Fisher & Paykel HEALTHCARE

MR850 RESPIRATORY HUMIDIFIER

Technical Manual

REVISION J

Auckland, New Zealand

Fisher & Paykel Healthcare Head Office:
PO Box 14-348, Panmure,
Auckland 1134
New Zealand
Email: info@fphcare.com
Web Site: www.fphcare.com
Tel: +64-(0)9-574-0100
Fax: +64-(0)9-574-0158

France/Benelux:
Parc Silic-Bal F,
10 Avenue de Quebec,
Silic 512 Villebon, 91946,
Courtaboeuf, Cedex, France.
Tel: +33–(0)1-6446-5201
Fax: +33–(0)1-6446-5221

Australia:
36-40 New Street,
Ringwood, Victoria 3134,
Australia,
Tel: +61-(0)3-9879-5022
Fax: +61-(0)3-9879-5232

USA:
Suite 101 22982 Alcalde Drive,
Laguna Hills, California 92653, USA
Tel: +1-(949)-470-3900
Fax: +1-(949)-470-3933
Toll Free: (800)-446-3908

Germany:
Hundsbergerstrasse 45
73642 Welzheim
Germany
Tel: +49-(0)7182-93777-0
Fax: +49-(0)7182-93777-99

UK and Ireland(European Authorised Representative):
Unit 16, Cordwallis Park
Clivemont Road, Maidenhead, SL6 7BU,
United Kingdom
Tel: +44-(0)1628626 136
Fax: +44-(0)1628626 146

TABLE OF CONTENTS

Revision	Description of Technical Manual Change	Date Issued
A	First release technical manual. Covers Revision **A** PCB's **ONLY**.	12 Jan. 1999
B	Second release technical manual. Covers Revision **C** and later PCB's **ONLY**.	6 May 1999
C	Add "View850" Software Instructions	1 Mar. 2000
D	Neonatal volume ventilation capability. 3.4 Performance 4.1.2 Power Up sequence. 4.1.3 Manual Temperature Compensation (TC). 5.3 Cleaning Instructions Appendix E – Product Change History.	15 May 2001
E	Covers release of software version 6.00. 3.4 Performance Recommended Operating Temperature: 15 to 26ºC 4.1.1 Stand-by. Changed stand-by power limits. 4.1.3 Humidity Compensation (HC) mode. Auto HC mode option. 4.2 Humidifier Controls Power button must be held for 1 second to switch OFF. 4.4 Setup Indicators Two LED's now indicate heater wire connect alarm. 4.5 Operational Alarms Low temperature alarm enabled during stand-by. 6.4 Diagnostic Menu "OFF" Offset removed from diagnostic menu.	1 November 2001
F	Covers release of software version 7.00. 3.4 Performance Recommended Operating Temperature: 18 to 26ºC 4.1.3 Humidity Compensation (HC) mode Changed step size to 1 °C in non-invasive mode 4.1.4 Breathing Circuit Recognition added 6.3 See – Manual, Error Codes removed redundant error code "E33" 6.4 Diagnostic Menu add new functions "CHP" and "Cct"	2 April 2002
G	Technical manual now covers software versions 5.45, 5.70, 6.00, 7.00 and 7.14 The following sections have been modified: 3.3, 4.1.3, 4.1.5, 4.4, 5.3, 6.4, 7.2.3, 7.2.6, Appendix E	1 May 2003
H	Added Non-Heater Wire Mode in sections 3.0, 4.0, 6.0, and updated Product Change History	1 July 2004
I	8.1.2 Humidifier Calibration Check – Equipment Required Removed the reference to the service kit 10 Spare Parts Added parts 17 to 22. 12.1 Introduction Updated how to get View850 and the serial cable 12.2 Installation Changed View850 installation from floppy disk to CD 12.3.1 Viewing Humidifier Data Updated how to run View850 and how to change the com. Port Add section, 13. EMC Information	1 August 2005

Revision	Description of Technical Manual Change	Date Issued
J	1.4 Product Application, Add warning to connect humidifier only to a pure sine wave power source 5.2 Safety Check, add CAUTION: and NOTE: 6.3 “See manual” Error codes, Elaborate the fault description 8.1.5 Humidifier Warm-up and Control Check, Change test flow rate from 20±10 SLPM to 10±5 SLPM. Reference test limits to airway and chamber set temperatures rather than fixed values. 8.2.2 Probe Flow Accuracy Test, Change test flow rate from 20±2 SLPM to 10±1 SLPM. Check flow measurement is now between 5 and 15 LPM 10 Spare Parts, add items 23,24,25,26	1 November 2005

Note:

1. Fisher & Paykel Healthcare have a policy of continued product improvement and reserve the right to change specifications without notice.
2. This Technical Manual covers software version 5.45, 5.70, 6.00, 7.00, 7.14, 7.21, 7.22, 7.23 and PCB Revision C, D and E. Refer to previous revisions of the Technical Manual for earlier software and PCB versions.

Introduction

1.1 About this Manual

This manual is intended for qualified service personnel who will perform maintenance and servicing on the Fisher & Paykel Healthcare MR850 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 Fisher & Paykel Healthcare representative for the appropriate software version. Maintenance procedures should be carried out at regular intervals (as recommended in the maintenance schedule), to ensure that the humidifier and its accessories are working correctly.

If a fault should occur with the humidifier, follow the troubleshooting guide (section 6) 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. Instead, if the PCBs are found to be malfunctioning, they should be replaced.

1.2 Glossary

Chamber	Device that allows gas to be to be heated and humidified by passing it over heated water.
Temperature / Flow Probe	Sensor assembly for measuring temperature and flow of respiratory gases traveling through the breathing circuit. Consists of a chamber and airway probe.
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 temperature that the humidifier attempts to maintain at the chamber probe port.
Airway Set Point	The temperature that the humidifier attempts to maintain at the airway probe port.
Heater Wire Adaptor	Electrical connector between the breathing circuit and the humidifier.
Breathing Circuit	Tubing that carries respiratory gases to and from the patient.
Dual Heated Breathing Circuit	A breathing circuit that is heated by means of heater wires, in both the expiratory and inspiratory limbs.
Single Heated Breathing Circuit	A breathing circuit that is heated by means of a heater wire, in only the inspiratory limb.
PCB	Printed Circuit Board.
Heater Wire	Wire inside the breathing circuit 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 from the patient.

1.3 Definitions

NOTE: A NOTE provides important information or explanation of procedures or conditions which may otherwise be misinterpreted or overlooked.

CAUTION: A **CAUTION** statement designates the possibility of damage to this or other equipment if a procedure is not followed exactly.

WARNING:
A WARNING statement refers to conditions with a possibility of personal injury if a procedure is not followed exactly.

1.4 Product Application

The MR850 is a respiratory humidifier designed for use in hospital intensive care units. It is used to provide optimum humidity to respiratory gases delivered to patients via endotracheal tubes or face masks.

Refer to the Respiratory Humidification Product Catalogue or your local Fisher & Paykel Healthcare representative for a list of approved accessories.

WARNING:

- ***The use of breathing circuits, chambers or other accessories which are not approved by Fisher & Paykel Healthcare may impair performance or compromise safety.***
- ***Ensure that Invasive mode is set for patients that have bypassed airways.***
- ***Ensure maintenance of grounding integrity by connection to a "hospital grade" receptacle.***
- ***Always disconnect supply before servicing.***
- ***When mounting a humidifier adjacent to a patient ensure that the humidifier is always securely mounted and positioned lower than the patient.***
- ***The operation of high frequency surgical apparatus, shortwave or microwave equipment in the vicinity of the humidifier may adversely affect its function. If this occurs, the humidifier should be removed from the vicinity of such devices.***
- ***Ensure that both temperature probe sensors are correctly and securely fitted. Failure to do so may result in gas temperatures in excess of 41 °C being delivered to the patient.***
- ***Do not touch the glass tip of the chamber temperature probe during use. Keep black connectors dry at all times.***
- ***Visually inspect accessories for damage before use.***
- ***Normal operation can not be guaranteed if powered from a source other than a pure sine wave, such as a square wave inverter.***

2 Humidifier Symbols

Caution: Hot surfaces may exceed 85 °C

Type BF

Attention – consult accompanying documents

Alternating Current

IPX 1

Drip proof protection to IPX1

Year-month

Date of manufacture

C-tick for EMC

Do not discard

WEEE collection (EU only)

Power On/Off (stand by)

Invasive Mode

Non-invasive mode

Temperature Alarm

Serial Port

Protective Earth

Caution: Electrostatic Sensitive Device

3 Specifications

3.1 Mechanical

Dimensions: 140 mm x 173 x 135 (without chamber fitted)
Weight: 2.8 kg (without chamber fitted)
Approx. 3.1 kg (with chamber fitted, and filled with water)

3.2 Electrical

MR850 Model Number	Supply Voltage	Supply Current
MR850Axx	230 V~	1.0 A Max
MR850Pxx	127 V~	1.8 A Max
MR850Jxx	115 V~	2.0 A Max
MR850Gxx	100 V~	2.4 A Max

Supply Frequency: 50 or 60 Hz, Sine Wave
Heater Plate Capacity 150 W at nominal mains voltage
HP Thermal Cutout: 118 ± 6 °C
Heater Wire Supply: 22 ± 5 V~, 2.73 A Max, 50 or 60 Hz
Maximum Heater Wire Load: 8.0 Ω.

3.3 Temperature Range

3.3.1 Heater Wire Mode

Invasive Mode: Chamber Set Point: 35.5 to 37 °C
Chamber Set Point: 35.5 to 40 °C (versions 5.33, 5.34, 5.45, 5.70, 6.00, 7.00, 7.21).
Chamber Set Point: 35.5 to 42 °C (versions 7.14, 7.17 & 7.22).
Airway Set Point: 35 to 40 °C

Non-Invasive Mode: Chamber Set Point: 31 °C
Chamber Set Point: 31 to 34 °C (versions 5.33, 5.34, 5.45, 5.70, 6.00).
Chamber Set Point: 31 to 36 °C (versions 7.00, 7.14, 7.17, 7.21, 7.22).
Airway Set Point: 28 to 34 °C

3.3.2 Non Heater Wire Mode

Invasive Mode: Airway Set point: 37 °C (chamber temperature limited to 66 °C)
Non-invasive Mode: Airway Set point: 31 °C (chamber temperature limited to 66 °C)
Display: Three digit, 14 mm, 7 segment LED
Range: 10 to 70 °C
Accuracy: ± 0.3 °C (in 25 to 45 °C temperature range)

3.3.3 Alarm Parameters

High Temperature Alarm: Causes an immediate, audible and visible alarm at a displayed temperature of 41 °C or if the airway temperature exceeds 43 °C (see section 4.3)

Temperature Alarm: Invasive Mode:
After 10 minutes @ 29.5 °C causes an audible and visible alarm.
After 60 minutes @ 34.5 °C causes an audible and visible alarm (see section 4.5)
NOTE: The temperature indicator lights if the displayed temperature drops below 35.4 °C, initially providing a temperature warning.

	Non-heater wire operation: Invasive Mode: Airway temperature < 29.5 °C causes an audible and visible alarm. Non-invasive Mode: Airway temperature < 26.0 °C causes an audible and visible alarm.
Sound Pressure Level:	Alarms exceed 50 dBA @ 1 m.

3.4 Performance

Invasive Mode:	Flow up to 60 LPM, humidity output >33 mg/L
Non-Invasive Mode:	Flow up to 120 LPM, humidity output >10 mg/L **NOTE**: Performance results with RT100 breathing circuit
Maximum System Operating Pressure:	20 kPa, gas leakage at max. pressure <100 mL/minute.
Warm-up time:	Less than 30 minutes.
Recommended ambient temperature range:	18 to 26 °C

CAUTION: If operating outside the recommended ambient temperature range, consult your local Fisher & Paykel Healthcare representative or refer section 4.1.5.

3.5 Transport and Storage Environmental Conditions

Transport Conditions:	-10 to +50 °C
Storage Conditions:	-10 to +50 °C

3.6 Standards and Approvals

AS/NZS 3200.1.0, CAN/CSA 22.2 No.601.1, UL 60601-1, IEC 60601-1, EN 60601-1

4 Operating Modes and Controls

4.1 Humidifier Operation

The MR850 humidifier is designed to add heat and moisture to respiratory gases. The gas is passed through a humidification chamber where it is warmed and humidified.

The MR850 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 non-invasive mode.

4.1.1 Heater wire operation

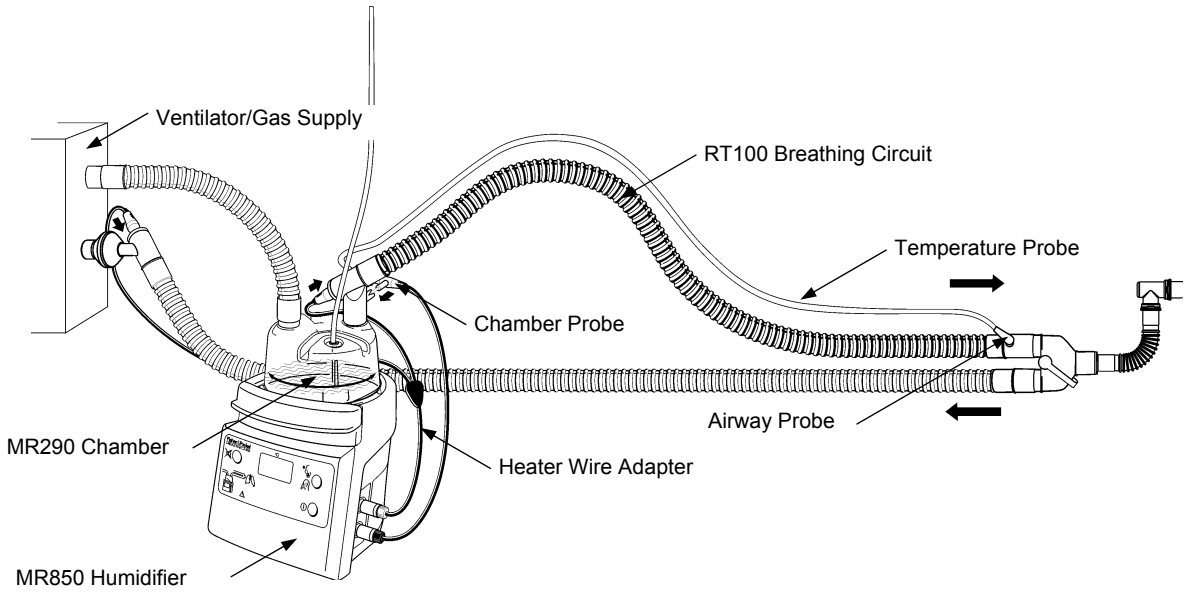


Figure 4.1 Typical Heater Wire Humidifier Setup

Humidified gas from the chamber travels through the inspiratory limb, where its temperature must be maintained in order to prevent the generated humidity from condensing. This is achieved with a heater wire encapsulated within the inspiratory limb. The humidifier maintains the temperature along the inspiratory limb by monitoring the temperature at the airway probe and controlling the power delivered to the heater wire. Under normal conditions the gas is heated to 40 °C in the invasive mode, 34 °C for the non-invasive mode.

