Somnus® DM18 APAP

CPAP Ventilator

Service Manual

Preface

Thank you for purchasing the CPAP Ventilator manufactured by Dymind Biotech.

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

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

Product name: CPAP Ventilator

Model: DM18 APAP

CE 0197

Contact Information of Service Department

Manufacturer: Shenzhen Dymind Biotechnology Co., Ltd.

Address: 2/F, Nanfeng Building B, Nanshan Yungu Innovation Industrial Park, No.1183, Liuxian Blvd, Taoyuan Street, Nanshan District, Shenzhen 518055, P.R.China

European Representative: 5 Bankside, Hanborough Business Park, Witney Ox29 8LJ UK

24/7 Service Hotline: 400-998-7276

Tel.: +86 755 26008015

Fax: +86 755 26746162

Email: dymind@dymind.com.cn

Website: http://www.dymind.com.cn/english/

Intellectual Property Rights

Declaration

Dymind Biotech reserves the right of final interpretation of this service manual. The pictures in this service manual are indicative only. If there is inconsistency between the pictures and the actual product, the actual product shall govern. Do not use the pictures for other than intended use.

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

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

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Maintenance Services

Scope of free services:

All products complying with Dymind Biotech's Product Warranty specifications may qualify for free services.

Scope of fee-based services:

- Free services are available to all products exceeding Dymind Biotech's Product Warranty specifications.
- Products within the warranty period require maintenance under the following circumstances:
  - Artificial damage
  - Improper use
  - When grid voltage exceeds the specified operational range
  - Unavoidable natural disasters
  - When parts and supplies are replaced with no prior consent from Dymind Biotech, or machine maintenance is performed by personnel with no prior authorization from Dymind Biotech

WARNING

Any failure by hospitals or organizations responsible for using the device to implement a competent repair/maintenance plan is likely to result in abnormal instrument failure or even a health hazard.

Contents

1 Overview

This chapter explains the procedures for maintaining CPAP Ventilator. Please read this manual carefully to guarantee proper device maintenance and operator safety.

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

NOTE

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

1.1 Who Should Read This Manual

This service manual should be used by professionals who possess:

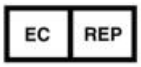
- A comprehensive knowledge of electrical circuits
- A comprehensive knowledge of troubleshooting
- The ability to skillfully operate this ventilator
- An understanding of basic mechanical tools and any relevant terms
- Skills for using digital voltmeters and oscilloscopes
- The ability to analyze electrical-circuit graphs and to understand the related terminology

1.2 Symbols and Legends

The symbols that may be found in this document are defined as follows.

Symbol	It means
 WARNING	Alert you to injury if not operating based on the description under this symbol.
NOTE	Alerts you to device damage if not operating based on the description under this symbol.

You may find the following symbols of the ventilator system:

Symbol	It means
	Alert you to injury if not operating based on the description under this symbol.
	Serial No.
	Date of manufacture
	Manufacturer
IP21	Ingress protection
	Type BF applied part
	Refer to the operator's manual
	European CE declaration of conformity
	Authorized EU Representative

1.3 Safety Instructions

Device maintenance done in accordance with the following instructions guarantees the safety of both patients and operators.

WARNING

- To prevent risk of explosion, do not use combustible gases (e.g. anesthetics) or liquids (e.g. ethanol) near this product.
- The machine should be powered off while troubleshooting. Any maintenance operation while the power is on can lead to electric shock or damage to its electrical components.
- Please connect the device to the socket using a separate fuse and surge protection switch. If the device shares a fuse and surge protection switch with other equipment, e.g. life support equipment, any malfunction may cause an electric surge to occur when the instrument is powered on, which can trip the circuit breaker.

NOTE

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

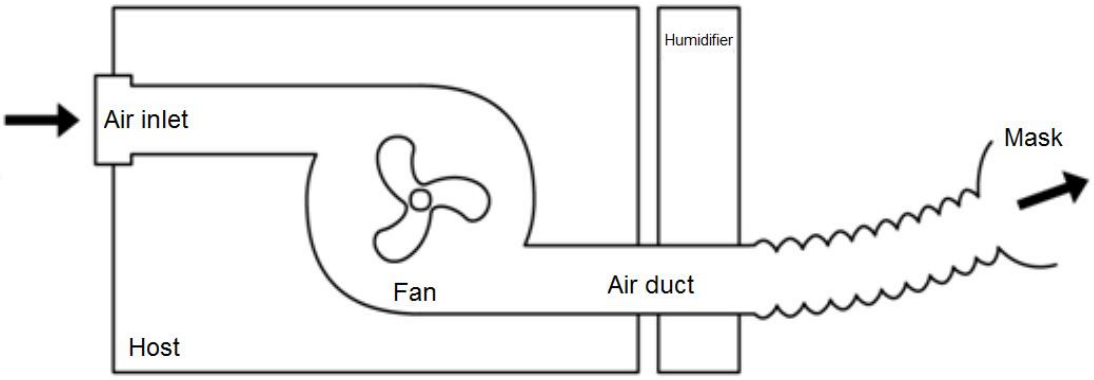
2 Device Composition

2.1 Mechanical System

2.1.1 Working Principles

The CPAP Ventilator uses dedicated air compressor to compress filtered air from the surrounding environment to produce continuous positive pressure. The positive pressure is transported to the patient through a breathing tube. The upper airway of the patient is kept open under the positive pressure so that the patient can breathe normally. The working principle of the ventilator is illustrated by Figure 2-1.

Figure 2-1 Working Principle



The ventilator is operated by using the display screen and control buttons on top of the host. The device functions are adjustable. The ventilator is fitted with a heated humidifier, which is used to increase the temperature and humidity of the breathed air so as to prevent mucosa drying in nasal cavity and ensure comfort of the patient.

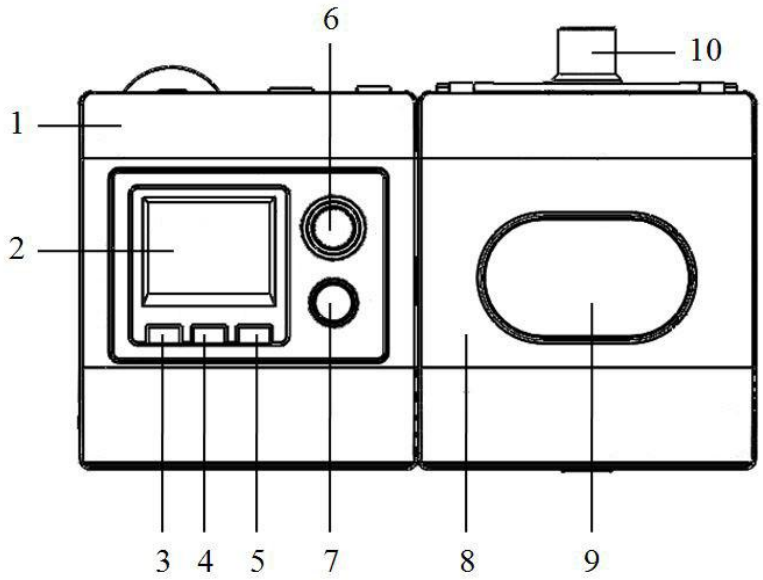
2.1.2 Mechanical Composition

DM18 APAP CPAP Ventilator mainly includes two parts: the host and the humidifier. Among them:

- The host is composed of the main control panel assembly system, fan module power system and air inlet & outlet duct system.
- The humidifier is composed of the water tub assembly, main humidifier tripping assembly, humidifier sealing assembly and humidifier exhaust unit.

Front view of CPAP Ventilator is shown in Figure 2-2.

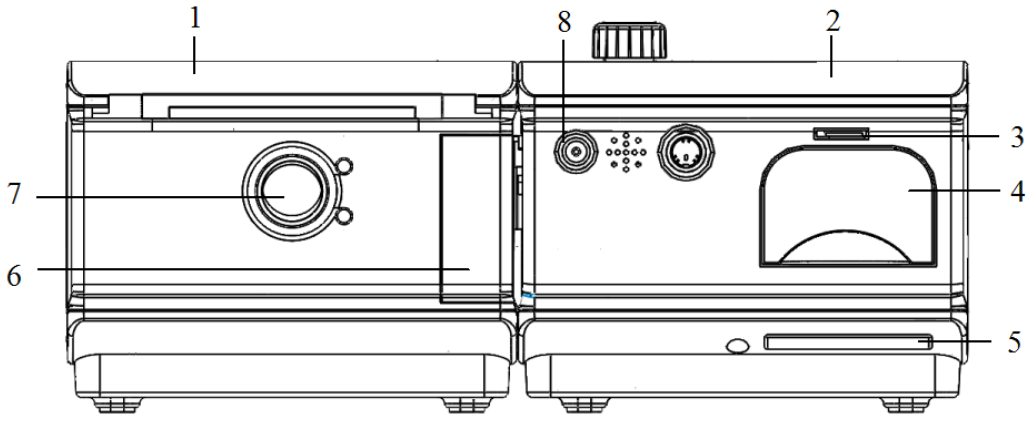
Figure 2-2 Front view of the ventilator



1 - Host	2 - Display screen
3 - Information button	4 - Setup button
5 - Return button	6 - Shuttle button
7 - Start/Stop button	8 - Humidifier
9 - Humidifier window	10 - Humidifier air outlet

Rear view of CPAP Ventilator is shown in Figure 2-3.

