



Plasma Dry Cleaner

PDC610

Instruction Manual

First version

Thank you for your selecting Yamato Scientific's "plasma dry cleaner".

To ensure proper handling of the machine, please read this instruction manual and the warranty thoroughly. After reading the manual, please keep it together with the warranty in a safe place where it is available any time necessary.



WARNING: Prior to using the product, carefully read all warning instructions contained in the manual and understand them fully.

YAMATO SCIENTIFIC CO., LTD.

This paper has been printed on recycled paper.

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1. Safety precautions

Description of Warning Symbols

About pictograms

A variety of pictograms are indicated in this operating instruction and on products for safe operation. Possible results from improper operation ignoring them are as follows.

Be sure to fully understand the descriptions below before proceeding to the text.

-
- | | | |
|---|----------------|--|
|  | Warning | Indicates a situation which may result in death or serious injury (Note 1.) |
|  | Caution | Indicates a situation which may result in minor injury (Note 2) and property damages (Note 3.) |
-

(Note 1) Serious injury means a wound, an electrical shock, a bone fracture or intoxication that may leave after effects or require hospitalization or outpatient visits for a long time.

(Note 2) Minor injury means a wound or an electrical shock that does not require hospitalization or outpatient visits for a long time.

(Note 3) Property damage means damage to facilities, devices and buildings or other properties.

Meanings of pictograms



This pictogram indicates a matter that encourages the user to adhere to warning ("caution" included).
Specific description of warning is indicated near this pictogram.



This pictogram indicates prohibitions
Specific prohibition is indicated near this pictogram.



This pictogram indicates matters that the user must perform
Specific instruction is indicated near this pictogram.

1. Safety precautions

A List of Symbols

Warning



General warnings



Danger!: High voltage



Danger!: High temperature



Danger!: Moving part



Danger!: Hazard of explosion

Caution



General cautions



Electrical shock!



Burning!

Prohibitions



General bans



Do not disassemble



Do not touch

Compulsions



General compulsions



Connect ground wire



Install levelly



Pull out the power plug



Periodical inspection

1. Safety precautions

Warning and Caution



Warning

1. Never use the machine in atmosphere containing ignitable and explosive gases.



Never use the machine in atmosphere containing ignitable and explosive gases. The machine is not of explosion-proof construction. Turning on and off the switches and operating the machine will produce sparks, which may become a cause of a fire or explosion. (See "List of Hazardous Substances.")

2. Never use explosive and flammable substances.



Never use explosive and flammable substances and substances containing such substances. The machine is not equipped with safety features against such substances. They are a cause of explosion and fire.

3. Never use the machine in abnormal conditions.



If you notice smoke, offensive odor or other problems, immediately turn off the circuit breaker of the machine and also turn off the power of the distribution panel on the building side. They are a cause of a fire and electric shock.

4. Never disassemble or modify the machine.



The machine must not be disassembled or modified by the user. Unauthorized disassembly and modification are a cause of failure, fire, electric shock and other accidents.

5. Handling of the power cords.



Do not use bundled power cords. Such a way of use may cause the cords to overheat to cause a fire.
Do not machine power cords or bend, twist or pull them by undue force. Hazard of a fire and electric shock.
Do not damage power cords by for example placing them under a desk or chair or clamping them by devices. Hazard of a fire and electric shock.
Do not bring power cords near heating devices such as a heater. The coating of the cords will be burnt to cause a fire or electric shock.
If a power cord is damaged (core wires exposed or broken), immediately turn off the power of the machine and also turn off the source power supply. Then request the dealer for replacement of the cord. If such damaged cords are used, a fire or electric shock may result.
Use only one power cord. Never join two or more power cords.
Depending on the connecting method, screws may be loosened and cause a fire or an electrical shock.

6. Be sure to use the specified reaction gas.



Be sure to use the specified processing gas (argon gas, oxygen optional). If other gas is used, the actual flow rate becomes different from the indicated flow rate. Also other problems such as damage to products and insufficient cleaning may happen.

2. Before operating the unit

Precautions for Installation



Warning

1. Be sure to connect the ground wire.



- To prevent electric shock accidents due to fault current, be sure to connect the ground wire to the ground terminal on the building side. This machine falls in the category of Class D Ground Work.
- Never connect the ground wire to a gas pipe, water pipe, ground wire of a telephone or lightning conductor. Hazard of a fire and electric shock.

2. Select a suitable installation site.



Do not install the machine in the following places:

- An unstable place.
- A place where flammable or corrosive gas is produced.
- A place where ambient temperature rises above 35°C.
- A place where temperature changes largely.
- A place filled with dust or a humid place.
- A place under direct sunlight.
- A place that is subjected to vibrations.

3. Install the machine on a level foundation.



Install the machine on a level foundation. If the machine is not in contact with the floor uniformly, vibration and noise may be produced. Also unexpected troubles or failures may occur.

4. Use a suitable distribution panel.



Use a distribution panel that is suitable for the electric rating of the machine.

Electric rating: 3-phase, 200 VAC (Differ depending on the region. See page 19.), 15 A, 50/60 Hz

If the capacity is insufficient or the machine is used on a line to which other equipment is connected, the machine may not function properly or the circuit breaker in the distribution panel may operate.

3. MAIN APPLICATIONS

Applications

Applications

The unit is used to plasma-process work pieces to modify their surfaces or to clean them.
The unit has two modes (RIE and DP) to support various applications.

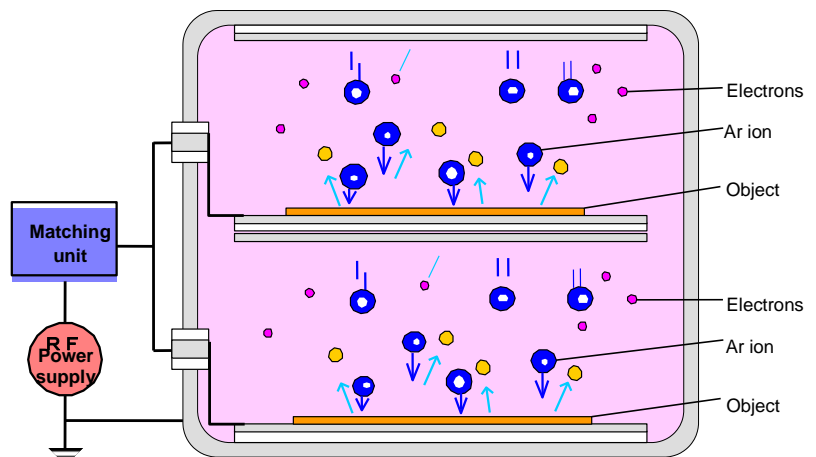
Application of the RIE mode

This mode is used to clean objects whose soil contains inorganic matters as well as organic ones, or to modify surfaces.

When Ar gas plasma process is performed in the RIE mode, the surface of a work piece put on the electrode surface will be cleaned with physical action caused by ions accelerated toward it and hit against it, which is the main feature of this mode. (Because the work piece on the electrode is processed with Ar ions hit from the above, only its top surface will be processed. The range in which Ar gas is accelerated is several millimeters above the electrode.)

<Examples of applications>

- Improving adhesiveness and surface modification of different materials
- Light etching process
- Preprocessing of implementation board bonding
- Preprocessing of plastic package
- Preprocessing of print board plating
- Processing of part for LED related markets
- Cleaning of electronic parts
- Cleaning of optical parts, dies, machine parts and other precision parts
- Modification of fluoride or other resin surfaces



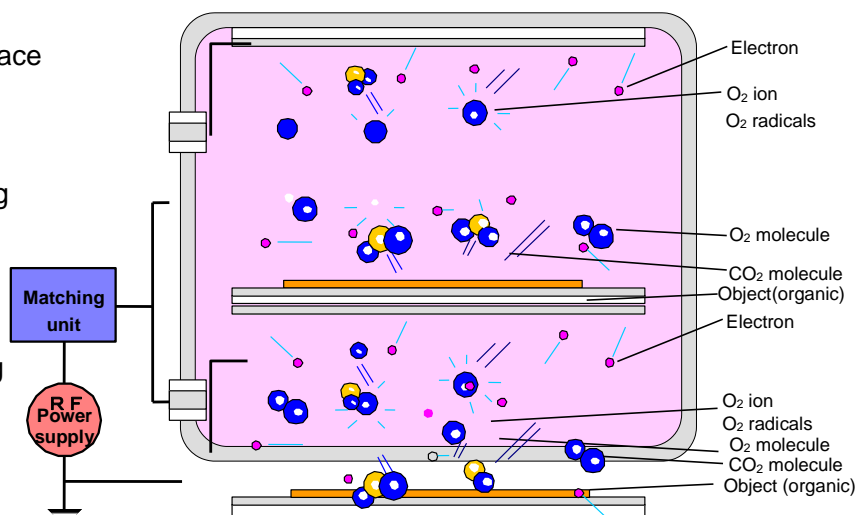
Application of the DP mode

This mode is used to clean objects whose soil contains organic ones, or to modify surfaces.

When O₂ gas plasma process is conducted in the DP mode, O₂ plasma acts to organic matters on the surface of the object, then those organic matters and O₂ radicals will be converted chemically in vacuum to clean the surface. Because O₂ ions and O₂ radicals in the plasma spread non-directionally between the electrodes in the DP mode, the whole surface of the work piece between the electrodes and that contacts the plasma will be processed.

<Examples of applications>

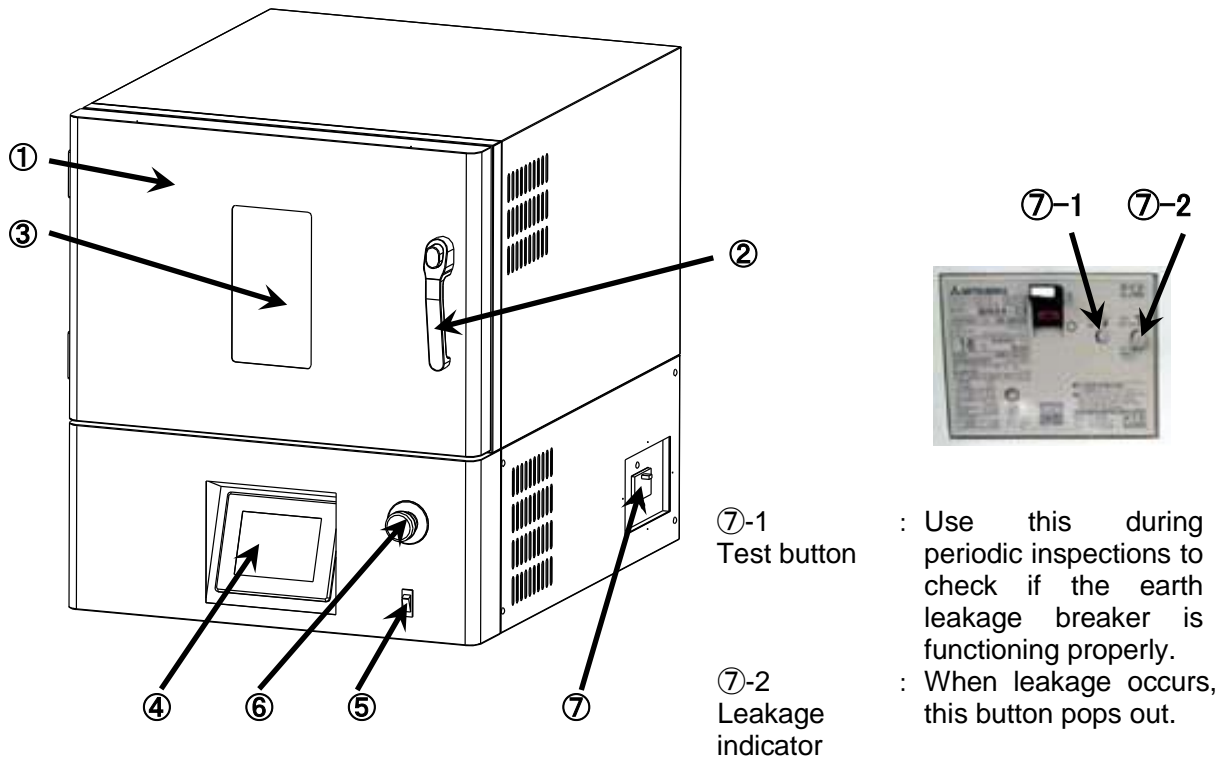
- Improving adhesiveness and surface modification of different materials
- Light ashing process
- Preprocessing of plastic package
- Preprocessing of print board plating
- Cleaning of electronic parts
- Cleaning of optical parts, dies, machine parts and other precision parts
- Peeling off of resists or removing residue after wetting process
- Modification of resin surfaces



4. COMPONENTS AND FUNCTIONS

Main Unit

Front of the machine

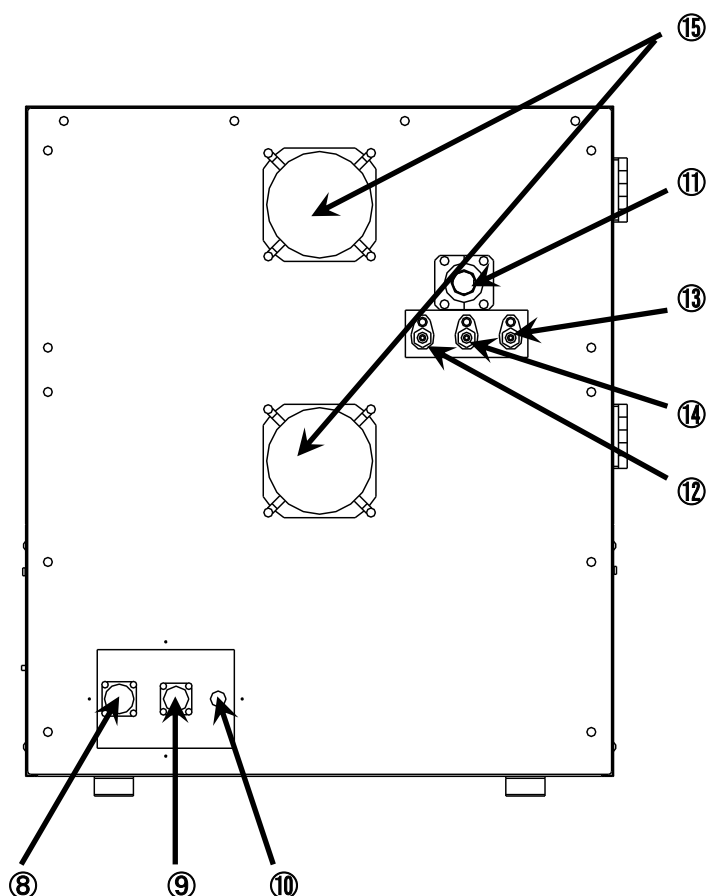


- ① Door : This door is manually opened sideways.
- ② Grip : Used to open and close the door.
- ③ Check window : This window is used to check plasma status.
- ④ Touch panel : Used to operate various keys and show various information.
- ⑤ Operation power switch : When this button is pressed, electricity is applied to the touch panel and other parts of the machine to set the machine ready to run.
- ⑥ Emergency stop switch : Press this button when an emergency situation occurs. When this button is pressed, the RF power, vacuum pump and operation panel power are turned off. To reset the button, turn it in the arrow direction.
- ⑦ Earth leakage breaker : When this breaker is turned on, electricity is applied to the machine. If leakage exceeding 30 mA or overcurrent exceeding 16 A flows, it cuts off the current to protect the machine.

