



Plasma Dry Cleaner PDC510 Instruction Manual

Version 1

**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 man-
ual and understand them fully.**

YAMATO SCIENTIFIC CO., LTD.

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1. SAFETY PRECAUTIONS

Description of Warning Symbols

Warning Symbols

Various warning symbols are contained in the manual and attached to the product to ensure safe use. Accidents which may result from mishandling are classified as follows. Understand them fully before reading the body.



WARNING

Indicates matters that may cause possible death or serious injury (Note 1).



CAUTION

Indicates matters that may cause possible minor injury (Note 2) and damage to property (Note 3).

Note 1: Serious injury refers to injuries, electric shock, fracture, poisoning, etc. which will entail after effects and those which will require hospitalization or long-time treatment to be cured.

Note 2: Minor injury refers to injuries, electric shock, etc. which will not require hospitalization or long-time treatment to be cured.

Note 3: Damage to property refers to damages to property such as facilities, equipment and buildings.

Meaning of Symbols



This symbol indicates matters that concern "warning" (including caution). Specific contents of warning are provided near this symbol.



This symbol indicates prohibited matters. Specific contents of prohibition are provided near this symbol.



This symbol indicates matters that must be performed. Specific contents of instruction are provided near this symbol.

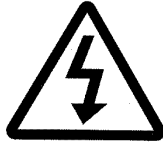
1. SAFETY PRECAUTIONS

A List of Symbols

WARNING



General



High Voltage



High Temp.



Drive Unit



Explosion

CAUTION



General



Electric Shock



Burn

PROHIBITED



General



No Disassembly



No Contact

COMPULSORY



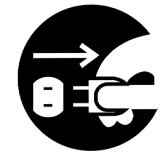
General



Connect Ground Wire



Install Horizontally



Unplug Power



Periodic 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 13. List of Hazardous Substances on page 26.)

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.

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. PRIOR TO USE

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.

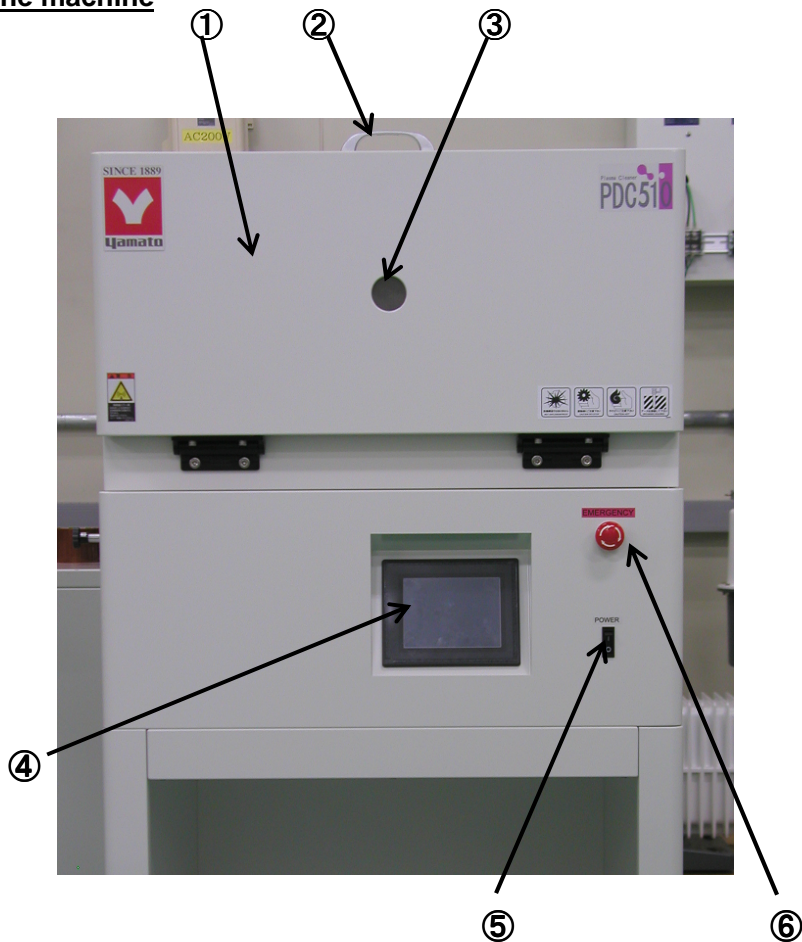
Electric rating: 3-phase, 220 VAC, 20 A, 50/60 Hz