Figure 2-3 Rear view of the ventilator



1 - Host	2 - Humidifier
3 - SD card interface	4 – Air filter and air filter cover:
5 - Air inlet	6 - Humidifier separation button
7 - Air outlet	8 - DC power interface

2.2 Hardware System

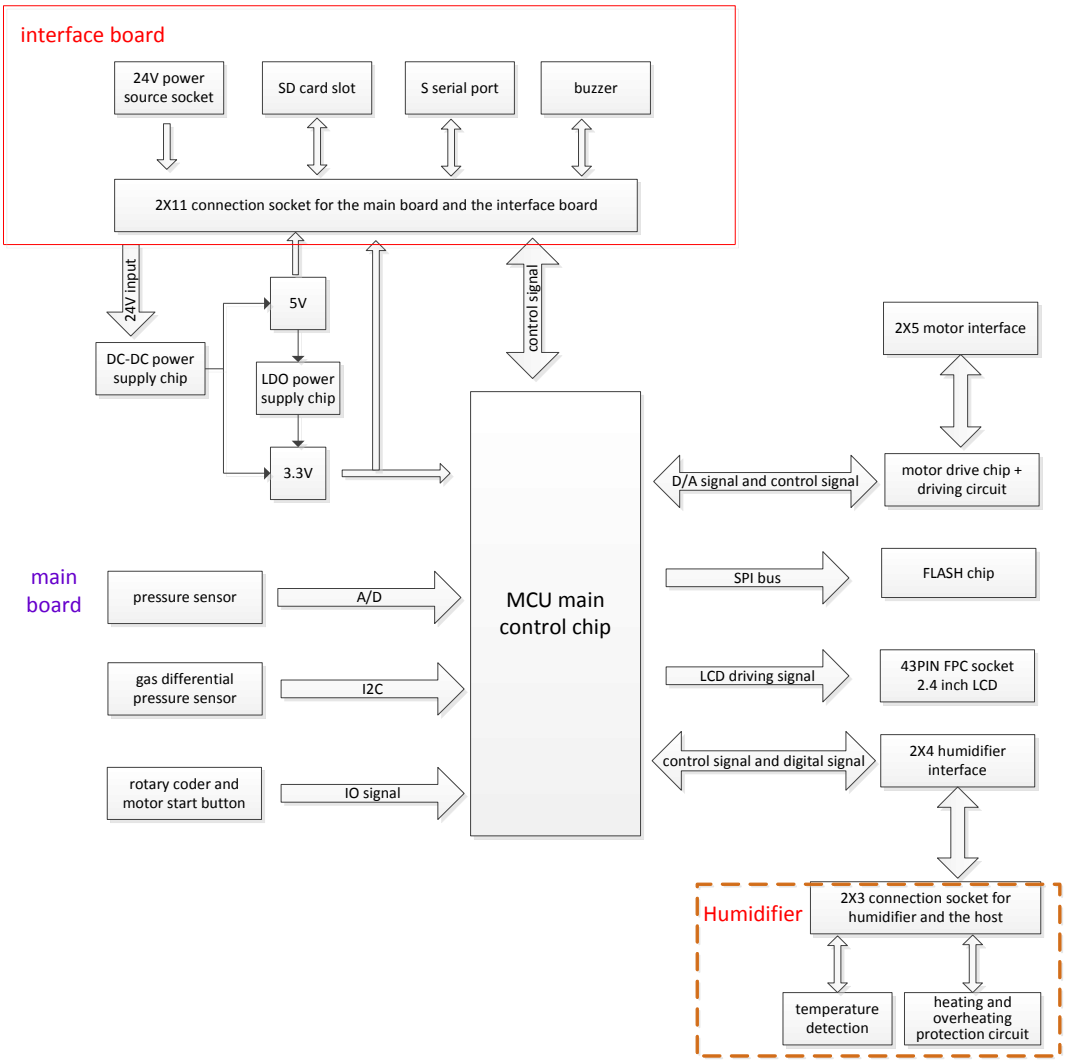
2.2.1 Hardware Composition

The hardware circuit of DM18 APAP CPAP Ventilator mainly includes two parts: the hardware main control panel of the host and humidifier control circuit.

- The hardware main control panel of the host includes two parts: the mainboard and interface board.
- The humidifier control circuit is the circuit composed of the heater, temperature sensor and temperature detect switch.

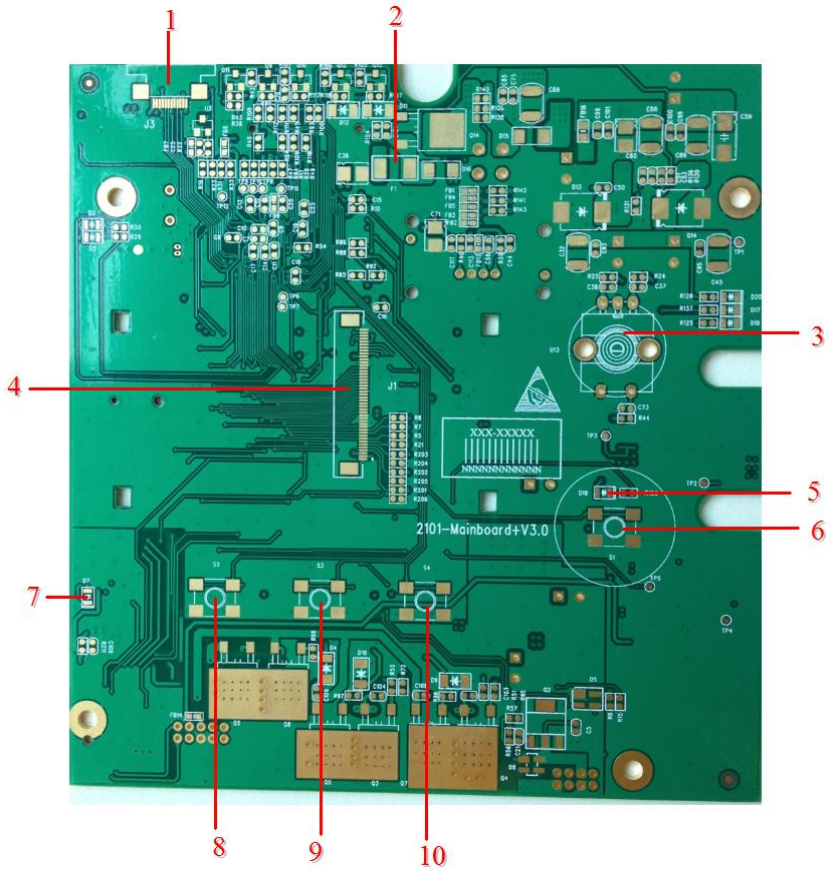
The system hardware block diagram is shown in Figure 2-4.

