleaning process. Measures the amount of Silicon Flouride ions. This corresponds to when the chamber is clean.
3	Rough Isolation Valve	Isolates the Chamber from the foreline.
4	Foreline Maonmeter	Measures the foreline pressure.
5	Roughing Foreline Weldments	Path where the turbo pumped is bypassed during higher pressure pumping.
6	Turbo Isolation Valve	Isolates the turbo from the foreline.

1.3 Independent Helium Cooling

The Independent Helium Cooling Assembly supplies Helium to the backside of the wafer during process. Helium serves as a medium for transferring the heat from the wafer to the Heat Exchanger cooled cathode. Dual IHC (Independent Helium Control) assembly is capable of controlling and maintaining two different pressure setpoints to accommodate the Dual Zone Electrostatic Chuck.

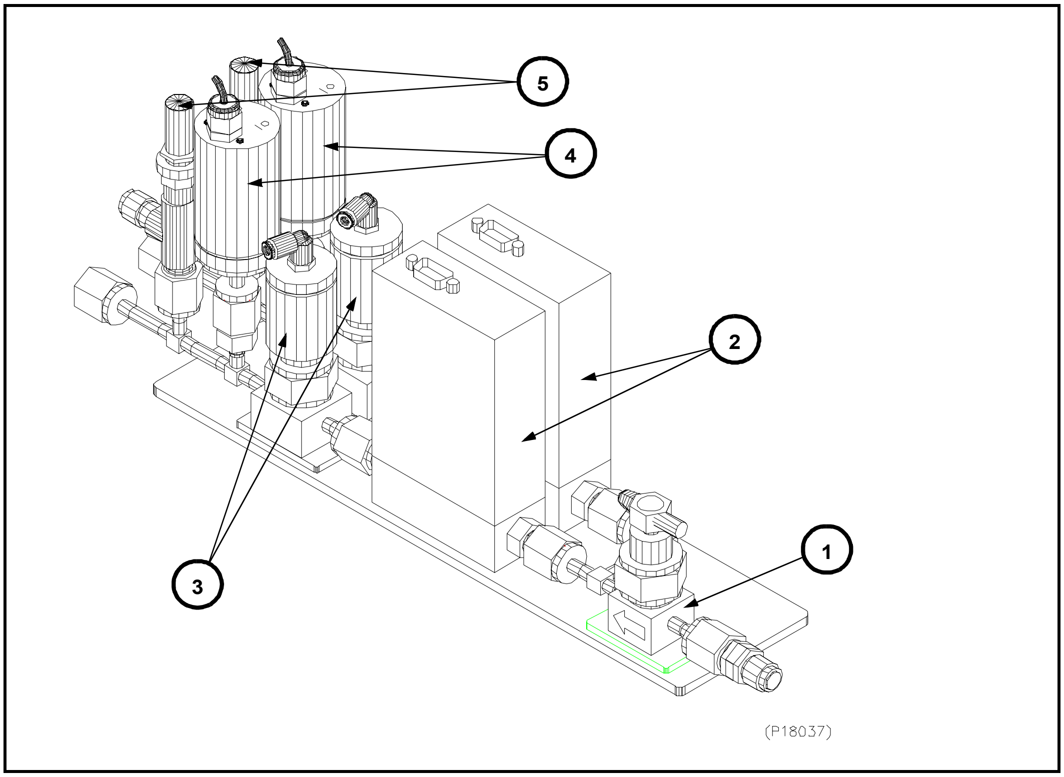


Figure 1-22. Independent Helium Cooling (IHC) Assembly

Table 1-22. Independent Helium Cooling (IHC) Assembly

No.	Item	Description
1	Manual Shutoff	Used to isolate the IHC from the helium supply
2	10 sccm MFCs	Modified MFC that adjusts flow to control pressure.
3	Pneumatic valves	Independent valves used to turn on/off zones.
4	10 Torr Manometers	Monitors the pressure in each zone.
5	Needle Valve	Adjusted to set helium flow to the dump.

1.4 Coolant Routing

Chamber components such as chamber body, cathode assembly and top lid assembly have to maintain a certain temperature in order for the process to be most efficient. The RPS assembly and the Trubo Pump are cooled via facilties cooling.See Figure 1-23 for and graphical represnetation of the chamber cooling loop.

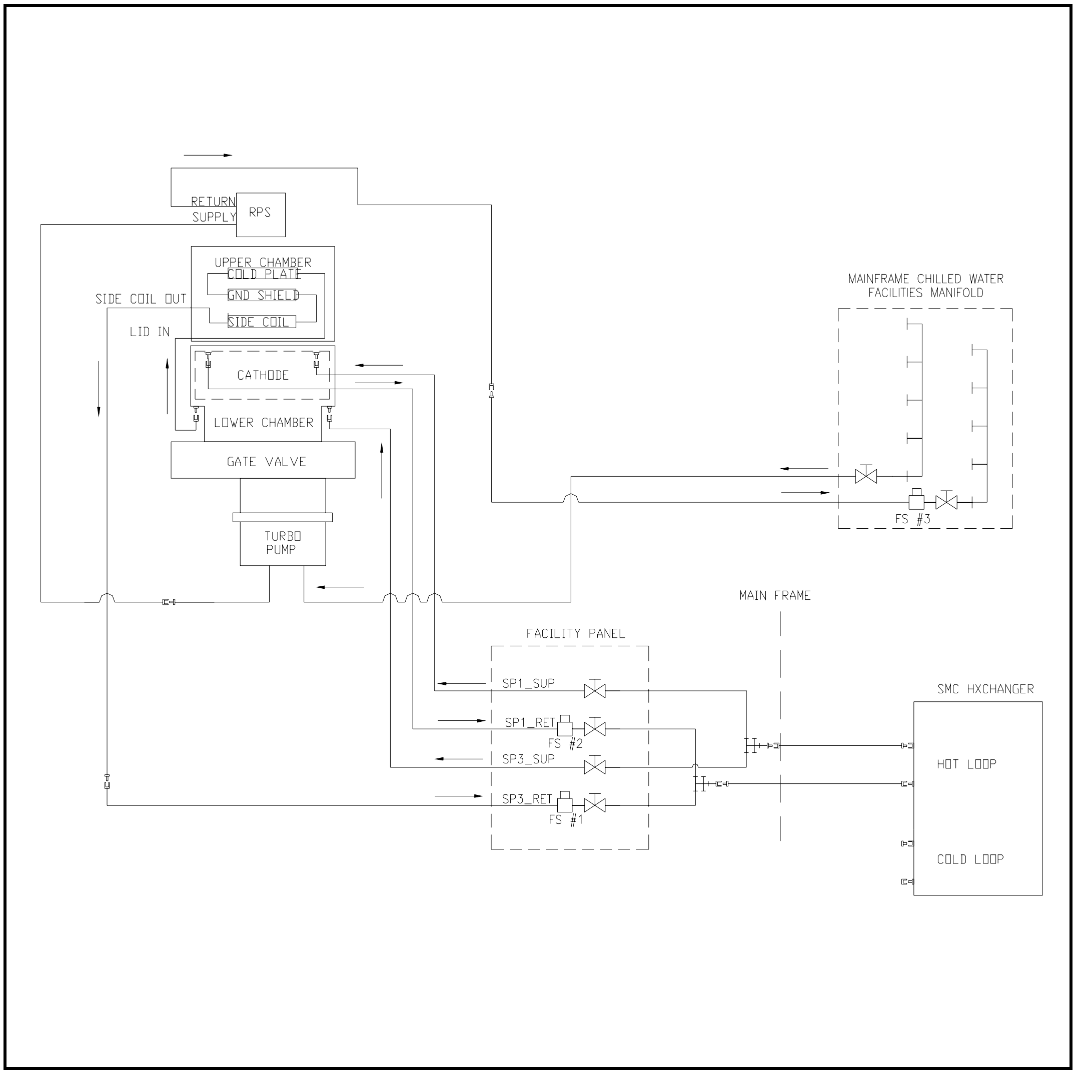


Figure 1-23. Ultima Plus Chamber Coolant Routing

1.5 Wafer Temperature Monitor (WTM)

WTM is used to monitor the temperature of the wafer during processing. Wafer temperature monitor provides temperature verification through fiber optic technology by measuring IR emission from the backside of the wafer. WTM features passive real time tracking of wafer temperature during the HDP-CVD deposition processes >250 ^{o}C. The WTM enables enhanced process monitoring and provides early detection of potential temperature related process issues. User interface display and control is integrated into legacy software. The Legacy software control also features a warning band which allows for troubleshooting of process temperature drift. The WTM is fully integrated into an electrostatic chuck, therefore process control is not affected by the WTM. Temperature sensitive processes should be equipped with WTM.

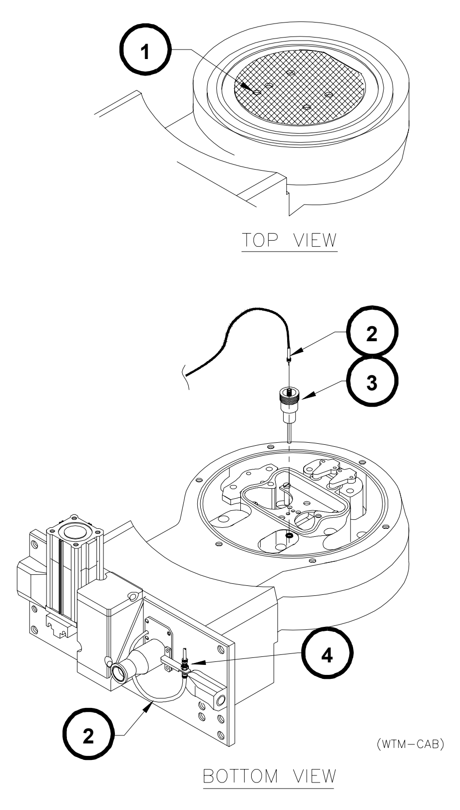


Figure 1-24. Wafer Temperature Monitor

Table 1-23. Wafer Temperature Monitor

No.	Item	Description
1	WTM Probe Hole	The probe sits below the ESC surface and senses wafer IR emission.
2	Fiber Optic Cable (1mm)	Transmits the light signal from the probe to the controller.
3	Light Pipe Assembly	This Assembly contains the Sapphire Light Pipe and optical connection to the fiber optic cable.
4	Optical Coupler	This is where the fiber optic cable (1mm) from the cathode connects to the fiber optic cable (1.5mm) that connects to the WTM Controller.

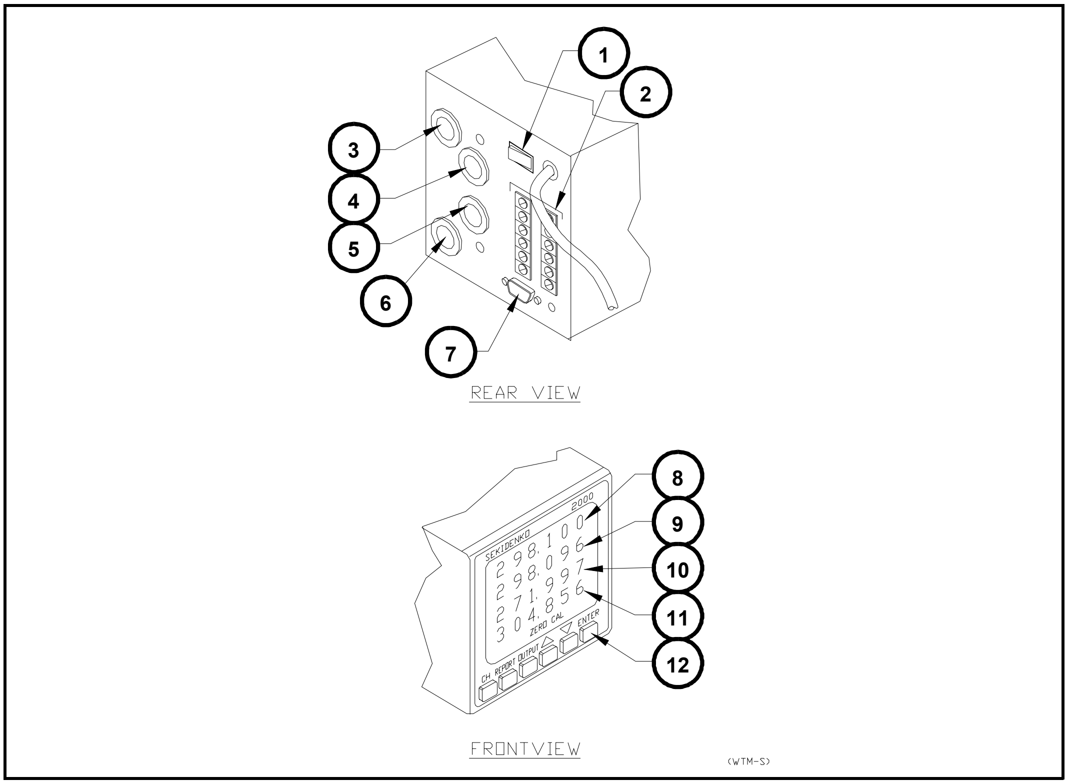


Figure 1-25. Radiometer (WTM Controller)

Table 1-24. Radiometer (WTM Controller)

No.	Item	Description
1	On/Off Switch	Turns on the WTM Controller
2	Terminal Block	Can be used to take signals to a chart recorder.
3	Channel 1	Configurable Channel to Monitor Temperature
4	Channel 2	Configurable Channel to Monitor Temperature
5	Channel 3	Configurable Channel to Monitor Temperature
6	Channel 4	This Channel is used for calibration only.
7	RS232 Interface	This port is used to communicate with the System Controller.
8	Channel 1 Display	Displays Wafer Temperature Reading from Channel 1
9	Channel 2 Display	Displays Wafer Temperature Reading from Channel 2
10	Channel 3 Display	Displays Wafer Temperature Reading from Channel 3
11	Channel 4 Display	Displays Wafer Temperature Reading from Channel 4
12	Menu Keys	Used only for Calibration of WTM

1.6 Gas Panel

The Centura gas panel is located on the upper rear of the mainframe. The main gas panel enclosure is divided into four sections, one for each system chamber. Gas lines can either enter from the top with an individual line for each chamber pallet gas position, or from the top or bottom through a Single Line Drop (SLD) enclosure on the side of the main gas panel. With SLD only a single supply line for each unique system gas required. If the SLD option is chosen, the supply gases are manifolded from the SLD enclosure to each of the individual chamber gas pallet positions.

Each chamber gas pallet contains the valves (pneumatic and manual), Mass Flow Controllers (MFC) and other flow measurement and control devices necessary to safely supply the required process gases, at the controlled pressures and flow rates, to the proper locations in the process chamber. The HDP-CVD gas pallets provide the control hardware required to supply up to ten process gases along with Nitrogen and vacuum purge to the respective chamber.

HDP-CVD offers three process configurations that affect the content of the gas panel. They are USG, FSG and PSG. A representative mechanical assembly drawing of a set of chamber gas pallets is shown in Figure 1-27,

Software instructions are converted to Input / Output signals which are supplied to electronic-to-pneumatic conversion hardware and safety interlocks located on the back outside of the gas main panel enclosure, for each chamber. For USG and FSG, a two to one pneumatic lockout device restricts simultaneous gas flow of SiH_4 and NF_3 into the chamber. For PSG a four to one pneumatic lockout device restricts the flow of PH_3/SiH_4 and NF_3 as well as SiH_4 and NF_3.

The individual pressure regulators and transducers shown in the chamber pallets are required with, and supplied as part of, the SLD option. When individual gas sources are supplied for each chamber position this regulation can be provided externally within the customer’s facilities, or on the pallet as shown, as an option.

SLD options are offered for either top or bottom feed to the left side (as viewed by the operator) of the main gas panel enclosure. Either top or bottom feed is available with per-gas manual isolation valves, pneumatic isolation and sample port valves or no per-gas valves. All SLD valve (or no valve) options are mounted within the SLD enclosure, while the chamber manifold lines are in the exhaust plenum above the main gas panel enclosure. See figure SLD_REF for a representative SLD option assembly drawing.

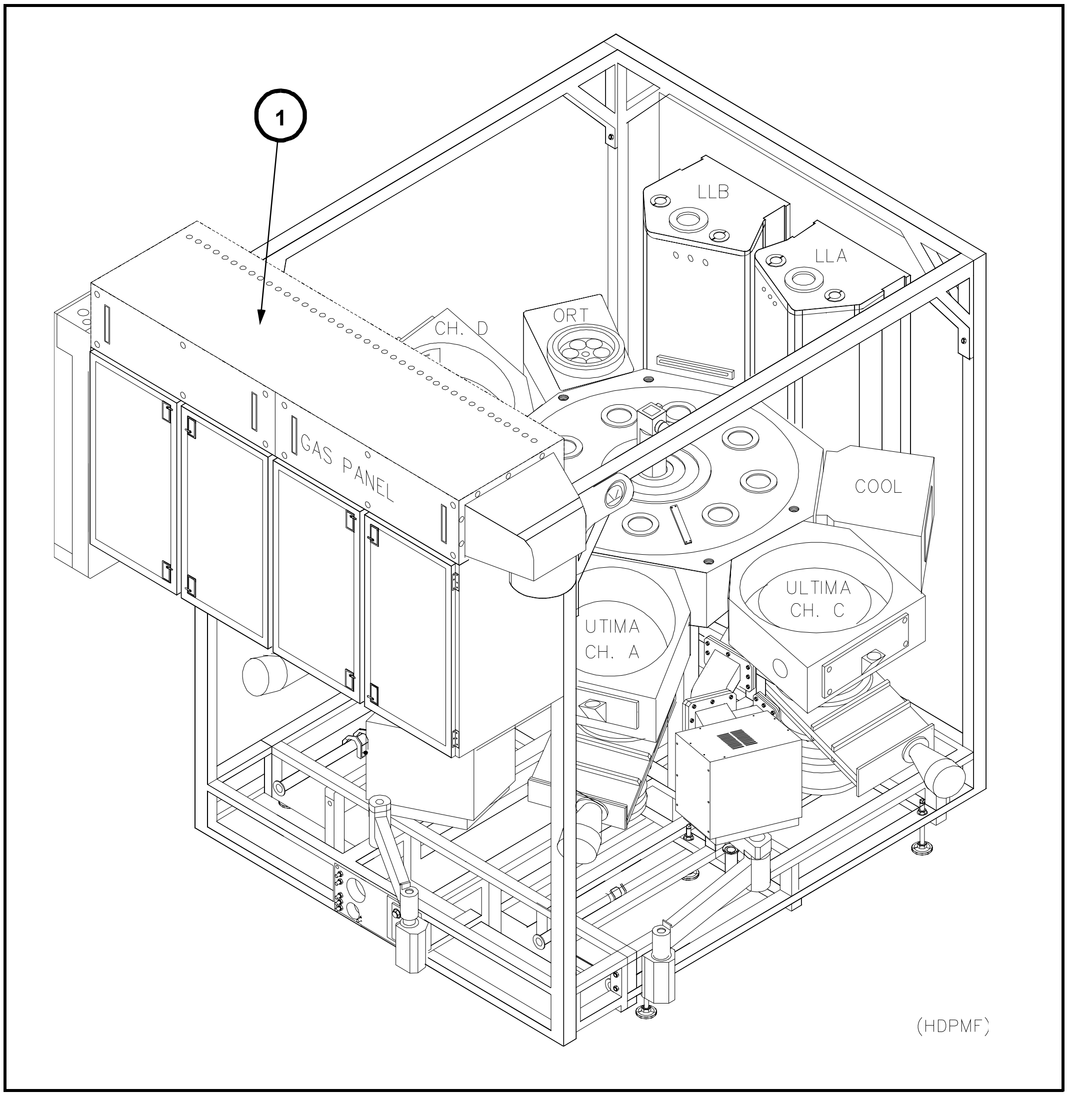


Figure 1-26. Gas Panel Location

Table 1-25. Gas Panel Assembly

No.	Item	Description
1	Gas Panel Assembly	• Supplies controlled gas flow to process chambers. • Houses mass flow controllers, shutoff valves, and support plumbing equipment. • Located on the rear of the mainframe. • Configured to Customer specification. a. Available Options: •Single line drop for decreased points of connections. •Pressure Regulators •Transducers

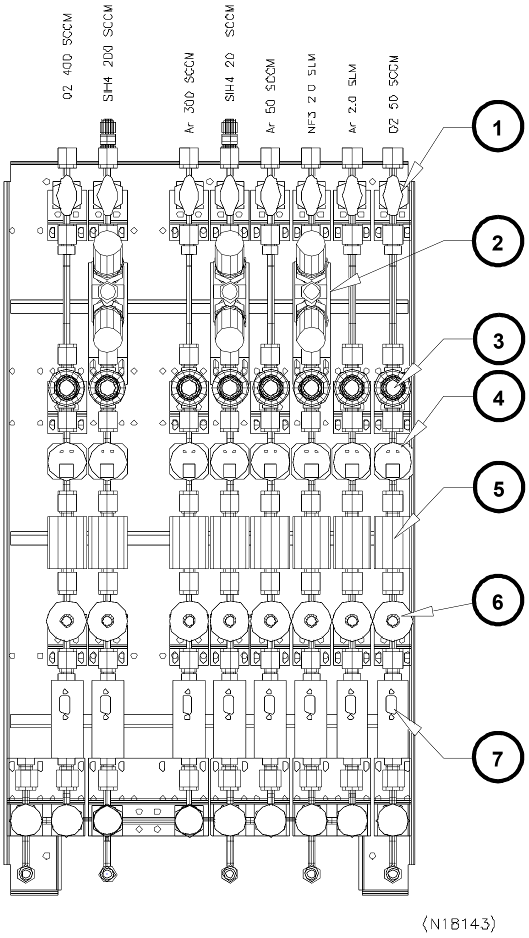


Figure 1-27. Typical USG Gas Pallet

Table 1-26. Typical USG Gas Panel Pallet

No.	Item	Description
1	Manual shutoff valve	Each gas line has a manual shutoff valve.
2	V block valve	Normally closed, two pneumatic valves that are tied together.
3	Regulator	Regulates process gas pressure. (optional)
4	Transducer	Converts a gas pressure to an electronic signal. (optional)
5	Filter	Removes particles that are 0.01 microns or larger. The filters are disposable.
6	Pneumatic valve	Normally closed, these valves provide positive on/off control of process gasses. In the event of a power failure, the valves close to ensure system safety.
7	Mass flow controller (MFC)	Regulates the flow of gasses to the chamber.

1.7 Remote Components

Remote Components for the Ultima Plus HDP-CVD system include RF Generator Rack, Heat Exchangers, and Dry Pumps.

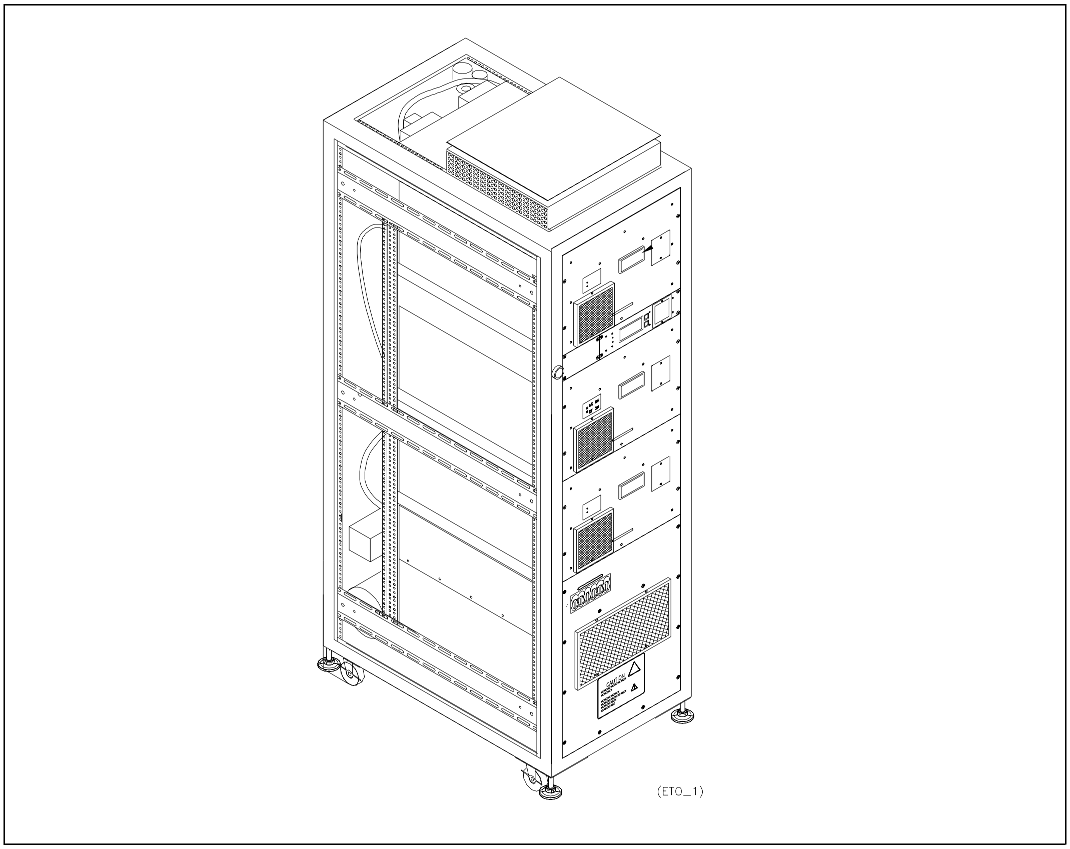
1.7.1 RF Generator Racks

The Ultima Plus system will have two configurations of RF generators:

ETO Generator Racks (Section 1.7.1.1)
ENI Generator Racks (Section 1.7.1.2)

1.7.1.1 ETO Generator Rack

This section describes the ETO (Earhorn Technology Operations) RF generators .



The generators in the generator rack are named correspondingly to the components that they supply RF power to — Top Source, Side Source, and Bias RF generators.

The microwave power supply supplies high voltage DC to the magnetron assembly that is mounted on the HDP-CVD chamber.

ETO’s model 80-S09-µw generator is fully automatic, water cooled, four channel generator. The system is capable of providing up to 10,000 watts of simultaneous RF.Each RF channel utilizes a water cooled vacuum tube power amplifier driven by a high efficiency switch mode solid state driver. They are specifically designed for industrial use, and are conservatively rated for continuous operation into adverse load conditions. A selective wattmeter and adaptive microprocessor controlled leveling loop are employed to maintain a constant RF output independent of load, line, or environmental conditions.

The maximum output and frequency of each generator is noted below:

Generator	Frequency	Maximum Output
Top Source	1.80-2.00 MHz variable	5,000 Watts
Side Source	2.02-2.17 Mhz variable	5,000 Watts
Bias	13.56 MHz fixed	5,000 Watts

NOTE

The three channel system can be used in any combination of powers up to 10,000 Watts.

