

GGM

Respiratory Gas Humidifier VH-2600/VH-2600A



Respiratory Gas Humidifier Technical Manual

REV A 2017/06/09

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ISO 13485 / CE 2460 / GMP

Manual Revision History

REVISIONE	DATA	DESCRIPTION
REV A	2017-06-09	RELEASE

NOTE :

1. Great Group Medical Co., Ltd. has a policy of continued product improvement and reserve the right to change specifications without notice.

Revision History

VH/2600/VH-2600A humidifier. firmware and hardware version of the record as shown in the table.

Operation of the machine should pay attention to the use of version, the version of the operation may be different.

VH-2600				
PCB Version		Data	Serial number	DESCRIPTION
P:BC23024F12210	YY MM P XXX	P:2014/03	GGC VV CC YY MM XXX	New issue
D:BC31013A12210	YY MM D XXX	D:2012/11		
VH-2600A				
PCB Version		Data	Serial number	DESCRIPTION
P:BC23024F12210	YY MM P XXX	P:2014/03	GGD VV CC YY MM XXX	New issue
D:BC31013A12210	YY MM D XXX	D:2012/11		

Description: YY : Year ; MM : Month ; XXX : serial number ; VV : voltage ; CC : country °

VH-2600		
Version	DESCRIPTION	Date
V2.00	New issue	2010/11
V2.10	Added Heater Wire low impedance detection.	2011/01
V2.22	Added RS-232 debug function.	2011/06
V2.24	Revise Airway temp Low Alarm of the mute time from 3 to 10 minutes.	2011/09
VH-2600A		
Version	DESCRIPTION	Date
V1.00	New issue	2012/04
V1.01	Chamber temp setting range 36~40 change to 34~40	2012/09

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1. Introduction

1.1. About This Manual

This manual is intended for qualified service personnel who will perform maintenance and servicing on the Great Group Medical Co., Ltd. VH-2600/VH-2600A Respiratory Humidifier. This manual covers the product specifications, includes a maintenance schedule, and provides the necessary information required for servicing.

NOTE: Some software may not be available in your country. Refer to your local Great Group Medical Co., Ltd. representative for the appropriate software version. Maintenance procedures should be carried out at regular intervals (as recommended in the maintenance schedule 8), to ensure that the humidifier and its accessories are working correctly.

If a fault should occur with the humidifier, follow the troubleshooting guide (section 5.2) in order to find the most likely cause. If the unit requires servicing, make sure the servicing procedures are followed in order to prevent damage to the humidifier. After service, or as part of the maintenance schedule, a humidifier performance check should be completed.

Due to the nature of the electronics contained within this humidifier, it is not recommended that the printed circuit boards be serviced at component level.

1.2. Glossary

Chamber	Device that allows gas to be heated and humidified by passing it over heated water.
Temperature Probe	Sensor assembly for measuring gas temperature.
Airway Probe	Sensor assembly for measuring gas temperature at the end of the inspiratory limb.
Chamber Probe	Sensor assembly for measuring gas flow and temperature at the outlet of the humidification chamber.
Thermistor	A temperature sensitive resistor placed inside the chamber and airway probes.
Chamber Set Point	The humidifier is expected to remain at chamber temperature.
Airway Set Point	The humidifier is expected to remain at airway temperature.
Heater Wire Adapter	Electrical connector between the breathing tube and the humidifier.
Breathing Circuit	Tubing that carries respiratory gases to and from the patient.
Dual heated Breathing Circuit	Wire inside the breathing circuit which heats the respiratory gases.
Single heated Breathing Circuit	Wire inside the inspiratory tube which heats the respiratory gases.
PCB	Printed Circuit Board.
Heater Wire	Wire inside the breathing tube which heats the respiratory gases.
Inspiratory Limb	The section of the breathing circuit that takes the inspired gases to the patient.
Expiratory Limb	The section of the breathing circuit that takes the expired gases to the patient.

1.3. Definitions

NOTE: Possible be misunderstood or ignored the steps, to provide additional information.

Warning: indicates that a situation may occur which is potentially harmful to the patient or user.

Caution: indicates a condition that may lead to equipment damage, malfunction, or inaccurate operation.

1.4. Product Application

The unit is humidifier for hospital in the Intensive Care Unit (ICU). It's used to provide humidity by breathing circuit or mask for the patient.

Please refer to the list of Respiratory Humidification Products or local Giant Medical Materials Great Group Medical Co., Ltd. for a list of approved accessories.

Warning :

- The use of breathing circuits, chambers and other accessories which are not authorized by GGM may cause malfunction, damages or injuries.
- Make sure the invasive mode is set for patients having bypass airways.
- The unit's power cord only be connected medical grade power socket.
- Before servicing, always disconnect the supply.
- When installing the humidifier close to the patient, make sure that the humidifier is securely fastened and lower than the patient.
- Know adverse effects on the performance and safety of the humidification system when exposed to, for electro cautery, electro surgery, defibrillation, X- ray (gamma radiation), infrared radiation, conducted transient magnetic fields including magnetic resonance imaging (MRI), and radiofrequency interference.
- Make sure the temperature probes are connected correct.
- The user must check safety performance of the unit, to ensure its complete work function well.
- Make sure the power supply is stabilize.

1.5. Humidifier Symbol definition



Type BF



Consult instruction
for use



Caution Consult
accompanying



IPX 1

Drip Proof



Alternating
Current



Warn Electrical
shock hazard



Warn Surface
temperature



Ground Protection



On (Power)



Off (Power)



Do not reuse



Do not throw
away



Notified Body

2. Product Specifications

2.1. Mechanical

Dimensions: W135mm x D170mm x H156mm (without chamber fitted)

Weight: 2.9 kg (without a chamber fitted)

2.2. Electrical Rating

Model Number	Supply Voltage	Supply Current
VH-2600-115	AC 115 V	2.0 A Max
VH-2600-230	AC 230 V	1.0 A Max
VH-2600A-115	AC 115 V	2.0 A Max
VH-2600A-230	AC 230 V	1.0 A Max

Supply Frequency: 50 / 60 Hz

Heater Plate Capacity: 150W, maximum temperature 110°C

Heater Wire: 60W Max

Heater Wire Supply: 22 ±3 V~

Safety protection

Over current protection: 115V/3A (fast burn type); 230V/1.5A (fast burn type).

Over heat protection : 115±3°C thermostat (manual rest type).

2.3. Temperature Control Range:

2.3.1. Temperature

Display: 4 digit 14 segment LED

Range: 5.0 to 80.0°C, Accuracy: ±0.3°C (in 25.0 - 45.0°C temperature range)

VH-2600
Airway set Point: 31 - 40 °C (default 39°C) Chamber set Point: 31-40 °C (default 37°C, limited to Airway set Point -5 to +2°C)
VH-2600A
<p>● Heater Wire Circuit</p> <ul style="list-style-type: none"> ● Invasive mode Airway Set Point: 36~40 (default: 40°C) Chamber Set Point: 36~40 (default : 37°C) ver 1.00 Chamber Set Point: 34~40 (default : 37°C) ver 1.01 ● Non –Invasive Airway Set Point: 31~35 (default: 34°C) Chamber Set Point: 31~35 (default : 31°C) <p>● Non-Heater Wire Circuit:</p> <ul style="list-style-type: none"> ● Invasive mode: Airway Set Point: 36~38 (default: 37°C) (chamber temperature limited to 66 °C) ● Non –Invasive: Airway Set Point: 30~32 (default : 31°C) (chamber temperature limited to 66 °C)

2.3.2. Alarm Parameters:

Heater Wire Circuit:

- High Airway Alarm: An immediate, audible alarm at a displayed temperature of 41°C or if the airway temperature exceeds 42°C.
- Low Airway Alarm: An audible alarm between 10 minutes @29.5°C, and 60 minutes @34.5°C
- High Humidity Alarm: An audible alarm if the humidity temperature exceeds 41°C.
- Low Humidity Alarm: An audible alarm between 10 minutes @26°C.

