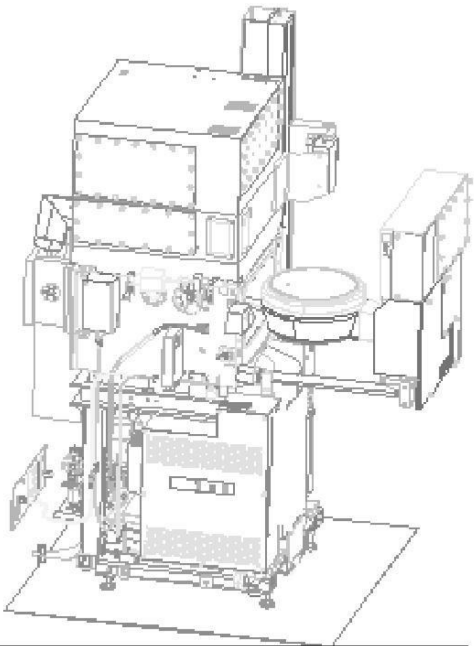
Purchase Specification

Specification For The Versys Metal 2300 PM



Version	Description	Date	Authorize By
1.0		7/25	Rem Chang
1.1	requested : 1.RF Accuracy +/- 5W of setpoint; 2. T-Mach tuning < 5W after stable. 3.MTBC > 333 RF hours. 4.Striper Uptime > 90% 5.Striper stable < 10 sec 6.Striper MTBA >100hours 7.Striper RF Accuracy +/- 5W 8.Striper MTBC >666RF hours	8/1	Rem Chang

1. **Scope**

This specification defines the standard configuration, options, and performance specification for the Lam Research Corporation (Lam) 2300 plasma etch process module.

2. **Reference Documents**

The following manuals will be available
2300 Installation & Start-up
2300 Domino Operations & Maintenance Manual
2300 Domino Drawings
2300 Domino Facility Manual
2300 Safety Manual

3. **Codes, Standards, and Safety**

The 2300 System was designed to adhere to the codes listed in this section. Lam also bases equipment performance specifications on definitions used in these codes and standards. If at any time a conflict is discovered with local safety standards with regard to design or manufacturing process of the 2300 system, Lam will work to resolve the conflict on a best effort basis. Software and/or hardware modifications to correct system safety issues will be made free of charge, provided that issue has been recognized as a safety hazard by Lam.

SEMI E5-92: SEMI Equipment Communications Standard (SECS II).

SEMI E10-92: Guidelines for definition and measurement of equipment Reliability, Availability, and Maintainability (RAM).

Applicable standards published by the following organizations were taken into consideration during the design of Lam etch systems:

National Electrical Manufacturer's Association (NEMA)

Occupational Safety and Health Administration (OSHA)

California Occupational Safety and Health Administration (CAL/OSHA)

National Electric Code (NEC)

National Fire Protection Association

Federal Communication Commission (FCC)

Underwriter's Laboratory (UL)

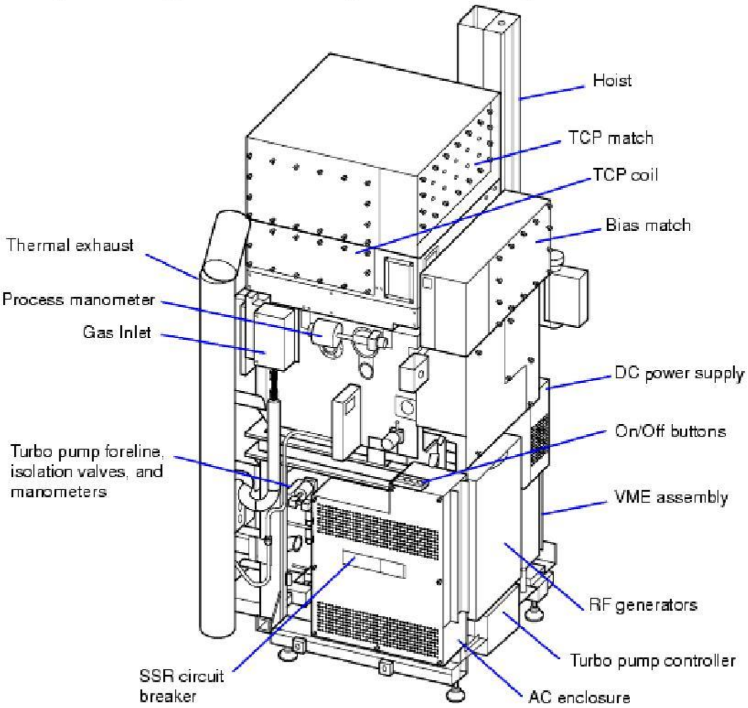
International Business Machine (IBM)

SEMI S2-93 third party evaluation report is available upon request.

CE Mark evaluation has been completed. The CE Mark will be attached to the system.

