OPERATING INSTRUCTIONS

POLI-400/400L/500 CMP SYSTEM

G&P TECHNOLOGY

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- SAFETY -

WARNING

This section contains important information for your safety. Please read it carefully before operating the equipment.

The purpose of safety symbols is to attract your attention to possible hazardous conditions. This manual uses a series of symbols and signal words which are intended to convey the level of importance of the safety messages. The progression of symbols is described below. Remember that safety messages by themselves do not eliminate danger and are not a substitute for proper accident prevention measures. The safety guidelines for the equipment in this manual do not purport to address all the safety issues with the use of the equipment.

Safety Icon	**DANGER**
	HAZARD TYPE **DANGER indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury. This is limited to the most extreme situations**

Safety Icon	**WARNING**
	HAZARD TYPE **WARNING indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.**

Safety Icon	**CAUTION**
	HAZARD TYPE **CAUTION indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury. It may also be used to alert against unsafe practices.**

NOTICE
This symbol is used to alert the user to useful information about proper operation of the equipment.

Table of Contents

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INTRODUCTION

1 PURPOSE STATEMENT

This manual provides the overview of POLI-400/400L/500 Chemical Mechanical Polishing system design and specification parameters. It is intended for use in establishing quotations and equipment specification review and response documentation.

CAUTION

The usability and the life cycle of the system as well as the avoidance of premature repairs depend on proper operation, care and competent repair under consideration of these operating instructions.

2 POLI-400/400L/500 CMP SYSTEM OVERVIEW

2.1 System description

The POLI-400/400L/500 polishing system is designed to polish a wafer to planarize patterned surface as well as to smooth surface roughness of semiconductor materials. The POLI-400/400L system can accommodate three to six inch diameter wafers (75mm through 150mm) and POLI-500 system can polish three to eight inch diameter wafers (75mm through 200mm).

The POLI-400/400L/500 system consists of the following separate functional areas:

- One polishing platen and drive	Rotating polishing table
- One polishing head	Rotating carrier to polish a wafer
- One optional conditioning head	Rotating axis for pad conditioning
- Slurry supply pump	Two peristaltic pumps for slurry/DI supply
- Electrical system	Power distribution
- Pneumatic system	Controlling polishing pressure

2.2 Polishing Process Parameters

The following process parameters can be adjusted in the primary polishing cycle.

- Polishing Pressure
- Rotational speed of the polishing platen
- Rotational speed of the polishing head
- Oscillation on / off
- Rotational speed of conditioning head
- Polishing time
- Buffing time
- Flow rate of slurry
- Flow rate of DI water for buffing

3 DIMENSIONS

3.1 Standard configuration

POLI-400

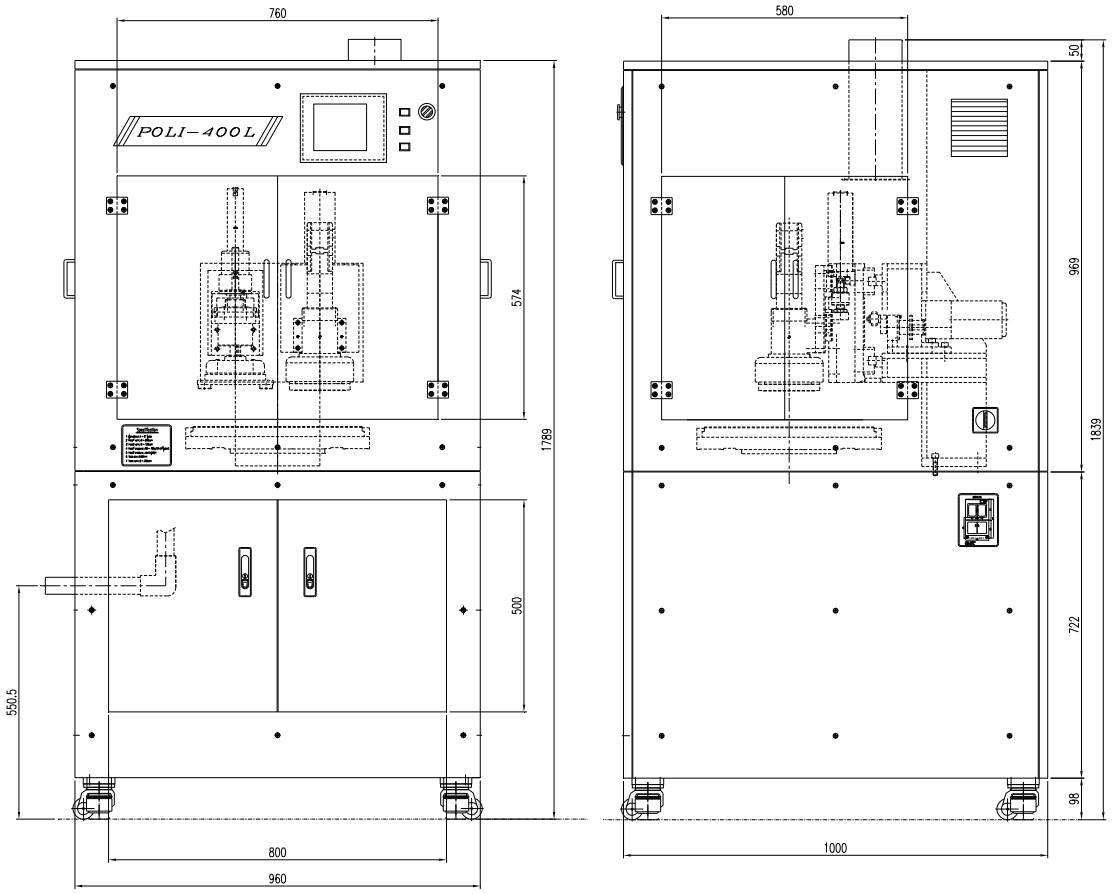
Width: 700mm Depth: 770mm Height: 1,204mm

POLI-400L

Width: 960mm Depth: 1,000mm Height: 1,880mm

POLI-500

Width: 1,100mm Depth: 1,150mm Height: 1,880mm



Dimension of the Equipment(POLI-400L)

3.2 Maintenance Dimensions

POLI-400

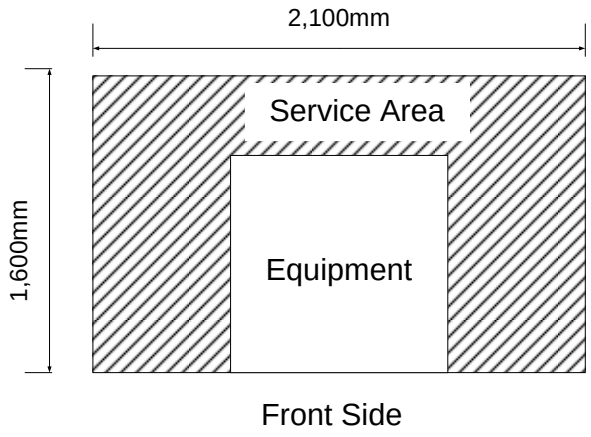
Width: 1,840mm, Depth: 1,270mm

POLI-400L

Width: 2,100mm, Depth: 1,600mm

POLI-500

Width: 2,240mm, Depth: 1,650mm



Maintenance Area for the Equipment (POLI-400L)

NOTICE
The maintenance dimension includes the working area for electricity and for repair of mechanical parts.

4 Safety Mark Location

(optional)


WARNING
Moving parts can crush and cut.
Keep hands clear.
Do Not operate with guard removed.

5 Safety

5.1 Training

All operating personnel must have the appropriate safety training pertaining to the hazards of the system.

5.2 Environmental Regulations

Environmental regulations and requirements vary by the geographic location or governmental jurisdiction in which the product is installed. Various local, regional, and national standards either exist, or are emerging, for the environmental performance.

Existing environmental requirements, as they pertain to process equipment, include the following categories: air emissions, water effluent, and solid or liquid hazardous wastes. Refer to the regulations and obey the facility-approved procedure to dispose the wastes.

5.3 Hazardous Waste

Various CMP process generate waste products such as lint-free wipes soaked in IPA, DI water, slurry, excess grease, and so forth. Treat all waste as toxic. If disposal is required, please observe the facility-approved disposal practices. Wearing protective gears, such as gloves, goggles and mask is recommended during handling of chemicals.

5.4 Ergonomics

Use proper lifting and handling when working on the system. Improper ergonomic handling may result in injury. It is recommended that an operator have to use a sturdy stool or step ladder when performing all service and troubleshooting tasks. These tasks may require access to areas that are difficult to reach.

5.5 Protective Gear

CAUTION
PHYSICAL HAZARD Wear protective gloves, safety glasses and approved respiratory protection whenever appropriate.

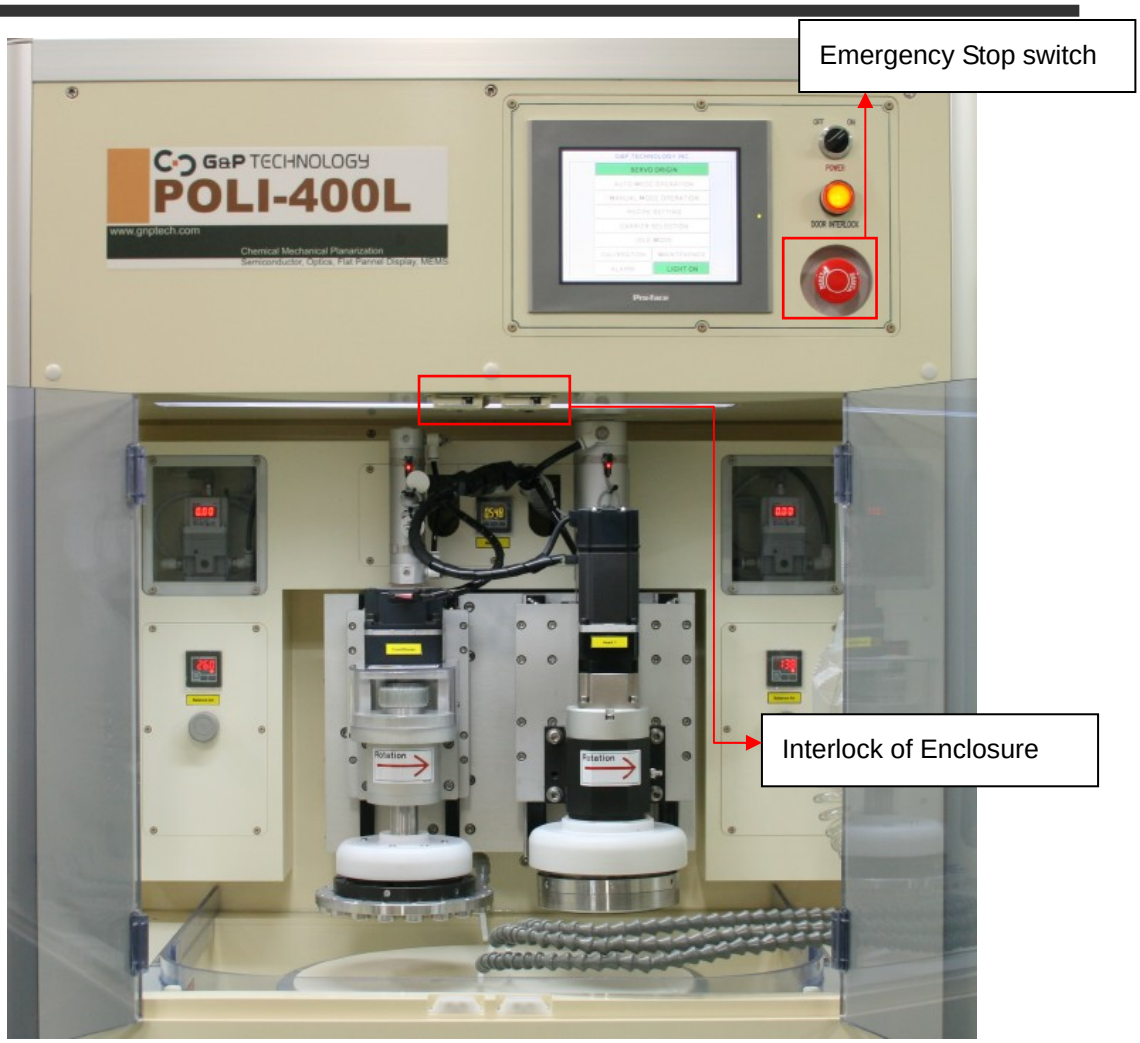
5.6 Liquid Chemicals

It is highly recommended that all personnel using or maintaining the system be trained in chemical safety specific to the chemicals being used on POLI-400/400L/500 system. Most popular chemicals used in the system are polishing slurries. Read MSDS sheet carefully supplied by slurry maker and check the component which should be avoided from contact or inhalation during operation.

5.7 Interlock of the Equipment

Front door is equipped with interlock which stops all moving parts including the polishing platen, polishing head, conditioner head and fluid supply systems. The interlock-switch stops the machine when the front door is opened (Before open the front door, always press the “DOOR INTERLOCK” button.)

CAUTION
MACHINE HAZARD If the front door is open, all the operation of moving parts is terminated. To resume a process, close the front door.



Emergency off and Interlock of Equipment

5.8 Emergency STOP (EMO) System

An emergency off switch enables an operator or service technician to quickly disconnect power to the unit. The EMOs are red, palm-sized button placed in front panel, left side and right side.

