BA-88A Semi-auto Chemistry Analyzer

Service Manual

CE

For this Operator's Manual, the issued Date is 2009-03 (Version: 1.1).

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- the electrical installation of the relevant room complies with the applicable national and local requirements;
- the product is used in accordance with the instructions for use.

NOTE:

This equipment must be operated by skilled/trained clinical professionals.

WARNING:

It is important for the hospital or organization that employs this equipment to carry out a reasonable service/maintenance plan. Neglect of this may result in machine breakdown or personal injury.

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Return Procedure

In the event that it becomes necessary to return this product or part of this product to Mindray, the following procedure should be followed:

1 Return authorization: Contact the Customer Service Department and obtain a Customer Service Authorization number. This number must appear on the outside of the shipping container. Returned shipments will not be accepted if the number is not clearly visible. Please provide the model number, serial number, and a brief description of the reason for return.

2 Freight policy: The customer is responsible for freight charges when this product is shipped to Mindray for service (this includes customs charges).

3 Return address: Please send the part(s) or equipment to the address offered by the Customer Service department

Company Contact

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Foreword

Who Should Read This Manual

This manual is geared for service personnel authorized by Mindray.

What Can You Find in This Manual

This manual covers principles, installation procedures, theories, maintenance and troubleshooting guidelines of the BA-88A. Please service the system strictly as instructed by this manual.

Conventions Used in This Manual

This manual uses the following typographical conventions to clarify meanings in the text.

Bold and Italic font indicates text displayed on the screen, such as ***Sample Request***.

Safety Symbols

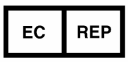
This chart explains the symbols used in this manual.

When you see…		Then…
	**WARNING**	Read the statement following the symbol. The statement is alerting you to an operating hazard that can cause personal injury.
	**BIOHAZARD**	Read the statement following the symbol. The statement is alerting you to a potentially biohazardous condition.
	**CAUTION**	Read the statement following the symbol. The statement is alerting you to a possibility of system damage or unreliable results.
	**NOTE**	Read the statement following the symbol. The statement is alerting you to information that requires your attention.

Labels Used On the System

The labels attached to the panels of the system use symbols to clarify the meaning of the text. The chart below explains the symbols on the labels.

	Serial Number

	Date of Manufacture
	Manufacturer
	CE marking. The device is fully in conformity with the Council Directive Concerning In Vitro Diagnostic Medical Devices 98/79/EC.
	Authorized Representative in the European Community
	The following definition of the WEEE label applies to EU member states only: The use of this symbol indicates that this product should not be treated as household waste. By ensuring that this product is disposed of correctly, you will help prevent bringing potential negative consequences to the environment and human health. For more detailed information with regard to returning and recycling this product, please consult the distributor from whom you purchased the product.
	In Vitro diagnostic equipment
	Biohazard warning: risk of potentially biohazardous infection
	Warning: Risk of personal injury or equipment damage
	Protective ground terminal
	ON (Power)

Graphics

All graphics, including screens and printout, are for illustration purposes only and must not be used for any other purpose.

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Safety Precautions

Observe theses safety precautions when using the system. Ignoring any of the precautions may lead to personal injury or equipment damage.

WARNING

If the instrument is used in a manner not specified by our company, the protection provided by the system may be impaired.

Preventing Electric Shock

Please observe the following instructions to prevent electric shock.

WARNING

When the instrument is turned on, users must not open the cover.

Spillage of reagent or sample on the analyzer may cause equipment failure and even electric shock. Do not place sample and reagent on the analyzer. In case of spillage, switch off the power immediately, remove the spillage and contact our company customer service department or your local distributor.

This instrument is supplied with a slow-blow fuse (250V, 3.15A), which must not be replaced by the user.

Power supply: 100-240V~, 50/60Hz.

The instrument is supplied with a three-wire power cord and should be properly grounded during application.

Preventing Personal Injury Caused by Moving Parts

Please observe the following instructions to prevent personal injury caused by moving parts.

WARNING

Do not put your finger or hand into any open part when the system is in operation.

Preventing Personal Injury Caused by Photometer Lamp

Please observe the following instructions to prevent personal injury caused by photometer lamp.

WARNING

Light sent by the photometer lamp may hurt your eyes. Do not stare into the lamp when the system is in operation.

If you want to replace the photometer lamp, first switch off the Main Power and then wait at least 15 minutes for the lamp to cool down before touching it. Do not touch the lamp before it cools down, or you may get burned.

Preventing Infection

Please observe the following instructions to protect against the biohazardous infection.

BIOHAZARD

Inappropriately handling samples may lead to biohazardous infection. Do not touch the sample, mixture or waste with your hands. Wear gloves and lab coat and, if necessary, goggles.

In case your skin contacts the sample, follow standard laboratory safety procedures and consult a doctor.

Handling Reagents and Wash Solution

WARNING

Reagents and enhanced wash solution may hurt human skins. Exercise caution when using the reagents and enhanced wash solution. In case your skin or clothes contact them, wash them off with clean water. In case the reagents or wash solution spill into your eyes, rinse them with much water and consult an oculist.

Treating Waste Liquids

Please observe the following instructions to prevent environmental pollution and personal injury caused by waste.

BIOHAZARD

Some substances in reagent, control, enhanced wash solution and waste are subject to regulations of contamination and disposal. Dispose of them in accordance with your local or national guidelines for biohazard waste disposal and consult the manufacturer or distributor of the reagents for details.

Wear gloves and lab coat and, if necessary, goggles.

Treating Waste Analyzer

Please observe the following instructions to dispose of the waste analyzer.

WARNING

Materials of the analyzer are subject to contamination regulations. Dispose of the waste analyzer in accordance with your local or national guidelines for waste disposal.

Preventing Fire or Explosion

Please observe the following instructions to prevent fire and explosion.

WARNING

Ethanol is flammable substance. Please exercise caution while using the ethanol.

Precautions on Use

To use the system safely and efficiently, please pay much attention to the following operation notes.

Intended Use

WARNING

The system is an analyzer designed for in vitro quantitative determination of clinical chemistries in serum, plasma, urine and CSF samples. Please consult Mindray first if you want to use the system for other purposes.

To draw a clinical conclusion, please also refer to the patient's clinical symptoms and other test results.

Operator

WARNING

The system is to be operated only by clinical professionals, doctors or laboratory experimenters trained by our company or our authorized distributors.

Environment

CAUTION

Please install and operate the system in an environment specified by this manual. Installing and operating the system in other environment may lead to unreliable results and even equipment damage.

To relocate the system, please contact our customer service department or your local distributor.

Preventing Interference by Electromagnetic Noise

CAUTION

Electromagnetic noise may interfere with operations of the system. Do not install devices generating excessive electromagnetic noise around the system. The electromagnetic environment should be evaluated prior to operation of the device. Do not use such devices as mobile phones or radio transmitters in the room housing the system. Do not use other CRT displays around the system. The electromagnetic noise might lead to system failures.

Do not use other medical instruments around the system that may generate electromagnetic noise to interfere with their operations.

NOTE

It is the manufacturer's responsibility to provide equipment electromagnetic compatibility information to the customer or user.

NOTE

It is the user's responsibility to ensure that a compatible electromagnetic environment for the equipment can be maintained in order that the device will perform as intended.

Operating the System

CAUTION

Operate the system strictly as instructed by this manual. Inappropriate use of the system may lead to unreliable test results or even equipment damage or personal injury.

Before using the system for the first time, run the calibration program and QC program to make sure the system is in normal status.

Be sure to run the QC program every time you use the system, otherwise the result may be unreliable.

Do not touch the screen with wet hands or hands contaminated by chemicals.

Do not place the Power to ON again within 10 seconds since placing it to OFF;

Maintaining the System

CAUTION

Maintain the system strictly as instructed by this manual. Inappropriate maintenance may lead to unreliable results, or even equipment damage and personal injury.

To wipe off dust from the system surface, use a soft, clean and wet (not too wet) cloth, soaked with mild soap solution if necessary, to clean the surface. Do not use such organic solvents as ethanol for cleaning. After cleaning, wipe the surface with dry cloth.

Switch off all the powers and unplug the power cord before cleaning. Take necessary measures to prevent water ingression into the system, otherwise it may lead to equipment damage or personal injury.

Replacement of such major parts as lamp assembly must be followed by a calibration.

Check the pump tubing for leakage as needed and replace the tubing in time. Otherwise, the normal aspiration of the system might be affected. It is recommended that the inner system tubing should be replaced every 24 months to avoid possible blockage or invalidation brought about by aging.

Setting up the System

CAUTION

To define such parameters as calculation method and wavelength, follow the instructions in this manual and the package insert of the reagents.

Samples

CAUTION

Use samples that are completely free of insoluble substances like fibrin, or suspended matter; otherwise the probe may be blocked.

Medicines, anticoagulants or preservative in the samples may lead to unreliable results.

Hemolysis, icterus or lipemia in the samples may lead to unreliable test results, so a sample blank is recommended.

Store the samples properly. Improper storage may change the compositions of the samples and lead to unreliable results.

Sample volatilization may lead to unreliable results. Do not leave the sample open for a long period.

Some samples may not be analyzed on the system based on parameters the reagents claim capable of testing. Consult the reagent manufacturer or distributor for details.

Certain samples need to be processed before being analyzed by the system. Consult the reagent manufacturer or distributor for details.

Reagents, Calibrators and Controls

CAUTION

Use appropriate reagents, calibrators and controls on the system.

Select appropriate reagents according to performance characteristic of the system. Consult the reagent suppliers, our company or our authorized distributor for details, if you are not sure about your reagent choice.

Store and use reagents, calibrators and controls strictly as instructed by the suppliers. Otherwise, you may not obtain reliable results or best performance of the system.

Improper storage of reagents, calibrators and controls may lead to unreliable results and bad performance of the system even in validity period.

Perform a calibration after changing reagents. Otherwise, you may not obtain reliable results.

Contamination caused by carryover among reagents may lead to unreliable test results. Consult the reagent manufacturer or distributor for details.

External Equipment

WARNING

External equipment connected to the analogue and digital interfaces must be complied with the relevant Safety and EMC standards (e.g., IEC 60950 Safety of Information Technology Equipment Standard and CISPR 22 EMC of Information Technology Equipment Standard (CLASS B)). Any person, who connects additional equipment to the signal input or output ports and configures an IVD system, is responsible for ensuring that the system work normally and complies with the safety and EMC requirements. If you have any problem, consult the technical services department of your local representative.

Communication interface

CAUTION

The system is equipped with two USB ports which can be used in connecting the keyboard, mouse, printer and other external equipments or in system upgrading. RS232 is used in connecting the PC with the analyzer to transfer data.

These three ports should not be used to operate the system for usage other than those mentioned above. Otherwise, system might be damaged.

Contents

1 System Specifications

1.1 System specifications

- Dimension: ≤420mm ×350mm ×158mm(L×W×H)
- Weight: ≤7Kg
- Power supply: 100-240V～, 50/60Hz;
- Power consumption: maximum 140VA;
- Operating methods: touchscreen, USB key board and mouse.

1.2 Parameters

- Reaction type: Endpoint, Kinetics, Fixed-time, Absorbance;
- Analyzing methods: single/double- wavelength;
- Clinical chemistries, immunoassays, TDM (Therapeutic Drug Monitoring)
- Aspiration volume: 200μl-9000μl;
- Temperature: room temperature, 25℃, 30℃, 37℃;
- Capable of storing and outputting various data and tables/graphs, and calculating among different tests
- Storage capacity: capable of storing more than 3000 test results.

1.3 Instrument Configuration

- Wavelengths: 6 wavelengths (available): 340nm, 405nm, 510nm, 546nm, 578nm and 630nm.2 wavelengths (optional): 450nm and 670nm.
- Reaction container: flow cell or cuvette.
- Printing: thermal recorder.

1.4 Overview

- Colorimetric system: The colorimetric analysis is realized through the combination of optical collimating, mono-color filter, mechanical parts and software, hardware module.
- Aspiration system: it is used to aspirate the matter to be tested or to wash the tubing system (only for flow cell system).
- Software/hardware system: it is used to set tests, enter operating instructions, control the data collection, calculate and save the results.

2 System Installation

2.1 Basic

- Make sure the installation site of the hospital meet the system installation requirements on space, power supply and environment. Please refer to the operator's manual for details.
- If data management software or test and maintaenance software is used on PC, please make sure the configuration of the PC meet the system requirement.

1 PC requirement for test and maintenance software:

- CPU: Celeron 1.7 or above;
- Memory: 256M or above;
- Resolution of the screen: 1024*768;
- Operating system: windows 2000(professional/server SP4), windows xp(home/professional SP1 or above)
- Communication interface: RS-232C

2 PC requirement for data management software:

- CPU: Pentinum II or above;
- Memory: at least 1G for Vista operating system; at least 512 M for other operating system.
- Resolution of the screen: 1024*768 or above;
- Operating system: Windows XP/Vista/Windows 2000

- Databse: SqlServer 2005 Express
- Network communication: 10/100M 10/100M
- Communication interface: RS-232C
- Hard disk (the disk on which the software is installed): 10G
- Printer (connected with PC)

2.2 Installation Procedures

1 When you receive the system, carefully inspect the package. After opening the package, check the delivered goods against the packing list.

2 Move the instrument to the installation site and remove all the package and protective materials.

3 Connect the instrument to waste container.

4 Connect the power cable and power on the analyzer. After self-check and tubing wash is completed, the main screen is displayed.

5 After the system is stable, request one or two routine tests and run. Assess the test results. Please refer to the operator's manual for details.

6 Follow the normal procedure to shutdown the analyzer.

7 Training:

Can the customer complete daily tests? Yes ☐ No ☐

Is the customer familiar with the daily, weekly and monthly maintenance and relevant maintenance methods? Yes ☐ No ☐

Is the customer familiar with cleaning and washing the system? Yes ☐ No ☐

Is the customer familiar with troubleshooting the common failures? Yes ☐ No ☐

Is the customer familiar with replacing the peristaltic pump tubing and calibrating the flow volume? Yes ☐ No ☐

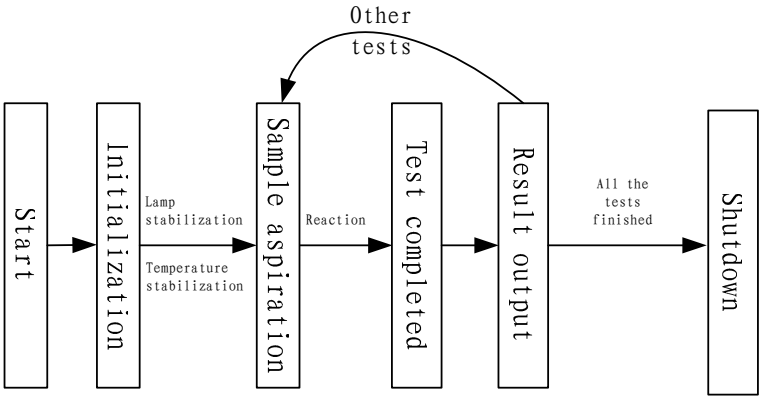
Is the customer familiar with replacing the aspiration tubing? Is the customer familiar with replacing the lamp? Yes ☐ No ☐

3 System Description

3.1 Operating Procedures

The typical operating procedure of BA-88A is shown as follows:

Figure 3-1 Operating procedure



Procedures:

1 Empty the waste. Connect the waste tubing to the waste container. Prepare the samples, reagents and distilled water;

2 Connect power cable correctly. Power on the analyzer. The instrument will under go the initialization processes, including; system startup, hardware self-check, parameters download, dark current testing. After initialization, wait until the temperature and the light source are stable. The whole process lasts for about 15 minutes;

3 After the system is stable, set the parameters of the tests, such as wavelength, temperature, methods and etc. Start the test.

4 After the test is completed, run other tests if necessary. Washing should be inserted between two tests to minimize the carryover, when the concentrations of the two tests are too different or the two tests are different.

5 After all the tests are completed, shutdown the analyzer. Cut off the instrument power after washing is completed.

3.2 Component Structure and Functions

3.2.1 Photometer Assembly

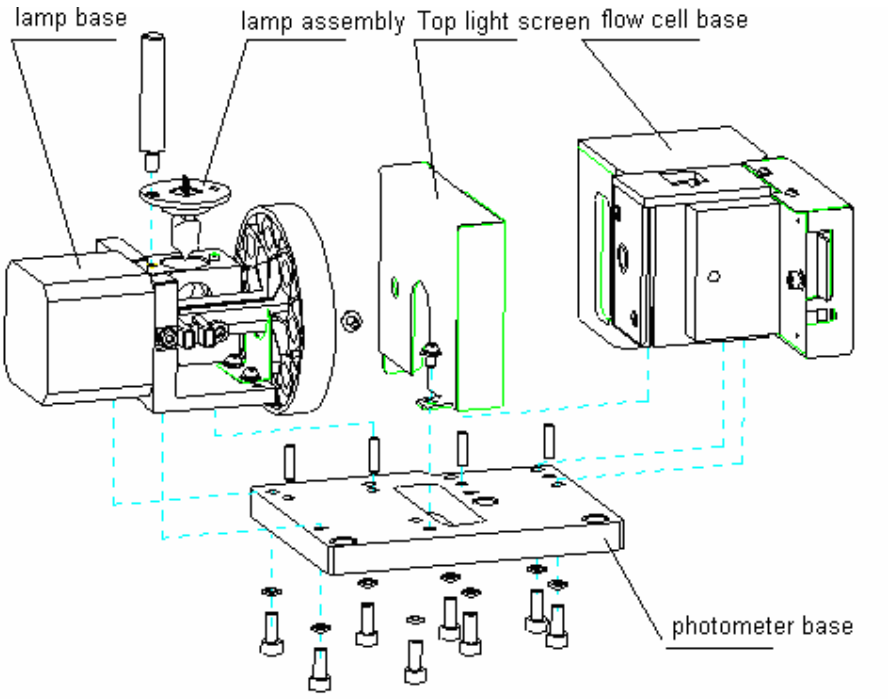
3.2.1.1 Introduction

Photometer assembly is the core of BA-88A, integrating optical system, temperature control system and photoelectrical collection system. The photometer assembly is the key for reliability of the system. Photometer assembly includes lamp assembly, lamp base assembly, flow cell assembly and other components, which are used to position and install the optical components, thermal components and analogue board.

3.2.1.2 Components and Structure

The basic structure of the photometer assembly is shown as figure 3-2.

Figure 3-2 Photometer assembly structure



3.2.1.3 Assembly and Disassembly of the Photometer Assembly

Photometer assembly is fixed on the instrument base by 3 M4 socket head screws.

Maintenance of the system, except for replacing the assemblies or components other than lamp assemblies will involve the assembly and disassembly of the photometer assembly as a whole. Please pay attention to the following:

1 When disassembling the instrument, do not drag the cable with excessive force. If necessary, you can disconnect the connection of some cables in advance. Do not make any cable pressed, especially the cable under the photometer base.

2 When disassembling the instrument, do not press the air duct or conduct any operation that might distort the air duct, otherwise the refrigeration plate might be damaged.

