BC-3000 Plus

Auto Hematology Analyzer

Service Manual

For this Service Manual, the issued Date is 2007-04 (Version: 1.2).

Intellectual Property Statement

SHENZHEN MINDRAY BIO-MEDICAL ELECTRONICS CO., LTD. (hereinafter called Mindray) owns the intellectual property rights to this Mindray product and this manual. This manual may refer to information protected by copyrights or patents and does not convey any license under the patent rights of Mindray, nor the rights of others. Mindray does not assume any liability arising out of any infringements of patents or other rights of third parties.

Mindray intends to maintain the contents of this manual as confidential information. Disclosure of the information in this manual in any manner whatsoever without the written permission of Mindray is strictly forbidden.

Release, amendment, reproduction, distribution, rent, adaption and translation of this manual in any manner whatsoever without the written permission of Mindray is strictly forbidden.

MINDRAY MINDRAY are the registered trademarks or trademarks owned by Mindray in China and other countries. All other trademarks that appear in this manual are used only for editorial purposes without the intention of improperly using them. They are the property of their respective owners.

Responsibility on the Manufacturer Party

Contents of this manual are subject to changes without prior notice.

All information contained in this manual is believed to be correct. Mindray shall not be liable for errors contained herein nor for incidental or consequential damages in connection with the furnishing, performance, or use of this manual.

Mindray is responsible for safety, reliability and performance of this product only in the condition that:

- all installation operations, expansions, changes, modifications and repairs of this product are conducted by Mindray authorized personnel;
- 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.

Upon request, Mindray may provide, with compensation, necessary circuit diagrams, calibration illustration list and other information to help qualified technician to maintain and repair some parts, which Mindray may define as user serviceable.

⚠ **Note** ⚠

This equipment is not intended for family usage.

This equipment must be operated by skilled/trained medical 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 injury of human health.

Warranty

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

Exemptions

Mindray's obligation or liability under this warranty does not include any transportation or other charges or liability for direct, indirect or consequential damages or delay resulting from the improper use or application of the product or the use of parts or accessories not approved by Mindray or repairs by people other than Mindray authorized personnel.

This warranty shall not extend to:

- any Mindray product which has been subjected to misuse, negligence or accident;
- any Mindray product from which Mindray's original serial number tag or product identification markings have been altered or removed;
- any product of any other manufacturer.

Safety, Reliability and Performance

Mindray is not responsible for the effects on safety, reliability and performance of 3003 plus Auto Hematology Analyzer if:

- Assembly operations, extensions, re-adjusts, modifications or repairs are carried out by persons other than those authorized by Mindray.
- Personnel unauthorized by Mindray repairs or modifies the instrument.

Return Policy

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. Obtain return authorization: Contact the Mindray Service Department and obtain a Customer Service Authorization (Mindray) number. The Mindray number must appear on the outside of the shipping container. Returned shipments will not be accepted if the Mindray 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 Customer Service department

Company Contact

Manufacturer: **Shenzhen Mindray Bio-Medical Electronics Co., Ltd.**

Address: Mindray Building, Keji 12th Road South, Hi-tech Industrial Park, Nanshan, ShenZhen 518057, P.R.China,

Tel: +86 755 26582479 26582888

Fax: +86 755 26582934 26582500

Authorized Representative

Name: Shanghai International Holding Corp. GmbH (Europe)

Address: Eiffestraβe 80 D-20537 Hamburg Germany

Tel: +49 40 2513175

Fax: +49 40 255726

Content

CHAPTER1 HARDWARE INTRODUCTION.. 1-1

1.1 POSITION OF ELECTRONIC UNIT 1-1

1.2 POSITION AND FUNCTION OF THE VOLUMETRIC UNIT 1-2

1.3 POWER SUPPLY UNIT 1-2

1.4 PANELS 1-3

1.5 CONFIGURING FPGA 1-4

CHAPTER2 HARDWARE 2-1

2.1 CPU BOARD.. 2-1

2.2. ANALOG BOARD.. 2-10

2.3 DRIVE BOARD.. 2-15

2.4 VOLUMETRIC UNIT 2-20

2.5 KEYPAD 2-21

2.6 LCD ADAPTER 2-23

CHAPTER3 DISASSEMBLE/REPLACE PARTS AND COMPONENTS 3-1

3.1 SYSTEM STRUCTURE 3-1

3.2 DISASSEMBLE MAIN UNIT 3-6

CHAPTER4 FLUIDIC SYSTEM.. 4-1

4.1 CHANGE INTRODUCTION 4-1

4.2 INTRODUCTION OF BASIC TIMING 4-1

4.3 TIMING 4-3

CHAPTER5 HISTOGRAMS AND PULSE GRAPHS.. 5-1

5.1 HISTOGRAMS 5-1

5.2 PULSE GRAPHS 5-4

CHAPTER6 MAINTAINING YOUR ANALYZER.. 6-1

6.1GENERAL GUIDELINES.. 6-1

CHAPTER7 TROUBLESHOOTING 7-1

7.1 ERROR CODES 7-1

7.2 SOFTWARE ERROR.. 7-2

7.3 SOLUTION 7-2

CHAPTER8 PASSWORD.. 8-1

APPENDIXA SPARE PART LIST I

LIQUID SYSTEM DIAGRAM.. I

Chapter1 Hardware Introduction

According to the mechanical structure design, the hardware structure can be divided into four modules: electronic unit, volumetric unit, power supply unit and panels

1.1 Position of Electronic Unit

Located inside the analyzer, the electronic unit comprises CPU board, analog board and power drive board, as shown in figure 1-1.

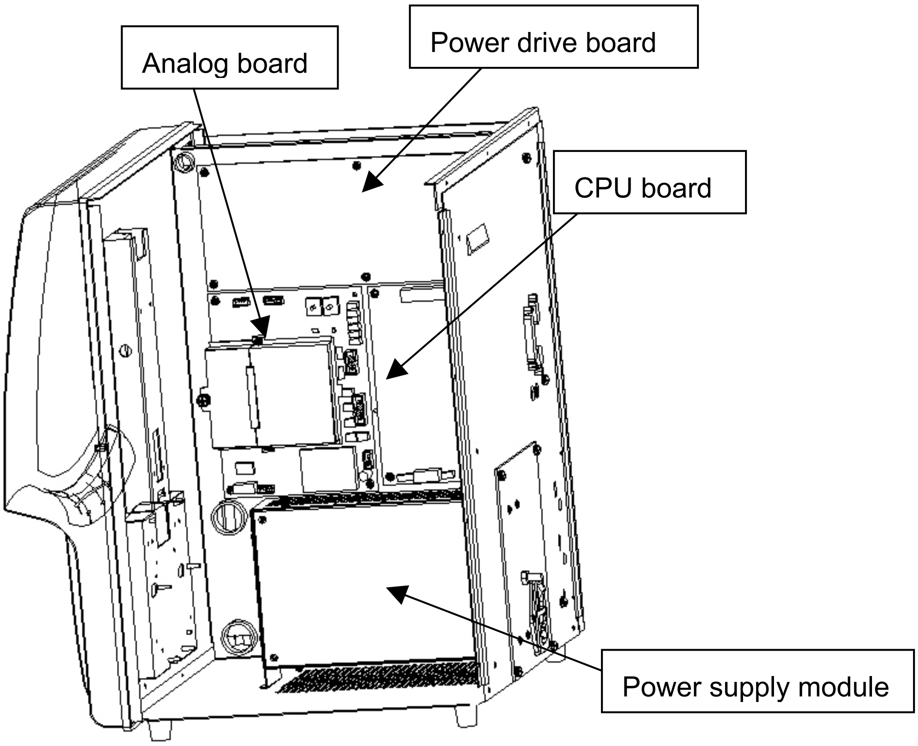


Figure 1-1 Inside left of the analyzer

The boards are fixed directly by screws. The drive board is fixed with 6 M3 screws, while both the CPU board and analog board are fixed with 4 M3 screws respectively. The drive board is 1.5MM away from the CPU board and analog board, which are separated by about 2MM.

1.2 Position and Function of the Volumetric Unit

The volumetric unit is located above the vacuum chamber assembly, as shown in figure 1-2

The upper end of the metering tube is connected to the solenoid valve by a T-piece, while the lower end to the vacuum chamber unit by a hose. The metering tube itself is fixed on the volumetric unit by 2 brackets. Together with the metering tube, the pot on the metering tube can be adjusted to ensure correct level signals.

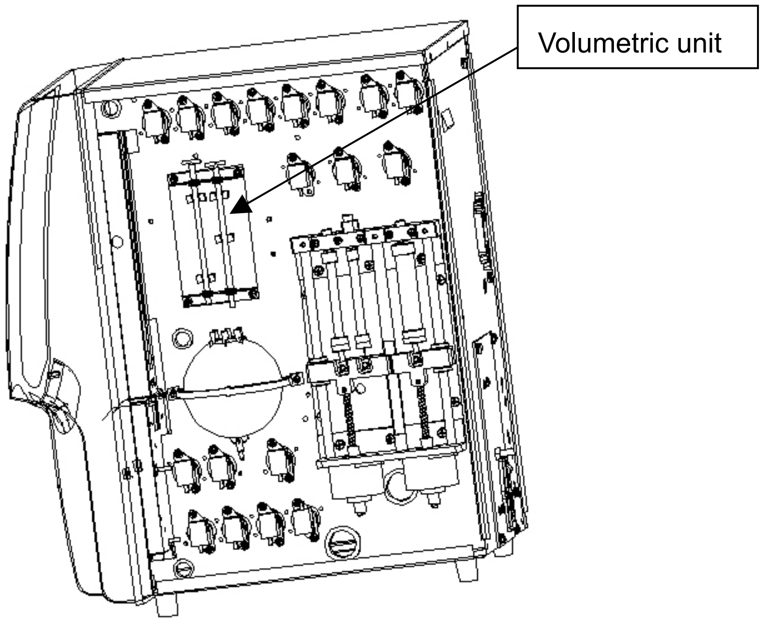


Figure 1-2 Volumetric unit

Note that after replacing the WBC and/or RBC metering tube, you need to enter the “Setup” → “Others” screen to modify the WBC and/or RBC tube volume setting.

1.3 Power Supply Unit

As shown in figure 1-3, the power supply unit consists of power board, filter and equipotentiality terminal, etc.

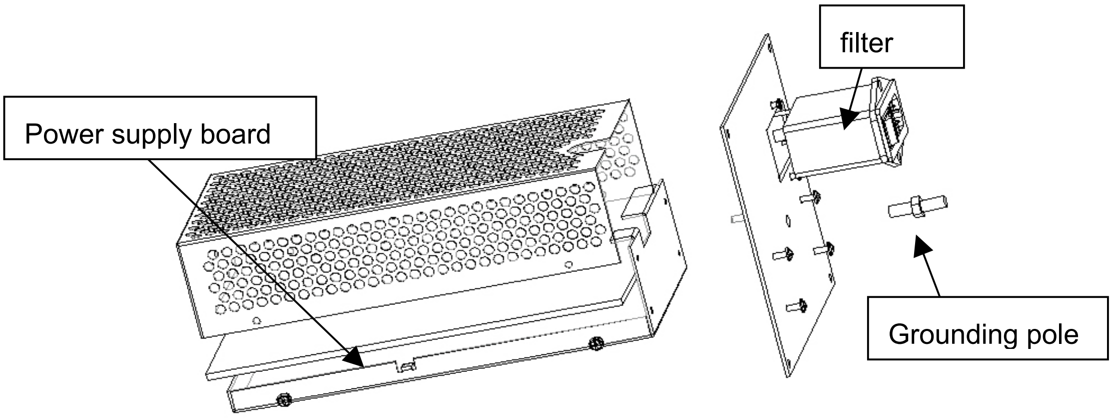


Figure 1-3 Power supply module

1.4 Panels

Panels consist of main user interfaces, such as recorder unit (recorder drive board), keypad, indicator board and screen unit (LCD, inverter and LCD Adepter), as shown in figure 1-4:

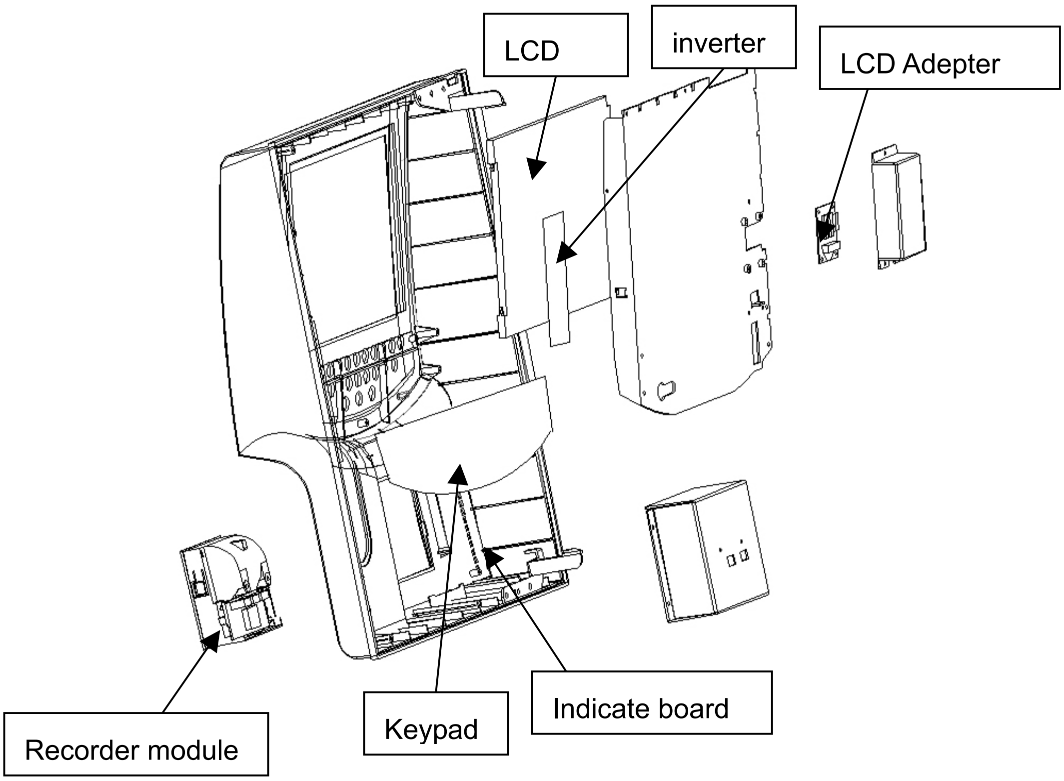


Figure 1-4 Panels disassembly view

The serial signal lines, +5V and +12V power lines, the 5V ground line and the power ground are directed from the same connector of the CPU board. They are connected to the front panel by one cable and then split respectively to the recorder and the keypad. The LCD signal line is isolated. The inverter, powered by keypad power supply, drives the backlight of LCD. The backlight brightness can be adjusted via keypad. An LCD adapter is added here.

1.5 Configuring FPGA

If the system cannot start normally after the LCD, main board and/or DOM was replaced, you need to re-configure the FPGA as instructed below:

1. Start the analyzer. After file initialization ends and before after hardware initialization begins, press [DEL] wthin 2 seconds after you hear a beep to enter the FPGA configuration state.
2. Press [↑][↓] to choose the configuration you desire.
3. When you hear a beep tone again, it inidicates the FPGA has been re-configured. Note that during the process of re-configuration, the screen first blacks out, and then if the configuration is appropriate, the startup screen appears again. If not, the screen press [↑][↓] to try another configuration.
4. After the FPGA has been re-configrued successfully, press [ENTER] to exit the configuration state. The system will automatically save the changes and re-start the analyzer. Note that if you press [MENU] to exit the configuration state, the system will save the changes.

Chapter2 Hardware

2.1 CPU board

2.1.1 General

2.1.1.1Schematic

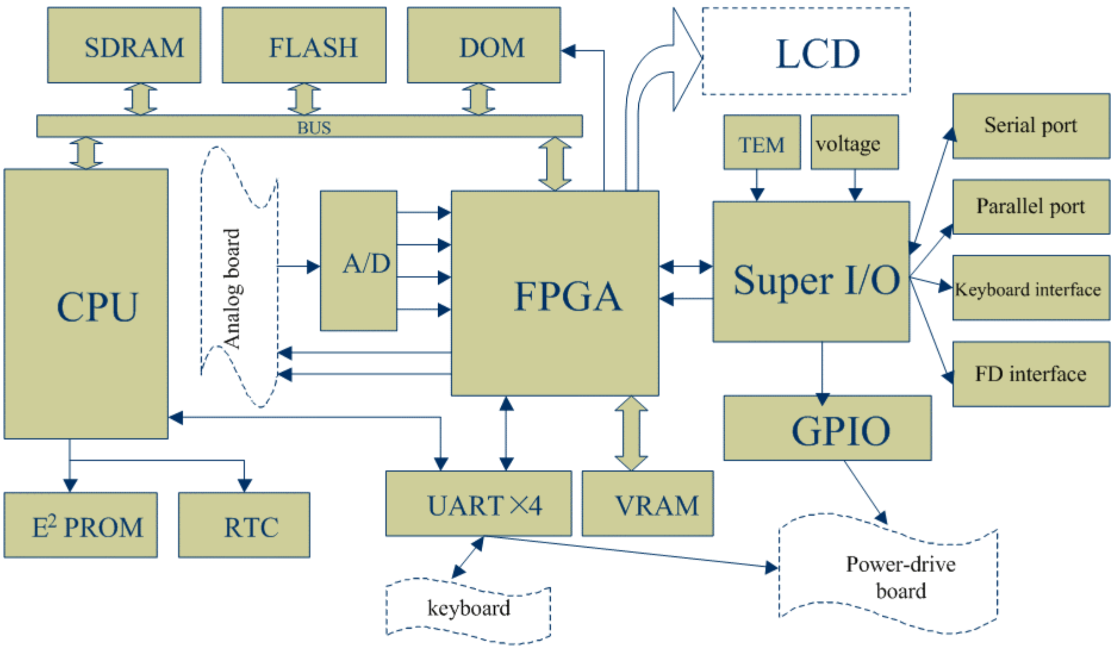


Figure 2-1 Schematic of the CPU board

The CPU, FPGA and Super I/O are the major components on the board. The CPU carries out the instructions and functions as the core of the board. The FPGA functions as the relay between the CPU and the Super IO. The Super I/O includes various interfaces that can be accessed by the CPU through the FPGA. System memories are SDRAMs. The DOM is a Disk-On-Module that stores the system software and test data. The RTC is a real time clock. System configurations are stored in the EEPROM. The VRAM is the memory for video display.

2.1.1.2Basic Functions of the CPU Board

1. To receive such analog signals as the WBC/RBC/PLT counts, HGB measurement,

aperture voltage vacuum/pressure signals, etc.

2. To monitor such system status as the +48V, +12V and -12V supplies of the analog board, the +3.3V and +12V supplies of the CPU board itself and the temperature of the whole analyzer.
3. To receive the keypad signal and control the keypad buzzer and LCD backlight.
4. To generate control signals to control the valves, aperture zapping, HGB LED, current source and digital pot.
5. To drive and turn on the LCD and adjust the contrast.
6. To drive the keyboard, printer and floppy drive.

2.1.2 Power Supply

The CPU board is powered by two independent external power supplies, a +5V supply and a 12V supply. Two 5A fuses are respectively installed on the two power entries. The +5V supply is converted a +3.3V supply to power the digital components and the +3.3V supply is also further converted into a +1.5V supply to power the FPGA. The +12.8V supply serves the CPU board only.

