Respironics V60 Ventilator

User Manual

PHILIPS

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Chapter 1. Warnings, cautions, and notes

Before using the Respironics V60 Ventilator on a patient, familiarize yourself with this user manual, particularly the safety considerations listed. Be aware, however, that this manual is a reference only. It is not intended to supersede your institution's protocol regarding the safe use of assisted ventilation.

Definitions

WARNING: **Alerts the user to the possibility of injury, death, or other serious adverse reactions associated with the use or misuse of the device.**

CAUTION: Alerts the user to the possibility of a problem with the device associated with its use or misuse, such as device malfunction, device failure, damage to the device, or damage to other property.

NOTE: Emphasizes information of particular importance.

General

WARNING: **An alternative means of ventilation shall be available whenever the ventilator is in use. If a fault is detected in the ventilator, disconnect the patient from it and immediately start ventilation with such a device. The ventilator must be removed from clinical use and serviced by Respironics-authorized service personnel.**

WARNING: **Use the Respironics V60 Ventilator on spontaneously breathing patients only. It is an assist ventilator and is intended to augment the ventilation of a spontaneously breathing patient. It is not intended to provide the total ventilatory requirements of the patient.**

WARNING: **We do not recommend you use the Respironics V60 Ventilator on patients who require ventilation at predetermined tidal volumes. The ventilator provides continuous positive airway pressure (CPAP) and positive pressure ventilation (S/T, PCV, and AVAPS) and is indicated for assisted ventilation only. These modes do not provide ventilation with guaranteed tidal volume delivery.**

WARNING: **We do not recommend you use AVAPS on patients who require rapid and frequent IPAP adjustments to maintain a consistent tidal volume. AVAPS, a volume targeted mode, changes the IPAP setting in order to achieve the target tidal volume. During AVAPS setup, there may be a period of time before the target tidal volume is achieved. AVAPS is ideal for more stabilized patients.**

WARNING: **To reduce the risk of CO_2 rebreathing, make sure EPAP pressures and exhalation times are sufficient to clear all exhaled gas through the exhalation port. In noninvasive ventilation continuous air flow through the port flushes exhaled gases from the circuit. The ability to completely exhaust exhaled gas from the circuit depends on the EPAP setting and I:E ratio. Higher tidal volumes further increase the volume of CO_2 rebreathed by the patient.**

WARNING: **To reduce the risk of CO_2 rebreathing, monitor the patient for changes in respiratory status at the start of ventilation and with each change in ventilator settings, circuit configuration, or patient condition. Pay attention to ventilator alarms that warn of increased CO_2 rebreathing risk.**

WARNING: **Be aware of the possibility of contamination from patient exhalate being exhausted into the room through the exhalation port.**

WARNING: **To ensure accuracy of oxygen administration and to monitor for the presence of contamination (incorrect gas connected), use an external oxygen monitor to verify the oxygen concentration in the delivered gas.**

WARNING: **To reduce the risk of fire, use the ventilator in well-ventilated areas away from flammable anesthetics. Do not use in a hyperbaric chamber or other similarly oxygen-enriched environments. Do not use near an open flame.**

WARNING: **To reduce the risk of electric shock from liquid entering the device, do not put a container filled with a liquid on the ventilator.**

WARNING: **To reduce patient risk of hypoxemia, keep free-flowing oxygen away from air inlet of ventilator.**

WARNING: **The nurse call/remote alarm should be considered a backup to the ventilator's primary alarm system.**

WARNING: **To ensure that the alarm will be heard, make sure the alarm loudness is adequate and avoid blocking the alarm speakers beneath the ventilator.**

CAUTION: Federal law (USA) restricts this device to sale by or on the order of a physician.

CAUTION: The Respironics V60 Ventilator is designed to operate in the temperature range of 5 to 40 °C (41 to 104 °F). To minimize the risk of overheating the device, do not operate adjacent to heaters or other heat sources.

NOTE: The displays shown in this manual may not exactly match what you see on your own ventilator.

NOTE: Pressures are indicated on the ventilator in cmH_2O. Millibars and hectopascals (hPa) are used by some institutions instead. Since 1 millibar equals 1 hPa, which equals 1.016 cmH_2O, the units may be used interchangeably.

NOTE: The ventilator is intended for use as an ambulance transport ventilator or as an Automatic Transport Ventilator as described by the American Hospital Association and referenced by the FDA. It intended to allow the patient to be transported within the hospital setting using a cart to move the ventilator.

NOTE: When attachments or other components or subassemblies are added to the ventilator breathing system, the pressure gradient across the ventilator breathing system, measured with respect to the ventilator outlet, may increase.

NOTE: To ensure the correct performance of the ventilator and the accuracy of patient data, we recommend you use only Respironics-approved accessories with the ventilator. See Appendix D, “Parts and accessories”.

NOTE: This Respironics V60 Ventilator and its recommended accessories that have patient contact are free of latex.

NOTE: If an alarm persists for no apparent reason, discontinue ventilator use and contact Respironics.

NOTE: If you detect any unexplained changes in the performance or visual displays of the ventilator, discontinue ventilator use and contact Respironics.

NOTE: The Respironics V60 Ventilator does not support automatic record keeping.

Preparing for ventilation

WARNING: Connect the ventilator to an appropriate medical-grade oxygen source only. The source must be able to deliver 100% oxygen regulated to 276 to 600 kPa (40 to 87 psig).

WARNING: To reduce the risk of hypoxia, connect only oxygen to the high-pressure connector at the rear of the ventilator.

WARNING: To reduce the risk of fire, do not use a high-pressure oxygen hose that is worn or contaminated with combustible materials like grease or oil.

WARNING: Always check the status of the oxygen cylinders before using the ventilator during transport.

WARNING: To prevent possible asphyxia and to reduce the risk of CO_2 rebreathing, take these precautions with respect to mask and exhalation port use:

- **Use only a mask with an exhalation port or a nasal mask for noninvasive ventilation.**
- **Do not occlude the exhalation port.**
- **Turn on the ventilator and verify that the port is operational before application. Pressurized gas from the ventilator should cause a continuous flow of air to exhaust from the leak port, flushing exhaled gas from the circuit.**
- **Never leave the mask on the patient while the ventilator is not operating. When the ventilator is not operating, the exhalation port does not allow sufficient exhaust to eliminate CO_2 from the circuit. Substantial CO_2 rebreathing may occur.**

WARNING: To ensure normal air circulation and exchange, do not cover or block the ports on the ventilator or ventilator circuit. Do not block the air inlet panel on the right side of the ventilator.

WARNING: To prevent possible patient injury and possible water damage to the ventilator, make sure the humidifier is set to appropriate temperature and humidification settings.

WARNING: To prevent the possibility of inadequate humidification, pay close attention to the humidifier's functioning when operating the ventilator at an ambient temperature > 30 ºC (86 ºF). The ventilator warms the air delivered to the patient above ambient temperature, which may impair the humidifier's performance.

WARNING: To reduce the risk that the patient will aspirate condensed water from the breathing circuit, position any humidifier lower than both the ventilator and the patient.

WARNING: To prevent possible patient injury and equipment damage, do not turn the humidifier on until the gas flow has started and is regulated. Starting the heater or leaving it on without gas flow for prolonged periods may result in heat build-up, causing a bolus of hot air to be delivered to the patient. Circuit tubing may melt under these conditions. Turn the heater power switch off before stopping gas flow.

WARNING: To reduce the risk of fire, use only patient circuits intended for use in oxygen-enriched environments. Do not use antistatic or electrically conductive tubing.

WARNING: To prevent patient or ventilator contamination, we recommend you use a Respironics-approved main flow bacteria filter on the patient gas outlet port. Filters not approved by Respironics may degrade system performance.

WARNING: To reduce the risk of bacterial contamination or damage, handle bacteria filters with care.

WARNING: Any additional accessories in the patient circuit may substantially increase flow resistance and impair ventilation.

WARNING: To reduce the risk of strangulation from patient tubing, use a tubing support arm and secure the proximal pressure line with clips.

WARNING: To reduce the risk of electric shock, connect the ventilator to an AC supply mains with protective earth only.

WARNING: Do not use extension cords, adapters, or power cords with the ventilator that are not approved by Respironics.

WARNING: To prevent unintentional disconnection of the power cord, always use the correct, Respironics-supplied power cord and lock it into place with the power cord retainer before you switch the ventilator on. The retainer is designed to hold the connector end of the Respironics-supplied cord securely in place.

WARNING: To reduce the risk of electric shock, regularly inspect the AC power cord and verify that it is not frayed or cracked.

WARNING: To reduce the risk of strangulation, route the power cord to avoid entanglement.

WARNING: To reduce the risk of power failure, pay close attention to the battery's charge level. The battery's operation time is approximate and is affected by ventilator settings, discharge and recharge cycles, battery age, and ambient temperature. Battery charge is reduced at low ambient temperatures or in situations where the alarm is continuously sounding.

WARNING: **To ensure the ventilator's safe operation, always run the full preoperational check described in "Preoperational check" on page 5-8 before using the ventilator on a patient. If the ventilator fails any tests, remove it from clinical use immediately. Do not use the ventilator until necessary repairs are completed and all tests have passed.**

WARNING: **To prevent possible patient injury, disconnect the patient from the ventilator before running the preoperational check. Make sure another source of ventilatory support is available.**

WARNING: **To prevent possible patient injury due to nonannunciating alarms, verify the operation of any remote alarm device before use.**

WARNING: **To prevent possible patient injury, always return alarm settings to hospital-standard values after the preoperational check.**

CAUTION: To prevent possible damage to the ventilator, ensure that the connection to the oxygen supply is clean and unlubricated, and that there is no water in the oxygen supply gas.

CAUTION: For 120 V equipment, grounding reliability can only be achieved when it is connected to an equivalent receptacle marked "hospital only" or "hospital grade."

Operation

WARNING: **To prevent possible patient injury, avoid setting alarm limits to extreme values, which can render the alarm system useless.**

Alarms and messages

WARNING: **If AC power fails and the backup battery is not installed or is depleted, an audible and visual alarm annunciates for at least 2 minutes. Immediately discontinue ventilator use and secure an alternative means of ventilation. As in most ventilators with passive exhalation ports, when power is lost, sufficient air is not provided through the circuit and exhaled air may be rebreathed.**

Care and maintenance

WARNING: **To reduce the risk of electric shock, power down the ventilator and disconnect it from AC power before cleaning or servicing it.**

WARNING: **To prevent patient or ventilator contamination, inspect and replace the main flow bacteria filter between patients and at regular intervals (or as stated by the manufacturer).**

WARNING: **To prevent possible patient injury, inspect and verify the proper operation of the exhalation port regularly during use.**

WARNING: **To reduce the risk of fire, explosion, leakage, or other hazard, take these precautions with respect to the battery:**

- **Do not attempt to disassemble, open, drop, crush, bend or deform, insert foreign objects into, puncture, or shred the battery pack; modify or remanufacture it; immerse or expose it to water or other liquids; expose it to fire, excessive heat (including soldering irons); or put it in a microwave oven.**
- **Replace the battery only with another battery specified by the manufacturer.**
- **Follow all instructions for proper use of the battery.**
- **Do not short-circuit the battery or allow metallic or conductive objects to contact the battery connector housing.**
- **Use the battery with the Respironics V60 Ventilator only.**

WARNING: This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or federal laws. (Within this system, the backlight lamps in the monitor display contain mercury.)

CAUTION: Do not attempt to sterilize or autoclave the ventilator.

CAUTION: To prevent possible damage to the ventilator, use only those cleaning agents listed in this manual.

CAUTION: To prevent possible damage to the touchscreen, take care when cleaning it. Do not drip water and/or soap solution. After cleaning and rinsing, remove all moisture with a dry, soft cloth. Never clean the touchscreen with an abrasive brush or device, since this will cause irreparable damage.

CAUTION: To avoid introducing foreign matter into the ventilator and to ensure proper system performance, change the air inlet filter at regular intervals (or as stipulated by your institution).

CAUTION: To ensure proper system performance, use a Respironics-approved air inlet filter.

CAUTION: Because some environments cause a quicker collection of lint and dust than others, inspect the filters more often when needed. The air inlet filter should be replaced; the cooling fan filter should be cleaned.

CAUTION: To prevent possible damage to the ventilator, always ship it with the original packing material. If the original material is not available, contact Respironics to order replacements.

First-time installation

WARNING: Never attempt to disconnect or connect the battery during operation.

CAUTION: To prevent possible damage to the ventilator, always secure it to its stand or securely place it on a flat, stable surface that is free of dirt and debris. Do not use the ventilator adjacent to, or stack it with, other equipment.

Communications interface

WARNING: **Connect to the ventilator only items that are specified as part of or compatible with the ventilator system. Additional equipment connected to medical electrical equipment must comply with the respective IEC or ISO standards. Furthermore, all configurations shall comply with the requirements for medical electrical systems (see IEC 60601-1-1 or clause 16 of edition 3 of IEC 60601-1, respectively). Anybody connecting additional equipment to medical electrical equipment configures a medical system and is therefore responsible for ensuring that the system complies with the requirements for medical electrical systems. Also be aware that local laws may take priority over the above mentioned requirements. If in doubt, consult Respironics.**

WARNING: **It is the responsibility of the end user to validate the compatibility and use of information transmitted from the ventilator to the device to be connected to the ventilator.**

WARNING: **The data provided through the communications interface is for reference only. Decisions for patient care should be based on the clinician's observations of the patient.**

WARNING: **To prevent possible patient injury due to nonannunciating alarms, verify the operation of any remote alarm device before use.**

WARNING: **To ensure the functionality of the remote alarm, connect only Respironics-approved cables to the remote alarm port.**

CAUTION: The remote alarm port is intended to connect only to an SELV (safety extra-low voltage and ungrounded system with basic insulation to ground), in accordance with IEC 60601-1. To prevent damage to the remote alarm, make sure the signal input does not exceed the maximum rating of 24 VAC or 36 VDC at 500 mA with a minimum current of 1 mA.

Diagnostic mode

WARNING: **To prevent possible patient injury, do not enter the diagnostic mode while a patient is connected to the ventilator. Verify that the patient is disconnected before proceeding.**

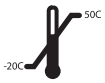
Chapter 2. Symbols

Refer to these tables to interpret symbols used on the ventilator labels and packaging and on the ventilator screen. To interpret symbols pertaining to accessories, refer to their instructions for use.

Symbol	Description
	Warning: Risk of explosion. Do not use in the presence of flammable anesthetics.
	Attention, consult the accompanying documents.
	Read the user manual before using the ventilator.
	Protective earth (ground)
	Type B applied part, which is equipment that provides a particular degree of protection against electric shock, particularly in regard to allowable leakage current and of the protective earth connection
	Requires alternating current (AC)
IPX1	Degree of fluid ingress protection provided by the enclosure (drip-proof)
	Alarm and remote alarm
	Two states of control: ON and Shutdown
	Battery
CE 0086	European Conformity
	Date of manufacture
	Manufacturer

Symbols

Symbol	Description
RS-232	RS-232 serial input/output
	USB port
	Oxygen
	Ethernet connection
	Accept button on the navigation ring
	Adjustment direction on the navigation ring
	Canadian Standards Association approval
	Do not disassemble. Refer to Respironics-authorized service personnel.
	Product must be disposed of in accordance with the WEEE directive.
	Noninvasive ventilation (patient with mask)
	Invasive ventilation (intubated patient)
	Do not block the cooling fan Inlet (at the rear of the ventilator).
 (On power cord)	Hospital-grade

Symbol	Description
	This side up
	Recycle
	Fragile
	Keep dry
	Do not stack > 3 high
	Do not stack > 7 high
	Limit temperature to between -20 and 50 ºC (-4 and 122 ºF)
	Hazmat class 9
	Fire hazard
	uR UL recognition symbol
	Battery option

Symbols

Symbol	Description
	Alarm (audible)
	Alarm is silenced
	Alarm
	Alarm reset
	Informational message
	Alarm message is displayed. Touch to hide alarm messages.
	Alarm message is hidden. Touch to display alarm messages.
	Increase and decrease (adjustment arrow) buttons. Adjusts a setting or selects a value.
	Accept button. Accepts set values.
	Cancel button. Cancels set values.
	Ventilator is powered by AC power the optional battery is installed.
	Ventilator is powered by AC power the optional battery is not installed.
	Ventilator is powered by the battery. This symbol shows the approximate battery time remaining in hours and minutes, and it shows the capacity graphically.
	Help button. Touch to display onscreen help information.

Symbol	Description
	Vertical autoscale button. Autoscales the Y axis of the graphs to fit the data currently displayed.
	Pause button. Freezes waveforms in the Waveform window.
	Pause in progress
	Resume button. Resumes all waveform graphs from a paused state.
	Time base adjust button. Rescales the X axis of the graph display data at 3, 6, 12, and 24 second increments.
$\dot{V}_E$	Estimated minute ventilation
V_T	Estimated exhaled tidal volume
T_I/T_{TOT}	Duty cycle. Inspiratory time divided by total cycle time.
	No valid data to display
	Data is under range
	Data is over range
	Pressure, centimeters of water
	Flow, liters per minute. BTPS compensated.
	Volume, milliliters
	User-set Ramp Time. Ramp graphic fills in as Ramp Time progresses.

Symbol	Description
	Ramp Time is OFF (no ramp time set).
	Intentional leak. The number corresponds to the leak symbol printed on Respironics masks.

Chapter 3. General information

Intended use

The Respironics V60 Ventilator is an assist ventilator and is intended to augment patient breathing. It is intended for spontaneously breathing individuals who require mechanical ventilation: patients with respiratory failure, chronic respiratory insufficiency, or obstructive sleep apnea in a hospital or other institutional settings under the direction of a physician.

The ventilator is intended to support pediatric patients weighing 20 kg (44 lb) or greater to adult patients. It is also intended for intubated patients meeting the same selection criteria as the noninvasive applications. The ventilator is intended to be used by qualified medical professionals, such as physicians, nurses, and respiratory therapists. The ventilator is intended to be used only with various combinations of Respironics-recommended patient circuits, interfaces (masks), humidifiers, and other accessories.

About CO_2 rebreathing

As with mask ventilation in general, patient CO_2 rebreathing may occur under some circumstances. Follow these guidelines to minimize the potential for CO_2 rebreathing. If rebreathing is a significant concern for a particular patient and these guidelines are not sufficient to acceptably reduce the potential for CO_2 rebreathing, consider an alternative means of ventilation.

- Increase EPAP to decrease the potential for CO_2 rebreathing. Higher pressures produce more flow through the exhalation port, which helps to purge all CO_2 from the circuit to prevent rebreathing.
- Be aware that the potential for CO_2 rebreathing increases as inspiratory time increases. A longer inspiratory time decreases exhalation time, allowing less CO_2 to be purged from the circuit before the next cycle. In such circumstances, higher tidal volumes further increase the volume of CO_2 rebreathed by the patient.

Potential side effects

Advise the patient to immediately report any unusual chest discomfort, shortness of breath, or severe headache. Other potential side effects of noninvasive positive pressure ventilation include: ear discomfort, conjunctivitis, skin abrasions due to mask/patient interface, and gastric distention (aerophagia). If skin irritation or breakdown develops from the use of the mask, refer to the accompanying mask instructions for appropriate action.

Contraindications

The Respironics V60 Ventilator is contraindicated for patients with any of the following conditions:

- Lack of spontaneous respiratory drive
- Inability to maintain a patent airway or adequately clear secretions
- At risk for aspiration of gastric contents
- Acute sinusitis or otitis media
- Hypotension
- Untreated pertussis
- Epistaxis (nosebleed)

General description

The Respironics V60 Ventilator (Figure 3-1) is a microprocessor-controlled, bilevel positive airway pressure (BiPAP) ventilatory assist system that provides noninvasive positive pressure ventilation (NPPV) and invasive ventilatory support for spontaneously breathing adult and pediatric patients.

Ventilation modes. The ventilator offers a range of conventional pressure modes, CPAP (continuous positive airway pressure), PCV (pressure-controlled ventilation), and S/T (spontaneous/timed). The volume-targeted AVAPS (average volume-assured pressure support) mode combines the attributes of pressure-controlled and volume-targeted ventilation.

Auto-Trak Sensitivity allows the ventilator to automatically compensate for unintentional leaks by maintaining a stable baseline and adjusting trigger and cycle thresholds for optimum patient-to-ventilator synchrony.

User interface. The ventilator's ergonomic design, including a 12.1-inch (31-cm) color touchscreen, a navigation ring, and key panel, lets you easily access ventilator settings and monitored parameters.

Monitoring. The ventilator displays monitored parameters as numbers and as real-time waveforms (curves or scalars).

Alarms. The ventilator's operator-adjustable and nonadjustable alarms help ensure the patient's safety.

Power and gas supplies. The ventilator uses as its primary power source AC mains. An optional internal backup battery powers the ventilator typically for 6 hours.

The ventilator uses high-pressure oxygen. An integral blower pressurizes gas for delivery to the patient.

Mounting. The ventilator can be mounted to the universal stand. When equipped with the optional cylinder holder, the stand can accommodate two E-size oxygen cylinders.

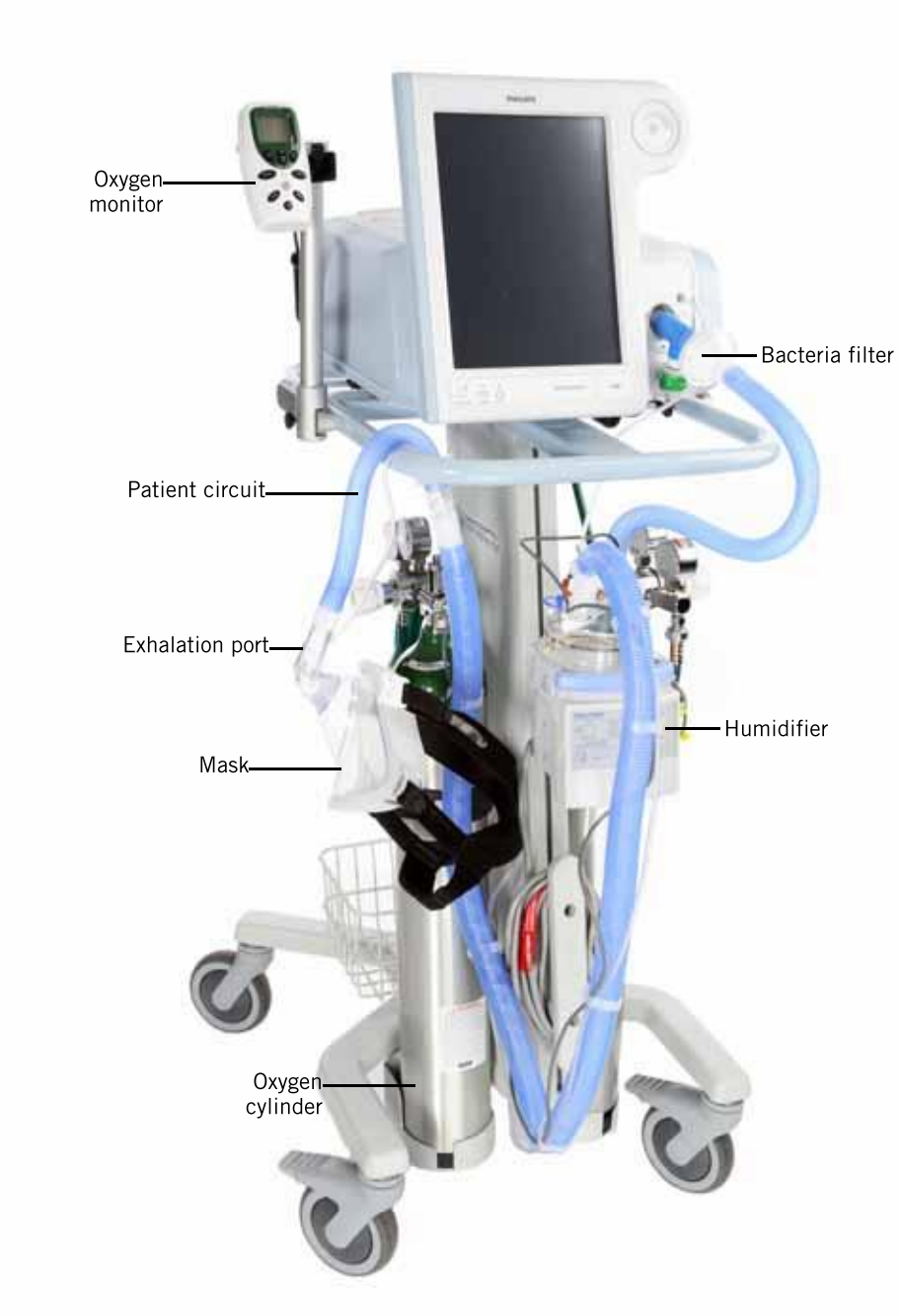
Communications interface. The ventilator can output data through the RS-232 serial port upon receiving a command from a host computer or bedside monitoring system. The ventilator is equipped with a remote alarm/nurse call connection to activate alarms remotely.

