

1) What classification is this ventilator?

- A) Intensive care type ventilator
- B) Anaesthetic machine type
- C) Transport ventilator
- D) Primarily CPAP device
- E) In extremis

A) Intensive care type ventilator

2) Connect and set up

- Expiratory module with: exhaust port, expiratory port, water trap and a latch to disconnect the whole module
- Inspiratory port with an oxygen sensor (paramagnetic sensor with a year of use)
- Nebuliser output port

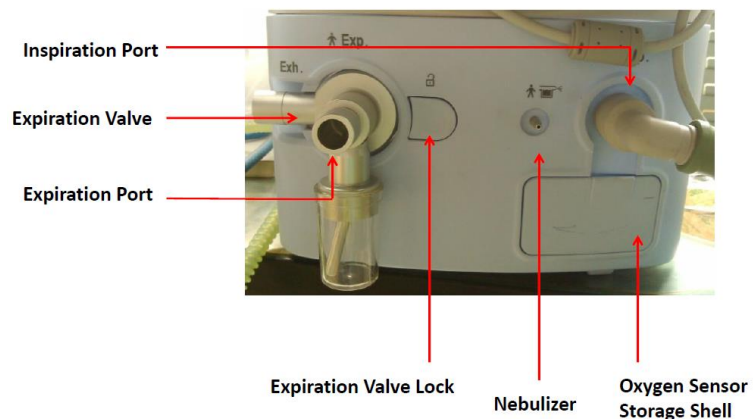


Image of the front of the device

2a) What connections are there?

- Power socket
- CO2 module connector to attach mainstream CO2 monitor. (If monitoring CO2 on this machine, an IRMA connector and IRMA adapter from the manufacturer are needed to attach to the CO2 module or to attach after the HME). However, a side stream analyser can be used
- Low flow oxygen inlet
- Hyperbaric oxygen inlet
- Power supply switch



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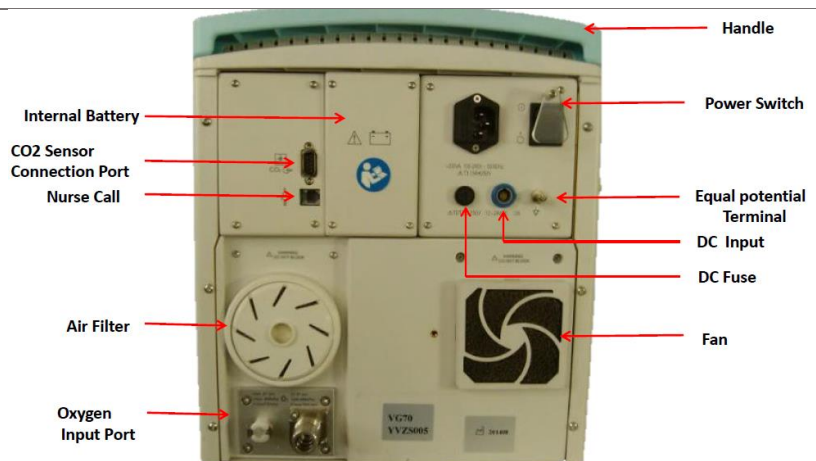


Image of the rear of device

<p>2b) How is the ventilator powered?</p>	<ul style="list-style-type: none"> • Mains AC power via plug. There is an Internal battery. An icon in the top right corner of the screen illustrates which power source is in use • (When the battery is in use the expiratory port heater, the cooling fan and nebuliser functions are disabled)
<p>2c) What gas supply is used?</p>	<ul style="list-style-type: none"> • Cylinder Oxygen or Wall. Connected to the 4Bar oxygen connection port • Low flow oxygen can be connected to the low flow inlet to a max of 15L/min
<p>2d) Can an Oxygen Concentrator be used Y/N</p>	<p>Yes, via low flow oxygen inlet to a max of 15L/min.</p>
<p>2e) Is the oxygen consumption high or low (related to drive e.g. Turbine, air or oxygen)</p>	<p>The ventilator is turbine driven with additional oxygen from supply for FiO₂ to the patient.</p>
<p>2f) Any other connections?</p>	<ul style="list-style-type: none"> • Optional Humidifier • Patient connection arm • Optional Cylinder storage unit
<p>3) Breathing system</p>	
<p>3a) What type of patient circuit is used?</p>	<p>A double limb circuit which can also incorporate a humidifier and connects to the patient interface via a Y piece.</p>
<p>3b) How is the patient circuit connected to the ventilator?</p>	<ol style="list-style-type: none"> 1. Attach tubing to the inspiratory port. This can then connect to the humidifier if one is in use 2. The inspiratory tube is then connected to the Y piece, via a water trap



