1. PURPOSE

1.1 Purpose

This is an ISM (Inductively Super Magnetron) dry etching system.
The main application is for semiconductor production and experiments.

1.2 Size of Substrate

①. Wafer size
- ☐ 4 inch wafer (OF JEITA)
- ☐ 6 inch wafer (OF JEITA)
- ☑ 8 inch wafer (Notch JEITA)

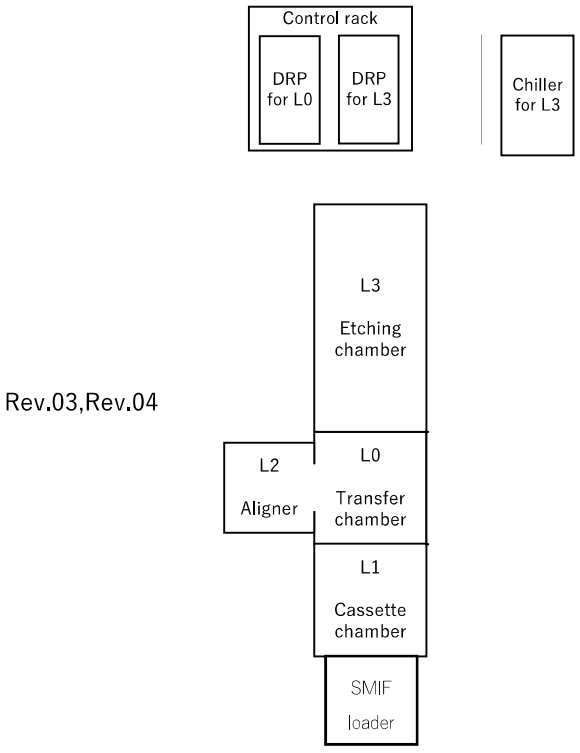
1.3 System Overview

This system has the following structure.

Module		Spec.	Pumping	Stage temp. control	Other system
L0	Transfer chamber	Rectangular core	DRP		
L1	Cassette chamber	25 Slot Cassette	DRP Shared with L0		SMIF loader
L2	Aligner	Wafer drop type			
L3	Etching chamber	STD	TMP+DRP	Chiller He assisted	Control Rack
L4					

[Schematic diagram]

(Other system)
- Chiller for electrode cooling (for L3)
- DRP (for L0)
- DRP (for L3)
- Control / Power supply rack



Rev.03,Rev.04

2. SPECIFICATION

2.1 System Description

2.1.1 L0 module

①. This module is equipped with a transfer module (Transfer chamber) equipped with a vacuum transfer system. The transfer chamber is a rectangular made of Al alloy, and it is possible to mount up to two process modules.

②. A transfer system is mounted in the center of the transfer chamber, and the wafer can be transferred between modules in a vacuum. The maximum payload of the transfer system is 2000g (including trays and end effectors).

③. Equipped with N2 gas piping and vent valve for chamber vent. The gas piping is made of SUS and is equivalent to UJR fittings (made by Fujikin). The vent valve is a smooth vent valve with a slow vent function.

④. Equipped with a Pirani vacuum gauge and an atmospheric check switch for checking the pressure inside the chamber.

⑤. The maximum transferable wafer size is Φ200 mm (8 inch wafer), and the corresponding wafer size can be selected from the following specifications.

- ☐ 4 inch wafer (OF JEITA)
- ☐ 6 inch wafer (OF JEITA)
- ☑ 8 inch wafer (Notch JEITA)

⑥. The rough valve is equipped with a flow rate two-step control valve with a slow rough function.

⑦. Equipped with a dry pump for rough exhaust. The vacuum piping that connects the main body and the dry pump is attached only within the range that can be installed within the range of W 2000 mm x D 4000 mm including the main body and ancillary equipment (dry pump, control rack, chiller).

⑧. The front of the main body is covered with a panel, which supports partitions (Please contact us for installation).

⑨. A gas connection port is provided on the right side of the device. In this specification, the following gas connection ports are prepared.

- ☑ N2 for vent
- ☐ Ar for process
- ☐ O2 for process
- ☐ N2 for process
- ☑ He for substrate cooling

⑩. It is possible to attach a grounding rod for static elimination of the high-voltage charging part as an option.

- ☐ Without grounding rod
- ☑ With grounding rod (Option)

⑪. As an option, an exhaust duct for process chamber maintenance (corrosive gas compatible specifications) can be installed.

- ☐ Without Maintenance duct
- ☑ With Maintenance duct (Option)

2.1.2 SMIF loader

①. The system equips SMIF loader that is set in front of the cassette chamber.

②. Operators set SMIF pod including wafer cassette manually onto the stage of SMIF loader.

③. SMIF loader open the SMIF pod then transfer wafer cassette into cassette chamber by transfer system automatically.

④. It can be used dedicated cassette.