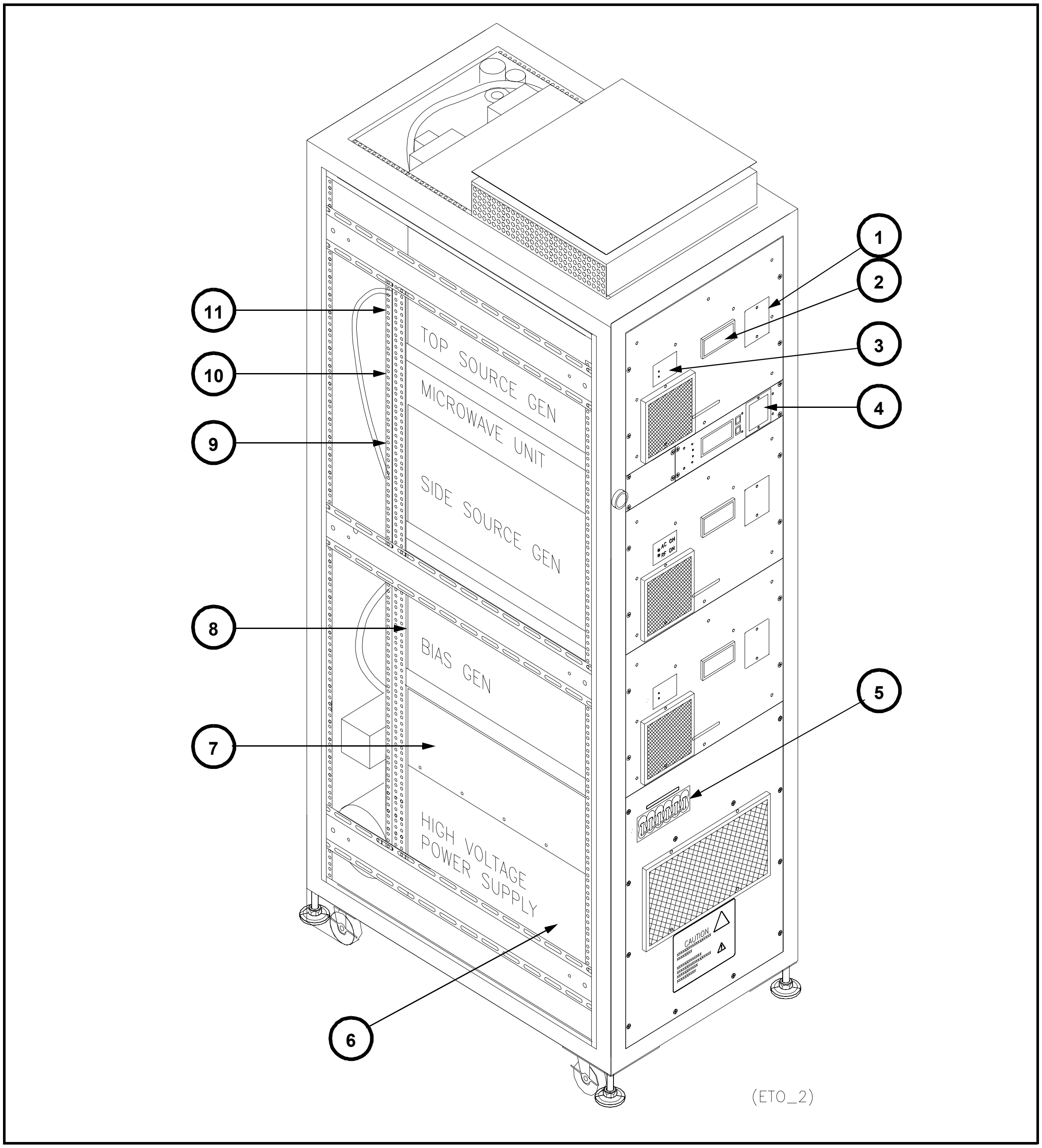


Figure 1-28. RF Generator (Front View)

Table 1-27. RF Generator Rack (Front View)

	Item	Description
1	Access Panel	Used to control RF generators in local mode
2	LCD Display	Used to monitor the status of the RF generator

Table 1-27. RF Generator Rack (Front View)

	Item	Description
3	LED Board	Used to monitor the state of the RF generator
4	Microwave controller	Disabled for Ultima Plus
5	Primary Circuit Breaker	Ganged circuit breaker. When tripped, shuts off the power to the whole rack
6	High Voltage Power Supply	Supplies High DC Voltage to the PA tubes in the RF decks and to the Magnetron Filament
7	Power Deck	Supplies 45V @ 50A, 12V, 7.5V, and 7kV to the RF Generators
8	Bias RF generator	Supplies RF power to the cathode of HDP-CVD chamber
9	Side Source RF Generator	Supplies RF power to the Side coil of HDP-CVD chamber. Includes master controller that controls operation of all of the components in the rack.
10	Microwave Unit	Disabled for Ultima Plus
11	Top Source Generator	Supplies RF power to the Top coil of HDP-CVD chamber

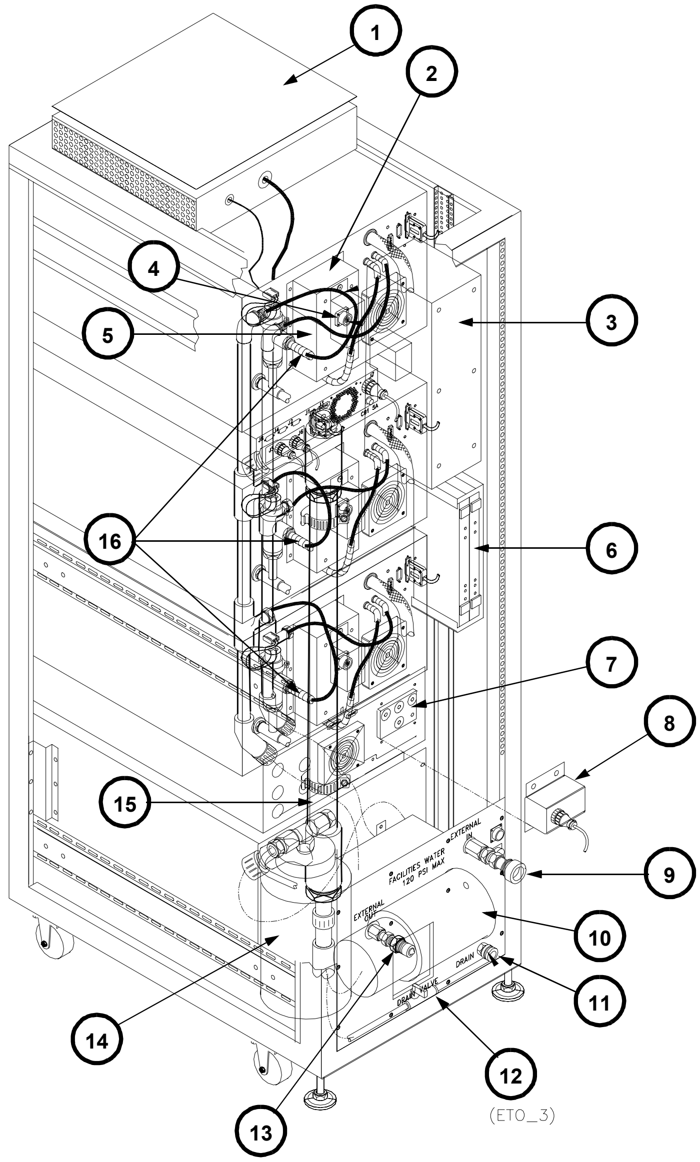


Figure 1-29. RF Generator Rack (Back View)

Table 1-28. RF Generator Rack (Back View)

No.	Item	Description
1	Noise Filter (Top Hat)	Filters out electronic noise produced by microwave generator
2	500W Solid State Driver	Amplifies the RF signal by 10. Also called a Power Amplifier. Cover needs to be removed to access the SSD.
3	Seriplex Power Supply	Supplies DC power to remote Seriplex Assembly.
4	RF output	RF output to the chamber component
5	Wattmeter	Internal wattmeter. Measures Forward and Reflected RF power.
6	Seriplex Assembly	Consists of I/O Wiring Distribution Board and MUX I/O board. Depending on system configuration can control RF racks, Heat Exchangers and Dry Pumps.
7	RF Rack AC input	3-phase, 208V, up to 125A power supplied from the System Controller to the RF Rack
8	AC Cover	Covers the 3-phase input connections
9	External water inlet	Inlet for Facilities Chilled water that is used to cool internal Heat Exchanger
10	Pump	Internal Heat Exchanger Pump
11	Drain	Drain plug. Used to empty the internal Heat Exchanger
12	Drain Valve	Has to be opened to empty the internal Heat Exchanger
13	External water outlet	Outlet for Facilities Chilled Water that is used to cool internal Heat Exchanger
14	DI cartridge	Deionizer Cartridge for the internal Heat Exchanger. Used to maintain high resistivity of the cooling fluid.
15	DI reservoir	Supplies DI water that cools all of the components on the RF Rack.
16	Flow switches	Ensure that internal Heat Exchanger supplies sufficient amount of cooling fluid to all of the components in the rack.

1.7.1.2 ENI RF Generator Racks

The Ultima Plus Chamber Utilizes a modular RF Rack and generators for each Chamber position. Two racks are capable of being stacked together to save footprint space. Each rack houses three generators for TOP, SIDE and BIAS power. The TOP and SIDE generators are capable of delivering 5000 W each of RF energy. The TOP and SIDE generators are frequency tuning generators and work in conjunction with the chamber top and side local matches to achieve a 50 ohm impedance, thus delivering maximum power to the process chamber. The frequency ranges have not changed from current Ultima and do not crossover in their tuning. The BIAS generator is capable of 5000 W of RF energy. It is a fixed frequency of 13.56 MHz and works in concert with the chamber's bias match for optimum power delivery to the chamber.

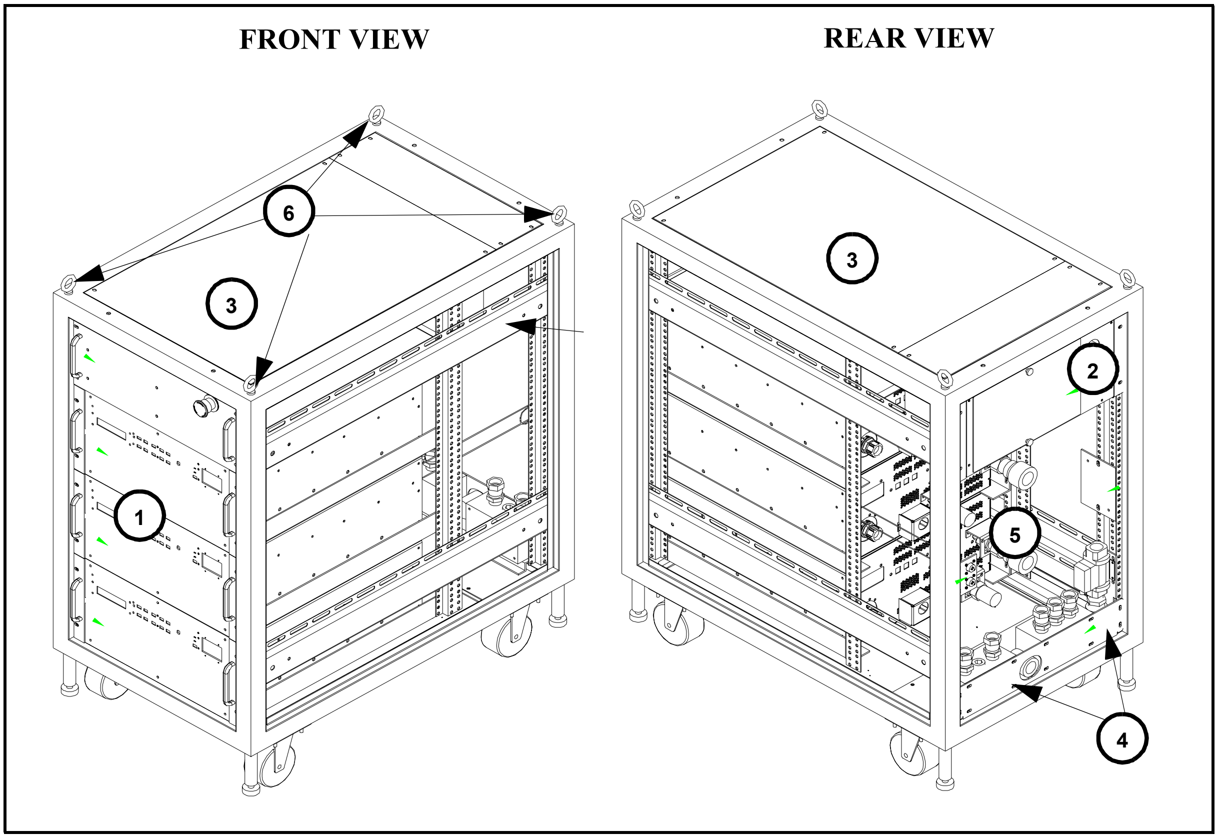


Figure 1-30. Modular ENI RF Racks

Table 1-29. ENI RF Racks

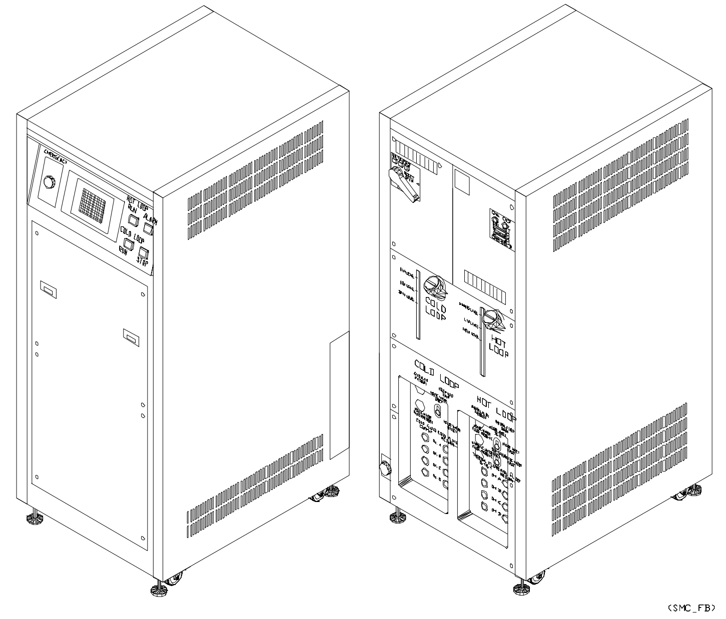
No.	Item	Description
1	RF Generators	TOP, SIDE and BIAS Generators per chamber, per rack.
2	AC and CB locations	Incoming AC power for entire rack and individual CBs for each generator. Each generator is designed to plug into AC box.
3	Seriplex Housing	This is where the Remote Seriplex and DC power supply is housed. There will be on DC power supply on one RF rack, supplying power for 4 chambers. Also, there will be one Seriplex controller per two racks.
4	Facilities Cooling water	The supply and return of the facilities cooling water. The required flow is a minimum of 5 gpm.
5	Rear of generators	All RF cables and control cables and water will be connected here.
6	Lifting Bolts.	These lifting bolts can be removed when stacking two rack together. A maximum of two rack should be stacked together.

1.7.2 SMC Heat Exchanger

SMC heat Exchanger ships as standard on all HDP-CVD stand-alone systems. SMC Heat Exchanger provides temperature control of crucial parts of HDP-CVD chamber, such as chamber body, chamber top lid assembly, chamber cathode and microwave applicator assembly as was shown in chamber components discussion.

SMC Heat Exchanger is capable of providing temperature control at two different setpoints. To achieve that it utilizes two separate loops — hot loop and cold loop. The hot loop section of the Heat Exchanger is capable of providing a temperature range between 20 °C and 90 °C. The cold loop provides ambient temperature.

One SMC Heat Exchanger is capable of supporting three ultima HDP-CVD chambers.



1.7.2.1 Benefits of the SMC Heat Exchanger:

- Separate Hot Loop and Cold Loop
- Accurate temperature control (± 0.2°C on Hot Loop)
- Programmable water resistivity fault / warning limit
- Reduces number of required Heat Exchangers (e.g.,6 AMAT Heat Exchangers to 1 SMC for a three chamber tool)
- Compact footprint
- DI cartridge and Particle Filter change can be performed while system is running

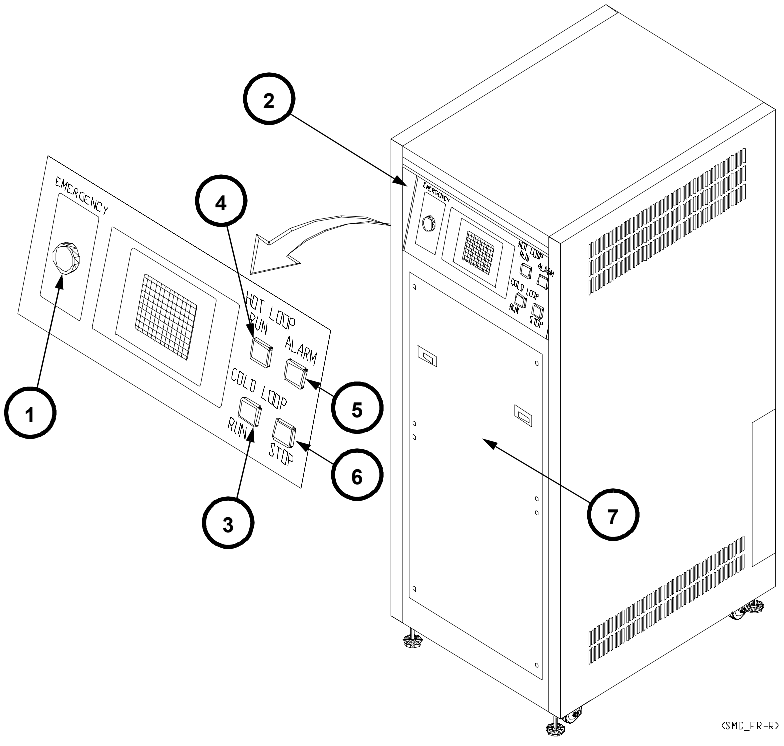


Figure 1-31. SMC Heat Exchanger Operator Panel

Table 1-30. SMC Heat Exchanger Operator Panel Components

	Component	Function
1	EMO switch	Shuts off the system (connected in series with all EMO buttons on the system)
2	Control Display Panel	Operation Mode display including run/stop, temperature setting, operating condition and alarm message
3	COLD LOOP run lamp	The lamp is ON during the operation of COLD LOOP
4	HOT LOOP run lamp	The lamp is ON during the operation of HOT LOOP
5	Alarm lamp (yellow)	The lamp blinks when alarm is generated
6	Off switch (red)	The switch forcefully stops HOT LOOP and COLD LOOP operations simultaneously.
7	Maintenance panel	The panel is removed by taking off six screws for replacing DI filter and filter element

1.7.2.2 SMC Heat Exchanger Hot Loop

The main purpose of the Hot Loop is to control the temperature and the resistivity level of the circulating fluid. The Hot Loop uses a pump to circulate the fluid through chamber components where the circulating fluid will absorb both heat load and the ion deposits. As the circulating fluid makes it's way back, it goes through the particle filter. The filter is used to stop loose particles from entering Heat Exchanger, pump external components, etc.

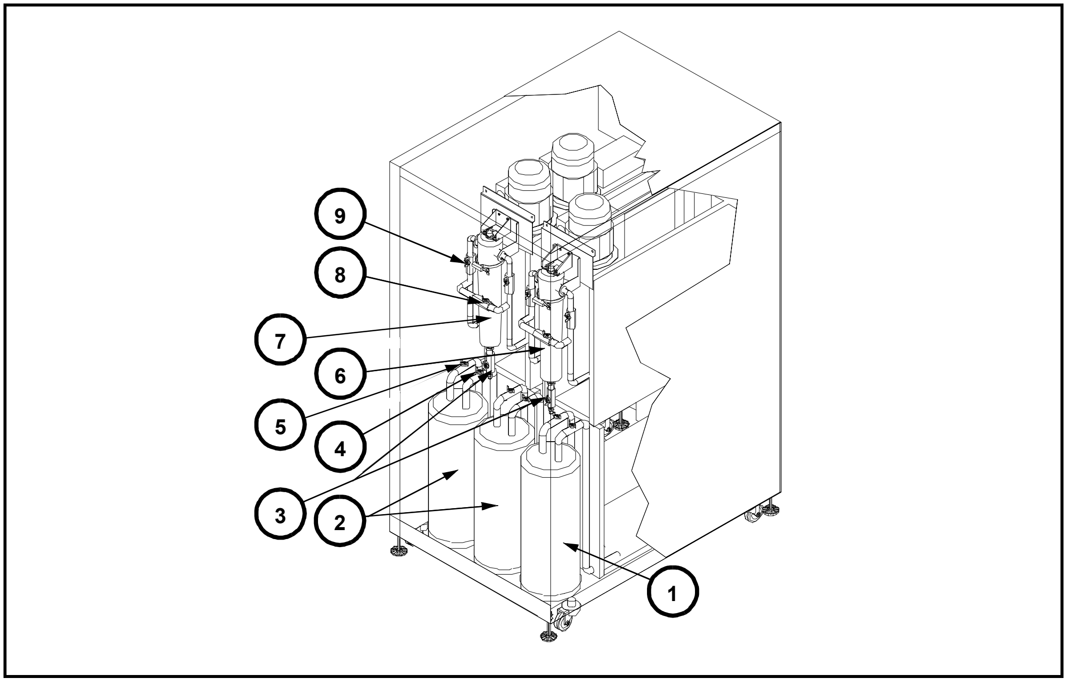


Figure 1-32. SMC Heat Exchanger (Hot and Cold Loops)

Table 1-31. SMC Heat Exchanger (Hot and Cold Loops)

	Item	Description
1	DI Canister (Cold Loop)	Captures the ionized impurities in the cold loop fluid
2	DI Canisters (Hot Loop)	Capture the ionized impurities in the hot loop
3	Drain Valve	Is used to drain the hot and cold loop fluid from the particle filter during PM
4	Inlet Ball Valve	Opens to allow coolant flow into the DI canister
5	Outlet Ball Valve	Opens to allow coolant flow out of the DI canister
6	Filter (Cold)	Particle Filter for the Cold Loop
7	Filter (Hot)	Particle Filter for the Hot Loop
8	Bypass Valve	Is used during PM's to bypass the particle filter so it can be changed without taking the Heat Exchanger down
9	Stop Valve	Stops the fluid circulation into and out of the particle filter so it can be replaced during PM

After passing through the filter, the hot fluid will be mixed with much cooler fluid as it returns to the storage tank.

The heating of the circulating fluid involves the use of electrical heater. A PID controller controls the heater. By having both the Cooling Pump and the Heater working in a synchronized manner, the temperature of the circulating fluid is under control.

Another important variable that must be controlled or maintained is the Resistivity level of the circulating fluid. Ultima chamber process requires the circulating fluid to have good dielectric properties.

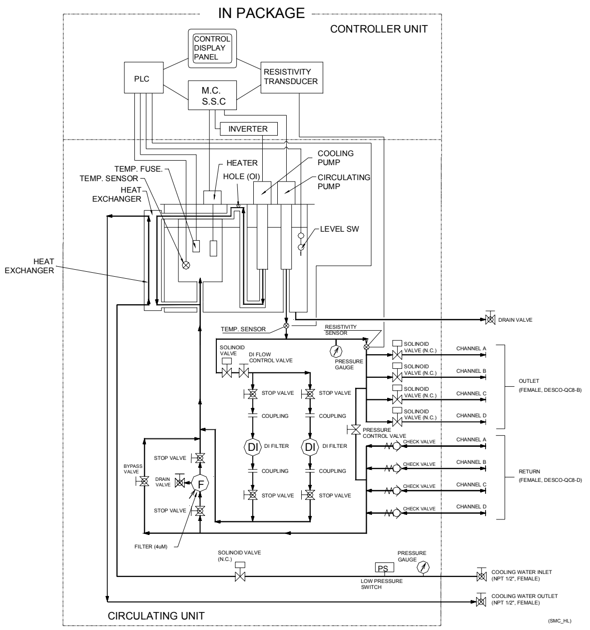


Figure 1-33. SMC Heat Exchanger Hot Loop Flow Diagram

As fluid circulates through the chamber components, high energy from sources such as plasma, microwave, RF, etc. incites the surrounding metals, causing them to ionize more readily. The ionized particles that are in contact with the circulating fluid will be absorbed into the fluid. These ionized particles are the impurities of the fluid and can conduct electricity. Higher impurity levels cause lower resistivity level in the fluid, therefore, they must be removed. A de-ionizer (DI) circuit is integrated parallel to the circulating loop to capture the ionized impurities. As the resistivity level falls below the certain set point, a solenoid valve will automatically open to allow some amount of circulating fluid to enter the DI cartridge. As he resistivity regains its set point, the solenoid valve closes.There are two DI filters in the Hot Loop. One is on-line while the other one is on standby. Hot Loop is operating at high temperatures, therefore, it is not safe to replace the DI filter immediately after resins become exhausted. The standby DI filter can be put on line immediately when the other DI filter becomes exhausted. This allows the operator to have time to wait for the exhausted DI filter to cool down before attempting to replace it.

1.7.2.3 SMC Heat Exchanger Cold Loop

The main purpose of the Cold Loop is to control the temperature and resistivity level of the circulating fluid for the microwave applicator. The Cold Loop fluid needs to be cold enough to ensure the applicator does not overheat, causing Aluminum Fluoride build-up on the applicator. Therefore, the Cold Loop does not require a high precision temperature control. The Heat Exchanger provides enough coolant to maintain the applicator at ambient temperature.

Just like the Hot Loop, the Cold Loop uses the pump to circulate the fluid through the external components (applicator in case of Ultima) where the circulating fluid will both absorb the heat and the ion deposits.