3.2.2 Lamp assembly

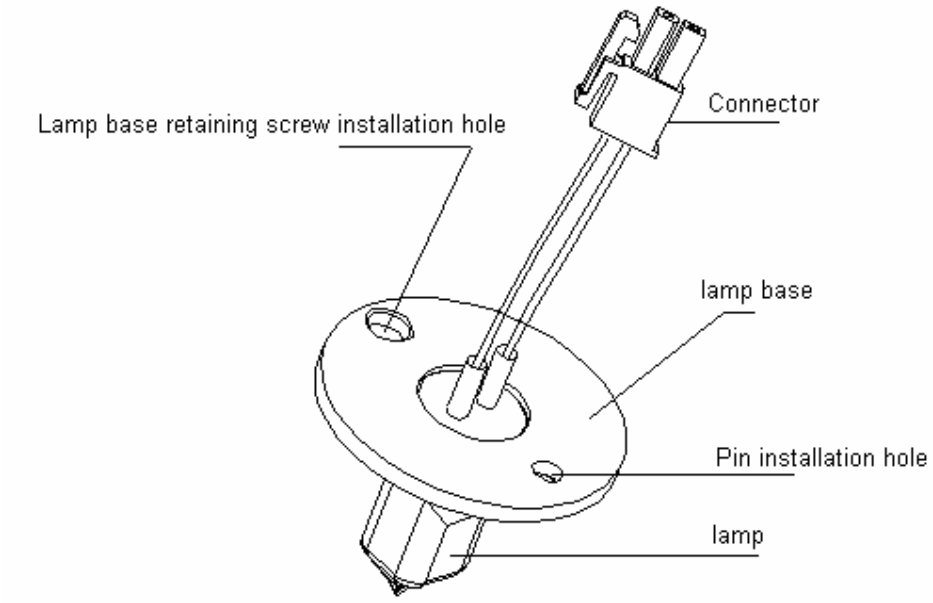
3.2.2.1 Introduction

The lamp assembly is the light source of the instrument, providing energy source for the detection system. Among the components of the lamp assembly, the lamp should be replaced regularly, so when we design the system, we take the manual replacement into consideration, taking the assembly as a whole connected with the lamp base, fixing it with a long hand screw to facilitate manual disassembly.

3.2.2.2 Components and Structure

The basic structure of the lamp assembly is shown as figure 3-3.

Figure 3-3 Lamp assembly structure

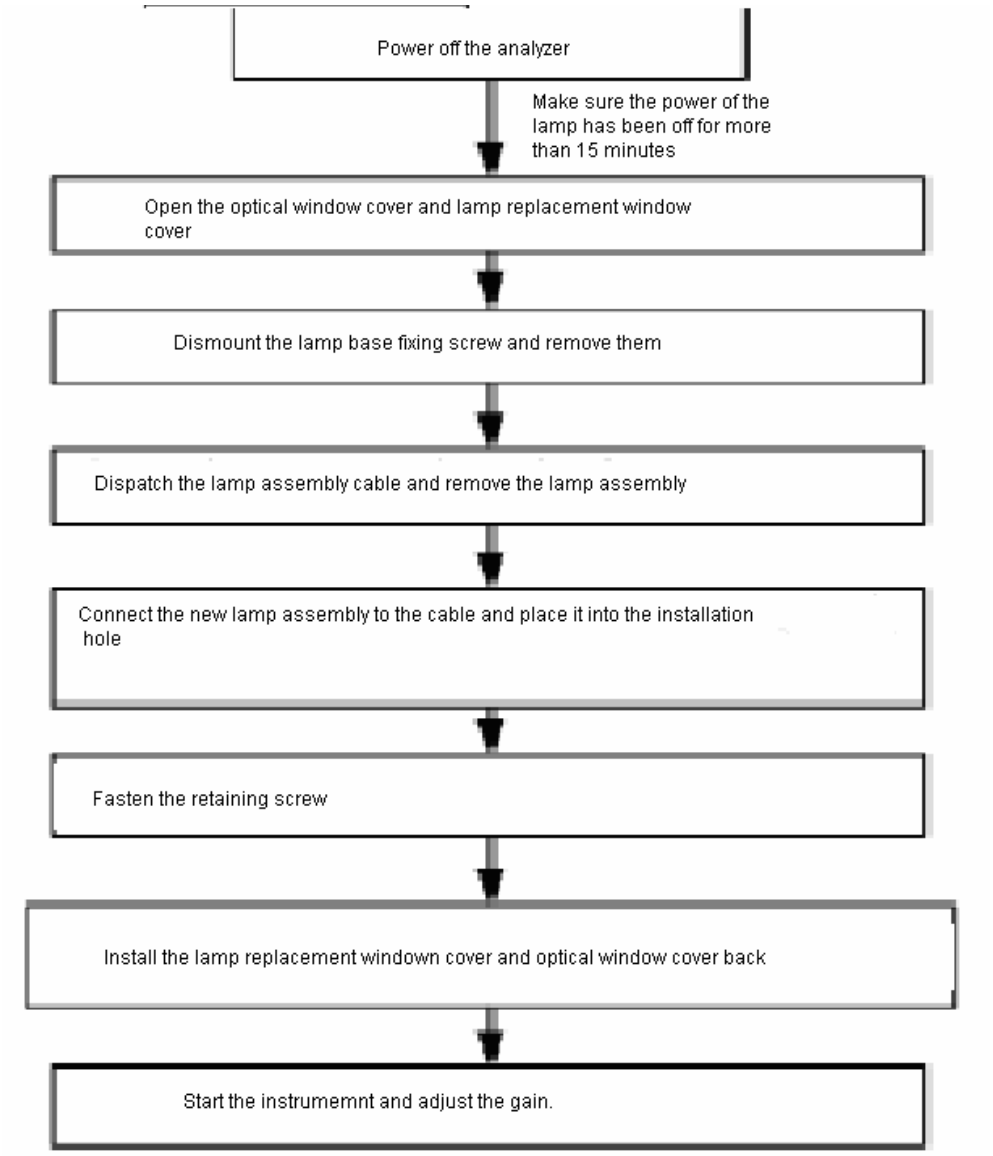


3.2.2.3 Assembly and Disassembly of the Lamp Assembly

Lamp assembly is connected with lamp base assembly through lamp fixing screw and a Φ3 pin. (figure 3-2).

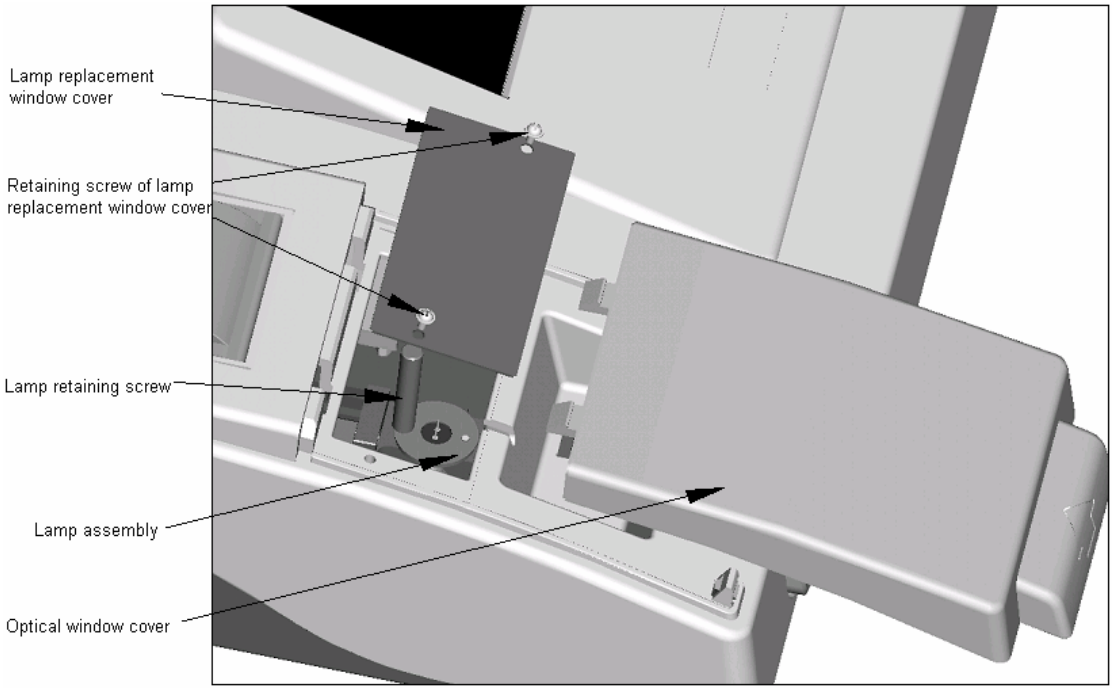
The replacement of lamp assembly is shown in the following picture.

Figure 3-4 Procedure for lamp replacement



Components relevant to lamp replacement are shown in the following figure. For more details please refer to 5.3.3.

Figure 3-5 Lamp assembly structure



WARNING

If you want to replace the lamp, first switch off the power and then wait at least 15 minutes for the lamp to cool down before touching it. Do not touch the lamp before it cools down, or you may get burned.

NOTE

When replacing the lamp assembly, do not touch the surface of the bulb to avoid contamination.

When dismounting the restraining screw of the lamp base, please take extra care to avoid element falling into the inside of the instrument. If it is difficult to dismount, some tools like the clipper might be used. The photoelectric gain should be adjusted after the lamp is replaced. For more details, please refer to the operator's manual.

3.2.3 Lamp Base Assembly

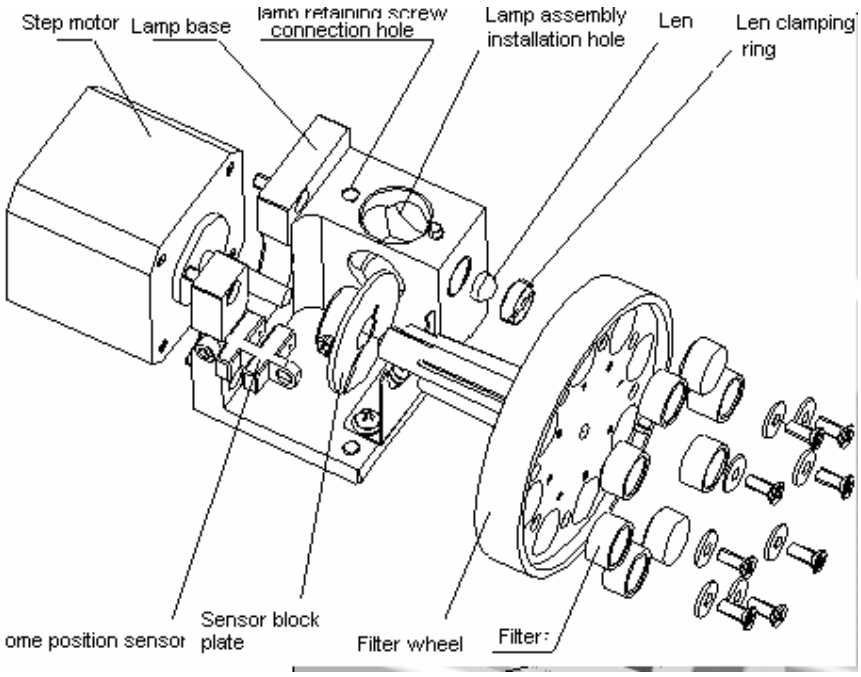
3.2.3.1 Introduction

The lamp base assembly supports the installation and positioning of the lamp assembly and in the meantime supports the installation and positioning for filter wheel and driver motor.Integration structure design will increase the positioning accuracy of the optical elements.

3.2.3.2 Components and Structure

The assembly is composed of lamp base, filter wheel, step motor and etc. The structure is shown as the following figure.

Figure 3-6 Lamp base assembly structure



3.2.3.3 Assembly and Disassembly of the Lamp Base Assembly

Lamp base assembly is fixed on the instrument base by 4 M4 socket head screws and positioned by 2 ϕ 3 pins. When the assembly is dismounted as a whole, you can disassemble the components, but you have to pay attention to the following problems:

1 If fixture is not used when you assemble or disassemble the filter, extra care should be taken lest the filter is scratched by the screw driver. Please follow the correct order to install the filter. The order is shown in the following table.

No.	1	2	3	4	5	6	7	8
Wavelength nm	340	405	546	670	450	510	578	630

450 nm and 670 nm are optional wavelengths. When these two wavelengths are not configured, relevant position is shielded by stop plate; when relevant filters are installed, the arrow on the circle should point outward of the hole.

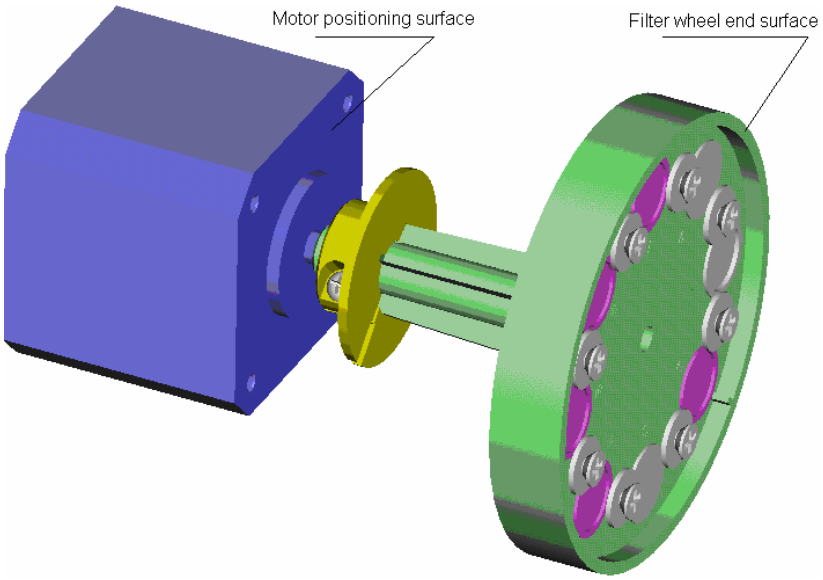
2 When assembling or disassembling the home position sensor, place the surface with text onward (refer to the base plate).

3 When assembling or disassembling the lens, make sure the spherical surface face the outside. Press it until secure with clamping ring. Make sure that the outer surface of the clamping ring is at the same level with or higher than the

surface of the lamp base. If obvious blow-up is found, skewed installation of the lens might be the cause and the readjustment might be needed.

4 When disassembling, if it is not necessary to replace the motor, filter wheel or sensor stop plate, we recommend you to keep the connection between the motor and the filter wheel, thus the installing procedure would be simplified; otherwise, the relative position between the filter wheel and the motor positioning surface might change. Fixture BA89-J01 should be used to position. If there is no fixture on the spot, ensure distance between the position surface of the control motor and the filter wheel end face is 59.6±0.5mm. Please refer to the following figure.

Figure 3-7 Filter wheel positioning



5 During assembly and disassembly, ensure that optical elements like filter, lens and bulb are properly protected. When installation is completed, use balloon to blow away the dust or other impurities from the surface of the optical elements.

3.2.3.4 Adjust the Filter Wheel Home Position

If any of the following components: filter wheel, home position sensor, motor is dismounted or conduct any operation that might lead to the dismounting of these components, the home position of the filter wheel might be modified, so the test result might be inaccurate. Thus, dismounting of these elements should be followed with the adjustment of home position of the filter wheel. During adjustment, PC, serial cable and test&maintenance software are used. The procedure for adjusting is shown as follows:

1 After the instrument is reassembled, power on the analyzer.

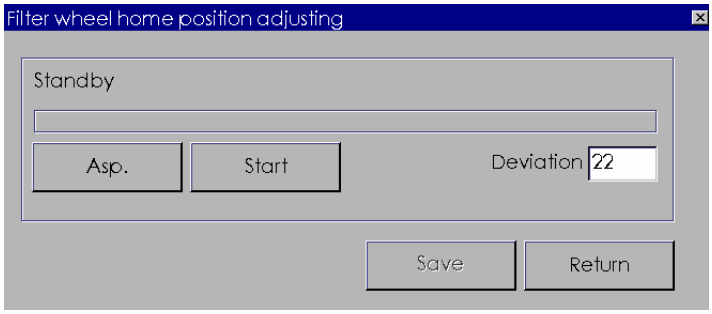
2 Click ***Maintenance*** on the main screen of the instrument. Select ***Maintenance*** tab. Click ***Advanced*** and enter the password “analyzer” to enter the advanced adjustment interface.

3 Click ***H pos.***.

4 When the system is in Standby (if ***Lamp stabilizing*** is displayed, tests can only be started when lamp is stabilized), Put the aspiration tubing into a tube filled with about 2 ml of distilled water. Click ***Asp.***. When the aspiration is completed, click ***Start*** to calculate the deviation.

5 After completing the serial port setting, click ***Enable Para. Modification*** on the screen. Select the tab ***Photoele. And Fluid*** and then select ***Filter wheel home position*** to enter the following screen.

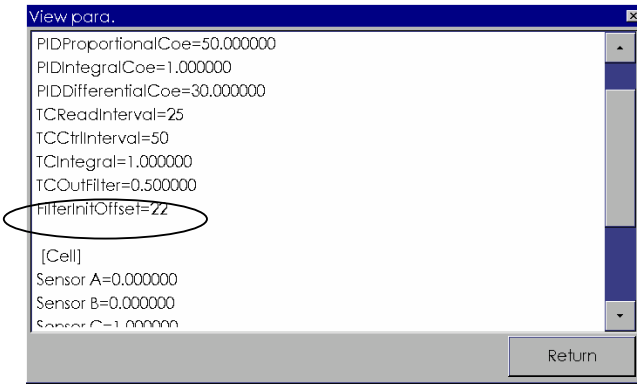
Figure 3-8 Adjusting home position of the filter wheel



6 It will take 3 minutes to complete the test. When the test is completed, the deviation of the filter wheel will be displayed in ***Deviation***. The deviated steps should be within 0-63, otherwise, the position of the home position sensor should be adjusted before testing.

Tips: when the value of the deviated steps is higher than 63, move the sensor downward; when the value is lower than 0, move it upward. When the above requirements are met, click ***Save***.

Figure 3-9 View parameters



7 When operations above are completed, click ***Return*** to go back to the main screen. The analyzer will restart automatically. When analyzer is stable (after about 15-20 minutes), click ***Maintenance-Maintenance*** on the analyzer to enter the maintenance screen. Select ***Gain adjust*** on the screen to adjust the photoelectric gain of the system. When adjustment is completed, wait at least 15 minute to start testing. Please refer to the operator's manual for details on photoelectric adjustment.

NOTE

Wear clean cotton gloves, when replacing the filter or lens. If contaminant is found on the surface of the filter or lens, clean it with ethanol.

NOTE

The assembly or disassembly of the filter wheel, motor or home position sensor should be followed with home position deviation adjustment. Otherwise, the test result might not be reliable.

The home position deviation adjustment of the filter wheel should be followed with the adjustment of photoelectric gain. Otherwise, the test result might not be reliable.

