Infitek

HEMA-D6190

AUTO HEMATOLOGY ANALYZER

MAINTENANCE MANUAL

Version 2024.03.01

INFITEK CO., LTD.

Chapter 1 Introduction

To be well up in the instrument, please read this manual carefully to have the knowledge for servicing the instrument perfectly and avoid extra costs and wasting precious time.

This Technician Manual contains the functional descriptions of analyzer, the operation of the fluidic systems, the adjustments and settings and very important information for the Service Personnel about the service operations and possible problems.

1.1 Name and serial number

Name: Automatic Hematology Analyzer

Serial No.: Each instrument has its own serial number, which is pasted on the rear panel label.

1.2 Intended use

Hematology analyzer is fully automated cell counter for in vitro diagnostic use. The compact instruments were developed for small to medium size labs or hospitals.

HEMA-D6190 can process 60 samples per hour and they are intended to determine the following 21 hematology parameters and 3 histograms.

. WBC - LY# - MID# - GR# - LYM% - MID% - GR% (three parts WBC differential)

. HGB - RBC - HCT - MCV - RDW-CV - RDW-SD - MCH - MCHC

. PLT - MPV - PCT – PDW- P-LCR-P-LCC

Three cell histograms: WBC histogram-RBC histogram-PLT histogram

1.3 Integrated software

The integrated software controls the instrument operations, displays, stores, recalls data, and allows the User to perform QC and calibration procedures and modify the user settings. The software version can be read from the Maintenance menu.

1.4 Specification

Hemoglobin Analysis

Wavelength 540nm

Sampling Features

Volumes Required for Each Analysis：

Whole Blood Mode (vein blood) 10uL

Prediluted Mode (capillary blood) 20uL +500ul diluent

Aspirated volumes： 1ml of lyse for WBC measurement

Dilution Ratios	Whole Blood	Prediluted
WBC/HGB	1: 277	1:365
RBC/PLT	1:24476	1: 32480

Cell Counting Aperture Size：WBC 80um RBC 80um

Throughput 60 tests/hour

Display

10.4 inch color touch screen，resolution: 800×600

Input/Output

2 USB ports to connect external printer, keyboard, mouse

1 External display interface

1 LAN network port

2 RS232 serial port

External Thermal Printer

Internal Reagent Barcode Reader (optional)

Reagents Required

Diluent, Lyse, Detergent, Concentrated Cleaner for aperture maintenance

Power Input:

AC 100-240V±10%

50/60±1 Hz

Consumption: 300 VA

Fuse: 2A

Ambient Temperature and Humidity

Temperature:

15℃～35℃ (59℉～95℉)

Humidity:

10%～85% without condensation

Dimensions

Height Width Depth

35.4cm 43cm 44cm

Weight

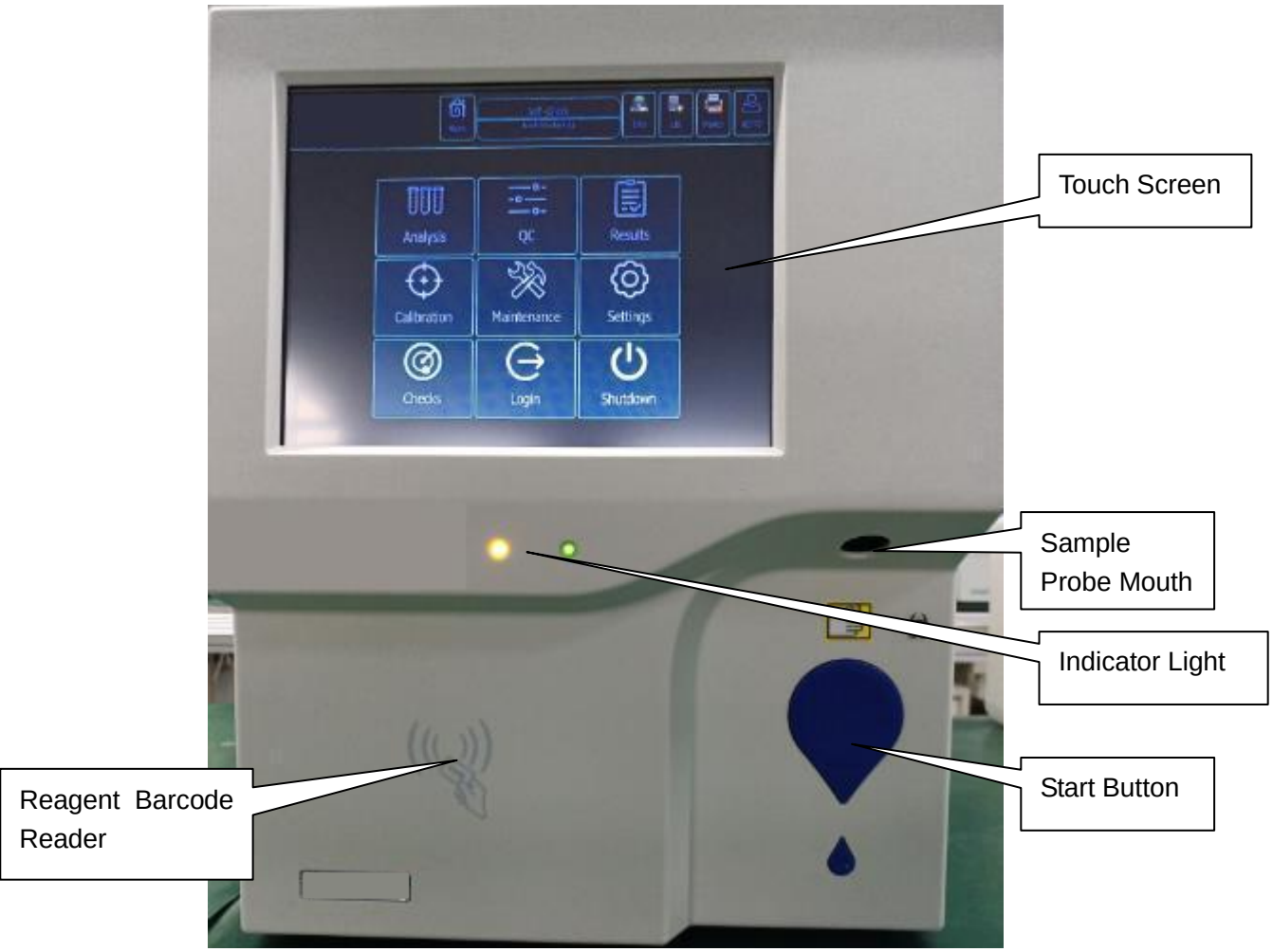
Net: 25KG Gross: 21.8KG

Recommended Anticoagulant

A salt of EDTAK2 with the proper proportion of blood to anticoagulant, as specified by the tube manufacturer.

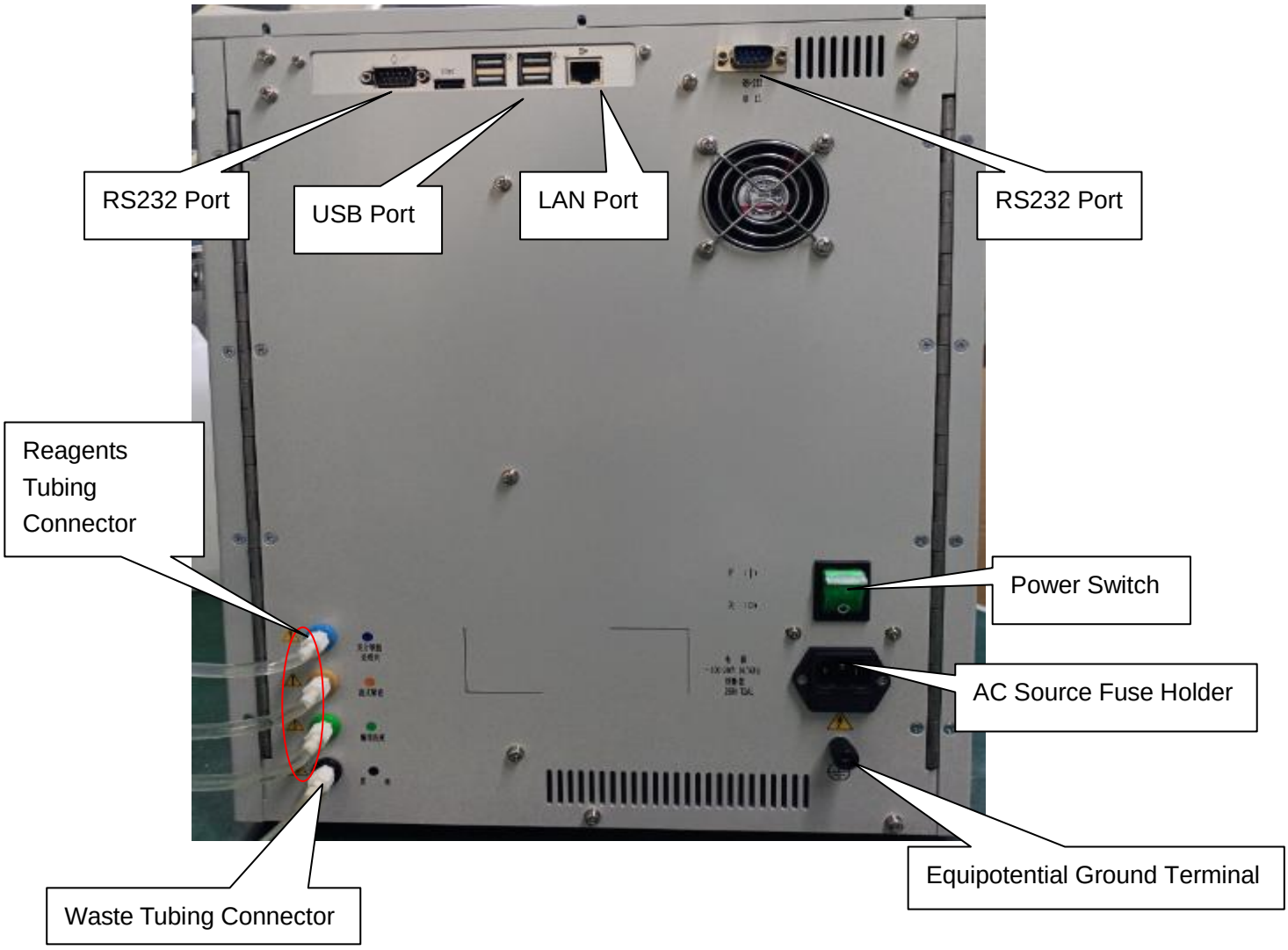
1.5 Panel Description

1.5.1 Front Panel



No.	Name	Description
1	Touch Screen	Display various messages, measured data and histograms Operate menus and input message
2	Sample Probe	Aspirate the sample and dispense reagents
3	Start Button	Press to aspirate the sample and start counting
4	Thermal Printer	Print out measured result
5	Indicator Light	Show hematology analyzer work status. Green lighting is power on; yellow light is lighting means analyzer is waiting to test, yellow light is blinking means analyzer is testing, yellow light is not light, means some hardware has problem.

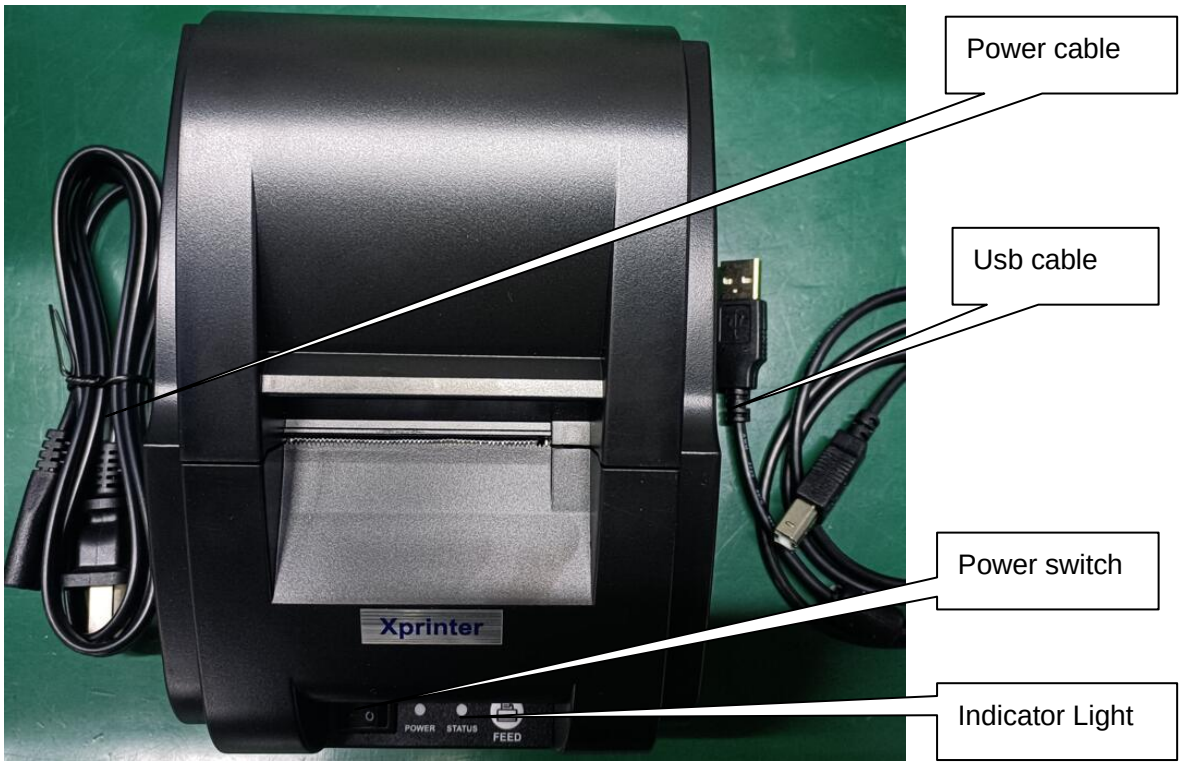
1.5.2 Rear Panel



No.	Name	Description
1	External Display Interface	Connects external display screen
2	USB Port	Connect keyboard, mouse, external printer
3	LAN Port	Connects LIS or network

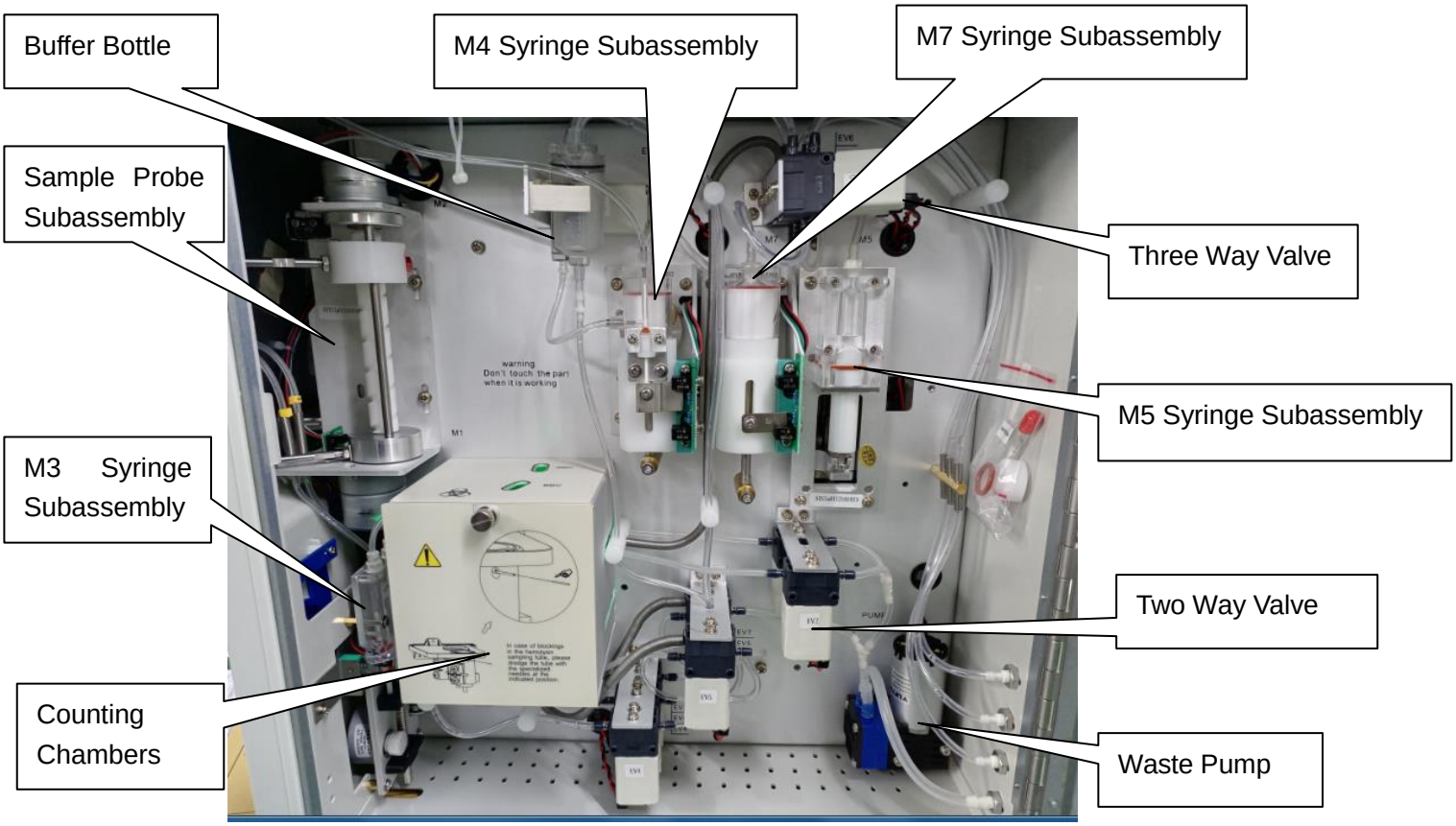
4	RS232 Port	Connects LIS or data terminal
5	Reagent Tubing Connector	Inlet for diluent, detergent, lyse. Connect one end of the reagent tube (standard accessory) to the reagent inlet and attach the other end of the tube to reagents
6	Waste Tubing Connector	Outlet for waste. Connect one end of the tube (standard accessory) to the waste outlet and attach the other end of the tube to the waste
7	Power Switch AC Source Fuse Holder	Turns power on or off Connects the AC power cord to supply the AC power to the instrument Contains two time lag fuses (T2A)
8	Equipotential Ground Terminal	Connects the ground lead to the Equipotential ground terminal on the wall for earth grounding

External printer



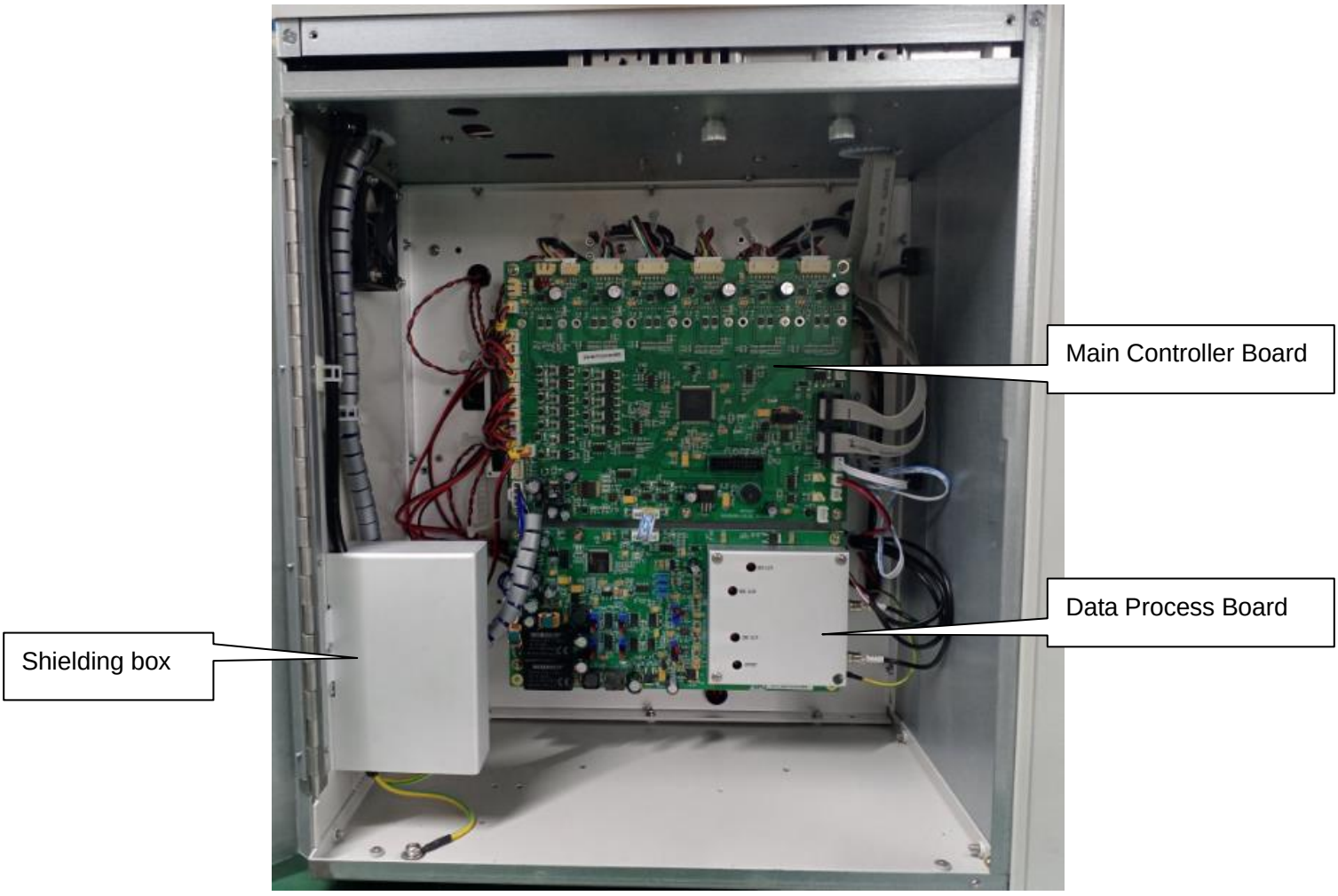
Thermal printing paper size is 57Xø40mm

1.5.3 Right-side view without the door



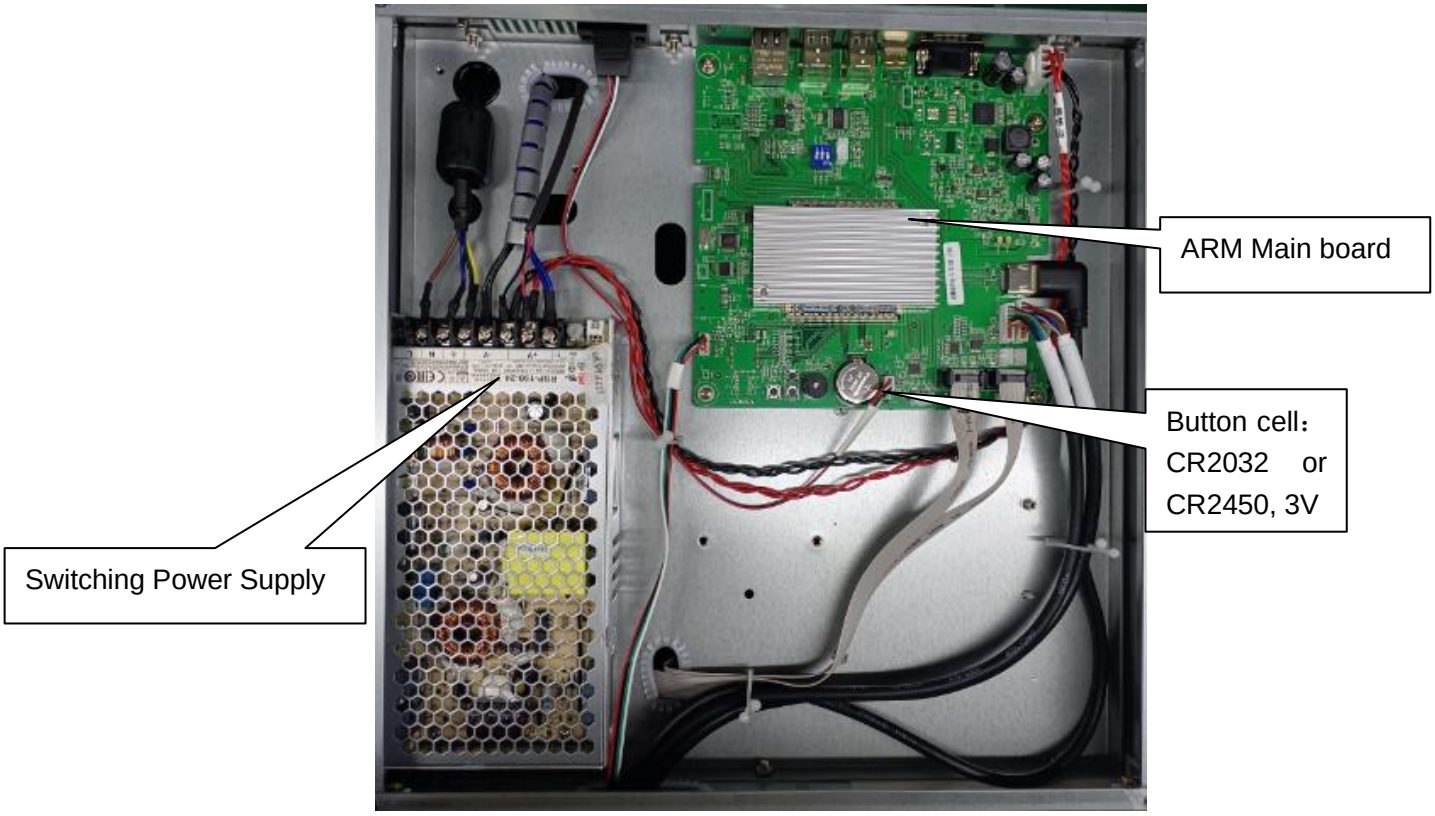
No.	Name	Description
1	Sample Probe Subassembly	Makes probe vertical and horizontal movement.
2	M3 Syringe Subassembly	Makes cell liquid across aperture for count.
3	M4 Syringe Subassembly	Aspirate and dispense sample and lyse.
4	M5 Syringe Subassembly	Aspirate and dispense diluent
5	M7 Syringe Subassembly	Aspirate and dispense detergent
6	Two Way Valve	There are two ports in this valve, one is NC port, the other is COM port
7	Three Way Valve	There are three ports in this valve, one is NC port, the second is NO port, the third is COM port.
8	Waste Pump	Make waste liquid drain
9	Waste Buffer Bottle	Filled with diluent to eliminate bubbles
10	Counting Chambers	There are two counting chambers, one is WBC/HGB counting chamber, the other is RBC/PLT counting chamber. It is used to count cells and HGB measurement.

1.5.4 Left-side view without the door



No.	Name	Description
1	Main Controller Board	Control mechanical components movement and valve\pump
2	Data Process Board	Pre-amplify cell signal and HGB signal, make discriminator for all signal.
3	Shielding box	Reduce power interference

1.5.5 Top-side view without the cover



No.	Name	Description
1	ARM Main board	Makes all relative parts running, Supplies software running environment, Stores data and supplies software running space
2	Switching Power Supply	Supplies different kinks of voltage to parts

Chapter 2 Installation

2.1 Working Conditions

2.1.1 Location

- The HEMA-D6190 should be placed on a clean and level table or workbench.
- Avoid exposure to sunlight
- Proper ventilation requires adequate space behind the instrument. At least 20cm (8 inches) must be maintained behind the instrument.
- Place your instrument where it is not exposed to water or vapor.
- Place your instrument where it is free from vibration or shock.
- Place your instrument with reagents container on the same level.
- Place your instrument where an independent power receptacle can be used.
- Use a receptacle different from the one used by a device that easily generates noise such as a centrifuge etc.
- Provide a space of at least 20cm (8 inches) at the back of the instrument for arranging the power cable and tubing.
- The power switch and input voltage supply connection should always be accessible

2.1.2 Grounding

Proper grounding is required when connecting HEMA-D6190 to an electrical power outlet. Have the facilities electrician check that the (earth) ground connection is correct and solid.