Non-Heater Wire Circuit:

- High Airway Alarm: An audible alarm if temperature exceeds 41°C
- Low Airway Alarm: An audible alarm if temperature descends @29.5°C in invasive mode, or @26°C non-invasive mode
- High Humidity Alarm: Light will twinkle but no alarm if the humidity temperature exceeds 66°C.
- Low Humidity Alarm: An audible alarm between 10 minutes @26°C.

2.4. Performance

Recommended ambient temperature range: 18-26°C.

Recommended Flow Range:

Invasive Mode: up to 60 L/min, Noninvasive Mode : up to 120 L/min.

Refer to breathing circuit specifications for minimum flow.

Humidity Performance: Invasive Mode: > 33 mg/L, Noninvasive Mode: > 10 mg/L.

Warm-up time: Less than 30 minutes.

Maximum Operating Pressure: 20 kPa, gas leakage at max. pressure < 50 mL/minute.

2.5. Operating, Transport and Storage Environment

	Operating	Transport	Storage
Temperature	18- 26°C(64.4-78.8°F)	-10- 50°C (14-122°F)	-10- 50°C (14-122°F)
Relative humidity	30%-75%	30%-95%	30%-95%
Atmospheric pressure	70kPa-106kPa	50kPa-106kPa	50kPa-106kPa
Altitude	0-3000m(9000ft)	0-3000m(9000ft)	0-3000m(9000ft)

2.6. Standards Compliance

Safety requirements of IEC60601-1, IEC60601-1-2

Design requirement of ISO8185

Electric Shock Protection: Class I

Applied Part type BF

Water proof and Drip proof: IPX1

3. Explanation of Controls and Indicators

3.1. Humidifier Operation

This unit is designed to add heat and moisture to respiratory gases. The gas is passed through a humidification chamber where it is warmed and humidified.

This unit has two heating systems. The first is a heater plate, which heats the water contained in the humidification chamber, humidifying the air passing through it. The humidifier monitors the temperature of the gas at the chamber outlet with the chamber probe, and controls the amount of power delivered to the heater plate, in order to maintain the chamber set point.

Under normal conditions the gas is heated to 37 °C in the invasive mode, 31 °C for the noninvasive mode.

3.2. Power on Self-check

The purpose to internal inspection when turn on the unit.

Program of Power on Self-check:

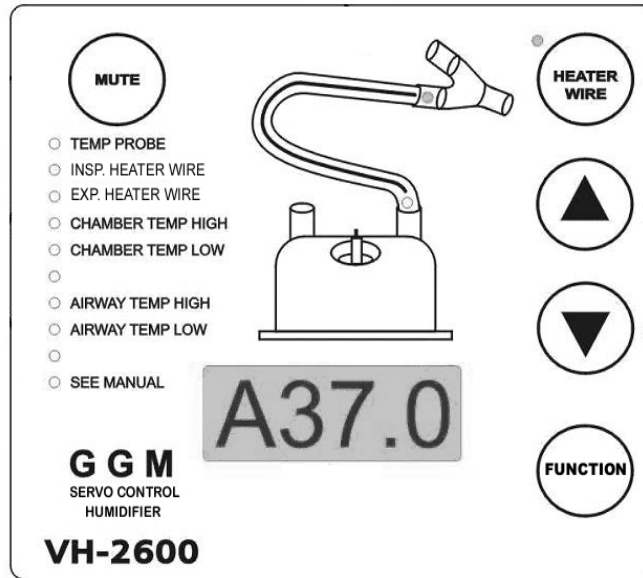
1. Check the heater wire fuse is well.
2. Check the heater plate over heat.
3. Check the heater plate temperature probe open or short.
4. Check the heater wire adapter open or short.
5. Check the airway temperature probe open or short.
6. Check the chamber temperature probe open or short.
7. Check the heater wire open or short.






Visual / Audio Test Sequence :

The LED will light up and the 15-segment display will flash and the buzzer will be given Be-Be When the power switch is on.

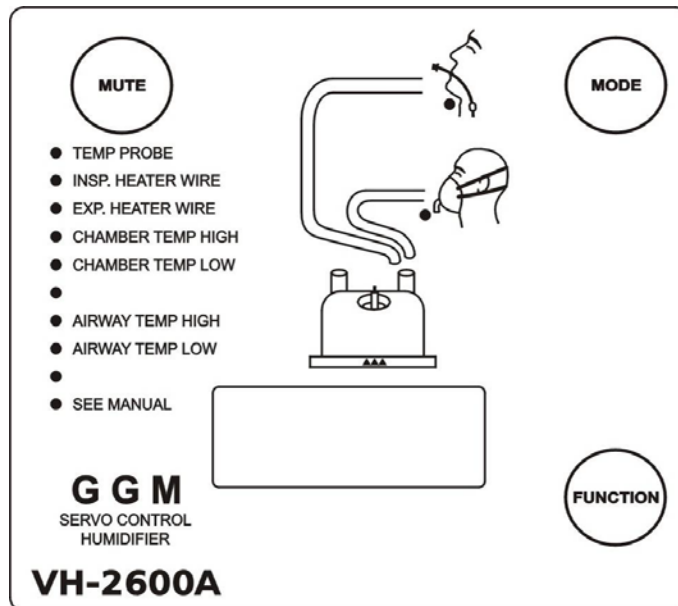
3.3. Front Panel






VH-2600



	<p>When this button is pressed power to the heater wire is turned on and the green indicator light will be illuminated. For non-heated wire circuits, the indicator light must be off. An alarm will occur if the heater wire function is turned off while a heated wire circuit is connected.</p>
	<p>To adjust the set temperature Up, each press of adjustment 0.5 °C.</p>
	<p>To adjust the set temperature Down, each press of adjustment 0.5 °C.</p>
	<p>To select the parameter to display “Airway” to ”Chamber”.</p>
	<p>Mutes all audible alarms. Normal mute time is 3 minutes. The alarm condition indicator lights will continue to flash until the condition is rectified.</p>

VH-2600A



	<p>1. Locked / Unlock</p> <p>*System will automatic “Lock” the panel after 60 sec when power on, and display the chamber temperature.</p> <p>*Hold FUNCTION for 3 sec ==> Unlock</p> <p>*Hold FUNCTION for 3 sec ==> Lock</p> <p>【The system will relock automatically after 60 sec, if there is no more operation.】</p> <p>2. Exchange Temperature</p>
	<p>1. Heater Wire Mode:</p> <p>The system will automatically swift to “Heater Wire Mode”, when the system equipped with heater wire while power on. System will swift to “Non-Heater Wire Mode” after holding MODE 3 sec.</p> <p>2. Patient Mode</p> <p>*In Patient Mode, button will be locked after 60 sec when power on.</p> <p>*After power on, it is in “Invasive” Mode.</p> <p>*Hold FUNCTION for 3 sec + Push MODE 1 times and system will swift to “Non-Invasive” Mode.</p>
	<p>Will silent all alarm sound for 3 min, the alarm indicator will keep on flashing until the alarm situation improved.</p>
	<p>Invasive mode</p> <p>Heater Wire Mode : Airway 40°C ; Chamber 37°C ◦</p> <p>Non-Heater Wire Mode : Airway 37°C ; Chamber ≤ 66°C ◦</p>
	<p>Non-Invasive mode</p> <p>Heater Wire Mode : Airway 34°C ; Chamber 31°C ◦</p> <p>Non-Heater Wire Mode : Airway 31°C ; Chamber ≤ 66°C ◦</p>

