Plasma Treatment System

PiPi

Instruction Manual

Version 3

Thank you for purchasing the YAMATO MATERIAL Plasma Treatment System (PiPi).
To ensure your proper handling of the, please read this instruction manual and the warranty carefully.
After reading keep the manual and the warranty documents in a safe place for future use.

⚠ **WARNING: Prior to use of this equipment, read this manual carefully and familiarize yourself with all the aspects for its safe use.**

Yamato Scientific Co. LTD.

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1. SAFETY PRECAUTIONS

Description of Warning Symbols

Warning Symbols

A variety of warning symbols are contained in the manual and applied to the product to assist safe and proper usage of the product as well as to warn you of potential hazards to yourself. Possible accidents are classified below. Be sure to read and observe the following.

⚠ **WARNING**	Indicates matters that may cause serious injury or possible death (Note 1).
⚠ **CAUTION**	Indicates matters that may cause possible 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 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 type refers to "WARNING".
Details of the warning are provided after the symbol.


This type refers to "CAUTION".
Details of the caution are provided after the symbol.


This type refers to prohibited matters.
Details of the prohibition are provided after the symbol.


This type refers to the matters that you must follow.
Detail of the instruction are provide after the symbol

1. SAFETY PRECAUTIONS

List of Symbols

WARNING


General


High Voltage


High Temp.


Mechanical Power


Explosion

CAUTION


General


Electric Shock


Burn

PROHIBITED


General


No Disassembly


No Contact

COMPULSORY


General


Connect Ground

Level Installation


Unplug


Periodic Inspection

1. SAFETY PRECAUTIONS

Warning and Caution

⚠ Warning

1. Do NOT use in flammable or explosive environment

Never operate the equipment in a flammable or explosive environment. The equipment is not explosion proofed. Electric sparks caused by switching on and off or during the operation may cause a fire or explosion. (See 15. List of Hazardous Substances on page 30.)

2. Do NOT use explosive or flammable substances

Never use explosive or flammable substances or substances which contain any of these. The equipment is not designed or equipped with safety features against the use of such substance. They may cause an explosion or fire.

3. Do NOT use in abnormal conditions.

If you encounter unusual problems such as smoke, offensive odor, etc., immediately turn off the equipment and also turn off the power distribution panel in the building. They may cause a fire and electric shock.

4. Do NOT disassemble or modify

Customers shall never disassemble or modify the equipment. Unauthorized disassembly or modification may cause a failure, fire, electric shock and other accidents.

5. Attention to power cord handling

Do not use bundled power cords. Use of bundled cords may cause a fire due to overheating.
Do not alter, bend, twist or pull the power cords by force. Such actions may cause a fire or electric shock.
Do not damage power cords by placing a desk or chair on or crimping them with some device. Such actions may cause a fire or electric shock.
Do not put the power cords by heating devices such as a heater. The coating of the cords may be burnt and cause a fire or electric shock.

If a power cord is damaged (exposed core wire or wire breakage), immediately turn off the power to the equipment and also power off any power source. Then request the dealer for a cord replacement. Continued use of such damaged cords may cause a fire or electric shock.

6. Use specified processing gas

Make sure to use the specified processing gas (argon gas). If other gas is used, the actual flow rate may be different from the specified value. Be aware that damages to the product, insufficient cleaning or other problems may also occur.

2. PRIOR TO USE

Precautions for Installation

⚠ Warning

1. Ensure ground connection

- To protect from electric shock due to faulty current, be sure to connect the ground wire to the ground terminal of the building.
- Never connect the ground wire to a gas pipe, a water pipe, a ground terminal of a telephone or a lightning rod. Such connections may cause a fire and electric shock.

2. Select a suitable installation site

Do NOT install the equipment in the following places:

- An unstable place.
- A place where flammable or corrosive gas is generated
- A place where ambient temperature rises above 95 degrees F
- A place where temperature fluctuates greatly.
- A place with a lot of dust or moisture.
- A place receiving direct sunlight.
- A place with a lot of vibrations.

3. Install on a level surface

Install the equipment on a level surface. If the equipment does not have full contact with the floor, vibration and noise may occur and cause unexpected trouble or failure.

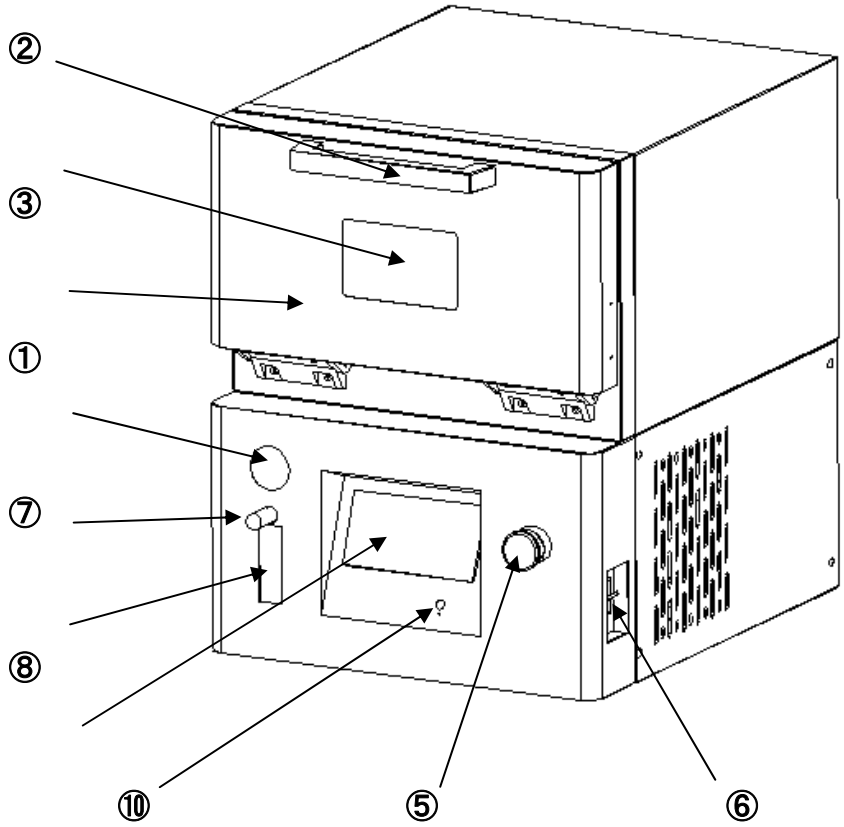
4. Appropriate connection to a power supply

Use an outlet with 3 prongs with ground connection.
Power source: single- phase, 100VAC, 15A, 50/60Hz
If the power supply does not meet the specification, for example sharing the line with other equipment, the equipment not run properly.

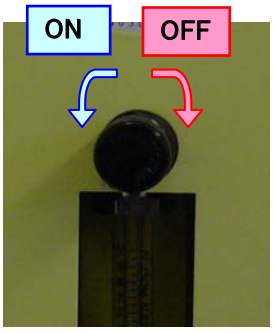
3. COMPONENTS AND FUNCTIONS

Main Unit

Front of the main unit



①	Door	: A manual door which opens out flat.
②	Door handle	: Use to open and close the door.
③	Observation window	: Use to check the plasma conditions.
④	Touch panel	: Displays operation keys and other information.
⑤	Emergency stop switch button	: Use in an emergency. Press this button to turn off the RF power supply, vacuum pump and power supply to the touch screen display panel. A red-light indicates an emergency stop. Turn clockwise to reset.
⑥	Power Switch (Earth leakage breaker)	: Turn on to power the equipment. Leakage of 30mA or over or excess current over 15A cuts off the power in order to protect the safety of the operator and the equipment.
⑥-1	Test button	: Use to check that the leakage breaker functions properly during periodic inspections.
⑦	Bourdon Vacuum gauge	: Measures vacuum.
⑧	Flow rate control knob	: Use to set flow rate of Ar gas.
⑨	Mass flow meter	: Measure flow rate of Ar gas.
⑩	RF power control knob	: Use to set RF power.