5.9 Light Tower Operation

Status	Light Tower Signal		
	Red	Orange	Green
Power Off	Off	Off	Off
Ready to Operate (Power On)	Off	On	Off
During Operation	Off	Off	On
Alarm	On	Off	Off

a. Power Off: All Off

b. Ready: Orange On

c. Operation: Green On

d. Alarm: Red On

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INSTALLATION

6 Facilities Requirement

6.1 Model POLI-400/400L/500 Facilities Specifications

Parameters	Specification for POLI-400/400L
Power	220VAC, 1phase, 50/60Hz, 2.2kW
Compressed Air	Peak pressure < 10 kg/cm^2 Minimum pressure > 6kg/cm^2
DI Water	Peak Flow: 10 l/min Average Flow: 2 l/min Pressure: 3 kg/cm^2 (tolerance ±1 kg/cm^2)
Used DI / Slurry Drain	PVC pipe terminal with outer diameter of 38mm Maximum waste flow: 10 l/min
Air Exhaust	Stainless steel exhaust pipe with outer diameter of 125mm

Parameters	Specification for POLI-500
Power	220VAC, 3phase, 50/60Hz, 5.5kW
Compressed Air	Peak pressure < 10 kg/cm^2 Minimum pressure > 6kg/cm^2
DI Water	Peak Flow: 10 l/min Average Flow: 2 l/min Pressure: 3 kg/cm^2 (tolerance ±1 kg/cm^2)
Used DI / Slurry Drain	PVC pipe terminal with outer diameter of 38mm Maximum waste flow: 20 l/min
Air Exhaust	Stainless steel exhaust pipe with outer diameter of 125mm

6.2 Facility Interface Requirements

Parameters	Specification for POLI-400/400L
Power Requirements	220VAC, 1phase, 50/60Hz, 2.2kW Circuit Break: 15Amps
Compressed Air	Minimum pressure > 6kg/cm^2 Oil free to : 500ppm Moisture content (Max) : 2500ppm Filter size (Max) : 5microns
DI Water	Supply Pressure : 2.5 ~ 4 kg/cm^2 Preferred Pressure : 3.5 kg/cm^2 Peak Flow : 20 l/min
Main Drain	Peak Flow : 25 l/min Drain Fluid concentration : Process Dependent Types of Drained Fluid : 99.9% Slurry/DI mix <0.1% Wafer/Pad residue

Parameters	Specification for POLI-500
Power Requirements	220VAC, 3phase, 50/60Hz, 10.4kW Circuit Break: 30Amps
Compressed Air	Minimum pressure > 6kg/cm^2 Oil free to : 500ppm Moisture content (Max) : 2500ppm Filter size (Max) : 5microns
DI Water	Supply Pressure : 2.5 ~ 4 kg/cm^2 Preferred Pressure : 3.5 kg/cm^2 Peak Flow : 20 l/min
Main Drain	Peak Flow : 25 l/min Drain Fluid concentration : Process Dependent Types of Drained Fluid : 99.9% Slurry/DI mix <0.1% Wafer/Pad residue

6.3 Equipment Specification

6.3.1 Polishing Platen

Diameter of Platen	: 400mm (POLI-400/400L), 500mm (POLI-500)
Material	: Anodized Aluminum
Platen Speed	: 0 ~ 200 rpm
Speed Control	: Induction Motor and Inverter

6.3.2 Polishing Head

Wafer Size	: 200mm (8inch), 150mm (6inch), 100mm (4inch), 75mm (3inch)
Wafer Retaining Method	: Template Assembly
Carrier Head Speed	: 0 ~ 200 rpm
Material	: SUS316
Speed Control	: Servo Motor and Drive
Oscillation Range	: (+15mm) ~ (-15mm)

6.3.3 Slurry and DI Supply

Method	: Peristaltic pump
Nozzle Material	: Silicone and others available (Masterflex Co.)
Fluid Flow Rate	: 0 ~ 200 ml/min

6.3.4 Diamond Conditioning Head

Type	: Diamond Pellet Type Conditioner
Diameter of Conditioner	: 190mm (outer diameter), 150mm (inner diameter), Size may vary depending on customer’s request.
Shank Material	: SUS316

6.3.5 Main Body

Material	: SUS Frame and Enclosure
Painting	: Semiconductor grade anti-electrostatic painting

6.3.6 Dimension and Weight

POLI-400

Width * Depth * Height	: 700mm * 770mm * 1204 mm
Weight	: 550Kg

POLI-400L

Width * Depth * Height	: 960mm * 1000mm * 1880 mm
Weight	: 850Kg

POLI-500

Width * Depth * Height	: 1100mm * 1150mm * 1880 mm
Weight	: 1,250Kg

NOTICE
The dimension and weight of equipment may vary without notice depending on product upgrade.

6.3.7 Utility

Main Power

POLI-400/400L	: AC 220V, 2.2kW 50/60Hz, single phase
POLI-500	: AC 220V, 5.5kW 50/60Hz, 3 phase

6.3.8 LCD Screen

Touch Panel wit 7.4 inch diagonal length

6.4 Electric Connection

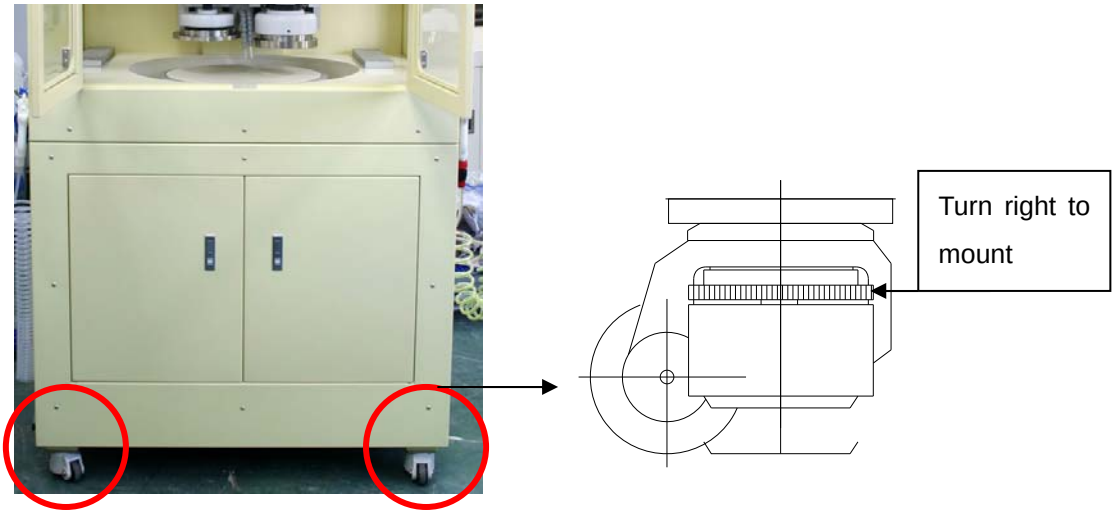
The POLI-400/400L/500 is completely equipped and wired. The equipment merely has to be connected to a power supply.

	CAUTION
	Machine Hazard Before connecting the power cord, make sure that the connection should be plugged in proper power supply of **220V 50/60Hz, Single phase for POLI-400/400L** and **220V 50/60Hz 3 phase for POLI-500.**

The equipment is to be protected by circuit protector as defined in the wiring diagram. The connection is made by an installed cable with grounded plug and the operator has to provide for a grounded socket.

6.5 Mounting and Leveling

POLI-400/400L/500 has four roller/mounting leg units. Tightly fix all four legs on the ground to avoid vibration during operation.



	CAUTION
	MACHINE HAZARD Improper leveling and mounting of the equipment will be a source of equipment vibration during operation. Make sure the four legs are firmly fixed on the ground.

	CAUTION
	PHYSICAL HAZARD During installation of the equipment, close all front and side doors. If the doors are opened, watch out your head not to hit the doors while you stand up. Proper head protection gear is recommended during installation.

6.6 CDA connection

1. Press the tubing into the fitting. Pull out on the tubing to ensure a tight fit.

2. To remove tubing, push in on the orange plastic lock to release the tubing.

3. Pull the tubing out of the fitting.

6.7 DI connection

1. Prepare tube

2. Insert compress fitting component into tube

3. Put the end of tube into the screw

4. Turn right the locking nut tightly

OPERATION

7 System Power Up

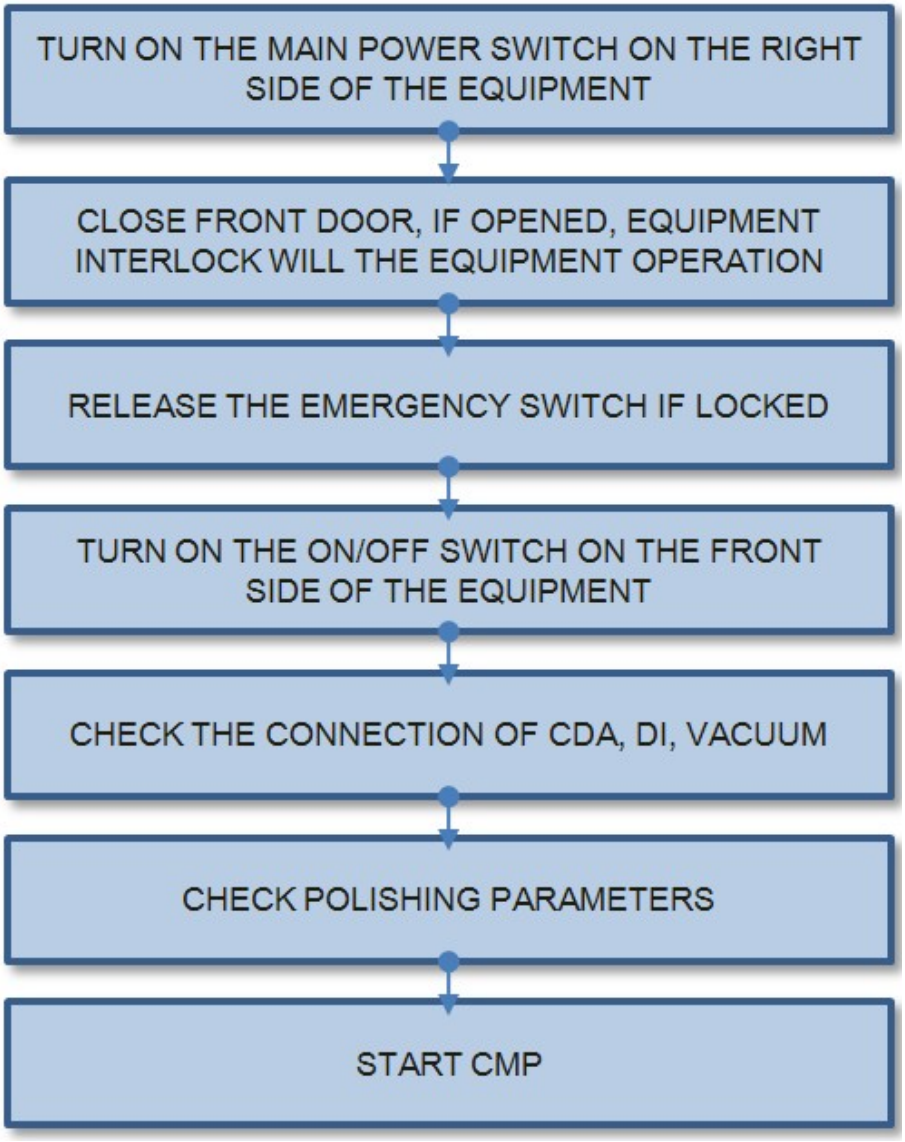
7.1 Operation Procedure

CAUTION

PHYSICAL HAZARD
Do not operate the equipment with wet hand. 220V single phase power is in use.

The facilities used in POLI-400/400L/500 are the electricity of **220V (50/60Hz)**, compressed CDA (clean dry air) and DI water. Make sure that all utilities connected to the equipment are turned on before SYSTEM POWER UP.

- Connecting the electricity of **POLI-400/400L**, make sure the terminal is plugged in proper socket of **single phase 220V (50/60Hz)**.
- Connecting the electricity of **POLI-500**, make sure the terminal is plugged in proper socket of **3 phase 220V (50/60Hz)**.
- Make sure the CDA is properly supplied and check the pressure of main regulator **higher than 6kg/cm^2**.
- Make sure the DI water supply line is turned on.

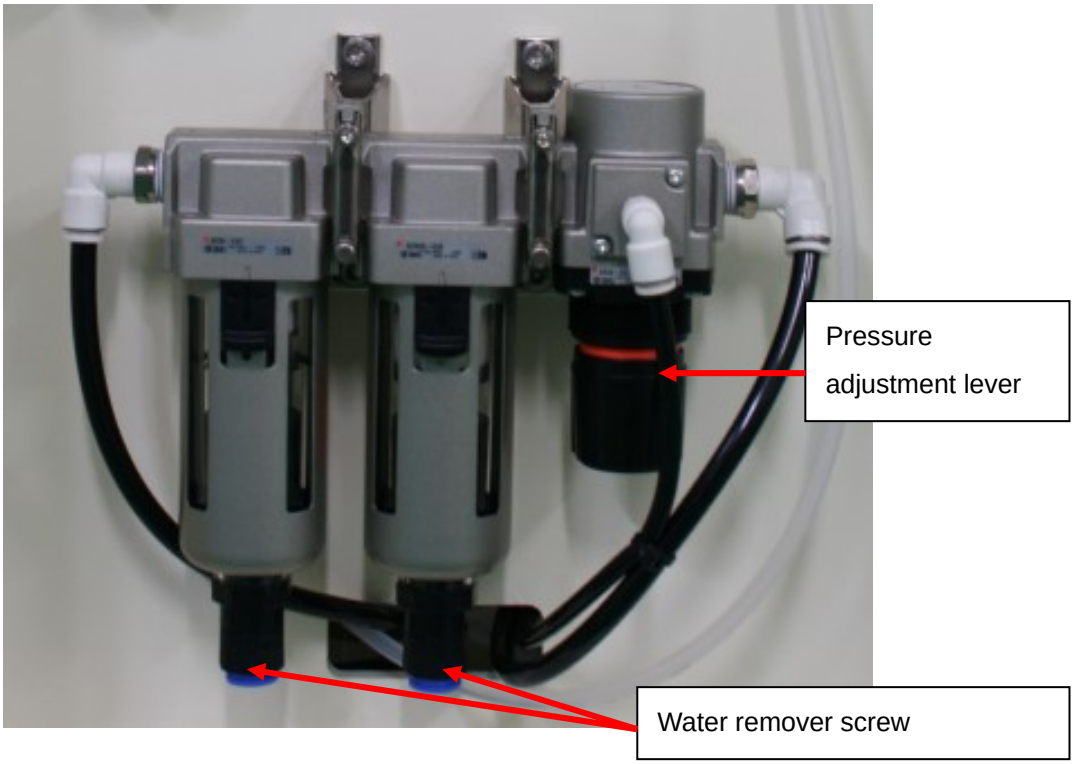


System Power Up Procedure

7.2 CDA Check

Minimum of 5kg/cm^2 pressure is required to properly operate the equipment and recommended pressure is 6 kg/cm^2. Check the main regulator placed behind the equipment for proper operation of the POLI-400/400L/500.