2.1.3 Working Environment Conditions

Environment temperature range：15 ℃～35 ℃

Relative humidity range：10%～85% without condensation

Atmospheric pressure range：70 KPA～106 KPA

No frost, condensation, water seepage, rain, sunshine, etc.

2.1.4 Power Requirements

Voltage	Input power	Frequency
～100V-240V	≤300VA	50/60 Hz

2.2 Unpacking and Inspecting the Instrument

Your instrument is tested before it is shipped from our factory. When you receive our instrument, please unpack the instrument.

1. Place the carton on the floor upright with the arrows on the side upwards.

2. Remove the tape and take out the accessory bag, check the accessories against the packing list. If you find anything missing, notify the after-sales department or your local distributor.

3. Remove the top protective foam. Carefully carry out the instrument from the box and place it on the workbench.

4. Open the cover of the instrument. Check the components are damaged or not. If you find some components damaged, notify the after-sales department or your local distributor.

2.3 Installation Procedure

2.3.1 Reagents and waste container connection

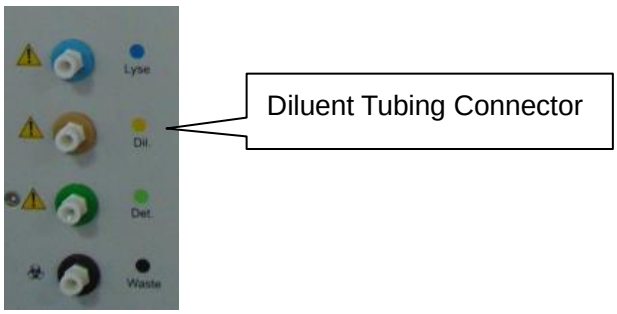
On the rear panel of the instrument, you can find four tubing connectors.

1. Connect the diluent container

● Take out the diluent reagent tube (the yellow one) from the accessory bag.

● Open the cap of diluent container in which there should be enough volume and place it on the workbench.

●Locate the yellow tubing connector marked “Dil.”



●Plug the connector of the tube until properly secured.

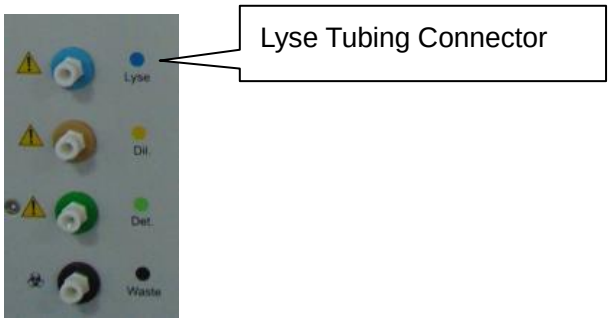
● Insert the tube end into the diluent container.

2. Connect the lyse container

● Take out the lyse reagent tube (the blue one) from the accessory bag.

● Open the cap of lyse container in which there should be enough volume and place it on the workbench.

● Locate the blue tubing connector marked “Lyse”



●Plug the connector of the tube until properly secured.

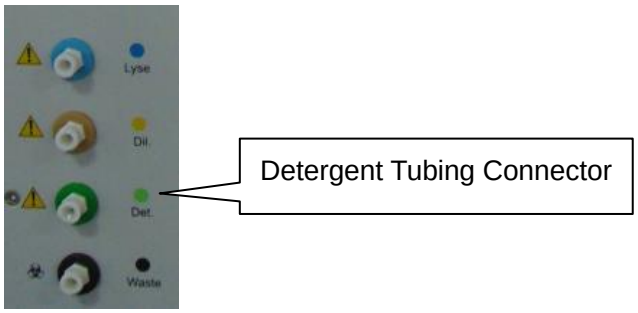
● Insert the tube end into the lyse container.

3. Connect the detergent container

● Take out the detergent reagent tube (the green one) from the accessory bag.

● Open the cap of detergent container in which there should be enough volume and place it on the workbench.

● Locate the green tubing connector marked “Det.”



●Plug the connector of the tube until properly secured.

● Insert the tube end into the detergent container.

4. Connect the waste container

● Prepare one empty container for waste.

● Take out the waste tube from the accessory bag.

●Locate the black tubing connector marked “Waste”.

Waste Tubing Connector

●Plug the connector of the tube until properly secured.

● Insert the tube end into the waste container.

Note: Three kinds of reagent containers must be on the same level with instrument, and waste container must be lower than instrument.

2.3.2 Install Internal Printer Paper

Open the cover

External Thermal Printer

2. Prepare thermal printer paper and confirm thermal sensitivity side.

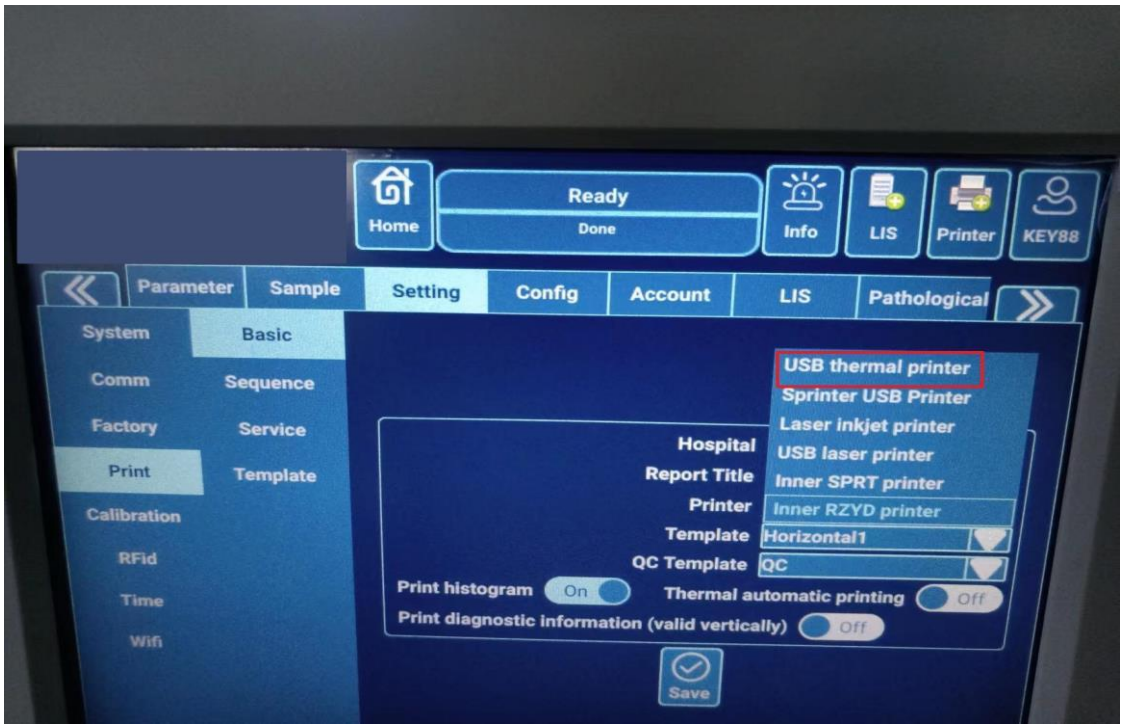
Thermal sensitivity side is which will be some scratches, when use finger to scratch. Paper size is 57XØ40mm

3. Insert paper into printer cavity according below picture showing.

4. Close the door of the printer.

5. When switch on the printer, the green light is always lighting. And if paper is detected by printer, the red light is always lighting also, otherwise red light is flickering.

6. Re-install the printer driver if it can not print report. And check the printer setting:



2.3.3 Connection of keyboard and mouse

Make connection between keyboard and mouse with USB ports which is on the rear panel of instrument.

2.3.4 Startup Procedure

1. Turn on the instrument and input ID "1" and don’t input password, then click login, instrument will perform self-test procedure.

2. During self-test procedure, instrument will automatically perform one blank test and show blank results in the work list.

3. After self-test, Click “Maintenance” and enter “Reagent prime” to perform “Prime all” one time.

4. Click “Mode Switch” to select blank to run one blank again.

5. If blank result is in the limit range, instrument is ready to use.

Note: during operate software, if you want to change test mode, you need to click “Exit mode” and then click “Mode switch” to select corresponding test mode.

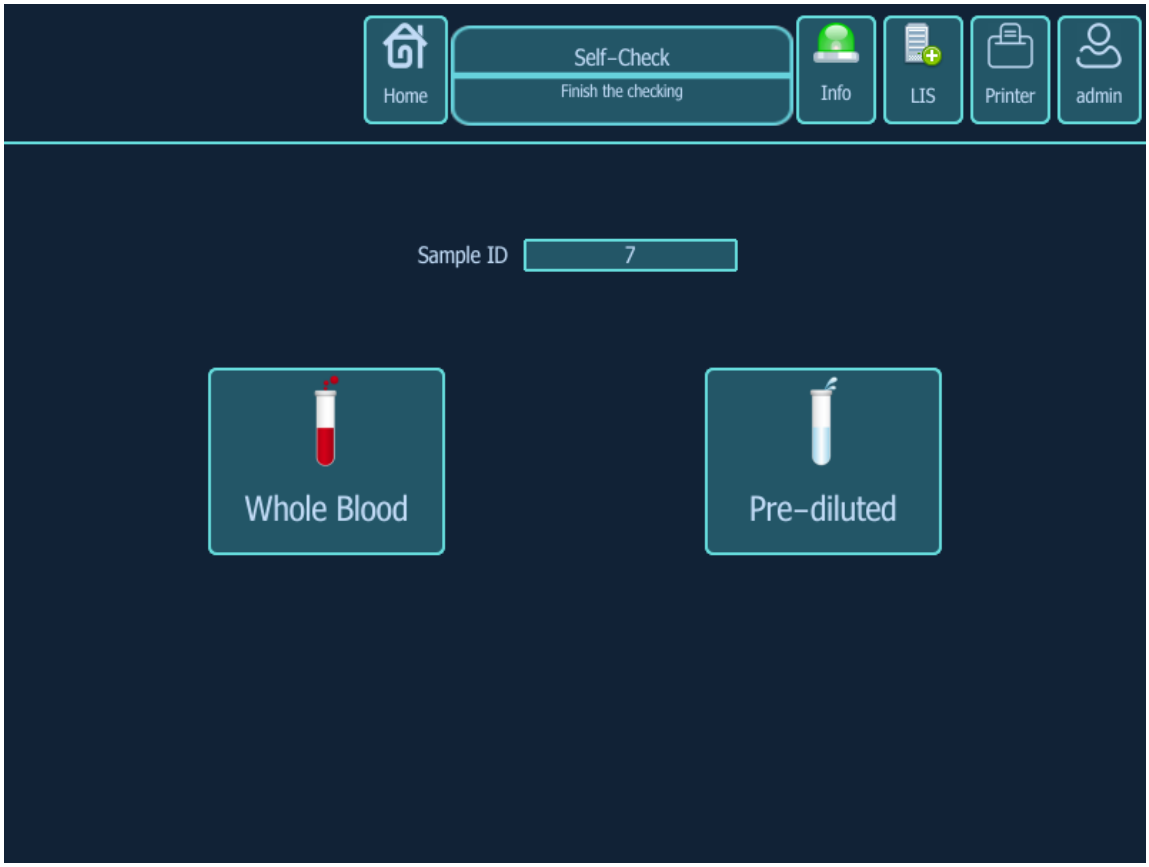
Chapter 3 System principle

3.1 Introduction

This analyzer uses electrical impedance to detect red blood cells and platelets, white blood cell. Hemoglobin concentration is measured with colorimetric method. On this basis, the analyzer calculates the rest of the parameters of the results.

3.2 Test Mode

HEMA-D6190 has 2 different test modes. They are Whole Blood-Direct, Prediluted-Direct.



Note: When you want to change test mode for next sample, you must click “Exit mode” and then click “Mode switch” to select corresponding mode.

3.2.1 Whole Blood-Direct Mode

Click “Mode switch” to select Whole Blood –Direct Mode, software will display test menu, and then press start button to aspirate sample blood, following parameters result will be displayed.

WBC - LY# - MID# - GR# - LYM% - MID% - GR%

HGB - RBC - HCT - MCV - RDW-CV - RDW-SD - MCH - MCHC

PLT - MPV - PCT – PDW- P-LCR-P-LCC

Three cell histograms: WBC histogram-RBC histogram-PLT histogram

Note:

You should collect at least 2mL venous blood sample.

For the whole blood samples to be used for WBC differential or PLT count, you shall store them at the room temperature and run them within 4 hours after collection.

If you do not need the PLT, MCV and WBC differential results, you can store the samples in a refrigerator (2℃ to 8℃) for 24 hours.

You need to warm the refrigerated samples at room temperature for at

least 30 minutes before running them.

Be sure to mix any sample that has been prepared for a while before running it.

3.2.2 Prediluted-Direct mode

Click “Mode switch” to select Prediluted –Direct Mode, software will display test menu, present a 2ml clean centrifugal tube to the sample probe and make sure the tube is tilted towards the probe to avoid spills and bubbles. Click “Distribute the diluent” to dispense 0.5mL of diluent (the dispensing volume is controlled by the analyzer) into the tube. Add 20μL of capillary blood to the diluent and shake the tube to mix the sample, and then press start button to aspirate prediluted sample, following parameters result will be displayed.

WBC - LY# - MID# - GR# - LYM% - MID% - GR%

HGB - RBC - HCT - MCV - RDW-CV - RDW-SD - MCH - MCHC

PLT - MPV - PCT – PDW- P-LCR-P-LCC

Three cell histograms: WBC histogram-RBC histogram-PLT histogram

Note:

Be sure to keep dust from the prepared diluent.

After mixing the capillary sample with the diluent, be sure to wait 5 minutes before running the sample.

Be sure to run the prediluted samples within 30 minutes after the mixing.

Be sure to mix any sample that has been prepared for a while before running it.

Be sure to evaluate predilute stability based on your laboratory's sample population and sample collection techniques or methods.

3.2.3 Self-test

WBC, RBC, HGB, PLT blank results will be displayed.

Blank limit range:

WBC≤0.3, RBC≤0.02, HGB≤1, PLT≤10.

3.3. WBC/HGB Measurement Principle

3.3.1 WBC Measurement

WBCs are counted and sized by the impedance method, as below figure shows. This method is based on the measurement of changes in electrical resistance produced by a particle, which in this case is a blood cell, suspended in a conductive diluent as it passes through an aperture of known dimensions. An electrode is submerged in the liquid on both sides of the aperture to create an electrical pathway. As each particle passes through the aperture, a transitory change in the resistance between the electrodes is produced. This change produces a measurable electrical pulse. The number of pulses generated signals the number of particles that passed through the aperture. The amplitude of each pulse is proportional to the volume of each particle. Each pulse is amplified and compared to the internal reference voltage channels, which only accepts the pulses of certain amplitude. If the pulse generated is above the WBC threshold, it is counted as a WBC.

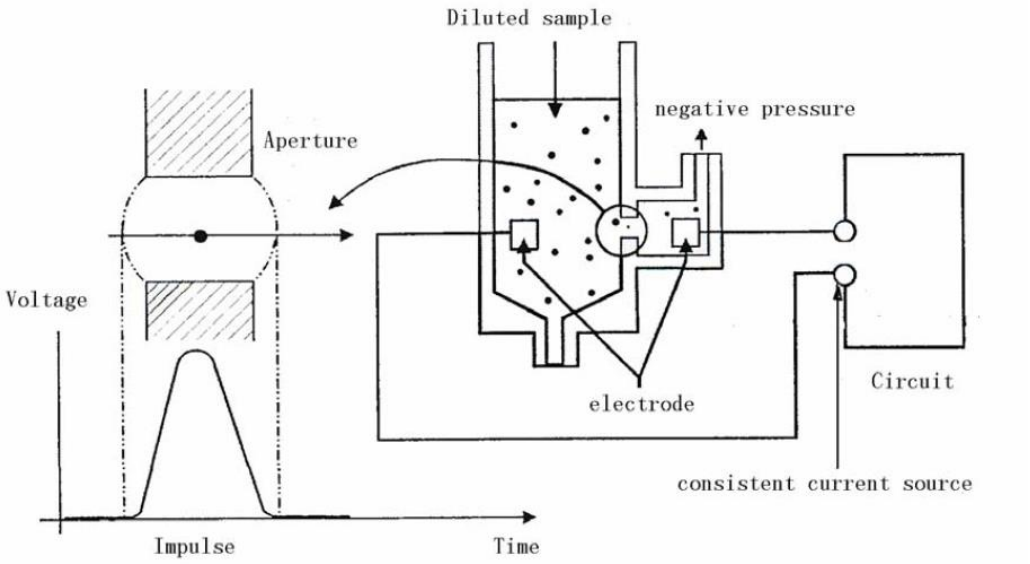


Figure: Impedance Method of Counting and Sizing

3.3.2 HGB Measurement

HGB is determined by the colorimetric method. The WBC/HGB dilution is delivered to the bath where it is bubble mixed with a certain amount of lyse, which converts hemoglobin to a hemoglobin complex that is measurable at 540

nm. An LED is mounted on one side of the bath and emits a beam of monochromatic light, whose central wavelength is 525nm, and then is measured by a photo-sensor that is mounted on the opposite side. The signal is then amplified and the voltage is measured and compared to the blank reference reading (readings taken when there is only diluent in the bath). The HGB is calculated per the following equation and expressed in g/L.

HGB(g/L) = Constant×Log 10 (Blank Photocurrent/Sample Photocurrent)

3.3.3 Derivation of WBC-Related Parameters

1. WBC

WBC (109/ L) is the number of leukocytes measured directly by counting the white blood cells passing through the aperture.

$$\mathrm{WBC} = \mathrm{n} \times 10^{9} / \mathrm{L}$$

Note that when you observe NRBCs (nucleated red blood cells), which do not react with the lyse and can be mistaken by the analyzer for white cells, in the microscope, be sure to correct the system-generated result by the following formula,

$$\mathrm{WBC'} = \mathrm{WBC} \times \frac{100}{100 + \mathrm{NRBC}}$$

where WBC represents the system-generated white cell number, NRBC the number of NRBCs counted in 100 white cells and WBC′ the corrected white cell number.

2. WBC differential

With the help of the diluent and lyse, this analyzer can size the white cells into three sub-populations - lymphocytes, mid-sized cells (including monocytes, basophils and eosinophils) and granulocytes. Based on the WBC histogram, this

analyzer calculates Lymph％, Mid％ and Gran％ as follows and express the results in percent.

$$\text{Lymph\%} = \frac{\text{PL}}{\text{PL} + \text{PM} + \text{PG}} \times 100$$

$$\text{Mid\%} = \frac{\text{PM}}{\text{PL} + \text{PM} + \text{PG}} \times 100$$

$$\text{Gran\%} = \frac{\text{PG}}{\text{PL} + \text{PM} + \text{PG}} \times 100$$

where PLT = particles in the lymphocyte region(109 / L)

PM = particles in the mid size region(109 / L)

PG = particles in the granulocyte region(109 / L).

Having achieved the three parameters above, this analyzer proceeds to calculate the Lymph# , Mid# and Gran# per the following equations and express them in 109 / L .

$$\text{Lymph\#} = \frac{\text{Lymph\%} \times \text{WBC}}{100}$$

$$\text{Mid\#} = \frac{\text{Mid\%} \times \text{WBC}}{100}$$

$$\text{Gran\#} = \frac{\text{Gran\%} \times \text{WBC}}{100}$$

3. WBC Histogram

Besides the parameters mentioned above, this analyzer also presents a WBC histogram whose x-coordinate represents the cell volume（fL）and y-coordinate represents the number of the cells.

3.4 RBC/PLT Measurement Principle

3.4.1 RBC/PLT Measurement

RBCs/PLTs are counted and sized by the impedance method, as below figure shows. This method is based on the measurement of changes in electrical resistance produced by a particle, which in this case is a blood cell, suspended in a conductive diluent as it passes through an aperture of known dimensions.

An electrode is submerged in the liquid on both sides of the aperture to create an electrical pathway.

As each particle passes through the aperture, a transitory change in the resistance between the electrodes is produced.

This change produces a measurable electrical pulse. The number of pulses generated signals the number of particles that passed through the aperture. The amplitude of each pulse is proportional to the volume of each particle. Each pulse is amplified and compared to the internal reference voltage channels, which only accepts the pulses of a certain amplitude. If the pulse generated is above the RBC/PLT lower threshold, it is counted as a RBC/PLT.

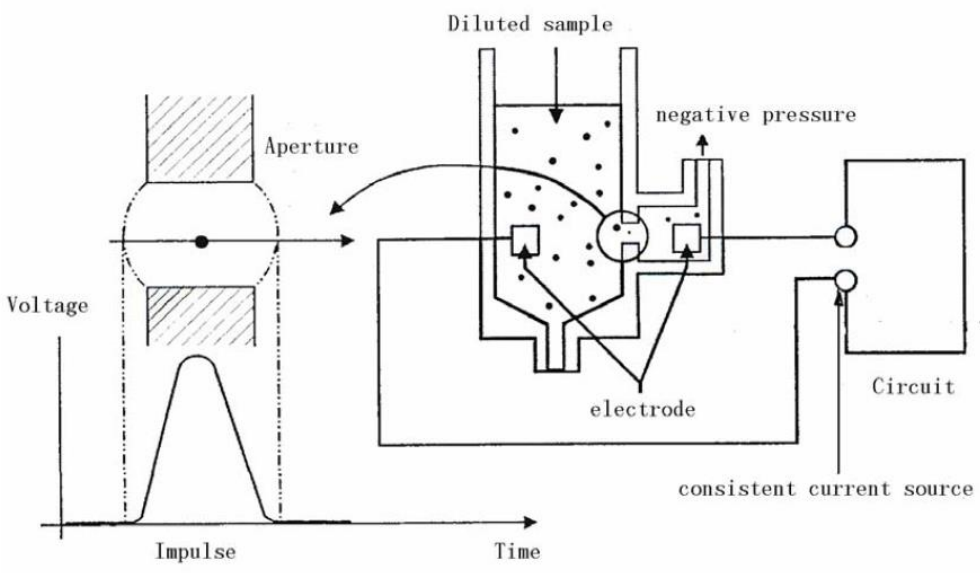


Figure: Impedance Method of Counting and Sizing

3.4.2 Derivation of RBC-Related Parameters

1. RBC

RBC (1012/L) is the number of erythrocytes measured directly by counting the erythrocytes passing through the aperture.

2. MCV

Based on the RBC histogram, this analyzer calculates the mean cell volume (MCV) and expresses the result in fL.

This analyzer calculates the HCT (%), MCH (pg) and MCHC (g/L) as follows:

$$HCT = \frac{RBC \times MCV}{10}$$

$$MCH = \frac{HGB}{RBC}$$

$$MCHC = \frac{HGB}{HCT} \times 100$$

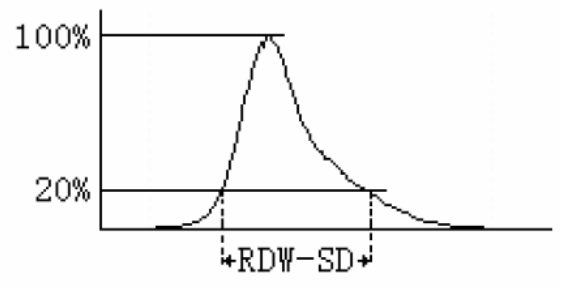
Where the RBC is expressed in 1012/L，MCV in fL and HGB in g/L.

3. RDW-CV

Based on the RBC histogram, this analyzer calculates the CV (Coefficient of Variation) of the erythrocyte distribution width.

4. RDW-SD

RDW-SD (RBC Distribution Width – Standard Deviation, fL) is set on the 20% frequency level with the peak taken as 100%, as below figure shows.



5. RBC Histogram

Besides the parameters mentioned above, this analyzer also presents a RBC histogram, whose x-coordinate represents the cell volume（fL）and y-coordinate represents the number of the cells.

3.4.3 Derivation of PLT-Related Parameters

1. PLT

PLT (109/L) is measured directly by counting the platelets passing through the aperture.

2. MPV

Based on the PLT histogram, this analyzer calculates the mean platelet volume (MPV,fL).

3. PDW

Platelet distribution width (PDW) is the geometric standard deviation (GSD) of the platelet size distribution. Each PDW result is derived from the platelet histogram data and is reported as 10(GSD).

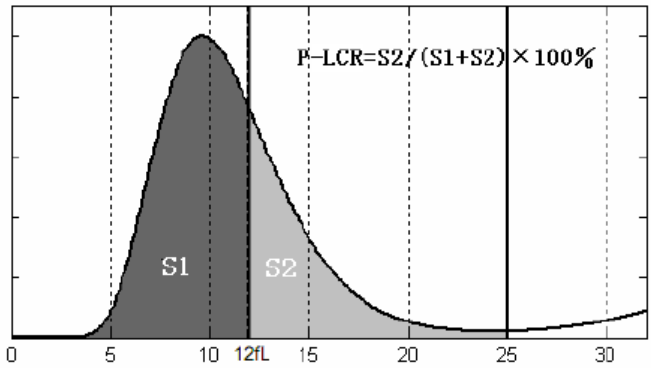
4. PCT

This analyzer calculates the PCT as follows and expresses it in ％, where the PLT is expressed in 109/L and the MPV in fL.

$$PCT = \frac{PLT \times MPV}{10000}$$

5. P-LCR

Platelet larger cell ratio (P-LCR) is the ratio of the larger platelet (volume larger than 12fL) count to the total PLT count. This analyzer calculates the P-LCR based on the PLT histogram and expresses the result in %. In the following figure, S2 represents the number of larger platelet cells, and S1+S2 represent the total PLT count.



