RESmart® BPAP System

# Service Manual

# Table of Contents

# IMPORTANT

**All data in this manual have been verified correctly. It is sufficient for servicing and repairing this device. If applying this manual on other purpose, the validation should be confirmed by BMC Medical Co., Ltd. Other wise, BMC Medical Co., Ltd. has no responsibility for the result. All information in this manual is protected by law and regulation. All copyrights belong to BMC Medical Co., Ltd.**

IMPORTANT, CAUTION AND WARNING in this manual are to emphasize dangers to service people.

**WARNING:** If do not operate properly, may cause damage to people and environment.

**CAUTION:** If do not operate properly, may cause damage to instrument.

**IMPORTANT:** Important information for servicing and repairing.

## Safety Notice

### Electric Shock

There is above 100VAC voltage inside this device, please be sure to repair device after power off.

### Chemical Safety

There may be risk of virus after touching by patient. Please clean device or wear protective glove before servicing and repairing. Please deal with the waste according to regulation. Wash hands by disinfector after operating this device.

# 1. Introduction

## 1.1 Intended Use

The RESmart® BPAP system is a BIPAP (Bi-level Positive Airway Pressure) device. It is intended to provide non-invasive ventilation for patients with respiratory insufficiency or obstructive sleep apnoea (OSA), in the hospital or home.
The RESmart® BPAP is to be used only on the instruction of a licensed health care professional. Your home care provider will make the correct pressure settings according to your health care professional's prescription.
This device is not intended for life support.

This service manual is used to help service people maintenance RESmart® BPAP system of BMC Medical Co., Ltd. more efficiently. Instructions in this manual may help device work best.
Engineer can find needed instruction from this manual quickly.

***IMPORTANT!***
Read and understand instruction in this manual before operating.

***IMPORTANT!***
RESmart® BPAP system can not be used for life support.

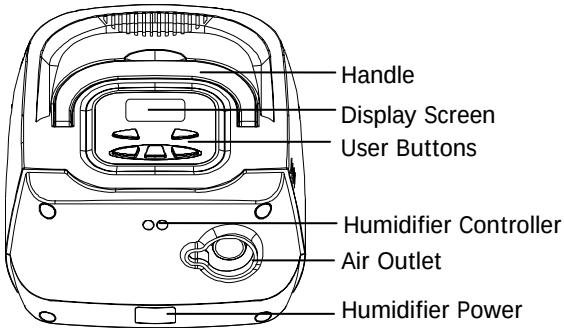
## I.2 Implement

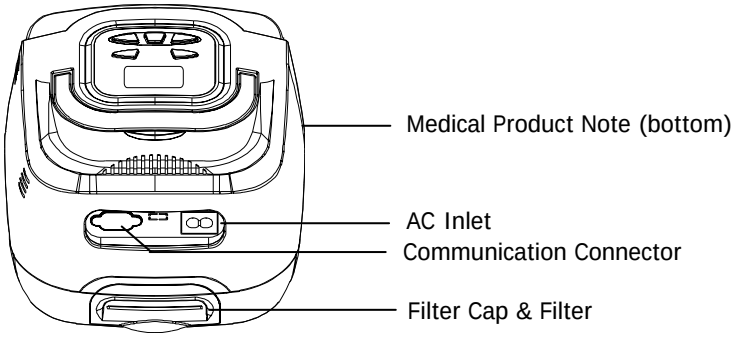
1. Implement for repairing
   Type '+' screw driver
   Pincers

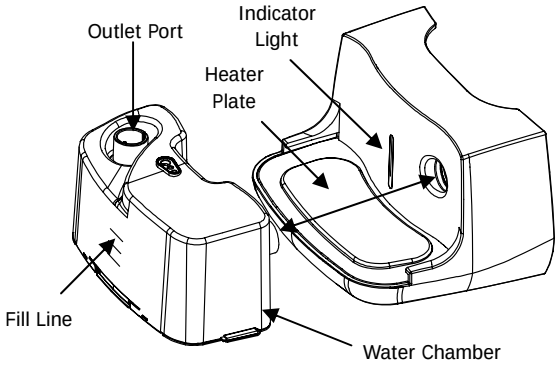
2. Implement for measuring
   Pressure meter

# 2. Structure

## 2.1 Outer Illumination






## 2.2 Inner Construction

See appendix A

## 2.3 Spare Part

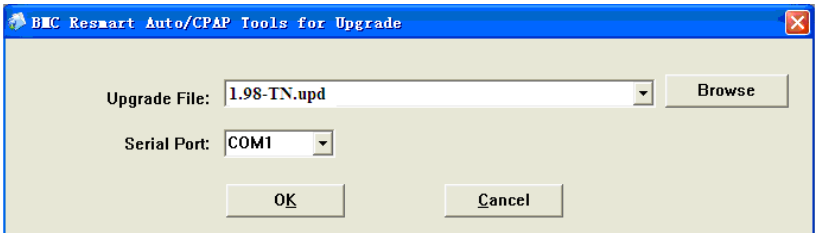
See appendix B

# 3. Software

## 3.1 Instruction for Upgrading Device Software

Note: Once the RESmart® BPAP device is powered on, the LED display screen will show the software version of the device as the following picture. Please remember the software version in the red frame.