- ☑ 8inch 25slot or 13slot cassette compatible with SMIF pod

Rev.02

2.1.3 L1 module

①. This module is equipped with a cassette module (cassette chamber). The cassette chamber is made of stainless steel.
②. The transfer chamber and cassette chamber are separated by an isolation valve.
The system equips vacuum cassette chamber. Operators set cassette manually into cassette station.
③. Manually open and close the front door of the cassette chamber to handle the cassette.
④. The cassette stage can be moved up and down by the elevating mechanism to select any slot.
⑤. The wafer and cassette are detected by the wafer detection sensor and the cassette detection switch.
⑥. Equipped with N2 gas piping and vent valve for chamber vent. The gas piping is made of stainless steel and UJR fittings (made by Fujikin). The vent valve is a smooth vent valve with a slow vent function.
⑦. The rough valve is equipped with a flow rate two-step control valve with a slow rough function.
⑧. Use a dry pump for rough exhaust. The dry pump is shared with the transfer chamber. The vacuum piping that connects the main body and the dry pump is attached only to the same floor.
⑨. Equipped with a Pirani vacuum gauge and an atmospheric pressure switch for checking the pressure inside the chamber.
⑩. The wafer cassette can be selected from the following specifications.
☐ Metal cassette for ϕ100 mm (4 inch wafer)
☐ Metal cassette for ϕ150 mm (6 inch wafer)
☐ Metal cassette for ϕ200 mm (8 inch wafer)
☑ Other (8inch 25slot or 13slot cassette compatible with SMIF pod) Rev.02
*Wafers(including MEMS coupon) 400-600um will be in 25 slot cassette,
*Wafers(including MEMS coupon) 600-800um will be in 13 slot cassette
⑪. A dummy cassette can be installed as an option.
☑ Without dummy cassette
☐ With dummy cassette (option)

2.1.4 L2 module

①. This module is equipped with an alignment module (aligner). The alignment chamber is made of Al alloy. The alignment module does not come with an exhaust system (vacuum pump, pressure gauge). Also, there is no mechanism to separate the aligner from the transfer chamber.
②. The aligner drops into the wafer guide for centering and detects orientation flats or notches.
③. Equipped with a wafer lifting mechanism for transferring the wafer to and from the vacuum transfer system.
④. Equipped with a window for a checking the inside of the chamber.

2.1.5 L3 module Rev.03, Rev.04

①. The process chamber is equipped with a module for the etching process using an ISM plasma source.
②. The transfer chamber and the etching chamber are separated by isolation valve.
③. The top plate has a structure that allows it to rise and turn, making it easy to access and maintain the inside of the chamber.
④. The upper electrode part and the lower electrode part are covered with a shield box.
⑤. L3 module is equipped with a wafer lift mechanism for transferring the wafer to and from the vacuum transfer system.
⑥. L3 module is equipped with gas piping and gas valve for process gas supply and chamber vent. The gas piping is made of stainless steel and UJR fittings (made by Fujikin). The vent valve is a smooth vent valve with a slow vent function.
⑦. Gas introduction equipment such as gas valves and mass flow controllers (MFCs) are housed in gas boxes. The gas box has a connection port for exhausting the housing.
⑧. It is equipped with a gas regulator and a pressure controller with a mass flow meter as a He gas supply device to the wafer stage.

⑨. Rough valve is equipped with a flow rate two-step control valve equipped with a slow rough function.
⑩. L3 module is equipped with a bake heater for heating the chamber.
⑪. The structure makes it easy to replace the shield plate. The shield plate is equipped with a bake heater for heating.
⑫. The side of process chamber is equipped with a viewing window for checking the discharge. Equipped with a discharge confirmation sensor.
⑬. The process chamber equipped with a diaphragm gauge, Pirani vacuum gauge, cold cathode gauge and atmospheric pressure switch for checking the pressure inside the chamber.
⑭. The shield plate has an opening for transporting the wafer. A shutter can be attached to the opening. A shutter heater can be attached to the shutter as an option.
☐ Without shutter heater
☑ With shutter heater (Option)
⑮. The exhaust system is equipped with a turbo molecular pump (TMP) and a pendulum pressure control valve (APC). APC and diaphragm gauge allow pressure adjustment during the process. The TMP, APC and fore valve are equipped with a heater.
⑯. An end point detector can be installed as an option.
☑ Without end point detector
☐ Plasma process monitor / C10346 (Option)
☐ Real Time Interferometric Process Monitor (Manual stage) (Option)
⑰. As an option, it is possible to install an atmosphere introduction valve for maintenance after using corrosive gas.
☑ Without Atmospheric introduction valve
☐ With Atmospheric introduction valve (Option)
⑱. The system is equipped with a wafer temperature control function that includes a chiller and a He gas introduction mechanism, and can be controlled according to the process.
The temperature setting range of the chiller can be selected from the following specifications.
☑ cooling chiller (-20°C～+40°C)
☐ cooling chiller (+20°C～+90°C)
☐ Heating chiller (+70°C～+200°C)
*The set temperature is the temperature control range of the circulating fluid, not the wafer temperature itself.
*Before operating the chiller, make sure that the circulating fluid is filled in the specified amount.
*For circulating fluid, check the instruction manual of the chiller before making a selection.
⑲. The gas system consists of a gas box system and can be equipped with up to 8 gas lines, and stop valves are equipped each gas lines.
⑳. The gas system is equipped with a mass flow controller (MFC) for adjusting the process gas flow rate. See Section 4-1 for MFC full scale and compatible gas types.
㉑. The wafer holding mechanism can be selected from the following specifications.
☐ Mechanical chuck
☑ ESC (Electrostatic chuck)
㉒. An antenna is placed on the upper electrode. The RF power supply installed in the antenna section is 1000W / 13.56MHz.
* Actual applicable power varies depending on the process conditions.
㉓. A substrate bias mechanism is placed on the lower electrode. The RF power supply installed in the substrate bias section has a different frequency from the RF power supply for the antenna. The maximum output of the RF power supply can be selected from the following specifications.
☐ Maximum output 1000W (12.5MHz)
☑ Maximum output 600W (12.5MHz)
☐ Maximum output 300W (12.5MHz)
☐ Maximum output 1000W (400kHz)
㉔. It is equipped with a dry pump for rough exhaust and as an auxiliary pump for turbo molecular pumps. The vacuum piping that connects the main body and the dry pump is attached only to the same floor.