An optional, second heater wire, located in the expiratory limb, minimises condensate in this limb.

4.1.2 Non-Heater Wire Operation (Software version 7.23 only)

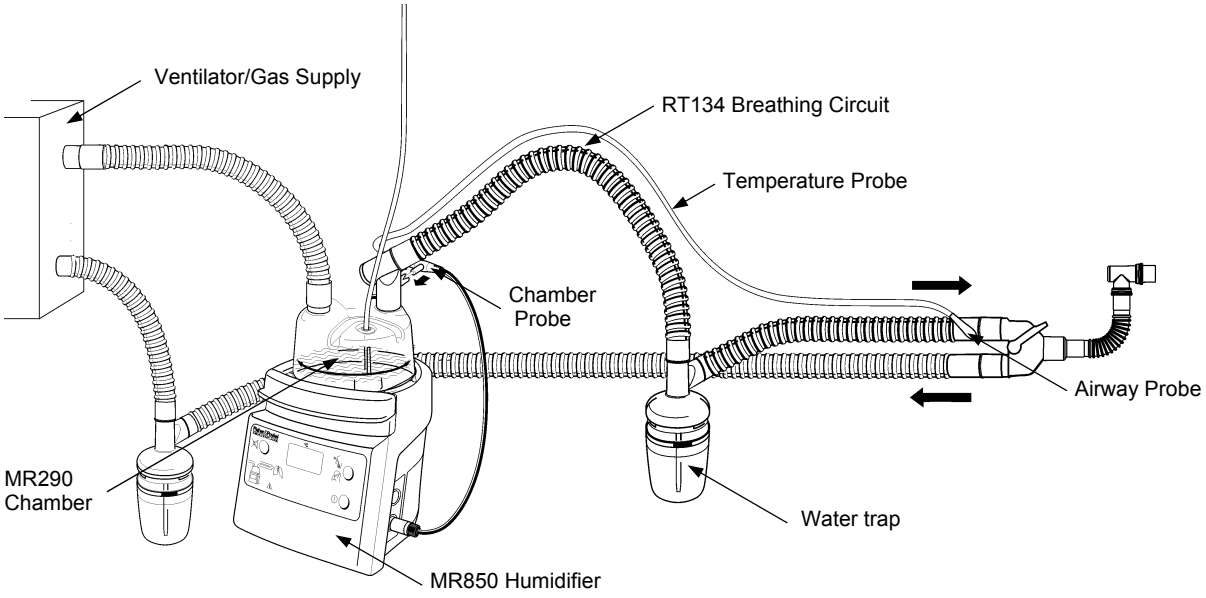


Figure 4.2 Typical Non-Heater Wire Humidifier Setup

In this application the MR850 maintains the airway temperature at the desired set point (invasive 37 °C or non-invasive 31 °C) by heating the chamber of water through the heater plate. As the gas cools considerably down the unheated circuit, a water trap circuit must be used to collect the resulting condensate.

Activating Non-Heater Wire Operation

Refer also to the diagnostic menu in section 6.4.

1 Turn on the humidifier with **NO** heated circuit connected, and mute the heater wire alarm.

2 Access the diagnostic menu by pressing the mute and mode buttons together for 1 second, the display should show two rows of dashes '= = ='. Releasing both buttons will allow the diagnostic menu to cycle automatically.

3 Allow the menu to cycle through to "cct" – the circuit identification. Press mute to access this function.

4 To enable non-heated operation, press both mute and mode buttons simultaneously for 1 second, the humidifier will beep twice and the temperature display will show "nhh". Release both buttons. The humidifier is now configured for non-heated circuits. This setting will be remembered each time the humidifier is turned on.

Deactivating Non-Heater Wire Operation

The simplest way to de-activate non heater wire operation is to connect a heated breathing circuit. Alternatively it can be de-activated the same way that non-heated circuit operation was activated (see above).

4.1.3 Stand-by Operation

If the humidifier detects a problem with its setup or operation it will alarm. Depending on the severity of the alarm condition, the humidifier will either remove all power from the heating systems, or enter stand-by. The humidifier will also enter stand-by if the gas flow through the breathing circuit has stopped.

Stand-by (Software versions: 5.45 & 5.70)

- Heater wire power is set at 30 %.
- Control of chamber temperature is attempted, within the following limits:
- Heater plate temperature is limited to 60 °C.
- Heater plate power is limited to 20 %.

Stand-by (Software version: 6.00 onward)

- Heater wire power is set at 15 %.
- Control of chamber temperature is attempted, within the following limits:
- Heater plate temperature is limited to 50 °C.
- Heater plate power is limited to 20 %.

NOTE: The temperature alarm algorithm continues to function in stand-by.

4.1.4 Power Up Sequence

The purpose of the power up sequence is to perform internal checks on various parts of the humidifier and provide the user with a visual and audible check.

Internal self test sequence:
1. Test presence of heater wire.
2. Test correct operation of heater wire triac.
3. Test correct operation of protection relays.
4. Test integrity of temperature/flow probe.

Visual/Audio test sequence:
1. The temperature display and indicator LEDs turn on.
2. The temperature display is blanked and indicators set to their default.
3. Display shows humidifier model number i.e. 850.
4. Display is blanked.
5. Display shows software version number.
6. Display is blanked and an audio tone of 2100 Hz sounds.
7. Normal display.

4.1.5 Humidity Compensation (HC) mode (Software version 6.00 onward, except 7.23)

Normal ambient environments between 18 °C and 26 °C do not affect humidity output of temperature controlled heated humidifiers. However once the ambient temperature increases above 26 °C, and/or the temperature of the incoming gas becomes greater than 32 °C, e.g. due to ventilator heating, then the humidity output maybe reduced.

This can be identified by the lack of beading condensate on the inner walls of the humidification chamber and rectified by modifying the breathing circuit or humidifier settings. Increasing the length of breathing circuit between the ventilator and the humidification chamber will assist in cooling the gas before it enters the chamber and improve humidity output.

If beading condensate does not form, humidity output can be further improved by increasing the humidifier's chamber set point. This can be achieved by accessing the HC mode (or Tc) in the Diagnostic Menu (see section 6.4) and either manually selecting a level of chamber temperature compensation or letting the automatic mode do it for you.

Automatic Humidity Compensation

When automatic HC mode is selected the humidifier calculates the power required to adequately humidify the gas flow through the chamber. If the minimum power level is not met

then the chamber set point will automatically be increased in 0.5 °C steps (1 °C steps for non-invasive mode) until the minimum power is achieved. The maximum amount of compensation applied is either 3 or 5 °C depending on the mode and software version (section 6.4 Diagnostic Menu details how compensation is applied for each software version).

If conditions improve and too much power is being applied, then the MR850 will automatically reduce the chamber set temperature.

NOTE: Excessive condensate may form in the breathing circuit if the auto HC function is used with turbine driven ventilators (i.e. ventilators that use room air). It is recommended to switch off the auto HC function in these situations if the condensate becomes excessive.

NOTE: Auto HC function is factory set to enabled on all MR850 models.

Manual Humidity Compensation

For manual HC the level of compensation should be increased until beading condensate is observed on the inner walls of the humidification chamber. It should be noted that if environmental conditions change then it might be necessary to re-adjust this setting. For example, a fall in room temperature could produce a build up of unwanted condensate in the delivery circuit. A reduction in this setting may stop further build up.

NOTE: The previous manual HC setting is restored when power is applied to the humidifier

Refer to section 6.4 Diagnostic Menu for further information regarding this feature.

Activating/Deactivating Humidity Compensation

Refer also to the diagnostic menu in section 6.4

1. Access the diagnostic menu by pressing the mute and mode buttons together for 1 second, the diagnostic menu is entered, indicated by the display of two rows of dashes '= = ='. Releasing both buttons will allow the diagnostic menu to cycle automatically through the menu.
2. The first item is "HC" this is the humidity compensation item, press and hold mute to access this function.
3. The setting may show either '0' or '-A-' to change the setting press both mute and mode buttons simultaneously for 1 second, the humidifier will beep twice and the setting will increase. Release both buttons.
4. To increase again repeat step 3. To decrease the setting press the mute and power buttons for 1 second.
5. To exit the menu, release all buttons, the menu will continue to cycle until 'end' is displayed, the menu will automatically exit.

Temperature Display

To alert users during normal operation that either manual or automatic HC mode has been enabled, the decimal point on the temperature display will flash. Each of the two modes can be further identified by the flash rate, where auto HC mode has a slower flash rate than manual HC mode.

Note: The displayed temperature may also be higher than normal indicating (up to 39°C) the amount of compensation present.

4.1.6 Breathing Circuit Recognition (Software version 7.00 onward)

Fisher & Paykel Healthcare has developed a range of breathing circuits that offer optimum performance for the type of treatment selected while working within recommended operating conditions. Some of these breathing circuits require a slightly modified controller to optimize performance. To do this the MR850 must first recognize what type of delivery circuit has been

connected. Breathing circuit recognition is performed via three electrical connections on the heater wire adaptor. Re-configuring the electrical connection pins on a heated circuit and the way it connects to this adaptor identifies the type of heated circuit. In this way three separate heater wire circuits can be identified by the MR850.

4.2 Humidifier Controls

4.2.1 Power Button

The humidifier will power on if this button is held down briefly, but must be held for one second to turn the humidifier off.

Note: For software version 5.45, 5.70 the power button need only be pressed briefly to turn off the MR850.

CAUTION: Although the display is not illuminated, the unit may still be energized. **Be sure to disconnect power from the MR850 before servicing.**

After power-on the humidifier starts an internal diagnostic routine which checks for possible problems in the humidifier setup. If everything is working correctly, normal control is initiated.

4.2.2 Mode Button

When held down for one second, the mode button toggles the humidifier between Non-Invasive and Invasive mode. The Mode indicator LED shows the user which mode is selected.

Invasive mode is for use with patients whose upper airways have been bypassed by either a tracheostomy or endotracheal tube. In this mode of operation the humidifier attempts to deliver optimal humidity to the patient (37 °C, 100 % RH). This mode is the default mode on power up of the humidifier.

The humidifier normally controls the chamber outlet temperature to 37 °C, and the airway temperature to 40 °C, maintaining a +3 °C temperature gradient along the inspiratory limb[1].

If however this temperature gradient is not maintained, the chamber set point is reduced in 0.5 °C steps (minimum setting of 35.5 °C), in order to reduce condensate buildup in the breathing circuit[2]. If the chamber set point is less than 37 °C and sufficient temperature gradient has been maintained along the inspiratory limb, then the chamber set point is increased back up to 37 °C in 0.5 °C steps.

Non-Invasive mode is suitable only for patients whose natural humidification system (i.e. upper airways) has **not** been bypassed, but are receiving gas via a facemask or similar.

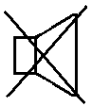
The humidifier normally controls the chamber outlet temperature to 31 °C, and the airway temperature to 34 °C, maintaining a +3 °C temperature gradient along the inspiratory limb[1].

---

[1] If automatic or manual humidity compensation has been activated then the displayed temperature may be higher than 37 °C (Invasive mode) or 31 °C (Non-Invasive mode).

[2] The humidity compensation algorithm takes precedence over the condensation control algorithm.

4.2.3 Mute Button



The mute button silences the humidifier's audible alarm. The muted time depends on the alarm condition. In general, alarms will be muted for 2 minutes.

A chamber or airway probe alarm is muted for a longer time, until the humidifier determines whether the probe is in or out. The temperature alarm is treated differently - see section 4.5.

4.3 Temperature Display

The front panel shows the lower of the chamber or airway temperatures. This temperature gives an indication of the dew point (in °C) of the gas that is being supplied to the patient. The dew point of a gas is the best indication of both its humidity and energy content. Under normal operation, the displayed temperature will be the chamber temperature, as its control set point is lower. If the temperature is above 70 °C, "Hi" will be displayed. If the temperature is below 10 °C, "Lo" will be displayed. If HC mode has been enabled the decimal point on the temperature display will flash.

4.3.1 Showing Chamber and Airway Temperature

Both the chamber and airway temperature can be displayed by pushing and holding the mute button for 1 second. The temperatures are displayed in the following sequence:

1 Chamber temperature is displayed until two seconds after the mute button is released. The chamber probe indicator (see section 4.4) will also light to show which temperature is being displayed.

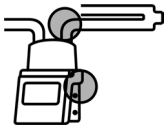
2 The display will blank, and then the airway temperature will be displayed until two seconds after the mute button is released. The airway probe indicator will also light (see section 4.4) to show which temperature is being displayed.

3 The temperature display will blank again, and revert to normal operation.

4.4 Setup Indicators

The MR850 setup indicators, placed on the lower left of the front panel, are intended to aid the user in identifying problems with the incorrect setup of the device and its accessories.

4.4.1 Heater wire connector

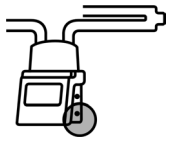


These indicators light if the heater wire in the breathing circuit has not been connected correctly, or if the heater wire or heater wire adaptor is faulty. An intermittent connection, or excessive current (total current in all limbs > 3.5 A) in the heater wires will also produce this alarm. The humidifier will remove power from the heating systems if this alarm is active.

NOTE: Software versions 5.45 and 5.70 do not light the upper indicator located on the breathing circuit.

NOTE: Software versions 7.22 and 7.23 in non heater wire operation and without a heater wire connected no audible or visual heater wire alarm will be given. Connecting a heated wire circuit will automatically cause the MR850 to default to heater wire operation.

4.4.2 Temperature / Flow Probe Connector



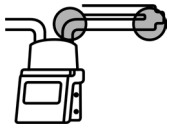
This indicator will light if the temperature probe is not correctly plugged in, or the probe used is faulty. The humidifier tests for the following probe fault conditions:

- Temperature probe disconnected
- Chamber thermistor open or short circuit
- Airway thermistor open or short circuit
- Flow thermistor open or short circuit (shorted probe test)
- One thermistor shorted to another (shorted probe test)
- Flow calibration resistor open or short circuit (shorted probe test)

An alarm will be generated if any of the above faults are found, and the humidifier will remove power from all heating systems.

NOTE*:* the shorted probe tests and flow thermistor tests are only performed on start-up, or when temperature probe or heater wire alarms are cancelled.