After long period of operation, compressed air with humidity may result in water trapped in water reservoir attached on the bottom of air regulator. Check the water reservoir in every three months and remove the water by pulling off “water remover screw” placed on the bottom of water reservoir.



Main Regulator

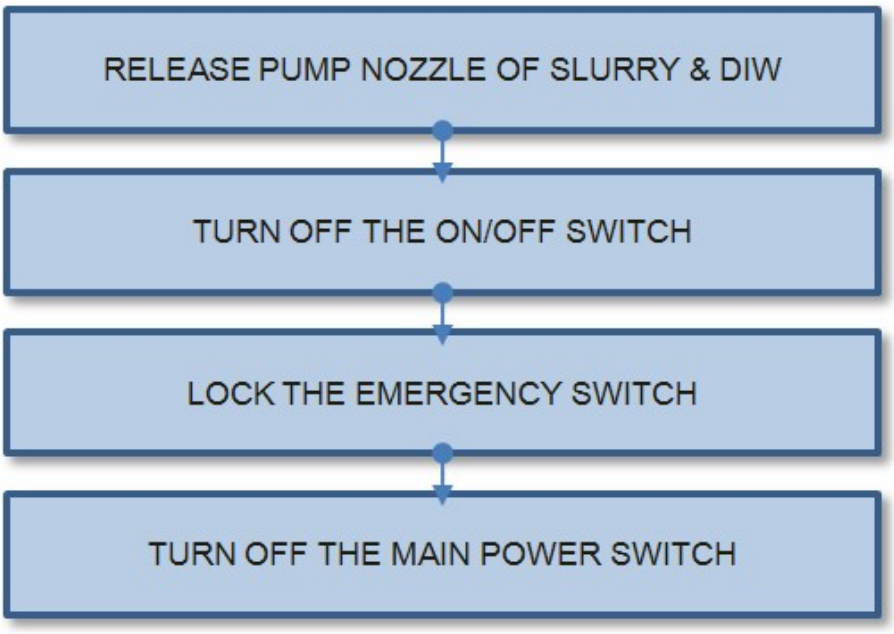
8 System Power Off

8.1 Operation Procedure

After a CMP process, move the polishing head and the conditioning head to upper position and release the slurry nozzle lock lever to prevent clogging of supply line.

CAUTION

MACHINE HAZARD
Do not turn on the **MAIN POWER** switch within **30sec** right after turning off the switch. Remaining power may result in malfunction of PLC program.

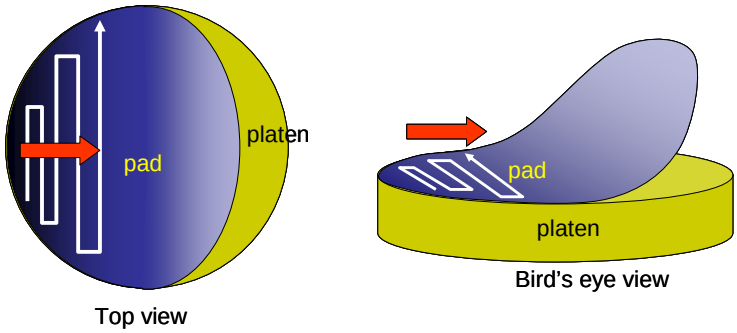


System Power Off Procedure

9 Preparation of Consumables

9.1 Application of Polishing Pad on Platen

An operator can choose variety of polishing pad for CMP of different materials. Please consult with pad manufacture to choose a proper pad for your own process. During application of new pad on the platen, air entrapment must be avoided. Therefore, rub the pad gradually from one end of the pad to the other end of the pad while holding the other end of the pad, as depicted in the picture below.



Application Method of a Pad on the Platen

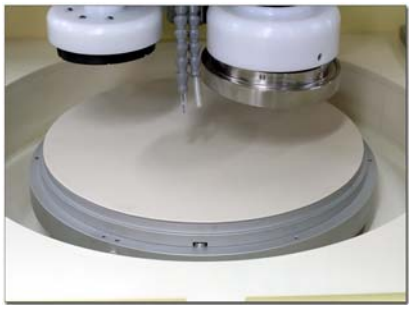
NOTICE
To achieve better process results, avoid any air bubbles from trapping in between pad and platen during application of pad.

After application of new pad, break-in of new pad is recommended with diamond conditioner to achieve consistent CMP results.

9.2 Platen Replacement

9.2.1 Installation of polishing platen

	**CAUTION**
	PHYSICAL HAZARD Wear protective gloves during replacing the platen to prevent possible contact with hazardous chemicals.

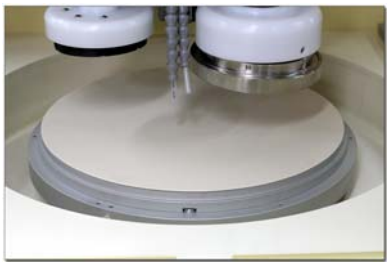
	Press the “DOOR INTERLOCK” button to release the Interlock system, and open the front door
	Clean the bottom surface of upper platen and upper surface of lower platen with alcohol or DI water before placing the upper platen.
	Place upper platen on lower platen.

	Fasten the fixture tightly with hexa-wrench.
	After upper platen is placed in position, use DI water gun to remove particulate contamination that might be attached on the pad surface.
	Close the front door, and press the “DOOR INTERLOCK” button to activate the Interlock system.
	POLI-400/400L/500 is ready to use.

9.2.2 Platen Removal

CAUTION
PHYSICAL HAZARD Wear protective gloves during replacing the platen to prevent possible contact with hazardous chemicals.

	Press the “DOOR INTERLOCK” button to release the Interlock system, and open the front door
	Wide view of inside of equipment
	Upper polishing platen
	All the screws (8ea) should be removed to loosen the upper polishing platen [Screw] Hex Socket Head Cap Screw : M6 x 25 <8 ea>

	After platen fixture is removed, an operator can take the platen off from lower platen.
	Remove upper platen. After upper platen is removed, clean the bottom of upper platen and surface of lower platen with alcohol or IPA.

9.3 Application of Template Assembly on Carrier Head

During application of new template assembly on the carrier head, air entrapment must be avoided. Therefore, rub the template assembly gradually from one end to the other end. The application method is same as the pad application.

NOTICE
To achieve better process results, avoid any air bubbles from trapping in between template assembly and carrier head during application of template assembly. Air trapping **WILL** result in degradation of polishing result.

9.4 Carrier Head & Conditioner Installation

POLI-400L can use two different sizes of carrier head, e.g. 4inch-carrier and 6inch-carrier. Those two sizes of carrier head can be interchangeable by simple procedure.

9.4.1 Carrier Head Installation

	CAUTION
	PHYSICAL HAZARD Wear protective gloves during replacing the carrier head to prevent possible contact with hazardous chemicals.

	Press the “DOOR INTERLOCK” button to release the Interlock system, and open the front door

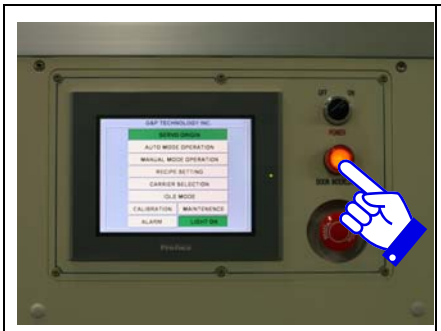
	View of polishing head axis. Before placing a wafer on a template assembly (T/A) applied on carrier head, use DI water to completely soak the T/A surface with water to have sufficient surface tension.
	Place a wafer on the carrier head with tweezers Ensure the tweezer grips do not touch any device areas, but place them far enough in to get a good handle on the wafer.
	Use both hands to hold the carrier head.
	Align the pin on the carrier head and the recess to attach the carrier head
	After the carrier head is completely pushed up, turn left to fix the carrier head.

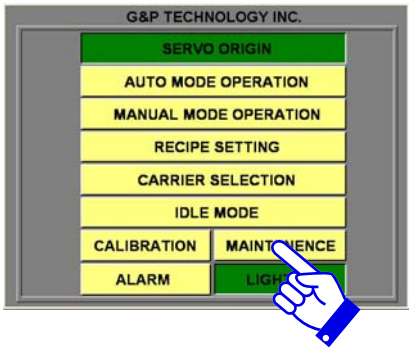
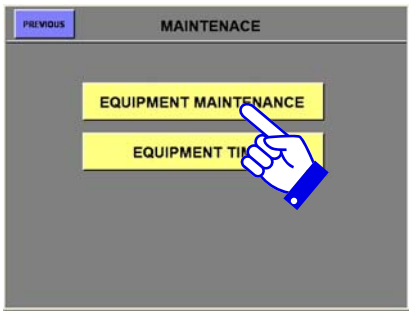
	Carrier head is placed in position.

9.4.2 Removal of Carrier Head

	Detaching the carrier head is inverse step of head installation.

9.4.3 Conditioner (of Head2) Installation

	Press the “DOOR INTERLOCK” button to release the Interlock system, and open the front door

	Main Menu Press the one of the “MAINTENANCE” button
	MAINTENANCE Press the one of the “EQUIPMENT MAINTENANCE” button
	Same the way the carrier head attach.
	Press the one of the “HEAD2 DOWN” button to move down the conditioner.  DO NOT PLACE YOUR HAND OR FINGER BETWEEN PLATEN AND CONDITIONER. HANDS MAY STUCK IN THE GAP.

	Fasten all the 3 screws. [Screw] Socket Set Screw : M6 x 15 <3 ea>
	Conditioner is placed in position.

9.4.4 Removal of Conditioner

	Detaching the conditioner is inverse step of head installation. If conditioner is stuck with head axis due to surface tension of water, use compressed air to release it. After blowing in the hole with air, turn the head to the right.

10 Manual Mode Operation

10.1 Setting Parameters

Polishing Parameters

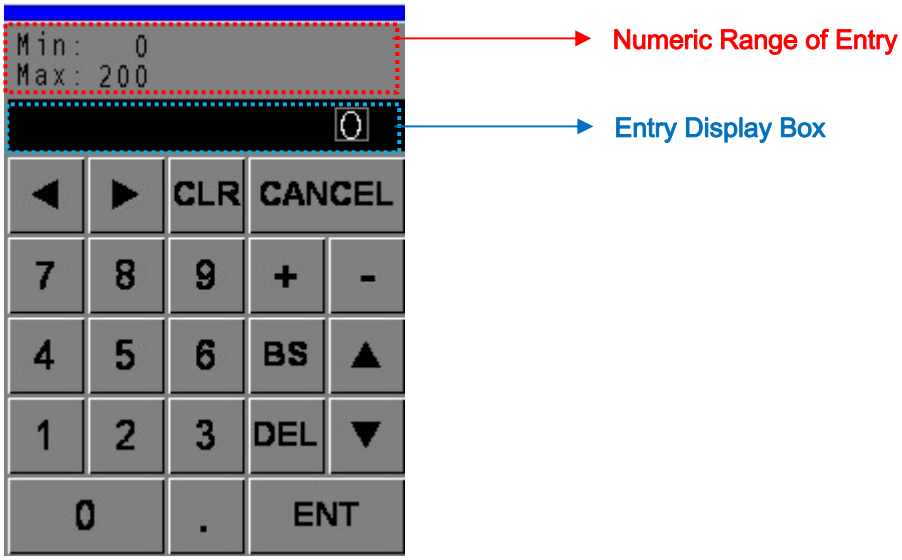
Pressure	: 70 ~ 500 g/cm2 for 4inch wafer
Carrier Velocity	: 0 ~ 200 rpm
Platen Velocity	: 0 ~ 200 rpm
Polishing Time	: 0 ~ 999sec
Oscillation	: On / Off, ±15mm oscillation
Slurry pump	: On / Off, Flow control by RPM of pump
DI pump	: On / Off, Flow control by RPM of pump

Conditioning Pcaarameters

Conditioner Carrier Velocity	: 0 ~ 120 rpm

10.2 Data Input

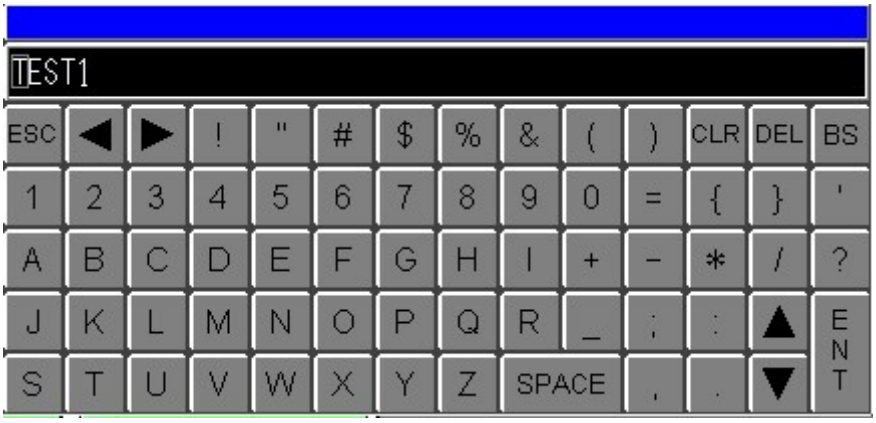
Numeric Keypad: If the chosen data entry box requires numbers for a value, the keypad shown in the figure below will appear on the screen. The keypad is laid out like a standard calculator type keypad. Refer to the figure below for an example.