3.4. Display

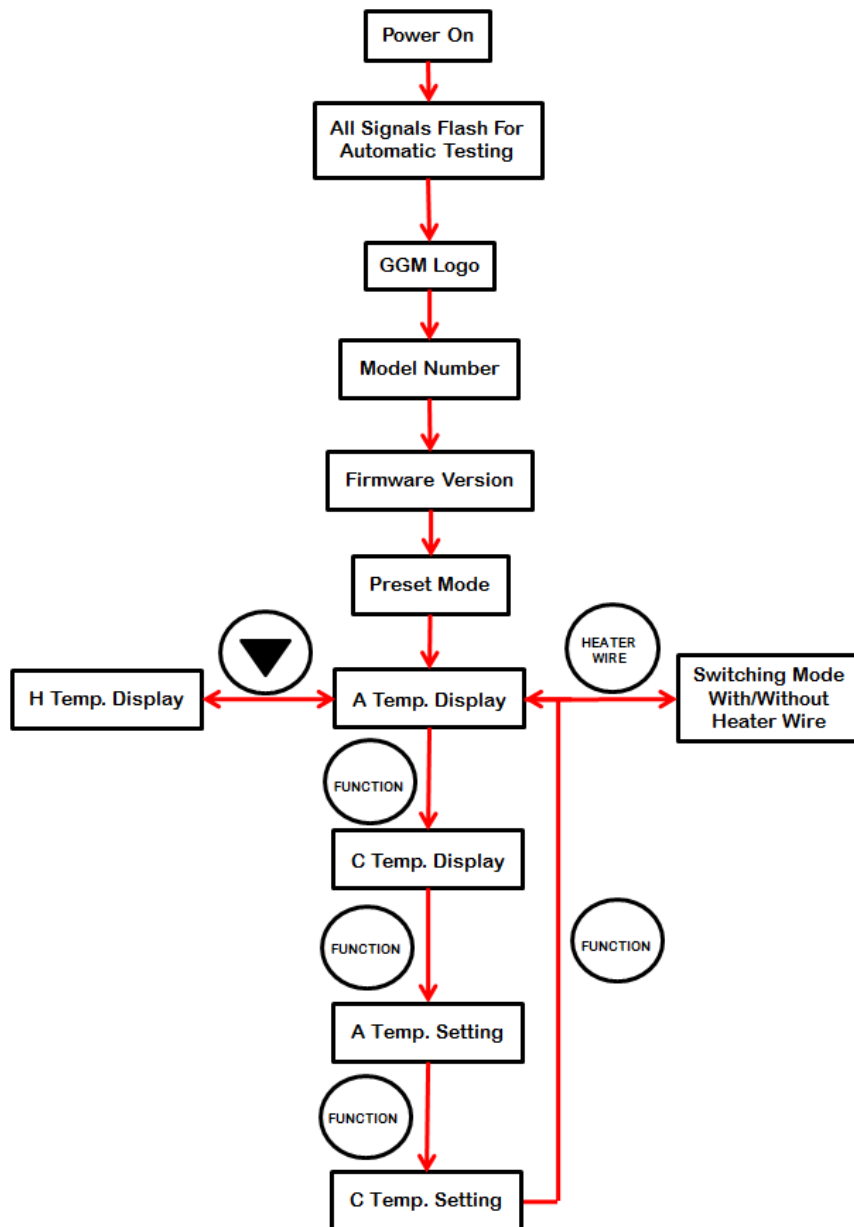
In generally condition: Display the actual temperature of gas being delivered from the chamber or the airway temperature.

Symbols :

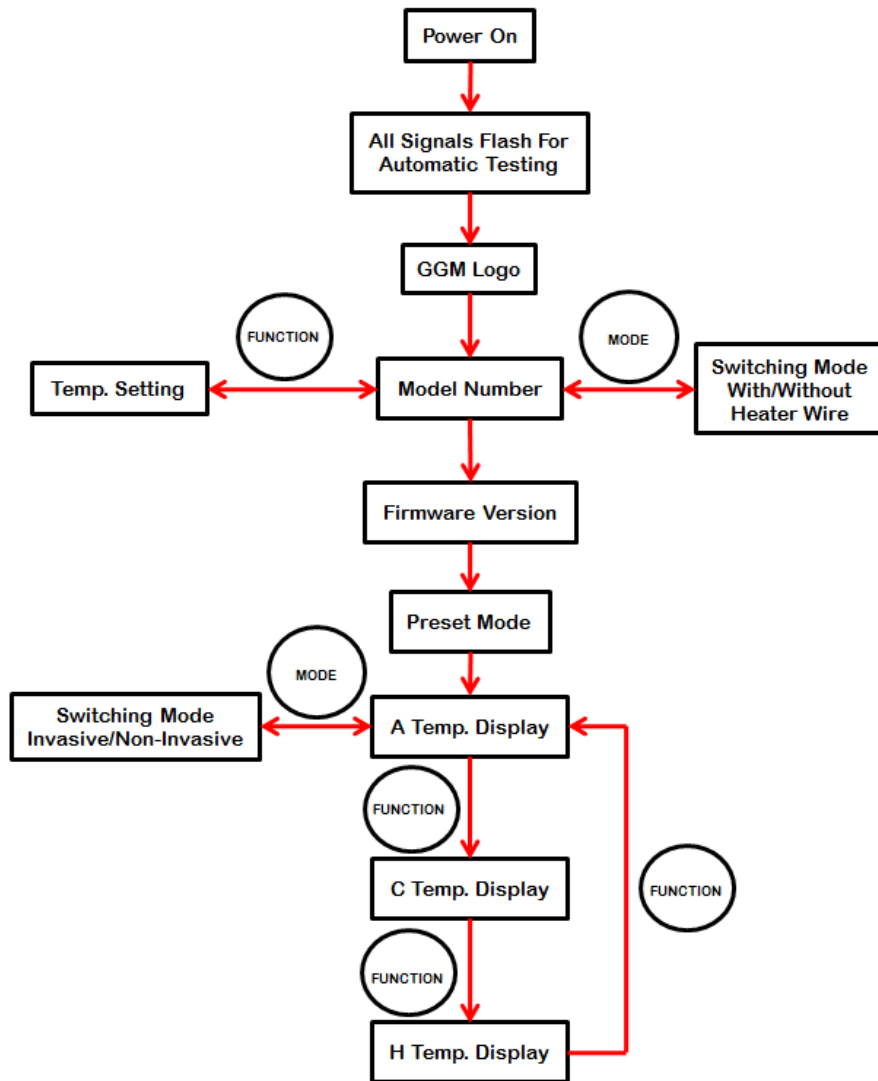
A40.0	Airway temperature	A=40	Airway temperature set point
C37.0	Chamber temperature	C=37	Chamber temperature set point
H100	Heater plate temperature	ER.01	When heater wire short.
LOCK	Button is lock	UNL.K	Button is unlock
A.OPEN	When airway probe is abnormal (opening).	A.SHT	When airway probe is abnormal (disconnection).
C.OPEN	When chamber probe is abnormal (opening).	C.SHT	When chamber probe is abnormal (disconnection).
H.OPEN	When heat plate probe is abnormal (opening).	H.SHT	When heat plate probe is abnormal (disconnection).
N-HW	Without heat wire mode.	R < 55	Sum of Insp. & Exp. Heater wire resistance < 5.5Ω.
OPEN	When airway and chamber probe is abnormal (opening).	A-CS	Airway or Chamber temperature
AHI	Airway temperature too high	ALO	Airway temperature too low
CHI	Chamber temperature too high	CLO	Chamber temperature too low
HHI	Heater plate temperature too high	HLO	Heater plate temperature too low

3.5. Flow Chart

3.5.1. Flow Chart for VH-2600



3.5.2. Flow Chart for VH-2600A



4. Maintenance Schedule

Keep routine maintenance to ensure safety for continuous usage.

