dPOFLEX PFS/PFU Precise Filling System Operating Manual

Version: 1.01

Contents

Statement

- The content of this manual and the specifications of the equipment are subject to change without further notice.
- The screenshots and the function descriptions contained in this manual may vary upon the equipment model and software version.
- Before using the equipment, make sure to read all attached documents and learn the information about safety and correct operations.

1. Precautions

- To maintain the safety of the equipment, please use a power supply meeting the requirements.
- Please use a power cord specified for the equipment.
- Please ground the equipment reliably before power on so as to protect personal safety.
- Please connect the power cord, communication cable, remote-control cable in correct way, and do not damage the plug. Disconnect the equipment from mains power before connecting the cables.
- Make sure fluid in the tubing has been drained out, no pressure in the pipeline and disconnect the equipment from mains power, while removing or loading the tubing.
- Please do not disassemble, refit or maintain the equipment without permission, so as to avoid dangers such as fire or electric shock and thus prevent any personal injury or any damage to the equipment. Please contact Longer Pump or its authorized distributors for after-sales service.

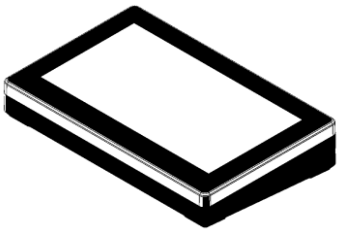
2. Product Introduction

dPOFLEX PFU and dPOFLEX PFS are high-precision peristaltic pump filling systems, which can do the precise filling (accuracy better than ±1%) of micro volumes as low as 30uL. One PFU has one filling channel. Multi-channel filling system could be constructed with multiple PFUs. One PFS has four filling channels. Multi-channel filling system (>4 channels) also could be constructed with multiple PFSs. Both PFU and PFS could be mounted with microliter pump head PFH01 and milliliter pump head PFH02. And the filling volume could be set as 1uL to 99.99L. The controller PFC has 7-inch high -resolution touchscreen. The intuitive graphic interface design is easy for use. One PFC could control up to 32 channels, namely 32 units of PFU or 8 units of PFS. Each channel could have individual parameters.

Filling stand FPT1 could be used for the precise filling application, and supports vials, bottles, microtubes or 96-well plates. FPT1 could be mounted with 1 to 8 filling probes. Please refer to the instructions of FPT1 for more details.

PFH01

PFH02



PFC

FPT1

2.1 Specifications

Product Model		**dPOFLEX PFU single-channel high-precision filling unit**	**dPOFLEX PFS four-channel high-precision filling system**
Main performance	Pump head	PFH01 (microliter pump head), PFH02 (milliliter pump head)	
	Housing material	Anodized aluminum alloy	Stainless-steel
	Suitable tubing	Silicone tubing and tubing kits	
	Filling volume	1ul - 99.99L	
	Filling accuracy	Better than ±1%*	
	Filling precision	CV< 0.5%	
	Filling time	0.1s – 999.9h	
	Filling cycle	0-999,999 cycles (“0” means unlimited cycles)	
	Interval time	0.1s - 999.9s	
	Back suction parameter	0-30, for anti-drop function	
	Filling direction	Clockwise	
	Work mode	Single-channel filling; multi-channel filling with the same parameters or individual parameters	
	Channel quantity	Channel numbers can be increased via the communication cable, and one PFC controller can control up to 32 channels	
	Emergency stop function	Triggered by an external input signal	
	System noise	＜60dB	＜70dB
Controller (optional)	Display	7-inch LCD with touchscreen	
	Language	Chinese or English	
	Channel quantity	To control up to 32 channels simultaneously, namely 32 PFUs or 8 units of PFS	
	RTC (real-time clock)	Date and time can be set.	
	Access management	Three levels of user accesses (administrator, developer, operator)	
	Password protection	The users can set exclusive password.	
	Parameter recipe	Up to 500 recipes can be stored and recalled easily on the PFC controller, and the recipes can be imported and exported.	
	Calibration	Manual input calibration, balance reading calibration or online ratio calibration, with volume or weight data	

	Software/firmware upgrade	Upgrade via the USB port of the controller or direct upgrade via the host computer	
	Batch report	To be exported via a USB flash drive or thermal printing	To be exported via a USB flash drive or thermal printing or stored in a remote server (only available under the Ethernet communication mode)
	Log record	To record the complete operating history of the equipment, which can be directly exported	
Communication control	Communication interface	RS485	RS485; industrial Ethernet (optional)
	Protocol	Modbus RTU	Modbus RTU or Modbus TCP/IP (optional)
External control interface	Input	Support start signal input, emergency stop signal input, and disable channel signal input	
	Output	1 alarm output, configurable with motor stall or hardware error	
Regulations	Certification	CE-LVD (2014/35/EU), NB CE, UKCA, CE-EMC	
	Standard	EN61010-1; EN610326-1	
	GMP	21 CFR Part 11 and EU Annex 11	
	RoHS	2011/65/EC	
	3Q qualification system	IQ/OQ	
IP rating	IP	IP31	IP32
Physical characteristics	Power supply	AC 100V-240V, 50/60Hz	AC 100V-240V, 50/60Hz
	Power	60W	250W
	Dimension of pump (L*W*H）	203mm×119mm×176mm (without pump head)	245mm×548mm×198mm (without pump head)
	Weight	Approximately 3.5kg (without pump head)	Approximately 15.4kg (without pump head)
	Dimension of controller (L*W*H）	187mm×123mm×39mm	
	Controller weight	Approximately 0.6kg	
	Working condition	Temperature: 5 - 40°C; Relative humidity: ≤85%, no condensation	
	Transportation and storage condition	Temperature: -40 - 70°C Relative humidity: ≤85%, no condensation	

*The filling accuracy and precision are tested under lab conditions, and inlet/ outlet pressure is 0 with deionized water. To ensure the filling precision, it is hereby recommended to use suitable tubing kits and accessories from Longer Pump.

2.2 Equipment Function and Filling Performance

2.2.1 Functions

- Precise filling function

A filling system PFS or filling unit PFU can be mounted with either a microliter pump head PFH01 or a milliliter pump head PFH02. And each pump head can be loaded with a variety of tubing sizes. Refer to Chapter 2.2.2 for the pump head, tubing options, filling capacity and accuracy. The filling volume, filling time, filling cycles and all the other filling parameters can be set via the PFC controller or other remote controller.

- Filling volume calibration

To improve the filling precision and accuracy, several calibration methods are available in the system: online ratio calibration, volume calibration, weight calibration, and multiple-filling calibration.

- ✓ Online ratio calibration: When the pump is running the filling operation, the filling volume could be

adjusted without stopping the pump. The adjustment range is 95%-105% of the target volume. Please refer to Chapter 3.5.2 for more details.

- ✓ Volume calibration: calibrate the filling volume by entering the actual filled volume. Please refer to Chapter 3.5.5 for more details.
- ✓ Weight calibration: calibrate the filling weight by entering the actual filled weight. Please refer to Chapter 3.5.5 for more details.
- ✓ Multiple-filling calibration: The PFC controller supports the function of multiple-filling calibration, to calibrate the total filling volume or weight by entering the total actual volume or weight after multiple filling cycles. Please refer to Chapter 3.5.5 for more details.

The PFC controller supports two calibration modes and two calibration trigger modes. Please refer to Chapter 3.5.5 for more details.

- ✓ Calibration modes: the actual filled volume or weight can be entered into the PFC by hand or via balance reading function. If the mode of balance reading calibration is selected, PFC controller will read the weight from the balance automatically. If the mode of manual input is selected, the actual volume or weight needs to be entered manually.
- ✓ Calibration trigger mode: the calibration can be triggered through PFC touch screen or remote signal.

- Multi-channel system

Filling channels can be increased by connecting several PFU units or PFS systems together via the communication cables to construct a multi-channel system. One PFC controller can control up to 32 channels simultaneously. Please refer to Chapter 3.4.4 for more details.

- Control mode

The pump can be controlled through PFC controller, remote communication control and remote digital signal control.

- ✓ PFC controller: with the 7-inch industrial touchscreen, all the operating parameters can be set manually, and the filling operations can be controlled manually.
- ✓ Remote communication control: Communication interface could be RS485 and Ethernet (Ethernet only applicable to PFS); protocol could be Modbus RTU and Modbus TCP/IP (TCP/IP only applicable to PFS). When control the pump through communication control, the parameter setting and control commands could be send to the PFU or PFS directly from the remote controller. PFC is not needed for this communication control function.
- ✓ Remote digital signal control: The functions of start filling, emergency stop and disable the channel can be controlled through remote digital signals.

- Disable the channel

The channel will not start the filling operation when the disable channel signal inputs to the equipment. Each channel has an independent terminal for its own disable signal. When a disable channel signal inputs to the equipment, no further filling will be started after the current filling cycle is completed. The disable signal is normally sent by the filling machine equipped with the PFU/ PFS. Please refer to Chapter 3.4.1 and 3.4.2 for disable channel signal wiring, and Chapter 3.5.7.5 for disable channel signal setting.

- Emergency stop function

When the emergency stop signal is received, the pump will immediately stop filling operations. Please refer to Chapter 3.4.1 and 3.4.2 for emergency stop signal wiring, and Chapter 3.5.7.5 for emergency stop signal setting.

- Alarm output function

When the pump malfunctions, the pump will output an alarm signal based the system settings. Please refer to Chapter 3.4.1 and 3.4.2 for alarm output wiring, and Chapter 3.5.7.5 for alarm output setting.

- Fast filling/emptying function

Fast filling: the fluid is filled into the tubing at high speed. The running direction of fast filling operation is clockwise.

Fast emptying: the fluid in tubing can be recycled at the inlet port of the tubing. The running direction of fast emptying operation is counterclockwise.

Please refer to Chapter 3.5.3 for more details.

- Recipe of filling parameters

The filling parameters can be created and saved as recipes on PFC controller. The recipes can be imported and exported via a USB flash drive. The recipes also can be edited, deleted and protected (prohibit modification). PFC controller can store up to 500 recipes. Please refer to Chapter 3.5.4 for more details.

- Anti-drop function

The anti-drop function could be achieved by back suction function, which effectively prevent dropping liquid when the filling operation stops. Please refer to Chapter 3.5.4 for more details.

- Batch report function

The batch report will be generated automatically following the completion of filling operation by PFC controller. Please refer to Chapter 3.5.6 for more details.

- Log record function

The log record will be generated automatically by PFC controller. Please refer to Chapter 3.5.7.8 for more details.

- User accesses management

The PFC controller has three levels of user accesses management. The users can be the Administrator, the Developer, and the Operator. Please refer to Chapter 3.5.7.7 for more details.

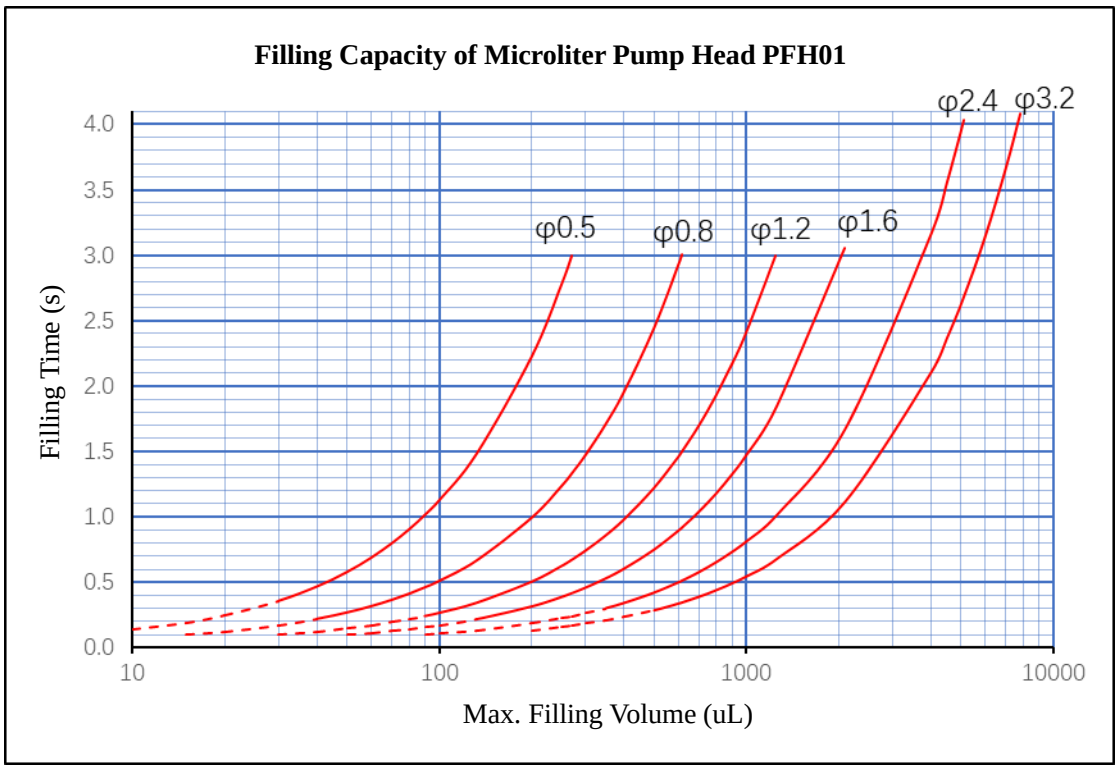
- Function of software/firmware upgrade

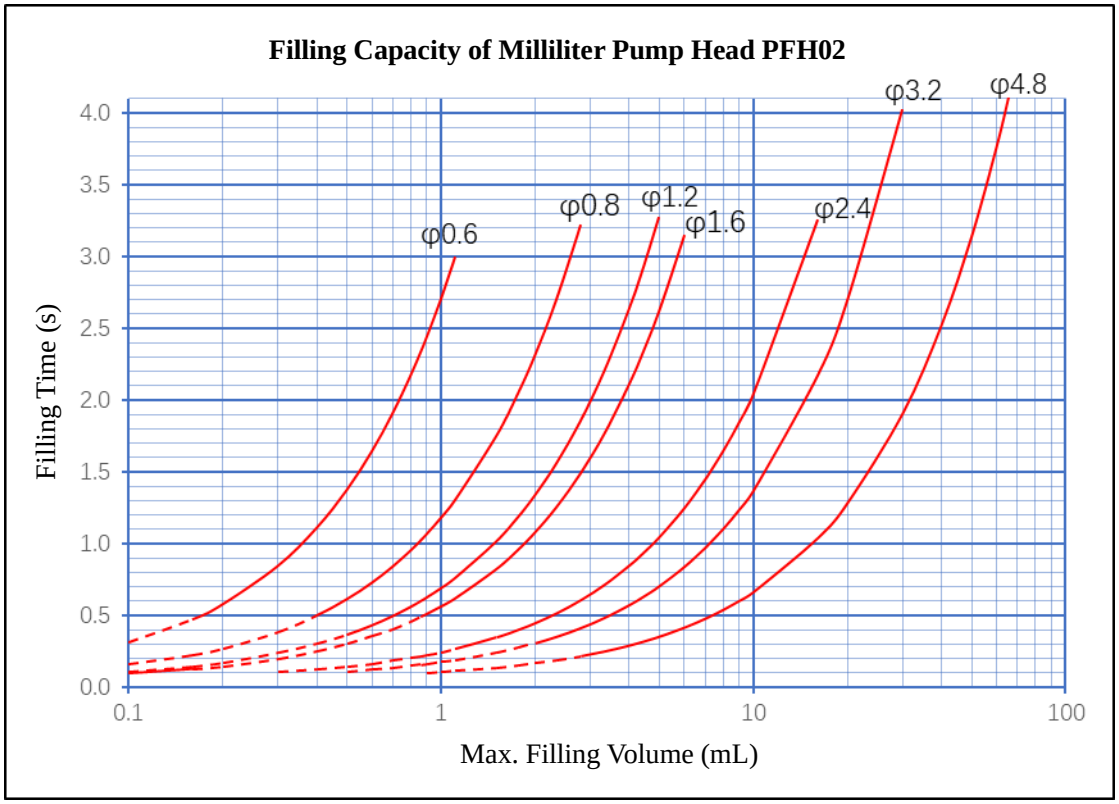
The PFC controller has the function of software/firmware upgrade. Please save the software and firmware with the latest versions in the specified directory of a USB flash drive and insert it into the USB-A port of the PFC controller, and then upgrade the firmware of the pump and the software of the controller. Please refer to Chapter 3.5.7.11 for more details.

2.2.2 Filling Performance

PFU and PFS can be mounted with microliter pump head PFH01 and milliliter pump head PFH02. The following figure shows the filling capacity curve of each pump head. Each curve in the figure indicates the

recommended maximum filling volume for the specified tubing size within a certain filling time.





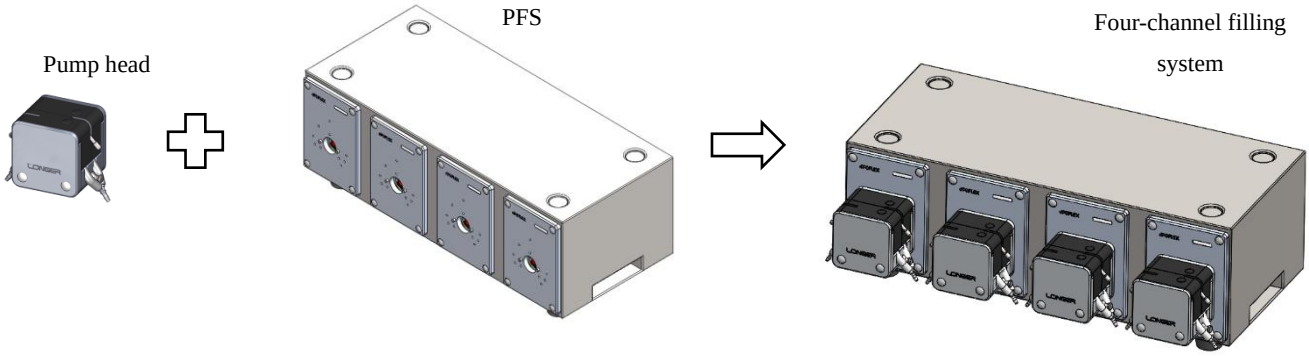
Note: The dotted-line part represents the minimum filling volume but the accuracy would possibly worse than ±1%; and the full-line part represents the recommended filling volume with accuracy better than ±1%.

