Winpact Solid State Fermentation System

INSTRUCTION MANUAL

Catalog No.
FS-V-SA05P

Catalog No.
FS-07-110
FS-07-220

Version: V.06D
Issue date: 2016/9/18
Last Revised Date: 2017/12/27

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Packing List

When you receive the merchandise, please make sure that all items are included in the package. The following Packing List can help you check the items. If one of the items is missing, please contact the local Major Science representative or e-mail to the following address: service@majorsci.com.

Controller Package					
FS-07- 110			**FS-07 -220**		
Item	Description	Qty.	Item	Description	Qty.
1.	Controller, 110V	1	1.	Controller, 110V	1
2.	Remote Control Software CD	1	2.	Remote Control Software CD	1
3.	Instruction Manual	1	3.	Instruction Manual	1

Vessel Kit Package		
FS-V-SA05P		
Item	Description	Qty.
1.	Culture Vessel (5L Double Jacketed Vessel) - One type of impeller included  Broken type FS-A-IM305  Anchor type FS-A-IM405  Spiral type FS-A-IM505	1
2.	Vessel Holder Set	1
3.	Protective Vessel Cover in Sterilization	1
4.	PT-100 Temperature Probe	1
5.	PT-100 Temperature Probe Cable	1
6.	Brushless Motor	1

FS-A-SK25 for 1 solid state vessel Start-up kit Packing List		
Item	Description	Qty.
1.	500 ml Glass Feeding Bottle(including 2-port Stainless Steel Connector Cap)	1
2.	250 ml Glass Feeding Bottle(including 2-port Stainless Steel Connector Cap)	1
3.	O-ring	4
4.	Twin Loading Port	1
5.	Autoclavable 50mm 0.2 μM disc type air filter	4
6.	Silicon Tubing Clamp	6
7.	#16 Silicon Tube (ID 3.1mm, 25ft)	1
8.	2 mm Hex Wrench	1
9.	2.5 mm Hex Wrench	1
10.	5 mm Hex Wrench	1
11.	Screwdriver NO.107X4"och-length 100mm	1
12.	Funnel	1
13.	Fixed Baffle	2

Signed by:

Date:

Winpact is liable for all missing or damaged parts / accessories within 7 days after customer received this instrument package. Please contact Major Science immediately regarding this issue. If no response within such time period from consignee party, that will be consignee party's whole responsibility.

WARNING

This equipment has been tested and verified to comply with safety limits. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment may generate, use, and radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference with radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their expense. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. It is strongly recommended that the user carefully read the following prints before operating any equipment.

1. Read and follow the instruction manual thoroughly.
2. Do not modify the equipment. Failure to adhere to these directions could result in personal and/or laboratory hazards, as well as invalidate the equipment warranty.
3. Use a properly grounded electrical outlet with correct voltage and current handling capacity.
4. Disconnect the equipment from power supply before servicing and maintenance.
5. In the event of spilling solutions accidentally into the instrument, disconnect the grounded plug and you must have an appropriate decontamination. And replace the damaged parts.
6. Do not use in the presence of flammable or combustible material, which may cause fire or explosion. The instrument contains the components that can ignite such materials.
7. Refer maintenance and servicing to qualified personnel.
8. Ensure that the system is connected to electrical service according to local and national electrical codes. Failure to properly connect may cause a fire or shock hazard.
9. Ensure the use of appropriate materials and correct operation to avoid possible hazards of explosion, implosion or release of toxic or flammable gases arising from the heated materials.
10. Handle the culture vessel with cares to prevent the glass vessel from any damages or crashes, especially before and after autoclave / sterilization.
11. Always use the supplied handle or appropriate protection to handle the culture vessel to prevent hands from heat burns, especially after autoclave/sterilization.

ATTENTION: Hot Surface!

12. The instrument is intended for scientific research use only, and must be operated by qualified personnel who realize the potential risks of the use of this instrument. Major Science makes no claim that its instruments are designed or certified as medical device; no representation, promises, express warranty, or implied warranty will be made concerning the suitability of these instruments for any medical use. Major Science will not provide customers any notice or certification concerning its products being compliant as a medical device.

Safety Information

Use high levels of precaution when using any electrical device. Before connecting the electric supply, check to see if the supply voltage is within the range stated on the rating label, and see to it that the device be seated firmly. Place the unit in a safe and dry location; it MUST NOT touch any surrounding objects. Follow the safety precautions for chemicals/dangerous materials, and hot surfaces (after autoclave/sterilization). If needed, contact a qualified service representative or service@majorsci.com.

Environmental Conditions

Ensure the instrument is installed and operated strictly under the following conditions:

1. Indoor user only
2. ≤ 95% RH
3. 75 kPa – 106 kPa
4. Altitude must not exceed 2000 meters
5. Ambient to 40℃ operating temperature
6. Pollution degree: 2
7. Mains supply voltage fluctuations up to ± 10% of the normal voltage

Electrical Shock Precaution

Follow the guidelines below to ensure safe operation of the unit.

The Bench Top Programmable Fermentation System has been designed for use with shielded wires thus minimizing any potential shock hazard to the user. Major Science recommends against the use of unshielded wires.

1. Dry out for a period of time and restore the instrument to NORMAL CONDITION before operation.

2. NEVER connect or disconnect wires leading from the power jacks when the red indicator light on the "Start/Stop key is on or when "RUNNING" is displayed on the screen.
3. WAIT at least 5seconds after stopping a run before handling output leads or connected apparatus.
4. ALWAYS make sure that your hands, work area, and instruments are clean and dry before connecting any cables or operating the power supply.
5. ONLY connect the power cord to a properly grounded AC outlet.

Preventive Measures of Damaging Instrument

1. Do not attempt to operate the device if damaged.
2. Protect this unit from physical damage, corrosive agents and extreme temperatures (direct sunlight etc).
3. For proper ventilation, leave at least 10 cm of space behind the instrument, and at least 5cm of space on each side.
4. Do not operate the instrument in high humidity environments (> 95%), or where condensation may occur.
5. Before using any cleaning or decontamination method except those recommended by the manufacturer, you should check with the manufacturer that the proposed method will not damage the equipment.

Equipment Operation

1. Check that the culture and all the accessories are assembled well and undamaged before starting the autoclave and fermentation process.
2. Ensure all other associated instruments and equipment, such as the Autoclave and Cooling Water Bath are in normal condition and their specifications meet the fermentation process needs. These instruments and equipment must be operated according to their instruction manual. Furthermore, the assembly and connection between themselves and the fermentation system must be carried out correctly.
3. NEVER access any HAZARDOUS LIVE parts that violate International Biosafety Regulations.
4. When operating other fermentation system-associated instruments, use the same level of precaution to prevent potential damage and ensure the fermentation performance.

Symbols

The symbols used on the Bench Top Programmable Fermentation System are explained below:

The symbol indicates an area where a potential shock hazard may exist.

The symbol indicates a warning. Consult the manual to avoid possible personal injuries or instrument damages.

ATTENTION: Hot Surface!

Warranty Agreements & Customer Service

Warranty Agreements

Major Science warrants its products against defects in materials and workmanship, under normal service, for a period of 12 months from the shipping date to purchaser, unless other terms are agreed upon in writing. The date of shipping date must be evidenced by presenting the corresponding delivery confirmation.

The guarantee is given against defects in manufacture and against malfunctioning, but not for parts subject to wear and tear (O-ring, seals, membrane filter), defects or damages caused by improper handling, or defects and malfunctions caused by corrosion (due to lack of resistance against solvents, etc., which are used for fermentation).

The warranty does not cover parts subject to wearing and tearing, or damages caused by improper handling. In addition, it does not cover the following:

1. Corrosion/damage to the tubing clamps on the peristaltic pump, which is caused by contacting with strong acid/base or chemicals.
2. Damage to the fermentor controller, vessel and cables caused by negligence during the installation or adjustment.
3. All probes (pH probe, DO probe, excluding DO probe membrane) are covered by the warranty for 6 months starting from the date of completion of installation.
4. O-rings, mechanical seals and start-up kits components (silicon tubing, clamps, feeding bottles, etc.)
5. All glass parts are excluded from the warranty.

Note:

Before first use or use under specific environmental conditions in the laboratory and/or together with special nutrients or additional solutions, you must test the resistance of all parts.

Major Science's obligation under this warranty is limited to repairing parts or providing replacement parts at no charge, which prove to be defective during the warranty period. A part shall be considered defective after inspection of Major Science's technical staff. At Major Science's option, we will repair or replace any defective part, which is returned to Major Science's facilities. The cost of shipping the repaired or replacement part will be borne by Major Science. Any unit where repair or modification has been performed by anyone other than Major Science or an appointed distributor/representative is no longer under warranty from the time the unit was modified.

Return Policy

A local Major Science representative can repair defects and damages. Defective appliances can also be returned to a local Major Science representative. It will be the customer's liability to pay all carriage charges. The repairs will be carried out and charged in accordance with our terms of maintenance.

Note:

Upon return, the equipment must be clean, in good hygienic condition and carefully packed. Contagious parts must be disinfected or sterilized, according to chemical, biological, biotechnological or genetic safety regulations. The sender has to prove compliance with corresponding safety regulations. The sender will be charged for repair or damages due to transport and for necessary cleaning and disinfection of any parts.

For returning any equipment, please notify the local Major Science representative or contact Major Science directly.

No. 37, Wuquan 5th Rd., Wugu Dist., New Taipei City 24888 Taiwan, R.O.C.
TEL: 886-2-2298-1055
FAX: 886-2-2299-7871

19959 Sea Gull Way, Saratoga, CA 95070, U.S.A.
TEL:1-408-366-9866
FAX:1-408-446-1107
E-mail: service@majorsci.com

Chapter 1. Delivery & Installation

1.1 Unpacking and Parts Check

Please pay attention to the following advice:

1. Carefully check the outer packaging, the packaging of each single component, as well as the parts themselves to see if any damage.

Warning:

Do not use the culture vessel when damage is suspected. If the vessel is damaged, it might burst or break during the sterilization in the autoclave.

2. Check if the delivery is complete. To prevent scratching, please unwrap the packaging carefully.
3. Please be cautious to prevent any damage due to collision when loading or unloading the instrument.
4. When moving or positioning the controller, do not lift it by holding the heads of peristaltic pumps. The pumps are fragile.
5. If the components are missing or damaged during the transportation, please inform the local Major Science representative.

Note:

(1) When connecting ***the temperature probes***, ***agitation motors*** and ***glass vessel devices*** to the controller, please connect them to the appropriate and assigned side of the controller carefully.

Please carefully exam the devices (such as temperature probes, agitation motors, and glass vessel devices) which are labelled clearly for each side and connect them accordingly.

Please be cautious that probes calibration is controller-specific; therefore, switching probes between different controllers is prohibited as it may result in inaccurate readings. Unauthorized pairing of probes is not recommended unless specified.

(2) If additional vessels are required, please contact the local Major Science representative or Service Department of Major Science for detailed installation instruction.

1.2 Space Requirement

1. The system will require an area of approximate 1,500 × 600 mm (W × D), including the space for the culture vessel and the cooling circulating water bath.
2. You might vary the arrangement of components based on the lengths of the cables and tubes. It is suggested that you consider additional space for handling the equipment conveniently.

1.3 Utility Requirement

1.3.1 Gas Source

Before first use, use the (+) screwdriver to open the back panel for gas pressure adjustment. (The screwdriver is provided in the standard package.) Detailed instructions are given in the following paragraphs.

The incoming gas must be reduced to at least 2 bar (29 psi.) before entering the air inlet (Fig.2). If you are using an air compressor or a cylinder, please make sure to use an external regulator to reduce the gas pressure. The inlet gas must be further adjusted to 0.5 bar (approx. 7 psi.) by using the built-in pressure gauge (Fig.3) inside of the back panel. The built-in pressure gauge will be fully shut off when the fermentation system first starts, which means no air flow will be observed in the rotameter.

To adjust the air flow, open the back panel and lift up the pressure knob, turn counterclockwise to open the pressure valve; turn clock wise to close it. After adjusting to 0.5 bar, push the knob down to lock and close the back panel.

Vessel's cooling coil water inlet

Condenser's cooling water inlet

Condenser's cooling water outlet

Vessel's cooling coil water outlet

Flow-rate regulator for condenser water

Main water outlet (Drain)

Main water inlet

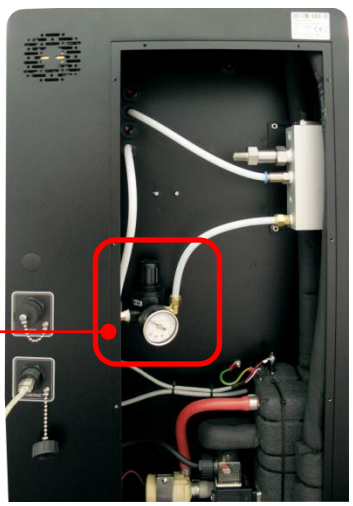
figure 1

Gas outlet to sparger

O_2 inlet

Air inlet

figure 2



Gas Pressure Gauge

1.3.2 Cooling Source

It is important to make sure that your water quality is clean (50 micron filter). And in order to prevent calcareous deposits, the hardness of water should be below 12 German Degree of Hardness. The water pressure must be reduced to the range of 0.3 bar (4.35 psi.) to 1 bar (14.5 psi.) to prevent damage to the water circulation pump. It is suggested setting the coolant temperature at least 15 - 20˚C below the desired culture temperature.

NOTE that DO NOT use DI water (deionized water) since sensor such as level sensor (/probe) detects by the ions in water, DI water is not suitable for water source in fermentation system.

Please tighten the main water inlet connection to avoid leaking or bursting. Damages caused by impure water quality are not covered by the warranty. Major Science does not recommend using tap water for the coolant source for the following reasons:

A. The temperature of tap water varies depending on the environment, which may cause unstable water condition and affect the temperature control capability of the system. The temperature cooling effect will be compromised and unable to achieve excellent result.
B. Salt and minerals often heap at the bottom and gradually cause damages to the valve and pump.
C. Tap water pressure is not regulated and likely to cause the water circulation pump jacketed vessels broken.

Recommended tubing size for coolant and air connection:
(Fittings might be needed for connecting to the coolant and air source)

Chiller	Main Water Inlet	3/8” (9.6mm)
	Main Water Outlet	
Air	Gas Outlet	3/16” (4mm)
	Air Inlet	
	O_2 Inlet	

1.4 Headplate Installation

Note:
You will receive the vessel with the headplate installed already. This section shows you the safe and correct method to install the headplate when you put the medium into the vessel in the beginning of the fermentation process, and make sure the vessel is airtight.

Align the screwholes on the headplate with the bolts on the vessel. Then gently put the headplate onto the glass vessel. Make sure the headplate is placed with balance on the vessel before use the nuts to fasten the headplate and vessel.

In case the vessel is not hermetically sealed, we suggest you tighten the 2 nuts in diagonal position *(fig.1)* at the same time. And rotate the nuts downward 1 rotation (approximately the distance between 2 screw threads) each time; repeat this step in the sequential order of the next set of nuts until all nuts are tightened. Then place your palm onto the headplate and put a little pressure while fastening the nut simultaneously; this step is to make sure the headplate has been fastened to the bottom of the bolt, and the vessel is airtight *(fig.2)*.

fig.1 *Example of vessel locks and the diagonal position*

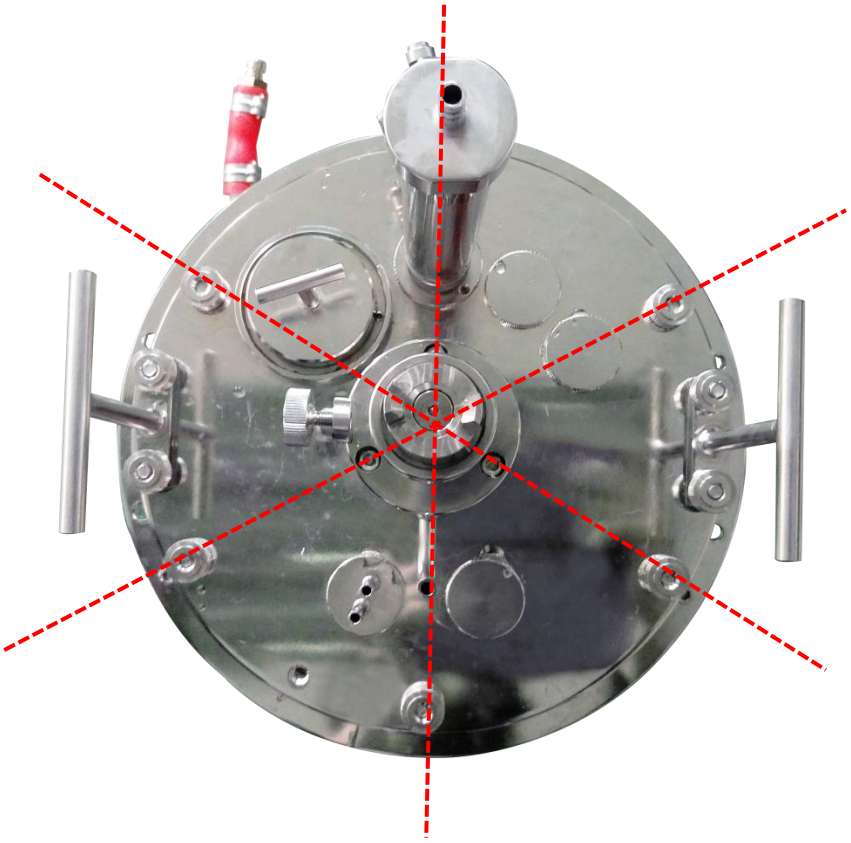


fig.2

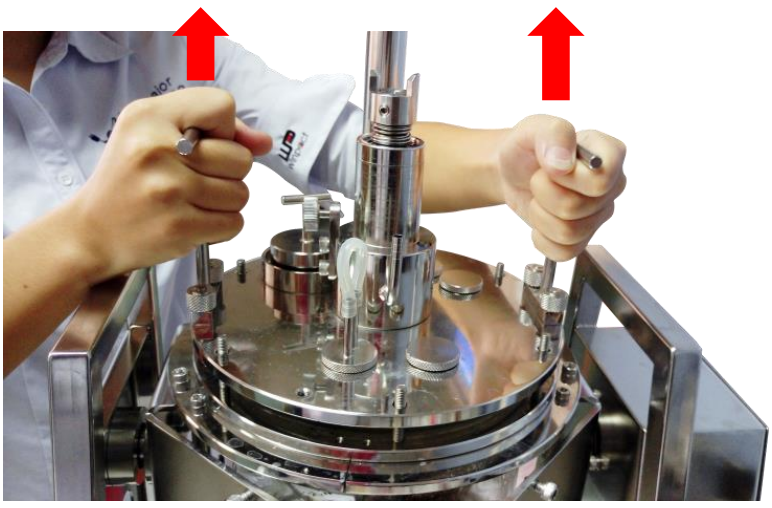
Use one hand to push the headplate downward and the other hand to fasten the nut.

To make sure the vessel is actually airtight, you can put the whole vessel into the bucket filled with water and check for leakage. If it bubbles, that means the headplate is not tightly closed, repeat the above steps to fasten the vessel.

1.5 Vessel Installation

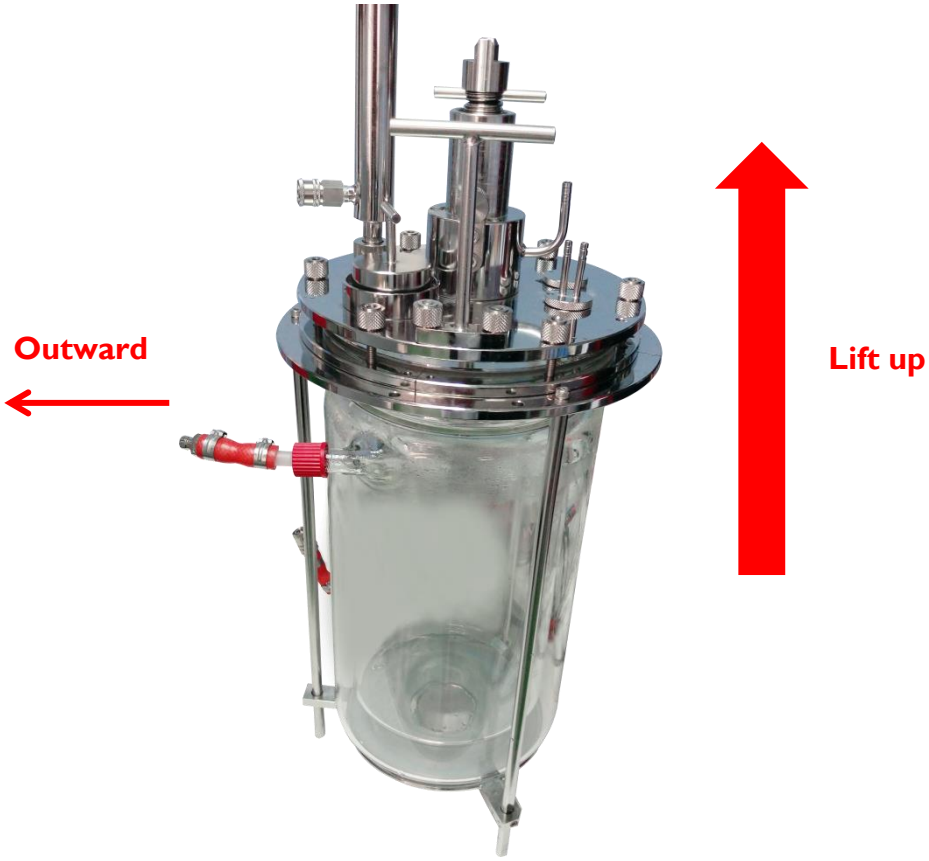
To install vessel completely, see the following steps:

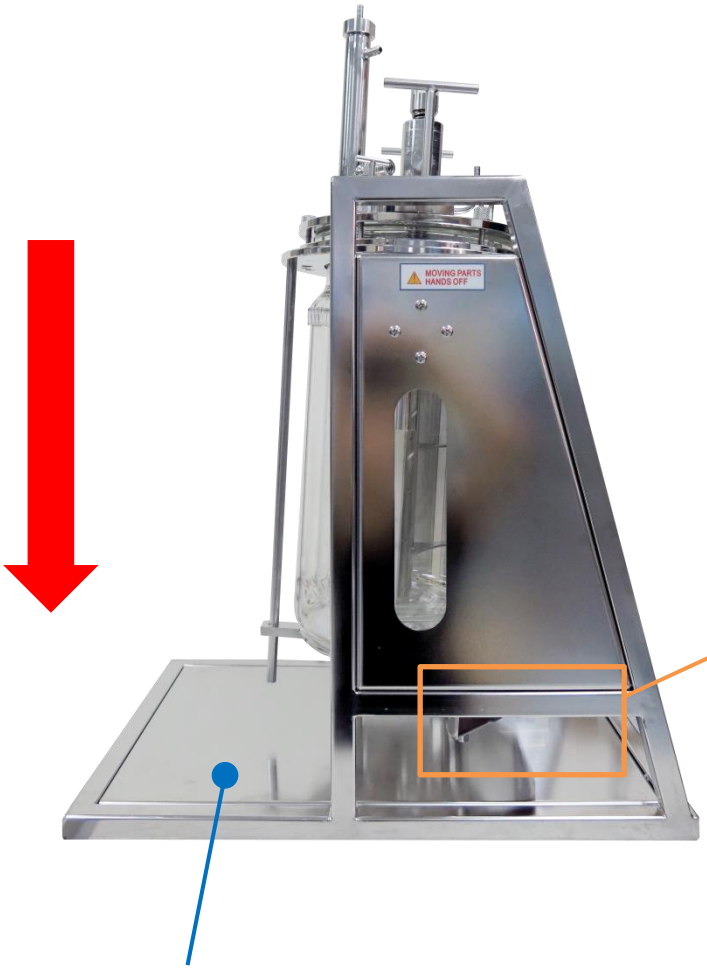
a. Lift up the vessel with both hands by holding the T-hand lifters.

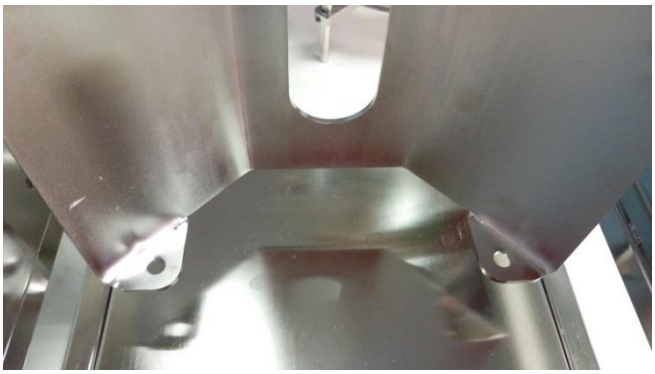


Note: Before lifting the vessel, make sure you have screwed up all the 6 screw nuts on the headplate tightly. Otherwise vessel may disconnect with headplate and cause unexpected danger.

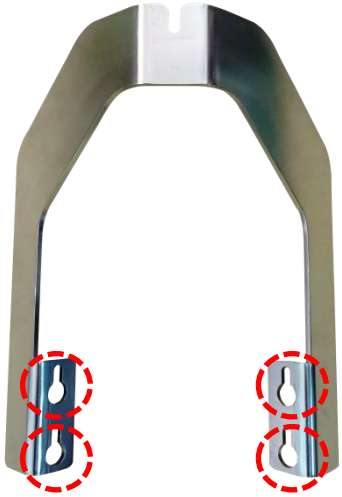
b. Pose the water inlet outward, and then make the two behind vessel supports penetrate through the two holes on the vessel holder.




MOVING PARTS
HANDS OFF
Vessel Holder

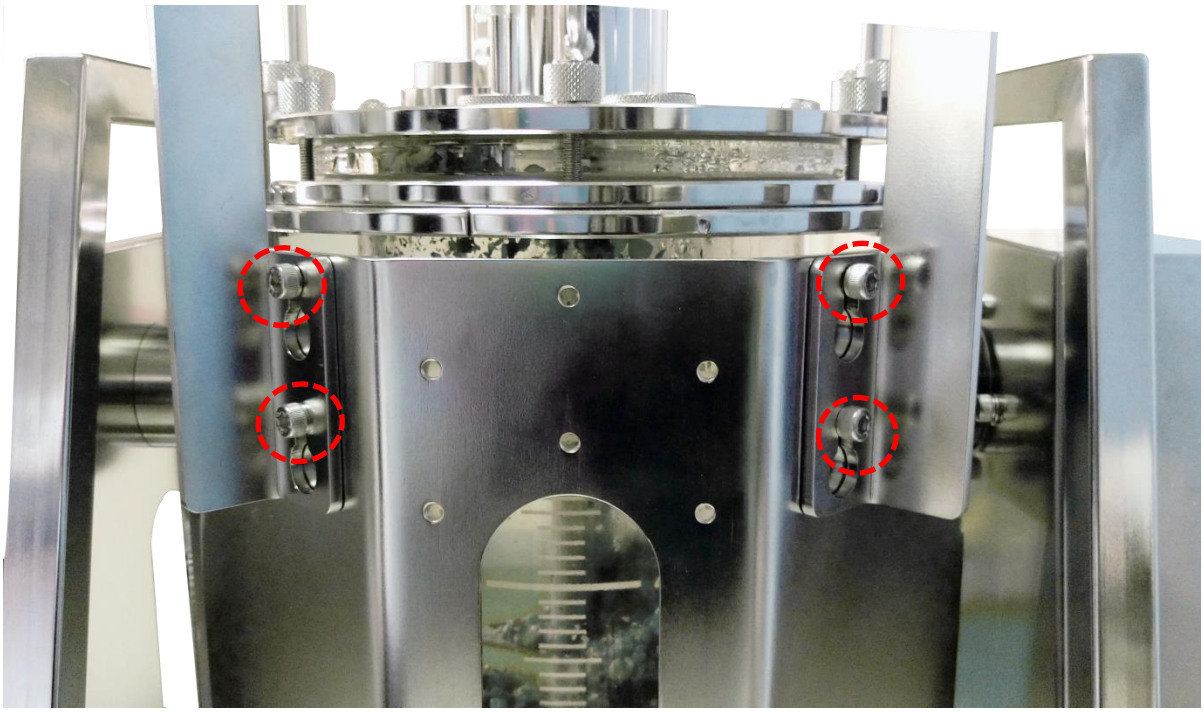


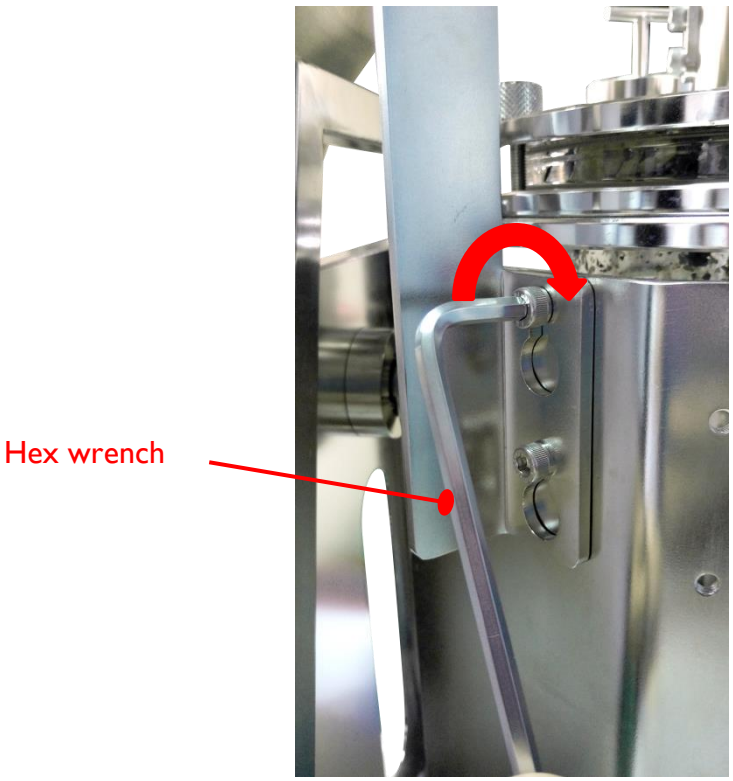
c. Align the motor support to the four hex screws and use hex wrench to screw up the hex screw tightly.



▲ Motor Support

▲ Hex screw

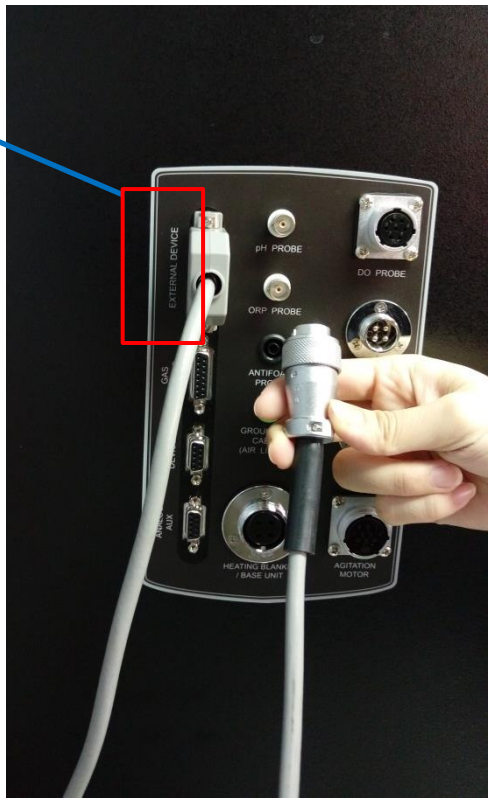




d. Plug in and fix the motor by tightening the screw.

e. Connect the motor cable with one end while the other end connect to "AGITATION MOTOR" socket on the side of controller.

f. Connect motor cable at one end and the other connect to "EXTERNAL DEVICE" socket on the side of controller.



Chapter 2. Specifications

2.1 FS-07 -110/220 Specification

FS-07-110 / FS-07-220		
Control Unit	Control Panel	10.4" color touch-screen Interface (Resolution: 800 × 600 pixels)
	Communication Port	Remote control through Ethernet Analog AUX port for system extension
	Number of Vessels Controlled per Remote Control Software	16 maximum
	Program Storage	Up to 59,994 programs for different kinds of condition.
	Log Data Storage	Up to 100 process monitoring data files.
	Data External Storage Interface	USB port
	Cabinet Material	Front panel: ABS / Housing: Painted iron
	Dimension	Footprint: 400 × 600 mm (W × D) Height: 740 mm
	Weight	Approx. 39.25 kg
	Rated Voltage	110V~ /220V~; 50/60Hz, 10A
Function		
Aeration	Inlet Gas Flow-meter	0, 0.2 – 2.5 LPM (FS-V-SA05)
	Sparger	Orifice ring
	Baffle	Removable 316L stainless steel baffles
Temperature	Heating	1. Thermostat system for FS-V-A/B/C/SA05: Built-in heat exchanger (550W heater/water circulation pump) 2. Dry heating system for FS-V-B/D(heating blanket or heating base unit)
	Cooling	Cooling Coil for FS-V-B and FS-V-D, heat exchanger for FS-V-A/C/SA05
	Range	- With FS-V-A/ B/ C/ SA05 series: 5˚C (41˚F) above coolant up to 60˚C (140˚F) - With FS-V-D series: 5˚C (41˚F) above coolant up to 90 ˚C (194˚F)
	Probe	Platinum RTD probe (PT-100), none autoclavable
	Resolution	0.1 ˚C
	Control Mode	Manual or programmable 15 steps PID control.
Agitation	Drive	Removable top brushless motor (M4)
	Speed Range	- For Broken type/Spiral type/Skeleton type/Anchor type impellers (only for FS-V-SA05 vessel): 1 – 60 rpm
	Resolution	1rpm
	Control Mode	Manual or programmable 15 steps PID control

Vessel Swing *(only for FS-V-SA05)*	Angle Range	Normal operation: 0^0~90^0, adjustable time interval Harvest mode: 0^0/ 120^0
	Control Mode	Programmable control
pH※	Range	2 - 12 pH
	Resolution	0.01 pH
	Control Mode	Manual /Programmable 15 steps PID control with adjustable dead-band/pH Stat with smart feeding technology
DO※	Range	0-200%
	Resolution	0.1%
	Control Mode	- 2-stage DO cascade response: (Manual *or* Process mode) a. Increase or decrease agitation speed b. Oxygen Enrichment Module *(optional)* c. Gas Mixing Station Module *(optional)* - 1-point & 2-point feedback feeding strategy - DO Stat with smart feeding technology
ORP※	Transmitter	± 2000 mV
	Resolution	1mV
Foam/ Level※	Probe	316L stainless steel detector with insulated PTFE tube; On/Off control; autoclavable; adjustable sensitivity
	Control Mode	Foam: On/Off switch Level: On/Off switch with wet/dry probe set up
Peristaltic Pump	Pump Number	4 built-in pumps; 1 to 2 external pumps *(optional)*
	Motor Type	Precise stepping motor; minimum speed is 1 rpm
	Speed Range	0 – 65 rpm
	Resolution	1 rpm
	Control Mode	- Manual or Programmable 15 steps feeding control - pumps can be assigned for Acid, Base, Antifoam *and/or* Feedings - Flow rate and total volume of each pump can be calculated.
Exhaust	Device Type	SUS316L stainless steel condenser
Utility Requirement	Power Source	100- 120V/210-230V~ 50/60 Hz with electrical safety cutoff switch
	Water Source	1 bar maximum(14.5 psi); soft water with at least 10-15°C below set operating temperature
	Air Source	2 Bar maximum, dry, oil-free and filtered
	Sterilization	Autoclave ; size of autoclave inner chamber must be able to accommodate vessel with condenser attached.

※ To use pH, DO, ORP, and foam probes on solid state vessel, it depends on the medium and impeller type.

2.2 Vessel Specification

FS-V-SA05P (Solid State 5L Double Jacketed)		
Vessel Type		Solid state 5L double jacketed dish bottom vessel kit
Vessel Cat. No		FS-V-SA05P
Max Working Volume		5L
Total Volume		6.8L
Headplate Material		316L stainless steel
Vessel Material		Glass fully enclosed capsule-type tank,
Vessel Holder		with a tiltable shelf(0^0~90^0) and an outer autoclave protective shield
Overall Diameter		350 mm
Overall Height with Condenser		683 mm
Overall Height without Condenser		448 mm
Dimension (with vessel holder)		430mm(L) x 730mm(W) x 780 mm(H)
Weight		Approx. 35.5 Kg (Including Vessel Holder, motor; not including impeller)
Agitation	Motor	Removable top brushless motor (M4)
	Shelf Material	Non-stick surface
	Impeller	1. Broken type (FS-A-IM305) 2. Anchor type (FS-A-IM405) 3. Spiral type (FS-A-IM505) *(*Select one from the above type)*
Harvest		Motor-drive, to 120 degree.
Temperature		Detect the temperature of jacket.
Exhaust Device Type		316L stainless steel condenser
Sterilization		Autoclave **the size of autoclave inner chamber must be able to accommodate the vessel with condenser attached.*

Chapter 3. Introduction

Winpact Scientific is a product brand under Major Science, an innovative, R&D-based manufacturer supplying a broad product portfolio to the life science market. Winpact provides a comprehensive and innovative line of cultivation products designed for different cell culture experiments and applications. It comes in a benchtop scale and has a large, color touch-screen panel with a user-friendly interface. Its distinctive functions include various programming operations to control the pump speed, pH levels, temperature, and more. Winpact Fermentation System is equipped with a full connection device to connect to any PC for real-time recording and control within the vessel.

Features

- 10”4 color touch screen & graphical user interface
- Ethernet remote control and data logging function
- Flexible optional device selections
- Storage program: Up to 59,994 programs for different kind of conditions
- Data storage: Up to 100 data files
- Data export interface: USB port
- Modular system for easy upgrade & maintenance
- Complementary start-up package

Chapter 4. Component Description

A functional fermentation system is comprised of two major constituent units: a controller and a culture vessel along with peripheral utilities. An external heater unit such as: a heating blanket or base unit may require if dry heating temperature control is selected. This chapter introduces the functions of each unit, and gives a general guidance for the machine operation.

4.1 Control Unit

The control unit is like the brain of a human body. It gives the culture vessel and other devices instructions to achieve your requirements. To have better understanding about the structure of the machine, you can refer to the sections below.

Front View

Rear View

4.1.1 Control Unit Layout

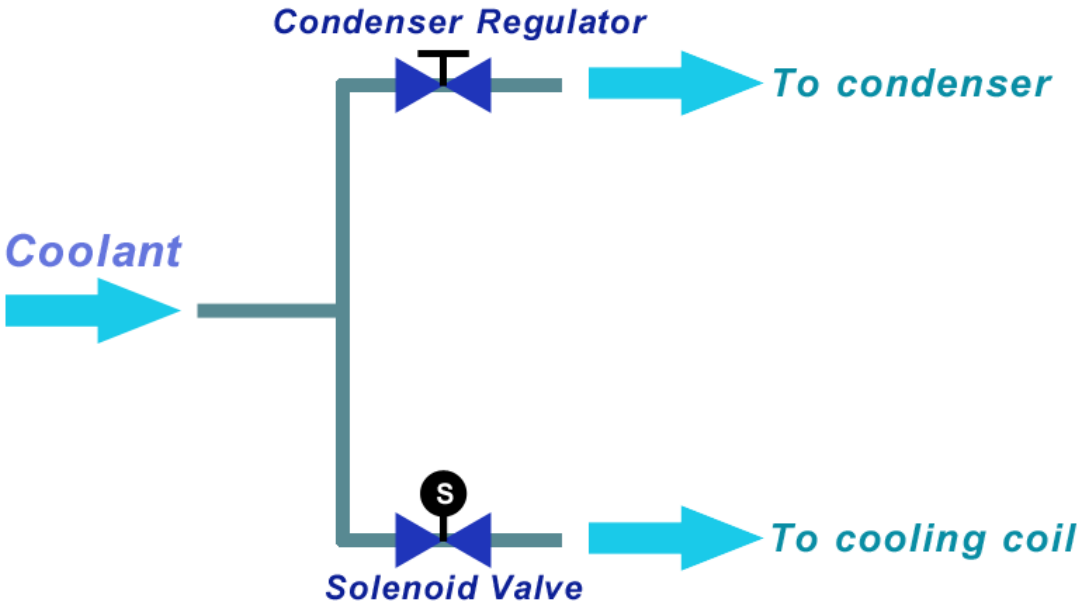
No.	Description	Function
1	10.4" Color Touch screen	Graphical interface (resolution: 800 × 600 pixels).
2	Power Touch	ON/OFF switch for the controller.
3	Gas Rotameter	Regulate the gas flow.
4	Peristaltic Pump	Control pH, foam level and feed nutrients.
5	USB port	For data transfer.
6	pH Probe	Connect to pH probe.
7	ORP Probe	Connect to ORP sensor.
8	Antifoam Probe	Connect to antifoam sensor.
9	Grounding Port	Connect to the grounding cable. **This port is only needed when connecting to the air-lifter vessel. The grounding cable is the accessory of FS-V-C053 and FS-V-C054.*
10	Heating Blanket / Base Unit	Heating unit when dry heating is selected.
11	DO Probe	Connect to the DO probe.
12	Vessel Temperature Probe	Connect to the vessel temperature sensor (PT-100).
13	Blanket Temperature Probe	Connect with blanket temperature probe. / Measure the blanket temperature.
14	Agitation Motor	Connect to the brushless motor.
15	External Device	For external pump.
16	Gas Mixing	Connect to the gas mixing station (optional: FS-O-GM).
17	Optional Device	For MS optional device (optional: FS-O-PB or FS-O-GA).★
18	Analog AUX	For system expansion (device under developing).
19	Gas out	Connect to the air sparger.
20	O_2 in	Connect to the oxygen source (optional).
21	Air in	Connect to the air source (external air pump or house air).
22	Vessel Water in	Connect to the cooling coil (jacket) inlet.
23	Condenser in	Connect to the condenser inlet.
24	Condenser out	Connect to the condenser outlet.
25	Main Water out (drain)	Connect to the coolant inlet.
26	Vessel Water out	Connect to the cooling coil (jacket) outlet.
27	Condenser Regulator	Control the water flow of the condenser.
28	Main Water in	Connect to the coolant outlet.
29	Ethernet Port	Connect to the Ethernet and perform remote control function.
30	Power Socket	Connect the power cord to the electric outlet.

4.1.2 Temperature Control System

A. Cooling System

The air and cooling system is at the left panel of the controller. You can refer to the "Help" page on the controller interface to have a detailed instruction of the system connection.

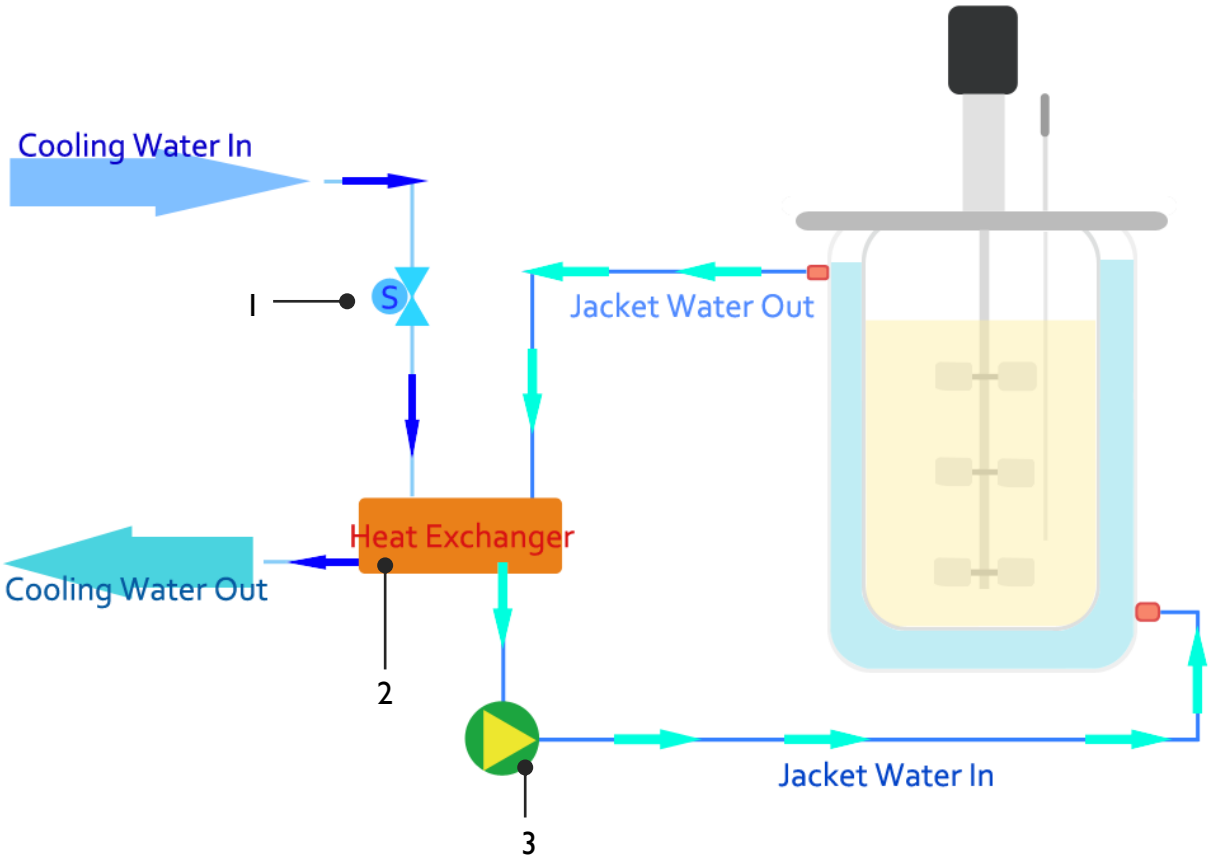
No.	Description	Function
19	Gas-out	Connect to the air sparger on the headplate.
20	O_2-in	Connect to the oxygen source (optional).
21	Air-in	Connect to the air source (external air pump or house air).
22	Vessel Water-in	Connect to the cooling coil (jacket) inlet.
23	Condenser-in	Connect to the condenser inlet.
24	Condenser-out	Connect to the condenser outlet.
25	Main Water-out (drain)	Connect to the coolant inlet port.
26	Vessel Water-out	Connect to the cooling coil (jacket) outlet.
27	Condenser Regulator	Control the water flow of the condenser.
28	Main Water-in	Connect to the coolant outlet port.



Note:

1) The condenser water flow is controlled by a condenser water flow regulator (see the figure below). The cooling coil water flow is controlled by the solenoid valve, which opens only when the vessel requires the cooling function. When the system performs the temperature control, the valve will open to let water flow into the cooling coil. And you can hear the sound from the solenoid valve; this means that the valve is functioning correctly.
2) To provide the constant water flow through the condenser, you must turn the regulator knob about halfway to open the regulator valve. This action can prevent the media evaporation, and the condenser will help the evaporated media re-condense back to the liquid.

B. Heating System



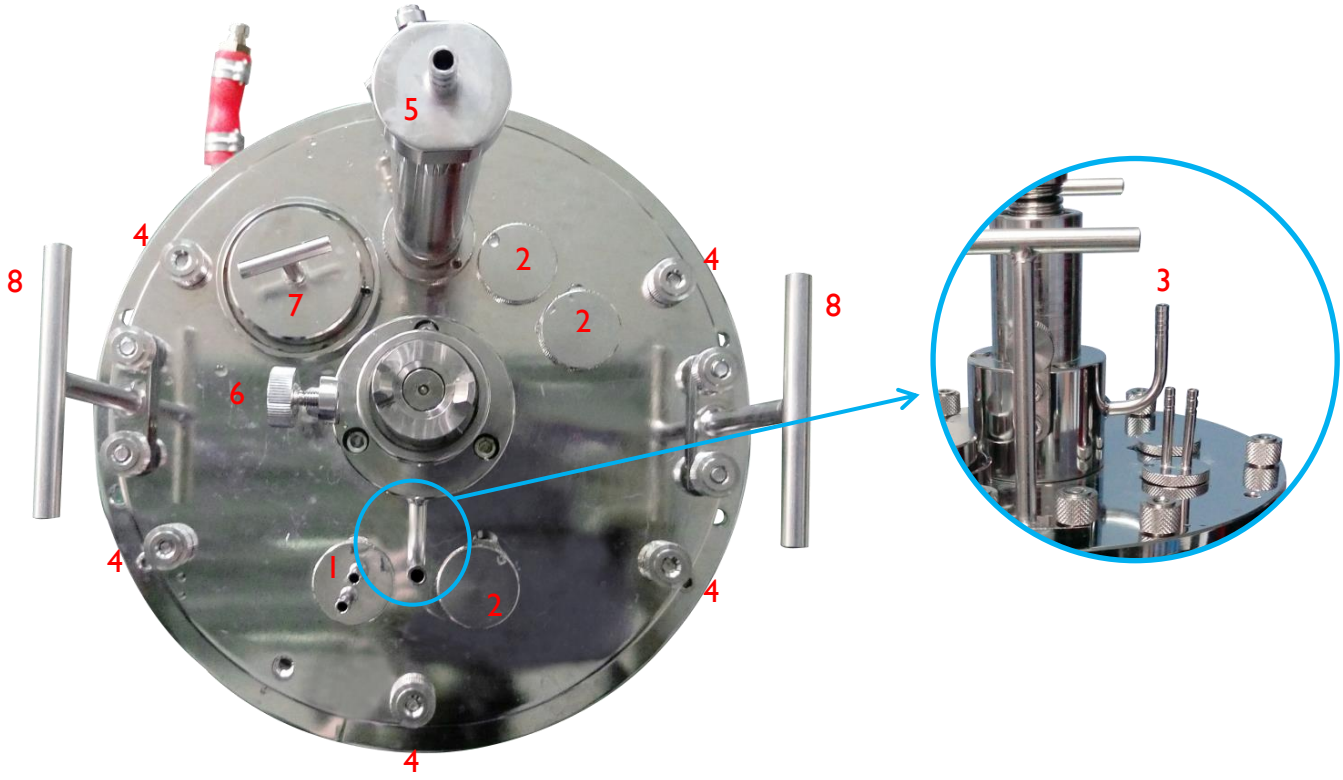
No.	Description	Function
1	Coolant Valve	Control the coolant inlet flow.
2	Heat Exchanger	Built-in heater to provide the heating function.
3	Circulation Pump	Help the water circulate in the jacket.

Note:

1) The minimum operating temperature in the culture vessel should be 5 degrees (˚C) above the coolant temperature. And to provide an efficient cooling control, the cooling temperature is normally set at least 15-20 degrees (˚C) below the culturing temperature.
2) The water must be soft, clean and ionized.
3) The hardness of water should be below 12 German Degree of Hardness to prevent calcareous deposits.
   - *Defects and damages caused by dirty water or calcareous deposits will not be covered by Major Science's warranty.*

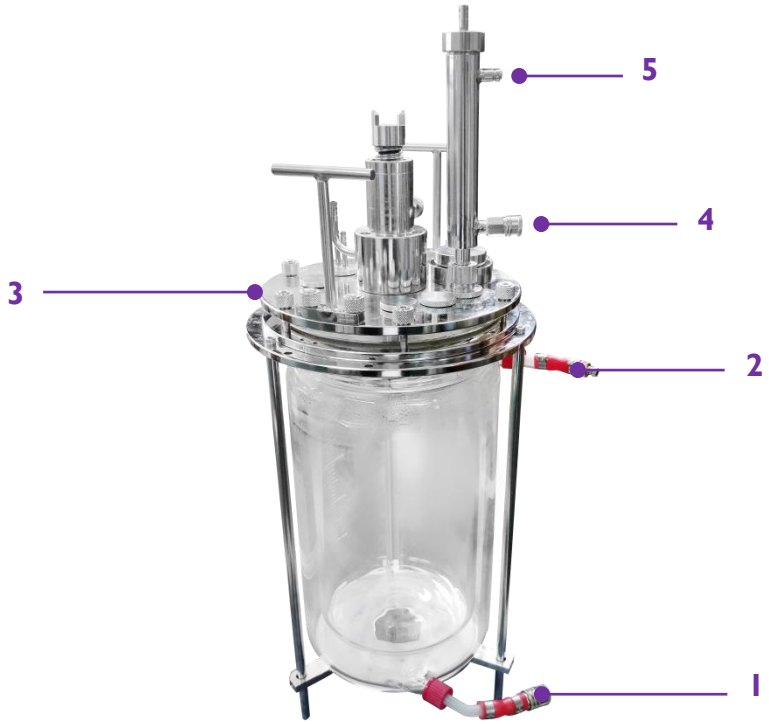
4.2 Culture Vessel

A. Headplate (FS-V-SA05)



No.	Description	Function
1	Feeding Port	For Acid/Base/ Other feeding.
2	Blind Stopper	Spare ports
3	Aeration Port	Sparge the gas into the media (Air inlet).
4	Screw Nut	To fix headplate
5	Condenser	Prevent media evaporation.
6	Screw	For loosening/tightening motor
7	Inoculation Port	Sample inoculation.
8	Removable T-hand Lifter	Lift up the vessel.

B. Vessel Body (FS-V-SA05)



No.	Description	Function
1	Jacket Water-in	Water inlet for the jacket.
2	Jacket Water-out	Water outlet for the jacket.
3	Headplate	For nozzle arrangement.
4	Condenser-in Port	Condenser coolant inlet.
5	Condenser-out Port	Condenser coolant outlet.
6	Impeller	Stir and mix the substance in the vessel.

There are total 3 types of impeller for your selection. Select one as your standard equipment.

Broken type

Anchor type

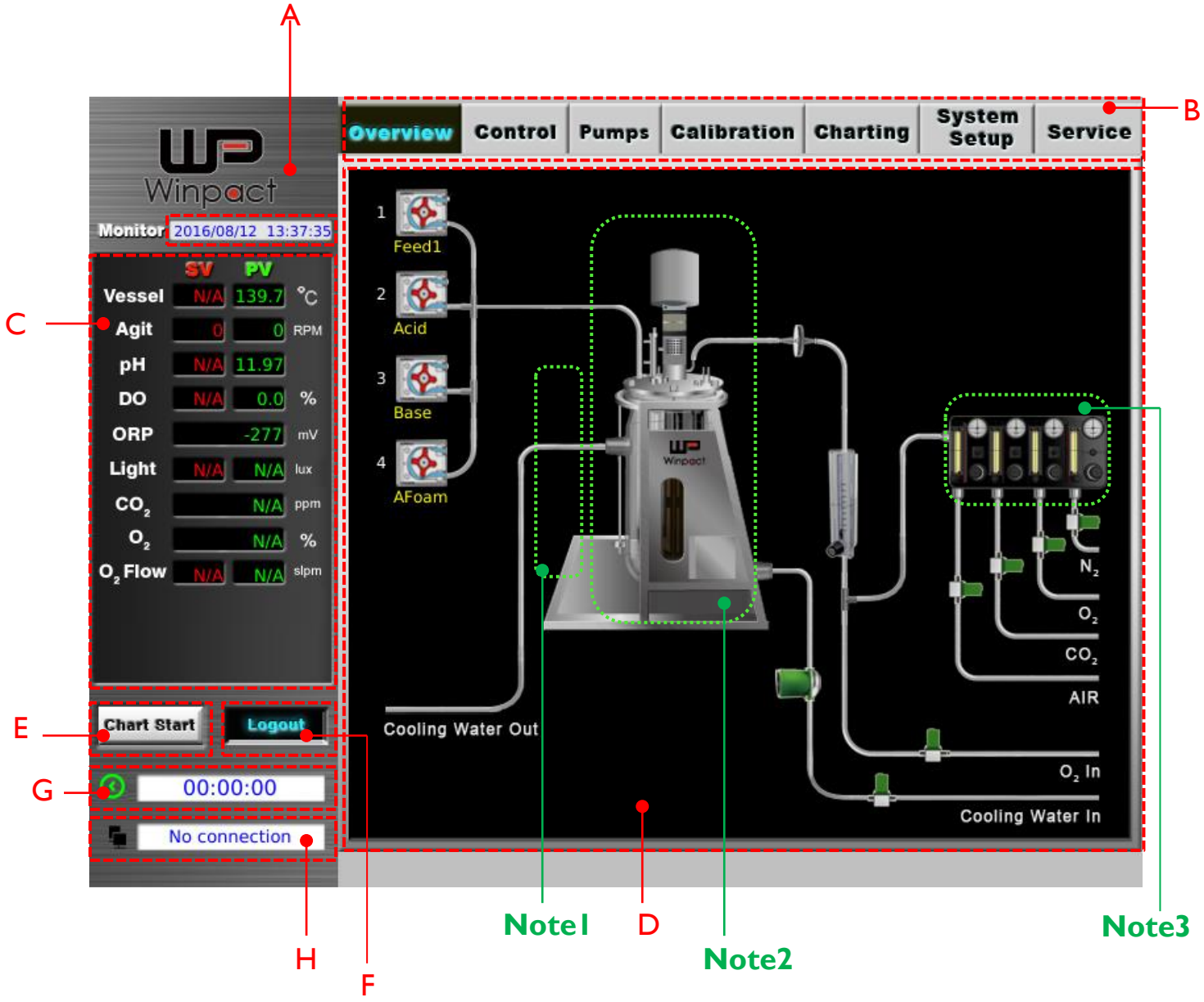
Spiral type

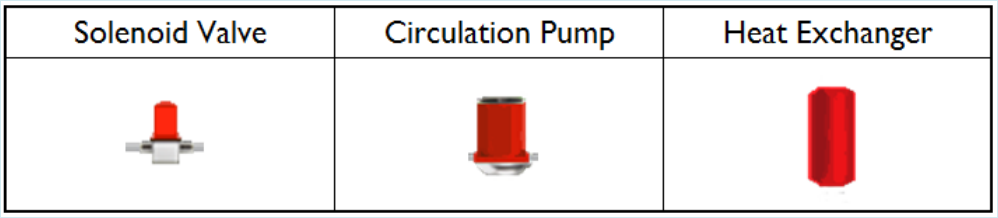
Chapter 5. Control Interface

FS-10-A05P control interface is divided into 7 parts for each vessel according to the functions:

Overview	The page that shows the current status of each components of the system.
Control	The page that controls and sets up the parameters.
Pumps	The page that controls and adjusts the speed and direction of peristaltic pumps.
Calibration	The page that performs the sensor calibration.
Charting	The page that records and observes the trend of fermentation process.
System Setup	The page that sets up and changes the system features.
Service	The page that is mainly for system maintenance and service.