4.1. Maintenance Schedule

It is necessary to avoid pollution by checking facilities and parts regularly. It is suggested contact with in local for maintenance every 12 months.

NOTE: Keep routine maintenance to ensure safety for continuous usage.

4.1.1. Humidifier

The outer case of the unit is made of plastic. DO NOT use antiseptic liquid or sharp stuff to clean it.

Cleaning

It should turn off the power before cleaning.

Clean the humidifier with recommended disinfectants using a damp cloth: must be used 75% Isopropyl Alcohol.

Wipe the humidifier clear of any cleaning residues before use.

1. Disconnect the humidifier from any electrical outlet.
2. Clean the humidifier with one of the following recommended disinfectants using a damp cloth:
 - a. Isopropyl Alcohol
 - b. Normal dishwashing detergent

NOTE: Follow the manufacturer's instructions carefully.

NOTE: Use the correct dilution of the disinfectant.

NOTE: DO NOT immerse the humidifier in any liquid.

3. Wipe the humidifier clear of any cleaning residues before use.

4.1.2. Temperature Probe

The cleaning methods listed below comply with FDA regulations for these types of equipment and do not affect the integrity or performance of the temperature probe.

Please contact your local dealer for suggestions on other cleaning methods not mentioned here.

1. Clean the probe and remove all visible contaminants by physically.
2. Use the following solutions to sterilize the temperature probe : Sporocidin™、Sporox™、Cidex™、Cidex™ OPA or Ethylene Oxide sterilization. The temperature probe was sterilized at 55 ° C (131 ° F) and 80 kPa, allowing the remaining ETO to evaporate at least 15 hours before use.

NOTE : Please follow the manufacturer's instructions. Use the correct dilution disinfectant.

Warning : Do not immerse the connector plug in the disinfectant.

Do not use autoclaves.

Do not use detergent or solvent.

3. Wipe the patient end temperature probe before use
4. Stored in a clean environment.

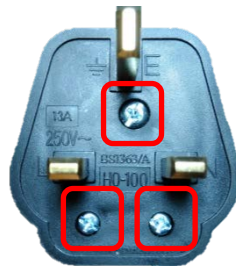
4.1.3. Heater Wire Adapter

Clean the heater wire at with one of the following recommended disinfectants using a damp cloth:

- a. Isopropyl Alcohol
- b. Normal dishwashing detergent

4.1.4. Mains Plug

If the mains plug detachable design, check whether the screw is locked or not.



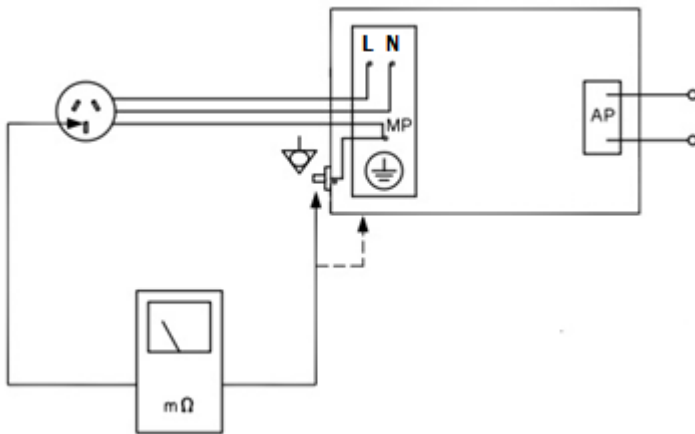
4.1.5. Safety

The resistance to earth from protectively earthed parts in the unit shall be low enough to permit adequate fault current to flow in the event of insulation failure, thereby ensuring that the protection device in the final sub-circuit opens quickly.

The protective earthing conductor also ensures that most of the capacitive leakage current from the mains part in the unit flows via a low-resistance path to earth and does not appear as excessive leakage current from the device enclosure or as Applied Part current, when the earthing conductor is intact.

The housing using plastic insulation material and the heater plate plating the insulating anodizing layer. Protect of any person from electric shock hazards.

The value of their earth leakage current tested prior to commissioning and at regular intervals during their service life. The mains plug and any part that is protectively earthed shall not exceed 0.2Ω as shown in Figure. (Refer to IEC/EN 60601-1 §8.6.4)



4.1.6. Breathing Circuit

Breathing circuit is a single use when you use a period of time or dirty, please replace the new product directly.

5. Alarm and Troubleshooting

5.1. Alarm Indicator

1. **TEMPERATURE PROBE** <Alarm>

While the temperature probe does not well connected or defected, system will alarm with sound and flashing red LED.

2. **INSP.HEATER WIRE** <Alarm>

While the INSP. Heater wire does not well connected or defected, system will alarm with sound and flashing red LED.

3. **EXP.HEATER WIRE** <Alarm>

While the EXP. Heater wire does not well connected or defected, system will alarm with 1 sound and flashing red LED.

4. **CHAMBER TEMPERATURE HIGH** <Alarm>

While the chamber temp higher than 41°C, system will alarm with sound.

NOTE : Alarm will be unworkable and it will only have twinkle yellow indicator while in Non-Heater Wire Mode, and alarm will happen while the chamber higher than 66°C.

5. **AIRWAY TEMPERATURE HIGH**<Alarm>

Heater Wire on :

While the airway temp higher than 42°C or While panel temp higher than 41°C

Heater Wire off :

While the airway temp higher than 41°C system will alarm with sound and flashing red LED.

6. **CHAMBER TEMPERATURE LOW**<Alarm>

While the chamber temp lower than 26°C and continuous 10 min system will alarm with sound and flashing LED.

7. **AIRWAY TEMPERATURE LOW**<Alarm>

Heater Wire :

Lower than 29.5°C and continuous 10min, or lower than 34.5°C and continuous 60min.

(System will flashing red LED, if the temperature of patient end is lower than 34.5°C and continuous 25 sec after warming up.)

Non-Heater Wire :

Lower than 29.5°C and continuous 10 min in Invasive mode, or lower than 26°C and continuous 10 min in Non-Invasive mode

System will alarm with sound and flashing red LED.

8. **SEE MANUAL**<Alarm>

When the red LED illuminates, a microprocessor fault occurred and system will be no function, the system should be disconnected from patient and call service center for repair.

Error Codes :

Item	Explanation
A.OPN	When airway probe is abnormal (opening).
A.SHT	When airway probe is abnormal (disconnection).
C.OPN	When chamber probe is abnormal (opening).
C.SHT	When chamber probe is abnormal (disconnection).
H.OPN	When heat plate probe is abnormal (opening).
H.SHT	When heat plate probe is abnormal (disconnection).
OPEN	When airway and chamber probe is abnormal (opening).
ER.01	When heater wire short.
ER.02	Opening of the fuse circuit of the heated line (F4).
ER.03	Opening of the circuit of heat shielding prevention.
R < 5.5	Sum of Insp. & Exp. Heater wire resistance < 5.5Ω.