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3. The Y Piece is can be connected to the mainstream CO2 monitor (IRMA CO2 specific to this ventilator) or side stream analyser can be connected here
4. The HME filter should be connected up-stream from the CO2 monitor if the IRMA is used
5. The patient interface is then connected
6. The expiratory limb attaches to the Y piece connector and travels back to the ventilator, attaching at the expiratory port.
A bacterial filter should be positioned before the expiration valve.

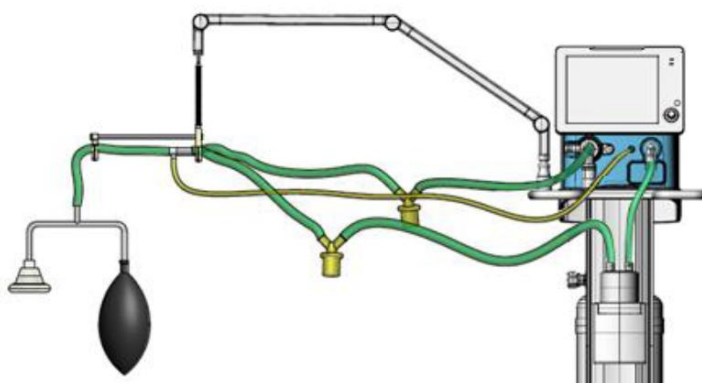


Image of the patient circuit



Image of bacteria filter at expiratory limb

<p>3c) Is PEEP valve required, or is PEEP integrated within controls?</p>	<p>Integrated within the controls</p>
<p>3d) What happens to waste gas?</p>	<p>This is released via the exhaust port in the expiratory module into room air.</p>
<p>3e) Any other considerations?</p>	<p>N/A</p>



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4) Controls	
4a) What controls can be adjusted?	<ul style="list-style-type: none"> • Tidal volume • Respiratory rate • Inspiratory time • Inspiratory pause • FiO₂ • PEEP/CPAP • P_{supp} • P_{high} and P_{low} in bivent mode
4b) Recommended frequency / rate setting for adult	Depends on clinical picture for lung protective ventilation. Can deliver 1-80BM
4c) Recommended tidal volume for adult	Depends on clinical picture for lung protective ventilation. Can deliver 20-2000ml
4d) Recommended (max) pressure for adult	P _{insp} 5-70cmH ₂ O can be delivered. Titrate for clinical situation
4e) Oxygen concentration options (%)	21-100%
4f) PEEP range	0 – 35cmH ₂ O
4g) I:E ratio	Factory set at 1:2. Setting range 1:10 – 4:1
4e) Any other controls?	<ul style="list-style-type: none"> • Inspiratory hold: Available in all modes except spontaneously breathing. Expiration is not initiated until release of the key or until 30s have elapsed (whichever comes first) • Expiratory hold: Available in all modes. Inspiration is not started until the key is released or 30s (whichever comes first). When both inspiratory and expiratory hold are in use a message stating this appears on the screen, with a countdown timer • Nebuliser: when nebuliser key is activated a message stating this will appear on the screen <p>Manual trigger:</p> <ul style="list-style-type: none"> • Suction: Activating this button allows for suction support and circuit disconnection without alarms and the ventilator will be paused if disconnection is detected • Freeze: Pressing this button allows the ventilator waveforms to be paused if the user would like to analyse a still image. Press freeze again to restart

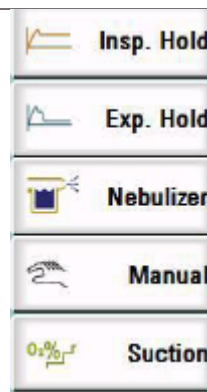


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5) Setting the mode

5a) What ventilation modes are available?

