

User manual

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# **ARA G-FL**

Laboratory Fermenter System

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**A R A**

# ARA

## **Product Code**

ARA G-FL

## **Manufacturer**

Hanil Scientific Inc.

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[www.ihanil.com](http://www.ihanil.com)

## **Package**

1 set of Main Controller, Vessel Assembly, Motor, and Accessories

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RESEARCH USE ONLY

Doc. No. : UM-H\_G-FL(E)(Rev.1), 20220822

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# 1. Safety Precautions

## 1.1 General safety instructions

- 1) Before supplying power to use the bioreactor, remove all packaging materials used to prevent damage during transport.
- 2) Check if any of the necessary parts and devices are missing
- 3) Main Controller and Vessel should be installed flat, so they do not shake.
- 4) Install the product in a dry environment, avoiding high temperature and high humidity.
- 5) Check that there are no abnormalities in the tubes and valves connected to each device.
- 6) Connect the power cord securely to the device that requires power. This bioreactor uses 220V, 60Hz power.
- 7) Use only the cables supplied by the manufacturer. The manufacturer is not responsible for any problems caused by the user arbitrarily changing it.
- 8) The manufacturer is not responsible for any problems caused by improper operation by the user outside the range permitted by the product.
- 9) If water or other liquids are not used, they should be stored in a safe place and handled according to the instructions in the user's manual.
- 10) Do not arbitrarily change the gas and air supply tube. The manufacturer is not responsible for any problems caused by the user's arbitrary change and use.
- 11) Periodically inspect the equipment, wiring, and tubes for abnormalities.
- 12) Stripped or damaged cables must be replaced immediately upon discovery.
- 13) Do not overload with a properly sized electrical extension cord/power outlet.
- 14) Do not touch devices, sockets, outlets, or switches with wet hands

## 1.2 Precautions for use

- 1) Since the bioreactor is used in combination with several components, it is necessary to know the precautions for the use of each component.
- 2) Please check the following precautions one more time before using.
- 3) Check that none of the necessary components and devices are missing.
- 4) Check that there are no abnormalities in the tubes and valves connected to each device.
- 5) Make sure the power cable is properly-connected.
- 6) As this is an electrical device, be careful for an electric shock when handling it.
- 7) Make sure that there are no objects around the product.
- 8) Make sure that you have prepared the tools used to inject the culture medium or collect the results.
- 9) The culture capacity in the vessel should not exceed 70% of the total capacity.
- 10) When not operating the product, unplug the power cord and close the gas and air input valves.
- 11) When the liquid input port (4P feeding port) is not used, the port must be sealed to maintain the airtightness inside the vessel.
- 12) Be sure to clean the vessel after use, especially to ensure that the air vents are not blocked.
- 13) Be careful that the hot glass of the vessel may break if it comes in contact with cold water or a cold surface.
- 14) Do not apply excessive pressure to the glass vessel. If the exhaust port of the vessel is blocked, the pressure may increase and the vessel may break or endanger the surroundings.
- 15) When the air (gas) supply valve is opened, immediately check whether the air (gas) is flowing. If the air (gas) is not discharged from the exhaust port, immediately close the supply valve.

## 2. Check the packaging and components

### 2.1 Check the packaging

Upon receipt of the product, carefully check the condition of the box to make sure that the outside of the box has not been damaged during transportation.

### 2.2 Check the components

After opening the box, check that the list and components are correct, and if any components are missing, contact the place of purchase or service center.

### 2.3 Component List

Component	Quantity
Main Controller & cable	1
Vessel Assembly	1
Motor	1
Temp Sensor & cable	1
pH Sensor & cable	1
DO Sensor & cable	1
Foam Sensor & cable	1
Heating Plate & cable	1
Condenser	1
Air Pump	1
Air Filters	1 set
Spare parts	1 set
Reagent bottle	1 ~ 4

## 3. Product Overview

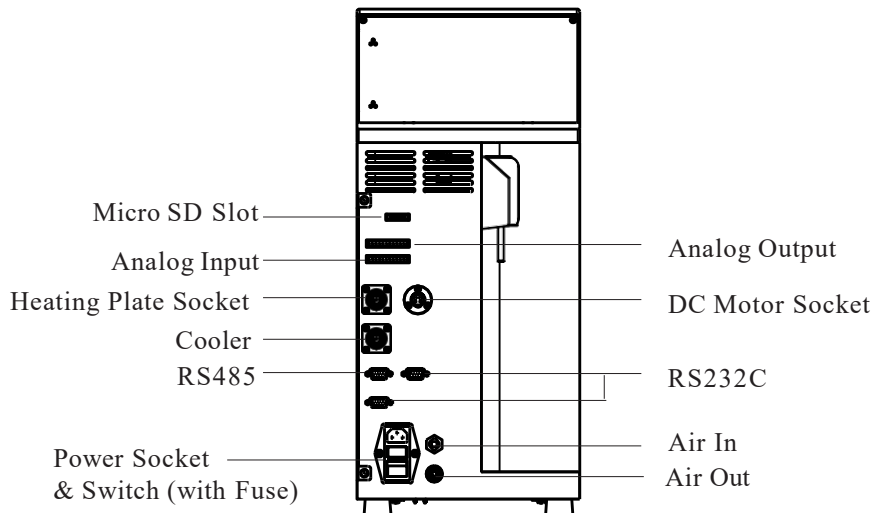
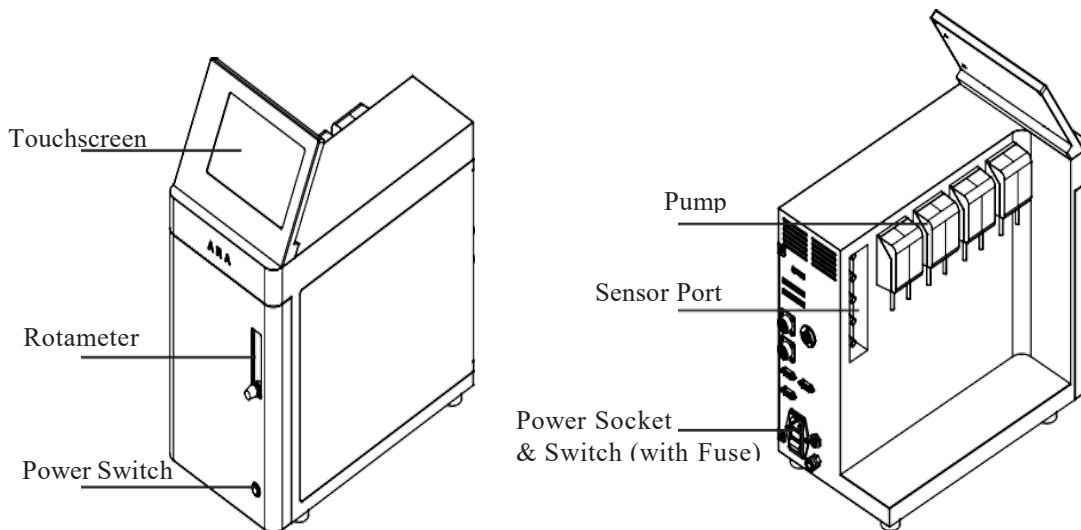
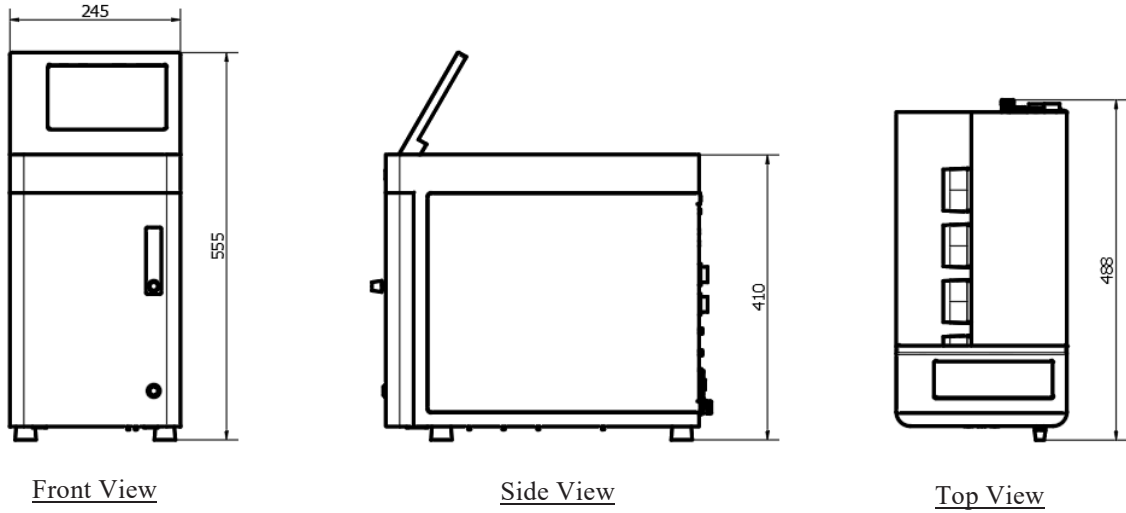
### 3.1 Summary

- Easy-to-operate 8-inch touch screen
- Compact structure that enables culture experiments in a small laboratory space
- Vessel size of various culture volumes from 1.5 to 14 L
- Single, Double, Bowl Type Vessel can be controlled
- Supports simple calibration function of temperature, pH, DO and form sensor
- Configurable Gas Mixer Controller to control the gas concentration
- Variable FEED and DO control (DO Control Mode) is possible
- All data such as temperature, pH, DO, and stirring speed are displayed in a graph
- Real-time data during incubation can be saved to a Micro SD card
- Data log file can be saved in Excel or CSV format to a Micro SD card
- Control is easy by an inverter function board, and quick A/S is possible in case of failure