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. COMPONENTS AND FUNCTIONS

Main Unit

Front of the machine

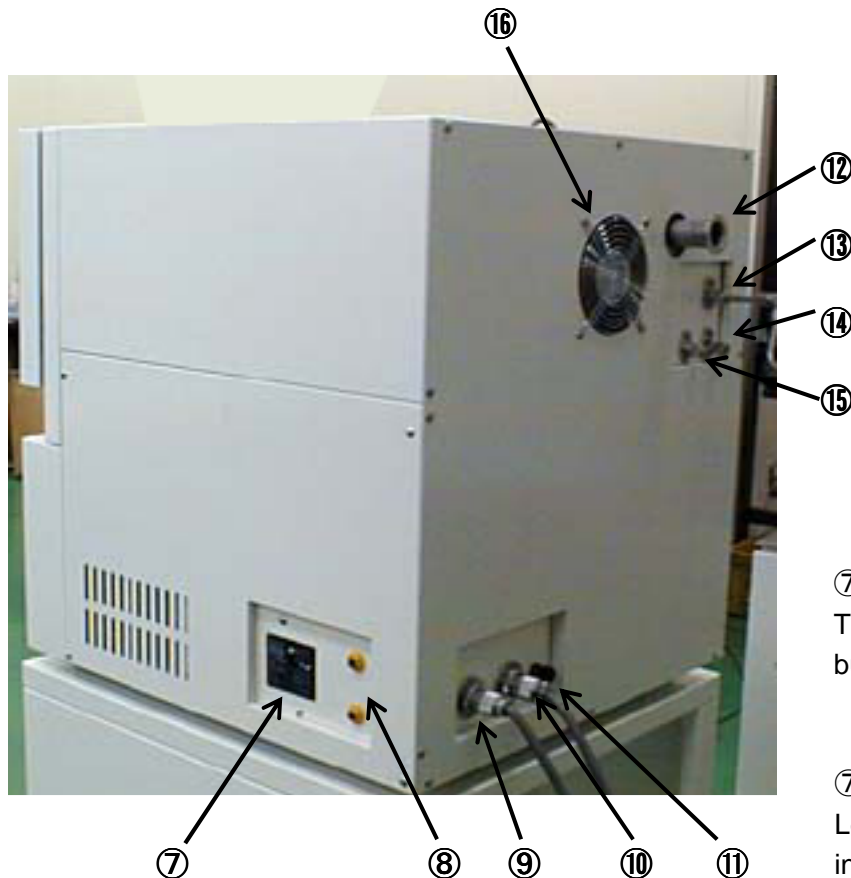


- | | |
|--------------------------------|---|
| ① Door | : A manual door to be opened toward the front. |
| ② Grip | : Used to open and close the door. |
| ③ Check window | : Used to check the plasma conditions. |
| ④ Touch panel | : Used to operate various keys and show various information. |
| ⑤ Operation 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 button | : 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. |

3. COMPONENTS AND FUNCTIONS

Back of the Main Unit

Back of the main unit



- ⑦-1 : Use this during periodic inspections to check if the earth leakage breaker is functioning properly.
- Test button
- ⑦-2 : When leakage occurs, this button pops out.
- Leakage indicator

- 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.
- ⑧ Circuit protector : If overcurrent exceeding 5 A flows in the 100 V line, this protector cuts off the current to protect the machine.
- ⑨ Connector for power cord : Connect this to the distribution panel on the building side. (A 3-m cord is attached for connection.)
- ⑩ Connector for vacuum pump : Connect the cable from the vacuum pump.
- ⑪ Ground terminal : Use this to ground the machine by a line other than the attached power cord or to ground measuring instruments.
- ⑫ Vacuum nozzle : Connect the vacuum pump with the attached flexible tube.
- ⑬ Nitrogen (N₂) gas nozzle : Connect piping from the N₂ gas cylinder. Adjust the pressure to the range of 0.2 MPa to 0.3 MPa.
- ⑭ Argon (Ar) gas nozzle : Connect piping from the Ar gas cylinder. Adjust the pressure to the range of 0.15 MPa to 0.25 MPa.
- ⑮ Oxygen (O₂) gas nozzle : Connect piping from the O₂ gas cylinder. Adjust the pressure to the range of 0.15 MPa to 0.25 MPa.
- ⑯ 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.

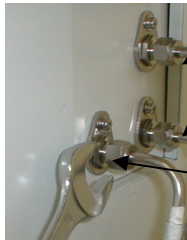
4. INSTALLATION METHOD

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 to connect the machine and the piping and tighten them as described below.

(1) Gas supply nozzle locations and supply pressures

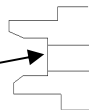


Nitrogen gas (N2)	Supply pressure = 0.2 to 0.3 MPa
Argon gas (Ar)	Supply pressure = 0.15 to 0.25 MPa
Oxygen gas (O2)	Supply pressure = 0.15 to 0.25 MPa

(2) Flare-less joint tightening procedure

- ① Pass a nut, back ferrule and front ferrule to the pipe.
- ② Insert the pipe to the joint to the specified depth.

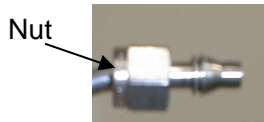
Apply the end face of the pipe here



- 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, 220 VAC, 16 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 vacuum pump cable to the 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.