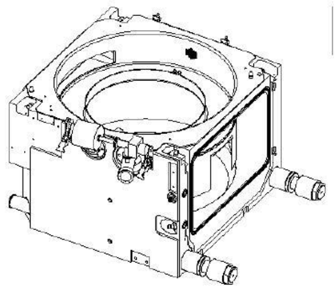
4. System Description

The 2300 process module is configured for use on Lam's 2300 Domino cluster system, with either 300mm wafers. It is designed for 0.13-µm and below , applications utilizing a low pressure, high density plasma source. The standard system includes an electrostatic chuck, backside helium temperature control, advanced pressure control, chamber liners, and two independent RF generators for TCP power and RF bias power.



5. Hardware

5.1. Reaction Chamber



The reaction chamber is a vacuum vessel where an R.F. plasma is established and a silicon wafer is clamped onto a biased ESC. The charged reactive species created by the plasma bombard and erode thin films on the wafer.
The reactants enter the chamber by means of a gas injection assembly, which controls the direction and distribution of the reactants. Mass flow controllers meter gases.
The by-products of the reactants are pumped by means of a turbo-molecular pump isolated by a large gate valve (pendulum valve) at the base of the chamber. The pendulum valve controls the chamber pressure for a given process gas input by varying the gate position and, thus, valve conductance.

Upper Chamber:
Fixed-gap chamber; 16 cm
16 inch, flat, roughened, quartz window
16 inch, 3-turn coil for 300mm
Digitally controlled T-match network
Symflo central top gas injection

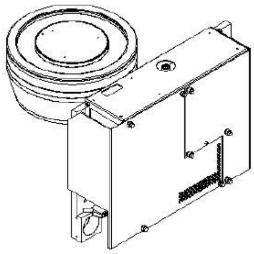
5.2. Lower Chamber:

The lower electrode assembly consists of a cantilever arm, which supports an electrode housing in the center of the process chamber. The ESC bolts on top of the electrode housing separated by a ceramic insulator ring that provides electrical isolation from the ESC. A ceramic focus ring rests along the periphery of the

ESC to prevent ion bombardment of the edge of the ESC. All the facilities that must be routed to the ESC run through a channel in the center of the cantilever arm. Facilities which must be provided to the ESC include temperature controlled fluid to keep the ESC cool, helium for backside helium, DC power for ESC clamping, RF power for ion bombardment, pin lifters for picking up the wafer for handoff, helium for leak detection, heater cartridges to heat the housing, a thermocouple for measuring ESC temperature and an optional optical probe for verifying wafer temperature.
Servicing of the lower electrode is done by sliding the entire lower electrode assembly out on at which point access is granted to the top and bottom of the electrode housing. The bottom cover of the electrode housing can be removed for service access, and access to the inside of the electrode housing is available though the top by removing the ESC.

Features:
Wafer size configurable for 300 mm
Electrostatic chuck (ESC), proprietary dielectric coating and helium cooling channels with dynamic offset power supply
Memory-metal 3-pin lifter
Backside He wafer temperature control
Quartz edge ring
Bottom symmetrical pumping

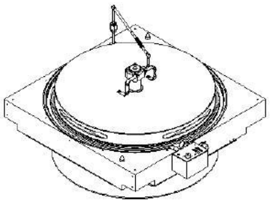
5.3. Bias Electrode



The Bias Electrode Assembly is responsible for accepting a wafer from the transport module handler, clamping that wafer to a flat chuck in the middle of the process chamber, providing RF power to that platen to promote ion bombardment and keeping the wafer cool during this process. The layout of the bias electrode assembly is designed to maximize serviceability without impeding chamber conductance.
The cantilever arm design of the Bias Electrode Assembly allows the turbopump to be bolted directly to the bottom of the process chamber, which allows for increased conductance of the process chamber. The cantilever arm supports an

electrode housing in the center of the process chamber.
Servicing of the lower electrode is accomplished by sliding the entire lower electrode assembly out on slides, which allows access to the top and bottom of the electrode housing. The bottom cover of the electrode housing can be removed for service access, and access to the inside of the electrode housing is available though the top by removing the ESC.

5.4. Symflow™ Gas Injection



Process gas flows into the top of the chamber through a hole in the middle of the TCP quartz window, providing symmetrical gas flow. (This is also known as top gas feed). This increases the significance of gas flow for the process, providing greater flexibility for developing processes

5.5. Ceramic Monopolar Electrostatic Chuck (ESC)

The ESC is the portion of the bias electrode assembly that holds the wafer in the chamber and provides RF power underneath the wafer to promote ion bombardment. The ESC is composed of an aluminum base with a ceramic disc on top of it. Imbedded within the ceramic disc, and very close to the top surface of the disc, is a layer of conductive metal.
To keep the wafer from overheating during etching, temperature controlled fluid is circulated through channels cut in the base of the ESC. The temperature of the fluid is controlled by a thermocouple located in the chiller, but a separate thermocouple is provided in the ESC to monitor the ESC temperature. Wafers are raised and lowered onto the ESC via three Pin Lifters located in the body of the ESC.