Pump Head Model	Speed (rpm)	Tubing specifications	Tubing ID (mm)	Max. Reference Flow Rate (mL/min)	Min. Filling Volume (with accuracy better than ±1%)	Max. Filling Volume per Second	Recommended ID of Filling Probe (mm)
PFH01	≤350	PFH01-05G	0.5	7	30uL	118uL	0.3 or 0.6
		PFH01-08G	0.8	17	42uL	269uL	0.6
		PFH01-12G	1.2	34	90uL	534uL	1
		PFH01-16G	1.6	63	132uL	987uL	1 or 1.6
		PFH01-24G	2.4	104	400uL	1.61mL	1.6
		PFH01-32G	3.2	159	760uL	2.47mL	1.6 or 3.2
PFH02	≤450	PFH02-06G	0.6	27	0.2mL	0.42mL	0.6
		PFH02-08G	0.8	66	0.4mL	1.03mL	0.6
		PFH02-12G	1.2	114	0.5mL	1.78mL	1
		PFH02-16G	1.6	147	0.8mL	2.29mL	1 or 1.6
		PFH02-24G	2.4	371	1.16mL	5.77mL	1.6
		PFH02-32G	3.2	566	2.15mL	8.80mL	1.6 or 3.2
		PFH02-48G	4.8	1178	3mL	18.28mL	3.2 or 4.5

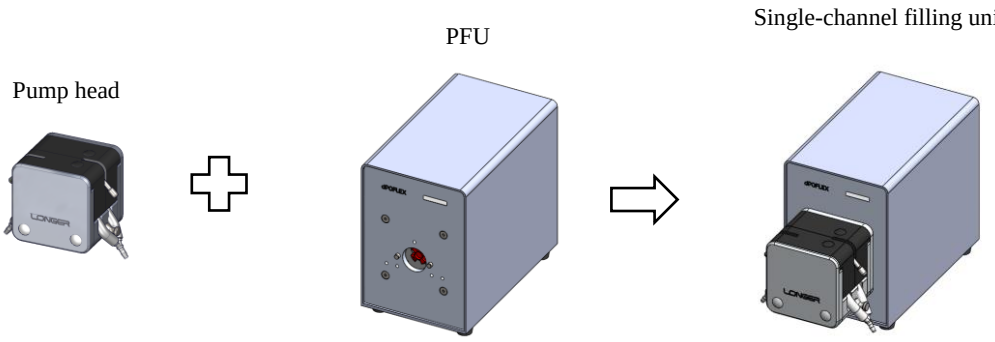
2.3 Product Structure and Dimensions

2.3.1 Product Structure

Structure of PFS

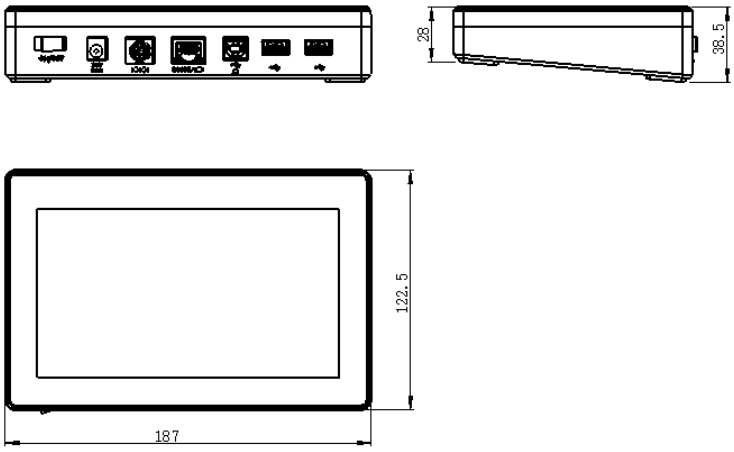


Structure of PFU

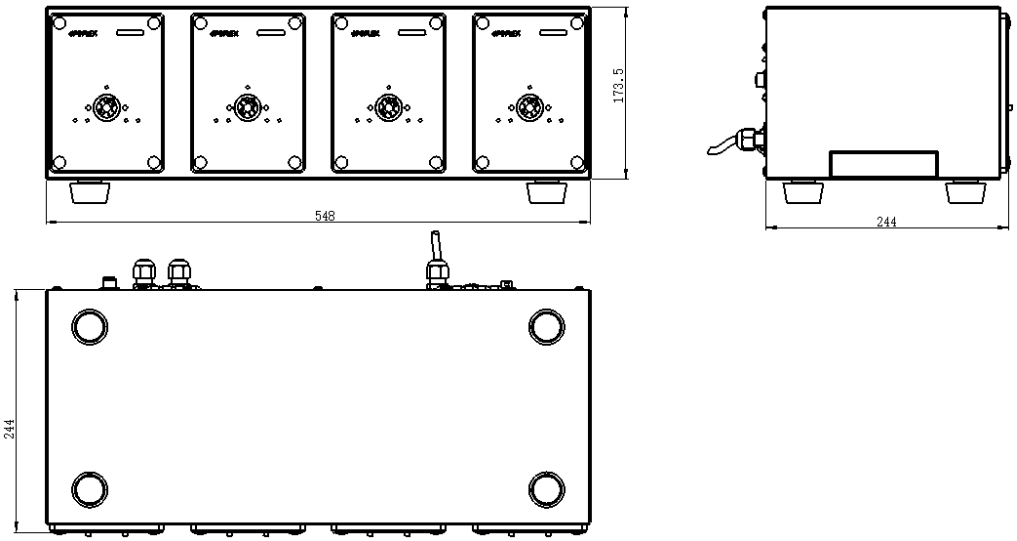


2.3.2 Dimensions

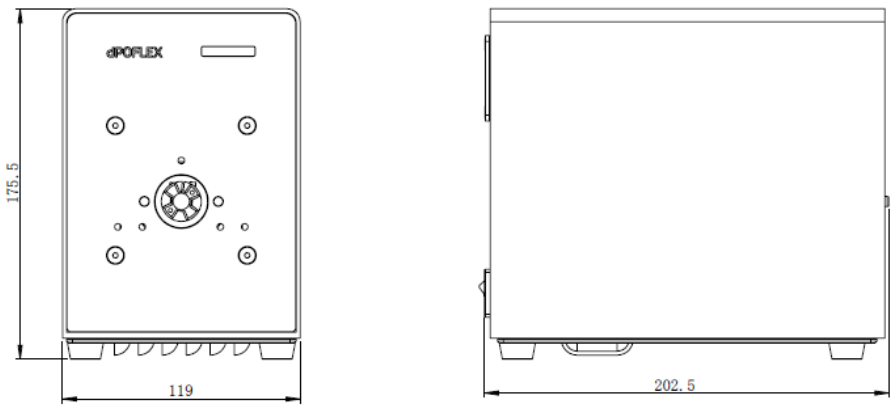
Dimensions of PFC controller



Dimensions of PFS



Dimensions of PFU



3. System Operating

3.1 Quick Start Guide

- Set the physical address of each channel: The default physical address of a PFU is 1. The default physical addresses of the four channels of PFS are 1, 2, 3, and 4. When there are more than 1 unit of PFU in a multi-channel filling system, or there are more than 1 unit of PFS in a multi-channel filling system, please set the physical address of each channel, which must be unique. Please refer to Chapter 3.4.1 and Chapter 3.4.2 for more details.
- Wiring and power-on: Connect the PFC to PFU or PFS. If there are more than one PFU or PFS, connect each unit with cables. Please refer to Chapter 3.4.4 for more details. Turn on the power switches of the PFU, PFS and PFC to power on the system.
- Channel scanning: Enter the channel setting screen through [System]-> [Channel] on the PFC Controller. Click the [Scan Unit] button to scan the channels. Make sure all the channels are scanned successfully. If failed, double confirm the cable wiring is correct and scan again.
- Create and activate recipe: Select [Recipe] on the navigation bar of the PFC controller. Create a new recipe or select an existing recipe. Enable the channels as required, and edit the recipe parameters. Activate the recipe to be run on the screen of [Dispense].
- Start filling operation: Select [Dispense] on the navigation bar of the PFC controller, edit the cycles of filling, and start the filling operation.

3.2 Unpacking

To unpack the equipment, follow below steps:

(1) Take out of the equipment and accessories from the shipping carton.

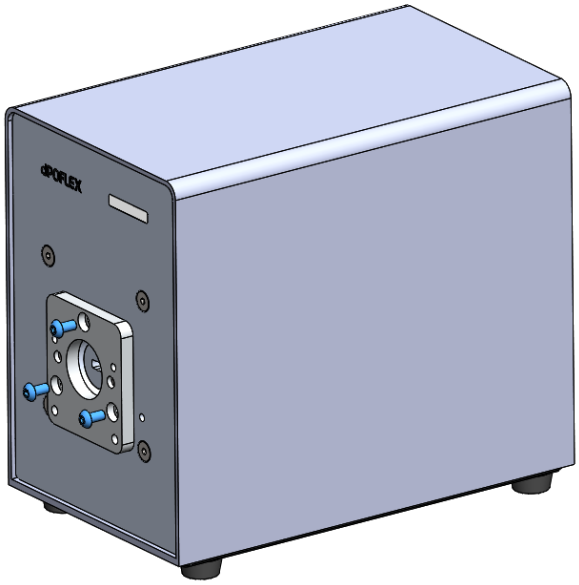
(2) Check the packing list to make sure all components are present.

In case of any question, please contact Longer Pump or the local distributor.

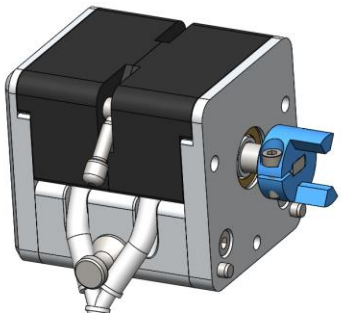
3.3 Installation of Pump Head and Tubing

3.3.1 Installation of Microliter Pump Head PFH01

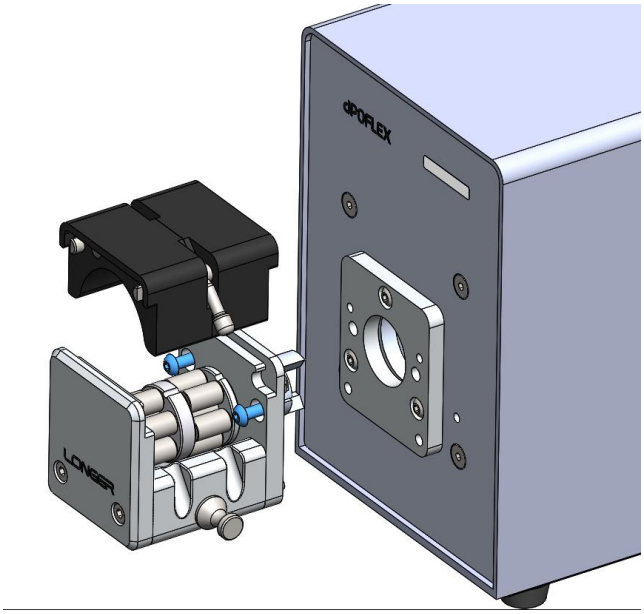
1. Mount the pump head mounting plate on the PFU or PFS with three M4X8 hexagon socket flat head screws and a socket head wrench (2.5mm).



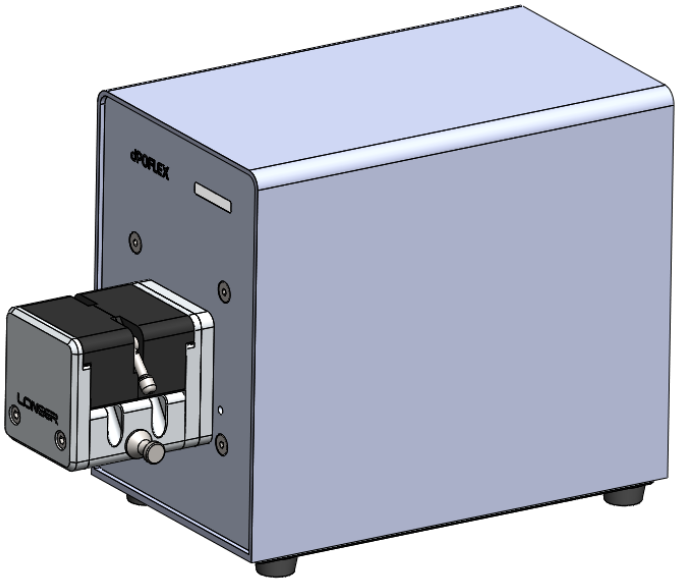
2. Install the φ8 coupling on the tang of the pump head shaft. Make sure the tang is fully inserted into the slot of the coupling and tighten the screw.



3. Align the projection of the coupling on the pump head shaft with the groove of the rubber coupling on the motor shaft, and couple those two couplings to the bottom position. Mount the pump head on the mounting plate with two M4X8 hexagon socket flat head screws and a socket head wrench (2.5mm).

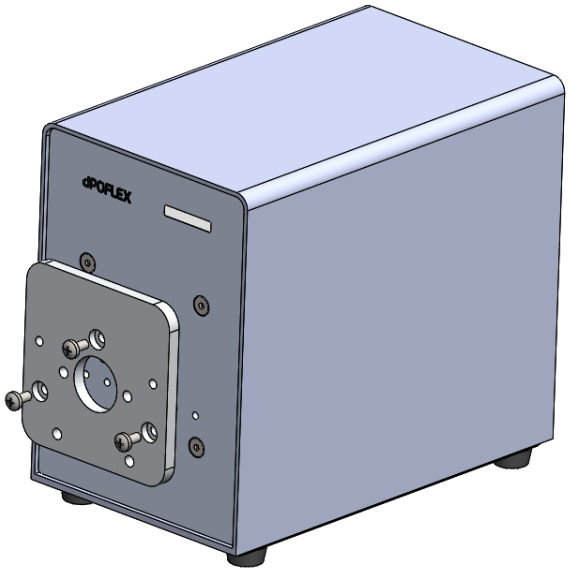


Remove the pump head as opposed to Steps 1-3.

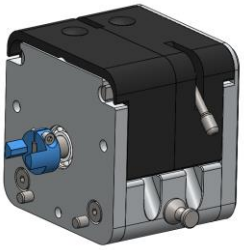


3.3.2 Installation of Milliliter Pump Head PFH02

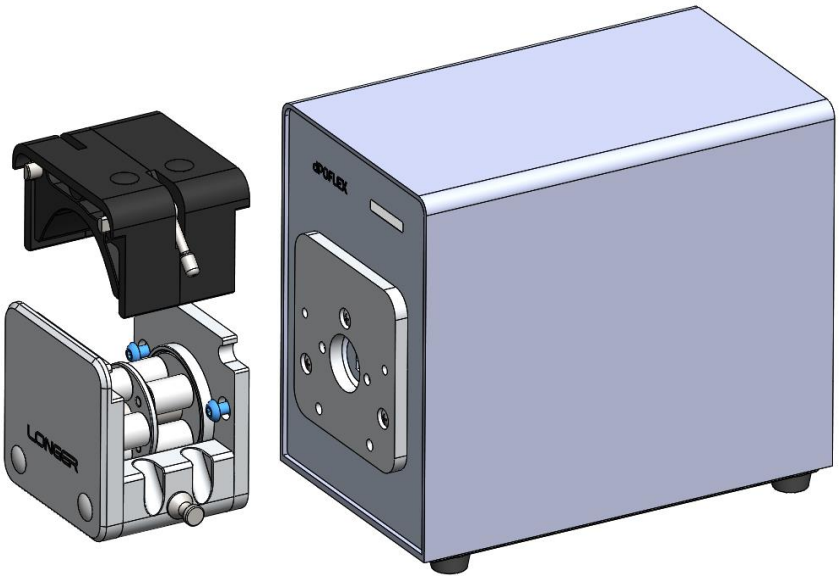
1. Mount the pump head mounting plate on the PFU or PFS with three M4X8 cross recess head screws.



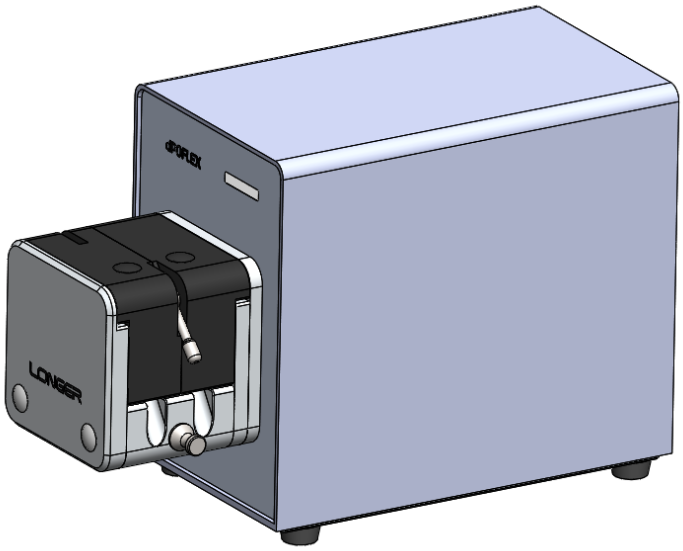
2. Install the φ10 coupling on the tang of the pump head shaft. Make sure the tang is fully inserted into the slot of the coupling and tighten the screw.



3. Align the projection of the coupling on the pump head shaft with the groove of the rubber coupling on the motor shaft, and couple those two couplings to the bottom position. Mount the pump head on the mounting plate with two M5X8 hexagon socket flat head screws and a socket head wrench (3mm).



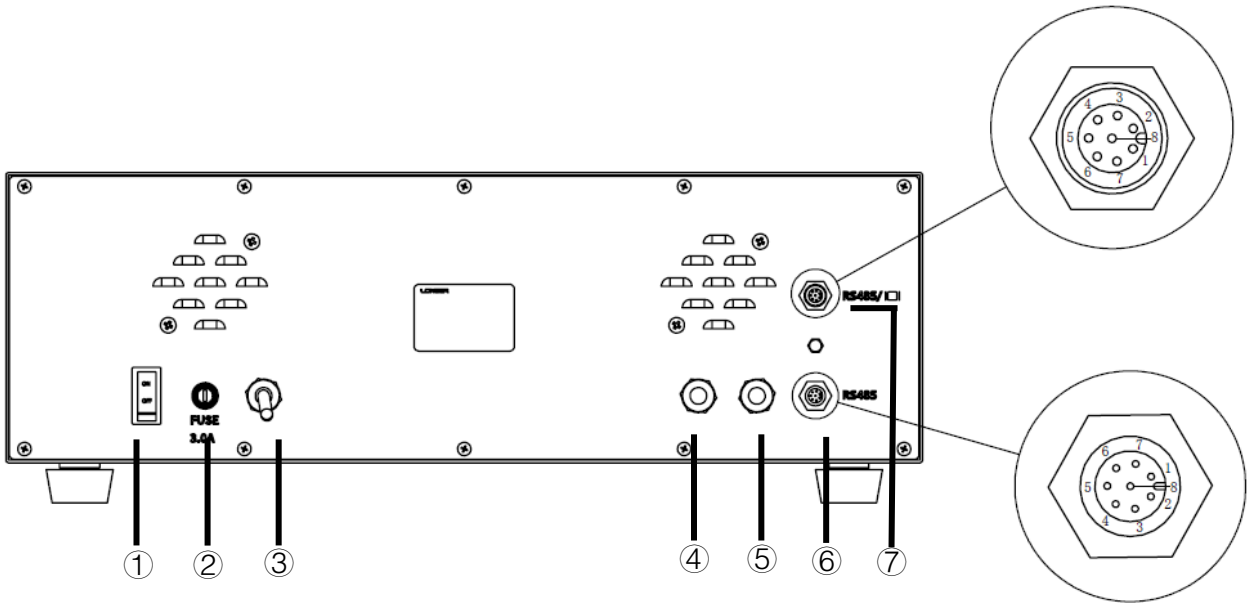
Remove the pump head as opposed to Steps 1-3.



3.4 Hardware Setting and Control Wiring

3.4.1 Hardware Setting and Control Wiring of PFS

3.4.1.1 Back Panel of PFS



The ports and interfaces are defined as below:

① Power switch

② Fuse

③ AC power cord

④ Reserved port

⑤ Reserved port

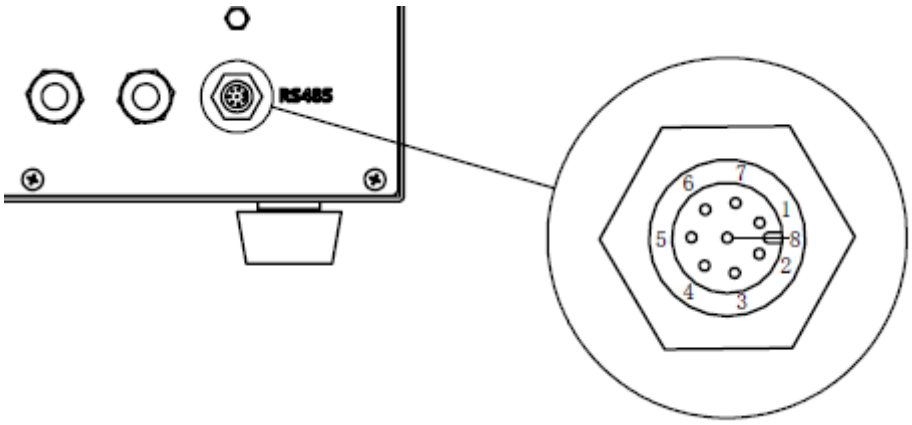
⑥ Port for communication control and external control

⑦ Port for PFC controller

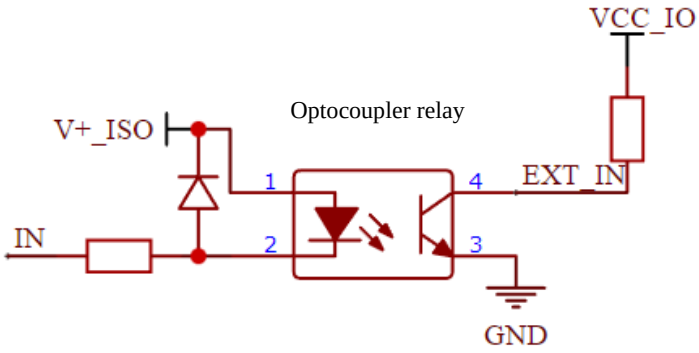
Port (⑥) for communication control and external control

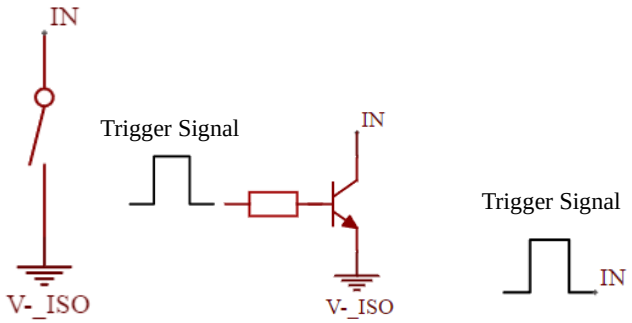
Port (⑥) uses aviation socket with 8 pins for communication control and external control signals. When the system has more than one PFS, the PFSs will be connected to each other through the port (⑥) and port (⑦). Refer to Chapter 3.4.4 for the cabling details.