To make correction, touch the “CLR” button and enter the correct value. To cancel the data entry, touch the “CANCEL” button to return to the

current screen without changing any values.
Once the correct desired information is entered, touch the “Enter” button.

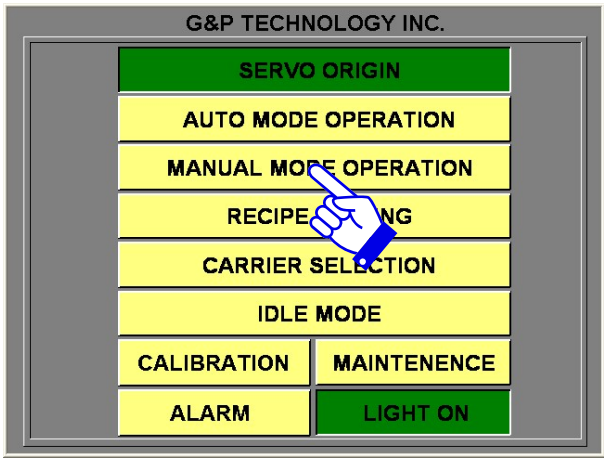
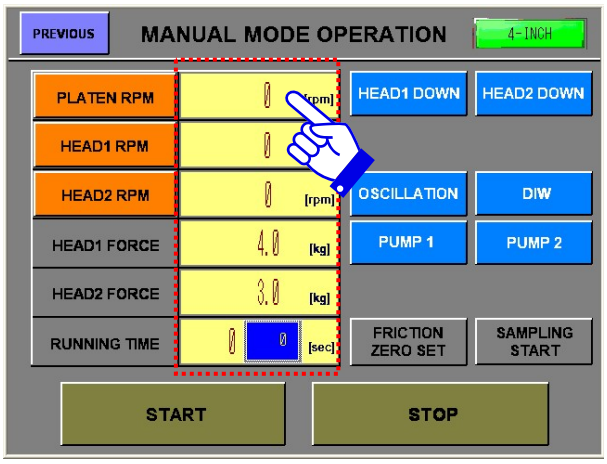
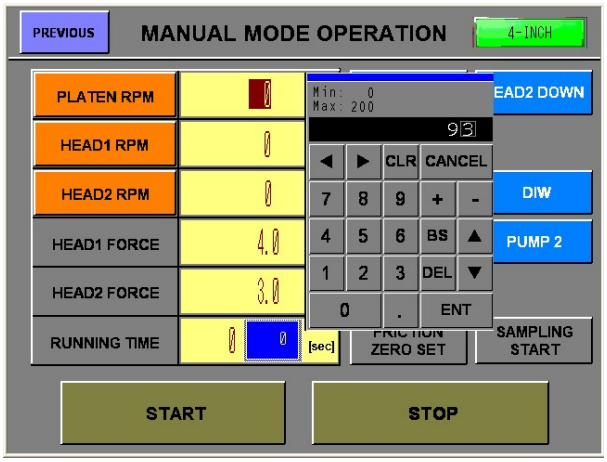
QWERTY Keyboard: If the chosen data entry requires numbers and/or letters for a value, the keyboard shown in the figure below will appear on the screen.



10.3 Parameter Setting with LCD Touch Panel

CAUTION

PHYSICAL HAZARD
Keep hands clear of polishing and conditioning head and close all front and side doors before operating the equipment. Interlock will terminate the process if doors are open.
Failure to do so may result in injury.

<table>
<tr>
<td> 
</td>
<td>Main Menu
Press the “MANUAL MODE OPERATION” button</td>
</tr>
<tr>
<td> 
</td>
<td>Press the numeric button to pop-up numeric keypad to change the values of each parameter.</td>
</tr>
<tr>
<td> 
</td>
<td>Input the numbers for a value of each parameter.
(each parameter is just example)</td>
</tr>
</table>

<table>
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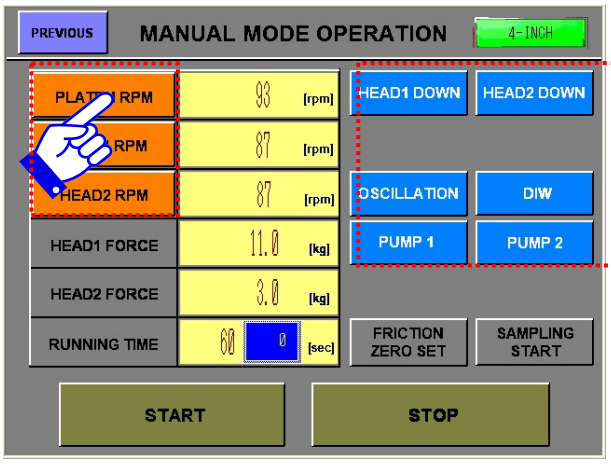
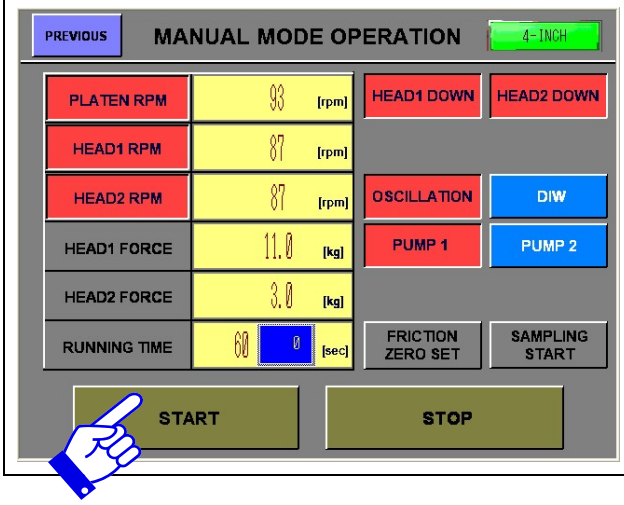
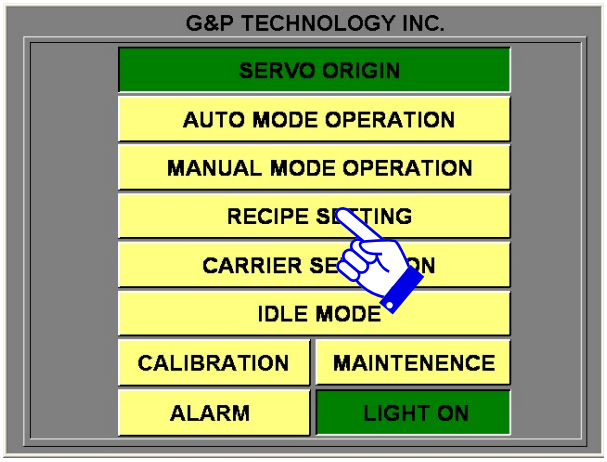
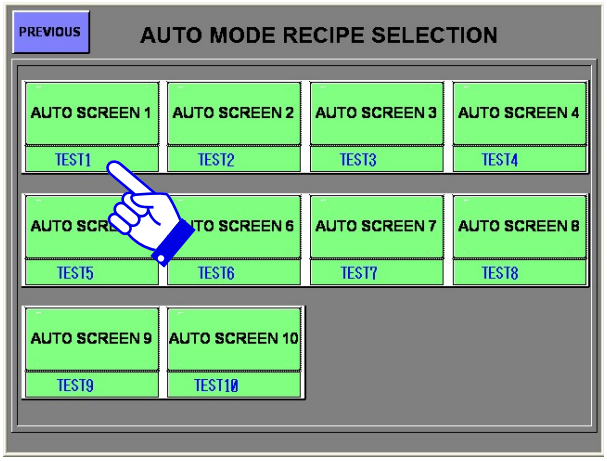
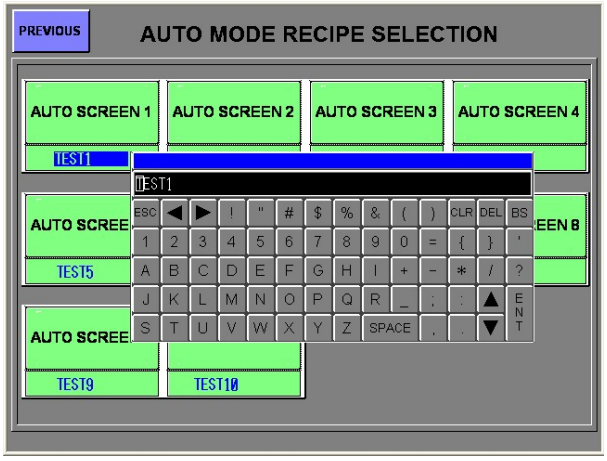
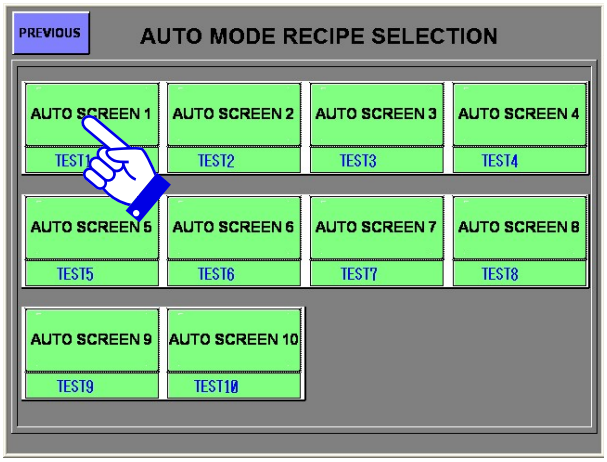
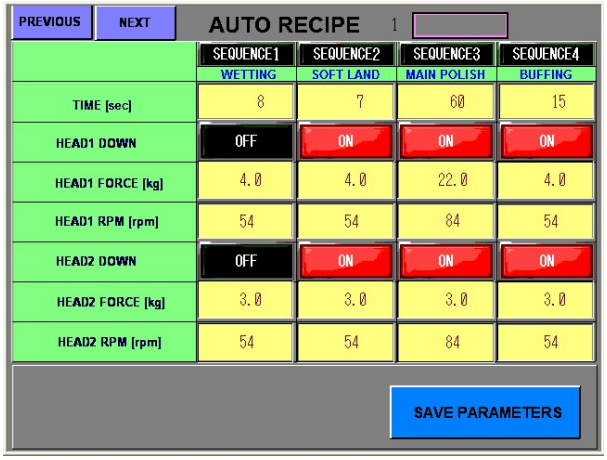
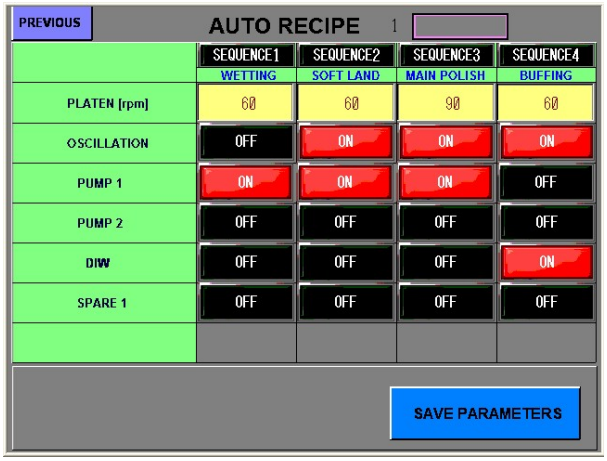
<td> 
</td>
<td>Press ORANGE and BLUE COLOR specified in the box to operate each moving component.