5.2. Troubleshooting

5.2.1. Low Temperature

Condition detected	Possible cause	Action to take
Temperature less than desired, no alarm.	Humidifier warming up.	Wait for a few minutes.
Airway temperature low alarm activated.	Temperature probe not in position.	Check position of temperature probe in the circuit.
	Gas flow stopped or interrupted.	Turn humidifier off until gas flow resumed.
	Temperature probe not in probe housing.	Fit temperature probe.
	Gas flow rate too low.	Increase gas flow to more than 5 liters per minute.
Chamber temperature low alarm activated.	Too much distance between end of heater wire and temperature probe.	Use longer heater wire or shorten inspiratory hose so that distance is between 25 (1”) and 100 mm (4”), ideally 30mm.
	Poor thermal contact between base of chamber and heater plate.	Check that chamber base and heater plate are clean, smooth and flat. If necessary clean or replace.
	Temperature probe not inserted at chamber outlet.	Fit temperature probe correctly.
	Heater element needs replacement.	Send for repair.

5.2.2. High Temperature

Condition detected	Possible cause	Action to take
Airway temperature high alarm activated.	Sudden spurious increase in gas flow.	Wait for temperature to fall below threshold.
	Heater wire too close to temperature probe.	Use shorter heater wire or lengthen inspiratory hose so that distance is between 25 (1”) and 100 mm (4”), ideally 30 mm.
	Possibly faulty Airway sensor on temperature probe (low resistance).	Check probe.
Chamber temperature high alarm activated.	No water in chamber.	Refill humidification chamber.
	Possibly faulty Chamber sensor on temperature probe (low resistance).	Check probe.

5.2.3. Temperature Fluctuating

Condition detected	Possible cause	Action to take
High and low temperature alarms.	Ventilation rate too low or too erratic for proper humidifier temperature control.	Ventilation rates below about 6 bpm or of highly erratic nature may affect the stability of the temperature control.
	Humidifier temperature control influenced by external heating or cooling such as air conditioner.	Shield breathing circuit from external influence.
	Temperature probes incorrectly positioned.	Check temperature probe position in the circuit.
	Possibly faulty temperature probe (Could be intermittent short or open circuit)	Check probe. (Wriggle probe to pick up intermittent faults)

5.2.4. Excessive Water in Circuit

Condition detected	Possible cause	Action to take
Excessive water in inspiratory circuit due to rainout.	If in non-heated wire mode, water trap not at the lowest point of the circuit.	Reposition water trap.
	If in heated wire mode, heater wire too close to temperature probe.	Increase distance from heater wire to temperature probe so that the distance is between 25 (1”) and 100mm (4), ideally 30mm.
	Inspiratory circuit being cooled by air conditioner.	Shield circuit from air conditioner or use heater wire circuit.
	Chamber control set too high.	Reduce setting.
	Maximum permissible peak flow rate of humidification chamber has been exceeded.	Use correct chamber. Refer to the operating instructions for the type of chamber used.
	Humidifier chamber tilted.	Ensure chamber is level.
	Possibly faulty temperature probe (low resistance).	Check probe.
Excessive water in expiratory circuit due to rainout.	Condensation due to cooling in Expiratory line.	Use dual heated circuit.
Water ejected from humidification chamber into Circuit.	Humidification chamber filled beyond maximum water level line.	Reduce water level.
	Maximum permissible peak flow rate of humidification chamber has been exceeded.	Use correct chamber. Refer to the operating instructions for the type of chamber used.
	Humidifier chamber tilted.	Chamber should be level.

5.2.5. Low Humidity

Condition detected	Possible cause	Action to take
Low humidity.	Chamber control set to low.	Increase setting.
	No water in humidification chamber.	Fill chamber.
	Chamber temperature low.	Check chamber temperature setting on display when humidifier is switched on, chamber base and heater plate are smooth and flat and in good contact.
	Gas flow rate too high for chamber.	Check maximum flow rate in to chamber operating instructions.

5.2.6. Alarms

Condition detected	Possible cause	Action to take
Temperature probe alarm 'OPEN' appears on display.	Temperature probe unplugged.	Check connection.
	Temperature probe plug dirty.	Clean plug.
	Temperature probe faulty.	Replace probe.
Temperature probe alarm 'A.OPN' appears on display.	Airway temperature probe open.	Replace probe.
Temperature probe alarm 'A.SHT' appears on display.	Airway temperature probe short.	Replace probe.

Temperature probe alarm 'C.OPN' appears on display.	Chamber temperature probe open.	Replace probe.
Temperature probe alarm 'C.SHT' appears on display.	Chamber temperature probe short.	Replace probe.
Temperature probe alarm 'A-C.S' appears on display.	Airway & chamber temperature probe short	Replace probe.
Temperature probe alarm 'H.OPN' appears on display.	Internal temperature probe open.	Send for repair.
Temperature probe alarm 'H.SHT' appears on display.	Internal temperature probe short.	Send for repair.
Heater wire alarm while temperature still displayed.	Ins. Heater wire unplugged.	Check connection.
	Insp. Heater wire broken.	Replace heater wire.
Exp. Heater wire alarm while temperature still displayed.	Exp. Heater wire broken.	Replace heater wire. Or push twice of HEATER WIRE button.
'ER.01' appears on display.	Heater wire short.	Replace heater wire.
'ER.02' appears on display.	Internal fuse (F4) blown.	Send for repair.
'ER.03' appears on display.	Heater plate broken.	Send for repair.
	Heater plate overheated protector activated.	Reset overheated protector.

5.2.7. Temperature Display

Condition detected	Possible cause	Action to take
No temperature display, no alarm lights.	Internal fuse blown.	Check F1 F2 Fuse 1.5A (3A) Check F3 Fuse 1A
	Transformer over heat protector operated.	Replace transformer.
No temperature display, „see manual“ indicator light on.	Control PCB fault.	Check control PCB for water damage or contamination.

5.2.8. Breathing Circuit Leak

Condition detected	Possible cause	Action to take
Breathing circuit leak.	Faulty circuit connections.	Check all circuit connections.
	No water bag.	Connect water bag.
	Temperature probes incorrectly fitted.	Check connections.

5.2.9. External Water Leak

Condition detected	Possible cause	Action to take
Water leak with reusable chamber.	Chamber O-ring faulty.	O-ring should be clean and properly fitted. Replace if damaged.

Water leak with disposable chamber.	Chamber used beyond lifespan.	Replace with new chamber.
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6. Servicing Procedures

6.1. General Precautions

Warning: Although the unit display may not be illuminated, the unit may still be energized. Be sure to disconnect the unit from the power supply before servicing.

All servicing procedures should be followed by a humidifier performance test, and an electrical safety test to ensure proper operation.

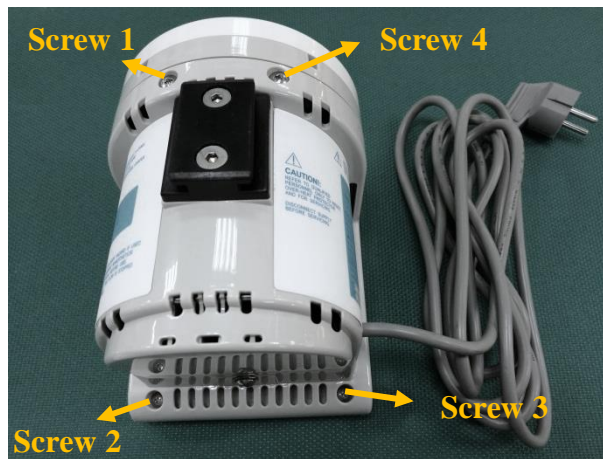
Warning : Do not use excessive force when re-locking.

Maintenance this unit should comply with anti-static procedures.

