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InSight™ V5

Veterinary Haematology Analyser

Service Manual

Preface

Before performing maintenance on the device, please read this service manual carefully to gain an understanding of how to properly maintain it.

After reading, keep the manual in a convenient location for future reference and easy access.

Product name: InSight V5 Veterinary Haematology Analyser

Declaration

We reserve the right to final interpretation of this service manual.

We shall be responsible for the safety, security and performance of the product only when all of the following conditions are met:

- The assembly, re-commissioning, extension, modification and repair of the product are performed by authorised and trained personnel only.
- The installation of the relevant electrical devices complies with applicable national standards.
- The product is operated in accordance with this service manual.

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Maintenance Services

Scope of free services:

All products complying with our product warranty specifications may qualify for free services.

Scope of fee-based services:

- Fee based services are available to all products exceeding the product warranty specifications.
- Products within the warranty period require maintenance under the following circumstances:
  - Artificial damage
  - Improper use
  - When grid voltage exceeds the specified operational range
  - Unavoidable natural disasters
  - When parts and supplies are replaced with no prior consent from us, or machine maintenance is performed by personnel with no prior authorisation.

WARNING

- Any failure by hospitals or organisations responsible for using this instrument to implement a competent repair/maintenance plan is likely to result in abnormal instrument failure or even a health hazard.
- Make sure the analyser is only operated under the conditions of use as specified in the operator's manual. If operated outside of the specified conditions of use, the analyser may not work properly, which could lead to unreliable measurement results and damaged instrument components or even bodily injury.

NOTE

This analyser must be operated by trained medical testing professionals, doctors, nurses, or laboratory technicians.

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1 Manual Overview

1.1 Instruction

This chapter explains the procedures for maintaining the InSight V5 Haematology Analyser. Please read this manual carefully to guarantee proper device maintenance and operator safety.

This manual is complemented by the operator's manual; there is no overlap between the two.

NOTE

Be sure to operate the device in strict accordance with the instructions in the maintenance and operator's manuals.

1.2 Who Should Read This Manual

This service manual should be used by professionals who possess:

- A comprehensive knowledge of electrical circuits and hydraulics
- A comprehensive knowledge of reagents
- A comprehensive knowledge of quality control
- A comprehensive knowledge of troubleshooting
- The ability to skillfully operate this analyser
- An understanding of basic mechanical tools and any relevant terms
- Skills for using digital voltmeters and oscilloscopes
- The ability to analyse electrical-circuit graphs and hydraulics diagrams, and to understand the related terminology

1.3 Symbols and Legends

Symbols used in the manual:

Symbol	It means
 WARNING	The operator should follow the instruction below each symbol to avoid personal injury.

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Symbol	It means
	The operator should follow the instructions below each symbol to prevent instrument failure, damage, or disrupted test results.
	The operator should follow the instructions below each symbol and pay special attention to any pertinent information when following the procedures.
	The operator should follow the instructions below each symbol to prevent any danger of infection.

The following symbols can be found on the analyser, reagents, QC materials, or calibrator:

Symbol	It means
	Caution
	Biohazard
	Exercise caution to prevent puncture
	Protective grounding
	Laser radiation warning: It is a Class 3R laser product with 5.0 mW of maximum power output at 635nm. Avoid direct eye exposure to the laser beam.
	Instruction for Moving
	Network interface
	Protective grounding
	Alternating current (AC)
	In Vitro diagnostic medical device
	Type B applied part
	Lot Number

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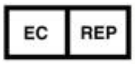
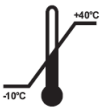
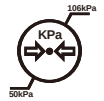
Symbol	It means
	Expiry date
	Serial number
	European CE declaration of conformity
	Authorized Representative in the European Community
	Date of manufacture
	Manufacturer
	Storage temperature
	Humidity level for storage
	Atmospheric pressure level for storage
	Consult the Operator’s Manual
	Keep away from sunlight
	Keep dry
	No rolling
	No Stacking.
	Let this side face upward.
	Fragile, handle with care
	Recyclable materials

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Symbol	It means
	The analyser, after being scrapped, should not be disposed with other household garbage, instead, it should be collected and recycled following the disposal instructions for scrapped electronic and electrical equipment.

1.4 Safety Instructions

- Device maintenance carried out in accordance with the following instructions guarantees the safety of both patients and operators. For use by trained personnel only.

WARNING

- Any failure by hospitals or organisations responsible for using this instrument to implement a competent repair/maintenance plan is likely to result in abnormal instrument failure or even a health hazard.
- To prevent risk of explosion, do not use combustible gases (e.g. anesthetics) or liquids (e.g. ethanol) near this product.
- The machine should be powered off while troubleshooting. Any maintenance operation while the power is on can lead to electric shock or damage to its electrical components.
- Please connect the device to the socket using a separate fuse and surge protection switch. If the device shares a fuse and surge protection switch with other equipment, e.g. life support equipment, any malfunction may cause an electric surge to occur when the instrument is powered on, which can trip the circuit breaker.
- Maintenance personnel must keep their clothes, hair, and hands away from moving parts such as the sample probe, jaws, and puncture needle to avoid being stabbed or pinched during maintenance.
- Parts with special warnings may be subject to mechanical movements and thus lead to injuries from pinching or stabbing during normal operation or disassembly and repair.
- Operators are obligated to comply with local and national regulations with regard to the disposal and emission of expired reagents, waste, waste samples, consumables, and so on.
- The reagents are irritating to eyes, skin and mucosa. When handling reagents and their related items in the laboratory, the operator should comply with laboratory safety regulations and wear personal protective equipment (such as a protective lab suit, gloves, etc.).
- If the reagent accidentally comes in contact with your eyes or skin, wash it off immediately with water.

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CAUTION

- Improper maintenance may damage the analyser. Maintenance personnel should maintain the device in accordance with the instructions contained in the service manual, and inspect the device properly after each maintenance.
- If you encounter a problem not specified in the service manual, please contact our after sales service department. A professional will be assigned to offer you maintenance advice.
- When repairing the electronic components of the device, please take off any metal accessories you might be wearing to prevent personal injury or damage to the device.
- Electrostatic discharge may cause damage to the device's electronic components. If the repair process can result in any electrostatic damage, please wear an antistatic wrist strap or maintain the device on an antistatic workstation.

NOTE

This analyser must be operated by trained medical testing professionals, doctors, nurses, or laboratory technicians.

- Samples, controls, calibrators, and waste may pose a potential risk of bio-contamination. When handling reagents and related items in the laboratory, the operator should comply with laboratory safety regulations and wear personal protective equipment (such as a protective lab suit, gloves, etc.).
- Both the parts and surface of the analyser are potentially infectious, so please take safety precautions during operation and maintenance.
- The pointed sample probe, any blood stains left on it, QC materials, and calibrators may be potentially bio-infectious, so please avoid contact with the sample probe.

This sign warns of laser radiation. Do not look directly at the laser beams or see through the optical system.

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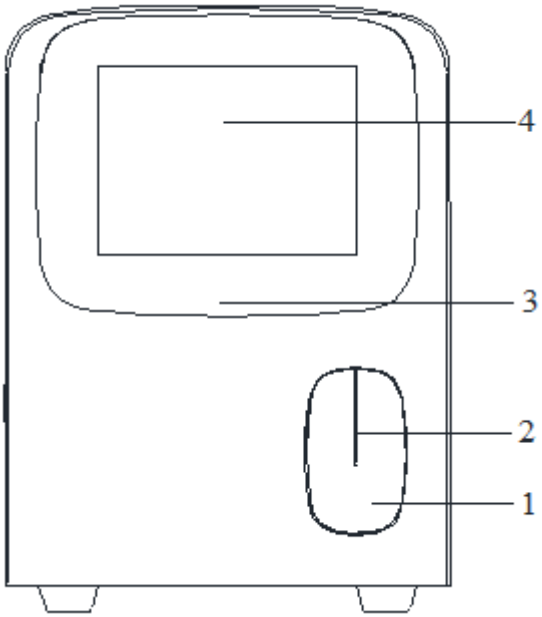
2 Instrument Configuration

2.1 Mechanical Components

The InSight V5 Haematology Analyser consists of the main unit and its accessories.

Figure 2-1 Front of the analyser



1 - Aspirate key	2 - Sample probe
3 - Status indicator light	4 - Touch screen

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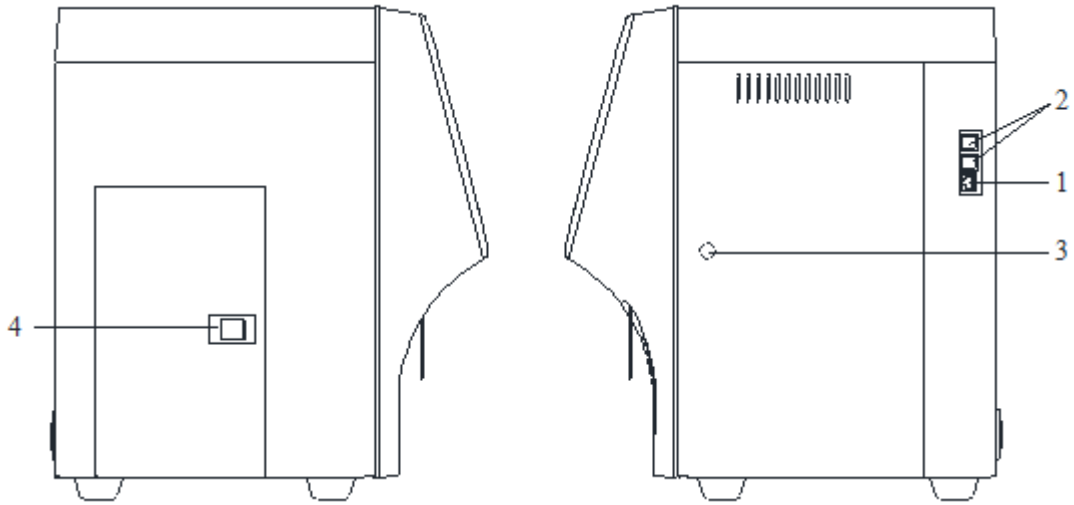
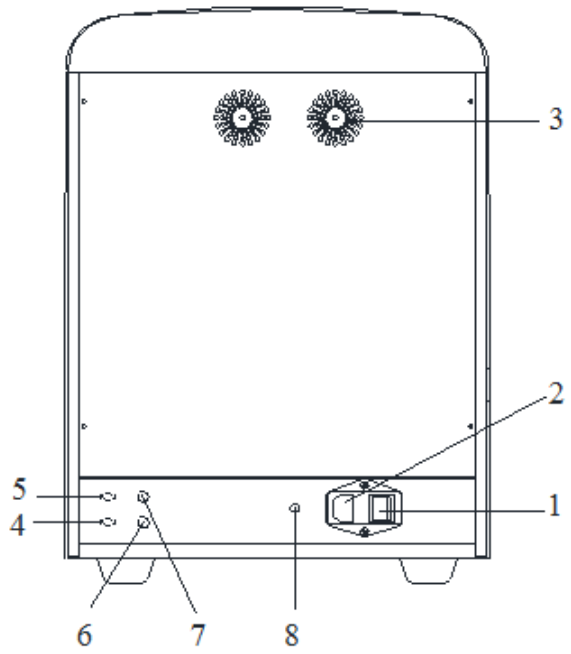
Figure 2-2 Side view of the analyser



1 - LAN network interface	2 - USB interface
3 - Right side door buckle	4 - Left side small door buckle

Figure 2-3 Back view of the analyser



1 - Power switch	2 - Power supply input connector
3 - Cooling fan	4 - Waste outlet connector
5 - Diluent inlet connector	6 - BNC socket for the diluent sensor
7 - BNC socket for the waste sensor	8 - Ground studs

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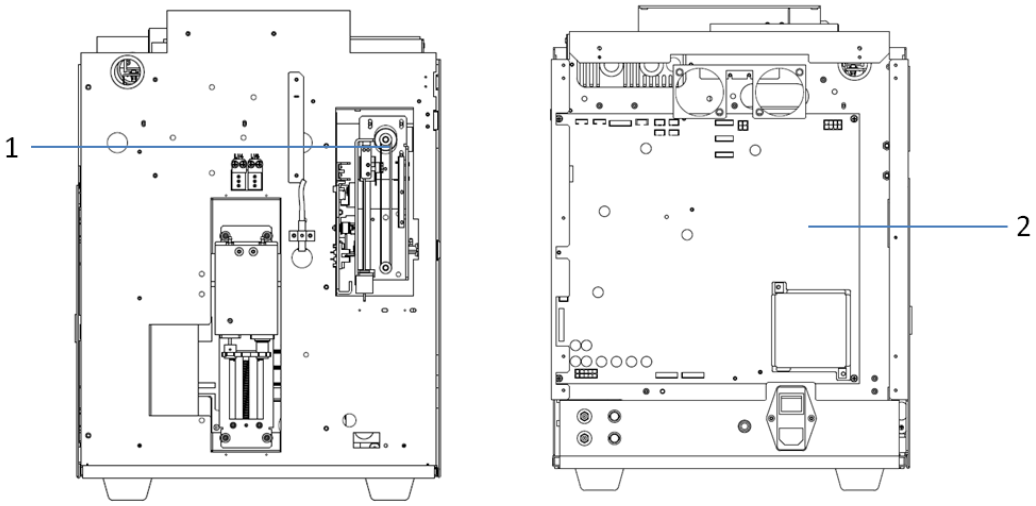
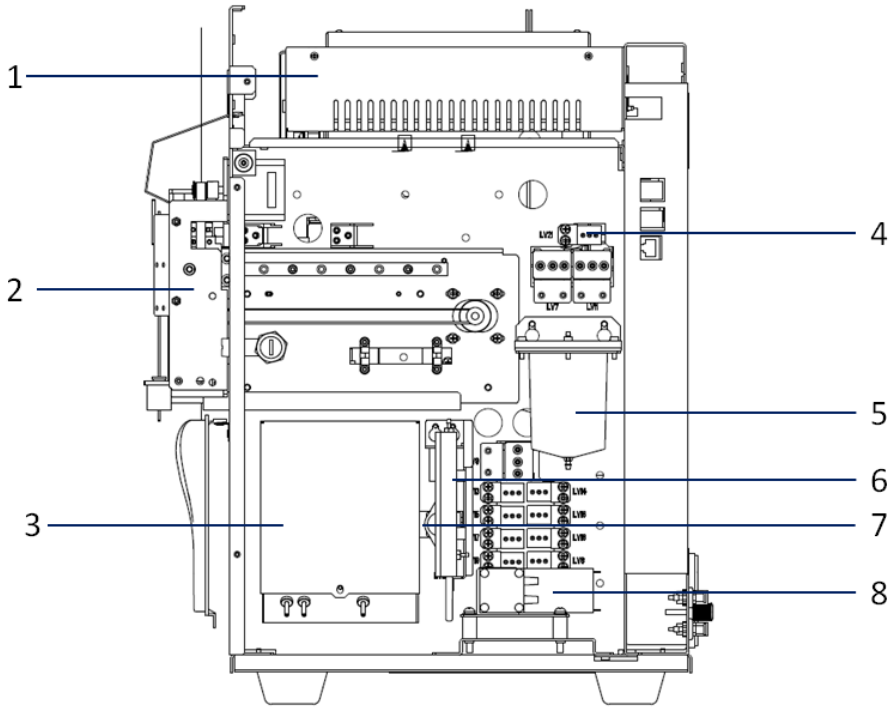
Figure 2-4 Front view of the analyser (panel cover, rear shell removed)



1 - Sampling assembly	2 - Main control panel

Figure 2-5 Right-side view of the analyser (right-side door removed)



1 - Power assembly	2 - Sampling assembly
3 - Counting bath assembly	4 - Electromagnetic valve assembly
5 - Negative-pressure chamber	6 - Preheating bath assembly
7 - Pinch valve	8 - Liquid pump assembly

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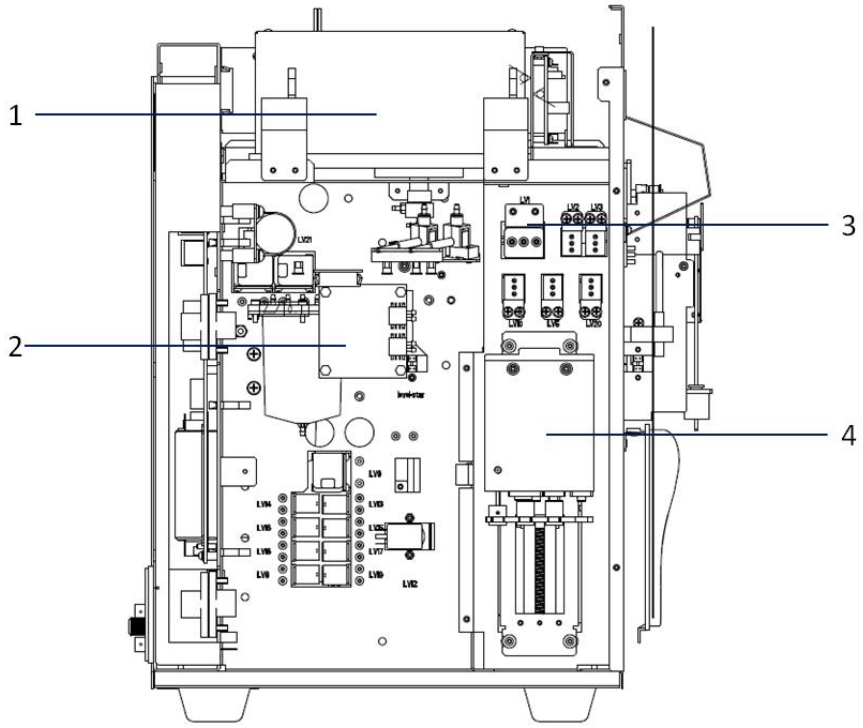
Figure 2-6 Left-side view of the analyser (Left-side door removed)



1 - Optical assembly	2 - Reagent testing panel
3 - Electromagnetic valve assembly	4 - Sampling syringe

2.2 Hydraulics System

The hydraulics system consists of the DIFF/WBC measurement module, the HGB measurement module, the RBC/PLT measurement module, the sampling and blood dispensing module, the power supply and waste discharge module, and the status monitoring module. Detailed description:

- DIFF/WBC measurement module:

  Consists of the dosing syringe, WBC reaction bath, flow chamber, tubing, and valve.

- HGB measurement module:

  Consists of the dosing syringe, WBC reaction bath, tubing, valve, HGB emission light, and HGB receiving tube.

- RBC/PLT measurement module:

  Consists of the dosing syringe, RBC/PLT counting bath assembly, tubing, and valve.

- Sampling and blood dispensing module:

  Consists of the sample probe, sampling syringe, swabs, and sampling assembly.

- Power supply and waste discharge module:

  Consists of the vacuum chamber, liquid pump, valve, and tubing.

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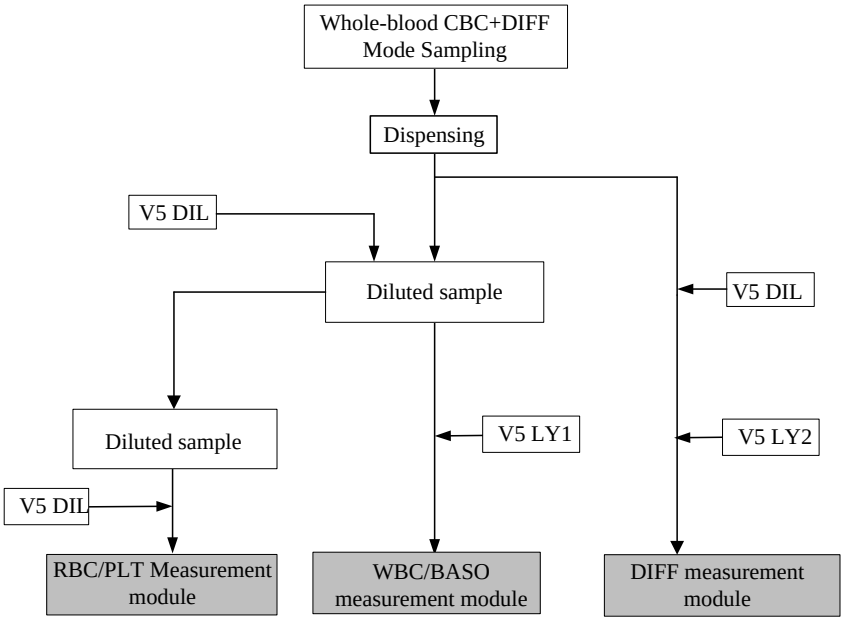
- Status monitoring module:
  Consists of the optocoupler and sensor.

2.2.1 Schematic Diagram of the Hydraulic System

Figure 2-7 Schematic diagram of the hydraulic system



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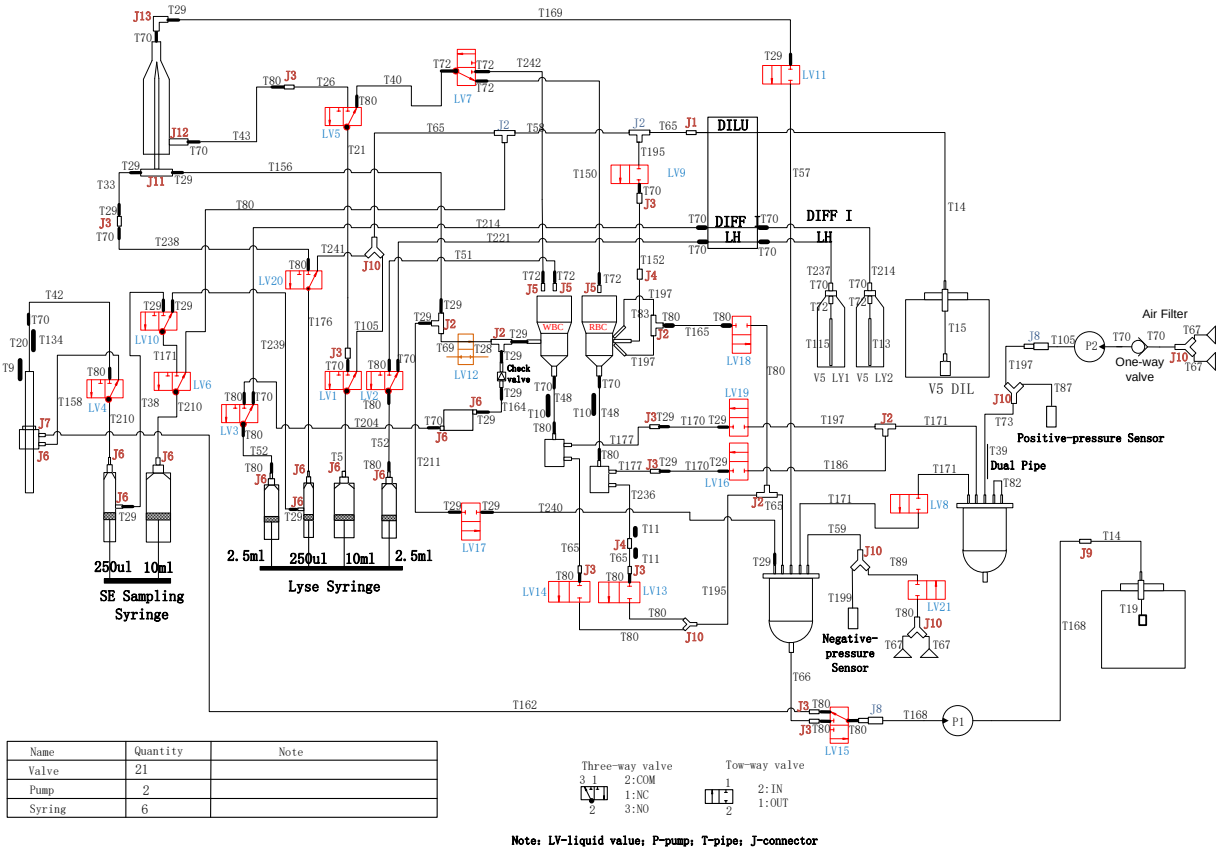
2.2.2 Hydraulics Diagram for the Overall Unit

Figure 2-8 Hydraulics diagram for the overall unit



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

2.2.3 DIFF/WBC Measurement Channel

2.2.3.1 Channel Principles and a Description of Their Functions

- Measurement principles: Flow cytometry and scattering emission of the semiconductor laser
- Measurement parameters: WBC, Mon#, Mon%, Lym#, Lym%, Neu#, Neu%, Eos#, Eos%, Bas#, Bas%
- Graph information: DIFF 2D scattergram and BASO 2D scattergram.
- Reagents for use
  - V5 LY1 Lyse: Lyses the RBC and combines with haemoglobin.
  - V5 LY2: Lyses the RBCs and specifically treats different types of WBCs.
  - V5 DIL Diluent: This diluting and cleaning agent can provide an electrically conductive environment and process cells and so on in bulk.
- Function description
  - DIFF parameters measurement

    The diluted sample is mixed well for a full reaction with V5 LY2 Lyse in the WBC bath. Then the sample is placed between the flow chamber inlet and the sampling syringe; meanwhile, the sheath flow is activated and kept steady so that it can hold the sample in motion until it

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reaches the measurement section of the flow chamber. The sampling syringe, at a constant speed and within a certain period of time, pushes the sample fluid wrapped in the sheath flow so that it travels steadily through the flow chamber for optical measurement.

- WBC parameters measurement

  After the first section sheath flow is measured, add the quantitative V5 LY1 Lyse into WBC reaction bath to make it react fully. After that, place the sample between the inlet of the flow chamber and sampling syringe, and open the sheath flow and make it stable, then the sheath flow wrapping the sample reaches the measurement section of the flow chamber. The sampling syringe, at a constant speed and within a certain period of time, pushes the sample fluid wrapped in the sheath flow so that it travels steadily through the flow chamber for optical measurement.

  The measurement channels are cleaned after measurement to restore them to their pre-measurement status.

2.2.3.2 Measurement Process

The measurement process for the DIFF measurement module is as follows:

1. Dosing: The diluent syringe is first applied to add the diluent into the WBC bath, and then the sample probe is used to add the blood sample into the WBC bath, where they are mixed with V5 LY2 evenly for incubation.
2. Mixing: Open Valve LV19 to generate air bubbles through the intermittent valve opening to mix the sample well.
3. Measurement: Aspirate the incubated sample from the WBC bath using the sampling syringe, then close LV12, and open LV01 and LV05, so that the sheath flow syringe can push the sheath fluid into the flow chamber to form a stable sheath flow. Then push the sample into the flow chamber via the sample injection tube. This is how the sample, wrapped in the sheath flow, enters the measurement section for measurement.

The measurement process for the WBC measurement module is as follows:

1. Dosing: The diluent syringe is first applied to add the diluent into the WBC bath, and then the sample probe is used to add the blood sample into the WBC bath, where they are mixed evenly. After aspirating the diluted sample for the RBC channel measurement, V5 LY1 Lyse is added into the WBC bath for mixing and incubation.
2. Mixing: Open Valve LV19 to generate air bubbles through the intermittent valve opening to mix the sample well.
3. Measurement: Aspirate the incubated sample from the WBC bath using the sampling syringe, then close LV12, and open LV01 and LV05, so that the sheath flow syringe can push the sheath fluid into the flow chamber to form a stable sheath flow. Then push the sample into the flow chamber via the sample injection tube. This is how the sample, wrapped in the sheath flow, enters the measurement section for measurement.
4. Cleaning: To clean, open LV01 and LV07, and add the diluent into the WBC bath using the dosing syringe.
5. Waste discharge: Waste is discharged by opening Valve LV14, LV15 and Pump P1.

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2.2.4 HGB Measurement Channel

2.2.4.1 Channel Principles and a Description of Their Functions

- Measurement principles: Colorimetric method
- Measurement parameters: HGB
- Reagents for use
  - V5 LY1: Lyses the RBC and combines with haemoglobin.
  - V5 DIL Diluent: This diluting and cleaning agent can provide an electrically conductive environment and process cells in bulk.
- Function description

  HGB is measured by colorimetry: Prior to the addition of the blood sample, the baseline voltage of the diluent is first measured. Then the blood sample and lyse are mixed well for a complete reaction so that the parameter voltage of the sample can be measured. HGB can then be calculated based on the local voltage and parameter voltage according to Lambert-Beer's Law.

2.2.4.2 Measurement Process

The measurement process for the HGB measurement module is as follows:

1. Dosing: The diluent syringe is first applied to add the diluent into the WBC bath, and then the sample probe is used to add the blood sample into the WBC bath, where they are mixed evenly. After aspirating the diluted sample for the first time, V5 LY1 Lyse is added into the WBC bath for incubation.
2. Mixing: Open Valve LV19 to generate air bubbles through the intermittent valve opening to mix the sample well.
3. Measurement: The blood sample and lyse are mixed well for a complete reaction so that the parameter voltage of the sample can be measured. HGB can then be calculated based on the local voltage and parameter voltage according to Lambert-Beer's Law.

2.2.5 RBC/PLT Measurement Module

2.2.5.1 Channel Principles and a Description of Their Functions

- Measurement principles: Impedance method
- Measurement parameters: RBC and PLT
- Graph information: RBC histogram and PLT histogram
- Reagents for use

  V5 DIL Diluent: This diluting and cleaning agent can provide an electrically conductive environment and process cells and so on in bulk.
- Function description

  RBC and PLT measurement makes use of the impedance method: After the addition of V5 LY1 Lyse, the red blood cells are dissolved. Through the negative-pressure chamber (with a negative pressure of -30Kpa), the sample is aspirated out of the WBC bath through the aperture. The RBC and PLT particles generate electric pulses of various amplitudes when travelling through

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the aperture, allowing them to be counted according to the number of pulses emitted.

2.2.5.2 Measurement Process

The measurement process for the RBC/PLT measurement module is as follows:

1. Dosing: The diluent syringe is first applied to add the diluent into the RBC/PLT bath as the base liquid, before using the sample probe to aspirate the sample diluted for the first time from the WBC bath into the RBC/PLT bath.
2. Mixing: Open Valve LV16 to generate air bubbles through the intermittent valve opening to mix the sample well.
3. Measurement: Open Valve LV18 to aspirate the sample out of the RBC/PLT bath through the aperture by means of the negative-pressure chamber (with a negative pressure of -30Kpa). The RBC and PLT particles generate electric pulses of various amplitudes when travelling through the aperture, allowing the RBC and PLT cells to be counted according to the number of pulses emitted.
4. Cleaning: To clean, open Valve LV02 and add the diluent into the RBC/PLT bath using the diluent syringe.
5. Waste discharge: Waste is discharged by opening Valve LV13, LV15 and Pump P1.

2.2.6 Sampling and Blood-dispensing Module

This module consists of the sample probe, the sampling syringe, the sampling tube, the swab, the horizontal motor, and the vertical motor.

This is how the sampling and blood-dispensing module works:

Open LV04 and aspirate the sample from the testing tube using the sampling syringe→Clean the outer wall of the sample probe→ …until it reaches the WBC bath→Put aside a fixed amount of blood in the WBC bath→Clean the outer and inner wall of the sample probe→Aspirate out of the WBC bath a fixed amount of the sample that has been diluted once→Clean the outer wall of the sample probe and move the sample probe to the RBC bath→Add into the RBC bath the sample that has been diluted once→Clean the outer wall of the sample probe to complete the entire process of sampling and blood dispensing.

In summary, this module works by aspirating the sample and dispensing a fixed amount of the sample into the corresponding reaction baths, while cleaning the inner and outer walls of the sample probe to prevent cross-contamination.

2.2.7 Power Supply and Waste Discharge Module

- Power supply module

  By opening LV15 and Pump P1 to establish a negative pressure of -30Kpa, this module provides propulsion for the counting of the impedance channel.

- Waste disposal module

  This module consists of the following parts:

  - Discharge of waste resulting from swab cleansing

    Pump P1 is opened to discharge any waste resulting from using the swab to clean the sample probe.

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- Discharge of waste from the WBC bath

  Valve LV14, LV15 and Pump P1 are opened to discharge any waste from the WBC bath.

- Discharge of waste from the RBC/PLT bath

  Valve LV13, LV15 and Pump P1 are opened to discharge any waste from the RBC/PLT bath.

- Discharge of waste from the impedance counting bath

  After any waste from impedance counting (RBC/PLT counting) flows through the aperture and after any waste that results from cleaning the rear section of the RBC/PLT bath flows into the negative-pressure chamber, Valve LV15 and Pump P1 are opened for waste discharge.

2.2.8 Status Monitoring Module

This module involves:

- Monitoring of V5 DIL

  Detection is done by way of a floating sensor; the float moves downwards, the diluent level falls, and an alarm is activated when it reaches empty.

- Monitoring of V5 LY1

  A reflecting optocoupler is used to monitor the V5 LY1 level; as it gets lower, the optocoupler's status changes until an alarm is activated once there is no V5 LY1 left.

- Monitoring of V5 LY2

  A reflecting optocoupler is used to monitor the V5 LY2 level; as it gets lower, the optocoupler's status changes until an alarm is activated once there is no V5 LY2 left.