At this moment,
- The button colors of chosen moving component change to RED COLOR.
-If HEAD1 and HEAD2 (CONDITIONER) are selected, those move down at once.
-If DIW, PUMP1 and PUMP2 are selected, those work at once.</td>
</tr>
<tr>
<td> 
</td>
<td>After pressing the buttons, press “START” button to start process.</td>
</tr>
</table>

11 Auto Mode Operation

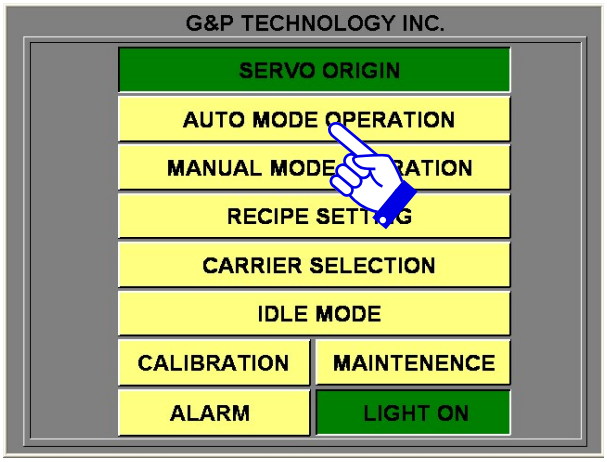
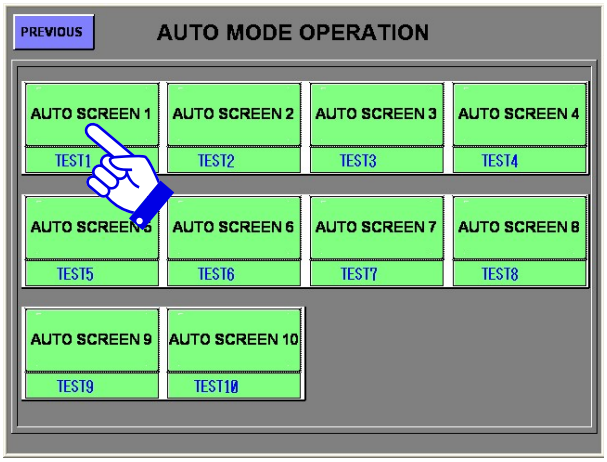
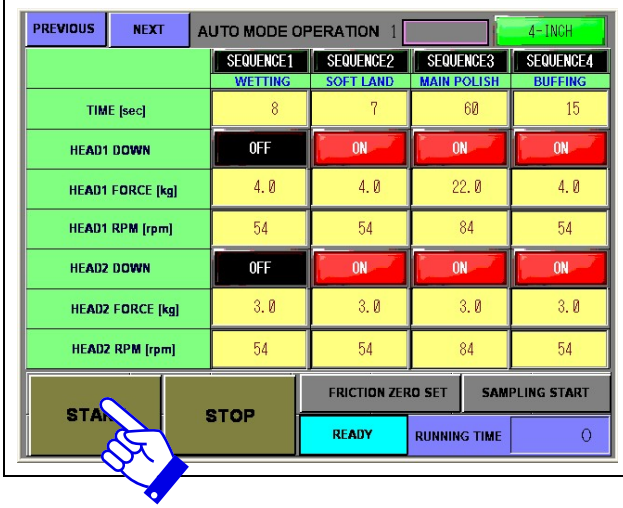
11.1 Parameter Setting with LCD Touch Panel

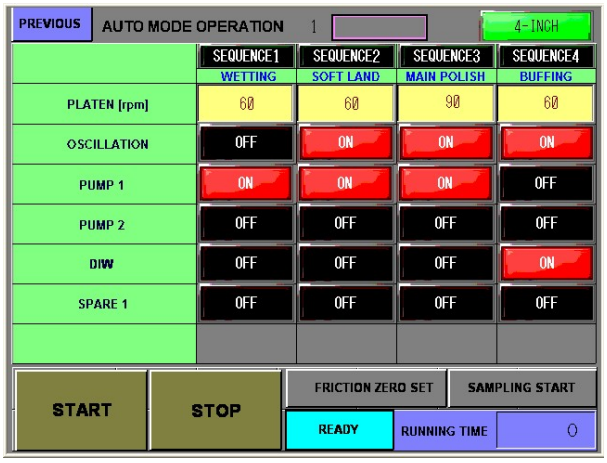
	Main Menu Press the one of the “RECIPE SETTING” button
	Press the lower buttons to pop-up key pad. If you want to assign the model name.
	Input the model name.

<table>
<tr>
<td> 
</td>
<td><AUTO MODE RECIPE setting>
Press “AUTO SCREEN #” button.</td>
</tr>
<tr>
<td> 
</td>
<td>Select or set the parameters. The auto screen is composed of two pages.(1/2 page)</td>
</tr>
<tr>
<td> 
</td>
<td>Select or set the parameters. The auto screen is composed of two pages.(2/2 page)

AFTER NEW VALUES ARE CHANGED, PRESS “SAVE PARAMETER” BUTTON. Then return to previous page. (each parameter is just example</td>
</tr>
</table>

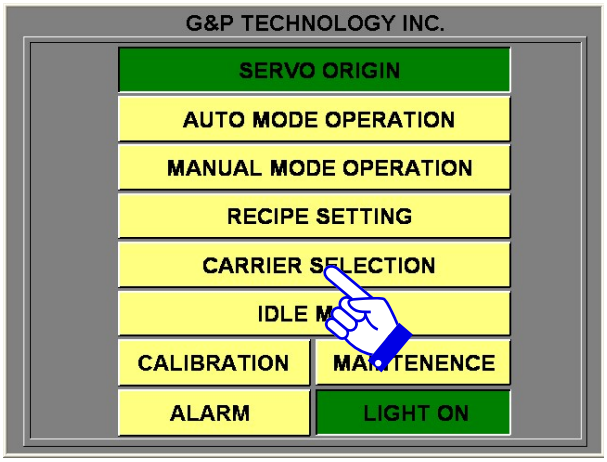
11.2 Auto Mode Operating Process

	Main Menu Press the one of the “AUTO MODE OPERATION” button
	Press the lower buttons to pop-up key pad. If you want to assign the model name.
	Press “START” button to start process. <Optional> -FRICTION ZERO SET -SAMPLING START

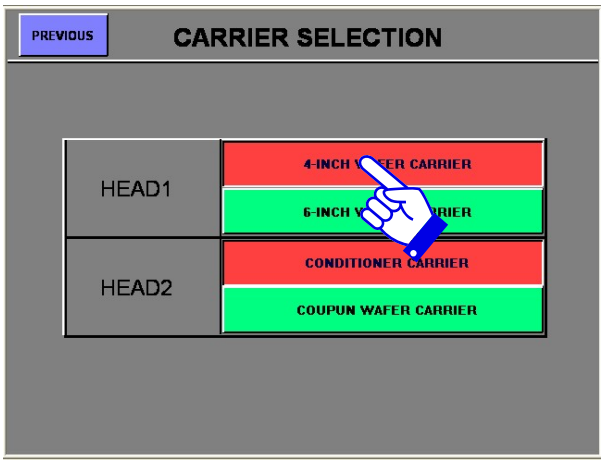
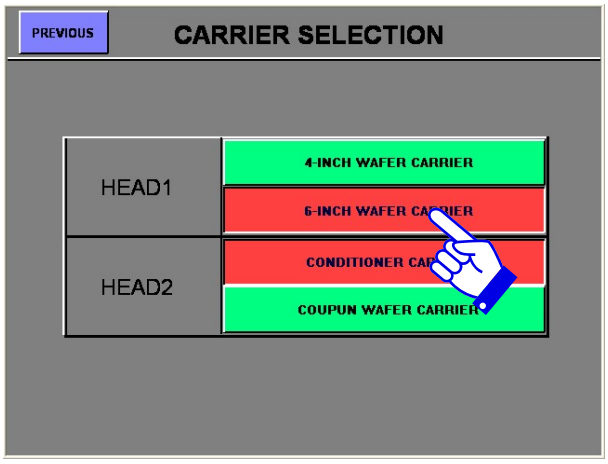


12 Others Setting

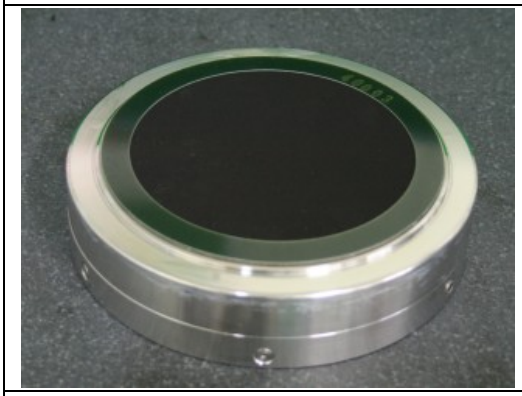
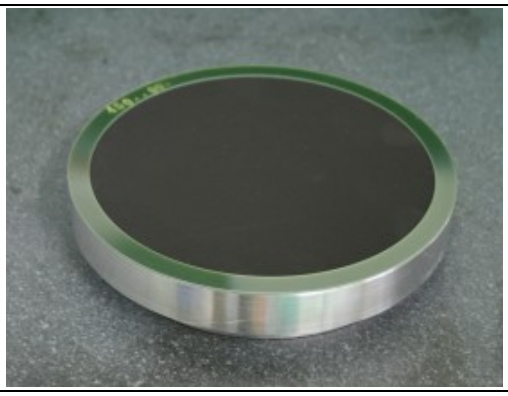
12.1 Carrier Selection

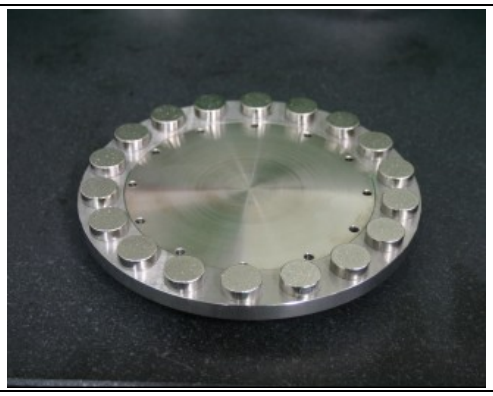
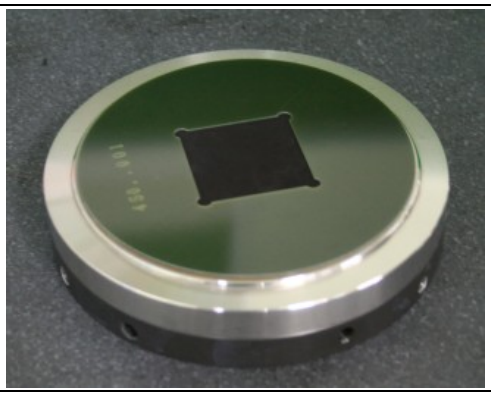


Main Menu
Press the one of the “CARRIER SELECTION” button

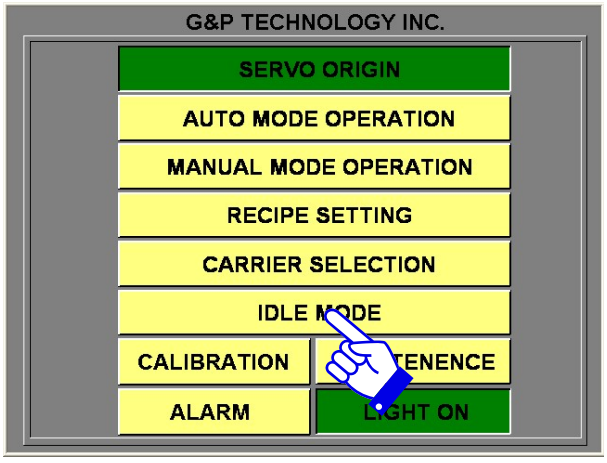
	Press “4-INCH WAFER CARRIER” and “CONDITIONER CARRIER” button, if you want to polish 4” wafer.
	Press “6-INCH WAFER CARRIER” and “CONDITIONER CARRIER” button, if you want to polish 6” wafer.

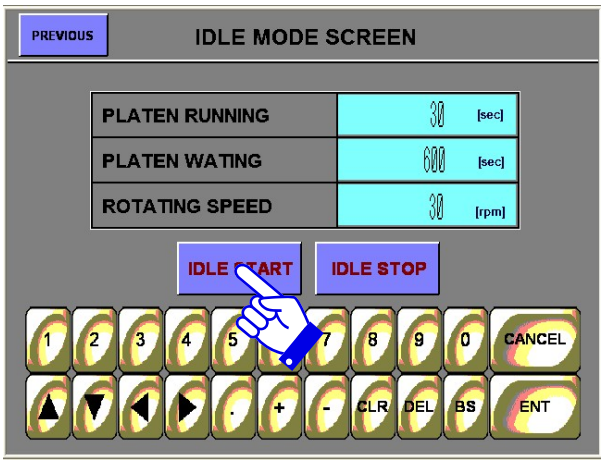
- Carrier type

4inch Carrier for Head 1	6inch Carrier Head for Head 1
	
Conditioner for Head 2	Coupon Carrier for Head 2

12.2 Idle Mode

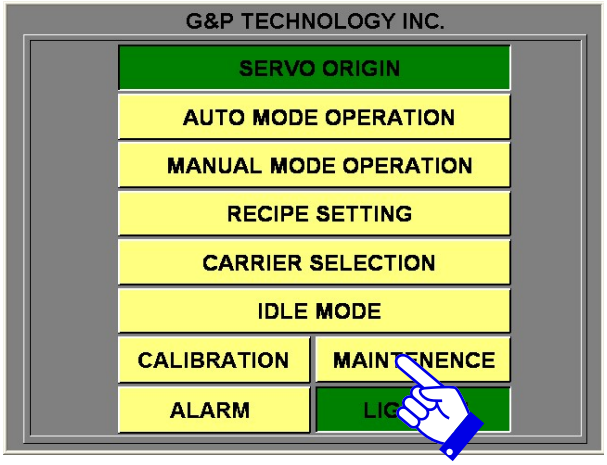
	Main Menu Press the one of the “IDLE MODE” button



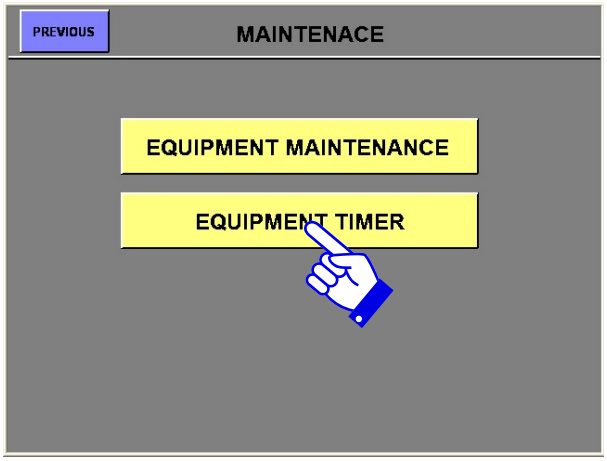
On : Platen running with DIW
Off : Platen waiting

-The purpose of “Idle Mode” is wetting pad during not working.
-Idle Mode is endlessly repeated with “platen rotational speed”

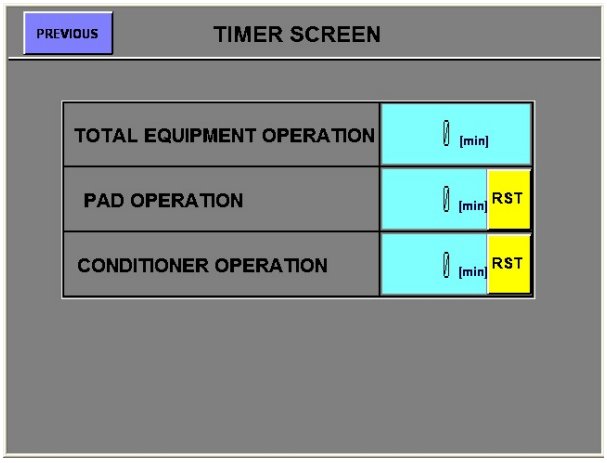
12.3 Equipment Timer



Main Menu
Press the one of the “MAINTENANCE” button



MAINTENANCE
Press the one of the “EQUIPMENT TIMER” button

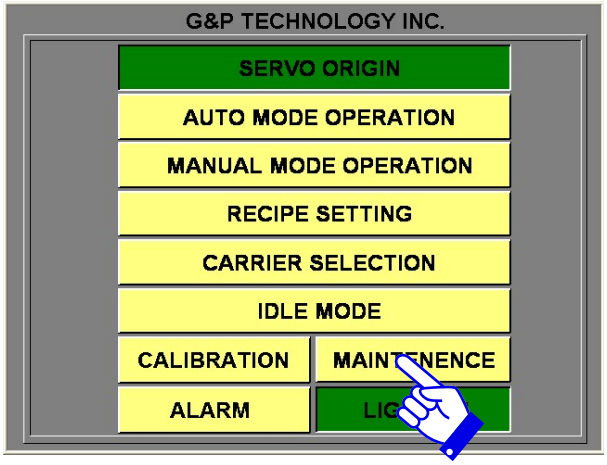


Total Equipment Operation
- time of platen working.