Invasive modes:

- Volume Controlled Ventilation (VCV)
- Pressure Controlled Ventilation (PCV)
- SIMV
- Pressure Regulated Volume controlled (PRVC)
- Spontaneous/CPAP
- Bivent

Non-invasive modes:

- CPAP
- NIV-T
- NIV-S/T

(See section 9 for more detail on ventilator settings)

There are also weaning parameters incorporated in the ventilator functions.

5b) How is volume-controlled ventilation mode set?

- 1) Once the ventilator is turned on and the self test has occurred, press the blue button in the bottom right corner which says **START VENTILATION**
- 2) Select the type of patient (machine will default to adult)
- 3) Select the type of ventilation (invasive or non-invasive)
- 4) Patient information can be entered by pressing the **PATIENT INFORMATION** button or if it is the same patient press **PREVIOUS PATIENT**
- 5) Then click the **MAIN MENU** button above the standby button.
- 6) Then select the **MODE BUTTON (see diagram below)** and select the type of ventilation required e.g. VCV. The ventilatory mode selected will be highlighted yellow at this stage



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7) The individual settings can then be set and once this is done, press accept. (The ventilator mode will then be highlighted in green)

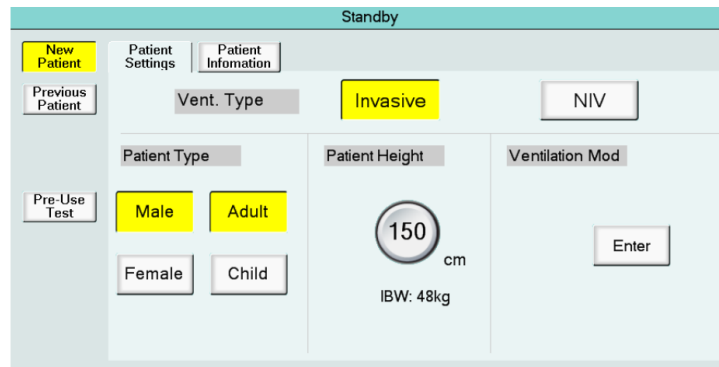


Image of the patient settings screen

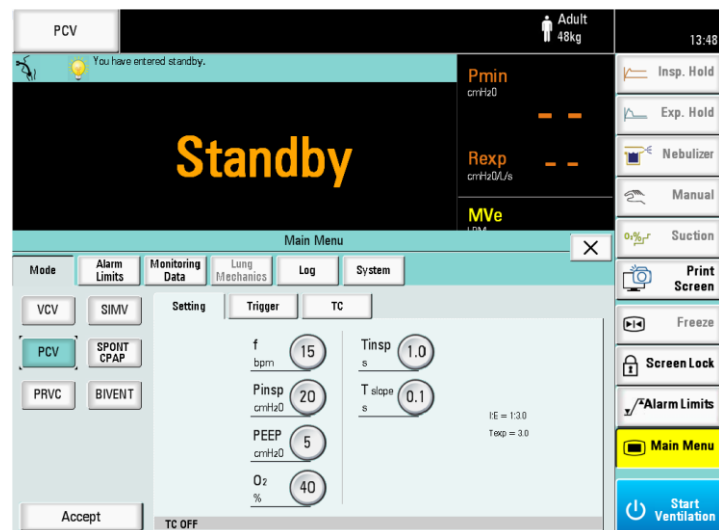


Image of the mode and ventilation buttons

5c) Can the machine be used for weaning?