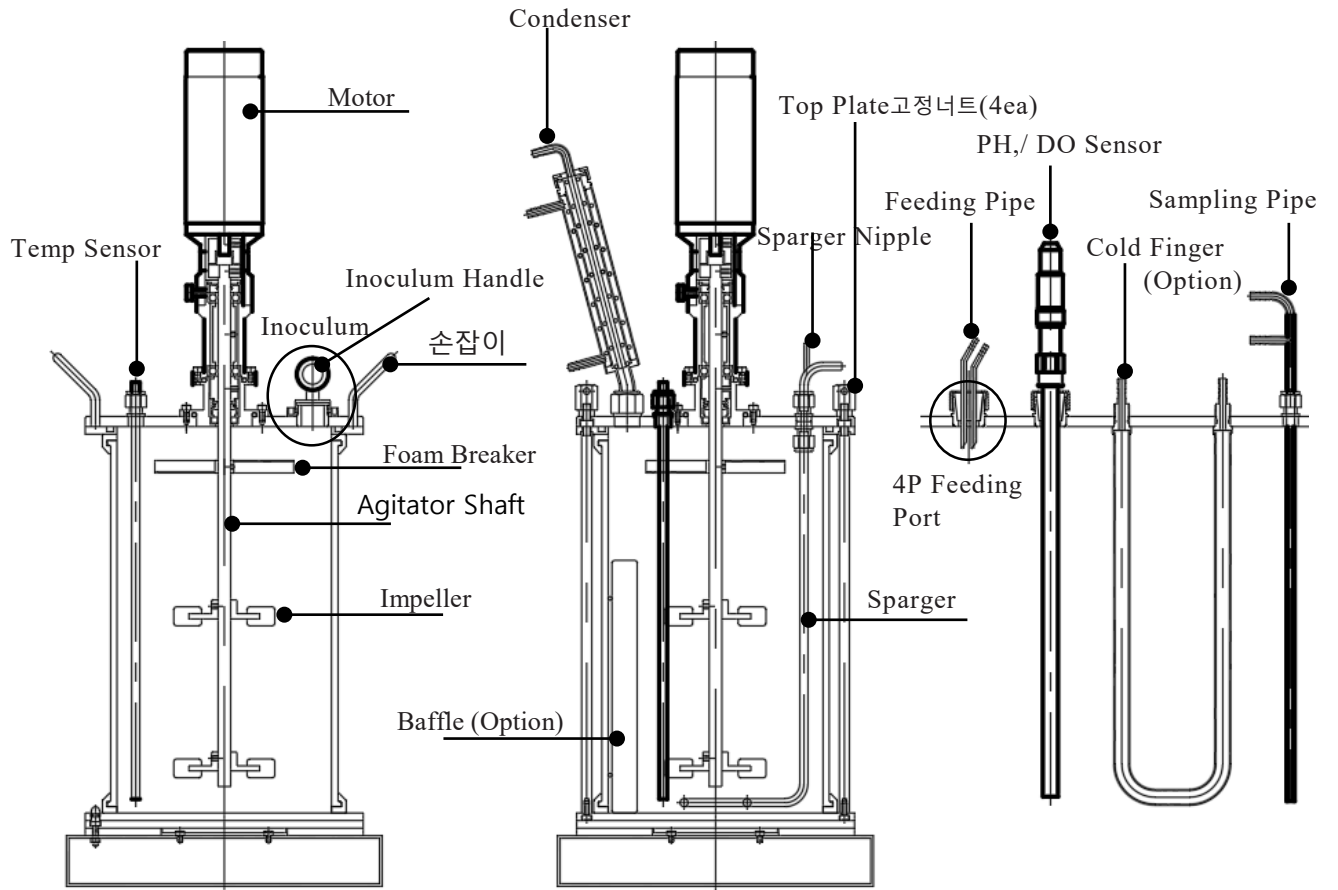


## 3.2 Product Composition

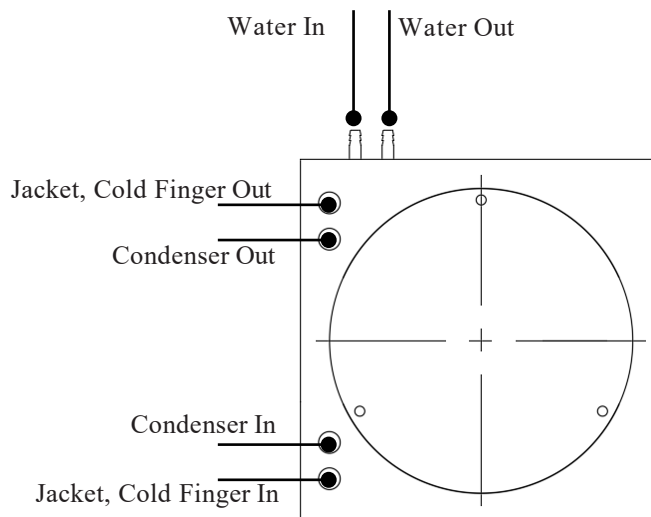
### 1) Main Controller



## 2) Vessel Assembly



## 3) Heating Plate



### 3.3 Specification

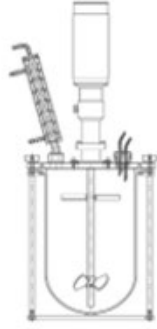
#### 1) Main Controller

Main Controller		8" Touch Screen IPS LCD capacitive
Temperature	Display	Digital display, Graph, incensement 0.1 °C
	Range	8 ~ 70°C (±0.5°C)
	Sensor	PT100
Agitation	Drive	Direct drive / Capacity select (60W: ~ 7 L, 150w: 10 L or more)
	Display	Digital display, incensement 1 rpm
	Range	60 ~ 1,200 rpm
pH	Display	Digital display, incensement 0.01 pH
	Range	2 ~ 14
	sensor	EasyFerm Plus PHI K8, pH probe
DO	Display	Digital display, incensement 0.1 %
	Range	Air 0 ~ 100 %
	Sensor	OxyFerm FDA VP, DO probe
Antifoam		Conductivity type
ORP	Display	Digital display, incensement 0.1 %
	Range	± 2,000 mV
	Sensor	EasyFerm Plus ORP S8 225
Pump		Assignable peristaltic pump, 102R 14 rpm
Power Consumption		AC 220 V 50/60 Hz, Single phase, 50 watt
Dimension		245 x 478.5 x 555 (W x D x H mm)
Weight		16.2 kg

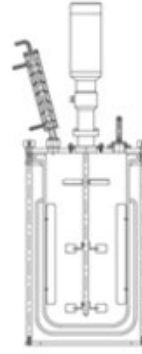
2) Vessel Assembly



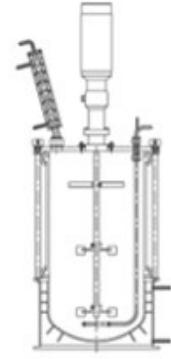
1. Single Vessel  
(1.5L, 3L, 5L 7L, 10L)



2. Single Round Vessel  
(3L, 5L)




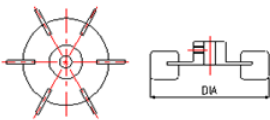

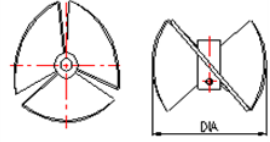

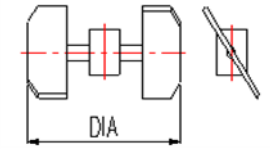
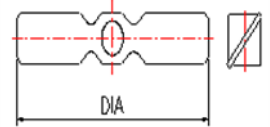
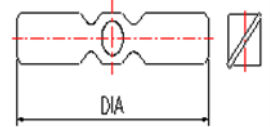
3. Double Vessel  
(3,5,7L)



4. Bowl Vessel  
(10, 14L)

		1.5	3	5	7	10	14
Single	Working Vol.(L)	1.0	2.0	3.0	5.0	7.0	-
	Diameter(mm)	114	133	170	170	190	-
	Height(mm)	160	220	208	388	345	-
	Top Plate Dia. (mm)	162	190	210	220	250	-
	pH/DO Sensor Length (mm)	120	225	225	325	325	-
	Temp. Sensor Length (mm)	170	235	235	315	355	-
Single Round	Working Vol.(L)		2.0	3.0			
	Diameter(mm)		143	160			
	Height(mm)		250	280			
	Top Plate Dia. (mm)		240	240			
	pH/DO Sensor Length (mm)		225	225			
	Temp. Sensor Length (mm)		235	285			
Double	Working Vol.(L)		2.0	3.0	5.0		
	Diameter(mm)		124	143	160		
	Height(mm)		270	300	340		
	Top Plate Dia. (mm)		190	220	240		
	pH/DO Sensor Length (mm)		225	325	325		
	Temp. Sensor Length (mm)		285	315	355		
Bowl	Working .l.(L)					7.0	10.0
	Diameter(mm)					190	190
	Height(mm)					355	500
	Top Plate Dia. (mm)					250	250
	pH/DO Sensor Length (mm)					325	425
	Temp. Sensor Length (mm)					355	355

3) Impeller and Foam Breaker

Type	Diagram	Description	Dia. (mm)
Rushton turbine 		<p><b>Rushton turbine</b> impeller is a flat bladed type that has low resistance and can rotate at high speed, which is why it is generally used the most. It is suitable for culturing bacteria, yeast and fungi with low shear sensitivity.</p>	75, 90, 110
Marin 		<p><b>Marin Impeller</b> has a flat or curved top surface and a convex back surface, useful when gentle mixing is required which causes less damage to the cells.</p>	65, 80, 100
Pitched paddle 		<p><b>Pitched paddle impeller</b> creates vertical and horizontal fluid flow depending on the angle of the wing, and is designed to mix gently without causing cell damage. Also widely used in high-viscosity fermentation processes such as fibrous Bacteria, fungi, and anaerobic culture.</p>	65, 80, 100
Foam Breaker 		<p><b>The foam breaker</b> is used to remove the foam generated during incubation in the vessel. Install it inside the working volume of the vessel.</p>	55, 60, 80

## 4. Product assembly and installation

### 4.1 Before installation

- 1) The surface which the product will be installed must be flat and hard.
- 2) When installing the product on a workbench, it must be able to support the weight of the product.
- 3) Sufficient space is needed to install all auxiliary instrument on the side and rear of the main instrument
- 4) The proper operation conditions are ambient temperature of 10 ~ 30 °C, and a maximum relative humidity of 80%.

### 4.2 Vessel Assembly



The vessel is assembled at the factory before delivery

- 1) Installing the Foam Breaker and Impeller.
  - ① Insert the Foam Breaker, Impeller 1, and Impeller 2 into the Agitator Shaft in order.
  - ② Place the Foam Breaker 30 ~ 50 mm away from the bottom of the Top Plate and fix it by tightening the socket set screw (M3 x5).
  - ③ Place Impeller 1 (center position) at the center position of the agitator shaft and fix it by tightening the socket set screw (M3 x5).
  - ④ Place Impeller 2 (bottom position) 15 mm away from the lower end of the agitator shaft and fix it by tightening the socket set screw (M3 x5).
  - ⑤ Depending on the capacity and characteristics of the culture medium, the location of the Foam Breaker and the quantity and location of the Impeller can be changed.
- 2) Installing the Sparger
  - ① Insert the nut (Φ6.35), Back Ferrule, and Front Ferrule into the sparger in order.
  - ② Insert the sparger into the sparger port at the bottom of the top plate and tighten the nut.
  - ③ When assembling, be careful not to let the ferrule and nut come off, tighten the nut by hand, and tighten an additional 1 1/4 turns with a spanner. When reassembling, tighten an additional 1/4 turn.
  - ④ Assemble the lower part of the sparger 10mm away from the bottom of the vessel.
  - ⑤ Insert the sparger nipple into the sparger port on the top of the top plate and tighten the nut.

### 3) Installing the 4P Feeding Port

- ① Insert 4 Feeding Pipes ( $\Phi 4$ ) into each of the 4 holes in the rubber stopper.
- ② Insert the rubber stopper with the feeding pipe into the 4P Feeding Port of the Top Plate and tighten the rubber cap nut.
- ③ After assembling the Top Plate and Vessel, connect the silicone tubes (Acid, Base, Feed, Anti-Foam) connected to the Peristaltic Pump to each of the 4P Feeding Pipes.

### 4) Installing the Sampling Pipe

- ① Insert the nut ( $\Phi 6.35$ ), Back Ferrule, and Front Ferrule into the sampling pipe in order.
- ② Be careful not to let the ferrules and nuts fall out, insert the sampling pipe into the sampling port on the top of the top plate vertically and tighten the nut to assemble.
- ③ Determine the discharge direction of the sampling pipe, tighten the nut by hand, and tighten an additional 1 1/4 turns with a spanner. When reassembling, tighten an additional 1/4 turn.

### 5) Inoculum

- ① Insert the Inoculum Dish (flame dish) into the Inoculum Port.
- ② After inserting the O-ring to prevent leakage inside the Inoculum Handle, Assemble the Inoculum Handle to the Inoculum Port by turning it clockwise.

### 6) Installing the Baffle (Option)

- ① Remove the Top Plate Assembly from the Vessel.
- ② Roll the baffle so that it can be put into the vessel and insert it so that the three sides of the baffle blade touch the floor.
- ③ Be careful not to interfere with the sampling pipe, temp sensor, cold finger, etc. of the top plate assembly and the baffle.

### 7) Installing the Cold Finger (Option)

- ① Assemble O-ring on both nipples of Cold Finger.
- ② Align the cold finger nipple from the bottom of the top plate to the cold finger hole and assemble it upward.
- ③ Tighten the nut to the nipple of the Cold Finger that comes up the Top Plate.

8) Top plate assembly and sensor installation

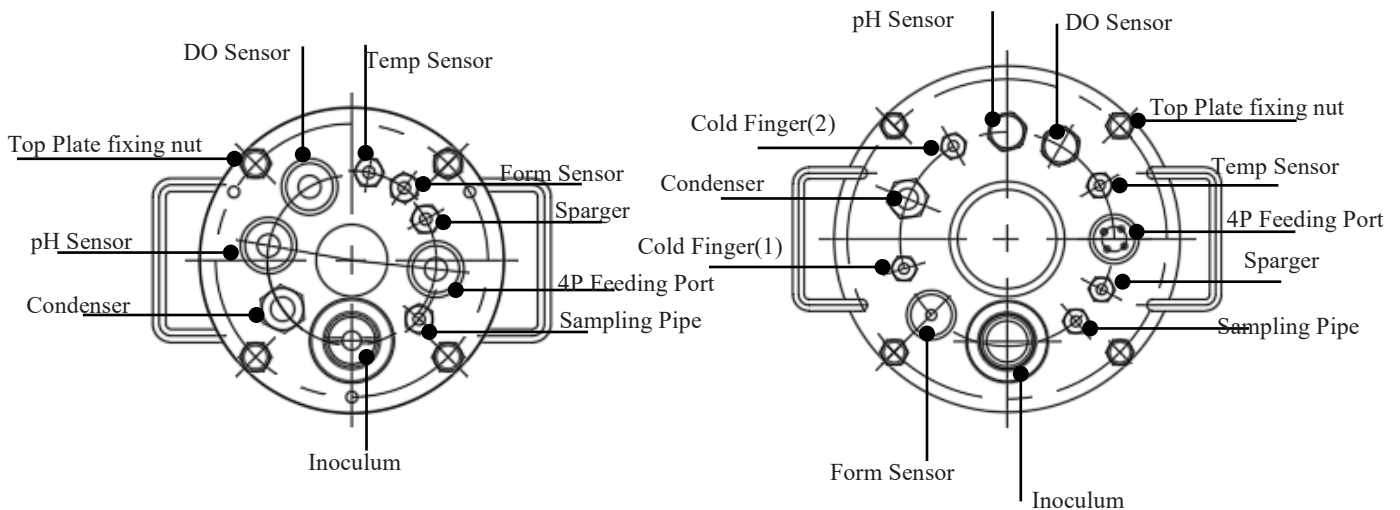
- ① Insert the gasket on the upper part of the vessel.
- ② After installing the Top Plate on the Vessel, tighten the Top Plate fixing nut. Tighten the Top Plate retaining nuts diagonally. Make sure that the sampling pipe, sensors, and cold fingers do not interfere with the baffle.
- ③ Install the sensors (pH, DO, Temperature, Foam) accordingly in the TOP Plate port.



The top plate has a different structure depending on the order specifications.

[ 1.5 L ]

[ 3 ~ 10 L ]



9) Installing the Condenser

- ① Insert the Back Ferrule and Front Ferrule into the inside of the nut ( $\Phi 6.35$ ) in order and assemble them in the Condenser port on the top of the Top Plate.
- ② After inserting the pipe under the condenser into the nut, tighten the nut to assemble.
- ③ When assembling, be careful not to let the ferrule and nut come off, and then tighten the nut by hand and then tighten another 1 1/4 turns with a spanner. When reassembling, tighten 1/4 turn more.

### 4.3 Heating Plate Assembly and Water Line Connection

- ① Place the vessel assembled with the TOP Plate in alignment with the mounting groove of the heating plate.
- ② Connect the water lines (cooling water, condenser, jacket, cold finger) according to the In and Out positions of each nozzle of the heating plate.
- ③ After connecting the water line, fix the tube with a tubing tie or hose band so that it does not fall out.