1. Power off the RESmart® BPAP device, and then connect PC and the device via data cable.
2. Run the software “BMC RESmart® Tools for Upgrade” from PC and display as below:



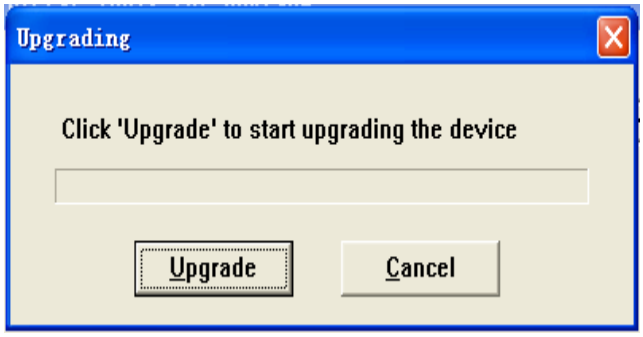
a) Select the upgrade file which has same suffix letter as the machine version. (For example Version 1.88-TN should choose file name 1.98-TN)

b) Select the right serial port, default is COM1.

3. Click “OK”, display as below:


Power on the BPAP device. If the device is powered on from beginning, please power off the device and power on again after 5 seconds or more.

4. After the device is turned on, the following will display:




Click “Upgrade” to start. If success, the right version number will be displayed on BPAP device screen when every power on.

**Note:** If failed during upgrading, please repeat from above 1-4 steps.

If you select an incorrect upgrade file (for example: apply a CPAP upgrade file to a BPAP device), the device will display “Error 08” and cannot work. In this case, apply correct software and upgrade again.

## 3.2 Hidden Function

1. **Humidifier matching**

Assemble humidifier on main device, without water chamber. Enter the maintenance menu, and set Ramp=40, then press Heated Humidifier Button when the Init P appears. Thus the humidifier is matched. When ‘OK’ appears on screen, humidifier matching succeeded.

2. **Reset** (Available on version 1.58 and later)

Press and hold the Ramp Button until the user menu appears (about 3 seconds) when the device is on standby, press +/- User Buttons to access the Date Setting, set ‘YYYY/MM/DD’=’2097/07/01’, then press ‘Pressure Start/Stop Button’ when ‘Hour’ setting appears, thus all device settings and therapy records (doesn’t include Use Days and Use Time) will be reset.

If set ‘Minute’=’16’ during the above procedure, then not only device settings and therapy records, but also patient information will be reset.

If set ‘Minute’=’26’ during the above procedure, then not only device settings, therapy records and

patient information, but also Use Days and Use Time will be reset.

3. **Pressure calibration** (Available on version 1.58 and later)

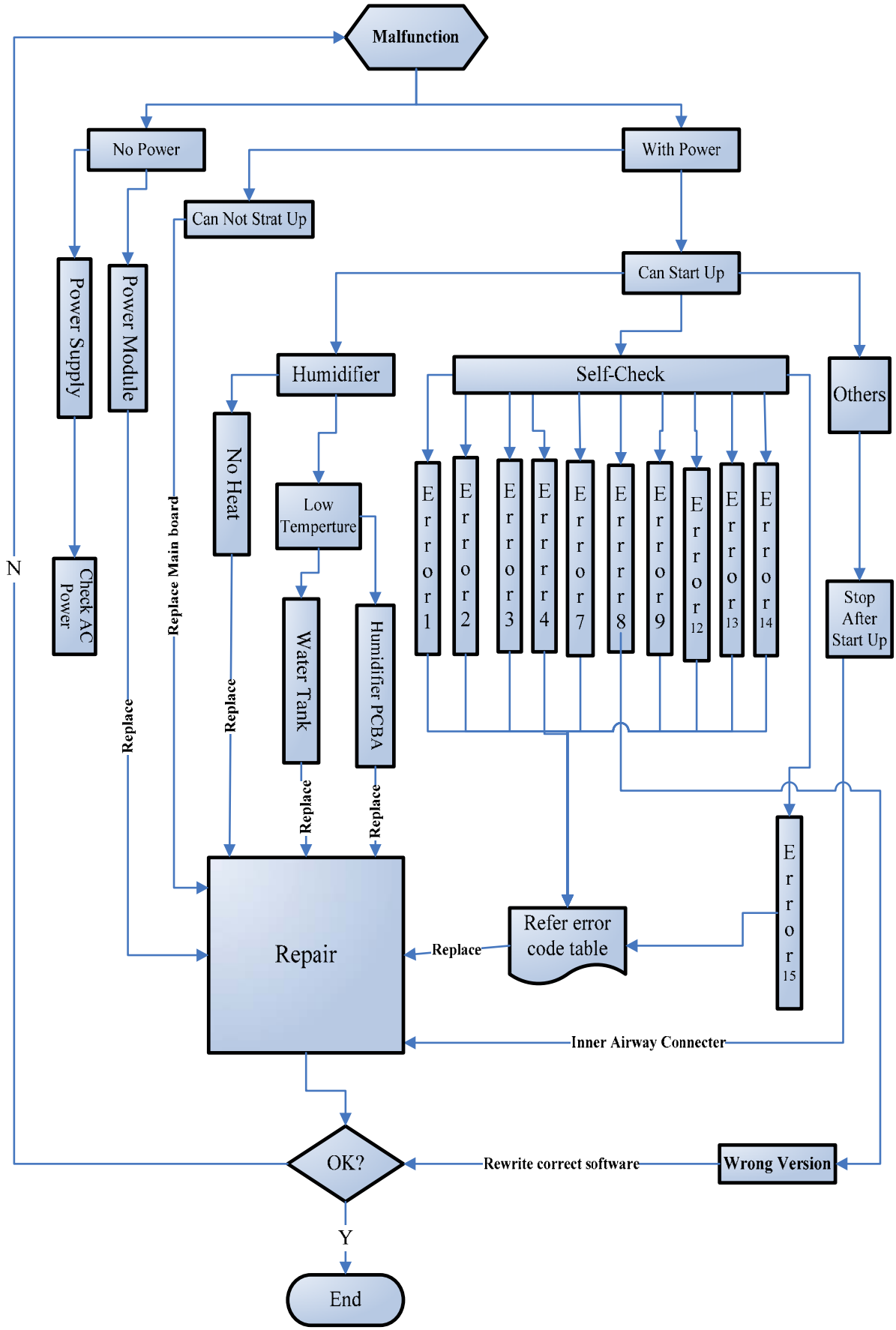
Connect pressure meter to the air outlet of the device, in the Date and Time Setting menu, set 'YYYY/MM/DD'='2098/08/18', press 'Pressure Start/Stop Button' when Hour Setting appears to start the Pressure Calibration. The device output pressure is based on 20 hPa ($cmH_2O$), and a number will appear on the screen, when the output pressure is stable, if the value on the pressure meter is not 20 hPa ($cmH_2O$), press '+/-' User Buttons to adjust the output pressure , finally press 'Pressure Start/Stop Button' to finish the Pressure Calibration.