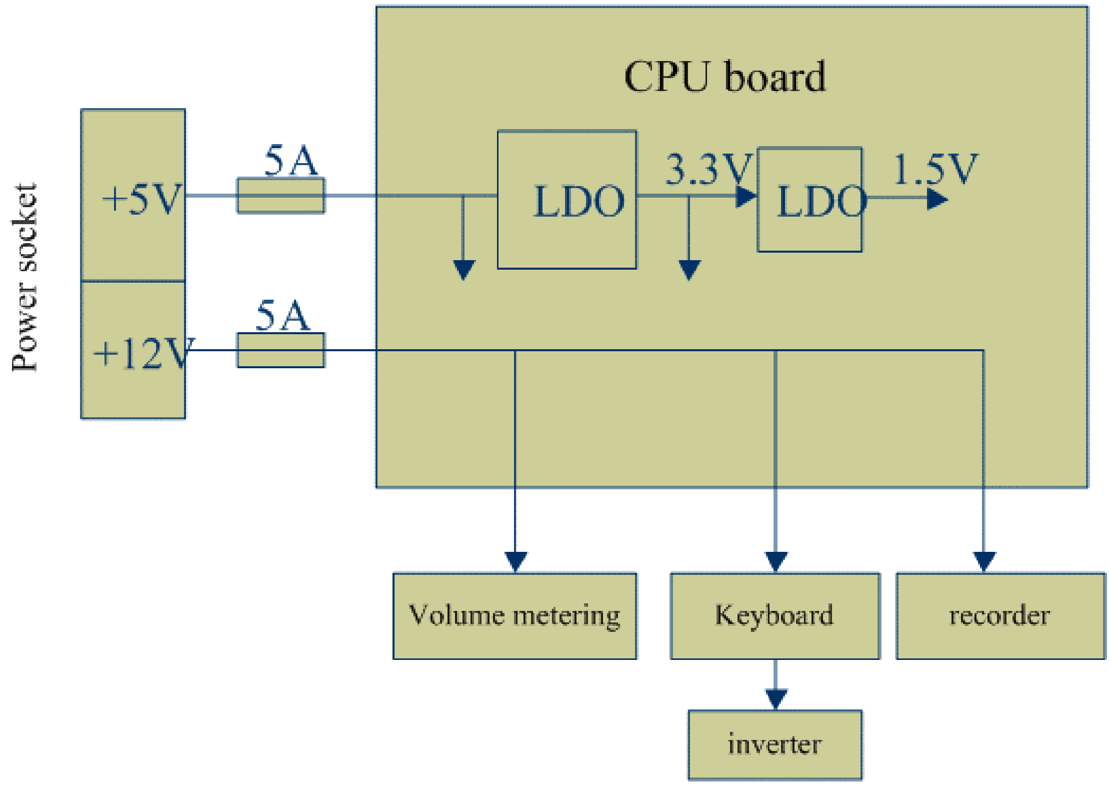


Figure 2-2 Power distribution of the CPU board

2.1.3RTC

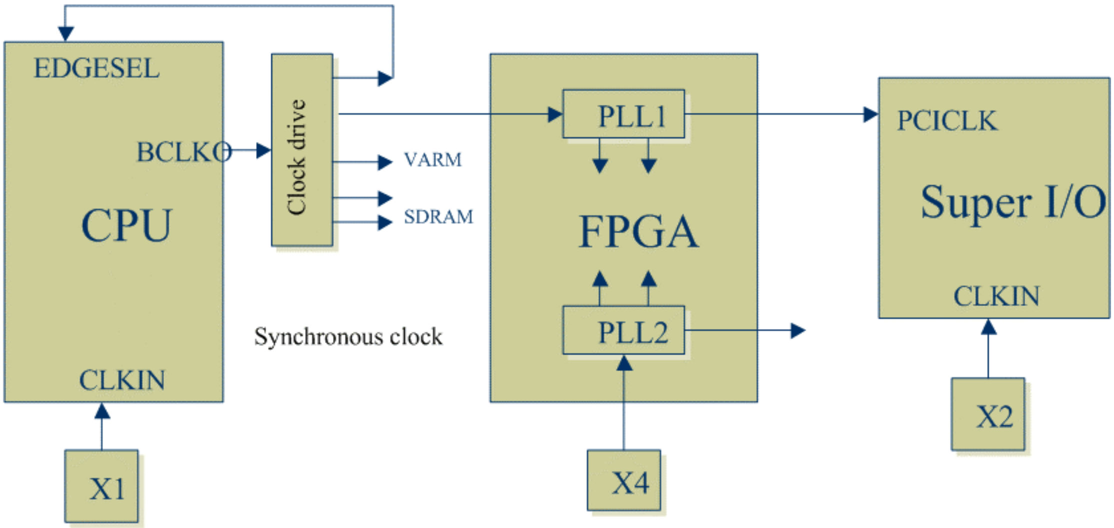


Figure 2-3 Arrangement of the CPU Clock

The X1, X4 and X2 are external crystal oscillators whose frequencies are 45MHz, 45MHz and 24MHz respectively. The clock output of the CPU, BCLKO, is main clock signal of the CPU board.

2.1.4CPU and Peripheral Devices

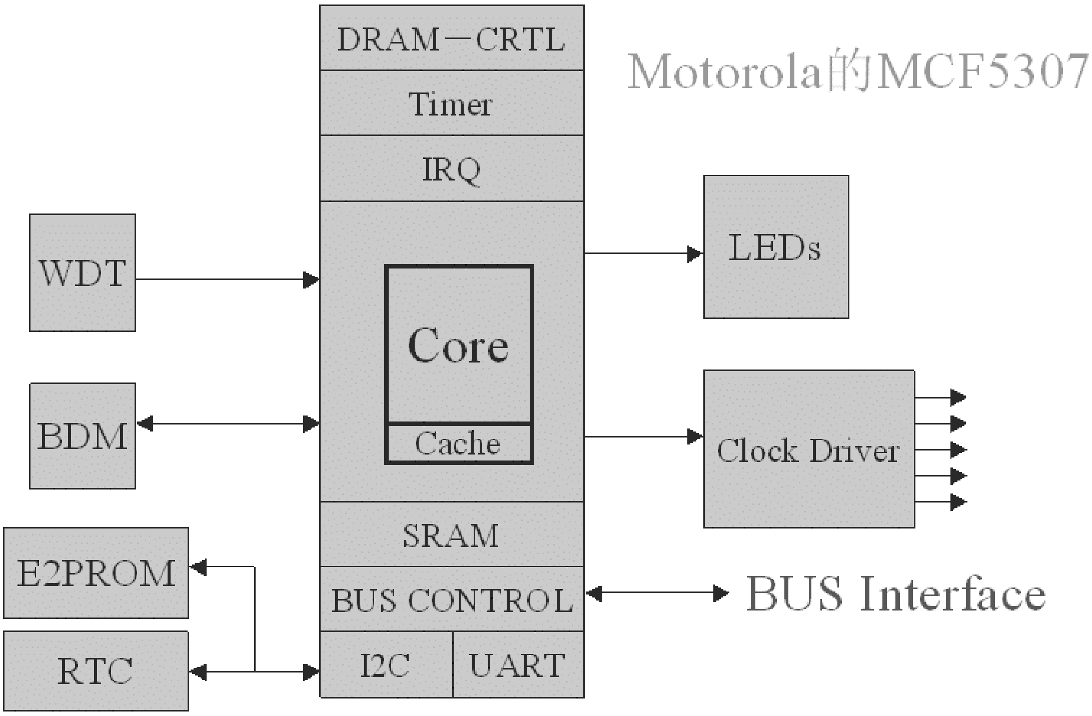


Figure 2-4 CPU and peripheral devices

- The CPU is MOTOROLA MCF5307 (external frequency 45MHz; operation frequency 90MHz; processing speed as high as 75MIPS).
- The MCF5307 features a 32-bit data bus and a 32-bit address bus. The board uses a 24-bit addressing mode, reserving the most-significant 8 bits as the general purpose I/Os for the FPGA.
- The MCF5307 can be tuned through the BDM port (J18 of the CPU board).
- The CPU board utilizes the built-in I^2C and UART controllers of the MCF5307 to use the EEPROM and RTC as expanded serials ports.
- The CPU boards utilizes the built-in DRMA controller of the MCF5307 to use the 2×8M SDRAM as the expanded memory.

2.1.4.1WDT

The Watch-Dog-Timer (WDT) is TI TPS3828. It monitors the running of the software. The CPU must send a feedback to the WDT every 1.6s, otherwise the WDT will force the CPU to restart.

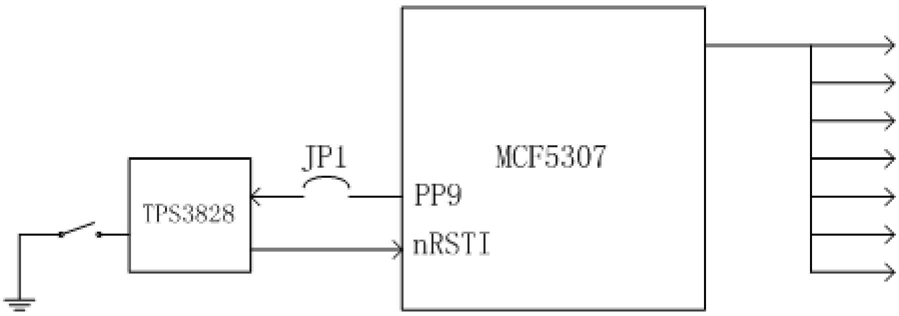


Figure 2-5 WDT

2.1.4.2FLASH

The FLASH is TE28F160(2M bytes) . The boot program is stored in the FLASH, so the FLASH is also called the BootROM. Every time the system is powered on, the CPU first executes the boot program that initializes the system and loads the control software from the DOM. The FLASH also contains such information as the FPGA configuration, FPGA version and LCD contrast.

2.1.4.3SDRAM

The system memory consists of two 8M memories.

2.1.4.4DOM

The CPU board uses a 32M DOM that is powered by a 3.3V supply (the DOM can also be supplied by 5V supply). The DOM is only operational after the FPGA is configured.

2.1.4.5RTC

The CPU board uses a real time clock (RTC) to record the time. The RTC is connected to the I^2C bus of the CPU board and synchronized by a 32.768KHz crystal oscillator. When the analyzer is powered on, the RTC is powered by the CPU board; when the analyzer is powered off, it is powered by the built-in battery.

2.1.4.6EEPROM

The CPU board uses an 8K EEPROM to store such information as system configurations and settings. It is connected to the I2C bus of the CPU and can be written by CPU on-line.

2.1.4.7LEDs

When D1 is on, it means +3.3V is functioning properly. When D9 is on, it means +12.8V is functioning properly. When D5 is on, it means the system is reading or writing the DOM. When D7 is on, it means the FPGA has been configured and is functioning properly. When D20 is on, it means the FPGA is restarting; The D11～D18 indicate the system status as defined by the software.

Test Points

Position No.	Mark	Test Point	Description
TP1	AVCC	+12V analog input	Input through J1.31/33 and then supplied by the analog board
TP2	CLK0	Main clock 0	Frequency 45MHz; reference clock; affecting the whole board
TP3	CLK1	Main clock 1	Frequency 45MHz, affecting the FPGA and all the devices connected to it
TP4	CLK2	Main clock 2	Frequency 45MHz, affecting the LCD buffering
TP5	CLK3	Main clock 3	Frequency 45MHz, affecting the SDRAM
TP6	CLK4	Main clock 4	Frequency 45MHz, affecting the SDRAM
TP7	GND	Digital ground	
TP8	AVDD	+5V analog input	On the condition of normal AVCC input
TP9	AGND	Analog ground	Same potential as the digital ground
TP10	VCC	+5V digital power supply	
TP11	VDD	+3.3V digital power supply	
TP12	GND	Digital ground	
TP13	GND	Digital ground	
TP14	GND	Digital ground	
TP15	AOUT	PWM output	Set through the software and not used currently.
TP16	XCK	LCD shift clock	Frequency 9MHz, ensuring the LCD works normally
TP17	DISCLK	Oscillation	Frequency 45MHz, affecting the LCD and A/D

		frequency X4	conversion
TP18	PCLK	LPC bridge clock	Frequency 30MHz, ensuring the Super I/O can be accessed correctly
TP19	SIOCLK	Oscillation frequency X2	Frequency 24MHz, affecting the Super I/O
TP20	RTCCLK	Oscillation frequency X3	Frequency 32.768KHz, affecting the real-time clock
TP21	VDDC	+1.5V digital power supply	Special power supply for the FPGA, ensuring the FPGA works normally
TP22	V+12	+12.8V power supply	Not used for this board, isolated from other power supply of this board and supplied to the recorder and keypad, affecting the recorder, buzzer and backlight of the LCD
TP23	G+12	Power ground	Ground of the +12.8 power supply
TP24	HGB	HGB analog signal	Input to the A/D of this board, marked “H” on the PCB
TP25	RBC	RBC analog signal	Input to the A/D of this board, marked “R” on the PCB
TP26	WBC	WBC analog signal	Input to the A/D of this board, marked “W” on the PCB
TP27	PLT	PLT analog signal	Input to the A/D of this board, marked “P” on the PCB
TP28	VREF	A/D reference voltage	2.5V, ensuring the A/D works normally

2.1.5 **Analog Inputs and Outputs**

2.1.5.1 Signals of Blood Cell Counts

The CPU board has three A/D converters, U10 (AD7928), U11(AD7908) and U14 (AD7908). Both the AD7928 and AD7908 feature 8-channel and 1MSPS, only the former is 12-bit converter and the latter 8-bit. The U10 is actually installed and powered by a 2.5V supply, while the U11 and U14 are reserved. The sampling speed is set to 500KSPS.

2.1.5.2 Signals of System Monitoring

The Super I/O monitors such system status as the +48V, +12V and -12V supplies of the analog board, the +3.3V and +12V supplies of the CPU board itself and the temperature of the whole analyzer.

2.1.5.3 Signals of LCD Contrast

The Super I/O generates PWM signals that are then integrated to output a 0~2.5V analog signal to control the LCD contrast. The user can adjust the contrast through the software interface.

2.1.6 Digital Inputs and Outputs

2.1.6.1Serial Port

The analyzer has 6 serial ports, which are illustrated in Figure 7.

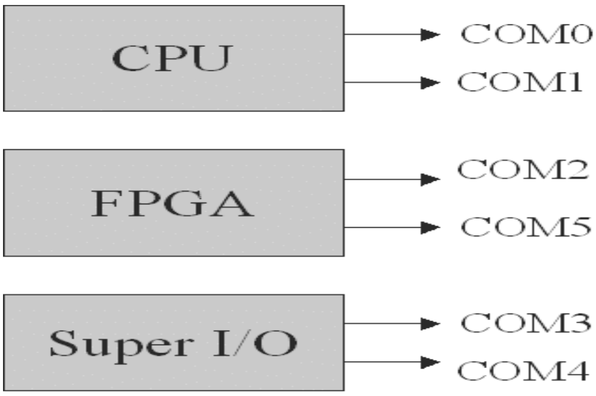


Figure 2-6 Serial ports

The CPU incorporates 2 UART controllers (3.3LVTTL), one to control the motor of the driving board and the other communicates with the recorder (powered by 5VTTL). The FPGA implements 2 UART (3.3VTTL), one to connect the keypad and the other reserved to control the pump. Another 2 UARTs (RS232) are implemented inside the Super I/O to connect the scanner and to communicate with the PC.

2.1.6.2Parallel Port and PS/2 Port

The Super I/O provides a DB25 parallel connector to connect to connect a printer or a floppy drive (the power supply of the floppy drive is supplied by the PS/2). The software will automatically adapt to the connected printer or the floppy drive.

The Super I/O provides a keyboard interface and a mouse interface (COM3 and COM4). Note that the BC-2800 does not support the mouse yet.

2.1.6.3GPIOs

1 Signals of the Start key

The FPGA detects the input signal, which will turn low when the Start key is pressed.

2 Volumetric metering Signals

The FPGA detects the signals sent by the start transducer and the end transducer.

3 Signals of level detection

The BC-2800 has not level sensors

4 Digital pot

The SPI bus interface implemented by the FPGA controls the 4 digital potential-meters on the analog board to control the HGB gain.

5 Signals controlling valves and pumps

The Super I/O outputs 20 control signals to control the valves and pumps through the driving board. Since the BC-2800 only has 1 pump and 11 valves, the redundant lines and ports are reserved.

6 Signals controlling bath

The Super I/O outputs 4 control signals (through the analog board) to control the three switches that respectively control the aperture zapping, current source and HGB LED.

7. Others

The Super I/O outputs 2 control signals to control the photo-couplers of the volumetric metering board and the buzzer of the keypad.

2.2. **Analog Board**

2.2.1Overview

The analog board mainly includes six units:

- Interface unit
- Power supply unit (DC-DC)
- Power monitoring unit
- Volume signal unit
- HGB unit
- Vacuum/Pressure unit

2.2.2.Interface Unit

2.2.2.1. Digital Pot Control Interface

When isolated by the photocoupler H11L1, the control signals GAIN0-GAIN2 of the main board correspond to the SDI, CLK and/or CS signals of the digital pot respectively. The powered main board can position the digital pot in the middle through the jumper J6, and the impedance of the digital pot is 5K.

2.2.2.2. Switch Control Interface

The switch control signal includes the aperture electrode, zapping, consistent-current and HGB indicator control signals. All the signals coming from these four main boards are also isolated by photocouplers.

The jumper J7 acts as the consistent-current control signal CONST, when the jumper is short-wired, it indicates the consistent current works normally. The jumper J8 acts as the zapping control signal BURN, when the jumper is short-wired, the zapping circuit starts working. However, J7 and J8 can not be short-wired simultaneously. The jumper J9 acts as the mode control signal SELECT, when the jumper is short-wired, the zapping voltage is loaded to the aperture electrode; otherwise the consistent current is loaded to two terminals of the aperture electrode.

The jumper J10 acts as the HGB control signal HGB-CTL, when the jumper is short-wired, the HGB sensor is driven to work normally.

2.2.3.Power Supply Unit

The ±12V power supply is used to power the signal adjusting circuit and DC-DC circuit, drive the consistent current and generate the +5V power supply. The DC +5V powers the digital pot and relevant circuits and acts as the +5V clamp for analog output signals.

There are three points on the board to test the low-voltage power supply:

Where, TP15 for detecting if the AVCC/+12V voltage works normally.

TP16 for detecting if the VCC/+5V voltage works normally.

TP17 for detecting if the AVSS/-12V voltage works normally.

Through the +12V power supply, the DC-DC circuit obtains the DC100V with the greatest load capacity of 20mA, which powers zapping of the aperture electrode and generate the +56V power supply for its consistent current. The aperture electrode is controlled by the main board by switching the relay.

2.2.4.Power Monitoring Unit

The power monitoring unit consists of the resistor network and a voltage follower. The ±12V analog power supply outputs a voltage within 3V±3% when parted, while the DC+56V outputs a voltage (about 2.24V) that is 4% of the original one.

2.2.5.HGB Measuring Circuit

The HGB measuring circuit is composed of the consistent-current circuit, HGB signal adjusting circuit and the HGB measuring control circuit.

2.2.6.Pressure Measuring Circuit

This board has a vacuum measuring circuit and a pressure measuring circuit, technical specifications of which are completely the same.

In normal condition, the voltage of both TP13 and TP14 is +2.5V.

TP11 is the pressure detection output. The pressure measuring circuit can be zeroed by adjusting the pot VR4. When the sensor is connected to the atmosphere, the voltage of TP11 can be set to 2.5V by adjusting VR4. VR1 is the pressure gain pot, which can be adjusted to calibrate the output of the pressure measuring circuit.