4. INSTALLATION METHOD

Processing Mode Changeover Method

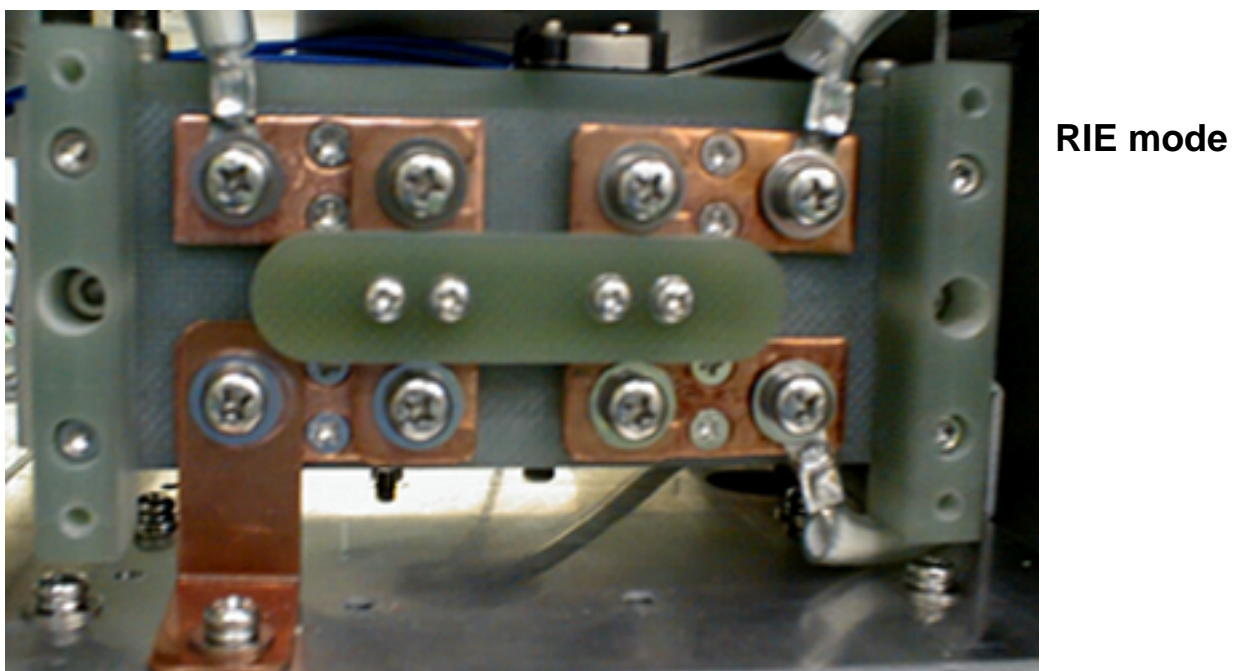
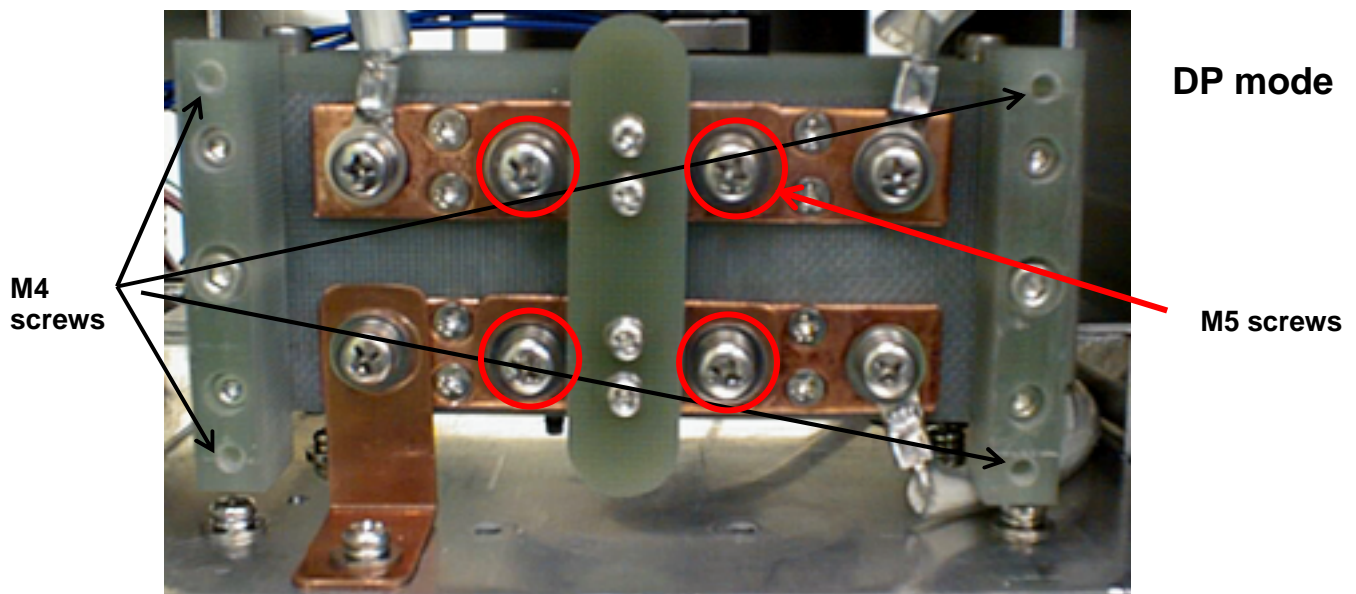
! Prior to starting the work, be sure to turn off the earth leakage breaker.

Handling of the processing mode changeover box

When the left side face plate is removed, you will see the changeover box used to change over the processing mode between DP and RIE.

Prior to running the machine, determine which mode is to be used and set the changeover lever to the desired side.

- (1) Remove the front transparent plate of the changeover box. (M4 screws, 4 pieces)
- (2) Loosen the four screws (M5) colored red. They need not be removed.
- (3) Set the changeover lever to the required mode as shown below and secure it with four screws.
- (4) Attach the transparent plate and then attach the left side face plate.
- (5) When the operation power is turned on, the mode status indicator lamp on the front panel will illuminate. Confirm it.



4. INSTALLATION METHOD

Auto-Tuning adjustment procedure

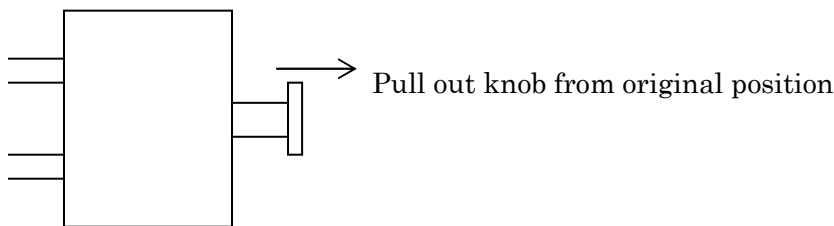
How to adjust the RF matching when conversion RIE and DP mode

- ⚠ This Auto-tuning adjustment procedure is only use following conditions when after conversion RIE to DP or DP to RIE mode.**
- 1) RF power does not match. (RF error occurrence)
 - 2) Load in the chamber does not get in the matching range.

High frequency has to need to take matching for load in the chamber. If can not take matching, Reflection wave become bigger and then RF power does not descend effectively for the load sample in the chamber. Also, in this case sometimes RF generator will become broken cause.

Auto-tuning adjustment switch location is inside left side panel.

- (1) Release interlock switch on side panel.