2.2 Exterior color

①. Painting color of the main part: NCS-S-1005-R80B
②. Purchase components such as vacuum pump and vacuum valve are the standard color of the maker.

2.3 Training

Note: This revised specification does not include the following training(2.3.1~2.3.3). Rev.03

2.3.1 GPCS operation system (Standard required days: 0.5 day)
ULVAC describes how to operate GPCS (name of the controller used for system control) with reference to the operation manual.
For details of the training, refer to the training menu submitted separately.

* Training beyond the standard required days above is outside the scope of the quotation. If necessary, contact ULVAC in advance. ULVAC will submit a separate quotation. (Paid work)

2.3.2 Maintenance (Standard required days: 0.5 day)
ULVAC describes periodical maintenance works related to system operation performed by the customer, such as replacement of the film-deposited parts with reference to the maintenance manual. For details of the training, refer to the training menu submitted separately.

* This training does not include transfer system teaching and parts replacement other than the above.
* Training beyond the standard required days above is outside the scope of the quotation. If necessary, contact ULVAC in advance. ULVAC will submit a separate quotation. (Paid work)

2.3.3 Safety training
In order to use the device safely, we will explain based on the user safety training items specified by us.
For details of the training, please refer to the training menu submitted separately.

* Training for more than the above standard required days is out of the estimated range. If necessary, please let us know your request in advance. We will submit a separate quotation. (Paid work)

2.4 Optional Functions

2.4.1 Communication interface
①. SECS/GEM Rev.03
This specification includes SECS/GEM following the Standard On-line Equipment Communication Specification(MA21-0111-0-J-151/05) discussed with LGD.

3. PERFORMANCES

3.1 Vacuum performances

Rev.03

Measurements are made when no work is loaded, and the chamber is clean at room temperature.

3.1.1 Ultimate pressure

[Presence/Absence of test and how to confirm the test result]

✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	✔	－	－	－

Measuring equipment, Required equipment, etc.
- Cold cathode gauge
- Pirani gauge

[Guaranteed value]

①. L0 / L2 module Transfer chamber 10 Pa or lower
②. L1 module Cassette chamber 10 Pa or lower
③. L3 module Etching chamber 1.0×10^{-3}Pa or lower

[Measurement conditions/Testing method]

Chamber temperature must be 20-30 degrees C.
Chamber cleaning must be done prior to pumping down the chamber.
The process chamber is heated to 50 degrees C for more than 5 hours and is pumped for more than 12 hours continuously.
No wafer and no cassette loaded in the chamber.

Rev.02

3.1.2 Pressure build-up

[Presence/Absence of test and how to confirm the test result]

✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－

Measuring equipment, Required equipment, etc.
- Cold cathode gauge
- Pirani gauge

[Guaranteed value]

①. L0 / L2 module Transfer chamber 1.0×10^{-3}Pa・m^3/sec or lower
②. L1 module Cassette chamber 1.0×10^{-3}Pa・m^3/sec or lower
③. L3 module Etching chamber 5.0×10^{-5}Pa・m^3/sec or lower

[Measurement conditions/Testing method]

Chamber temperature must be 20-30 degrees C.
No wafer and no cassette loaded in the chamber.

Rev.02

After ultimate pressure is confirmed, the build-up is measured by the vacuum gauge attached to the system after the valve is closed and 10 min elapsed.

3.1.3 Pumping time

[Presence/Absence of test and how to confirm the test result]

✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－
Measuring equipment, Required equipment, etc. ・Cold cathode gauge ・Pirani gauge					

[Guaranteed value]

①. L0 / L2 module Transfer chamber　　Within 10 minutes from ATM to 10 Pa or lower
②. L1 module Cassette chamber　　Within 10 minutes from ATM to 10 Pa or lower
③. L3 module Etching chamber　　Within 10 minutes from ATM to 2.7×10^{-3} Pa or lower

[Measurement conditions/Testing method]

Vent to atmospheric pressure with dry N2, leave at atmospheric pressure for three minutes then pump down the chamber with the auto pump-down function. The state while keeping at atmospheric pressure is described below;

The Transfer chamber and Etching chamber cannot be opened to atmosphere after venting.
The Cassette chamber is opened the door.

Chamber temperature of 20-30 degrees C, after cleaning.
The cold cathode gauge and Pirani gauge are used to measure pressure.
The pump down time includes slow roughing.
No wafer and no cassette is loaded in the chamber.