TP12 is the vacuum detection output. The vacuum measuring circuit can be zeroed by adjusting the pot VR2. When the sensor is connected to the atmosphere, the voltage of TP12 can be set to 2.5V by adjusting VR2. VR3 is the vacuum gain pot, which can be adjusted to calibrate the output of the pressure measuring circuit.

2.2.7.WBC, RBC and PLT Pre-amplifying Circuit

The 3003 analog board has two channels for cell volume measuring, RBC/PLT and WBC.

The pre-amplifying circuit has two inputs and five outputs, within which two aperture voltage monitoring outputs are DC signals (WBC-HOLE and RBC-HOLE), while the other three are AC signals (WBC, RBC and PLT).

TP9 is for detecting the RBC volume and TP10 for PLT volume.

RBC and PLT signals are adjusted through the same channel; however, the PLT signal is amplified for 1^{st} level at the RBC signal output as its adjusted output.

The WBC channel is similar to the RBC channel except for the adjustable amplifying times. The WBC volume is detected at TP1.

2.2.8.Board Interface

2.2.8.1. Connection

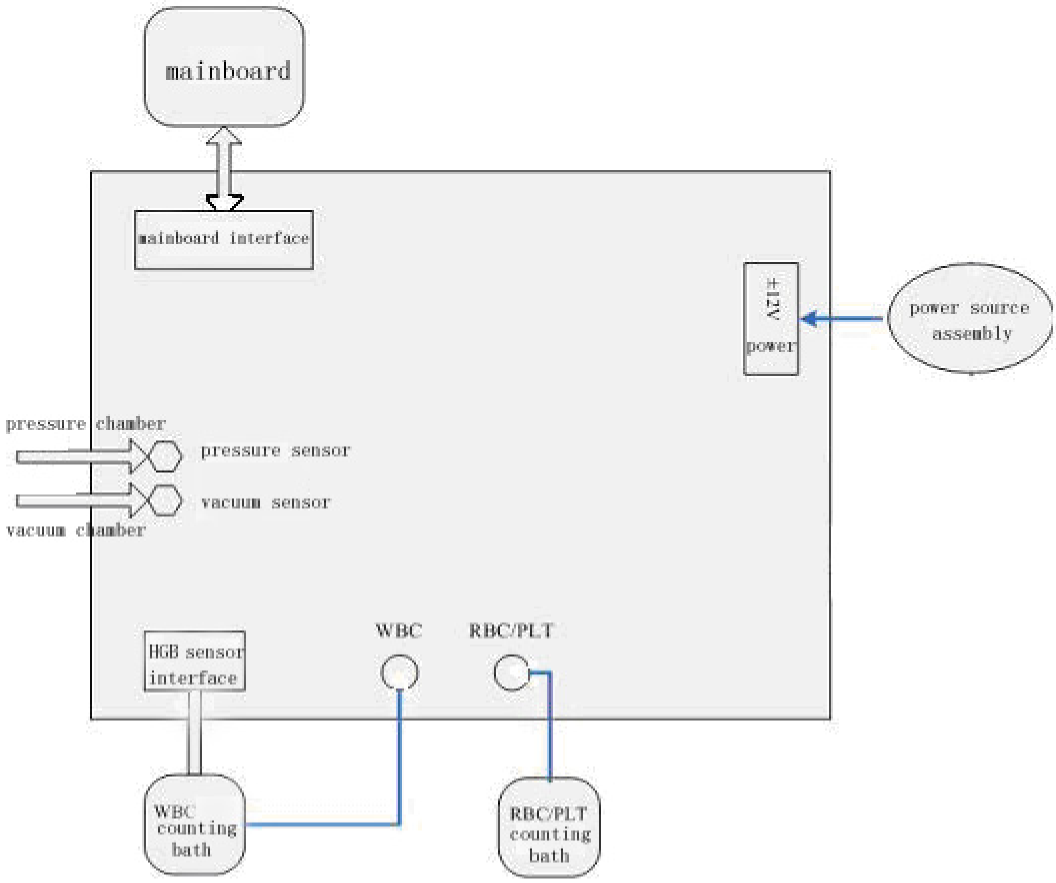


Figure 2-7 Board Connection

2.2.8.2. Interface to CPU

Pin	Signal	Description
1	GAIN2	Data obtained by the digital pot
2	DVCC	power supply
3	GAIN1	Digital pot clock
4	DGND	Digital ground
5	GAIN0	Digital pot chip select
6	DGND	Digital ground
7	BURN	Zapping control
8	HGB_LIGHT	HGB indicator control
9	SELECT	Aperture electrode control
10	CONST	Consistent current control

11	AGND	Analog ground
12	NC	
13	AGND	Analog ground
14	AGND	Analog ground
15	PLT	PLT
16	AGND	Analog ground
17	RBC	RBC
18	AGND	Analog ground
19	WBC	WBC
20	AGND	Analog ground
21	HGB	HGB
22	AGND	Analog ground
23	PRESSURE	Pressure
24	AGND	Analog ground
25	VACUUM	Vacuum
26	AGND	Analog ground
27	WBC-HOLE	WBC aperture voltage
28	AGND	Analog ground
29	-12VA-MON	-12V analog power supply detection
30	+56V-MON	+48V analog power supply detection
31	RBC-HOLE	RBC aperture voltage
32	+12VA	12V analog power supply
33	+12VA-MON	+12V analog power supply detection
34	+12VA	12V analog power supply

2.2.8.3. Test Points

Test Point	**Description**	**Voltage Range**
TP1	Output of the WBC amplifying channel	0-5V
TP2	Test point 1 where the HGB circuit supplies consistent current for the LED	0-5V
TP3	Output of the HGB detection circuit	0-5V
TP4	AVCC-MON voltage monitoring point	3V±3%
TP5	RBC branch aperture voltage monitoring point	0-5V
TP6	WBC branch aperture voltage monitoring point	0-5V
TP7	AVSS-MON voltage monitoring point	3V±3%

TP8	+56VA-MON voltage monitoring point	2.2 V±3%
TP9	Output of the RBC amplifying channel	0-5V
TP10	Output of the PLT amplifying channel	0-5V
TP11	Output of the pressure measuring circuit	0-5V
TP12	Output of the vacuum measuring circuit	0-5V
TP13	Detection of the consistent current for the vacuum pressure unit	2.5V
TP14	2.5V output	2.5V
TP15	AVCC power supply test point	+12V
TP16	+5V power supply	+5V
TP17	AVSS power supply test point	-12V
TP18	+100V test point	+100V
TP19	AGND	0V
TP20	Test point 2 where the HGB circuit supplies consistent current for the LED	0-5V

2.3 Drive Board

2.3.1 **Basic Functions**

The drive board drives the valves, pumps and motors of the BC-3000 Plus. It carries out the following instructions sent by the CPU: to open/close the pumps or solenoid valves; to control the motors of the syringes; to control the movement of the sample probe; to remain the torques of the motors when the analyzer has entered the screen saver.

2.3.2 **Basic Units**

The drive board mainly consists of a power supply unit, switch control unit and motor control unit.

2.3.2.1 Power Supply Unit

The power supply unit includes a 5V, 12V and 30V DC. The 12V and 30V supply comes from the power interfaces, where two LEDs are installed to respectively indicate whether the 12V or 30V supply is connected. When the LED is on, it indicates the corresponding power has been connected to the drive board. The MC7805T converts the received 12V supply into the 5V supply, as shown in the figure below.

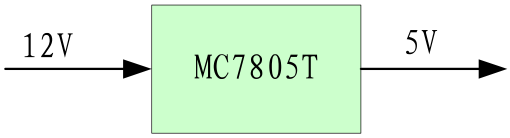


Figure 2-8 How the 5V supply is obtained

2.3.2.2 Switch Control Unit

The switch control unit mainly consists of the photocoupler circuit and drive circuit of valves and pumps, as shown in the figure below.

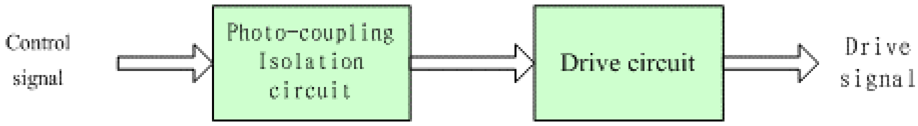


Figure 2-9 Switch Control Unit

Photocoupler circuit

The photocoupler circuit mainly consists of the photocoupler and resistors. It provides 20 TTL outputs to the valves and pumps. The photocoupler, TLP521-2, isolates the digital ground from the power ground.

Drive circuit of valves and pumps

The drive voltage of the valves and pumps is 12V (TTL). The circuit mainly consists of ULN2068. In the BC-3000 Plus, the circuit can drive 18 valves and 2 pumps at most. The fluidic system decides how many pumps or valves are to be actually used.

2.3.2.3 Motor Control Unit

The motor control unit includes: serial communication circuit, control/drive circuit of the sample probe mechanism, control/drive circuit of the syringe motors, and drive/signal-detecting circuit of the position sensors.

Serial communication circuit

Since the CPU board requires a 3.3V power supply while the drive board requires a 5V power supply, a photocoupler (H11L1) is needed for the purposes of conversion and isolation.

Control/Drive circuit of the sample probe mechanism

The control/drive circuit of the sample probe mechanism includes the control/drive circuit of the elevating motor and that of the rotation motor. The control system of the sample probe motor consists of an AT89S51 MCU and ADM705 WDT. The AT89S51 also detects the signals coming from the position sensor when controlling the motors.

- Control/Drive circuit of the elevating motor

The MCU system provides the sequence signals for the elevating and rotation motors and controls the position sensor, as shown in the figure above. The MCU reset signal (RST_XY) is active for high level.

The drive part mainly consists of a control device (L6506), drive device (L298N) and follow-current device (UC3610). The drive voltage is 30V. The sequence signal and the enabling signal of the driver come from the MCU.

- Control/Drive circuit of the rotation motor

The circuit mainly consists of a control part (MCU system) and a drive part. Refer to the previous introduction for the MCU system. The drive part is the ULN2068B and the drive voltage is 12V.

Control/Drive circuit of the Syringe Motors

The circuit mainly consists of a control part (MCU system) and a drive part.

The MCU is the P87LPC762 with built-in WDT. The MCU system executes the aspirating and dispensing operation of the syringes and detects the signals sent by the position sensor.

The drive part is similar to that of the elevating motor. See figure 2-9 for details.

Drive/Signal-detecting Circuit of the Position Sensor

The control system judges the motor positions by the signals sent by the position sensor (photocoupler). The photocoupler is driven by the MCU through a 74LS07 and sends the position signals to the MCU through a 74LS14 (inverter). See the figure below for the position-detecting circuit. The photocoupler is installed on the sample probe assembly or syringe assembly and feeds the control and feedback signals to the drive board through cables.

2.3.3 **Interfaces**

2.3.3.1 Interface to the Power Supply

Power supply assembly – Drive board J13.

Pin	Mark	Description		Pin	Mark	Description
1	PGND	Power ground		2	PGND	Power ground
3	+12VP	12V power supply		4	+30VP	30V power supply

2.3.3.2 Interface to the CPU Board

Main board J16 – Drive board J3.

Pin	Mark	Description		Pin	Mark	Description
1	VAL17	Valve 18 control		2	VAL0	Valve 1 control
3	NC	Reserved		4	VAL1	Valve 2 control
5	NC	Reserved		6	VAL2	Valve 3 control
7	+3.3V	3.3V power supply		8	VAL3	Valve 4 control
9	RXD_PC	Serial port 0 of CPU board receives		10	VAL4	Valve 5 control
11	DGND	Digital ground		12	VAL5	Valve 6 control
13	TXD_PC	Serial port 0 of CPU board sends		14	VAL6	Valve 7 control
15	DVCC	5V power supply		16	VAL7	Valve 8 control
17	DVCC	5V power supply		18	VAL8	Valve 9 control
19	DVCC	5V power supply		20	VAL9	Valve 10 control
21	DVCC	5V power supply		22	VAL10	Valve 11 control
23	nPUMP0	Pump 1 control		24	VAL11	Valve 12 control
25	nPUMP1	Pump 2 control		26	VAL12	Valve 13 control
27	NC	Reserved		28	VAL13	Valve 14 control
29	NC	Reserved		30	VAL14	Valve 15 control
31	DGND	Digital ground		32	VAL15	Valve 16 control
33	DGND	Digital ground		34	VAL16	Valve 17 control

2.3.3.3 Interface to the 10mL Syringe Motor

Drive board J7 – 10mL syringe motor.

Pin	Mark	Description		Pin	Mark	Description
1	L1_WHITE	Start of phase voltage 1		2	L1_YELLOW	End of phase voltage 1
3	L1_BLUE	Start of phase voltage 2		4	L1_RED	End of phase voltage 2

2.3.3.4 Interface to the 50μL Syringe Motor

Drive board J8 – 50μL syringe motor.

Pin	Mark	Description		Pin	Mark	Description
1	L1_WHITE	Start of phase voltage 1		2	L1_YELLOW	End of phase voltage 1
3	L1_BLUE	Start of phase voltage 2		4	L1_RED	End of phase voltage 2

2.3.3.5 Interface to the Rotation Motor

Drive board J4 – Rotation motor of the sample probe.

Pin	Mark	Description		Pin	Mark	Description

1	803_D	Terminal 1 of phase voltage 1		2	+12VP	12V power supply (phase voltage 1)
3	803_C	Terminal 2 of phase voltage 1		4	803_B	Terminal 1 of phase voltage 2
5	+12VP	12V power supply (phase voltage 2)		6	803_A	Terminal 2 of phase voltage 2

2.3.3.6 Interface to the Elevating Motor

Drive board J6 – Elevating motor of the sample probe.

Pin	Mark	Description		Pin	Mark	Description
1	851_D	Start of phase voltage 1		2	851_C	End of phase voltage 1
3	851_B	Start of phase voltage 2		4	851_A	End of phase voltage 2

2.3.3.7 Interface to the Position Sensor

Drive board J10 – Photocoupler position sensor mechanism.

Pin	Mark	Description		Pin	Mark	Description
1	P1_803	Left position of the rotation motor		2	P2_803	Right position of the rotation motor
3	PGND	Power ground		4	PGND	Power ground
5	SD1	Enable the left photocoupler of the rotation motor		6	SD2	Enable the right photocoupler of the rotation motor
7	SK1	Drive the left photocoupler of the rotation motor		8	SK2	Drive the right photocoupler of the rotation motor
9	P1_851	Up position of the elevating motor		10	P2_851	Reserved
11	PGND	Power ground		12	PGND	
13	SD3	Enable the photocoupler of the elevating motor		14	SD4	
15	SK3	Drive the photocoupler of the elevating motor		16	SK4	
17	P_L1	Up position of the 10mL syringe motor		18	P_L2	Up position of the 50μL syringe motor
19	PGND	Power ground		20	PGND	Power ground
21	SD5	Enable the photocoupler of the 10mL syringe motor		22	SD6	Enable the photocoupler of the 50μL syringe motor
23	SK5	Drive the photocoupler of the 10mL syringe motor		24	SK6	Drive the photocoupler of the 50μL syringe motor

25	NC	Reserved		26	NC	Reserved

2.3.3.8 Interface to the Valves/Pumps Control Unit

Drive board J1 – Valves/Pumps controlled.

Pin	Mark	Description		Pin	Mark	Description
2	Q_PUMP0	Drive output of pump 1		22	Q_VAL8	Drive output of valve 9
4	Q_PUMP1	Drive output of pump 2		24	Q_VAL9	Drive output of valve 10
6	Q_VAL0	Drive output of valve 1		26	Q_VAL10	Drive output of valve 11
8	Q_VAL1	Drive output of valve 2		28	Q_VAL11	Drive output of valve 12
10	Q_VAL2	Drive output of valve 3		30	Q_VAL12	Drive output of valve 13
12	Q_VAL3	Drive output of valve 4		32	Q_VAL13	Drive output of valve 14
14	Q_VAL4	Drive output of valve 5		34	Q_VAL14	Drive output of valve 15
16	Q_VAL5	Drive output of valve 6		36	Q_VAL15	Drive output of valve 16
18	Q_VAL6	Drive output of valve 7		38	Q_VAL16	Drive output of valve 17
20	Q_VAL7	Drive output of valve 8		40	Q_VAL17	Drive output of valve 18
Odd pins	+12VP	12V power supply				

2.4 Volumetric Unit

2.4.1 Overview

The volumetric unit measures the volume of the samples during counting and outputs the start and end signals of counting.

The volumetric unit consists of a sensor, consistent-current circuit and output circuit.

2.4.2 Circuit

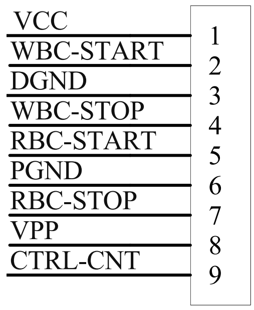
Test point P1 is PGND and P2 is ZR431 output (2.5V). The consistent current can be checked by testing the voltage of P2 for P1.

Moreover, the consistent-current switch is controlled by Q1. The jumper TX1 debugs and tests the analog signals CTRL-CNT. The consistent current can be switched on/off manually.

In the circuit, a 10K pot is in serial connection with a 220Ω resistor for I/V conversion. The pot can be adjusted in background status (no obstacle between sending and receiving of the photocoupler) to set the voltage of P3 to 3V. Therefore, the voltage of P3 is above 2.7V or below 2.3V when there is or no fluid in the metering tube. The WBC-STAR outputs low level (LED D1 on) or high level (LED D1 off) accordingly.

2.4.3 **Interface**

The volumetric unit has one interface to the CPU board, as shown in the figure below:



2.5 Keypad

2.5.1 **Functions**

To scan the keypad

The keypad adapter scans the keypad and reports the scanned key code to the main board.

To control the LCD brightness

The keypad adapter receives instructions from the main board to turn on/off the backlight and power indicators of the LCD and to control the brightness of the backlight.

To control the buzzer

The keypad adapter receives instructions from the main board to turn on/off the buzzer.

2.5.2 **Architecture of the Adapter**

The adapter mainly consists of a MCU, keypad matrix, backlight control, power indicator control and buzzer,

2.5.3 **Detailed Description**

Power supply module

The main board provides +12V and 3.3V supplies, which are isolated from each other.

The 3.3V supply is the main power of the adapter and the +12V is passed to the backlight board (inverter) of the LCD and also converted to a 5V supply to drive the buzzer and control the backlight of the LCD. Since the 3.3V and +12V are isolated, the MCU send the control signals to the buzzer and backlight board through photocouplers.

MCU module

The MCU is AT89C2051, which has 13 I/O interfaces, two timers and one serial port. The voltage returned is within 2.7V-6V. The frequency of the clock is up to 24MHz. The MCU can be reset in 470ms and uses an 11.0592MHz oscillation frequency.

Keypad scanning module

The keypad matrix is a 6x4 one, incorporating 10 I/O wires and 24 keys. Note that the key at line 6 and column 4 is not used.

Backlight control module

The keypad adapter shuts off the backlight and make the 11 power indicators blink when instructed by the main board to do so (usually after the analyzer enters the screen saver). The backlight board uses an independent 12V power supply and receives the control signals through photocouplers.

Buzzer control module

The buzzer is controlled by a DC signal (5V DC; current<40mA). The 5V supply of the buzzer is isolated from the VDD and the control signal is received through a photocoupler （TLP521-2） that is controlled by a current around 10mA.

2.5.4 **Test Points**

Position No.	Mark	Test Point	Description
TP1	VDD	+3.3V digital power supply	Affecting the whole keypad
TP2	+5V	+5V power supply	Converted from the +12V
TP3	GND	Ground	
TP4	PGND	Power ground	Affecting the buzzer and backlight
TP5	+12V	+12V power supply	Nominal value: +12.8V
TP6	CLK	External crystal clock	Affecting the MCU

2.6 LCD Adapter

2.6.1 **Functions**

The LCD adapter connects the LCD to the CPU board.