6.2. Disassemble

6.2.1. Opening the Case

1. Ensure the power supply has been disconnected.



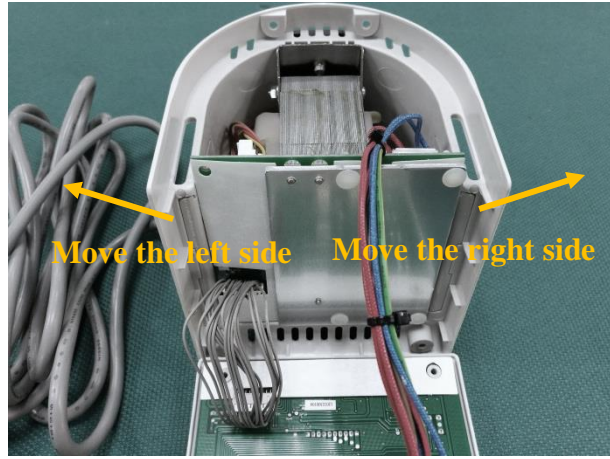
2. Remove the four screws at the back of the unit.

Separate the case by sliding the two halves apart. Pull the front half of the case away from the rear.

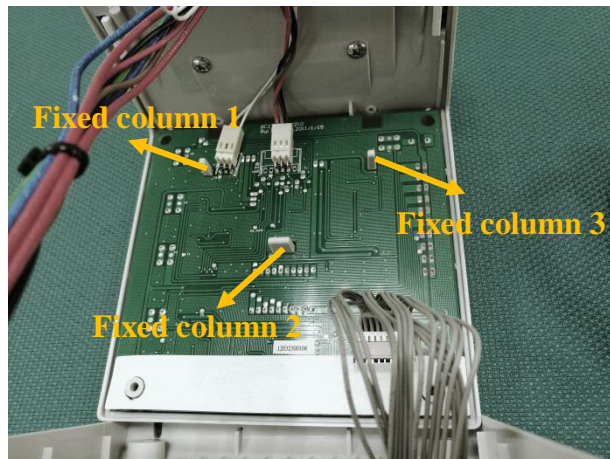
The control PCB is attached to the front half of the case and is connected via ribbon cable to the power PCB fitted to the rear half of the case.



3. Separate the case by sliding the two halves apart. Pull the front power supply PCB to separate the case.

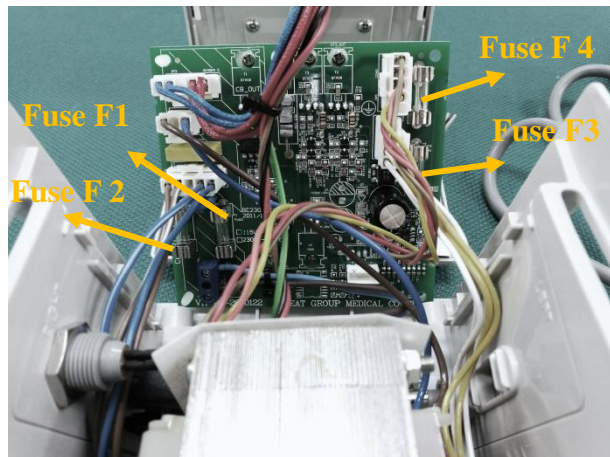


4. Un-clip the three fasteners which hold the front control PCB to the front of the case, and separate the front PCB from the case.



6.2.2. Replacing Fuses

1. Open the case to remove the power PCB.



2. The four fuses have the following ratings.

Model	Supply voltage	Fuse Type
VH-2600/VH-2600A	230V	F1 : 1.5A 250V Fast Blow F2 : 1.5A 250V Fast Blow F3 : 1A 250V Fast Blow F4 : 4A 250V Fast Blow

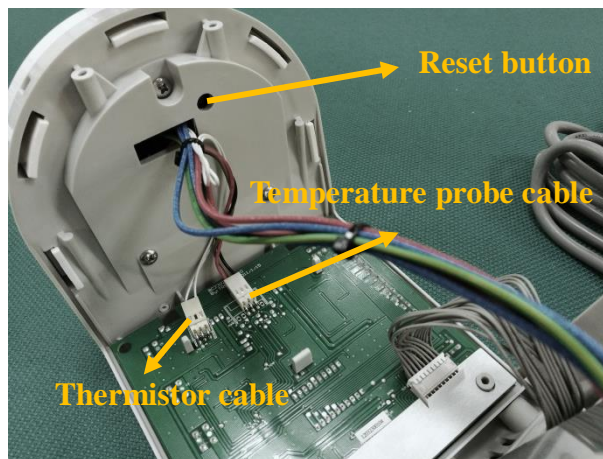
VH-2600/VH-2600A	115V	F1 : 3A 250V Fast Blow F2 : 3A 250V Fast Blow F3 : 1A 250V Fast Blow F4 : 4A 250V Fast Blow
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Warning: Be sure to replace the correct type of fuse. Do not use unspecified fuse, causing patient injury.

3. Replace fuse.
4. Close the case.

6.2.3. Resetting the Thermal Cutout

1. Open the case.
2. Check the thermal cutout on the heater plate by pushing the reset button with a pen or small screwdriver.



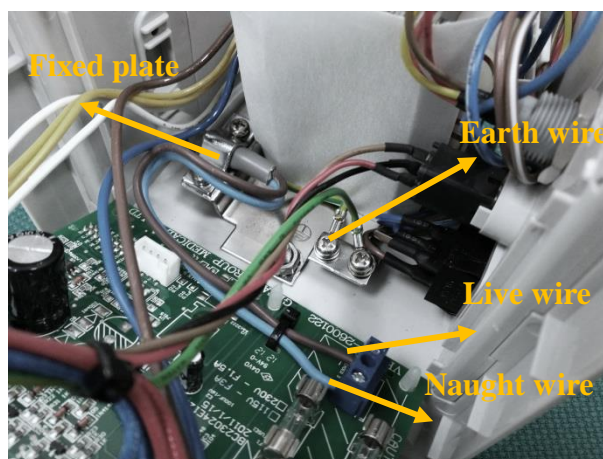
3. If the thermal cutout “clicks” when pushed, it has been previously activated, and is now reset.

NOTE: If the heater plate is still hot, it must be allowed to cool sufficiently before the thermal cutout will reset.

4. Close the case.

6.2.4. Replacing the Mains Cable

1. Open the case.
2. Remove then mains cable terminals on the power supply board and cut cable tie on the PCB.



3. Remove the fixed plate.

- Remove the earth wire, live wire and neutral wire.
- Attach the mains cable wires to the terminal block on the power PCB, and attach the new cable tie.