- Monitoring of waste overflow

  Waste overflow is done by way of a floating sensor; as waste levels rise, the float moves upward until it eventually activates an alarm indicating that it is full.

2.2.9 Hydraulic Components

List of Hydraulic Components

No.	Component No.	Illustration	Material No.	Function Description	Remarks
1	Sample probe		56.01.0163 A	Collects blood samples in the testing tube and dispenses a certain portion of the sample to be placed in the corresponding counting bath	None
2	Swab		20.01.098 4A	Cleans the outer and inner walls of the sample probe	None

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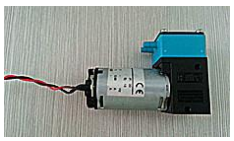
No.	Component No.	Illustration	Material No.	Function Description	Remarks
3	Two-way valve (L)		20.01.0314 A	On-off switch for fluid control	None
4	Three-way valve (L)		20.01.0315 A	Directional hydraulic valve	None
5	Two-way valve (S)		20.01.0312 A	On-off switch for fluid control	None
6	Three-way valve (S)		20.01.0313 A	Directional hydraulic valve	None
7	Liquid pump		23.99.0008 A	Discharges waste and creates a vacuum	None
8	LS Lyse syringe		20.01.0124 A	Add the diluent and lyse, push the sample into the measurement area of the flow chamber for measurement, and form the sheath flow.	None
9	Isolation chamber		60.01.0012 A	This chamber insulates the liquid from the electric circuits to prevent any electrical interference.	None

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No.	Component No.	Illustration	Material No.	Function Description	Remarks
10	WBC/HGB bath		20.01.0121 A	• Sample incubation bath • The counting bath is accompanied by a HGB emission light and a HGB signal receiving device for HGB measurement.	None
11	RBC/PLT bath		20.01.0008 A0144A	This consists of the front bath and the rear bath, with an aperture in between; the sample flows from the front bath through the aperture to generate electric pulses that facilitate RBC and PLT counting.	None
12	Negative-pressure chamber		20.01.1106 A	• This chamber builds the negative pressure needed to drive impedance-channel counting • This chamber builds positive pressure needed to drive the mixing • This chamber builds negative pressure needed to flush the rear bath of the impedance counting bath and to discharge the waste liquid in the counting bath.	None
13	Lyse check valve (7856803)		24.13.0015 A	Separate the lyse and the diluent, to prevent the lyse from back flow	None

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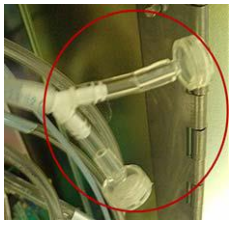
No.	Component No.	Illustration	Material No.	Function Description	Remarks
14	Pinch valve		23.99.000 5A	Control the passing and suspension of the flow	None
15	One-way valve		24.13.000 8A	Air intake at the inlet of the air pump, and to prevent reverse air leakage	None
16	Air pump		24.01.000 2A	Build positive pressure	None
17	Positive-pressure chamber		20.01.120 4A	• Build the positive pressure needed for bubble generation in DIFF bath, WBC/HGB bath, and RBC/PLT bath • Build the positive pressure needed for back flushing the aperture of the counting bath	None
18	Filter		53.99.001 8A	Prevent tiny particles from blocking the fluidics system	None
19	SE Sampling syringe		20.01.111 4A	Divide the blood for a fixed amount, clean the sampling probe, and help the pushing	None

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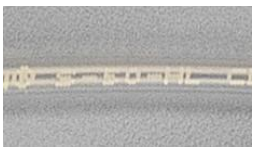
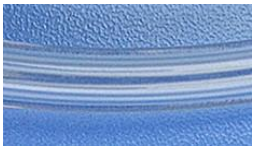
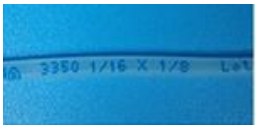
List of Tube Types

No.	Tube Name	Illustration	Material No.	Inner Diameter (mm)	Outer Diameter (mm)	Features
1	STHT Tube		63.01.0001 A	0.9	4.87	Soft tube, adapter for hard tube
2	Pharmed Tube		63.01.0002 A	1.6	4.8	Soft tube with good resilience
3	EVA Tube		63.01.0007 A	1.0	3	Has good flexibility and resistance to bending and fatigue
4	Thin 50 Tube		63.01.0008 A	1.6	3.2	Soft Tube
5	Thick 50 Tube		63.01.0009 A	2.4	4	Soft Tube
6	3603 Tube		63.01.0010 A	3.2	6.4	A soft tube used for the external inflow of diluent and waste discharge
7	MPF Tube		63.01.0011 A	2	3.5	A hard tube, resistant to pressure and deformation
8	1.5mm Teflon Tube		63.01.0013 A	1.5	2.5	This tube is hard and transparent, and is very resistant to erosion
9	1.0mm Teflon Tube		63.01.0014 A	1.0	1.68	This tube is hard and transparent, and is very resistant to erosion
10	ABW00002 Silicone Tube		63.01.0003 A	1.6	3.2	Soft tube, the pinch tube of the pinch valve

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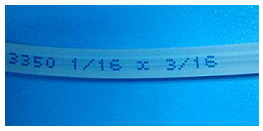
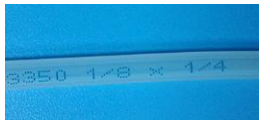
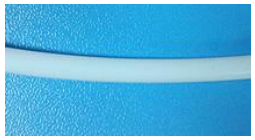
No.	Tube Name	Illustration	Material No.	Inner Diameter (mm)	Outer Diameter (mm)	Features
11	ABW00003 Silicone Tube		63.01.0004A	1.6	4.8	This tube is soft and can be connected to hard tubes
12	3.2mm Saint-gobain Silicone Tube		63.01.0021A	3.2	6.4	This tube is soft and can be connected to hard tubes; it can also be used as a protective shell
13	2.4mm TPU Tube		63.01.0016A	2.4	4.8	A hard tube, resistant to pressure and deformation
14	2.0mm (i.d.) PTFE Tube		63.01.0020A	2	4	This tube is hard, has good resistance to erosion, and can be used as an aspiration tube inside the bottle of lyse
15	1.6mm EVA Tube		63.01.0051A	1.6	3.2	Has good flexibility and resistance to bending and fatigue
16	Rubber Tube		63.01.0080A	3.2	6.4	Soft Tube

List of Connector Types

No.	Connector Name	Illustration	Material No.	Material	Features
1	T420-1 Connector		53.05.0003A	White nylon	T-type Connector for 1.6-2.4mm (i.d.) Tubing
2	K420-6005 Connector		53.05.0005A	PP	10-32 screw-thread connector for 1.6-2.4mm (i.d.) tubing
3	S220-6005 Connector		53.05.0008A	PP, natural color	1/4-28 screw-thread connector for 1.6-2.4mm (i.d.) tubing

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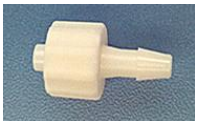
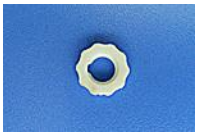
No.	Connector Name	Illustration	Material No.	Material	Features
4	L420-1 Connector		53.05.0010 A	White nylon	L-type Connector for 1.6-2.4mm (i.d.) Tubing
5	Y420-1 Connector		53.05.0012 A	White nylon	Y-type Connector for 1.6-2.4mm (i.d.) Tubing
6	N430/420-1 Connector		53.05.0013 A	White nylon	Thick-to-thin tube connector for 1.6-2.4mm configuration
7	N420-6005 Connector		53.20.0012 A	PP, natural color	Barrel connector for 1.6-2.4mm (i.d.) tubing
8	MTLL230-1Integrated locking ring		53.05.0016 A	White nylon	Integrated locking ring
9	MTLL013-3 Integrated locking ring		53.05.0044 A	Red nylon	Integrated locking ring
10	LNS-1 Locking bolt for panel installation		53.05.0023 A	White nylon	Locking bolt for white panel installation
11	LNS-3 Locking bolt for panel installation		53.05.0025 A	Red nylon	Locking bolt for red panel installation
12	CCLR-1 Color-coded locking ring		53.05.0028 A	White nylon	White-coded locking ring
13	CCLR-3 Color-coded locking ring		53.05.0030 A	Red nylon	Red-coded locking ring
14	FTLB230-1 Connector		53.05.0021A	White nylon	Female Luer FTLB230-1 Connector

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No.	Connector Name	Illustration	Material No.	Material	Features
15	FTLLB220-JIA Connector		53.05.0077A	Natural PVDF	Female Luer FTLLB220-JIA Connector

2.2.10 Main Measurement Modes

The measurement modes of the analyser include:

- Whole-blood CBC+DIFF Mode

  Whole-blood sample aspiration for CBC+DIFF measurement.

- Predilute CBC+DIFF Mode

  Dilution is performed in vitro, and the diluted sample is then aspirated for CBC+DIFF measurement.

- Whole-blood CBC Mode

  Whole-blood sample aspiration for CBC measurement.

- Predilute CBC Mode

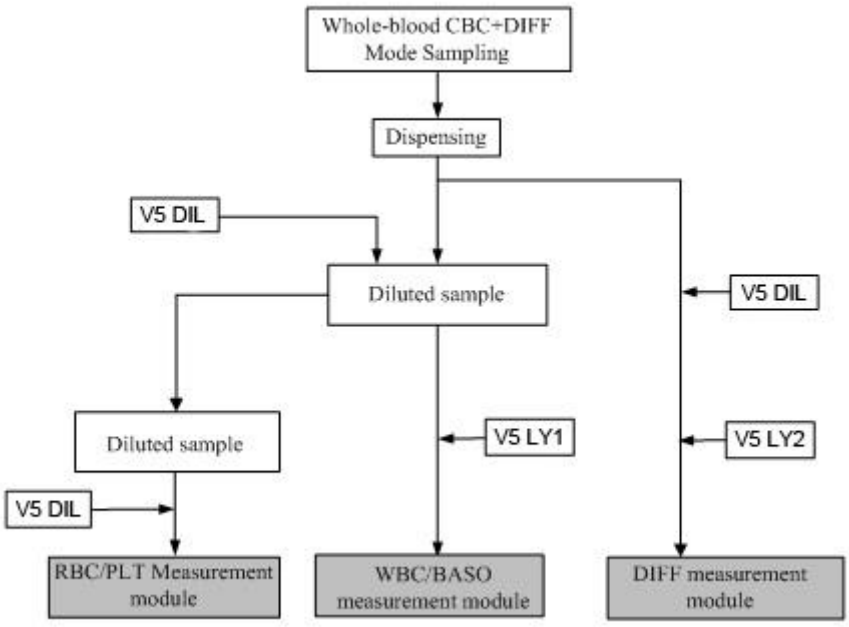
  Dilution is performed in vitro, and the diluted sample is then aspirated for CBC measurement.

The dilution and measurement procedures of the sample in different measurement mode will be presented on the following pages.

2.2.10.1 Dilution Procedure in Whole-blood CBC+DIFF Mode

The dilution procedure in whole-blood CBC+DIFF mode is shown in Figure 2-9.

Figure 2-9 Dilution Procedure in Whole-blood CBC+DIFF Mode



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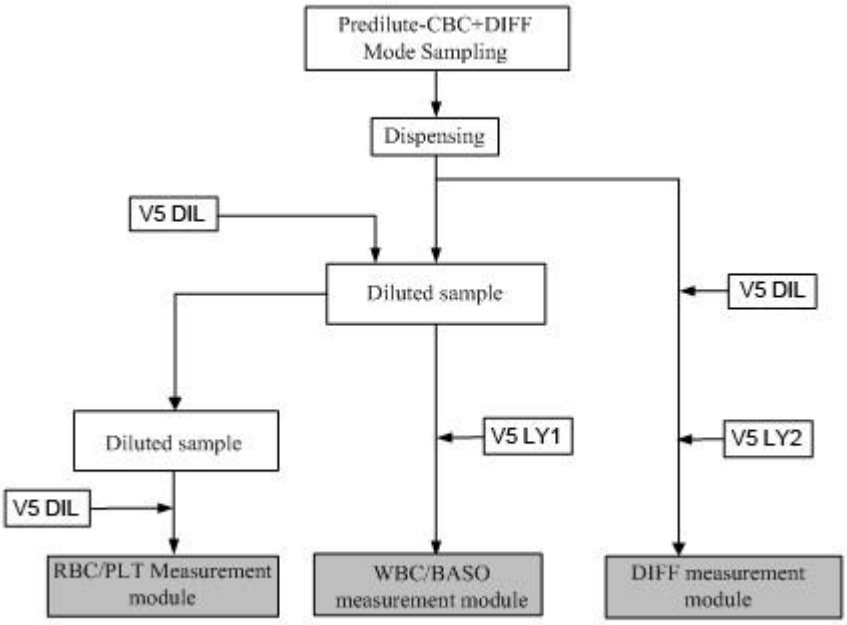
2.2.10.2 Dilution Procedure in Predilute CBC+DIFF Mode

The dilution procedure in Predilute CBC+DIFF mode is shown in Figure 2-10.

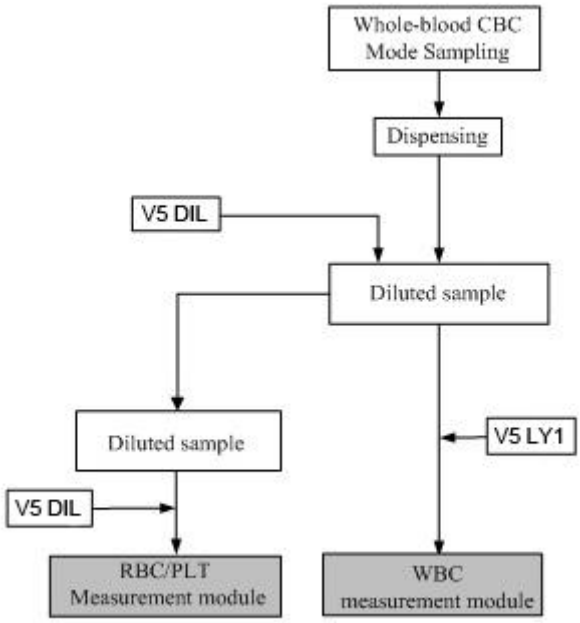
Figure 2-10 Dilution Procedure in Predilute CBC+DIFF Mode



2.2.10.3 Dilution Procedure in Whole-blood CBC Mode

The dilution procedure in whole-blood CBC mode is shown in Figure 2-11.

Figure 2-11 Dilution Procedure in Whole-blood CBC Mode



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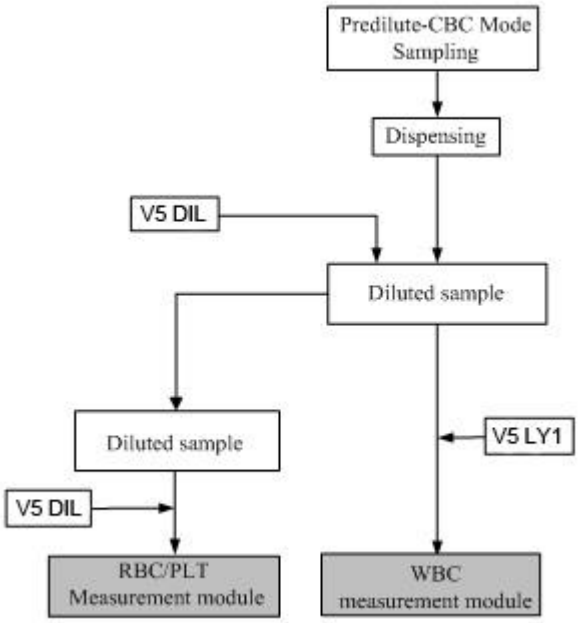
2.2.10.4 Dilution Procedure in Predilute CBC Mode

The dilution procedure in predilute CBC+DIFF mode is shown in Figure 2-12.

Figure 2-12 Dilution Procedure in Predilute CBC Mode



2.2.10.5 Measurement Procedure in Whole-blood CBC+DIFF Mode

In whole-blood mode, a total of 5 time slots for sample measurement are set at 0s~4s, 5s~10s, 11s~22s, 20s~64s, and 64s~72s, respectively, during each of which different steps are taken. Detailed description:

- Steps taken between 0s~4s (Figure 2-13)
  a. Aspirate the whole blood using the sampling syringe.
  b. Set the sample probe in the upper position for outer-wall cleaning.
  c. Empty WBC/HGB bath.

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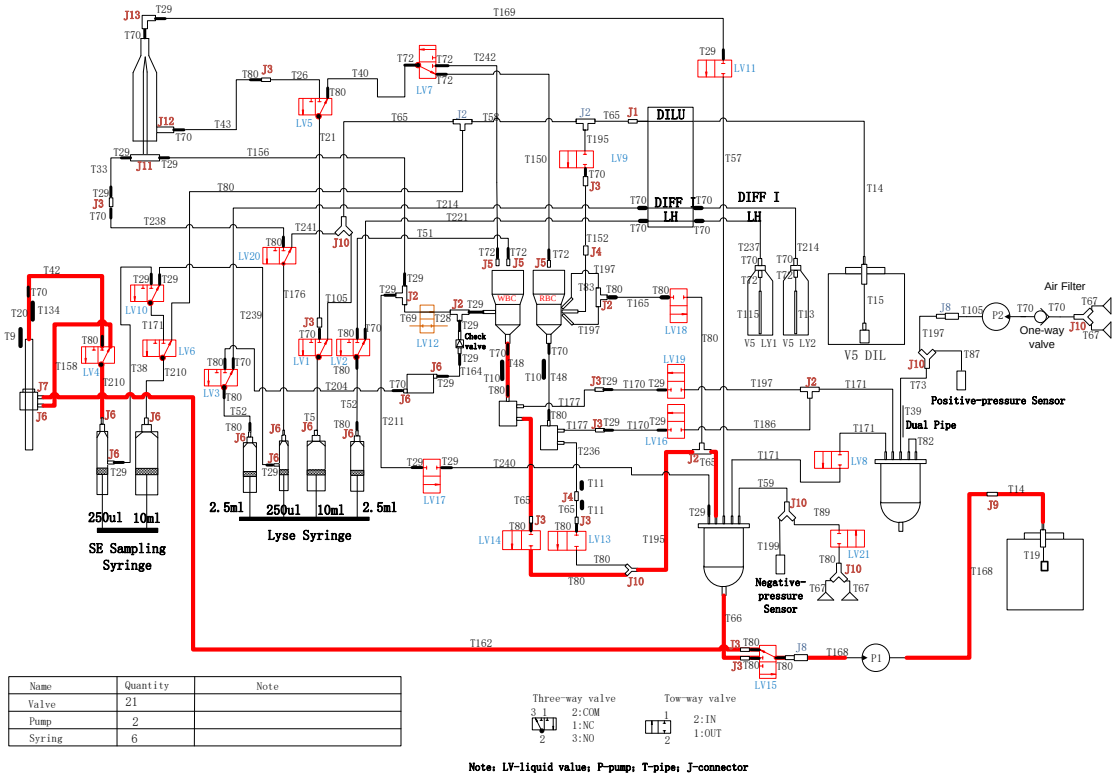
Figure 2-13 Measurement Flowchart A



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

- Steps taken between 5s~10s (Figure 2-14)
  a. The sampling probe moves down into the WBC/HGB bath, and adds V5 LY2 into WBC/HGB bath.
  b. Add the blood sample and the diluent into the WBC/HGB bath, and mix them thoroughly through air bubbles.
  c. Empty the RBC/PLT bath.

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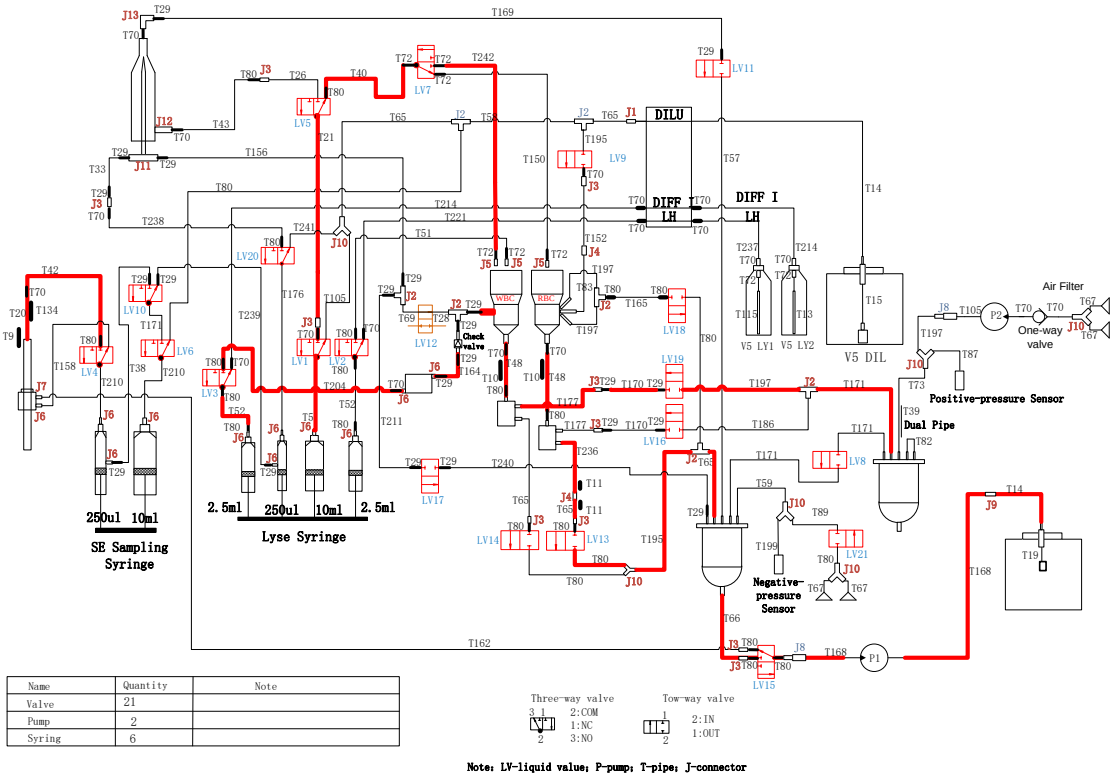
Figure 2-14 Measurement Flowchart B



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

- Steps taken between 11s~22s (Figure 2-15)
  a. Pump the DIFF sample in the WBC/HGB bath to the sample preparation tube, and then empty the WBC/HGB bath.
  b. Clean the WBC/HGB bath.
  c. Add the diluent and the blood sample into the RBC/PLT bath.
  d. Add the diluent and the blood sample into the WBC/HGB bath, and mix them thoroughly with air bubbles.

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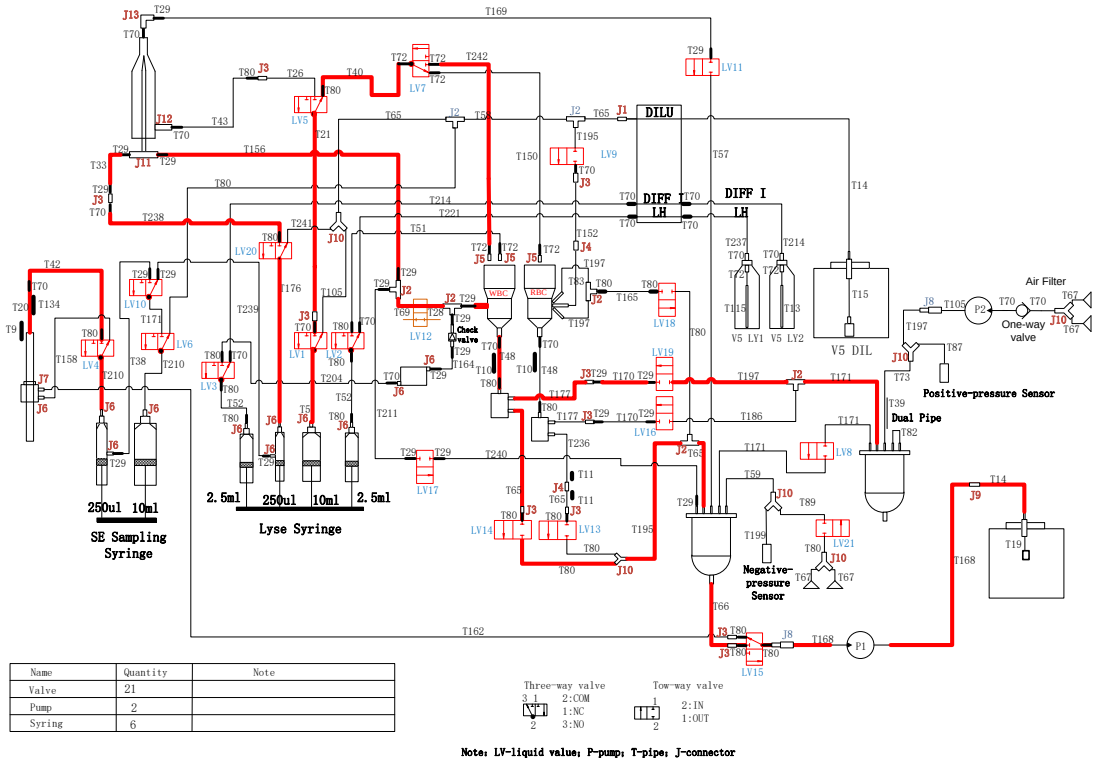
Figure 2-15 Measurement Flowchart C



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

- Steps taken between 20s~64s (Figure 2-16)
  a. The sampling probe moves up to the initial position to clean the inner wall, and then enters into the WBC/HGB bath to aspirate the first diluted sample.
  b. The sampling probe moves to the initial position, then moves to the top of the RBC/PLT bath to add V5 LY1 into the WBC/HGB bath, and mix them thoroughly.
  c. The sampling probe moves down to the RBC/PLT bath to add into the first diluted sample aspirated from WBC/HGB bath, and mix them thoroughly.
  d. The sampling syringe and lyse syringe push the DIFF sample and the sheath flow at the same time. After the sheath flow is forming, the measurement in DIFF channel is started.
  e. Build negative pressure -24kpa~-27kpa, clean the rear RBC/PLT bath, build negative pressure -28kpa~-31kpa, and then the measurement in RBC/PLT channel is started.
  f. Clean the sample channel after DIFF measurement is completed. Push the residual WBC reacting sample treated with V5 LY1 into the flow chamber to form the second stable sheath flow. The measurement in WBC/BASA channel is in progress. The measurement in RBC channel is completed.

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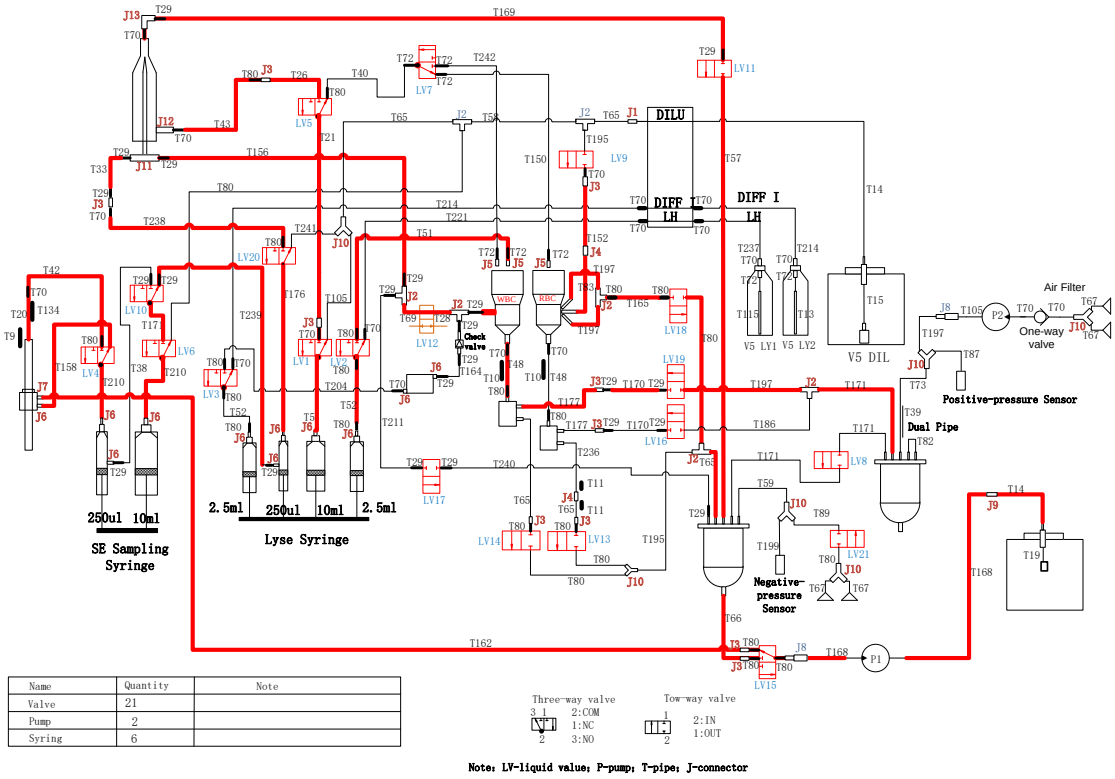
Figure 2-16 Measurement Flowchart D



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

- Steps taken between 64s~72s (Figure 2-17)
  a. Empty the WBC bath and RBC/PLT bath.
  b. Add the diluent into the RBC/PLT bath for cleansing.
  c. Zap the RBC/PLT bath.
  d. Clean the sample tube of flow chamber and WBC bath, and add diluent as the base solution after emptying.
  e. Drain the RBC/PLT bath before adding the diluent as the base solution.
  f. Clean the rear bath of the RBC/PLT bath.
  g. Restore the sample assembly to measurement preparation status.
  h. At around the 69s mark, the screen will show the current counting results.
  i. The next sample can be made as soon as 72s measurement is completed.

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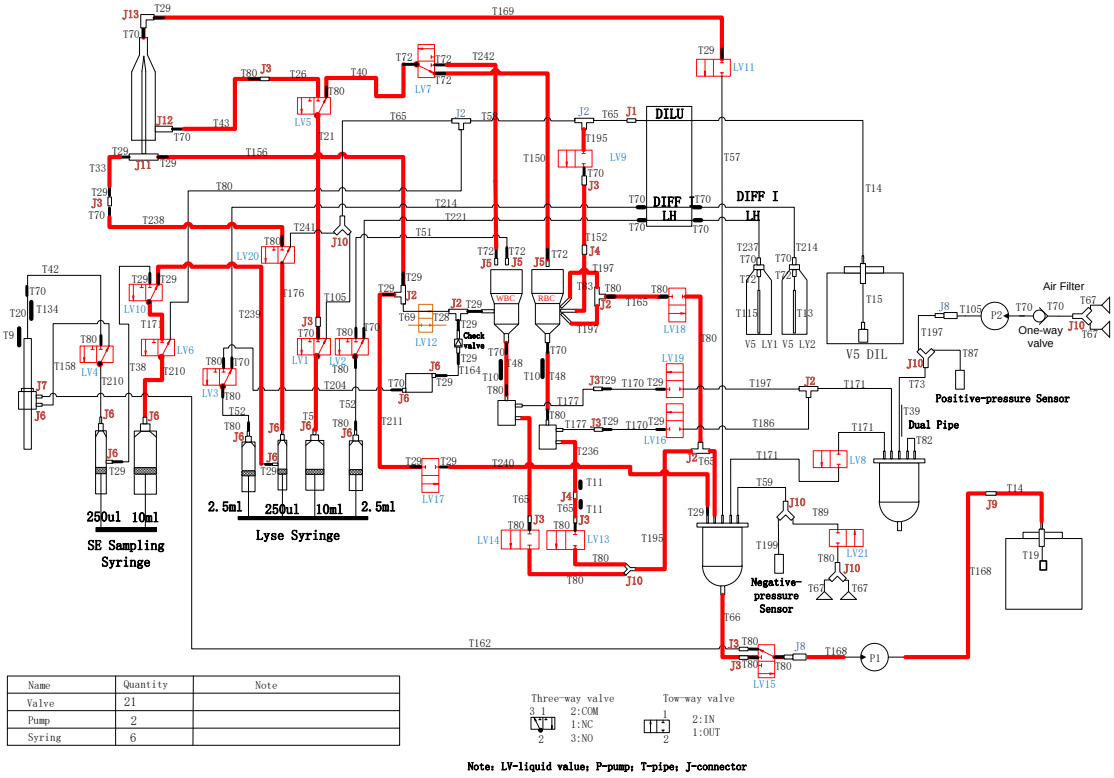
Figure 2-17 Measurement Flowchart E



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

2.2.10.6 Measurement Procedure in Predilute Mode

The measurement principle in predilute mode is generally the same as that in whole-blood mode, while the difference lies in that the whole-blood measured shall be quantitatively prediluted prior to the measurement in predilute mode.

2.2.11 Hydraulics Maintenance

2.2.11.1 Swab Cleaning and Maintenance

The swab requires cleaning and maintenance to get rid of any contamination found on its lower surface.