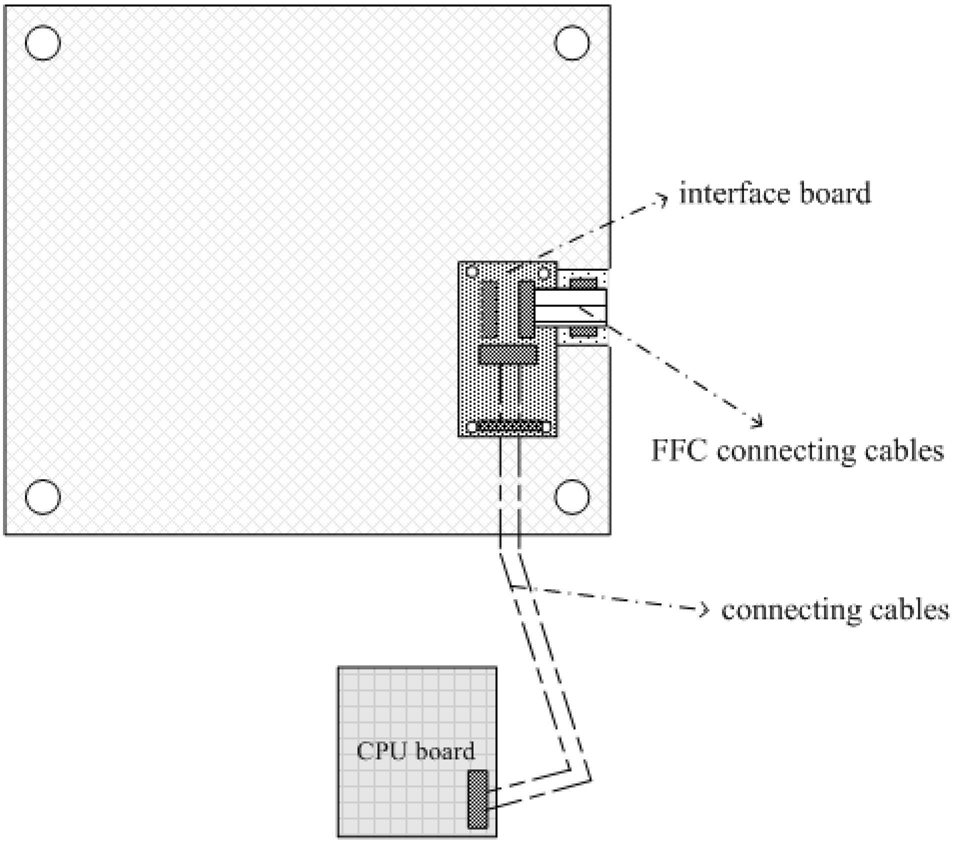


Figure 2-10 Adapter Connection

2.6.2 **Introduction of the Adapter**

The adapter incorporates two FPC/FFC connectors, J2 and J3. J2 is for the BC-3000 Plus display while J3 is reserved for other Mindray analyzers. Only J2 is installed for the BC-3000 Plus. J1 serves to connect the LCD signal cable.

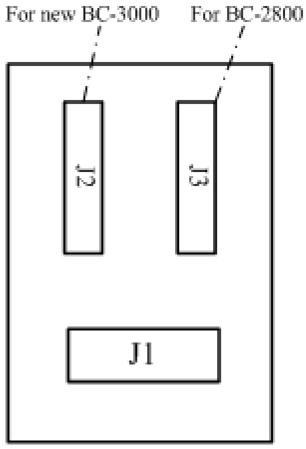


Figure 2-11 LCD Adapter

2.6.3 **Analog Inputs and Outputs**

2.6.3.1 Signals of Blood Cell Counts

The CPU board has three A/D converters, U10 (AD7928), U11(AD7908) and U14 (AD7908). Both the AD7928 and AD7908 feature 8-channel and 1MSPS, only the former is 12-bit converter and the latter 8-bit. The U10 is actually installed and powered by a 2.5V supply, while the U11 and U14 are reserved. The sampling speed is set to 500KSPS.

2.6.3.2 Signals of System Monitoring

The Super I/O monitors such system status as the +48V, +12V and -12V supplies of the analog board, the +3.3V and +12V supplies of the CPU board itself and the temperature of the whole analyzer.

2.6.3.3 Signals of LCD Contrast

The Super I/O generates PWM signals that are then integrated to output a 0~2.5V analog signal to control the LCD contrast. The user can adjust the contrast through the software interface.

Chapter3 Disassemble/Replace Parts and Components

3.1 System Structure

3.1.1 User Interfaces

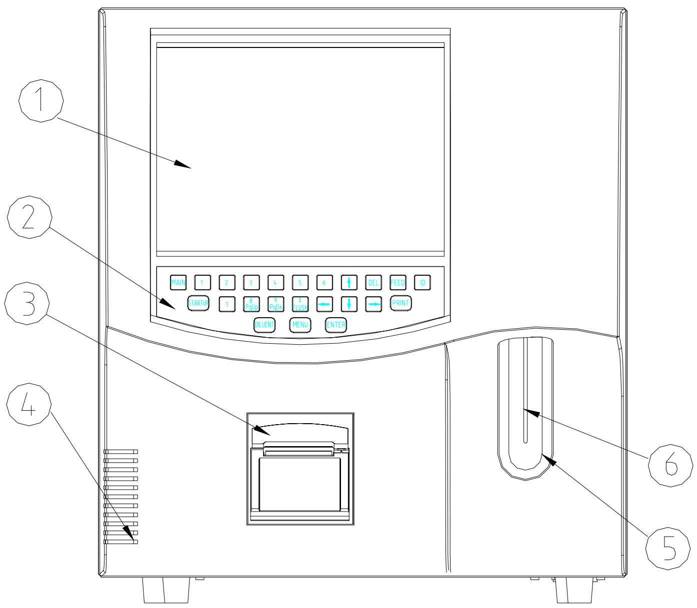


Figure3-1 Front view

1 ---- LCD	2 ---- Keypad
3 ---- Recorder	4 ---- Power indicator
5 ---- Aspirate key	6 ---- Sample probe

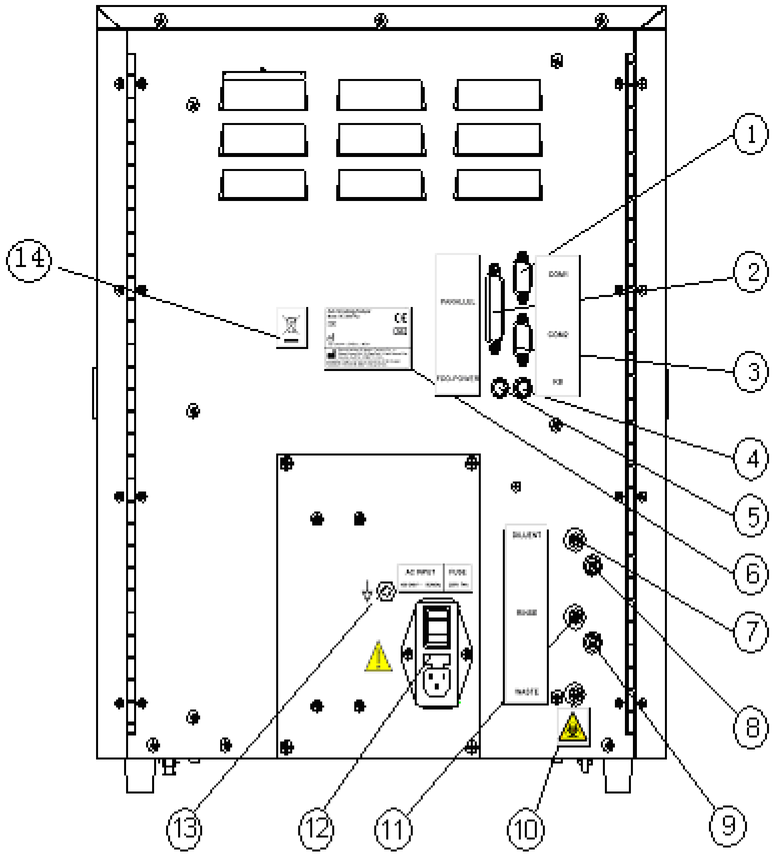


Figure3-2 Back view

1 --- RS-232 Port1	2 --- Parallel Port
3 --- RS-232 Port2	4 --- Keyboard interface
5 --- Power Interface of Floppy Disk Drive	6 --- Safety labeling
7 --- Diluent inlet	8 --- Diluent sensor connector
9 --- Rinse sensor connector	10 --- Waste outlet
11 --- Rinse inlet	12--- Power switch
13--- Equipotentiality	14--- WEEE labeling

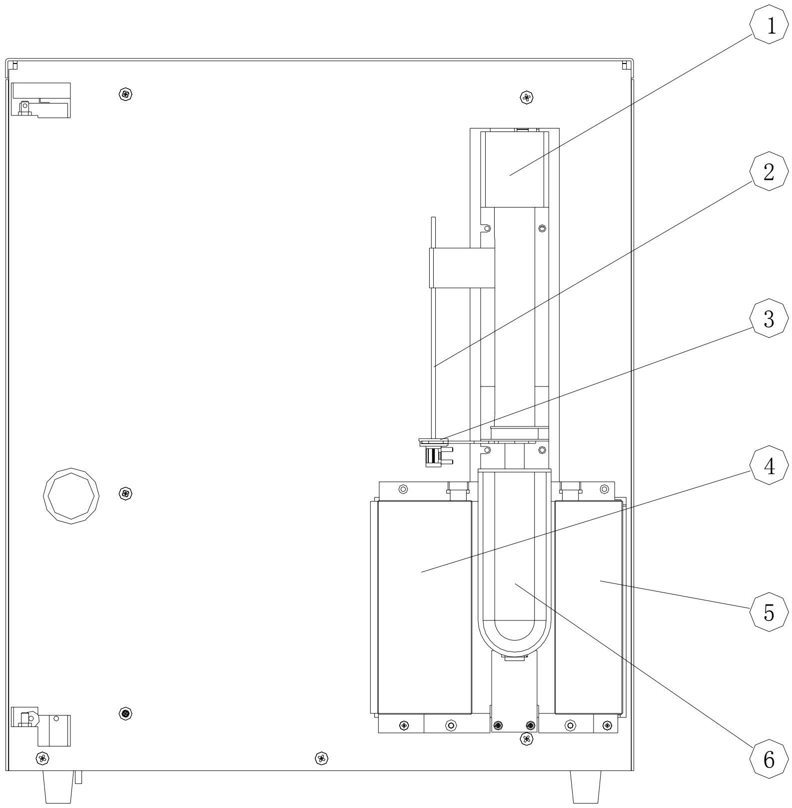


Figure3-3 Inside front of the analyzer

1 --- Elevator motor
2 --- Sample probe
3 --- Probe wipe
4 --- WBC shielding box
5 --- RBC shielding box
6 --- Aspirate key

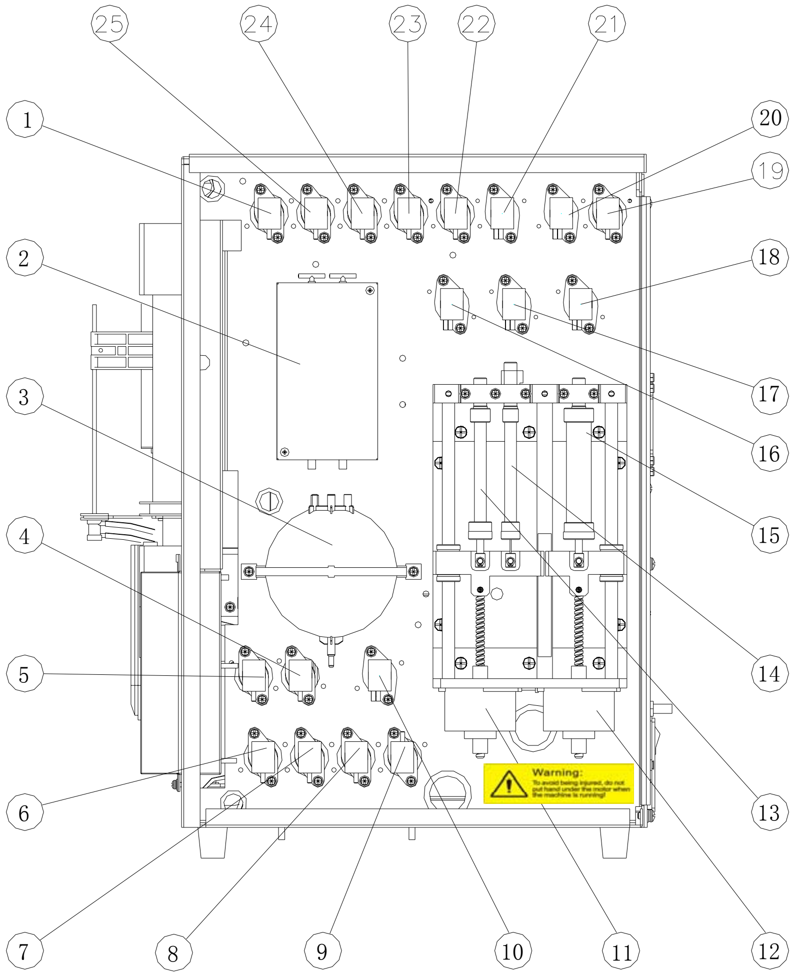


Figure3-4 Inside right of the analyzer

1 --- Valve8

2 --- Volumetric metering unit

3 --- Vacuum chamber

4 --- Valve13

5 --- Valve14

6 --- Valve12

7 --- Valve11

8 --- Valve10

9 --- Valve2

10 --- Valve9

11 --- 50ul and 2.5ml motor

12 --- 10ml motor

13 --- 2.5ml syringe

14 --- 50ul syringe

15 --- 10ml syringe

16 --- Valve6

17 --- Valve4

18 --- Valve3

19 --- Valve1

20 --- Valve5

21 --- Valve15

22 --- Valve16

23 --- Valve17

24 --- Valve7

25 --- Valve18

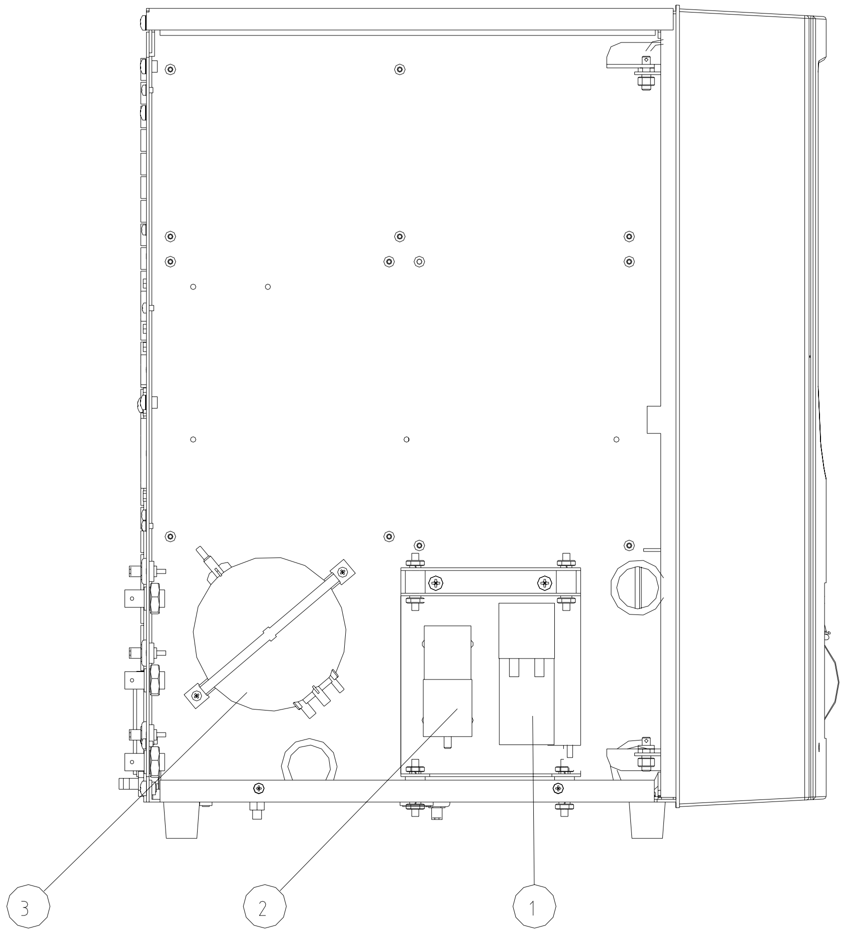


Figure3-5 Inside left of the analyzer

1 --- Fluid pump

2 --- Gas pump

3 --- Pressure chamber

3.2 Disassemble Main unit

3.2.1 remove top cover：

as shown in figure，remove 3 screws indicated by the arrow with cross screw driver to remove top cover.

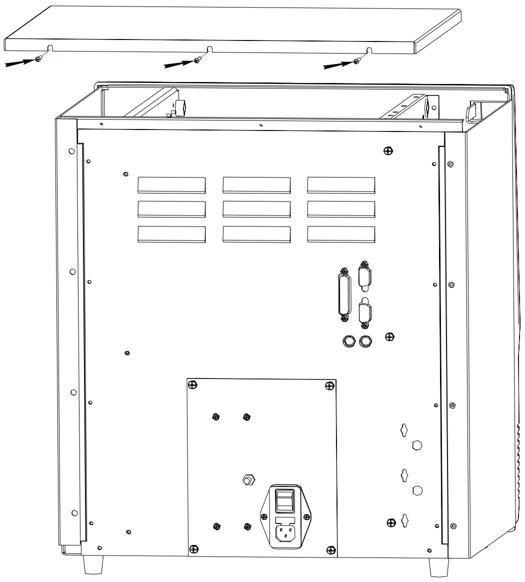


Figure 3—6

3.2.2 remove back cover and power supply assembly

as shown in figure，remove screws(total 12 screws) indicated by the arrow with cross screw driver to remove back cover and power supply assembly.

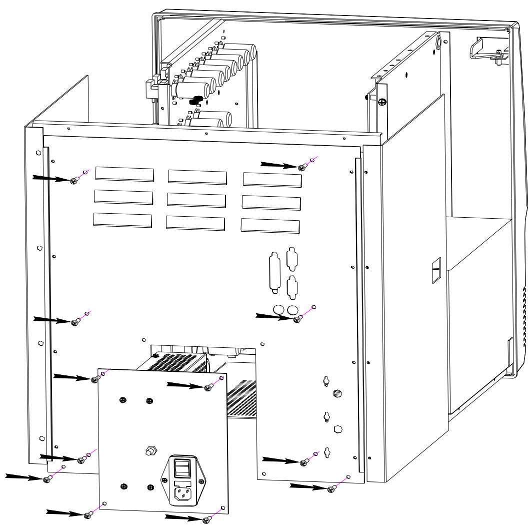


Figure 3—7

3.2.3 **replace liquid system Parts and Components：**

as shown in figure，open the right side door of the machine. ：

1) remove valves, remove 2 screws indicated by the arrow with cross screw driver to remove valves (total 18 valves).
2) remove the syringe assembly, remove 4 screws indicated by the arrow with cross screw driver to remove the syringe assembly.
3) remove the vacuum assembly, remove 2 screws indicated by the arrow with cross screw driver to remove the vacuum assembly.
4) remove the volumetric assembly, Remove the fixing screw on the shielding box of the volumetric assembly,open the shielding box, remove 2 screws indicated by the arrow with cross screw driver and wrench to remove the volumetric assembly.