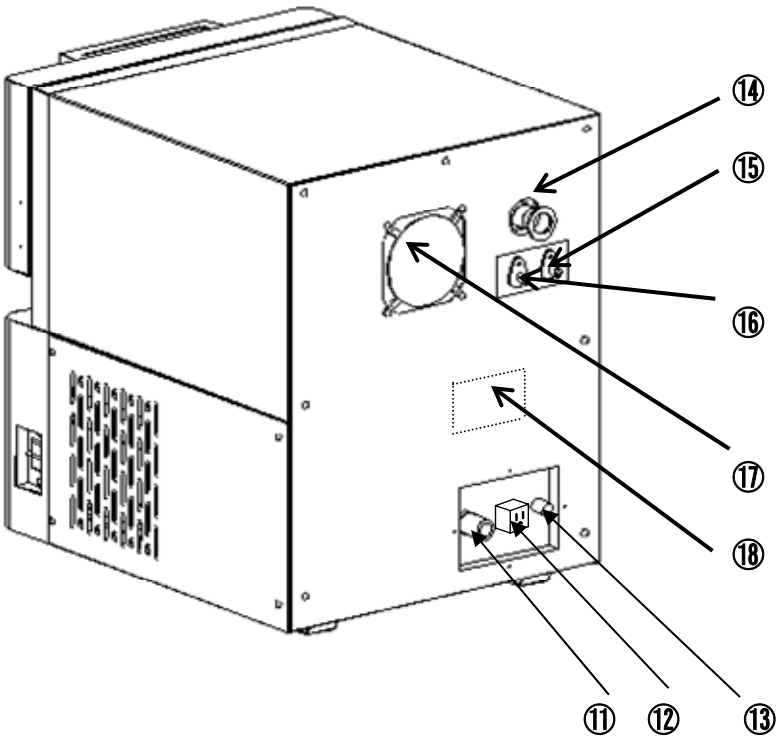


Flow rate control knob

3. COMPONENTS AND FUNCTIONS

Back of the Main Unit

Back of the main unit



⑪	Connector for power cable	: Connect to a building 3 prong ground connection receptacle. (Use the provided 3 meter power cable)
⑫	Receptacle for Vacuum Pump	: Connect the power cable plug of vacuum pump.
⑬	Ground terminal	: Grounding from other ground connection than the provided power cable or use to ground other equipment.
⑭	Vacuum nozzle	: Connect to the vacuum pump using the provided flexible tube.
⑮	Argon (Ar) gas nozzle	: Connect the tube from the Ar gas cylinder. Adjust the gas pressure to 0.2 MPa.
⑯	Nitrogen (N2) gas nozzle (for purge)	: Connect the tube from N2 gas cylinder. Adjust the gas pressure in the range of 0.2 to 0.3 MPa.
⑰	Cooling fan	: Cools inside the enclosure. Maintain at least 10 cm of clearance around the equipment for unobstructed airflow.
⑱	Nameplate label	: Describes model, rating and serial number of the equipment.

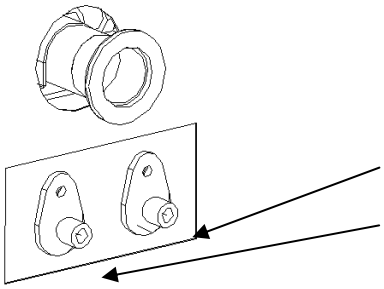
4. INSTALLATION METHOD

Required Equipment / Connection of Cables and Tubes

1） Gas piping

Gas piping for the equipment must be prepared by the user. Connect piping to the gas supply ports on the back of the equipment and supply gases at the prescribed pressures. Use the provided 1/4-inch Swagelok to connect the equipment and the piping and fasten them as described below.

(1) Position of gas supply nozzles and supply pressures



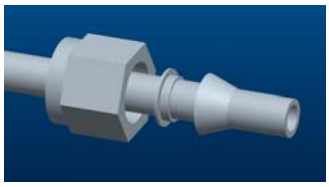
Argon (Ar) gas　　Supply pressure ＝ 0.2 MPa

Nitrogen (N2) gas　　Supply pressure ＝ 0.2 to 0.3 MPa

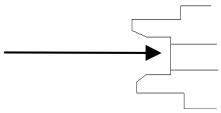
(2) Fastening compression bite-type tube fitting

① Run a nut, back ferrule and front ferrule through the pipe.

② Insert the pipe into the joint to the specified depth.



Put the end of the pipe here

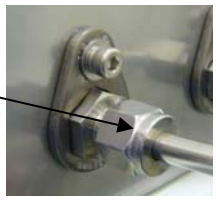


Nut　Back ferrule　Front ferrule

③ Tightly finger-fasten the nut.

► Watch that the pipe does not bend to produce resistance.

④ Using a wrench, tighten the finger-tightened nut one and a quarter turns.



The left picture shows the correctly tightened installation.

2） Electrical connection

The equipment requires single-phase, 100VAC and 15A (3A for the main unit, PDC100, and 8A for YSC recommended Pump Model PD138).

3） Vacuum pump

Install the vacuum pump by the following procedure (for reference):

① Referring to the instruction manual for the provided vacuum pump, put oil in the vacuum pump.

② Place the vacuum pump horizontally on the floor or a sturdy table.

③ Connect the power cable plug of the vacuum pump to the receptacle located behind the equipment

④ Attach the oil mist trap to the vacuum pump.

⑤ Connect the nozzle and the vacuum pump with the provided flexible tube and NW25 clamp.

4. INSTALLATION METHOD

Connection of Vacuum Pump

⚠
This instruction will be applied for YSC recommended Pump Model PD138 only.

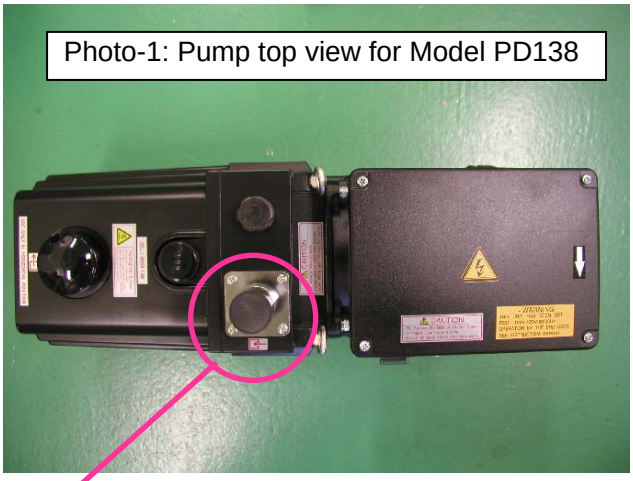


Photo-1: Pump top view for Model PD138

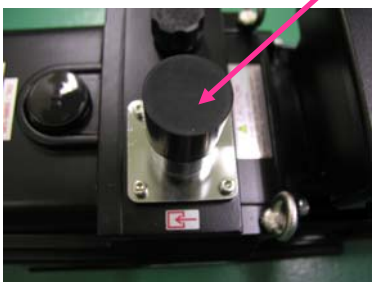


Photo-2: Attached flange at delivery

Photo-3: New flange for Model PiPi

The attached flange with its pump at delivery as showing Photo-2 must be changed to new flange as showing Phpto-3 at first, that a flexible tube will be connected onto its new flange.

① 4(four) fasteners will be taken off. And the attached flange removed, then new flange must be mounted by those 4(four) fasteners to its position for Plasma Treatment System(**PTS**) Model PiPi connecting with a flexible tube.
（Do not remove the O-ring at the new flange assembly as showing the photo-4 & -5 below.）

Photo-4: Set O-ring in its groove

Photo-5: The mounted new

Follow the procedure below ② thru. ⑥ referring with Pump Instruction Manual (No.58500-2-03-1) of Model PD138.