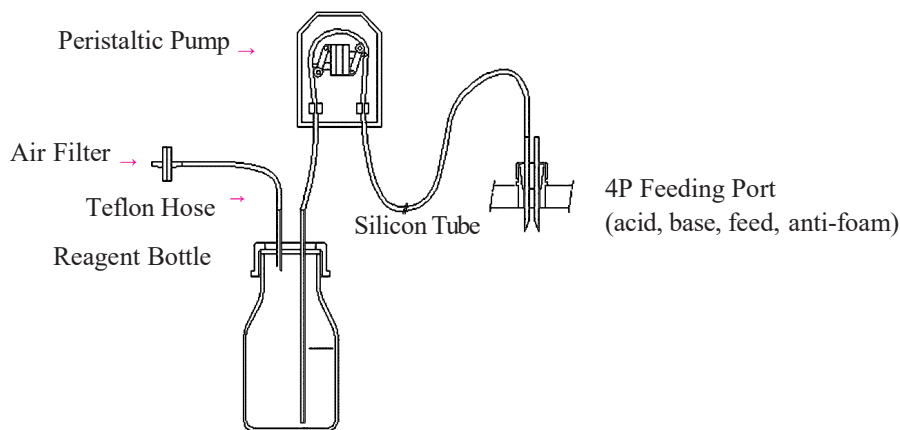


## 4.4 Installing the Motor

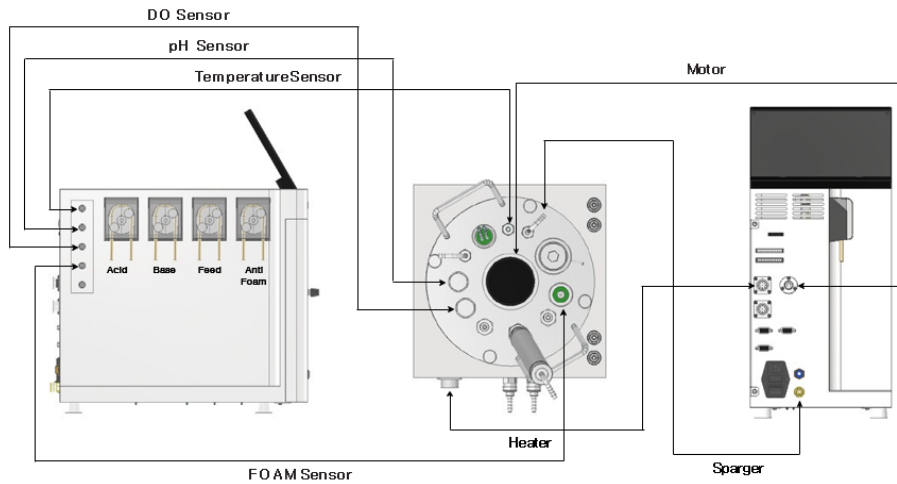
- ① Insert the motor by aligning the coupling groove in the center of the TOP Plate.
- ② Tighten the motor fixing bolt by turning it clockwise.

## 4.5 Silicone Tube and Cable Connection

- ① Connect the silicone tubes (Acid, Base, Feed and Anti-foam tube) to the Peristaltic Pump as shown in the figure below.
- ② To connect the silicone tube to the Peristaltic Pump, open the acrylic cover of the Pump and Insert the tube carefully to secure it and close the cover.
- ③ Connect the silicone tubes to the 4P Feeding Port.



- ① Connect each Sensor cable to the Sensor port on the side of the Main Controller.
- ② Connect the motor power cable to the DC Motor Socket on the back of the Main Controller.
- ③ Connect the heating plate power cable to the heating plate socket on the back of the main controller.
- ④ After checking the power rating, connect the power cable to the power socket on the back of the main Controller



## 4.6 Air Connection

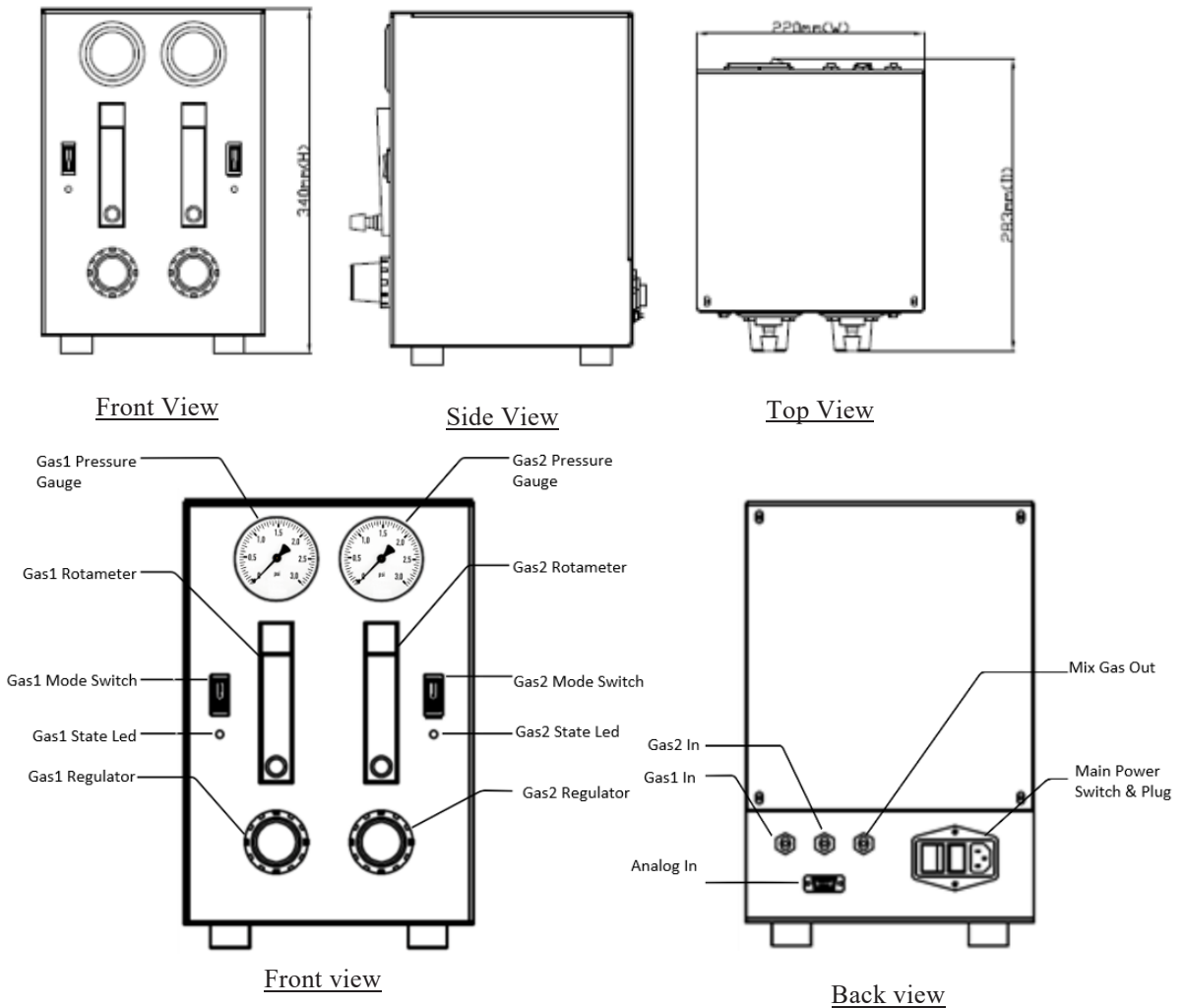
- ① Connect the air outlet of the air pump to the air in port on the back of the main controller with an air hose.
- ② Connect the Air Out Port on the back of the Main Controller and the Sparger Nipple on the TOP Plate with an air hose.
- ③ For the amount of air supplied to the vessel, refer to the Rotameter Air Flow Rate below.

### [Rotameter Air Flow Rate]

Total Vol. (Work Vol.) (L)	Min Vol. (L)	Air Flow Meter (cell culture)	Air Flow Meter (fermentation) 1 VVM
0.5 (0.3)	0.1		
1.5 (1)	0.5	0.5 L/min	0.2~2.5L/min
3 (2.1)	0.8	0.5~1.5 L/min	0.5~3L/min
5 (3)	1	0.5~2.5 L/min	0.5~5L/min
6.5 (5)	1	~2.5 L/min	1~10L/min
10(7)	3	5 L/min	1~10L/min

## 4.7 Gas Mixer Connection (Option)

### 4.7.1 Gas Mixer composition



### 4.7.2 Installing Gas Mixer (2 gas)

- 5 Connect the gas (N<sub>2</sub>, O<sub>2</sub>, CO<sub>2</sub>, Air, etc.) supply port, Gas1, and Gas2 port to the back of the gas mixer with an air hose (Φ4).
- 6 The input and discharge rates of the connected Gas1 and Gas2 lines are controlled by the main controller (pH, DO) by switch and solenoid valve.
- 7 Mixed Gas1 and Gas2 are discharged to the Mix Gas Out Port, so use the air hose (Φ4) to Connect the port and the sparger nipple to supply the mixed gas to the vessel.
- 8 When adjusting the amount of each gas, set the same pressure of the regulator and use the gas rotameter to make fine adjustments.
- 9 Make sure that the sum of the rotameter capacity (L) of each gas does not exceed the capacity (L) of the vessel.

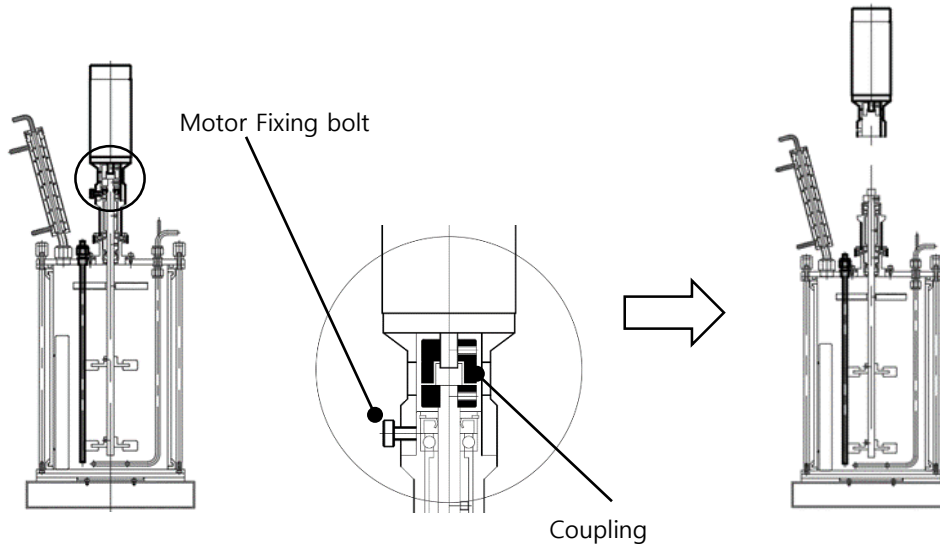
### 9.1.1 Installing Gas Mixer (4 gas)

- ① Connect Gas 3 and Gas 4 in the same way as the Gas Mixer.

## 5. Disassembly and cleaning

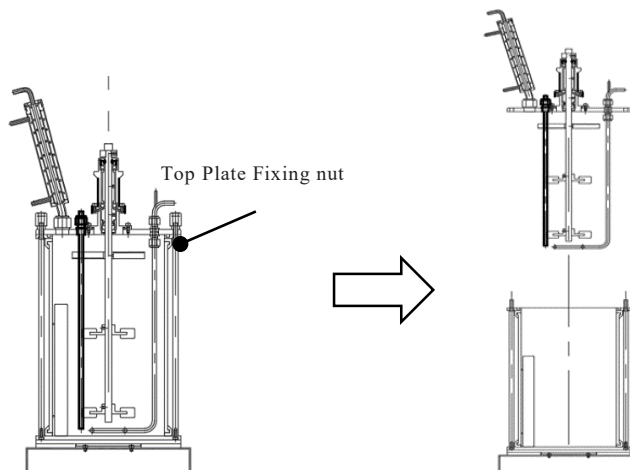
### 5.1 Disconnecting the motor

- 1) Disconnect the motor power cable from the Main Controller.
- 2) Loosen the motor fixing bolt by turning it counterclockwise, then lift the motor in the vertical direction to remove.



### 5.2 Top Plate Disassembly and Vessel Cleaning

- 1) Remove all cables and tubes connected to the vessel.
- 2) After loosening the 4 top plate fixing nuts counterclockwise, lift the top plate assembly in the vertical direction to remove.



- 1) Wash the vessel with a soft brush using a non-abrasive detergent and rinse with purified water, then dry.
- 2) Avoid contact with metal to the glass of the vessel.
- 3) Wash the Top Plate Assembly with a soft brush using detergent and rinse with purified water, then dry. Clean the foam breaker and the impeller thoroughly so that no foreign substances remain in the gap between.