3.2.4 Flow Cell Base Assembly

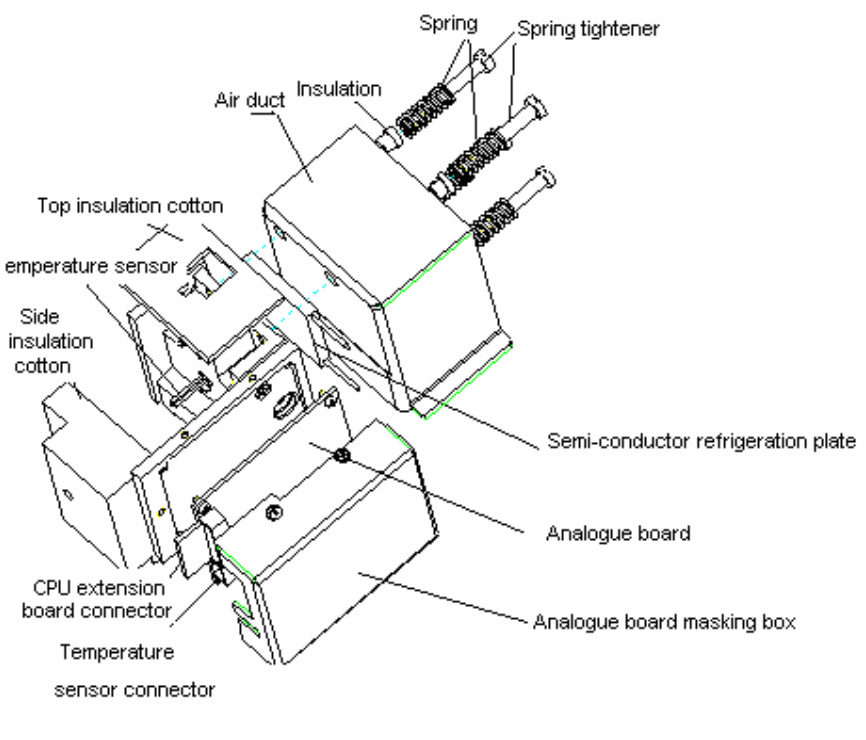
3.2.4.1 Introduction

The flow cell, temperature control elements, analogue board and etc are installed and positioned by the flow cell base assembly. Two modes—flow cell and cuvette are available on the system. Manual replacement is supported. The temperature control system is composed of semi-conductor refrigeration plate, air duct, temperature sensor and insulation material, providing 37℃, 30℃ and 25℃ which are needed on the system. Analogue board collects the data of absorbance and temperature.

3.2.4.2 Components and Structure

The structure of the flow cell assembly is shown in the following figure.

Figure 3-10 Flow cell assembly structure



3.2.4.3 Assembly and Disassembly of the Flow Cell Base Assembly

Flow cell assembly is fixed on the instrument base by 4 M4 socket head screws and positioned by 2 ϕ 3 pins. When maintaining the components on the side of analogue board and air duct, it is not necessary to dismount the flow cell base assembly and maintenance can be done on the dismounted photometer assembly. When dismounting the components other than the position mentioned above, dismounting of the whole assembly is needed. When dismounting the assembly and relevant components, please pay attention to the following:

1 When replacing the refrigeration plate, we recommend you to replace it after dismounting the photometer assembly. The order is: 1. dismount the photometer assembly as a whole; 2. dismount the flow cell air duct; 3. dismount the refrigeration plate; 4. replace the refrigeration plate. Reverse the above procedures to install.

2 When installing the refrigeration plate, please pay attention to the installing direction. The cable should project at the side of the analogue board and the red cable should be lower;

3 The semi-conduct refrigeration plate should be installed between the air duct and the flow cell base. Before installing, apply heat conducting gel to both sides of the refrigeration plate (the thickness is about 0.05-0.1mm, the gel should be evenly applied and no granule or nodular matter is allowed; the gel should not be too watery). Correctly stick the plate inside the groove of the flow cell assembly (follow step 2).Stick the air duct to the other side of the plate and tighten it with spring and spring lightener. The two longer spring lightener should be inside the hole on the upper side of the air duct and insulation is needed. Use straight slot head screw driver to tighten the screws.

4 When replacing the optical components, take care to protect the components. Do not touch the surface of the optical elements with bare hand.

5 Wear antistatic gloves to dismount and mount the analogue board;

6 Do not drag the cable with excessive force. If necessary, you can disconnect the connection of some cables in advance.

7 When replacing the temperature sensor, please take care to dismount the insulation cotton, otherwise damage might occur; when reinstalling, use double glue to stick the insulation back.

3.2.4.4 Replacement of the Temperature Measurement Assembly

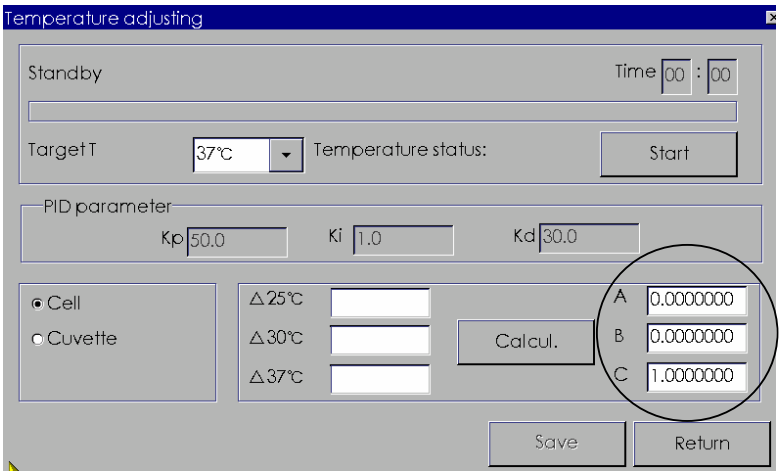
The analogue board and the temperature sensor are components for measuring the temperature on flow cell base assembly, so they should be replaced together. Replacement of the two should be followed with parameter configuration. The method is indicated as follows:

1 When the instrument is reinstalled, power on the system.

2 Click ***Maintenance*** on the main screen of the instrument. Select ***Maintenance*** tab. Click ***Advanced*** and enter the password “analyzer” to enter the advanced adjustment interface.

3 Select ***Temp.*** to enter the following screen. Select ***Cell***. Enter the A, B, C parameters on the flow cell accessory into their respective positions, making sure that they are in accordance with those on the accessory. Click ***Save***.

Figure 3-11 Parameter configuration



4 Select ***Cuvette***. Repeat the operation in step 3 to configure the A, B and C parameters.

5 After above operations are completed, click ***Return***. Click ***View para.*** and make sure the inquired A, B and C parameters are in accordance with those on the accessory. Click ***Return***.

6 Exit the Maitenance screen and the system will restart. Follow the instruction to complete the configuration of the temperature.

NOTE

If either of the temperature sensor or analogue board is damaged, both of the two should be replaced by one assembly at the same time. And the replacement should be followed with temperature paremter configuration.

During configuration, modifying parameters other than temperature parameters should not be allowed. Otherwise, the test result might be affected.

3.2.5 Base Plate Assembly

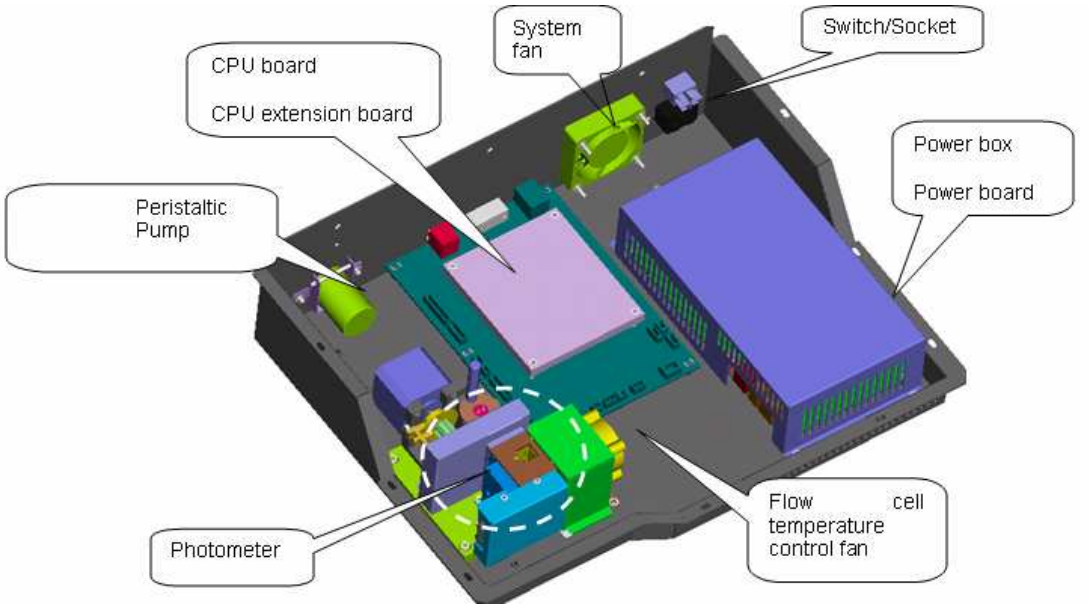
3.2.5.1 Introduction

The base plate assembly supports the system, providing fixing and support for photometer assembly, hardware board, interface and other components.

3.2.5.2 Components and Structure

The basic structure of the base plate assembly is shown as figure 3-12.

Figure 3-12 Base plate assembly structure



3.2.5.3 Assembly and Disassembly of the Base Plate Assembly

The base plate assembly is a strutting piece of sheet metal, providing fixing and support for photometer assembly, hardware board, interface and other components. Pay attention to the following while assembling and disassembling it.

1 When assembling and disassembling the photometer assembly, do not drag the cable with excessive force, especially the cable of the semiconductor

refrigeration plate, lamp cable and the connection cable of analogue board. If necessary, you can disconnect the connection of some cables in advance.

2 Replacement of the peristaltic pump should be followed with flow volume calibration (this is not for system configured with cuvette). Please refer to the operator's manual for details.

3 Wear antistatic gloves to replace the hardware board.

WARNING

When the enclosure is opened, do not touch the boards, sockets, switch and etc, when the system is powered on, otherwise, electric shock might occur.

3.2.6 **Enclosure** Assembly

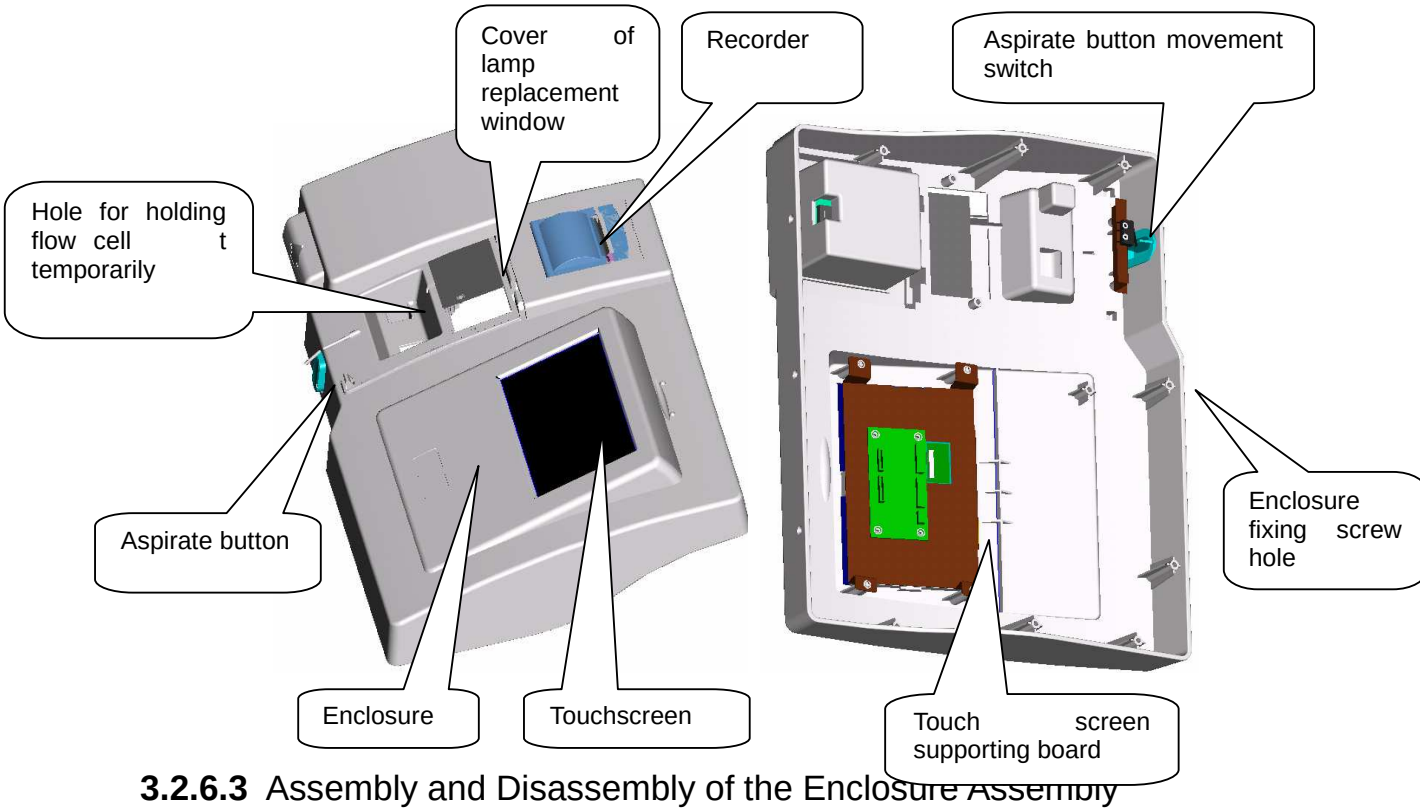
3.2.6.1 Introduction

The enclosure assembly supports and fixes the touchscreen, recorder, aspirate button, other input and output components and etc. Optical window cover and lamp replacement window cover are designed to facilitate the replacement of flow cell, cuvette and lamp.

3.2.6.2 Components and Structure

The basic structure of the enclosure assembly is shown as figure 3-13.

Figure 3-13 Enclosure assembly structure



3.2.6.3 Assembly and Disassembly of the Enclosure Assembly

The enclosure assembly is fixed by 11 screws which are connected to the base plate. Of the 11 screws, 3 are located at the back of the system and the remaining which can be dismounted directly are located under the enclosure. When assembling and disassembling the enclosure, please pay attention to the following:

1 If the system is configured with flow cell, before opening the enclosure, move the flow cell out of the installing location and place it in the hole for holding flow cell temporarily. Otherwise, the tubing connection will be dragged off.

2 When opening the enclosure, do not drag the cable with excessive force.

3 Place the enclosure in a stable location to make it stand vertically. If the enclosure falls down, some cables, especially the touchscreen board cable, aspirate button cable, might be dragged.

When installing the LCD/touchscreen module, pay attention to the following as shown in figure 3-14.

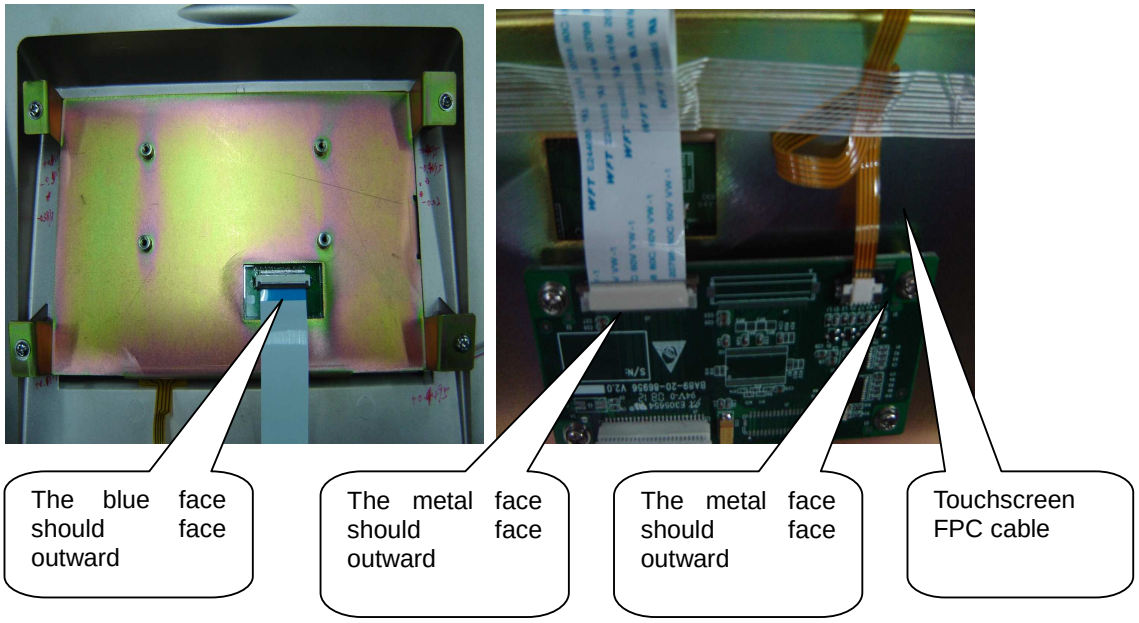
1 When installing LCD cable, the blue face (untouchable face) of the FPC should face outward;

2 When installing the LCD data cable of LCD&touchscreen board, the metal face of the FPC cable (touchable face) should face outward;

3 When installing the touchscreen data cable of LCD&touchscreen board, the metal face of the FPC cable (touchable face) should face outward;

4 When installing the supporting plate of the touchscreen, tighten the four screws gradually one by one to avoid uneven force on the screen and excessive tightening force on the screw which will result in false reaction of the touchscreen.

Figure 3-14 LCD/touchscreen cable



4 Hardware

4.1 Overview

This chapter describes the function of circuit boards in the BA-88A.

4.2 Safety Precautions

WARNING

Don't touch the circuit boards by hand or others, when the analyzer is working.

If you are about to detach the circuit boards, you should cut off the power of the analyzer.

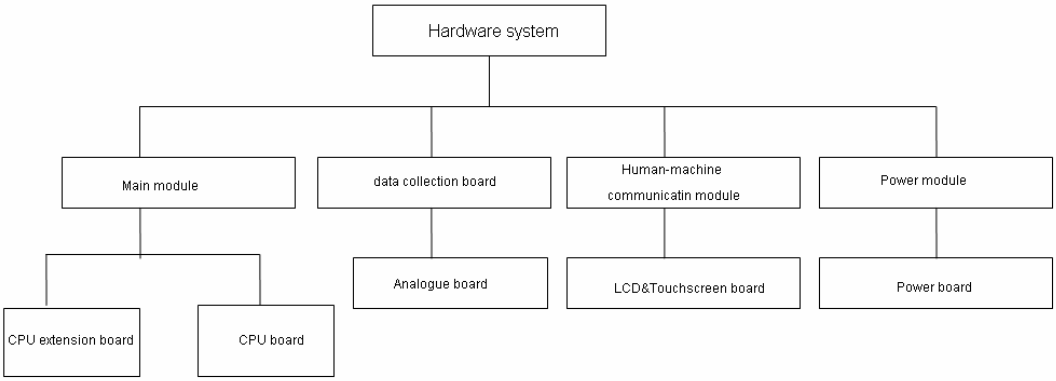
Please wear the glove to protect the circuit boards from ESD or release the charge first when you detach the circuit boards.