② Check Changeover Switch to be set as 100-120V Class in the terminal box of this Vacuum Pump.
<See Page 9 in Vacuum Pump Instruction Manual(**VPIM**) of Model PD138 (No.58500-2-03-1)>

4. INSTALLATION METHOD

Connection of Vacuum Pump

③ Install Unplug-preventive Hardware to An Inlet of this Pump.（Do not throw the plastic bag/envelop out by mistake, because Unplug-preventive Hardware will be in its bag/envelop.）<See Page 2/2 and 4 in **VPIM** >

④ Insert Plug of the power cable into An Inlet. <See Page 2/2 and 4 in **VPIM** >

⑤ Pour the specified oil to Vacuum Pump. At this time, this Vacuum Pump must be placed on the leveled floor or on the rigid table. <See Page 7 in **VPIM** >

⑥ Screw Oil Mist Trap CW direction into Outlet Pipe of this Vacuum Pump. <See Page 17 in **VPIM** >

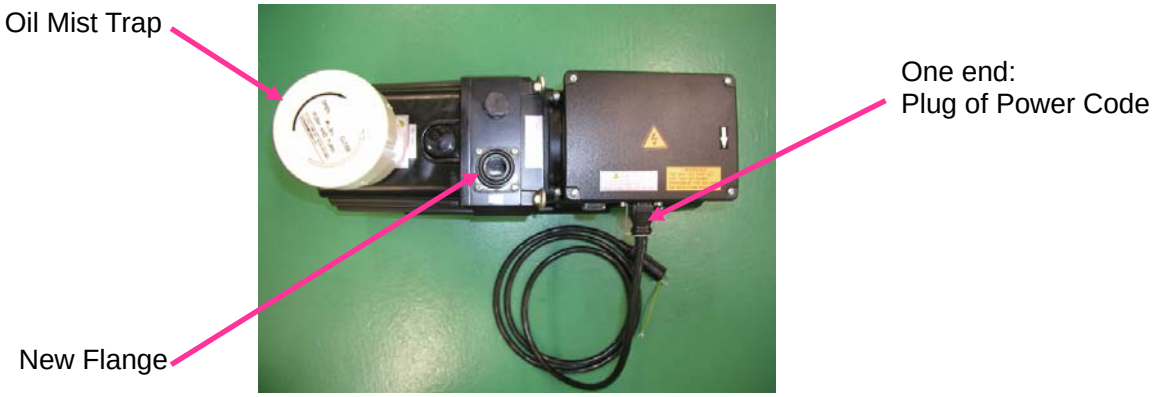


Photo-7: Procedure ① thru. ⑥ are done on this Pump

⑦ Connect Vacuum Nozzle of **PTS** Model PiPi with the new flange of this Vacuum Pump by the accessory flexible tube.

（Flange Size & its clamp: NW25 clamp required only on this Pump, and NW25 clamp w/O-ring on **PTS** Model PiPi.）

⑧ Connect the other side of the power cable plug to the receptacle located behind **PTS** Model PiPi.

（**Caution**：**Must be disconnected PTS Model PiPi power OFF at this Procedure ⑧.**）

Photo-8: Receptacle on **PTS** Model PiPi.

Photo-9: Plug into the receptacle on **PTS** Model PiPi.

⑨ Switch on Vacuum Pump.

The installation of this Vacuum Pump is completed.

⚠ **Do not connect a vacuum pump of power required single phase 200V AC.**

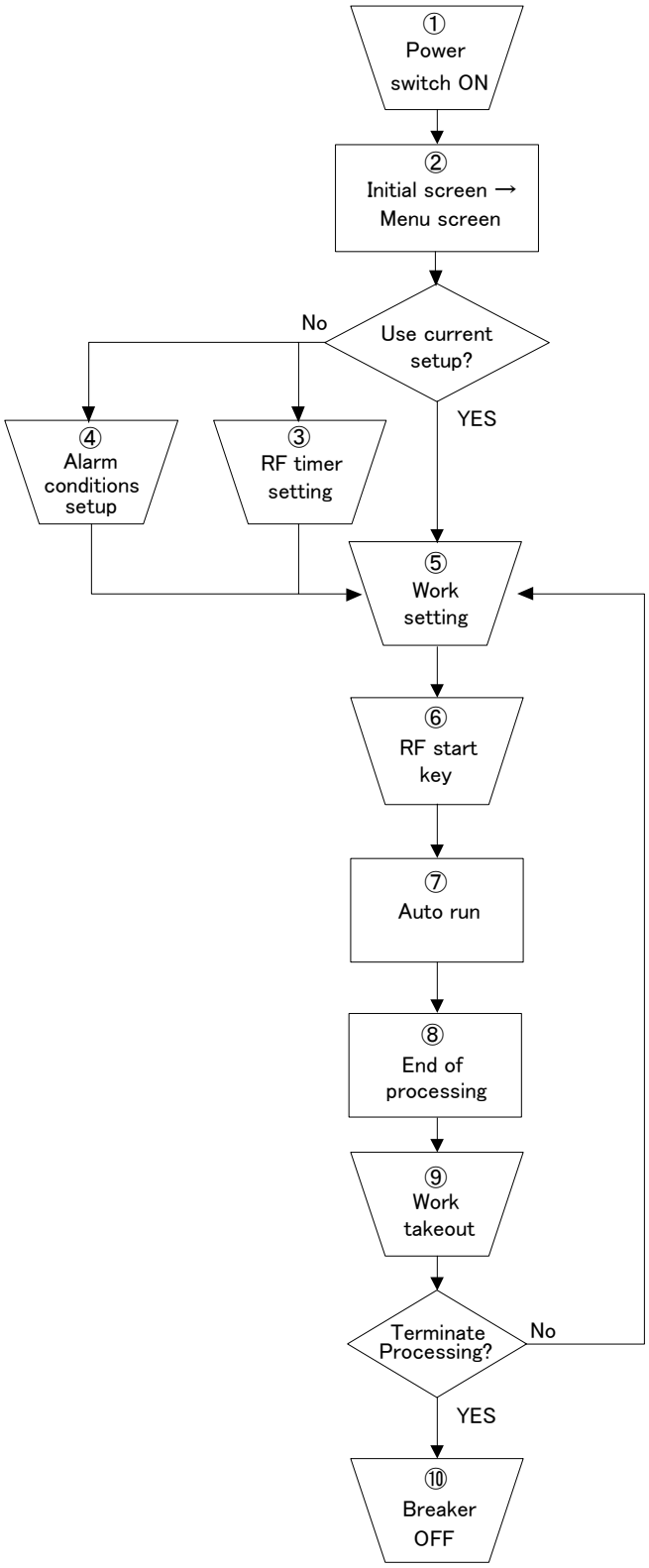
PTS Model PiPi has equipped with the single phase 100V AC receptacle only.

＊If a single phase 200V AC vacuum pump is connected accidentally, that pump will not be started, and also 'Pump Error' will be displayed on PTS Touch Panel.

5. OPERATION PROCEDURE

Auto Run Procedure

The procedure and setup items for auto run are outlined below.



① Turn on the power switch (earth leakage breaker) to supply power to the machine.
When the power switch is turned on, the operation panel and the vacuum pump are turned on and ready to run.

② The initial screen will be displayed for a few seconds after the power switch is turned on. During this time, the controller performs initialization, and when it is completed, the processing screen will appear.

③ Set RF process time (by RF timer). No setup is required unless any of the previous setup parameters needs to be changed.

④ Set the upper limit of reflected wave of RF power. No setup is required unless any of the previous conditions needs to be changed.

⑤ Set the work piece inside the chamber and shut the door.

⑥ Press the RF start key.

⑦ The controller automatically performs the following processes according to the conditions set.
Evacuation for a pre-set time → Gas supply start → Diffusion → Turning on RF → Processing time → Closure of the main valve → N_2purge → Atmospheric pressure in the chamber back to normal level

⑧ When the processing is completed, “END OF AUTO RUN” is displayed.

⑨ Take out the work piece.
(To go on to the next processing, set the next work piece inside the chamber and press the RF start key.)

⑩ Turn off the power switch.

: Indicates an item manipulated by the operator.

5. OPERATION PROCEDURE

Operation Procedure

1) Equipment start up

Start up the equipment according to the following procedure:

① Feed single-phase100-volt AC to the equipment.

② Turn on the power switch of the equipment.

③ The touch panel will display the initial screen for several seconds followed by the menu screen to set the equipment ready for running.

2) Plasma-cleaning procedure and operating instructions

After starting up the equipment, plasma-clean the work piece according to the following procedure:

(1) If parameters of plasma-cleaning process need to be set up (or changed)

① Press the manual run screen key to display the manual run screen.

② Press the main valve open/close key to open the valve (stand by for about 30 seconds).

③ Press the open/close key for the reaction gas valve and adjust the flow rate by the mass flow meter.

(Gas displacement takes approximately 30 seconds)

④ Press the RF power on/off key to start plasma-cleaning.

⑤ Check the finished condition, then perform purge.

►Set any process changes before performing auto run.

(2) If no change in the plasma-cleaning time is needed,

① Press the auto run screen key to display auto run screen.

② Set the work piece inside the chamber and shut the door.

③ Press the RF start key.

④ The controller automatically processes according to the setup parameters.

⑤ End of auto run is displayed.

⑥ Open the door to take out the work piece.

⑦ In the same manner, set the next work piece inside the chamber and start processing (by pressing the RF start key).

(3) If the plasma-settings need to be changed,

① Press the setup key on the auto run screen to display RF auto run and RF timer setup screens.

② Set the RF timer (RF power and flow rate of reaction gas can be adjusted by corresponding knobs).

③ Press the RF start key for processing.