Rev.02

3.1.4 Gas flow characteristics

[Presence/Absence of test and how to confirm the test result]

✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－
Measuring equipment, Required equipment, etc. ・Diaphragm gauge					

[Guaranteed value]

①. L3 module Etching chamber　　Reference Only

[Measurement conditions/Testing method]

Divides MFC maximum flow rate into five and records the chamber pressure to each flow rate

3.1.5 Auto pressure control(APC) Characteristic

[Presence/Absence of test and how to confirm the test result]

✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－
Measuring equipment, Required equipment, etc. ・Diaphragm gauge					

[Guaranteed value]
①. L3 module Etching chamber Reference Only

[Measurement conditions/Testing method]
Flows 20sccm of Ar into the process chamber and records APC opening level for each pressure setting. Rev.02

3.1.6 PFC pressure - He flow Characteristic Rev.02

[Presence/Absence of test and how to confirm the test result]
✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－
Measuring equipment, Required equipment, etc. ・PFC unit					

[Guaranteed value]
①. L3 module Etching chamber 1.0sccm or lower @PFC1000Pa

[Measurement conditions/Testing method]
Wafer : ϕ200mm SiO2 wafer
Records the He flow at each PFC pressure

3.2 Helium leak check

3.2.1 He leak check

[Presence/Absence of test and how to confirm the test result]
✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－
Measuring equipment, Required equipment, etc. ・He leak detector Supplied by the customer					

[Guaranteed value]
①. He leak rate 5.0×10^{-8}Pa・m^3/sec or lower

[Measurement conditions/Testing method]
Check each seal for leaks in the Etching chamber, Transfer chamber, and Cassette chamber.

3.3 Process performance

3.3.1 Discharge pressure range

[Presence/Absence of test and how to confirm the test result]
✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－
Measuring equipment, Required equipment, etc. ・Si wafer 1pc Supplied by the customer					

[Guaranteed value]
①. L3 module Etching chamber 0.07～6.7 Pa

[Measurement conditions/Testing method]
The operating pressure range is a range in which discharge can be set up in stable condition at a flow rate of Ar gas that can be fed within the range of pumping and pressure control range

3.3.2 RF calibration Rev.02, Rev.03

[Presence/Absence of test and how to confirm the test result]
✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
－	－	－	－	－	－
Measuring equipment, Required equipment, etc. ・Power sensor, RF cable, Dummy load Supplied by the customer					

[Guaranteed value]
①. L3 module Etching chamber Reference Only

[Measurement conditions/Testing method]
Disconnect RF cable at the M.Box side.
Connect power sensor to the RF cable from RF generator and connect dummy load by other RF cable from power sensor.
Record power monitor value and calibration parameter at each RF power before and after calibration.

3.3.3 SiO2 Etching uniformity within wafer

[Presence/Absence of test and how to confirm the test result]
✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
－	－	－	－	－	－
Measuring equipment, Required equipment, etc. ・8 inch SiO2(1000nm)/Si wafer 1 pc Supplied by the customer ・NANOSPEC equivalent ※Prepare the measuring instrument at customer.					

[Guaranteed value]
①. L3 module Etching chamber ±5% or lower

[Measurement conditions/Testing method]
Stage ; Electrostatic chuck
Substrate ; 8 inch SiO2/Si wafer
Process condition ; using ULVAC recommendation condition
Measuring instrument ; NANOSPEC equivalent
Measuring point ; 5 points within wafer described below
*Etched thickness is measured 5 mm inside the periphery at the orientation flat and notch.

The following formula is used to calculate the etching uniformity.
・Within wafer
Uniformity=(A.max-A.min) / (A.max+A.min) X 100 (%)

A.max; maximum value of etched thickness within a wafer.
A.min; minimum value of etched thickness within a wafer.

3.3.4 SiO2 Etching uniformity wafer to wafer

[Presence/Absence of test and how to confirm the test result]

✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
－	－	－	－	－	－

Measuring equipment, Required equipment, etc.
・8 inch SiO2(1000nm)/Si wafer 3 pc Supplied by the customer
・NANOSPEC equivalent ※Prepare the measuring instrument at customer.

[Guaranteed value]

①. L3 module Etching chamber ±5% or lower (Continuous 3 wafer processing)

[Measurement conditions/Testing method]

Stage ; Electrostatic chuck
Substrate ; 8 inch SiO2/Si wafer
Process condition ; using ULVAC recommendation condition
Measuring instrument ; NANOSPEC equivalent
Measuring point ; 5 points within wafer
*Etched thickness is measured 5 mm inside the periphery at the orientation flat and notch.

The following formula is used to calculate the etching uniformity.
・Wafer to wafer
Uniformity=(B.max-B.min) / (B.max+B.min) X 100 (%)
B.max; maximum value of average value of etched thickness within 3 wafers..
B.min; minimum value of average value of etched thickness within 3 wafers.

3.4 Etching performance for L3 module

3.4.1 Chuck temperature uniformity within wafer

[Presence/Absence of test and how to confirm the test result]

✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－

Measuring equipment, Required equipment, etc.
・8 inch TC wafer 1 pc Prepared by ULVAC

Performance of below items are checked on customer site.

[Guaranteed value]

①. Temperature uniformity < +/- 3 degrees C

[Measurement conditions/Testing method]

Stage ; Electrostatic chuck
Substrate ; 8 inch TC wafer
Process condition ; under vacuum, no plasma

Measuring instrument ; TC
Measuring point ; 5 points within wafer
*TC measuring point are 10 mm inside the periphery at the orientation flat and notch.