6. P-LCC

This analyzer calculates the platelet large cell count (P-LCC) and expresses the result in 109/L.

$$P\text{-}LCC = PLT \times P\text{-}LCR$$

7. PLT Histogram

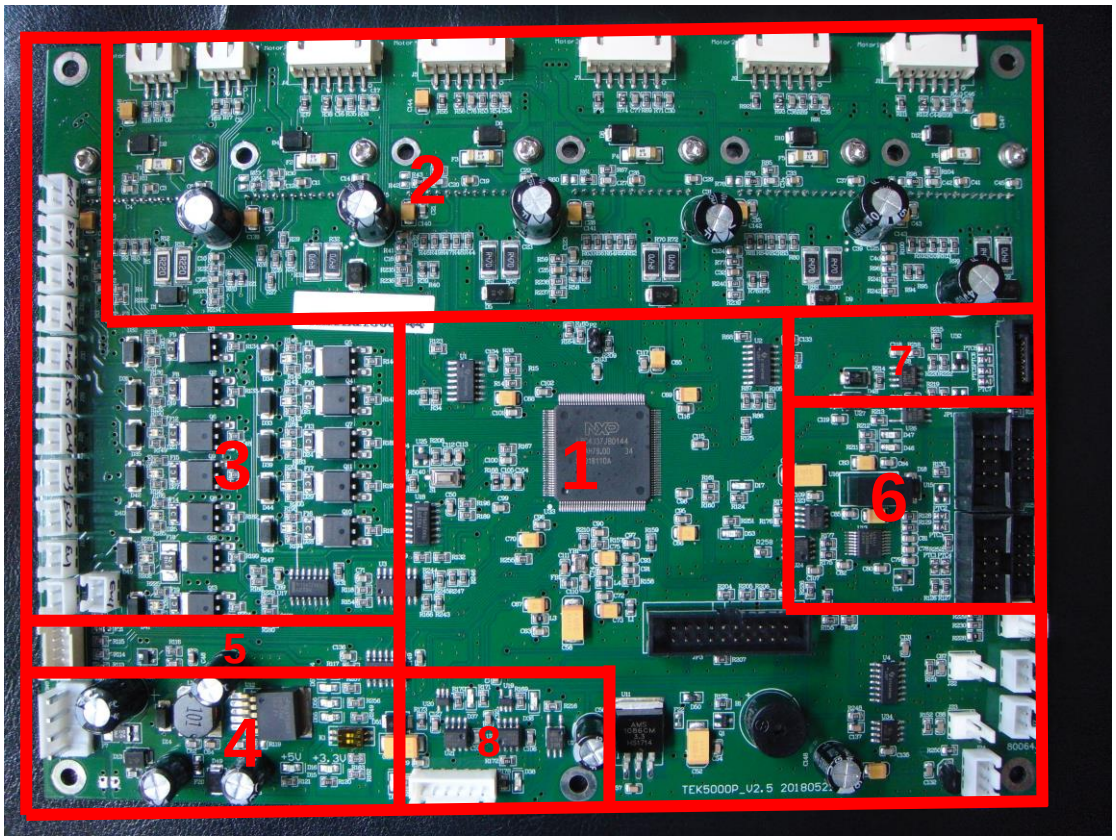
Besides the parameters mentioned above, this analyzer also presents a PLT histogram, whose x-coordinate represents the cell volume（fL）and y-coordinate represents the number of the cells.

3.5 Rinse

Analyzer automatically in the process of each counting on the sample flows through each part to wash, to ensure liquid with sample residue left in the road.

Chapter 4 Hardware Functional Description

4.1 Main Controller Board



The Main controller board consists of eight modules according function.

1. CPU Module

2. Stepping Motor Drive Module

3. Pump&Valve Drive Module

4. Power Module

5. Reagent Alarm Detection Module

6. Communication Module 1

7. Extended Stepping Motor Module

8. Communication Module 2

4.1.1 CPU Module

1. U33(LPC4337) is main CPU chip, it controls following parts.

·M1 stepping motor

·M2 stepping motor

·M3 stepping motor

·M4 stepping motor

·M5 stepping motor

·M7 stepping motor

·Valves and waste pump

·Buzzer

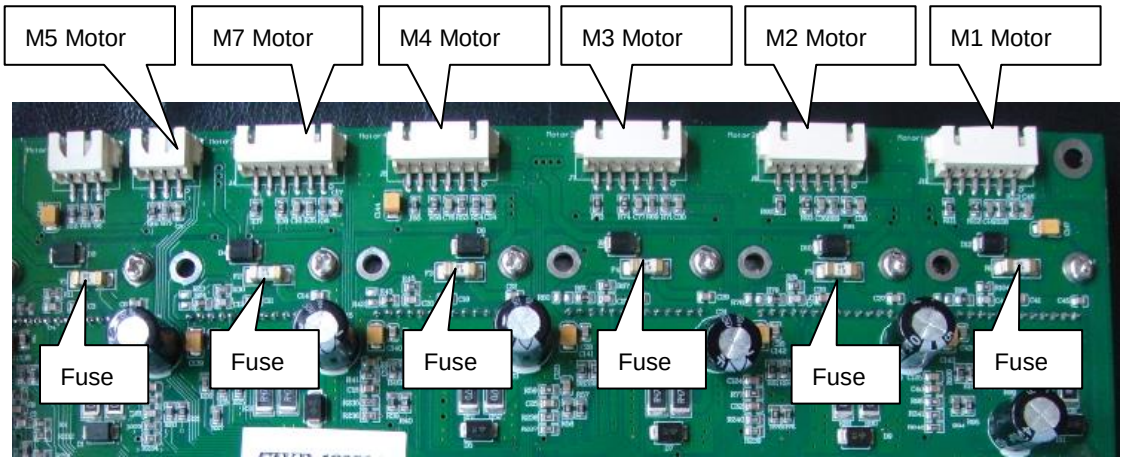
·Program running

2. JP3 is JPAG program port.

3. P2 is ISP programmer jumper pin.

4. U35(LM35) is temperature sensor.

4.1.2 Stepping Motor Drive Module



Motor Number	Function
M1	Make sample probe horizontal movement
M2	Make sample probe vertical movement
M3	Make M3 syringe vertical movement
M4	Make M4 syringe vertical movement
M5	Make M5 syringe vertical movement
M7	Make M7 syringe vertical movement

Motor Number	Drive IC
M1	U10(THB6032MQ);U2(SN74ACT04)
M2	U9(THB6032MQ);U2(SN74ACT04)
M3	U8(THB6032MQ);U1(SN74ACT04)
M4	U7(THB6032MQ);U1(SN74ACT04)
M5	U5(THB6032MQ);U1(SN74ACT04)
M7	U6(THB6032MQ);U1(SN74ACT04)

There is one 4A fuse for each motor drive channel, if find one motor can't work, maybe corresponding fuse is damaged, this fuse model type is 045.004.MRL,

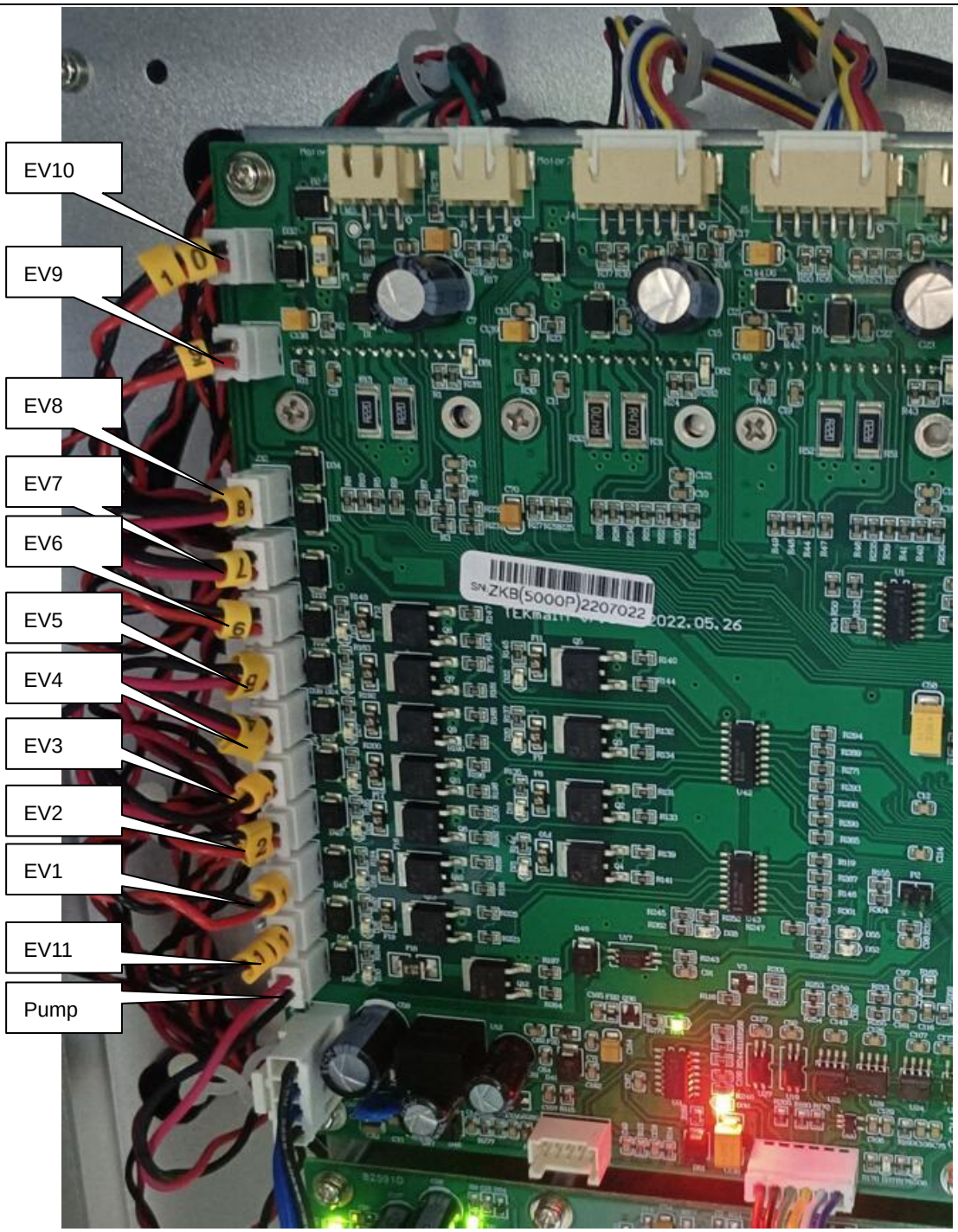
trademark is little fuse.

4.1.3 Pump&Valve Drive Module

There are eleven valves and one waste pump in the fluidic system, and in the eleven valves there are seven three way valve and four two way valve.

Valve Number	Valve Model	Drive IC
EV1	Two-way	Q10 (IRLR3410);U18E(SN74ACT04)
EV2	Two-way	Q8 (IRLR3410);U17C(SN74ACT04)
EV3	Two-way	Q11(IRLR3410);U18F(SN74ACT04)
EV4	Three-way	Q9(IRLR3410);U17F(SN74ACT04)
EV5	Three-way	Q7(IRLR3410);U18C(SN74ACT04)
EV6	Three-way	Q6(IRLR3410);U17E(SN74ACT04)
EV7	Three-way	Q4(IRLR3410);U18B(SN74ACT04)
EV8	Two-way	Q2(IRLR3410);U17D(SN74ACT04)
EV9	Three-way	Q5(IRLR3410);U18A(SN74ACT04)
EV10	Three-way	Q3(IRLR3410);U18D(SN74ACT04)
EV11	Three-way	Q13(IRLR3410);U17A(SN74ACT04)

Waste pump’s driver chip is Q12(IRLR3410) and U17B (SN74ACT04)



Note: pump and EV connectors must connect with the according sockets that name marked on the board. Different version board the sockets positions may be different.

4.1.4 Power Module

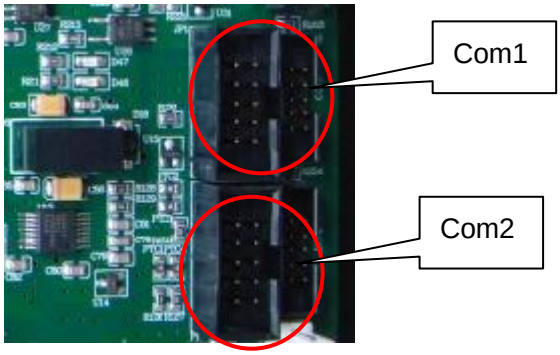
Voltage Type	Source	Supply
+5v	LM2576S-5V (U12) transformer	74ALS07,SN74ACT04,LM324,LM35,SN74LVC1G08, SP3087E,ACPL-M61L,SP3232EEA,B0505S-1W, ACPL-064L,Buzzer

+24v	Switching Power Supply	U5(THB6032MQ),U6(THB6032MQ),U7(THB6032MQ)、U8(THB6032MQ),U9(THB6032MQ),U10(THB6032MQ) Q2(IRLR3410),Q3(IRLR3410),Q4(IRLR3410); Q5(IRLR3410);Q6(IRLR3410);Q7(IRLR3410); Q8(IRLR3410);Q9(IRLR3410);Q10(IRLR3410); Q11(IRLR3410); Q12(IRLR3410); Q13(IRLR3410);
+3.3v	AMS1086CM(U11) transformer	LPC4337(U33), 12MHZ Crystal Oscillator （YB1）;CAT803TTBI (U25)

4.1.5 Reagent Alarm Detection Module

It controls diluent, lyse, detergent, waste liquid alarm.

4.1.6 Communication Module 1



Com1 is connecting with com1 of ARM main board. It is used to communicate between analyzer software with main controller board.

Com2 is connecting with com2 of ARM main board. It is used to communicate between analyzer software with data process board.

4.1.7 Extended Stepping Motor Module

It is for stepping motor development in the future.

4.1.8 Communication Module 2

It is connecting with data process board and communication each other.

4.1.9 Indicator Light Status

Light No.	Indication Information	Normal Status
D16	+5V power indicate	Always light
D15	+3.3V power indicate	Always light
D17	CPU(ARM M4) program running	Flicker

D53	CPU(ARM M0) program running	Flicker
D37	Data is sent to analyzer software by data process board	During data sending, it flickers, otherwise it is off.
D36	Data is received from analyzer software by data process board	During data receiving, it flickers, otherwise it is off.
D38	Count process indication	During counting, it is on, otherwise it is off.
D52	HGB signal is collected from data process board by main controller board	During collection, it is on, otherwise it is off.
D46,D47	They are for future hardware development	
D54	Diluent alarm	Diluent is enough, it is on, diluent is insufficient, it is off.
D55	Lyse alarm	Lyse is enough, it is off, lyse is insufficient, it is on.
D56	Waste alarm	Waste is full, it is on, waste is empty, it is off.
D57	Detergent alarm	Detergent is enough, it is on, detergent is insufficient, it is off.
D30	Waste pump working indication	During working, it is green lighting, during standby, it is off. If shorten occurred, it is red lighting. This LED is double color LED
D28	EV1 working indication	
D25	EV2 working indication	
D29	EV3 working indication	
D27	EV4 working indication	
D24	EV5 working indication	
D23	EV6 working indication	
D21	EV7 working indication	
D19	EV8 working indication	
D22	EV9 working indication	
D20	EV10 working indication	
D26	EV11 working indication	

4.2 Data Process Board

The data process board consists of three modules according function.

1. Preamplifier Module

2. Discriminator Module

3. Power Module

4.2.1 Preamplifier Module

The impedance method is used for determination of volume and number of cells, in this method, a known volume of dilution is drawn through a small aperture, constant current is passed through the aperture from one side to the other, when a cell passes through the aperture. It causes a change in resistance, which generates a voltage pulse.

The amplitude of the voltage pulse is proportional to the ratio of cell volume per aperture volume. This is used to determine the volume of cells, the number of cells can be obtained by counting the pulses.

In the HEMA-D6190, there are two apertures. WBC aperture size is 80um and RBC aperture is also 80um. Aperture is made of ruby and it is glued into the pedestal. The consistent fixing of glue is very important for measurement.

Preamplifier module performs following functions.

- Provides a constant current to electrodes of RBC/PLT and WBC.
- Amplifies the initial RBC/PLT,WBC and HGB signal.

1. RBC/PLT channel

This channel is composed of three class amplifiers. First class amplifier is Q104(3DJ9F), second class amplifier is U105(TL071), third class amplifier is U107(OP27).

When input a pulse of 20us and 0.2mv, the amplified signal of output should be pulse with about 1.4V peak.

RP103 potentiometer is used to adjust RBC channel gain.

RP101 potentiometer is used to adjust PLT channel offset.

2. WBC channel

This channel is composed of three class amplifiers. First class amplifier is Q103(3DJ9F), second class amplifier is U104(TL071), third class amplifier is U106(OP27).

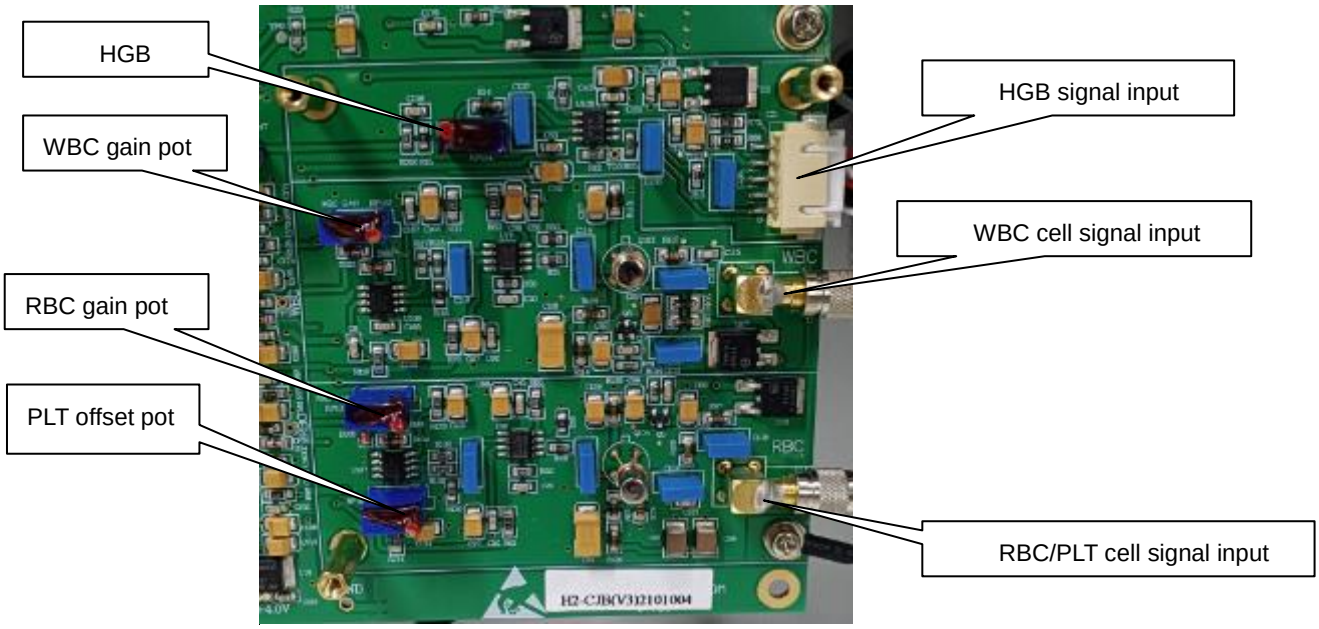
When input a pulse of 20us and 0.2mv, the amplified signal of output should be pulse with about 1.4V peak.

RP102 potentiometer is used to adjust WBC channel gain.

3. HGB channel

The output of the initial HGB signal is amplified by U108(TL082)

HGB gain is adjusted by RP104 potentiometer



Note: U102 (L78M18) and U103(L78M18) transform DC24V to DC 18V for WBC and RBC channel cell count.

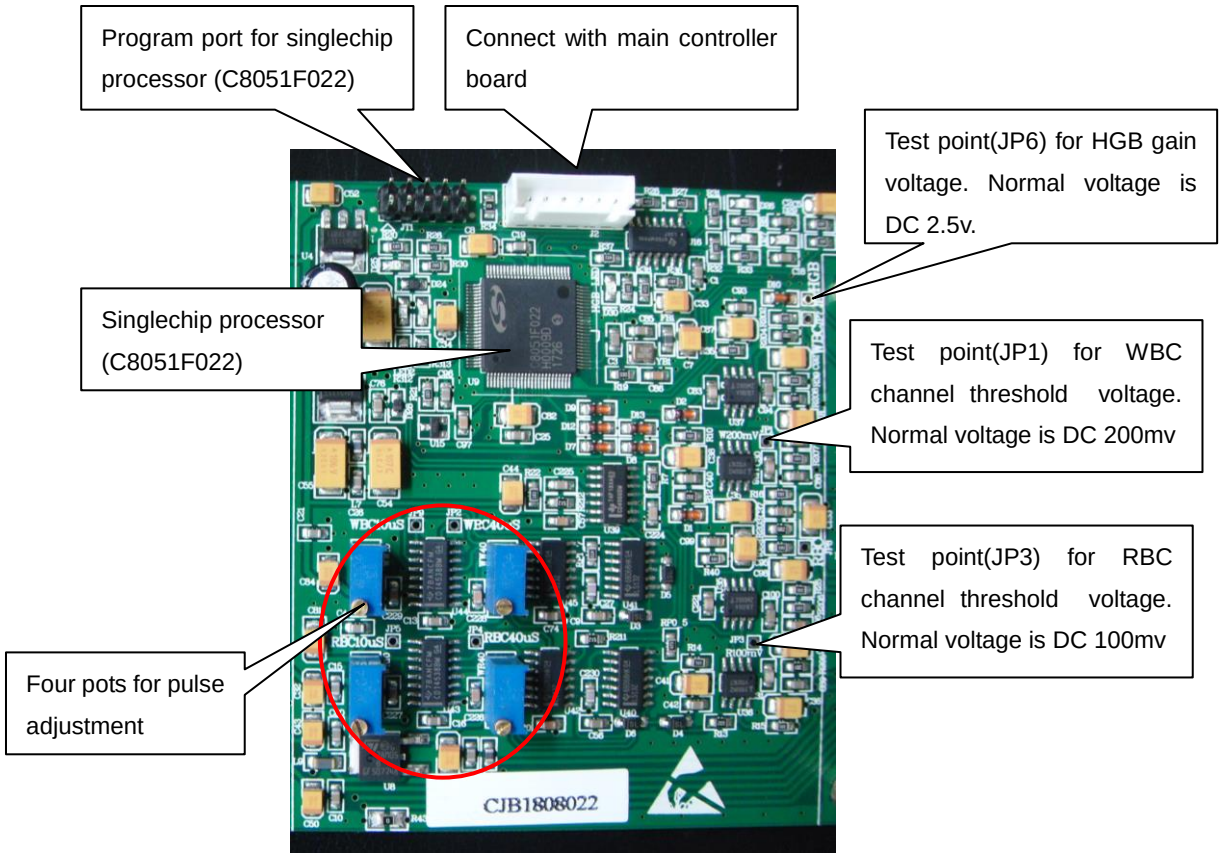
4.2.2 Discriminator Module

1. WBC channel

The amplified WBC signal are compared by U38(CA3100) and filtrate signals that is under 200mv in case to affect the count results. U41,U45(74LS132) output inversely the signals which are compared by U38. The inverse pulses are used for touch off U44(CD4538). Regulate the pulse that the potentiometer(WW40) makes U44A output 40us, the pulse is used as interruptive signal in the AD convert procedure. Regulate the pulse that the potentiometer(WW10) makes U44B output 10us. The output inverse pulse control that U39B(CD4066) is on or off and make electric capacity discharge, thus control the WBC data sampling.

2. RBC channel

The amplified RBC signal are compared by U36(CA3100) and filtrate signals that is under 100mv in case to affect the count results. U40,U42(74LS132) output inversely the signals which are compared by U36. The inverse pulses are used for touch off U43(CD4538). Regulate the pulse that the potentiometer(WR40) makes U43A output 40us, the pulse is used as interruptive signal in the AD convert procedure. Regulate the pulse that the potentiometer(WR10) makes U43B output 10us. The output inverse pulse control that U39C(CD4066) is on or off and make electric capacity discharge, thus control the RBC data sampling.



Note: Potentiometer of WW10,WW40,WR10,WR40 are used to adjust WBC and RBC channel pulse, they are only adjusted by factory engineer using oscillography, otherwise it is very difficult to adjust for service engineer and customers.

4.2.3 Power Module

Voltage Type	Source	Supply
+5v	Switching power supply	74ALS07,SPX1117M3-3.3
+12v	Switching power supply	TL082(U108);TL071(U104);OP27(U107); CA3100(U36,U38); LM78M05(U8), HGB Lamp,OP27(U106)
-12v	Switching power supply	TL082;TL071;OP27;CA3100(U36,U38) OP27(U106)
+24v	Switching power supply	3DJ9F(Q103,Q104); Constant Current supply
-8v	LM7908(U6) transformer	CA3100(U35,U37)

4.2.4 Indicator Light Status

Light No.	Indication Information	Normal Status
D23	+5V power	Always light
D21	+12V power	Always light
D22	-12V power	Always light
LED1	+24V power	Always light
LED2	Program running	Flicker
LED3	Reserved	None
D29	Cell count indication	During cell counting, it is on, otherwise it is off.
D30	HGB signal collection from main controller board	During signal receiving, it is on, otherwise it is off.
D25	Cell count start signal from main controller board	During counting, it is on, otherwise it is off.
D26	Data receiving from analyzer software	During receiving, it flickers, otherwise it is off.
D27	Data sending to analyzer software	During sending, it flickers, otherwise it is off.

4.3 Arm Main Board

Arm main board: Makes all relative parts running, Supplies operation software running environment, Store data.

4.4 Power Supply

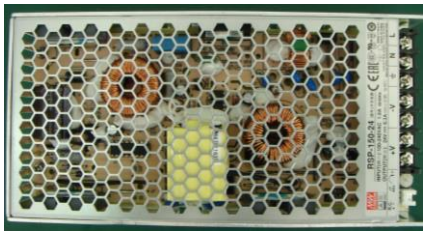
1. Switching Power Supply

There is a switching power supplies in the HEMA-D6190.

One is RSP-150-24, specification as following:

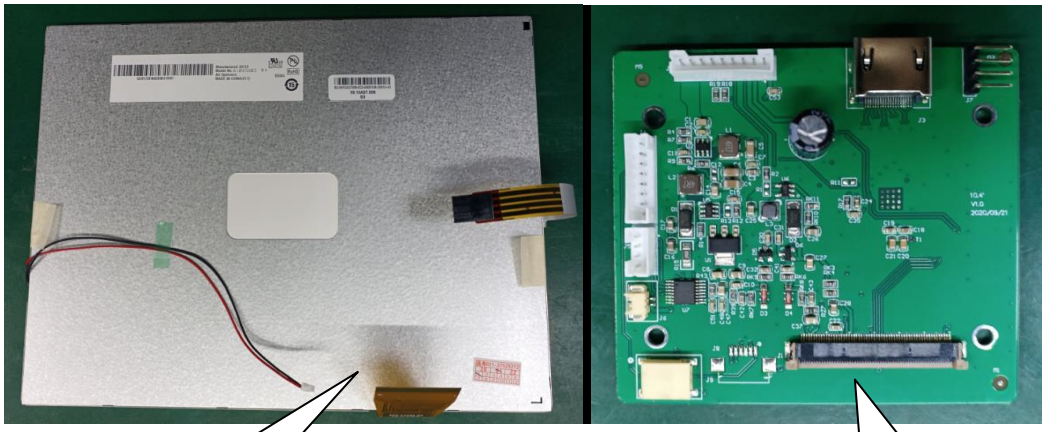
INPUT: 100-240VAC, 1.9A, 50/60HZ.