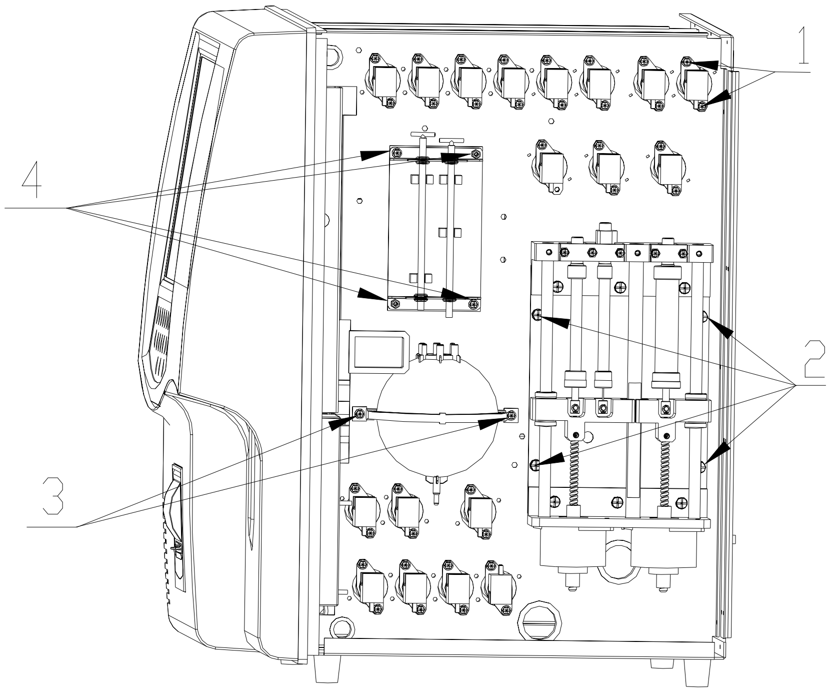


Figure 3—8

3.2.4 **Replace LCD screen：**

as shown in figure，open panel assembly and remove screws(total 7 screws) indicated by the arrow with cross screw driver to replace LCD screen.

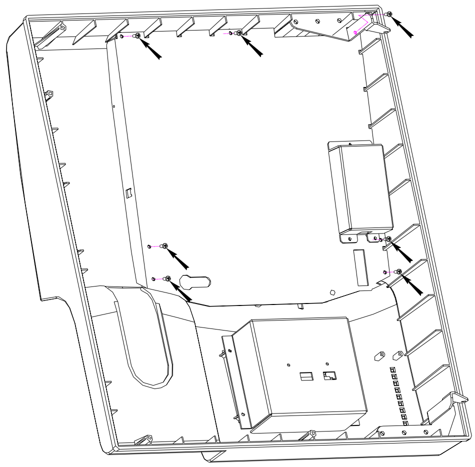


Figure 3—9

3.2.5 **replace keypad**：

as shown in figure，remove LCD screen on the panel assembly and remove screws(total 6 screws) indicated by the arrow with cross screw driver to replace keypad.

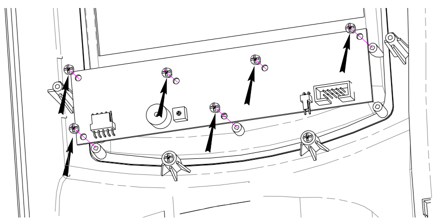


Figure 3—10

3.2.6 **Replace LCD screen and LCD board**：

as shown in figure, remove 3 screws indicated by the arrow with cross screw driver to remove LCD. Remove the 4 fixing screw on the shielding box of the LCD assembly,open the shielding box, remove the LCD board.

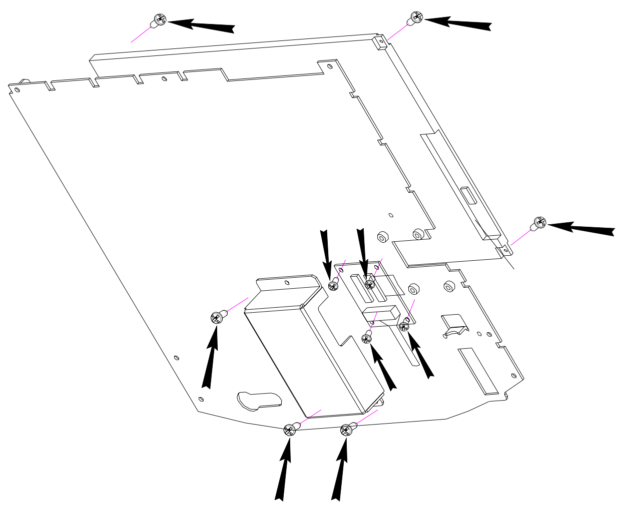


Figure 3—11

3.2.7 **replace power supply board**：

as shown in figure, remove screws(total 7 screws) indicated by the arrow with cross screw driver to remove the cover of power supply board.

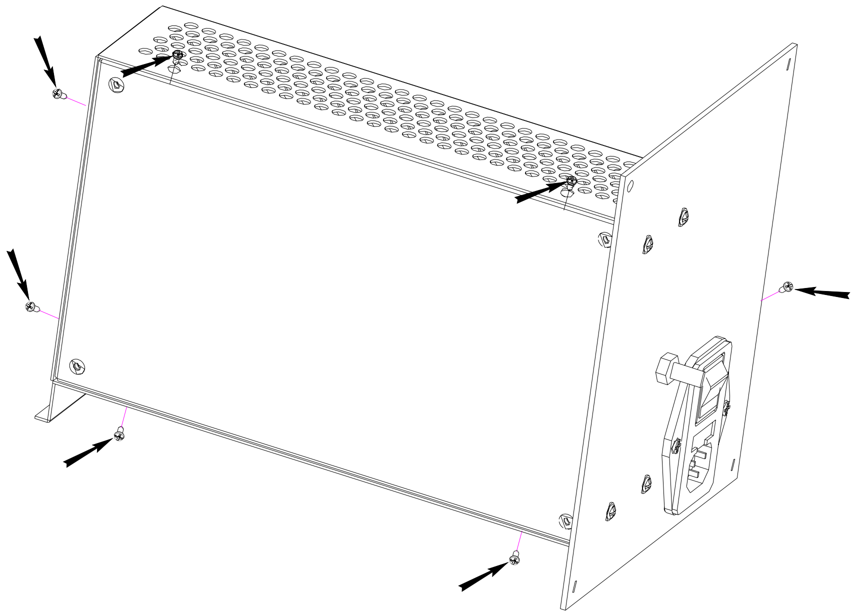


Figure 3—12

3.2.8 **replace power driver board,analog board ,cpu board**：

as shown in figure, remove screws(total 14 screws) indicated by the arrow with cross screw driver to remove power driver board,analog board ,cpu board.。

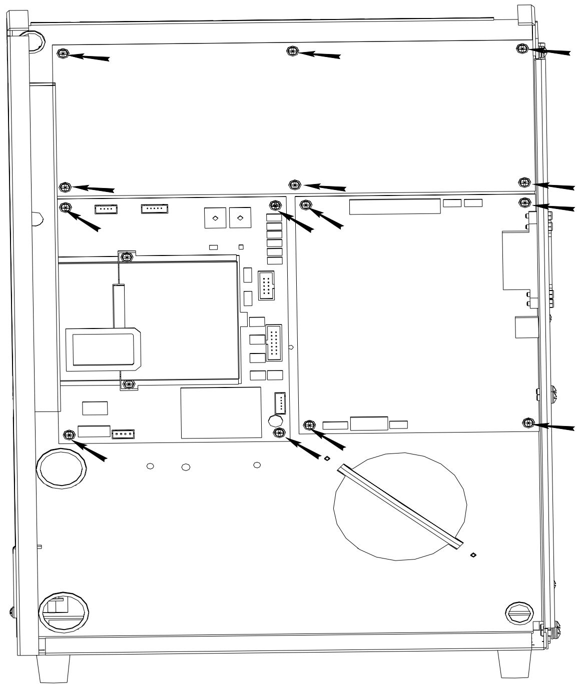


Figure 3—13

3.2.9 **Replace pressure Chamber and pump：**

as shown in figure：

1）、Replace pressure Chamber，remove 2 screws indicated by the arrow with cross screw driver to remove pressure Chamber.

2）、Replace pump，remove 2 nuts and 2 screws indicated by the arrow with wrench and screw driver

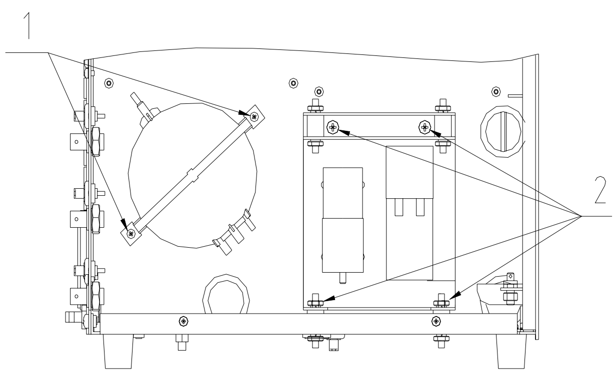


Figure 3—14

3.2.10 Replace Sample Probe：

as shown in figure, remove 4 screws indicated by the arrow with cross screw driver to remove Sample Probe

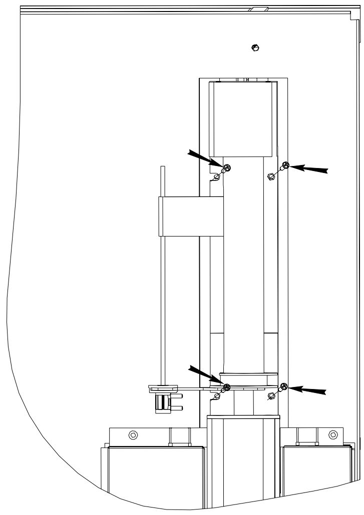


Figure 3—15

Chapter4 Fluidic System

4.1 Change Introduction

The changes on 3003 timing are based on 3001. Timings changed include dispensing prediluent, preparation for whole blood counting mode, preparation for predilute counting mode as well as post-cleaning for probe cleanser cleaning. A cleaning timing for mode switching is added too.

The changed timings are mainly as follows:

1. Timing for dispensing prediluent: With time not changed, the amount of diluent the probe aspirates and dispenses decreases from 1.6mL to 0.7mL.

2. Preparation timing for whole blood counting mode:

   After the sample has been dispensed to the WBC bath, 2 bubbles are pumped into it.

   Number of bubbles pumped into the RBC bath decreases from 6 to 3.

   The sample probe moves. (new)

   The pressure in the pressure chamber changes from 20-30 to 15-25.

3. Preparation timing for predilute counting mode:

   After the sample has been dispensed into the WBC bath, 2 bubbles are pumped into it.

   Number of bubbles pumped into the RBC bath decrease from 6 to 3.

   The sample probe moves. (new)

   The amount the probe aspirates is changed.

   The pressure in the pressure chamber changes from 20-30 to 15-25.

4. Post-cleaning timing for probe cleanser cleaning:

   The cleanser discharging speed decreases from level 8 to level 7.

5. Cleaning timing for mode switching:

   This timing is to clean the tubing on the probe.

4.2 Introduction of Basic Timing

1. To clean the sample probe: The probe is cleaned when it goes up and down. Valve 1 is opened and the 10mL syringe discharges fluid. Valve 2 is opened and the waste pump starts working.

2. To establish vacuum: To establish vacuum, valve 10 is opened and the waste pump starts working. The vacuum pressure value can be controlled in two ways, one is to be

controlled by command in the timing, and the other is to be controlled directly with the valve 10 opened and the waste pump starts working. When counting, the vacuum pressure must be -24kPa.

3. To establish pressure: Pressure can be established by starting the pressure pump. The pressure value can be controlled in two ways, one is to be controlled by command in the timing, and the other is to be controlled directly with the pressure pump started. Pressure is used to pump bubbles into baths for mixing the sample and to increase the pressure in vacuum chamber to flush the aperture. To do this, the pressure pump is started and valve 9 is opened.

4. To aspirate diluent: Via 10mL syringe, diluent is aspirated.

5. To dispense diluent: Via 10mL syringe and valve 3 is opened, diluent will be dispensed into the WBC bath, RBC bath or to the probe wipe.

6. To dispense diluent to the probe wipe: When diluent is dispensed into the WBC bath or RBC bath, valve 1 is opened simultaneously and diluent is dispensed to the probe wipe.

7. To dispense diluent to the sample probe: To dispense diluent to the sample probe, valve 4 is opened simultaneously so that diluent is dispensed into the sample probe.

8. To dispense diluent to the RBC bath: To dispense diluent to the RBC bath, valve 5 is opened simultaneously so that diluent is dispensed into the RBC bath.

9. To aspirate lyse: Via 2.5mL syringe, lyse is aspirated.

10. To dispense lyse: Via 2.5mL syringe and valve 6 opened, lyse is dispensed into the WBC bath.

11. To empty RBC bath: with the waste pump started and valve 11 opened, the RBC bath is emptied.

12. To empty WBC bath: with the waste pump started and valve 12 opened, the WBC bath is emptied.

13. To pump air into the RBC bath: A certain pressure should be established in the pressure chamber via system command, then valve 15 is opened and the air in the pressure chamber can be pumped into the RBC bath.

14. To pump air into the WBC bath: A certain pressure should be established in the pressure chamber via system command, then valve 16 is opened and the air in the pressure chamber can be pumped into the WBC bath.

15. To aspirate the sample: Via 50mL syringe, the sample is aspirated into the sample probe.

16. To dispense the sample: Via 10mL syringe and valve 4 opened, sample is

dispensed from the sample probe. At the same time, a little diluent is dispensed too.

17. To empty the RBC metering tube: After vacuum is established, valve 17 is opened to empty the RBC metering tube.

18. To count in the RBC metering tube: After the RBC metering tube is emptied and vacuum is established, valve 18 is opened and the counting is started.

19. To empty the WBC metering tube: After vacuum is established, valve 7 is opened to empty the WBC metering tube.

20. To count in the WBC metering tube: After the WBC metering tube is emptied and vacuum is established, valve 8 is opened and the counting is started.

21. To clean the RBC back bath and the RBC metering tube: After vacuum is established, valve 13 and valve 18 are opened so that rinse can pass from the RBC back bath and the RBC metering tube and then to the vacuum chamber.

22. To clean the WBC back bath and the WBC metering tube: After vacuum is established, valve 14 and valve 8 are opened so that rinse can pass from the WBC back bath and the WBC metering tube and then to the vacuum chamber.

4.3 Timing

4.3.1 Timing for Dispensing Prediluent

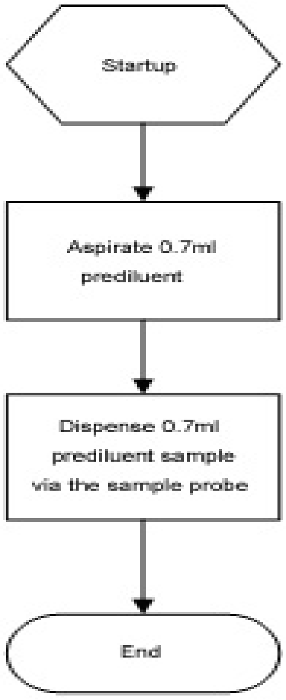
1. In the predilute mode, press the DILUENT key on the keypad to enter the timing for dispensing prediluent.

2. 0.7mL diluent should be dispensed from the sample probe by pressing the START key every time.

3. You can repeat the operations above.

4. Press the ENTER key on the keypad to exit the timing.

Timing Flow Chart



4.3.2 Preparation Timing for Whole Blood Counting Mode

1. In the preparation timing for whole blood counting mode, the analyzer aspirates 13μL blood sample via sample probe.

2. Before dispensing blood sample into RBC bath and WBC bath, the baths must be cleaned.

3. The sample probe must be cleaned by probe wipe when the sample probe is moving to the WBC bath.

4. Before dispensing sample into the WBC bath, there must be some diluent. Sample is dispensed into the bath with sample probe moving. Then, it finishes the first dilution (about 1: 269).

5. 2 bubbles are pumped into the WBC bath when dispensing sample, in order to prevent sample coming into the tubing under the bath.

6. Via the sample probe, 15.6μL first dilute sample is aspirated.

7. Before dispensing the first dilute sample into the RBC bath, there must be some diluent. Sample is dispensed into the bath with sample probe moving. Then, it finishes the second dilution (about 1: 44492).

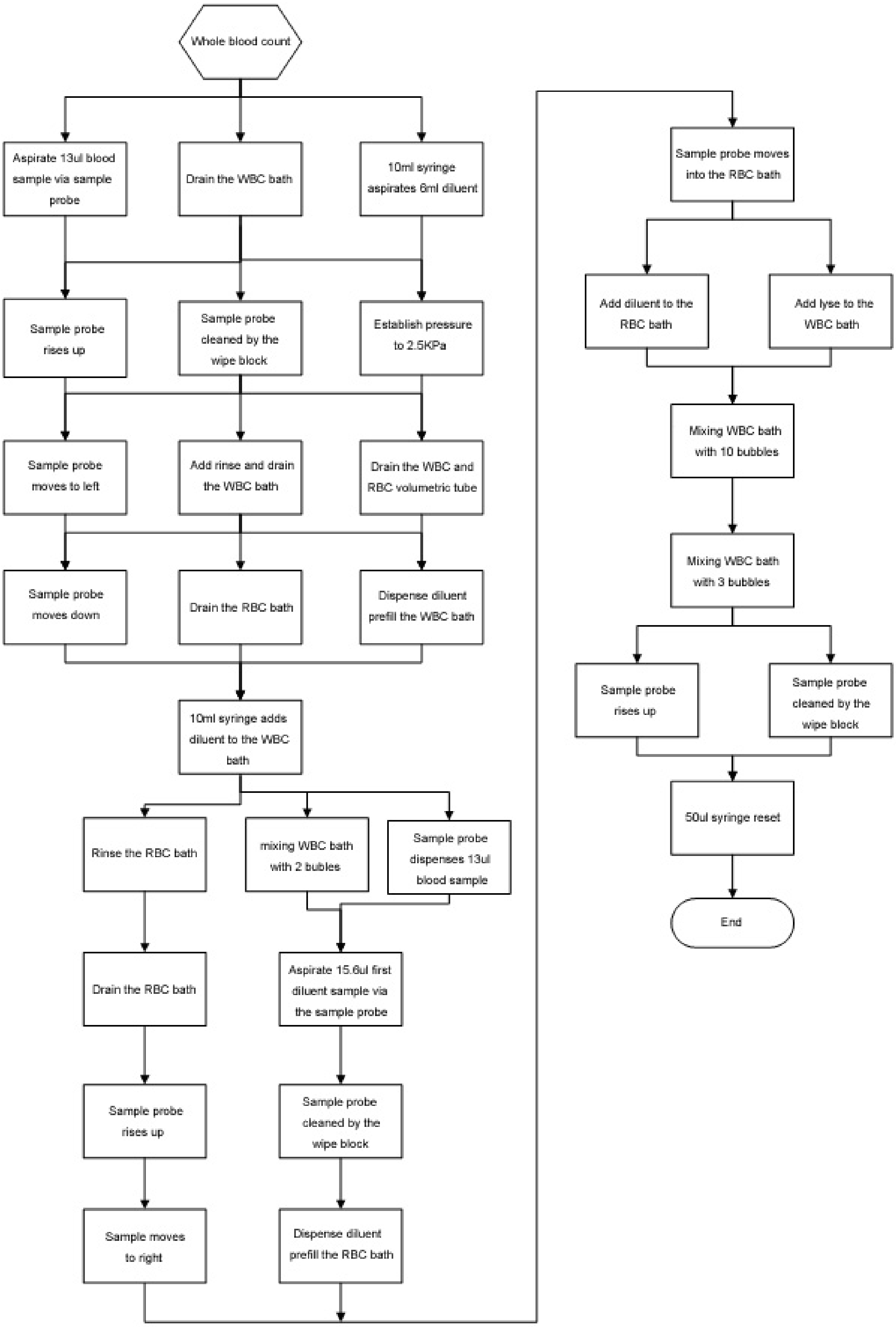
8. When the preparation timing is ended, the pressure in the vacuum chamber should be in the range of 24±0.5kPa.