The operating procedure is as follows:

1. Shut down the device.
2. Disassemble the swab. A certain amount of probe cleanser is diluted with the diluent into a 1:3 (probe cleanser to diluent) solution.
3. Repeatedly scrub the bottom end of the swab and the inside of its lower aperture with a cotton swab dampened with the diluted probe cleanser. After scrubbing, use another clean cotton swab dampened with pure diluent to clean away the probe cleanser residue at the bottom end of the swab and the inside of its lower aperture.

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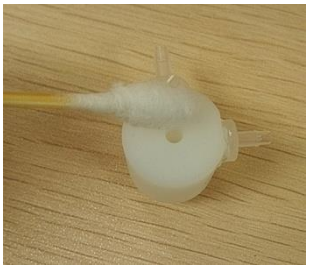
Figure 2-18 Cleaning the swab

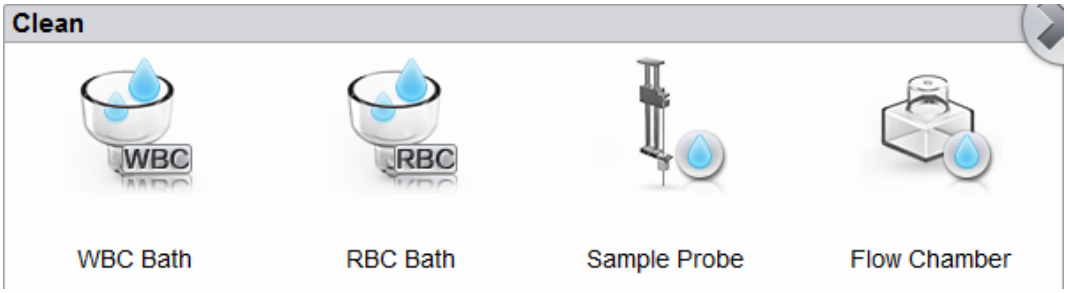


4. After cleaning and reassembling the swab, check and make sure the inflow/outflow interface tubing is connected correctly.
5. Turn on the device.
6. Go to **Service** > **Maintenance** > **Clean**. Click the **Clean Sample Probe** icon to perform the operation before performing cleaning and maintenance on the swab.

2.2.11.2 Cleaning and Maintenance of the WBC Bath

Go to **Service** > **Maintenance** > **Clean** and click the **Clean WBC bath** button. See Figure 2-19.

Figure 2-19 Cleaning and maintenance interface



2.2.11.3 Cleaning and Maintenance of the RBC Bath

Go to **Service** > **Maintenance** > **Clean** and click the **Clean RBC bath** button.

2.2.12 Troubleshooting Common Hydraulics Problems

2.2.12.1 Commonly Used Equipment and Tools

Name	Illustration	Usage	Remarks
small sample cup		• Used to contain liquid after a tube is pulled out • Used as a diluent container • The ratio of probe cleanser to diluent is 1:3.	None

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Name	Illustration	Usage	Remarks
plastic syringe (disposal syringe with no needle)		• Used to manually unclog the WBC and RBC channels • Used to inject other liquids.	None
Barrel connector		tubing connection	None
Silicone tube		Used to connect tubing and the plastic syringe	None
Cotton swabs		• Used to clean the swab • Used for other cleaning tasks	None

2.2.12.2 Inspection and Troubleshooting of Valve Clogging

1. To prevent the possibility of liquid flowing onto the base plate when the tube connected to the valve is pulled out, the tube pulled out needs to be placed into the small sample cup, and tissue paper should be used as a pad to prop up any affected components. The sample cup should be removed once the liquid has stopped flowing.
2. Disassemble the valve. Then open the valve cap to check if there is any clogging caused by impurities; if so, remove the impurities.
3. See Figure 2-20 and Figure 2-21.

Figure 2-20 3-way valve (L)

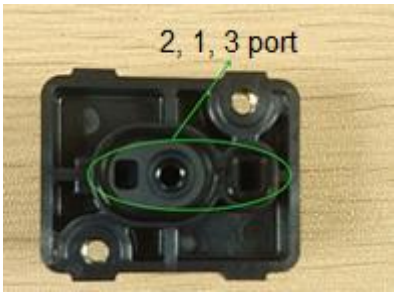

Figure 2-21 2-way valve (L)

4. Place the components in their original positions. (Note that the parts with instructions are kept on the same side during installation. Then remove the tissue paper and clean the bottom.)

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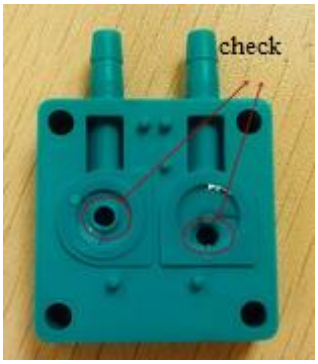
Figure 2-22 Installation of the large valve

Figure 2-23 Installation of the small valve

2.2.12.3 Liquid Pump Clogging: Inspection and Troubleshooting

1. Pull out the tubing and place it into the small sample cup. Then prop up any relevant parts with tissue paper and disassemble the pump.
2. Use the Phillips screwdriver to open the pump cap to observe any clogging resulting from impurities, as shown in Figure 2-24.

Figure 2-24 Pump cap



3. Remove the impurities and place the pump in its original position.

   Make sure to align the two marked lines correctly while installing, as shown in Figure 2-25.

Figure 2-25 Installing the marked lines

4. Make sure the liquid inlet and outlet are connected to the correct tubing (See Figure 2-26).

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Figure 2-26 Symbols for inflow and outflow direction

2.2.12.4 Clogging of the Flow Chamber/DIFF Probe

In the case of flow chamber/DIFF probe clogging, you can manually push the probe cleanser to clean the flow chamber/DIFF probe. Detailed steps are shown below:

1. Pull out the white tube connected to Valve 11 from the flow chamber (while making sure that the connecting tube has been pulled out correctly). Put the tube into the probe cleanser with a dilution ratio of 1:3 (probe cleanser to diluent) below the surface of the liquid. Then pull out the tube connected to connector No.1 of Valve 20 (this tube is the transfer tube for white Teflon tube 1.5 and thin 50 tube, covered with marking ring **3**), and connect the plastic syringe to the 50 transfer tube through the silicone tube (as shown in Figure 2-27).

Figure 2-27 Cleaning the flow chamber/DIFF probe

2. Press the pinch valve of Valve 12 with the fingers of one hand, and pull the plastic syringe in step 1 with the other hand, to absorb the probe solution into flow chamber. If the absorption resistance is high, the plastic syringe shall be pulled with hand to hold for a certain time, and release to enter into the probe cleanser stage after the level of the diluted probe cleanser in small sample cup is observed to drop.

NOTE

When pushing the syringe, the pinch valve must be pressed tightly by hand; otherwise the cleaning effects cannot be reached.

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3. After soaking it for five minutes or so, restore the original tubing.
4. Click the error message area, and then click **Remove Error** in the pop-up dialog box to see if the problem has been resolved. If the problem persists, keep taking the aforementioned steps until the problem has been resolved.

2.2.12.5 Aperture Clogging of the RBC Channel

Aperture clogging can be resolved by implementing the procedure for cleaning the RBC bath. The procedures are shown as below:

1. Go to **Service** > **Maintenance** > **Clean** and click the **Clean RBC bath** button.
2. Go to the **Service** > **Maintenance** > **Maintain** screen, and click the **Zap Apertures** button.
3. After you are done, click the error message area, and then click **Remove Error** in the pop-up dialog box to see if the clogging problem is resolved.

If clogging persists, the probe cleanser needs to be manually pushed through to clean the RBC-channel aperture, and the following steps should be taken:

4. Empty the RBC bath.

   There are two ways of emptying the RBC bath:

   - Go to the **Service** > **Maintenance** > **Maintain** screen, click the **Empty RBC Bath** button (note that a prompt box will pop up for confirmation after draining; do not press the **OK** button, otherwise the RBC bath will be refilled with liquid).
   - The liquid can also be aspirated dry manually using a plastic syringe or other tools.

5. Pull out the tubing connected to the RBC outflow tube and connect the plastic syringe filled with the diluted probe cleanser (with a ratio of probe cleanser to diluent of 1:3) to the RBC outflow tube (as shown in Figure 2-28). Pushing the plastic syringe back and forth will facilitate the repeated flushing of the aperture with the probe cleanser.

Figure 2-28 Cleaning the RBC-bath aperture

Apply proper force while pushing to prevent the tube from dropping and spilling (you can hold the tube with your hand to keep it in place).

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6. Flush back and forth ten times, and then let it settle for 3 minutes. Afterward, flush it three more times with a syringe containing the pure diluent using the aforementioned method.
7. After the diluent cleaning, drain the liquid inside the WBC bath and reconnect the original tubing. (To drain the RBC bath by interface operation, click the **OK** button in the prompt confirmation box after draining.)
8. Click the error message area, and then click **Remove Error** in the pop-up dialog box to see if the clogging problem is resolved.
9. If aperture clogging persists, redo the above procedures until the problem has been resolved.

2.2.12.6 Overflowing of the WBC Bath

First wipe off the liquid with tissue paper, and perform the following troubleshooting steps:

1. Check if the liquid pump is clogged.

   Follow the steps specified in ***2.2.12.3 Liquid Pump Clogging: Inspection and Troubleshooting*** to inspect and resolve any clogging of the liquid pump. After troubleshooting, run the CBC+DIFF counting procedure to see if the problem has been resolved.

   If the problem has been resolved, end the procedure; if the problem persists, continue to perform the following steps:

2. Check if Valve 14 is clogged.

   Follow the steps specified in ***2.2.12.2 Inspection and Troubleshooting of Valve Clogging*** to inspect and resolve any clogging of Valve 14. After the troubleshooting, run the whole-blood counting procedures to see if the problem has been resolved.

   If the problem has been resolved, end the procedure; if the problem persists, continue to perform the following steps:

3. Check if there are any kinks or damage along the tubing, as highlighted in red in the picture below, and replace the corresponding tubing if the problem persists. After the troubleshooting, run the whole-blood counting to see if the problem has been resolved.

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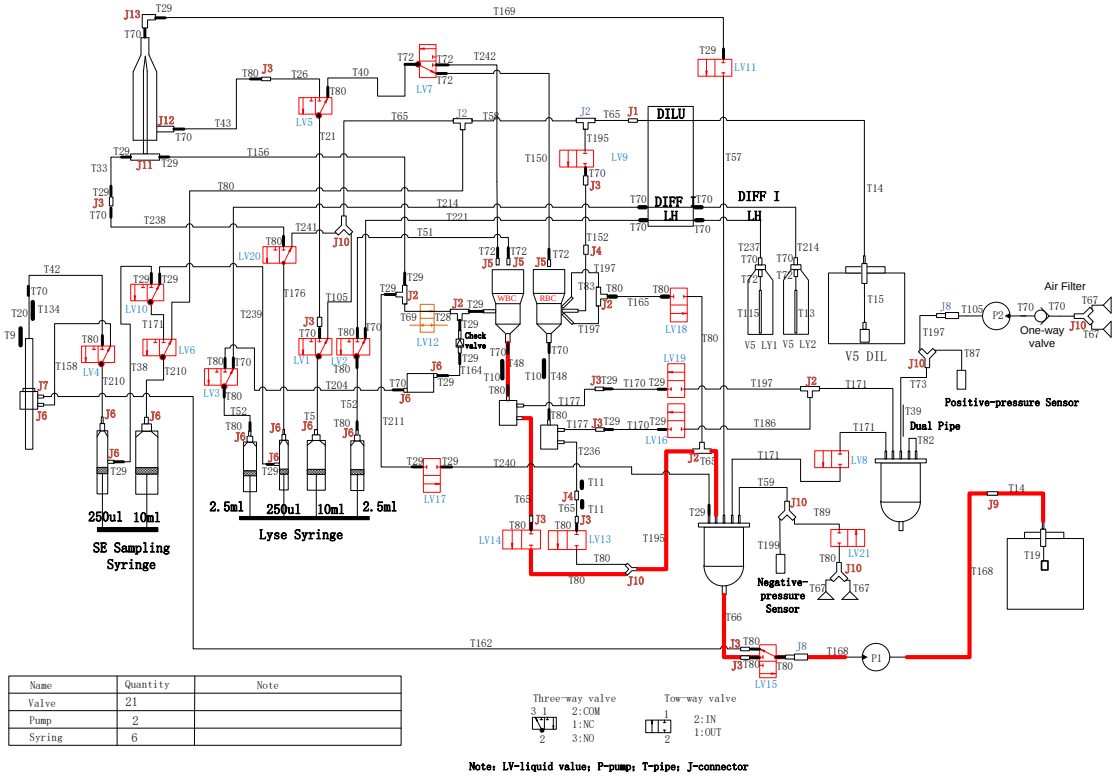
Figure 2-29 WBC tubing for fluid discharge



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

If the problem has been resolved, end the procedure; if the problem persists, continue to perform the following steps:

4. Check whether or not the isolation chamber is airtight.
   a. Empty the WBC bath. There are two ways of emptying the WBC bath:

      Method I: Go to the **Service** > **Maintenance** > **Maintain** screen, click the **Empty WBC Bath** button (note that a prompt box will pop up for confirmation after draining; do not press the **OK** button, otherwise the WBC bath will be refilled with liquid).

      Method II: the liquid can be aspirated dry manually using a plastic syringe or other tools.

   b. Disassemble the isolation chamber below the WBC bath and pull out the corresponding tubing. Use the thick No. 50 tube or 1.6mm (i.d.) silicone tube to attach the two connectors to the side of the isolation chamber, plugging both apertures. Then attach the plastic syringe to the connector above the isolation chamber using a 1.6mm (i.d.) silicone tube. Push the plastic syringe to pressurise the isolation chamber, and hold the syringe steady for 30 seconds to check for any appearance of air bubbles. If any air bubbles occur, the isolation chamber needs to be replaced. See Figure 2-30.

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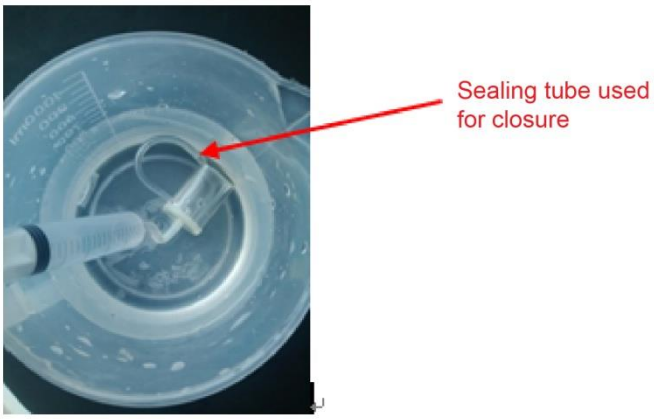
Figure 2-30 Checking whether or not the isolation chamber is airtight



5. After inspection, the components and tubing need to be restored to their original locations. Click the **OK** button in the confirmation box that pops up after the counting bath is drained by opening the user interface.

NOTE

If the liquid level in the WBC bath is found to be too high, immediately shut down the device to prevent any further overflowing.

2.2.12.7 Overflowing of the RBC Bath

The troubleshooting procedure is the same as that in ***2.2.12.6 Overflowing of the WBC Bath***; the only difference is that valve to be inspected is Valve 13. The tubing for inspection is shown in the picture below, and the isolation chamber to be inspected is the one below the RBC bath.

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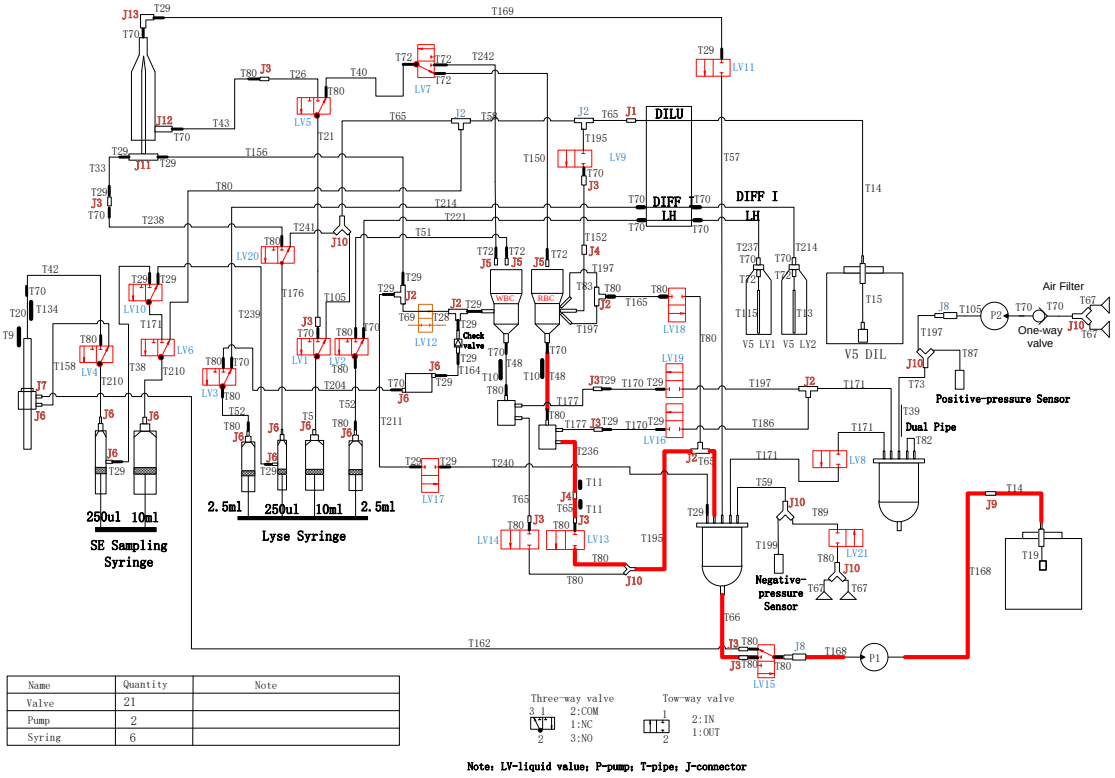
Figure 2-31 RBC tubing of liquid discharge



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

2.2.12.8 Leakage from the Swab

First wipe off any liquid with tissue paper, and then perform the following troubleshooting steps:

1. Check if the liquid pump is clogged.

   Follow the steps specified in ***2.2.12.3 Liquid Pump Clogging: Inspection and Troubleshooting*** to inspect and resolve any clogging of the liquid pump. After the troubleshooting, run the whole-blood counting procedures to see if the problem has been resolved.

2. Check if Valve 17 is working normally.

   Follow the steps specified in ***2.2.12.2 Inspection and Troubleshooting of Valve Clogging*** to inspect and resolve any clogging of Valve 17. After the troubleshooting, run the CBC+DIFF counting procedures to see if the problem has been resolved.

   If the problem has been resolved, end the procedure; if the problem persists, continue to perform the following steps:

3. Check if there are any kinks or damage along the tubing.

   Check if there are any kinks or damage along the tubing, as highlighted in red in the picture below, and replace the corresponding tubing if the problem persists. After the troubleshooting, run the whole-blood counting to see if the problem has been resolved.

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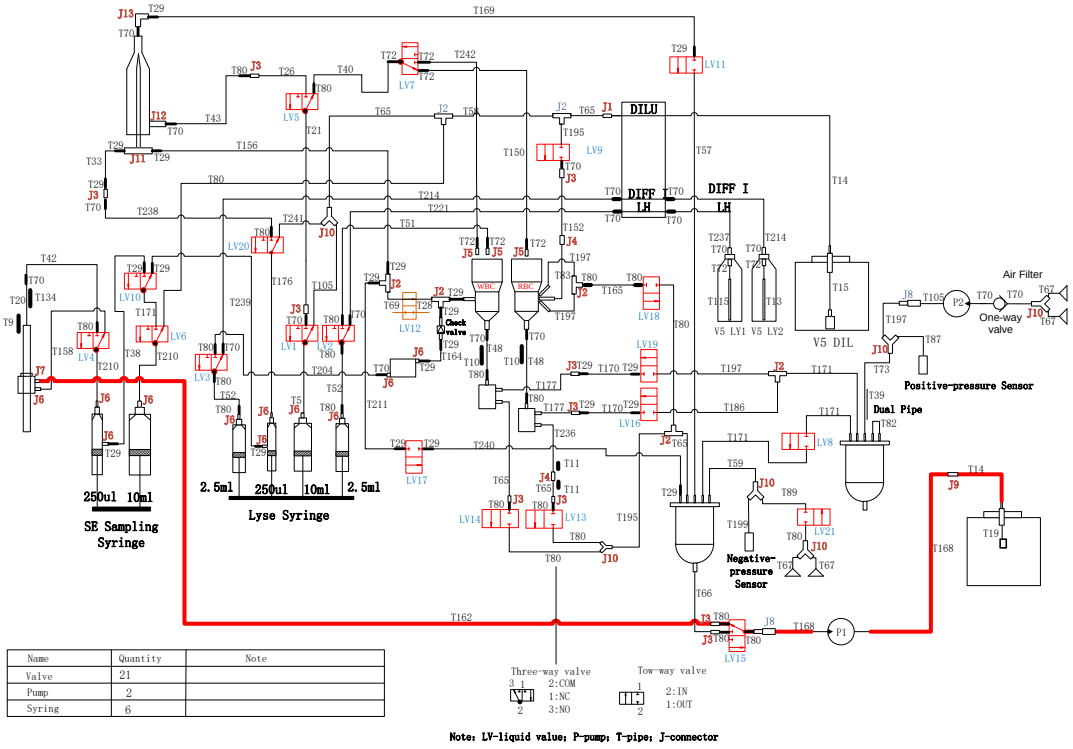
Figure 2-32 Swab tubing for fluid aspiration



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

If the problem has been resolved, end the procedure; if the problem persists, continue to perform the following steps:

4. Check if there is perforation at the bottom of the sample probe.
   a. Set the small sample cup below the probe. When pulling out the tube above the probe (push the tube end outward to pull it out; otherwise there will be crimping in the sampling tube connected to the end of the probe), disassemble the probe, and connect it to the plastic syringe filled with the diluent using a 1.6mm (i.d.) silicone tube. Manually push the syringe to see if any liquid flows from the bottom end of the probe. If such a flow is detected, this indicates that perforation exists at the bottom of the probe (the liquid normally flows from the sides. Be sure to collect the waste when pushing the liquid to the correct location, as shown in the picture below).

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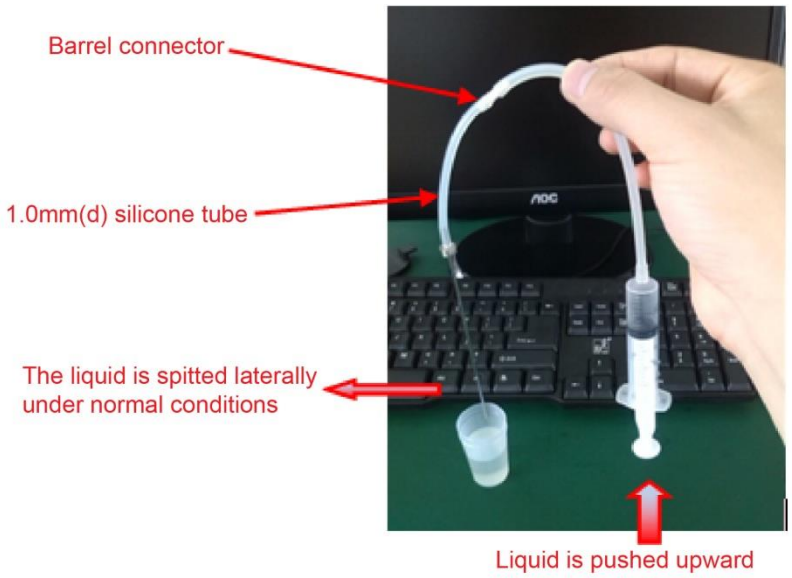
Figure 2-33 Check the liquid pushing of the sample probe



b. Restore the tubing to its original status (cut off the crimped part at the front end of the sampling tube, and readjust the tubing for installation. Make sure to check if the sampling tubing gets into the way of other assemblies whenever the sampling assembly moves up and down, or if it feels too tight. If this is the case, continue to adjust the sampling tubing until it looks like it fits properly.)

5. Check for any wear and tear in the top aperture of the swab.
   a. To disassemble, take off the swab's fixed jump ring. Pull out the swab's inflow and outflow tubes.
   b. Measure the upper-section aperture with a caliper; an aperture with a diameter of more than 1.71mm indicates that the swab needs to be replaced.
   c. When reinstalling or replacing the swab, first put the inflow tube and outflow tube in place, then put on the swab (insert the probe into the swab aperture) and tap the swab's fixed jump ring to complete the procedure.

NOTE

The inflow tube is the Thin 50 tube, connected to the bottom connector; the outflow tube is the Thick 50 tube, connected to the top connector.

2.2.12.9 Problems with Creating Positive Pressure

The troubleshooting steps are:

1. Check if the pressure chamber is broken: Disassemble the pressure chamber if necessary and seal the openings with rubber tubes. Then place the pressure chamber into the water tank. Use a syringe or other equipment to pressurise the pressure chamber. Any air bubbles detected indicate that the pressure chamber needs to be replaced.
2. Check if there are any kinks or damage along the tubing to the pressure chamber. Any replacements should be made using tubing of the proper length and type.

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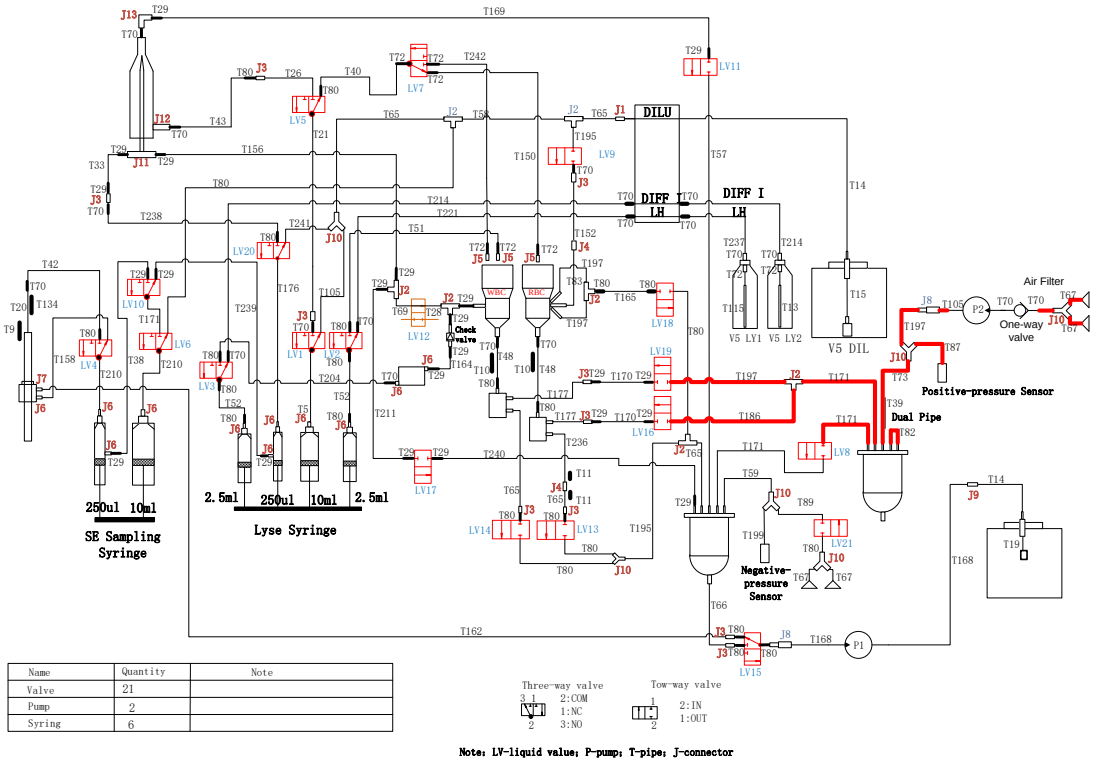
Figure 2-34 Tubing of the positive-pressure chamber



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

3. Check if the pump is working; if not, replace the pump.
4. Check if the positive-pressure sensor and the corresponding electrical circuit are in normal working order. First replace a reagent testing panel and reconnect its tubing, then check if the positive pressure is normal in the status interface; if it is normal after the replacement, this means that the positive-pressure sensor and the corresponding electrical circuit are causing a problem with building positive pressure (After the reagent testing panel is replaced, note that the tubing needs to be connected correctly. First keep a record of where it was by marking it before disassembling the tubing).
5. Check the valve directly connected to the tubing of the positive-pressure chamber to see 1) whether the on-off switch is normal; and 2) whether there is any clogging.
6. After troubleshooting, complete the steps shown in the **Remove Error** wizard.

2.2.12.10 Problems in Creating the Negative Pressure

The troubleshooting steps are as follows:

1. Check if the negative-pressure chamber is broken: Disassemble the negative-pressure chamber if necessary and seal the openings with rubber tubes. Then put the negative-pressure chamber into the water tank. Use a syringe or other equipment to pressurise the negative-pressure chamber. Any air bubbles that occur indicate that the negative-pressure chamber needs to be replaced.
2. Check if there are any kinks or damage along the tubing connected to the negative-pressure chamber. Any replacements should be made using tubing of the proper length and type.

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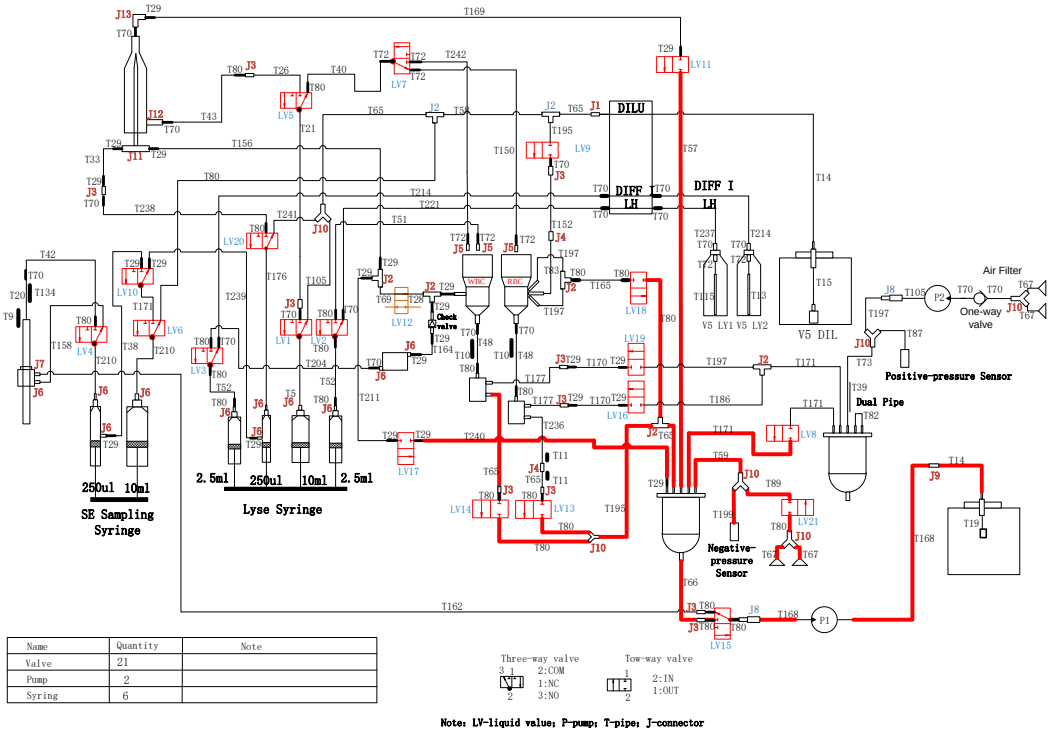
Figure 2-35 Tubing of the negative-pressure chamber



Name	Quantity	Note
Valve	21	
Pump	2	
Syring	6	

3. Check if Liquid Pump P1 is working; if not, replace the pump.
4. Check if the negative pressure sensor and the corresponding electrical circuit are in normal working order. First replace a reagent testing panel and reconnect its tubing; then check if the negative pressure is normal in status interface. If it is normal after the replacement, this means that the negative-pressure sensor and the corresponding electrical circuit have caused a problem with building negative pressure (After the reagent testing panel is replaced, note that the tubing needs to be connected correctly. First keep a record of where it was by marking it before disassembling the tubing).
5. Check the valve directly connected to tubing of the negative-pressure chamber to see 1) whether the on-off switch is normal; and 2) whether there is any clogging.
6. After troubleshooting, complete the steps shown in the **Remove Error** wizard.

2.2.12.11 No Scattergram

Troubleshooting steps are as follows:

1. Check if the two tubes are connected correctly in pinch valve LV12. First confirm that they are correctly positioned; then determine whether both soft tubes are tucked into the bottom of the tank (as shown in Figure 2-36). (Note that the position of tubes marked in red in the following figure shall not be installed reversely.)