Figure 2-4 System hardware block diagram



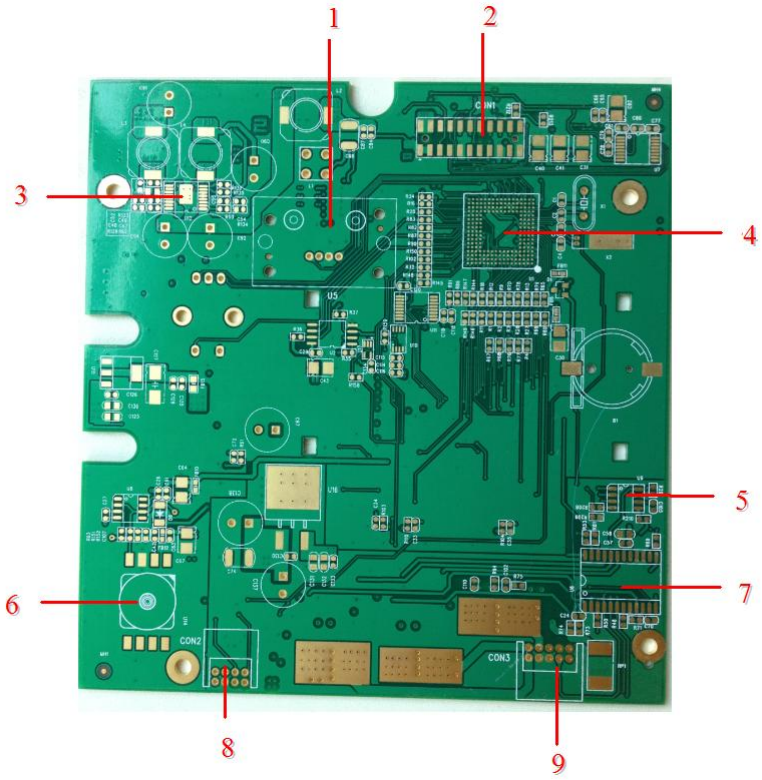
Specific physical maps of the double sided layout of the mainboard are shown in Figure 2-5 and Figure 2-6.

Figure 2-5 Front view of the mainboard



1 - Program downloading interface	2 - fuse
3 - Rotary coder	4 - Display screen FPC socket
5 - Motor start indicator light	6 - Motor start button
7 - Motor operation indicator light	8~10 - Display screen operation buttons

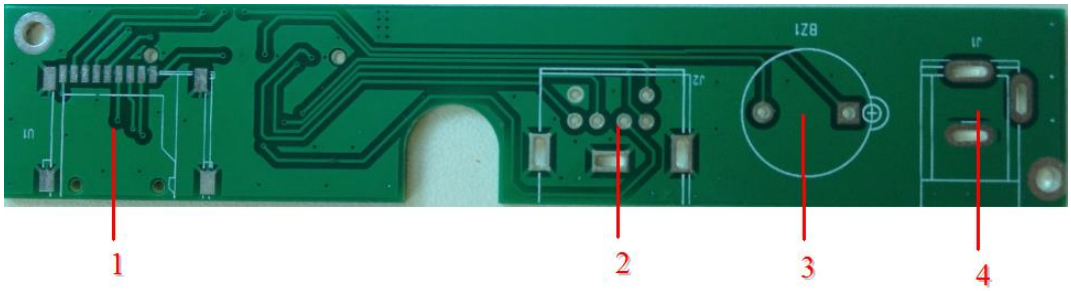
Figure 2-6 Rear view of the mainboard



1 - Gas differential pressure sensor	2 - Male socket of the mainboard and interface board
3 - Power supply chip	4 - MCU chip
5 - Motor speed controller	6 - Pressure sensor
7 - Motor driver	8 - Humidifier interface
9 - Motor interface	

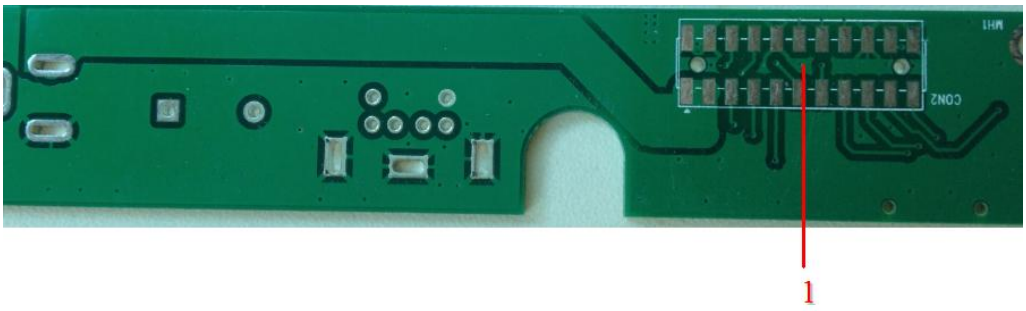
The hardware layout of the interface board is shown in Figure 2-7.

Figure 2-7 Front view of the interface board



1 - SD card slot	2 - S serial port
3 - Buzzer	4 - 24V power supply socket

Figure 2-8 Bottom view of the interface board



1 - Interface female socket for the interface board and mainboard

2.2.2 Main Control Panel Detection

Hardware main control panel interfaces include the external interface of the interface board, power supply interface J1, software upgrading serial port J2, Micro SD card slot U1. The internal interface is 2X11 interface female sockets CON2 connecting to the mainboard. The internal interfaces of the mainboard are 2X5 motor interfaces which connect to the motor. The external interfaces are 2X3 interface male sockets connecting to the humidifier. The interface for the partial circuit of the humidifier is 2X3 interface female sockets. All circuit wiring is connected to the connector. The temperature detect switch (TDS) is connected with the heater in series. The protection circuit temperature shall not exceed 75 ℃. Both the temperature sensor and the temperature detect switch shall be fixed with fixing blocks.

2.2.3 Maintenance of the Main Control Panel

The maintenance of the main control panel mostly deals with problems not related to connections. In theory, only designated maintenance professionals are allowed to perform the maintenance steps for the main control panel. If non-connectivity problems occur on the mainboard and the interface board, please replace them directly. The maintenance of the main control panel only applies to designated maintenance professionals.

Generally, the hardware main control panel problem is caused by power failure. If functional problems occur, it can be tested by replacing with the correct mainboard directly. There are four steps for locating specific problems.

1. Look. Power on the main control panel and pay attention to the power indicator lights. If any abnormality is spotted, then there is something wrong with the loading of the indicator light’s corresponding power supply. Light abnormality refers to situations in which a light is off or dimmer than normal.
2. Smell. Some components may be burned out due to power failure. The damaged components can be roughly determined via smell, and do not power on during determination.
3. Touch. Power on and touch the corresponding component on the main control panel by hand (Do not touch it for a long time in order to prevent scorching). If the temperature feels hot, the component could be broken.
4. Test. The first three steps can be used to identify power overload problems on the main control panel.

Step 4 is designed for determining what has malfunctioned. This step is also part of maintenance. A multimeter is used to test for power problems. Common problems have been described as above-mentioned power failure, connectivity problems and functional problems. If other unusual problems occur, it can be tested by replacing the main control panel directly.

3 Repairs

3.1 Overview

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

3.2 Preparatory Work before Repairs

- Refer to ***7 List of Spare Parts***, and get the spare parts for maintenance ready.
- Prepare the maintenance tools: #2 (Ph2) Phillips screwdriver

3.3 Disassembly of the Host's Top Panel Cover

Purpose

During maintenance and overhauling of the machine, it is necessary to disassemble the host's top panel cover when replacing the LCD screen, main control panel, power supply interface board, interface socket for host and humidifier, fan, etc.

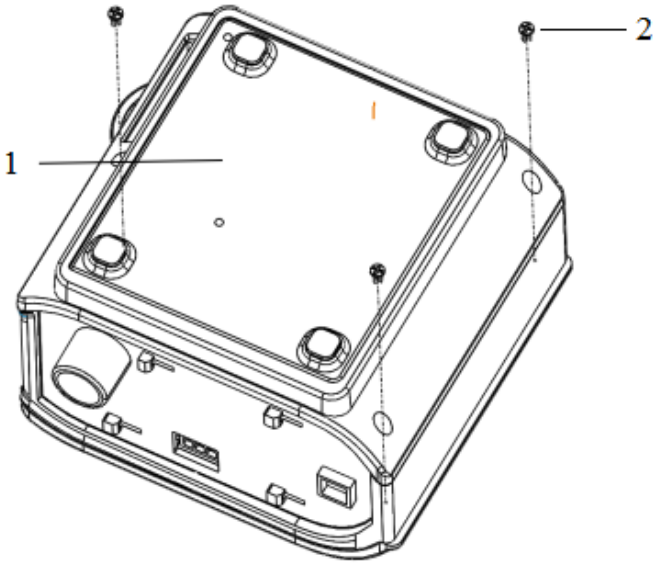
Tools/Spare Parts

#2 (Ph2) Phillips screwdriver

Disassembly

1. Pull out the power plug and all external connections of the host.
2. If the host is connected to the humidifier, separate them.
3. Remove all three M3X8 machine thread screws in the host base, see Figure 3-1.