Upgradability via Respironics Respi-Link remote diagnostic system. The Respi-Link interface permits software upgrade and remote troubleshooting of the ventilator through the RS-232 port.

Physical description

Patient circuits, masks/patient interfaces, and accessories

Figure 3-2 shows the Respironics V60 Ventilator with its patient circuit and accessories. Table 3-1 on page 3-5 lists recommended patient circuits, masks/patient interfaces, and other accessories for use with the ventilator. Appendix D provides ordering information for Respironics parts and accessories.



Part	Use...
Patient circuit	Single-limb patient circuit intended for noninvasive or invasive ventilation. To minimize turbulence, we recommend that you use smooth-bore tubing. Use a Respironics circuit listed in Appendix D or the equivalent.
Patient interface (noninvasive or invasive)	• Respironics masks listed in Appendix D • Invasive interface (tracheostomy or ET tube)
Exhalation port	Respironics exhalation port listed in Appendix D or the equivalent
Inspiratory filter	Respironics main flow (inspiratory) bacteria filter listed in Appendix D or the equivalent
Humidifier	• Fisher & Paykel MR810 or MR850 • Hudson RCI CONCHATHERM or CONCHATHERM Neptune
Oxygen monitor	• CRITERION OxiCheck oxygen analyzer (PN 8-100661-00) • Teledyne MX300 oxygen monitor • An equivalent that complies with ISO 7767

Ventilator unit

Figure 3-3 through Figure 3-5 show the controls, indicators, and other important parts of the ventilator unit.

Key panel

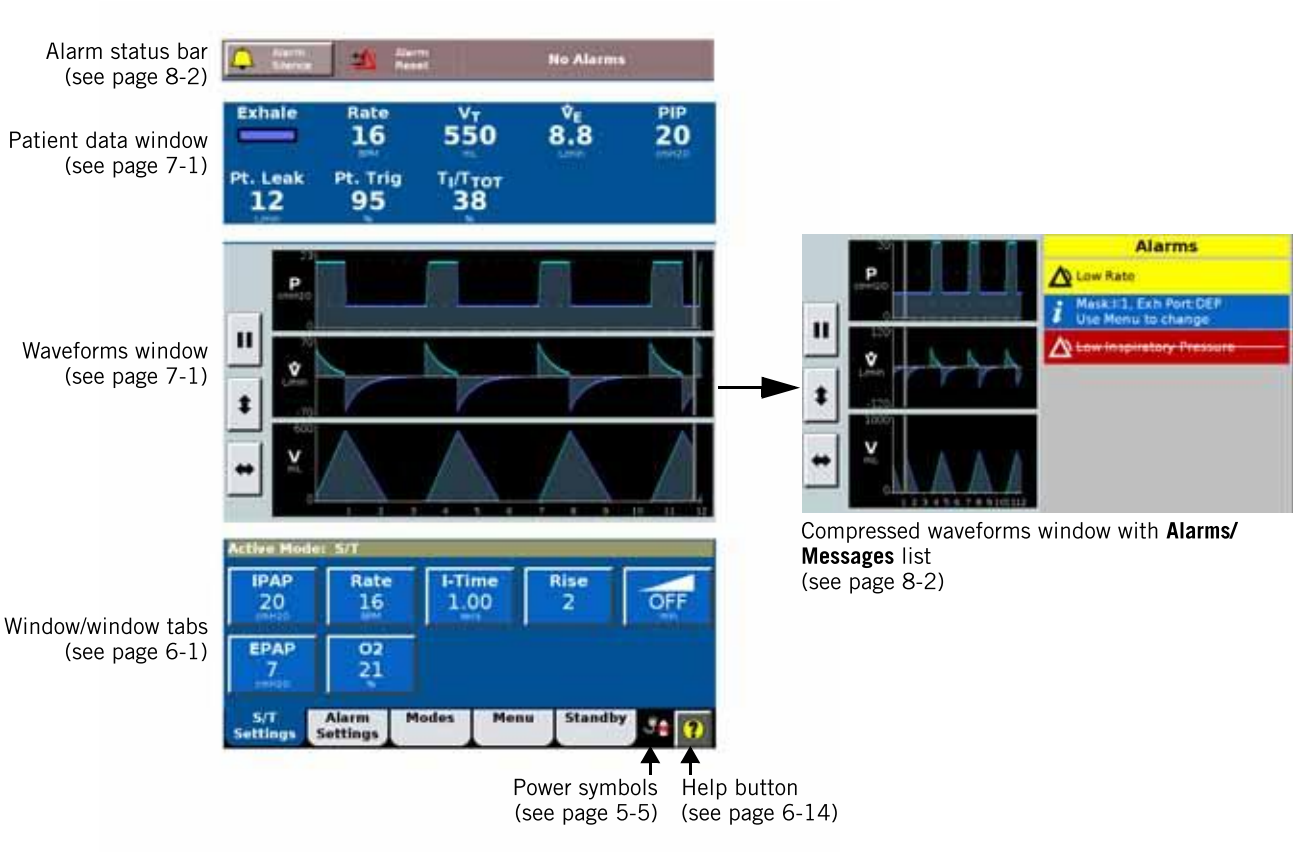
Number	Description
1	**Graphical user interface.** Color LCD (liquid crystal display) with touchscreen.
2	**Navigation ring.** Lets you adjust values and navigate the graphical user interface by rotating the finger on its touchpad.
3	**Accept button.** Activates selections.
4	**Proximal pressure port.** Connection for tubing that monitors patient pressure in the patient circuit.
5	**Ventilator outlet (To patient) port.** Main connection for the patient circuit. Delivers air and oxygen in prescribed pressures to the patient.
6	**Alarm speakers** (beneath ventilator)
7	**Alarm LED.** Flashes during a high-priority alarm. On continuously during a ventilator inoperative condition.
8	**Battery (charged) LED.** Flashes when battery is charging. On continuously when battery is charged. Off when ventilator is running on battery or when the ventilator is off and AC power is not connected.
9	**ON/Shutdown key with LED.** Turns on AC power and initiates ventilator shutdown. LED is continuously on when AC power is connected.

Number	Description
1	**Ventilation vents.** Allow intake of air for delivery to the patient.
2	**Air inlet filter** (under side panel). Filters the air for delivery to the patient.

Number	Description
1	**Backup battery (compartment under side panel).** Optional, 6-hour backup battery.
2	**Remote alarm/nurse call connector**
3	**Reserved for future use**
4	**Power cord retainer**
5	**Power cord**
6	**RS-232 serial and analog I/O connector (female DB-25).** Connects to hospital information systems and other serial devices, and functions as an interface for analog signals. Connects Respi-Link remote diagnostic system gateway for software updates.
7	**Cooling fan filter**
8	**High-pressure oxygen inlet connector**
9	**Option labels**

Graphical user interface

Through the graphical user interface (Figure 3-6) you make ventilator settings and view ventilator and patient data. During ventilation, the upper screen displays alarms and patient data. The middle screen displays real-time waveforms and alarm and informational messages. The lower screen lets you access modes and other ventilator settings, display help information, and see the power status.



Chapter 4. Principles of operation

System operational overview

The Respironics V60 Ventilator is a microprocessor-controlled pneumatic system that delivers a mixture of air and oxygen. It is powered by AC with optional battery backup to protect against power failure or unstable power and to facilitate intrahospital transport. The ventilator's pneumatics deliver gas and its electrical systems control pneumatics, monitor the patient, and distribute power.

The user provides inputs to the ventilator through a touchscreen, keys, and a navigation ring. These inputs become instructions for the pneumatics to deliver a precisely controlled gas mixture to the patient. Pressure and flow sensors provide feedback, which is used to adjust gas delivery to the patient. Monitored data based on sensor inputs is also displayed by the graphical user interface.

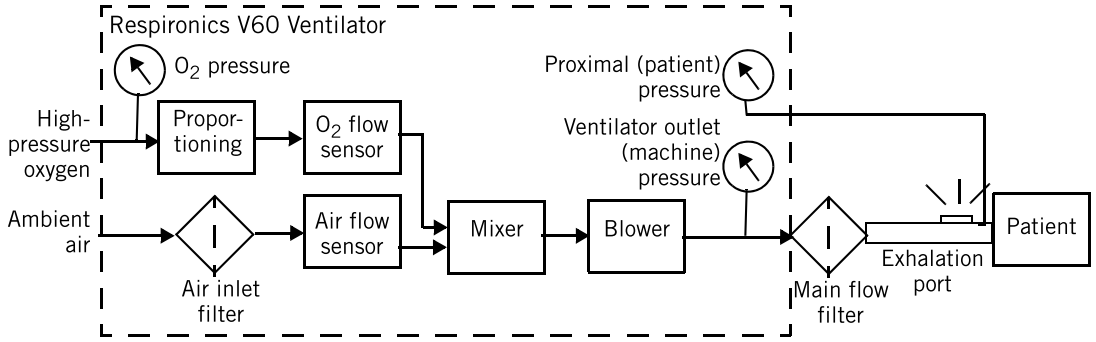
The ventilator's gas delivery and monitoring functions are cross-checked. This cross-checking helps prevent simultaneous failure of these two main functions and minimizes the possible hazards of system failure.

A comprehensive system of visual and audible alarms helps ensure the patient's safety. Clinical alarms can indicate an abnormal physiological condition. Technical alarms, triggered by the ventilator's self-tests, can indicate a hardware or software failure. In the case of some technical alarms, limited ventilation is provided to give the user time for corrective actions. When a condition is critical enough to possibly compromise safe ventilation, the ventilator is placed into the ventilator inoperative state, in which oxygen flow and blower operation are disabled.

The ventilator has several means to ensure that safe patient or respiratory pressures are maintained. The maximum working pressure is ensured by the high inspiratory pressure (HIP) alarm limit. If the set high pressure limit is reached, the ventilator cycles into exhalation.

Pneumatic system operation

The ventilator uses ambient air and high-pressure oxygen (Figure 4-1). Air enters through an inlet filter. Oxygen enters though a high-pressure inlet, and a proportioning valve provides the operator-set concentration. The system mixes the air and oxygen, pressurizes it in the blower, and then regulates it to the user-set pressure. To do this, the ventilator compares the proximal (patient) pressure measurement with the ventilator outlet (machine) pressure, and adjusts the machine pressure to compensate for the pressure drop across the inspiratory filter, patient circuit, and humidifier. This helps ensure accurate and responsive pressure delivery and leak compensation.



The ventilator delivers gas to the patient through a main flow (inspiratory) bacteria filter, a single-limb patient breathing circuit, a humidification device (optional) and a patient interface such as a mask or ET tube. A pressure tap proximal to the patient is used to monitor patient pressure. The exhalation port continually exhausts gas from the circuit during inspiration and exhalation to minimize rebreathing and ensure CO_2 removal.

Breath delivery characteristics

Control variable

Breaths delivered by the Respironics V60 Ventilator are pressure controlled. In the AVAPS mode, the ventilator's applied pressure is automatically adjusted over several breaths to maintain a target tidal volume.

Triggering, cycling, and leak adaptation

Unlike other ventilators, the Respironics V60 Ventilator does not require you to set triggering and cycling sensitivity or to adjust baseline flow.The ventilator's unique Auto-Trak Sensitivity algorithm adjusts these automatically; see "Auto-Trak Sensitivity" on page 4-3.

Baseline pressure

A positive baseline pressure (EPAP or CPAP) may be set for all breaths in all modes.

Pressure rise time

The operator-set **Rise Time** defines the time required for inspiratory pressure to rise to the set (target) pressure.

Negative pressures

There are no negative pressures generated during exhalation.

Oxygen concentration

The Respironics V60 Ventilator incorporates an oxygen mixer. Oxygen concentration can be set in all modes.

Auto-Trak Sensitivity

An important characteristic of the Respironics V60 Ventilator is its ability to recognize and compensate for unintentional leaks in the system and to automatically adjust its triggering and cycling algorithms to maintain optimum performance in the presence of leaks. This is called Auto-Trak Sensitivity. The following subsections describe this function in detail.

Triggering

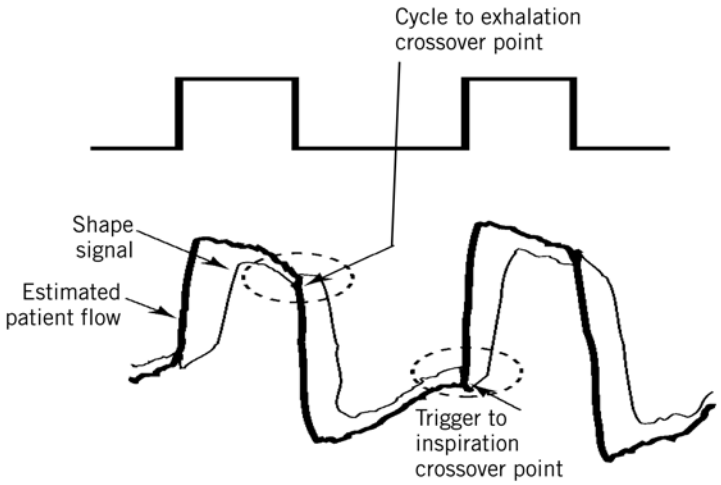
Breaths are patient (flow) triggered in all modes, typically when patient effort causes a certain volume of gas to accumulate above baseline flow (volume method). An inspiration is also triggered when the patient inspiratory effort distorts the expiratory flow waveform sufficiently (shape signal method; see page 4-4).

Cycling

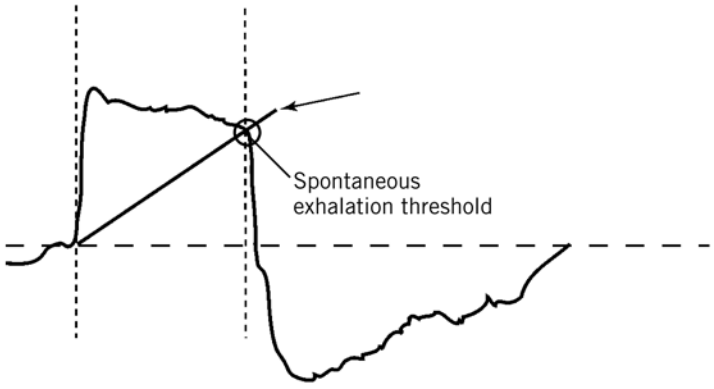
Cycling to exhalation occurs in these cases:

- Patient expiratory effort distorts the inspiratory flow waveform sufficiently (shape signal method). See “Shape signal method of cycling and triggering.” on page 4-4.
- Patient flow reaches the spontaneous exhalation threshold (SET). See “SET method of cycling.” on page 4-4.
- After 3 seconds at the IPAP level (timed backup safety mechanism)
- When a flow reversal occurs, typically due to a mask or mouth leak

Shape signal method of cycling and triggering. The shape signal or "shadow trigger" method uses a mathematical model derived from the flow signal. A new flow signal (shape signal) is generated by offsetting the signal from the actual flow and delaying it (Figure 4-2). This intentional delay causes the flow shape signal to be slightly behind the patient's flow signal. If there is a sudden change in patient flow, the patient's flow signal crosses the shape signal; this results in a trigger or a cycle. As a result, a sudden decrease in expiratory flow from an inspiratory effort will cross the shape signal and create a signal for ventilator triggering.



SET method of cycling. Patient flow reaches the spontaneous exhalation threshold (SET); see Figure 4-3. The SET represents the intersection of the flow waveform and a line of a given slope. SET is updated each breath.

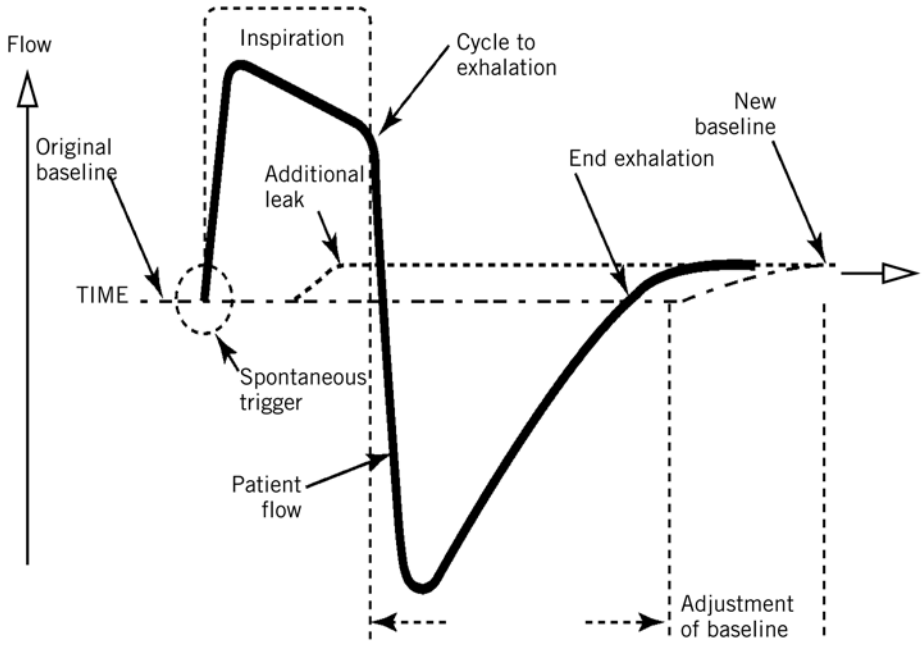


Leak adaptation

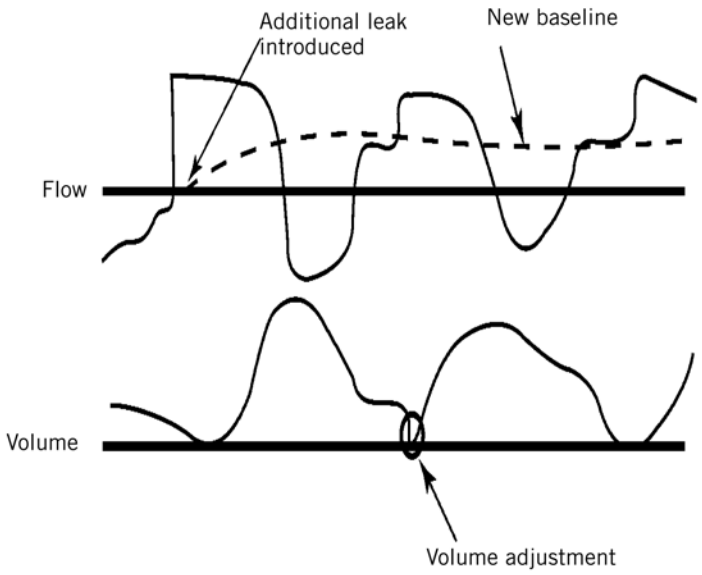
Noninvasive ventilation in particular may involve considerable leakage around the mask or through the mouth. Some leakage is known or : it is a characteristic of the mask/patient interface design. So that it can accurately adjust its baseline flow, the ventilator has you enter the intentional leakage value specific to the mask/patient interface (“Selecting the mask and exhalation port” on page 6-7). Other leakage is unpredictable or , and it changes as the patient’s breathing pattern changes.

To maintain prescribed pressures in the presence of leakage, the ventilator adjusts its baseline flow. Because the unintentional part of the leakage may constantly change, the ventilator recalculates the baseline flow each breath at the end of exhalation. The ventilator uses two main mechanisms to update its baseline flow: expiratory flow adjustment and tidal volume adjustment.

Expiratory flow adjustment. Every breath, at end-exhalation, the ventilator updates its flow baseline. At end-exhalation patient flow is assumed to be zero, so any difference between actual patient flow and the original baseline flow indicates a change in leakage. Figure 4-4 shows how the ventilator adjusts the baseline.



Tidal volume adjustment. Every breath, the ventilator compares the inspiratory and expiratory tidal volumes. Any difference is assumed to be due to an unintentional circuit leak. The ventilator adjusts the baseline to reduce this tidal volume difference for the next breath. Figure 4-5 shows how the ventilator adjusts the baseline.



Ventilation modes

The Respironics V60 Ventilator operates in the following ventilation modes:

- CPAP (continuous positive airway pressure) mode
- S/T (spontaneous/timed) mode
- PCV (pressure-controlled ventilation) mode
- AVAPS (average volume-assured pressure support) mode (optional)

Table 4-1 summarizes the characteristics of these modes. Note that on the ventilator, the **Timed** breath indicator means the breath is ventilator triggered, while the **Spont** breath indicator means the breath is patient triggered.

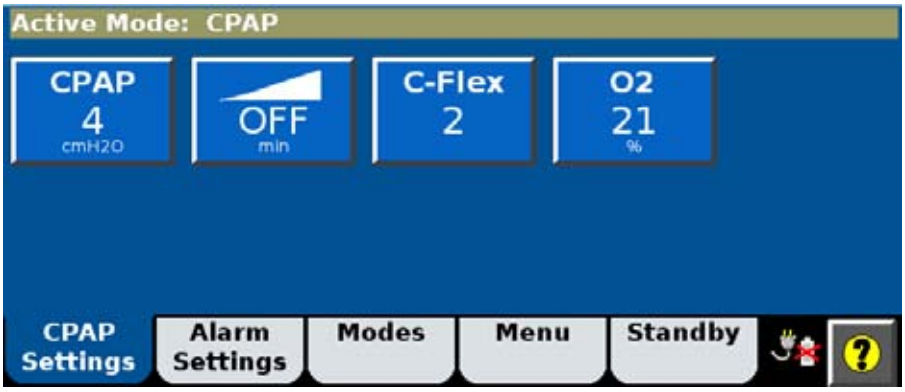
	Mandatory breaths			Spontaneous breaths		
Mode	**Trigger***	**Limit†**	**Cycle‡**	**Trigger**	**Limit**	**Cycle**
CPAP	N/A	N/A	N/A	Auto-Trak	Pressure	Auto-Trak
PCV	Time, Auto-Trak	Pressure	Time	N/A	N/A	N/A
S/T	Time, Auto-Trak	Pressure	Time	Auto-Trak	Pressure	Auto-Trak
AVAPS	Time, Auto-Trak	Pressure	Time, Auto-Trak	Auto-Trak	Pressure	Auto-Trak

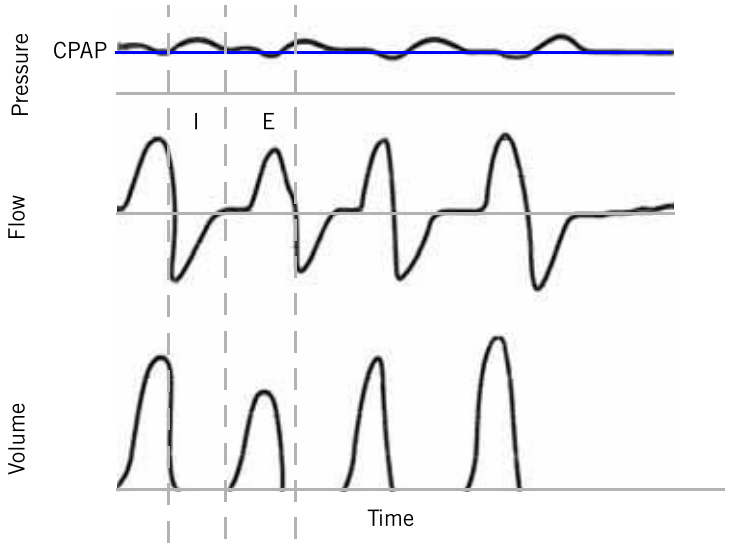
* A trigger variable starts inspiration.
† A limit variable can reach and maintain a preset level inspiration ends but it does not end inspiration.
‡ A cycle variable is a measured parameter used to end inspiration.

