Date : September 8, 2014

SPECIFICATION

(For Reference Only)

Product : Dry Etching System
Model : NE-950EX(autoloader)

CUSTOMER				
ULVAC				
Approved by	*Checked By*	*Checked By*	*Checked By*	*Written by*

Advanced Electronics Equipment Div.
ULVAC , Inc.

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Revision History

* Be sure to attach the Revision History table as the last page of the specification

Rev. No.	Rev. Mark	Date	Description		Approve By	Checked By	Checked By	Checked By	Written by
			Page	Item #					
01		Jun./13/ 2014		New Manufacture					
02			P1	1.2(1) clerical error correction 1.2(3) clerical error correction 1.2(6) clerical error correction 1.3(3) clerical error correction					
			P2	1.4(5) specification change 1.5(1) specification change 1.5(2) specification change					
			P3	2.1.1(3) specification change					
			P4	2.3 specification change					
			P10	5.2.6 clerical error correction					
			P11	5.2.7 clerical error correction 5.2.7(1) specification change 5.3.3(1) specification change					
			P13	5.4.4(1) specification change					
03	⚠	August 25, 2014	P1	1.2 (5) clerical error correction					
			P2	1.4 (2) clerical error correction 1.5 (1) DRP is able to change speed at idle					
			P5	specification change					
04	⚠	August 27, 2014	P2	1.5 (1) dual mode process add					
			P13	5.4.3(7) add Plasma Process monitor					
			P16	5.5 change					
05	⚠	September 8,2014	P5 P22	Etching Uniformity calculations change					

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1 GENERAL DESCRIPTION

This system <NE-950EX> is a load lock type high-density plasma etching system with a CCP (Capacitively Coupled Plasma) source adopted.

1.1 FEATURES

(1) Repeatability of etching performance is achieved by employing load lock structure and a turbo molecular pump for the etching chamber.

1.2 SYSTEM CONFIGURATION

(1) The NE-950EX ~~basically has~~ includes the auto loader(1 pc),transfer chamber (1 pc), process chamber (1pc), and Loadlock chamber (1 pc) .

(2) The evacuation system is composed by turbo-molecular pump and dry pump (1set) for the process chamber, and the dry pump (1 set) for the Load Lock chamber and transfer chamber.

(3) The substrate size ~~shall be~~ is specified to 330mm Tray.

(4) Mechanical chuck mechanism and He gas-assist mechanism are adopted for efficient control of substrate temperature.

(5) ~~Six (6)+Four(4)~~ 5+5 (corrosive) ⚠ gas lines are equipped.

(6) Heating-up of the anodic-oxidation treated deposition shield is ~~available~~possible. Temperature setting of the heater is ~~available~~capable up to 200°C. (However, 200°C is not a temperature of the deposition shield itself.)

1.3 TRANSFER SYSTEM SPECIFICATION

(1) ϕ330mm tray is available.

(2) Trays are transferred one by one by the single-pick vacuum transfer system.

(3) Tray ~~is~~ can be loaded and processed with seven ~~pieces of wafers of~~ φ 100mm wafers ~~on a tray, and processing is possible~~.

1.4 PROCESS CHAMBER SPECIFICATION

In this specification, the process chamber is [CCP etching chamber]..

(1) The process chamber employs the CCP plasma source.

(2) The process chamber is made of ~~aluminum~~ chemically polished Aluminum⚠. In addition, the chamber has a deposition shield temperature can be controlled for prevention of material accumulation on the shield.

(3) The Substrate electrode has a mechanical chuck and controls the substrate temperature.
Control range of chiller temperature: -20 °C to +40 °C.

* This is a value obtained by using one chiller individually. Controllable substrate temperature varies depending on the charged power and pressure.
* When the temperature is at 10 [°C] or lower, the system may be condensed depending on the environmental conditions. In that case, the dry air system is required.

(4) As the power supply for the plasma, the RF power supply (12.56 MHz) with the maximum output power of 3[kW] is attached at the bias side.

(5) The gas inlet system consists of the gas box system. ~~Six (6)+Four(4) process gas lines are prepared (General gas: 3 lines, corrosive gas: 3 lines)+ (General gas: 2 lines, corrosive gas: 2 lines)~~. The system will include a total of 10 gas lines. Of these 10 gas lines, 5 are for corrosive gas, 2 of 5 are heated (the base spec includes only 3 corrosive gas lines, the additional 2 are optional).In addition, the stop valves are mounted at the entrance of each line.

1.5 EVACUATION SYSTEM SPECIFICATION

The evacuation system consists of the following assemblies that includes a gas evacuation system such as the turbo-molecular pump (Corrosion-resistant and heating), so that the sufficient gas flow is available in a wide pressure range. In addition, the dry pump used in the evacuation line of the process chamber corresponds to by-products from the process chamber.