9. During the preparation timing, the metering tube should be emptied.

10. When 0.5mL lyse is dispensed into the WBC bath, the sample is mixed by pumping bubbles into the bath.

11. Sample and the second dilution are mixed by pumping bubbles into the bath.
12. The 50μL syringe is replaced before the end of the timing.

Timing Flow Chart



4.3.3 Preparation Timing for Predilute Counting Mode

1. 0.3mL prediluent (about 1:36, prepared by timing for dispensing prediluent) is aspirated from the test tube by the sample probe.

2. The WBC bath and RBC bath are cleaned twice respectively.

3. The metering tube should be emptied at the end of the timing.

4. Before the end of the timing, the pressure in the vacuum chamber should be -24kPa.

5. 1.6mLBefore dispensing the prediluent into the WBC bath, there must be some diluent.

6. The sample probe dispenses prediluent as well as 1.6mL diluent into the bath to finish the first dilution (about 1:420).

7. 2 bubbles are pumped into the WBC bath when dispensing sample, in order to prevent sample coming into the tubing under the bath.

8. Via 50μL syringe, 24.8μL first diluent sample is aspirated.

9. Before the first dilute sample is dispensed into the RBC bath, 1.4mL diluent should be dispensed into it.

10. The first diluent sample is dispensed into the RBC bath with sample probe moving. At the same time, 1.2mL diluent is dispensed. Then, it finishes the second dilution (about 1: 44032).

11. 0.36mL lyse is dispensed into the WBC bath.

12. 10 bubbles are pumped into the WBC bath.

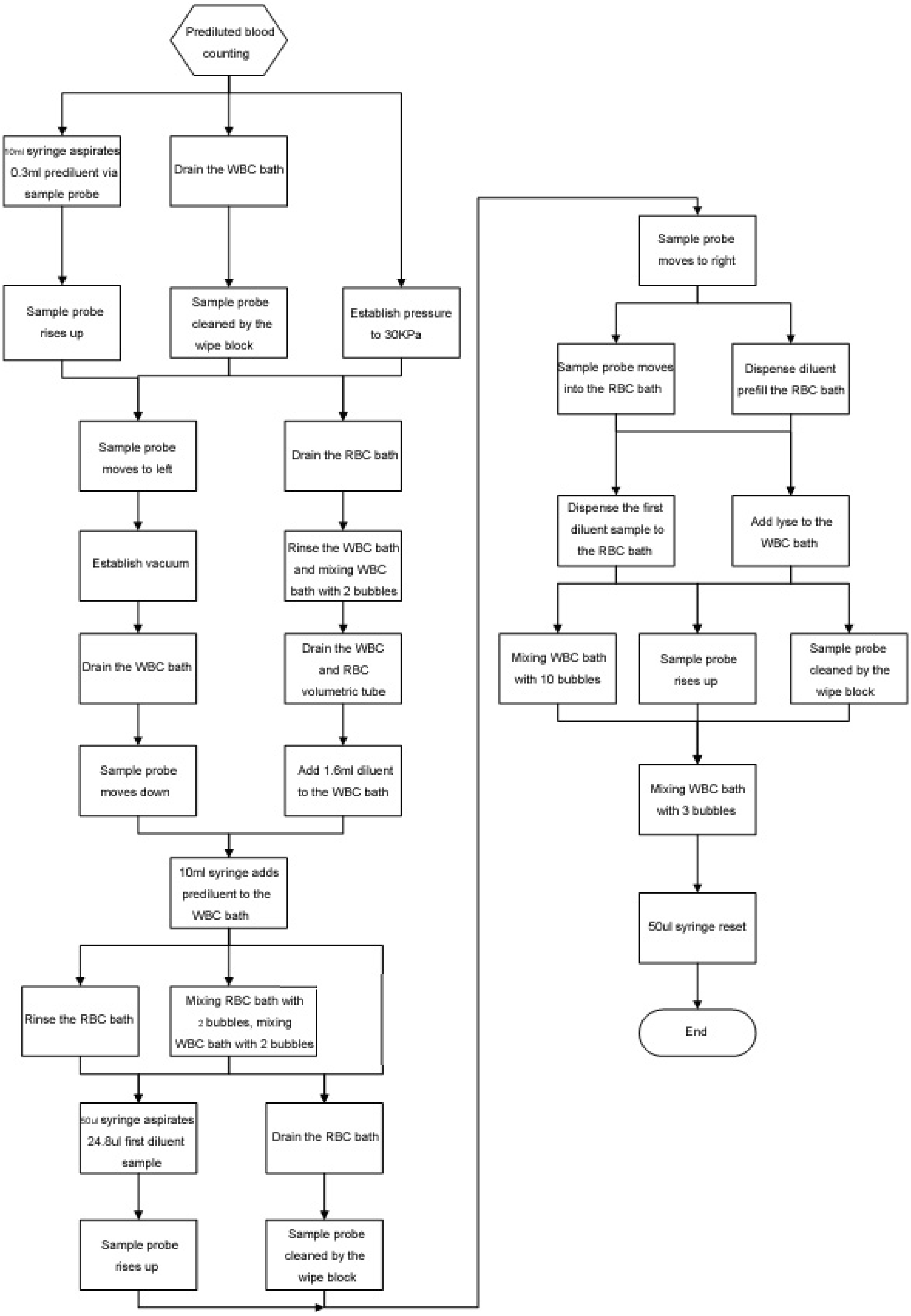
13. 3 bubbles are pumped into the RBC bath.

14. The sample probe is cleaned when it goes up again.

15. At the end of the timing, the sample probe will be replaced.

16. Before the end of the timing, 50μL syringe is replaced.

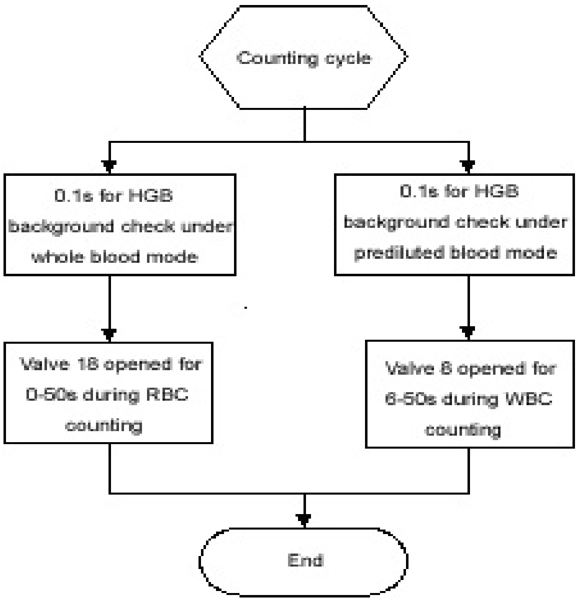
Timing Flow Chart



4.3.4 **Counting Timing**

The valve 8 is opened later than valve 18 (the aperture of WBC is bigger than that of RBC so that the flow rate of WBC metering tube is faster than that of RBC).

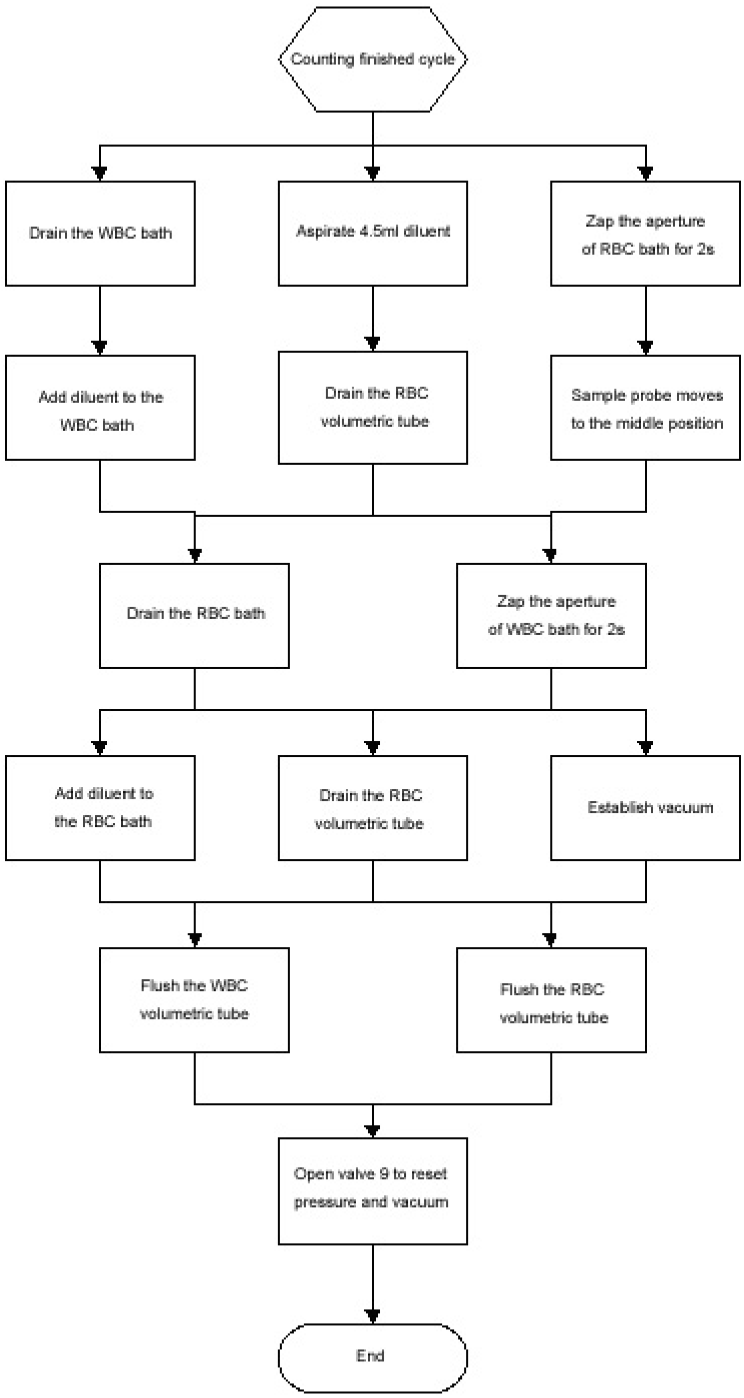
Timing Flow Chart



4.3.5 **Counting Ending Timing**

1. Clean respectively WBC bath and RBC bath once.
2. Zap the aperture of WBC and RBC.
3. Restitute the pressure in the vacuum chamber.
4. Restitute the pressure in the pressure chamber.
5. The sample probe is replaced. When the probe is being replaced, the 50μL syringe aspirates 5μL of diluent to prevent extra drops drip from the probe.

Timing Flow Chart


Counting finished cycle
Drain the WBC bath
Aspirate 4.5ml diluent
Zap the aperture of RBC bath for 2s
Add diluent to the WBC bath
Drain the RBC volumetric tube
Sample probe moves to the middle position
Drain the RBC bath
Zap the aperture of WBC bath for 2s
Add diluent to the RBC bath
Drain the RBC volumetric tube
Establish vacuum
Flush the WBC volumetric tube
Flush the RBC volumetric tube
Open valve 9 to reset pressure and vacuum
End

Chapter5 Histograms and Pulse Graphs

5.1 Histograms

This section demonstrates some usual WBC histograms.

1. Normal histogram

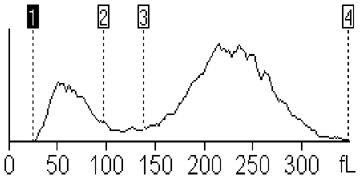


Figure 5-1

⚠NOTE⚠:

Blood cells lain between the first and the second discriminators are lymphocyte; those between the second and the third discriminators are mid-sized cells; those between the third and the fourth discriminators are granulocyte. The fourth discriminator is the fixed line.

2. No differential result because the WBC histogram is over-narrowly compressed.

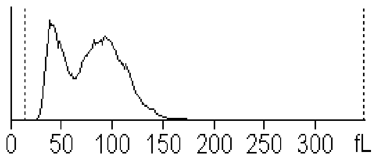


Figure 5-2

3. No differential result because WBC count result is less than a certain value (WBC < 0.5).

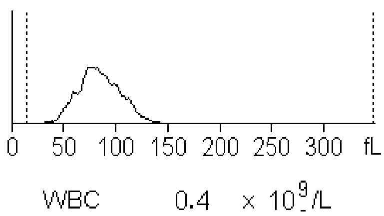


Figure 5-3

4. No differential result because the peak of WBC histogram lies in the middle of the histogram and thus cannot identify the type of peak cells.

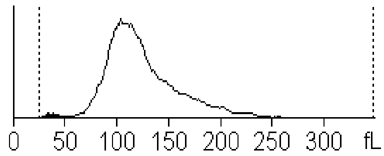


Figure 5-4

5. Increased nucleated erythrocytes or interference or inadequate hemolysis.

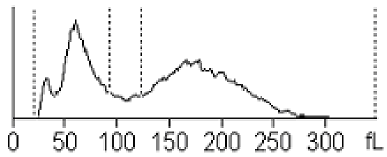


Figure 5-5

6. Severe interference in WBC channel (identifying if it is interfered by observing the pulse graph)

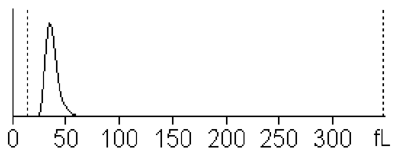


Figure 5-6

7. No lyse reagent or poor hemolysis

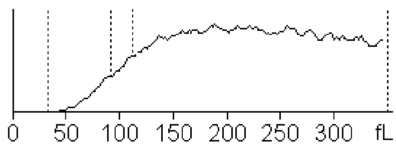


Figure 5-7

8. Increased neutrophilic granulocytes

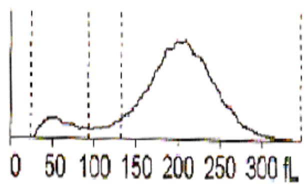


Figure 5-8

9. Increased lymphocytes

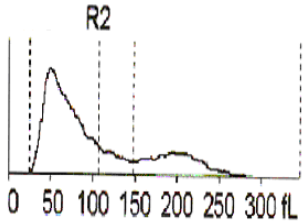


Figure 5-9

10. Tumor patient

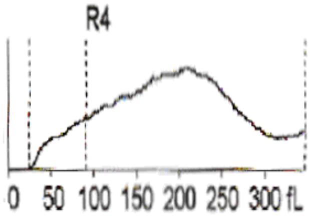


Figure 5-10

11. Increased mid-sized cells

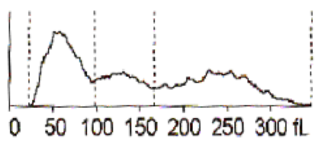


Figure 5-11

5.2 Pulse Graphs

After each count, the system can save the original sampling pulses of this time. We can analyze the reason leading to the fault by viewing these original data.

Enter password “3210”, after a count, you can view the WBC pulse graph of this count by pressing “F5” and view RBC pulse graph , PLT pulse graph by pressing “F1”. Presses “ENTER” to exit.

When the instrument is working normally, the length of pulse data is related to the concentration of the blood sample. The length of the pulse data should be within a limit range. For general samples, the range should be:

WBC: < 1M RBC: < 600K PLT: < 1M

Data length of abnormal sample will not lie in this range.

Length of normal level controls data should be:

WBC：400 ~ 700K RBC：250 ~ 450K PLT：300 ~ 600K

5.2.1 **Normal Pulse Graphs**

- WBC pulse graph of normal sample

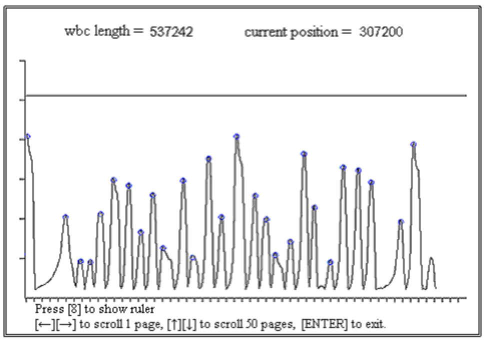


Figure 5-12

● Pulse graph of normal WBC background

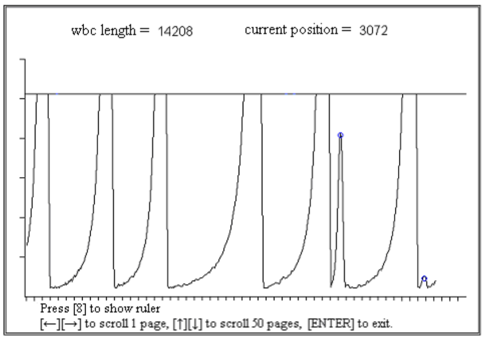


Figure 5-13

● RBC pulse graph of normal sample

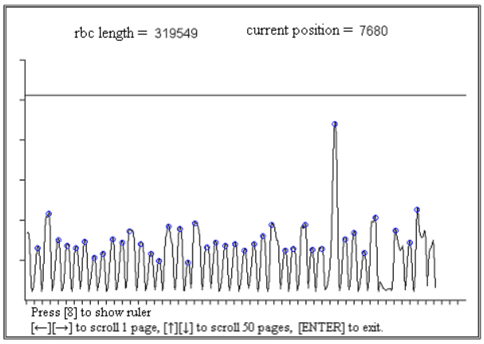


Figure 5-14

● Pulse graph of normal RBC background

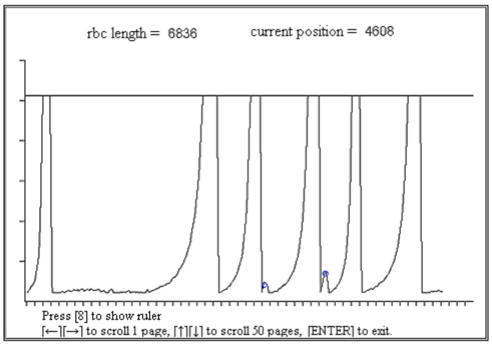


Figure 5-15

- PLT pulse graph of normal sample

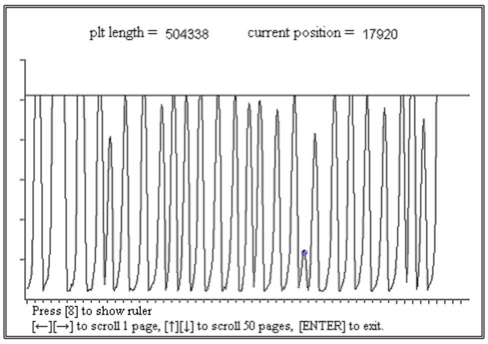


Figure 5-16

- Pulse graph of normal PLT background

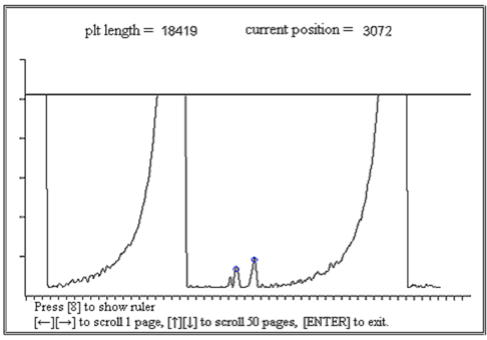


Figure 5-17

5.2.2 **Abnormal Pulse Graphs**

- Severe interference in WBC channel

  Data length increases obviously (background)