(Interlock switch)

VC 1 AUTO/MANUAL selection switch

VC 1 motor switch

VC 2 AUTO/MANUAL selection switch

VC 2 motor switch



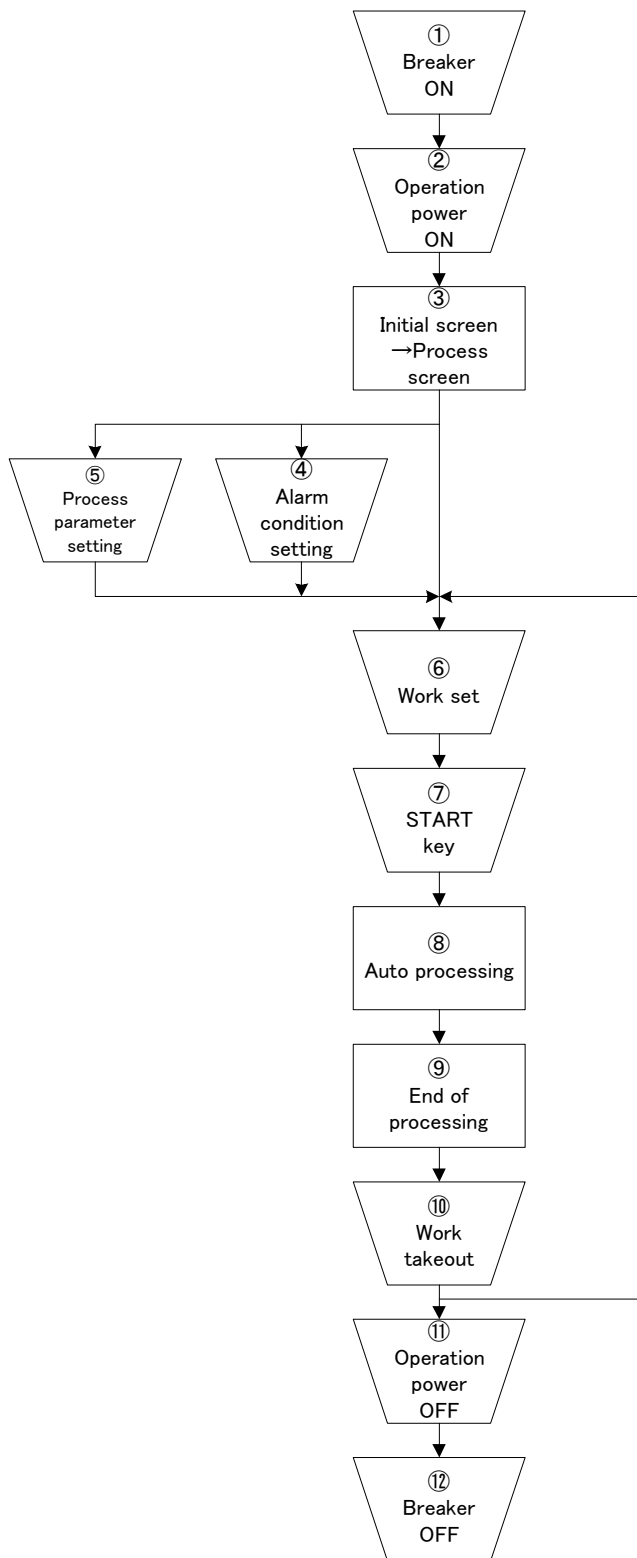
(Auto-tuning adjustment switch)

- (2) Select down position of VC1 and VC2 motor switch.
- (3) Select MANUAL position of AUTO/MANUAL selection switch.
After that about 5 to 10 sec VC1 or VC2 motor are moving.
- (4) AUTO/MANUAL switch return to AUTO position.
- (5) Remain VC1 and VC2 motor switch position.
- (6) Irradiation RF power by this condition. And then check matching.
- (7) After take matching, interlock switch return to original position, and then cover the side panel

5. 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 → 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.

1) How to start the machine

Start the machine by the following procedure:

- ① Supply 3-phase, 220 VAC power to the machine.
- 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 START key.
- ③ The controller automatically performs the process according to the set parameters.
- ④ The end of process is displayed.
- ⑤ 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.
- ⑥ Similarly, set the next work in the chamber and repeat the procedure.

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

- ① Press the SETUP key in the process screen to display the SETUP PROCESS PARAMETER screen.
- ② Set CLEANING 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 SETUP key in the process screen to display the SETUP PROCESS PARAMETER screen.
- ② Press the ALARM key in the SETUP PROCESS PARAMETER screen to display the SETUP ALARM CONDITION screen.
- ③ Set alarm conditions such as RF PERMISSIBLE LEVEL, GAS PERMISSIBLE LEVEL, etc.
- ④ Press the FIRST WINDOW key to return to the process screen.
- ⑤ To begin processing, follow the procedure in (1) above.

5. RUNNING PROCEDURE

Running Procedure

3) Machine stopping procedure

Stop the machine by the following procedure:

- ① Set the machine in the standby state.
- ② Turn off the operation power.
- ③ 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 recovered, 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 22.)

- 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.
- ⑥ 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.



: When the left side face plate is removed, the power to the touch panel, RF and vacuum pump is turned off as when the emergency stop switch is pressed.

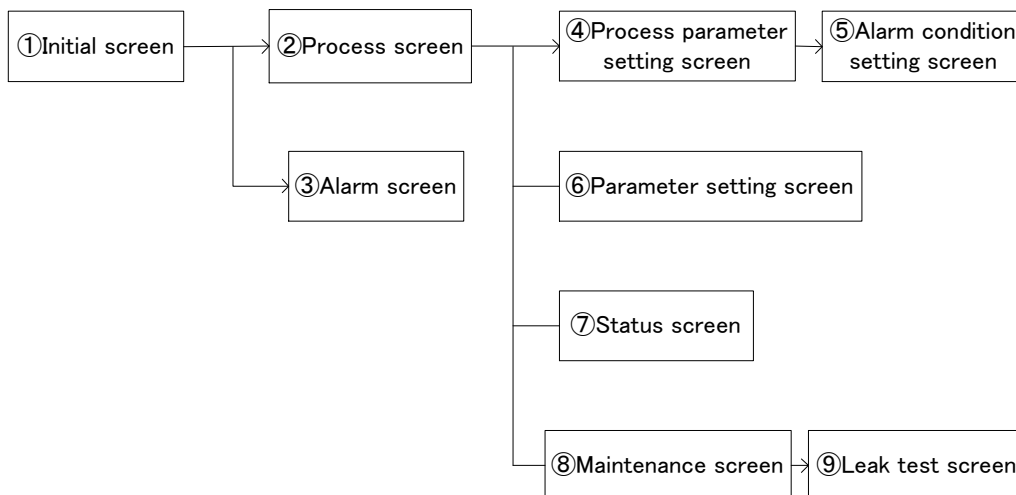
To return the machine to the original status, replace the side face plate to original position.