4. COMPONENTS AND FUNCTIONS

Back of the Main Unit

Back of the main unit



- | | |
|--|---|
| ⑧ Connector for power cord | : Connect this to the distribution panel on the building side. (A 3-m cord is attached for connection.) |
| ⑨ Connector for vacuum pump | : Connect the cable from the vacuum pump. |
| ⑩ Ground terminal | : Use this to ground the machine by a line other than the attached power cord or to ground measuring instruments. |
| ⑪ Vacuum nozzle | : Connect the vacuum pump with the attached flexible tube. |
| ⑫ Nitrogen (N ₂) gas connector | : Connect piping from the N ₂ gas cylinder. Adjust the pressure to the range of 0.2 MPa to 0.3 MPa. |
| ⑬ Argon (Ar) gas connector | : Connect piping from the Ar gas cylinder. Adjust the pressure to the range of 0.15 MPa to 0.2 MPa. |
| ⑭ Oxygen (O ₂) gas connector | : Connect piping from the O ₂ gas cylinder. Adjust the pressure to the range of 0.15 MPa to 0.2 MPa |
| ⑮ Cooling fan | : Cools the inside of the enclosure. Provide a space of more than 10 cm around the enclosure so that the airflow will not be disturbed. |

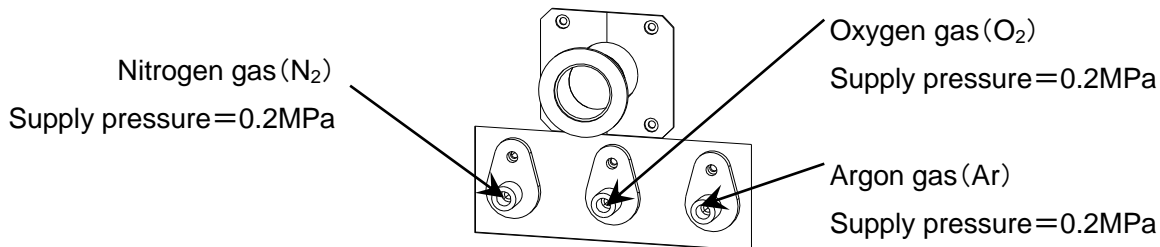
5. INSTALLATION METHOD

Required Equipment / Methods to Connect Cables and Tubes

1) Gas piping

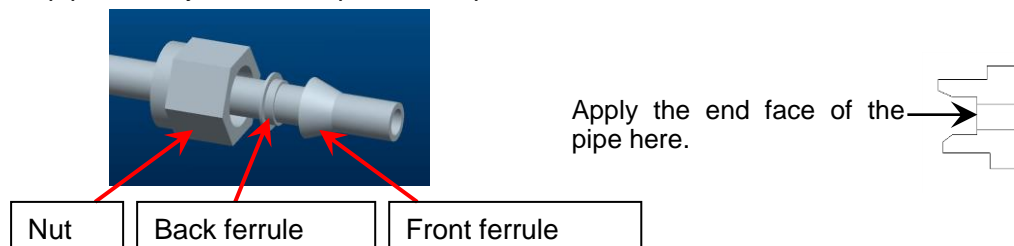
Gas piping up to the machine must be provided by the user. Connect piping to the gas supply ports on the back of the machine and supply gases at the specified pressures. Use the included 1/4-inch flare-less joints (attached in the coupling portion on rear side) to connect the machine and the piping and tighten them as described below.

(1) Gas supply nozzle locations and supply pressures



(2) Flare-less joint tightening procedure

- ① Pass a nut, back ferrule and front ferrule(attached in the coupling portion on rear side) to the pipe.
- ② Insert the pipe to the joint to the specified depth.



- ③ Tighten the nut strongly with fingers.
Exercise care so that the pipe will not be bent to become resistance.
- ④ Using a wrench, tighten the nut one turn and a quarter from the finger-tightened point.



The left side figure shows the correctly tightened pipe.

2) Electricity connection and supply

The wiring from the building side distribution panel to the machine must be laid by the user. The machine requires an electric capacity of 3-phase, 200 VAC (differ depending on the region. See page 19), 15 A or more. Connect the red, white and black cables to the R, S and T phases respectively. **The green cable is for grounding. Connect it to the terminal of Class D Ground Work.**

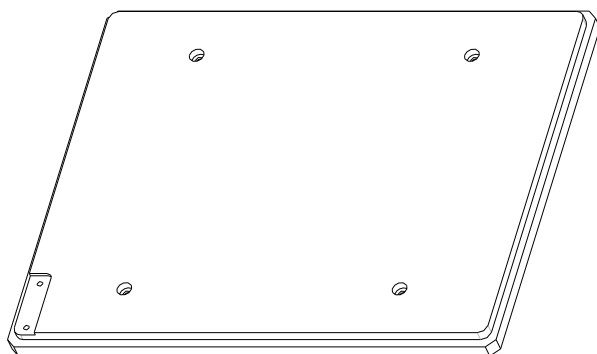
3) Vacuum pump

Install the vacuum pump by the following procedure:

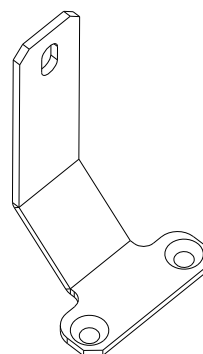
- ① Referring to the attached vacuum pump instruction manual, fill oil to the vacuum pump.
- ② Place the vacuum pump on a horizontal floor or sturdy table.
- ③ Connect the power cable for vacuum pump to the vacuum pump connector of the machine.
- ④ Install the oil mist filter on the vacuum pump using a clamp.
- ⑤ Cap the suction port of the vacuum pump and turn on the switch on the operation panel momentarily. When the cap is sucked, the pump is running in the correct direction. If the cap is blown out, it is running in a reverse direction.
- ⑥ If the pump runs in a reverse direction, exchange two out of three power cables connected to the distribution panel.
- ⑦ Connect the nozzle and the vacuum pump with the included flexible tube and NW25 clamp.

6. INSTALLING ELECTRODES

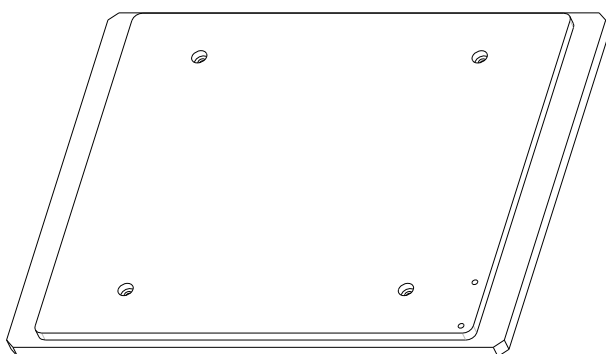
List of electrode related accessories



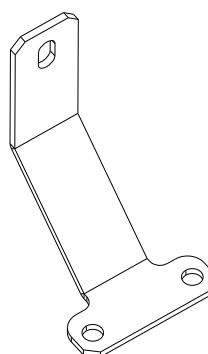
① Lower electrode x 1



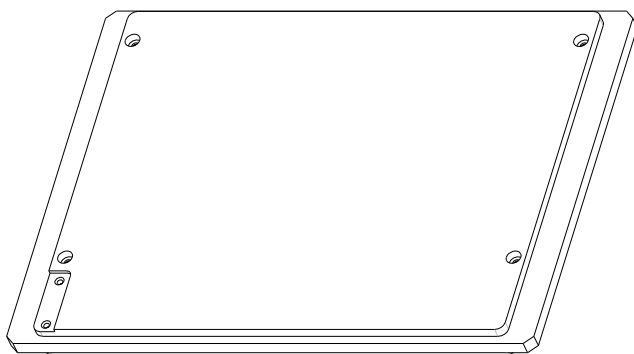
② Lower electrode fixing clamp



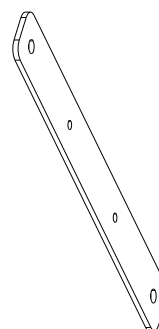
③ Upper electrode x 1



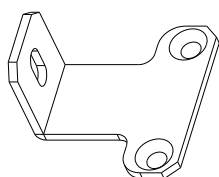
④ Upper electrode fixing clamp



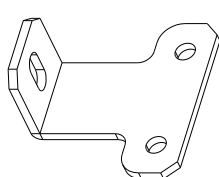
⑤ Shelf board electrode x 2



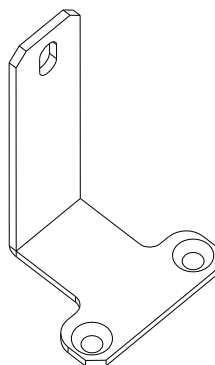
⑥ Feed through connecting plate
(used for three-stage configuration)



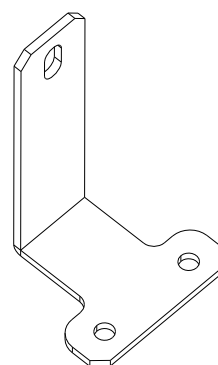
⑩ RIE fixing clamp for shelf board electrode (used for 3-stage configuration)



⑨ DP fixing clamp for shelf board electrode (used for 3-stage configuration)



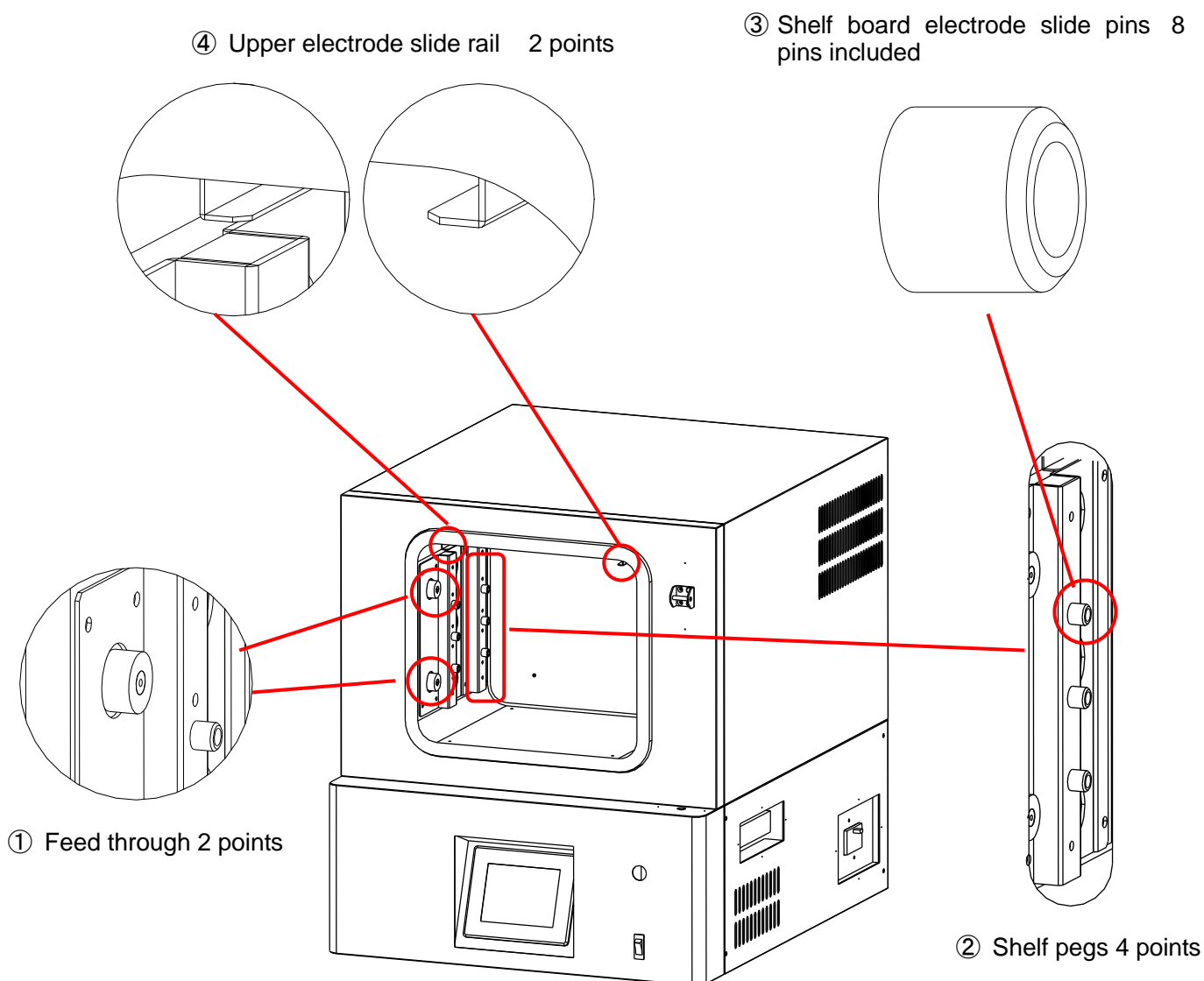
⑧ RIE fixing clamp for shelf board electrode (used for 2-stage configuration)



⑦ DP fixing clamp for shelf board electrode (used for 2-stage configuration)

6. INSTALLING ELECTRODES

Internal structure and of the chamber and parts names



- | | |
|-----------------------------------|--|
| ① Feed through | : High frequency wave is supplied here. |
| ② Shelf peg | : Cable from the vacuum pump is connected here. |
| ③ Shelf board electrode slide pin | : This is used when earthing from a source other than the included power cord or for earthing measuring devices. |
| ④ Upper electrode slide rail | : Connected to the vacuum pump with the included flexible tube. |

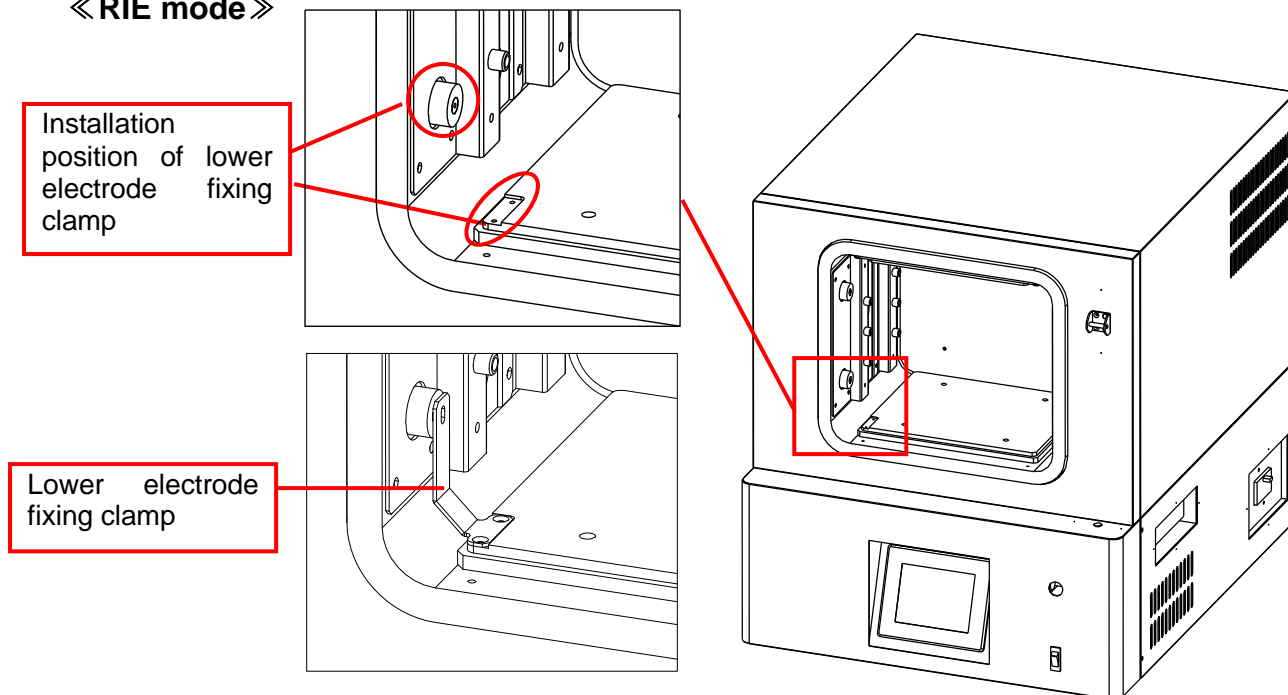
6. INSTALLING ELECTRODES

When one-stage electrode is used

Installing electrodes

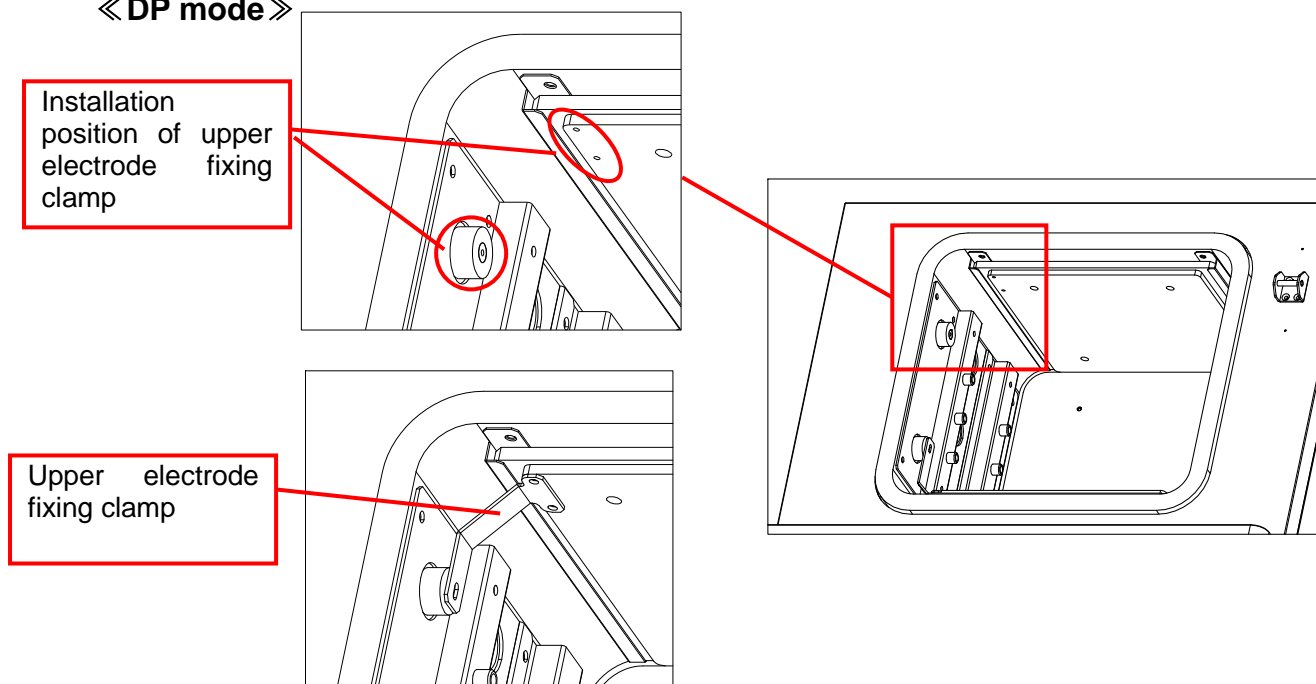
- i) Insert the upper electrode into the slide rail.
- ii) Install the lower electrode onto the bottom of the chamber.