4.3 Introduction of the Modules

The hardware system of the BA-88A is divided into the following modules or boards:

1 Main unit: CPU board, CPU extension board;
2 Data collection board: analogue board;
3 Human-machine communication module: LCD&touchscreen board;
4 The power module: Power board

Figure 4-1 The structure of hardware system

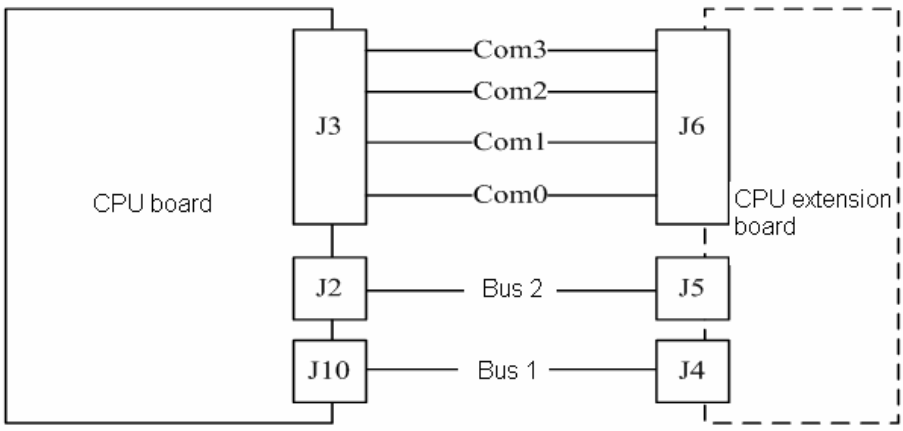


4.4 CPU Board

CPU board which is the minimum structure system of CPU system uses 32 digit chip microcomputer as its core. CPU board and CPU extension board make up of the main module.

The CPU communicates with the CPU extension board via CPU external interface in multiple-buses communication mode.

Figure 4-2 Structure of the CPU board



4.4.1 **LED** Indicator

D3: ＋3.3V power indicator

4.4.2 Memory Module

Flash which communicates with CPU via local bus, is used to store the CPU program, system parameters and test results.

SDRAM which is configured on CPU board, is used to run the software.

4.4.3 Clock Module

The real time clock circuit which is composed of real time clock and battery, is to realize the function of real time clock on CPU board.

4.4.4 Interface Module

CPU communicates with the CPU extension board via various bus interfaces on CPU board. The sockets on CPU board are, J2, J3 and J10; the sockets on CPU extension board are J5, J6 and J4.

4.5 CPU Extension Board

4.5.1 Overview

The CPU extension board realizes some functions of the CPU external interfaces. Such as:

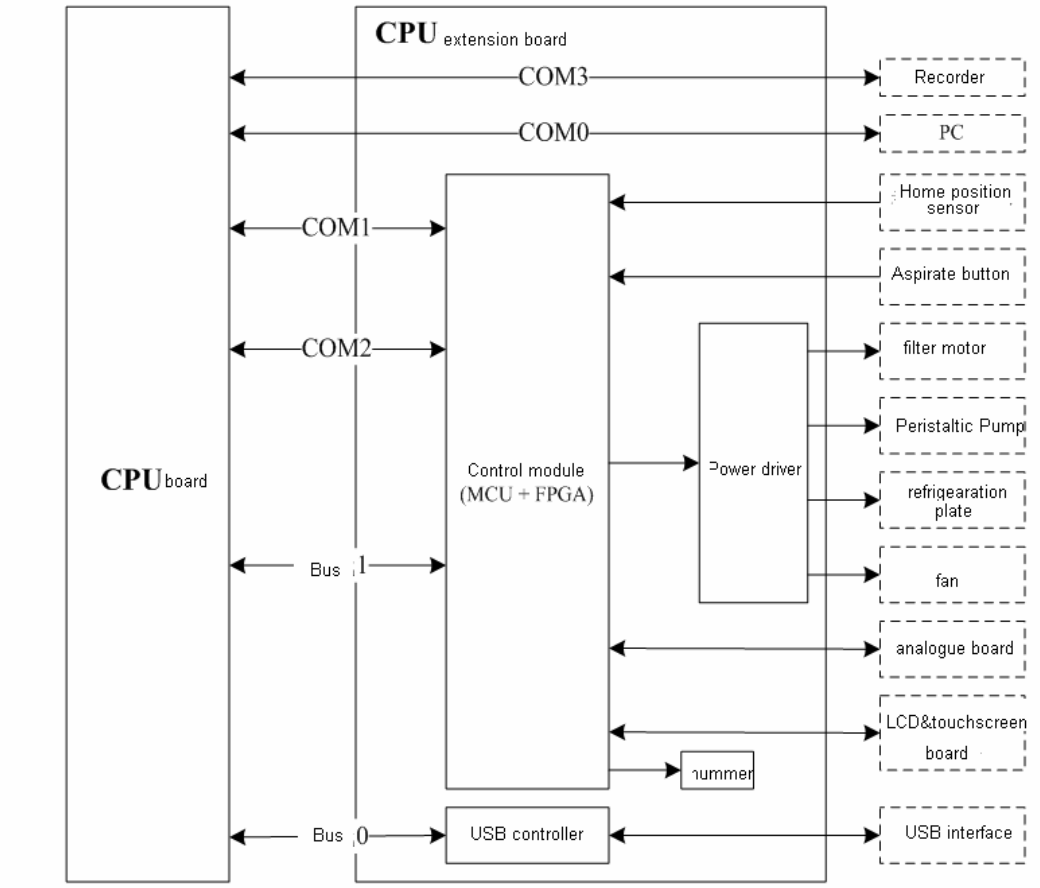
- USB functions;
- LCD driver control;
- Touchscreen control;
- Recorder serial port communication;
- Hummer control;
- PC serial port communication.

In the meantime, the CPU extension board receives the command and completes the following tasks:

- Control and driving of the moving parts;
- Checking of the input signal;
- Data collection;
- Data transfer of the CPU board.

The function graph is shown in the following figure:

Figure 4-2 Structure of the CPU extension board



4.5.2 LED Indicator

D3: +12V power indicator

D6: +24V power indicator

D7: +5.0V power indicator

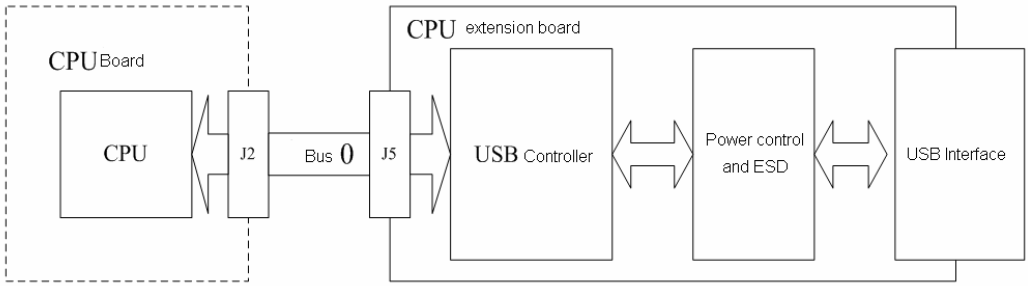
D17: +3.3V power indicator

4.5.3 USB Functions

USB controller is configured on the CPU extension board which communicates with the CPU via bus and realizes the USB communication function via USB interface.

USB power control and ESD protector is added between the USB controller and the USB interface.

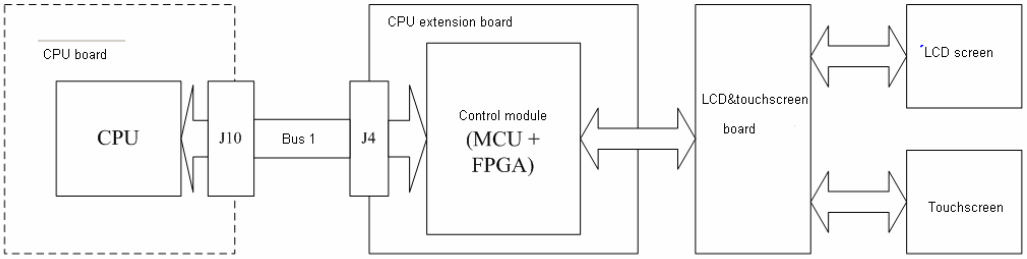
Figure 4-4 Structure of USB functions



4.5.4 LCD&Touchscreen Driver Control

CPU realizes the functions of LCD drive control, reading touch screen data, transforming data transfer protocol.

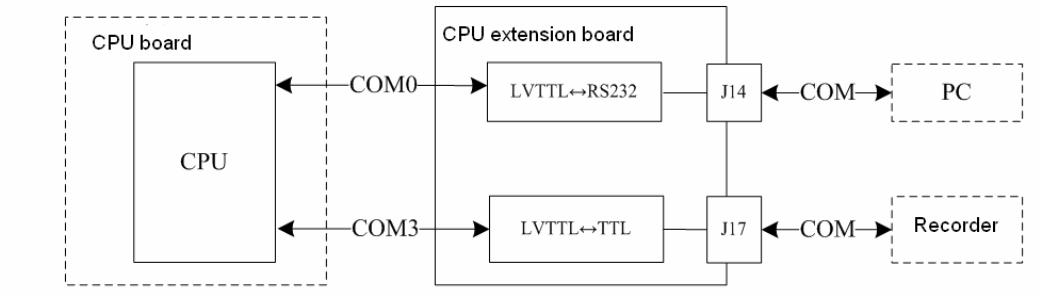
Figure 4-5 Graph of LCD/touchscreen drive control



4.5.5 Serial Port Communication

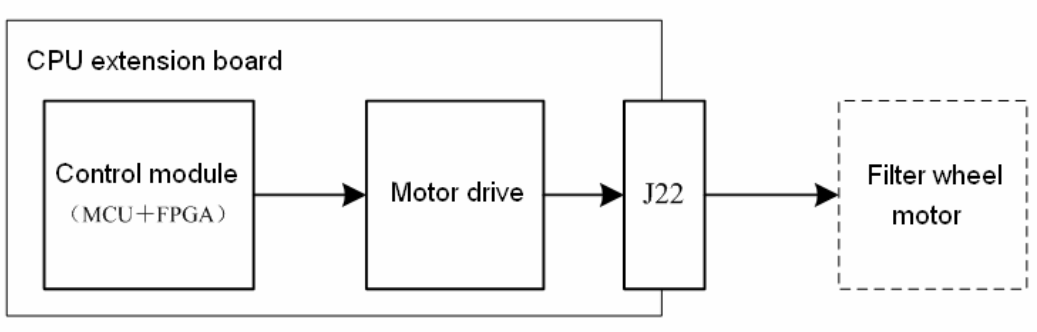
The COM0 of CPU board uses RS232 level translator to translate the level, realizing the serial port communication with PC. The communication between COM3 and recorder is realized through the level translation between LVTTL and TTL.

Figure 4-6 Graph of serial port communication



4.5.6 Driver of the Step Motor

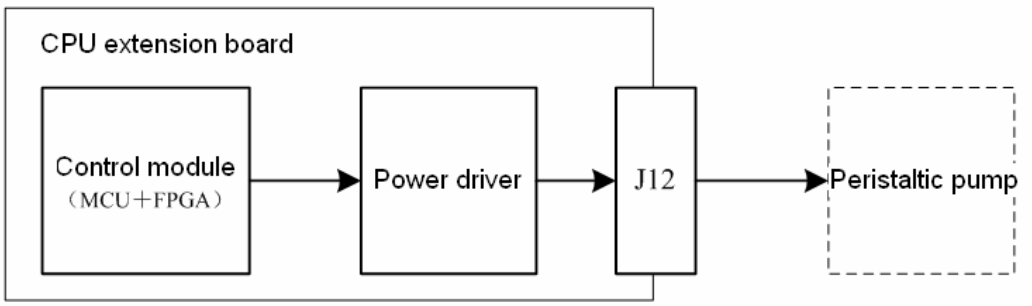
Figure 4-7 Graph of the step motor driver



The control module of the CPU extension board (including: MCU and FPGA) outputs motor control signal, which can control the step motor of the filter wheel via step motor driver circuit.

4.5.7 Driver of the Peristaltic Pump

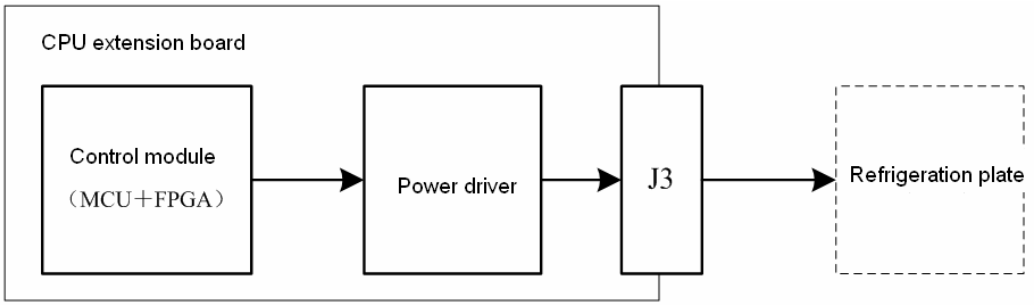
Figure 4-8 Graph of the peristaltic pump driver



The control module of the CPU extension board (including: MCU and FPGA) outputs peristaltic pump control signal, which can control the motor of peristaltic pump via power driver circuit.

4.5.8 Driver of the Refrigeration Plate

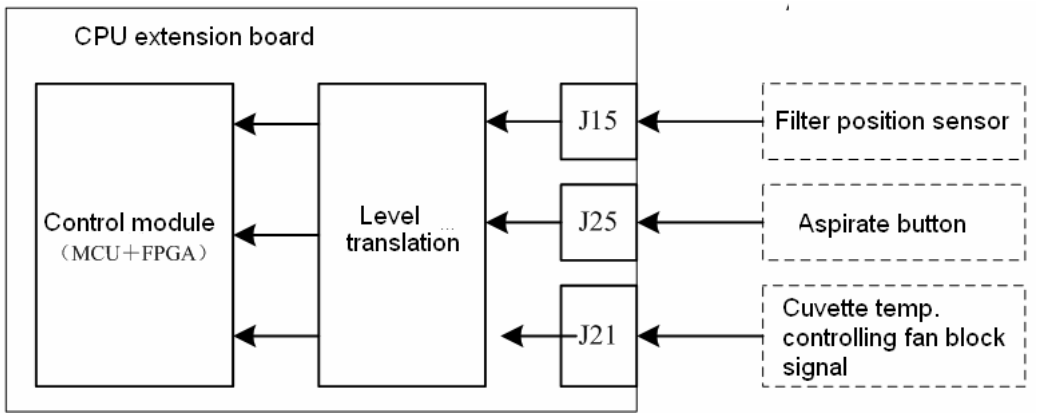
Figure 4-9 Graph of the refrigeration plate driver



The control module of the CPU extension board (including: MCU and FPGA) outputs motor control signal, which can control the refrigeration plate via power driver circuit.

4.5.9 Detection of the Input Signal

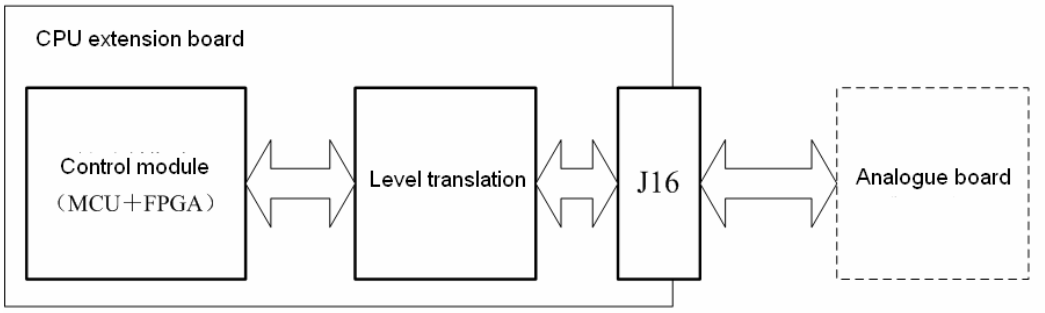
Figure 4-10 Graph of input signal detection



The system should detect the signal from filter position sensor, aspirate button, cuvette temp. controlling fan blocking. Before detected by control module, all input signals should go through the level translation circuit.

4.5.10 Analogue Board Control

Figure 4-11 Graph of analogue board controlling



Three signals are controlled by analogue board: digital potentiometer control signal (DCPx), channel selection signal (CH), AD collection and control signal (AD_Ox and AD_Ix). All control signals are generated by control module. The signals between the control module end and analogue board should go through level translation (TTL to LVTTL).

4.6 Analogue Board

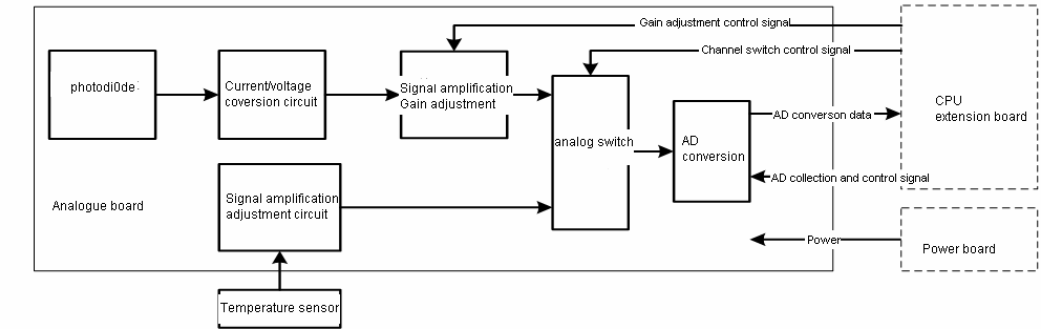
The analogue board realizes the functions of photoelectric signal, temperature sensor signal modulation and amplification, AD collection.

- The photodiode transforms the light signal which has passed through the flow cell (or cuvette) into voltage signal. The voltage signal will be filtered, amplified inversely, and finally output at the outputting end of the AD converter through selectable switch.

- The temperature sensor outputs the voltage signal to the analogue board, where it will go through amplification and modulation. Finally, it will be output at the inputting end of the AD converter through selectable switch.
- The AD converter receives control signal from the CPU extension board and samples the processed photoelectric/temperature signal and sends the AD value to CPU extension board for processing.

The power of the analogue board is provided by power board.