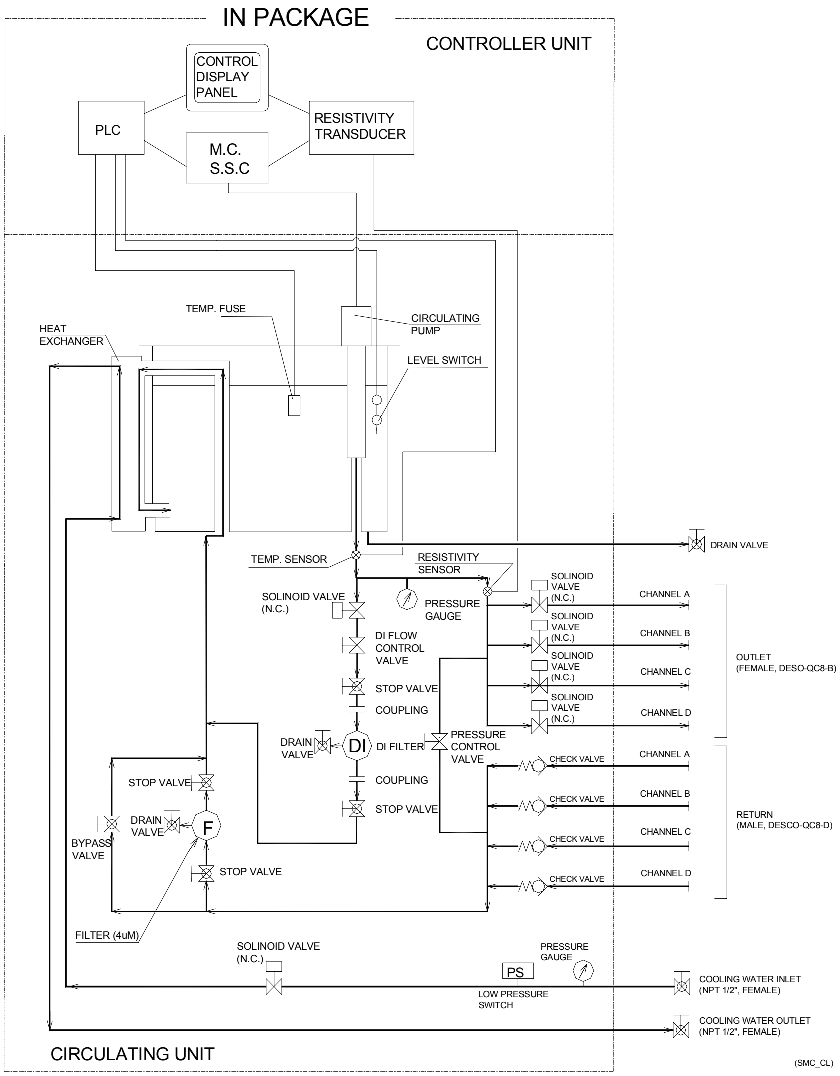


Figure 1-34. Cold Loop Flow Diagram

As the hot circulating fluid travels back to the Heat Exchanger, the fluid goes through the particle filter which stops the loose particles from entering the essential components. After passing through the filter, the hot fluid will travel through the heat exchanger to cooldown.

Cold loop also uses external cooling water to cool down the circulating fluid. There is a solenoid valve installed in line with the cooling water. By turning the valve on and off, the temperature of the circulating fluid can be controlled.

The dielectric control for the Cold Loop is similar to that of the Hot Loop. The only difference is that the Cold Loop has only one DI filter. Because the Cold Loop is operating at much lower temperature, the operator can immediately replace the DI filter once the resins become exhausted.

The Thermal Reaction Section features a resistive heating element and a cylindrical liner. The liner absorbs thermal energy from the heater element and becomes a “hot body” type reaction source. The Thermocouple monitors the Thermal Reaction Section temperature. The temperature controller maintains the temperature for reaction of flammable and toxic gases. This continuous “hot body” reaction source enhances thermal decomposition and oxidation in a contained/controlled manner.

The Primary and Secondary Cooling/Scrubbing Sections cool the gas stream to below 50 °C and scrub the gas stream, thereby removing solid particulate by-products, water soluble gases, and vapors. Liquid scrubbing of soluble gases and particulate occurs in a small, unpacked spray chamber in the Primary Cooling/Scrubbing Section. Fine particulate removal and high efficiency liquid scrubbing is achieved by a counter-current packed bed liquid scrubber in the Secondary Liquid Cooling/Scrubbing Section. Gases then pass through the Dual Scrub section to remove entrained moisture and residual particulate.

Recirculation of cooling/scrubbing liquid for the purpose of reducing fresh water consumption is an available option for the 858 CDO. A shell-in-tube heat exchanger utilizes chilled water to maintain recirculation liquid temperature. Cooling/scrubbing liquid drains to the recirculation tank through an internal negative slope/vapor barrier drain to prevent bypass of process gases to the tank. The sump option allows cooling/scrubbing liquid to collect in the sump tank, which is then pumped to a remote drain. Liquid level switches automatically control the pumping cycle.

2 Ultima TE Functional Description

The solution to extending the gap fill performance of the Ultima plus from 150 nanometer to 90 nanometer is the Ultima TE package. With its increased pumping capacity, higher RF power ,improved dome tempature management and process chemistry the Ultima TE will provide the gap fill requiremets for the next generation in wafer production. This chapter is an overview of the major components of the Ultima TE.

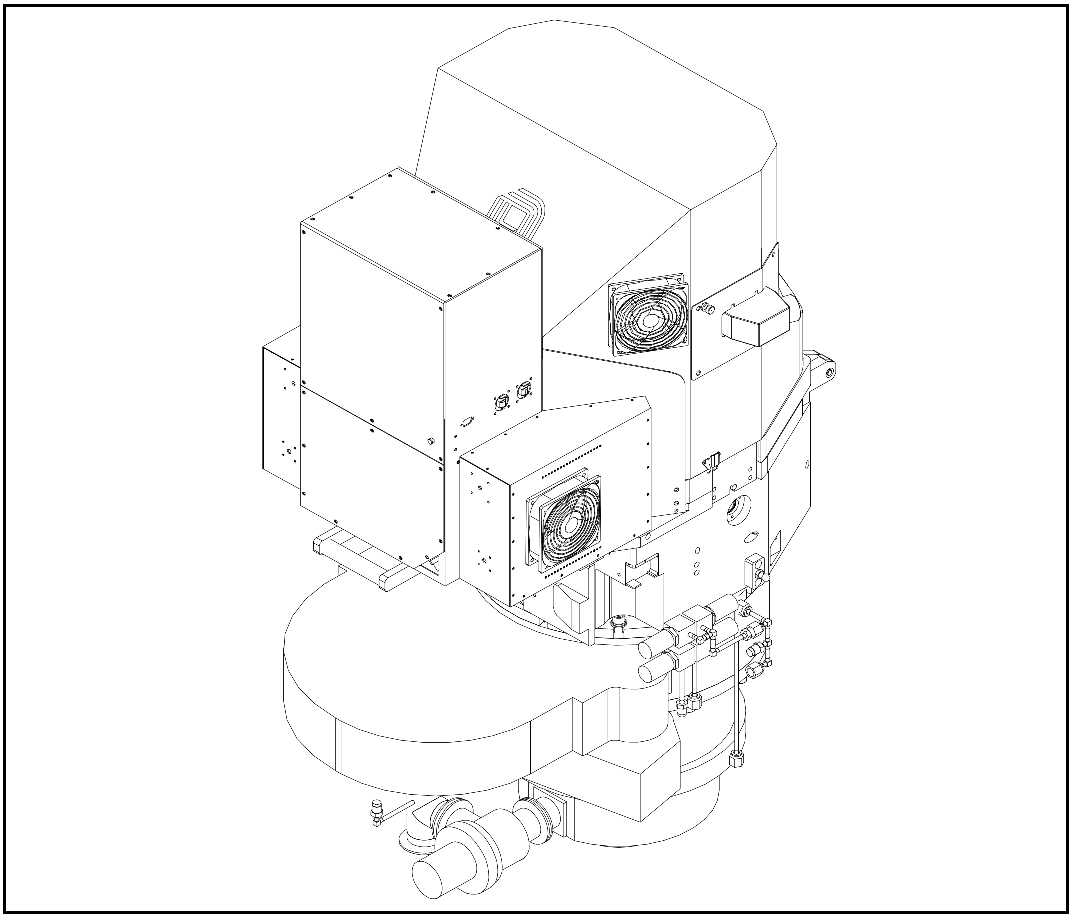


Figure 2-1. 200 mm Ultima TE Chamber Assembly

This chapter includes the following sections:

- Section 2.1, Upper Chamber Components
- Section 2.2, Lower Chamber Components
- Section 2.3, Coolant Routing
- Section 2.4, ENI RF Generator Racks
- Section 2.5, Gas Panel Components
- Section 2.6, Mainframe AC Boxes

2.1 Upper Chamber Components

In this section the components of the Upper Chamber are introduced. Upper Chamber assembly houses the components that are responsible for Dome temperature control, RF supply and gas delivery. The AE RPS Unit responsible for the cleaning process is also a part of the Upper Chamber assembly. See Figure 2-2.

Table 2-1. Upper Chamber Assembly

No.	Item	Description
1	Dome Temperature Controller (DTCU)	The dome temperature control is more robust with the addition of the Watlow heater controller. The controller is much less susceptible to RF noise and has a more reliable PID control than previous Thermologic PBC. In conjunction with the dome cooling strategy the temperature of the 4 heater zones are better controlled.
2	Balanced Local Matches	The purpose of the new Top and Side Matches is to ensure the optimum power transfer from Top and Side RF Generator to the Chamber. Each Match is set according to the specific chamber requirements and expected process conditions. The capacitors are now situated before and after the coil.
3	Improved Dome cooling	The dome cooling is optimized by flowing cooler water through the dome heater components (sidecoil-->top plate-->groundshield). 25C heat exchanger water is circulated through the upper chamber at different flow rates to achieve optimum heating and cooling of the dome. Additionally, for Ultima TE H2 process Heatpath material is replaced with Thermagon for improved heat transfer at sidecoil and top plate.
4	NF3 RPS Flow Switching	NF3 is normally flowed through the RPS unit for cleaning the chamber. For the current Dep-Etch-Dep process on Ultima TE, NF3 is also used for processing the wafer. The NF3 gasline going to the RPS unit is now connected/Tee'd to go below the RPS unit as well. There are two pneumatic valves which control the flow of NF3 either through the top of the RPS for clean, or through the bottom of the RPS for process. Additionally, there is an Ar purge feature that allows purge either through the RPS or below the RPS.
5	Sidecoil with Thermal Putty	With RF power increasing for H2 process, the side coil is seeing a higher temperature. To improve heat transfer at sidecoil, thermal putty has been added at the sidecoil and tabs. With the addition of both the Thermagon at the sidecoil to dome interface and thermal putty, sidecoil temperature is dramatically improved.

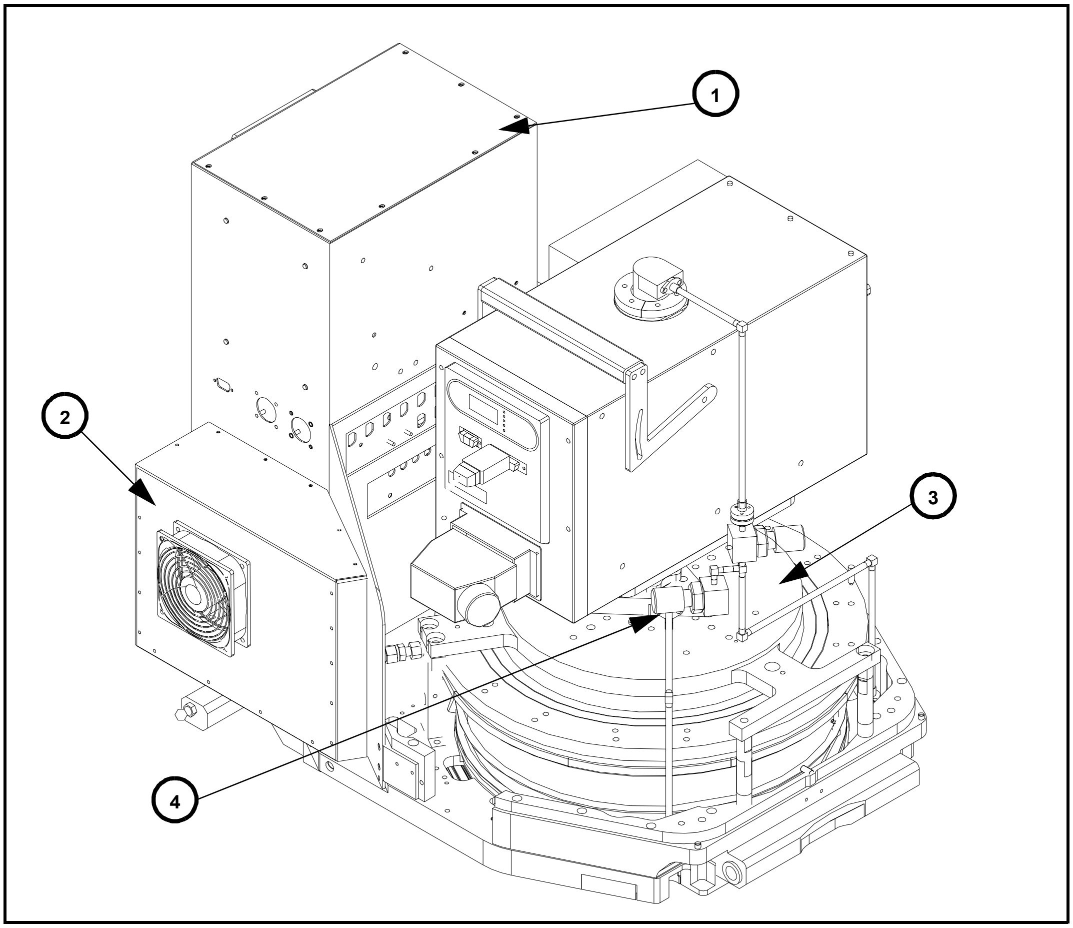


Figure 2-2. Ultima TE Upper Chamber Components

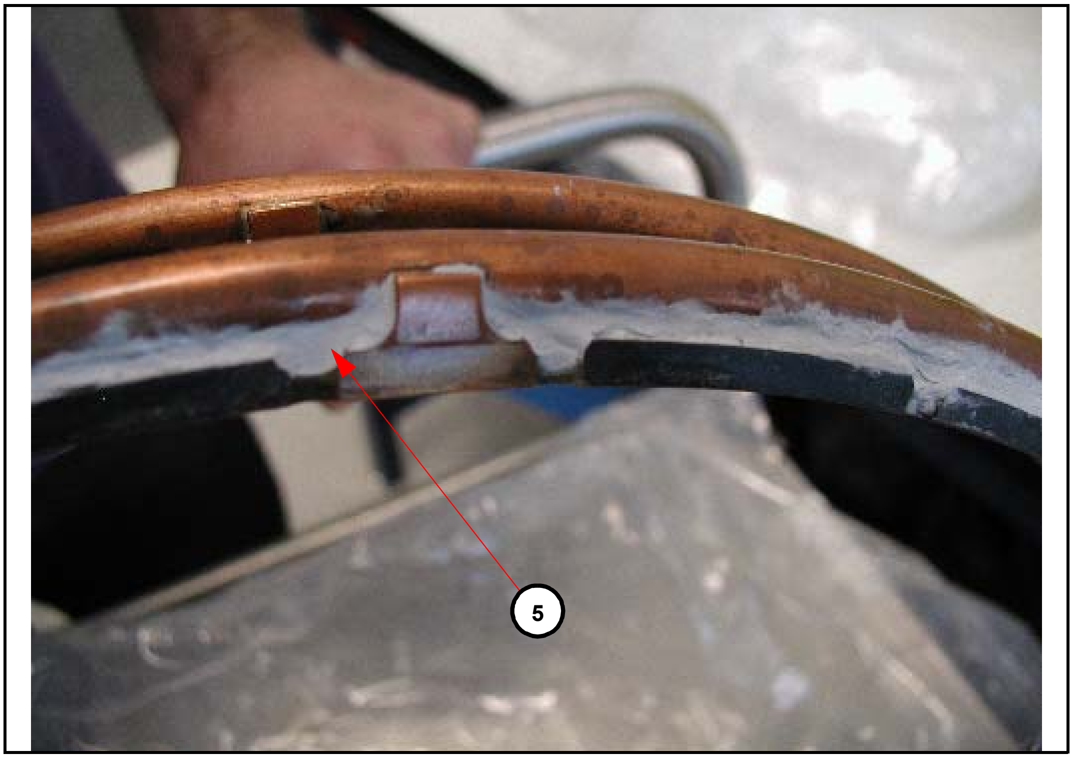


Figure 2-3. **Sidecoil with Thermal Putty**

2.1.1 Top Gas Feed Assembly

Center gas block has been modified to improve venturi seal as well as to provide better heat transfer from the center baffle.

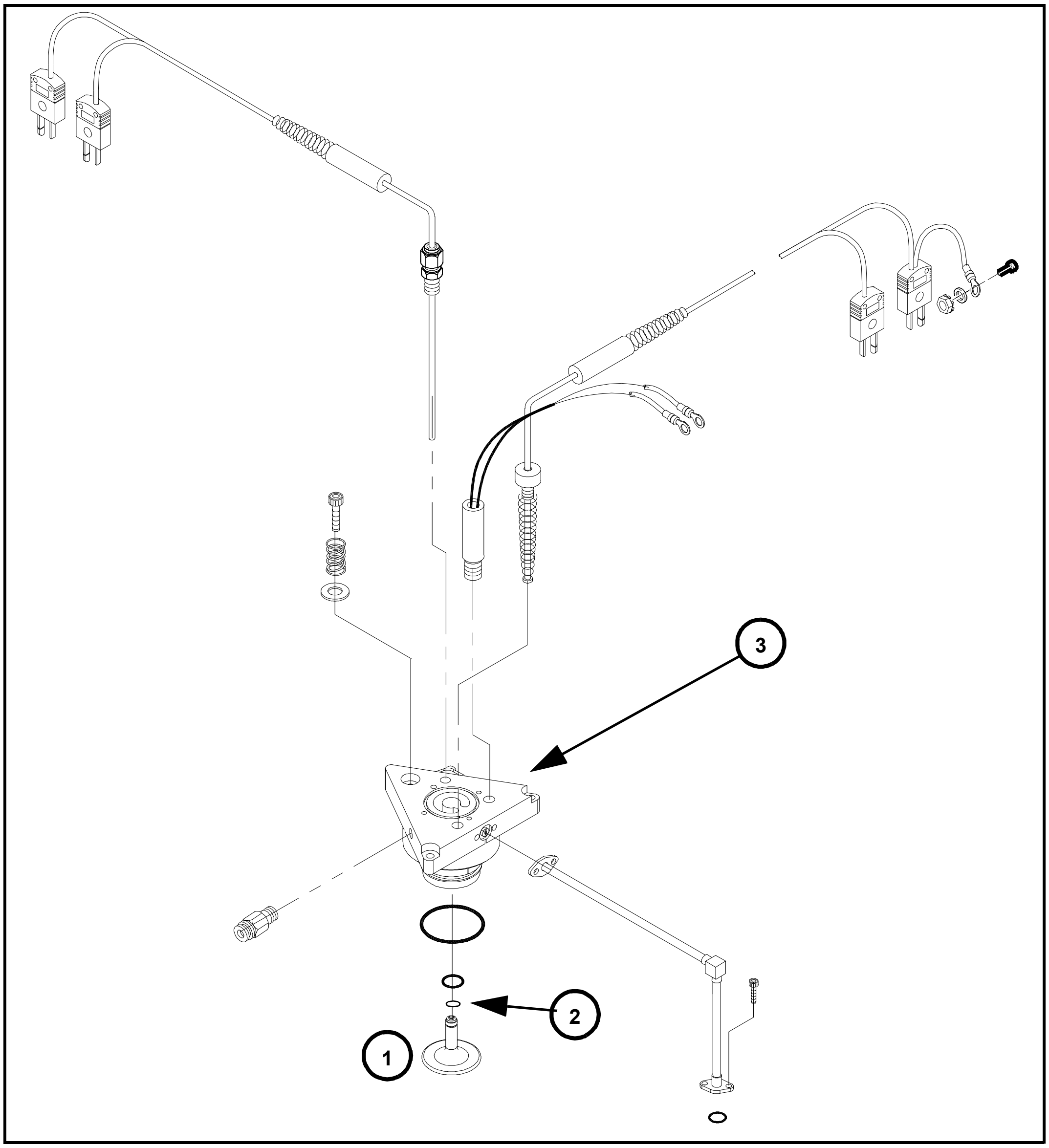


Figure 2-4. Top Gas Feed Assembly

Table 2-2. Top Gas Feed Assembly

No.	Item	Description
1	Top Baffle	Serves as a point of entry for O_2, SiH_4 and AR into the top of the dome for process recipes. (PH_3/SiH_4 for PSG, SiF_4/SiH_4 for FSG). Top Baffle is now shorter and is made out of AlN material to allow for better heat dissipation and reduction in particles.
2	Al Washer	Provides additional heat transfer surface and is less likely to deform due to heat.
3	Top Gas Feed Block	Supplies the top gases and cleaning gases to the top nozzle/baffle. New top gas block extends further into the dome to allow a shorter Top Baffle. Gas feed block piston o-ring location has been modified to allow better venturi vacuum seal.

2.1.1.1 Gas Distribution

The gas Distribution Ring supplies the process gases to the chamber. It houses either 18 or 24 ceramic gas supply nozzles, 12 (16 for 24 nozzle gas ring) nozzles supply SiH_4/Ar to the chamber and 6 (8 for 24 nozzle gas ring) nozzles supply O_2 to the chamber. Internal SiH_4/Ar channel transfers the gases to the gas nozzles. The nozzle and washer material has changed for He and H2 process. Reference Table 2-4 for configuration.

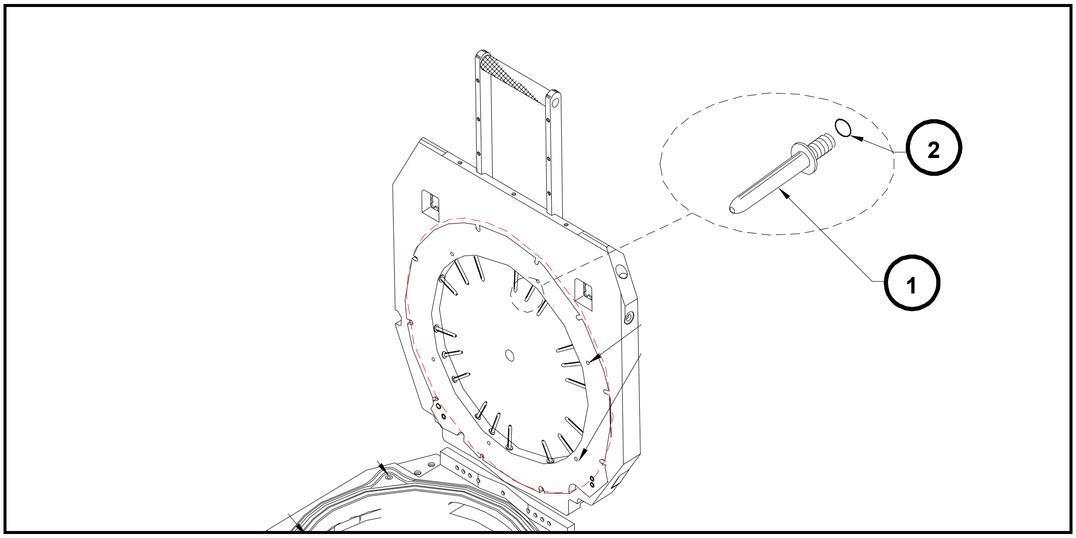


Figure 2-1. Side Nozzles and Washers

Table 2-3. Chamber Body and Gas Ring Configuration

No.	Item	Description
1	Gas Nozzles	Ultima TE has two types of nozzle configuration depending on what process is being used. Side nozzles are made out of AlN material to allow for better heat dissipation and reduction in particles. Reference Table 2-4 for configuration.
2	Teflon Washers or Aluminum Washers	Two types of washers are available. He process uses the standard teflon washers. H2 process uses Al washers with calibrated orifice (20mil +/-.0002). Reference Table 2-4 for configuration.

Table 2-4. Side Nozzle/O-ring Configuration

Process	Nozzle Type	Washer Type
He	2.55" AlN with 20 mil orifice	Teflon
H2	1.76" AlN with 63 mil orifice	Aluminum with 20 Mil orifice

2.2 Lower Chamber Components

This section contains the items that maintain and measure vacuum in the process chamber, and supply process and cleaning gases.

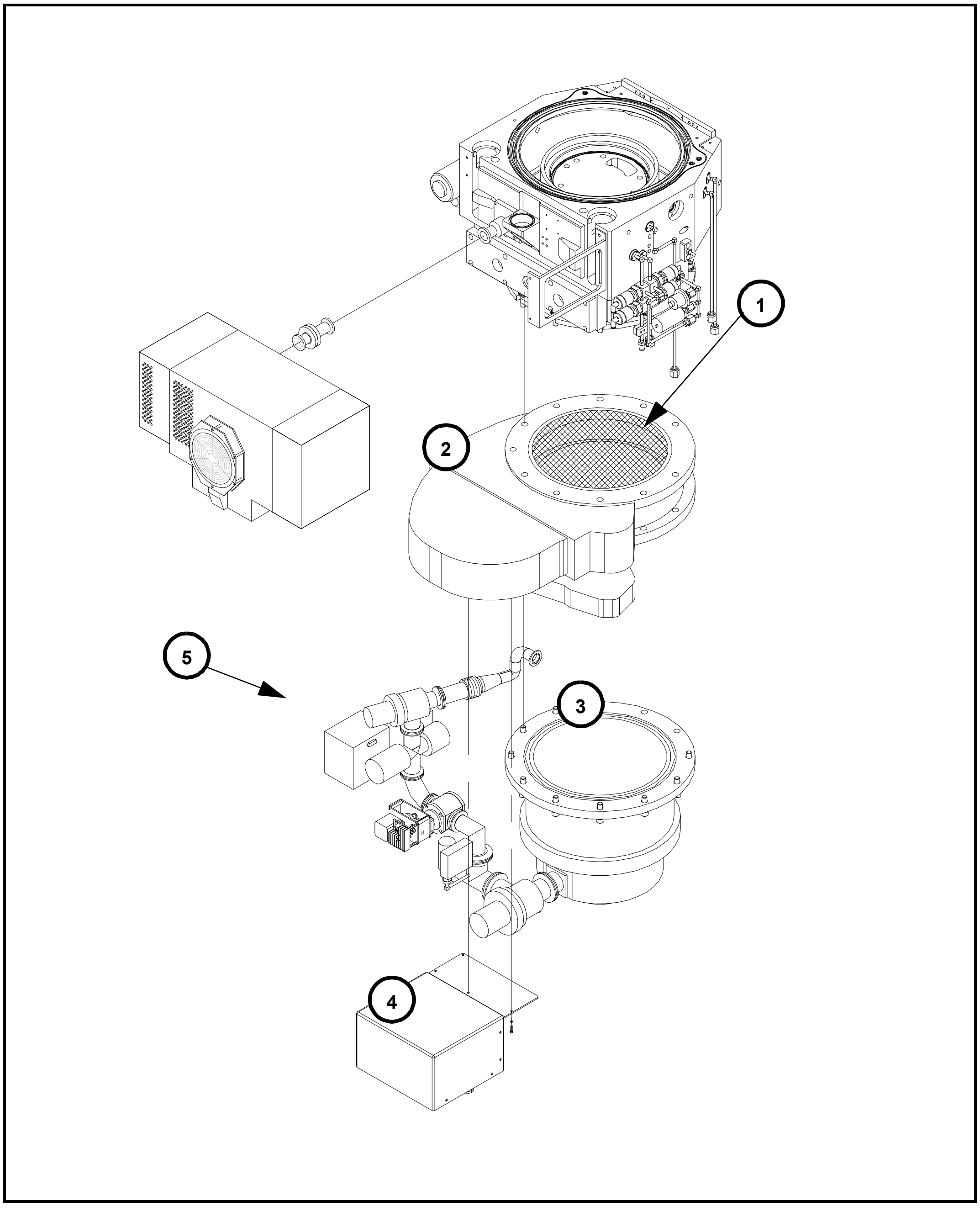


Figure 2-5. Ultima TE Lower Chamber Components

Table 2-5. Ultima TE Lower Chamber Components

No.	Item	Description
1	Aluminum Turbo Screen	The aluminum turbo screen is placed above the gate valve for particle reduction caused by deposition. During the chamber cleaning process the gate vale is typically closed and by placing the screen above the gate valve it will ensure the that the screen is also cleaned. Some customers require the Al screen above the turbo. Please check with GPM for correct configuration.
2	Pendulum Gate Valve	The pendulum gate valve provides a more reliable method of isolating the turbo pump and contributes to better particle performance. Additional, Norcal GV actuator is rotated to allow access to all hardware securing GV to turbo.
3	2200 L/s Turbo Pump	With the increased pumping capacity of the 2200l/s turbo pump it extends the gap fill performance of the chamber.
3a	Enhanced Hydrogen Turbo Pump	For chambers using Hydrogen process, a more efficient turbo pump is required. The enhanced hydrogen turbo pump provides greater equivalant pumping capacity. The rough pump used with this turbo pump will have to meet the 600 cubic m/hr pumping capacity. Reference SSPS for requirements/specs.
4	Dome cooling flow switch box	This is used to control the Ultima TE chamber dome cooling water. Low and high flow switching provides high flow when the chamber is running a process recipe and low flow when the chamber is idle. Low water flow during idle conditions allows the dome temperature to be increased to the desired temperature quicker with less demand on the heater drivers. High water flow will prevent dome temperature run away resulting in better process results
5	OPTIONAL: IR Diagnostics	The Optional IR diagnostic equipment can improve the clean time by determining how much silicon fluoride is generated during the cleaning process.