« RIE mode »



- ※ Connect the feed through and the lower electrode with the lower electrode fixing clamp. (Flat head screw M4×5, truss screws M4×6)
At this time, install M4×6 truss screws (included) to the screw points of the upper feed through that is not used.

« DP mode »

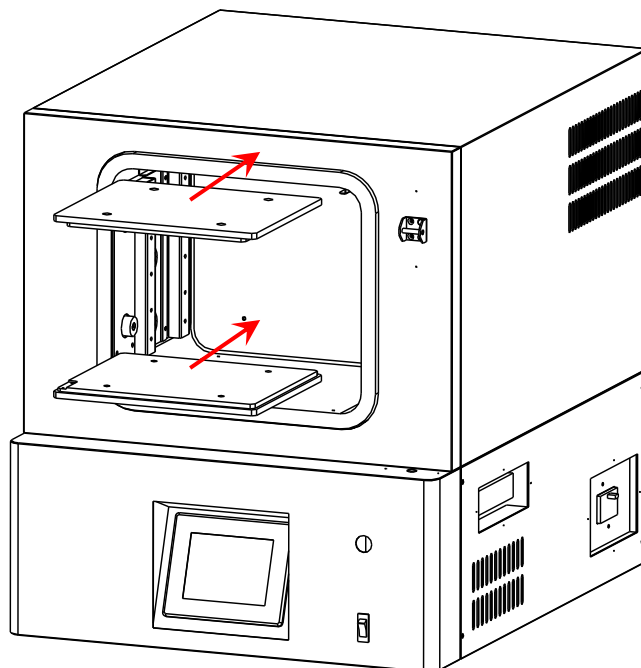


- ※ Connect the feed through and the upper electrode with the upper electrode fixing clamp. (Truss screw M4×6)
At this time, install M4×6 truss screws (included) to the screw points of the lower feed through that is not used.

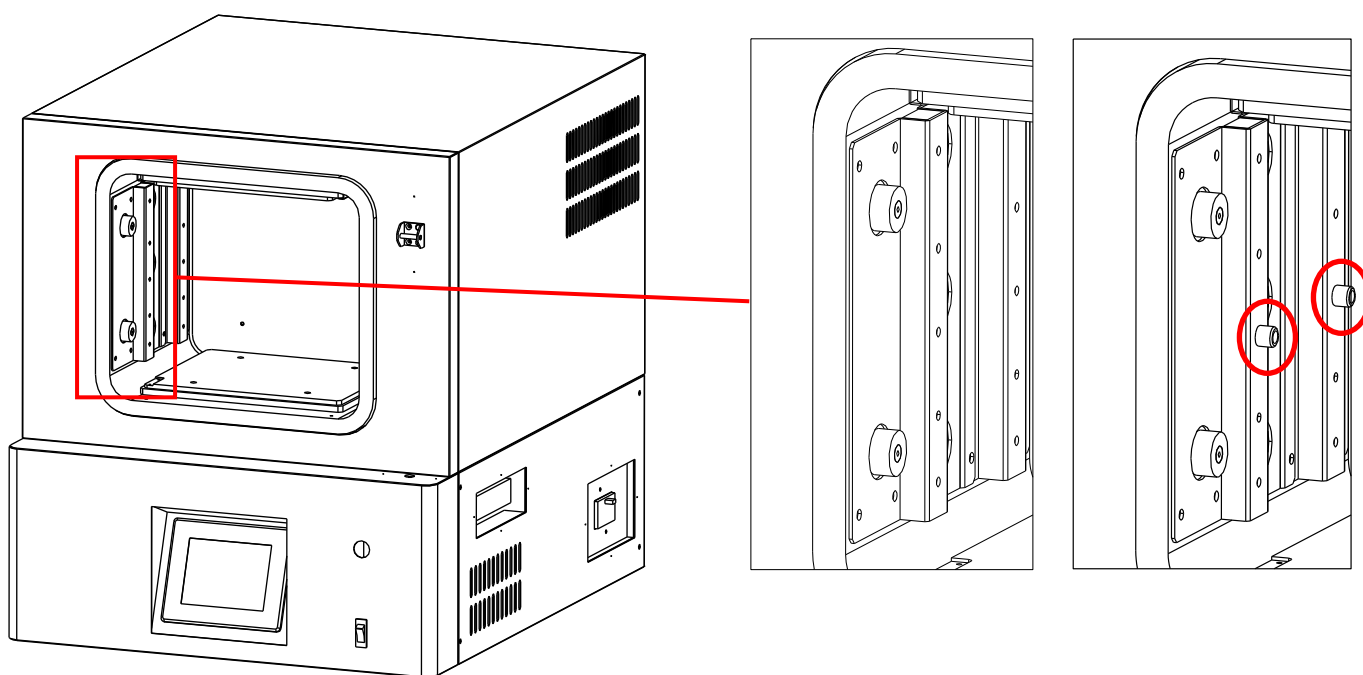
6. INSTALLING ELECTRODES

When 2-stage electrode is used (installation of electrodes)

- i) Insert the upper electrode into the slide rail.
- ii) Install the lower electrode onto the bottom of the chamber.



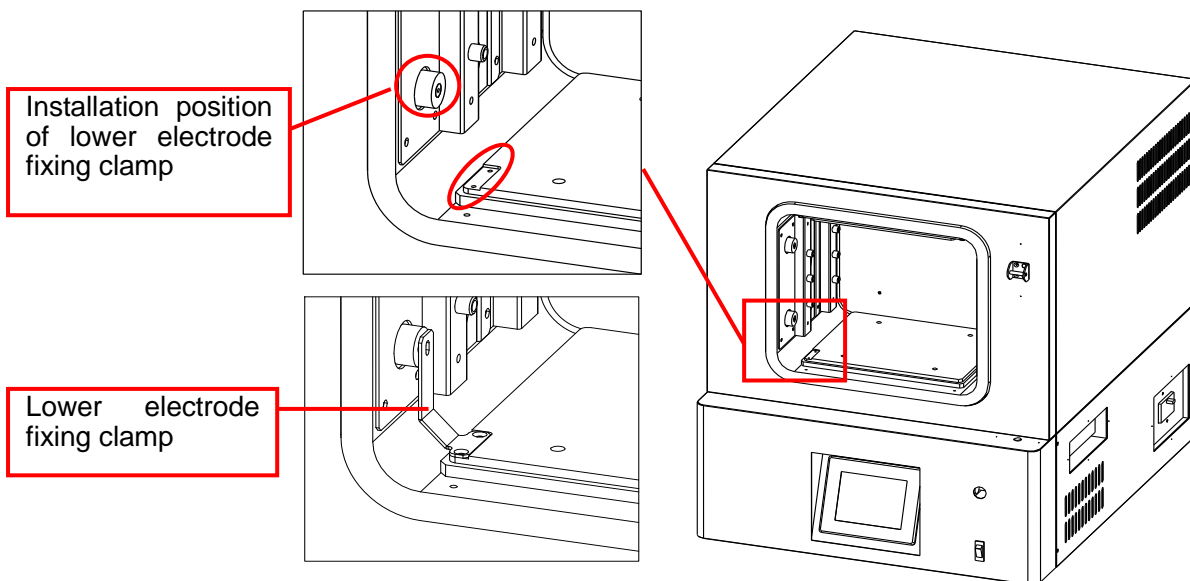
- iii) Install shelf board electrode slide pins into the screw holes in the middle of each of shelf pegs. (CAP bolts M4×10) (Right/left Four points in total)



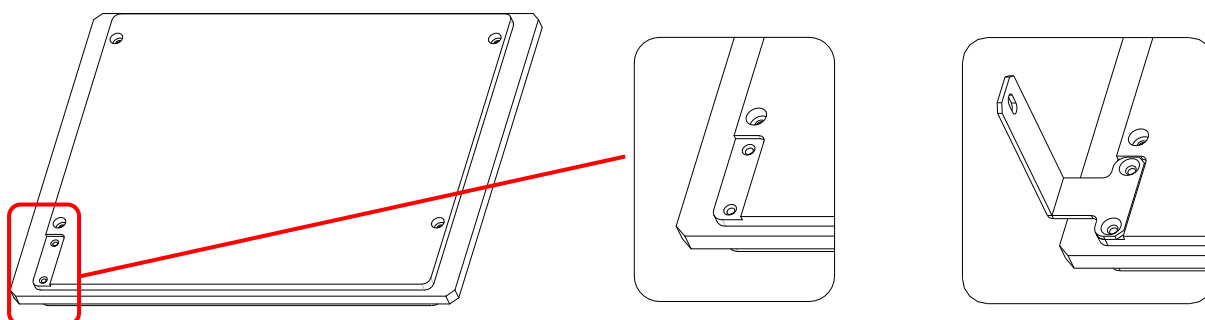
6. INSTALLING ELECTRODES

When 2-stage electrode is used (RIE mode)

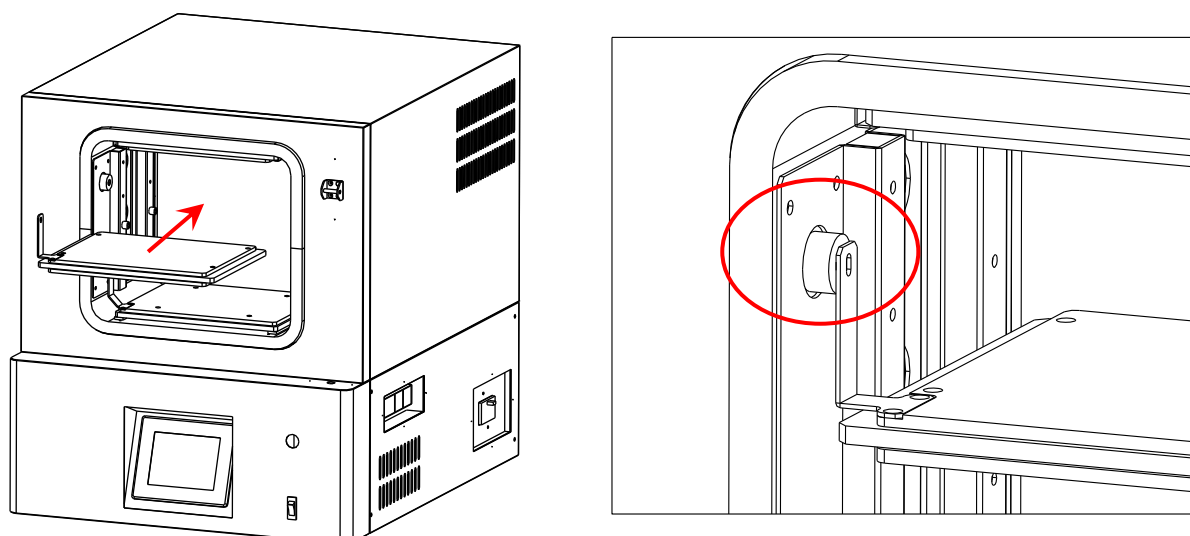
- ① Connect the feed through and the lower electrode with the lower electrode fixing clamp. (Flat head screws M4×5, truss screws M4×6)



- ② Install the RIE fixing clamp for shelf board electrode at the point of the shelf board electrode shown in the diagram below. (Flat head screw M4×5)



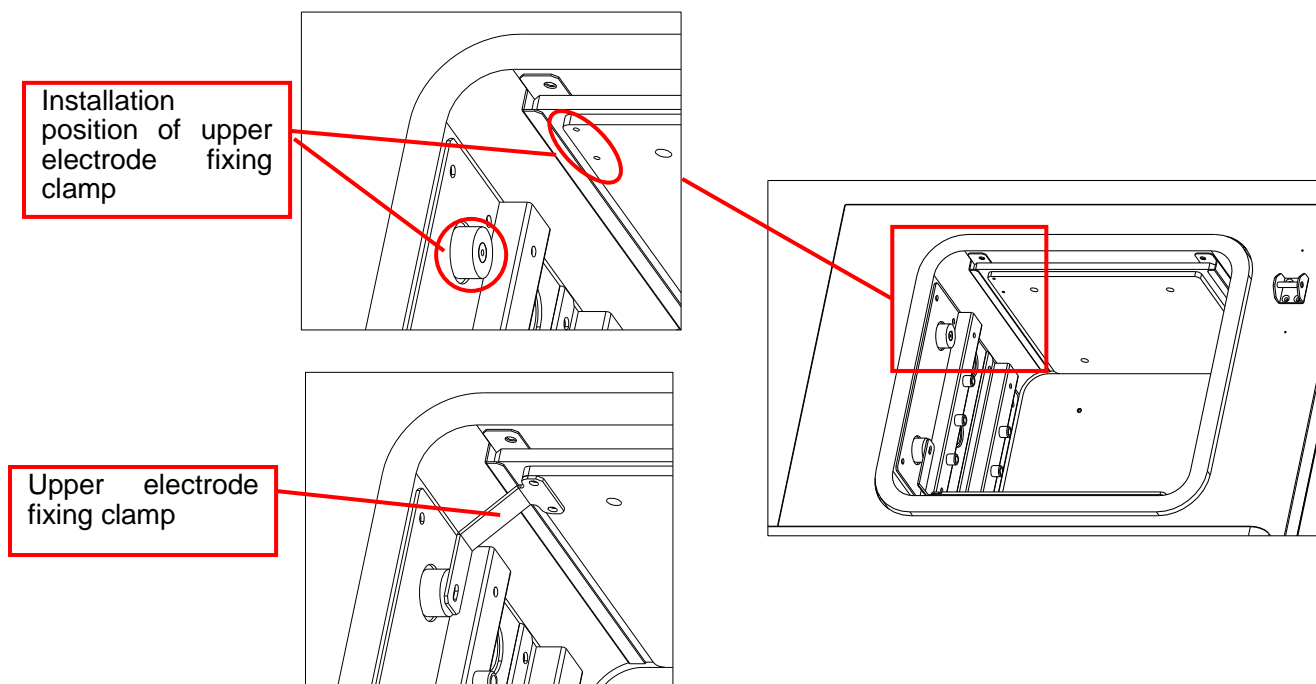
- ③ Insert the shelf board electrode into the chamber and connect the feed through and the RIE fixing clamp for the shelf board electrode. (Truss screw M4×6)