## 6 Control screen overview

### 6.1 Feature introduction

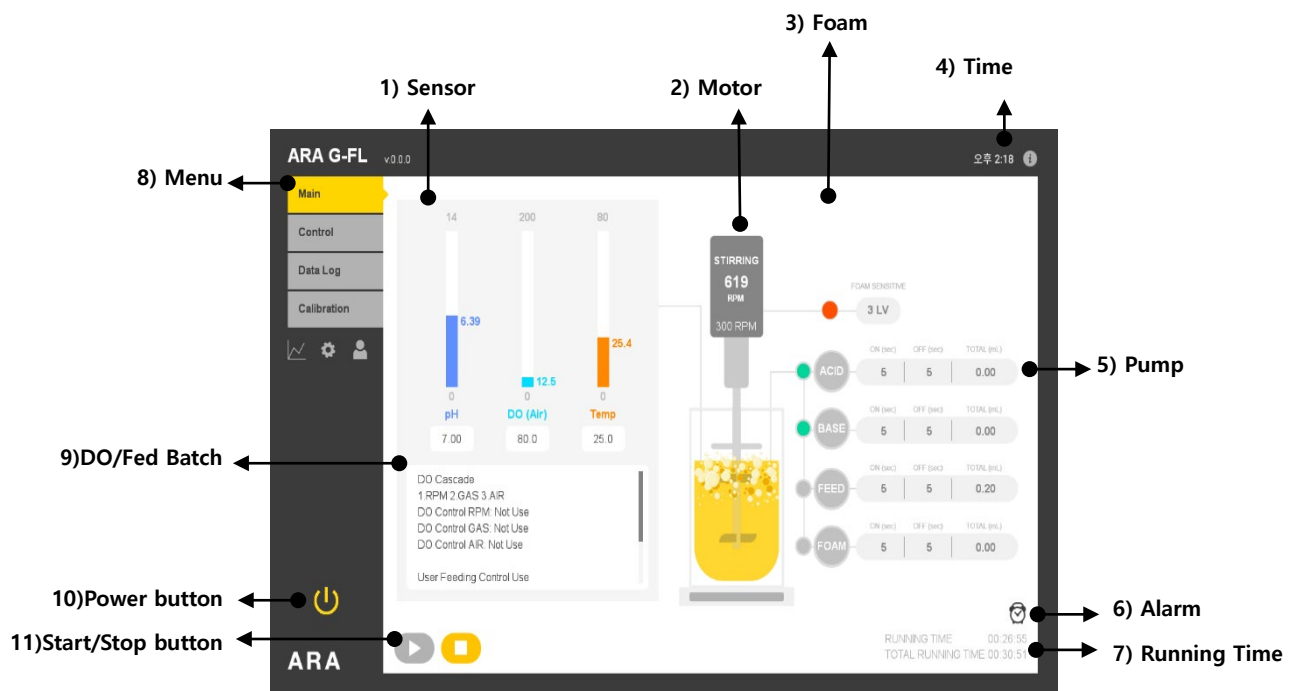
ARA G-FL product is a multifunctional product that can be used for culturing various substances such as microorganisms, plant cells, and animal cells, and can be fermented in various ways such as batch, fed-batch, and continuous. This control system controls pH, temperature, agitation speed, and DO. pH and DO enable fed-batch culture according to time and continuous culture. In addition, graphic data can be displayed in real-time and the recorded data can be retrieved to a tablet, flash memory, etc.

### 6.2 Touch monitor

The system is designed to control the fermentation process by touching the settable parameter buttons that appear on the screen.

## 7 Control Screen Configuration

### 7.1 Main screen



- 1) Sensor: Displays the current value and set value of the sensor. (The graph displays the current value and the value at the bottom of the graph displays the setting value. You can change the setting value by touching the setting area.)
- 2) Motor: Displays the motor's current RPM and set RPM.
- 3) Foam: Displays the status of Foam detection. (Usually it is displayed in gray, and it is displayed in red for the indication of foam feeling.)
- 4) Time: Displays the current time. (When touched, it moves to the time setting screen. When connected to Wi-Fi, the time is automatically synchronized. If you touch the "Info" icon, the product information is displayed, and you can go to the Wi-Fi setting screen. 6.2. Refer to the product information screen)
- 5) Pump: Displays the pump operation mode (Auto / Always On / Always Off), operation status (On / Off), operation time, and total input amount.
  - When Pump Mode is Auto, it is displayed in green, otherwise it is displayed in gray.
  - When the pump is in operation, it is displayed in yellow, and when it is not in operation, it turns gray.
  - Touch the On/Off area to change the On/Off time.
  - Touch the total input area to reset the total input amount.
- 6) Alarm: You can set an alarm for the sensor and pump input amount.
- 7) Running Time: Displays the running time of the fermenter.
- 8) Menu: Displays the menu.
- 9) DO / Fed Batch: Displays DO Control and Fed Batch operation status.
- 10) Power button: This is the fermenter power button. If you press and hold, the [Exit] pop-up appears, and if you touch the end button, the fermenter ends.
- 11) Start/Stop button: It is a button to start/stop the fermenter operation.



The time is reset when the fermenter is powered on. Set it to the current time. However, if a Wi-Fi connection is established, the time is set automatically. For Wi-Fi connection, refer to page 31.



Before turning off the power of the fermenter, always turn off the display power first. If the power of the fermenter is turned off without turning off the display power, the changed setting value will be erased.

## 7.2. Product Information screen.



- **Wi-Fi Setting**

Touch ARA CI at the bottom of the product information screen to move to the Wi-Fi setting screen. After setting Wi-Fi, touch the Back button [◀] at the bottom to return to the previous screen

## 7.3. Control Screen

This is a menu to set various controls.

If you touch the [Control] menu on the main screen, the [Fed Batch Setup], [DO Step Control Setup], and [Pump Mode Setup] menus are displayed. Select the item you want to set and proceed.

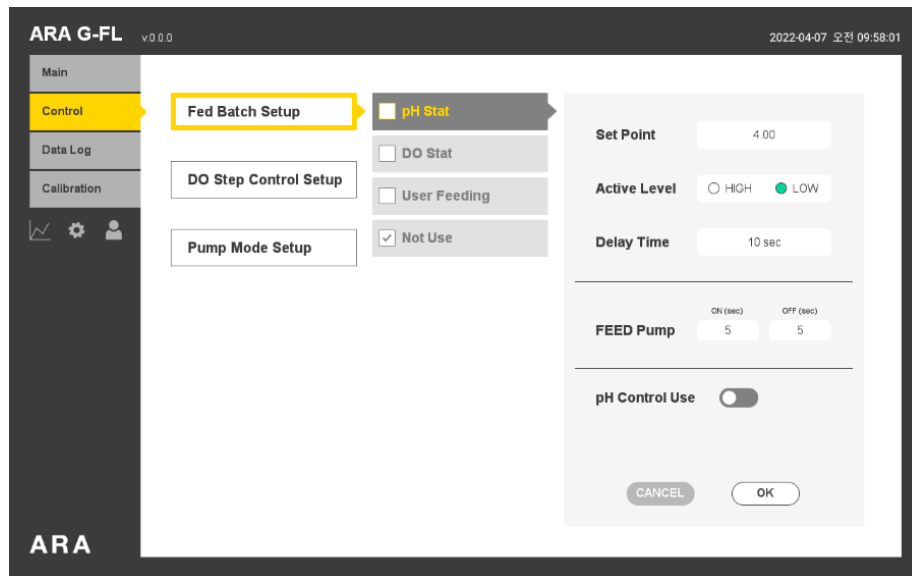
### Fed Batch Setup

If you touch the [Fed Batch Setup] menu on the [Control] menu screen, there are 4 items [pH Stat], [DO Stat], [User Feeding], and [Not Use]. Select the desired mode.

The currently selected Fed Batch mode can be checked with a checkbox (☑)

## pH Stat

If you select the [pH Stat] menu on the [Fed Batch Setup] screen, the following is displayed.



[Set Point]: The pH setting value. When touched, a pop-up window to set the pH is displayed.

[Active Level]: If the current pH value is higher than the set value, the feed pump operates. If the current pH value is lower than the set value, the feed pump operates.

[Delay Time]: When the pump is operating, there is a delay time to prevent excessive feeding. When touched, a pop-up window to set the time is displayed.

[Feed Pump]: Displays the ON/OFF time of the feed pump and displays a pop-up window to set the time when touched.

[pH Control Use]: When this key is selected, fed-batch culture is performed using the pH. stat method, while pH is controlled by acid and base pumps.

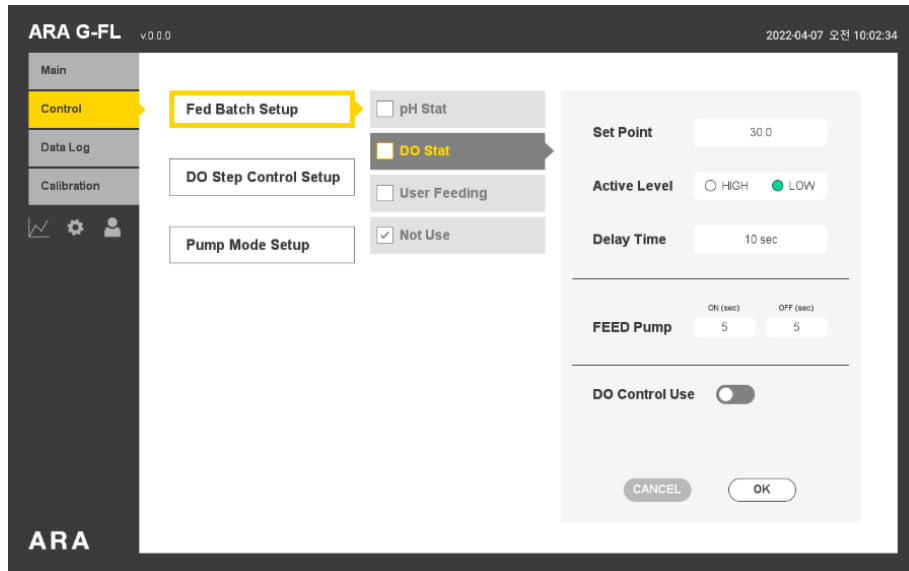
[OK]: Complete the setting.

[CANCEL]: Cancels the setting.



## DO Stat

If you select the [DO Stat] menu on the [Fed Batch Setup] screen, the following is displayed.



[Set Point]: When touched, a pop-up window to set DO. is displayed.

[Active Level]: If the current DO. value is higher than the set value, the feed pump operates. If the current pH value is lower than the set value, the feed pump operates.

[Delay Time]: When the pump is operating, there is a delay time to prevent excessive feeding. When touched, a pop-up window to set the time is displayed.

[Feed Pump]: Displays the ON/OFF time of the feed pump and displays a pop-up window where you can set the time when touched.

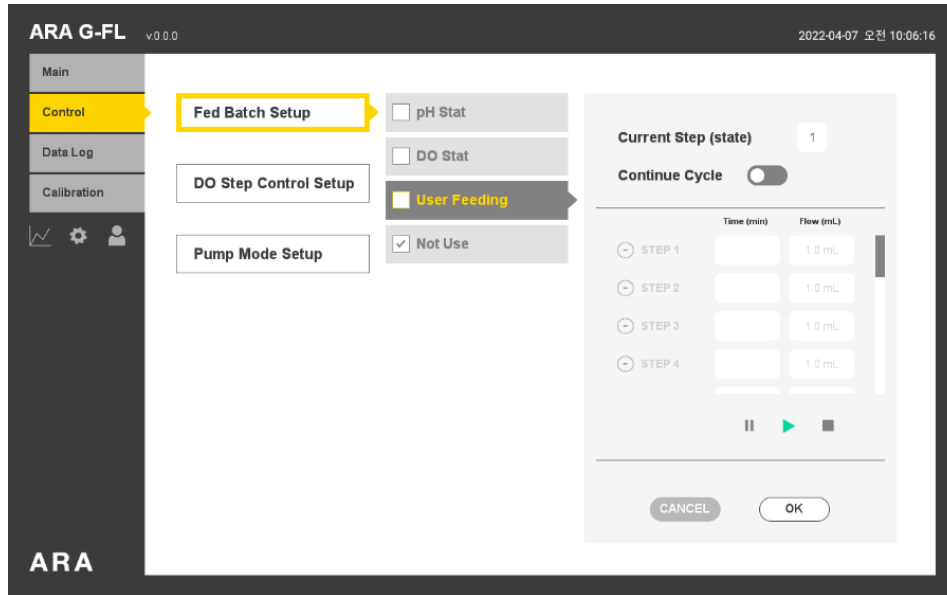
[DO Control Use]: When this key is selected, fed-batch culture is performed in the DO stat method and DO is controlled in the cascade method.

[OK]: Complete the setting.

[CANCEL]: Cancels the setting.

## User Feeding

If you select the [User Feeding] menu on the [Fed Batch Setup] screen, the following is displayed.



[Current Step (state)]: Displays the currently executing step number.

[Continue Cycle]: If this item is checked, it repeats the operation within the set section.

[Step]: Displays the step number. You can set up to 16 steps. It is basically disabled, and if you touch the step number, it is activated and you can set Time and Flow.

[Time (min)]: Displays the time the pump operates in each step. Touch to display a window where you can set the time.

[Flow (mL)]: The amount of medium added by the pump in each step. Touch to display a window where you can set the amount.

[Pause]: When this key is touched, feeding is paused.

[Stop]: Touching this key stops feeding.

[Start]: Feeding starts when this key is touched.

[OK]: Complete the setting.

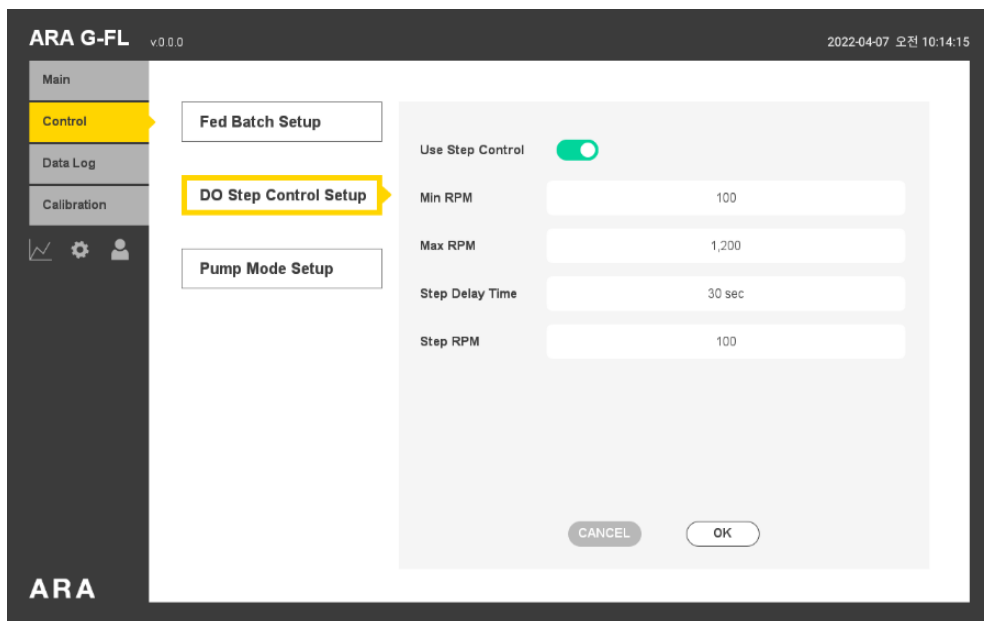
[CANCEL]: Cancels the setting

### Not Use

If [Not Use] is selected on the [Fed-Batch Setup] screen, the feed pump does not operate. This mode applies to batch culture.