The following formula is used to calculate the chuck temperature uniformity.
・within wafer
Uniformity=(D.max-D.min) / 2 degrees C
D.max; maximum value of temperature within a wafer.
D.min; minimum value of temperature within a wafer.
D.mean; mean value of temperature within a wafer.

3.4.2 Mechanical particle test

[Presence/Absence of test and how to confirm the test result]
✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
－	－	－	－	－	－

Measuring equipment, Required equipment, etc.
・8 inch blanket Si wafer 1 pc Supplied by the customer
・Tencol equivalent ※Prepare the measuring instrument at customer.

Mechanical particle test of below items are checked on customer site. Rev.02

[Guaranteed value]
①. Particle adders <20 particle adders size > 0.3um

[Measurement conditions/Testing method]
Substrate ; 8 inch blanket Si wafer
Substrate conditions : Initial particle number <10 particle size >0.3um
Transfer conditions ; pumpdown, transfer into chamber, clamping, flow gasses, transfer out
Measuring instrument ; Tencol equivalent
Measuring area ; EE 5mm inside the periphery at the orientation flat and notch.

3.4.3 Photo resist Etching Performance within wafer

[Presence/Absence of test and how to confirm the test result]
✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
－	－	－	－	－	－

Measuring equipment, Required equipment, etc.
・8 inch blanket photo resist wafer 1 pc Supplied by the customer
・NANOSPEC equivalent ※Prepare the measuring instrument at customer.

Etching performance of below items are checked on customer site.
Details of the specifications will be decided after the demo result are obtained .

[Guaranteed value]
①. Etching Rate > 100nm/min
②. Etch uniformity ≦ +/-5%

[Measurement conditions/Testing method]
Stage ; Electrostatic chuck
Substrate ; 8 inch blanket photo resist wafer
Process condition ; using ULVAC recommendation condition
Measuring instrument ; NANOSPEC equivalent
Measuring point ; 17 points within wafer
*Etched thickness is measured 5 mm inside the periphery at the orientation flat and notch.

The following formula is used to calculate the etching uniformity.
・within wafer
Uniformity=(C.max-C.min) / (C.mean X 2) X 100 (%)
C.max; maximum value of etched thickness within a wafer.
C.min; minimum value of etched thickness within a wafer.
C.mean; mean value of etched thickness within a wafer.

3.4.4 Wafer handling test
[Presence/Absence of test and how to confirm the test result]
✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－
Measuring equipment, Required equipment, etc. ・8 inch blanket Si wafer 100 pcs Supplied by the customer					

Wafer handling test of below items are checked on customer site.
Details of the specifications will be decided after the demo result are obtained .

[Guaranteed value]
①. Total 1000 wafers run No faults

[Measurement conditions/Testing method]
Substrate ; 8 inch blanket Si wafer
Transfer conditions ; transfer in, N2 flow, pump down, return
*Total 1000 wafers test with in-house and on-site.

3.5 Component action

3.5.1 Automatic/Interlock operation Rev.02
[Presence/Absence of test and how to confirm the test result]
✔: Test is conducted/－: Test is not conducted

ULVAC plant			Customer plant		
Test	Data submission	Witness test	Test	Data submission	Witness test
✔	✔	－	－	－	－
Measuring equipment, Required equipment, etc. ・SiO2 wafer 1pc Supplied by the customer					

[Guaranteed value]
①. Perform automatic operation and check that it operates normally

[Measurement conditions/Testing method]
Confirm that the interlock works according to the interlock list.

<Precautions>
When there is no particular instruction in performance check at the time of contract, the tests will be conducted in accordance with ULVAC standard.
Please note that the cost and delivery date may change if you instruct the performance check after the contract.
The performance check is conducted to confirm that each unit works properly and the specified basic performance is satisfied.
Therefore, the tests based on the customer's usage conditions (condition settings) are excluded.
Please note that if the substrates, process gas, and testing equipment required to acquire the acceptance test data cannot be prepared, the acquisition of data for the test items may be excluded from the acceptance conditions.

4. CONPONENTS DESCRIPTION

4.1 Components

4.1.1 L0 module

①. Transfer chamber

a)	Transfer chamber	1set
b)	Transfer system	1set
c)	Wafer sensor	1set
d)	Rough valve	1set
e)	Vent valve	1set
f)	Atmospheric pressure check switch	1set
g)	Pirani vacuum gauge	1set
h)	Dry pump	1set
i)	Vacuum pipe	1set

4.1.2 SMIF loader

①. SMIF loader

a)	SMIF pod stage	1set
b)	Cassette present sensor	1set
c)	SMIF pod cover lifting mechanism	1set
d)	SMIF pod with compatible 8inch wafer cassette (supplied by customer)	1set
e)	Robot arm for picking up and placing wafer cassette	1set
f)	Static-dissipative plastic windows	1set

4.1.3 L1 module

①. Cassette chamber

a)	Cassette chamber	1set
b)	Auto door	
c)	Cassette elevating mechanism	1set
d)	Wafer cassette for 8 inch wafer compatible with SMIF pod (supplied by customer)	1set
e)	Isolation valve	1set
f)	Rough valve	1set
g)	Vent valve	1set
h)	Atmospheric pressure switch	1set
i)	Pirani vacuum gauge	1set
j)	Dry pump	Shared with L0 module
k)	Vacuum pipe	1set