CPAP mode

In the CPAP (continuous positive airway pressure) mode, the ventilator functions as a demand flow system, with the patient triggering all breaths and determining their timing, pressure, and size. You set no triggering or cycling sensitivities: the patient triggers and cycles based on the ventilator's Auto-Trak Sensitivity algorithms. The control settings active in the CPAP mode are shown in Figure 4-6. Figure 4-7 shows CPAP mode waveforms.

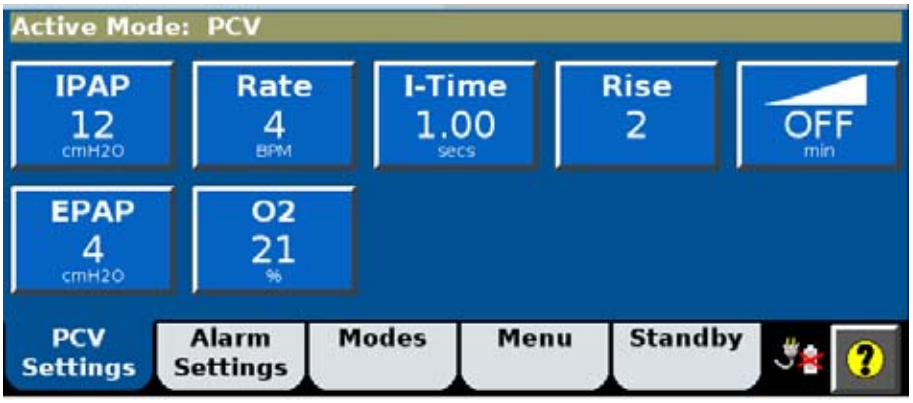
The optional C-Flex setting enhances traditional CPAP by reducing the pressure at the beginning of exhalation – a time when patients may be uncomfortable with CPAP – and returning it to the set CPAP level before the end of exhalation.

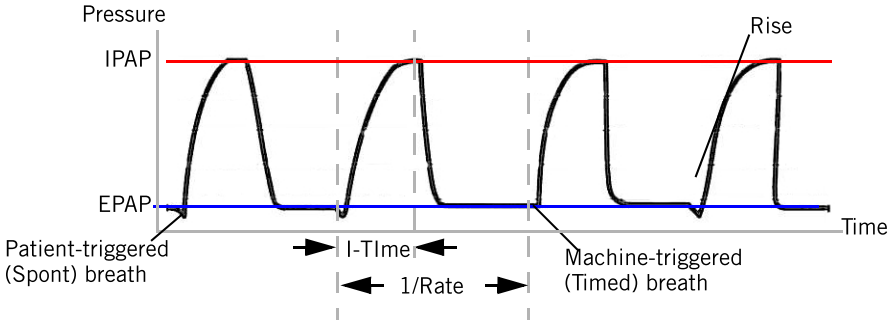




PCV mode

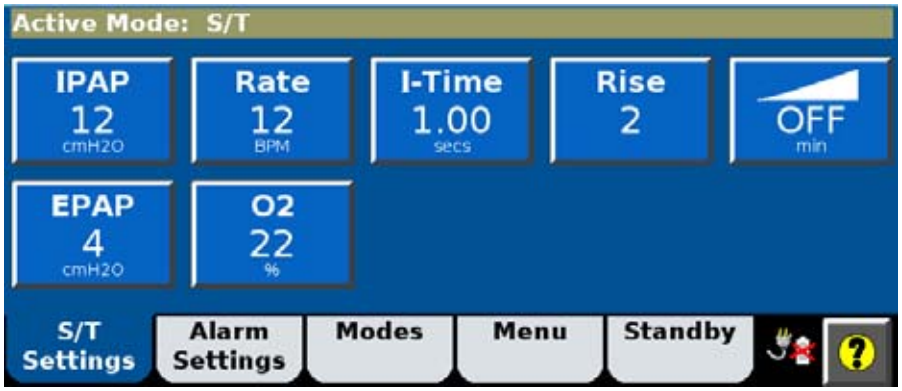
The PCV (pressure-controlled ventilation) mode delivers pressure-controlled mandatory breaths, either triggered by the ventilator (Timed) or the patient (Spont). You set no triggering sensitivity: the patient trigger is based on the ventilator's Auto-Trak Sensitivity algorithms. The control settings active in the PCV mode are shown in Figure 4-8. The IPAP setting defines the applied pressure for all breaths. Rate and I-Time define the breath timing for all breaths. You set no triggering or cycling thresholds: the ventilator's Auto-Trak Sensitivity algorithms automatically determine when to trigger and cycle based on patient efforts. Figure 4-9 shows a PCV mode pressure waveform.

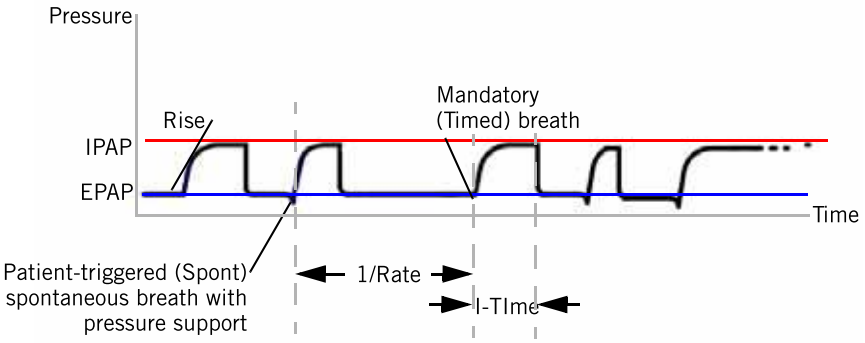




S/T mode

The S/T (spontaneous/timed) mode guarantees breath delivery at the user-set rate. It delivers pressure-controlled, time-cycled mandatory and pressure-supported spontaneous breaths, all at the IPAP pressure level. If the patient fails to trigger a breath within the interval determined by the Rate setting, the ventilator triggers a mandatory breath with the set I-Time. You set no patient triggering or cycling sensitivities: the patient triggers and cycles based on the ventilator's Auto-Trak Sensitivity algorithms. The control settings active in the S/T mode are shown in Figure 4-10. Figure 4-11 shows an S/T mode pressure waveform.





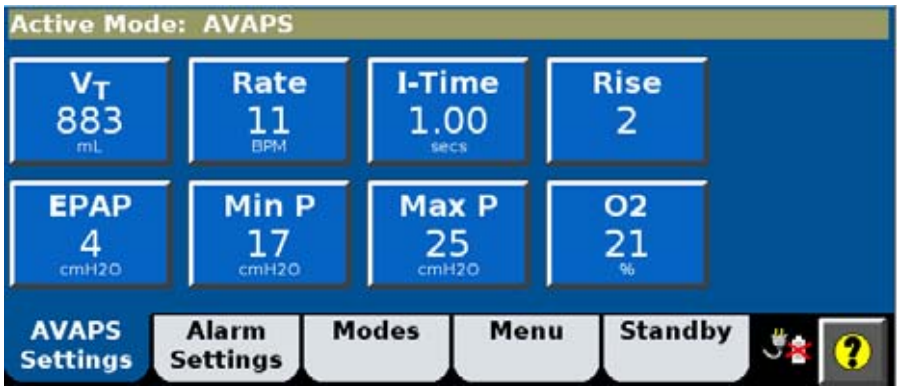
AVAPS mode (optional)

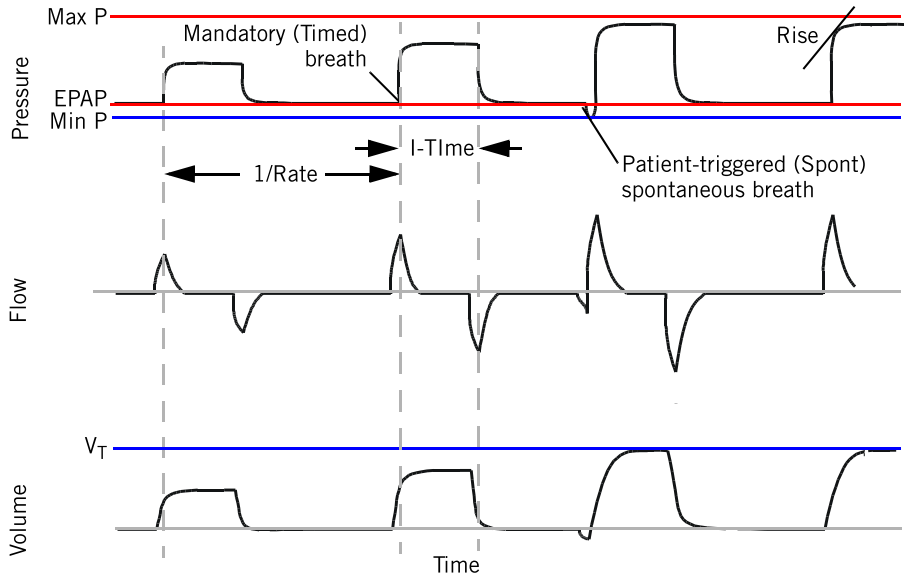
NOTE: When you adjust AVAPS minimum and maximum pressures, remember that IPAP is adjusted to meet the target value. If the calculated target pressure is outside of the minimum and maximum pressure range, the target volume will not be achieved.

Unlike most pressure modes, the AVAPS (average volume-assured pressure support) mode delivers a target tidal volume. It achieves the target volume by regulating the pressure applied following an initial pressure ramp-up. The AVAPS mode delivers time-cycled mandatory breaths and pressure-supported spontaneous breaths.

If the patient fails to trigger a breath within the interval determined by the Rate control, the ventilator triggers a mandatory breath with the set I-Time. Mandatory and spontaneous breaths are delivered at a pressure that is continually adjusted over a period of time to achieve the volume target, V_T. Min P and Max P define the minimum and maximum pressures that can be applied. You set no patient triggering or cycling sensitivities: the patient triggers and cycles based on the ventilator's Auto-Trak Sensitivity algorithms.

The control settings active in the AVAPS mode are shown in Figure 4-12. Figure 4-13 shows AVAPS mode waveforms.




Max P
Mandatory (Timed)
breath
Rise
Pressure
EPAP
Min P
I-TIme
1/Rate
Patient-triggered (Spont)
spontaneous breath
Flow
V_T
Volume
Time

Chapter 5. Preparing for ventilation

Set up the ventilator for each patient use as described in this chapter. For first-time installation, refer to Appendix A.

Connecting external devices

You can connect the ventilator to a remote alarm (nurse call) device and a patient monitor or other external device. See Appendix B for details.

Connecting oxygen

WARNING: Connect the ventilator to an appropriate medical-grade oxygen source only. The source must be able to deliver 100% oxygen regulated to 276 to 600 kPa (40 to 87 psig).

WARNING: To ensure accuracy of oxygen administration and to monitor for the presence of contamination (incorrect gas connected), use an external oxygen monitor to verify the oxygen concentration in the delivered gas.

WARNING: To reduce the risk of fire, do not use a high-pressure oxygen hose that is worn or contaminated with combustible materials like grease or oil.

WARNING: To reduce patient risk of hypoxemia, keep free-flowing oxygen away from air inlet of ventilator.

WARNING: Always check the status of the oxygen cylinders before using the ventilator during transport.

CAUTION: To prevent possible damage to the ventilator, ensure that the connection to the oxygen supply is clean and unlubricated, and that there is no water in the oxygen supply gas.

NOTE: To avoid depleting the cylinders, close the cylinder valves when using the wall oxygen supply.

Connect the oxygen hose to the ventilator's oxygen inlet connector (Figure 5-1) or to the oxygen manifold, if applicable.

Installing the patient circuit

WARNING: **To reduce the risk of strangulation from patient tubing, use a tubing support arm and secure the proximal pressure line with clips.**

WARNING: **To prevent possible patient injury and possible water damage to the ventilator, make sure the humidifier is set to appropriate temperature and humidification settings.**

WARNING: **To prevent possible patient injury and equipment damage, do not turn the humidifier on until the gas flow has started and is regulated. Starting the heater or leaving it on without gas flow for prolonged periods may result in heat build-up, causing a bolus of hot air to be delivered to the patient. Circuit tubing may melt under these conditions. Turn the heater power switch off before stopping gas flow.**

WARNING: **To reduce the risk that the patient will aspirate condensed water from the breathing circuit, position any humidifier lower than both the ventilator and the patient.**

WARNING: **To reduce the risk of fire, use only patient circuits intended for use in oxygen-enriched environments. Do not use antistatic or electrically conductive tubing.**

WARNING: **To prevent patient or ventilator contamination, we recommend you use a Respironics-approved main flow bacteria filter on the patient gas outlet port. Filters not approved by Respironics may degrade system performance.**

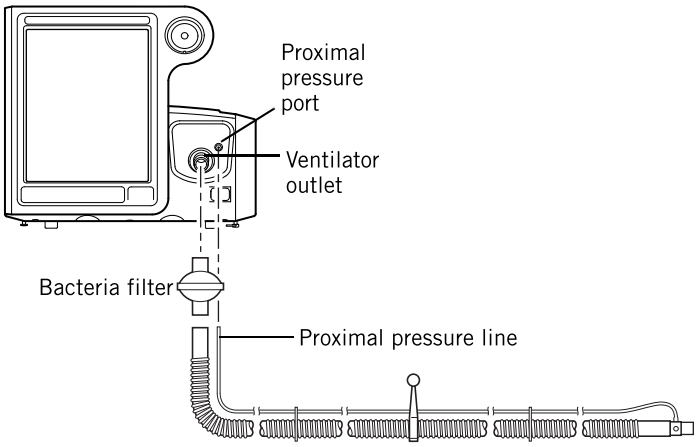
WARNING: **To reduce the risk of bacterial contamination or damage, handle bacteria filters with care.**

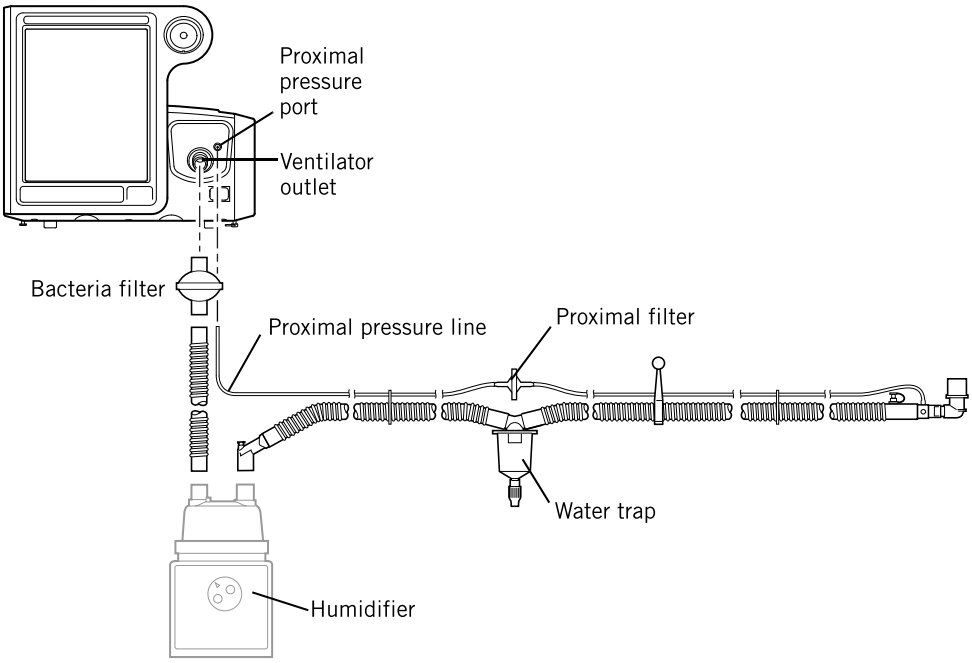
WARNING: **Any additional accessories in the patient circuit may substantially increase flow resistance and impair ventilation.**

Install the patient circuit as follows. For a complete list of compatible parts and accessories offered by Respironics, see “Parts and accessories” on page D-1.

1. Assemble the patient circuit, including the main flow (inspiratory) bacteria filter, proximal pressure line, and humidifier (if desired). Figure 5-2 and Figure 5-3 show circuit configurations for noninvasive

and invasive ventilation. Follow the manufacturers' instructions for use for the individual parts, including the humidifier.





2. Properly position the patient circuit after assembly. Make sure the tubing will not be pushed, pulled, or kinked during patient movement or other procedures.

Connecting to AC power

WARNING: To reduce the risk of electric shock, connect the ventilator to an AC supply mains with protective earth only.

WARNING: Do not use extension cords, adapters, or power cords with the ventilator that are not approved by Respironics.

WARNING: To prevent unintentional disconnection of the power cord, always use the correct, Respironics-supplied power cord and lock it into place with the power cord retainer before you switch the ventilator on. The retainer is designed to hold the connector end of the Respironics-supplied cord securely in place.

WARNING: To reduce the risk of electric shock, regularly inspect the AC power cord and verify that it is not frayed or cracked.

WARNING: To reduce the risk of strangulation, route the power cord to avoid entanglement.

CAUTION: For 120 V equipment, grounding reliability can only be achieved when it is connected to an equivalent receptacle marked “hospital only” or “hospital grade.”

Plug the power cord into a grounded outlet that supplies AC power between 100 and 240 V, 50/60 Hz.

Always check the reliability of the AC outlet. If you are using a 120 V outlet, make sure that it is hospital grade.

About the optional backup battery

WARNING: To reduce the risk of power failure, pay close attention to the battery’s charge level. The battery’s operation time is approximate and is affected by ventilator settings, discharge and recharge cycles, battery age, and ambient temperature. Battery charge is reduced at low ambient temperatures or in situations where the alarm is continuously sounding.

NOTE: The backup batteries are intended for short-term use only. They are not intended to be a primary power source.

NOTE: We recommend that the ventilator’s batteries be fully charged before you ventilate a patient. If the batteries are not fully charged and AC power fails, always pay close attention to the level of battery charge.

The optional internal backup battery protects the ventilator from low, or failure of, AC (mains) power. If AC power fails, the ventilator automatically switches to operation on backup battery with no interruption in ventilation. The battery powers the ventilator until AC power is again adequate or until the battery is depleted. The battery powers the ventilator typically for 6 hours.

As a safeguard, the ventilator provides a low battery alarm. It also has a capacitor-driven backup alarm that sounds for at least 2 minutes when battery power is completely lost.

The ventilator charges the battery whenever the ventilator is connected to AC, with or without the ventilator switched on. The Battery (charged) LED flashes to show that the battery is being charged.

Check the battery charge level before putting a patient on the ventilator and before unplugging the ventilator for transport or other purposes. The power source symbol at the bottom right-hand corner of the screen shows the power source in use and, if the ventilator is running on battery, the level of battery charge (Figure 5-4). If the battery is not fully charged, recharge it by connecting the ventilator to AC power for a minimum of 5 hours. Pressing the Help button shows you the time remaining until the battery is full. If the battery is not fully charged after this time, have the ventilator serviced.

ON/Shutdown LED

AC power is connected

Battery (charged) LED

Battery is charging

Battery is charged (90 to 100%)

Ventilator is running on battery, or the ventilator is off and AC power is not connected

Power source symbol

The ventilator is powered by AC and the battery is installed.

The ventilator is powered by AC and the battery is not installed.

The ventilator is powered by the battery. This symbol shows the approximate battery time remaining in hours and minutes, and it shows the capacity graphically.

Starting up the ventilator

NOTE: Upon power-on the ventilator automatically runs a test of the backup audible alarm followed by the primary audible alarm. You should hear two high-pitched tones, followed by a beep approximately 2 seconds later. If you do not hear all of these sounds, discontinue use of the ventilator and have it serviced.

1. Power on the ventilator with the **ON/Shutdown** key.
2. Run the preoperational check on page 5-8.

Shutting down the ventilator

Shut down the ventilator as follows:

1. Press and release the **ON/Shutdown** key. The **Shutdown** window opens.
2. Select **Ventilator Shutdown**. The ventilator shuts down.

NOTE: Improper shutdown may cause a **Power has been restored** message the next time the ventilator is turned on.

NOTE: If the screen is blank and the dialogue box cannot be displayed, shut down the ventilator by pressing the **ON/Shutdown key**, then the Accept button on the navigation ring.

Navigating the graphical user interface

Select a function by touching the desired tab or button on the touchscreen. Use this as the primary method to control the ventilator.

You can use the navigation ring as an alternative to the following touchscreen functions:

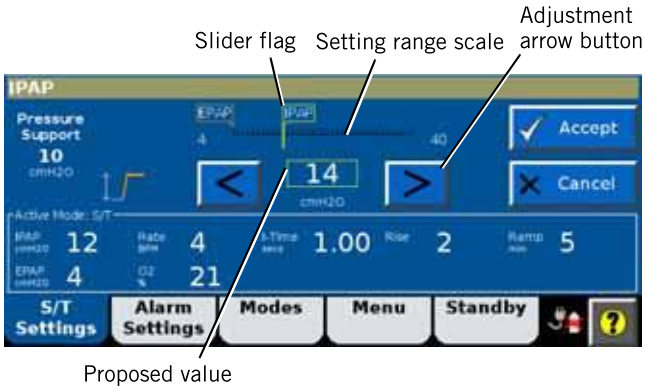
Touchscreen equivalent	Navigation ring equivalent
 Touch increase button (adjustment arrow)	Touch and rotate finger clockwise to increase value or move cursor forward
 Touch decrease button (adjustment arrow)	Touch and rotate finger counterclockwise to decrease value or move cursor backward
 Touch **Accept** button (applies selection)	 Press Accept (checkmark) button (applies selection)

After making selections and adjusting values, accept selections by pressing the circular Accept button (the checkmark) in the middle of the navigation ring to accept and apply the change.

To open a window, touch the window tab.

To cancel a function and close the window, either select **Cancel** or touch another window tab.

To adjust a parameter, touch the arrow buttons repeatedly or select the value with the navigation ring. The slider flag moves along the setting range scale. Select **Accept** to apply.



The navigation ring also lets you adjust the position of the cursor in the waveforms window while the screen is frozen. See “Freezing and unfreezing waveforms” on page 7-3 for more information.

Preoperational check

WARNING: To ensure the ventilator's safe operation, always run the full preoperational check described in "Preoperational check" on page 5-8 before using the ventilator on a patient. If the ventilator fails any tests, remove it from clinical use immediately. Do not use the ventilator until necessary repairs are completed and all tests have passed.

WARNING: To prevent possible patient injury, disconnect the patient from the ventilator before running the preoperational check. Make sure another source of ventilatory support is available.

Before you connect a new patient to the ventilator, run the preoperational check to verify the ventilator's operation, including alarm functionality.

Required materials

To ensure that the ventilator also functions according to specifications on your patient, we recommend that your test circuit be equivalent to the circuit used for ventilation.

- Breathing circuit, PN 582073 or the equivalent
- 1-L test lung, PN 1021671 or the equivalent
- CRITERION OxiCheck oxygen analyzer (PN 8-100661-00), Teledyne MX300 oxygen monitor, or the equivalent

Procedure

Do or observe...	Verify...
1. Connect ventilator to AC power and the oxygen supply. Assemble the patient breathing circuit.	Breathing circuit is assembled correctly. See Figure 5-2 on page 5-3 or Figure 5-3 on page 5-3.
2. Switch on power.	You hear tones from both the backup alarm (high pitch) and the primary alarm (lower pitch).
3. Check active mask and exhalation port selection in **Messages** list. 	Displayed mask and exhalation port match ones in use (see "Selecting the mask and exhalation port" on page 6-7).
4. Set the mode to S/T and make the following control settings: Rate: 4 BPM, IPAP: 10 cmH_2O, EPAP: 6 cmH_2O, I-Time: 1 sec, Rise: 1, Ramp: Off, O_2: 21%. Make the following alarm settings: Hi Rate: 90 BPM, Lo Rate: 1 BPM, Hi V_T: 200 mL, Lo V_T: OFF, HIP: 50 cmH_2O, LIP: OFF, Lo V_E: OFF.	Test lung expands during inspiration and collapses during exhalation. There is a continuous flow of gas from the exhalation port.
5. Disconnect the proximal airway pressure line from the ventilator connector.	**Proximal Pressure Line Disconnect** alarm is annunciated (audio, visual, and flashing Alarm LED) by the ventilator and remote alarm, if connected.