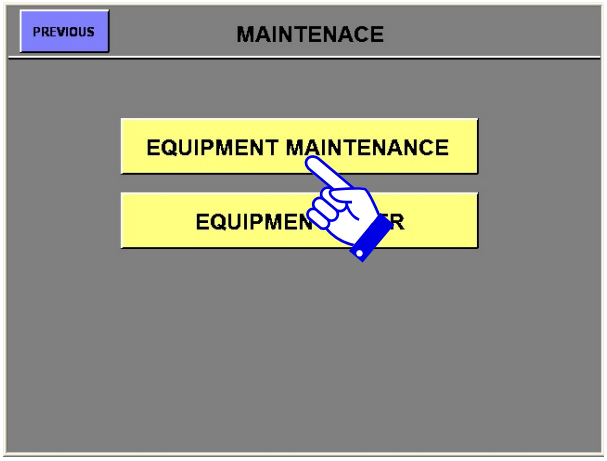
Pad Operation
- time of platen & head working

Conditioner Operation
time of platen & conditioner working

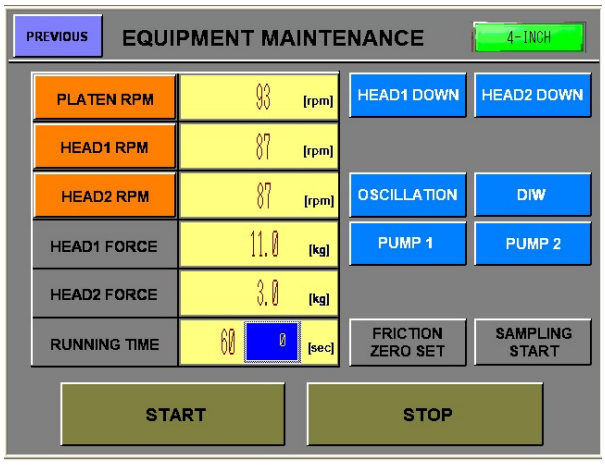
12.4 Equipment Maintenance



Main Menu
Press the one of the "MAINTENANCE" button



MAINTENANCE
Press the one of the "EQUIPMENT MAINTENANCE" button

	Maintenance Screen Engineer can work without Door-Interlock

13 Slurry and DI Flow Control

13.1 Flow Rate Control

Slurry and DI water are supplied by each peristaltic pump which have rotation speed control button, RUN/STOP switch and nozzle lock lever. The flow rate can be controlled by adjusting the rotation speed of roller. Before conducting polishing process, make sure that all nozzle lock lever is locked to right position and refer to Appendix A.

13.2 Cleaning of hose

NOTICE
After CMP process, clean the slurry nozzle with DI water to prevent the slurry contained in the nozzle from drying or making large particles.

MAINTENANCE

14 General

Regular periodic maintenance on POLI-400/400L/500 will ensure its optimum performance. Make a habit of inspecting your equipment each time you use it. Check for the following conditions and repair or replace when necessary:

1. Loose fasteners.
2. Slurry supply tube.
3. Worn or damaged cords and plugs.
4. Worn or damaged template assembly and polishing pad.
5. Any other condition that could hamper the safe operation of this machine.

15 Keeping Tool Clean

POLI-400 will give you best performance if you keep it clean and free of built-up dust or grime. Ensure that all slurry line and DI line are clear of leakage. You can check the leakage by watching the inside of lower part of the equipment after opening the doors of the equipment.

CAUTION

PHYSICAL HAZARD
Wear safety glasses when cleaning tool with compressed air.

Parts can easily be cleaned with a wiper cloth, but never use water to clean any electrical parts. Mechanical parts can be cleaned with soft wiper cloth.

Solvents, such as acetone, should also be avoided on plastic because of the possibility of damage. If possible use a soft plastic brush to remove dried slurry or water marks from the surface of table

	CAUTION
	MECHANICAL HAZARD Disassembly and improper reassembly of the equipment can result in electrical shock danger. Always have this device serviced by a qualified electrical repair technician. Failure to do so may result in injury.

1. Daily Maintenance

Subject	Action	Note
Wafer Carrier	Clean and inspect the wafer retaining ring for damage each time the membrane is changed, or each time a wafer slips out of the wafer carrier during polishing. Change the retaining ring according to supervisor requirements. Inspect and change membrane according to supervisor requirements. Inspect the O-ring positioned well and change as needed.	
Platen	Wipe the platen surface down, removing residue. Inspect the condition of pad, and change as needed	
Pressure Gauge Readings	Check for proper settings of compressed air, chuck vacuum, de-ionized water flow.	
Wafer Load/Unload Parts(Optional)	Wipe down inside and out, removing residue.	
Equipment Surfaces	Wipe down inside and out, removing residue using DI water spray and soft cloth to prevent any abrasion.	
Slurry Lines	Flush slurry lines after each use.	
Drain Lines	Flush drain lines to remove residue.	
Drain Connection	Inspect drain connections for leaks & clogging.	
Drain Basin	Flush and clean the polisher basin to remove residue.	
Touch Screen	Clean the touch screen using a non-residue cleaner such as a mild window cleaning solution.	

2. Weekly Maintenance

The following Preventive Maintenance Procedures should be performed in addition to the Daily Preventive Maintenance Schedule.

Subject	Action	Note
Conditioning Disk	Check pad conditioning disk for cleanliness and condition and replace as needed	
Conditioning Bath	Flush and Clean the Conditioning bath	
Slurry Distribution Lines	Check slurry distribution lines for condition, clogging and leaks; Replace as needed.	
Utility Connection	Check D.I water, coolant, air, drain and slurry distribution lines for condition and leaks; Replace as needed.	
rotary joint for coolant (Optional)	Check rotary joint for leaks	
HPR (Optional)	Clean nozzle of the HPR. Replace if needed	

3. Monthly Maintenance

The following Preventive Maintenance Procedures should be performed in addition to the Daily Preventive Maintenance Schedule, and Weekly Preventive Maintenance Schedule.

Subject	Action	Note
Wafer Carrier	Check the condition of rubber pad in wafer carrier, Replace as needed. Check the condition of rubber pad each time a wafer slips out of the wafer carrier during polishing.	
Air Supply Regulation	Check air supply regulator settings. If it work unstably.	
EMO Switches and Door Interlocks	Check for proper operation, and adjust or replace if needed.	
Load/Unload Alignment(Optional)	Check that both stations move freely to home and alignment.	
Tower Lamp	Check for proper operation of Power On and Machine On indicator lamps.	
Wafer Slip-out Detecting Sensor (Optional)	Check operation and setting value. Clean lens as needed.	
Inspect electrical cabinet cooling fans	Check operation and clean the fans.	
Monitoring System (Optional)	Inspection the sensor(friction & Temperature) signal and calibrate as needed	
Timing Belt	Inspection and change timing belt – Conditioner & Polishing Head(Optional)	
CDA	Inspect compressed air filters / mist separator	

4. Six-Month Maintenance

The following Preventive Maintenance Procedures should be performed in addition to the Daily Preventive Maintenance Schedule, Weekly Preventive Maintenance Schedule, and Monthly Preventive Maintenance Schedule.

Subject	Action	Note
LM guide	Inspect the condition of LM guide Supplement grease as needed	
Arm-type Conditioning Down-force (Optional)	Test and calibrate as needed.	Load-Cell
Arm-type Conditioning Rotational Speed (Optional)	Test and calibrate as needed.	Tachometer
Oscillation-type Conditioning Down-force (Optional)	Test and calibrate as needed.	Load-Cell
Oscillation-type Conditioning Rotational Speed (Optional)	Test and calibrate as needed.	Tachometer
Platen Rotational Speed	Test and calibrate as needed.	Tachometer
Polishing Head Rotational Speed	Test and calibrate as needed.	Tachometer
Slurry System	Check peristaltic pump and replace '*Master-flex*' tube if needed	
DIW	Check flow rate	

5. Yearly Maintenance

The following Preventive Maintenance Procedures should be performed in addition to the Daily Preventive Maintenance Schedule, Weekly Preventive Maintenance Schedule, Monthly Preventive Maintenance Schedule, and Six-Month Preventive Maintenance Schedule.

Subject	Action	Note
Polishing Platen Bearings	Supplement grease as needed, if checked noise	
Conditioner	Supplement grease as needed, if checked noise	
Polishing head axis	Supplement grease as needed, if checked noise	
Platen coolant system	Flush the water and clean the coolant line by clean water circulation.	
Oscillation Rod End Bearing Lubrication	Lubricate grease Approximately 1/2-oz. every 1 year.	

PM CHECK LIST

System	Items	Items2	Check list
hardware check	leakage	DI line	leakage
	leakage	CDA lines	leakage
	leakage	slurry line	clogging, leakage
	leakage	drain line	clogging, leakage
	leakage	pump nozzles	flatening, leakage
	leakage	rotary joint for coolant	leakage
	leakage	rotary joint for air pressure	leakage
	leakage	coolant leakage at platen	leakage
	degradation	bearing noise	platen
	degradation	bearing noise	head
	degradation	bearing noise	oscillation
	degradation	bearing noise	conditioner
	degradation	loose parts	cover, bolts
	degradation	air cylinder	main axis
	degradation	air cylinder	conditioner cylinder
	electronic parts	main switch	
	electronic parts	LCD screen	
	electronic parts	Fluorescent light	
	electronic parts	interlock	
	electronic parts	emergency switch	
	electronic parts	relays	
	electronic parts	switches	
	electronic parts	brakers	
	electronic parts	PLC	
	electronic parts	limit sensors	
	electronic parts	Wafer slip-out detector	
	greasing	main head axis	

	greasing	platen	
	greasing	conditioner	
	greasing	LM guide	
	power parts	timing belts	conditioner lower
	power parts	timing belts	conditioner arm
	de-painting or rust	doors	
	de-painting or rust	main construction frame	
	de-painting or rust	upper platen	
	de-painting or rust	lower platen	
	mechanical parts	membrane carrier	o-ring (retainer, wafer)
	mechanical parts		o-ring (3-port)
	mechanical parts		membrane rubber(retainer)
	mechanical parts		rubber pad
	mechanical parts		retainer ring
	mechanical parts	clamp	bolt, pin, washer
	mechanical parts		
	monitoring system	friction sensor	force calibration
	monitoring system	temperature sensor	temperature calibration
control parameter check	rpm check	head rpm	
	rpm check	platen rpm	
	rpm check	conditioner rpm	
	pressure check	wafer pressure regulator	
	pressure check	retainer ring pressure regulator	
	pressure check	conditioner regulator	

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Appendix A: Peristaltic Pump Controller Manual of POLI-400L

POLI-400L

< INDEX >

1. Sfety Instruction

The safety instruction is classified with「caution」and「warning」

⚠Warning ● Has possibility of death or get serious injury caused from dangerous situation by unfitted operation

⚠Caution ● Has possibility of death or get serious injury or physical damage caused from dangerous situation by unfitted operation.

In addition, the contents of ⚠Caution also can be caused dangerous result by case. Please keep in mind any contents of Warning and Caution as very important instructions.

⚠Warning

- The back part of controller has care-armature. It needs covering to do not be touched by people. Otherwise may get electric shock.
- Careful to do not be spattered by water when you use in the place, watery. May get electric shock.
- Do not operate with wet hands. May get electric shock. May get electric shock.
- Should turn off the power before installing, moving, wiring and checking.
- Do not touch on rotatory parts. May get injury.
- Turn off the power when electricity is cut off and Thermal Protect is operated. May get injury by sudden restarting.

⚠Caution

- Do not remodeling. Can not get warranty for remodeling
- Contact to Manufacturer or the agent you purchased for repairing.
- Controller does not have any additional protector. Please install protector of over current, leakage current circuit breaker and Thermal protector for safety.
- Do not use in place, generated lots of static electricity. It may abnormally operate.
- Do not use damaged motor. May get electric shock or injury.
- Check if the purchasing goods are same as your ordering. May get injury or fire.
- Do not touch with hand or part of body during running and the moment of stopping.
- Never stand or hanging on motor. May get injury
- Turn off the power in case of showing any abnormal phenomenon. May get electric shock or injury or fire.
- Do not place it in close with inflammable gas or corrosive gas. May get fire
- Do not place controller in close with flammables. May get fire.
- Divide with industrial waste for disposal.

2. Check points when goods arrive

The safety instruction is classified with caution and warning.

⚠ Caution

Check if the purchasing goods are same as your ordering. May get injury or fire in case of installing other products.