(1) In the gas evacuation system of the process chamber, the turbo-molecular pump with its evacuation speed in approx. 1300 (300*)[L/sec.] of N_2 and the dry pump (~~HR-600/ULVAC~~Ebara ESR-100WN-CE) with its evacuation speed in approx. 10000 [L/min.] of N_2 . Ebara ESR-100WN-CE is able to change speed at idle. ⚠
*note: To prevent an increase in the temperature of the pump rotor blades in high flow rate process, The number of revolutions of the TMP will set at 60%
Dual Mode Processing is possible. (Low or high pumping speeds process(DRP or TMP) is able to choice by recipe) ⚠

(2) In the evacuation system of transfer chamber, the dry pump (~~DRP:LR-60/ULVAC~~Ebara EVA-10-3) with its evacuation speed in approx. ~~350~~1000 [L/min.] of N_2 is used (shared with LoadLock chamber).

1.6 OTHERS

(1) The uninterruptible power supply system is mounted for the CPU backup.
(It is not for back of the entire system.)

2. PERFORMANCE

The basic performance of the NE-950EX is as follows. Refer to the Acceptance Criteria Document for the final agreed acceptance spec.

2.1 VACUUM PERFORMANCE

2.1.1 Transfer chamber, Loadlock chamber

(1) Ultimate pressure: 10 Pa or better

(2) Evacuation time: Within 10 minutes to 10 Pa

* Measurement condition:

- Vacuum chamber temperature: 20°C - 30°C
- Vent the chamber with dry N_2. After the chamber becomes at atmospheric pressure, open the chamber door for 3 minutes, and then start evacuating the chamber.
- Measurement will be conducted by using the Pirani vacuum gauge attached to the system.
- Auto pump down is used. The evacuation time measurement for the chamber includes slow roughing time.

(3) Leak rate: ~~1.0 Pa/min.~~ 1.0×10^{-3} Pam^3/sec or lower

* Measurement condition:

- Vacuum chamber temperature: 20°C - 30°C
- Measurement will be conducted by using the Pirani vacuum gauge attached to the system.
- Measurement will be conducted after confirmation of the ultimate pressure. Leak rate measurement will be conducted for 10 minutes.

2.1.2 Process chamber (ISM Etching chamber)

(1) Ultimate pressure: 2.7×10^{-3} Pa or better

(2) Evacuation time: Within 10 minutes to 5.0×10^{-3} Pa

* Measurement condition:

- After 5 or more hours of chamber baking, continuous evacuation of 12 hours or longer will be conducted.
- Vacuum chamber temperature will be 20°C - 30°C.
- No substrate is loaded.
- Vent the chamber with dry N_2. After the chamber becomes at atmospheric pressure, open the chamber door for 3 minutes, and then start evacuating the chamber.
- Measurement will be conducted by using the Pirani vacuum gauge and ionization vacuum gauge.
- Auto pump down will be conducted. The evacuation time measurement includes the slow roughing time.

(3) Leak rate: 5.0×10^{-5} Pam^3/sec or lower

* Measurement condition:

- Vacuum chamber temperature shall be between 20°C - 30°C.
- Measurement will be conducted on the ionization vacuum gauge.
- Measurement will be conducted after conforming the ultimate pressure. The leak rate will be measured after 10 minutes.

2.2 STABLE DISCHARGE PRESSURE

(ISM etching chamber)

0.7 - 67 Pa (Pressure trigger: 10 Pa)

Above value is obtained when Ar or O_2 gas is used, and is used for checking the system condition. Stable discharge range changes according to the gas type in actual process gas. Therefore, above value may be different from the actual process-able range for your process gas.

2.3 ETCHING UNIFORMITY

2.3.1 Etching uniformities between substrates and within a substrate

(Inspection at Customer site by using φ330mm tray)

~~(1) For GaN within wafer : Within ±5%~~
~~(2) For GaN wafer to wafer : Within ±7%(In comparison of average values in a wafer)~~
~~(3) For GaN Tray to Tray (2 trays) : Within ±3%(In comparison of average values in a tray)~~

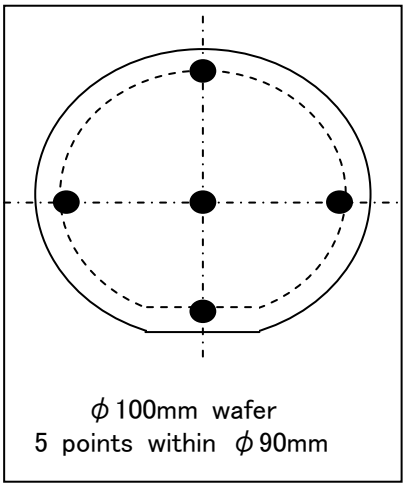
~~Samples that are used for the test shall be provided by the customer.~~

~~∗ Measurement condition:~~

~~● The measuring points for uniformity value within a wafer are 5 points as shown in the following drawing.~~

~~● The edge cut shall be 5 mm for the mechanical chuck or electro static chuck. At the orientation flat (or a notch) section, the measuring point shall be 5 mm from the edge of the orientation flat/notch.~~