5.1 Control Interface Overview

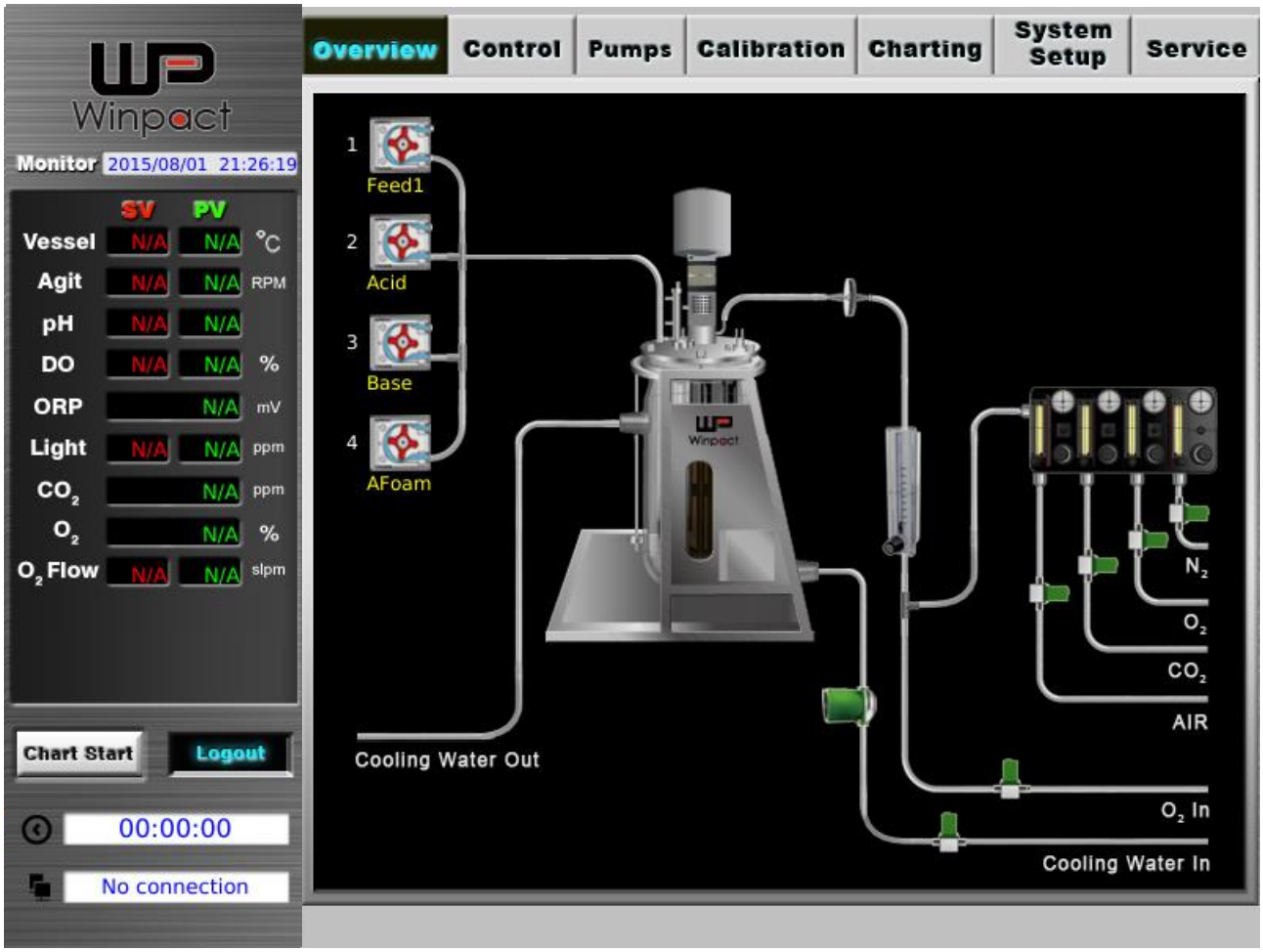


A	The column displays the current date and time.
B	The column contains 7 pages which allow user to switch and change settings.
C	This area displays the readings received from sensors. The vessel temperature, agitation speed, pH value and DO value are basic readings on the controller. Others like ORP value, CO_2 amount, O_2 concentration, light illumination or O_2 and air flow are optional readings, which becomes available when the corresponding devices are installed onto controller unit. "SV" represents the set value while "PV" represents the present value, which indicates the temporal condition of each device throughout whole fermentation process. ★ If the controller is not connected to the optional device but enabled its function in the system, the reading column will display "N/A" or "No device". ★ The reading columns of optional devices would not appear when using remote control if there's no optional application attached.
D	This area displays the status of each device. If the device is operating, the indicator will flash with red light, otherwise, it will display in green color. 
E	Tap this button to start recording the fermentation process. User can observe the trend of the fermentation process under the Charting page.
F	Tap this button to log in the system. The level of operating accessibility varies with users.
G	The timer for the process time. (base on minute)
H	When user log in the system via remote control, this column will present the IP address of user's computer.
Note1	The lighting module (FS-O-PB) illustration. If the controller is connected with the lighting modules, and the system is correctly selected to enable the function, the lighting module illustration will show up on Overview page.
Note2	The vessel type varies according to user's selection at **Vessel Type and Size page under System Setup**. Select the vessel type user is using and it would show on the Overview page.
Note3	If controller is equipped with gas mixing station or gas analyzer, they show on Overview page as well as System Setup page.

5.1 Overview

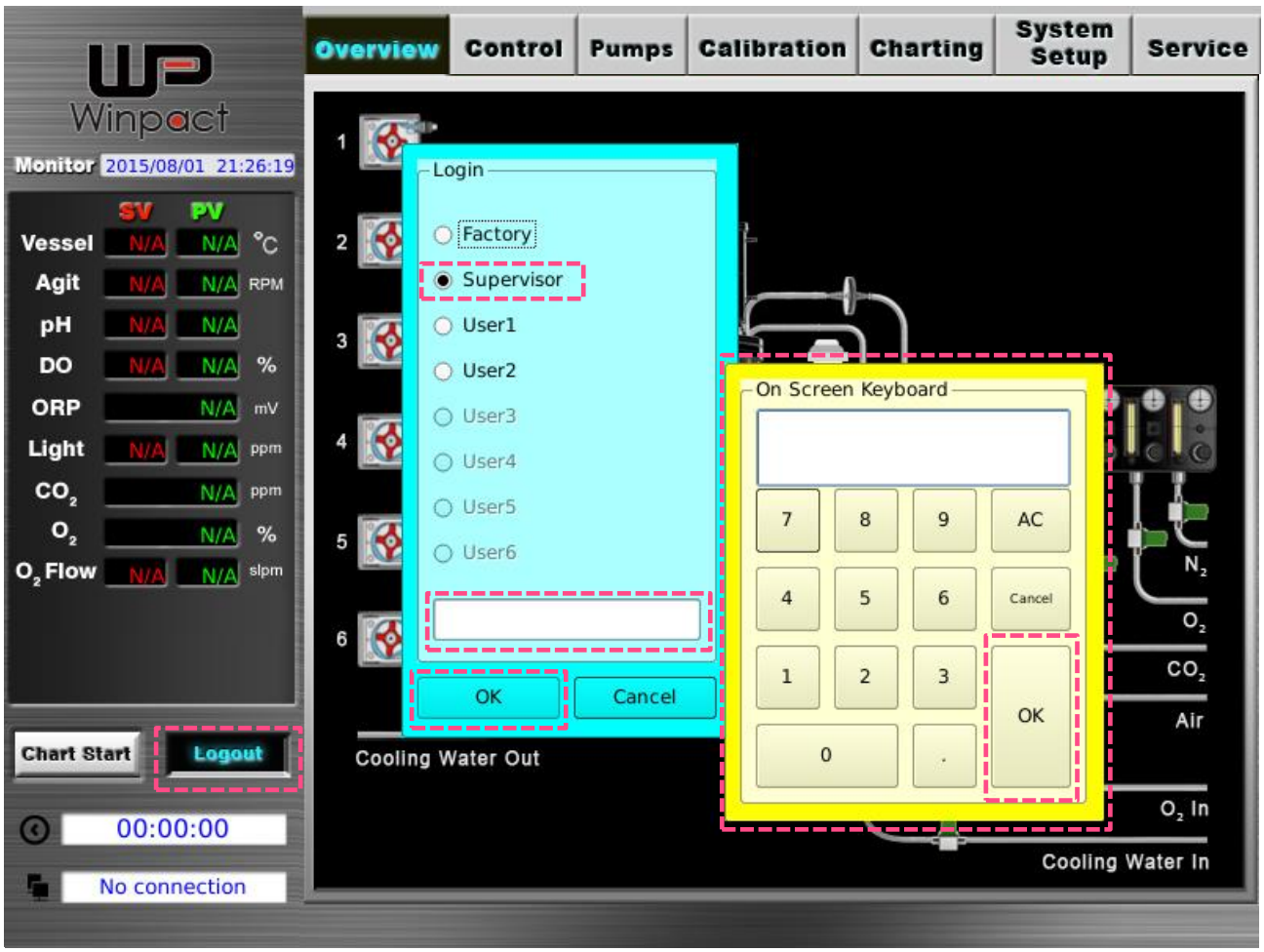
Every time user starts the system, Overview page will be shown on the screen. The overview page displays the connection between each device and the condition of vessels.

> **Note:**
> The vessel type presented in the center of this page can be edited on System Setup > Vessel Type and Size.



5.1.1 Log in to the System

User has to log in the system before starting the operation of FS-10-A05P system.



Step1. Press "Login" button and the log-in dialog will show up on the screen.

Step2. Select "Supervisor" and tap the blank column at the bottom of the dialog, a keypad will pop up; then key in the default password "1234". Press OK on the keypad and press OK again to enter the system.

Step3. To log out of the system, press "Logout" button.

Note:

User can access the system with different usernames with different level of operating accessibility. User can choose "Supervisor" and "User" as the user ID since "Factory" is used for manufacturer and maintenance staff only. To change the password of accounts, check "System Setup">"Admin".

5.1.2 Control the Oxygen Gas Flow (Optional Device: FS-O-OE)

Step1. Connect the oxygen source to O_2-in port on controller. To check the position of O_2-in port, please refer to *Chapter 4, Section 4.1 Control Unit* for more details.

Step2. Open the controller back panel and find 2 pressure gauges. Left one and right one are for oxygen and for air. Then open the oxygen source, manually adjusting the O_2 pressure gauge to the desired value. The ideal pressure resistance of our culture vessel is 0.5 bar. If the pressure of user's O_2 source is over 20 bars, please install an external regulator to reduce the inlet gas pressure (see *Chapter 1, Subsection 1.3.1*).

Step3. Make sure the function (icon) of "**O2 Enrichment**" and" **Gas Analyzer**" (See NOTE below) in the page of **System Setup** are enabled. If user wants to control CO_2 instead of O_2, tap "**CO_2 Control**" button below and enter the settings in the dialogue.

Step4. User can adjust the flow rate through the flowmeter and working command under DO cascade.

5.1.3 Control the Mass Flow Controller (Optional Device: FS-O-MF)

Step1. Connect the oxygen source to the O_2-in port on the controller. To check the position of O_2-in port, please refer to *Chapter 4, Section 4.1 Control Unit* for more details.

Step2. Open the controller back panel and find 2 pressure gauges. The left one is for oxygen, and the right is for air. Then open the oxygen source, manually adjusting the O_2 pressure gauge to the desired value. The ideal pressure resistance of our culture vessel is 1 bar (14.5 psi.). If the pressure of user's O_2 source is over 20 bars, please install an external regulator to reduce the inlet gas pressure (see *Chapter 1, Subsection 1.3.1*).

Step3. Make sure the function(icon) of "**Mass Flow Controller**" and" **Gas Analyzer**"(See NOTE below) in the interface of "**System Setup**" is enabled. Usually the maximum flow of O_2 is equal to the volume of vessel (1 vvm, otherwise specified when placing the order). For example, if user is using a 3L vessel, and controller has equipped with mass flow controller, the maximum flow should be "3"(slpm). If user only needs a very

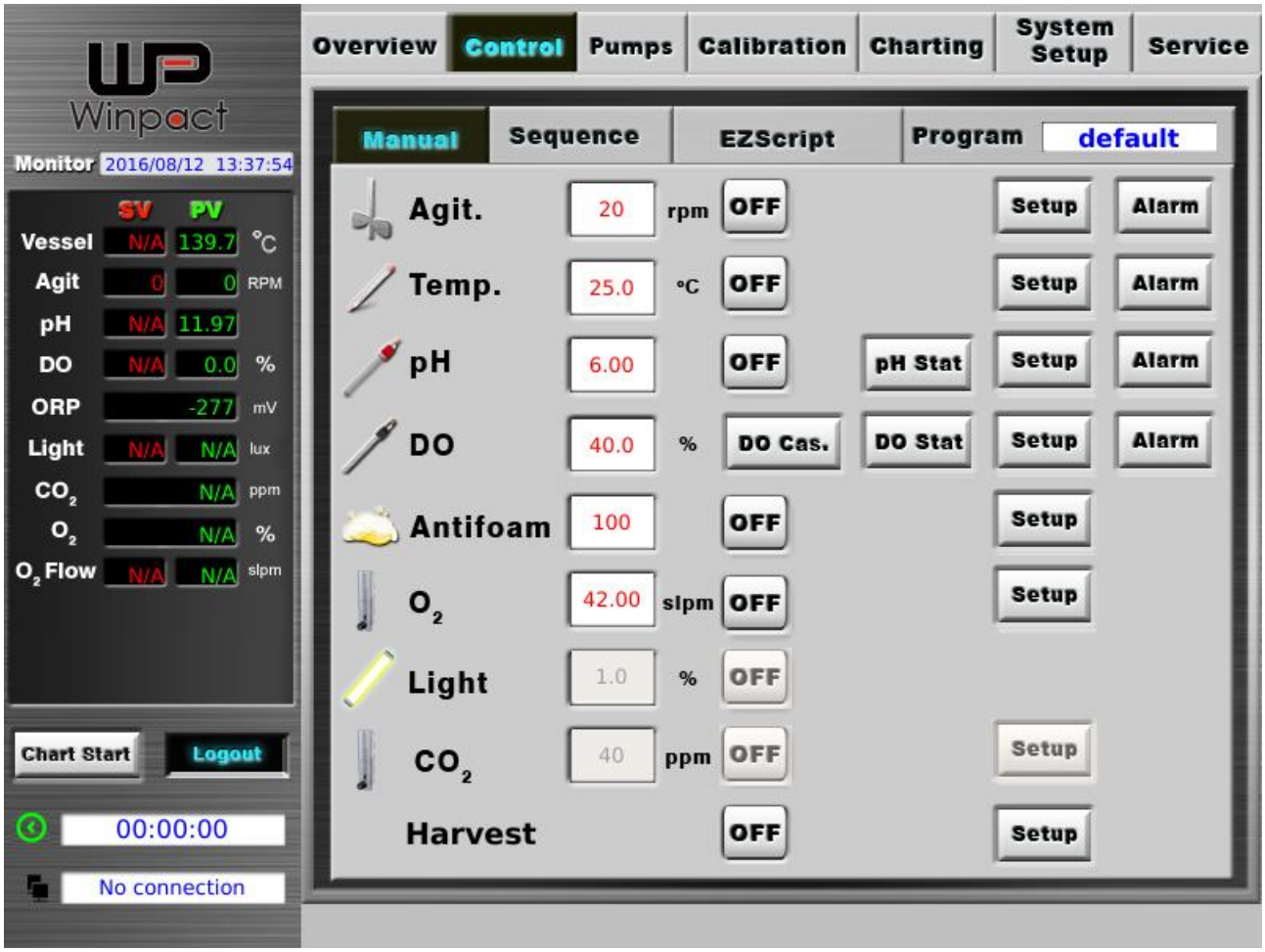
small amount of O_2 flow; user can input the desired value in the column.

Step4. Go to "**Control**" interface to adjust the flow rate to user's desired value. And tap on/off button to activate the function.

NOTE: If user needs to monitor the quantity of exhausted gas, user may purchase MS Gas Analyzer (FS-O-GA). For more information, please contact the service department of Major Science, or user's local representative.

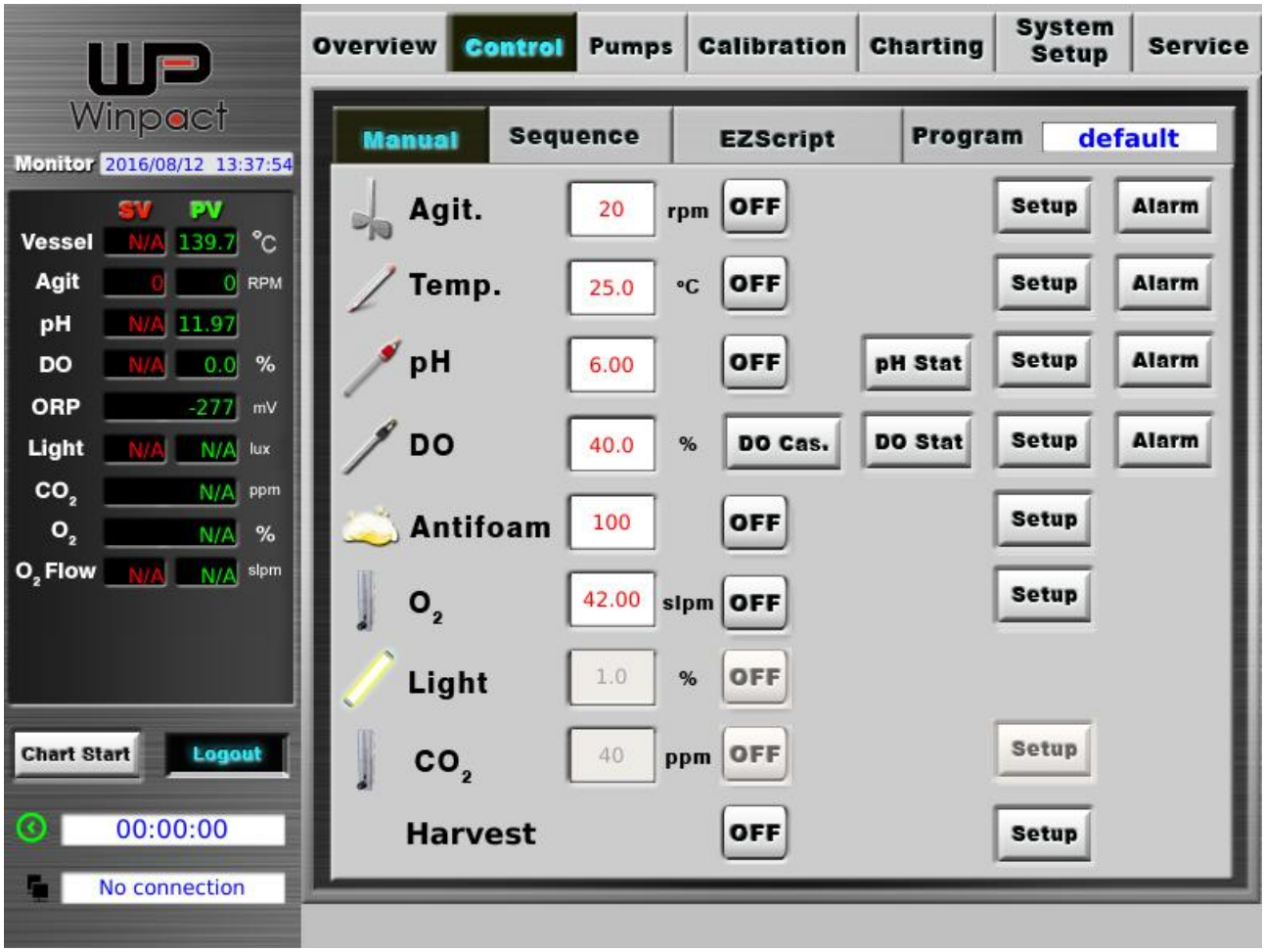
5.2 Control

In Control page, user is able to switch on or off each function manually, adjust and edit the values of parameters, and set up the schedules of each parameter for running the fermentation automatically. Control page contains 3 tabs: Manual, Sequence, and Program. Detailed explanations of each tab are described as below.



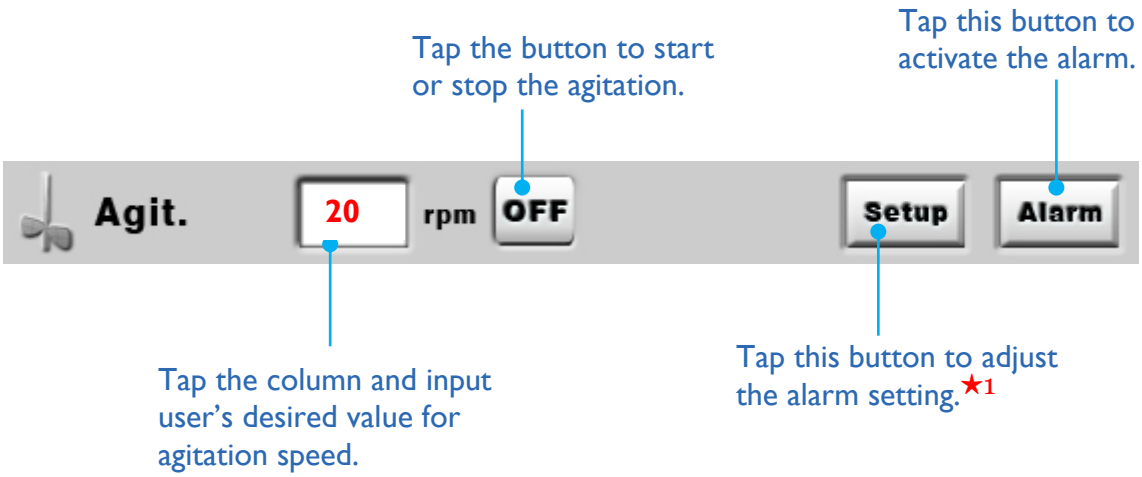
5.2.1 Manual

In Manual tab, user can directly edit the values of each parameter and switch on or off the functions to run fermentation. And every parameter contains several features for user to set up and reach user's specific requirements.



Each function in the tabs is explained in the following paragraphs.

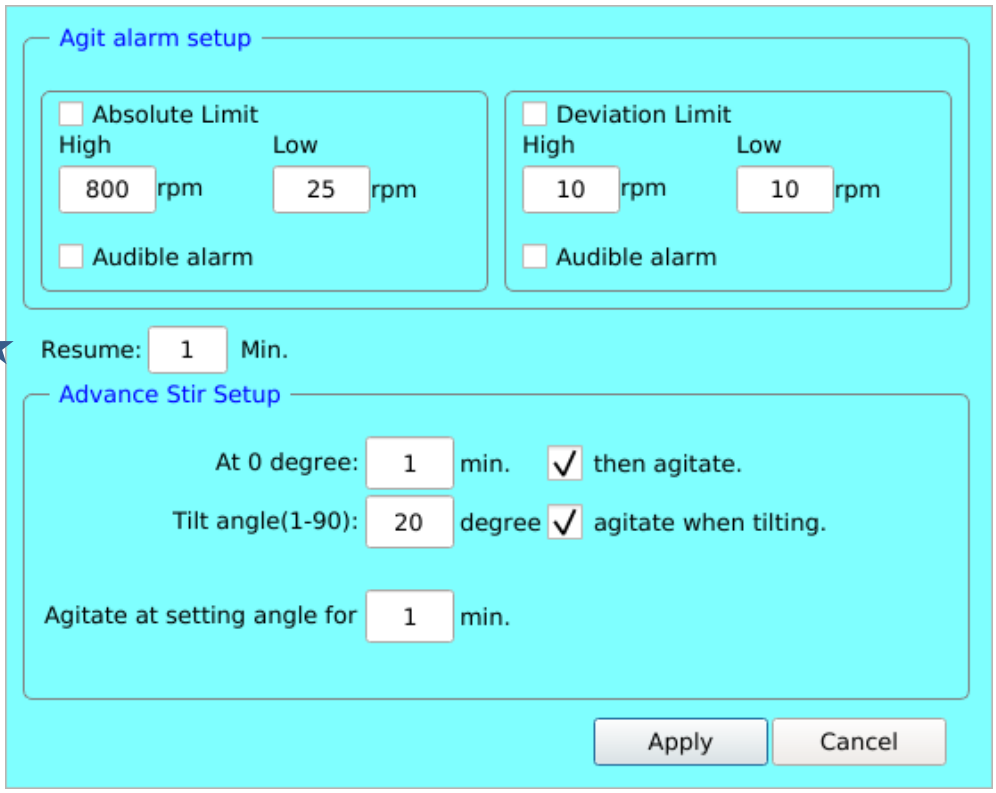
5.2.1.1 Agitation



Note: Agit. Speed varies from different volume of vessels. The value 0 can be set in both "Manual" and "Sequence" function, the value between 1 to minimum is considered the minimum speed of corresponding vessel; the value above maximum is considered the maximum speed of corresponding vessel.

★1

When user taps the "**Setup**" button, a setup dialogue will pop up on the screen:



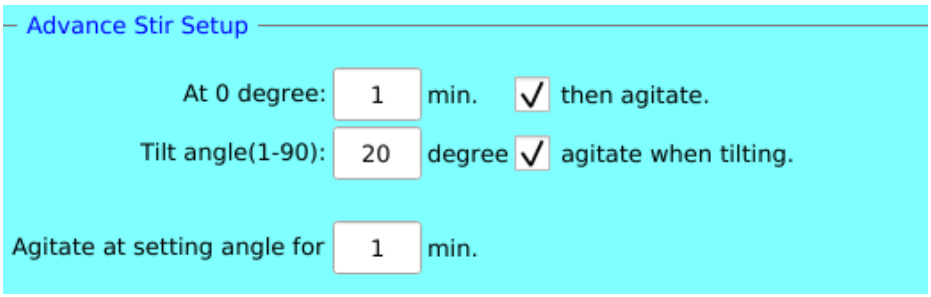
Select either "*Absolute Limit*" or "*Deviation Limit*" for the alarm feature.

Absolute Limit: The system will show up a warning dialogue either when the agitation speed exceeds the maximum (High) or below the minimum (Low). If user checks the box of "Audible alarm", system pops up a dialogue along with warning sound.

Deviation Limit: It indicates the tolerance of the agitation set point. Take the above picture for example, if the minimum agitation speed is set at 200 rpm; the maximum and minimum of deviation limit are 15 rpm and 5 rpm, it means that the alarm will be activated either when the speed rises above 215 rpm *(200 rpm +15 rpm)* or falls below 195 rpm *(200 rpm - 5 rpm)*. User can select "Audible alarm" to have the alarm with warning sound.

Select the box of "Audible alarm" to enable the audible alarm if necessary.

★ "Resume Time" allows warning mechanism to "sleep" for a period of time after users clean and close the first warning message. Define the period of time in the blank (min.). That is, the secondary warning will not initiate during the resume time even present value have reached the limits. The minimum value is 1.



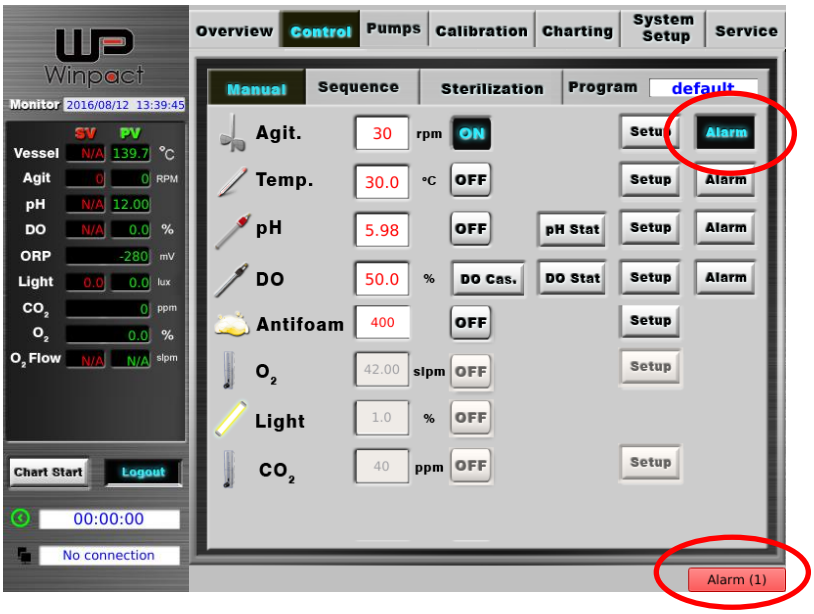
At 0 degree: User can decide the time span between routines of angles changing from degree 0 (vertical) to assigned degrees. Take the above picture for example, every time the vessel turns to degree 0, the vessel will remain vertical for one minute, then it continues to tilt to degree 20. The following check box allows user to determine whether the vessel agitate or not when vessel is at 0 degree.

Tilt Angle: User could assign desired tilt angels at this space. The maximum tilt degrees are 90 (horizontal) and the minimum degree is one degree. The following check box allows user to determine whether agitate or not while tilting.

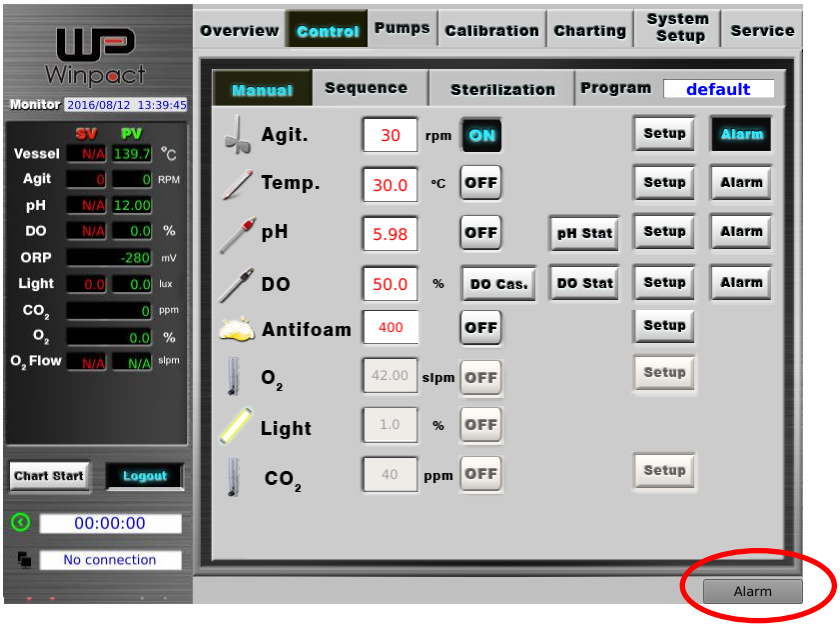
Agitate at setting angle: At this space user can assign desired time span of agitating when the vessel is at the ***Tilt Angle***.

Alarm Message:

Tap the button of "Alarm" on the page of Control > Manual to turn on the function of alarm. When the function is on, and the present value triggers the alarm's setting value, there will be a beep-beep sound and a button "Alarm" at the right corner of screen. (See in the pictures below)

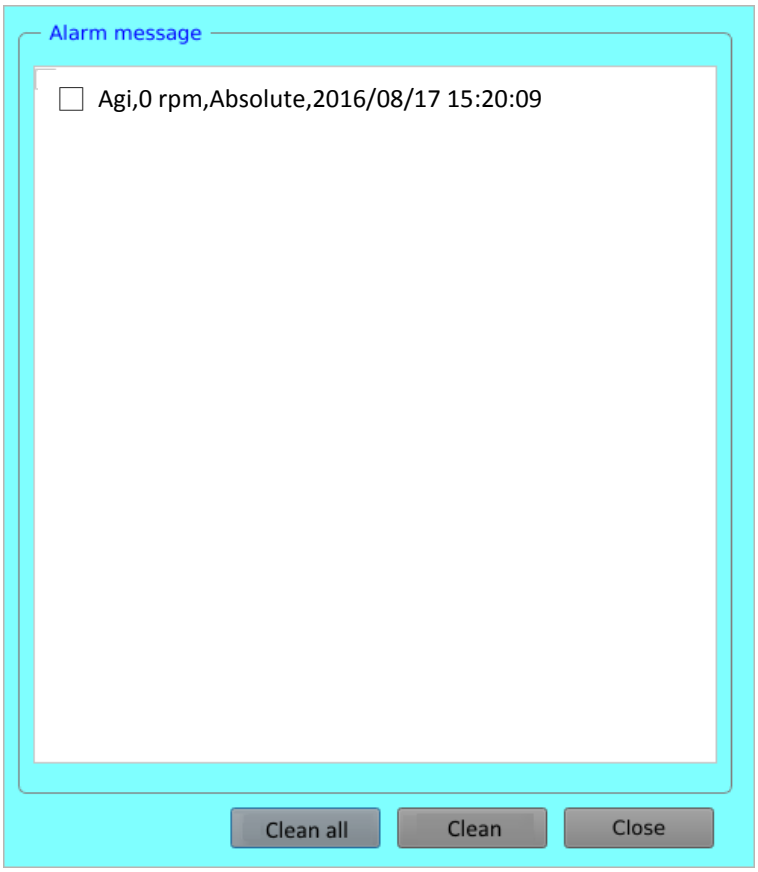


The number displays in the brackets indicates the number of pieces of messages unread. For example, "Alarm(1)" indicates one unread piece of message in Alarm Message. After user has opened the Alarm Message by tapping the button of "Alarm", the number will be concealed. If user clears all the messages in Alarm Message, the button of "Alarm" disappears; if user closes the page of Alarm Message without clear all the messages, the button remains grey.



Click the button of “Alarm” to open the Alarm Message page. To stop the beep-beep sound, check any message user would like to delete, and press “Clean selected” to delete the message checked, or press “Clean all” to delete ALL messages at once. Click” Close” to close Alarm Message.

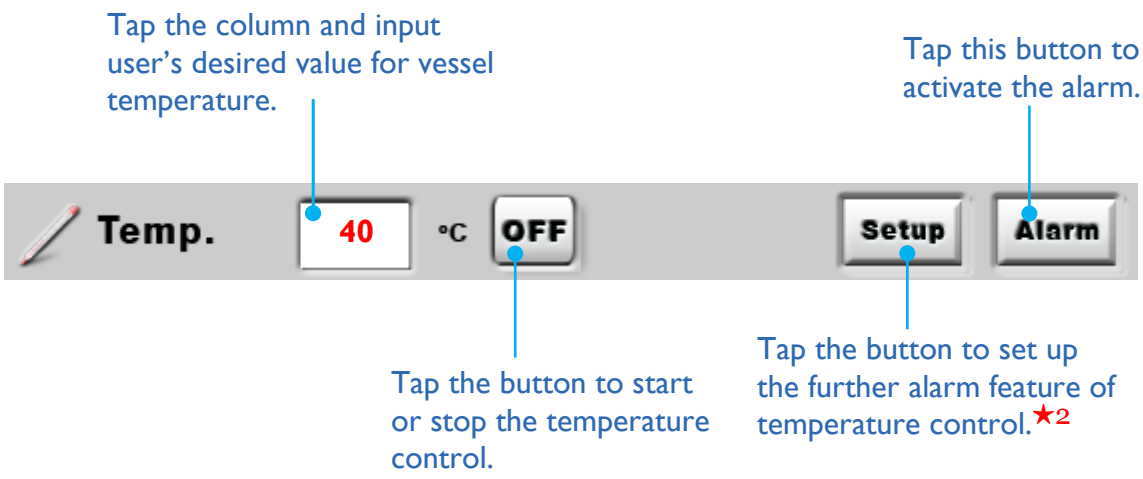
If user doesn't check and clear any message then close Alarm Message, the messages would remain in the system record and can be seen when user opens Alarm Message next time.



Free Space Detect Function

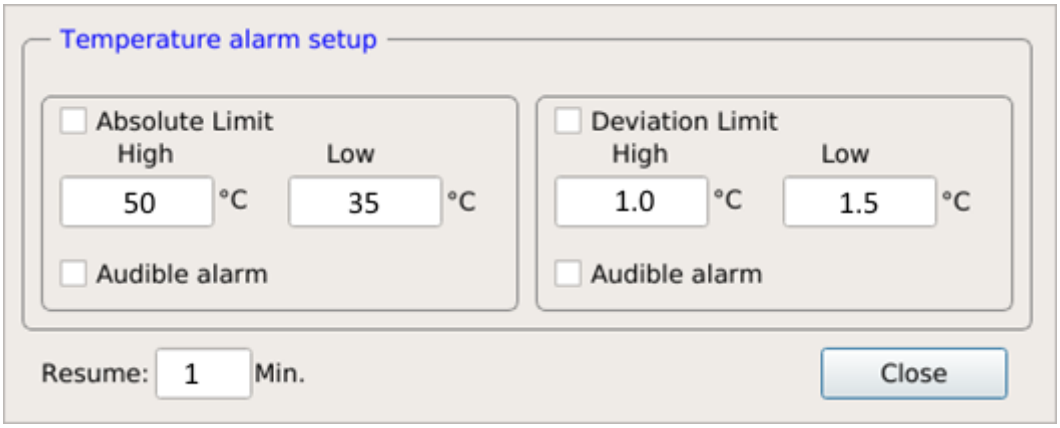
If the available space in the internal hard disk is lower than 10%, there would be a “low space” alarm with beep-beep sound. This alarm would show only ONCE. Please go to Charting page and delete redundant files.

5.2.1.2 Temperature



★2

Tap "**Setup**" button to select the different alarm features for temperature control:



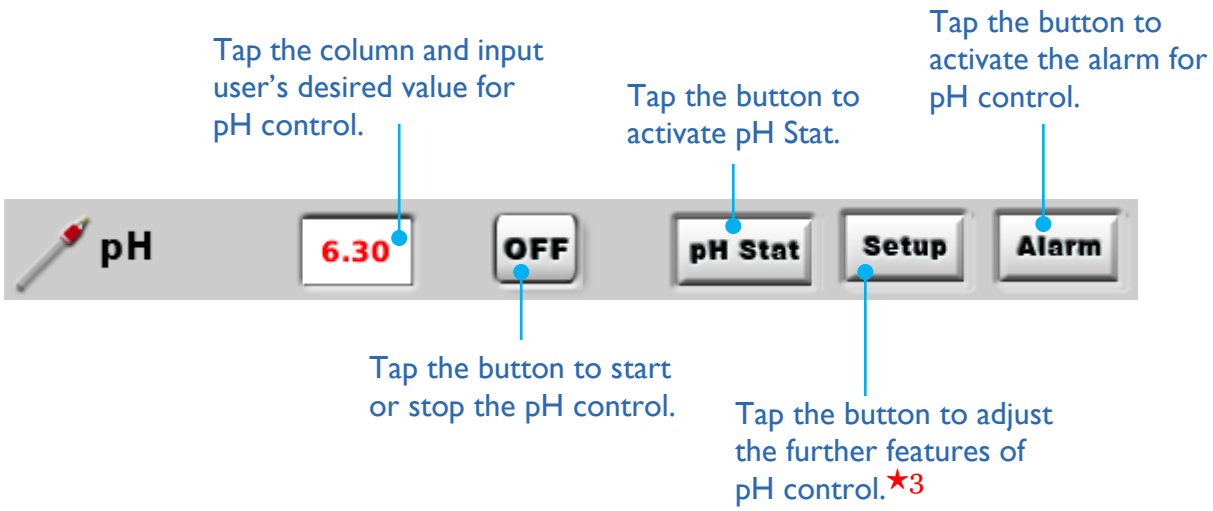
Select either "*Absolute Limit*" or "*Deviation Limit*" to control the temperature alarm.

Absolute Limit: The system will show up a warning dialogue either when the vessel temperature exceeds the maximum (High) or when it is beneath the minimum (Low). If selected "Audible alarm", the system will pop up the dialogue along with warning sound.

Deviation Limit: It indicates the tolerance of the temperature setpoint. Take the above picture for example, if the temperature is set at 40˚C; the maximum and minimum of deviation limit are 1˚C and 1.5˚C, it means that the alarm will be activated either when the temperature rises above 41˚C *(40 ℃ + 1 ℃)* or falls below 38.5˚C *(40 ℃ - 1.5 ℃)*. User can select "Audible alarm" to have the alarm with warning sound.

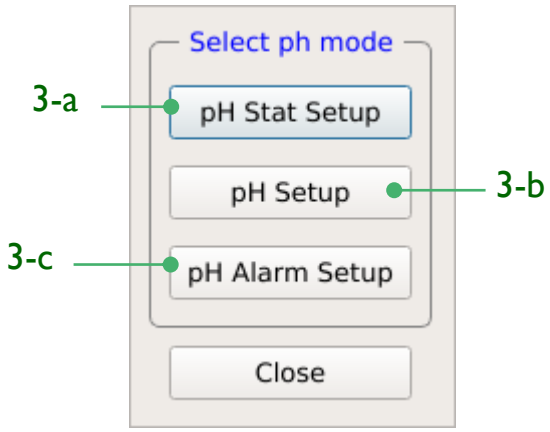
★ "Resume Time" allows warning mechanism to "sleep" for a period of time after users clean and close the first warning message. Define the period of time in the blank (min.). That is, the secondary warning will not initiate during the resume time even present value have reached the limits. The minimum value is 1.

5.2.1.3 pH



★3

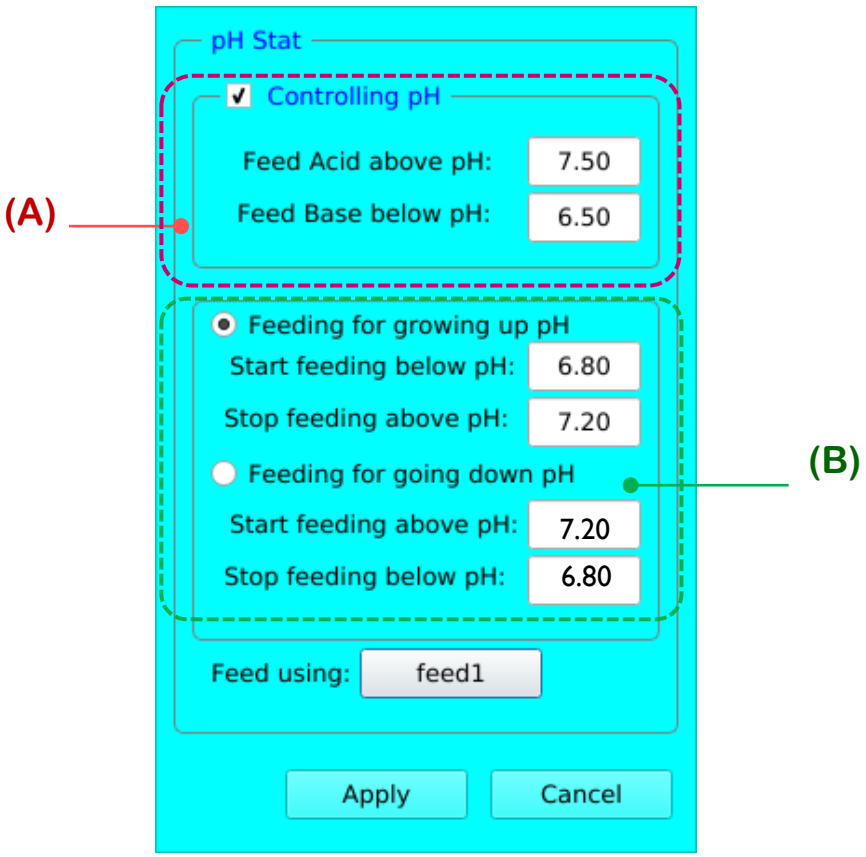
Tap "**Setup**" button to adjust the further features of pH control:



Use "pH Stat" to switch on/off a feeding schedule to a user-defined pH range; pH Setup executes PID control to maintain a pH setpoint. As for "pH Alarm", user can set up the alarm to alert user when pH value deviates from fluctuations.

3-a pH Stat Setup

Enter parameters of pH control and feeding control in "pH Stat".



pH Stat is a function that helps user controlling pH environment of medium. The system will pump acid or base to control pH value according to the settings. In addition, user can add feedings into vessel based on pH environment in the vessel. For example, when some bacteria consume glucose, acid will be produced, and cause pH value decreased. In order to minimize the impact of pH change to the cells, this function will initiate a smart feeding schedule to optimize the metabolic state of the cells.

Note:
pH Stat can be activated only in Manual mode. If user switches to programing (15 steps) mode in the middle of Manual mode, pH Stat will stop running, and the system will activate the pH Programming Control instead.

(A) Using Acid & Base to Control pH

Select the box of "**Controlling pH**" to control the environment in the vessel. User can use this function to have the environment stabilized in a fixed acid-base range.

Fill in the desired pH value to the first column so that the system will activate the assigned acid pump to the vessel automatically when pH value is above the set value. On the contrary, the system feeds in base when pH value is below the set value in the second column. In the above picture, for instance, the system will start feeding acid when pH

value is above 7.5, and feeding base when it is below 6.5.

(B) Using Feed to Control pH

User can use this function to feed the bacteria based on pH value. Choose either "**Feeding for growing up pH**" or "**Feeding for going down pH**" option, and input the desired values. Take the above picture as an example, the system will start feeding the bacteria based on the Feed1 schedule when pH value below 6.8, and stop feeding as long as pH value rises above 7.2.

☝ Choose the feed table to feed the bacteria according to the chosen schedule. Tap **the button next to "Feed using"** to switch the feed table.

Note:

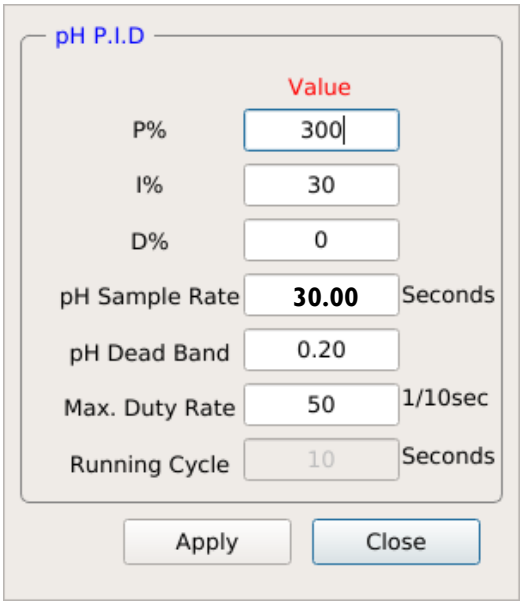
1) Usually the values in B column should fit into the range of A column, or the feeding might not be activated. However, there might be exceptions depending on the experiment.

2) User can decide to control pH value by acid & base feeding and feeding pump at the same time or either one of them respectively. If user prefers to only control pH by acid & base feeding, tap the button beside "Feed using" until "**None**" appears on the button.

3-b pH Setup

Tap "pH Setup" to adjust pH P.I.D. values.

Note:
PID values have been optimized by factorial testing. It is suggested users not to change these values without specific requirement.



A **proportional-integral-derivative controller** (**PID controller**) is a control loop feedback mechanism (controller) commonly used in industrial control systems. A PID controller continuously calculates an "error value" as the difference between a measured process variable and a desired setpoint. The controller attempts to minimize the error over time by adjustment of a control variable, such as the position of a control valve, a damper, or the power supplied to a heating element, to a new value determined by a weighted sum. The value of P.I.D has been optimized when it is delivered to users, thus it is recommend that user do not change the value unless there are professional experts operating.

The pH PID control is a pump-on/pump-off mechanism for controlling the pH value of vessel. The system will adjust the operation time of pumping acid/base based on the ratio. Each cycle is fixed in 10 seconds, which is defined as "*Running Cycle*" in the system and is not changeable. User can adjust "*pH Sample Rate*" for controlling the numbers of the same cycle. Use the above picture as the example, pH Sample Rate is set at 30 (seconds), then the cycle will not change the increment/decrement until the system runs the cycle 3 times -- i.e. a cycle is 10 seconds; 30 seconds of pH Sample Rate means running the same cycle 3 times.

Moreover, adjust "*pH Dead Band*" to minimize repetitive acting of pH PID control on minor pH fluctuation. For instance, if user wants to maintain pH stabilization at between 7.2 and 6.8, set the

dead-band value at 0.2 (7 ± 0.2 = 7.2 or 6.8).

Input a proper value to "Max. Duty Rate" to control the on-off time of pump. Assume the maximum duty rate is set at 50 (1/10 second); then the control mechanism will pump acid or base for 5 seconds at most in a cycle when activated. If the pH value is still out of the desired range and control mechanism has reached the maximum duty rate, then system will not increase the duty rate anymore; it will remain at the maximum value constantly.

Note (1):

The range of "**Max. Duty Rate**" is 0 to 100. If it is set at 0, pH PID control won't be activated. If 100, then pump will run for 10 seconds fully in a running cycle, which means it is possible that at last system won't close the pump in cycles if the pH value hasn't reached the desired range.

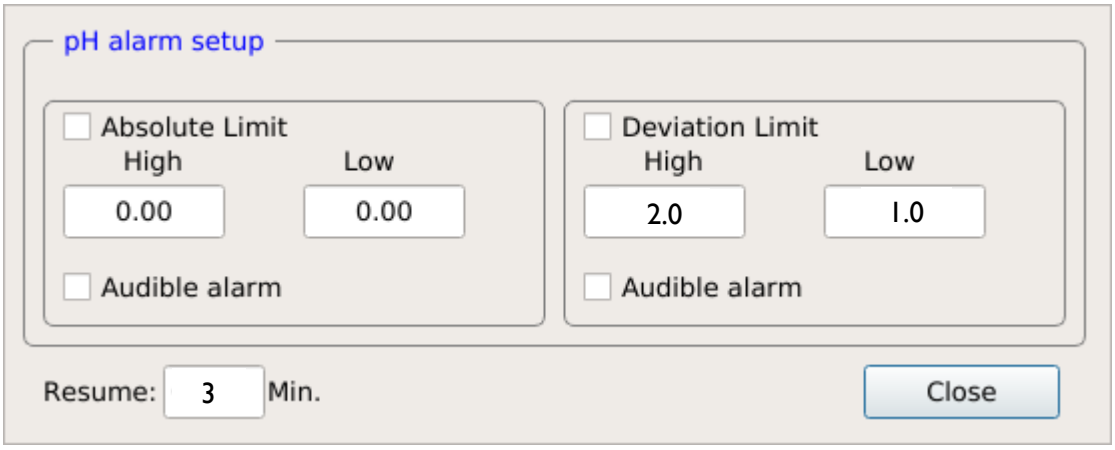
Note (2):

The control strategy between "pH Stat" and "pH PID Control" is different. "pH Stat" starts a constant activation when pH value is out of the set range. It'll continuously pump acid or base to reach user's desired range; as for "pH PID Control", it uses on-off cycles to control the pH value.

User can enable both pH Stat and pH PID Control at the same time to control the pH value.

3-c pH Alarm Setup

Tap "pH Alarm Setup" to edit the alarm features:



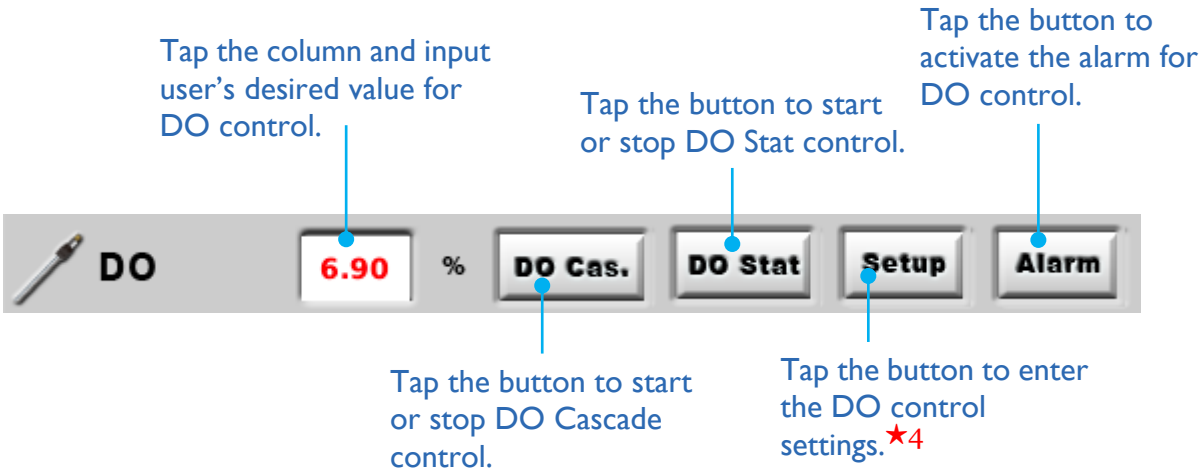
Select either "*Absolute Limit*" or "*Deviation Limit*" to control the pH alarm.

Absolute Limit: The system will show up a warning dialogue either when the pH value reaches over the maximum (High) or when it falls below the minimum (Low). If selected "Audible alarm", the system will pop up the dialogue along with warning sound.

Deviation Limit: It indicates the tolerance of pH set point. Take the above picture for example, if pH value is set at 6.3 the maximum and minimum of deviation limit are 2.0 and 1.0, it means that the alarm will be triggered either when the value rises above 8.3(6.3+2.0) or falls below 5.3(6.3-1.0). User can select "Audible alarm" to have the alarm with warning sound.

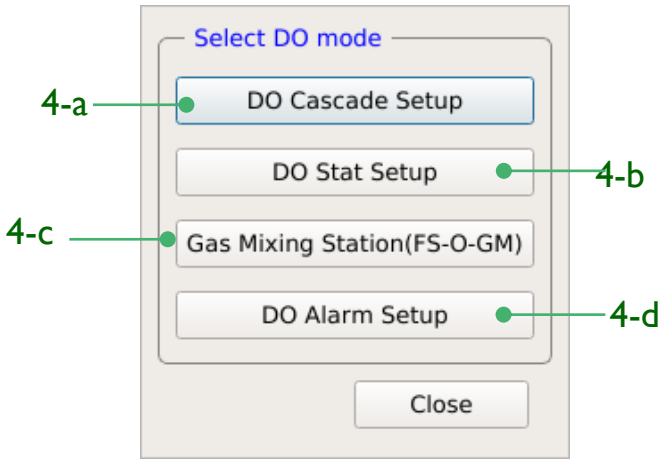
★ "Resume Time" allows warning mechanism to "sleep" for a period of time after users clean and close the first warning message. Define the period of time in the blank (min.). That is, the secondary warning will not initiate during the resume time even present value have reached the limits. The minimum value is 1.

5.2.1.4 DO



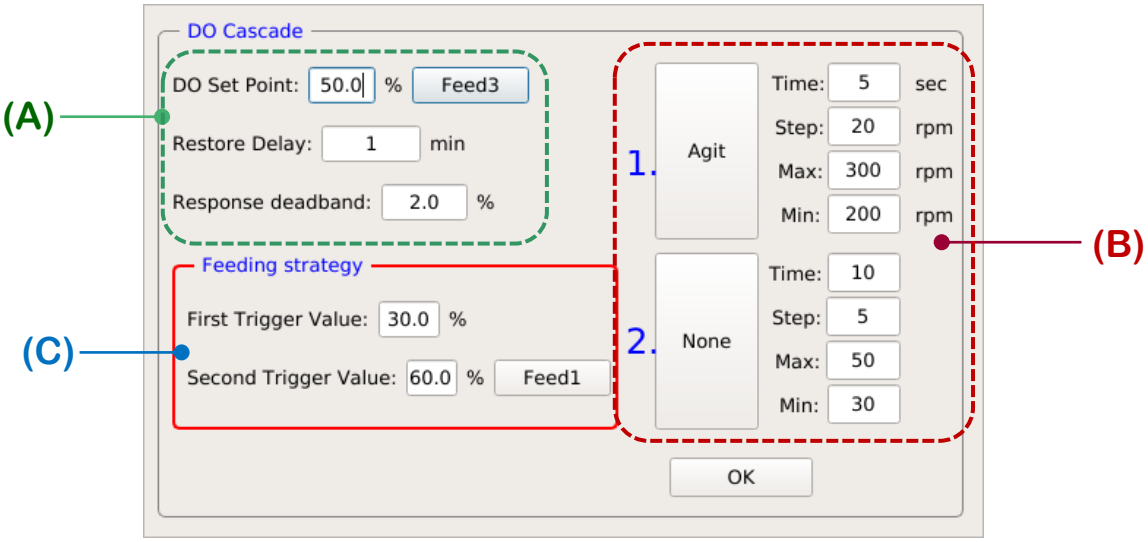
★4

Tap "**Setup**" to set up DO control settings. Detailed explanations of these functions will be described below:



4-a DO Cascade Setup

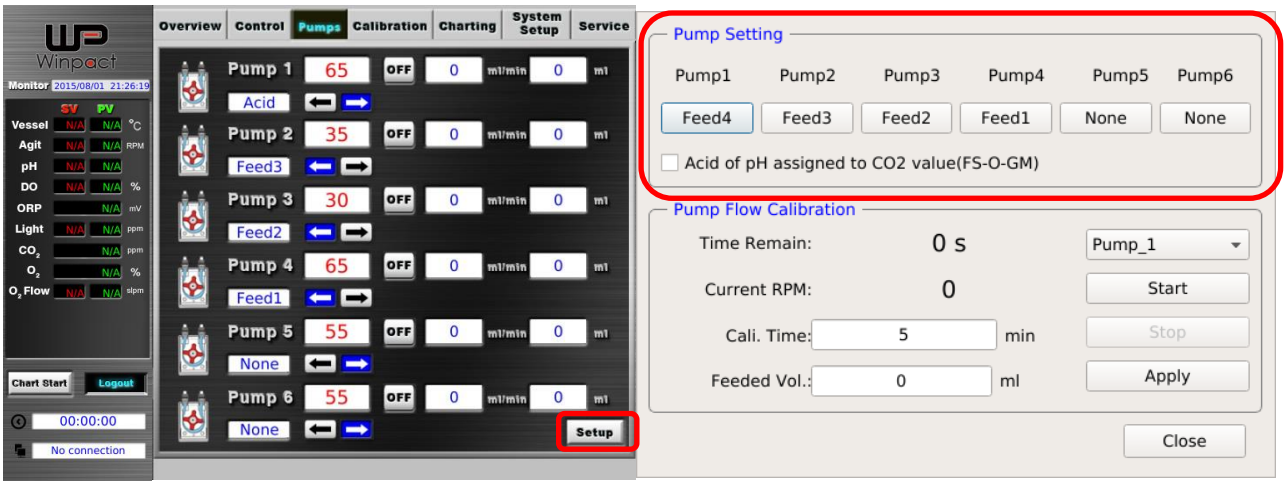
DO Cascade program aims to meet most of the experimental needs when operating a fermentation or bio-reaction experiment. The purpose of DO Cascade program is to maintain DO level of the medium. When a tremendous amount of oxygen is consumed by bacteria or yeast, DO level will decrease. If the level reaches the set point, system will activate DO Cascade program.



(A) DO Cascade Settings

"***DO Set Point***" value decides when to start DO Cascade program. Tap the column and enter the value.

The button behind the blank of "DO Set Point" allows user to choose one feeding pump for addition of substrates when DO level drops below the set value (e.g. 40%). Tap the button and switch to the feedings that have been assigned to different applications in the interface of "**Pump Setting**". (See the pictures below)



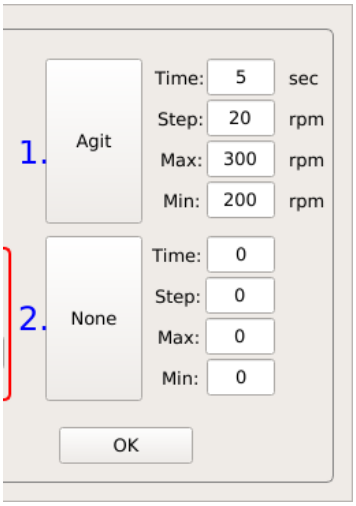
"***Restore Delay***" is a user-defined period of time that monitors effectiveness of DO cascade setting. ie. Restoration of medium DO level to a setpoint, for example, the DO

set point is 40%, the Response deadband is 2%, the Resotre delay is 1 minute, then DO cascade will stop working for 1 minute after the Do value is increased to 42%((DO set point)40%+(Response deadband)2%).
In this case, the DO Cascade program will not initiate until the DO level reaches 38% or 42% (40%±2% (Response Dead-band value)).

The purpose of DO cascade is to control DO value fluctuate above and below the maximum (DO set point + Response dead-band) and minimum value (DO set point - Response dead-band) gradually and smoothly. DO cascade will not work if DO value remains within the max. and min. value.