The pins of the port (⑥) are defined as follows:



Description of pins:

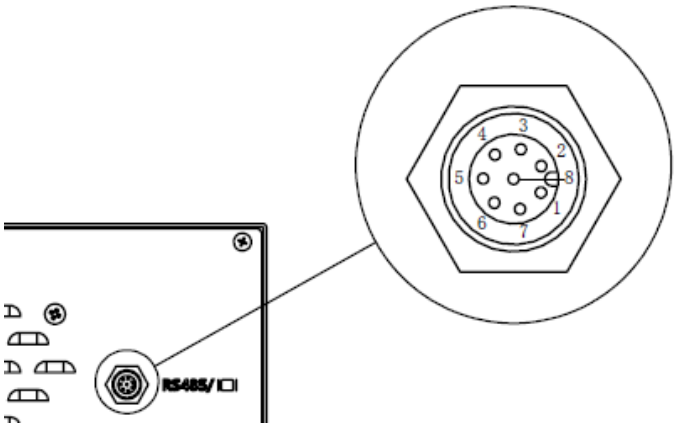
Pin No.	Definition	Description	Remarks
1	485_B	RS485- Interface	For communication control
2	485_A	RS485+ Interface	For communication control
3	CFG_485_B	RS485- Interface	For communication parameter configuration (device address, baud rate, parity, stop bit); The communication parameters for this function are: device address: 1, baud rate: 38,400bps, 8 data bits, no parity, 1 stop bit
4	V-_ISO	Ground	
5	IN1	External control input: start filling	High level (5V) by default; circuit shown below:  Three kinds of input signals and wiring: 1. Switch signal 2. OC gate signal, the current output when the node is conducting

			is less than 5mA 3. Level signal; high level range for IN: 5-24V Please refer to Chapter 3.5.7.5 for the control logic setting of start filling. 
6	CFG_485_A	RS485+ Interface	For communication parameter configuration (channel address, baud rate, parity, stop bit); The communication parameters for this function are: device address: 1, baud rate: 38,400bps, 8 data bits, no parity, 1 stop bit
7	IN2	External control input: emergency stop	High level (5V) by default; circuit is identical to that of IN1
8	Reserved	/	

Port (⑦) for PFC controller

Port (⑦) uses aviation socket with 8 pins for PFC controller connection. When the system has more than one PFS, the PFSs will be connected to each other through the port (⑥) and port (⑦). Refer to Chapter 3.4.4 for the cabling details.

The pins of the port (⑦) are defined as follows:



Description of pins:

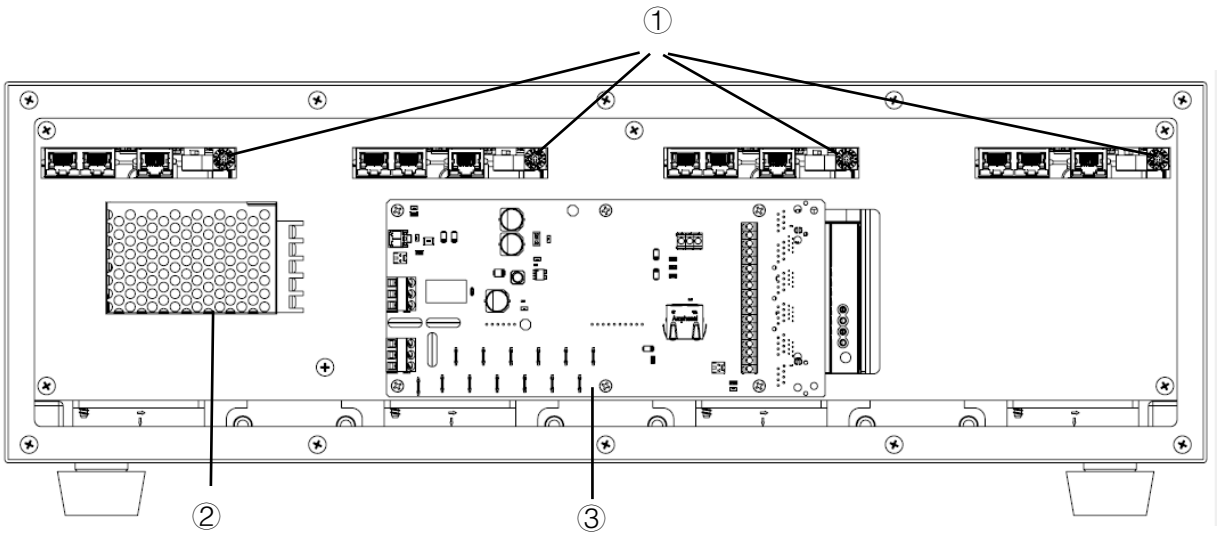
Pin 8 is 24V power supply for the PFC controller. The definitions of the other pins are the same as those of the port (⑥).

3.4.1.2 External Control Board and Channel Address Setting

Open the back panel of PFS, connect the disable channel signal input cable and alarm output cable to the control board, and set the channel physical address using the DIP switch.

The default physical addresses of the four channels of PFS are 1, 2, 3, and 4 (from left to right when facing the front of the pump). When there are more than 1 unit of PFS in a multi-channel filling system, it is necessary to set the channel physical address, ensuring the uniqueness of the physical address for each channel.

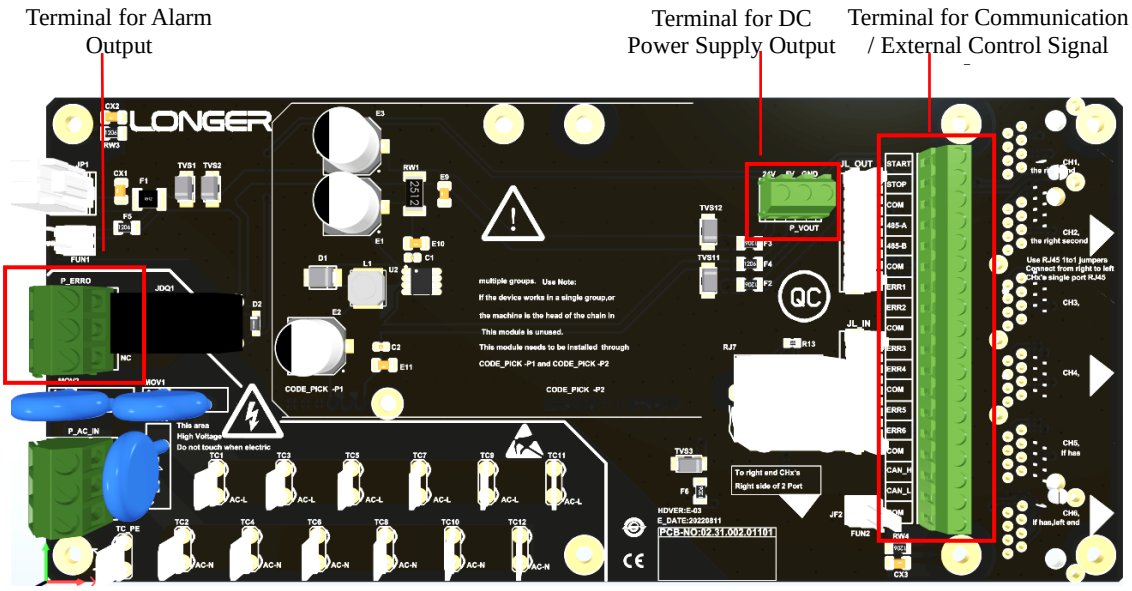
The following figure shows the case after the back panel is removed.



① In conjunction with the left-side bit switch, the DIP can be used to set 32 physical addresses.
When the bit switch is set to L (Left), the DIP switch addresses 0-F correspond to physical addresses 1-16. When the bit switch is set to R (Right), the DIP switch addresses 0-F correspond to physical addresses 17-32. When there are more than 1 unit of PFS in a multi-channel filling system, it is necessary to set the channel physical address to ensure they have unique addresses. The default DIP switch positions of every PFS is 0,1,2 and 3, representing physical addresses 1,2,3 and 4 respectively.

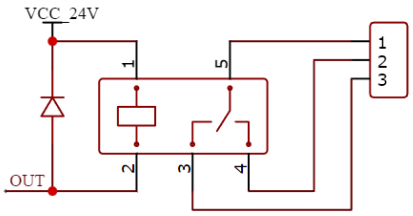
② Switched power supply

③ Control board
The control board is used to connect communication signal, external control signal and alarm output signal. Refer to below figure for the interface details.



- Terminal for Alarm Output P_ERRO

The alarm output is a relay signal, which is shared by the 4 channels of PFS, and the corresponding circuit is as follows:



Terminal definitions: Pin 1-COM; Pin 2-NO; Pin 3-NC
Maximum load voltage of relay contact: 250VAC/30VDC
Maximum load power: 1,250VA /150W

- Terminal for DC Power Supply Output

Output DC5V and 24V, maximum current: 100mA

- Terminal for Communication/External Control Signal Input

Terminal definitions from top to bottom:

START: For start filling signal, valid to all the 4 channels of PFS. This terminal is connected to the IN1 of Port ⑥ and ⑦.

STOP: For emergency stop signal, valid to all the 4 channels of PFS. This terminal is connected to the IN2 of Port ⑥ and ⑦.

COM: GND

485-A: For RS485 communication terminal +, valid to all the 4 channels of PFS. This terminal is connected to the 485_A of Port ⑥ and ⑦.

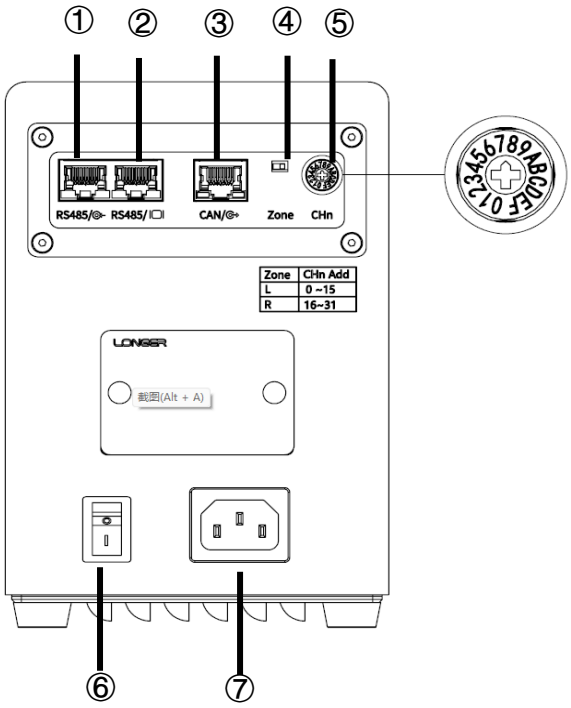
485-B: For RS485 communication terminal -, valid to all the 4 channels of PFS. This terminal is connected to the 485_B of Port ⑥ and ⑦.

COM: GND

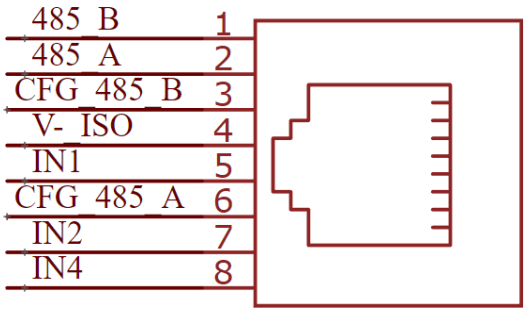
ERR1: Disable channel signal for Channel 1 (from right to left when facing the back of the pump, the Channels are 1, 2, 3, and 4.)
ERR2: Disable channel signal for Channel 2
COM: GND
ERR3: Disable channel signal for Channel 3
ERR4: Disable channel signal for channel 4
COM: GND
ERR5: Disable channel signal for Channel 5 (reserved)
ERR6: Disable channel signal for Channel 6 (reserved)
COM: GND
CAN_H: For CAN communication signal + (reserved)
CAN_L: For CAN communication signal - (reserved)
COM: GND

3.4.2 Hardware Setting and Control Wiring of PFU

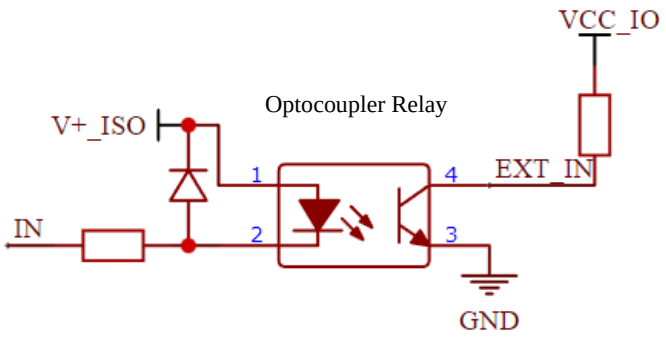
The following is the back of PFU:

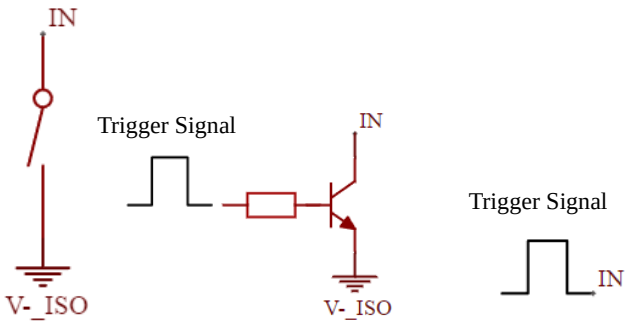


① RS485/: It is a RJ45 terminal for communication control and external control. When the system has more than one PFU, the PFUs will be connected to each other through the port ① RS485/ and port ② RS485/. Refer to Chapter 3.4.4 for the cabling details.

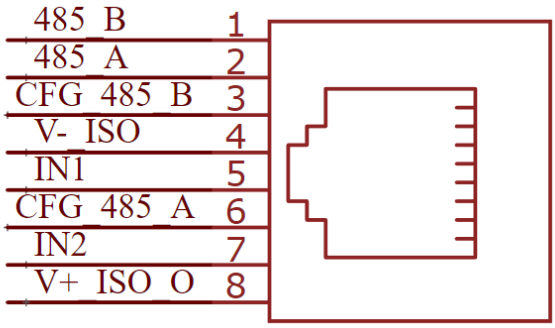


Definitions of pins:

Pin No.	Definition	Description	Remarks
1	485_B	RS485- Interface	For communication control
2	485_A	RS485+ Interface	For communication control
3	CFG_485_B	RS485- Interface	For communication parameter configuration (device address, baud rate, parity, stop bit); The communication parameters for this function are: device address: 1, baud rate: 38,400dps, 8 data bits, no parity, 1 stop bit
4	V-_ISO	Ground	
5	IN1	External control input: start filling	High level (5V) by default; circuit shown below:  Three kinds of input signals and wiring: 1. Switch signal 2. OC gate signal, the current output when the node is conducting is less than 5mA 3. Level signal; high level range for IN: 5-24V Please refer to Chapter 3.5.7.5 for the control logic setting of start filling.

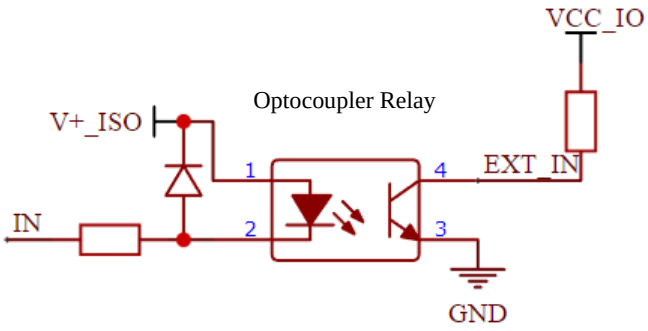
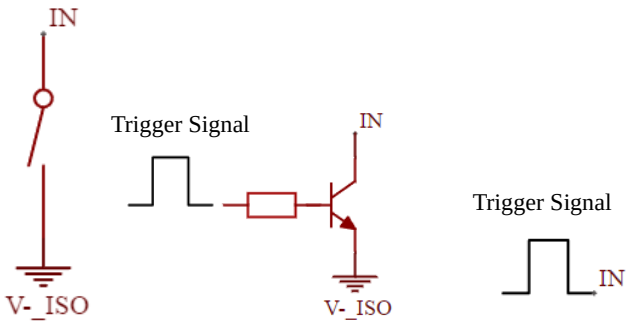
			
6	CFG_485_A	RS485+ Interface	For communication parameter configuration (device address, baud rate, parity, stop bit); The communication parameters for this function are: device address: 1, baud rate: 38,400bps, 8 data bits, no parity, 1 stop bit
7	IN2	External control input: emergency stop	High level (5V) by default; circuit identical to that of IN1
8	IN4	Input for multi-channel indication	In multi-channel system (daisy chain), connecting the port RS485/ of the next pump to the port RS485/ of the previous pump (Chapter 3.4.4) will input 24V to this pin, the indicator light next to the port RS485/ of the previous pump will illuminate.

② RS485/: It is a RJ45 terminal for PFC controller. When the system has more than one PFU, the PFUs will be connected to each other through the port RS485/ and RS485/. Refer to Chapter 3.4.4 for the cabling details.



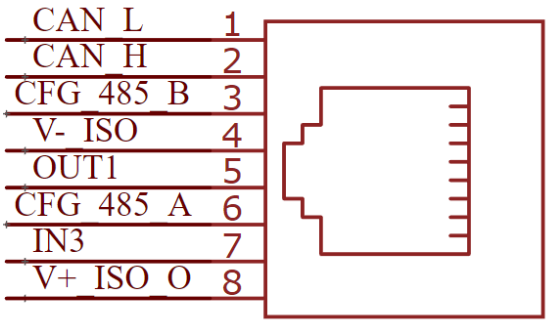
Definitions of pins:

Pin No.	Definition	Description	Remarks
1	485_B	RS485- Interface	For communication control
2	485_A	RS485+ Interface	For communication control

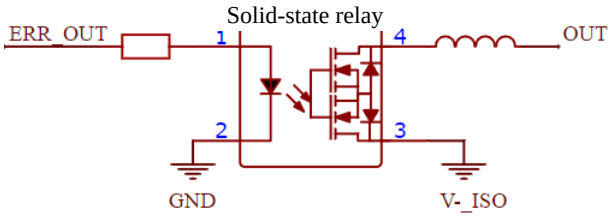
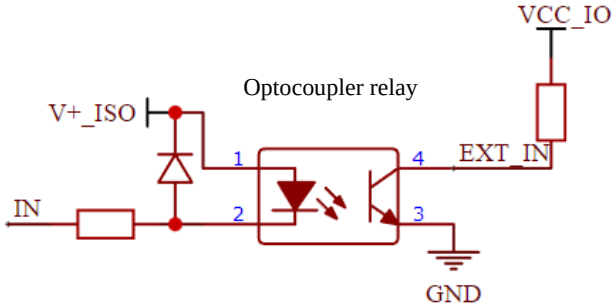
3	CFG_485_B	RS485- Interface	For communication parameter configuration (device address, baud rate, parity, stop bit); The communication parameters for this function are: device address: 1, baud rate: 38,400bps, 8 data bits, no parity, 1 stop bit
4	V-_ISO	Ground	
5	IN1	External control input: start filling	High level (5V) by default; circuit shown below:  Three kinds of input signals and wiring: 1. Switch signal 2. OC gate signal, the current output when the node is conducting is less than 5mA 3. Level signal; high level range for IN: 5-24V Please refer to Chapter 3.5.7.5 for the control logic setting of start filling. 
6	CFG_485_A	RS485+ Interface	For communication parameter configuration (device address, baud rate, parity, stop bit); The communication parameters for this function are: device address: 1, baud rate: 38,400bps, 8 data bits, no parity, 1 stop bit
7	IN2	External control input: emergency stop	High level (5V) by default; circuit identical to that of IN1 by default
8	V+_ISO_O	24V power supply	To supply 24V power to the PFC controller while connected with the controller. In multi-channel system, to supply the 24V to the Pin 8 of the port RS485/⊙ of the previous pump.

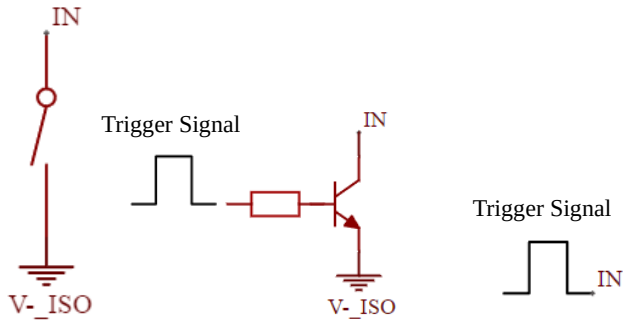
Pin description:

③ CAN/⊖. It is a RJ45 terminal which can be used to output an alarm signal and receive disable channel signal.



Definitions of terminals:

Pin No.	Definition	Description	Remarks
1	CAN_L	CAN- Interface	Reserved
2	CAN_H	CAN+ Interface	Reserved
3	CFG_485_B	RS485- Interface	For communication parameter configuration (device address, baud rate, parity, stop bit); The communication parameters for this function are: device address: 1, baud rate: 38,400bps, 8 data bits, no parity, 1 stop bit
4	V-_ISO	Ground	
5	OUT1	Digital signal output; alarm output	The output circuit is as follows:  Withstand voltage: 24V/0.5A
6	CFG_485_A	RS485+ Interface	For communication parameter configuration (device address, baud rate, parity, stop bit); The communication parameters for this function are: device address: 1, baud rate: 38,400bps, 8 data bits, no parity, 1 stop bit
7	IN3	External digital signal input / disable channel signal input	High level (5V) by default, circuit shown below: 

			Three kinds of input signals and wiring: 1. Switch signal 2. OC gate signal, the current output when the node is conducting is less than 5mA 3. Level signal; high level range for IN: 5-24V 
8	V+_ISO_O	24V power supply	To supply power to the controller while connected to the controller.