The machine can be used for weaning under the guidance of an experienced clinician. There are parameters such as tube compensation and RSBI as well as the other ventilatory modes that can all be utilised.

6) Setting the parameters

6a) How is frequency / rate set / adjusted?

- Once the ventilatory mode is selected, the settings tab can be selected by the user and the rate, VT, PEEP, Oxygen, Tinsp, I:E, Insp pressure can all be set
- There is another tab for trigger values that can be accessed by pressing it



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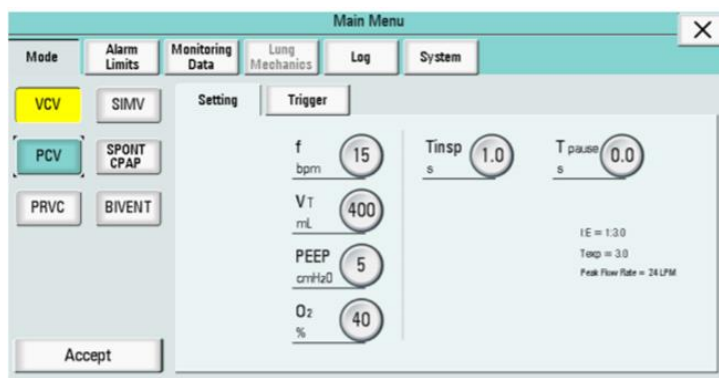


Figure 6-18

6b) How is tidal volume set / adjusted?

Using the touch screen to adjust the value as shown in the picture above

6c) How is (max) pressure set / adjusted?

Maximum pressure can be set in the alarms screen. This is accessed via the main menu > Alarm limits and using the touch screen:

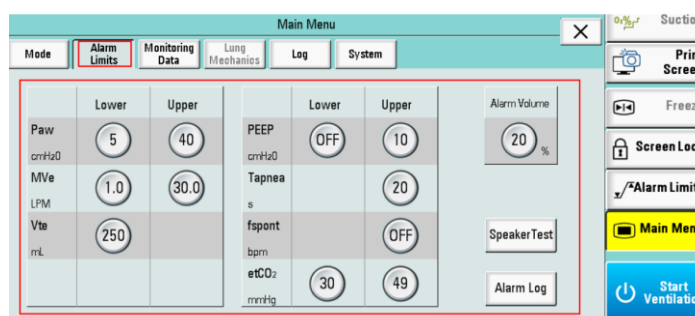


Image showing the alarm limits screen

6d) How is oxygen concentration set / adjusted?

The FiO2 is adjusted using the touch screen in the settings tab, after the ventilatory mode has been selected

6e) How is PEEP set / adjusted?

Using the touch screen in the settings tab, after the ventilatory mode has been selected

6f) Any other parameters?

N/A

6g) Which parameters can be monitored, how?

- Press **MONITORING DATA** tab on the touch screen
- The parameters monitored will be show as a list
- During ventilation, the main screen will display monitoring information



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Main Menu						
Mode	Alarm Limits	Monitoring Data	Lung Mechanics	Log	System	
Ppeak cmH ₂ O	--	Vti mL	--	Rexp cmH ₂ O/L/s	--	FICO ₂ mmHg
Pplat cmH ₂ O	--	Vte mL	--	Cdyn mL/cmH ₂ O	--	LEAK NIV %
PEEP cmH ₂ O	--	MVe LPM	--	RSBI bpm/mL	--	
Pmean cmH ₂ O	--	MVespont LPM	--	WOB J/L	--	Vdaw mL
Pmin cmH ₂ O	--	ftotal bpm	--	I:E	--	Tispont s
O ₂ %	--	fspont bpm	--	etCO ₂ mmHg	--	

Image of the monitoring tab

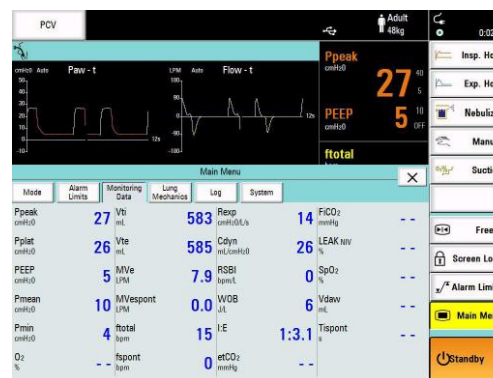


Image of the main monitoring screen

7) Checking the device

7a) How is the start-up test done?