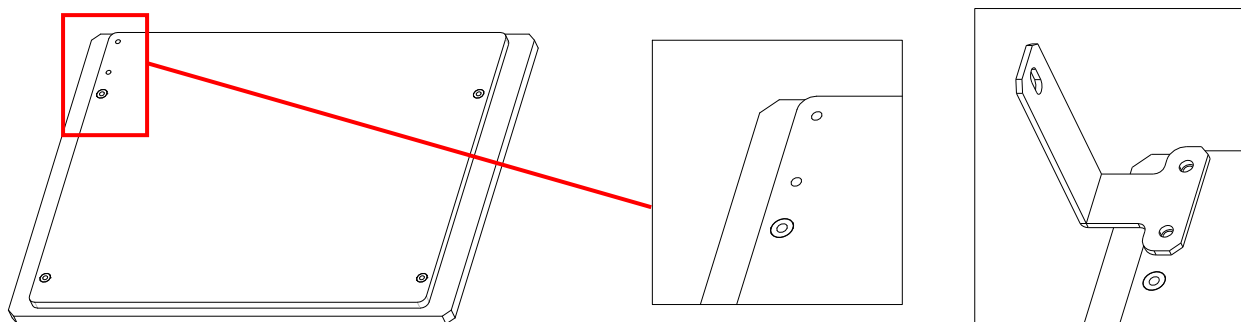
6. INSTALLING ELECTRODES

When 2-stage electrode is used (DP mode)

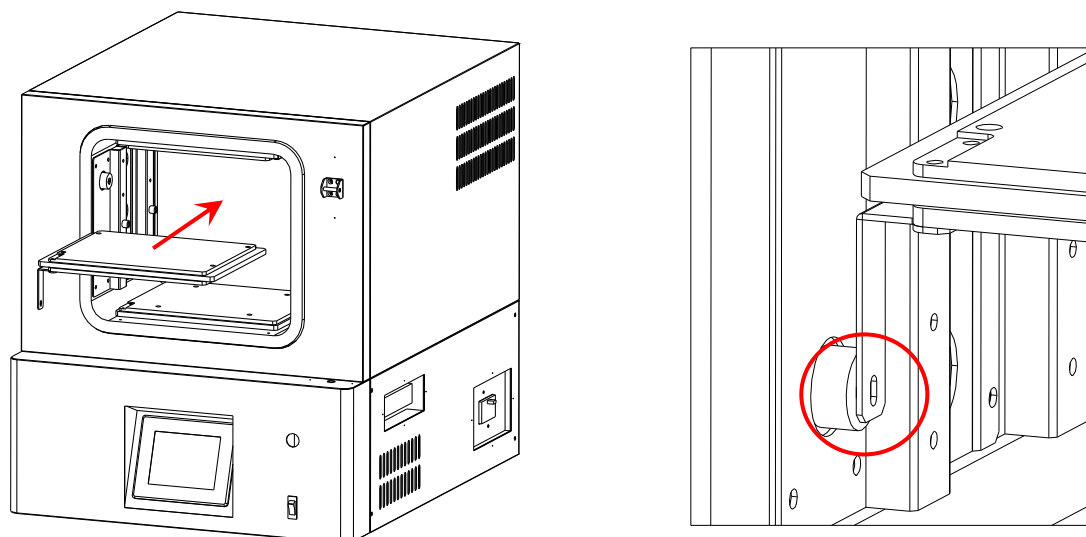
- ① Connect the feed through and the upper electrode with the upper electrode fixing clamp. (Truss screws M4×6)



- ② Install the DP fixing clamp for shelf board electrode at the point of the shelf board electrode shown in the diagram below. (Truss screw M4×6)



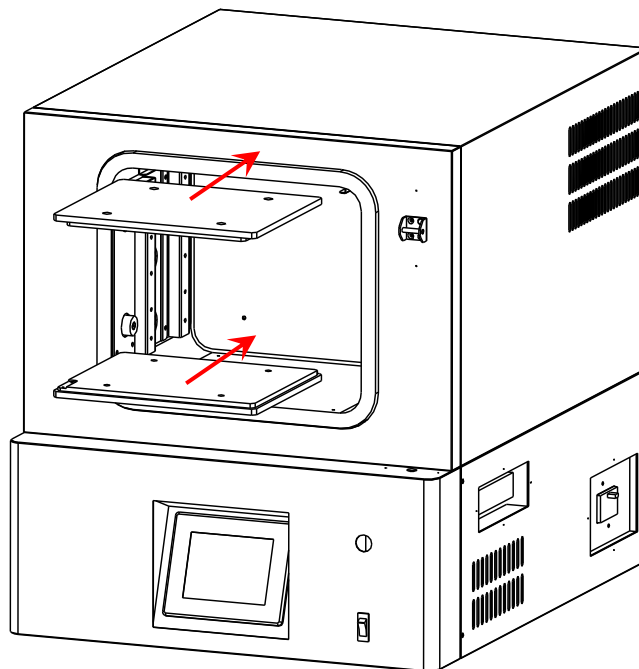
- ③ Insert the shelf board electrode into the chamber and connect the feed through and the RIE fixing clamp for the shelf board electrode. (Truss screws M4×6)



6. INSTALLING ELECTRODES

When 3-stage electrode is used (installation of electrodes)

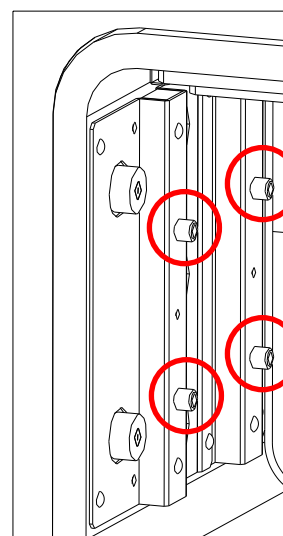
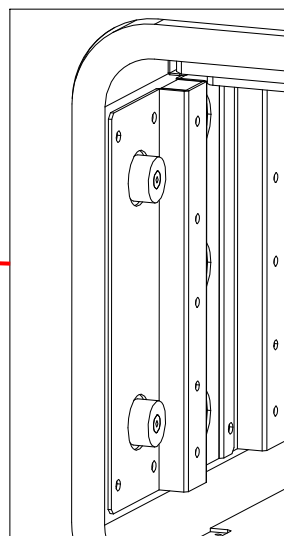
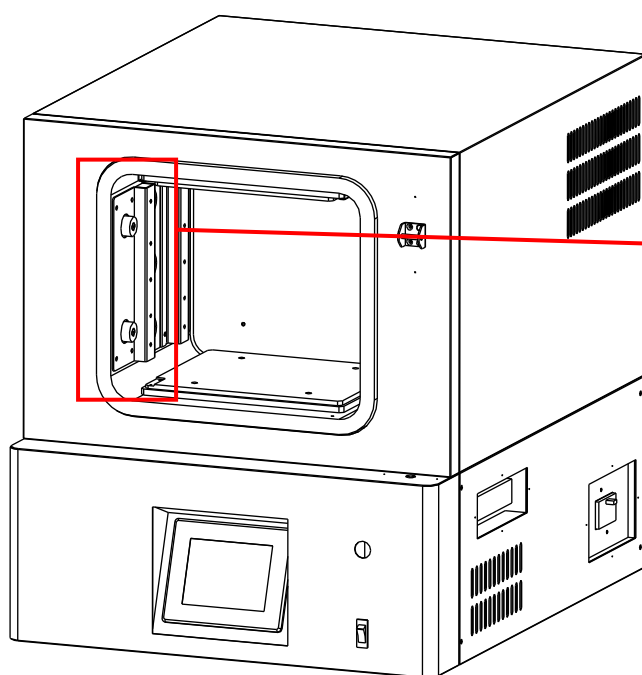
- i) Insert the upper electrode into the slide rail.
- ii) Install the lower electrode onto the bottom of the chamber.



- iii) Install shelf board electrode slide pins into upper and lower screw holes on each of shelf pegs. (CAP bolts M4×10)

At this time, install truss screws (M4×6) to those unused screw holes.

(Right/left Eight points in total)

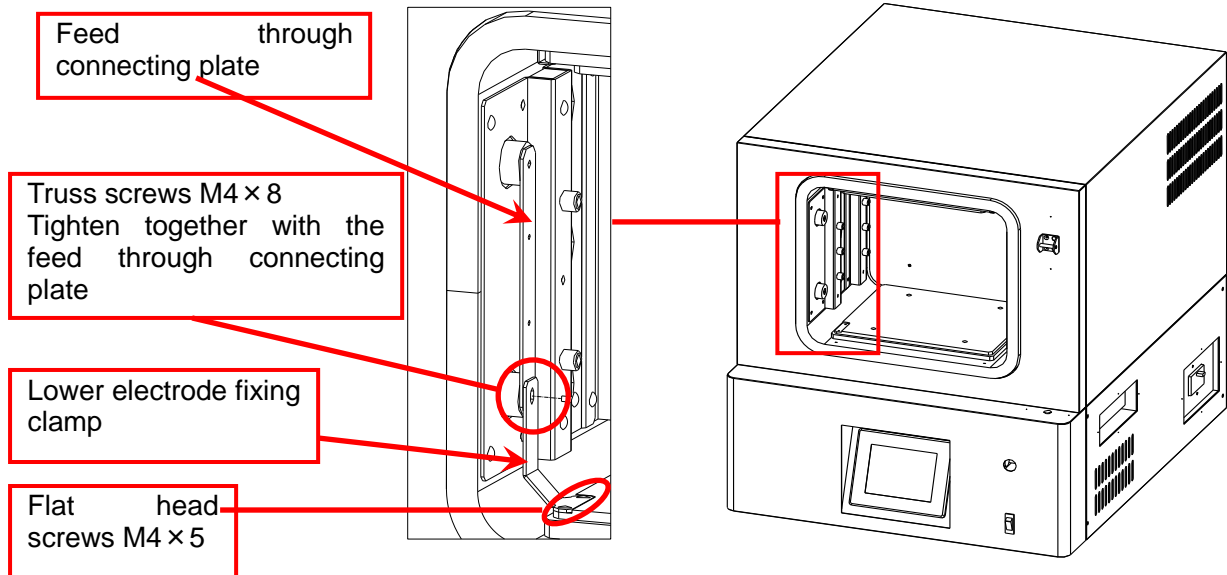


6. INSTALLING ELECTRODES

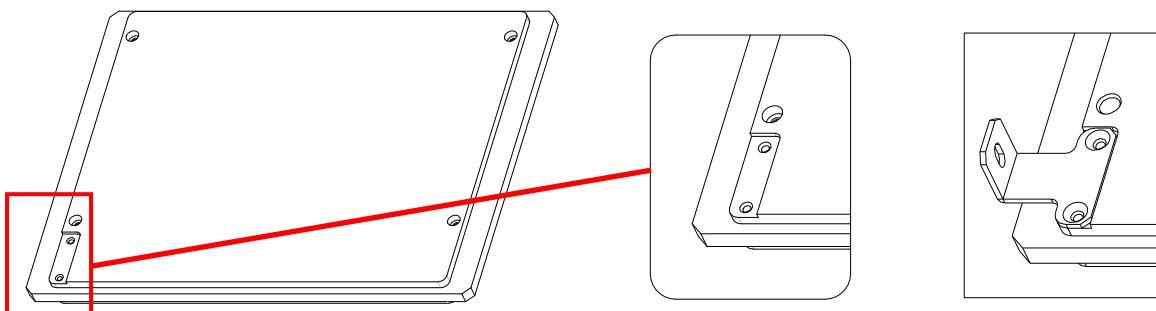
When 3-stage electrode is used (RIE mode)

« RIE mode »

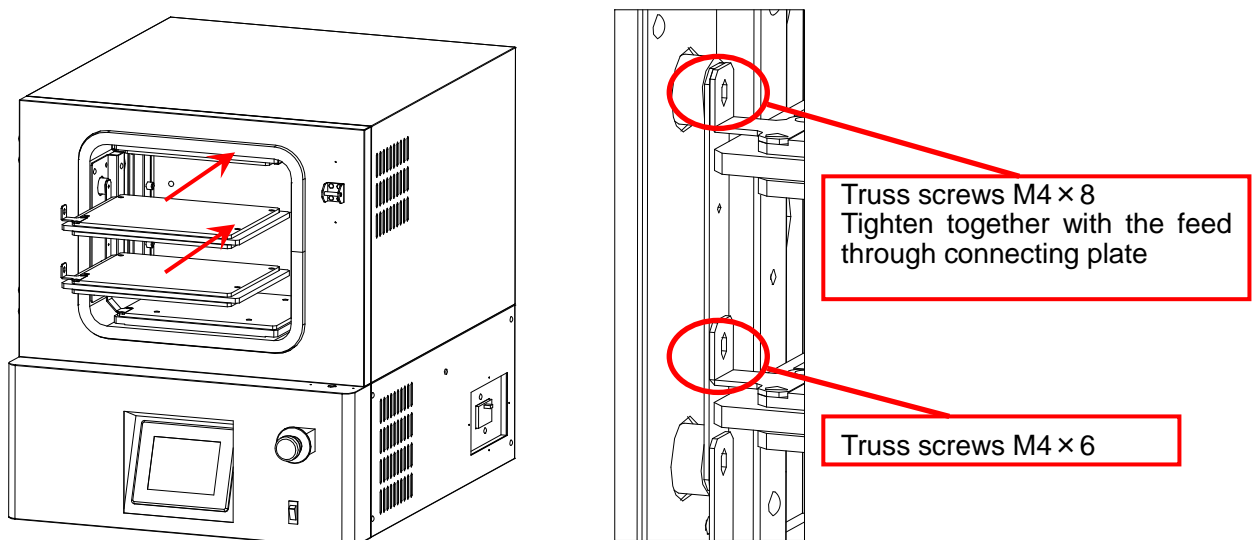
- ① Install the lower electrode fixing clamp to the lower electrode. (Flat head screws M4×5)
- ② Tighten the feed through connecting plate and the lower electrode fixing clamp altogether to the feed through. (Truss screws M4×8)



- ③ Install the RIE fixing clamp for shelf board electrode at the point of the shelf board electrode shown in the diagram below.



- ④ Insert the shelf board electrode into the chamber and connect it to the feed through. (Truss screws M4×6, M4×8)

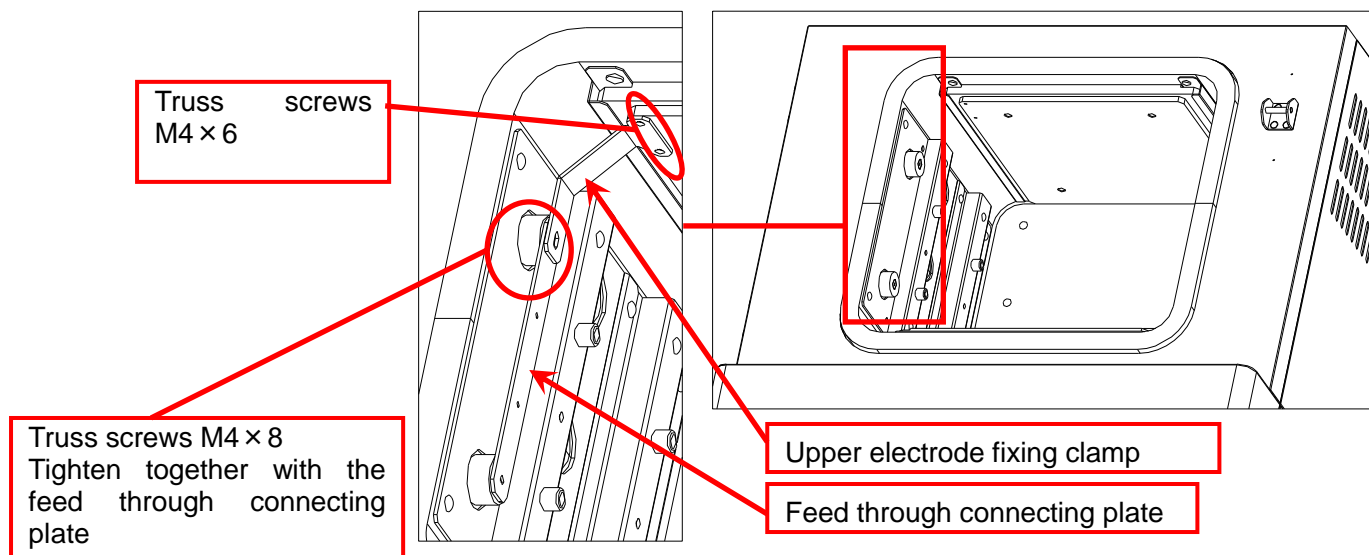


6. INSTALLING ELECTRODES

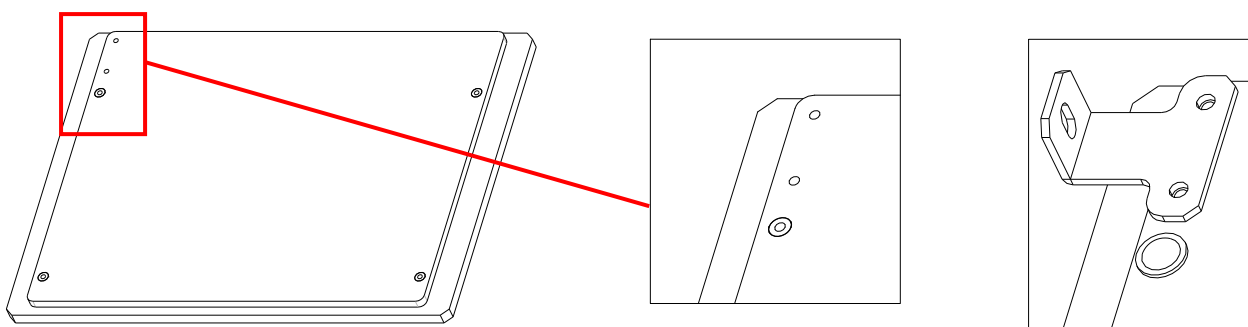
When 3-stage electrode is used (DP mode)