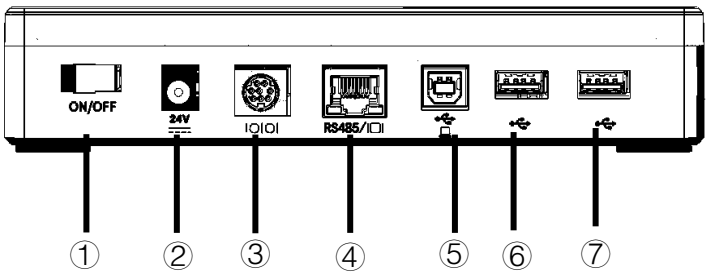
④ **Zone** : Bit switch, when set to L (Left), the DIP switch addresses 0-F correspond to physical addresses 1-16. When set to R (Right), the DIP switch addresses 0-F correspond to physical addresses 17-32.

⑤ **CHn** : DIP switch for physical addresses, positions 0-F

⑥ AC power switch

⑦ AC power interface 220VAC

3.4.3 Controller Interface



① Power ON/OFF switch

② 24VDC power input interface (reserved)

③ S port (reserved)

④ RJ45 terminal: integrated communication signal, control signal, and power supply. The pins are corresponding to the port (**RS485/**) of PFU

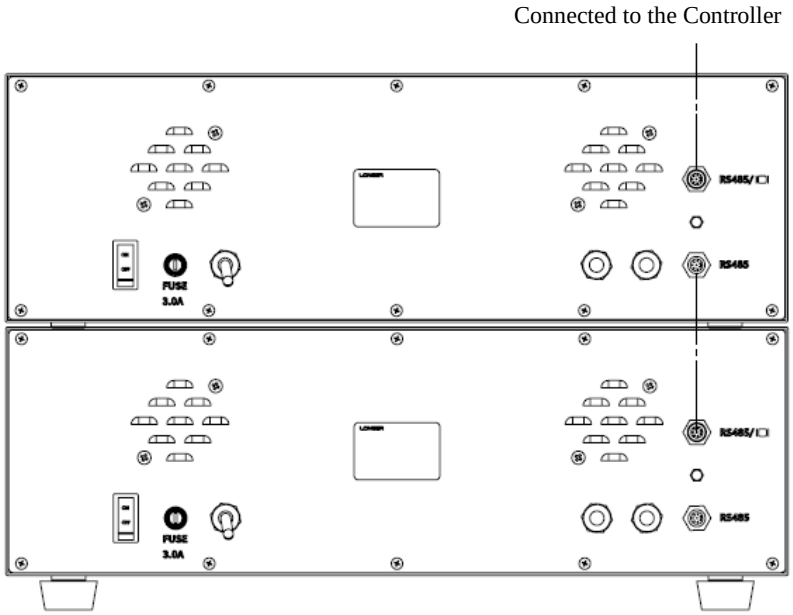
⑤ USB_B terminal (reserved)

⑥ /⑦ USB_A terminal: interface for software/firmware upgrade, data export, balance calibration or connected to a printer

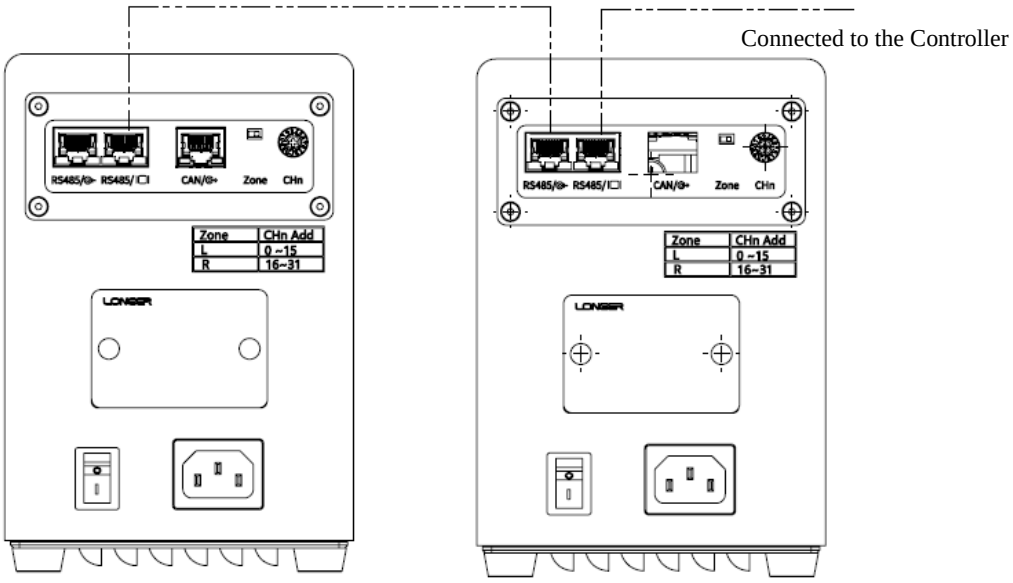
3.4.4 Multi-channel Configurations

Configuration for multiple PFSs

Remove the ground feet and stack them, only keep the ground feet of the system at the bottom.



Configuration for multiple PFUs



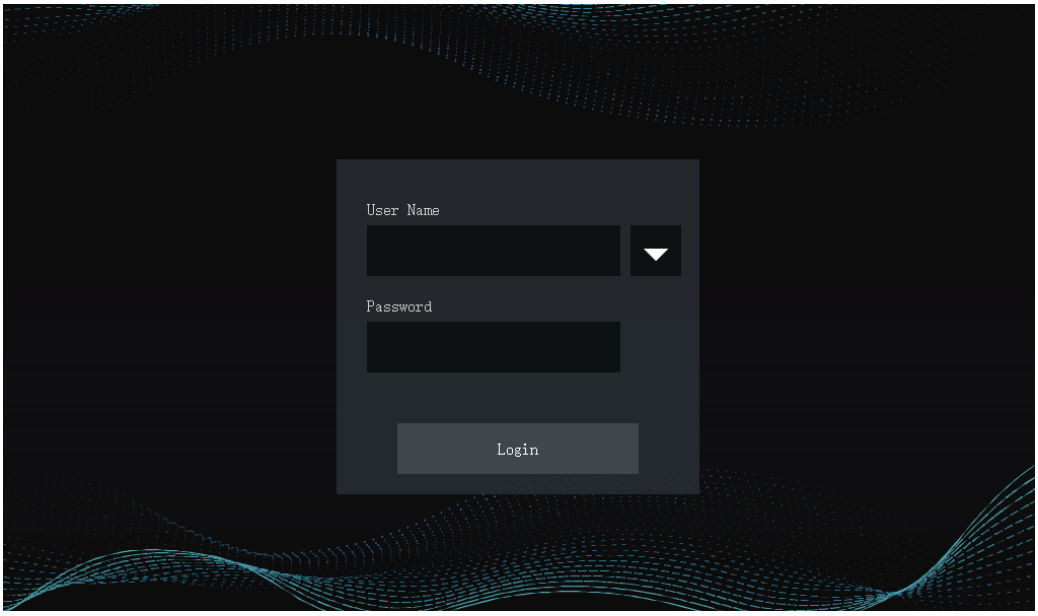
In a multi-channel filling system, it is necessary to set the channel physical address to ensure they have unique addresses.

Note: The default DIP position of the four channels of PFS are 0, 1, 2, 3 (from left to right when facing the front of the pump), representing physical addresses 1,2,3 and 4 respectively. The default DIP position of PFU is 0, representing physical address 1.

3.5 Operating Instructions of PFC Controller

3.5.1 Login

Select the login account for the controller and enter the password. The Administrator account is named ‘admin’, with the initial password ‘123456’ (the admin password can be changed). If other accounts have been created, please log in with the respective username and password.



3.5.2 Dispense

Select [Dispense] from the left-hand navigation bar to enter the screen of dispense.

The recipe to be run on the [Dispense] screen is an activated recipe. Please refer to Chapter 3.5.4 for activation of a recipe.

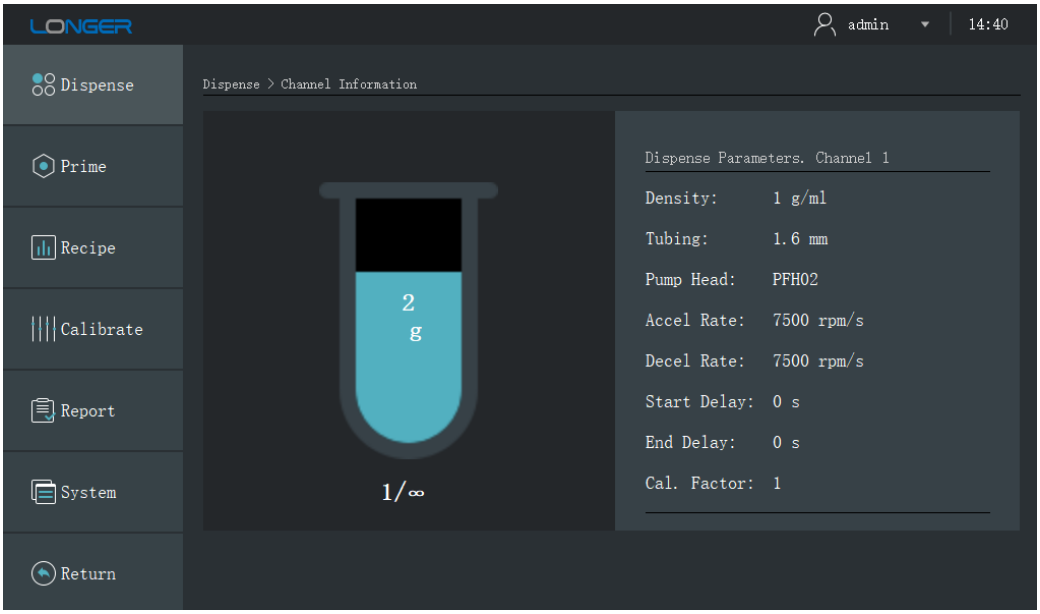
The display area of the [Dispense] screen is described as below:

① Channel navigation: to display the channel quantity range for the current recipe.

② Channel logical address: to display the logical address of the current channel. Please refer to Chapter 3.5.7.6 for the specific definition of a logical address.

③ Liquid name display area: to display the liquid name for the current channel featured in the current recipe.

④ Dynamic display of vial filled: to display the filling status of the vial in a dynamic way. Clicking on this area will display the specific parameters for that channel, as shown in the following figure.



⑤ Filling quantity setting: to display the setting of the filling volume or weight for the current channel in the current recipe.

⑥ Recipe display area:

- Recipe name: to display the name of the currently activated recipe
- Batch name: to display the batch name during runtime. The batch name can be manually set or automatically generated upon startup. Whenever filling operations are initiated using the PFC controller, it is necessary to either edit the batch name or use the batch name generated by the PFC. To edit the batch name, please click [Edit]. When filling is initiated via an external start signal, no batch report is available.
- Running mode: to display the running mode of the current recipe.
- 1/1: Number of vials already filled/total cycles to be filled; Click [Edit] to set the total cycles to be filled; This data is not valid when filling is initiated via an external start signal.

⑦ Button area

⑧ Alarm indicator: to display the alarm messages when the system can not work.

⑨ Function icons: Icons will appear here when the controller is connected to a printer, balance or in external control mode.

 : Printer connected

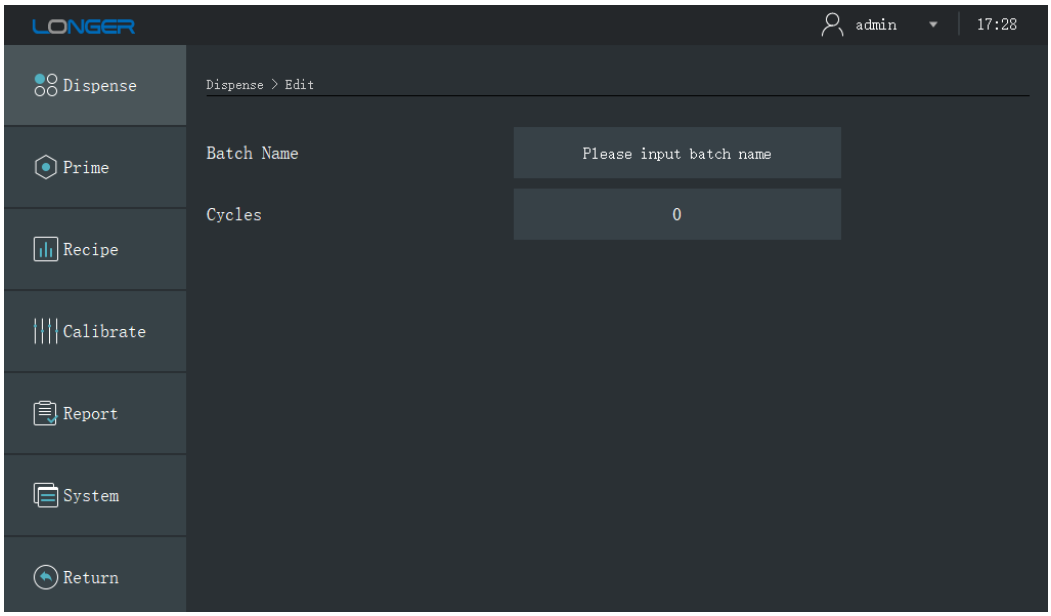
 : Balance connected

 : External control mode

⑩ User display: to display the current username. Please refer to Chapter 3.5.7.7 for the user setting.

The functions of the button area are as below:

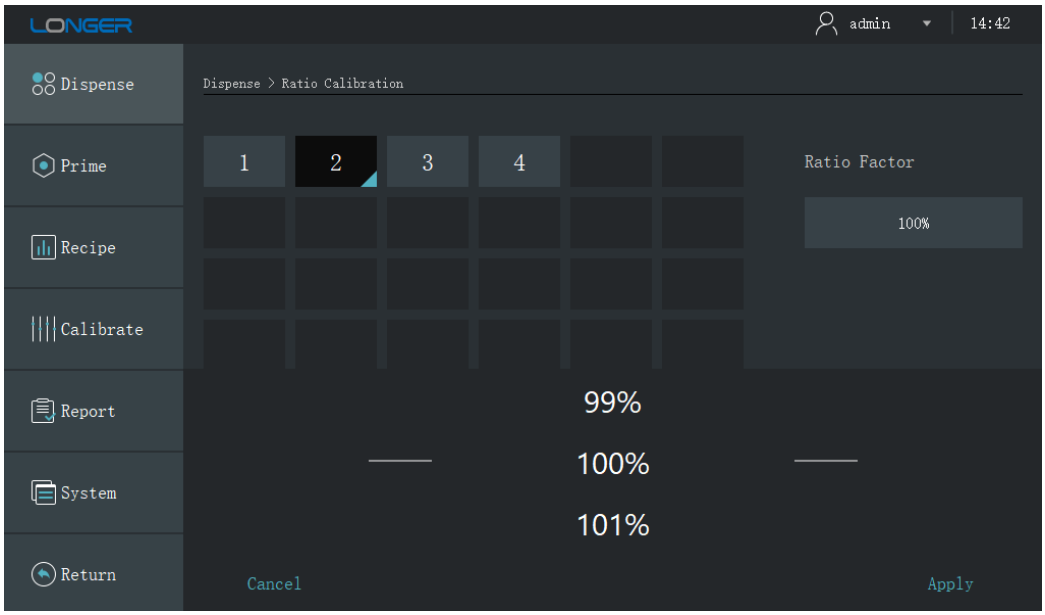
- [Edit]



Click this button and edit the “Batch Name” or “Cycles”. When not editing the batch name, a PFC controller will automatically generate a batch name with the format of “Batch_year/month/day_hour/minute/second”. The setting of the “Cycles” as 0 refers to unlimited cycles.

- [Ratio Calibration]

Click this button to make an online ratio calibration for each channel without stop the filling process. The ratio calibration range is 95%-105% (cumulative calibration factor).



Calibrated liquid volume or weight = Set liquid volume or weight * calibration factor

After using the online ratio calibration function multiple times, the calibrated liquid quantity = Set liquid quantity * cumulative calibration factor. For example, if the set filling weight is 1g and the calibration factor set for the first online calibration is 1.01, then the calibrated liquid weight (theoretical value) = 1 * 1.01 = 1.01g; if the calibration factor set for the second online calibration is 1.01 as well, then the calibrated liquid weight (theoretical value) after two online calibrations = 1 * 1.01 * 1.01 = 1.02g.
Note: after setting the calibration factor, it is necessary to return to the [Dispense] screen for the calibration factor or cumulative calibration factor to take effect during following filling cycles.

The calibration factor will be reset to 1 in the following two situations:

1. Change the following parameters in the recipe and return to the [Dispense] screen: pump head, tubing, density, flowrate factor.
2. Restore factory default.

- [Test]

After clicking this button, the equipment will perform a trial run once according to the current recipe parameters.

- [Start]

After clicking the [Start] button, if a batch name has not been set in advance, a prompt will appear: 'Batch name not defined, use default?' Selecting 'Ok' will start the equipment according the selected recipe parameters. Choosing 'Cancel' will return to the [Dispense] screen.
Once the equipment starts filling process, the button [Start] will change to [Pause].

- [Pause]

While the equipment is in the filling process, clicking the [Pause] button will pause the equipment after the current filling cycle is completed, the button will change to [Resume].

- [Resume]

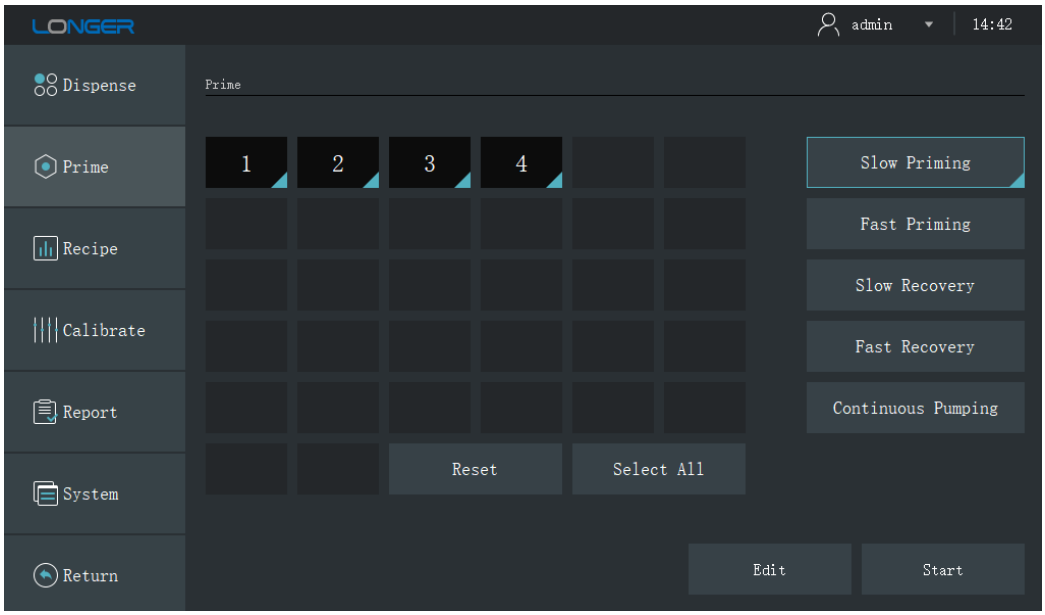
When the equipment is paused during the filling process, clicking the [Resume] button will resume the equipment to complete the remaining filling operations and the button will change back to [Pause].

- [Stop]

While the equipment is running or paused during the filling process, click the [Stop] button to initiate a stop operation.
If the current recipe's run time is less than 1 second and click the [Stop] button, the equipment will stop running after the current filling cycle is completed.
If the current recipe's run time is greater than 1 second and the current filling cycle is not yet completed when click the [Stop] button, a prompt will appear: ' System is running… System will stop after current dispensing is completed.' Click [Stop] on the prompt screen to stop the equipment immediately. Otherwise, the equipment will stop running after the current filling cycle is completed.

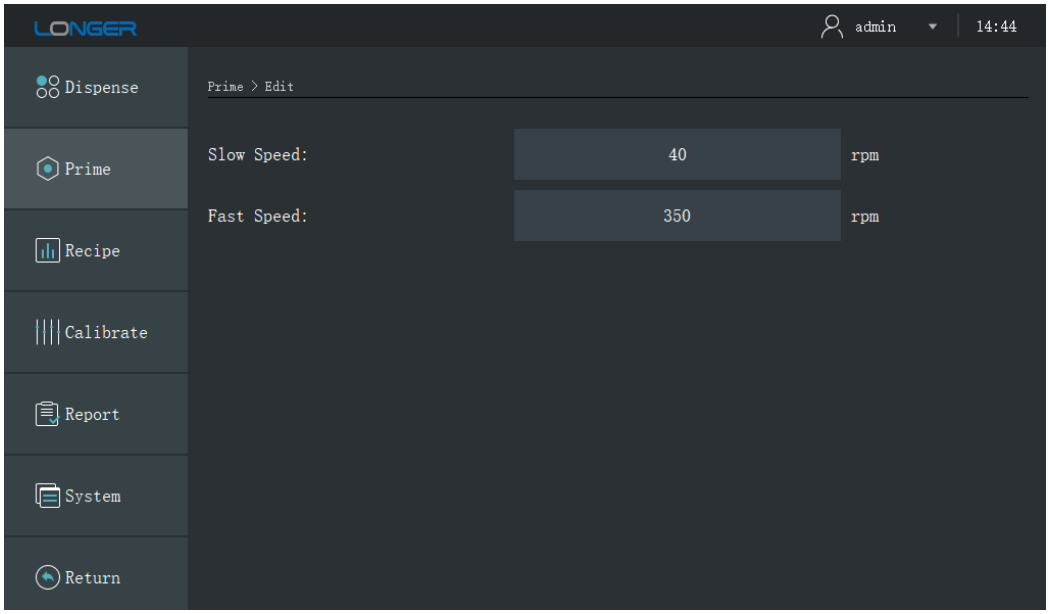
3.5.3 Prime

Select [Prime] from the left-hand navigation bar to enter the screen of prime operation.