(4)If alarm conditions need to be et up,

① Press the alarm setup key in the menu screen.

② Set the upper limit of RF reflected wave to detect errors.

③ Press the menu screen key to return to the menu screen.

④ Follow the procedure indicated in instruction (1) above for processing.

(5)If parameters need to be set up,

① Press the parameter setup on the menu screen to display the parameter setup screen.

② Set N2 purge time and inflow time of reaction gas.

3) How to stop the equipment

Stop the equipment according to the following procedure:

① Set the equipment in standby mode (or return to the menu screen).

② Turn off the power switch.

You may turn off the power switch at any mode. By turning off the equipment in standby mode, the pressure inside the chamber returns to normal atmospheric pressure so that the door is ready to either open or close any time. To keep a vacuum state inside the camber, stop the equipment by the following procedure: MANUAL RUN SCREEN → Turn the MAIN on (open the main valve) → Hold for more than one minute) → Turn off the power switch.

4) Action if there is a power failure

When a power fails, all the operations will stop, and no operating condition will be stored. When the power is recovered, the controller displays the initial screen for seconds followed by the menu screen that indicates standby mode. For the rest of the operation, perform the normal procedure.

5) Action if there is an alarm

(See page 23 for causes of and responses to alarms)

① If an abnormal situation occurs, the alarm buzzer sounds, and simultaneously the corresponding type of abnormal state will show on the touch panel.

② Identify the problem and implement appropriate solutions. (Press the ALARM RESET key to stop the alarm)

③ After implementing the solutions, press the RESET key for N2 purge. When it is completed, the vacuum pump will start running, and simultaneously, the screen will switch to the menu.

④ Return to the normal procedure.

6)Emergency stop

Use the switch button when an abnormal simulation requires emergency stop of the equipment.

Press the “Emergency Stop Switch” button on the front panel, and you will see the lamp for emergency stop turned on. Then the power to the touch panel, the RF and the vacuum will be disconnected.

To reset the equipment, perform the following procedure:

① Correct the cause of the emergency.

② Turn the emergency stop switch button a quarter turn in the direction of the arrow sign and return clockwise to reset the equipment.

③ The controller will display the initial screen for several seconds, followed by the menu screen that indicates standby mode.

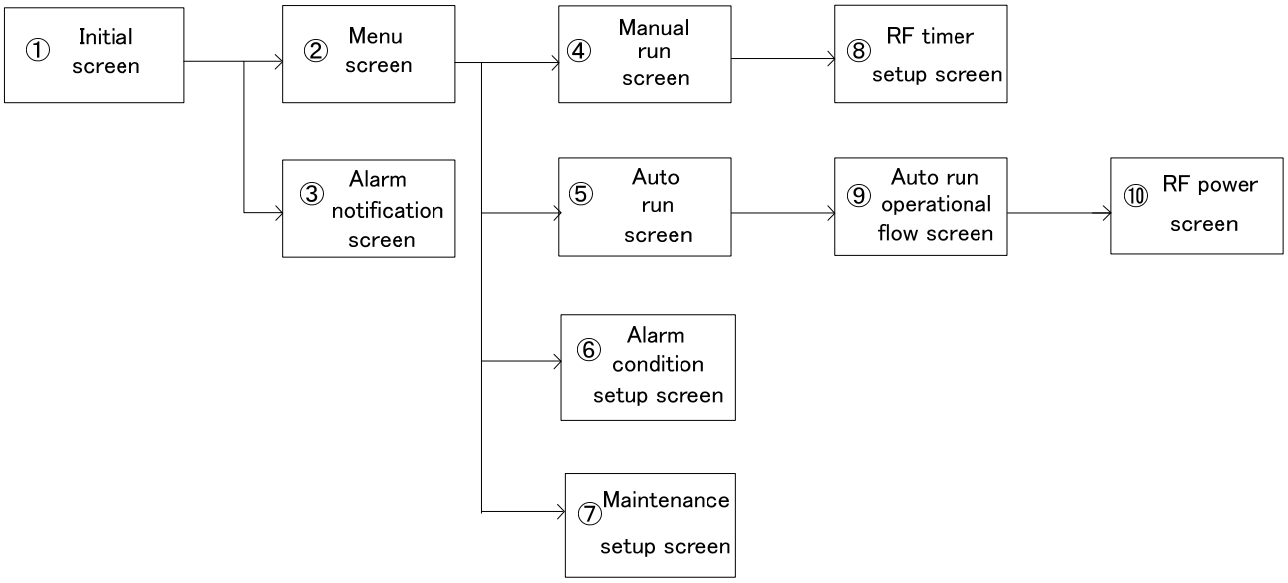
④ Set the pressure inside the chamber equal to atmospheric pressure (select MANUAL RUN from MENU then press PURGE key) before returning to the normal procedure.

5. OPERATION PROCEDURE

Touch Panel Operation

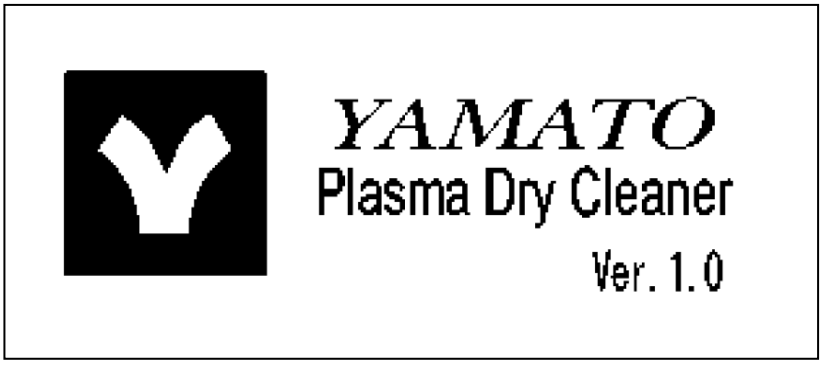
1) Screen structure

The operating screens are structured as follows (the arrow signs (→) indicate lower-level screens) :



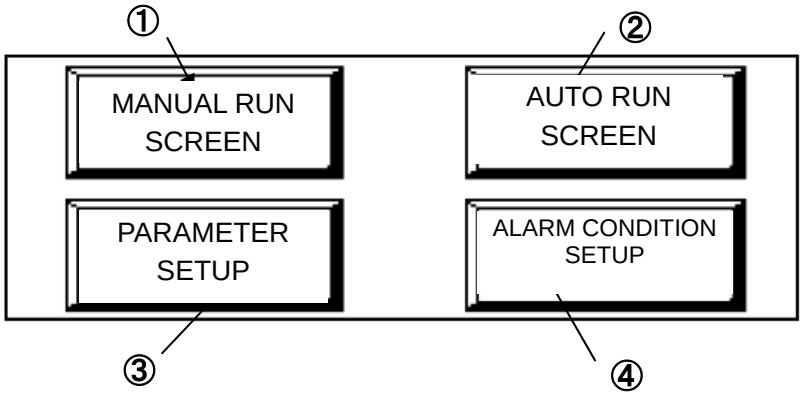
(1) Initial screen

This screen below will automatically appear when the equipment is powered on. While this screen is displayed, the controller will perform initial setting without any inputs by the user.



(2) Menu screen

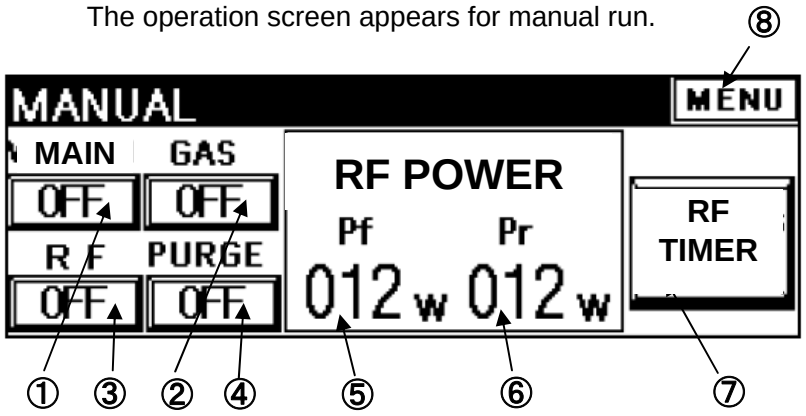
This screen display manus for manual / auto run and all the setup screens.