OUTPUT: DC24V, 6.3A



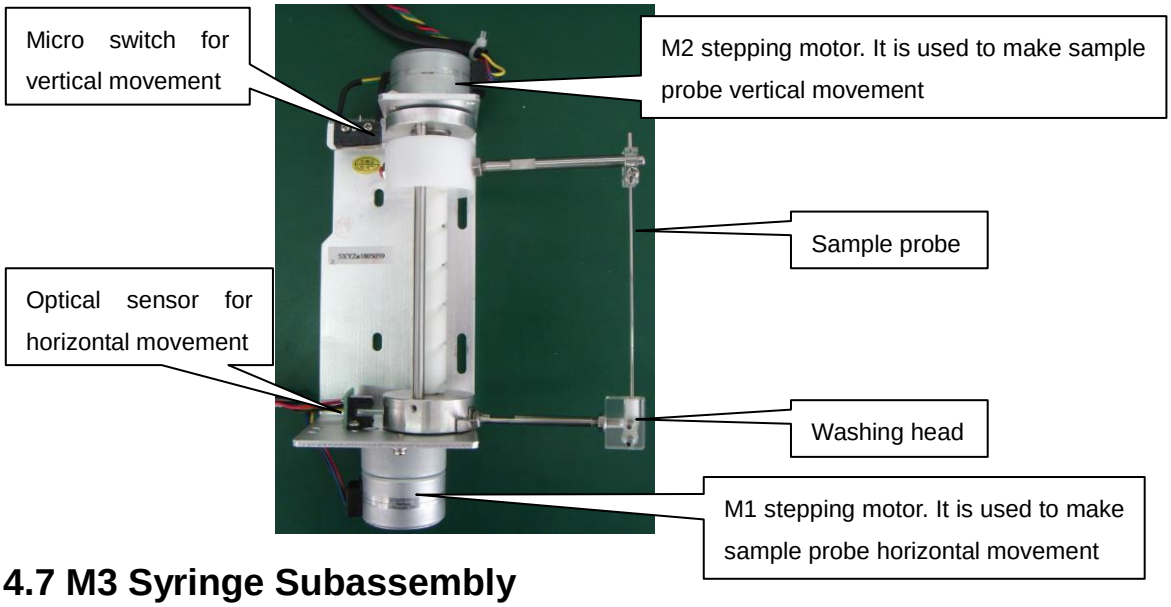
4.5 Touch Screen Display Module

10.4 inch display and touch screen



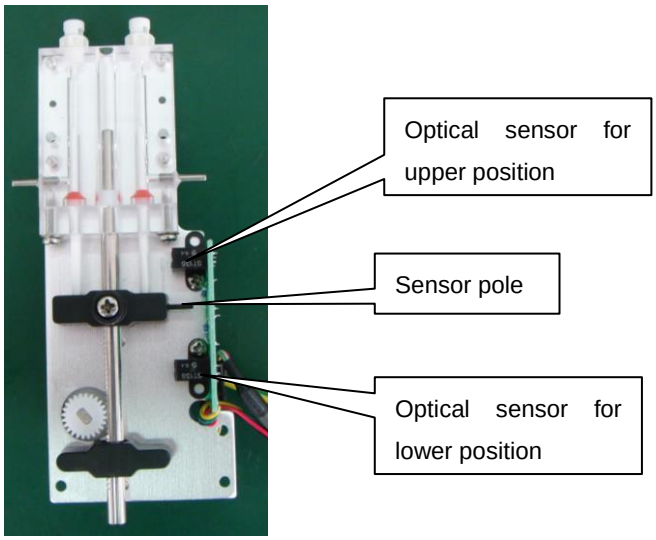
4.6 Sample Probe Subassembly

The sample probe subassembly is used to make sample probe vertical and horizontal movement for sample aspiration and reagent dispense.



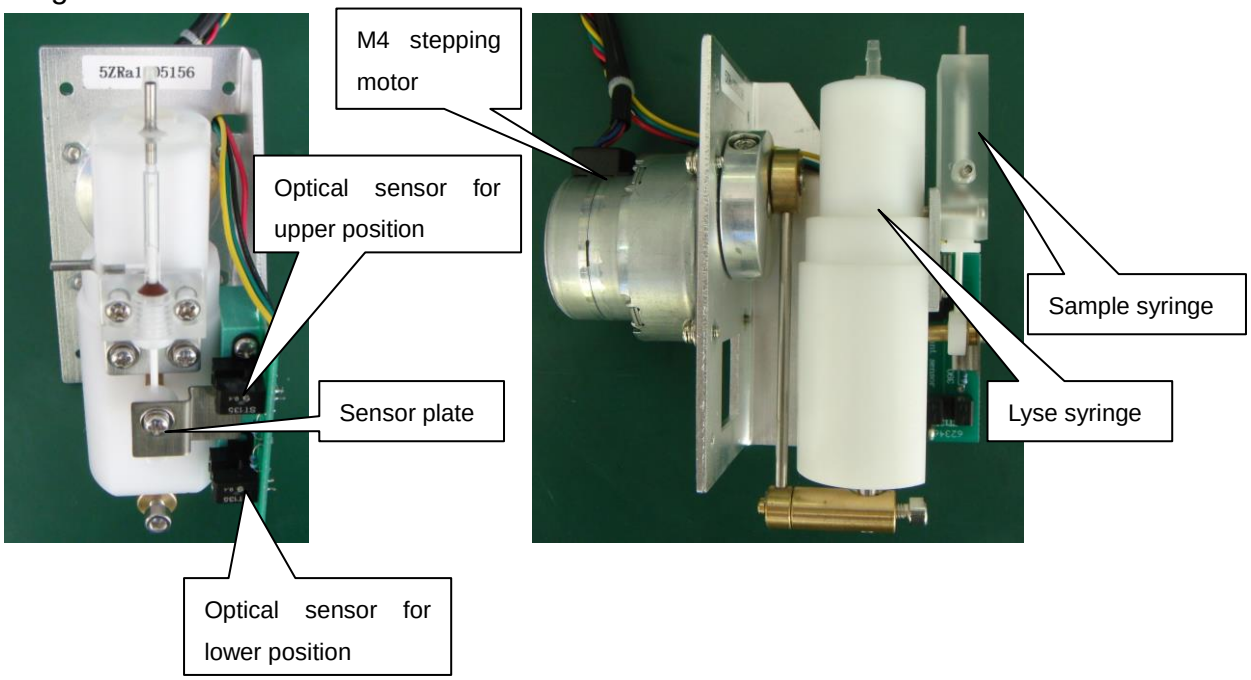
4.7 M3 Syringe Subassembly

The M3 syringe subassembly is used to make cell liquid pass through aperture for cell count.



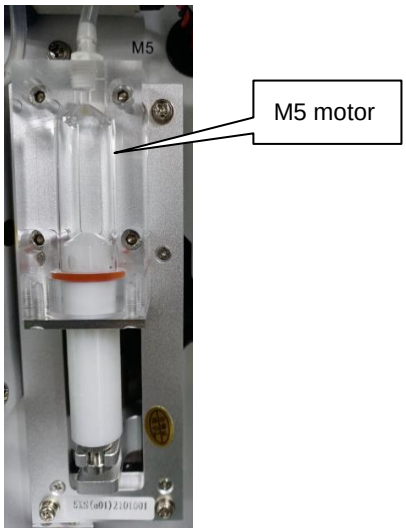
4.8 M4 Syringe Subassembly

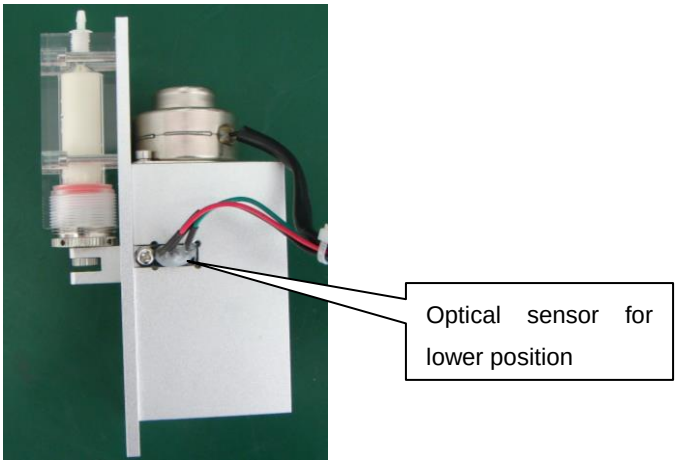
The M4 syringe subassembly is used to aspirate and dispense sample and lyse reagent.



4.9 M5 Syringe Subassembly

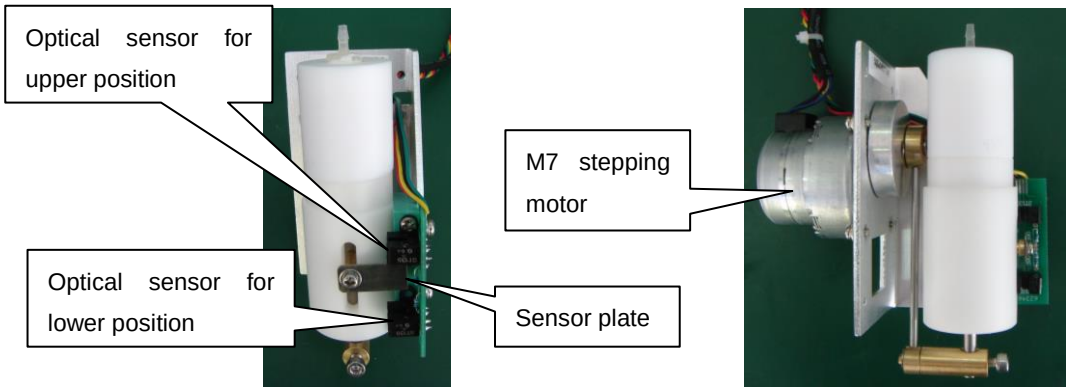
The M5 syringe subassembly is used to aspirate and dispense diluent reagent.





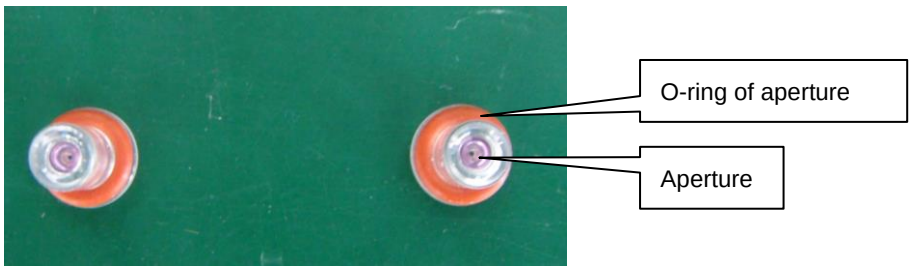
4.10 M7 Syringe Subassembly

The M7 syringe subassembly is used to aspirate and dispense detergent reagent or concentrated cleaner.



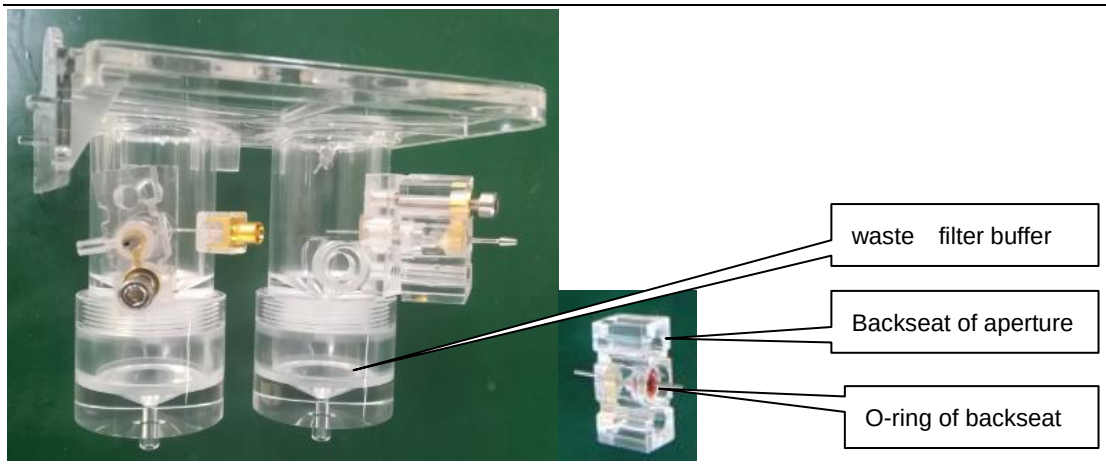
4.11 Aperture

WBC and RBC aperture size are both 80um.



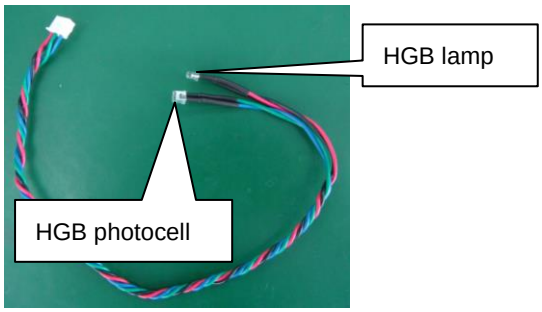
4.12 Counting Chamber

The counting chamber is used to hold cell liquid for count.



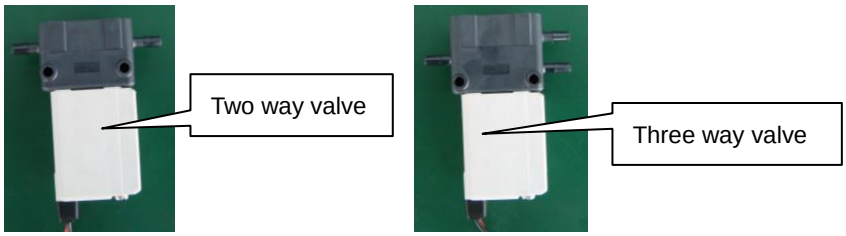
4.13 HGB Unit

The HGB unit is used to measure HGB signal.



4.14 Valve

The valve is used to control liquid flow to pass or stop.



- **Two way valve**

  Digit 1 is inlet port of the valve, digit 2 is outlet port of the valve.

- **Three way valve**

  Digit 1 is NC port of the valve, this port is normally closed till valve working voltage added.

  Digit 2 is COM port of the valve, this port is always opened.

  Digit 3 is NO port of the valve, this port is normally opened till valve working voltage added.

4.15 Waste Pump

The waste pump is used to drain waste liquid.

Chapter 5 Operation of the fluidic system

This section describes the whole blood mode fluidic steps of HEMA-D6190 measurement cycle. The HEMA-D6190 fluidic schematics are shown this section of this manual. The following figures show the actual process and help to understand how fluidic system works. The following steps are introduced in this section:

（1） Sampling

（2） WBC diluting

（3） Secondary sampling and lyse reagent aspiration

（4） RBC diluting and lyse reagent dispense

（5） Counting

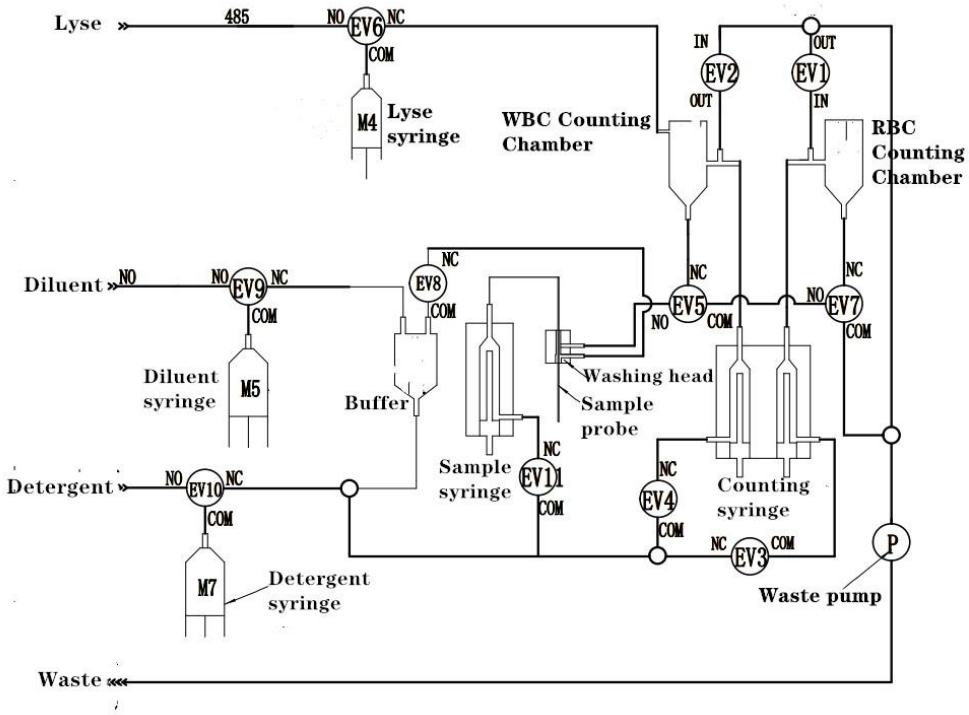
（6） Aperture backflush

（7） Clean counting tube path

（8） Clean counting chambers using diluent

（9） Dispense diluent into counting chambers for standby

（10）Sample probe back to home position



Fluidic Diagram

5.1 Sampling

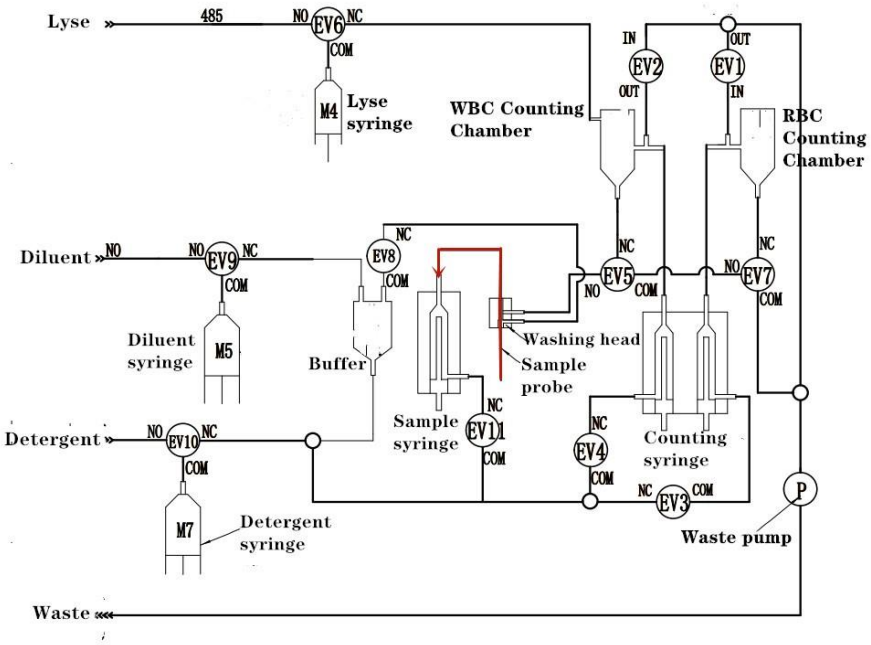
This process includes four steps as following.

Step1. After press start button, 10μl whole blood is aspirated by the sample probe while the sample syringe moves down.

Step2. Measure HGB blank signal.

Step3. Waste pump is working, open EV5 for WBC counting chamber drain, and open EV7 for RBC counting chamber drain.

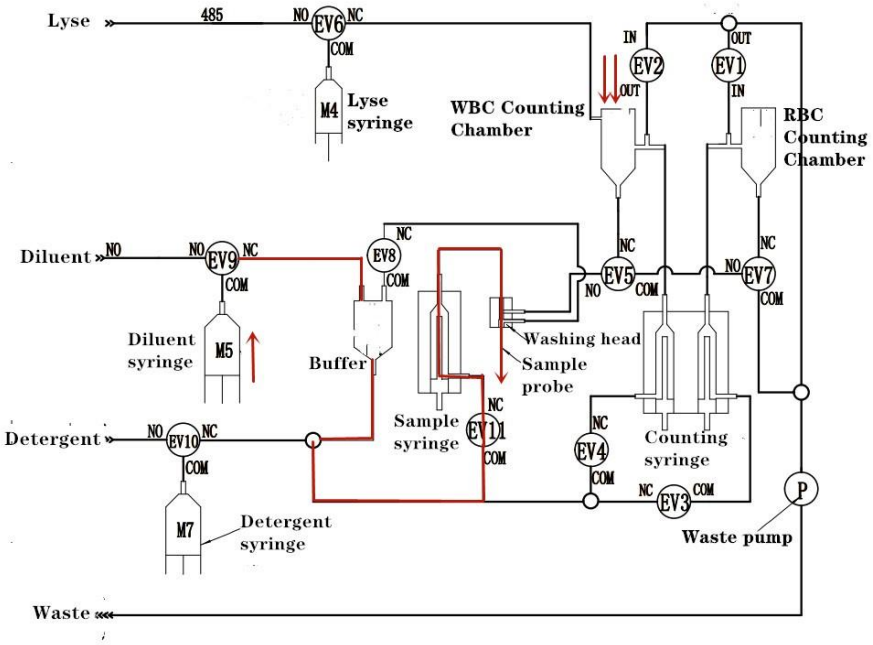
Step4. Open EV8 and EV11 to clean outer surface of sample probe. Instrument clean sample probe with diluent in the washing head, it is important to clean the outer surface of the sample probe to avoid inaccurate, while the sample probe moves upwards, the total length of sample probe washed.



Sampling

5.2 WBC diluting

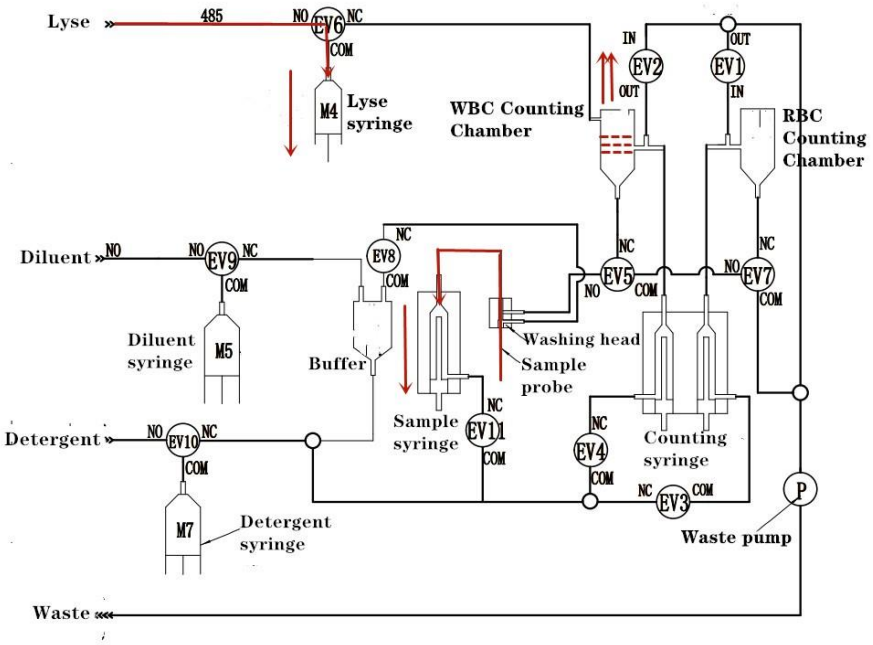
The sampling process has aspirated 10ul blood ,which is in the sample probe ,in this step ,the blood is dispensed into WBC counting chamber with 3.8ml diluent, which comes from the diluent syringe through Ev9(on),Ev4,while the diluent syringe moves upwards. This process makes 1:211 dilution rate in the WBC counting chamber.



WBC Diluting

5.3 Secondary sampling and lyse reagent aspiration

The secondary sampling process aspirates 40ul of diluted liquid from WBC counting chamber and lyse syringe downwards moves to aspirate lyse reagent.



Secondary Sampling and lyse reagent aspiration

5.4 RBC diluting and lyse reagent dispense

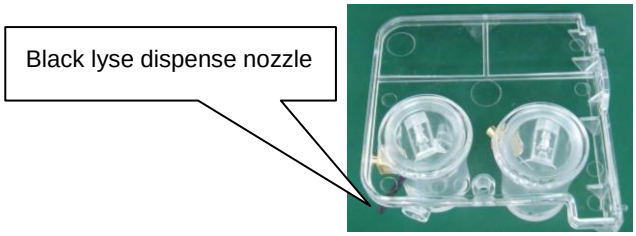
40ul diluted liquid from WBC counting chamber is added with 4.6ml of diluent

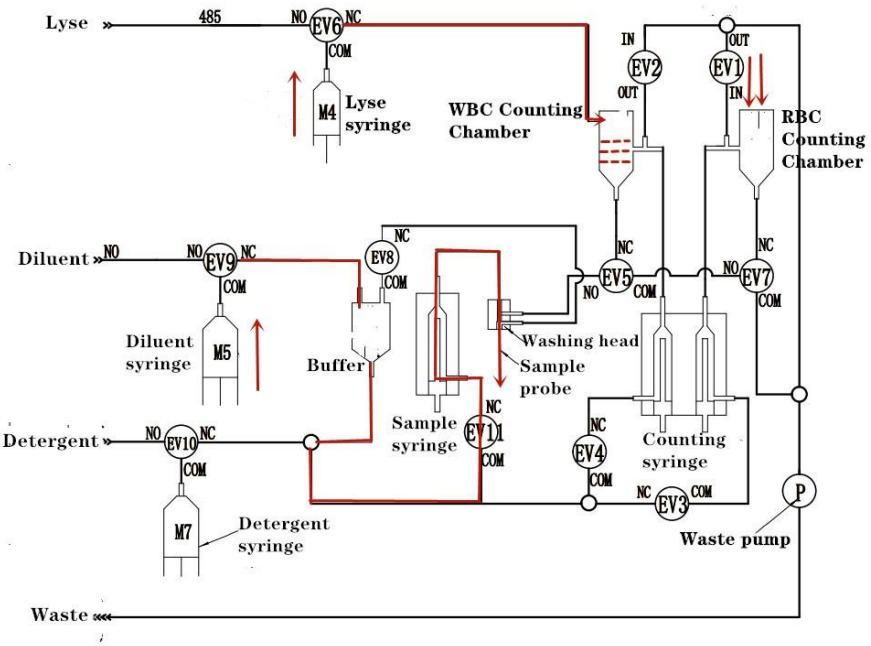
into the RBC counting chamber, which comes from the diluent syringe through Ev9(on),Ev4,while the diluent syringe moves upwards .

EV6 is one and 1ml lyse reagent is dispensed to WBC counting chamber through dispense nozzle which is on the wall of WBC counting chamber while the lyse syringe moves upwards.

This process makes 1:24476 dilution rate liquid in RBC chamber.

Note: after lyse reagent is dispensed into WBC counting chamber, M4 motor (lyse syringe drive motor) rotates counterclockwise a little distance to make some air enter tube which is connecting with lyse dispense nozzle. This process is used to avoid WBC count effect. If this process can't be observed, WBC total result will be high.



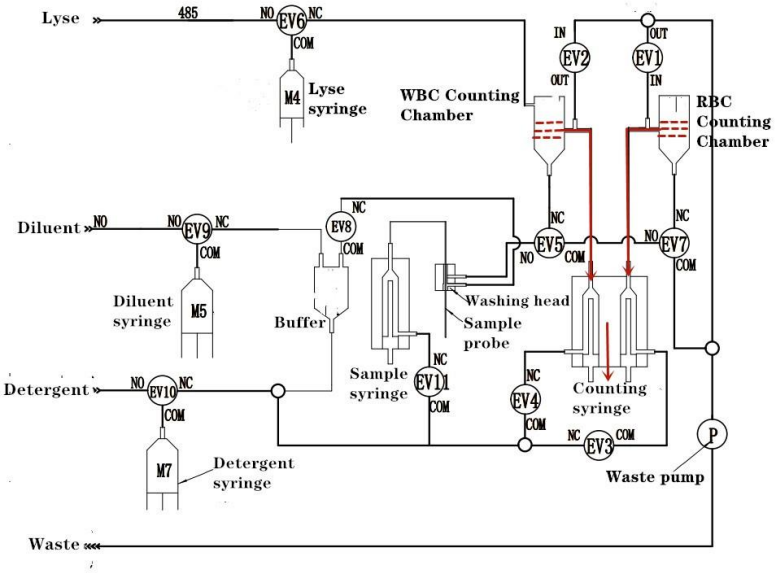


RBC Diluting and lyse reagent dispense

5.5 Counting

The counting syringe (M3) moves down, 270ul cell liquid from WBC counting chamber and RBC counting chamber through apertures is aspirated until sensor pole is detected by lower sensor of counting syringe, at the same time,

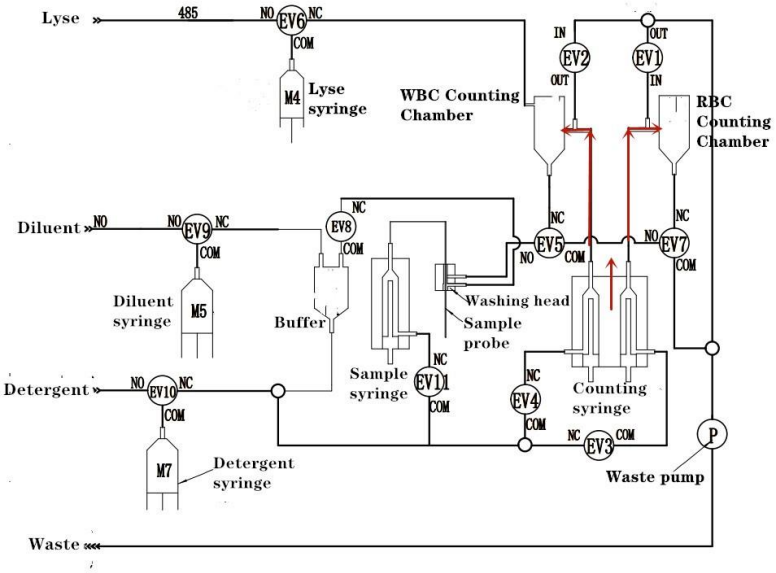
HGB sample signal measurement is executed.