The response dead-band value can prevent the DO level from great fluctuation or repeated activation-deactivation cycles of DO Cascade.

(B) Control Strategy of DO Cascade



User can set two strategies to control DO value. ☝ Tap the buttons of 1 and 2 to switch to the device as a strategy to control DO value when it is above the maximum (DO set point + Response dead-band) or below the minimum value (DO set point - Response dead-band)
There are four optional strategies: agitation, O_2 Enrichment Module (FS-O-OE), O_2 with Mass Flow Controller Enrichment (FS-O-MF) and Gas Mixing Station (FS-O-GM) for user's requirement.
User is allowed to set two of the four strategies above. When the DO Cascade is triggered, the program will run Stage1 first. If Stage1 fails to control DO level, the system will proceed to Stage2 automatically. Tap the buttons to select user's preferable methods which runs for each stage; the following paragraphs explain the parameters of each strategy methods:

Agit

Select "Agit" to increase or decrease the DO level by agitation.

Time (sec.)	The time interval that each step lasts.
Step (rpm)	The magnitude of increment/ decrement acting on each step until Max/min is reached.
Max (rpm)	The maximum amount of time that solenoid valve opens.
min (rpm)	The minimum amount of time that solenoid valve opens.

Built-in O_2

Select "Built-in O_2 (OE)" based on user's optional device to adjust DO level. User can only choose either OE or MF at one time.

MS O_2 Enrichment Module (FS-O-OE):

Select "Built-in O_2" when system connects with MS O_2 Enrichment Module (FS-O-OE).

Time (sec.)	The time interval that each step lasts.
Step (%)	The magnitude of increment/ decrement acting on each step until Max/min is reached.
Max (%)	The maximum amount of time that solenoid valve opens.
min (%)	The minimum amount of time that solenoid valve opens.

MS Oxygen Enrichment with Mass Flow Controller (FS-O-MF):

Time (sec.)	The time interval that each step lasts.
Step (%)	The magnitude of increment/ decrement acting on each step until Max/min is reached.
Max (%)	The maximum amount of time that solenoid valve opens.
min (%)	The minimum amount of time that solenoid valve opens.

O_2 (GM)

Select "O_2 (GM)" when system connects with Winpact Gas Mixing Station (FS-O-GM) and user prefers to use O_2 only for adjusting DO level

Time (sec.)	The time interval that each step lasts.
Step (%)	The magnitude of increment/ decrement acting on each step until Max/min is reached *(Cycle, able to adjust in the block of "Gas Mixing Station (GM)" at the bottom of DO setup dialogue.)*

Max (%)	The maximum amount of time that solenoid valve opens.
Min (%)	The minimum amount of time that solenoid valve opens.

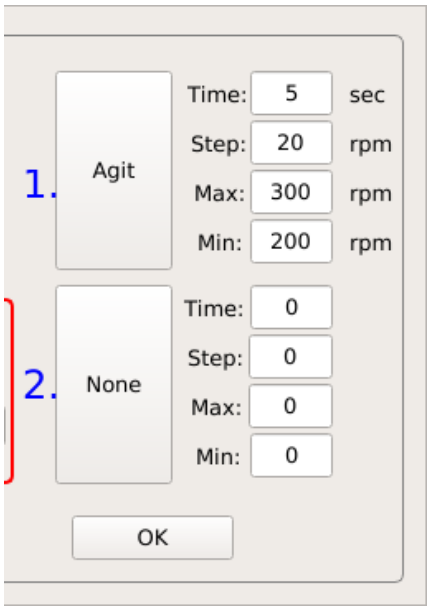
O_2/N_2 (GM)
(Bi-director)

Select "O_2/N_2 (GM)" when the system connects with MS Gas Mixing Station (FS-O-GM) and user prefers to use O_2 to increase DO and N_2 to decrease DO.

Time (sec.)	The time interval that each step lasts.
Step (%)	The magnitude of increment/ decrement acting on each step until Max/min is reached *(adjust the value of the cycle of "Gas Mixing Station (GM)" in "Select DO mode" dialogue.)*
Max (%)	The maximum amount of time that solenoid valve opens.
Min (%)	The minimum amount of time that solenoid valve opens.

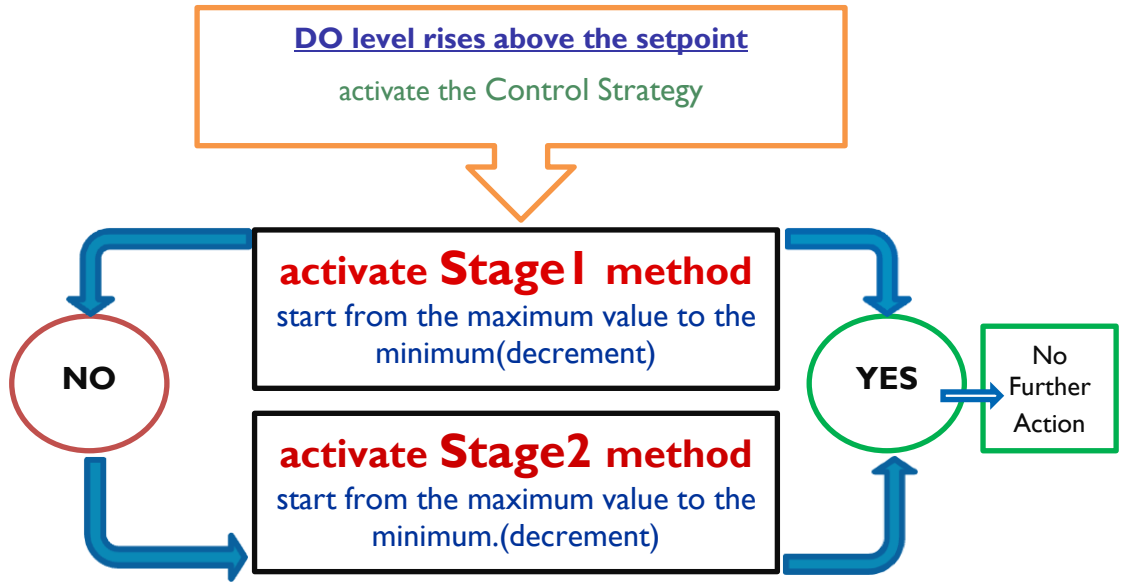
Control Strategy Example:

In the picture, the method of Stage1 is "Agitation" and Stage2 is "None". Once the DO level drops to 48%, DO Cascade will initiate Stage1 which is "Agitation" and increase agitation speed at 20rpm per cycle. The minimum speed is set at 200rpm, so agitation speed will increase 20rpm every 5 seconds; in that, 220 rpm for the next 5 seconds. After finishing a cycle (5 seconds), system checks DO level. If it does not meet the set value, the speed will increase to 240 rpm for another 5 seconds. Once system reaches the maximum speed (which is 300 rpm in this case) and still fails to raise the DO level to 52%, it proceeds to Stage2 if user set any strategy.

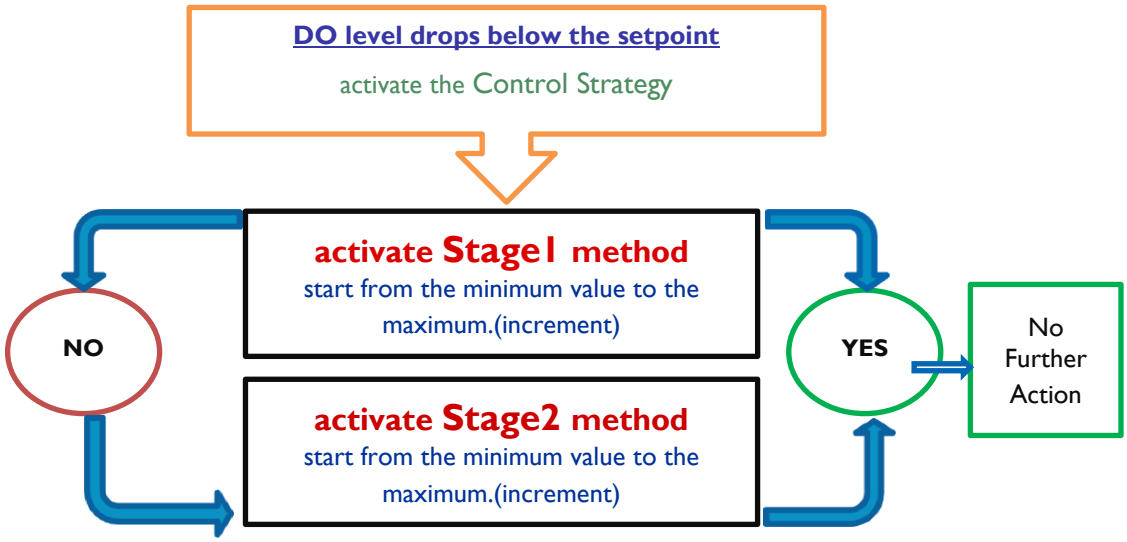


With optional device- GM installed, system runs the program with the value user enters in the columns.

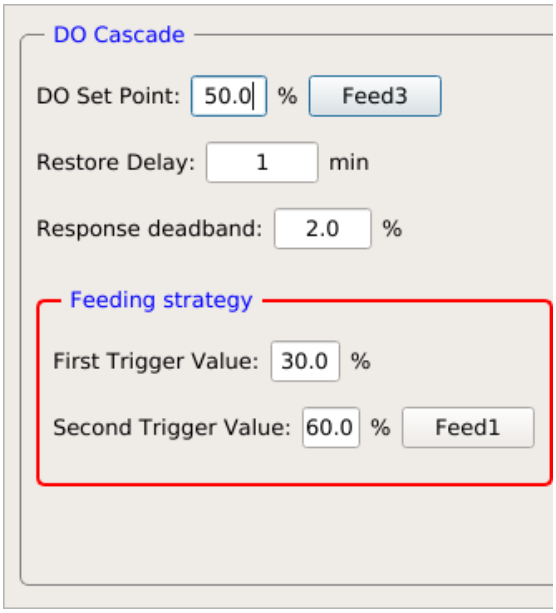
- **Flow Chart of Control Strategy (*decreasing*)**



- **Flow Chart of Control Strategy (*increasing*)**



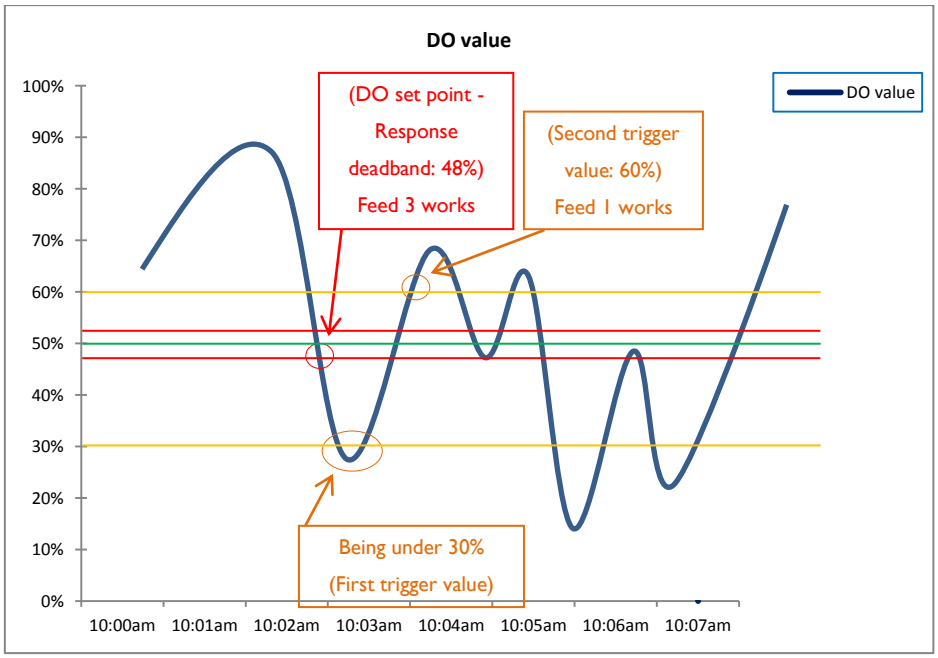
(C) Feeding Strategy



The value of **DO set point** decides the moment when "Feed 4" is triggered (in this case); as for the Feeding strategy,Feed3 will not work until DO value go through the "**First Trigger Value**" and the "**Second Trigger Value**". (See the example chart of the fluctuation of DO value below) On the other hand, Feed 3 will not work if the value reach to the Second trigger value without being through the First trigger value.

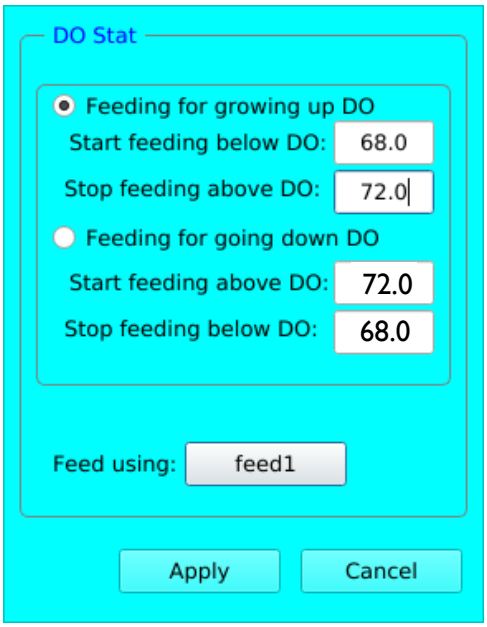
Note:

1. The process of feeding strategy only works for one time, if user would like to run Feeding strategy again, restart DO Cascade.
2. "First Trigger Value" **MUST** be lower than "DO Set Point", and the "Second Trigger Value" normally higher than "DO Set Point".



4-b DO Stat Setup

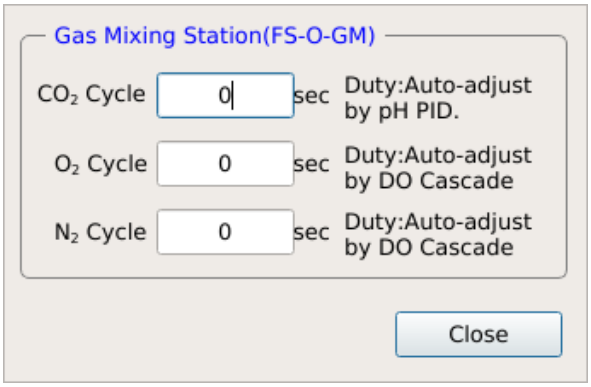
User can use DO Stat to control the DO level in vessel environment by pumping the substrates.

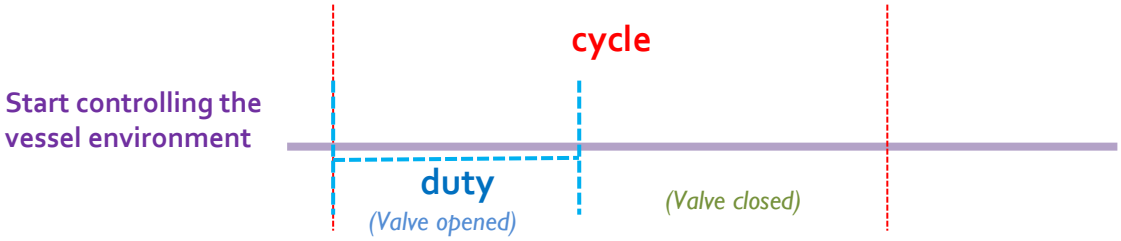


Select either one of the options and enter the desired values to satisfy user's requirement. User would also be able to choose the feeding table by tapping **the button behind "Feed using"**. Take the picture above for instance, the requirement is to control the DO value grow up to a value from a lower level, select the first dot of" Feeding for growing up DO" and enter the value of the lower point and the higher point which to start and stop feeding. On the other hand, if a going down DO value is necessary, select the second dot of "Feeding for going down DO" and enter the value of the higher point and the lower point in the followed blanks.

4-c Gas Mixing Station (FS-O-GM)

If the controller is equipped with Gas Mixing Station, input cycle time in the block of "Gas Mixing Station (FS-O-GM)" for setting up the related parameters. Tap the text column to set up the duration of each cycle. "Duty time" will be adjusted automatically by the system.



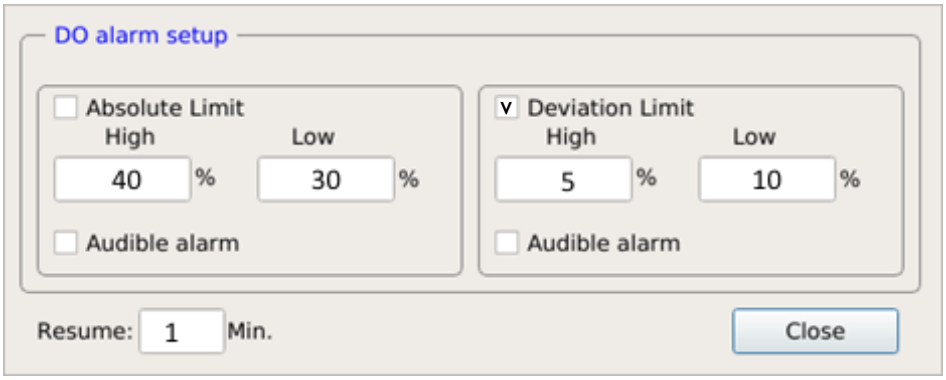


Cycle : The duration that valve opens and closes.
Duty : The duration which valve opens.

> **Note:**
> To enable the function, go to "System Setup" page. And select the related options.

4-d DO Alarm Setup

Set up the alarm to alert user when DO level deviates from user's setpoint. Input the desired values to the columns.

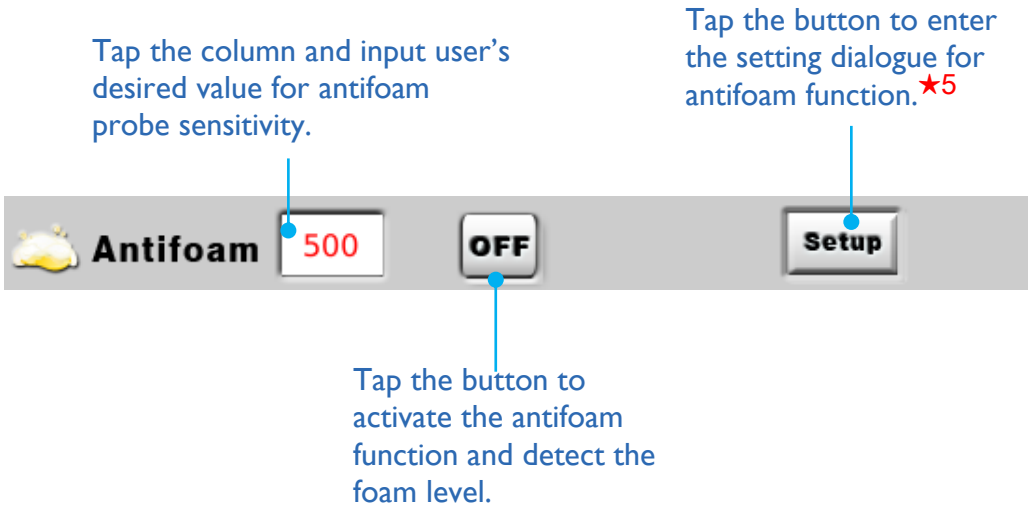


Absolute Limit: The system will show up a warning dialogue either when the pH value reaches over the maximum (High) or when it falls below the minimum (Low). If selected "Audible alarm", the system will pop up the dialogue along with warning sound.

Deviation Limit: It indicates the tolerance of pH setpoint. Take the above picture for example, if DO value is set at 70%; the maximum and minimum of deviation limit are 5% and 10%, it means that the alarm will be triggered either when the value rises above 75% or falls below 60%. User can select "Audible alarm" to have the alarm with warning sound.

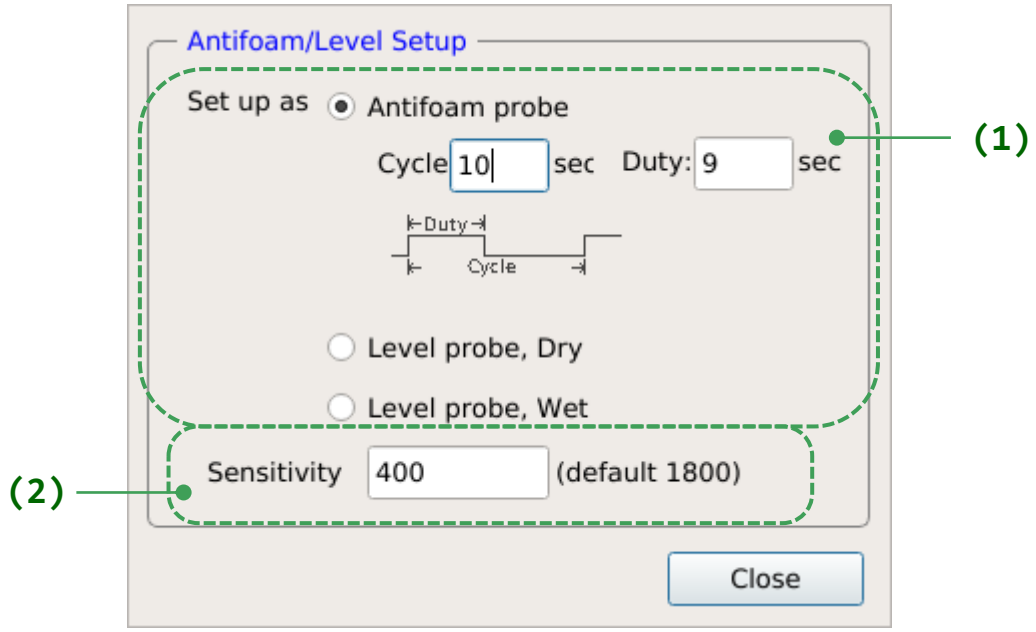
★ "Resume Time" allows warning mechanism to "sleep" for a period of time after users clean and close the first warning message. Define the period of time in the blank (min.). That is, the secondary warning will not initiate during the resume time even present value have reached the limits. The minimum value is 1.

5.2.1.5 Antifoam

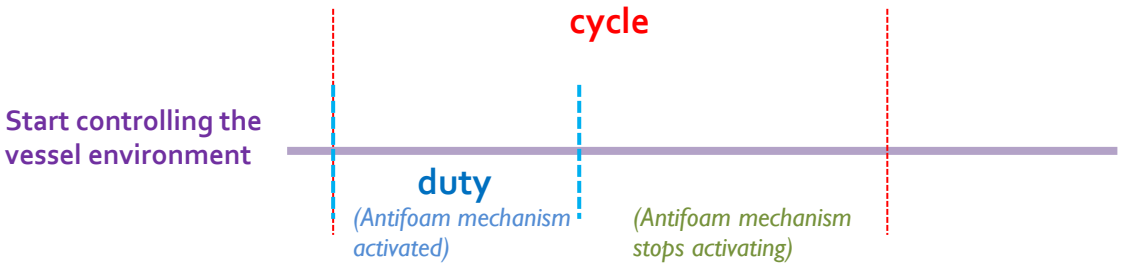


★5

Tap "**Setup**" to enter the setting dialogue for antifoam function:



(1) Cycle & Duty Settings



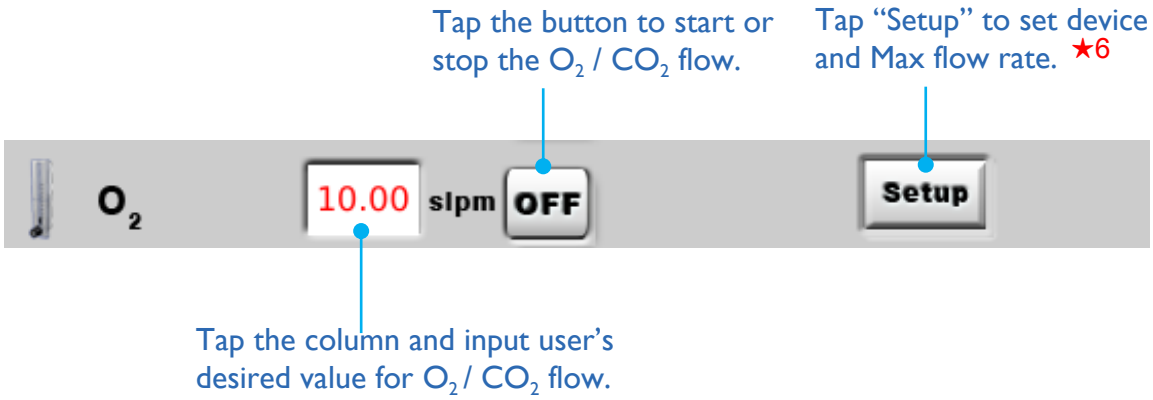
Cycle : The duration that the valve opens and closes.
Duty : The duration that the system activates to de-foam.

★ Select either “Level probe, Dry” if user prefer Antifoam program runs when the probe is dry or select “Level probe, wet” if user prefer Antifoam program runs when the probe is wet.

(2) Antifoam Sensitivity

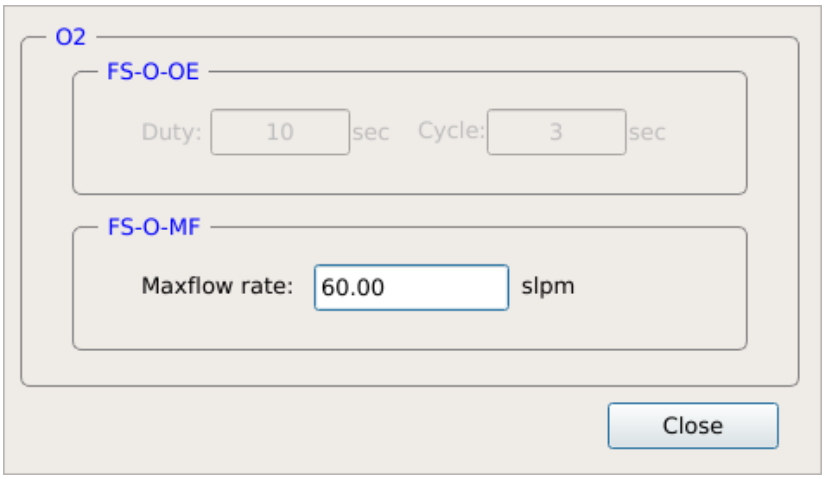
The default value of antifoam sensitivity should be 1800. Tap the column to input user’s desired antifoam sensitivity, or directly input it in the column on Manual tab. The sensitivity ranges from 0 to 4095. User can enter any integer within this range for the antifoam sensitivity. The bigger value user set, the higher sensitivity the probe gets.
If the detected value falls below the setpoint, the system will activate foam-level control.

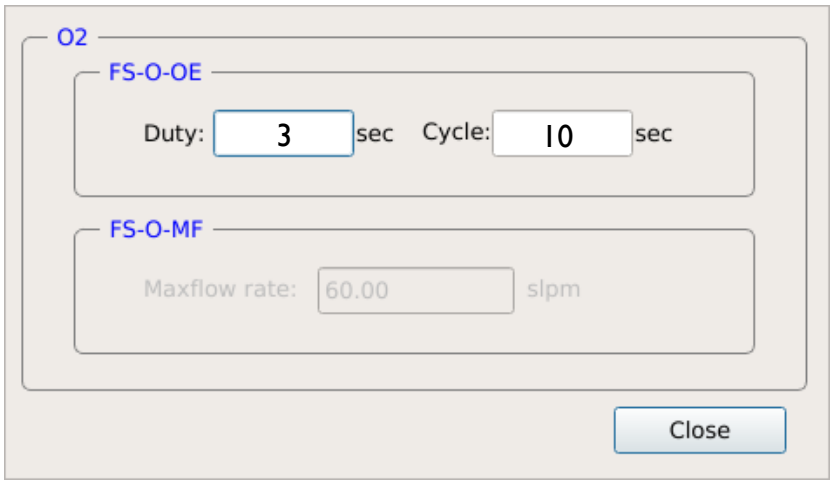
5.2.1.6 O2



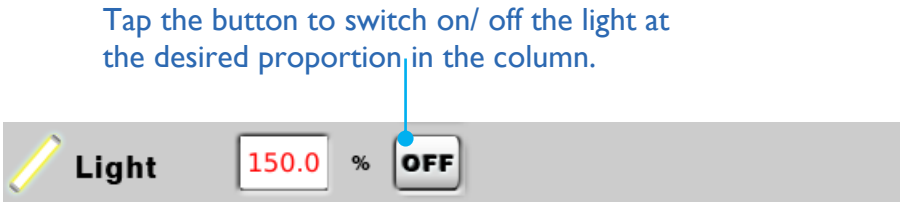
★6

Set up the related settings in the interface of System Setup.

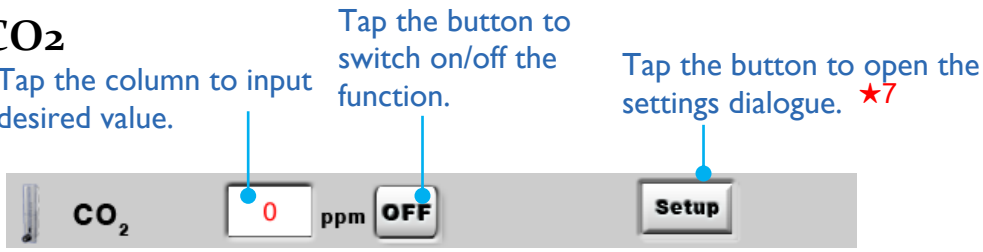




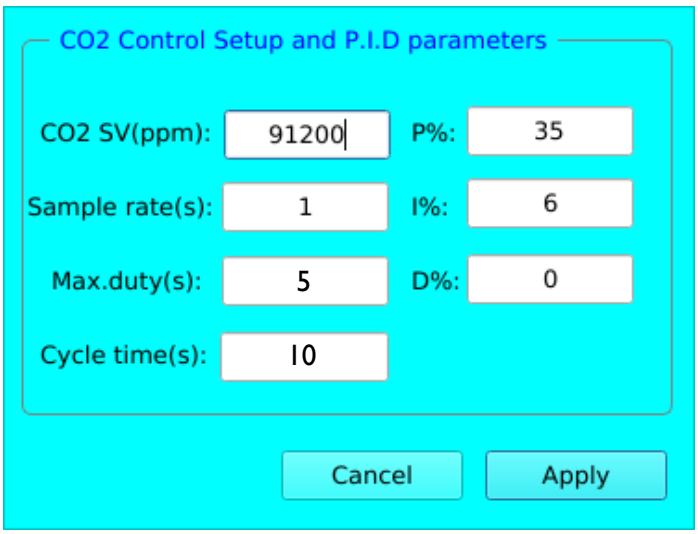
5.2.1.7 Light



5.2.1.8 CO_2



★7



A **proportional-integral-derivative controller** (**PID controller**) is a control loop feedback mechanism (controller) commonly used in industrial control systems. A PID controller continuously calculates an "error value" as the difference between a measured process variable and a desired setpoint. The controller attempts to minimize the error over time by adjustment of a control variable, such as the position of a control valve, a damper, or the power supplied to a heating element, to a new value determined by a weighted sum. The value of P.I.D has been optimized when it is delivered to users, thus it is recommend that user do not change the value unless there are professional experts operating.

In the other words, "**P.I.D. control**" is a pump-on/pump-off mechanism for controlling the CO_2 value of vessels. The system will adjust the operation time to control the value of CO_2 depends on the ratio.

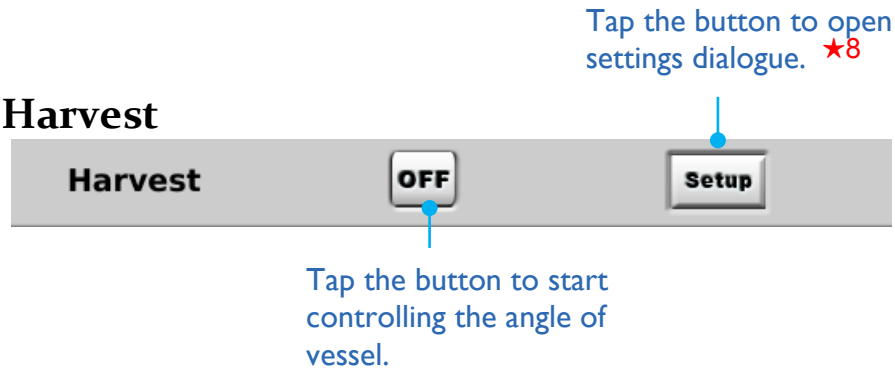
"**Max duty**" is the maximum time period which system keeps CO_2 solenoid valve open. Because

of P.I.D. control, system control the duration which valve is open depend on the ratio of P.I.D., the purpose of this mechanism is to prevent the value from fluctuating greatly.

Note: The maximum duty setting of each cycle is **60 seconds**.

User can adjust "*Sample Rate*" to decide the frequency system calculates the period of time to keep the valve open. For example, with "Sample Rate" 1 second, system calculates the value of the time solenoid valve open every "1" second, no matter what the value the system calculates during the first cycle, solenoid valve opens the time system calculates at the beginning second of the cycle,(refer to the picture below) system calculates the time -- 5 seconds, no matter what the values are from the first second to the forth second, the value system calculates at the fifth second is the time period CO_2 solenoid valve opens for the second cycle.

5.2.1.9 Harvest

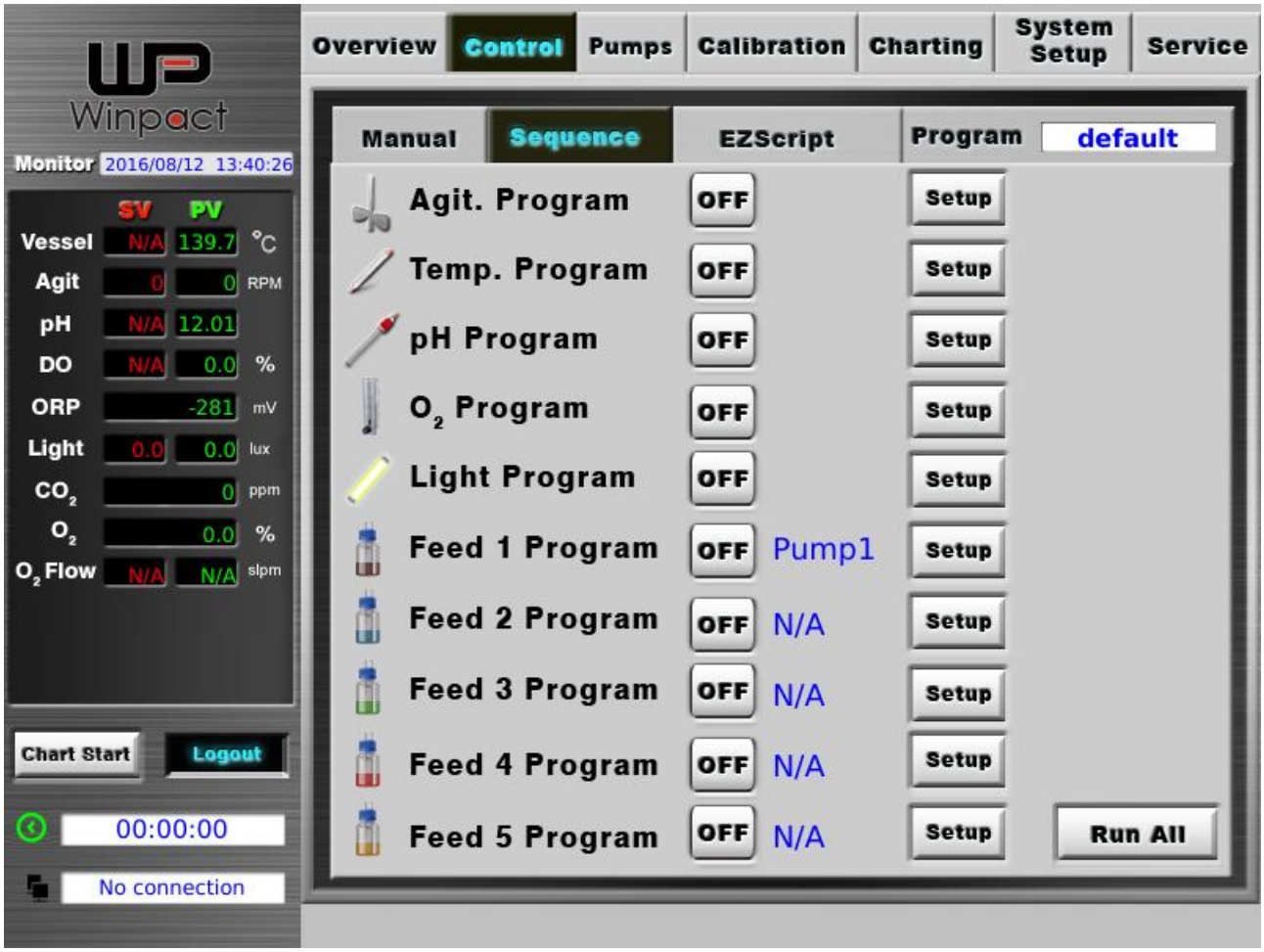


★8

"Home Return" indicates "0 degree" of vessel, if user select "Home Return" then press "ON", system would change the angle of vessel to 0 degree; while if user select "Harvest" then press "ON", system would change the angle to 120 degrees from its previous angle.

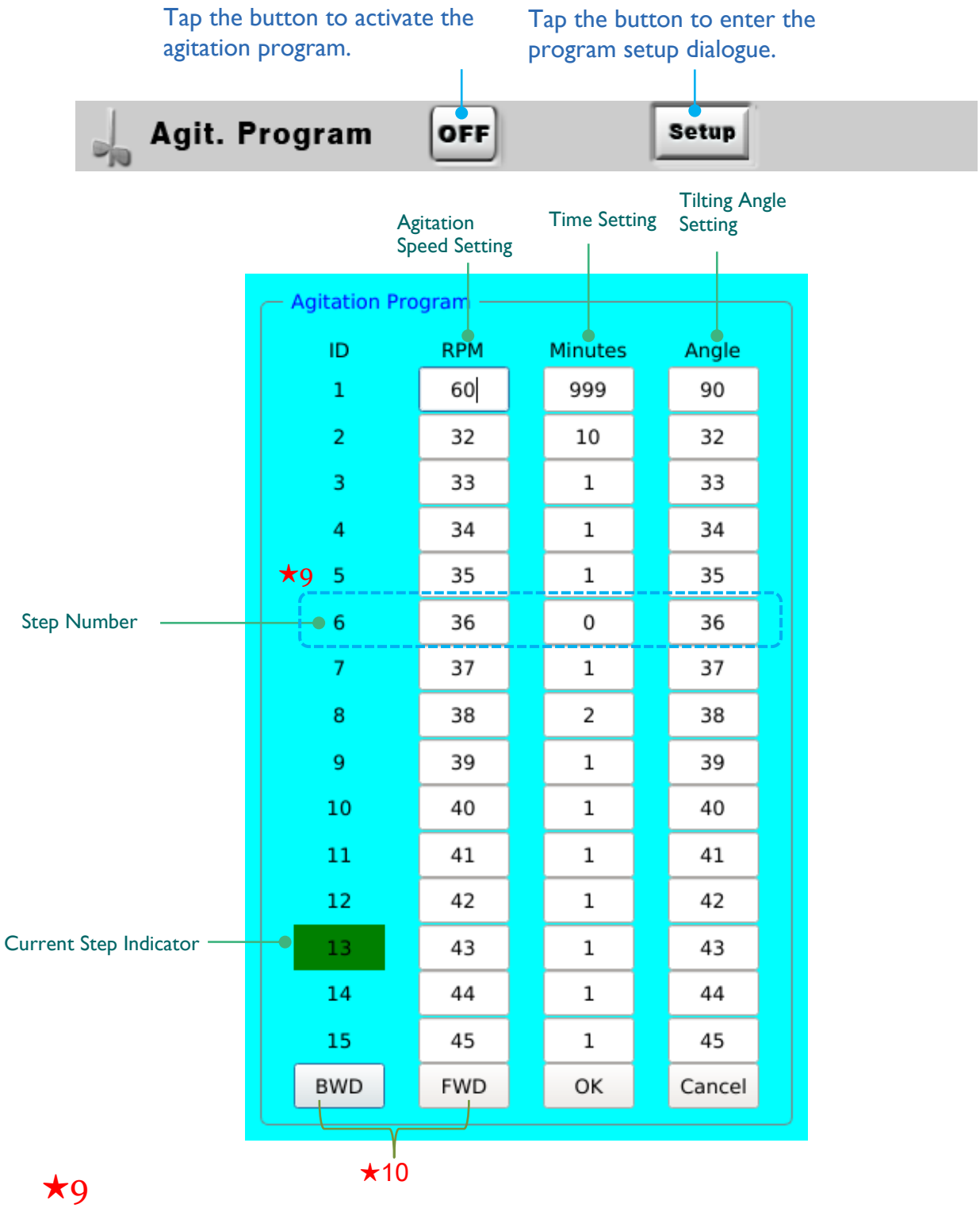
5.2.2 Sequence

User are able to set up the schedule of each parameter, including agitation, temperature, pH value, or O_2 flow, illumination and substrates (Feed1 – Feed5) for automatic fermentation process in Sequence tab. Each schedule (also called "Program") contains up to 15 steps; the system will run the program in sequence step-by-step (or based on user's setting).



Detailed instructions for setting the schedules are explained in the following subsections.

5.2.2.1 Agitation Program



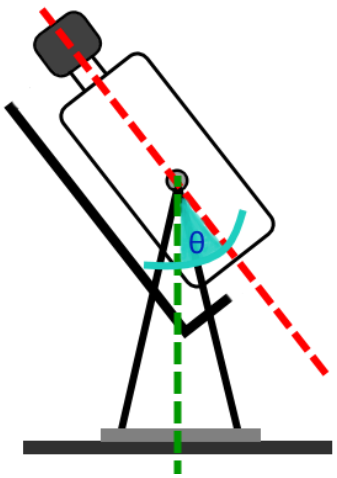
★9

RPM: RPM represent the speed of agitation, and it could be set from 1-60 rpm. **If user set "0", it means the system stop agitating temporarily at the set angle for set minutes.**

Minutes: Minutes represent the agitation time, and it could be set from 1-999 minutes. **If user sets the time 0 at certain step, the system will operate continuously at the value set**

in previous step, and ignore the rest of steps. In this case, the system will run at the speed of 35 rpm at 35 degree continuously until user stops the program manually.

Angle: Angle represents the tilting degree. "0" means the vessel remain vertical while 90 means the vessel tilts 90 degree hence the vessel is horizontal.



★10

Tap BWD /FWD button to move to the previous/next step from current operating step.

Note 1:

Besides tapping BWD/ FWD button to move to the previous/next step, user could also double click certain Step Number to jump to that step.

Note 2:

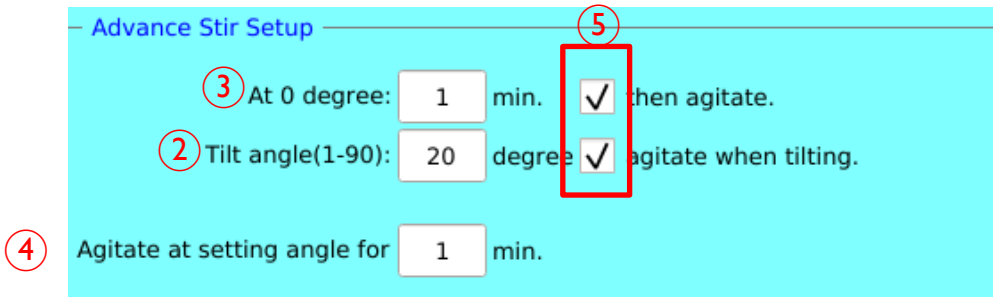
After finishing a step, the system will automatically return to 0 degree, and proceed to the next step. During this time span of angle changing, user could not arbitrarily jump to any step. User could neither tapping BWD/ FWD button to move to the previous/next step nor double click certain Step Number to jump to that Step.

5.2.2.2 Agitation Control (Manual vs. Sequence)

Manual:

1. Input the desired agitation speed.

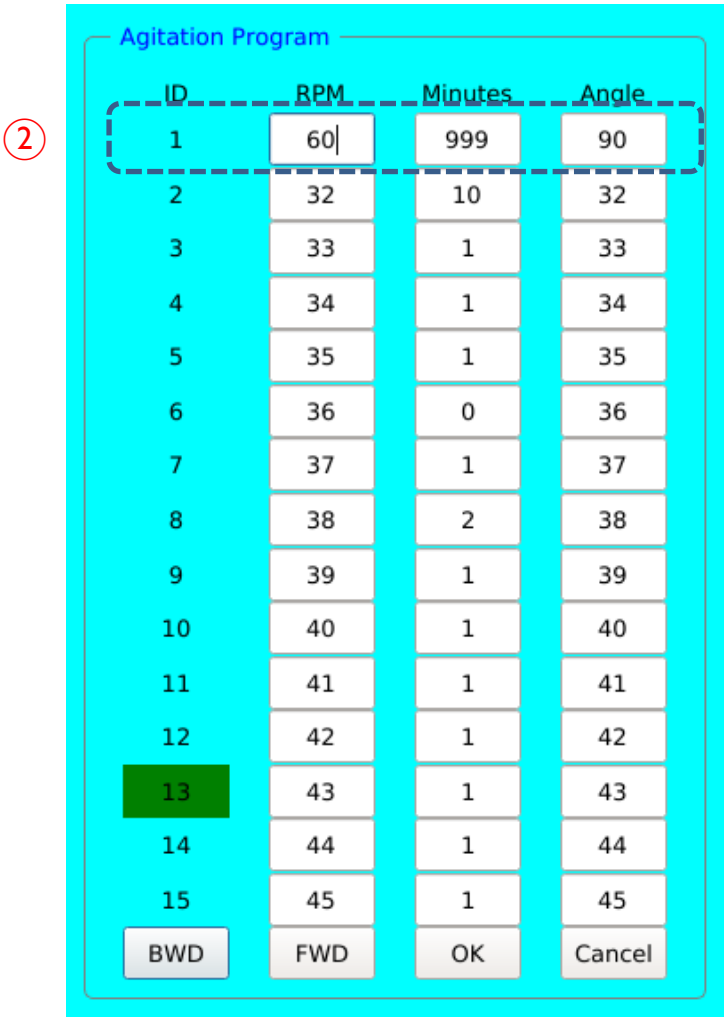
2. Input the desired tilt angle.
3. Input the desired time span between routines of angle changing from 0 degree to assigned degree.
4. Input the desired time span of agitating at assigned degree.
5. Select the checkbox to determine whether agitate or not during 0 degree/tilting.



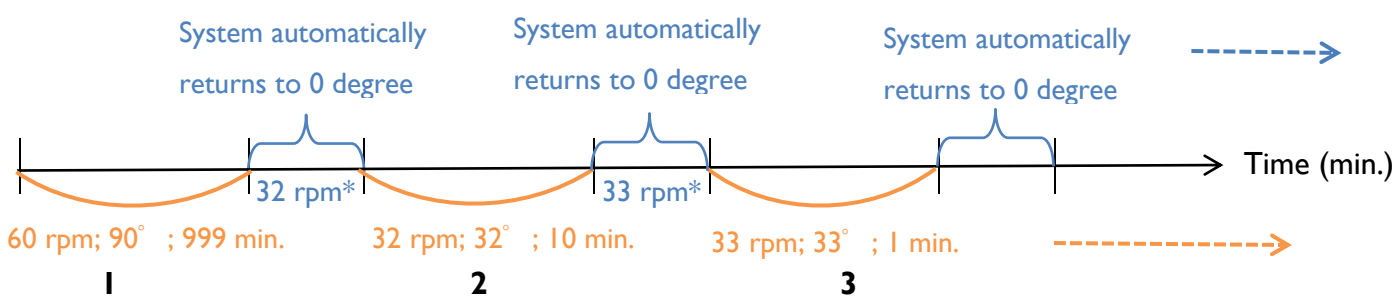
Sequence:

1. Tap "Setup" button to open the dialogue.

2. Input the desired speed, tilting angle and desired time span for each step.



Detailed figures set in Step 2 are shown below:

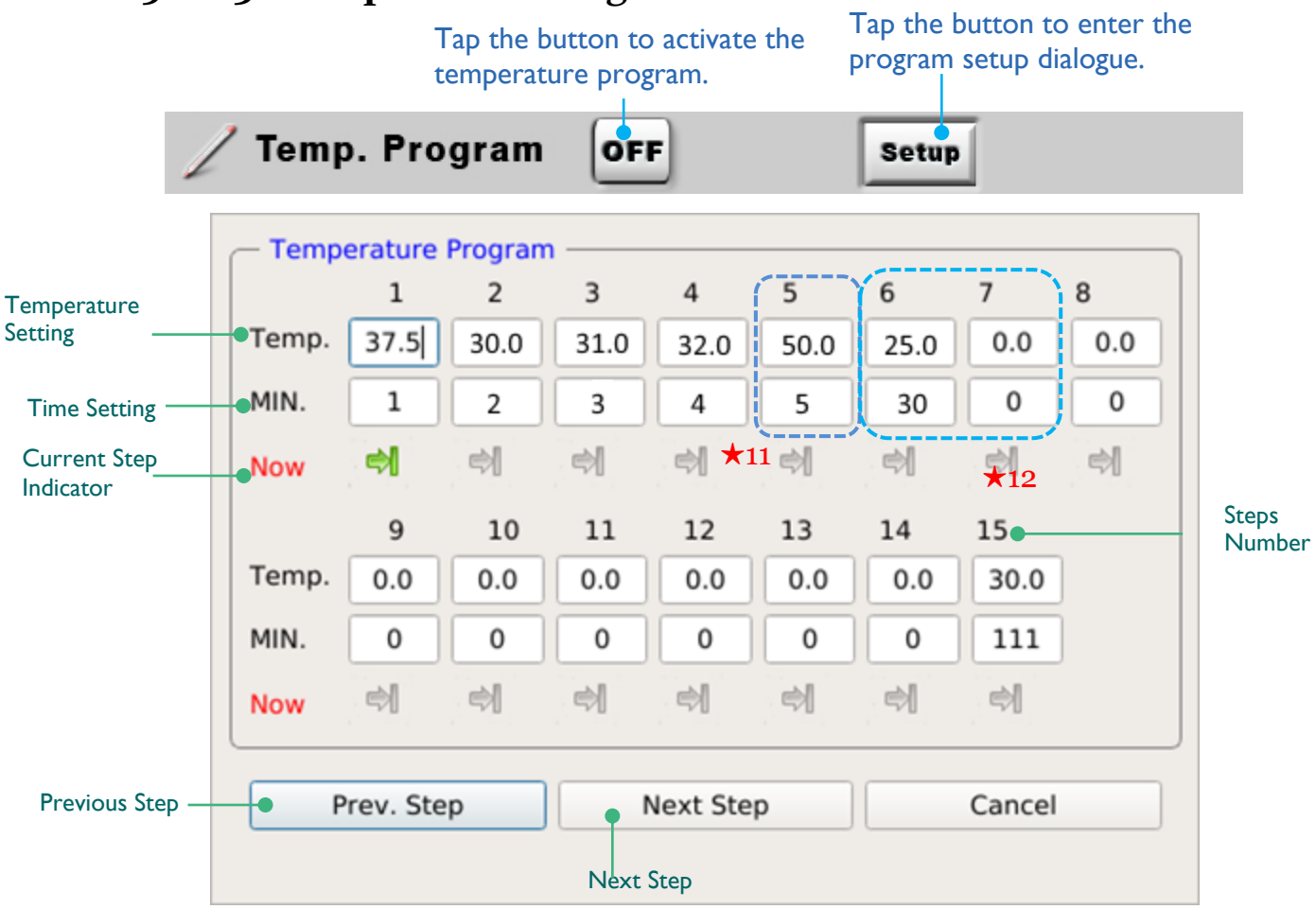


***The agitation speed during the time span of angle changing is identical to the agitation speed of the next step. Take the above figure for example, after finishing the first step (60 rpm; 90 degree), the system changes to agitate in 32 rpm and proceed to return 0 degree and proceed to move to 32 degree.**

Note:

The setting in the picture above is only an example. Please set up the values based on user's experiment requirement.

5.2.2.3 Temperature Program



★11

The range of the temperature is indicated in Chapter 2 Specification which varies with different size of vessels.

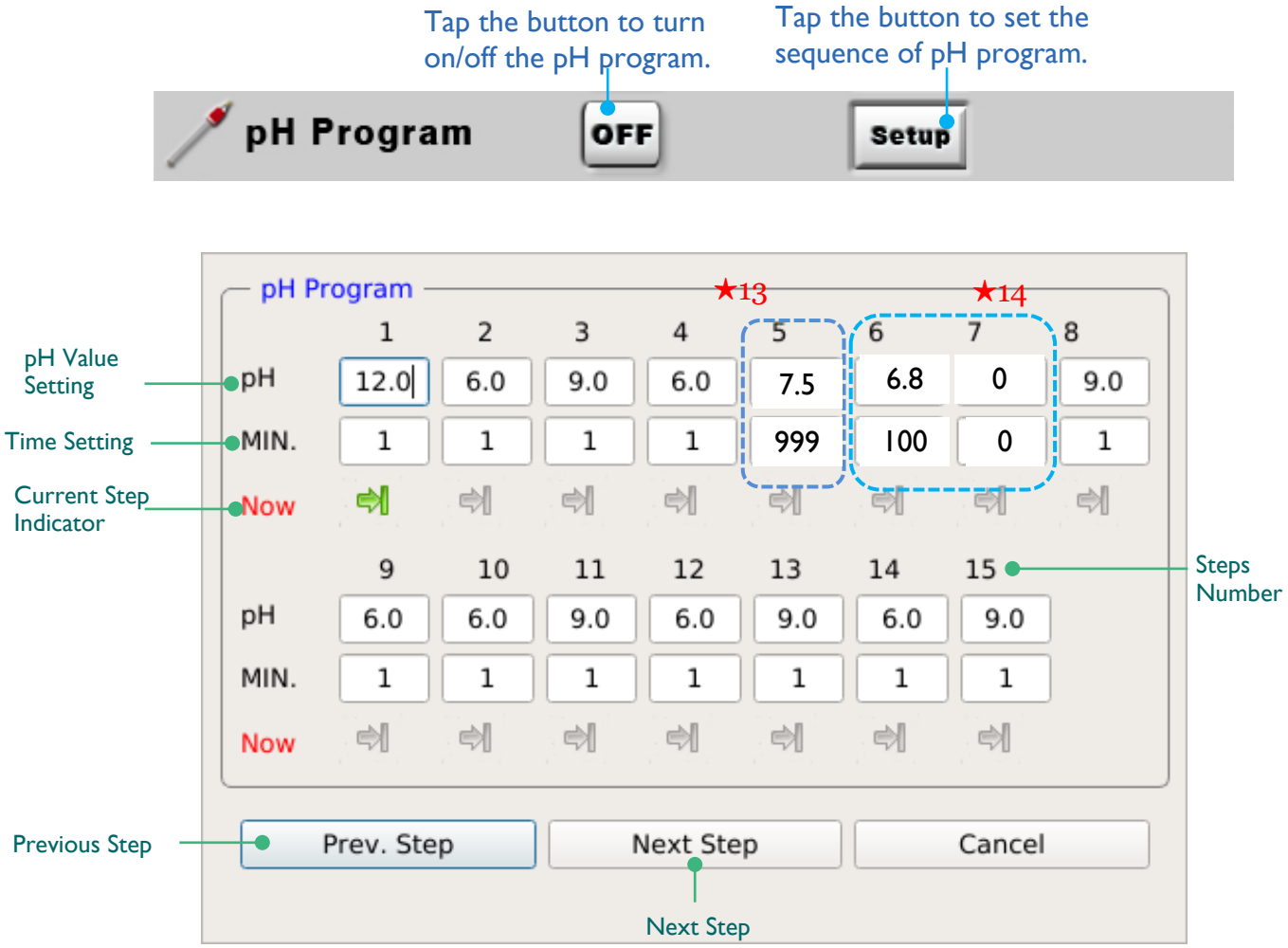
9999 is the maximum value of time setting. If "MIN" is set at 9999, then the system will run at the set temperature for 9999 minutes (approximately 6 days). In the picture above, system will keep the environment at 50 ˚C for 5 minutes, then proceeds to next step.

★12

If time and temperature are both set 0 in one step, the program runs the previous step continuously and ignores the rest of steps. In the picture above, the system will remain 25˚C until the program is terminated manually.

Note:
The setting in the picture above is only an example. Please set up the values based on user's experiment requirement.

5.2.2.4 pH Program



★13

The range of pH value can be refered in "Specification". 9999 is the maximum value of time setting. If "MIN." is set at 9999, the system will run at the set value for 9999 minutes (approximately 6 days). Take the picture above for instance; system will keep the environment at the pH value of 7.5 for 999 minutes, then proceeds to next step.

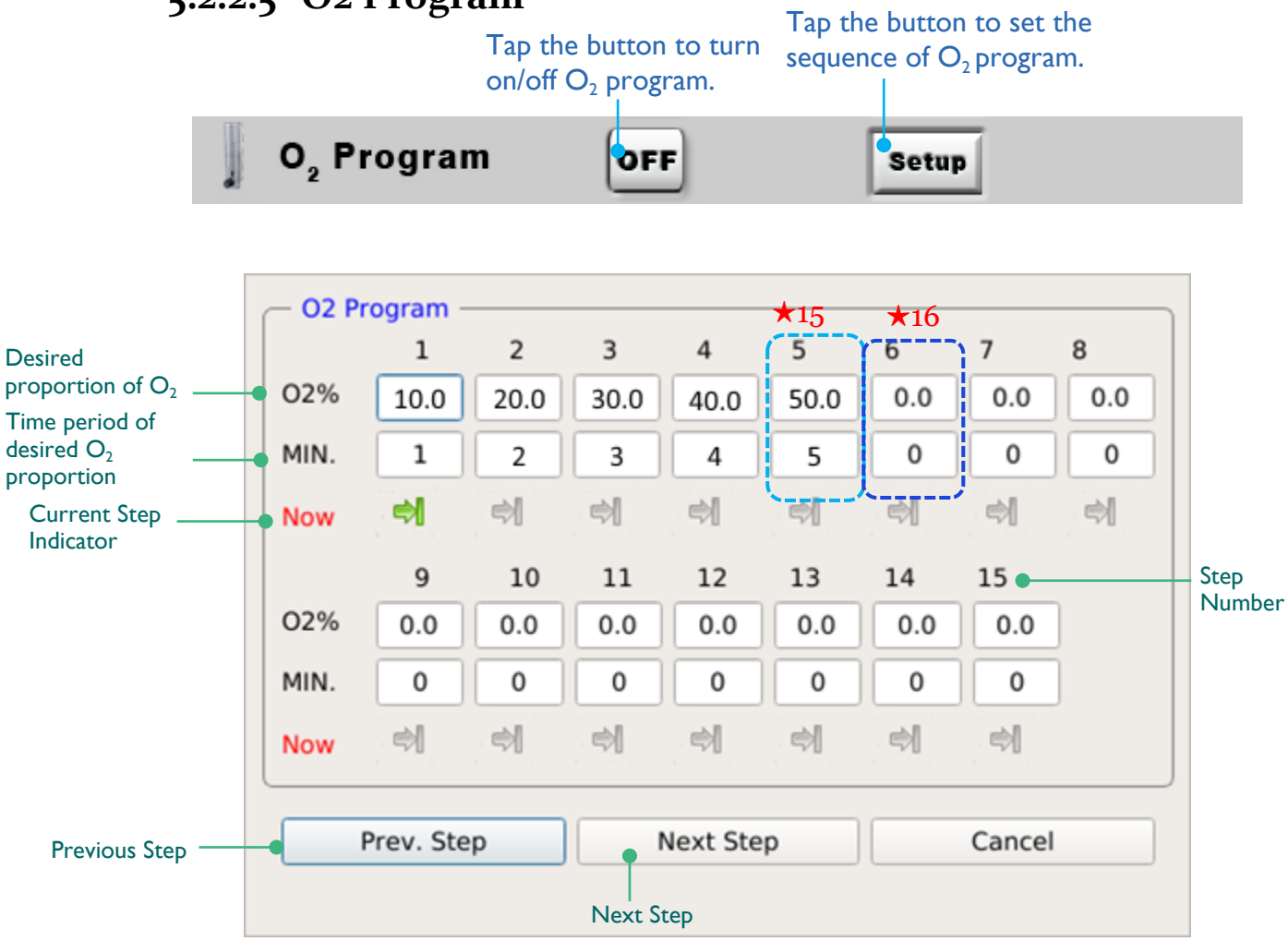
★14

If time and pH value are set at 0 in one step, program keeps the environment at the status of the previous step and ignores rest of the steps. In the picture above, the system will remain pH at 7.5 until program is terminated manually.