### DO Step Control Setup

If you touch the [DO Step Control Setup] menu on the [Control] menu screen, the DO Sensor value screen will be displayed allowing step-by-step control of the stirrer speed.



[Use Step Control]: Displays and sets whether to use Step Control.

[Min RPM]: Sets the minimum RPM when adjusting the stirrer speed. The motor speed will not decrease below the set minimum RPM.

[Max RPM]: Set the maximum RPM when adjusting the stirrer speed. It does not operate beyond the set maximum RPM.

[Step Delay Time]: Set the delay time for step-by-step speed adjustment.

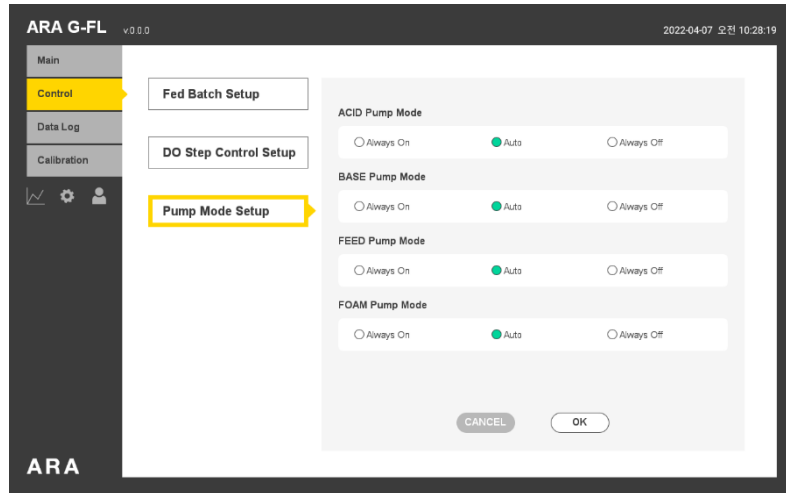
[Step RPM]: Set the step speed deviation.

[OK]: Complete the setting.

[CANCEL]: Cancels the setting.

## Pump Mode Setup

A screen to change the metering pump operation mode is displayed.



[ACID Pump Mode]: Select ACID pump operation.

[BASE Pump Mode]: Select the BASE pump operation.

[FEED Pump Mode]: Select the FEED pump operation.

[FOAM Pump Mode]: Select FOAM pump operation.

[OK]: Complete the pump configuration.

[CANCEL]: Cancels the pump configuration.

- Always On: The pump is set to always operate regardless of the sensor value.
- Auto: The pump is set to automatically turn ON/OFF based on the sensor value.
- Always Off: The pump is set not to always operate regardless of the sensor value.
- When Pump Mode is set to Always On or Always Off, on/off can be changed by touching Pump on the main screen.

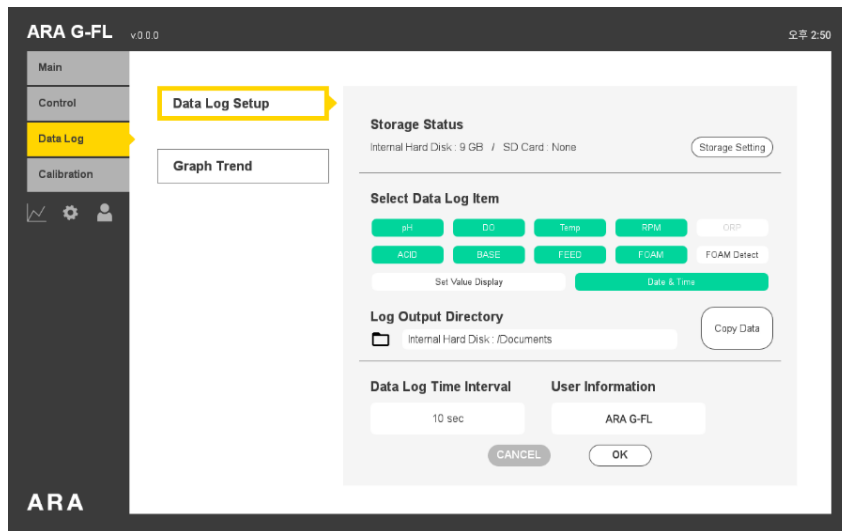
## 7.4. Data Log

This is a menu that allows you to designate data log items and change the settings of the graph that displays the sensor current value.

If you touch the [Data Log] menu on the main screen, the [Data Log Setup] and [Graph Trend] menu is displayed. Select the item you want to set and proceed.

### 1) Data Log Setup

When [Data Log Setup] menu is selected, the following is displayed



[Storage Status]: The available storage space is displayed. (Secure at least 600 MB of space)

[Storage Setting]: A program to manage the storage space of the device is executed.

[Select Data Log Item]: Select the items to be saved in the log, and deselect the items not to be saved in the log. Selected items are displayed in green, and unselected items are displayed in white.

[Log Output Directory]: The location where the log will be saved is displayed. You can find the saved location on your PC. This part of the case cannot fit into the wall. If you have an SD card, you may have an SD card. The saved file is in CSV format.

[Copy Data]: You can copy the log file saved in the "/Documents" folder to another folder.

[OK]: Complete the setting.

[CANCEL]: Cancels the setting.

[Data Log Time Interval]: Set the log saving time interval.

[User Information]: Set the User Name written in the log file.

[Data Log Time Interval]: Set the log saving time interval.

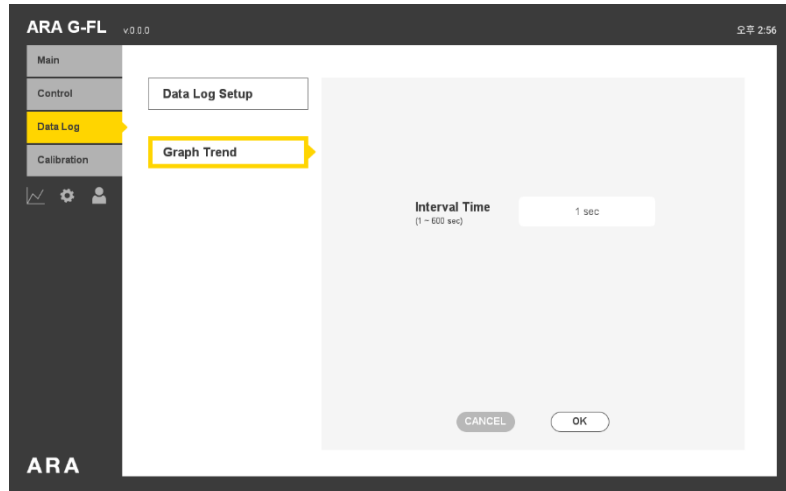
[User Information]: Set the User Name written in the log.



If there is a file in the folder to be copied, it will be deleted. Be sure to copy it to an empty folder.

## 2) Graph Trend

If you select the [Graph Trend] menu, it is displayed as shown below.



[Interval Time]: Set the time interval for displaying each sensor value on the Graph View screen.

[OK]: Complete the setting.

[CANCEL]: Cancels the setting.

## 7.5. Calibration

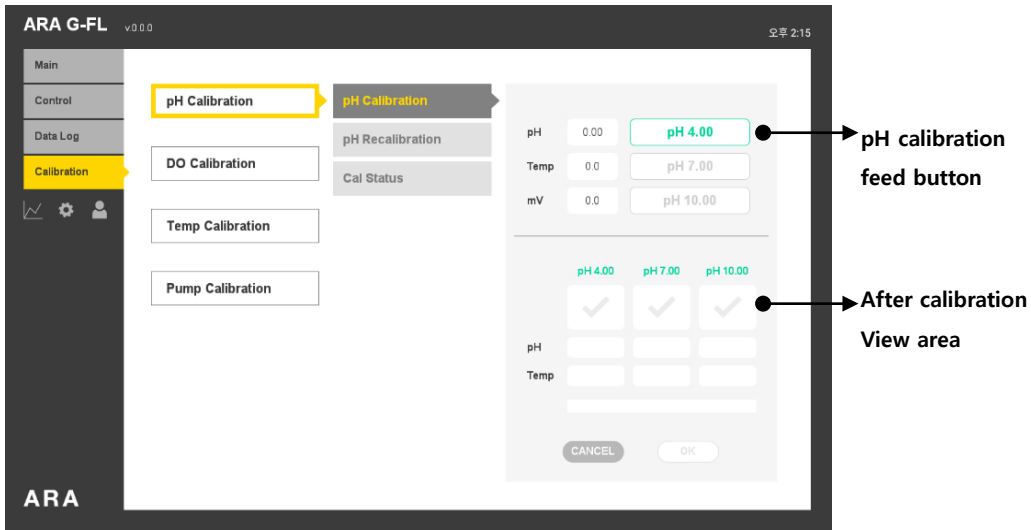
If you touch the [Calibration] menu on the main screen, [pH Calibration], [DO Calibration], [Temp Calibration], [Pump Calibration], menus are displayed, select the item you want to set and proceed.

### 1) pH Calibration

If you touch the [pH Calibration] key on the [Calibration] menu screen, you can select [pH Calibration], [pH Recalibration], and [Cal Status].

[pH Calibration] is the process of calibrating the pH sensor with three pH calibration solutions before sterilizing the vessel. In this fermentation system, users can calibrate with three buffer solutions: pH7, pH4, and pH10. (Recalibration is a method of compensating when there is a large error in the measurement value during the fermentation process.)

If you touch the [pH Calibration] key on the [pH Calibration] menu screen, the following is displayed.



[pH][Temp][mV]: Displays the current measured value. It displays the measured pH value, temperature value, and volt value at the same time.

[pH4.00]: This is the pH 4.00 calibration solution button.

[pH7.00]: This is the pH 7.00 calibration solution button.

[pH10.00]: This is the pH 10.00 calibration solution button

[OK]: Complete the pH calibration.

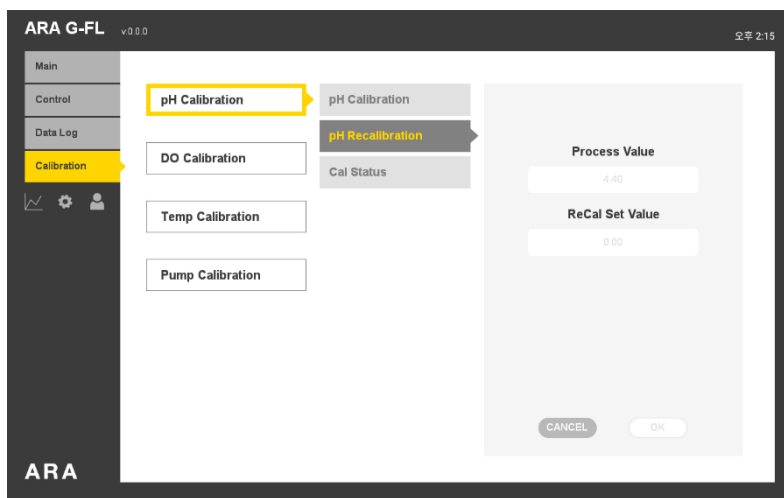
[CANCEL]: Cancels the pH correction.

- The pH calibration is carried out according to the process below.
  - ① Before starting calibration, if the fermenter is running, touch the [Stop] key on the main screen to stop the fermenter. Connect the sensor and the Main Controller with a cable. And prepare three calibration solutions and beakers, and prepare some absorbent paper (tissue, gauze).
  - ② Immerse the pH sensor and temperature sensor in the pH4.00 calibration solution. At this time, the current measured value is displayed in the pH column, the temperature column, and the mV column. When the electrode value in the mV column has stabilized to some extent (when there is little change, it usually takes about 20 minutes), touch the [pH4.00] button on the screen to start calibration.

- ③ The system automatically calibrates, and the progress bar displays the progress of the calibration.
- ④ When calibration is complete, remove the sensor from the solution, rinse with distilled water, and dry the sensor outer wall with absorbent paper.
- ⑤ Repeat the previous process with a different calibration solution. (Dip the pH sensor in the pH7.00, pH10.00 calibration solution and go through steps ② to ④.)
- ⑥ After calibration, touch the [OK] key to complete the pH calibration. (To cancel correction, touch the [Cancel] key.)
- ⑦ After cleaning the sensor thoroughly, mount it on the vessel.

### pH Recalibration

If you touch the [pH Recalibration] key on the [pH Calibration] menu screen, the following is displayed. The pH recalibration function cannot be set unless the pH calibration is completed.



[Process Value]: Displays the current measured value.

[ReCal Set Value]: Set the pH recalibration value.

[OK]: Complete pH recalibration.

[CANCEL]: Cancels pH recalibration.