① Switch to the manual run screen (3).
② Switch to the auto run screen (5).
③ Switch to the parameter setup screen (10) for auto run.
④ Switch to the alarm condition setup screen (9)

(3) Manual run screen

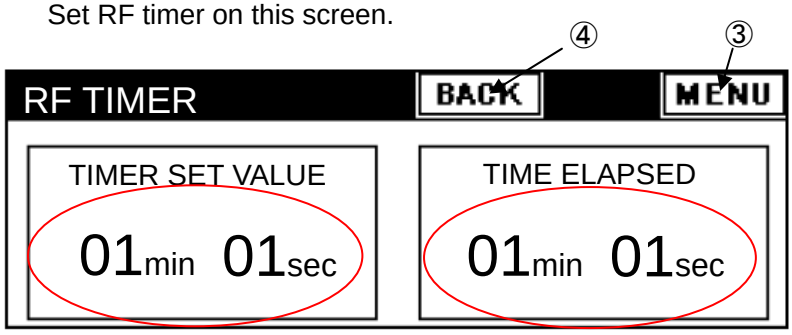
The operation screen appears for manual run.



① Perform open/close of the main valve.
② Perform open/close of the reaction gas valve.
③ Perform turning on/off for RF power.
④ Perform turning on/off for the purge valve.
⑤ Indicating RF output
⑥ Indicating reflected wave RF power.
⑦ Switch to the RF timer setup screen (4).
⑧ Switch to the screen (2).

(4) RF timer setup screen

Set RF timer on this screen.



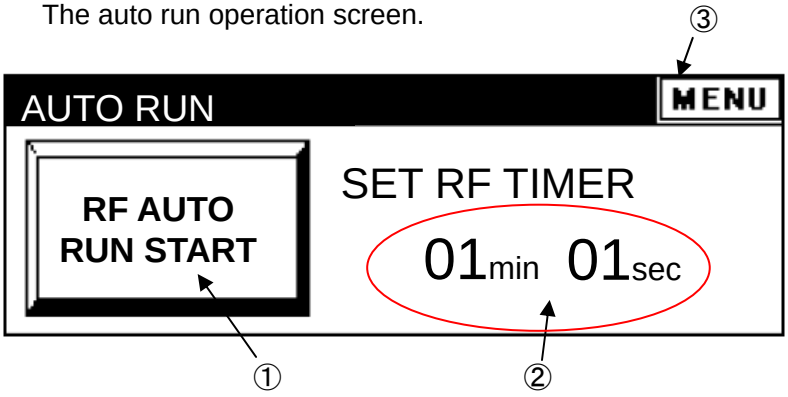
① Indicating set value of the timer.
② Indicating time elapsed since RF power was turned on.
③ Press to return to screen (2).
④ Press to return to screen (3).

《Timer setup procedure》

1) Touch the number display ① to display the keyboard screen.
   ► Touch ⑤ for setup by minutes and ⑥ for setup by seconds.
2) Enter RF output duration time from the keyboard.
3) Press the ④ key to return to screen (3).
   ► During plasma-cleaning, time setting cannot be changed.

(5) Auto run screen

The auto run operation screen.

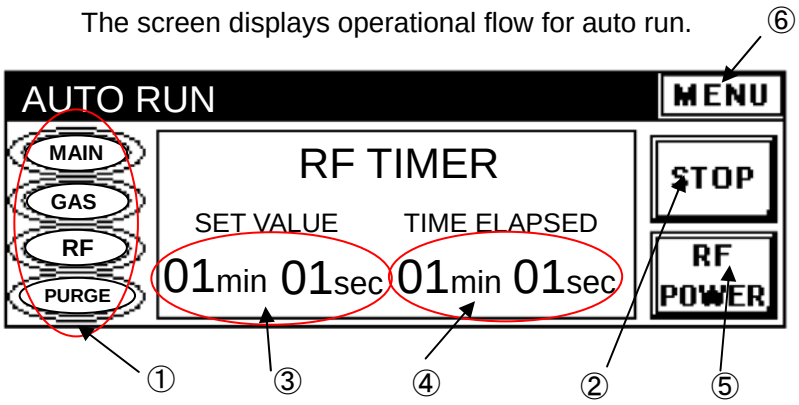


① Press to start auto run and switch to screen (6) (the auto run operational flow screen).
② Indicates set value of the timer.
③ Press to return to screen (2)

► RF timer can be set up in the same manner as explained for the manual run.
► Set reaction gas flow / purge time on the parameter setting screen as explained in (10).

(6) Auto run operational flow screen

The screen displays operational flow for auto run.

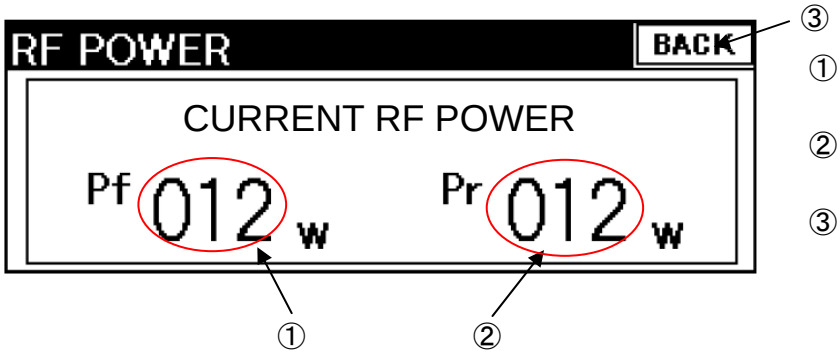


① Displaying operational flow. The item is blackened as soon as it starts running.
② Press stop auto run.
③ Indicating setup value of the timer.
④ Indicating time elapsed since RF power was turned on.
⑤ Press to switch to the screen (7), auto run RF power screen.
⑥ Press to switch to the screen (2).

► You cannot change the setup value of the timer on this screen.

(7) Auto run RF Power screen

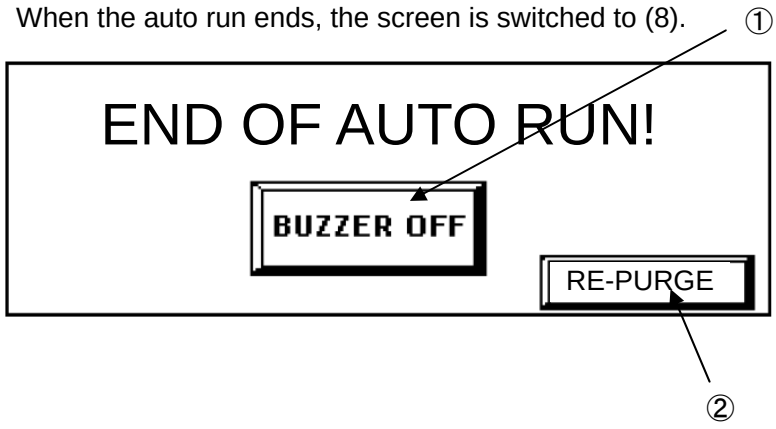
This screen displays output wave / reflected wave of RF power.



① Indicating output wave of RF power.
② Indicating reflected wave of RF power.
③ Press to return to screen (6)

(8) Auto run exit screen

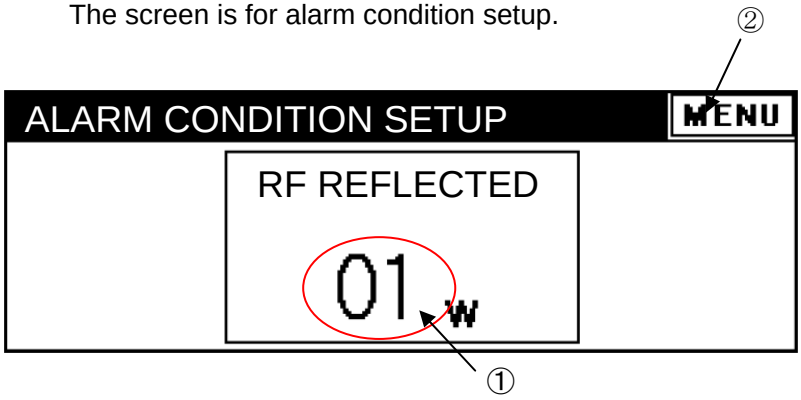
When the auto run ends, the screen is switched to (8).



① Press to turn off the alarm.
② Press to re-purge.
(Use this key if you cannot open the door after auto run ends.)

(9) Alarm condition setup screen

The screen is for alarm condition setup.