Note:

The setting in the picture above is only an example. Please set up the values based on user's experiment requirement.

5.2.2.5 O2 Program



★15

System proceed the condition of O_2 proportion as the setting sequence table, for example, the proportion of O_2 is set at 50% at the fifth step and" MIN." is 10, O_2 proportion will be controlled at the level 50% for 10 seconds. The maximum of the time setting is 9999 seconds.

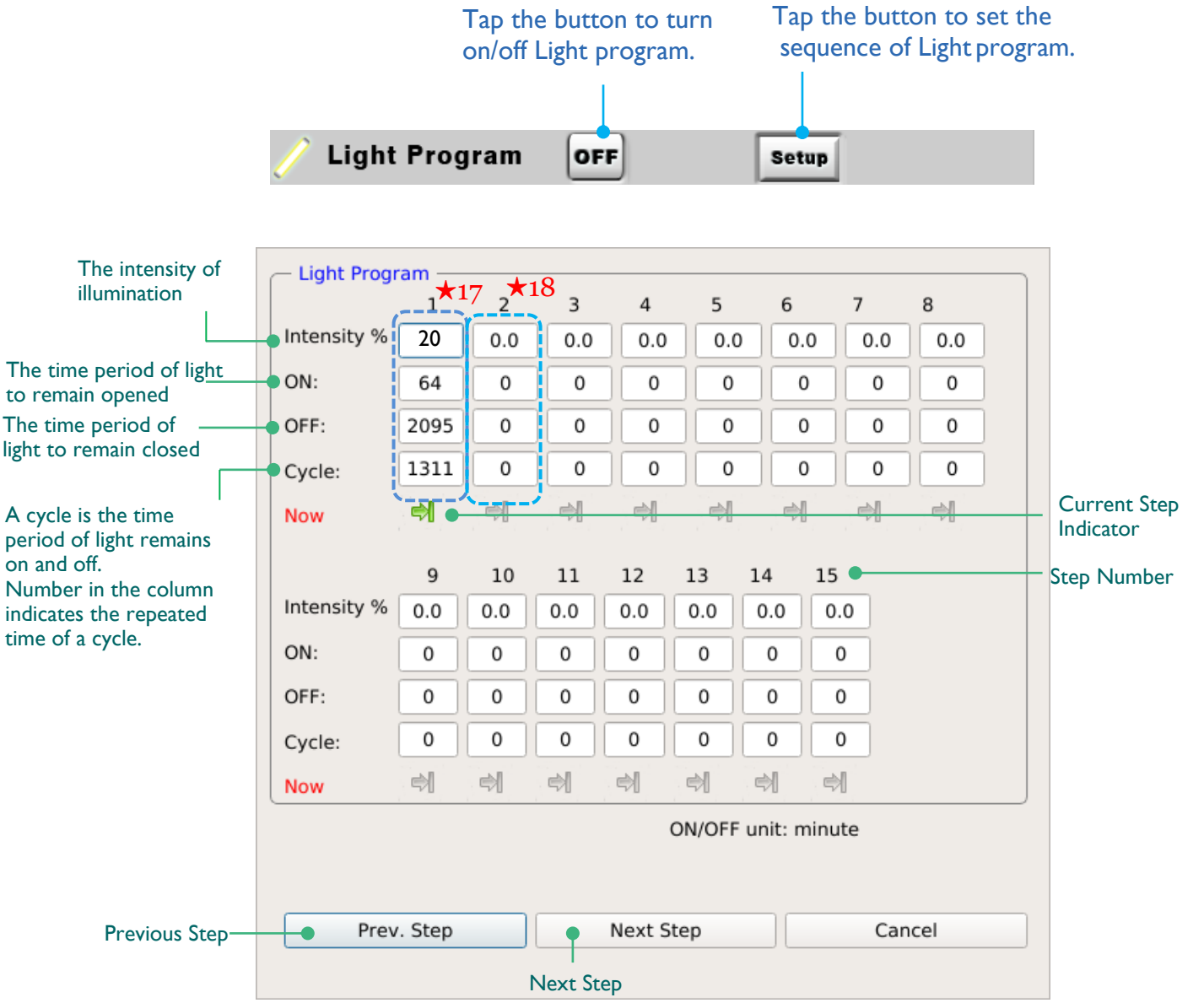
★16

To stop O_2 program, input 0 in both proportion and time columns, system will stop after the prior step is finished.

Note:

The setting in the picture above is only an example. Please set up the values based on user's experiment requirement.

5.2.2.6 Light Program



★17

9999 is the maximum of all the 3 parameters: ON, OFF and Cycle. Light keeps on at the intensity of 20% for 64 minutes and remains off for 2095 minutes, the cycle of on and off will be repeated for 1311 times, system then proceeds to next step.

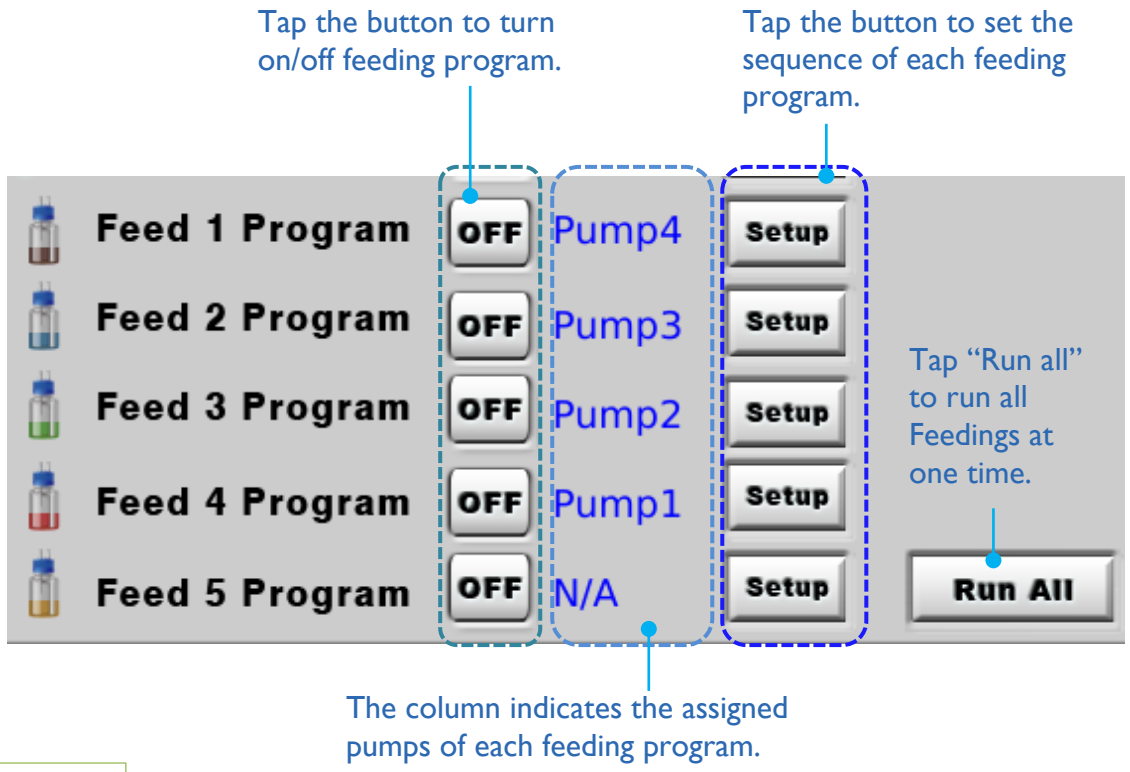
★18

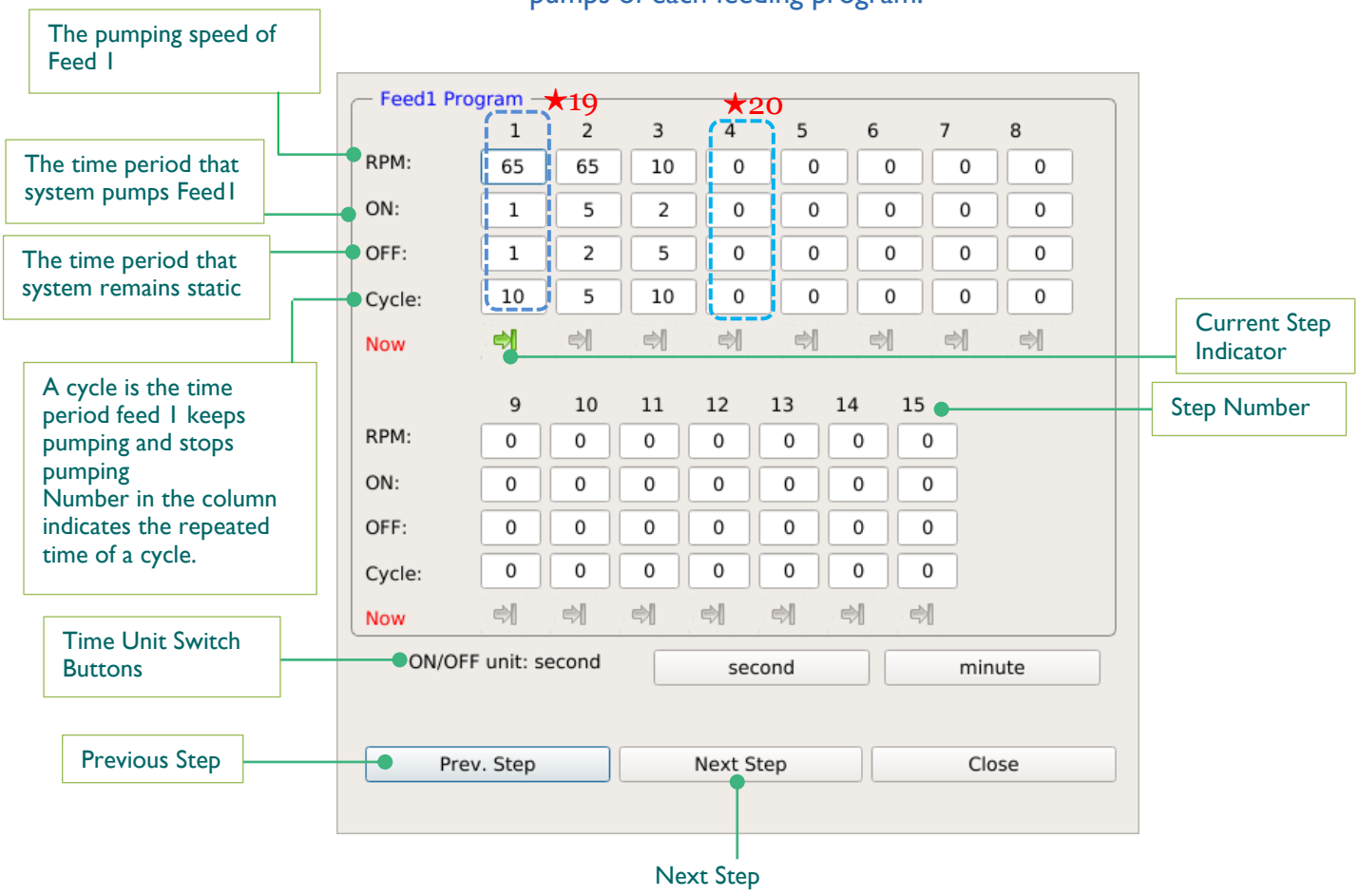
There are 2 ways to stop light program with sequence setting. One is to set the cycle 0, system will recognize the step of the set cycle as the last step. Take the picture above for instance, system stops after the seventh step and ignores the rest of the settings. The other method is to set both "ON" and "OFF" 0, system stops at the step with the value of both "ON" and "OFF" 0.

Note:

The setting in the picture above is only an example. Please set up the values based on user's experiment requirement.

5.2.2.7 Feed1 – Feed5 Program





★19

9999 is the maximum of all the 3 parameters: ON, OFF and Cycle. System keeps pumpimng Feed 1 at the speed of the column for the set time period of On and Off, and repeat the cycle witht the number times in the column, for example, system pumps Feed 1 at the speed of 65 rpm for 1 second then stop for 1 second, after repeat the cycle for 10 times, it proceeds to the next step.

★20

There are 2 ways to stop feeding program with sequence setting. One is to set the cycle 0, system will recognize the step of the set cycle as the last step. Take the picture above for instance, system stops after the seventh step and ignores the rest of the settings. The other method is to set both "ON" and "OFF" 0, system stops at the step with the value of both "ON" and "OFF" 0.

Note:

The setting in the picture above is only an example. Please set up the values based on user's experiment requirement.

5.2.3 Program

In this tab, user will be able to name each program that user set up in Sequence tab so user could have several programs saved in the system. Or user can export the used program to user's personal computer or flash drive for further experimental research.

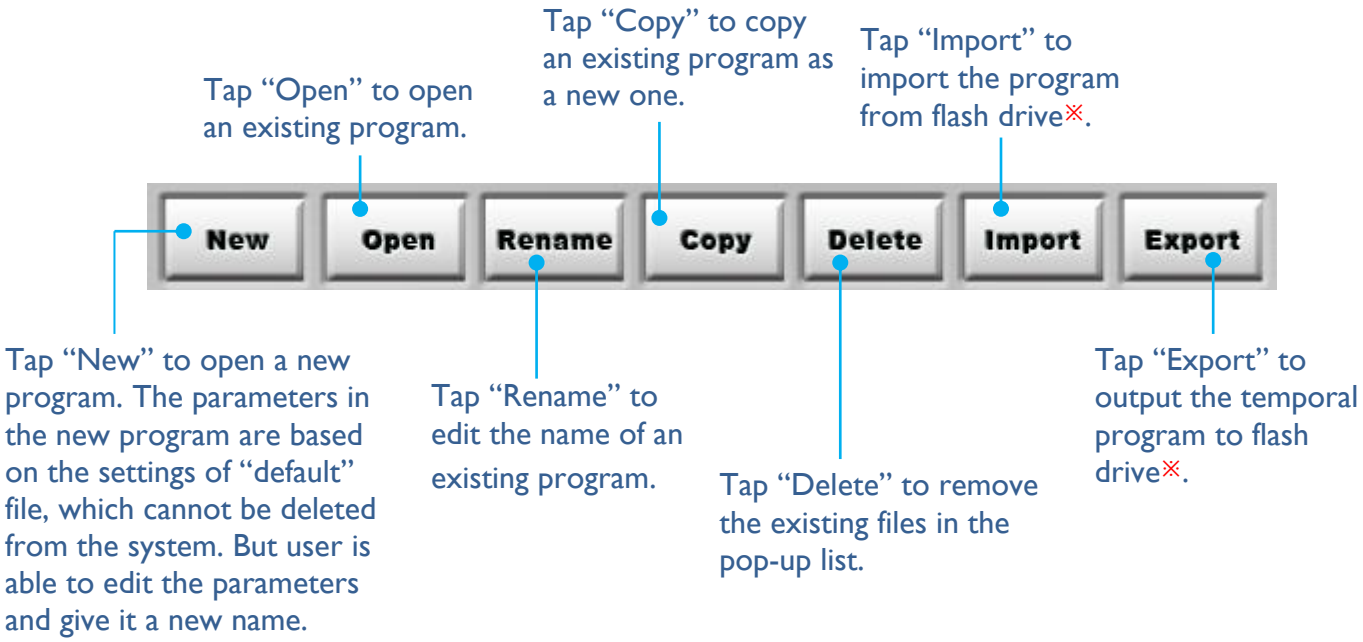
Detailed instructions are described in the following paragraphs.

5.2.3.1 Name the Program

In “Program” tab user can name the program with the keypad below. Press “OK” button at the bottom left of the keypad to confirm the name setting.

5.2.3.2 Features of the Buttons

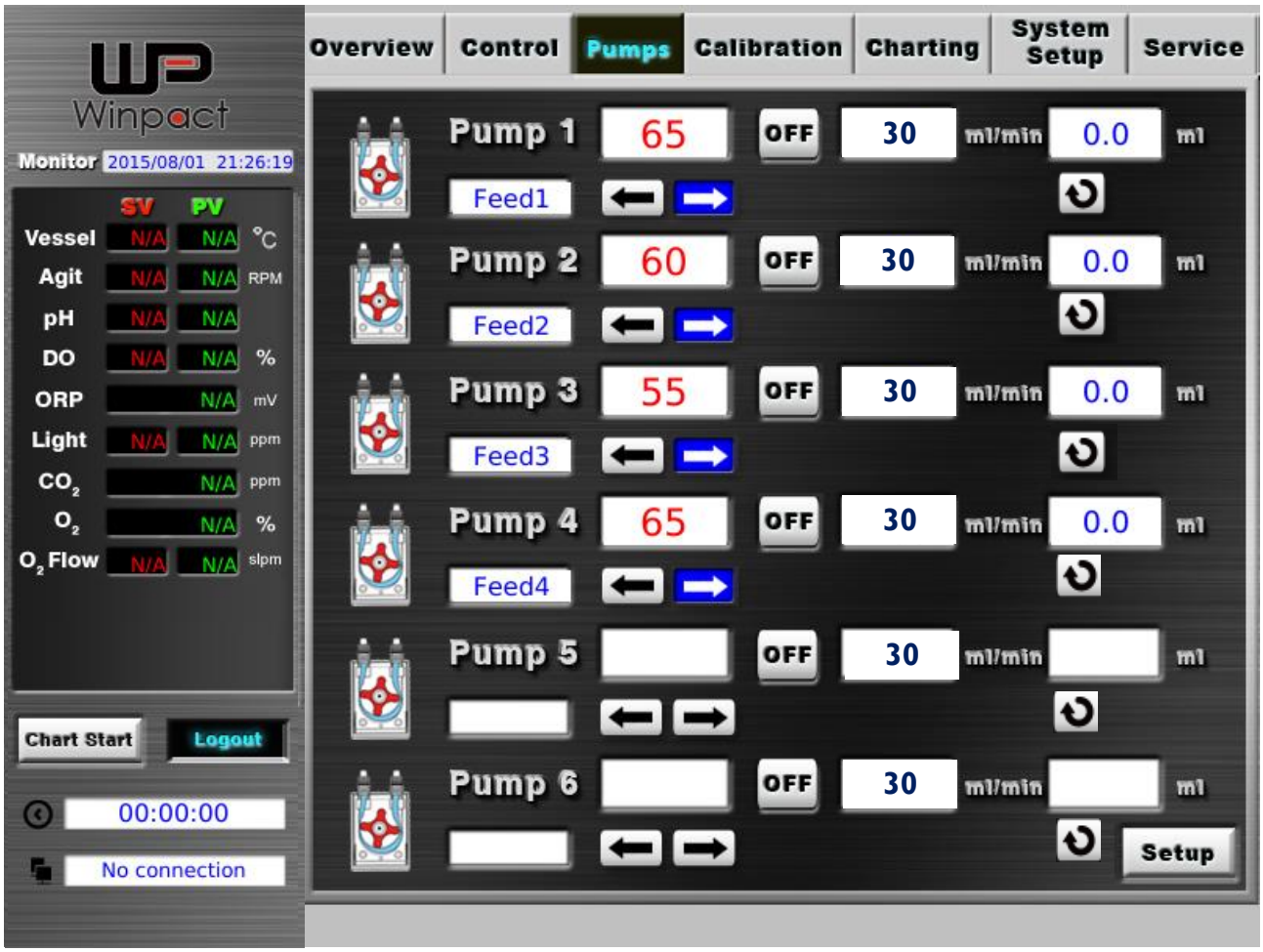
There are 7 buttons below the keypad for user to edit or adjust the program in the system. Details of these buttons are described in the next page.



※ The type of exported program file is a specific file format (.prgz) that only can be used in FS controller. User may not be able to edit the program on user's personal computer or other devices. The settings of Manual and Sequence are stored in the file with the name which is displayed in the column above.

5.3 Pumps

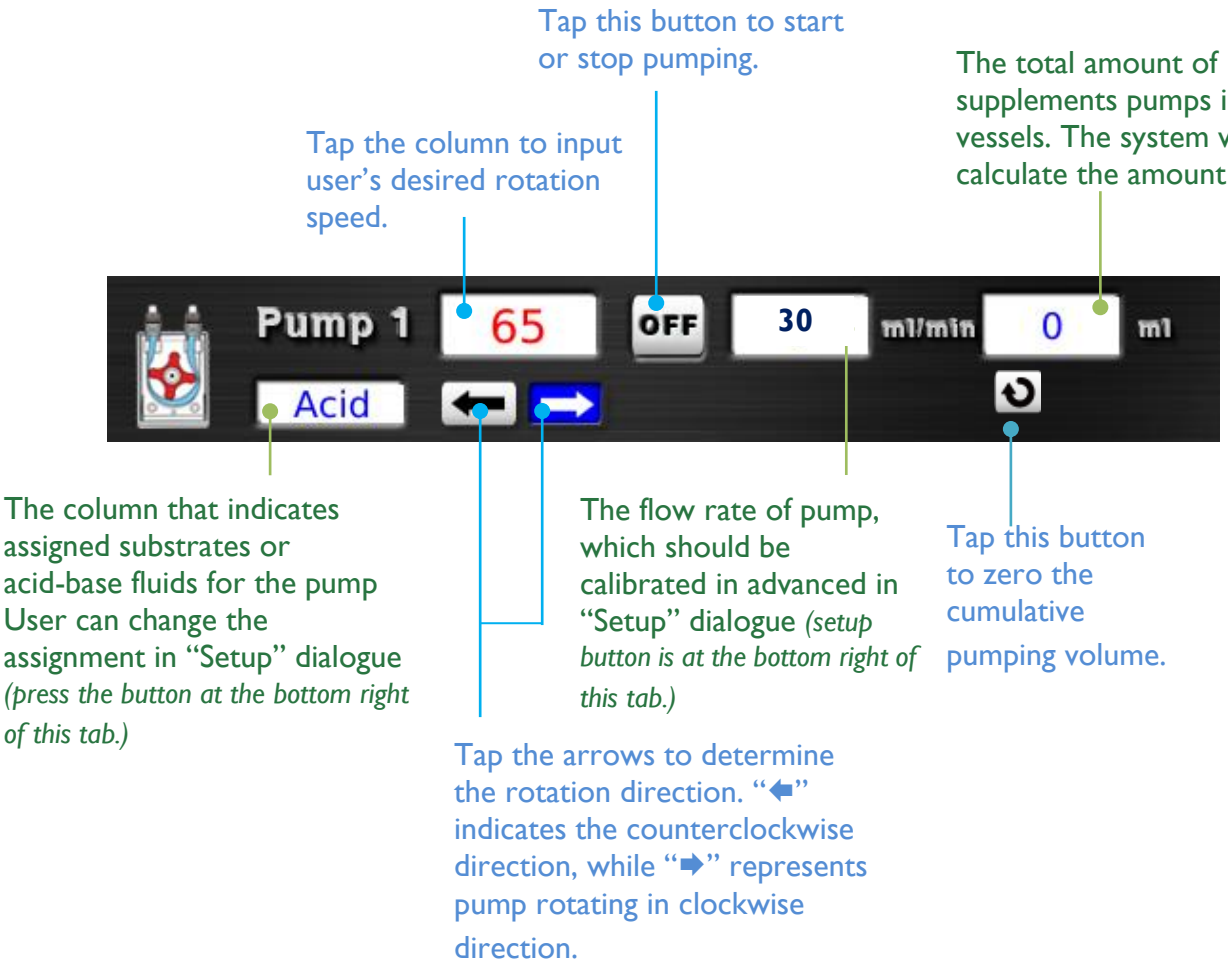
Each controller contains 4 built-in peristaltic pumps; in addition, user can connect 2 external pumps (Pump5 & Pump6) at most. To purchase our external pumps, please contact the sales department of Major Science.



The following subsections will introduce the features of Pumps tab.

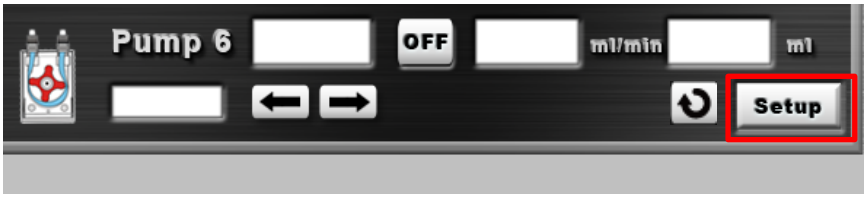
Note:
If the system is not connected with any external pump, the columns of Pump5 and Pump6 will be unable to edit.

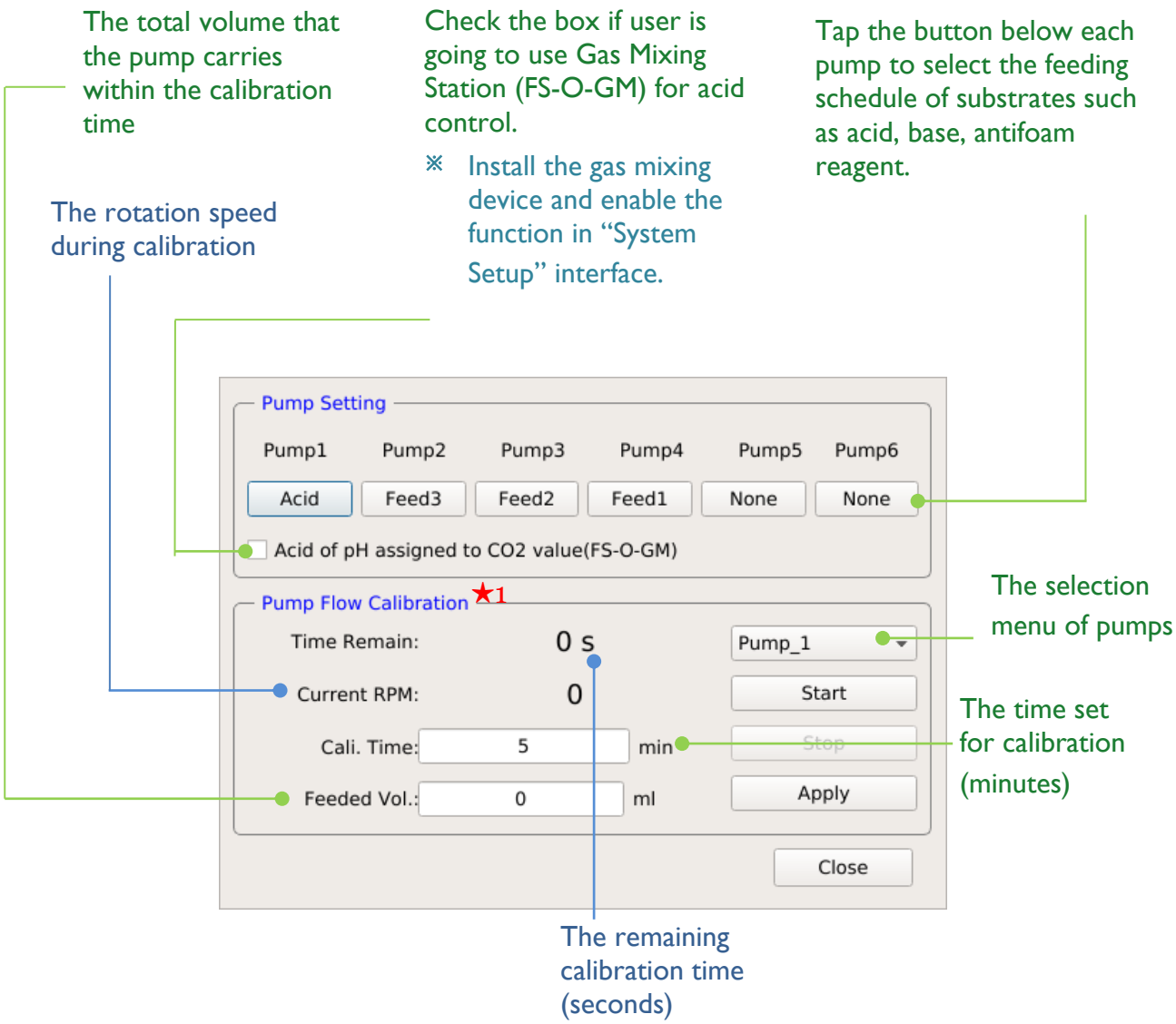
5.3.1Pumps Tab Features



5.3.2 Pumps Setup

In Setup dialogue, user will be able to assign the pumps to substrates, acid or base to control the fermentation environment. Also, user can calibrate the flow rate of each pump in this dialogue for more accurate pump settings. Tap "**Setup**" button at the bottom right of Pump tab to open the setting dialogue.





★1

To calibrate the pump flow rate, follow the instructions below to complete the calibration:

Step1. Prepare 2 graduated cylinders. (The cylinder will be the best choice. But the beaker and flask with detailed graduation are acceptable as well. The choice of containers is related to the accuracy of flow calibration.) One should be empty and the other should be filled with a proper amount of water, approximately at least 1000 ml.

Step2. Prepare a piece of silicone tube, which with the same size with what user uses in the experiment. Install the tube on the pump. Put one end of the silicone tude into the cylinder with water, while the other end into the empty cylinder.

Note:
(1) The direction of the pump should be drawing the water from the cylinder with filled water to the empty one.
(2) Fill the tube with water before calibration.
(3) The pump speed is assigned according to the settings in Pump tab. User can change the speed in the column of corresponding pump before calibrating.

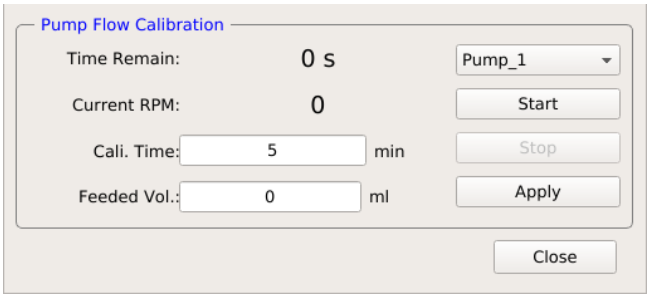
Step3. Choose the pump number, then enter the calibration time. Press "Apply" to confirm the setting.

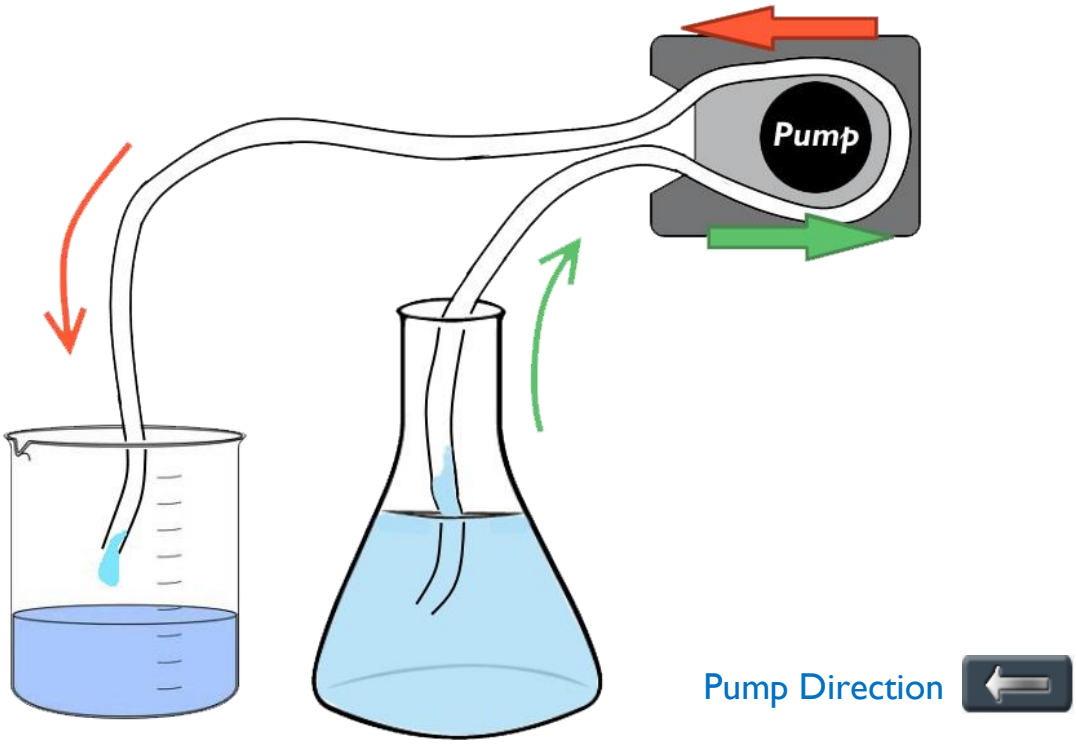
Note:
The pump will run calibration process according to the time setting (Cali. Time). For example, if the setting is 5 minutes, then the designated pump will draw the water for 5 minutes. When the time is up, it stops running.

Step4. Press "Start" to begin calibration. System will display time counting at "Time Remain" column.

Step5. After pump flow calibration, measure the amount of water in the previous-empty cylinder; input the volume to "Feed Vol." column. Tap "Apply" to finish the calibration and close the dialogue.

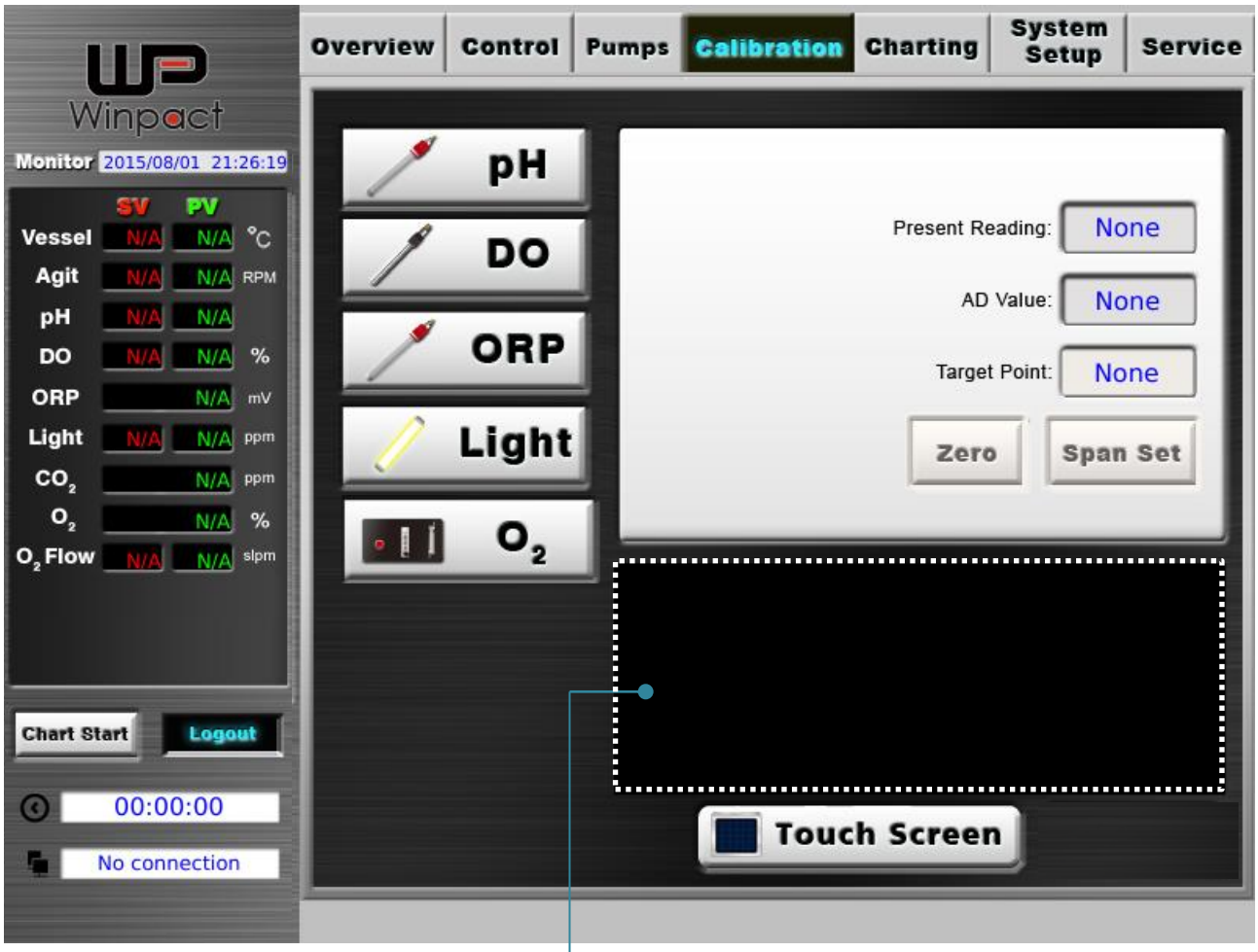
Note:
System will calculate the pump flow rate (mlpm) based on the information user inputs, and display the results of each pump in "Pump" page.





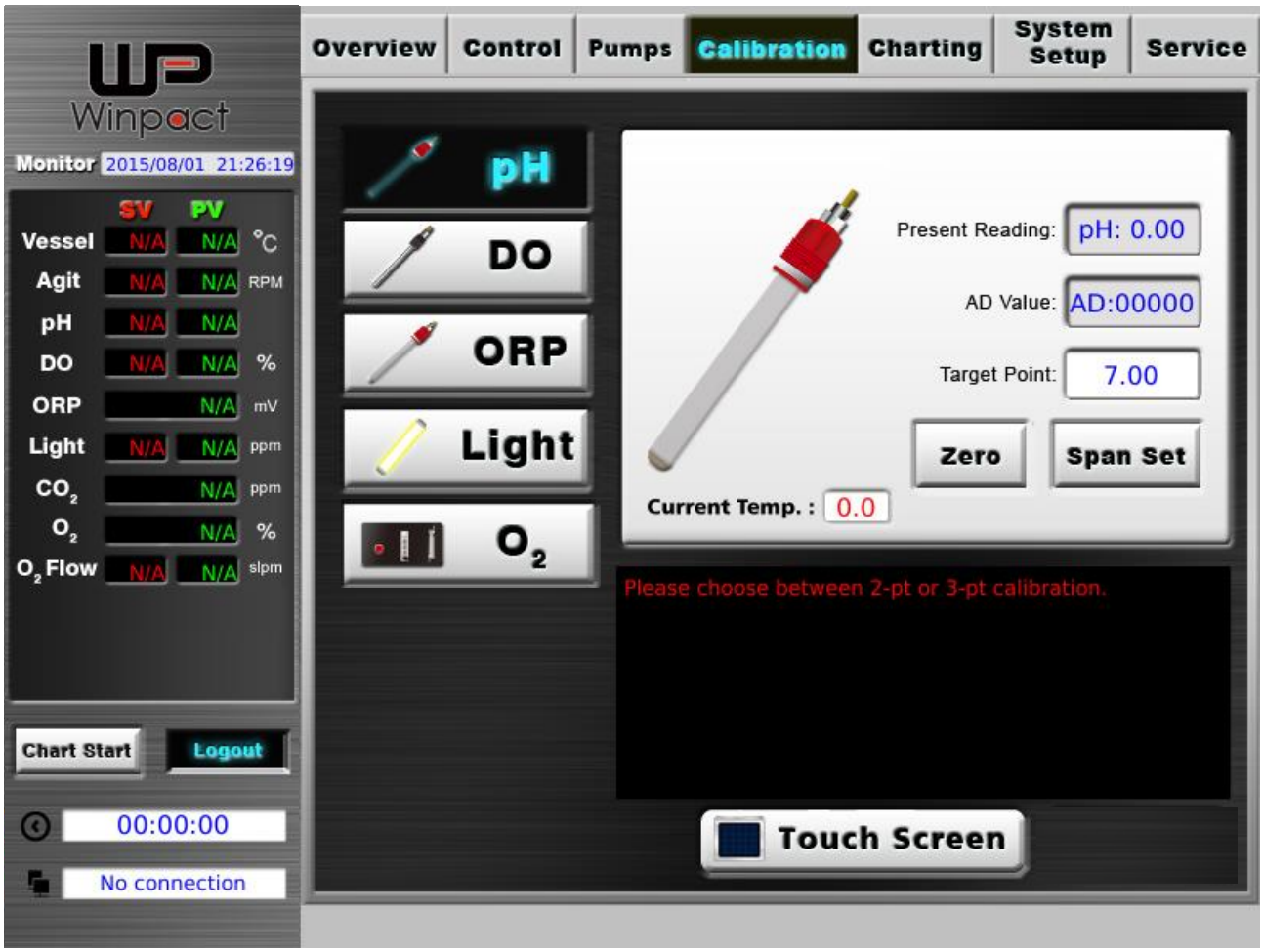
5.4 Calibration

In the interface of Calibration, user will be able to perform the calibration of pH, DO, ORP probe and light. Also, the accuracy of touch screen can be calibrated in this interface as well. The calibration process of each device is displayed in the black screen below the operating area. If user is not familiar with the operating steps, user may follow the instructions in black screen for instructions. Additionally, user can calibrate "Vessel temperature" and "jacket temperature" under "Service" tag if user has logged in as "supervisor".

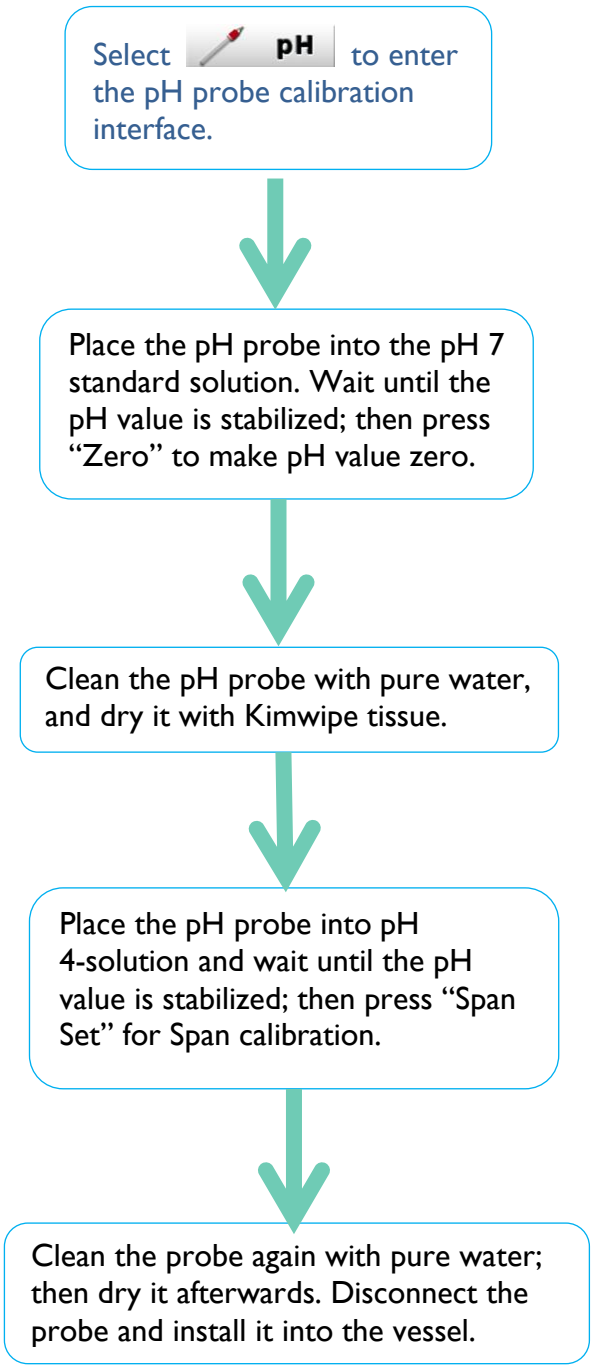


The black area which displays the calibration process instructions

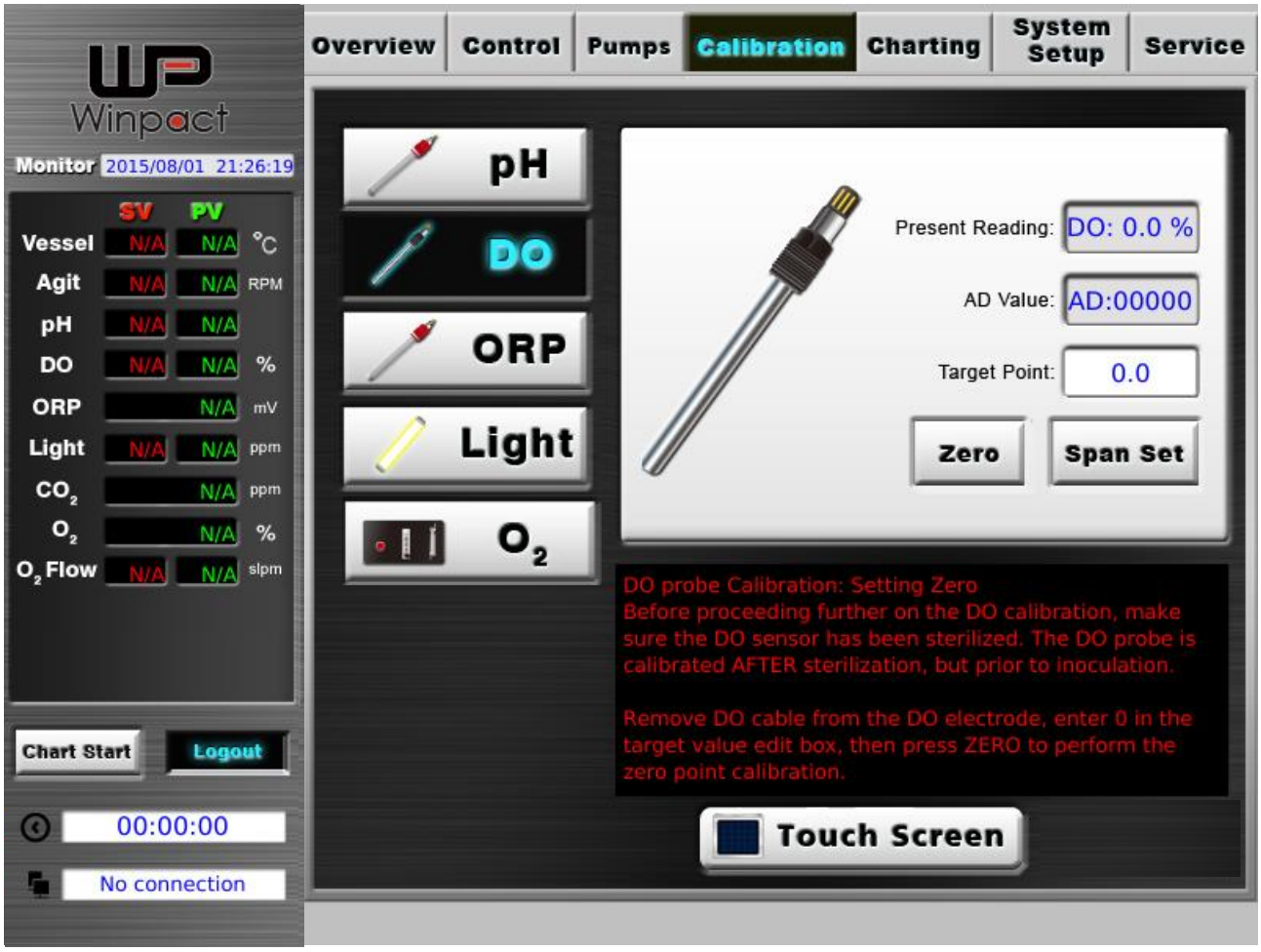
5.4.1 pH Probe Calibration



※ **NOTE**: pH calibration should be performed before sterilization.


Select pH to enter the pH probe calibration interface.
Place the pH probe into the pH 7 standard solution. Wait until the pH value is stabilized; then press "Zero" to make pH value zero.
Clean the pH probe with pure water, and dry it with Kimwipe tissue.
Place the pH probe into pH 4-solution and wait until the pH value is stabilized; then press "Span Set" for Span calibration.
Clean the probe again with pure water; then dry it afterwards. Disconnect the probe and install it into the vessel.

5.4.2 DO Probe Calibration



Select DO to enter the DO probe calibration interface.

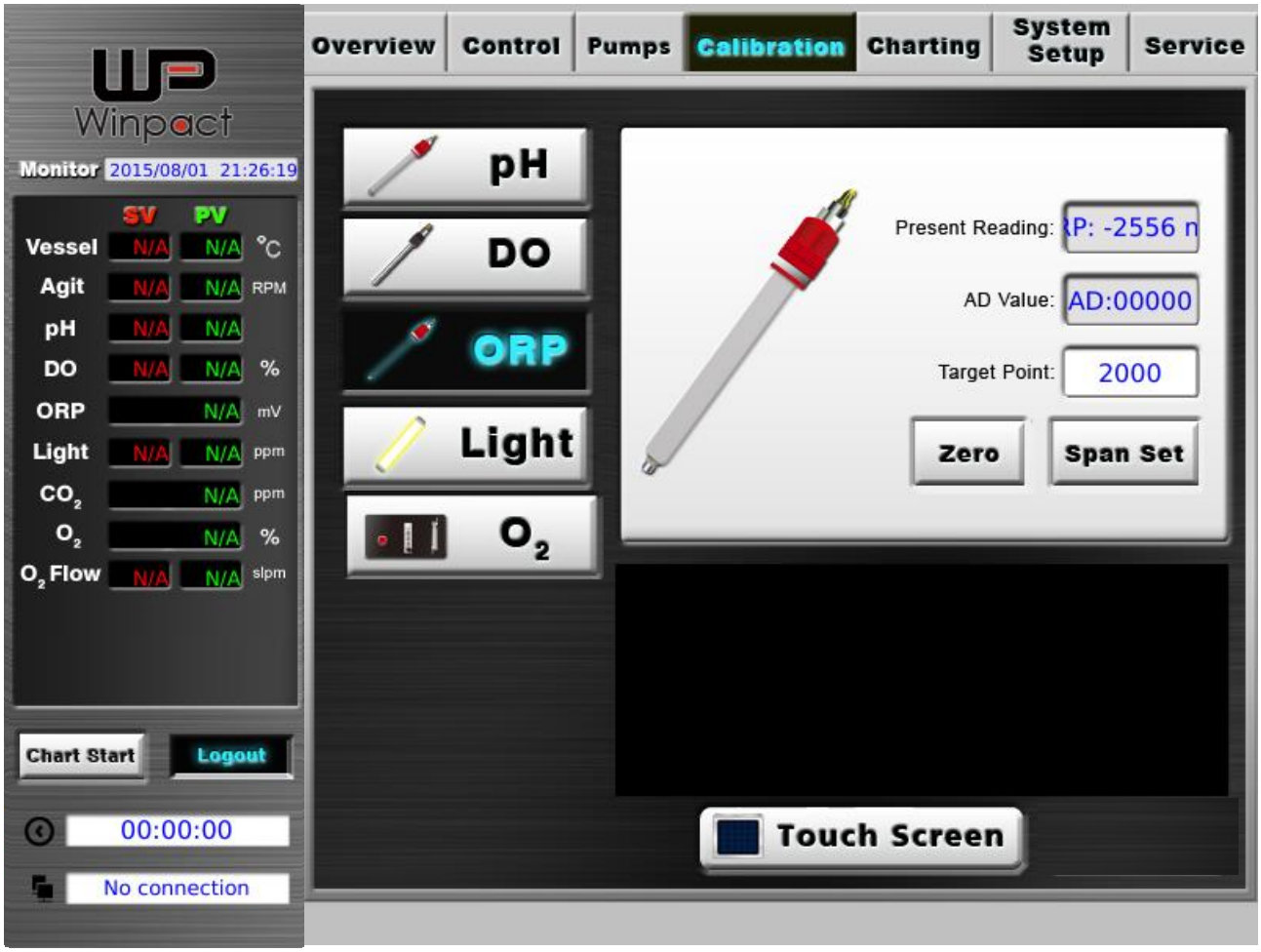
Disconnect the cable from the DO probe, and tap Zero to make rhe value zero.

Place the probe into the vessel and connect the cable. Start the air pump and agitation to saturate the media dissolved oxygen which may take up to several hours.

As the AD value stabilizes, press "Span Set" to set the DO value to 100% for fully polarizing the sensor.

5.4.3 ORP Probe Calibration

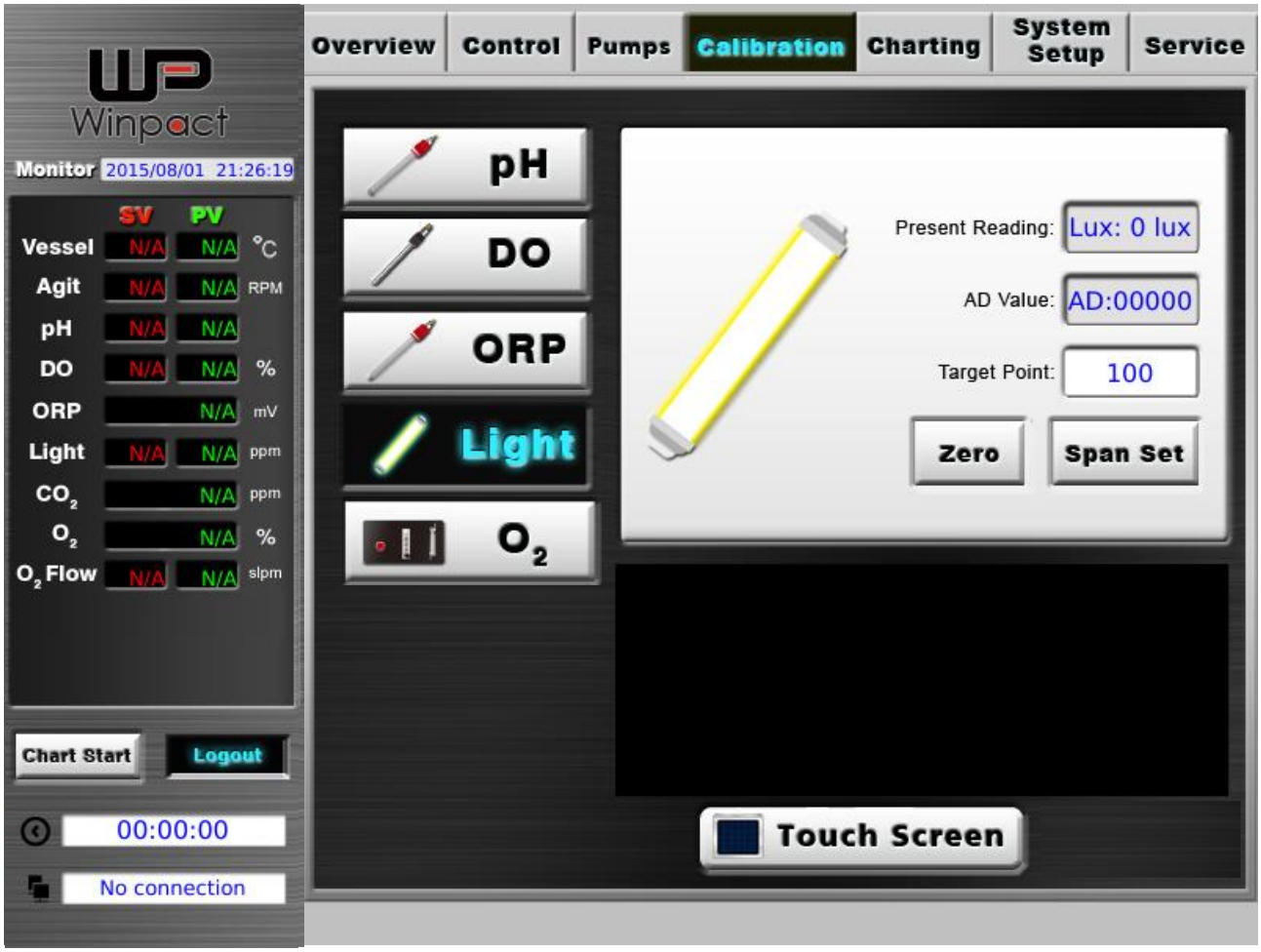
* Require purchase of a MS ORP probe (FS-O-ORP)



※ ORP probe is calibrated by Major Science before delivered to users. It is suggested that user not to do ORP calibration. If the calibration is necessary, please contact the service department of Major Science, or user's local representative.

5.4.4 Light Calibration

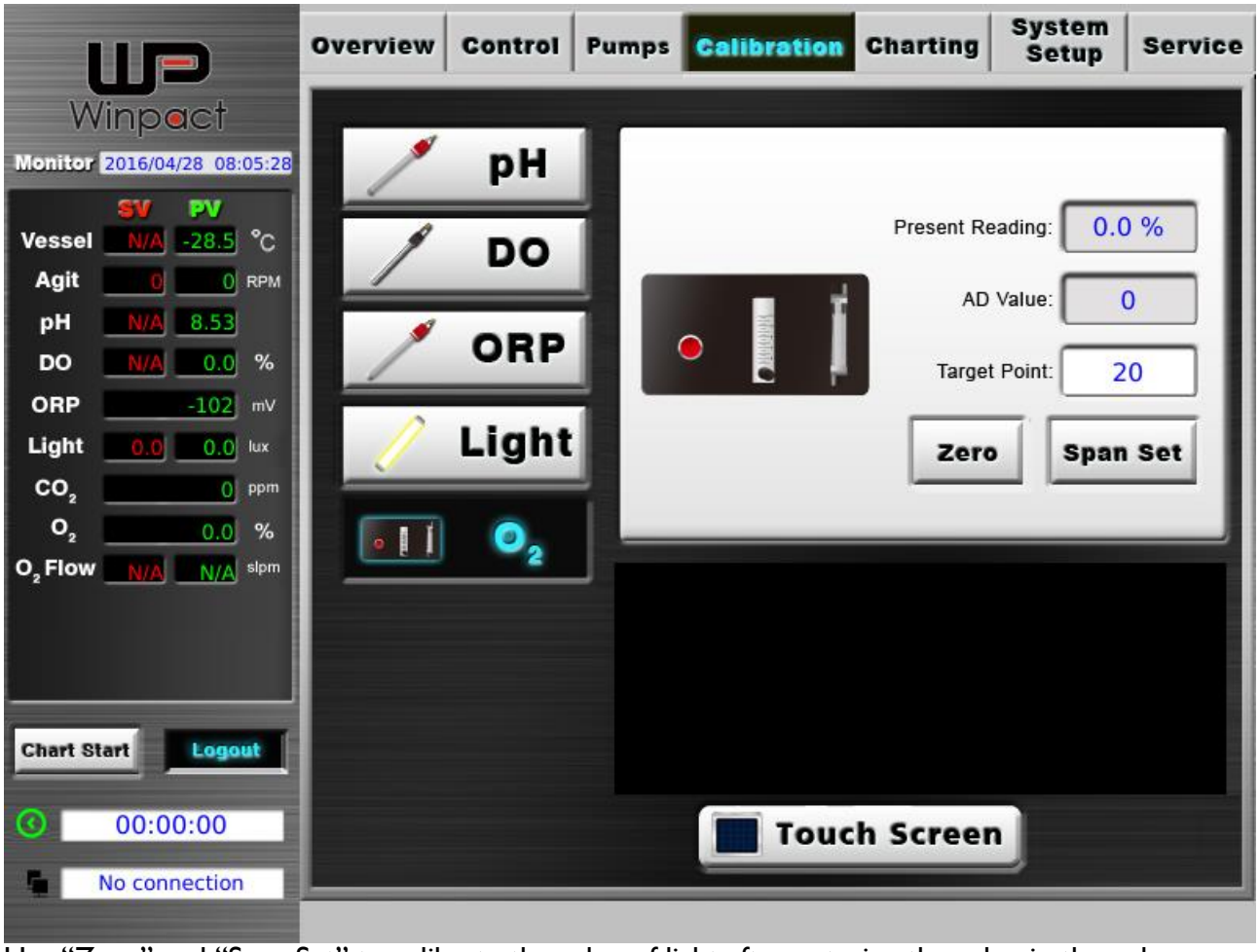
* Require purchase of a MS lighting module (FS-O-PB)



Use "Zero" and "Span Set" to calibrate the value of light after entering the value in the columns.