《DP mode》

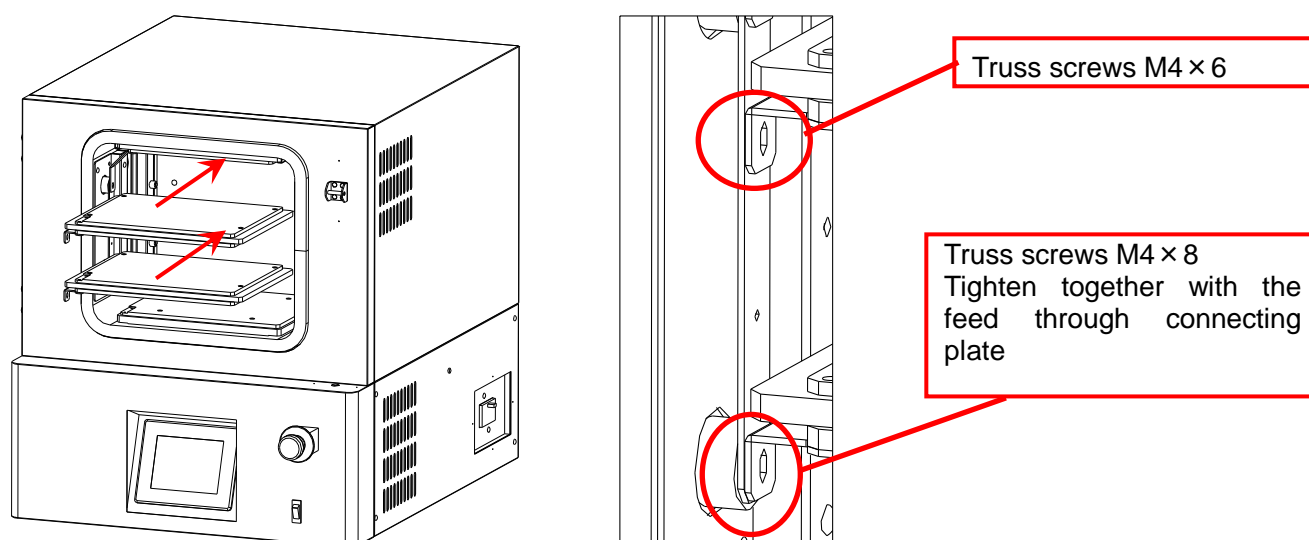
- ① Install the upper electrode fixing clamp to the upper electrode. (Truss screws M4×6)
- ② Tighten the feed through connecting plate and the upper electrode fixing clamp altogether to the feed through. (Truss screws M4×8)



- ③ Install the DP fixing clamp for shelf board electrode at the point of the shelf board electrode shown in the diagram below. (Truss screws M4×6)



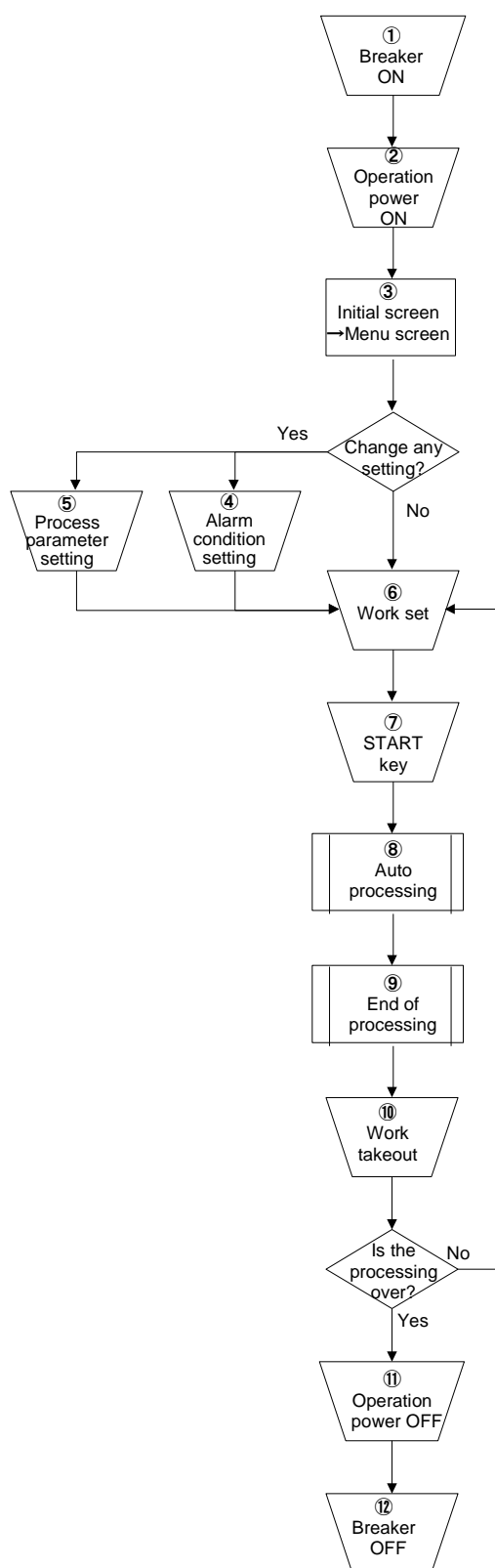
- ④ Insert the shelf board electrode into the chamber and connect it to the feed through. (Truss screws M4×6, M4×8)




7. RUNNING PROCEDURE

Operation in Auto Run

The operation and the setting items in the auto run are outlined below.



- ① Turn on the breaker to power on the machine.
- ② When the operation power is turned on, the operation panel and the pump are turned on to set the machine ready to run.
- ③ After the operation power was turned on, the initial screen will be shown for several seconds. During this period, the controller performs initial setting. When the initial setting is over, the processing screen will appear.
- ④ Set gas flow rates, RF power and RF processing time. If they need not be changed from the previous setting, they need not be set.
- ⑤ Set alarm conditions such as the RF power permissible fluctuation range and gas flow rate permissible fluctuation ranges. If they need not be changed from the previous setting, they need not be set.
- ⑥ Set the work in the chamber and close the door.
- ⑦ Press the START key.
- ⑧ The controller automatically performs the following processes according to the set parameters. Evacuating to set pressure → gas supply start → diffusion → RF on → processing time over → evacuating to set pressure → vacuum source valve close → N₂ purge → chamber to atmospheric pressure
- ⑨ When the processing is over, the end of process is displayed.
- ⑩ Take out the work. (To start the next process, set the work in the chamber and press the START key.)
- ⑪ Turn off the operation power.
- ⑫ Turn off the circuit breaker.

 : indicates the actions by the operator.

7. RUNNING PROCEDURE

Running Procedure

1) How to start the machine

Start the machine by the following procedure:

- ① Supply 3-phase, 200 -230V VAC power to the machine.



First switch the power terminals

Make sure that the switches on the control assembly and the ELB are OFF and securely connect the power cord to a power supply meeting the specified voltage and current.

The standard specification for the power supply is AC200V. When you use this product at a place where AC208V or AC230V is used, switch the terminals inside unit before connecting the power supply. The terminal block can be found on the transformer inside the right side of the unit.

- ② Turn on the circuit breaker on the machine.
- ③ Turn on the operation power switch.
- ④ The touch panel shows the initial screen several seconds and then shows the process screen to set the machine ready to run.

2) Processing procedure and operating method

When the machine has been started, plasma-clean the work by the following procedure:

(1) When the processing parameters need not be set:

- ① Set the work in the chamber and close the door.
- ② Press the AUTO Screen key.
- ③ Press the START key.
- ④ The controller automatically performs the process according to the set parameters.
- ⑤ The end of process is displayed.
- ⑥ Open the door and take out the work.

※To prevent overlapped processing, the machine is designed to prevent the start of the next process before the door is opened.

- ⑦ Similarly, set the next work in the chamber and repeat the procedure.

(2) When the processing parameters need to be set:

- ① Press the PROCESS SETUP, SECRET NO INQUIRY, RECIPE keys on the SELECT screen to display the PROCESS SETUP screen.
- ② Set RE processing time, RF POWER, Ar GAS and O2 GAS.
- ③ Press the PROCESS??? key to return to the process screen.
- ④ To begin processing, follow the procedure in (1) above.

(3) When the alarm conditions need to be set:

- ① Press the PROCESS SETUP, SECRET NO INQUIRY keys on the SETUP screen to display the ALARM SETUP screen.
- ② Set alarm conditions such as RF PERMISSIBLE LEVEL, GAS PERMISSIBLE LEVEL, etc.
- ③ Press the FIRST WINDOW key to return to the process screen.

- ④ To begin processing, follow the procedure in (1).

7. RUNNING PROCEDURE

Running Procedure

3) Machine stopping procedure

Stop the machine by the following procedure:

- ⑤ Set the machine in the standby state.
- ⑥ Turn off the operation power.
- ⑦ Turn off the circuit breaker.

The power may be turned off in any state. The purpose of turning off the power in the standby state is to open the chamber to the atmospheric pressure to enable the door to be opened closed any time. To keep the chamber in the vacuum state, stop the machine in the order of PROCESS → START → vacuum reaches about 20 Pa → operation power off → circuit breaker off.

4) Motion when a power failure occurs

If the power fails, all motion stops and the status of motion is not stored. When the power is re-covered, the controller will display the initial screen for several seconds and the machine will enter the standby status. The following procedure is the same as the normal running procedure.

5) Motion when an alarm occurs

(The causes of alarms and corrective actions are listed on page 23.)

- ① If an abnormal situation occurs, the buzzer sounds and the alarm state is shown on the touch panel.
- ② Check the problem and take corrective actions.
(The buzzer can be stopped with the **BUZZER OFF** key.)

- ③ After the corrective actions, press the **RESET** key. The vacuum pump will run and the process screen will appear.
- ④ Follow the normal procedure.

6) Emergency stop

Use the emergency stop switch to stop the machine immediately when an emergency situation occurs. When the “emergency stop switch” installed on the operation panel is pressed, the power to the touch panel, RF and vacuum pump is turned off. To return the machine to the running status, use the following procedure:

- ① Remove the cause of the emergency stop.
- ② Turn the emergency stop switch about 1/4 turn in the arrow direction (clockwise) to reset it.
- ③ The controller will display the initial screen for several seconds and the machine will enter the standby status. The following procedure is the same as the normal running procedure.

1) Configuration of screens

The operating screens are configured as follows. The arrow → indicates the lower-level screens.

① Initial Screen

(1) Initial screen

This screen will appear automatically when the power is turned on. While this screen is being shown, the controller performs initial setting. There is nothing to be done by the operator.

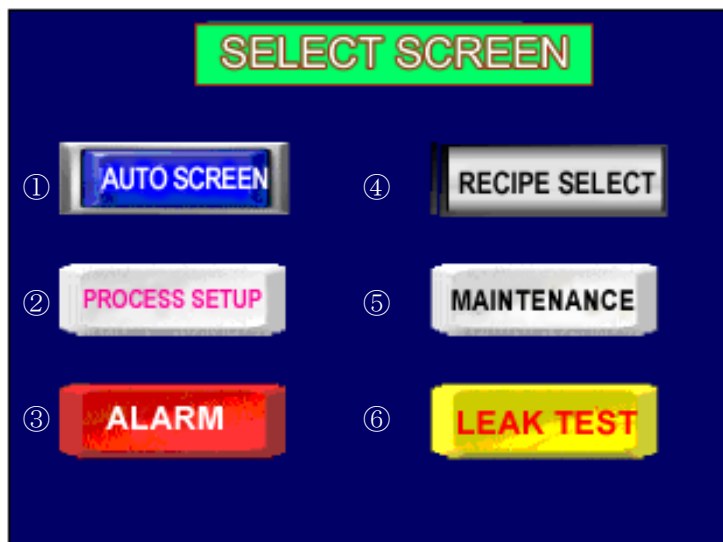


7. RUNNING PROCEDURE

Touch Panel Operations

(2) SELECT Screen

The SELECT screen is used to display the SETUP screen for the START and PROCESS SETUP.



① AUTO (MEAS screen)
Displays selected recipe conditions.

② When you enter the secret number in the SECRET NO INQUIRY screen, displays the SETUP screen.

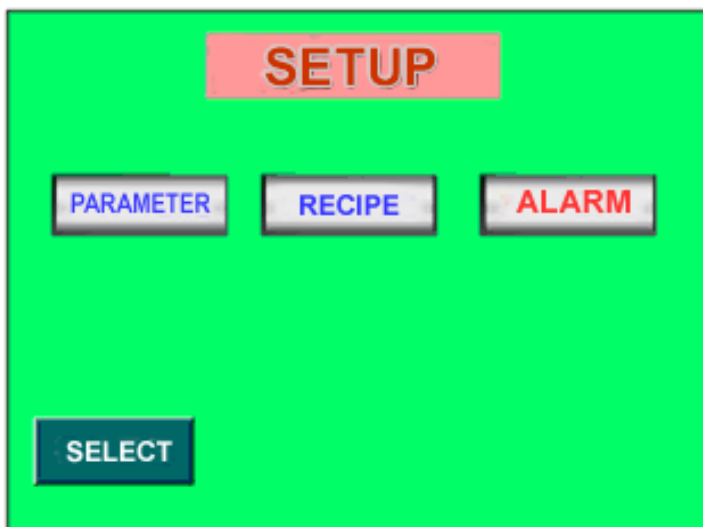
③ ALARM
Displays the ALARM screen.

④ RECIPE
Displays the RECIPE screen.

⑤ MAINTENANCE screen
Displays the MAINTENANCE screen.

⑥ LEAK TEST
Displays the LEAK TEST screen.

(3) PROCESS SETUP screen



① PARAMETER
Displays the PARAM screen.

② RECIPE
Displays the PROCESS SETUP screen.

③ ALARM
Displays the ALARM screen.

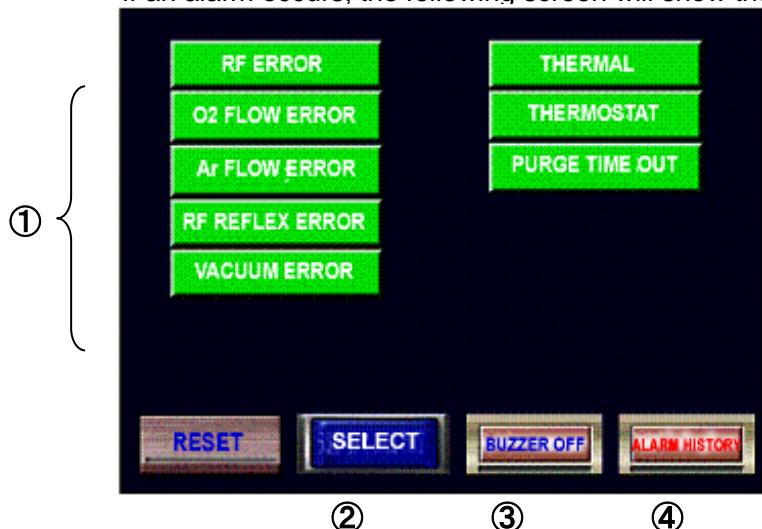
④ SELECT
Displays the SELECT screen.