4.4.3 Chamber Probe & Airway Probe

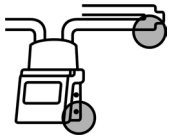


These indicators are used to show that either the chamber probe or airway probe is not inserted into the breathing circuit correctly. On start-up, and during rapid changes in temperature, the humidifier tests to see if a probe is in place by cooling and then heating the probe. If the humidifier finds that either probe is not inserted into the breathing circuit, an alarm will be generated and the humidifier will enter stand-by. During this alarm the humidifier will initiate a probe out test periodically, or a test will be initiated immediately after mute has been pressed.

During periods of low or zero gas flow, the airway probe out alarm is disabled. As soon as flow is detected however, an airway probe test is initiated.

NOTE: For software versions 7.22 and 7.23 in non-heater wire operation, the airway probe out alarm does not function, instead the low temperature of the disconnected probe will activate the temperature alarm (refer section 4.5).

4.4.4 Chamber or Airway Probe Alarm with Probe connector alarm

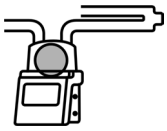


The humidifier checks to see if the temperature probe is faulty by testing for the following conditions:

- Chamber temperature has been greater than 50 °C for 20 minutes
- Chamber temperature is greater than 80 °C
- Airway temperature has been greater than 50 °C for 5 minutes
- Airway temperature is greater than 80 °C

If an apparent fault is found, the humidifier will give a temperature / flow probe connector alarm, and also indicate either the chamber or airway probe. The humidifier will stay in stand-by until the chamber or airway temperature drops below 50 °C. Once this occurs, a probe test will also be initiated.

4.4.5 Water Out Indicator



This indicates that there is insufficient water in the humidification chamber.

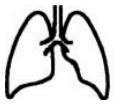
The humidifier measures the amount of power used to obtain the chamber temperature. If a lower than expected amount of power is used, a 'water out' alarm is generated. It may take 15 minutes or longer to generate an alarm especially if there is a disturbance (change in flow).

This alarm can be cancelled by pressing the mute button. If however the water out condition remains, the humidifier will alarm again.

4.5 Operational Alarms

These alarms are generated if problems occur with the operation of the humidifier.

4.5.1 Temperature Indicator



This alarm will occur if the displayed temperature is too high, or if the delivered temperature (Invasive mode only) has been low for a period of time.

High temperature:
The humidifier will immediately alarm if at any time the displayed temperature exceeds 41 °C, or if the airway temperature exceeds 43 °C. If either of these high temperature alarms occur, the humidifier will immediately shut down the heater wire and heater plate.

Low Temperature:
The low temperature warning (visual only) and alarm (visual and audible) are active only when the humidifier is in Invasive mode. Both are disabled during warm-up conditions. The warning alerts the user that low temperature is being delivered to the patient. The alarm alerts the user that a low level has been delivered to an Invasive patient for too long.

The low temperature warning and alarm operate by monitoring the displayed temperature. If the displayed temperature is below 35.5 °C for 25 seconds, the temperature indicator will light, and act as a warning to the user. If the temperature remains below this level for too long, then a Temperature Alarm is activated. The time taken for the humidifier to alarm is dependent on how far below the 35.5 °C threshold the displayed temperature is. Figure 4.3 shows the relationship between temperature, a temperature warning and the time before a temperature alarm:

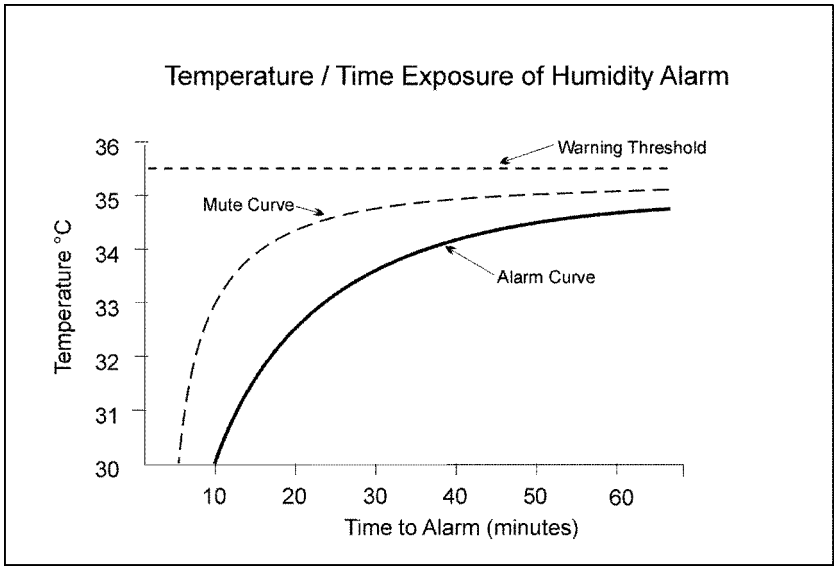


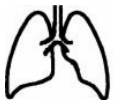
Figure 4.3 Temperature vs Time to Alarm

Pressing mute during a temperature alarm silences the alarm for half the normal time period, if the same temperature is maintained.

The low temperature warning and alarm can be caused by cold or drafty ambient conditions, or can result from using gas flow rates outside the specification of the breathing circuit, chamber or humidifier.

NOTE: The low temperature alarm is disabled in stand-by on software version 5.45 and 5.70.

4.5.2 Non-Heater Wire Operation (Software versions 7.22 & 7.23)



When the airway temperature exceeds 41 °C, the heater plate is shut off, and an immediate visible and audible high temperature alarm is activated.

In invasive mode, the low temperature warning and alarm is identical for the heater wire mode (see above) after warm-up.

In addition the airway temperature must reach 29.5 °C in invasive mode (or 26 °C for non-invasive mode) within 15 minutes, otherwise a visible and audible low temperature alarm will be given, and the heater plate will be switched off. This will occur if the airway probe has not been inserted into the breathing circuit.

After warm-up, if the airway temperature drops below 29.5 °C (or 26 °C non-invasive mode), a visible and audible low temperature alarm will be given, and the heater plate will be switched off.

NOTE: The low temperature alarm will be inactive in stand-by.

4.5.3 See Manual Indicator

This indicates a serious hardware fault. Please refer to section 6, "Troubleshooting".

5 Maintenance Procedures

In order to keep your humidifier in good working order, it is necessary to perform maintenance at regular intervals.

5.1 Maintenance Schedule

5.1.1 MR850 Humidifier

Annually

a. Check MR850 for physical damage:
   - Check the mains cable for damage, replace if necessary.
   - Check the heater plate for deep scratching etc., replace if necessary.
   - Check the heater wire adaptor for kinks, abrasions and damaged connectors. Check that the plugs couple with the sockets on the humidifier.

b. Carry out a full performance test. This procedure is detailed in section 8.

NOTE: A maintenance check sheet is given in Section 9.

5.1.2 MR850 Temperature Probe

Every Six months

a. Visually check the humidifier probes for physical damage:
   - Check that the chamber probe's glass thermistor has not been damaged. Replace probe if required.
   - Inspect the chamber probe's glass thermistor for deposits or foreign material. Clean probe as required.
   - Check the probe cable for kinks and abrasions etc.
   - Check that the probe connectors couple with the humidifier sockets.

b. A temperature accuracy check and flow accuracy check should be performed on the MR850 temperature probe as outlined in section 8.2.

5.2 Safety Check

The unit should be tested to the current medical electrical standards for in-house testing for each specific country (example, refer to AS/NZS 3551 for Australia and New Zealand).

CAUTION: Permanent damage to this humidifier will result if the serial port is used as a ground point during electrical safety testing.

NOTE: The correct ground test point location is on the heater plate front underside edge, as shown in Figure 5.1., where the insulating anodizing layer has been removed.

Figure 5.1 Showing the correct location of ground test point on the heater plate

5.3 Cleaning Instructions

5.3.1 MR850 Humidifiers

It is recommended that only the following cleaners be used on the MR850 as at the time of revision of this technical manual. The disinfectants in the list below have been tested to ensure that no damage will result to the outer plastic or metal components of the humidifier.

1. Disconnect the humidifier from any electrical outlet.
2. Clean the humidifier with one of the following recommended disinfectants using a damp cloth:

   Isopropyl Alcohol
   Normal dishwashing detergent

NOTE: Follow the manufacturer's instructions carefully.
Use the correct dilution of the disinfectant.
DO NOT immerse the humidifier in any liquid.

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

5.3.2 Temperature Flow Probe

The cleaning methods listed below meet the FDA regulations for these types of devices, and do not affect the integrity or performance of the probe. It is the user's responsibility to qualify any deviations from these procedures, both for disinfecting efficacy and physical effect on the probe. For advice on other cleaning methods not mentioned here, contact your local Fisher and Paykel Healthcare distributor.

NOTE: Refer also to the disinfection instructions on the instruction sheet for the airway temperature probe, Ref 185042434.

1. Physically clean the probes, removing all visible contaminants.
2. Disinfect the probes with one of the following solutions:

   Sporicidin™; Sporox™; Cidex™; Cidex ™ OPA

   OR Sterilise the probe using Ethylene Oxide sterilisation at 55 °C (131 °F), 80 kPa, allow at least 15 hours for residual ETO to disperse before use.

NOTE: Follow the manufacturer's instructions carefully. Use the correct dilution of the disinfectant.

CAUTION: **DO NOT** immerse the black electrical connector plug in disinfectant.
DO NOT autoclave probes.
DO NOT use dishwater detergents or solvents.

3. Wipe the airway temperature probes clear of any cleaning residues before use.
4. Store in clean conditions.

Cidex™ is a registered trademark of Johnson & Johnson Medical Pty. Ltd. North Ryde, NSW, Australia.
Sporicidin™ is a registered trademark of Sporicidin International Ltd, Rockville, MD 20852, USA.
Sporox™ is a registered trademark of Reckitt & Colman Inc. 1655 Valley Rd. Wayne NJ USA

6 Troubleshooting

6.1 Operational Problems

This section deals with faults that cause the humidifier to alarm. This may be caused by incorrect setup, faulty accessories, or a faulty humidifier. Refer below for troubleshooting.

Symptom	Corrective Action	Reference
See manual indicator flashing with audible alarm	Record the displayed error code.	Section 6.3
See manual indicator light permanently on, without an audible alarm	1. If "PtS" is displayed on the front panel, then the production test mode has been accessed. Check the production test button is not depressed or mode set by serial command. 2. Humidifier faulty. Replace PCBs.	Section 7.2.6 Section 7.2.3
Water Out indicator flashes, accompanied by an audible alarm	1. Check that there is sufficient water in the chamber. Refill or replace chamber as necessary. Check that the water bag is not empty, and the delivery tube is not kinked or occluded. 2. Check that the water level in the MR290 chamber is not above the marked line. Replace chamber if the water is above this line. 3. Check that the gas flow rate is within specification of the humidifier and accessories being used. Adjust as necessary. 4. Has condensate formed on the chamber probe? Dry Probe and re-insert. 5. Temperature probe faulty. Complete a temperature and flow accuracy test on the probe. Replace probe as required. 6. Humidifier faulty. Complete a performance test. Service humidifier as required.	 Section 8.2 Section 8
Chamber Probe alarm flashes accompanied by an audible alarm	1. Check that the chamber probe is inserted into the breathing circuit correctly, and that the breathing circuit is set up correctly. 2. Check that there is sufficient water in the chamber. Refill as necessary. Check that the water bag and delivery tube are not kinked or occluded. 3. Ensure correct chamber is being used (refer Operating Manual) 4. Check that the gas flow rate is within specification of the humidifier and accessories being used. Adjust as necessary. 5. Has condensate formed on the chamber probe? Dry probe and re-insert. 6. Temperature probe or humidifier faulty. Complete performance tests. Replace probe or service humidifier as required.	 Section 8
Heater wire connector alarm flashes, accompanied by an audible alarm	1. Check that the heater wire adaptor is correctly plugged into the humidifier along with the breathing circuit. **NOTE**: The short lead must connect to the inspiratory limb. 2. Replace breathing circuit, and re-rest. 3. Replace heater wire adaptor, and check for intermittent connections. Re-test. 4. Humidifier faulty. Replace PCBs.	 Section 7.2.3

Symptom	Corrective Action	Reference
Heater wire alarm not working	Non-heater wire mode has been activated, connect a heated wire circuit or disable this mode via the diagnostic menu.	Section 4.1.2
Airway Probe alarm flashes along with an audible alarm	1. Check that the airway probe is inserted into the breathing circuit correctly, the breathing circuit assembled correctly, and that there is water in the chamber. 2. Check that the circuit is connected correctly to the ventilator – gas flow could be reversed through the humidifier. 3. Check that the gas flow rate is within specification of the humidifier and type of accessories being used. Adjust as necessary. 4. Check for excessive condensate build up. Excessively cold or drafty ambient conditions may cause this alarm to occur. Ensure there are no strong drafts around the breathing circuit. 5. Complete a probe accuracy check. Replace probe as necessary. 6. Humidifier faulty. Replace PCBs.	 Section 3.4 Section 8.2
Temperature / Flow Probe alarm with airway or chamber indicators flashing	1. If the Temperature / Flow Probe alarm occurs with chamber or airway indicators also flashing, the temperature probe is faulty. 2. Complete a probe accuracy check, and replace probe if required.	Section 4.4 Section 8.2
Temperature probe connector indicator flashes, accompanied by an audible alarm	1. Is the probe connector correctly plugged into the humidifier? Plug in probe as required. 2. Check that the circuit is connected correctly to the ventilator – gas flow could be reversed through the humidifier. 3. Perform a humidifier calibration check. 4. Replace temperature probe and re-test. If the alarm condition disappears, the temperature probe is faulty. Discard faulty probe. 5. Humidifier faulty. Replace PCBs.	 Section 8.1.2 Section 8.2 Section 7.2.3
Temperature Indicator flashes, with audible alarm, coupled with a low temperature (< 35.5 °C) displayed	The humidifier has been unable to maintain temperature over a period of time. 1. Gas flow has been disconnected from the humidifier either reconnect gas flow or turn the humidifier off. 2. Check that the gas flow rate is within specification of the humidifier and accessories being used. 3. Check for drafts around the breathing circuit. This can be caused by fans or room air conditioning. If this is found to be the cause, the breathing circuit should be shielded from the ambient airflow. 4. Check that the circuit is connected correctly to the ventilator – gas flow could be reversed through the humidifier. **WARNING: Never cover the breathing circuit.** 5. Check for excessive condensate pooling in the breathing circuit. Drain circuit if necessary. 6. Humidifier or probe faulty? Complete humidifier & probe performance test. Replace probe or service humidifier as required. 7. Check that there is sufficient water in the chamber. Refill as necessary. Check that the water bag and delivery tube are not occluded.	 Section 8

Symptom	Corrective Action	Reference
A low temperature is shown on the humidifier's display, with no audible alarm	1. Make sure the humidifier has had time to warm up and that there is sufficient gas flow through the breathing circuit.	
	2. The humidifier cannot maintain temperature. If the temperature indicator is also on then an alarm will occur eventually.	Section 4.5
	3. Humidifier or probe faulty. Complete humidifier and probe performance test. Replace probe or service humidifier as required.	Section 8
High displayed temperature, no temperature alarm	1. Flow has recently been changed, allow 30 minutes for temperature to stabilise	
	2. Manual or automatic humidity compensation is active	Section 4.1.5
Temperature indicator flashes, with audible alarm, and a high temperature is shown.	The gas flow rate may have suddenly changed. Monitor the displayed temperature, if the temperature does not fall rapidly then remove humidifier from patient, and complete a performance test on the humidifier, and temperature / flow probe. Replace probe or service humidifier as required.	Section 8

6.2 Technical Problems

Problems that cause the humidifier to malfunction without an audible alarm are discussed in this section.