5.4.5 O_2 Calibration

* Require purchase of a MS Off –Gas Analyzer (FS-O-GA)

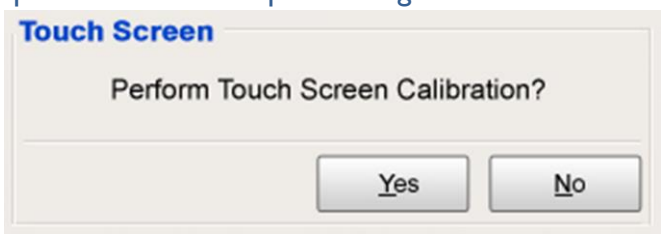


Use "Zero" and "Span Set" to calibrate the value of light after entering the value in the columns.

5.4.6 Touch Screen Calibration

Select Touch Screen to start the touch screen calibration.

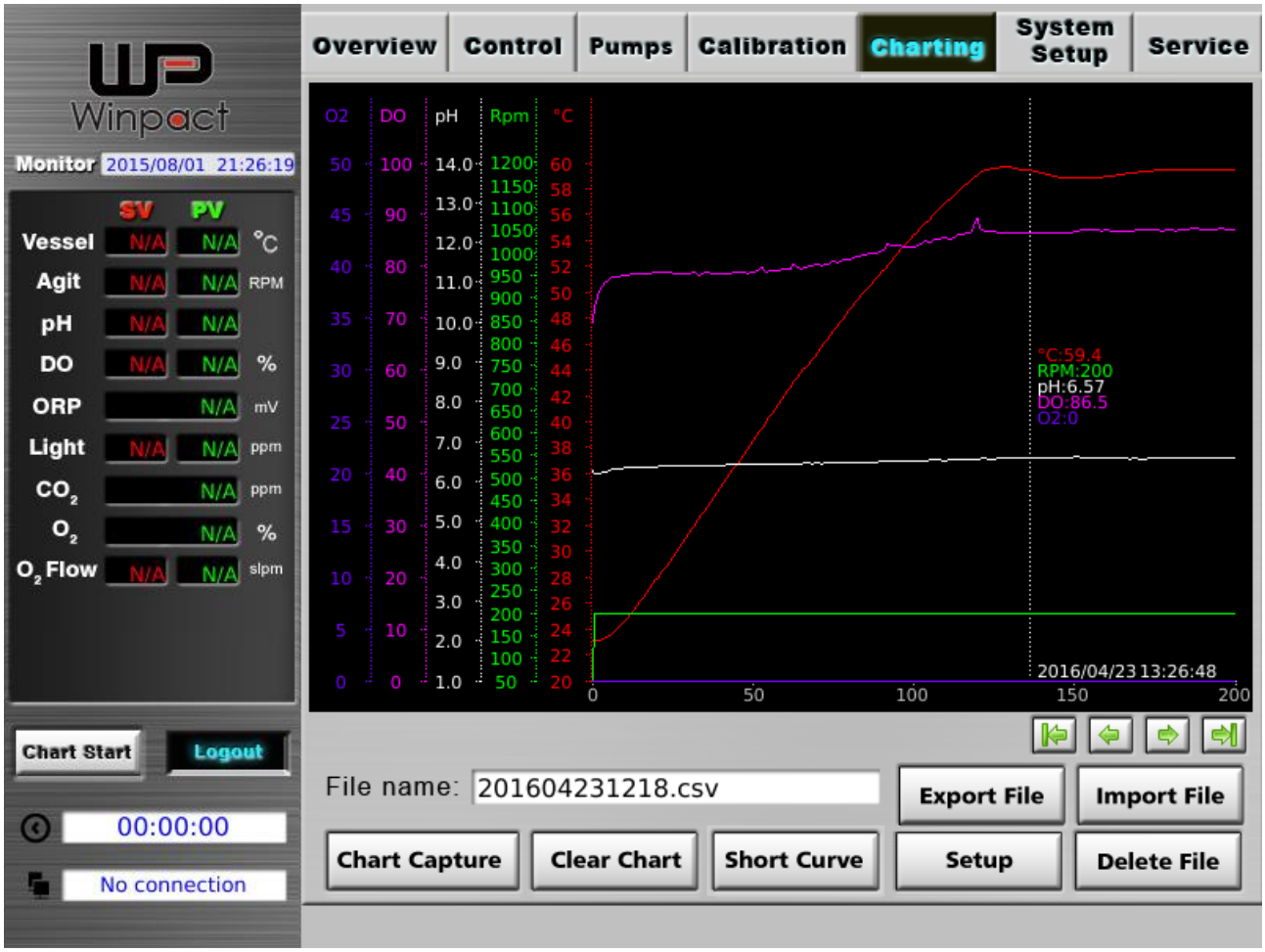
Tap "Yes" to confirm performing the calibration.



The screen will become green. And flashing circles start popping up on the screen. Press and hold the circle until it fills with blue. Then repeat the same method until no circle pops up.

5.5 Charting

During the fermentation process, user can record and observe the process by using the "Charting" page. In this page, user will be able to adjust the related chart setting to meet user's personal requirement.



Charting instructions please refer to next page.

5.5.1 *Features of Charting Page*

Tap at any charting area to show the parameter values of particular record time

Use these four arrows to move forward or backward the chart.

Tap the button to select desired background color and export the current image of chart. (Export image as **png** format)

The name of the current file

Tap the button to clear the recorded data on present chart.

Tap the button to switch the scale of curve.

Tap the button to enter the setting dialogue. (See as the following page.)

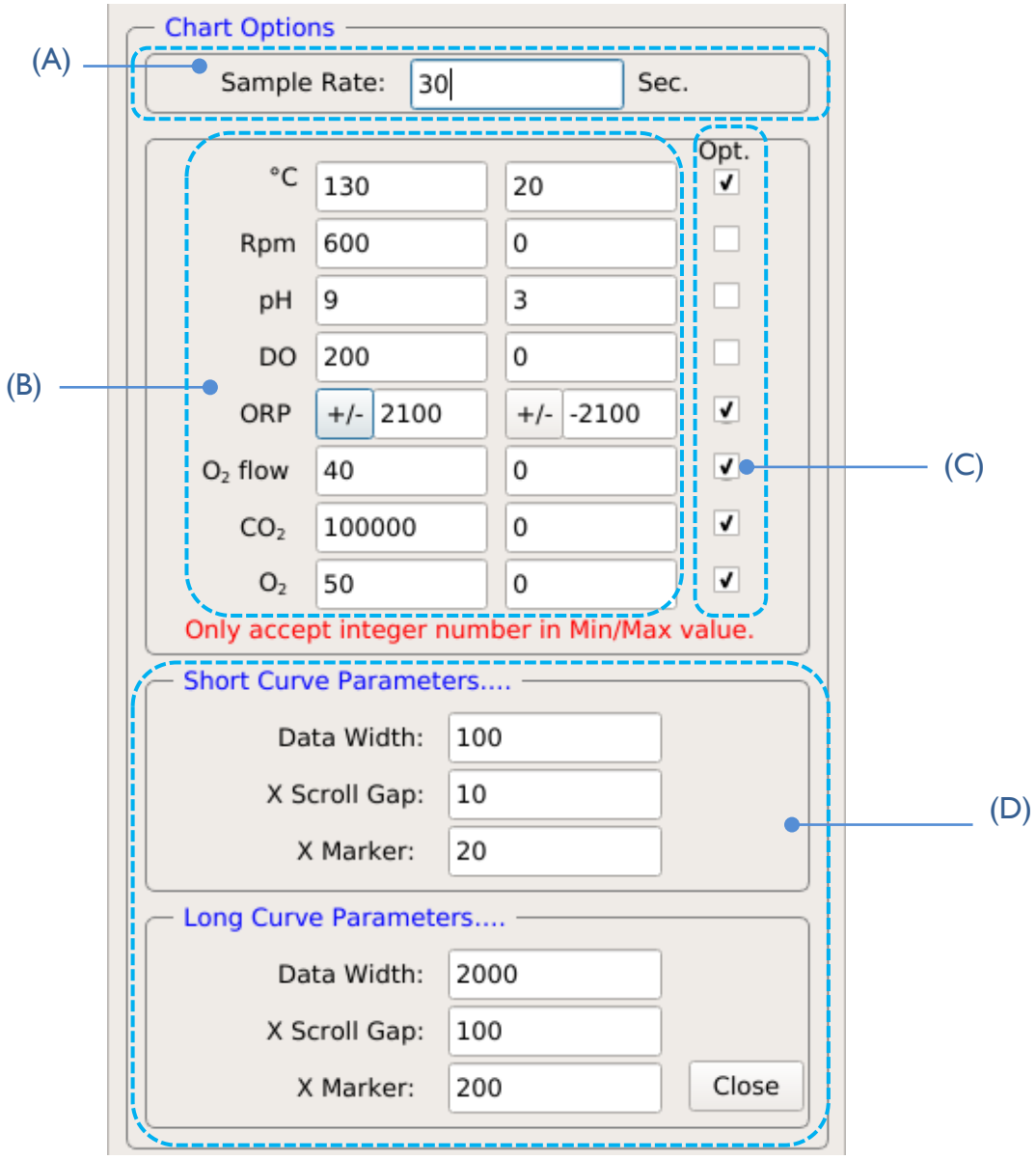
Tap the button to select the file from pop-up list that user is going to delete.

Tap the button to import the selected file into system. Then user can observe the data directly on the controller screen.

Tap the button to export the selected file from system to flash drive so that user can view the data details on computer. (Export file as **csv** format.)

5.5.2 *Chart Settings*

Tap "**Setup**" to enter the setting dialogue of Charting. User can edit or adjust the scales of the chart to have different point of views. Read the following paragraphs to know how to set up the parameters.



(A) The frequency of recording. For example, if the sample rate is set at 2 seconds, the system will collect the data points for every 2 seconds.

(B) The scale range of each parameter. Input the maximum of scale to the left column, and the minimum to the right column.

Temperature (Temp.)	The scale range of temperature.
Rpm	The scale range of agitation speed.
pH	The scale range of pH value.
DO	The scale range of the DO level.
ORP	The scale range of the ORP value.
O_2 flow	The scale range of O_2 flow value.
CO_2	The scale range of CO_2 concentration.
O_2	The scale range of O_2 percentage.

(C) Tap the box to choose which parameter user'd like to record on the chart.

(D) To help user monitor the trend of fermentation accurately, the chart has "Long Curve" and "Short Curve" displays, which purpose of these 2 options is to zoom in and zoom out the curve. Fewer points of data will be display when user is using short curve display.

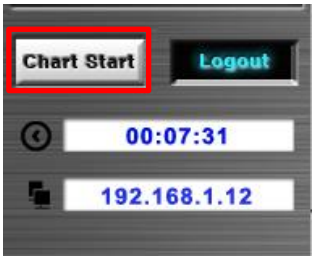
(a) Data Width: The range showed on the screen of the chart

(b) X Scroll Gap:
The gap that every time user move the chart forward or backward by pressing  or  .

(c) X Marker:
The gap of X-axis scale.

5.5.3 Start Charting

Please note that recording must be initiated manually via "**Chart Start**" button.



Step 1. Press "Chart Start" below the reading columns to start recording fermentation process. The data will be saved automatically into the built-in memory in log-file format. File name is based on the time (Year Month Day Hour Minute) user start recording to name the file. User can see the file name during the recording in the lower-left corner of "Charting" page.

Timing bar: the timing bar count the time based on "minutes", for example, if the timing bar shows" 00:07:31", it means system has run the chart for 7 hours and 31 minutes.

Note:

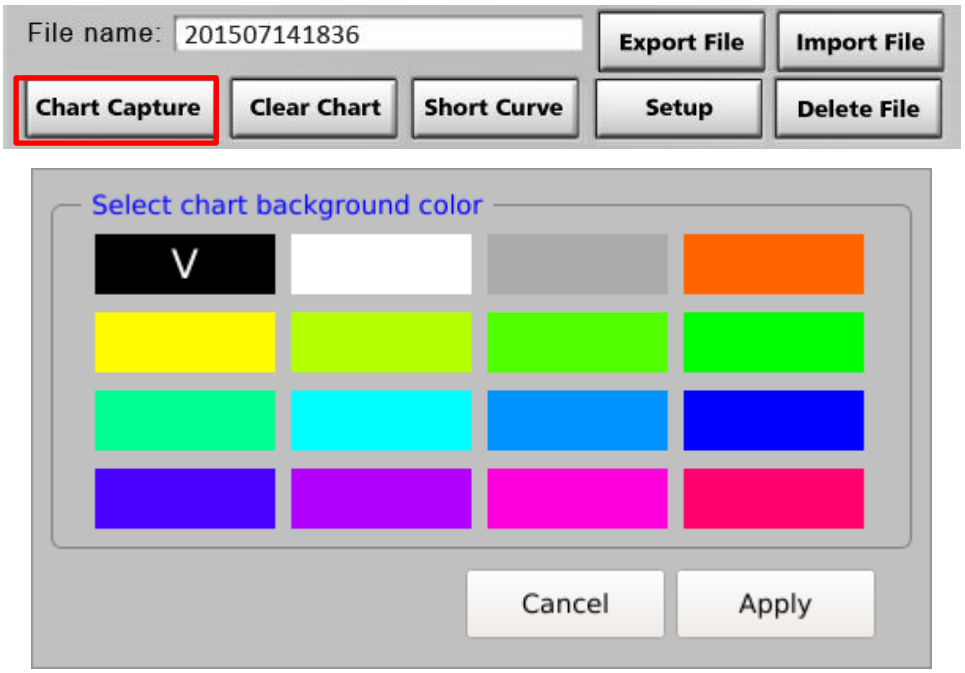
A file can store up to 80,000 data points at one time. When the file reaches the maximum data points (80,000), it will continue to record data in a separate file with a suffix of "-(no.)" followed at the end of the new file name. For example, if user starts recording the fermentation process at 11:40, 2015/01/01, the file will be named as "201501011140". Then when the data reaches 80,000 pieces, the 80,001th data will be saved in the file named "201501011140-1"; if the data has been recorded over 160,000, the 160,001th data will be saved in another new file named "201501011140-2", and so forth.

The curves with different colors represent different parameters on the chart:

- *Purple* represents "O_2 percentage (%)"
- *Blue* represents "CO_2 concentration (ppm)"
- *Yellow* represents "Mass flow value", "O_2 flow value" or "ORP value", depending on the option user select.
  (* the measuring unit will vary according to the unit assigned on the mass flow controller.)
- *Pink* represents "DO value (%)"
- *White* represents "pH value"
- *Green* represents "the speed of agitation (rpm)"

- *Red* represents "the temperature of vessel (˚C)"

Step 2. Insert a USB flash drive, and user can capture a specific period of curves by tapping "Chart Capture" in the middle of the charting. The color-choosing dialogue will pop up. Choose and apply the desired background color and the image will be saved both in the system and to the USB.



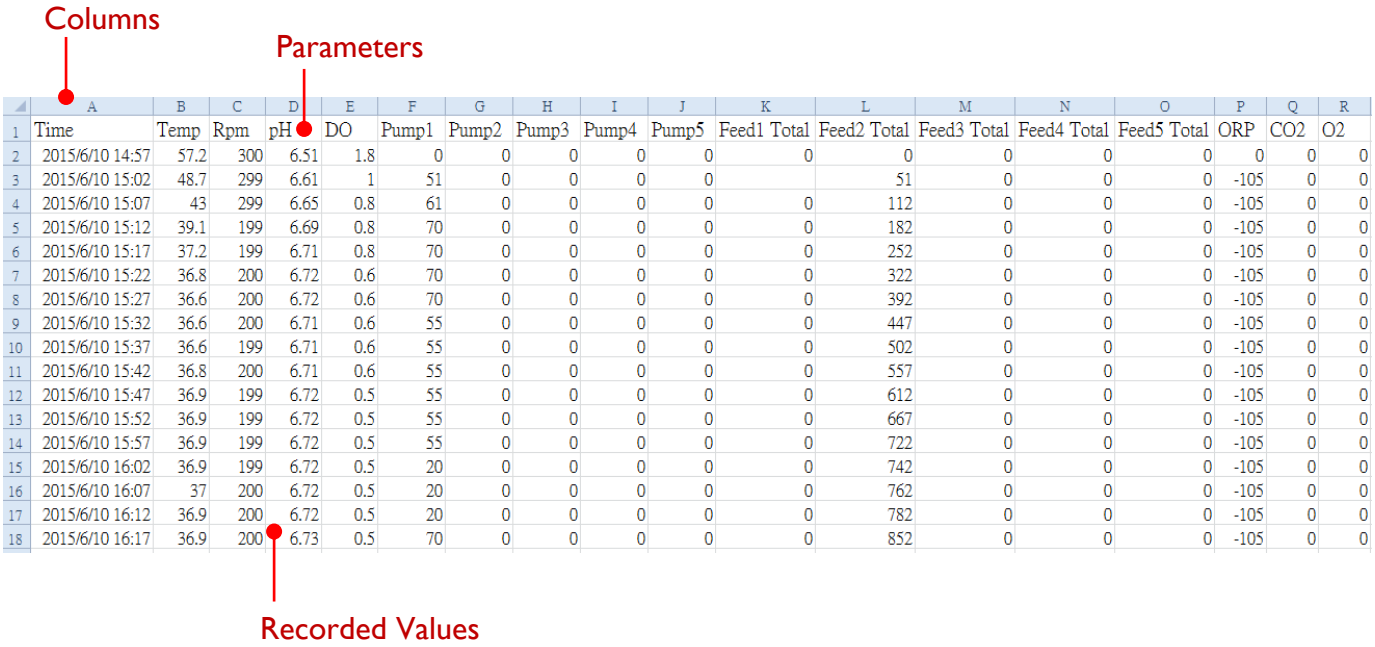
Step 3. To stop charting, tap "Chart Stop" next to the login/logout button. Then user can insert a flash drive into the controller and press "Export" to export the file. Remember to tap "Clear" before the next recording to remove all the previous recorded data points from Charting area.

Note:
In addition to the chart image, the system will save the recorded data points with actual values in a file of csv format. User can only export the csv file and read it on the computer with Microsoft Excel.

Note2:
If you find difficulty in data transmission through USB, it is suggested to format your hard drive to FAT32 before connected to Winpact controller.

5.5.4 Read the Data File

Step1. User can import the saved chart image to view it on the controller by tapping "Import" button or press "Export" to export the chart and data point record (the csv file). The csv file includes every parameter such as the recording rate, date, pump flow, agitation speed and so forth. The picture below is the example of a csv file.



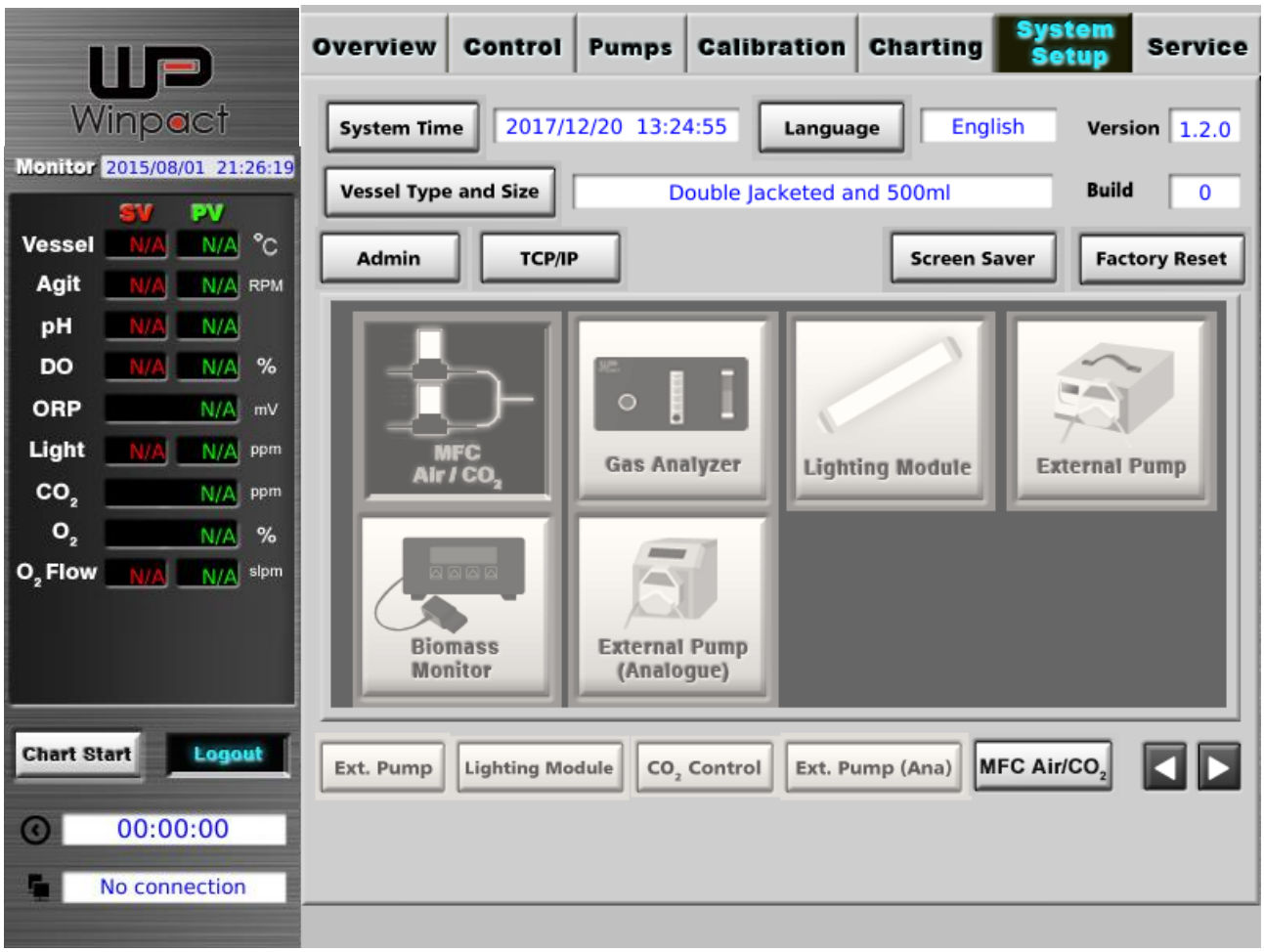
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Time	Temp	Rpm	pH	DO	Pump1	Pump2	Pump3	Pump4	Pump5	Feed1 Total	Feed2 Total	Feed3 Total	Feed4 Total	Feed5 Total	ORP	CO2	O2
2	2015/6/10 14:57	57.2	300	6.51	1.8	0	0	0	0	0	0	0	0	0	0	0	0	0
3	2015/6/10 15:02	48.7	299	6.61	1	51	0	0	0	0		51	0	0	0	-105	0	0
4	2015/6/10 15:07	43	299	6.65	0.8	61	0	0	0	0	0	112	0	0	0	-105	0	0
5	2015/6/10 15:12	39.1	199	6.69	0.8	70	0	0	0	0	0	182	0	0	0	-105	0	0
6	2015/6/10 15:17	37.2	199	6.71	0.8	70	0	0	0	0	0	252	0	0	0	-105	0	0
7	2015/6/10 15:22	36.8	200	6.72	0.6	70	0	0	0	0	0	322	0	0	0	-105	0	0
8	2015/6/10 15:27	36.6	200	6.72	0.6	70	0	0	0	0	0	392	0	0	0	-105	0	0
9	2015/6/10 15:32	36.6	200	6.71	0.6	55	0	0	0	0	0	447	0	0	0	-105	0	0
10	2015/6/10 15:37	36.6	199	6.71	0.6	55	0	0	0	0	0	502	0	0	0	-105	0	0
11	2015/6/10 15:42	36.8	200	6.71	0.6	55	0	0	0	0	0	557	0	0	0	-105	0	0
12	2015/6/10 15:47	36.9	199	6.72	0.5	55	0	0	0	0	0	612	0	0	0	-105	0	0
13	2015/6/10 15:52	36.9	199	6.72	0.5	55	0	0	0	0	0	667	0	0	0	-105	0	0
14	2015/6/10 15:57	36.9	199	6.72	0.5	55	0	0	0	0	0	722	0	0	0	-105	0	0
15	2015/6/10 16:02	36.9	199	6.72	0.5	20	0	0	0	0	0	742	0	0	0	-105	0	0
16	2015/6/10 16:07	37	200	6.72	0.5	20	0	0	0	0	0	762	0	0	0	-105	0	0
17	2015/6/10 16:12	36.9	200	6.72	0.5	20	0	0	0	0	0	782	0	0	0	-105	0	0
18	2015/6/10 16:17	36.9	200	6.73	0.5	70	0	0	0	0	0	852	0	0	0	-105	0	0

Columns	Parameters	Description
A	Time (YYYY/M/D hh:mm)	Display the recording time of each data point. In the above example, the recording starts at 02:57 PM, June 10th, 2015. The sample rate is set at 300 seconds, which indicates the system records the values of each paremeter in every 5 minutes (e.g. 300 seconds). User can edit the sample rate at the "Option" dialogue of "Chart" page.
B	Temp	Record the transient value of temperature (˚C).
C	Rpm	Record the transient value of agitation speed (rpm).
D	pH	Record the transient value of pH.

E	DO	Record the transient value of DO (%).
F - J	Pump1 – Pump5	Record the total running time (seconds) of every pump during each recording time of data point. In the above example, Pump1 runs for 51 seconds within the time between 14:57 and 15:02; then runs for 61 seconds between 15:02 and 15:07. The rest pumps (Pump2 to Pump5) remain static (off).
K- O	Feed1 Total – Feed 5 Total	Record the accumulated feeding time (seconds). Take the above image for example, Feeding 2 is assigned to Pump1. So when the system has recorded data for 30 minutes (from 14:57 to 15:27), the column of "Feed2 Total" would show the total running time within the 30 minutes, while Pump1 column only shows the running time between 2 sequential recording time points.
P	ORP	Record the transient value (mV) of ORP.
Q	CO_2	Record the transient value (PPM) of CO_2.
R	O_2	Record the transient value (%) of O_2.

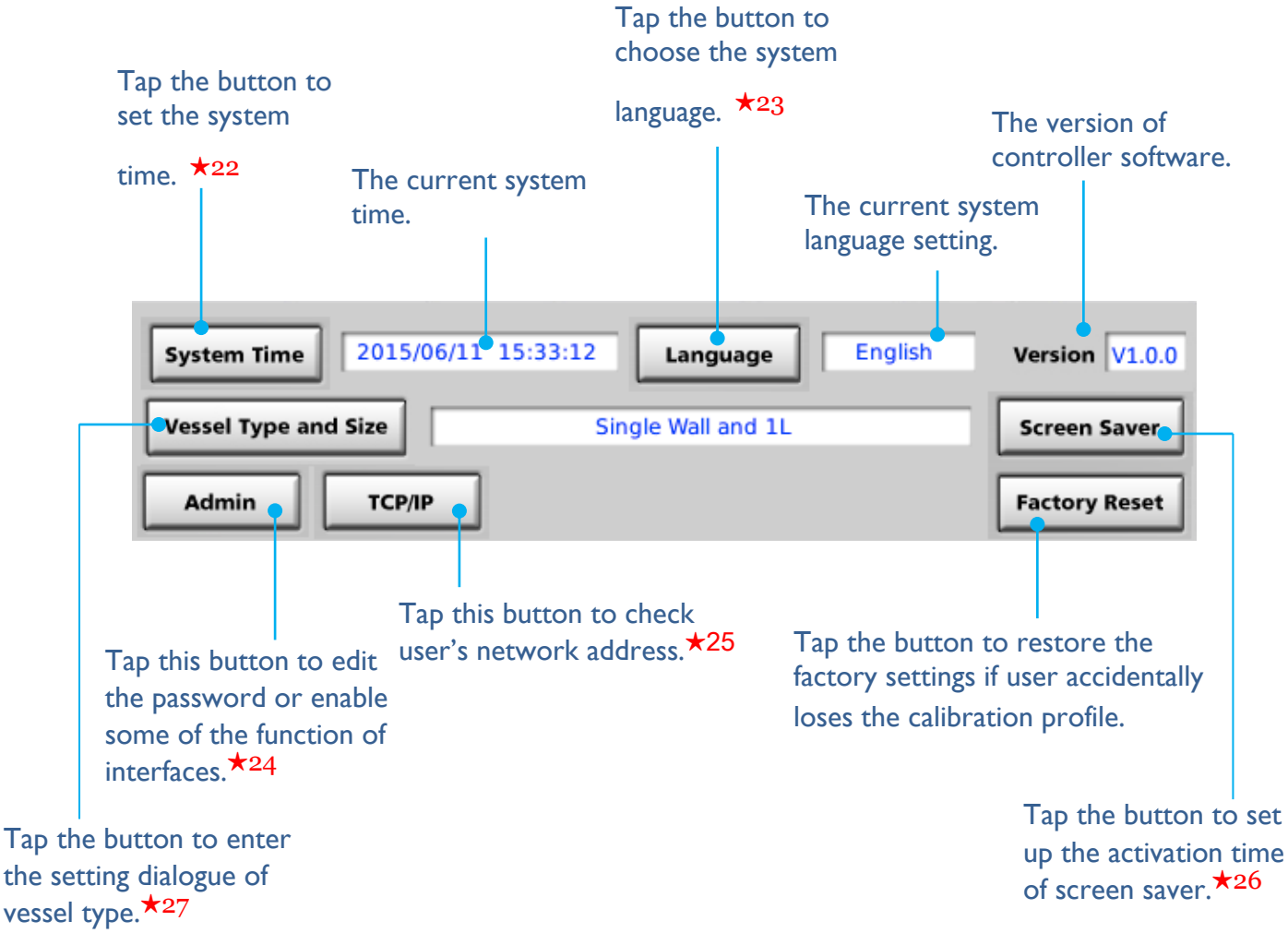
5.6 System Setup

"System Setup" page allows user to set up details of system such as "System Time", "Language", "Vessel Type and Size", "Screen Saver", "Admin", and "TCP/IP".



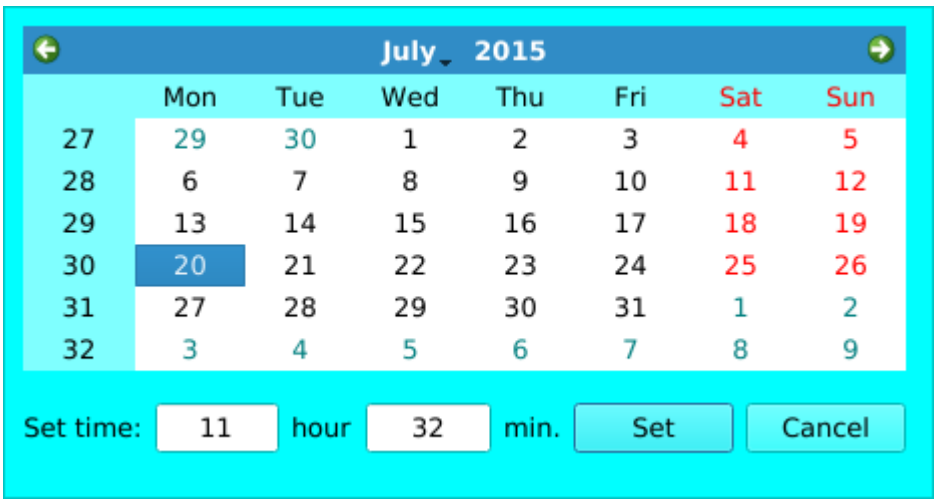
The features on this tab will be explained in the following subsections.

5.6.1 System Features Setup



★22

The dialogue of "**System Time**"

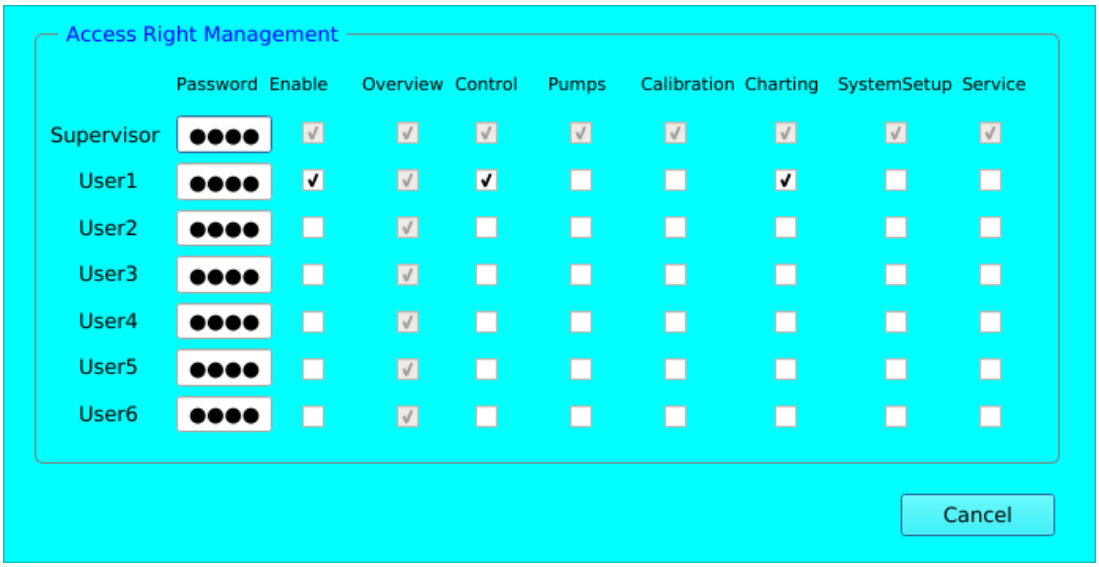


★23

Press" **Language**" to open the dialogue of "Language Selection"

★24

Tap "**Admin**" button to enter the administrator setting page.

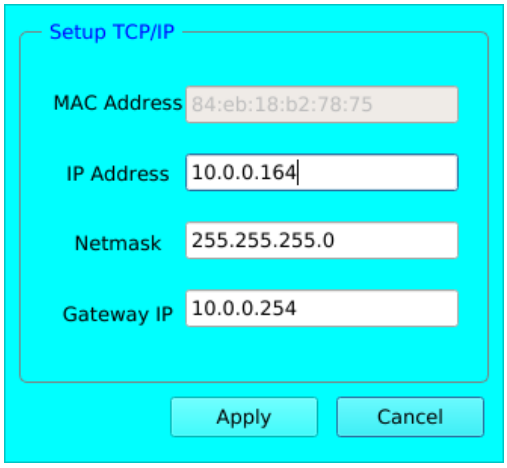


User will log in the system as "Supervisor" when operating the controller at the first time. The default password of this username is 1234; the login instructions can be referred to *Section 5.1.1*. In addition, user will be able to create up to 6 accounts by tapping the column of "Enable" in the usernames of "User1" to "User6"; then set up the passwords for each username.

Every time user changes the authority of a username or create a new account, remember to tap "Apply" to confirm the adjustment.

★25

Tap "**TCP/IP**" to get the information about the network addresses of controller.

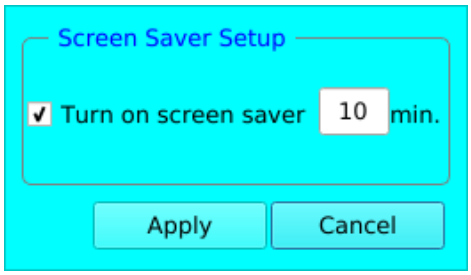


The information will help user linking to remote control software on the computer.

> **Note:**
> DO NOT modify the addresses unless user has been authorized by Major Science or our representative distributors.

★26

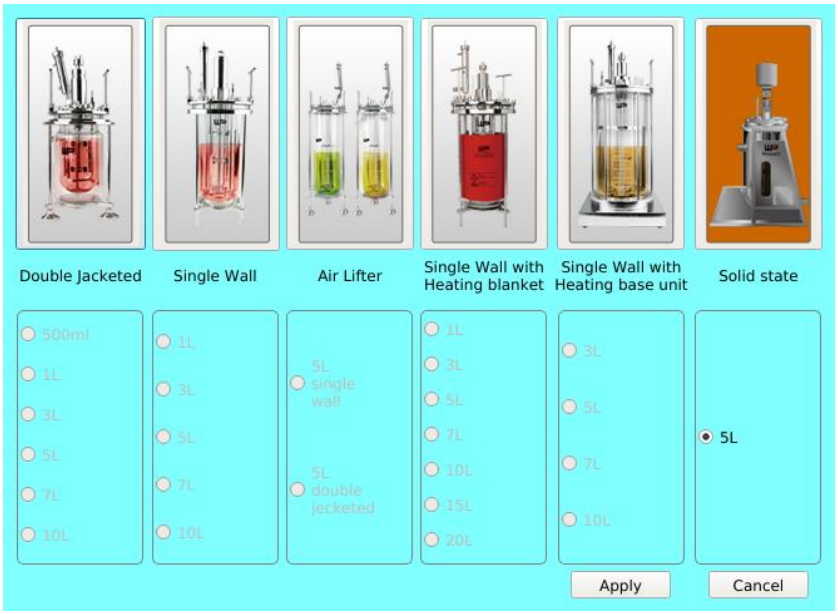
Tap "**Screen Saver**" to enter the setting dialogue.



Tap in the checkbox to turn on screen saver, and set up activation time. When screen saver is activated, it automatically logs out to the system. User needs to log in again when return.

★27

Tap "**Vessel Type and Size**" to enter the setup dialogue and select the vessel user is using.



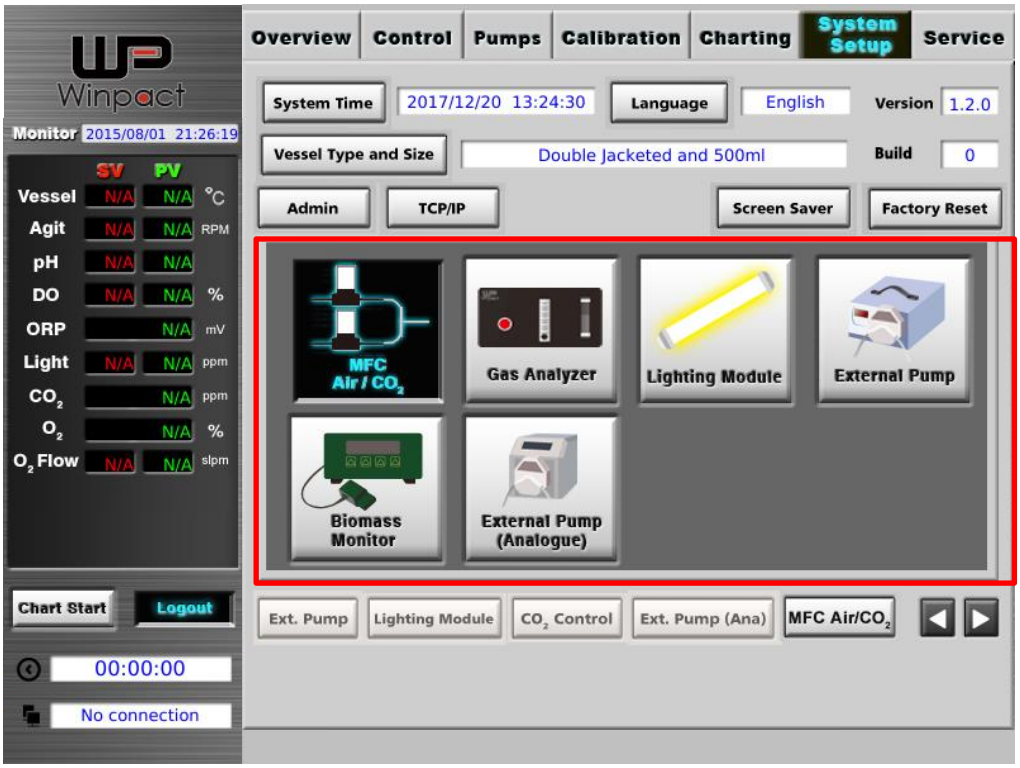
Choose the vessel type first by tapping the button that presents vessel image. Then select the volume user is using. Tap "Apply" after finishing the setup.

Note:

The types of vessel from left side to right side are double-jacketed (A type), single-wall dish bottom (B type), air lifter (C type), single-wall dish bottom (with heating blanket) and single-wall plain bottom with heating base unit and solid state in sequence.

5.6.2 Enable/Disable Optional Devices (for Factory only)

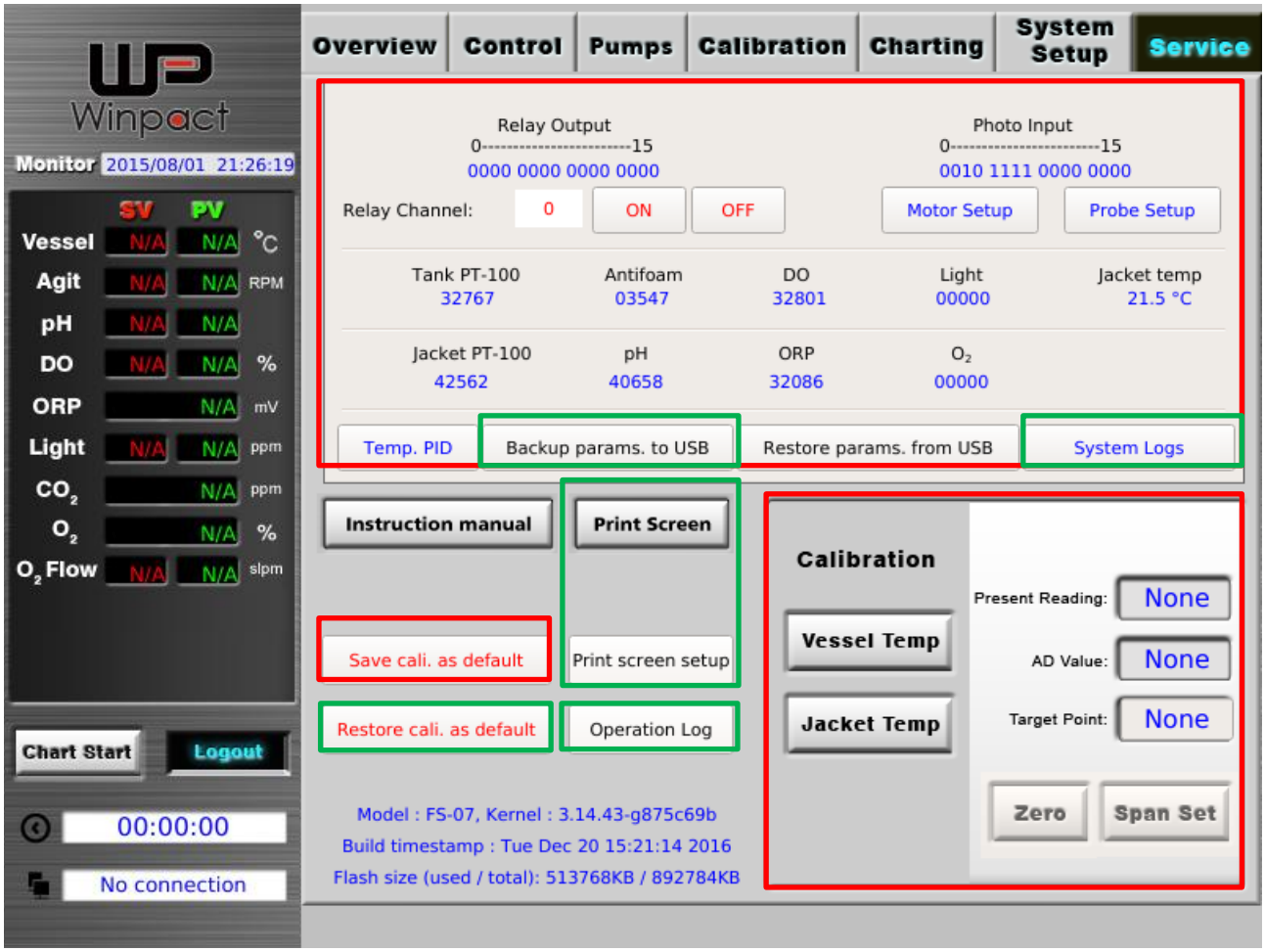
Items in red box are optional devices. To enable/disable the function of these devices user has to log in as "Factory" first. For those devices that have been activated, the corresponding setting buttons will be lit at below. People who log in as a "Supervisor" or "User" can enter the setting dialogue, too.



5.7 Service

The “Service” page is mainly for “Factory” loggers and for manufacturer maintenance and system service. User might have limited access of some the functions. Please refer to the following section for the detail function of “Service” page.

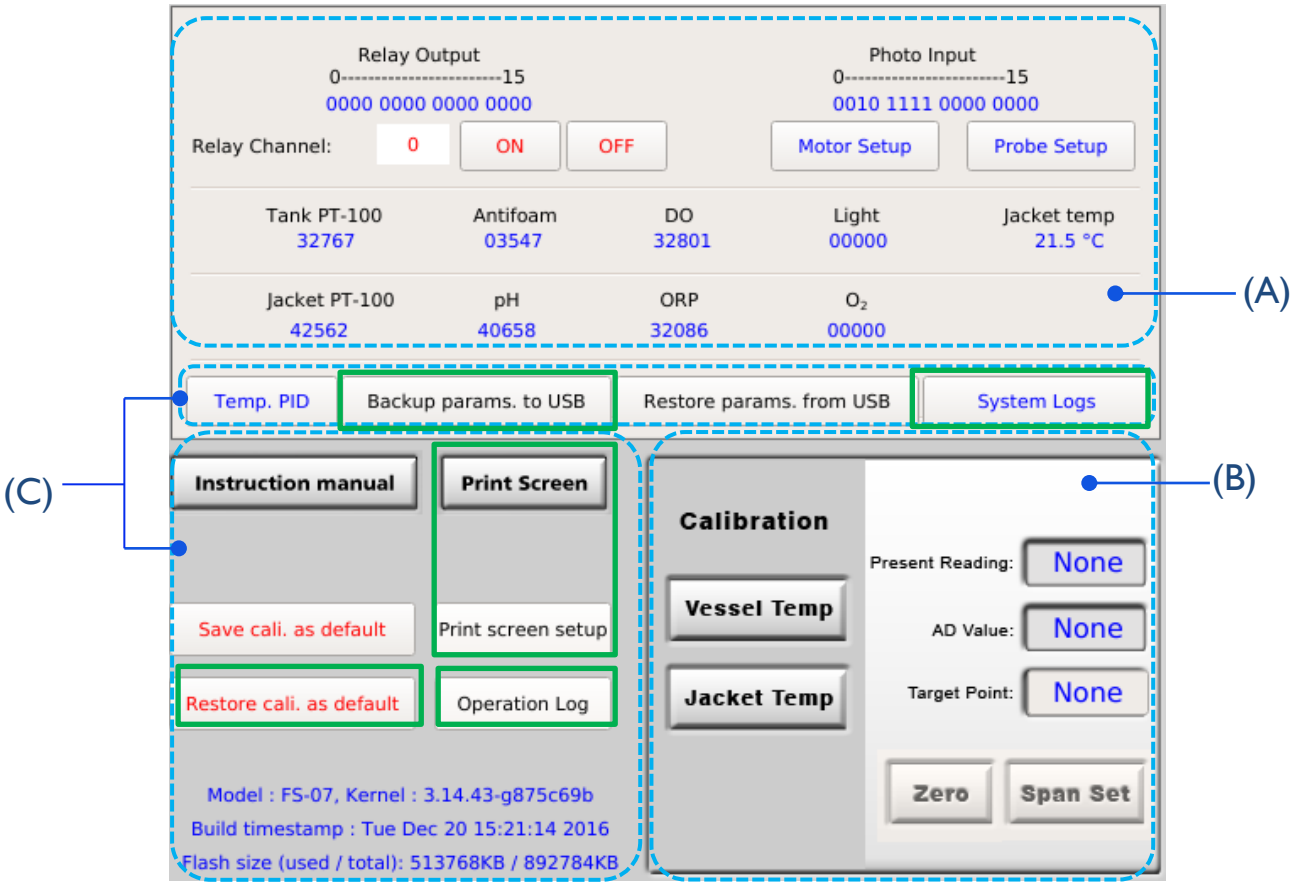
*The buttons in green squares are opened to “Supervisor” loggers as well as “Factory” loggers.



Refer to the following sections for more detail of functions in Service Page

5.7.1 Features of Service Interface

Check the illustration below and refer to the detailed explanations of each function accordingly.

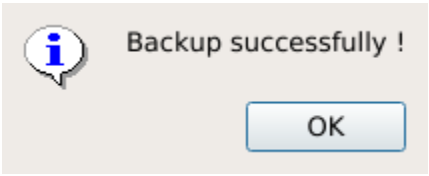


(A)	A/D Values Column	This area displays the A/D values of each function. It is mainly used for factory maintenance and service. The functions in this area will not be able to use with normal user or supervisor loggers.
(B)	Vessel Calibration	Calibration of vessel temperature, jacket temperature and vessel pressure can be only performed in Service page. But they are operated exclusively for manufacturers or the authorized distributor for maintenance usage.
(C)	Advanced Functions & Settings	User can access “Backup params. to USB”, “System Logs”, “Print Screen”, “Print screen setup”, “Restore cali. as default”, and “Operation log”. Detailed instruction is provided in the following pages.

Backup params. to USB

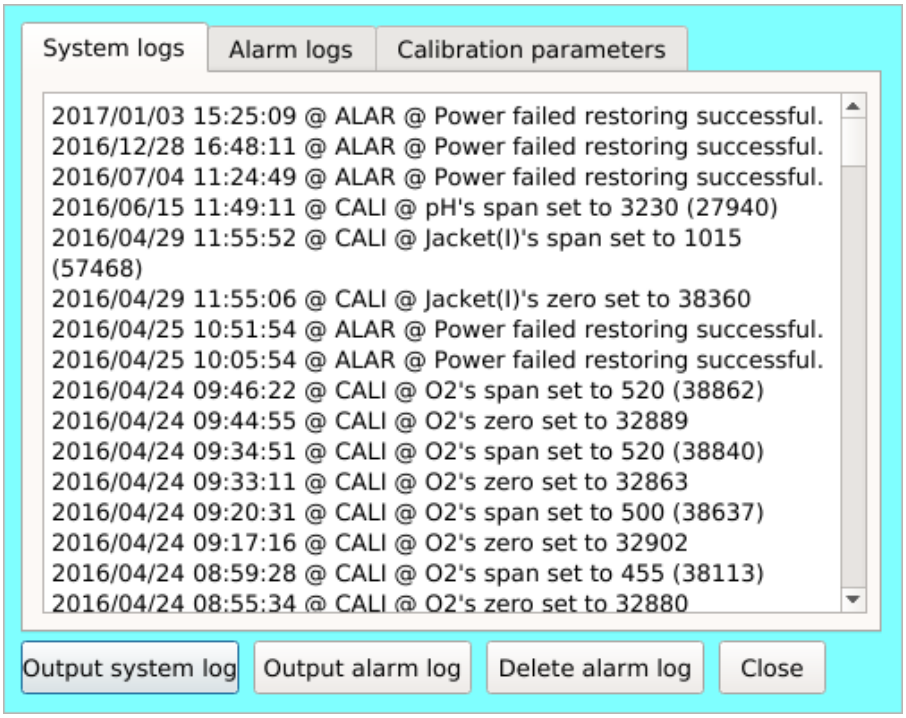
Press 

to backup parameters to USB, the dialogue below will show up after the system has completed the action.

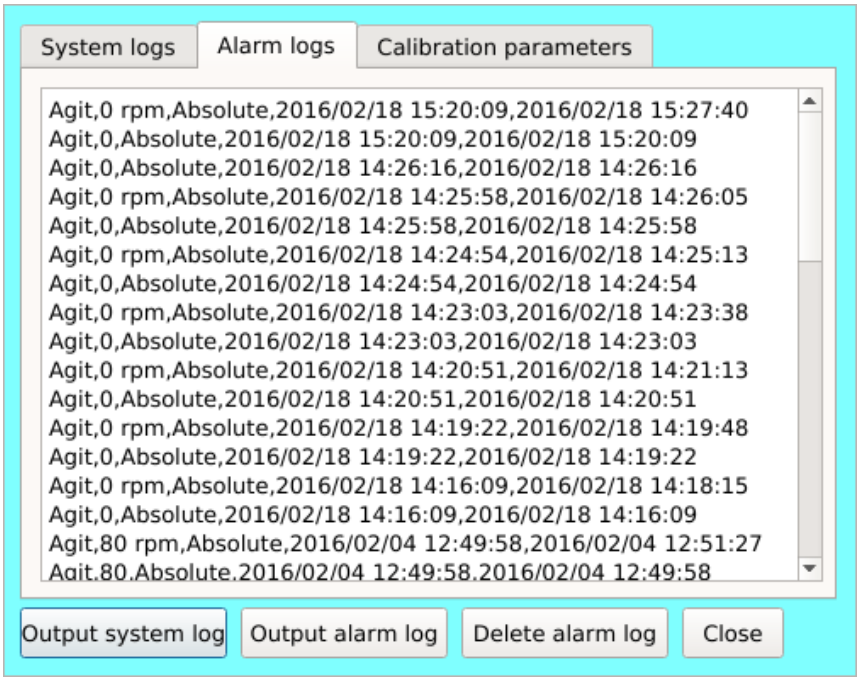


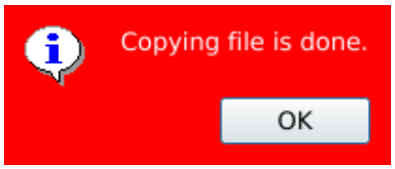
System Logs, Alarm Logs, and Calibration Parameters

Main events of the system such as probe calibration and sudden power failure are recorded in "**System Logs**", user can refer to the readings in this tab.

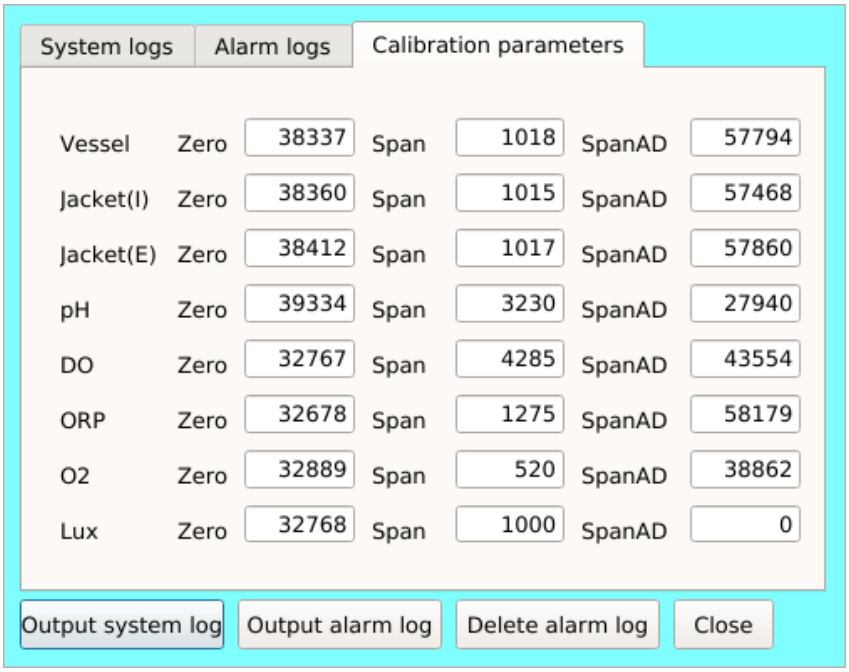


In **Alarm Logs**, every alarm message is recorded; if user does not need the alarm logs anymore, tap "**Delete alarm log**" button then ALL alarm logs will be deleted. System logs and alarm logs can be output to USB. Plug in a USB, tap the **Output system/alarm log** button, when the system has completed, a dialogue will show up.





Calibration parameters and detail settings of the span and AD are showed in "**Calibration parameters**", user can "**Clear system log**" or" **Clear alarm log**" in this tab.



Print Screen

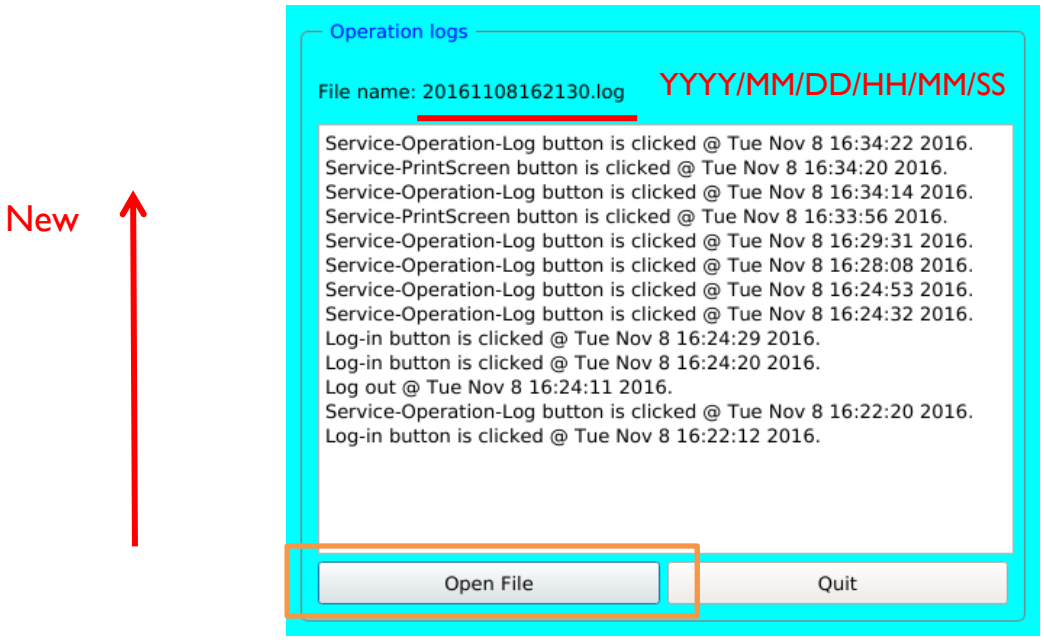
Insert a flash drive to the controller before using this function. Tap this button to capture the screen user require on the controller. Tap Print screen setup below to set the second user needs to operate. After the time is up, system capture the picture of screen and pops up an information dialogue , after user press ”OK”, system saves it into the flash drive. For example, the print screen setup time is set 3 seconds, after the print screen function is enabled, user goes to the screen which user would like to capture in 3 seconds, after the screen image is captured and saved automatically, user can adjust the timing for another capture and press “Print Screen” again to have another capture.