### Cal Status

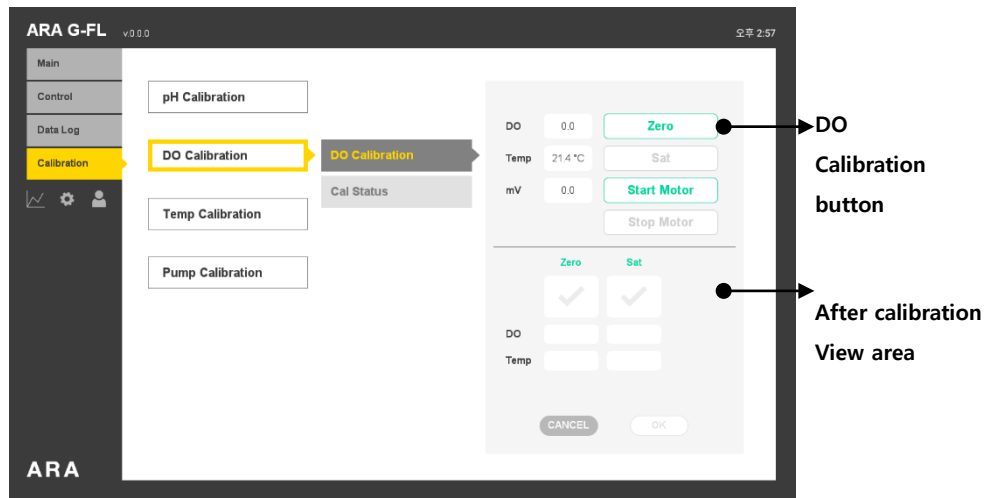
The Cal Status screen displays pH calibration information.



## 2) DO Calibration

If you touch the [DO Calibration] key on the [Calibration] menu screen, you can select [DO Calibration] and [Cal Status].

Touching the [DO Calibration] key on the [DO Calibration] menu screen displays the following display.



[DO][Temp][mV]: Displays the current measured value. Measured DO value, temperature value, volt value.

[Start Motor]: A button to operate the agitator.

[Stop Motor]: Button to stop the agitator operation.

[Zero]: Set to zero button.

[Sat]: Saturation correction button.

[OK]: DO correction is completed.

[CANCEL]: Cancels DO correction.

- DO calibration is performed after the vessel is sterilized and before fermentation. In DO compensation, zero compensation can be done in various ways. For example, passing nitrogen gas through the vessel or disconnecting the sensor cable. Sat correction is performed when dissolved oxygen is saturated under fermentation conditions.

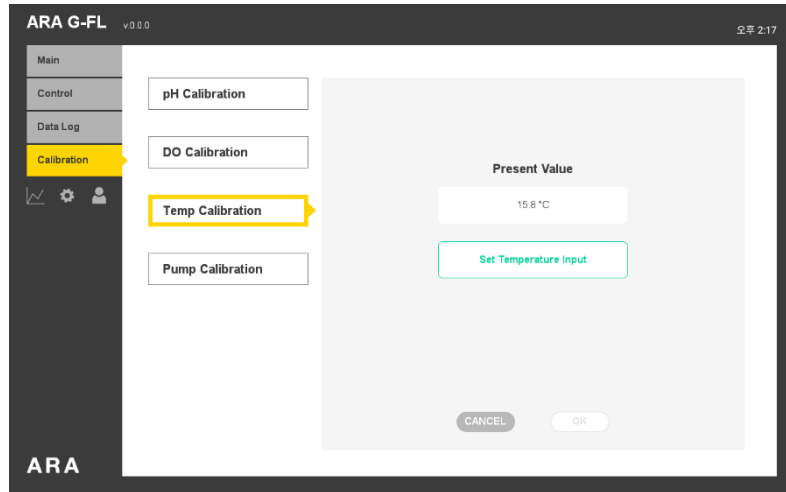
- ① Before starting DO calibration, stop the operation of the fermenter and set the stirring speed to the value when fermenting. (You can set it by touching the motor image on the main screen.) Then, prepare nitrogen gas for zero calibration and perform Sat calibration. Connect the air to the vessel.
- ② Pass nitrogen gas sufficiently through the vessel. After touching the Start Motor button to operate the stirrer at the set RPM, when the DO voltage (mV) measured value is stabilized, touch the [Zero] key to start zero calibration. Zero calibration is performed automatically in this system.
- ③ "0" appears in the calibration value display column at the bottom of the calibration screen, indicating that zero calibration is complete. => Zero calibration is performed by disconnecting the DO cable, setting the DO value to "0", and then connecting the DO cable.
- ④ Allow enough air to pass through the vessel. After confirming that the DO voltage (mV) measured value is stabilized, touch the [Sat] key to start Sat compensation.
- ⑤ The system will automatically calibrate. When the correction value is displayed in the correction value display column on the screen, it indicates that the correction has been completed.
- ⑥ Touch the [OK] key to finish the DO calibration and exit the calibration screen. (To cancel the correction, touch the [Cancel] key.)

### **Cal Status**

Touch the [Cal Status] key on the [DO Calibration] menu screen to display DO calibration information.

### 3) Temp Calibration

If you touch the [Temp Calibration] key on the [Calibration] menu screen, the following is displayed.



[Present Value]: Displays the current temperature measurement.

[Set Temperature Input]: Set the temperature value to be corrected. (Enter the value measured by the standard sensor.)

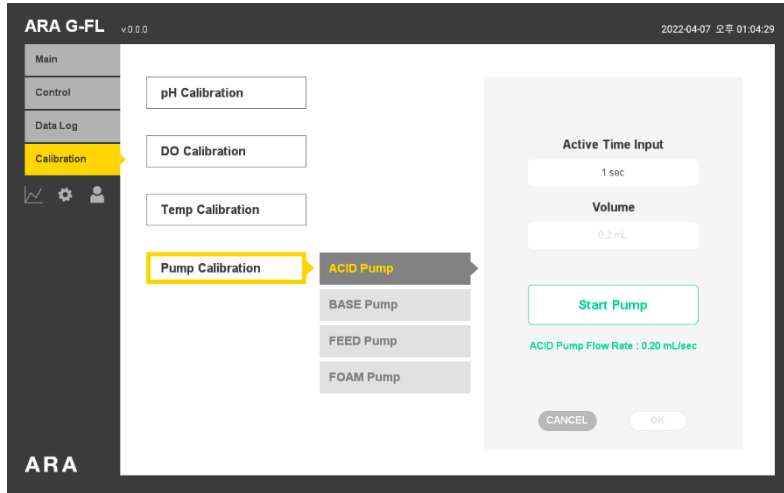
[OK]: Completion of temperature calibration.

[CANCEL]: Cancels temperature compensation.

- Temperature compensation is performed in the following way.
  - ① When the temperature sensor is placed in a solution (or air), the current measured value is displayed in the [Present Value] column.
  - ② Measure the temperature of the solution (or air) with another standard sensor.
  - ③ Touch the [Set Temperature Input] button to input the value measured by the standard sensor.
  - ④ Temperature calibration is performed automatically. When the temperature calibration is complete, touch the [OK] key to complete calibration. (To cancel the correction, touch the [CANCEL] key.)

#### 4) Pump Calibration

If you touch the [Pump Calibration] key on the [Calibration] menu screen, you can select [ACID Pump], [BASE Pump], [FEED Pump], and [FOAM Pump]. (Each pump calibration method is all same.)



[Active Time Input]: The time the pump operates during calibration.

[Volume]: The amount of liquid moved while the pump is operating.

[Start Pump]: When this key is touched, the pump starts to operate.

[OK]: ACID Pump calibration is completed.

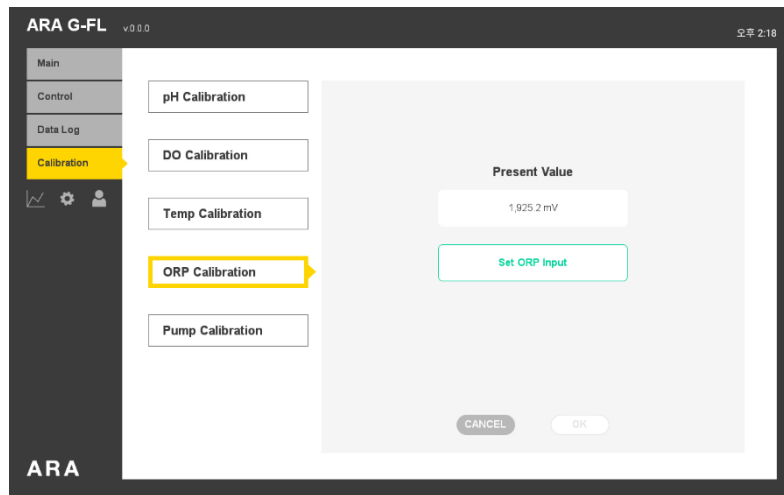
[CANCEL]: Cancels ACID Pump calibration.

- ACID Pump calibration is performed as below
  - ① ACID Pump calibration is performed in the following way.
  - ② Insert a silicone tube (3mm standard) of the same size as that used during fermentation into the pump. All. Insert one end of the tube with water (or you can use a medium used for fermentation). Put it in a container and place the other end into an empty container.
  - ③ Touch the time display area at the bottom of the [Active Time Input] phrase to set the time enough to fill the tube with liquid and press [Start Pump] to start the pump and fill the tube with liquid.
  - ④ Put the end of the tube that was placed in the empty container into the empty measuring cylinder.
  - ⑤ On the calibration screen, touch the time display area at the bottom of the [Active Time Input] phrase to set the operation time and touch the [Start Pump] key to start calibration.

- ⑥ The pump stops automatically after operating for the entered time.
- ⑦ Enter the amount of liquid in the measuring cylinder in the [Volume] field.
- ⑧ The system automatically calculates the flow rate of the pump and displays it on the screen. Touch [OK] to complete the calibration of the pump
- All BASE, FEED, and FOAM pumps can be calibrated in the same way.

## 5) ORP Calibration

After attaching the ORP sensor, if you enable the ORP sensor in the Sensor Configuration menu, the [ORP Calibration] menu is displayed in the [Calibration] menu. If you touch the corresponding menu, it is displayed as shown below.



[Present Value]: Displays the current ORP measurement value.

[Set ORP Input]: Touch this key to display a window for entering a value. Then, input the ORP standard value.

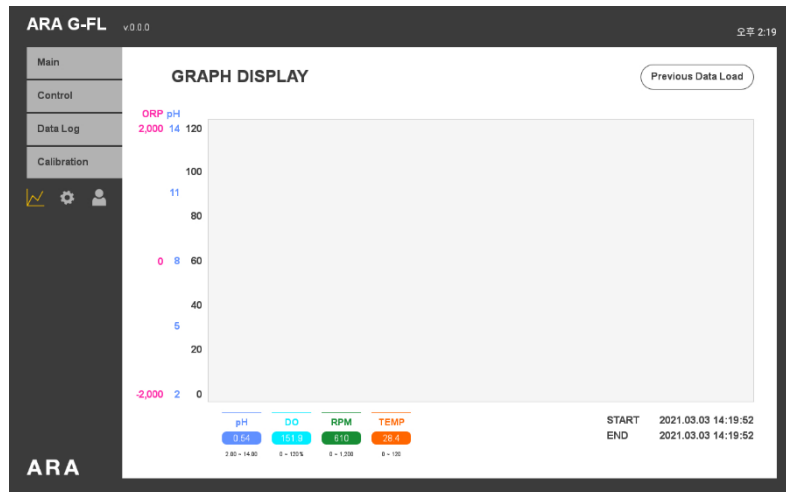
[OK]: ORP correction is completed.

[CANCEL]: Cancel ORP correction.

- ORP calibration is performed in the following way.
  - ① When the ORP sensor is placed in the standard solution, the current measured value is displayed in the [Present Value] column.
  - ② Touch the [Set Temperature Input] button to input the mV value of the standard solution.
  - ③ ORP calibration is performed automatically. When the ORP calibration is complete, touch the [OK] key to complete the calibration. (To cancel the correction, touch the [CANCEL] key.)

## 7.6. Graph

It is a screen that displays the current value of each sensor as a graph. (After attaching the ORP sensor, if you set the ORP sensor to use in the "12.1.1. Sensor Configuration" menu, the ORP value will also be shown in a graph.)



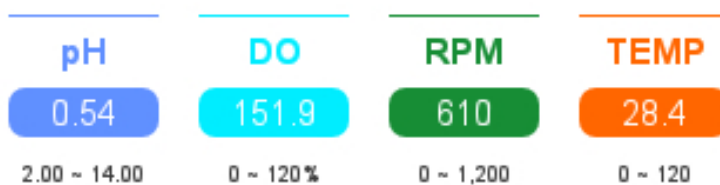
[Previous Data Load]: This button can load previously tested data. When touched, a list popup appears, and you can check the data sorted by time.

[Start]: The time the graph was first drawn.

[End]: The last time the graph was drawn

(The maximum data that can be displayed is 3,600, and when it exceeds 3,600, the old data disappears and the latest data is accumulated and displayed as a graph.)

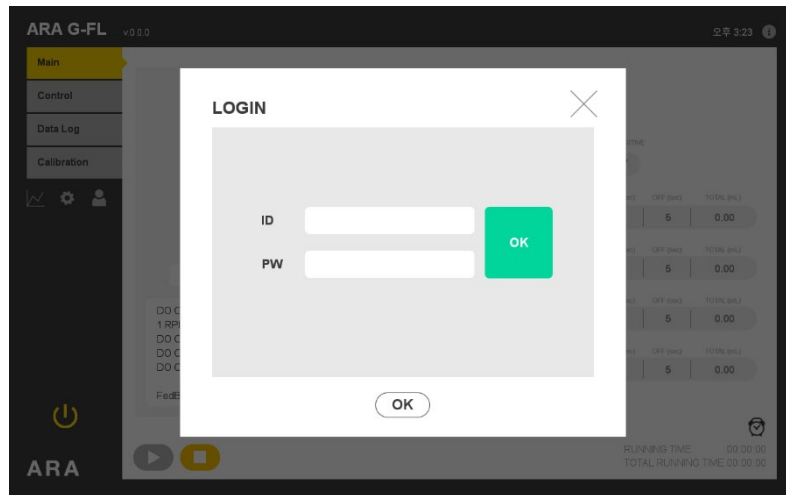
When entering the Graph menu during operation, the sensor values during operation are summarized and displayed in real-time after the displayed graph.)