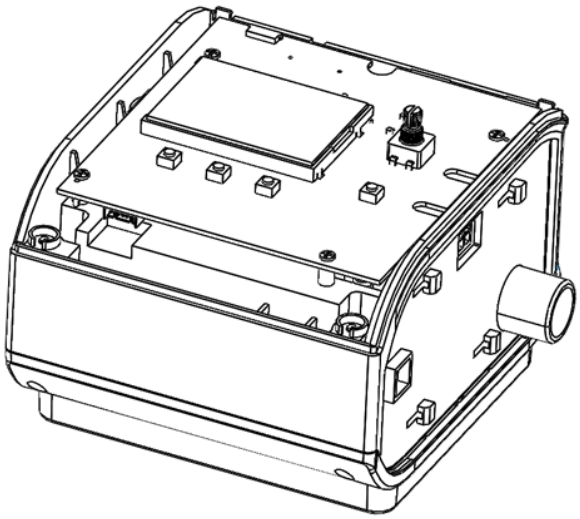
Figure 3-1 Disassembly of the host's top panel cover (1)



1 - Host base	2 - M3X8 machine thread screw (x3)

4. Remove the host's top panel cover as shown in the picture below.

Figure 3-2 Disassembly of the host's top panel cover (2)



Installation

Follow the corresponding disassembly steps in reverse order. Pay attention to tighten all the binding screws, and do not miss any.

3.4 Disassembly and Replacing of the LCD

Purpose

Follow the operations in this section to complete the disassembly and replacing of the liquid crystal display (LCD).

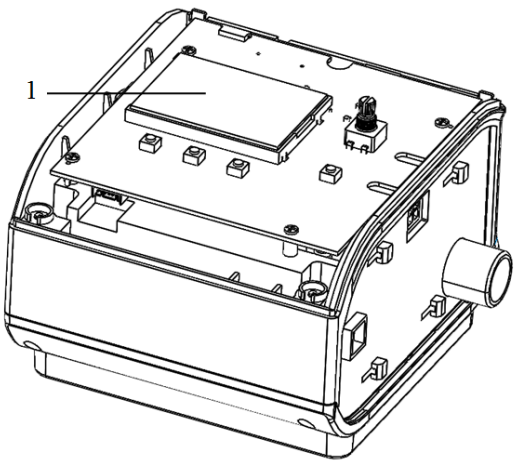
Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- Corresponding liquid crystal display specifications

Disassembly

1. Refer to ***3.3 Disassembly of the Host's Top Panel Cover***, and remove the host's top panel cover.
2. See the picture below, remove the LCD screen, and replace with the new screen.

Figure 3-3 Disassembly and replacing of the LCD screen



1 – LCD Screen	

Installation

Follow the corresponding disassembly steps in reverse order.

NOTE

- When installing the display screen, protect the ribbon cable from being broken off.
- Tighten all the screws, and do not miss any.

3.5 Disassembly and Replacing of the PCB Mainboard

Purpose

Follow the operations in this section to complete the disassembly and replacing of ventilator's PCB mainboard.

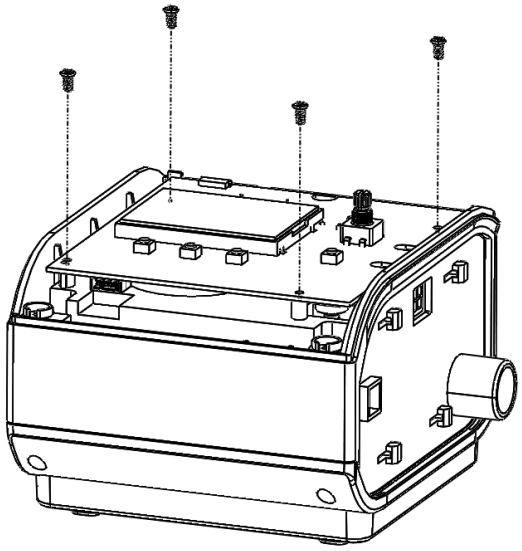
Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- Corresponding ventilator PCB mainboard specifications

Disassembly

1. Refer to ***3.3 Disassembly of the Host's Top Panel Cover***, and remove the host's top panel cover.
2. Remove the top plastic shell of the ventilator host, screw out all four screws to fasten the main control panel of the ventilator as shown in picture below.

Figure 3-4 Sketch map of PCB mainboard



3. Pull out all the power plugs connecting to the ventilator, remove damaged PCB mainboard of the ventilator.

Installation

Follow the corresponding disassembly steps in reverse order.

NOTE

- Plug all the power plugs connecting to the PCB mainboard into their corresponding position on the PCB mainboard.
- Tighten all the binding screws, and do not miss any.

3.6 Disassembly and Replacing of the Power Supply Interface Board

Purpose

Follow the operations in this section to complete the disassembly and replacing of the interface board.

Tools/Spare Parts

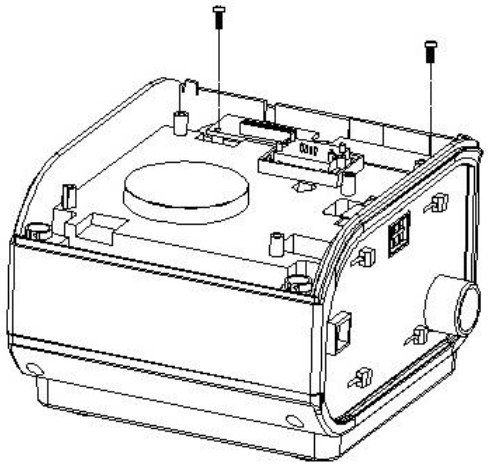
- #2 (Ph2) Phillips screwdriver
- Corresponding power supply interface board specifications

Disassembly

1. Refer to ***3.5 Disassembly and Replacing of the PCB Mainboard***, and remove the PCB mainboard.

   See the picture below. Now, the power supply interface board is fixed on the host shell via two screws.

Figure 3-5 Power supply interface board



2. Unscrew both screws using a screw driver, and remove the power supply interface board.

Installation

Follow the corresponding disassembly steps in reverse order.

NOTE

- The power supply interface board shall be well connected.
- Plug all the power plugs connecting to the PCB mainboard into their corresponding position on the PCB mainboard.
- Tighten all the binding screws, and do not miss any.

3.7 Disassembly and Replacing of the Host and Humidifier Interface Sockets

Purpose

Follow the operations in this section to complete the disassembly and replacing of the host and humidifier interface sockets.

Tools/Spare Parts

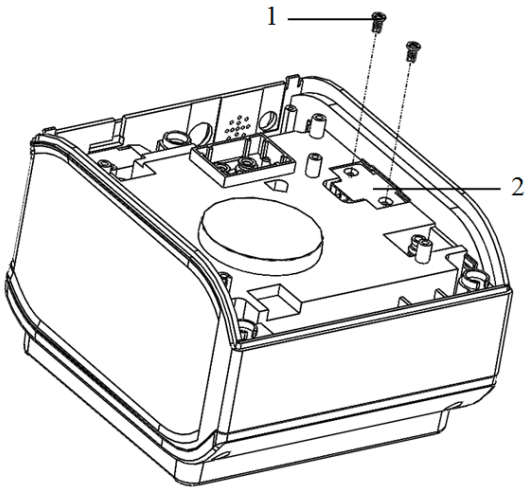
- #2 (Ph2) Phillips screwdriver
- Complete and functional female socket of host and male socket of humidifier

Disassembly

Disassembly steps of the host female terminal block are as follows:

1. Refer to ***3.5 Disassembly and Replacing of the PCB Mainboard***, and remove the PCB mainboard.
2. Remove both tapping screws fastening the female terminal block, pull out the terminal block interface from the PCB mainboard, and disassemble the female terminal block.