~~Etching uniformity in a wafer shall be calculated by using a formula below.~~



ϕ100mm wafer
5 points within ϕ90mm

~~Etching uniformity: measuring procedure~~

~~Within wafer (5 points of the left drawing)~~
~~Wafer to wafer (Comparison of average values in a wafer)~~
~~Tray to tray (Comparison of average values in a tray)~~

$$\frac{\text{MAX}-\text{MIN}}{\text{MAX}+\text{MIN}} \times 100\ (\%)$$

<Etching Uniformity>

Across substrate	within ±5% with GaN EE10mm*
Substrate-to-substrate	within ±7% with GaN for 7 wafers*
Tray-to-tray	within±3% with GaN for ~~2~~ 4⚠ trays*

The following formula is used to calculate the etching uniformity.

$$\text{Etching Uniformity} = \frac{\max - \min}{(\text{Max} + \text{Min})} \times 100\ [\%]$$

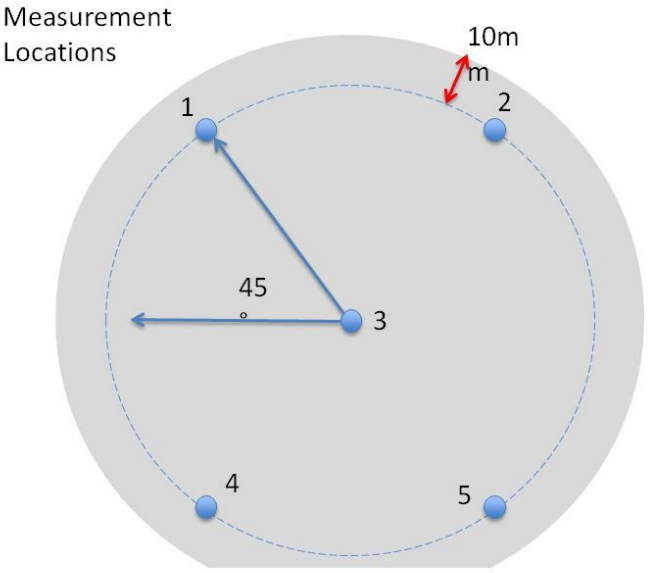
* Within wafer : To be measured by measuring 5 points across the wafer at the center and 4 edge locations shown to the right. Max and Min points taken from the 5 point data set and uniformity to be calculated by the formula (Max-Min)/(Max+Min) *100. Test to be completed on ~~blank~~ patterned⚠ wafers.

**Wafer to wafer : ~~ER uniformity within tray will be calculated by average ER of the substrate. (Average ER is calculated by 5 points described in *.)~~
~~Max and Min points taken from the 7 point dataset and uniformity to be calculated by the formula (Max-Min)/(Max+Min) *100. Test to be completed on blank wafers.~~ **To be measured by measuring 35 points across the carrier. 5 points/wafer at the center and 4-edge locations described in section *. Max and Min points taken from the 35 point data set and uniformity to be calculated by the formula (Max-Min)/(Max+Min) *100. Test to be completed on ~~blank~~ patterned⚠ wafers. ⚠

***Tray to tray : Run repeatability will be calculated by running ~~24~~⚠ trays and average ER of the tray. (Average ER is calculated by 7 wafers 5 points described in*.) Max and Min points taken from the 2 point dataset and uniformity to be calculated by the formula (Max-Min)/(Max+Min) *100. Test to be completed on ~~blank~~ patterned⚠ wafers.

Measurement points are five points as the figure to the right.

Etching conditions set by ULVAC demo results.



Provision of test wafers

Customer shall provide wafers that are used in an etching test before the test.

2.4 VACUUM TRANSFER PERFORMANCE

At the customer's site, vacuum transfer checks will be executed by using tray~~(Total 5 cassette.~~
(Total 100 transfer of tray)

2.5 OTHER TEST ITEMS

When there is any other desired test items, meetings will be held separately and the necessary cost will be quoted.

3. CONTROL SYSTEM

3.1 OVERVIEW OF FUNCTIONS

Key functions of the NE-950EX are as follows.
All operations are available on the touch panel. In addition, the multi-window method is applied to the software, improving the operation-ability.
Etching conditions can be registered on the recipe control screen. Etching with max. of 3 layers and 100 steps can be executed for each chamber.
Data logging management can be conducted on the media. In addition, data exchange is easily available with Windows applications such as Microsoft Excel.

3.1.1 Operation

(1) Preparation

PUMP DOWN	High vacuum evacuation

(2) Process operation

PROCESS	Confirmation and setting of the total automatic process, which is the main function of this system. Etching operation by the multi-steps

(3) Non-scheduled operation

VENT	Release of a chamber to the air
BUILD UP	Build-up test used for checking of vacuum leak

(4) Stop operation

ABORT	All systems excluding main pumps stop.
PAUSE	Temporary stop during an automatic operation
JUMP	Jump operation for the next layer operation during an automatic operation

(5) Shut down operation

SHUT DOWN	Total system stop

(6) Manual operation

MANUAL	Manual operation

3.1.2 Monitoring

(1) Monitoring fault

System fault monitor	Actuates the buzzer and displays message if any fault occurs in the system state or action
Process fault monitor	In case a process control value has an abnormal condition, a buzzer and a message are output.