Each sensor is displayed in the same color as the buttons above, and you can hide the sensor value by touching the button once. Hidden sensor values appear when you touch them again.

## 7.7. Setting

A login is required to change various settings, and it proceeds in the following pop-up window.



If you have not added a user, enter an available user ID/PW initially and enter the setting menu. After successful login, the [System Configuration], [Advanced Configuration], and [Setting Value Reset] menus are displayed.



The initial user ID / PW is hanil / hanil.

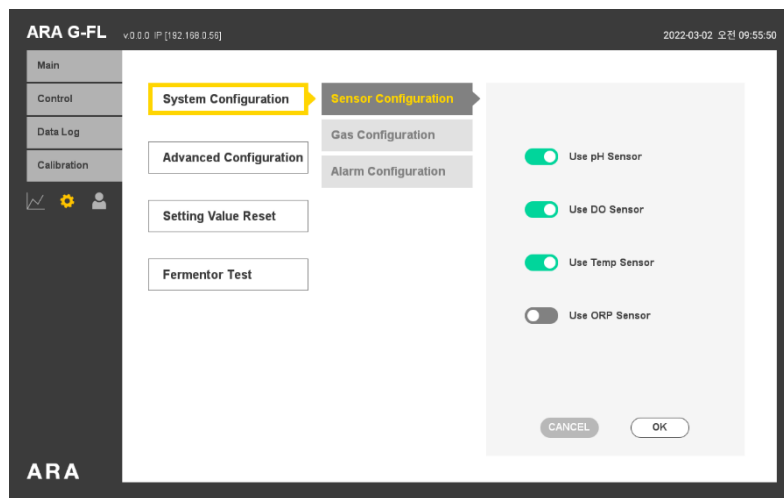
Recommended to delete the initial user after additional user input for security reasons.

## System Configuration

Touch the [System Configuration] key on the [Settings] menu screen to display the [Sensor Configuration], [Gas Configuration], and [Alarm Configuration] menu.

### 1) Sensor Configuration

If you touch the [Sensor Configuration] menu in the [System Configuration] menu, it is displayed as shown below.



[Use pH Sensor]: Select when using a pH sensor. (It is set to "Enabled" by default.)

[Use DO Sensor]: Select when using DO sensor. (It is set to "Enabled" by default.)

[Use Temp Sensor]: Select when using a Temp sensor. (It is set to "Enabled" by default.)

[Use ORP Sensor]: Select when using ORP sensor. (After attaching the ORP sensor, it must be changed to the "Use" setting. When the "Use" setting is set, the OPR sensor is displayed on the main screen, and calibration can be performed in the "6.5.5. ORP Calibration" menu.)

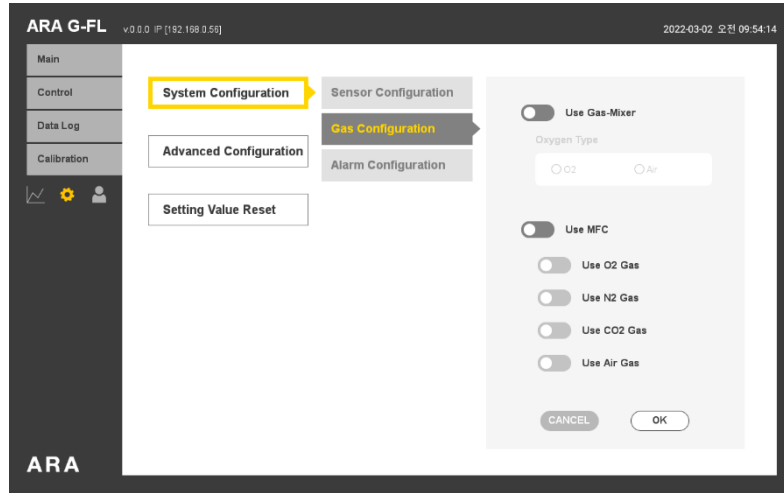
[OK]: Complete the sensor configuration.

[CANCEL]: Cancels the sensor configuration.



## Gas Configuration

If you touch the [Gas Configuration] menu in the [System Configuration] menu, the following is displayed.



[Use Gas-Mixer]: Select when using Gas-Mixer. (It is set to "Disabled" by default.)

- Oxygen Type: When using a Gas-Mixer, select one of O2 / Air for the first pump. (When Air is selected, AIR is displayed instead of O2 on all screens (Main / Gas-Mixer Setup / Gas Calibration))

[Use MFC]: Select when using MFC. (It is set to "Disabled" by default.)

- Use O2 Gas: Select when using O2 MFC. (When selected, Air MFC is changed to "Not used".)
- Use N2 Gas: Select when using N2 MFC.
- Use CO2 Gas: Select when using CO2 MFC.
- Use Air Gas: Select when using Air MFC. (When selected, O2 MFC is "not used It will be changed to "None".)

[OK]: Gas configuration is completed.

[CANCEL]: Cancels the Gas configuration.

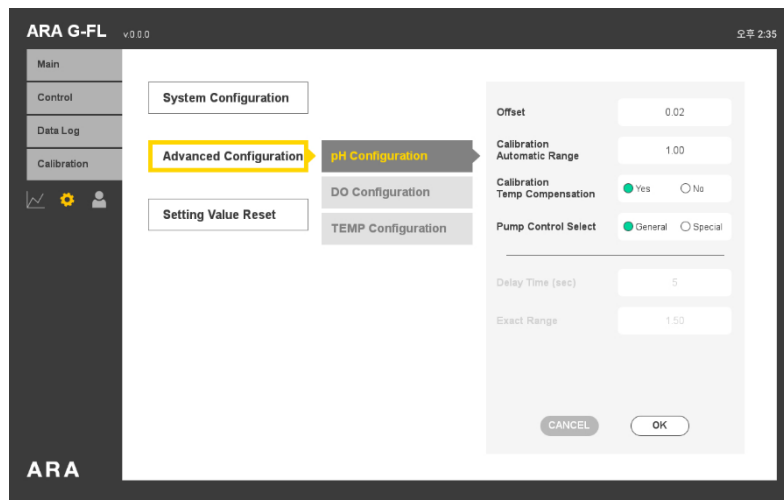
- ❖ Gas Mixer and MFC cannot be used at the same time.
- ❖ When using gas, menus for gas use are displayed on the main screen and on the Control/ Calibration menu.
- ❖ For details, refer to "14. Using Gas-Mixer (optional)", "15. Please refer to "Use MFC (optional)".

## 2) Advanced Configuration

If you touch the [Advanced Configuration] key on the [Settings] menu screen, [pH Configuration], [DO Configuration], [Temp Configuration] menu can be selected.

### pH Configuration

You can connect by selecting the [pH Configuration] menu from the [Advanced Configuration] menu.



[Offset]: The error range of the pH control and the range value that is not controlled by the pH value is displayed.

[Calibration Automatic Range]: Indicates the automatic pH calibration range. For the corresponding buffer when calibrating When it is within the liquid range, automatic calibration starts.

[Calibration Temp Compensation]: Determines whether to compensate the temperature compensation action.

[Pump Control Select]: Determines the pump operation method for pH control.

[Delay Time(sec)]: Specifies the time to stop the operation for a certain period of time during the operation of the pump for pH control.

[Exact Range]: Indicates the range to fine-tune the pH control.

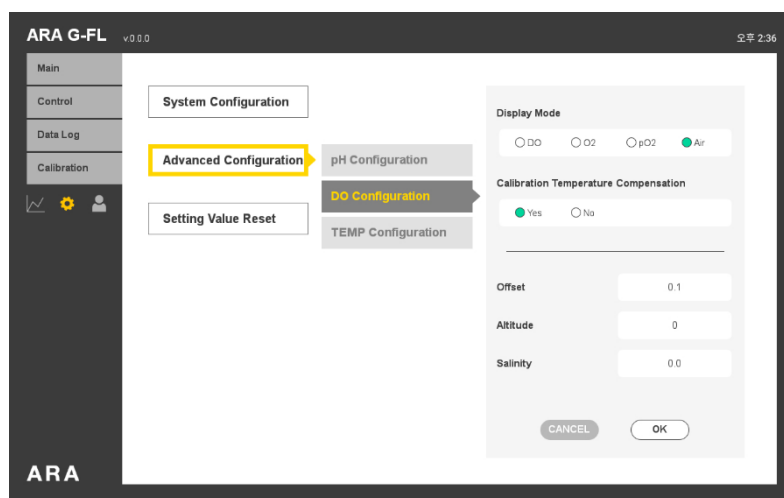
[OK]: Complete the pH setting.

[CANCEL]: Cancels the pH setting.

- **General Mode:** Always keep the same pump operation for pH control.
- **Special Mode:** This is a mode for detailed pH control by making the pump operation for pH control longer in the section beyond the Exact Range and shorter in the Exact Range.

## DO Configuration

If you select the [DO Configuration] menu from the [Advanced Configuration] menu, it is displayed as shown below.



[Display Mode]: Select the item to display from [DO], [O2], [pO2], and [Air].

[Calibration Temperature Compensation]: Determines whether to compensate the temperature compensation.

[Offset]: Displays the range value not controlled by the DO value as the DO control error range.

[Altitude]: Enter the value required for DO calculation according to the altitude.

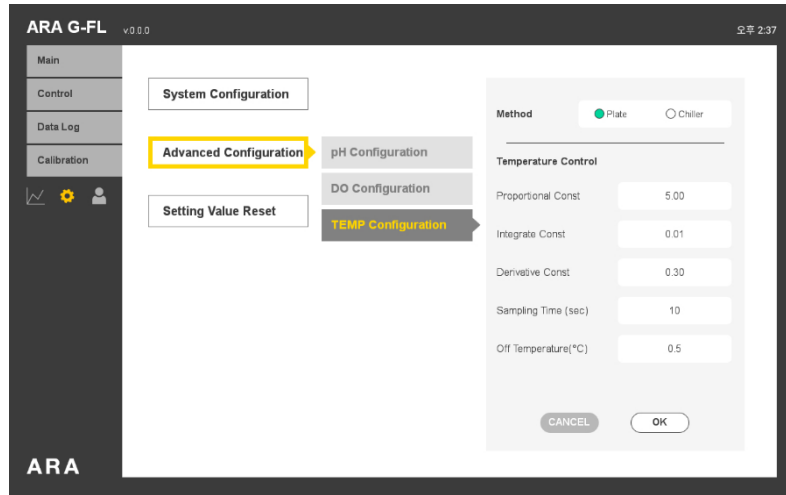
[Salinity]: Enter the value required for DO calculation according to salinity.

[OK]: Complete the DO setting.

[CANCEL]: Cancels the DO setting.

## Temp Configuration

If you select the [Temp Configuration] menu from the [Advanced Configuration] menu, it is displayed as shown below.



[Method]: It sets which product (Plate or Chiller) is used for temperature control.

[Proportional Const]: Set the proportional value for temperature control. Adjust the temperature control speed. A high proportional value has the effect of reducing rise time. On the other hand, it does not eliminate the error.(Range: 0.00 to 100.00)

[Integrate Const]: Set the integral value for temperature control. It has the effect of removing the steady-state error, but it makes the characteristic poor with the transient response. Overshoot occurs due to transient response. (Range: 0.00 to 100.00)

[Derivative Const]: Set the derivative value for temperature control. It has the effect of improving stability, reducing overshoot, and eliminating transient responses. (Range: 0.00 to 100.00)

[Sampling Time]: Set the time to measure the temperature.

[Off Temperature]: Displays the range value that is not controlled by the temperature value as the temperature control error range.

[OK]: Complete the temperature setting.

[CANCEL]: Cancels the temperature setting.

## Reset

This is the menu to initialize the settings.

[Pump Reset]: Initialize pump related settings.

[Time Reset]: Resets the time setting values.

[Reset All]: Resets all setting values.

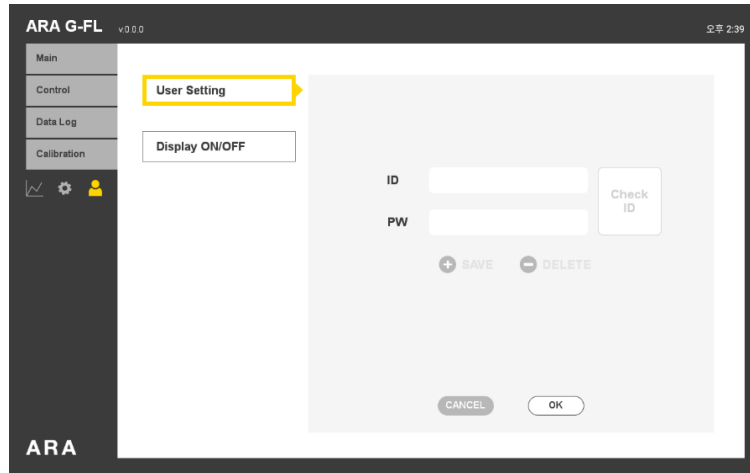
## 7.8. User Setting

It is a menu to add and delete users and to set user-related functions.

When entering the menu, see "6.7. Login is required in the same way as entering the "Settings" menu. (For login, refer to "6.7 Settings".)

### 1) User Setting

Selecting the [User Setting] menu from the [User Management] menu will display as shown below.



- ① Enter an ID of 4 or more characters (English) in the ID input field. (Maximum input is 20 characters.)
- ② When the [Check ID] button is activated, touch it to check if the ID is usable. (Available for one ID, the phrase "Available User ID" is displayed.)
- ③ Enter the password (4 or more characters) to be used for the item in PW and touch the [Check ID] button once again. (Maximum input is 20 characters.) When the [SAVE] button is activated, touch to complete the user addition.
- ④ Touch the [CANCEL] or [OK] button to close the screen. (The entered user information (password) cannot be checked again. Be careful not to lose it.)