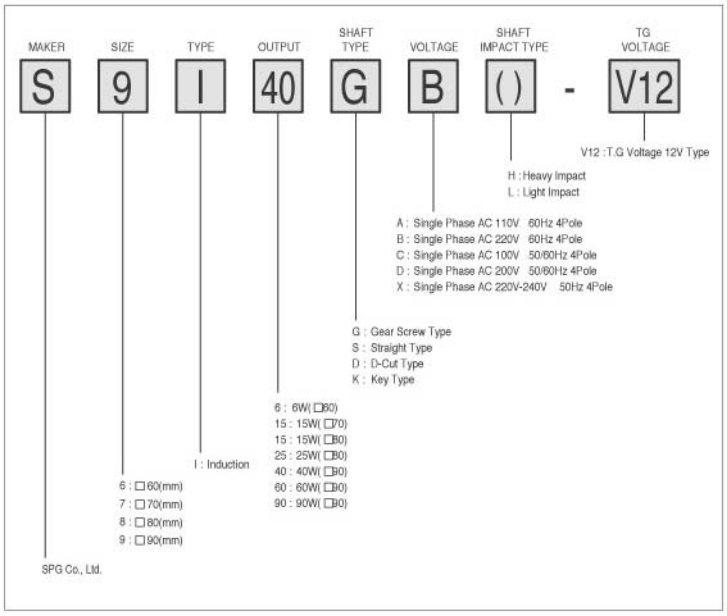
2.1 Check your ordering goods

Please check the parts in below are all included.
Contact to local agent incase of lack or damaged.

- Controller---1pcs
- Extension cable(0.5mm)---1pcs
- Instruction manual---1pcs

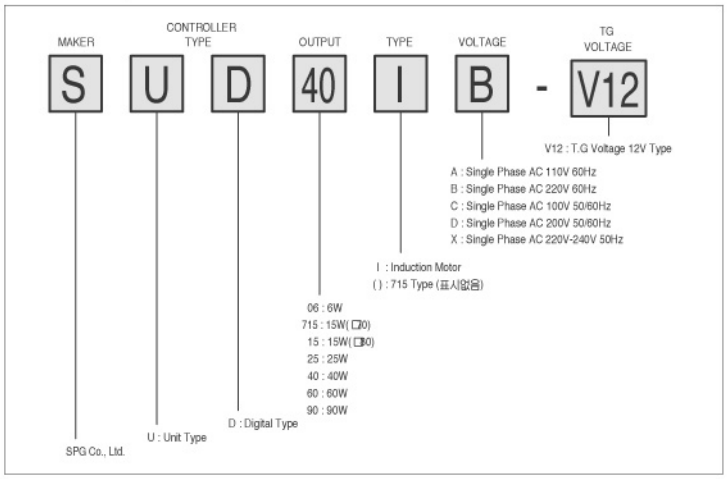
2.2 Check part number (model name)

MOTOR



3. About mounting

CONTROLLER



⚠Warning

- Do not use in close with explosive material, inflammable gas or material, corrosive material and water. May get electric shock, injury and fire.
- Do not mount during power is on. Please off the power before mounting. May get electric shock.
- The work, mounting, connecting and checking should behaved by specialist. May get electric shock, injury and fire.

⚠Warning

- Do not use on the condition, over specification. May get injury or goods damage.
- Install the cover to do not touch the rotor. May get injury.
- Make sure the direction of rotation is correct before mounting. May get injury or goods damage.
- Do not hold motor output shaft or cable during moving. May get injury by dropping.
- Do not stand or hanging on motor. May get injury.
- Do not touch motor output shaft (Key-gab, cutting part) with naked hand. May get injury.
- Be careful your finger when assemble the motor and gearbox or mount the motor on application. May get injury

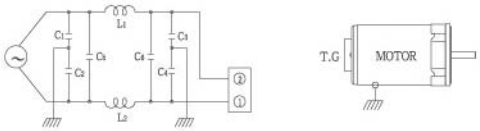
3.1 Condition of installation

Mount the motor in condition of the place.
The products can get damage if does not follow

- Inside of building (the products build based on assembly part of machinery set)
- Ambient temperature -10C ~ +40C (No freezing)
- Humidity under 85% (No dew condensation)
- No explosive gas, inflammable gas and corrosive gas.
- No direct sunlight
- The place, does not effect from dusty
- The place, does not effect from water and oil.
- The place easy for thermolysis.
- No continuous vibration or hard impact

3.2 Precaution of Noise

Use the noise filter for wrong operating by outer line noise



C1 ~ C4: 1000PF(2000VDC) C5 ~ C6: 0.1uF ~ 0.2uF(AC 125W or AC 250W) L1 ~ L2: About 100uH

[NOTE]

- Use L1~L2 with the specification, does not magnetic saturation by current
- Connect the motor in same place with capacitor
- Wire in short and use thick lead wire

4. Use in correct

4.1 Switch for Power on/off (set up with "NO" when it ships from factory)

The mode has two different functions for running when turn on the pow

YES	It Runs if the condition is Run before off the power It Stops if the condition is Stop before off the power
NO	It Stops in the both of conditions, Run or Stop before off the power

- Usually set up to "NO" to prevent from the danger of sudden running.
- When use "YES" mode (Please use in set mode)

Can remote control of 'run' 'stop' by RUN/STOP key operating when on/off the power.

Installation

① Set the switch to "YES" when power is on
② Operate RUN/STOP once when power is on (It recognizes YES)

⚠ Caution

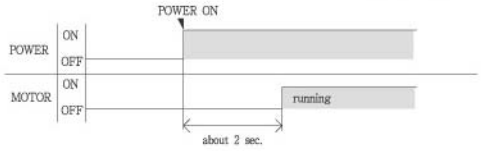
- Reset time from power on till run takes 2 sec.
- The operating of slow and will light on "Run" "Stop" at same time if keeps operating the switch (over 10,000 times) Then, please place the switch to "NO" for minimum 1sec. Then it will work correctly

4.2 Switch for Power on/off (set up with "NO" when it ships from factory)

It will follow the condition, before electricity cut off

4.3 Reset time

Takes about 2 sec. for reset time. Does not signal, digital during the time.



Operate the key after digital signal is on.
Before off the power, if the on/off switch is on "Run" it will run after 2 sec. after turn on the power.
It runs after 2 sec. when electricity cut off Instantaneously.

4.4 Auto operating of frequency

Runs 1,500rpm at 50Hz when it installed 1400rpm~1800rpm at 60Hz
But Runs 1,500rpm at 60Hz when it installed 1500rpm at 50Hz

4.5 Signal for abnormal

"RUN" "STOP" signals in same time. Sometimes it returns correctly after reapplying power.(But the mode will be return at beginning, the purchase condition) If the both "RUN" "STOP" signals are keeps on, need to consider of circuit failure. (Please contact to R&D of manufacturer) But if it caused by overly operating (operate switch over 10,000 times) please refer to the #. 4.1 section.

4.6 Thermal protector

There is motor that installed, thermal protector (TP), which is for preventing from over heating.
TP operates when motor is overly heated.(Motor stops running when TP is operating)
TP cut out automatically after motor temperature is down. Same time motor starts running automatically.

4.7 Test for withstand voltage & Impulse voltage

Need to disconnect of two power codes from outer motor wire in the case of withstand voltage testing with line earth, impulse voltage testing and testing of heat transfer resistance.

In case marking magnification is Not 1.000

Operate on "Ratio" Mode by follows magnification and Gear ratio value

Example) Gear ratio value=3

Base Unit, 5÷3rpm. Marking the value, until first digit after decimal point.

0 ↔ 1.6 ↔ ... ↔ 29.9 ↔ 31.6 ↔ 33.3 ↔ ... ↔ 466.6 ↔ ... ↔ 566.6rpm

Example) Multiple magnification value=0.500

Base Unit, 5X0.500. Marking the value, until first digit after decimal point.

Example) 0 ↔ 1.6 ↔ ... ↔ 29.9 ↔ 31.6 ↔ 33.3 ↔ ... ↔ 466.6 ↔ ... ↔ 566.6rpm

[NOTE]

- Marking "rpm" from and over 1.000 magnification.
  Does not mark under 1.000

6.4 S/R Mode

The mode for operating Slow Run time Use ↑, ↓ buttons.

Base unit, 0.1sec. Max 30sec.

0 ↔ 0.1 ↔ ... ↔ 0.2 ↔ 0.3 ↔ 0.4 ↔ ... ↔ 29.9 ↔ 30.0sec.

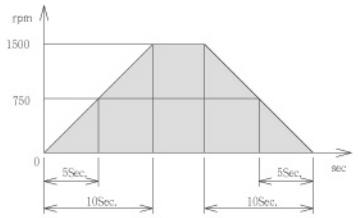
6.5 S/S Mode

The mode for operating Slow Stop time Use ↑, ↓ buttons.

Base unit, 0.1sec. Max 30sec.

0 ↔ 0.1 ↔ ... ↔ 0.2 ↔ 0.3 ↔ 0.4 ↔ ... ↔ 29.9 ↔ 30.0sec.

Note 1. SLOW RUN · SLOW STOP time



Slow Run and Slow Stop is the changing time from 0rpm ~ 1500rpm to 1,500rpm ~ 0rpm

〈ex〉 When Slow Run time is 10sec. And "Set" rpm is 750rpm

$$10s \times \frac{750\ rpm}{1500\ rpm} = 5s$$

It takes about 5sec. from 0rpm to 750rpm. Slow Stop time takes same.

Note 2. Slow Run and Slow Stop time can be longer if Inertia of load is bigger.

6.6 Power On set up status mode

Power On set up status switch can operate run/stop function when Power is applied again.

(1) "Yes" Mod

When power is applied, the reaction condition is same as before off the power

Before off the power	When power is applied again
"RUN"	Run(after 2Sec.)
"STOP"	Stop

(2) "No" Mode

When power is applied, the reaction condition is always off

Before off the power	When power is applied again
"RUN"	Stop
"STOP"	Stop

7. Basic Operation

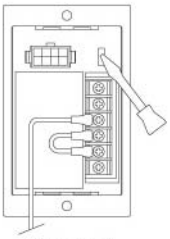
7.1 Prepare for running

Operation 1.

Power on set up status mode (Set up "NO" when you purchasing)
Set-up the mode for applying power

How to operate

1. Choose "Yes" or "No" with Power on set up status switch on rear of case. Usually set up to "No" (Picture 1)



〈 Picture 1 〉

⚠ Caution

- Refer to 4.1 on page 5.
- Push up or down completely by using screw driver.

How to operate

1. Choose CW or CCW by changing CW/CCW wiring on rear of the case (Set up to CW when you purchasing)

⚠ Caution

*Rotating direction can be different up to the gear ratio if you use gear head.

•Instruction of rotating direction

Rotating direction from view of shaft end	
C.W	Clock Wise
C.C.W	Counter Clock Wise

Operation 3.

Connecting with motors : Plug the connector for using motors

Operation 4.

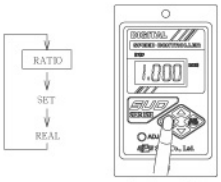
Applying power : Apply the power

Operation 5.

Select marking magnification (set up 1.00 when you purchasing)
:Select gear ratio or multiple magnifications

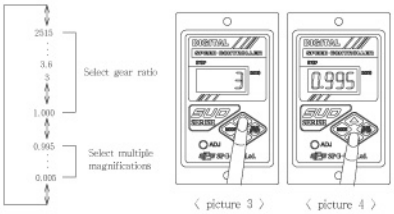
How to operate

1. Select the "Ratio" mode with press Mode key. (Picture 2)



〈 picture 2 〉

2. Select gear ratio or multiple magnifications by ↑, ↓ keys. (Picture 3, 4)



〈 picture 3 〉 〈 picture 4 〉

⚠Caution

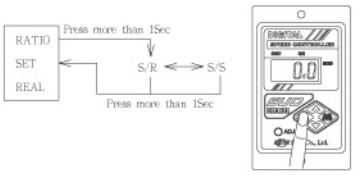
Refer to the "gear ratio" on the page 14.

Operation 5.

Set-up time for "Slow Run" and "Slow Stop" (set up 0sec. when you purchasing)

How to operate

1. Press mode Key more than 1sec at the mode "Ratio" or "Set" or "Real" to change S/R mode and marking S/R. (picture 5)



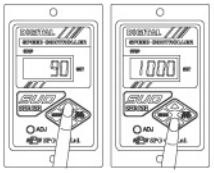
〈 picture 5 〉

2. It changes between S/R and S/S if press Mode key.
3. Use ↑, ↓ keys for setting time of Slow Run and Slow Stop. Possible rage is Min.0.1 sec. Max.30sec. with unit value 0.1sec.
4. Press mode key to complete the setting
5. Press mode key Min.1sec to return "Ratio" mode.

Operation 1. Set up RPM

1. Select "Set" mode by using Mode key.

2. Set up RPM by ↑, ↓ keys. (picture 6, 7)



〈 picture 6, 7 〉

7.2 Running

How to operate

1. Select "Run" by use Run/Stop key (picture 8)

〈 picture 8 〉

⚠ Caution

* S/R lights on during the time Slow run and the light off after finishing S/R time
- Can change RPM with use ↑, ↓ keys with selecting "Set" though it is running
- Can set up time for Slow Run and Slow Stop with selecting "S/R" "S/S" though it is running

7.3 Changing direction of rotation

How to operate

1. change the CW/CCW lead on the rear

⚠ Caution

* S/R lights on during the time Slow run and the light off after finishing S/R time "CW", CCW" means the rotating direction of motor shaft
- Change CW/CCW leads after stop the motor (Change the direction on motor is running can cause the failure)

7.4 Stop

How to operate

1. Select "Stop" by Run/Stop key (picture 9)

〈 picture 9 〉

⚠ Caution

* "S/S" lights on during Slow Stop time and lights off after finishing Slow Stop time.
- Change the rotation after stop the motor
- Can work at same condition by memory function of "Ratio", "Set", "S/R" and "S/S" when you restart the motor.