(2) Operation guide

Information	System performance, starting, ending, notifying, and error messages are displayed in real time.
Graphic monitor	System operation status and wafer transfer condition are displayed in real time.
Process data monitor	Process status is displayed in real time.
Error information	Error messages are displayed. The logs are stored and used for searching.

3.1.3 Log function

(1)	Process log	Saves the result of automatic etching process as a log. A number of logs to be stored is 3,000.
(2)	Alarm log	Alarms that have occurred in last 30 days period of system operation are saved, allowing check of the alarm history.
(3)	Event log	History of system operation for 30 days is saved, allowing check of the event history.

4. SAFETY PROVISIONS

This system is prepared following safety functions to prevent accidents and for the safety of the operator.

4.1 SAFETY PROVISIONS

(1)	Emergency system stop	:	There are emergency buttons at the front side, rear side, and power supply rack of the system. Pressing one of these buttons stops all assemblies of this system.
(2)	Voltage	:	RF power supply and charged sections that have AC24 [V] or DC24 [V] are covered by a cover or a panel; therefore, high voltage sections cannot be touched directly.
(3)	Current feed-through	:	The current feed-through terminal is covered by a cover, so that an operator cannot directly touch the terminal.
(4)	Moving mechanical parts	:	Each vacuum valve and each gear is covered with protection covers.
(5)	Earth leakage breaker	:	This system is applying the electromagnetic earth leakage breaker with the sensitivity current of 30 [mA]. At the customer's site, the sensitivity current breaker with 100 [mA] or higher shall be prepared.
(6)	Control system	:	The control system is designed to operate by DC24V, ±15V, and 5V.
(7)	External interlock	:	The whole system can be stopped by transmitting the contact signal from the external unit. In addition, the contact output is prepared, so that the external unit also stops in conjunction with the stopping operation of this system when the system's EMO (emergency stop) switch is pressed.
(8)	Anti-earthquake measures	:	On the main body and the power supply rack of this system, anti-earthquake fittings are attached. The anchor work shall be conducted by the customer.

4.2 PROTECTION OF UNITS

During an operation, following interlocks work (representative ones only).

(1) Turbo molecular pump : It does not turn on if the cooling water flow rate is lower than the specified value.

(2) Main valve : It does not open until the Pirani vacuum gauge reaches (or goes below) the set pressure.

(3) Ionization vacuum gauge : It does not turn on unless the main valve is opened. Also when the meter pointer breaks limit, the vacuum gauge will automatically turn off.

(4) Vent : Chamber vent does not start unless a filament of the ionization vacuum gauge is turned off and the main valve is closed.

(5) Power failure, Water shortage : In case of power failure or water shortage, the turbo-molecular pump stops, and the vacuum valve closes. System does not recover automatically.

(6) Compressed air : The system cannot be started up if the compressed air is insufficient. (Buzzer alarm is provided.)

(7) RF power supply : The RF power supply can be turned on only when the process chamber is in vacuum.

(8) Process gas : The gas valve can be opened only when the process chamber is in vacuum.

4.3 FOR OTHER SAFETY SPECIFICATION

Safety provisions other than above (including addition of a water leakage sensor) will be quoted separately.

This system is designed and manufactured based on Japanese safety guidelines(JIS etc.)

5. LISTING OF COMPONENTS

5.1 SUBSTRATE SIZE

The size of substrates transferred in this system is compatible to SEMI standard.
If special substrate size (thick substrate, warped substrates, etc.) is used, consult us separately.

5.2 Auto Loader system

5.2.1 Cassette

The cassette uses customer supplies.

5.2.2 Cassette stage

(1)	Cassette stage for product wafer	2 sets
(2)	Cassette stage for dummy wafer	1 set
(3)	Cassette detection sensor	1 set
(4)	Light curtain	1 set

5.2.3 Transfer system

(1)	Transfer system	TAZMO:S0-417(double arm)	1 set
(2)	Bernoulli pickup		1 set
(3)	vacuum pickup		1 set
(4)	Wafer detection sensor		1 set
(5)	Buffer stations	2slot	1 set
(6)	Dry pump	for vacuum pickup	1 set
(7)	Ionizer		2set

5.2.4 Alignment system

(1)	Alignment system for wafer		1 set
(2)	Alignment system for tray	TAZMO:S0-297	1 set

5.2.5 Panel

(1)	Front panel		1 set
(2)	Door	Open and close interlock	1 set
(3)	Side panel		1 set

5.2.56 Loadlock chamber

(1)	Loadlock chamber		1 set
(2)	Top lid of chamber		1 set
(3)	Isolation valve	SMC	1 set