Counting

5.6 Aperture backflush

After count, counting syringe moves upwards till sensor pole is detected by upper sensor. During this process, cell liquid will be pushed back to apertures and then dispensed from apertures. This process will decrease aperture clog rate.

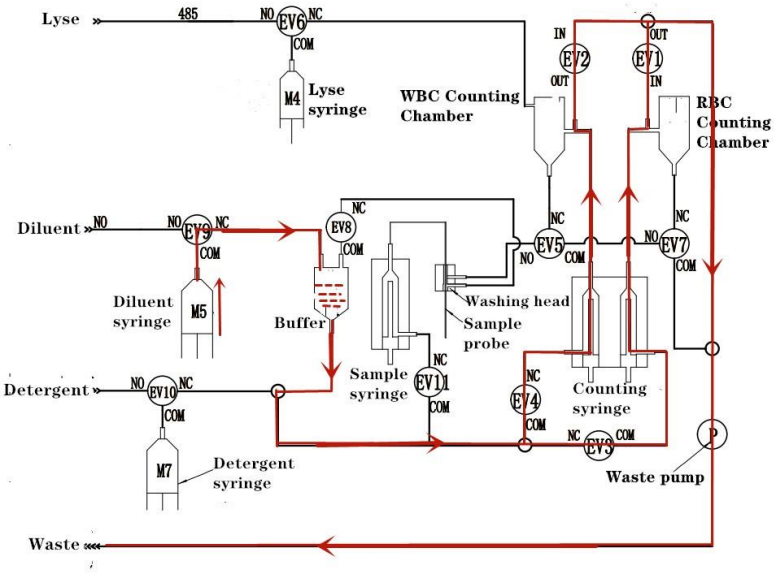


Aperture Backflush

5.7 Clean count tube path

In this process, diluent syringe pushes diluent to flow through count tube path as following figure showing. Ev9(on), Ev4(on), Ev1(on),Ev2(on), Ev3(on),Waste

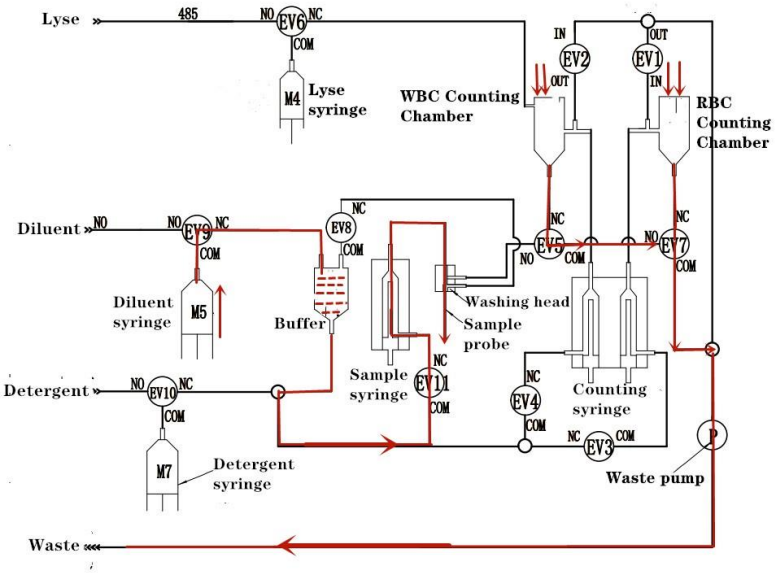
pump(on).



Clean Count Tube Path

5.8 Clean counting chambers using diluent

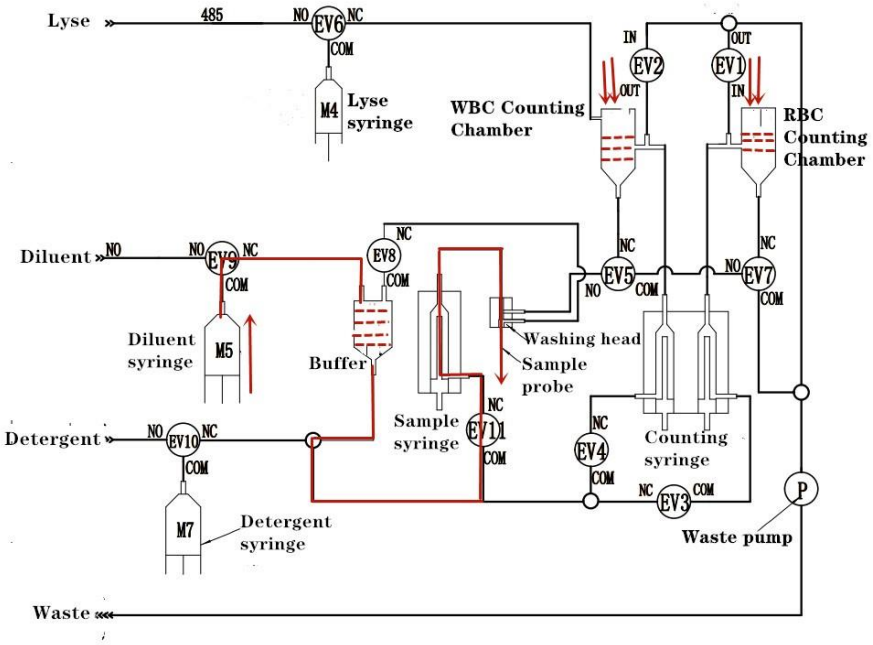
During this process, diluent syringe pushes diluent to dispense into WBC counting chamber for cleaning three times, and also dispense into RBC counting chamber for cleaning two times.



Clean Counting Chambers Using Diluent

5.9 Dispense diluent into counting chambers for standby

In this process, diluent syringe pushes diluent to dispense into WBC and RBC counting chamber for standby.



Dispense Diluent into Counting Chambers for Standby

5.10 Sample probe back to home position

After diluent dispense, sample probe back to home positon for next sample test.

Chapter 6 Parts adjustment or replacement

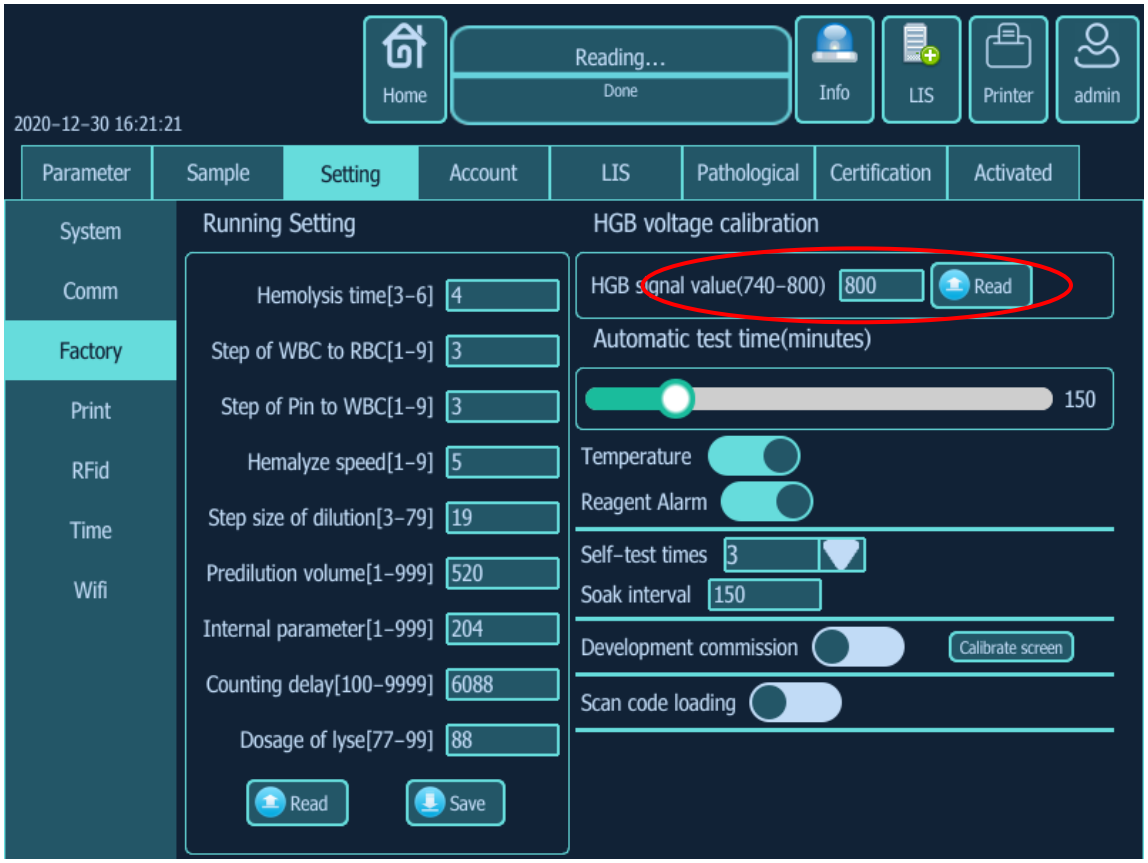
The chapter describes hardware and software adjustment, and also guide engineer how to adjust cell histogram.

6.1 Adjustment of HGB Gain

1. HGB Blank Voltage adjustment

Step 1, Empty WBC counting chamber manually.

Step 2, Enter Setting→factory Click “read” button which is in the “HGB blank voltage correction”, then software will display HGB signal value, this signal value should be from 400 to 550.



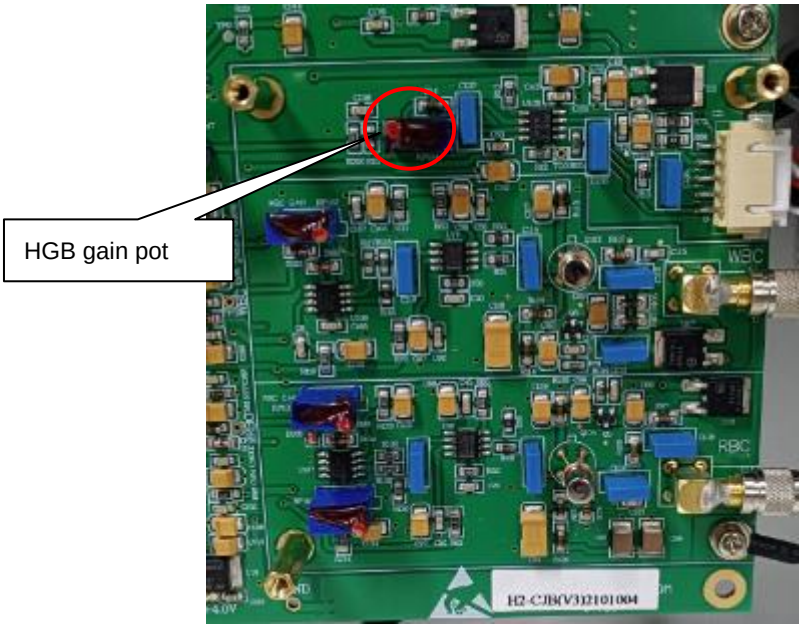
Step 3, if this signal value is not in the range, we need to replace the HGB lamp or it photocell.

Step 4, Make sure there is same volume of diluent with standby status in the WBC counting chamber.

Step 5, Enter Setting→factory Click “read” button then software will display HGB signal value, this signal value should be from 740 to 1000.

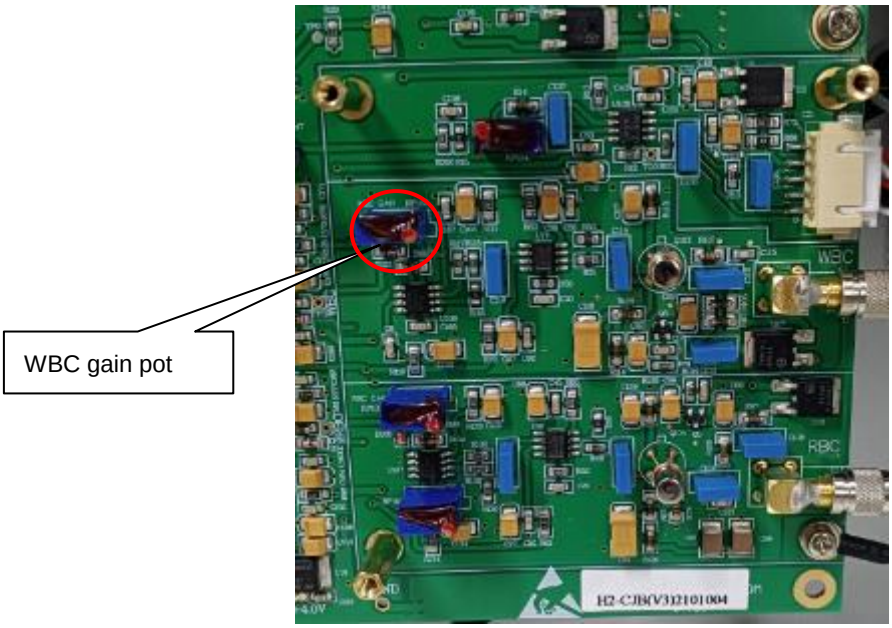
if this signal value is not in the range, we need to adjust RP104 potentiometer

on the data process board as below picture until displayed signal value is about 800.

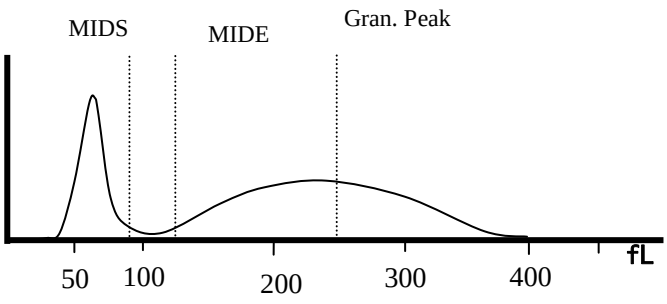


3. Run one background test and then adjustment procedure is finished.

6.2 Adjustment of WBC differential results



WBC Histogram



There are two discriminator lines in the WBC histogram, one is MIDS, the other is MIDE.

Lym. Cell is counted in the left area of MIDS.

Mid. Cell is counted between MIDS with MIDE.

Gran. Cell is counted in the right area of MIDE.

There are two items which affect WBC diff. results.

One is WBC gain pot which is on the data process board

If you clockwise adjust WBC gain pot, the WBC total result will be higher and the WBC histogram will move right direction and get more width.

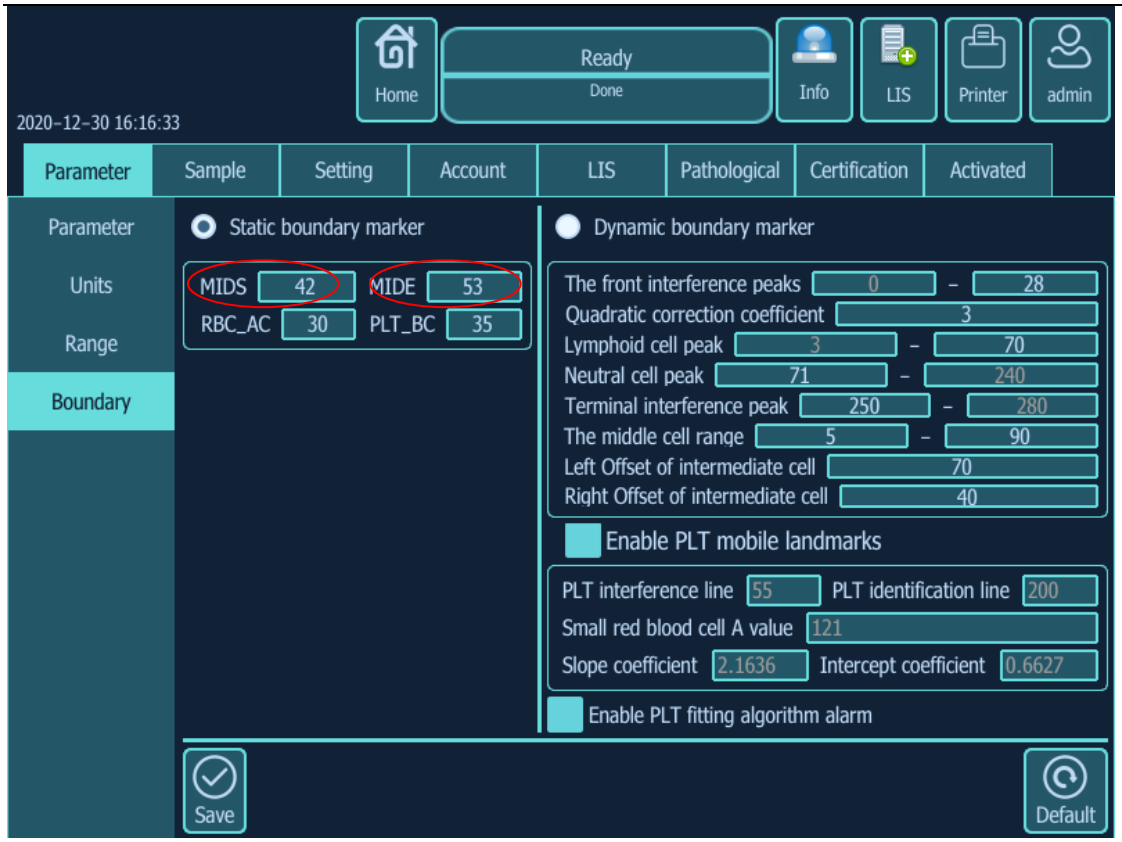
If you counterclockwise adjust WBC gain pot, the WBC total result will be lower and the WBC histogram will move left direction and get more compressed.

WBC gain pot adjustment purpose: make X axis value of Gran, cell peak to be about 230fl.

The other is MIDS and MIDE which is in the Setup-Factory-Basic setup menu where software should be login with factory mode as following login ID and password.

User ID: KEY77

Password: 1407



If you increase MIDS value, the LYM result will be higher and MID result will be lower.

If you decrease MIDS value, the LYM result will be lower and MID result will be higher.

If you increase MIDE value, the MID result will be higher and GR result will be lower.

If you decrease MIDE value, the MID Result will be lower and GR result will be higher.

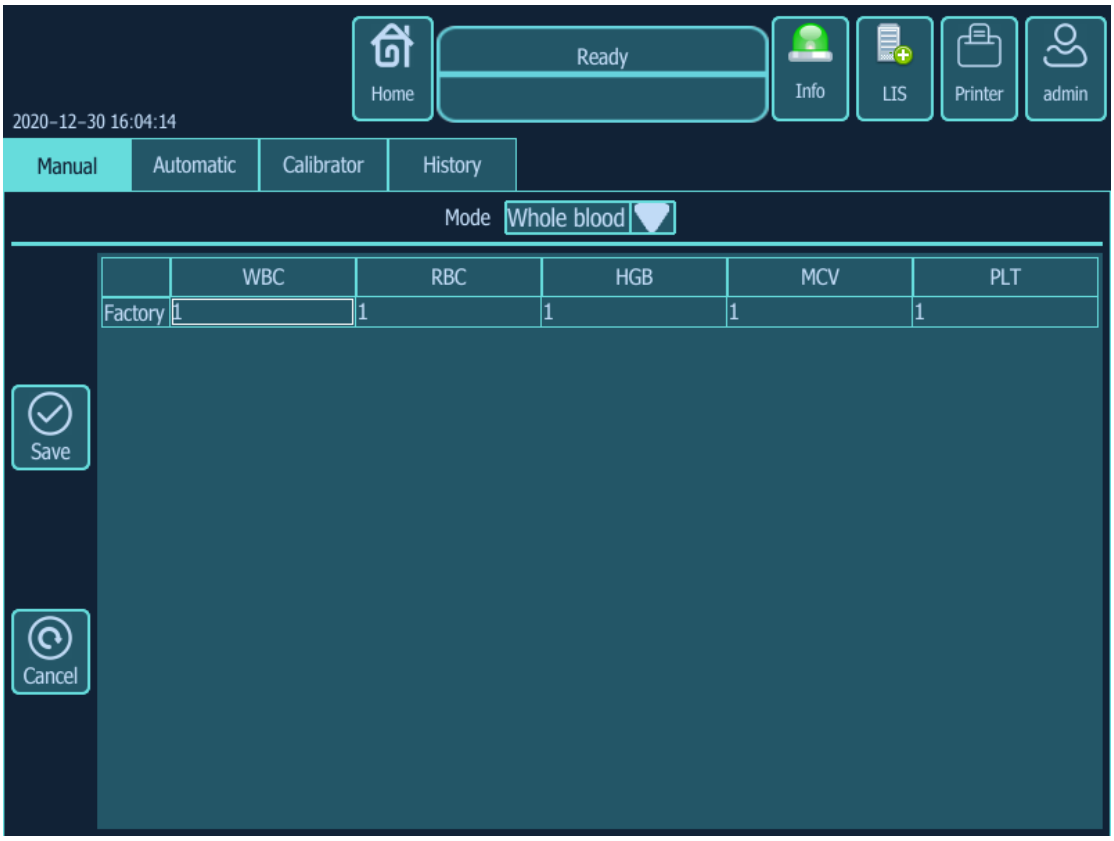
The MIDE setting value must be more than MIDS setting value.

When you understand the meaning of adjustment, you can start to adjust the WBC following steps.

1. Prepare fresh healthy venous blood which is gotten WBC target total value and diff. result.

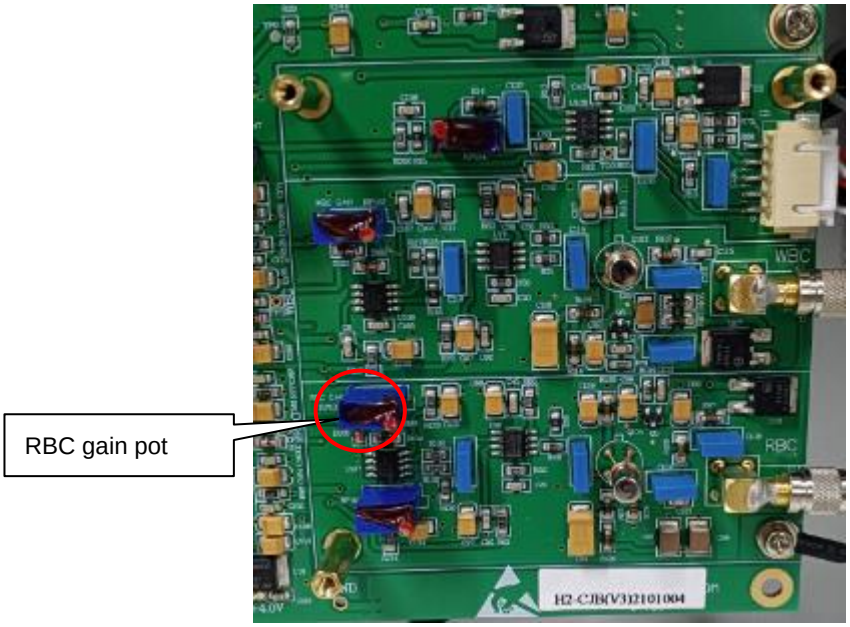
   Run this sample one time, and observe whether X axis value of Gran. Cell peak is about 230fl or not, if not, adjust WBC gain pot until X axis value of Gran. Cell peak is about 230fl.

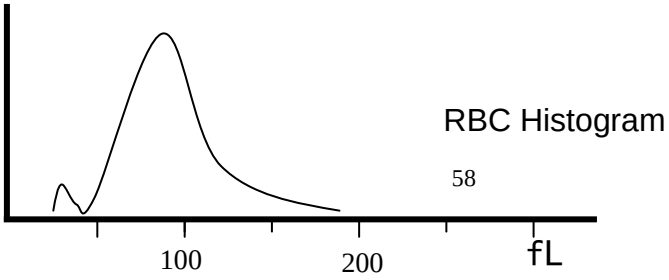
2. Calibrate WBC total result using WBC engineer menu calibration factor.



3. Adjust MIDS and MIDE value according to the sample's differential result.
4. Run QC till results are good.

6.3 Adjustment of RBC histogram





RBC Histogram

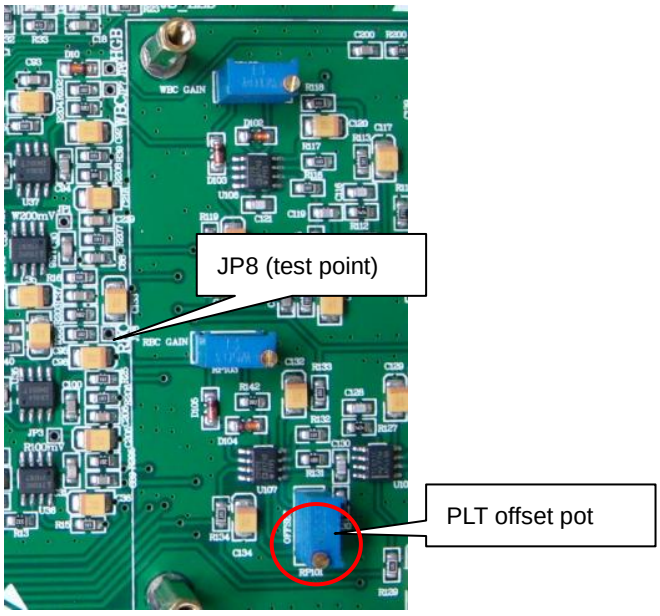
There are two peaks on the RBC histogram, small one is PLT cell peak, the other big one is RBC cell peak.

If you clockwise adjust RBC gain pot, the RBC total result will be higher and the RBC histogram will move right direction and MCV result will be increased.

If you counterclockwise adjust RBC gain pot, the RBC total result will be lower and the RBC histogram will move left direction and MCV result will be decreased, if MCV value is decreased to be very low.it will affect PLT calculation, PLT result will be increased.

RBC gain pot adjustment purpose is to make X axis value of RBC Cell peak to be equal to MCV result.

6.4 Adjustment of PLT offset



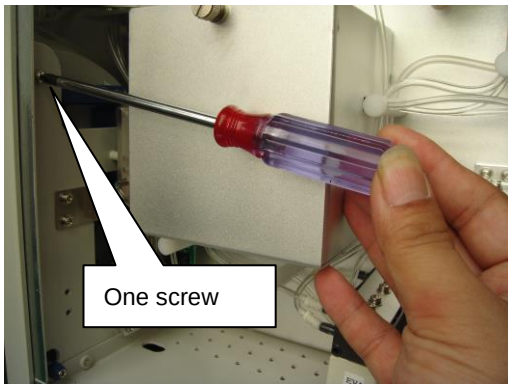
This PLT offset affects PLT blank result is a little high, so when we meet high PLT blank problem, we need to check this point.