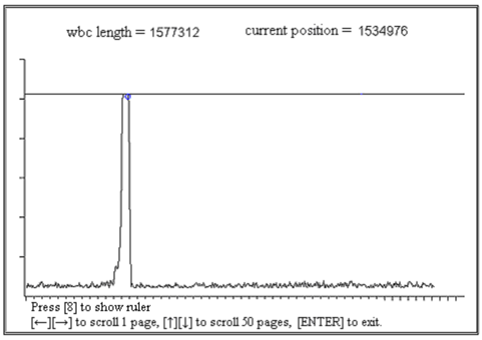


Figure 5-18

- Severe interference in WBC channel

  Data length increases obviously (normal sample)

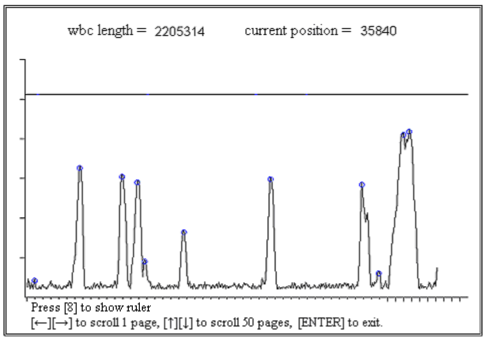


Figure 5-19

- Severe interference in RBC channel

  Data length increases obviously (background)

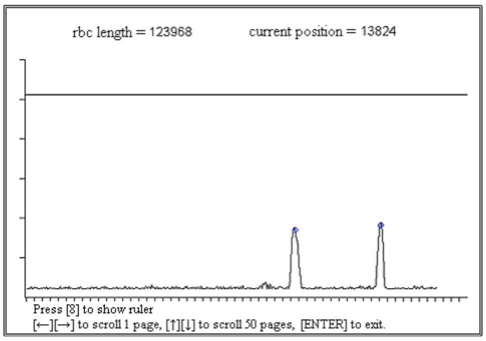


Figure 5-20

- Severe interference in RBC channel

  Data length increases obviously (normal sample)

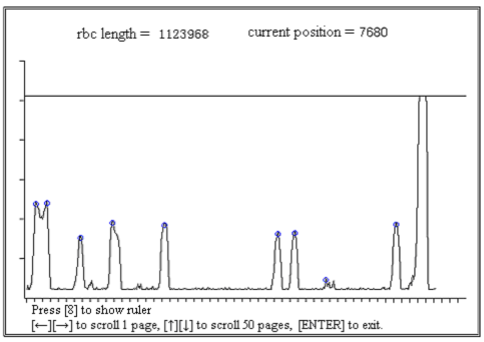


Figure 5-21

- Severe interference in PLT channel

  Data length increases obviously (background)

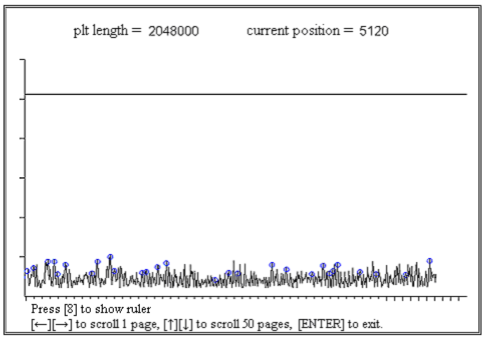


Figure 5-22

- Severe interference in PLT channel

  Data length increases obviously (normal sample)

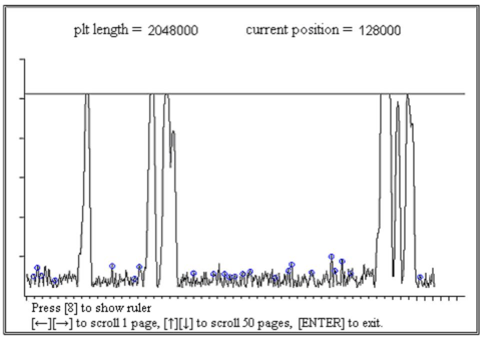


Figure 5-23

- Interference occurs because gain of PLT channel is too large

  Data length increases (background count)

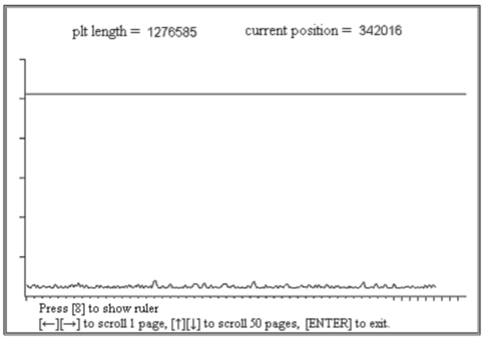


Figure 5-24

- Interference occurs because gain of PLT channel is too large

  Data length increases (normal sample)

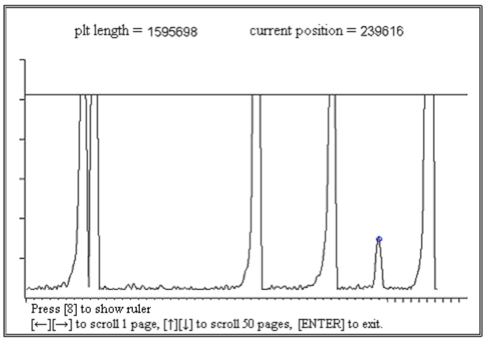


Figure 5-25

- Slight interference in WBC channel

  Data length does not increase obviously (normal sample)

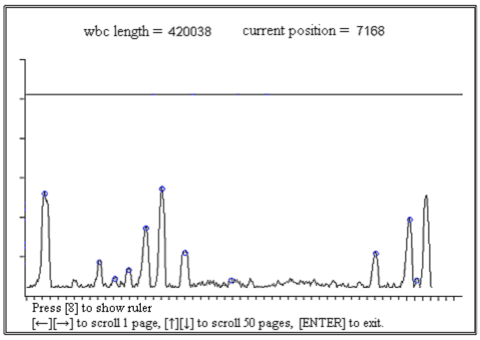


Figure 5-26

- Inadequate or no hemolysis in WBC channel

  Data length increases

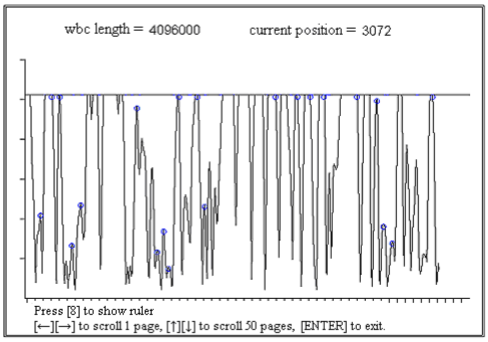


Figure 5-27

● Slight interference in RBC channel

Data length does not increase obviously (normal sample)

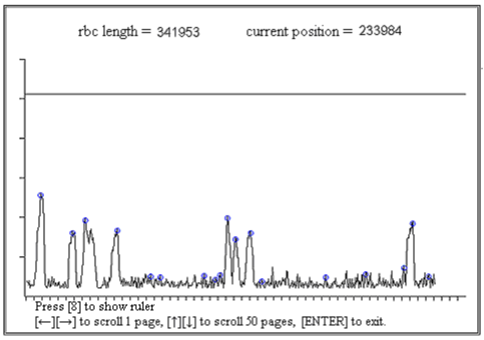


Figure 5-28

● Sample of too dense concentration in RBC channel (Does not occur in normal situation)

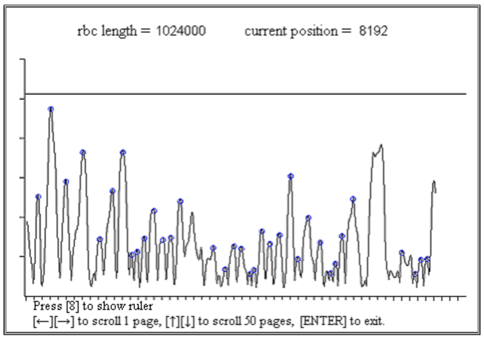


Figure 5-29

● Slight interference in PLT channel

Data length does not increase obviously (normal sample)

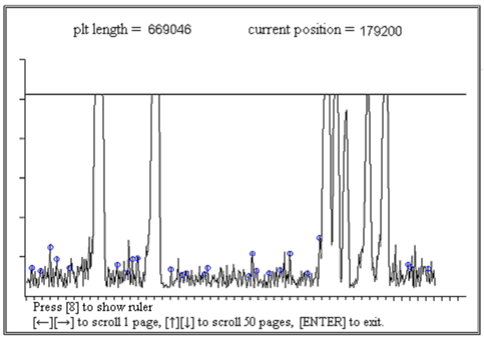


Figure 5-30

● Sample of too dense concentration in PLT channel(Does not occur in normal situation)

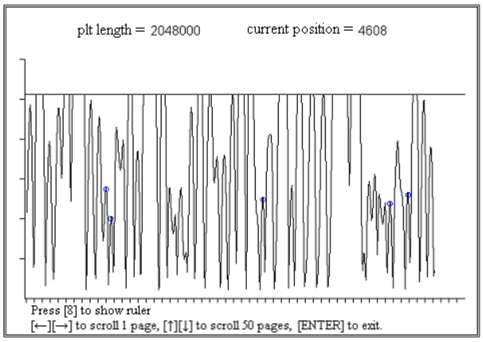


Figure 5-31

● Interference in WBC channel caused by inverter

Feature: sine wave with cycle of 20～26us

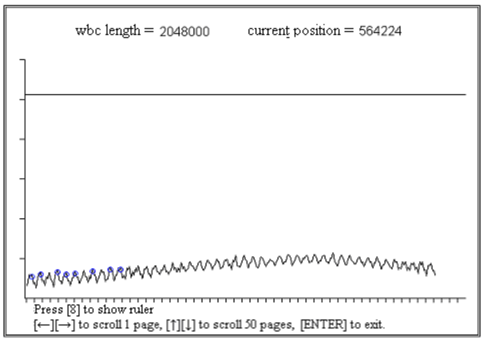


Figure 5-32

● Measuring interference from inverter

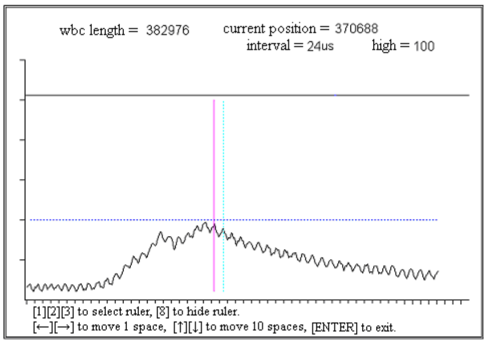


Figure 5-33

- Insufficient liquid in WBC bath during count

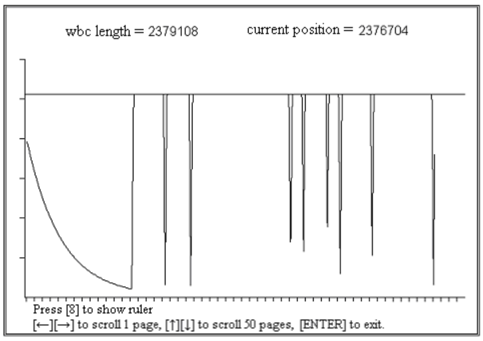


Figure 5-34

- Interference in RBC channel from tubing

  Feature: data length increases, the base line of signal is not stabile.

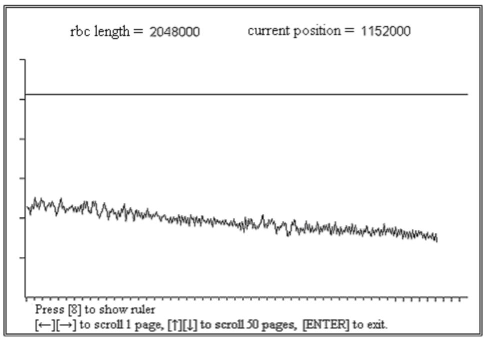


Figure 5-35

- Insufficient liquid in RBC bath during count

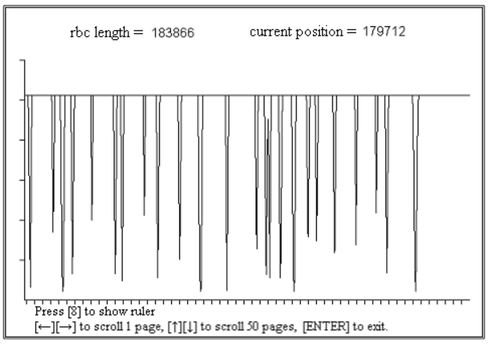


Figure 5-36

- Interference in PLT channel from tubing

  Feature: data length increases, the base line of signal is not stabile.

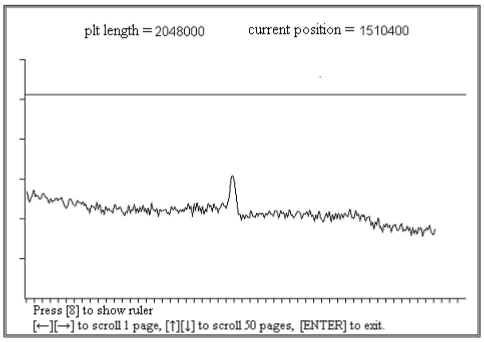


Figure 5-37

- Insufficient liquid in RBC bath during count

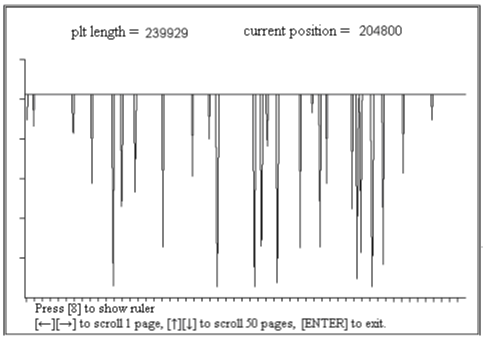


Figure 5-38

- Interference in WBC channel from tubing

  Feature: data length increases, the base line of signal is not stabile.

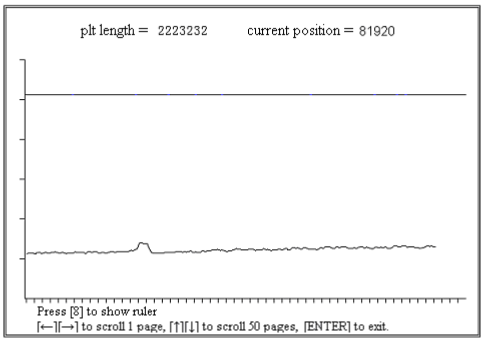


Figure 5-39

Chapter6 Maintaining Your Analyzer

6.1General Guidelines

Maintenance Period	Content of Maintenance
Everyday	If you are to use this analyzer 24 hours a day, be sure to perform the "**E-Z cleanser cleaning**" procedure everyday.
	Run the QC program everyday. See **Operation manual chap QC** for details.
Every three days	If you are to use this analyzer 24 hours a day, be sure to perform the "**Probe cleanser cleaning**" procedure every three days.
Every Week	If you shut down your analyzer every day and follow the specified shutdown procedure to do that, you need to perform the "**Probe cleanser cleaning**" procedure every week**.**
Every Month	You should use the supplied probe localizer to calibrate the position of the probe to that of the probe wipe. The analysis result is sensitive to their alignment.
As needed	When you think the baths might be contaminated, perform the "**Clean the baths**" procedure.
	When the analyzed whole blood samples add up to 300 or prediluted samples add up to 150, the analyzer will remind you to perform the "**Probe cleanser cleaning**" procedure. **Note that you can enter the "Setup" → "Others"** screen to change the threshold to trigger the reminder. If you enter 0 as the threshold, this reminder function will be disabled.
	When the analyzed whole blood samples add up to 2,000 or prediluted samples add up to 4,000, the analyzer will remind you to perform the "**Clean wipe block**" procedure.
	When this analyzer is not to be used for two weeks, be sure to perform the "**Prepare to ship**" procedure to empty and wash the fluidic lines and then wipe the analyzer dry and wrap it up for storage.

	To obtain reliable analysis results, this analyzer needs to work in a normal status. Be sure to run the "**System Test**" items regularly to check the status of this analyzer.
	When this analyzer gives alarms for clogging, you can perform the "**Flush Apertures**" or "**Zap Apertures**" procedure, or press [FLUSH] to unclog the apertures.
	If you see other error messages, see **operation manual chap troubleshooting**, for solutions.

Chapter7 Troubleshooting

7.1 Error Codes

Table 7-1 Errors and codes

Code	Error	Code	Error	Code	Error
0x0401	Environmental Temperature Abnormal	0x0402	Background abnormal	0x0403	HGB error
0x0404	HGB adjust	0x0405	WBC clog	0x0406	WBC bubble
0x0407	RBC clog	0x0408	RBC bubbles		
0x0801	Communication error	0x0802	Scanner error	0x0803	Scanner communication error
0x1001	Printer out of paper	0x1002	Printer connection error	0x1003	Recorder communication error
0x1004	Recorder out of paper	0x1005	Recorder too hot	0x1006	Press bar up
0x2001	Lyse out	0x2002	Diluent expired	0x2003	Rinse expired
0x2004	Lyse expired	0x2005	Filter error	0x2006	Real-time clock error
0x4002	10ml Syringe motor error	0x4001	2.5ml and 50ul Syringe motor error	0x4004	Elevator motor error
0x4003	Rotation motor error	0x4008	DC-DC 12V error	0x400A	5V error
0x4009	3.3V error	0x4012	DC-DC -12V error	0x4006	RBC A/D error
0x4005	WBC A/D error	0x400B	56V error	0x400D	Pressure1 error
0x400C	Vacuum error	0x4007	PLT A/D error	0x400F	Diluent out
0x4010	Rinse out	0x400E	Pressure2 error		

0x8001	File error	0x8002	Flash RAM error	Dynamic memory error	

7.2 Software error

When there is a shortage of source during running, system will stop:

The background color change to black and following error message can be seen on the screen：

Error Code = xxxx   xxxxstand for error code

If happens, write down thee error code and contact Mindray person。（**Note:you may restart your unit first**）

7.3 Solution

See the information below for the error messages and their probable causes and recommended action. If the problem still remains after you have tried the recommended solutions, contact Mindray customer service department or your local distributor.

7.3.1 WBC A/D error

Something is wrong with the A/D part of the CPU board.

Recommended Action：

Enter the "Service → System Test" screen and check the WBC AD interrupt as instructed in operation manual;

The error will be removed if the test result is normal;

If the problem remains, shut down your analyzer and change CPU board.

7.3.2 RBC A/D error

Something is wrong with the A/D part of the CPU board.

Recommended Action：

Enter the "Service → System Test" screen and check the WBC AD interrupt as instructed in operation manual;

The error will be removed if the test result is normal;

If the problem remains, shut down your analyzer and change CPU board.

7.3.3 **PLT A/D error**

Something is wrong with the A/D part of the CPU board.

Recommended Action：

1. **Enter the "Service → System Test" screen and check the WBC AD interrupt as instructed in operation manual;**
2. **The error will be removed if the test result is normal;**
3. If the problem remains, shut down your analyzer and change CPU board.

7.3.4 **Dynamic Memory Error**

Something is wrong with the system memory.