2.3 Coolant Routing

Chamber coolant routing has been improved with the Ultima TE. The upper chamber components are cooled at a lower temperature while controlling the flow during process conditions. The lower chamber components are kept at a higher temperature to improve the performance of the process. The only components that require facilities cooling water are the RPS unit and the turbo pump. See Figure 2-6 for the chamber cooling schematic.

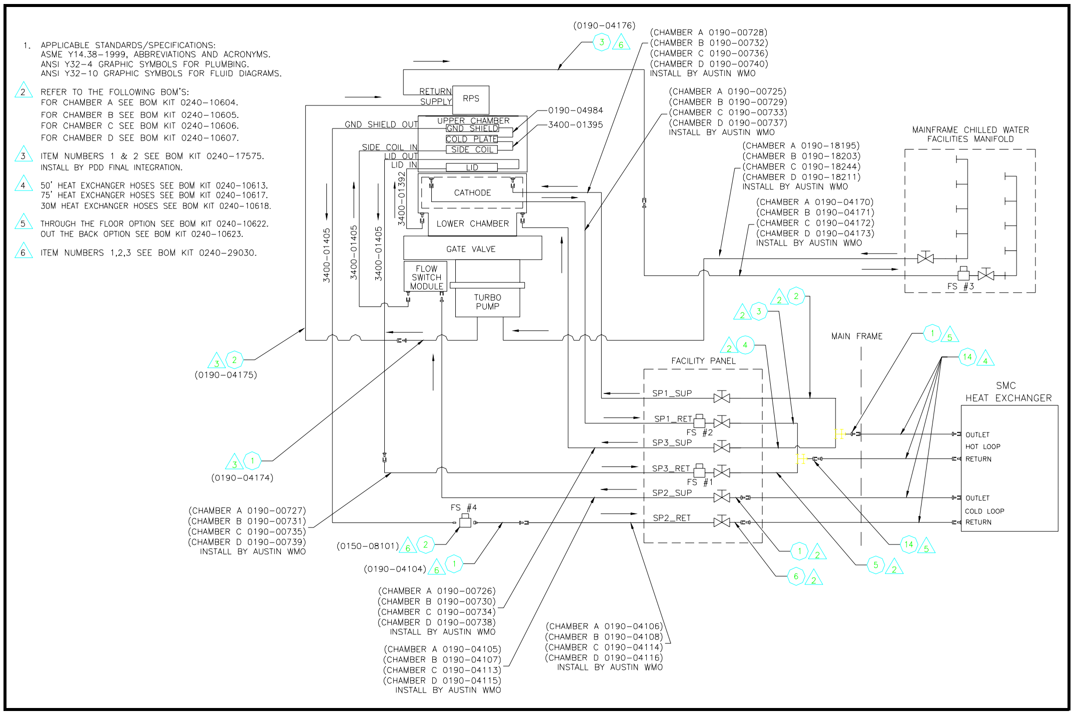


Figure 2-6. Coolant Routing

2.4 ENI RF Generator Racks

The Ultima TE Chamber Utilizes a modular RF Rack and generators for each Chamber position. Two racks are capable of being stacked together to save footprint space. Each rack houses three generators for TOP, SIDE and BIAS power. The TOP and SIDE generators are capable of delivering 5000 W each of RF energy. The TOP and SIDE generators are frequency tuning generators and work in conjunction with the chamber top and side local matches to achieve a 50 ohm impedance, thus delivering maximum power to the process chamber. The frequency ranges have not changed from current Ultima and do not crossover in their tuning. The BIAS generator is capable of 5000 W of RF energy. It is a fixed frequency of 13.56 MHz and works in concert with the chamber's bias match for optimum power delivery to the chamber.

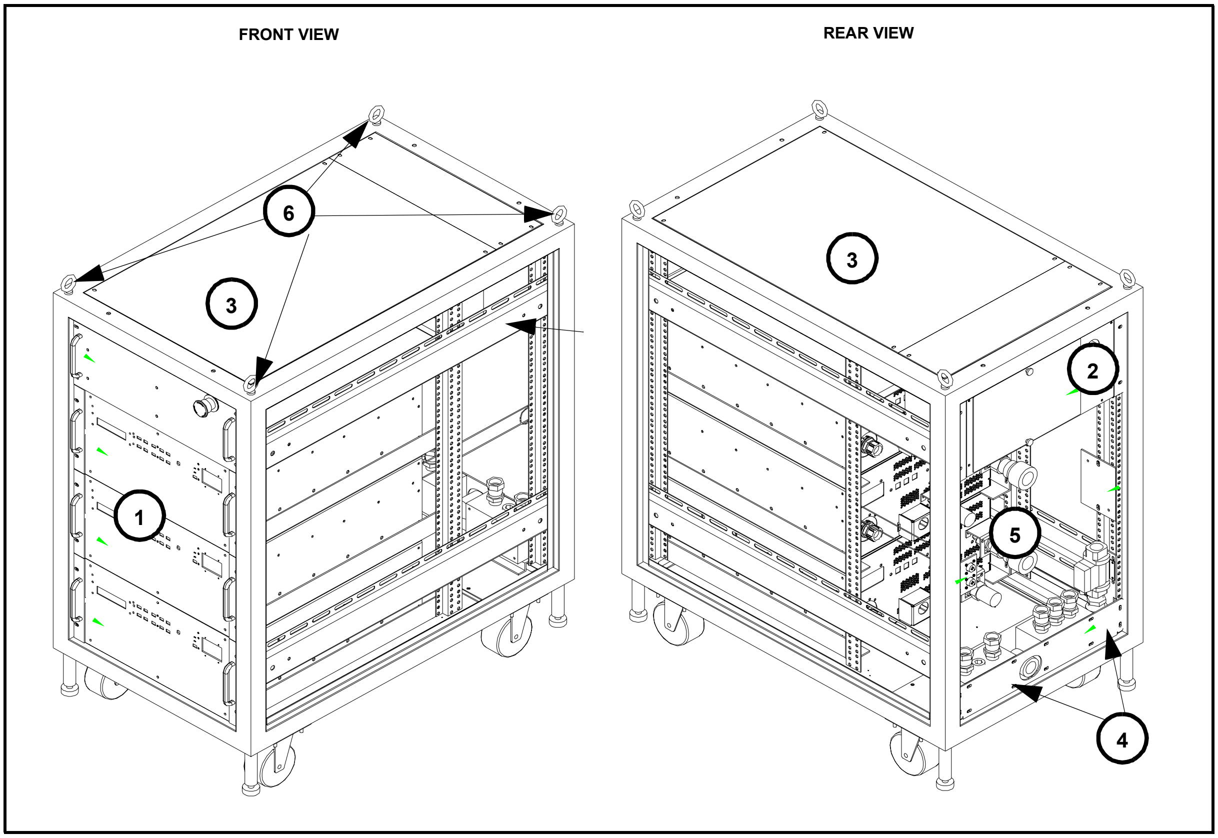


Figure 2-7. Modular ENI RF Racks

Table 2-6. ENI RF Racks		
No.	**Item**	**Description**
1	RF Generators	TOP, SIDE and BIAS Generators per chamber, per rack.
2	AC and CB locations	Incoming AC power for entire rack and individual CBs for each generator. Each generator is designed to plug into AC box.
3	Seriplex Housing	This is where the Remote Seriplex and DC power supply is housed. There will be on DC power supply on one RF rack, supplying power for 4 chambers. Also, there will be one Seriplex controller per two racks.
4	Facilities Cooling water	The supply and return of the facilities cooling water. The required flow is a minimum of 5 gpm.
5	Rear of generators	All RF cables and control cables and water will be connected here.
6	Lifting Bolts.	These lifting bolts can be removed when stacking two rack together. A maximum of two rack should be stacked together.

2.5 Gas Panel Components

Since the existing gas panel can only accommodate 10 gas stick positions, NF_3 Gas Panel MFC Bypass was added to supply an additional NF_3 line without having an additional gas stick. NF_3 goes through the bypass for clean recipes, and through the MFC for process recipes. This features works in conjuction with NF_3 RPS flow switching.

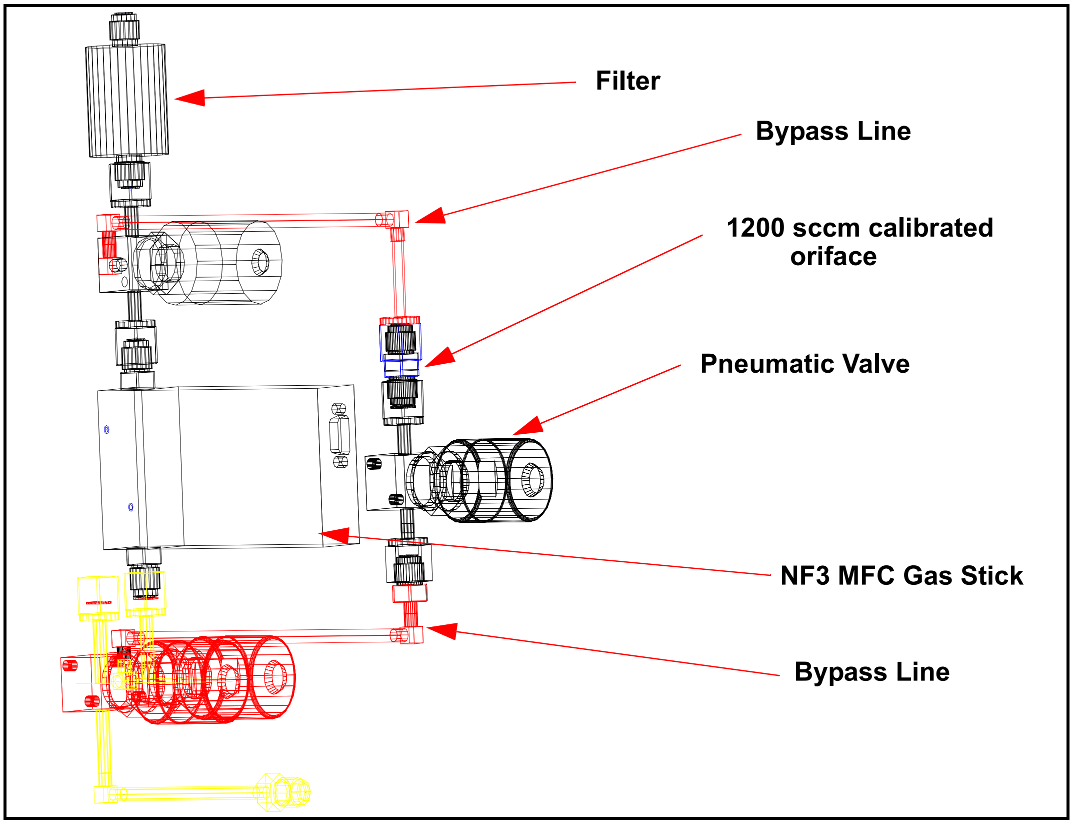
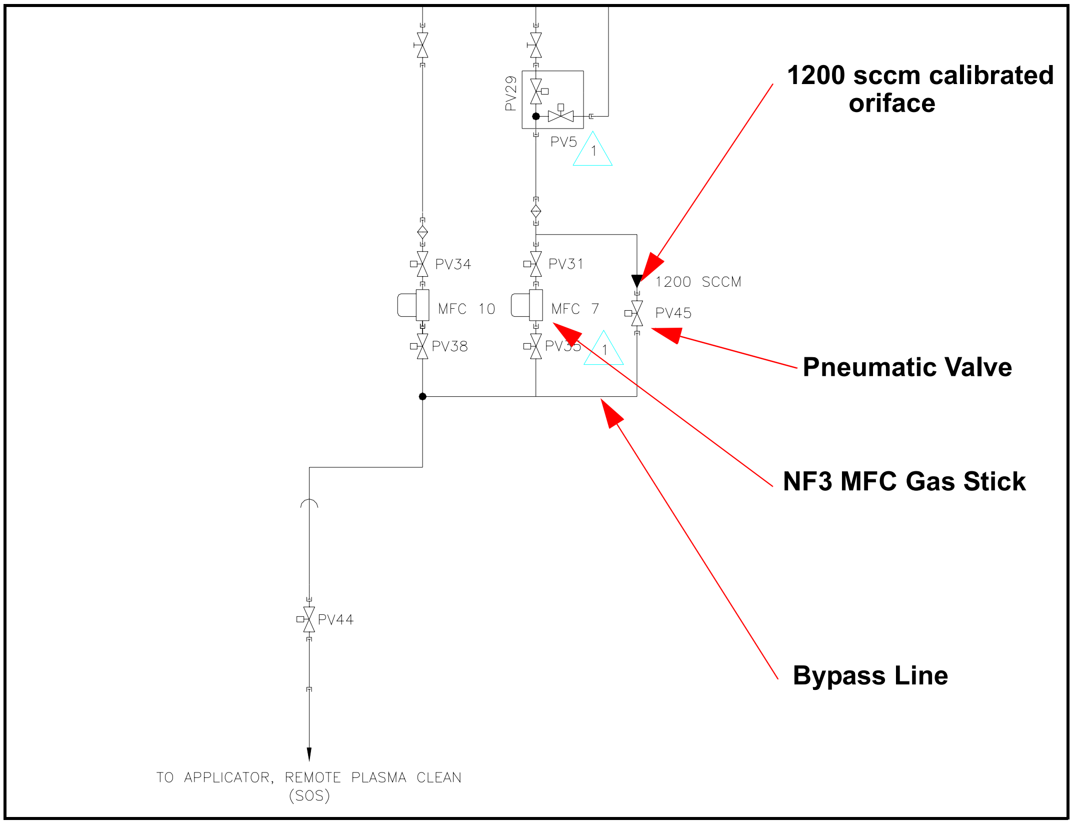


Figure 2-8. NF3 Gas Panel Bypass



1200 sccm calibrated oriface

Pneumatic Valve

NF3 MFC Gas Stick

Bypass Line

Figure 2-9. NF3 Gas Panel Bypass Schematic

2.6 Mainframe AC Boxes

AC box location has moved from inside the mainframe to outside of the mainframe (underneath gas panel). The AC boxes have been redesigned and relocated to ease AC facilitization.

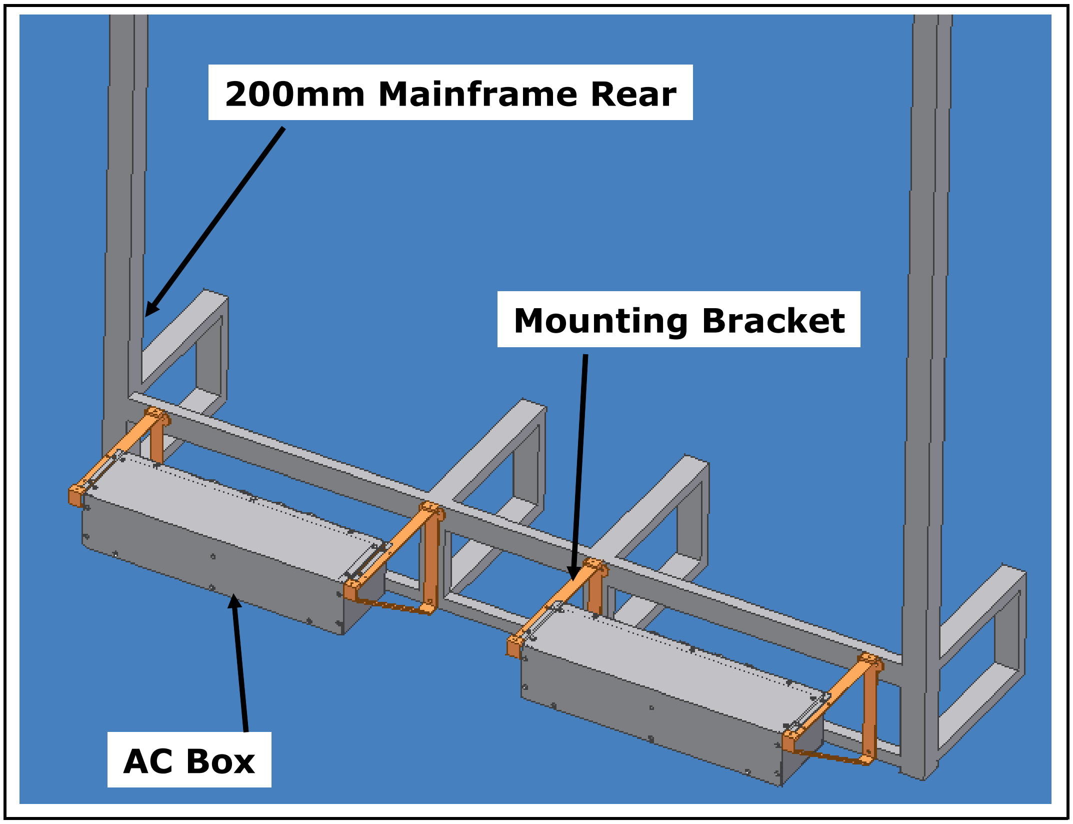


Figure 2-10. New AC Box Location

2.7 Ultima TE Package Configuration

The Ultima TE package contains the following components:

1. Ultima TE Upper chamber, mentioned in this chapter.
2. Ultima TE Lower chamber components mentioned in this chapter.
3. ENI RF generator rack mentioned in this chapter.
4. SMC Dual loop heat exchanger.
5. Gas Panel Components (Application Specific. See local Applied Material Sales Person for details.)
6. Compatible software for Ultima TE.

3 Operations and Programming

This chapter is a describes the Operations and Programming of the Ultima Plus and Ultima TE chambers. It should be noted that some software relating to the screens may have changed at the time of this manual's release. Because of this, some of the screens and software functions described in this chapter may vary slightly from the software screens shown on the system monitor. Reference Ultima Plus / Ultima TE Start Up Manual P/N 0230-01854 for latest BKM Syscons for Ultima TE.

3.1 Operation and Programming Screen

NOTE

Software Version 4.2_22 and higher should be installed in order to run the Ultima Plus chamber. Also, if upgrading from software ver. 3.4 or lower you *MUST* upgrade the EPROM in the Thermologic board.

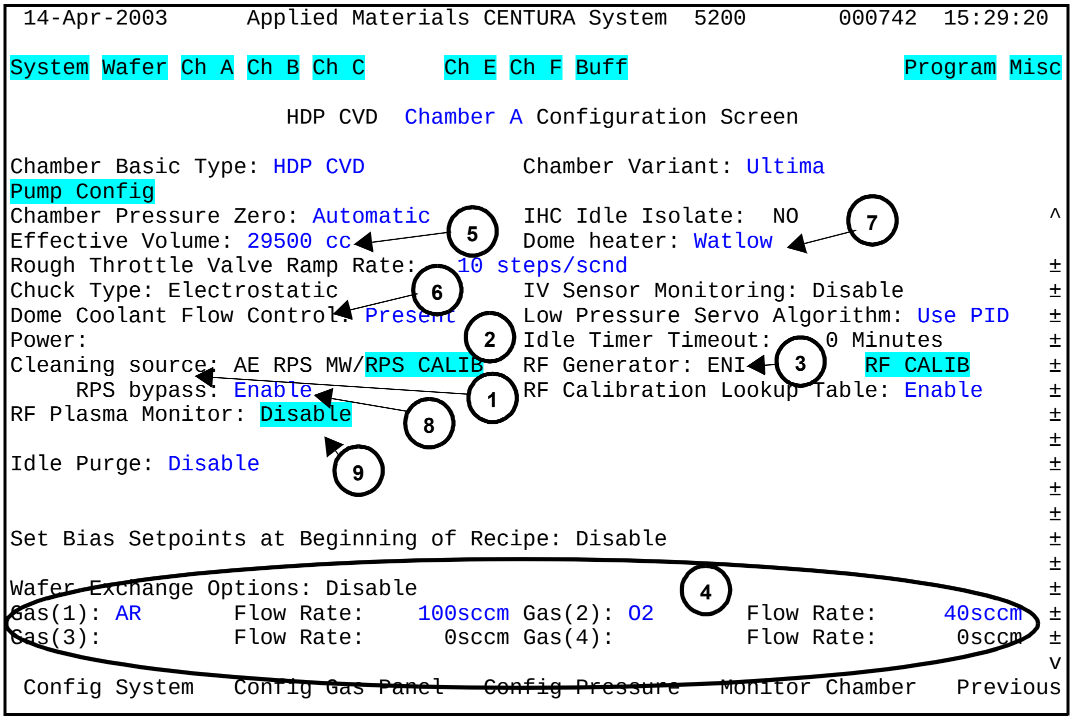
The following sections describe the screens for the Ultima Plus and TE HDP-CVD chamber

- Section 3.2, Ultima Plus/ TE Chamber Configuration Screen
- Section 3.3, Ultima Plus/TE Monitor Chamber Screen
- Section 3.4, Chamber Service Screen
- Section 3.5, Dome Heater/ Temperature Control Detail Screen
- Section 3.6, RPS Calibration and Interlock Screens
- Section 3.7, SMC/ Heat Exchanger Monitor Screen
- Section 3.8, ENI RF Calibration Screen
- Section 3.9, HDPCVD Process Recipe Screens
- Section 3.10, Clamped VHP+ Robot Screens

3.2 Ultima Plus/ TE Chamber Configuration Screen

The Chamber Configuration Screen is used to match the system software to the process chamber hardware. Access the Chamber Configuration Screen by touching the MISC header, then selecting “System Configuration” and “Configure Chamber” from the pulldown menus.

To configure a specific chamber, touch the “Chamber X” area in the header of the screen to select the chamber to configure. Only chambers that have been configured into the system software will be shown on the pulldown menu (see System Configuration, Chapter 4 of the *Centura DCVD Operations and Programming Manual*).

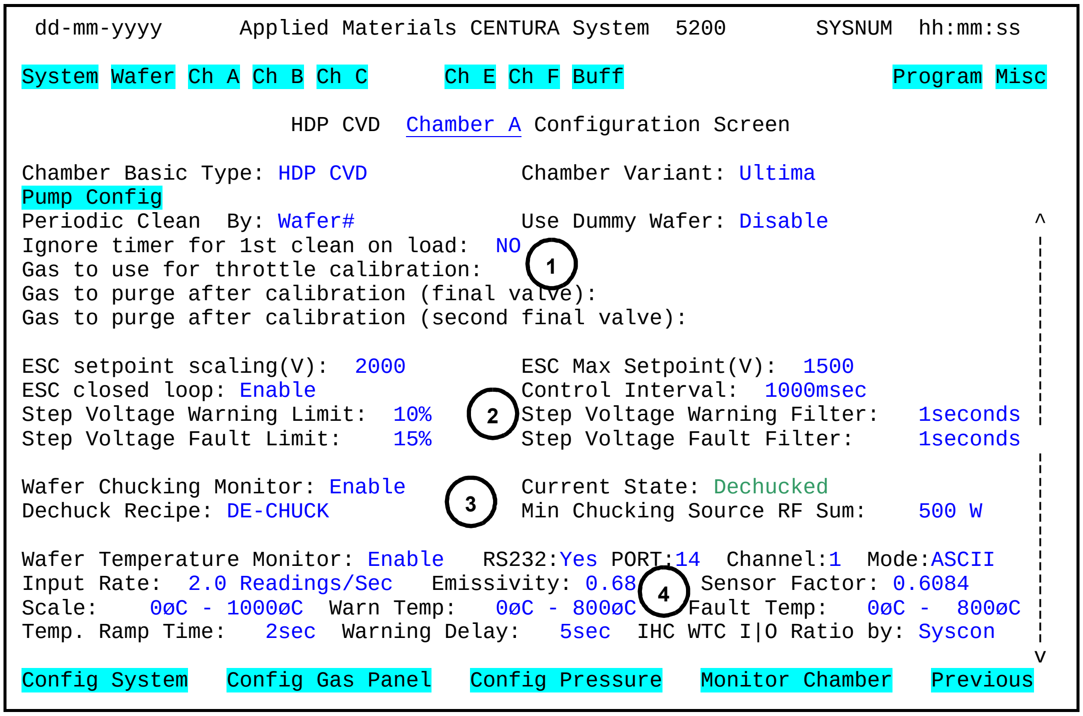


```
 14-Apr-2003      Applied Materials CENTURA System  5200       000742  15:29:20

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                     Program Misc

                    HDP CVD  Chamber A Configuration Screen

Chamber Basic Type: HDP CVD             Chamber Variant: Ultima
Pump Config
Chamber Pressure Zero: Automatic        IHC Idle Isolate:  NO                    ^
Effective Volume: 29500 cc              Dome heater: Watlow
Rough Throttle Valve Ramp Rate:   10 steps/scnd                                  ±
Chuck Type: Electrostatic               IV Sensor Monitoring: Disable            ±
Dome Coolant Flow Control: Present      Low Pressure Servo Algorithm: Use PID    ±
Power:                                  Idle Timer Timeout:    0 Minutes         ±
Cleaning source: AE RPS MW/RPS CALIB    RF Generator: ENI       RF CALIB         ±
     RPS bypass: Enable                 RF Calibration Lookup Table: Enable      ±
RF Plasma Monitor: Disable                                                       ±
                                                                                 ±
Idle Purge: Disable                                                              ±
                                                                                 ±
                                                                                 ±
Set Bias Setpoints at Beginning of Recipe: Disable                               ±
                                                                                 ±
Wafer Exchange Options: Disable                                                  ±
Gas(1): AR          Flow Rate:    100sccm Gas(2): O2          Flow Rate:    40sccm ±
Gas(3):             Flow Rate:      0sccm Gas(4):             Flow Rate:     0sccm ±
                                                                                 v
 Config System   Config Gas Panel   Config Pressure   Monitor Chamber   Previous
```

Figure 3-1. Chamber Configuration Screen (1 of 5)

Table 3-1. Chamber Configuration Screen (1 of 5)

No	Item	Description
1	Cleaning Source	Choose AE RPS for Ultima Plus/TE
2	MW/RPS CALIB	System will send user to RPS calibration screen when selected. See Figure 3-10.
3	RF Generator	Depending of what RF genterators are configured to the chamber, a choice of ETO or ENI is provided. Selecting RF CALIB will send user to the Generator RF calibration screen. See Figure 3-12.
4	Wafer Exchange Option	When enabled a choice of purge gas and flow is available during wafer exchange.
5	Chamber Volume	For Ultima Plus and Ultima TE the chamber volume must be **29500cc.**
6	Dome Coolant Flow Control	For Ultima TE this is enabled. See CHapter 3 for Utlima Plus Te Functional Descritption.
7	Dome Heater	The Dome Heaters are controlled by Thermologic (Ultima Plus) or Watlow (Ultima TE)
8	RPS Bypass Ar Purge	TE system only; this feature enables Ar purge through or below the RPS. With this feature disabled gases will only flow through the RPS.
9	Plasma Detect	TE system only; This feature allows the user to enable or disable the plasma interlock exclusion tables. Reference TE Start-Up procedure, Section 10.17.