Figure 3-6 Disassembly of host's female terminal block

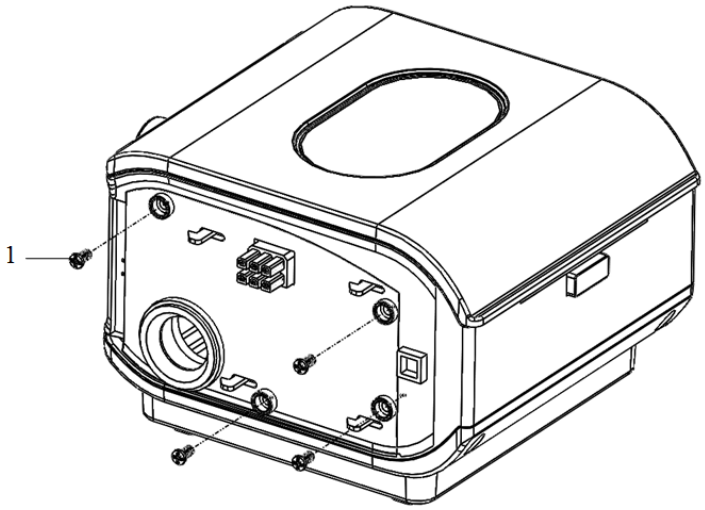


1 - M3X6 countersunk head tapping screw (x2)	2 - Female terminal block

Disassembly steps of humidifier male terminal block are as follows:

1. See Figure 3-7, first remove all 4 screws fixing the left side plate of the humidifier.

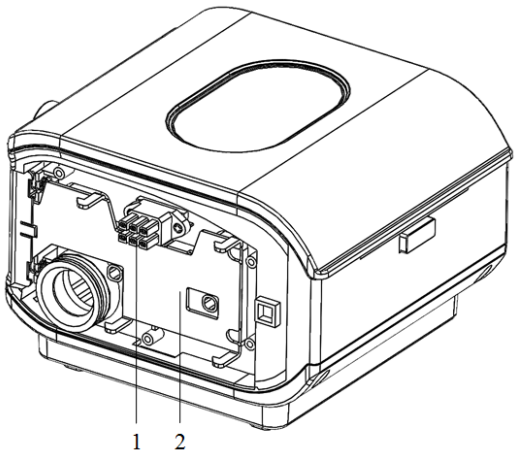
Figure 3-7 Disassembly of humidifier's male terminal block (1)



1 - M3X6 tapping screw (x3)	

2. Remove the left side plate, and then remove the tripping button panel of the main humidifier.

Figure 3-8 Disassembly of humidifier's male terminal block (2)



1 - Male terminal block	2 - Tripping button panel of the main humidifier

NOTE

When removing the tripping button panel of the main humidifier, be cautious not to remove both springs.

Installation

Follow the corresponding disassembly steps in reverse order.

NOTE

When assembling the tripping button panel of the main humidifier, it is necessary to level the male terminal wire rod, otherwise, movement of the tripping button panel of the main humidifier will be influenced.

3.8 Replacing of Motor

Purpose

Follow the operations in this section to complete the disassembly and replacing of the motor.

Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- Motor of corresponding specification

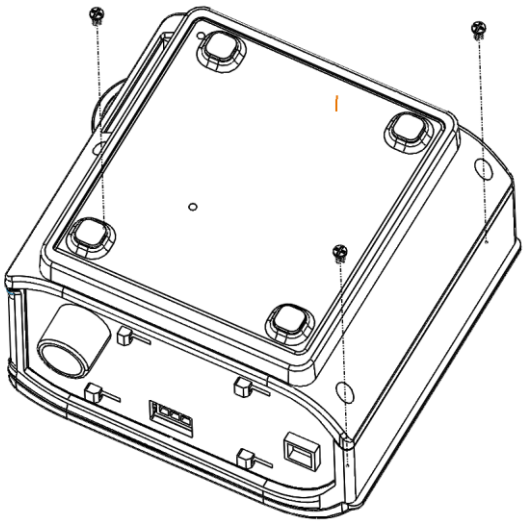
Preliminary Steps

Pull out the host power supply plug, and separate the ventilator host from the humidifier.

Disassembly

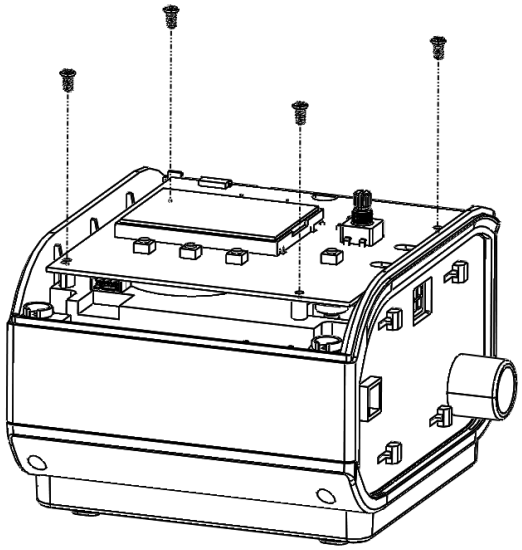
1. Remove all 3 M3X8 machine thread screws in the host base as shown in Figure 3-9.

Figure 3-9 Sketch map of motor disassembly (1)



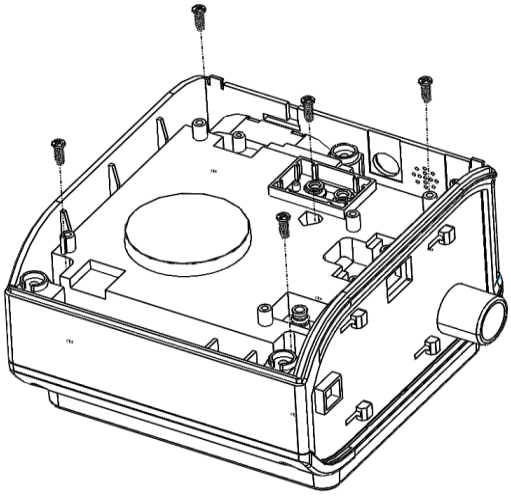
2. Remove the top plastic shell of the ventilator host, unscrew all 4 screws fixing the main control panel of the ventilator as shown in Figure 3-10.

Figure 3-10 Sketch map of motor disassembly (2)



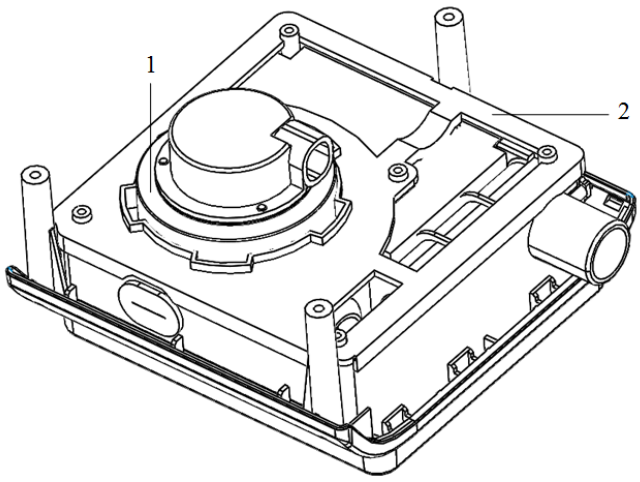
3. Pull out all the power supply plugs connecting to the ventilator, remove the main control panel of the ventilator, and unscrew all 5 screws fixing the middle plastic shell of the ventilator host and bottom base of ventilator. See Figure 3-11.

Figure 3-11 Sketch map of motor disassembly (3)



4. Remove the middle plastic shell of the ventilator, see Figure 3-12.

Figure 3-12 Sketch map of motor disassembly (4)



1 - Motor	2 - Sealing pad

5. Take off the sealing element, and remove the motor.

Installation

Follow the corresponding disassembly steps in reverse order.

NOTE

- When replacing the motor's air outlet, it must be fully stuck in the tower-type draft tube.
- Prior to the assembly of the ventilator's main control panel, it is required to plug both the motor power cable plug and host's female plug into their corresponding interfaces on the main control panel.
- Tighten all the binding screws, and do not miss any.

3.9 Replacing of Humidifier's Heating Element

Purpose

Follow the operations in this section to complete the disassembly and replacing of the humidifier's heating element.

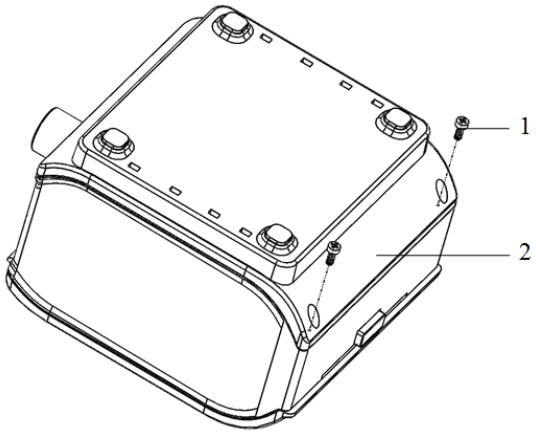
Tools/Spare Parts

- #2 (Ph2) Phillips screwdriver
- Complete and functional humidifier heater

Disassembly

1. Remove both screws fixing the lower shell of the humidifier, and disassemble the lower shell. See Figure 3-13.

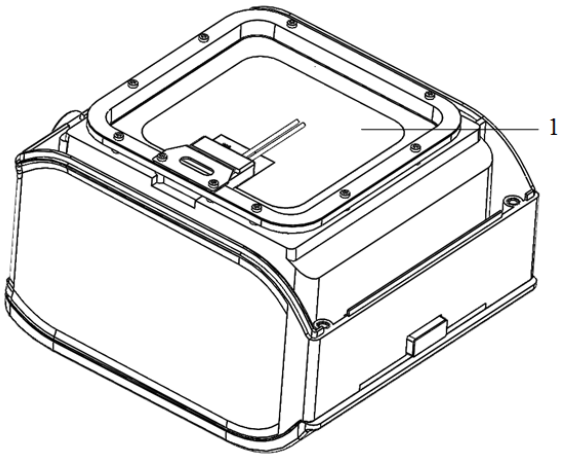
Figure 3-13 Disassembly of the humidifier's lower shell



1 - M3X8 machine thread screw (x2)	2 - Lower shell of the humidifier

2. Remove the heater as shown in Figure 3-14.

Figure 3-14 Disassembly of the heater



1 - Heater	

Installation

Replace with a new heater, and follow the corresponding disassembly steps in reverse order.