Do or observe...	Verify...
6. Reconnect the proximal airway pressure line, and manually reset alarm.	**Proximal Pressure Line Disconnect** alarm is reset.
7. Set O_2 to 40%. Wait for oxygen concentration to stabilize.	Oxygen analyzer reads between 35 and 45%.
8. Disconnect the ventilator from AC power while the ventilator is running. NOTE: If the ventilator has a backup battery, the battery must be adequately charged to run this test. Recharge as necessary before running the test.	**If the optional backup battery is installed:** • The ventilator switches over to battery power (battery symbol in right-hand corner of screen is displayed). • The green LED above the ON/Shutdown key remains lit. • The audible alarm sounds intermittently. • **Running on Internal Battery** is shown. • The Battery LED is off. **If the optional backup battery is not installed:** • An alternating backup alarm tone sounds and the Alarm LED flashes for a minimum of 2 minutes.
9. If the backup battery is installed, reconnect the ventilator to AC power.	• The alarm resets. • The ventilator is again running on AC (symbol displayed in right-hand corner of screen). • The Battery LED flashes to indicate the battery is charging.
10. Return settings to hospital-standard values. **WARNING: To prevent possible patient injury, always return alarm settings to hospital-standard values after the preoperational check.**	

Troubleshooting

If any test step fails, discontinue ventilator use and contact Respironics.

Alarm tests

The ventilator performs a self-check during start-up and continuously during operation. Alarm functionality is verified by this self-check. You may also want to run alarm tests, which demonstrate the alarms' operation.

WARNING: To prevent possible patient injury, always return alarm settings to hospital-standard values after the preoperational check.

Preparation

1. Set the ventilator up as for normal ventilation, complete with breathing circuit (PN 582073 or the equivalent) and a 1-liter test lung assembly (PN 1021671).
2. Set the mode to S/T and make the following control settings: Rate: 4 BPM, IPAP: 10 cmH2O, EPAP: 6 cmH_2O, I-Time: 1 sec, Rise: 1, Ramp: Off, O_2: 21%.
3. Make the following alarm settings: Hi Rate: 90 BPM, Lo Rate: 1 BPM, Hi V_T: 200 mL, Lo V_T: OFF, HIP: 50 cmH_2O, LIP: OFF, Lo $\dot{V}_E$: OFF, LIP T: 5 secs.

High Inspiratory Pressure

1. Lower the HIP alarm limit to 8 cmH_2O.
2. VERIFY that the **High Inspiratory Pressure** alarm is activated, the ventilator cycles into exhalation, and pressure falls to 6 cmH_2O (the EPAP level).
3. Raise the HIP alarm limit to 15 cmH_2O.

Low Tidal Volume

1. Raise the Lo V_T alarm setting above the displayed, measured V_T.
2. VERIFY that the **Low Tidal Volume** alarm is activated.
3. Turn the Lo V_T alarm setting OFF.
4. VERIFY that the alarm resets.

Patient Disconnect

1. Disconnect the test lung.
2. VERIFY that the **Patient Disconnect** alarm is activated.
3. Reconnect the test lung.
4. VERIFY that the alarm resets and that the ventilator automatically resumes ventilation.

Patient Circuit Occluded

1. Disconnect the patient circuit (including bacteria filter) from the ventilator outlet, and block the ventilator outlet with your thumb.
2. VERIFY that the **Patient Circuit Occluded** alarm is activated.
3. Unblock the outlet, and reconnect the circuit.
4. VERIFY that the alarm resets.

Chapter 6. Operation

WARNING: **To ensure the ventilator's safe operation, always run the full preoperational check described in "Preoperational check" on page 5-8 before using the ventilator on a patient. If the ventilator fails any tests, remove it from clinical use immediately. Do not use the ventilator until necessary repairs are completed and all tests have passed.**

NOTE: Before operation, prepare the ventilator as instructed in Chapter 5.

After power-on, the ventilator starts up in the mode and with the settings that were active before last power down. Check these settings and adjust as required. You must be familiar with using the touchscreen and navigation ring to select, adjust, activate, and confirm parameters. For details, see "Navigating the graphical user interface" on page 5-7.

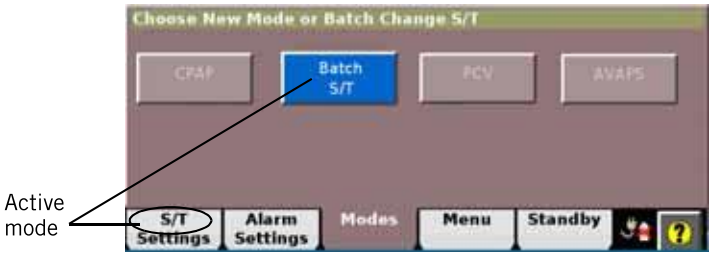
Access the ventilator setting windows from the tabs at the bottom of the screen.

page 6-3 page 6-6 page 6-2 page 6-11 page 6-12 page 6-14

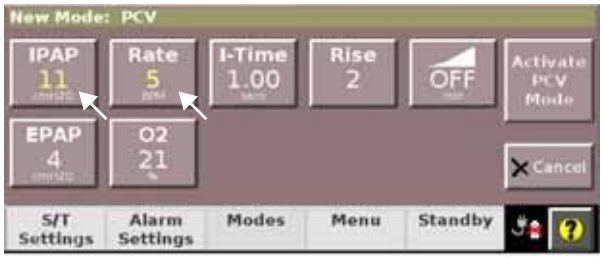
Changing the mode

The active ventilation mode is displayed in the bottom, left-hand corner of the screen. Change the mode as follows. For details on modes, see “Ventilation modes” on page 4-7.

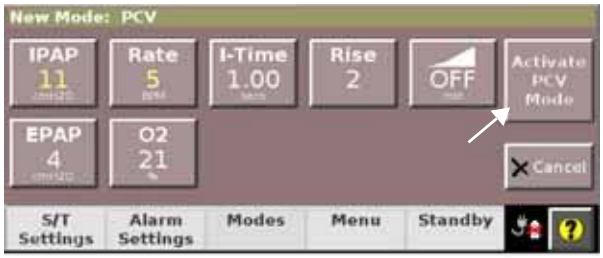
1. Open the **Modes** window.
2. Select the desired mode.



3. Adjust settings as desired (see “Changing individual ventilator settings” on page 6-4). Newly adjusted setting values are shown in yellow.



4. Select **Activate Mode** to apply.



Changing control settings

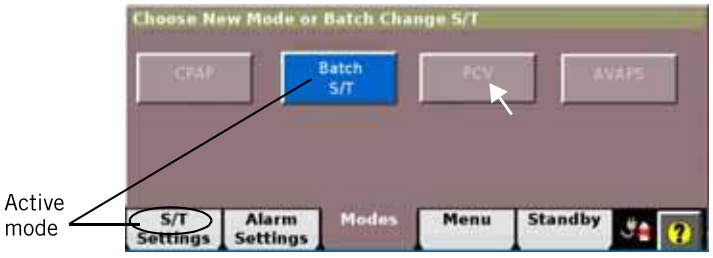
Table 6-3 on page 6-15 is an alphabetical list of the control settings with their ranges. Table 10-2 on page 10-2 shows the control settings applicable to the different modes. For more information on control settings as they apply in the different ventilation modes, see “Ventilation modes” on page 4-7.

Making batch setting changes

NOTE: During a batch setting change, you cannot change the Ramp Time setting when a ramp is active.

This process applies to ventilation settings only, not to alarm settings.

1. Open the **Modes** window.
2. Select the active mode.



3. Adjust settings as desired (see “Changing individual ventilator settings” on page 6-4). Newly adjusted setting values are shown in yellow.

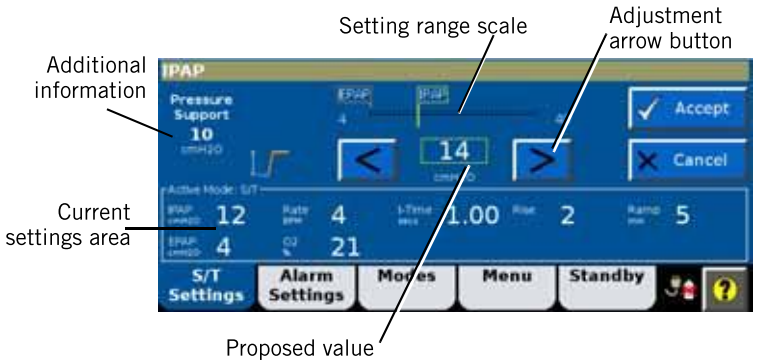
4. Select **Activate Batch Change** to apply.

Changing individual ventilator settings

You can make ventilator settings from the **Settings** window.

1. Open the **Settings** window.
2. Select the desired setting. As an example we will show the IPAP adjustment.

3. The setting window opens. Adjust the setting. Select **Accept** to apply.



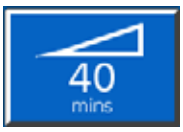
Using the Ramp Time function

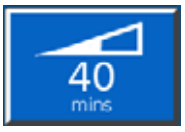
The Ramp Time function helps your patient adapt to ventilation by gradually increasing inspiratory and expiratory pressure (IPAP and EPAP/CPAP) from subtherapeutic to user-set pressures over a user-set interval. Table 6-3 on page 6-15 describes this function's principles of operation.

Follow these instructions to use the Ramp Time function:

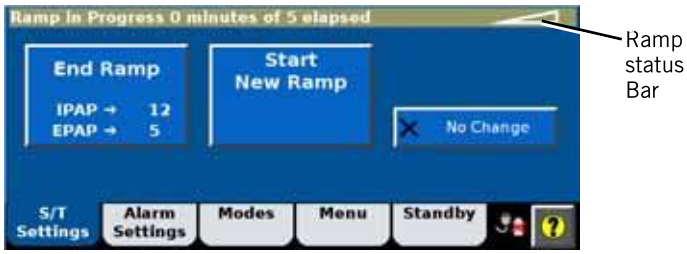
1. Select the **Ramp Time** button in the **Settings** window.

The ramp starts. As the ramp progresses, the **Ramp Time** button graphic fills in.





2. To change the ramp interval or to end the ramp, select the **Ramp Time** button again. The **Ramp in Progress** window opens.



3. To end the ramp and apply the full IPAP and EPAP/CPAP immediately, select **End Ramp**.

4. To end the ramp and start a new one, select **Start New Ramp**. The **Ramp Time** setting window opens again so that you can set up a new ramp.

Changing alarm settings

WARNING: To prevent possible patient injury, avoid setting alarm limits to extreme values, which can render the alarm system useless.

Some ventilator alarm settings are operator adjustable. You can adjust these at any time. Table 6-4 on page 6-17 lists the alarm settings and their ranges.

Review and adjust the alarm settings as follows:

1. Open the **Alarm Settings** window.

2. Select the desired setting, adjust it, and select **Accept** to apply.

The ventilator annunciates an alarm when a monitored value goes out of the range bounded by the alarm limits.

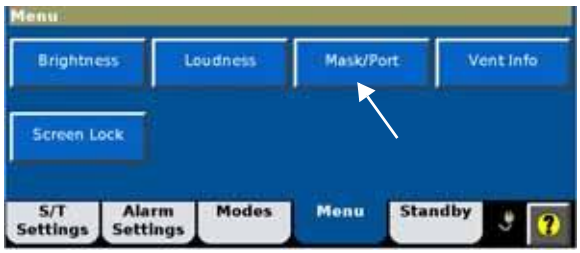
Selecting the mask and exhalation port

To be able to display full leakage data plus accurate tidal and minute volumes, the ventilator must know the intentional leak characteristics of the specific mask/patient interface and exhalation port.

After power-on, the **Messages** list displays the current mask and port settings for 5 minutes.

Change these settings as follows:

1. Open the **Menu** window.
2. Select **Mask/Port**.



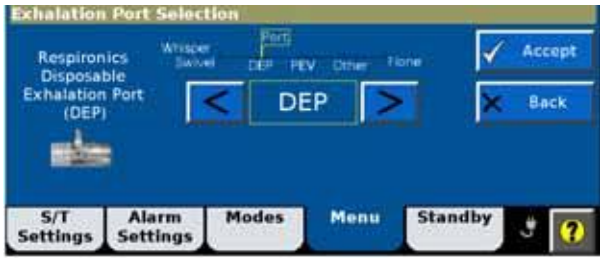
3. Select the desired mask/patient interface type (Table 6-1). Select **Accept** to apply.

For information concerning mask/port leak characteristics, see the instructions provided with each mask/port. See Appendix D for a complete list of masks, circuits, and related components used with the ventilator.

Mask/patient interface type*	Description
ET/ Trach ET/Trach	ET or tracheostomy tube
1 Leak 1	Mask with minimal intentional leak characteristics. Enter **Leak 1** for any of these Respironics masks: • Respironics Vinyl Nasal Single-Patient-Use Mask • Respironics Contour Deluxe Nasal Single-Patient-Use Mask • Respironics PerformaTrak Mask • Respironics Image3 Full Single-Patient-Use Mask
2 Leak 2	Mask with medium intentional leak characteristics. Enter **Leak 2** for this mask: • Respironics PerforMax Face Mask [EE]
3 Leak 3	Reserved for future Respironics mask releases
4 Leak 4	Total Reusable Full Face Mask
Other Other	Mask not manufactured by Respironics NOTE: If you select **Other**, the ventilator displays **Tot.Leak** rather than **Pt. Leak**.

* A leak symbol is printed on Respironics masks.

4. Select the desired exhalation port type (Table 6-2). Select **Accept** to apply.



If you select an exhalation port that is not compatible with the selected mask, **Not allowed with current interface** is displayed.

NOTE: ET/trachestomy tubes and most Respironics masks require the use of an exhalation port. If you selected **ET/Trach** or **Leak 1** as a mask/patient interface, you may not select **None** as an exhalation port.

Port type	Exhalation port test recommended?
 **DEP** Respironics Disposable Exhalation Port	No
 **Whisper Swivel** Respironics Whisper Swivel	No
 **PEV** Respironics Plateau Exhalation Valve	Yes
 **Other** Exhalation port not supplied by Respironics.	Yes
 **None** No inline circuit exhalation port NOTE: If you select **None**, refer to the manufacturer's instructions to make sure the mask selected contains an exhalation port.	No

5. Run the exhalation port test if indicated in the table (see "Running the exhalation port test" on page 6-10 for instructions).

CAUTION: If you selected **PEV** or **Other** as an exhalation port, you must run an exhalation port test.

NOTE: If the exhalation port test fails, the intentional leak is unknown. **Tot.Leak** rather than **Pt. Leak** is displayed in the patient data window.

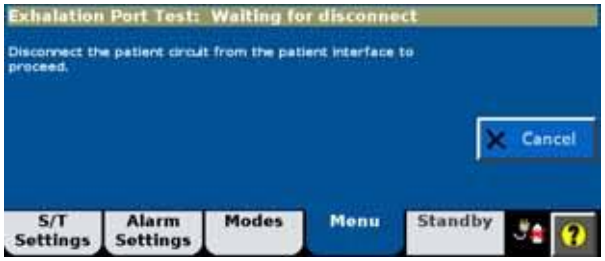
Running the exhalation port test

The exhalation port test is required and its window is automatically displayed when **PEV** or **Other** is selected.

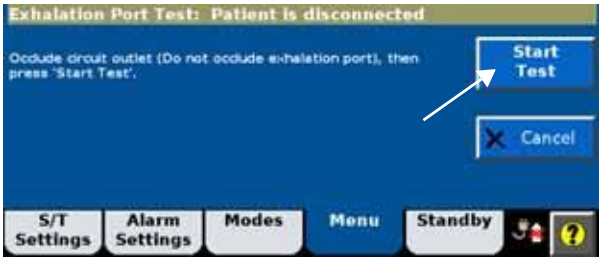
Procedure

Run the test as follows:

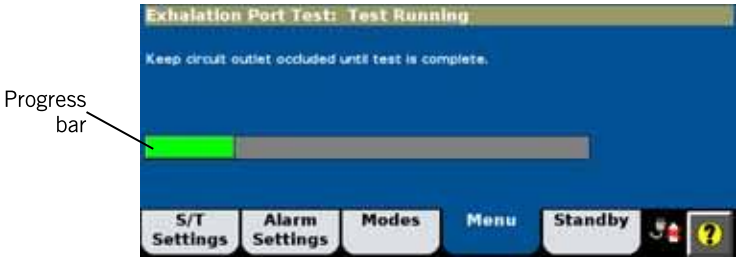
1. Disconnect the patient circuit from the mask/patient interface.



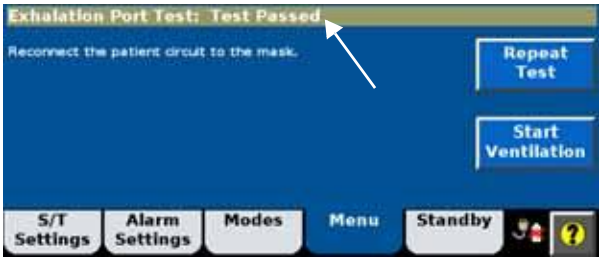
2. Occlude the circuit outlet. Select **Start Test**.



3. Wait while the test runs.



4. Verify that **Test Passed** is displayed.



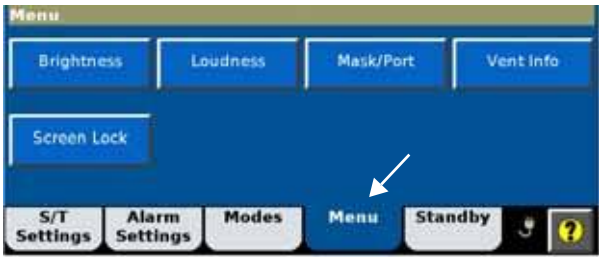
5. Reconnect the patient circuit to the mask/interface.
6. Select **Start Ventilation** to initiate ventilation.

Troubleshooting

If **Test Failed** is displayed, check for leaks in the patient circuit, and install an exhalation device with lower leak characteristics. Repeat test. If the exhalation port test fails again, the intentional leak is unknown and **Tot.Leak** rather than **Pt. Leak** is displayed in the patient data window.

Other functions: the Menu window

From the **Menu** window you can adjust user preferences.



Brightness

Use **Brightness** to adjust the screen for optimum daytime or nighttime viewing.

Loudness

Use **Loudness** to adjust the volume of the alarm and touchscreen audible feedback. You will hear audible feedback as you go through the selections.

Mask/Port

See “Selecting the mask and exhalation port” on page 6-7.

Vent Info (ventilator information)

The **Ventilator Information** window displays version and other information specific to your ventilator.

Screen Lock

Screen Lock deactivates all buttons and tabs on the touchscreen except **Alarm Silence, Alarm Reset**, the Alarm/Message button, and Help. Tabs are grayed out as in this example.

This message bar is displayed at the top of the screen:

To unlock the screen, press the Accept button in the center of the navigation ring.

NOTE: If Screen Lock is active, the touchscreen remains locked even if an alarm becomes active.

Standby

Standby lets you safely suspend ventilation to temporarily disconnect the patient from the ventilator or to set up the ventilator before connecting the patient. Alarms are disabled during standby.

You can also change ventilator settings and most menu functions during standby. The settings changes are effective when you exit standby. Enter standby as follows:

1. Select **Standby**. The **Entering Standby** window opens.

NOTE: Remove the mask/patient interface in order to enter standby. The ventilator will not enter standby with a patient connected. If the patient is not disconnected, the ventilator continues breath delivery while waiting for the patient to be disconnected. The standby mode request cancels in 60 seconds if the patient remains connected.

NOTE: Standby mode disables alarms and should be used when the patient is disconnected.

2. Disconnect the patient from the ventilator now. The ventilator enters standby and displays the **Standby** screen.

3. To resume ventilation, reconnect the patient. When the ventilator senses a patient breathing effort, ventilation automatically resumes in the previous mode.

NOTE: You can also manually resume ventilation with the **Restart Mode** button.

Help function

Select the help button to display additional information.