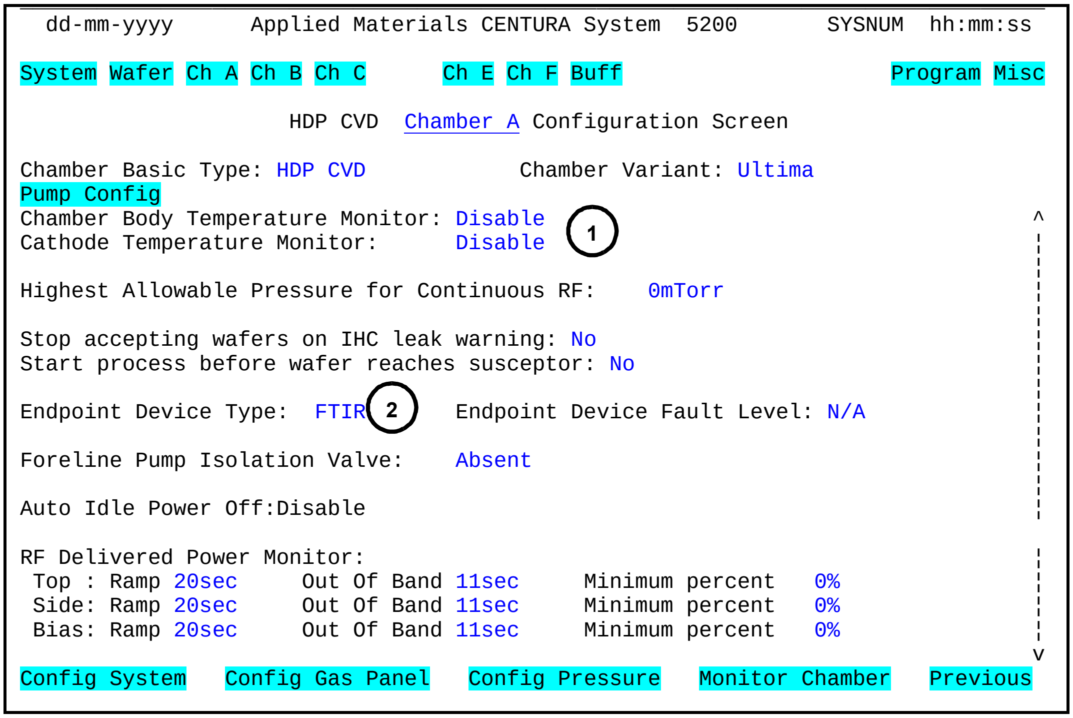


```
 dd-mm-yyyy      Applied Materials CENTURA System  5200       SYSNUM  hh:mm:ss

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                    Program Misc

                     HDP CVD  Chamber A Configuration Screen

Chamber Basic Type: HDP CVD           Chamber Variant: Ultima
Pump Config
Periodic Clean  By: Wafer#            Use Dummy Wafer: Disable                ^
Ignore timer for 1st clean on load:  NO                                       ¦
Gas to use for throttle calibration:                                          ¦
Gas to purge after calibration (final valve):                                 ¦
Gas to purge after calibration (second final valve):                          ¦
                                                                              ¦
ESC setpoint scaling(V):  2000        ESC Max Setpoint(V):  1500              ¦
ESC closed loop: Enable               Control Interval:  1000msec             ¦
Step Voltage Warning Limit:  10%      Step Voltage Warning Filter:   1seconds ¦
Step Voltage Fault Limit:    15%      Step Voltage Fault Filter:     1seconds
                                                                              ¦
Wafer Chucking Monitor: Enable        Current State: Dechucked                ¦
Dechuck Recipe: DE-CHUCK              Min Chucking Source RF Sum:    500 W    ¦
                                                                              ¦
Wafer Temperature Monitor: Enable   RS232:Yes PORT:14  Channel:1  Mode:ASCII  ¦
Input Rate:  2.0 Readings/Sec   Emissivity: 0.68   Sensor Factor: 0.6084      ¦
Scale:    0øC - 1000øC  Warn Temp:   0øC - 800øC  Fault Temp:   0øC -  800øC  ¦
Temp. Ramp Time:   2sec  Warning Delay:   5sec  IHC WTC I|O Ratio by: Syscon  ¦
                                                                              v
Config System   Config Gas Panel   Config Pressure   Monitor Chamber   Previous
```

Figure 3-2. Chamber Configuration Screen (2 of 5)

Table 3-2. Chamber Configuration Screen (2 of 5)

No	Item	Description
1	Periodic Clean Settings	Controls chamber clean count by wafer or by time. The default should be selected by "wafer #"
2	ESC Setting	Controls ESC parameters
3	Wafer Chucking Settings	Controls wafer chucking warning
4	Wafer Temp Monitor (WTM) Settings.	Controls WTM parameters

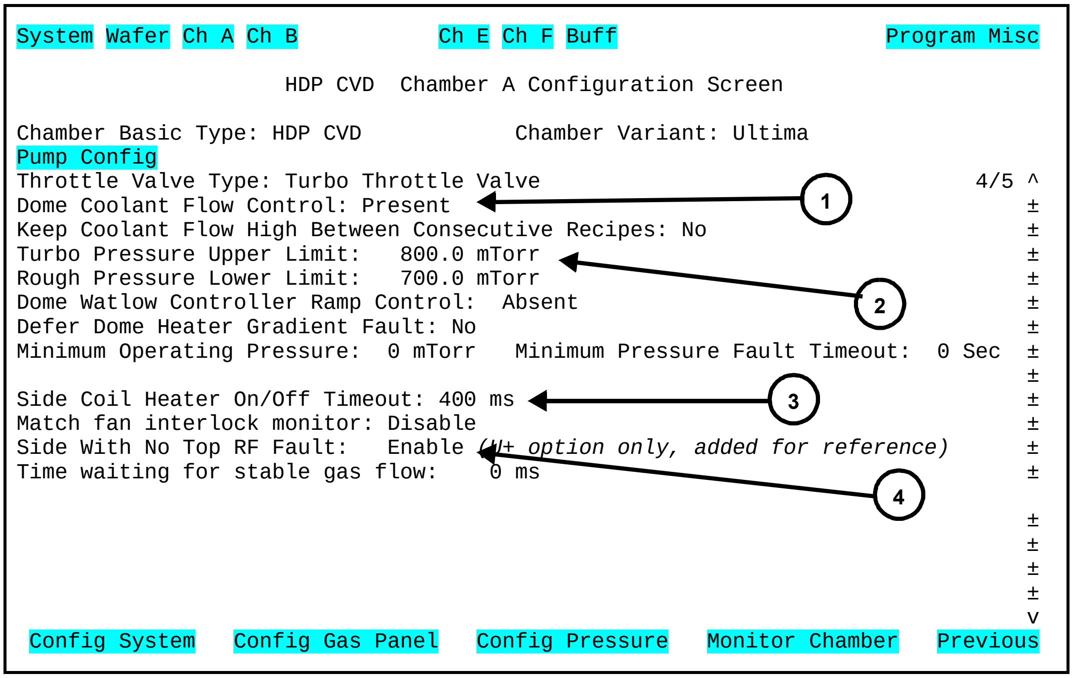


```
  dd-mm-yyyy      Applied Materials CENTURA System  5200       SYSNUM  hh:mm:ss

                             HDP CVD  Chamber A Configuration Screen

Chamber Basic Type: HDP CVD             Chamber Variant: Ultima

Chamber Body Temperature Monitor: Disable
Cathode Temperature Monitor:      Disable

Highest Allowable Pressure for Continuous RF:    0mTorr

Stop accepting wafers on IHC leak warning: No
Start process before wafer reaches susceptor: No

Endpoint Device Type:   FTIR      Endpoint Device Fault Level: N/A

Foreline Pump Isolation Valve:    Absent

Auto Idle Power Off:Disable

RF Delivered Power Monitor:
 Top : Ramp 20sec     Out Of Band 11sec     Minimum percent   0%
 Side: Ramp 20sec     Out Of Band 11sec     Minimum percent   0%
 Bias: Ramp 20sec     Out Of Band 11sec     Minimum percent   0%
```

Figure 3-3. Chamber Configuration Screen (3 of 5)

Table 3-3. Chamber Configuration Screen (3 of 5)

No	Item	Description
1	Temperature Monitoring	Enables the monitoring of the cathode and chamber body Temperatures. (if Hardware is installed on the chamber)
2	IR Diagnostics	Enables the Charting and process availability of IR diagnostics.

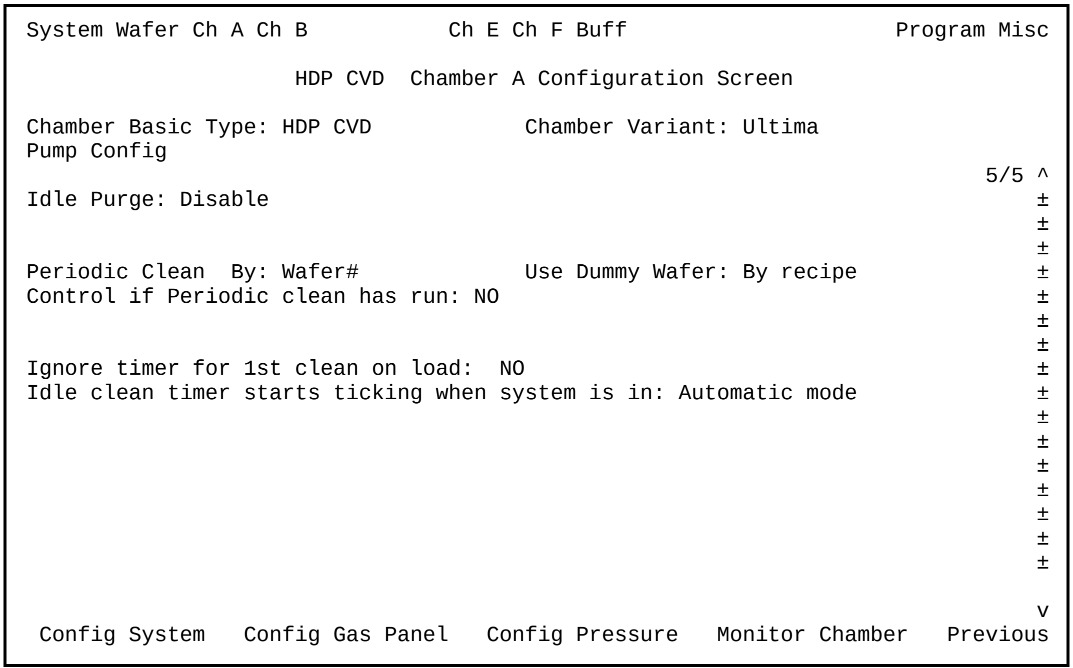


```
System Wafer Ch A Ch B          Ch E Ch F Buff                    Program Misc

                     HDP CVD  Chamber A Configuration Screen

Chamber Basic Type: HDP CVD           Chamber Variant: Ultima
Pump Config
Throttle Valve Type: Turbo Throttle Valve                                  4/5 ^
Dome Coolant Flow Control: Present                                             ±
Keep Coolant Flow High Between Consecutive Recipes: No                         ±
Turbo Pressure Upper Limit:   800.0 mTorr                                      ±
Rough Pressure Lower Limit:   700.0 mTorr                                      ±
Dome Watlow Controller Ramp Control:  Absent                                   ±
Defer Dome Heater Gradient Fault: No                                           ±
Minimum Operating Pressure:  0 mTorr   Minimum Pressure Fault Timeout:  0 Sec  ±
                                                                               ±
Side Coil Heater On/Off Timeout: 400 ms                                        ±
Match fan interlock monitor: Disable                                           ±
Side With No Top RF Fault:   Enable (U+ option only, added for reference)      ±
Time waiting for stable gas flow:    0 ms                                      ±

                                                                               ±
                                                                               ±
                                                                               ±
                                                                               ±
                                                                               v
 Config System   Config Gas Panel   Config Pressure   Monitor Chamber   Previous
```

Figure 3-4. **Chamber Configuration Screen (4 of 5)**

Table 3-4. **Chamber Configuration Screen (4 of 5)**

No	Item	Description
1	Dome Coolant Setting	Ultima TE chambers need to enable this setting.
2	Pressure Limits	This setting enable the upper pressure limit of the turbo pump. Primarilty used during the turbo ON clean process. (NOTE: Pressure setting should not exceed 800mT, for risk of damaging the turbo pump)
3	Side Coil Heater Timeout	Used for Ultima TE. Controls the timing of the Balanced Side coil during process.
4	Side With No Top RF Fault	Ultima Plus option only. Feature was added with SW version 4.1_X. This feature is only used on Ultima Plus when ’Thermologic" is selected for the Dome Heater. The default should be set to ’Enable’. With this feature enabled, the TOP RF must be ON before side and setpoint must be >600W.



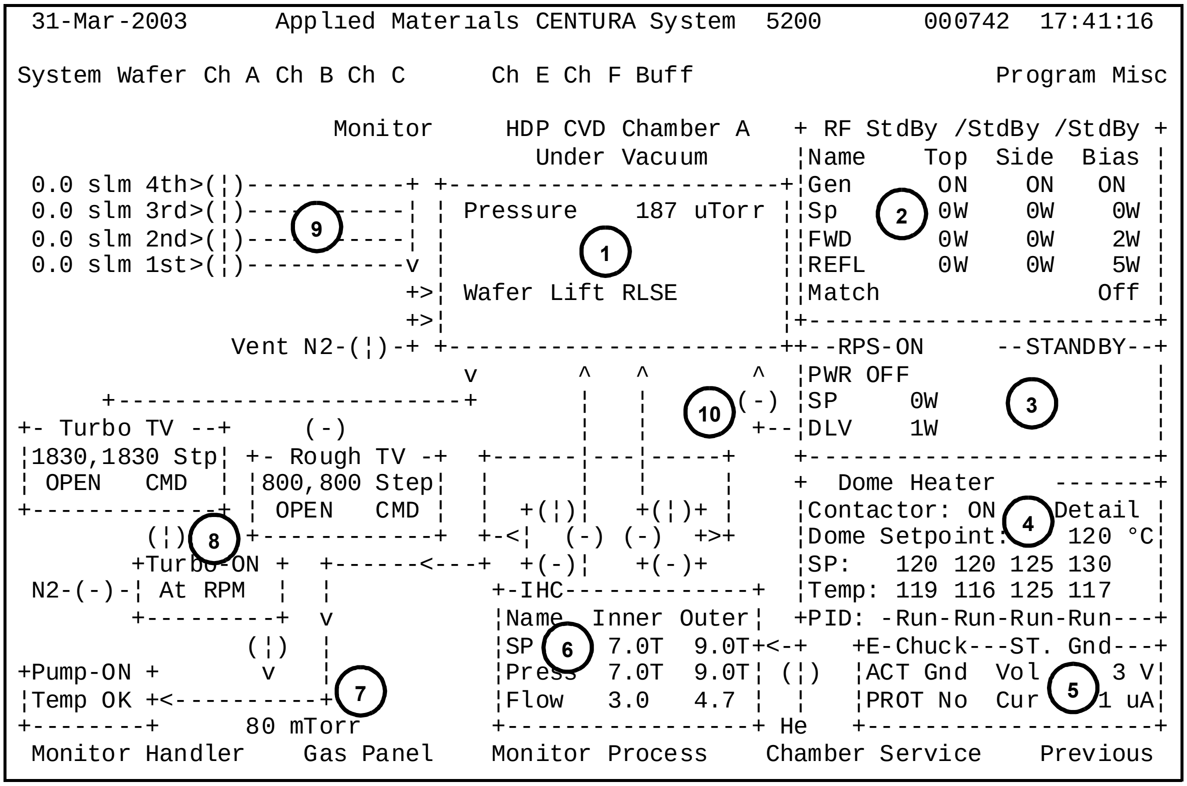
```
System Wafer Ch A Ch B           Ch E Ch F Buff                     Program Misc

                     HDP CVD  Chamber A Configuration Screen

Chamber Basic Type: HDP CVD            Chamber Variant: Ultima
Pump Config
                                                                           5/5 ^
Idle Purge: Disable                                                            ±
                                                                               ±
                                                                               ±
Periodic Clean  By: Wafer#             Use Dummy Wafer: By recipe              ±
Control if Periodic clean has run: NO                                          ±
                                                                               ±
                                                                               ±
Ignore timer for 1st clean on load:  NO                                        ±
Idle clean timer starts ticking when system is in: Automatic mode              ±
                                                                               ±
                                                                               ±
                                                                               ±
                                                                               ±
                                                                               ±
                                                                               ±
                                                                               ±

                                                                               v
 Config System   Config Gas Panel   Config Pressure   Monitor Chamber   Previous
```

Chamber Configuration Screen (5 of 5)

With SW version 4.9_X, several sequencer/recipe configuration options were moved from chamber configuration pages 1 and 2 to page 5.

3.3 Ultima Plus/TE Monitor Chamber Screen

The HDP-CVD Monitor Chamber Screen is a graphical representation of the HDPCVD chamber. It is used to monitor the status of each of the major components of the chamber, such as pressure, isolation valves, temperature, purge flows, He cooling, rf generators and pumps. Access Monitor Chamber Screen by touching the CH X header and selecting “Monitor Chamber” from the pulldown. The screen header may be toggled to the specific chamber to be monitored.



```
 31-Mar-2003      Applied Materials CENTURA System  5200       000742  17:41:16

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                     Program Misc

                      Monitor     HDP CVD Chamber A   + RF StdBy /StdBy /StdBy +
                                    Under Vacuum      ¦Name    Top  Side  Bias ¦
 0.0 slm 4th>(¦)-----------+ +-----------------------+¦Gen      ON    ON   ON  ¦
 0.0 slm 3rd>(¦)-----------¦ ¦ Pressure    187 uTorr ¦¦Sp       0W    0W    0W ¦
 0.0 slm 2nd>(¦)-----------¦ ¦                       ¦¦FWD      0W    0W    2W ¦
 0.0 slm 1st>(¦)-----------v ¦                       ¦¦REFL     0W    0W    5W ¦
                           +>¦ Wafer Lift RLSE       ¦¦Match               Off ¦
                           +>¦                       ¦+------------------------+
               Vent N2-(¦)-+ +-----------------------++--RPS-ON     --STANDBY--+
                               v       ^   ^       ^  ¦PWR OFF                 ¦
      +------------------------+       ¦   ¦      (-) ¦SP     0W               ¦
+- Turbo TV --+     (-)                ¦   ¦       +--¦DLV    1W               ¦
¦1830,1830 Stp¦ +- Rough TV -+  +------¦---¦-----+    +------------------------+
¦ OPEN   CMD  ¦ ¦800,800 Step¦  ¦      ¦   ¦     ¦    +  Dome Heater    -------+
+-------------+ ¦ OPEN   CMD ¦  ¦  +(¦)¦   +(¦)+ ¦    ¦Contactor: ON    Detail ¦
         (¦)    +------------+  +-<¦  (-) (-)  +>+    ¦Dome Setpoint:    120 °C¦
        +Turbo-ON +  +------<---+  +(-)¦   +(-)+      ¦SP:   120 120 125 130   ¦
 N2-(-)-¦ At RPM  ¦  ¦           +-IHC-------------+  ¦Temp: 119 116 125 117   ¦
        +---------+  v           ¦Name  Inner Outer¦  +PID: -Run-Run-Run-Run---+
                (¦)  ¦           ¦SP     7.0T  9.0T+<-+   +E-Chuck---ST. Gnd---+
+Pump-ON +       v   ¦           ¦Press  7.0T  9.0T¦ (¦)  ¦ACT Gnd  Vol     3 V¦
¦Temp OK +<----------+           ¦Flow   3.0   4.7 ¦  ¦   ¦PROT No  Cur    1 uA¦
+--------+      80 mTorr         +-----------------+ He   +--------------------+
 Monitor Handler    Gas Panel    Monitor Process    Chamber Service    Previous
```

Figure 3-5. Chamber Monitor Screen

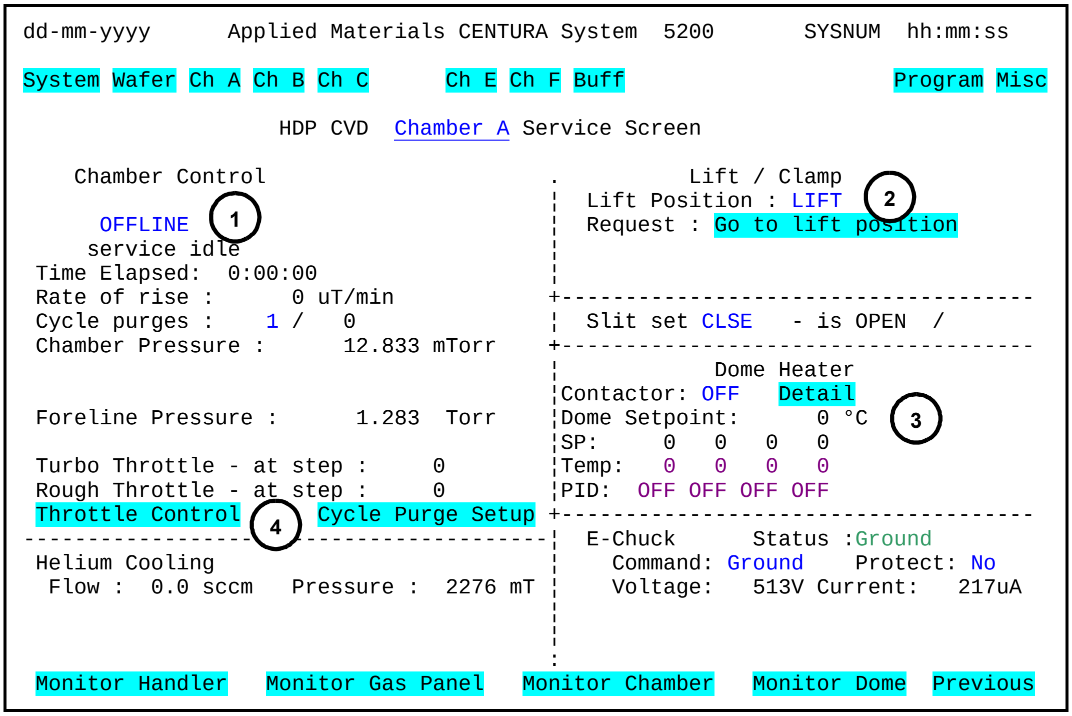
Table 3-5. Chamber Monitor Screen

No	Item	Description
1	Chamber Pressure and Wafer Lift Status	Displays Chamber Pressure and Wafer Lift Status. Above this box is the interlock display for pressure and lid cover interlock.
2	RF Generator States	Displays the RF generators, Setpoint, Forward and Reflected Power. Also displays the interlock status for each generator.
3	RPS Status	Displays the status of the AE RPS unit. Forward power, and any interlock status can be viewed on this window.
4	Dome Heater Display	Displays the primary TC's of the 4 dome heater zones. There are 3 color codes on the Temp: Section: Yellow: Heaters are ramping up or down to meet setpoint Purple: Fault Situation See Dome Detail Screen Green: Zones at Setpoint and in Servo Mode.
5	ESC Display	Displays the State of the ESC Power supply
6	IHC Display	Displays the Pressure, flow and valving for both zones of the IHC
7	Foreline Pressure	Displays the Foreline pressure
8	Turbo Pump State, Rough and Turbo Throttle Valve States	The tubo pump will display SLOW or ATSPEED. The Rough and turbo throttle valve will display the OPEN, CLOSE, or STEP count while in operation.
9	Gas Final valve States	Displays the 4 final lines and thier valve states.
10	RPS Flow Bypass	Ultima TE only; NF3 is normally flowed through the RPS unit for cleaning the chamber. For the current Dep-Etch-Dep process, NF3 is also used for processing the wafer. The NF3 gasline going to the RPS unit is now connected/Tee'd to go below the RPS unit as well. There are two pneumatic valves which control the flow of NF3 either through the top of the RPS for clean, or through the bottom of the RPS for process. Additionally, there is an Ar purge feature that allows purge either through the RPS or below the RPS. Reference Figure 3-15 and Table 3-15 for recipe operation.

3.4 Chamber Service Screen

The Chamber Service Screen makes available the service routines for the HDPCVD chamber. Various fucntions include, putting the chamber ONLINE or OFFLINE, Chamber Venting, Chamber cycle purging, etc.. A list of available service routine can be seen on Figure 3-7. Furthermore, operation of the wafer lift, throttle valve control and a link to the dome heater detail screen can be found her as well.