The pre-use test is available on power on. To start tests, the user must press OK - otherwise the test will be skipped. These tests should be performed before the machine is connected to the patient.



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Image of the pre-use test screen

8) Troubleshooting

8a) What alarms are there?

- There are high, medium and low priority alarms. Red is high, yellow flashing is medium priority and a continual yellow light is low priority. The alarms default to the manufacturers setting unless the clinician changes these
- The alarm volume can also be adjusted. Alarms are accessed via the main menu> alarm limits
 1. High airway pressure
 2. Leakage
 3. Low oxygen supply pressure
 4. High respiratory rate
 5. Oxygen sensor failure
 6. High FiO2
 7. Low FiO2
 8. High/low MV
 9. Apnoea
 10. High PEEP
 11. Low expiratory VT
 12. High expiratory Vt
 13. Disconnection
 14. Circuit occlusion
 15. Maximum inspiratory time with no breath
 16. AC failure
 17. Low battery
 18. Inspiratory or expiratory hold interrupted
 19. Nebuliser interrupted
 20. Battery calibration required
 21. Alarms associated with CO2 sensor (if using)



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22. Fan failure and technical alarms

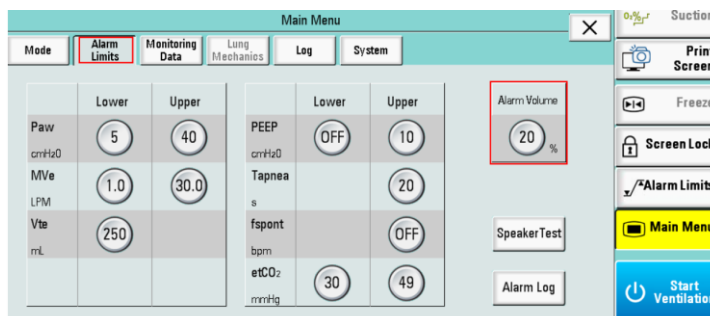


Image of the alarm touch screen

8b) What could go wrong? (top 3 – 5 most likely) How should the user resolve?

- 1) High or low airway pressure: check the patient and the ventilator settings. Ensure settings and alarms are appropriately set. Address any clinical reason for the alarm
- 2) Apnoea: review the patient and ventilator settings. Patient safety is the first priority and ensure alternative ventilation not required. Assess settings and alarms settings
- 3) Disconnection: check connection to patient and also machine
- 4) Low or High VT: check the patient and ventilator settings. Ensure appropriate settings to achieve desired tidal volume
- 5) High PEEP: check patient e.g. coughing or cause for high PEEP. Check ventilator settings and PEEP appropriately set in conjunction with alarm limits

9) Anything else?

Supporting links or information

- Not for use in MRI
- Invasive modes:
 - Volume Controlled Ventilation (VCV)
 - Pressure Controlled Ventilation (PCV)
 - Pressure regulated volume controlled (PRVC): allows a set tidal volume to be delivered but inspiratory pressure is regulated. There is an initial volume-controlled breath to gauge pressure requirements and subsequent breaths are pressure-controlled breaths. The pressure required will adapt automatically to maintain the tidal volume
 - SIMV (PCV)+Pressure support (PS): mandatory and spontaneous respiration to maintain minute ventilation. Spontaneous respiration is supported by the set pressure support. Mandatory breaths are delivered with pressure control
 - SIMV (VCV)+PS: As above but mandatory breaths target a tidal volume and deliver pressure to achieve this