Help messages are displayed:

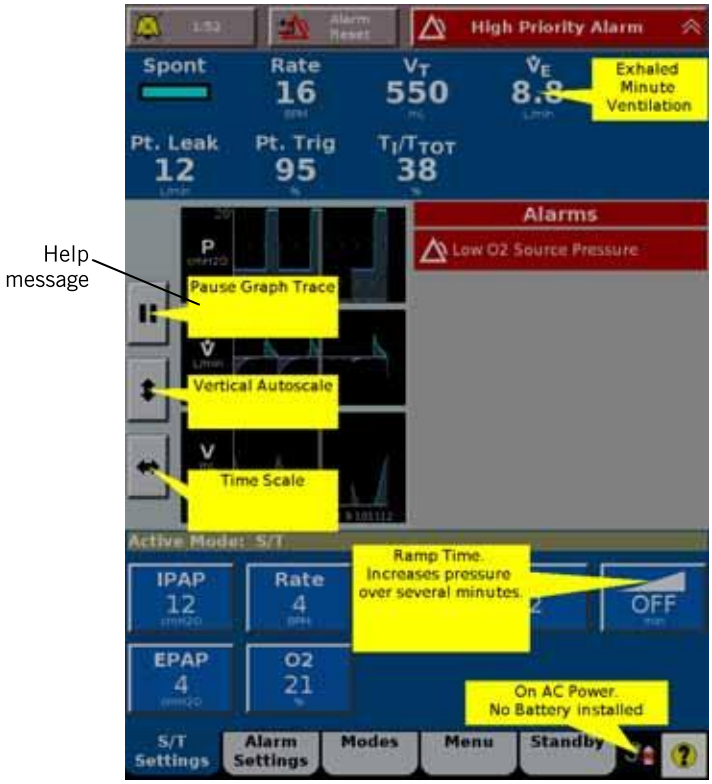
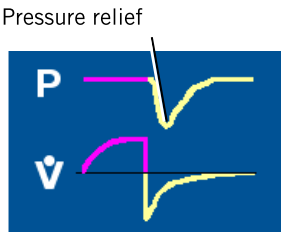
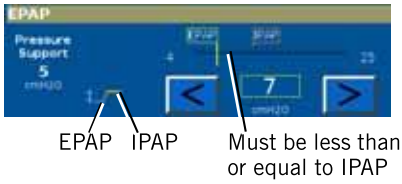
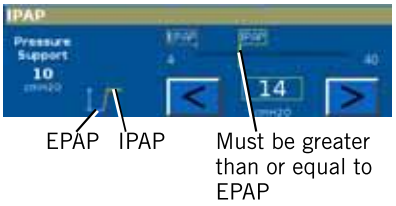
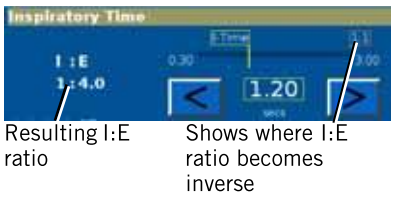
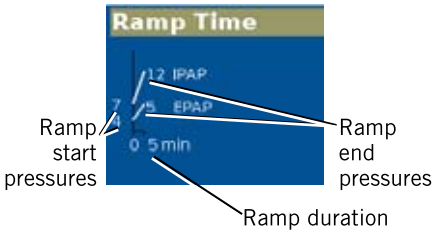
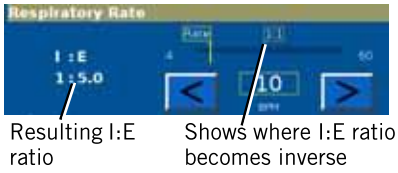
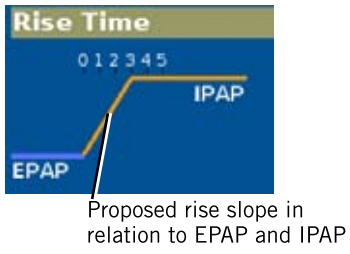


Table of modes and control settings

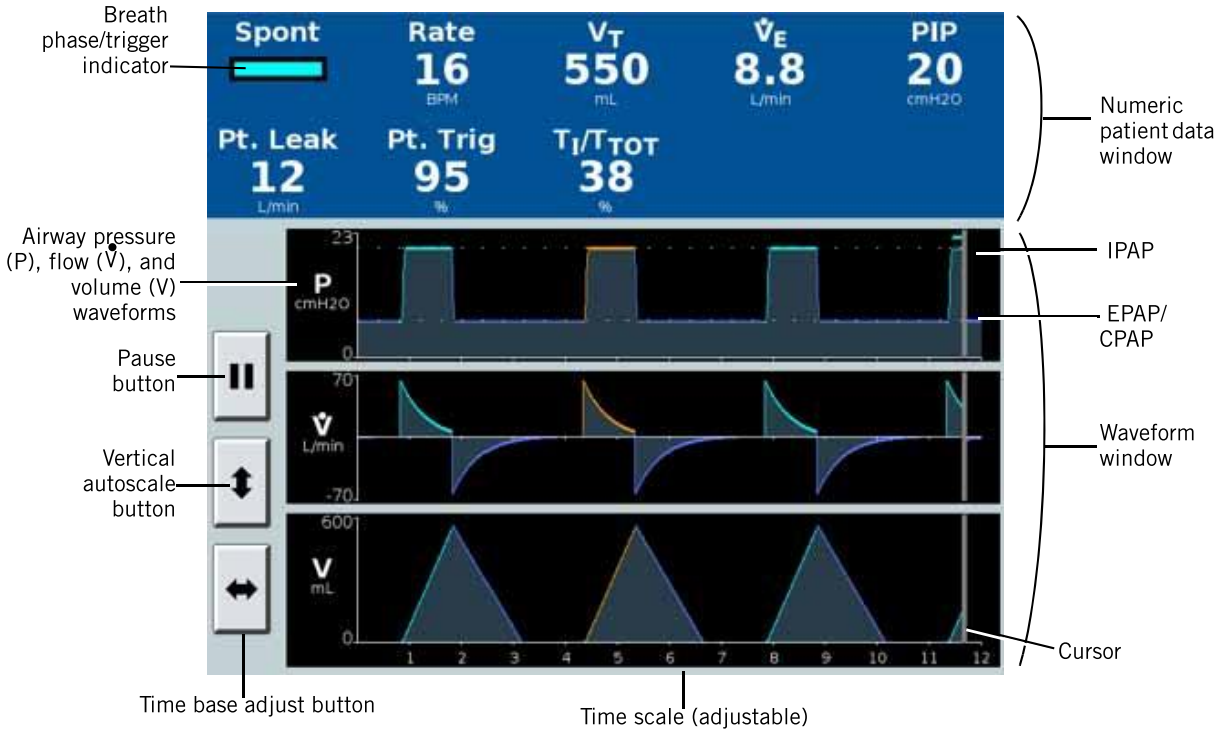
Setting	Description	Range
Modes		
Modes	Ventilation mode	CPAP, S/T, PCV, AVAPS (optional)
Control settings		
C-Flex (optional)	Enhances traditional CPAP by reducing the pressure at the beginning of exhalation—a time when patients may be uncomfortable with CPAP—and returning it to the set CPAP pressure before the end of exhalation. The amount of pressure relief is determined by the C-Flex setting and the expiratory flow. The higher the setting number (1, 2 or 3) and the greater the expiratory flow, the greater the pressure relief (during the active part of exhalation only). Applies in CPAP mode only. 	OFF, 1 to 3
CPAP	Continuous positive airway pressure. The baseline pressure applied during the expiratory phase. Applies in CPAP mode only.	4 to 25 cmH_2O
EPAP	Expiratory positive airway pressure. The application and maintenance of pressure above atmospheric at the airway throughout the expiratory phase of positive-pressure mechanical ventilation. 	4 to 25 cmH_2O
IPAP	Inspiratory positive airway pressure. The application and maintenance of pressure above atmospheric at the airway throughout the inspiration phase of positive-pressure mechanical ventilation. 	4 to 40 cmH_2O
I-Time (Inspiratory Time)	Time to deliver the required gas. Inverse ratio ventilation is not allowed. 	0.30 to 3.00 secs

Setting	Description	Range
Max P (AVAPS Maximum IPAP Pressure)	The maximum pressure to be applied. NOTE: When you adjust the AVAPS minimum and maximum pressures, remember that IPAP is adjusted to meet the target value. If the calculated target pressure is outside of the minimum and maximum pressure range, the target volume will not be achieved. Applies in AVAPS mode only.	6 to 40 cmH_2O
Min P (AVAPS Minimum IPAP Pressure)	The minimum pressure to be applied. NOTE: When you adjust the AVAPS minimum and maximum pressures, remember that IPAP is adjusted to meet the target value. If the calculated target pressure is outside of the minimum and maximum pressure range, the target volume will not be achieved. Applies in AVAPS mode only.	5 to 30 cmH_2O
O_2	Oxygen concentration to be delivered.	21 to 100%
Ramp Time	An interval during which time the ventilator linearly increases pressure, helping to reduce patient anxiety. Initial CPAP/EPAP $= \frac{\text{CPAP/EPAP} + 4\ \text{cmH2O}}{2}$ Initial IPAP $=$ Initial EPAP $+ \frac{(\text{IPAP} - \text{EPAP})}{2}$ 	OFF, 5 to 45 min
Rate (Respiratory Rate)	Respiratory frequency or number of breaths per minute. Inverse ratio ventilation is not allowed. 	4 to 60 BPM
Rise (Rise Time)	Speed with which inspiratory pressure rises to the set (target) pressure. If the Rise Time is insufficient to reach the target IPAP pressure, adjust the Rise Time or I-Time setting. 	1 to 5 (1 is fastest)
V_T (AVAPS Target Tidal Volume)	Target tidal volume to be delivered during inspiration. The ventilator meets this target by adjusting the inspiratory pressure with each breath. Applies in AVAPS mode only.	200 to 2000 mL

Setting	Description	Range
Hi Rate (High Rate Alarm)	High total breath rate.	5 to 90 BPM
Lo Rate (Low Rate Alarm)	Low total breath rate.	1 to 89 BPM
	NOTE: In non-CPAP modes, the Low Rate Alarm is essentially off if set below the Respiratory Rate setting.	
Hi V_T (High Tidal Volume Alarm)	High exhaled tidal volume.	200 to 2500 mL
Lo V_T (Low Tidal Volume Alarm)	Low exhaled tidal volume.	OFF to 1500 mL
HIP (High Inspiratory Pressure Alarm)	High pressure at the patient airway.	5 to 50 cmH_2O
LIP (Low Inspiratory Pressure Alarm)	Low pressure at the patient airway.	OFF to 40 cmH_2O
LIP T (Low Inspiratory Pressure Delay Time)	The interval from the detection of low inspiratory pressure until the alarm becomes active.	5 to 60 secs
Lo $\dot{V}_E$ (Low Minute Ventilation Alarm)	Low expiratory minute volume.	OFF to 99.0 L/min

Chapter 7. Patient monitoring

The ventilator displays numeric patient data in the patient data window and real-time graphics in the waveform window (Figure 7-1). Numeric patient data is updated every breath.Table 7-1 on page 7-2 lists the ventilator's monitored parameters.



Display conventions

The following symbols may be displayed in place of numeric values:

*** Data is not valid, and/or ventilator is in standby mode or disconnected

+++ Data is over range

- - - Data is under range

Table of monitored parameters

Parameter	Definition
Patient data window	
Breath phase/trigger indicator	**Spont** (spontaneous): Inspiratory phase, patient-triggered breath (color: turquoise) **Timed:** Inspiratory phase, ventilator-triggered breath (color: orange) **Exhale:** Expiratory phase (color: blue)
PIP	Peak inspiratory pressure. The highest patient pressure during the previous breath cycle.
Pt. Leak	Estimated patient leak or unintentional leak. Average during the previous breath cycle. Displayed only after a suitable exhalation port and mask/patient interface are selected.
Pt. Trig	Patient-triggered breaths, as a percentage of total breaths over the last 15 minutes.
Rate	Respiratory rate or total breathing frequency. Moving average over the last 6 breaths (or 15 seconds).
T_I/T_{TOT}	Inspiratory duty cycle or inspiration time divided by total cycle time. Moving average over the last 8 breaths.
Tot.Leak	Estimated total leak. Average during the previous breath cycle. Displayed before a suitable exhalation port and mask/patient interface are selected.
$\dot{V}_E$	Estimated minute ventilation. The product of tidal volume (spontaneous and timed) and rate (spontaneous and timed). Moving average over the last 6 breaths.
V_T	Estimated exhaled tidal volume. Moving average over the last 6 breaths. It is body temperature pressure saturated (BTPS) compensated.
Waveform window	
P	Airway pressure. Where applicable, dotted lines represent target IPAP and EPAP.
$\dot{V}$	Estimated patient flow. The total delivered flow minus the leak flow (**Tot.Leak**), where **Tot.Leak** includes known (intentional) leakage through the exhalation port plus any unintentional leakage in the circuit or at the mask/patient interface.
V	Estimated patient volume. In AVAPS mode, the dotted line represents target volume.

Scaling the waveform axes

Scale the vertical and horizontal waveform axes with the scale buttons.

The vertical scale button autoscales the Y axes to best fit the current data.

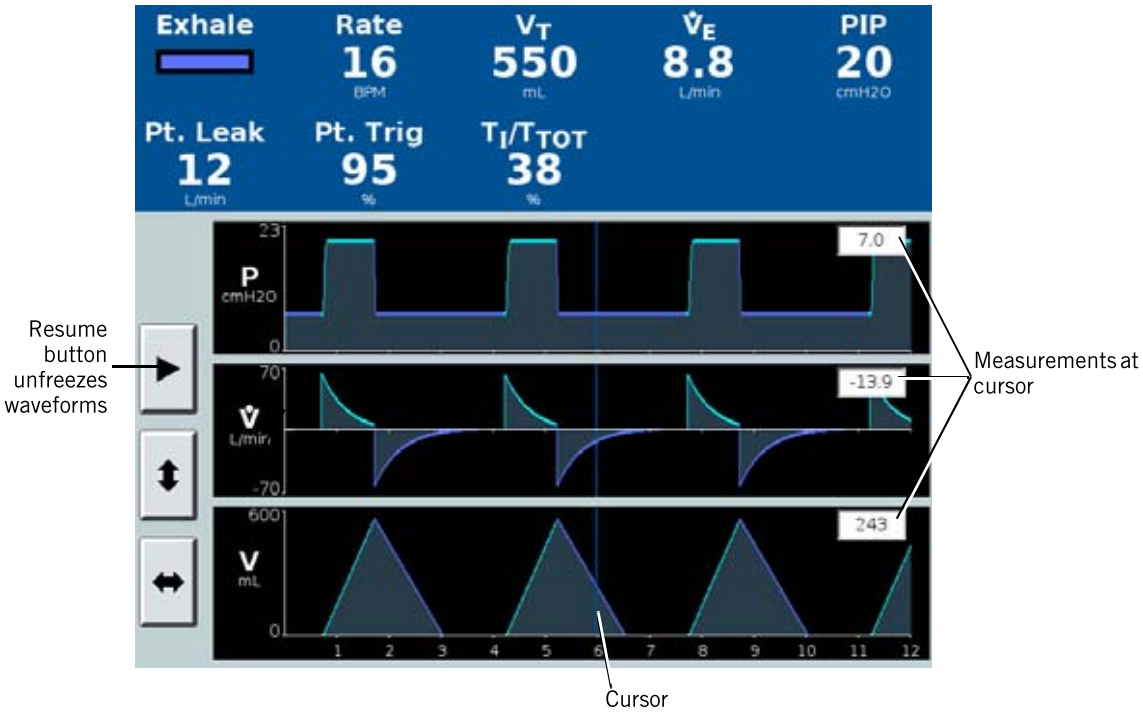
The horizontal (time adjust) button rescales the X axis to show 3, 6, 12, or 24 seconds.

Freezing and unfreezing waveforms

Freeze waveforms for extended viewing by selecting the pause button to the left of the waveform window.

The cursor makes one complete sweep across the waveform and then displays the pause in progress symbol. The graphic display is then frozen, and the cursor is visible in the middle of the display (Figure 7-2). Reposition the cursor with the navigation ring or by touching the waveform screen. Data values at cursor location for pressure, flow, and volume are displayed in the white boxes.

Unfreeze the waveforms with the resume button.



Chapter 7

Patient monitoring

Chapter 8. Alarms and messages

Alarms and messages on the ventilator alert you to situations that require your attention. The ventilator can also actuate remote alarms. Figure 8-1 on page 2 shows the visual alarm characteristics. Table 8-2 on page 8-6 summarizes the different types of alarm and tells you how to respond to each.

Responding to alarms

WARNING: **If AC power fails and the backup battery is not installed or is depleted, an audible and visual alarm annunciates for at least 2 minutes. Immediately discontinue ventilator use and secure an alternative means of ventilation. As in most ventilators with passive exhalation ports, when power is lost, sufficient air is not provided through the circuit and exhaled air may be rebreathed.**

NOTE: If an alarm persists for no apparent reason, discontinue ventilator use and contact Respironics.

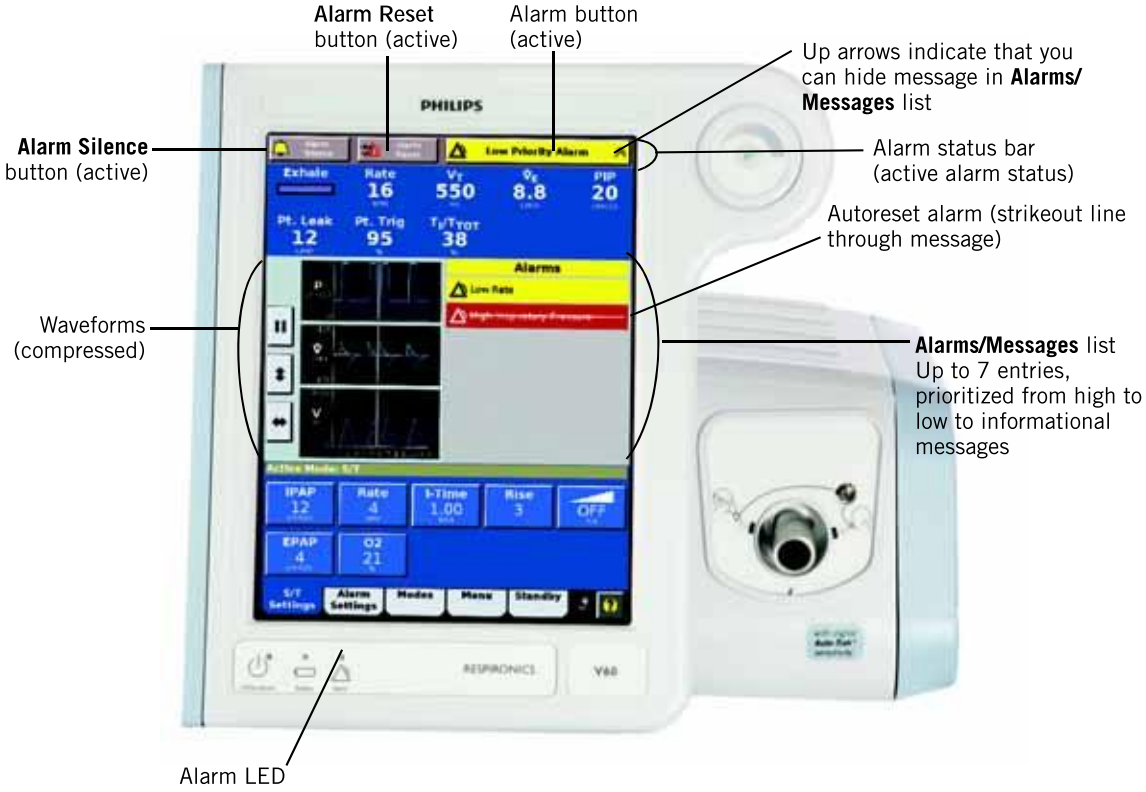
Respond to an alarm as follows:

1. Approach the patient immediately. Secure sufficient and effective ventilation for the patient. You may silence the alarm if possible.
2. Correct the alarm condition, referring to the alarm messages in Table 8-2.

You can modify alarm settings at any time through the **Alarm Settings** tab.

Alarm status bar (nonalarm status)

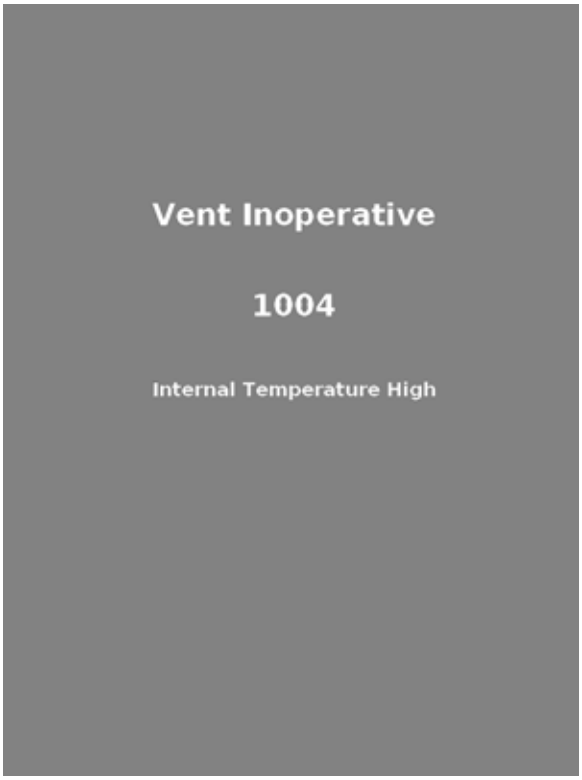
No active alarms



Active alarms

Status	Alarm LED on front panel	Alarm status bar	Alarm message in Alarms list	Audio*	Action required	Remote alarm
No alarms	Off		None	Off	None	Off
Autoreset alarm	Off		Background color same as that of active alarm. Message with strike-out text. Alarm icon.			
Informational message	Off	Blue 	Blue background color. Informational icon.		Important information or instructions.	
Low-priority alarm	Off	Yellow 	Yellow background color. Alarm icon.	Intermittent tone at an interval of approximately 20 seconds	Respond promptly. Troubleshoot as per Table 8-2.	
High-priority alarm	Flashes	Alternates black and red 	Red background color. Alarm icon.	Repeating sequence of 5 tones	Respond immediately to ensure patient safety. Troubleshoot as per Table 8-2.	On
High-priority alarm – Check Vent					Respond immediately to ensure patient safety. Do not use equipment that is malfunctioning or that indicates a potential problem until the problem is corrected. Troubleshoot as per Table 8-3.	
High-priority alarm – Vent Inoperative	On continuously	Vent Inoperative screen, including code (Figure 8-2)		Primary alarm (Repeating sequence of 5 tones) or backup alarm (alternating tone for a minimum of 2 minutes)	Continued safe ventilator operation may be in jeopardy. Oxygen flow and blower operation are disabled. Immediately secure alternative ventilation for the patient. Troubleshoot as per Table 8-4.	
Loss of power	Off	Blank	Blank		Immediately secure alternative ventilation for the patient.	

* The volume of the primary alarm is the same for low- and high-priority alarms.



Setting alarm loudness

You can set the alarm loudness from the **Menu** window (see “Loudness” on page 6-11).

Silencing alarms

Silence an alarm for 2 minutes by selecting the **Alarm Silence** button.

The button icon is replaced by this one. A timer shows time remaining in the 2-minute alarm silence period.

Select **Alarm Silence** again at any time to reset the counter to 2:00 minutes. During patient maneuvers, you can pre-silence audible alarms as desired.

Some alarms cannot be silenced; these are listed in Table 8-2. When a non-silenceable alarm is annunciated, the following is shown.

Resetting alarms

Most alarms reset themselves (autoreset) when the alarm triggering condition is removed, but you must manually reset others. Table 8-2 specifies whether an alarm is autoreset.

Manually resetting alarms

Manually reset an alarm by selecting **Alarm Reset**.

When an alarm is manually reset, the message is cleared from the **Alarms** list, any other alarm indications are removed, and the alarm silence is terminated.

If the alarm cannot be manually reset, you see the following:

Clearing autoreset alarms from the Alarms list

Autoreset alarms are shown with text crossed out in the **Alarms** list.

Clear the message from the **Alarms** list by selecting **Alarm Reset**.

Hiding/displaying alarm messages

To hide an alarm or informational message in the **Alarms** or **Messages** list, touch the flashing alarm indicator button or informational message button when up arrows are present. To display messages, touch the flashing alarm indicator or **Informational Message** button when down arrows are present. Both active and autoreset alarms and informational messages are displayed and hidden.

Alarms and other messages

Table 8-2 is a list of alarms and other messages displayed by the ventilator, along with descriptions, suggested corrective actions, and other information. The ID (identifier) listed with the priority type is the priority number of the alarm. This priority number determines the order of alarm message display. Unless otherwise indicated, alarms listed as autoresettable are reset when the alarm condition is removed.