(4)	Stocker elevator mechanism		1 set
(5)	Stage for stocker		1 set
(6)	Tray detection sensor		1 set
(7)	Tray stocker	Two steps for tray sets	1 set
(8)	ϕ330 mm tray	for ϕ100mm wafer	2 sets
(9)	Ttay cover	SiC	2 sets

5.2.~~5~~7 Evacuation system

(1)	Roughing pump (dry pump)	~~LR-60: ULVAC~~Ebara EVA-10-3 Shared with Transfer chamber	1 set
(2)	Rough valve	SMC	1 set
(3)	Vent valve	SMC	1 set
(4)	Pirani vacuum gauge		1 set
(5)	Atmospheric pressure check switch		1 set

5.3 TRANSFER CHAMBER (T chamber)

5.3.1 Vacuum chamber

(1)	Transfer chamber		1 set
(2)	Top lid of transfer chamber		1 set

5.3.2 Transfer system

(1)	Tray transfer system	SCRV2240-PM-08212:JEL	1 set
(2)	Tray pick-up	Made of alumina Exclusively used for 330mm-dia.	1 pc

5.3.3 Evacuation system

(1)	Roughing pump (dry pump)	~~LR-60: ULVAC~~Ebara EVA-10-3 Shared with Load Lock chamber	1 set
(2)	Rough valve		1 set

5.3.4 Measuring system

(1)	Vacuum gauge sensor head	Pirani vacuum gauge	1 set
(2)	Atmospheric pressure check switch		1 set

5.4 PROCESS CHAMBER

5.4.1 Vacuum chamber

(1)	Process chamber	Made of aluminum	1 set
(2)	Deposition shield (With a heating system attached)		

		Made of aluminum	1 set
(3)	Isolation valve		1 set

5.4.2 Transfer system

(1)	Substrate hoist mechanism	Lift pins Made of stainless steel	1 set

5.4.3 Etching chamber

<BIAS etching electrode >

(1)	RF power supply	Max. output: 3000W, Frequency: 12.5MHz	1 set
(2)	Auto matching box		1 set
(3)	VPP sensor	5 kV sensor	1 set
(4)	Mechanical chuck for 330 mm-dia.		1 set
(5)	Shield box		1 set
(6)	Electrostatic chuck power supply		1 set
(7)	Plasma Process Monitor	（To Detect Etching of GaN)）	1 set⚠

<Helium cooling mechanism>

(1)	Regulator		1 set
(2)	Cooling gas filter		1 set
(3)	Pressure gauge		1 set
(4)	Pipes		1 set
(5)	Automatic pressure controller		1 set

<Chiller for cooing the electrode>

(1)	Electrode cooling chiller	Medium temperature control range: -20 - +40°C TBD by demo results	1 set
(2)	Chiller pipes		1 set

5.4.4 Evacuation system

(1) Turbo-molecular pump — Corrosion-resistant type, Evacuation speed: N_2 1200(300*) L/sec — 1 set

*note: To prevent an increase in the temperature of the pump rotor blades in high flow rate process, The number of revolutions of the TMP will set at 60%

(2) Dry pump — ~~Heating type,~~ evacuation speed: 10000 L/min ~~HR-600: ULVAC~~Ebara ESR-100WN-CE — 1 set

(3) Oscillating type control gate valve O-ring: Viton, non-heating type — 1 set

(4) High vacuum angle valve — 1 set

(5) Roughing valve — 1 set

(6) Smooth vent valve — 1 set

(7) Vacuum piping and Pipe support — 1 set

(8) Cold trap — 1 set

(9) trap — 1 set

5.4.5 Measuring system

(1) Ionization vacuum gauge — 1 set

(2) Pirani vacuum gauge — 1 set

(3) Baratron vacuum gauge — Orthogonal calibration, 13.3 Pa head — 1 set

(4) Protection valve — For Ionization vacuum gauge, — 1 set; For Baratron vacuum gauge — 1 set

(5) Atmospheric pressure check switch — 1 set

5.4.6 Gas system

(1) Pipes — SUS316L, Connection: VCR or equivalent — 1 set

(2) Mass flow controller — 10 sets

No.1	Gas type	Flow rate (SCCM)	MFC type	Gas set at the system delivery (Max. flow rate)
1	N_2 calibration	100	SEC-E40-N2(STEC)	
2	N_2 calibration	200	SEC-E40-N2(STEC)	
3	N_2 calibration	400	SEC-E40-N2(STEC)	
4	N_2 calibration	200	SEC-E440J-N2(STEC)	
7	N_2 calibration	100	SEC-E440J-N2(STEC)	
8	$SiCl_4$ calibration	200	SEC-E440J-SiCl4(STEC)	

No.2	Gas type	Flow rate (SCCM)	MFC type	Gas set at the system delivery (Max. flow rate)
1	N_2 calibration	100	SEC-E40-N2(STEC)	
6	N_2 calibration	200	SEC-E440J-N2(STEC)	
7	N_2 calibration	100	SEC-E440J-N2(STEC)	
8	$SiCl_4$ calibration	200	SEC-E440J-SiCl4(STEC)	

- Basically, the MFC conducts N_2 calibration and convert the flow rate at the C.F. The gas flow rate will be determined separately in a meeting. With some gas types, the MFC conducts calibration by using the actual gas.
- For general gas lines, rubber seal will be mounted.
- For corrosive gas lines, metal seal will be mounted. (Option)

(3) Line filter 10sets

(4) Gas box 1 set

5.5 Spare parts

The following spare parts are provided.