5. RUNNING PROCEDURE

Touch Panel Operation

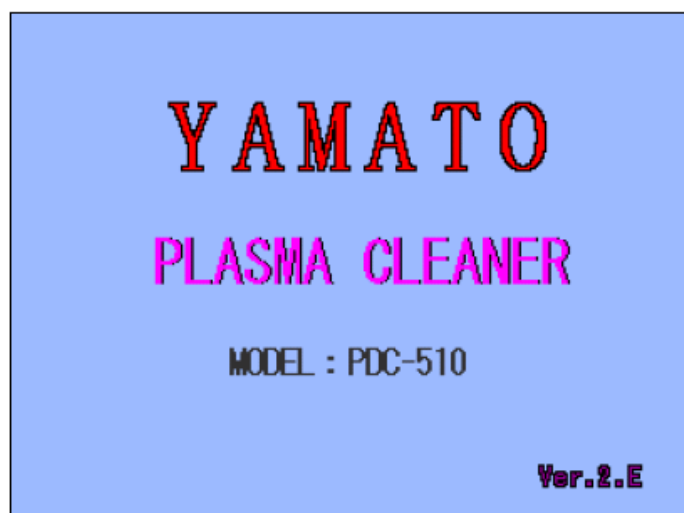
1) Configuration of screens

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



(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.

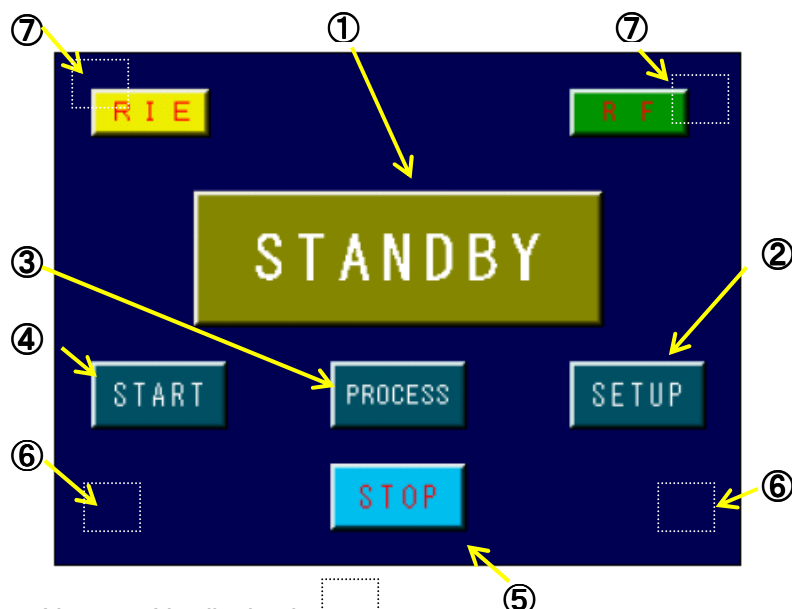


5. RUNNING PROCEDURE

Touch Panel Operation

(2) Process screen

This screen is used to start processing and show the process parameter setting screen.



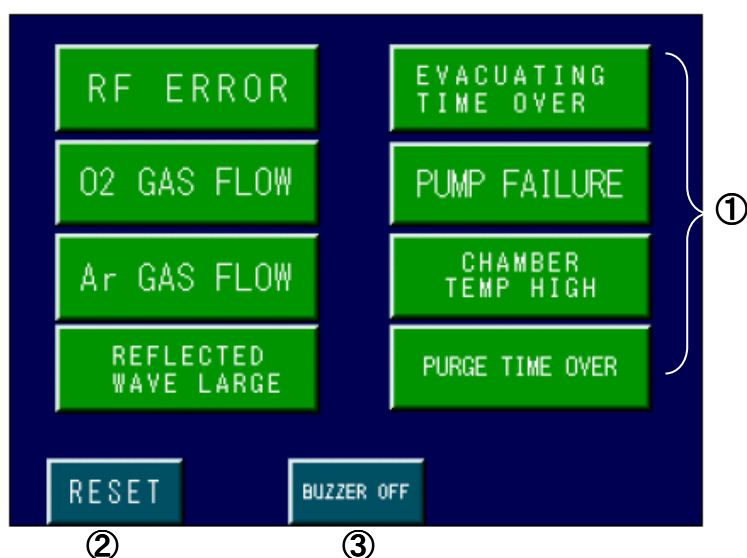
Note 1 No display in  .

- 2 Only the blue keys may be operated.
- 3. After the end of processing, the START key is not accepted before the door is opened.
- 4. The process cannot be started if the door is open.

- ① Shows standby, processing or end of processing according to the current status of the machine.
- ② Changes to the screen to set processing parameters.
- ③ Changes to the status screen to show RF power, reflected waves, gas flow rate, etc. during processing.
- ④ Starts the process.
- ⑤ Stops the process.
- ⑥ When the squares are pressed from the left in sequence, the maintenance screen will appear. In the maintenance screen, evacuating, gas filling and RF on/off operations can be performed independently.
- ⑦ When the squares are pressed from the left in sequence, the parameter setting screen will appear. The parameter setting screen is used to set various parameters such as the max. flow rate of the mass flow controller. Once they have been set, they need not be set again.