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autoresettable	Silenceable
AVAPS: Target V_T Exceeded. Min Pressure Too High	AVAPS target pressure is less than Min P setting. The ventilator limits its applied pressure to Min P.	Check the patient. Confirm pressure settings are compatible with target. Evaluate pressure and volume settings.	Information (54)	No	Yes	N/A
AVAPS: Target V_T Not Achieved. Insufficient Max Pressure	AVAPS target pressure exceeds Max P setting. The ventilator limits applied pressure to Max P.	Check the patient. Confirm pressure settings are compatible with target. Evaluate pressure and volume settings.	Information (53)	No	Yes	N/A
Check Vent:	See Table 8-3 on page 8-10					
High Inspiratory Pressure	Measured inspiratory pressure is greater than the HIP setting, and the ventilator cycles into exhalation. Autoresets after a complete inspiration without the alarm condition.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (39)	Yes	Yes	Yes
High O_2 Supply Pressure	O_2 inlet pressure is greater than 92 psig, so O_2 enrichment ends. Autoresets when O_2 supply pressure falls below 87 psig.	Check the patient. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (44)	No	Yes	Yes

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
High Rate	Measured respiratory rate is greater than the Hi Rate setting. Escalates to a high-priority alarm if the alarm condition persists for more than 60 sec.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low (50)	Yes	Yes	Yes
High Tidal Volume	Measured estimated tidal volume is greater than the Hi V_T setting. Escalates to a high-priority alarm if the alarm condition persists for more than 60 secs.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low (49)	Yes	Yes	Yes
Low Inspiratory Pressure	Measured inspiratory pressure is less than the LIP setting.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (41)	Yes	Yes	Yes
Low Internal Battery	Battery can provide operating power for only an additional 15 minutes under nominal conditions. Autoresets when ventilator is connected to AC power.	Connect ventilator to AC power. Provide alternative ventilation.	High (37)	No	Yes	No
Low Leak–CO_2 Rebreathing Risk	Estimated volume of exhaled gas returned to the patient is high.	Check the patient, as possibility of CO_2 rebreathing could pose a potential problem. Check the port for occlusions. Check for appropriate patient interface and exhalation port settings.	High (26)	Yes	Yes	Yes
Low Minute Ventilation	Estimated minute ventilation is less than the Lo $\dot{V}_E$ setting. Escalates to a high-priority alarm if the alarm condition persists for more than 60 sec.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low (47)	Yes	Yes	Yes
Low O_2 Supply Pressure	Oxygen supply pressure is less than 30 psig and delivered oxygen is at least 5% lower than O_2 setting. The ventilator continues to deliver as much oxygen as possible, but ends oxygen support when oxygen inlet pressure drops to less than 18 psig. Autoresets when oxygen supply pressure exceeds 23 psig.	Check the patient. Attach to oxygen source with sufficient pressure. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (43)	No	Yes	Yes

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Low Rate	A low-priority alarm if the measured respiratory rate is less than the Lo Rate setting, escalating to a high-priority alarm in 60 sec. A high-priority alarm from the start if: • The Lo Rate setting is ≤ 4 BPM and there are no breaths for > 60/Lo Rate setting. • The Lo Rate setting is > 4 BPM and there are no breaths for > 15 sec.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low/ High (46)	Yes	Yes	Yes
Low Tidal Volume	Estimated tidal volume is less than the Lo V_T setting. Escalates to a high-priority alarm if the alarm condition persists for more than 60 sec.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	Low (48)	Yes	Yes	Yes
Mask: , Exh Port: Use Menu to change	Displays when ventilator is turned on. Displays selected mask type and exhalation port.	Select mask and port from Menu tab. Message is removed when user confirms selections, or after 5 minutes.	Information (55)	No	Yes	N/A
Oxygen Not Available	Oxygen supply pressure out of range, oxygen device failed, air flow sensor and/or oxygen flow sensor calibration failed, or oxygen inlet pressure sensor calibration failed. The ventilator discontinues oxygen support.	Check the patient. Check if high/low O_2 source is the problem and correct. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (42)	No	Yes	Yes
Patient Circuit Occluded	Proximal pressure and patient flow are low. Patient circuit occluded.	Check the patient. Check the patient circuit for bulk liquid, crimps, or blocked filter. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (35)	Yes	Yes	Yes

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autoresettable	Silenceable
Patient Disconnect	Excessive flow to the patient for a few seconds. Patient is no longer connected to the ventilator, either through circuit, mask, or ET tube; or the patient circuit is disconnected from the ventilator and the patient is no longer receiving ventilatory support. Ventilation continues.	Check the patient. Reconnect patient circuit. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (36)	Yes	Yes	Yes
Power has been restored	Power is restored following loss of power. The ventilator restarts and continues ventilation in the set mode before power was lost.	Check the patient. Confirm ventilator and alarm settings are appropriate.	Information (56)	Yes	Yes	N/A
Pressure Regulation High	Pressures exceed ventilator-defined thresholds. Ventilation continues. Autoresets when alarm condition removed; otherwise, transitions to the ventilator inoperative state if pressure continues to rise.	Check the patient. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (38)	Yes	Yes	Yes
Proximal Pressure Line Disconnect	Proximal pressure low for a few seconds. Proximal pressure line is disconnected. Air flow to the patient continues.	Check the patient. Reconnect proximal pressure line. Confirm ventilator and alarm settings are appropriate. If problem persists, provide alternative ventilation. Have ventilator serviced.	High (34)	Yes	Yes	Yes
Running on Internal Battery	System is powered by the internal battery. Autoresets when ventilator is connected to AC power.	Connect ventilator to AC power.	Low (51)	Yes	Yes	Yes
Using Default Settings	Displayed after power on if setting values are corrupted or not set, or if default values were restored by the user.	Check the patient. Check and adjust settings as required.	Information (52)	Yes	Yes	N/A
Vent Inoperative description of failure	See Table 8-4 on page 8-13					

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Check Vent: 1.8 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (20)	Yes	No	No
Check Vent: 3.3 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (21)	Yes	No	No
Check Vent: 5 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (22)	Yes	No	No
Check Vent: 12 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (23)	Yes	No	No
Check Vent: 24 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (24)	Yes	No	No
Check Vent: 35 V Supply Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (25)	Yes	No	No
Check Vent: Air Flow Sensor Calibration Data Error	Flow-related patient data is disabled. Oxygen concentration switches to 21% (ventilates with air only). Default volume used in AVAPS mode. Standby disabled. Volume, leak, disconnect, and occlusion alarms compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (12)	Yes	No	No
Check Vent: Alarm LED Failed	Technical failure.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (5)	Yes	No	No
Check Vent: Auxiliary Alarm Supply Failed	Backup alarm problem	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (19)	Yes	No	No
Check Vent: Backup Alarm Failed	Backup alarm problem	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (4)	Yes	No	No
Check Vent: Barometer Calibration Data Error	Default barometric pressure of 686.0 mmHg (approximately 900 m/2953 ft above sea level) used in calculations	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (17)	Yes	No	No

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autoresettable	Silenceable
Check Vent: Barometer Sensor Range Error	Default barometric pressure of 686.0 mmHg (approximately 900 m/2953 ft above sea level) used in calculations	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (18)	Yes	No	No
Check Vent: Battery Failed	Battery problem	Check the patient. Connect the ventilator to AC. Provide alternative ventilation. Have the ventilator serviced.	High (57)	Yes	No	No
Check Vent: Battery Temperature High	Battery problem	Check the patient. Connect the ventilator to AC. Check for causes of overheating, such as high room temperature, blocked vents, clogged air inlet filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (33)	Yes	No	No
Check Vent: Blower Temperature High	Technical failure	Check the patient. Check for causes of overheating, such as high room temperature, blocked vents, clogged air inlet filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (32)	Yes	No	No
Check Vent: Cooling Fan Speed Error	Overheating of ventilator possible	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (34)	Yes	No	No
Check Vent: CPU PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (28)	Yes	No	No
Check Vent: Data Acquisition PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (26)	Yes	No	No
Check Vent: Flash File System Error	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (35)	Yes	No	No
Check Vent: Internal Temperature High CPU	Technical failure	Check the patient. Check for causes of overheating, such as high room temperature, blocked vents, clogged air inlet filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (29)	Yes	No	No

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Check Vent: Internal Temperature High Daq	Technical failure	Check the patient. Check for causes of overheating, such as high room temperature, blocked vents, clogged air inlet filter, or nonfunctional fan. Provide alternative ventilation. Have the ventilator serviced.	High (30)	Yes	No	No
Check Vent: Internal Temperature High Mtr	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (31)	Yes	No	No
Check Vent: Machine Pressure Sensor Auto-Zero Failed	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (8)	Yes	No	No
Check Vent: Machine Pressure Sensor Calibration Data Error	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (6)	Yes	No	No
Check Vent: Machine Pressure Sensor Range Error	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (10)	Yes	No	No
Check Vent: Motor Control PCBA ADC Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (27)	Yes	No	No
Check Vent: Oxygen Device Failed	Continues to ventilate with air only	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (15)	Yes	No	No
Check Vent: O_2 Flow Sensor Calibration Data Error	Continues to ventilate with air only	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (13)	Yes	No	No
Check Vent: O_2 Pressure Sensor Calibration Data Error	Continues to ventilate with air only	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (14)	Yes	No	No
Check Vent: O_2 Supply Pressure Sensor Range Error	Continues to ventilate with air only	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (16)	Yes	No	No
Check Vent: OVP Circuit Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (58)	Yes	No	No
Check Vent: Primary Alarm Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (3)	Yes	No	No
Check Vent: Program CRC Test Failed	Technical failure	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (1)	Yes	No	No

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Check Vent: Proximal Pressure Sensor Auto-Zero Failed	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (9)	Yes	No	No
Check Vent: Proximal Pressure Sensor Calibration Data Error	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (7)	Yes	No	No
Check Vent: Proximal Pressure Sensor Range Error	Proximal pressure is not measured. Pressure-related alarms are compromised.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (11)	Yes	No	No

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Vent Inoperative 1000 3.3 V Supply Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (2)	Yes	No	No
Vent Inoperative 1001 12 V Supply Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (3)	Yes	No	No
Vent Inoperative 1002 Blower Temperature Too High	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (4)	Yes	No	No
Vent Inoperative 1003 Internal Temperature High	Technical failure of the CPU PCBA. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (5)	Yes	No	No
Vent Inoperative 1004 Internal Temperature High	Technical failure of the DAQ PCBA. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (6)	Yes	No	No
Vent Inoperative 1005 Internal Temperature High	Technical failure of the motor PCBA. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (7)	Yes	No	No
Vent Inoperative 1006 Data Acquisition PCBA ADC Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (8)	Yes	No	No

Message	Description	Corrective Action	Priority type (ID)	Manually resettable	Autore-settable	Silence-able
Vent Inoperative 1007 Machine and Proximal Pressure Sensors Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (9)	Yes	No	No
Vent Inoperative 1008 Machine and Proximal Pressure Sensors Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (10)	Yes	No	No
Vent Inoperative 1009 Pressure Regulation High	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (11)	Yes	No	No
Vent Inoperative 100A Data Acquisition PCBA ADC Reference Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced.	High (12)	Yes	No	No
Vent Inoperative 100B Watchdog Test Failed	Technical failure. The ventilator is in the ventilator inoperative state.	Check the patient. Provide alternative ventilation. Have the ventilator serviced	High (13)	Yes	No	No

Chapter 9. Care and maintenance

WARNING: **To reduce the risk of electric shock, power down the ventilator and disconnect it from AC power before cleaning or servicing it.**

WARNING: **This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or federal laws. (Within this system, the backlight lamps in the monitor display contain mercury.)**

NOTE: It is the user's responsibility to comply with the information provided in this chapter.

To ensure the safety and reliability of your ventilator, follow these maintenance procedures along with your own institutional policies for cleaning, disinfecting, and maintaining equipment. All the procedures in this manual are intended to be performed by the operator. For further maintenance, contact your service representative.

Decontamination

CAUTION: To prevent possible damage to the ventilator, use only those cleaning agents listed in this manual.

CAUTION: Do not attempt to sterilize or autoclave the ventilator.

Ventilator exterior

Use a soft, moist, lint-free cloth to clean the outside surfaces of the ventilator. We recommend the following cleaning agents:

- Water
- Hydrogen peroxide (3%)
- Soapy water or mild detergent
- 10% bleach solution (10% bleach, 90% water)
- 91% isopropyl alcohol
- Germicidal disposable cloth (alkyl dimethyl benzyl ammonium chloride 0.07%; alkyl dimethyl ethybenzyl ammonium chloride 0.07%, remaining inert ingredients)
- Ammonium cleaner disinfectant
- Ethyl alcohol (70%)

Touchscreen

CAUTION: To prevent possible damage to the touchscreen, take care when cleaning it. Do not drip water and/or soap solution. After cleaning and rinsing, remove all moisture with a dry, soft cloth. Never clean the touchscreen with an abrasive brush or device, since this will cause irreparable damage.

Dampen a soft cloth with isopropyl alcohol or a nonabrasive glass cleaner and wipe the screen. Avoid using cleaners other than glass cleaners. Do not use any vinegar-based solutions. Avoid using gritty cloths. Handle the touchscreen with care. To facilitate cleaning the touchscreen during ventilation, use the Screen Lock function.

Bacteria filter, patient circuit, and other accessories

Follow the manufacturer's guidelines.

Preventive maintenance

WARNING: To prevent patient or ventilator contamination, inspect and replace the main flow bacteria filter between patients and at regular intervals (or as stated by the manufacturer).

WARNING: To prevent possible patient injury, inspect and verify the proper operation of the exhalation port regularly during use.

CAUTION: Because some environments cause a quicker collection of lint and dust than others, inspect the filters more often when needed. The air inlet filter should be replaced; the cooling fan filter should be cleaned.

CAUTION: To ensure proper system performance, use a Respironics-approved air inlet filter.

Perform preventive maintenance on your Respironics V60 Ventilator according to the schedule in Table 9-1. You can view the hours of ventilator operation in the **Vent Info** window ("Vent Info (ventilator information)" on page 6-11). The following subsections provide details for some of these preventive maintenance procedures.

Frequency	Component	Maintenance
Every week and between patients	Patient circuit, including mask and main flow bacteria filter	Per manufacturer recommendations. Regularly check water traps and patient circuit hoses for water accumulation. Empty as required.
Every month	Cooling fan filter	Inspect for occlusions, dust, lint, etc. If discolored or dirty, remove and wash or rinse thoroughly, and let dry completely before reinstalling.
Periodically, not to exceed every 6 months of use	Air inlet filter	Inspect and replace if needed
Every year	Backup battery	Inspect and replace if needed*
	Ventilator	Preventive maintenance*

* Must be done by Respironics-authorized service personnel according to the instructions in the service manual.

Replacing the air inlet filter

Replace the air inlet filter as follows, referring to Figure 9-1.

1. Power down the ventilator and disconnect it from AC power.
2. Turn the captive D-ring fastener counter-clockwise one-quarter turn and release. Remove the side panel.
3. Remove the inlet filter by pinching it out of the recess in the bracket.
4. Install a new air filter by tucking it into the recessed area. Replace the side panel, and push in and turn the D-ring fastener one-quarter turn until it locks.

Cleaning or replacing the cooling fan filter

Clean or replace the cooling fan filter as follows, referring to Figure 9-2:

1. Insert a small, flat blade driver tip between the foam filter and the filter retaining cover (Figure 9-2).
2. Gently pry the filter cover from the back of the ventilator. Do not remove the fan retaining pins.
3. Wash or rinse the filter. Let it dry completely before reinstalling.
4. Replace the filter, then snap the filter cover into place.

Removing and replacing the battery

See “Installing the optional battery” on page A-3.

Disposal

Dispose of all parts removed from the device according to your institution’s protocol. Follow all local, state, and federal regulations with respect to environmental protection, especially when disposing of the electronic device or parts of it (for example, oxygen cell, batteries).

Storage

See Table 10-8 on page 10-5 for ventilator storage requirements.

Repairs

For technical service or repair information not included in this chapter, contact Respironics.

Repacking and shipping

CAUTION: To prevent possible damage to the ventilator, always ship it with the original packing material. If the original material is not available, contact Respironics to order replacements.

NOTE: Transport of lithium ion batteries is strictly controlled by international regulations and laws. Do not ship the battery either in the ventilator or separately by sea or air. Contact your Respironics representative to obtain appropriate packaging for ground trasnport of batteries.

Remove the battery from the ventilator before shipping the ventilator. See “Installing the optional battery” on page A-3 for more information. Ship the battery and ventilator separately in appropriate packaging in conformance with federal, state, and local regulations. Contact Respironics to obtain appropriate ventilator or battery packaging.

Chapter 10. Technical specifications

Control settings

Table 10-1 lists ventilator control setting ranges, resolutions, and accuracies. Table 10-2 lists the controls active in the different ventilation modes.

Parameter	Range	Resolution	Accuracy	Factory default
Mode settings				
Modes	CPAP, S/T, PCV, AVAPS (optional)	N/A	N/A	S/T
Control settings				
C-Flex	OFF, 1 to 3	1	N/A	2
CPAP	4 to 25 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	4 cmH_2O
EPAP	4 to 25 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	4 cmH_2O
IPAP	4 to 40 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	12 cmH_2O
I-Time (Inspiratory Time)	0.30 to 3.00 sec	0.05 sec	± 0.03 sec	1.00 sec
Max P (AVAPS Maximum IPAP Pressure)	6 to 40 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	25 cmH_2O
Min P (AVAPS Minimum IPAP Pressure)	5 to 30 cmH_2O	1 cmH_2O	± (2 cmH_2O + 4% of target)	10 cmH_2O
O_2 (Oxygen)	21 to 100%	1%	± 5%	21%
Ramp Time	OFF, 5 to 45 min	5 min	± 1 sec	OFF
Rate (Respiratory Rate)	4 to 60 BPM	1 BPM	± 1 BPM	4 BPM
Rise (Rise Time)	1 to 5	1	N/A	3
V_T (AVAPS Target Tidal Volume)	200 to 2000 mL BTPS	5 mL	± 15%	500 mL

	CPAP	S/T	PCV	AVAPS
Timing		Rate		
		I-Time		
Baseline pressure	CPAP	EPAP		
Inspiratory pressure		IPAP		
				MinP
				MaxP
Rise Time		Rise		
O_2	O_2			
Volume				V_T
Ramp feature	Ramp Time			
Mode-specific	C-Flex			

Patient data

Parameter	Range	Resolution	Accuracy
Patient data window			
	Spont, Timed, Exhale	Color-coded display: Spont - turquoise, Timed - orange, Exhale - blue	N/A
PIP	0 to 50 cmH_2O	1 cmH_2O	± 2 cmH_2O
Pt. Leak	0 to 200 L/min BTPS	1 L/min	N/A
Pt. Trig	0 to 100%	1%	± 10%
Rate	0 to 90 BPM	1 BPM	± 1 BPM
T_I/T_{TOT}	0% to 91%	1%	± 5%
Tot.Leak	0 to 200 L/min BTPS	1 L/min	N/A
$\dot{V}_E$	0 to 99.0 L/min BTPS	0.1 L/min	± 15% or 0.3 L/min (whichever is greater)
V_T	0 to 3000 mL BTPS	5 mL	± 15% for volumes above 200 mL
Waveform window			
P	0 to 50 cmH_2O	Time axis: 1 second	N/A
$\dot{V}$	-240 to 240 L/min BTPS	Time axis: 1 second	N/A
V	0 to 3000 mL BTPS	Time axis: 1 second	N/A

Alarms

Table 10-4 lists the adjustable alarm ranges and resolutions. Table 8-2 on page 8-6 describes other, nonadjustable alarms.

Parameter	Range	Resolution	Factory default
Hi Rate (High Rate Alarm)	5 to 90 BPM	1 BPM	30 BPM
Lo Rate (Low Rate Alarm)	1 to 89 BPM	1 BPM	10 BPM
Hi V_T (High Tidal Volume Alarm)	200 to 2500 mL BTPS	5 mL	2500 mL
Lo V_T (Low Tidal Volume Alarm)	OFF, 5 to 1500 mL BTPS	5 mL	OFF
HIP (High Inspiratory Pressure Alarm)	5 to 50 cmH_2O	1 cmH_2O	50 cmH_2O
LIP (Low Inspiratory Pressure Alarm)	OFF, 1 to 40 cmH_2O	1 cmH_2O	OFF
Lo $\dot{V}_E$ (Low Minute Ventilation Alarm)	OFF, 0.1 to 99.0 L/min BTPS	0.1 L/min	OFF
LIP T (Low Inspiratory Pressure Delay Time Alarm)	5 to 60 sec	1 sec	20 secs

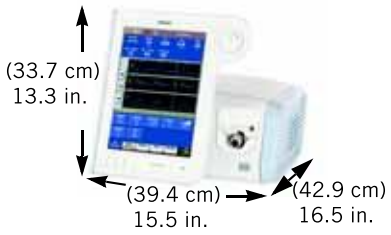
Menu window settings

Parameter	Range
Brightness	1 to 5
Loudness	1 to 10
Mask/ET Selection	ET/Trach, 1, 2, 3, 4, Other
Exhalation Port Selection	DEP (Respironics Disposable Exhalation Port, Whisper Swivel (Respironics Whisper Swivel), PEV (Respironics Plateau Exhalation Valve, Other (Other Exhalation Port), None (No inline circuit exhalation port)
Screen Lock	Off, On

Operator-accessible diagnostic mode functions

Function	Range
Language	English, Nederlands, Français, Deutsch, Italiano, Português, Español, Dansk, Suomi, Norsk, Svenska
Date/Time	--
Pressure Units	cmH_2O, hPa
Restore Default Settings	--
Software Options	--
Baud Rate	9,600, 19,200, 115,200
Significant Event Log	
Touch Screen Calibration	

Physical characteristics

Parameter	Specification
Weight	10.9 kg (24 lb) with optional battery 10 kg (22 lb) without battery
Dimensions	

Environmental specifications

Parameter	Specification
Temperature	Operating: 5 to 40 ºC (41 to 104 ºF) Storage: -20 to 50 ºC (-4 to 122 ºF)
Relative humidity	Operating: 15 to 95% (noncondensing) Storage: 10 to 95% relative (noncondensing)
Barometric pressure	600 to 765 mmHg (approximately -51 to 1951 m (-167 to 6400 ft) relative to sea level)

Pneumatic specifications

Parameter	Specification
High-pressure oxygen supply	Pressure: 2.76 to 6.00 bar / 276 to 600 kPa / 40 to 87 psig Flow: 175 SLPM Connector: DISS male, DISS female, NIST, SIS
Air supply	Integrated blower
Inspiratory outlet (To patient port)	Connector: ISO 15 mm female/22 mm male conical

Electrical specifications

Parameter	Specification
AC voltage	100 to 240 VAC
AC frequency	50 to 60 Hz
AC power	300 VA
Battery (optional)	14.4 V, 11.5 Ah Maximum system current draw: 11 A Charge voltage: +16.9 V maximum Operating time: 360 minutes under normal conditions

Other specifications

Parameter	Specification
Flow delivery	150 L/min at 40 cmH_2O at 1951 m (6400 ft) altitude (10% degradation in flow at 2286 m (7500 ft))
Flow range	-240 to 240 L/min BTPS
Pressure range	4 to 40 cmH_2O
Dynamic pressure regulation	± (2 cmH_2O + 4% of target) NOTE: Negative (subatmospheric) pressure settings are not available.
Start-up time	Ready to ventilate 9 seconds after power on
Triggering, cycling, and leak tolerance	As per the Digital Auto-Trak Sensitivity algorithms (see "Auto-Trak Sensitivity" on page 4-3)
Inspiratory and expiratory pressure drop: measured at patient connection, when the recommended breathing system is in use and normal ventilation is compromised by the total or partial loss of power supply	≤ 4 cmH_2O (at 60 LPM) ≤ 1.5 cmH_2O (at 30 LPM)
Audio alarm loudness	60 to 95 dB(A) (primary alarm) ≥ 65 dB(A) (backup alarm)
Acoustic noise	Less than 45 dB(A) at 1 m

Appendix A. First-time installation

Before putting the ventilator into service for the first time, install it as described in this chapter.

Unpacking and inspection

Unpack the ventilator and inspect it for damage. Inspect the exterior cabinet of the ventilator for cracks, scratches, or blemishes. Inspect the front panel for scratches or abrasions. Correct and/or report any problems found to Respironics before using the ventilator.

Before using the ventilator the first time, we recommend wiping the exterior clean and disinfecting components according to the instructions in Chapter 9.

Mounting the ventilator

CAUTION: To prevent possible damage to the ventilator, always secure it to its stand or securely place it on a flat, stable surface that is free of dirt and debris. Do not use the ventilator adjacent to, or stack it with, other equipment.

NOTE: If you mount the ventilator to a stand, make sure the stand is approved by Respironics.

The ventilator may be mounted to the optional universal stand or placed on a flat, stable, clean surface. Installing the ventilator to the stand requires a Respironics V60 Ventilator specific mounting plate; follow the instructions included with the mounting plate. Figure A-1 shows the installed ventilator.

Use the brakes to lock and unlock the wheels as needed. Make sure the wheels are unlocked before moving the ventilator.

Installing the optional battery

WARNING: To reduce the risk of fire, explosion, leakage, or other hazard, take these precautions with respect to the battery:

- **Do not attempt to disassemble, open, drop, crush, bend or deform, insert foreign objects into, puncture, or shred the battery pack; modify or remanufacture it; immerse or expose it to water or other liquids; expose it to fire, excessive heat (including soldering irons); or put it in a microwave oven.**
- **Replace the battery only with another battery specified by the manufacturer.**
- **Follow all instructions for proper use of the battery.**
- **Do not short-circuit the battery or allow metallic or conductive objects to contact the battery connector housing.**
- **Use the battery with the Respironics V60 Ventilator only.**

Install the battery as follows (Figure A-2). You will need a Phillips screwdriver.

1. Shut down and then unplug the ventilator.

NOTE: Failure to properly shut down the ventilator before battery installation may result in erroneous alarms after power-on.

2. Remove the side panel by turning the captive Phillips head fastener a ¼ turn and releasing.
3. Using a 3-mm hex wrench, remove the battery bracket by removing two screws.
4. Holding the battery so that the vent hole faces up and the Philips logo faces out, thread the battery cable through the battery bracket. Position and place the battery inside the battery compartment. Pinching the end of the battery connector, plug it in so that it locks in place.
5. Reinstall the battery bracket by replacing the two screws. Reinstall the side panel and secure the fastener with a ¼ turn clockwise.
6. Make sure the battery is properly installed by plugging the ventilator into an AC power receptacle and verifying that the yellow Battery

(charged) LED on the front panel flashes. The flashing LED indicates the battery is being charged.