(1)	Deposition shield (2)	Made of aluminum	~~1~~ 3 pcs ⚠3
(2)	Aluminum screw for deposition shield		~~12~~36 pcs ⚠3
~~(3)~~	~~Special nut~~		~~12 pcs~~ ⚠3
(3)	Clamp ring		~~1~~ 3 pcs ⚠3
(4)	Clamp ring cover		4 pcs ⚠3
(5)	ϕ330 mm tray (for 100mm GaN etching)	ESC Tray	~~1~~ 2pcs ⚠3
(6)	tray cover		~~2~~4 pcs ⚠3
(7)	Bernoulli pickup(autoloader)		1 set
(8)	vacuum pickup(autoloader)		1 set
(9)	Tray pickup		1 set
(10)	Shower plate		~~1~~3 pcs ⚠3
(11)	Aluminum screw for shower plate		~~24~~120pcs ⚠3

5.6 CONTROL SYSTEM

5.6.1 Operation unit

(1) PC — 1 set

- Hard disk
- TFT touch panel display

5.6.2 PLC unit

(1)	DI/O unit	1 set
(2)	AI unit	1 set
(3)	AO unit	1 set

5.6.3 Others

(1)	Uninterruptible power supply system for PC	1 set
(2)	Circuit protector	1 set
(3)	Magnet conductor	1 set
(4)	Relays and timers	1 set
(5)	Emergency stop switch	1 set

5.7 UTILITY

5.7.1 Compressed air system

(1)	Filter regulator	1 set
(2)	Pressure switch	1 set
(3)	Compressed air pipe	1 set
(4)	Speed controller	1 set
(5)	Solenoid valve	1 set

5.7.2 Cooling water system

(1)	Water supply header	1 set
(2)	Water drain header	1 set
(3)	Ball valve	1 set
(4)	Pressure gauge	2 sets
(5)	Flow meter	2 sets
(6)	Cooling water pipe	2 sets

5.8 PANEL/FRAME

(1)	Main body frame, Front panel, Side panel	1 set

6. UTILITY

◎ Following values are approximate values. The final values will be provided on the final equipment drawing.
Any work at the customer's site shall be conducted in accordance with the final equipment drawing.

6.1 FOOTPRINT, HEIGHT, AND WEIGHT

(1) Main System : 1200W × 3630D × 2200H 2500 kg
(2) Pump Rack

* The size and weight are approximate values. For details, please refer to the final equipment drawing.

6.2 UTILITY

(Main System)

Item	Application	Amount of consume or require pressure	Connector	Condition
Electricity	Power line	3-phase 200V,27.8 kVA	M8 terminal block	125A Electric Leak Braker attached
	Grounding		M8 terminal block	A-type grounding
Compressed air	Compressed air drive	0.6 - 0.9 MPaG 5 L/min.	Rc1/4	Regulator attached
Dry air	Prevention for dew condensations (shield box)	0.02 - 0.03 MPaG 10 L/min.	Rc1/4	Dew point: -40°C or lower, No regulator
N_2 gas	System vent	0.1 MPa - 0.7 MPaG 180 L/count	1/4 UJR (male)	No regulator
	Pump purge	0.1 MPa - 0.7 MPaG 75 L/min.	1/4 UJR (male)	No regulator
	Gas pipe purge	0.05 MPa - 0.3 MPaG 0.1 L/min. or higher	1/4 UJR (male)	No regulator
	Ionizer Bernoulli	0.6~0.9MPaG 100L/min.	1/4 UJR (male)	
Process gas	For etching	0.05 MPa - 0.1 MPaG	1/4 UJR (male)	No regulator
Helium Gas	For cooling substrate	0.1 MPa - 0.7 MPaG 1 L/min. or higher	1/4 UJR (male)	No regulator
Exhaust	Main system heat exhaust	3 m^3/ min.	ϕ 125 mm	Connect to the acid exhasut line. *1
	Gas box	1 m^3/ min.	ϕ 60.5 mm	Connect to the acid exhasut line. *1
	Maintenance duct	1 m^3/ min.	ϕ 125 mm	Connect to the acid exhasut line. *2
	Compressed air	5 L/min.	Rc 3/8	Connect to the heat exhasut line.