(3) 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.

5. RUNNING PROCEDURE

Touch Panel Operation

(4) Process parameter setting screen

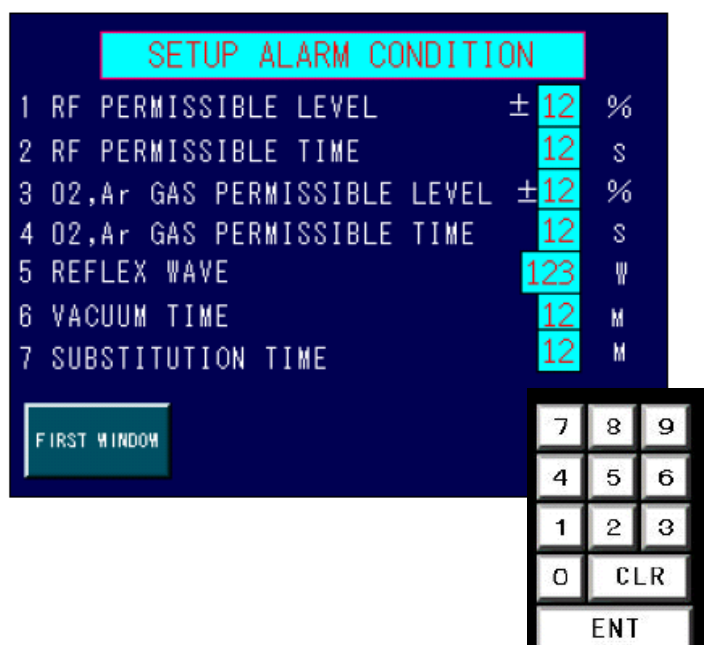
Set process parameters on this screen.



- 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 remains 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 **PROCESS** key to return to the process screen.
- ④ To set alarm conditions, press the **ALARM** key to display the SETUP ALARM CONDITION screen.

(5) 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 remains 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 **PROCESS** key to return to the process screen.
- ④ The default values and input ranges are as follows.

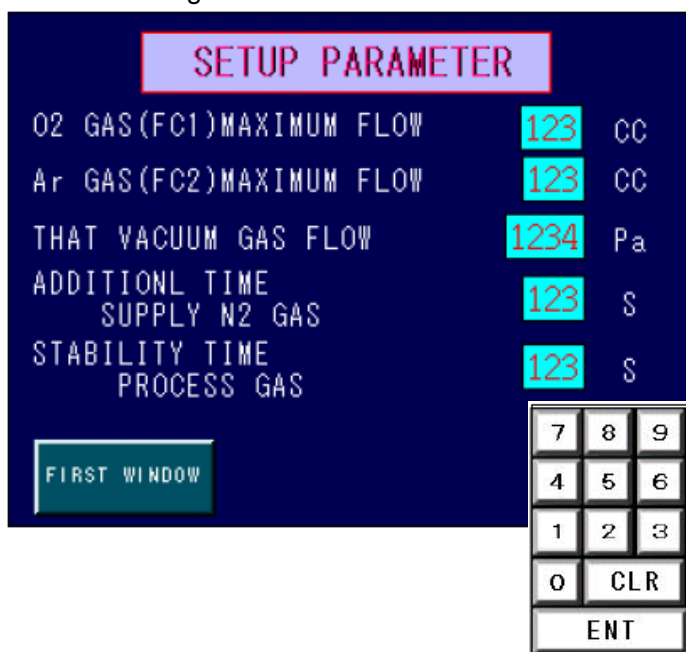
Param. No.	1	2	3	4	5	6	7
Default value	20	10	20	10	20	2	2
Input range	1 – 50	1 – 60	1 – 60	1 – 60	1 – 100	1 – 30	1 – 10

5. RUNNING PROCEDURE

Touch Panel Operation

(6) 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.

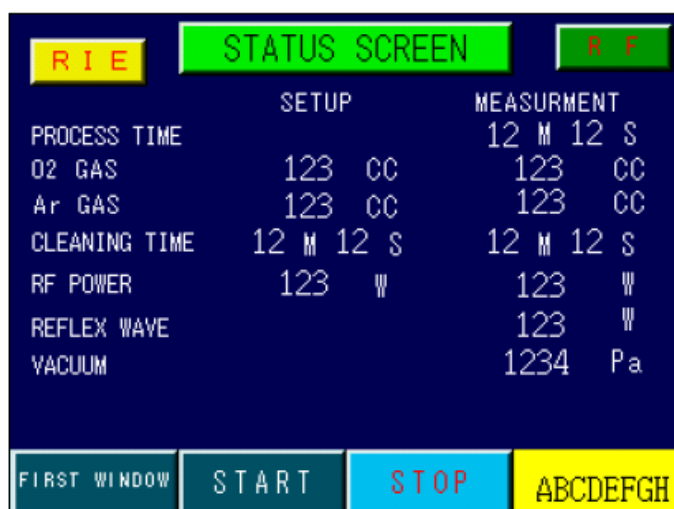


- ① Using the numeric keys, enter a value to a place where the cursor is blinking.
- ② After entering a value, press the **ENT** key. If the **ENT** key is not pressed, the previous value remains unchanged. When the **ENT** key is pressed, the cursor moves to the next item. Enter a value similarly. If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

Parameter	Ar Gas	O2 Gas	Ultimate Vacuum	N2 Add	Stability Time
Default value	100	200	10	5	30

(7) Status 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 Returns to the process 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.