Figure 4-12 Structure of the analogue board



D12: ＋12V power indicator

D13: －12V power indicator

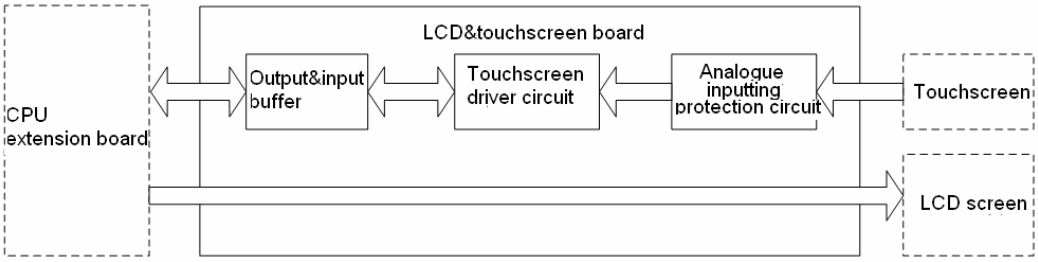
D14: +5.0V power indicator

4.7 LCD&Touchscreen Board

LCD&touchscreen board realizes the functions of LCD and touchscreen driver and signal transmission.

- LCD&touchscreen board receives the LCD display control/data signal which is exported from CPU extension board and outputs the LCD display control/data to LCD screen.
- LCD&touchscreen board realizes the function of four-wire resistance touchscreen AD collection. It receives the touchscreen control signal from the CPU extension board and output the touchscreen data to CPU extension board.

Figure 4-13 LCD&touchscreen structure



D6: ＋3.3V power indicator

D5: touchscreen valid-clicking indicator

4.8 Power board

4.8.1 Overview

The power board provides stable and reliable DC power to the modules and devices of the system. The circuit is of Flyback converter structure, providing ＋24V, ±12V and ＋5V voltage to the system and the functions of over-current protection, over-power protection and over-voltage protection are available on the system.

4.8.2 The Basic **Feature** of the Power Module

4.8.2.1 Alternating Voltage Input

- Input power: 140VA
- Input AC voltage: 100-240V～
- AC2 frequency: 50/60±3Hz

4.8.2.2 Output

- A5V output – for circuit board
- A12V output – for circuit board (analogue)
- -12V output – for circuit board (analogue)
- 24V output- board motor/power driver
- B12V output-recorder/fan/peristaltic pump motor/semi-conductor heater and power driver
- 9.9V output-LCD background light power
- B5V output-lamp power supply

4.8.2.3 Output Protection

- Over-current and over-power protection
- Over-voltage protection
- Short circuit protection
- Over-heating protection

4.9 LCD Background Adjustment

If the power board or CPU extension board is serviced or replaced, the LCD background voltage might change. To ensure the voltage meet the requirement, it is necessary to adjust it. The procedure for adjusting is shown as follows:

1 Install all the boards back and ensure all the connections are well connected;

2 Set the digital universal meter to volt measurement. Connect the connectors of the universal meter to LCD background cable connectors. (“+” is connected to red cable; “-“ is connected to white cable). Turn on the power of the analyzer.

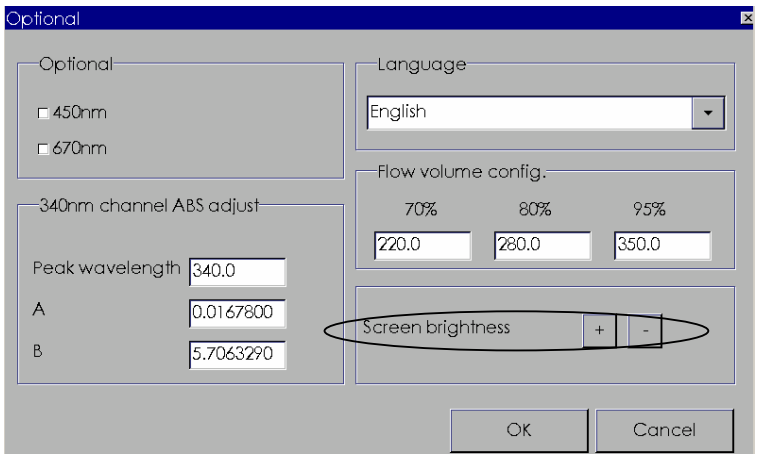
3 Observe the voltage result measured by digital universal meter, if the voltage is within the range of 9.80V≤V≤10.10V, it meets the requirement; Otherwise, the voltage should be adjusted by operating software. The procedure for adjusting is shown as follows:

4 Click ***Maintenance*** on the main screen of the instrument. Select ***Maintenance*** tab. Click ***Advanced*** and enter the password “analyzer” to enter the advanced adjustment interface as shown in figure 4-14.

5 Click ***Optional*** to enter the advanced setting interface. Use “+” or “-“in ***Screen brightness*** area to adjust the background voltage. Click “+” to increase the LCD background voltage (LCD background is brightening); click “-“to decrease the LCD background voltage (LCD background is darkening). The adjustment range is: 9.80V≤V≤10.10V;

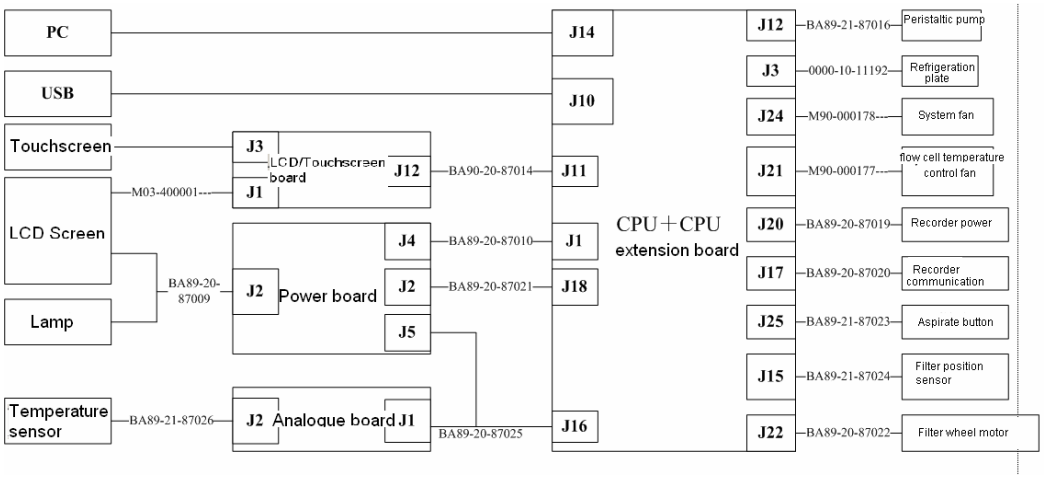
6 Return to the main screen when adjustment is completed.

Figure 4-14 LCD background adjustment



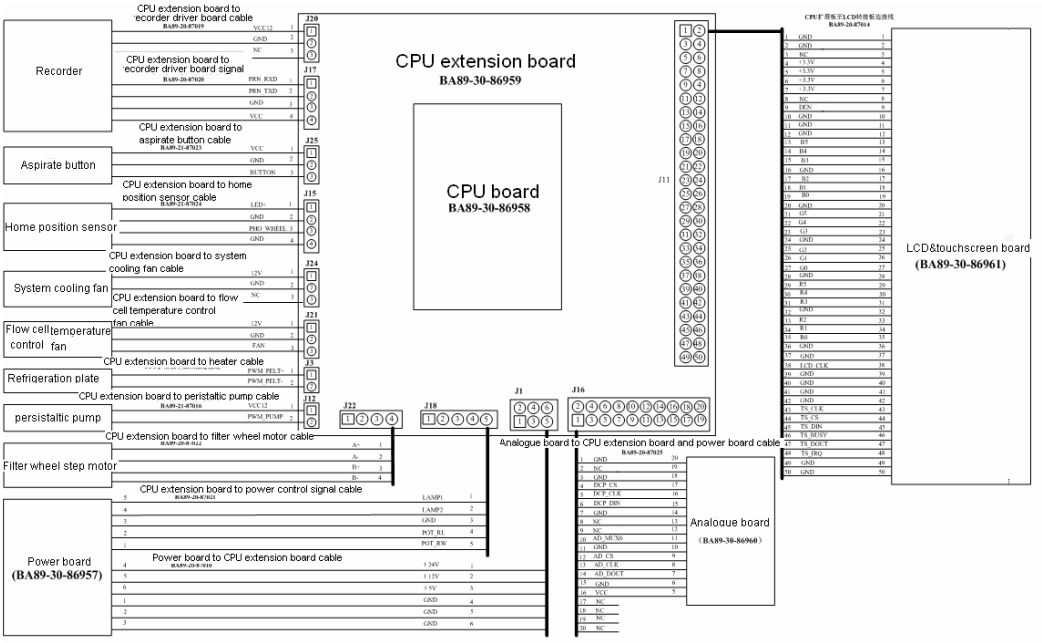
4.10 Connection of the Hardware System

Figure 4-15 System connection



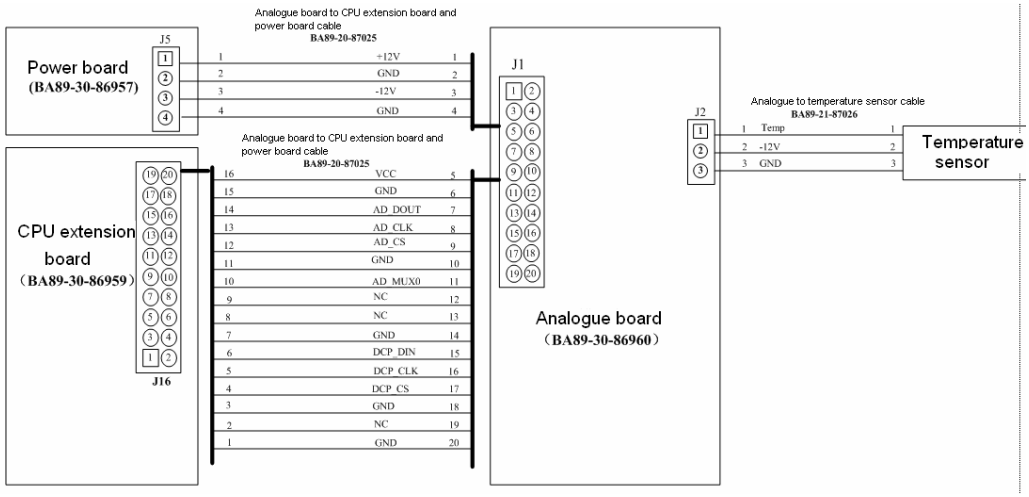
4.10.1 Definition of the CPU Board + CPU Extension Board Interface

Figure 4-16 CPU board + CPU extension board interface



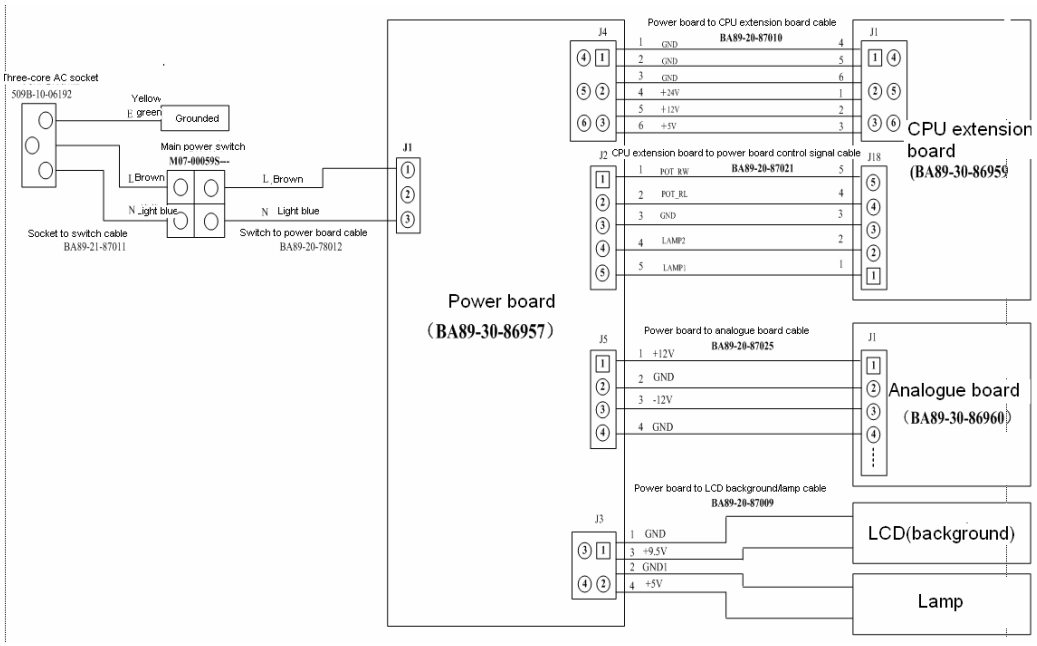
4.10.2 Analogue Board Interface

Figure 4-17 Analogue board interface



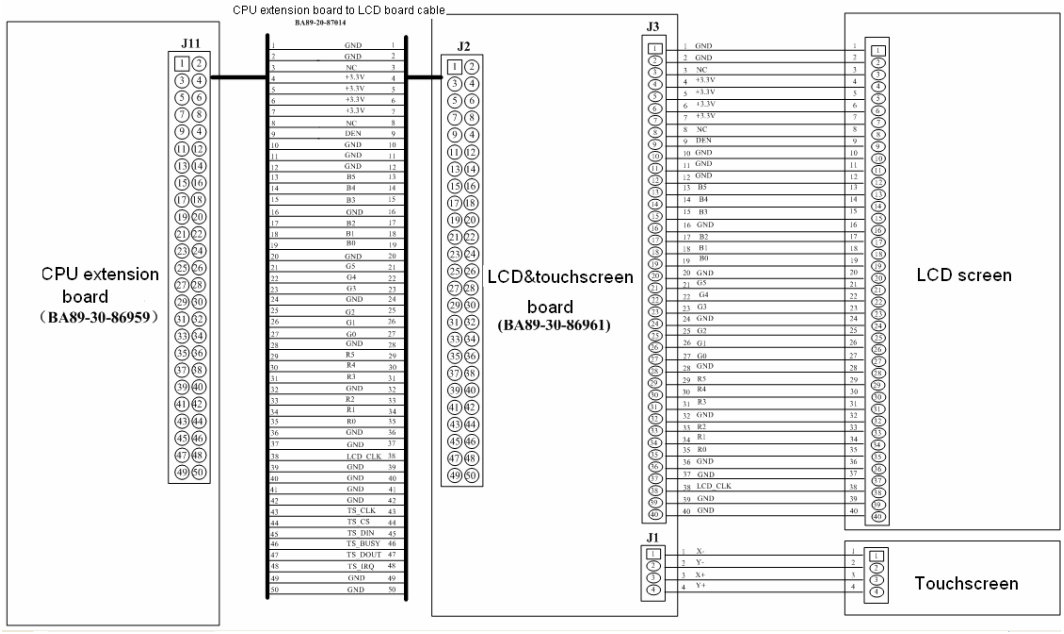
4.10.3 Power Board Interface

Figure 4-18 Power board interface



4.10.4 LCD&Touchscreen Board Interface

Figure 4-19 LCD& touchscreen board interface



5 Service and Maintenance

To ensure reliability, good performance and service life of the system, regular maintenance is required. Be sure to follow the instructions given below to maintain the system. Even you're only an operator, it's very important for you to learn this chapter. Your thorough understanding will help you obtaining the best performance of the system.

WARNING

Do not perform any maintenance procedures that are not described in this chapter.

Do not touch the components other than the ones specified in this chapter.

Performing unauthorized maintenance procedures may damage your system, void any applicable warranty or service contract and even cause personal injury.

After performing any maintenance actions or procedures, ensure that the system runs normally.

Do not spill water or reagent on mechanical or electrical components of the system.

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles during maintaining process.

5.1 Maintenance

5.1.1 Daily Maintenance

1 Use neutral wash solution and wet cloth to clean the spillage on the instrument.

2 Wash the tubing with distilled water or DI water before shutting down the analyzer (for instrument installed with flow cell).

3 When the system is not in use, make sure that the tubing and the flow cell is filled with clean distilled water (or DI water).

5.1.2 Weekly Maintenance

1、 Wash the waste bottle interior with clean water. Soak the bottle with disinfector if necessary.

2、 If the instrument will not be in use for a long time. Detach the pump head from the pump to elongate the service life of the pump tubing. Refer to the step 2 in 5.3.1 for details about detaching pump head. Do not disconnect the connection of the tubing.

5.1.3 Irregular Maintenance

5.1.3.1 Cleaning Flow Cell

1 Low Background

Contamination of the flow cell or bubble in the flow cell might cause low background. You can use the absolute alcohol to clean the flow cell (also applies for bubble in the flow cell). The procedure is as follows:

A） Click ***Wash*** on the software to wash the tubing. After 10 seconds, click ***Stop***.

B） Prepare about 5 ml absolute alcohol in the tube. Put the aspiration tubing into the tube and click ***Wash***. After 5 seconds, click ***Stop***. Wait for 10 seconds.

C） Wash with absolute alcohol for 5 seconds again, and then wait for 10 seconds. Wash the tubing with DI water for 10-20 seconds. The cleaning is completed.

D） Other recommended wash solutions include: 0.1N NaOH (KOH) solution (with some surfactant); or, enzyme solution capable of decomposing the protein; or, reagent used in chemistry analysis, capable of removing the protein, total protein reagent (biuret) and etc.

2 Before switching to other tests

Before switching to other tests, it is recommended the flow cell be washed with distilled water (or DI water). This is very necessary for tests which carryover might take place, or samples whose concentration differs a lot. The cleaning should last for no less than 5 seconds. The amount of distilled water (or DI water) should be around 1.5 ml. You can also use the wash solution specifically for chemistry analyzer to wash first, then with the distilled water (or DI water).

3 Cleaning Exterior of the Flow Cell

If the optical surface of the flow cell is contaminated, use cloth soaked with certain amount of absolute alcohol to clean it.

5.1.3.2 Adjust the photoelectric gain

Photoelectric gain should be adjusted, if it is low. After entering the ***Maintenance*** screen, click ***Gain adjust*** to pop up the ***Gain adjust*** page. Click ***Start*** and do as the system prompts. The system will complete the photoelectric adjustment and parameter configuration automatically. If the adjustment failed, possible reasons are: bubble in the flow cell or dirty optical elements or low intensity of the lamp, or damaged boards. After photoelectric gain is completed, wait for 10 min before testing. Otherwise, test result might be affected because of unstable light source.

5.1.3.3 Calibrate the Peristaltic Pump

The flow volume of the peristaltic pump might change after being used for a certain period, so it is necessary to calibrate the flow volume of the pump. If obviously incorrect aspiration volume of the pump is observed. Please refer the operator's manual for details on adjustment.