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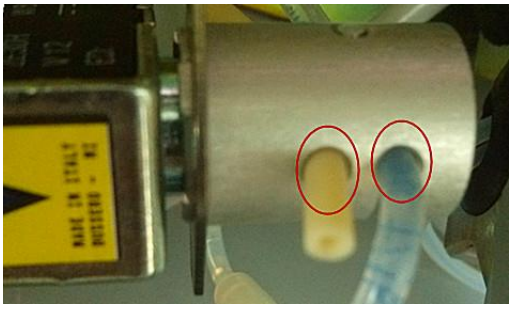
Figure 2-36 Tubing connection of pinch valve



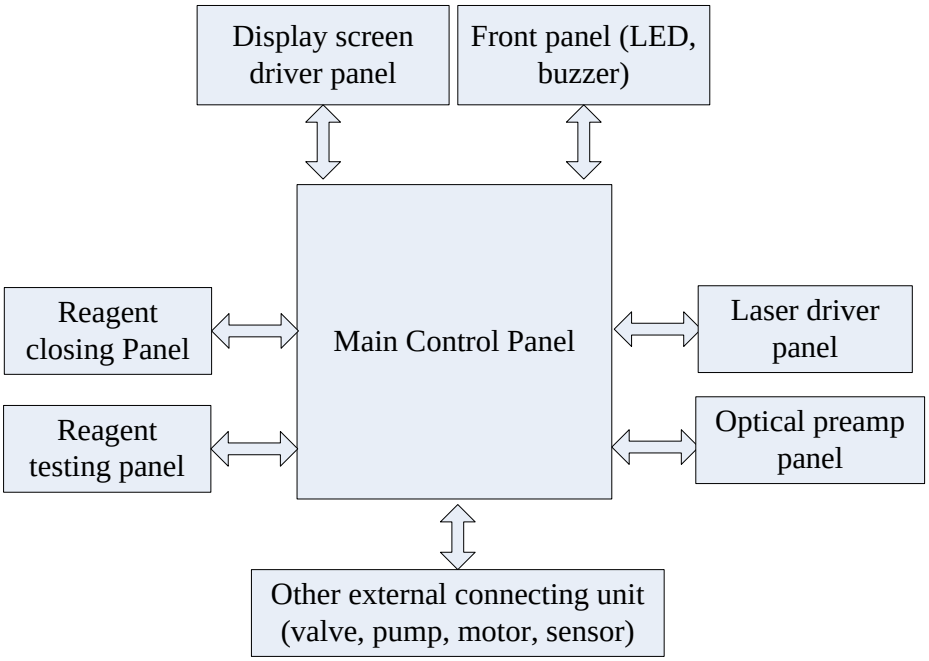
2. If the problem persists after the inspection, please check if the optical system is working properly.

   For the common problems of the optical system and their solutions, see ***2.4.6 Common Problems and Solutions***.

2.3 Hardware System

The hardware system of the InSight V5 Haematology Analyser consists of the main control panel, reagent testing panel, laser driver panel, optical preamplifier panel, front panel, reagent sealing panel, etc. and its block diagram is shown in Figure 2-37.

Figure 2-37 Block Diagram of Hardware System



Hardware maintenance principles apply to all the panels. All the panels have passed hardware tests before leaving the factory, and any hardware problem found later may be mainly caused by power problems. Thus, hardware maintenance primarily involves the power supply. Hardware problems and maintenance methods for each panel are described in the subsequent sections.

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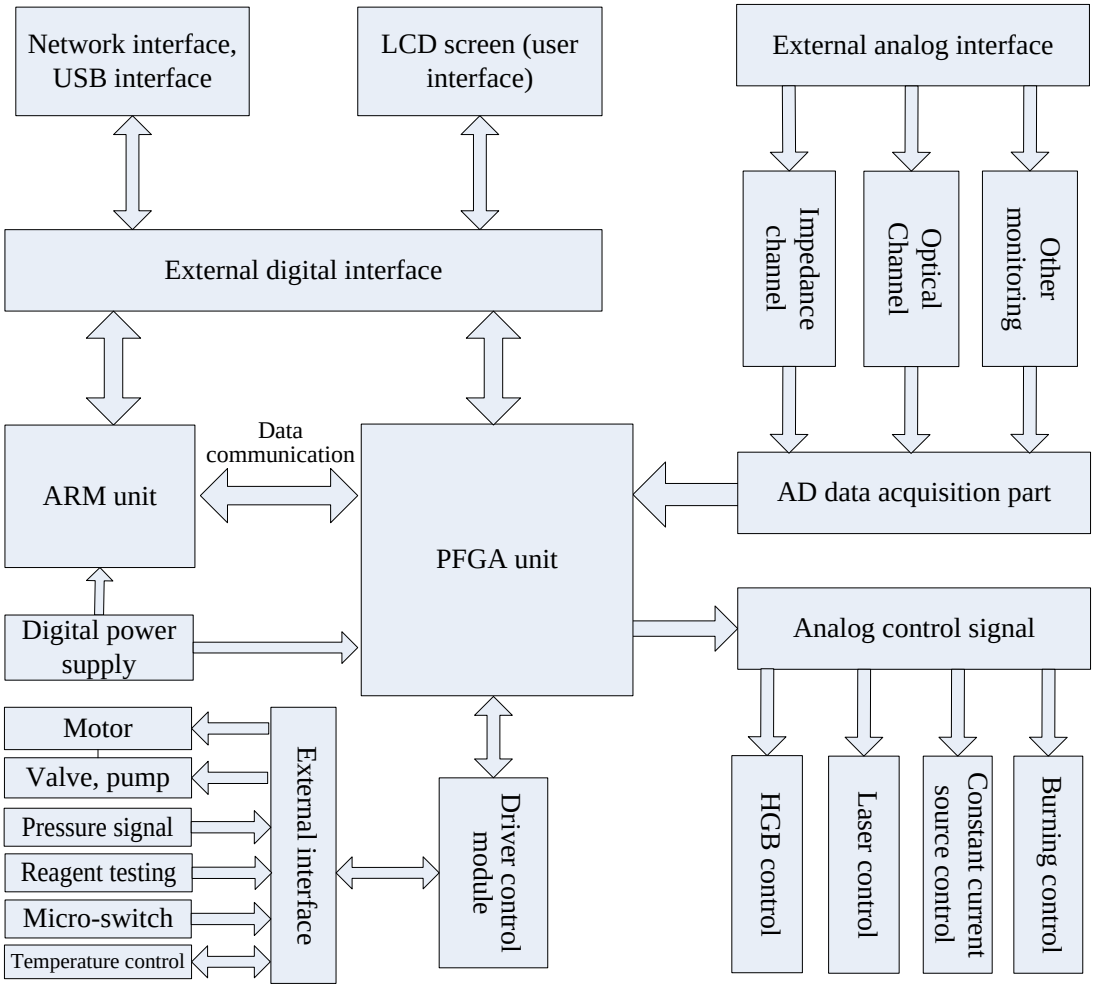
2.3.1 Main Control Panel

The main control panel is the core panel of the InSight V5 Haematology Analyser; the device cannot work properly with a problematic main control panel. This section introduces the main control panel from the perspectives of composition, problem identification, and maintenance.

2.3.1.1 Composition of the Main Control Panel

The block diagram of main control panel functions is shown in Figure 2-38.

Figure 2-38 Block Diagram of Main Control Panel Functions



The block diagram above gives a brief overview of the composition of main control panel and the function of each module. Further description can be found below based on the pictures for each panel. Picture of main control panel is shown in Figure 2-39.

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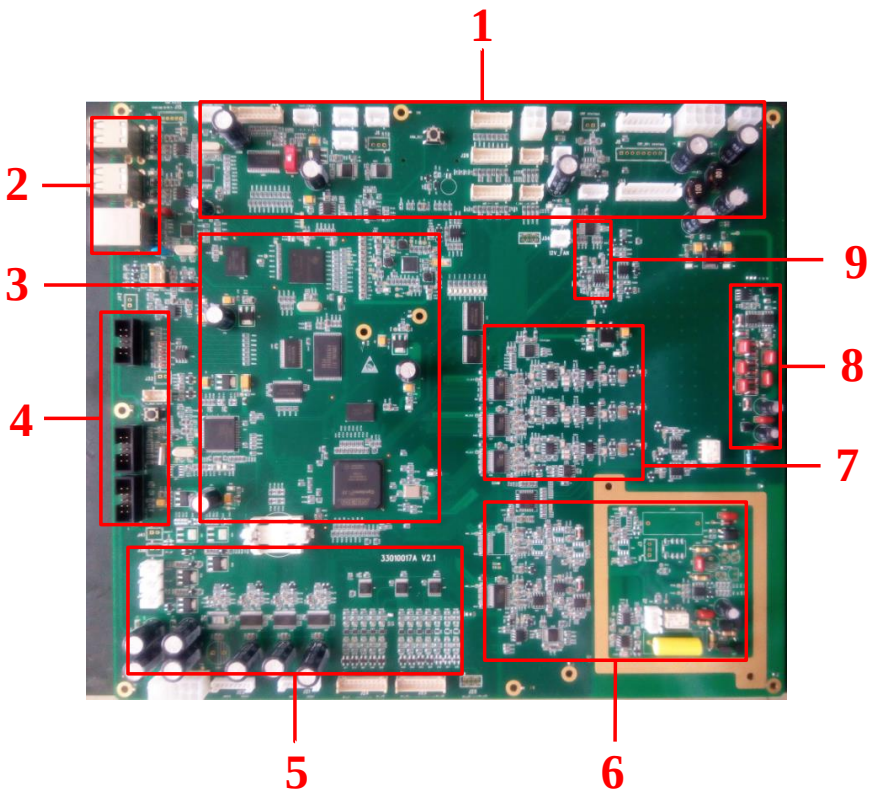
Figure 2-39 Main control panel



1 - External wiring interface	2 - Network interface and USB interface
3 - Digital circuit module	4 - Debugging interface
5 - Motor, pump valve and temperature-control module	6 - Analog impedance channel module
7 - Analog DIFF channel module	8 - Voltage-multiplying circuit module
9 - Analog HGB channel module	

The main control panel can be clearly divided into digital part, analog part and driver part. Among them:

- The left half of the panel is the digital part, including ARM unit, FPGA unit, external interface, debugging interface, power supply, etc.
- The right half of the panel is the analog part, including impedance channel, DIFF channel, hardware monitoring channel, external interface, power supply, etc.
- The lower left corner of the panel is the driver part, including motor driver, valve & pump driver, temperature control, etc.
- In the middle of the panel there are AD and interface chips, where AD is responsible for analog-to-digital conversion and the interface chip is responsible for on-off control for relevant functions of the analog part.

2.3.1.2 Peripheral Interface of the Main Control Panel

There are several interfaces on the main control panel, and the detailed interface description is

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shown in Table 2-1.

Table 2-1 Definition Table of External Interfaces on the Main Control Panel

No.	Tag No.	Description
1	J2	RBC analog signal interface
2	J21	Motor driver interface
3	J22	Motor driver interface
4	J23	Valve driver interface
5	J24	Valve driver interface
6	J17	Power supply input interface
7	J37	Pump driver interface
8	J39	Heating rod control interface
9	J40	Heating rod control interface
10	J7	MPU_JTAG interface
11	J12	FPGA_JTAG interface
12	J13	FPGA_AS interface
13	J31	Pressure sensor signal interface
14	J35	Front display panel interface
15	J43	Network interface
16	J46	USB interface
17	J47	USB interface
18	J14	Back-light panel interface
19	J44	Display screen data communication interface
20	J45	Touch screen data interface
21	J4	Serial port
22	J5	Serial port
23	J48	Printer interface
24	J26	Reagent testing signal interface
25	J27	Micro-switch signal interface
26	J28	Motor position optocoupler signal interface
27	J29	Motor position optocoupler signal interface

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No.	Tag No.	Description
28	J30	Temperature sensor interface
29	J18	5V power inlet
30	J19	5V power inlet
31	J20	5V power outlet
32	J49	5V power outlet
33	J50	12V power outlet
34	J11	HGB signal interface
35	J36	Laser drive panel interface
36	J33	Preamplifier panel signal interface
37	J10	±12V power inlet
38	J16	110V burning power input interface

NOTE

The debugging Interfaces designated for the main control panel are serial interface J7 (RS232 signals), FPGA JTAG interface J3, FPGA AS interface J4, and SD interface for programming before shipping. Use of these debugging Interfaces is restricted to developers only.

2.3.1.3 Power input and indicator lights on the Main Control Panel

Digital power input and indicator lights

Power input of the digital part is 5V, and it can be tested via testing point TP15 (multimeter shall be adopted for testing, and during the testing, the red probe shall be connected to TP15, while the black probe shall be connected to the metal part on the housing). The 5V power input is accompanied by the fuse F2. Normally the fuse will not be blown since the power supply of the device is equipped with surge protection. If a short circuit occurs under the input of 5V of power, the power supply will fail to work properly and a buzzing sound can be heard.

All digital power supplies of the main control panel are equipped with an indicator light and testing point, and corresponding relationships between the digital power supply, indicator light, and testing point is shown in the Table 2-2.

Table 2-2 Digital power indicator light

Position Code of Indicator Light	Meaning	Normal Status
D21	5V digital power supply	On
D17	3.3V digital power supply	On
D16	2.5V digital power supply	On

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Position Code of Indicator Light	Meaning	Normal Status
D15	1.8V digital power supply	On
D14	TPS65910 3.3V working status[1]	On

NOTE

1- D14 usually indicates the working status of the ARM power management chip, TPS65910A31A1, but this indicator light only indicates the working status of one LDO signal channel in TPS65910; the multimeter can be used to test the corresponding testing points for other LDO and DC-DC channels. For details, see ***Digital Testing Points*** in the section of ***2.3.1.4 Testing Points on the Main Control Panel***.

Analog power input and indicator lights

The analog power input of +12V and -12V on the main control panel can be tested for actual voltage values via the testing points TP21 and TP22. The +12V power input is accompanied by the fuse F4, while -12V is accompanied by the fuse F5. Like the 5V digital power input, +12V and -12V derive power from the device's power supply; if both are subject to overload, they will receive surge protection from the power source and the corresponding indicator lights will not be activated.

Table 2-3 lists the analog power indicator lights:

Table 2-3 Analog power indicator light

Position Code of Indicator Light	Meaning	Normal Status
D18	+12V power indicator light	On
D19	-12V power indicator light	On
D23	-5V power indicator light	On
D25	+5V power indicator light	On

NOTE

+5V and -5V originate from the linear stabiliser. The corresponding lights will not be activated by the +5V or -5V overload, and the linear stabiliser will be very hot. If either the +5V or the -5V power indicator light is not on, immediately power off the device and troubleshoot the corresponding electrical circuits. We recommend replacing the main control panel.

Other indicator lights on the main control panel

The ARM and FPGA units are each assigned a single indicator light to show their working status on the main control panel. In addition, a USB0 power indicator light is designated for the ARM unit.

Table 2-4 lists the indicator lights.

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Table 2-4 Other indicator lights on the main control panel

Position Code of Indicator Light	Meaning	Normal Status
D79	It indicates the ARM working status and flashes after proper system loading.	Flashing
D90	It indicates the FPGA working status and flashes after proper system loading.	Flashing
D52	It indicates the MPU working status and flashes after proper system loading.	Flashing

Indicator lights are very useful in practice; hardware problems can be identified by the status of the indicator lights. For details, see ***2.3.1.5 Identification of Main Control Panel Problems***.

2.3.1.4 Testing Points on the Main Control Panel

There are two types of testing points on the main control panel: Digital and analog.

Digital testing points

The digital testing points on the main control panel listed here are commonly used ones, in particular for power supply and key signals.

Table 2-5 Digital testing point on the main control panel

Position Code of Testing Points	Description
TP15	The testing point for 5V digital input, with the expected voltage of 5V
TP9	TPS65910 VRTC output, with the expected voltage of 1.8V
TP61	DDR3 reference voltage, with the expected value of 0.75V
TP7	TPS65910 VDIG1 output, with the expected value of 1.8V
TP8	TPS65910 VDIG2 output, with the expected value of 1.8V
TP6	TPS65910 VAUX33 output, with the expected value of 3.3V
TP5	TPS65910 VMMC output, with the expected value of 3.3V
TP3	TPS65910 VAUX2 output, with the expected value of 3.3V
TP4	TPS65910 VAUX1 output, with the expected value of 1.8V
TP1	TPS65910 VDAC output, with the expected value of 1.8V
TP2	TPS65910 VPLL output, with the expected value of 1.8V
TP20	The testing point for 3.3V digital power supply, with the expected voltage of 3.3V
TP19	The testing point for 2.5V digital power supply, with the expected voltage of 2.5V

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Position Code of Testing Points	Description
TP17	The testing point for 1.2V digital power supply, with the expected voltage of 1.2V
TP18	The testing point for 1.8V digital power supply, with the expected voltage of 1.8V
LS_CLK	DIFF low-angle AD clock,4MHz clock signal
MS_CLK	DIFF medium-angle AD clock, 4MHz clock signal
HS_CLK	DIFF high-angle AD clock, 4MHz clock signal
WBC_CLK	WBC-channel AD clock, 1MHz clock signal
RBC_CLK	RBC-channel AD clock, 1MHz clock signal

Analog testing points

The following table lists the analog testing points.

Table 2-6 Analog testing point on the main control panel

Position Code of Testing Points	Description
TP5	AVCC_+5V testing point, with the expected voltage of 5V
TP21	AVCC_+12V testing point, with the expected voltage of +12V
TP22	AVCC_-12V testing point, with the expected voltage of -12V
TP25	AVCC_-5V testing point, with the expected voltage of -5V
TP58	HGB_LED_CTL testing point, HGB light-driven control switch; 0 for on and 1 for off
TP47	WBC channel first-level OPAMP output testing point
TP46	WBC channel third-level OPAMP output testing point
TP43	WBC channel fourth-level OPAMP output testing point
TP44	WBC channel sixth-level OPAMP output testing point
TP45	WBC channel seventh-level OPAMP output testing point
WBC_AD	WBC-channel AD front-end testing point
TP39	RBC channel first-level OPAMP output testing point
TP40	RBC channel third-level OPAMP output testing point
TP38	RBC channel fourth-level OPAMP output testing point
TP41	RBC channel sixth-level OPAMP output testing point
TP42	RBC channel eighth-level OPAMP output testing point
RBC_AD	RBC-channel AD front-end testing point

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Position Code of Testing Points	Description
TP31	SELECT_WBC_CTL testing point, the switch control signal for WBC bath zap and CC source; 0 for zap and 1 for CC source
TP29	SELECT_RBC_CTL testing point, the switch control signal for RBC bath zap and CC source; 0 for zap and 1 for CC source
TP53	VCONST_MON_AD testing point, 1.36V±0.2V
TP28	RH_MON testing point, 1.9V±0.2V
TP30	WH_MON testing point, 1.7±0.2V
TP33	VCONST_CTL testing point, the switch control signal for CC source; 0 for on and 1 for off
LSIN	The testing point for DIFF low-angle signal input
LS_AD	DIFF low-angle AD front-end testing point
MSIN	The testing point for DIFF medium-angle signal input
MS_AD	DIFF medium-angle AD front-end testing point
HSIN	The testing point for DIFF high-angle signal input
HS_AD	DIFF high-angle AD front-end testing point
HGB_AD	HGB-channel AD front-end testing point
TP37	LASER_MON_AD testing point, reflecting the laser current
TP36	AVCC_+12VMON_AD testing point, reflecting the voltage of AVCC_+12V power source
TP35	AVCC_-12VMON_AD testing point, reflecting the voltage of AVCC_+12V power source

2.3.1.5 Identification of Main Control Panel Problems

Problems with the main control panel can be categorised as power problems, connection problems, and functional problems. Power problems can be identified using the status of power indicator lights, and connection problems can be identified by way of direct observation. However, functional problems are a little tricky, and can be indirectly shown using other indicators.

Power Problems of the Main Control Panel and their Indicators

The power supply of the main control panel is clearly divided between digital and analog. Where,

- A digital power input of 5V is realised by the upper middle J18, J19 interfaces on the main control panel, as shown in Figure 2-40.

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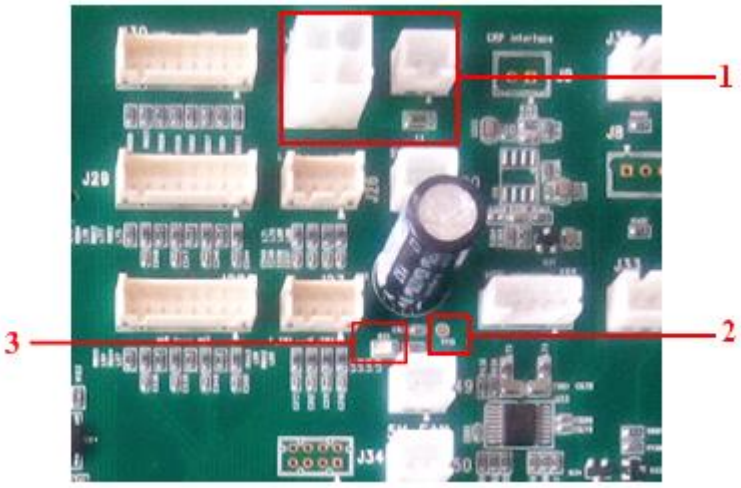
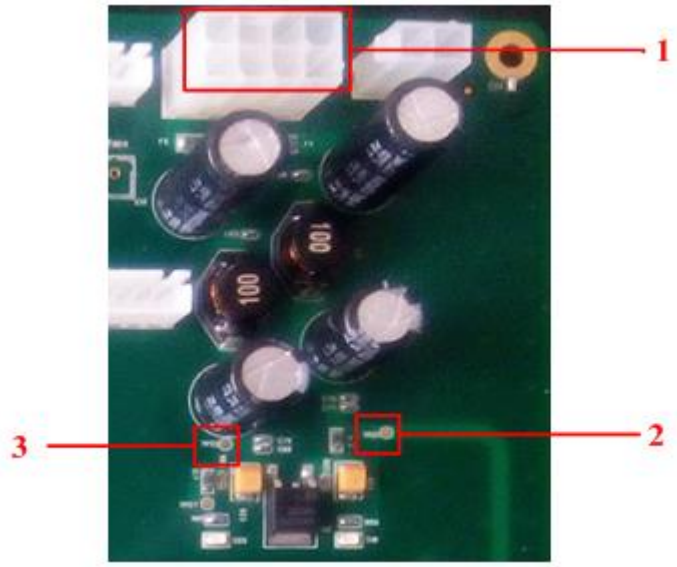
Figure 2-40 Digital power input, testing point and indicator light



1 - 5V power inlet	2 - testing point for 5V power supply
3 - 5V power indicator light	

- An analog power input of +12V and -12V is enabled by the upper right J10 interface on the main control panel, as shown in Figure 2-41.

Figure 2-41 Analog power input



1 - ±12V power inlet	2 - +12V testing point
3 - -12V testing point	

- A power input of 12V and 24V is enabled by the lower left J17 interface on the main control panel, as shown in the figure below.

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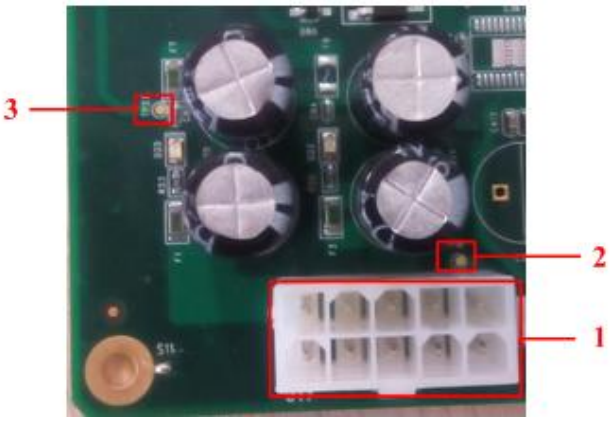


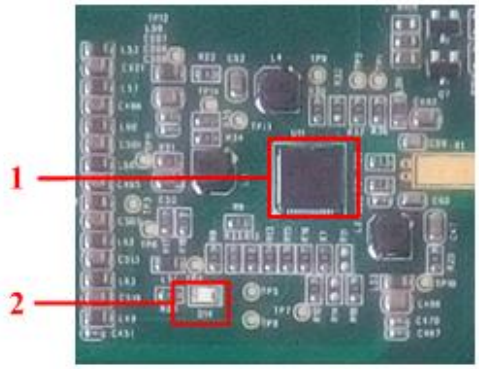
1 - 12V and 24V power input interface	2 - 24V testing point
3 - 12V testing point	

All power inputs on the main control panel derive from the power input of the device. If either of the power inputs on the main control panel receives a surge from a grounded or any other input power source, the device's power supply will activate its automatic protection mechanism and produce a buzzing sound.

For the normal status of power indicator lights shown in the figures above, please refer to the descriptions of the power supply and indicator lights of the main control panel in ***2.3.1.1 Composition of the Main Control Panel***. If the power indicator light is in a status different from normal, this means that the power supply is not working properly.

U11 deserves further description as follows. U11 is the ARM power management chip in the digital section of the main control panel. The working status of this chip determines the working status of the main control panel. As shown in Figure 2-42, D14 turned on indicates the proper working of U11.

Figure 2-42 ARM power management chip in the main control panel



1 - Power management chip U11	2 - U11 working indicator

Functional Problems with the Main Control Panel and their Indicators

Functional problems with the main control panel are typically related to one of two causes. One cause may be that the counting function of the main control panel cannot be realised. For example, the digital part's operating system on the main control panel is not operational, the FPGA program does not load, or there is abnormal counting. The other cause refers to control failure of the motor, valve-pump, temperature control, etc.

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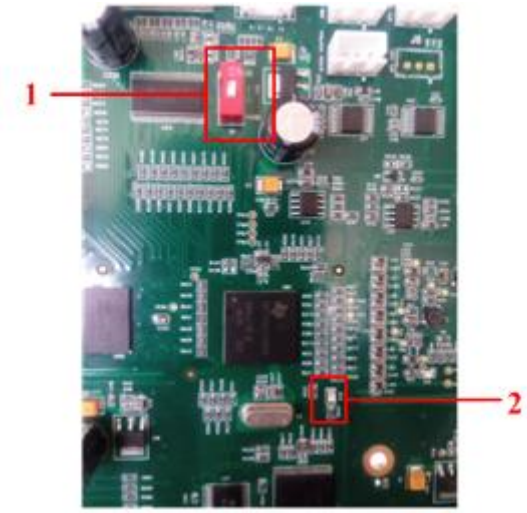
- ARM OS on the main control panel fails to boot

  The ARM on the main control panel boots from NAND using its default factory setting, so the booting media selection switch S6 should be turned to NAND (i.e. OFF state for DIP switches), as shown in Figure 2-43.

Figure 2-43 ARM booting and running



1 - DIP switch status	2 - ARM normal working indicator light D79

When the ARM OS is booted properly, the working-status indicator light D79 will flash on the main control panel. If D79 is not lit up, it means that the ARM OS has failed to boot.

- MPU program loading fails

  When the MPU program is booted properly, the working-status indicator light D52 will flash on the main control panel. If D52 is not lit up, it means that the MPU program has failed to boot. The location of D52 is shown below.

Figure 2-44 Location of D52

1 - MPU status indicator light	

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- Loading problems with the FPGA program

  The FPGA program is loaded from the serial port FLASH. A successful loading of the FPGA will cause the indicator light D90 to flash. If D90 is not lit up, it means that FPGA program has not loaded. The location of D90 is shown in Figure 2-45.

Figure 2-45 Indicator of FPGA working status

1 - FPGA status indicator light	

- Counting abnormalities

  There are many causes that lead to counting abnormalities, and they can include problems with main control panel problem. Counting abnormalities caused by main control panel problems usually involve counting results of zero or overly high counting results on multiple occasions. A counting result of zero usually results from a failure to apply the CC source to the counting bath, while an overly high counting result is usually caused by too much noise in the analog-channel circuit.

2.3.1.6 Maintenance of the Main Control Panel

The maintenance of the main control panel mostly deals with problems not related to connections. In theory, only designated maintenance professionals are allowed to perform the maintenance steps for the main control panel. Please replace the main control panel if any non-connection problems occur.

This section will introduce the location of fault of the main control panel, as well as common faults and solutions in repairing the main control panel. The instructions above only apply to designated maintenance professionals.

Locating Main Control Panel Problems

Successful troubleshooting is a precondition of maintenance. Main control panel problems mostly involve the power supply. As for functional problems, there is no real value in maintenance and the main control panel should therefore be replaced at your earliest convenience.

There are four steps in locating power-related problems:

1. Look. Power on the panel and pay attention to the power indicator lights. If any abnormality is spotted, then there is something wrong with the loading of the indicator light's corresponding power source. Light abnormality here refers to situations in which a light is off or dimmer than normal.

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2. Smell. Power problems may burn out some components; an acrid smell can suggest a burnout. Do not power on in this case.
3. Touch. Power on and touch the corresponding component on the main control panel by hand. If the temperature feels abnormal, the component could be broken.
4. Test. The first three steps can be used to identify power overload problems on the main control panel. Step 4 is designed for determining what has malfunctioned. Testing can also identify the problem of circuit breakage. This step is also part of maintenance. A multimeter is used to test for power problems.

Common Problems Found in Main Control Panel Maintenance and their Indicators

See the following table for details.

Problem Description	Problem Indicators	Solution
Analogy power input of -12V is not loaded, and the device power supply is switched into auto protection mode when powered on.	The power indicator light D19 is not activated.	This issue is mostly caused by the fact that the analog power input of -12V has shorted out. Another possible reason is the breakdown of the polar capacitors (mostly tantalum capacitors here). Due to the abundance of -12V networks, users are recommended to replace the motherboard. The damaged components can be located by PCB for replacement by qualified maintenance personnel.
Analogy power input of +12V is not loaded, and the device power supply is switched into auto protection mode when powered on.	The power indicator light D18 is not activated.	This issue is mostly caused by the fact that the analog power input of +12V has shorted out. Another possible reason is the breakdown of the polar capacitors (mostly tantalum capacitors here). Due to the abundance of +12V networks, users are recommended to replace the motherboard. The damaged components can be located by PCB for replacement by qualified maintenance personnel.

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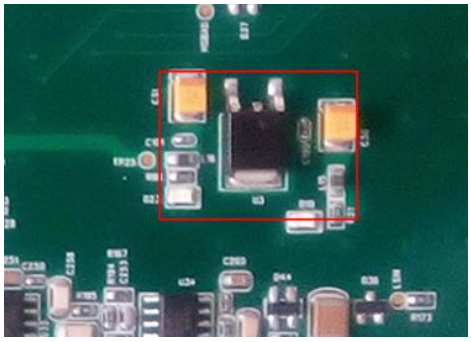
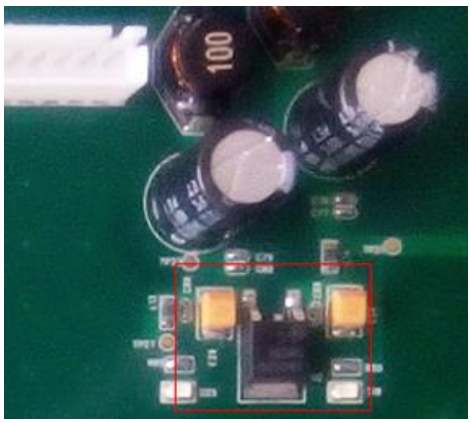
Problem Description	Problem Indicators	Solution
Analogy power input of -5V is not loaded	The power indicator light D23 is not lit up or looks dim, and the power chip U3 feels very hot. 	This issue is mostly caused by the fact that the analog power input of -5V has shorted out. Another possible reason is the breakdown of the polar capacitors (mostly tantalum capacitors here). Due to the abundance of -5V networks, users are recommended to replace the motherboard. The damaged components can be located by PCB for replacement by qualified maintenance personnel.
Analogy power input of +5V is not loaded	The power indicator light D25 is not lit up or looks dim, and the power chip U2 feels very hot. 	This issue is mostly caused by the fact that the analog power input of +5V has shorted out. Another possible reason is the breakdown of the polar capacitors (mostly tantalum capacitors here). Due to the abundance of +5V networks, users are recommended to replace the motherboard. The damaged components can be located by PCB for replacement by qualified maintenance personnel.
The ARM system on the main control panel is not running	The powered-on device fails to do self-test; the ARM status indicator light D79 is not flashing and the indicator light for ARM power management chip D14 is lit up.	The power management chip U11 may be damaged; it is recommended that a qualified maintenance person replace U11
The ARM system on the main control panel is not running	The powered-on device fails to do self-test; the ARM status indicator light D79 is not flashing and the indicator light for ARM power management chip D14 is on.	Some circuit in the power management chip U11 may have shorted out. Qualified maintenance personnel can use a multimeter to test the power output testing points throughout U11 to locate the problematic circuit. Start from the capacitor and move along until locating the short circuit.