# 4. Malfunction and Countermeasure

## 4.1 Error Code Table and Information

| Error Index | Problem | Causing |
|---|---|---|
| Error1 | Over temperature inside or Temperature sensor fault | Malfunction on main board |
| Error2 | Motor stop | Malfunction on motor or main board |
| Error3 | Motor low speed | Malfunction on motor or main board |
| Error4 | Low temperature inside | Malfunction on main board |
| Error7 | Pressure sensor fault | Malfunction on main board |
| Error8 | Wrong software version | Software |
| Error9 | Host parameter error | Malfunction on main board |
| Error12 | Over temperature inside or flowrate sensor fault | Malfunction on main board |
| Error13 | Temperature below 0℃ or flowrate sensor fault | Malfunction on main board |
| Error14 | The motor is over temperature or motor temperature sensor fault | Malfunction on motor or Motor temperature sensor |
| Error15 | Motor temperature sensor fault | Malfunction on motor temperature sensor |

## 4.2 Malfunction Determination



# Appendices

## Appendix A:

### Device Configuration

#### 1. Main device

Fig. A - Main board (backside)

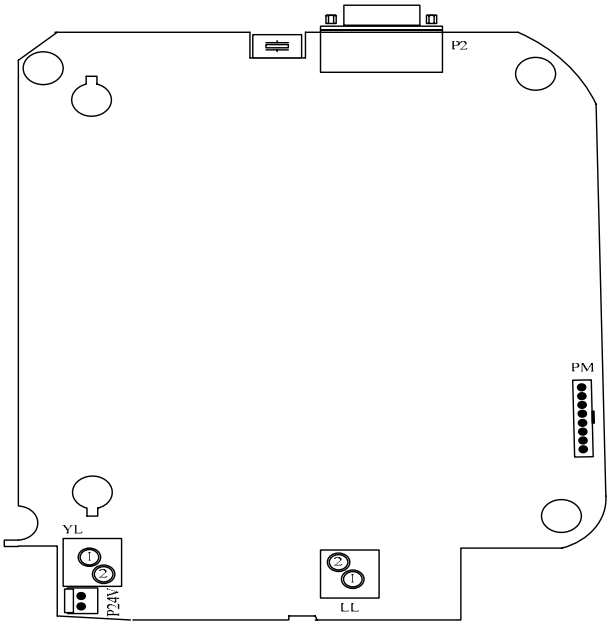
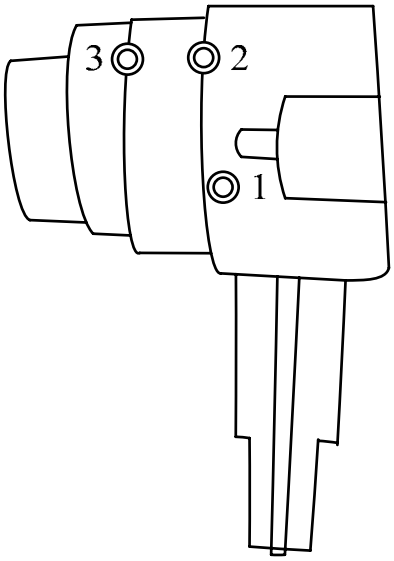



Fig. B – Outlet (leftside)




Hole #1, 2 and 3 in Fig. B, connect to sensor YL and LL via silicon rubber canal. Specified in Table 1:

| Fig. B | Fig. A | Specification of canal |
|---|---|---|
| 1 | Hole #1 on sensor YL | ϕ2mm, Φ4mm, L12cm |
| 2 | Hole #2 on sensor LL | ϕ2mm, Φ4mm, L12cm |
| 3 | Hole #1 on sensor LL | ϕ2mm, Φ4mm, L8cm |