Restore cali. as default

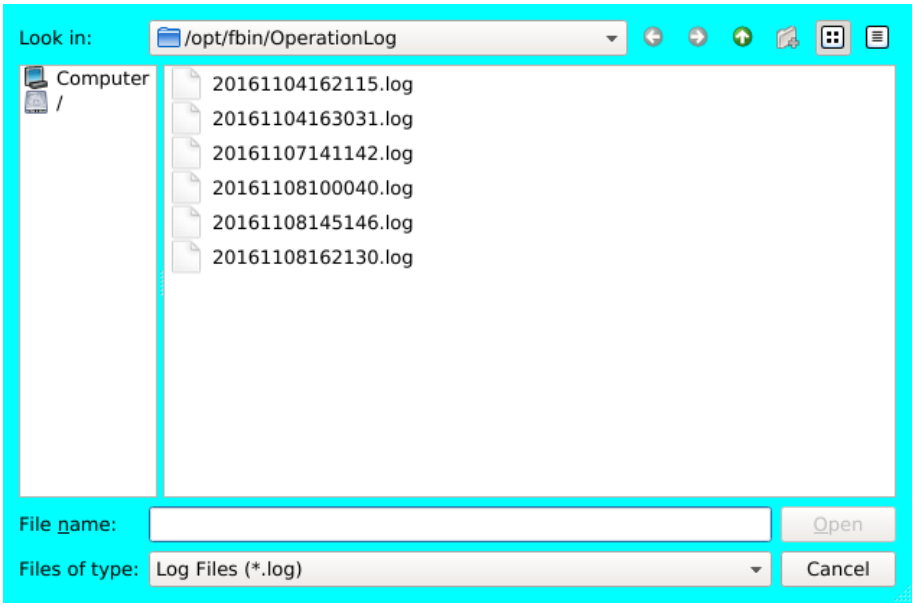
Tap the button Restore cali. as default to restore the factory settings if users accidentally lose the calibration profile.

Operation Log

The system would start recording the operation process as user switch on the controller. Tap this button and the history of operation process would show up. The upper message the newer it is. When user switch off the controller, the system would stop recording and automatically save the operation process in the build-in memory as a file. The file is named according to the system start-up time point.



Tap “Open File” to select desired logs to read.



Note:
If you find difficulty in data transmission through USB, it is suggested to format your hard drive to FAT32 before connected to Winpact controller.

Chapter 6. System Operation

6.1 Preparation & Connection of the Controller

1. Examine the workplace

a. Set up the controller at the operating site and connect is to the required laboratory equipment:

   (i) Power Supply: Make sure that the rated voltage is correct before plugging in the power cord.

   (ii) Coolant Source: Make sure the rated voltage is correct if a chiller is chosen as the coolant source.

   (iii) Air Source: Make sure that the rate voltage is correct before plugging in the power cord and the pressure of output air is reduced to at least 2 bar (29psi)

b. Autoclave: Make ensure that its chamber size is compatible with a culture vessel of choice.

c. For more details, please refer to Chapter 1.

2. Set up the water circulation system

Step1. Connect Coolant Source (Chiller-Out port) to Main Water-in port on the cooling system.

Step2. Connect Coolant Return (Chiller-return port) to Main Water-out (Drain) port.

Step3. Connect Cooling Coil Inlet to Water-in port and Cooling Coil Outlet to Water-out port.

Step4. Connect Condenser-in to the Condenser Inlet and Condenser-out to Condenser Outlet. (Please refer to *Section 5.8 Help* or the picture in *Section 4.1.2 A Cooling System*.)

6.2 Preparation of the Culture Vessel

A. Examine the equipment

Before installing the culture vessel, or fitting the probes and accessories, you should carefully check all components to see if any damages. And pay special attention to any potential cracks on the glass vessel, splits on the O-rings (especially the one at the bottom of the headplate), and any possible damage done to the seals on the rotating shaft.

Warning:

1) When the bursting strength of a damaged glass vessel no longer reaches the standard required for the sterilization in the autoclave, or the operation of fermentation, the vessel must be replaced immediately.
2) Damages to the seal can cause contamination of the culture during the fermentation process. Seals-on accessories which are often removed or refit should be replaced regularly.

B. Assemble the Vessel and Arrange the Headplate

1. Unscrew the screws on the top of the headplate and remove it.
2. Attach all parts (excluding the tubing) that should be mounted on the headplate.
3. Make sure the O-ring is properly fit on the bottom of the headplate.
4. Any port that is to which has no accessories attached must be fitted with a blind port to avoid any leak.
5. If an O-ring is damaged, it must be replaced. You may apply the silicone sealant to the O-rings to prevent them from deforming, and stop air from leaking out the vessel.

C. Set up the Air Supply

1. Attach 2 pieces of silicone tubing to either side of a 0.2 micron air filter (provided). Make sure the tubing length is long enough to connect the controller and the vessel. Use clamps to close the tubing on each side of the filter.
2. Connect and secure one end of the silicone tubing-air filter assembly to To-air sparger port on the vessel and the other to Gas-out port on the

controller. For the storage exhaust bottle, connect one port with the silicone tube to the exhaust port on the top of the condenser.

3. Connect the other port to a filter (an exhaust filter) with a short piece of the silicone tube.

D. Set up the Feeding Port

1. Fill a 250ml storage bottles with acid, base, antifoam reagent or nutrient.
2. Connect the bottles with silicone tubes to the feeding ports on the headplate. The length of tubes should be enough long for the feedings passing through the peristaltic pumps smoothly.
3. If no acid/base/antifoam/nutrient is used, use a short piece of silicone tubing to connect 2 feeding ports to prevent air leakage.

E. Prepare the Media

1. Attach a piece of silicone tubing to the sampling port and clamp the other end.
2. Adjust the height of the antifoam probe based on the projected working volume. It is suggested that tip of the probe is positioned at least 50mm above the surface of media.
3. Prepare the media and reagents.
4. Pour the now-mixed and ready-to-use media and water into the vessel.

F. pH Calibration

1. Connect the pH probe to the pH probe port on the controller.
2. Switch the page on the controller screen to the "Calibration" page. And select pH.
3. Put the pH probe into a pH 7 standard solution, and wait until the value is stable.
4. Select "Zero"
5. Clean and dry the probe with distilled water and kimwipe issues or equivalents. .
6. Place the probe in a pH4 standard solution, and wait until the value is stable.
7. Select "Span Set".
8. Press "Finish". Then clean and dry the electrode again. (For more details

about pH Calibration, please refer to *Section 5.4.1 Calibration*.)

G. DO Calibration

1. Select DO on the "Calibration" page.
2. Make sure DO probe and the DO probe port on the controller are not connected and select "Zero".
3. Place the probe into the vessel and connect the cable.
4. Start up the air pump and agitation.
5. Press "Span Set" when the sensor is fully polarized.
6. Press "Finish". (For more details about DO Calibration, please refer to *Section 5.4.2 Calibration*.)

H. Final Details

1. Check all ports if they are all properly connected.
2. Secure the headplate back to the vessel by tightening the screws.
3. Make sure the O-rings at the bottom of the headplate is fit well.
4. Perform the air leakage tests. If leakage happens, examine again the possible source of leakage area.
5. Wrap any exposed electrode part of the sensor (DO and pH) and THE HEAD OF THE STIRRING SHAFT with aluminum foil to protect against the influence of steam.

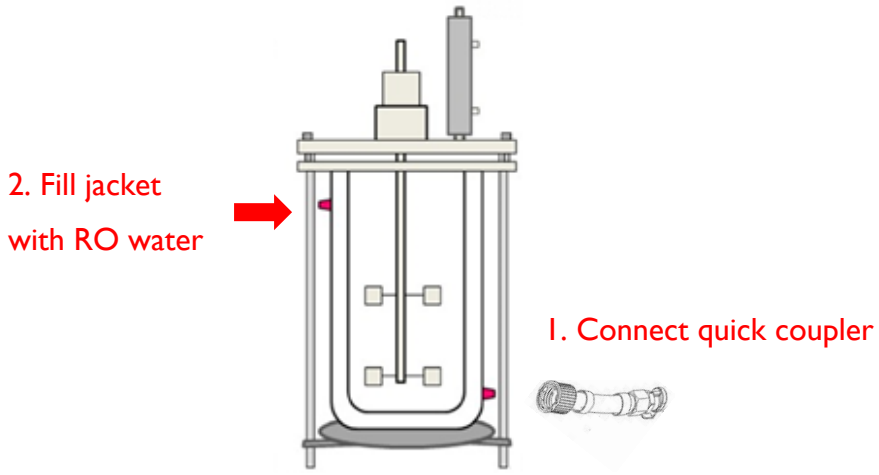
NOTE: User can purchase MS Motor Shaft Protection Cap (FS-A-MCAP) instead of aluminum foil on the head of stirring shaft. The purpose of the covering is to prevent rotting of bearing because of the water in them during the process of sterilization.

I. Sterilization of the Culture Vessel

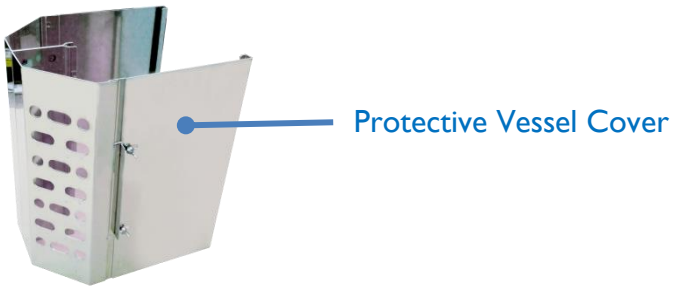
1. Carefully check all opened ports on the headplate are closed.
2. Examine the electrode plugs are covered with aluminum foil. You can apply Process Indicator Tape on aluminum foil; the tape should turn black after sterilization. 3. Completely disconnect the water circulation system.

4. LOOSEN THE EXHAUST BOTTLE CAPS BEFORE STERILIZATION (Half-turn).
5. For jacketed vessel, pour RO water into the jacket to make sure the jacket is full of water before putting in autoclave. It is suggested to connect quick

coupler to the port of jacket water-in (the lower port) first, and then fill the jacket with RO water (from the upper port).

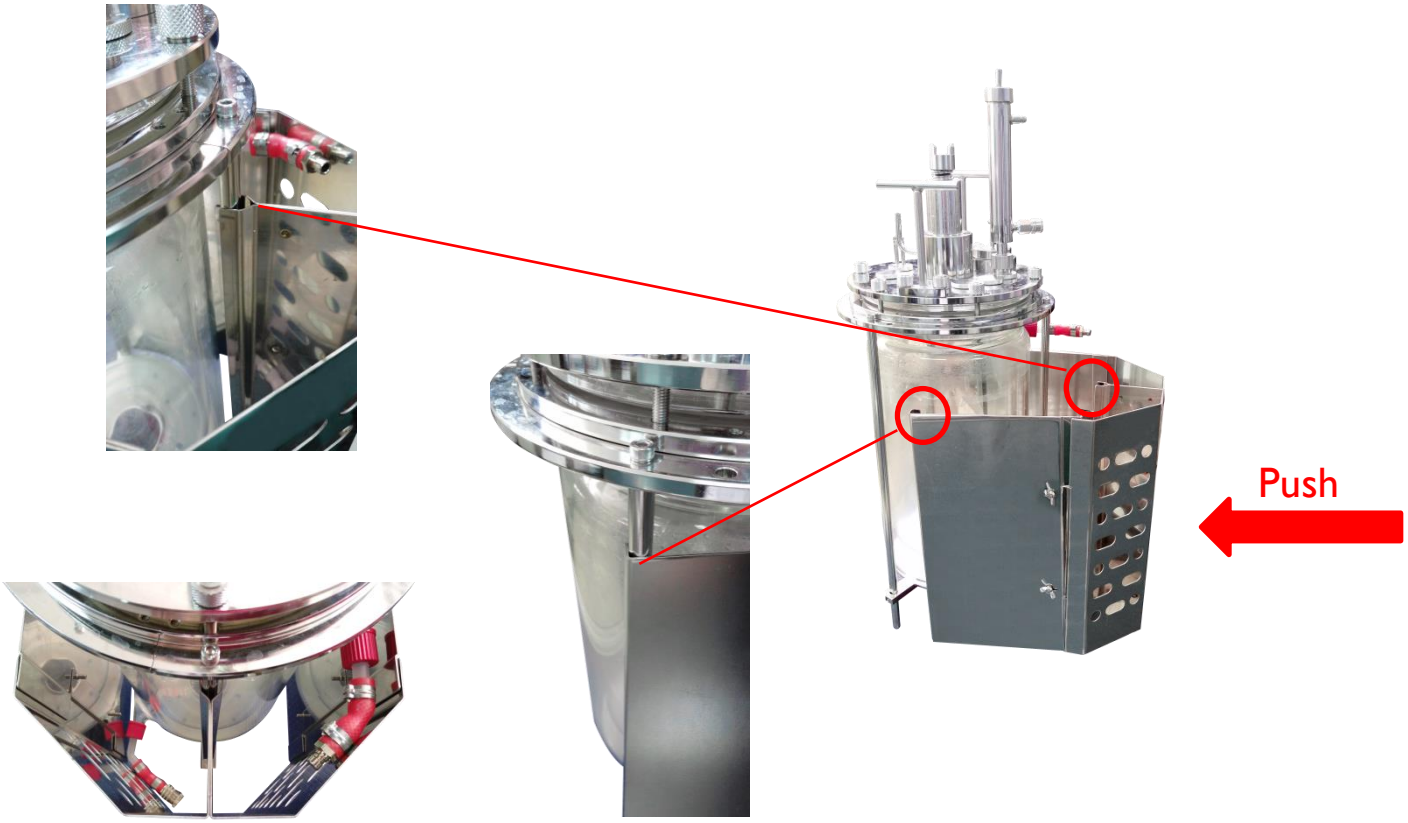


6. Arrange Protective Vessel Cover to provide vessel with better protection during sterilization.



6.1 Loosen the four screws on the sides of the protective shield.

6.2 Align and clip on the three vessel supporters with the protective shield.



6.3 Tighten the four screws on the protective shield.

7. Put the culture vessel, all storage bottles and 500ml exhaust bottles into the autoclave.

8. Regarding single-wall vessels, the proper sterilization requires an environment of 121℃ for 40 minutes. As for jacketed vessels, it needs 60 minutes for sterilization.

9. Do NOT open autoclave until the temperature drops to ambient temperature. Make sure there is no pressure in the chamber before opening the door of the autoclave.

6.3 Preparation of the Fermentation Run

A. Post-sterilization

1. After sterilization, wear heat-protective gloves to fasten the caps for all bottles immediately.
2. After the culture vessel and all bottles cool down, take them out from the autoclave to the workplace. Please be careful when moving the equipment out of the autoclave. And check all the components are taken out from the autoclave.
3. Place a piece of silicone tubing on the Air-out port on the controller, and insert the other end through a filter; then connect to the To-air sparger port on the vessel.
4. Connect the Water-in port on the controller to the Cooling Water-in port (the coolant inlet) on the vessel.
5. Connect the Water-out port on the controller to the Cooling Water-out port (coolant outlet) on the vessel.
6. Connect the Condenser-in port on the controller to the Condenser-in port on the condenser.
7. Connect the Condenser-out port on the controller to the Condenser-in port on the condenser (For more details, please check *Subsection 5.4.1 DO calibration*).
8. Remove the protective aluminum foil from the electrode connectors.
9. Connect the cable to the electrodes, including the pH probe, the DO probe and the foam level probe.
10. Fill up the thermowell with water. Insert the PT-100 temperature probe.
11. Connect the tubing from the feeding bottle to the feeding port, and sterilize connector tubing via the use of a handy burner.
12. Place the silicon tubing to the peristaltic pump.

B. Priming

Perform "Priming" to remove air from the tubing.

1. Select the "Pump" page on the controller screen.
2. Set the counterclockwise direction to the pumps. (The arrow is headed forward.)
3. Enter the desired rate (rpm).
4. Press the "AUTO" button to start up the pumps and perform priming.
   (For more details about the manually adjusting the peristaltic pump options, please

refer to *Section 5.3 Pump*)

C. *Mount the Motor*

1. Fit the bumper onto the stirring shaft.
2. Locate the small notches on both the motor and the stirring shaft, and place the motor onto the stirring shaft.
3. Secure the motor by matching the latch.

D. *Cool Down*

1. Make sure the condenser regulator is open halfway,
2. Start the temperature control via programmable PID or manually to cool down the system. (When pressing the temperature control button from the control surface, you can hear a sound from solenoid valve. After cooling down the vessel to the working temperature, vessel heating and thermostat could be controlled via the built-in heat exchanger.)

* FS-V-B and FS-V-D type vessels use a heating blanket and a heating base unit respectively.

Warning:

DO NOT wrap the blanket around the vessel before the vessel cools down. The heat-resisting limit of blanket is 60℃. Overtemperature might cause damages to the blanket. Damages resulted from incorrect use is not covered by Major Science's warranty.

E. *Inoculation*

1. Use silicone tubing, connecting the inoculation bottle to the peristaltic pump.
2. Sterilize the feeding port and the silicone tubing. You may apply high-temperature flames (≥ 1,200℃) toward the feeding port and leave the silicone tubing opened for 10 seconds.
3. After a proper sterilization to the feeding ports, connect the silicone tubes to the feeding ports.
4. Manually pump the seed cells into the culture vessel. You can change the pump speed in the "Pump" page to have a higher flow rate.

Note:

1) Tubing setup of the water circulation system: Detailed tubing arrangement can be found in the "Help" page.
2) Half-turn the condenser water regulator to provide continuous flow to the condenser.
3) Peristaltic Pump:
   a. Quick and simple tube change
   b. Tubing is available is 4 sizes and 5 materials, which are listed as below:

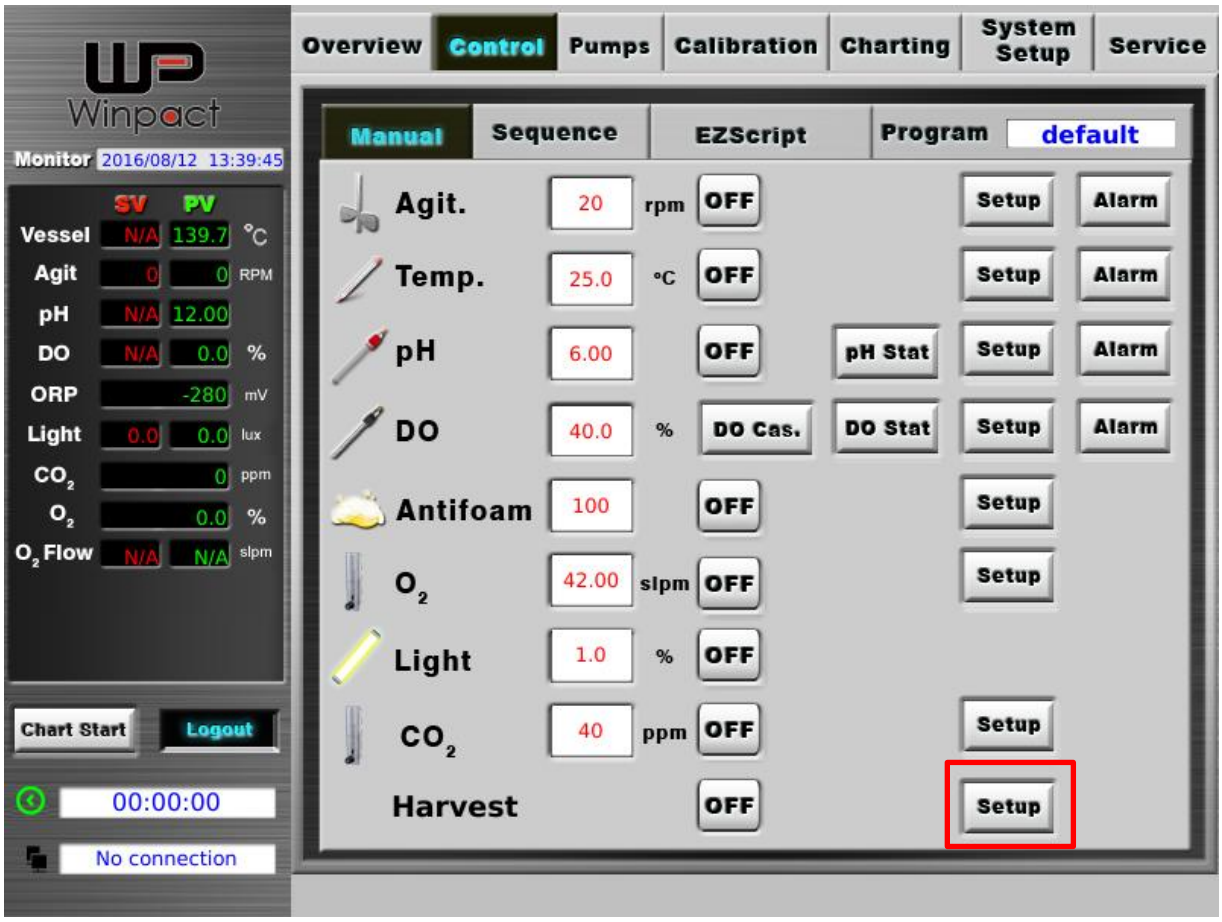
Bore x Wall	Autoprene	Silicone	Tygon	Viton	Prothane II
0.8mm x 1.6mm	T0016 SAT 24	T0016 SLT 25			
1.6mm x 1.6mm	T0016 SAT 07	T0016 SLT 12	T0016 TYG 12	T0016 VIT 16	T0016 PRO 16
3.2mm x 1.6mm	T0016 SAT 08	T0016 SLT 16	T0016 TYG 13	T0016 VIT 10	T0016 PRO 10
4.8mm x 1.6mm	T0016 SAT 01	T0016 SLT 02	T0016 TYG 10	T0016 VIT 02	T0016 PRO 03

Warning:

Major Science provides you silicone tubing as the standard accessory. The silicone tubing is for general purpose only. Please DO NOT use it for strong acid and base. To pump strong acid or base, please choose chemical-resistant material (Viton or Tygon). Damages caused by misuse of liquids are not covered by Major Science's warranty.

6.4 Ready to Harvest

After fermentation, user could go to Control>Manual page and tap Setup button behind Harvest to select desired harvest way: either harvest in 0 degree vessel or harvest in 120 degree vessel.

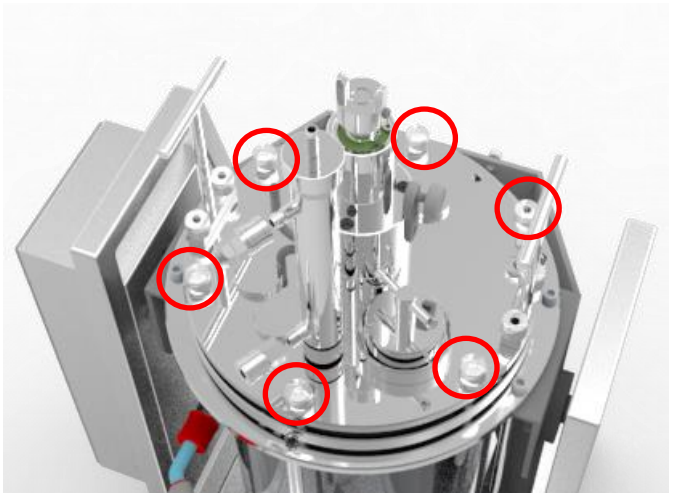


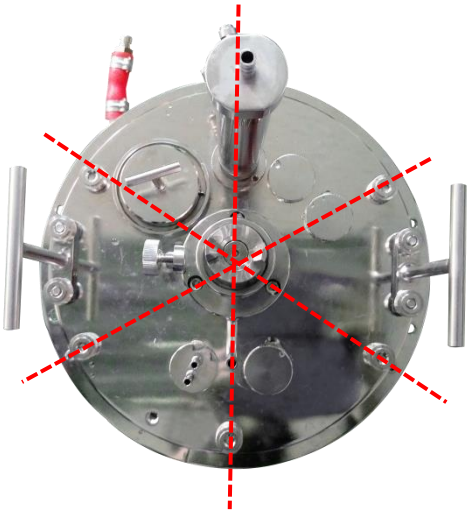
"Home Return" indicates "0 degree" of vessel, if user select "Home Return" then press "ON", system would change the angle of vessel to 0 degree; while if user select "Harvest" then press "ON", system would change the angle to 120 degrees from its previous angle.

If user wants to harvest the medium in 120 degree vessel, notice that the installation of fixed baffle before activating Harvest is necessary. The function of fixed baffle is to prevent the glass part of culture vessel separate from its fixed ring during harvest. If fixed baffles are not installed, the fixed ring may not able to hold the glass part of culture vessel and the glass part may slide and cause unpredictable damage. Follow the instruction below to install fixed baffle.

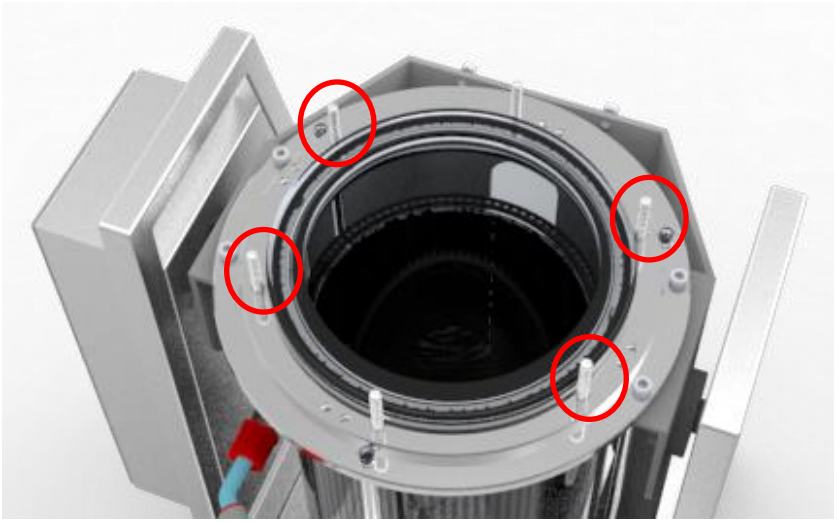
A. Install Fixed Baffle

1. Keep culture vessel stand vertical, and loosen the 6 fixed screws on headplate.

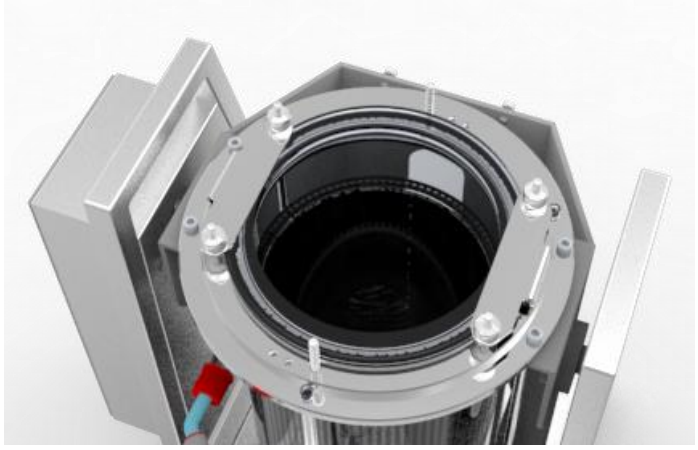




2. Lift up and remove the headplate carefully. Align the screw holes of fixed baffle with the studs, and then lay down two fixed baffles. The slot side face down.



3. Tighten the four screws. The vessel is ready for harvest.

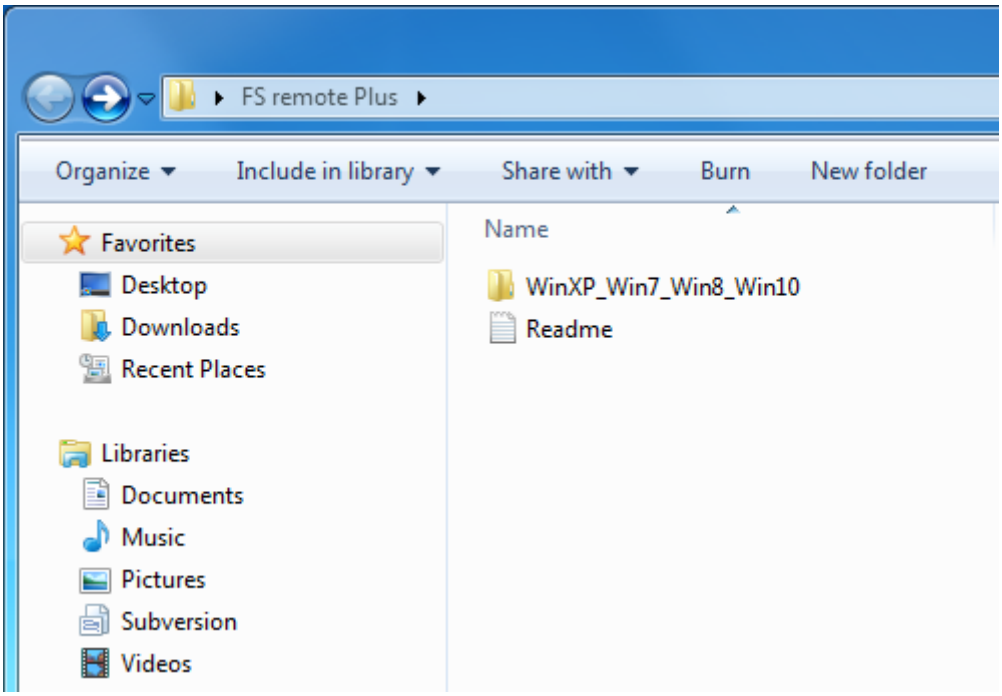


Chapter 7. Remote Control

User can control fermentor settings on computer which is called "remote control". In addition, user can perform data monitoring, To operate the system, user has to install FS remote control software on PC.

7.1 Preparation for Winpact FS Remote Control

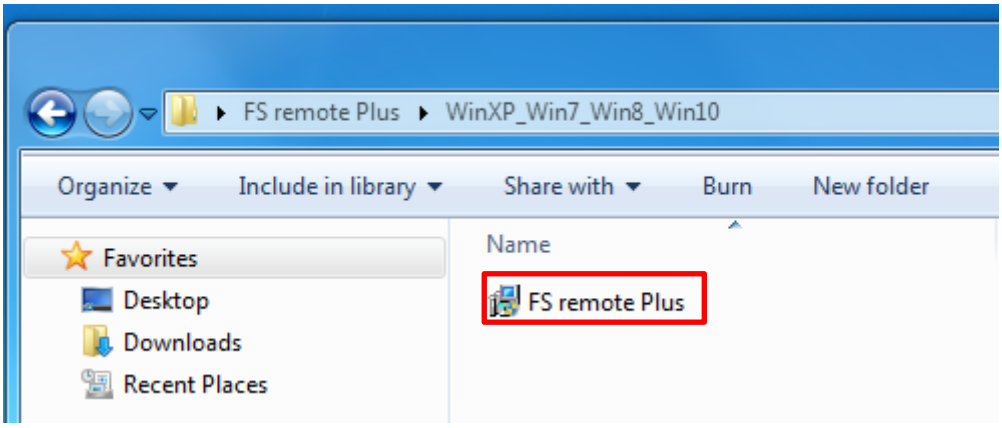
To connect PC to Winpact Controller, user needs to install the Winpact FS Remote Software from the CD comes with package.



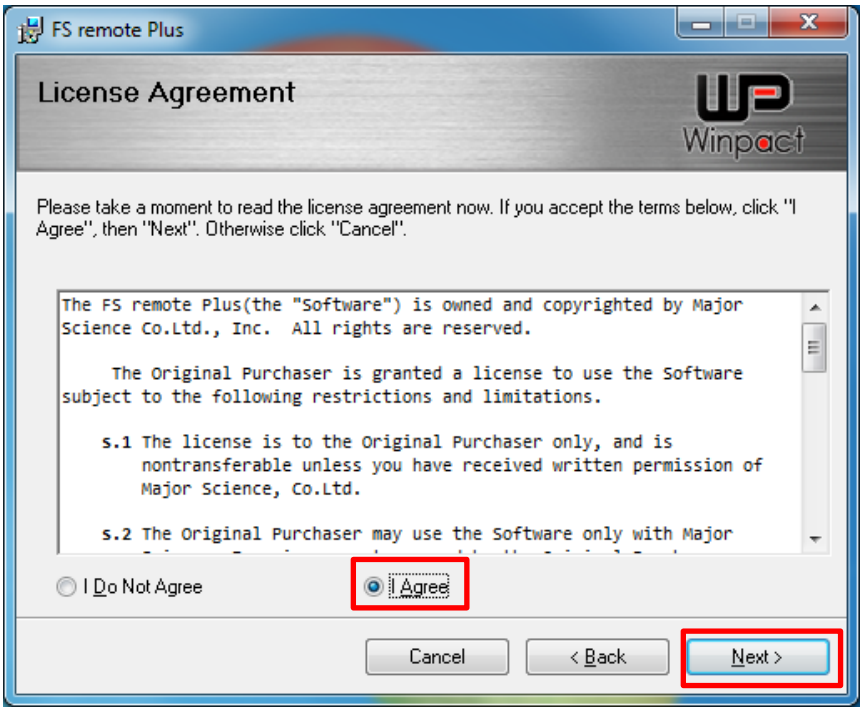
In **FS remote Plus** folder, one folder and one text file is contained, read **"Readme**" first to have the information about FS remote Plus. FS remote control software fits in WindowsXP, Windows7, Windows 8 and Windows 10. **User who uses system other than Windows such as iMac is not compatible.**

7.1.2 Winpact FS Remote Control Installation Instructions

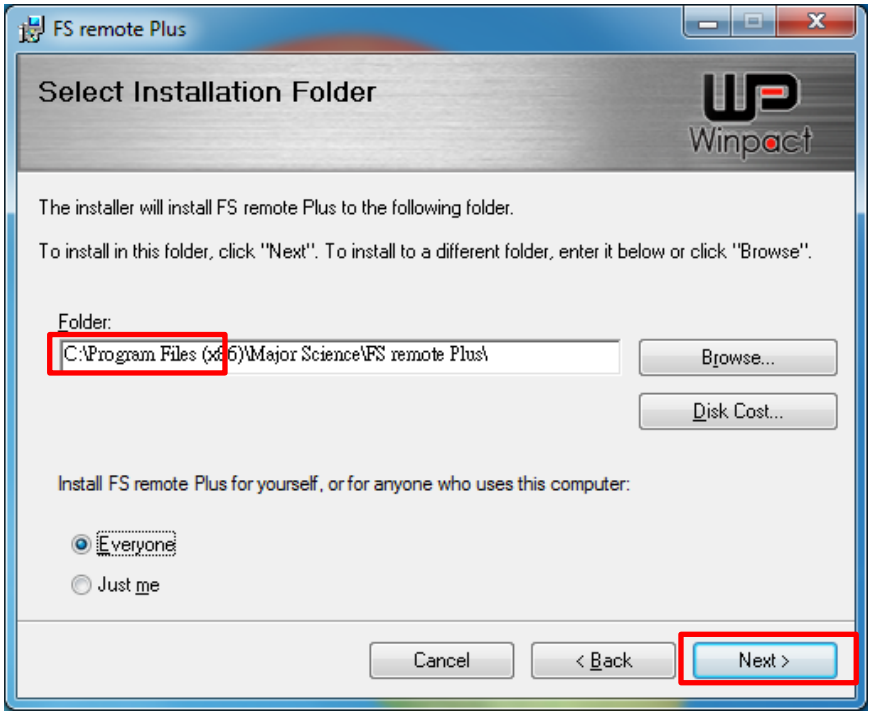
Step1. Double click “FS remote Plus.exe” to start installation.



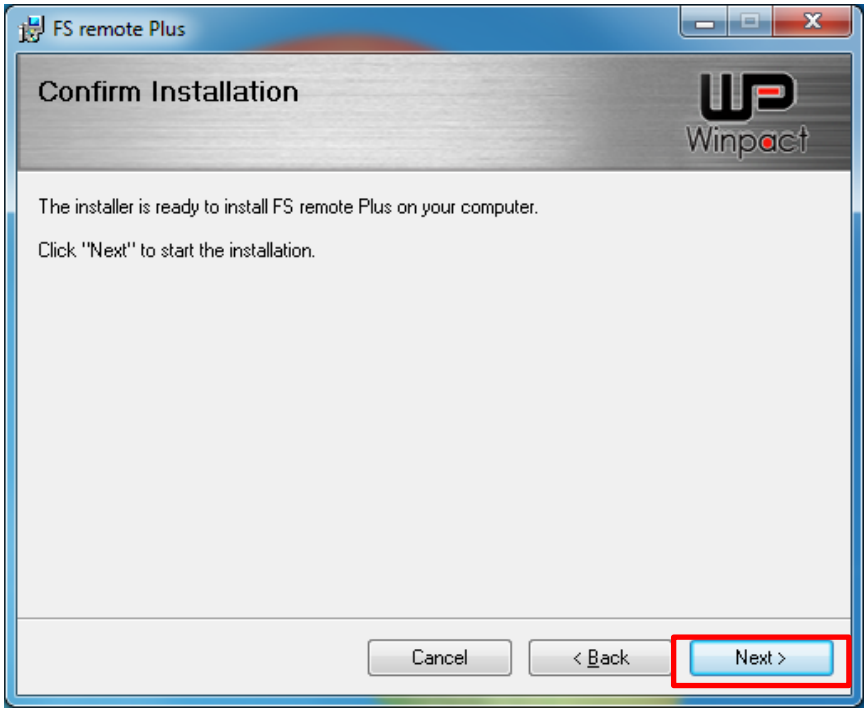
Step2. The installation dialogue will show up on the screen; check” I Agree” then press “Next” to continue the installation.

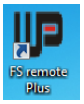


Step3. Select the preferable folder to install. Press “Next” to proceed to the next step.

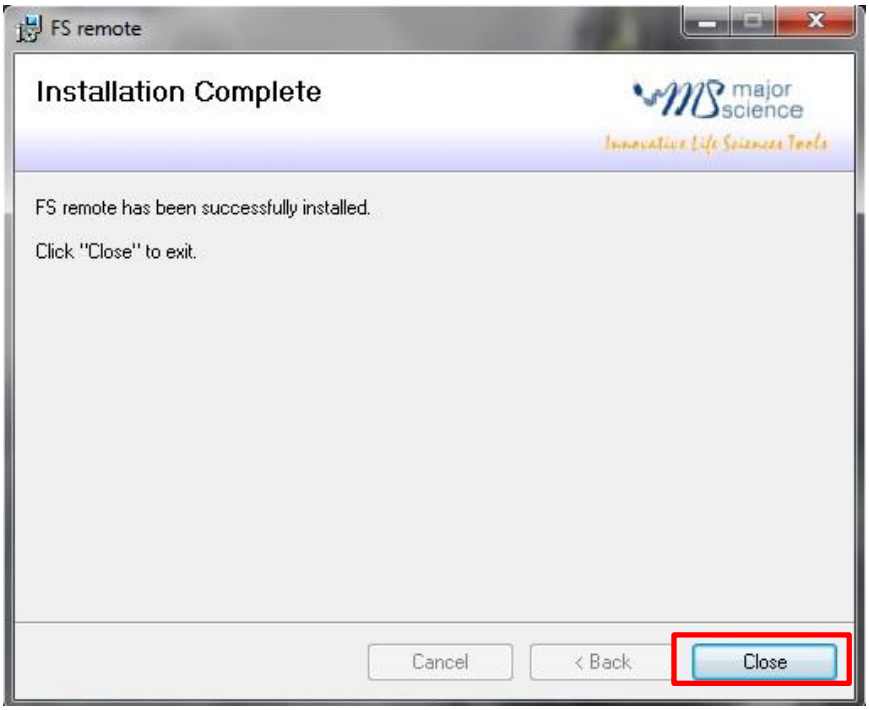


Step4. Press “Next” to confirm installation.



Step5. Select “Close” once the installation is completed. After completing the installation, user can find a “WP” icon 

showing on desktop. Double-click the icon to start the operation of remote control.

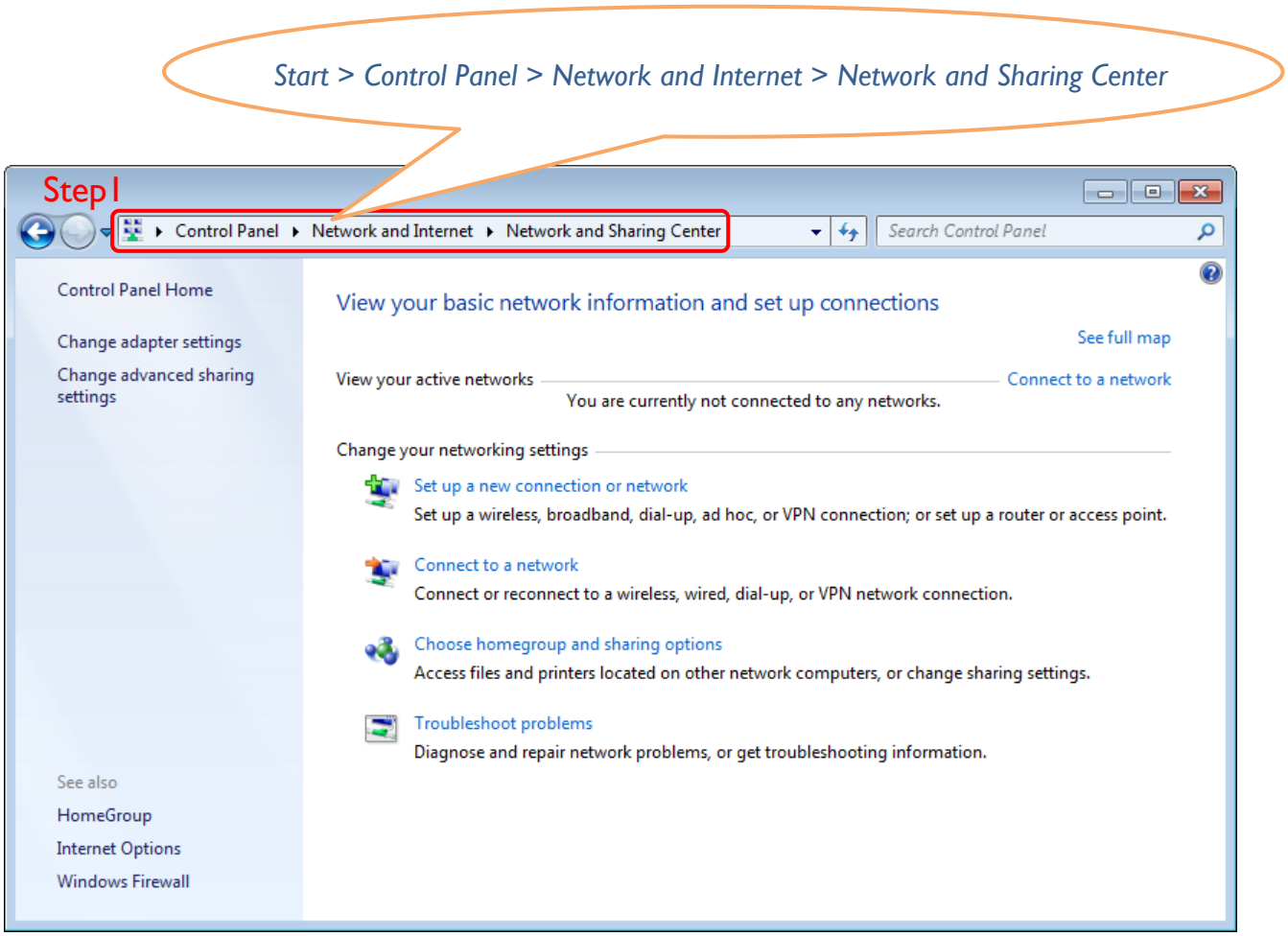


Note:
After finishing the Winpact FS remote control software installation, user will need to set up the IP settings correctly to enable the remote control function. Please proceed to the next section: *7.1.3 IP Address Setup*.

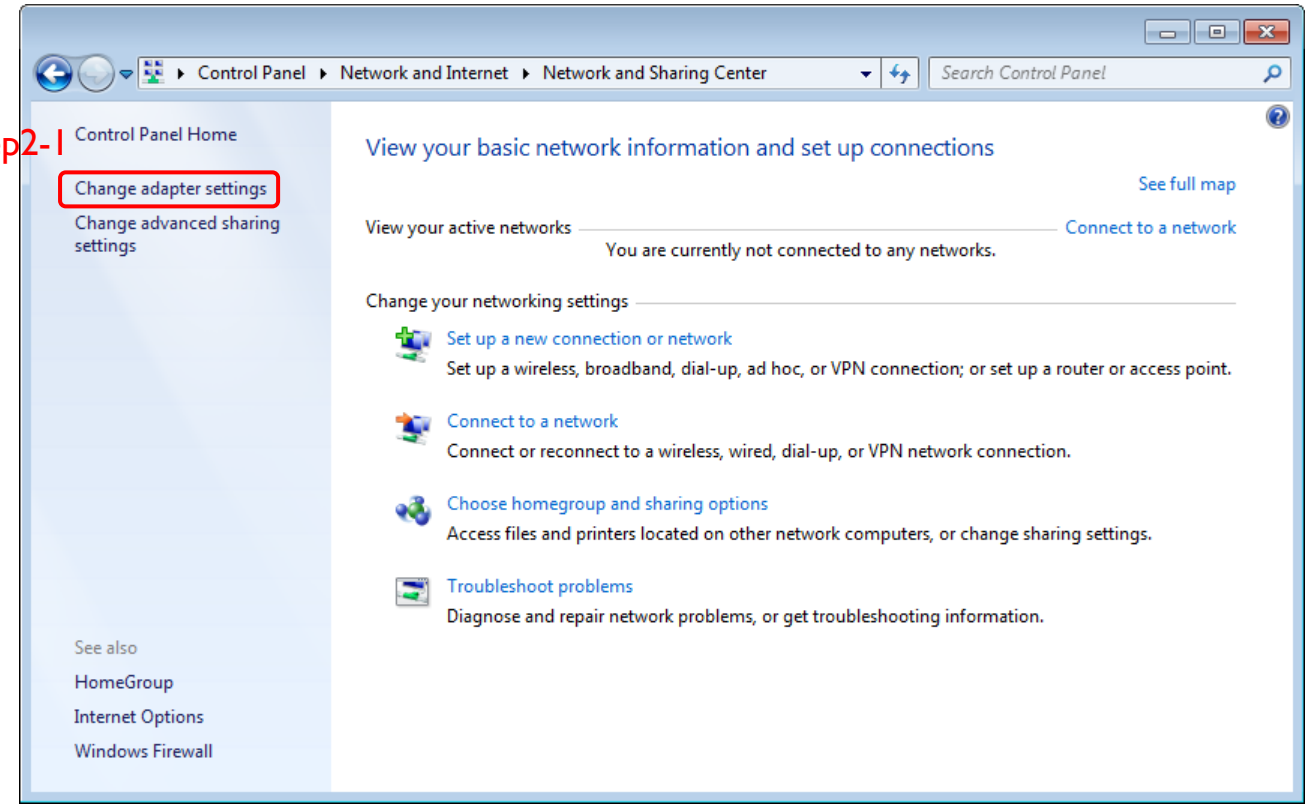
7.1.3 IP Address Setup

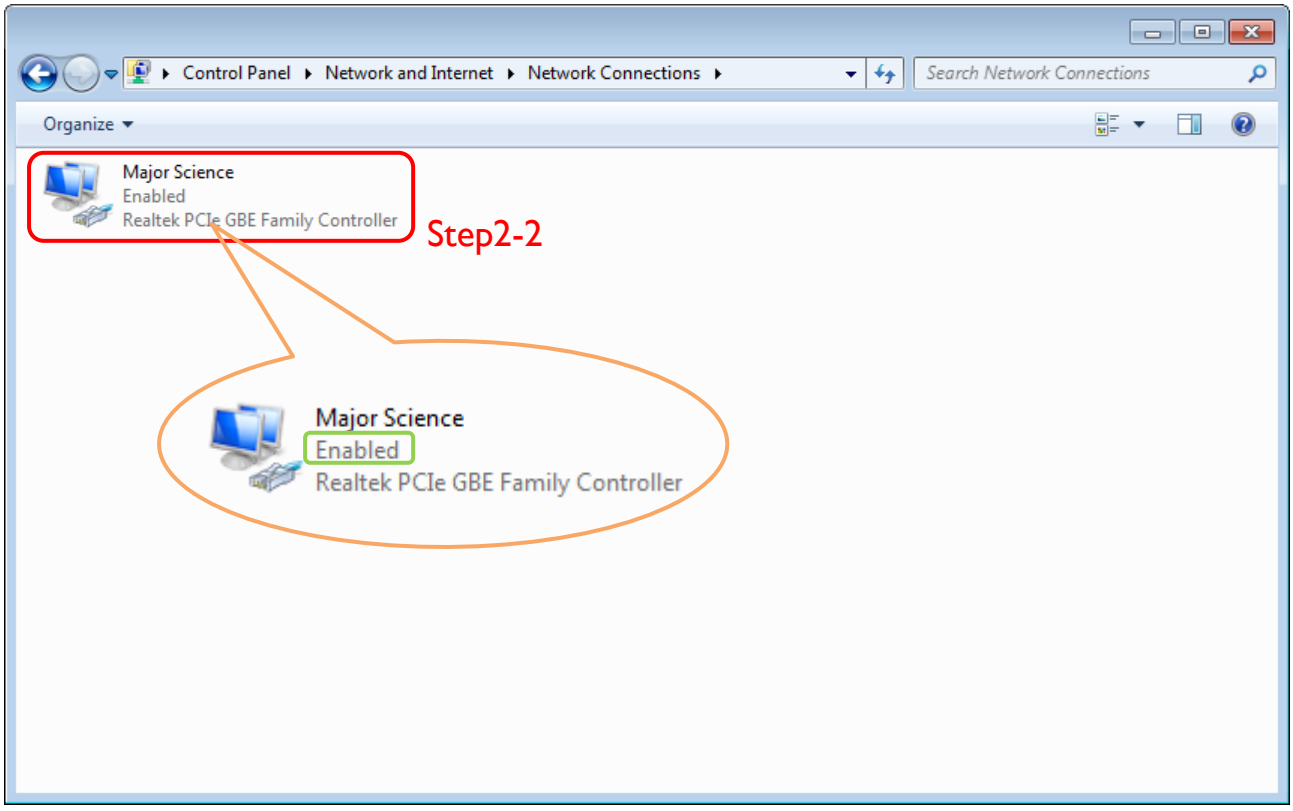
In some cases, user might not be able to connect the remote control when user completes all the installation. So we suggest user check the IP address of user's computer. Follow the instructions below.

Step1. Open "Control Panel" on the computer. Enter "Network and Internet"; then "Network and Sharing Center". (The following pictures are captured under Microsoft Windows7 operating system.)

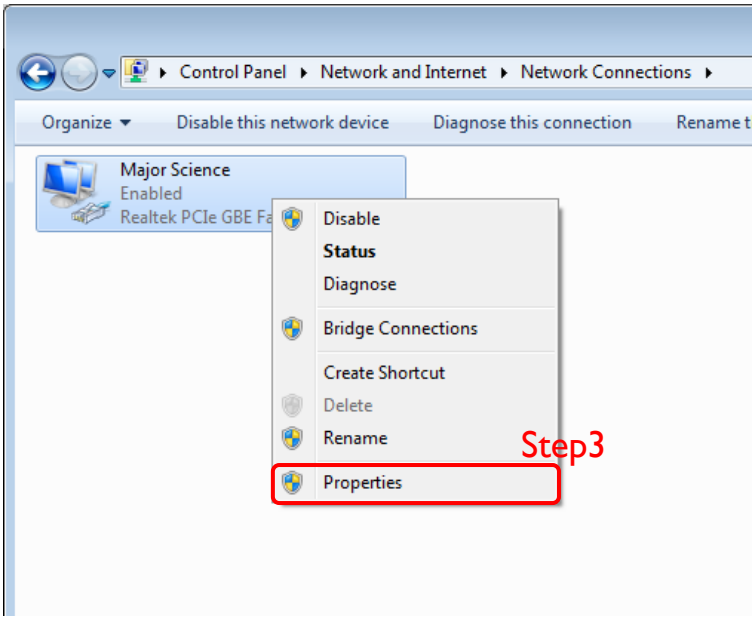


Step2. Click on “Change adapter settings”. User can see the connected LAN (Local Area Network). “Enabled” means the network that user’s computer is using, and the network is connected.

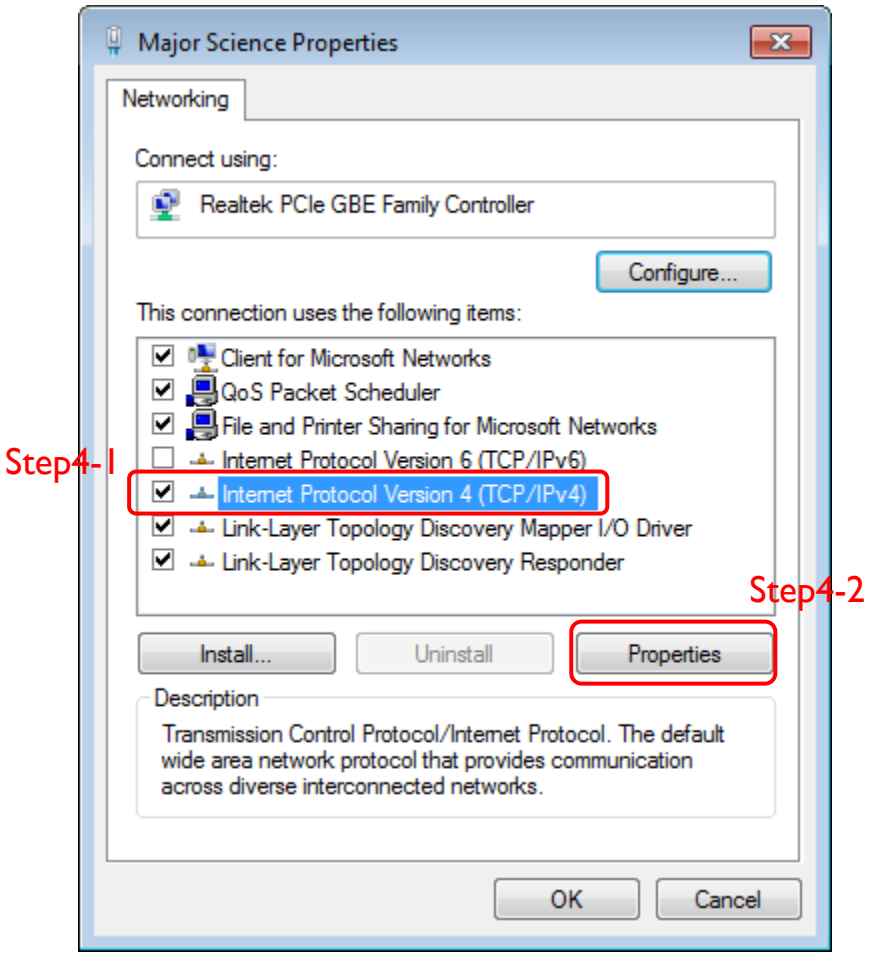




Step3. Right click on the connected network, and select “Properties”. The Network properties dialogue will pop up on the screen.

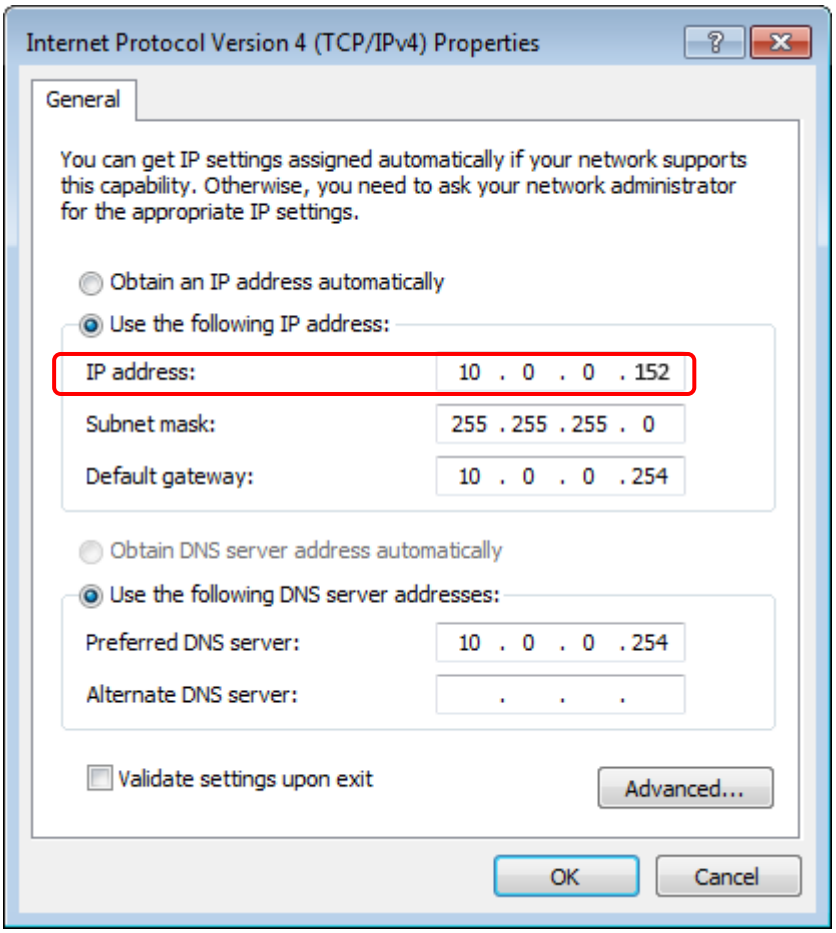


Step4. Select “Internet Protocol Version 4 (TCP/IPv4)”; then click “Properties”



Step5. Check the IP address of user’s computer to see if user’s computer IP conflicts

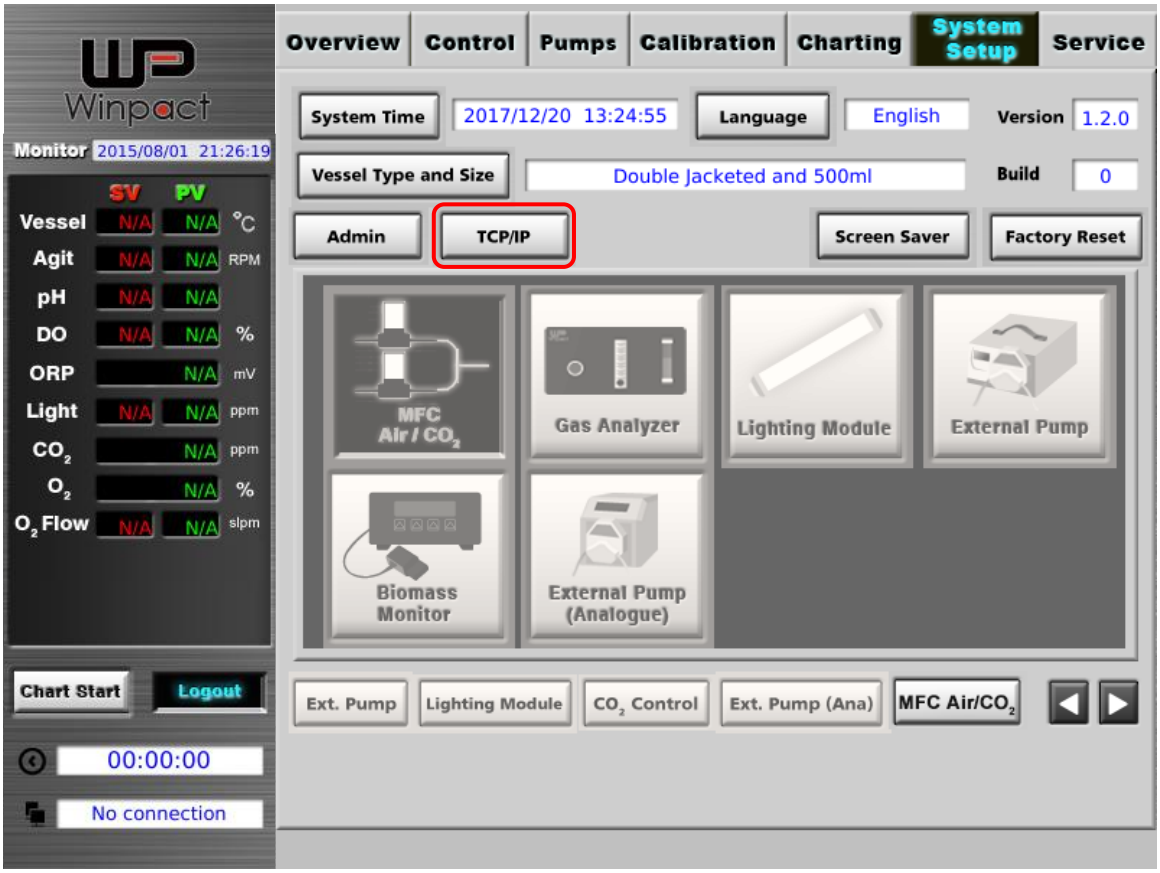
with the IP address of the FS-10-A05P controller or other computers. To set up a new IP address, the first 3 numbers should be the same as the first 3 numbers of user's network IP address. All user need is to change the last number, which has to be different from the IP address of user's controller*1 and other computer.