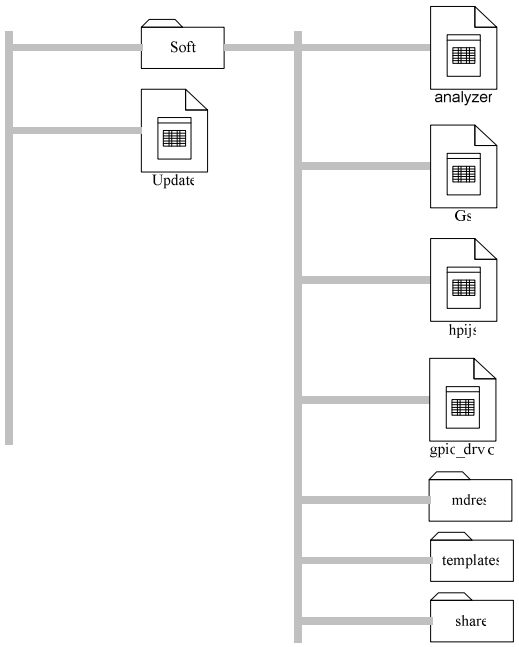
5.2 Software Upgrading

In order to facilitate operation, U disk is used at the customer end to upgrade the software. All softwares that might be upgraded at the customer end are located in 2 boards: CPU board and CPU extension board.

- CPU extension board: lower computer software and FPGA software
- CPU board: operating software, operating software resource package, device driver, printing software, printing software resource package, printer driver, printing template.

5.2.1 Software Structure

Figure 5-1 System structure of the software



5.2.2 Software List

The software on CPU board that should be upgraded:

Name	Code	Example of Version	File or file folder
BA89 operating software	G87048	G87048-xxxxxx	analyzer
BA89 operating software resource package	G87057	G87057-xxxxxx	mdres（file folder）
BA89 printing template	G87054	G87054-xxxxxx	templates（file folder）
BA89 printing software GS	G87052	G87052-xxxxxx	Gs
BA89 printing software GS resource package	G87053	G87053-xxxxxx	share（file folder）
BA89 printing driver Hpijs	G87055	G87055-xxxxxx	hpijs
BA89 device driver	G87051	G87051-xxxxxx	gpio_drv.o

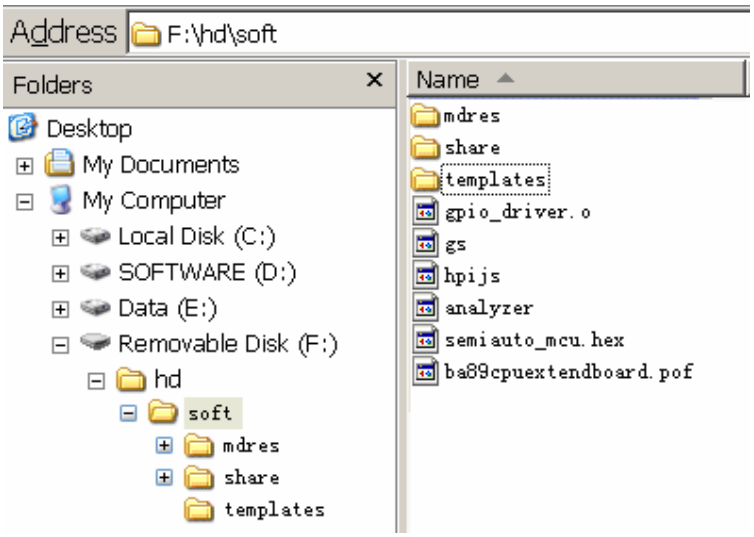
The software on CPU extension board that should be upgraded:

Name	Code	Example of Version	File or file folder
BA89 control software （ lower computer ） _ijsresource packagepgraded: ce driver, printing software, printing software resource package, pringer dir	G87049	G87049-xx	semiauto_mcu.hex
CPU extension board EPCS1SI8N write software (FPGA software)	G87045	G87045-xx	ba89cpuextendboard.pof

5.2.3 Upgrading Procedures for Software on CPU Board

1 Connect the U disk to the computer. Clear the U disk to ensure it is not infected by virus.

2 Set up a file directory in U disk: \hd\soft\ and copy the software to be upgraded as shown in the figure.



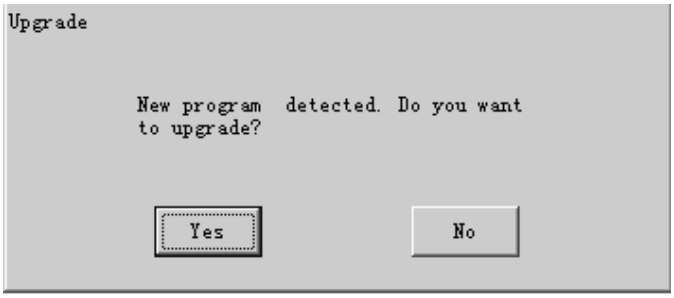
NOTE

Only the copy the software that needs to be upgraded to the relevant directory. The upgrading time is in direct proportion to the size of the file.

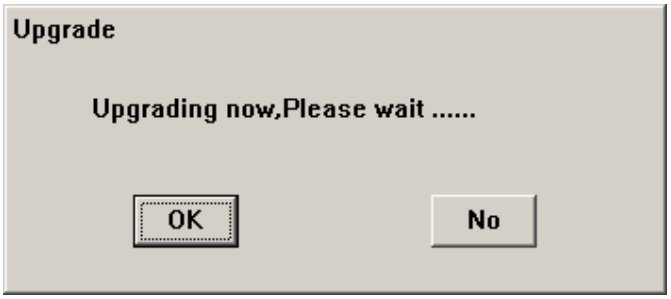
3 Remove the U disk from the PC.

4 Connect the U disk which contains the upgrading program to the analyzer, and power on the analyzer.

5 It will take about 15 minutes for the system to initialize, then the interface to detect the upgrading program on the U disk will be displayed.



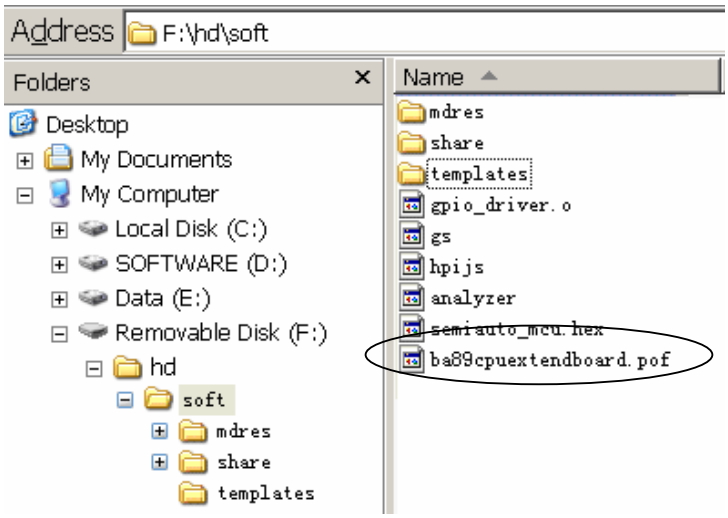
6 Click ***Yes*** to pop up the interface for upgrading.



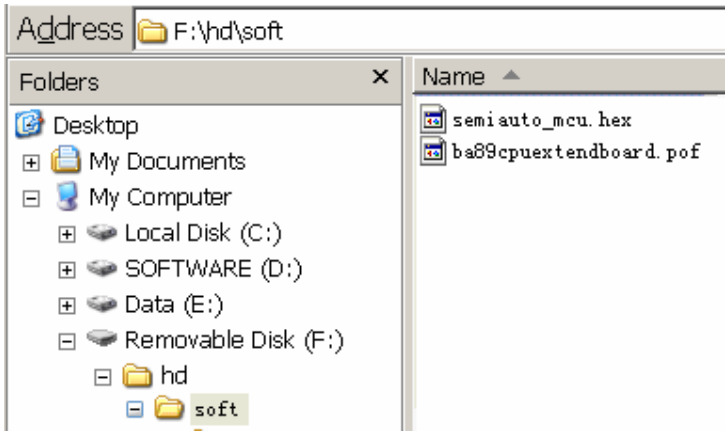
7 The upgrading time is in direct proportion to the size of the file. It will take 10 minutes to upgrade the operating software. After upgrading is completed, the following interface is displayed, click ***OK***. And the system will be restarted. Remove the U disk.

5.2.4 Upgrading Procedures for Software on CPU Extension Board

1 Please make sure the FPGA software or lower computer software has been copied to relevant directories on U disk.

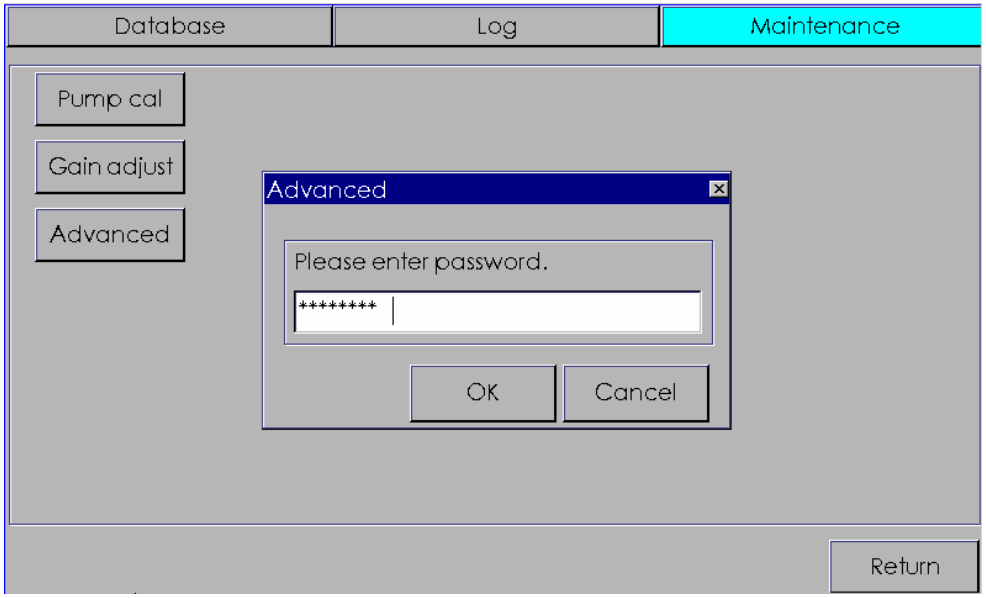


If not, execute the CPU board software upgrading again. But only FPGA software or lower computer software is needed to be copied the U disk.

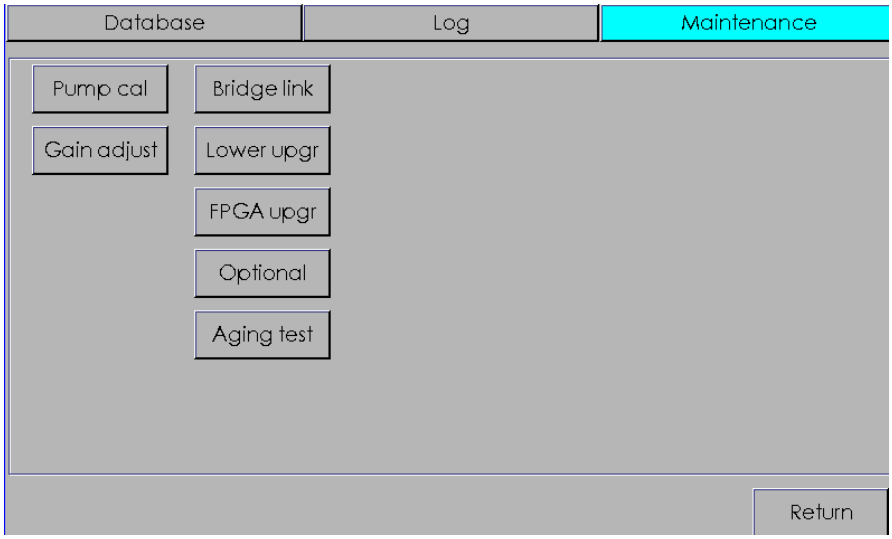


2 After confirming that the FPGA software or the lower computer software has been copied to the instrument memory, enter the ***Maintenance*** interface.

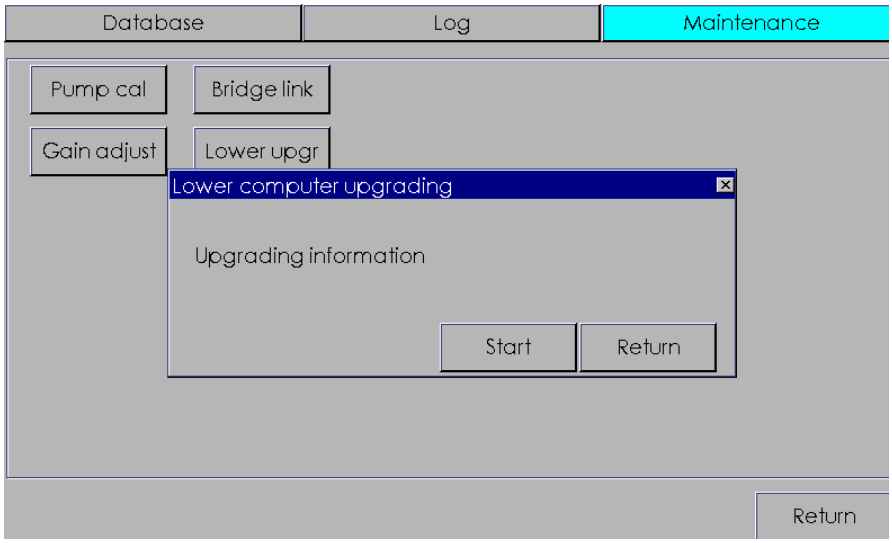
Click ***Advanced*** to pop up the dialog box shown in the following figure. Enter the password—analyzer and click ***OK***.



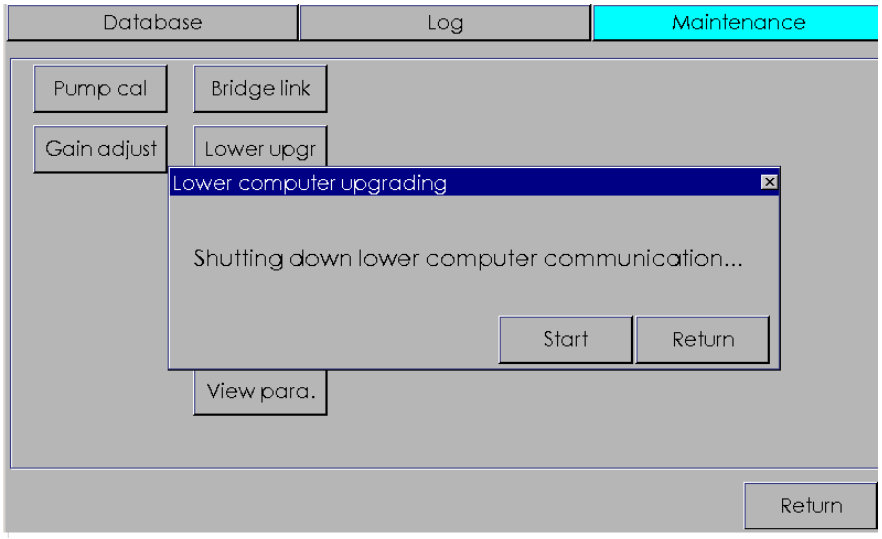
And the following screen will be displayed:



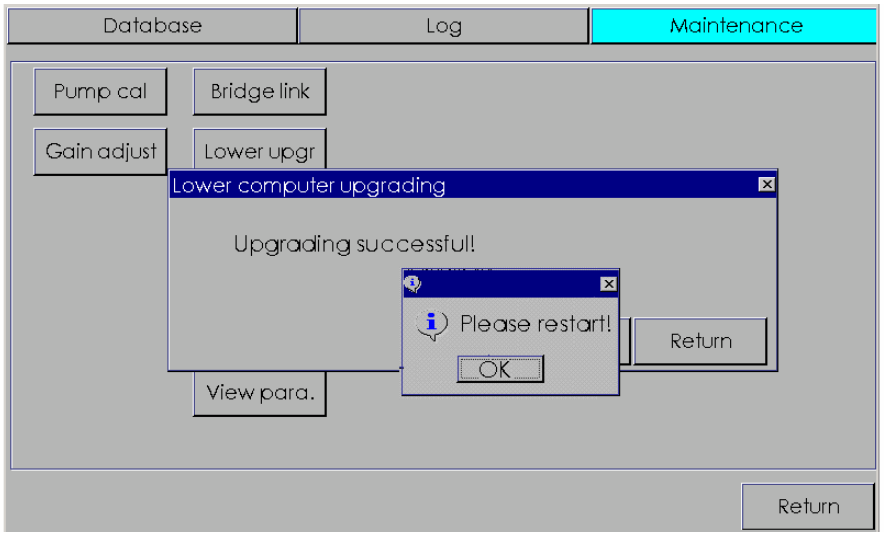
Click ***Lower upgr*** and the Lower computer upgrading dialog box will be displayed.



Click start and a dialog box notifying the user to shut down lower computer communication will be displayed.

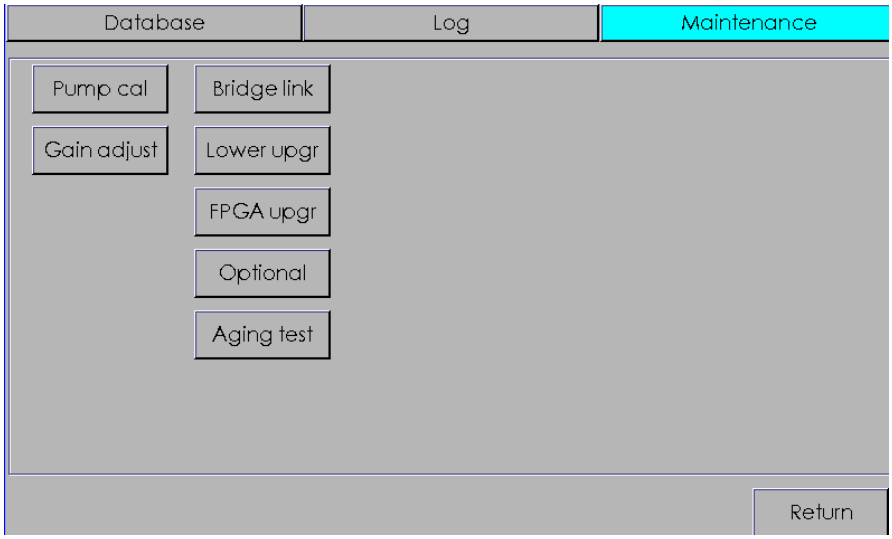


After upgrading is completed, a dialog box will pop up to notify the user to restart.

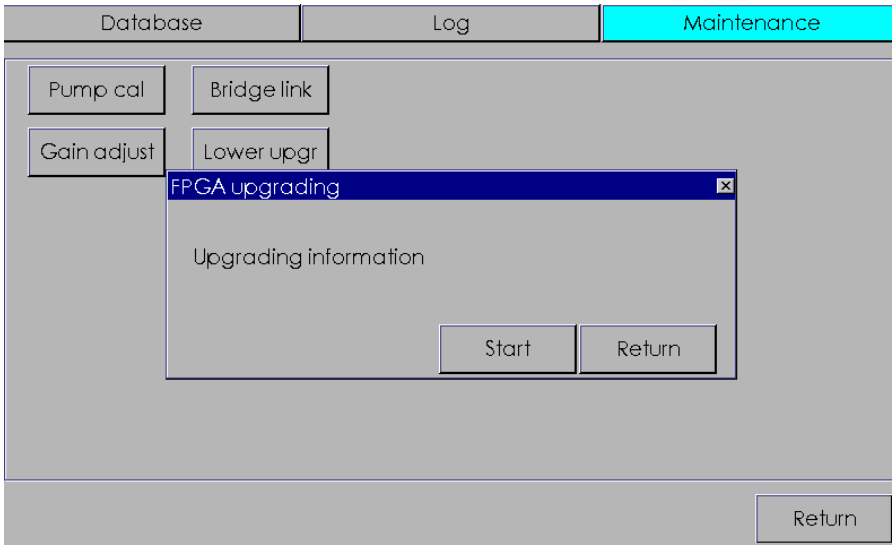


Restart the system.