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Problem Description	Problem Indicators	Solution
The ARM system on the main control panel is not running	The powered-on device fails to do self-test; the ARM status indicator light D79 is not flashing and the indicator light for ARM power management chip D14 is on. A multimeter is used to test the power management chip only to find that the power output is normal throughout the chip and the device lifetime can last for more than three years.	The boot media for the main control panel, NAND Flash U107, may be damaged; replace the main control panel as soon as possible.
The ARM system on the main control panel is not running	The powered-on device fails to do self-test; the ARM status indicator light D79 is not flashing and the indicator light for ARM power management chip D14 is on. A multimeter is used to test the power management chip only to find that the power output is normal throughout the chip and the ARM chip U50 feels hot.	The ARM of the main control panel is damaged; replace the main control panel immediately.
The FPGA program fails to load	The FPGA running status indicator light, D90, is not flashing, the FPGA 3.3V power indicator light D17 is in normal ON status, and so is the FPGA 2.5V power indicator light D16. The FPGA 1.8V power indicator light, D15, is in normal ON status; test the FPGA 1.2V with a multimeter and the voltage tested at TP17 is normal.	The FPGA on the main control panel is damaged; replace the main control panel immediately.
The FPGA program fails to load	The FPGA running status indicator light, D90, is not flashing, and the FPGA 3.3V power indicator light D17 is not lit up.	The FGPA 3.3V power circuit is problematic and the issue can be located by multimeter testing.
The FPGA program fails to load	The FPGA running status indicator light, D90, is not flashing, and the FPGA 2.5V power indicator light D16 is not lit up.	The FGPA 2.5V power circuit is problematic and the issue can be located by multimeter testing.
The FPGA program fails to load	The FPGA running status indicator light, D90, is not flashing, and the FPGA 1.8V power indicator light D15 is not lit up.	The FGPA 1.8V power circuit is problematic and the issue can be located by multimeter testing.
The FPGA program fails to load	FPGA running status indicator light, D90, is not flashing; test the FPGA 1.2V power with a multimeter, and the voltage tested at testing point TP17 is not 1.2V.	The FGPA 1.2V power circuit is problematic and the issue can be located by multimeter testing.
Liquid has been spilled onto the main control panel.	The main control panel is eroded.	Replace the main control panel

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Problem Description	Problem Indicators	Solution
The driver unit is not working properly.	The hydraulic tubes have collapsed.	Some valves' drivers may have malfunctioned; it is suggested that the panel be replaced as soon as possible. If the problem persists, check the driver path for valves, since this problem is usually caused by wiring issues or a broken valve.
The driver unit is not working properly.	The pump is not working.	First confirm the reliability of the connection between the driver panel and the rear panel. If the connection is reliable, then the pump may have a problematic driver; it is suggested that the panel be replaced right away. If the problem persists, check the driver path for pumps, since this problem is mostly caused by wiring issues or a broken pump.
The driver unit is not working properly.	The motor is not working.	First confirm the reliability of the connection between the driver panel and the rear panel. If the connection is reliable, then the motor may have a problematic driver; it is suggested that the panel be replaced right away. If the problem persists, check the driver path for motors, since this problem is mostly caused by wiring issues.
The driver unit is not working properly.	The driver panel has no heating.	Some heating systems may have a problematic driver; it is suggested that the panel be replaced right away. If the problem persists, check the driver path for heating, since this problem is mostly caused by wiring issues.

NOTE

Panel maintenance is time-consuming. In principle, panel maintenance is not performed on-site. If a panel problem is confirmed on-site, please replace the panel.

2.3.2 Other Panels

Except for the above-mentioned main control panel, other panels (including reagent testing panel, laser driver panel, optical preamplifier panel, reagent sealing panel, front display panel, LCD screen

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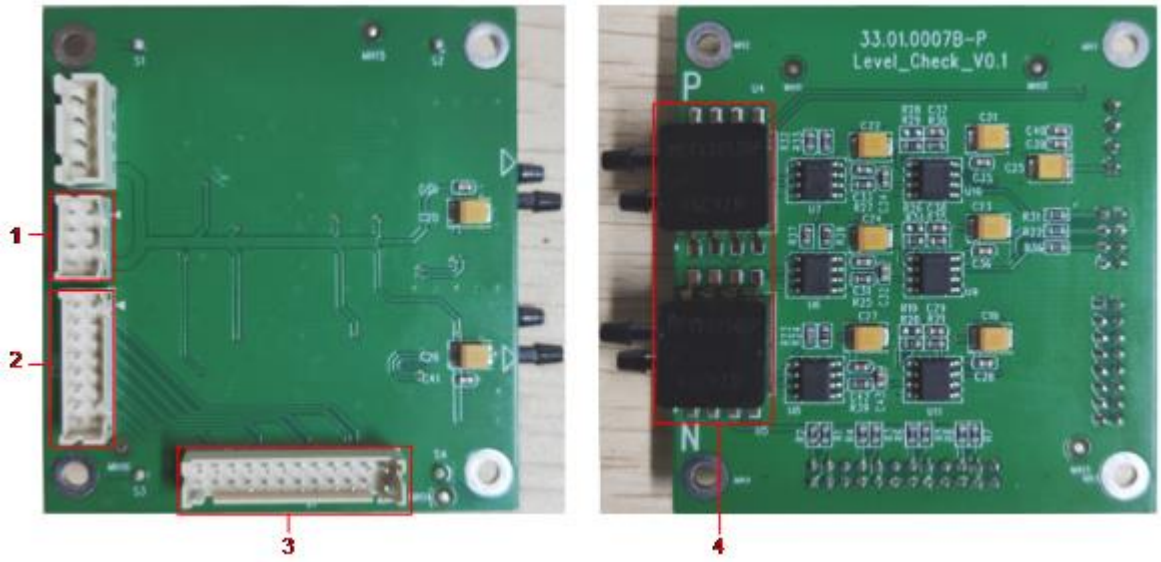
driver panel) will not be repaired in principle. If problems with any small panel are found on site, please replace it directly.

Functions of interfaces on other panels are briefly introduced below.

2.3.2.1 Reagent Testing Panel

Reagent testing panel is mainly responsible for testing whether or not there is reagent. Functions of interfaces on the reagent testing panel are shown in Figure 2-46.

Figure 2-46 Reagent testing panel

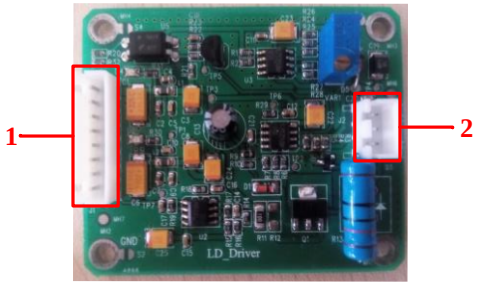


1 - Positive/negative pressure signal output interface	2 - Reagent testing result output interface
3 - Photocoupler signal collecting module interface	4 - Pressure signal collecting module interface

2.3.2.2 Laser Driver Panel

Functions of interfaces on the laser driver panel are shown in Figure 2-47.

Figure 2-47 Picture taken of the laser driver panel



1 - Power interface for connecting to main control panel	2 - Output interface of laser driver

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2.3.2.3 Optical Preamplifier Panel

In general, the optical preamplifier panel is classified into two small panels, one for LS, MS signal amplification panel, as shown in Figure 2-48; the other for HS signal amplification panel, as shown in Figure 2-49.

Figure 2-48 Physical picture of LS, MS Signal Amplifier Panel

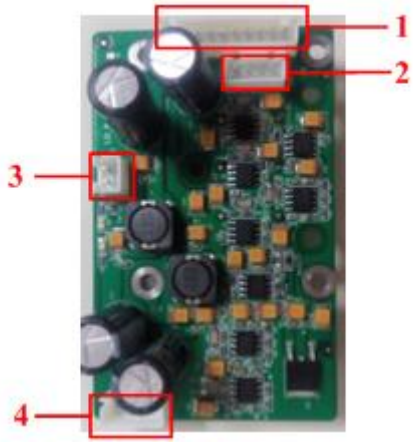
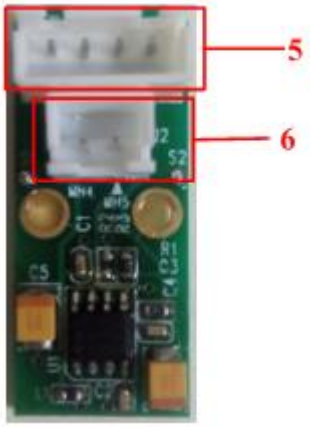


Figure 2-49 Physical picture of HS Signal Amplifier Panel

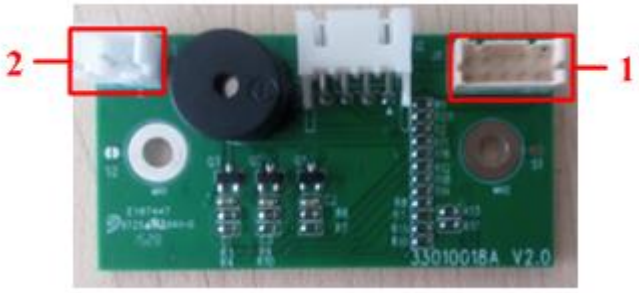


1 - Panel card power interface	2 - Signal testing interface
3 - HS signal input interface	4 - HS panel power outlet interface
5 - HS panel power inlet interface	6 - HS signal output interface

2.3.2.4 Front Panel

The front panel is mainly responsible for indicating the running status of the device, alarm notification and linking with the manual control of the sampling touch signal switch, as shown in Figure 2-50.

Figure 2-50 Picture of the front panel



1 - Control signal communication interface	2 - micro-switch interface

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2.4 Optical System

2.4.1 Integral Replacement of the Optical Assembly

Purpose

The optical assembly can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***Preliminary Steps*** need to be taken before you begin.

Tools/Spare Parts

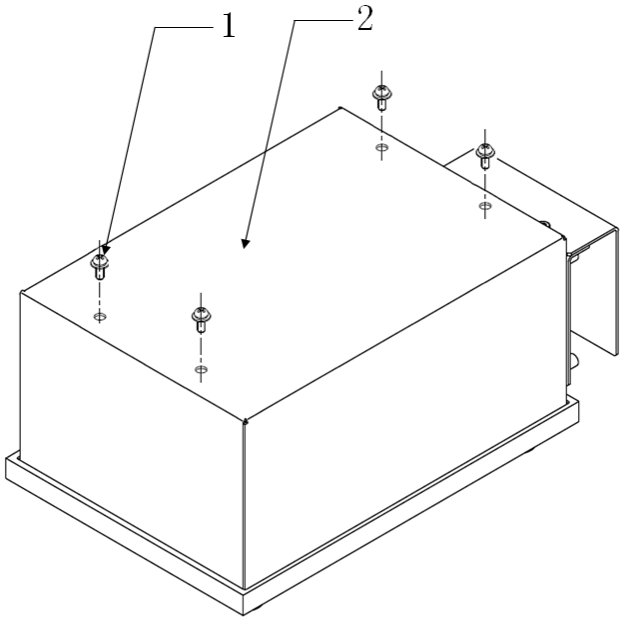
- #2 (Ph2) Phillips screwdriver
- Medical syringe attached to a silicone tube
- Optical components that have passed tuning tests

Preliminary Steps

1. Turn off the power switch on the left side of the device.
2. Pull out the power cord plug from the rear panel of the device.
3. Open the right-side door and disassemble the top cover panel.

Disassembly

1. Use a #2 (Ph2) Phillips screwdriver to disassemble the four M3×8 cross-recessed pan-head combination screws which affix the cover panel of the optical system, and carefully detach it.



1 - M3×8 cross-recessed pan-head combination screw (×4)	2 - cover panel of the optical system

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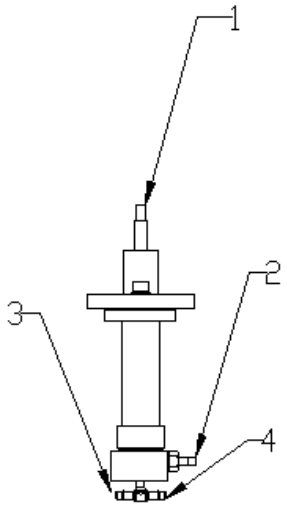
2. Pull out the tubing. First pull out Tube P1 of Connector 2 in Figure 2-51 and connect the medical syringe with the silicone tube to Connector 2. Pull out Tube P6 from the L-type connector at the top end of Connector 1. Drain the water from the sheath flow device with a syringe and pull out Tube P21 and P4c from the Connector 3 and 4 at the bottom of the flow chamber.

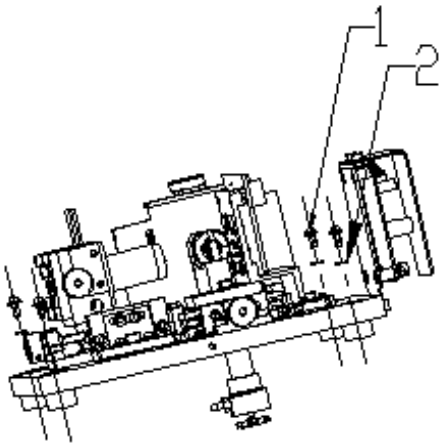
Figure 2-51 Pulling out the tubing



1 - Tube P6	2 - Tube P1
3 - Tube P21	3 - Tube P4c

3. Use a #2 (Ph2) Phillips screwdriver to disassemble the four M3×8 cross-recessed pan-head combination screws which affix the optical assembly, and take off the four large D3 gaskets. Carefully push upwards and slowly detach the optical assembly.

Figure 2-52 Disassembling the optical assembly



1 - M3×8 cross-recessed pan-head combination screw (×4)	2 - Large D3 gasket

4. Pull out the wires from the J66 and J4 ports on the rear panel; then pull out the heating wire inside the optical system box, the temperature sensor wire, and the temperature switch wire. To take the optical assembly apart, slowly hold it up and remove the flow chamber from the opening of the affixed optical panel.

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Installation

Follow the corresponding disassembly steps in reverse order.

NOTE

- Put on antistatic gloves and an electrostatic-shielding ring while operating to avoid damaging the LED.
- All the wirings need to be set up according to the original positions of the machine components to prevent them from being crushed or otherwise damaged.
- During transportation and installation, the flow chamber exposed at the bottom of the optical system needs to be protected from being crushed or pressed. When pulling out the tubes, hold the flow chamber by hand to prevent it from being dislocated by external force.

2.4.2 Replacing the Optical Preamplifier Panel

Purpose

The optical preamp panel can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***Preliminary Steps*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- New optical preamplifier panel

Preliminary Steps

1. Turn off the power switch on the left side of the device.
2. Pull out the power cord plug from the rear panel of the device.
3. Open the right-side door and disassemble the top cover panel.
4. Take down the cover panel of the optical system box.

Disassembly

1. Pull out the three wires from the optical preamp panel.
2. Use a #2 (Ph2) Phillips screwdriver to disassemble the four M3×8 cross-recessed pan-head combination screws which affix the optical preamp panel, and carefully detach the cover panel of the optical system box.

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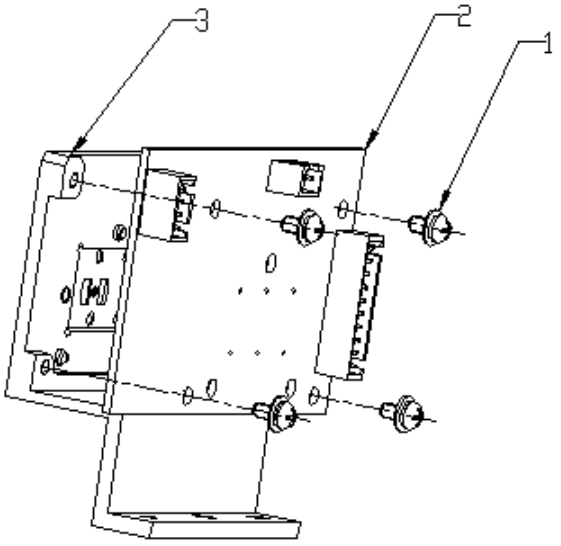
Figure 2-53 Taking down the cover panel of the optical system box



1 - M3×8 cross-recessed pan-head combination screw (×4)	2 - Optical preamplifier panel
3 - Pre-optical fixation panel	

Installation

Follow the corresponding disassembly steps in reverse order.

NOTE

- Put on antistatic gloves and an electrostatic-shielding ring while operating to avoid damaging the LED.
- All the wirings need to be set up according to the original positions of the machine components to prevent them from being crushed or otherwise damaged.

2.4.3 Replacing the Laser Driver panel

Purpose

The laser driver panel can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***Preliminary Steps*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- 2.5mm hex-socket screwdriver
- New laser driver panel

Preliminary Steps

1. Turn off the power switch on the left side of the device.

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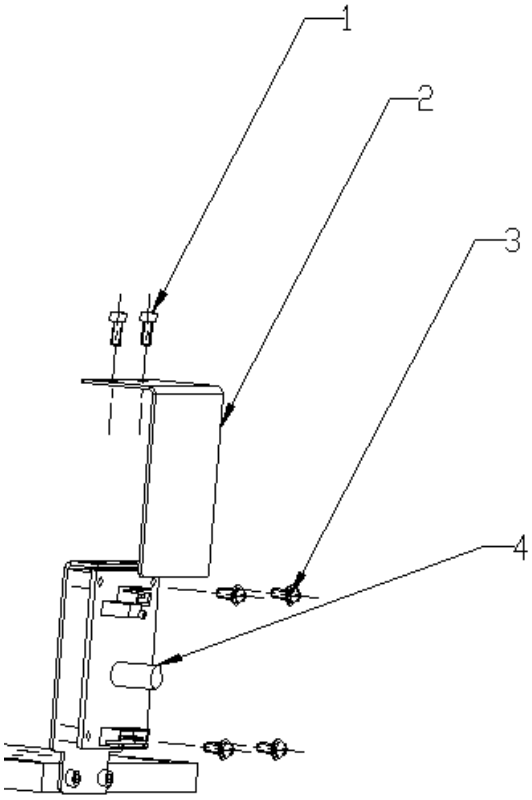
2. Pull out the power cord plug from the rear panel of the device.
3. Open the right-side door and disassemble the top cover panel.

Disassembly

1. Use a 2.5mm hex-socket screwdriver to disassemble the four M3×6 stainless-steel inner hex screws that affix the baffle plate of the laser driver panel.
2. Pull out the two wires from the laser driver panel.
3. Use a #2 (Ph2) Phillips screwdriver to disassemble the four M3×8 cross-recessed pan-head combination screws, and carefully detach the laser driver panel.

Figure 2-54 Replacing the Laser Driver Panel



1 - M3×6 stainless-steel inner hex screw (×4)	2 - Baffle plate of the laser driver panel
3 - M3×8 cross-recessed pan-head combination screw (×4)	3 - Laser driver panel

Installation

Follow the corresponding disassembly steps in reverse order.

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NOTE

- Put on antistatic gloves and an electrostatic-shielding ring while operating to avoid damaging the LED.
- All the wirings need to be set up according to the original positions of the machine components to prevent them from being crushed or otherwise damaged.

2.4.4 Fine Tuning of the Flow Chamber

Purpose

The fine tuning of the flow chamber can be performed by following the procedures specified in this section; however, in each case, ***Preliminary Steps*** need to be taken before you begin.

Tools/Spare Parts

#2 (Ph2) Phillips screwdriver

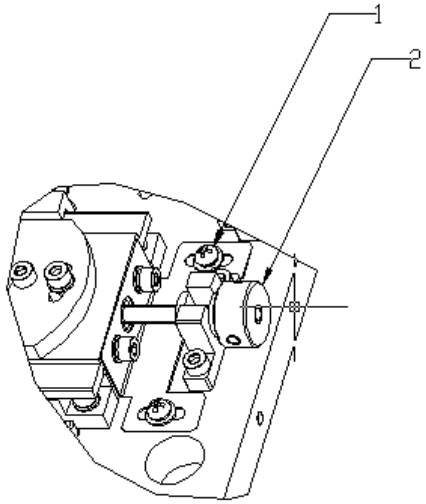
Preliminary Steps

- Open the right-side door and disassemble the top cover panel.
- Take down the cover panel of the optical system box.
- Turn on the device and launch the software application; then enter the Optical Tuning screen.

Tuning Procedures

1. Use a #2 (Ph2) Phillips screwdriver to loosen the two M3×8 cross-recessed pan-head combination screws that affix the locking plates of the flow chamber.

Figure 2-55 Fine tuning of the flow chamber



1 - M3×8 cross-recessed pan-head combination screw (×2)	2 - Adjustment knob of the flow chamber

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2. Shake the 7um nominal particles well, and use the 7um nominal particles as a sample for DIFF testing.
   - If the resultant scattergram shows a square or diamond with the upper and lower sides parallel to each other, the device does not need fine-tuning.
   - If the scattergram shows that the upper and lower sides are not parallel, then take the next step.
3. If the slanting directional arrow shown in the scattergram is ↗, then rotate the adjustment knob of the flow chamber counter-clockwise; if the slanting direction shown in the scattergram is ↘, then rotate the adjustment knob of the flow chamber clockwise (the adjustment knob should be lightly rotated).
4. Use the 7um nominal particles as a sample for DIFF testing.
   - If the resultant scattergram shows a square or diamond with the upper and lower sides parallel to each other, the device does not need fine-tuning.
   - If the scattergram shows that the upper and lower sides are not parallel, then repeat Step 3.
5. After tuning, tighten the two locking screws of the flow chamber, and reinstall the cover panel of the optical system box as well as the four affixing screws; then lock them in place.

2.4.5 Replacement of High-angle Receiving Plate

Purpose

The high-angle receiving plate can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***Preliminary Steps*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- 2.5mm hex-socket screwdriver
- New high-angle receiving plate

Preliminary Steps

1. Turn off the power switch on the left side of the device.
2. Pull out the power cord plug from the rear panel of the device.
3. Open the right-side door and disassemble the top cover panel.

Disassembly

1. Disassemble 2 M3 ×8 stainless steel internal hexagon screws used for fixing the fixed seat of the side panel card by 2.5mm internal hexagonal wrench, and then remove the fixed seat from the side basal plate.
2. Pull out 2 connecting wires on the high-angle receiving plate.
3. Disassemble 2 M2.5 ×6 cross recess head screws used for fixing the high-angle receiving plate by #2 (Ph2) Philips screwdriver, and remove the laser driver plate carefully.

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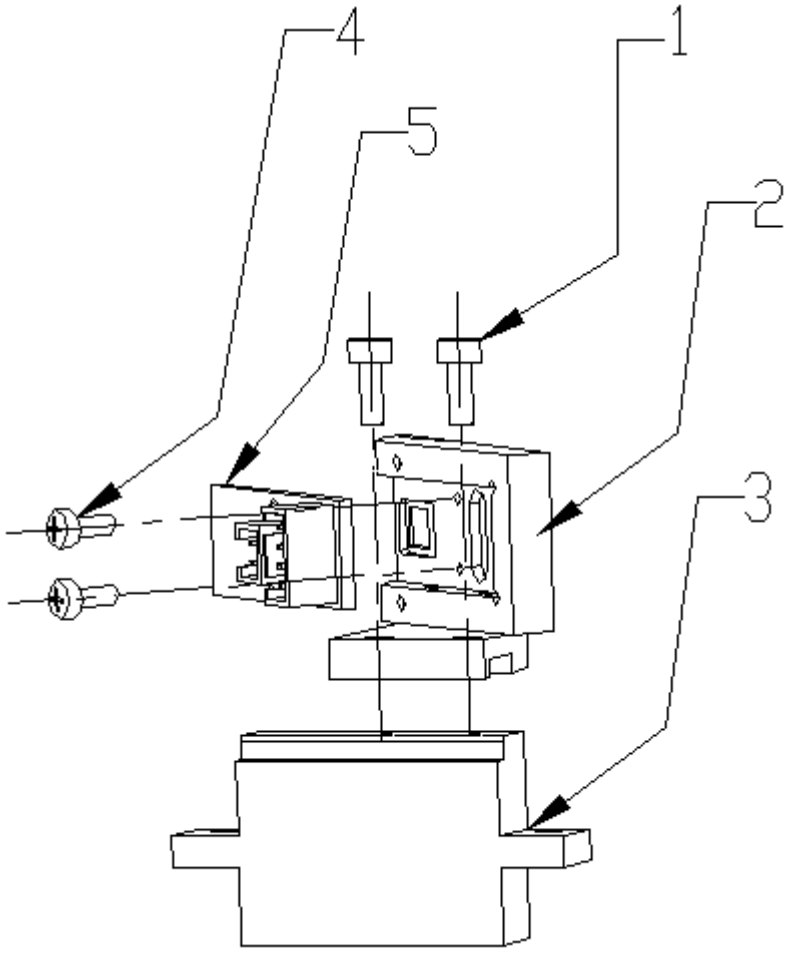
Figure 2-56 Replacement of High-angle Receiving Plate



1 - M3×6 inner hex screw (×2)	2 - Fixed seat of side panel card
3 - Side basal plate	4 - M2.5×6 Cross recess head screw (2x)
5 - High-angle receiving plate	

2.4.6 Common Problems and Solutions

Problem Description	Possible Cause	Solution
There is no scattergram signal when testing the DIFF signal of whole blood.	• The laser driver panel is not working. • The optical preamplifier panel is not working.	Check if the laser is working. • If not, replace the laser driver panel. • If the laser is working, check the power supply of the optical preamp panel and replace the optical preamp panel.

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Problem Description	Possible Cause	Solution
One or some of the signals from the three angles are 0 when testing the DIFF signal of whole blood.	Optical preamplifier panel problem	Check if the laser is working. ● If not, replace the laser driver panel. ● If the laser is working, check the power supply of the optical preamp panel and replace the optical preamp panel. If the problem persists after the replacement, replace the main control panel.
There are only sporadic background scattergram signals when testing the DIFF signal of whole blood.	The flow chamber is dislocated. The hydraulics have no sheath flow.	Check if the collecting corner plate has two bilaterally symmetric light spots in the shape of red vertical stripes. ● If there is only one red vertical stripe or the two stripes are significantly different in brightness, make small adjustment to the location of the flow chamber and return the nominal-particle scattergram to normal. ● If there are two red vertical stripes which are not significantly different in brightness, check if the pinch valve is working; if it is, check if Valve 10, 11, 12, 13, and 18 are also working.
The scattergram signals are basically normal but compressed in size when testing the DIFF signal of whole blood.	The laser is burnt out.	Replace the laser.
The neutral-particle signal (the long horizontal stripe at the top right corner) in the scattergram is considerably slanted and the three signals are mostly overlapping with inaccurate classification when testing the DIFF signal of fresh whole blood.	The flow chamber is dislocated.	Make a small adjustment to the location of the flow chamber and return the nominal-particle scattergram to normal.
There is a lot of noise when testing the background signal.	The reagent is contaminated. Tiny air bubbles get into the hydraulics.	● If the background noise has a certain shape and is concentrated at the lower half of the scattergram, keep the DIFF1 and DIFF2 fluids at room temperature and perform three rounds of the reagent replacement sequence each for the diluent, DIFF1 and DIFF2. ● If the background signal has no shape and randomly spreads all over the scattergram, replace the sheath flow syringe. If the problem persists, replace the optical assembly.

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3 Repairs

3.1 Overview

The repair engineer can repair the analyser using standard tools. See the following section for repairing procedures (including the tools needed). If any repairing step requires a validating step, the repair engineer should strictly follow the procedure and take the validating step.

NOTE

When following the repairing procedure as specified in this section, the operator should put on rubber gloves and clean both hands with disinfectant after performing any repair work.

3.2 Preparatory Work before Repairs

3.2.1 Disassembling the Left Side Panel

Purpose

While performing regular machine maintenance and inspection, the left-side door needs to be opened to disassemble the sampling syringe assembly, reagent testing panel, or electromagnetic valve assembly, which are all in the left section of the machine.

Tools/Spare Parts

#2 (Ph2) Phillips screwdriver

Opening

1. As shown in Figure 3-1, use #2 (Ph2) cross screw driver to take out four M3×8 cross recessed pan-head combination screws on the back panel, and take off the back panel.

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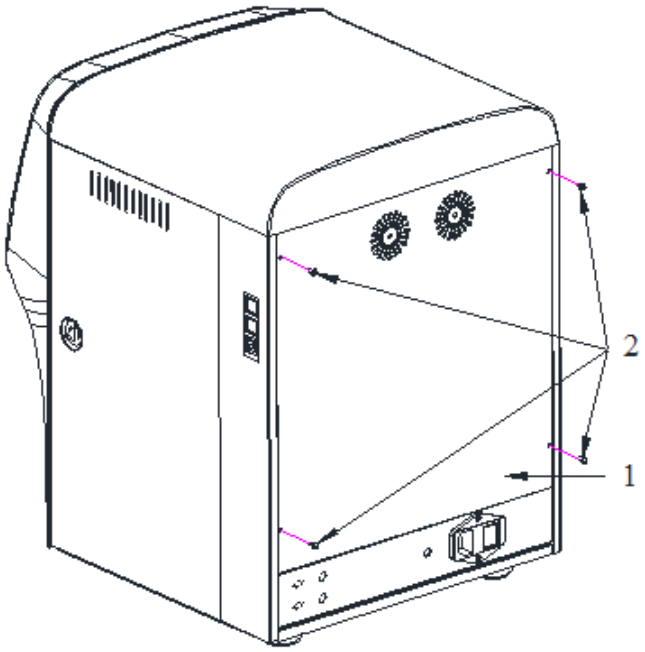
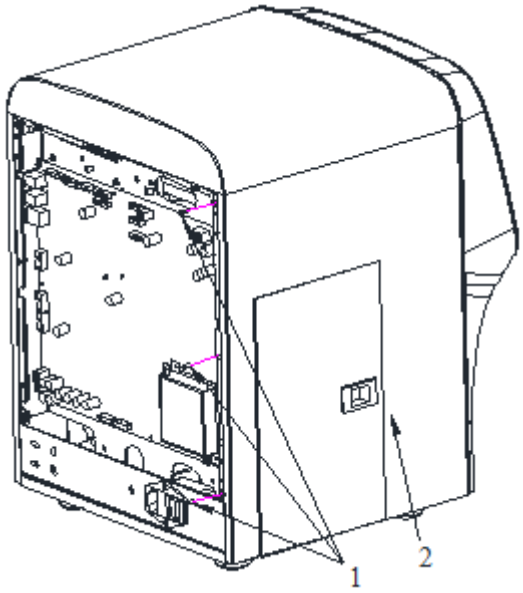
Figure 3-1 Disassembling the back panel



1 - Back panel	2 - M3×8 cross-recessed pan-head combination screw (×4)

2. As shown in Figure 3-2, use #2 (Ph2) cross screw driver to take out three M3×8 cross recessed pan-head combination screws on the left side panel, and take off the left side panel.

Figure 3-2 Disassembling the left side panel



1- M3×6 cross-recessed countersunk-head screw (×3)	2 - Left side panel

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3.2.2 Open the Right Side Door

Purpose

While performing machine maintenance and inspection, the right side door needs to be opened to disassemble the preheating bath assembly, pinch valve, sampling assembly, liquid pump assembly, impedance counting reaction bath assembly (WBC & RBC), negative-pressure chamber, or electromagnetic valve & pump assembly, which are all in the right section of the machine.

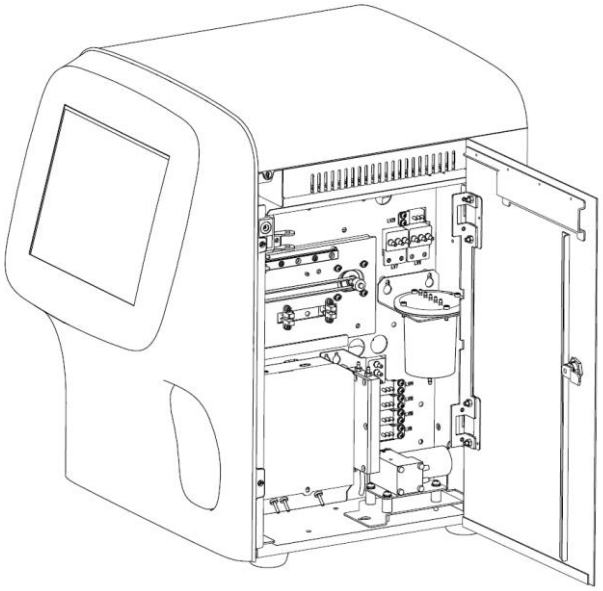
Tools/Spare Parts

Slot-type screwdriver

Opening

As shown in Figure 3-3, insert the slot-type screwdriver into the slot in the right side door lock and rotate 90° counterclockwise, then manually open the right side door.

Figure 3-3 Opening the right side door



3.2.3 Disassembling the Panel Cover

Purpose

While performing regular machine maintenance and inspection, the panel cover needs to be taken down for disassembling the sample probe, cleaning swab, sampling assembly, or indicator light panel.