4.1.4 L2 module

①. Aligner

a)	Alignment chamber	1set
b)	Alignment mechanism	1set
c)	Wafer sensor	1set

4.1.5 L3 module Rev.03, Rev.04

①. Process chamber

a)	Etching chamber	1set
b)	Chamber opening and closing mechanism	1set
c)	Deposition shield (Made of aluminum, anodic oxidation treatment)	1set
d)	Deposition shield heater (Max 200°C)	1set
e)	Deposition shield glass	1set
f)	Deposition shield shutter (Made of aluminum, anodic oxidation treatment)	1set

☐ Without heating mechanism
☑ With heating mechanism (MAX200°C)

g) Plasma monitor for RF discharge confirmation 1set
h) Atmospheric pressure switch 1set
i) Pirani vacuum gauge 1set
j) Diaphragm gauge 1set
k) Cold cathode gauge 1set
l) Automatic Pressure Control (APC) valve 1set
m) Endpoint monitor 1set
☑ Without End point detector
☐ Plasma process monitor/C10346 (Option)
☐ Real Time Interferometric Process Monitor (Manual stage)(Option)
n) Isolation valve 1set
o) Rough valve 1set
p) Vent valve 1set

②. Upper electrode
a) RF power supply (1kW 13.56MHz) 1set
b) Automatic matching box (13.56MHz) 1set
c) Antenna coil 1set
d) Upper electrode Shield box 1set
e) Star electrode 1set
f) Capacitor for star electrode 1set
g) Star electrode switching mechanism 1set

③. Lower electrode
a) RF power supply 1set
☐ Maximum output 1000W (12.5MHz)
☑ Maximum output 600W (12.5MHz)
☐ Maximum output 300W (12.5MHz)
☐ Maximum output 1000W (400kHz)
b) Automatic matching box 1set
c) Lower electrode shield box 1set
d) Vpp monitor 1set
☑ Max 5kV sensor (Standard)
☐ Max 1kV sensor
e) Wafer holding system 1set
☐ Mechanical chuck
☑ Electrostatic chuck
f) Wafer hoist mechanism 1set

④. Gas system
a) Mass flow controller 4sets
b) Process gas inlet valve 4sets
c) Process gas pipe 1set

No.	Calibration gas	Max flow N_2 Gas conversion	Bypass line	Pipe heater	Max flow Actual gas
1	N_2	100			Ar：140.9
2	N_2	100			O2：98.2
3	N_2	100			N2：100
4	N_2	200			CF4：84.6

5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-

⑤. Temperature control system

a) Chiller 1set
- ☑ —20～+40°C
- ☐ +20～+90°C
- ☐ +70～+200°C

b) Circulating liquid 1set
- ☑ Galden (HT-135)(−20～+40°C)
- ☐ Galden (HT-270)(+70～+200°C)
- ☐ Other

c) Pressure flow controller 1set

d) He inlet pipe 1set

e) Regulator for He gas 1set

⑥. Exhaust system

a) Turbo molecular pump (TMP) (Heating type) 1set

b) Dry pump 1set

c) TMP fore valve (Heating type) 1set

d) Vacuum pipe 1set
- ☑ Without heating mechanism
- ☐ Customer supply

4.1.6 Others

①. Control system

a) PLC 1set

b) Touch panel monitor 1set

c) PC 1set

d) Electrical components 1set

e) Control panel (Built in Mani body) 1set

②. Compressed air

a) Filter regulator 1set

b) Compressed air piping 1set

③. Panel, Flame

a) Main flame 1set

b) Panel 1set

c) Signal tower 1set

4.2 Spare parts

4.2.1 L0 module

①. Pick up 1pc

4.2.2 L1 module

No items

4.2.3 L2 module

No items

4.2.4 L3 module Rev.03, Rev.04

①. Deposition shield glass	2pcs
②. Deposition shield (1)	2pcs
③. Deposition shield (2)	2pcs
④. Special nut	16pcs
⑤. Shutter	2pcs
⑥. 8inch electrode plate	2pcs

* Details are described in the spare parts list submitted after the design is completed.

4.3 Optional Parts

No items

4.4 Customer's Scope of Supply Rev.02, Rev.03

①. 8 inch SiO2(1000nm)/Si Wafer (Including spare) (for FAT)	25 pcs
②. 8 inch Si Wafer (Including spare) (for FAT)	25 pcs
③. 8 inch PhotoResist(1um)/Si Wafer (for etching test on demo system)	25 pcs
This item to be supplied by the start of production of the system.	
④. 8inch SMIF pod Entegris part # M200-ET2067RF2P (specified by customer)	2 pcs
⑤. 8inch 25slot cassette Entegris part # C126-1776-97C02 (specified by customer)	2 pcs
⑥. 8inch 13slot cassette Entegris part # C126-1780-97C02 (specified by customer)	2 pcs
Above items to be supplied by the start of production of the system (SMIF loader and main system)	

Please prepare the items supplied by the customer by the date specified by ULVAC. If they are delayed, which may affect the system delivery date.
(For the due date, refer to the separate list of the items supplied by the customer.)

5. UTILITY SPECIFICATION

Rev.03

Note.: This chapter is only reference because this system will be not installed at customer's plant.