NOTE

- Both the temperature sensor and temperature detect switch shall be fixed on the heater using fixing blocks.
- The tripping button spring of the main humidifier must be installed in place.
- Tighten all the binding screws, and do not miss any.

4 Common Problems and Handling Methods

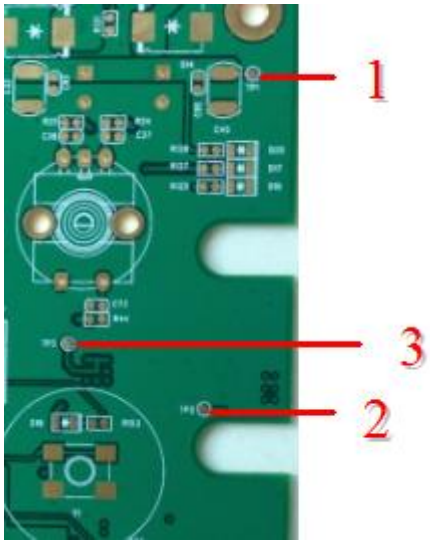
4.1 Power Failure

4.1.1 Location and solutions for power failure

Common power supply problems are mainly caused by short circuits. Check the power indicator light. If any abnormality is spotted, there may be short circuit with the power supply. Then, locate and solve the problem via the following methods:

1. Disconnect the power supply immediately.
2. Use a multimeter to check, connect the red probe to the test point prints of each power supply including TP1 (VCC24V), TP2 (VCC5V), TP3 (VCC3V3), and connect the black probe to the nearby screw or screw hole, set the multimeter to the diode grade, if the buzzer sounds, there may be a short circuit with the power supply. See Figure 2-2.

Figure 4-1 Test points of power supply voltage on the panel



1 - 24V voltage test point	2 - 5V voltage test point
3 - 3.3V voltage test point	

3. If a short circuit occurs on 24V voltage, replace the mainboard directly, and then, use a multimeter to test, and power on after no problems are detected.
4. If a short circuit occurs on 5V or 3.3V voltage, while the 24V voltage is normal, it is advisable to replace the circuit board directly. Use a multimeter to test the test points of each voltage and power on after no problems are detected.

4.1.2 Meaning of indicator lights

Indicator lights include power indicator light and motor start and operation indicator lights. Among them:

- The power indicator light basically indicates whether the voltage of the hardware circuit is normal or not.
- The motor indicator light is used to monitor the operational state of the motor and to indicate the motor has started treatment.

The table below shows specific meanings of each indicator light.

Table 4-1 Meaning of indicator lights

Position Code of Indicator Light	Meaning	Normal Status
D20	Power input 24V power supply indication	On
D17	MCU system 3.3V power supply indication	On
D19	Motor sensor and pressure sensor 5V power supply indication	On
D18	Motor start indicator light	On[a]
D7	Motor operation indicator light	Off[b]
D2 D3	Normal operation of MCU	Flashing

a - D18 is off after start-up. But it is on during the treatment; if the treatment has started without output, it is off.

b - When the motor stops turning, D7 is on.

4.2 Connectivity Problems

Connectivity problems mainly include poor contact between connectors, looseness of connectors. The connector interface base of each main control panel is unique, therefore, there will be no wrong connection phenomenon of connectors.

There are several phenomenon and solutions for connectivity problems listed below.

Unstable Operation or No Operation of the System after Powering on

First, check whether all four positioning holes are aligned with the screw holes, and whether all 3 positions of sensor are aligned with structural parts. If there is poor alignment, align again and then install.

System Not Operational after Powering on

Check whether there is looseness between the power supply interface and the input terminal, and test by powering on after plugging back in tightly.

Figure 4-2 Wrong power port connection

Figure 4-3 Correct power port connection

Motor Not Operational after the Treatment has Started

Check whether the 2X5 flexible socket CON3 connection between the motor interface and the mainboard is normal, test again after plugging back in tightly.

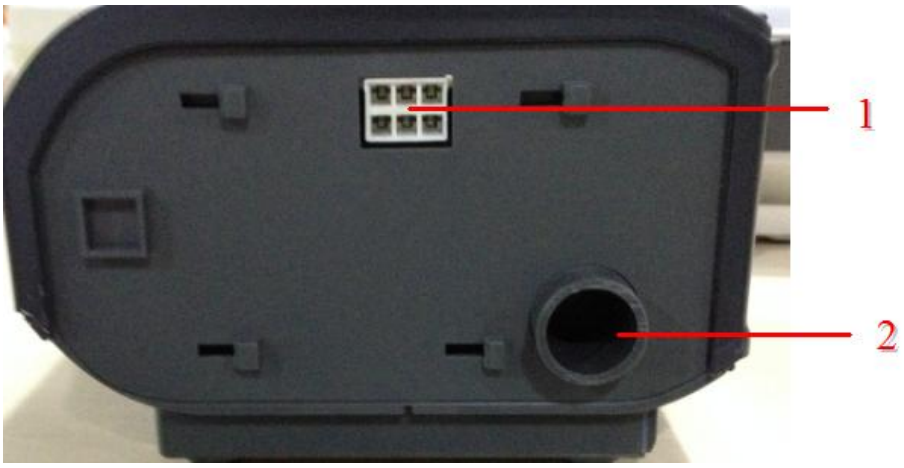
Figure 4-4 The mainboard and motor interface

1 - Motor interface	

No prompt after the humidifier is connected

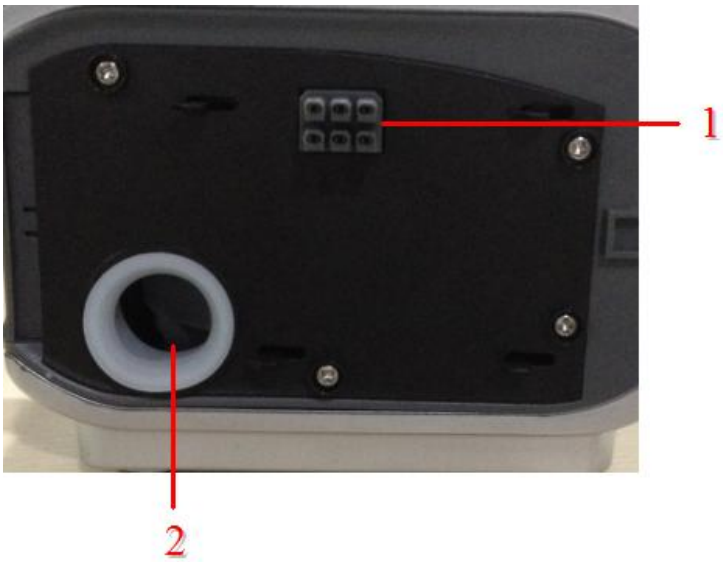
Check the 2X4 flexible socket CON2 connection between the humidifier interface and the mainboard, and the connection between the male socket of the host and female socket of the humidifier, test again after plugging back in tightly.

Figure 4-5 Interface female socket connecting the host to the humidifier



1 - Interface female socket for the host and the humidifier	2 - Air outlet

Figure 4-6 Interface male socket connecting the host to the humidifier



1 - Interface male socket for the host and the humidifier	2 - Air inlet

4.3 Functional Problems

After confirming the correct welding of hardware main control panel, functional problems of hardware main control panel mainly include no MCU operation, no motor operation, abnormal motor operation, no display of display screen, etc.