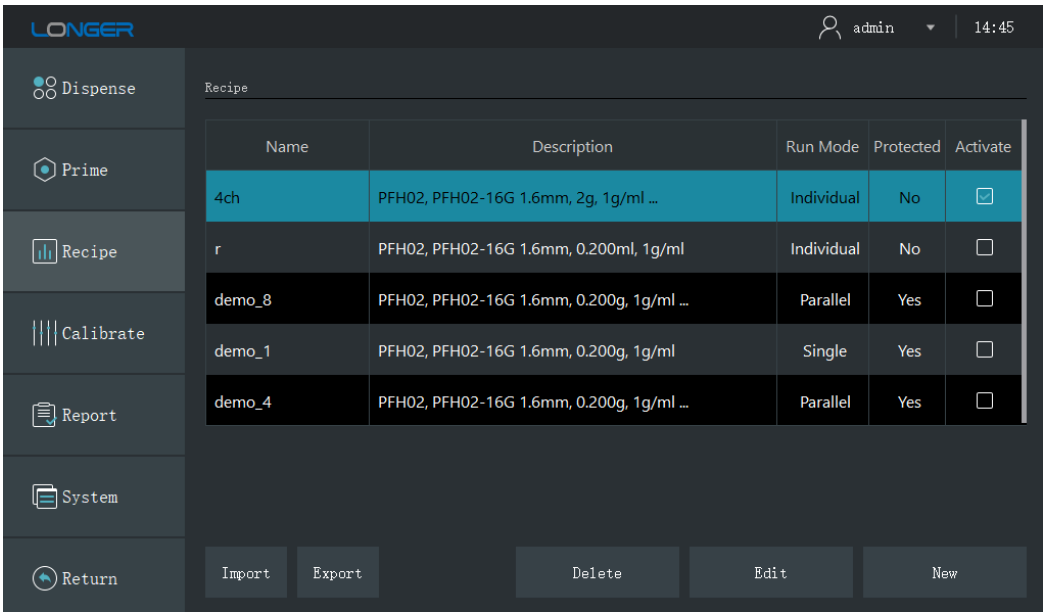
On the [Prime] screen, the prime operation can be performed on all selected channels. The prime operation is mainly used to fill the tubing or empty the tubing.

- [Slow Priming]: Fill the tubing with slow pump speed. The default speed is 40rpm. The speed for slow priming can be set by clicking the [Edit] button on the bottom of [Prime] screen, within the range of 5-40rpm. When [Slow Priming] is selected, press and hold the [Start] button to fill the tubing clockwise at the set slow speed. Release the [Start] button to stop the filling.
- [Fast Priming]: Fill the tubing with fast pump speed. The default speed is 350rpm. The speed for fast priming can be set by clicking the [Edit] button, within the range of 41-350rpm. When [Fast Priming] is selected, press and hold the [Start] button to fill the tubing clockwise at the set fast speed. Release the [Start] button to stop the filling.
- [Slow Recovery]: Empty the tubing with slow pump speed. The default speed is 40rpm. The speed for slow recovery can be set by clicking the [Edit] button on the bottom of [Prime] screen, within the range of 5-40rpm. When [Slow Recovery] is selected, press and hold the [Start] button to empty the tubing counterclockwise at the set slow speed. Release the [Start] button to stop the empty operation.
- [Fast Recovery]: Empty the tubing with fast pump speed. The default speed is 350rpm. The speed for fast recovery can be set by clicking the [Edit] button, within the range of 41-350rpm. When [Fast Recovery] is selected, press and hold the [Start] button to fill the tubing counterclockwise at the set fast speed. Release the [Start] button to stop the empty operation.
- [Continuous Pumping]: When [Continuous Pumping] is selected, click the [Start] button to fill the tubing clockwise continuously at the set fast speed, and the [Start] will change to [Stop]. Click [Stop] will stop the filling. The default fast speed is 350rpm, which can be set to 41-350rpm by clicking [Edit] button.



3.5.4 Recipe

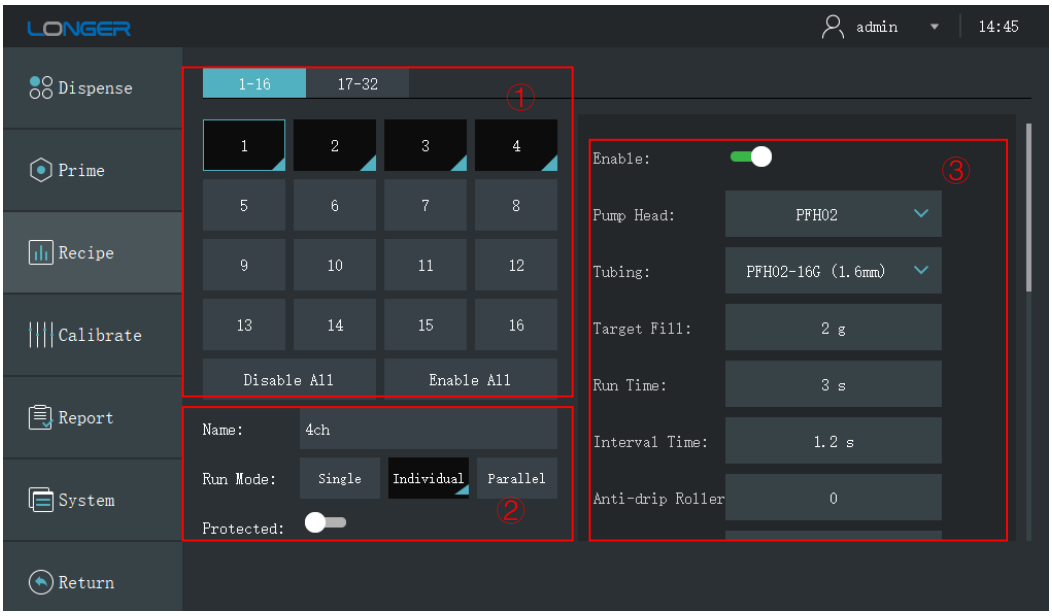
Select [Recipe] from the left-hand navigation bar to enter the screen of recipe list. The demo recipe will be displayed by default. A total of 500 parameter recipes can be stored.



- Name: display the recipe name set in the recipe
- Description: display the information about pump head, tubing, fluid density and other details in the recipe
- Run mode: display the run mode set in the recipe
- Protected: display whether the recipe is protected or not. If it is protected, it cannot be changed but can be deleted.
- Activate: When selected, the corresponding recipe will become the current active recipe, which can be run at the [Dispense] screen.
- [Import]: import a recipe from a USB flash drive. Insert a USB flash drive containing the recipe file into the USB port of the PFC controller. After clicking [Import], select the target recipe and it will be

imported to the controller. The recipe should be stored on the USB drive in the following path: USB Flash Drive>LONGER>dPOFLEX PFU_PFS_'Product SN'>Recipe". If the product SN in the path is different from the product SN to be imported, the recipe import function is still valid.

- [Export]: export a recipe from PFC controller to a USB flash drive. Select the recipe to be exported, insert the USB flash drive to the PFC controller, and click [Export] to export the recipe to the USB flash drive. The export path is: USB Flash Drive>LONGER>dPOFLEX PFU_PFS_"Product SN">Recipe".
- [Delete]: Select the recipe to be deleted (the selected recipe will have a blue background) and click the button [Delete] to remove the selected recipe.
- [Edit]: Select the recipe to be edited and click [Edit] to enter the recipe edit screen.
- [New]: To create a new recipe, click [New] to enter the new recipe edit screen, as shown in the following figure.



① Channel selection area: Select the channel needed

② Recipe editing area

- **Name:** The recipe name can have max 20 characters, including numbers, letters, and underlines.
- **Run Mode:** Single, Individual, and Parallel

  Single: This mode can be used when a single channel is used.

  Individual: This mode can be used when the number of channels is greater than or equal to 1. In this mode, each channel has its individual operating parameters. And the parameters for each channel shall be set and modified individually.

  Parallel: This mode can be used when the number of channels is greater than or equal to 1. In this mode, all channels have same operating parameters. The modifications to the parameters of one channel can be synchronized to the other channels in the same recipe.

③ Editing area for channel operating parameters

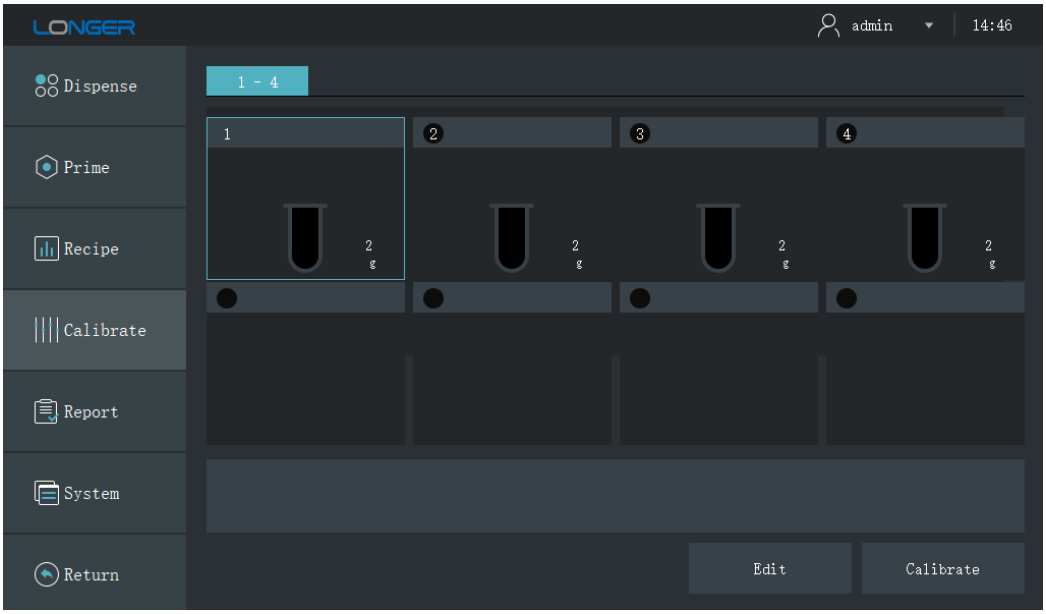
- **Enabling:** to enable the selected channel
- **Pump Head:** to set the pump head model which is same as the one mounted on the related channel. The pump head can be a microliter pump head PFH01 or a milliliter pump head PFH02.
- **Tubing:** to set the specifications of the tubing actual used by the related channel. Refer to the Chapter 2.2.2 for the tubing options.

- **Target Fill:** The volume or weight to be filled in one cycle. Setting range: 0.1mg-1,999kg or 1uL-99.99L.
- **Run Time:** The filling time in one cycle, range: setting range: 0.1s to 999.9h. (The run time includes the delay prior to back suction and the back suction operating time.)
- **Interval time:** The time between each filling cycle when filling operation is initiated by PFC controller. The setting range of interval time: 0.1s to 999.9s. The interval time is invalid when the filling operation is initiated by a remote start signal.
- **Anti-drop Roller**: the angle at which the pump rotates counterclockwise during back suction after a single filling cycle completed. For PFH01 pump head, value 1 represents 30°, and value n represents 30°*n. While for PFH02 pump head, value 1 represents 45°, and value n represents 45°*n. The anti-drop roller value range: 0-30.
- **Anti-drop Speed:** the pump speed during back suction after a single filling cycle completed. For PFH01 pump head, the anti-drop speed range is 1-350rpm. For PFH02 pump head, the anti-drop speed range is 1-450rpm.
- **Anti-drop Delay:** the interval time before back suction starts after a single filling cycle is completed, with a range of 0 to 10 seconds.
- **Fluid name:** the fluid name to be filled for individual channel, which will be displayed on the [Dispense] screen.
- **Density:** the density of the fluid to be filled, with a range of 0.1 to 20g/ml.
- **Flowrate Factor:** used to perform a coarse adjustment on the current channel when there is a big difference between the actual filled quantity and the set target quantity (This may happen when filling viscous liquids). For example, if the set target volume is 5mL, but the actual volume is 1mL, then the flowrate factor can be set to 5 (calculated as 5mL/1mL=5). The range is 0.1-20.
- **Acceleration:** the acceleration upon the startup of the motor, with a range of 100 to 7,500rpm/s.
- **Deceleration:** the deceleration upon the stop of the motor, with a range of 100 to 7,500rpm/s.
- **Startup Speed:** the initial speed of the motor, with a range of 1 to 150rpm.
- **Cutoff Speed:** the stop speed of the motor, with a range of 1 to 450rpm.
- **Start Delay:** the interval time between receiving the start signal at the pump (either initiated by the PFC controller or externally) and the start of filling, with a range of 0-6,000 seconds. The start delay parameter is the same for all channels.
- **End Delay:** the interval time between the stop of the pump and the next time it can accept a start signal, with a range of 0 to 6,000 seconds.

Note: When the run mode in a multi-channel system is set to Individual mode, and the run times and interval times for different channels are not the same, the start signal for all channels is sent simultaneously. The sending cycle of the start signal is determined by the longer sum of the run time and interval time.

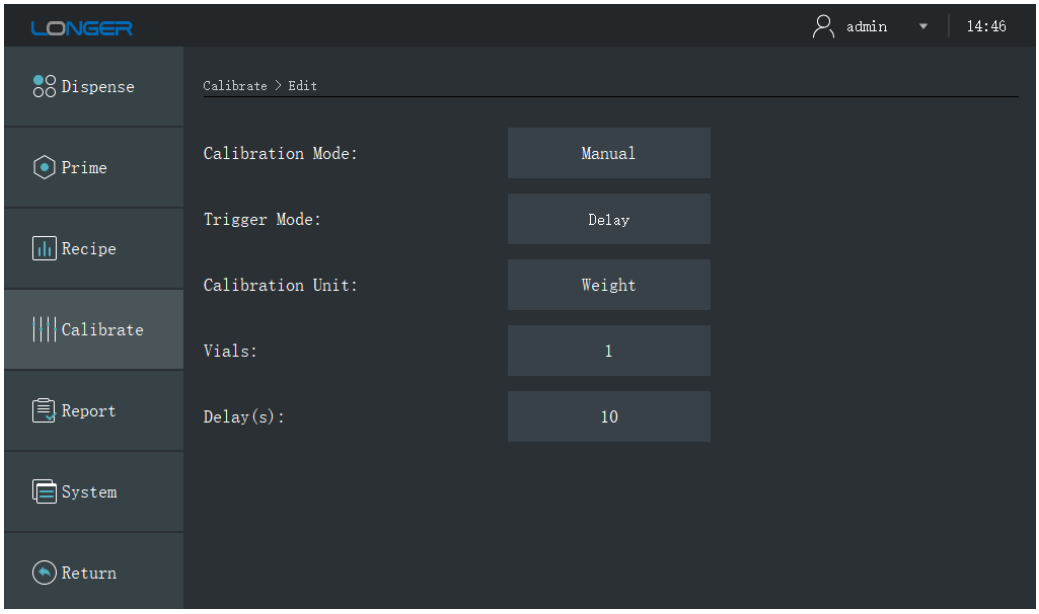
3.5.5 Calibrate

Select [Calibrate] from the left-hand navigation bar to enter the screen of pump calibration. Each channel can be calibrated individually.



- [Edit]

Click [Edit] button to enter the calibration editing screen.



Calibration Mode: The calibration mode can be set as **Manual** or **Balance**. When choosing **Manual,** the actual filling volume or weight needs to be input manually. When choosing **Balance**, connect the balance to the PFC controller, then the controller can read the balance measured value automatically. Currently supported balance brand is OHAUS. The communication parameters are: baud rate 9600bps, 1 stop bit, no parity.

Triggering Mode: The triggering mode can be set as **Internal, External or Delay.** When choosing **Internal,** the signal calibration will be initiated by a manually clicking [Start] button on the calibration screen. When the value of **Vials** is greater than 1 (to fill multiple vials and calibrate the total filling volume or weight), after each vial's filling, manually clicking [Start] button again to initiate next vial's filling. When choosing **External**, a signal to start the calibration filling will be initiated by an external start signal. When choosing **Delay**, multiple filling will be automatically run without manual start or remote signal start, and the interval

time between two calibration fillings is set in **Delay(s)**.

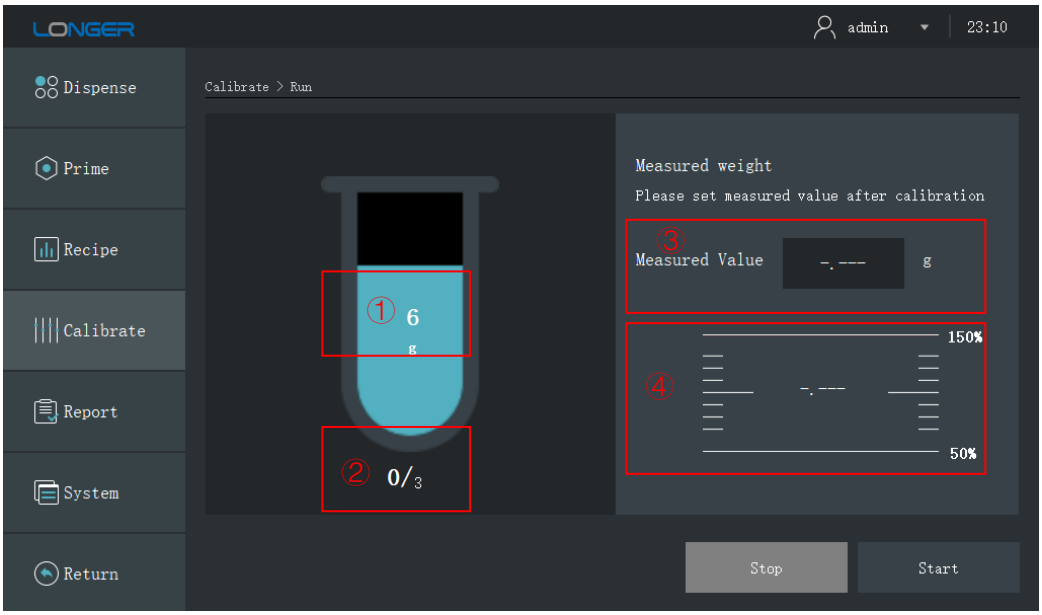
Calibration Unit: The calibration can be set as volume calibration or weight calibration. When choosing **Weight**, and the Target Fill in recipe is configured in volume unit, then weight= volume * density.

Vials: The number of vials to be filled, then calibrate the total volume or weight, with a range of 1 - 999,999. For the multiple calibrations, the value should be greater than 1.

Delay(s): When the triggering mode is set as **Delay**, the value of **Delay(s)** is the interval time between two calibration fillings**.** The range is 1 to 999,999 second.

- [**Calibrate**]

On the [**Calibrate**] screen, click the button [**Calibrate**] to enter the calibration running screen.



① Total calibration value: the displayed value= the calibration value of a single vial * the number of vials to be calibrated

② Calibration count: displays the number of filled vials/ the total number of vials to be filled and calibrated

③ Measured value: the actual filled volume or weight after calibration operation. When in Manual mode, this value needs to be input manually. When in Balance mode, this value will be read automatically from the connected balance. When using multiple calibration, input the total measured value after completing all the vials.

④ Calibration factor: the valid calibration factor is between 50% to 150%. The calibration factor= previous calibration factor * current measured filling quantity / target filling quantity. (For example, if the target filling quantity is 1.0g, and after the first calibration, the measured weight is 0.9g, then the factor after the first calibration is 0.9. If the second calibration is completed based on the first calibration, and the actual measured quantity for second calibration is 1.1g, then the factor after the second calibration is 0.9*1.1/1=0.99) After setting the measured value, calibration factor will be calculated and displayed. If the calibration factor exceeds the valid range, the border lines turn red as a warning, and the calibration is not

effective.

Click the [Start] button on the calibration running screen to initiate the calibration operation. After a single or multiple calibration is completed, the button changes to [Confirm]. Input the measured value, and then click [Confirm] to complete the calibration and generate a calibration summary.