**Table 1**

Fig. C – Power PCBA (front side) Sockets figuration

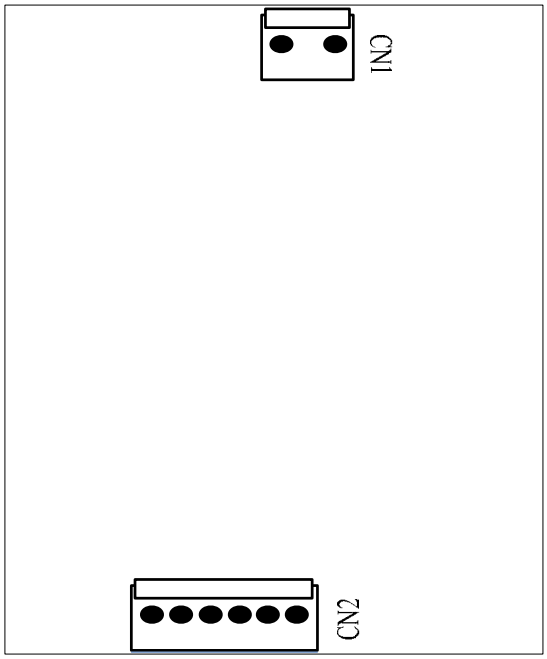



Fig. D – Wire connecting on power PCBA

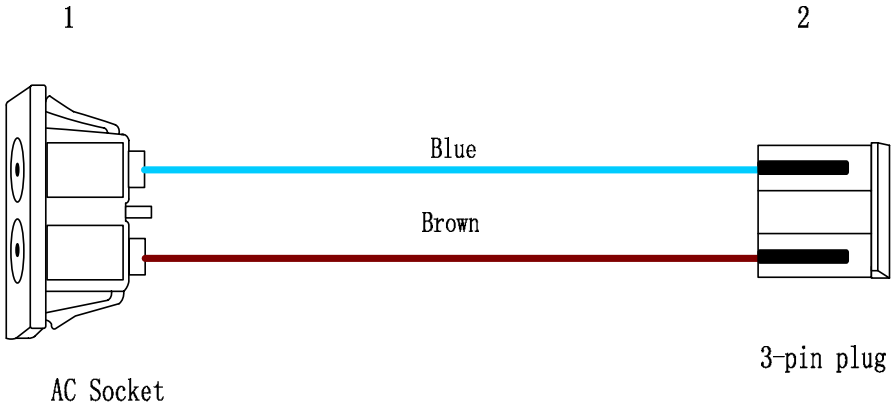



Fig. E – Power supply connecting

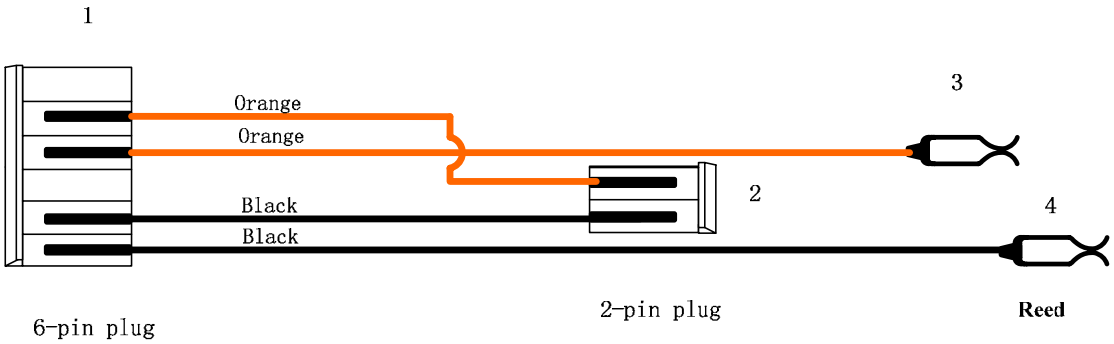
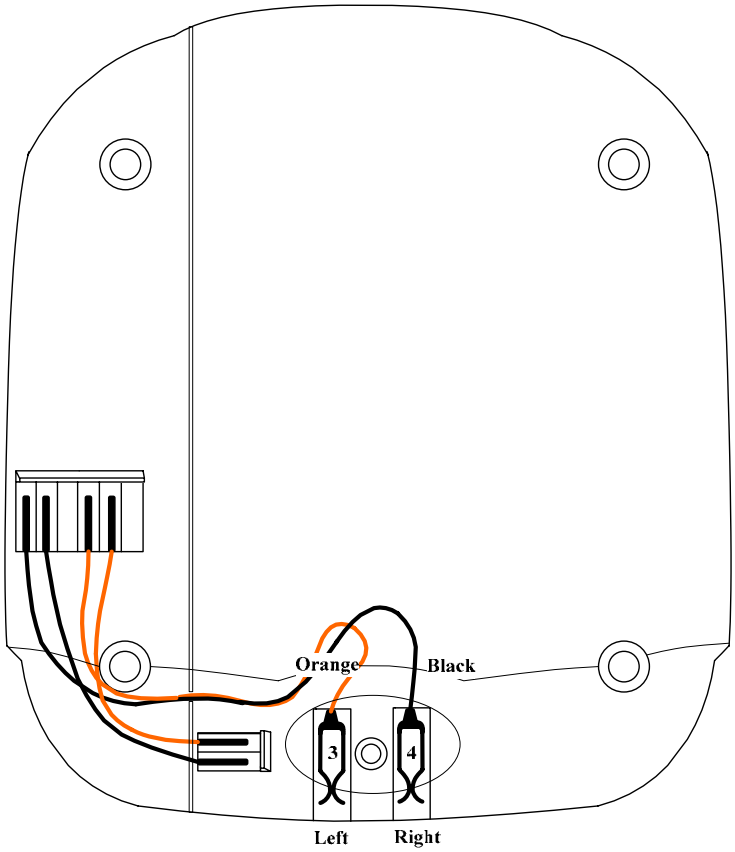