7. RUNNING PROCEDURE

Touch Panel Operations

(4) ALARM screen

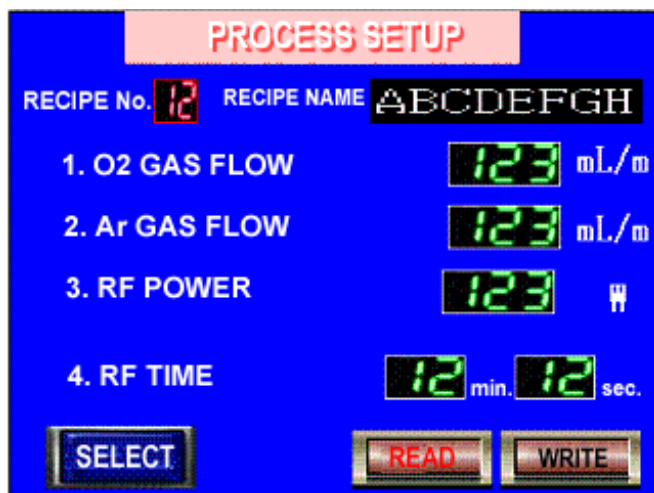
If an alarm occurs, the following screen will show the contents of the alarm..



- ① Shows the cause of the alarm.
- ② When this key is pressed after removing the cause of the alarm, the initial screen will appear.
- ③ Stops the buzzer.
- ④ Shows alarm history

(5) Process parameter setting screen

Set process parameters on this screen.



(Numeric keys)



(For recipe name)

- ① Using the numeric keys, enter a value to a place where the cursor is blinking.
- ② After entering a value, press the **ENT** key. If the **ENT** key is not pressed, the previous value re-mains unchanged. When the **ENT** key is pressed, the cursor moves to the next item. Enter a value similarly. If a wrong value has been entered, press the **CLR** key to clear it.
- ③ After the entry, press the **WRITE** key to return to the process screen.
- ④ Press the **READ** key after setting a recipe No to load the settings.

※ Enter eight alphanumeric characters for a recipe name. After entering a name, press the "ENT" key.

7. RUNNING PROCEDURE

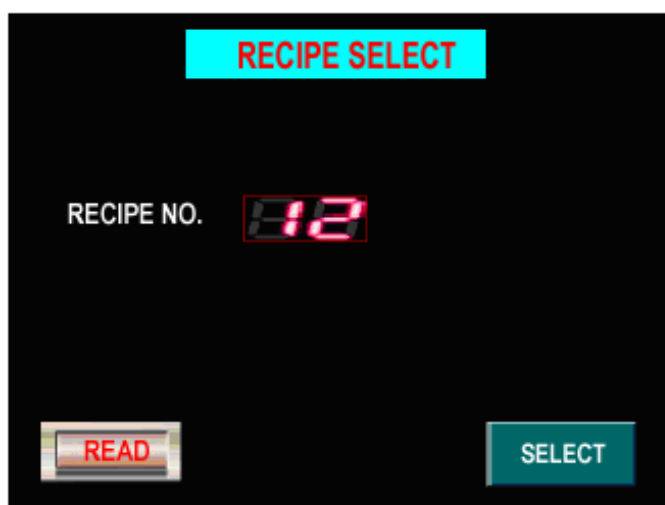
Touch Panel Operation

(6) ALARM HISTORY



- ① Returns to the ALARM screen.
- ② Clears alarm history.

(7) RECIPE SELECT



Touching the RECIPE. No ☐, displays the ten keyboard.

After entering a value using 1~10 numbers, press the **READ** key.

The data will not loaded unless you press the **READ** key.

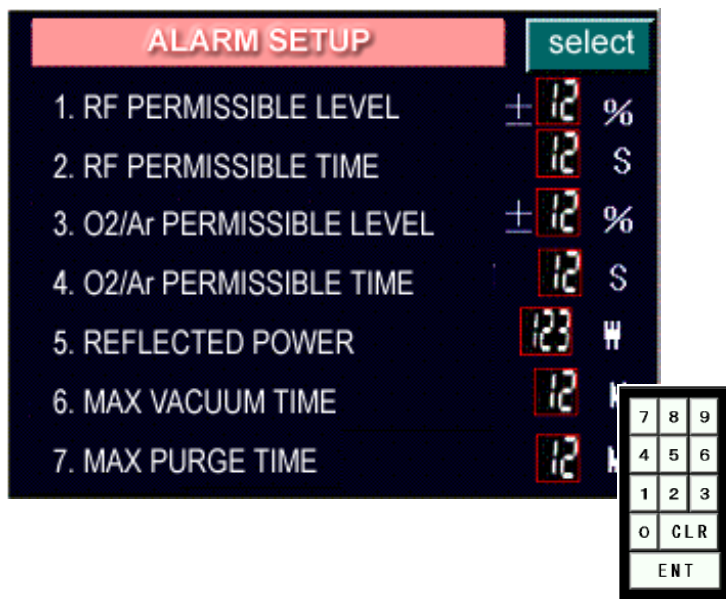


7. RUNNING PROCEDURE

Touch Panel Operation

(8) Alarm condition setting screen

Set conditions to issue alarms on this screen.

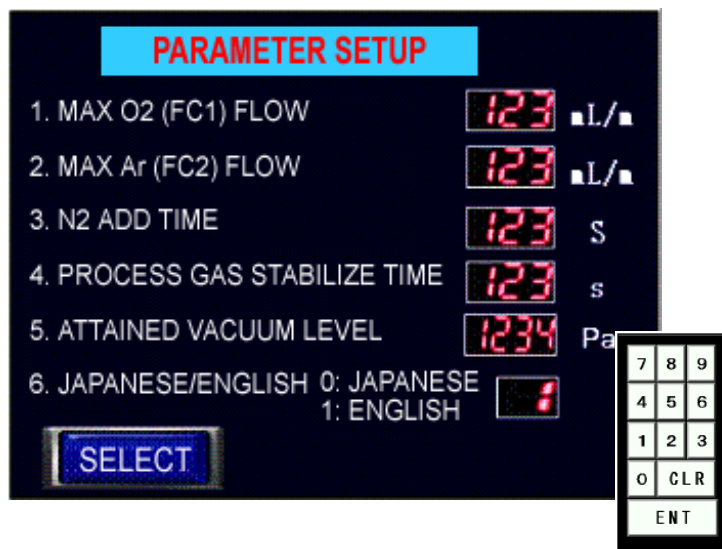


- ① Using the numeric keys, enter a value to a place where the cursor is blinking.
- ② After entering a value, press the **ENT** key. If the **ENT** key is not pressed, the previous value re-mains unchanged. When the **ENT** key is pressed, the cursor moves to the next item. Enter a value similarly. If a wrong value has been entered, press the **CLR** key to clear it.
- ③ After the entry, press the **SELECT** key to return to the SELECT screen.
- ④ The default values and input ranges are as follows.

| Param. No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---------------|------|------|------|------|-------|------|------|
| Default value | 20 | 10 | 20 | 10 | 20 | 3 | 2 |
| Input range | 1~50 | 1~60 | 1~50 | 1~60 | 1~100 | 1~30 | 1~10 |

(9) Parameter setting screen

Set the maximum flow rates of the mass flow controller, ultimate vacuum when filling gas, time to add N2 gas after operation of the pressure switch for purge (an operation to ensure that the chamber is returned to atmospheric pressure which may be under negative pressure when the pressure switch operates) and processing gas stability time. Once they have been set, they need not be set again for normal run.



- ① Using the numeric keys, enter a value to a place where the cursor is blinking.
- ② After entering a value, press the **ENT** key. If the **ENT** key is not pressed, the previous value re-mains unchanged. When the **ENT** key is pressed, the cursor moves to the next item. Enter a value similarly. If a wrong value has been entered, press the **CLR** key to clear it.
- ③ After the entry, press the **SELECT** key to return to the SELECT screen.
- ④ The default values are as follows.

| Item | O ₂ gas | Ar gas | N ₂ add time | Stable time | Attained vacuum level | Japanese/English |
|---------|--------------------|--------|-------------------------|-------------|-----------------------|------------------|
| Default | 200 | 100 | 5 | 30 | 10 | 0 |

7. RUNNING PROCEDURE

Touch Panel Operation

(10) AUTO screen

This screen shows the time that has elapsed after the start of processing, gas flow rates, RF power, degree of vacuum, etc. Use this screen to check these conditions during processing.



- ① ② ③ ④

- ① Returns to the SELECT screen.
- ② Starts processing.
- ③ Stops processing.
- ④ According to the current status, standby, processing or end of process is displayed.

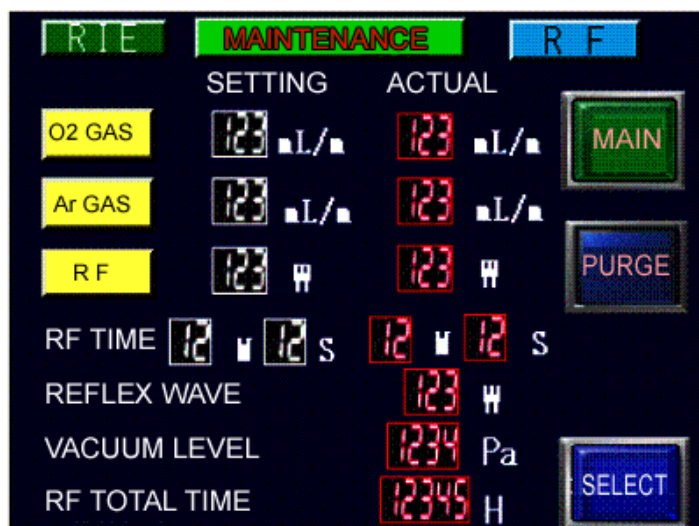
Note 1: Only the blue keys may be operated.

Note 2: After the process has been ended, the START key will not be accepted before the door is opened.

Note 3: The process cannot be started if the door is open. 3.

(11) Maintenance screen

Use this screen to operate the units independently during maintenance.



- ① Using the numeric keys, enter a value to a place where the cursor is blinking.
- ② After entering a value, press the **ENT** key. If the **ENT** key is not pressed, the previous value re-mains unchanged. When the **ENT** key is pressed, the cursor moves to the next item. Enter a value similarly.
- ③ If a wrong value has been entered, press the **CLR** key to clear it.
- ④ Each time the O₂ GAS key is pressed, the supply of O₂ gas is turned on and off.
- ⑤ Each time the Ar GAS key is pressed, the supply of Ar gas is turned on and off.
- ⑥ Each time the RF key is pressed, the RF is turned on and off.
- ⑦ Each time the **MAIN** key is pressed, evacuating is turned on and off.
- ⑧ When the **PURGE** key is pressed, N₂ gas is filled to the chamber. When the chamber has been returned to the atmospheric pressure, the purge is automatically turned off.
- ⑨ When the **SELECT** key is pressed, the SELECT screen will appear.
- ⑩ When the door is open, **DOOR OPEN** will appear. Close the door

Note 1: If the main valve is not on, the **O2 GAS**, **Ar GAS** and **RF** keys are not accepted.

7. RUNNING PROCEDURE

Touch Panel Operation

(12) Leak test

Use this screen to check leak of the vacuum system and verify the performance of the vacuum pump during the periodic maintenance, etc.

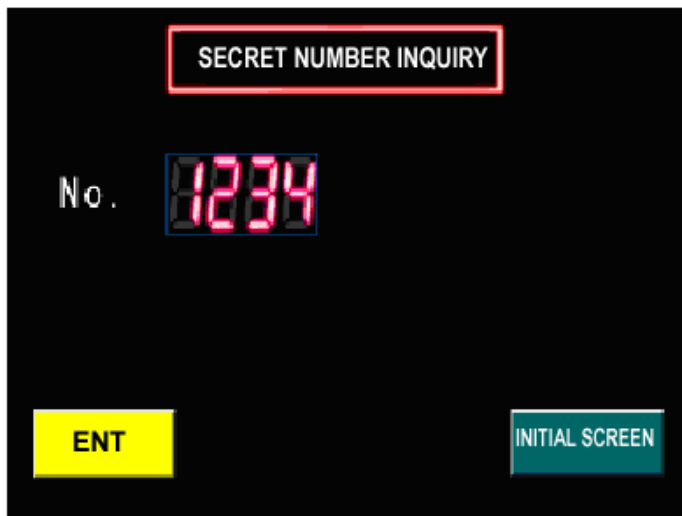


- ① Shows the time to reach the required vacuum. If the chamber has been left in highly humid atmosphere, 2 to 3 minutes may be required to reach 13 Pa. If 1 Pa cannot be reached, "0:00" will be shown, but it is no problem.
- ② Shows the ultimate vacuum after 20 minutes. OK when below 10 Pa.
- ③ The valve of the evacuating line is closed and the chamber is closed completely 20 minutes after the start of evacuating. Leak is detected by a change in the degree of vacuum. When a pressure rise is 60 Pa or be-low after 20 minutes, there is no problem in the cleaning performance.
- ④ Starts the leak test. A series of exhausting to the vacuum leak is carried out automatically. The required time is 40 minutes.
- ⑤ Stops the test.
- ⑥ According to the current status, standby, testing or end is shown.
- ⑦ Returns to the SELECT screen.

7. RUNNING PROCEDURE

Touch Panel Operation

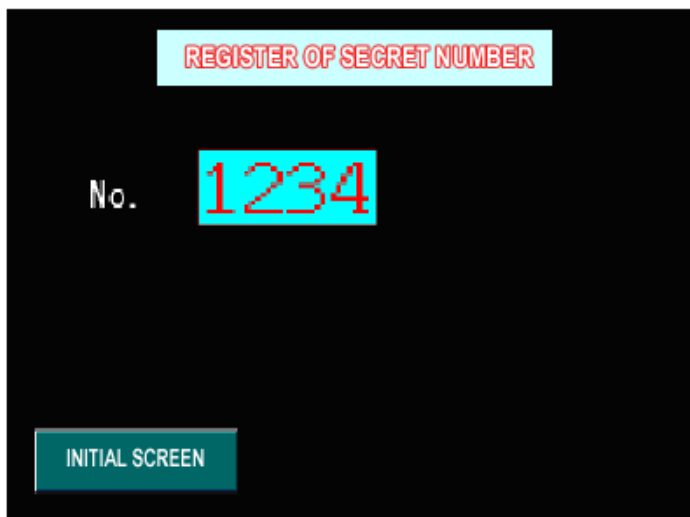
(13) SECRET NO INQUIRY



This is a screen for inquiry of the secret number.

After entering the secret number, press the **ENT** key.

(14) SECRET NO REGISTER



The screen is used to register a secret number.

Enter a four-digit secret number.

8. PRECAUTIONS FOR HANDLING



Warning and Caution

1. Substances that must not be used



Do not use explosive substances, flammable substances and other substances containing such substances with this machine. They are a cause of explosion and fire. (See 17. "List of Hazardous Substances")

2. Prohibition of use and corrective actions in the event of abnormal situations



This machine incorporates a high-frequency power supply. If you notice smoke or offensive odor or other abnormalities, immediately turn off the machine power and the distribution panel power and request the dealer or Yamato Scientific sales office for inspection. If the machine is left as it is, a fire or electric shock may occur. Never try to repair the machine by yourself. It is a very dangerous practice.

3. Dry the work



If the work is wet, a very long evacuating time is required, which may cause the evacuation alarm. Also water may deposit in the vacuum pump to deteriorate the evacuating performance. Be sure to dry the work prior to plasma cleaning.

4. Do not bring the work in contact with the chamber



The work in contact with the chamber causes a short circuit between the electrode and the chamber, which may damage the work and the machine. Place the work above the electrode and provide a clearance of more than 20 mm between the chamber and the work.

5. Attention to high temperature when taking out work



When taking out the work from the chamber, be careful not to touch the chamber and electrode because the inside of the chamber may be very hot.