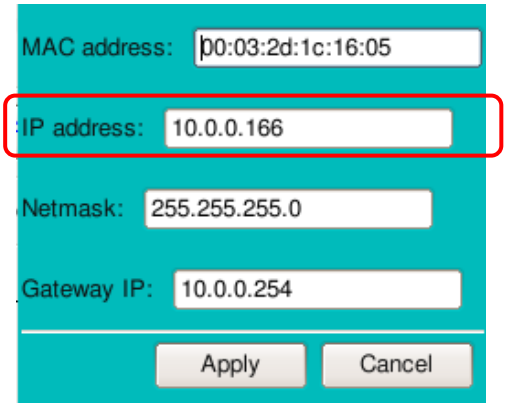


Note:

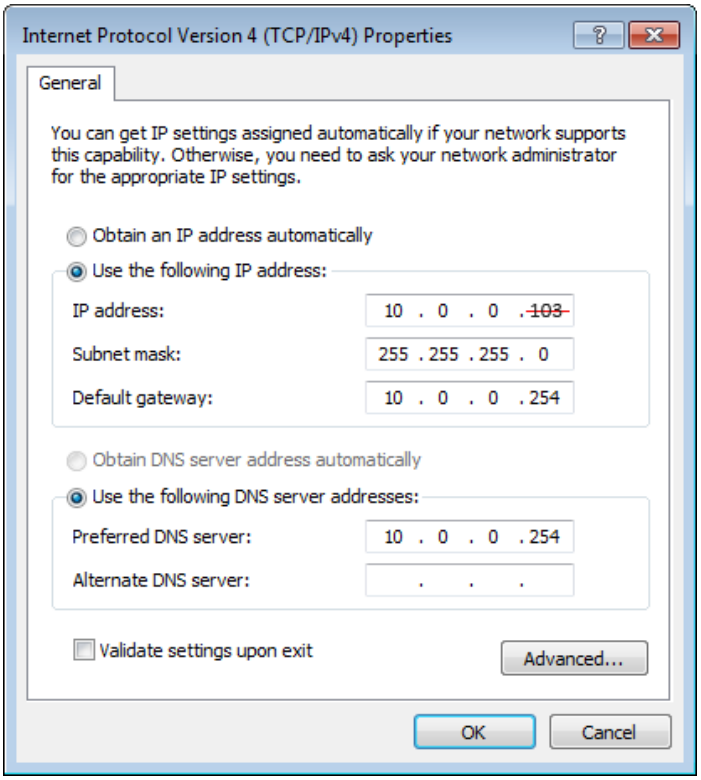
The IP address of FS controller can be obtained in “System Setup” page on controller.

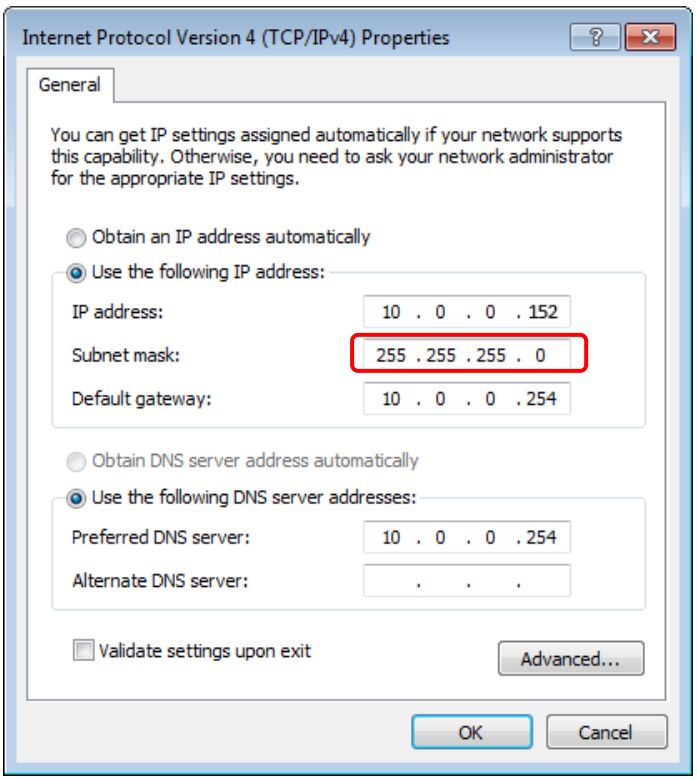
Press “TCP/IP” to see IP address in the popped-up dialogue.





For example, if the IP address of the conflicted IP address is “10.0.0.103”, and the controller IP address is “10.0.0.166”. Then the IP address of user’s computer should be set up like “10.0.0.152”. User can use the numbers ranging from 1 to 254 except 103 (the conflicted IP address) and 166 (the controller IP address).

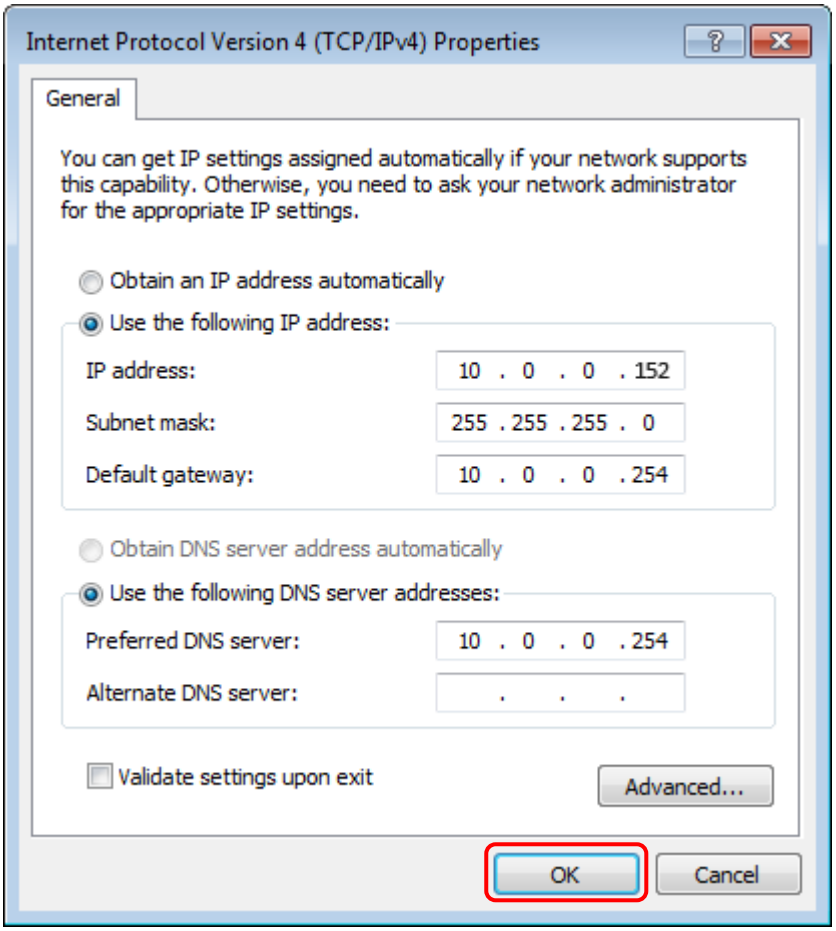




***Hint*:**

There are odds that the new IP address which user sets might conflict with other's network. Try another number to set up the IP address.

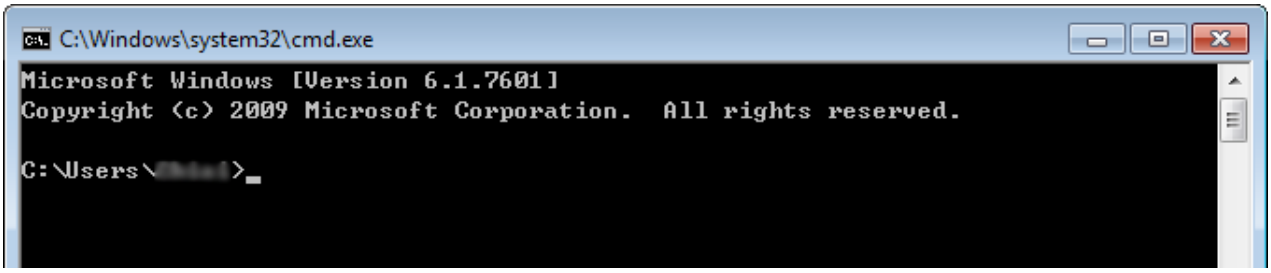
Step6. After finishing the setting, press "OK" to confirm the settings and exit the dialogue.



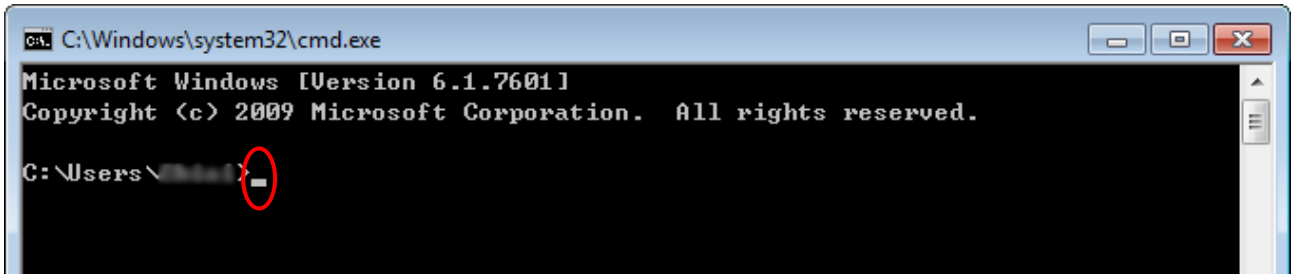
7.1.4 IP Address Confirm

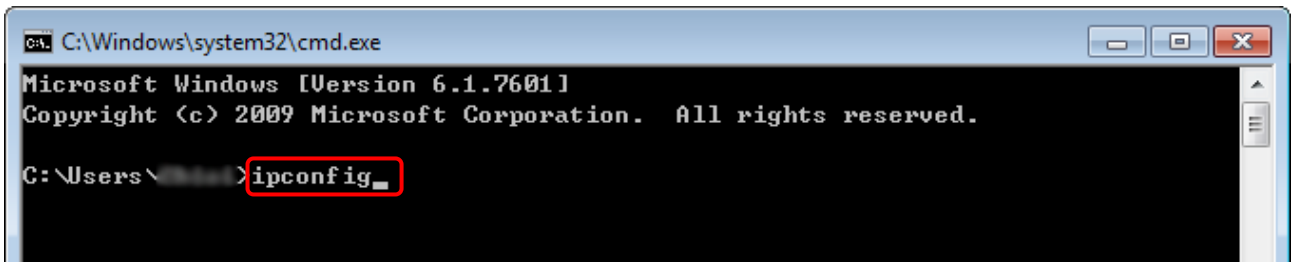
To confirm the new IP address. Follow the next step.

Step7. Click on the "Start" button. Type "cmd" in the search bar and press "Enter" key to execute the program. MS-DOS will pop up on the screen.

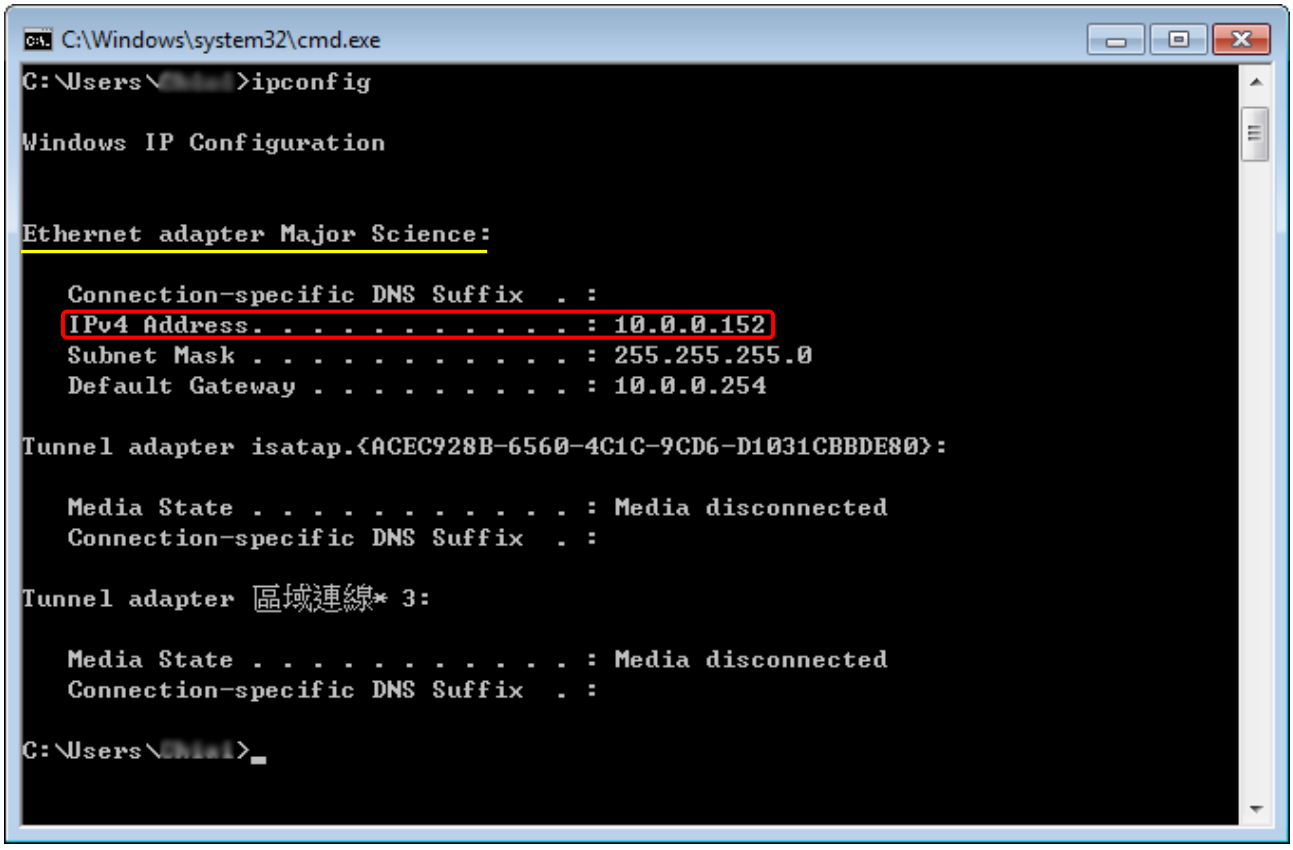


Step8. Type "ipconfig" after the flashing cursor. And press "Enter" key.

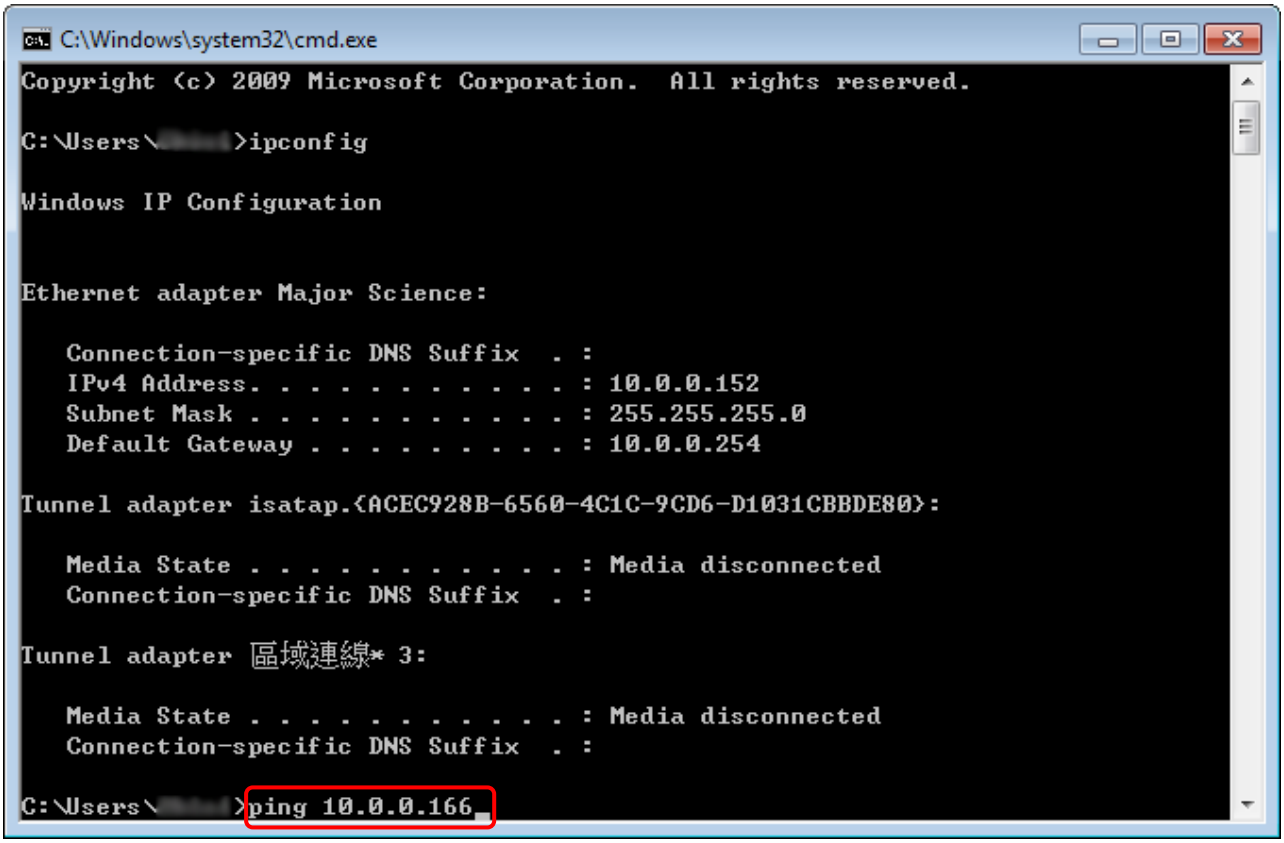




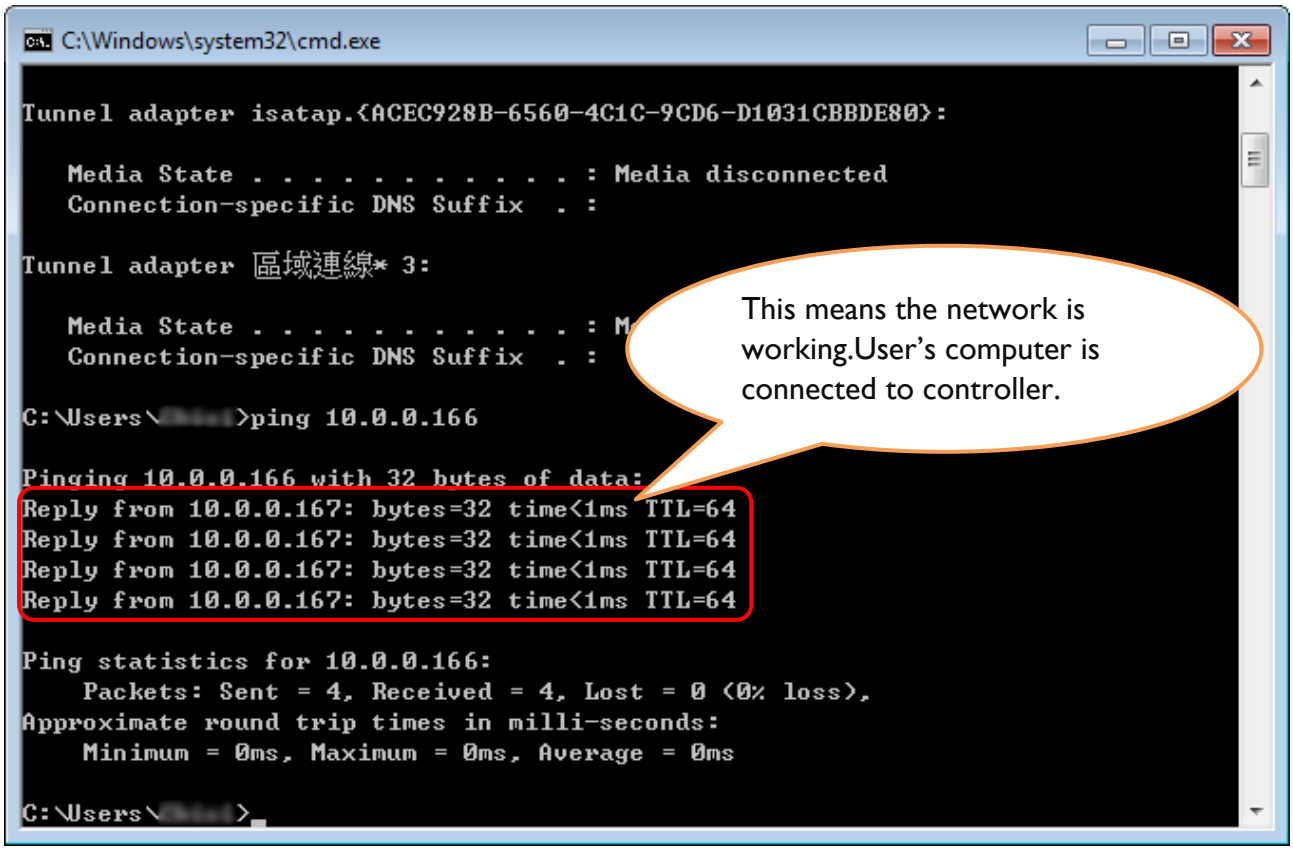
Step9. System then shows the IP address of user's, the example in step 5, user's IP has been changed to "10.0.0.152", therefore the same IP address is showed in the screen. However, if it is not showed on the screen, the IP address might conflict with others'. Search the Internet for "IP address conflict" to solve the problem.

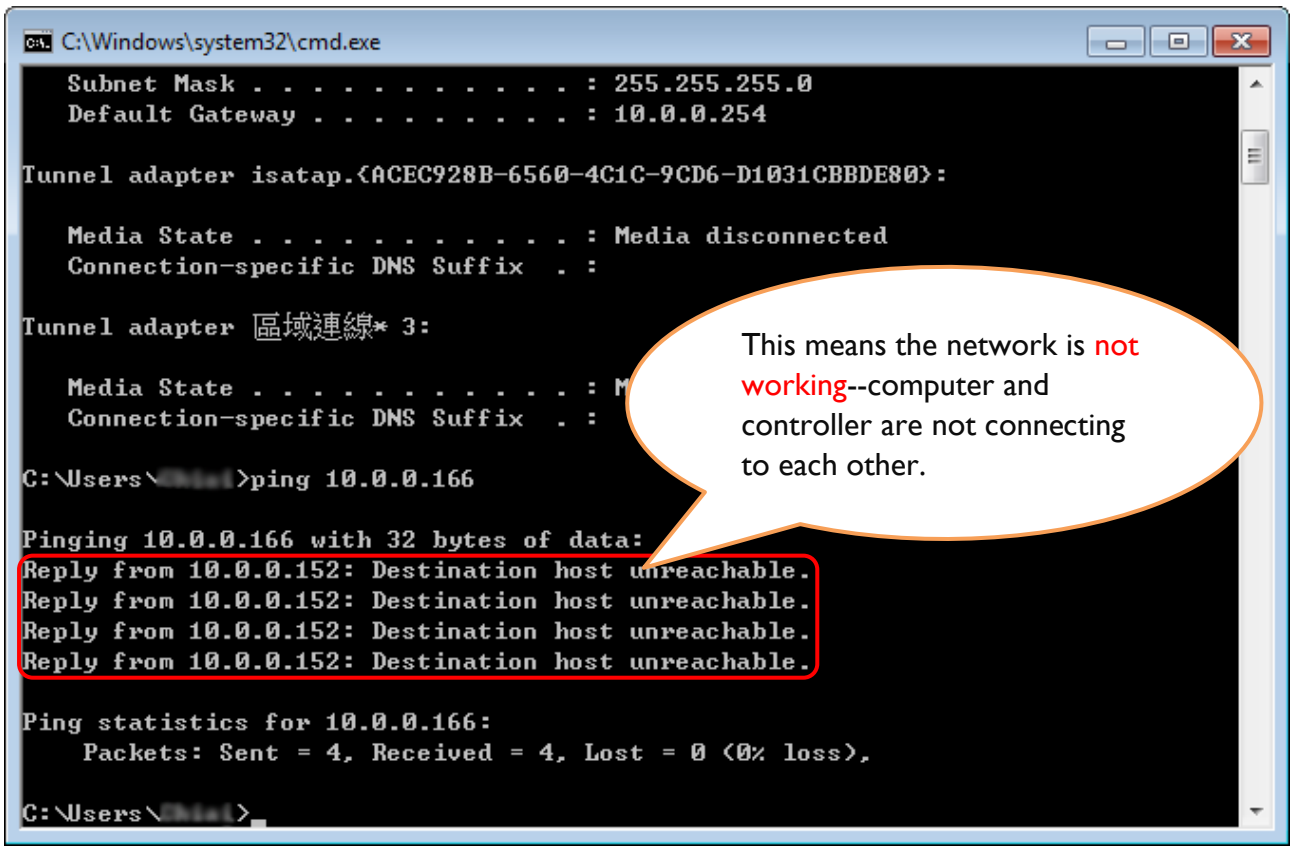


Step10. Then type “ping + *(Space)* + *controller’s IP address*” right after the flashing cursor. For instance, the IP address of the used controller is “10.0.0.166”; then type “ping 10.0.0.166”, and press “Enter”.



Step11. The program will start connecting user's computer to controller. The information showed on the screen tells user if the network is connected.



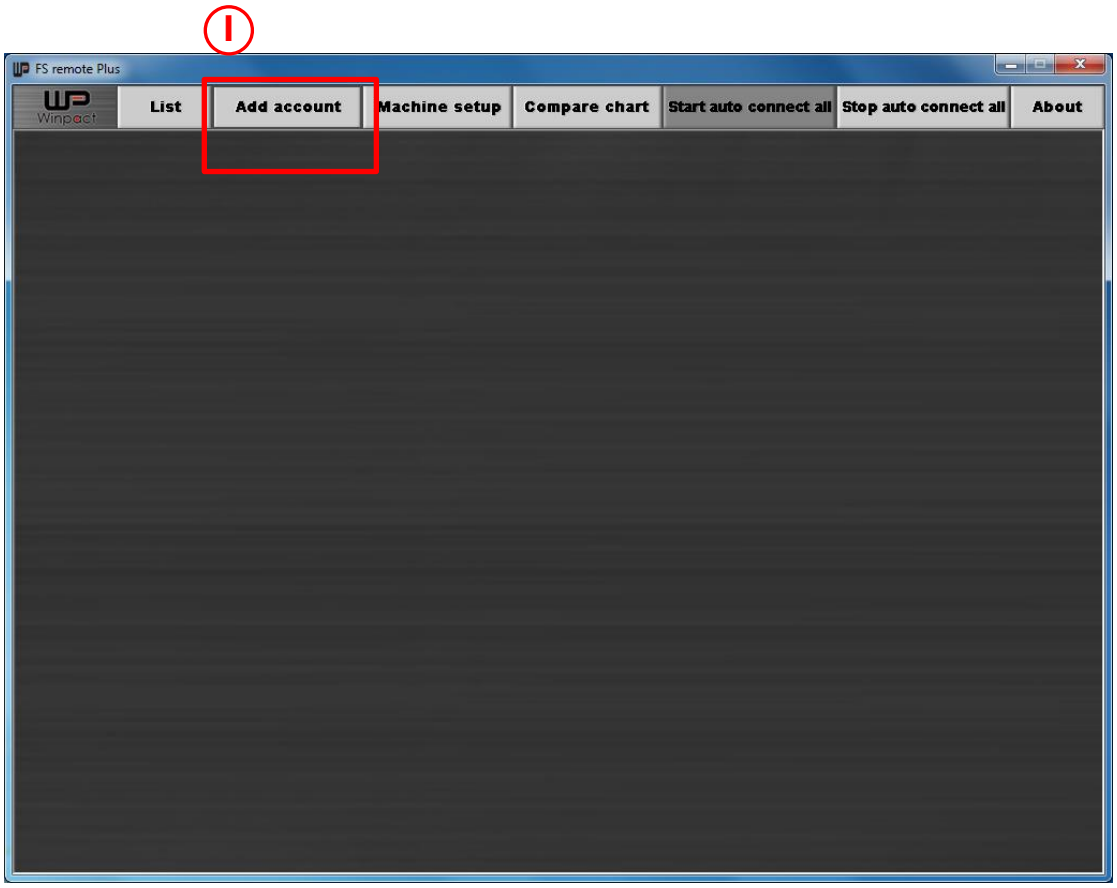


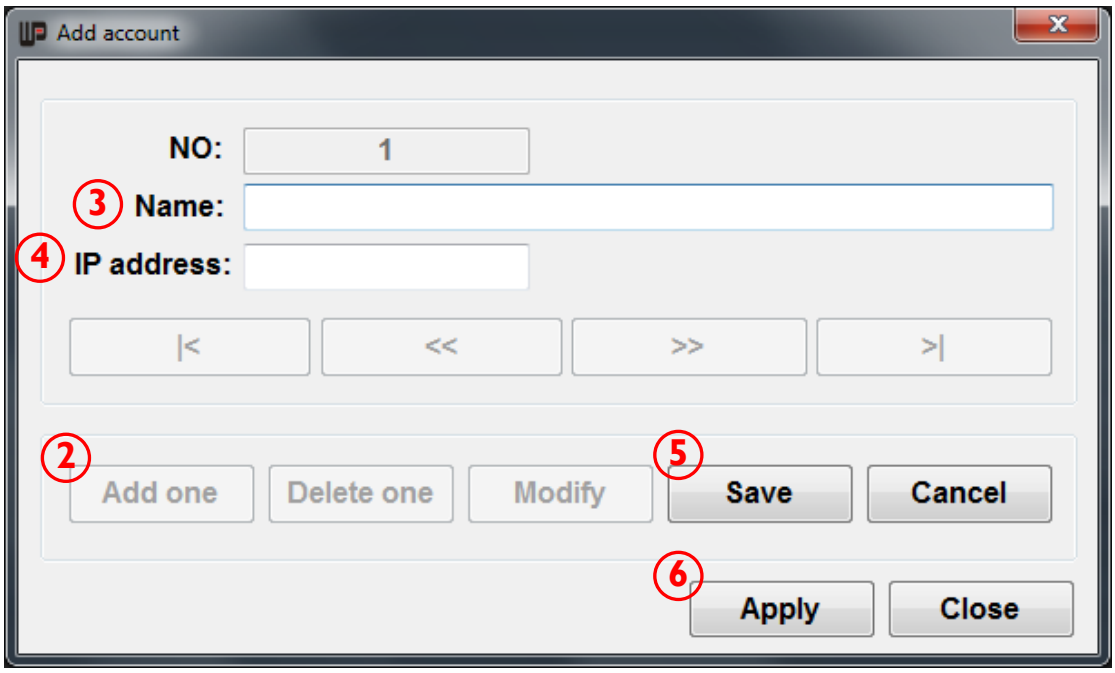
If the network is connected, user can start up the remote control software to monitor user's controller. If not, please check the connection and settings of user's network equipment.

7.2 Connect the PC to Winpact Controller

Once finishing the installation of the Winpact FS software to the PC, you will have a few steps to set up the remote control.

Step 1 Press "Add account" >"Add one" and name your fermenter. For the IP Address, it can be obtained in "System Setup" page on controller. Press "TCP/IP" to see IP address



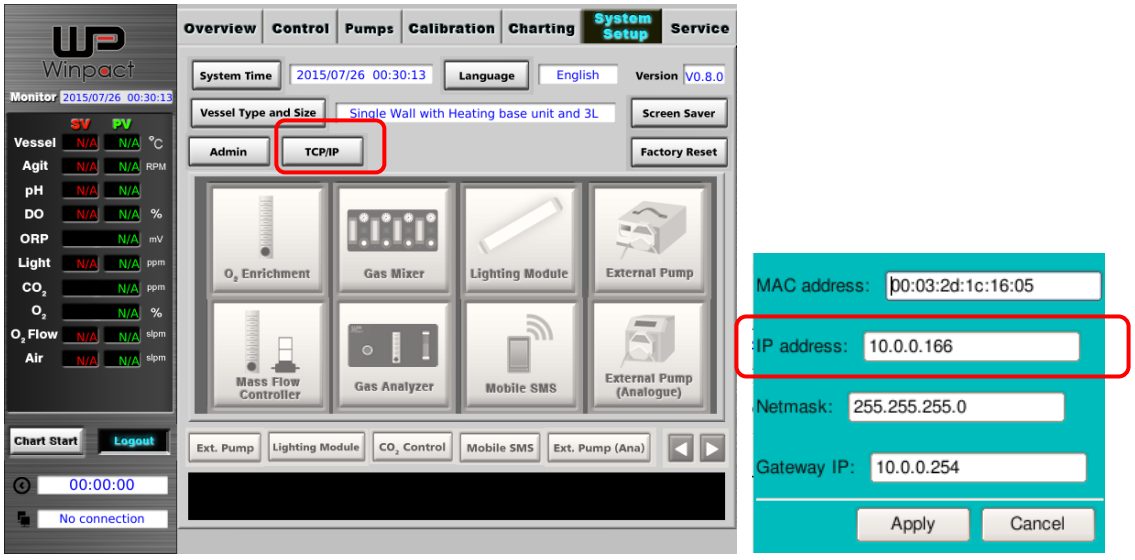


Note: An account represents a fermenter. You can monitor up to 16 fermenters at the same time.

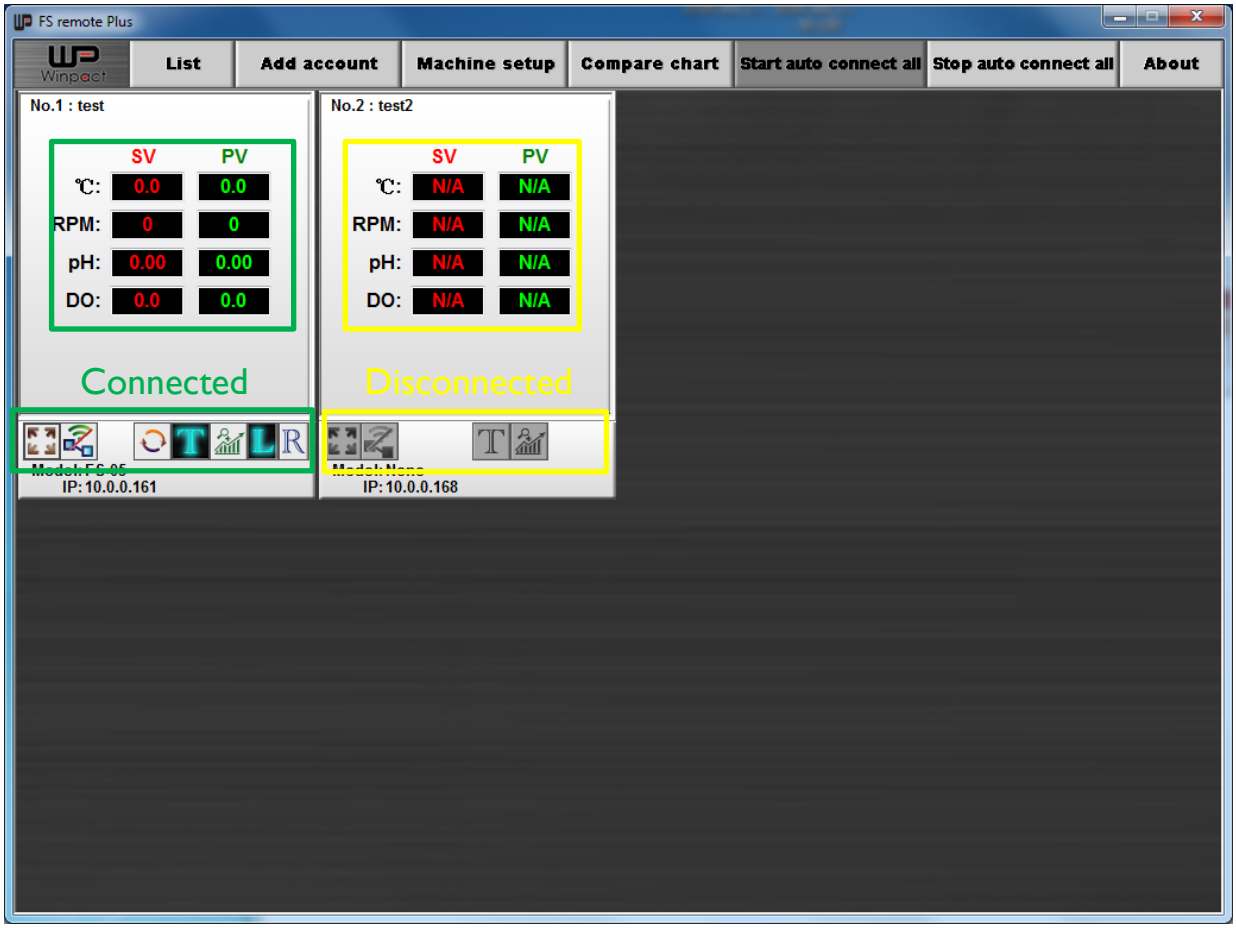
Note:

The IP address of FS controller can be obtained in "System Setup" page on controller.

Press "TCP/IP" to see IP address in the popped-up dialogue.



A connected account tool bar is lit and shows real time value of fermenter; if not, the tool bar is displayed as grey and shows “N/A.”

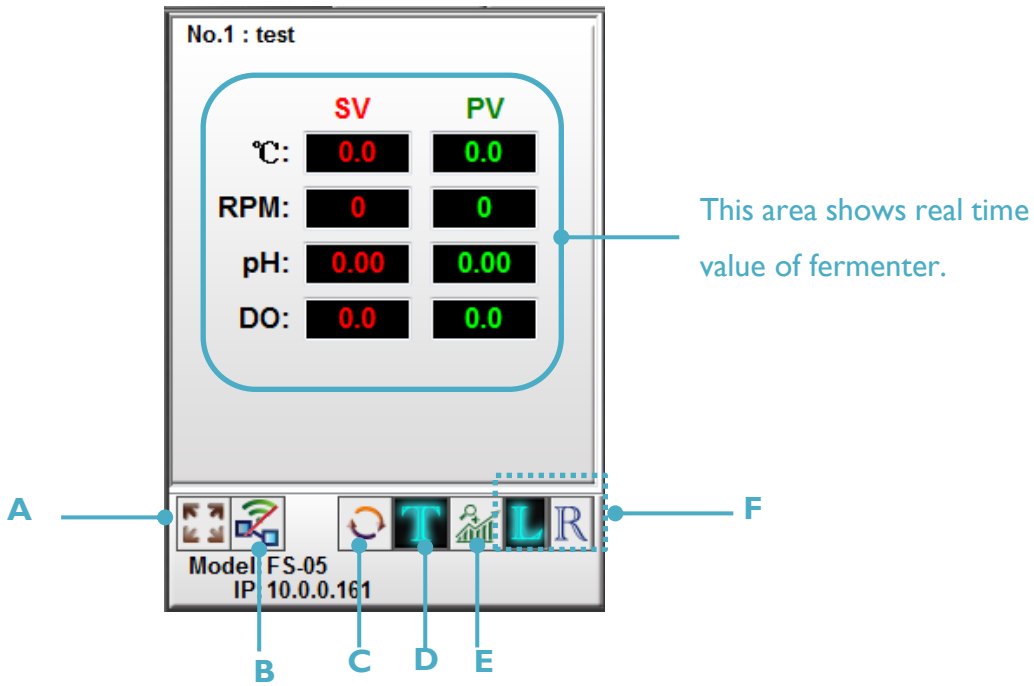


7.3 Operate the Winpact Controller via Remote Control

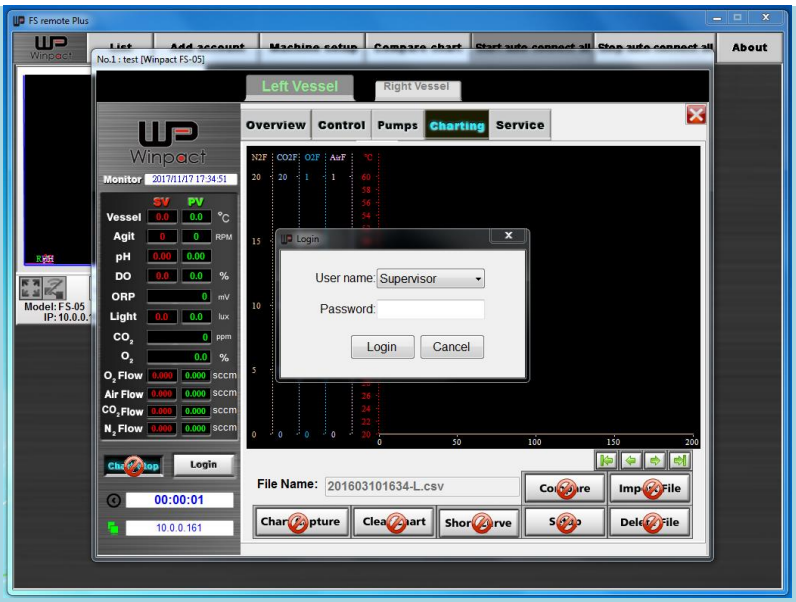
The layout of remote control can be divided as 2 parts: the outer monitor part and inner detailed part. Through outer monitor window, user can monitor several fermenters at the same time. On the other hand, through inner detailed part, user can acquire detailed information and do some value-changing remotely. The following instructions can help you have better understanding.

7.3.1 Outer Monitor Window

7.3.1.1 Tool Bar Overview



No.	Icon	Description
A.		Click this button to enter detailed interface of remote control.



Please refer to 7.3.2 for further information.

B. 

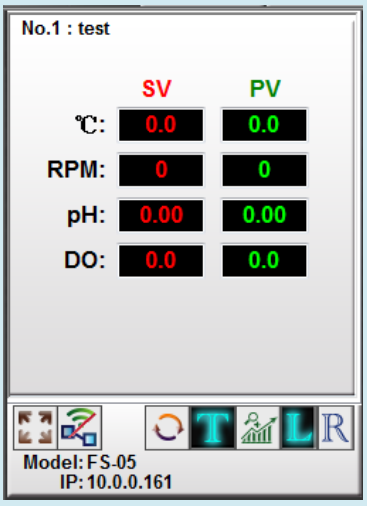
Disconnect software from fermenter.

C. 

Refresh data from controller manually.

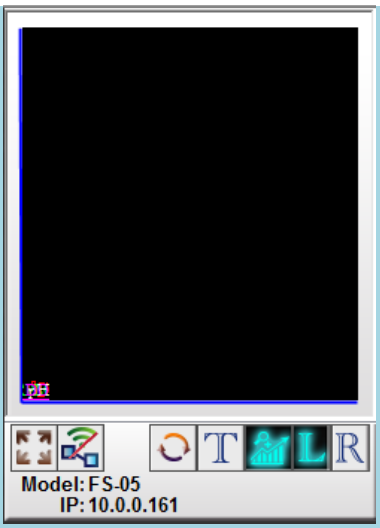
D. 

Click this button to view real time value of fermenter.



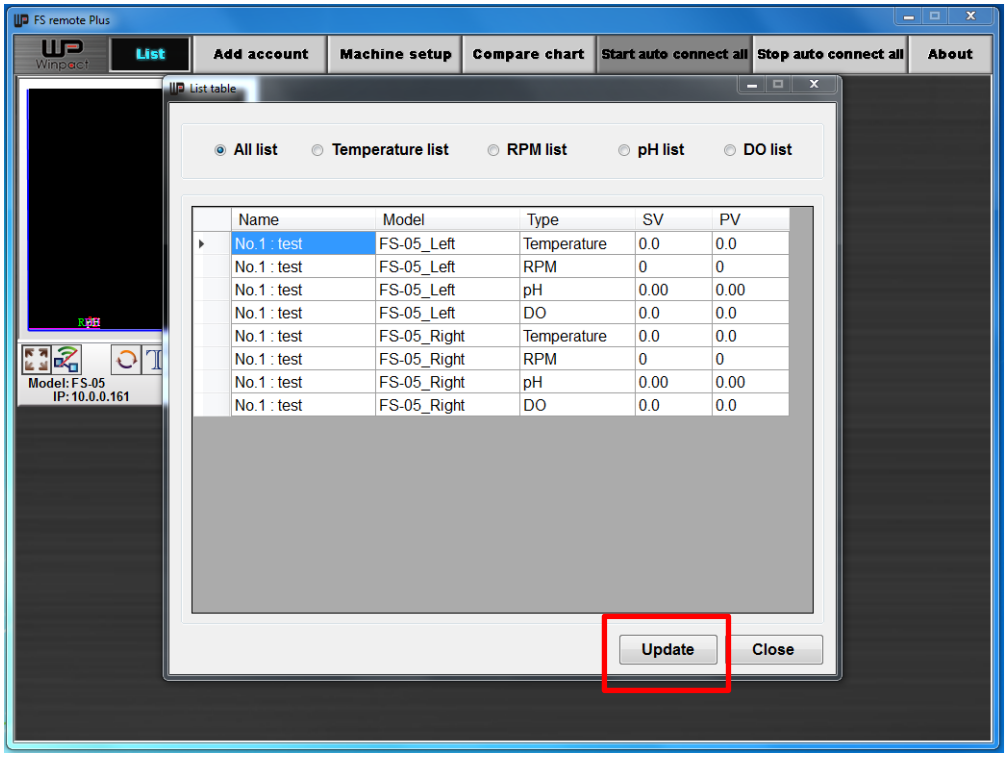
E. 

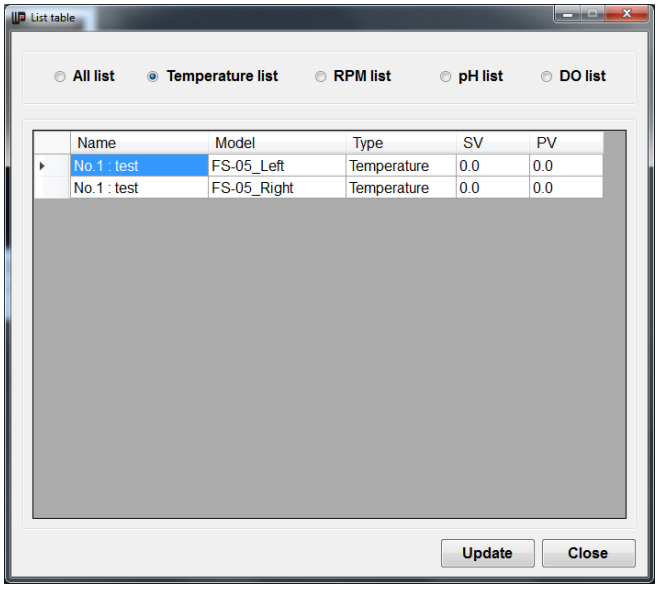
Tap this button to view rough trend chart of real time value from fermenter. **<u>What you see here is not recorded</u>**; user needs to press "Chart Start" on controller side to record complete data.

		 ※**Note**: This area only shows rough trend of temperature, agitation speed, pH, and DO value. User can neither change the XY axis scale nor save this trend chart, which both can be fulfilled in detailed interface. Tap  to enter detailed interface. ***(See 7.3.2.4)***
F		A function only for FS-05; it displays data of either left side or right side.

7.3.1.2 List

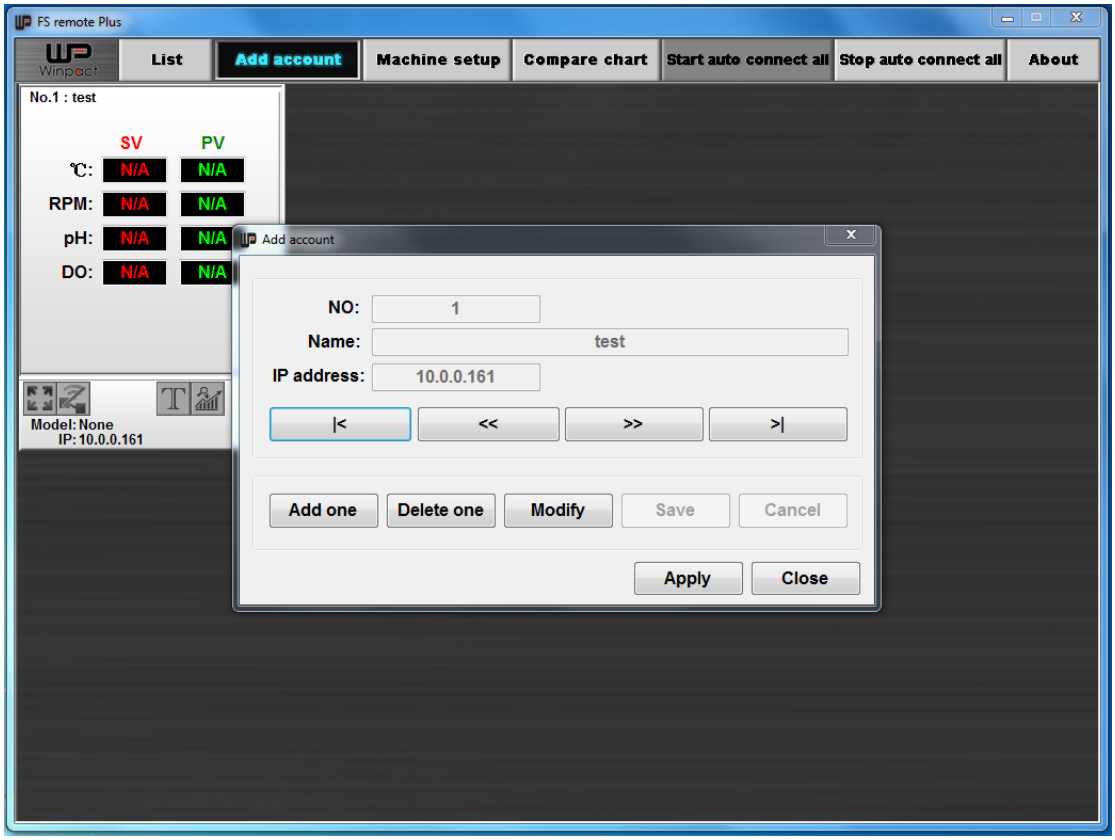
“List” is a table form of trend chart. Click “Update” to view the latest value. User can also select only one parameter (Temperature, RPM, pH, DO) to view.

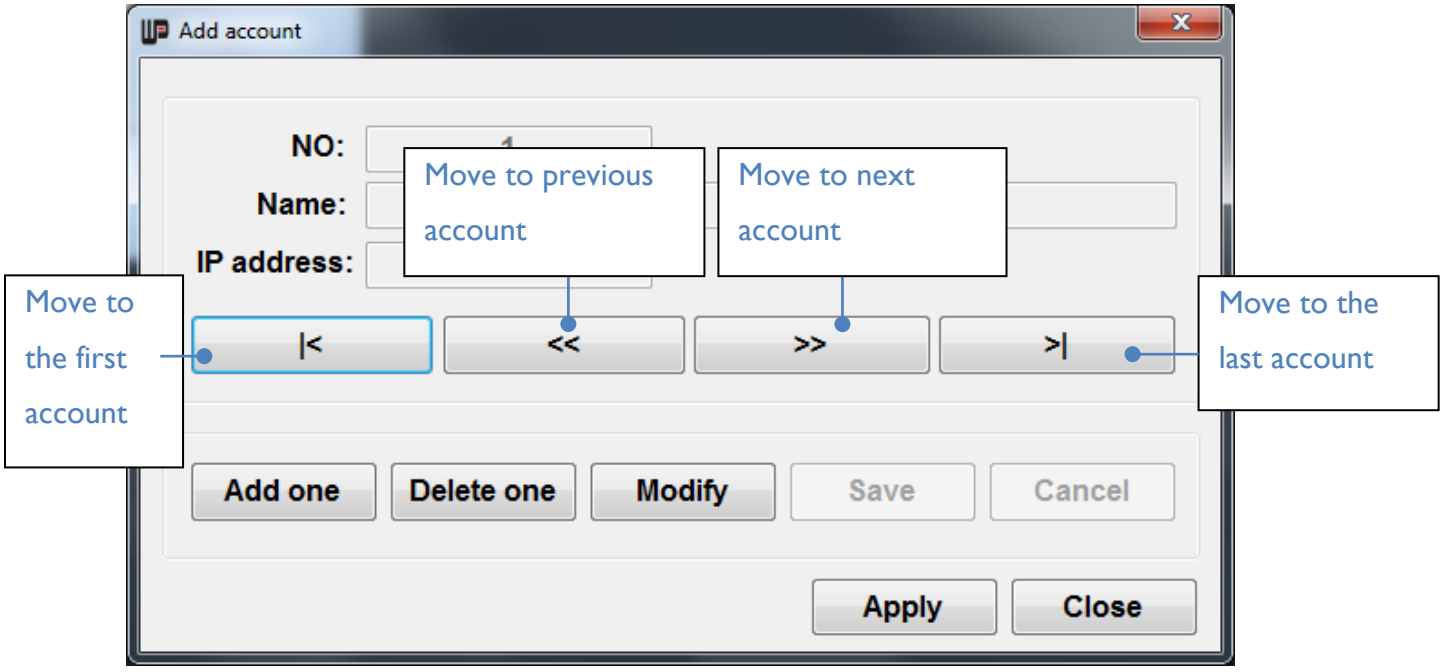




7.3.1.3 Add/ Delete/ Modify Account

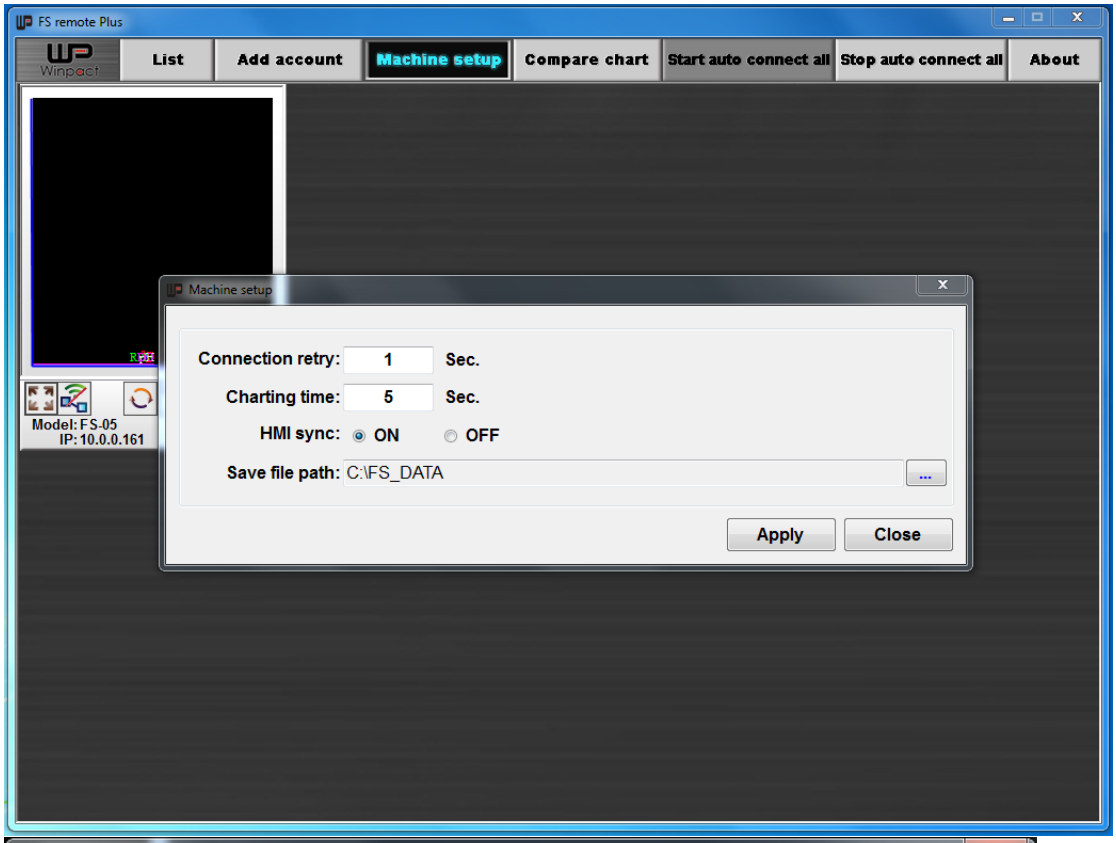
User can add up to 16 accounts. Click "**Add One**" to create an account, "**Delete One**" to delete an account, "**Modify**" to change account name and IP address. When the modification is finished, click **"Save"** and **"Apply."**

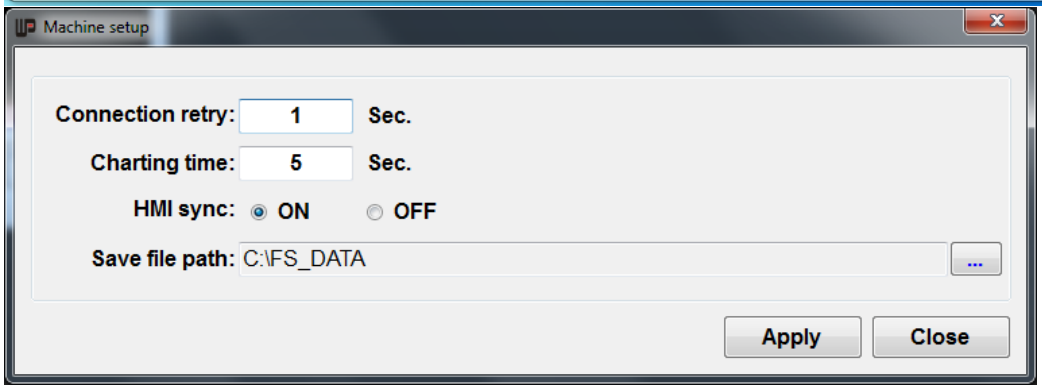




7.3.1.4 Machine Setup

In this page, user can set some basic default value of the software. Clip "Apply" to apply the setup.