(Pump Rack)

Cooling water		0.1 - 0.3 MPaG >= 30 L/min.	Inlet: Rc 1 (female) Outlet: Rc 1 (female)	10°C - 30°C Differential pressure: 0.1 MPa or higher Filter: 75 μm or lower
Exhaust	For heat exhaust	3m^3/min.	ϕ 50mm	Connect to the acid exhasut line.
	For pump exhaust	1.5m^3/min	NW40	Connect to the hazardous gas teratment equipment
	For pump exhaust	1.5m^3/min.	NW40	

* 1 If chlorine-based gas is used, add the chemical to the system panel and then connect the duct to the acied exhaust line.

* 2 Using the chlorine-based gas require the maintenance duct.

The contents may change depending on the system specification. For details, refer to the Final equipment drawing.

Remark 1: Quality of coolant water for instrument cooling must comply with guideline of THE JAPANESE REFRIGERATION AND AIR CONDITIONING INDUSTRY ASSOCIATION (JRA-GL-02-1994) requirements.

(Extracts from JRA-GL-02-1994)

LIST		Coolant Water
		Circulating water
Baseline Item	pH(25 deg C)	6.5 to 8.2
	Electrical conductivity (mS/m)	10 to 80
	Chloride ion (mg/l)	200 or less
	Sulfate ion (mg/l)	200 or less
	M alkali level (mg/l)	100 or less
	Total hardness (mg/l)	200 or less
	Calcium hardness (mg/l)	150 or less
	Ionized silica (mg/l)	50 or less
Reference Item	Fe (mg/l)	1.0 or less
	Cu (mg/l)	0.3 or less
	Sulfide ion (mg/l)	Undetectable
	Ammonium ion (mg/l)	1.0 or less
	Chlorine residual (mg/l)	0.3 or less
	Free carbonic acid (mg/l)	4.0 or less
	Stability index	6.0 to 7.0

6.3 GROUNDING

(1) Type-A grounding

According to "Laws for Electrical Engineering and Electrical Facility Management," this system is classified as high-voltage equipment. For safety, preparation of Type-A grounding(<10Ω) for high-voltage equipment is required.

7. SCOPE OF QUOTATION

This specificatgion includes the design, fabrication, and test of the equipment described in Item 1 ,2 and 5 above, and witness test at ULVAC's site, witness test, move-in and installation at the customer's site, test run, and adjustment.

8. ITEMS EXCLUDED FROM QUOTATION

(1) The following items are excluded from this specification. If customer needs ULVAC to do following item(s), it is to be quoted separately.

a. Building work, foundation work, grounding work, and work relating to the move-in of the system, and securing the move-in pathoof the cust
b. Crane, etc. if necessary during move-in
c. Electrical wire, cooling water pipes, wiring work, and piping work for cooling water, compressed air, and exhaustion at the customer's site
d. Units and works not described in "Listing of components"
e. Special processing of the transfer tray
f. Test materials and consumable necessary during a test run
g. Equipment and work not described in this specification
h. Cost necessary for specification change
i Communication software

9. DOCUMENTATION TO BE SUBMITTED

(1) Final equipment drawing (Electric drawings, mechanical drawings) 1 pc (Clean paper) and electronic copy

(2) Instruction manuals 1 pc (Clean paper) and electronic copy

(3) Instruction manuals (Units, Power supply) 1 pc of CDR
<Temporary operation manual: Submitted at the completion of test run>
<This specification and handling manual: Submitted within 2 months from completion of the test run>

(4) Inspection results 1 pc (Clean paper) and electronic copy

10. SHIPPING AND ACCEPTANCE CRITERIA

◎ The system will be shipped when the following check items are satisfied in the in-house test at the ULVAC's site

◎ The system will be accepted when the following items are satisfied during the test run at the customer's site.

∗ For the test at the customer's site, necessary measuring instrument (film thickness measuring instrument, etc.) shall be prepared by the customer.

10.1 CHECK ITEMS

	ITEM	SPECIFICATION	MEASUREMENT	CONDITION
1	Process chamber ultimate pressure	<= 2.7 × 10^{-3}Pa	Ionization gauge	Evacuate without substrate, continuously for 12 hours.
2	Evacuation time	LoadLock chamber Transfer chamber: Within 10 min. from atmospheric pressure to 10 Pa	Pirani gauge	Vent the chamber with N2, open the LoadLock chamber door, leave the chamber for 3 minutes, and then start evacuating.
		Process chamber: Within 10 min. from atmospheric pressure to 5.0 × 10^{-3} Pa	Ionization gauge	Vent the chamber with N2, leave the chamber for 3 minutes without opening the process chamber door, and then start evacuating.
3	Discharge maintain pressure	0. 7 - 67 Pa	Baratron	Discharge check by using Ar or O_2 gas
4	Unit performance	Auto etching interlock etc. (Item 4-2)		For Item 4-2, check items that may be affected are not conducted on a day of the witness test.
5	GaN Etching Uniformity <Customer site>	Within Wafer :Within ±5% Wafer to Wafer : Within ±7% (In comparison of average values in a wafer) Tray to Tray(±24 ⚠ trays): Within ±5% (In comparison of average values in a Tray)		Prepare wafers by Customer
6	Build-up test	process chamber 5.0 × 10^{-5} Pa･m^3/s or lower	Ionization gauge	After the continuous evacuations of 12 hours or longer, close the main valve and measure the pressure for 10 minutes. Deposition shield heater and chamber bake heater are OFF
7	Interlock test			Confirm by following the ULVAC's interlock list.
8	Vacuum transfer test <Customer site>	Vacuum transfer check by using tray		10 cassette

If you need any other items for the acceptance, a discussion will be held separately. Some items may be quoted separately. Refer to the Acceptance Criteria Document for the final agreed upon acceptance spec.