9. MAINTENANCE

Daily Inspection

Conduct the daily inspection at least once a day according to the following table.

| Daily Inspection Table | | | | | |
|------------------------|-----------------------------|------------------|---|--------|---------|
| No. | Place | Item | Criteria | Result | Remarks |
| 1 | Cooling fan | Noise | Smooth rotation with no abnormal noise. | | |
| | | Vibration | No abnormal vibration. | | |
| | | Odor | No offensive odor. | | |
| 2 | Chamber door | Opening/closing | Smooth movement. | | |
| | | Tightness | No gap between the chamber and the door. | | |
| 3 | Supply gases | Pressure | Process gas = 0.15 to 0.2 MPa | | |
| | | | Purge gas = 0.2 to 0.3 MPa | | |
| 4 | Gas connect port | Gas leak | No gas leak. | | |
| 5 | Vacuum exhaust connect port | Tightness | Not loose. | | |
| 6 | Commercial in-put line | Connection | No loose connectors. | | |
| | | | No abnormal temperature rise of connectors. | | |
| 7 | Vacuum pump | Oil level | Within the level lines. | | |
| | | Oil color | Not contaminated. | | |
| | | Noise | No abnormal noise. | | |
| | | Vibration | No abnormal vibration. | | |
| | | Oil leak | No leak. | | |
| | | Connection wires | No loose connections. | | |

- Prior to the inspections and maintenance, turn off the power switch on the distribution panel for safety.
- Wait until the machine has returned to the normal temperature before maintenance.
- Never disassemble the machine.

9. MAINTENANCE

Periodic Inspection

Conduct the periodic inspections according to the following tables.

| Every Month | | | | | |
|-------------|----------------------|---|--|-----------|---|
| Date: | | Temperature: | °C | Humidity: | % Inspected by: |
| No. | Place | Method | Criteria | Result | Remarks |
| 1 | Exhaust speed test | Conduct test under normal operating conditions. | 3 minutes max. from atmospheric pressure to 13 Pa. | | If the criteria are not met or the oil is contaminated, the oil must be replaced. |
| 2 | Ultimate vacuum test | Conduct test under normal operating conditions. | 10 Pa or below. after 20 minutes of evacuation. | | |
| 3 | Vacuum leak test | Conduct test under normal operating conditions. | +20 Pa max. 20 minutes after start from the ultimate vacuum. | | If over 20 Pa, vacuum may be leaking. |

Note: If the first test did not meet the criteria, a possible cause may be adsorption of water. If the criteria are not met, conduct the leak test again immediately after the first test.

| Every Year | | | | | |
|------------|-----------------------------|--|--|-----------|-----------------|
| Date: | | Temperature: | °C | Humidity: | % Inspected by: |
| No. | Place | Method | Criteria | Result | Remarks |
| 1 | Retighten connection screws | All motion at a stop. | Not loose. | | |
| 2 | Retighten piping joints | All motion at a stop. | Not loose. | | |
| 3 | Replace O-rings | All motion at a stop. | No damage or adhesion of foreign matter. | | |
| 4 | Earth leakage breaker | Under the normal operating conditions. | Turned off when the breaker's red button is pressed. | | |
| 5 | Emergency stop button | Under the normal operating conditions. | The pump and operation panel power is turned off. | | |

| Every 4 Years | | | | | |
|---------------|-----------|-------------------------|---------------------|-----------|-----------------------------|
| Date: | | Temperature: | °C | Humidity: | % Inspected by: |
| No. | Place | Installed on | Criteria | Result | Remarks |
| 1 | Battery | Programmable controller | | | Replace every 4 years. |
| | | Programmable terminal | | | |
| 2 | Backlight | Touch panel | Correct brightness. | | Replace every 40,000 hours. |

- ◆ The intervals of replacing the oil in the vacuum pump largely depend on the conditions of use, but usually it must be replaced every three to six months.
- ◆ The recommended intervals of parts replacement as a result of the inspections are for reference. Parts may be replaced earlier depending on the frequency of use.
- ◆ If you have any questions, please contact the dealer or Yamato Scientific.

10. ALARMS AND CORRECTIVE ACTIONS

Alarms and Corrective Actions

| Alarm | Probable Cause | Corrective Action | Reference page |
|--|---|--|----------------|
| RF error | The alarm condition, RF PERMISSIBLE LEVEL, is too low. | Increase the level. (Set this based on the default value 10%) | P27 |
| | The electrode and the chamber are shorted by the work, etc. to disable the set power due to a matching error. | Place the work above the chamber so that it does not contact the chamber. | |
| | Plasma is not produced because the vacuum is too high or low. | Supply the process gas to ensure the vacuum in the chamber is in the range of 100 Pa to 1 Pa. | P28 |
| Ar gas flow rate error O ₂ gas flow rate error | The alarm condition, O ₂ , Ar PERMISSIBLE LEVEL, is too low or PERMISSIBLE TIME is too short. | Increase the level or time. (Set this based on the default values 20% and 30 seconds) | P27 |
| | The source valve of the gas is closed or the gas cylinder is empty. | Open the source valve of the gas. Replace the gas cylinder. | |
| | | | |
| Reflected wave large | The alarm condition, REFLEX WAVE, is too small. | Increase the value. (Set this based on the default value 20 W) | P27 |
| | The electrode and the chamber are shorted by the work, etc. to disable matching. | Place the work above the chamber so that it does not contact the chamber. | |
| | Plasma is not produced because the vacuum is too high or low. | Supply the process gas to ensure the vacuum in the chamber is in the range of 100 Pa to 1 Pa. | P28 |
| Evacuating time over | Plasma is not produced because the vacuum is too high or low. | Supply the process gas to ensure the vacuum in the chamber is in the range of 100 Pa to 1 Pa. | P27 |
| | The alarm condition, VACUUM TIME, is too short. | Increase the value. (Set this based on the default value 3 min.) | |
| | The evacuating time becomes longer because of wet work. | Dry the work before plasma-cleaning. | |
| | Vacuum is leaking because of such problems as foreign matter caught by the door, damaged O-ring and loose piping joint. | Conduct the leak test. If leak is detected, take necessary actions such as replacing the defective O-ring and re-tightening the loose piping joint. | |
| Purge time over | The alarm condition, SUBSTITUTION TIME, is too short. | Increase the time. (Set this based on the default value 3 min.) | P27 |
| | The source valve of the gas is closed or the gas cylinder is empty. | Open the source valve of the gas. Replace the gas cylinder. | |
| Vacuum pump failure | The oil in the vacuum pump has deteriorated to overload the motor. | Replace the oil. | |
| Chamber temperature high | The chamber temperature has risen above 90°C because of a long time of plasma radiation. | Stop using the machine until the chamber cools down. (Even if one process is finished within the limit time, if operation intervals are short, the limit value may be exceeded.) | |

If any problem not listed above has occurred, please contact the dealer or Yamato Scientific.

10. WHEN ALARM OCCURS

Operating Procedures for Auto Tuning Adjusting Switch

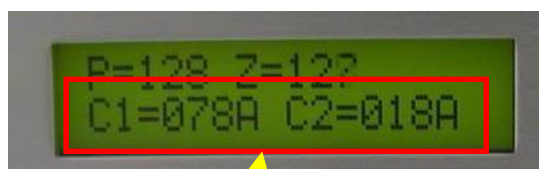
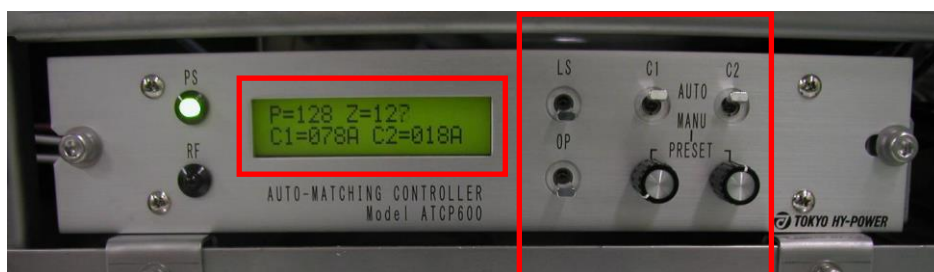
⚠ This operation is used when proper matching cannot be obtained or load in the chamber will not go into the matching range after switch the plasma mode (RIE \leftrightarrow D P).

High frequency wave output must be matched with load. If not, reflective wave will be larger and preventing effective transmission of output to the load and may cause a malfunction of the high frequency wave power supply.

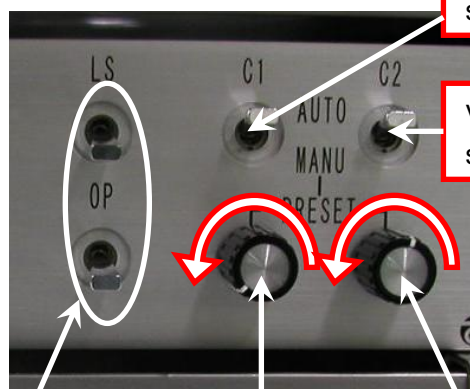
The auto tuning adjustment switch is located in the right panel.

(1) Remove the right panel.

※Make sure that RF is OFF before removing the panel.



Position of the variable condenser



VC1 AUTO/MANUAL selector switch

VC2 AUTO/MANUAL selector switch

※Never attempt to touch.
(Set at down at the default setting.)

VC1 variable condenser MANUAL position adjustment

VC2 variable condenser MANUAL position adjustment

- (2) Set the "AUTO/MANUAL selector switch (VC1 and VC2)" to the MANU side.
- (3) Turn the "MANUAL position adjustment (VC1 and VC2)" counterclockwise.
- (4) Turn the value on the "Variable condenser position display (VC1 and VC2)" is 0.
- (5) Set the "AUTO/MANUAL selector switch (VC1 and VC2)" to the AUTO side.
- (6) Replace the right panel to the original position.
- (7) Make sure whether matching will be made properly.

11. AFTER-SALE SERVICE AND WARRANTY

Request for Repair

Request for repair

If any problem occurs, stop the machine immediately and turn off the circuit breaker on the machine and the circuit breaker on the distribution panel. Then contact the dealer or Yamato Scientific.

Required information:

- Model of the product
- Serial No.
- Date of purchase
- Description of the problem (as detailed as possible)

When the service staff arrives at your factory, please present the warranty.

Warranty (Delivered separately)

- The warranty is delivered by the dealer or Yamato Scientific. Please confirm that the name of the dealer, date of purchase and other information are described correctly and keep the warranty in a safe place.
- The warranty period is one year from the date of purchase. During this period, failures will be re-paired free of charge pursuant to the terms and conditions stipulated in the warranty.
- As for repair of failures which may occur after the warranty period has expired, please contact the dealer or Yamato Scientific. Where the function can be maintained by repair, such failure will be repaired with charge if such repair is requested by the customer.

Minimum retention period of repair parts

The minimum retention period of repair parts of the machine is seven years after the discontinuation of production.

The repair parts are those parts that are required to maintain the performance of the product.

12. SPECIFICATIONS

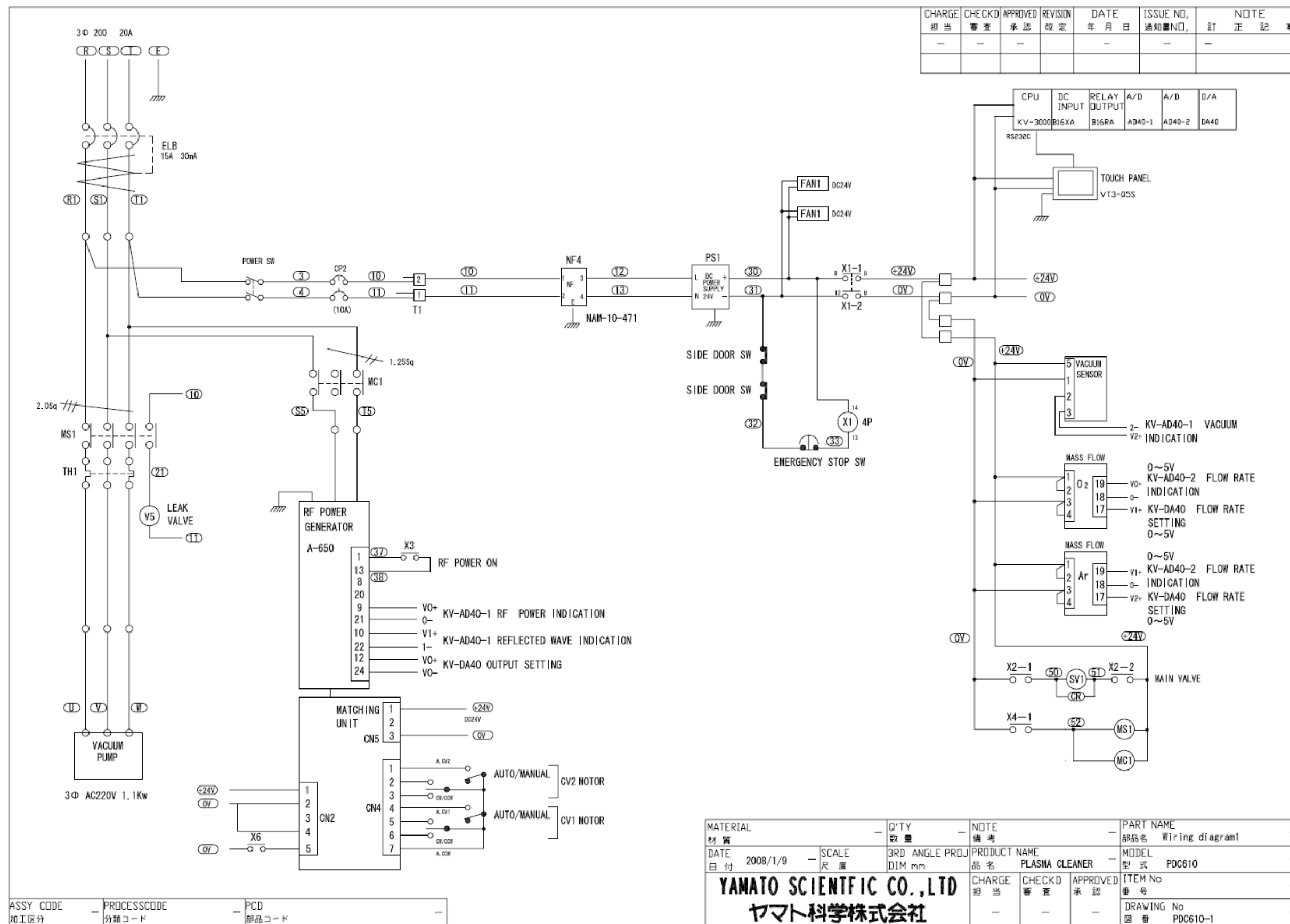
SPECIFICATIONS

| | | |
|-----------------------------|--------------------------------|---|
| Model | | PDC610 |
| Main unit | Power supply | 200 - 230 VAC 15A 50/60 Hz (Vacuum pump included) |
| | Internal dimensions of chamber | (Width) 350 × (depth) 270 × (height) 300 mm |
| | Electrode structure | Parallel flat type (Plasma mode: RIE/DP change-over type) |
| | Electrode dimensions | (Width) 250 × (depth) 220 mm three stages |
| | Plasma method | RIE / DP change-over type |
| | Vacuum meter | Capacitance manometer |
| | Control device | Sequencer |
| | Operation/display unit | 5 inch STN color LCD touch panel |
| High-frequency power supply | High-frequency output power | 100 – 600W |
| | Reference oscillator | Quartz oscillator |
| | Oscillation frequency | 13.56 MHz |
| | Output setting method | Manual setting on the touch panel |
| | Matching method | Auto tuning |
| Vacuum pump | Model | Alcatel T2021 |
| | Effective exhaust speed | 345 L/min (50 Hz) |
| | Suction port shape | NW25 |
| | Exhaust port shape | NW25 |
| | Motor rated output | 450 W (50 Hz) |
| Gas system | Purge gas | N ₂ 1/4-inch flare-less joint |
| | Reaction gas | Ar gas Mass flow controller 100 SCCM 1/4-inch flare-less joint |
| | | O ₂ gas Mass flow controller 100 SC 1/4-inch flare-less joint |