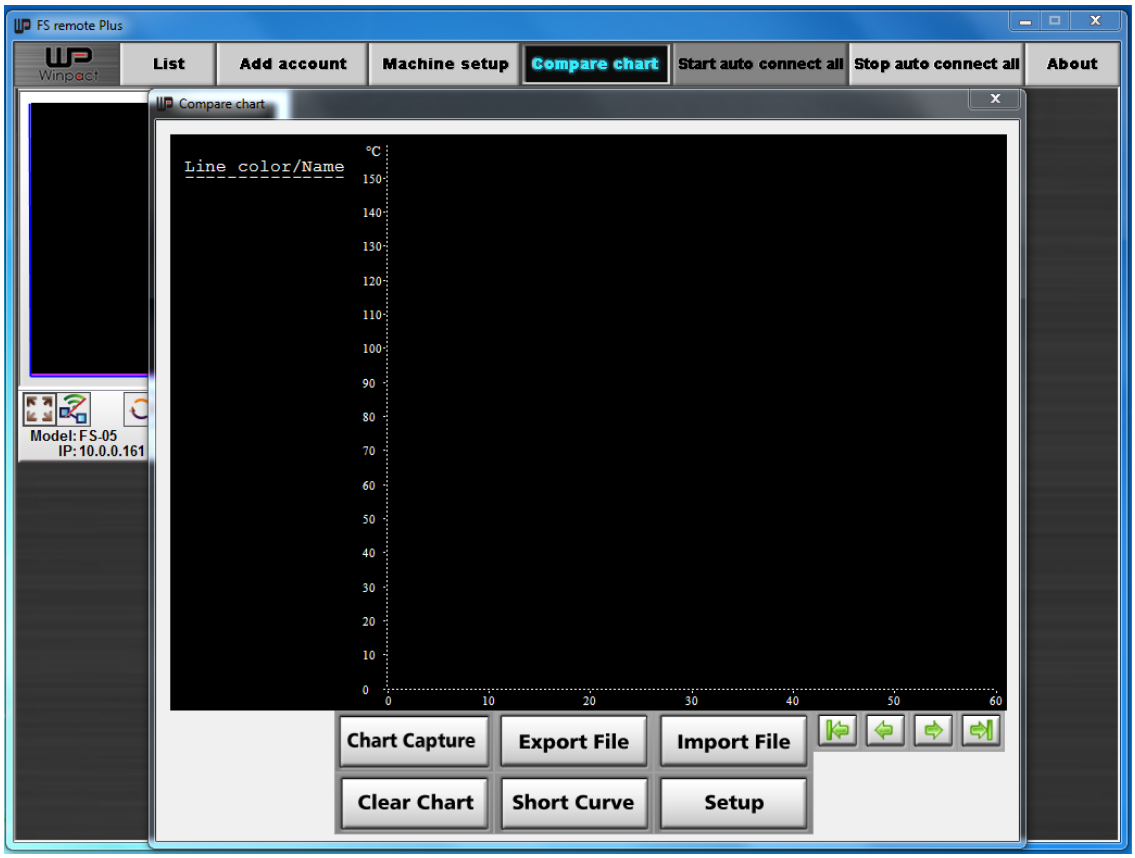


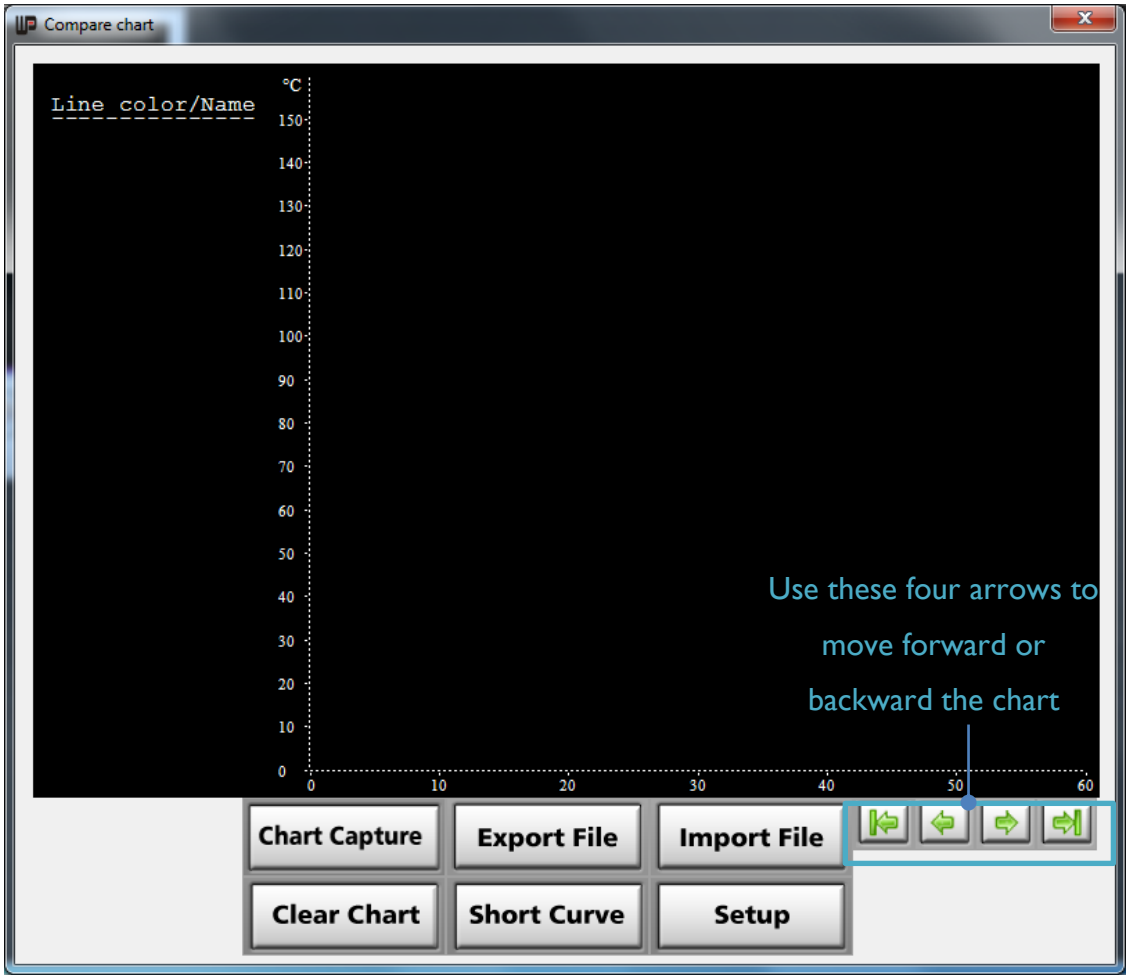


Connection retry	If user set 1 second, for example, system retries to connect the fermenter every 1 second when system fails to do so.
Charting time	The time interval of trend chart update. For example, if user set 5 second, then system will update charting data and show it every 5 second.
HMI sync	Click ON to synchronize fermenter charting data
Save file path	Click to choose desired save path

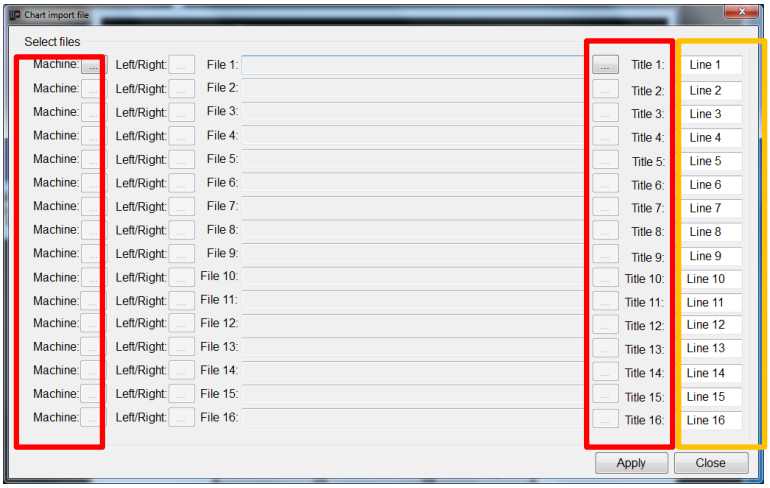
7.3.1.5 Compare chart

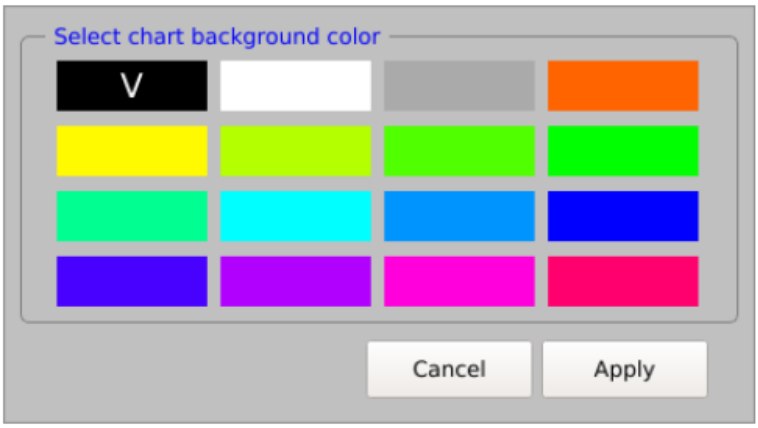
In Compare chart, user can compare single parameter diagram of current data or saved csv files. Detailed function is as followed.





1. **Import File** Click "Import File" to import files or current running machine data. Name the file at the right column.



2.	**Chart Capture**	Click “Chart Capture” The color-choosing dialogue will pop up. Choose and apply the desired background color.  The image of the chart will be exported and saves as png format.
3.	**Export File**	Tap the button to export the selected file as csv format.
4.	**Short Curve** **Long Curve**	To help user monitor the trend of fermentation accurately, the chart has “Long Curve” and “Short Curve” displays, which purpose of these 2 options is to zoom in and zoom out the curve. Fewer points of data will be display when user is using short curve display. Tap the button to switch the scale of curve.
5.	**Clear Chart**	Tap the button to clear the recorded data on present chart.
6.	**Setup**	**Select type**: Select parameter type **Y-axis**: User can input the maximum and minimum scale of Y axis in the followed blank. **Short/Long curve parameters:** ***(a) Data Width*:** The range showed on the screen of the chart ***(b) X Scroll Gap:*** The gap that every time user move the chart forward or backward by pressing  or  . ***(c) X Marker:*** The gap of X-axis scale.

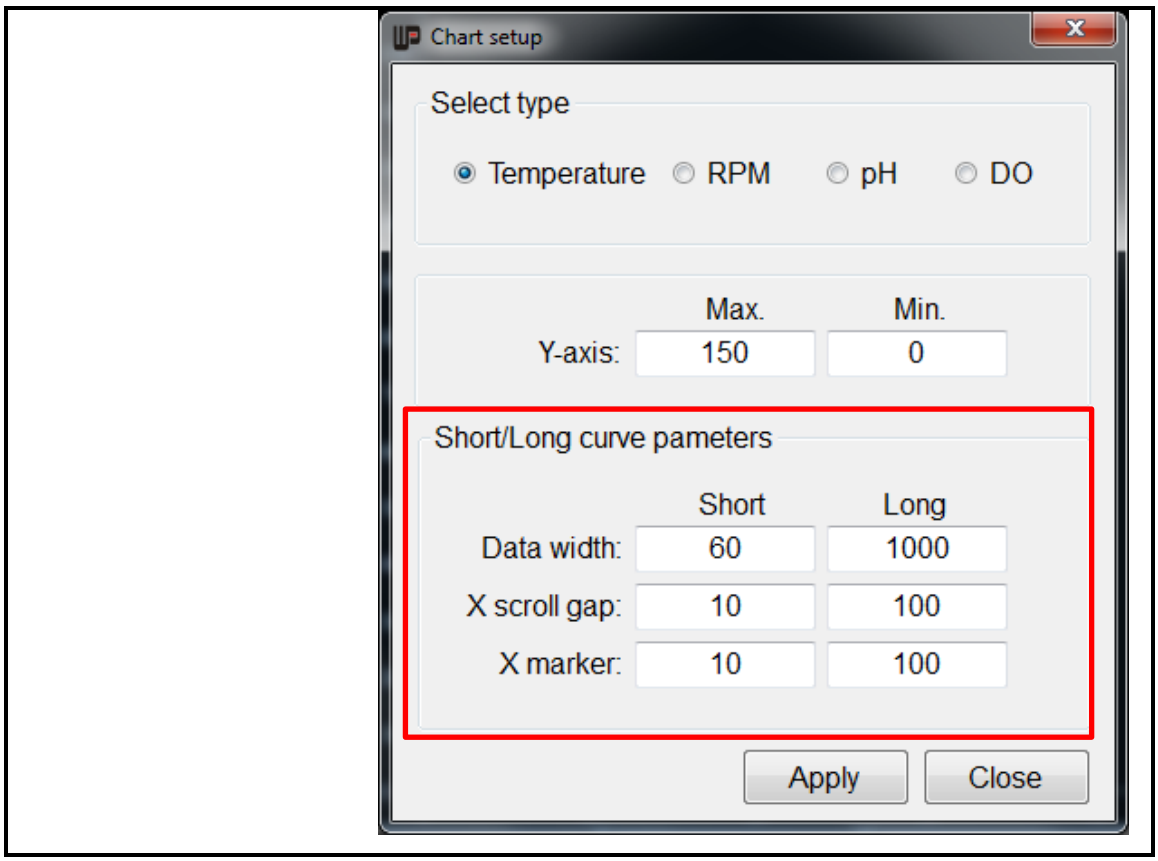
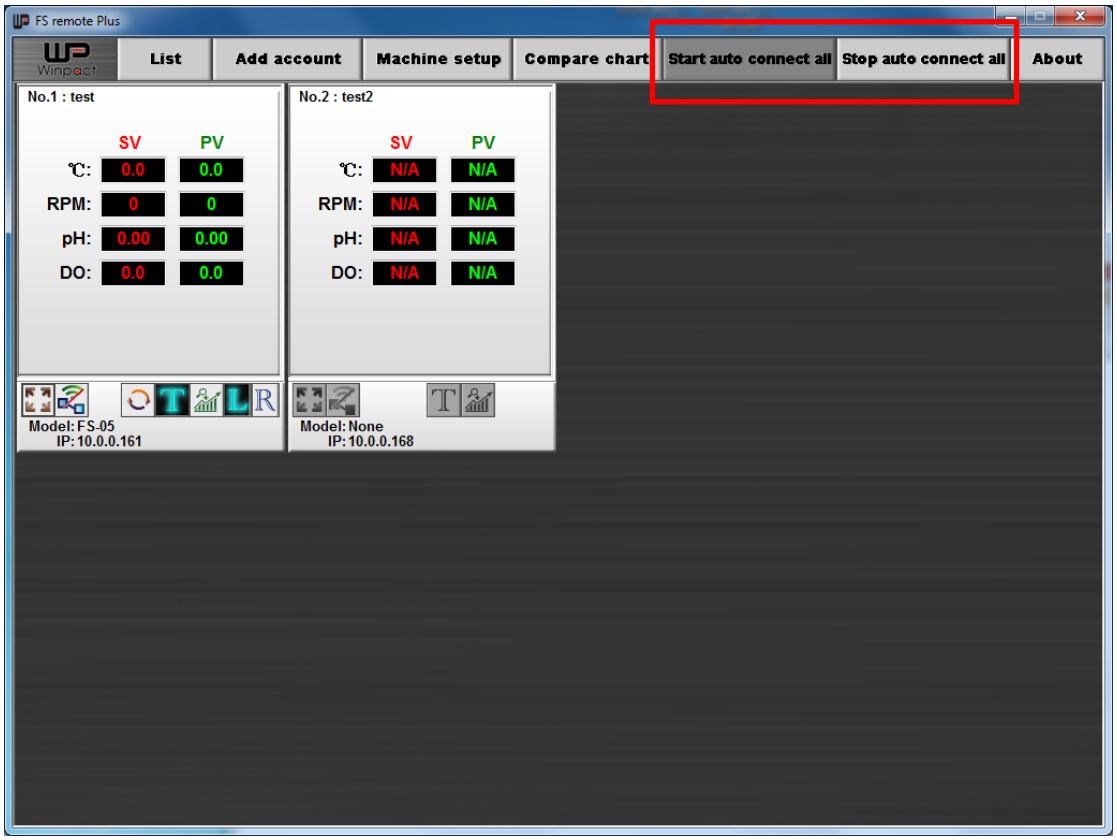


Chart setup
Select type
Temperature
RPM
pH
DO
Max.
Min.
Y-axis:
150
0
Short/Long curve pameters
Short
Long
Data width:
60
1000
X scroll gap:
10
100
X marker:
10
100
Apply
Close

7.3.1.6 Start/ Stop Auto Connect All

Click **Start auto connect all** to start connect multiple accounts; click **Stop auto connect all** to stop connect multiple accounts.



7.3.2 Inner Detailed Window

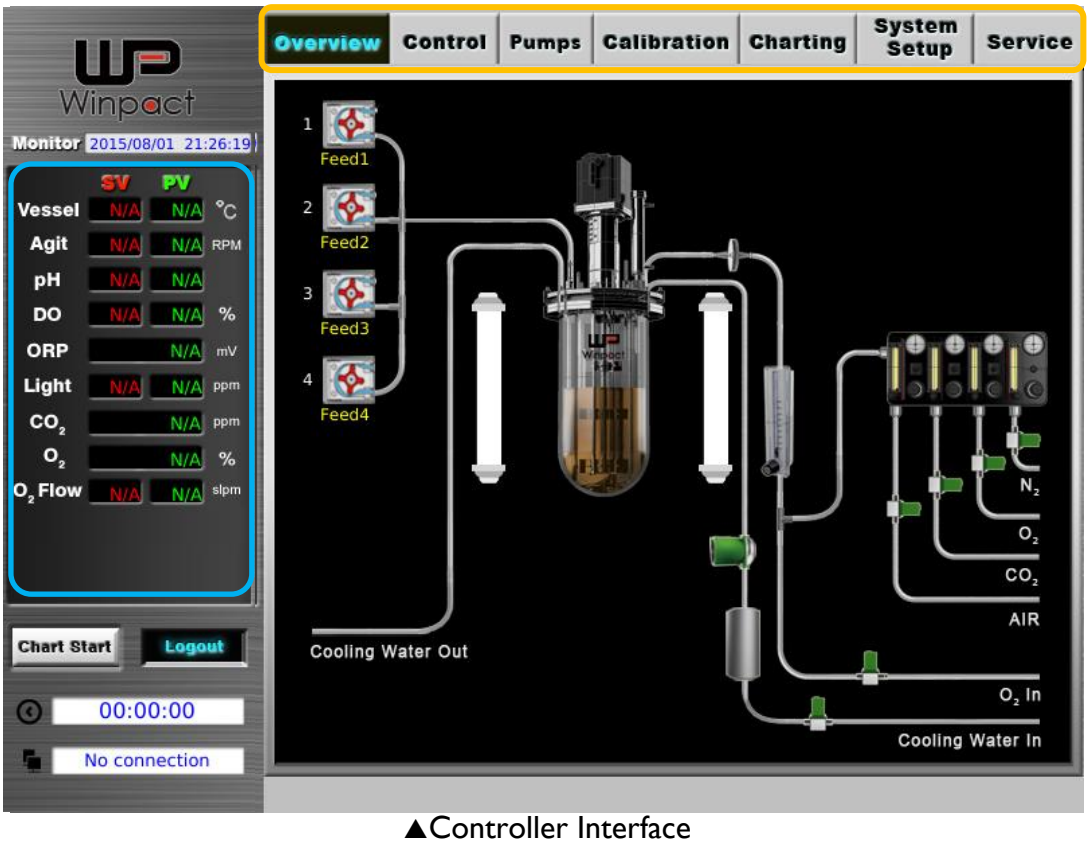
The interface of inner window software looks similar to the one on fermentor. However, there are some functions limited to control via remote control system. And the selection buttons of vessels at bottom-left corner are moved above to the pages. The rest of inner layouts on the remote control remain the same as it is on the controller.

Note:

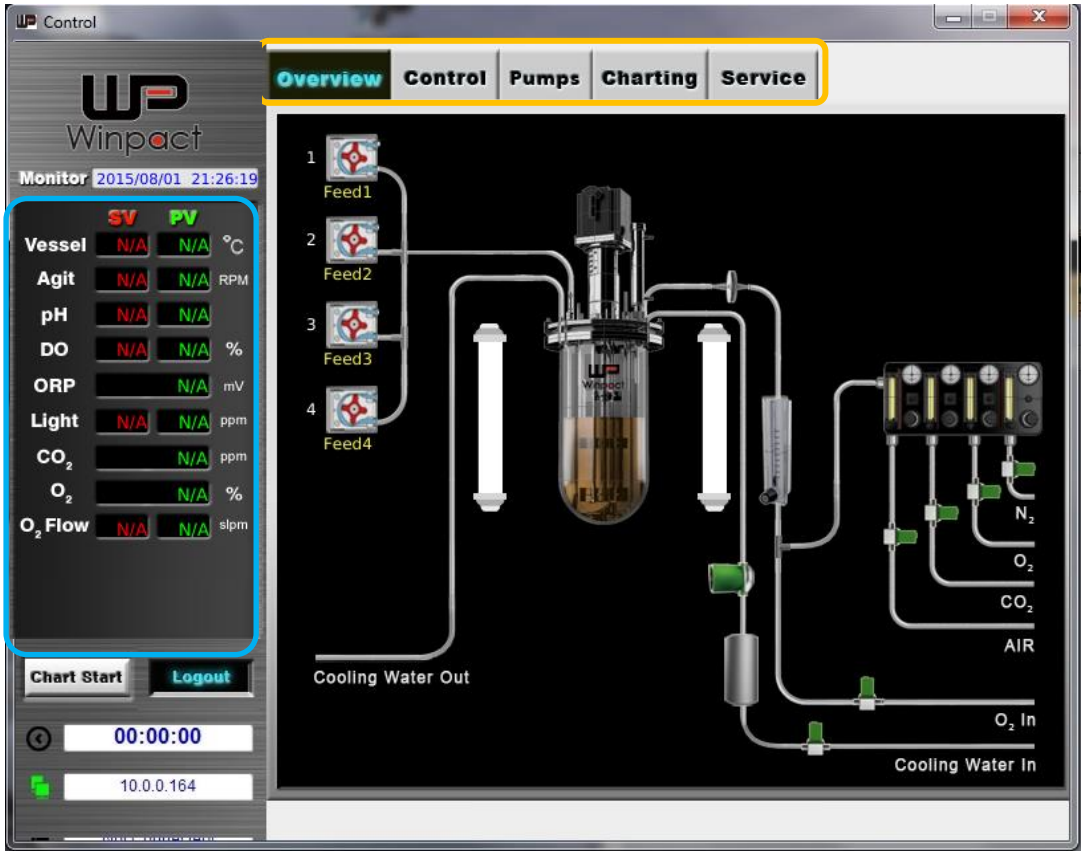
The optional application readings on remote control will show up only when you connect the related devices. If one of the optional devices is not connected to the controller, the reading columns will show "N/A", instead of a normal value.

7.3.1 Overview

The comparison of controller interface and remote control interface



▲Controller Interface



▲Remote Control Interface

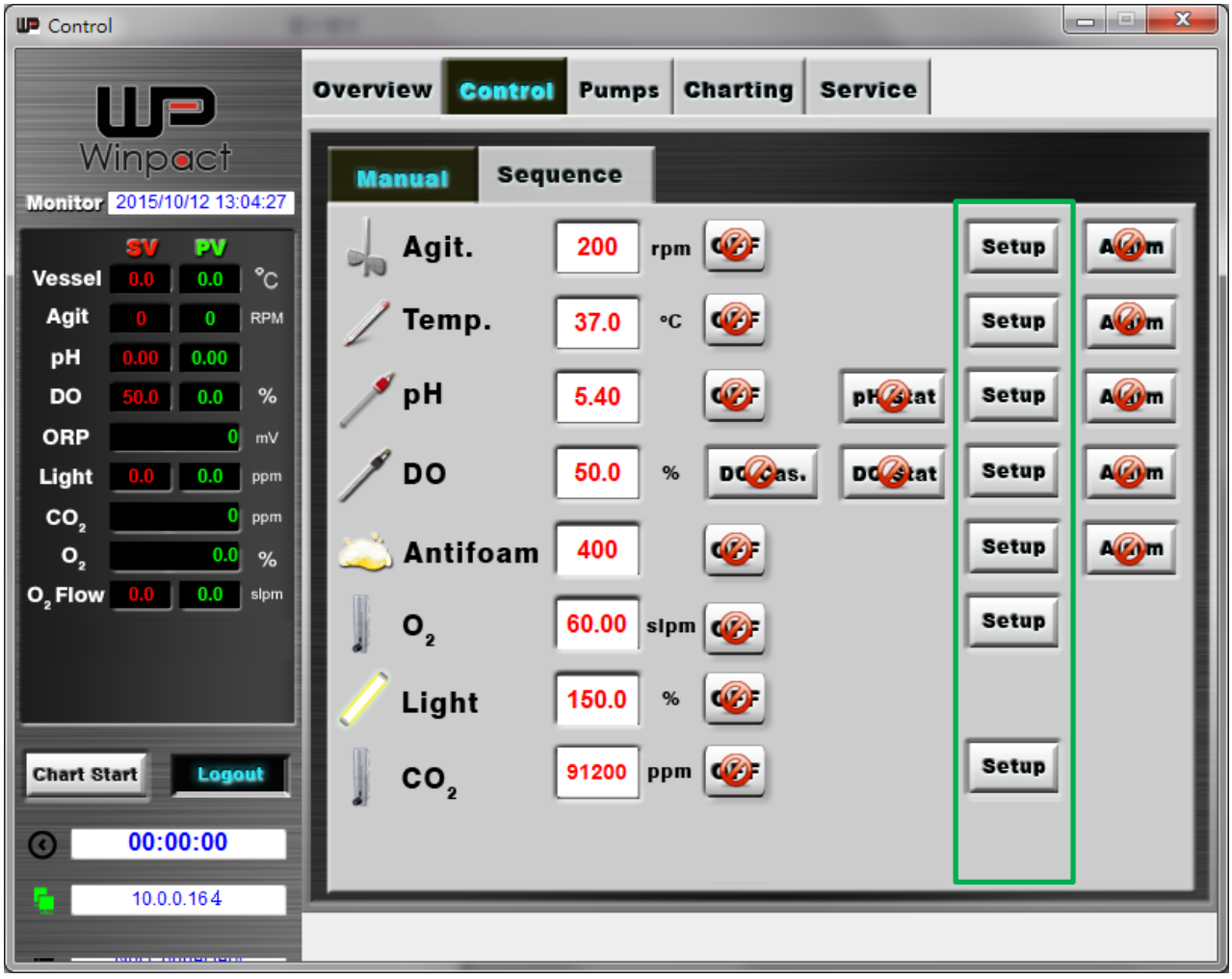
This page shows the current working condition of each device. If the device is operating, the indicator light will turn to flashing red.

Solenoid Valve	Circulation Pump	Heat Exchanger
		

7.3.2.2 Control

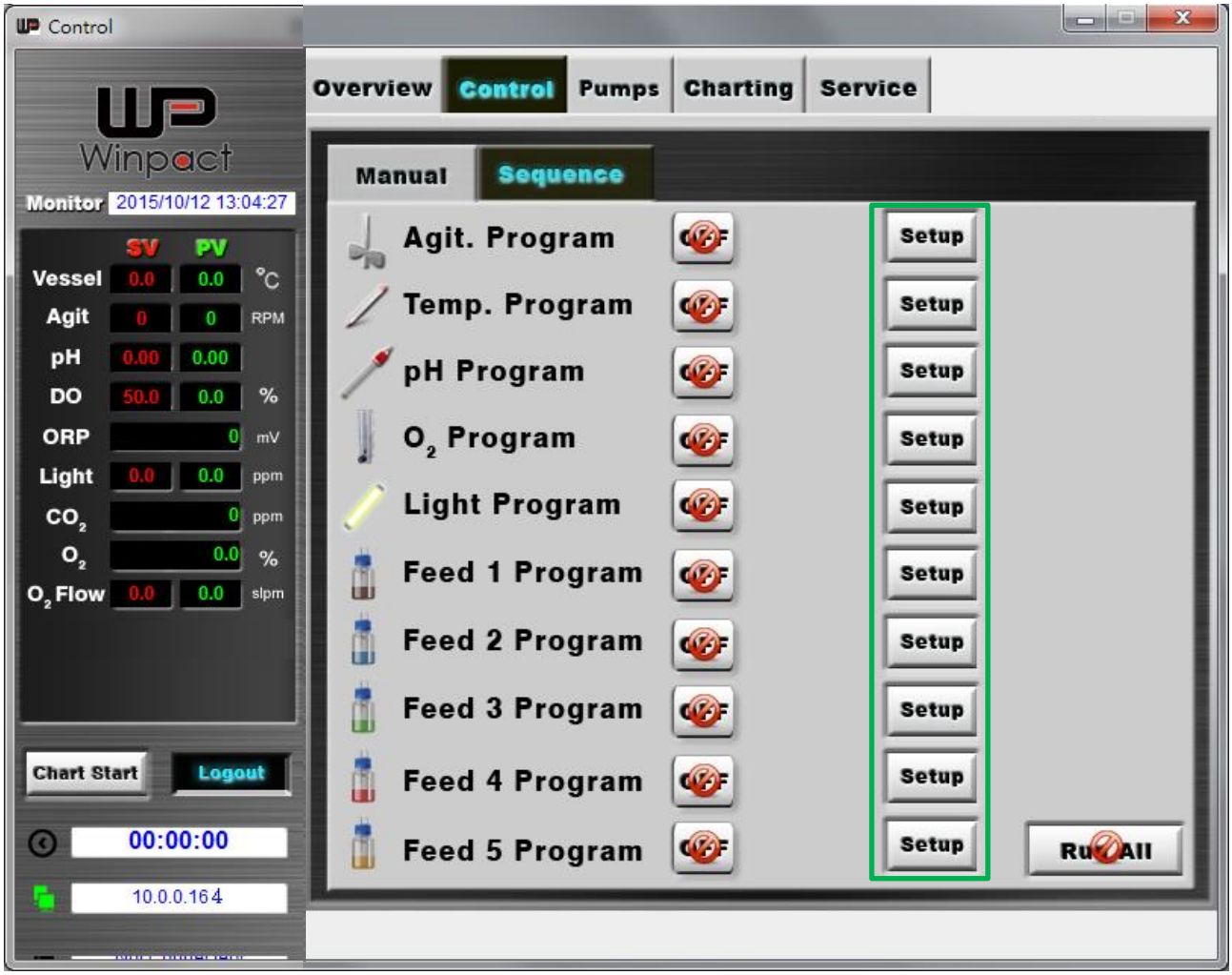
Manual

User can control "**Setups**" of agitation, Temperature, pH etc. on the manual page, the content of "**Setups**" are same as those of controller interface.



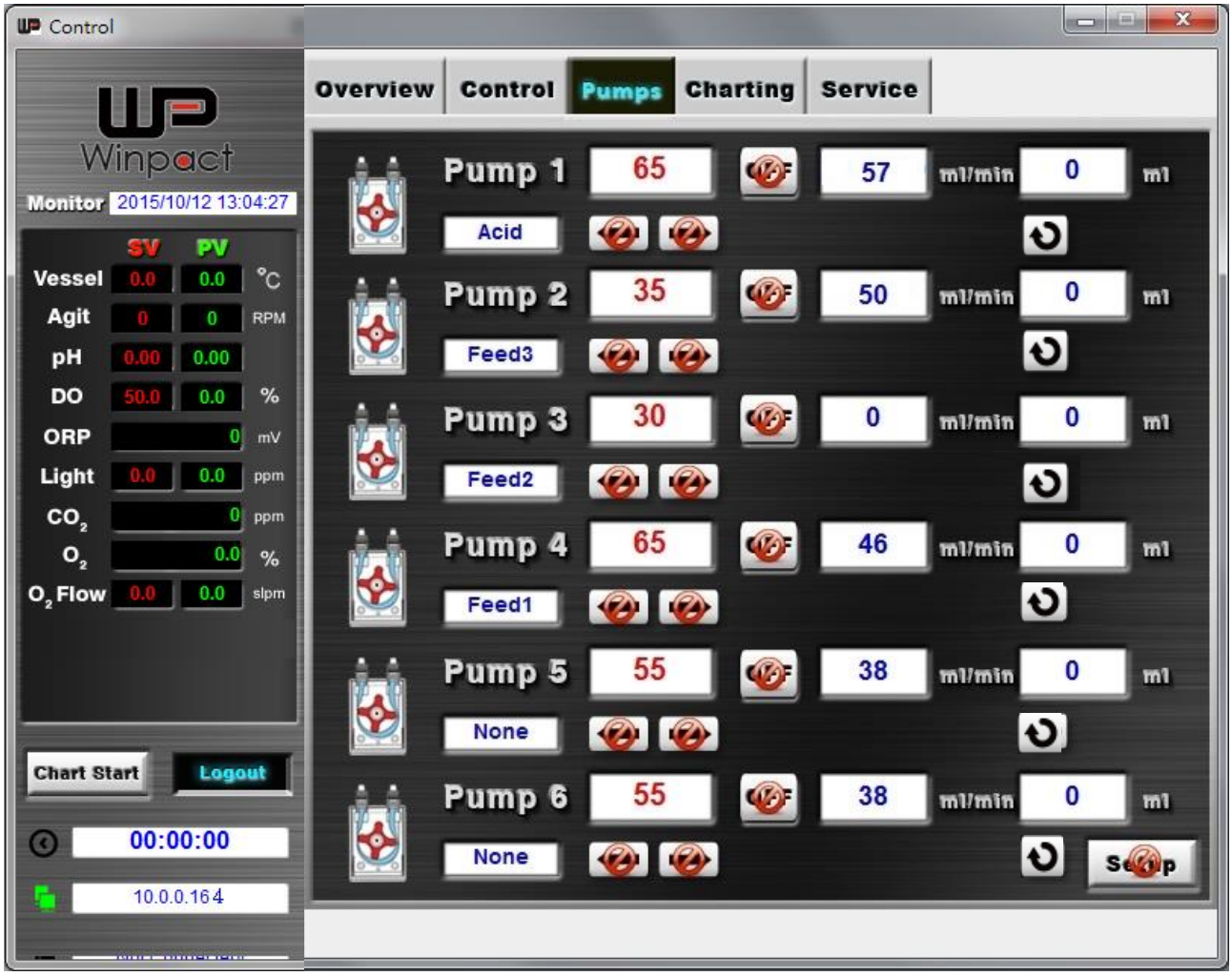
7.3.2.2 Sequence

User can control "**Setups**" of agitation program, Temperature program, pH program etc. on the sequence page, the content of "**Setups**" are same as those of controller interface.



7.3.3 Pumps

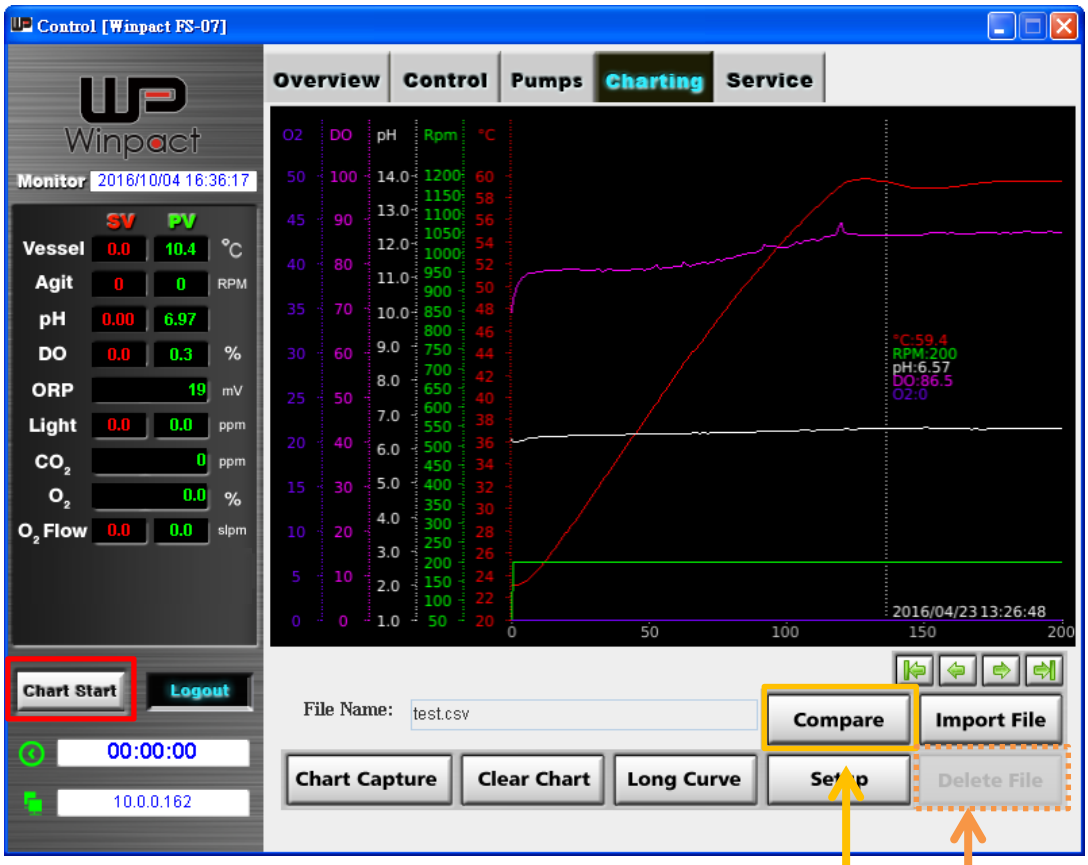
The **"Pumps"** page is limited in functions of turning on and off of each pump; however, user can change the speed of each pump and monitor the parameters in this page via remote control.



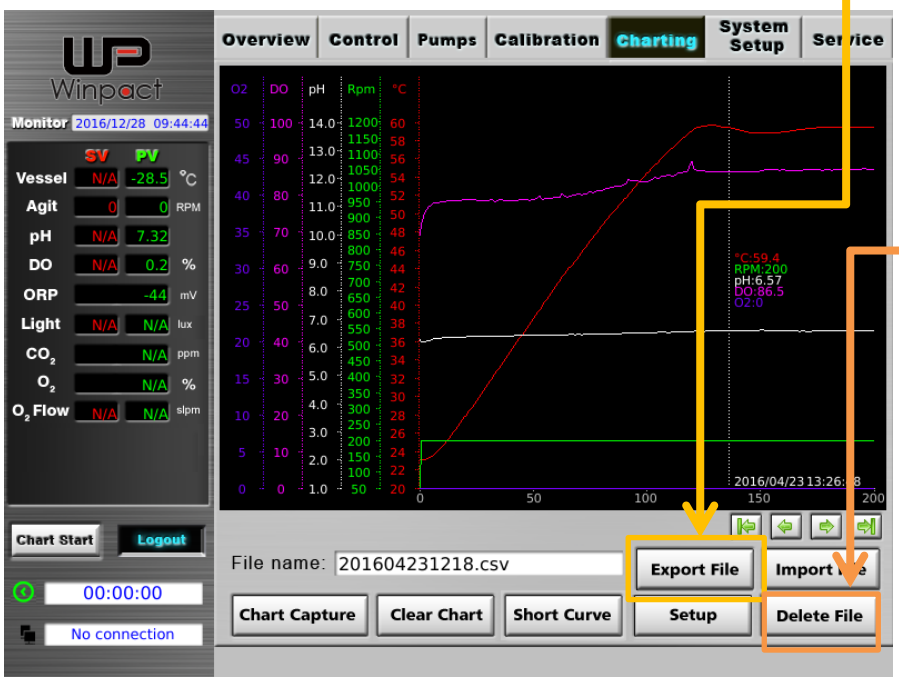
Click the column to input user's desired rotation speed.

7.3.4 Charting

During the fermentation, user can record the trend of process in the **"Charting"** page. The functions of "Delete file" are unable to operate in this page, since user can delete files on user's computer; also, the "Export File" function at controller is deleted in remote control since user could export files with other program. The exported file is saved when user press "**Chart Start**" and "**Chart Stop**". Instead of "Export File" function, the "**Compare**" function is added in the remote control.



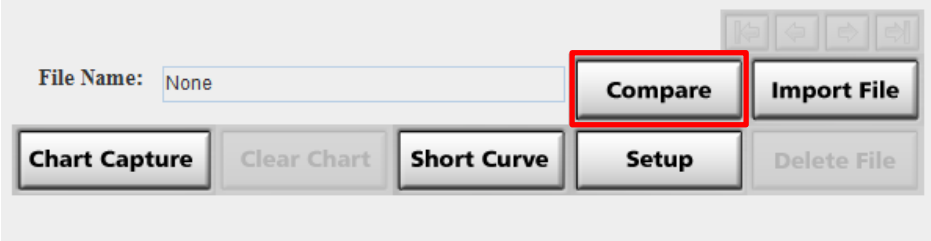
◀ Remote control interface

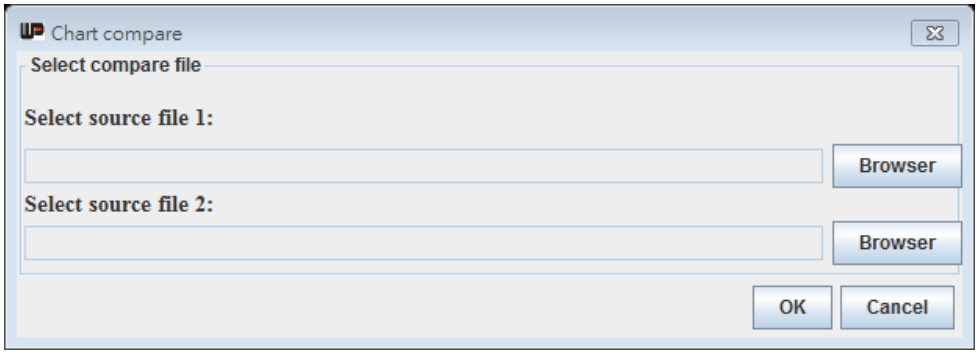


◀ Controller interface

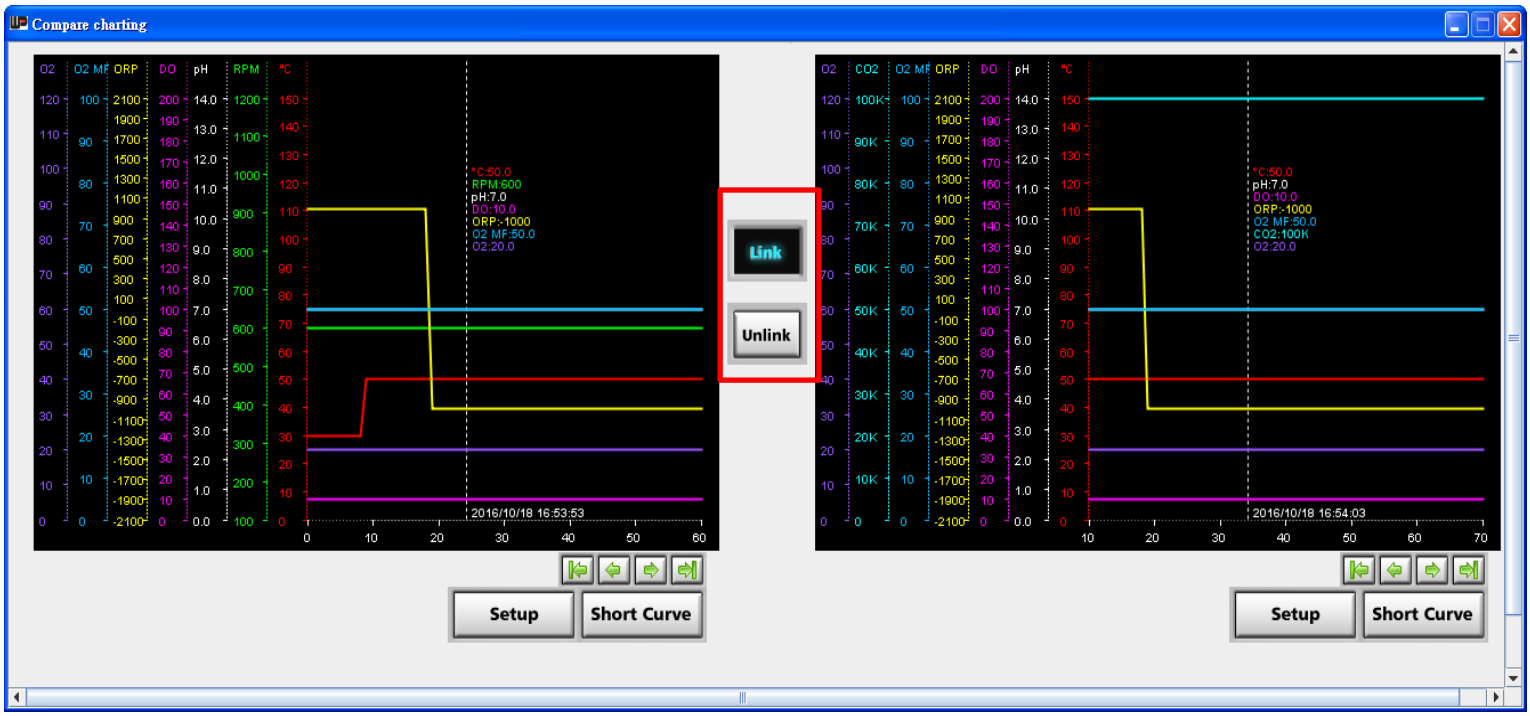
The Compared Image between Remote Control Interface & Controller Interface

In remote control, user could compare two charts on computer by clicking the "**Compare**" button; the file-choosing dialogue will then pop out. Select the source files and press OK, the chart-comparing page would show up.





Switch between "Link" and "Unlink" to observe the charts simultaneously or separately.



7.3.5 Service

There are 3 sections in the remote control interface: Relay Output, Status and System Logs. All the values and data are synchronized with those on the controller.

User can check **"System Logs"** by clicking the button of" System Logs". For more information, please refer to 5.7.1 Features of Service Interface.

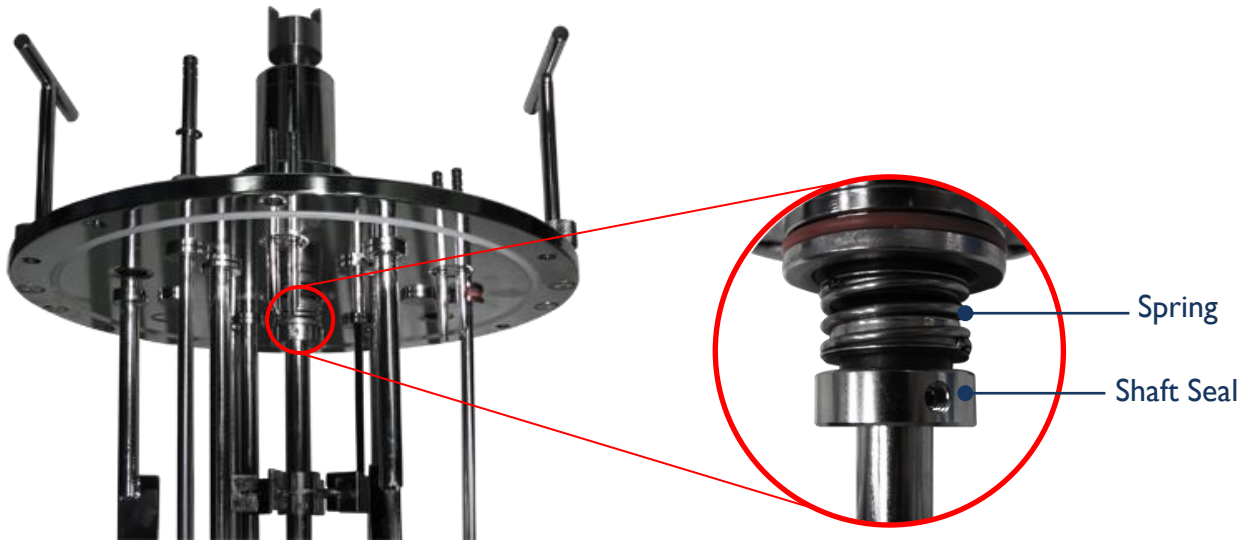
Chapter 8. Cleaning & Maintenance

8.1 Vessel Cleaning

1. Fill the vessel with a mild detergent and water solution.
2. Let the solution stay for 1 hour, and then clean the vessel thoroughly with a soft brush. The soft brush can be used for smaller parts and the areas that are hard to reach.
3. Drain the solution out of the vessel, and rinse several times with tap water.
4. Rinse a final time with distilled water, and allow to dry.

8.2 Shaft Seal Cleaning

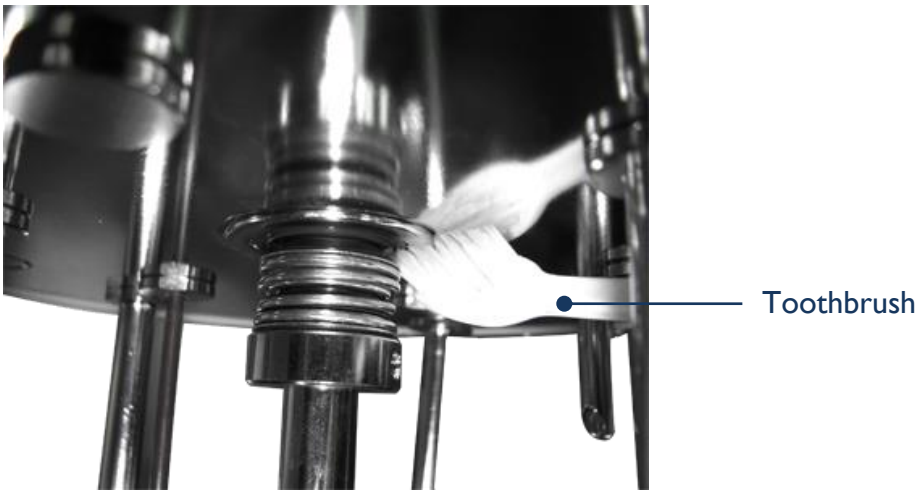
1. Remove the headplate from vessel. The shaft seal is located beneath the headplate (shown as below).



2. Use a small soft brush, such as toothbrush, to gently clean the surfaces of shaft seal and spring with tap water. Rotate the shaft while brushing the shaft seal and spring to make sure the whole surfaces of shaft seal and spring.

Note:

- DO NOT disassemble or loosen the shaft seal when cleaning.
- DO NOT touch or move the spring when cleaning.
- Remember brushing the parts gently.



8.3 Control Station Cleaning

The control station can simply be cleaned by wiping with a damp cloth or towel.

8.4 Cooling Tubing Cleaning

It is suggested to clean the tubing of cooling circuit for every 3 to 6 months to avoid blockage caused by sediment.

Connect the controller with chiller first. And pour citric acid solution prepared in advance into the tank of chiller.

When sediment is removed, use clean water to rinse the tubing.

Note:

It is suggested that mixing ratio of water to citric acid is approximately 15 : 1. User may adjust the amount of citric acid depending on the extent of sediment.

8.5 DO Probe Information & Maintenance

Please follow the instructions below to maintain your D.O. Probe:

A. Cleaning the probe

One effective way to remove contamination from the cathode surface is to wash it with a toothbrush and toothpaste. Then rinse with D.I. Water.

B. D.O. probe malfunction

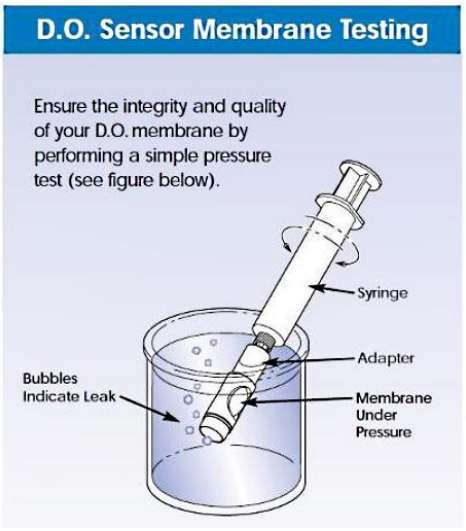
10 probable causes of D.O. sensor malfunction are listed below:

1. Punctured membrane.
2. Torn or ripple membrane.
3. Dirty cathode.
4. Dirty or fouled anode surface.
5. Damaged O-ring.
6. Missing O-ring.
7. Damaged cathode.
8. Dirty membrane.
9. Corroded connector.
10. Electrolyte level too low.

Reference: Summer 1998 Broadley-James corporation

C. Testing the D.O. sensor membrane

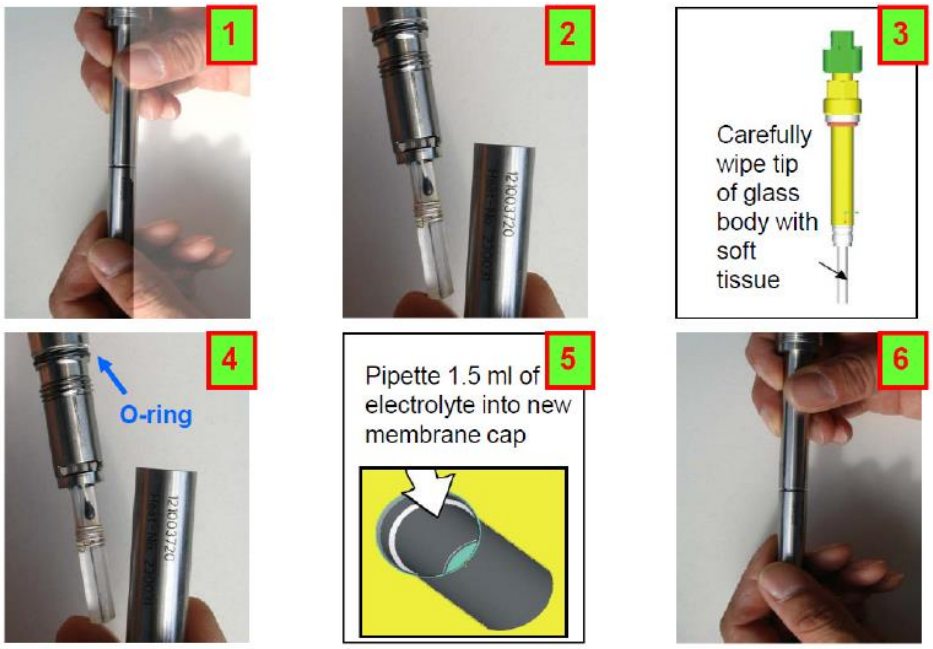
One simple way to test the membrane puncture is to connect the membrane cartridge with a syringe using an adapter. Monitor the bubble formation during pumping (See figure). Bubble formation may indicate leakage of the membrane.



D. *Membrane replacement and electrolyte refill*

1. Keep the sensor in an upright orientation, then unscrew the old membrane cap.
2. Remove the membrane, expose the glass body in the air.
3. Clean the tip of the glass body with a soft tissue.
4. Gently introduce 1.5 ml DO solution into the new membrane cap.
5. Carefully screw the new membrane cap onto the sensor shaft.

※ How to replace the DO solution



E. *Membrane kit*

1. DO solution, 20ml
2. Spare O-rings
3. Pipette
4. Polishing strip
5. Membrane cartridge

F. Storage and electrolyte replacement

The DO probe can be stored in 3M Potassium Chloride solution. The DO solution is used for inner cartridge electrolyte replacement. After using the probe a few times, you can check the solution condition by naked eyes (check if there is precipitation or color change). If precipitation or color change occurs, please replace with new solution.

8.6 pH Probe Information & Maintenance

Please follow the instructions below for your pH electrodes maintenance:

A. Cleaning the measuring electrode

Remove any deposits from the membrane or diaphragm by rinsing the electrode with mild detergents.

For calcium deposit, soak the electrode in a 0.1M HCl solution for a few minutes.

For proteins, soak the electrode in a solution of 1% pepsin and 0.1M HCl for several hours.

Inorganic coatings can be removed using commercially available glass cleaning solution (e.g., Windex).

Silver sulphide deposits, caused by the reaction of sulphides containing solution with silver chlorides in most electrodes, can be removed by soaking the electrode in a 0.1 M thiourea/HCl solution until the diaphragm is totally bleached.

To remove highly resistant deposits, hydrogen peroxide or sodium hypochlorite is recommended.

Rinsing the electrodes in a 0.1M HCl or 0.1M NaOH solution for a few minutes may be able to remove the acid or alkaline soluble deposits.

B. After cleaning

After the cleaning process, soak the pH electrode in the storage solution (3M KCl) for 12 to 24 hours. Cleaning solution may penetrate the diaphragm during cleaning. It is necessary to calibrate the pH measurement after the hydration process.

C. Storage of the electrode

For long-term storage, immerse the pH electrode in a 3M KCl solution.

D. Aging

Aging is unavoidable. However, proper maintenance can delay the process. Typical symptoms of an "aged" measuring electrode includes:

1. Increased response time.
2. Increased membrane resistance.
3. Declining slope, especially in the alkaline region.
4. Shift of the asymmetry potential (zero point shift).

Lifetime of each electrode depends on the operating and handling conditions. The electrodes have a maximum operating lifespan of 18 months if handled properly. The lifetime may only last 2 months if operated at the temperatures exceeding 90°C. The electrode stops working after only 2 weeks when exposed to strong base (pH > 13) and high temperature (> 90°C).

In most cases, we will find that pH electrodes age gradually. An increased response time is the most direct indication of aging. If the response time becomes unacceptable for your fermentation process control, we recommend replacing the pH electrode with a new one.

E. Storage solution

To prevent dehydration of the probe, we recommend storing the probe in the 3M Potassium Chloride solution every time after use.

Chapter 9. Ordering Information

Controller	
Catalogue. No.	***Description***
FS-07-110	Winpact Evo Fermentor / Bioreactor System, 110V
FS-07 -220	Winpact Evo Fermentor / Bioreactor System, 220V
Remote Control Software (which is contained in the package of FS-07-110/220)	
FS-A-SW	Go-Smart Winpact remote control software

Vessel Kit Package	
Catalogue. No.	***Description***
FS-V-SA05P	Solid state 5L double jacketed dish bottom vessel kit Including FS-V-SA05, Vessel holder set, Protective vessel cover in sterilization, Temperature probe & Temperature probe cable, Brushless motor
Startup Kit	
Catalogue. No.	***Description***
FS-A-SK25	Winpact Solid state Fermentation System Start-up Kit

Accessories	
Catalogue. No.	***Description***
FS-O-PC01	Protective Double Jacket 5L Vessel Cover in Sterilization