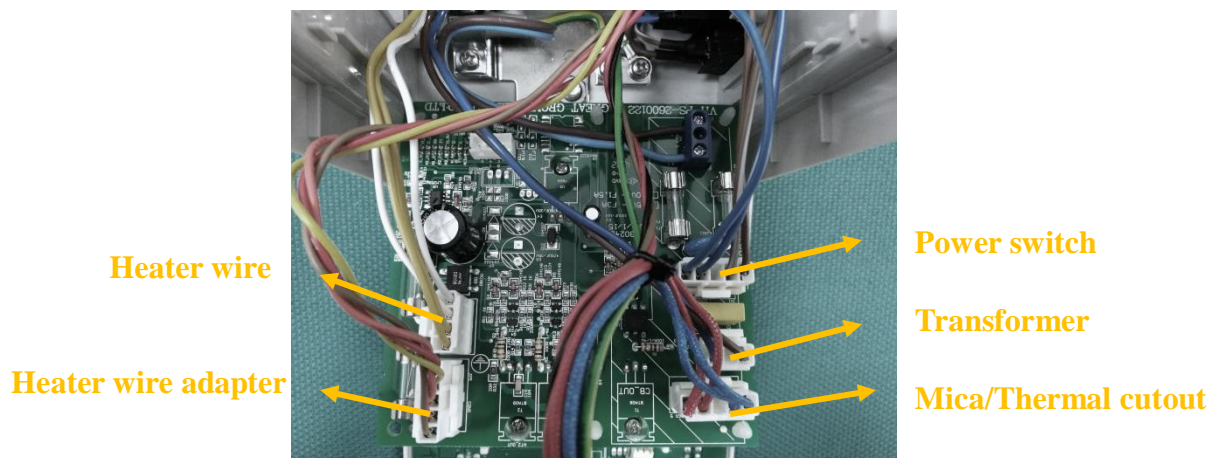
Cord type	Live wire	Neutral wire	Earth wire
USA/ JAPAN (115/ 100 V)	Black or Brown	White or Blue	Green or Green/Yellow
EUROPEAN (230V)	Brown	Blue	Green/Yellow
NZ/ AUSTRALIA (230 V)	Brown	Blue	Green/Yellow

Caution : When attaching the mains cable wires, ensure that the correct polarity of the mains wiring is followed. The table given above only applies to power cords supplied by Great Group Medical Co., Ltd.

- To fixed the power cord.
- Close the case.

6.2.5. Replacement of Printed Circuit Boards (PCBs)

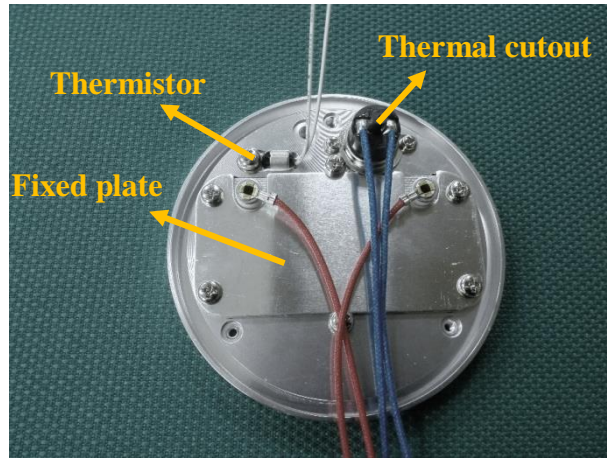
- Open the case.
- Disconnect all harnesses attached to the power PCB. Disconnect the mains and protective earth wires by unscrewing the terminal blocks, and cutting the cable ties.



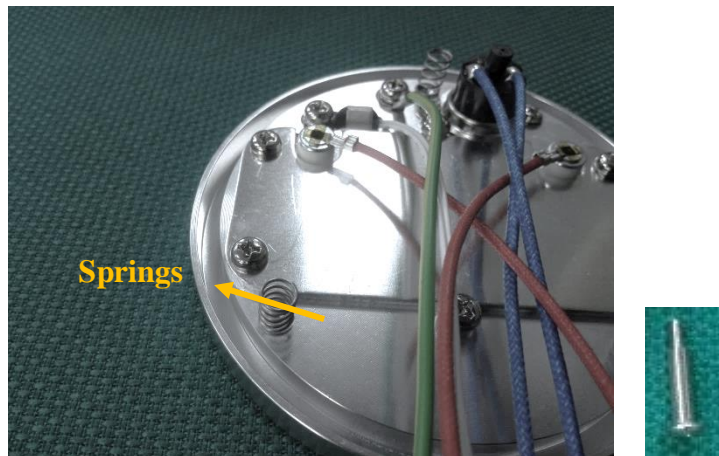
- Remove the power PCB and replacement the new one.
- Connect harnesses from the transformer and heater plate to the power PCB.
- Close the case.
- Check that the unit powers up normally, and complete a full performance test.

6.2.6. Replacing the Thermistor.

- Open the case.
- Disconnect the mica cable, thermistor and thermal cutout harnesses attached to the power PCB.
- Remove the three screws holding the heater plate.



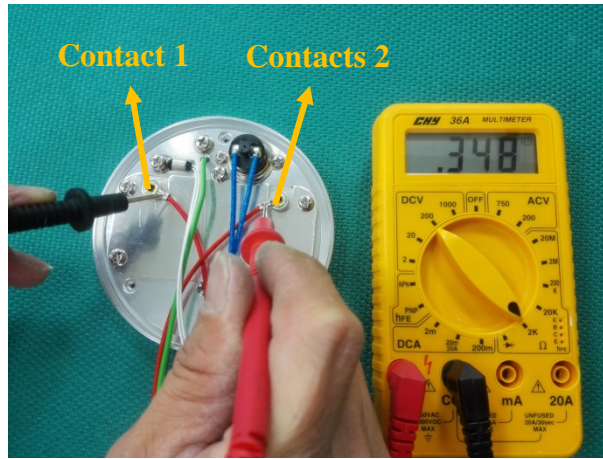
4. Remove the three screws holding the heater plate.
5. Place the new thermistor into position, and attach using the screw.
6. Replace the fixing screw.
7. Place heater plate back into position, ensuring the springs underneath the heater plate are in place. Attach to the humidifier's case using the three long screws that were previously removed..



8. Connect the mica cable, thermistor and thermal cutout harnesses to the power PCB.
9. Close the case.

6.2.7. Checking the heater plate element

1. Open the case.
2. Disconnect the mica cable, thermistor and thermal cutout harnesses from the power PCB.
3. Remove the three screws holding the heater plate.
4. Measure the resistance between the 2 contacts on the mica connector.



The resistance of the heater plate element should measure the same as outlined in the table below:

Supply Voltage	Heater Plate Resistance
230V	$353.0 \pm 18.0 \Omega$
115V	$88.0 \pm 4.0 \Omega$

If the measured resistance is outside this range, replace the mica.

5. Remove the six screws holding the mica.
6. Remove the heater element, leaving the mica insulator in place.
7. Attach the six screws holding fixed plate.
8. Place the heater plate assembly back into position, ensuring the springs underneath the heater plate are in place. Attach to the humidifier case using the three long screws that were previously removed.
9. Connect the heater plate element, thermistor and thermal cutout harnesses to the power PCB.
10. Close the case.

6.2.8. Replacing the Thermal Cutout

1. Open the case
2. Disconnect the mica cable, thermistor and thermal cutout harnesses from the power PCB.
3. Remove the three screws holding the heater plate.
4. Remove the two screws holding the thermal cutout.
5. Place new thermal cutout in position and fasten using screws provided.
6. Attach the screws holding.
7. Place heater plate back into position, ensuring the springs underneath the heater plate are in place. Attach to the humidifier's case using the three long screws that were previously removed.
8. Connect the mica cable, thermistor and thermal cutout harnesses to the power PCB.

6.2.9. Closing the Case

1. Make sure that all harnesses that were previously disconnected have been reconnected. If the mains wiring was disconnected during servicing, check that the mains polarity is correct.
2. Slide the power PCB back into position, ensuring that the side panel slides in the slots and latches into the case rear.
3. Place the control PCB back into position in the front of the case, ensuring all clips are located properly.
4. Slide the case together, and replace the four screws.

5. In order to check that the humidifier is working properly, complete a full performance test as outlined in section 7.

7. Performance Testing

7.1. Humidifier Performance Testing

7.1.1. Humidifier Calibration Check

Return the unit to an authorized service center for examination and repair.

7.1.2. Humidifier Display Check

Check the display window and LED indicator will all light when turn on the power.

7.1.3. Humidifier Voltage Calibration Check

Return the unit to an authorized service center for examination and repair.