ESC Configuration Options 300mm: *SEMI 300mm*

5.6. ESC Pin Lifter

The pinlifter and pinlift actuator is responsible for lowering the wafer from the transfer arm to the top of the ESC and lifting the wafer for pickup by the transfer arm. With the pins in their "up" position above the ESC, a wafer is brought into the chamber at 0.5" above the top of the ESC. The wafer is then transferred to the pins when the handler drops to a position of 0.25" above the top of the ESC. The handler then retracts back into the transport module and the pins are lowered to bring the wafer to the surface of the ESC.
An air cylinder assembly (the actuator) which is located in the helium/RF enclosure actuates the three pinlifters that are located under the ESC. Three independent flexible cable assemblies allow precise positioning of wafers onto the transfer arm is required so that their loads should be distributed equally over a wide tripod to optimizes its stability during the up and down motions necessary for its transport.

5.7. Viton O-Rings

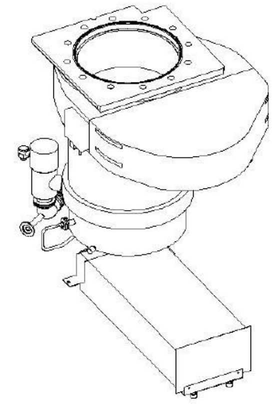
The standard process module chamber is configured with Viton O-rings, which are exposed to the plasma.

6. Vacuum System

The system uses a dry mechanical pump to rough the process chamber. A magnetically levitated, heated turbomolecular pump located beneath the main chamber provides the high vacuum pumping. A throttling valve isolates the inlet to the turbomolecular pump and controls the chamber pressure during process.

6.1. Turbomolecular Pump (TMP)

TMP shown with VAT Valve attached



A magnetically levitated, heated turbomolecular pump located beneath the main chamber provides vacuum. A controlled nitrogen purge protects the turbo pump magnetic bearings and an injection of nitrogen into the foreline eliminates backstreaming from the roughing pump back into the turbo pump. Controllable water cooling keeps the pump from overheating while a heating element controlled by the Anafaze temperature controller keeps the temperature from dropping too low. TMP controller is located onboard the process module.

Turbo Configuration Options 300mm:
Default: ***2200 l/s Seiko Seiki***

6.2. Backing Pump Requirements *

The 2300 PM requires a roughing pump for the process chamber, which also serves as the TMP backing pump. Dry pumps are available as an option from Lam or may be purchased separately by the customer. Customer supplied pumps must have LON Works interface.
Lam recommends all pumps to be located less than 50 feet from the etch system.
Optional Dry pump from Lam:

6.3. Pressure Control

Chamber pressure is controlled by a heated pendulum valve, which is mounted between the turbo pump and the chamber. The valve controller compares the pressure measured by the chamber capacitance manometer with the setpoint value selected in process recipes. The valve controller adjusts the gate valve position with a stepper motor to maintain the chamber pressure setpoint. The pendulum valve also acts as an isolation valve for the chamber. Valve size is automatically selected with the turbo configuration.

Valve Configuration Options 300mm:

Default: ***250-mm VAT Series 65 gate valve is standard with the 2200 l/s TMP***

6.4. Vacuum Manometers

100 mtorr MKS manometer heated to 100 C for main chamber
10 torr MKS manometer as reference for gas calibrations
10 torr MKS manometer for foreline
20 torr Tylan General manometer for backside He cooling

7. RF System

7.1. RF Generator

Two Generators provide the RF power for the TCP coil and the ESC bias. The RF generators convert AC line power into higher frequency RF power. A high stability oscillator operating at the desired frequency drives a chain of power amplifiers. At the output, built in sensors measure the forward and reflected power. These signals are used to regulate the output power through a feedback loop.

Configuration 300mm:

AE RF Generators	Where used	Power Range*	Accuracy*
AE Apex	RF power for TCP coil	0 – 1500 W	±1% of set point or 0.1% full rated output power, whichever is greater
AE RFDS	RF power for wafer electrode (bias)	0 – 1250 W	±1% of setpoint from 20 to 1250 W

7.2. Matching Networks

7.2.1. TCP Match:

The TCP match has the purpose of transforming the impedance of the load back to the output impedance of the generator so that maximum power transfer to the load is achieved. The TCP match is a T-type with four vacuum variable capacitor elements. The phase offset of the phase/mag sensor is chosen such that series capacitor C3 tunes the reactive part of the load and series capacitor C1 tunes the resistive part. Capacitor C2 varies the sharpness of the tuning wells of C1 and C3, and capacitor C4 balances the voltages at the ends of the TCP source coil. A pair of stepper motors drives capacitors C1 and C3. Output signals from the phase/mag sensor are processed by the host computer and are fed back the stepper drive board which provides the necessary pulse trains to move the stepper motors in the appropriate direction at an appropriate speed.