The calibration factor will be reset to 1 in below 2 situations:

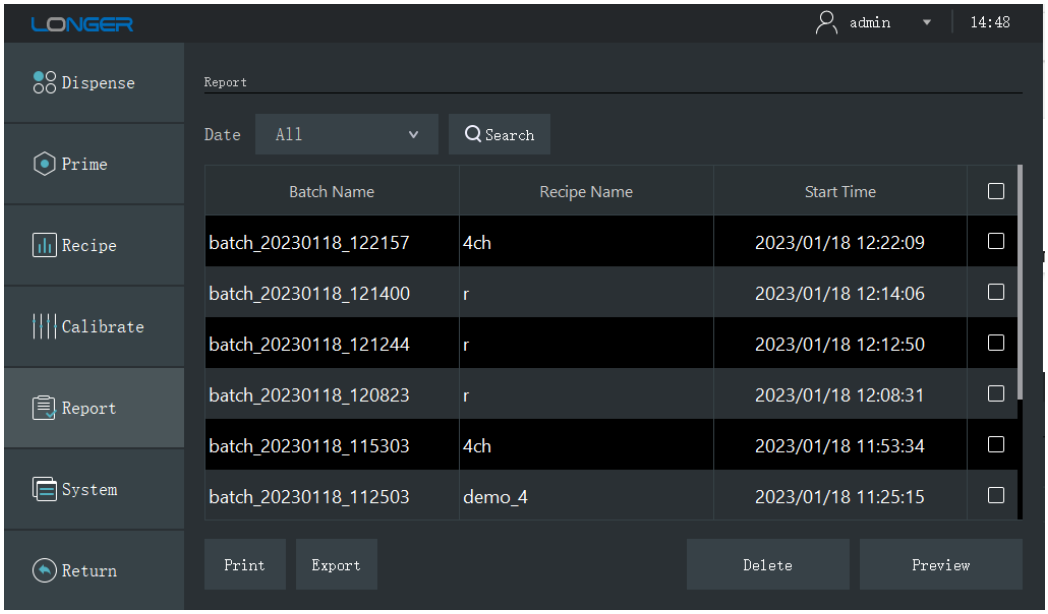
1. Configured different recipe parameters, and filling is initiated base on the new recipe parameters.
2. Restore the equipment to factory settings

Reasons for calibration failure:

1. The cumulative calibration factor exceeds the allowed range 50%-150%
2. The input calibration quantity exceeds the equipment limit
3. The pump speed after calibration exceeds the max speed

3.5.6 Batch Report

Select [Batch Report] from the left-hand navigation bar to enter the screen of batch report. A total of 800 batch reports can be stored.



After a successful filling operation, a batch report is recorded. The reports can be filtered and searched by date using options such as ‘All’, ‘Latest One Month’, ‘Latest Six Months’, ‘Latest One Year’.

Batch name: the batch name can be manually set or automatically generated by PFC controller.

Recipe name: corresponding recipe name for the batch report

Date: the date on which the batch report was generated

- [**Print**]: to print the selected batch reports after connecting a printer.
- [**Export**]: to export the selected batch reports to a USB flash drive, in PDF format. The export file path is: USB Flash Drive>LONGER>dPOFLEX PFU_PFS_Product SN>Report
- [**Delete**]: to delete the selected batch reports. The reports generated within the last month cannot be

deleted.

- [**Preview**]: to preview a selected batch report. The preview screen can be zoomed in or out.

Contents of batch report

User Name:

Start Time:

End Time:

Batch Name:

Recipe Name:

Run Mode:

Product Capacity:

Total Channels:

Channel 1:

Pump Head:

Tubing:

Target Fill:

Cal. Factor:

Serial Number:

Firmware Version:

Channel 2:

Pump Head:

Tubing:

Target Fill:

Cal. Factor:

Serial Number:

Firmware Version:

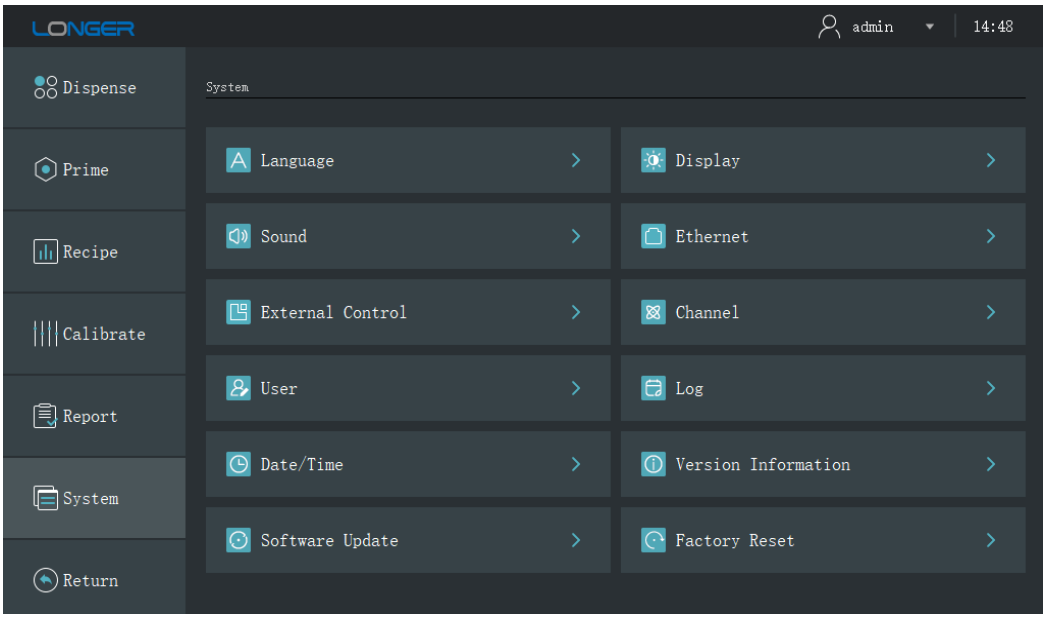
Channel n…

Software Version:

Kernel Version:

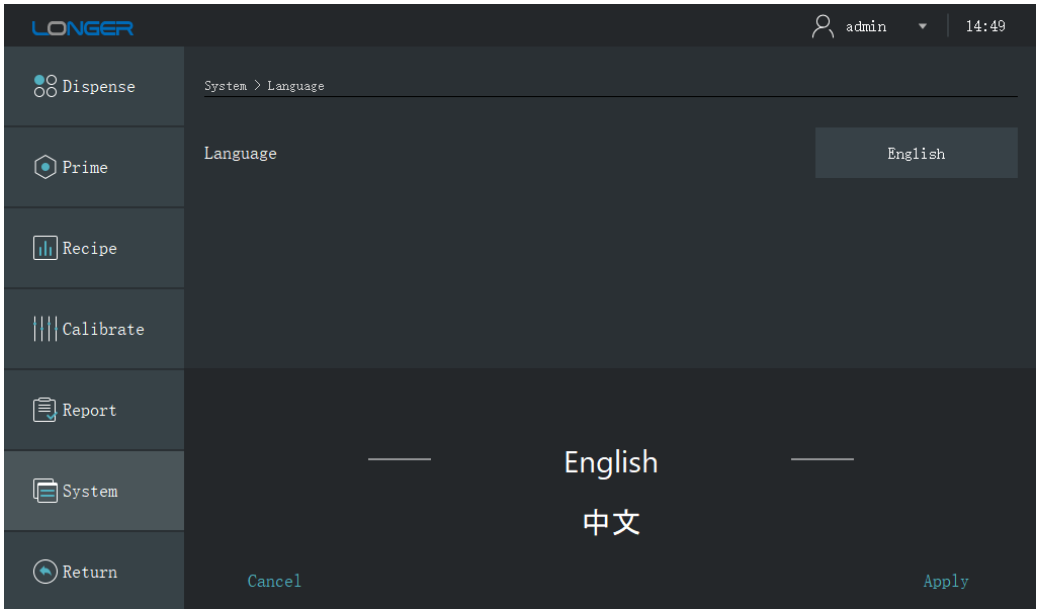
3.5.7 System

Select [System] from the left-hand navigation bar to enter the screen of system parameter setting.



3.5.7.1 Language

Click [Language] to enter the language setting screen. The language can be set to English or Chinese.

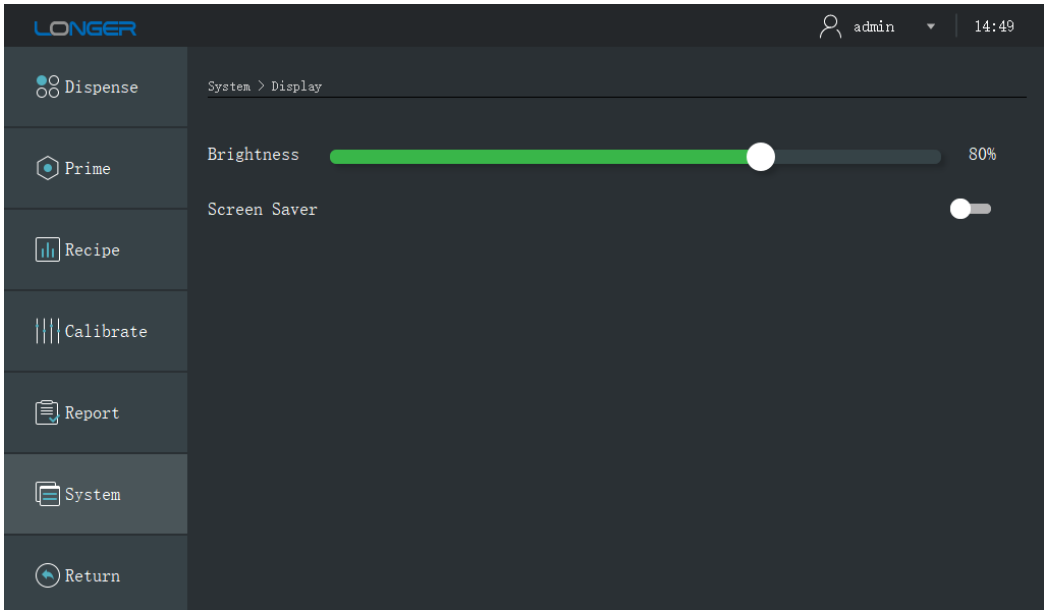


3.5.7.2 Display

Click [Display] to enter the display setting screen.

Screen brightness: can be adjusted from 30% to 100%.

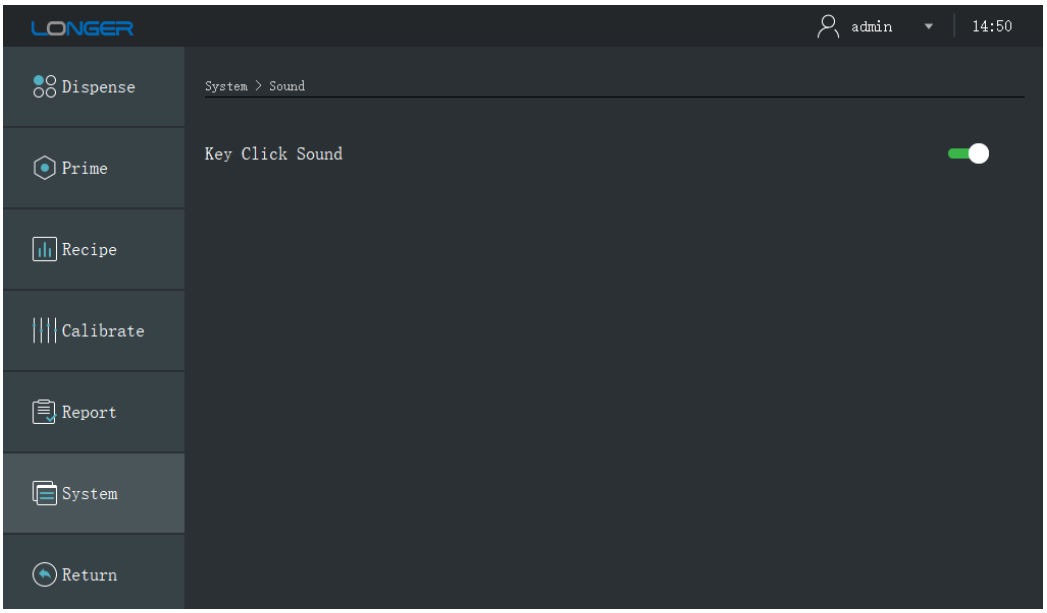
Screen saver: when the screen saver function is enabled, if there is no activity on the controller's interface for 5 minutes, the controller enters screen saver mode, and the screen brightness is automatically adjusted to 40%.



3.5.7.3 Sound

Click [Sound] to enter the key click sound setting screen.

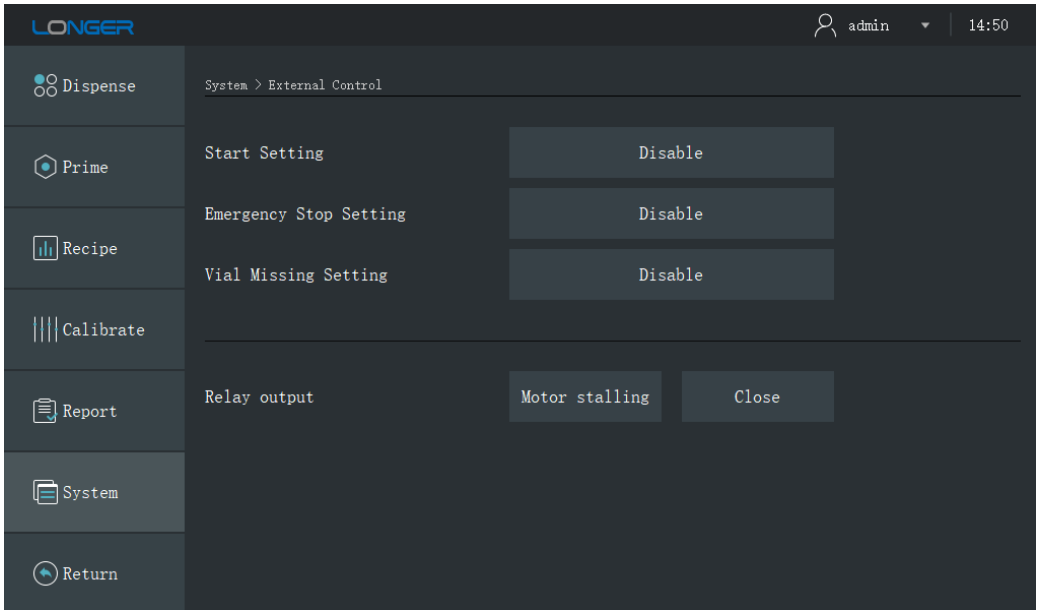
The key click sound can be enabled or disabled. When enabled, all key click will produce audio feedback.



3.5.7.4 Ethernet (Reserved)

3.5.7.5 External Control

Click [External Control] to enter the external control setting screen. The remote control input and output signals can be set on this screen.



Control Input Signals

(1) **Start Setting**: Disable, Rising Edge, and Falling Edge.

The external start signal inputs to the PFU via the pin IN1 of the port RS485/⊙ or port RS485/⊡. The external start signal inputs to the PFS via the pin IN1 of the port ⑥ or ⑦, or the terminal START on the external control board.

When the start setting is set as Rising Edge or Falling Edge, the filling start can not be initiated through PFC controller, but only can be initiated through remote start signal. The setting takes effect when returning to the [Dispense] screen, and the controller can be turned off during external control.

Disable: the filling operation can only be initiated through the controller.

Rising Edge: on the [Dispense] screen, the filling operation is initiated when the equipment received an rising edge start signal.

Falling Edge: on the [Dispense] screen, the filling operation is initiated when the equipment received an falling edge start signal.

Please refer to Chapter 3.4.1 and 3.4.2 for the start signal wiring.

(2) **Emergency Stop Setting**: Disable, High Level, and Low Level

The external emergency stop signal inputs to the PFU via the pin IN2 of the port RS485/⊙ or port RS485/⊡. The external emergency stop signal inputs to the PFS via the pin IN2 of the port ⑥ or ⑦, or the terminal STOP on the external control board.

The enabled external emergency stop function is always valid no matter what the **Start Setting** is.

Disable: emergency stop function is not working.

High Level: during the filling operation, when the equipment receives a high-level emergency stop signal, the filling operation will stop immediately.

Low Level: during the filling operation, when the equipment receives a low-level emergency stop signal, the filling operation will stop immediately.

While the emergency stop signal is active, the equipment can not start filling operation while in the standby state.

In the multi-channel system, an emergency stop signal will take effect for all the channels.

Please refer to Chapter 3.4.1 and Chapter 3.4.2 for emergency stop signal wiring.

(3) **Vial Missing Setting**: Disable, High Level, and Low Level

The disable channel signal (vial missing signal) inputs to the PFU via the pin IN3 of the port CAN/⊖. The disable channel signal (vial missing signal) inputs to the PFS via terminals ERR1-ERR4 on the external control board.

The enabled function of disable the channel is always valid no matter what the **Start Setting** is.

Disable: the function of disable the channel is not working.

High Level: during the filling operation, when the equipment receives a high-level disable channel signal, next filling cycle will not be initiated after the current filling cycle completed.

Low Level: during the filling operation, when the equipment receives a low-level disable channel signal, next filling cycle will not be initiated after the current filling cycle completed.

When the disable channel signal is active, the corresponding channel can not start filling operation while in standby mode. The PFC controller interface can still display normally and record the number of missing vials (one valid signal means one missing vial). In the multi-channel system, the disable channel signals for each channel are independent.

Please refer to Chapter 3.4.1 and Chapter 3.4.2 for the wiring of disable channel signal.

Relay Output Signals

The PFU alarm signal outputs to the remote controller via the pin OUT1 of the port CAN/⊖. The PFS alarm signal outputs to the remote controller via the terminal P_ERRO on the external control board.

The enabled alarm output function is always valid no matter what the **Start Setting** is.

The alarm signal could be configured to indicate one of the following fault states:

(1) Motor stalling
(2) Hardware error

The alarm signal could be configured to one of the following types:

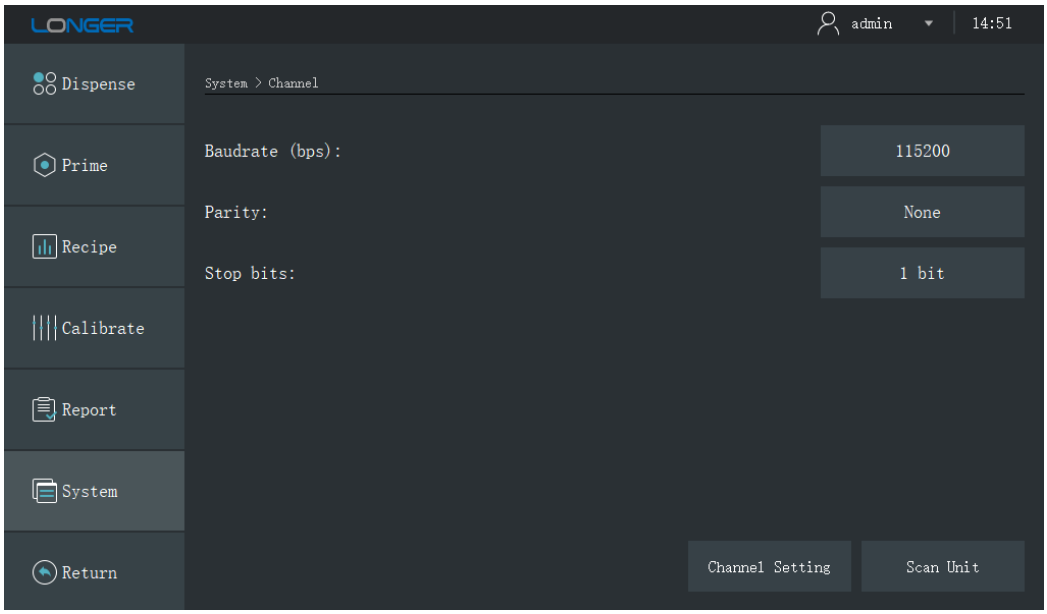
(1) Disable: when there is motor stalling or hardware error, the system will stop but no alarm signal output
(2) Close: when there is motor stalling or hardware error, the system will stop, and the alarm output node is closed. Refer to Chapter 3.4.1 and Chapter 3.4.2 for the output circuit.
(3) Open: when there is motor stalling or hardware error, the system will stop, and the alarm output node is open. Refer to Chapter 3.4.1 and Chapter 3.4.2 for the output circuit.

In the multi-channel system, each PFU has its own independent alarm output signal, and the four channels of PFS share one alarm output signal. Refer to Chapter 3.4.1 and Chapter 3.4.2 for the wiring of alarm output.

Note: All external signal settings including the input and output will take effect after the system returns to [Dispense] screen.