8. Special Operation

8.1 ADJ

The RPM on "Set" mode may not exactly same as actual RPM that marked on REAL MODE. The difference can be adjust with "ADJ"

How to operate

1. Select RPM that you need at "SET" mode. Set with 1,000rpm if you need to use wide range, such as 90rpm thru 1,700rpm
2. Can adjust the rpm with "ADJ" channel when rpm on real mode is not same as at the "SET" mode rpm. (picture10)

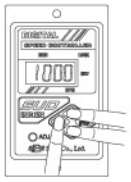
〈 piture 10 〉

⚠ Caution

- The tolerance of adjusting can be changeable from effecting of load, temperature.
- Can not adjust nonlinear range.
- Do not force to turn the channel, nor push.ratio" on the page 14.

8.2 Lock function

"Lock" function is the protection from operation mistake of setting condition.
〈The key cannot operate during "Lock" 〉

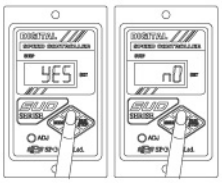


〈 picture 11 〉

8.3 Set up Power On/Off

How to operate

1. Set to "Stop"
2. Can see signal "Yes" or "No" if you press ↑ key for 5 sec. after setting Max. rpm. (Max RPM - 1,800rpm at 60Hz, 1,500rpm at 50Hz) (Picture 12)
3. Press ↓ Key to return previous condition.



〈 picture 12 〉

9. Inspection

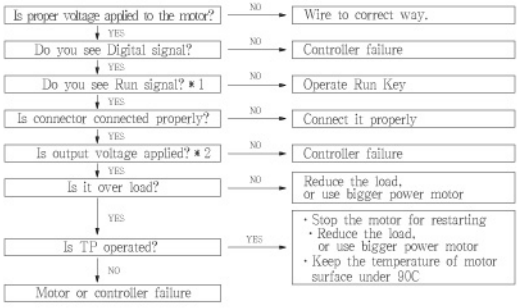
It is very important to take inspection to prevent from accident and minimize damage effect from environment such as temperature, humidity, dust and vibration…etc.

1. Is it running smoothly?
2. Any abnormal noise during running
3. Any abnormal temperature ring on the motor

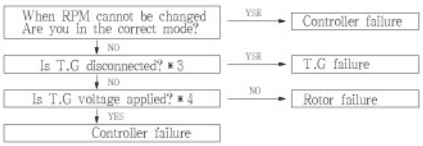
10. TrubleShooting

In case of motor get failure, check and correspondence as the list in below.
If you do not know the cause of failure please contact to the place, you purchased motors or to engineer lab. of head office.

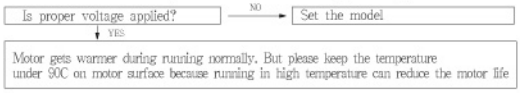
1. The motor does not rorate



2. When RPM cannot be changed



3. When abnormal temperature occurs during running



✱1. If Run/Stop signals are on same time, it means controller failure or time limit for operating "Yes" key. Use in "NO" mode.
✱2. Check the voltage : Check the motor voltage of black-white, black-gray during motor connector is plugged. 〈C.W black-white=100V〉〈CCW black-grey=100V〉(twice times voltage for 200V)
✱3. Turn on Test
Check the current of Red-Red wires after disassemble the motor connector
✱4. Check the voltage
Check the voltage of Red-Red wires after connecting the motor connector

11. Specification

Part # / List	SUD☐ IA-V12	SUD☐ IB-V12	SUD☐ IC-V12	SUD☐ ID-V12	SUD☐ IX-V12
Rating voltage	1-phase 110V	1-phase 220V	1-phase 100V	1-phase 200V	1-phase 220V-240V
Voltage range	±10% (Compared with arted Voltage)				
Frequency	60Hz	60Hz	50/60Hz	50/60Hz	50Hz
Speed control range	60Hz : 90 - 1700 rpm 50Hz : 90 - 1400 rpm				
Speed changing rate	5% (Standard)				
Set speed	Digital setting				
Slow run/ Slow stop time	0.1 ~ 30 sec.				
Temperature range	0 ~ 40°C				
Conservation temperature range	-10 ~ 60°C				
Humidity range	Less than 85%(There is not dewing)				

12. Option

· When controller needs distance from motor, consult the left diagram.

〈Extension cable〉

Items	Length
SOEW-05	0.5 m
SOEW-10	1.0 m
SOEW-15	1.5 m
SOEW-20	2.0 m
SOEW-40	4.0 m
SOEW-50	5.0 m

13. Function chat

Function	Contents
Change rotating direction	CW/CCW terminals(set CW when purchase)
Run/Stoop	Operate with Run/Stop Keys
Set RPM	Set digital(multiple magnification unit, 10rpm)
Set mark magnification	Set with Gear ratio(refer to gear ratio chat) & multiple magnification(Unit 0.005)
Slow run/Slow stop	0.1 sec. ~ 30 sec. (Unit 0.005)
Power On/Off	Set the mode when power is applied
Lock function	Prevent from mis-operating
Memorize of Parameter	Keep the memory of Parameter when power is off

14. Gear Ratio Chart

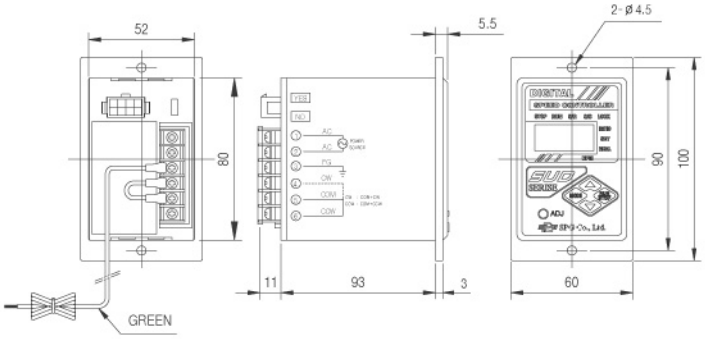
Nominal gear ratio	Actual gear ratio							Inter-decimal gear head
	60/6W	70/15W	80/15W	80/25W	90/40W	90/60W	90/90W	
3	3.00	3.00	3.00	3.00	3.00	3.00	3.00	
3.6	3.60	3.59	3.57	3.57	3.60	3.60	3.60	
5	5.00	5.00	5.00	5.00	5.00	5.04	5.04	
6	6.00	6.00	6.00	6.00	6.03	6.00	6.00	
7.5	7.50	7.50	7.50	7.50	7.50	7.50	7.50	
9	9.00	9.00	9.00	9.00	9.00	9.00	9.00	
10	10.00	10.29	10.00	10.00	10.00	10.00	10.00	
12.5	12.50	12.14	12.50	12.50	12.50	12.50	12.50	
15	15.00	15.00	15.00	15.00	15.00	15.00	15.00	
18	18.00	17.92	18.08	18.08	17.67	18.00	18.00	
20	19.90	20.00	20.00	20.00	20.00	20.19	20.19	
25	25.06	24.80	25.00	25.00	24.73	25.00	25.00	10
30	30.25	30.00	30.00	30.00	30.00	30.00	30.00	
36	36.30	36.00	36.00	36.00	36.00	36.00	36.00	
40	40.80	40.36	40.11	40.11	40.36	39.68	39.68	
50	50.00	50.00	50.00	50.00	50.00	50.00	50.00	
60	60.00	60.00	60.00	60.00	60.00	60.00	60.00	
75	75.00	75.00	75.00	75.00	75.00	76.02	76.02	
90	90.00	90.67	90.00	90.00	90.00	90.00	90.00	
100	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
120	120.0	118.0	120.0	120.0	120.0	120.0	120.0	
150	150.0	154.0	150.0	150.0	150.0	149.9	149.9	
180	180.0	181.2	180.0	180.0	180.0	179.8	179.8	
200	198.9	194.8	200.0	200.0	201.8	197.2	197.2	
250	251.5	-	-	-	-	-	-	

● The gear ratio between actual and nominal can be rather different. Pleaes refer to the chart in below

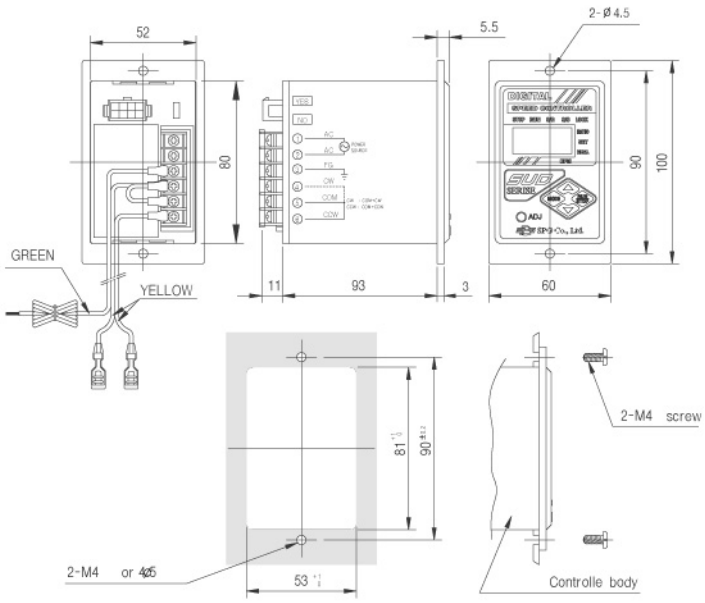
〈Example〉
Set the ration to 201.8:1, when the ratio is 201.8:1 with 40W motor because the actual ration is 201.8:1

15. Dimensions(Controller)

■ Internal condenser type(Exception over 60W and 110V type)



■ External condenser type(100V type 60W and over)



Appendix B: Pressure Calculation

(Input force x 0.1 = Actual force)

$$\frac{\text{Actual force} \times 1000}{78.5} = \text{Actual pressure}$$

$$\frac{\text{Actual pressure} \times 78.5}{1000} = \text{Actual force}$$

4INCH WAFER

pressure (g/㎠)	Pressure (psi)	actual force	input force
		4inch area[㎠]	4inch area[㎠]
		78.5	78.5
70	1.0	5.495	5.5
80	1.1	6.28	6.3
90	1.3	7.065	7.1
100	1.4	7.85	7.9
110	1.6	8.635	8.6
120	1.7	9.42	9.4
130	1.8	10.205	10.2
140	2.0	10.99	11.0
150	2.1	11.775	11.8
160	2.3	12.56	12.6
170	2.4	13.345	13.3
180	2.6	14.13	14.1
190	2.7	14.915	14.9
200	2.8	15.7	15.7
210	3.0	16.485	16.5
220	3.1	17.27	17.3

230	3.3	18.055	18.1
240	3.4	18.84	18.8
250	3.6	19.625	19.6
260	3.7	20.41	20.4
270	3.8	21.195	21.2
280	4.0	21.98	22.0
290	4.1	22.765	22.8
300	4.3	23.55	23.6
310	4.4	24.335	24.3
320	4.5	25.12	25.1
330	4.7	25.905	25.9
340	4.8	26.69	26.7
350	5.0	27.475	27.5
360	5.1	28.26	28.3
370	5.3	29.045	29.0
380	5.4	29.83	29.8
390	5.5	30.615	30.6
400	5.7	31.4	31.4
410	5.8	32.185	32.2
420	6.0	32.97	33.0
430	6.1	33.755	33.8
440	6.3	34.54	34.5
450	6.4	35.325	35.3
460	6.5	36.11	36.1
470	6.7	36.895	36.9
480	6.8	37.68	37.7
490	7.0	38.465	38.5
500	7.1	39.25	39.3

6INCH
WAFER

pressure (g/㎠)	Pressure (psi)	actual force 6inch area[㎠]	input force 6inch area[㎠]
		176.6	176.6
70	1.0	12.362	12.4
80	1.1	14.128	14.1
90	1.3	15.894	15.9
100	1.4	17.66	17.7
110	1.6	19.426	19.4
120	1.7	21.192	21.2
130	1.8	22.958	23.0
140	2.0	24.724	24.7
150	2.1	26.49	26.5
160	2.3	28.256	28.3
170	2.4	30.022	30.0
180	2.6	31.788	31.8
190	2.7	33.554	33.6
200	2.8	35.32	35.3
210	3.0	37.086	37.1
220	3.1	38.852	38.9
230	3.3	40.618	40.6
240	3.4	42.384	42.4
250	3.6	44.15	44.2
260	3.7	45.916	45.9
270	3.8	47.682	47.7
280	4.0	49.448	49.4

COUPON

pressure (g/㎠)	Pressure (psi)	actual force coupon(40x40) area[㎠]	input force coupon(40x40) area[㎠]
		16	16
190	2.7	3.04	3.0
200	2.8	3.2	3.2
210	3.0	3.36	3.4
220	3.1	3.52	3.5
230	3.3	3.68	3.7
240	3.4	3.84	3.8
250	3.6	4	4.0
260	3.7	4.16	4.2
270	3.8	4.32	4.3
280	4.0	4.48	4.5
290	4.1	4.64	4.6
300	4.3	4.8	4.8
310	4.4	4.96	5.0
320	4.5	5.12	5.1
330	4.7	5.28	5.3
340	4.8	5.44	5.4
350	5.0	5.6	5.6
360	5.1	5.76	5.8
370	5.3	5.92	5.9
380	5.4	6.08	6.1
390	5.5	6.24	6.2
400	5.7	6.4	6.4
410	5.8	6.56	6.6
420	6.0	6.72	6.7
430	6.1	6.88	6.9
440	6.3	7.04	7.0
450	6.4	7.2	7.2
460	6.5	7.36	7.4
470	6.7	7.52	7.5

480	6.8	7.68	7.7
490	7.0	7.84	7.8
500	7.1	8	8.0

END OF PAGE