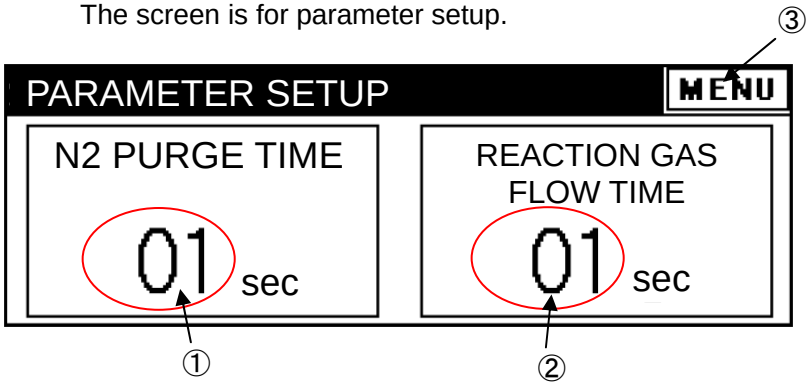


① Indicating the alarm setting for reflected wave of RF power.
② Press to return to screen (2).

► Alarm condition can be set up in the same manner as explained for the manual run.

(10) Parameter setup screen

The screen is for parameter setup.



① Indicating the setup for N2 purge time.
② Indicating the setup for flow time of reaction gas.
③ Press to return to screen (2).

► Parameters can be set up in the same manner as explained for manual run.

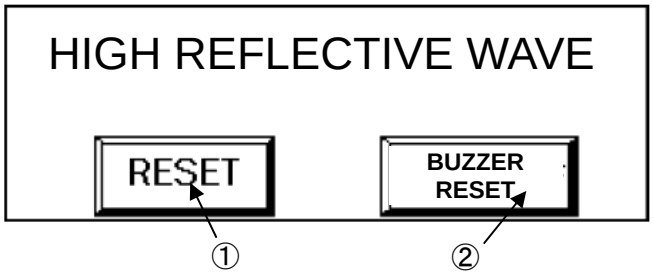
(11) Door open

Notifies that the door is open.

► Close the door to return to the previous screen displayed before the door was opened.

(12) Abnormal RF reflected wave

Notifies when the reflected wave of RF power exceeds the set value.

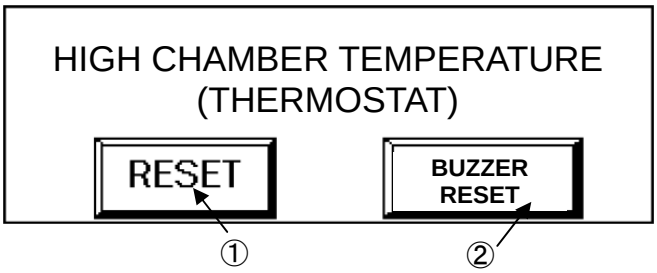


① Press to start purge. When the task is completed, the screen switches to (2).
② Press to turn off the alarm.

► Refer to the section in about the possible causes of alarm and correct the situation (page 23).

(13) Abnormal chamber conditions

Notifies when abnormal temperature in the chamber is detected.

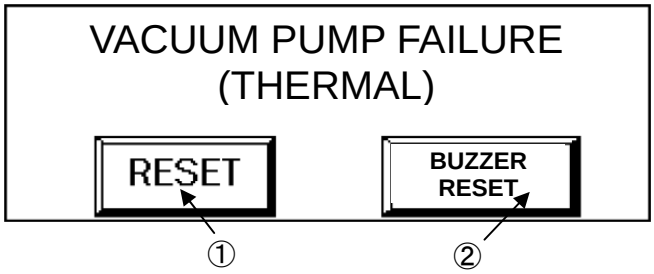


① Press to start purge. When the task is completed, the screen switches to (2)
② Press to turn off the alarm.

► Refer to the section in about the possible causes of alarm and correct the situation (page 23).

(14) Vacuum pump failure

Appears when the vacuum pump fails.



① Press to start purge. When the task is completed, the screen switches to (2)
② Press to turn off the alarm.

► Refer to the section in about the possible causes of alarm and correct the situation (page 23).

6. CAUTIONS FOR HANDLING

⚠ Warning and Caution

1. Prohibited substances

Do not use any explosive or flammable substances or other substances that contain any of these. They may be a cause of explosion or fire. (See “15.” on page 30)

2. Prohibition of use and measures in abnormal states

A high-frequency power source is built into the equipment. In an unlikely abnormal event such as smoke or questionable odor, immediately power off the distribution panel as well as the equipment and request the dealer or Yamato Material for inspection. The equipment, if is left uninspected, may cause a fire or electrical shock. Customers should not attempt and never perform any repair by themselves for safety reasons.

3. Dry the work

A wet work piece will prolong vacuum time and may also cause moisture buildup inside the vacuum pump, which may decrease vacuum performance. Ensure that the work piece is fully dried before plasma-cleaning.

4. Keep the work piece from chamber walls

A work piece touching the chamber wall(s) will cause a short circuit between the electrode and the chamber, and eventually the work piece and the equipment will be damaged. Ensure that the work piece is set on the top of lower electrode.

5. High temperature caution

The temperature inside the chamber may be high enough to cause burns and other damage. When taking out a work piece from the chamber, do not come in contact with the chamber wall or the electrode.

7. MAINTENANCE

Daily Inspection

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

Daily Inspection Table					
No.	Place	Inspection Item	Criteria	Checked	Remarks
1	Cooling fan	Sound	Running without abnormal sound		
		Vibration	No abnormal vibration		
		Odor	No questionable odor		
2	Chamber door	Open/ close	Opening/ closing smoothly		
		Tightly closed	No clearance between the chamber and the door		
3	Supply gas	Pressure	Reaction gas ＝ 0.2MPa		
			Purge gas ＝ 0.2- 0.3 MPa		
4	Gas connector port	Gas leak	No gas leak		
5	Vacuum Nozzle	Tightly connected	No looseness		
6	Commercial input line	Connection status	No loose connectors		
			No abnormal temperature rise of the connectors		
7	Vacuum pump (for reference)	Oil amount level	Within the level line		
		Oil color	No contamination		
		Sound	No abnormal sound		
		Vibration	No abnormal vibration		
		Oil leak	No leak		
		Connection wires	No loose connections		

- Prior to the inspections and maintenance, power off at the distribution panel for safety.
- Do not perform maintenance until the equipment is cooled down to normal temperature.
- Never disassemble the equipment.

7. MAINTENANCE

Periodic Inspection

Conduct periodic inspection according to the inspection period specified in the table below.

Monthly

Inspection Date: Temperature: degrees F Humidity: % Inspected by:

No.	Part	Method	Criteria	Checked	Remarks
1	Earth leakage breaker	Test under normal operating conditions	The breaker is turned off if the test button is pressed.		
2	Emergency stop switch	Test under normal operating conditions	The pump and the operation panel are powered off when the switch is off.		

► If the first inspection fails to meet the criteria, moisture absorption may be a possible cause of the failure. Conduct an exhaust speed test again immediately after the first test.

◆Oil change interval for the vacuum pump varies significantly depending on the use conditions. As a guideline, changing the oil once every three to six months is recommended.
◆Parts replacement suggested by the inspection above should be considered only as a guide. Some parts may require earlier replacement depending on the frequency of use.
◆Please do not hesitate to contact the dealer or Yamato Material should you have any questions.

8. ALARMS

Measure against Alarms

Alarm	Probable Cause	Corrective Action
HIGH REFLECTIVE WAVE	The value of reflected power set in the alarm conditions is too small	Increase the setup value (Set referring to the default 20W)
	Short-circuit between the electrode and the chamber caused by the work piece, etc. disables matching	Set the work piece on top of the electrode, ensuring that the work piece does not touch the chamber
VACUUM PUMP FAILURE	Deteriorated oil caused motor overload	Change oil
HIGH CHAMBER TEMPERATURE	The chamber temperature exceeds 194°F due to prolonged plasma irradiation	Half the operation until the chamber cools down (Even if a single process is completed within the preset time, short operating cycles may cause excessive temperature rise over the limit)
	Loose connector or faulty wiring	Tighten the connector Change wiring harness
	Defective thermostat	Change the thermostat

If the problem is not attributable to any of the causes listed above, please contact the dealer or Yamato Material.