Fig. F – Power supply to humidifier




**Connecting relationship:**

| Part / Fig. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| D | Back of device | Fig. C: CN1 | | |
| E | Fig. C: CN2 | Fig. A: P24 | Fig. F: Left | Fig. F: Right |
| Blower 8-pin plug | Fig. A: PM | | | |

**Table 2**

## 2. Humidifier

Fig. G – Humidifier PCBA (back side)

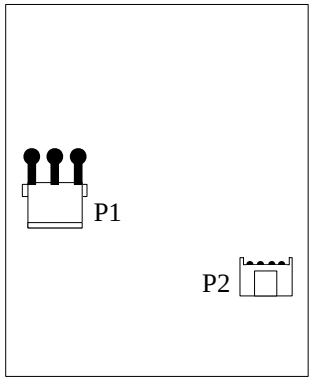


Fig. H – Power supply to humidifier

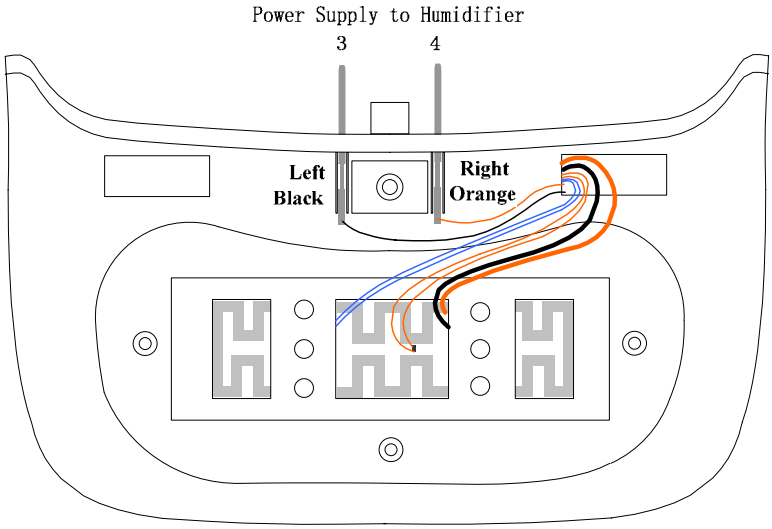
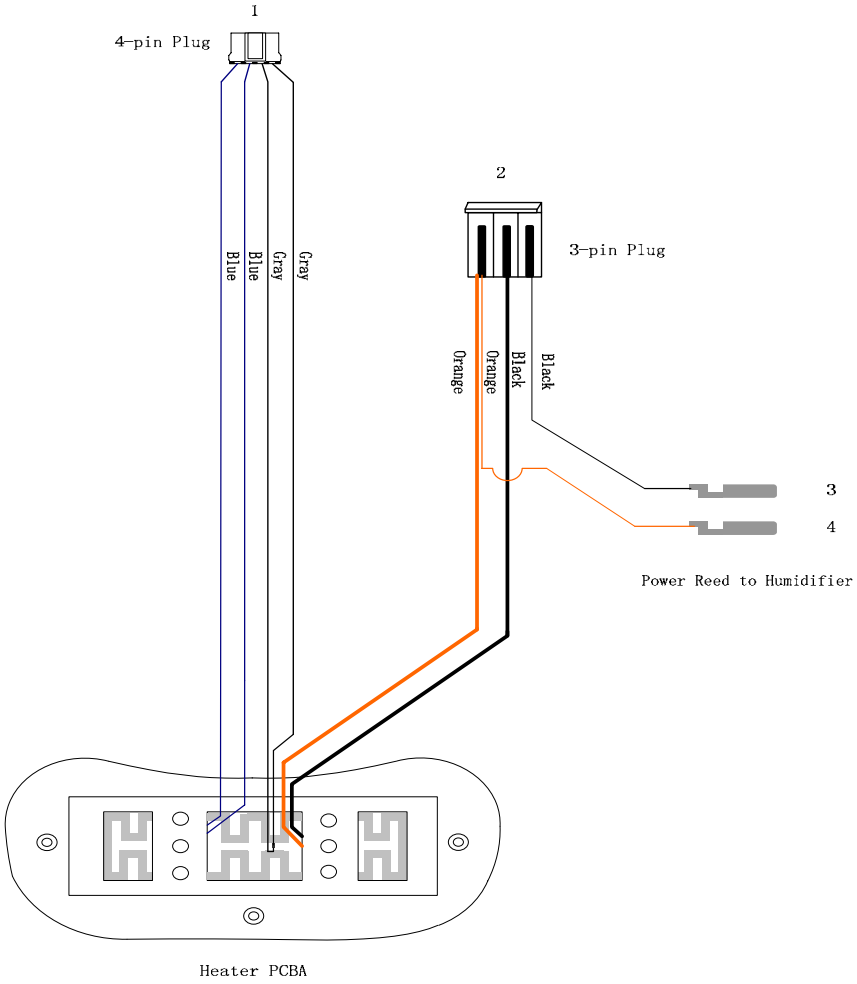