Access the Chamber Service Screen by touching the "CH. X" header, then select “Chamber service” from the pulldown menus.

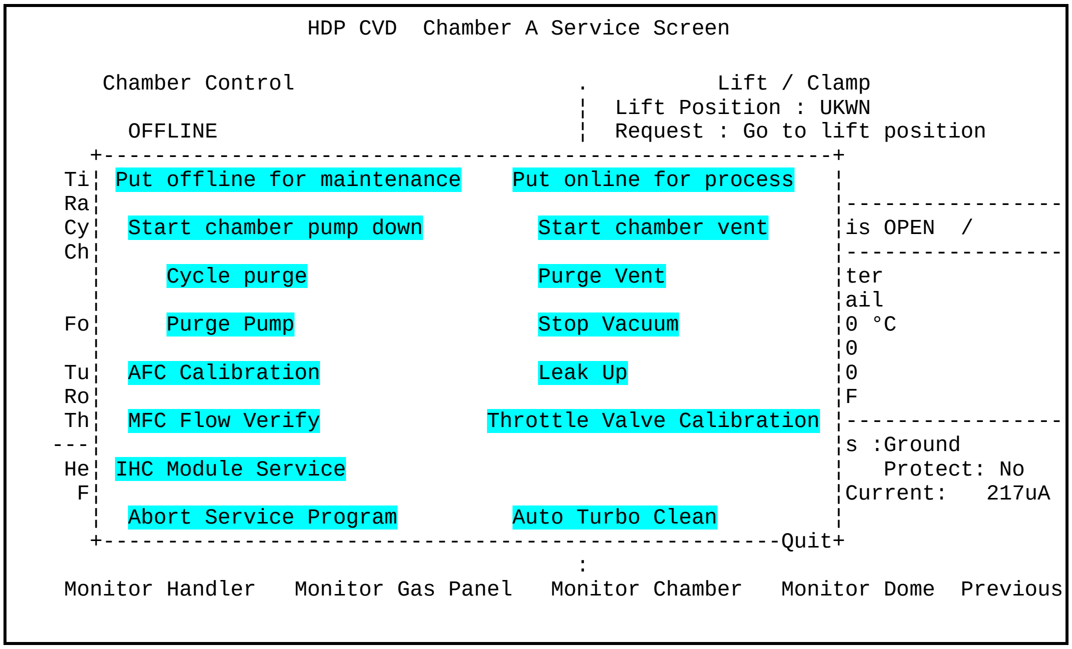


```
dd-mm-yyyy      Applied Materials CENTURA System  5200       SYSNUM  hh:mm:ss

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                   Program Misc

                    HDP CVD  Chamber A Service Screen

    Chamber Control                         .         Lift / Clamp
                                            ¦  Lift Position : LIFT
      OFFLINE                               ¦  Request : Go to lift position
     service idle                           ¦
 Time Elapsed:  0:00:00                     ¦
 Rate of rise :      0 uT/min               +-------------------------------------
 Cycle purges :    1 /   0                  ¦  Slit set CLSE   - is OPEN   /
 Chamber Pressure :      12.833 mTorr       +-------------------------------------
                                            ¦          Dome Heater
                                            ¦Contactor: OFF    Detail
 Foreline Pressure :      1.283   Torr      ¦Dome Setpoint:        0 °C
                                            ¦SP:     0   0   0   0
 Turbo Throttle - at step :     0           ¦Temp:   0   0   0   0
 Rough Throttle - at step :     0           ¦PID:  OFF OFF OFF OFF
 Throttle Control     Cycle Purge Setup     +-------------------------------------
-------------------------------------------¦  E-Chuck      Status :Ground
 Helium Cooling                             ¦    Command: Ground      Protect: No
  Flow :  0.0 sccm    Pressure :  2276 mT   ¦    Voltage:     513V Current:    217uA
                                            ¦
                                            :
 Monitor Handler  Monitor Gas Panel  Monitor Chamber  Monitor Dome  Previous
```

Figure 3-6. Chamber Service Screen

Table 3-6. Chamber Service Screen

No	Item	Description
1	Service routine	This fuction will open a window displaying the service routines available for the HDP chamber. see Figure 3-7 for the list.
2	Wafer Lift Control	The wafer lift mechanism can be controlled on this screen.
3	Dome Heater display	In addition the monitor chamber screen, each on the four heater zones can me monitored here. Also, a link to the dome heater detail screen can be accessed her as well.
4	Throttle control	A link to the rough and turbo throttle valves can be accessed her as well.



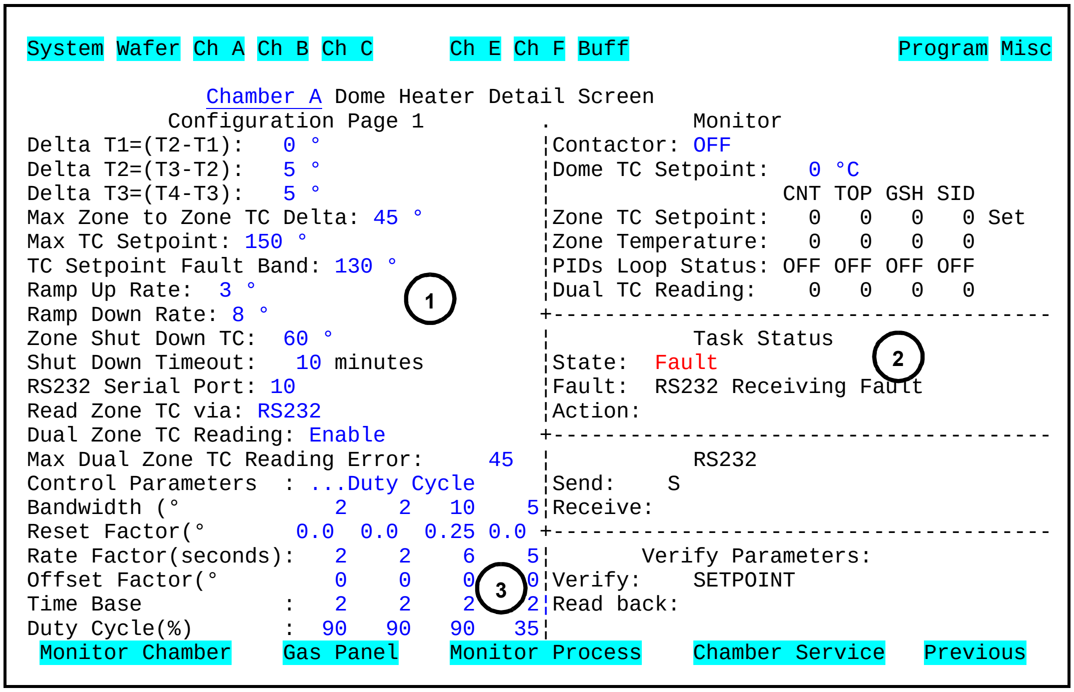
```
                    HDP CVD  Chamber A Service Screen

    Chamber Control                      .          Lift / Clamp
                                         ¦  Lift Position : UKWN
      OFFLINE                            ¦  Request : Go to lift position
   +---------------------------------------------------------+
 Ti¦ Put offline for maintenance   Put online for process   ¦
 Ra¦                                                         ¦-----------------
 Cy¦  Start chamber pump down         Start chamber vent     ¦is OPEN  /
 Ch¦                                                         ¦-----------------
   ¦     Cycle purge                  Purge Vent             ¦ter
   ¦                                                         ¦ail
 Fo¦     Purge Pump                   Stop Vacuum            ¦0 °C
   ¦                                                         ¦0
 Tu¦  AFC Calibration                 Leak Up                ¦0
 Ro¦                                                         ¦F
 Th¦  MFC Flow Verify             Throttle Valve Calibration ¦-----------------
---¦                                                         ¦s :Ground
 He¦ IHC Module Service                                      ¦   Protect: No
  F¦                                                         ¦Current:   217uA
   ¦  Abort Service Program         Auto Turbo Clean         ¦
   +-----------------------------------------------------Quit+
                                         :
 Monitor Handler   Monitor Gas Panel   Monitor Chamber   Monitor Dome  Previous
```

Figure 3-7. **Service Routines**

3.5 Dome Heater/ Temperature Control Detail Screen

The following screens describe the dome heater detail screen for an Ultima Plus chamber and an Ultima TE chamber.

Access the Heater Configuration Screen by touching the "Details" header from the Chamber Service Screen.



```
              Chamber A Dome Heater Detail Screen
           Configuration Page 1           .           Monitor
Delta T1=(T2-T1):   0 °                   ¦Contactor: OFF
Delta T2=(T3-T2):   5 °                   ¦Dome TC Setpoint:   0 °C
Delta T3=(T4-T3):   5 °                   ¦                 CNT TOP GSH SID
Max Zone to Zone TC Delta: 45 °           ¦Zone TC Setpoint:  0   0   0   0 Set
Max TC Setpoint: 150 °                    ¦Zone Temperature:  0   0   0   0
TC Setpoint Fault Band: 130 °             ¦PIDs Loop Status: OFF OFF OFF OFF
Ramp Up Rate:  3 °                        ¦Dual TC Reading:   0   0   0   0
Ramp Down Rate: 8 °                       +----------------------------------------
Zone Shut Down TC:  60 °                  ¦           Task Status
Shut Down Timeout:   10 minutes           ¦State:  Fault
RS232 Serial Port: 10                     ¦Fault:  RS232 Receiving Fault
Read Zone TC via: RS232                   ¦Action:
Dual Zone TC Reading: Enable              +----------------------------------------
Max Dual Zone TC Reading Error:     45    ¦           RS232
Control Parameters  : ...Duty Cycle       ¦Send:    S
Bandwidth (°           2    2   10    5   ¦Receive:
Reset Factor(°       0.0  0.0  0.25 0.0   +----------------------------------------
Rate Factor(seconds):  2    2    6    5   ¦       Verify Parameters:
Offset Factor(°        0    0    0    0   ¦Verify:    SETPOINT
Time Base           :  2    2    2    2   ¦Read back:
Duty Cycle(%)       :  90   90   90   35  ¦
```

Figure 3-8. Ultima Plus Dome Heater Detail Screen

Table 3-7. Ultima Plus Dome Heater Detail Screen

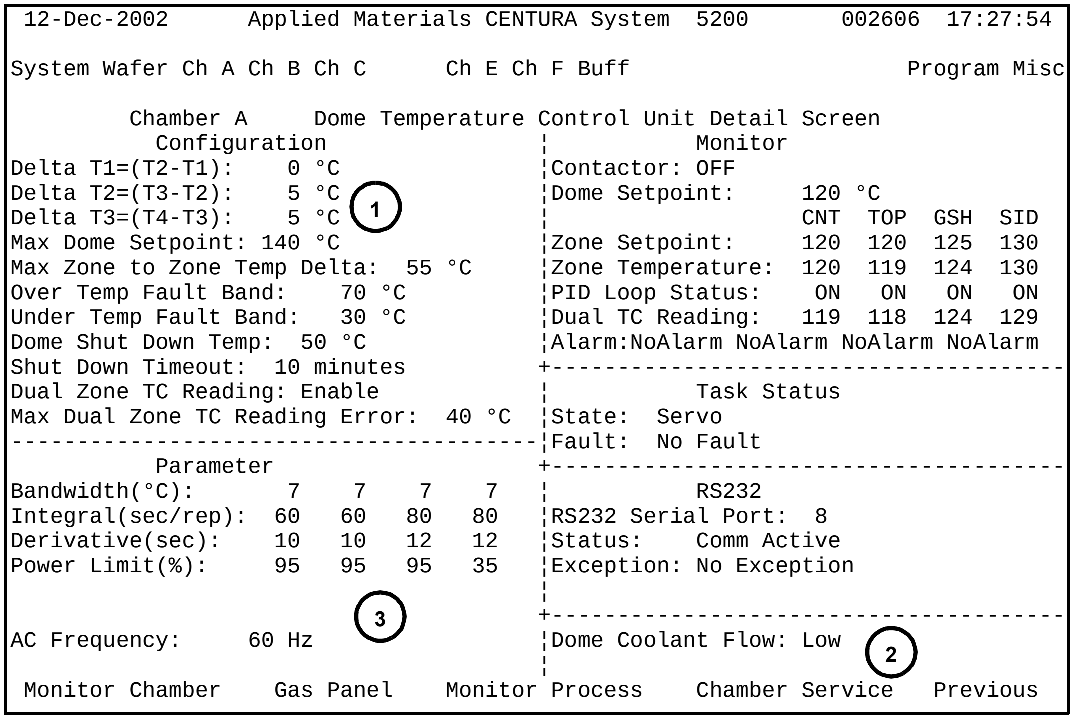
No	Item	Description
1	Configurations	The following paramters described are the BKM setting for optimum operation of the dome heaters. Zone Deltas: Temperature readings based on the setting are compared and if they fall ouside the specifications the heaters are disabled and a fault will occur. Ramp Rates: This controls the ramp rates during the heatup to setpoint or during shutdown. Communications: Thermologic control is communicated via RS232 and each port is chamber dependant.
2	Communications Status	The communication status between the Thermologic PCB and the system is displayed here.
3	Control Parameters Duty Cycles	The duty cycles of each heater zones are regulated in this section. These are the optimum settings that will provide the best perfotrmance and reiablity of the dome heaters. Reference Table 3-8 for Duty Cycle Parameter description.

Table 3-8. Ultima Plus Control Parameter Description

Parameter	Description
Bandwidth (C)	Bandwidth (C) is the effective gain of the controller. A small bandwidth, typically 1 degree, will approach on-off type control while a large bandwidth, typically 10 degrees, will accommodate thermal systems with large time lag and allow Rate and Reset parameters to operate effectively.
Reset factor (C/min)	Reset factor (C/min) is the gain of the proportional setpoint error correction. In a proportional control, the zone temperature can come to rest at any temperature within the bandwidth (not necessarily at the setpoint), depending on the ratio of heat available to heat loss from the load. The RESET FACTOR, sometimes called INTEGRAL, can correct this offset between setpoint and equilibrium temperature. A large RESET FACTOR, however, can cause instability in the control system and result in continuous oscillation of the zone temperature. The RESET FACTOR is entered in units of 100/ min. A RESET FACTOR of 0 will turn reset action off.
Rate factor (sec)	Rate factor (sec) is the gain of the rate error correction. A small RATE FACTOR, such as 2 seconds, will hold off heating only for very rapid rates of temperature rise at the load. Conversely, a large RATE FACTOR, such as 40 seconds, will hold off heating for smaller rates of temperature rise. The rate factor inhibits overshoot in thermal systems where there are large amounts of heat available for relatively small loads. The RATE FACTOR is entered in units of seconds. A RATE FACTOR of 0 will turn rate action off.
Offset factor (C)	Offset factor (C) is used to correct the constant Thermocouple reading error. If a thermocouple reading is constantly higher than actual temperature, a negative value should be entered for that zone. Conversely, a positive value should be entered. Enter 0 means no constant error correction for thermocouple reading.

Table 3-8. Ultima Plus Control Parameter Description

Parameter	Description
Time base	Time base parameter sets the smallest increment of time over which the basic control functions are repeated. It can be set from 200 milliseconds, upwards in increments of 50 milliseconds, to 2 seconds. A smaller TIME BASE will allow the control to react more rapidly to system conditions, but will reduce resolution of the output heat control. The numbers entered on the screen are not the actual time base values. The formula for actual time base in seconds is: (TIMEBASE+3)*0.05. So a TIMEBASE parameter of 2 means (2+3)*0.05=0.25 second. TIME BASE parameter may be entered from 1 to 37 (200ms to 2 seconds in actual value.)
Duty cycle (%)	Duty cycle (%) is a limitation on the maximum proportion of the time for which the control may be ON or, in other words, “call for heat”. A duty cycle of 35%, for example, will only allow the connected heat to be 35% “on”, regardless of the error from setpoint. DUTY CYCLE is adjustable from 10% to 100%.



```
 12-Dec-2002      Applied Materials CENTURA System  5200       002606  17:27:54

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                     Program Misc

         Chamber A     Dome Temperature Control Unit Detail Screen
           Configuration                  ¦           Monitor
Delta T1=(T2-T1):    0 °C                 ¦Contactor: OFF
Delta T2=(T3-T2):    5 °C                 ¦Dome Setpoint:     120 °C
Delta T3=(T4-T3):    5 °C                 ¦                   CNT  TOP  GSH  SID
Max Dome Setpoint: 140 °C                 ¦Zone Setpoint:     120  120  125  130
Max Zone to Zone Temp Delta:  55 °C       ¦Zone Temperature:  120  119  124  130
Over Temp Fault Band:    70 °C            ¦PID Loop Status:    ON   ON   ON   ON
Under Temp Fault Band:   30 °C            ¦Dual TC Reading:   119  118  124  129
Dome Shut Down Temp:  50 °C               ¦Alarm:NoAlarm NoAlarm NoAlarm NoAlarm
Shut Down Timeout:  10 minutes            +---------------------------------------
Dual Zone TC Reading: Enable              ¦           Task Status
Max Dual Zone TC Reading Error:  40 °C    ¦State:  Servo
------------------------------------------¦Fault:  No Fault
           Parameter                      +---------------------------------------
Bandwidth(°C):       7    7    7    7     ¦           RS232
Integral(sec/rep):  60   60   80   80     ¦RS232 Serial Port:  8
Derivative(sec):    10   10   12   12     ¦Status:    Comm Active
Power Limit(%):     95   95   95   35     ¦Exception: No Exception
                                          ¦
                                          +---------------------------------------
AC Frequency:     60 Hz                   ¦Dome Coolant Flow: Low
                                          ¦
 Monitor Chamber    Gas Panel    Monitor Process    Chamber Service   Previous
```

Figure 3-9. **Ultima TE Dome Temperature Control Detail Screen**

Table 3-9. Ultima TE Dome Temperature Control Detail Screen

No	Item	Description
1	Heater Configurations	See Table 3-7 for a description.
2	Dome flow control	The cooling to the dome cooling can be controlled here.
3	Heater Parameters	Similar to the duty cycles of Ultima Plus this sections regulates the heaters in the Ultima TE chamber to thier optimum perfomance. Reference Table 3-10 for Duty Cycle Parameter description.

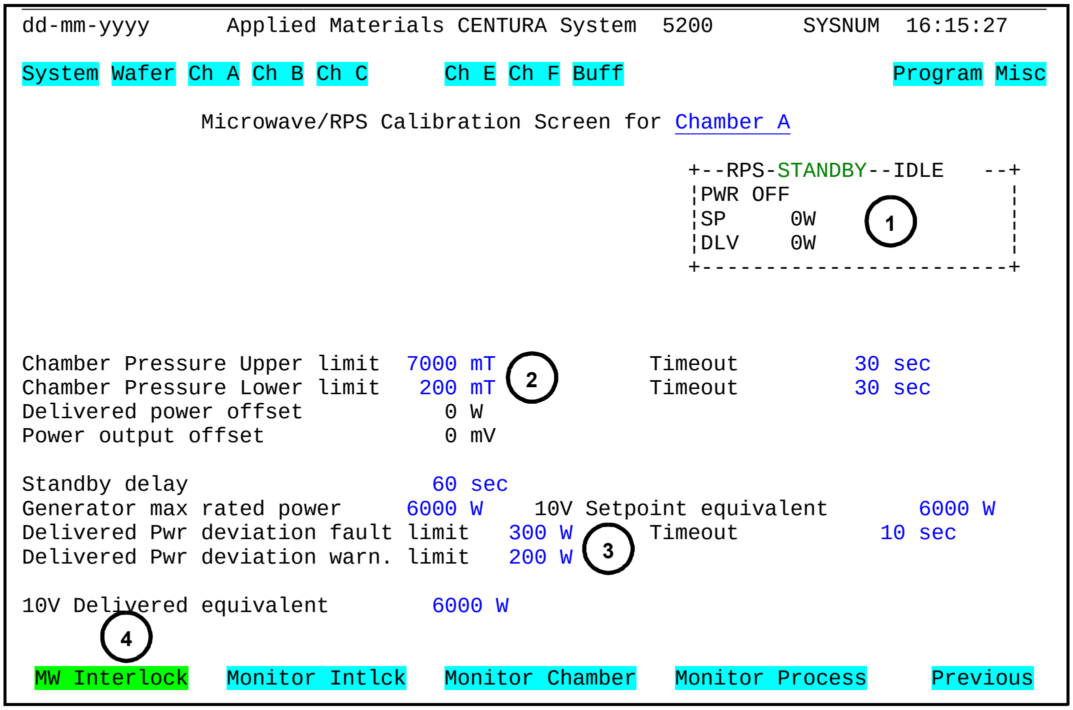
Table 3-10. Ultima TE Control Parameter Description

Parameter	Description
Bandwidth (C)	Bandwidth (C) is a range in which the Propotioning function of the control is active (This function is same as Ultima Plus Bandwidth)
Interval (sec/rep)	Interval (sec/rep) is control action that automatically eliminates offset or droop between set point and actual temperature. (This function is same as Ultima Plus Reset factor/Offset factor)
Derivative (sec)	Derivative (sec) is the action that anticipates the rate of change of actual temperture and compensates to minimize overshoot and undershoot. (This function is same as Ultima Plus Rate factor)
Power Limit (%)	Power Limit (%) is restriction of output power to a predetermined level. (This function is same as Ultima Plus Duty cycle)

3.6 RPS Calibration and Interlock Screens

The RPS Calibration and interlock screens are used to monitor the performance of the RPS unit. This will include all interlocks associated with the RPS unit. Also, the calibration screen is used to configure the RPS's warning and fault limits, and chamber conditions for the operation of the unit.

Access the RPS Calibrations Screen by touching the "Program" header, then select "Configure Chamber" from the pulldown menus. From pg. 1 of the chamber configuration screen touch the "MW/RPS Calib".

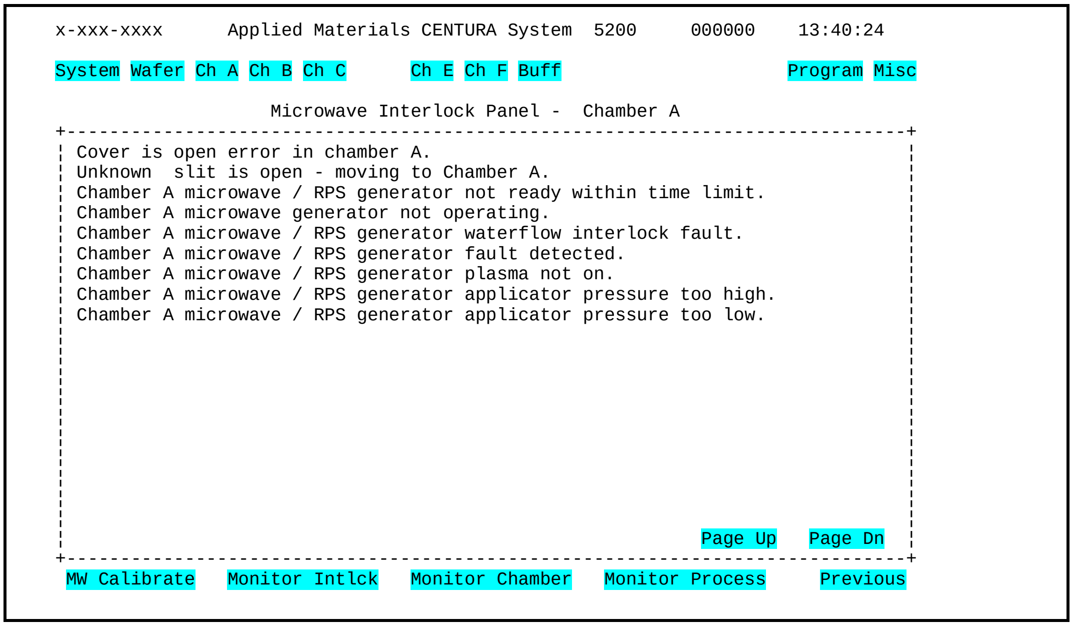


```
dd-mm-yyyy      Applied Materials CENTURA System  5200       SYSNUM  16:15:27

              Microwave/RPS Calibration Screen for Chamber A

                                                  +--RPS-STANDBY--IDLE   --+
                                                  ¦PWR OFF                 ¦
                                                  ¦SP      0W              ¦
                                                  ¦DLV     0W              ¦
                                                  +------------------------+

Chamber Pressure Upper limit  7000 mT          Timeout        30 sec
Chamber Pressure Lower limit   200 mT          Timeout        30 sec
Delivered power offset           0 W
Power output offset              0 mV

Standby delay                   60 sec
Generator max rated power     6000 W   10V Setpoint equivalent      6000 W
Delivered Pwr deviation fault limit   300 W    Timeout          10 sec
Delivered Pwr deviation warn. limit   200 W

10V Delivered equivalent        6000 W
```

Figure 3-10. RPS Calibration Screen

Table 3-11. RPS Calibration Screen

No	Item	Description
1	RPS Mointor	Monitrs the delivered power and Staus of the RPS unit
2	Pressure Limits	This setting enable the upper and lower pressure limits when the RPS is ON. These limits should not be changes as they are the optimum settings for the RPS unit.
3	Fault and Warning settings	These are the default fault and warning settings for the RPS unit.
4	RPS Interlock stab	Will open another scree showing which interlocks are associated with the RPS and the staus if each interlock. see Figure 3-11



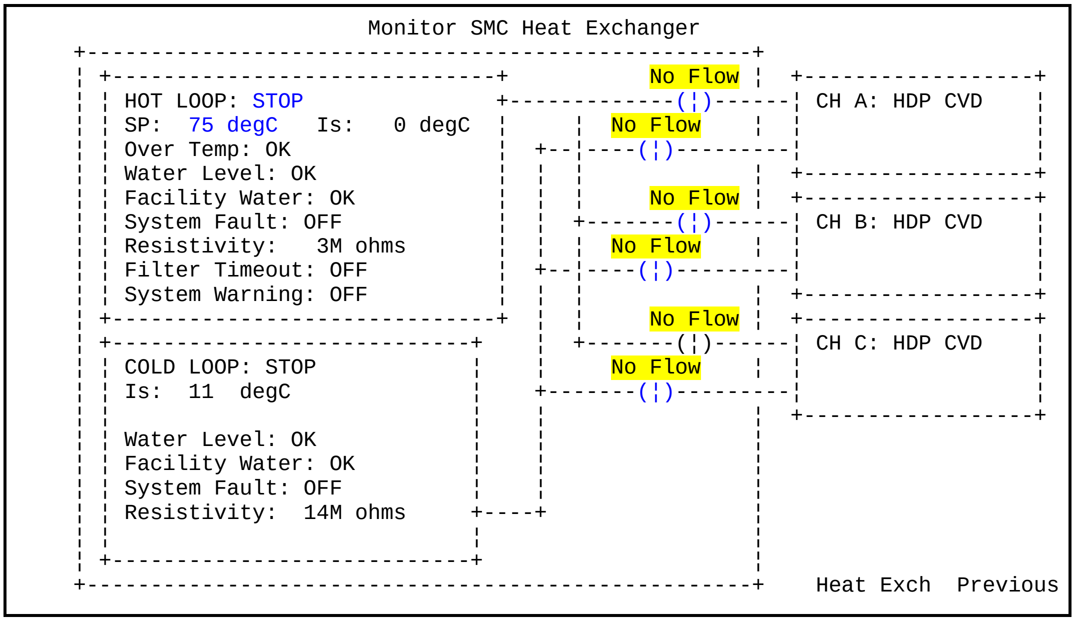
```
x-xxx-xxxx      Applied Materials CENTURA System  5200     000000    13:40:24

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                     Program Misc

                    Microwave Interlock Panel -  Chamber A
+-------------------------------------------------------------------------------+
¦ Cover is open error in chamber A.                                              ¦
¦ Unknown  slit is open - moving to Chamber A.                                   ¦
¦ Chamber A microwave / RPS generator not ready within time limit.               ¦
¦ Chamber A microwave generator not operating.                                   ¦
¦ Chamber A microwave / RPS generator waterflow interlock fault.                 ¦
¦ Chamber A microwave / RPS generator fault detected.                            ¦
¦ Chamber A microwave / RPS generator plasma not on.                             ¦
¦ Chamber A microwave / RPS generator applicator pressure too high.              ¦
¦ Chamber A microwave / RPS generator applicator pressure too low.               ¦
¦                                                                                ¦
¦                                                        Page Up   Page Dn       ¦
+-------------------------------------------------------------------------------+
 MW Calibrate   Monitor Intlck   Monitor Chamber   Monitor Process     Previous
```

Figure 3-11. RPS Interlock Screen

3.7 SMC/ Heat Exchanger Monitor Screen

The screen is a graphical representaion of the SMC heatexchanger hot loop and cold loop. Parameters such as temperature, flow, and resistivity can be monitored here. Similarly the flow control to each chamber can be controled her as well. The remote control of the hot loop is available on this screen but the cold loop can not be done here.