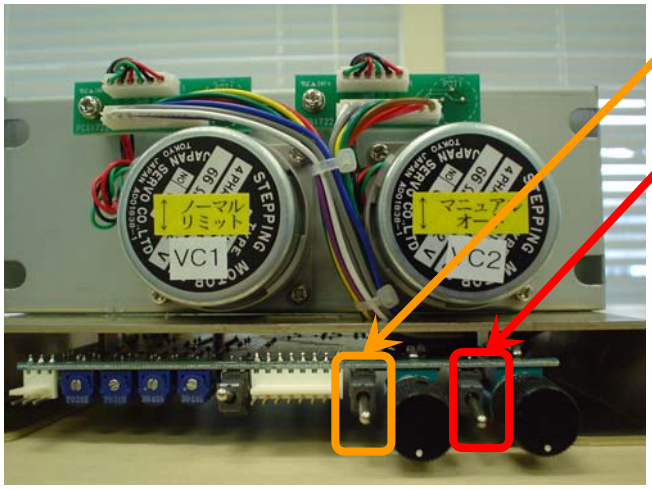
Matching Unit Reset Method

⚠ This operation is to be performed when the load within the chamber is beyond the matching scope.

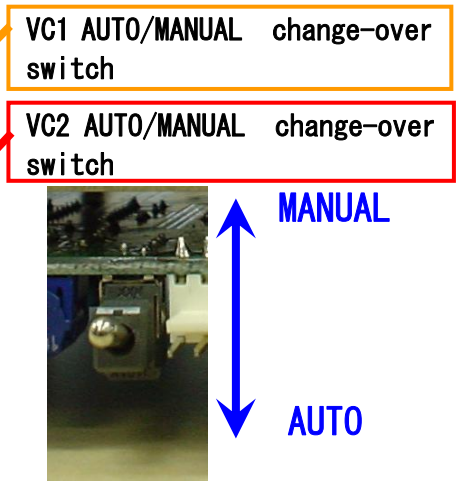
High-frequency power output must be matched against the load. If matching is not achieved, the reflected wave becomes too high to effectively power the load and also may cause a failure of the high-frequency power supply.

Normally, matching is automatically controlled. However, auto-tuning cannot be performed when plasma-cleaning conditions such as “gas flow rate” and “RF power” are changed.
In such a case, reset the matching unit conditions by conducting the following operation.

► Matching may be hard to achieve at low power (less than 50W).



Matching unit



Change-over switch (close up picture)

<Reset Procedure>

(1)Confirm that RF power is turned off.
(2)Confirm that the matching unit is installed in place by removing the right side panel of the equipment (by unscrewing four M4 Philips head screws).
(3)Set both VC1 and VC2 to MANUAL (UP) of the AUTO/MANUAL change-over switches.
(4)Hold (3) for 5 seconds.
► During the 5-second holding, the matching unit sets to the default mode.
(5)Set both VC1 and VC2 to AUTO (DOWN) of the AUTO/MANUAL change-over switches.
(6)Perform plasma-cleaning at this condition to confirm the matching being established.

9. AFTER-SALE SERVICE AND WARRANTY

Contact for service

Requesting a service call

Should these be any abnormality, please immediately stop the operation, turn off the breaker at the distribution panel as well as the power switch or the earth leakage breaker or the equipment, and contact the dealer or Yamato Material.

Have the following information available:

- product Model
- Serial number (see page 6)
- Date of purchase
- Description of the problem (as detailed as possible)

The warranty should be presented to the service staff upon their arrival.

Warranty (available upon purchase)

- The warranty is provided by the dealer or Yamato Material. Please confirm that the name of the dealer, date of purchase and other information are correctly entered and keep the warranty in a safe place.

- The warranty period is one year from the date of purchase. During the period, failures can be repaired free of charge in accordance with the terms and conditions stipulated in the warranty.

- For repair of failures after the warranty period is expired, please contact the dealer or Yamato Material. When the equipment can be fully repaired, repair will be done at owner's expense.

Minimum retention period of repair parts

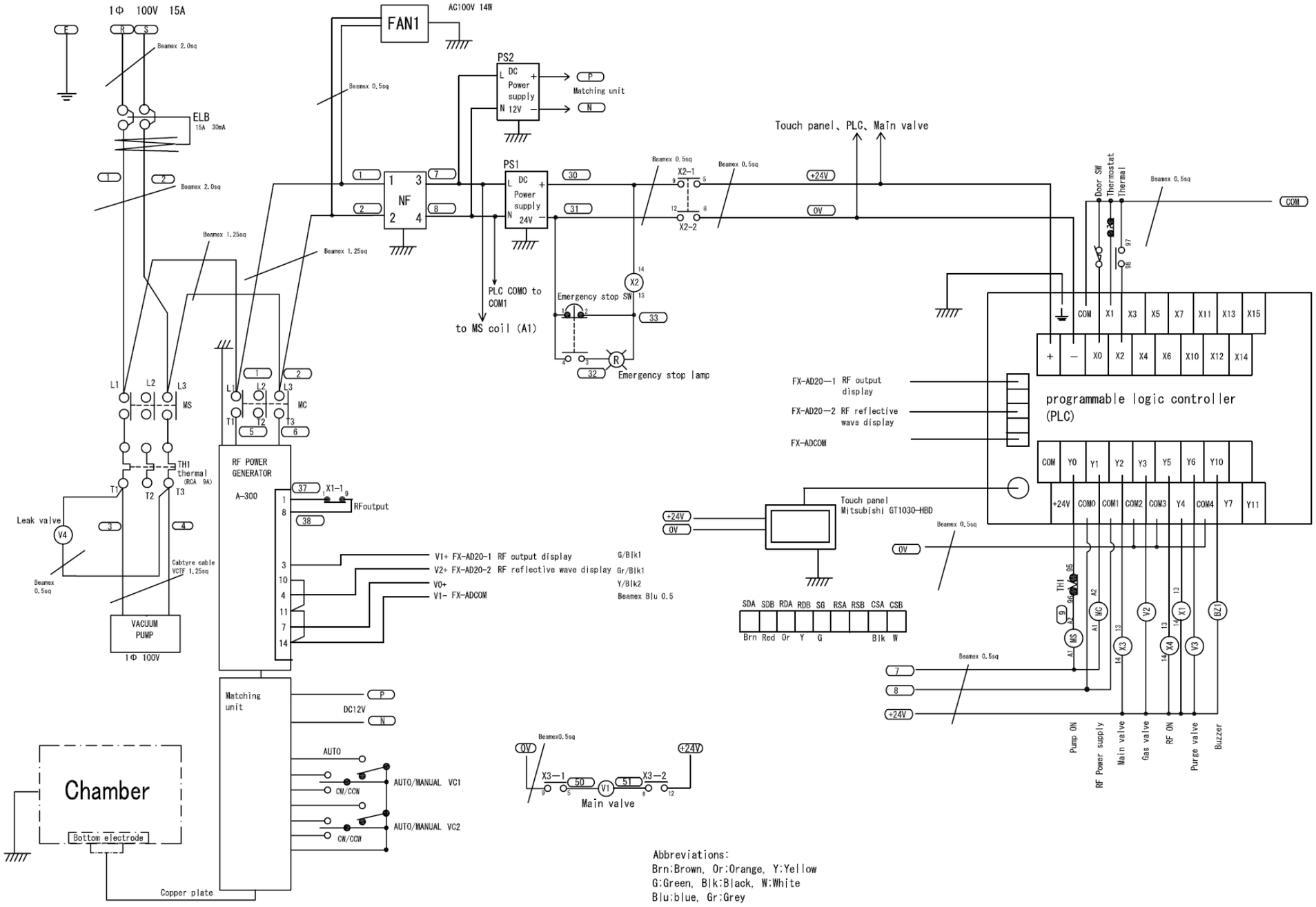
The minimum retention period of repair parts for the equipment is a minimum of seven years after the production is discontinued.
Repair parts are the parts that are needed to maintain performance of the equipment.