5.1 Footprint (reference value)

5.1.1 Installation space

①. Main body	: W 1917mm × D 2002mm × H 2251mm
②. Control rack	: W 600mm × D 1000mm × H 2202mm
③. Dry pump for L3 module	: W 370mm × D 770mm × H 453mm (EV-M20N)
④. Dry pump for L0 module	: W 230mm × D 450mm × H 274mm (EV-S20P)
⑤. Chiller for L3 module	: W 380mm × D 870mm × H 950mm (HRZ-010)

* Maintenance area is not included.
* The values listed above are reference values. The final values can be confirmed on the final drawing separately provided after design is completed after order placement.

5.1.2 Weight

①. System	Approx. 1300kg	Rev.02
②. Control rack	Approx. 230kg	Rev.02
③. Dry pump	Approx. 170kg (EV-M20N)	
	Approx. 60kg (EV-S20P)	

④. Chiller Approx. 200kg (HRZ010) Rev.02

* The values listed above are reference values. The final values can be confirmed on the final drawing separately provided after design is completed after order placement.

<Precautions> Dispersion plate
Dispersion plates, etc for load distribution are not included in this system and auxiliary equipment. Please contact ULVAC if you need dispersion plates due to the environment in which the system is installed.

5.2 Usage Environment

This system will work properly in the following environment.

Incoming AC supply	Voltage state voltage 0.9 times to 1.1 times of nominal voltage Frequency: 0.99 times to 1.01 times of nominal frequency continuously or 0.98 times to 1.02 times short time
Ambient air temperature	Temperatures between +20℃ and +35℃
Humidity	humidity does not exceed 50% at a maximum temperature of + 35℃ (with no dew condensation)
Altitude	1000m or less above sea level
Contaminants	Pollution Degree 2 or better
Liquids	System shall NOT be used under the circumstance that water will drip on the system
Radiation	Place not affected by radiation
Vibration	Place where there are no objects that vibrate around.
Transportation and storage A short time(24Hr)	Storage temperatures within a range of +5℃ to +40℃. +40℃
Overvoltage category	Category II

5.3 Safety Interlock

Gemini-200E prepares following three (3) interlocks.
Level A : The same function as EMO, No alarm happens
Level B : All process gas stop, Process stops, all units stop, The system alarm happens.
Level C : Process stops, Evacuation by TMP and dry pumps continue, The system alarm happens

Connect the signals as follows, please.

The alarm from Gas treatment system (Critical situation) should be connected to Level B

The warning from Gas treatment system (Not critical situation) and Gas leakage signal from gas detector should be connected to Level C

5.4 Utility list

Type	Usage	Usage amount/ Usage pressure	Connection	Condition	
Electricity	Motive power	3φ 200V±10V(3W+G) 60Hz Approx. 26KVA	M8	Type A Grounding : M8	Rev.02
Cooling water	DRP for L0(L1) module	Supply: 0.2 to 0.4MPaG Back pressure: 0.05MPaG or lower Differential Pressure: 0.2MPa or higher Flow rate: 1.5 to 3.0 L/min	Water supply: Rc1/4” Water drain: Rc1/4”	Gauge pressure Cooling water temperature: 20 to 30°C No regulator is attached to the system	
	DRP for L3 module	Supply: 0.2 to 0.3MPaG Back pressure: 0.05MPaG or lower Differential Pressure: 0.2MPa or higher Flow rate: 3.0 to 8.0 L/min	Water supply: Rc3/8” Water drain: Rc3/8”	Gauge pressure Cooling water temperature: 20 to 30°C No regulator is attached to the system	
	Chiller For L3 module	Supply: 0.35 to 0.70MPaG Back pressure: 0.05MPaG or lower Differential Pressure: 0.3MPa or higher Flow rate: 15 L/min	Water supply: Rc1/2” Water drain: Rc1/2”	Gauge pressure Cooling water temperature: 10 to 25°C No regulator is attached to the system	Rev.02
Compressed air	Pneumatic drive	0.6 to 0.9MPaG, some amounts Maximum compressed air usage: 38.9Nm3/Hr	Φ8mm Push in joint	Gauge pressure Regulator is attached to the system	
Dry air	Lower shield box (Condensation prevention)	0.02 to 0.03MPaG 15 to 20L/min Dew point : -40°C or lower	Φ8mm Push in joint	Gauge pressure No regulator is attached to the system	
N2 gas	System vent	0.2 to 0.4MPaG	1/4” UJR (male)	Gauge pressure No regulator is attached	
	DRP for L0(L1) module	0.15 to 0.70MPaG Flow rate : 15 L/min	1/4” Swagelok	Gauge pressure Regulator is attached	
	DRP for L3 module	0.15 to 0.70MPaG Flow rate : 45 L/min	1/4” Swagelok	Gauge pressure Regulator is attached	
He gas	Wafer Temperature control	0.1 to 0.4MPaG	1/4” UJR (male)	Gauge pressure Regulator is attached*1	Rev.02
Process gas	Process gas for L3 module	0.05 to 0.10MPaG	1/4” UJR (female)	Gauge pressure No regulator is attached	

Type	Usage	Usage amount/ Usage pressure	Connection	Condition	
Exhaust	Pump exhaust L0(L1) DRP	1.0m^3/min or higher	KF25	Connect to the acid exhaust duct.	Rev.02
	Pump exhaust L3 DRP	1.0 m^3/min or higher	KF40	Connect to the detoxification processing exhaust duct.	
	Pump heat exhaust L0(L1) DRP	1.0 m^3/min or higher	Φ50mm pipe end	Connect to the heat exhaust duct.	Rev.02
	Pump heat exhaust L3 DRP	1.0 m^3/min or higher	Φ50mm pipe end	Connect to the heat exhaust duct.	