Accessory list

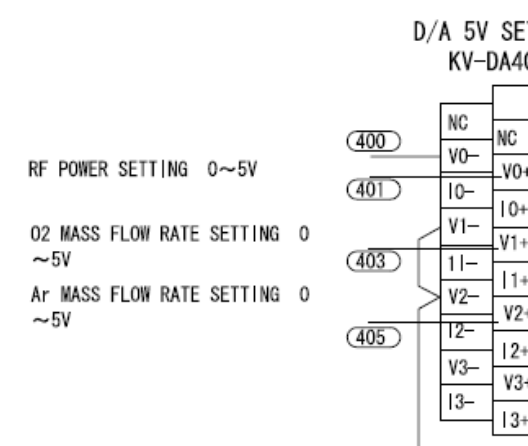
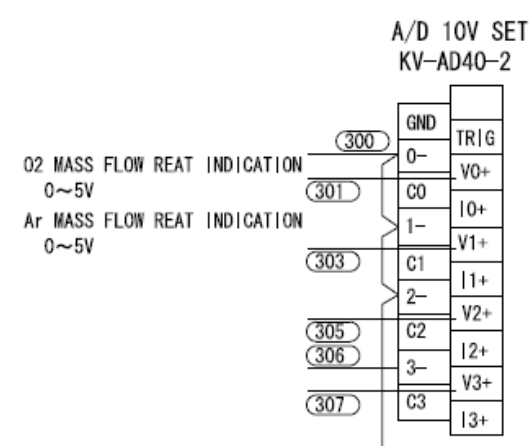
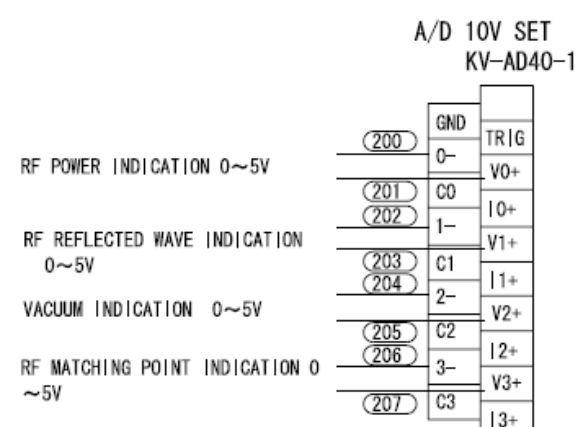
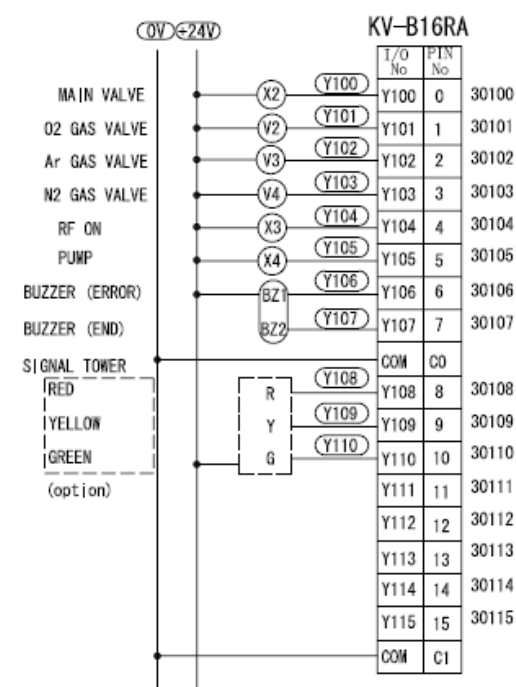
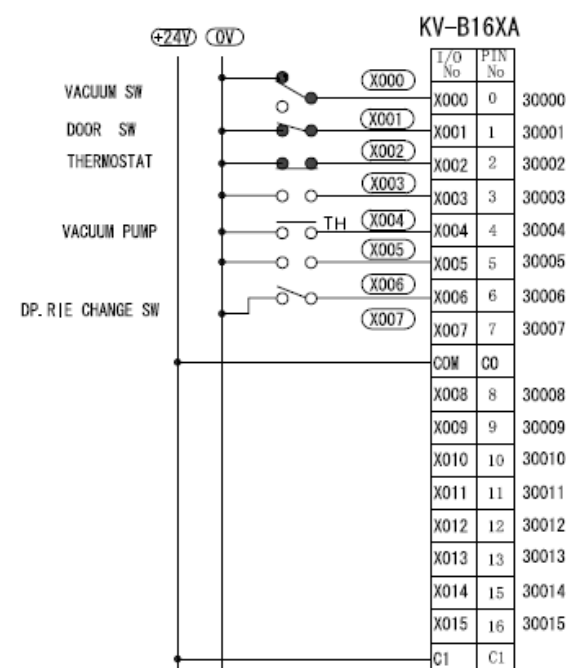
| No | Part name | Qty | No | Part name | Qty |
|----|--|--------|----|---|------|
| 1 | Main unit(PDC610) | 1 | 18 | Lower electrode | 1SET |
| 2 | Operation manual(plain paper) | 1 copy | 19 | Upper electrode | 1SET |
| 3 | Operation manual(dust-free paper) | 1 copy | 20 | Shelf board electrode | 2SET |
| 4 | Operation manual of vacuum pump | 1 copy | 21 | Lower electrode fixing clamp | 1 |
| 5 | Operation manual for capacitance manometer | 1 copy | 22 | Upper electrode fixing clamp | 1 |
| 6 | Operation manual for vacuum pump | 1 copy | 23 | Feed through connecting plate (used for 3-stage configuration) | 1 |
| 7 | Operation manual for mass flow controller | 1 copy | 24 | Shelf board electrode RIE fixing clamp (used for 2-stage configuration) | 1 |
| 8 | Warranty card | 1 copy | 25 | Shelf board electrode DP fixing clamp (used for 2-stage configuration) | 1 |
| 9 | Use of high frequency wave | 1 copy | 26 | Shelf board electrode RIE fixing clamp (used for 3-stage configuration) | 2 |
| 10 | High frequency wave | 1 copy | 27 | Shelf board electrode DP fixing clamp (used for 3-stage configuration) | 2 |
| 11 | High frequency wave | 1 copy | | | |
| | | | 28 | Truss screw (M4×6) | 15 |
| 12 | Power cord(for vacuum pump) | 1 | 29 | Truss screw (M4×8) | 5 |
| 13 | Vacuum pump (T2021SD) | 1 | 30 | Flat head screw (M4×5) | 10 |
| 14 | Oil mist eliminator | 1 | | | |
| 15 | Clamp | 3 | | | |
| 16 | Center ring | 3 | | | |
| 17 | Flexible tube | 1 | | | |

13.WIRING DIAGRAM



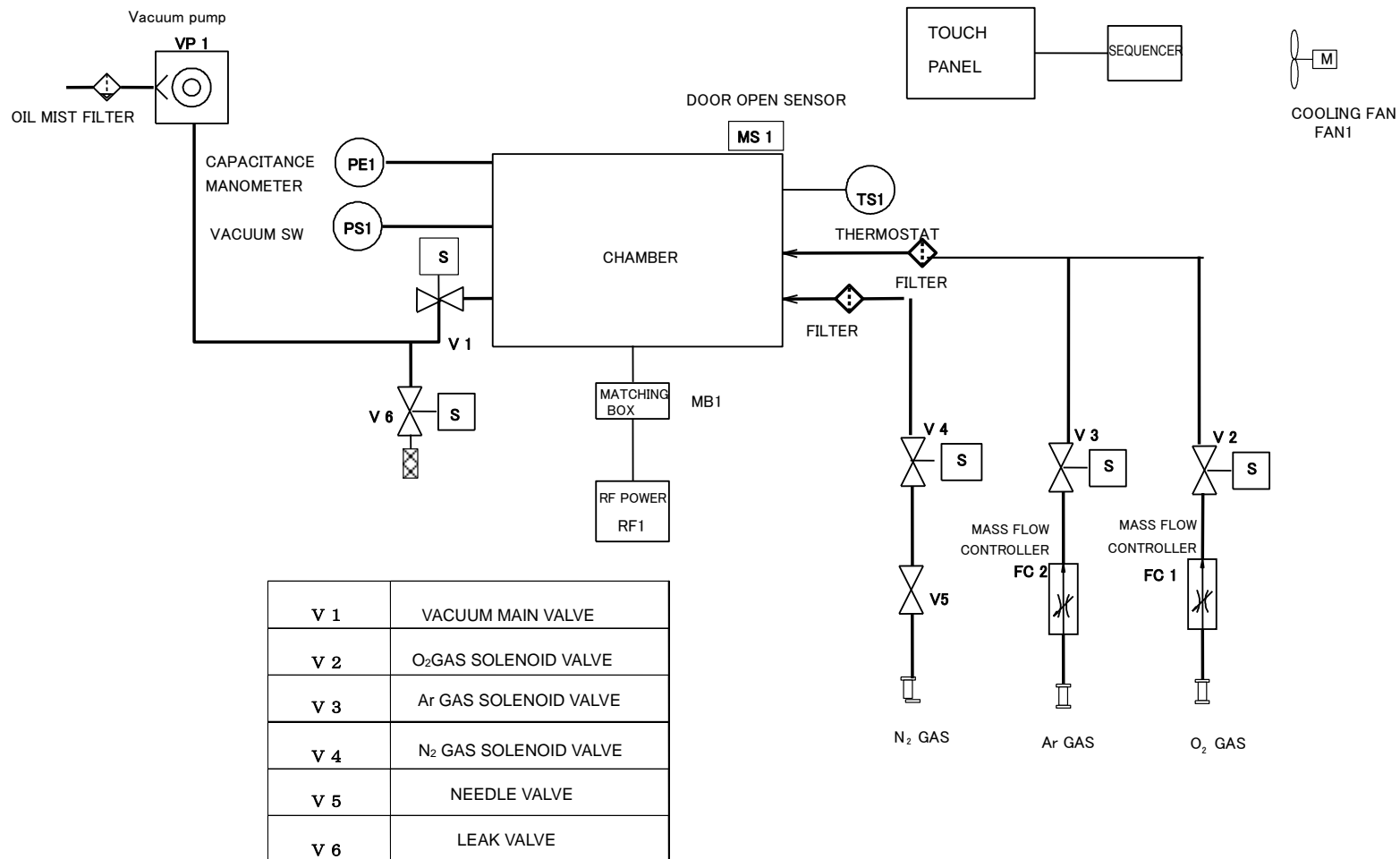
13. WIRING DIAGRAM

| CHARGE 担当 | CHECKED 審査 | APPROVED 承認 | REVISION 改定 | DATE 年月日 | ISSUE No. 通知書 No. | LOT No. 実施ロット No. | NOTES 訂正記事 |
|--------------|---------------|----------------|----------------|-------------|----------------------|----------------------|---------------|
| | | | | | | | |



| | | | | |
|--|------------------|--------------------------|----------------------------|----------------------------|
| MATERIAL 材質 | FINISH 処理 | NOTES 備考 | Q'TY 数量 | DRAWING TITLE 部品名 |
| DATE 年月日 2008/1/09 | SCALE 尺度 Free | 3RD ANGLE PROJ DIM mm | TITLE 品名 PLASMA CLEANER | MODEL 型式 PDC610 |
| YAMATO SCIENTIFIC CO.,LTD ヤマト科学株式会社 | | DRAWN 作成 matsumoto | CHECKED 審査 akiyama | APPROVED 承認 ookawa |
| | | ITEM No. 部品番号 | | DRAWING No. 図番 PDC610-2 |

14.Piping Diagram



PIPING SYSTEM DIAGRAM

15.Parts List

| Part name | Parts code | Material | Manufacturer |
|--|-----------------------|----------|--------------|
| Fixed electrode (RIE) | LT00028332 | Aluminum | YAMATO |
| Fixed electrode insulating plate (RIE) | LT00028334 | Ceramics | YAMATO |
| Fixed electrode (DP) | LT00028331 | Aluminum | YAMATO |
| Fixed electrode insulating plate (DP) | LT00028333 | Ceramics | YAMATO |
| Shelf board electrode (RIE) | LT00028363 | Aluminum | YAMATO |
| Shelf board electrode (DP) | LT00028362 | Aluminum | YAMATO |
| Shelf board electrode insulating board | LT00028368 | Ceramics | YAMATO |
| Insulating collar 1 | LT00028350 | Ceramics | YAMATO |
| Insulating collar 2 | LT00028351 | Teflon | YAMATO |
| Electrode SFT | LT00028386 | Aluminum | YAMATO |
| Inner cover (lower on the back) | LT00028239 | Aluminum | YAMATO |
| Inner cover (upper on the back) | LT00028240 | Aluminum | YAMATO |
| Inner cover (door) | LT00028241 | Aluminum | YAMATO |
| Shelf board holder BKT-FL | LT00028359 | Aluminum | YAMATO |
| Shelf board holder BKT-RL | LT00028358 | Aluminum | YAMATO |
| Shelf board holder BKT-FR | LT00028360 | Aluminum | YAMATO |
| Shelf board holder BKT-RR | LT00028361 | Aluminum | YAMATO |
| O-ring for electrode SFT | LT00028224,LT00028223 | Viton | YAMATO |
| O-ring for observation window | LT00028225 | Viton | YAMATO |
| O-ring for door/back plate | LT00028222 | Viton | YAMATO |

16. DISPOSAL

Precautions for Disposal

For protection of the global environment:

In order to protect the environment, it is requested that when disposing of the machine, break down the machine to as smallest pieces as possible and dispose of them by materials or recycle them wherever possible. The major components of the machine and their materials are as follows.

| Major Component | Material |
|---|--|
| Major components of the main unit | |
| Enclosure | Stainless steel (SUS304) |
| Chamber, door | Aluminum (A5052) |
| Insulating plate | Ceramics |
| Check window | Heat-resistant reinforced glass (Pilex) |
| Piping, piping joint | SUS304、 SUS316 |
| Suction/exhaust valve | Aluminum A6063、 SUS316 |
| Major components of the electrical system | |
| Switch, relay | Resin, copper and other composite materials |
| PC board | Glass fiber and other composite materials |
| Power cord | Synthetic rubber coating, copper, nickel and other composite materials |
| Wiring | Glass fiber, flame retardant vinyl, copper, nickel and other composite materials |
| Seal | Resin-based materials |

17. LIST OF HAZARDOUS SUBSTANCES



Never use explosive substances, flammable substances and other substances containing these substances with this machine.

| | | |
|------------------------|-------------|--|
| Explosive substances | Explosive | ①Nitroglycol, nitroglycerine, nitrocellulose, and other explosive nitric esters |
| | | ②Trinitrobenzen, trinitrotoluene, picric acid, and other explosive nitro compounds |
| | | ③Peracetic acid, methyl ethyl ketone peroxide, benzoyl peroxide, and other organic peroxides |
| Combustible substances | Ignitable | Metal "litium", metal "potassium", metal "sodium", yellow phosphorous, phosphorus sul-fide, red phosphorous, celluloid, calcium carbide (alias, carbide), lime phosphide, magnesium powder, aluminum powder, metallic powder other than magnesium powder and aluminum powder, sodium dithionite (alias, sodium hydrosulfite) |
| | Oxidizing | ①Potassium chlorate, sodium chlorate, ammonium chlorate, and other chlorates |
| | | ②Potassium perchlorate, sodium perchlorate, ammonium perchlorate, and other per-chlorates |
| | | ③Potassium peroxide, sodium peroxide, barium peroxide, and other inorganic perox-ides |
| | | ④Potassium nitrate, sodium nitrate, ammonium nitrate, and other nitrates |
| | | ⑤Sodium chlorite, and other chlorites |
| | | ⑥Calcium hypochlorite, and other hypochlorites |
| | Flammable | ①Ethyl ether, gasoline, acetaldehyde, propylene chloride, carbon disulfide, and other substances whose flash point is below minus 30°C |
| | | ②Normal hexane, ethylene oxide, acetone, benzene, methyl ethyl ketone, and other substances whose flash point is or is above minus 30°C and below 0°C |
| | | ③Methanol, ethanol, xylene, pentyl acetate (alias, amyl acetate), and other substances whose flash point is or is above 0°C and below 30°C |
| | | ④Kerosene, light oil, turpentine oil, isopentyl alcohol (alias, isoamyl alcohol), and other substances whose flash point is or is above 30°C and below 65°C |
| | Combustible | Hydrogen, acetylene, ethylene, methane, ethane, propane, butane, and other combus-tible substances that are in the gaseous state at a temperature of 15°C and a pressure of 1 atm. |

(Source: Attached Table No. 1, Article 6, Labor Safety and Health Enforcement Regulations)

Scope of Warranty

Be sure to comply with the handling instructions described in this manual when using the machine.

Yamato Scientific shall not be liable whatsoever for accidents or failures which may result from using the machine in manners not authorized in this manual.

Never attempt operations or actions which are prohibited in this manual.

Such a practice may become a cause of unexpected accidents and failures.

Notice

- This instruction manual is subject to change without notice in the future.
- If you notice the manual is missing pages or not in order, please inform us.

Instruction Manual

Plasma Cleaner

First Version August 8, 2008

Revision October. 28, 2013

Yamato Scientific Co., Ltd.

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Tokyo, 103-0022, Japan

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