Symptom	Corrective Action	Reference
See manual indicator lit (not flashing)	1. Check that the mains supply is within specification. Provide adequate mains supply if required.	
	2. If 'PtS' is displayed.	Section 6.1
	3. Replace PCBs.	Section 7.2.3
Humidifier will not turn on with on/off button, and no indicators are lit	1. Humidifier plugged into mains supply?	
	2. Check that the mains supply is within specification. Provide adequate mains supply if required.	
	3. Remove mains power and check the fuses.	Section 7.2.2
	4. Check continuity of mains power cord. Replace as necessary.	Section 7.2.7
	5. Check the transformer windings are not open circuit. Primary Winding: Red wires Secondary 10v winding: White wires Secondary 22v winding: Yellow wires If any windings are open circuit, replace the transformer.	Section 7.2.4
	6. Replace PCBs.	Section 7.2.3
Unit fails calibration check	Send unit to a Fisher & Paykel Healthcare service representative for calibration, or replace PCBs.	Section 7.2.3
Probe fails Probe Accuracy Check	Replace probe.	
Unit fails to reach temperature in humidifier control check. (Section 8.1.4)	1. If the chamber outlet temperature was low, the heater plate element should be checked. Replace element as necessary.	Section 7.2.5
	2. If the airway temperature was low, replace breathing circuit and re-test.	
	3. Replace PCBs.	Section 7.2.3

6.3 "See Manual" Error Codes

The following is an explanation of the error codes that are displayed in conjunction with the See Manual indicator flashing. A code is not displayed if the microprocessor has stopped functioning (see technical problems - section 6.2).

Error	Description of Fault
E00	No fault
E02	Microprocessor stack overflow
E03	RAM fault
E04	ROM fault
E05	EEPROM version older than ROM version. Update EEPROM. Refer to Section 7.2.6
E06	EEPROM version newer than ROM version – (old software). Contact Fisher & Paykel Healthcare
E07	Model mismatch with software, contact your Fisher & Paykel Healthcare representative. **NOTE**: included in software version 7.14 onward, except 7.21.
E10	Temperature circuit calibration out of range: Range Amp 0: 25.5 °C
E11	Temperature circuit calibration out of range: Range Amp 0: 65.0 °C
E12	Temperature circuit calibration out of range: Range Amp 1: 25.5 °C
E13	Temperature circuit calibration out of range: Range Amp 1: 34.5 °C
E14	Temperature circuit calibration out of range: Range Amp 2: 34.5 °C
E15	Temperature circuit calibration out of range: Range Amp 2: 44.6 °C
E16	Temperature circuit calibration out of range: Range Amp 3: 65.0 °C
E20	Heater wire circuit has malfunctioned, heater can not be energized: - Heater plate thermal cutout tripped (section 7.2.5) - Heater wire fuse (F2) is open circuit (section 7.2.2) - Heater wire triac, or heater wire relay is open circuit
E21	Heater wire circuit has malfunctioned, heater either can not be de-energized or monitoring circuit has failed : - Heater wire triac has shorted - Heater wire sense circuit has failed
E23	Heater wire voltage measurement circuit faulty
E25	Transistor Q17 is not turning on
E26	Transistor Q16 is not turning on
E27	The heater wire relay is short circuited
E28	Mains voltage measurement is uncalibrated (section 8.1.3)
E29	The heater plate thermistor is short circuited
E2A	The heater plate thermistor is open circuit
E2C	Heater plate element circuit has malfunctioned is not turning on: - Element is open circuit - Heater plate triac or driver faulty - Heater plate relay is faulty
E2D	The heater plate element is not turning off. Heater plate triac circuit faulty.
E30	Power (on/off) button stuck on
E31	Mute button stuck on
E32	Mode button stuck on
E40	Unit not functional tested at time of manufacture

Error	Description of Fault
E41	Failed the functional test at time of manufacture
E42	Was not stress tested during manufacture
E43	Failed the stress test during manufacture
E44	Not tested on functional tester 2
E45	Failed production functional tester 2
E4A	EEPROM write error occurred
E4B	EEPROM write verify error occurred
E4C	EEPROM read error occurred
E50	Flow circuitry not functioning
E51	Flow circuitry shorted on

6.4 Diagnostic Menu

By pressing the mute and mode buttons together for 1 second, the diagnostic menu is entered, indicated by the display of two rows of dashes '= = ='. Releasing both buttons will allow the diagnostic menu to cycle automatically through the menu, pausing at each function. Pressing the mute button at this time will display the value behind each function for as long as the mute button is held.

6.4.1 Diagnostic Menu for Software Versions 5.45 & 5.70

Display	Description
TC	Temperature Compensation (TC) algorithm '---' = 0.0 °C of chamber compensation. (CSP = 37.0 °C) 'Lo ' = 1.5 °C of chamber compensation. (CSP = 38.5 °C) 'Hi ' = 3.0 °C of chamber compensation. (CSP = 40.0 °C) To change the TC value the press the Mute and Mode buttons together for 1 second. The humidifier will confirm the change with a double-beep.
CSP	Chamber set point, in 0.1 °C resolution e.g.: 37.0
Cdc	Chamber Duty Cycle (%)
HP	Heater Plate Temperature (1 °C)
Flo	Gas Flow Rate (0.1 LPM) "---" = Unknown Flow (flow measurement not started)
FLr	Gas Flow Rate Range: "---" = Unknown Flow (flow measurement not started) "no" = No flow "Lo" = Low flow, (< 3 LPM) "In" = Intermediate flow, (2 to 17 LPM) "Hi" = High flow, (> 14 LPM) " -" = Ventilated flow detected
OFF	Offset temperature difference between the chamber and airway set temperatures (0.1 °C)
ASP	Airway temperature set point (0.1 °C)
Adc	Airway Duty Cycle (%)
LAS	Last Humidifier Alarm State, the display will blank, and the humidifier's last alarm will be shown on the indicators. To clear LAS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LAS has been cleared.
LFS	Last Humidifiers Fault State, refer to section 6.3. To clear LFS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LFS has been cleared.
SoF	Software version
End	Press the mute button to cycle to the start of the menu, or the diagnostic menu will automatically exit after 6 seconds

6.4.2 Diagnostic Menu for Software Version 6.00

Display	Description
HC	Humidity Compensation (HC) algorithm Invasive mode, compensation range is 0.0 to 3.0 °C (CSP = 37.0 to 40 °C) Non-Invasive mode, compensation range is 0.0 to 5.0 °C (CSP = 31.0 to 36.0 °C) By pressing the Mute and Mode buttons together for 1 second or pressing the Mute and Power buttons together for 1 second the user can respectively move up or down through the settings listed below. The humidifier will confirm the change with a double-beep. '5.0' = +5.0 °C of chamber compensation (Non-Invasive mode only) '4.0' = +4.0 °C of chamber compensation (Non-Invasive mode only) '3.0' = +3.0 °C of chamber compensation '2.0' = +2.0 °C of chamber compensation '1.0' = +1.0 °C of chamber compensation '0.0' = +0.0 °C of chamber compensation (**NO** compensation) '-A-' = Automatic humidity compensation mode: Invasive mode: 0 to 3 °C in 0.5 °C steps Non-invasive mode: 0 to 3 °C in 0.5 °C steps
CSP	Chamber set point, in 0.1 °C resolution eg: 37.0 Invasive mode range 35.5 to 40 °C. Non-Invasive mode range 31.0 to 36.0 °C.
Cdc	Chamber Duty Cycle (%)
HP	Heater Plate Temperature (1 °C)
Flo	Gas Flow Rate (0.1 LPM) "---" = Unknown Flow (flow measurement not started)
FLr	Gas Flow Rate Range: "---" = Unknown Flow (flow measurement not started) "no" = No flow "Lo" = Low flow, (< 3 LPM) "In" = Intermediate flow, (2 to 17 LPM) "Hi" = High flow, (> 13 LPM) " -" = Ventilated flow detected
ASP	Airway temperature set point (0.1 °C)
Adc	Airway Duty Cycle (%)
LAS	Last Alarm State, the display will blank, and the humidifier's last alarm will be shown on the indicators. To clear LAS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LAS has been cleared.
LFS	Last Fault State, refer to section 6.3. To clear LFS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LFS has been cleared.
SoF	Software version
End	Press the mute button to cycle to the start of the menu, or the diagnostic menu will automatically exit after 6 seconds

6.4.3 Diagnostic Menu for Software Version 7.00 & 7.21

Display	Description
HC	Humidity Compensation (HC) algorithm Invasive mode, compensation range is 0.0 to 3.0 °C (CSP = 37.0 to 40 °C) Non-Invasive mode, compensation range is 0.0 to 5.0 °C (CSP = 31.0 to 36.0 °C) By pressing the Mute and Mode buttons together for 1 second or pressing the Mute and Power buttons together for 1 second the user can respectively move up or down through the settings listed below. The humidifier will confirm the change with a double-beep. '5.0' = +5.0 °C of chamber compensation (Non-Invasive mode only) '4.0' = +4.0 °C of chamber compensation (Non-Invasive mode only) '3.0' = +3.0 °C of chamber compensation '2.0' = +2.0 °C of chamber compensation '1.0' = +1.0 °C of chamber compensation '0.0' = +0.0 °C of chamber compensation (**No** compensation) '-A-' = Automatic humidity compensation mode: Invasive mode: 0 to 3 °C in 0.5 °C steps Non-invasive mode: 0 to 5 °C in 1 °C steps
CSP	Chamber set point, in 0.1 °C resolution eg: 37.0 Invasive mode range 35.5 to 40 °C. Non-Invasive mode range 31.0 to 36.0 °C.
Cdc	Chamber Duty Cycle (%)
CHP	Chamber Power / Flow ratio (W/LPM)
hP	Heater Plate Temperature (1 °C)
Flo	Gas Flow Rate (0.1 LPM) "---" = Unknown Flow (flow measurement not started)
FLr	Gas Flow Rate Range: "---" = Unknown Flow (flow measurement not started) "no" = No flow "Lo" = Low flow, (< 3 LPM) "In" = Intermediate flow, (2 to 17 LPM) "Hi" = High flow, (> 13 LPM) " -" = Ventilated flow detected
ASP	Airway temperature set point (0.1 °C)
Adc	Airway Duty Cycle (%)
Cct	Connected Circuit heater identification: "S" = Standard inspiratory heater connected "C" = Coaxial inspiratory heater connected "E" = Expiratory heater connected "---" = No heaters connected
LAS	Last Alarm State, the display will blank, and the humidifier's last alarm will be shown on the indicators. To clear LAS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LAS has been cleared.
LFS	Last Fault State, refer to section 6.3. To clear LFS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LFS has been cleared.
SoF	Software version
End	Press the mute button to cycle to the start of the menu, or the diagnostic menu will automatically exit after 6 seconds

6.4.4 Diagnostic Menu for Software Version 7.14

Display	Description
HC	Humidity Compensation (HC) algorithm **Note:** HC is inactive while operating under non-heater wire control. Invasive mode, compensation range is 0.0 to 5.0 °C (CSP = 37.0 to 42 °C) Non-Invasive mode, compensation range is 0.0 to 5.0 °C (CSP = 31.0 to 36.0 °C) By pressing the Mute and Mode buttons together for 1 second or pressing the Mute and Power buttons together for 1 second the user can respectively move up or down through the settings listed below. The humidifier will confirm the change with a double-beep. '5.0' = +5.0 °C of chamber compensation '4.0' = +4.0 °C of chamber compensation '3.0' = +3.0 °C of chamber compensation '2.0' = +2.0 °C of chamber compensation '1.0' = +1.0 °C of chamber compensation '0.0' = +0.0 °C of chamber compensation (**NO** compensation) '-A-' = Automatic humidity compensation mode: Invasive mode: 0 to 5 °C in 0.5 °C steps Non-invasive mode: 0 to 5 °C in 1 °C steps
Cct	Connected breathing circuit identification: "S" = Standard inspiratory heater connected "C" = Coaxial inspiratory heater connected "E" = Expiratory heater connected "---" = No heaters detected while under heater wire control
CSP	Chamber set point, in 0.1 °C resolution eg: 37.0 Invasive mode range 35.5 to 42 °C. Non-Invasive mode range 31.0 to 36.0 °C.
Cdc	Chamber Duty Cycle (%) During selection of this menu and while a chamber probe out test is active the chamber probe indicator will light.
CHP	Chamber Power / Flow ratio (W/LPM)
hP	Heater Plate Temperature (1 °C)
Flo	Gas Flow Rate (0.1 LPM) "---" = Unknown Flow (flow measurement not started)
FLr	Gas Flow Rate Range: "---" = Unknown Flow (flow measurement not started) "no" = No flow, (Stand-by) "Lo" = Low flow, (< 3 LPM) "In" = Intermediate flow, (2 to 17 LPM) "Hi" = High flow, (> 13 LPM) " -" = Ventilated flow detected
ASP	Airway temperature set point (0.1 °C)
Adc	Airway Duty Cycle (%) During selection of this menu and while an airway probe out test is active the airway probe indicator will light.
H2O	Water out number, used to detect the presence of chamber water, calculated from, chamber power / (heater plate temp. – chamber temp.). During selection of this menu and while the water out number falls below a dry chamber threshold the water out indicator will light.
LAS	Last Alarm State, the display will blank, and the humidifier's last alarm will be shown on the indicators. To clear LAS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LAS has been cleared.
LFS	Last Fault State, refer to section 6.3. To clear LFS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LFS has been cleared.
SoF	Software version
End	Press the mute button to cycle to the start of the menu, or the diagnostic menu will automatically exit after 6 seconds.