Tools/Spare Parts

#2 (Ph2) Phillips screwdriver

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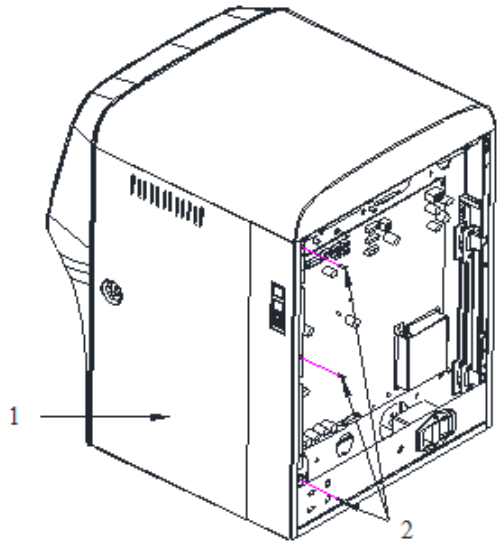
Preliminary Steps

1. Turn off the power switch on the left side of the device and pull out the power cord plug from the back panel of the device.
2. The left side panel has been disassembled. See ***3.2.1 Disassembling the Left Side Panel***.
3. The right-side door is opened. See ***3.2.2 Open the Right Side Door***.

Disassembly

1. Disassembly the back panel: use a #2 (Ph2) Phillips screwdriver to disassemble the three M3×6 cross-recessed pan-head combination screw on the back panel, and take off the back panel, as shown in Figure 3-4.

Figure 3-4 Disassembling the back panel



1 - Right side door	2 - M3×8 cross-recessed countersunk-head screw (×3)

2. Disassembling top cover: Open the right side door and disassemble 4 M3×8 cross-recessed countersunk-head screws on both sides of top cover by #2 (Ph2) Philips screwdriver, the top cover can be removed, as shown in Figure 3-5.

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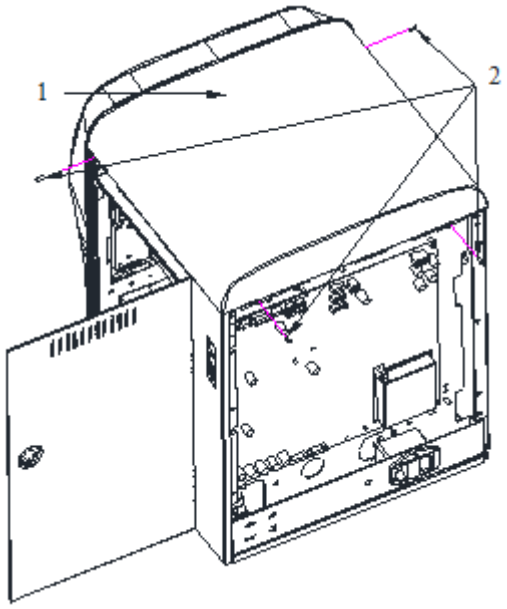
Figure 3-5 Disassembling the top cover panel



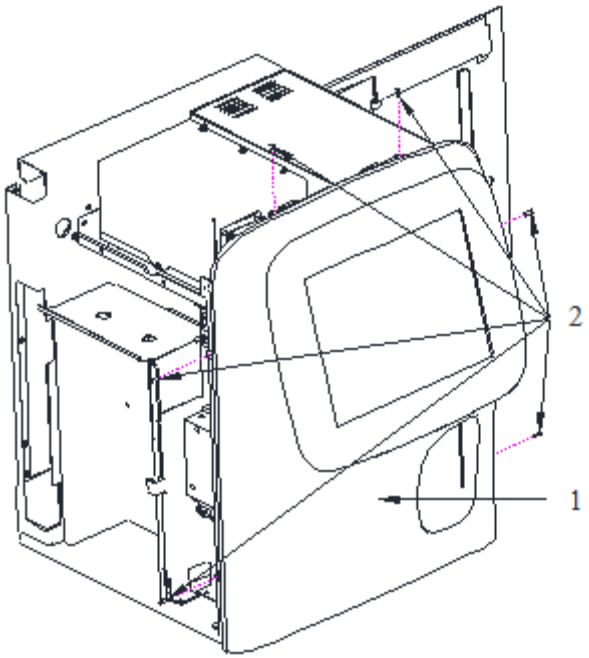
1 - Top cover panel	2 - M3×8 cross-recessed countersunk-head screw (×4)

3. Take off the panel cover: as shown in Figure 3-6, take out the six affixing M3×8 cross-recessed countersunk head screws in order to take off the panel cover.

NOTE

When removing the panel cover, make sure to pull out the wires connected to the display circuit panel on the panel cover.

Figure 3-6 Disassembling the panel cover



1 - Panel cover	2 - M3×8 cross-recessed countersunk-head screw (×6)

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3.3 Display Screen Assembly Replacement

3.3.1 Replacing the Touch Screen

Purpose

The display screen can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

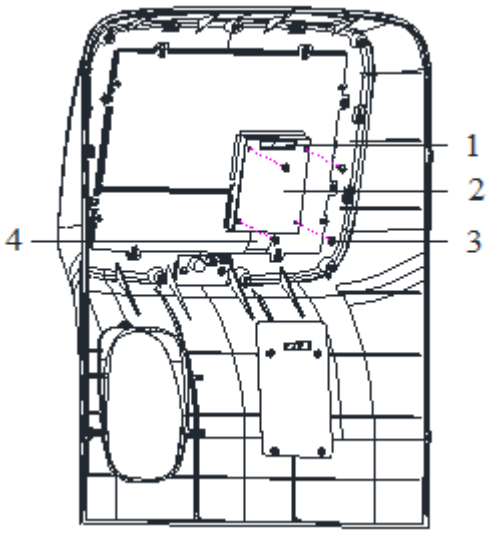
Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- Display screen

Disassembly

1. Pull out both interfaces at the shield panel of the LCD screen interface panel, use #2 (Ph2) cross screw driver to remove four M3×8 cross recessed pan-head combination screws on the shield panel, take off the shield panel, then detach the black buckles on both ends, gently pull out the golden ribbon cable, as shown in Figure 3-7.

Figure 3-7 Replacement of display screen (1)



1 - Bunch interface	2 - LCD screen interface panel
3 - M3×8 cross recessed pan-head combination screw (×4)	4 - Ribbon cable interface

2. Use #2 (Ph2) cross screw driver to remove eight M3×8 cross recessed pan-head combination screws on the screen support, take off the screen support, display screen and touch screen respectively, as shown in Figure 3-8.

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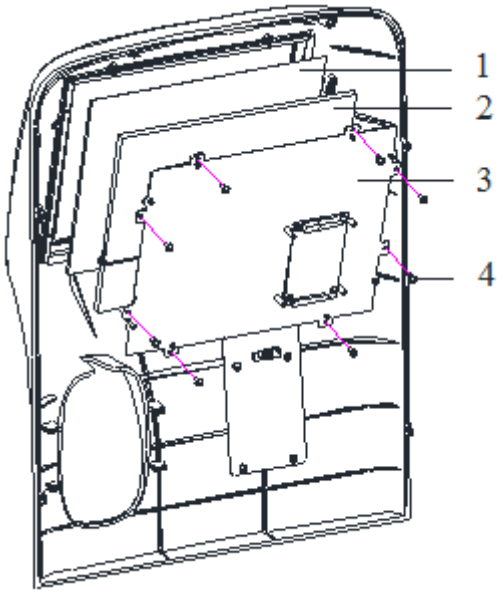
Figure 3-8 Replacement of display screen (2)



1 - Touch screen	2 - Display screen
3 - Screen support	4 - M3×8 cross recessed pan-head combination screw (×8)

3.4 Sampling Assembly Replacement

3.4.1 Replacing the Sample probe

Purpose

The sample probe can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- Sample probe

Disassembly

1. Pull out the swab's snap ring to detach it from the lower bracket panel. See Figure 3-9.

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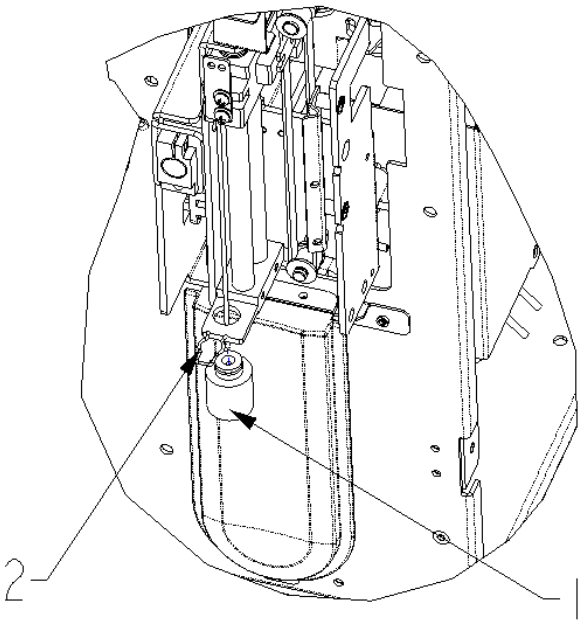
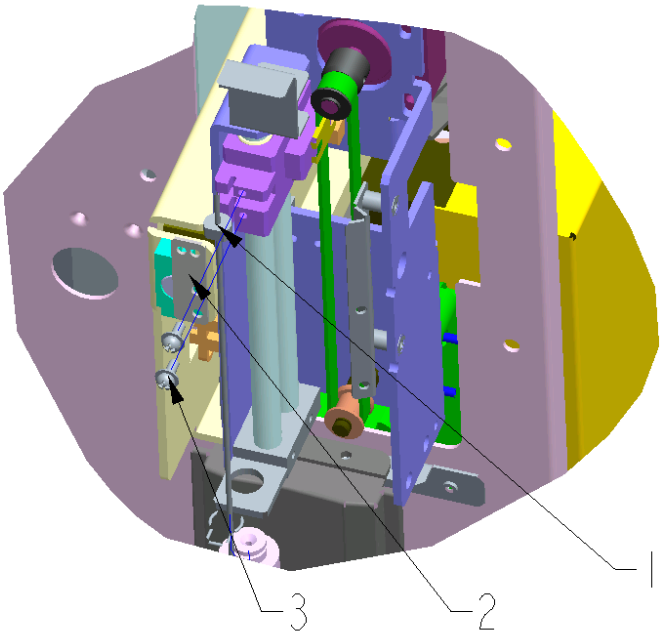
Figure 3-9 Replacement of sample probe (1)



1 - Cleaning swab	2 - Swab circle

2. Use a #2 (Ph2) Phillips screwdriver to take out the two M3×6 small cross recessed pan head combination screws on the fixed pressure plate of the sample probe, and then take off the fixed pressure plate. See Figure 3-10.

Figure 3-10 Replacement of sample probe (2)



1 - Sample probe	2 - Pressure plate affixing the sample probe
3 - M3×8 cross-recessed pan-head combination screw (×2)	

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3.4.2 Replacing the Optocoupler

Purpose

The optocoupler can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

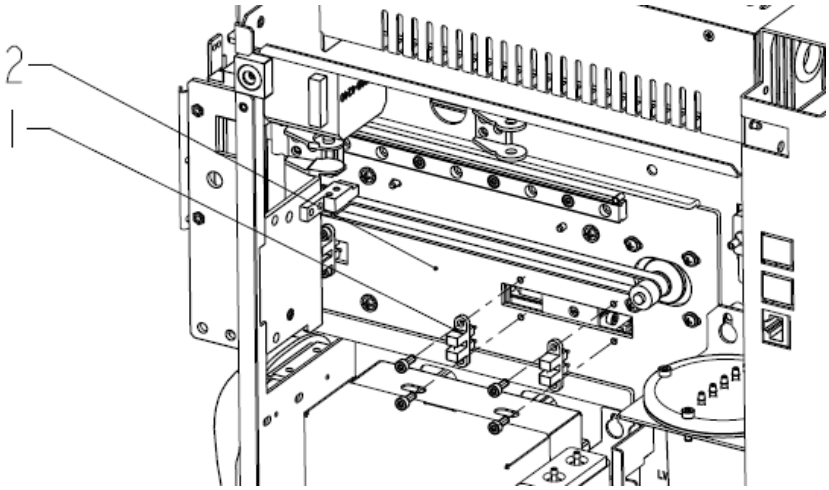
Tools/Spare Parts

- 2.5mm hex-socket screwdriver
- Optocoupler

Disassembly

Use the 2.5mm hex wrench to remove the M3 hex screw affixing the optocoupler, then pull out the plug attached to the optocoupler wire to disassemble the optocoupler to be replaced. See Figure 3-11.

Figure 3-11 Replacement of optocoupler



1 - Optocoupler	2 - Sampling assembly

3.4.3 Replacing the Sampling Assembly in X- or Y-direction

Purpose

The sampling assembly can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- diagonal cutting pliers

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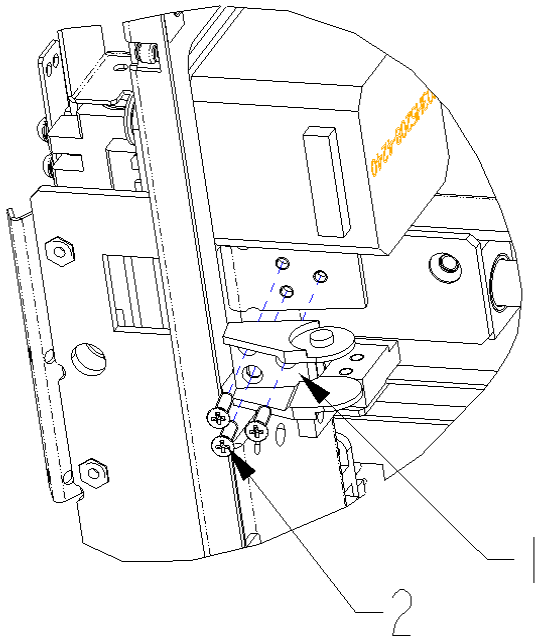
Disassembly

1. Use the diagonal cutting pliers to cut off all the nylon binding tapes affixing the fluid tubes (aspiration tubes of the sample probe and swab tubes), then pull out the fluid tubes of the sample probe and the swab to detach them from the sampling assembly.
2. Pull out all the motor wires and optocoupler plug from the horizontal moving module of the sample assembly, and use a #2 (Ph2) Phillips screwdriver to take out the three M3×6 cross recessed countersunk head screws affixing the bracket for drag chains to detach the sampling-specific drag chain from the sampling assembly. See Figure 3-12.

Figure 3-12 Replacement of the sampling assembly in X- or Y-direction (1)



1 - tank drag chain connector	2 - M3×6 cross-recessed countersunk-head screw (×3)

3. Use a #2 (Ph2) Phillips screwdriver to take out the four M4×10 cross recessed pan head combination screws affixing the sampling assembly, and then carefully and gently take the sampling assembly out of the machine; during the process of removal, carefully pull out the wires and plugs for the horizontal motor and optocoupler of the sampling assembly from the corresponding apertures in the machine. Then pull out all the plugs to completely remove the sampling assembly. See Figure 3-13.

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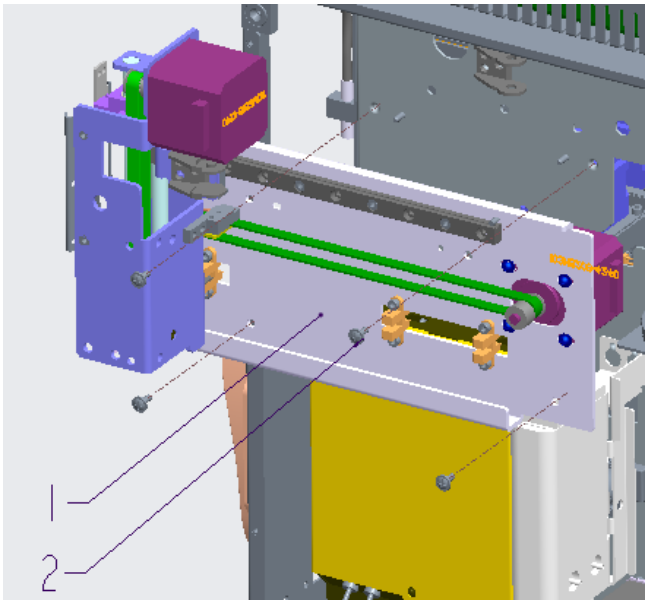
Figure 3-13 Replacement of the sampling assembly in X- or Y-direction (2)



1 - Sampling assembly	2 - M4×10 cross-recessed pan-head combination screw (×4)

3.5 Power Assembly Replacement

Purpose

The power assembly can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- Phillips screwdriver
- Power assembly with the same specifications

Disassembly

1. Use Phillips screwdriver to take out four M3×8 cross recessed pan-head combination screws on the back of the device power supply assembly, then remove one M3×8 cross recessed pan-head combination screw on the front, as shown in Figure 3-14.

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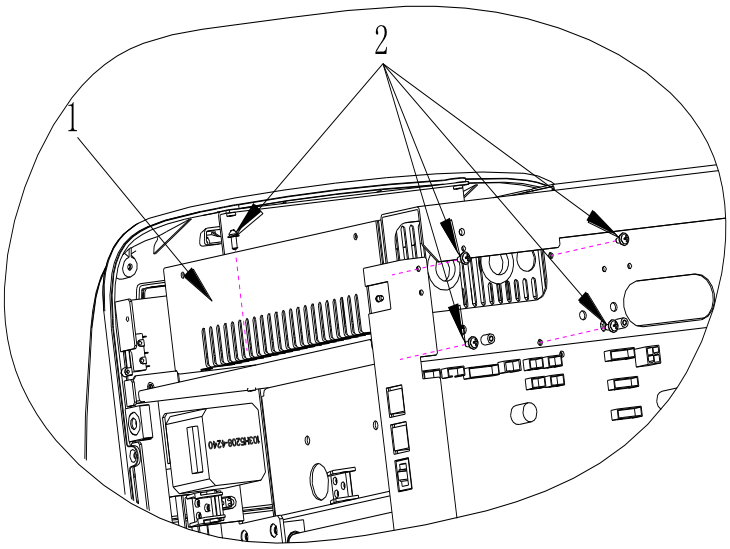
Figure 3-14 Replacement of power assembly (1)



1 - Power assembly	2 - M3×8 cross-recessed pan-head combination screw (×5)

2. Unplug all the connectors attached to the lead wire of the power assembly.
3. Take off the power supply required to be replaced from the power supply assembly, and replace with a new power supply, fix it with screws.

3.6 Hydraulics Components incl. Valves, Pumps, and Pressure Chambers Replacement

3.6.1 Replacing the valve assembly

Purpose

The valve assembly can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- The replacement valve with the same specifications

Preliminary Steps

1. Turn off the power switch on the left side of the device.
2. Pull out the power cord plug from the rear panel of the device.

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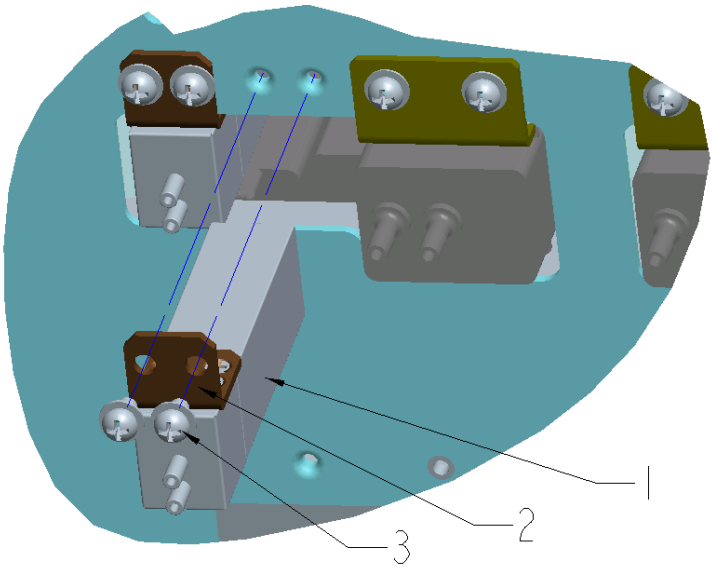
3. If it is only the electromagnetic valve on the left or right clapboard that needs to be replaced, open the corresponding left- or right-side door; if the one on the front panel needs to be replaced, remove the front panel cover by following the instructions in ***3.2.3 Disassembling the Panel Cover***.

Disassembly

1. Disassemble the peripheral fluid tubes connected to the valve assembly.
2. Use a #2 (Ph2) Phillips screwdriver to disassemble the two M3×8 cross-recessed pan-head combination screws which affix the valve assembly, and carefully take out the valve assembly while making sure to unplug the attached wires. See Figure 3-15.

Figure 3-15 Replacement of valve assembly



1 - the corresponding replacement valve	2 - Installation panel affixing the valve
3 - M3×8 cross-recessed pan-head combination screw (×2)	

Installation

NOTE

- Make sure to the use correct model of valve and create a reliable connection
- All the wirings need to be set up according to the original positions of the machine components to prevent them from being crushed or otherwise damaged.
- This machine involves a great number of valves. Only one valve is discussed as an example here, and all the other valves follow the same maintenance procedures.

Follow the corresponding disassembly steps in reverse order.

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3.6.2 Replacing the Liquid Pump Assembly

Purpose

The liquid pump assembly can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- 2.5mm hex-socket screwdriver
- The replacement liquid pump with the same specifications

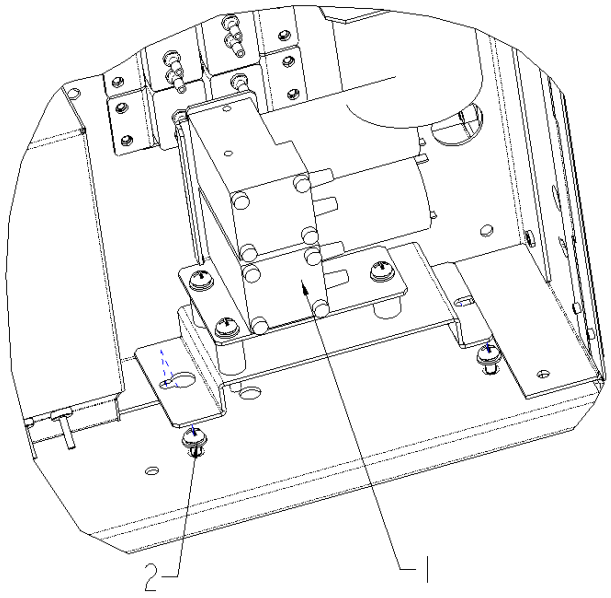
Preliminary Steps

1. Turn off the power switch on the left side of the device.
2. Pull out the power cord plug from the rear panel of the device.
3. Open the right side door.

Disassembly

1. Pull out the peripheral fluid tubes and wire connectors attached to the liquid pump.
2. Use a #2 (Ph2) Phillips screwdriver to loosen the two M4×10 cross-recessed pan-head combination screws which affix the liquid pump, and move the liquid pump assembly to the left until the big hole on the affixing panel of the liquid pump is aligned to the affixing screw, then carefully hold up the liquid pump assembly to take it out. See Figure 3-16.

Figure 3-16 Replacement of liquid pump assembly (1)



1 - Liquid pump assembly	2 - M4×10 cross-recessed pan-head combination screw (×2)

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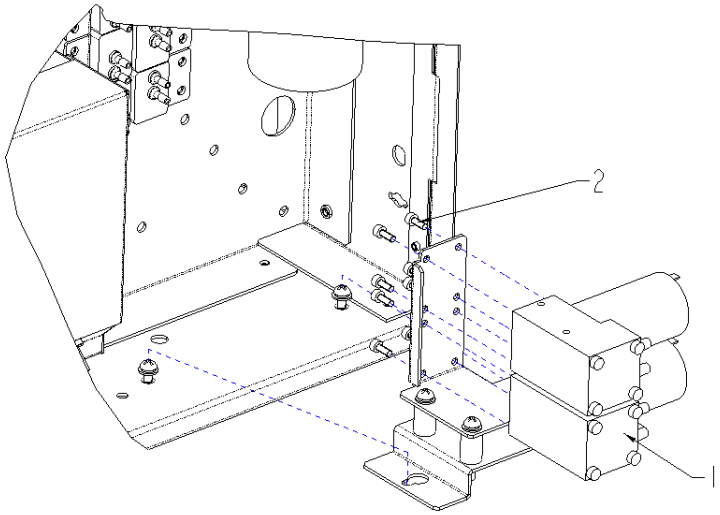
3. The further dismantling of the liquid pump assembly is shown in Figure 3-17.

Figure 3-17 Replacement of liquid pump assembly (2)



1 - Liquid pump	2- M3×8 stainless-steel inner hex screw (×8)

Installation

NOTE

- All the wirings need to be set up according to their original positions to prevent them from being crushed or otherwise damaged, and to prevent the working liquid pump from being shaken, which affects the fluid tubes.
- Pay special attention to the tubing joints and ensure that the connections are sound.

Follow the corresponding disassembly steps in reverse order.

Resetting the Machine

1. Close the right side door.
2. Plug the power cord into the back panel of the device and turn on the power switch on the left panel of the device.

3.6.3 Replacing the Negative-pressure Chamber Assembly

Purpose

The negative-pressure chamber assembly can be disassembled and replaced by following the procedures specified in this section; however, in each case, 3.2 Preparatory Work before Repairs need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- 2.5mm hex-socket screwdriver

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- The replacement parts or assembly of the negative-pressure chamber with the corresponding specifications

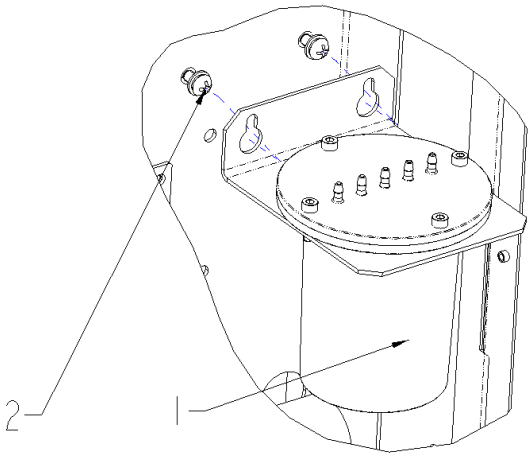
Preliminary Steps

Open the right side door.

Disassembly

1. Disassemble the peripheral fluid tubes connected to the negative-pressure chamber.
2. Use a #2 (Ph2) Phillips screwdriver to disassemble the two M4×10 cross-recessed pan-head combination screws which affix the negative-pressure chamber, and carefully take out the negative-pressure chamber assembly. See Figure 3-18.

Figure 3-18 Replacement of negative-pressure chamber assembly



1 - Negative-pressure chamber assembly	2 - M4×10 cross-recessed pan-head combination screw (×2)

3. The further dismantling of the negative-pressure chamber assembly is the same as that of the positive-pressure chamber assembly.

Installation

NOTE

- Make sure to place the seal ring into the seal tank to keep the pressure chamber airtight.
- All the tubing needs to be set up according to the relevant standards or the original positions of the machine components to prevent them from being crushed or otherwise damaged.

Follow the corresponding disassembly steps in reverse order.

Resetting the Machine

Close the right side door.

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3.7 Sheath Flow Syringe Assembly Replacement

3.7.1 Replacing the syringe

Purpose

The syringe can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- 2.5mm hex-socket screwdriver
- The replacement syringe assembly with the same specifications

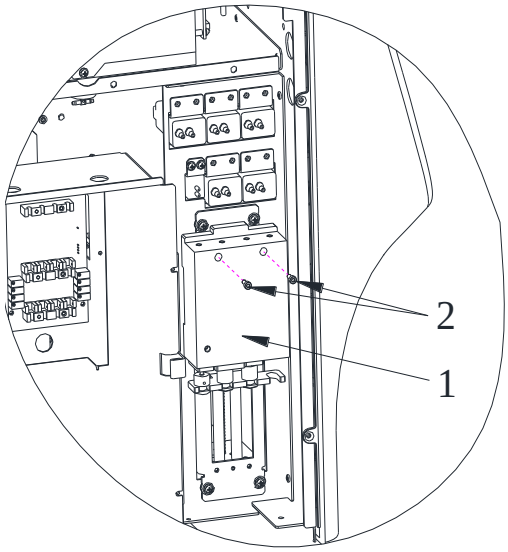
Preliminary Steps

- Open the left side door.

Disassembly

1. Pull out the peripheral fluid tubes connected to the syringe assembly to be replaced.
2. Use the 2.5mm hex-socket screwdriver to disassemble the two M3×8 stainless-steel inner hex screws affixing the syringe assembly. Then take out the syringe assembly. See Figure 3-19.

Figure 3-19 Replacement of syringe



1- Syringe module	2- M3×8 stainless-steel inner hex screw (×2)

Installation

Follow the corresponding disassembly steps in reverse order.

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3.7.2 Replacing the Motor

Tools/Spare Parts

- 2.5mm hex-socket screwdriver
- #2 (Ph2) Phillips screwdriver
- The replacement syringe assembly with the same specifications

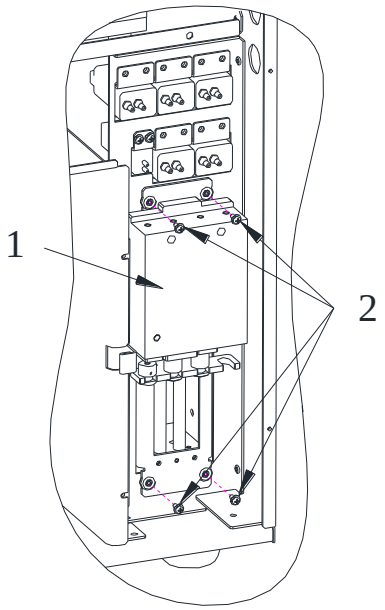
Preliminary Steps

Open the left side door.

Disassembly

1. Pull out the peripheral fluid tubes connected to the syringe module to be replaced.
2. Use #2 (Ph2) cross screw driver to remove four M3×8 cross recessed pan-head combination screws, take off the syringe assembly. See Figure 3-20.

Figure 3-20 Replacement of motor (1)



3. Use the 2.5mm hex-socket screwdriver to disassemble the two M3×8 stainless-steel inner hex screws affixing the syringe module. Then take out the syringe. See Figure 3-19.
4. Take out the two M3×8 inner hex screws on the shield cover, then remove the white bolt from the motor. Next, remove the four M3×8 inner hex screws from the back of the motor for the replacement. See Figure 3-21.

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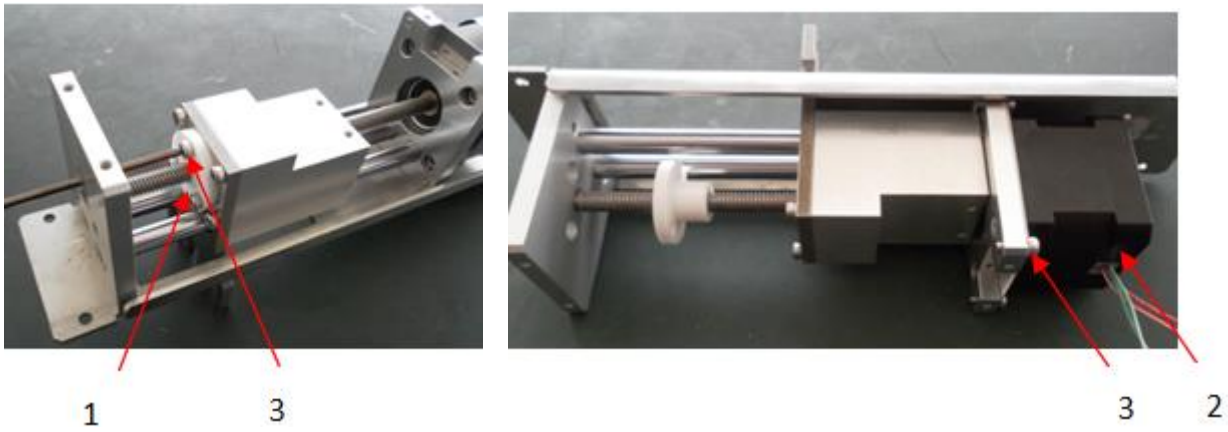
Figure 3-21 Replacement of motor (2)



1 - Motor bolt	2 - Motor
3 - M3×8 stainless-steel inner hex screw (×9)	

Installation

Follow the corresponding disassembly steps in reverse order.

3.8 WBC and RBC Bath Assemblies Replacement

3.8.1 Dismantling and replacing the WBC bath assembly

Purpose

The WBC counting bath assembly can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***Preliminary Steps*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- 2.5mm hex-socket screwdriver
- The replacement WBC counting bath assembly with the same specifications

Preliminary Steps

1. Run the draining sequence of the software to drain any residual liquid inside the machine.
2. Turn off the power switch on the left side of the device and pull out the power cord plug from the back panel of the device.
3. Open the right side door.