Fig. I – Heater PCBA



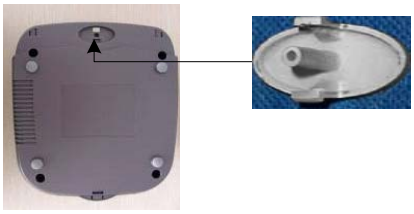
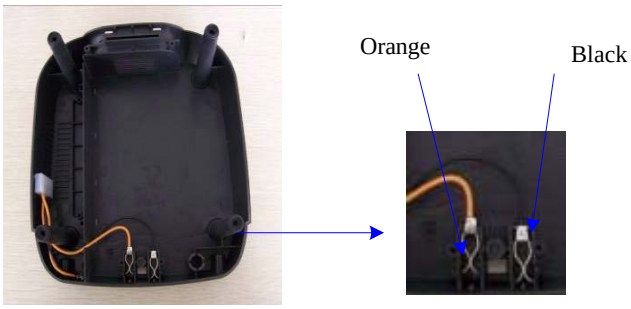
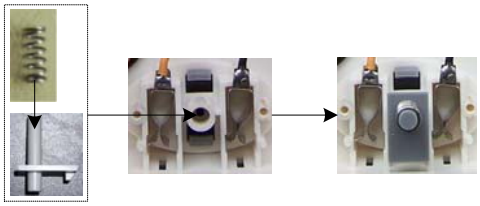
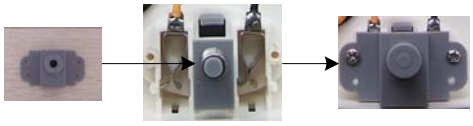

**Connecting relationship:**

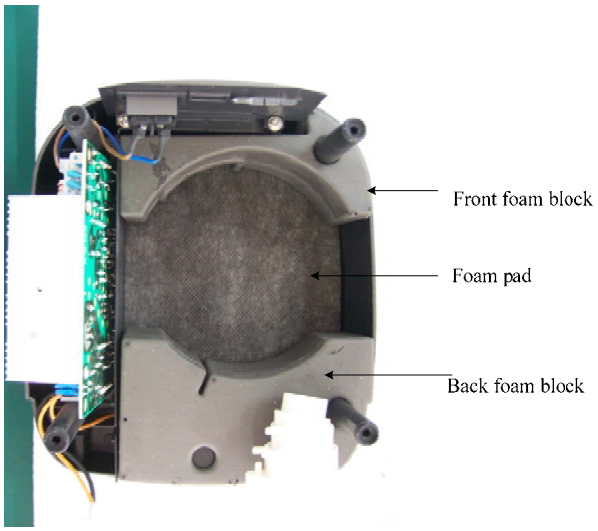
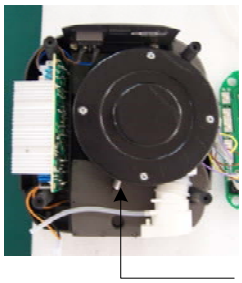
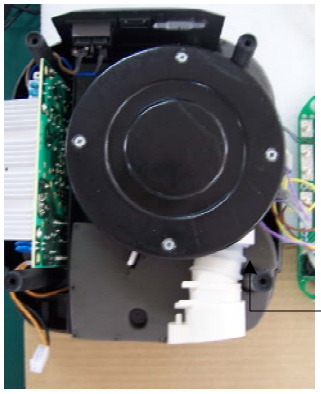
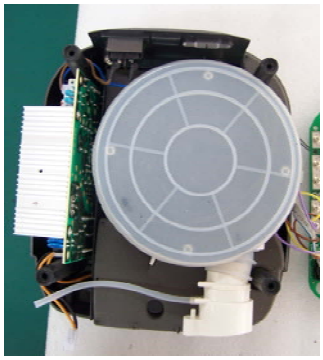
| Part / Fig. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| I | Fig. G: P2 | Fig. G: P1 | Fig. H: Left | Fig. H: Right |

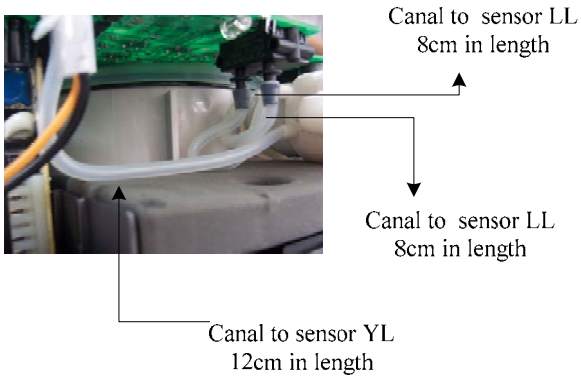
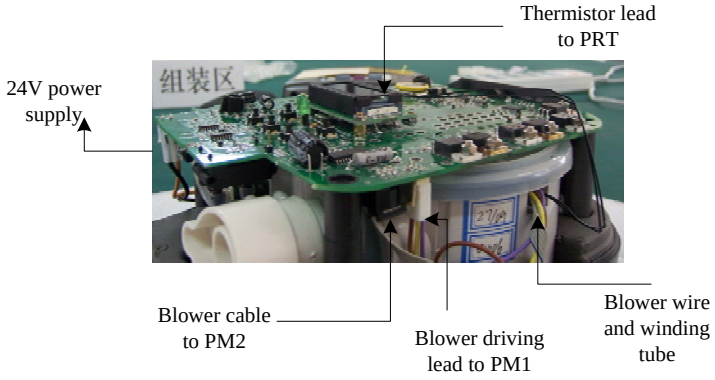
**Table 3**