3.5.7.6 Channel

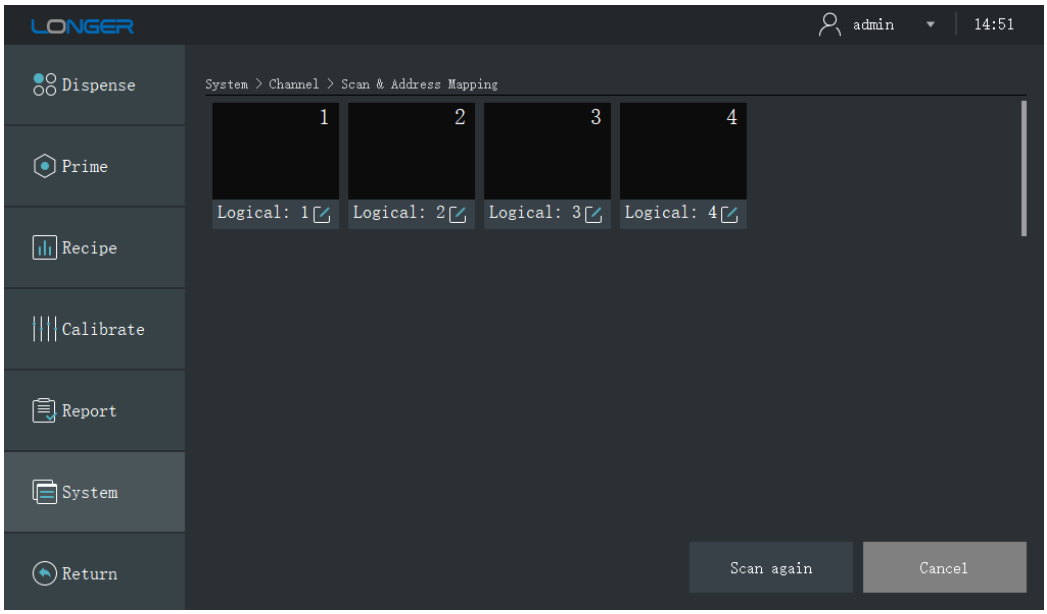
Click [Channel] to enter the channel parameters setting screen.



Set the PFC controller communication parameters according to the communication parameters of PFU or PFS. The default baud rate is 115,200 bps, default parity is none, default stop bits is 1bit.

The communication parameters of PFU or PFS only can be changed via communication commands. After setting new communication parameters of PFU or PFS, the parameters on this [Channel] screen need to be modified according to the new communication parameters. In the multi-channel system, the communication parameters for each channel should be the same.

Click [Scan Unit] to enter the scan unit screen.



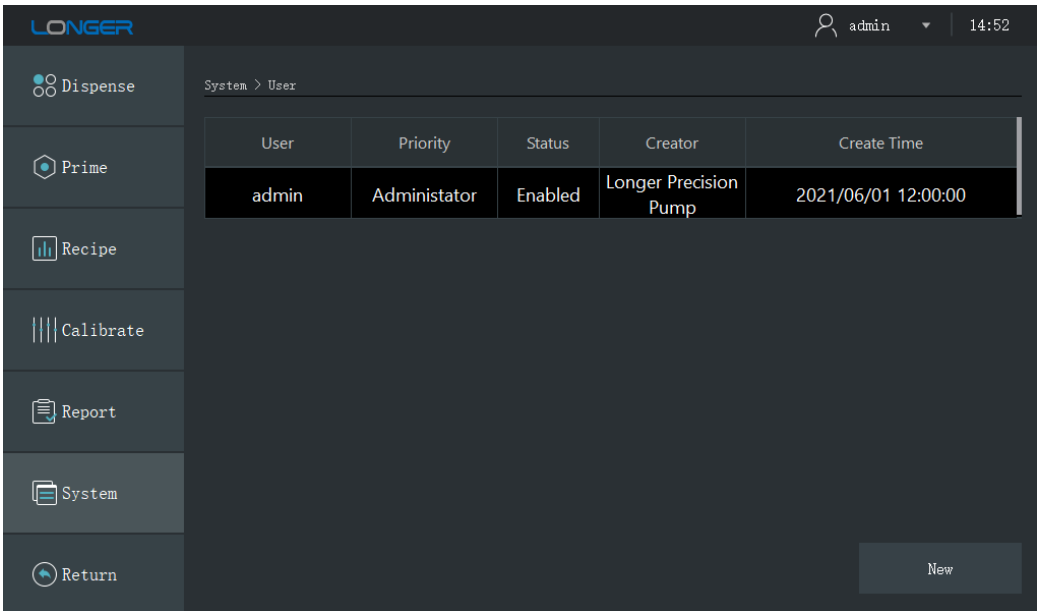
In the multi-channel system, make sure all channels have unique physical addresses (refer to Chapter 3.4.1 and Chapter 3.4.2 for the physical address setting). Then click [Scan again] to scan all the channels connected in the system. Each physical address corresponds to a logical address, and the logical address can be changed here and displayed on the [Dispense] screen.

Note: When changing the PFU or PFS in the system, adding /removing PFU or PFS, or resetting channel

physical addresses, it is necessary to scan the units firstly after power on the system. Otherwise, a communication error may occur.

3.5.7.7 User

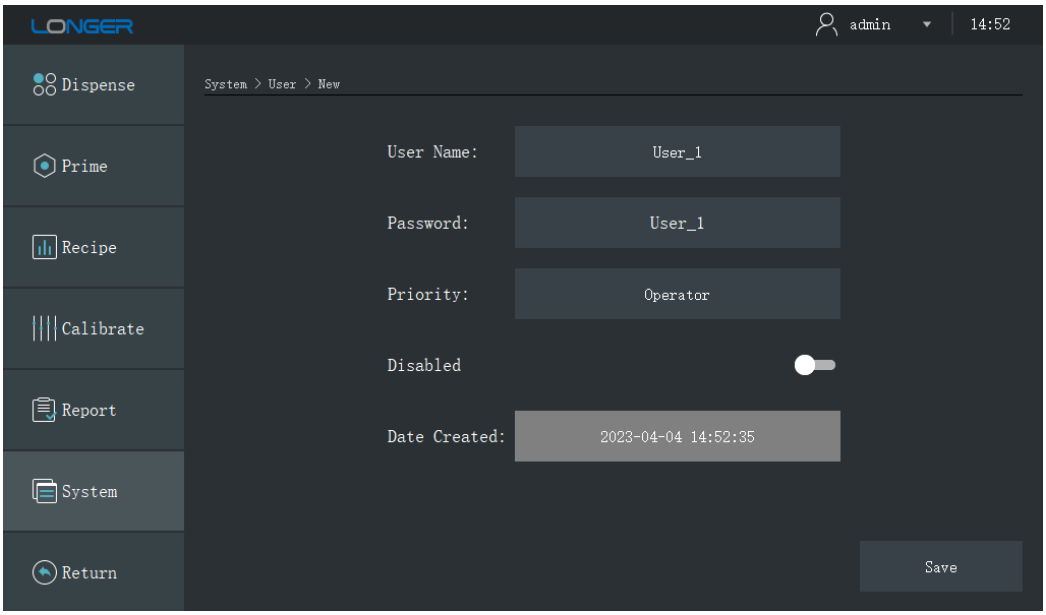
Click [User] to enter the user setting screen.



The PFC controller support three levels of user accesses: administrator, developer, operator. Please refer to Appendix A for the specific user permissions.

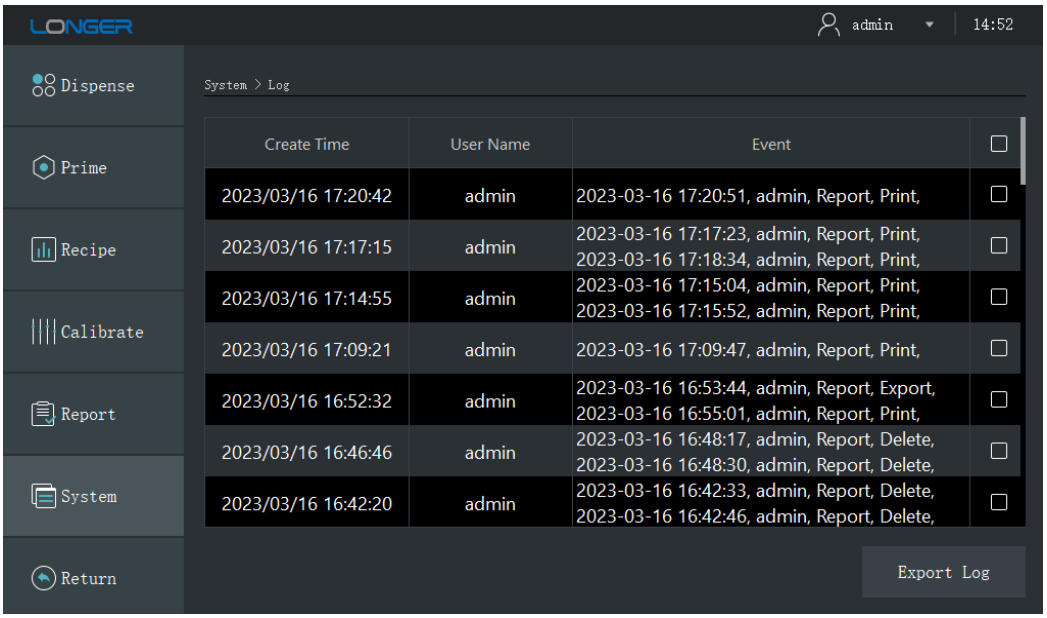
A new user can be created under the administrator account.

Note: Any user created cannot be deleted.



3.5.7.8 Log

Click [Log] to enter the log list screen.



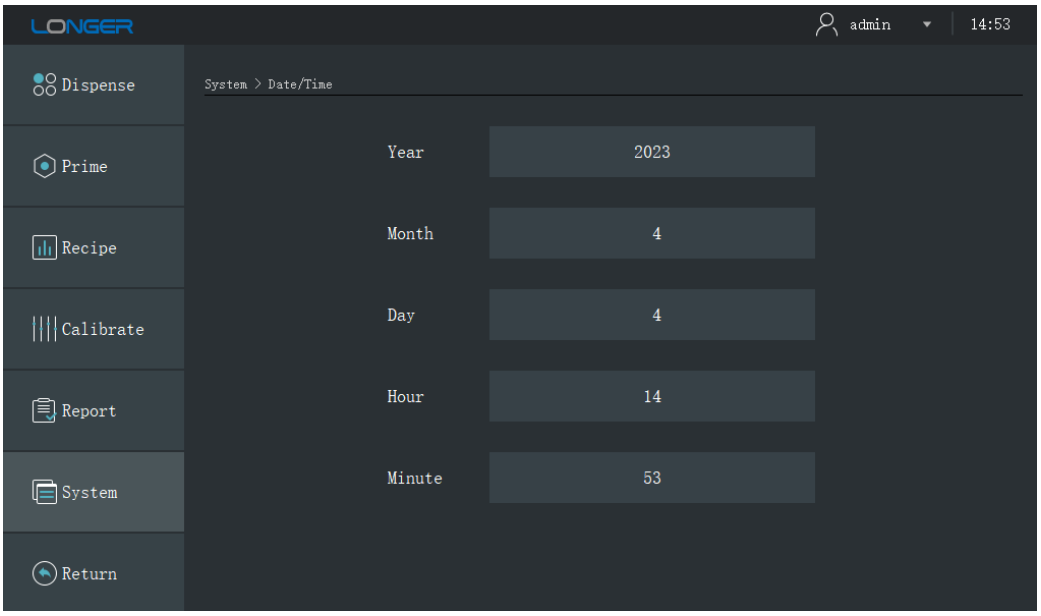
During the operation of the system, user actions are logged. The specific recorded information include:

- Actions related to user: create a new user, disable/ enable an existing user, and other actions
- Actions related to recipe: create a new recipe, edit/ delete/ export an existing recipe, and other actions
- Actions related to batch report: delete/ export/ print a batch report and other actions
- Filling start or stop
- Update the calibration factor
- Upgrade the firmware and software
- Restore to factory settings
- Equipment fault information
- When logging, the records include current username and date

A log can be exported to a csv file.

3.5.7.9 Date/Time

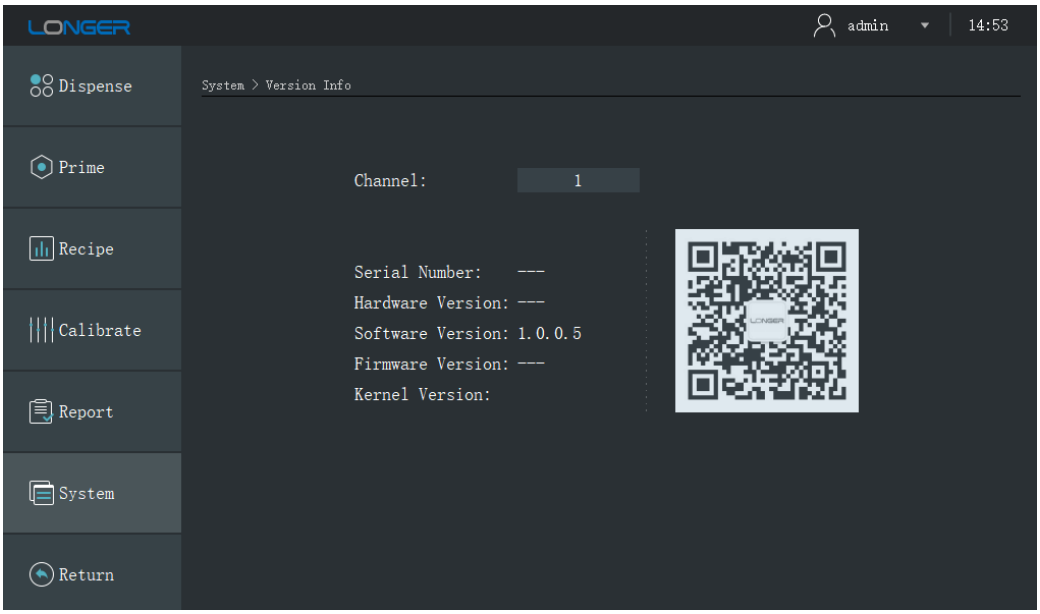
Click [Date/ Time] to enter the date and time setting screen.



The set date and time will be used for log records and batch reports.

3.5.7.10 Version Information

Click [Version Information] to check the version information.



Select a channel number to check the version information of each channel.

Serial Number: the serial number of the PFC controller.

Hardware version: the hardware version of the selected channel.

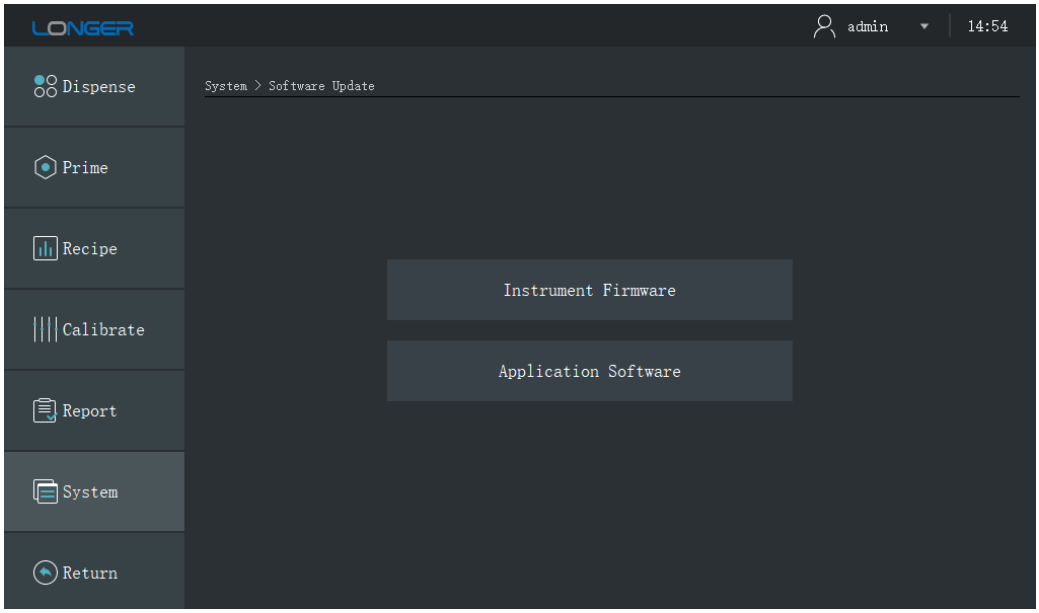
Software version: the version of the software of the PFC controller.

Firmware version: the firmware version of the selected channel.

Kernel version: the kernel version of the PFC controller.

3.5.7.11 Software Update

Click [Software Update] to update the software and firmware.

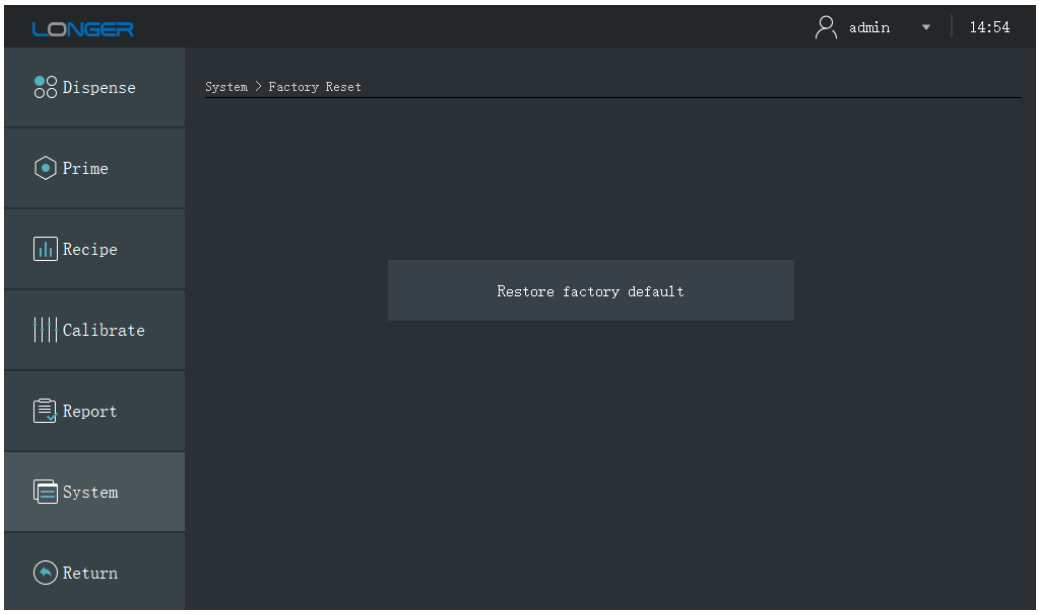


Update the firmware of the connected channel or application software of the PFC controller as needed:

- Make sure the latest software (firmware in .bin format and PFC controller application software in .tgz format) is placed in the root directory of a USB flash drive.
- During the update process, make sure the PFC controller remains powered on.
- Confirm that all channels in the system are connected to the PFC controller during the firmware update. Check this by going to System> Channel> Scan Unit> Scan again to verify that all channels are online. This is important to ensure the successful update of channel firmware.
- If there is a prompt indicating that no new version found in the USB flash drive, re-insert the USB flash drive and try to update again.
- If there is a prompt indicating that the channel firmware can not be updated, return to the previous screen and try to update again.

3.5.7.12 Factory Reset

Click [Factory Reset] to reset all parameters to Factory Settings.



Refer to Appendix C for factory setting parameters.

Note: After the factory settings are restored, it is necessary to scan the channels before setting parameters and control.

3.5.8 Return

Click the [Return] button to return to the previous menu or screen.

4 FAQ and Treatment

- After creating a recipe, click [Start] on the [Dispense] screen, if there is a notification of filling failure or communication error, solve the issue by following below steps:
  (1) Check if the communication cables are properly connected.
  (2) Ensure the enabled channel addresses in the selected recipe match the actual channel addresses in the system, and the physical address for each channel is unique. Scan the channel again by going to System> Channel> Scan Unit> Scan again. If some channels can not be scanned, check if there are any faults or abnormalities in the channels.

(3) Check for any alarm messages and resolve the alarm as indicated before starting.

- The running recipe is not the desired one after clicking [Start] on the [Dispense] screen:
  Select [Recipe] from the left-hand navigation bar, and verify if the currently activated recipe is the desired one.
- There is a message of no USB flash drive detected or no new version software or firmware found on the USB flash drive:
  Re-insert the USB flash drive or change to other USB port on the PFC controller.
- Unable to create a new recipe:
  Check if the parameters for the created recipe are correct.
  Verify if the number of existing recipes has exceeded 500. If it has, export some recipes and delete them from the PFC controller.
- Motor stall:
  If the indicator light of motor running state is red, re-load the tubing.

Appendix A - List of Three Levels of User Accesses

	Administrator	Developer	Operator
Create recipe	●	●	
Delete recipe	●		
Import/export recipe	●	●	
Edit recipe	●	●	
Prime operation	●	●	●
System-Ethernet	●	●	
System-external control	●	●	
System-channel	●	●	
System-user	●		
System-software update	●		
System- factory reset	●		
Calibration function	●	●	●
Print batch report	●	●	●
Export batch report	●	●	●
Delete batch report	●		
All the other functions	●	●	●

Appendix B - Modbus RTU Protocol

The following are the definitions of public area addresses.