10. SPECIFICATIONS

Specifications

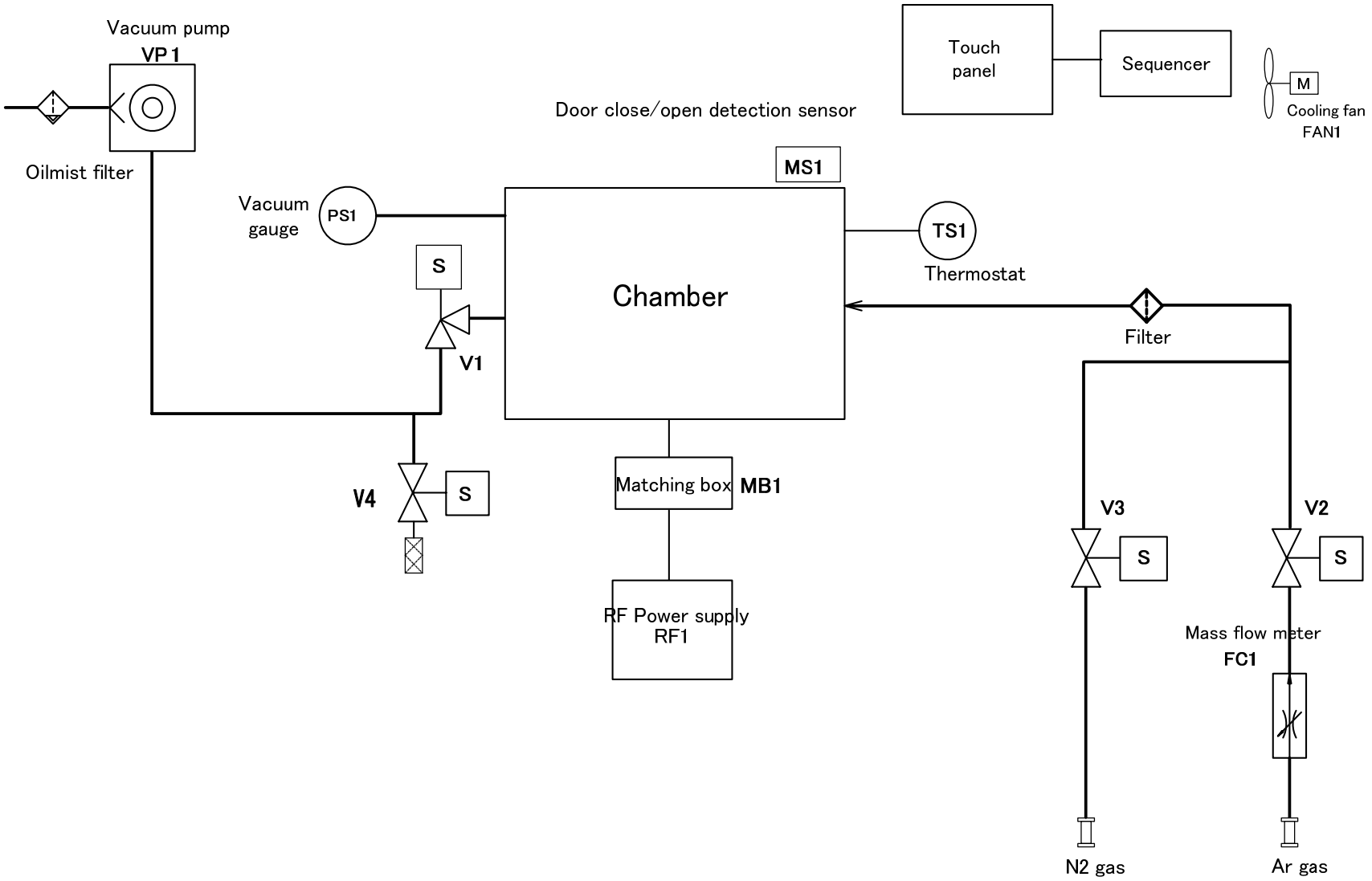
Model		PiPi
Main unit	Power supply	AC100V, 50/60 Hz, 15A
	Internal dimensions of chamber*	W230 × H130 ×D100 mm
	Electrode structure	Parallel flat panel type
	Electrode dimensions*	W130 ×D130 mm
	Plasma method	RIE
	Vacuum meter	Bourdon gauge
	Controller	<Controller>Sequencer
	Operation/display unit	4.5-inch Monochrome STN touch panel
	Overall size	438×520×565mm
High-frequency power supply	High-frequency out-put power	50- 200W
	Reference oscillator	Quartz oscillator
	Oscillation frequency	13.56 MHz
	Output setting method	Manual setting by knob
	Matching method	Auto tuning
Gas sys-tem	Purge gas	N_2 1/4-inch bite type tube fitting
	Reaction gas	Ar mass flow meter 1/4-inch bite type tube fitting

11. WIRING DIAGRAM



Abbreviations:
Brn:Brown, Or:Orange, Y:Yellow
G:Green, Blk:Black, W:White
Blu:blue, Gr:Grey

12. PIPING DIAGRAM



13. PARTS LIST

Parts	Code No.	Materials	Maker
Electrode plate	PD100-35060	Aluminum	YAMATO MATERIAL CO., LTD.
Electrode Insulating plate	PD100-35070	Heat-resistant Hardened grass	YAMATO MATERIAL CO., LTD.
Insulating collar 1	PD100-45071	Alumina or Photoveel	YAMATO MATERIAL CO., LTD.
Insulating collar 2	PD100-45080	Delrin	YAMATO MATERIAL CO., LTD.
Electrode SFT	PD100-35051	Aluminum	YAMATO MATERIAL CO., LTD.
Observation window	PD100-48020	Heat-resistant Hardened glass	YAMATO MATERIAL CO., LTD.
O ring1 for electrode plate	V40	Viton	YAMATO MATERIAL CO., LTD.
O ring2 for electrode plate	V55	Viton	YAMATO MATERIAL CO., LTD.
O ring (for observation window)	V120	Viton	YAMATO MATERIAL CO., LTD.
O ring (for door / back plate)	V225	Viton	YAMATO MATERIAL CO., LTD.

14. DISPOSAL

Disposal Precautions

For global environment protection:

From an environment protection standpoint, please break down the equipment into as small pieces as possible and separate recyclable from non-recyclable trash at the time of disposal. The major components and the materials of the equipment are as follows.

Major Component	Material
Major unit	
Exterior	Steel plate, melamine, epoxy composite resin paint
Chamber door, electrode	Aluminum A5052
Electrode insulating plate	Heat-resistant hardened glass
Observation window	Heat-resistant hardened glass
Chamber, piping, piping joint	SUS304、SUS316
Port valve	Aluminum A6063、SUS316
Electrical system	
Switch, relay	Composite article of resin, copper and other materials
PC board	Composite article of glass fiber and other materials
Power cord	Composite article of synthetic rubber coating, copper, nickel and other materials
Wiring	Composite article of glass fiber, fire retardant vinyl, copper, nickel and other materials
Seal	Resin-based materials

15. LIST OF HAZARDOUS SUBSTANCES

Never use explosive substances, flammable substances and other substances containing any of these with this equipment.

Explosive substances	Explosive	①Nitroglycol, nitroglycerine, nitrocellulose, and other explosive nitric acid esters
		②Trinitrobenzen, trinitrotoluene, picric acid, and other explosive nitro compounds
		③Peracetic acid, methyl ethyl ketone peroxide, benzoyl peroxide, and other organic peroxides
		④Sodium azide and other metal azide
Combustible substances	Ignitable	Metal “litium”, metalic “potassium”, metalic “sodium”, yellow phosphorous, phosphorus sulfide, red phosphorous, celluloid, calcium carbide (carbide), lime phosphide, magnesium powder, aluminum powder, metallic powder other than magnesium powder and aluminum powder, sodium dithionite (“hydrosulfite”)
	Oxidizing	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 with a flash point below minus 22 degrees F
		②Normal hexane, ethylene oxide, acetone, benzene, methyl ethyl ketone, and other substances with a flash point at minus 22 degrees F or higher and below 32 degrees F
		③Methanol, ethanol, xylene, pentyl acetate (alias, amyl acetate), and other substances with a flash point at 86 degrees F or higher and below 149 degrees F
		④Kerosene, light oil, turpentine oil, isopenthyl alcohol (alias, isoamyl alcohol), and other substances whose flash point is or is above 30℃ and below 65℃
	Combustible	Hydrogen, acetylene, ethylene, methane, ethane, propane, butane, and other combustible substances that are in the gaseous state at 59 degrees F and at one atmospheric pressure.

(Source: Appended Table No.1, Article 6, Order for Enforcement of the Industrial Safety and Health Act, Japan)

Disclaimer

Strictly observe and comply with the handling instructions described in this manual when using the equipment.

Yamato Material Co., Ltd. shall not be liable for accidents or failures whatsoever arising from the misuse or abuse of the equipment, when used in any manner other than that provided in this manual.

Never attempt operation or action that is prohibited in this manual.

To do so may cause unexpected accidents and failures.

Notice

●Information in this manual is subject to change without notice.

●If you notice any page(s) missing or mis-pagination, please inform us so we can replace the defective manual.

Instruction Manual

Plasma Treatment System

PiPi

Version 3　February 13, 2012

Revised　　May, 28, 2012

Yamato Scientific Co. LTD.