11. SYSTEM WARRANTY

ULVAC will warrant that the system is free from any defects due to its design workmanship for a period of twelve (12) months from the day of acceptance or 15 months from date of shipping from ULVAC factory,whichever terminates earlier and will repair or replace for free of charge.
However, even during the warranty period, defectives caused by improper handlings, and consumables such as the shaft section maintenance, O-ring, gasket, vacuum oil, insulators, electrostatic chuck, evacuation system, periodical maintenance part, etc. are excluded.
All driving sections of the system require periodical maintenance. Refer to the recommended maintenance period described in the instruction manual and conduct maintenance.
The followingcases are not covered by warranty and will be charged.

(1) Defects caused by disasters such as natural desasters or fire
(2) Defects caused by special atmosphere at the installation place
(3) Defects caused by improper operation conditions not described in the instruction manual (utilities, maintenance procedure, inspection, etc.)
(4) Defects caused by any cause othere than this system itself
(5) Defects caused by modification or change that was conducted by any third party other than ULVAC
(6) Any defects that is not due to responsibility of ULVAC
(7) TMP defect due to etching products

In addition, ULVAC will not incur any damages for accidents of other device, repair of damages, and compensation for loss, occurred by a cause in this system.

12. PRECAUTIONS REGARDING THIS SYSTEM

(1) Grounding work
This system is classified as high-voltage equipment; therefore, take Type-A grounding for the safety.
In addition, be sure to conduct the grounding work by taking consideration of controlling the electric interference.

(2) Application to Bureau of Telecommunications
Usage of this system is controlled by “Radio Law.” Before using this system, application and permission from Bureau of Telecommunications is necessary.

(3) Earth leakage breaker
To the main circuit, the pure electromagnetic earth leakage breaker (Rating sensed current: 30 mA is mounted. If the customer prepare the earth leakage breaker, mount the one with the sensed current of 100 mA or higher.

(4) Water leakage detection
The cooling water is supplied to the system. In case water failure occurrs by some trouble in the cooling water system, there is a possibility to give a damage to the customer’s facility.
Water leakage detection/alarm shall be mounted to the system framework and the floor around the system.

(5) Periodical maintenance
Conduct the periodical maintenance that is recommended in the instruction manual of the system.

(6) Test wafer
The wafers for the test shall be provided by the customer before the day of testing.

(7) Precautions at the system move-in
The system move-in path shall be examined by using the final equipment drawing.

(8) Change of the equipment and the equipment specification
For modification, the equipment and the equipment specification may be changed without notification.

(9) Handling of gas
This system uses combustible gas, corrosive gas, and hazardous gas. Be very cautious when handling the system.
In case any gas accident occurs due to improper handling of the system, ULVAC will not incur the damage.

◆Indemnity relating to intellectual property

We sell the Device to you only if you agree to the following conditions in the terms of sale:
If third party claims of patent infringement relate to the Apparatus sold to and used by your company are based on apparatus patent covering the Apparatus, our company will exert its best efforts in order that your company may continue the use of the Apparatus by such means as acquiring license or remo deling of the Apparatus.
In no event, however, the liability of our company including expenditure born by our company on such an occasion will exceed the amount equal to the selling price of the Apparatus sold to your company. With respect to any third party claims based on process patent and/or your products manufactured by using the Apparatus, no liability lies with our company

◆Disuse of the product

Please note that any product supplied by our company can be disused only at the customer's responsi bility and expense. And, the product in the meaning of this passage includes its appurtenances, annex documents and / or media, etc. attached to, as well as the product in itself.

◆Any items which are not described in this document

Matters not mentioned in this Specification shall be settled through discussion between the two parties and the decision shall take precedence over this Specification, provided that it is confirmed in writing by minutes of meeting or other documents.

◆The United Nations Convention on Contracts for the International Sale of Goods

This Agreement shall be governed by and construed in accordance with the laws of the People's Republic of China. The parties agree that the United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement, any Individual Agreements or any transactions contemplated thereby.

◆Trade Terms

Trade terms such as FCA, CIF and any other terms which may be used in this contract shall have the meanings defined and interpreted by the Incoterms 2000 Edition, ICC Publication No. 560, as amended, unless otherwise specifically provided in this contract.