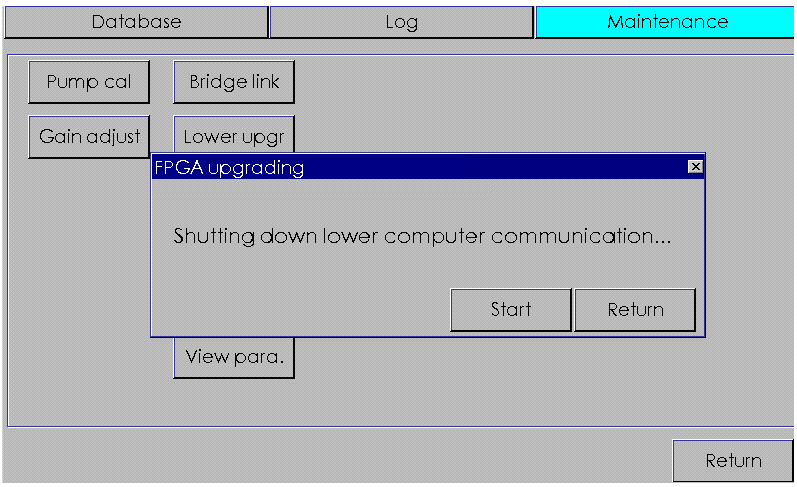
3 Click ***Advanced*** to enter the following screen;



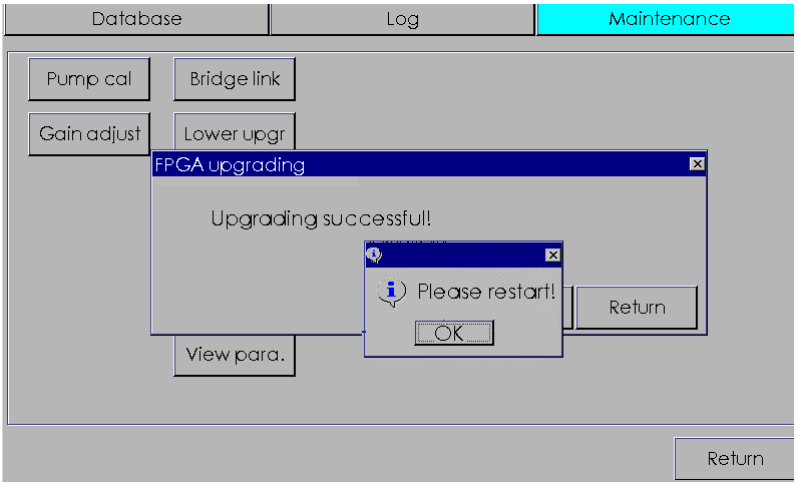
Click ***FPGA upgr*** and the FPGA upgrading dialog box will be displayed.



Click ***Start*** and a dialog box notifying the user to shut down lower computer communication will be displayed.

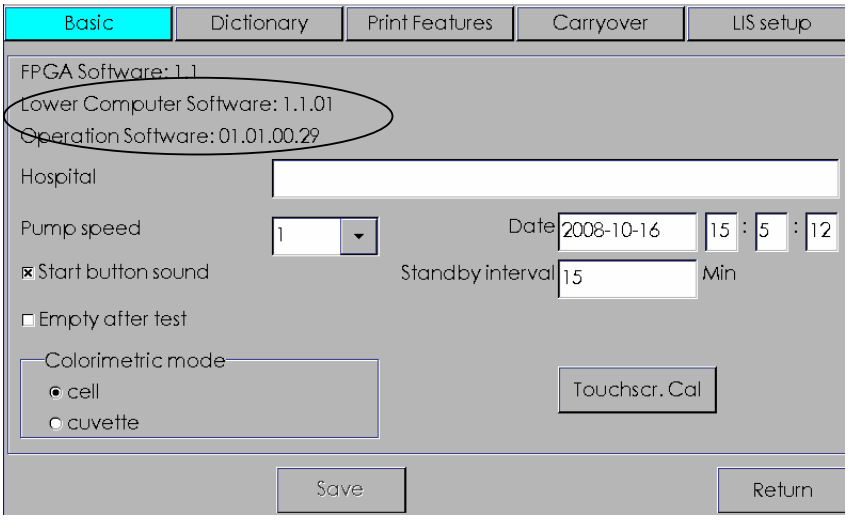


After upgrading is completed, a dialog box will pop up to notify the user to restart.



Restart the system.

4 When the software upgrading is completed, enter Setup-Basic to check whether the software is of the latest version.



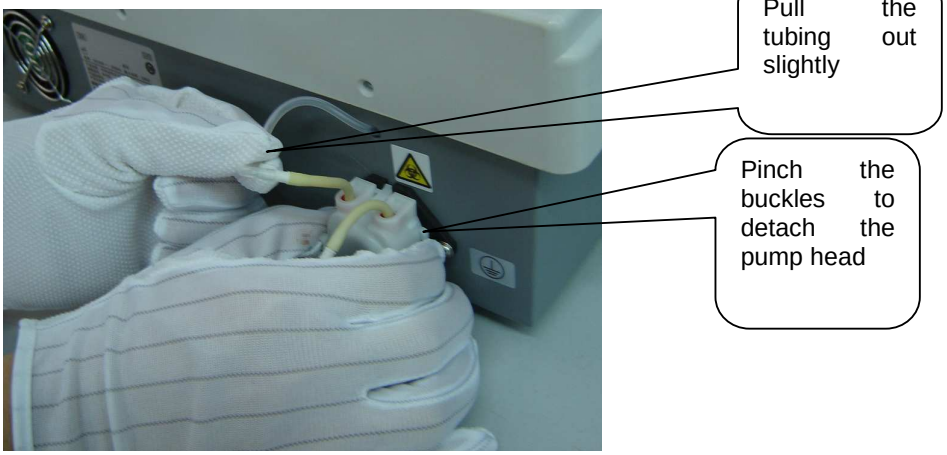
5.3 Maintenance

5.3.1 Replacing the tubing

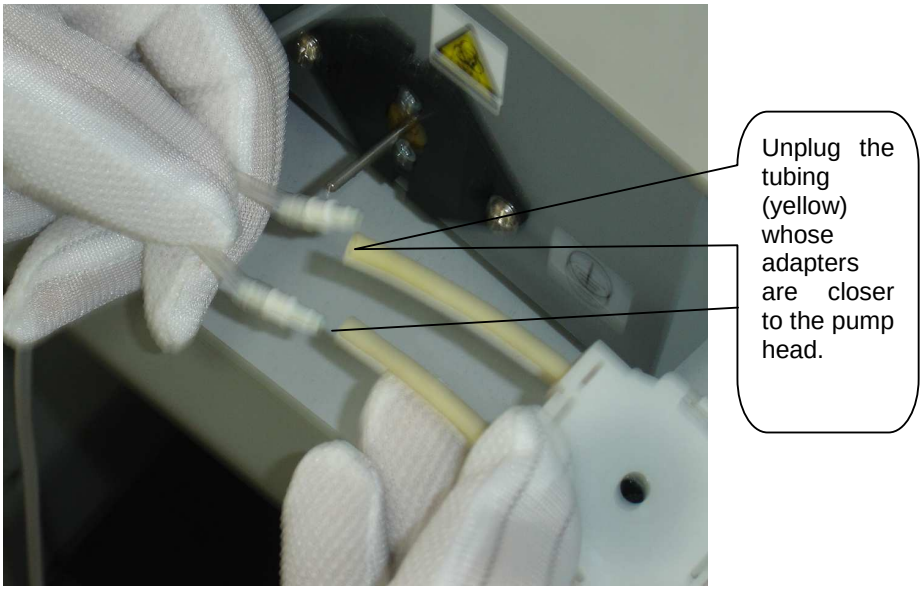
The tubing is a component that should be replaced regularly. When the instrument is in use, if you notice that the instrument can not aspirate or aspiration volume decreases obviously, check for leakage in the peristaltic pump. If yes, the pump tubing might be broken and it should be replaced. A pump tubing is in the accessory package (outer diameter 3.2mm, length 150-160mm, yellow).The procedure for replacing is shown as follows:

1 Shutdown the instrument and disconnect the power cable between the instrument and the power supply.

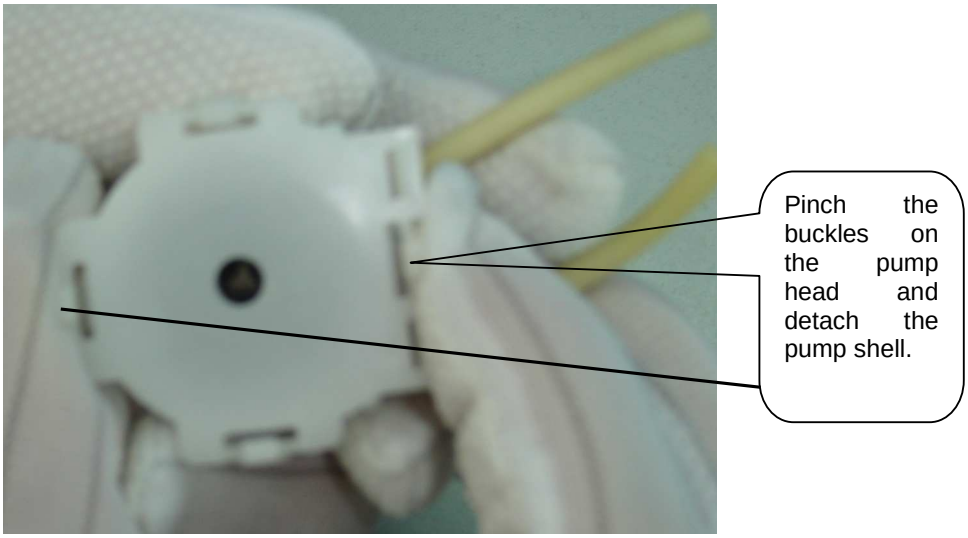
2 Locate the position where the peristaltic pump is installed. Pull out the tubing that goes through the backboard of the analyzer for 40-50mm until the adapter is exposed. Pinch the two buckles on the left and right side of the pump shell and detach the pump head carefully.



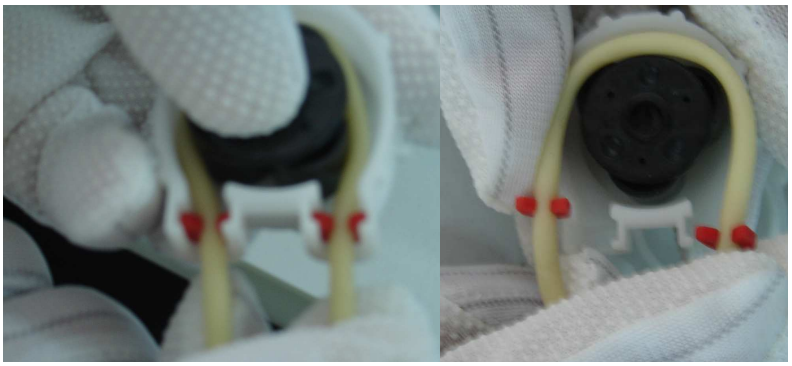
3 After detaching the pump head, unplug the tubing (yellow) whose adapters are closer to the pump head.



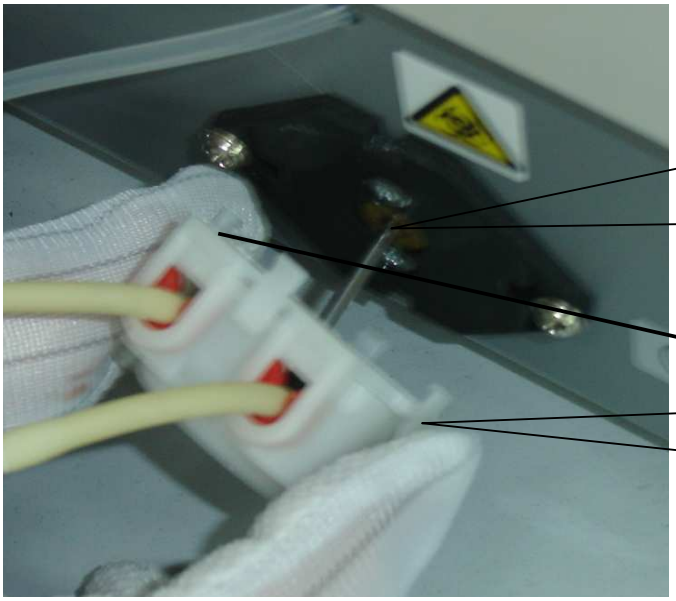
4 After unplugging the adapters, pinch the buckles on the pump head and detach the pump shell.



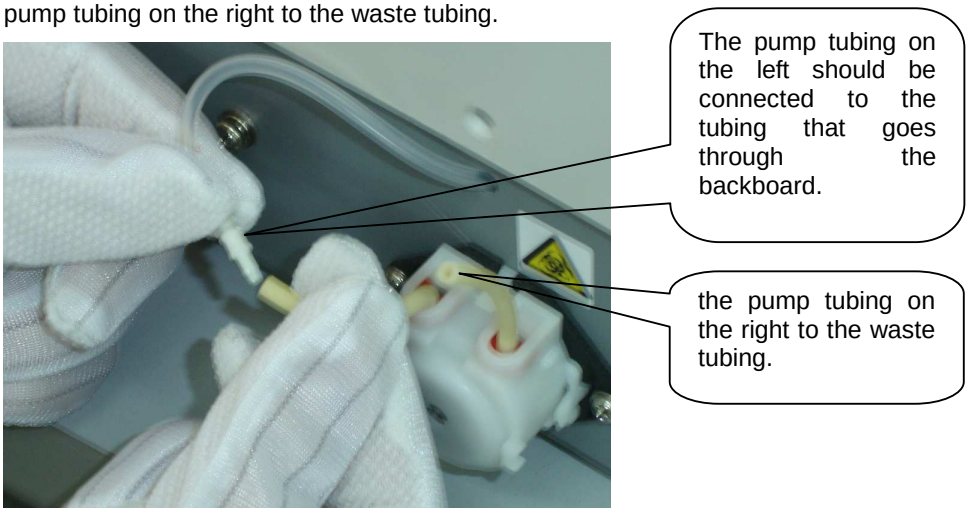
5 After detaching the pump shell, press the roller inside the pump to take the used pump tubing out. Remove the red ring on the used tubing and install them on the new tubing. Install the new pump tubing on the pump and carefully pull it to make the tubing fit well with the inside of the pump without any twisting. Make sure the lengths exposed at both ends are roughly the same. If necessary, pull both ends of the tubing slightly.



6 After mounting the pump shell, install the pump head on the pump.



7 After installing the pump head, connect the tubing with the tubing that goes through the backboard and the waste tubing. The pump tubing on the left should be connected to the tubing that goes through the backboard, the pump tubing on the right to the waste tubing.



8 After connecting the tubing, slip the tubing that goes through the backboard into the analyzer until the adapters does not expose to the outside.

9 Check the installation for any errors. Connect the analyzer to the power supply and calibrate the pump. Please refer to the relevant part of the operator's manual for calibration method.

BIOHARZARD

When replacing the pump tubing, wear gloves and lab coat and, if necessary, goggles. In case your skin contacts the waste, follow standard laboratory safety procedure and consult a doctor.

NOTE

The service life of the pump tubing is 18 month. Tubing should be checked irregularly and replaced in time.

Do not use excessive force while pulling, slipping the tubing or doing any operation that might pulling the tubing. Otherwise, the tubing might be damaged or the inner connection might be cut off.

While connecting the tubing, insert the tubing into the adapter until the tubing reaches the bottom of the adapter so as to ensure the reliability of the connection.

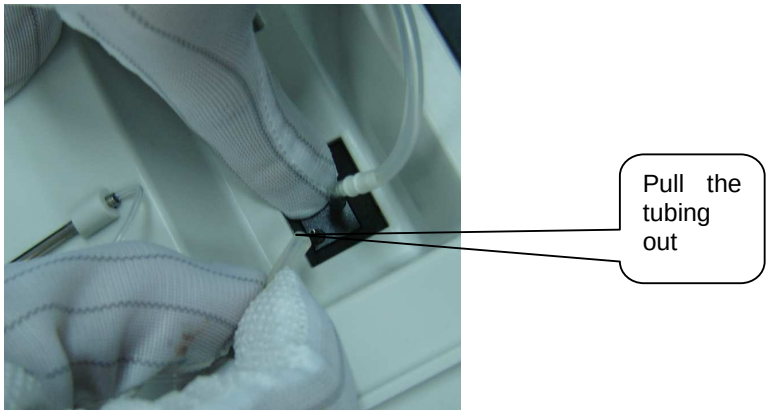
While installing the pump tubing into the pump, avoid twisting. If necessary, pull the tubing back and forth slightly.

Calibrate the pump after replacing the pump tubing. Otherwise, the aspiration volume might not be correct and the test may be affected.

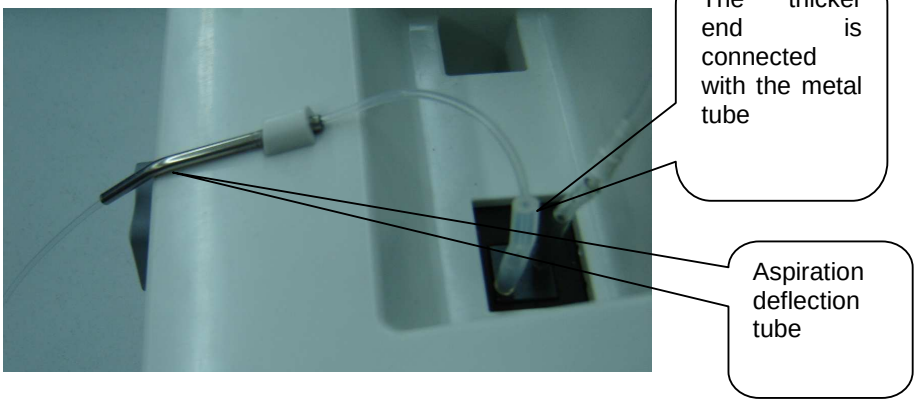
5.3.2 Replacing Aspiration Tubing

During operation, if the aspiration tubing is blocked and can not be unblocked, replace it with the tubing (OD: 1.6mm; length: 200-220mm, transparent material), with one end connected with silicone tube-OD: 4mm; length: about 30mm) in the accessory. The replacement procedure is as follows:

1 Open the optical window cover and press the bottom of the flow cell (if flow cell fastening screw is installed, you do not have to press), then carefully pull the metal inlet tubing which is connected with the flow cell (the slimmer one which is closer to the front of the instrument)



2 Connect the thicker end of the new tube to the inlet metal tube and then guide the tube through the deflection tube.



BIOHAZARD

When replacing the pump tubing, wear gloves and lab coat and, if necessary, goggles. In case your skin contacts the waste, follow standard laboratory safety procedure and consult a doctor.