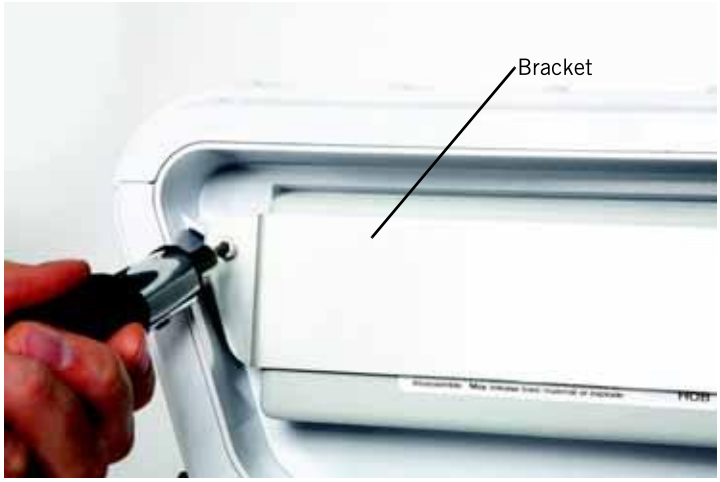
7. Attach the option label as shown in Figure 3-5 on page 3-8.

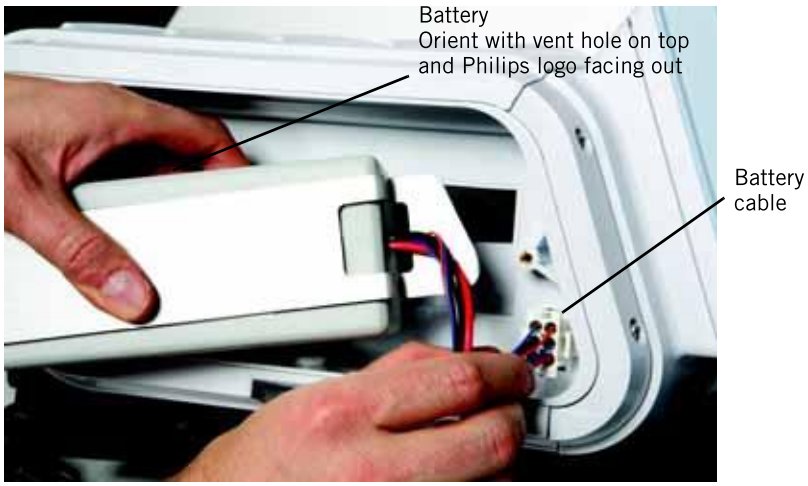
WARNING: **Never attempt to disconnect or connect the battery during operation.**

CAUTION: Following battery installation, if a **Check Vent** or **Vent Inoperative** alarm occurs during the preoperational check, discontinue use of the ventilator immediately and contact Respironics. The **Vent Inoperative** alarm occurs if AC power is disconnected and a battery is not installed, or if the battery is fully discharged.

NOTE: A new battery must be charged for at least 5 hours before being placed into service.


Captive fastener

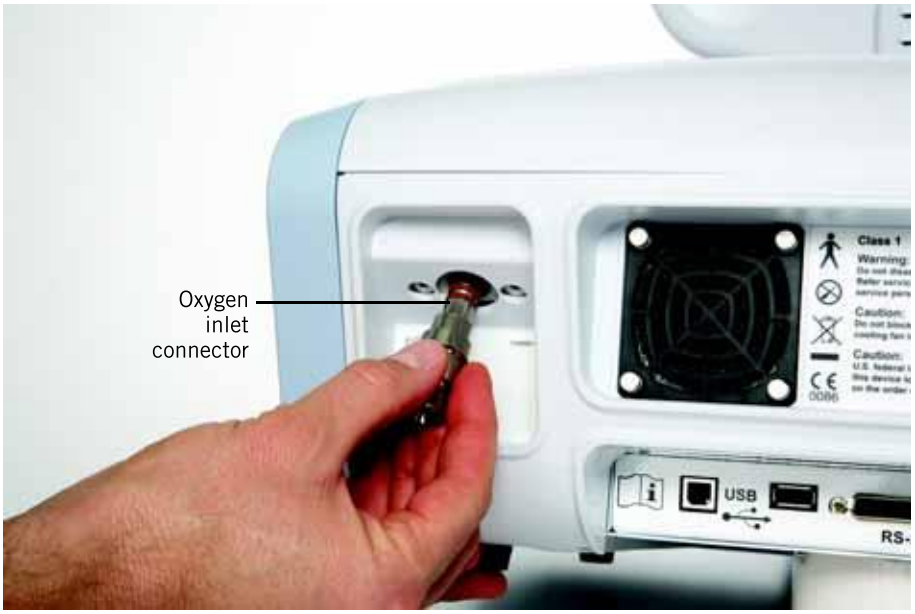

Bracket


Battery
Orient with vent hole on top and Philips logo facing out
Battery cable

Installing oxygen inlet connector and AC power cord (Outside the USA and Japan only)

Each Respironics V60 Ventilator is customized for the country of destination. In some cases, you must install the power cord and oxygen inlet connector.

1. Install the oxygen inlet connector as follows (Figure A-3):
   a. Gently fit connector into the hole provided with flat sides to the left and right.
   b. Install the oxygen inlet connector retaining plate. Tighten the two screws with a 2.5-mm hex wrench.



WARNING: **To prevent unintentional disconnection of the power cord, always use the correct, Respironics-supplied power cord and lock it into place with the power cord retainer before you switch the ventilator on. The retainer is designed to hold the connector end of the Respironics-supplied cord securely in place.**

2. Secure the power cord with the power cord retainer (Figure A-4):
   a. Remove the power cord retainer by removing two screws.
   b. Connect the power cord that is appropriate to your region into the AC power connector.
   c. Reinstall the power cord retainer over the power cord, and tighten the screws with a 3.0-mm hex wrench.

Installing the oxygen manifold kit

If desired, install the oxygen manifold kit as described in the accompanying instructions.

Configuration and screen calibration

After completing the setup activities described in Chapter 5, set or check the ventilator settings for language, units of measure, and time in the diagnostic mode (see Appendix F). Calibrate the screen as required, referring to Appendix F.

Appendix A

First-time installation

Appendix B. Communications interface

WARNING: **Connect to the ventilator only items that are specified as part of or compatible with the ventilator system. Additional equipment connected to medical electrical equipment must comply with the respective IEC or ISO standards. Furthermore, all configurations shall comply with the requirements for medical electrical systems (see IEC 60601-1-1 or clause 16 of edition 3 of IEC 60601-1, respectively). Anybody connecting additional equipment to medical electrical equipment configures a medical system and is therefore responsible for ensuring that the system complies with the requirements for medical electrical systems. Also be aware that local laws may take priority over the above mentioned requirements. If in doubt, consult Respironics.**

WARNING: **It is the responsibility of the end user to validate the compatibility and use of information transmitted from the ventilator to the device to be connected to the ventilator.**

WARNING: **The data provided through the communications interface is for reference only. Decisions for patient care should be based on the clinician's observations of the patient.**

The ventilator provides the following communications interface ports (Figure B-1):

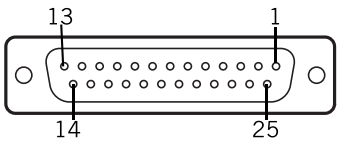
- RS-232 serial and analog I/O port. Through this port the ventilator receives commands from a host computer or bedside monitoring system and responds with fixed-format records. The port is also used for ventilator servicing and software downloading.
- Remote alarm/nurse call port. This port is used to activate alarms remotely.

RS-232 serial and analog I/O port

The ventilator can exchange both analog and RS-232 digital data through a 25-pin D-sub connector on the rear panel. The ventilator assumes the "slave" role and responds to commands from the external "master." The digital port uses a standard RS-232, null modem pin configuration with the auxiliary pins supporting analog data I/O.

Pinout of connector

Figure B-2 shows the pinout of the 25-pin D-sub connector used for the RS-232 serial and analog I/O port.



Pin	Signal	I/O	Description
1	HIS_RS232_SHLD	Power	HIS RS232 cable shield
2	HIS_RS232_TxD	Output	HIS RS232 transmit data output
3	HIS_RS232_RxD	Input	HIS RS232 receive data input
4	HIS_RS232_RTS	Output	HIS RS232 Ready To Send
5	HIS_RS232_CTS	Input	HIS RS232 Clear To Send
6	HIS_RS232_DSR	Input	HIS RS232 Data Set Ready
7	HIS_SIG_RTN	Power	HIS RS232/Signal common
8	Unused	N/A	N/A
9	HIS_DIG_IN0	Input	HIS digital Input #0
10	HIS_DIG_IN1	Input	HIS digital Input #1
11	HIS_ANALOG_IN00	Input	HIS analog input #0 (0 to 5 V)
12	HIS_ANALOG_IN01	Input	HIS analog input #1 (0 to 5 V)
13	HIS_SIG_RTN	Power	HIS RS232/Signal common

Pin	Signal	I/O	Description
14	HIS_DIG_IN2	Input	HIS digital Input #2
15	HIS_DIG_IN3	Input	HIS digital Input #3
16	HIS_DIG_OUT0	Output	HIS digital output #0 (0 to 3.3V)
17	HIS_DIG_OUT1	Output	HIS digital output #1 (0 to 3.3V)
18	HIS_DIG_OUT2	Output	HIS digital output #2 (0 to 3.3V)
19	HIS_DIG_OUT3	Output	HIS digital output #3 (0 to 3.3V)
20	HIS_RS232_DTR	Output	HIS RS232 Data Terminal Ready
21	HIS_SIG_RTN	Power	HIS RS232/Signal common
22	HIS_BOOT_SEL	Input	Boot Select Signal, 0 – Download, 1 – Flash
23	HIS_ANALOG_OUT0	Output	HIS analog output #0 (0 to 5 V)
24	HIS_ANALOG_OUT1	Output	HIS analog output #1 (0 to 5 V)
25	HIS_ANALOG_OUT2	Output	HIS analog output #2 (0 to 5 V)
SHLD	Chassis	Power	Cable shield

Communications protocol

The RS-232 serial protocol is configured as follows for all communications functions:

- Baud rate: Configurable in diagnostic mode
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

Commands and transmission conventions

The ventilator supports the following commands that are of interest to the user:

- VRPT (Send Ventilator Report) (Table B-1)
- SNDA (Send Variable-Length Ventilator Report) (Table B-2 on page B-8)

These commands, which are available during ventilation, return raw data that can be used for monitoring the patient and ventilator.

After receiving a command, followed by a carriage return, the ventilator responds by transmitting the information in the tables. The fields that comprise these tables are separated by commas. The ventilator stores and responds to valid commands in the order received. It returns invalid commands in an error message.

The ventilator also supports service-oriented commands. Contact Respironics for details.

In the tables shown, a space is designated as "◆". When a field is unused, the output field contains all spaces.

Field	Description	Example	Resolution	Range	Units	Comments
H1	Command name	VRPT	N/A	N/A	N/A	
H2	Number of characters between the start and stop codes	990	N/A	N/A	N/A	3-character field
H3	Number of fields between the start and stop codes	134	N/A	N/A	N/A	3-character field
H4	Start code	0x02	N/A	N/A	N/A	ASCII Start Transmission character (STX)
1	Time of request	13:45◆	N/A	N/A	N/A	24-hour clock, hh:mm◆
2	Date	FEB◆23◆2008◆	N/A	N/A	N/A	12-character field, MMM◆DD◆YYYY◆

Field	Description	Example	Resolution	Range	Units	Comments
3	Current ventilation type	NPPV◆◆	N/A	NPPV◆◆	N/A	
4 to 52	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
53	NPPV mode setting	S/T◆◆◆◆	N/A	S/T◆◆◆◆ PCV◆◆◆◆ CPAP◆◆◆ AVAPS◆◆ STDBY◆◆	N/A	7-character field representing available modes in NPPV, including STDBY (during leak test)
54	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
55	NPPV respiratory rate setting	12◆◆◆◆	1	4 to 60	BPM	"◆◆◆◆◆◆" in CPAP mode Rate setting in other modes
56	NPPV EPAP setting	5◆◆◆◆◆	1	4 to 25	cmH_2O	CPAP or EPAP setting
57	NPPV IPAP setting (or CPAP)	5◆◆◆◆◆	1	4 to 40	cmH_2O	IPAP setting in S/T and PCV CPAP setting in CPAP mode "◆◆◆◆◆◆" in other modes
58	NPPV inspiratory time setting	1.0◆◆◆	0.05	0.30 to 3.00	sec	
59	NPPV rise time	0.1◆◆◆	0.1	0.1 to 0.6	N/A	
60	NPPV I-trigger type	AUTO◆◆	N/A	N/A	N/A	
61	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
62	NPPV E-cycle type	AUTO◆◆	N/A	N/A	N/A	
63	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
64	NPPV oxygen concentration setting	21◆◆◆◆	1	21 to 100	%	
65	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
66	NPPV low inspiratory pressure alarm limit setting	3◆◆◆◆◆	1	0 to 40	cmH_2O	Off = 0
67	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
68	NPPV low tidal volume alarm limit setting	0◆◆◆◆◆	5	0 to 1500	mL	Off = 0

Field	Description	Example	Resolution	Range	Units	Comments
69	NPPV high respiratory rate alarm limit setting	150◆◆◆	1	5 to 90	BPM	
70	NPPV low minute volume alarm limit setting	1.00◆◆	0.01 for 0.00 to 9.99 0.1 for 10.0 to 99.0	0 to 99	L/min	
71 to 72	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
73	Measured peak inspiratory pressure	24◆◆◆◆	1	0 to 50	cmH_2O	
74 to 76	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
77	Measured (exhaled) tidal volume	460◆◆◆	5	0 to 3000	mL	
78	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
79	Measured minute volume	5.83◆◆	0.1	0 to 99	L/min	
80	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
81	Measured total breath rate	12◆◆◆◆	1	0 to 90	BPM	Rate measurement
82 to 83	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
84	Measured patient leak	20◆◆◆◆	1	0 to 200	L/min	
85	Measured percent of breaths triggered by the patient	20◆◆◆◆	1	0 to 100	%	
86	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
87	Ti/Ttot	0.23◆◆	0.01	0.00 to 1.00	N/A	
88 to 91	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
92	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
93	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
94	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"

Field	Description	Example	Resolution	Range	Units	Comments
95	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
96	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
97 to 98	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
99	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
100	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
101	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
102	Occlusion alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
103	Safety valve status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
104	Low internal battery alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
105	Nonvolatile memory failure—Using default settings	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
106	Primary alarm failure	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
107	High inspiratory pressure alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
108	Apnea alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	Low Rate alarm status
109	Low inspiratory pressure alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	

Field	Description	Example	Resolution	Range	Units	Comments
110	Air source fault alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
111	O_2 valve stuck closed alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
112	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
113	Low O_2 supply alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	High and low supply pressure
114	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
115	Low minute volume alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
116 to 117	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
118	Low tidal volume alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
119	Low spontaneous tidal volume alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	Low Tidal Volume Alarm status
120	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
121	High respiratory rate alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
122	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
123	High enclosure temperature alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
124	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
125	Low PEEP alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	

Field	Description	Example	Resolution	Range	Units	Comments
126	Low EPAP alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	Patient Disconnect alarm status
127	High leak alarm status	NORMAL	N/A	NORMAL ALARM◆ RESET◆	N/A	
128	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
129	Alarm silence status	OFF◆◆◆	N/A	ON◆◆◆◆ OFF◆◆◆	N/A	
130	Screen lock status	OFF◆◆◆	N/A	ON◆◆◆◆ OFF◆◆◆	N/A	
131 to 134	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
135	Stop code	0x03	N/A	N/A	N/A	ASCII End Transmission character (ETX)

Field	Description	Example	Resolution	Range	Units	Comments
H1	Command name	MISCA	N/A	N/A	N/A	5-character field
H2	Number of characters between the start and stop codes	706	N/A	N/A	N/A	3-character field
H3	Number of fields between the start and stop codes	97	N/A	N/A	N/A	2-character field
H4	Start code	0x02	N/A	N/A	N/A	ASCII Start Transmission character (STX)
1	Time of request	13:45◆	N/A	N/A	N/A	24-hour clock, hh:mm◆
2	Unused	◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆"
3	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
4	Date (ventilator system clock)	FEB◆23◆2008◆	N/A	N/A	N/A	12-character field, MMM◆DD◆YYYY◆

Field	Description	Example	Resolution	Range	Units	Comments
5	Mode setting	PCV◆◆◆	N/A	S/T◆◆◆ PCV◆◆◆ CPAP◆◆ AVAPS◆ STDBY◆	N/A	
6	Active respiratory rate setting	12.0◆◆	0.1 for 4.0 to 9.0 1 for 10 to 60	4.0 to 9.0 10 to 60	BPM	"◆◆◆◆◆◆" in CPAP mode Rate setting in other modes
7 to 8	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
9	Oxygen concentration setting	21◆◆◆◆	1	21 to 100	%	
10	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
11	PEEP or EPAP setting	0.0◆◆◆	0.1	4.0 to 25.0	cmH_2O	CPAP or EPAP setting
12 to 21	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
22	Pressure support setting	0◆◆◆◆◆	1	0 to 56	cmH_2O	IPAP - EPAP in S/T and PCV modes 0 in CPAP mode "◆◆◆◆◆◆" in AVAPS mode
23 to 29	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
30	Measured total respiratory rate	0.0◆◆◆	0.1 for 1.0 to 9.9 1 for 10 to 100	0.0 to 9.9 10 to 100	BPM	
31	Measured tidal volume	0.00◆◆	0.01	0.00 to 9.99	L	For values out of range set output to "◆◆◆◆◆◆"
32	Measured total minute volume	0.00◆◆	0.01 for 0.00 to 9.99 0.1 for 10.0 to 99.9	0.00 to 9.99 10.0 to 99.9	L	For values out of range set output to 99.9◆◆
33	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
34	Measured peak inhalation pressure	50.0◆◆	0.1	0.0 to 99.0	cmH_2O	

Field	Description	Example	Resolution	Range	Units	Comments
35 to 37	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
38	High inhalation pressure alarm setting	20◆◆◆◆	1	10 to 50	cmH_2O	
39	Low inhalation pressure alarm setting	3◆◆◆◆◆	1	0 to 40	cmH_2O	
40	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
41	Low exhaled mandatory tidal volume alarm setting	0.00◆◆	0.01	0.00 to 1.50	L	Lo V_T alarm setting
42	Low exhaled minute volume alarm setting	0.0◆◆◆	0.1	0.0 to 99.0	L	
43	High respiratory rate alarm setting	0◆◆◆◆◆	1	5 to 90	BPM	
44	High inhalation pressure alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
45	Low inhalation pressure alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
46	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
47	Low exhaled mandatory/spontaneous tidal volume alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
48	Low exhaled minute volume alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
49	High respiratory rate alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
50	Low oxygen supply pressure alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	
51	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
52	Low battery alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	

Field	Description	Example	Resolution	Range	Units	Comments
53 to 80	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
81	Inhalation pressure setting	12.00◆	0.01	4.00 to 40.00	cmH_2O	IPAP in PCV mode IPAP in S/T mode CPAP in CPAP mode "◆◆◆◆◆◆◆" in AVAPS mode
82	Inhalation time setting	0.10◆◆◆	0.01	0.10 to 3.00	sec	I-Time in PCV mode "◆◆◆◆◆◆" in other modes
83 to 88	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
89	Alarm silence status	ON◆◆◆◆	N/A	ON◆◆◆◆ OFF◆◆◆	N/A	
90	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
91	Occlusion alarm status or I-time too long alarm status	NORMAL	N/A	NORMAL RESET◆ ALARM◆	N/A	Report highest urgency of these alarms: Patient Circuit Occluded and Patient Disconnect
92 to 95	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
96	Parameter control setting	I-TIME	N/A	N/A	N/A	Always output "I-TIME"
97	Unused	◆◆◆◆◆◆	N/A	N/A	N/A	Always output as "◆◆◆◆◆◆"
98	Stop code	0x03	N/A	N/A	N/A	ASCII End Transmission character (ETX)

Remote alarm port

WARNING: To prevent possible patient injury due to nonannunciating alarms, verify the operation of any remote alarm device before use.

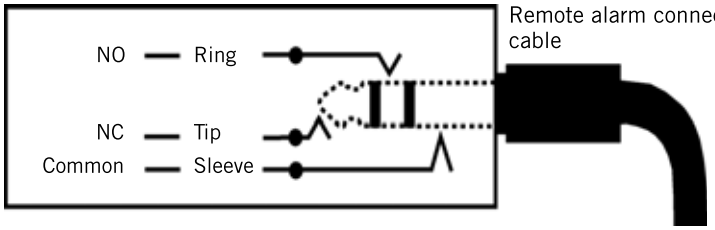
WARNING: To ensure the functionality of the remote alarm, connect only Respironics-approved cables to the remote alarm port.

CAUTION: The remote alarm port is intended to connect only to an SELV (safety extra-low voltage and ungrounded system with basic insulation to ground), in accordance with IEC 60601-1. To prevent damage to the remote alarm, make sure the signal input does not exceed the maximum rating of 24 VAC or 36 VDC at 500 mA with a minimum current of 1 mA.

NOTE: Pressing **Alarm Silence** deactivates the remote alarm.

The remote alarm (nurse call) port allows ventilator alarm conditions to be annunciated at locations away from the ventilator (for example, when the ventilator is in an isolation room). The ventilator sends alarm signals to a remote alarm through the connector at the rear of the ventilator (Figure B-1 on page B-1). Figure B-3 shows the pin assignments for this connector. The connector is a standard ¼-inch, female, audio (ring, tip, sleeve) connector.

The ventilator signals an alarm using either a normally open (NO) or normally closed (NC) relay contact. The de-energized state of the relay represents an alarm state (any high-priority alarm) and the energized state represents a non-alarm state.This application requires one of the cables listed in Table B-3.



System	Part Number
Remote alarm cable kit, normally open protocol	1003741
Remote alarm cable kit, normally closed protocol	1003742
Remote alarm cable kit, Respironics (LifeCare)	1003743

Appendix C. Warranty

One-year warranty

Respironics warrants the Respironics V60 Ventilator to be free from defects in materials or workmanship for a period of one year from the date of delivery to the purchaser (the "warranty period"). If the product contains a defect in materials or workmanship and the product is returned to Respironics within the warranty period, Respironics will repair or replace the product, or issue a credit for the purchase price of the product, with the choice to repair, replace, or credit being within the sole discretion of Respironics. Respironics will pay customary freight charges from Respironics to the dealer location only. The foregoing repair, replacement, or credit remedy will be the sole remedy for breach of the foregoing warranty.

Without limiting the foregoing, this warranty does not cover damage to the product caused by accident, misuse, abuse, negligence, failure to install in accordance with Respironics' installation instructions, failure to operate under conditions of normal use, and in accordance with the terms of the User Manual, failure to maintain in accordance with the applicable service manuals, alteration or any defects not related to materials or workmanship. This warranty does not cover damage which may occur in shipment. This warranty does not apply to any unit or individual parts which have been repaired or altered by anyone other than Respironics or an authorized Respironics service center. This warranty does not apply to products which are not purchased new.

Warranty limits

Respironics does not make and hereby specifically disclaims all other warranties, express or implied, including without limitation, any implied warranty of merchantability or fitness for a particular purpose.

In no event shall Respironics be liable for lost profits, loss of good will, or incidental or consequential damages, even if Respironics has been advised of the possibility of the same. Purchaser is cautioned that no person or entity is authorized to make any warranties on behalf of Respironics and any such alleged warranties are hereby disclaimed by Respironics.

Laws vary from state to state and some states do not allow the exclusion or limitation of implied warranties or the disclaimer of incidental and consequential damages. Accordingly, the laws of your state may give you additional protections. In addition, if you are located outside of the United States, the laws of your country may give you additional rights.