6.4.5 Diagnostic Menu for Software Version 7.22

Display	Description
HC	Humidity Compensation (HC) algorithm **Note:** HC is inactive while operating under non-heater wire control. Invasive mode, compensation range is 0.0 to 5.0 °C (CSP = 37.0 to 42 °C) Non-Invasive mode, compensation range is 0.0 to 5.0 °C (CSP = 31.0 to 36.0 °C) By pressing the Mute and Mode buttons together for 1 second or pressing the Mute and Power buttons together for 1 second the user can respectively move up or down through the settings listed below. The humidifier will confirm the change with a double-beep. '5.0' = +5.0 °C of chamber compensation '4.0' = +4.0 °C of chamber compensation '3.0' = +3.0 °C of chamber compensation '2.0' = +2.0 °C of chamber compensation '1.0' = +1.0 °C of chamber compensation '0.0' = +0.0 °C of chamber compensation (**NO** compensation) '-A-' = Automatic humidity compensation mode: Invasive mode: 0 to 5 °C in 0.5 °C steps Non-invasive mode: 0 to 5 °C in 1 °C steps
Cct	Connected breathing circuit identification: "S" = Standard inspiratory heater connected "C" = Coaxial inspiratory heater connected "E" = Expiratory heater connected "---" = No heaters detected while under heater wire control **Non-Heater Wire Operation** To enable non heater wire operation, press and hold both the mute and mode buttons simultaneously for 1 second. The display will show 'nhh' and the humidifier will confirm with an audible beep. Ensure that no heated breathing circuit is connected to the humidifier otherwise the humidifier won't change operation. To disable non-heater wire mode, repeat the above process or connect a heater breathing circuit.
CSP	Chamber set point, in 0.1 °C resolution eg: 37.0 Invasive mode range 35.5 to 42 °C. Non-Invasive mode range 31.0 to 36.0 °C.
Cdc	Chamber Duty Cycle (%) During selection of this menu and while a chamber probe out test is active the chamber probe indicator will light.
CHP	Chamber Power / Flow ratio (W/LPM)
hP	Heater Plate Temperature (1 °C)
Flo	Gas Flow Rate (0.1 LPM) "---" = Unknown Flow (flow measurement not started)
FLr	Gas Flow Rate Range: "---" = Unknown Flow (flow measurement not started) "no" = No flow, (Stand-by) "Lo" = Low flow, (< 3 LPM) "In" = Intermediate flow, (2 to 17 LPM) "Hi" = High flow, (> 13 LPM) " -" = Ventilated flow detected
ASP	Airway temperature set point (0.1 °C)
Adc	Airway Duty Cycle (%) During selection of this menu and while an airway probe out test is active the airway probe indicator will light.
H2O	Water out number, used to detect the presence of chamber water, calculated from, chamber power / (heater plate temp. – chamber temp.). During selection of this menu and while the water out number falls below a dry chamber threshold the water out indicator will light.
LAS	Last Alarm State, the display will blank, and the humidifier's last alarm will be shown on the indicators. To clear LAS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LAS has been cleared.
LFS	Last Fault State, refer to section 6.3. To clear LFS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LFS has been cleared.
SoF	Software version
End	Press the mute button to cycle to the start of the menu, or the diagnostic menu will automatically exit after 6 seconds.

6.4.6 Diagnostic Menu for Software Version 7.23

Display	Description
Cct	Connected breathing circuit identification: "S" = Standard inspiratory heater connected "C" = Coaxial inspiratory heater connected "E" = Expiratory heater connected "---" = No heaters detected while under heater wire control **Non-Heater Wire Operation** To enable non heater wire operation, press and hold both the mute and mode buttons simultaneously for 1 second. The display will show 'nhh' and the humidifier will confirm with an audible beep. Ensure that no heated breathing circuit is connected to the humidifier otherwise the humidifier won't change operation. To disable non-heater wire mode, repeat the above process or connect a heater breathing circuit.
CSP	Chamber set point, in 0.1 °C resolution eg: 37.0 Invasive mode: range 35.5 to 42 °C. Non-Invasive mode: range 31.0 to 36.0 °C.
Cdc	Chamber Duty Cycle (%) During selection of this menu and while a chamber probe out test is active the chamber probe indicator will light.
CHP	Chamber Power / Flow ratio (W/LPM)
hP	Heater Plate Temperature (1 °C)
Flo	Gas Flow Rate (0.1 LPM) "---" = Unknown Flow (flow measurement not started)
FLr	Gas Flow Rate Range: "---" = Unknown Flow (flow measurement not started) "no" = No flow, (Stand-by) "Lo" = Low flow, (< 3 LPM) "In" = Intermediate flow, (2 to 17 LPM) "Hi" = High flow, (> 13 LPM) " -" = Ventilated flow detected
ASP	Airway temperature set point (0.1 °C)
Adc	Airway Duty Cycle (%) During selection of this menu and while an airway probe out test is active the airway probe indicator will light.
H2O	Water out number, used to detect the presence of chamber water, calculated from, chamber power / (heater plate temp. – chamber temp.). During selection of this menu the water out indicator will light if the water out number falls below a dry chamber threshold.
LAS	Last Alarm State, the display will blank, and the humidifier's last alarm will be shown on the indicators. To clear LAS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LAS has been cleared.
LFS	Last Fault State, refer to section 6.3. To clear LFS, press and hold the mute and mode buttons for 1 second. The humidifier will beep when LFS has been cleared.
SoF	Software version
End	Press the mute button to cycle to the start of the menu, or the diagnostic menu will automatically exit after 6 seconds.

7 Servicing Procedures

7.1 General Considerations

WARNING:
Although the MR850 display may not be illuminated, the unit may still be energized. Be sure to disconnect the MR850 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. The performance tests are outlined in section 8.

CAUTION:
Where screws and bolts have been removed from the product, do not use excessive force when re-fastening.
Antistatic procedures should be followed when servicing this product.

7.2 Disassembly

7.2.1 Opening the case

1. Ensure mains power is disconnected from the unit.
2. Remove the four screws at the back of the humidifier.
   Separate the case by sliding the two halves apart. Pull the front half of the case away from the rear (Figure 7.1). 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.

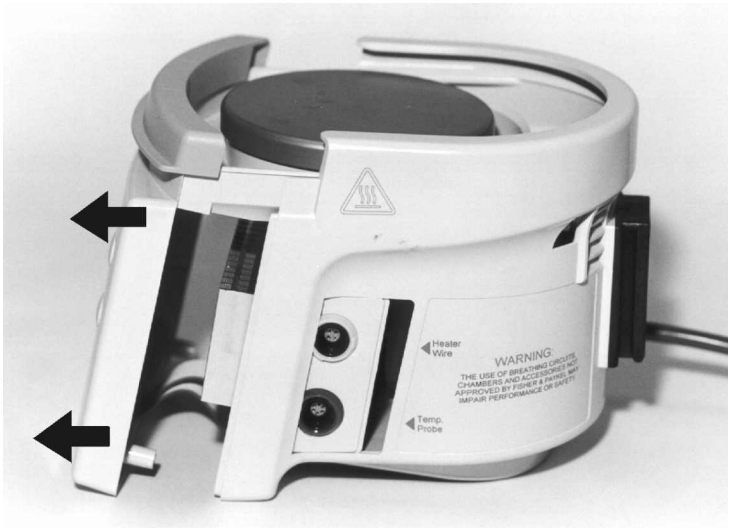


Figure 7.1 Case separation

3. Slide the power PCB forward with the side panel (the side panel is attached to the power PCB). The side panel will need to be pushed inwards during this action in order to unlatch and clear the electrical connectors.
4. Un-clip the three fasteners (Figure 7.2) which hold the front (control) PCB to the front of the case, and separate the front PCB from the case.

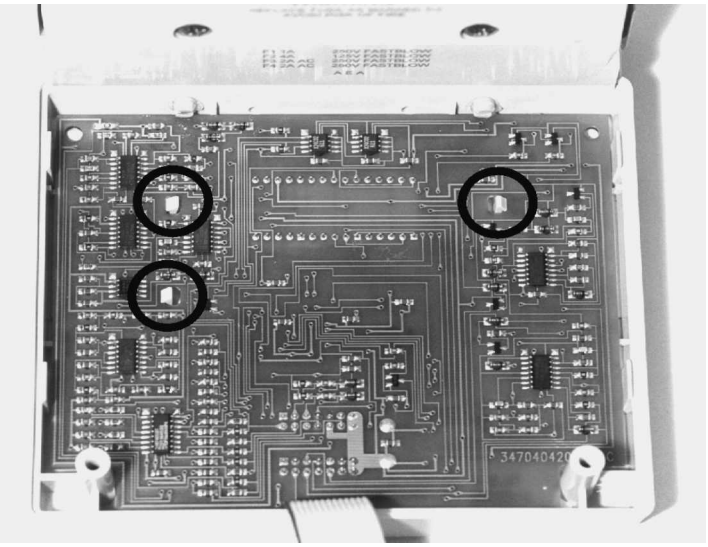


Figure 7.2 Showing PCB fasteners

7.2.2 Replacing Fuses

1. Open the case (section 7.2.1).
2. The fuses can now be accessed. See Figure 7.3 for the location of the fuses on the power PCB.

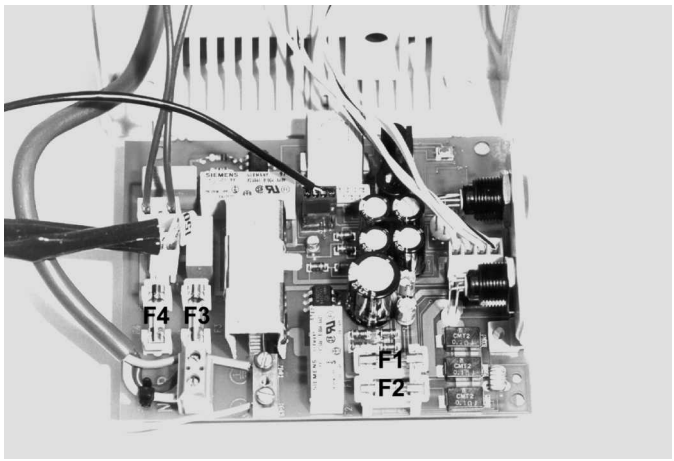


Figure 7.3 Showing location of the fuses on power PCB

The four fuses have the following ratings:

MR850 Model Number	Supply Voltage	Fuse Type	Part Number
MR850Axx	230 V~	F1: 1 A 250 V FastBlow F2: 4 A 125 V FastBlow F3: 2 A 250 V FastBlow F4: 2 A 250 V FastBlow	999 830 001 999 830 017 999 830 009 999 830 009
MR850Pxx	127 V~	F1: 1 A 250 V FastBlow F2: 4 A 125 V FastBlow F3: 3 A 250 V FastBlow F4: 3 A 250 V FastBlow	999 830 001 999 830 017 999 830 012 999 830 012

MR850 Model Number	Supply Voltage	Fuse Type	Part Number
MR850Jxx	115 V~	F1: 1 A 250 V FastBlow F2: 4 A 125 V FastBlow F3: 3 A 250 V FastBlow F4: 3 A 250 V FastBlow	999 830 001 999 830 017 999 830 012 999 830 012
MR850Gxx	100 V~	F1: 1 A 250 V FastBlow F2: 4 A 125 V FastBlow F3: 3 A 250 V FastBlow F4: 3 A 250 V FastBlow	999 830 001 999 830 017 999 830 012 999 830 012

WARNING:
Be sure to replace the fuse with the correct rating and type. Do not under any circumstances replace F2 with anything other than a fast blow fuse of the type and rating specified, as serious injury could result.

3. Replace fuse.
4. Close the case (section 7.2.8).

7.2.3 Replacement of Printed Circuit Boards (PCBs)

1. Open the case (section 7.2.1).
2. 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 (Figure 7.4).
3. Remove PCBs, and using an appropriate tool, remove the ROM from the 32-pin socket on the control PCB. Store the ROM in an antistatic bag or box.
4. Unpack replacement PCBs, install the ROM from the previous PCB.
5. Replace the mains fuses (F3, F4) with the correct type, and attach mains and protective earth wires, using the cable ties provided (Figure 7.4).
6. **NOTE**: If revision A PCBs are being replaced with revision C PCBs or later, (look for identification on the control board), then the wiring of the heater plate thermal cutout (and thermistor) will need to be changed. Un-clip the four pins from the connector by using a small flat bladed screwdriver. Re-wire the connector so the thermistor wires (white) are located on the inner two pins, and the thermal cutout wires (black) are located on the two outer pins.
7. Connect harnesses from the transformer and heater plate to the power PCB.
8. Close the case (section 7.2.8).
9. Update the EEPROM software version (step 5, section 7.2.6).
10. Check that the humidifier powers up normally, and complete a full performance test (section 8).

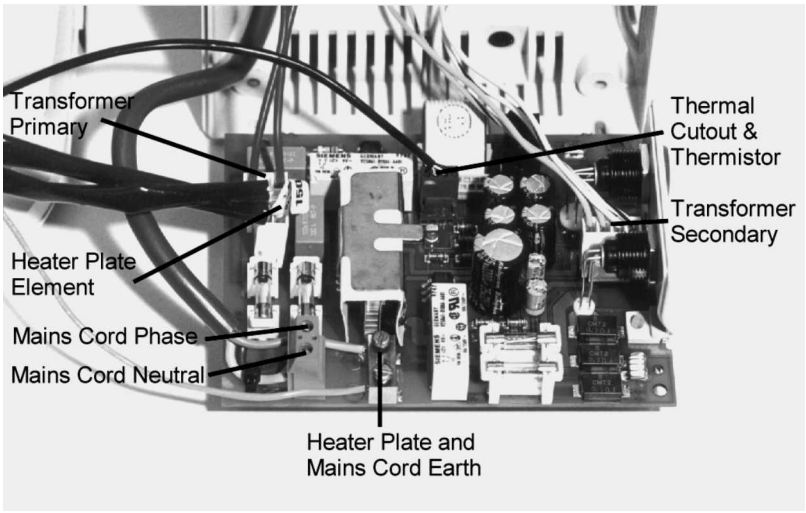


Figure 7.4 Showing Humidifier Power PCB wiring

7.2.4 Replacement of Transformer

1. Open the case (section 7.2.1).
2. Disconnect the transformer primary and secondary harnesses attached to the power PCB.
3. Unscrew the four mounting screws fixing the transformer, and remove the transformer from the case.
4. Place the new transformer inside the case, and mount using the four screws.
5. Connect transformer primary and secondary harnesses to the power PCB.
6. Close the case (section 7.2.8).

7.2.5 Servicing the Heater Plate

Resetting the thermal cutout.

1. Open the case (section 7.2.1).
2. Check the thermal cutout on the heater plate by pushing the red button with a pen or small screwdriver - see Figure 7.5.