MCU abnormal operation

After the main control panel has powered on, if the power indicator light is in normal state, while

indicator lights D2, D3 of MCU are abnormal (normal state of them is flickering), it may be caused by unsuccessfully downloading a program or unsuccessfully loading a program. In this case, download the MCU program again via FPC socket, and observe whether the indicator lights are in normal condition. If indicator lights remain abnormal, there may be pseudo soldering or damage on MCU chip (it is advisable to replace the BGA chip at the U1 position).

No motor operation

If there is no motor operation after pressing the start button S1 of the motor, while the motor start indicator light is in normal state, there may be damage to the button S1 or pseudo soldering of S1 button pin. In this case, replace S1 button or check the welding pad, and test again.

Abnormal motor operation

If the motor starts to operate after pressing the start button S1, but indicator light D7 of the motor remains on, there may be abnormal motor operation. It may be caused by motor burnout (less likely), burnout of power resistor 0.1 R, overloading, MOS tube burnout caused by too high temperature of MOS tube, and so on, in this case, it is required to replace the damaged component.

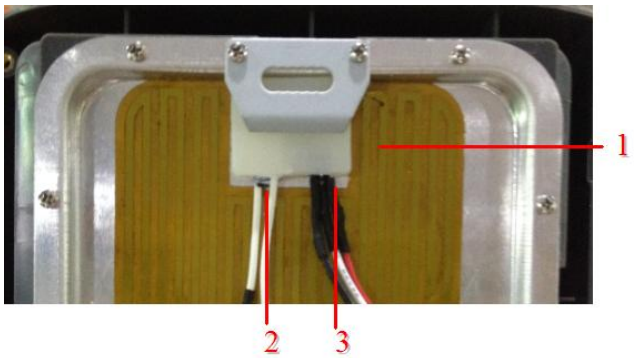
Abnormal display

After the system has powered on, if there is a black screen, blurred screen, or flickering screen, it may be caused by damage or burnout of drive LED back-lit chip U10, poor connection between the FPC cable and FPC socket of the display screen, or pseudo soldering or adhered tin of FPC base. Replace the LED drive chip or pull out the FPC cable and reconnect, the display screen may be blurred or flashing.

Partial circuit problem of the humidifier

If the heating circuit cannot heat the water tub, it may be caused by a malfunctioning temperature detect switch and temperature sensor. The heating circuit of the humidifier is shown in the picture below.

Figure 4-7 Partial circuit of the humidifier



1 - Heater	2 - Thermal switch
3 - Temperature sensor	

4.4 Hardware Problems

For hardware problems, on the basis of ***2.2.3 Maintenance of the Main Control Panel***, please first exclude system problems caused by power failure. Confirm that there is no power failure, and check corresponding problems. Relatively common hardware problems are shown in the table below.

NOTE

For hardware problems, on-site disassembly for maintenance is not allowed. Faulty machines shall be sent to the agent or designated service department for repairs.

Problem Description	Problem Indicators	Solution
Mainboard not operational	3.3V power indicator light D17 is off.	1. Check whether indicator lights D19, D20 are illuminated. If D20 is illuminated, while D19 is off, power chip U12 may be damaged. ReplaceU12 and test with power on. If all D17, D19 and D20 are illuminated, it is normal. 2. Use a multimeter to measure the voltage value of the 3.3V test point. If it is 0V or far less than 3.3V, there may be a short circuit at the 3.3V output terminal or at lower load, and it can be solved by replacing the main control panel of the mainboard directly. If the voltage is normal at the 3.3V test point, both the indicator light D17 and MCU may be damaged, then replace the mainboard directly.
	No flickering of indicator lights D2 and D3 for MCU operation	Check whether the power indicator light D17 is illuminated. • If D17 is illuminated, the power supply is normal, please replace with the correct main control panel of the mainboard, and power on after securely reconnecting. • If indicator light D17 is off, check for power failure.
	Power indicator light D20 is off	It may be caused by abnormal input of 24V voltage. Use a multimeter for troubleshooting on 24V. If the measured voltage is 0, please replace the fuse, and test again. If the problem remains unsolved, please replace the mainboard directly.
	If the power indicator light D20 is illuminated, while other lights D17 and D19 are off	Please replace the mainboard directly; if you are a professional, please replace the U12 chip. (Reasons for this problem: 5V voltage and 3.3V voltage are abnormal, or the power chip U12 is damaged.)
Abnormal display of display screen	Black screen, blurred screen or flickering on LCD screen after powering on,	Test the 3.3V voltage. • If it is normal, shut off the system power, remove the display screen from the FPC base, and replace with an intact LCD screen. When installing the LCD, pay attention to connect the yellow soft ribbon cable securely with the FPC base, so as to prevent display problems. • If 3.3V voltage is abnormal, check for power failure.

Problem Description	Problem Indicators	Solution
Motor not operational	Motor operation indicator light D7 remains bright.	First, press S1, and observe whether the start indicator light D18 is off. • If it is off, S1 button is normal, and test whether both ends of power resistance RP1 on the back are shorted to ground. • If it is on, the resistor has been damaged. Replace with new resistor, and test again. If the problem remains unsolved, please replace the mainboard directly.
	Motor operation indicator light D7 is flickering	Check whether the connection between the motor cable and interface socket is correct, reconnect the motor cable.
Humidifier not heating up	Water temperature remains unchanged after being heated for some time.	First, remove the water tub, wait for half an hour, and heat again. If the humidifier cannot be heated either, the temperature sensor may be damaged, please replace the temperature sensor, and test again. If you are not a professional, please replace the humidifier directly.
Display screen not operational	Switching operation failure between button and screen	Replace U13 rotary coder and all the three buttons S2, S3, S4, and retry operating. If the problem remains unsolved, please replace the PCB mainboard.
Insufficient respiratory pressure	When wearing the mask, you feel insufficient air when breathing.	Disassemble the mainboard, then check whether 3 holes contacting with the sensor are blocked or damaged. If any hole is blocked or damaged, please replace the infrastructure host first for testing. If the problem remains unsolved, please replace the mainboard and test again.
SD card is unavailable for storage.	There is no storage information on the SD card.	Check for SD card slot welding problem. If no problem is found, please replace the interface board; if the problem remains unsolved, please replace the mainboard for SD card storage.
Not operational after the ventilator has powered on.	Device not operational	Please check the connection between the household power supply socket and system power cable to ensure correct and secure connection. If the problem remains unsolved, please contact the supplier for detection and maintenance.
Ventilator not operational, no air flow output.	There may be problems with the ventilator’s turbine motor.	Check for secure system power supply connection. If the power connection is normal, while the ventilator cannot start operation, there may be turbine motor problems of the system, please contact the supplier for detection and maintenance immediately.

Problem Description	Problem Indicators	Solution
Gibberish occurs on the screen	• The ventilator or power adapter has been severely bumped, broken or wrongly operated. • The ventilator or power adapter is in a strong electromagnetic interference area.	Connect the ventilator's power adapter to the household power supply socket again. If the problem remains unsolved, try to change the ventilator position, and put it in a weak electromagnetic interference area (away from electronic equipment with strong electromagnetic interference, such as mobile phones, wireless phones, TV sets, computers, game consoles, hairdryers and so on). If the problem remains unsolved, please contact the supplier for detection and maintenance.

4.5 Mechanical Problems

Problem Description	Problem Indicators	Solution
Ventilator not operational, no air flow output.	Turbine motor of the ventilator not operational	Check for a secure connection of system power supply. If the ventilator cannot start operation, there may be problems with the turbine motor of the system, please contact the supplier for detection and maintenance immediately.

4.6 Other

Problem Description	Problem Indicators	Solution
There is neither ventilator operation nor alarm sound after powering on.	• Poor connection of device power supply • Household power supply socket has no power on or poor contact.	Please check the connection between household power supply socket and system power cable to ensure correct and secure connection. If the problem remains unsolved, please contact the supplier for detection and maintenance.