Access the SMC Hx Service Screen by touching the "CH. X" header, then select “Monitor Chamber” from the pulldown menus. From the monitor chamber screen, select "SMC Monitor Frame".



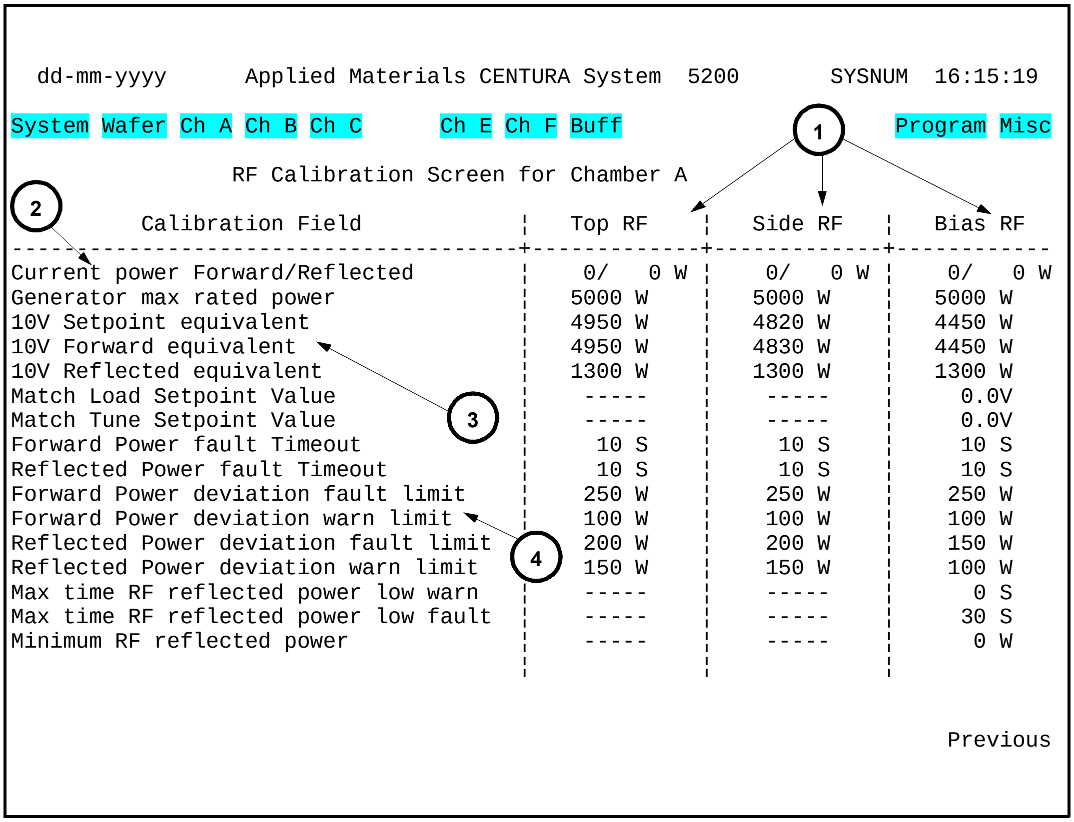
```
                       Monitor SMC Heat Exchanger
+----------------------------------------------------+
¦ +------------------------------+           No Flow ¦  +------------------+
¦ ¦ HOT LOOP: STOP               +-------------(¦)------¦ CH A: HDP CVD    ¦
¦ ¦ SP:  75 degC   Is:   0 degC  ¦     ¦  No Flow    ¦  ¦                  ¦
¦ ¦ Over Temp: OK                ¦  +--¦----(¦)---------¦                  ¦
¦ ¦ Water Level: OK              ¦  ¦  ¦             ¦  +------------------+
¦ ¦ Facility Water: OK           ¦  ¦  ¦     No Flow ¦  +------------------+
¦ ¦ System Fault: OFF            ¦  ¦  +-------(¦)------¦ CH B: HDP CVD    ¦
¦ ¦ Resistivity:   3M ohms       ¦  ¦  ¦  No Flow    ¦  ¦                  ¦
¦ ¦ Filter Timeout: OFF          ¦  +--¦----(¦)---------¦                  ¦
¦ ¦ System Warning: OFF          ¦  ¦  ¦             ¦  +------------------+
¦ +------------------------------+  ¦  ¦     No Flow ¦  +------------------+
¦ +----------------------------+    ¦  +-------(¦)------¦ CH C: HDP CVD    ¦
¦ ¦ COLD LOOP: STOP            ¦    ¦     No Flow    ¦  ¦                  ¦
¦ ¦ Is:  11  degC              ¦    +-------(¦)---------¦                  ¦
¦ ¦                            ¦    ¦                ¦  +------------------+
¦ ¦ Water Level: OK            ¦    ¦                ¦
¦ ¦ Facility Water: OK         ¦    ¦                ¦
¦ ¦ System Fault: OFF          ¦    ¦                ¦
¦ ¦ Resistivity:  14M ohms     +----+                ¦
¦ ¦                            ¦                     ¦
¦ +----------------------------+                     ¦
+----------------------------------------------------+    Heat Exch  Previous
```

THIS PAGE INTENTIONALLY LEFT BLANK.

3.8 ENI RF Calibration Screen

The following screen describe the calibration page of the ENI option generators. All calibrations for the ENI generators can be performed here.

Access the ENI Calibration Screen by touching the "CH. X" header, then select “Chamber service” from the pulldown menus. From pg. 1 of the chamber configuration screen touch the "RF Calib".



```
 dd-mm-yyyy      Applied Materials CENTURA System  5200       SYSNUM  16:15:19

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                     Program Misc

                 RF Calibration Screen for Chamber A

          Calibration Field                  ¦  Top RF      ¦  Side RF     ¦  Bias RF
---------------------------------------+-------------+-------------+------------
Current power Forward/Reflected        ¦  0/   0 W   ¦  0/   0 W   ¦  0/   0 W
Generator max rated power              ¦  5000 W     ¦  5000 W     ¦  5000 W
10V Setpoint equivalent                ¦  4950 W     ¦  4820 W     ¦  4450 W
10V Forward equivalent                 ¦  4950 W     ¦  4830 W     ¦  4450 W
10V Reflected equivalent               ¦  1300 W     ¦  1300 W     ¦  1300 W
Match Load Setpoint Value              ¦  -----      ¦  -----      ¦   0.0V
Match Tune Setpoint Value              ¦  -----      ¦  -----      ¦   0.0V
Forward Power fault Timeout            ¦   10 S      ¦   10 S      ¦  10 S
Reflected Power fault Timeout          ¦   10 S      ¦   10 S      ¦  10 S
Forward Power deviation fault limit    ¦  250 W      ¦  250 W      ¦  250 W
Forward Power deviation warn limit     ¦  100 W      ¦  100 W      ¦  100 W
Reflected Power deviation fault limit  ¦  200 W      ¦  200 W      ¦  150 W
Reflected Power deviation warn limit   ¦  150 W      ¦  150 W      ¦  100 W
Max time RF reflected power low warn   ¦  -----      ¦  -----      ¦    0 S
Max time RF reflected power low fault  ¦  -----      ¦  -----      ¦   30 S
Minimum RF reflected power             ¦  -----      ¦  -----      ¦    0 W
                                       ¦             ¦             ¦

                                                                      Previous
```

Figure 3-12. ENI RF Calibration Screen

Table 3-12. ENI RF Calibration Screen

No.	Item	Description
1	Generator Description	Describes the parameters on either the TOP, SIDE or BIAS generators
2	Current Power Forward/Refl. Generator Max Rated	Displays the generators power when ON Displays each generator’s max power setting
3	10 V Setpoint equiv. 10 V Forward equiv.	Used when calibrating the RF gen’s forward power. Used to adjust the screen reading to match the calibrated power.
4	Power Deviation Limits	Used to set the fault and warning limits for the generators.

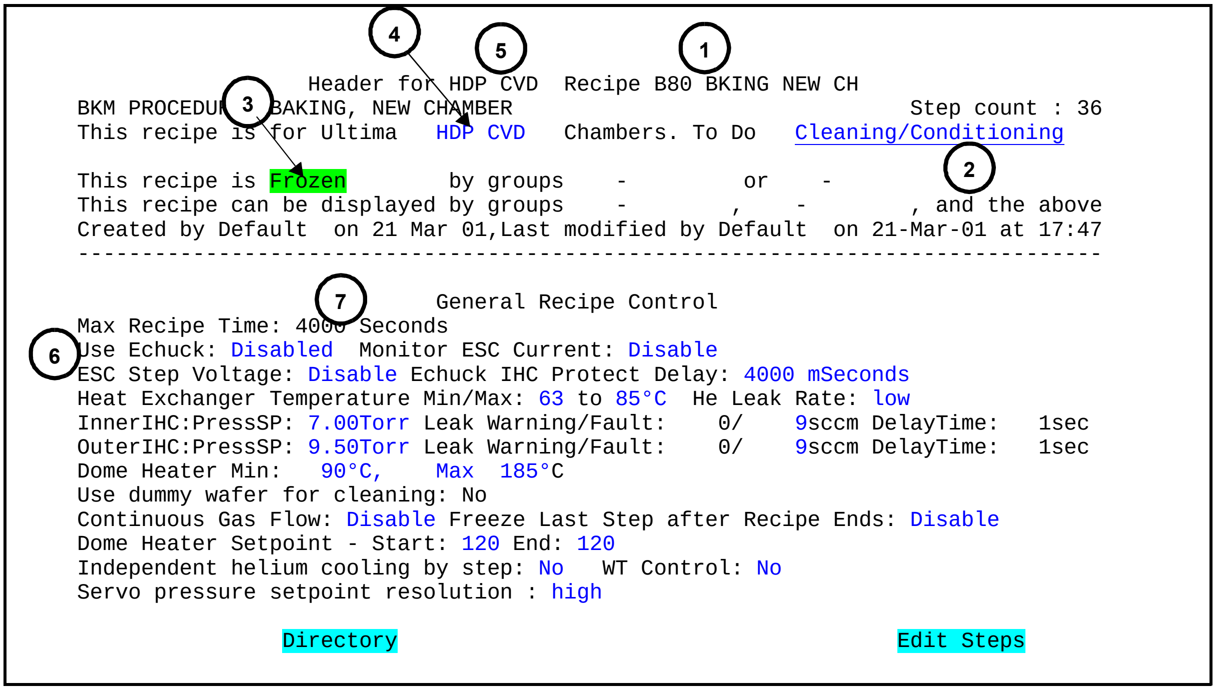
3.9 HDPCVD Process Recipe Screens

There are two main areas in an HDP CVD process recipe, the Header screen and the Recipe step screen.

The Header screen controls the overall parameters of the process recipe. In addition to the name and description of each recipe the Header screen controls the modifcation access of the recipe, the type of recipe (wafer process or not), the usage if the ESC, the dome temperature limits, and the IHC leak by fault parmeters. Figure 3-13 and Figure 3-14 describe the Recipe Header Screen.

The Recipe Step Screens proved a chronological order of how the recipe is performed. Each step in the HDPCVD process is a very detailed and exact procedure in producing the right film. Many parameters can be controlled during each step of the recipe, such as RF power, gas flow , Time, Pressure, etc.. Figure 3-15 and Figure 3-17 describe the Recipe sep screens.

Access the Recipe Header Screen by touching the "Program" header, then select “Process Programs” from the pulldown menus. Select the recipe from the screen. From the recipe configuration screen touch "Header/Exchange".

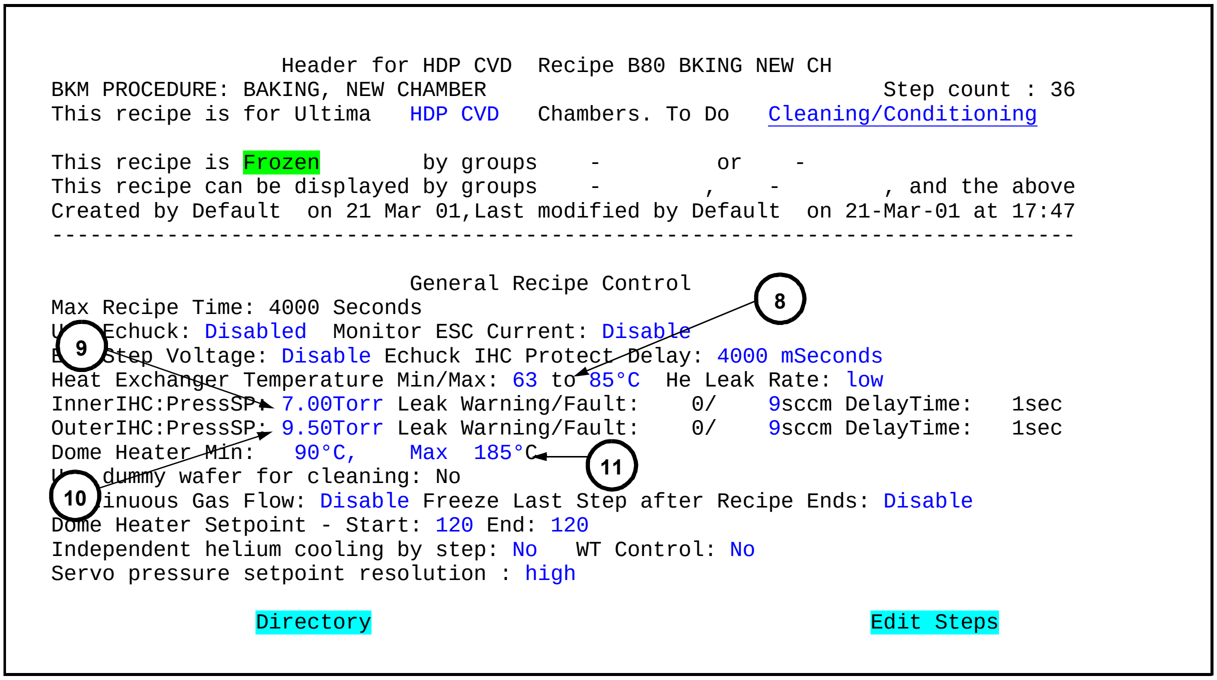


```
                  Header for HDP CVD  Recipe B80 BKING NEW CH
BKM PROCEDU   BAKING, NEW CHAMBER                           Step count : 36
This recipe is for Ultima   HDP CVD   Chambers. To Do   Cleaning/Conditioning

This recipe is Frozen        by groups    -         or    -
This recipe can be displayed by groups    -        ,    -         , and the above
Created by Default  on 21 Mar 01,Last modified by Default  on 21-Mar-01 at 17:47
--------------------------------------------------------------------------------

                            General Recipe Control
Max Recipe Time: 4000 Seconds
Use Echuck: Disabled  Monitor ESC Current: Disable
ESC Step Voltage: Disable Echuck IHC Protect Delay: 4000 mSeconds
Heat Exchanger Temperature Min/Max: 63 to 85°C  He Leak Rate: low
InnerIHC:PressSP: 7.00Torr Leak Warning/Fault:    0/    9sccm DelayTime:   1sec
OuterIHC:PressSP: 9.50Torr Leak Warning/Fault:    0/    9sccm DelayTime:   1sec
Dome Heater Min:   90°C,     Max  185°C
Use dummy wafer for cleaning: No
Continuous Gas Flow: Disable Freeze Last Step after Recipe Ends: Disable
Dome Heater Setpoint - Start: 120 End: 120
Independent helium cooling by step: No   WT Control: No
Servo pressure setpoint resolution : high

                Directory                                Edit Steps
```

Figure 3-13. Ultima HDP-CVD Header/Exchange Screen (1 through 8)

Table 3-13. Ultima HDP-CVD Header/Exchange Screen (1 through 8)

No.	Item	Description
1	Recipe	This field displays the recipe name. Touch this field to display an alphanumeric keyboard pulldown and enter the recipe name.
2	To Do	Touch this field to display the pulldown menu choices: “Wafer Processing” or “Cleaning/Conditioning”.
3	This recipe is Modifiable by groups - or -This recipe can be displayed by groups	The recipe creator uses this field to limit user access to the recipe. Two types of access levels are available to the creator: “Modifiable” and “Frozen”. The access level set up in this field overrides the authorization levels set up on the Screen Access Control screen, for this recipe only. “Modifiable” access allows a user to edit the recipe. “Frozen” access allows the user to display the recipe only. Touch the dashes (-) in the field to display the following pulldown menu choices: “Supervisor”, “Manager”, “Process Engr”, “Technician”, “Maintenance”, “Field Maint”, and “All”. These define what groups have access to the process recipe as well as defining who can view the recipe.
4	This recipe is for	This field displays the process–specific type of chamber the recipe is written for. Touch this field to display the pulldown menu choices.
5	Header for	This field displays the type of chamber for which the recipe is written. Touch this field to display the pulldown menu choices: “CVD”,), “Strip”, “RFI”, “PVD”, “Clean”, “Cool”, “Flat”, “Store”, and “WE CAl”.
6	E-Chuck	Yes/No
7	Max Recipe Time	Maximum time need to run a recipe.

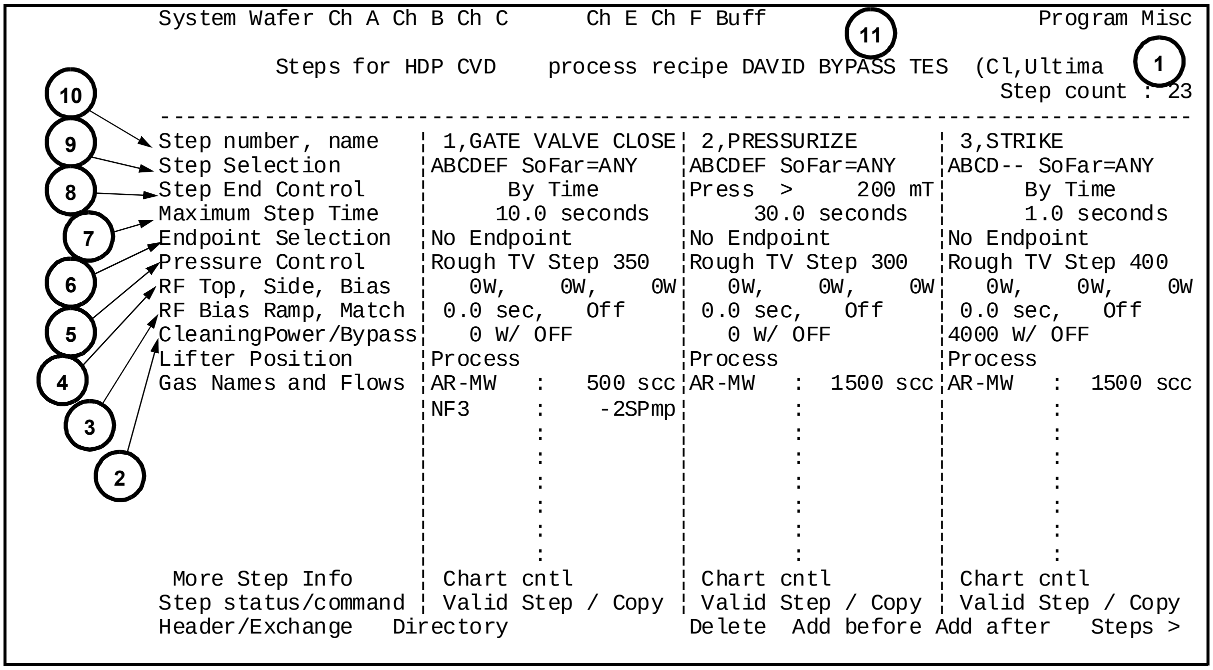


```
                  Header for HDP CVD  Recipe B80 BKING NEW CH
BKM PROCEDURE: BAKING, NEW CHAMBER                          Step count : 36
This recipe is for Ultima   HDP CVD   Chambers. To Do   Cleaning/Conditioning

This recipe is Frozen        by groups    -         or    -
This recipe can be displayed by groups    -        ,    -        , and the above
Created by Default  on 21 Mar 01,Last modified by Default  on 21-Mar-01 at 17:47
--------------------------------------------------------------------------------

                            General Recipe Control
Max Recipe Time: 4000 Seconds
U   Echuck: Disabled  Monitor ESC Current: Disable
E   Step Voltage: Disable Echuck IHC Protect Delay: 4000 mSeconds
Heat Exchanger Temperature Min/Max: 63 to 85°C  He Leak Rate: low
InnerIHC:PressSP: 7.00Torr Leak Warning/Fault:    0/    9sccm DelayTime:   1sec
OuterIHC:PressSP: 9.50Torr Leak Warning/Fault:    0/    9sccm DelayTime:   1sec
Dome Heater Min:   90°C,    Max  185°C
U   dummy wafer for cleaning: No
    inuous Gas Flow: Disable Freeze Last Step after Recipe Ends: Disable
Dome Heater Setpoint - Start: 120 End: 120
Independent helium cooling by step: No   WT Control: No
Servo pressure setpoint resolution : high

                Directory                                            Edit Steps
```

Figure 3-14. Ultima HDP-CVD Header/Exchange Screen (9 through 11)

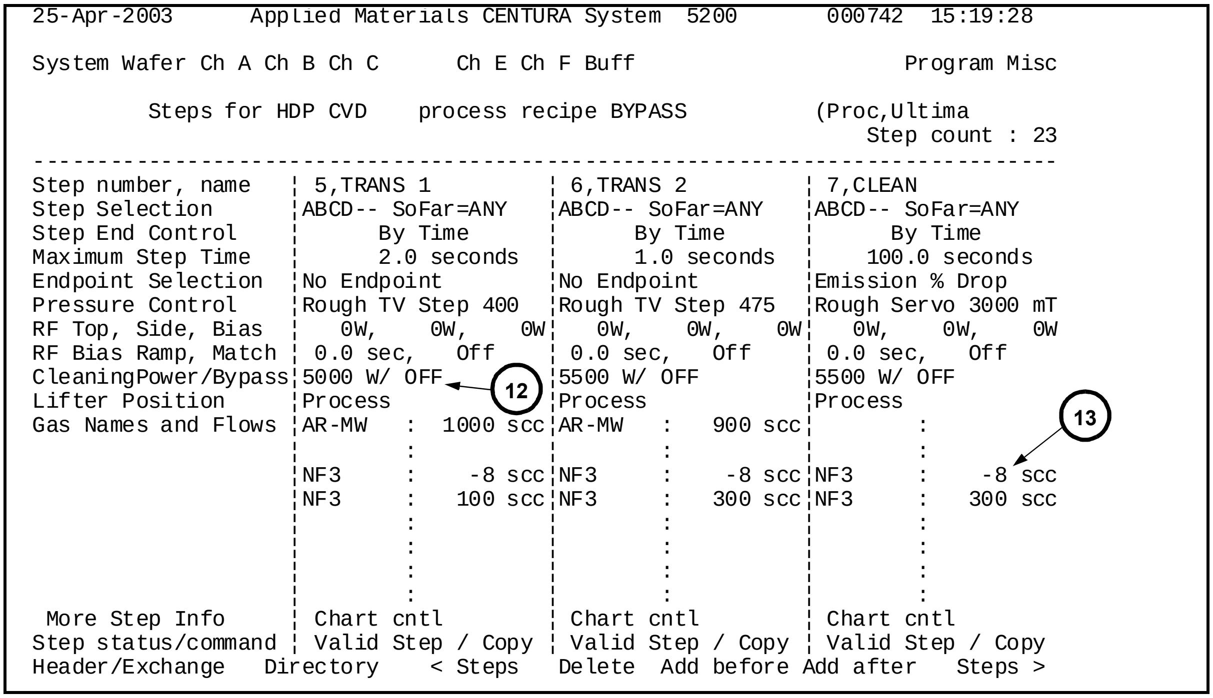
Table 3-14. Ultima HDP-CVD Header/Exchange Screen (8 through 11)