## Components Illumination

### 1. Device Inside

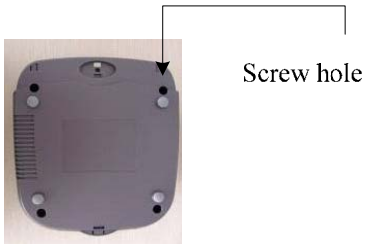
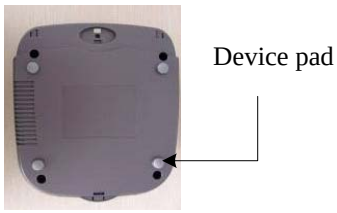
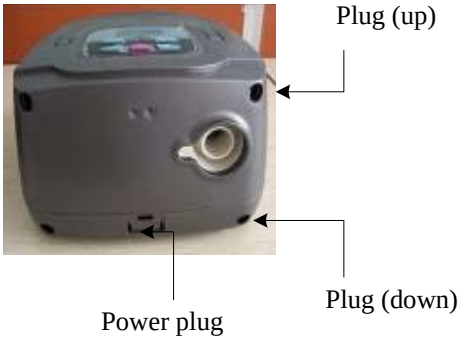
| S/N | Assembly | Figure |
|---|---|---|
| 1 | Insert humidifier locker on the shield bottom. |  |
| 2 | Insert humidifier power supply reed on the shield bottom as per Fig. E and F. |   |
| 3 | Assembly the humidifier locker and button spring. |  |
| 4 | Put fixing on the spring and fix by screw (2×3mm*8mm). |  |
| 5 | Put power wire. |   |
| 6 | Assembly the shield back on the bottom, fix by screw (2× 3mm*8mm). |  |

| | | |
|---|---|---|
| 7 | Assembly the foam pad (non-woven side up), the front and back foam blocks of the blower unit in the shied bottom. |  |
| 8 | Align the location column of blower unit to the location port in the front block, Place the blower unit right between the front and back foam blocks in the shield bottom and lay it down till the bottom. |  |
| 9 | Clean the air outlet of the blower and insert it into the fixing hole, and set the protruding tube of the blower unit into the air outlet. It is required that the top of blower tube stand up against the bottom of air outlet. |  |
| 10 | Fit silicon rubber cap onto the top surface of blower unit. |  |

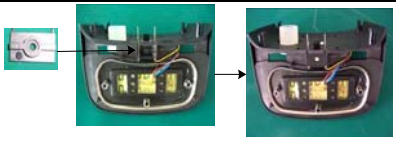
| | | |
|---|---|---|
| 11 | 1. Connect the air hole of the pressure sensor YL on the main board with the bottom hole(hole#1) in the front of the blower outlet with a canal of 12cm in length and 2mm in inner-diameter.<br>2. Crosswise connect the two air holes of the pressure sensor LL on the main board with the two top holes (hole#2 & hole#3) around the blower outlet via two canals of 8cm in length and 2mm in inner-diameter. |  |
| 12 | Clean up the blower wires and wind them with a tube. Insert the plugs into sockets PM1 and PM2. Put the lead of thermistor into socket PRT on main board. Connect the main board to 24V power supply. |  |
| 13 | Draw the shield back backwards and put the 9-pin plug into the corresponding socket on its back. Lay the main board onto the 4 supporting poles on the shield bottom and set it into the power board via the fixing pole on PCB and get the main board fixed.<br>Put blower wires on the side into the gap between blower unit and shield bottom. |  |

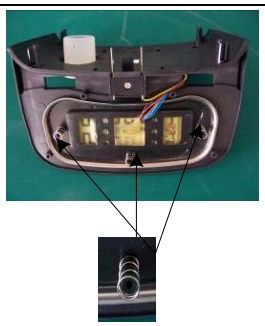
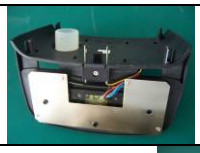
## 2. Device Outside

| S/N | Assembly | Figure |
|---|---|---|
| 14 | Put handle in the socket on shield cover. |  |
| 15 | Assembly handle fixing to handle and fix by screw (4×3mm*8mm). |  |
| 16 | Assembly and fix the panel. |  |
| 17 | Put on the key button. |  |
| 18 | Assembly the infrared window, and put the shield cover on the bottom, adjust the position of outlet and make sure it is clamped in the right socket. |  Infrared window |

| | | |
|---|---|---|
| 19 | Fix the shield by screws (4×M3*10mm). |  |
| 20 | Stick four device pads. |  |
| 21 | Put in filter and assembly the cover. |  |
| 22 | Put on all plugs if necessary (without humidifier). |  |

### 3. Humidifier

| S/N | Assembly | Figure |
|---|---|---|
| 1 | As per Fig. H, assembly the heater plane and wire. Fix them by screw (3mm*8mm). |  <br>  |

| | | |
|---|---|---|
| 2 | Put spring on each of three poles on heater plane. |  |
| 3 | Assembly the scaleboard on the heater plane and fix by screw (3mm*8mm). |  Scaleboard  |
| 4 | As per Table 3, assembly heater PCBA and wires. |  |
| 5 | Put on light window. |  |
| 6 | Assembly the inner and outer shield. |  |
| 7 | Fix on screw (M3*10mm). | Screw  |