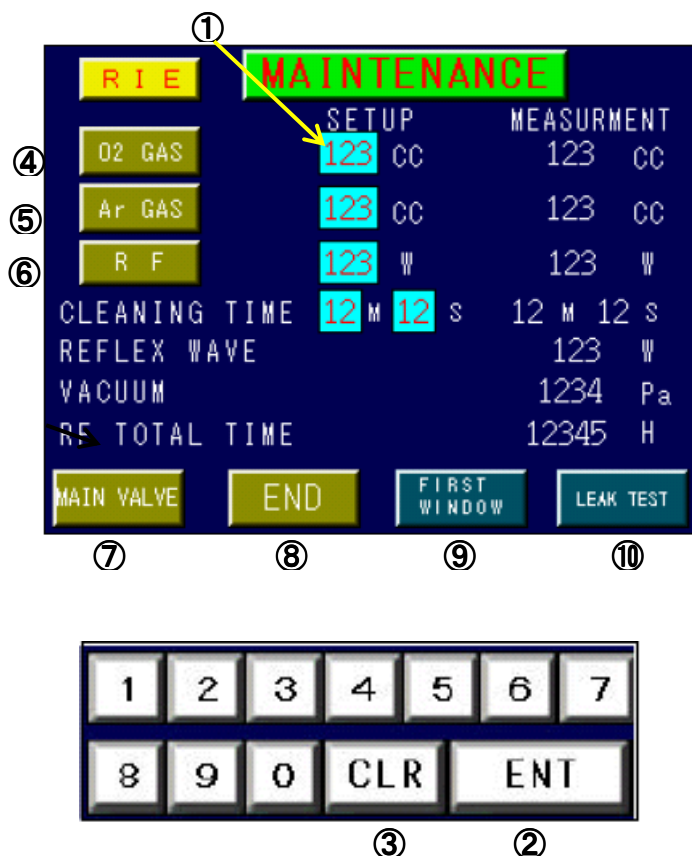
Note 3: The process cannot be started if the door is open.

5. RUNNING PROCEDURE

Touch Panel Operation

(8) Maintenance screen

Use this screen to operate the units independently during maintenance.



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

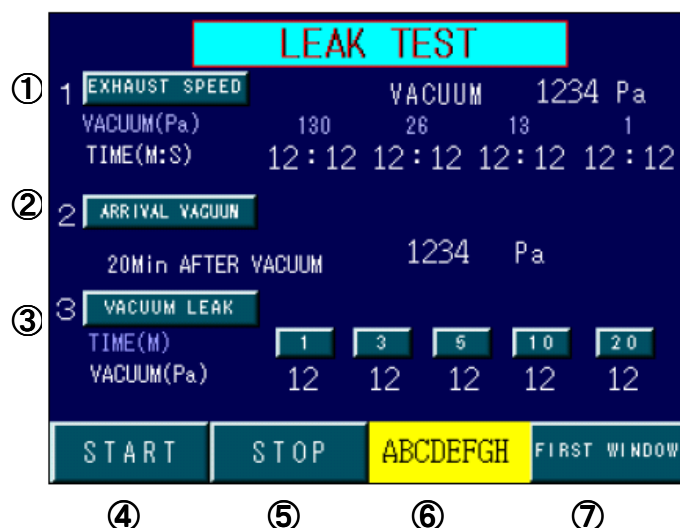
- ① Using the numeric keys, enter a value to a place where the cursor is blinking.
- ② After entering a value, press the **ENT** key. If the **ENT** key is not pressed, the previous value remains unchanged. When the **ENT** key is pressed, the cursor moves to the next item. Enter a value similarly.
- 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 VALVE** key is pressed, evacuating is turned on and off.
- ⑧ When the **END** 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 **FIRST WINDOW** key is pressed, the process screen will appear.
- ⑩ When the **LEAK TEST** key is pressed, the leak test screen will appear.

5. RUNNING PROCEDURE

Touch Panel Operation

(9) 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 20 Pa or below 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 process screen.

6. 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 15. List of Hazardous Substances on page 29.)

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.

7. 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 0.25 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 input 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.

7. 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.

8. ALARMS AND CORRECTIVE ACTIONS

Alarms and Corrective Actions

Alarm	Probable Cause	Corrective Action
RF error	The alarm condition, RF PERMISSIBLE LEVEL, is too low.	Increase the level. (Set this based on the default value 10%)
	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.
Ar 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)
O ₂ gas flow rate error	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 20W)
	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.
Evacuating time over	The alarm condition, VACUUM TIME, is too short.	Increase the value. (Set this based on the default value 2 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 retightening 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 2 min.)
	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 80°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.)
Door open	The door is open.	Close the door firmly.

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

9. 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)

Storage Term of Stock Part(s) for repair

The Unit is manufactured by the customized specification. Therefore, the repair parts will be in stock around 1(one) year.

Some of the repair part(s) will be hard to get on time, so that those parts must be prepared or be bought as the device part(s) in advance. In case for the discontinued parts, we will let you know the substituted part(s), however, Unit may not be kept its maximum performance. And also, some of the repair work will be done at Yamato Facility. Please understand this situation.

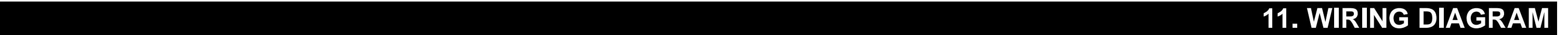
We recommend you to contact with the dealer for the service part(s).