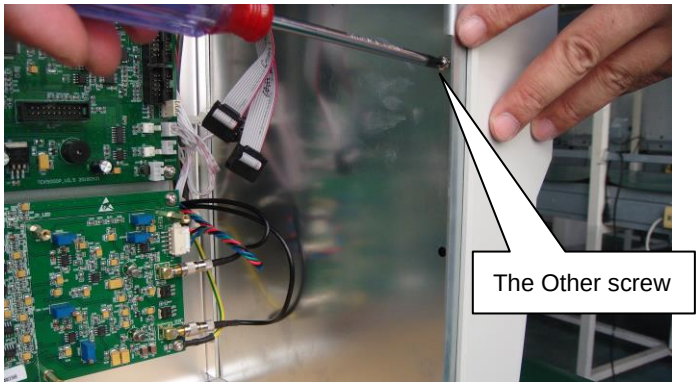
1. Confirm machine is standby.
2. Use red pen of multi-meter to connect with JP8 point.
3. Use black pen of multi-meter to connect with GND point.
4. Adjust PLT offset pot to make JP8 test voltage to be zero.
5. Finish adjustment.

Note: PLT offset voltage range is 0mv to +20mv.

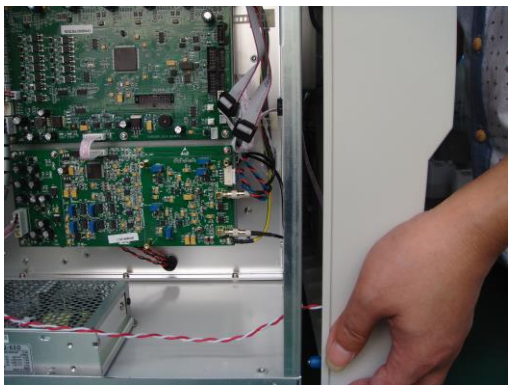
6.5 Replacement of sample probe

1. Switch off machine and remove two fixed screws of front panel.

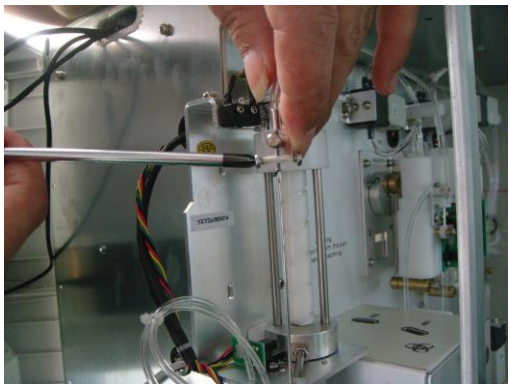




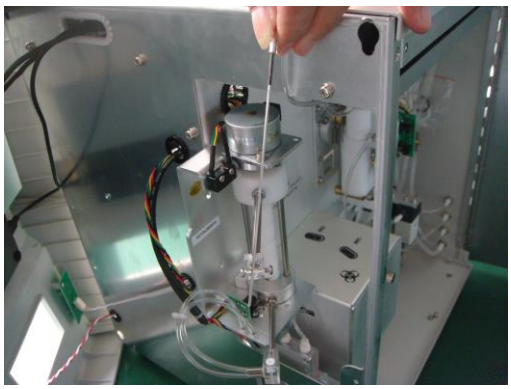
2. Lift up the front panel and then pull outward.



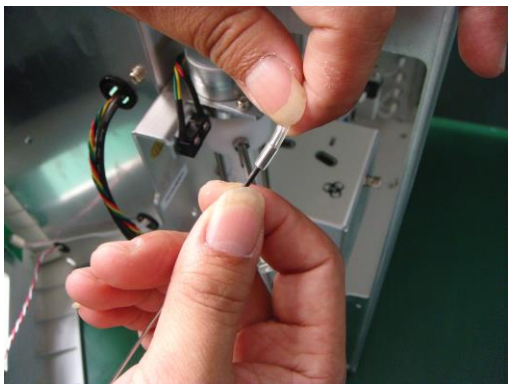
3. Loosen the two fixed screws of sample probe.



4. Pull sample probe out of washing head.



5. Remove tube of sample probe.



Note: it is a little difficult to remove this tube from sample probe, it is very tight,

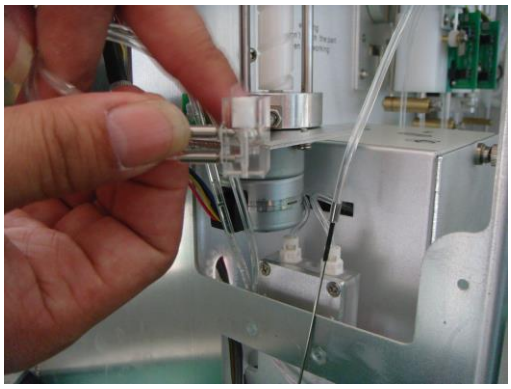
we can use hair drier to make the tube soft and then easier remove.

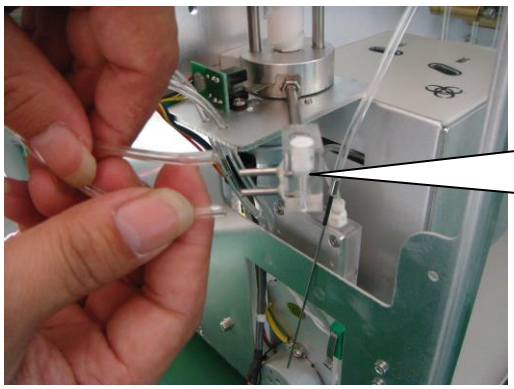
6. Reverse above steps to install new sample probe.

6.6 Replacement of washing head

1. Switch off machine, and pull sample probe out of washing head according “replacement of sample probe”.

2. Remove the two tubes from washing head.

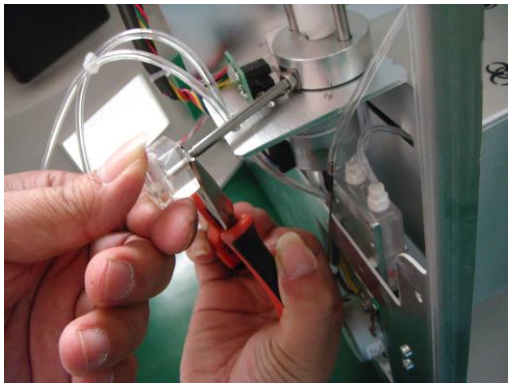




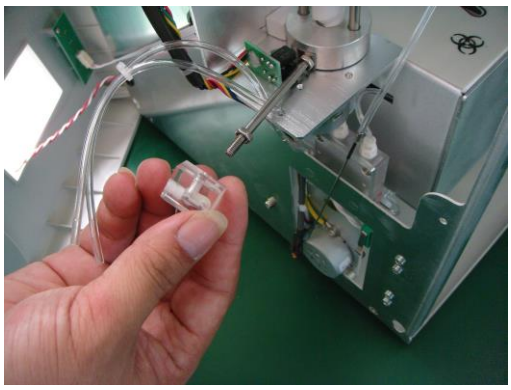
The upper connector of washing head is outlet EV5

The lower connector of washing head is inlet of diluent liquid.

3. Loosen one fixed screw of washing head.



4. Rotate washing head and then can remove it.



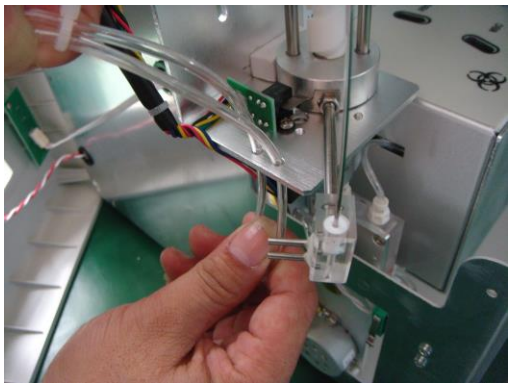
5. Reverse above steps to install new washing head.

Note: during fix position of washing head, should make sample probe perpendicular to the washing head.

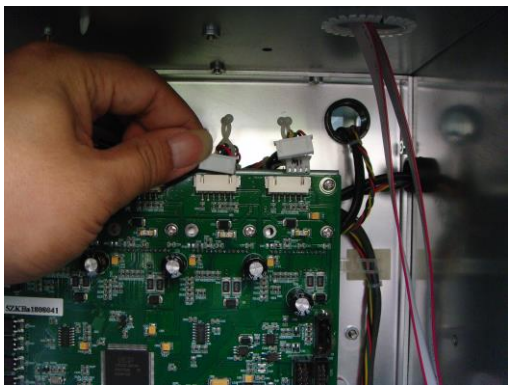
6.7 Replacement of sample probe subassembly

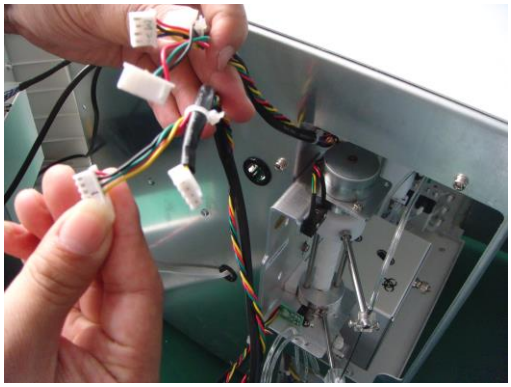
1. Switch off machine and then remove the two tubes of washing head.

2. Pull out the two tubes from assembly holes.

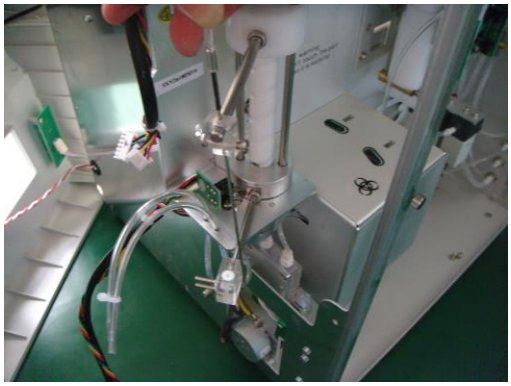


3. Remove signal cable connectors of sample probe subassembly from main controller board.

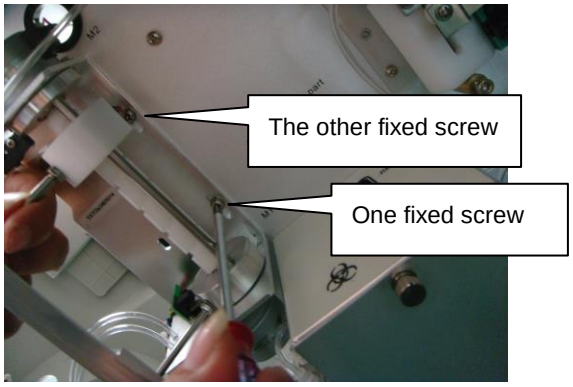




4. Pull out sample probe from washing head.



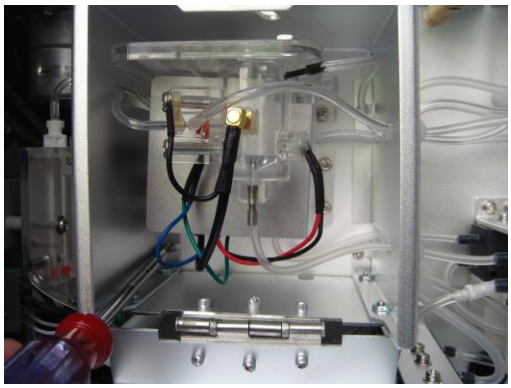
5. Remove two fixed screws of subassembly and then can remove the whole subassembly.



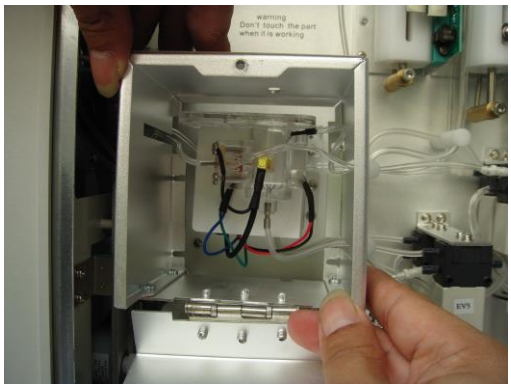
6. Reverse above steps to install new sample probe subassembly.

6.8 Replacement of counting syringe O-ring

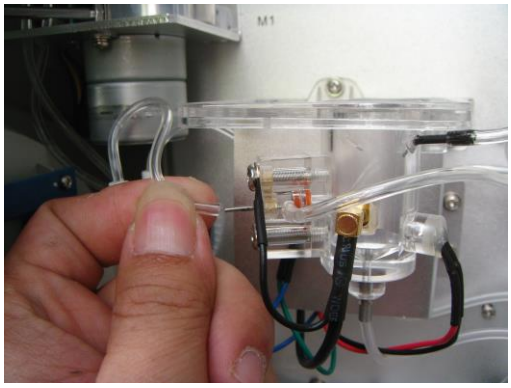
1. Switch off machine and loosen the four fixed screws of shield cover.



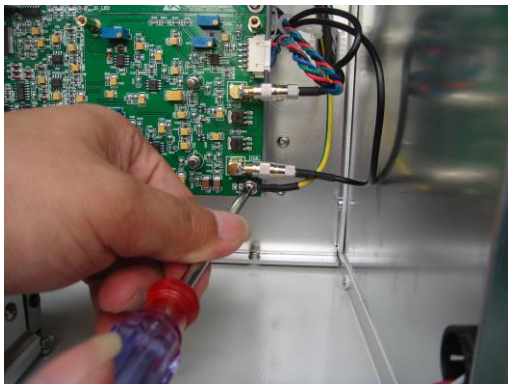
2. Pull out the shield cover.



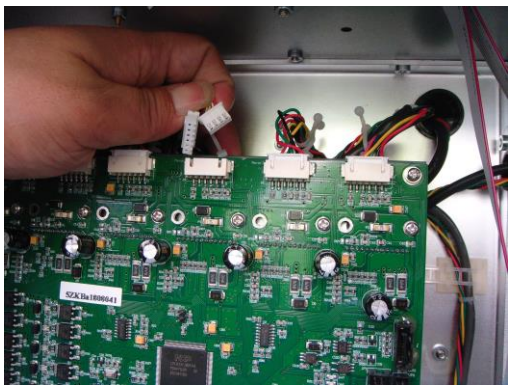
3. Remove the four tubes from counting syringe.



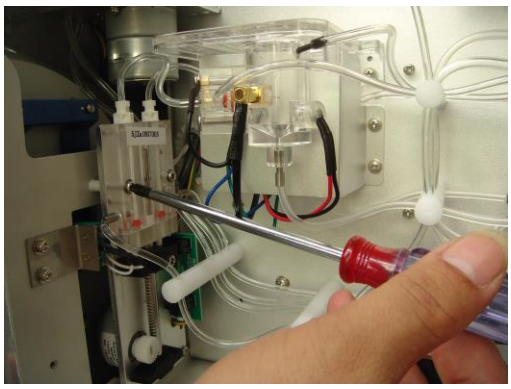
4. Remove ground connector of syringe from data process board.

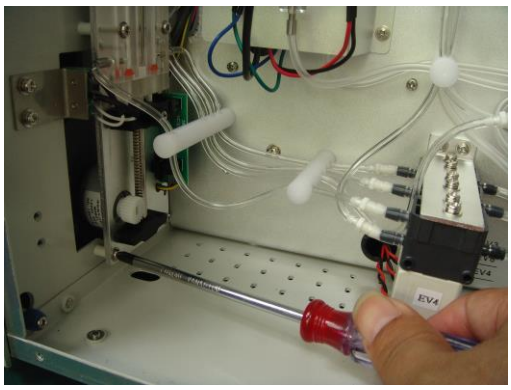


5. Remove signal cable connectors from main controller board.

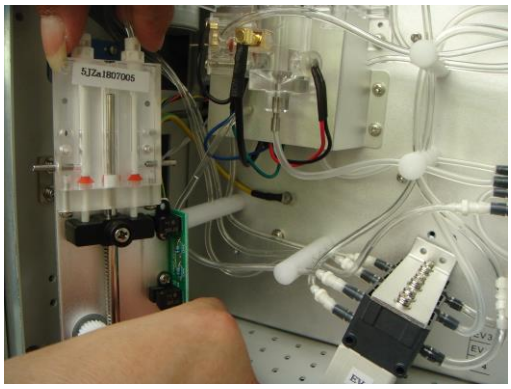


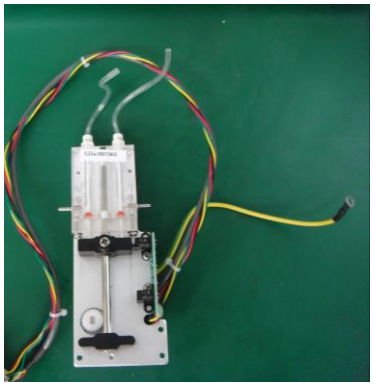
6. Remove four fixed screws of syringe.



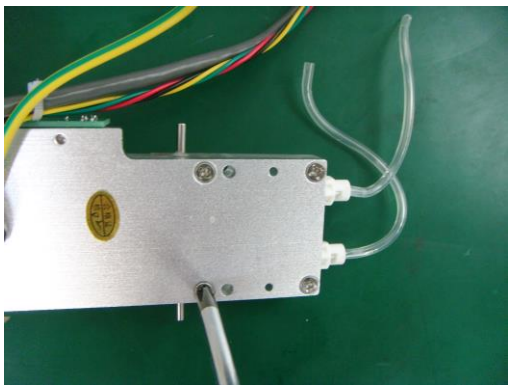


7. Pull out the whole subassembly.

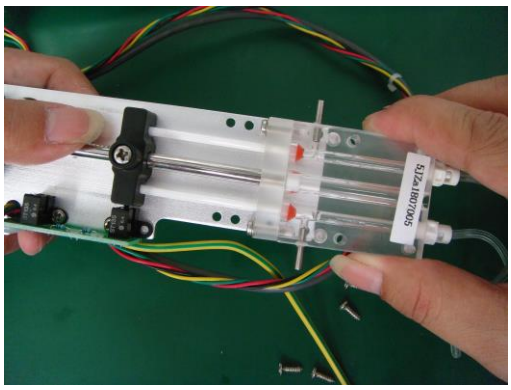




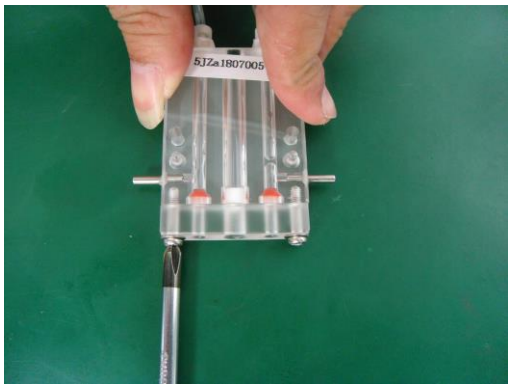
8. Remove the four fixed screws of syringe cavity.

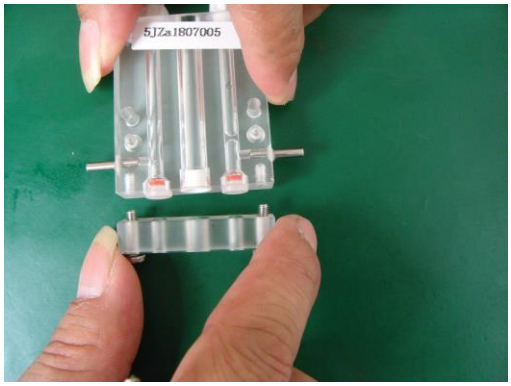


9. Pull the syringe cavity out.

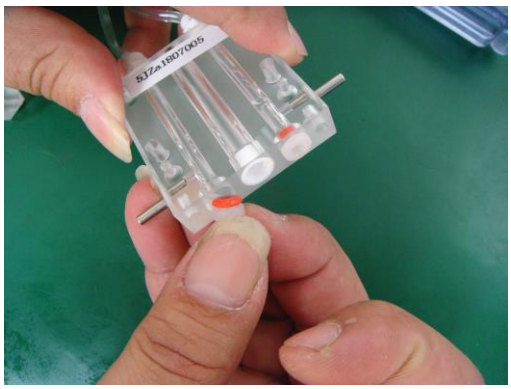


10. Remove the two fixed screws of O-ring block.



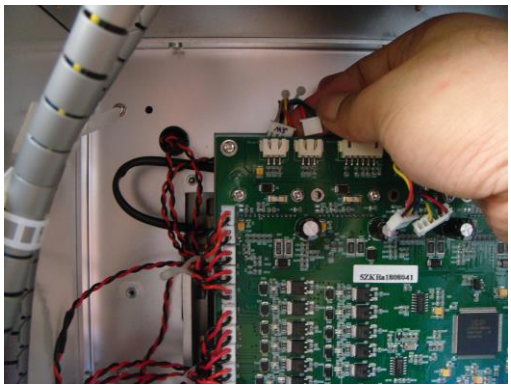


11. Reverse above steps to install new O-ring.

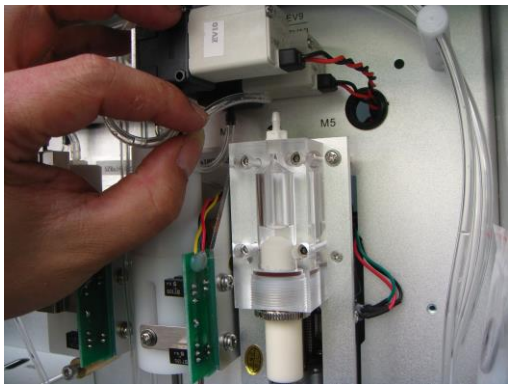


6.9 Replacement of diluent syringe O-ring

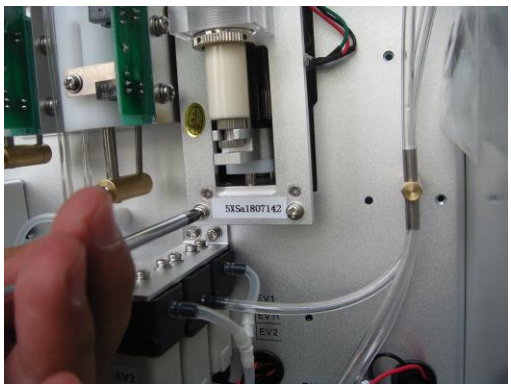
1. Remove signal cable connector from main controller board.



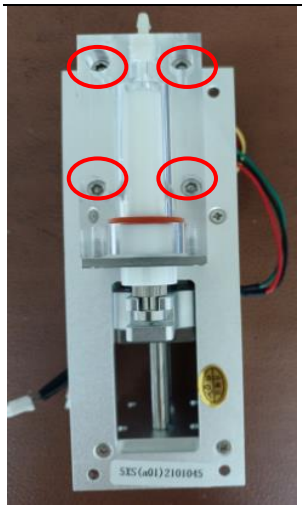
2. Remove the one tube of syringe.



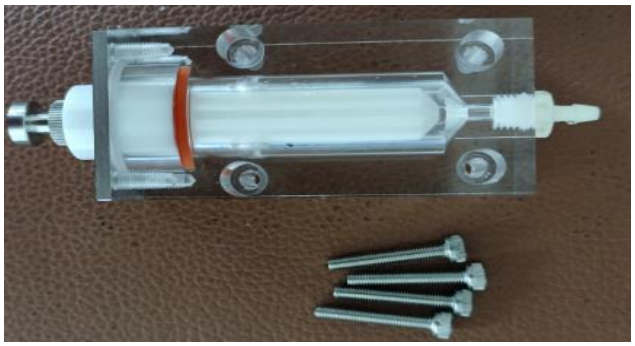
3. Remove the four fixed screws of subassembly.



4. Take out the diluent syringe subassembly.



5. Remove the four screws and pull out the piston from the diluent syringe cavity.

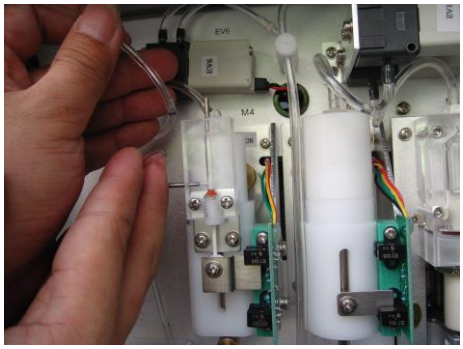


6. Remove lock screw of O-ring.

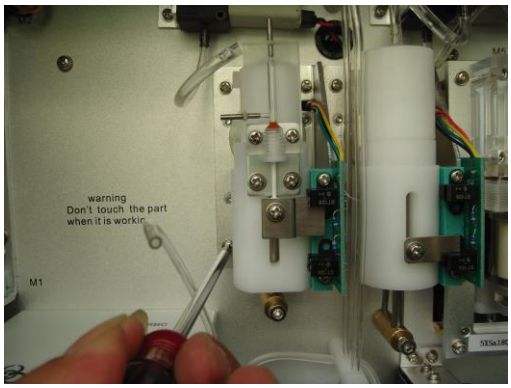
7. Reverse above steps to install new O-ring.

6.10 Replacement of sample and lyse syringe O-ring

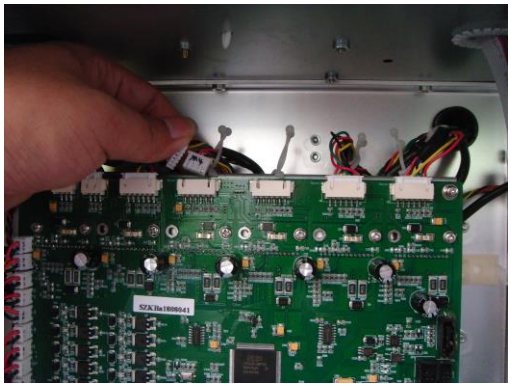
1. Remove the two tubes of syringe.



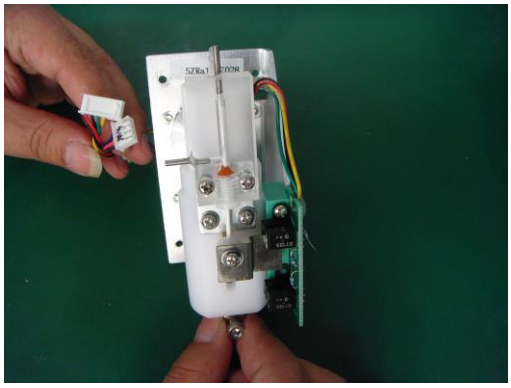
2. Remove the three fixed screws of subassembly.



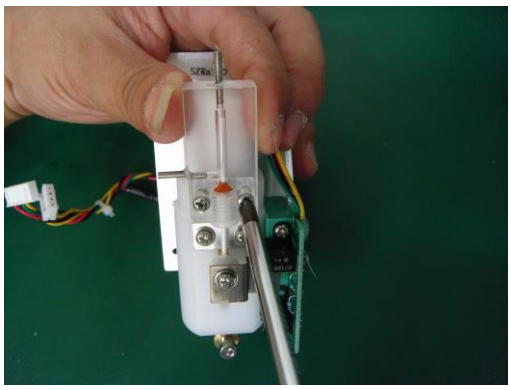
3. Remove signal cable connector from main controller board.