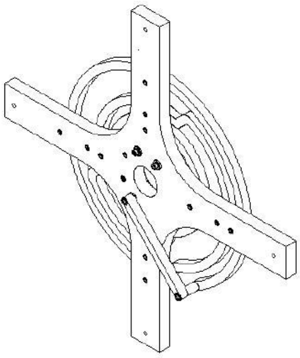
7.2.2. Bias Match

The bias match has the purpose of transforming the impedance of the load back to the output impedance of the generator so that maximum power transfer to the load is achieved. The bias match is an L-type with a fixed inductor in the series leg and two vacuum variable capacitors (one in series (C2) and one in shunt (C1)) as the tunable elements. The phase offset of the phase/mag sensor is chosen such that the series capacitor tunes the reactive part of the load and the shunt capacitor tunes the resistive part. A pair of stepper motors drives the capacitors. Output signals from the phase/mag sensor are processed by the host computer and are fed back to the stepper drive board which provides the necessary pulse trains to move the stepper motors in the appropriate direction at an appropriate speed.

7.3. Voltage Control Interface (VCI)

The DC bias on the wafer, which sets the ion energy during plasma processing, is determined by the amplitude of the bias of the RF voltage on the lower electrode or ESC. The conventional procedure has been to control the bottom electrode power at its setpoint in the software. Even with the same power setpoint, the resulting voltage on the wafer can be substantially different due to different efficiencies of the lower RF power delivery system, which includes the lower match network. The purpose of the VCI hardware is to compensate for such different efficiencies, by continuously measuring the RF voltage amplitude on the lower electrode, and adjusting the generator power to keep this voltage stable and reproducible over time, and from one chamber to another.
By setting this voltage directly, the VCI allows decoupling of plasma generation and wafer biasing. The ion energy and ion flux can be determined independently, enabling faster process optimization. The VCI hardware produces better process stability than the standard bias-power control mode. Gains in process stability and chamber-chamber matching are also observed. The VCI ensures that the lower RF system produces the same results regardless of changes in the lower match power delivery.

7.4. TCP Coil



Patented planar 3-turn, center feed, TCP coil creates uniform, high-density plasma directly above the wafer.

Coil Configuration 300mm: 16 inch Diameter

8. Temperature Control

8.1. Electrode Temperature

Temperature control unit (TCU) circulates coolant through the electrode. Electrode temperature is set in the process recipe. A thermocouple in the lower electrode monitors temperature. The TCU outlet temperature is controlled by closed-loop feedback within the TCU.

TCU Performance Requirements *

Temperature Control Unit (TCU)

Cooling capacity:	750W @ - 40°C 2400W @ - 20°C ~ +80°C
Temperature range*:	- 20°C to 80°C
Temperature regulation:	$\pm$ 1°C at TCU
Ramp rate:	$\geq$ 3°C/min

Lam specified temperature operating range is shown in the 2300 Process Module Hardware Specifications.
** Flourinert coolant must be used for the 2300 for optimum performance of the ESC. Any substitution will void the warranty.

Chillers other than those recommended above are treated as non-recommended fits and supported on a best effort basis. Process and/or reliability failures associated with substituted parts are not the responsibility of Lam and will not be considered a system failure. All chillers, recommended or non-recommended must use Flourinert coolant as stated above.

Default: ***Customer supplied the Chiller***

8.2. Backside Helium Wafer Temperature Control

The helium backside cooling system provides helium pressure between the wafer and the electrostatic chuck surface to improve the heat transfer between the electrode and wafer. All of the helium supplied by the pressure controller is delivered to the wafer backside. There is no bypass line on the 2300 tools so that the helium flow (leakage) measured by the pressure controller would provide a better monitor for wafer clamping.

8.3. Chamber Wall Temperature

Chamber components are heated by embedded resistive heaters controlled via a closed loop PID controller. Feedback is provided by thermocouples (TC). Each channel is separate and may have a separate temperature setpoint up to a maximum 100°C. A separate overtemp circuit monitors hardware temperature using either RTDs or thermoswitches and turns off power to the heaters in the event of an overtemp situation. A Ground Fault Indicator (GFI) monitors a ground fault condition and turns off power to the heaters when this occurs. The system has the ability to control 16 independent channels, 14 of which are heaters only and two that are selectable to be either heat or cool channels. The 16-channel Anafaze™ temperature controller is located in the AC/DC distribution enclosure. Thermocouples report temperatures of the chamber walls, electrode, turbomolecular pump, manifold, and gate valve (VAT valve) to the temperature controller.

8.4. Foreline Manifold Heating

Self regulating heaters are used prevent process byproducts from collecting on the internal surfaces of the rough vacuum foreline. The heaters are installed on the foreline from the turbo-pump exhaust to where the foreline exits the module frame assembly.