No.	Category	Parameter Variable	Register Address	Data Type	Read/ Write	Description	Remarks
1	Fast Filling	Fast filling control	0x0002	uint_16	R/W	Start/stop: 0 – Stop; 1 - Start	
2		Fast filling speed value	0x0090	uint_16	R/W	0 - 9999	PFH01:1-350rpm PFH02:1-450rpm
3		Unit of fast filling speed	0x0091	uint_16	R/W	96 - 102 corresponding to *0.0001rpm, *0.001rpm, *0.01rpm, *0.1rpm, *1rpm, *10rpm, *100 rpm	Example: 100 means 1rpm, 99 means 0.1rpm, 101 means 10rpm If the data in register 0x0090 is 50, data in register 0x0091 is 100, then the fast filling speed is 50rpm
4	Fast Emptying	Fast emptying control	0x0003	uint_16	R/W	Start/stop: 0 – Stop; 1 - Start	
5		Fast emptying speed value	0x00A0	uint_16	R/W	0 - 9999	PFH01:1-350rpm PFH02:1-450rpm
6		Unit of Fast emptying speed	0x00A1	uint_16	R/W	96 - 102 corresponding to *0.0001rpm, *0.001rpm, *0.01rpm, *0.1rpm, *1rpm, *10rpm, *100 rpm	Example: 100 means rpm, 99 means 0.1rpm, 101 means 10rpm If the data in register 0x00A0 is 50, data in register 0x00A1 is 100, then the fast emptying speed is 50rpm
7	Dispensing / Filling	Channel enabling setting	0x0000	uint_16	R/W	Channel enable / disable: bit 0: 0-disable; 1 – enable	
8	Dispensing / Filling	Dispensing control	0x0001	uint_16	R/W	Start/stop: 0 – Stop; 1 - Start	The stop function is only used to stop the start delay process and end delay process. The dispensing process (motor running) can not be stopped but only can be emergency stopped (register 0x000C).

9	Dispensing / Filling	Dispensing unit	0x0048	uint_16	R/W	System unit: 0 - Volume; 1 - Weight	
10	Dispensing /Filling	Pump head type	0x0049	uint_16	R/W	Pump head type: 6 or 7 6: PFH01; 7:PFH02	
11	Dispensing /Filling	Tubing spec	0x004A	uint_16	R/W	0-5: corresponding to the tubing for PFH01 pump head: PFH01-05G, PFH01-08G, PFH01-12G, PFH01-16G, PFH01-24G, PFH01-32G 10-16: corresponding to the tubing for PFH02 pump head: PFH02-06G, PFH02-08G, PFH02-12G, PFH02-16G, PFH02-24G, PFH02-32G, PFH02-48G	Example: 0 means PFH01-05G, 1 means PFH01-08G, 2 means PFH01-12G, 3 means PFH01-16G, 4 means PFH01-24G, 5 means PFH01-32G, 10 means PFH02-06G, 16 means PFH02-48G
12	Dispensing /Filling	Maximum speed value	0x004B	uint_16	R	0 - 9999	PFH02 pump head: 450rpm, PFH01 pump head: 350rpm
13	Dispensing /Filling	Unit of maximum speed	0x004C	uint_16	R	96 – 102 corresponding to *0.0001rpm, *0.001rpm, *0.01rpm, *0.1rpm, *1rpm, *10rpm, *100 rpm	Example: 100 means 1 rpm, 99 means 0.1rpm, 101 means 10rpm
14	Dispensing /Filling	Flowrate Factor	0x004D	uint_16	R/W	Range: 10 – 2000; unit: 0.01, so the factor range is 0.1 - 20	Flowrate factor is used to coarsely adjust the current channel. Flowrate factor = Set target fill quantity/ actual filled quantity
15	Dispensing /Filling	Liquid density value	0x004E	uint_16	R/W	0 - 9999	Density range: 0.100-20g/ml. 3 digits after a decimal point
16	Dispensing /Filling	Unit of liquid density	0x004F	uint_16	R/W	96 - 102 corresponding to *0.0001 g/mL, *0.001 g/mL, *0.01 g/mL, *0.1 g/mL, *1 g/mL , *10 g/mL , *100 g/mL	Example: 100 means 1g/mL, 99 means 0.1g/mL, 101 means 10g/mL If the data in register 0x004E is 1.2, and data in register 0x004F is 101, then the density is 12g/mL
17	Dispensing	Acceleration	0x0052	uint_16	R/W	0 – 9,999	Range: 100- 7,500rpm/s

	/Filling	value					
18	Dispensing /Filling	Unit of acceleration	0x0053	uint_16	R/W	96 - 102 corresponding to *0.0001rpm/s, *0.001rpm/s, *0.01rpm/s, *0.1rpm/s, *1rpm/s, *10rpm/s, *100 rpm/s	Example: if data in register 0x0052 is 10, data in register 0x0053 is 100, the acceleration is 10rpm/s
19	Dispensing /Filling	Deceleration value	0x0054	uint_16	R/W	0 - 9999	Range: 100- 7500rpm/s
20	Dispensing /Filling	Unit of deceleration	0x0055	uint_16	R/W	96 - 102 corresponding to *0.0001rpm/s, *0.001rpm/s, *0.01rpm/s, *0.1rpm/s, *1rpm/s, *10rpm/s, *100 rpm/s	Example: if data in register 0x0054 is 10, data in register 0x0055 is 100, the deceleration is 10rpm/s
21	Dispensing /Filling	Start filling speed value	0x0056	uint_16	R/W	0 - 9999	Range: 10- 150rpm
22	Dispensing /Filling	Unit of start filling speed	0x0057	uint_16	R/W	96 - 102 corresponding to *0.0001rpm, *0.001rpm, *0.01rpm, *0.1rpm, *1rpm, *10rpm, *100 rpm	Example: 100 means the unit is 1rpm, 99 means the unit is 0.1rpm
23	Dispensing /Filling	Cutoff speed value	0x0058	uint_16	R/W	0 – 9,999	Range: 10 - 450rpm
24	Dispensing /Filling	Unit of cutoff speed	0x0059	uint_16	R/W	96 - 102 corresponding to *0.0001rpm, *0.001rpm, *0.01rpm, *0.1rpm, *1rpm, *10rpm, *100 rpm	Example: 100 means the unit is 1rpm, 99 means the unit is 0.1rpm
25	Dispensing /Filling	Mode of dispensing parameters	0x0062	uint_16	R/W	0 – dispensing / filling mode	
26	Dispensing /Filling	Target filling volume or weight	0x0063	uint_16	R/W	0 – 9,999	Range: 1ul-99.99L
27	Dispensing /Filling	Unit of target filling volume or weight	0x0064	uint_16	R/W	Volume: 97-106 corresponding to 1nL, 10nL, 100nL, 1uL, 10uL, 100uL, 1mL, 10mL, 100mL, 1L Weight: 97-106 corresponding to 1ug, 10ug, 100ug, 1mg, 10mg, 100mg, 1g, 10g, 100g, 1kg	Example: For volume, 100 means 1uL, 99 means 0.1uL, 101 means 10uL For weight, 100 means 1mg, 99 means 0.1mg, 101 means 10mg If data in register 0x0048 is 0, data in register 0x0063 is 100, data in register 0x0064 is 100, then the target filling quantity is 100uL.

28	Dispensing /Filling	Dispensing time value	0x0065	uint_16	R/W	0 – 9,999	Range: 0.1-999.9h
29	Dispensing /Filling	Unit of dispensing time	0x0066	uint_16	R/W	97-104 corresponding to 1ms, 10ms, 0.1s, 1s, 0.1min, 1min, 0.1h, 1h,	Example: 100 means 1s, 99 means 0.1s, 101 means 0.1min If data in register 0x0065 is 2, data in register 0x0066 is 100, the dispensing time is 2s.
30	Dispensing /Filling	Dispensing start delay time value	0x0071	uint_16	R/W	0 – 9,999	Setting range: 0-6000s
31	Dispensing /Filling	Unit of dispensing start delay time	0x0072	uint_16	R/W	97-104 corresponding to 1ms, 10ms, 0.1s, 1s, 0.1min, 1min, 0.1h, 1h,	Example: 100 means 1s, 99 means 0.1s, 101 means 0.1min If data in register 0x0071 is 2, data in register 0x0066 is 99, the dispensing start delay time is 0.2s.
32	Dispensing /Filling	Dispensing end delay time value	0x0073	uint_16	R/W	0 – 9,999	Range: 0-6,000s
33	Dispensing /Filling	Unit of dispensing end delay time	0x0074	uint_16	R/W	97-104 corresponding to 1ms, 10ms, 0.1s, 1s, 0.1min, 1min, 0.1h, 1h,	Example: 100 means 1s, 99 means 0.1s, 101 means 0.1min
34	Dispensing /Filling	Anti-drop roller	0x0077	uint_16	R/W	The angle at which the pump rotates counterclockwise during back suction after one-time filling. The anti-drop roller value range: 0-30. unit: 1. (Note: integer value is good for ensuring high filling precision)	For PFH01 pump head, value 1 represents 30˚, and value n represents 30 ˚*n. For PFH02 pump head, value 1 represents 45˚, and value n represents 45 ˚*n.
35	Dispensing /Filling	Anti-drop delay time value	0x0078	uint_16	R/W	0-9,999 setting range: 0s-10s	The interval time before back suction starts after a single filling cycle is completed. To be used with the anti-drop roller, can better prevent dripping while the dispensing probe moves dynamically.

36	Dispensing /Filling	Unit of anti-drop delay time	0x0079	uint_16	R/W	97-104 corresponding to 1ms, 10ms, 0.1s, 1s, 0.1min, 1min, 0.1h, 1h,	Example: 100 means 1s, 99 means 0.1s, 101 means 0.1min
37	Dispensing /Filling	Anti-drop speed value	0x007A	uint_16	R/W	0 – 9,999	Range: PFH02 pump head: 1-450rpm; PFH01 pump head: 1-350rpm
38	Dispensing /Filling	Unit of anti-drop speed	0x007B	uint_16	R/W	96 - 102 corresponding to *0.0001rpm, *0.001rpm, *0.01rpm, *0.1rpm, *1rpm, *10rpm, *100 rpm	Example: 100 means the unit is 1rpm, 99 means the unit is 0.1rpm
39	Calibration	Calibration control	0x0004	uint_16	R/W	Start/stop: 0 – Stop; 1 – Start	
40	Calibration	Calibration unit	0x00BF	uint_16	R/W	System unit: 0 – Volume; 1: Weight	
41	Calibration	Actual filling volume or weight	0x00C0	uint_16	R/W	0 – 9,999	
42	Calibration	Unit of actual filling volume or weight	0x00C1	uint_16	R/W	Volume: 97-106 corresponding to 1nL, 10nL, 100nL, 1uL, 10uL, 100uL, 1mL, 10mL, 100mL, 1L Weight: 97-106 corresponding to 1ug, 10ug, 100ug, 1mg, 10mg, 100mg, 1g, 10g, 100g, 1kg	
43	Calibration	Calibration factor	0x00C4	uint_16	R/W	Range: 5,000-15,000 Unit: 0.01%; range: 50%-150%;	Calibration factor= previous calibration factor * measured filling quantity/ target filling quantity
44	Calibration	Online ratio calibration factor	0x00C5	uint_16	R/W	Range: 9,500-10,500 Unit: 0.01%; range: 95%-105%;	The ratio calibration factor can be used to adjust the filling quantity at any time and will take effect during next filling cycle
45	Communication	Device address	0x0010	uint_16	R/W	Communication address, range: 1-247	
46	Communication	Baud rate	0x0011	uint_16	R/W	0-5, corresponding to baud rate value: 2,400bps, 9,600bps, 19,200bps, 38,400bps, 57,600bps, 115,200, bps	Example: 0 means 2,400bps, 1 means 9,600bps, 5 means 115,200bps

47	Communication	Parity	0x0012	uint_16	R/W	0 – No parity; 1 – Odd parity; 2 – Even parity	
48	Communication	Stop bit	0x0013	uint_16	R/W	0 – 1 stop bit; 1 – 2 stop bit	
49	System	Reset total filling cycles	0x0007	uint_16	R/W	1 – reset	
50	System	Factory Reset	0x0009	uint_16	R/W	1 –reset system to factory setting	
51	System	Emergency stop	0x000C	uint_16	R/W	1 – Emergency stop	
52	Dispensing /Filling	Filling mode	0x005F	uint_16	R/W	Reserved	
53	Dispensing /Filling	Motor running direction during filling process	0x0060	uint_16	R	1 represents clockwise direction.	
54	Configuration	Fan startup temperature	0x00B8	uint_16	R/W	Range: 0-550, Unit: 0.1℃	
55	Commissioning	Max. AD of encoder	0x00E0	uint_16	R	Read the data after encoder calibration	
56	Commissioning	Calibration of motor encoder	0x00E1	uint_16	R/W	1: start the encoder calibration 2: calibrate successfully 3: calibrate failed	
57	System state	System state (High)	0x0100	uint_16	R	Error code: BIT0=1 Motor stall BIT2=1 Disable channel BIT3=1 External emergency stop BIT4=1 Speed is below the lower limit BIT5=1 Speed exceeds the upper limit BIT6=1 Micro-step is below the lower limit BIT7=1 Micro-step exceeds the upper limit BIT8=1 3.3V abnormality BIT10=1 5V abnormality BIT11=1 24V abnormality BIT12=1 Temperature exceeds fan startup temperature BIT13=1 Temperature exceeds 65℃; exceeds the warning limit BIT14=1 Temperature exceeds 70℃, stop running	

58	System state	System state (low)	0x0101	uint_16	R	Running state (lower 8 bits) 0: standby 1: Dispensing start delay (01) 2: Dispensing (10) 3: Back suction/ anti-drop delay (0011) 4: Back suction /anti-drop (0100) 5: End delay (0101) 16: During fast filling (10000) 32: During fast emptying (10 0000) Other states (higher 8 bits): BIT15=1: Enabled external control BIT14=1: under external control	
59	System state	Filling cycle count (higher 16 bits)	0x0102	uint_16	R	Cumulative filling cycles	
60	System state	Filling cycle count (lower 16 bits)	0x0103	uint_16	R	Cumulative filling cycles	
61	System state	Current motor speed value	0x0104	uint_16	R	0 – 9,999	
62	System state	Unit of current motor speed	0x0105	uint_16	R	96 - 102 corresponding to *0.0001rpm, *0.001rpm, *0.01rpm, *0.1rpm, *1rpm, *10rpm, *100 rpm	
63	System information	Filling speed	0x010D	uint_16	R	Unit: 0.1rpm	
64	System information	Current temperature	0x0110	uint_16	R	Unit: 0.1℃	
65	System information	24V voltage detect value	0x0111	uint_16	R	Unit: 1mV	
66	System information	5V voltage detect value	0x0112	uint_16	R	Unit: 1mV	
67	System information	3.3V voltage detect value	0x0113	uint_16	R	Unit: 1mV	
68	System information	Hardware version number	0x0134	uint_16	R	Hardware version number	
69	System information	Hardware version number	0x0135	uint_16	R		
70	System	Hardware	0x0136	uint_16	R		

	information	version number					
71	System information	Hardware version number	0x0137	uint_16	R		
72	System information	Firmware version number	0x0138	uint_16	R	Firmware version number	
73	System information	Firmware version number	0x0139	uint_16	R		
74	System information	Firmware version number	0x013A	uint_16	R		
75	System information	Firmware version number	0x013B	uint_16	R		
76	System	External control enabled	0x000B	uint_16	R/W	0 – Disabled; 1 - Enabled	Work with 0x0061 control method
77	Configuration	Filling control method	0x0061	uint_16	R/W	0 – Control by host computer (PFC controller or PLC); 1 – External control	If set to 1 external control, the register 0x000B needs to set to 1 enabled
78	Configuration	Input configuration	0x00B0	uint_16	R/W	Input of filling start signal: Bit 0: 1 – Start filling based on rising edge signal; 0 – Start filling based on falling edge signal Input of disable channel signal: Bit 1: 1 – disable channel basd on opened signal; 0 – disable channel based on closed signal Input of emergency stop signal: Bit 2: 1 – emergency stop based on opened signal; 0 – emergency stop based on closed signal Enabling configuration of disable channel signal and emergency stop signal: BIT9=1: Enabled input signal of disable channel BIT10=1: Enabled input signal of emergency stop	1. The signals of disable channel and emergency stop take effect at both of the PFC control and the external control. 2. When start filling is set to be based on a rising edge signal, no stop will happen upon a falling edge Default signal is high level.
79	Configuration	Output configuration	0x00B1	uint_16	R/W	Alarm output: Bit 15: 1 – Opened signal of abnormality; 0 – Closed signal of abnormality Alarm output configuration:	Corresponding to system state register 0x0100 Error code: BIT0=1 Motor stall BIT2=1 Disable channel BIT3=1 External

						BIT0=1 Enabled output signal of motor stall BIT2=1 Enabled output signal of disable channel; BIT3=1 Enabled external output signal of emergency stop BIT4=1 Enabled output signal of speed is below the lower limit BIT5=1 Enabled output signal of speed exceeds the upper limit BIT6=1 Enabled output signal of micro-step is below the lower limit BIT7=1 Enabled output signal of micro-step exceeds the upper limit BIT8=1 Enabled output signal of 3.3V abnormality BIT10=1 Enabled output signal of 5V abnormality BIT11=1 Enabled output signal of 24V abnormality BIT13=1 Enabled output signal of warning of high temperature over 65℃ BIT14=1 Enabled output signal of stopped running due to high temperature over 70℃	emergency stop BIT4=1 Speed is below the lower limit BIT5=1 Speed exceeds the upper limit BIT6=1 Micro-step is below the lower limit BIT7=1 Micro-step exceeds the upper limit BIT8=1 3.3V abnormality BIT10=1 5V abnormality BIT11=1 24V abnormality BIT12=1 Temperature exceeds fan startup temperature BIT13=1 Temperature exceeds 65℃; exceeds the warning value BIT14=1 Temperature exceeds 70℃, stop running

The register addresses for each channel are as shown in the following table:

Physical address 1 (DIP address 0)	Start address	0x2000
	End address	0x23FF
Physical address 2 (DIP address 1)	Start address	0x2400
	End address	0x27FF
Physical address 3 (DIP address 2)	Start address	0x 2800
	End address	0x 2BFF
Physical address 4 (DIP address 3)	Start address	0x 2C00
	End address	0x 2FFF
… …	Start address	… …
	End address	… …
Physical address 32 (DIP address 31)	Start address	0x 9C00
	End address	0x 9FFF

Appendix C - Factory Settings

Parameter Variable	Register Address	Stored or not	Is the parameter restored to the default settings when restore factory default?	Default
Channel setting	0x0000	Y	Y	1
Device address	0x0010	Y	Y	1
Baud rate of communication control	0x0011	Y	Y	5
Parity of communication control	0x0012	Y	Y	0
Stop bit of communication control	0x0013	Y	Y	0
Unit setting	0x0048	Y	Y	1
Pump head type	0x0049	Y	Y	7
Tubing spec	0x004A	Y	Y	13
Flowrate factor	0x004D	Y	Y	100
Liquid density value	0x004E	Y	Y	1
Unit of liquid density	0x004F	Y	Y	100
Acceleration value	0x0052	Y	Y	7,500
Unit of acceleration	0x0053	Y	Y	100
Deceleration value	0x0054	Y	Y	7,500
Unit of deceleration	0x0055	Y	Y	100
Start filling speed value	0x0056	Y	Y	30
Unit of start filling speed	0x0057	Y	Y	100
Cutoff speed value	0x0058	Y	Y	30
Unit of cutoff speed	0x0059	Y	Y	100
Filling mode	0x005F	Y	Y	0
Filling control method	0x0061	Y	Y	0
Target filling volume or weight	0x0063	Y	Y	2,000
Unit of target filling volume or weight	0x0064	Y	Y	100
Dispensing time value	0x0065	Y	Y	100
Unit of dispensing time	0x0066	Y	Y	98
Dispensing start delay value	0x0071	Y	Y	0
Unit of dispensing start delay	0x0072	Y	Y	100
Dispensing end delay value	0x0073	Y	Y	0
Unit of dispensing end delay	0x0074	Y	Y	100

Anti-drop roller	0x0077	Y	Y	0
Anti-drop delay value	0x0078	Y	Y	1
Unit of anti-drop delay time	0x0079	Y	Y	100
Anti-drop speed value	0x007A	Y	Y	450
Unit of anti-drop speed	0x007B	Y	Y	100
Fast filling speed value	0x0090	Y	Y	50
Unit of fast filling speed	0x0091	Y	Y	100
Fast emptying speed value	0x00A0	Y	Y	450
Unit of fast emptying speed	0x00A1	Y	Y	100
Input configuration	0x00B0	Y	Y	0
Output configuration	0x00B1	Y	Y	1
Fan startup temperature	0x00B8	Y	Y	550
Calibration factor	0x00C4	Y	Y	10,000
User			N	Keep the user settings
Recipe			Y	Delete the user settings and keep the demo recipes
Batch report			Y	Blank
Log			N	Keep logs
Language			Y	Chinese
Screen			Y	80%
Sound			Y	Key click sound enabled
Ethernet			Y	The password to the ID with the username of 0.0.0.0 is blank.
External control			Y	All disabled by default
Channel			Y	1
Date/time			Y	Jan-1-2022
Prime speed setting			Y	Speed: Slow-40rpm; Fast-350rpm
Calibration setting			Y	1. Calibration mode: manual 2. Triggering mode: internal 3. Calibration unit: weight 4. Number of vials to be filled: 1 5. Delay time: 10
Parameters for [Edit] on [Dispense]			Y	Cycles: 1
DEMO recipe			Y	Demo_1, Demo_4