No.	Item	Description
8	Heat exchanger temperature	Indicates the minimum and maximum temperature for the AMAT-0 heat exchanger.
9	Inner IHC	Allows user to set the inner helium parameters (pressure set point, leak fault limit and fault delay).
10	Outer IHC	Allows user to set the outer helium parameters (pressure set point, leak fault limit and fault delay).
11	Dome Heater	Indicates the dome heater minimum and maximum temperature



```
System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                     Program Misc

         Steps for HDP CVD    process recipe DAVID BYPASS TES  (Cl,Ultima
                                                                 Step count : 23
--------------------------------------------------------------------------------
Step number, name   ¦ 1,GATE VALVE CLOSE¦ 2,PRESSURIZE      ¦ 3,STRIKE
Step Selection      ¦ABCDEF SoFar=ANY   ¦ABCDEF SoFar=ANY   ¦ABCD-- SoFar=ANY
Step End Control    ¦      By Time      ¦Press  >     200 mT¦      By Time
Maximum Step Time   ¦     10.0 seconds  ¦     30.0 seconds  ¦      1.0 seconds
Endpoint Selection  ¦No Endpoint        ¦No Endpoint        ¦No Endpoint
Pressure Control    ¦Rough TV Step 350  ¦Rough TV Step 300  ¦Rough TV Step 400
RF Top, Side, Bias  ¦   0W,    0W,    0W¦   0W,    0W,    0W¦   0W,    0W,    0W
RF Bias Ramp, Match ¦ 0.0 sec,   Off    ¦ 0.0 sec,   Off    ¦ 0.0 sec,   Off
CleaningPower/Bypass¦   0 W/ OFF        ¦   0 W/ OFF        ¦4000 W/ OFF
Lifter Position     ¦Process            ¦Process            ¦Process
Gas Names and Flows ¦AR-MW   :   500 scc¦AR-MW   :  1500 scc¦AR-MW   :  1500 scc
                    ¦NF3     :    -2SPmp¦        :          ¦        :
                    ¦        :          ¦        :          ¦        :
                    ¦        :          ¦        :          ¦        :
                    ¦        :          ¦        :          ¦        :
                    ¦        :          ¦        :          ¦        :
                    ¦        :          ¦        :          ¦        :
 More Step Info     ¦ Chart cntl        ¦ Chart cntl        ¦ Chart cntl
Step status/command ¦ Valid Step / Copy ¦ Valid Step / Copy ¦ Valid Step / Copy
Header/Exchange   Directory              Delete  Add before Add after   Steps >
```

Figure 3-15. Ultima HDP-CVD Chamber Recipe Step Screen (1 through 11)

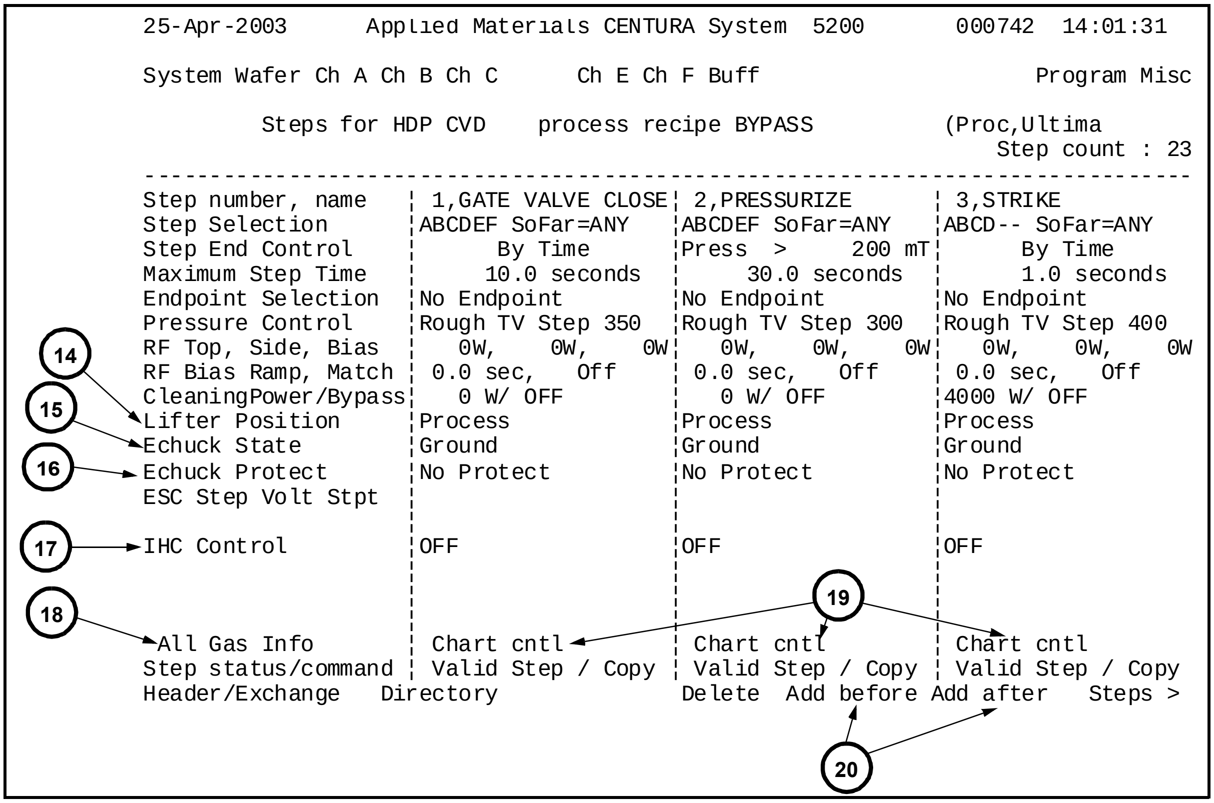


```
25-Apr-2003      Applied Materials CENTURA System  5200       000742  15:19:28

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                    Program Misc

         Steps for HDP CVD    process recipe BYPASS         (Proc,Ultima
                                                                Step count : 23
-------------------------------------------------------------------------------
Step number, name   ¦ 5,TRANS 1         ¦ 6,TRANS 2         ¦ 7,CLEAN
Step Selection      ¦ABCD-- SoFar=ANY   ¦ABCD-- SoFar=ANY   ¦ABCD-- SoFar=ANY
Step End Control    ¦      By Time      ¦      By Time      ¦      By Time
Maximum Step Time   ¦      2.0 seconds  ¦      1.0 seconds  ¦    100.0 seconds
Endpoint Selection  ¦No Endpoint        ¦No Endpoint        ¦Emission % Drop
Pressure Control    ¦Rough TV Step 400  ¦Rough TV Step 475  ¦Rough Servo 3000 mT
RF Top, Side, Bias  ¦   0W,    0W,    0W¦   0W,    0W,    0W¦   0W,    0W,    0W
RF Bias Ramp, Match ¦ 0.0 sec,   Off    ¦ 0.0 sec,   Off    ¦ 0.0 sec,   Off
CleaningPower/Bypass¦5000 W/ OFF        ¦5500 W/ OFF        ¦5500 W/ OFF
Lifter Position     ¦Process            ¦Process            ¦Process
Gas Names and Flows ¦AR-MW   :  1000 scc¦AR-MW   :   900 scc¦        :
                    ¦        :          ¦        :          ¦        :
                    ¦NF3     :    -8 scc¦NF3     :    -8 scc¦NF3     :    -8 scc
                    ¦NF3     :   100 scc¦NF3     :   300 scc¦NF3     :   300 scc
                    ¦        :          ¦        :          ¦        :
                    ¦        :          ¦        :          ¦        :
                    ¦        :          ¦        :          ¦        :
 More Step Info     ¦ Chart cntl        ¦ Chart cntl        ¦ Chart cntl
Step status/command ¦ Valid Step / Copy ¦ Valid Step / Copy ¦ Valid Step / Copy
Header/Exchange   Directory    < Steps  Delete  Add before Add after   Steps >
```

Figure 3-16. Ultima HDP-CVD Chamber Recipe Step Screen (12 through 13)

Table 3-15. Ultima HDP-CVD Chamber Recipe Step Screen (1 through 11)

No.	Item	Description
1	Step count	This field displays the total numnberof steps in this recipe. The field updates automatically when new steps are created.
2	Cleaning power	Use this field to select the RPS power setpoint for the recipe step.
3	Bias Ramp Up	This feature allows the bias to ramp up within the given amount of seconds entered in the previous recipe step.
4	RF Power Top, Side, and Bias	Use this field to select the RF power setpoint for the top and side source powers. Touch the RF Power field to display a numeric keypad and enter the power, in watts.
5	Pressure control	Use this field to select the type of pressure control. Touch this field to display the pulldown menu choices.
6	Endpoint selection	Use this field to select the type of recipe endpoint detection. Touch this field to display the pulldown menu choices.
7	Maximum step time	Use this field to establish the maximum allowable time, in seconds. If the step end control parameter is not met within the maximum step time, the step ends and the recipe proceeds to the next step. Touch this field to display a numeric keypad pulldown menu and enter the value, in seconds.
8	Step end control	Use this field to select the parameter for determining when a step ends. A step may be ended by time, pressure, gas flow, temperature, endpoint detection, or dechuck. Touch this field to display the pulldown menu choices, and select the step end control parameter.
9	Chamber Selection	Use this field to designate a step as chamber–specific. Touch this field to display a pulldown menu with individual chamber selections (A, B, C, and D or any combination of chamber positions). If a step is designated as chamber–specific, that step can run only on the chamber specified. If the recipe is selected for different chamber, chamber–specific steps are skipped.
10	Step number, name	The step number is automatically assigned as a step is created. To create a step name, touch the prompt “Enter Name” to display an alphanumeric keyboard pulldown. Then enter the step name.
11	Recipe Title	This area of the screen displays the recipe title information entered on the Header/ Exchanger screen.
12	NF3 RPS Bypass	TE only: Use this field to either flow through the RPS unit for cleaning the chamber (OFF), or for current Dep-Etch-Dep process NF3 can flow bypass the RPS for processing wafers (ON). Additionally during the clean step, there is an Ar purge feature that allows purge either through the RPS (OFF) or bypassing the RPS (ON).
13	NF3 MFC Bypass	TE only: Use this field to either flow through the MFC during DED process, by entering a standard MFC flow. Enter -8 sccm to bypass the MFC and flow through the 1200 sccm orifice. When performing a clean recipe NF3 can flow through the MFC and bypass simultaneously.



```
25-Apr-2003      Applied Materials CENTURA System  5200       000742  14:01:31

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                      Program Misc

         Steps for HDP CVD    process recipe BYPASS         (Proc,Ultima
                                                                Step count : 23
--------------------------------------------------------------------------------
Step number, name    ¦ 1,GATE VALVE CLOSE¦ 2,PRESSURIZE       ¦ 3,STRIKE
Step Selection       ¦ABCDEF SoFar=ANY   ¦ABCDEF SoFar=ANY    ¦ABCD-- SoFar=ANY
Step End Control     ¦      By Time      ¦Press  >     200 mT¦      By Time
Maximum Step Time    ¦     10.0 seconds  ¦     30.0 seconds   ¦      1.0 seconds
Endpoint Selection   ¦No Endpoint        ¦No Endpoint         ¦No Endpoint
Pressure Control     ¦Rough TV Step 350  ¦Rough TV Step 300   ¦Rough TV Step 400
RF Top, Side, Bias   ¦   0W,    0W,    0W¦   0W,    0W,    0W¦   0W,    0W,    0W
RF Bias Ramp, Match  ¦ 0.0 sec,   Off    ¦ 0.0 sec,   Off     ¦ 0.0 sec,   Off
CleaningPower/Bypass¦   0 W/ OFF         ¦   0 W/ OFF         ¦4000 W/ OFF
Lifter Position      ¦Process            ¦Process             ¦Process
Echuck State         ¦Ground             ¦Ground              ¦Ground
Echuck Protect       ¦No Protect         ¦No Protect          ¦No Protect
ESC Step Volt Stpt   ¦                   ¦                    ¦
                     ¦                   ¦                    ¦
IHC Control          ¦OFF                ¦OFF                 ¦OFF
                     ¦                   ¦                    ¦
                     ¦                   ¦                    ¦
 All Gas Info        ¦ Chart cntl        ¦ Chart cntl         ¦ Chart cntl
Step status/command ¦ Valid Step / Copy ¦ Valid Step / Copy ¦ Valid Step / Copy
Header/Exchange   Directory              Delete  Add before Add after   Steps >
```

Figure 3-17. Ultima HDP-CVD Chamber Recipe Step Screen (14 through 20)

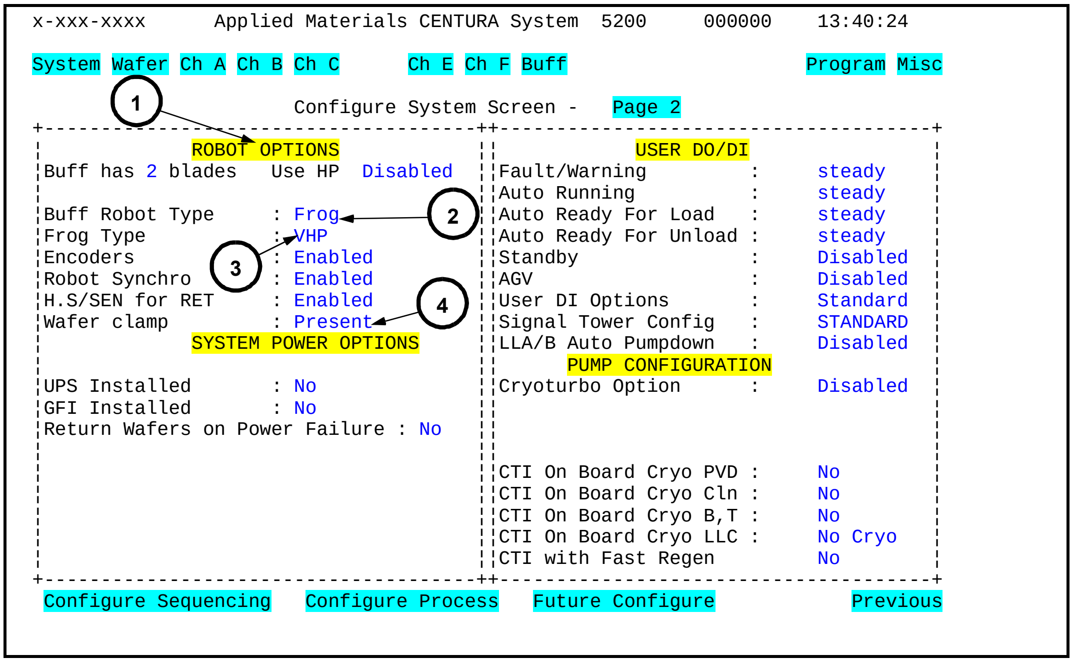
Table 3-16. Ultima HDP-CVD Chamber Recipe Step Screen (12 through 20)

No.	Item	Description
14	Wafer lift position	This field allows the programming of the chamber lift position in a recipe step.
15	E-chuck state	The electrostatic chuck state can be entered here (On, off, bias negative, bias positive)
16	E-chuck Protect	Enables the electrostatic chuck over current/voltage protect circuit. Monitors e-chuck leak current.
17	IHC WaferV,DumpV	Select the back side cooling through he inner helium channel.
18	All gas infor	Enter the gas flow set points.
19	Char cntl	Not used.
20	Add before/after	Touch these fields to add a recipe step before or after an existing recipe step. At the bottom of each recipe step the option “Before this step” or “After this step” is highlighted. Select the step and the following pulldown menu choices appear. Choose one of the options. Add original step — This selection adds a new recipe step and highlights all parameters to be entered to complete the step. Copy from previous step — This selection duplicates the previous recipe step, all parameters included, except that the step number is incremented by the software. Copy from the next step — This selection duplicates the recipe step to the right of the step being added. Copy from another step — This selection duplicates the recipe step from the chosen recipe step of the specified recipe. None of the above — This selection has no effect on the recipe steps

3.10 Clamped VHP+ Robot Screens

The following figures, Figure 3-18, Figure 3-19,Figure 3-20 show the necessary changes and enhancements to the Ultima Plus software that pertain to the clamped VHP+ Robot.

Access the Configure System Screen by touching the "Misc" header, then select “Configure System” from the pulldown menus. Select configure system and go to page 2 of the configure system screen.

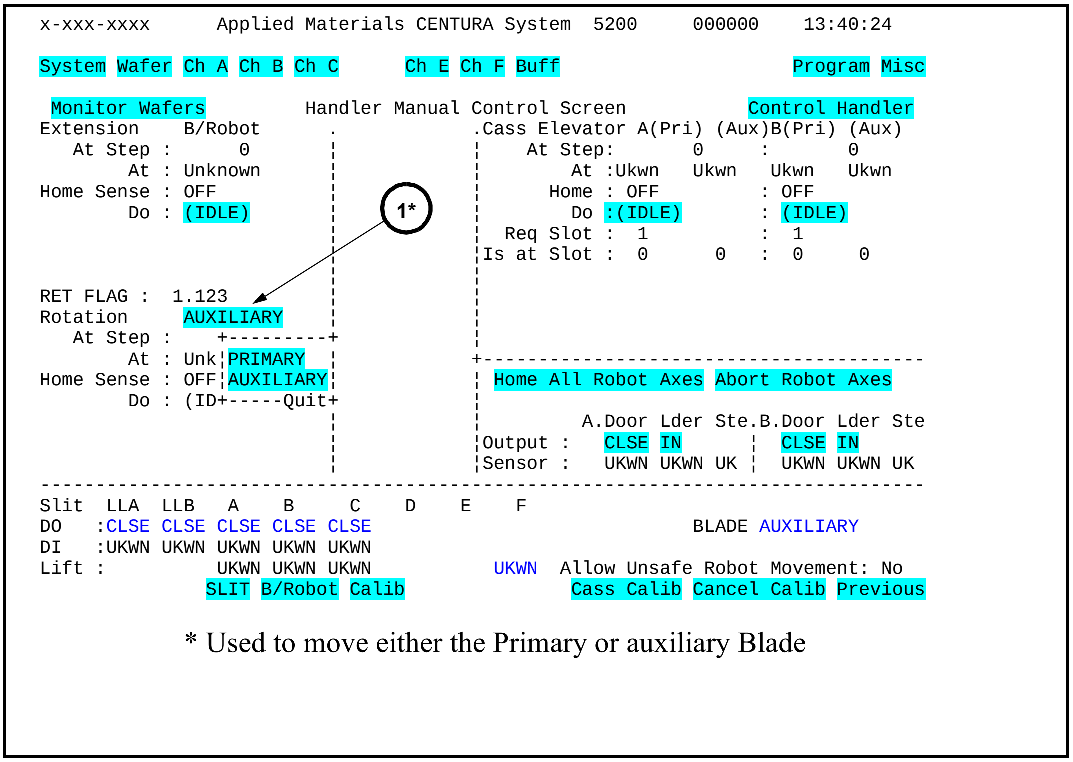


```
x-xxx-xxxx      Applied Materials CENTURA System  5200     000000    13:40:24

System Wafer Ch A Ch B Ch C     Ch E Ch F Buff                      Program Misc

                       Configure System Screen -   Page 2
+---------------------------------------++-------------------------------------+
|             ROBOT OPTIONS             ||             USER DO/DI              |
|Buff has 2 blades   Use HP  Disabled   ||Fault/Warning          :     steady  |
|                                       ||Auto Running           :     steady  |
|Buff Robot Type     : Frog             ||Auto Ready For Load    :     steady  |
|Frog Type           : VHP              ||Auto Ready For Unload  :     steady  |
|Encoders            : Enabled          ||Standby                :     Disabled|
|Robot Synchro       : Enabled          ||AGV                    :     Disabled|
|H.S/SEN for RET     : Enabled          ||User DI Options        :     Standard|
|Wafer clamp         : Present          ||Signal Tower Config    :     STANDARD|
|             SYSTEM POWER OPTIONS      ||LLA/B Auto Pumpdown    :     Disabled|
|                                       ||      PUMP CONFIGURATION             |
|UPS Installed       : No               ||Cryoturbo Option       :     Disabled|
|GFI Installed       : No               ||                                     |
|Return Wafers on Power Failure : No    ||                                     |
|                                       ||                                     |
|                                       ||CTI On Board Cryo PVD :      No      |
|                                       ||CTI On Board Cryo Cln :      No      |
|                                       ||CTI On Board Cryo B,T :      No      |
|                                       ||CTI On Board Cryo LLC :      No Cryo |
|                                       ||CTI with Fast Regen          No      |
+---------------------------------------++-------------------------------------+
 Configure Sequencing   Configure Process   Future Configure            Previous
```

Figure 3-18. Configure System Screen Page 2

Table 3-17. Configure System Screen Page 2

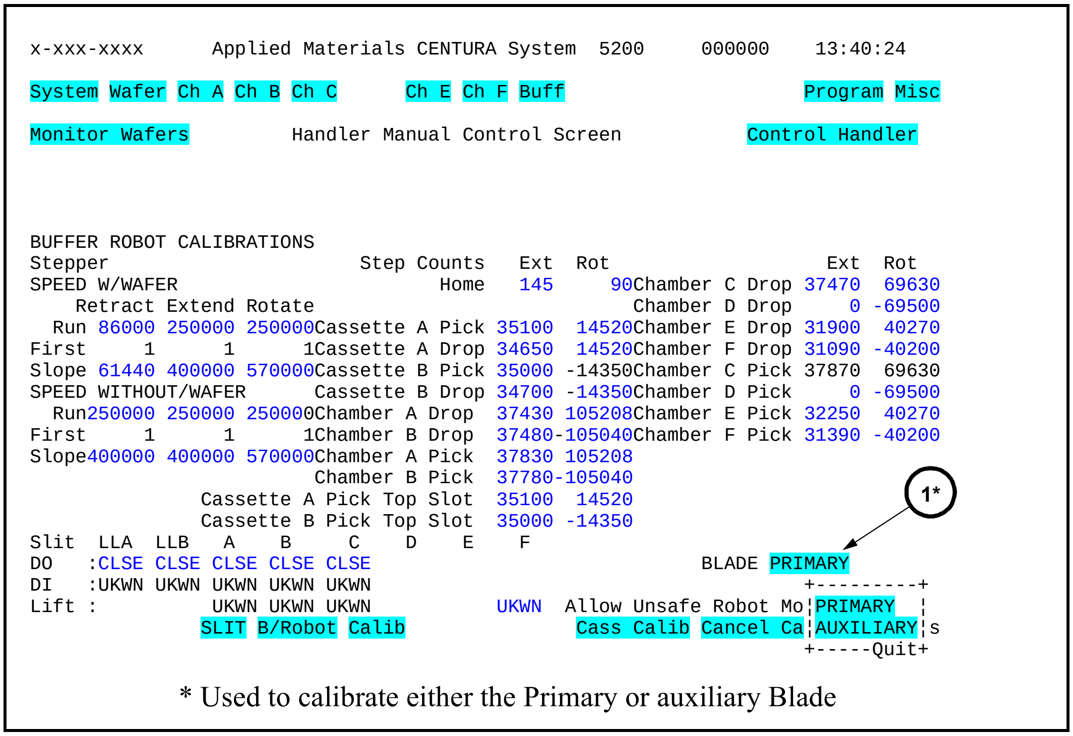
No	Item	Description
1	Blade option	Use 2 blades. The VHP+ Robot has two blades
2	Robot Type	Use Frog type
3	Frog Type	Use VHP
4	Wafer Clamp	Use Present. Allows the system to recognize a clamped wafer on the blade.



```
x-xxx-xxxx      Applied Materials CENTURA System  5200     000000    13:40:24

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                     Program Misc

 Monitor Wafers         Handler Manual Control Screen           Control Handler
Extension    B/Robot      .            .Cass Elevator A(Pri) (Aux)B(Pri) (Aux)
   At Step :      0       ¦            ¦    At Step:       0     :       0
        At : Unknown      ¦            ¦        At :Ukwn   Ukwn   Ukwn   Ukwn
Home Sense : OFF          ¦            ¦      Home : OFF         : OFF
        Do : (IDLE)       ¦            ¦        Do :(IDLE)       : (IDLE)
                          ¦            ¦  Req Slot :  1          :  1
                          ¦            ¦Is at Slot :  0      0   :  0     0
                          ¦            ¦
RET FLAG :  1.123         ¦            ¦
Rotation     AUXILIARY    ¦            ¦
   At Step :    +---------+            ¦
        At : Unk¦PRIMARY  ¦            +-----------------------------------------
Home Sense : OFF¦AUXILIARY¦            ¦ Home All Robot Axes Abort Robot Axes
        Do : (ID+-----Quit+            ¦
                          ¦            ¦         A.Door Lder Ste.B.Door Lder Ste
                          ¦            ¦Output :   CLSE IN      ¦  CLSE IN
                          ¦            ¦Sensor :   UKWN UKWN UK ¦  UKWN UKWN UK
--------------------------------------------------------------------------------
Slit  LLA  LLB   A    B     C    D    E    F
DO   :CLSE CLSE CLSE CLSE CLSE                             BLADE AUXILIARY
DI   :UKWN UKWN UKWN UKWN UKWN
Lift :          UKWN UKWN UKWN           UKWN  Allow Unsafe Robot Movement: No
               SLIT B/Robot Calib               Cass Calib Cancel Calib Previous
```

* Used to move either the Primary or auxiliary Blade

Figure 3-19. Monitor Handler Screen



```
x-xxx-xxxx      Applied Materials CENTURA System  5200     000000    13:40:24

System Wafer Ch A Ch B Ch C      Ch E Ch F Buff                     Program Misc

Monitor Wafers         Handler Manual Control Screen           Control Handler



BUFFER ROBOT CALIBRATIONS
Stepper                      Step Counts   Ext  Rot                   Ext  Rot
SPEED W/WAFER                       Home   145     90Chamber C Drop 37470  69630
    Retract Extend Rotate                            Chamber D Drop     0 -69500
  Run 86000 250000 250000Cassette A Pick 35100  14520Chamber E Drop 31900  40270
First      1      1      1Cassette A Drop 34650  14520Chamber F Drop 31090 -40200
Slope 61440 400000 570000Cassette B Pick 35000 -14350Chamber C Pick 37870  69630
SPEED WITHOUT/WAFER      Cassette B Drop 34700 -14350Chamber D Pick     0 -69500
  Run250000 250000 250000Chamber A Drop  37430 105208Chamber E Pick 32250  40270
First      1      1      1Chamber B Drop  37480-105040Chamber F Pick 31390 -40200
Slope400000 400000 570000Chamber A Pick  37830 105208
                         Chamber B Pick  37780-105040
               Cassette A Pick Top Slot  35100  14520
               Cassette B Pick Top Slot  35000 -14350
Slit  LLA  LLB   A    B     C    D    E    F
DO   :CLSE CLSE CLSE CLSE CLSE                             BLADE PRIMARY
DI   :UKWN UKWN UKWN UKWN UKWN                                      +---------+
Lift :          UKWN UKWN UKWN           UKWN  Allow Unsafe Robot Mo¦PRIMARY  ¦
               SLIT B/Robot Calib               Cass Calib Cancel Ca¦AUXILIARY¦s
                                                                    +-----Quit+
```

* Used to calibrate either the Primary or auxiliary Blade

Figure 3-20. VHP+ Handler Calibration Screen

Index

Applied Materials, Inc.
3050 Bowers Avenue
Santa Clara, CA 95054-3299

Address correspondence to:
Applied Materials, Inc.
P.O. Box 58039
Santa Clara, CA 95052-8039
Tel: (408) 727-5555
Telex: 6719476 AMTUW
Fax: (408) 748-9943
Web Site: http://www.AppliedMaterials.com

To order copies of this manual or other manuals, call 1-800-HOT-TTTT option 3

APPLIED MATERIALS