Heater Configuration Options 300mm:

Default: ***No Heaters***
Option: ***Heaters***

9. Gas Distribution System

The remotely located gas box delivers process chemistry to process module. (Described in 2300 transport module specification)

Non - Standard Gas Line Configuration:

Gas	MFC Size (sccm)	Location
BCL3	200	MFC# 1
O2	500	MFC# 2
CL2	400	MFC# 3
N2	100	MFC# 4
CHF3	50	MFC# 5
AR	300	MFC# 6
SF6	500	MFC# 7
He	100	MFC# 8

Gas Box Configuration 300mm:

Standard: ***8 Gas Lines***
Option: ***10 Gas Lines***
Option: ***12 Gas Lines***

MFC Configuration 300mm:

Non-Standard Requirement:

Option: ***Hitachi SFC-1480F***
Option: ***STEC SEC-7440MC***

Note: MFC's other than those shown on the 2300 process module Machine Description are treated as non-recommended fits and supported on a best effort basis. Process and/or reliability failures associated with substituted parts are not the responsibility of Lam and will not be considered a system failure.

10. Endpoint Detection

10.1. Optical Emission Spectrometer

The optical endpoint detector system (OES) is based on a miniature spectrometer with a 2048-element CCD detector array, which provides full spectrum for endpoint detection and chamber condition monitoring. The spectrometer comprises four main optical components including a quartz fiber optic for optical input, an entrance slit for spectrum resolution control, a diffraction grating for separating the light into its constituent wavelengths, and a CCD array as the detector. The electronics includes the signal preamplifier, a 12-bit analog to digital converter, timing, and computer interface. The CCD is sensitive to photons for a wavelength range of 200 nm to 1000 nm.

11. Particle Reduction Hardware

Particle control is accomplished by providing features on components to minimize or contain particles as well as designing components to be easily replaced during scheduled maintenance periods.

One of the primary means of reducing particle contamination is to maintain a uniform temperature throughout the process chamber and in the throttling pendulum valve. By not allowing for cold spots, particles do not tend to adhere to any specific spot. The chamber housing, bias electrode housing and mounting plate are heated with cartridge heaters and controlled with a thermocouple (TC). The throttling pendulum valve is the Vat series 65, an all aluminum valve with excellent temperature uniformity.

Gas ballasting occurs during wafer transfer to reduce particle settling and minimize the migration of corrosive chemicals such as chlorine out of the PM into the TM. Additionally, ballasting occurs in idle mode when the wafer is not being processed. This continual flow of gas keeps the particles from settling and allows them to be pumped out of the system by the TMP.

Liners are used to protect the chamber walls. Not only does this make chamber cleans quicker, it eliminate the need to perform a chamber wet clean. Wet cleans can cause fluid to flow into gaps between parts leading to outgassing during pump down.

The top window is roughened to provide more surface area to capture particles. The window is one of the components that will be replaced during a scheduled chamber clean and cleaned away from the chamber. Gaslines are filtered with a metal filter at chamber inlets.

12. Maintenance Options

12.1. Quick Clean Kit

The lit includes all the item required for preventative maintenance so that a low MTTC can be achieved. One kit per process module is recommended. The kit items are listed in appendix B

12.2. Pendulum Valve Clean Kit

Provides parts for Pendulum valve maintenance and cleaning. Available for the 8" and 10" valves. The kits item are listed in appendix C

Facility Information

12.3. Power Requirement

Electrical Power Supplied via TM

Description	Volts (AC)	Hz	Phase	Wire	Type	Main CB rating	Conduit required	Peak Demand (Amps)	Peak Demand (kVA)	% Time at Peak	Avg. Demand (kVA)	Comments
Main Power	208 +10% -15%	50/60	3	4	Delta	50 A	1.25'' Flex	20	6	TBD	3.5	Peak demand during process run

12.4. Heat Load

(Thermal Output)

Description	In Water (kW)	In Exhaust (kW)	To Ambient (kW)	Total output (kW)

Process Module	2.64	2.35	5.86	10.96

12.5. Exhaust

Description	Draw (CFM)	Pressure inches H2O	System	Hazard	% Time at Peak	Avg. Req. (CFM)	Conn Size, inches	size	Flange type	Oil content	Removable connection
Upper match box	150	.50	Scrubber	Possible*	100 cont. vent	75	4	10.2	Tube	no	yes

Duct Material	Flexible material or spiral wire reinforced PVC fume duct (with V- flammability rating under UL-94 and UL- recognition)

*Only in the event of a primary containment failure. Primary purpose of exhaust is to remove heat.