### 2) How to delete a user

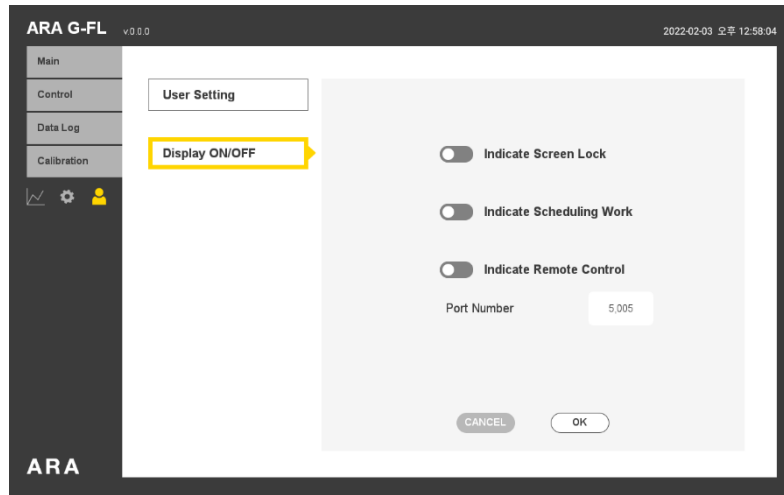
- ① Enter the ID you want to delete in the ID input field.
- ② When the [Check ID] button is activated, touch it to check if the ID is in use. (If the ID is in use, the phrase "User id already in use." is displayed.)
- ③ Enter the password of the ID to be deleted in the PW and touch the [Check ID] button once more.
- ④ When the [DELETE] button is activated, touch it to complete the user deletion.
- ⑤ Touch the [CANCEL] or [OK] button to exit the screen.



Once deleted, the user ID cannot be recovered

## 2) Display ON/OFF

If you select the [Display ON/OFF] menu from the [User Management] menu, it is displayed as shown below.



[Indicate Screen Lock]: Determines whether to display the screen lock function button on the main screen.

[Indicate Scheduling Work]: Determines whether to display the scheduled job function button on the Main screen.

[Indicate Remote Control]: Allows you to use the separately provided G-FL remote control PC program. (Port Number is the number used when connecting to the G-FL remote control PC program.)

[OK]: Complete the display setting.

[CANCEL]: Cancels the setting.

- ❖ If you change Remote Control to "Enable", the IP address of G-FL is displayed on the right side of the Version display area at the top of the screen. (The IP address is used by the G-FL remote control PC program.)
- ❖ If the G-FL is not connected to Wi-Fi, the remote control PC program cannot be connected.

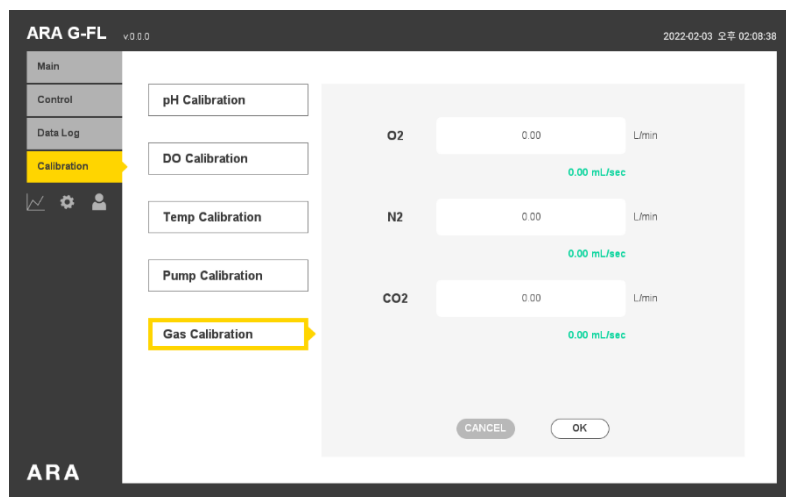
## 7.9. Use of Gas-Mixer (Option)

Gas-Mixer can be used as an option when you want to adjust the connected sensor using O<sub>2</sub> (or AIR) / N<sub>2</sub>/ CO<sub>2</sub> gas in addition to the pump (ACID / BASE / FOAM / FEED) connected to G-FL.

To connect and use a Gas-Mixer to G-FL, you need to change to Use Gas-Mixer in the "Settings -> System Configuration -> Gas Configuration" menu.

### 1) Calibration

When using the Gas-Mixer, if you touch the [Calibration] menu on the main screen, the [Gas Calibration] menu is displayed. (Gas-Calibration must be completed before fermenter operation.)



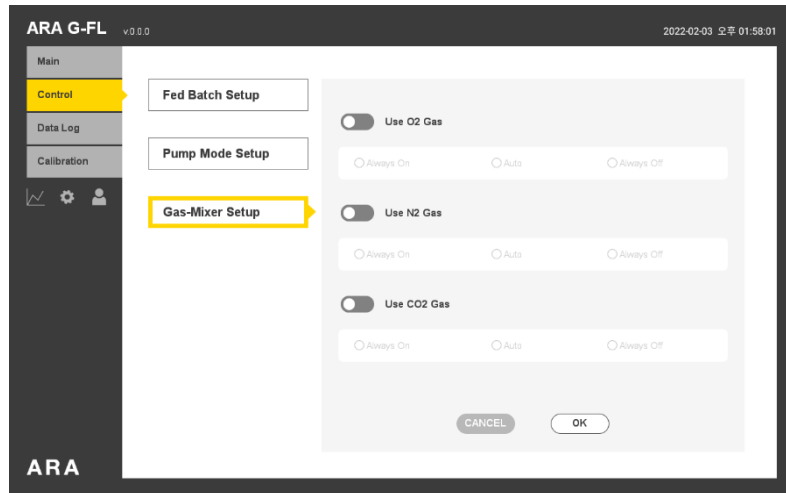
Touch the O<sub>2</sub> / N<sub>2</sub> / CO<sub>2</sub> input value (L/min) area to input the set value of the Flow-Meter for each gas connected to the Gas-Mixer body. (When the input is completed, the input amount per second is automatically calculated at the bottom of the input value.)

[OK]: Complete Gas-Mixer Calibration.

[CANCEL]: Cancels Gas-Mixer Calibration.

## 2) Control

When using the Gas-Mixer, touch the [Control] menu on the main screen to display the [Gas-Mixer Setup] menu.



[Use O2 Gas]: Displays whether O2 Gas is used. (When changing to "Use", select Always On / Auto / Always Off to set the operation of the O2 gas pump.)

[Use N2 Gas]: Displays whether or not to use N2 Gas. (When changing to "Use", select Always On / Auto / Always Off to set the N2 gas pump operation.)

[Use CO2 Gas]: Displays whether or not to use CO2 Gas. (When changing to "Use", select Always On / Auto / Always Off to set the CO2 gas pump operation.)

[OK]: Complete Gas-Mixer Control.

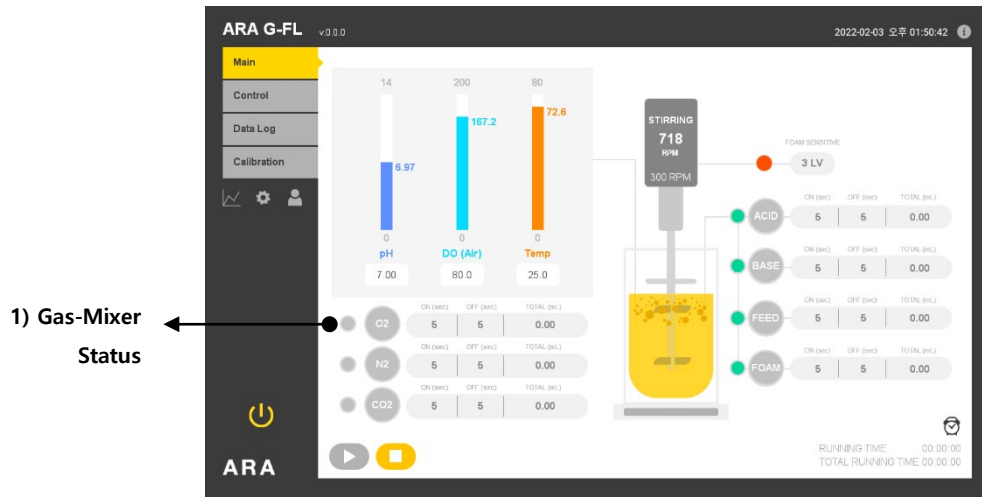
[CANCEL]: Cancels Gas-Mixer Control.

- Always On: When selected, the pump is set to always operate regardless of the sensor value.
  - Auto: When selected, the pump is set to automatically turn ON/OFF based on the sensor value.
  - Always Off: When selected, the pump is set not to always operate regardless of the sensor value.
- ❖ When Gas Pump Mode is set to Always On or Always Off,



### 3) Main

When using the Gas-Mixer, the Main screen is displayed as follows



- Gas-Mixer status: You can set the gas operation status and input amount ON/OFF operation time.

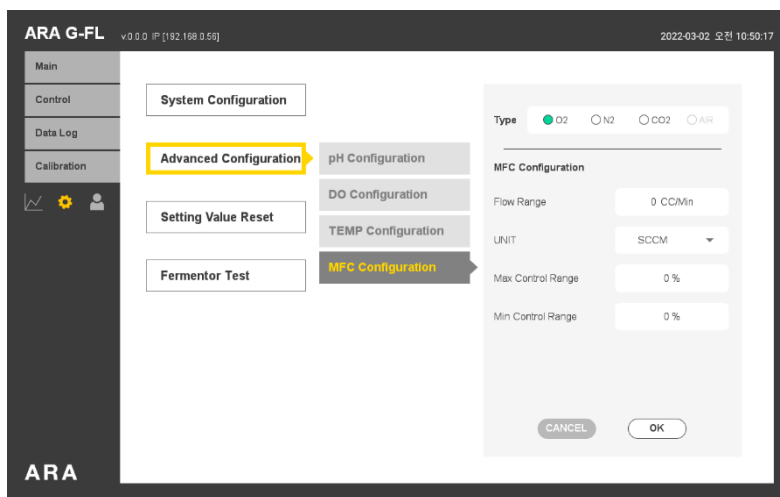
## 7.10. MFC Usage (option)

MFC can be used as an option when you want to adjust the connected sensor using O<sub>2</sub> (or AIR) / N<sub>2</sub>/ CO<sub>2</sub> Gas in addition to the pump (ACID / BASE / FOAM / FEED) connected to G-FL.

To connect and use MFC to G-FL, change MFC and gas to be used in "Settings -> System Configuration -> Gas Configuration" menu.

### 1) MFC Configuration

When using MFC, you need to complete the specification setting of the MFC device in Settings -> Advanced Configuration -> MFC Configuration.



When MFC Configuration is selected, it is displayed as shown below.

Set the specifications of MFC equipment.

[Type]: Select the MFC Type to set.

[Flow Range]: Enter the maximum flow value.

[UNIT]: Set the Unit value of the Flow Range value. (SCCM/SLPM)

[Max Control Range]: Set the maximum flow control value.

[Min Control Range]: Set the minimum flow control value.

[OK]: Complete the MFC setting.

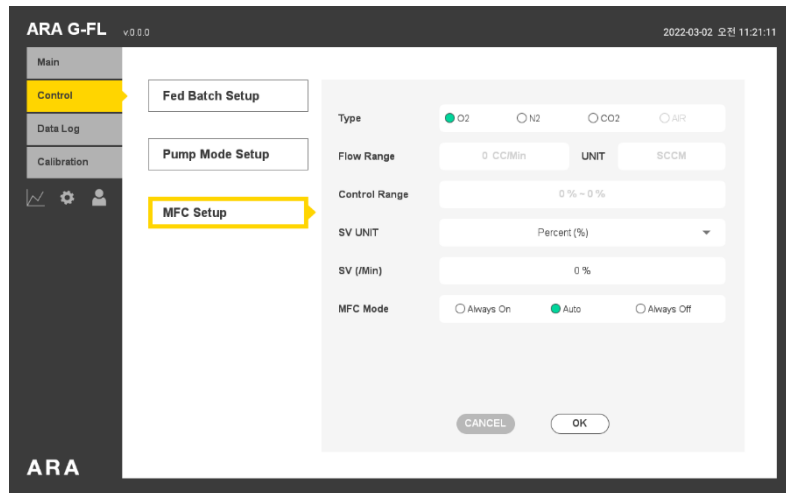
[CANCEL]: Cancels the MFC settings.

❖ All MFCs to be used must be set.

## 2) MFC Setup

Set MFC dosage and operation mode.

When the Control -> MFC Setup menu is selected, it is displayed as shown below.



[Type]: Select the MFC Type to set.

[Flow Range]: Shows the Flow Range value set in the MFC Configuration menu.

[UNIT]: Shows the UNIT value set in the MFC Configuration menu. (SCCM/SLPM)

[SV UNIT]: Set the gas setting unit to be injected. (Percent / Volume)

[SV (/Min)]: Set the input amount per minute.

[MFC Mode]: Set the MFC usage behavior.

[OK]: Complete MFC Setup.

[CANCEL]: Cancels MFC Setup.

- Always On: When selected, MFC is set to always operate regardless of the sensor value.
- Auto: When selected, it is set to automatically turn on/off the MFC based on the sensor value.
- Always Off: When selected, MFC is always disabled regardless of the sensor value.
- ❖ When MFC Mode is set to Always On or Always Off, you can change On/Off by touching MFC on the Main screen.

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