NOTE

After replacement is completed, please make sure that the flow cell is pressed to the bottom of the installation hole (the top of the flow cell should be on the same level with the installation surface). Otherwise the test result might not be reliable.

NOTE

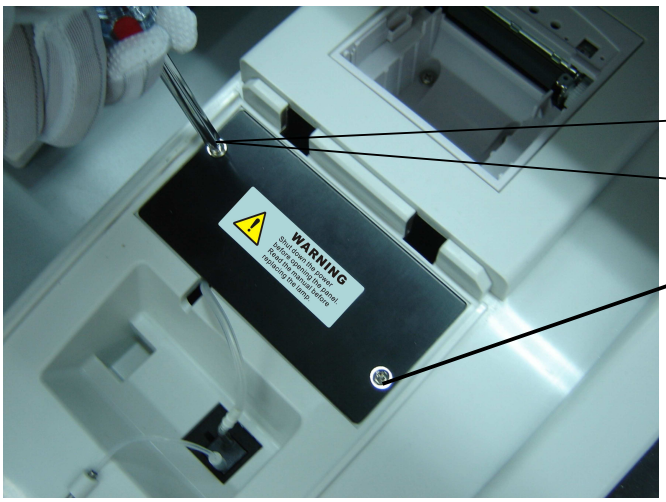
When connecting the tube, the tube should reach the root of the metal tube to ensure reliability.

After the aspiration tubing is installed, the bending part should be transitioned smoothly, no sharp angle, corrugation is allowed

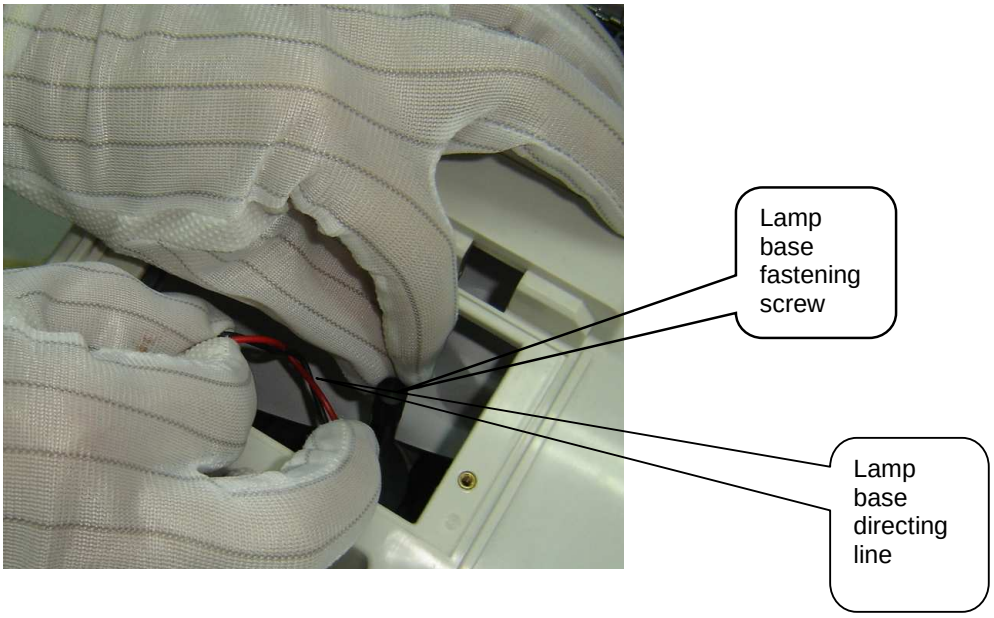
5.3.3 Replacing Lamp

When the system warns that the background is too weak (no bubble in the flow cell) and the warning can not be dealt with by cleaning the flow cell, the optical element and adjusting the photoelectric gain. The detailed operation is as follows:

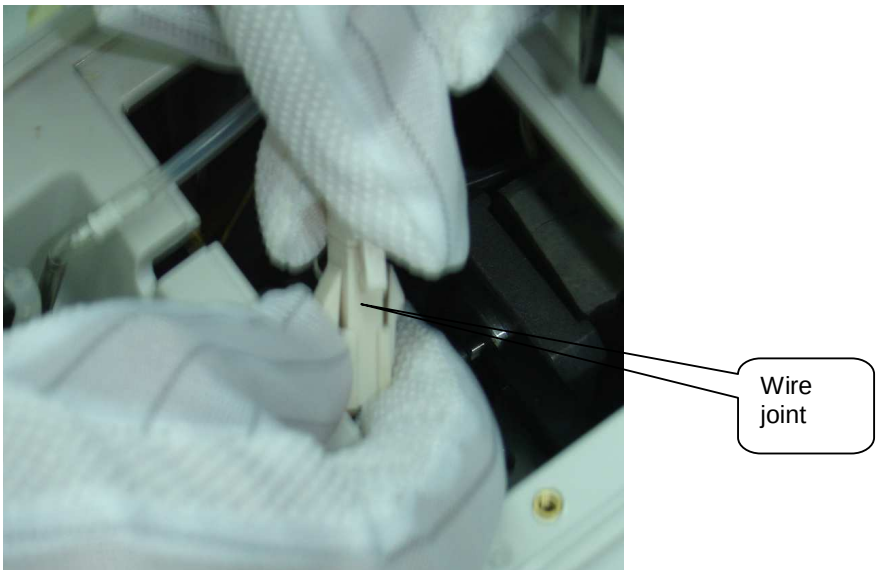
1 Open the optical window cover, use cross screw driver to unscrew the screws on the lamp replacement window cover. Remove the cover.



2 Unscrew the fastening screw of the lamp base (if it is difficult to dismount, some tools like the clipper might be used). Put the screws in a proper place outside the instrument. Pinch the lamp base directing line and then carefully take the lamp assembly out).



3 Pull the wire out and you can see the wire joint connecting the lamp assembly, with one end connecting to the lamp and the other end connecting to the inside of the instrument. Pinch both ends of the joint and press the buckle to disconnect the joint. The dismounting is completed.



4 Connect the new lamp with the wire joint of the lamp assembly and wire joint in the instrument. Install the lamp into the installing hole in the lamp base. Fasten the retaining screw on the lamp base.

5 After installation, power on the instrument. Adjust the gain. Check the background after the instrument is stabilized to check whether the replacement is successful.

WARNING

If you want to replace the lamp, first switch off the power and then wait at least 15 minutes for the lamp to cool down before touching it. Do not touch the lamp before it cools down, or you may get burned.

NOTE

When replacing the lamp assembly, do not touch the surface of the bulb.

When dismounting the restraining screw of the lamp base, please take extra care to avoid element falling into the inside of the instrument. If it is difficult to dismount, some tools like the clipper might be used. The photoelectric gain should be adjusted after the lamp is replaced. For more details, please refer to 5.3.2 Adjusting the Photoelectric Gain.

5.3.4 Replacing CPU Board

After the CPU board is replaced, the system can not read the original parameter configuration. These parameters include flow cell temperature adjustment parameters, cuvette temperature adjustment parameters, filter wheel home position deviation, original flow volume of the peristaltic pump and the peak wavelength of the 340 nm. The temperature adjustment parameters and filter wheel home position

deviation can not be directly measured in operating software, so they are configured by other methods. The configuration procedures are shown as follows:

1 Find the “sensor parameter A, B and C”, “filter wheel home position deviation” and “340 nm peak wavelength” in parameter configuration based on the SN.

2 Click ***Maintenance*** on the main screen of the instrument. Select ***Maintenance*** tab. Click ***Advanced*** and enter the password “analyzer” to enter the advanced adjustment interface. Select ***H pos.*** and enter the filter wheel photo-coupler offset in the ***Deviation***. Click ***Save*** to return. Note the offset should be within 0-63, otherwise it can not be saved.

3 Configure the sensor parameters of flow cell and cuvette in parameter configuration table to the system. If the temperature measurement assembly has been replaced, configure the new one.

4 Click ***Maintenance*** on the main screen of the instrument. Select ***Maintenance*** tab. Click ***Advanced*** and enter the password “analyzer” to enter the advanced adjustment interface. Click ***Optiona***l in the interface. Enter the value of 340 nm channel peak wavelength to peak wavelength in the parameter configuration into the ***Peak Wavelength***. Click ***OK***.

5 Adjust the photoelectric gain and refer to 5.1.3.2 for details; calibrate the pump and refer to 5.1.3.3 for details.

NOTE

If the temperature sensor or analogue board has been replaced before replacing the CPU board, enter new parameters after replacement

If the home position sensor, motor, filter wheel and sensor stop plate has been dismounted and repaired before replacing the CPU board, enter new parameters after replacement.

6 Troubleshooting

This chapter presents all warning messages and recommended corrective actions, which should be taken in time once any error occurs.

When an error or failure occurs, relevant alarm message will be displayed, and the system will take corresponding actions.The logs will record the time, level, code and detailed information of each warning to help user record and search errors.

6.1 Alarm Message Classification

The error messages are divided into different types according to their severity.

In case of an error/warning message, check its error code on the ***Logs*** screen, and then check the table below for recommended corrective measures.

WARNING

When troubleshooting the analyzer, first find out whether it is necessary to switch off the Main Power or Power.

BIOHAZARD

Wear gloves and lab coat and, if necessary, goggles.

6.2 Levels

Of all the system failures, the causes of many failures are similar. Classifying the failure into different levels and allocating all failures to different levels will facilitate troubleshooting and make failures of the same level have common corrective measures.

All the failures recorded in the log can be classified into 3 levels.

6.2.1 Errors to Warn User (0)

The movement of the system and the test result will not be affected, however, the user should be informed of the error.After calibration is completed, calibration formula can not be gained, but the previous calibration formula can be used to calculate the formula and the test will not be affected. But the system should inform the user of the cause of the calibration failure in the form of dialog box and remind the user of reclibration. The system will not alarm if the test result exceeds reference limit, only commenting on the result.

6.2.2 Errors to Invalidate Tests (1)

The test results are not reliable and rerun is necessary, such as ABS out of limit, out of linearity range, the reaction curve of the kinetics test out of linearity range, out of ABS limit, reagent blank higher or lower than set points, test result of non-linear calibration higher the maxium set point or lower than the minimum set point. In such cases, system should pop up dialog boxes to notify the user that the test results are not reliable and rerun is necessary. The test results are market by a specified symbol.

6.2.3 Errors to Forbid Test (2)

When system is started, if relevant conditions do not meet certain requirements, the tests will be forbidden, such as over high temperature, over low temperature, abnormal temperature control sensor, block of fan during testing, flow cell out of control, filter wheel home position damaged. In such cases, all the tests will be forbidden.

6.3 Error Display

There are two ways to display the errors on the system: dialog box and sound.

6.3.1 Dialog Box

Whatever the cause of the error is, once there is an error, the system will pop up dialog box to notify the user. All the alarm messages will be recorded in log (not including out of reference range).

The phenomenon and the error code will be displayed in the dialog box. Users can use the error code to search the detailed information and corrective measures in the logs.

The error information recorded in the logs includes: alarm date, alarm time, alarm name, code, level, and details. The details include: error description, causes and corrective measures.

6.3.2 Sound

The sound alarm is available on the system as well. You can enable or disable the sound alarm in ***Setup***.

6.4 Details

Code	Level	Description	Causes	Corrective measures provided by log
↑	0	Above Reference High	/	/
↓	0	Above Reference Low	/	/
MON	1	（XX Test）Calibration monotone checking error	Nonlinear calibration curve is not monotone	Recalibrate
COV	0	Iterative but not convergent while calculating the calibration parameter or result!	When calculating nonlinear calibration result, if no qualified result is obtained after 1000 iterations, calibration is failed	Rerun
R!	0	（Nonlinear calibration test）The response of sample or control out of response range of the calibrator	Abnormal sample (hemolysis, etc). Calibrator concentration is too low	Run diluted sample, or recalibrate
PR1	1	Printer can not print	Not enough paper in the printer, printer error or printer not connected	Check whether there is enough paper. Restart the printer or replace the printer.
PR2	1	Thernal printer can not print	Not enough paper in the printer, printer error.	Check whether there is enough paper or replace the printer.
PR3	1	No printing template	No printing template	Upgrade printing template
ABS	0	The absorbance of sample, calibrator or control exceeds limit	Absorbance exceeds the limit	Check whether the sample is qualified; whether the reagent expired; whether the cuvettes are dirty; whether the flow cell is placed right.
ABS++	1	The absorbance of water blank, reagent blank or sample blank out of readable range: -5000-35000	Bubble in the cuvette or else	Remove the bubbles; rerun
ABS+	0	The absorbance of XX test out of readable range. (only for sample, calibration and QC test)	Bubble in the cuvette or else	Check the position of the flow cell and whether the optical system is normal.
RBK	1	（XX Test）Reagent blank out of range	Reagent expired or dirty cuvette	Rerun after replacing reagent
NLN-1	1	（XX Test）（xx sample or calibrator or control）The reaction curve has no linear interval	Measuring points in both kinetic read window and substrate limit are less than 3	Rerun or rerun after dilution
NLN-2	0	（XX Test）（xx sample or calibrator or control）The	Measuring points in both kinetic read window and substrate	Rerun or rerun after dilution

		reaction curve has no linear interval	limit are less than 3	
LIN	1	（XX Test）（xx sample or calibrator or control）The reaction curve Out of linear range	Reaction data does not meet linearity criteria	Rerun or rerun after dilution
>	0	（XX Test）（xx sample or calibrator or control）Above Linearity High	Calculated concentration exceeds high limit of linearity range	Rerun or rerun after dilution
<	0	（XX Test）（xx sample or calibrator or control）Above Linearity Low	Calculated concentration exceeds low limit of linearity range	Rerun
CIE	1	（XX Test）No result calculated for calculation test!	Abnormal test result. Error occurs like 0 dividend	Rerun participated tests. Check and reset calculation formula
ADL	0	Light signal too weak	AD too low when running water blank, lamp off; replacement of the lamp is needed; light path is obstructed, or lamp falls off, or gain error occurs.	Rerun; wash flow cell (cuvette); adjust gain; clean optical path; replace lamp.
ADH	1	Light signal too strong	Gain adjustment error; lamp abnormal	Restart the system; adjust the gain; replace the analogue board
DRH	2	Dark current is too high	The installation hole of the flow cell is not covered; hardware abnormal; optical system abnormal	Check whether the flow cell (cuvette) is placed right; restart the system; replace the analogue board
DRL	2	Dark current is too low	Hardware abnormal; optical system abnormal	Restart the system; replace the analogue board
01	0	Temp. control failled	Temp. data collection error; refrigeration plate error; main board error; refrigeration plate invalid.	Restart thesystem; check the connection of the semi-conductor refrigeration plate; replace the refrigeration plate; replace the temperature sensor; replace the analogue board
02	0	Temperature too high	Ambient temperature too high; Temp. data collection error; refrigeration plate error; main board error; refrigeration plate invalid.	Confirm the ambient temperature; check the connection of the semi-conductor refrigeration plate; restart the system; replace the refrigeration plate; replace the temperature sensor; replace the analogue board

03	0	Temperature too low	Ambient temperature too low; Temp. data collection error; refrigeration plate error; main board error; refrigeration plate invalid.	Confirm the ambient temperature; check the connection of the semi-conductor refrigeration plate; restart the system; replace the refrigeration plate; replace the temperature sensor; replace the analogue board
04	0	Temperature unstable!	Too much fluctuation of the ambient temperature; temperature data collection error; main board error; refrigearation plate error; too much temperature difference between the reactant and the system.	Conform the ambient and testing temperature; restart the system; replace the semi-conductor refrigearation plate; replace temperature sensor; replace analogue board
05	0	Fan blocked during running	The running of the fan is blcked or the fan is damaged; board error	Check the cable connection; restart the analyzer; replace the fan; replace the board
06	0	Temperature sensor abnormal	Temperature sensor error; sensor cable falling off; analogue board error; temperature out of range	Confirm the ambient temperature; check the connection of the temperature sensor; replace the temperature sensor; replace the analogue board
07	0	Gain adjustment failed	Lamp error; optical path contaminated; data collection error; analogue board error	Readjust the gain; clean the optical elements; replace the lamp; replace the analogue board
08	2	Filter wheel can not find home position. The failure can not be recovered	Home position sensor damaged or dust accumulation on sensor, or motor damaged	Check the connection of sensor and motor. Clean or replace home position sensor; replace the motor
09	1	Filter wheel can not find home position. The failure can be recovered	Accidental error of the home position sensor or motor	Rerun
010	1	Filter wheel step missing! The failure can be recovered	Accidental error of the home position sensor or motor	Rerun
011	2	Filter wheel step missing!	Motor driver error	Check whether the home position sensor is damaged or has dust collected; check whether the rotation of the filter wheel is blocked; check whether the CPU board is damaged
012	2	Can not pass hardware self-check	Circuit error	CPU board is damaged and should be replaced

013	2	Handshake failed	Communication error!	Check whether the connection of the CPU board or CPU extension board is loosen; CPU board or CPU extension board is damaged and should be replaced
014	2	Filter wheel does not respond in maximum delay!	The communication between MCU and FPGA failed, or FPGA failed	Check whether the connection of the CPU board or CPU extension board is loosen; CPU board or CPU extension board is damaged and should be replaced
015	1	Filter wheel does not respond in maximum delay!	Filter wheel does not respond in maximum delay and the failure can be recovered	The accidental communication between the CPU board and MCU or FPGA is not normal. The system can be recovered
016.	2	Peristaltic pump does not respond in maximum delay!	The communication between MCU and FPGA failed, or FPGA failed	Check whether the connection of the CPU board or CPU extension board is loosen; CPU board or CPU extension board is damaged and should be replaced
017	2	Gain adjustment or AD collection does not respond in maximum delay!	The communication between MCU and FPGA failed, or FPGA failed	Check whether the connection of the CPU board or CPU extension board is loosen; CPU board or CPU extension board is damaged and should be replaced
018	1	Gain adjustment or AD collection does not respond in maximum delay!	Gain adjustment or AD collection does not respond in maximum delay! The failure can be recovered	The accidental communication between the CPU board and MCU or FPGA is not normal. The system can be recovered
019	2	Photoelectric collection error!	The AD initialization is not executed or AD read data has been executed during data collection	Check whether the home position sensor is damaged or has dust collected; check whether the rotation of the filter wheel is blocked; check whether the CPU board is damaged
020	1	System is busy. Cannot respond to current instruction!	System can not respond temporily; hardware damaged; software error	Restart the system; replace the board or upgrade software
023	1	Can not calculate the result	Can not calculate the result	Replace reagent. Replace calibrator. Recalibrate or recalculate calibration parameters

P/N: BA89-20-87067 (V1.1)