12.6. Cooling Water

For RF Generator, Bias Match, and TMP

Description	Inlet Temp (ºC)	Avg. Outlet Temp (C)	Peak Flow		Avg. Flow (GPM)	Pressure		Fitting/size
			GPM	LPM		∅PSI	Max PSIG	
PCW	15 ~ 25	<50	9	34.07	TBD	40	100	5/8’’ Compression

12.7. Environment

Description	Temperature	Humidity	Vibration	
			Sensitivity	Emission
Process Module	25 ±5 °C	<50%	Slight	No

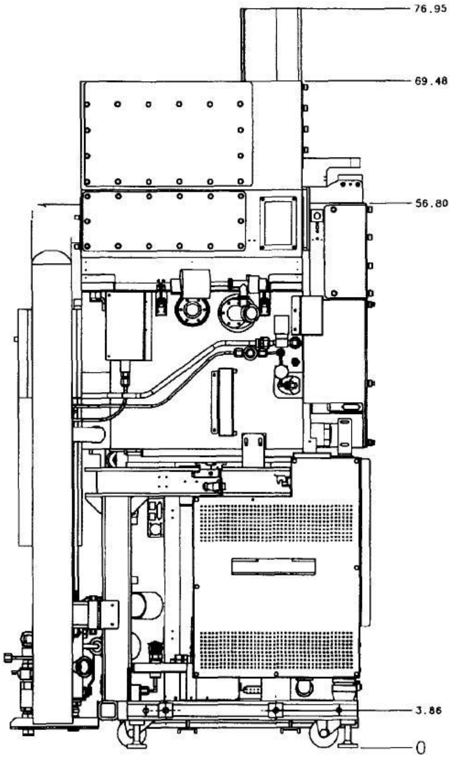
12.8. Bulk Gases:

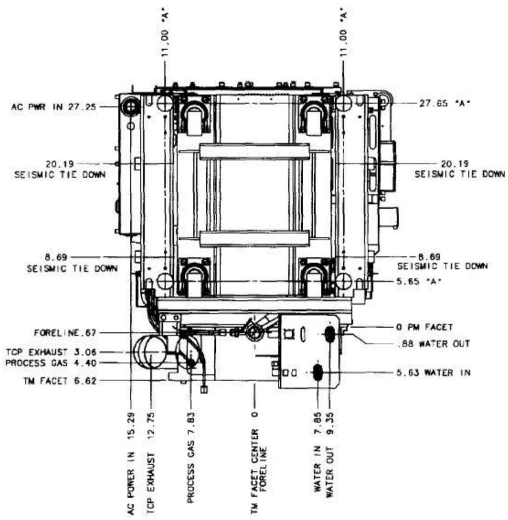
Gasses are supplied via TM.

Description	Pressure		Fitting		Source	Peak Demand (SCCM)	Ave. Demand (SCCM)	Idle Demand (SCCM)	Usage	Filter (∝)
	Psig	±	Size	type						
House N2	50	2	¼''	VCR (male)	TM	1,000	1,000 cont. flow	12,000	Cont.	.05
Helium	20 min 100max	2	¼''	VCR (male)	TM	50	N/A	0	Intermittent	
CDA	90	5	3/8''	compression	TM	10,000	N/A	0	Intermittent	.05

12.9. Physical Dimensions

Description	Width		Depth		Height		Center of Gravity x.y.z from 0.0
	IN	CM	IN	CM	IN	CM	
Process Module	34.22	86.9	29.59	75.1	76.95	195.3	1.05. 15.87. 31.34





12.10. Total Weight

Total Weight LBS (KG)	1500 (680)
Load Per Leveling Pad LBS (KG)	375 (170)

13. Drawings and Documentation

Drawings Supplied by Lam
Dimensions and information required for design of supports and foundation
Wiring and control logic diagrams
Sufficient detail to identify field replaceable units

14. Spares and Consumables

Lam will supply recommended spares and consumables parts list upon request.

15. Manuals

One set of manuals comes standard with system. Additional manuals are available with purchase of option (clean-room and non-clean room sets available). Please specify request on the quotation.

All Systems (Domino/2300)

406-240390-002 Domino/2300 Safety
405-240311-001 Domino Transport Module Facility W/Process Modules
406-000953-001 Domino 2300 Quick Start Guide

2300 Poly Process Module

405-240320-001 2300 Process Module Facility
406-240320-001 2300 Process Module Installation Guide
Part number Manual
405-240340-001 Metal/Silicon 2300 Process Module Facility

406-240340-201 Metal/Silicon 2300 Process Module Installation Guide

406-240340-201 Metal/Silicon 2300 Process Module Maintenance

16. Cost of Ownership

- List of consumables and recommended spares is available upon request.
- Cost of consumables (CoC) on an annual basis is available upon request.
- Cost of ownership (CoO) is estimated using the "Two-Cool" model, © 1992-95 D.W. Jimenez & Associtates, compliant to SEMI COO standard E-35 and is available upon request.

17. System Performance Specifications

Reliability, Availability, and Maintainability (RAM) indices are based on SEMI E10-92 definitions. The indices are further based on the following:

The customer's maintenance technicians, process engineers, and operators are properly trained on system operation, cleaning, and maintenance.
The customer follows recommended maintenance, cleaning, and operation procedures.
The customer maintains the recommended spare parts on hand.
Specifications subject to change without notice.