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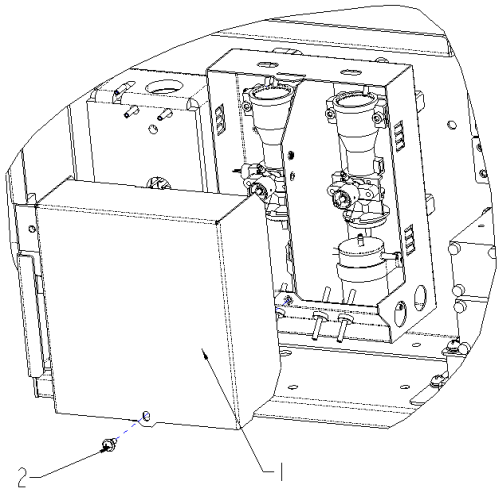
Disassembly

1. Use a #2 (Ph2) Phillips screwdriver to disassemble the M3×8 cross-recessed pan-head combination screw in the lower section of the shield cover to remove the cover; to take out the screw, move slightly upwards for 3mm or so and apply force in a direction perpendicular to the right clapboard. See Figure 3-22.

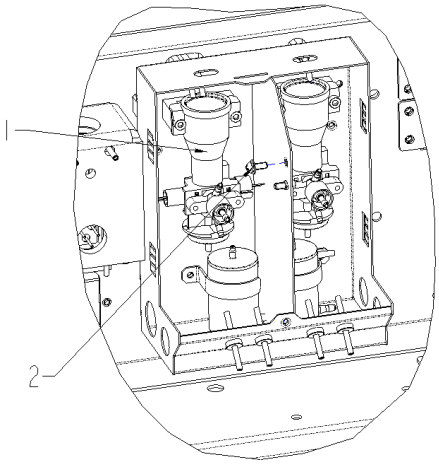
Figure 3-22 Dismantling and replacing the WBC bath assembly (1)



1 - Shield cover of the counting bath	2 - Cross-recessed pan-head combination screw

2. Pull out the peripheral fluid tubes attached to the WBC counting bath assembly. Pay attention to handling the residual fluid; try to prevent it from flowing onto the other components in the machine, and wipe clean if necessary.
3. Use a #2 (Ph2) Phillips screwdriver to disassemble the M3×8 cross-recessed pan-head combination screw for grounding on the middle clapboard of the shield case cover and pull out the grounding wire. See Figure 3-23.

Figure 3-23 Dismantling and replacing the WBC bath assembly (2)



1 - WBC counting chamber assembly	2 - M3×8 cross-recessed pan-head combination screw

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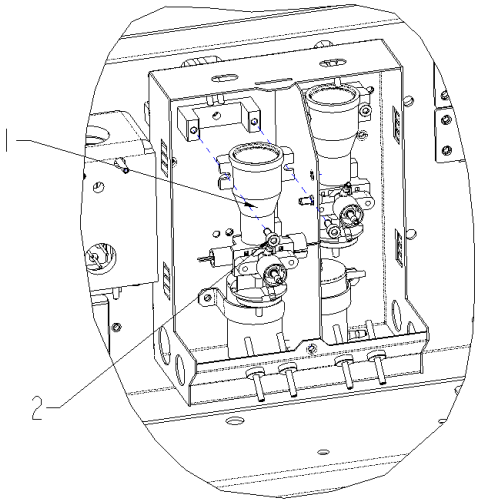
4. Use 2.5mm hex wrench to remove the two M3×8 stainless-steel hex-socket screws affixing the upper section of WBC counting bath assembly. See Figure 3-24.

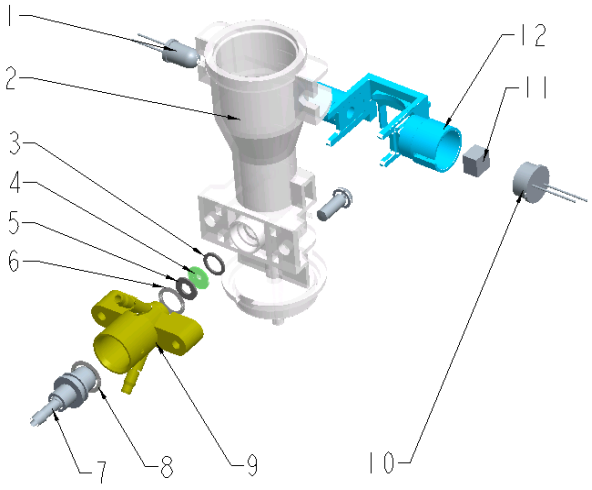
Figure 3-24 Dismantling and replacing the WBC bath assembly (3)



1 - WBC counting chamber assembly	2 - M3×8 stainless-steel inner hex screw (×2)

5. Carefully and slowly take out the WBC counting bath assembly. Pay attention to the wiring in the process of moving to avoid breaking the wires.
6. Remove the protective ring from the shield case and open the wire clip to take out the inner wire along the stretching direction of the wire. Then take out the WBC counting bath assembly as a whole.
7. The further dismantling of the WBC counting chamber assembly. See Figure 3-25.

Figure 3-25 Dismantling and replacing the WBC bath assembly (4)



1 - LED	2 - Front counting bath
3 - Flat rubber gasket 6*4.5*0.5	4 - WBC aperture
5 - Flat rubber gasket 6*3*0.5	6 - O-shaped ring 5.5*1.0

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7 - Electrode of the rear bath	8 - O-shaped ring 6.5*1.0
9 - Rear chamber	10 - Optical receiver
11 - Optical filter of the counting bath assembly	12 - HGB bracket

Installation

NOTE

- All the wirings need to be set up according to the working procedures or the original positions of the machine components to prevent them from being crushed or otherwise damaged.
- Pay special attention to the tubing joints and ensure that the connections are sound.
- The aperture, seal gasket, and seal ring need to be correctly positioned and oriented in the right direction.

Follow the corresponding disassembly steps in reverse order.

Resetting the Machine

1. Reinstall the shield case cover.
2. Close the right side door.
3. Plug the power cord into the back panel of the device and turn on the power switch on the left panel of the device.

3.8.2 Dismantling and replacing the RBC bath assembly

Purpose

The RBC counting bath assembly can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- 2.5mm hex-socket screwdriver
- The replacement WBC counting bath assembly with the same specifications

Preliminary Steps

1. Run the draining sequence of the software to drain any residual liquid inside the machine.
2. Turn off the power switch on the left side of the device and pull out the power cord plug from the back panel of the device.
3. Open the right side door.

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Disassembly

1. Use a #2 (Ph2) Phillips screwdriver to disassemble the M3×8 cross-recessed pan-head combination screw in the lower section of the shield cover to remove the cover; to take out the screw, move slightly upwards for 3mm or so and apply force in a direction perpendicular to the right clapboard.

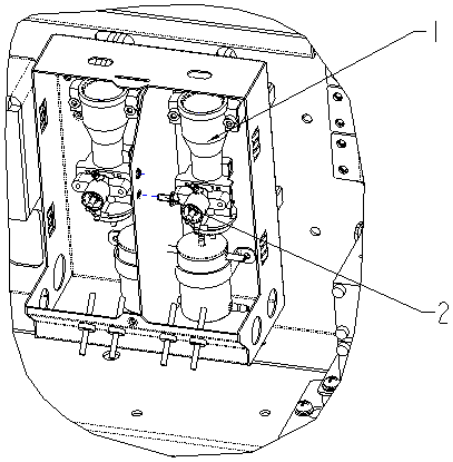
   Refer to the corresponding section in ***3.8.1 Dismantling and replacing the WBC bath assembly***.

2. Pull out the peripheral fluid tubes attached to the RBC counting bath assembly.

   Pay attention to handling the residual fluid; try to prevent it from flowing onto the other components in the machine, and wipe clean if necessary.

3. Use a #2 (Ph2) Phillips screwdriver to disassemble the M3×8 cross-recessed pan-head combination screw for grounding on the middle clapboard of the shield case cover and pull out the grounding wire. See Figure 3-26.

Figure 3-26 Dismantling and replacing the RBC bath assembly (1)



1 - RBC counting chamber assembly	2 - M3×8 cross-recessed pan-head combination screw

4. Use 2.5mm hex wrench to remove the two M3×8 stainless-steel inner hex screws affixing the upper section of the RBC counting bath assembly. See Figure 3-27.

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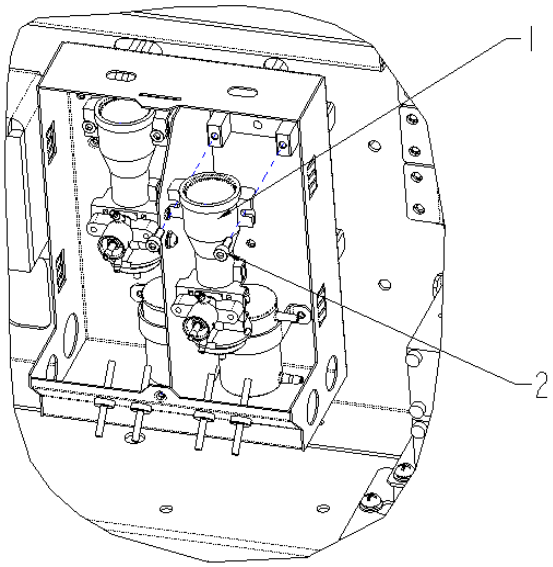
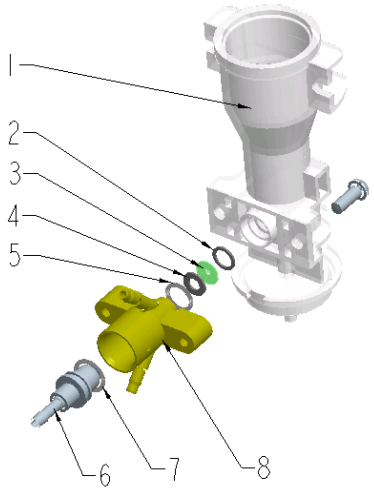
Figure 3-27 Dismantling and replacing the RBC bath assembly (2)



1 - RBC counting chamber assembly	2- M3×8 stainless-steel inner hex screw (×2)

5. Carefully and slowly take out the RBC counting bath assembly. Pay attention to the wiring during the process of moving to avoid breaking the wires.
6. Remove the protective ring from the shield case and open the wire clip to take out the inner wire along the stretching direction of the wire. Then take out the RBC counting bath assembly as a whole.
7. The further dismantling of the RBC counting chamber assembly. See Figure 3-28.

Figure 3-28 Dismantling and replacing the RBC bath assembly (4)



1 - Front counting bath	2 - Flat rubber gasket 6*4.5*0.5
3 - RBC aperture	4 - Flat rubber gasket 6*3*0.5
5 - O-shaped ring 5.5*1.0	6 - Electrode of the rear bath
7 - O-shaped ring 6.5*1.0	8 - Rear chamber

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Installation

NOTE

- All the wirings need to be set up according to the working procedures or the original positions of the machine components to prevent them from being crushed or otherwise damaged.
- Pay special attention to the tubing joints and ensure that the connections are sound.
- The aperture, seal gasket, and seal ring need to be correctly positioned and oriented in the right direction.

Follow the corresponding disassembly steps in reverse order.

Resetting the Machine

1. Reinstall the shield case cover.
2. Close the right side door.
3. Plug the power cord into the back panel of the device and turn on the power switch on the left panel of the device.

3.9 Main Control Panel Replacement

Purpose

The main control panel can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- Phillips screwdriver
- Corresponding specifications needed to replace the main control panel

Preliminary Steps

1. Pull out the power cord plug from the rear panel of the analyser, and turn off the power switch.
2. Disassemble the screws on the back panel of housing and remove the back panel of the housing.

Disassembly

1. Pull out the peripheral wires and connectors attached to the main control panel.
2. As shown in Figure 3-29, disassemble four M4×8 cross recessed pan-head combination screws fixing the main control panel, and remove the main control panel.

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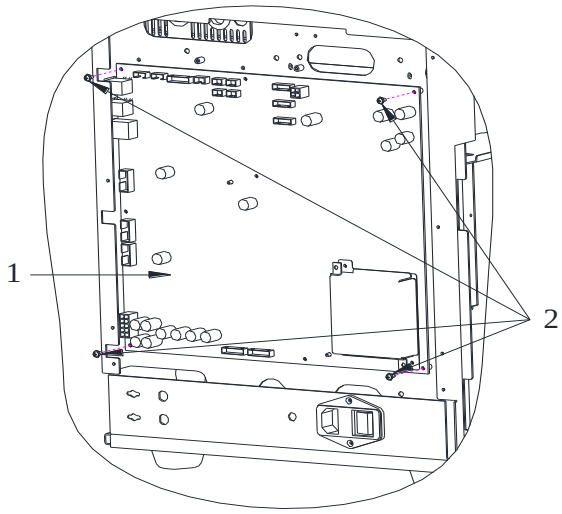
Figure 3-29 Replacement of the main control panel



1 - Main control panel	2 - M3×8 cross-recessed pan-head combination screw (×4)

Installation

Follow the corresponding disassembly steps in reverse order.

Resetting the Machine

1. Assemble the back panel of housing.
2. Plug the power cord into the back panel of the device and turn on the power switch.

3.10 Reagent Testing Panel Replacement

Purpose

The reagent testing panel can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- The replacement reagent testing panel with the same specifications

Preliminary Steps

1. Turn off the power switch on the left side of the device and pull out the power cord plug from the back panel of the device.
2. Open the left side door.

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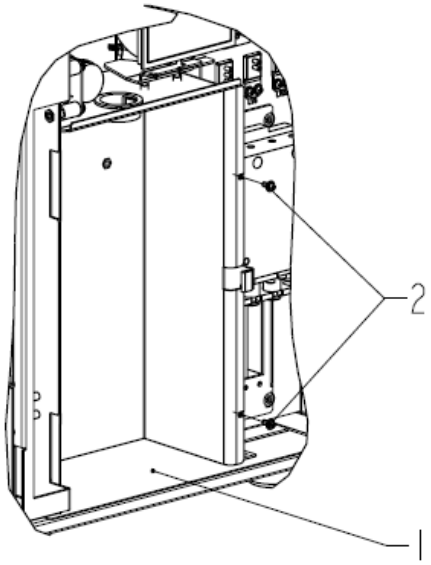
Disassembly

1. Remove the two M3×8 cross recessed pan-head combination screws fixing the reagent partition plate, and remove the protective cover. See Figure 3-30.

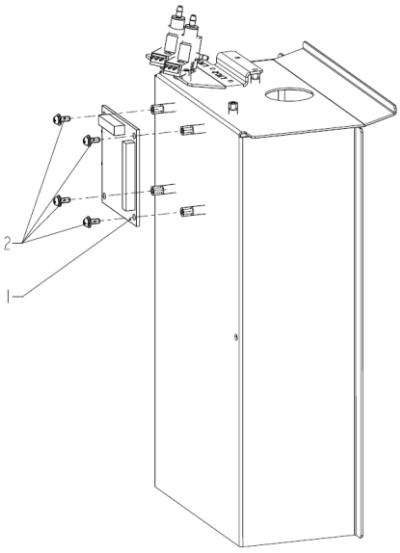
Figure 3-30 Replacement of reagent testing panel (1)



1- Reagent partition plate	2 - M3×8 cross-recessed pan-head combination screw (×2)

2. Pull out all the exposed peripheral wires connected to the reagent testing panel.
3. Remove the four M3×8 cross-recessed pan-head combination screws affixing the reagent testing panel and carefully take out the reagent testing panel. Make sure that the metal parts will not scratch the wiring at the rear of the panel. Pull out the rear wiring to remove the reagent testing panel. See Figure 3-31.

Figure 3-31 Replacement of reagent testing panel (2)



1 - Reagent detection panel	2 - M3×8 cross-recessed pan-head combination screw (×4)

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Installation

NOTE

- All the wirings need to be set up according to the working procedures or the original positions of the machine components to prevent them from being crushed or otherwise damaged.
- Pay attention to the position of wires when installing the sensor panel so as to prevent the wires from breaking.

Follow the corresponding disassembly steps in reverse order.

Resetting the Machine

1. Close the corresponding left side door.
2. Plug the power cord into the back panel of the device and turn on the power switch on the left panel of the device.

3.11 Disassembling and Replacing the Temperature Sensor

Purpose

The temperature sensor can be disassembled and replaced by following the procedures specified in this section; however, in each case, ***3.2 Preparatory Work before Repairs*** need to be taken before you begin.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- 2 hex-socket screwdrivers
- The replacement temperature sensor with the same specifications

Preliminary Steps

1. Turn off the power switch on the left side of the device and pull out the power cord plug from the back panel of the device.
2. Open the left side door and the front panel cover.

Disassembly

Loosen the screws in the bracket for temperature sensor to take the sensor out. Then replace it with a new sensor and tighten the screws. See Figure 3-32.

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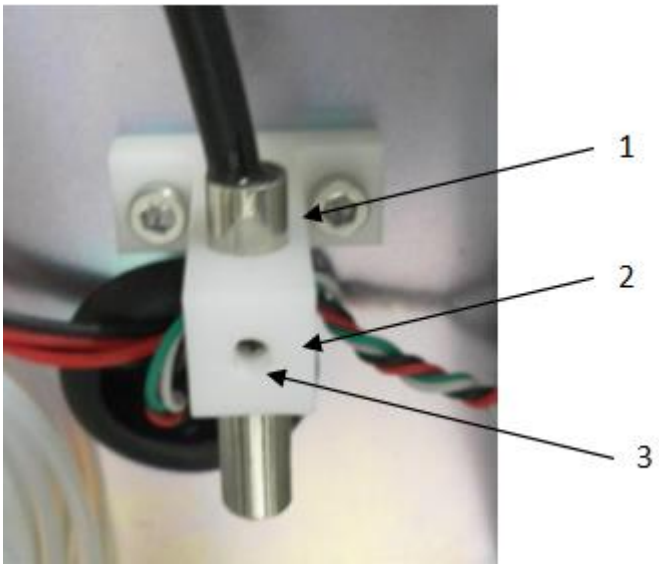
Figure 3-32 Disassembling the temperature sensor



1 - Temperature sensor	2 - Temperature sensor bracket
3 - M3×8 fixation screws	

Installation

Follow the corresponding disassembly steps in reverse order.

Resetting the Machine

1. Re-install the front panel cover, and close the corresponding left side door.
2. Plug the power cord into the back panel of the device and turn on the power switch on the left panel of the device.

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4 Software Upgrade

4.1 Preparation

1. Get officially provided upgrade package, and prepare a USB flash disk for storing the upgrade package.

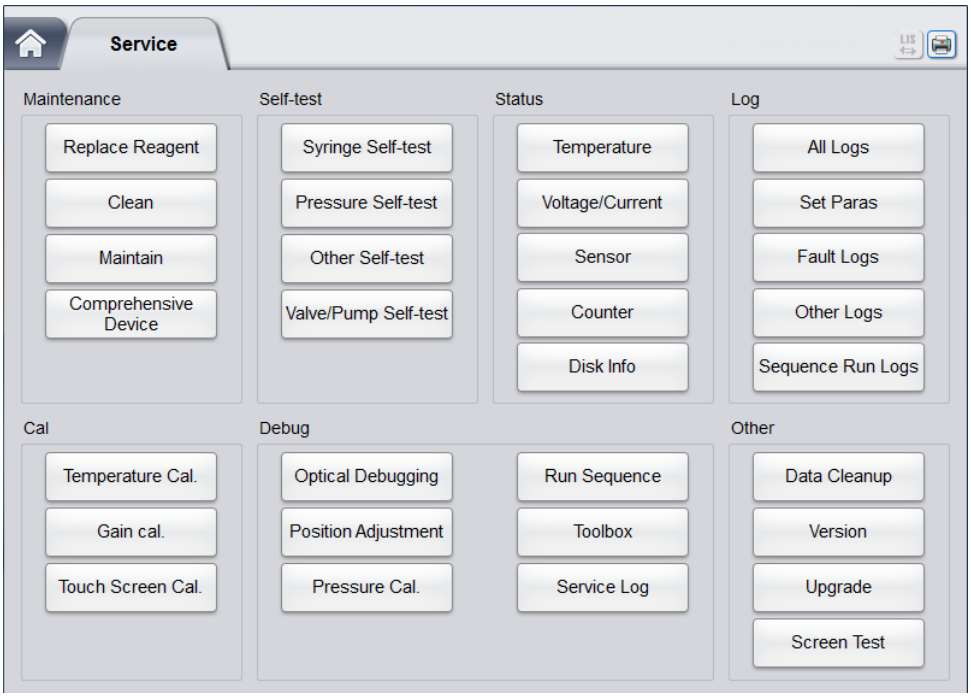
NOTE

- Please use USB flash disks manufactured by legitimate manufacturers.
- The USB flash disk capacity shall be larger than 1G, and the format is FAT32.

2. Copy the upgrade package to the root directory of the USB flash disk (Do not paste it into any newly-created folder).
3. Insert the USB flash disk with upgrade package into the USB interface of the host.
4. Use service authority to log in to the host.

4.2 Upgrading Steps

1. Enter the **Service** interface, and click the **Upgrade** button, as shown in the picture below.



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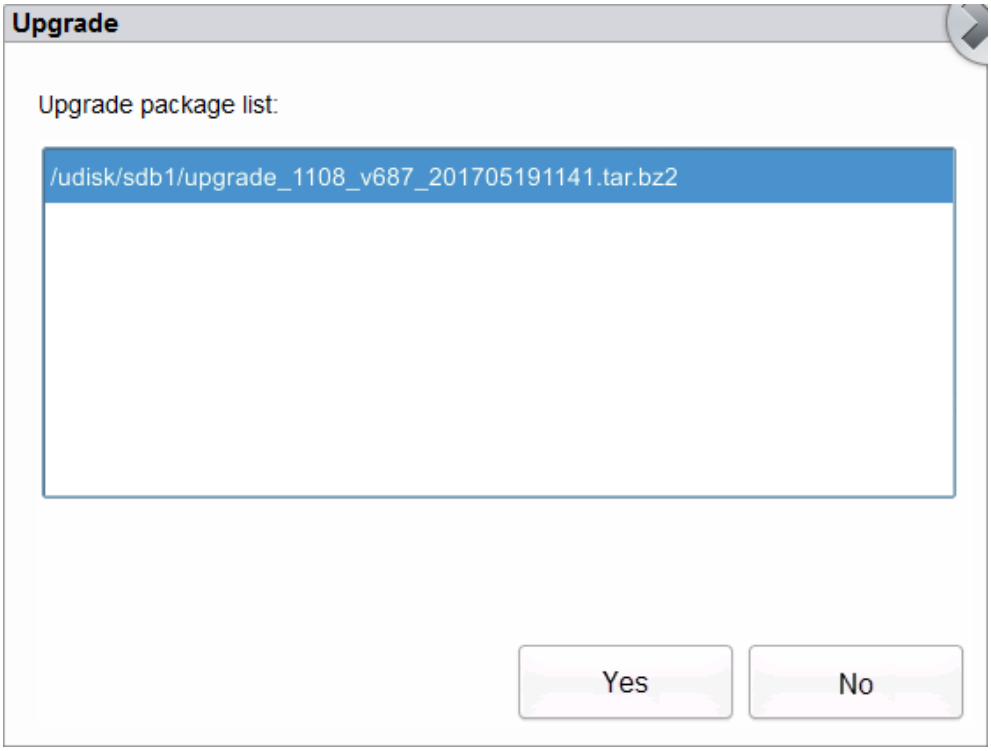
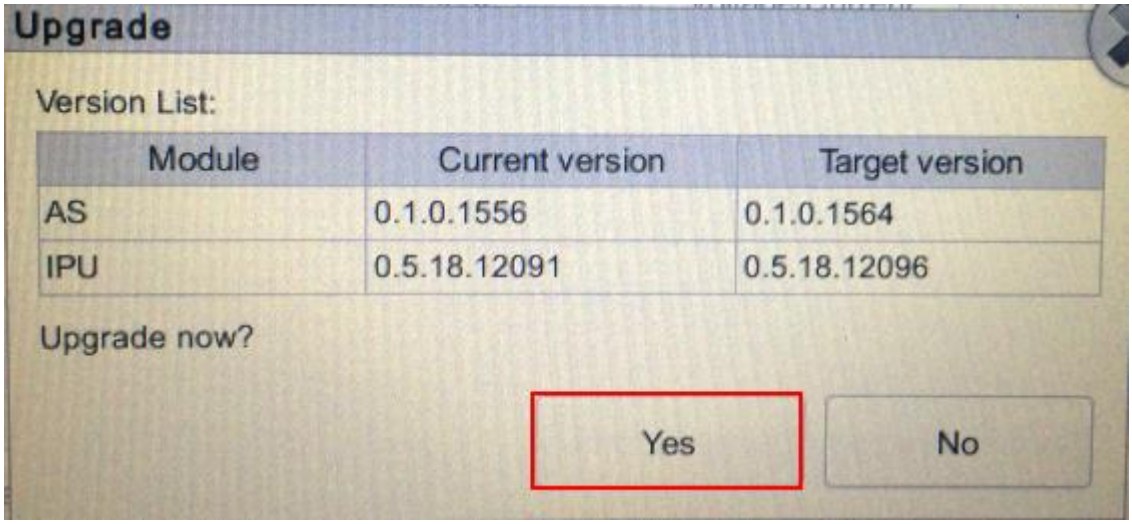
The host will detect the USB flash disk. 2~5 seconds later, if the USB flash disk cannot be recognised, there will be corresponding prompt in the interface, please insert the USB flash disk again; if the USB flash disk can be recognised, there will be dialog box in the interface as follows.



2. Select the upgrade file **upgrade_1108_v***xxx_XXXXXXXXXXXX***.tar.bz2**, and click **Yes**.

   v*xxx* indicates the version of the upgrade file, and *XXXXXXXXXXXX* indicates the release date of the upgrade file.

   The system will pop up a similar interface as follows, listing the modules able to be upgraded and their versions.



   Meaning of the name of each module:

   - LS: System boot program version
   - OS: Operating system version
   - HFPGA: FPGA program version

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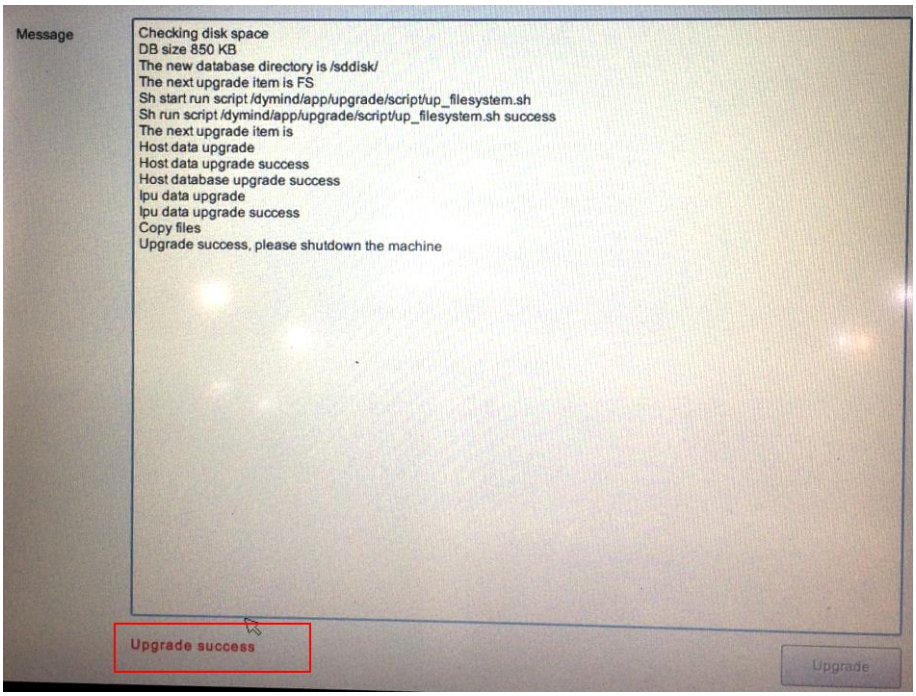
- DMCU: MCU program version
- AS: Application version

3. Click **Yes** to start the upgrade; click **No** to cancel the upgrade and restart the analyser.

   There will be prompt with the upgrading progress on the screen. If the upgrade is successful, the progress bar will display 100%. See the picture below.



4. Turn off the power supply of the analyser, and restart the analyser.

4.3 Touch Screen Calibration

After replacing with a new touch screen, it is necessary to calibrate the touch screen prior to use, steps for calibration are as follows:

1. Prepare a USB flash disk with FAT32 format, create a new **ts.txt** file under its root directory.
2. Insert the USB flash disk into the USB interface on the analyser.
3. Turn on the device power supply, and start the analyser.
4. When the login interface is displayed on the LCD screen, press and hold the sample Aspirate key for more than 15s.

   There will be black calibration interface displayed on the LCD screen, as shown in the picture below.

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5. Use a hard object, such as a toothpick or pencil to click the focal points successively appearing on the screen (5 points in total).

   After clicking 5 focal points, the touch screen calibration is complete.

6. Turn off the power supply of the analyser, and restart the analyser.

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5 Comprehensive Device Tuning

NOTE

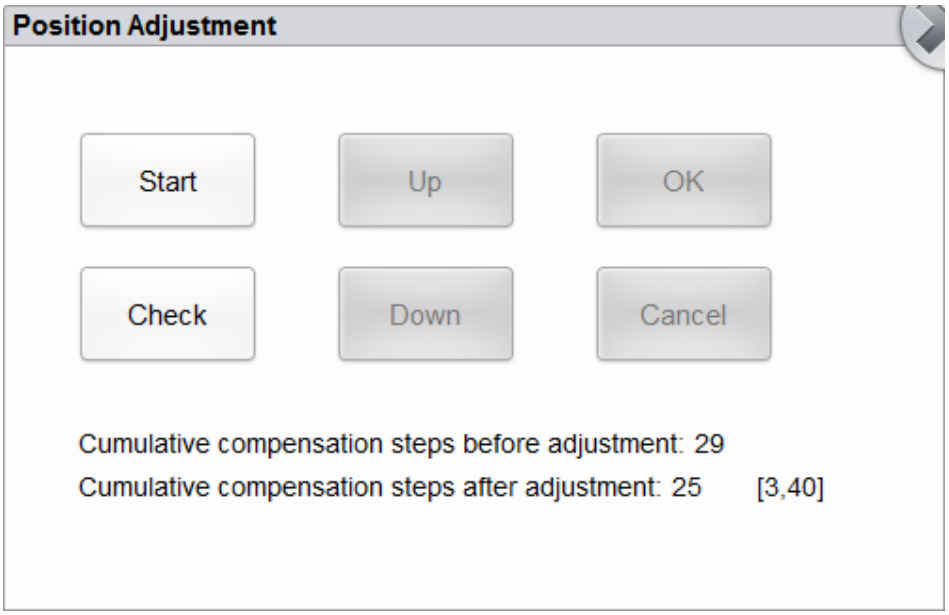
Since the replacement and maintenance of some components can lead to changes in relevant tuning parameters, this section introduces the tuning procedures for the parameters that may be affected.

5.1 Position Adjustment

NOTE: The swab height needs to be reset after the replacement of the sampling assembly and relevant parts of the sampling swab.

After the replacement of the sampling assembly or swab, perform the following tuning procedures.

1. Enter the **Service** screen and click **Position Adjustment**.
2. Click **Start** and check the distance between the bottom of the sample probe and the bottom of the swab. If the sample probe is lower than the swab, click **Up**; if higher, click **Down**. Each click will move the sample probe slightly. In the end, the bottom of the sample probe will be aligned with the bottom of the swab. Then click "OK".



3. Next, click **Check** to run the initialisation of the sample probe. Check if the bottom of the sample probe is still aligned with the bottom of the swab (see Figure 5-1). If it is, click **OK** to complete the tuning; if not, repeat Steps 1~2.