Appendix C

Warranty

Appendix D. Parts and accessories

NOTE: To ensure the correct performance of the ventilator and the accuracy of patient data, we recommend you use only Respironics-approved accessories with the ventilator.

This appendix lists parts and accessories supplied by Respironics that are compatible with the Respironics V60 Ventilator. Contact your Respironics representative to order these parts.

Adult masks

Description	Includes exhalation elbow (EE)	Includes standard elbow (SE)	Includes swivel connector	Headgear (Qty 4)	Size	Part number	
						US	Non-US
PerforMax reusable full face mask	●	●	●		Small	1049037	1044385
	●	●	●		Large	1049038	1044386
	●	●	●	●	Small	—	1052553
	●	●	●	●	Large	—	1052554
	●		●		Small	1047426	—
	●		●		Large	1047427	—
	●		●	●	Small	—	1052555
	●		●	●	Large	—	1052556
		●		●	Small	—	1052568
		●		●	Large	—	1052569

Parts and accessories

Description	Size	Quantity	Part number		
			US	Non-US	Japan only*
PerforMax single-patient-use full face mask with exhalation elbow	Small	1	1052531	1052535	1052549
	Large	1	1052532	1052536	1052550
PerformaTrak single-patient-use full face mask	Small	1	1012623	1012573	—
	Small	10	1018592	—	—
	Medium	1	1012624	1012574	—
	Medium	10	1018593	—	—
	Large	1	1012572	1012635	—
	Large	10	1018594	—	—
Disposable head strap with clips, for PerformaTrak mask series	—	1	1015788	—	—
PerformaTrak single-patient-use full face mask with CapStrap	Small	10	1019478	1019492	1002409
	Medium	10	1019479	1019498	1002408
	Large	10	1019480	1019507	1002405
Single-patient-use CapStrap headgear		5	1019543	1019543	1019543
PerformaTrak SE single-patient use nasal mask with CapStrap	Petite	10	1048706	1048709	1019481
	Small	10	1048705	1048708	1019483
	Medium/large	10	1048707	1048710	1019484
Total reusable full face mask with headgear	—	1	302433	302433	—
Headgear for Total full face mask	—	1	1003052	1003052	—
	—	9	1010609	1010609	—
Image3 single-patient-use full face mask with headgear	Small	1	1004878	1004879	—
	Small	10	1018585	1018581	—
	Medium	1	1004849	1004884	—
	Medium	10	1018586	1018583	—
	Large	1	1010871	1008887	—
	Large	10	1018587	1018584	—

Description	Size	Quantity	Part number		
			US	Non-US	Japan only*
Contour Deluxe single-patient use nasal mask	Petite	5	1016980	1016981	—
	Petite	10	1016982	1016983	—
	Small	5	1016693	1016697	—
	Small	10	1016694	1016698	—
	Medium/large	5	1016691	1016695	—
	Medium/large	10	1016692	1016696	—
Head strap	Petite	5	1018472	1018472	—
	Small/medium/ large	5	1007365	1007365	—

* If there is no part number listed for Japan, the non-US part number is used to order a part in Japan.

Pediatric masks

Description	Size	Quantity	Part number	
			US	Non-US
Contour Deluxe single-patient use nasal mask	Petite	5	1016980	1016981
	Petite	10	1016982	1016983
Head strap	Petite	5	1018472	1018472

Exhalation ports

Description	Quantity	Part number
Plateau exhalation valve (PEV)	1	302312
Replacement diaphragm for PEV	5	302310
Whisper Swivel II exhalation port	1	332113
Disposable exhalation port (DEP)	10	312149

Patient breathing circuits

Description	Quantity	Part number
BiPAP Vision single-patient-use circuit, for use without humidifier. Each includes 1.8 m (6 ft) tubing, exhalation port, 2.1 m (7 ft) proximal pressure line, tube hanger, and 2 hose clips.*	10	582073
BiPAP Vision invasive single-patient-use circuit, with exhalation port, water trap, temperature probe ports, proximal pressure line, proximal airway filter, humidifier coupling tube, tube hanger, and hose clips†	10	652002
	20	652001
Bilevel/CPAP single-limb heated circuit, with extension and Respironics disposable exhalation port (DEP) (Fisher & Paykel)	10	1020523
Circuit tubing, single-patient-use, 15 cm (6 in.)	10	312151
Circuit tubing, single-patient-use, 20 cm (8 in.)	10	312153
Humidifier tubing, single-patient-use, 91 cm (3 ft)	10	312111
Proximal pressure line assembly, with tee, single-patient-use, 2 m (6.5 ft)	10	312112
Proximal pressure bacteria filter, single-patient-use	1	1002362
Hose clip	25	312154

* For noninvasive use, without humidification
† For noninvasive and invasive use, with humidification

Bacteria filter

Description	Quantity	Part number
Single-patient-use bacteria/viral filter, with 22-mm M x F connectors	1	1014047
	10	342077

Operator maintenance parts

Description	Quantity	Part number
Cooling fan filter	5	1054280
Air inlet filter	5	1054279

Other parts

Description	Part number
Universal stand	1041139
Ventilator-to-universal stand mounting plate	1048873
E-cylinder holder for universal stand	1048903
Oxygen manifold kit	1057785
Support arm	332497
Support arm bracket	1002497
Backup battery	1056921
25-to-9-pin adapter	1058403

Appendix D

Parts and accessories

Appendix E. Regulatory compliance

Electromagnetic compatibility (EMC)

EN 60601-1-2	Electromagnetic Compatibility Requirements and Tests
EN 55011	Radiated and Conducted RF Disturbance Characteristics--Limits and Methods of Measurement (Level A)
EN 61000-3-2	Limits for Harmonic Current Emissions
EN 61000-3-3	Limitation of Voltage Changes, Fluctuations, and Flicker Emissions
EN 61000-4-2	Electrostatic Discharge Immunity Test (8/15KV)
EN 61000-4-3	Radiated Electromagnetic Field Immunity Test (10V/M)
EN 61000-4-4	Electrical Fast Transient/Burst Immunity Test
EN 61000-4-5	Surge Immunity Test
EN 61000-4-6	Immunity to Conducted RF Disturbances (10V)
EN 61000-4-8	Power Frequency Magnetic Field Immunity Test
EN 61000-4-11	Voltage Dips, Short Interruptions, and Voltage Variations Immunity Tests
MIL-STD 461E RE101	Electromagnetic Field Generation (Army Level)

WEEE recycling directive

Waste electrical and electronic equipment (WEEE) recycling directive.

Compliant with the WEEE recycling directive.

If you are subject to the WEEE directive, refer to http://www.healthcare.philips.com/main/about/Sustainability/Recycling/ for the passport for recycling this product.

Safety

Protection Against Electric Shock	Class 1
Degree of Protection Against Electric Shock	Type B
Degree of Protection Against Harmful Ingress of Fluids	IPX1
Rating	Continuous Operation
IEC 60601-1	Medical Electrical Equipment, Part 1: General Requirements for Safety
CSA C22.2 No. 601.1	Medical Electrical Equipment, Part 1: General Requirements for Safety
UL 60601-1	Medical Electrical Equipment, Part 1: General Requirements for Safety
EN 60601-1	Medical Electrical Equipment, Part 1: General Requirements for Safety
EN 60601-1-1	Medical Electrical Equipment, Part 1-1: Safety Requirements
IEC 60601-2-12	Medical Electrical Equipment – Part 2-12: Particular Requirements for the Safety of Lung Ventilators – Critical Care Ventilators
EN 60529	Degrees of Ingress Protection Provided by Enclosures (IPX1@zero degrees tilt)

Appendix F. Diagnostic mode

In the diagnostic mode you select the language of software display, set the date and time, select pressure units, enable software options, and calibrate the touchscreen.

NOTE: The diagnostic mode is primarily for use by Respironics-authorized service personnel to download software and perform other diagnostic procedures.

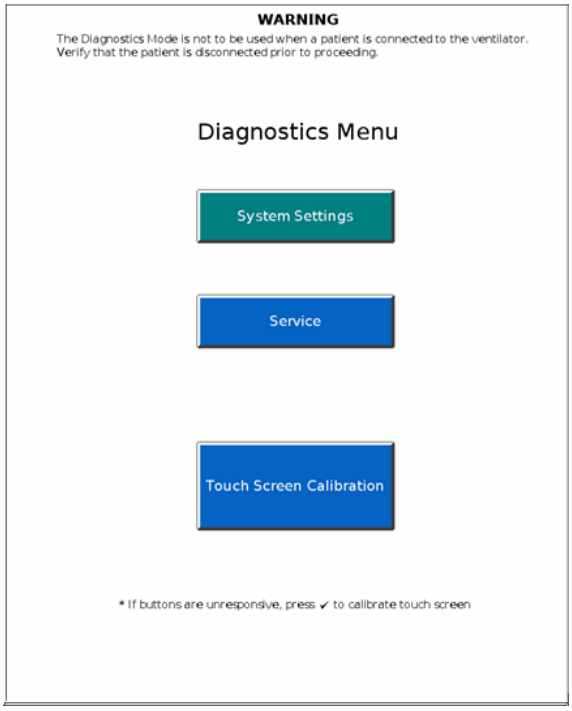
Entering the diagnostic mode

WARNING: To prevent possible patient injury, do not enter the diagnostic mode while a patient is connected to the ventilator. Verify that the patient is disconnected before proceeding.

Enter the diagnostic mode as follows:

1. Make sure the patient is disconnected and the ventilator is powered off.
2. Press and hold the Accept button on the navigation ring and turn on the ventilator by pressing the **ON/Shutdown** key. The screen displays **Press**  **again for Diagnostics or wait for Ventilation**.

3. Within less than 5 seconds, release and press the Accept button again. The **Diagnostics Menu** (Figure F-1) is displayed.



4. Select the desired function.

System settings

From the **System Settings** screen (Figure F-2) you can perform the functions below.

Language

The **Language** function lets you set the language of software display.

1. From the **System Settings** screen, select **Language** to display the **Set Language** screen (Figure F-3).

2. The active language is shown in white type. Select the new language.

3. A second **Set Language** screen is displayed (Figure F-4). Select **Ventilator Shutdown** to apply the change. The change is effective after you restart the ventilator.

Date/Time

The **Date/Time** function lets you verify date and time settings.

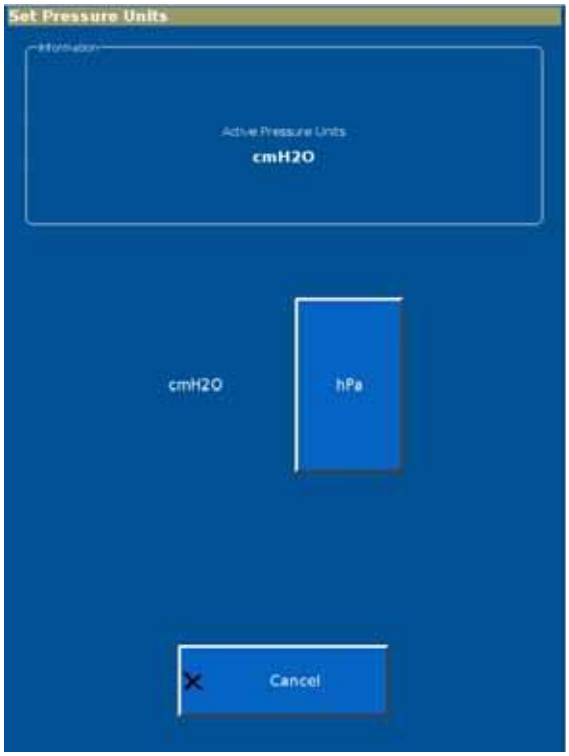
1. From the **System Settings** screen, select **Date/Time** to display the **Set Date and Time** screen (Figure F-5).

2. Adjust the date and time with the + and - buttons; then **Apply**.

Pressure Units

The **Pressure Units** function lets you select the unit of measure for pressure display.

1. From the **System Settings** screen, select **Pressure Units** to display the **Set Pressure Units** screen (Figure F-6).



2. The active pressure unit is shown in white type. Select the desired pressure unit. The change is effective after you restart the ventilator.

Restore Default Settings

The **Restore Default Settings** function lets you return ventilator settings to factory defaults. The factory defaults are listed in Chapter 10.

1. From the **System Settings** screen, select **Restore Default Settings** to display the **Restore Default Settings** screen (Figure F-7).

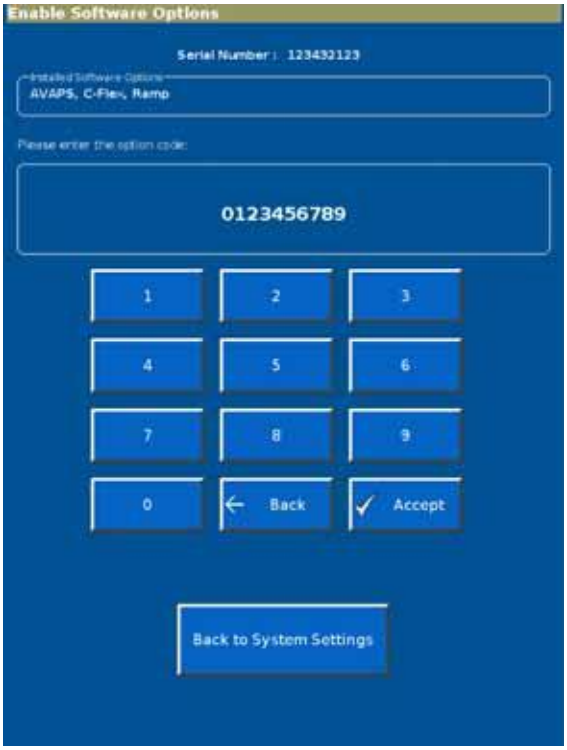
2. Select **Restore Defaults**.

Software Options

With the **Software Options** function, you enable a software option using a unique code specific to the option and the ventilator serial number. Options can also be enabled through the Respi-Link remote service program.

NOTE: Before installing an option, verify that the ventilator serial number matches the serial number shown in the **Vent Info** window ("Vent Info (ventilator information)" on page 6-11. If the serial numbers do not match, contact Respironics.

1. From the **System Settings** screen, select **Software Options** to display the **Enable Software Options** screen (Figure F-8).



2. Use the onscreen keypad to enter the code; then select **Enter**. The screen displays **Software option successfully enabled**.
3. Repeat as needed to enable additional options.
4. Verify that the options are enabled by selecting **Back to System Settings**, then **Back to Diagnostics Menu**, then **Service**. The **Vent Info** window should show the new options.
5. Attach the option label as shown in Figure 3-5 on page 3-8.

Baud Rate

The **Baud Rate** function lets you set the baud rate for serial communications.

1. From the **System Settings** screen, select **Baud Rate** to display the **Set Baud Rate for Serial Communications** screen (Figure F-9).

2. The active baud rate is shown in white type. Select the desired baud rate.

Service

The Service screen lets you view the event log. Other service functions are for use by Respironics-authorized service personnel.

Significant Event Log

The **Significant Event Log** contains data about clinically relevant ventilator occurrences, including alarms and setting changes. The time, date, and an identifier for event classification are included.

1. From the **Service** screen, select the **Misc** tab.

2. The **Miscellaneous** screen opens (Figure F-10). Select **Significant Event Log**.

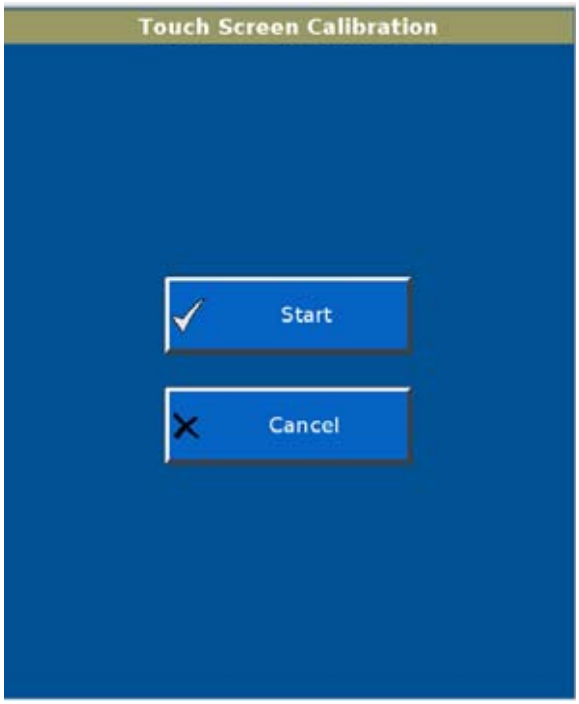
3. The **Significant Event Log** opens (Figure F-11). Use the buttons on right side to navigate through the log.

Touchscreen calibration

Calibrate the touchscreen X and Y coordinates as follows:

1. From the **Diagnostics Menu**, select **Touch Screen Calibration**. The **Calibrate Touch Screen** screen is displayed (Figure F-12).

NOTE: If the **Touch Screen Calibration** button does not respond, press the Accept button on the navigation ring to begin.



2. Follow the steps shown. Press on the middle of each target with a blunt, narrow object.

If the calibration is not successful, have the ventilator serviced.

Exiting the diagnostic mode

Exit the diagnostic mode by turning off ventilator power with the **ON/Shutdown** key.

Appendix F

Diagnostic mode

Glossary

A Ampere, a unit of current.

AC Alternating current.

Alarm Silence button Silences alarm sound for 2 minutes.

Assisted breath Breath in which the patient begins inspiration, but the ventilator controls the inspiratory phase and ends inspiration.

Auto-Trak Sensitivity A Respironics innovation in triggering and cycling that utilizes several different methods to provide enhanced sensitivity in the presence of leaks and changing breathing patterns.

AVAPS Average volume-assured pressure support. A ventilation mode in which pressure support is automatically adjusted to maintain the user-defined target tidal volume.

AVAPS Maximum IPAP Pressure See Max P.

AVAPS Minimum IPAP Pressure See Min P.

AVAPS Target Tidal Volume See V_T.

Average volume-assured pressure support See AVAPS.

Baseline As in . The pressure at end exhalation.

BPM Breaths per minute.

BTPS Body temperature (98 °F, ambient pressure), 100% saturated (with water vapor).

C-Flex A setting in CPAP mode, which enhances traditional CPAP by reducing the pressure at the start of exhalation.

cmH_2O Centimeters of water, a unit of pressure measurement.

Continuous positive airway pressure See CPAP.

CPAP Continuous positive airway pressure. A ventilation mode that provides a single, continuous level of positive pressure to the patient and a control setting in that mode.

Cycle To end inspiration.

Glossary

dB(A) Decibel, a unit of acoustic power.

DISS Diameter index safety standard, a standard for high-pressure gas inlet fittings.

EPAP Expiratory positive airway pressure. A control setting. The application and maintenance of pressure above atmospheric at the airway throughout the exhalation phase of positive-pressure mechanical ventilation.

Estimated exhaled tidal volume See V_T.

Estimated minute ventilation See $\dot{V}_E$.

Estimated patient leak See Pt. Leak

Estimated total leak See Tot.Leak.

ET Endotracheal.

Exhalation Port test Performed to assess the leak flow rate through the exhalation port.

Expiratory positive airway pressure See EPAP.

HIP High Inspiratory Pressure Alarm, an alarm setting.

Hi Rate High Rate Alarm, an alarm setting.

Hi V_T High Tidal Volume Alarm, an alarm setting.

hPa Hectopascal, a unit of pressure measurement. 1 hPa is equal to 1 mbar, which is approximately equal to 1 cmH_2O.

ID Inner diameter.

IEC International Electrotechnical Commission.

I:E ratio Ratio of inspiratory to expiratory time.

Inop Inoperative.

Inspiration:exhalation ratio See I:E ratio.

Inspiratory positive airway pressure See IPAP.

Inspiratory time See I-Time.

Inspiratory duty cycle See $\mathbf{T_I/T_{TOT}}$.

Intentional leakage “Known,” quantifiable leakage that is a function of the mask.

IPAP Inspiratory positive airway pressure. A control setting. The application and maintenance of pressure above atmospheric at the airway throughout the inspiration phase of positive-pressure mechanical ventilation.

ISO International Organization for Standardization, a worldwide federation of national standards bodies.

I-Time Inspiratory time. The duration of inspiration during mechanical ventilation.

L Liter.

LCD Liquid crystal display.

LED Light-emitting diode.

Limit To prevent from exceeding a specified maximum value during a breath.

LIP Low Inspiratory Pressure Alarm, an alarm setting.

Lo Rate Low Rate Alarm, an alarm setting.

Lo $\dot{V}_E$ Low Minute Ventilation Alarm, an alarm setting.

Lo V_T Low Tidal Volume Alarm, an alarm setting.

Mandatory breath A breath for which either the timing or volume is controlled by the ventilator. That is, the machine triggers and/or cycles the breath.

Max P AVAPS Maximum IPAP Pressure. A control setting in AVAPS.

Min P AVAPS Minimum IPAP Pressure. A control setting in AVAPS.

mL Milliliter.

mm Millimeter.

Noninvasive Pertaining to a diagnostic or therapeutic technique that does not require the skin to be broken or a cavity or organ of the body to be entered. Mechanical ventilation via mask, nasal prongs, or mouthpiece.

O_2 Oxygen (concentration). A control setting.

OD Outer diameter.

PCV Pressure-controlled ventilation. A ventilation mode that provides mandatory and spontaneous breaths with a set frequency, pressure, and inspiratory time.

Peak inspiratory pressure See PIP.

Percentage of patient-triggered breaths See Pt. Trig.

PIP Peak inspiratory pressure. The peak pressure for the previous inspiration.

Pressure-controlled ventilation See PCV.

Pressure-supported breath A patient-triggered, pressure-targeted breath.

psi Pounds per square inch.

psig Pounds per square inch gauge (above atmospheric pressure).

Pt. Leak The leak resulting from leaks around the mask or from unintentional leaks in the circuit. A monitored parameter shown when the intentional leak is known.

Pt. Trig Percentage of patient-triggered breaths. Patient-initiated breaths as a percentage of total breaths during the last 15 minutes.

Ramp Can be used to allow the patient to become accustomed to respiratory ventilatory therapy over time. Ramp will allow the pressure to linearly increase over a user-set period.

Rate Respiratory frequency, a control setting and monitored parameter.

Resistance The pressure drop across a pneumatic device (i.e., bacteria filter, patient circuit tubing) for a unit of flow when the volume of the device remains constant, i.e., $cmH_2O/mL/sec$.

Respiratory Rate (Rate) Respiratory frequency, a control setting.

Rise Time (Rise) The time required for a pressure-supported or pressure-controlled breath to reach its target pressure, a control setting.

RS-232 Serial data communications protocol.

Spont indicator Denotes patient-initiated breathing.

Spontaneous breath A breath for which both the timing and volume are controlled by the patient. That is, the patient both triggers and cycles the breath.

Spontaneous/timed mode See S/T mode.

S/T mode Spontaneous/timed mode. A pressure support ventilation mode that ensures patients receive a minimum number of breaths per minute if their spontaneous breathing rate drops below the respiratory rate setting.

Standby Suspends ventilation and retains current settings when the clinician wants to temporarily disconnect the patient from the ventilator.

Time Trigger Initiation of inspiration by the ventilator according to the Respiratory Rate setting.

Timed indicator Denotes machine-triggered (mandatory) breathing.

T_I/T_{TOT} Inspiratory duty cycle. Inspiratory time divided by total cycle time, averaged over 8 breaths, a monitored parameter.

Tot.Leak Estimated total leak, both intentional and unintentional. A monitored parameter shown when the mask leak and type of exhalation port are not known.

Trigger To begin inspiration.

Unintentional leakage Unpredictable leakage that cannot be quantified.

V Volt, a unit of electrical potential volume.

$\dot{V}$ Flow.

$\dot{V}_E$ Estimated minute ventilation. The product of tidal volume (spontaneous and timed) and rate (spontaneous and timed), a monitored parameter.

V_T Estimated exhaled tidal volume, a monitored parameter and AVAPS Target Tidal Volume, a control setting in AVAPS mode.

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Printed in USA
1047358 Rev C

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