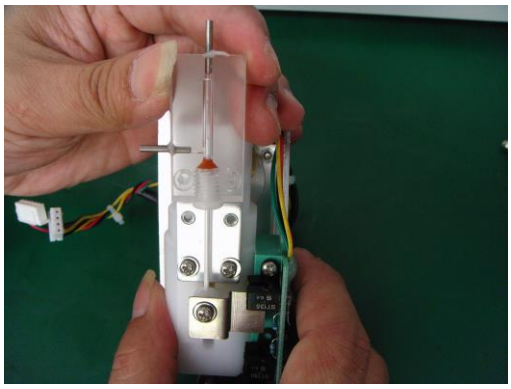
4. Take out the sample/lyse syringe subassembly.

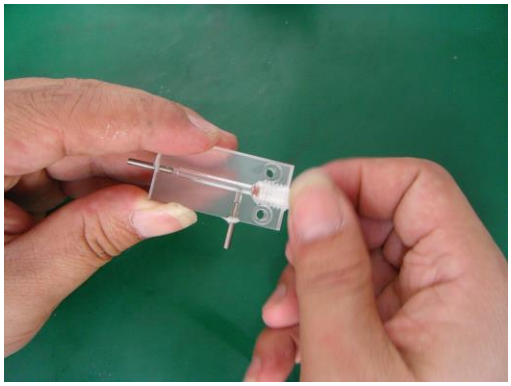


5. Remove the two fixed screws of sample syringe.



6. Pull out the sample syringe cavity.

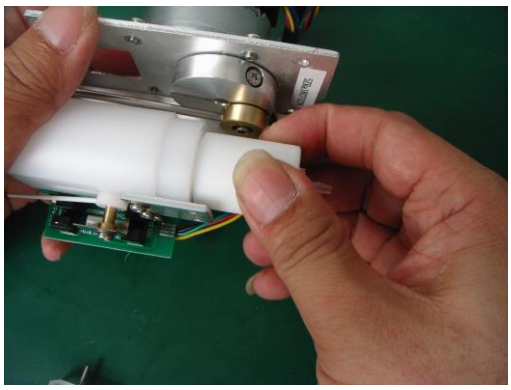


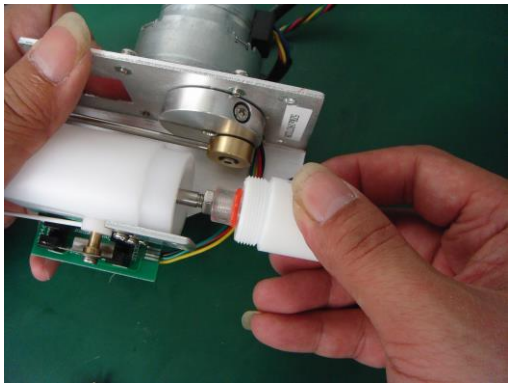


7. Unscrew the fixed screw of O-ring.

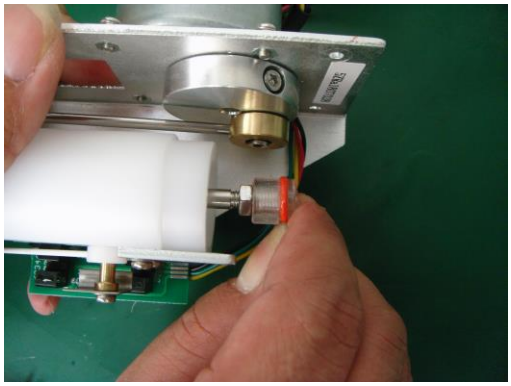
8. Reverse above steps to install new O-ring of sample syringe.

9. Rotate lyse syringe cavity and then can remove syringe cavity.



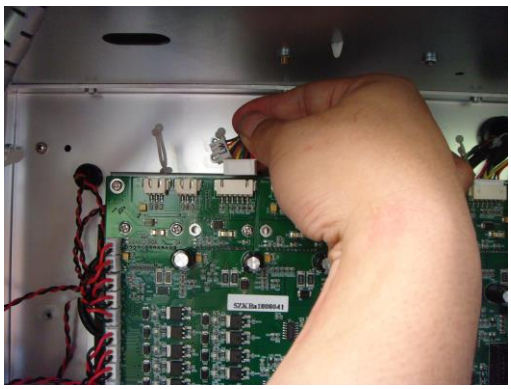


10. Reverse above steps to install new O-ring of lyse syringe.

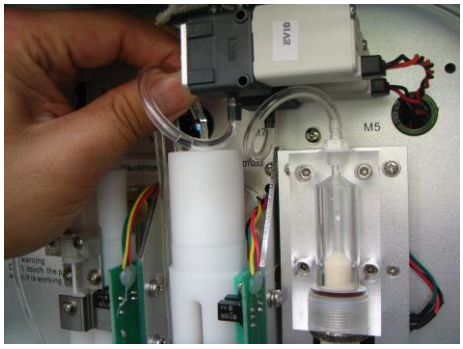


6.11 Replacement of detergent syringe O-ring

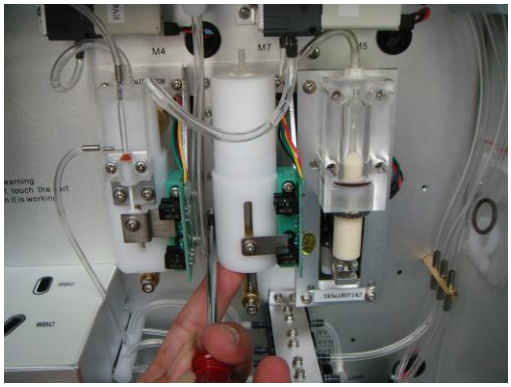
1. Remove signal cable connector from main controller board.



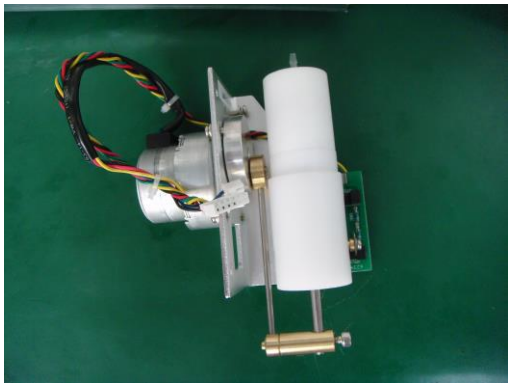
2. Remove the one tube of syringe.



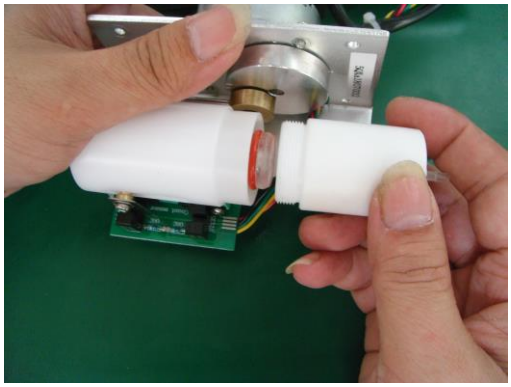
3. Remove the three fixed screws of subassembly.



4. Take out the sample/lyse syringe subassembly.



5. Rotate detergent syringe cavity and then can remove syringe cavity.

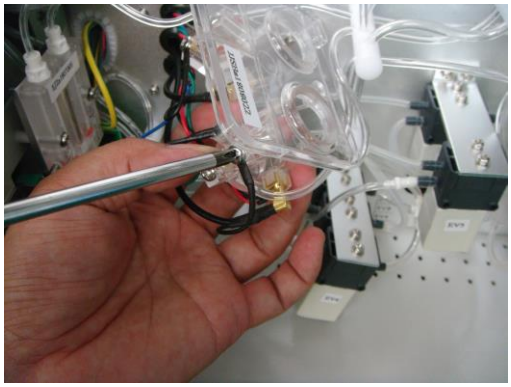


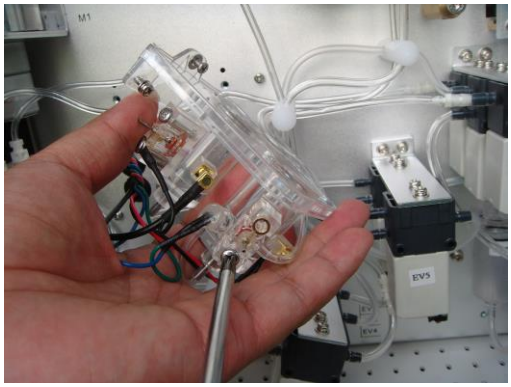
6. Reverse above steps to install new O-ring of detergent syringe.

6.12 Replacement of aperture

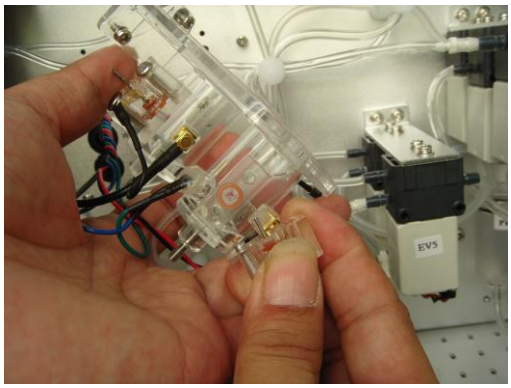
1. Switch off machine and make counting chamber empty.

2. Remove the two fixed screws of aperture backseat.

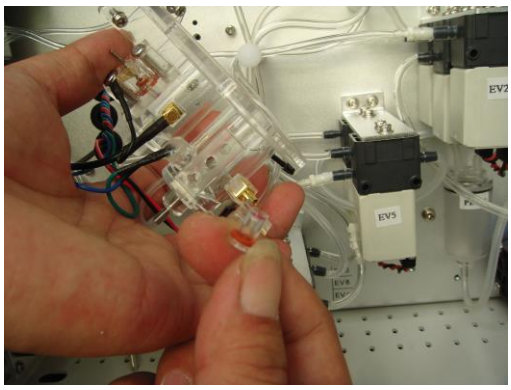




3. Remove backseat of aperture.



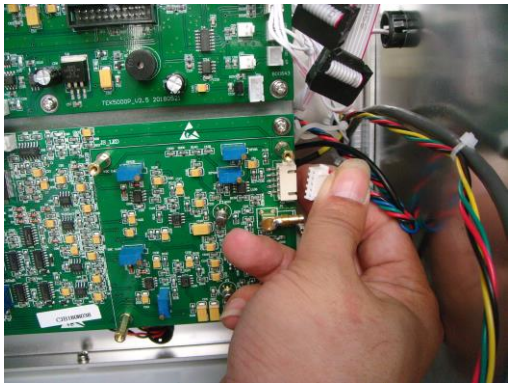
4. Take out the aperture



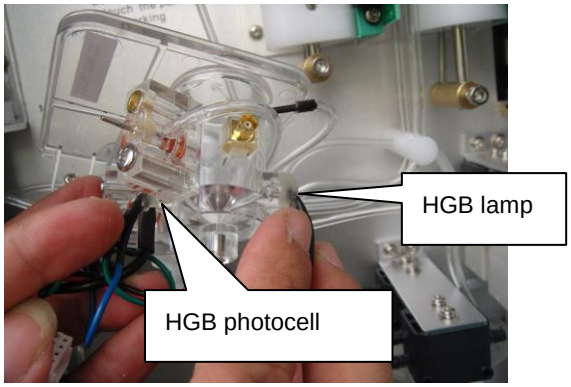
5. Reverse above steps to replace new aperture.

6.13 Replacement of HGB unit

1. Switch off machine and remove HGB unit cable connector from data process board.



2. Remove the glue of HGB lamp and HGB photocell from counting chamber.



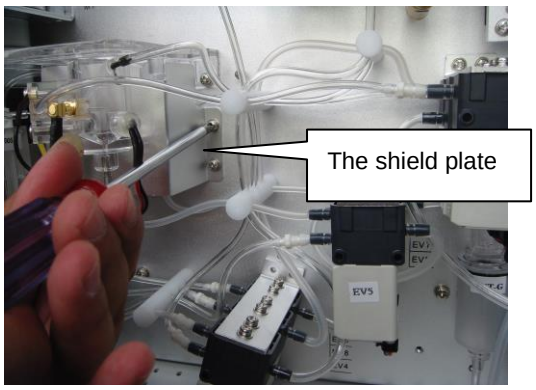
3. Pull out the HGB lamp and HGB photocell from counting chamber.

4. Remove old HGB unit and then reverse above steps to install new HGB unit.

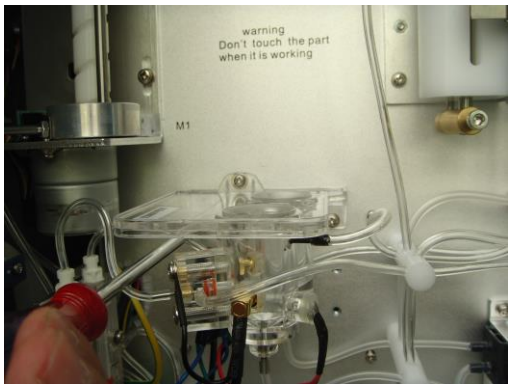
Note: After new HGB unit replacement, should adjust HGB voltage again.

6.14 Replacement of electrode cable

1. Switch off machine and remove shield plate of counting chamber

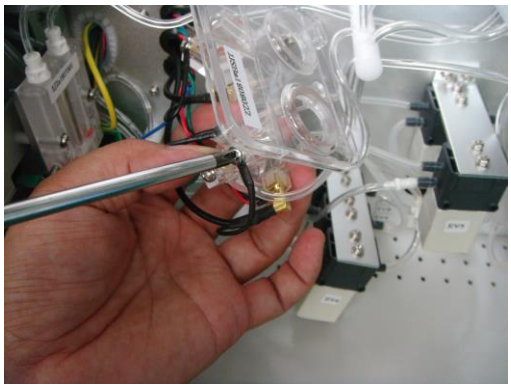


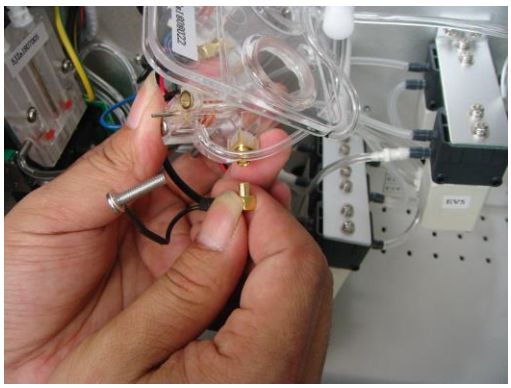
2. Remove the three fixed screws of counting chamber



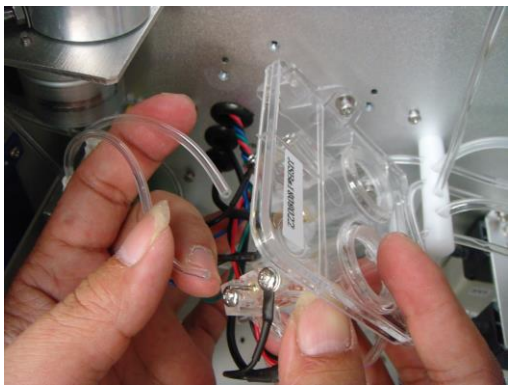
Note: before this procedure, make counting chamber empty.

3. Remove the two fixed screws of electrode cable from counting chamber.

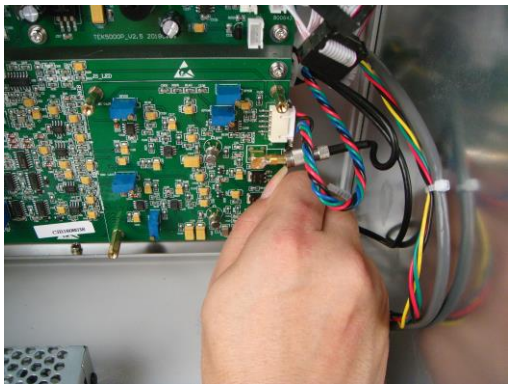


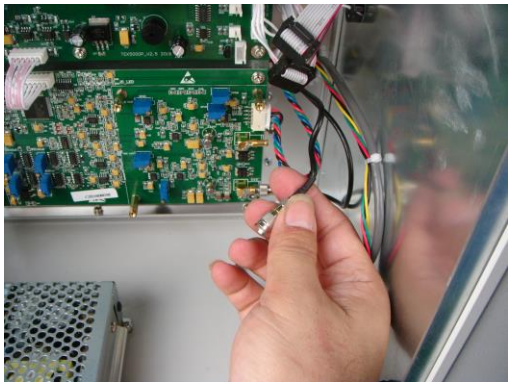


4. Remove two tubes which are connecting with backseat of aperture.

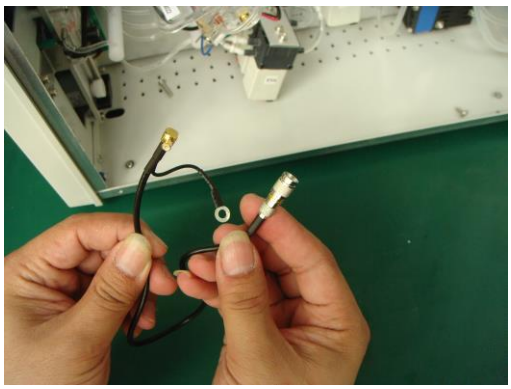


5. Unplug electrode cable from data process board.





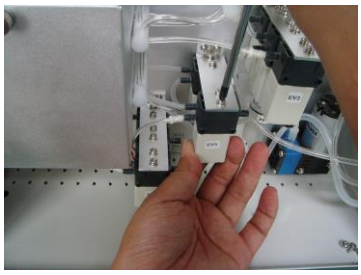
6. Reverse above steps to install new electrode cable.



6.15 Clean two way and three way valve

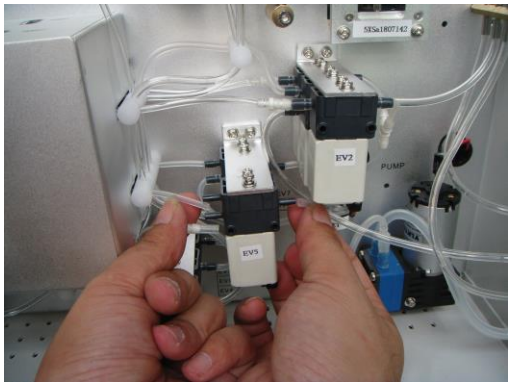
6.15.1 Clean three way valve

1. EV5 is example.
2. Remove two fixed screws of valve.

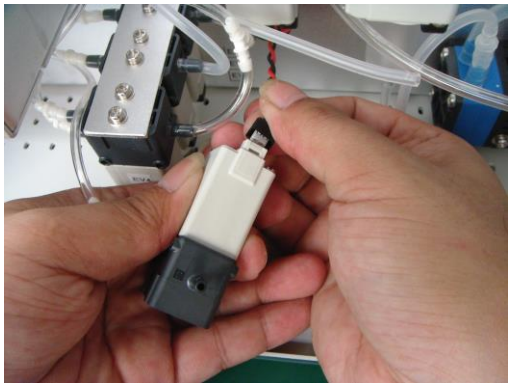


Note: before this procedure, make counting chamber empty.

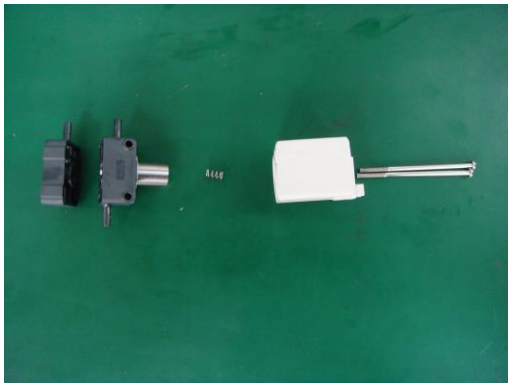
3. Remove three tubes of valve.



4. Unplug power cable of valve.



5. Remove the two fixed screws to open valve.

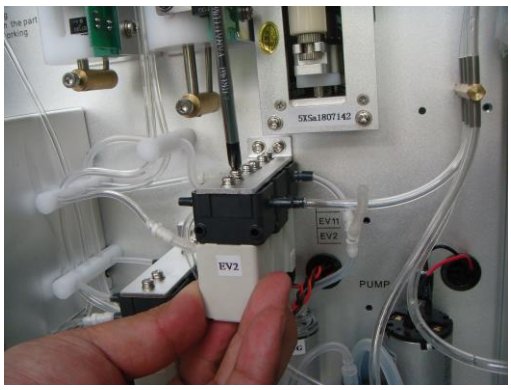


6. Clean below parts using dry gauze.

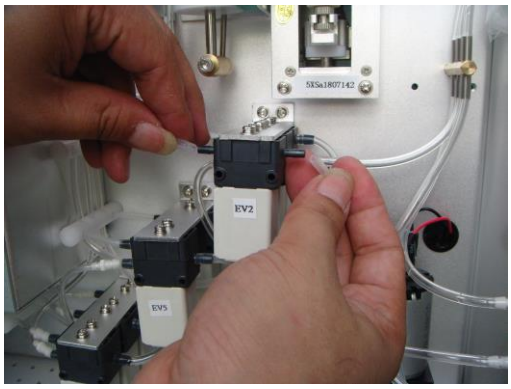
6.15.2 Clean two way valve

1. EV2 is example.

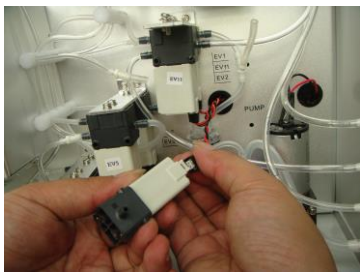
2. Remove two fixed screws of valve.



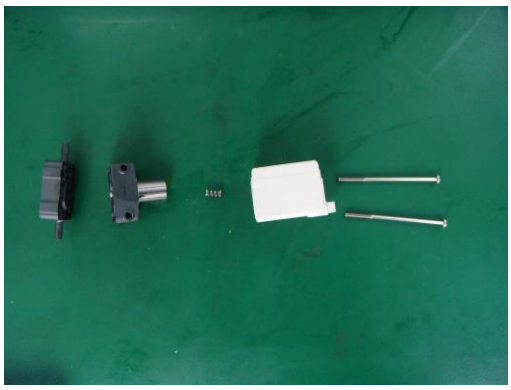
3. Remove two tubes of valve.



4. Unplug power cable of valve.



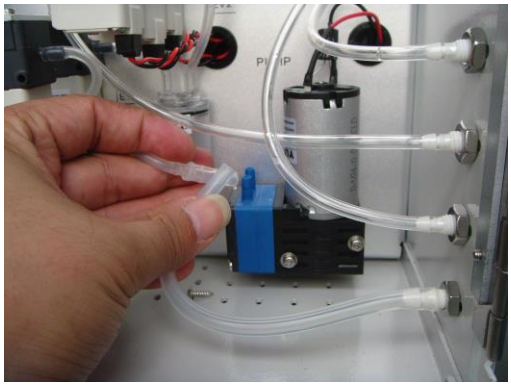
5. Remove the two fixed screws to open valve.



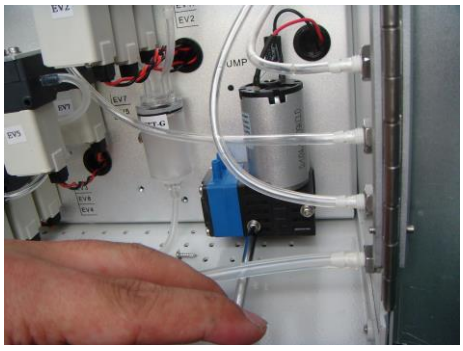
6. Clean below parts using dry gauze.

6.16 Clean waste pump

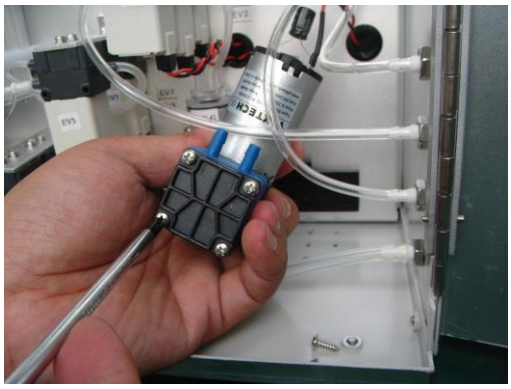
1. Remove the two tubes of waste pump.