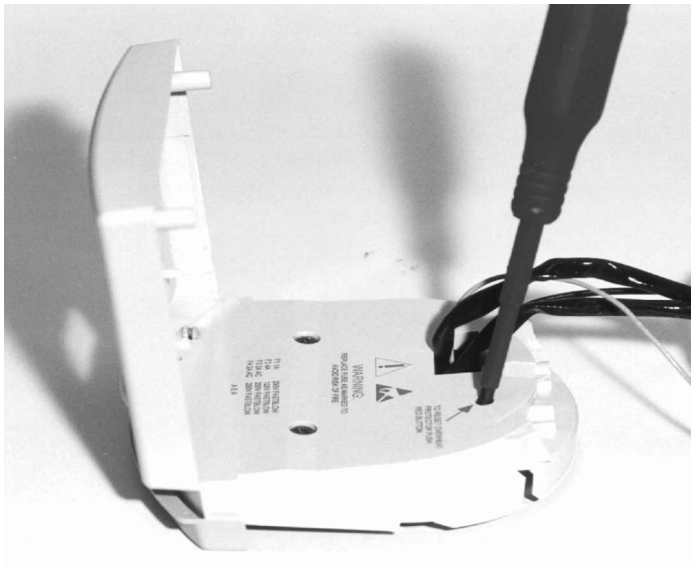


Figure 7.5 Showing location of thermal cutout

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 (section 7.2.8).

Replacing the heater plate thermistor

NOTE: A Heater plate thermistor service kit is required. (Part Number: 043 041 254)

1. Open the case (section 7.2.1).
2. Disconnect the heater plate element, thermistor and thermal cutout harnesses attached to the power PCB.
3. Remove the three screws holding the heater plate - see Figure 7.6.
4. Cut cable ties attached to the heater plate harnesses.

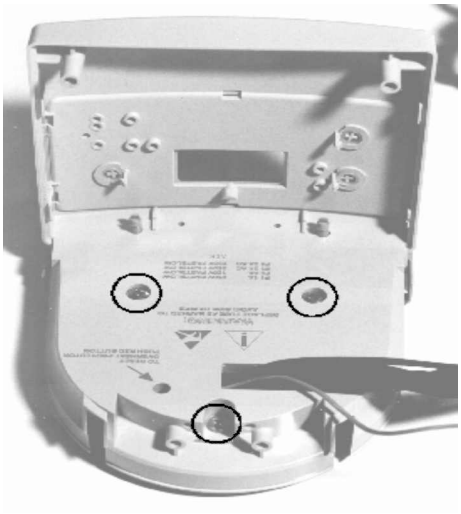


Figure 7.6 Showing location of Heater Plate screws

5. Remove screw holding heater plate thermistor - see Figure 7.7.
6. Unsolder the wires attached to the thermal cutout, and remove the old thermistor and harness.
7. Place the new thermistor into position, and attach using the screw.

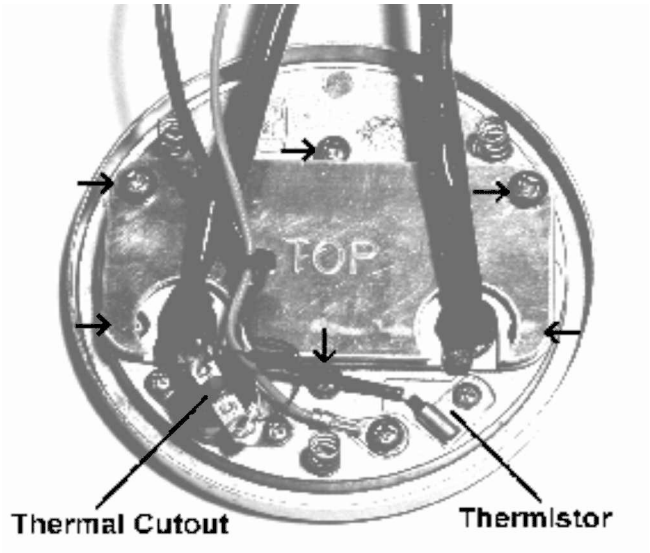


Figure 7.7 Showing location of Heater Plate Thermistor Thermal Cutout and Element Screws

8. Solder the wires from the new harness to the heater plate thermal cutout.
9. Attach the cable ties provided to the heater plate harness.
10. 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.
11. Connect the heater plate element, thermistor and thermal cutout harnesses to the power PCB.
12. Close the case (section 7.2.8).

Checking the heater plate element

1. Open the case (section 7.2.1).
2. Disconnect the heater plate element, thermistor and thermal cutout harnesses from the power PCB.
3. Measure the resistance between the 2 contacts on the heater plate element connector (this is the large three pin connector).

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

MR850 Model Number	Supply Voltage	Heater Plate Resistance
MR850Axx	230 V~	353 ± 12 Ohms
MR850Pxx	127 V~	108 ± 3 Ohms
MR850Jxx	115 V~	88 ± 3 Ohms
MR850Gxx	100 V~	67 ± 2 Ohms

If the measured resistance is outside this range, replace the heater plate element (steps 4 to 9). If the heater plate element is within specification, go to step 10.

NOTE: If the heater plate element requires replacing, a heater plate element service kit is required - see Section 10. Spare Parts.

4. Remove the two visible screws holding the heater plate element reflector. Remove the shield, making sure the washers are not lost. Unscrew the last four screws on the element cover (Figure 7.7).

5. Remove the heater element, leaving the mica insulator in place.
6. Insert the new element into position, making sure the insulating mica is between the element and the heater plate.
7. Replace the element cover, using the four screws that were previously removed.
8. Replace the element reflector, making sure the washers that separate the reflector from the cover are placed back into position. Screw into place.
9. 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.
10. Connect the heater plate element, thermistor and thermal cutout harnesses to the power PCB.
11. Close the case (section 7.2.8).

Replacing the Thermal Cutout

1. Open the case (section 7.2.1).
2. Disconnect the heater plate element, thermistor and thermal cutout harnesses from the power PCB.
3. Remove the three screws holding the heater plate - see Figure 7.7.
4. Un-solder the two black wires attached to the thermal cutout.
5. Unscrew fasteners used to secure the thermal cutout, and remove.
6. Place new thermal cutout in position and fasten using screws provided.
7. Depress the thermal cutout's red button to ensure it is reset.
8. Solder the black wires that were previously disconnected to the contacts on the new thermal cutout.
9. 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.
10. Connect the heater plate element, thermistor and thermal cutout harnesses to the power PCB.
11. Close the case (section 7.2.8).

7.2.6 Installing New Software

NOTE: A software upgrade kit is required.
Some software may not be available in your country. Refer to your local Fisher & Paykel Healthcare representative for the appropriate part number:

	Single ROM pack	32 ROM Pack
GJU model	043042459	043042461
JHU model	043042458	043042460
All other models	043042066	043041255

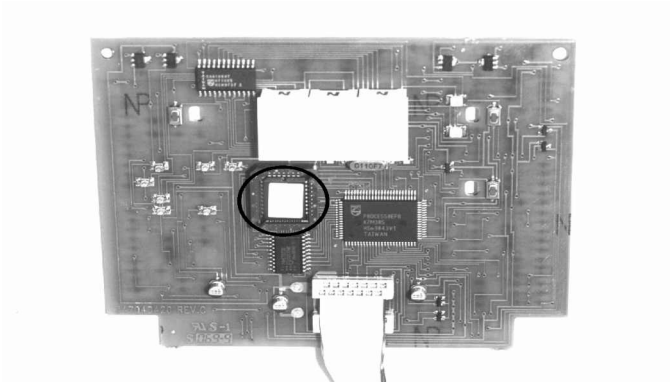


Figure 7.8 Showing location of U3

1. Open the case (section 7.2.1).
2. Remove ROM integrated circuit U3 (Figure 7.8) using appropriate tools.
3. Place new ROM into the empty socket, ensuring correct orientation.
4. Close the case (section 7.2.8)
5. Turn the humidifier upside down; use a non conducting tool to hold the production test button down. This button is accessible through the right air vent slot (when looking at the rear of the humidifier). See Figure 7.9.

WARNING:
Never use an electrically conducting tool to depress the production test button, as there are live mains voltages inside the humidifier.

Figure 7.9 Showing Location of the Production Test Button

6. Apply mains power to the humidifier, while keeping the production test button depressed. The display should read: “PTS”. This ensures that the new software version number will be properly updated in the EEPROM.
7. Turn off the mains power to the humidifier, and remove the tool.
8. Check that the humidifier powers up normally, and complete a full performance test (section 8).

(An alternative method for software versions 7.21 onward.)

1. Perform steps 1 to 4 as above.
2. Apply mains power to the humidifier. An error code E05 (EEPROM version is older than the ROM version) or E06 (EEPROM version is newer than the ROM version) will be given. Press the Mute button to confirm that the software is to be changed to the version in the ROM. Once the Mute button is pressed the software version is changed and the MR850 is automatically restarted.
3. Complete a full performance test (section 8).

7.2.7 Replacing the Mains Cable

1. Open the case (section 7.2.1).
2. Unscrew the three mains cable wires from the terminal blocks on the power PCB (see Figure 7.4), and cut the cable tie on the PCB.
3. Slide the mains cable retainer away from the rear of the case.
4. Replace the power cord, and affix to the case by forcefully pushing the retainer back into position (towards the rear of the case).
5. Attach the 3 mains cable wires to the terminal blocks on the power PCB (see table below for correct mains cable wiring), and attach the phase and neutral wires with a new cable tie.

CORD TYPE	PHASE	NEUTRAL	EARTH
USA / JAPAN (115 / 100 V~)	Black or Brown	White or Blue	Green or Green/Yellow
EUROPEAN / IEC (230/ 127 V~)	Brown	Blue	Green / Yellow
NZ / AUSTRALIA (230 V~)	Brown	Blue	Green / Yellow

WARNING:
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 Fisher & Paykel Healthcare.

6. Close the case (section 7.2.8).

7.2.8 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 (see table in section 7.2.7).
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 8.

8 Performance Testing

This section discusses the performance testing of the MR850 humidifier and also the MR850 temperature / flow probe. Performance testing is required as part of ongoing maintenance or after servicing of the humidifier has been completed.

8.1 Humidifier Performance Testing

If the humidifier has been operating normally, but a performance check is required as part of the maintenance schedule, it is recommended that the following tests are completed:

1. A humidifier Calibration Check (Section 8.1.2)
2. A humidifier Display Check (Section 8.1.3)

However, if there is a problem with the humidifier, or if the humidifier has recently been serviced, then the following tests should be completed ***in addition*** to those outlined above.

3. *A humidifier Voltage Calibration Check (only required if the MR850's PCBs or mains transformer have been serviced or replaced). (*Section 8.1.4*)*
4. *A humidifier Warm-up and Control Check. (*Section 8.1.5*)*

8.1.1 Entering the Service Menu

The MR850 humidifier has a special mode which enables the operator to verify correct operation. To enter this mode, hold down the power button on the front of the humidifier then apply mains power. The See-Manual indicator will light, and the humidifier will enter the service menu. The service menu has six different tests:

Display	Description	Reference
-1-	Calibration Probe #1 Check	Section 8.1.2
-2-	Calibration Probe #2 Check	Section 8.1.2
-3-	Voltage Calibration Check	Section 8.1.4
-4-	Temperature Probe Check	Section 8.2.1
-5-	Flow Check	Section 8.2.2
-6-	Display Test	Section 8.1.3
End	Service Menu Exit	

Pushing the mute button while a number is displayed enters the relevant service test. When 'End' is displayed the user can press the mute button to cycle back to the start of the service menu. If no button is pushed, the service menu will automatically exit after six seconds.

NOTE: All tests performed in the service menu will automatically exit after 30 minutes.

8.1.2 Humidifier Calibration Check

This section describes how to check the accuracy of the humidifier's temperature and flow measurement electronics.

Equipment Required:

- MR850 Humidifier
- Reference Probe Set, Fisher & Paykel Healthcare part number: 900MR870

1. Hold down the power button, then apply mains power to the humidifier. This action places the humidifier into service mode.
2. Select service mode number 1 (Calibration Probe #1 Check) by pushing the mute button when '-1-' is displayed.
3. Insert the calibration probe with the GREY collet into the temperature / flow probe socket of the humidifier.
4. Allow the display to stabilize for a few seconds, and check the number shown on the humidifier display. The table below shows the numbers displayed by the humidifier in this mode:

TEST	PASS	FAIL (LOW)	FAIL (HIGH)
Airway Temperature	100	101	102
Chamber Temperature	100	104	108
Flow Temperature	100	110	120
Calibration Resistor	100	140	180
Overheat	Heater Wire LED OFF	Heater Wire LED ON	Heater Wire LED ON

If the humidifier displays any other value than '100' or if the heater wire indicator is on, check that you have the correct calibration probe plugged in, otherwise the MR850 PCBs are faulty and they will need to be serviced or replaced (refer 7.2.3).

5. Press the power button (this causes the Calibration Probe #2 Check to be executed).
6. Insert the calibration probe with a BLUE collet into the temperature / flow probe socket of the humidifier.
7. Allow the displayed value to stabilize for a few seconds. Check the humidifier display. The table below shows the numbers displayed by the humidifier in this mode:

TEST	PASS	FAIL (LOW)	FAIL (HIGH)
Airway Temperature	200	201	202
Chamber Temperature	200	204	208
Flow Temperature	200	210	220
Calibration Resistor	200	240	280
Overheat	Heater Wire LED OFF	Heater Wire LED ON	Heater Wire LED ON

If the humidifier displays any other value than '200' or if the heater wire indicator is on, check that you have the correct calibration probe plugged in, otherwise the MR850 PCBs are faulty and they will need to be serviced or replaced (refer 7.2.3).

8. Remove the calibration probe, and press the mute button to exit service mode.

8.1.3 Humidifier Display Test

This test is used to determine whether the humidifier's display is working correctly.

1. Enter the service menu (refer section 8.1.1).
2. Select service mode number 6 (Display test) by pushing the mute button when '-6-' is displayed.
3. Check that all of the display LEDs and indicators are turned on.
4. Push the mode button to change to a display cycle test. Check that all the LEDs and indicators light in sequence, and that there is only ever one LED on at a time.
5. Push the Mute button to exit back to the service menu.

If the humidifier does not pass the display test, then it is recommended that the humidifier PCBs are either replaced or sent for servicing (refer 7.2.3).

8.1.4 Humidifier Voltage Calibration Check

This check is required when the humidifier's PCBs have been serviced or replaced, or if the mains transformer has been replaced.

Equipment Required:

- An AC voltmeter, capable of measuring RMS mains voltage to ±0.5 % accuracy.
- Suitable breathing circuit for MR850 (for example 900RT100).
- MR850 Heater Wire Adaptor (for example 900MR800).