7.1.4. Humidifier Warm-up and Control Check

Return the unit to an authorized service center for examination and repair.

7.2. Humidifier Warm-up and Control Check

This section describes how to check the humidifier's heater control systems. This test should be performed if there is a problem with the humidifier, or after servicing of the humidifier.

Equipment Required :

- VH-2600/VH-2600A Humidifier
- Heat wire adaptor
- Temperature probe
- Breathing circuit
- Chamber
- Gas supply : 10 ± 5 LPM

1. Make sure that the humidifier passes the calibration and display checks
2. Follow the instructions to set up the humidifier.
3. Connect the humidifier chamber inlet to the gas supply, and turn the humidifier on.
4. Wait approximately 30 minutes for the humidifier to stabilise.

Chamber and Airway temperature can be checked by the display pattern. The set temperature can be checked by setting mode. After the humidifier is heated, Airway and Chamber end temperature should be within $\pm 2.0^{\circ}\text{C}$ of its set value, and no alarm. If an alarm occurs, refer to Section 5.2 troubleshooting. If the temperature is out of range, refer to the operating manual settings.

7.3. Temperature accuracy calibration

The temperature probe must be check every 12 months. It's operated according to the manufacturer's specifications.

The following procedures must be carried out by a specialist technician:

1. Get the accurate thermometer.

2. Place both the airway and chamber probes in a container of water 32~40 °C, along with the accurate thermometer.
3. Turn on the humidifier. Place the temperature probe and the accurate thermometer, Compare the temperatures obtained with the thermometer.
4. The temperature margin of error ± 0.5 °C between the humidifier temperatures and the thermometer. If it's not that the probe should be replaced.

8. Recommended Maintenance Checklist

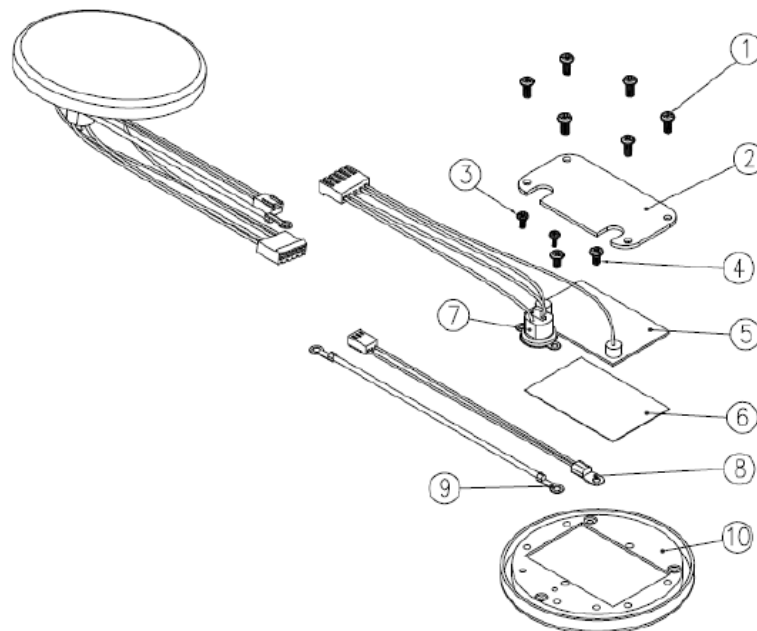
This sheet can be copied and used to keep a record of the maintenance procedures carried out on your VH-2600/VH-2600A Humidifier, and sensor. Place the serial number and the date that the maintenance was carried out in the spaces provided.

8.1. Humidifier Check (Annually)

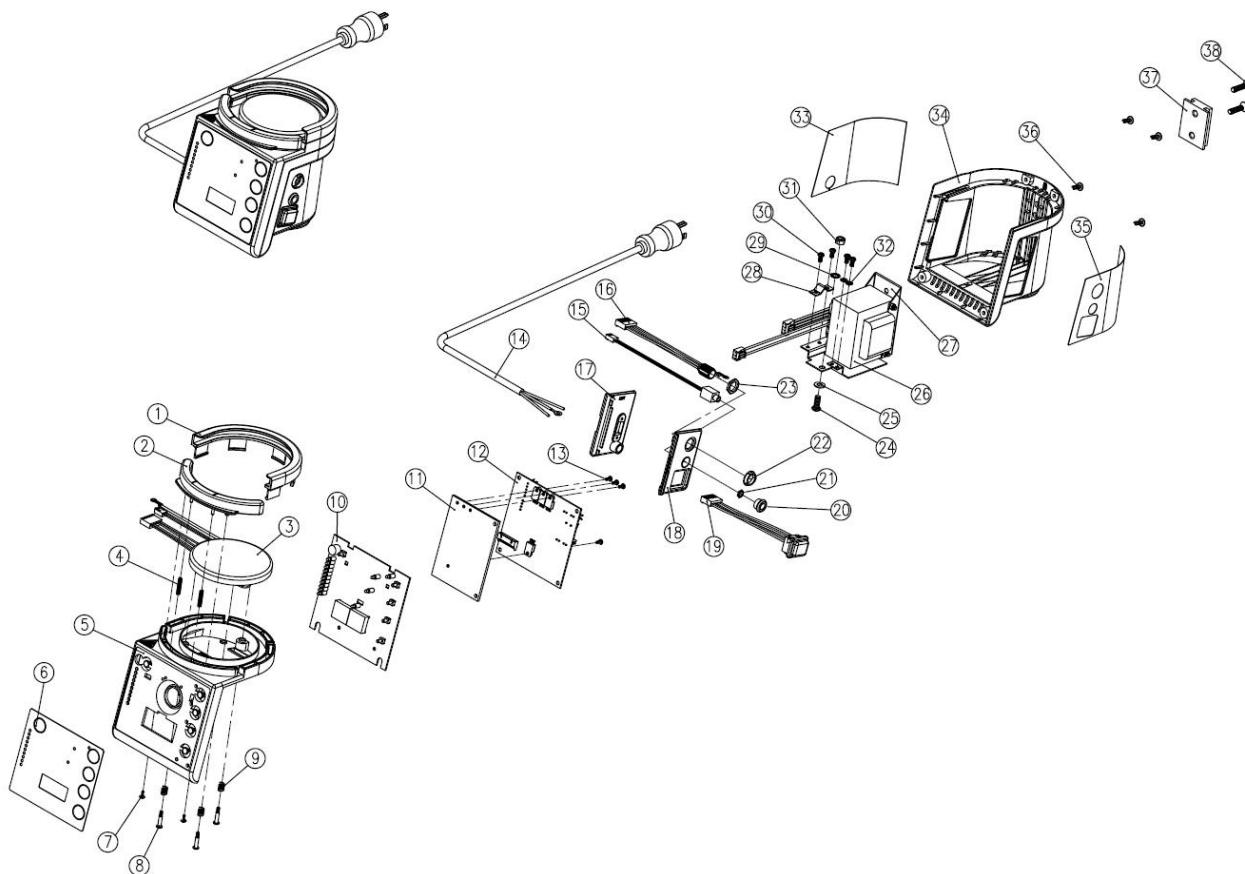
Serial Number	Visual Checks	Performance Checks	Electrical Safety	Signature and Date
	1. Mains Cable 2. Heater Plate 3. Heater Wire Adaptor	1. Calibration Check 2. Display Check	1. Earth Resistance 2. Insulation Resistance 3. Earth Leakage 4. Other tests as required	
	1. Temperature Sensor	1. Temperature Accuracy		

9. Exploded Diagram

9.1. Heater Plate



9.2. VH-2600 Exploded Diagram



9.3. VH-2600A Exploded Diagram