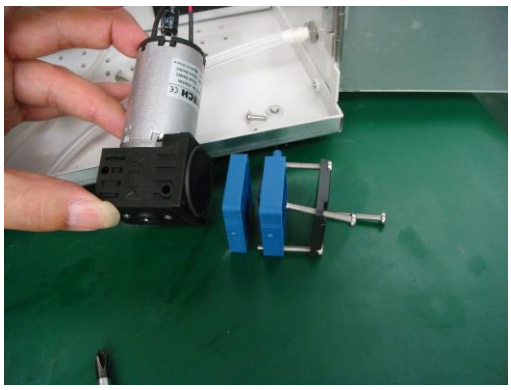


2. Remove the two fixed screws of waste pump.

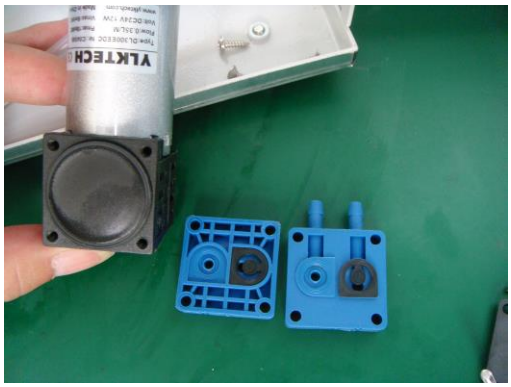


3. Remove the four fixed screws of membrane cover.





4. Clean below membranes using dry gauze.



Problem	Possible reason	Remedy
The background data on RBC or PLT is high	1.AC interference from AC power line	1.Ground the instrument
	2. Sudden drop in AC power line voltage	2.Do not share the same power line with another instrument
	3. Some bubbles in the diluent reagent tubing	3. Make diluent bucket same level with instrument Diluent is insufficient
	4. RBC/PLT aperture is dirty or clogged	4.Clean the aperture
	5.Damaged RBC/PLT aperture	5.Replace the aperture
	6.Diluent reagent is dirty	6.Replace fresh diluent
	7.RBC electrode cable attached to the RBC counting chamber is loose	7.Fix this point
	8.RBC electrode cable to the RBC counting chamber is broken	8.Replace the RBC electrode cable
	9.The 2-way valve 1 or 3 is dirty	9.Clean the two valves or replace
	10.There is some leakage in the counting syringe	10.Replace the syringe O-ring
	11.The 3-way valve 7 is clogged or damaged	11.Clean the valve or replace
	12. PLT offset voltage is not good	12. Adjust PLT offset voltage
	13. Faulty counting chamber	13. Replace the chamber
	14.Q104(3DJ9F) is damaged in the amplifier part of data process board	14.Replace Q104
	15.U105 or U107 is damaged in the	15.Replace U105 or U107

	amplifier part of data process board	
	16.Faulty circuit	16.Replace the data process board
The background data on WBC is high	1.AC interference from AC power line	1.Ground the instrument
	2. Sudden drop in AC power line voltage	2.Do not share the same power line with another instrument
	3. Some bubbles in the diluent reagent tubing	3. Make diluent bucket same level with instrument Diluent is insufficient
	4.WBC aperture is dirty or clogged	4.Clean the aperture
	5.Damaged WBC aperture	5.Replace the aperture
	6.Diluent reagent is dirty	6.Replace fresh diluent
	7.WBC electrode cable attached to the WBC counting chamber is loose	7. Fix this point
	8.WBC electrode attached to the WBC counting chamber is broken	8.Replace the WBC electrode
	9.The 2-way valve 2 or 4 is dirty	9.Clean the two valves or replace
	10.There is some leakage in the counting syringe	10.Replace the syringe O-ring
	11.The 3-way valve 5 is clogged or damaged	11.Clean the valve or replace
	12.Q103(3DJ9F) is damaged in the amplifier part of data process board	12. Replace Q103.
	13.Lyse reagent temperature is low	13.Increase temperature
	14.There is some leakage in the lyse syringe	14.Replace the syringe O-ring
	15.There is no back shrink air in the	15.Check lyse syringe or

	lyse dispense nozzle	replace
	16. U104 or U106 is damaged in the amplifier part of data process board	16. Replace U104 or U106
	17. Faulty circuit	17. Replace the data process board
The background data on HGB is high	1.The WBC counting chamber is dirty	1.Clean the WBC counting chamber
	2. Diluent is insufficient	2. Confirm diluent bucket is full
	3. HGB lamp or HGB photocell is loose	3. Fix it
	4.HGB signal value is not in the range	4.Adjust HGB signal value to be from 850 to 950
	5.HGB lamp is damaged	5.Replace HGB lamp
	6.HGB photocell is damaged	6.Replace HGB photocell
	7.U108(TL082) is damaged	7.Replace U108(TL082)
Only WBC, RBC, PLT sample results, the others are zero	1.System do not confirm the HGB voltage	1.Enter Setup→System→ Parameter setting, confirm HGB voltage is in the range or not
	2.HGB photocell is damaged	2.Replace HGB photocell
	3.HGB lamp is damaged	3.Replace HGB lamp
	4.U108(TL082) is damaged	4.Replace U108(TL082)
Only WBC;HGB sample results are high, the others are ok	1. Lyse reagent temperature is low	1. Increase temperature
	2.Lyse reagent is not enough	2.Check reagent bucket
	3.The 3-way valve ⑥ is clogged or damaged	3.Clean the valve or replace
	4. Some leakage in the lyse syringe	4.Replace syringe O-ring
	5. Lyse syringe motor is damaged	5. Replace subassembly

	6.The lyse dispense nozzle is clogged	6.Clear the nozzle
Only HGB result is high, the others is ok	1.It is necessary to calibrate	1.Use QC blood and calibrate HGB
	2.The WBC counting chamber is dirty	2.Clean the chamber
	3.HGB voltage is low	3.Adjust HGB gain to increase the voltage
	4. HGB lamp is damaged	4. Replace HGB lamp
	5. HGB photocell is damaged	5.Replace HGB photocell
PLT sample result is low	1.It is necessary to calibrate	1.Use QC blood and calibrate PLT
	2.Wrong anticoagulant	2.Use EDTA –K2 or K3 as an anticoagulant
	3.Coagulated blood sample	3.Sample whole blood from patient again
	4. Blood mix time is not enough	4. At least five minutes mix time
	5. RBC gain is low and PLT offset is not good	5. Adjust RBC gain and PLT offset
	6.The blood sample is abnormal	6.Check the blood sample with microscope
RBC; PLT sample results are low	1.The 3-way valve ⑦ is clogged or damaged	1.Clean the valve or replace
	2.The RBC aperture is clogged	2.Clean the aperture
	3.The secondary sample is abnormal	3.Check sample needle if loosen and went up
	4.The 2-way valve 1 or 3 is dirty	4.Clean the valve or replace
	5.The ceramics piston of M3 is broken	5.Change the ceramics piston

RBC;PLT sample result is zero, the others are ok	1. RBC electrode cable to RBC counting chamber is unconnected or broken	1.Reconnect or replace
	2. The secondary sampling procedure is abnormal	2.Check this procedure
	3.The RBC aperture is damaged	3.Replace the aperture
	4.U35(CA3100) or U36(CA3100) is damaged	4.Replace U35 or U36
	5. Faulty circuit	5. Replace data process board
WBC sample result is zero, the others are ok	1.WBC electrode cable to WBC counting chamber is unconnected or broken	1.Reconnect and replace cable
	2.WBC aperture is clogged or damaged	2.Clean or replace the aperture
	3.U37(CA3100) or U38(CA3100) is damaged	3.Replace U37 or U38
	4. Faulty circuit	4. Replace data process board
#1 motor error	1.horizontal optical sensor of probe arm is damaged or loose	1.Replace or adjust sensor
	2.Stepping motor is damaged	2.Replace sample probe subassembly
	3.Sensor plate is loosen	3.Tighten the screw securing the plate
	4. F6(fuse) of main controller board is damaged	4. Replace fuse
#2 motor error	1.Plastic bolt fixer is loosen or damaged	1.Adjust or replace the plastic bolt fixer
	2.Micro switch of vertical movement	2.Adjust or replace the switch

	is loosen or damaged	
	3.Stepping motor is damaged	3.Replace sample probe subassembly
	4.F5(fuse) of main controller board is damaged	4. Replace fuse
#3 motor error	1.M3 upper or lower sensor is damaged or dirty	1.Clean or replace the sensor
	2.Stepping motor is damaged	2.Replace the subassembly
	3.Sensor pole is loosen	3.Tighten the sensor pole
	4.F4(fuse) of main controller board is damaged	4. Replace fuse
#4 motor error	1.M4 sensor plate is loosen	1.Adjust the sensor plate and tighten
	2.There is some resistance in the syringe	2.Grease or replace the syringe O-ring
	3.Stepping motor is damaged	3.Replace the subassembly
	4.3-way valve ⑥ is clogged or damaged	4.Clean or replace the valve
	5.Lyse dispense nozzle on the wall of WBC counting chamber is clogged	5.Clear the nozzle
	6.F3(fuse) of main controller board is damaged	6. Replace fuse
#5 motor error	1.M5 sensor plate is loosen	1.Adjust the sensor plate and tighten
	2.There is some resistance in the syringe	2.Grease or replace the syringe O-ring
	3.Stepping motor is damaged	3.Replace the subassembly
	4.Sample probe is clogged	4.Clear sample probe
	5.3-way valve ④ or ⑨ is clogged	5.Clean or replace

	or damaged	
	6.F1(fuse) of main controller board is damaged	6. Replace fuse
#7 motor error	1.M7 sensor plate is loosen	1.Adjust the sensor plate and tighten
	2.There is some resistance in the syringe	2.Grease or replace the syringe O-ring
	3.Stepping motor is damaged	3.Replace subassembly
	4.Sample probe is clogged	4.Clear sample probe
	5.3-way valve ④ or ⑩ is clogged or damaged	5.Clean or replace
	6.F2(fuse) of main controller board is damaged	6. Replace fuse
BCOS error	1.AC interference from AC power line	1.Ground the instrument and reset
	2.The system operation has bug	2.Upgrade newest operation software
	3.The ARM control board is faulty	3.Replace the board

Chapter 8 Periodic Maintenance

In order to keep instrument in its best state, it is necessary to maintain the instrument periodically. Please do not use it if you do not know or specially trained the instrument.

Attention: In order to avoid infection, rubber gloves must be worn on all plot or  maintenance work. Wash your hands with disinfectant after work.

8.1 Daily Maintenance

Before starting the analyzer power supply, the operator must check the following requirements to ensure the system is ready.

1. Check waste bucket

The operator must prepare the waste bucket and make sure that it is emptied before the daily operation.

Note: waste bucket must be on the lower level with instrument.

2. Check the rest reagents, if remained regents are not enough, the user should change a new one.

Note: three kinds of reagent bucket must be on the same level platform with instrument.

3. Check the liquid tube and power supply

Check whether the tubes of the reagent and waste are bent and the connection are reliable.

4. Check whether the power plug of the host plugs into the power outlet.

5. Check internal printer

Check whether the printing paper is sufficient.

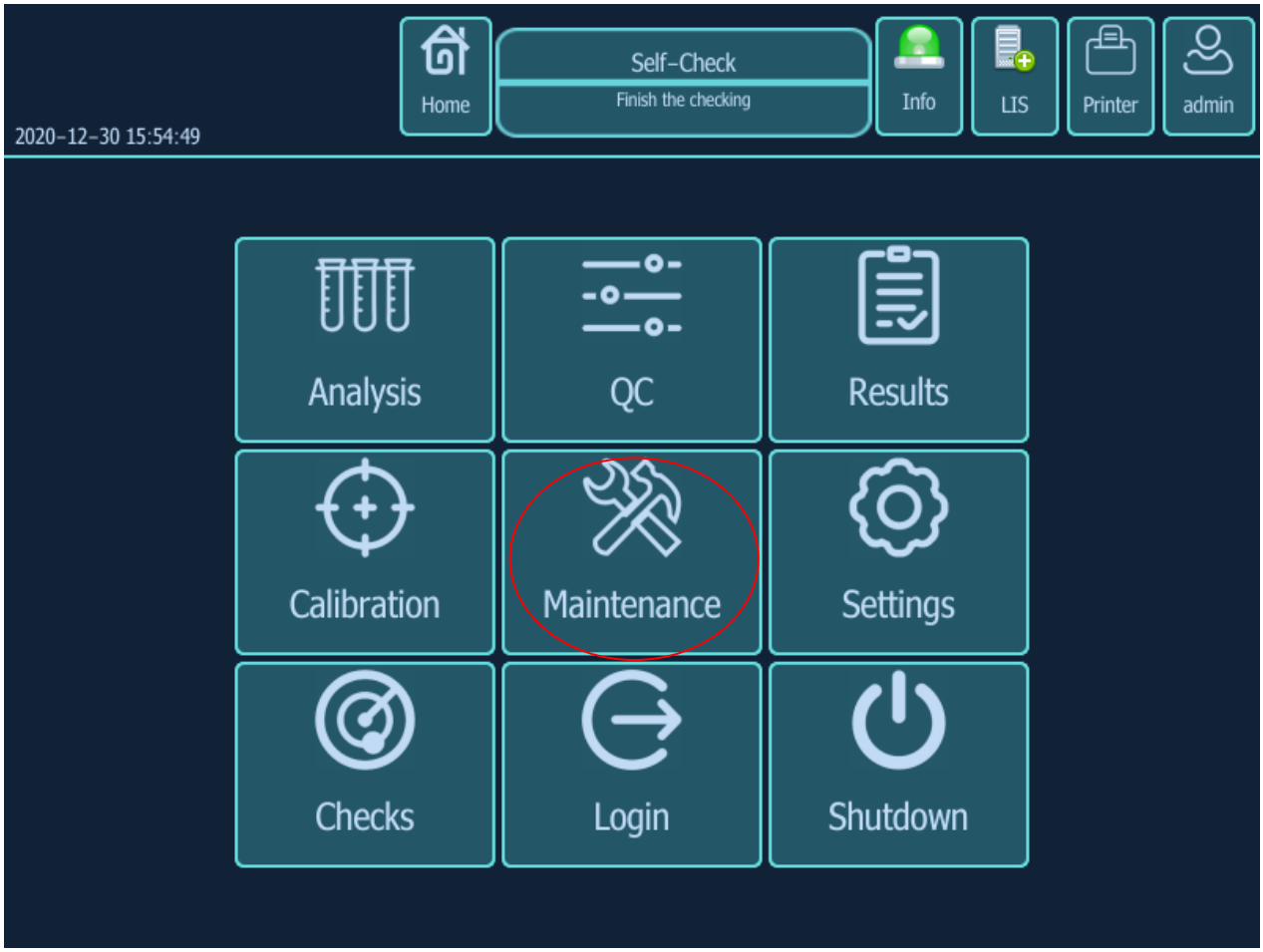
6. Check whether the keyboard and mouse cables are connected to instrument.

7. Clean the instrument and TFT screen with wet soft cloth. Clean the TFT screen, only water or distill water are available, otherwise will damage the screen.

8.2 Weekly maintenance

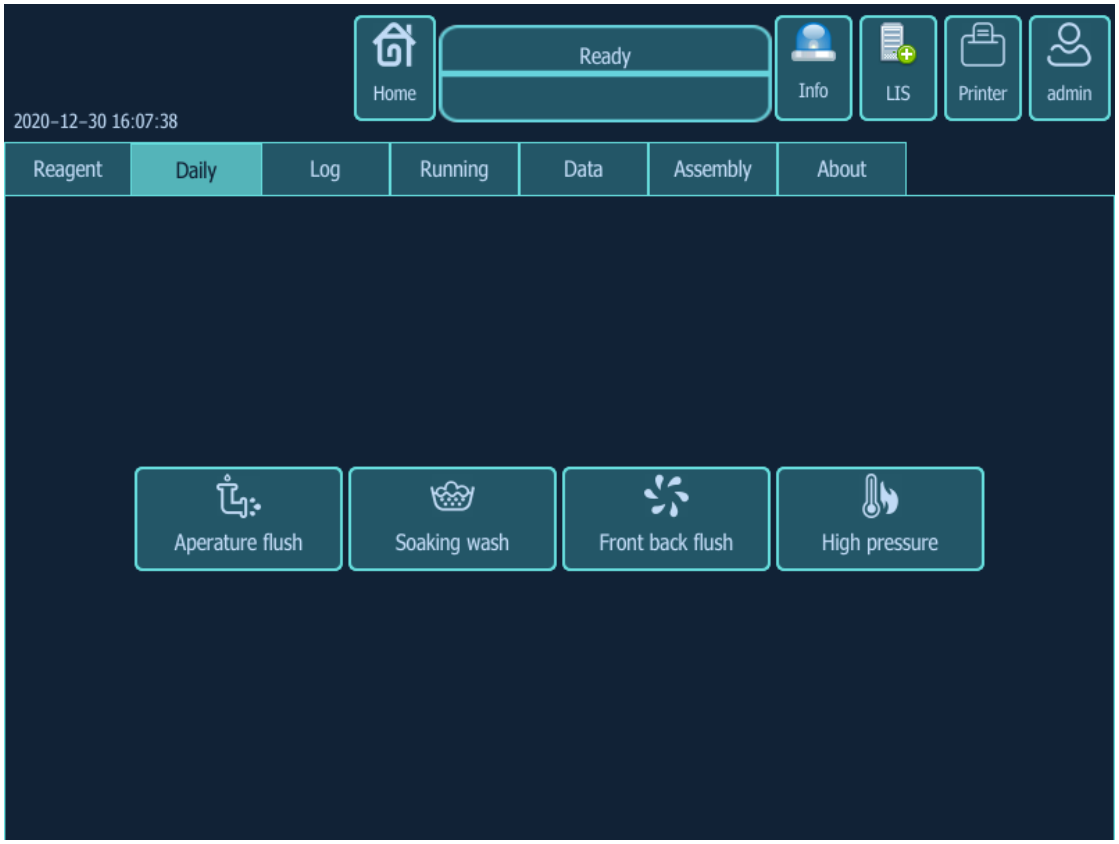
Weekly maintenance should be done by User on the first workday. Enter into

Maintenance — Maintenance menu.

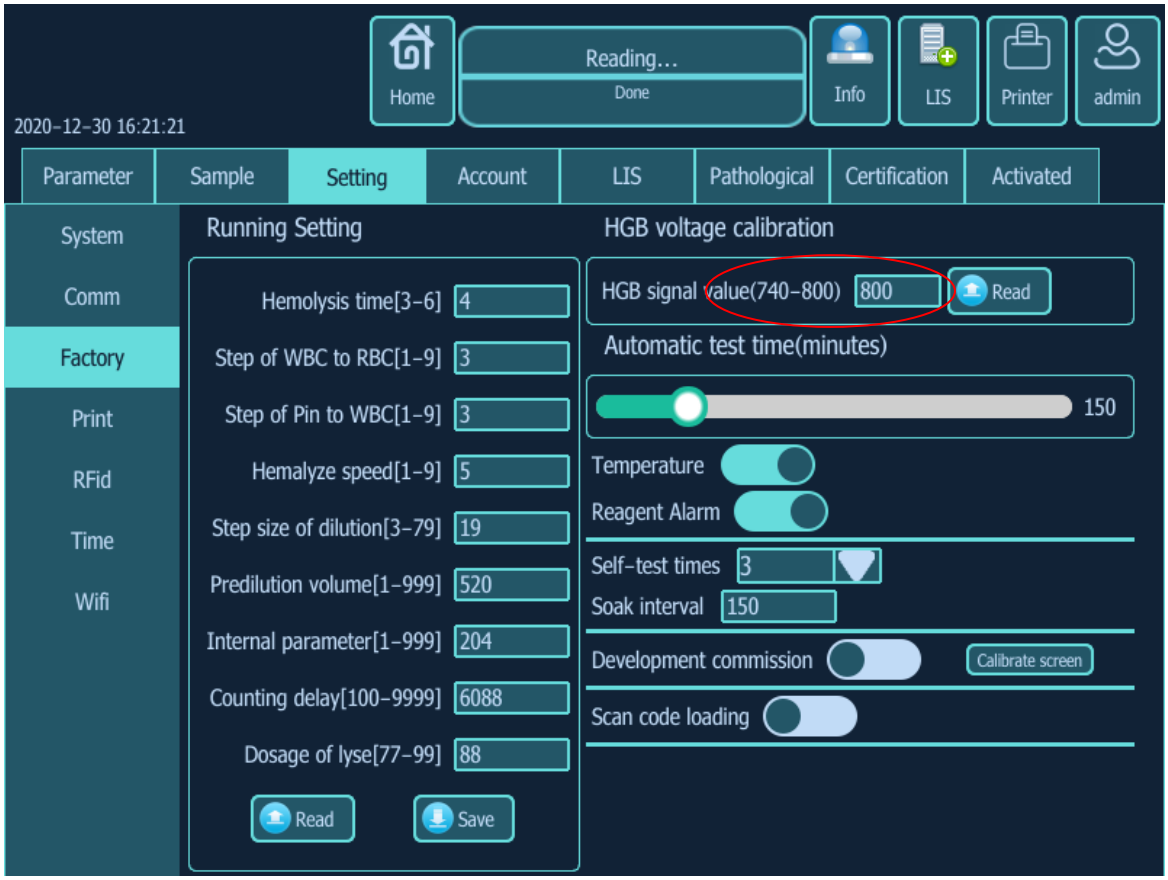


1. Aperture flush

Click “Maintenance→Daily→Aperture”, sample probe will go down, and put concentrated cleaner under the sample probe, then press start button. Sample probe will aspirate some concentrated cleaner to dispense into WBC and RBC counting chamber, apertures will be soak with concentrated cleaner and counting syringe makes movement for aperture cleaning process.



2. Check HGB voltage



When instrument is standby, enter main menu ,Setting →Setting→ Factory

Click “read” button which is in the “HGB blank voltage correction”, then software

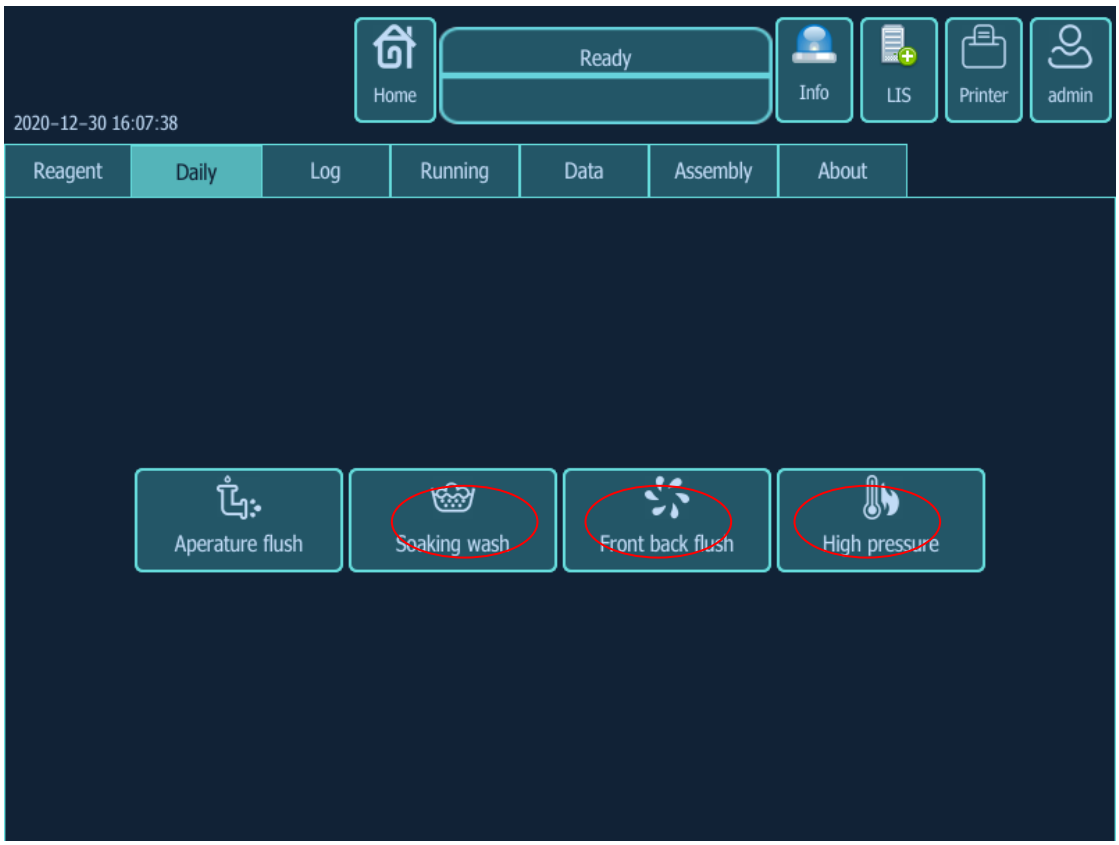
will display HGB signal value, this signal value should be from 740 to 800. If not, need to adjust it.

8.3 Half-year maintenance

1. Take WBC/RBC counting chamber out and clean it using gauze with concentrated cleaner.
2. Take valve out and clean EV5, EV7 and EV8 using gauze with distilled water.
3. Replace washing head of sample probe.
4. Replace the two waste filter buffer under the two chambers.
5. Check counting syringe, if leakage occurred, replace O-ring.
6. Check diluent syringe, if leakage occurred, replace O-ring.
7. Check detergent syringe, if leakage occurred, replace O-ring.
8. Check lyse syringe, if leakage occurred, replace O-ring.
9. Check sample syringe, if leakage occurred, replace O-ring.
10. Check all valves and assembly in software as below picture.

11. Click sock wash\ front black flush\ high pressure procedures one by one.

Machine will perform that procedures automatically.



AppendixA LIS setting

It is applicable to connect LIS system protocol with 3part Auto Hematology Analyzers: H E M A - D 6 1 9 0 .

一、 Content:

1、Form 1

<STX>	Word group transfer begins with the character 0x02
Text Data	Transmitted as binary data
Image Data	Transmitted as binary data
<ETX>	The word group transfer end character 0x03

1.1 Adopt serial port setting：

Note 1：Setting the serial port number in machine system setting→ communication setting, connect with host is ttysWK2, and chose connecting with internet data. According to the requirements, please set up: Send Graphics/Automatic Transfer/ Only Send Confirmed Results.

Note 2：Docking LIS computer to set serial port parameters：

Baud rate: 115200, check bit: n, data bit: 8, stop bit: 1.

Note 3：use RS232 serial direct cable to connect machine with PC (2pin to 2pin; 3pin to 3pin).

1.2 Adopt LAN port setting：

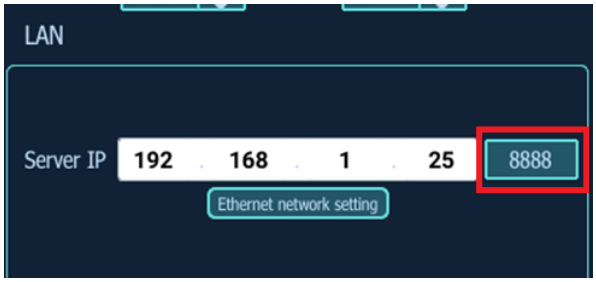
Note 1：Please use standard crossover line as crystal connector data line.

Note 2：Please set up the IP address and send port number of the server side according to the configured external computer, the figure above shows the default IP

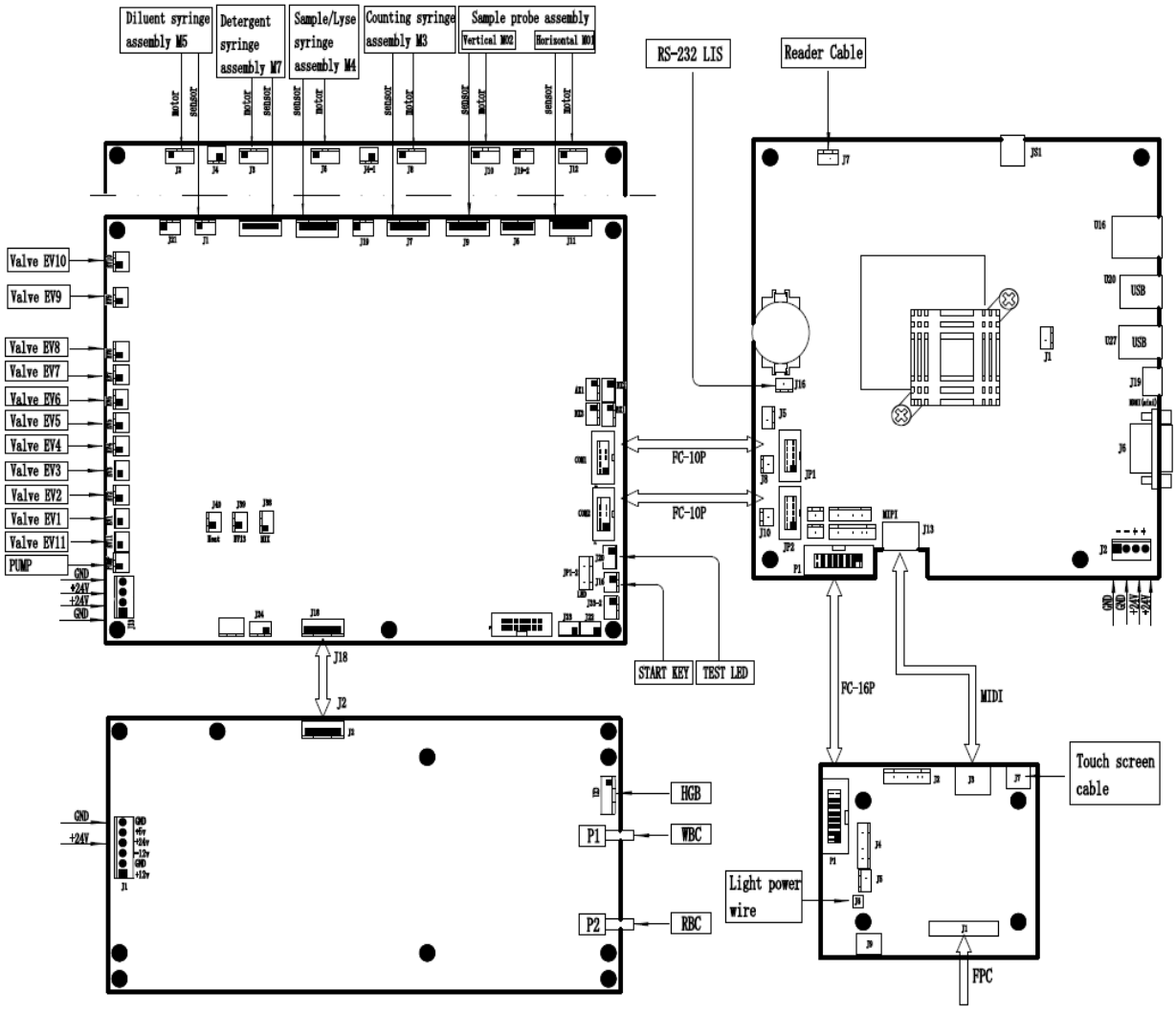
and port number of the device.

Note 3: If chose LIS HL7, please refer to our company's LIS HL7 Protocol; if not, this protocol transport will be used by default.

Note 4: 8888 in red rectangle is host port.



AppendixB Wire diagram



Wiring diagram

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