1. Connect a breathing circuit to the humidifier with the heater wire adaptor. Make sure the inspiratory limb is correctly plugged in, and that a temperature or calibration probe is not plugged in to the humidifier.
2. **Safely** connect the AC voltmeter to the mains supply.
   NOTE: Connect the voltmeter in close proximity to the mains socket used to power the humidifier.
3. Enter the service menu (refer section 8.1.1).
4. Select service mode number 3 (Voltage Calibration Check) by pushing the mute button when '-3-' is displayed.
5. Calculate the percentage of the actual mains voltage (the AC voltmeter reading) to the nominal mains voltage for the humidifier model being tested.
   NOTE: The nominal mains voltage is the voltage indicated on the left side of the humidifiers case, and will be either 230 V~, 127 V~, 115 V~, or 100 V~.

   Percentage mains = 100 x [Actual mains voltage (RMS) / Nominal Mains voltage]

   For example:

MR850 Model AEK :	Nominal Mains Voltage is 230 V~
Voltmeter Reading :	240.5 V~
Percentage mains:	100 x [240.5 / 230] = 104.5 %
Round any decimal points:	105

6. Adjust the reading on the humidifier's display to read the same as the value calculated above. This is achieved by pushing the mode button to increase, or the power button to decrease the percent value on the humidifier's display.
7. Check that the mains voltage has remained constant. If necessary recalculate the percentage of actual mains voltage.
8. Store the new value in the humidifier's memory by pushing and holding the mute and mode buttons together for 1 second. The humidifier will beep when the value has been correctly stored.
9. Exit the voltage calibration test by pushing and holding down the mute button for longer than one second.

8.1.5 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:

- MR850 Humidifier
- MR850 Heater Wire Adaptor
- Flow/Temperature Probe
- Suitable breathing circuit for MR850 (for example: RT100)
- Suitable chamber for MR850 (for example: MR290) filled with water
- Gas supply - constant flow of: 10±5 SLPM (Standard Litres Per Minute)

1. Make sure that the humidifier passes the calibration and display checks (refer 8.1.2 and 8.1.3).
2. Set up the humidifier as shown in section 4.1. Make sure the chamber probe is correctly inserted and invasive mode selected.

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 temperatures can be checked by using the display mode (section 4.3.1) and set temperatures can be checked by using the diagnostic menu (section 6.4).

After the humidifier has had time to warm up, the temperature at the airway and chamber should be within +0.3 to -1.8°C of their set point, with no alarms occurring.
If any alarms do occur, refer to section 6 (troubleshooting), and determine the cause. If the temperatures displayed are out of range, then refer to the MR850 operating manual, and check the humidifier's setup.

8.2 Probe Accuracy Check

A probe accuracy check is used to test for the correct operation of the temperature / flow probe.

A Probe accuracy check consists of the following tests:

1. *Probe Temperature Accuracy Test (section 8.2.1)*
2. *Probe Flow Accuracy Test (section 8.2.2)*

8.2.1 Probe Temperature Accuracy Test

This test is used to determine the temperature accuracy of the temperature/flow probes that are used with the MR850 humidifier.

Equipment Required:

- MR850 Humidifier
- Flow/Temperature Probe
- Accurate Thermometer (Accuracy ± 0.5 degrees)
- Container of water at approximately 40 °C, or a stirred water bath at 40 °C.

1. Perform a humidifier calibration test as outlined in section 8.1.2 to make sure the humidifier is reading temperature correctly (ignore this step if recently completed).
2. Place both the airway and chamber probes in a container of water (at approx. 40 °C), along with the accurate thermometer.
3. Make sure the water is constantly stirred, and wait approximately 30 seconds for the temperature to stabilise.
4. Enter the service menu (refer section 8.1.1).
5. Select service mode number 4 (Temperature Probe Check) by pushing the mute button when '-4-' is displayed.
6. Plug the probe under test into the humidifier.
   NOTE: if a probe fault condition exists, the humidifier will alarm at this time.
7. The chamber temperature will be displayed; pressing the mode button will toggle between the airway and chamber temperature.
8. Compare the temperatures obtained with the thermometer. The temperature difference (between the humidifier temperatures and the thermometer) should not be greater than 1.5 degrees. If the difference is larger than 1.5 °C, the probe should be replaced.

8.2.2 Probe Flow Accuracy Test

This test is used to determine the flow accuracy of the temperature/flow probes that are used with the MR850 humidifier.

Equipment Required:

- MR850 Humidifier
- Flow/Temperature Probe
- Suitable Breathing Circuit for MR850 (for example: 900RT100)
- Suitable Chamber for MR850 (for example: MR290)
- Gas supply - constant flow of: 10 ± 1 SLPM (Standard Litres Per Minute)

1. Perform a humidifier calibration check as outlined in section 8.1.2 (ignore this step if recently completed).
2. Set up the humidifier as shown in Figure 4.1. Make sure the chamber probe is correctly inserted into the breathing circuit.
3. Connect the humidifier chamber inlet to the gas supply.
4. Enter the service menu (refer section 8.1.1).
5. Select service mode number 5 (Flow Accuracy Check) by pushing the mute button when '-5-' is displayed.
6. Plug the probe under test into the humidifier.
   NOTE: If a probe fault condition exists, the humidifier will alarm at this time.
7. The humidifier will display '---' until a flow measurement has been acquired.
8. Check that the flow measurement is between 5 and 15 LPM.
9. If the flow measurement is outside this range, make sure there are no water drops or deposits on the temperature / flow probe's glass thermistor, and repeat test.
10. If the flow measurement remains outside the specified range, the probe should be replaced.

9 Recommended Maintenance Checklist

This sheet can be copied and used to keep a record of the maintenance procedures carried out on your MR850 Humidifier(s), and probes. Place the serial number and the date that the maintenance was carried out in the spaces provided. Refer to section 5 for a description of the maintenance procedures required.

9.1 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	

9.2 Probe Check (Every six months)

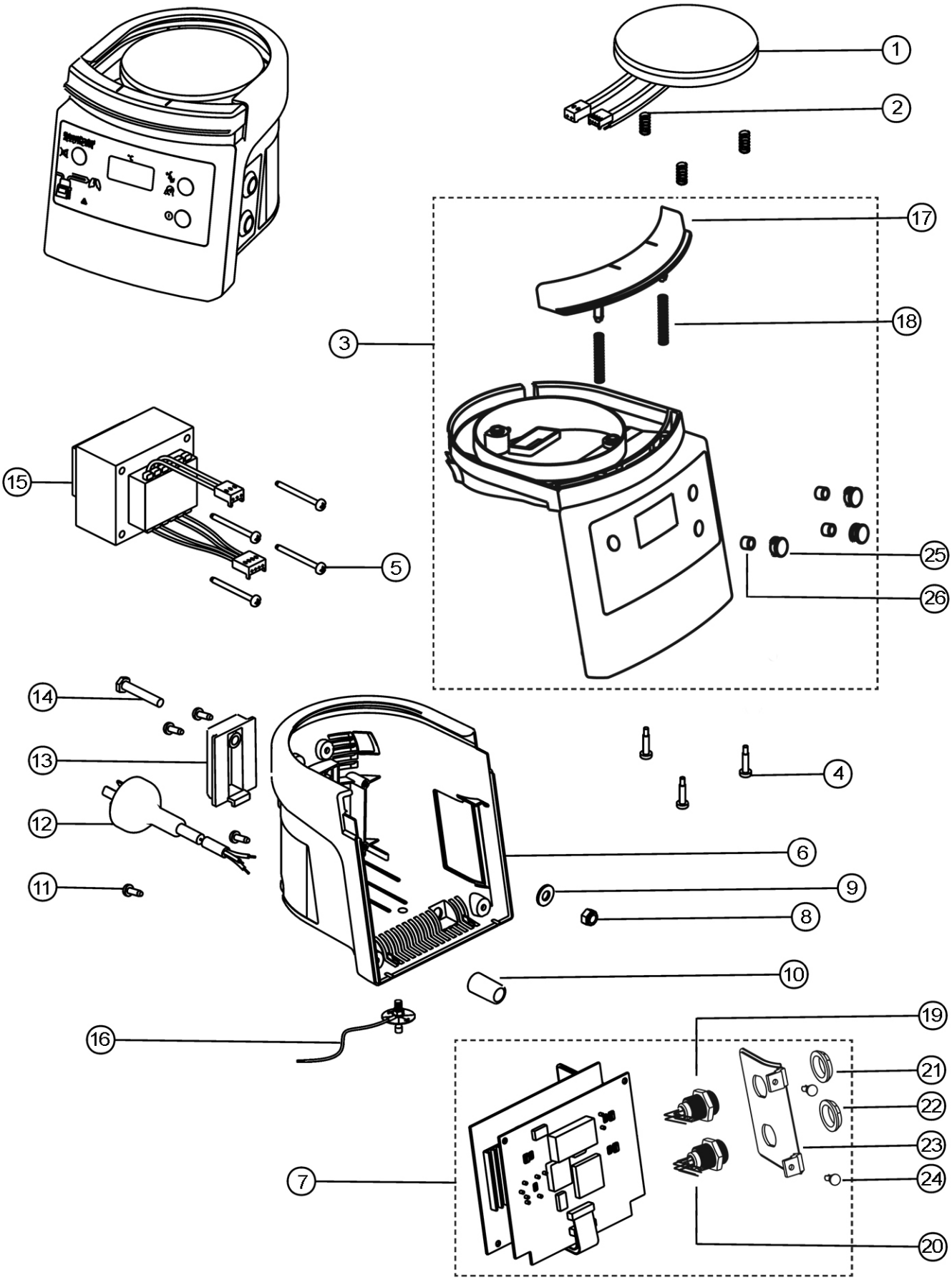
Batch ID	Visual Checks	Performance Checks	Signature and Date
	1. Check Glass Thermistor 2. Check for Foreign Deposits 3. Check Cable for Kinks, etc. 4. Check Probe Connectors	1. Temperature Accuracy 2. Flow Accuracy	

(Blank)

10 Spare Parts

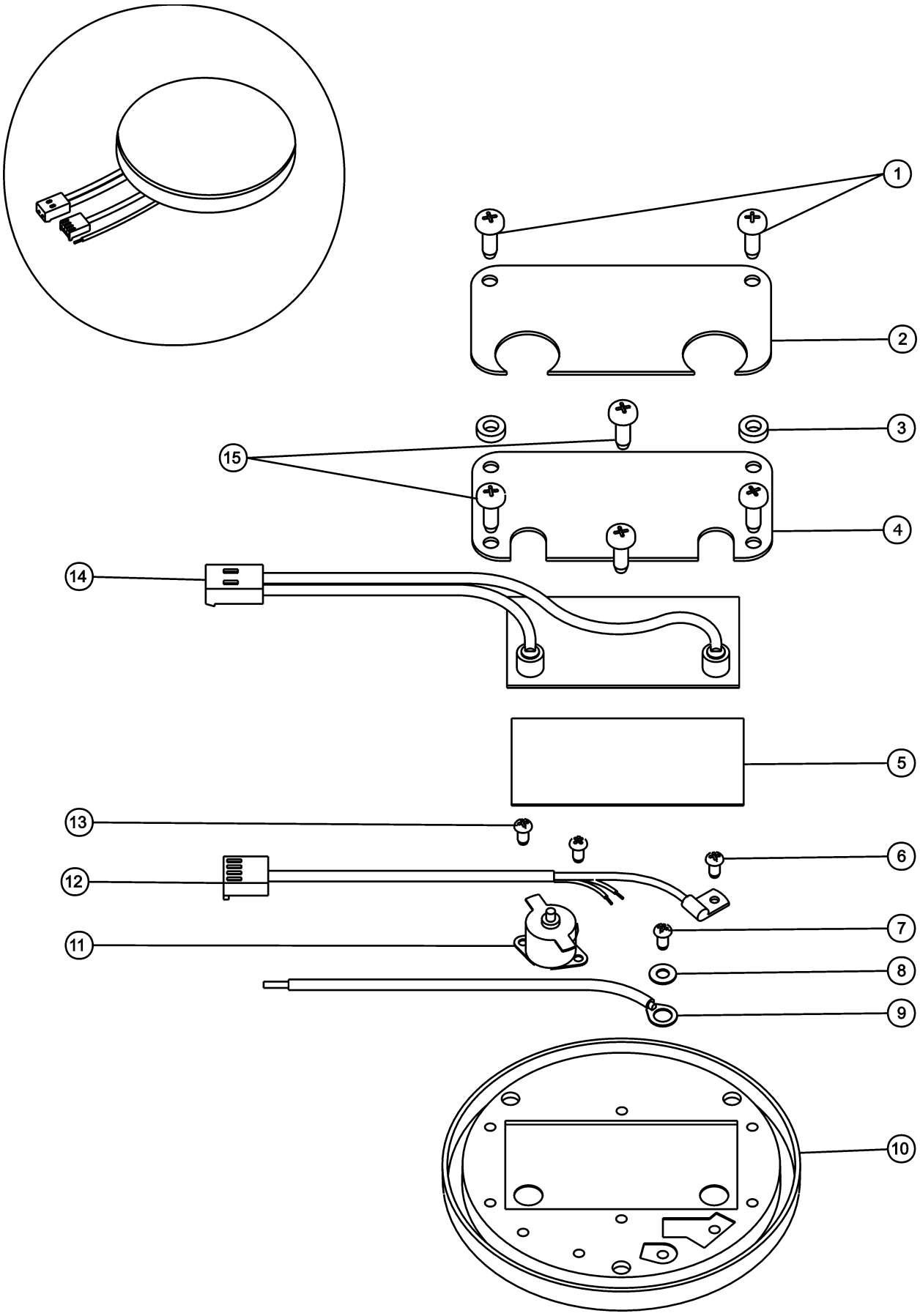
Should any parts of the humidifier require replacement, the following parts list is provided. Refer to the exploded diagram on the opposite page for part identification.