# Appendix B:

## Spare Part Configuration

| S/N | Name | Qty | Figure |
|---|---|---|---|
| 1 | Shield Cover | 1 |  |
| 2 | Handle | 1 |  |
| 3 | Handle Fixing | 2 |  |

| | | | |
|---|---|---|---|
| 4 | Shield Bottom | 1 |  |
| 5 | Humidifier Clip | 1 |  |
| 6 | Humidifier Locker | 1 |  |
| 7 | Humidifier Fixing | 1 |  |
| 8 | Filter Cover | 1 |  |
| 9 | Shield Back | 1 |  |
| 10 | Outlet | 1 |  |
| 11 | PCBA Fixing | 2 |  |
| 12 | Infrared Window | 2 |  |
| 13 | Panel | 1 |  |
| 14 | Humidifier Outer Shield | 1 |  |

| | | | |
|---|---|---|---|
| 15 | Humidifier Inner Shield | 1 |  |
| 16 | Light Window | 1 |  |
| 17 | Pole Platelet | 1 |  |
| 18 | Humidifier Power Plug | 1 |  |
| 19 | Humidifier Plug (left-up) | 1 |  |
| 20 | Humidifier Plug (left-down) | 1 | |
| 21 | Humidifier Plug (right-up) | 1 |  |
| 22 | Humidifier Plug (right-down) | 1 | |
| 23 | Device Pad | 6 |  |
| 24 | Humidifier Inner Connector | 1 |  |
| 25 | Key Button | 1 |  |
| 26 | Humidifier Scaleboard | 1 |  |
| 27 | Heater Plane Spring | 3 |  |
| 28 | Button Spring | 1 |  |

# Spare Part List

| Part Name | S/N | Qty | Unit | Classify | Use |
|---|---|---|---|---|---|
| Main Board PCBA | 140022 | 1 | PC | PCBA | Main Device |
| Heater PCBA | 140017 | 1 | PC | PCBA | Humidifier |

| | | | | | |
|---|---|---|---|---|---|
| Power Supply PCBA | 270031 | 1 | PC | PCBA | Main Device |
| Blower Unit | 120069 | 1 | PC | Assembly | Main Device |
| Heater Plane | 120006 | 1 | Set | Assembly | Humidifier |
| Power Supply PCBA Wire | 120002 | 1 | Set | Wire | Main Device |
| Main Board PCBA Wire | 120003 | 1 | Set | Wire | Main Device |
| Silicon Rubber Cap | 220029 | 1 | PC | Assembly | Main Device |
| Silicon Rubber Canal | 290001 | 3 | PC | Assembly | Main Device |
| Foam (front/back) | 240048 | 1 | PC | Foam | Main Device |
| Shied Cover | 210067 | 1 | PC | Plastic | Main Device |
| Handle | 210068 | 1 | PC | Plastic | Main Device |
| Handle Fixing | 210011 | 2 | PC | Plastic | Main Device |
| Shield Bottom | 210069 | 1 | PC | Plastic | Main Device |
| Humidifier Clip | 210070 | 1 | PC | Plastic | Main Device |
| Humidifier Locker | 210012 | 1 | PC | Plastic | Main Device |
| Humidifier Fixing | 210013 | 1 | PC | Plastic | Main Device |
| Filter Cover | 210071 | 1 | PC | Plastic | Main Device |
| Shield Back | 210072 | 1 | PC | Plastic | Main Device |
| Outlet | 210080 | 1 | Set | Plastic | Main Device |
| PCBA Fixing | 210014 | 2 | PC | Plastic | Main Device |
| Infrared Window | 210010 | 2 | PC | Plastic | Main Device |
| Panel | 210073 | 1 | PC | Plastic | Main Device |
| Humidifier Outer Shield | 210074 | 1 | PC | Plastic | Humidifier |
| Humidifier Inner Shield | 210075 | 1 | PC | Plastic | Humidifier |
| Pole Platelet | 210025 | 1 | PC | Plastic | Humidifier |
| Light Window | 210023 | 1 | PC | Plastic | Humidifier |
| Button Spring | 230001 | 1 | PC | Metal | Main Device |
| Humidifier Scaleboard | 230004 | 1 | PC | Metal | Humidifier |
| Heater Plane Spring | 230005 | 3 | PC | Metal | Humidifier |
| Humidifier Power Plug | 220023 | 1 | PC | Rubber | Main Device |
| Humidifier Plug (left-up) | 220024 | 1 | PC | Rubber | Main Device |
| Humidifier Plug (left-down) | 220025 | 1 | PC | Rubber | Main Device |
| Humidifier Plug (right-up) | 220026 | 1 | PC | Rubber | Main Device |
| Humidifier Plug (right-down) | 220027 | 1 | PC | Rubber | Main Device |
| Device Pad | 220001 | 6 | PC | Rubber | All |
| Key Button | 220002 | 1 | PC | Rubber | Main Device |
| Humidifier Inner Connector | 220009 | 1 | PC | Rubber | Humidifier |
| Screw-M3*6 | 240008 | 4 | PC | Screw | All |
| Screw-M3*10 | 240009 | 4 | PC | Screw | All |
| Screw-M3*8 | 240010 | 8 | PC | Screw | Main Device |
| Filter | 240014 | 1 | PC | Accessory | All |
| Power Cord | 110099 | 1 | PC | Accessory | All |