2300 Process Module Hardware Specifications

Equipment Parameter	**Specification**
Reliability, Availability, and Maintainability	
Unscheduled Downtime	″ 5%
Scheduled Downtime	″ 8%
Equipment Availability / Uptime	≥ 87%
Mean Time To Clean (MTTC)[1]	≤ 6 hours
Mean Time Between Clean (MTBC)	≥ 200 RF hours ; Goal ≥ 300 RF hrs on LAM approved processes
Mean Time Between Failures (MTBF)	≥ 250 hours
Mean Time To Repair (MTTR)	″ 4 hours
Mean Time Between Assists (MTBA)	≥ 72 hours
Mean Wafers Between Breakage (MWBB)	No broken wafer
ESC Warranty[2]	
Lifetime	6000 Hours
Leakage Current	≤ 100 μ A
Maximum RF Power to bottom electrode	750 Watts
Backside He Pressure Range	0 torr to 50 torr
Backside Leak Rate	″2 sccm
Vacuum Performance (for clean chamber)	
Main Chamber Base Pressure	≤ 1 mtorr
Main Chamber Leak Rate[3]	≤ 1 mtorr/min.

Temperature Control	
Electrode Temperature Control	± 2° C of setpoint
Electrode Temperature Range[4]	- 20° to 75° C
Chamber Wall Temperature Control	± 5° C of setpoint
RF Power	
H/W Power Test Range	0W to 1500W
H/W Power Test Range (Bias)	0W to 1250W
RF Accuracy	± 5W
Process Pressure Tolerance	± 1 mtorr (20% ≤ VAT valve opening ≤ 80%)
Time to pressure stability	5-10 sec. (including backside He stabilization)
CoC *	US$0.24 $/RF min
Matching network -- T-Match tuning and reflected power	Reflected power < ± 3 % of full power within 5 seconds on Lam approved processes , ″ 5W after stable. RF and VAT presets & delays and/or an ignition step may be required.

2300 Striper Module Hardware Spec

Equipment Parameter	Specification
Reliability, Availability, and Maintainability	
Unscheduled Downtime	< 5%
Scheduled Downtime	< 5%
Equipment Availability / Uptime	> 90%
Mean Time To Clean (MTTC)1	< 4 hours
Mean Time Between Clean (MTBC)	>300hours
Mean Time Between Failures (MTBF)	>350 hours
Mean Time To Repair (MTTR)	< 4 hours
Mean Time Between Assists (MTBA)	> 72 hours
Mean Wafers Between Breakage (MWBB)	No Broken wafer
Vacuum Performance (for clean chamber)	
Main Chamber Base Pressure	< 1mtorr
Main Chamber Leak Rate3	< 1mtorr/min.
CoC	US$ 0.18 $/RF min
H/W Power Test Range	0 W to 3000 W
RF Accuracy	± 5W from Generator
Time to pressure stability	< 10 sec
Matching network -- T-Match tuning and reflected power	Reflected power < ± 3 % of full power within 5 seconds ; ″ 5W after stable

CoC is preliminary estimates. Individual consumable prices are not fixed and are under supplier negotiation for volume quantities.

See MTTC definition under Appendix A: 2300 Specification Definitions
See conditions of ESC lifetime guarantee under Appendix A: 2300 Specification Definitions
After ≥ 1 hour pump time and with Lam recommended cleaning procedures

Appendix A

2300 Specification Definitions

ETCH RATE MICROLOADING:
Etch wafer with 40 - 60% partial etch (except with shallow trench etch where 100% etch is performed) Measure etch depth using SEM cross section in dense and isolated areas at center and edge of the wafer
Etch rate microloading is average % difference between etch depth in dense and isolated

CD BIAS NESTED TO ISOLATED:
Measure CD bias in dense and isolated areas as per CD bias definition
CD bias microloading is the difference in average isolated bias and average dense bias

PROFILE MICROLOADING:
Measure profile in dense and isolated areas as per profile definition
Profile microloading is the difference in average isolated profile and average dense profile

PERCENT OVERETCH:
Etch time is based upon 50% of total film thickness and the overetch etch rate

EDGE EXCLUSION:
The area within 3 mm of the outside perimeter of the wafer will not be used for any measurement

THROUGHPUT:
Throughput is based on steady state operation of the system and assumes that one VCE is running, while the other is vented to remove or reload wafers. Throughput is measured as the amount of time required to etch 100 wafers (four sequential cassettes with 25 wafers each loaded into the VCEs). Wafers per hour (wph) are equal to 100 wafers divided by the time to process the two cassettes. Time includes initial 180s pump time and final 240s vent time.
Throughput is based on total recipe time including initiation, stability, and RF-on steps.
Throughput based on 90 mtorr crossover pressure, PRK enabled.