Item	*Part Number*	*Description*
1	043 041 247	100 V~ Heater Plate Assembly
	043 041 248	115 V~ Heater Plate Assembly
	043 042 575	127 V~ Heater Plate Assembly
	043 041 249	230 V~ Heater Plate Assembly
2	662 040 058	Heater Plate Spring
3	043 042 068	Front Case Replacement kit – 115 V~ (J models)
	043 041 334	Front Case Replacement kit – 230 V~ (A models)
	043 042 067	Front Case Replacement kit – 100 V~ (G models)
	043 042 578	Front Case Replacement kit – 127 V~ (P models)
4	336 060 143	Heater Plate Case Screw
5	614 061 141	Transformer Mounting Screw
6	043 042 267	Rear case replacement kit – ADU model
	043 042 268	Rear case replacement kit – AEA model
	043 042 269	Rear case replacement kit – AEK model
	043 042 270	Rear case replacement kit – AEU model
	043 042 271	Rear case replacement kit – AFU model
	043 042 272	Rear case replacement kit – AGU model
	043 042 273	Rear case replacement kit – ALU model
	043 042 274	Rear case replacement kit – ANU model
	043 042 275	Rear case replacement kit – ARU model
	043 042 276	Rear case replacement kit – JHU model
	043 042 277	Rear case replacement kit – JSU model
	043 042 278	Rear case replacement kit – PEU model
	043 042 454	Rear case replacement kit – GJU model
7	043 041 250	Electronics PCB Assembly
8	621 040 524	Mounting Tongue Nut
9	622 040 512	Mounting Tongue Washer
10	693 041 483	Mains Cable Collet
11	614 040 120	Case Screw
12	095 428 322	Mains Cord, USA Plug, Right Angle (115 V~)
	095 428 869	Mains Cord, USA Plug, Straight (100 V~)
	095 428 317	Mains Cord, NZ / Australian Plug (230 V~)
	095 428 569	Mains Cord, UK Plug (230 V~)
	095 428 323	Mains Cord, European Schuko Plug (230 V~)
13	693 041 482	Mounting Tongue
14	614 063 026	Mounting Tongue Bolt
15	043 041 304	Transformer : 230 V~
	043 042 576	Transformer : 127 V~
	043 041 305	Transformer : 115 V~
	043 041 306	Transformer : 100 V~
16	043 041 336	Equipotential Stud Kit (Option)
17	693 041 487	Finger guard MR850 blue
18	662 040 067	Spring for finger guard
19	341 040 560	Socket heater wire 4-way
20	341 040 561	Socket temperature/flow probe 6-way
21	341 040 559	Socket retaining ring yellow
22	341 040 558	Socket retaining ring blue
23	693 040 783	Side panel
24	336 060 148	Plastic rivet
25	693 041 486	Rubber button
26	653 040 124	Button retaining ring


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

Heater Plate Assembly

Item	*Part Number*	*Description*
1	614 040 861	Screw (M4x12)
2	641 040 829	Reflector
3	336 060 149	Reflector Spacer Washers
4	641 040 707	Element Cover
5	331040 114	Mica Insulator
6	614 040 327	Thermistor Screw
7	614 040 117	Earth Strap Screw
8	622 040 130	Earth Strap Washer
9	095 428 320	Earth Strap
10	655 040 111	Aluminium Heater Plate
11	349 040 052	Thermal Cutout
12	043 041 254	Thermistor Assembly Kit
13	614 040 327	Thermal Cutout Screw
14	043 041 251 043 042 577 043 041 252 043 041 253	Element Kit: 230 V~ Element Kit: 127 V~ Element Kit: 115 V~ Element Kit: 100 V~
15	614 040 117	Screw (M4x8)

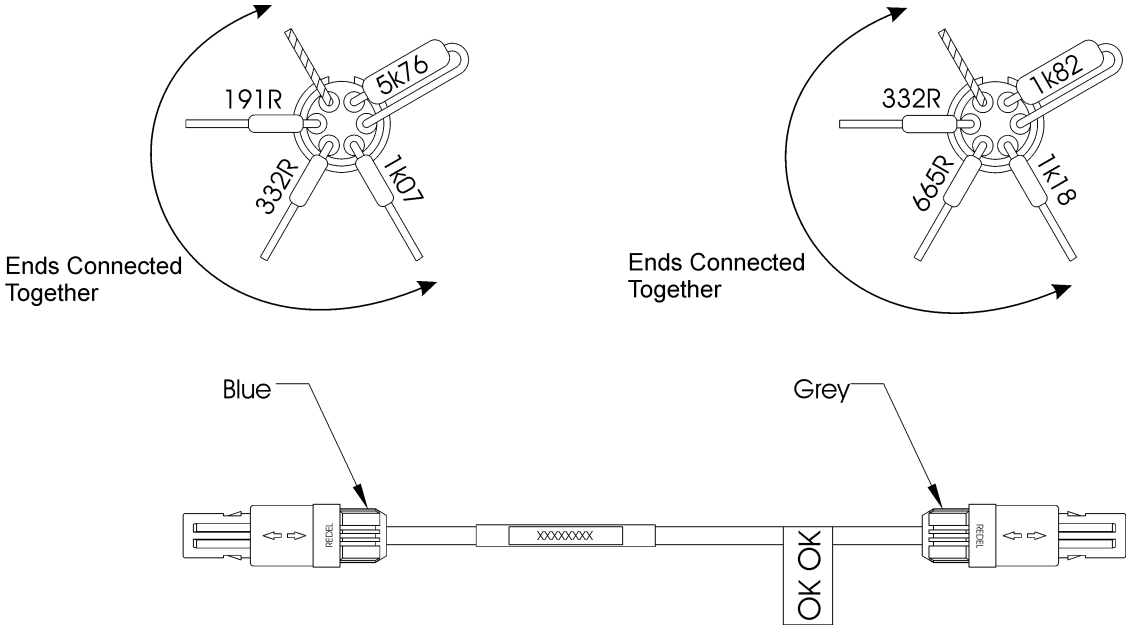

1
2
3
15
4
14
5
13
6
12
7
11
8
9
10

11 Calibration Probe

The information presented here refers to the construction of the MR850 Calibration Probe. This information is provided so that the probe can be checked for correct operation if required.

The calibration probe consists of two Redel plugs, each containing four 0.1 % tolerance resistors. In order to measure the absolute accuracy of these resistors; it is recommended that an ohm meter with better than ± 0.2 % accuracy is used.

To measure the value of the resistors used in the probes, unscrew the cable collet holding the plug together in order to gain access to the connector pins.



Blue collet
Chamber temperature = 75.0 °C
Airway temperature = 42.8 °C

Grey collet
Chamber temperature = 55.2 °C
Airway temperature = 40.5 °C

The measured values must be accurate to ± 0.3 % of their nominal value when using a meter accurate to ± 0.2 %.

Contact a Fisher & Paykel Healthcare representative if an independent calibration probe check is required.

12 Serial Port & Logging Software

12.1 INTRODUCTION

The View850 software* is intended for use with the Fisher & Paykel Healthcare MR850 Respiratory Humidifier. The software can be used to display humidifier data and log the results to a file. A serial cable, part number 900MR888*, is required in order to link the MR850 humidifier to a PC.

WARNING:

The serial port must not be used when the humidifier is in patient use.

Equipment connected to the serial -port must comply with the safety standard IEC60950 for Personal Computers.

No liability for consequential damage: In no event shall Fisher & Paykel Healthcare or its suppliers be liable for any damages arising out of the use of this View850 product.

* View850 software is supplied on the MR850 Technical CD and can be ordered along with the 900MR888 serial cable from Fisher and Paykel Healthcare.

12.2 INSTALLATION

Installing View850 software from the MR850 Technical CD.
1. Insert CD into Personal Computer.
2. Select ‘Install View850’ from menu list.
3. Follow the install instructions.
4. The software is now ready to run.

12.3 OPERATING INSTRUCTIONS

12.3.1 Viewing Humidifier Data

Connect a 900MR888 serial cable* from the serial socket located on the bottom of the MR850 to a communications port (RS-232) on the host computer. Run the View850.exe program from the Microsoft Windows Start Menu, Programs, View850.

Set the correct com. port in the View850 software by going to the Config. Menu and clicking on Settings. The com. port can be changed within the Settings dialog box.

Finally, start the program running by clicking on the `RUN' button. To stop, click the `Running' button.

12.3.2 Logging Humidifier Data to File

The View850 software can log the data it receives to a text file. This text file can then be opened at a later date (by programs such as Microsoft Excel), in order to review humidifier performance.

In order to log the humidifier data, first start the program running. Next set the directory you want the log files to be placed in, by using the menu buttons. Select a directory, and then click on the `OK' button.

To start the program logging, click on the `Log Data to file' button. A log-file will be created. The name of the file will be the current time and date, followed by an `.850' extension. To stop, click the `Logging Data to File' button.

The log rate (how often the data is saved to file) can be changed through the menu buttons.

Note: For further information on this program, view the ‘Readme.txt’ file.

13 EMC INFORMATION

WARNING:
The use of accessories other than those specified by Fisher & Paykel Healthcare may result in increased emissions or decreased immunity of the equipment or system.

Guidance and manufacturer's declaration – electromagnetic emissions		
The MR850 is intended for use in the electromagnetic environment specified below. The customer or the user of the MR850 should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The MR850 uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The MR850 is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class B	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Guidance and manufacturer's declaration – electromagnetic emissions			
The MR850 is intended for use in the electromagnetic environment specified below. The customer or the user of the MR850 should assure that it is used in such an environment.			
Emissions test	**IEC 60601-1 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	< 5 % U_T (> 95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (> 95 % dip in U_T) for 5 sec	< 5 % U_T (> 95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (> 95 % dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the MR850 requires continued operation during power mains interruptions, it is recommended that the MR850 be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the a.c. mains voltage prior to application of the test level.			

Guidance and manufacturer's declaration – electromagnetic immunity

The MR850 is intended for use in the electromagnetic environment specified below. The customer or the user of the MR850 should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment – guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the MR850 including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 V	$d = 1,2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3 V/m	$d = 1,2\sqrt{P}$ 80 MHz to 800 MHz $d = 2,3\sqrt{P}$ 800 MHz to 2.5 GHz
			where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey [a] should be less than the compliance level in each frequency range [b]. Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the MR850 is used exceeds the applicable RF compliance level above, the MR850 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the MR850.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended separation distances between portable and mobile RF communications equipment and the MR850

The MR850 is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the MR850 can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the MR850 as recommended below, according to the maximum output power of the communications equipment.

	Separation distance according to frequency of transmitter (m)		
Rated maximum output power of transmitter (W)	**150 kHz to 80 MHz** $D = 1,2\sqrt{P}$	**80 MHz to 800 MHz** $D = 1,2\sqrt{P}$	**800 MHz to 2,5 GHz** $D = 2,3\sqrt{P}$
0,01	0,12	0,12	0,23
0,1	0,38	0,38	0,73
1	1,2	1,2	2,3
10	3,8	3,8	7,3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

14 Product Change History

Due to upgrades performed on delivered MR850 Respiratory Humidifiers, software and hardware versions are listed below.
It should be realised that possible future upgrades may change the operation of the Humidifier.
Please note that software Versions 4.40 and 4.44 will only work with Revision A or B PCB's and Version 5.12 or later will only work with Revision C, D or E PCB's.

History Change for model JHU

PCB Version	*Software Version*	*Introduction*	*Serial Number*	*Comments*
A	4.40	19 September 1998	9885xxx00000	First production release.
A	4.44	22 October 1998		Software upgrade.
C	5.12	12 April 1999	9985xxx00053	Release of new PCB to accommodate change in temperature probe circuit redesign.
C	5.13	5 May 1999		Software upgrade.
D	5.13	14 January 2000	2000-85xxx00028	Release of new PCB to improve manufacture.
D	5.23	3 April 2000	2000-85xxx01661	Software upgrade for low flow control stability.
D	5.33	25 July 2000	2000-85xxx02806	Software upgrade, allowing Neonatal volume ventilation capability. Manual Temperature Compensation (TC) implemented.
D	5.34	11 October 2000	2000-85xxx04212	Software upgrade to improve EMI immunity.
D	5.45	19 February 2001	2001-85xxx00427	Software upgrade.
D	7.00	2 April 2002	2002-85xxx00976	Software upgrade. Improve HC speed in Non-invasive mode. F&P Co-axial circuit recognition and control.
D	5.70	14 April 2003	2003-85JHU008266	Software release USA only.
D	7.23	31 May 2004	2004-85JHU006084	Added Non-heater wire operation. PTS access through serial command. Humidifier model protection. Remove HC. Software release USA only.
E	7.23	5 July 2004	2004-85JHU008300	Release of new PCB capable of selective soldering.

History Change for model GJU

PCB Version	*Software Version*	*Introduction*	*Serial Number*	*Comments*
A	4.40	19 September 1998	9885xxx00000	First production release.
A	4.44	22 October 1998		Software upgrade.
C	5.12	12 April 1999	9985xxx00053	Release of new PCB to accommodate change in temperature probe circuit redesign.
C	5.13	5 May 1999		Software upgrade.
D	5.13	14 January 2000	2000-85xxx00028	Release of new PCB to improve manufacture.
D	5.23	3 April 2000	2000-85xxx01661	Software upgrade for low flow control stability.
D	5.33	25 July 2000	2000-85xxx02806	Software upgrade, allowing Neonatal volume ventilation capability. Manual Temperature Compensation (TC) implemented.
D	5.34	11 October 2000	2000-85xxx04212	Software upgrade to improve EMI immunity.
D	5.45	19 February 2001	2001-85xxx00427	Software upgrade.
D	6.00	15 November 2001	Only released as software upgrade kits.	Software upgrade. Introduction of the automatic and manual Humidity Compensation (HC) mode. Added time delay to the OFF button. Enable low temperature alarm in stand-by.
D	7.00	2 April 2002	2002-85xxx00976	Software upgrade. Improve HC speed in Non-invasive mode. F&P Co-axial circuit recognition and control.
D	7.20	18 March 2004	2004-85GJU002592	Software upgrade.
D	7.21	9 June 2004	2004-85GJU006775	Software upgrade. PTS access through serial command. Humidifier model protection. Software release Japan only.
E	7.21	9 July 2004	2004-85GJU008765	Release of new PCB capable of selective soldering.

History Change for all model except JHU & GJU

PCB Version	Software Version	Introduction	Serial Number	Comments
A	4.40	19 September 1998	9885xxx00000	First production release.
A	4.44	22 October 1998		Software upgrade.
C	5.12	12 April 1999	9985xxx00053	Release of new PCB to accommodate change in temperature probe circuit redesign.
C	5.13	5 May 1999		Software upgrade.
D	5.13	14 January 2000	2000-85xxx00028	Release of new PCB to improve manufacture.
D	5.23	3 April 2000	2000-85xxx01661	Software upgrade for low flow control stability.
D	5.33	25 July 2000	2000-85xxx02806	Software upgrade, allowing Neonatal volume ventilation capability. Manual Temperature Compensation (TC) implemented.
D	5.34	11 October 2000	2000-85xxx04212	Software upgrade to improve EMI immunity.
D	5.45	19 February 2001	2001-85xxx00427	Software upgrade.
D	6.00	15 November 2001	Only released as software upgrade kits.	Software upgrade. Introduction of the automatic and manual Humidity Compensation (HC) mode. Added time delay to the OFF button. Enable low temperature alarm in stand-by.
D	7.00	2 April 2002	2002-85xxx00976	Software upgrade. Improve HC speed in Non-invasive mode. F&P Co-axial circuit recognition and control.
D	7.14	22 April 2003	2003-85xxx009621	Software upgrade. Auto HC increased to +5 °C. Diagnostic menu changes. Added Non-heater wire operation.
D	7.17	31 July 2003	2003-85xxx013518	Software upgrade.
D	7.22	28 May 2004	2004-85xxx006024	PTS access through serial command. Humidifier model protection.
E	7.22	2 July 2004	2004-85xxx008200	Release of new PCB capable of selective soldering.