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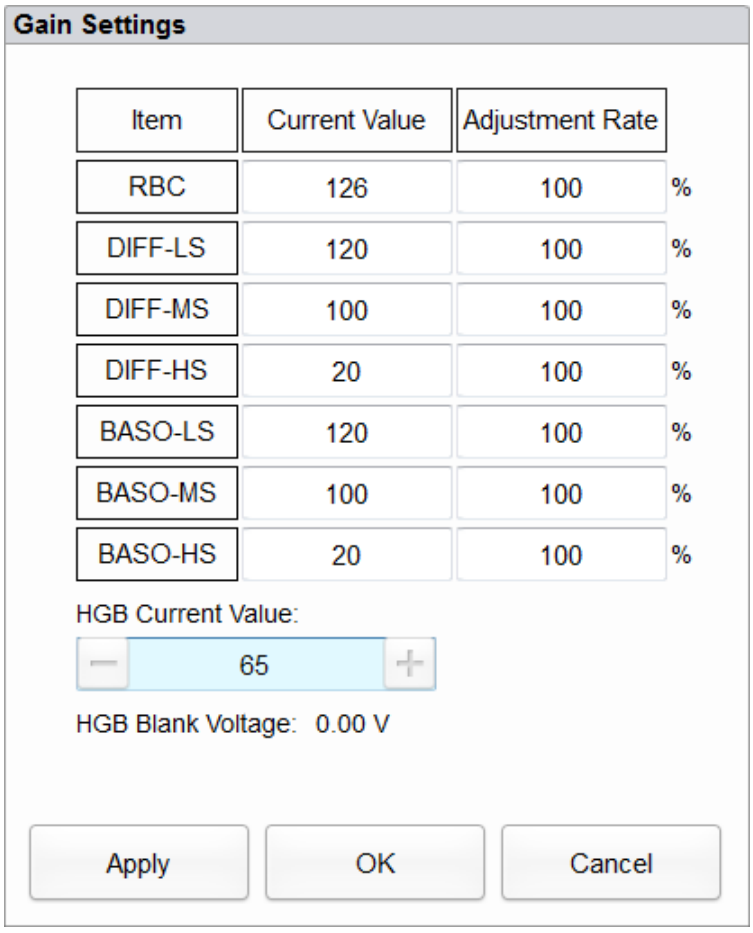
Figure 5-1 Position Adjustment

5.2 HGB Voltage Gain Setting

NOTE: The HGB voltage gain setting needs to be performed for the replacement of WBC bath, HGB wire and/or main control panel.

1. In the **Setup** > **Meterage** screen, click **Gain Settings**.
2. Click the up/down adjustment button after the filling blank for HGB value and HGB background voltage value will change accordingly within 4.5+/-0.3V.
3. Click **OK** (see Figure 5-2).

Figure 5-2 HGB voltage gain setting



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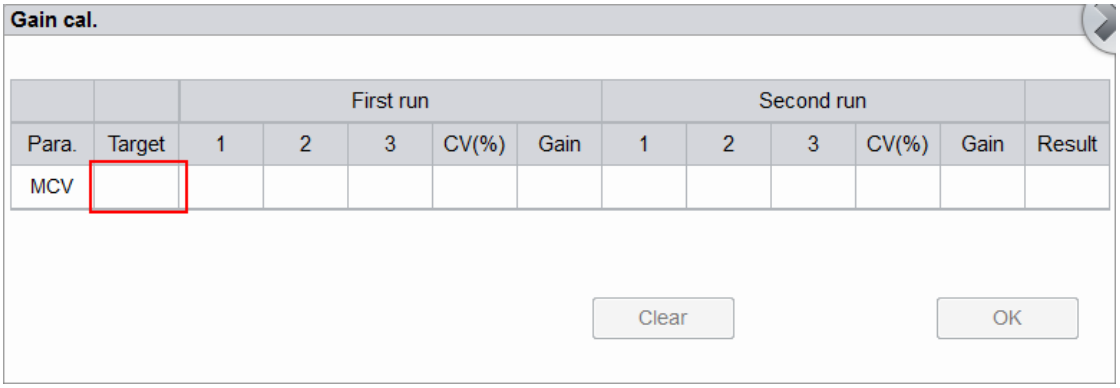
5.3 Gain Calibration

NOTE: Gain calibration needs to be performed for the replacement of RBC bath and/or main control panel.

1. Click **Service** > **Gain cal.** to access the gain calibration screen. See Figure 5-3.

Figure 5-3 Gain calibration



2. Fill in the cell corresponding to MCV with the MCV reference value for quality control.
3. Perform the QC test for three times in a row for the first run.

   The results for each time will be automatically displayed.

   - If the CV falls within reasonable parameters, the screen will show the CV and Gain values for the first run. Go to step 4.
   - If it does not fall within reasonable parameters, you'll be prompted to redo the calibration. Please click **OK** to close the message box. Then click **Clear** to delete the data, and repeat step 3.
4. Perform the QC test for three times in a row for the second run.

   The results for each time will be automatically displayed.

   - If the CV falls within reasonable parameters, the screen will show the CV and Gain values for the second run, and show the final results. Please click "OK" to complete gain calibration.
   - If it does not fall within reasonable parameters, you'll be prompted to redo the calibration. Please click **OK** to close the message box. Then click **Clear** to delete the data, and repeat step 4.

5.4 Calibration of Calibrators

NOTE: The calibrators need calibration for the replacement of the WBC bath, the RBC bath, and/or the main control panel.

5.4.1 Calibration in Whole-blood Mode

1. In standby mode, click **Cal** to enter the calibration screen.
2. Select **Calibrator** (see Figure 5-4).

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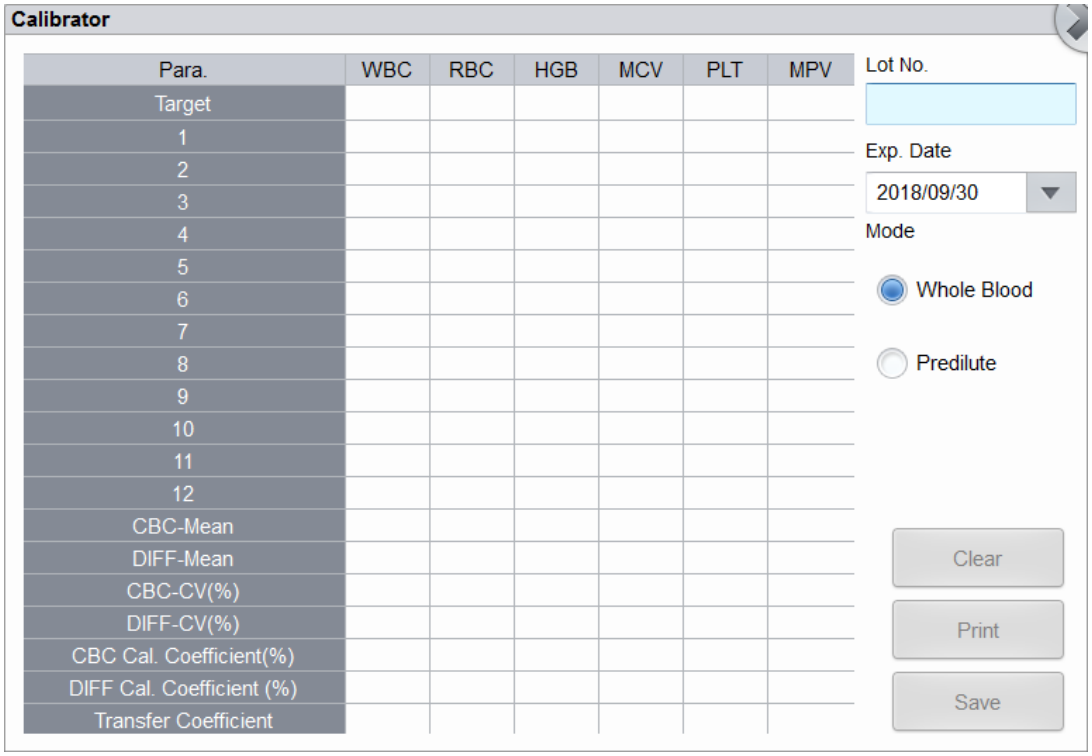
Figure 5-4 Auto Calibration Using Calibrators



3. Input the calibrator lot No. **JZQX-01** in the text box for **Lot No.**, and click **Exp. Date** to set the expiry date of the calibrator.
4. Input the target value of the current calibrator parameter.

   The calibration mode is **Whole Blood** by default, so there is no need to set the mode.
5. Set the well-mixed calibrator under the sample probe, then press the aspiration key on the analyser to start the calibration counting.
6. Repeat step 5 for a total of 12 times to get 12 results of calibration counting.

   - After the counting is complete, a dialog box will pop up indicating that the test is complete. Click the **Save** button to save the calibration result.
   - If significant differences are found across results, a dialog box for data abnormality will pop up. Please redo the calibration.

5.4.2 Calibration in Predilute Mode

1. In standby mode, click **Cal** to enter the calibration screen.
2. Select **Predilute** on the right side of the screen.
3. Input the calibrator lot No. **JZYXS-01** in the text box for **Lot No.**, and click **Exp. Date** to set the expiry date of the calibrator.
4. For calibration using the prediluted calibrators, please refer to steps 4~6 in whole-blood mode.

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5.5 LIS Connection

If the analyser needs to be connected to laboratory information system (hereinafter referred to as LIS), you can complete the connection by following the steps in this section.

5.5.1 Installing LIS Workstation

1. Install LIS workstation and set instrument type and model.
2. Enter LIS workstation network setup interface after installation and set monitoring IP address and port number.

NOTE

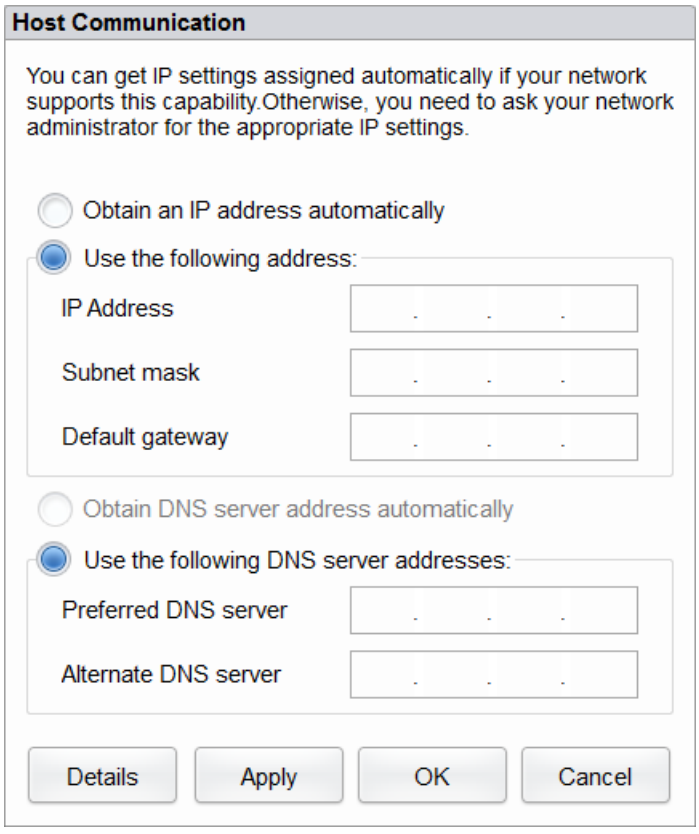
Refer to ***Description of LIS Communication Protocol for Haematology Analysers*** to complete the support of the LIS workstation to the LIS communication protocol.

5.5.2 Host Communication Settings

1. Use a network cable to connect the analyser to LIS local area network.
2. Log on the InSight V5 Haematology Analyser software; if the analyser is turned on, skip this step.

   The whole process lasts for 4 to 12 minutes.
3. In the **Setup** interface, click **Host Communication** in the **Communication** selection to access the Laboratory Information System (LIS) communication setting interface. See Figure 5-5.

Figure 5-5 Host Communication Settings



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4. Set the IP address and other network information of the analyser according to the actual situation.
   - If the network is accessed through a router on the site, please select **Obtain an IP address automatically** and **Obtain DNS server address automatically**.
   - If the network is accessed through a network switch, or the analyser is directly connected to the LIS on the site, please select **Use the following address**, so as to manually set the IP address and subnet mask of the analyser. The IP addresses of the analyser and LIS must be in the same network segment. Furthermore, their subnet masks shall be the same, while other parameters can maintain null.
5. Click **OK** to save the settings and close the dialog box.

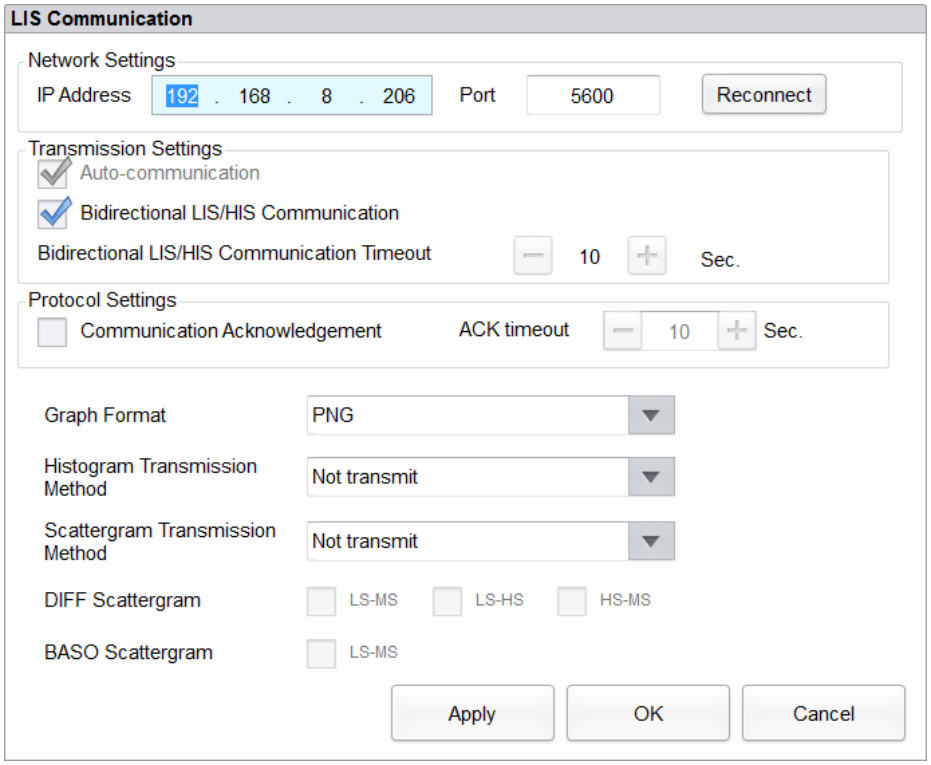
5.5.3 Connecting Analyser with LIS

1. Log on the InSight V5 Haematology Analyser software; if the analyser is turned on, skip this step.

   The whole process lasts for 4 to 12 minutes.
2. In the **Setup** interface, click **LIS Communication** in the **Communication** selection to access the Laboratory Information System (LIS) communication setting interface.

   See Figure 5-6.

Figure 5-6 LIS Communication Settings



3. Input the IP address and port of LIS workstation in **Network Settings** area.

   Find the IP address and port of LIS in the network setup interface in the LIS workstation; if IP address can't be found, try the method below:

   a. Enter the operating system of LIS workstation.

   b. Press combination key [Windows+R] to open the **Run** window.

   c. Input cmd, and then click **OK**.

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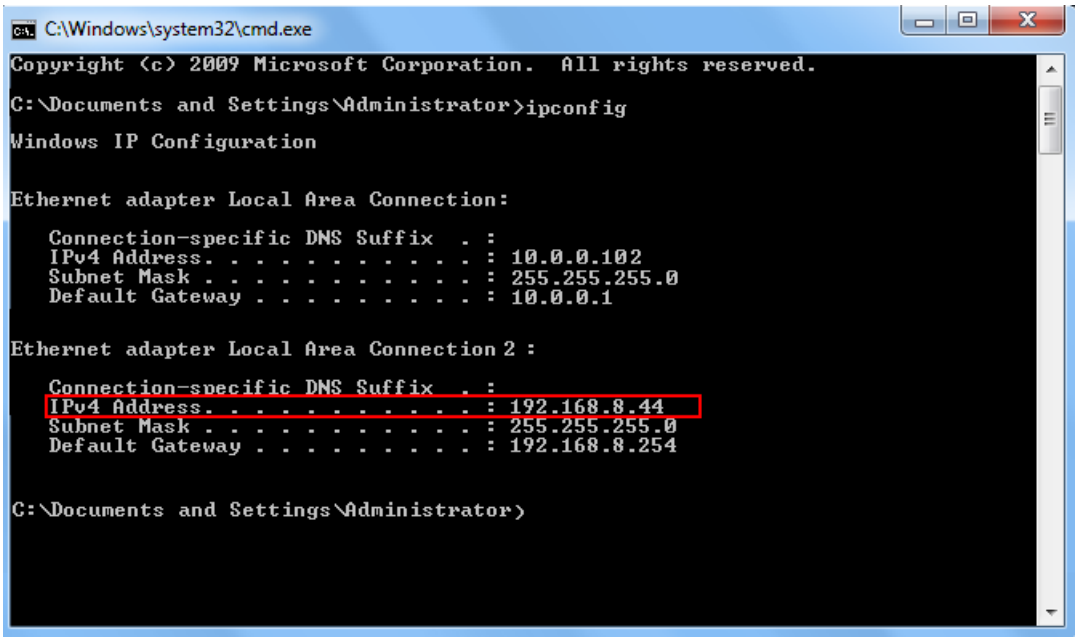
d. Input the ipconfig command into the **cmd.exe** window popped out.

The interface shows similar content as follows:



The IPv4 address in the red box is the IP address of LIS workstation.

NOTE

The IP address **192.168.8.44** of the LIS workstation shown as above is used as an example, real IP should be in the same network segment with LIS server.

4. Click **OK** to save the settings.
5. Check if the connection is successful.

   The LIS icon in the upper right side on the analyser screen turns from grey 

to black 

, which indicates the InSight V5 Haematology Analyser software is connected to LIS successfully.

   If the icon stays grey, the connection has failed. Please check if the IP address and port of LIS is correct and reconnect as the steps above; if the problem still exists, please contact the hospital network administrator.

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6 Alarms and Solutions

This section introduces error messages that can appear in the analyser, possible causes, and troubleshooting steps to be taken by the operator. If the problem persists after troubleshooting, please take hardware issues into account and consider replacing the relevant parts or panels.

For the following issues, please click the error message box at the bottom right corner of the software interface, then click **Remove Error** in the popup dialog box. Usually the problem will be automatically resolved; if it persists, refer to the **Solution** column in Table 6-1 for further maintenance.

Table 6-1 Alarms and Solutions

No.	Problem Name	Problem Description	Solution
1	Syringe problem	The syringe fails to leave its initial position.	This syringe problem can occur while it is being moved. Please refer to the following solution: 1. Follow the instructions in ***3.7 Sheath Flow Syringe Assembly Replacement*** to disassemble the syringe, then remove the dust cover and optocoupler. Plug the optocoupler into the connector of the syringe optocoupler. The user enters the **Status** > **Sensor** screen and covers the center of the optocoupler with a piece of paper. Check if the optocoupler status shown in the screen is blocked; if yes, then the optocoupler is working properly. 2. Follow the instructions in ***3.7.2 Replacing the Motor*** to disassemble the syringe motor and replace it with a new motor. Then go to syringe self-test under **Service** > **Self-test** > **Syringe**; if the syringe is working, then the maintenance has been successful.
		Syringe fails to return to its initial position.	
		The syringe takes too many steps to return to its initial position.	
		Syringe busy.	
		Syringe action overtime.	
2	Horizontal motor problem	The horizontal motor fails to leave its initial position.	1. The user enters the **Status** > **Sensor** screen and covers the center of the optocoupler with a piece of paper. Check if the optocoupler status shown in the screen is blocked. If it is, then the optocoupler is working properly; if not, then refer to ***3.4.2 Replacing the Optocoupler*** on how to replace the optocoupler. 2. Refer to ***3.4.3 Replacing the Sampling Assembly in X- or Y-direction*** to disassemble the sampling assembly and make sure the motor wiring is secure. If the wiring is OK, then disassemble the motor and replace it with a new one. After the installation, make proper adjustments to the belt's tension, then go to the syringe self-test under **Service** > **Self-test** > **Syringe**. If the syringe is working, then the maintenance
		The horizontal motor fails to return to its initial position.	
		The motor fails to move to the WBC position.	
		The motor fails to move to the RBC position.	

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No.	Problem Name	Problem Description	Solution
		The motor fails to move to the open sampling position.	process is OK.
		The horizontal motor is busy.	
		Horizontal motor timeout	
		The optocoupler of the horizontal motor is not working properly.	
3	Vertical motor problem	The vertical motor fails to leave its initial position.	1. The user enters **Status** > **Sensor** screen and covers the center of the vertical optocoupler with a piece of paper. Check if the corresponding optocoupler status shown in the screen is blocked. If it is, then the optocoupler is working properly; if not, then refer to ***3.4.2 Replacing the Optocoupler*** on how to replace the optocoupler. 2. Refer to ***3.4.3 Replacing the Sampling Assembly in X- or Y-direction*** to disassemble the motor from the sampling assembly and make sure motor wiring is secure. If the wiring is OK, then disassemble the motor and replace it with a new one. After the installation, make the proper adjustments to the belt tension, then go to the syringe self-test under **Service** > **Self-test** > **Syringe**. If the syringe is working, then it has been successfully fixed.
		The vertical motor fails to return to its initial position.	
		The motor fails to move into position to isolate the air bubbles.	
		The motor fails to move to the DIFF bath position.	
		The motor fails to move to the counting bath position.	
		The motor fails to move to the open sampling position.	
		The vertical motor is busy.	
		Vertical motor timeout	
4	The CC source voltage is abnormal	The CC source voltage is abnormal.	Refer to ***3.9 Main Control Panel Replacement*** to replace the main control panel.

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No.	Problem Name	Problem Description	Solution
5	The laser current is abnormal	Abnormal laser current.	Refer to ***2.4.1 Integral Replacement of the Optical Assembly*** to disassemble the optical shield cover and see if the optical laser is on with normal power input (the normal measurement range of the optical power meter is 4.8+/-0.5). If the optical laser is not on or the measured optical power is far lower than 4.8, this means that the laser is burnt out. Please refer to ***2.4.1 Integral Replacement of the Optical Assembly*** to replace the entire optical assembly.
6	The 12V power is not working properly	+12V power is not working properly.	Refer to ***3.9 Main Control Panel Replacement*** to replace the main control panel.
		-12V power is not working properly.	
7	Abnormal background voltage	Abnormal HGB background voltage. (The rated range of background voltage is 4.2~4.8V; a system message "abnormal background voltage" will be shown to remind the user to adjust HGB gain.)	1. Take another measurement after performing the soaking with probe cleanser to see if the problem has been resolved. If not, enter into the system for multiple times to check HGB background voltage. If the voltage is steady and exceeds the standard ratings, please perform the following procedures. 2. Go to **Setup** > **Host Settings** > **Gain Settings** screen, adjust the current HGB gain and set HGB background voltage within 4.5+/-0.1V. 3. If the problem persists, please try to clean the transmitting end and the receiving end of the HGB bracket. These two areas should not be cleaned with alcohol or organic solvents. Instead, use a rubber pipette bulb for purging. If the counting bath is contaminated with liquid, wipe it clean with lint free tissue. 4. If the problem persists after the above steps are taken, please consider replacing any relevant components such as the HGB bracket or analog panel.
8	Abnormal temperature	The ambient temperature exceeds the working range.	Check if the ambient temperature is within the specified range of 15~30°C; if yes, refer to ***3.11 Disassembling and Replacing the Temperature Sensor*** to replace the temperature sensor.
		Preheating bath temperature out of working range	Check if the wiring between the temperature sensor and the heating plate in DIFF bath is loose. If the connection is OK, replace the DIFF bath.
		Optical system temperature out of working range.	Check if the wiring between the optical temperature sensor and the heating rod in the DIFF bath is loose; If the connection is OK, use a thermometer to measure the temperature inside the aperture at the top of the front-end optical assembly. Check if the temperature is within the working range. If it is not, replace the heating rod; otherwise, replace the temperature sensor.

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No.	Problem Name	Problem Description	Solution
9	Pressure chamber problem	The positive-pressure chamber fails to create pressure	Refer to ***2.2.12.9 Problems with Creating Positive Pressure*** for troubleshooting.
		Abnormal pressure of positive-pressure chamber (lower than normal)	
		Abnormal pressure of positive-pressure chamber (higher than normal)	
		The negative-pressure chamber fails to create pressure	Refer to ***2.2.12.10 Problems in Creating the Negative Pressure*** for troubleshooting.
		Abnormal pressure of negative-pressure chamber (lower than normal)	
		Abnormal pressure of negative-pressure chamber (higher than normal)	
10	Clogging of flow chamber /DIFF probe	Flow cell clog.	Refer to ***2.2.12.4 Clogging of the Flow Chamber/DIFF Probe*** to clean the flow chamber or DIFF probe for multiple times.
		DIFF probe clogging.	
11	Abnormal background	Abnormal background. (One or multiple results of background measurement exceed the background range.)	1. Check if the reagent has expired or is contaminated. 2. Go to the **Service** > **Maintenance** > **Maintain** screen and click **cleanser soaking** to clean the hydraulics. Then return to the **Sample Analysis** screen and conduct background measurements to see if the problem has been resolved. 3. If the problem persists, please check for any peripheral interference from the grounding wire or shield wire, or if any electrical devices are being used on and off in the area. This can influence the counting results. 4. If there is no such interference, please check the airtightness of each syringe and the rear chamber of the counting bath. If the airtightness is unsatisfactory, then replace accordingly.

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No.	Problem Name	Problem Description	Solution
12	Abnormal RBC counting	RBC clogging.	1. Go to the **Service** > **Maintenance** > **Maintain** screen and click **Unclog** to start unclogging. 2. Go to the **Service** > **Self-test** > **Valve/Pump Self-test** screen, click **Valve 18** and check if it is working. If it is OK, please refer to ***2.2.12.5 Aperture Clogging of the RBC Channel*** for operation. 3. Go to the **Service** > **Maintenance** > **Maintain** screen and click **RBC Channel Cleanser Soak**.
13	Waste overflow	Waste container is full.	Check the connection of the float sensor at the rear section of the machine; if the connection is OK, replace the float sensor for waste overflow detection.
14	Abnormal reagent	V5 DIL expiration.	Expired reagent or insufficient residual amount. This means that the reagent has gone out of date or the amount remaining is insufficient to support hydraulics operations such as counting. Please follow the troubleshooting procedures below: Go to the **Reagent Management** > **Setup** screen, scan the barcode of the new reagent as shown in the alarm message, and then load the reagent to resolve the problem.
		Insufficient V5 DIL.	
		V5 DIL not replaced.	
		V5 LY2 expiration.	
		Insufficient V5 LY1.	
		V5 LY2 not replaced.	
		V5 LY2 expiration.	
		Insufficient V5 LY1.	
		V5 LY2 not replaced.	
15	No reagent	No V5 DIL.	1. Check if V5 DIL is running out. 2. If the remaining volume of V5 DIL is a lot, check if the diluent float sensor is placed correctly. If it does, click the Remove Error button to automatically resolve the error. 3. If V5 DIL is running out, replace with new V5 DIL. And then click the Setup button on the reagent management interface, and set up the reagent information according to prompts. 4. Click the Remove Error button to automatically resolve the error. 5. If the remaining volume of V5 DIL is a lot, or the error persists after replacing with new V5 DIL, replace the diluent float sensor.

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No.	Problem Name	Problem Description	Solution
		No V5 LY1.	1. Check if V5 LY1 has air bubbles in inlet tubing or is running out. 2. If there is no V5 LY1, replace with new V5 LY1. Click the **Remove Error** button to automatically resolve the error. 3. If the remaining volume of V5 LY1 is a lot, or the error persists after replacing with new V5 LY1, perform the next step. 4. Check whether the reagent detection module is cracked. If it is cracked, replace the reagent detection module component with a new one.
		No V5 LY2.	1. Check if V5 LY2 has air bubbles in inlet tubing or is running out. 2. If there is no V5 LY2, replace with new V5 LY2. Click the **Remove Error** button to automatically resolve the error. 3. If the remaining volume of V5 LY2 is a lot, or the error persists after replacing with new V5 LY2, perform the next step. 4. Check whether the reagent detection module is cracked. If it is cracked, replace the reagent detection module component with a new one.
16	Door or cover open error	The right-side door is open.	Check if the right-side door is open. The door should not press against the microswitch. If the door is properly closed, please replace the microswitch on the side door.
		Optical assembly cover is open.	Open the optical shield cover, then close it again to check if the problem has been resolved; if not, replace the optical microswitch.

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7 Maintenance Inventory

No.	Material No.	Material Name
1	20.01.0121A	WBC counting bath assembly
2	20.01.0144A	RBC counting bath assembly
3	20.01.0321A	1104 syringe holder assembly
4	20.01.0322A	Main body of the syringe assembly (1104)
5	20.01.1282A	Sampling syringe main body assembly (1104B)
6	20.01.0039A	3-in-1 syringe holder assembly
7	20.01.1107A	Sampling assembly
8	20.01.1106A	Negative-pressure chamber assembly
9	20.01.1204A	Positive-pressure chamber assembly
10	20.01.0125A	Front panel cover
11	22.01.0018A	Indicator light panel PCBA
12	22.01.0204A	Reagent presence testing PCBA
13	22.01.0021C	PCBA of the main control panel (Programmed) (1104)
14	22.01.0025A	Reagent sealing panel PCBA (Programmed)
15	20.01.0312A	Two-way valve assembly (S)
16	20.01.0313A	Three-way valve assembly (S)
17	20.01.0314A	Two-way valve assembly (L)
18	20.01.0315A	Three-way valve assembly (L)
19	23.99.0005A	Wire for the pinch valve
20	23.99.0007C	Wire for the location optocoupler
21	23.99.0008A	Wire for the liquid pump
22	23.99.0015A	Wire for sample absorption micro-switch
23	34.18.0007A	Wire for the temperature sensor
24	24.02.0003A	Linear motor
25	23.99.0018A	Wire for the side door microswitch
26	24.13.0015A	Check valve for lyse

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No.	Material No.	Material Name
27	53.08.0016A	Belt pulley
28	53.99.0018A	Air filter
29	24.13.0008A	One-way valve
30	43.11.0010A	Photoelectric sensor
31	60.01.0109B	Reagent detection module
32	24.01.0002A	Air pump
33	23.99.0043A	Wire for dual fan
34	24.02.0022A	Stepping motor
35	24.05.0033A	Synchronous belt (BANDO140MXL6.4mm)
36	24.05.0034A	Synchronous belt (BANDO192MXL6.4mm)
37	31.02.0001B	LCD screen
38	68.02.0008A	Consumer screen (accessory)
39	68.02.0009A	Industrial screen (accessory)
40	31.11.0004A	Touch screen
41	32.01.0006B	Power
42	37.01.0010A	Control wire for AD input
43	37.01.0021A	Grounding wire for the rear panel
44	37.02.0748A	Valve control wire 1~10 (1104B)
45	37.02.0750A	Valve control wire 11~20 (1104B)
46	37.02.0534A	Control wire for the sampling syringe (1104B)
47	37.02.0035A	Control wire for the horizontal/vertical stepping motor
48	37.02.0036B	Control wire for the sampling optocoupler
49	37.02.0533A	Control wire for the syringe optocoupler (1104B)
50	37.02.0048A	Control wire for the float sensor
51	37.02.0040A	Liquid pump control wire
52	37.02.0042A	Control wire for the temperature sensor
53	37.02.0043A	Control wire for heating of preheating bath
54	37.02.0044A	Control wire for heating of optical system
55	37.02.0645B	Control wire for the display screen (1004)
56	37.02.0641A	Control wire for the touch screen (1004)
57	37.02.0642A	Back-light control wire (1004)
58	37.02.0049A	Reagent control wires

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No.	Material No.	Material Name
59	37.02.0055A	Control wire for the front panel cover
60	37.02.0060A	Data signal wire for industrial screen
61	37.02.0061A	Backlight wire for industrial screen
62	37.02.0751A	CAN control wire of closed reagent panel (1104B)
63	37.02.0535A	Air pump control wire (1104B)
64	37.02.0536A	Control wire of reagent detection optocoupler (1104B)
65	37.02.0749A	Valve control wire 21 (1104B)
66	53.02.0001A	Cross blind hinge
67	53.09.0003A	Guide shaft
68	53.20.0001A	Towing-chain connectors
69	53.99.0001A	Towing chain
70	20.01.0984A	Cleansing swabs
71	56.01.0163A	Open sample probe (Needle open)
72	60.01.0012A	Isolation chamber
73	60.01.0046A	1104 Keyboard plate for sample absorption switch
74	60.10.0024A	1104 series screen-printing housing
75	63.01.0001A	STHT tube for maintenance
76	63.01.0002A	Pharmed tube for maintenance
77	63.01.0007A	EVA tube (1100mm) for maintenance
78	63.01.0008A	Slim No. 50 tube (1000mm) for maintenance
79	63.01.0009A	Wide No. 50 tube (850mm) for maintenance
80	63.01.0010A	No. 3603 tube (1500mm) for maintenance
81	63.01.0011A	MPF tube (1000mm) for maintenance
82	63.01.0013A	1.5mm Teflon tube (1100mm) for maintenance
83	63.01.0014A	1.0mm Teflon tube (1000mm) for maintenance
84	63.01.0003A	ABW00002 silicone tube for maintenance
85	63.01.0004A	ABW00003 silicone tube for maintenance
86	63.01.0021A	3.2mm Saint-gobain silicone tube for maintenance
87	63.01.0016A	2.4mm TPU rubber tube (300mm) for maintenance
88	63.01.0020A	2.0mm (i.d.) PTFE tube (220mm) for maintenance
89	63.01.0051A	1.6mm tube for maintenance
90	63.01.0080A	Rubber tube for maintenance

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