10. SPECIFICATIONS

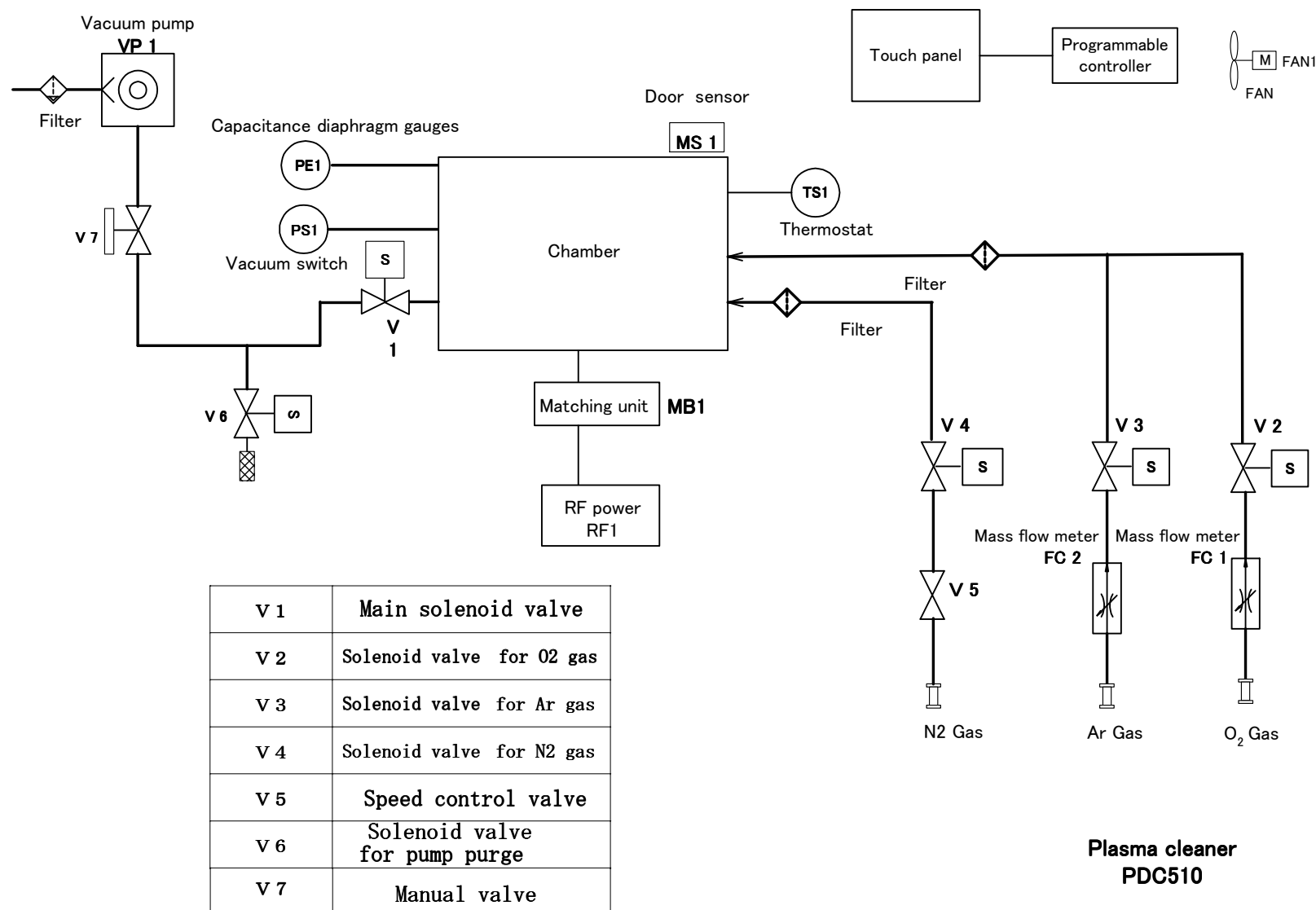
Specifications

	Model	PDC510
Main unit	Power supply	220 VAC 16A 50/60 Hz
	Internal dimensions of chamber	(Width) 500 × (depth) 300 × (height) 200 mm
	Electrode structure	Parallel flat type
	Electrode dimensions	(Width) 410 × (depth) 210 mm
	Plasma method	RIE/DP
	Vacuum meter	Capacitance manometer
	Controller	Programmable controller
	Operation/display unit	5.7-inch STN color LCD touch panel
High-frequency power supply	High-frequency output power	50–500W
	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 T2033SD
	Effective exhaust speed	450/533 L/min (50/60 Hz)
	Suction port shape	NW25
	Exhaust port shape	NW40
	Motor rated output	1.1 kW
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 200 SCCM 1/4-inch flare-less joint

11. WIRING DIAGRAM



12.GAS/PRESSURE DELIVERY MODULE 1er



13. PARTS LIST

Part name	Specification	Maker
Electrode	PDC51-30750 Aluminum	YAMATO SCIENTIFIC CO.,LTD
Insulation plate for electrode	PDC51-30742 Ceramics	YAMATO SCIENTIFIC CO.,LTD
Insulating collar 3	PDC21-40010 Ceramics	YAMATO SCIENTIFIC CO.,LTD
Insulating collar 2	PDC21-40800 Teflon	YAMATO SCIENTIFIC CO.,LTD
Shaft for electrode	PDC21-30780 Aluminum	YAMATO SCIENTIFIC CO.,LTD
Holder	PDC21-30770 Aluminum	YAMATO SCIENTIFIC CO.,LTD
O-ring(for electrode)	V40 Viton	YAMATO SCIENTIFIC CO.,LTD
O-ring(for observation window)	V55 Viton	YAMATO SCIENTIFIC CO.,LTD
O-ring(for Front door/Rear panel)	V430 Viton	YAMATO SCIENTIFIC CO.,LTD

14. 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	Steel plate, melamine, epoxy composite resin paint
Chamber, door	Aluminum A5052
Insulating plate	Ceramics
Check window	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

15. 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
	Ignitable	Metal "lithium", metal "potassium", metal "sodium", yellow phosphorous, phosphorus sulfide, 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)
		①Potassium chlorate, sodium chlorate, ammonium chlorate, and other chlorates
		②Potassium perchlorate, sodium perchlorate, ammonium perchlorate, and other perchlorates
		③Potassium peroxide, sodium peroxide, barium peroxide, and other inorganic peroxides
		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, isopenthyll 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 combustible 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

Version 1 March 29, 2010

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