Problem Description	Problem Indicators	Solution
Gibberish occurs on the screen	• The ventilator or power adapter has been severely bumped, broken or wrongly operated. • The ventilator or power adapter is in a strong electromagnetic interference area.	Connect the ventilator, power adapter to the household power supply socket again. If the problem remains unsolved, try to change the position of the ventilator, and put it in a weak electromagnetic interference area (away from electronic equipment with strong electromagnetic interference, such as mobile phones, wireless phones, TV sets, computers, game consoles, hairdryers and so on). If the problem remains unsolved, please contact the supplier for detection and maintenance.
The ventilator falls from bedside table or table	• The ventilator is incorrectly placed on the table or bedside table. • The respiratory tube is incorrectly placed or twisted.	1. Make sure that the ventilator is placed horizontally on a flat and hard plane, so that all the anti-skid rubber pads at the ventilator bottom contact securely with the plane (do not place the ventilator on a plane covered with fabric), it (including the humidifier) must be placed horizontally during the operation. 2. Do not place the ventilator on the edge of a table or bedside table, in order to prevent unexpected falling. 3. If the humidifier is used together with the ventilator, please make sure that they are placed on a plane lower than your head, so that condensed water in the respiratory tube will automatically flow back to the water tub of humidifier. 4. If water in the water tub gets into the system after the ventilator and humidifier fall, please put the air flow outlet of the ventilator downward immediately, pour out all the water in the ventilator (including the humidifier), and then, put them in a ventilated place to dry. The ventilator can be reused after it has totally dried! 5. If the respiratory tube falls due to incorrect placement, please refer to the instruction book for correct installation and placing of the respiratory tube, in order to prevent the ventilator from falling due to tube twisting. 6. If the system is still unable to work normally by following the above steps, please contact your supplier for troubleshooting and maintenance.

Problem Description	Problem Indicators	Solution
Abnormal temperature increase of air flow coming out from ventilator	• Air filter has been obstructed by dust. • The ventilator works in an area directly exposed to sunlight or near a heating source.	1. Clean or replace the air filter. 2. The temperature of air flow will change along with the change of ambient temperature to some extent, therefore, it is necessary to put the ventilator in a ventilated place and away from objects which may obstruct normal airflow around the ventilator, such as quilts, curtains and so on. The ventilator shall work in an area without direct exposure to sunlight or away from heating source. If it is required to use a heated humidifier, please check the humidifier settings. 3. If problems remain unsolved by following the above steps, please contact the supplier for detection and maintenance.
The user feels uncomfortable when wearing the respiratory mask, or there is an obvious air leak or other problems related to the mask	• Improper adjustment of mask band tightness. • Inappropriate respiratory mask size.	Please refer to the user manual of the respiratory mask for correct adjustment of the mask band; if the mask size is inappropriate, please contact the supplier to exchange. If there are other problems related to mask use, please contact the supplier.

5 Software Upgrade

In this section, upgrade of DM18 APAP (0.3.111) is taken as an example to describe the software upgrading steps for the continuous positive pressure ventilator.

1. Get the official software upgrade package and decompress it to the local disk, and check whether the files in upgrade package are complete.

   Document structure of the upgrade package is shown in **Figure** 5-1.

   Figure 5-1 Document structure of the upgrade package

   Related descriptions:

   - DM18 APAP (0.3.111): Name of upgrade package. Of which, DM18 APAP refers to product model, while 0.3.111 refers to the version no. of software ready to be upgraded.
   - **Upgrade** is the directory name of the upgrade package. Of which, **app.bin** refers to the application program, **data.bin** refers to the graphical interface file, and **upgrade.cfg** refers to the upgrade configuration file.
2. Insert the SD card into the card reader, then insert the card reader into the USB port of the computer.
3. Copy the upgrade folder to the root directory of the SD card.
4. Insert the SD card when the ventilator is powered off, and hold the button and release after powered on for about 1 second.

   The system will automatically install the software upgrade program and enter the start interface. Now, the SD card can be taken out.
5. Press on the button and rotate the control wheel, enter the Service interface, and check whether the model and version no. displayed on the interface are the same with that of upgrade package.

   If the content is the same, the upgrade is successful.
6. If upgrade fails, please contact the after-sales service department of Dymind Co., and Dymind Co. will assign a professional to provide you advice.

6 Comprehensive Device Tuning

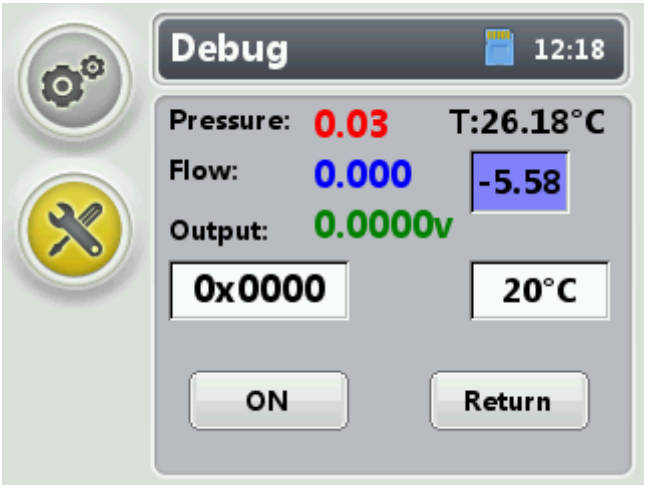
After replacing the sensor or motor, debugging the whole machine is necessary, so as to ensure normal device operation. Specific steps are shown below:

1. After normal start up, press button to enter the Setup interface; and simultaneously press on button and button to go back to the main interface, then press button to enter the Setup interface again.

   Now, the **Setup** interface will show the **Debug** icon.

2. Rotate the control wheel to enter the **Debug** interface, see Figure 6-1.

Figure 6-1 Debug interface



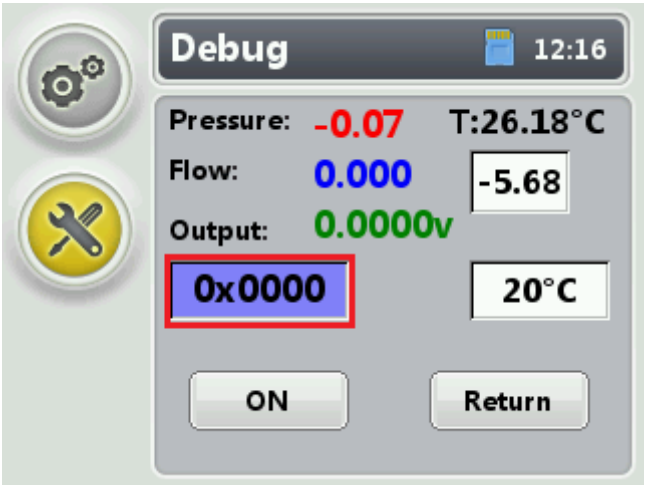
3. Rotate the control wheel to switch to the edit box (-5.58) in the red box as shown in Figure 6-2, change the value in the edit box, so that the **Pressure** value can float within ±0.5 range (Pressure value is best to be 0).

Figure 6-2 Tuning of pressure sensor

The **Pressure** value can be changed by changing the value in the red box, so as to complete the pressure sensor tuning. The setting range is -3.88 to -7.88. If the **Pressure** value cannot be adjusted to ±0.5 within this range, this assembly may be installed improperly or damaged.

4. Rotate the control wheel to switch to the edit box (0x0000) in the red box as shown in Figure 6-3, change the value in the edit box to 0x01c0±100.

Figure 6-3 Motor debugging



5. Connect the plug, click the ON button in the interface to turn it to OFF to start the motor. Any value of Pressure and Flow floating within normal range shows normal motor operation.
   - If the value of **Pressure** floats within the10±1 range, it means that the pressure sensor works normally. Conversely, the pressure sensor works abnormally.
   - If the value of **Flow** floats within the 34±1 range, it means that the flow sensor works normally. Conversely, the flow sensor works abnormally.
6. When the heated humidifier is not used, check whether the top right T in the interface shows temperature.
   - If there is temperature display and it is close to the ambient temperature, it indicates that the temperature sensor works normally.
   - No temperature display indicates abnormal connection between the host and the humidifier.

7 List of Spare Parts

No.	Material No.	Name	Unit	Quantity
1	20010049A	Ventilator host assembly	PCS	1
2	20010050A	Ventilator humidifier assembly	PCS	1
3	60020055A	Water tub body	PCS	1
4	60020056A	Water tub holder	PCS	1
5	60020057A	Exhaust pipe joint	PCS	1
6	60020058A	Clasp	PCS	1
7	62020009A	Sealing ring for air outlet	PCS	1
8	62020014A	Sealing element connecting to the host airway	PCS	1
9	60020059A	Buckle for connecting the humidifier to the host	PCS	1
10	62020016A	Flip seal of humidifier	PCS	1
11	62020017A	Upper and lower sealing rings of water tub	PCS	1
12	62020019A	Rubber gasket for humidifier outlet	PCS	1
13	59010005A	Water Tub	PCS	1
14	59010009A	Button spring for main humidifier tripping	PCS	1

NOTE

All necessary spare parts in the ***List of Spare Parts*** must be provided by Dymind Biotech. If you have questions, please contact Dymind's after-sales service department.