2300 Specification Definitions

DEFECT DENSITY:

Measure particles on 3 bare silicon wafers using a Tencor Surfscan or equivalent metrology tool. Cycle the 3 wafers through the PM system with gases on and RF off using equivalent time and conditions as a production process. Measure particles on the same three bare silicon wafers post cycling. A control wafer should be used, and the environmental contribution must be factored out. The control wafer can be a single wafer placed either in a cassette on the system or in the fab in close proximity to the system. The control needs to use the same "non-system" handling that the monitor wafers use (i.e. any boat transfers, transport between particle monitoring instruments and etch tool, etc.). The control wafer is not cycled through the etch system.

Particles added per wafer is equal to the post cycling measurements minus the pre cycling measurements. Average particles per wafer is equal to the average of the particles added to the 3 wafers minus the particles added to the control wafer.

Defect density is calculated by dividing the average particles per wafer by the wafer area using a 3 mm edge exclusion

Use of Lam Best Known Methods (BKM) for chamber cleaning, plasma cleans, and O_2 flash required to achieve particle defect density levels specified in this document

ESC LIFETIME:
The ESC for the 2300 is classified as a spare part. ESC's for systems under warranty are covered under those contracts, please reference Lam Terms and Conditions of Sale. For ESC's purchased as spare parts the warranty period is 90 days; same policy as all other spare parts supplied by Lam.

In addition to Lam's warranty for spare parts and consumables, the following warranty conditions apply to all Lam ESC's.

The following events will void the ESC warranty:
The customer fails to maintain Lam equipment in accordance with Lam published or BKM (Best Known Method) maintenance procedures.
The customer fails to perform Lam published or BKM troubleshooting procedures to verify the ESC has failed.
The system is used to run a process outside Lam's standard process windows as published in Lam's standard specifications.
The ESC is damaged by mishandling or otherwise altered by the customer.
The ESC failure is due to wafer quality issues.
The customer fails to return any ESC claimed to be a warranty failure.

Lam reserves the right to test or otherwise verify ESC warranty returns and to finally determine whether any ESC failure is a warranty failure.

If the ESC installation is not performed by a Lam field service engineer the customer is required to provide the date of the ESC installation and the RF minute count to Lam.

MEAN TIME BETWEEN CLEANS, (MTBC)*:
Total number of RF minutes within a chamber between wet cleans
Use of Lam Best Known Methods (BKM) procedures required to meet specifications
Use of plasma cleans may be required to meet specifications

MEAN TIME TO CLEAN, (MTTC)*:
Total cleaning time including recovery time (i.e., time is tracked from when the system is no longer available for production to when the system is once again available for production)
Use of Lam Best Known Methods (BKM) procedures required to meet specifications
Purchase of Quick Clean chamber kit is required to meet specification.

UPTIME*:
Based upon SEMI E10-92 definitions

MEAN-TIME-BETWEEN-FAILURE, (MTBF)*:

Based upon SEMI E10-92 definitions

MEAN-TIME-TO-REPAIR, (MTTR)*:

Based upon SEMI E10-92 definitions
UPTIME, MTBF, MTTR, MTBC, and performance based on the following:
The customer's maintenance technicians, process engineers and operators are properly trained on system operation and maintenance.

The customer follows recommended maintenance and operation procedures.

The customer maintains a supply of the recommended spare parts and consumables on hand and purchases a quick-clean chamber kit.

Preventive maintenance is carried out as per Lam recommended schedule.

Clean Kit, Metal 300mm

QUICK CLEAN KITS	
714-801511-002	LIN, MTG PL, ESC , 300MM
715-801021-005	LINER , UPPER , 300 MM
716-003686-188	INSR , FOC ,R SHLD , 300MM
716-801568-002	WIN , QTZ
716-800592-001	BASE , FOCUS RING , SHLD , 300MM
716-801306-001	WDO , QRTZ , GAS INJ
716-000486-001	NOZ , GAS INJ , SNGL JET , 2300 METAL
849-800096-202	KIT , ORING , CLEAN , 300 , VITON
PEGULUM VALVE CLEAN KITS	
796-098655-002	PL , DN250 VAT VALVE
796-098654-002	RNG , LOCK , SER 65 DN250
STRIP CHAMBER QUICK CLEAN KITS	
716-801140-002	LINER , QTZ ,PLASMA CHAMBER
716-801141-003	LINER ,QTZ, GAS PORT/FD ,CHAMBER

716-801142-003	WDO , QTZ , CHAMBER , 6IN
716-801146-002	INS ,ADPTR PL ,300MM BPCES
716-801148-002	SPCR , INS ,300MM BPCES
716-801450-001	LINER ,CHAMBER ,TOP ,300MM STPR
716-801451-005	BAFFLE ,MID
716-801628-001	LINER , BOT ,ELCTD ,300MM STRP