Recommended Action：

shut down your analyzer and change CPU board.

7.3.5 **HGB error**

HGB blank voltage within 0 V - 3.2 V or 4.9 V - 5 V.

Recommended Action：

1. **Do the "Probe Cleanser Cleaning" procedure as instructed in operation manual.;**
2. **If the problem remains, adjust the HGB gain as instructed by operation manual to set the voltage within 3.4 - 4.8V, preferably 4.5V;**
3. **If the problem remains, shut down your analyzer and clean HGB unit.**

7.3.6 **HGB adjust**

HGB blank voltage within 3.2 V - 3.4 V or 4.8 V – 4.9 V.

Recommended Action

1. **Do the "Probe Cleanser Cleaning" procedure as instructed in operation manual.;**
2. **If the problem remains, adjust the HGB gain as instructed by operation manual to set the voltage within 3.4 - 4.8V, preferably 4.5V;**
3. If the problem remains, shut down your analyzer and clean HGB unit.

7.3.7 **RBC clog**

If the difference between the reference RBC count time and the actual RBC count time is less than 2 seconds, your analyzer will give RBC clog alarm:

possible reason：

Clogged RBC aperture;

Inappropriate RBC count time setting;

Solenoid valve error.

Recommended Action:

Enter the "**Service → Maintenance**" screen. Zap and flush the aperture as instructed in operation manual.

Enter the "**Setup → Count Time**" screen and record the RBC count time. Then enter the "**Service → System Test**" screen and test the actual RBC count time

If the difference between the references RBC count time and the actual RBC count time is less than 2 seconds, the error has been removed;

If not, enter the "Service → Maintenance" screen and do the probe cleanser cleaning procedure.

Enter the "Setup → Count Time" screen and record the RBC count time. Then enter the "Service → System Test" screen and test the actual RBC count time again: If the difference between the reference RBC count time and the actual RBC count time is less than 2 seconds, the error has been removed.

If the difference is still greater than 2 seconds but consistent, enter the "Setup → Count Time" and reset the RBC count time. Then enter the "Service → System Test" screen and test the actual RBC count time as instructed by operation manual **to confirm the difference is less than 2 seconds.**

7.3.8 **RBC bubbles**

If the difference between the reference RBC count time and the actual RBC count time is greater than 2 seconds, your analyzer will give RBC clog alarm:

possible reason：

1. **Diluent or rinse running out;**
2. **Loose tube connections;**
3. Inappropriate RBC counts time setting.

Recommended Action:

1. Check if the diluent or rinse has run out. If so, change a new container of

diluent or rinse as instructed in **operation manual**.

2. Check the connection of the diluent and rinse pickup tube. If necessary, reconnect and tighten them **operation manual**.
3. If the problem remains, adjust the RBC count time。

7.3.9 **WBC Clog**

If the difference between the reference WBC count time and the actual WBC count time is less than 2 seconds, your analyzer will give WBC clog alarm:

possible reason：

1. **Clogged WBC aperture;**
2. **Inappropriate WBC count time setting;**
3. **Solenoid valve error.**

Recommended Action:

1. Enter the "**Service → Maintenance**" screen. Zap and flush the aperture as instructed in operation manual.
2. Enter the "**Setup → Count Time**" screen and record the WBC count time. Then enter the "**Service → System Test**" screen and test the actual WBC count time

   If the difference between the references WBC count time and the actual RBC count time is less than 2 seconds, the error has been removed;

   If not, enter the "Service → Maintenance" screen and do the probe cleanser cleaning procedure.
3. Enter the "Setup → Count Time" screen and record the WBC count time. Then enter the "Service → System Test" screen and test the actual WBC count time again: If the difference between the reference WBC count time and the actual WBC count time is less than 2 seconds, the error has been removed.
4. If the difference is still greater than 2 seconds but consistent, enter the "Setup → Count Time" and reset the WBC count time. Then enter the "Service → System Test" screen and test the actual WBC count time as instructed by operation manual to confirm the difference is less than 2 seconds.

7.3.10 **WBC Bubble**

If the difference between the reference RBC count time and the actual RBC count time is greater than 2 seconds, your analyzer will give RBC clog alarm:

possible reason：

1. Diluent or rinse running out;
2. Loose tube connections;
3. Inappropriate RBC counts time setting.

Recommended Action:

1. Check if the diluent or rinse has run out. If so, change a new container of diluent or rinse as instructed in operation manual.
2. Check the connection of the diluent and rinse pickup tube. If necessary, reconnect and tighten them **operation manual**.
3. If the problem remains, adjust the RBC count time。

7.3.11 **Background Abnormal**

When testing background，one or some of the test results are out of the reference range.

1. **Contaminated diluent, diluent lines or bath (s);**
2. **Expired diluent;**
3. The tubes at the back of the analyzer are pressed.

Recommended Action

1. **Check if the diluent is contaminated or expired;**
2. **Check if the tubes connected at the back of the analyzer is pressed;**
3. **Enter the "**Count**" screen and press [STARTUP] (or [F3] of the external keyboard) to do the startup procedure;**

4. If the problem remains, enter the "**Service → Maintenance**" screen and do the probe cleanser cleaning procedure as instructed in **operation manual.** When the procedure is finished, return to the "**Count**" screen and do the background check again;

7.3.12 **Rinse Expiry**

possible reason：Expired rinse or wrong expiration setting

Recommended Action

1. Check if the rinse has expired. If so, change a new container of rinse
2. If not, reset the expiration date

7.3.13 **Printer out of paper**

possible reason：Printer paper running out or not properly installed.

Recommended Action

1. Check if there is printer paper;
2. Check if the printer paper is well installed.

7.3.14 **Printer Offline**

possible reason：Poor connection between the printer and the analyzer.

Recommended Action

Check if the printer is well connected to the analyzer.

If the problem remains, shut down your analyzer and change CPU board.

7.3.15 **Vacuum Filter Error**

possible reason：The air inside the vacuum chamber is not extracted within the given time.

Recommended Action

1. Enter the “**Service → System Test**” screen and test the “Vacuum” as instructed in Chapter 10.6. The error will be removed if the test result is normal;
2. If the problem remains, change a new filter;。

7.3.16 **Ambient Temp. Abnormal**

possible reason:：Abnormal ambient temperature or temperature transducer error.

Recommended Action

Enter the “**Service → System Status**” screen to check the ambient temperature;

If the actual ambient exceeds the pre-defined ambient temperature, adjust the temperature. Otherwise, the analysis results may be unreliable;

If the actual temperature is within the pre-defined range and the problem remains, change sensor and CPU board

7.3.17 **Recorder out of paper**

possible reason：Recorder paper running out or not properly installed..

Recommended Action

Check if the recorder paper has run out. If so, install the paper

Check if the recorder paper is properly installed. If not, re-install the paper

If the problem remains, check the recorder module

7.3.18 **Recorder Com Error**

possible reason：Poor connection between the recorder and the analyzer;

Damaged recorder.

Recommended Action

If the problem remains, shut down your analyzer and check the recorder module and CPU board and power supply.

7.3.19 **Recorder too Hot**

possible reason：Recorder head too hot.

Recommended Action:

Stop using the recorder.

7.3.20 **Press Bar Up**

possible reason：Tension lever not replaced

Recommended Action:

Stop using the recorder. Press the tension lever。

If the problem remains, shut down your analyzer and check the recorder module

7.3.21 **Rotation Motor Error**

possible reason：

1. **Jammed sample probe;**
2. **Poor contact of the signal line;**
3. **Damaged motor;**
4. **Poor connection between the drive board and the CUP board;**
5. Malfunctioning photo coupler.

Recommended Action:

6. Open the front panel and check if the sample probe is jammed;
7. Enter the “**Service → System Test**” screen and check the motor as instructed in **operation manual**. The error will be removed if the test result is normal

7.3.22 Lyse Expiry

possible reason：Expired lyse or wrong expiration setting.

Recommended Action:

Check if the lyse has expired. If so, change a new container of lyse

If not, reset the expiration date

7.3.23 Elevator Motor Error

possible reason：Jammed sample probe;

Poor contact of the signal line;

Damaged motor;

Poor connection between the drive board and the CUPboard;

Malfunctioning photo coupler.

Recommended Action:

Open the front panel and check if the sample probe is jammed;

Enter the “**Service → System Test**” screen and check the motor as instructed in operation manual. The error will be removed if the test result is normal;

7.3.24 Real-Time Clock Error

possible reason：Someone tempered with the on-board battery off the board;

Something is wrong with the on-battery (poor contact, dead battery, etc.);

Recommended Action:

Enter “**Setup → Date & Time**” screen and reset the time as instructed by **Chapter 5.7**. Restart the analyzer after the adjustment and the time should be correct;

If the problem remains, shut down your analyzer and check the battery on CPU board and CPU board.

7.3.25 **Barcode Error**

possible reason：Poor connection between the scanner and the analyzer;

Invalid bar code.

Recommended Action:

Check if the analyzer is well connected to the analyzer;

Check if the bar code is valid;

Check the bar code and cpu board

7.3.26 **Barcode Com Error**

possible reason：Poor connection between the scanner and the analyzer.

Recommended Action:

Check if the analyzer is well connected to the analyzer;

Check the bar code and cpu board。

7.3.27 **Com Error**

possible reason：Communication cable not well connected;

Inappropriate communication settings.

Recommended Action:

Check if the communication cable is well connected;

Check the communication settings as instructed by **operation manual** and make sure they are the same with the host.

7.3.28 **File Error**

possible reason：Something is wrong with the file system.

Recommended Action:

Shut down the analyzer and check disk on module, CPU board

7.3.29 **Rinse Empty**

possible reason：No rinse or a malfunctioning level transducer.

Recommended Action:

1. **Check if the rinse has run out, and if so, Change a new container of rinse**

2. Check transducer

7.3.30 Lyse Empty

possible reason：No lyse or a malfunctioning level transducer.

Recommended Action:

1. **Check if the rinse has run out, and if so, Change a new container of rinse**

2. **Check transducer**

7.3.31 Diluent Empty

possible reason：No Diluent or a malfunctioning level transducer.

Recommended Action:

Check if the rinse has run out, and if so, Change a new container of rinse

Check transducer

7.3.32 Diluent Expiry

possible reason：Expired Diluent or wrong expiration setting.

Recommended Action:

Check if the Diluent has expired. If so, change a new container of lyse

If not, reset the expiration date

7.3.33 Pressure 1 low

possible reason：The pressure inside the vacuum chamber does not reach the expected value within the given time.

Recommended Action:

Enter the "**Service → System Tes**t" screen and do the "**Pressure 1**" procedure as instructed in **operation manual** The error will be removed if the test result is normal;

check tubing system and analog board

7.3.34 **Vacuum Low**

possible reason：The vacuum degree does not reach the expected value within the given time.

Recommended Action:

Check the tubes connected to the back of the analyzer and make sure they are not pressed;

If the tubes are fine, enter the “**Service** → **System Test**” screen and test the “**Vacuum**” as instructed in **operation manual**. The error will be removed if the test result is normal

check tubing system and analog board

7.3.35 **Pressure 2 Low**

possible reason：The pressure inside the pressure chamber does not reach the expected value within the given time

Recommended Action:

Enter the “**Service** → **System Test**” screen and test the “**Chamber Pressure**” as instructed in **operation manual.** The error will be removed if the test result is normal

Check tubing system and analog board

7.3.36 **10ml Motor Error**

Syringe moters are used to control the volume of adding or draining sample and reagent.

possible reason：Pressed or blocked tubes;

Poor contact of the signal line;

Damaged motor;

Poor connection between the drive board and the CUPboard;

Malfunctioning photo coupler.

Recommended Action

1. **Check if the tubes at the back of the analyzer is pressed or blocked;**

2. If not, enter the “**Service** → **System Test**” screen and check the motor as instructed in

operation manual The error will be removed if the test result is normal;

7.3.37 **2.5ml&50ul Motor Error**

Syringe moters are used to control the volume of adding or draining sample and reagent. Possible reason：

Poor contact of the signal line;

Damaged motor;

Poor connection between the drive board and the CUP board;

Malfunctioning photo coupler

Recommended Action

Enter the "**Service** → **System Test**" screen and check the motor as instructed in **operation manual** *The* error will be removed if the test result is normal.

7.3.38 **DC-DC 12V Error**

Possible reason：Something is wrong with the internal DC power supplies.

Recommended Action:

Enter the "**Service**" → "**System Status**" screen and record the "**DC-DC 12V**" values.

If the reading is not within the 11.04V—12.96V range, shut down the analyzer and check analog board

7.3.39 **DC-DC -12V Error**

Possible reason：Something is wrong with the internal DC power supplies.

Recommended Action:

Enter the "**Service**" → "**System Status**" screen and record the "**DC-DC -12V**" values.

If the reading is not within the -11.04V—-12.96V range, shut down the analyzer and check analog board.

7.3.40 **5V Power Error**

possible reason：Something is wrong with the power board.

Recommended Action:

Enter the "**Service → System Status**" screen and record the "**5V**" voltage;

Shut down the analyzer and check analog board

7.3.41 **3V Power Error**

possible reason：Something is wrong with the 5V power supply.

Recommended Action:

Enter the "**Service → System Status**" screen and record the "**3.3V**" voltage;

Shut down the analyzer and check analog board

7.3.42 **56V Power Error**

possible reason：Something is wrong with the power board.

Recommended Action:

Enter the "**Service → System Status**" screen and record the "**56V**" voltage;

Shut down the analyzer and check analog board

Chapter8 Password

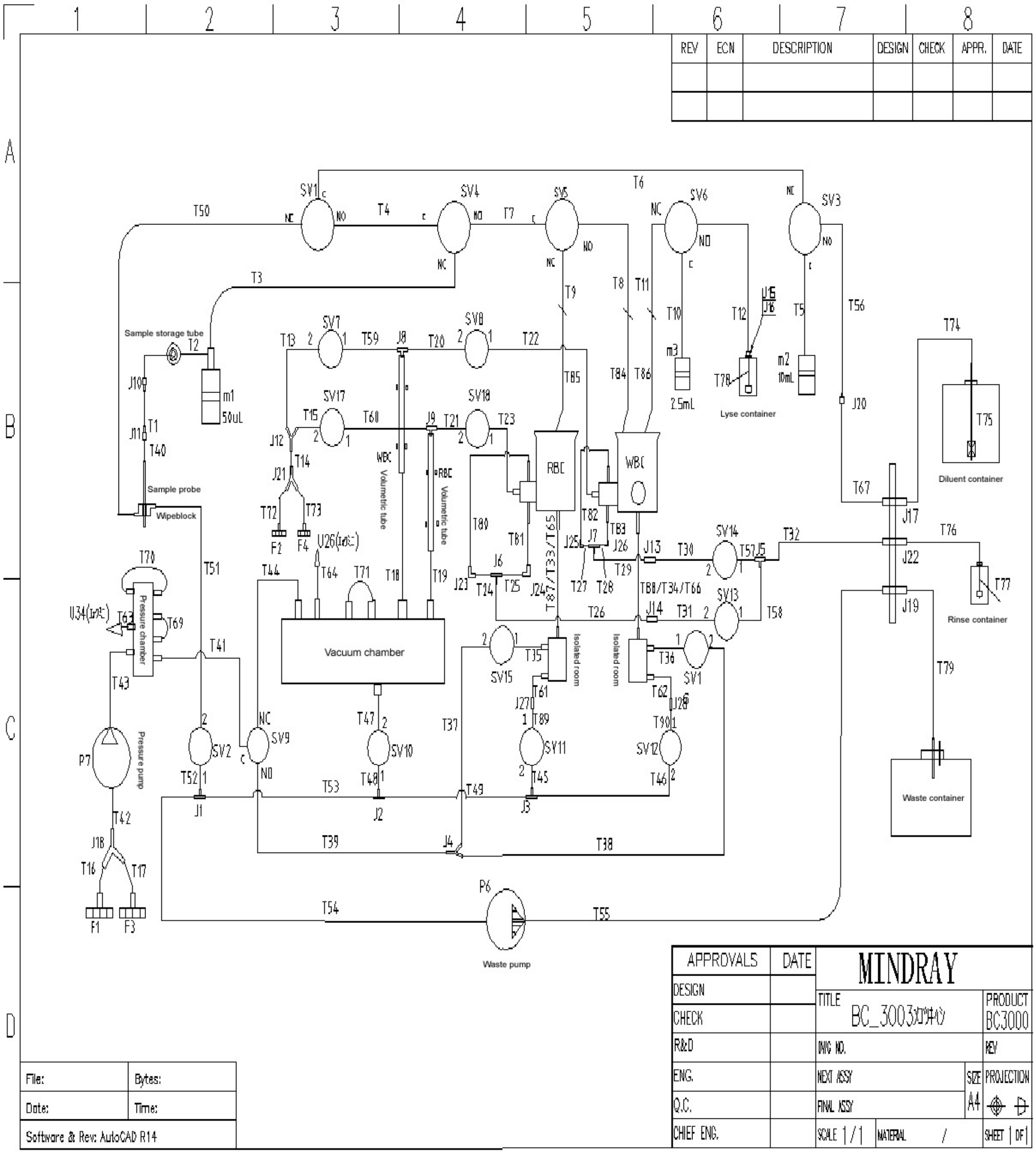
Level	Password	Operation menu	Functions
1	Service engineer (3210)	Count	press[1]、[2]、[3]view WBC、RBC、PLT pulse graph
		Count	Press [↑] to upgrade
		Review\histogram	[F5] sample information
		Review\table	Delete sample results
		Setup\other	1、Display and modify "delete sample results" option: On/off 2、Change language
		Setup\other	press[DEL], view configuraton
		Service\error	press[DEL], delete error message
		Setup\gain	View PLT gain (can't be changed)
2	administrator (3000)	Setup	Adjust WBC(WH/PRE)、RBC、HGB gain (Counting time) counting time (parameter unit) parameter unit (Reference range) general/man/woman/child/neonate
		Calibrator\manual	Calibrate by manual
		Calibrator\auto	Calibrate by auto
		Calibrator\fresh	Calibrate by fresh blood
		Service\system test	Test the running status of the motor
		Review\table	"delete sample results" option: on, delete sample results
3	user	Refer to operation manual	

AppendixA Spare part list

Part number	Part name
0000-10-10937	Keyboard 104 button
3001-20-06898	STARTbutton
3003-30-34926	Sample probe assembly
3001-10-18499	Rotation motor
3001-10-18516	Elevator motor
3001-10-07059	Sample probe
3001-30-06957	Wipe block assembly
3001-30-06931	WBC bath
3001-30-06930	RBCbath
3003-30-34921	Pump assembly
530B-10-05275	Rotation pump（pressure pump）
3003-20-34941	3 way ASCO valve
3003-20-34942	2 way ASCOvalve
3003-30-34909	Volumetric board
3003-30-34927	Syringes assembly
3001-30-07021	Vacuum chamber assembly
3003-30-34910	CPUboard
3003-30-34911	Power driver board
3003-30-34903	Analog board
0000-10-10910	64M module on disk
2800-30-28670	Power supply board
3001-20-07072	transformerYP2888
3003-20-34934	Keypad panel
3001-30-06870	Indicate board
3003-30-34905	keypad

Part number	Part name
3003-30-34887	LCD assembly
TR6D-30-16659	TR60-D recoder
TR6D-30-16662	TR60-D recorder driver board
3001-20-07172	Front bath clip
3001-10-07054	Filter
3001-10-07207	Cross screw driver
3001-10-07208	Wrench
3001-30-06925	CAP Component For Rinse
3001-30-06923	CAP Component For Lyse
3001-30-06924	CAP Component For Diluent
3001-20-07247	Localizer

Liquid System diagram



P/N：3003-20-34859（1.2）