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- SIMV (PRVC) +PS: As above but mandatory breaths are pressure regulated but target a tidal volume
- In SIMV, if apnoea occurs, the ventilator will default to the back-up ventilator setting e.g. CV, VCV or PRVC. Back up ventilation will cease if the patient triggers two consecutive breaths or when the operator resets the apnoea alarm and confirms this.
 - Spontaneous/CPAP: the patient determines inspiration and expiration with the machine detecting inspiratory and expiratory triggers. The machine delivers the set level of PEEP. If apnoea occurs, the back-up mode is triggered
 - BIVENT: breaths are controlled by the ventilator delivering pressure-controlled inspiration and expiration. When the inspiratory time is less than the expiratory time the mode will display as BiVENT APRV. PCV is the back up mode if no patient triggered breaths.
- Non-invasive modes:
 - CPAP: PEEP delivered and patient controls respiratory rate
 - NIV-T: breathing is triggered by the patient or the machine. Ventilator-controlled breaths are time cycled and pressure limited to the P_{insp} set. Patient breaths are flow triggered
 - NIV-S/T: No ventilator-controlled breaths but spontaneous ventilation supported during inspiration and expiration with pressure support and PEEP
- In the main menu, there is a systems tab. Accessing this tab will take you settings, configuration, machine information and service sections.
 - Settings: can adjust gas standard, compliance compensation, dead space compensation and chosen units
 - Configuration: allows for patient measured parameters to be set and the trends measured graphically to be changed. Screen brightness can be changed in the second tab. In the 3rd tab a password is required to access site configurations but if accessed configurations for chosen values can be altered (see image below)
 - Service tab: this also requires password access. This area of the machine can take you to calibration settings and enable calibration to be performed as well as accessing the alarm log, machine information, test information and changing the language (see image below).



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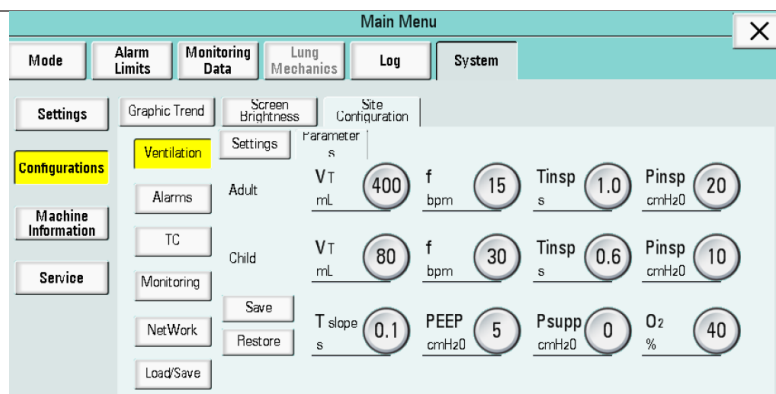


Image showing the systems tab and configurations that can be adjusted

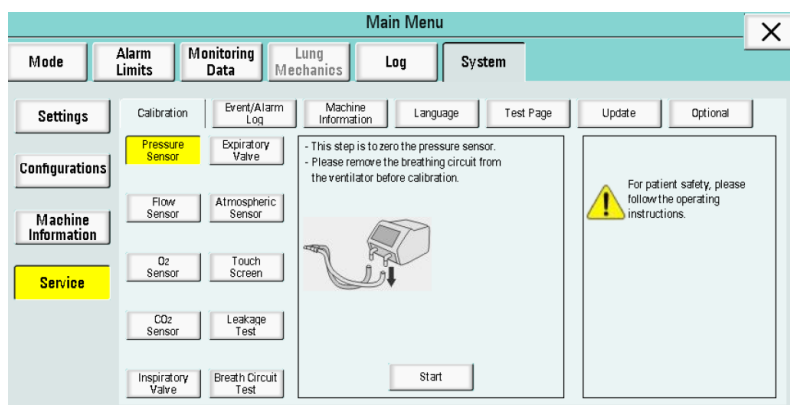


Image of the Service tab

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