	Gas box exhaust for L3 module	1.0 m^3/min or higher	Φ60.5mm pipe end	Hazardous gas treatment equipment to be connected
	Maintenance exhaust	1.0 m^3/min or higher	Φ63.5mm pipe end	Connect to the acid exhaust line.
	Chiller heat exhaust L3	2.0 m^3/min or higher	Φ114.3mm pipe end	Connect to the heat exhaust duct.
	Air (CDA) exhaust	back pressure less than atmosphere	Φ8mm Push in joint	Connect to the general exhaust duct.

Rev.02

The values listed above are reference values. The final values can be confirmed on the final drawing separately provided after design is completed after order placement.

When using chlorine gas, connect the duct to the acid exhaust.

Maintenance duct is required when using chlorine-based gas. Do not install a gas detector at the connection destination of the maintenance duct.

A nylon tube is used for He piping. The acceptance standard value for the amount of leakage from the He pipe due to the permeation of the thin flex tube is set at 6.67 x 10-3 MPa / h.

Power supply and gas supply are on the top of the machine. For details, refer to "Device external view".

If there is a risk that the equipment installation location will be extremely low, high, or humid, please indicate so before making a contract. We will consider countermeasures, but if there are some devices that cannot be used depending on the conditions, the estimated price may differ.

For equipment that requires cooling water, prepare water quality that meets the water quality standards of the "cooling water system" of the Water Quality Guidelines for Refrigerating and Air-Conditioning Equipment (JRA-GL-02-1994: Japan Refrigerating and Air-Conditioning Industry Association).
(Must meet the following water quality standards)

(Based on JRA-GL-02-1994) * Circulating water standard

LIST		Cooling Water
Baseline Item	pH(25 deg C)	6.5 to 8.2
	Electrical Conductivity (μS/cm) Resistivity (kΩ・cm)	10 to 800 1.25 to 100
	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

5.5 Earthing

①. Type-A grounding work (No. 1 type earth: Earth with grounding resistance of 10Ω or lower) is required.
According to "Laws for Electrical Engineering and Electrical Facility Management," this system is classified as high-voltage equipment, Type-A grounding work must be conducted for safety.
②. Type-D grounding work (No. 3 type earth: Earth with grounding resistance of 100Ω or lower) is required.

5.6 Installation environment

①. If the installation area has possibility of getting extremely cold or hot, please provide such information before signing the contract.
②. ULVAC will examine the countermeasures; however, some components cannot be used under a certain condition. In this case, quotation amount may be changed.
③. Please contact ULVAC regarding the connecting sections of the partitions.
④. When organic material is used, it may scatter around the system during maintenance.
⑤. Countermeasures to this issue is not included in this quotation and shall be taken by the customer.

6. SAFETY

6.1 Standards

Rev.02

This system complies with the following regulations.

① S-mark third party authentication

② KCs autonomous (Robot)

This system incorporates the contents of bellow check sheet agreed with the factory where the system is installed.

① "장비안전평가 Check Sheet_r6.0_v0.1_v0.1_20220107ULVAC 回答.xlsx"

* Please contact ULVAC in advance if you need to comply with the customer's safety standards. Otherwise, ULVAC will make a separate quotation and charge a fee for the items not informed in advance.

6.2 Safety measures (excerpts of major parts only)

6.2.1 Emergency stop

An emergency stop button is provided on this system and the control panel at intervals of approx. 3 meters. When this emergency button is pressed, all electrical systems stop.

6.2.2 High voltage section

The energized section exceeding 24V is covered with a panel, etc. so that it cannot be easily touched.

6.2.3 High-temperature section

The high-temperature section exceeding 60°C is covered with a panel, etc. so that it cannot be easily touched.

6.2.4 Movable section

The movable section is covered with a panel, etc. so that it cannot be easily touched.

6.2.5 Electrical leakage measures

All electrical systems are stopped by an earth leakage breaker in case of an electrical leakage.

6.2.6 Other control system

Control system is designed as to be operated with 24 VDC or lower.
(All breakers excluding the main breaker are installed in the power supply panel.)

6.3 Unit protection (excerpts of major parts only)

6.3.1 Unit that requires cooling water

The unit cannot be activated when amount of cooling water is lower than the specified flow rate.
(ex. dry pump, turbo molecular pump, cryo compressor, etc.)

6.3.2 Action in case of power failure or water outage

In case of power failure or water outage, the pumps stop and the valves close.
(The door valves remain in a condition right before the power failure or water outage occurred.)
This system does not recover automatically, and manual startup is necessary.

6.3.3 Compressed air

When compressed air pressure is insufficient, the system cannot start.

6.3.4 Power supply

Each power supply can be safely turned ON under the determined conditions only.
For example, the sputtering power supply can be turned ON only when the sputtering chamber is in a vacuum and the process gas is flowing.